Supplementary Information

Wide Electrochemical Window Ionic Salt for use in Electropositive Metal Electrodeposition and Solid State Li-ion Batteries

*Sankaran Murugesan[a], Oliver A. Quintero[a], Brendan P. Chou[a], Penghao Xiao[a], Kyusung Park[b], Justin W. Hall[a], Richard A. Jones[a], Graeme Henkelman[a], John B. Goodenough[b] and Keith J. Stevenson[a]**

[a]Department of Chemistry and Biochemistry, The University of Texas at Austin, 1 University Station, Austin, Texas, 78712, USA

[b]Texas Materials Institute and Materials Science and Engineering Program, The University of Texas at Austin, Austin, Texas 78712, United States

[*] Corresponding author: Keith J. Stevenson (stevenson@mail.cm.utexas.edu) (T) +1-512- 232-9160; (F) +1-512-471-8696

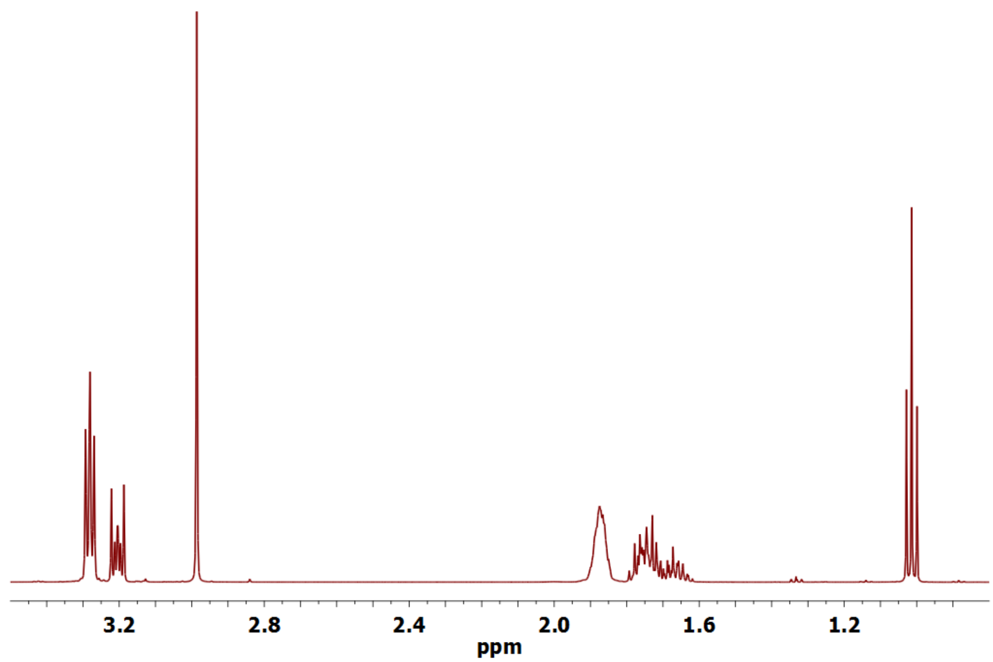

Figure S1a. ^{1}H NMR spectrum of $PP_{13}PF_6$ in CD_2Cl_2.

