Cellulose for Versatile High-Performance Membrane Applications

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Background

Cellulose is an important membrane material due to its low cost, excellent hydrophilicity and solvent resistance. Existing state-of-the-art of cellulose membranes are predominantly based on integrally skinned asymmetric membranes prepared using selected solvents and water-induced phase separation. However, this usually leads to a porous thick layer that suffer from excessive shrinkage under dry conditions. Moreover, only very few common organic solvents for cellulose are known, and these often suffer from high reactivity and toxicity.

Challenges

- Convenient cellulose membrane preparation through cellulose functionalization using a common solvent.
- Cellulose thin film composite membrane with a good stability, reproducibility and high scale-up potential.
- A high membrane performance useful for many applications.

Strategy

Cellulose

- Dissolution
- Cyclodextrin
- Acetalization
- TMSC
- Drying
- Polymeric support
- Regenerated cellulose membrane

Membrane Preparation

- Spin coating
- Hydrolysis
- No irreversible fouling.
- A controlled sulf-group removal is important for the evolution of cellulose performance as a selective barrier.

Applications

1. Charge-selective separation

A perfect discrimination of anionic over the similarly sized neutral molecules due to charge interaction.

2. Size-selective separation

A sharp membrane pore size distribution: a 3.5 nm molecule is 100% rejected, while the 1.7 nm one is completely passed.

3. Dye wastewater reuse

A nearly complete dye removal combined with maximum brine recovery. The flux reaches 600 LMH at 80 °C.

4. Whey demineralization

A good sucrose recovery with nearly complete degree of demineralization. This could not be achieved with commercial membranes under the same conditions.

5. Dehumidification

A high-performance dehumidification: more than 6,500 GPA H₂O(g) permeance and close to 200,000 selectivity of H₂O(g) over N₂.

References


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