

Supplementary Information

Effect of ammonium groups on the properties of anion conductive membranes based on partially fluorinated aromatic polymers

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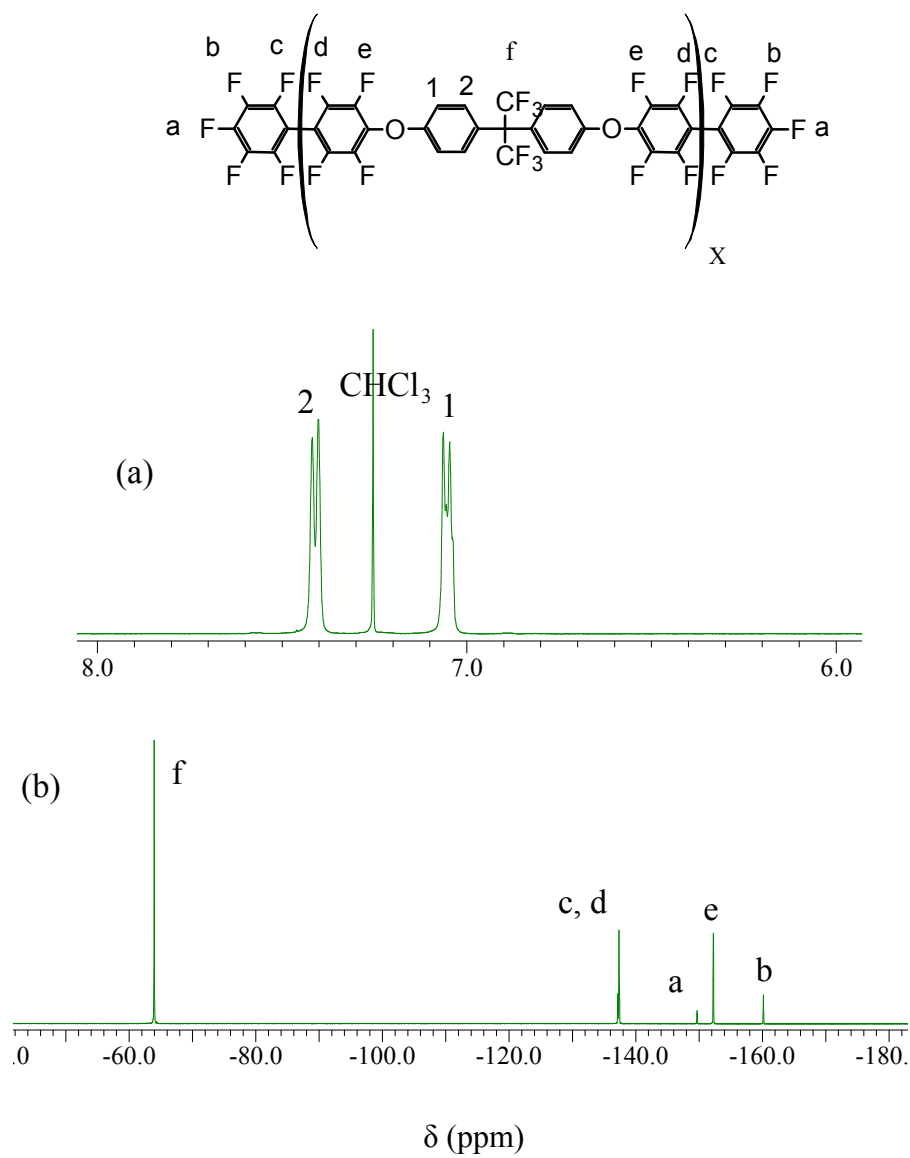


Fig. S1 (a) ^1H and (b) ^{19}F NMR spectra of oligomer 1 in CDCl_3 at room temperature.

