

---

# Polycation-Intercalated MXene Membrane with Enhanced Permselective and Anti-Microbial Properties

Jie Yang <sup>1,\*</sup>, Shilin Zhu <sup>2</sup> and Hongli Zhang <sup>2,\*</sup>

<sup>1</sup> School of Materials Science and Engineering, Xi'an Polytechnic University, Xi'an 710048, China

<sup>2</sup> School of Materials Science and Chemical Engineering, Xi'an Technological University, Xi'an 710021, China; shilin971020@163.com

\* Correspondence: jieyang0320@126.com (J.Y.); zhanghongli@xatu.edu.cn (H.Z.)

## Supplementary Figures

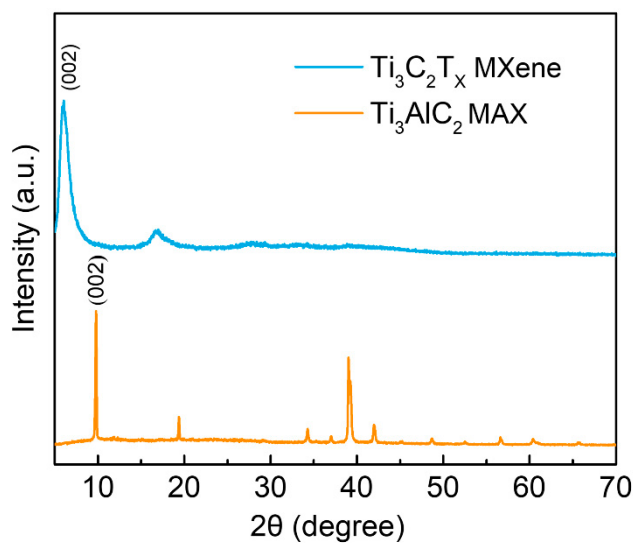


Figure S1 (a) XRD pattern of the Ti<sub>3</sub>AlC<sub>2</sub> MAX powder and Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> MXene.

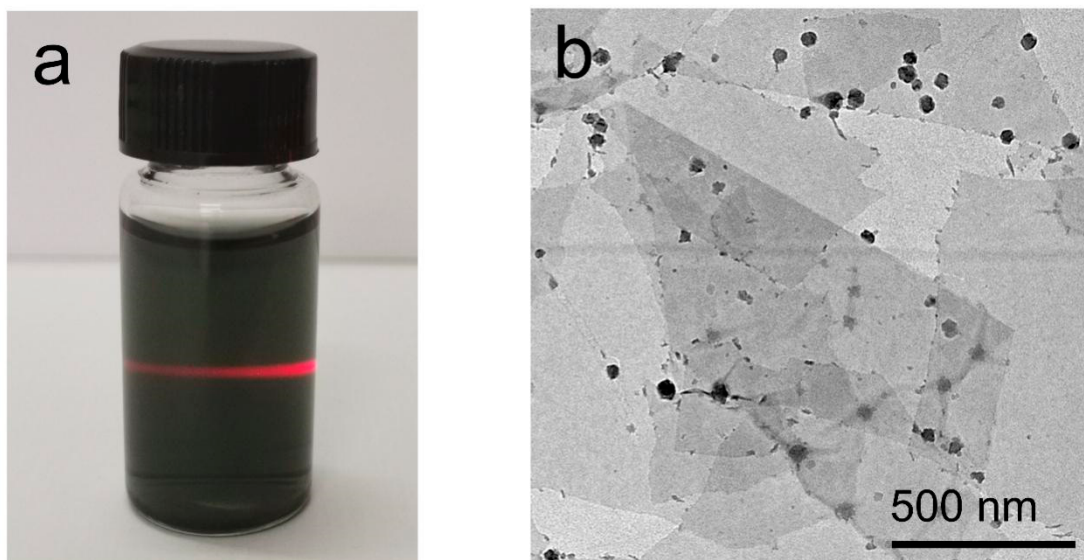


Figure S2 (a) Photograph of few-layered  $\text{Ti}_3\text{C}_2\text{T}_x$  MXene suspension with a significant Tyndall scattering effect, (b) TEM image of the  $\text{Ti}_3\text{C}_2\text{T}_x$  MXene nanosheets.



