

Supplementary Information

Spent graphite from lithium-ion batteries: Re-use and the impact of ball milling for re-use

Jian Peng,^a Stefanie Maslek,^b and Neeraj Sharma^{*a}

^aSchool of Chemistry, UNSW Sydney, Sydney NSW 2052, Australia

^bMint Innovation, 13 Lorien Place, Auckland 2013, New Zealand

Table S1 Lattice parameter of phases of PRG-LCO derived from Rietveld analysis

Phases	$a(\text{\AA})$	$c(\text{\AA})$	$\text{vol}(\text{\AA}^3)$	wt%
Al_2O_3	4.761(3)	13.011(5)	255.4(2)	2.9(3)
Graphite	2.4642(2)	6.72200(9)	35.350(3)	97.1(3)

Table S2 Lattice parameter of phases of PRG-NMC derived from Rietveld analysis

Phases	$a(\text{\AA})$	$c(\text{\AA})$	$\text{vol}(\text{\AA}^3)$	wt%
Al_2O_3	4.7652(6)	13.012(2)	255.88(4)	3.24(4)
$\text{Ni}_{0.3}\text{Fe}_{0.7}$	3.614(1)	3.614(1)	47.21(4)	3.76(7)
Graphite	2.4644(2)	6.72555(8)	35.373(3)	93.00(6)

Table S3 Lattice parameter and microstructure parameter of recycled graphite before and after ball milling

Sample	$a(\text{\AA})$	$c(\text{\AA})$	$\text{vol}(\text{\AA}^3)$	L_c (nm)
PRG-LCO	2.4642(2)	6.72200(9)	35.350(3)	33.55
PRG-LCO-3h	2.4977(7)	6.72228(6)	36.32(1)	26.72
PRG-LCO-30h	2.412(2)	6.7573(3)	34.05(3)	14.29
PRG-NMC	2.4644(2)	6.72555(8)	35.373(3)	31.43
PRG-NMC-3h	2.3747(4)	6.72404(5)	32.839(7)	25.02
PRG-NMC-30h	2.4538(7)	6.6970(2)	34.92(1)	17.22
Sigma graphite	2.4526(4)	6.68309(9)	34.814(8)	26.53

