**Microstructure Tailoring of Infiltrated Cathode to Control Activity and Stability**

Shiwoo Lee, Nicholas Miller, and Kirk Gerdes

U.S. Dept. of Energy, National Energy Technology Laboratory, Morgantown, WV 26508 (leesn@netl.doe.gov)

**Prior work: Cathode Activation by Electrocatalyst Infiltration**

- Dramatic reduction in electrode overpotential due to enhanced oxygen reduction reaction rate.

**Motivation of current work**

1. **New electrocatalyst: Noble Metal (Pt)-substituted Perovskite (LSCo)**
   - Solid-solution of noble metal with perovskite oxides is expected to
     (1) prevent the metals’ irreversible coarsening (agglomeration),
     (2) reduce losses due to volatilization at high operating temperatures, and
     (3) avoid reactions with other components that lead to catalyst deactivation.

2. **Demonstration: Microstructure tailoring**
   - **Solution chemistry**
   - **Microstructure of cathode**
   - **Cell performance**

**Experimental**

- **Precursor of infiltration solution**
  - Metal precursors vs. Nitrate of La, Sr, Co, and Pt
  - Polymeric additives vs. Citric acid
  - Solvent vs. Water / Ethanol / Mixed solvent

**(2) Non-PC route (NPC)**

- Non-Polymerizable complex route:
  - Precursor solution composition: Nitrate of La, Sr, Co, and Pt + citric acid (w/ ethylene glycol).
  - SEM image of the composite cathode infiltrated with aqueous solution unsupplied with ethylene glycol (LSCo-PNPC) followed by calcinations at 850 °C and operation at 750 °C for 280 h.
  - Removal of ethylene glycol and resultant non-polymerizable complexing process made infiltrated particles much smaller in size (~ 50 nm) free of macro-network structure.

**(3) Mixed solvent (MS)**

- Water-based solution vs. Mixed solvent solution
  - X-ray diffraction patterns of Pt-substituted LSCo calcined at 850 °C for 4 h with different Pt doping level: (a) 0% (0.1), and (c) 0.2 mol.

**Effects on cell performance**

- Bode plots of a baseline cell, cell LSCoPt-PC and the cells infiltrated with LSCoPt precursor of different compositions (LSCoPt-NPC and LSCoPt-NPC-MS).
- Impedance of region II (10-200 Hz) is reduced for the cells LSCoPt-NPC and LSCoPt-NPC-MS:
  - Clear evidence of activation by infiltration

**Conclusion**

- Microstructure and electrochemical performance of commercially available SDC-LSCF composite cathode infiltrated with La₀.₅Sr₀.₅CoₓPt₀.₃₋ₓ₋₀.₀₃Oₓ₋ₓ was investigated.
- Modification of polymeric additives and solvent exerted critical influence on nanostructure of infiltrated cathode and, ultimately, cell performance.
- The cells infiltrated with the modified solution system showed enhanced cathode activity and exceptional stability for 280 hours.
- Additional mechanistic understanding and microstructural scrutiny will allow further control over activity and stability of infiltrated cathode systems.