Supporting Information

Development of metal-ligand ion-exchange membranes functionalized with crown ether-ionic liquids for selective Li^+/Mg^{2+} separation

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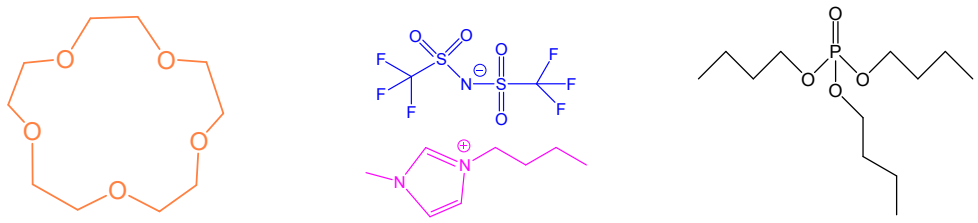

15C5 $[C_4mim][NTf_2]$ TBP

Fig. S1 Structures of 15-crown ether-5 (15C5), 1 -butyl- 3 -methylimidazolium bis(trifluoromethanesulfonyl)imide salt ($[C_4mim]$ $[NTf_2]$) and tributyl phosphate (TBP).

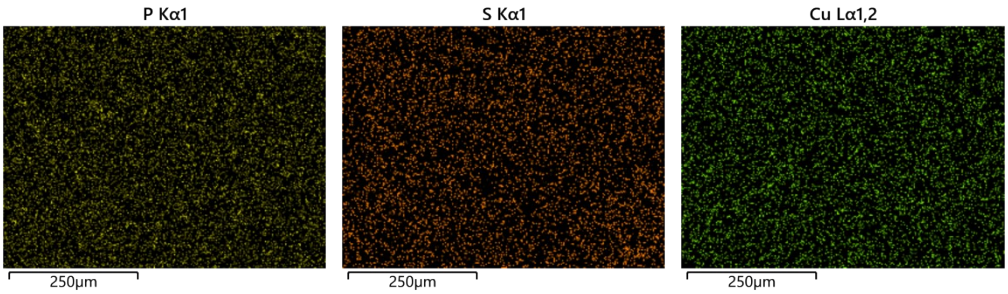

Fig. S2 Surface EDS elemental maps of (a) PVDF, (b) 15C5-IL(2), and (c) 15C5-IL(2)/Cu-MPD.

Table S1 Total number of EDS elemental profiles for PVDF, 15C5-IL(2), 15C5-IL(2)/Cu-MPD surfaces spectra.

Membrane materials	C (wt%)	N (wt%)	O (wt%)	F (wt%)	S (wt%)	P (wt%)	Cu (wt%)
PVDF	42.47	-	2.15	54.8	0.24	0.34	-
15C5-IL(2)	41.95	1.21	2.05	53.25	0.18	1.36	-
15C5-IL(2)/Cu-MPD	47.84	4.06	4.17	42.16	0.14	0.15	1.48

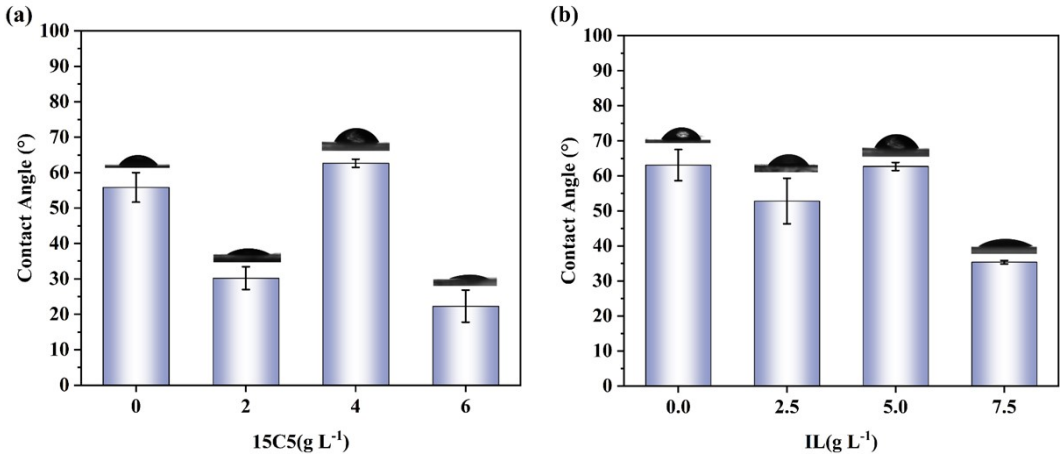

Fig. S3 WCA of 15C5-IL(2)/Cu-MPD membranes prepared under different (a) 15C5, (b) IL concentration conditions.

