Support information for

Preparation of Positively Charged Nanofiltration Membrane Based on Hydrophilic-hydrophobic Transformation of Poly(ionic liquid)

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■ SUPPORTING RESULTS:

1.

Table S1. PWF and rejection to PEG 10000, PEG 20000 of PSf supporting membrane at 0.2 MPa

PSf supporting membrane	Pure water flux ($L/m^2 \cdot h^{-1}$)	Rejection (%)	
		PEG 10000	PEG 20000
Performance	360	32	50

2.

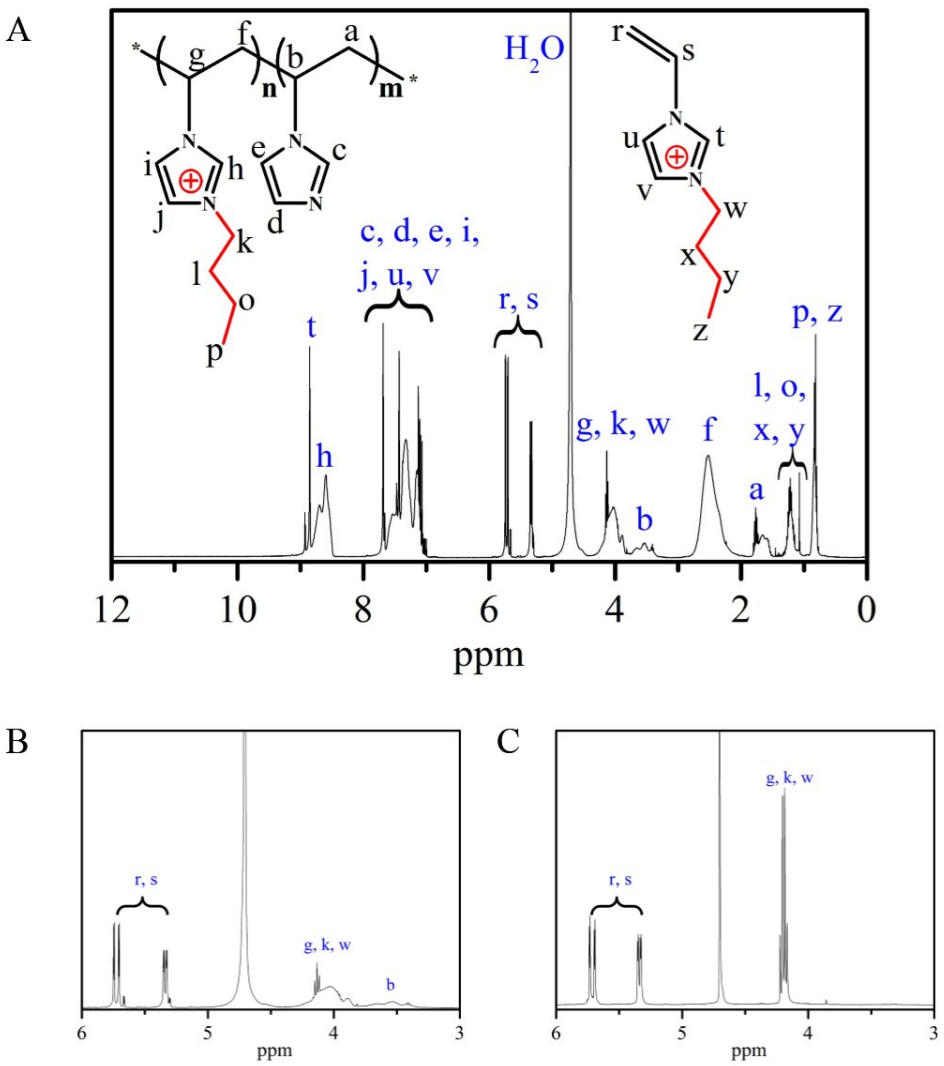

Fig. S1 (A). ^{1}H NMR spectrum (12-0 ppm) of PIL product (prepared with VIM, BuBr and obtained by drying the original reacted aqueous without further purification), (B). Enlarged ^{1}H NMR spectrum of (A) in the range of 6 to 3 ppm, (C). ^{1}H NMR spectrum (6-3 ppm) of product of PIL homopolymer (prepared with IL monomer and obtained by drying the original reacted aqueous without further purification) in D_2O at 25 ^{o}C.

