Supporting Information

for

Pervaporation Removal of Water from Ionic Liquid Solutions Using Nafion

Membranes

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Table S1. Resistivity of Various Solutions

Solution	Resistivity (Ω cm)
NMP	3.6×10^5
IL-NMP*	1.6×10^3
IL ^a	1.6×10^3
IL ^b	5.3×10^4
H ₂ O	1.4×10^6

*The weight ratio between IL and NMP is 7:3. ^aIL contains >1 % H₂O. ^bIL contains <0.1 % H₂O.

Table S2. Softness Parameter and Size of Cations

Cation	H ⁺	Li ⁺	Na ⁺	K ⁺
Radius ($\times 10^3$ nm)	~0	60	95	133
Softness parameter	0.00	-0.95	-0.75	-0.58

Table S3. Pervaporation Experiment Performed Using Plate-and-frame Cell and XL Membrane[&]

Temperature (°C)	Water content (wt %)		Duration (h)	H ₂ O flux (mg h ⁻¹ cm ⁻²)	Solution flux ^{\$} (mg h ⁻¹ cm ⁻²)	H ₂ O selectivity*
	Initial	Final				
100	1.00	0.41	56	7.2	117	1.9

[&]Liquid and gas flow rates of 5 and 50 mL min⁻¹, respectively. ^{\$}H₂O and NMP. *H₂O selectivity = (wt_{H₂O}/wt_{NMP})_{permeated} / (wt_{H₂O}/wt_{NMP})_{reservoir@to}.

Table S4. Effect of Pervaporation Temperature on Pervaporation Rate: XL and Gore A Membranes[&]

Membrane	Temperature (°C)	Water content (%)		H ₂ O flux (mg h ⁻¹ cm ⁻²)	Solution flux ^{\$} (mg h ⁻¹ cm ⁻²)	H ₂ O selectivity*
		Initial	Final			
XL	60	1.05	0.85	2.0	24	2.1
XL ^a	80	1.10	0.53	3.7	68	1.5
		1.01	0.34			
XL ^a	90	1.11	0.37	5.3	86	1.7
		0.97	0.25			
		1.07	0.32			
XL ^a	100	1.01	0.36	6.8	110	2.0
		0.98	0.49			
		1.00	0.41			
Gore A ^a	80	1.02	0.47	3.3	52	1.9
		1.01	0.43			
Gore A ^a	90	1.03	0.43	4.7	82	1.7
		1.00	0.46			
Gore A ^a	100	1.19	0.50	7.0	106	2.0
		1.14	0.46			

[&]Liquid and gas flow rates are 5 and 50 mL min⁻¹, respectively. ^aData showed in the table are averages from at least two runs. ^{\$}H₂O and NMP. *H₂O selectivity = (wt_{H₂O}/wt_{NMP})_{permeated} / (wt_{H₂O}/wt_{NMP})_{reservoir@to}.

Table S5. Effect of Gas-Sweep Rate on Pervaporation Rate: Gore A Membrane at 100 °C^a

Gas-sweep rate (mL min ⁻¹)	Water content (%)		H ₂ O flux (mg h ⁻¹ cm ⁻²)	Solution flux ^{\$} (mg h ⁻¹ cm ⁻²)	H ₂ O selectivity*	Resistivity [#] (Ω cm)
	Initial	Final				
50	1.19	0.46	7.0	106	2.0	1.4×10 ⁶
100	1.07	0.49	8.2	163	1.5	1.1×10 ⁶
150	1.04	0.47	8.9	184	1.3	1.3×10 ⁶
200 ^{&}	1.12	0.54	10.4	185	1.0	3.5×10 ³

^aThick gaskets (762 μm) with liquid flow rate of 5 mL min⁻¹. ^{\$}H₂O and NMP. *H₂O selectivity = (wt_{H₂O} / wt_{NMP})_{permeated} / (wt_{H₂O} / wt_{NMP})_{reservoir@to}. [&]Membrane leaked. [#]Resistivity of the permeates from EIS.

Figure S1. Nafion-based pervaporation process for removal of water from IL-NMP-H₂O solution.

Figure S2. Plate-and-frame cell, gasket, and membrane. The width and depth of the serpentine channel are 0.8 and 1.0 mm, respectively. The liquid velocity in the channel and Reynolds number of IL-NMP-H₂O solution are 0.1 m s⁻¹ and 2.1, respectively.

Figure S3. (a) IL-NMP-H₂O solution after pervaporation and (b) permeated liquid at the end-of-run. Pervaporation performed at 100 °C with XL membrane and metal grid support. The liquid and gas flow rates are 5 and 50 mL min⁻¹, respectively. The resistivities were 2.7×10^3 and 1.2×10^6 Ω cm for the IL-NMP-H₂O and permeate, respectively.