Grain boundary dominated thin films of strontium-doped lanthanum manganite for μSOFCs

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Interface-dominated thin films are a promising solution to enhance the mass transport properties of oxides, which opens new perspectives in the miniaturization of oxide-based devices, such as micro Solid Oxide Fuel cells (μSOFC). In order to assure a broad deployment of this technology, the operation temperature of the μSOFCs needs to be lowered, while maintaining fast oxygen reduction reactions (ORR) and oxygen diffusion typical of the high temperature operation mode. Recent studies demonstrated that Sr-doped $LaMnO_3$ (LSM) dense thin films with columnar nanometric grains present several orders of magnitude of increase of oxygen diffusion and surface exchange coefficient, due a strongly enhanced oxygen pathway parallel to the grain boundaries [1]. In this work, the origin of this remarkable improvement has been deeply investigated. Pulsed laser deposited (PLD) LSM thin films on single crystal Yttria-stabilized zirconia (YSZ) have been characterized by electrochemical impedance spectroscopy (EIS) as a function of temperature and oxygen partial pressure (PO_2) [2]. The structure and composition of the LSM grain boundaries have been analyzed by transmission electron microscope (TEM) and electron energy loss spectroscopy (EELS). The results obtained from the different techniques are coherent with a high concentration of oxygen vacancies strongly bounded in the grain boundaries, enhancing the diffusion across the thin film and consequently the oxygen exchange rate at the surface.

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