High-performance CO_2 separation membranes based on PEO blend membranes with micelle-forming copolymer

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Hydrophobic monomethacryloxypropyl-terminated poly(dimethyl siloxane) (PDMS-Ma, 10,000 g mol^{-1}) and hydrophilic poly(ethylene glycol)-behenyl ether methacrylate (PEGBEM, 1500 g mol^{-1}) were used to synthesize PDMS-PEGBEM comb copolymer. Micellar structures were induced by self-assembly of the copolymer in ethanol/tetrahydrofuran mixed solvent. Highly selective membranes were prepared by incorporating the copolymer into non-selective poly(ethylene oxide) (PEO, 10^6 g mol^{-1}). Amphiphilic micelles were aligned in the interlamellar nanospaces of PEO and PDMS-PEGBEM was encapsulated in the interlamellar domain, confirmed by transmission electron microscopy and small-angle X-ray scattering. PDMS could act as a rubbery filler between the crystallites, and the copolymer could penetrate the interlamellar space of PEO due to the chemical similarity between PEGBEM and PEO. The CO_2/N_2 and CO_2/CH_4 selectivity was improved on the loading of 10 wt.% of the copolymer from 0.78 to 41.7 and from 0.71 to 13.3, respectively. The PEO/PDMS-PEGBEM 50% membrane exhibited the highest CO_2 permeability of 240 barrer and CO_2/N_2 and CO_2/CH_4 selectivity of 34.6 and 12.2, respectively.