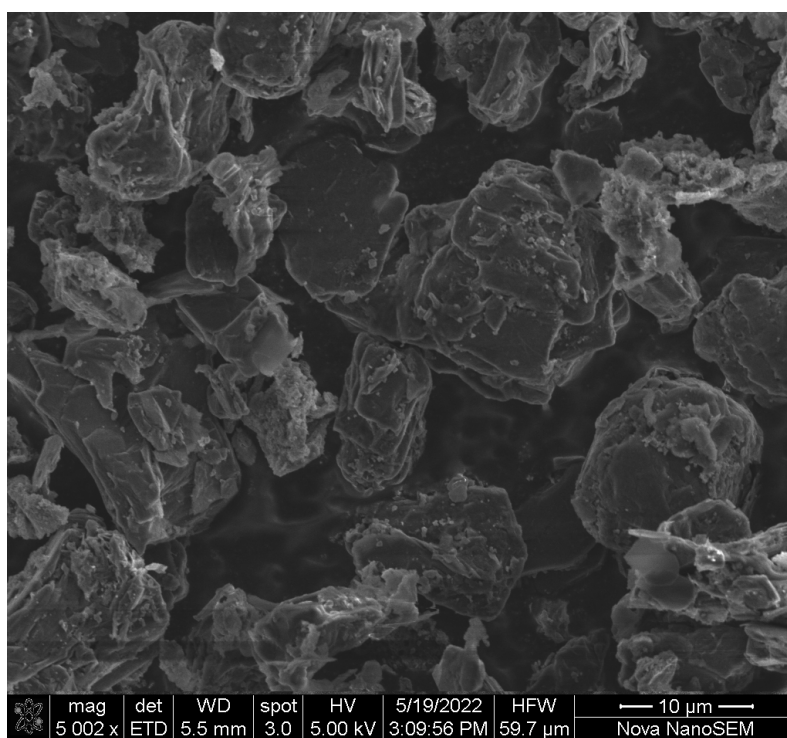


Figure S1 Microstructure of PRG-LCO powder

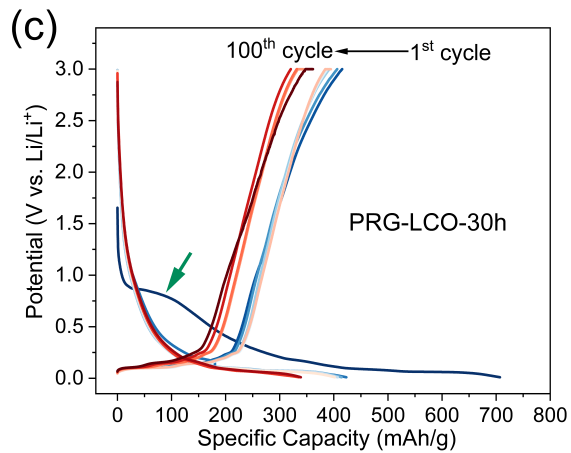
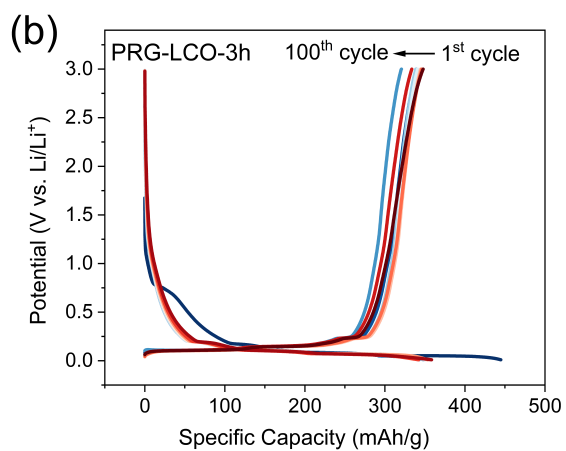
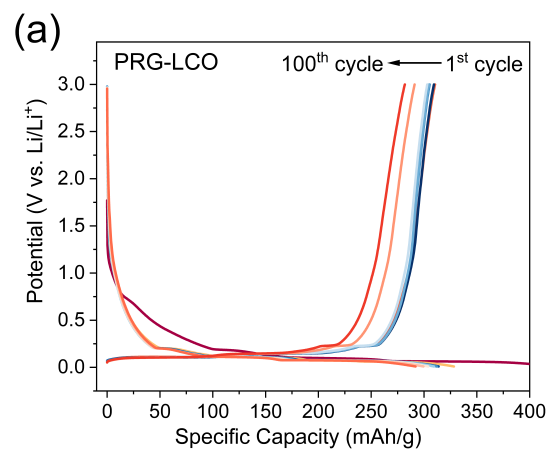


Figure S2 Charge/discharge curves of (a) PRG-LCO; (b) PRG-LCO-3h; (c) PRG-LCO-30h

