Supporting Information

Ion Channels in Sulfonated Copolymer-Grafted Nanoparticles in Ionic Liquid

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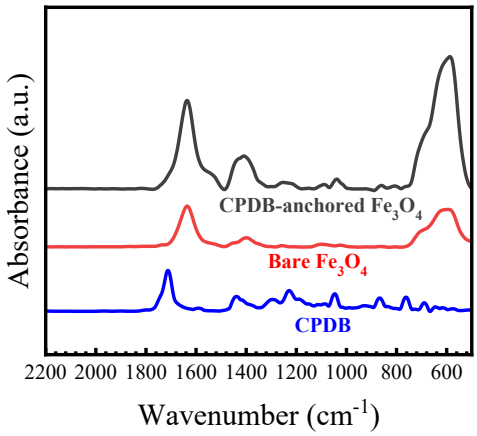

Figure S1| FTIR spectra of bare Fe_3O_4, CPDB-anchored Fe_3O_4 and CPDB.

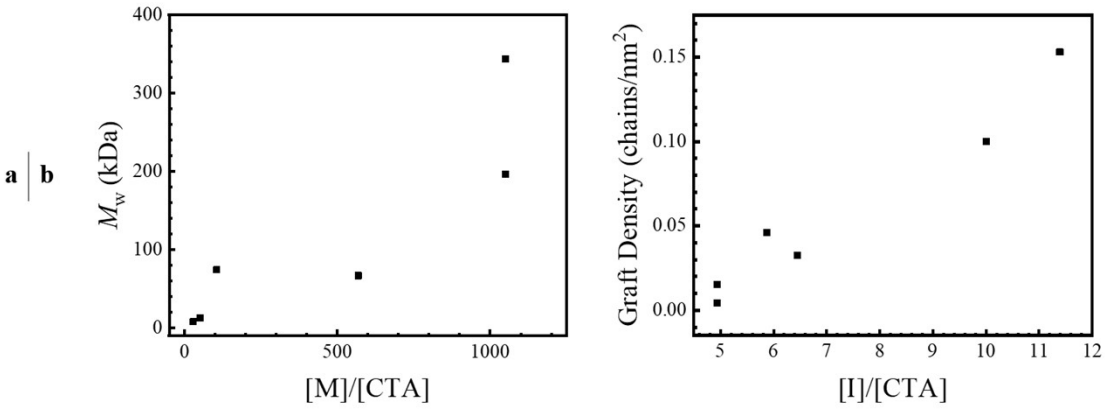

Figure S2 | **(a)** Weight-averaged molecular weight of PMMA dependence on monomer and CTA molar ratio. **(b)** Graft density changes with initiator and CTA molar ratio.

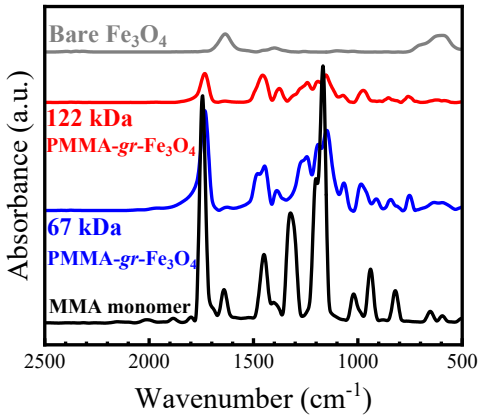

Figure S3 | FTIR spectra of PMMA-***gr***-Fe_3O_4, bare Fe_3O_4 and MMA monomer.

