Oxygen Reduction Kinetics on La$_{1-x}$Sr$_x$MnO$_{3-\delta}$
($x = 0.1 \sim 0.7$)/YSZ for SOFC Systems

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Electrochemical O$_2$ reduction kinetics were investigated with the perovskite manganites, La$_{1-x}$Sr$_x$MnO$_{3-\delta}$ ($x = 0.1 \sim 0.7$). The apparent transfer coefficient values in the Butler-Volmer equation for multi-electron process, which were obtained from the steady-state polarization curves and Tafel plots, indicated that the charge transfer step to atomically adsorbed oxygen is rate-limiting. The same conclusion was drawn with the P$_{O2}$-dependent AC impedance studies, where the exponent m in the relation of I$_0$ (exchange current density) $\propto$ P$_{O2}^m$ was evaluated. The symmetry factors ($\beta$) for the charge transfer step were dependent on the oxygen stoichiometry of the electrode materials; higher symmetry factors for more oxygen deficient samples. The oxygen stoichiometry ($\delta$) at high temperatures was also varied depending on the Sr-doping contents. Among those samples ($x = 0.1 \sim 0.7$), the manganite with $x = 0.4$ showed the smallest value in the oxygen stoichiometry both at P$_{O2} = 0.21$ atm and 7.7$\times$10$^{-3}$ atm, with which sample the highest symmetry factor was observed.