Effiective CO_2 separation membranes based on mesoporous TiO_2 hollow nanospheres

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By using dual-functionalized mesoporous TiO_2 hollow nanospheres (f-MTHS), both CO_2 permeability and CO_2/N_2 selectivity could improve simultaneously in mixed-matrix membrane (MMM). At first, f-MTHS affected increased CO_2 affinity and interfacial characteristics between inorganic nanofillers and polymer matrix by dual-functionalizing. The MTHS could be synthesized by a hydrothermal reaction using potassium titanium oxide oxalate dehydrate (PTO), water, and poly(ethylene glycol) (PEG). Also, the surface of MTHS was functionalized with (3-aminopropyl)-trimethoxysilane (APS) and poly(ethylene glycol) diglycidyl ether (PEGDE), which offer to dual functionality by enhancing CO_2 affinity via acid-base interactions and to improve the interfacial characteristics at the interface between organic and inorganic surface, which result in void-free MMMs and uniform distribution. By adding 30 w.t% f-MTHS in the MMM, we could enhance CO_2 permeability to 90.7% as well as selectivity to 13.3%. Therefore, we concluded that the effective way to enhance the gas permeability can add the mesoporous hollow sphere and also the selectivity by surface modification can add APS and PEGDE. The MTHS could be substituted by adding other inorganic materials such as SiO_2, Fe_2O_3, Al_2O_3 and MgO.