PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

CLEAN FUELS & CHEMICALS

Basic Studies for the Production and Upgrading of Fischer-Tropsch Synthesis Products to Fuels

Alternative fuel such as Fischer-Tropsch (FT) jet fuel possesses physical properties compatible with the design characteristics of fuel for next generation aviation engines. In fact, some characteristics of FT fuel, such as the higher flash point and lower freezing point, are superior to conventional jet fuel Jet A-1.

CAER is assisting NASA to further develop Fischer-Tropsch synthesis catalysts by defining the kinetics of the reaction over different supported cobalt catalysts (e.g., using titania, silica, and alumina supports) and different precipitated iron catalysts (e.g., with different levels of alkali promotion for producing low or high alpha waxes). With cobalt catalysts, emphasis is placed on defining the impact of water, which can in many cases deleteriously impact conversion and stability. To carry out these experiments, CAER researchers make use of a battery of >20 continuously stirred tank reactors which mimic commercial slurry phase reactors. Tests are carried out for thousands of hours and reaction conditions (e.g., reactant partial pressures, space velocities, and temperature) are changed periodically in order to obtain kinetically relevant information. Syngas feed ratios are selected to mimic gas-to-liquids (e.g., with cobalt) and coal-to-liquids (e.g., with iron) processes.

To define the changes in the electronic state, cobalt particle size, and morphology, CAER is also applying a number of state-of-the-art tools to characterize the catalysts. These include the application of synchrotron methods such as XANES and EXAFS spectroscopies, the latter of which provides information on structural changes occurring at the atomic level.

CAER is also aiding NASA in applying bifunctional metal/acid catalysts to hydrocrack the heavy waxes produced by Fischer-Tropsch synthesis with an emphasis on optimizing both the catalytic properties and reaction conditions to obtain a narrow chain length distribution for application as jet fuel.

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