R & D facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Separations and Fuels Processing

2/2007

Hexaaluminate Reforming Catalyst Development

Background

Reforming middle distillate fuels for distributed fuel cell power is a very attractive source of H_2 and CO. However, these fuels contain heavy hydrocarbons that are prone to coking and contain organosulfur compounds that are not easily removed. The simplest reforming technology employs a catalyst to reform the fuel into H_2 and CO and convert the organosulfur compounds into more easily removed H_2S. This approach necessitates the development of a catalyst which does not deactivate under these conditions.

For this application, the National Energy Technology Laboratory (NETL) is developing a new class of catalysts based on transition metal doped hexaaluminate. The use of hexaaluminate is of growing importance in catalysis due to its refractory properties. The thermal stability of hexaaluminate is attributed to its structure, which has proven useful in retaining the large surface area necessary for catalytic reaction. With this project, catalytically active metals are doped directly into the hexaaluminate lattice, resulting in active sites that are both isolated and well-dispersed.

Objective

The overall objective of this research is to test and develop a durable, low-cost catalyst to reform middle distillate fuels into H_2 and CO that can be utilized by fuel cell systems. Ultimately, the technical and economic feasibility of using hexaaluminate catalysts within the context of an auxiliary power unit will be examined.

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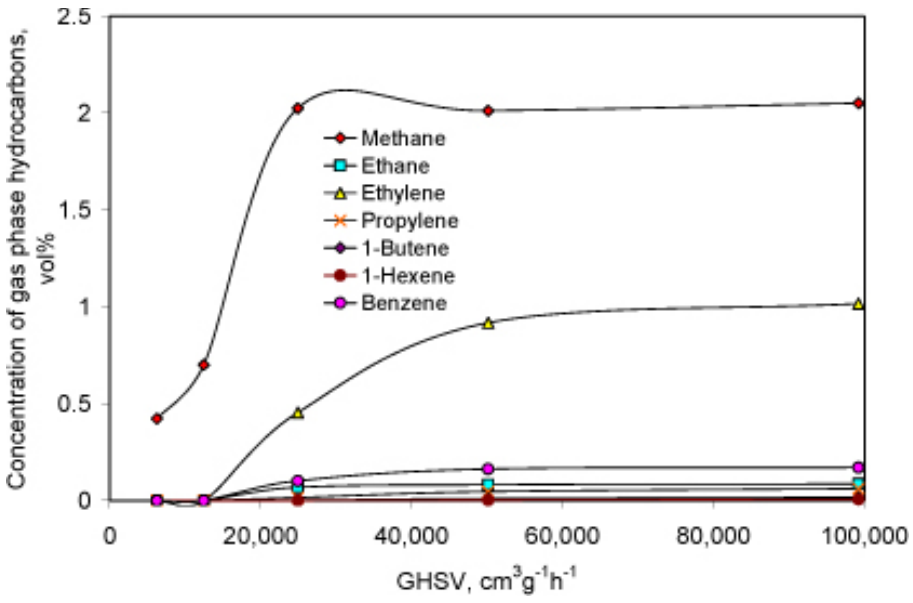
Accomplishments

In FY 2006, several hexaaluminatete catalysts were formulated and tested, and a number of key tests were completed, including the demonstration of 25 hours of stable operation on diesel fuel. The catalysts being developed are characterized by x-ray diffraction, temperature programmed reduction, and temperature programmed oxidation. They are also evaluated for activity and selectivity on diesel fuel. Additionally, the incorporation of other technologies has also been examined including the effect of carbon formation with the addition of thin films of O_2- ion conducting gadolinium doped ceria (GDC10) to the surface of these catalysts.

Benefits

One goal of the reforming catalyst development effort has been to develop a fundamental understanding of carbon deposition resistance and apply this knowledge to the design of a reforming catalyst that will minimize carbon formation and achieve the desired catalyst durability and performance targets.



The effect of space velocity on hydrocarbon reformate product formation from diesel fuel. Shown is the catalytic performance of hexaaluminate reforming catalyst at a temperature of 900°C, a pressure of 2 atm, and an O/C of 1.2.