Tunable electrode architectures for $La_{0.8}Sr_{0.2}Fe_{1-x}Ti_xO_{3-\delta}$ based Symmetrical Solid Oxide Fuel Cells.

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The efficiency of SOCF electrodes can be improved by optimizing the microstructure from alternative preparation methods, such as infiltration and nanostructured electrodes deposited at low temperature. Recent studies have demonstrated that spray-pyrolysis deposition is a versatile method to obtain nanostructured electrodes with improved performance in comparison with conventional electrodes prepared at high sintering temperatures. Among the different electrodes studied in the last few year, titanium-doped ferrites are one of the most promising because of their high redox stability and great electrochemical performance in both oxidizing and reducing conditions[2,3]. In this work, $(La_{0.8}Sr_{0.2})_{0.95}Fe_{1-x}Ti_xO_{3-\delta}$ (x=0.2, 0.4) perovskites, hereafter labelled as LSFT02 and LSFT04, respectively, with different architectures were obtained by spray-pyrolysis deposition and they were tested as symmetrical electrodes for solid oxide fuel cell (SSOFC).

The electrodes were deposited on as-prepared YSZ pellets and porous $Ce_{0.9}Gd_{0.1}O_{1.95}$, preciously fixed on the electrolyte. The electrolyte was sprayed with a precursor solution containing the corresponding nitrates and etilendiaminetetraacetic acid (EDTA) as a complexing agent in a 25% molar ratio in Milli-Q water with a concentration of 0.025 M. The temperature deposition, time and flow rate was optimized to 325 ºC, 1 h and 20 mL min^{-1}, respectively. After the deposition, the samples were calcined at 800 ºC for 1h to achieve crystallization.

The structural characterization by XRD revealed that both LSFT02 and LSFT04 are nanocrystalline compounds without secondary phases after annealing in air and reducing conditions. Figure 1 shows SEM images of the different electrode architectures cross-section at different magnifications. The electrodes deposited into the CGO backbone consists of a porous backbone (10 µm) coated with a layer of LSFT nanoparticles (~50 nm of diameter) (Fig. 1a).

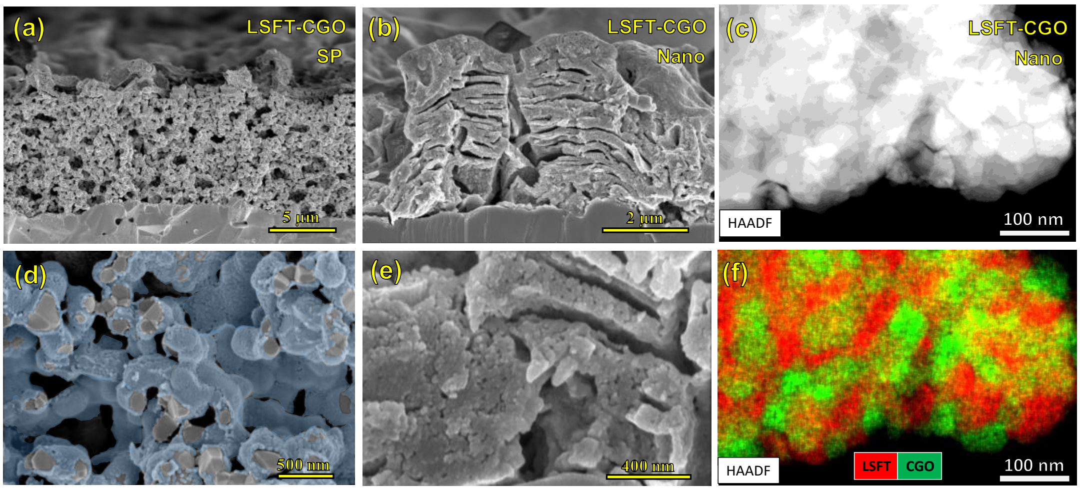
The electrochemical properties of the symmetrical cells were tested by impedance spectroscopy. The polarization resistance (R_p) in air of $LSFT_{0.2}$ and $LSFT_{0.4}$ impregnated CGO backbone by spray pyrolysis (SP) decrease from 1.19 and 8.84 $\Omega\cdot cm^2$ to 0.23 and 0.67 $\Omega\cdot cm^2$ at 700 ºC, respectively, when compared with the powders obtained by freeze drying precursor method. Similar behavior was observed for both compositions measured in reducing conditions, confirming the increase of the TPB length, highly improving the electrochemical performance. Same results were obtained for the nanocomposite architecture.

On the other hand, the Rp values in H_2 for SP-$LSFT_{0.4}$ are slightly lower when compared with SP-$LSFT_{0.2}$, explained by the great efficiency of Ti-doped electrodes in reducing conditions at high temperature.

In other to further improving the electrochemical performance, $LSFT_{0.2}$ was doped with Ni and Ru, deposited with SP architecture and tested as SSOFC. The electrochemical performance in H_2 improves substantially for the Ni-doped sample, achieving 0.08 $\Omega \cdot cm^2$ at 750 ºC, which is one of the lowest ASR values for related materials, mainly attributed to the Ni^0 nanoparticle exsolution combined with an advance microstructure configuration.

The influence of d.c. bias in a 3-probe configuration was studied under cathodic and anodic polarization in symmetrical cells in both oxidizing and reducing conditions. The results revealed a considerable decrease on the LF process, attributed to surface diffusion and/or charge transfer in the electrode.

The study of performance of the different architectures electrodes in real SOFC conditions are currently in process, but high maximum power densities are expected due to the low ASR values achieved**.**



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