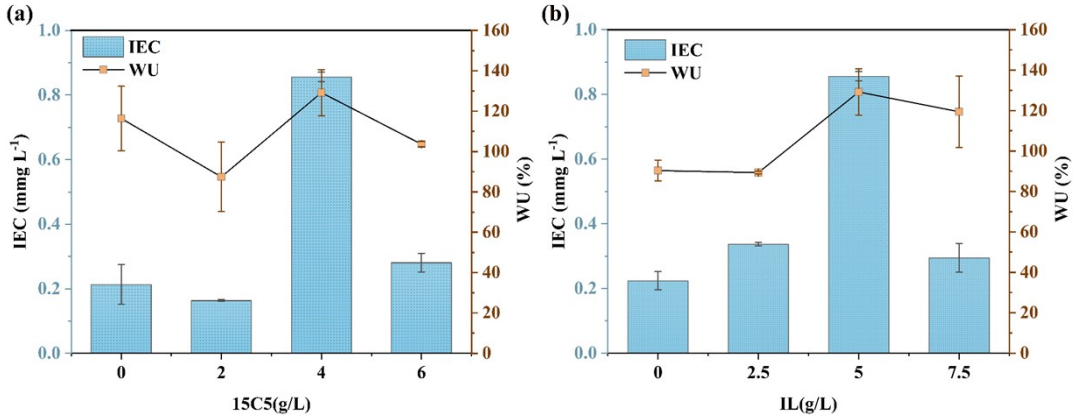

Fig. S4 IEC and WU of 15C5-IL(2)/Cu-MPD membranes prepared under different (a) 15C5, (b) IL concentration conditions.

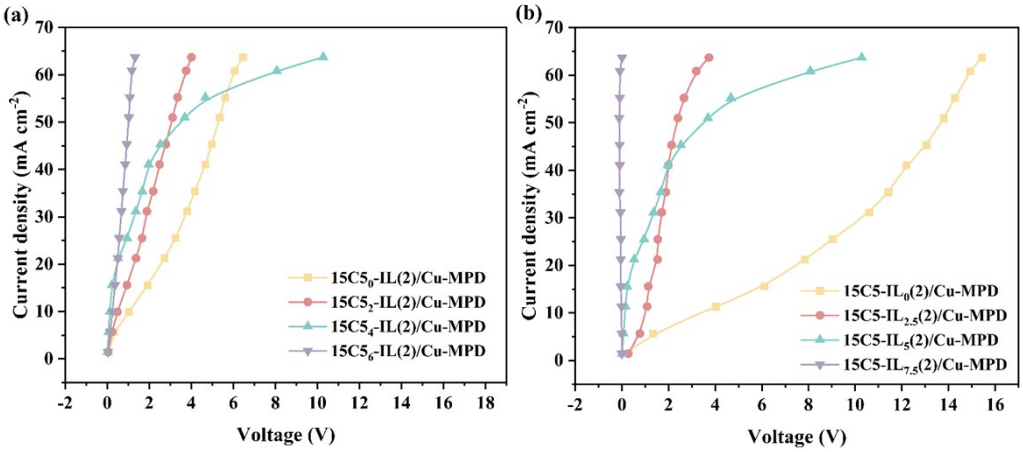

Fig. S5 (a) current density-voltage curves of composite membranes with different 15C5 concentrations (IL concentration of 5 g L^{-1}), (b) current density-voltage curves of composite membranes with different IL concentrations (15C5 concentration of 4 g L^{-1}).

Table S2 LSR of different membranes.

