Supplementary Information (SI) for Nanoscale Advances.
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Bio-based poly(benzimidazole-co-amide) as a fast charging anode of lithium-ion battery

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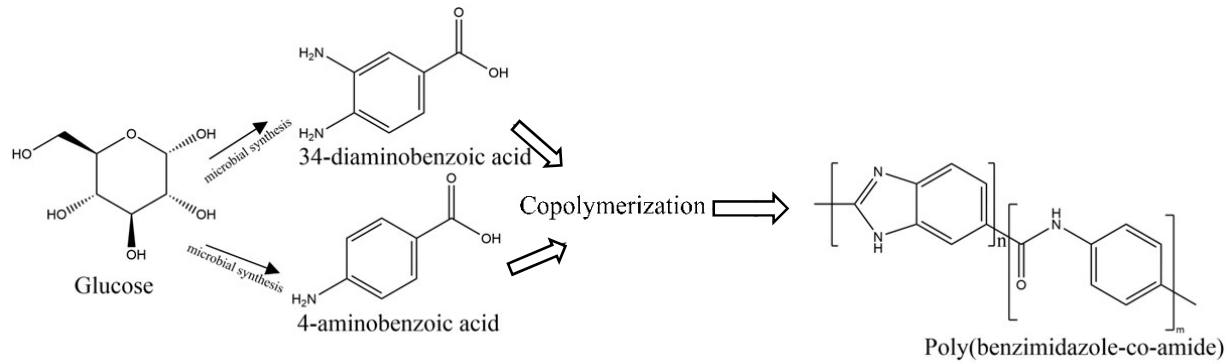

Synthetic scheme1: Synthetic procedure for poly(benzimidazole-co-amide) [1]

Calculation of R factor

- R factor is a measure of the number of carbon sheets arranged as single layers.

$$R = \frac{B}{A}$$

Where A refers to the background
B refers to the peak height

- The background A is determined by drawing a straight line connecting the data on either side of the peak. And B is determined by drawing a line tangent to the background estimate which intersects 002 in a single point.

