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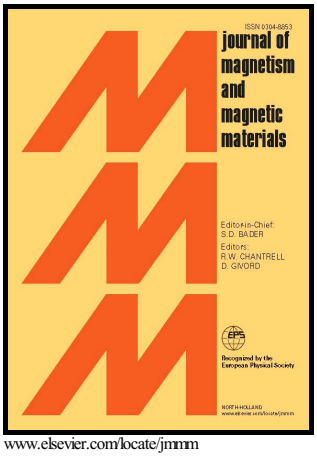

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Orientation-Modulated Exchange Coupling in $La_{0.67}Ca_{0.33}MnO_3/CaMnO_3$ Bilayer Films

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Abstract:

Epitaxial $La_{0.67}Ca_{0.33}MnO_3/CaMnO_3$ (LCMO/CMO) bilayers and the reference single layers were deposited by pulsed laser deposition on (001)- and (110)-oriented $SrTiO_3$ (STO) substrates, allowing us to perform a detailed study of the dependence of exchange coupling on crystal orientations. It is found that the exchange bias (coercive) field of the (110)-oriented LCMO/CMO bilayer are decreased (increased) compared to that of (001)-oriented bilayer, due to the enhanced (weakened) Mn^{3+}-Mn^{4+} ferromagnetic double-exchange interaction of LCMO layer. It is clear that the spin flop coupling that leads to the enhanced coercivity and the spin glass state that results in the exchange bias effect can coexist and are determined by the competition between Mn^{3+}-Mn^{4+} ferromagnetic double-exchange and Mn^{4+}-Mn^{4+} antiferromagnetic super-exchange interactions at the interface. We propose that strong Mn^{3+}-Mn^{4+} ferromagnetic double-exchange interaction facilitates the existence of spin flop coupling, not the formation of spin glass state at the LCMO/CMO interface.

Key words: spin glass state, exchange coupling, spin flop coupling, exchange bias

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