Supporting Information

Reuse, Recycle and Regeneration of $LiFePO_4$ Cathode from Spent Lithium-ion Batteries for Rechargeable Lithium and Sodium-ion Storage

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Total number of pages: 12 (S1 – S12)

Number of figures: 17 (S1-S17)

Number of Tables: 1 (Table S1)

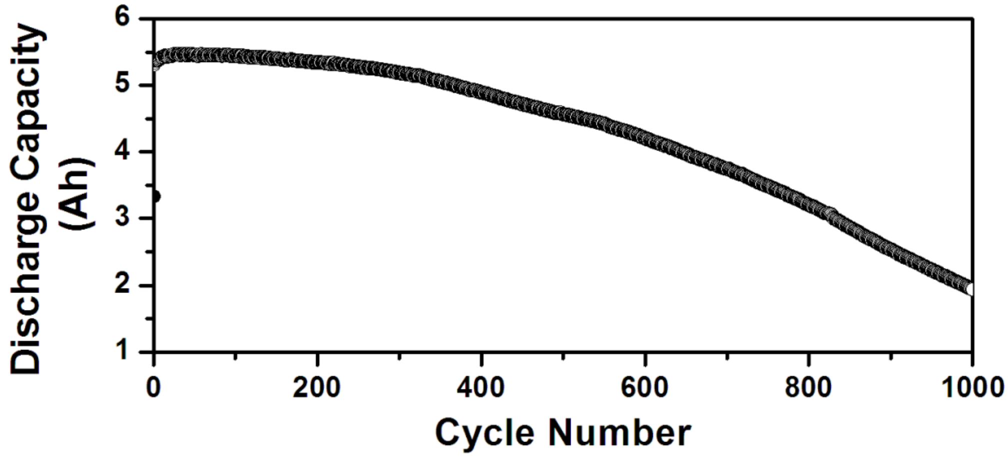

Figure S1. Cycling performance of the commercial cell for 1000 cycles at 5A current rate.

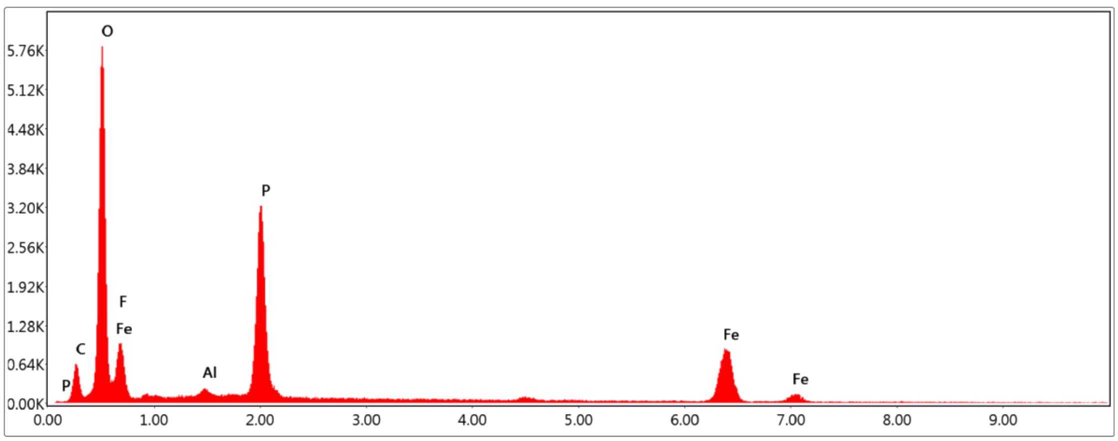

Figure S2. EDX spectra showing the presence of element Fe, P, O, F, C and Al.

