

To appreciate the importance of catalysts, look around the room. Almost everything you see is there because of a catalyst. Plastics, carpet, lighting, clothes – all use catalysts in their manufacture. In the most basic terms, catalysis is an acceleration of the rate of a reaction, brought about by a catalyst, usually present in small, managed quantities and unaffected at the end of the reaction. A catalyst permits reactions to take place more effectively or under milder conditions than would otherwise be possible.

Much of CAER's catalysis work involves Fischer-Tropsch catalysis. The Fischer-Tropsch (FT) process was developed in Germany during the 1930s by Hans Fischer, Franz Tropsch, and Helmut Pitchler to synthesize transportation fuels from coal. The process was created by the development of the hydrogenation of carbon monoxide and the introduction of a means to liquefy coal. The CAER's lab is open-access, and the largest FT lab at any university.

In addition to 16 Continuous Stirred Tank Reactors (CSTRs) already in use, a two-inch inside diameter, six-foot tall existing reactor was utilized as a slurry bubble column reactor and is operating. This reactor produces nearly the same amount of product that can be produced together in the 16 smaller CSTRs. This permits the lab to provide sufficient samples for companies to evaluate FT

## **catalysis - quickenning the path to clean fuel**

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products in a range of potential applications that they may wish to develop. A method to separate a wax product from one-micron sized catalyst particles was developed with this reactor and a patent has been applied for to cover the use of this technique.

The work on Fischer-Tropsch catalysis can be viewed as a model where academic research leads to practical results, which in turn promotes interactions with companies that provide significant funding. In addition to the practical work, the studies have led to many authoritative scientific publications and presentations at national and international meetings. The Center's effort in Fischer-Tropsch is now mature in that it has attained a size that is near or at its maximum effort.

In perhaps no other area of the CAER are industrial interactions as strong as with the Catalysis Group. During the last

three years, a large amount of industrial catalyst testing was performed for most of America's major petrochemical companies. Testing for companies has two major impacts: the interaction ensures that CAER's work is highly relevant to industrial needs, and it provides funding to bridge gaps between federal contracts. Another important outcome of the industry-supported testing carried out at CAER is that it documents the credibility of the work performed by the Catalysis Group: many of the companies also execute similar studies in their facilities and are able to corroborate CAER's work. In addition, the close contact with industry means that the lab's results will be transferred and used by the same companies that would most likely commercialize the Fischer-Tropsch process.



With an exceptionally strong expertise in FT work, the Catalysis Group is branching out and developing activities in other disciplines. An area that is attracting great attention and which experts believe is certain to lead to significant commercial activity is fuel cell development. For example the development of novel thermal management systems for low-temperature solid oxide fuel cells (SOFC) has been proposed as a joint effort between CAER, UK's Center for Robotics and Manufacturing Systems and the Valvoline Company. Improved nano-coolants could make the SOFC system more viable. Valvoline is interested in testing nano-coolants under realistic SOFC conditions.

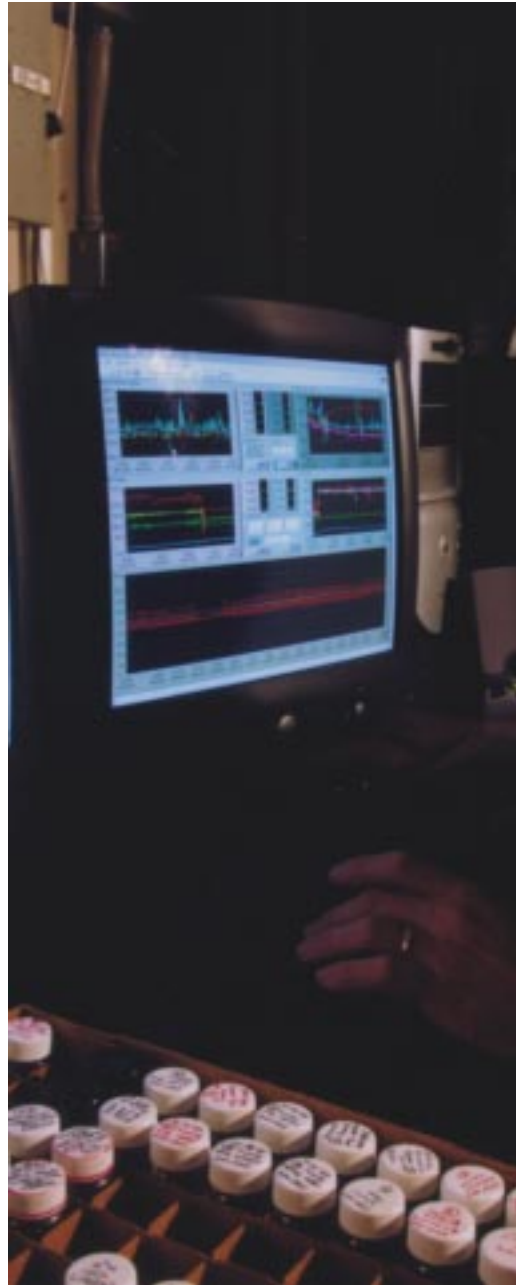


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## a hydrogen-purifying membrane process for fuel cells

The University of Kentucky's Department of Chemical and Materials Engineering and the UK's Center for Applied Energy Research are jointly engaged in research to develop a novel membrane process for the purification of hydrogen for fuel cells. The goal of this research is to develop a membrane device that purifies hydrogen derived from fossil fuel for use in a fuel cell. This research involves the design, preparation and characterization of new membranes that would achieve this purification process. The membrane would basically remove carbon dioxide so that purified hydrogen, on the high-pressure side of membrane, could be used directly for the fuel cell. For this research, two projects on different membrane compositions are being funded for three years by the Department of Energy and H2fuel, LLC.