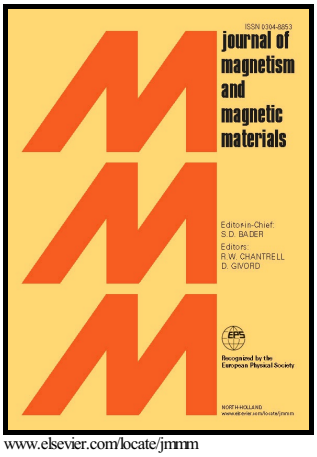

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A Kuncser, S Antohe, V Kuncser

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A general perspective on the magnetization reversal in cylindrical soft magnetic nanowires with dominant shape anisotropy

A Kuncser[a.b], S Antohe[b] and V Kuncser[a*]

[a]National Institute of Materials Physics, PO Box MG-7, 077125 Bucharest-Magurele, Romania,
[b]University of Bucharest, Faculty of Physics, PO Box MG-11, 077125, Bucharest-Magurele, Romania

[*]Corresponding author: V. Kuncser, National Institute of Materials Physics, P.O.Box MG 7, 77125, Bucharest-Magurele, Romania, E-mail: kuncser@infim.ro

Abstract

Peculiarities of the magnetization reversal process in cylindrical Ni-Cu soft magnetic nanowires with dominant shape anisotropy are analyzed via both static and time dependent micromagnetic simulations. A reversible process involving a coherent-like spin rotation is always observed for magnetic fields applied perpendicularly to the easy axis whereas nucleation of domain walls is introduced for fields applied along the easy axis. Simple criteria for making distinction between a Stoner-Wohlfarth type rotation and a nucleation mechanism in systems with uniaxial magnetic anisotropy are discussed. Superposed reversal mechanisms can be in action for magnetic fields applied at arbitrary angles with respect to the easy axis within the condition of an enough strong axial component required by the nucleation. The dynamics of the domain wall, involving two different stages (nucleation and propagation), is discussed with respect to initial computing conditions and orientations of the magnetic field. A nucleation time of about 3 ns and corkscrew domain walls propagating with a constant velocity of about 150 m/s are obtained in case of Ni-Cu alloys (Ni rich side) NWs with diameters of 40 nm and high aspect ratio.

Keywords: magnetic nanowires, magnetization reversal, micromagnetic simulations, nucleation and domain wall propagation

1. Introduction

Magnetic nanowires (NWs) with controlled dimensions and compositions are extensively studied in the last decades with respect to their magnetic and magneto-conduction properties due to both potential applications (e.g. in magnetic storage [1,2] or spintronics [3]) and specific magnetic effects at nanoscale [4]. From the fundamental point of view, magnetic nanowires represent the best physical supports for studying the peculiarities of the magnetic configurations in 1D nanostructures versus geometric and magnetic parameters and under