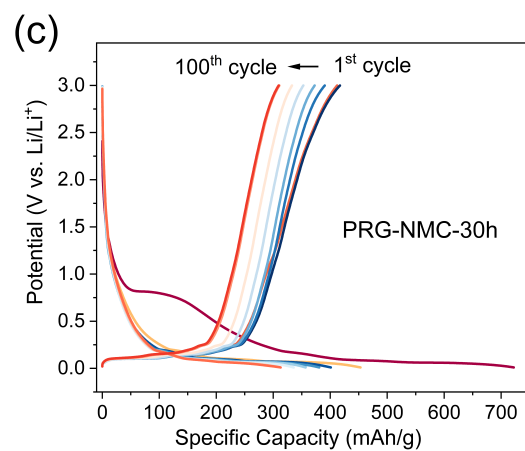
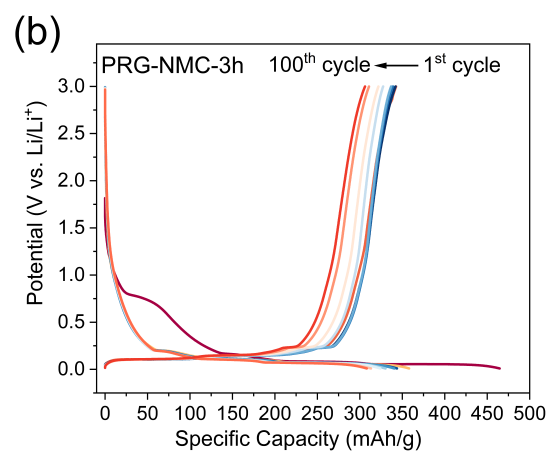
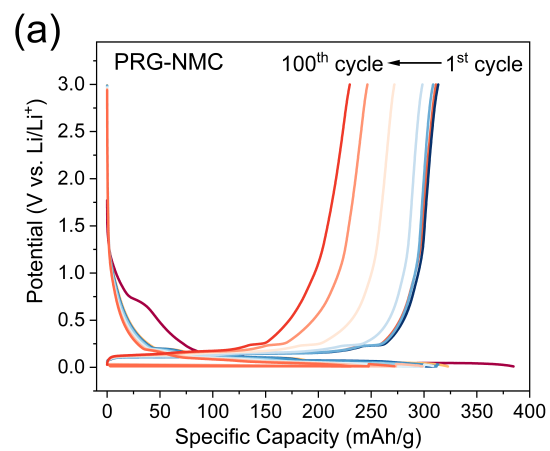


Figure S3 Charge/discharge curves of (a) PRG₄NMC; (b) PRG-NMC-3h; (c) PRG-NMC-30h

