390c Fundamental Study of the Interaction of Jp-8 Reformate Components with Sofc Anode Catalyst

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Recently, significant effort has been devoted to the development of solid oxide fuel cells (SOFCs), which appear to be promising for applications in auxiliary power units. One of the major advantages of SOFCs over other types of fuel cells is that internal reforming of simple hydrocarbon fuels is in principle possible. Current SOFCs, however, suffer from two major limitations when dealing with internal reforming. The first is coke formation that deactivates the anode catalyst, which is typically Ni-YSZ cermet. The second is poisoning of the catalyst by sulfur compounds. These problems are particularly challenging for logistic fuels such as JP-8 that are rich in heavy hydrocarbons and sulfur compounds. Even if JP-8 fuel is externally reformed, it is possible that small concentrations of unconverted JP-8 components reach the SOFC feed stream, especially during transient operation such as start-up. The effects of these reformate components on the SOFC anode catalyst are not well understood and the tolerance of typical SOFC anode catalysts toward these reformate components and impurities has not been systematically investigated.

We have utilized multiple anode catalyst synthesis methods and various in-situ characterization methods to analyze the interaction of different compounds, contained in JP-8 and its reformate with SOFC anode catalysts. The effect of different synthesis methods on crystallite size and the reducibility of the cermet catalyst will be discussed. Temperature programmed reaction (TPR) studies showed that the reduction behavior of the catalysts depends strongly on the preparation method. In situ conductivity measurements and temperature programmed reaction studies were utilized to explore the effect of different synthesis methods on the catalyst stability. We have also employed X-ray photoelectron spectroscopy (XPS) and X-ray diffraction (XRD) measurements to investigate the effect of different reformate components on the surface composition and the bulk phase structure of the anode catalysts. The type and quantity of carbon species deposited was monitored using temperature programmed oxidation (TPO) reaction studies. Aside from reformate hydrocarbon feeds, the interaction of the JP-8 sulfur compounds and additives with the anode catalyst will be discussed. We will also address strategies to improve the long term durability of the anode catalyst by incorporating alloy materials.