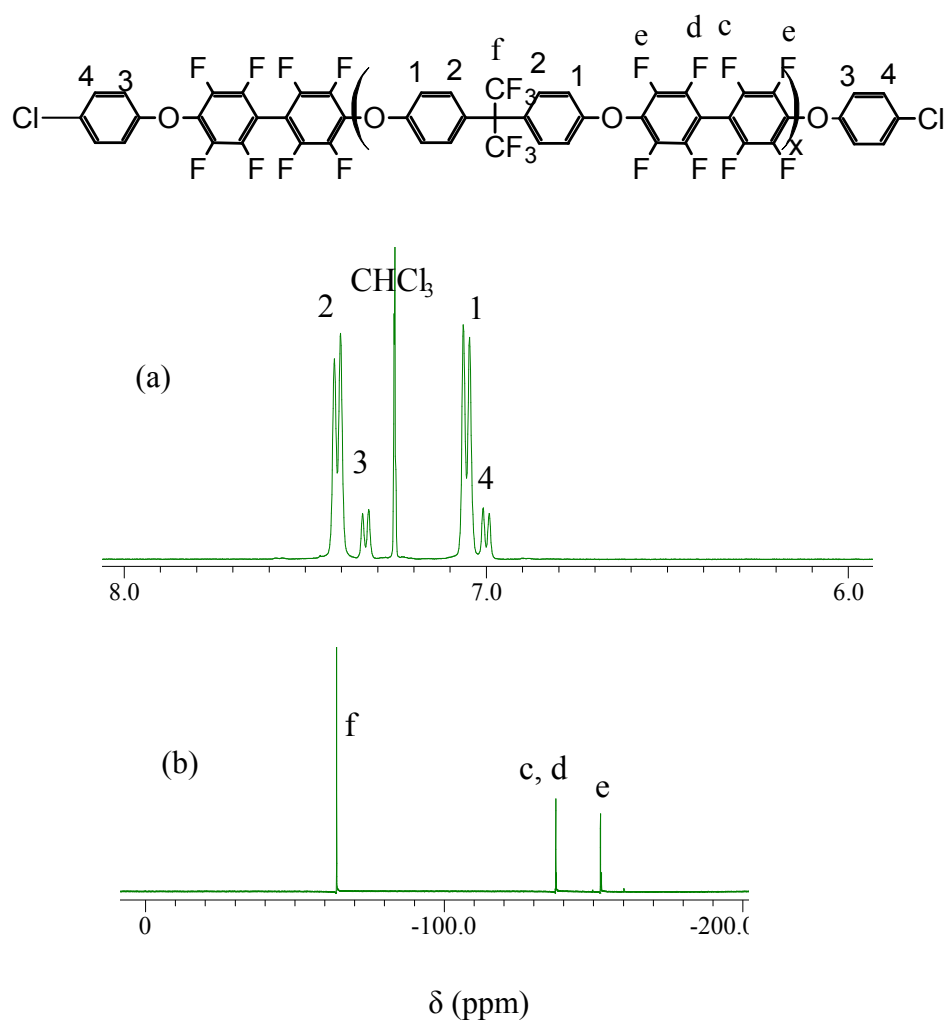


Fig. S2 (a) ^1H and (b) ^{19}F NMR spectra of oligomer 2 in CDCl_3 at room temperature.

