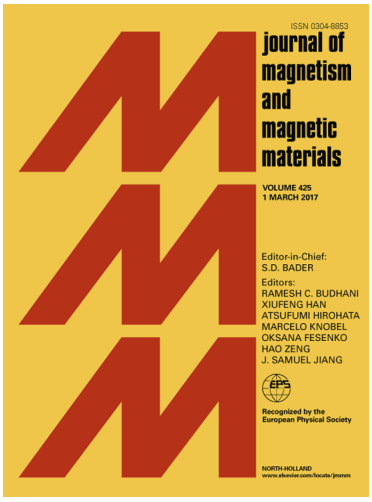

Effect of varying dimensions on gadolinium rectangular thin film elements: micromagnetic simulations

M.F. McMullan, S. Felton

PII: S0304-8853(17)32938-4
DOI: https://doi.org/10.1016/j.jmmm.2017.10.009
Reference: MAGMA 63223

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

Effect of varying dimensions on gadolinium rectangular thin film elements: micromagnetic simulations

M.F. McMullan & S. Felton[1]

Centre for Nanostructured Media, School of Mathematics and Physics, Queen's University Belfast, BT7 1NN, U.K

Abstract

Micromagnetic simulations of the ground state magnetization patterns of rectangular gadolinium thin film elements were performed and the effects of aspect ratio, size, and thickness of the island on net long axis moment were investigated. Highly remanent states were found in 15 nm thick gadolinium islands with high aspect ratios, 8:1 or greater, as well as in smaller islands with aspect ratios down to 5:1. The thickness of the island was also critical for the ability of a gadolinium island to maintain a highly remanent ground state; islands with thickness greater than or equal to 30 nm showed increased multidomain formation. These results provide information and guidance on what dimensions are suitable for fabrication of single-domain gadolinium nanostructures – a feat not yet achieved in literature. The proposed dimensions most suitable for experimental realisation of a single domain gadolinium element are 500 nm × 50 nm × 15 nm, lying within the range found in this investigation to be energetically favoured single domains.

Keywords: Micromagnetism, ferromagnetism, gadolinium, single-domain

1. Introduction

Gadolinium (Gd) is a rare earth metal which in hexagonally close packed (hcp) bulk form is notable for its high Curie temperature of 293 K (for rare earths) and high saturation magnetization value, in part due to a large magnetic moment from seven unpaired 4f electrons.[1] In single crystal gadolinium,