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Alternative route for the synthesis of Lanthanum Strontium Titanate as SOFC Ni-free anode material

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Among the perovskite structures, lanthanum-doped strontium titanates have attracted a lot of attention as possible candidates for SOFC Ni-free anodes. In particular the composition $La_xSr_{1-(3x/2)}TiO_3$ with x = 0.4 (LST) was recently considered for its tolerance to redox cycles and sufficiently high conductivities values. In this work an extensive study on the synthesis of LST powders with low-cost and easy-scalable methods is reported. The solid state and chemical synthesis as well as a combination of solution-solid state synthesis were considered. The influence of either the nature of the precursors (oxides, carbonates or nitrates) and the calcination temperature (from 500 to 1350°C) onto the perovskite formation was evaluated. The as-synthesized powders were morphologically, structurally and chemically characterized. The Pechini method leads to the pure perovskite phase at 700°C for 5h, but it allows the production of only few grams of powder for each batch. On the other hand the solid state synthesis is a more up-scalable method but the phase can be obtained only at 1100°C for 1h. In addition the high reactivity of the lanthanum towards the humidity leads to a difficult control of the system stoichiometry and therefore of the final phase composition. An alternative solution-solid state synthesis was considered to produce batch of 100g of LST powders with good phase purity and in relatively mild conditions. The pure perovskite phase with the correct stoichiometry was obtained starting from the La and Sr nitrate aqueous solutions, highly reactive TiO_2 followed by freeze-drying and calcination at 900°C for 1 h.