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On the evolution of microstructure, texture and corrosion behavior of a hot-rolled and annealed AZ31 alloy

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HIGHLIGHTS

- Twins and DRX strongly affected the deformation texture of the hot-rolled AZ31 alloy.
- Annealing at 350 °C up to 60 min led to normal grain growth.
- Grain refinement and texture weakening was responsible for the corrosion resistance enhancement.

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ABSTRACT

The microstructure and texture evolution of an AZ31 alloy were investigated after hot rolling and subsequent annealing using electron backscatter diffraction (EBSD). First, the alloy was hot-rolled at 350 °C up to low, medium and high strain (20, 50 and 85% of thickness reduction, respectively). The alloy samples where then annealed at 350 °C for 2, 10 and 60 min. The effect of strain level and annealing on corrosion behavior in seawater was also evaluated using electrochemical tests. At low strain, the microstructure was characterised by the absence of twinning, mainly due to the prior thermo-mechanical history of the as-received alloy. However, various modes of twinning were observed at medium strain. At high strain, the dynamic recrystallization process resulted in a microstructure with a typical basal texture. The results demonstrate that twins are responsible for the deviation of {0002} basal poles from normal towards the transversal direction. Annealing at 350 °C for up to 60 min led to normal grain growth in all the samples. In medium and highly strained samples, the deformation texture was retained, while the low strain sample underwent noticeable changes due to the absence of dynamic recrystallization. A synergetic effect of grain refinement and texture weakening was responsible for the alloy's enhanced corrosion resistance.

1. Introduction

Nowadays, one of the greatest challenges for the governments and scientists communities is to find new strategies and solutions for global warming and reducing environment pollution [1]. Among possible solutions, a replacement of the fossil fuel-based energy by renewable energy [2,3], an implementation of CO_2 capture and its storage (CCS) technologies [4] and a reduction of vehicle mass for transportation industries [5] have been proposed.

The low density of magnesium, which is 36 and 78% lighter than aluminium and steel, respectively, makes it the most promising candidate for lighting sources [6] and energy storage like water/seawater-activated magnesium batteries [7]. Moreover, Mg-based alloys are attractive candidates for using in biomedical engineering as biodegradable temporary implants [8–10]. However, traditionally, Mg-based alloys comprise less than 1% of a vehicle's weight

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