$(La_{0.8}Sr_{0.2})(Mn_{1-y}Fe_{y})O_{3\pm\delta}$ Oxides for ITSOFC Cathode Materials ?
Electrical and Ionic Transport Properties

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$(La_{0,8}Sr_{0,2})(Mn_{1-y}Fe_{y})O_{3\pm\delta}$ perovskites (LSMF) are prospective cathode materials for the development of solid oxide fuel cells (SOFCs) operating around 700°C. The substitution of iron for manganese in the usual cathode $La_{0,8}Sr_{0,2}MnO_{3+\delta}$ can induce modifications in transport and electrocatalytic properties of LSMF. In this view, the valence state of iron cations and the transport properties of LSMF were studied.

The Mössbauer spectroscopy revealed that, for the compound y=1, the complete substitution of Fe for Mn induces the formation of Fe^{5+}. However, for the LSMF compounds with y=0.2-0.8, no Fe^{4+} cation exists in air and only the manganese is oxidized. Consequently, doping with iron furthers the formation of oxygen vacancies.

The oxygen transport properties were determined by the isotopic exchange depth profile technique : after isotopic exchange of ^{18}O for ^{16}O using densified pellets, the tracer concentration profiles were measured by SIMS. Crank's diffusion model was used to describe the oxygen diffusion. The coefficients for oxygen diffusion and surface exchange were found to be greater for LSMF with y=0.8 and 1 than those of LSM (y=0). For LSMF with y=0.2 and 0.5, grain boundary diffusion was found to be preponderant by using the Le Claire's equation. Thus, in the LSMF perovskite materials, the oxygen diffusion *via* the oxygen vacancies is enhanced by iron.

The electrical performances of LSMF were measured by impedance spectroscopy. Porous electrodes were prepared using sol-gel route and deposited onto yttria-stabilized zirconia pellets by dip-coating. Compared to LSM, LSMF cathodes with y=0.2-0.8 exhibit poor electronic conductivity. Indeed, only the Mn^{3+}/Mn^{4+} couples are electronically active in the bulk, limiting the electrical conduction. Thus, when the electrical properties are considered, only the LSMF compounds with y=1 or 0 seem to be good materials for SOFC applications. Consequently, these two compositions were tested in working conditions of ITSOFCs after optimization of the cathode microstructure.