Advancing the use of commercially available fuels in onboard reformers

O A A T   A C C O M P L I S H M E N T S

Fuel Composition Effects on Fuel Processor Catalysts

Challenge

Onboard reforming uses catalysts to produce a hydrogen-rich fuel from petroleum-based fuels, such as gasoline. The hydrogen generated onboard the vehicle can power a fuel cell. Ideally, the onboard reformer should be able to use any commercially available fuel, but fuel components and impurities may affect a catalyst's ability to make hydrogen onboard.

Microreactor for long-term (1000 h) testing of fuels.

Technology Description

A microreactor was designed to test the effect of fuel composition on the ability of catalysts to autothermally reform fuels into hydrogen. Since gasoline is a complex mixture, the microreactor tested a series of chemical compounds representative of gasoline composition. The effects of microreactor temperature and space velocity (the speed of the chemical reactants across the catalyst bed) on the hydrogen yield from each of the chemical compounds was examined. One of the compounds – isooctane – was doped with sulfur impurities, representing the typical sulfur concentrations in gasoline, and then tested for hydrogen yield on two catalysts, one containing platinum (Pt), another nickel (Ni). The long-term tests (over 1,000 hours) of isooctane and a benchmark fuel mixture of the chemical compounds were performed on a Pt catalyst.

Accomplishments

Varying microreactor temperature produced the general trend that, in order to maintain high hydrogen yields, aromatic compounds require higher temperatures than napthenes, which require higher temperatures than straight chain and branched paraffins. Although hydrogen yields dropped as space velocity increased (shorter residence time of reactants within the catalyst bed) for some compounds (trimethylbenzene), no such trend for temperature effects was observed.

Benefits

- The ability of onboard reformers to use commercially available fuels will determine how easily highly efficient fuel cells can be introduced into the marketplace.
- As fuel cell technologies become commercially available in the next decade, new fuel standards can be adapted to match onboard reformer needs.

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Future Activities

Future investigations will focus on fuel compounds, like olefins, that produced the highest hydrogen yields, and minor constituents, like naphthalenes and substituted aromatics, that produced the lowest hydrogen yields. Investigation of the effects of sulfur will be expanded to a broader array of catalysts and sulfur compounds. The effects of additives (detergents, antioxidants) and other impurities on hydrogen yield will also be explored.

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