Table S2. Integrations of peaks in the spectrum of product (obtained by drying the original reacted aqueous without further purification) in D_2O at 25 ^oC in Fig. S1 (A).

Peak	Integrations
p, z	1.0
o, l, x, y	0.9
a	0.8
f	3.8
b	0.7
g, k, w	1.8
r, s	1.1
c, d, e, i, j, u, v	5.0
h	1.8
t	0.5

Illustration

The result of ^1H NMR shows the quaternization reaction is well completed. The main content in hydrophilic PIL solution is hydrophilic PIL (poly ($ViBuIm^+Br^-$-co-VIM)). Furthermore, estimated from the integrations, we can analyze that nearly 85 wt% the reactants were transformed to hydrophilic PIL (poly ($ViBuIm^+Br^-$-co-VIM)). Besides, in hydrophilic PIL chains the mole ratio of $ViBuIm^+Br^-$ to VIM is about 17:1 (only 5.5 mol% of VIM is unreacted with BuBr). Thus, the peaks of BuBr is not obvious in the NMR spectra.

3.

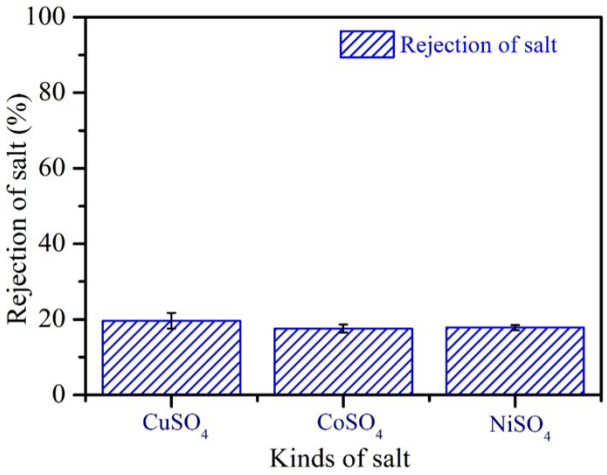

Fig. S2 Rejection to $CuSO_4$, $CoSO_4$ and $NiSO_4$ of PIL/PSf.

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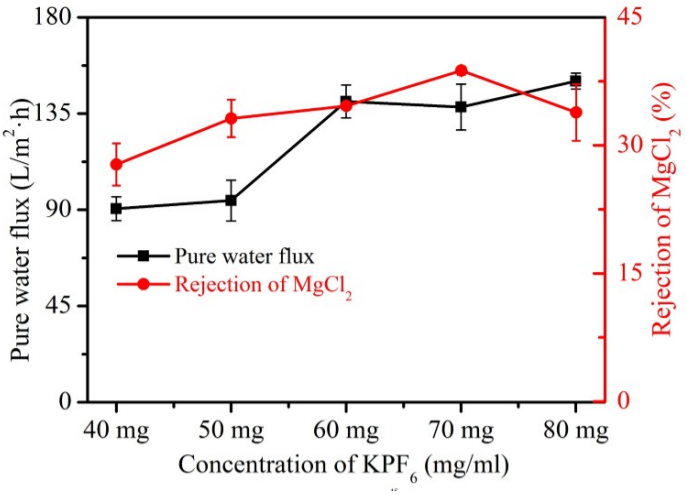

Fig. S3 PWF and $MgCl_2$ rejection of PIL/PSf prepared from KPF_6 aqueous with concentration of 40, 50, 60, 70 and 80 mg/ml, when fixed the hydrophilic PIL aqueous concentration to 6 wt%.

5.

