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Layer-by-layer assembled polymer/MOF membrane for H₂/CO₂ separation

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Abstract

Numerous investigators have produced polymer composites containing metal-organic framework (MOF) filler particles in attempts to combine the processability of polymers and the gas selectivity of MOF particles. However, filler particle aggregation and weak filler-matrix interaction have sometimes led to poor gas separation performance. In this study, we combined polyvinylpyrrolidone modified UiO-66-PA particles (PVP+MOF) with poly(acrylic acid) (PAA) through H-bonding assisted layer-by-layer assembly. The resultant PAA/(PVP+MOF) bilayers feature individually dispersed fillers and strong filler-matrix interaction. Of note, this filler-matrix interaction is stronger than the internal strength of fillers, which is a phenomenon previously not seen in polymer/MOF composites. The combination of individually dispersed fillers and strong filler-matrix interaction enables the polymer/MOF composite membrane, based on PAA/(PVP+MOF) bilayers, to be more selective ($H_2/CO_2 = 20.3$) than PAA/PVP bilayers ($H_2/CO_2 = 12.5$) and several pure-MOF membranes that were reported previously ($H_2/CO_2 < 10$).

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