

Microanalyses of Structure, Composition, and Morphology of the Surfaces and Interfaces in LSM-Infiltrated LSCF Cathodes

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Recent studies suggest that the stability and performance of a porous $\text{La}_x\text{Sr}_{1-x}\text{Co}_y\text{Fe}_{1-y}\text{O}_{3-\delta}$ (LSCF) cathode may be enhanced by the infiltration of a thin-film $\text{La}_x\text{Sr}_{1-x}\text{MnO}_{3-\delta}$ (LSM) coating. However, the mechanism of the observed enhancement is still unknown. This poster will present our recent findings in microanalyses of the structure, composition, and morphology of the LSM and LSCF surfaces as well as the LSM/LSCF interfaces in LSM-infiltrated LSCF cathodes. Results indicate that a thin (~ 50 nm thick) LSM film is relatively stable on the surface of an LSCF substrate after annealing at 850°C for 900 hours, although the regularity of atom arrangement in the outer layer (~80% of the film) was reduced from long to short range order. Also, it was found that ~ 3 at.% Co is present in the LSM film, but the Co content tapers off near the surface. On the other hand, the inner layer of the LSM film (~20% of the film) and the underlying LSCF maintain their respective perovskite structures and their structural coherence. For an LSM-infiltrated LSCF cathode after operation at a cell voltage of 0.8V at 750°C for 900 hours, an amorphous layer (thickness varies from 2 to 23 nm) was formed on the surface of LSCF grains. DES analysis of the amorphous layer suggest that it contains La, Sr, Co, Fe, and Mn, with ~ 3 at.% Co. The LSCF grain also maintains its perovskite structure and has a well-defined interface with the surface LSCFM layer. However, there was no evidence that Sr has enriched near the surfaces of these samples. Incorporation of Co, a highly mobile element, into LSM may contribute to the reduction in long range order for the LSCFM layer, and thus improve its oxygen ion conductivity (compared with crystalline LSM). The amount of LSM-infiltration shall be controlled so as for Mn or LSM to migrate on surfaces of LSCF grains until a sufficiently thin LSCFM uniformly covers the exposed surfaces of the LSCF grains. The resultant coating of LSCFM shall be thin enough for facile transport of oxygen ions to the underlying LSCF, and shall have one or all of the following traits: 1) to enhance O_2 adsorption compared with blank LSCF, and 2) to inhibit formation of Sr-oxide that will otherwise be present on the LSCF surfaces. More experiments are underway for improved understanding of the mechanisms.