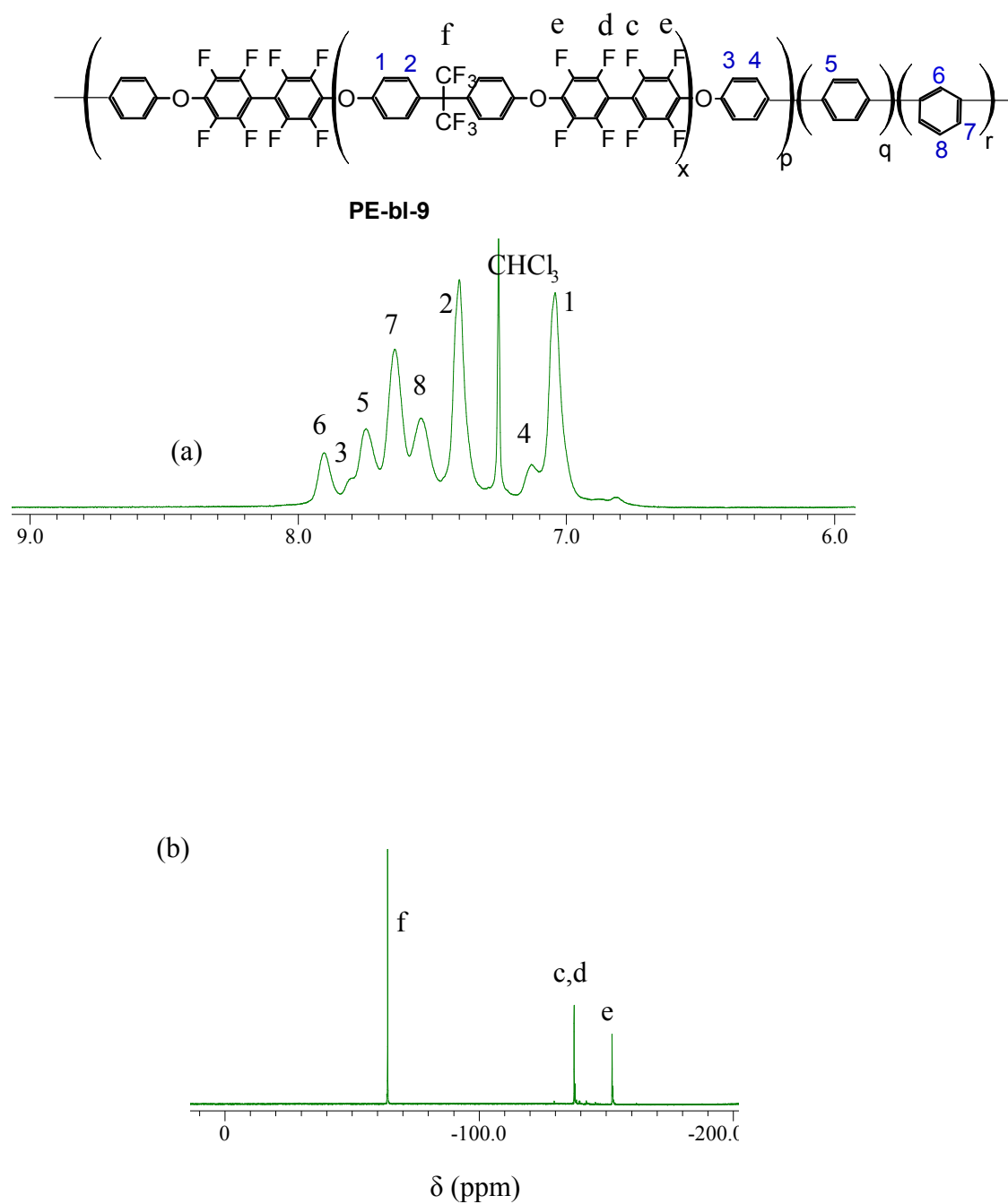


Fig. S3 (a) ¹H and (b) ¹⁹F NMR spectra of PE-bl-9 in CDCl₃ at room temperature.

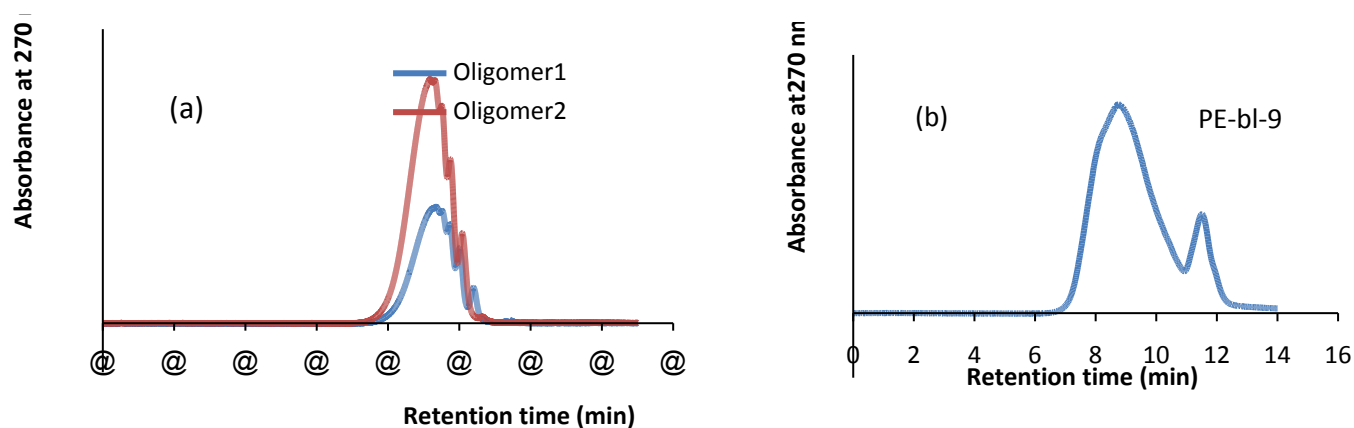


Fig. S4 GPC profiles of (a) oligomers 1, 2, and (b) PE-bl-9.