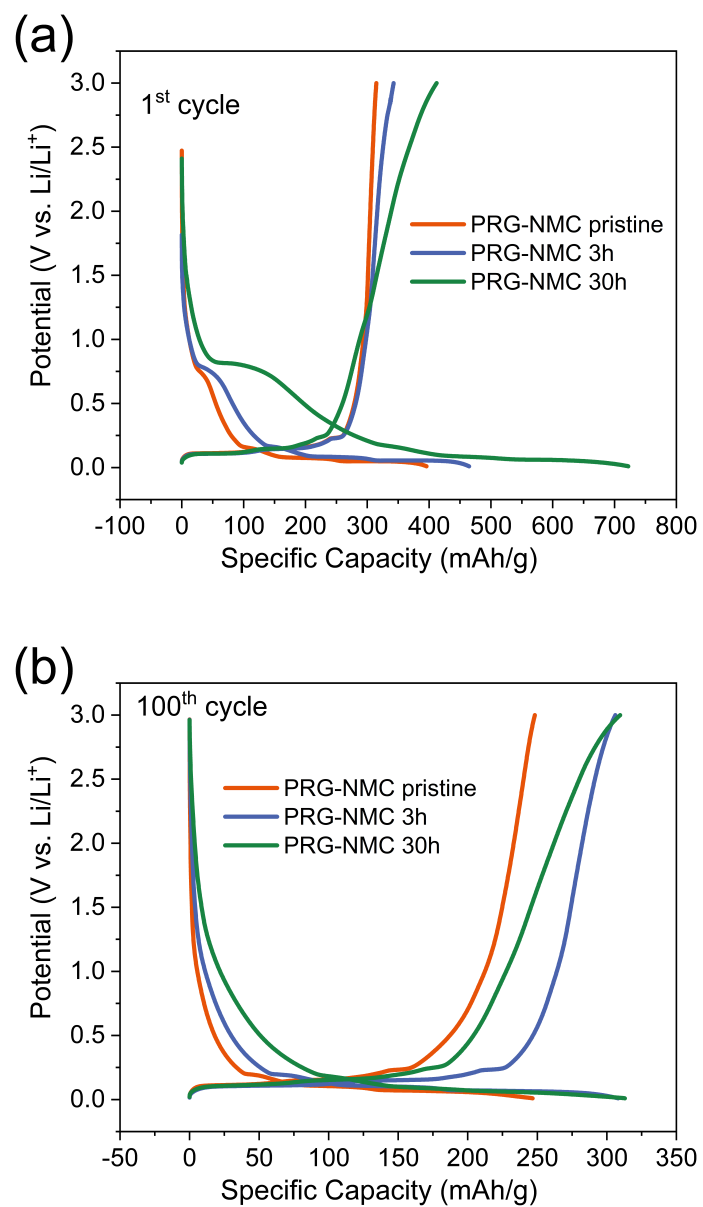


Figure S4 First cycle and 100th cycle charge-discharge curves of ball milled PRG-NMC cells, discharge capacity versus cycle number of ball milled cells

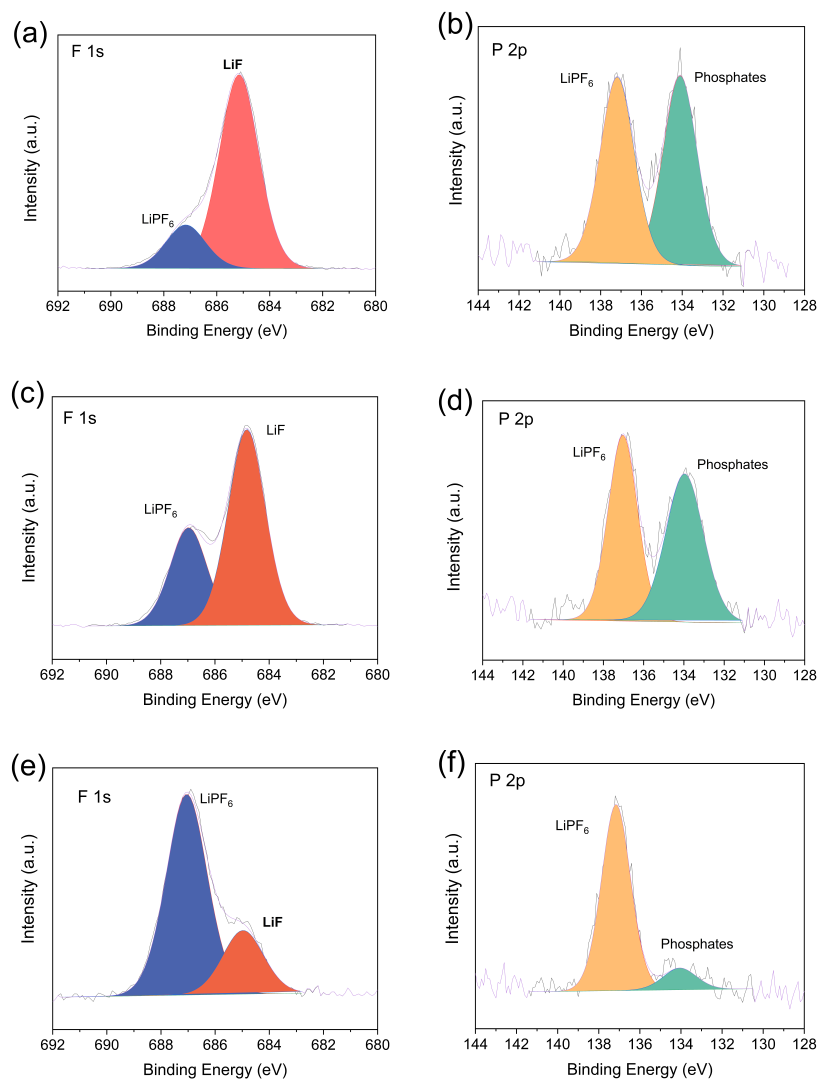


Figure S5 F 1s XPS pattern for (a) PRG-LCO electrode after 100 cycles; (c) PRG-LCO-3h electrode after 100 cycles; (e) PRG-LCO-30h electrode after 100 cycles; and P 2p XPS pattern for (b) PRG-LCO electrode after 100 cycles; (d) PRG-LCO-3h electrode after 100 cycles; (f) PRG-LCO-30h electrode after 100 cycles