Figure S3 Mixed MXene dispersion and PDDA solution

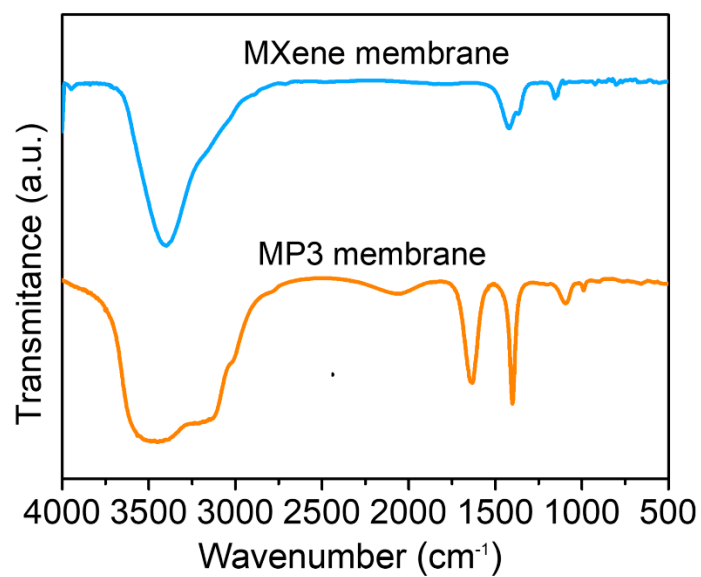


Figure S4 FTIR of the MXene membrane and MP3 membrane.

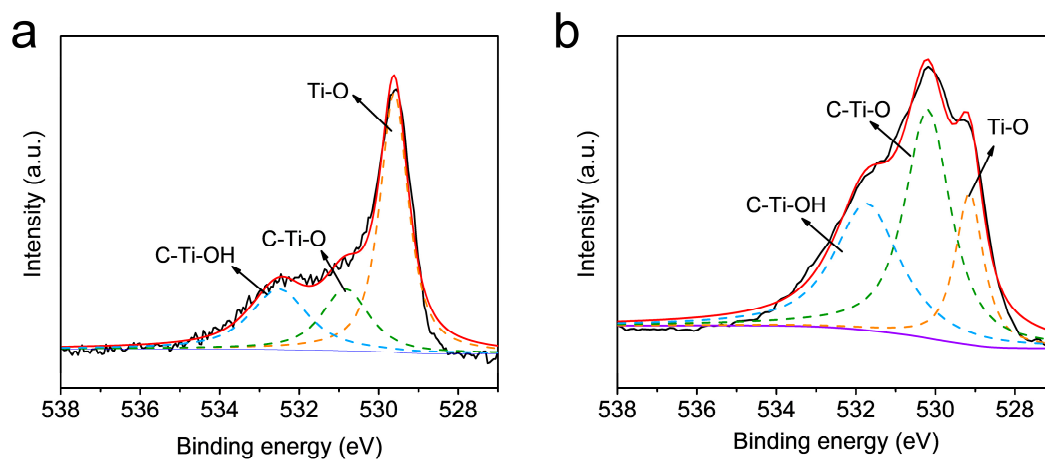


Figure S5 High-resolution O1s XPS spectra of (a) MXene membrane and (b) MXene/PDDA membrane.

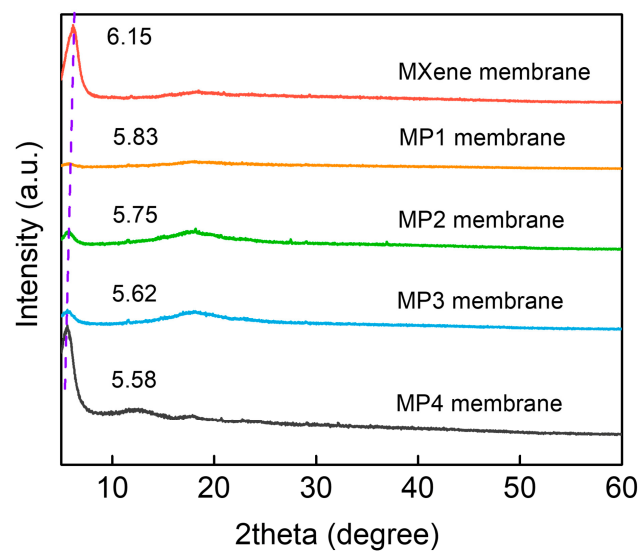


Figure S6 XRD patterns of the MXene/PDDA membrane with different PDDA content.

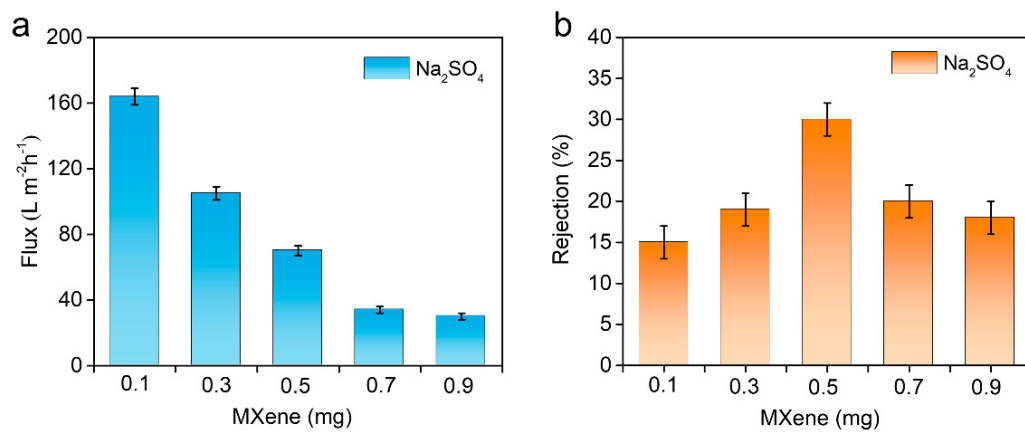


Figure S7 Separation performance of pure MXene membrane with different thickness.

