Argonne NATIONAL LABORATORY

Chemical Engineering Division

Nanoporous catalytic membranes could lead to cost-effective, renewable transportation fuels

Scientists at Argonne have started work that could provide clean, renewable fuels for transportation using a variety of feedstocks.

The work involves the conversion of the feedstocks into chemicals, diesel fuel or gasoline using catalytic membranes. One chemical process under study converts a mixture of hydrogen and carbon monoxide into high-purity hydrocarbon fuels with no sulfur content and little or no aromatic contamination. The feed gas for this reaction can be derived from many different sources including coal, natural gas, or biomass such as corn.

Existing catalysts for this process provide low selectivity over the hydrocarbon product distribution, and make inefficient use of the precious metal catalysts. Argonne aims to fabricate novel nanostructured catalytic membranes that will overcome these limitations and enable the cheap and efficient synthesis of hydrocarbons for gasoline and diesel fuel.

This work is part of an emerging interdisciplinary effort at Argonne, and is being conducted principally by Donald Cronauer of Argonne's

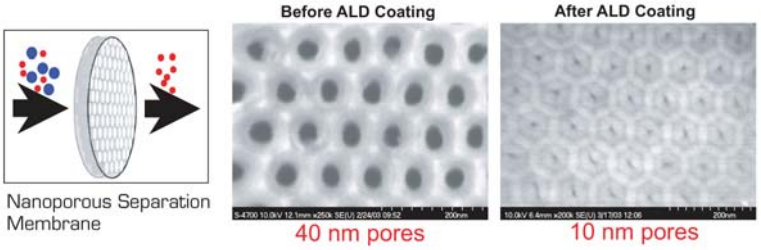
Chemical Engineering Division, Jeffrey Elam (Energy Systems Division), and Hau Wang (Materials Science Division).

Cronauer was recently recognized by the American Chemical Society for his contributions to the advancement of fuel chemistry.

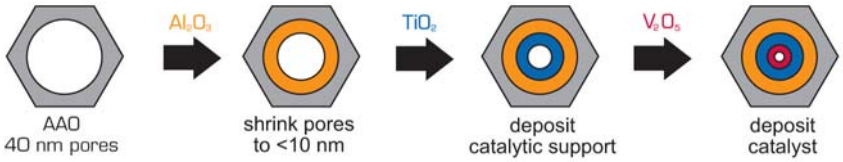
Chemist Jeffrey Elam holds a prototype membrane that is ready to be evaluated in a catalytic testing reactor operated by chemical engineer Donald Cronauer. Photo by George Joch.

Ultra-Uniform Nanoporous Membranes

Argonne's ultra-uniform nanoporous catalytic membranes are based on anodic aluminum oxide (AAO). AAO membranes are formed by the electrochemical etching of aluminum metal, and Argonne is pioneering the use of AAO membranes as templates for nanofabrication. By using atomic layer deposition (ALD) thin film growth techniques, Argonne scientists precisely tune the AAO pore size within ± 0.1 nm to control the reactant/catalyst contact time as well as to provide filtration capability. Next, catalyst support and active catalyst layers are deposited using ALD to form the nanoporous catalytic membrane.



A combination of anodized aluminum oxide (AAO) and atomic layer deposition (ALD) provides precisely controlled, ultra-uniform porous support for new and well-defined catalysts.



Argonne's nanostructured catalytic membranes offer higher selectivity for selective oxidation.

For More Information

Contact the Chemical Engineering Division (630-252-1858, chemtech@cmt.anl.gov).

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