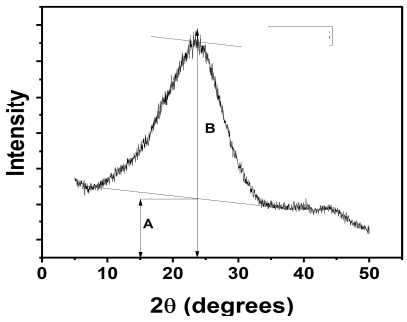

Fig.S1: Procedure for determination of R factor

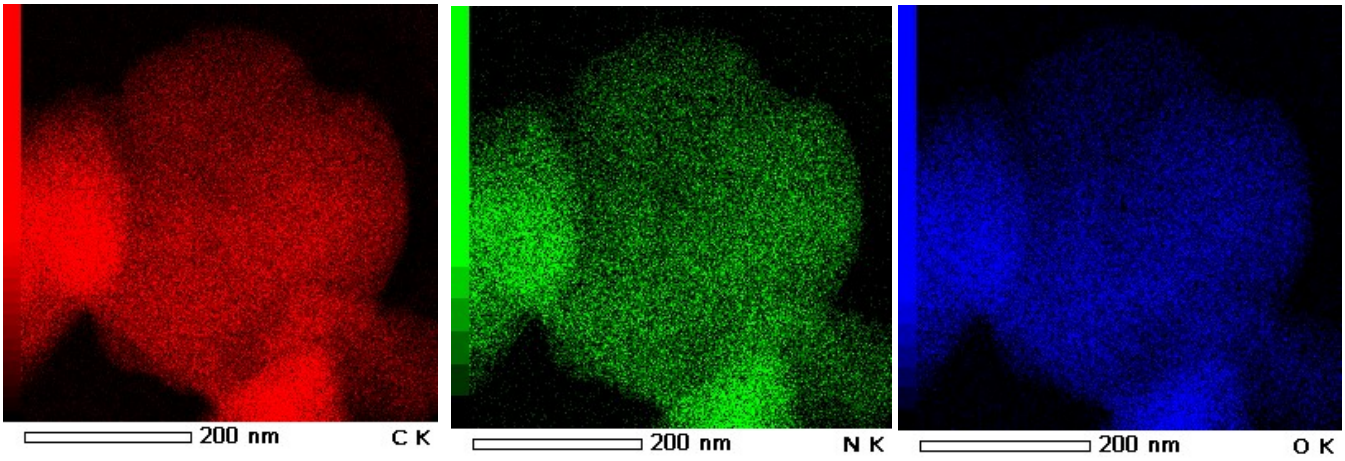

Fig.S2: TEM-EDX elemental mapping of PYPBIPA8.5-1.5

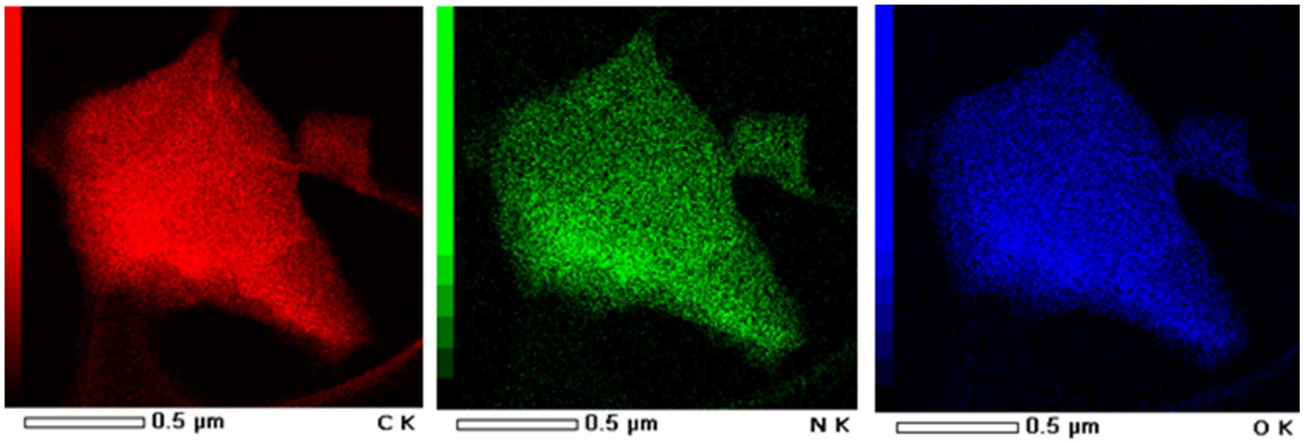

Fig.S3: TEM-EDX elemental mapping of PYPBIPA7-3

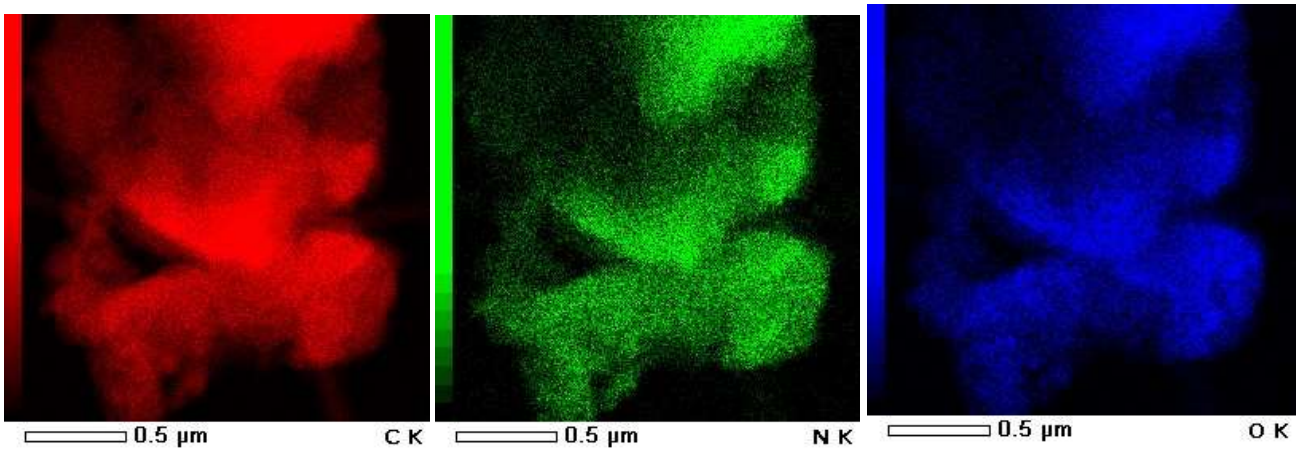

Fig.S4: TEM-EDX elemental mapping of PYPBIPA5-5

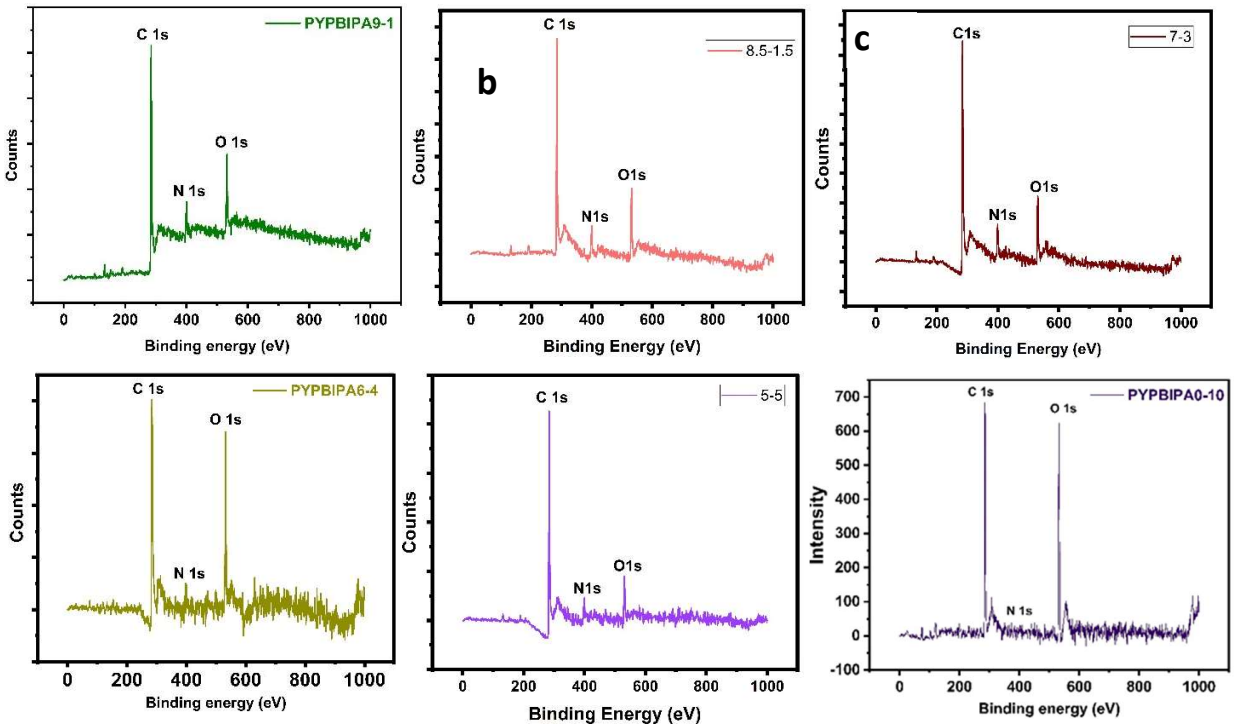

Fig.S5: XPS survey spectrum of PYPBIPA(a)9-1 (b) 8.5-1.5 (c)7-3 (d) 6-4 (e) 5-5 (f) 0-10

Table S1: Nitrogen and oxygen doping contents in various carbon materials derived from PBIPA.

Carbon material	N at%	O at%
PYPBIPA10- 0[1]	14.6	0.6
PYPBIPA 9-1	12.1	11.8
PYPBIPA8.5-1.5	11.2	13.1
PYPBIPA7-3	9.9	20.0
PYPBIPA6-4	9.2	21.8
PYPBIPA5-5	8.0	25.0
PYPBIPA0-10	2.6	31.3