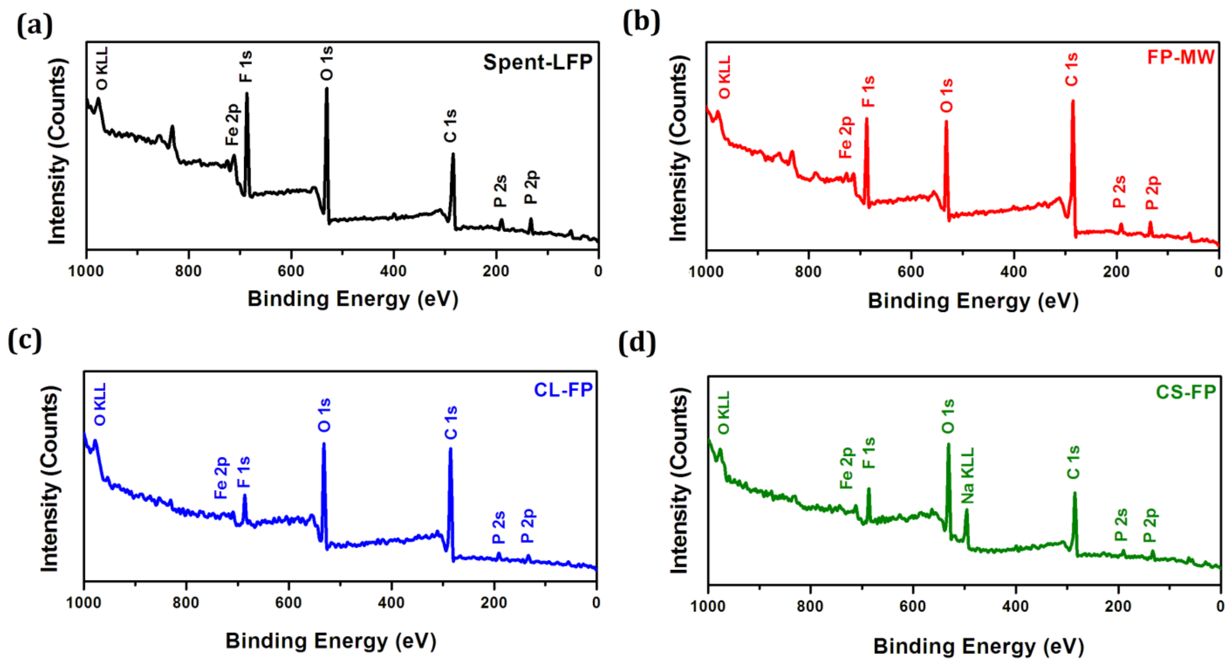

Figure S3. XPS survey spectrum (a) spent LFP, (b) FP-MW, (c) CL-FP and (d) CS-FP.

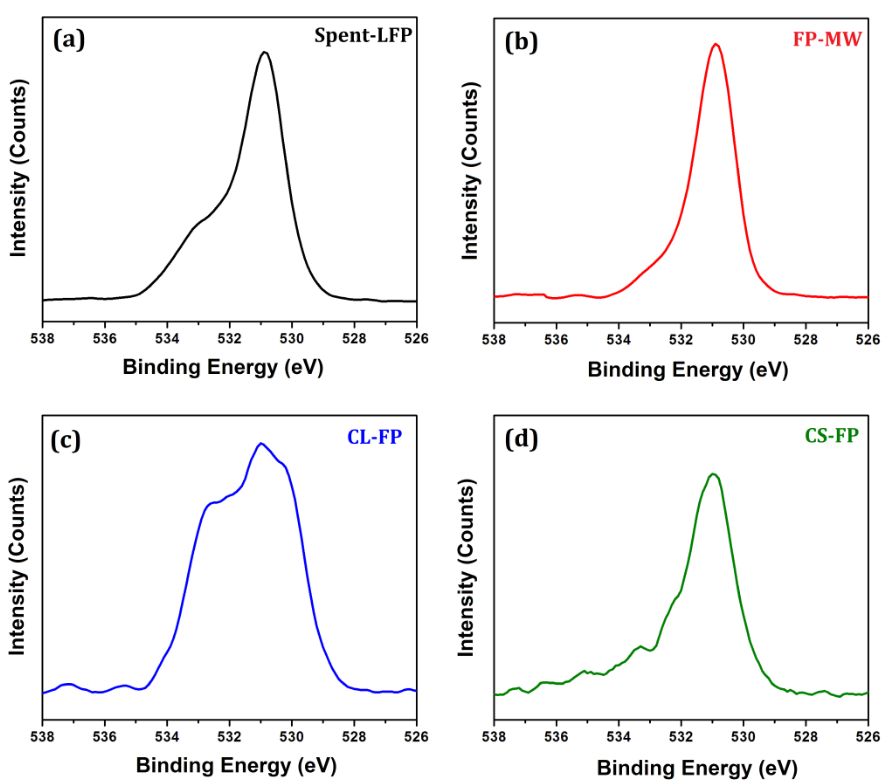

Figure S4. High resolution O 1s spectrum of (a) spent LFP, (b) FP-MW, (c) CL-FP and(d) CS-FP.

