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Interface Roughness influence on exchange bias behavior in $La_{2/3}Ca_{1/3}MnO_3$/ $La_{1/3}Ca_{2/3}MnO_3$ bilayers

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Abstract – A Monte Carlo simulation study of exchange bias properties in of $La_{2/3}Ca_{1/3}MnO_3$/ $La_{1/3}Ca_{2/3}MnO_3$ bilayers by using a classical Heisenberg model and the metropolis algorithm is addressed. In this model, several contributions included nearest neighbors exchange interactions; two different interface couplings, magnetocrystalline anisotropy and Zeeman term were considered. Our study focuses on the influence of interface roughness on hysteresis loops, particularly exchange bias field (H_{EB}) and coercive force (H_c). Results reveal that H_{EB} increases with the roughness while coercive force decreases.

The understanding of the physics behind the exchange bias (EB) phenomenology in ferromagnetic/antiferromagnetic (FM/AFM) bilayers is still a subject of interest and controversy [1]. Since the discovery of this phenomenon in 1956 by Meiklejohn and Bean [2] many controversies concerning the underlying mechanisms responsible for this effect and several theoretical models have been proposed [1].
The majority of theoretical models dealing with EB in films attribute such effects to the formation of domains and pinning of domain walls (DWs) either in the FM [3] or in the AFM layer [4]. On the other hand, parallel to the theoretical interest, this phenomenon is also relevant for practical and technological applications like for instance in magnetic recording media and magnetoresistive read heads based on spin valves or tunnel junctions [5]. On the other hand The manganite $La_{(1-x)}Ca_xMnO_3$ has been widely used in many technological applications. It is characterized for having three types of ions as Mn^{4+} (S=3/2), which is bonded with Ca^{2+} ions, Mn^{3+eg} and $Mn^{3+eg'}$ (S=2) that are related to La^{3+}. Depending on the x value it can behave as ferromagnetic or antiferromagnetic. Although in the literature there are many reported studies about magnetic properties of these compounds, enough explanations of phenomena responsible of their behavior have not been done. In this work a great influence of the interface morphology on hysteresis loops, specially exchange bias and coercive force has been found, by means of simulation processes and using two different interface exchange parameters.

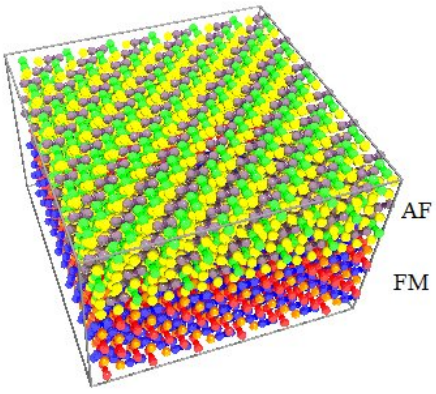

Figure 1: Scheme of $La_{2/3}Ca_{1/3}MnO_3$-$La_{1/3}Ca_{2/3}MnO_3$

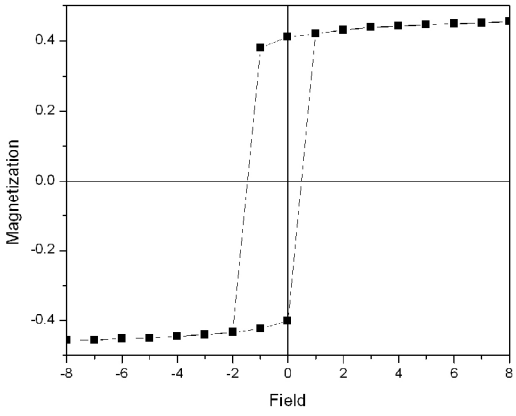

Figure 2: Hysteresis loop of $La_{2/3}Ca_{1/3}MnO_3$- $La_{1/3}Ca_{2/3}MnO_3$ bilayer

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