Performance Improvement of CO_2 separation membranes using dual-functionalized hollow nanostructure

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Simultaneous improvement in CO_2 permeability and CO_2/N_2 selectivity was obtained from mixed matrix membranes (MMMs) containing dual-functionalized mesoporous TiO_2 hollow nanospheres (f-MTHS). The MTHSs were synthesized through a hydrothermal reaction using PTO, water and PEG. The MTHS surface was covalently modified with APS and PEGDE to provide dual functionality. Dual functionality could improve CO_2 affinity via acid–base interactions and increase the interfacial properties at the organic/inorganic interface, leading to void-free MMMs and uniform distribution. The MMM with 30 wt % f-MTHS improved not only the CO_2 permeability by 90.7 %, but also the selectivity by 13.3 %. Thus, we proved that the mesoporous hollow spheres are a very effective way to improve the gas permeability, while the surface modification with APS and PEGDE plays an important role in improving the selectivity. This strategy could be applied to various other inorganic materials such as SiO_2, Fe_2O_3, Al_2O_3 and MgO, and is very versatile and can be applied to various polymer matrices.