ESRF	**Experiment title:** Microscopic compatibility and cation diffusion in complete solid-oxide fuel cells	**Experiment number**: ME-1396
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Report:

The complete SOFC were prepared by screen-printing with a novel five-layer architecture consisting of the following materials (cathode) LSC / LSCF / LSCF+GDC / GDC / YSZ / YSZ+Ni (anode). This is shown in Figure 1.

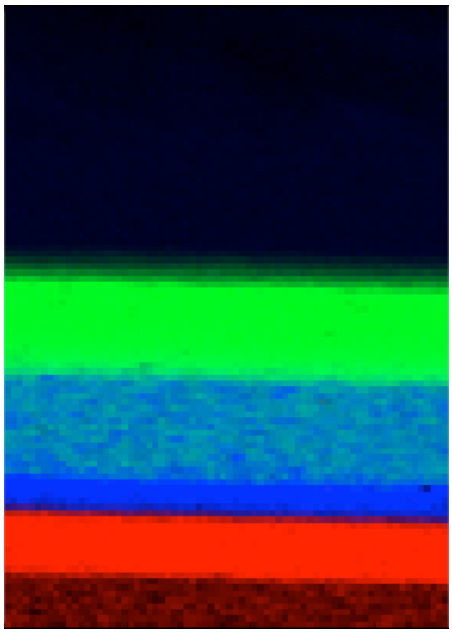

Figure 1 – microXRF concentration maps of the complete cell measured at the Fe K-edge. From top to bottom: LSC / LSCF / LSCF+GDC / GDC / YSZ / YSZ+Ni. Iron in green, cerium in blue, yttrium in red. The topmost layer constisting of LSC is not visible. Map size: 70 x 100 micron.

Cathode-electrolyte bilayers were also investigated at the Fe and Mn K-edges and Ce L_3-edges: the bilayers were prepared by placing the sintered electrolyte and cathode powder in contact, and aging the bilayer at 1150 °C for several hours (12 to 72h). The materials under investigation were the cathode $La_{0.8}Sr_{0.2}MnO_3$ (LSM), with different electrolytes: $Ce_{0.8}Sm_{0.2}O_2$ (SDC), $BaCe_{0.9}Y_{0.1}O_3$ (BCY) and $LaW_{0.16}Nb_{0.84}O_4$ (LWN); and the cathode $La_{0.6}Sr_{0.4}Fe_{0.8}Co_{0.2}O_3$ (LSCF) with the electrolyte BCY. The bilayer was then cast in resin, cross-cut to expose the interface and polished at < 1 micron roughness.

In all the samples the interdiffusion of the cations is observed. Some diffuse more than others, for example Sr^{2+} showing higher mobility. In some cases it's possible to see the formation of new phases: two possible morphologies (islands vs. continuous layer) are shown in Figure 2.

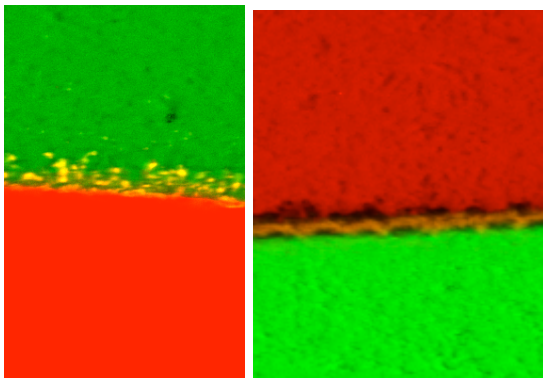

Figure 2 – Different morphology of secondary phase formation at the electrolyte/cathode interface. Map size: 65 x 100 micron; 78 x 100 micron.

Although the microXANES spectra of the different cations generally show space-dependent oxidation state changes in almost all samples, the most interesting results were acquired on the Mn K-edge, possibly hinting at the presence of Mn^{5+} in the LSM/SDC bilayer.

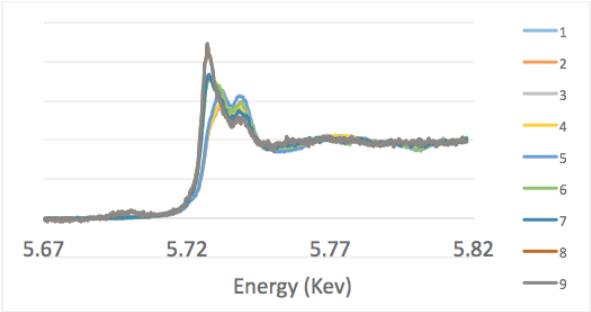

Figure 3 – microXANES at the Ce L_3-edge, showing the transition from Ce^{4+} to Ce^{3+} due to the formation of $CeMnO_3$.

In a further test (3 shifts in July 2017) we confirmed the feasibility of Co K-edge microXANES mapping: by acquiring several maps at 4 energies on the Co absorption edge, we were able to differentiate the Co oxidation and coordination state across one LSCF/SDC bilayer.