Manipulation of magnetic properties of glass-coated microwires by annealing

A. Zhukov, K. Chichay, A. Talaat, V. Rodionova, J.M. Blanco, M. Ipatov, V. Zhukova

www.elsevier.com/locate/jmmm

PII: S0304-8853(14)00898-1
DOI: http://dx.doi.org/10.1016/j.jmmm.2014.10.003
Reference: MAGMA59441

To appear in: *Journal of Magnetism and Magnetic Materials*

Received date: 12 June 2014
Revised date: 30 September 2014
Accepted date: 2 October 2014

Cite this article as: A. Zhukov, K. Chichay, A. Talaat, V. Rodionova, J.M. Blanco, M. Ipatov and V. Zhukova, Manipulation of magnetic properties of glass-coated microwires by annealing, *Journal of Magnetism and Magnetic Materials,* http://dx.doi.org/10.1016/j.jmmm.2014.10.003

Manipulation of magnetic properties of glass-coated microwires by annealing

A. Zhukov[1,2], K. Chichay[3], A. Talaat[1], V. Rodionova[3,4], J.M. Blanco[5], M. Ipatov[1] and V. Zhukova[1]

[1]*Dpto. Fisica de Materiales, Fac. Quimicas, UPV/EHU, 20009 San Sebastian, Spain*
[2]*IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain*
[3]*Immanuel Kant Baltic Federal University, 236041 Kaliningrad, Russia*
[4]*National University of Science and Technology «MISIS», 119049Moscow, Russia*
[5]*Dpto. Física Aplicada, EUPDS Basque Country University UPV/EHU, Spain*

Elsevier use only: Received date here; revised date here; accepted date here

Abstract

We demonstrated that magnetic properties (hysteresis loops, domain wall propagation and giant magnetoimpedance effect) of Fe and Co-rich amorphous microwires can be tailored by stress and conventional annealing. Observed dependences discussed considering stress relaxation, back stresses and change of the magnetostriction after samples annealing. These considerations have been proved by experimental observation of the change of the magnetostriction coefficient sign induced by annealing.

PACS: 75.30.Gw; 75.50.Kj, 77.80.Dj

Keywords: Thin wires, magnetic anisotropy, giant magnetoimpedance, domain wall propagation

1. Introduction

Studies of amorphous magnetically soft glass-coated microwires have attracted considerable interest in the field of applied magnetism because of their reduced dimensionality (metallic nucleus diameter ranging between 0.5 and 30 μm), cheap and simple fabrication method and outstanding soft magnetic properties [1, 2]. From the applications point of view the most attractive properties of these materials are excellent soft magnetic properties and giant magnetoimpedance, GMI, effect usually observed in Co-rich compositions and the magnetic bistability and fast domain wall propagation typical for Fe-rich compositions [1, 2]. Magnetic sensors developed using amorphous wires with GMI effect allow achieving of pT magnetic field sensitivity with low noise [3]. High circumferential permeability usually exhibited by Co-rich amorphous wires with vanishing magnetostriction constant is essential for observation of high GMI effect [1]. The Fe-rich amorphous wires are also proposed for various applications in the electronic article surveillance, magnetic tags, magnetic memories and logics [4-7]. Magnetic bistablility typical for Fe-rich glass-coated microwires has been interpreted in terms of depinning of the reversed domains inside the internal single domain and the consequent fast domain wall, DW, propagation [1, 4]. Naturally the DW speed is one of most important factors affecting the viability of aforementioned potential applications. As reported elsewhere amorphous and nanocrystalline microwires exhibit extremely high DW velocity [4,8,9].

Generally hysteretic magnetic properties of amorphous ferromagnetic microwires are affected by the magnetostriction coefficient, λ_s, and by the strength of internal stresses, σ_i , induced by glass-coating affected by the ρ-ratio of metallic nucleus diameter, d, to the total microwire diameter, D (ρ=d/D) [1]. The origin of the