Highly efficient $LaCr_{0.75}M_{0.25}O_{3+\delta}$ (M= Ti, Mn, Fe, Co and Cu) nanostructured electrodes for Solid Oxide Fuel Cells

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INTRODUCTION

Solid Oxide Fuel Cells (SOFCs) are considered as one of the most efficient electrochemical devices for power generation. One of the most effective strategies to enhance the electrode performance is the infiltration into a porous electrolyte to increase the triple-phase-boundary (TPB) leading to highly efficient devices. In this way, Spray-pyrolysis deposition is an easy and scalable method that has been used previously to obtain nanocrystalline electrodes, with a considerable improvement in comparation with conventional electrodes.[1] In this work, a new doping strategy in lanthanum chromite-based materials has been carry out to obtain potential anodes/cathodes for SOFCs. $LaCrO_3$ and $LaCr_{0.75}M_{0.25}O_3$ (M= Ti, Mn, Fe, Co and Cu) materials were obtained using Spray-Pyrolysis and Freeze-dry precursor method (FD) simultaneously for further comparation.

EXPERIMENTAL/THEORETICAL STUDY

YSZ pellets were made from commercial powders (Tosoh) pressed into disk and sintered at 1400 ºC for 4h. Afterwards, a $Ce_{0.9}Gd_{0.1}O_{1.95}$ a porous thin layer was printed and sintered at 1200 ºC for 1h. The electrolyte was sprayed with a precursor solution contain the corresponding nitrates in Milli-Q water with a concentration of 0.025 M. The optimum temperature deposition, time and flow rate was 325 ºC, 1h and 20 mL/min respectively. After the deposition, the samples were calcined at 800 ºC for 1h to achieve crystallization.

Simultaneously, the materials were synthesized by Freeze-dry precursor method using the corresponding nitrates in distilled water and adding 1:1 molar ratio of etilendiaminetetraacetic acid (EDTA) as a complexing agent. The resulting solution were frozen in liquid nitrogen, followed by dehydration by vacuum sublimation for 2 days. The dry powers were calcined at 300 ºC for 1h and 800 ºC 1h to eliminate carbonaceous species and phase formation.

RESULTS AND DISCUSSION

XRD patterns shows that single phase is achieved for $LaCr_{0.75}$(Ti, Mn, Fe)$_{0.25}O_3$ and $LaCr_{0.75}Cu_{0.25}O_3$ at 800 and 900 ºC, respectively.

The electrode polarization resistance (R_p) was determined by impedance spectroscopy obtaining ASR values as low as 0.1 and 0.35 $\Omega \cdot cm^{-1}$ at 750 ºC in air and 5%-H_2/Ar for $LaCr_{0.75}Mn_{0.25}O_3$(LCM), respectively being these values almost one magnitude order better in comparation with related materials.[2]

Figure 1. shows a cross-sectional image of the LCM-CGO composite deposited on a YSZ pellet. The electrode has a thickness of approximately 12 µm and high porosity and impregnation was achieved.

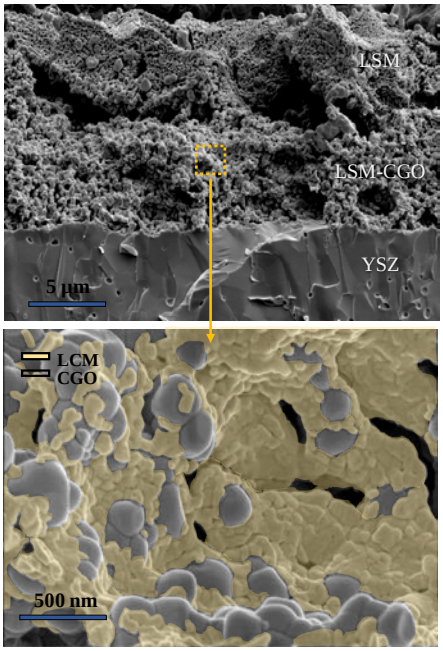

Fig. 1 SEM imagen of LCM-CGO nanostructured electrodes.

CONCLUSION

Nanostructured composites electrodes based on lanthanum chromites has been prepared using Spray-pyrolysis precursor method achieving better R_p as SOFC electrodes. The performance in real SOFC is still in progress.

REFERENCES

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