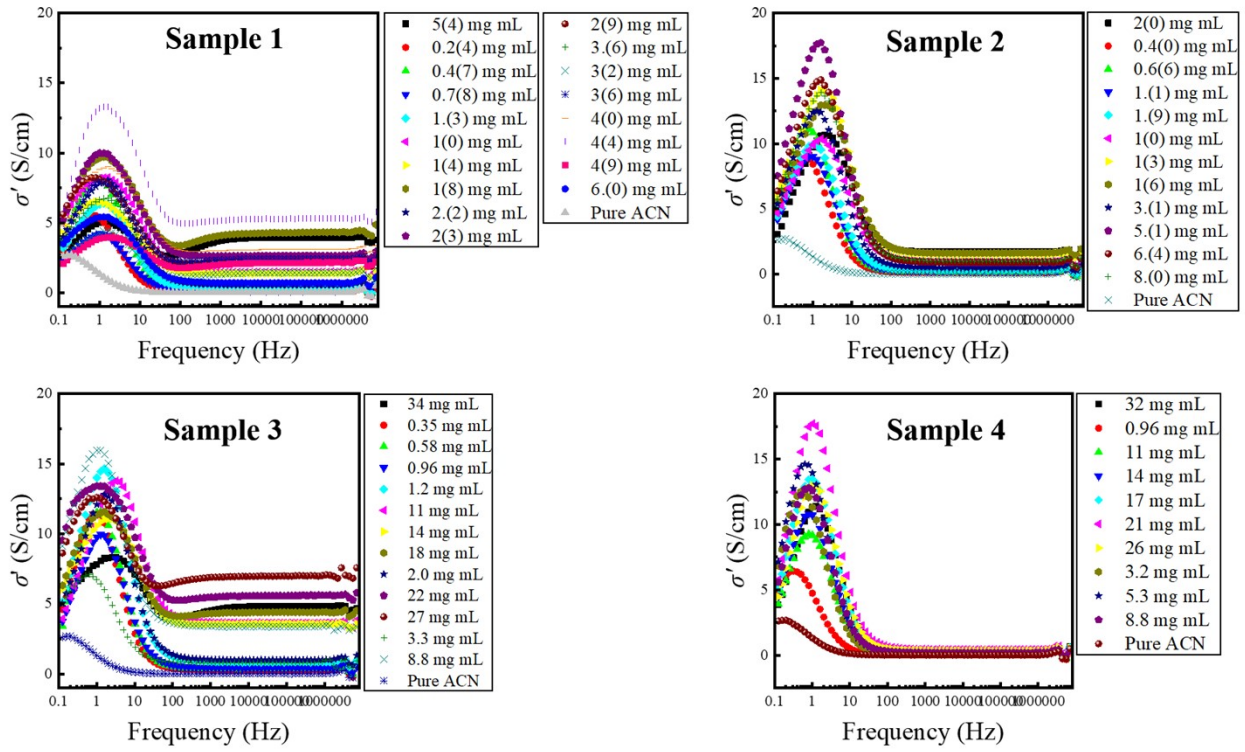

Figure S4 | Frequency dependence of bulk conductivity of grafted nanoparticles in acetonitrile for different concentrations.

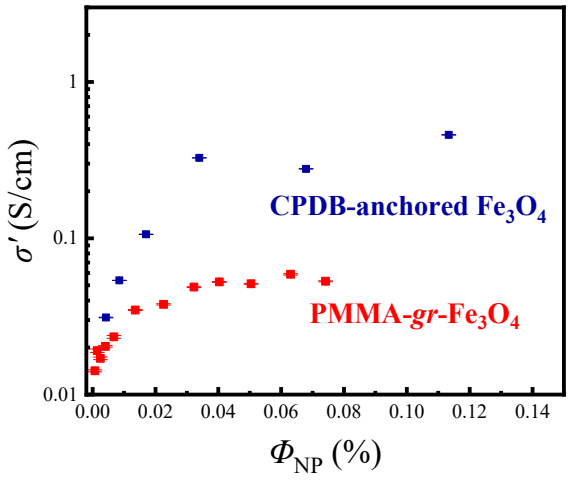

Figure S5 | Ionic conductivity of acetonitrile with PMMA-*gr*-Fe_3O_4 and CPDB-anchored Fe_3O_4 at different particle loadings ϕ_{NP}.

