Effect of the A cation size disorder and synthesis conditions on the properties of an iron perovskite series

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Solid state chemistry thrives on a rich variety of solids that can be synthesized using a wide range of techniques. It is well known that the preparative route plays a critical role on the physical and chemical properties of the reaction products, controlling the structure, morphology, grain size and surface area of the obtained materials. This is particularly important in the area of ABO_3 perovskite compounds given that they have for long been at the heart of important applications [1].

Particularly, perovskite systems such as $La_{1-x}Sr_xFeO_3$ (LSF) are now receiving researchers attention for their interesting applications [2-4] such as ceramic membranes (CMs) for oxygen separation, solid oxide fuel cells (SOFCs) electrodes for efficient power generation, catalysts for complete oxidation of CO in vehicle engines, etc. In order to develop these advanced materials, combustion methods (glycine-nitrate, urea based, and other modifications) have been proposed as one of the most promising methods for their synthesis [5,6]. This method consists of a highly exothermic self-combustion reaction between the fuel (usually glycine, urea or alanine) and the oxidant (metal nitrates), that produces enough heat to obtain the ceramic powders. The characteristics (including purity, structure and size) of the combustion synthesis oxide powders are typically determined by several synthetic parameters, such as the species of fuel and oxidizer reactants, the fuel/oxidizer ratio, and the subsequent sintering treatment after combustion process [7].

In the other hand, physical properties of these perovskite materials are very sensitive to changes in the doping level (x), the average size of the A cations ($\langle r_A \rangle$), and the effects of A cation size disorder ($\sigma^2(r_A)$) quantified as $\sigma^2(r_A) = \langle r_A^2 \rangle - \langle r_A \rangle^2$ [8]. Our searching approach to find the optimum synthetic conditions for new materials within the LSF system has been based on the study of only one of the indicated parameters isolated from the rest.

In this sense, this study is focused on the effect of the variation of the cation size disorder, calcination temperature and the fuel/oxidizer ratio of glycine/nitrate on the structural, morphological, electrical and catalytic properties of a series of $Ln_{0.5}M_{0.5}FeO_{3-\delta}$ perovskites (Ln = La, Sm; M = Ba, Sr).

Keywords: Combustion synthesis; SOFC cathodes; Perovskite catalysts; Cation size disorder

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