Flow synthesis of polycrystalline ZIF-8 membranes on polyvinylidene fluoride hollow fibers for recovery of hydrogen and propylene

ABSTRACT

It is highly desirable to prepare defect-free ZIF-8 membranes on commercially attractive scalable polymer hollow fibers, especially on the bore side of the fibers, yet quite challenging. Herein, we report a facile synthesis of well-intergrown ZIF-8 membranes on polyvinylidene fluoride (PVDF) microfiltration hollow fibers by a secondary growth method. Surface modification using a strong base promoted high heterogeneous nucleation, resulting in densely packed ZIF-8 seed layers on the hollow fibers. The seed crystals were secondarily grown under a continuous flow of growth solution to form ZIF-8 membranes with thickness of ˜1.2 μm. The prepared ZIF-8 membranes achieved high gas permeances, reaching values of 16,344 × 10−10 mol m-2 s-1 Pa-1 for H2 and 197 × 10−10 mol m-2 s-1 Pa-1 for C3H6. The selectivities for H2/CH4, H2/C3H6, H2/C3H8 and C3H6/C3H8 gas pairs were found to be 12, 57, 160 and 15, respectively. We anticipate that the method could potentially be applied to transform commercial PVDF ultrafiltration/microfiltration hollow fibers commonly used for water separation into high quality ZIF-8 membranes for H2 purification and C3H6/C3H8 separation.

Keyword: Metal organic frameworks; Zeolitic imidazolate frameworks; Membranes; Hollow fibers; Gas separations