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Supporting Information

High performance composite polymer electrolyte using polymeric ionic liquid-functionalized graphene molecular brushes

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Solvent	Dispersibility of modified graphene							
	PEG-N_3	PEGB-FG	PIL- (Br)	PILB(Br)-FG	PIL-TFSI	PILB-FG	PVI	PIL-FG
H_2O	○	○	○	○	×	×	○	×
CH_3OH	○	○	○	○	○	○	○	○
Acetone	○	○	○	△	○	△	○	○
THF	○	○	○	○	○	○	○	○
DMSO	○	○	△	△	○	○	△	○
DMF	○	○	○	○	○	○	○	○
$CHCl_3$	○	○	○	○	○	○	○	○
Toluene	○	△	○	△	×	×	○	○
EA	○	○	○	△	△	×	○	○
EG	○	○	○	○	×	○	○	△

○ : Well dispersion
△ : Partial dispersion
× : Poor dispersion

Figure S1. Dispersibility of polymer-FGs in tested solvents.

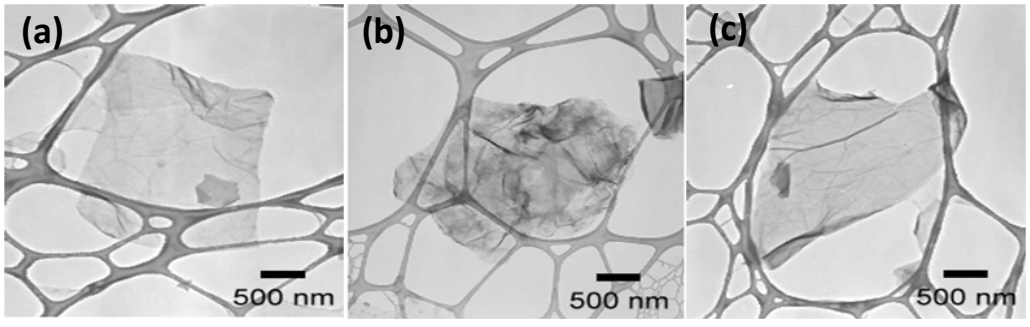

Figure S2. TEM images of (a) PIL(TFSI)-FG, (b) PEG-FG_{brush} and (c) PIL(TFSI)-FG_{brush}.

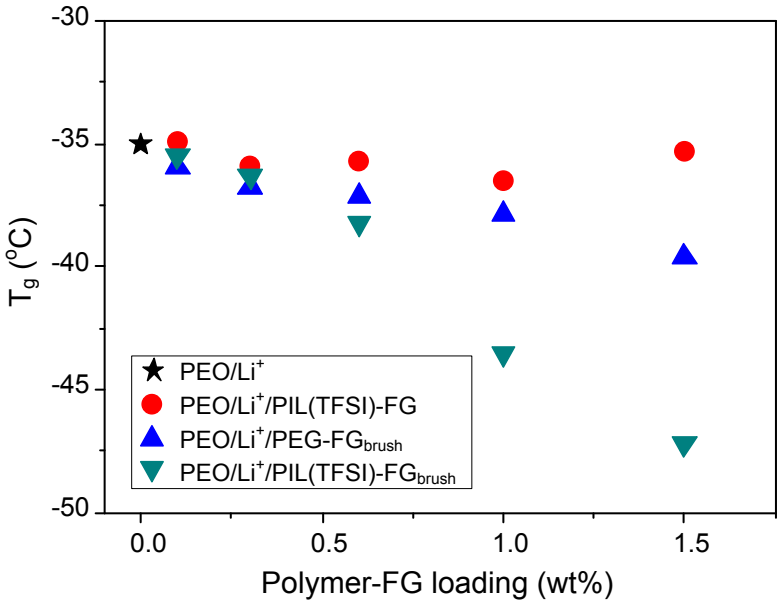

Figure S3. Thermal properties of PEO/Li^+ and PEO/LI^+/polymer-FG CPEs.