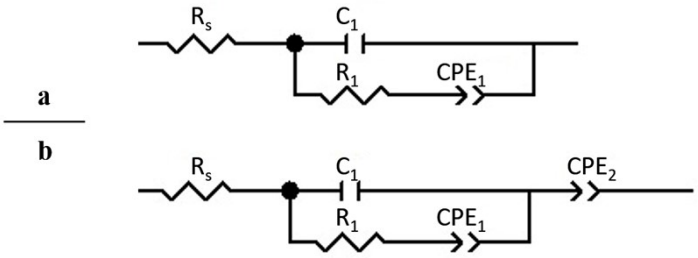

Figure S6 | Two equivalent circuit models are selected to fit the Nyquist plots of copolymer-grafted NP in acetonitrile. Model **a** is suitable for samples with $\sigma' < \sim 1\ S/cm$, and model **b** is suitable for σ' > 1 S/cm.

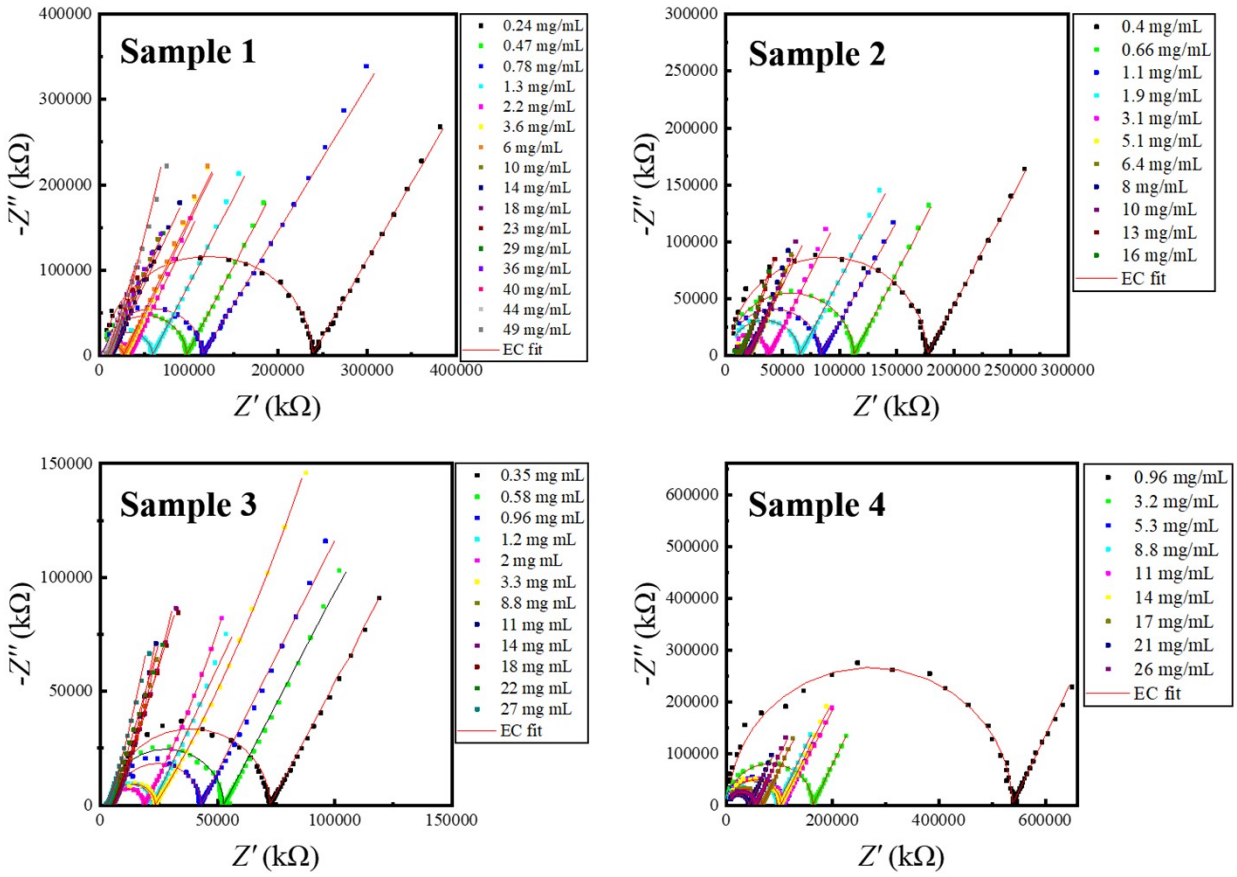

