Effect of Syngas Trace Contaminants on SOFC Anode Performance

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Abstract

National Institute for Fuel Cell Technology (NIFT) at West Virginia University (WVU) is a center of excellence on research related to fuel cell technology specifically and, in general, to clean power generation from coal derived fuels as well as renewable energy. The research cluster is based on a multi-scale, multi-disciplinary approach, conducted by nine faculty members in four departments at WVU including collaboration with the National Energy Technology Laboratory. NIFT members are conducting research to establish the tolerance limits of contaminant levels in the coal syngas for SOFCs and to predict the lifetime of the cells for a given contaminant level. Thus far, NIFT researchers performed extensive testing on SOFC anode degradation due to phosphorus impurity which shed light on different mechanisms through which phosphorus affects the anode performance. Other trace impurities that are tested include HCl, Zn and H_2S. Investigations are also performed on direct utilization of biogas contaminated with H_2S in SOFCs. Novel in-situ methods are being used for some of the tests along with state-of-the art ex-situ characterization instruments such as High Resolution Transmission Electron Microscopy (HRTEM). On the materials front, the button cell manufacturing techniques are perfected and significant progress has been made towards manufacturing of large planar cells. This will enable testing of industrial size cells for studying performance and degradation patterns. Impregnation of Lanthanum doped Ceria (LDC) into SOFC anode was shown to improve the sulfur tolerance and a layer of ceria on anode surface is shown to delay the onset of degradation due to phosphine. Finally, computational models are being developed to predict electrochemical as well structural degradation of SOFC anodes when exposed to trace impurities. The approach is to validate the computational models using short term accelerated tests and ultimately use the simulations to predict the cell performance during long term exposure to low contaminant levels.