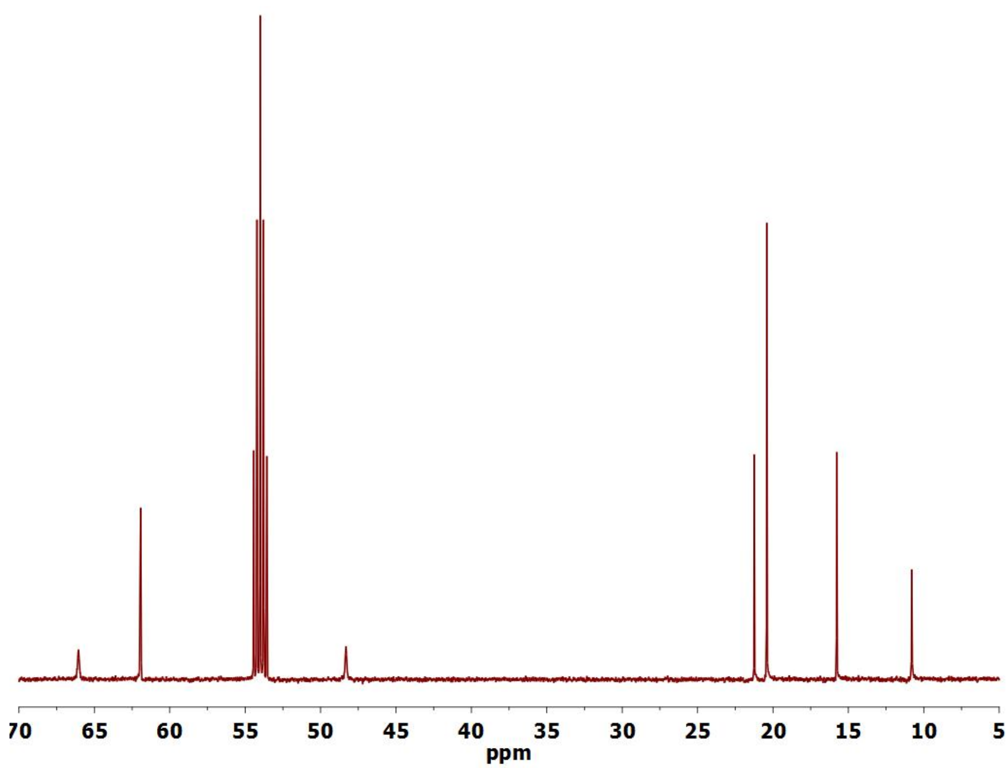

Figure S1b. ^{13}C NMR spectrum of $PP_{13}PF_6$ in CD_2Cl_2.

Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

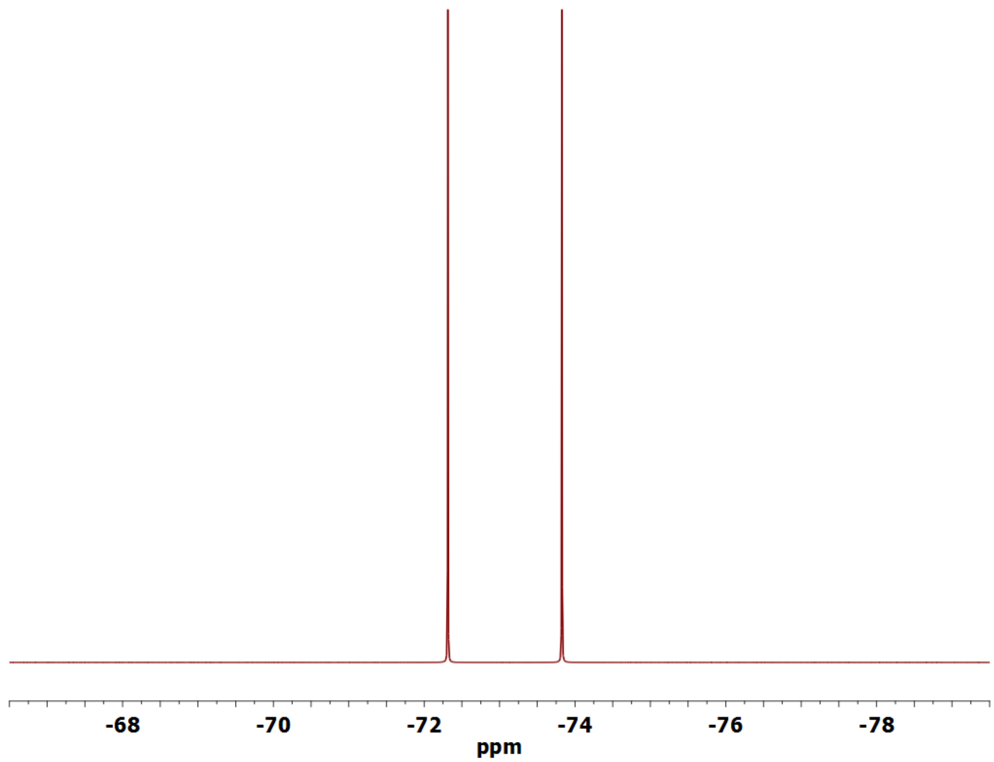

Figure S1c. ^{19}F NMR spectrum of $PP_{13}PF_6$ in CD_2Cl_2.

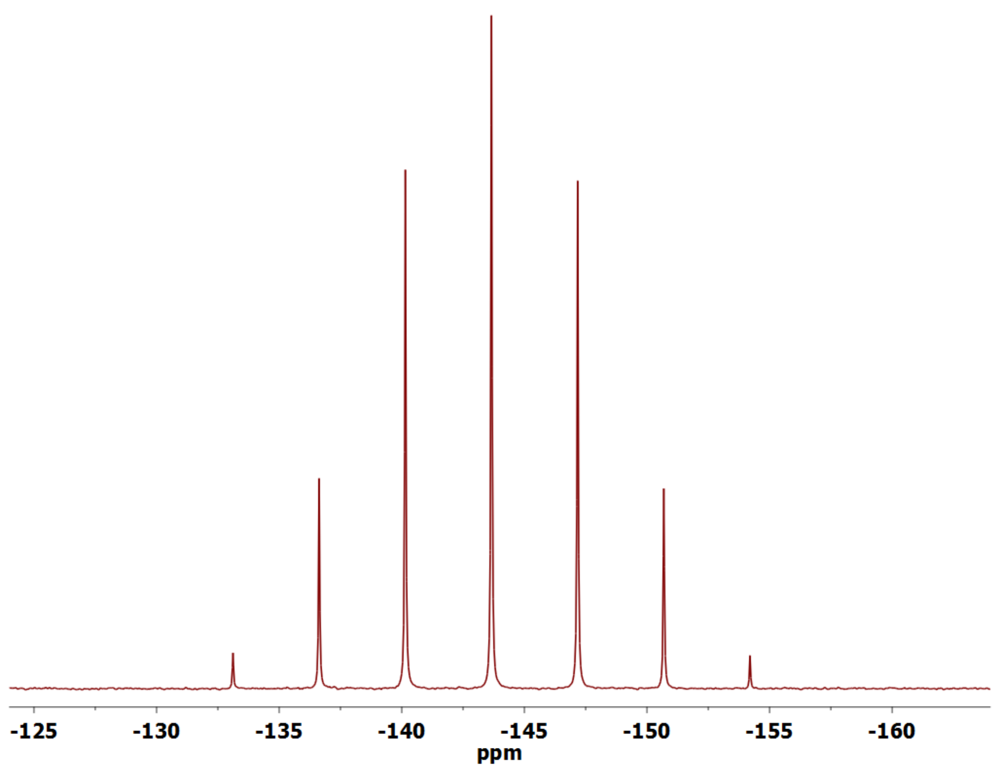

Figure S1d. ^{31}P NMR spectrum of $PP_{13}PF_6$ in CD_2Cl_2.