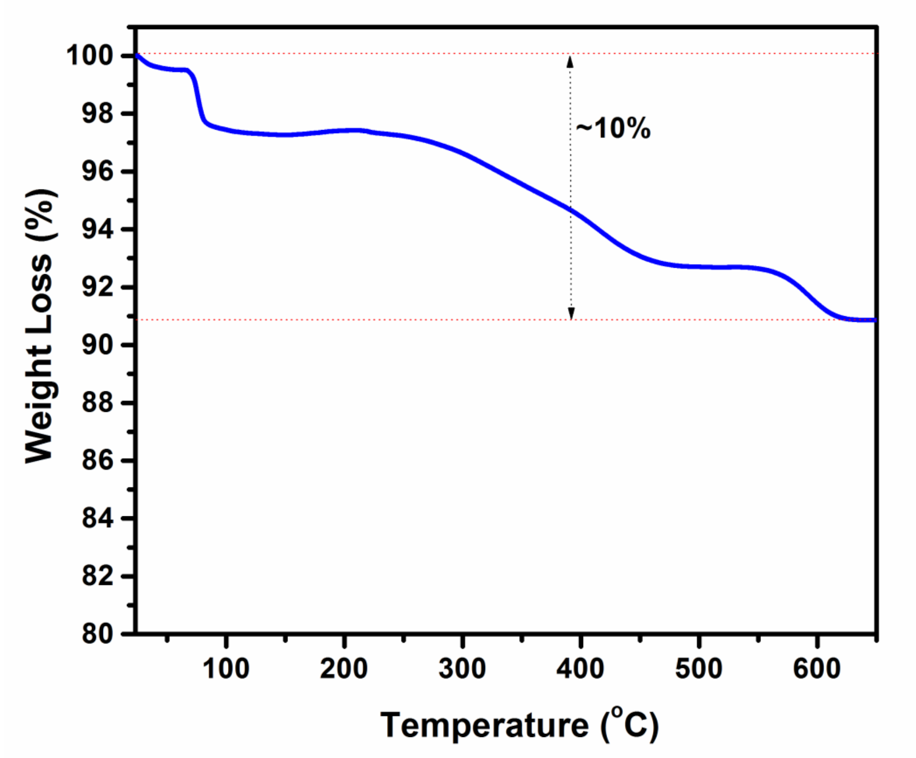

Figure S5. TGA analysis of the spent LFP electrode from 23°C to 650°C in air.

Table S1. Electrochemical performance comparison of fresh $LiFePO_4$ cathodes available in literature with reused and recycled LFP cells

Sl No.	$LiFePO_4$ Sample details	C-Rate	Capacity (mAh/g)	Reference*
1	LFP	C/5	110	
		1C	80	1
	LFP + 1% Cu	C/5	140	
		1C	100	
2	C-LFP	C/10	145	
		10C	50	2
	C-LFP/7% Polypyrrole	C/10	148	
		10C	100	
3	LFP Bare	C/10	146	
		5C	90	3
	LFP Surfactant	C/10	170	
		5C	142	

4	LFP	C/10 5C	132 83.4	4
5	LFP F-Doped LFP	C/10 C/10	118 175	5
6	LFP	C/10 10C	140 70	6
	LFP/Nanofibers	C/10 10C	150 80	
7	LFP @ Glucose	C/5 10C	160 100	7
8	Commercial LFP	1C 30C	130 60	8
	Self-assembled LFP	1C 30C	150 110	
9	Recycled LFP	1C 10C	150 95	This work
10	CL-FP	1C 10C	145 107	This work

**References included at the end*

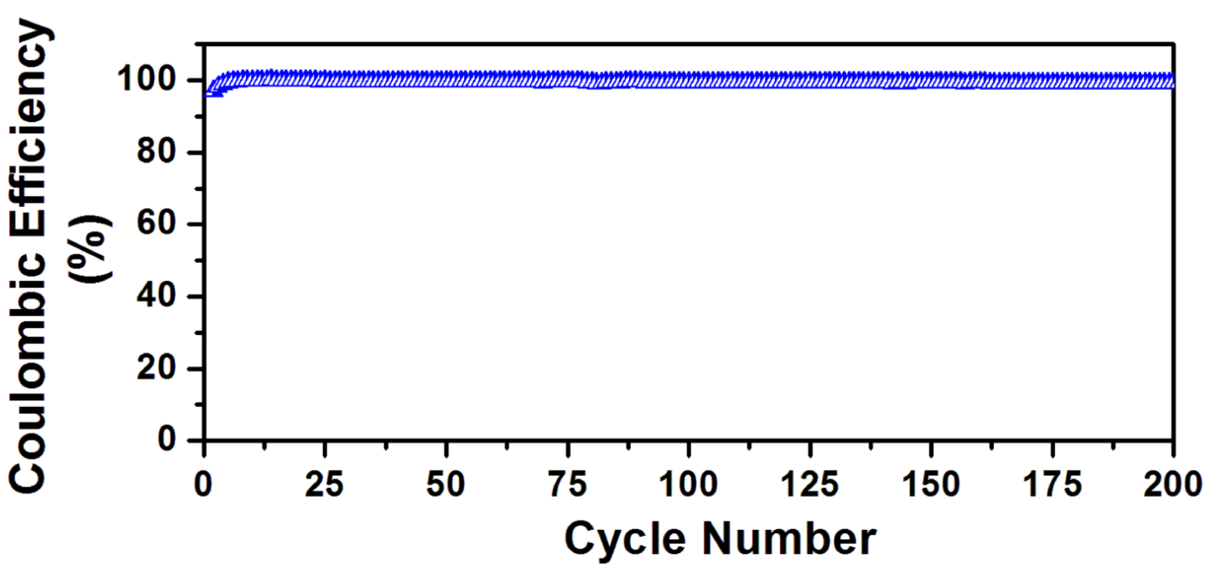

Figure S6. Coulombic Efficiency plot of reused spent-LFP LIB cell at 5C rate.

