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Zinc Electrodeposition from Deep Eutectic Solvent containing organic additives

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Abstract

The effect of the addition of a group of organic additives on the electrodeposition behavior of zinc was investigated in choline chloride:ethylene glycol (ChCl:EG) eutectic mixture in the molar ratio of 1:2. Cyclic voltammograms recorded on steel electrode showed a cathodic peak is only observed after reversing of the scan. Chronoamperometric measurements indicated that the deposition of zinc occurs through 3D progressive nucleation mechanism. The morphology of the zinc deposits and was evident that additives influence the deposits morphologies. X-ray diffraction confirmed the presence of crystalline zinc and reveal the grain refinement effect obtained by using the additives selected where the smallest grain size of 31.7 nm was obtained in the presence of Dimethyl sulfoxide (DMSO). Moreover the XRD data showed that the addition of additives modified the preferential growth plane. The corrosion resistance properties of the electrodeposited Zn coatings were evaluated in 3% NaCl aqueous solution using potentiodynamic polarization. The results showed that the zinc film deposited with DMSO was the best corrosion resistant coating.

Keywords: ionic liquids; zinc; electrodeposition; deep eutectic solvents; additives.

1. Introduction

Zinc and its alloys are indispensable to several technological fields, namely corrosion resistant coatings or energy storage. Traditionally zinc is electrodeposited from cyanide baths, from alkaline cyanide-free baths and from acid chloride baths [1, 2]. Such electrolytes are toxic and corrosive. Furthermore, the electrodeposition of zinc and its alloys from aqueous solutions it is usually accompanied by hydrogen evolution and therefore the search for alternative electrolytes for zinc electrodeposition is necessary.

Electrodeposition of zinc from ionic liquids has attracted the attention in the recent years because problems associated with hydrogen embrittlement can be avoided or considerably reduced [3, 4]. Furthermore, the use of ionic liquids in metal electrodeposition can be considered an environmentally friendly alternative to the traditional aqueous solutions.

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