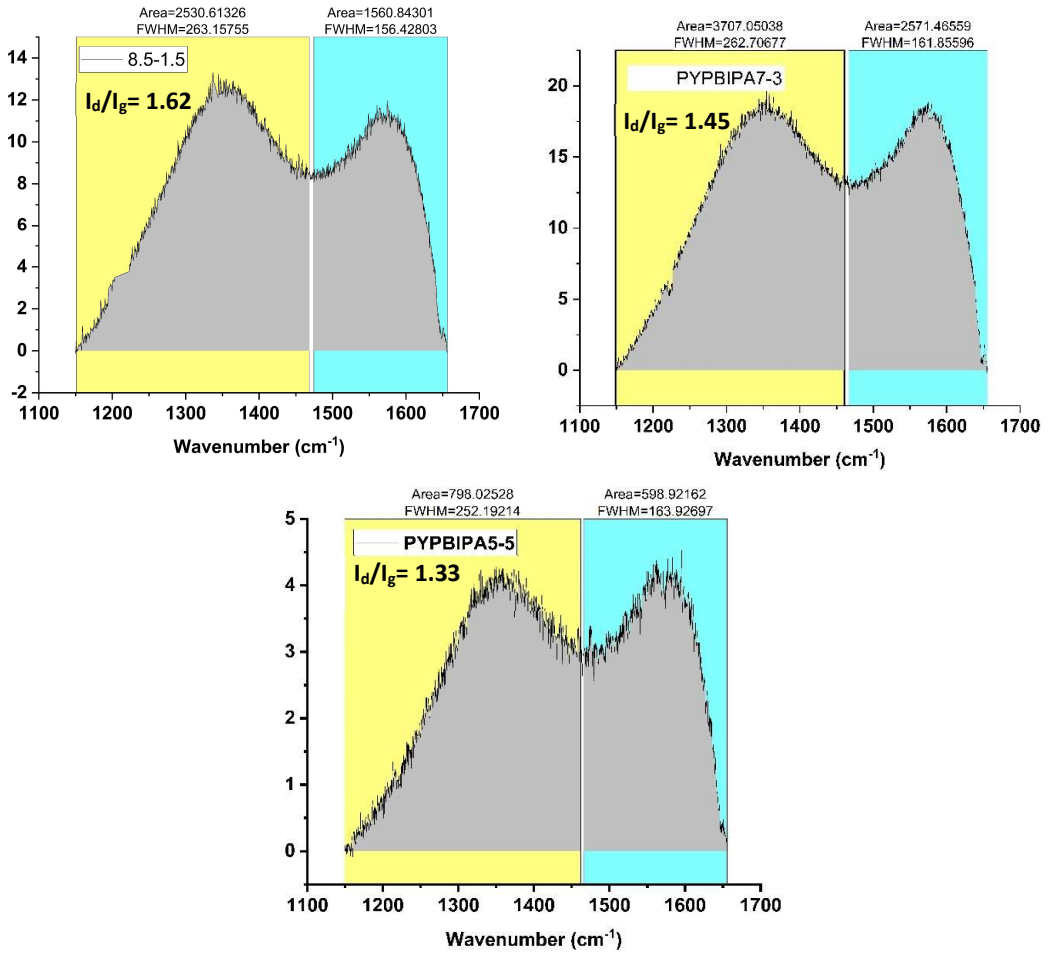

Fig. S6: Ratio of the D peak to G peak based on the ratio of the area of D peak and G peak.

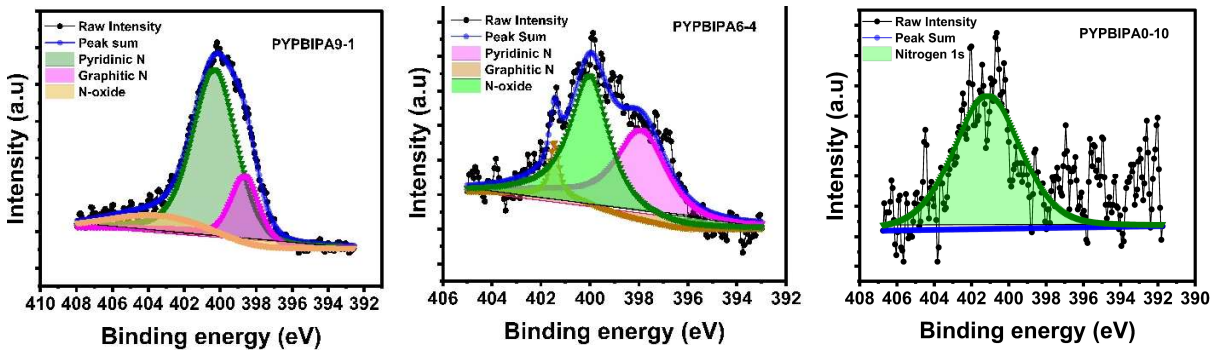

Figure S7: Deconvoluted N1s spectra of (a) PYPBIPA9-1 (b) 6-4 and (c) 0-10

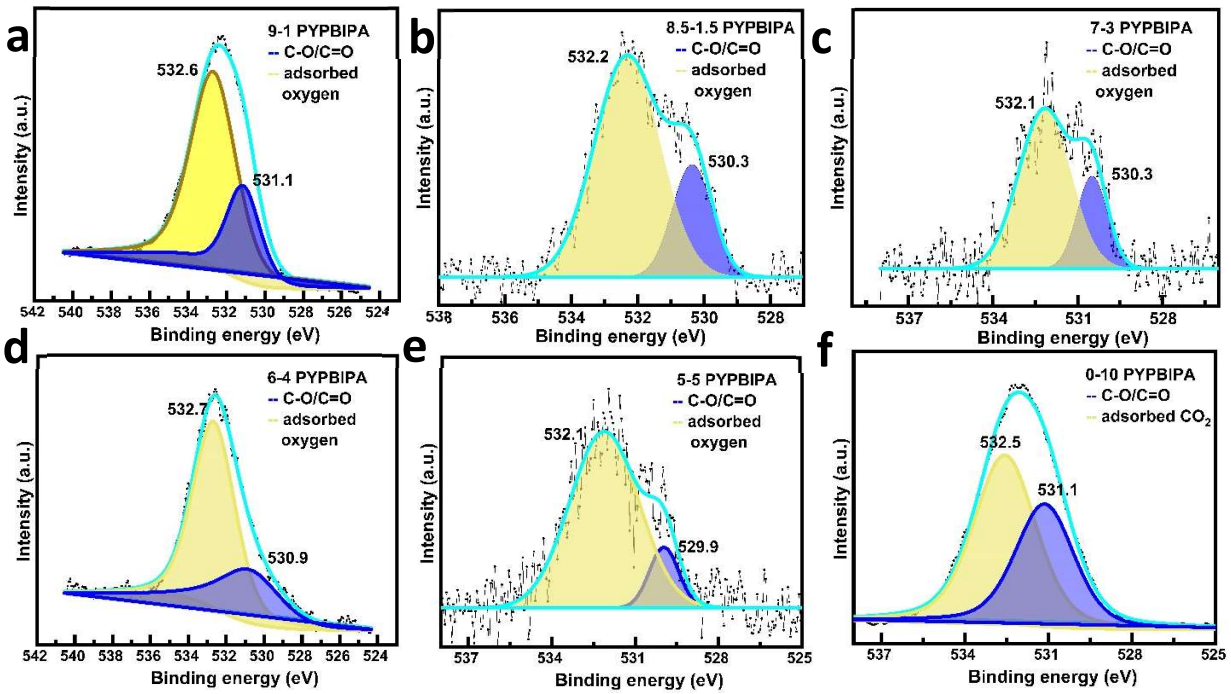

Fig. S8: Deconvoluted O1s peak for PYPBIPA (a) 9-1 (b) 8.5-1.5 (c) 7-3 (d) 6-4 (e) 5-5 (f) 0-10

