

Supporting Information

Fly ash carbon anodes for alkali metal-ion batteries

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1. Supplementary Figures

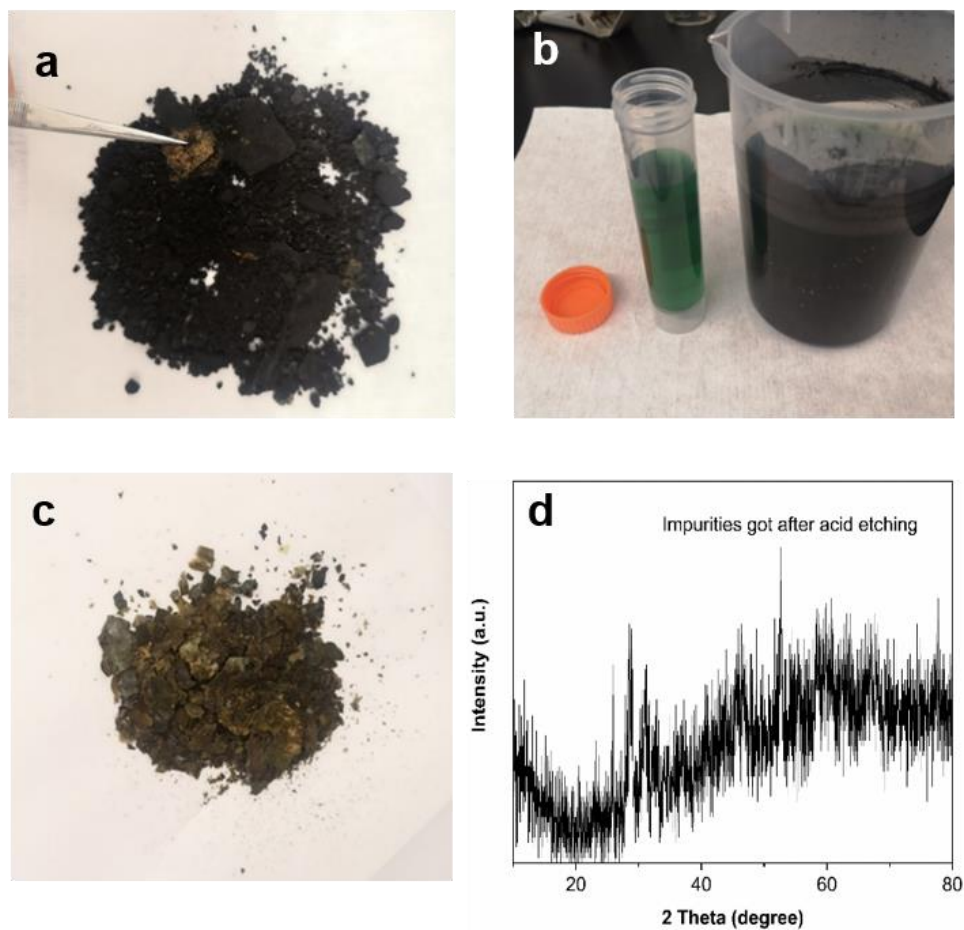


Figure S1. Optical photograph of (a) fly ash, (b) filter liquor after fly ash soaked in the 1 mol L⁻¹ HCl, and (c) impurities from the dried filter liquor. (d) XRD pattern of the impurities.

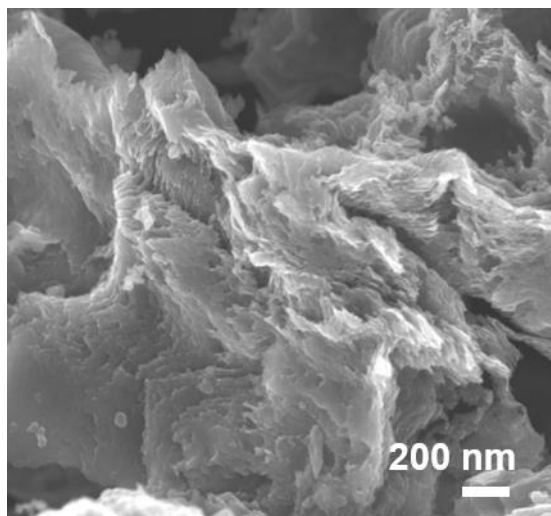


Figure S2. SEM image of FACT.

