Study of Oxygen Vacancies Generation Process in La0.7Ca0.3MnO3-x Perovskite by Polarized X-Ray Absorption Spectroscopy

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Complex oxides systems show notable superconductivity, colossal magnetoresistance, ferroelectricity and multiferroicity properties. These properties are consequence of combination of charge, spin, chemical composition and lattice features. La0.7Ca0.3MnO3 perovskite material shows a ferromagnetic-paramagnetic phase transition with a metal-insulator transition and colossal magnetoresistance behavior near to room temperature. This material has been studied in ultra-thin films form to be used in magneto-electronic devices. The magnetic and electronic properties of this mixed-valence manganite deteriorate when it is grown in thin film form. In mixed-valence manganites, magnetoresistance properties are managed by the amount of oxygen content in the sample. Oxygen vacancies induce lattice distortions and how the interaction between Mn3+ and Mn4+ ions are produced.
Previous experiments were carried out by X-Ray Diffraction and Hard X-Ray Photoelectron Spectroscopy synchrotron techniques. It was obtained that oxygen defects produce important changes in the crystal structure and electronic properties of manganite samples. The Mn valence is reduced and the metal-insulator transition is shifted to lower temperatures due to the modifications in the Mn-O bonds produced by oxygen defects.
In this work, we aim to study how the structural and magneto-electronic properties are modified and correlated by the generation of oxygen vacancies in La0.7Ca0.3MnO3 perovskite material. Polarized X-Ray Absorption Spectroscopy (P-XAS) experiment was carried out to study the oxygen vacancies generation process in 20 nm La0.7Ca0.3MnO3 thin films grown on SrTiO3 substrate by Pulsed Laser Deposition. XAS technique allow to study the structural properties of the first coordination shell. The polarized X-Ray source from synchrotron is used to distinguish between in-plane and out-of-plane contributions to XAS signal from octahedral MnO6 structure. Polarized-XAS characterization show clear evidences that the formation of oxygen vacancies is produced in the basal plane of the MnO6 block. This results confirm that the magnetoresistance properties are managed by the amount of oxygen content and where the vacancies are produced in the crystal structure. These results have been correlated with previous structural and electronic properties characterized by synchrotron techniques.

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