

Supporting information

MXene-regulation polyamide membrane featuring with bubble-like nodule for efficient dye/salt separation and antifouling performance

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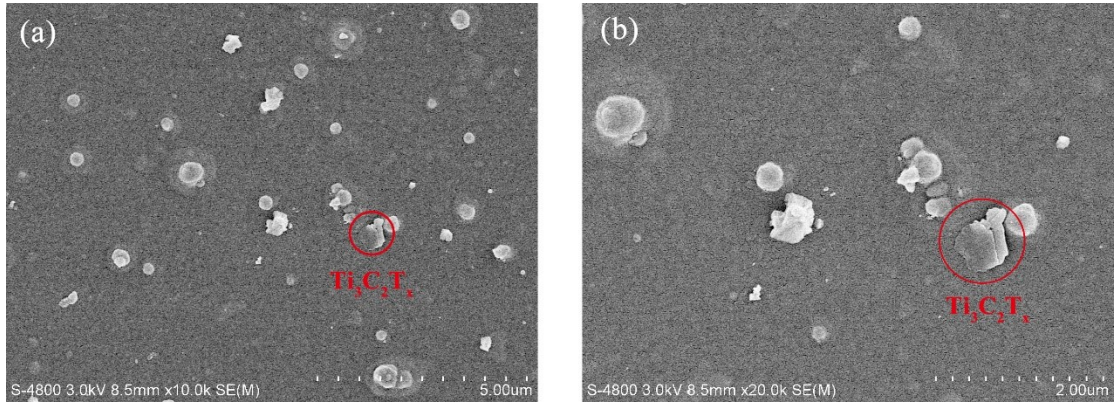
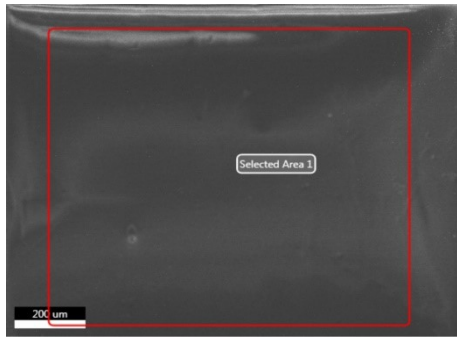
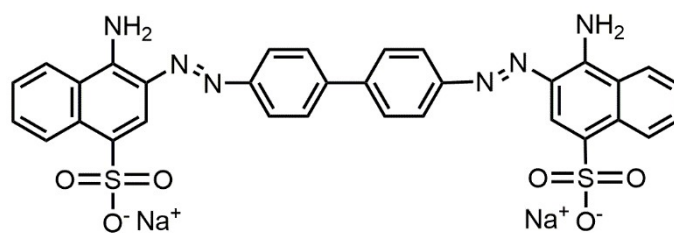


Fig. S1 Surface SEM images of Ti₃C₂T_x/NF membrane (M2), (a) low magnification, (b) high magnification

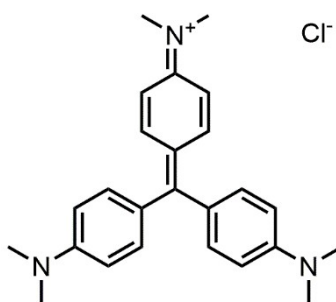


Element	Weight (%)	Atomic (%)
C K	50.99	56.91
N K	21.40	20.48
O K	24.02	20.13
F K	3.47	2.45
Ti K	0.12	0.03
Totals	100	

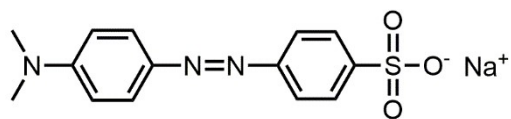
Fig. S2 The EDS image of Ti₃C₂T_x/NF membrane (M4).



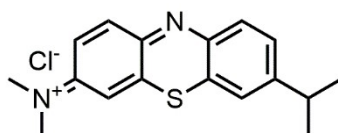
Congo Red (CR) 696.66 Da



Crystal Violet (CV) 407.99 Da



Methyl Orange (MO) 327.33 Da



Methylene Blue (MB) 319.85 Da

Fig. S3 Molecular structures of the model dyes in this study.