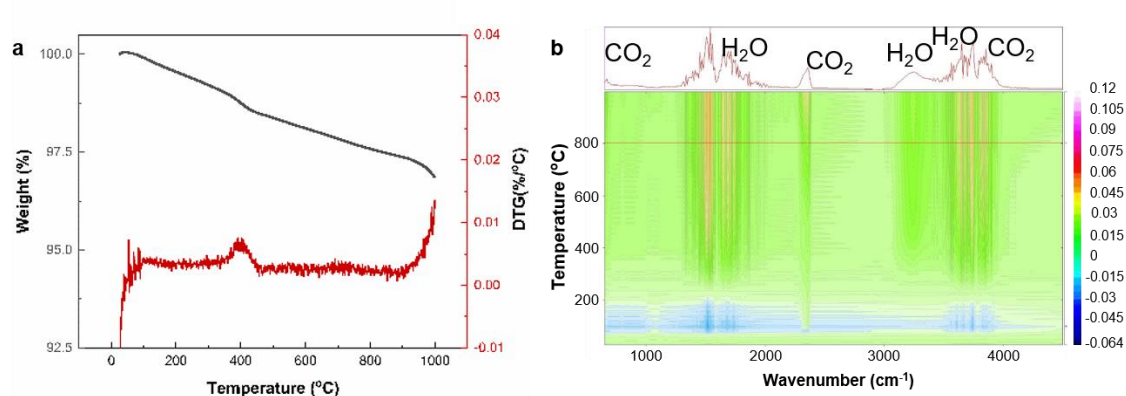


Figure S3. (a) TGA, DTG curves of FAC in the argon atmosphere, and corresponding (b) FTIR spectra of the gas produced in the thermal treatment of FAC.

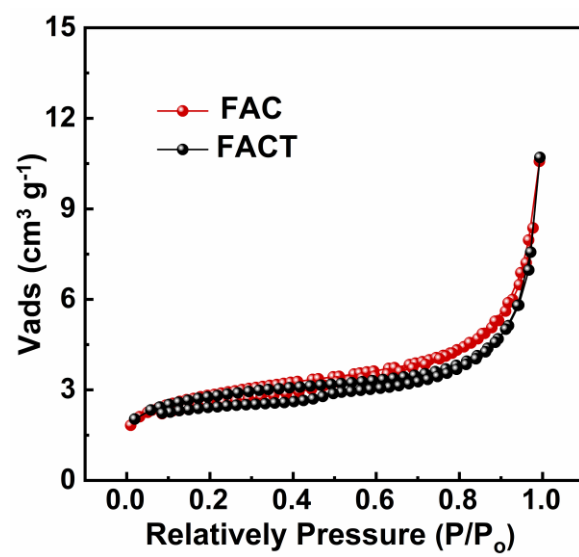


Figure S4. N₂ adsorption and desorption isotherms of FAC and FACT.