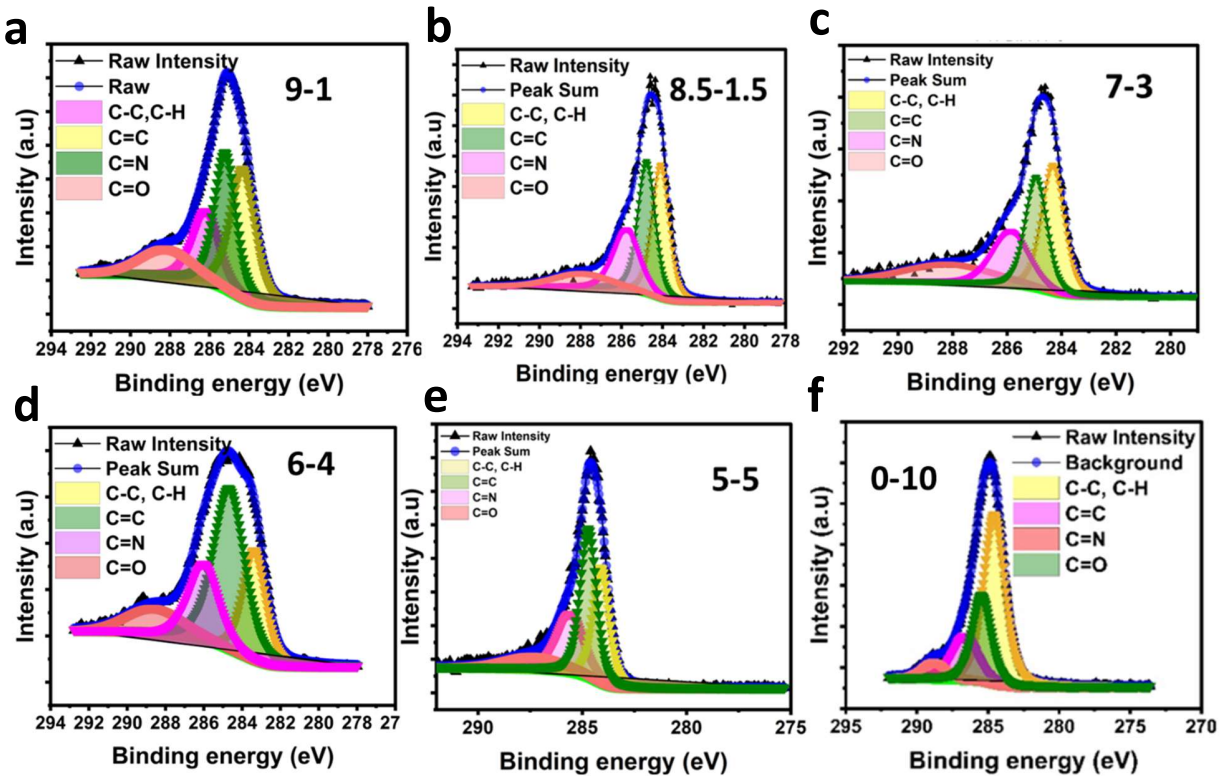

Fig.S9: Deconvoluted C1s peak for PYPBIPA (a)9-1 (b)8.5-1.5 (c) 7-3 (d) 6-4 (e) 5-5 (f) 0-10

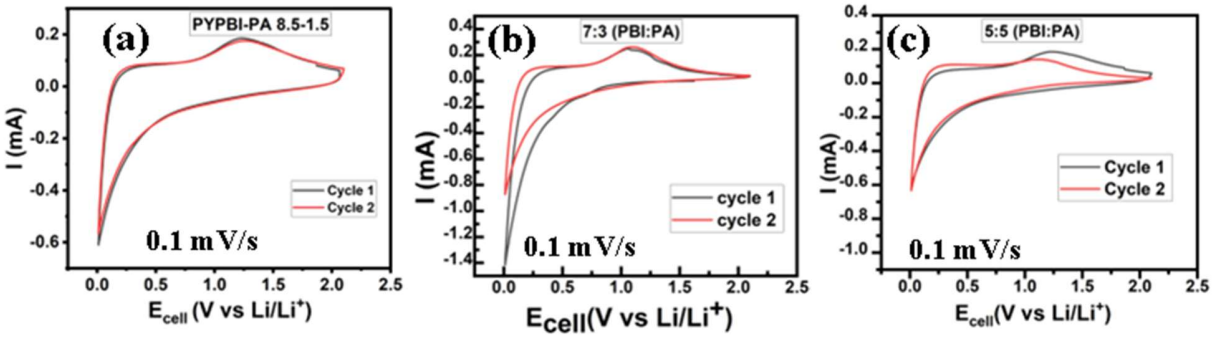

Fig. S10: Cyclic voltammograms of PYPBIPA (a)8.5-1.5 (b) 7-3 and (c) 5-5

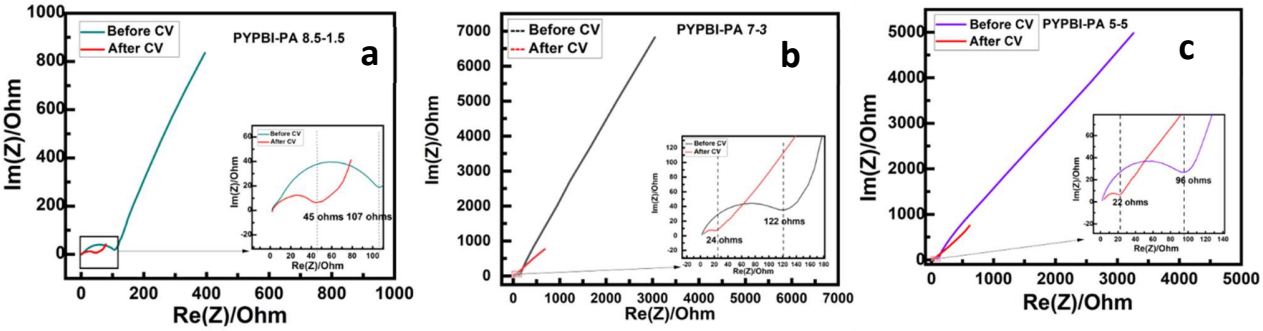

Fig.S11: PEIS before and after cyclic voltammetry for PYPBIPA(a) 8.5-1.5 (b) 7-3 (c) 5-5