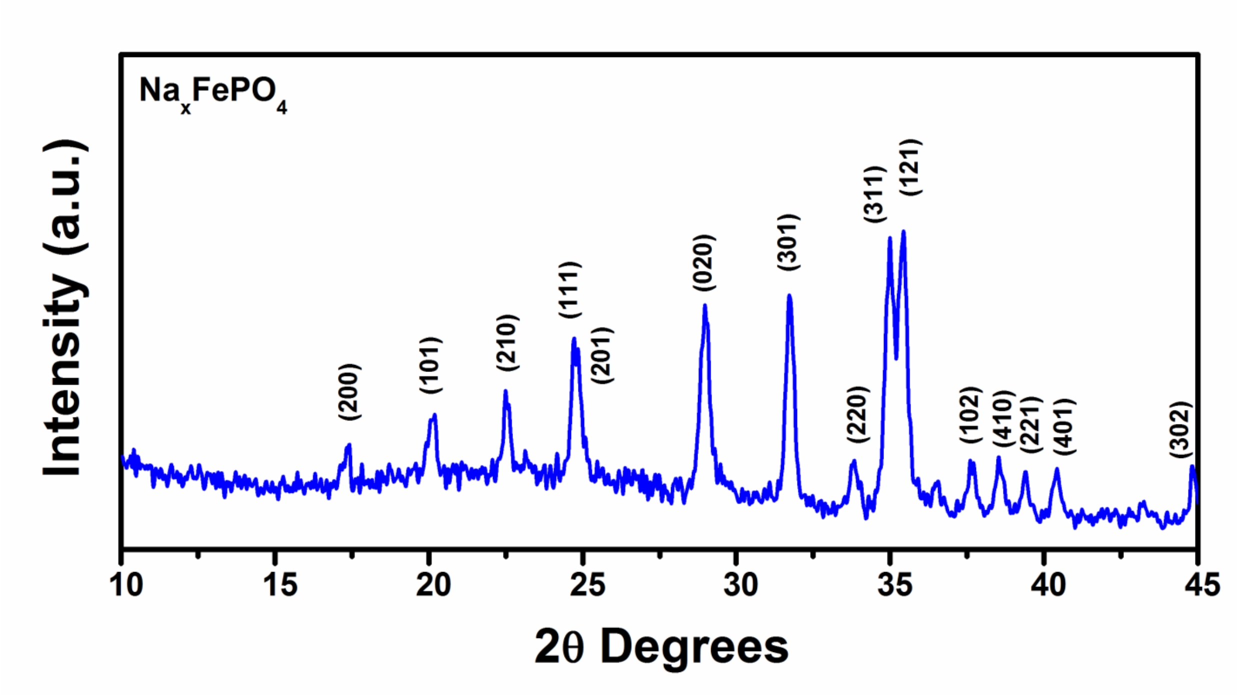

Figure S7. X-Ray diffraction pattern of electrochemically sodiated Na_xFePO_4.

