A Study of H_2S and PH_3 Effects on Alternative Anodes for Solid Oxide Fuel Cells

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As our precious resources continue to diminish, scientists and researchers across the world work tirelessly to try and develop alternate sources of energy for everyday life. One source with reasonable thermal efficiency and minimal emissions that has been investigated is the Solid Oxide Fuel Cell (SOFC). And though promising, one of the major problems with the SOFC is degradation of the anode network upon exposure to trace levels of contaminants that are present within coal-based syngas. In particular sulfur and phosphorus, which with current clean-up technologies are present in syngas in the ppm range, have been shown to cause degradation to the typical Ni/YSZ anode. Thus, this work will focus on alternate anodes and their tolerance to ppm exposure levels of H_2S and PH_3. Our studies demonstrate Ni/GDC anode tolerance up to 100 ppm H_2S for over 400 hours using YSZ electrolyte supported cells. The effects of adding a GDC barrier layer to this cell's long term performance will also be shown. Other system parameters assessed are the GDC concentrations in the active and current collection layers, water concentration in the fuel stream, fuel composition, and current density as they relate to cell poisoning and micro-structural changes of the anode over time.

Additionally, a double perovskite, sulfur tolerant anode $Sr_2MgMoO_{6-\delta}$ was synthesized and tested in varying concentrations of PH_3 in an effort to identify an anode material capable of tolerating fuels containing both sulfur and phosphorus. GDC was also incorporated into this cell both as a barrier layer and as a part of the active and current collection layers to determine its impact on the system. Post-mortem analysis was performed and power density and impedance curves were generated to observe the quantitative and qualitative differences and thus draw conclusions about how each of these cells evolve over time in response to these trace contaminants.