Study the Growth Mechanism and Corrosion Resistivity of Vanadate Conversion Coating on LZ91 Magnesium Lithium Alloy

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ABSTRACT

In this conversion treatment study, LZ91 magnesium lithium alloy is used as the experimental material. Meanwhile, both acidic vanadate and alkaline vanadate conversion coatings solution are selected. By controlling the operation parameters, conversion temperature and immersion time, to investigate the growth mechanism and corrosion resistance. Using SEM, EDS and XRD to observe the surface morphology of coatings and analyze their chemical composition. At the same time, the thickness and corrosion resistance of conversion coatings are also measured. In the last, examine the adhesion of conversion coatings from the scotch tape test. From experimental results shown that both the acidic and alkaline vanadate conversion coatings are including two layers, the upper layer with crack and loose structure, however, the lower layer is much more condensed. The growth mechanism of acidity and alkaline vanadate coating on LZ91 magnesium lithium alloy is the magnesium oxide deposited on matrix surface at the beginning to form the lower layer. With increasing the immersion time, the vanadium element from conversion solution and aluminum 、magnesium elements dissolves from matrix, will continuous deposit on the top of lower layer to form the more loosing upper layer, which is multi-element metal oxide compound. From EDS and XRD results shown that the element distribution of conversion coatings in the upper layer exist highest content of aluminum and vanadium, then at the lower layer and experimental metal. However, the distribution tendency of oxygen content decreases from the upper layer to the base metal. The structure of both type conversion coatings is amorphous. In addition, the corrosion resistance by polarization tests shown that the acidic vanadate conversion coatings can obtain the best corrosion resistance at 30°C and 5 minutes, because the lower layer already can provide good corrosion resistance. If continues increasing the conversion time, the corrosion resistance will be limited and not conform to the economic efficiency. If we bring the conversion temperature up to 40°C, then can shorten the conversion time apparently, which takes about 2 minutes will appear the best result. For the alkaline vanadate conversion coating, the best parameter of corrosion resistance is at 40°C and 15 minutes, due to the upper coating layer forms completely can provide the good corrosion resistance. The conversion temperature up to 50°C, the best conversion time is about 10 minutes. Because the lower layer already can provide the good resistance. If continues lengthen the conversion time, the corrosion resistance will not further improve and not conform to the economic efficiency. Finally, the property of adhesion from Scotch tape test shown that, at the acidic vanadate coatings, the lower coating layer and the base metal is good. But between the upper layer and lower layer is bad, because the upper coating layer has fallen off and exposes the lower layer after tape test. Similarly, the adhesion test of alkaline vanadate coating is similar to the acidic coatings. But the upper layer shows the better adhesion result at 40°C and 15 minutes conversion time.

Keywords : LZ91 Magnesium Lithium Alloy ; Acidic Vanadate Conversion Coatings ; Alkaline Vanadate Conversion Coatings ; Growth Mechanism ; Polarization Test ; Scotch Tape Test

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