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Title:

Interlayer space-induced horizontal arrangement of Zn-TCPP nanosheets for high-performance two-dimensional membrane

Authors & affiliations:

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Graphene oxide (GO)-based membranes can be fabricated by filtrating a GO suspension because the surface functional groups promote outstanding dispersibility. Thus, GO is considered a practical base material for the preparation of highly permeable membranes. Metal-organic framework (MOF) nanosheets intercalated GO can rapidly separate molecules owing to their regular in-plane pores of MOF, which provides a short pathway [1, 2]. However, during the deposition of MOF nanosheets, the charged edge with high surface energy induces agglomeration of MOF particles, which in turn induces the formation of cracks in the laminar structure [3]. Herein, to optimize MOF nanosheets arrangement in laminar structure, we first introduced ZnO nanoparticles on reduced GO, serving as the metal resource, and enlarging the interlayer space of reduced GO, then an in-situ method was used to transform ZnO into zinc tetrakis(4-carboxyphenyl) porphyrin (Zn-TCPP) nanosheets on this confined interlayer space.

By adjusting the transformation time and mass loading of ZnO precursor, Zn-TCPP-40 wt%/rGO membrane processing a 48h transformation showed the horizontal orientation of MOF nanosheets. As shown in the SEM images (Fig. 1), the surface of GO laminates was covered with Zn-TCPP nanosheets and kept a regular laminar structure with a thickness of 500 nm. The XRD patterns demonstrate that suitable ZnO (40 wt%) leads to the horizontal arrangement of Zn-TCPP nanosheets according to the preferred peak of (004) at 18.04° (Fig. 2a), in which the in-plane pore would dominate the molecule pathway. Finally, the water permeance and rejection of dyes (methyl blue (MB; MW = 799.8), eriochrome black T (EBT; MW= 461.4), and methyl orange (MO; MW = 327.3)) were investigated. The optimized Zn-TCPP-40 wt%/rGO showed a sharp enhancement in water permeance (19.0 L m^{-2} h^{-1} bar^{-1}) than rGO (0.3 L m^{-2} h^{-1} bar^{-1}), while keeping the high MB rejection.

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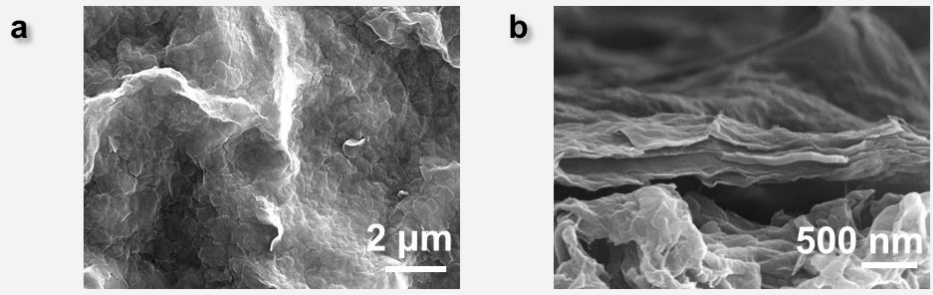

Fig. 1. a) Surface morphology and b) cross-section image of Zn-TCPP-40 wt%/rGO observed by SEM measurement.

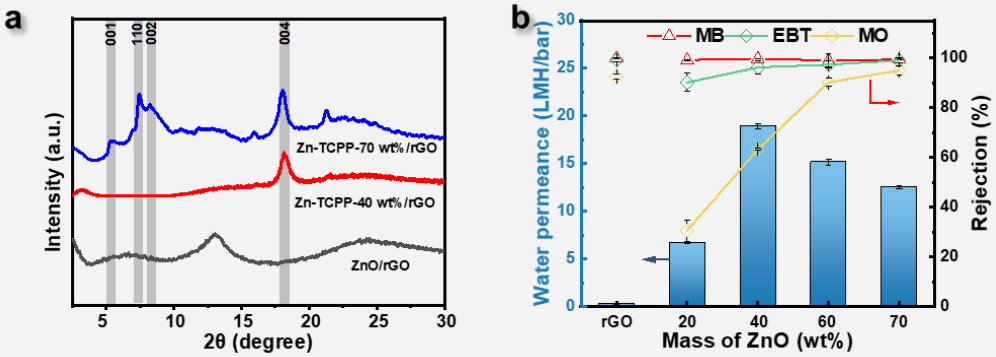

Fig.2 a) XRD patterns of ZnO/rGO, Zn-TCPP-40 wt%/GO and Zn-TCPP-70 wt%/GO and b) effect of mass loading of ZnO on the separation performance.

References

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