The Composition and Structure of $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ Thin Film Surfaces

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$La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$ (LSCF) perovskites are promising mixed-conducting cathodes and oxygen separation materials for SOFCs due to their thermal stability and catalytic activity. Previous studies have shown that oxygen reduction at the cathode is a rate-limiting step in the performance of SOFCs. The surface structure and composition of the cathode affect the oxygen reduction process. In order to better understand the interplay between the cathode microstructure and the cathode performance, we have studied a thin epitaxial film of LSCF (~5 nm) on TiO_2-terminated Nb-doped $SrTiO_3$ (001) by in situ synchrotron x-ray diffraction and x-ray reflectivity. Experiments were performed at room temperature, 500°C and 750°C in a He/O_2 mixture with a pO_2 of 150 Torr. Specular x-ray reflectivity data was analyzed using Coherent Bragg Rod Analysis (COBRA) and difference map (DM) algorithms. We find that strontium segregates to the surface at all temperatures. A (3x3) surface reconstruction is observed at 500°C and 750°C. The correlation between the changes in surface composition and structure of LSCF and its implication on oxygen reduction in SOFCs will be discussed.