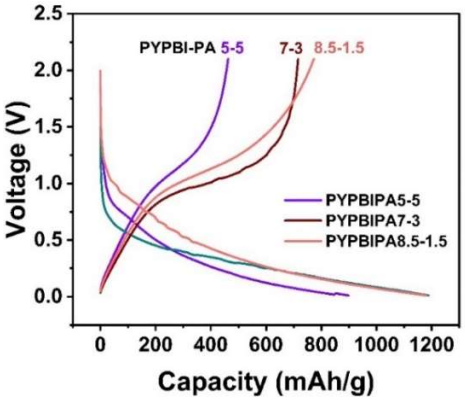

Fig. S12: Initial charge-discharge plot for PYPBIPA8.5-1.5,7-3,5-5

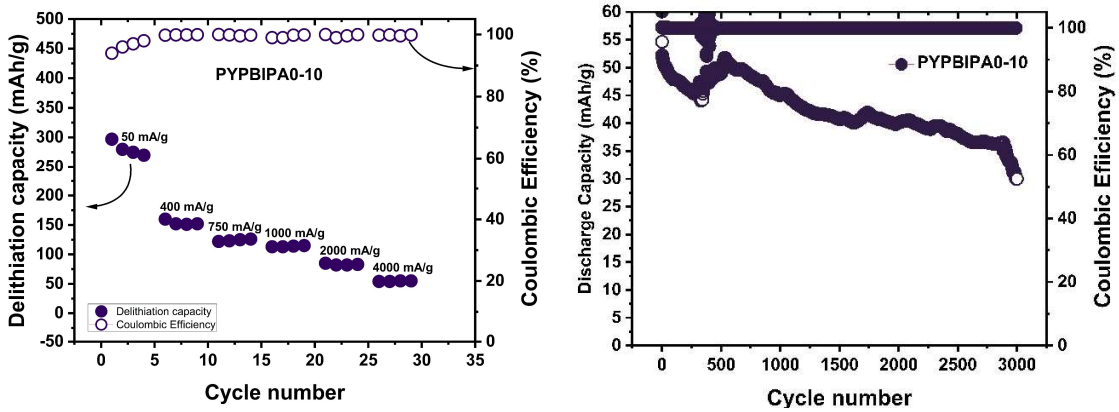

Figure S13: (a) Rate studies (b) long cycling for PYPBIPA0-10

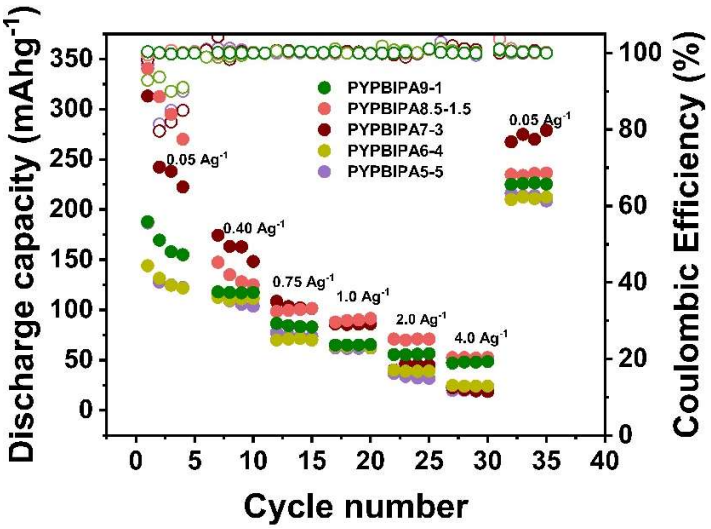

Figure S14: Comparison of rate studies for PYPBIPA9-1, 8.5-1.5, 7-3, 6-4, and 5-5

Table S2: Comparison of rate studies of PYPBIPA10-0, 9-1, 8.5-1.5, 7-3, 6-4, 5-5 and 0-10

Current density (A/g)			Capacity (mAh/g)				
	10-0[1]	9-1	8.5-1.5	7-3	6-4	5-5	0-10
0.05	-	330	600	500	250	270	280
0.40	206	235	256	325	220	211	152
0.75	168	167	199	204	140	147	125
1.0	-	130	180	171	128	123	113
2.0	125	111	140	90	80	64	85
4.0	-	94	100	38	48	39	55

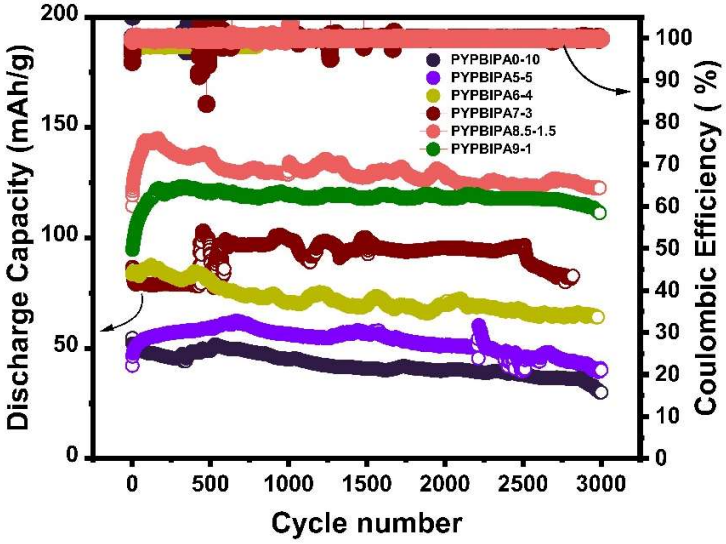

Figure S15: Comparison of long cycling for PYPBIPA9-1, 8.5-1.5, 7-3, 6-4, 5-5 and 0-10

Table S3: Comparison of rate studies of PYPBIPA10-0, 9-1, 8.5-1.5, 7-3, 6-4, 5-5 and 0-10

Carbon material	Discharge capacity (mAh/g)	Capacity retention (%)
PYPBIPA 9-1	122	90
PYPBIPA8.5-1.5	137	90
PYPBIPA7-3	100	83
PYPBIPA6-4	84	76
PYPBIPA5-5	60	65
PYPBIPA0-10	51	59

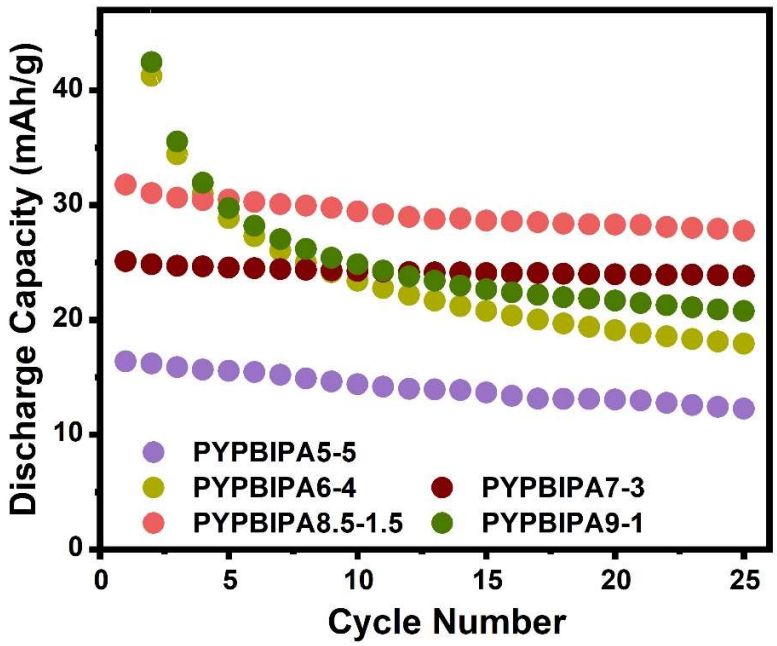

Figure S16: Long cycling plot for symmetric cells of PYPBIPA9-1, 8.5-1.5, 7-3, 6-4, and 5-5.