Table S1 Properties of PE-bl-9 and CMPE-bl-9.

polymer	X ^a	X ^b	X ^c	PE-bl-9		CMPE-bl-9		
				p : q : r ^a	p : q : r ^b	Mn ^c (kDa)	Mw ^c (kDa)	DC ^d
A	5	5.6	6.8	1.0 : 2.0 : 8.0	1.0 : 1.8 : 8.6	37	224	0.78
B	5	5.6	6.8	1.0 : 2.0 : 8.0	1.0 : 2.7 : 11.9	34	207	0.87
C	3	3.2	4.5	1.0 : 2.0 : 8.0	1.0 : 2.0 : 12.5	41	330	0.46
D	4	4.2	5.3	1.0 : 2.0 : 8.0	1.0 : 2.4 : 12.2	7	234	0.23
E	4	4.2	5.3	1.0 : 2.0 : 8.0	1.0 : 2.4 : 13.4	50	514	0.38

^a Calculated from the feed ratio. ^b Determined by ¹H NMR spectra. ^c Determined by GPC analyses calibrated with polystyrene standards. ^d Degree of chloromethylation = (number of chloromethyl groups per phenylene ring in the oligophenylene moieties).

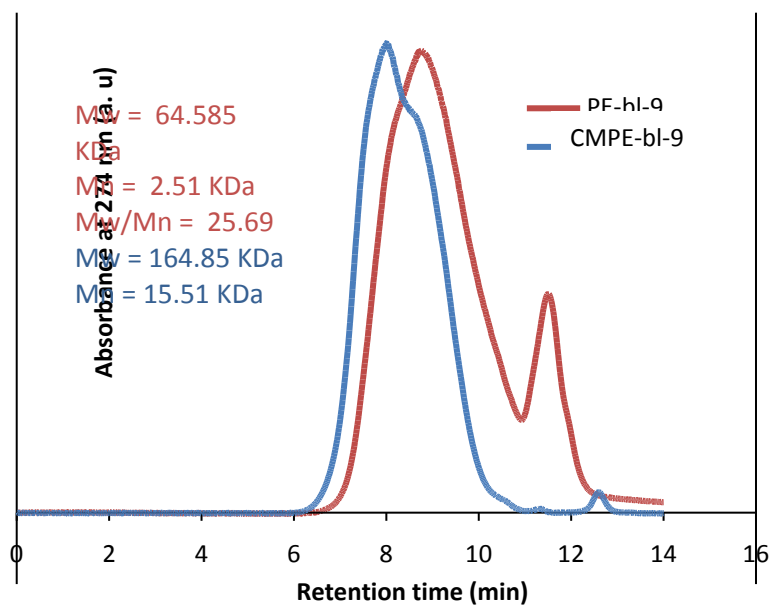


Fig. S5 GPC profiles of PE-bl-9 and CMPE-bl-9.

Table S2 Degree of quaternization (DQ) of QPE-bl-9-TBA, -DCHMA, and -DMHA under different conditions

CMPE-bl-9	quaternization conditions		QPE-bl-9-TBA		QPE-bl-9-DCHMA		QPE-bl-9-DMHA	
	solvent	temperature (°C)	IEC ^c (mequiv g ⁻¹)	DQ	IEC ^c (mequiv g ⁻¹)	DQ	IEC ^c (mequiv g ⁻¹)	DQ
A	Ethanol	60	0.08	0.06	0.06	0.05	0.80	0.60
B	Ethanol	60	0.14	0.12	0.2	0.16	0.70	0.54
C	Ethanol	60	0.13	0.07	0.09	0.05	0.57	0.29
D	Ethanol	60	0.24	0.15	0.08	0.05	0.55	0.31
D	N/S ^a	40	0.24	0.14	0.08	NA ^b	1.02	0.52

^aNo solvent was used. ^bSelf-standing membrane was not obtained. ^cDetermined by Mohr titration method.