Fig.S4 Digital photo of membrane **(M2)** after immersing into 2000 ppm Na_2SO_4 solution for 24h

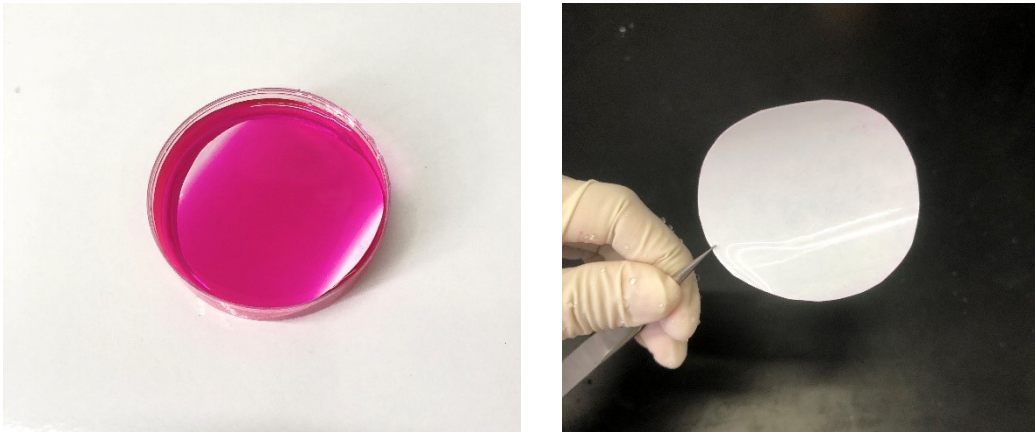


Fig.S5 Digital photo of membrane **(M2)** after immersing into 100 ppm dye solution for 24h (a) and backwashing with DI water (b)

Table S1. Comparison of NaCl/dye filtration performances with other reported study.

Membranes	Permeability ($\text{Lm}^{-2}\text{h}^{-1}\text{bar}^{-1}$)	Type of dyes (dyes content)	Dye rejection (%)	NaCl rejection (%) (Salt content)	Operating pressure (MPa)	α^a	Ref.
PES-CNT-PA nanofiltration membrane	~17.2	Methyl Violet (0.1 g/L)	99.4	24.7 (2 g/L)	0.5	123.5	64
Catechin-chitosan loose NF membrane	~33.2	Crystal Violet (0.1 g/L)	98.5	12.5 (1 g/L)	0.2	58.3	60
SPECMs M-4	~6.7	Methyl Blue (0.1 g/L)	99.9	15.8 (1 g/L)	0.6	850	22
Sepro NF 2A membrane	~10.2	Rhodanile Blue (0.1 g/L)	98.6	17.2 (2 g/L)	0.6	59.1	63
Cross-linked PAN/Boltorn membrane	~11.0	Methyl Blue (0.1 g/L)	97.5	10.6 (2 g/L)	0.5	35.8	65
PEA-TMC nanofiltration membrane	~16.6	Methyl Blue (0.1 g/L)	95.4	16.4 (1 g/L)	0.4	18.2	61
PA/TpPa-12/PAN TFNC membrane	~22	Acid Fuchsin (0.1 g/L)	99.8	19.5 (2 g/L)	0.5	402.5	62
TiO ₂ -COOH/CaAlg hydrogel nanofiltration membrane	~14.1	Brilliant Blue G250 (0.1 g/L)	96.1	7.5 (1 g/L)	0.1	23.7	59
Ti ₃ C ₂ T _x /NF membrane	12.9	Crystal Violet (0.1 g/L)	99.91	26.16 (2 g/L)	0.35	820	This work
	12.4	Congo Red (0.1 g/L)	99.86	29.92 (2 g/L)	0.35	501	This work

^a α denotes the selectivity of dye to NaCl, calculated by $\alpha = (1 - R_{\text{NaCl}})/(1 - R_{\text{dye}})$.