Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

Case ID:M21-183P
Published: 3/24/2022

Inventors

Jerry Lin

Seyed Mojtaba Mirfendereski

Contact

Shen Yan
shen.yan@skysonginnovations.com

High-Performance MFI-Type Zeolite Hollow Fiber Membranes for Organics/Water Separation

-Background Most zeolite membranes used in industrial processes are selective for water over organic compounds. Due to their good chemical stability, unique framework, and intermediate pore sizes, the hydrophobic MFI-type zeolite membranes have been extensively considered for a wide range of separation processes, particularly for pervaporation separation of organics from organic/water mixtures. Such membranes, if prepared on hollow fiber supports with high packing density (membrane surface area/volume ratio >1000 m2/m3), are attractive for industrial pervaporation separation of organic/water, such as ethanol/water separation involved in bio-fermentation ethanol production. However, reproducible synthesis of MFI zeolite membranes with high organic selectivity remains a challenge. Invention Description Researchers at Arizona State University have developed a new synthesis method consisting of dual-layer seeding and varying-temperature secondary growth for the synthesis of hydrophobic MFI zeolite membranes on alumina hollow fiber supports. The effects of seeding method, seed particle size, seed size ratio, and variable temperature/time profile on the microstructure, hydrophobicity and gas perm-selectivity of the membranes are investigated leading to identification of optimum seed structure and secondary growth conditions for synthesis of MFI zeolite membranes with high ethanol/water separation performance. The high-performance MFI zeolite membrane has a microstructure consisting of a thin, fully inter-grown, and dense top zeolite layer responsible for high selectivity, and a porous low inter-grown bottom zeolite layer minimizing resistance and retarding aluminum transfer from the support to zeolite. The best hollow fiber supported MFI zeolite membrane with a Si/Al ratio of 187 exhibits ethanol/water pervaporation separation factor of 160 with total flux of 3 kg m-2 h-1.

These MFI zeolite membranes offer highest ethanol to water selectivity. Potential Applications • Separation of organics from water mixtures • Ethanol/water or methanol/water separation • Membrane reactors for production of ethanol and methanol

Scanning electron microscopy (SEM) images of surface and cross section of hollow fiber α-alumina support.

Related Publication: High-performance MFI zeolite hollow fiber membranes synthesized by double-layer seeding with variable temperature secondary growthResearch Homepage of Professor Jerry Lin