ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY STUDIES OF PEROVSKITE/YSZ CERAMIC FILMS

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Mixed Ionic and Electronic conductors (MIEC) have been widely studied for applications as electrodes in Solid Oxide Fuel Cells (SOFC). $La_{0.8}Sr_{0.2}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (LSCF) is one of the most promising material used for cathode in SOFC because of its high oxygen ion conductivity (1). The SOFC performances are strongly dependent on interfacial polarization that occurs at the cathode/electrolyte interface, and it is directly related to the resistance associated with cell components. The rate of charge transfer is known to be function of microstructural characteristics of the electrocatalyst such as particle size and surface area. Hence, it is highly needed to understand the behavior of electrodes in terms of microstructural and electrochemical parameters to optimize the material performances (2). The impedance spectroscopy technique has been found to be an important tool for studying these parameters. This technique allows the separation of different contributions of each component related with the total cell resistance. LSCF perovskite powders used in this work were prepared by Pechini method (3) and calcined at 1100°C/5 h in air. TG/DTA measurements were carried out on the perovskite precursor gel. Phase analysis of the perovskite powder was investigated by X-ray diffraction. Fig. 1 shows that the Co_3O_4 phase was detected as impurity (4). For the electrochemical characterization, electrodes were deposited by wet spray technique on dense YSZ layers. Gold wires were attached for electrical measurements. The morphology of the deposited thick film of perovskite oxide was investigated by using FE-SEM (Fig. 2). Electrochemical impedance spectroscopy measurements were carried out over a synthetic air flux at temperatures from 200 °C to 600 °C at a frequency range of 10 MHz – 10 mHz. Fig. 3 shows a typical impedance diagram obtained for a system like LSCF/YSZ/LSCF at 600 °C. At frequencies below 0.1 MHz it is possible to observe the response of electrodes to the applied field. Three semicircles can be fitted. According to Adler (5) these contributions are related with the electron and ion transfer processes and with a non-charge transfer process that includes oxygen surface exchange, solid-state diffusion and gas diffusion.

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(4) L. W. Tai, *et. al.* , Solid State Ionics, **76**, 250 (1995).
(5) S. B. Adler, Solid State Ionics, **111**, 125 (1998).

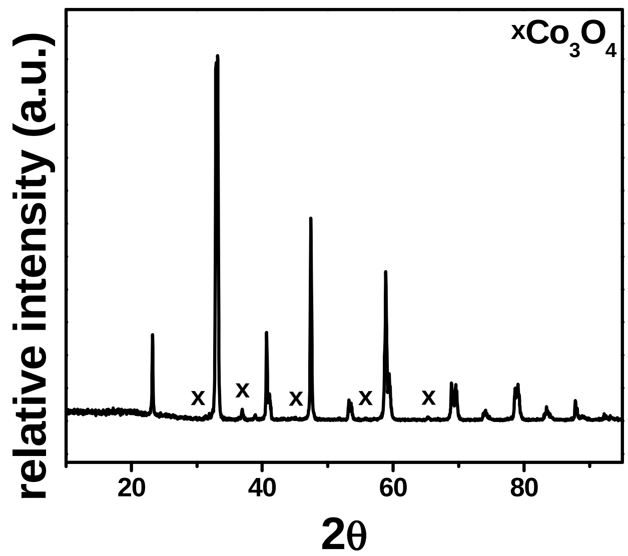

Fig. 1. XRD pattern of the perovskite powder. The unmarked peaks correspond to the $La_{0.8}Sr_{0.2}Co_{0.8}Fe_{0.2}O_{3-\delta}$ structure.

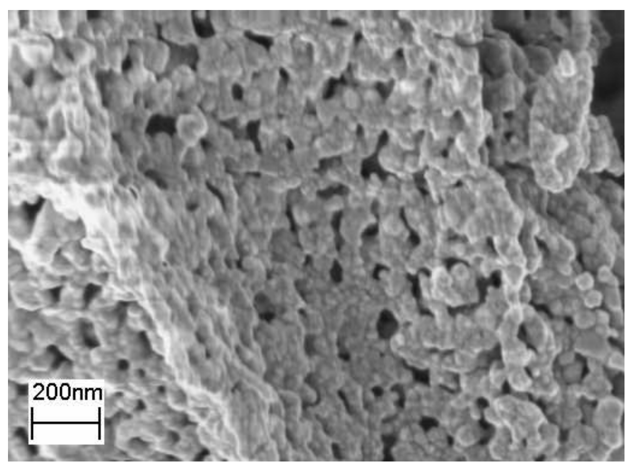

Fig. 2. SEM image of the LSCF thick film sintered at 800 °C/1 h.

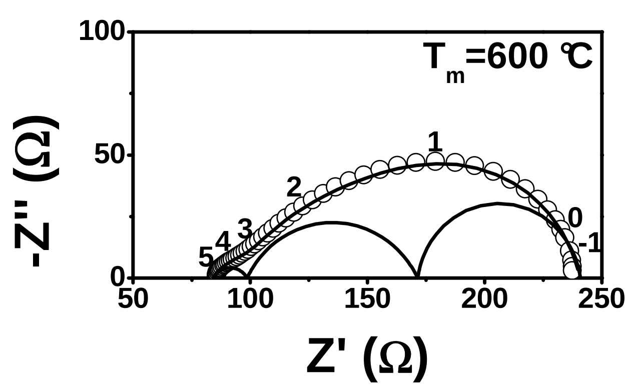

Fig. 3. Typical complex impedance diagram obtained for LSCF/YSZ/LSCF specimens. The numbers indicate the logarithm of the frequency.