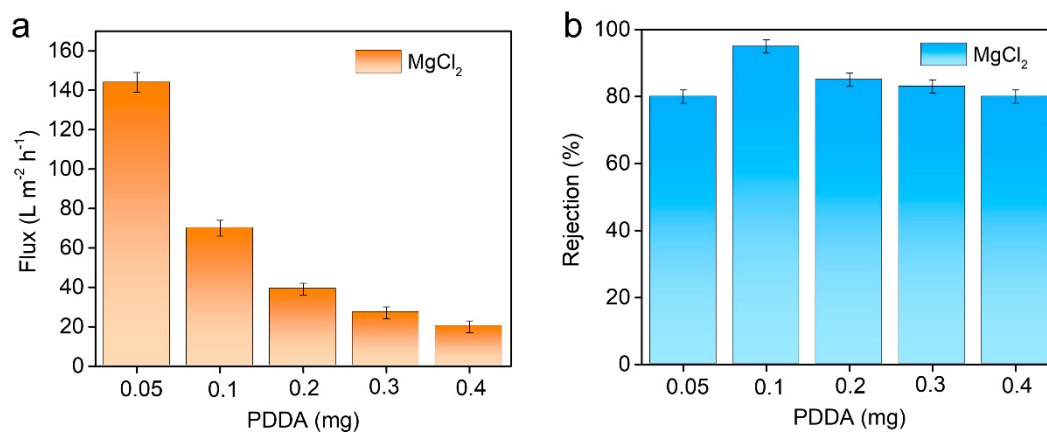


Figure S8 Separation performance of  $\text{Ti}_3\text{C}_2\text{T}_x/\text{PDDA}$  membrane with different PDDA content.

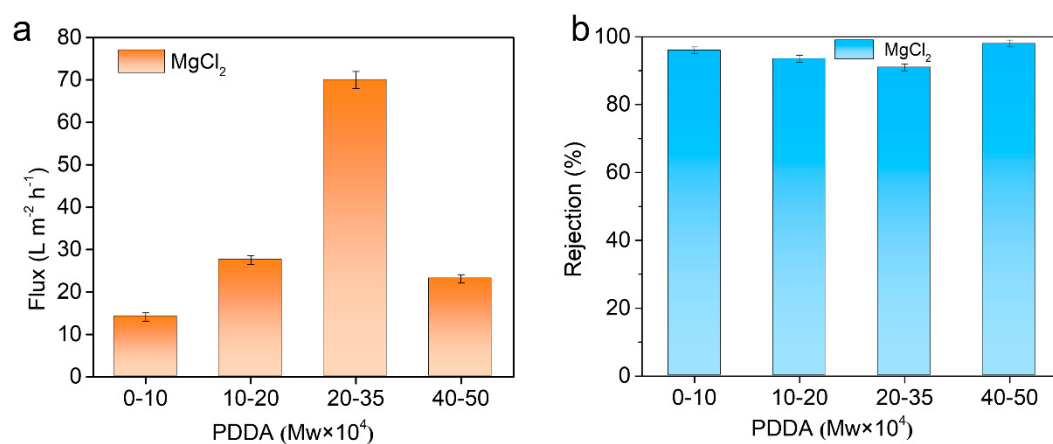


Figure S9 Separation performance of  $\text{Ti}_3\text{C}_2\text{T}_x/\text{PDDA}$  membrane with different molecular weight of PDDA.