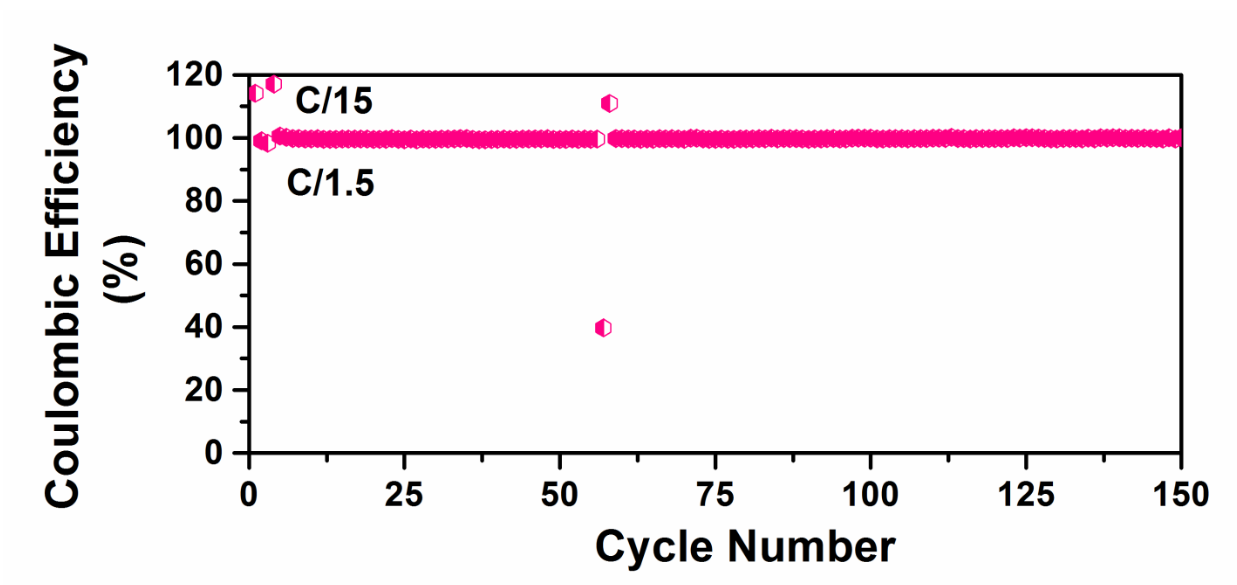

Figure S8. Coulombic Efficiency plot of MW processed FP-NIB cell, first 3 cycles at C/15 and then at C/1.5.

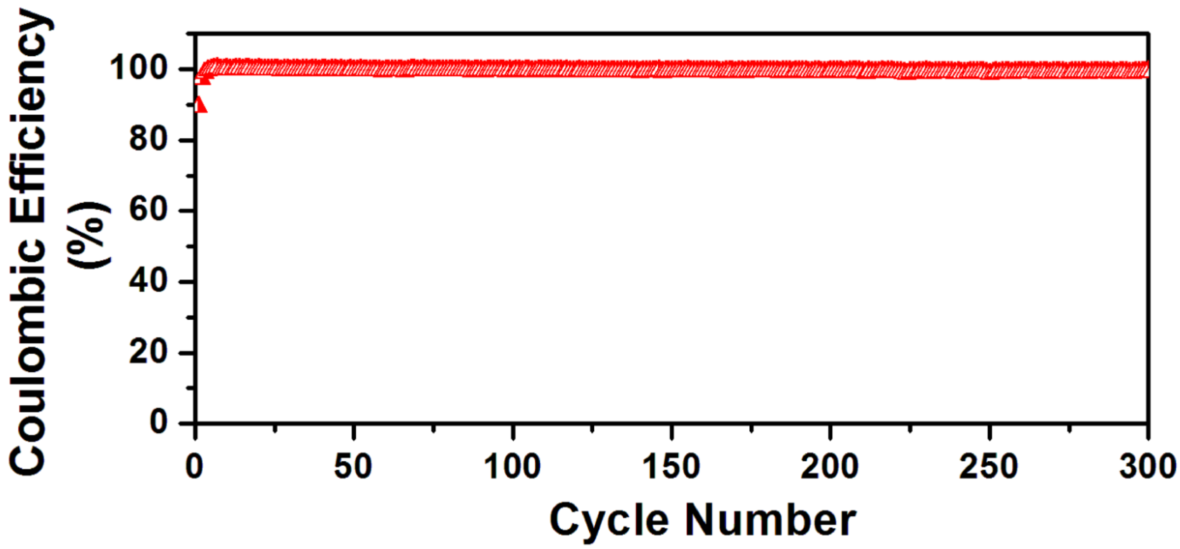

Figure S9. Coulombic Efficiency plot of LiI-FP LIB cell at 5C rate.

