

Supporting Information

Piperazine-Based Functional Materials as Draw Solutes for Desalination via Forward Osmosis

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Comprising 4 pages, 2 figures and 2 tables

18 **Table S1. Crystal data and structure refinement of P-2SO₃-2Na and P-2CO₂-2Na**

Complex	P-2SO ₃ -2Na	P-2CO ₂ -2Na
Chemical formula	C ₄ H ₁₀ NNaO ₄ S	C ₈ H ₃₄ N ₂ NaO ₁₅
Formula weight	191.18 g/mol	444.35 g/mol
Temperature	204(2) K	294(2) K
Crystal size	0.100 x 0.050 x 0.050 mm	0.150 x 0.100 x 0.100 mm
Crystal system	triclinic	triclinic
Space group	P-1	P-1
a (Å)	6.2115(3)	6.8397(5)
b (Å)	6.2586(3)	12.5528(10)
c (Å)	10.0328(5)	14.3093(13)
α (°)	99.760(2)	110.727(8)
β (°)	97.910(2)	101.964(7)
γ (°)	91.374(2)	102.021(6)
V (Å ³)	380.28(3)	1069.51(16)
Z	2	2
D _{calc} (mg m ⁻³)	1.670	1.380
Absorption coefficient (mm ⁻¹)	0.447	0.163
q range (°)	3.31 to 28.37	3.7190 to 30.6070
Reflections collected	6234	2229
Independent reflections	9736 [R(int) = 0.0359]	10754 [R(int) = 0.0334]
Final R indices [I > 2s (I)] R1, wR2	R1 = 0.0372, wR2 = 0.0842	R1 = 0.1068, wR2 = 0.1920
R indices (all data) R1, wR2	R1 = 0.0316, wR2 = 0.0820	R1 = 0.0664, wR2 = 0.1590
Extinction coefficient	MoK α	MoK α
Largest diff peak and hole (eÅ ⁻³)	0.434 and -0.537	1.134 and -0.975

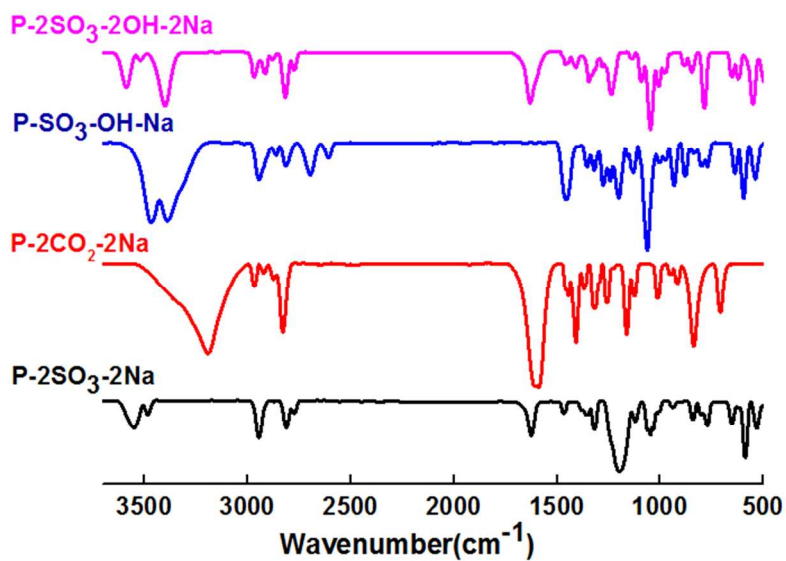


Figure S1. FTIR spectra of the PIFMs.

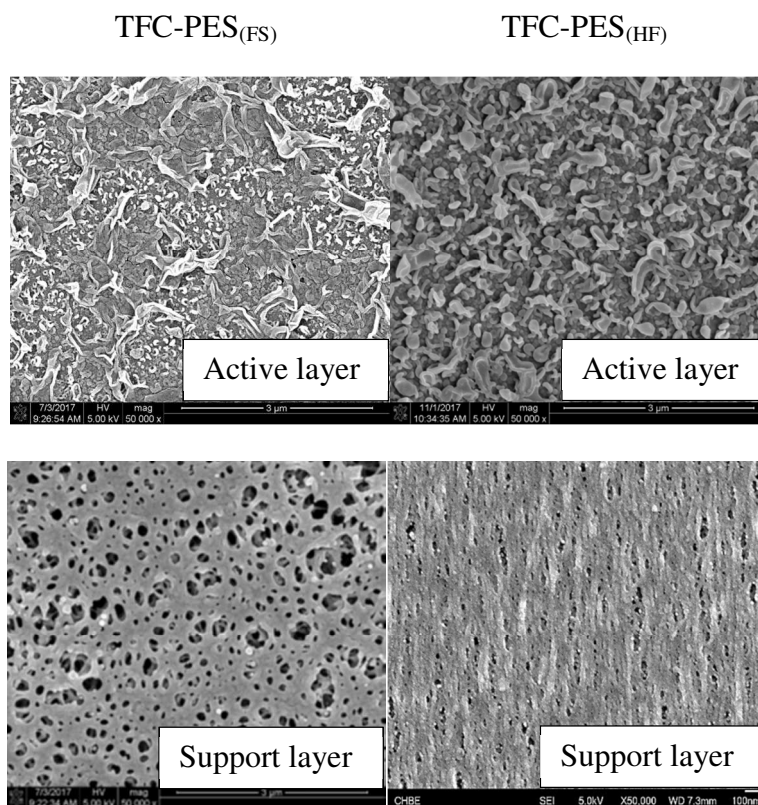


Figure S2. The SEM images of TFC-PES_(FS) and TFC-PES_(HF) membranes.

27 **Table S2.** Parameter comparison of the TFC-PES_(FS) and TFC-PES_(HF) membranes.

Membrane	PES _(FS)	PES _(HF)	TFC-PES _(FS)	TFC-PES _(HF)
Pure water permeability (LMH/bar)	299.0	1054.0	0.62	0.75
Mean pore size (nm)	15.87	12.35	0.30	0.28

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