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Effects of industrial gas impurities on the performance of mixed matrix membranes

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Abstract

A series of mixed matrix membranes using a commercially available aromatic polyimide (Matrimid® 5218) with nanoparticles formed from carbon, a porous organic polymer and metal organic frameworks were prepared to investigate the effects of flue gas impurities on gas permeation. We show that common impurities found in power station flue gases (H_2S, SO_2, and NO) have significant effects upon the performance of these mixed matrix membranes. The effects of NO, SO_2 and H_2S on the zeolitic imidazolate framework ZIF-8 are all large and rapid and would render these membranes unsuitable for flue gas service that do not use flue gas desulfurisation. Similarly, H_2S adsorbs irreversibly into membranes containing copper benzene-1,3,5-tricarboxylate (Cu-BTC), although the impacts of NO and SO_2 are less severe. The membranes containing a porous organic polymer or porous carbon are less affected by these contaminants. In particular, the permeability of the membrane containing the porous organic polymer is still significantly above that of the base Matrimid polymer after exposure for 80 days to 1000 ppm of each contaminant. Further, this mixed matrix structure shows enhanced H_2S selectivity. These results suggest that MMMs prepared using organic based nanoparticles can be effective in gas separation applications