J Supercond Nov Magn (2012) 25:2585–2589
DOI 10.1007/s10948-011-1225-2

ORIGINAL PAPER

Surface Morphology, Structural and Magnetic Properties of Electrodeposited NiFeCu/Cu Films

M. Celalettin Baykul · Umut Sarac · Mursel Alper

Received: 7 July 2011 / Accepted: 11 July 2011 / Published online: 12 August 2011

Abstract The magnetic and structural properties of the NiFeCu/Cu films electrodeposited on polycrystalline titanium (Ti) substrates and their characterizations were studied. The structural analysis by X-ray diffraction (XRD) has revealed that all films have face-centred cubic (FCC) structure. On the other hand, the XRD analysis showed that the degree of (111) texture is dependent on the Cu content within the film. The composition analysis was carried out by energy-dispersive X-ray spectroscopy (EDX). The result of EDX indicated that the Cu content within the film increases with increasing of non-magnetic Cu layer thickness. The hysteresis loops of the films measured by vibrating sample magnetometer (VSM) showed that all films have a small coercivity typical for soft magnetic materials. The surface morphological structure of the films was investigated by atomic force microscopy (AFM). AFM images indicated that all films have main grains (globular islands) and smaller secondary grains on the main grains with different sizes. The differences observed in the magnetic properties of the films were attributed to the Cu content within the films.

Keywords VSM · XRD · Electrodeposition · AFM · EDX

M.C. Baykul (✉) · U. Sarac
Department of Physics, Faculty of Arts and Science, Eskisehir Osmangazi University, 26480, Eskisehir, Turkey
e-mail: cbaykul@ogu.edu.tr

M. Alper
Department of Physics, Faculty of Arts and Science, Uludag University, 16059, Bursa, Turkey

1 Introduction

Magnetic thin films such as magnetic multilayers and alloy films have been studied for a long time because of their great potential applications in the technology as magnetoresistive sensors and magnetic recording devices. NiFe/Cu systems have attracted substantial attention both technologically and scientifically due to their low coercivity [1, 2]. Nanostructured materials are mainly produced by physical methods requiring high vacuum, such as sputtering, physical vapor deposition and molecular beam epitaxy [3, 4]. However, the electrodeposition has been widely used to grow magnetic thin films due to its advantage like fast production and cost-effectiveness in comparison to other techniques [4–9]. Furthermore, it provides an easy deposition irrespectively of surface size and area [10].

In the elecrodeposition method, the parameters such as electrolyte pH, electrolyte concentration, deposition potentials, additives, substrates, and control methods (galvanostatic and potantiostatic) substantially affect the properties of film deposits [3].

This paper reports magnetic and structural properties of electrodeposited NiFeCu/Cu films and their characterizations by XRD, AFM, VSM, and EDX.

2 Experimental Procudures

In this study, NiFeCu/Cu films were deposited from an electrolyte containing Ni^{+2}, Fe^{+2} and Cu^{+2} ions under galvanostatic conditions (constant current mode) at room temperature. The electrolyte was composed of $NiSO_4 7{\cdot}H_2O$ (1.0M), $FeSO_4{\cdot}7H_2O$ (0.04M), $CuSO_4{\cdot}5H_2O$ (0.01M), H_3BO_3(0.4M), and saccharin (0.01M). All chemicals were dissolved in distilled water. Polycrystalline titanium sheets