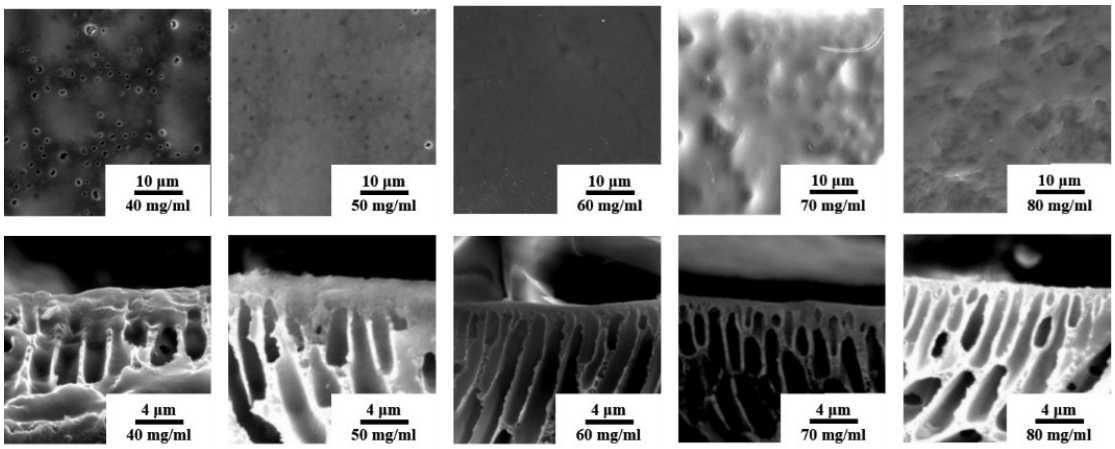

Fig. S4 SEM images of PIL/PSf prepared from KPF_6 aqueous with concentration of 40, 50, 60, 70 and 80 mg/ml, when fixed the hydrophilic PIL aqueous concentration to 6 wt%.

6.

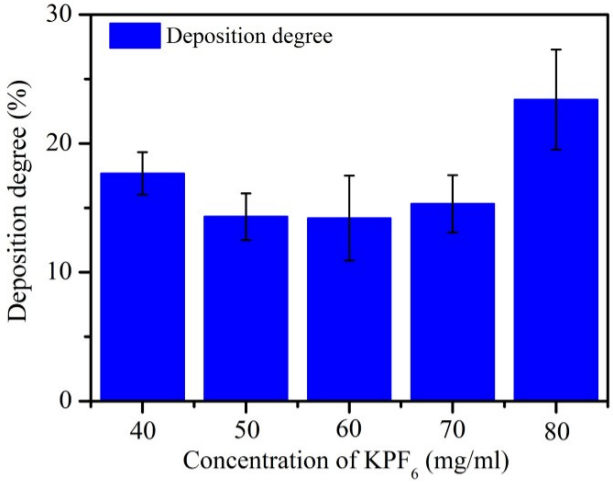

Fig. S5 Deposition degree of PIL/PSf prepared from KPF_6 aqueous with concentration of 40, 50, 60, 70 and 80 mg/ml, when fixed the hydrophilic IL aqueous concentration to 6 wt%.

7.

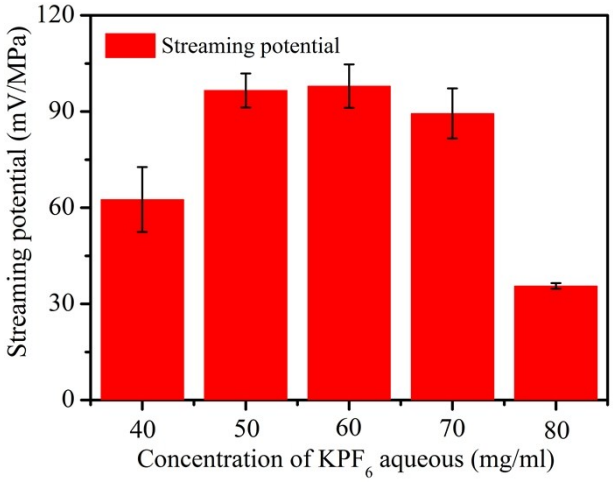

Fig. S6 Streaming potential of PIL/PSf prepared from KPF_6 aqueous with concentration of 40, 50, 60, 70 and 80 mg/ml, when fixed the hydrophilic PIL aqueous concentration to 14 wt%.