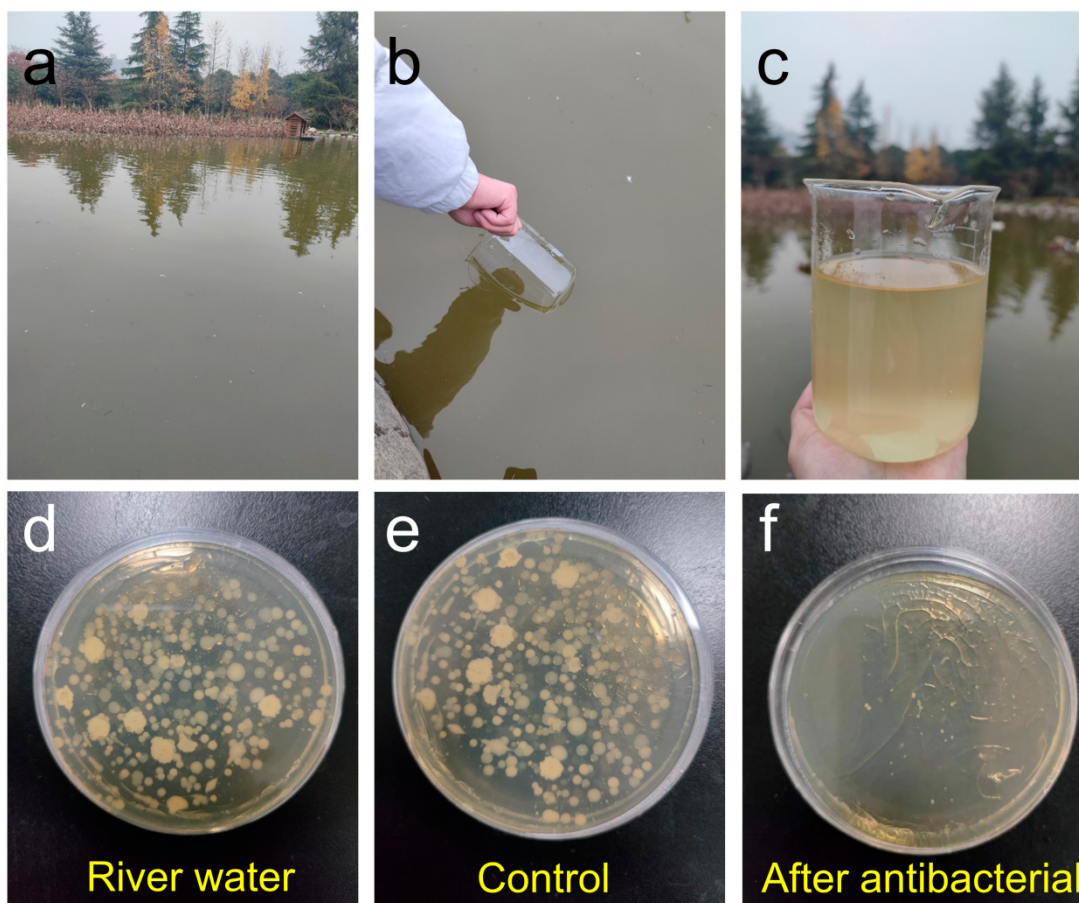


Figure S10 (a-c) Collection of the waste water from river; (d-f) Practical antibacterial results of the MP3 membrane.

Table S1 Comparison of membranes investigated in this work with other two-dimensional membranes in literature.

| Membrane                          | Water flux<br>( $\text{L m}^{-2} \cdot \text{h}^{-1}$ ) | Rejection<br>(%)         | FRR<br>(%) | Antibacterial<br>activity                          | References       |
|-----------------------------------|---------------------------------------------------------|--------------------------|------------|----------------------------------------------------|------------------|
| MP3                               | 73.4                                                    | 94.6%( $\text{MgCl}_2$ ) | 96.1       | <i>E. coli</i> : 90<br><i>S. aureus</i> : 95       | <i>This work</i> |
| MXene                             | /                                                       | /                        | /          | <i>E. coli</i> : 67<br><i>B. subtilis</i> : 73     | [43]             |
| MXene@CA                          | 256.85                                                  | 100 (BSA)                | /          | <i>E. coli</i> : 98<br><i>B. subtilis</i> : 96     | [21]             |
| AgCl-TiO <sub>2</sub><br>membrane | /                                                       | /                        | /          | <i>E. coli</i> : 58.7                              | [44]             |
| FN-GOQD/Ag                        | 65.8                                                    | /                        | 77.4       | <i>E. coli</i> : 99.8<br><i>B. subtilis</i> : 97.3 | [45]             |
| HPEIGO/PES                        | 153.5                                                   | 77.4                     | 51.7       | <i>E. coli</i> : 74.88                             | [46]             |

---

|             |       |           |      |                                                  |      |
|-------------|-------|-----------|------|--------------------------------------------------|------|
| GO-pPES     | 50    | /         | 80   | <i>E. coli</i> :80                               | [47] |
| rGO-DDA     | 89.6  | 100 (BSA) | 89.1 | <i>E. coli</i> :83.6                             | [48] |
| PSF/GO      | 158   | /         | /    | <i>E. coli</i> :66                               | [49] |
| PES/CRGO-Ly | 372.3 | /         | /    | <i>E. coli</i> :71                               | [50] |
| PES/ZGO-NH  | 95.49 | 95 (BSA)  | 84.4 | <i>E. coli</i> :81.1<br><i>B. subtilis</i> :85.7 | [51] |

---