NMR study of $La_{2/3}Ca_{1/3}MnO_3$ epitaxial films : (001) and (110) $SrTiO_3$ as a substrate and as an overlayer

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Optimally doped mixed valence manganites described by the formula $La_{2/3}Ca_{1/3}MnO_3$ (LCMO) display high spin polarization of the charge carriers which makes them interesting candidates for applications in spin-electronics devices. However, major drawback comes from the fact that magnetic and magnetotransport properties of manganite thin films deviate strongly from those observed in bulk materials. This has been attributed to the presence of ferromagnet/insulator interface which affects significantly their half metallic properties, as shown by the ^{55}Mn Nuclear Magnetic Resonance (NMR) study. This technique is particularly suitable for the study of electronic states in these materials as it readily identifies contributions from manganese atoms in the ionic state corresponding to the localized spin states (Mn^{4+}, M^{3+}) and those in $Mn^{3+/4+}$ mixed valence state.
^{55}Mn NMR experiments carried out on a series of epitaxial LCMO films grown on (001) $SrTiO_3$ (STO) substrates revealed a complex electronic phase separation and an insulating nature of the thinner films [1]. On the other hand, the films grown on (110) STO substrate show the absence of localized Mn^{4+} and Mn^{3+} states.
To investigate further the phenomena occurring at the LCMO/STO interface, two series of epitaxial STO/LCMO//STO bilayers with (001) and (110) orientation, respectively, have been grown. The capping thickness was varied in the range of 0 to 5 nm while the LCMO layer thickness was fixed to be 25 nm. ^{55}Mn NMR spectra indicate that the intrinsic electronic phase separation of (001) electrodes is enhanced by the STO capping, whereas the (110) samples do not present any localized states. These results, discussed in the context of structural and magnetization measurements shed a new light on the driving force behind the phase separation at the interface, showing that the strain is not the only source of this phenomenon.

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