8.

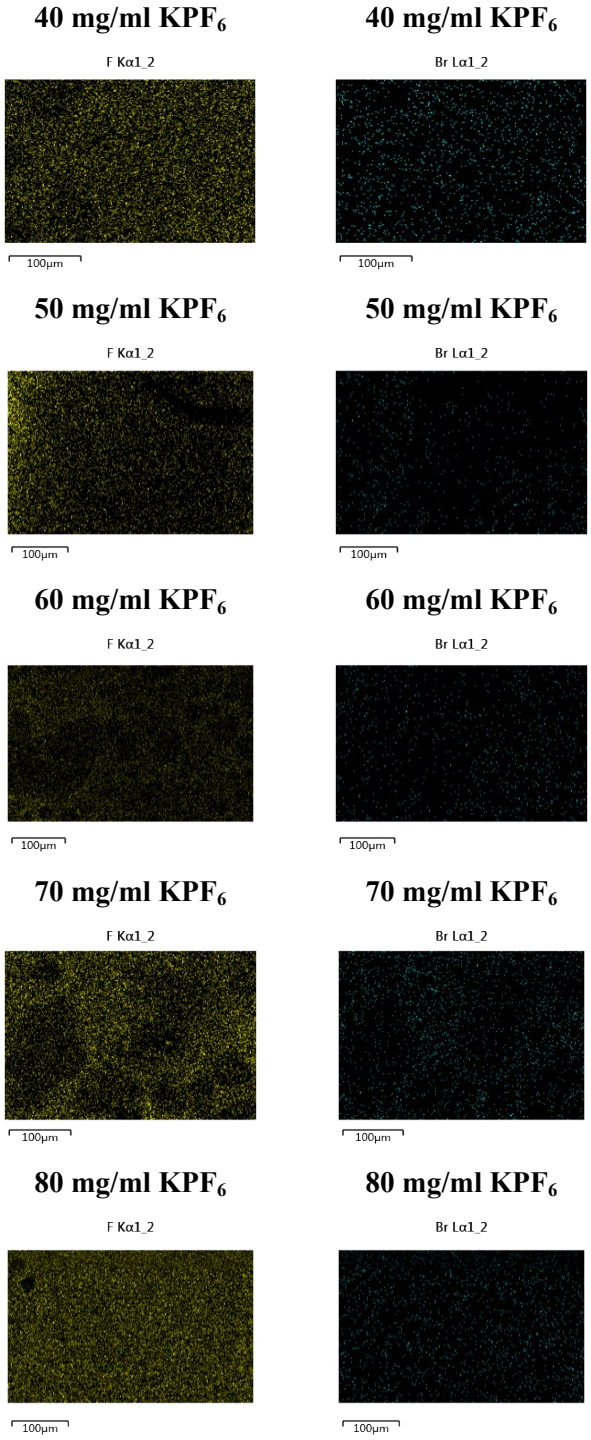

Fig. S7 Distribution of element F and Br in the surface of PIL/PSf prepared from KPF_6 aqueous with concentration of 40, 50, 60, 70 and 80 mg/ml, when fixed the hydrophilic PIL aqueous concentration to 14 wt%, investigated by EDS (Oxford Instrument X-MAX 50).

Table S3. Mole ratio of element F to Br and PF_6^- to Br^- in the surface of PIL/PSf prepared from KPF_6 aqueous with concentration of 40, 50, 60, 70 and 80 mg/ml, when fixed the hydrophilic PIL aqueous concentration to 14 wt%, investigated by EDS (Oxford Instrument X-MAX 50).

