Characterization of perovskite powders made by different synthesis routes

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Abstract

Strontium lanthanum manganite (LSM) and lanthanum ferrite (LSF) perovskite cathode and oxygen membrane materials were synthesized using different techniques: '*spray pyrolysis*', a modified citrate route, oxalate, carbonate and cyanide co-precipitations. The use of Ca, a cheaper substituent on the *A*-site, was explored along to the substitution of La by Pr. The preparation conditions of these oxides were explored in conjunction with their physical properties. Calcination temperature, composition homogeneity, phase purity, powder size distribution and the ease of fabrication were assessed. The differently sourced powders of the same nominal composition were characterized by *TG/DTA*, *XRD*, *ICP*, *TEM*, *XPS*, *PSD*, and *BET*. The fabrication conditions of the oxalates and carbonates were modified. The co-precipitation of La, Ca and Fe was also possible using the cyanide route. This complexation method allowed the precipitation of a crystalline phase as evidenced by *XRD*. Among all methods, the cyanide and carbonate co-precipitation allowed the lowest decomposition temperatures for LSF and LCF, followed by the nitrate decomposition (i.e. 'spray pyrolysis'). All decompositions were observed to proceed concomitantly, with a temperature close to that of the La complex as evidenced by *TG/DTA*. These phase transformation differences affected much the particle size distribution and the surface areas of these materials, the carbonate and the cyanide routes giving rise to very fine powders in the *n*m range. Moreover, *XPS* analysis indicated a high segregation of the *A*-site elements on the surface of the powders, whereas the La/Sr or La/Ca ratios were similar to the measured *ICP* values. *TEM* analysis indicated further uneven composition distributions. These differences are expected to affect the catalytic and electrochemical properties of these materials.

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