Characterization of Stack Components for Improved Mechanical Robustness

Ryan Berke, Dev Bodhayan, Mark Walter*
The Ohio State University

*Contact Author: walter.80@osu.edu, 614-292-6081

Michael Jansen, Scott Swartz
NexTech Materials Ltd

Planar Solid Oxide Fuel Cells (SOFCs) are made up of repeating sequences of thin layers of energy producing ceramics, seals, and current collectors. For electro-chemical reasons it is best to keep the ceramic layers as thin as possible, which also means that the cells are more susceptible to damage during production, assembly, and operation. The latest-generation electrolyte-supported SOFC membranes from NexTech Materials, have thin electrolyte layers that are supported by thicker frames and a honeycomb-type support structure. A two-scale modeling approach has been used in the past to optimize the electrolyte support structure.

The performance of the electrolyte within the context of a mechanically and thermally loaded stack is now being investigated. Temperature profiles are obtained from CFD models. Mechanical and thermal material properties are obtained from experiments with individual components. Single-component models are used to further characterize components with complex geometries, particularly the electrolyte and the compliant, electrically conducting metal foams. A 2-D stack model uses this data to evaluate the mechanical response of the cells to loads comparable to those experienced in assembly and operation. The model is run both at room temperature and operating temperature to determine which parameters can best reduce the demands on the brittle electrolyte. Once optimized, NexTech will be able to produce cells which are mechanically robust, while still maintaining the thin ceramics which are more electro-chemically efficient.