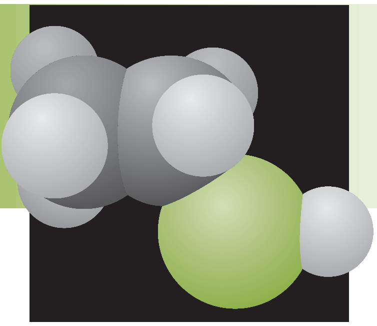
CHEMICALS
Project Fact Sheet



New Nanoscale Catalysts Based on Molybdenum and Tungsten Carbides and Oxycarbides

Benefits

- Potential energy savings of 45 trillion Btu in 2020 with associated reduction in greenhouse gas emissions
- Generates a lower volume of industrial wastes
- Replaces costly catalysts with less expensive more selective catalyst
- Increases yield and reduces reaction severity

Applications

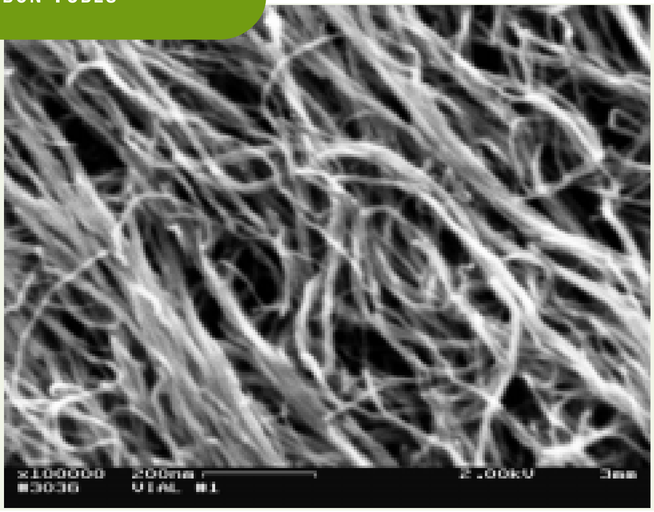
The commercial value of the new catalysts will be strong in the refining and large-scale petrochemical industries. Specific applications include removing sulfur from diesel fuel, conversion of n-butane to isobutane (isomerization), and dehydrogenation of ethylbenzene to styrene.

New catalysts will reduce costs for the chemical industry

A new family of selective nanoscale catalysts will be developed to improve the efficiency of a variety of important chemical reactions. Many chemical reactions require severe conditions (e.g., high temperatures, pressures, long residence times), or suffer from low product yields because available catalysts are not selective enough. Severe reaction conditions are usually accompanied by high energy consumption. Low yields mean multiple passes must be made over the catalyst to obtain a product with the desired purity—and more energy is required for every pass over the catalyst.

The new catalysts will be more selective, operate at lower temperature and/or increase per pass conversion. The new catalysts, comprised of carbides and oxycarbides of molybdenum and tungsten in the form of or supported on aggregates of nanotubes or nanorods, are expected to have catalytic properties analogous to platinum group metals. Carbon nanotube aggregates, which form the basis of the catalysts, are a new family of catalyst supports with a combination of features that are not currently available—high surface area, thermal stability, chemical purity, and macroporosity without micropores. The improved performance of these catalysts could considerably reduce energy consumption and associated emissions of pollutants and carbon dioxide from major chemical processes.

Nanoscale Carbon Tubes



Nanoscale carbide rods and particles are supported on carbon nanotubes to create a highly selective catalyst.

Project Description

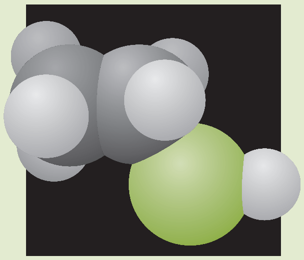
Goal: To develop a new family of industrial catalysts in the form of or supported on aggregates of nanotubes or nanorods.

These catalysts will be subjected to physical and chemical characterization, and tested in model reactions. Promising catalysts will advance through bench to pilot scale testing in industrially important reaction systems. A process design and economic analyses will be prepared for successful candidates.

Innovative concepts and methods will be used to prepare basic support structures ("extrudates") from carbon nanotubes and to synthesize the desired catalytic metal-carbide. Electron microscopy, spectroscopy, X-ray diffraction, chemisorption, and other advanced techniques will be used to characterize the compositions, and examine other properties of the particles.

Progress and Milestones

- Methods for preparing extrudates in the laboratory have been worked out; their scale-up appears to be straightforward.
- Screen promising catalysts on a large scale using actual industrial reactions, with promising systems subjected to life and pilot testing.
- Estimates of production costs will be made following pilot tests.
- Commercialization is anticipated 3 years after project start.



Project Partners

Harvard University
Cambridge, MA

Hyperion Catalysis International, Inc.
Cambridge, MA

Pacific Northwest National Laboratory
Richland. WA

Raytheon Engineers and
Constructors, Inc.
Cambridge, MA

University of Utrecht

Worcester Polytechnic Institute
Worcester, MA

For additional information, please contact:

Amy Manheim
Office of Industrial Technologies
Phone: (202) 586-1507
Fax: (202) 586-3237
Amy.Manheim@ee.doe.gov
http://www.oit.doe.gov/IOF/chemicals

Please send any comments,
questions, or suggestions to
webmaster.oit@ee.doe.gov

Visit our home page at
www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

OIT

February 1999