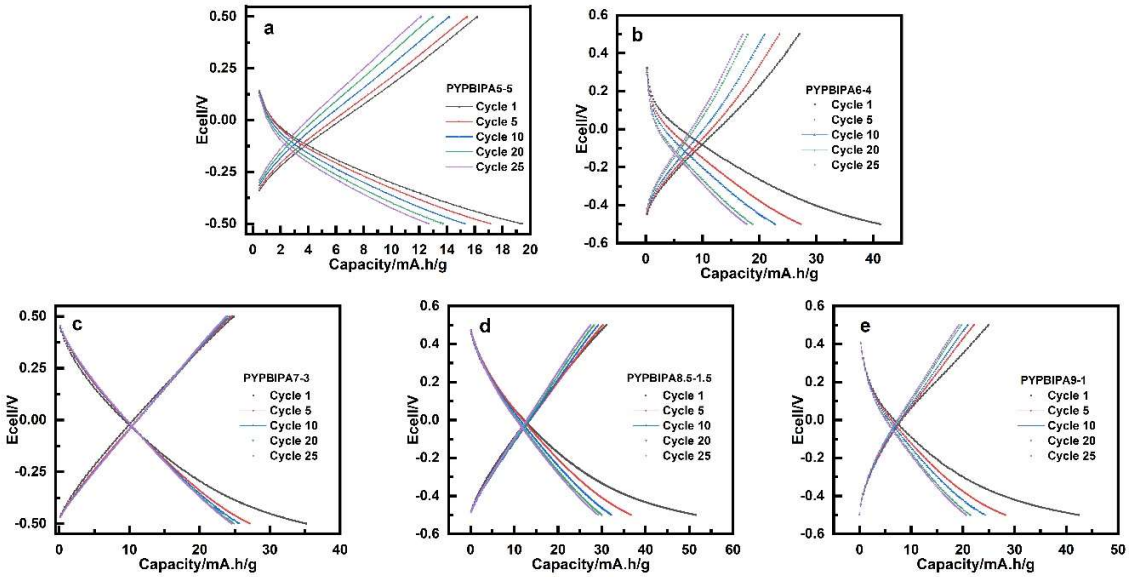

Figure S17: Voltage vs capacity plots for PYPBIPA 0-10, 5-5, 6-4, 7-3, 8.5-1.5 and 9-1 symmetric cells

Table S4-Capacity retention of PYPBIPA materials after 25 cycles

Sample	Retention (%)	Cycles
PYPBIPA5-5	47.6%	25
PYPBIPA6-4	52.9%	25
PYPBIPA7-3	88.0%	25
PYPBIPA8.5-1.5	91.3%	25
PYPBIPA9-1	68.7%	25

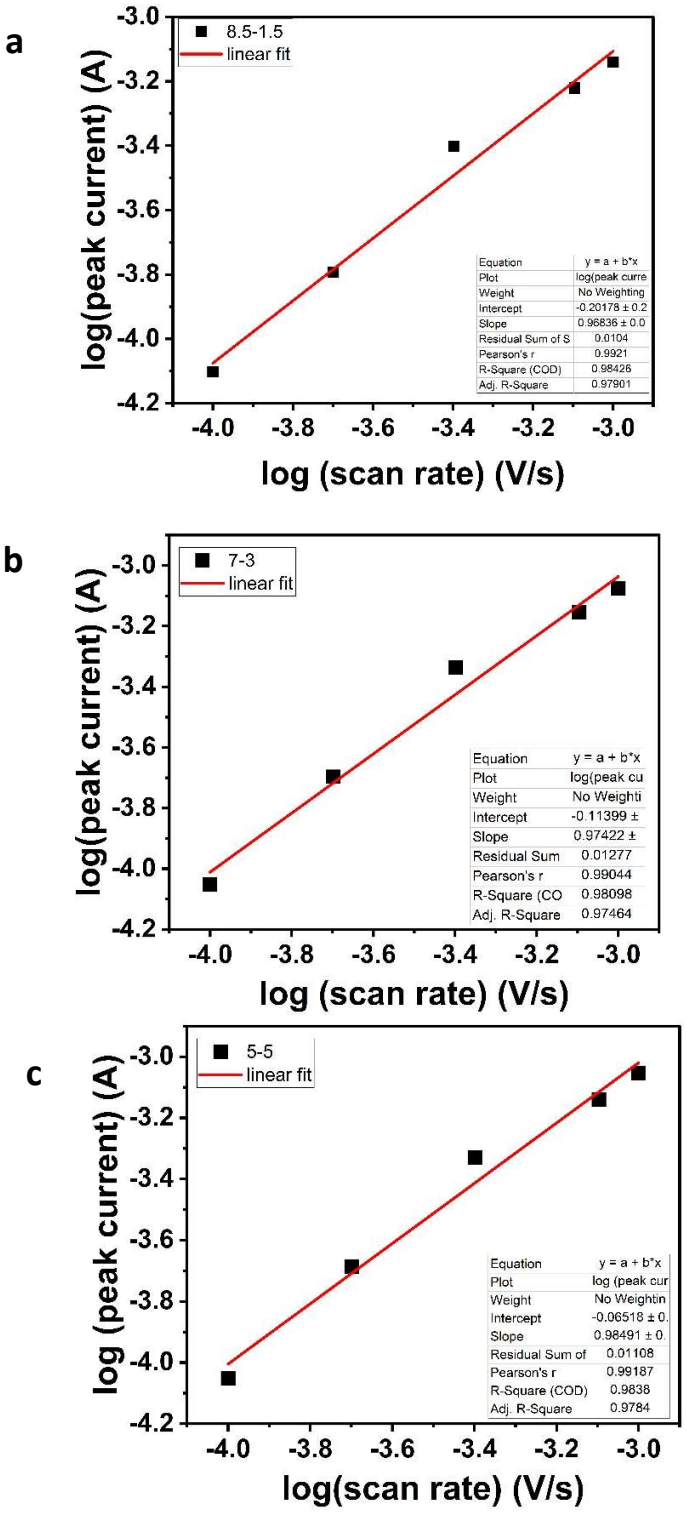

Fig.S18: Linear fit of logi vs logv for PYPBIPA (a) PYPBIPA8.5-1.5 (b) 7-3 and (c) 5-5