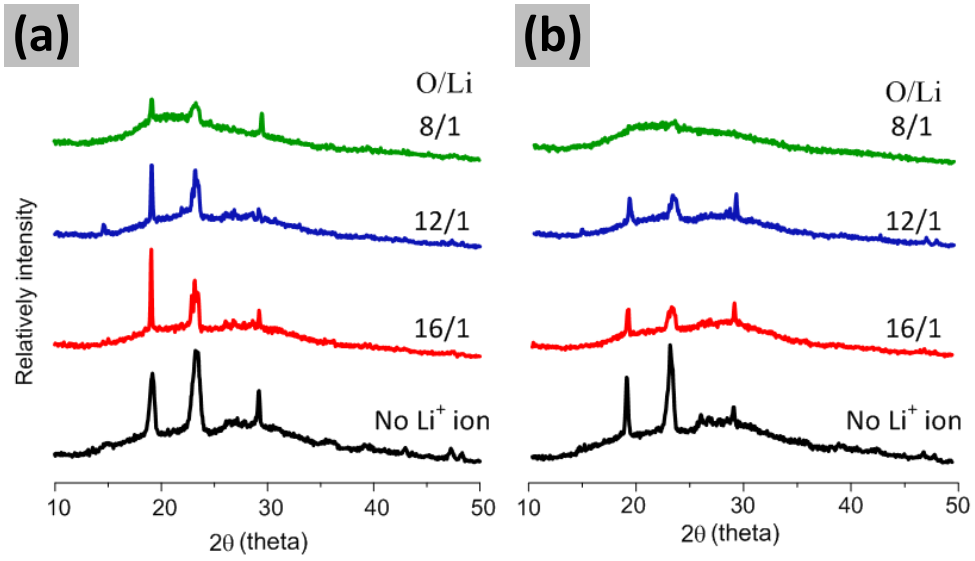

Figure S4. XRD pattern of (a) PEO/Li^+ and (b) PEO/Li^+/PIL(TFSI)-FG_{brush}.

