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# Unsaturated Sites Constructed Grafted Polymer Nanoparticles to Promote $CO_2$ Separation in Mixed-Matrix Membranes

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**Abstract :** Mixed matrix membranes (MMMs), as a separation technology, can improve $CO_2$ recycling efficiency and reduce the environmental impacts associated with huge emissions. Nevertheless, many challenges must be overcome to design excellent selectivity and permeability performance MMMs. Herein, this work demonstrates the design of nano-scale GNPs (Cu-BDC@PEG) with strong compatibility and high free friction volume (FFV) is an effective way to construct non-interfacial voids MMMs with a desirable combination of selectivity and permeability. Notably, the FFV boosted thanks to the chain length and shape of the GNPs. With this, the permeability and selectivity of Cu-BDC@PEG/PVDF MMMs had also been significantly improved. As such, compatible Cu-BDC@PEG proves very efficient for resolving challenges of MMMs with poor compatibility on the basis of the interfacial defect. Poly (Ethylene Glycol) (PEG) with oxygen groups can be finely coordinated with Cu-MOFs to disperse Cu-BDC@PEG homogenously and form hydrogen bonds with matrix to achieve continuous phase. The resultant MMMs exhibited a simultaneous enhancement of gas permeability (853.1 Barrer) and ideal $CO_2$/N selectivity (41.7), which has surpassed Robenson's upper bound. Moreover, Cu-BDC@PEG/PVDF has a high-temperature resistance and a long time sustainably. This attractive separation performance of Cu-BDC@PEG/PVDF offered an exciting platform for the development of composite membranes for sustainable $CO_2$ separations.

**Keywords :** metal organic framework, $CO_2$ separation, mixed matrix membrane, polymer
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