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Supporting Information

Compatibilizing hydrophilic and hydrophobic polymers via spray

coating for desalination

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1. Configurations for adhesion test



Figure S1. The experimental set-up deployed here to determine the adhesion strength between incompatible polymer layers of different morphologies – PVA: dense selective layer (blue), PTFE: nanofibrous support layer (grey fibers).

2. The calibration curve for estimating salt concentration in the permeate solution

As shown in Figure S2, a fitting curve was generated based on a series of solution

conductivities of known salt concentrations. After obtained the equation (Y=1.69 X), salt

concentration of unknown solution could be determined by measuring its conductivity.



Figure S2. The fitting curve of conductivity versus salt concentration.

3. A video (the video uploaded separately) showed the spray coating process

Small droplets were sprayed on to a PTFE board and then vaporized rapidly. Therefore, when spray a PVA solution on to PTFE fibrous substrate, small PVA/water droplet penetrates into pores of substrate and dry quickly. As shown in Figure S3, surface tension of the PVA/water droplet would decrease during water evaporation. As a result, the PVA droplet would easily spread out on the hydrophobic PTFE surface. As shown in video, the PVA droplet first filled in gaps between PTFE fibers and then formed defect-free films on to PTFE support.



Figure S3. Surface tension of PVA aqueous solution of different concentrations.



Figure S4. (a,b) The infiltration of PVA into PTFE pores formed (c, d) PVA islands merge into whole films on the PTFE support.

4. Surface and cross-sectional images of spray coated PVA/PTFE composites

As showed in Figure S5, there are some pin-holes on the surface of SC-1-PVA/PTFE composite membrane. They couldn't be tested in PV mode since the feed solution would penetrate into pores under vacuum. For other SC-PVA/PTFE membranes, thicker and defect-free PVA layers were formed so that these membranes could be tested in both DCMD and PV modes.



Figure S5. SEM images of the top surfaces and cross-sections to SC-1-PVA/PTFE (a1, a2), SC-2.6-PVA/PTFE (b1, b2), SC-3.5-PVA/PTFE (c1, c2), SC-5.2-PVA/PTFE (d1, d2).

5. Information of all spray coated PVA/PTFE composite membranes

Table S1. The coating solution volume, surface integrity, and layer thickness of SC-PVA/PTFE Composite Membranes.

Membrane ID	Coating solution	Surface integrity	Layer Thickness (µm)	
	$volume(\mu L/cm^2)$	Surface integrity	PTFE	PVA
SC-1-PVA/PTFE	41	Defects	17.8±1.8	1.0±0.1
SC-2.6-PVA/PTFE	82	Defect-free	17.8±1.8	2.6±0.2
SC-3.5-PVA/PTFE	123	Defect-free	17.8±1.8	3.5±0.4
SC-5.2-PVA/PTFE	164	Defect-free	17.8±1.8	5.2±0.1

6. Water transport properties of PV desalination membranes

We calculate water permeance and permeability of the PVA layer for the SC-2.6

PVA/PTFE membrane, and compare them with other two PV composite membranes, both of which use the same crosslinked PVA as the selective layer and have similar PVA layer thicknesses ^{1, 2}. As listed in Table S2, difference in water permeance and permeability of all three membranes is within 20%. However, membrane flux of SC-2.6-PVA/PTFE membrane was 1.6 fold higher than that of PVA/PVDF/PTFE membranes when two membranes were operated at similar feed solution and temperature. The much higher water flux of the PVA/PTFE membrane has to be caused by the lower resistance of the PTFE substrate than the PVDF/PTFE support.

Table S2. Water permeance and permeability of different PVA layers

*	*	•	•	
	Testing	PVA Layer	Water	Water
Membrane ID	Temperatur	Thickness	Permeance	Permeability
	e	(µm)	(×104 GPU)	(×10 ⁴ Barrer)
SC-2.6-	75	26	177	46.0
PVA/PTFE		2.0	1/./	40.0
PVA/PAN	30	2.5	14.8	38.2
PVA/PVDF/PTFE	70	2.3	17.1	39.4

 $1 \text{ GPU} = 1 \times 10^{-6} \text{ cm}^3(\text{stp})/(\text{cm}^2 \cdot \text{s} \cdot \text{cmHg});$

1 Barrer = $1 \times 10^{-10} \text{ cm}3(\text{stp}) \cdot \text{cm}/(\text{cm}^2 \cdot \text{s} \cdot \text{cmHg})$.

7. The surface photographs of RC-PVA/PTFE and SC-PVA/PTFE composite in long-term stability test

All the PVA/PTFE composite membranes were soaked in water for 24h to dissolve the unreacted PVA and cross-linking agent (SPTA). For RC-PVA/PTFE composite membrane, the PVA layer would be partially separated from the PTFE which will be teared during long-term stability in 1h as showed in figure S6. But for SC-PVA/PTFE, there were no delamination between PVA and PTFE after 24h long-term stability test.



Figure S6. The photo graphs of the RC-PVA/PTFE composite membranes(a) at1h and SC-PVA/PTFE(b) at 24h in the long-term stability test.

References:

1. J. Q. Meng, P. Li and B. Cao, ACS Applied Materials &

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