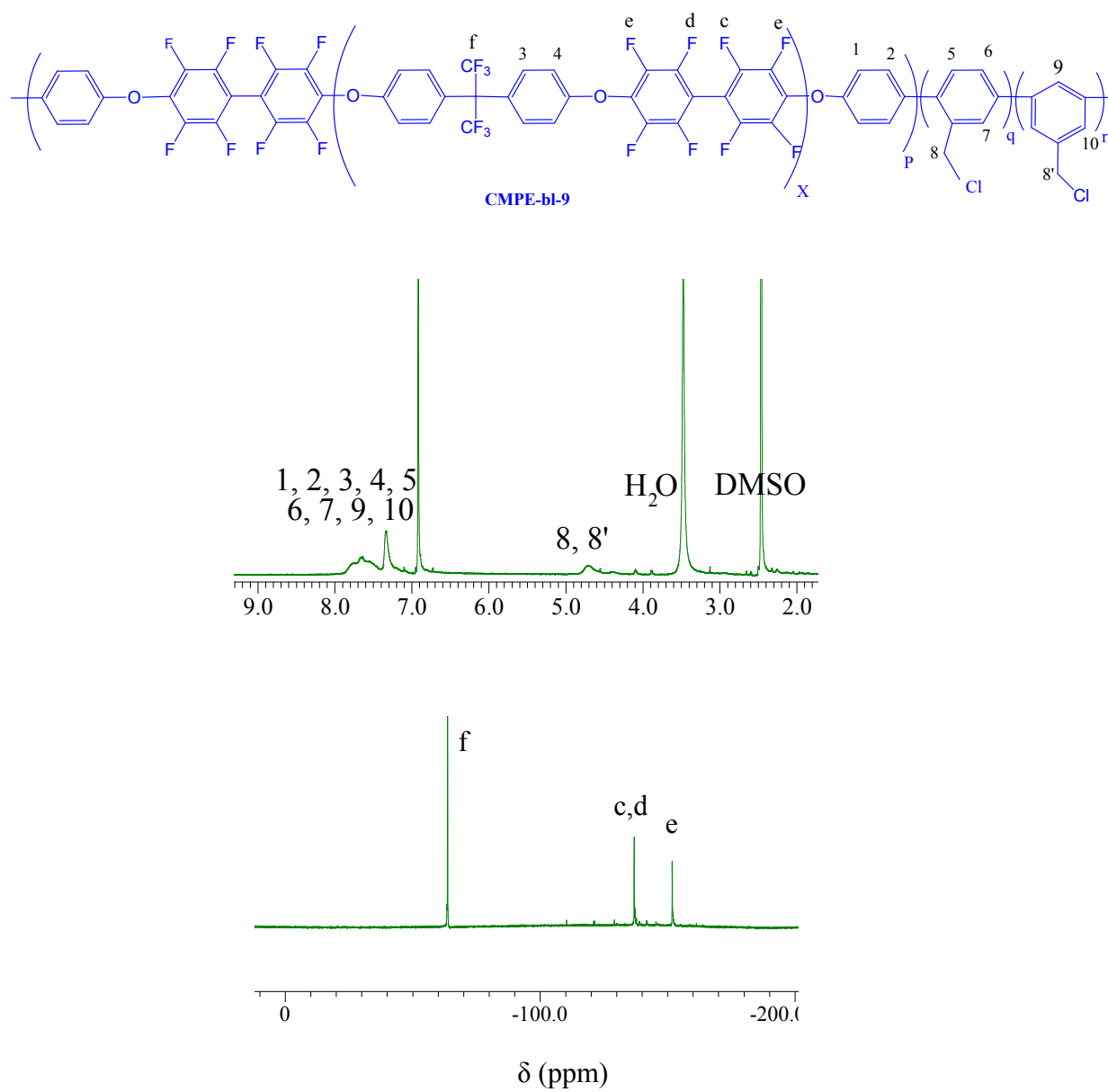


Fig. S6 (a) ^1H and (b) ^{19}F NMR spectra of CMPE-bl-9 in $\text{DMSO}-d_6$ at room temperature.