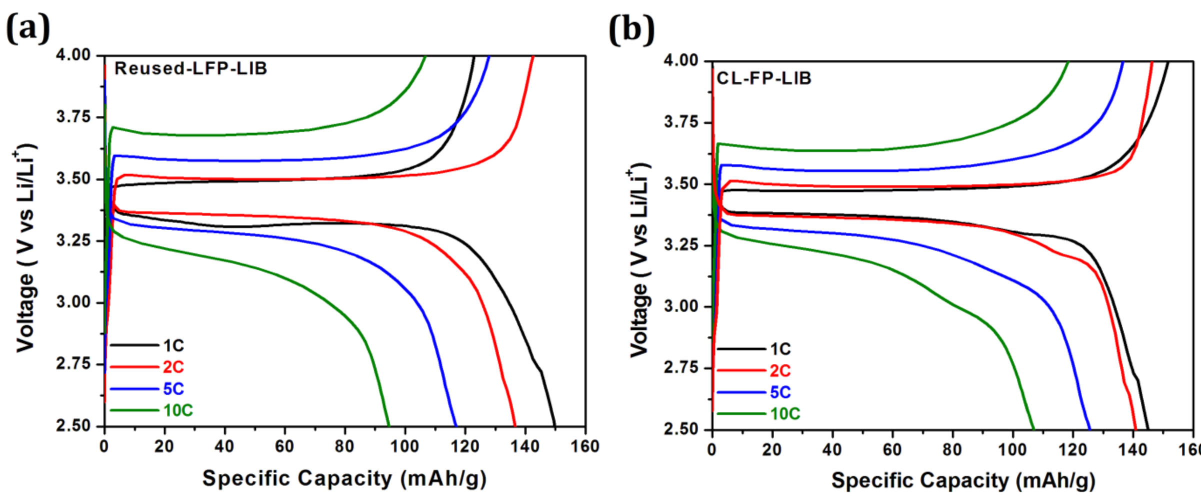

Figure S10: Lithium ion battery charge-discharge profiles of (a) reused-LIB and (b) CL-FP electrodes at different rates in the potential window from 2.5 V to 4V.

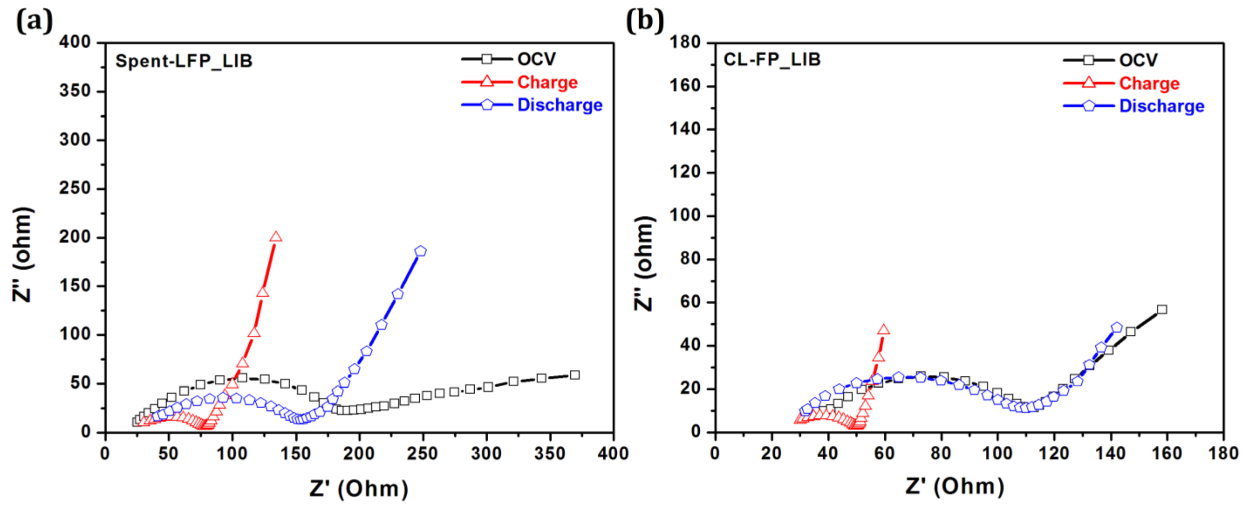

Figure S11: Electrochemical impedance analysis of (a) Spent-LFP and (b) CL-FP lithium ion cells in the frequency range from 10 kHz to 10 mHz at three different stages as indicated in legend.

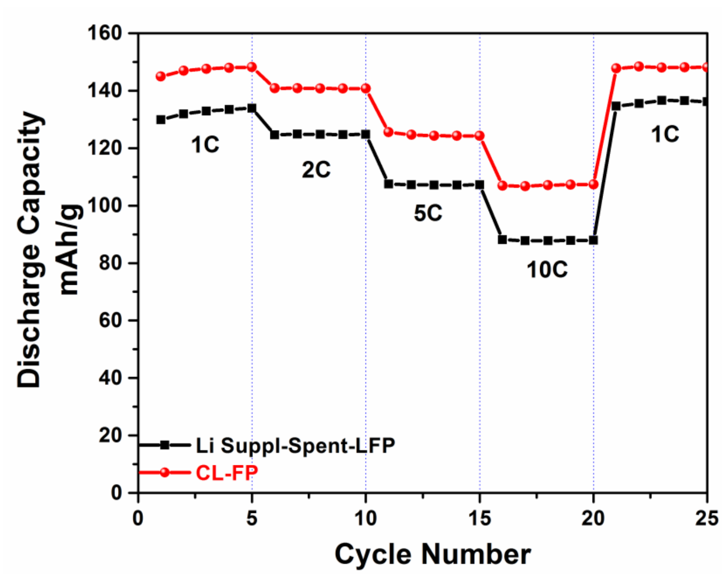

Figure S12: Rate performance comparison plot of lithium supplemented Spent-LFP and chemically lithiated FP.

