High-performance polymer/ionic liquid membranes for CO_2 separation by the synthesis of block copolymer

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In this work, we fabricated highly permselective and mechanically robust polymer/ionic liquid membranes for CO_2 capture. The membranes were fabricated by the synthesis of amphiphilic block copolymer; poly(ethylene glycol) monomethyl ether-block-poly(acrylonitrile). The copolymer had a strong interaction with the ionic liquid by the dipole-dipole interaction between them, resulting a distinctive crosslinked structure by the aggregation of amphiphilic block copolymer. Therefore, the membrane could contain a large amount of ionic liquid up to 300 wt% without a severe decrease of mechanical properties. Moreover, the microphase-separated nanostructures of the ionic liquid in the membranes were observed which could act as a CO_2 transport pathways enhancing the gas separation performances. The optimized polymer/ionic liquid membrane exhibited the best gas separation performances with a CO_2 permeability of 456.4 barrer, CO_2/N_2 selectivity of 61.4, CO_2/CH_4 selectivity of 18.1, and CO_2/H_2 selectivity of 12.3 as well as a great stability toward high pressure. It is worth noting that the CO_2/N_2 separation result surpasses the Robeson upper bound 2008 and reaches upper bound 2019. This work suggests that the functional amphiphilic block copolymer plays a pivotal role in the fabrication of high-performance membranes with excellent mechanical properties.

Reference

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