Hall effect in $La_{0.67}Ca_{0.33}MnO_3$ thin films with anisotropic strain

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It has been demonstrated that controlled relaxation of the in-plane anisotropic strain in thin films of $La_{0.67}Ca_{0.33}MnO_3$ grown on orthorhombic $NdGaO_3$ (001) substrates can induce a charge ordering state.[1] Three identically grown LCMO films on NGO, (PLD at 735^{o}C and 45 Pa O_2 pressure, 45 nm thick) were annealed at 780^{o}C in flowing O_2 for 1, 10 and 20 hours respectively to produce increasing degrees of strain relaxation. Hall measurements were performed. In all three samples, the Hall resistivity takes on two distinct slopes in the paramagnetic phase: a negative slope at low fields, which varies with temperature, and a temperature-independent positive slope at high fields. Notably, the switching field for the Hall slope decreases linearly with temperature and extrapolates to the paramagnetic Curie temperatures of the samples. The observation is similar to the behavior of the nonlinear Hall effect in EuB_6 in paramagnetic phase and suggests that the switches occur at a constant critical magnetization over a broad temperature range.[2] In apparent correlation with the appearance of charge ordered insulating state, dips in the Hall resistivity emerge when approaching T_C,and become more pronounced in the sample annealed for longer time. The origins of these observations will be discussed. Work supported in part by NSF DMR-0908625.

[1]Z. Huang et al., JAP 105, 113919 (2009).
[2]X. Zhang et al., PRL 103, 106602 (2009).