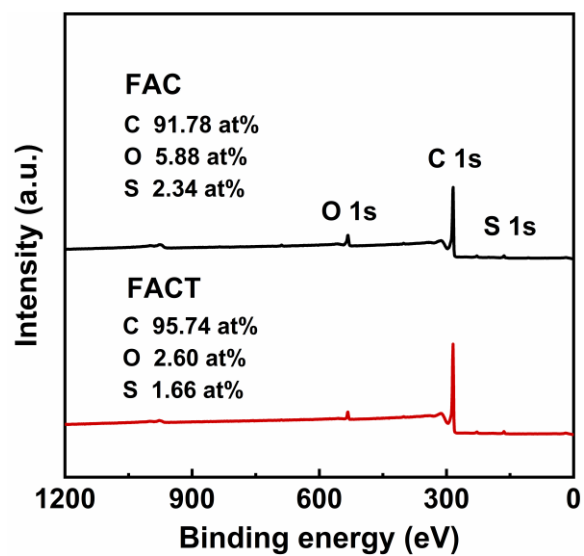


Figure S5. XPS survey of FAC and FACT.

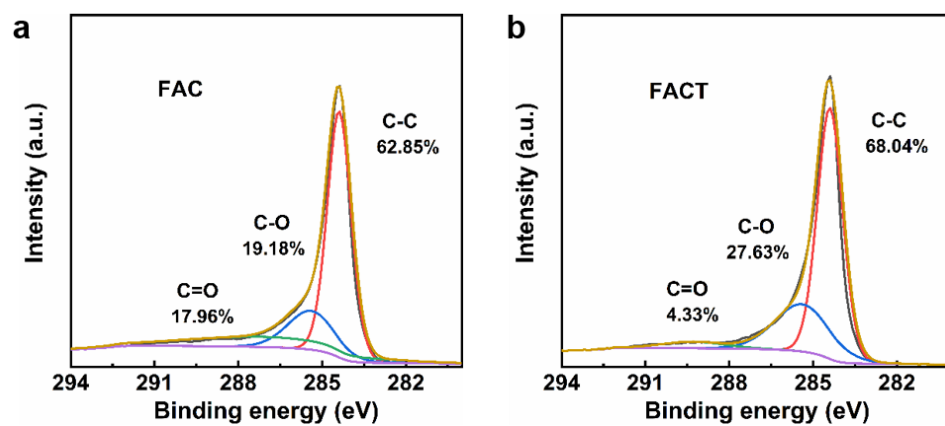


Figure S6. High-resolution C 1s XPS spectra of (a) FAC and (b) FACT.

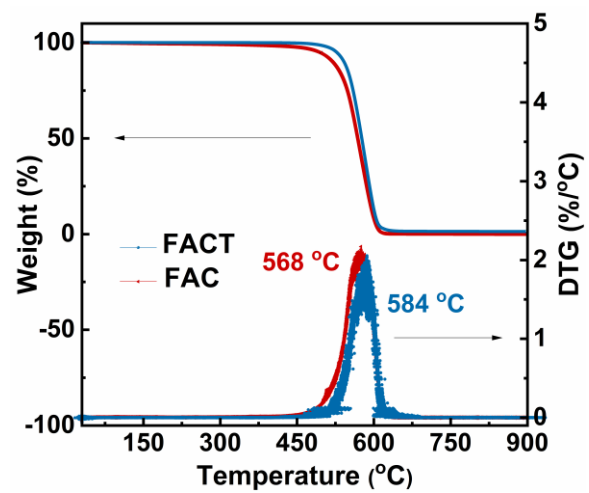


Figure S7. TGA and DTG curves of FAC and FACT in the air atmosphere.

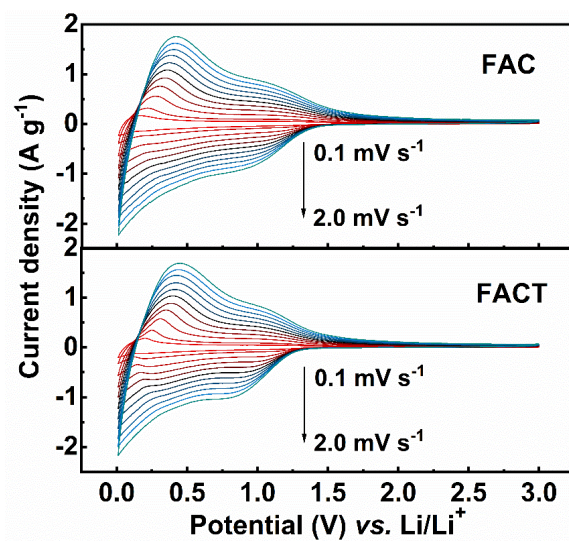


Figure S8. CV at various scan rates from 0.1 to 2.0 mV s^{-1} of FAC and FACT anodes in lithium-ion half cells.

