Mesoporous Carbon Membranes for Selective Gas Separations

Separation processes account for more than 5% of the total national energy consumption in the United States and will significantly contribute to the anticipated overall increase in energy consumption. It is therefore necessary to focus on the development of highly selective and energy-efficient separation systems. Particularly selective gas separation is a demanding problem in petrochemical industry, which significantly contributes to the overall costs in the production of related chemicals. It is therefore indispensable to develop separation processes that combine low energy consumption with high selectivity and high throughput. These requirements can only be fulfilled by new types of smart nanoscopic filters featuring properties superior to conventional separation systems.

This nanomanufacturing concept definition study is focused on translating a novel class of material developed at Oak Ridge National Laboratory—self-assembled mesoporous carbon—into robust, efficient membrane systems for selective industrial gas separations. These tailorable, nanostructured materials, described in US Patent Application 2006 057051, "Highly ordered porous carbon materials having well defined nanostructures and method of synthesis," consist of ordered mesopores and tunable micropores that are ideally sized for high throughput separation of gaseous species, such as O_2, CO_2, and alkanes. The carbon is synthesized by conventional chemical and materials processing approaches, which provides promise for cost-effective production of precision separations materials at large scale.

The project, which will involve collaboration with the Georgia Institute of Technology, will aim to develop supported mesoporous carbon membranes in the pores of anodized commercial alumina membranes for high-flux, high-selectivity separations. Recent preliminary tests have shown excellent selective transport of carbon dioxide and propylene relative to other gases.

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