Figure S7 | Nyquist plots of grafted nanoparticles in acetonitrile with the EC model fittings.

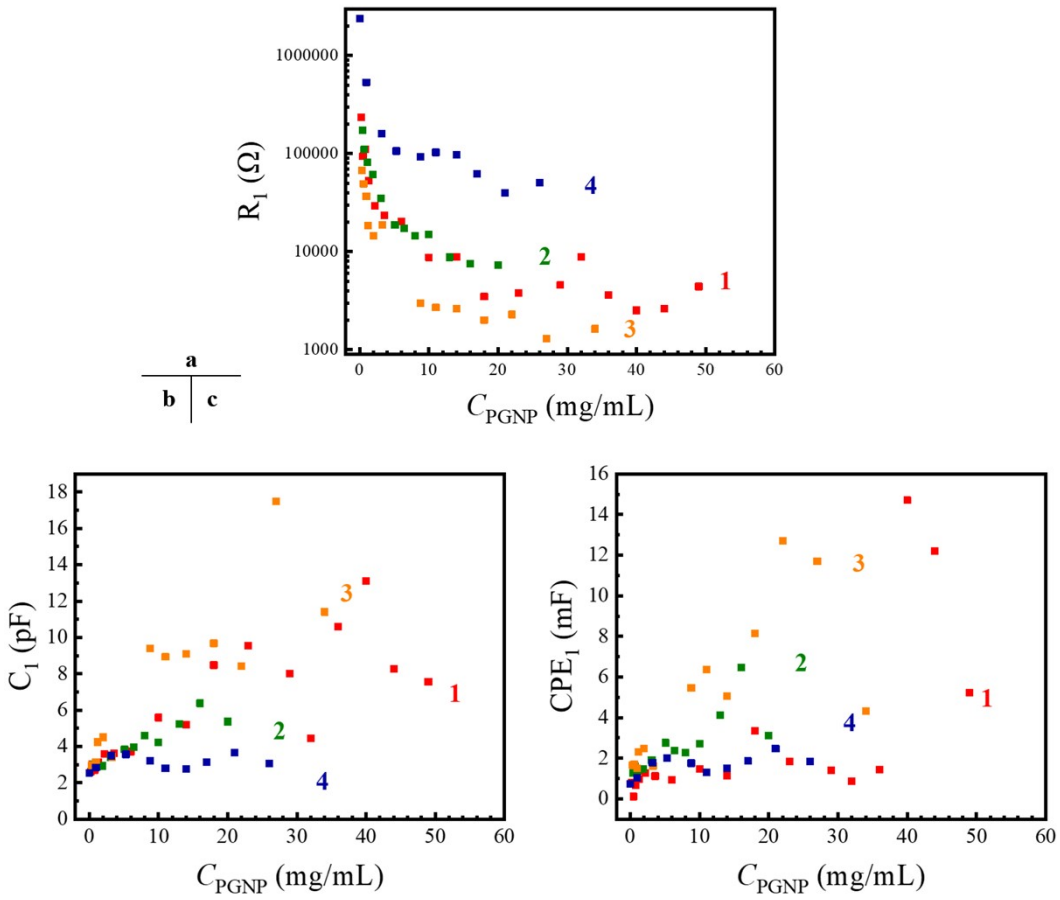

Figure S8 | The values of circuit elements **(a)** R_1, **(b)** C_1, and **(c)** CPE_1 versus the mass concentration of polymer-grafted nanoparticles (C_{PGNP}).