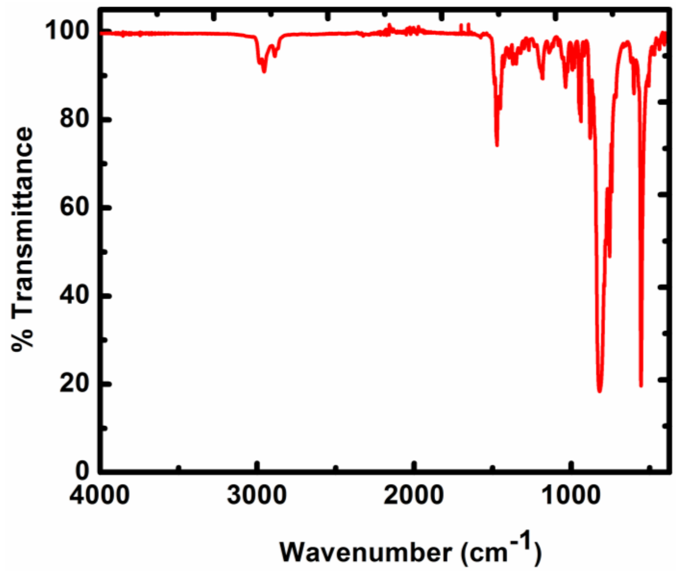

Figure S1e. FTIR (diamond ATR) spectrum of $PP_{13}PF_6$.

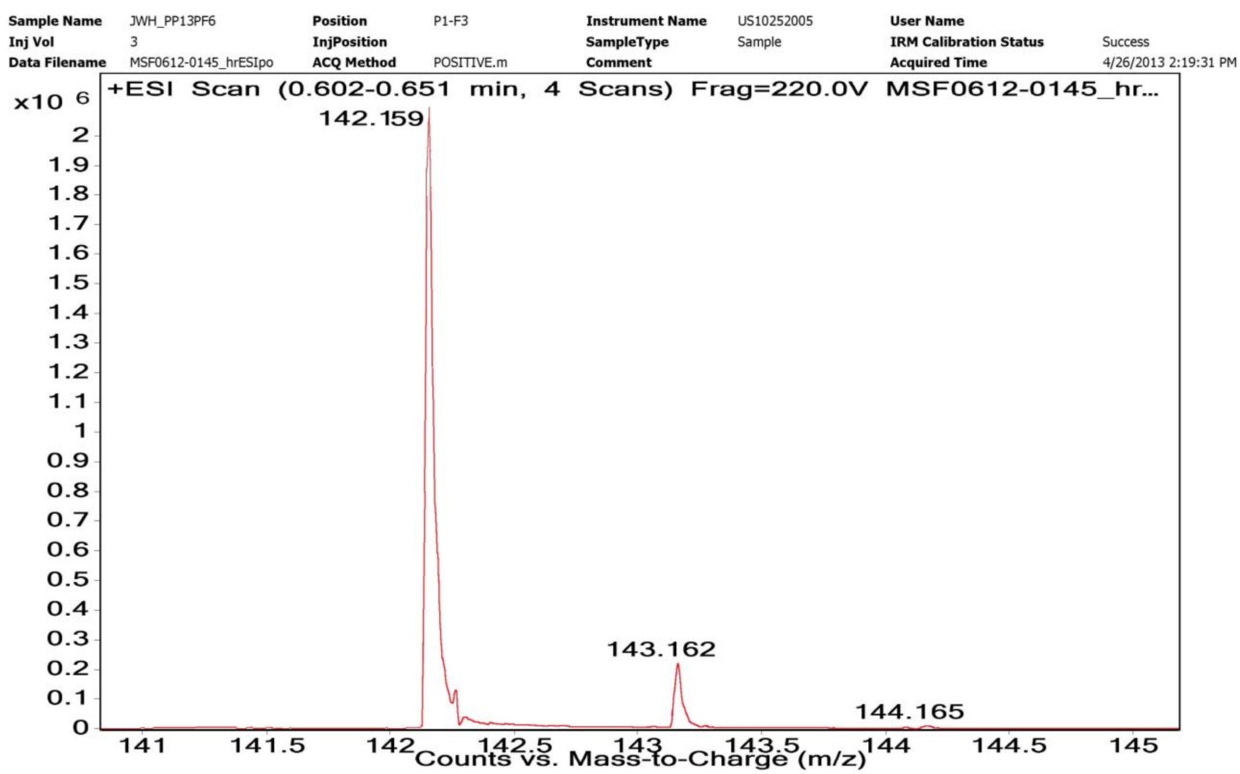

Figure S1f. Positive ion mass spectrum of $PP_{13}PF_6$.

