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Microstructure evolution and corrosion resistance of multi interfaces Al-TiAlN nanocomposite films on AZ91D magnesium alloy

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Abstract

Multi interfaces Al-TiAlN nanocomposite films were deposited on AZ91D magnesium alloy with ion source hybrid magnetron sputtering. Relationship between microstructure evolution and corrosion resistance of the films was investigated. The results show that the column structure is interrupted by multi interfaces. The nanocomposite films are consisted of nanocrystal TiN and amorphous AlN phase. The highest hardness of 31.3 GPa and lowest corrosion current density of 9.37 x 10^{-8} A/cm^2 can be obtained by tuning the interface period. The deflection effect of multi interfaces is the key for the improved corrosion resistance, and the failure mechanism is related to pitting and filiform corrosion.

Keywords: Magnesium alloys; Magnetron sputtering; TiAlN films; Interfaces; Corrosion resistance

1. Introduction

Due to its low density, high specific strength, good electromagnetic shielding effects and improved casting properties [1], magnesium alloys find its extensively application in aircraft and automotive applications [2], structural and digital products [3, 4] and biomaterials [5]. However, the high electrochemical activity (-2.37 V *vs.* normal hydrogen electrode) of magnesium alloys makes