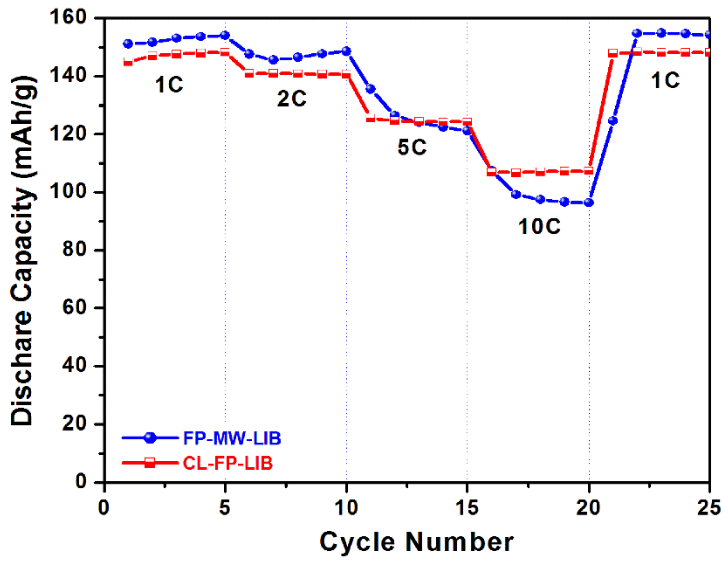

Figure S13: Rate performance plot of microwaved FP electrode (FP-MW) for lithium ion battery in comparison of chemically lithiated FP electrode. Rate performances were done at different rates (as shown in legend) for 5 cycles in the potential window from 2.5 V to 4V.

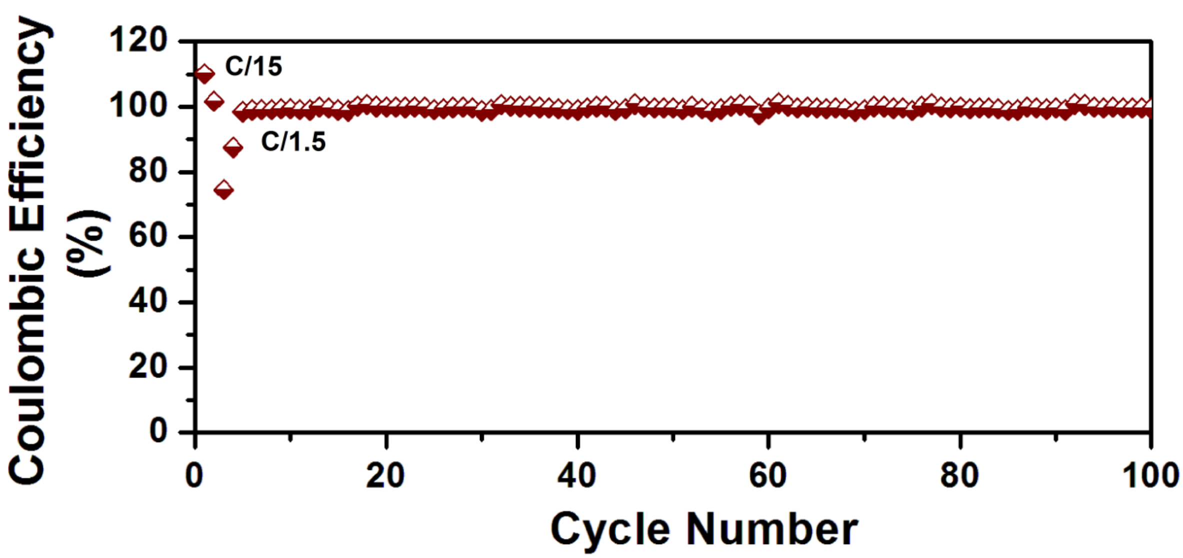

Figure S14. Coulombic Efficiency plot of NaI-FP sodium ion cell, first 3 cycles at C/15 and following cycles at C/1.5.