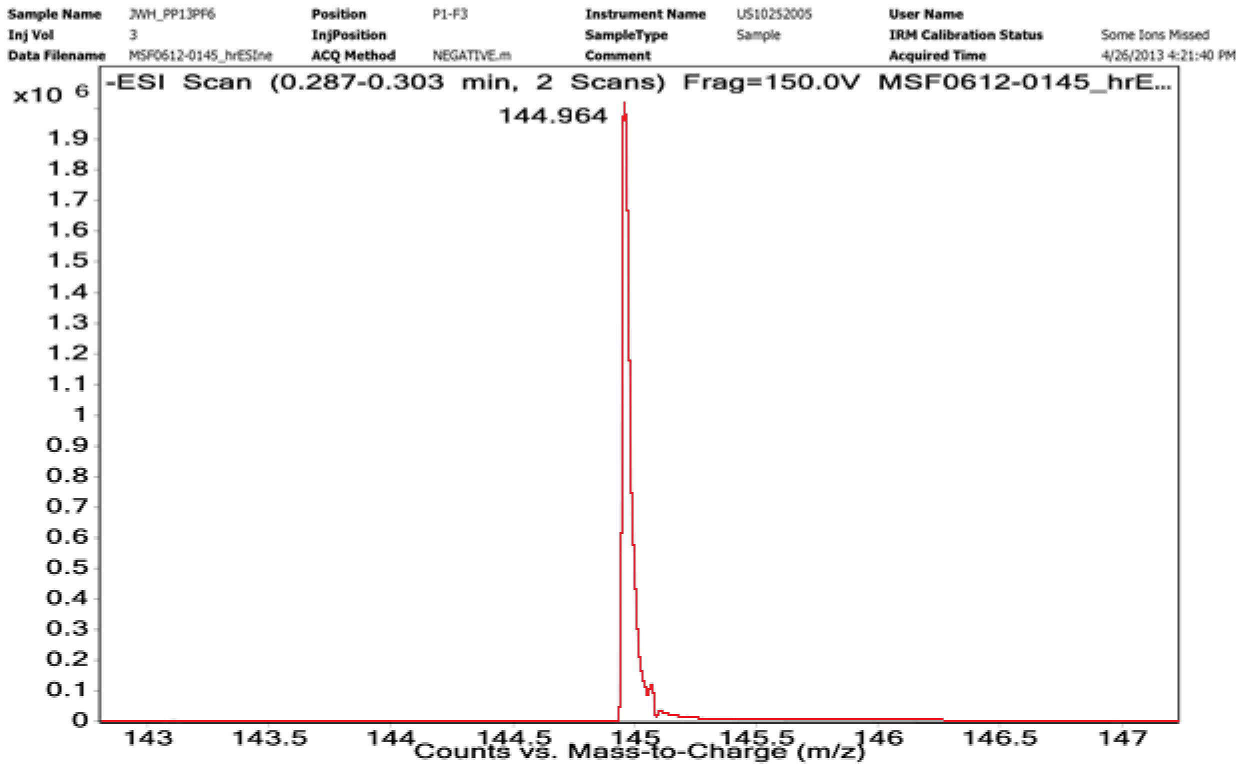

Figure S1g. Negative ion mass spectrum of $PP_{13}PF_6$.