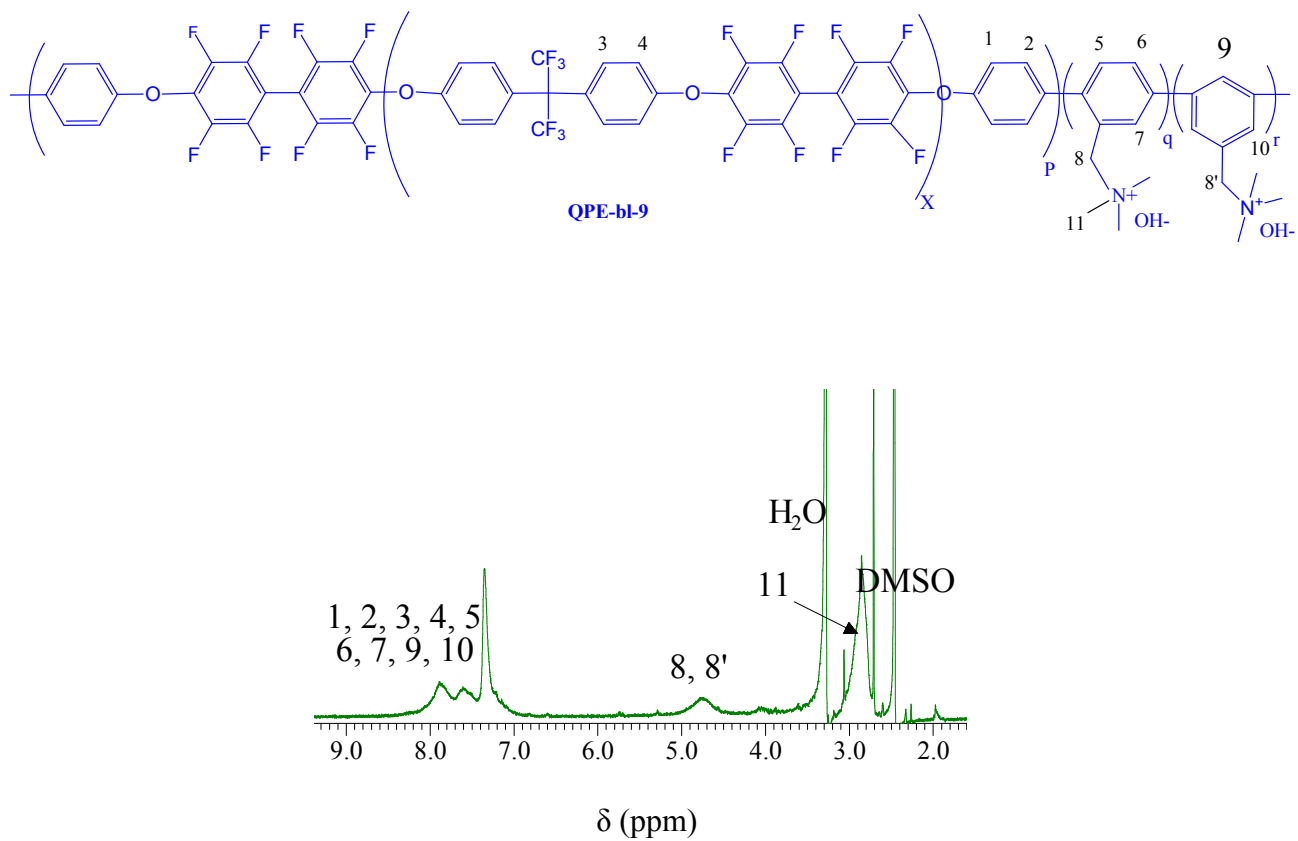


Fig. S7 ^1H NMR spectrum of QPE-bl-9-TMA in $\text{DMSO}-d_6$ at room temperature.

