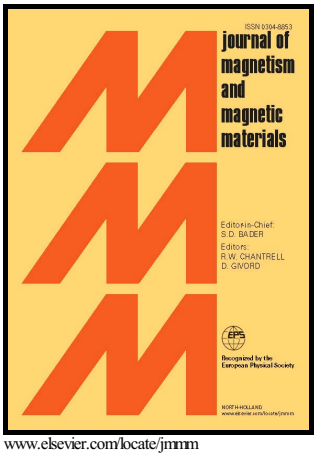

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Magnetization reversal mechanisms under oblique magnetic fields

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Abstract

In this work finite element micromagnetic simulations were performed in order to study the reversal mechanisms of spherical ferromagnetic particles with uniaxial magnetocrystalline anisotropy, when they are magnetized along an oblique direction with respect to the anisotropy axis. Magnetization loops are taken in different directions of external magnetic field, at different anisotropy constants and particle sizes. In the simulation results, the three reversal mechanisms (coherent, curling and domains) are observed and new phenomena arise due to the action of oblique magnetic fields. Moreover, the dependence of the critical fields with respect to the angle of the external field is presented.

Keywords

Micromagnetic simulation, Finite element method, Magnetization reversal, oblique magnetic fields

1. Introduction

The study of the magnetization - demagnetization process of nanostructured materials when the external field is applied under an angle with respect to the anisotropy axes is of great interest for many applications such as magnetic recording, magnetic sensors etc. [1-8]. The coercivity, the remanence and other macroscopic characteristics of permanent magnets are clearly angle dependent quantities. Therefore, the understanding of magnetization reversal mechanisms under oblique magnetic fields is a permanent challenge for researchers involved in studying the ferromagnetic materials theoretically [9-12]. Recent works refer to low dimensional magnetic structures, such as nanowires and nanotubes, but on 3D materials, they are restricted to the coherent reversal mechanism according to the classical Stoner - Wohlfarth model [13].

In this work a 3D simulation model of the particle's magnetic behavior is used, based theoretically on Brown's classical micromagnetic approach [14] and computationally on the Finite