Solubility selectivity-enhanced SIFSIX-3-Ni-containing mixed matrix membranes for improved CO_2/CH_4 separation efficiency

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Carbon molecular sieve (CMS) membranes are considered a next-generation membrane due to their exceptional gas separation performance. Controlling pyrolysis conditions and pre/post treatments have been reported to tune the pore structure of CMS membranes. Engineering pore structures of desirable dimensions, however, is still an on-going topic. Also, fabricating CMS hollow fiber membranes for large scale separation processes is challenging due to the collapsing of the porous sub-structure during pyrolysis. Here, we report polyimide/ladder-structured polysilsesquioxane (PI/LPSQ)-derived CMS membranes as a new approach for challenging gas separations, including C_3H_6/C_3H_8 and CO_2/CH_4. The impermeable SiO_x phases covalently bonded to the carbon matrix significantly enhanced C_3H_6/C_3H_8 selectivity up to as much as 67. Also, the homogeneous blending of PI and LPSQ enabled the formation of CMS hollow fiber membranes with excellent CO_2/CH_4 separation performance.