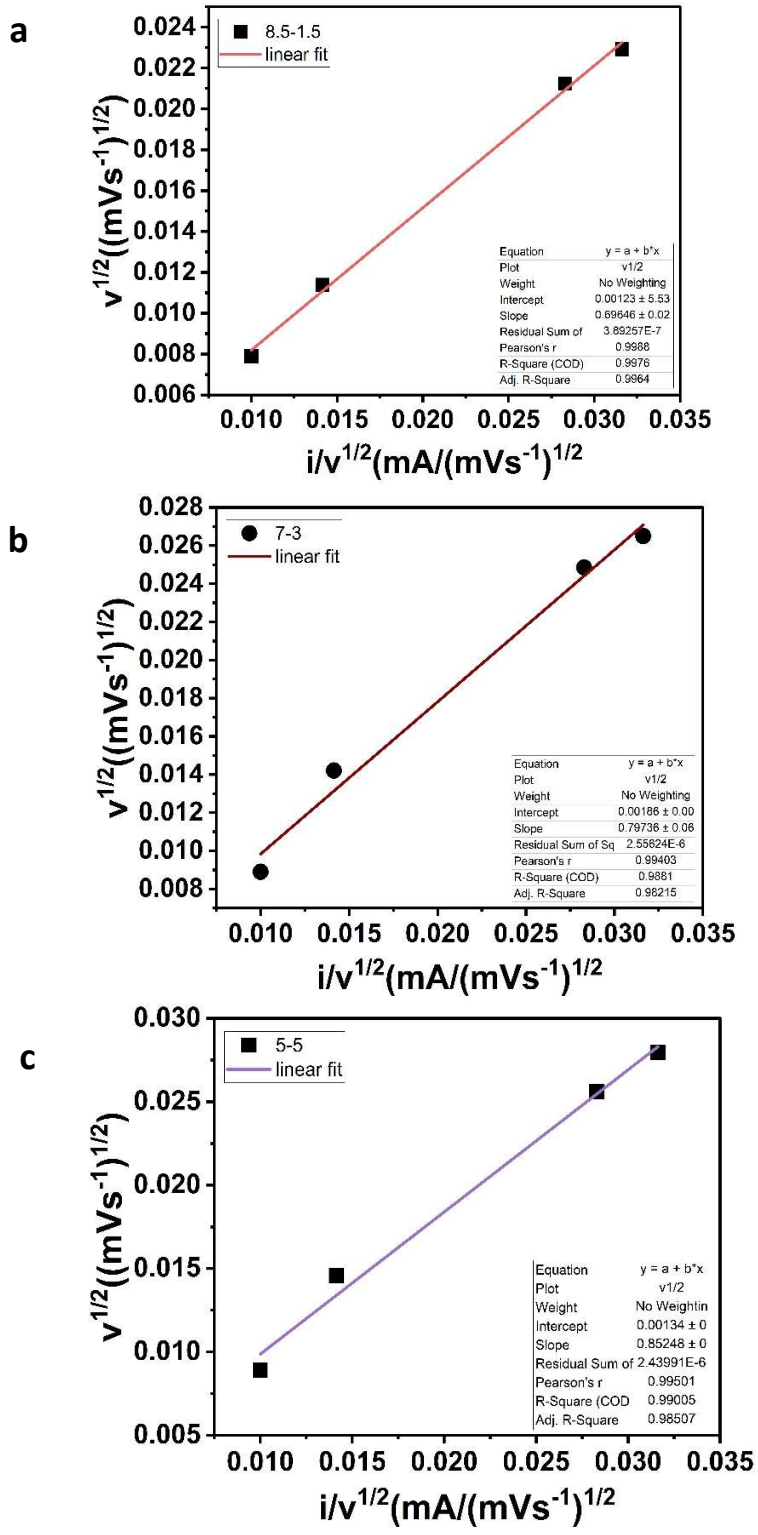

Fig.S19: Linear fit of $i/v^{1/2}$ vs $v^{1/2}$ for PYPBIPA (a) PYPBIPA8.5-1.5 (b) 7-3 and (c) 5-5