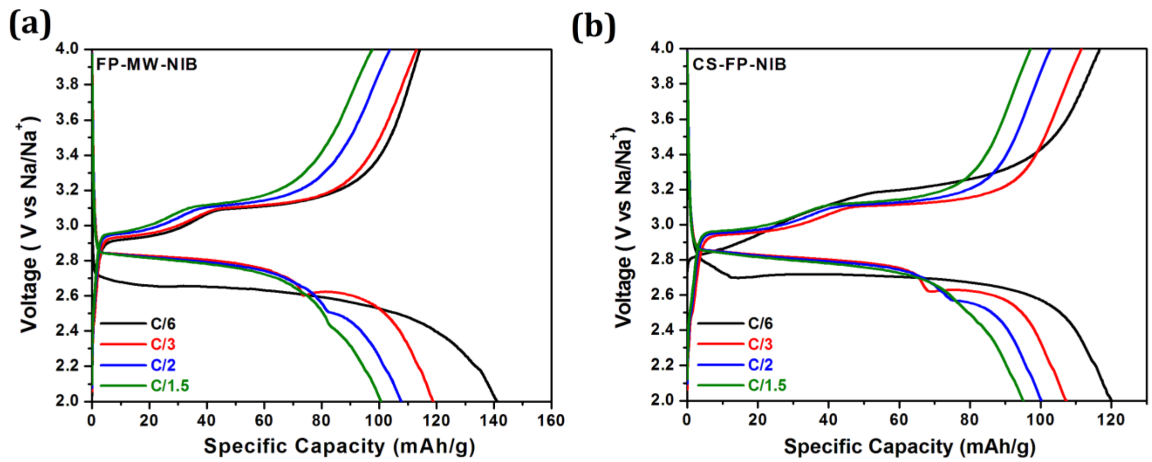

Figure S15: Sodium ion battery charge-discharge profiles of (a) FP-MW and (b) CS-FP electrodes at different rates from C/6 to C/1.5 as mentioned in the legend.

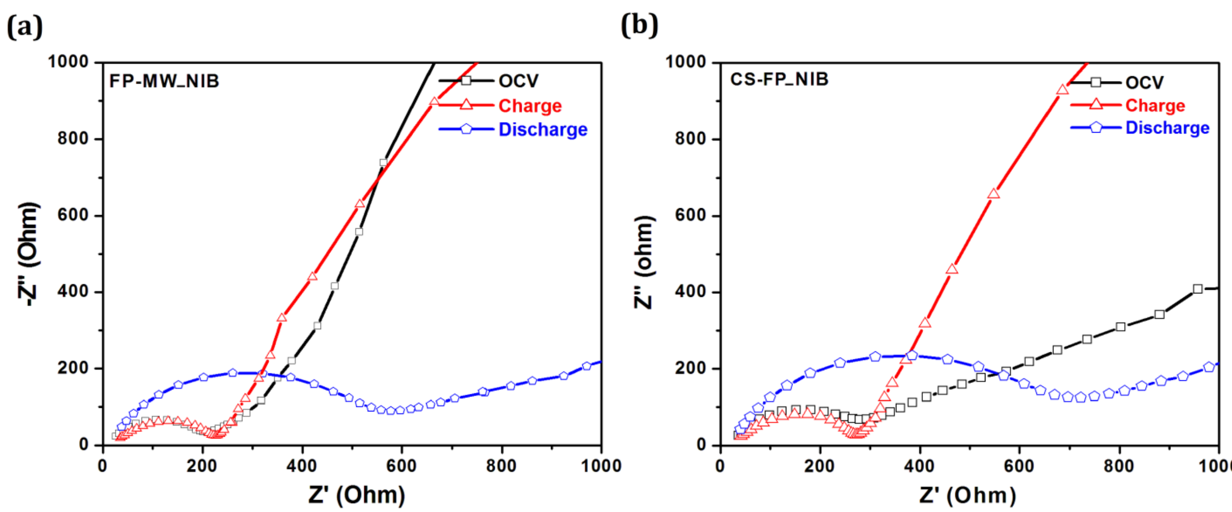

Figure S16: Electrochemical impedance analysis of (a) FP-MW and (b) CS-FP sodium ion cells in the frequency range from 10 kHz to 10 mHz at three different stages as indicated in legend.

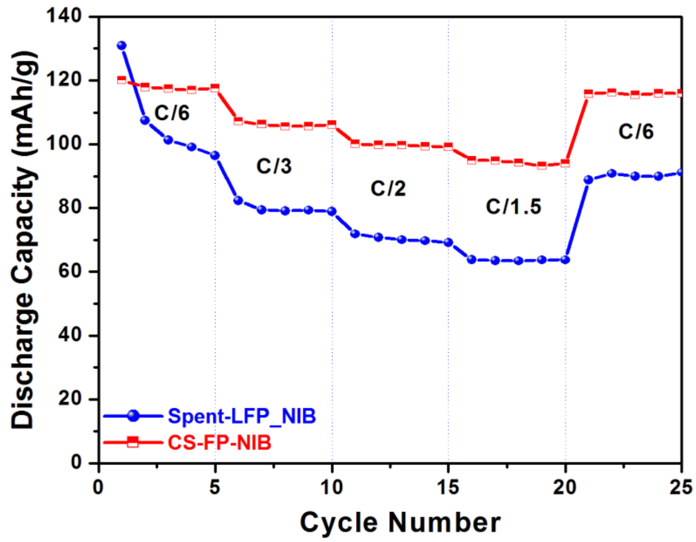

Figure S17: Rate performance plot of Spent-LFP electrode for sodium ion battery applications in comparison with CS-FP-NIB. The electrodes were cycled at different rates (as shown in legend) for 5 cycles in the potential window from 2.0 V to 4.0 V.

References:

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