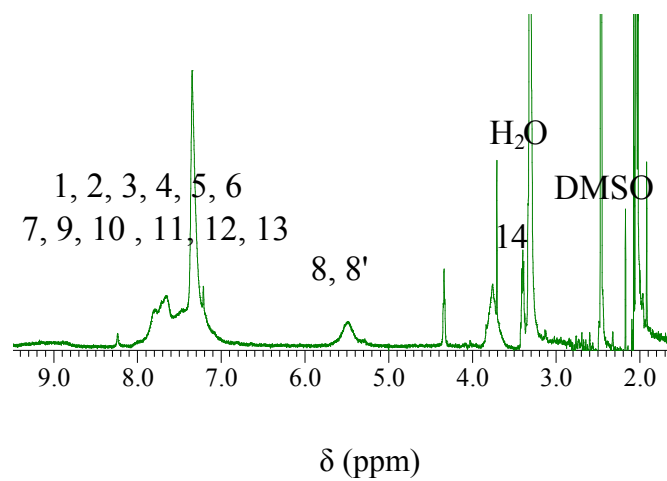
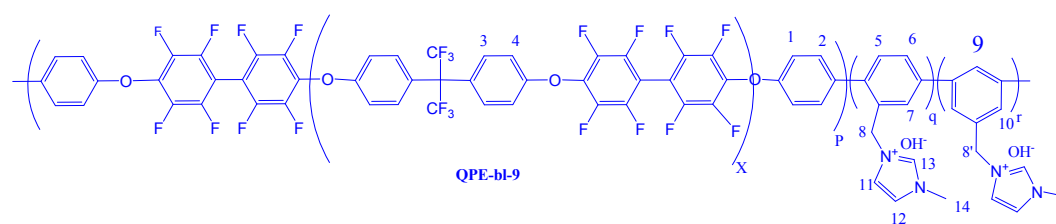


Fig. S8 ^1H NMR spectrum of QPE-bl-9-MIm in $\text{DMSO-}d_6$ at room temperature.

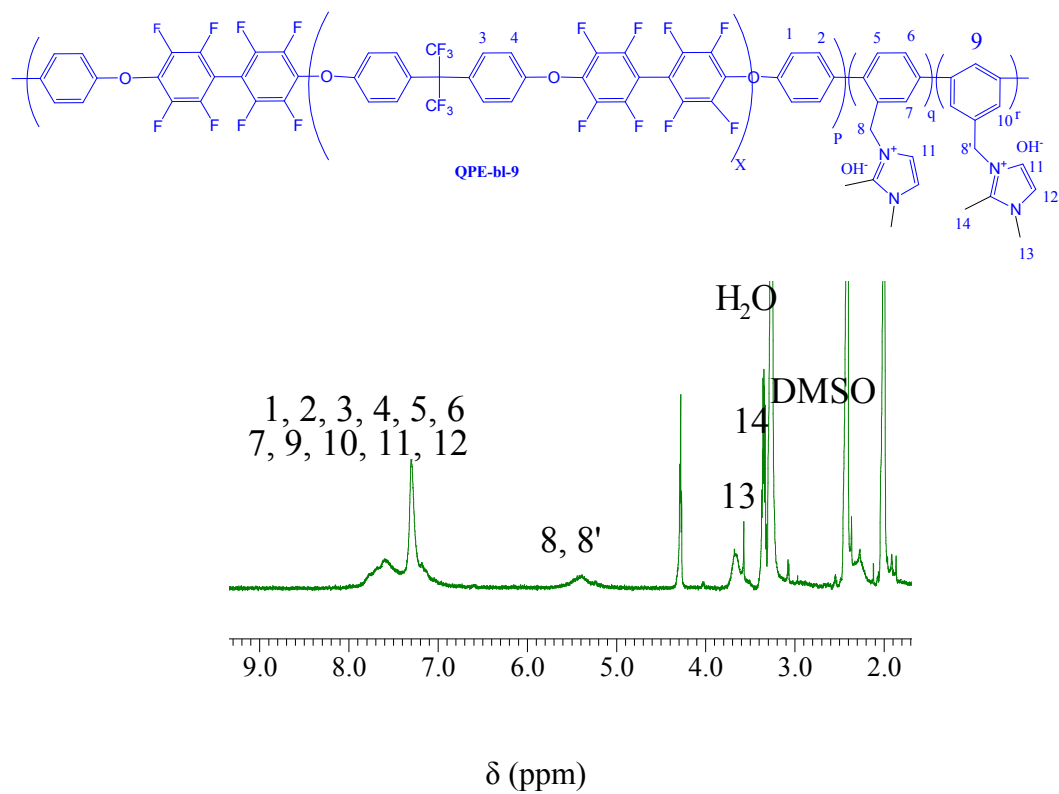


Fig. S9 ^1H NMR spectrum of QPE-bl-9-DMIm in $\text{DMSO}-d_6$ at room temperature.

