Characterization of $La_{1-x}Sr_xMnO_3$ (x=0,1) powders for cathode application in SOFCs obtained by combustion synthesis

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Strontium-doped lanthanum manganites (LSM) are potential materials for application as cathodes in solid oxide fuel cells (SOFC). It is possible to synthesized this material by different routes, which obviously modifies the characteristics and properties of the obtained powder; processes like modified Pechini method, reaction sintering and oxide mixture has been studied as possibilities for the synthesis of the LSM. However, combustion synthesis, that is also a studied method, presents itself as a good way for obtain LSM for specific application in SOFCs as a cathode, due to the characteristics that this electrode requires and because the reaction can be controlled with parameters like fuel ratio and type, temperature (in the case of using a muffle) and oxygen pressure; also it is a relatively cheap method compared to other methods. Mainly, good porosity and a small crystallite size are conferred to the powder using this method; the porosity is necessary because it allows the oxygen to diffuse trough the lattice until it reaches the electrolyte and it increases the triple phase boundary (TPB), promoting a higher catalytic activity. On the other hand, a small crystallite size increases the simultaneous conductivity, which can be a limiting factor in the global reaction of the fuel cell. The flame heat from the burning of the fuel can promote a sintering process during the combustion, which is not desirable, and then the flame heat and the ignition ratio of the fuel must be taking in account for a good choice of the fuel. In this work, the intent is to obtain powders with crystalline, nanometric and porous characteristics, via combustion synthesis, suitable for a cathode application in SOFCs. Therefore, $La_{1-x}Sr_xMnO_3$ (x=0,1) powders were synthesized using urea as fuel, due to its flame heat and ignition characteristics, in different stoichometric ratios (2:1 and 4:1), and the respective oxide nitrates; the combustion took place in a muffle (400˚C) and in a hot plate (290˚C) to analyze the influence of the environment. It is known that the muffle can offer better environment for the crystallization of the powder, however it is very likely that the crystallite size increases; in the hot plate it is expected that the opposite occurs. The characterization techniques applied in the study were X-ray diffraction (XRD) to determinate the present phases, crystallinity and the crystallite sizes, transmission electron microscopy (TEM) to verify if sintering occurred during combustion, scanning electron microscopy (SEM) for a visual analysis of the powder porosity and the Brunauer-Emmet-Teller gas adsorption method (BET) to measure the specific superficial area of the samples. X-ray diffractions showed that the LSM perovskite phase was obtained in both cases and that the environment has influence in the crystallite size and crystallinity of the powders. The later analyses are taking place in this moment for the complete material characterization.