Zeolitic Imidazolate Framework Membrane with Exceptional Thermochemical Stability Controlled by Solid/Solid Interface Chemistry

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Thermochemical stability of MOF membranes is vital for the applications in versatile chemical reaction and separation processes, yet detailed studies and understanding on the structure–property relationship of MOF membranes, beyond those of MOF micro- and nanocrystals, under antagonistic reaction environment is still lacking. A simple surface modification of common porous Al_2O_3 supports by tuning acid–base chemistry at the membrane/support (solid/solid) interface drastically enhances the hydrothermal stability of ZIF membrane, permitting the first application of MOF membranes for membrane reactor (MBR) under highly hostile chemical reaction environment. Applied to the catalytic water-gas shift reaction ($CO + H_2O \leftrightarrow CO_2 + H_2$) at unprecedented high temperatures (473–673 K) and steam concentrations (20–40%), the ZIF-MBR considerably increases the product yields over the conventional packed bed reactor via a concomitant separation of H_2 by molecular size discrimination, overcoming the thermodynamic equilibrium limitation.