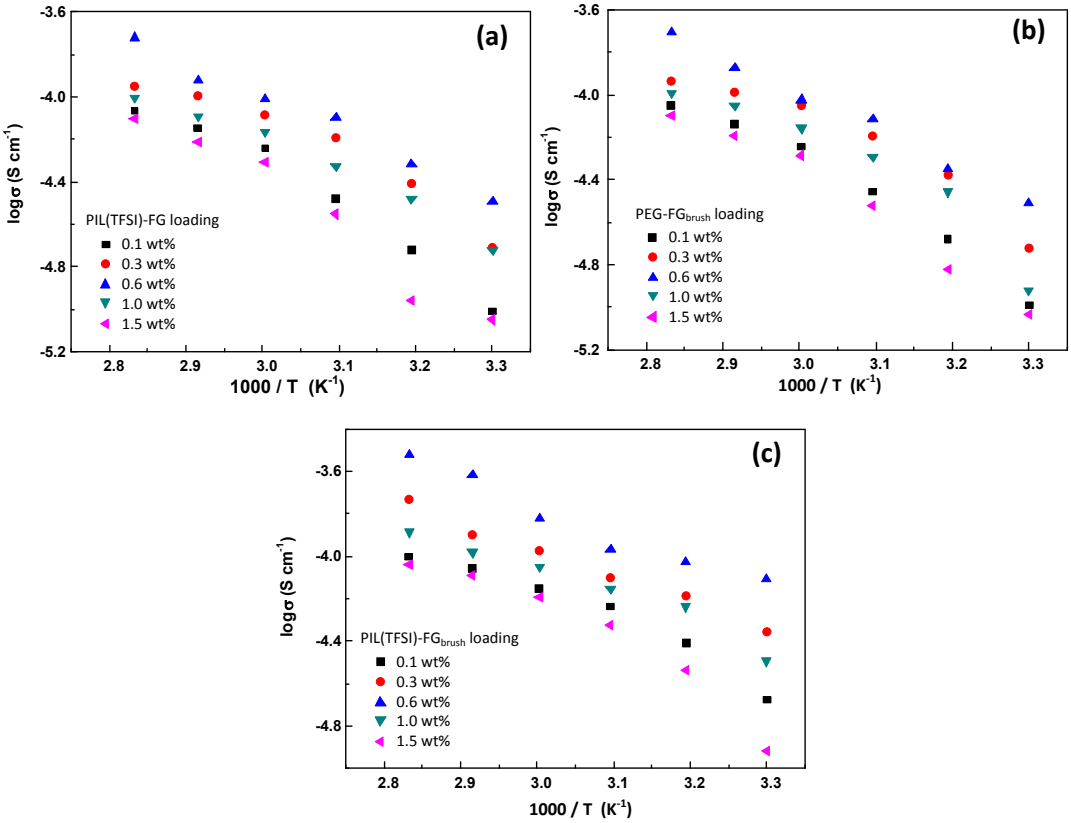

Figure S5. The ionic conductivity of PEO/Li^+ PEs with various polymer-FG contents at 30-80 °C.

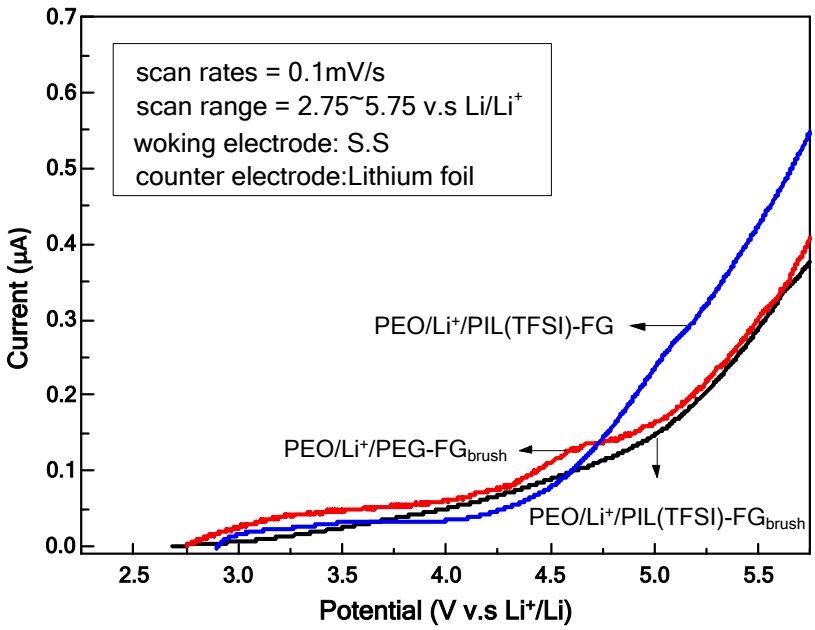

Figure S6. Linear sweep valtammograms of PEO/Li^+/polymer-FG at 60 °C at a scan rate of 0.1 mV s^{-1}.

Calculation of Grafting Density

$$\overline{A}_{pg1} = {M_C W_P}/{M_P W_C} \text{ (chains per carbon)} \qquad \text{eq S1}$$

The grafting density can also be expressed in the following relationship:

$$\overline{A}_{pg2} = {M_C W_P \times 10^8}/{M_P A_b W_C} \text{ (average chain density on a both sides)} \qquad \text{eq S2}$$

Where: M_C is the relative molar mass of carbon (M_C = 12 g mol^{-1}), M_P the average molecular weight (M_n) of grafted polymer (calculated from GPC), and W_C and W_F the weight fractions of the polymer-graphene backbone (not including propargyl phenyl groups and grafted polymer) and the grafted polymer, respectively. A_b represents the area of a benzene ring in graphene (5.24 Å^2). W_C and W_P can be readily obtained from the TGA curves of polymer functionalized graphene composite because the polymer functionalized graphene has a weigh loss stage below 600 °C, and the decomposed weight fraction above 800 °C is assigned to W_P and propargyl phenyl groups.