

CO₂/CH₄ 분리를 위한 용해 선택도 강화된 하이브리드 기체분리막

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Here, we report the enhanced organic solvent resistance of SIFSIX-3-Ni by characterizing their crystallinity and gas adsorption properties after exposure to organic solvents. SIFSIX-3-Ni microparticles were incorporated into polysulfone (PSF) matrix to prepare mixed matrix membranes (MMMs) for CO₂/CH₄ separation. PSF/SIFSIX-3-Ni MMMs with loading up to 30% were successfully prepared with the aid of the weak interaction between sulfonate groups in PSF and the fluorine atoms of SIFSIX-3-Ni. Interestingly, the CO₂ permeability of PSF/SIFSIX-3-Ni MMMs monotonically decreased with increasing CO₂/CH₄ selectivity as the SIFSIX-3-Ni concentration increased. Monte Carlo simulations suggest that the strong Coulombic interactions between SIFSIX-3-Ni and CO₂ significantly increased the free energy barrier for CO₂ over CH₄, leading to a reduction in the CO₂/CH₄ diffusivity selectivity of MMMs. Unlike diffusivity, the CO₂ solubility of PSF/SIFSIX-3-Ni MMMs increased with increasing SIFSIX-3-Ni contents due to the strong interaction between SiF₆²⁻ of SIFSIX-3-Ni and CO₂, significantly enhancing the CO₂/CH₄ adsorptive selectivity.