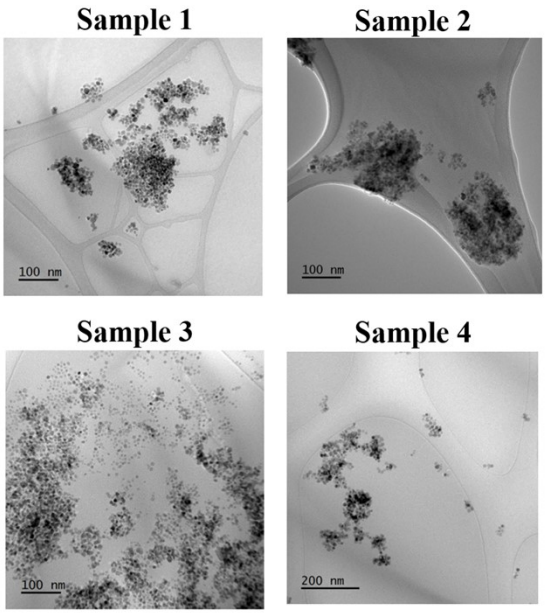

Figure S9 | TEM images of PSSTOA-***b***-PMMA-grafted nanoparticles in HMIm-TFSI.

Table S1 | The area integrated for PSSTOA and PMMA peaks of ^{1}H NMR spectra of copolymer-grafted NPs (Samples 1-4) and the calculated SS%.

Sample	A_{PSSTOA}	A_{PMMA}	**SS%**
1	487.95	11358.81	6.0
2	122.86	1772.21	9.4
3	208.60	2578.70	10.8
4	316.00	9274.28	4.9

Table S2 | Initiator, CTA, SSTOA amounts used in synthesis of PMMA-*b*-PSS-grafted NPs.

Sample	Initiator amount (μmol)	Calculated CTA amount (μmol)	SSTOA amount (mmol)	$\bar{D}P_{w,\,PSSTOA}$
1	17.47	63.41	17.50	43
2	16.17	38.26	5.41	70
3	7.18	26.03	7.30	81
4	7.17	10.00	6.66	62

Table S3 | The parameters of the power-law fitting to the conductivity data.

Sample	$\phi_c\,(vol\,\%)$	t	R^2
1	0.001	0.611	0.780
2	0.001	0.641	0.956
3	0.001	0.573	0.889
4	0.001	0.542	0.670

Table S4 | Values of EC components of Sample **1**.

C_{PGNP} (mg /mL)	χ^2	R_s (Ω)	C_1 (pF)	R_1 (Ω)	CPE_1-T (mF)	CPE_1-P	CPE_2-T (mF)	CPE_2-P
0	0.017947	5883	2.55	2.39E+06	72.7	0.66394		
0.24	0.0037513	5516	2.61	2.33E+05	80.0	0.67915		
0.47	0.0026422	3277	3.03	93966	11.6	0.70218		
0.78	0.0025518	5457	2.71	1.10E+05	65.6	0.66298		
1.3	0.002636	5870	3.15	53228	97.7	0.70909		
2.2	0.0021688	4701	3.58	29398	128	0.72406		
3.6	0.0013154	5688	3.62	23341	112	0.72598		
6	0.0013296	6421	3.72	20386	93.3	0.72549		

10	0.0010332	3940	5.59	8735	148	0.748		
14	0.0011003	4585	5.20	8857	114	0.73502		
18	0.00050303	786.8	8.48	3471	334	0.66779	311	1.032
23	0.00086537	3249	9.54	3779	184	0.74971		
29	0.00092738	3871	8.01	4554	141	0.73715		
32	0.0024702	4180	4.46	8816	86.9	0.69504		
36	0.0011353	4155	10.6	3610	143	0.73365		
40	0.00032584	3402	13.1	2517	1470	0.53002	175	0.86382
44	0.000204	856.9	8.28	2613	1220	0.60747	293	0.87923
49	0.00058418	4132	7.56	4398	522	0.55132	8.28	0.9243

Table S5 | Values of EC components of Sample **2**.

