Microstructural and Corrosion Studies by Immersion in 3.5% NaCl Solution on Aged Mg-9AI-1Zn-XCa Alloy

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Abstract The experimatal alloys were aged at different temperatures of 180°C, 200°C, 220°C, and 240° C with calcium addition levels of (X=0.5, 1, 1.5, 2%) on Mg-6Al-1Zn-XCa alloy were investigated in 3.5% NaCl solution. All the experimatal alloys were immersed in 3.5% NaCl solutions and the resulted surface were analyzed to study the corrosion behaviour and its surface topography by optical microscopy (OM), scanning electron microscopy (SEM), energy dispersed spectroscopy (EDS) and X-ray diffraction (XRD) techniques. The result shows that corrosion attack occurred predominantly on β phase and α phase exhibit relatively minor corrosion. In addition to that the increased aging temperature coarsens the intermetallic as well as α -Mg grains, which shows adverse effect to corrosion resistances and the best result were obtained at composition of 0.5wt.% Ca aged at 200°C.

Introduction

The need for lightweight materials in various industries, especially in automobile and aerospace applications has shown significant increase due to the advantage of fuel and great energy saving and utilization [1]. And among the lightweight materials Magnesium alloys are one of these light weight material, having great chemical stability, machinability and significant high strength to weight ratio [2]. However, their low level of mechanical properties and poor corrosion resistance in chloride environments limits their wider applications [3]. However, it was found that small addition of Ca to a magnesium alloy shows significant increase its strength and corrosion resistance [4-8] in chloride environment. At present, the most widely used magnesium alloys are AZ series materials and the corrosion behavior of magnesium alloy are depends on (i) the composition of the alpha- Mg matrix, (ii) the composition of the other phases and (iii) its distribution in the matrix[9-11].

Immersion testing is one of the simplest and effective method to study the corrosion behaviour, which was used in this study and the testing procedure been followed is compliance with ASTM G1-72 [12]. Based on the literatures the properties of PH Mg alloys are depends on the precipitates and its distribution in the matrix [13-15]. This study is focused on understanding the ageing phenomena with different temperatures and effect of Ca addition to its corrosion behaviour on AZ91D alloy.

2. Experimental Procedure

2.1. Casting

The melting of pure Mg (93wt.%), Al (9wt.%) and Zn(1wt.%) was carried out instir casting furnace of capacity 1Kg, once the melt was completely in liquid state,Mg-Ca master alloy was added at 720°C, and leave 0.5Hrs for reaction and stir the pool to make uniform melt, subsequently at 650°C of the melt, the gas mixture of 99 % Ar +1% SF₆ is passed into the crucible at flow rate of $0.25m^3/hr$