Samples	Mole ratio of F to Br	Mole ratio of PF_6^- to Br^-
40 mg/ml	44.96	7.49
50 mg/ml	58.33	9.72
60 mg/ml	74.10	12.35
70 mg/ml	97.99	16.33
80 mg/ml	103.71	17.29

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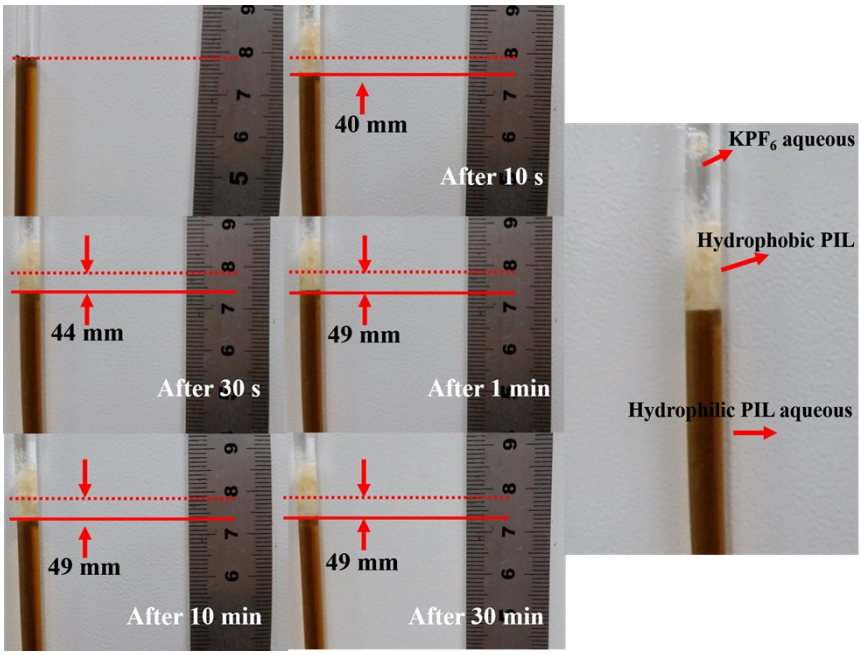
9.

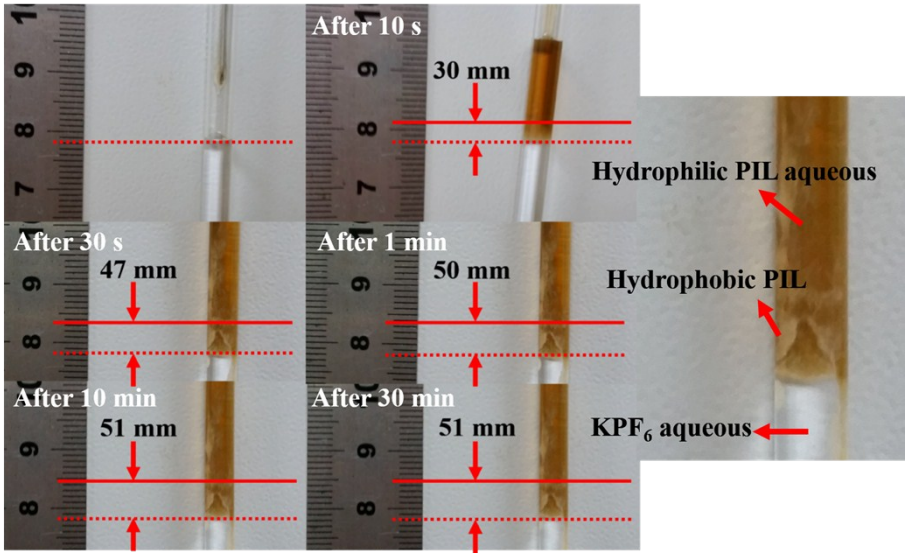
A



Picture A: The concentration of hydrophilic PIL is 14 wt% and the concentration of KPF_6 is 60 mg/ml.

Picture A shows the change of the interface of hydrophilic PIL aqueous and hydrophobic PIL (white opaque layer) in tube after injecting KPF_6 aqueous with different time. As a result, the interface moved quickly to the direction of hydrophilic PIL aqueous as the PF_6^- ion diffusing further into hydrophilic PIL aqueous within 1 min, which reflect the fast moving of PF_6^- into the hydrophilic PIL aqueous. After 1 min, the interface changes little.