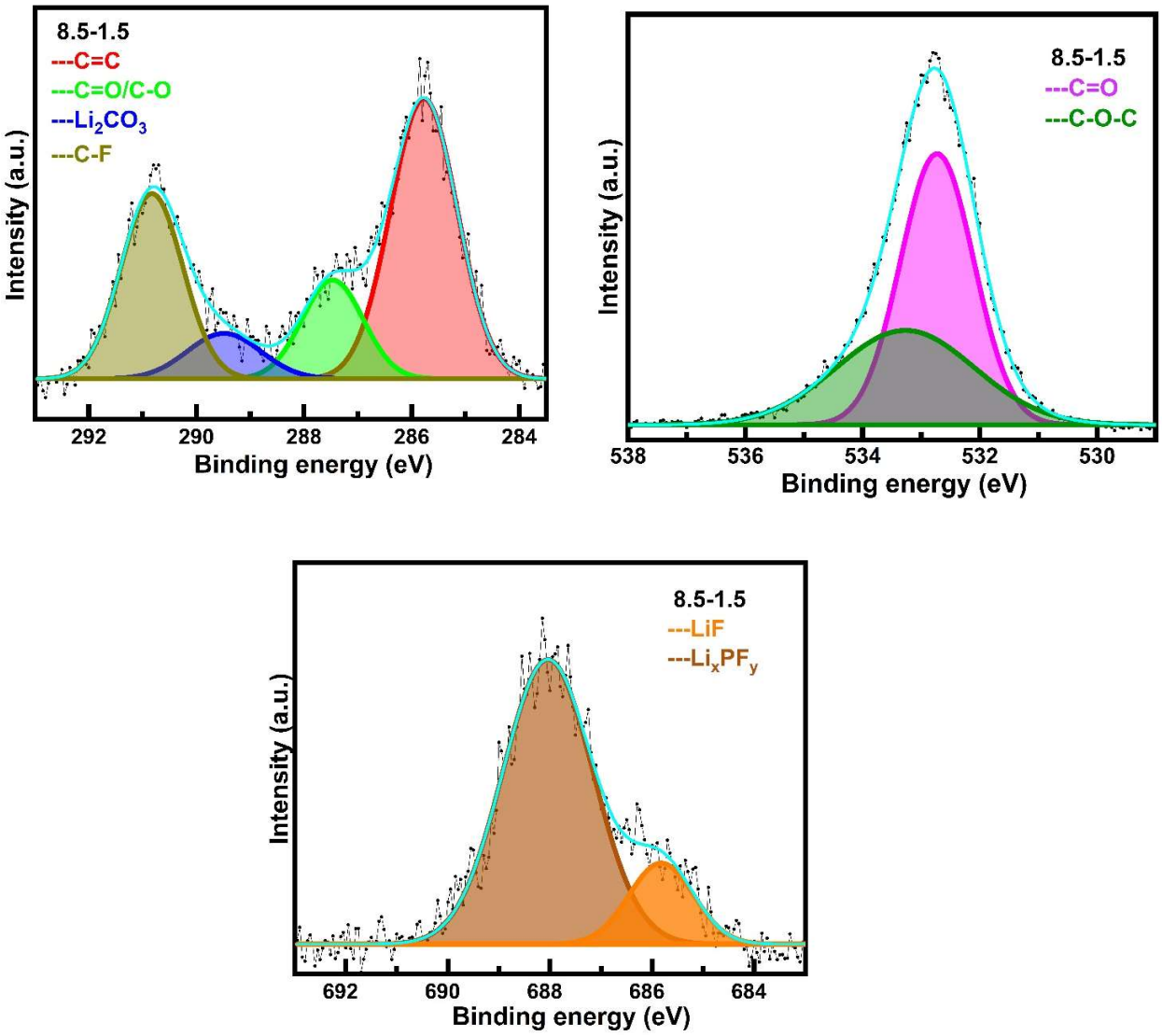

Fig.S20: XPS of decrimped anode of PYPBIPA8.5-1.5 (a) C1s (b) O1s (c) F1s

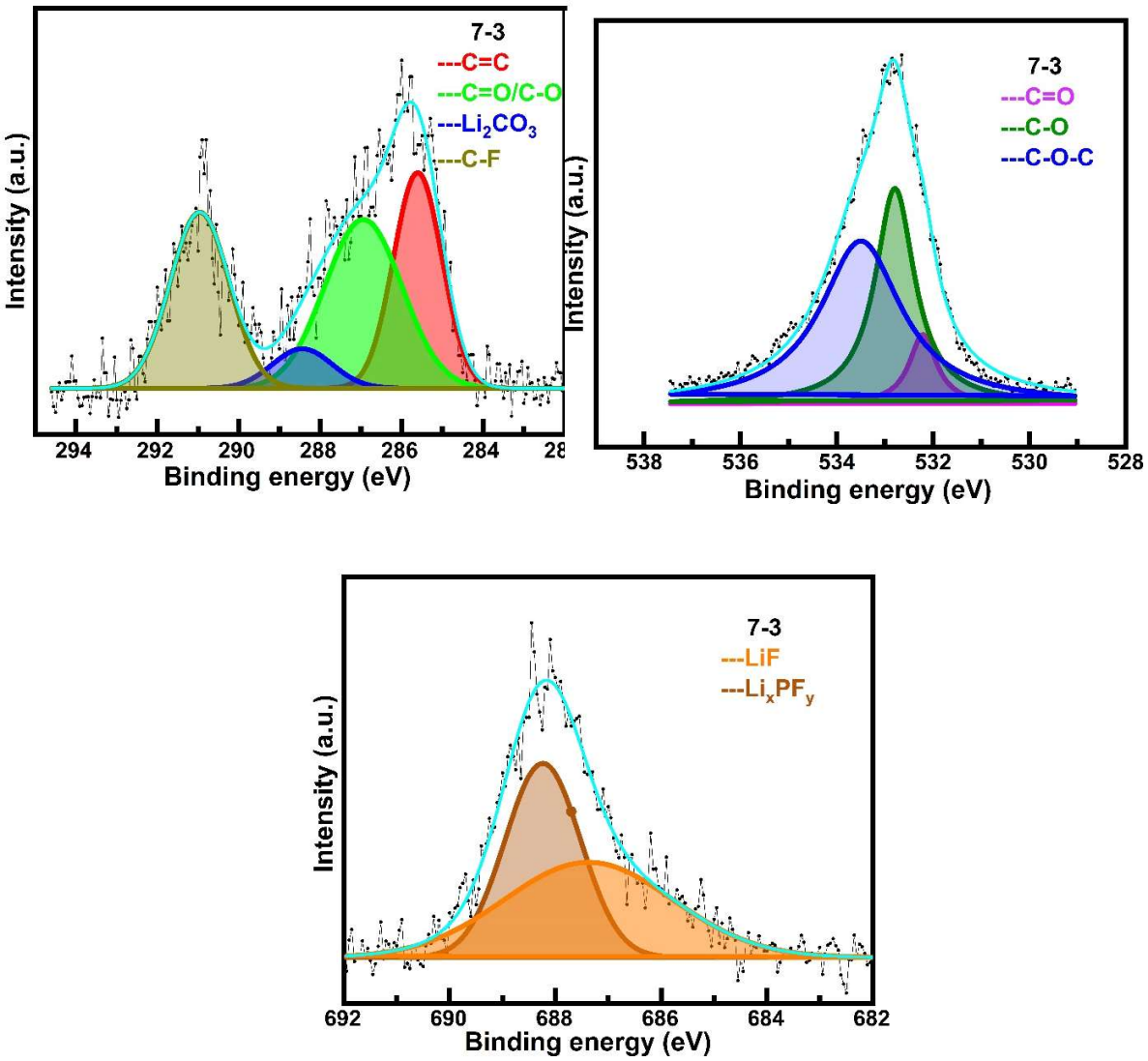

Fig.S21: XPS of decrimped anode of PYPBIPA7-3 (a) C1s (b) O1s (c) F1s

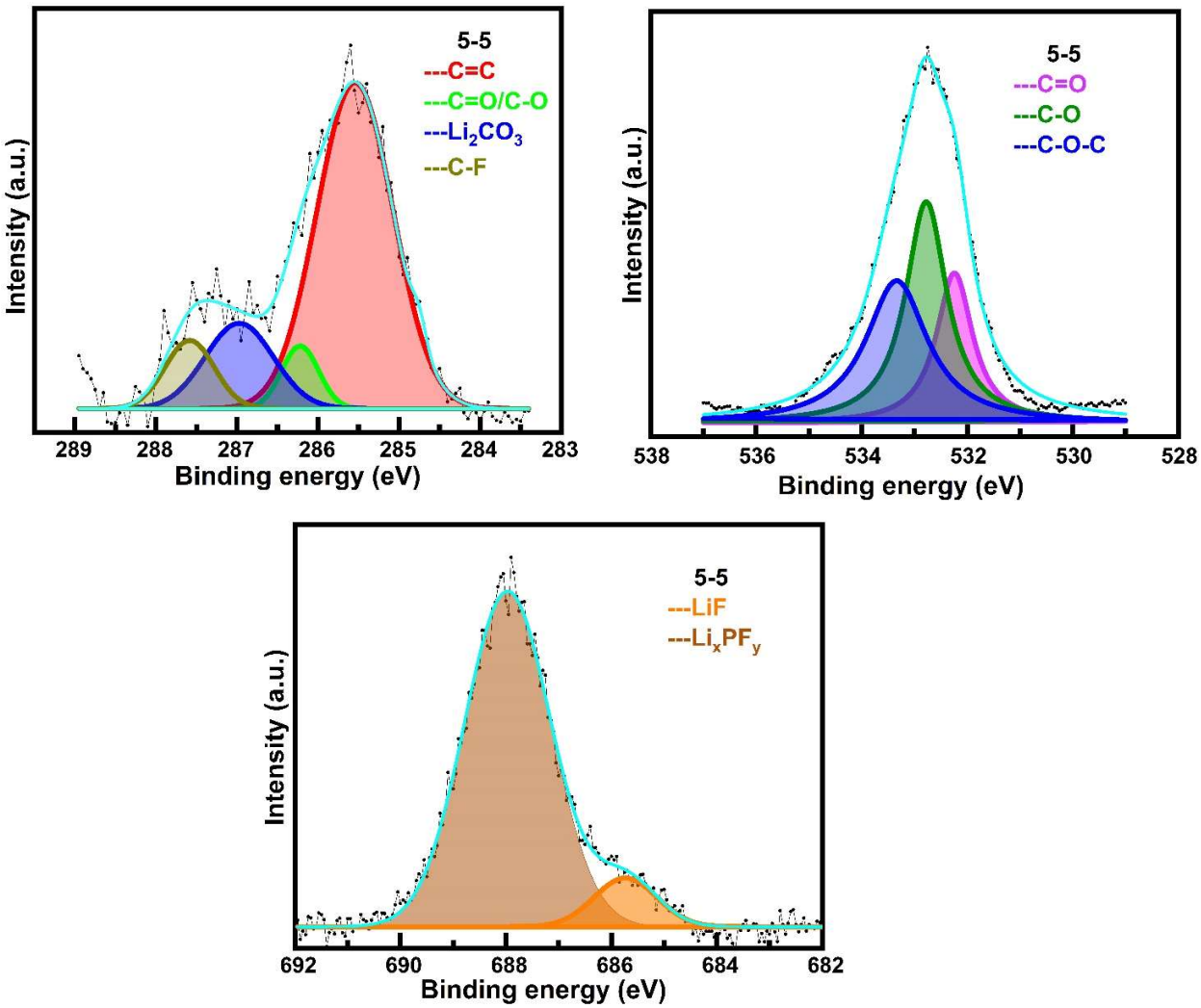

Fig.S22: XPS of decrimped anode of PYPBIPA5-5 (a) C1s (b) O1s (c) F1s

References:

[1] K. S. Patnaik, R. Badam, Y. Peng, K. Higashimine, T. Kaneko, N. Matsumi, *Chemical Communications* **2021**, *57*, 13704–13707.