Structural and Electrochemical Properties of A-Site Deficient Nickelates as High Performance Cathode Materials for Solid Oxide Fuel Cells

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The quest for high performance cathode materials is of great importance for solid oxide fuel cell (SOFC) research. One of the greatest challenges is to obtain stable and high power density cathodes. Recently discovered and stable Pr_2NiO_4 cathode material shows higher power density than LSFC and LSM cathode materials (Figure 1).[1]

In order to further investigate structure-property relationship in these nickelate compounds, A-site deficient materials were synthesized and characterized. X-ray diffraction measurements were carried out ($0 \leq x \leq 0.2$, in 0.05 increments) in atmosphere at room temperature. The electronic and ionic conductivity were measured as a function of pO_2 over a temperature range from 600 to 800°C in O_2-N_2 atmospheres. Dense bar-shaped samples were used for conductivity measurements and the Hebb-Wagner blocking technique was utilized to measure ionic conductivity. The surface exchange coefficient (k) and diffusion coefficient (D*) will be reported for all values of x. Porous-bars were used to improve the kinetics of the surface exchange process. Different particle size (≤300 nm) and thickness of A-site deficient compounds were investigated as possible factors for the cathode performance and degradation. The half-cell and full cell tests were conducted and the cell performance was measured.

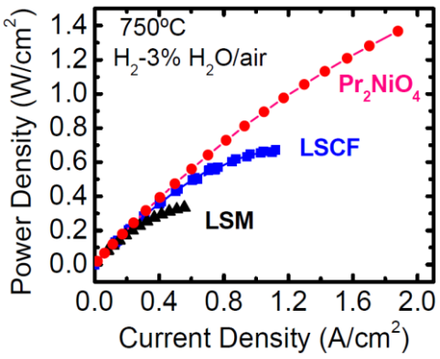

Figure 1. Power density v. current density for several high performance cathodes at 750 °C on the same batch of electrolyte/anode bilayers.

[1] Zhou, X. D., J. W. Templeton, et al. (2012). "Electrochemical performance and stability of the cathode for solid oxide fuel cells: V. high performance and stable Pr2NiO4 as the cathode for solid oxide fuel cells." Electrochimica Acta **71**: 44-49.