271a Development of Sulfur-Tolerant Catalysts for Jet Fuel Reforming

Amanda C. McCoy, Abdul-Majeed Azad, and Martin Abraham

NASA envisions employing fuel cells running on jet fuel reformates for its uninhabited aerial vehicles (UAV) and low emission alternative power (LEAP) missions, as well as for transatlantic and intercontinental flights. Additionally, the military foresees utilizing jet fuel, specifically JP-8, as a platform fuel in their fuel cell applications. Current available catalysts deactivate quickly and/or are poisoned due to large sulfur contents in logistics fuels. According to NASA, the two areas of utmost priority with respect to using jet fuel-operated fuel cells are the desulfurization and the development of sulfur-tolerant reforming catalysts for jet fuels. The development of robust desulfurizers and new reforming catalysts is a critical path in the development of processors for jet fuels and their eventual utilization in powering the research and commercial flights by NASA using fuel cells. The University of Toledo is developing novel jet fuel reforming catalysts and examining their sulfur removal capabilities. In cooperation with Catacel Corporation, the University is developing a compact design that provides enhanced performance resulting from the ability to regenerate the catalyst on-stream.

Steam and auto-thermal reforming experiments are performed on catalysts with model and surrogate fuels without sulfur. Several ceria-based catalyst compositions were studied to assess their performance based on their ability to optimize the hydrogen yield. A steam to carbon (S/C) ratio equal to 3 and oxygen to carbon (O/C) ratio equal to 0.6 was used, and the hydrogen yield measured as a function of time. The effect of inlet temperature, pressure, and different model fuels on each catalyst was also examined.

Preliminary testing of these novel reforming catalysts shows that, generally, at atmospheric pressures, steam reforming reaction provides higher hydrogen yields compared to auto-thermal reforming. The initial findings from ATR experiments showed that the hydrogen yield reached a maximum around 10% that gradually decreased with time. The steam reforming reaction also gave a steady yield of 10% hydrogen. However, under identical experimental conditions, an indigenous ceria-based catalyst improved the yield to 55% hydrogen in the product stream during ATR while stream reforming reaction produced 65% hydrogen. The effect of additives at varied loadings on the life of the catalyst, the amount of carbon (coke) produced, and the hydrogen yield will be presented.