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Effects of SIMA (Strain Induced Melt Activation) on Microstructure and Electrochemical Behavior of Al-Zn-In Sacrificial Anodes

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Abstract

The Strain Induced Melt Activation (SIMA) process is one of the semi-solid forming processes for preparation of non-dendritic microstructures. In current work, the effects of SIMA process on microstructure and electrochemical behavior of Al-Zn-In sacrificial anode were studied. The effect of plastic deformation on the semi-solid microstructure of Al-Zn-In alloy is investigated by applying 10-40% uniaxial compression at ambient temperature and semi-solid treatment was carried out in the range of 635 to 660°C for 40 min. Investigation of the electrochemical behavior of anode and Tafel polarization test are performed in 3.5 wt.% sodium chloride solution. The results indicate that microstructure of the SIMA processed specimens is finer and more spherical than that of the as-received material. The sphericity increases significantly with the increase of the compression ratio from 10 to 30%, but the variation rate of the average grain size increases and the shape factor decreases with more increase of the compression ratio up to 40%. The average size and sphericity of α-Al solid grains increase with the increase of the heat treatment temperature. Electrochemical tests results show that plastic deformation up to 30% following heat treatment at 650°C increases the anode efficiency. Furthermore, SEM results indicated uniform corrosion under the aforementioned condition.

Keywords: Sacrificial Anode, Al-Zn-In, SIMA, Non-Dendritic, Corrosion Rate.

1. Introduction

In recent decades, several protection systems have been used to overcome the corrosion problems and its related costs. One of the most important and extensive efforts is done on the cathodic protection system. Sacrificial anode system is one of the most successful methods in cathodic protection systems especially in marine structures or structures known as offshore structures [1]. Several anodes used in cathodic protection of offshore structures are developed day to day which are often based on aluminum. Al-Zn-In anode with a high current capacity of 2400 Ah/kg is one of the

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