

Catalyst/membrane system for propane dehydrogenation above equilibrium conversion with enhanced stability

TECHNOLOGY NUMBER: 2023-098

OVERVIEW

An improved propane dehydrogenation (PDH) catalyst

- Catalytic hollow fiber membrane for propane dehydrogenation
- Lower temperature operation, greater catalyst stability, high reaction rate
- Produces propylene from propane with high selectivity and 60% conversion efficiency

BACKGROUND

Propylene, a crucial building block in the petrochemical industry, is used in the production of several commodity chemicals, including polypropylene, propylene oxide, and acrylonitrile. Traditional methods of producing propylene utilize cracking of naphtha and are characterized by a low selectivity for propylene and high energy requirements. Furthermore, the shift towards shale gas has led to a decrease in the supply of naphtha and a concomitant undersupply of propylene. Propane, a neglected component of shale gas frequently flared and wasted, offers a potential source of propylene through the propane dehydrogenation (PDH) process. However, conventional PDH catalysts require high temperatures that lead to unwanted side reactions and necessitate frequent catalyst regeneration.

INNOVATION

Researchers at the University of Michigan, building upon their prior work with PDH catalysts, have developed an even more efficient catalytic system. The PDH catalyst, comprising PtSn nanoparticles supported on silica, is now incorporated into a hydrogen-permeable hollow fiber silica membrane. Exploiting Le Chatelier's Principle, the system removes hydrogen generated from the PDH reaction to increase propylene production, resulting in propane conversion efficiencies of up to 60% while maintaining complete selectivity for propylene. This system operates at markedly lower temperatures, which dramatically reduces coking onto the catalyst and lessens the frequency of catalyst regenerations; all without compromising reaction kinetics.

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Category

Chemical Processes and Synthesis
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