Chemically tailored microporous nanocomposite membrane with multiple transport channels for fast solvent permeation

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Abstract

Membrane technology is of great significance to realize efficient and energy-saving molecular separation in petrochemical, pharmaceutical, and food industries. However, current membrane materials are subject to an insurmountable trade-off be-tween permeability and selectivity. Herein, we report on a microporous nanocomposite membrane with multiple sophisticated transport channels to intensify solvent permeation. To achieve this goal, we designed polymers of intrinsic microporosity (PIMs) with precise contorted rejection pores as matrix, and covalent organic frameworks (COFs) with uniform one-dimensional (1D) channels as porous nanomaterials. Notably, the selected PIMs and COFs have similar chemical components and structures, ensuring the interfacial compatibility between them was perfectly addressed. The prepared PIMs/COFs nanocomposite membranes showed a significant boost in solvent permeances (18.1 and 4.2 L m–2 h–1 bar–1 for acetonitrile and ethanol), while leading to high rejections (>90%) towards solute molecules of larger than 450 Da. This work paves a promising avenue for efficient molecular separation.

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