Structural and magnetic characterization of La$_{0.7}$Sr$_{0.3}$MnO$_3$ nanoparticles obtained by the citrate-gel combustion method: Effect of fuel to oxidizer ratio

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Abstract

The effect of fuel to oxidizer ratio on the processing of nano-crystalline La$_{0.7}$Sr$_{0.3}$MnO$_3$ by the solution combustion technique is reported. The results show that the structural, morphological and magnetic properties of La$_{0.7}$Sr$_{0.3}$MnO$_3$ nanoparticles could be controlled by using different combinations of citric acid fuel and metal nitrates ratio (CN). Thermodynamic considerations of the combustion processes show that the exothermicity and the amount of gases released increase with increase in CN. The post-annealed powders were characterized by Thermo Gravimetric-Differential Thermal analysis (TG–DTA), X-ray Diffraction (XRD), Field Emission Scanning Electron Microscopy (FE-SEM), Energy Dispersive X-ray (EDAX) analysis and Vibrating Scanning Magnetometer (VSM) measurements. Only the fuel rich composition produced pure perovskite phase without any secondary phase. All samples had comparable crystallite sizes (≤ 37 nm). FESEM images of La$_{0.7}$Sr$_{0.3}$MnO$_3$ showed that the CN ratio had a pronounced effect on the microstructure regarding shape and porosity. Room temperature magnetization measurements revealed unusually low saturation magnetization but near super-paramagnetic behavior in all the samples.

Keywords: La$_{0.7}$Sr$_{0.3}$MnO$_3$; Perovskite manganese; Combustion method; Fuel to oxidizer ratio; Magnetism