

Enhanced carbon dioxide separation by polyethersulfone (PES) mixed matrix membranes deposited with clay

Abstract

Asymmetric mixed matrix membranes (MMMs) incorporating Cloisite15A (C15A) clay particles were prepared using solvent evaporation and phase inversion with polyethersulfone (PES) as the membrane matrix. C15A loadings varied at 1 wt% and 5 wt%. Membrane morphological and thermal properties were evaluated by means of X-ray diffraction (XRD), scanning electron microscopy (SEM), thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). Addition of the C15A favorably altered the microscopic structure of membranes from finger-like to homogeneous sponge-like structure as the loading increased. While the amorphous nature of MMMs was retained, the thermal stability was also found to be improved with a slight decrease in glass transition temperature (T_g). PES/C15A1 MMM showed the best gas transport properties, with 37% and 65% improvement in CO₂ permeance and CO₂/CH₄ selectivity, respectively. Unlike 1 wt%, the loss in selectivity shown by 5 wt% clay loadings suggested that the interphase voids and extent of silicate layers dispersion play a significant role in the overall performance of MMMs.