Overview

The overall goals of this SECA Core Technology Program (CTP) project are to understand the microstructural evolution of long-term degradation in LSM-based cathodes for commercial fuel cell systems (Figure A). Here we present results from recent LGFCS-CWRU collaborations as examples of work to be carried out under this CTP project. We will implement an accelerated testing protocol, developed and validated by LGFCS, to gather performance data at CWRU in time frames of e.g. 500 hours that are relevant to much longer-term normal cell operation (≥ 5 kHz) (Figure B), and compare these findings to results from non-accelerated tests (Figure C). Tested cells will undergo detailed microstructural and microanalytical studies (Figures D, E, F, and G). Analysis of performance histories, microstructural studies, and computational thermodynamic results (Figure H) will lead to design rules for improving the long-term stability and performance of LSM-based cathodes. We will iteratively refine the proposed design rules (GenA – GenD, Figure A), with a view to identifying and quantifying the mechanisms that lead to loss of performance in LSM-based cathodes.

References


Summary

The accelerated testing protocol enables the study of microstructural changes and effects on SOFC performance that are characteristic of years of testing, within time frames (~500 hours) amenable to applied laboratory-scale SOFC R&D. This brings, within the scope of a three-year program, the ability to modify cathode formulations and test hypotheses for their optimization. Because one of the key challenges in advancing SOFC technology is the difficulty of studying (and understanding) the mechanisms that lead to critical long-term performance loss, the research proposed here has the potential for breakthrough impact in improving the reliability, robustness, and longevity of SOFC technology.

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Figure A. Task flows and cooperative distribution of tasks between CWRU and LGFCS in the new CTP project.

Figure B. Thickness of densified cathode layer vs. duration of accelerated testing. The vertical line indicates that 1.2 kHz under the accelerated conditions produces the same thickness of densified cathode (5 pm) observed after 16 kHz of testing under simulated system conditions (Figure F).

Figure C. Cell ASR vs. time, with H2O in cathode environment, as a function of operating temperature: (a) 925 °C, 480 mA cm-2; (b) 800 °C, 400 mA cm-2. Both cells were tested with reformate at the anode [1].