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Abstract

The thermal stability of ZIF membranes is important for high temperature separation applications but has not been systematically studied. This work highlights the results of a thermal stability study of ZIF-8 membranes in terms of material structure, H_2/CO_2 gas permeation and separation characteristics. During binary and single gas temperature dependent permeance tests conducted from 25-250°C, both H_2 and CO_2 permeances decrease as a function of temperature. In the binary test, H_2/CO_2 selectivity increases between 25-225°C, and then decreases as temperature is further increased between 225-275°C. The results can be explained by the adsorption/diffusion mechanism. Beyond 275°C, H_2/CO_2 permeance and selectivity drastically increase with respect to temperature and is indicative of ZIF-8 membrane partial carbonization during the dynamic 30 hour temperature dependent test. The time/temperature dependency of the onset of ZIF-8 thin film structural change was deconvoluted in isothermal transient permeation experiments. Transient tests performed at 50, 100, 150 and 300°C for 24 hours indicate that ZIF-8 thin films maintain their crystallinity and structural integrity below 150°C. However, at temperatures of 150°C and greater the framework undergoes increased magnitudes of thermally induced carbonization as a function of temperature. Thermomechanically induced stresses