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COMMENT

Comment on 'Particle size dependent exchange bias and cluster-glass states in $LaMn_{0.7}Fe_{0.3}O_3$'

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Abstract
Thakur *et al* (2008 *J. Phys.: Condens. Matter* **20** 195215) have recently reported magnetization hysteresis loops shifted along the field axis of the cluster-glass compound $LaMn_{0.7}Fe_{0.3}O_3$, attributed there to exchange bias induced at ferromagnetic/spin-glass-like interfaces. The present comment affirms that their results are insufficient for assigning the phenomenon solely to exchange bias since the corresponding field shift, if any, cannot be separated from that of a minor hysteresis loop of a ferromagnet, naturally displaced from the origin.

Recently, Thakur *et al* [1] have studied low temperature properties of the cluster-glass compound $LaMn_{0.7}Fe_{0.3}O_3$. They have interpreted the shifts of the magnetic hysteresis loops traced after magnetic field cooling as a result of exchange bias induced at the ferromagnetic/spin-glass-like interface.

It must be emphasized that, when using dc magnetometry, the exchange bias effect is estimated from the hysteresis loop shift away from the zero-field axis of an *effectively saturated* system [2–5]. Here, a system is considered effectively saturated if the ascending and descending branches of its hysteresis loop coincide for fields higher than the anisotropy field. On the second page of the paper of Thakur *et al* [1], however, one finds that '... the magnetization curves do not show any saturating tendency even at 50 kOe ...', as clearly seen in figures 4 and 5 of their paper. However, the authors have used a much lower maximum measurement field of 20 kOe, thus obtaining only *minor hysteresis loops*. Such curves, traced after field cooling, are naturally displaced from the origin which, however, is irrelevant to the exchange bias phenomenon. One also notes that the (unsaturated) symmetrical and non-shifted loops measured after zero-field cooling shown in figure 3 in [1] represent typical minor loops obtained after demagnetization [8]. Discussion on the current problem can be found in [6] and, in more detail, in [7].

Thakur *et al* [1] have noted that the field shifts are strongly dependent on the maximum measurement field strength; when using 50 kOe instead of 20 kOe, a shift several times smaller has been estimated. This and all the above cited characteristics strongly indicate that the loops' displacements have, most probably, resulted from non-saturation of the samples. The exchange bias field, if any, is superimposed on the shift resulting from minor-loop effects and cannot be quantitatively estimated.

Unfortunately, one finds the same deficiency in other papers recently published by the same group of authors, where exchange bias is also claimed to be observed in similar systems, i.e., $La_{0.87}Mn_{0.7}Fe_{0.3}O_3$ [9] and $LaMnO_3$ [10]. The maximum field of only 10 kOe used in [9] has resulted, again, in non-saturated loops measured at 5 K. In [10], the natural enhancement of the minor loop's shift when decreasing the maximum measurement field [7] has been interpreted as an increase of the exchange bias field when decreasing the maximum field from 20 to 10 kOe.

In conclusion, in the present comment we affirm that the data reported by Thakur *et al* [1] on $LaMn_{0.7}Fe_{0.3}O_3$ are insufficient for assigning the displacement from the origin of the magnetization hysteresis loops solely to exchange bias. The manifestation of the latter, if it does exist, cannot be separated from the effect of non-saturation of the samples.

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