

Epitaxial Thin Films of $\text{La}_2\text{CoMnO}_6$ and $\text{La}_2\text{NiMnO}_6$ Ordered Double Perovskites by Polymer Assisted Deposition

Hailin Wang¹, J. Gazquez², C. Frontera¹, M.F. Chisholm², A. Pomar¹, B. Martínez¹, N. Mestres¹

¹ Institut de Ciència de Materials de Barcelona (ICMAB-CSIC), Campus de la UAB, Barcelona, Spain

² Materials Science and Technology Division, Oak Ridge National Laboratory, Oak Ridge, USA

hwang@icmab.es

Abstract

Epitaxial double perovskite $\text{La}_2\text{CoMnO}_6$ (LCMO) and $\text{La}_2\text{NiMnO}_6$ (LNMO) thin films are highly attractive due to their ferromagnetic behavior and magnetodielectric effect near room temperature, making them promising materials for applications into new devices and spintronics.^[1] However these properties are strongly dependent on the ordered arrangement of cations in the double perovskite $\text{A}_2\text{BB}'\text{O}_6$ structure.^[2] In this work, high quality epitaxial LCMO and LNMO films were grown on (001) SrTiO_3 substrates by a polymer assisted deposition (PAD) method.^[3] In the PAD process, the different metal salt precursors were dissolved in an aqueous Polyethylenimine (PEI) polymer solution. This technique allows an easy control of stoichiometry by mixing different metal-polymer precursor solutions with the corresponding metal molar ratios. The precursor solutions were spin coated on (001)-STO substrates and the resultant coatings were thermally treated at 900 °C in flowing oxygen.

We show that the particular crystallization and growth process conditions of PAD (very slow rate, close to thermodynamic equilibrium conditions) promote high crystallinity and quality of the films, as well as B-site cationic ordering. The LCMO films show saturation magnetization values of about 6 μ_B /f.u. and a $T_c \approx 230\text{K}$, thus indicating full cationic ordering of $\text{Co}^{2+}/\text{Mn}^{4+}$ in a double perovskite structure (fig. 1). Confirmation of full Co/Mn cationic ordering is found by scanning transmission electron microscopy (STEM) measurements (fig. 2). The LNMO films show saturation magnetization values of about 4 μ_B /f.u. with $T_c \approx 260\text{K}$, indicating that the $\text{Ni}^{2+}/\text{Mn}^{4+}$ cationic ordering needs to be improved.

References

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- [3] Q. X. Jia, T. M. McCleskey, A. K. Burrell, et al., *Nat. Mater.* **2004**, *3*, 529

Figures

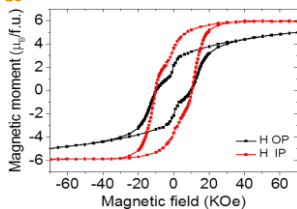


Figure 1: M-H loops recorded at 10K for a LCMO/STO film, displaying saturation magnetization value close to 6 μ_B /f.u. in good agreement with the theoretical value for fully ordered samples

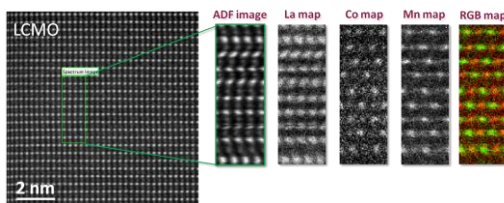


Figure 2: From left to right, Z-contrast image of the LCMO film, ADF image, atomic maps of La M, Co L, and Mn L absorption edges and RGB map produced by overlaying the Co (in red) and La (in green) elemental maps, indicating full cationic ordering