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Infrared spectroscopy, structural and morphological characterizations of LSM ceramics obtained by modified Pechini's method

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Abstract – Strontium doped lanthanum manganite ($La_{(1-x)}Sr_{(x)}MnO_3$ - LSM) is a commonly used cathode in solid oxide fuel cells (SOFC). In this work, LSM powders were prepared by modified Pechini's method and characterized by the techniques of XRD, SEM, FAR and MID-Infrared Spectroscopy.

The study and development of $La_{1-x}Sr_xMnO_3$ (LSM) ceramic material – with a distorted perovskite structure – has shown that this compound is quite feasible to be used as a SOFC cathode material, once it exhibits good chemical and thermal stabilities, high catalytic activity in reducing oxygen, a thermal expansion coefficient similar to yttria-zirconia solid electrolyte, and a high electrical conductivity, obtained with the increase of formation of Mn^{4+} cations and the substitution of La^{3+} by Sr^{2+} cations [1]. The properties of this material are strongly dependent on the method of synthesis. Previous works described the LSM synthesis by polymeric precursor, lyophilization (freeze drying), pyrolysis by nebulization (spray Pyrolysis), sol-gel, co-precipitation and self combustion method. In general, the obtained powders by the polymeric precursor method have advantages such as good homogeneity and good control of the stoichiometry.

In this work, $La_{0.8}Sr_{0.2}MnO_3$ was synthesized by modified Pechini's method with the use of gelatin which acts as polymerizing agent. The average size of crystallites and the lattice parameters were determined by the Rietveld method. Figure 1 shows that the LSM powder displays rhombohedral phase, with peaks of the impurities La_2O_3 and $La(OH)_3$, as minor phases. The morphological characterization by scanning electron microscopy (SEM), Fig. 2, shows that the material presents a broad particle distribution with sizes below 200 nm. Besides the synthesis and characterization by X-ray diffraction and SEM, this study also considers valuable information about structure and vibrational behavior of the material, through the analysis of data obtained by infrared reflectance spectroscopy, in the far (30-500 cm^{-1}) and mid (500-4000 cm^{-1}) frequency ranges. In particular, the infrared reflectance spectrum (Fig. 3) is dominated by a conduction phenomenon (continuous decrease of reflectivity with wavenumber), besides the signature of less pronounced phonon features, characteristic of the crystal lattice. The nature of the observed conduction mechanism is under current investigation.

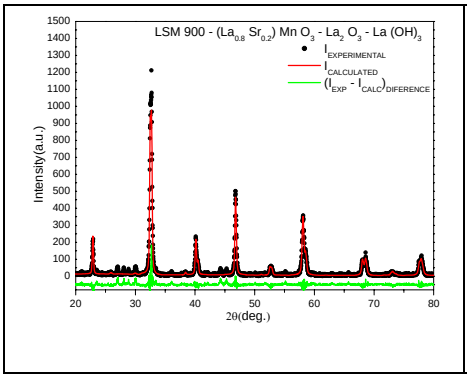

Figure 1: XRD patterns of LSM powder calcined at 900°C.

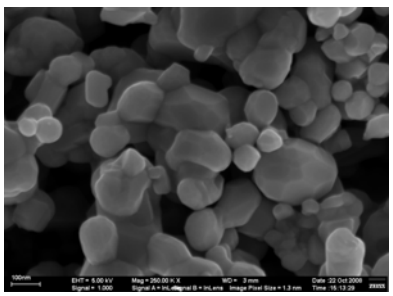

Figure 2: SEM-FEG micrographs for the LSM powder.

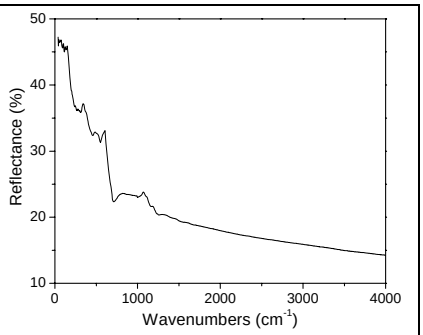

Figure 3: Infrared reflectance spectrum for the LSM, in the FAR and MID ranges.

[1] N. Q. Minh, Ceramic Fuel Cells. Journal of the American Ceramic Society, 76, n. 3, (1993).
[2] D. S Gouveia, R. Rosenhaim, De M MAMA, S. J. G. Lima, C. A. Paskocimas, E. Longo, A. G. Souza, I. M. G Santos, J. Therm Anal Cal. 75 (2004) 453.
[3] S. C. Souza, M. A. F. Souza, S.J.G. Lima, M. R.C. Santos, V. J. Fernandes Jr, L.E.B. Soledade, A. G. Souza, I. M. G. Santos, J. Therm Anal. Cal. 79 (2005) 455.