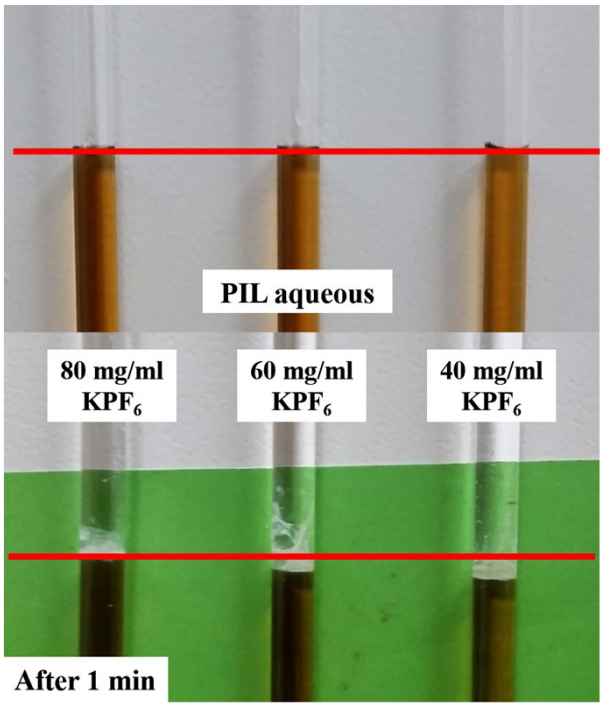
B



Picture B: The concentration of hydrophilic PIL is 14 wt% and the concentration of KPF_6 is 60 mg/ml.

Picture B shows the change of the interface of hydrophilic PIL aqueous and hydrophobic PIL (white opaque layer) in tube after injecting hydrophilic PIL aqueous with different time. As a result, the interface moved quickly to the direction of hydrophilic PIL aqueous as the PF_6^- ion diffusing further into hydrophilic PIL aqueous within 1 min. After 1 min, the interface changes little. It also verifies that the moving of interface (and PF_6^-) in Picture A is not caused by gravity.

C



Picture C: The concentration of hydrophilic PIL is 14 wt% and the concentration of KPF_6 is 40, 60, 80 mg/ml.

Picture C shows the different change ability of the height of hydrophilic PIL aqueous in tubes after injecting KPF_6 aqueous with different concentration for 1 min. As expected, in the system with lower concentration of KPF_6 aqueous, the moving distance of PF_6^- into the PIL aqueous is father probably due to the looser interface formed and a less inhibiting effect.

Fig. S8 Simulation of the hydrophobic PIL formation process in the membrane pores with small tubes.

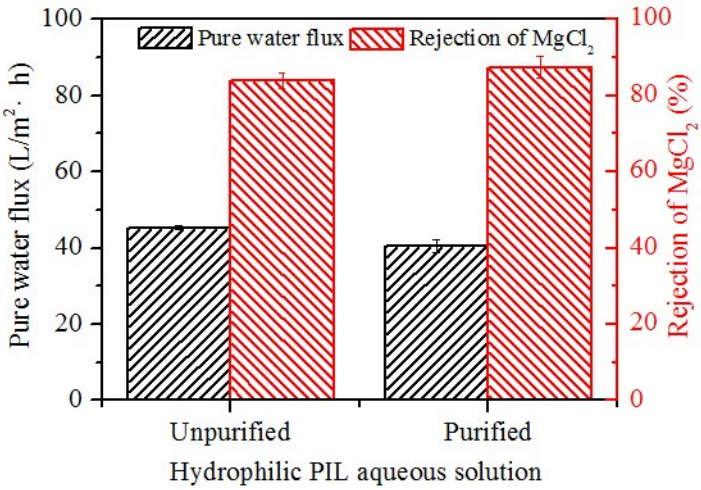


Fig. S9 PWF and $MgCl_2$ rejection of PIL/PSf prepared from unperified and purified hydrophilic PIL when fixed the hydrophilic PIL aqueous concentration to 14 wt% and KPF_6 aqueous with concentration of 60 mg/ml.