C_{PGNP} **(mg/ mL)**	χ^2	R_s **(Ω)**	C_1 **(pF)**	R_1 **(Ω)**	CPE_1**-T (mF)**	CPE_1**-P**	CPE_2**-T (mF)**	CPE_2**-P**
0	0.017947	5883	2.55	2.39E+06	72.7	0.66394		
0.4	0.0032679	3511	2.92	1.73E+05	129	0.68859		
0.66	0.0015355	2677	3.02	1.10E+05	160	0.69464		
1.1	0.0016277	2010	2.89	81334	137	0.66933		
1.9	0.0017106	3590	2.93	61337	147	0.69126		
3.1	0.0013115	2963	3.40	34785	191	0.70235		
5.1	0.0011114	2205	3.84	18746	276	0.71753		
6.4	0.001178	3284	3.95	17282	238	0.71543		
8	0.001432	3877	4.60	14586	228	0.72083		
10	0.00030381	4306	4.22	14977	270	0.64103	294	1.069
13	0.00018887	3500	5.23	8760	411	0.65043	372	1.05
16	0.00015083	3958	6.38	7511	647	0.59391	265	0.95154
20	0.00029378	3403	5.37	7320	311	0.64216	257	1.173

Table S6 | Values of EC components of Sample **3**.

C_{PGNP}(mg/mL)	χ^2	R_s (Ω)	C_1 (pF)	R_1 (Ω)	CPE_1-T (mF)	CPE_1-P	CPE_2-T (mF)	CPE_2-P
0	0.017947	5883	2.55	2.39E+06	72.7	0.66394		
0.35	0.0054907	5085	2.97	67173	166	0.69532		
0.58	0.0017064	3360	2.94	49180	171	0.70156		
0.96	0.0058244	6145	3.15	36697	150	0.70924		
1.2	0.002974	3842	4.24	18330	230	0.72547		
2	0.00040854	4229	4.51	14410	249	0.69042	441	1.319
3.3	0.00080955	4564	3.42	18726	162	0.64935	215	1.215
8.8	0.00018016	2492	9.39	2969	546	0.68085	416	1.091
11	0.00037406	2351	8.93	2690	636	0.65377	315	1.047
14	0.00028806	2558	9.09	2601	507	0.65998	293	0.99973
18	0.00046589	2172	9.68	2002	813	0.62068	270	0.90542
22	0.00032119	995.7	8.42	2284	1270	0.6061	294	0.89696
27	0.00036018	1331	17.5	1297	1170	0.62124	295	0.95247
34	0.00056341	2151	11.4	1629	432	0.64165	93.1	1.328

Table S7 | Values of EC components of Sample **4**.

C_{PGNP}(mg/mL)	χ^2	R_s (Ω)	C_1 (pF)	R_1 (Ω)	CPE_1-T (mF)	CPE_1-P
0	0.017947	5883	2.55	2.39E+06	72.7	0.66394
0.96	0.01624	5383	2.85	5.32E+05	104	0.72209
3.2	0.008573	2554	3.49	1.60E+05	178	0.72056
5.3	0.006084	3211	3.57	1.06E+05	202	0.72383
8.8	0.004707	3273	3.21	92851	176	0.7197
11	0.00712	4839	2.80	1.03E+05	130	0.70236

14	0.010628	6028	2.76	96854	151	0.71317
17	0.009092	5192	3.13	62493	186	0.72159
21	0.002509	3341	3.65	39740	247	0.7207
26	0.004676	4742	3.05	50418	184	0.72065