Membrane	LSR(%)	Membrane	LSR(%)
PVDF	21.05	15C5$_4$-IL$_0$(2)/Cu-MPD	2.17
Cu-MPD	7.14	15C5$_4$-IL$_{2.5}$(2)/Cu-MPD	5.88
PEI/TMC(2)	3.70	15C5$_4$-IL$_{7.5}$(2)/Cu-MPD	6.67
15C5-IL(2)	3.52	15C5$_4$-IL$_5$(1)/Cu-MPD	3.70
15C5$_0$-IL$_5$(2)/Cu-MPD	3.73	15C5$_4$-IL$_5$(2)/Cu-MPD	3.03
15C5$_2$-IL$_5$(2)/Cu-MPD	3.84	15C5$_4$-IL$_5$(3)/Cu-MPD	4.25
15C5$_6$-IL$_5$(2)/Cu-MPD	3.12	15C5$_4$-IL$_5$(4)/Cu-MPD	3.72

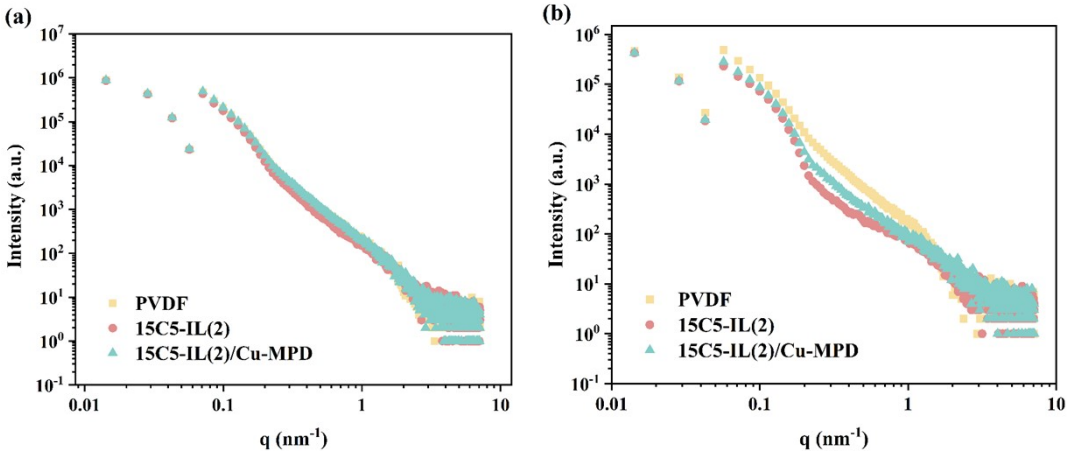

Fig. S6 (a) SAXS of PVDF substrate, 15C5-IL(2), 15C5-IL(2)/Cu-MPD dry film; (b) SAXS of PVDF substrate, PEI-TMC, 15C5-IL(2), 15C5-IL(2)/Cu-MPD wet film;

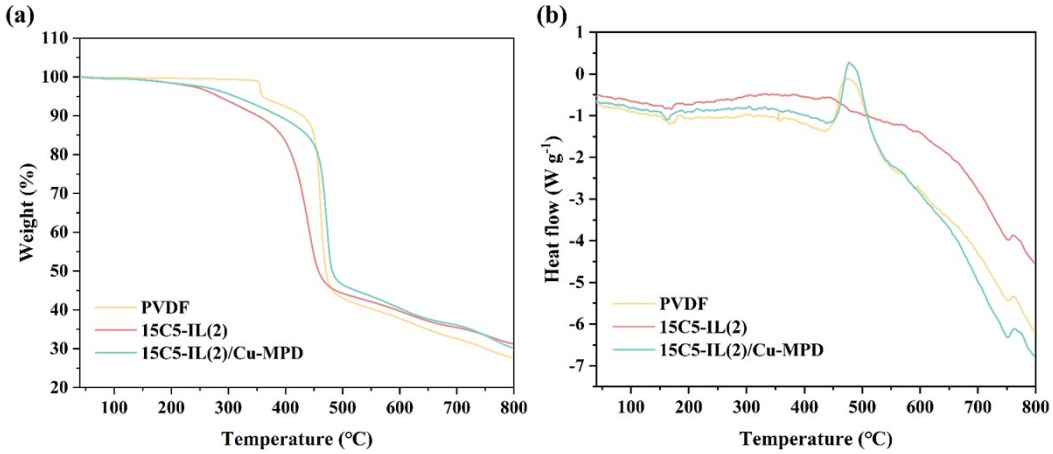

Fig. S7 (a) TGA and (b) DSC curves of PVDF, 15C5-IL(2), and 15C5-IL(2)/Cu-MPD.