CONTEMPORARY METALLIC MATERIALS

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Chapter 026

The effect of Cobalt addition on structural and magnetic properties of electrodeposited Iron-Platinum nanocrystalline thin films

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Abstract: Iron-Platinum (Fe-Pt) and Cobalt-Iron-Platinum (Co-Fe-Pt) nanocrystalline thin films were deposited on brass substrates using a stable single bath electrodeposition system. The effects of addition of various concentrations of cobalt on the composition, crystallographic structure, microstructure and magnetic properties of the resulting films were investigated. Ammonium tartrate and ammonia solution were used as complex forming additives to stabilize the Fe^{2+} and Co^{2+} ions and to enhance co-deposition with platinum complexes because of the big difference between Fe and Co standard reduction potentials. The composition of the electrodeposited film was controlled by varying concentration of the electrolytes and concentration of cobalt in the electrolyte. The as-synthesized Fe-Pt and Co-Fe-Pt films were characterized by energy dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), scanning electron microscopy (SEM) and alternating gradient magnetometer (AGM). EDS results showed that cobalt was more preferentially deposited compared to iron during Co-Fe-Pt film electrodeposition. SEM results showed that the microstructure feature of the Fe-Pt and Co-Fe-Pt films consisted of spherical granules. XRD showed formation of disordered face-centered cubic (FCC) Fe-Pt phase in the as-deposited films. All the peaks were shifted to slightly higher diffraction angles with increase of cobalt content. The average crystallite size of deposited films varied from 2.33nm to 6.54nm. The saturation magnetization and coercivity increased as the cobalt content were increased.

Introduction

One motivation for synthesizing ultra-high density magnetic recording media is to meet the demands of rapid development in the information society. The density growth of magnetic recoding media is expected to be 100 Gbit/in^2 within a few years, and such magnetic recording media can be achieved through advancement in fabrication technology of its nanostructured thin film [1, 2]. Any material that contains grains, clusters, layers or filaments with at least one dimension below 100nm, can be considered as nanostructured material [3]. The interest in these materials is stimulated by the fact that, owing to the small size of the building blocks (particle, grain or phase) and the high surface-to-volume ratio, these materials are expected to demonstrate unique mechanical, optical, electronic, and magnetic properties