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CO_2 permeation through asymmetric thin tubular ceramic-carbonate dual-phase membranes

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Abstract

Ceramic-carbonate dual-phase dense membrane is a promising high temperature CO_2 separation membrane with remarkable CO_2 permeance and theoretically infinite CO_2 selectivity. This paper reports synthesis and CO_2 permeation properties of asymmetric tubular dual-phase membranes with a thin samarium doped ceria ($Ce_{0.8}Sm_{0.2}O_{1.9}$, SDC)-carbonate separation layer and a thick porous SDC-$Bi_{1.5}Y_{0.3}Sm_{0.2}O_{3-\delta}$ (BYS) support. The asymmetric tubular thin (0.12 mm) dual-phase membrane has much higher CO_2 permeance and lower activation energy for permeation than the thick (1.0-1.5 mm) membranes. At 900 °C with 50%CO_2/N_2 feed at 1 atm, the CO_2 permeation flux and permeance for the thin membrane reach 1.53×10^{-2} mol·m^{-2}·s^{-1} (or 2.05 mL(STP)·cm^{-2}·min^{-1}) and 3.16×10^{-7} mol·m^{-2}·s^{-1}·Pa^{-1}, respectively, with activation energy for permeation of 62.5 kJ/mol. These dual-phase membranes exhibit slightly higher CO_2 permeance with essentially same activation energy