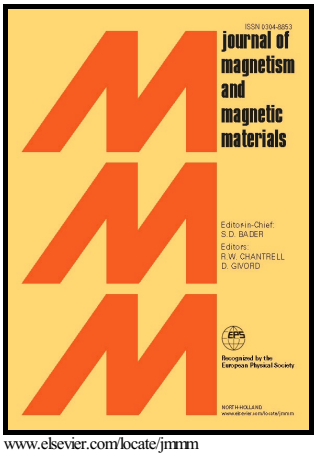

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PII: S0304-8853(16)31832-7
DOI: http://dx.doi.org/10.1016/j.jmmm.2017.01.057
Reference: MAGMA62405

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

Received date: 18 August 2016
Revised date: 8 December 2016
Accepted date: 17 January 2017

Cite this article as: Y. Xiang and C.W. Chen, Spatial distribution characteristics of magnetization in exchange-coupled bilayers with mutually orthogonal anisotropies, *Journal of Magnetism and Magnetic Materials* http://dx.doi.org/10.1016/j.jmmm.2017.01.057

Spatial distribution characteristics of magnetization in exchange-coupled bilayers with mutually orthogonal anisotropies

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Abstract:

The magnetization distribution of a bilayer exchange spring system with mutually orthogonal anisotropies was investigated by micromagnetic simulation. Results showed that the spatial change rate of the magnetization direction could be engineered by varying the material parameters, layer thicknesses, and magnetic field. When no magnetic field is applied, this angular change rate is determined by three parameter ratios: a ratio of the exchange energy and anisotropy constants of both layers and two thickness ratios of both layers. If these three ratios are kept invariant, the ratio of the angular change of the soft layer over the hard layer will remain the same. When a magnetic field is applied, two more ratios concerning the magnetic field should be added to determine the spatial angular change of the magnetization direction.

Keywords: exchange spring, competing anisotropies, micromagnetics, magnetization distribution

I. INTRODUCTION

In recent years, increasing attention has been paid to exchange spring multilayers, which consist of magnetically hard and soft layers. [1-6] These structures are expected to combine the high coercivity of the hard phase and the high saturation magnetization of the soft phase. In this case, exchange-coupled magnetic layers are excellent candidates for the next generation of permanent magnets. [7, 8] The soft layers reduce the composite coercive field, thus the magnetization in the soft layers can be reversed by a small external magnetic field. However, the magnetization in the hard layers does not change much because of the high anisotropy. If the magnetic