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Mixed Matrix Membranes Based on [M_2(DOBDC)] (M = Mg, Co, Ni) and Polydimethylsiloxane for CO_2/N_2 Separation

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Abstract : Metal-organic frameworks (MOFs), which are emerging absorbents assembled from metal ions and organic ligands, have attracted attention for their permanent porosity and design of tunable pore size. These microporous materials showed interesting properties for CO_2 storage and separation. In particular, MOFs with high surface area and open metal sites showed the remarkable adsorption capacity and selectivity for CO_2. [Mg_2 (DOBDC)] (DOBDC = 2,5-dioxidobenzene-1,4-dicarboxylate) (MOF-74 or CPO-27) is a well-known absorbent showing an exceptionally high CO_2 sorption capacity at low partial pressure and room temperature. In this work, we synthesized [M_2(DOBDC)(DMF)$_2$] (M = Mg, Co, Ni) and determined their single-crystal structures by X-ray crystallography. The removal of coordinated guest molecules generates Lewis acidic sites and showed high CO_2 adsorption affinity. Both CO_2 adsorption capacity and surface area are much higher than reported values in literature. To fabricate MMMs, microcrystalline [M_2 (DOBDC)(DMF)$_2$] was synthesized by microwave reaction and dispersed in PDMS solution. The MMMs with a various amount of [M_2 (DOBDC)(DMF) $_2$] in PDMS were fabricated by a solution casting method. [M_2 (DOBDC)(DMF)$_2$]@PDMS membrane showed higher CO2 permeability and CO_2/N_2 selectivity than those of PDMS. Therefore, we believe that MMMs combining polymer and MOFs provide new materials for CO_2 separation technology.

Keywords : metal-organic frameworks, mixed matrix membrane, CO2/N2 separation, polydimethylsiloxane (PDMS)
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