

# Nanostructured composites as active layer to boost cathode performance in Solid Oxide Fuel Cells

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## INTRODUCTION

Since the efficiency of Solid Oxide Fuel Cells (SOFCs) is largely limited by the high polarization resistance of the cathode<sup>1</sup>, several strategies have been proposed to enhance the electrochemical activity of such electrodes. Among them, optimizing the electrode microstructure by using different preparation methods, such as infiltration and spray-pyrolysis deposition, have rendered excellent and durable electrochemical performance<sup>2</sup>. In addition, the tailoring of the electrode/electrolyte interface by incorporating active layers have proven to be particularly useful to improve electrode properties<sup>3</sup>.

The present work proposes alternative active layers based on nanocomposites by combining the properties of the  $\text{La}_{0.8}\text{Sr}_{0.2}\text{MnO}_{3-\delta}$  (LSM) cathode and different ionic conductors with fluorite-type structure.

## EXPERIMENTAL/THEORETICAL STUDY

Different nanocomposite layers were prepared by spray-pyrolysis deposition at 450 °C for 30 min on  $\text{Zr}_{0.8}\text{Y}_{0.16}\text{O}_{1.92}$  (YSZ) electrolyte, i.e. LSM- $\text{Ce}_{0.9}\text{Gd}_{0.1}\text{O}_{1.95}$  (CGO) and LSM- $\text{Bi}_{1.5}\text{Y}_{0.5}\text{O}_3$  (BYO). Thereafter, the LSM was screen-printed on the YSZ pellet and sintered at 1000 °C.

The nanocomposite active layers were studied by different structural and microstructural techniques, such as XRD, SEM-EDX and HRTEM. The electrochemical properties of active layers were also investigated by impedance spectroscopy at different dc-bias and distribution of relaxation times. Similarly, fuel cell tests were performed in a NiO-YSZ anode supported cell.

## RESULTS AND DISCUSSION

The nanocomposite layers were dense with a thickness of approximately 700 nm. Interestingly, the particle size was significantly lower compared to the single-phase layers due to the intimate mixture of two different phases, which inhibit the grain growth at high annealing temperatures. Specially LSM-CGO layers showed improved adherence to the electrolyte without the presence of cracks, delamination or undesired reaction (Fig. 1).

Cathodes with active layer showed Area Specific Resistance (ASR) associated with a lower charge transfer resistance and a fast oxide ion transport at the electrode/electrolyte interface. For instance, ASR values of 1.71 and 0.46  $\Omega \text{ cm}^2$  at 700 °C were obtained for

symmetrical cells without and with LSM-CGO active layer, respectively. The full cell Ni-YSZ|YSZ|LSM-CGO/LSM rendered a maximum power density of 1.20  $\text{W cm}^{-2}$  at 800°C, higher than that obtained for the analogous cell without active layer, i.e. 0.79  $\text{W cm}^{-2}$ .

The obtained results confirm the improved performance of SOFCs when tailoring the cathode/electrolyte interface by incorporating nanocomposite active layers.

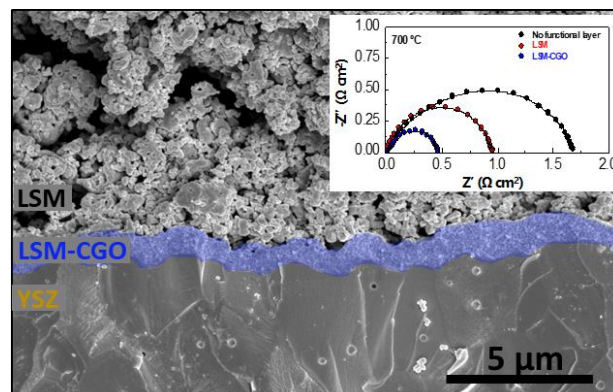


Fig. 1 SEM image of the LSM cathode deposited onto YSZ with LSM-CGO nanocomposite active layer. The inset figure shows EIS of LSM cathode without and with (single and composite) active layers.

## CONCLUSION

The use of nanocomposites active layers is a promising alternative to traditional single-phase layers. The mechanical and electrical properties at the electrode/electrolyte interface are improved without compromising the cell's integrity and performance.

## REFERENCES

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