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Preparation and Characterization of Electrodeposited Cadmium and Lead thin Films from a Diluted Chloride Solution

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ABSTRACT

Cd-Pb thin films were electrodeposited from a diluted chloride solution using stainless steel rotating disc electrode. The linear sweep voltammograms of the single metallic ions show that electrodeposition of these ions was mass transfer control due to the plateau observed for different rotations at concentration (50 and 200 ppm). The voltammograms of binary system elucidate that electrodeposition process always start at cathodic potential located between the potential of individual metals. Currents transients measurements, anodic linear sweep voltammetry (ALSV) and atomic force microscopy (AFM) were used to characterize the electrocryatalization process and morphology of thin films. ALSV profiles show a differentiation for the dissolution process of individual metals and binary system. Two peaks of dissolution Cd-Pb film were observed for the binary system with different metal ion concentration ratios. The model of Scharifker and Hills was used to analyze the current transients and it revealed that Cd-Pb electrocrystalization processes at low concentration is governed by three – dimensional progressive nucleation controlled by diffusion, while at higher concentration starts as a progressive nucleation then switch to instantaneous nucleation process. AFM images reveal that Cd-Pb film electrodeposited at low concentration is more roughness than Cd-Pb film electrodeposited at high concentrated solution.

Keywords: Electrodeposition, Anodic dissolution, Chronoamperometry, Cd-Pb thin film, Electrocrystalization.

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1. Introduction

Electrodeposition of metals is an attractive method for the recovery of metal ions from different industrial effluents such as plating, metal finishing and electronics [1,2]. Some of these toxic metals of particular concern in treatment of industrial wastewaters are cadmium, and lead. Cadmium has been classified by U.S. Environmental Protection Agency as a probable human carcinogen. Chronic exposure of cadmium results in kidney dysfunction and high levels of exposure will result in death. Lead can cause central nervous system, kidney and liver damage [3].

Various technologies such as precipitation, adsorption [4], biosorption [5], ion exchange [6], reverse osmosis [7], electrodialysis [8], ion exchange-assisted membrane separation [9-11] and electrochemical methods [12,13] have been employed to remove these metals from various effluents. However electrochemical methods have been receiving greater

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