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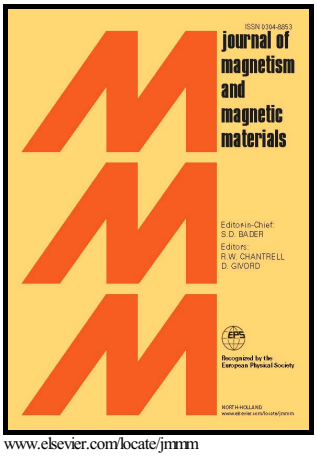

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Abstract

Magnetization reversal and magnetic microstructure of top soft magnetic layer (Fe) in exchange spring coupled $L1_0$ FePt/Fe is studied using high resolution Kerr microscopy. With remnant state of the hard magnetic layer ($L1_0$ FePt) as initial condition, magnetization (M-H) loops along with magnetic domains are recorded for the top soft magnetic layer (Fe) using Kerr microscopy. Considerable shifting of Fe layer hysteresis loop from center which is similar to exchange bias phenomena is observed. It is also observed that one can tune the magnitude of hysteresis shift by reaching the remanent state from different saturating fields (H_{SAT}) and also by varying the angle between measuring field and H_{SAT}. The hysteresis loops and magnetic domains of top soft Fe layer demonstrate unambiguously that soft magnetic layer at remanent state in such exchange coupled system is having unidirectional anisotropy. An analogy is drawn and the observations are explained in terms of established model of exchange bias phenomena framed for field-cooled ferromagnetic - antiferromagnetic bilayer systems.

Key words: Exchange spring magnets, exchange bias, magnetic domains, Kerr microscopy

1. Introduction

Exchange bias (EB) phenomena occurs due to unidirectional anisotropy induced across the ferromagnetic (FM) antiferromagnetic (AFM) interfaces when the system is field-cooled through the *Néel* temperature (T_N) of the AFM. EB phenomena manifests as a shift of hysteresis loop along the field axis[1]. Various applications of these materials such as permanent magnets, recording media, spin-valves etc., are demonstrated [1]. Since EB phenomena involves a complicated interfacial magnetic interaction between FM and AFM layers different magnetization reversal processes are observed [1]. In most of the cases asymmetric shaped hysteresis loops are observed. Different methods such as Lorentz microscopy, Kerr microscopy etc., are used to study the magnetic domain evolution in such FM-AFM exchange biased systems [2, 3]. Asymmetry in hysteresis loop or magnetic microstructure is found to be different from system to system, in some cases even it is almost negligible [4]. Typically, for the asymmetric loops, two magnetization reversal mechanisms are observed viz., coherent rotation, nucleation and domain wall propagation [3].

Field cooling through the T_N of AFM layer sets a prebiasing of some interface moments, which essentially imposes a shift of the hysteresis loop associated to the FM layer along the field axis generally in the opposite direction to the cooling field [1]. This shift i.e., EB phenomena decreases as a function of temperature and repeated application of magnetic field (known as training

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