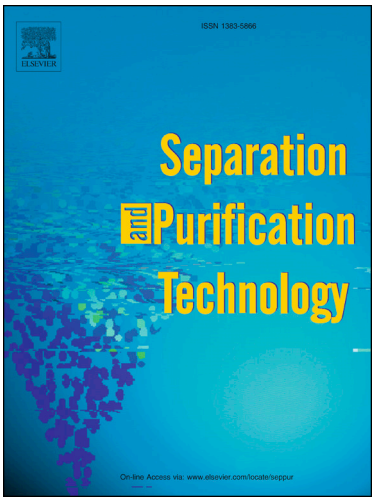

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Investigation of a new co-polyimide, 6FDA-bisP and its ZIF-8 mixed matrix membranes for CO_2/CH_4 separation

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Abstract

The ZIF-8 zeolitic imidazolate framework (ZIF) is known to enhance gas separation properties of a mixed matrix membrane (MMM) due to its inherent molecular sieving properties. We prepared ZIF-8 nanoparticles (NPs) in several particle sizes, characterized and incorporated (only the NPs with <100 nm) into a newly studied 6FDA-copolyimide, 6FDA-bisP between 5 – 20 wt.% loadings. The 6FDA-bisP co-polyimide membrane, consisting of multiple aromatic rings in its diamine moieties, was obtained from two fabrication protocols after the synthesis of its 10 wt.% polymer concentration poly(amic) acid (PAA) (protocol M1, direct synthesis; M2, with an additional precipitation step). The NPs and MMMs were characterized accordingly using XRD, DLS, BET, SEM, FTIR, TGA and DSC. Free fractional volume (FFV) was calculated using solid density, measured by helium pycnometry. Gas separation performance was evaluated by feeding an equimolar mixture of CO_2 and CH_4 at a constant pressure of 5 bar, at 25 °C. The new 6FDA-bisP, obtained from protocol M2 presented higher performances of 35.3 Barrer for CO_2 permeability (P_{CO2}) and 25.6 for CO_2/CH_4 selectivity ($\alpha_{CO2/CH4}$), comparable to several commercial polymer membranes. Its ZIF-8 MMMs showed not only significant FFV increment but also 130% and 37% improvements for P_{CO2} and $\alpha_{CO2/CH4}$, respectively, with the optimum loading of 15 wt.% ZIF-