Introduction to Advanced Coal

The global coal resource is vast and more widely distributed than other fossil fuels such as oil or natural gas. Since coal is abundant and inexpensive, it is used extensively for electric power generation in the US and in developing countries such as China, and India. A growing demand for transportation fuels and an alternative to petroleum may escalate the practice of converting coal to liquid fuels. Such processes require large energy inputs and have a significant carbon footprint. As a result, the challenge of reducing greenhouse gas emissions associated with the use of coal is a significant one.

In recent decades, most of the attention on advanced coal combustion has shifted from university-based research to industry-level development. Therefore GCEP is interested in advanced coal research that addresses conceptual approaches to coal conversion that go beyond incremental improvements towards systems and processes that emphasize CO_2 emission reductions. Previously funded work concluded in 2011 that involved coal energy conversion with aquifer-based sequestration.

A project started in the spring of 2013 on the "Co-generation of Carbon-Free Hydrogen and Electricity from Coal in a Steam-Carbon Fuel Cell with Carbon Capture" led by Reginald Mitchell of Stanford University. The steam-carbon fuel cell is a novel concept where steam gasification of coal in a fuel cell arrangement can generate electricity and physically separated streams of hydrogen and CO_2. The objective of the project is to gain better mechanistic and operational understanding of the steam-carbon fuel cell through experimental, materials and modeling efforts. Much of the work over the previous year involved screening, synthesizing, assessing materials to serve as sulfur tolerant anodes. Additionally, the team has successfully expanded the modeling work to demonstrate and quantify the effects from conductive, convective, and radiated heat transfer in carbon fuel cells. This advance in the modeling work has helped to more completely describe the different parameters relevant to predicting fuel cell performance.