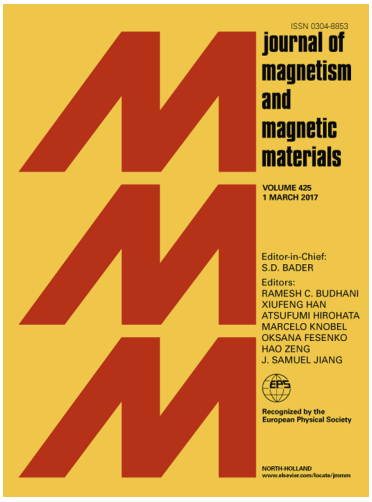

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Tuning magnetic microstructure in Gd-Fe thin films: experiment and simulation

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Abstract

This paper reports a detailed investigation of magnetic microstructure and magnetic properties in $Gd_{19}Fe_{81}$ thin films after rapid thermal processing at different temperature *viz.* 300, 400 and 500 ^oC for 20 minutes. While the as-prepared films show stripe domain with high magnetic contrast, the processed samples display a weak magnetic contrast shadowed with topographic feature. The perpendicular magnetic anisotropy observed in the as-prepared sample no longer exists after rapid thermal processing. Magnetization measurements and MFM respectively confirm the increase in saturation magnetization and decrease in perpendicular magnetic anisotropy. Micromagnetic simulations have been performed to understand the domain modification and associated magnetic properties as a function of saturation magnetization, anisotropy value and in-plane tilt of the easy axis.

Keywords: Rare-earth Transition metal Alloy, Rapid Thermal Processing, Magnetic Domain, Micromagnetic Simulation

1. Introduction

The knowledge of magnetic microstructure in magnetic materials is of great interest from the point of view of understanding the magnetization reversal mechanism for thin films and nanostructures. Magnetic domain imaging facilitates a direct access to the nano-scale magnetic properties and its modification. Along with the complementary integral magnetization measurements, the confluence of magnetic microstructure and simulation studies provide us the scope to venture the unrivaled insight into the magnetic properties and its manipulation by external stimuli. The magnetostatic energy, associated to the dimension and shape in magnetic material is the primary driving force for domain formation [1, 2]. However, the exchange and effective magnetic anisotropy energies along with the existing magneto-elastic energy determine the dimension and shape of the domains. The interaction of different

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