High Surface Area, Mesoporous Catalysts in Solid Oxide Fuel Cell Cathode

Robin Chao[1], Paul Salvador[1], John Kitchin[2], Kirk Gerdes[3]

1) Department of Materials Science and Engineering, Carnegie Mellon University
2) Department of Chemical Engineering, Carnegie Mellon University
3) National Energy Technology Laboratory, Department of Energy

Contact information: Email: hchao@andrew.cmu.edu, Telephone: (412) 260 - 5687

The efficiency of the solid oxide fuel cell (SOFC) is limited by the cathode polarizations. One approach to improving the efficiency is to include high-surface-area cathode materials into the fabrication of the cathode by means of infiltration. Though the exact mechanism of the improvement has not been determined, the increased total surface area and triple phase boundary (TPB) length are believed to have a major contribution to the reduced electrode polarization. However, conventional synthesis methods commonly used for solid oxide fuel cell cathodes are known to produce perovskites of limited specific surface areas of the particles produced (2 m^2/g - 30 m^2/g). Mesoporous nanoscale electrocatalysts should further enhance the SOFC energy efficiency owing to their extremely high surface areas and increased TPB length.

The high surface area, mesoporous catalyst was introduced to the porous cathode by wet impregnation. The prepared precursor solution was placed on the top surface of the porous cathode, and was drawn into the porous system by capillary force. After solvent evaporation, the cell with infiltrated precursor solution was calcined to form crystallized catalysts. The scanning electron microscopy (SEM) images show that the catalyst formed thin coatings on the surface of the pore walls. The coatings were formed on SOFC backbone materials, including yttria-stabilized zirconia (YSZ), $La_xSr_{1-x}MnO_3$ (LSM), and $La_xSr_{1-x}Co_yFe_{1-y}O_3$ (LSCF). The wettability of the precursor solution was sufficient to produce thin porous coatings on the pore walls. Under TEM, the mesoporous LSM coatings with pore sizes less than 50 nm were successfully generated in the porous LSCF cathode. The technology has also been successfully transferred to form LSC coatings. Both infiltrated coatings had shown maintained porous structure after 200 hours of cell operation at 750 °C. The performance of the SOFC button cells with mesoporous LSM coatings is currently being determined and will be discussed in this presentation.

Acknowledgement

This work was supported by the National Energy Technology Laboratory, Office of Research and Development through DOE contract DE-FE0004000.