

Properties of electrodeposited Fe–Cu films grown on ITO coated glass substrates at different electrolyte temperatures

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Received: 18 April 2012 / Accepted: 30 June 2012 / Published online: 9 August 2012
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Abstract In this study, effect of electrolyte temperature on structural and morphological properties of Fe–Cu films electrodeposited on ITO coated glass substrates has been investigated. Structural analysis carried out by using X-ray diffraction indicated that the films consist of a mixture of face-centered cubic (FCC) Cu and body centered cubic (BCC) α -Fe phases. It was found that the crystalline size of both Fe and Cu increases with increasing electrolyte temperature. Compositional analysis performed using energy dispersive X-ray spectroscopy showed that the Cu content within the films enhances with increasing electrolyte temperature. The surface morphology of Fe–Cu films was studied using a scanning electron microscopy (SEM). SEM results indicated that the surface morphology of Fe–Cu films significantly depends on the electrolyte temperature. The investigation of the residual stress in the films indicated that the residual stress for the FCC Cu is tensile in all films regardless of electrolyte temperature, whereas, for the BCC Fe, it depends on the electrolyte temperature. Correlation between the surface morphology and the residual stress is discussed in terms of the obtained results.

1 Introduction

Fe–Cu alloys are used in industry as materials for electrical device components such as semiconductor lead frames,

electrical connectors, and electrical fuses [1]. At the present time, there are many deposition techniques such as sputtering, molecular beam epitaxy (with vacuum), and electrodeposition (non-vacuum) in order to produce metallic films [2]. Among them, the electrodeposition is an excellent, simple, fast and inexpensive technique [2–11]. It is well known that the properties of electrodeposited films are influenced by many factors such as bath type, electrolyte temperature, additives, electrolyte pH, and deposition potential or current density [5, 12–16]. According to our best knowledge, the influence of electrolyte temperature on the structural, compositional, and surface morphological properties of the Fe–Cu films electrodeposited onto indium tin oxide (ITO) coated glass substrates has not been the subject of investigation till now. Therefore, the effect of the electrolyte temperature on the properties of Fe–Cu films is of interest.

In this present study, the role of electrolyte temperature on grain size, composition, structure, and surface morphology of the Fe–Cu films, which were deposited onto ITO coated glass substrate at a constant current density of -50 mA/cm^2 , has been investigated. It was found that the properties of the Fe–Cu films are significantly affected by the electrolyte temperature. This study might be useful to understand better how electrolyte temperature influences the structural and morphological properties of electrodeposited Fe–Cu films.

2 Experimental

The preparation of the Fe–Cu films onto ITO coated glass substrate from a single electrolyte was carried out under galvanostatic conditions. Fe–Cu films were prepared from an electrolyte consisting of 0.1 M Fe sulfate, 0.02 M Cu

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