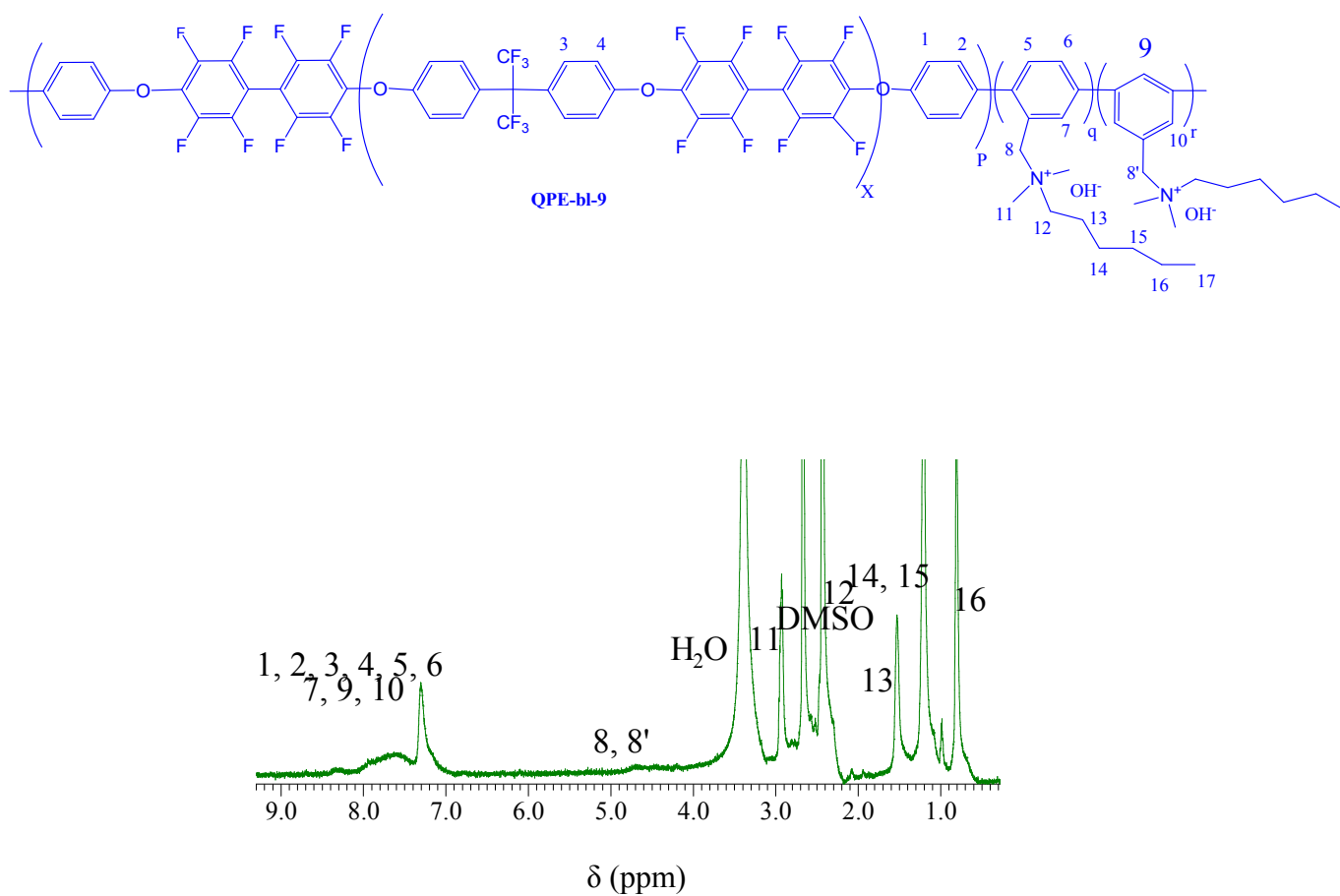


Fig. S10 ^1H NMR spectrum of QPE-bl-9-DMHA in $\text{DMSO-}d_6$ at room temperature.