Monte Carlo simulation of the FM layer thickness influence on the exchange bias in FM/AM bilayers

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1. Introduction

Most of the attention given to FM/AF systems is normally directed to the changes of the magnetic properties of the FM when it is in contact with the AF. The commonly observed effects are a unidirectional shift or exchange bias (EB) and a significant increase of the coercive field (H_c) [1].

2. The model

FM/AF and AF/FM films were studied. The films are magnetically coupled each other by exchange interactions and a simple cubic lattice with a perfect match across the FM/AFM and AF/FM interfaces. The next Hamiltonian was employed [2]:

$$H = -J_F \sum_{i \neq j \in FM} \mathbf{S}_i \cdot \mathbf{S}_j - K_F \sum_{i \in FM} (\mathbf{S}_i \cdot \hat{a}_{FM})^2 - J_{AF} \sum_{i \neq j \in AF} \mathbf{S}_i \cdot \mathbf{S}_j - K_{AF} \sum_{i \in AF} (\mathbf{S}_i \cdot \hat{a}_{AF})^2 - h \sum_i \mathbf{S}_i \cdot \hat{h}$$

Where S_i and S_j are classical Heisenberg spins vector. The first and third sums run over the nearest neighbors pairs of spins coupled with exchange interactions for FM and AF layer. Second and fourth terms represent the interaction between FM and AF layers and the fifth term represents the interaction with an external field.

3. Results

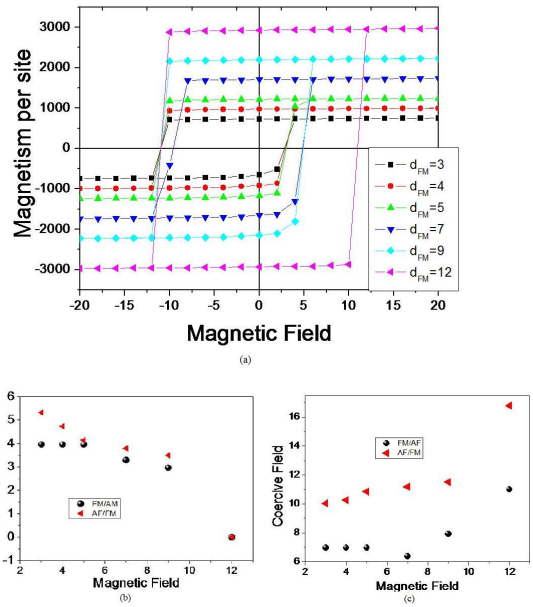

Fig.1: (a) Hysteresis loops for FM/AF bilayers varying the thickness of FM.(b) EB Vr. d_{FM} (c) H_c Vr. d_{FM}

Fig. 1(a) Presents graphics of hysteresis loops varying the thickness of the FM layer and Fig. 1(b) and (c) EB and H_c as a function of d_{FM}. It was observe that EB decreases and H_c increases when the thickness increases. It is because the materials tends to behave as a bulk. Models report an inversely proportional between HB and d_{FM}

4. Conclusions

Simulation of EB in FM/AF bilayers was carried out observing a decrease in this parameter as a function of d_{FM}, because the material tends to behave as a bulk.

5. Submission

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