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High performance lamellar structured graphene oxide nanocomposite membranes via Fe_3O_4-coordinated phytic acid control of interlayer spacing for organic solvent nanofiltration (OSN)

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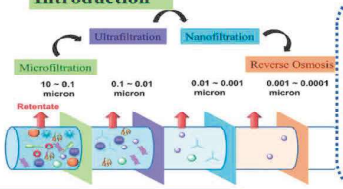
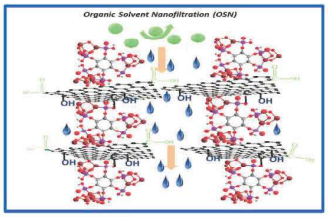
Introduction



- There is a lot of research being done on GO lamellar 2D membranes for separating organic solvents and solutes., [1]
- However, existing challenges include inadequate solvent permeability and limited dye rejection capacity due to swelling of membranes, [2]
- In this study, we proposed a novel technique that employs low-pressure assisted filtration to fabricate nanocomposite membranes using GO and PhA/Fe_3O_4
- Remarkably, these composite membranes exhibited outstanding separation performance for PM (≥99.88 %) in water



Experimental Section

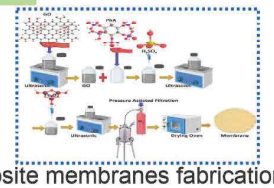
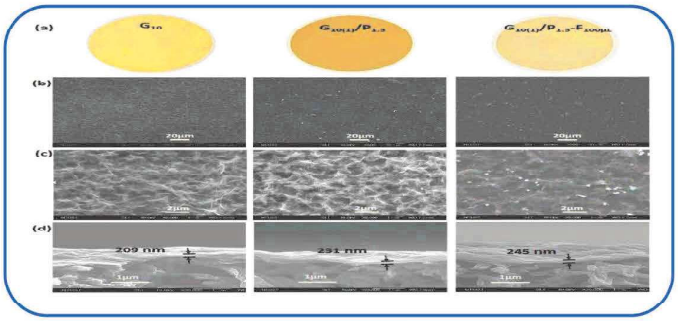


Figure 1. Nanocomposite membranes fabrication process

Morphological characterization



OSN Separation Performance

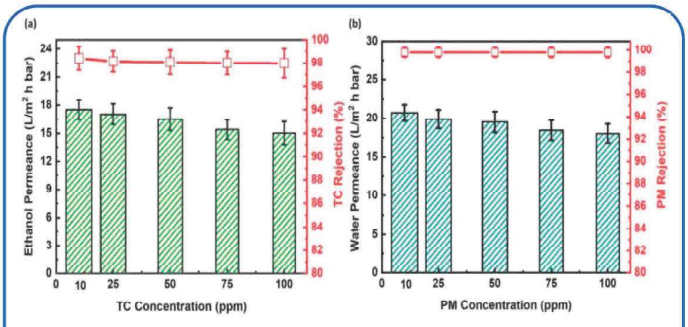


Fig. 3. Ethanol permeance and TC rejection (a) and water permeance and PM rejection (b)

XPS Characterization

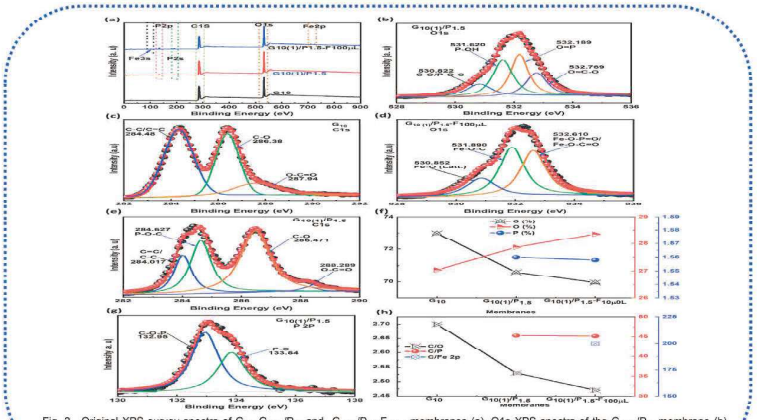


Fig. 2. Original XPS survey spectra of G_{10}, $G_{10(1)}/P_{1.5}$ and $G_{10(1)}/P_{1.5}$-$F_{100\mu L}$ membranes (a), O1s XPS spectra of the $G_{10(1)}/P_{1.5}$ membrane (b), C1s XPS spectra of the pure G_{10} membrane (c), O1s XPS spectra of the $G_{10(1)}/P_{1.5}$-$F_{100\mu L}$ nanocomposite membrane (d), C1s XPS spectra of the $G_{10(1)}/P_{1.5}$ composite membrane (e), elemental composition of C (%), O (%), and P (%) (f); P2p (g), and C/O, C/P and C/Fe2p(%) ratio (h)

Conclusion

- In summary, we have fabricated novel GO-PhA/Fe_3O_4 nanocomposite membranes using a pressure assisted filtration method
- In this study, the varied d-spacing of GO-PhA/Fe_3O_4 nanocomposite membranes was achieved by intercalation of PhA/Fe_3O_4 between GO layers
- The resulting nanocomposite membranes showed balanced organic solvent permeance and solute rejection
- The optimum $G_{10(1)}/P_{1.5}$-$F_{100\mu L}$ nanocomposite membrane showed long-term stability in harsh environments due to its high mechanical strength and chemical stability

Some selected publications

1. Abebe, S.H., *et al*, 2024. High performance lamellar structured graphene oxide nanocomposite membranes via Fe3O4-coordinated phytic acid control of interlayer spacing for organic solvent nanofiltration (OSN). *Chemical Engineering Journal*, *495*, p.153451.
2. Abebe, S.H., *et al.*, 2024. Lamellar structured GO-Melamine nanocomposite membranes with varying d-spacing for efficient organic solvent nanofiltration (OSN). *Journal of Membrane Science*, *699*, p.122643.
3. Subrahmanya, T.M., Chi, Y.J., Nayak, S., Abebe, S.H., Hung, W.S., Kadja, G.T., Hu, C.C., Lee, K.R. and Lai, J.Y., 2024. Sulfonated graphene oxide linked with alkali metal ions membranes for proton conductivity in hydrogen production from water electrolysis. *Journal of Membrane Science*, *705*, p.122903.

Acknowledgement

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