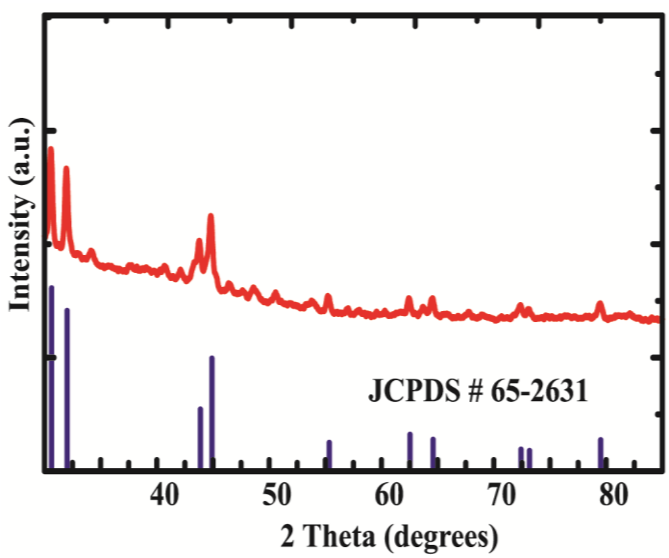

Figure S2. XRD of electrodeposited Sn over stainless steel electrode (red line) and blue lines shows the standard Sn (JCPDS#65-2631).

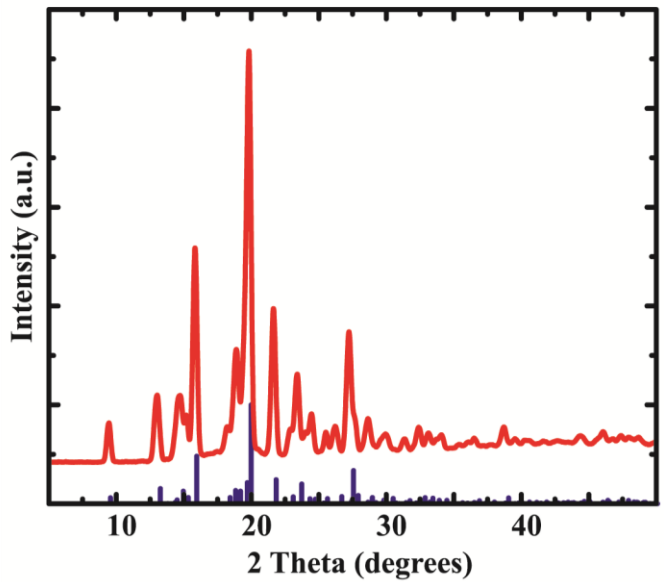

Figure S3. Experimental powder XRD of $PP_{13}PF_6$ (red line) compared with the theoretically generated XRD pattern (blue line) using the single crystal structure.

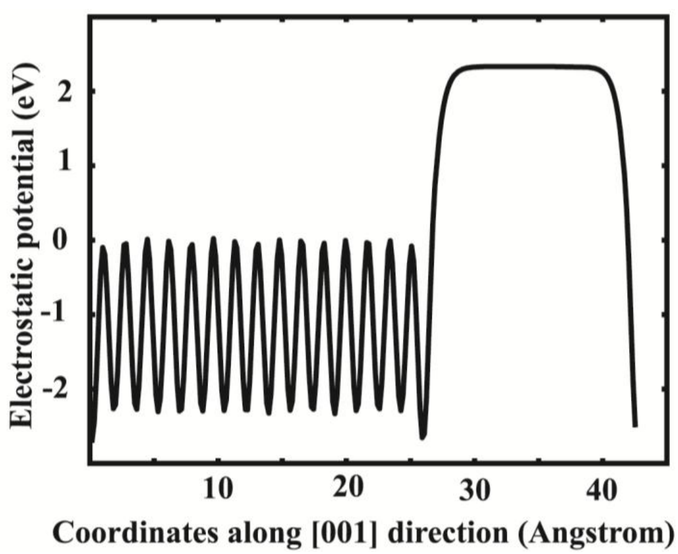

Figure S4. Calculated electrostatic potential of Li showing the lithium vacuum level at 2.33 eV. The Fermi-level is calculated as -0.67 eV.

