A Two Dimension Numerical Model for Identification of Surface Diffusion in Patterned Cathodes of $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$

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Patterned cathodes of $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ (LSCF-6428) were deposited on 8 mol% yttria-doped stabilized zirconia (YSZ) substrates with a Gd-doped ceria barrier layer by rf-magnetron sputter deposition. Patterns were generated with triple phase boundary (TPB) lengths which ranged from 50 to 1200 cm^{-1}. Electrochemical impedance spectroscopy (EIS) results were collected over a temperature and partial pressure of oxygen, p_{O_2}, range of 600-800 °C and 10^{-3} to 1.00 atm respectively. Plots of the inverse of the characteristic resistance, R_c (the maximum of the negative imaginary portion of the impedance), vs. the TPB length indicates the presence of surface diffusion. To gain further insight, the results were fitted to a 2-dimensional numerical model which includes the influence of bulk diffusion, surface diffusion, and surface exchange. These results also predict the presence of surface diffusion over all measured temperatures and p_{O_2}. Furthermore, the model predicts an increase in surface diffusivity with increasing p_{O_2} which suggests the mechanism may be related to an interstitial type mechanism, rather than vacancy diffusion. The model results were then compared against the experimental results at other TPB lengths, and a reasonable correlation was found at small TPB lengths, but significant non-linearity in the model results did not correspond with measured results. This suggests that further experimentation is necessary.