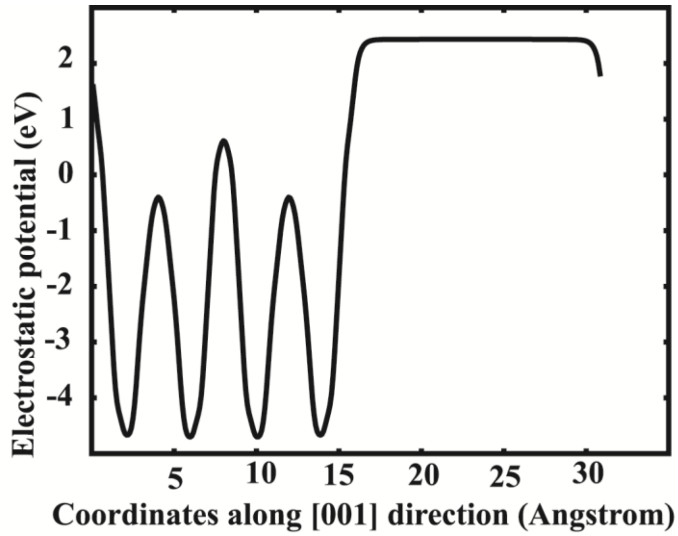

Figure S5. Calculated electrostatic potential of $PP_{13}PF_6$, showing a vacuum level of 2.39 eV and a Fermi-level of -6.20 eV.

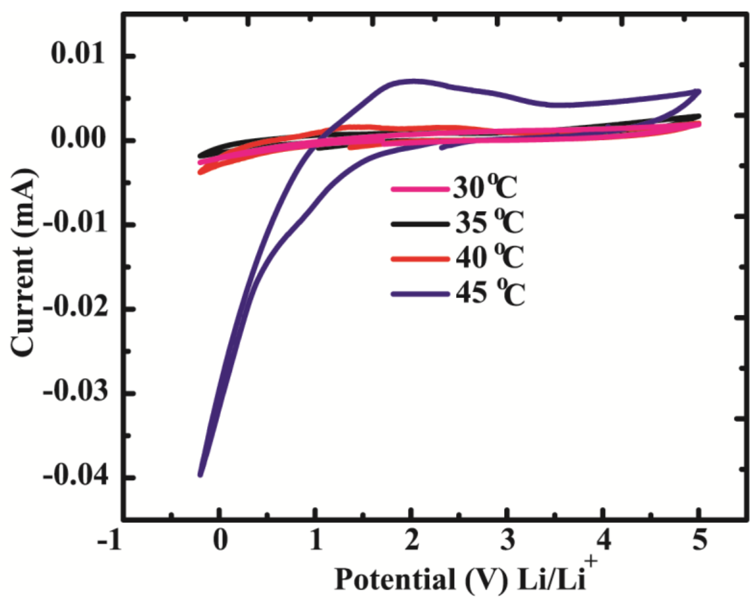

Figure S6. Cyclic voltammograms of $PP_{13}PF_6$ using the asymmetric cell (Li metal/ $PP_{13}PF_6$ + 10wt% LiTFSI)/stainless steel block) with different temperatures at the scan rate of 2 mV/s.

Table S1. Impedance and conductivity data of symmetric and asymmetric cells.

Symmetric cell						
Temp (°C)	**Temp (K)**	**(1/K)**	**R_p**	**Conductivity (σ)**	**log (σ)**	**ln (σ)**
22.7	295.7	0.00338	76718	2.06E-06	-5.6852	-13.091
32	305	0.00328	33994	4.66E-06	-5.3317	-12.277
35	308	0.00325	24387	6.49E-06	-5.18746	-11.945
40	313	0.00320	5059	3.13E-05	-4.50436	-10.372
45	318	0.00315	2158	7.34E-05	-4.13435	-9.520
Asymmetric cell						
25	298	0.00335	1.08E+05	3.78E-07	-6.42296	-14.789
30	303	0.00330	1.66E+04	9.31E-06	-5.03105	-11.584
35	308	0.00325	9.64E+03	1.61E-05	-4.79401	-11.039
40	313	0.00320	2.24E+03	6.90E-05	-4.16118	-9.581
45	318	0.00314	6.48E+02	2.39E-04	-3.62166	-8.339