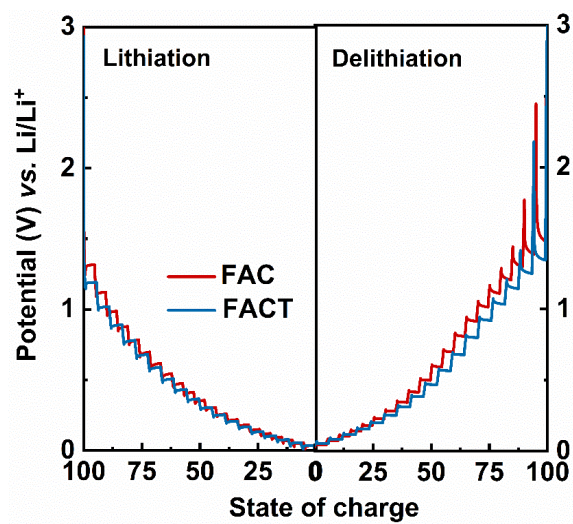


Figure S9. GITT profiles of FAC and FACT anodes in lithium-ion half cells tested at a current density of 50 mA g⁻¹.

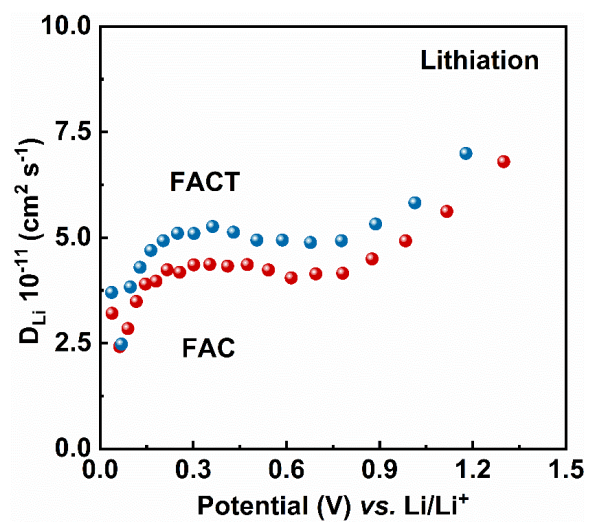


Figure S10. Diffusion coefficient of Li⁺ ions in the FAC and FACT anodes during the discharge process.

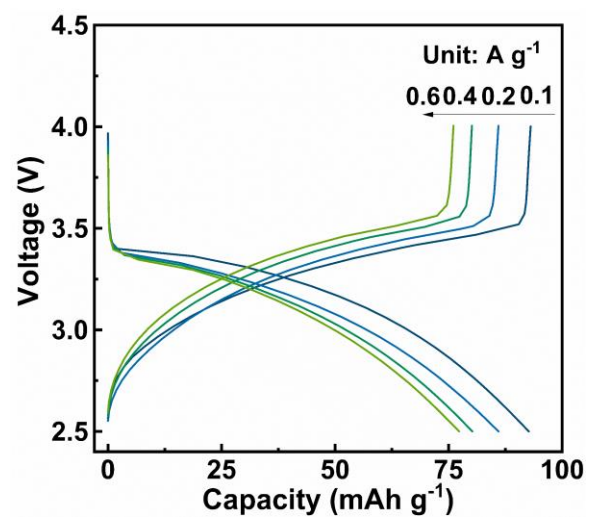


Figure S11. GCD curves of FAC//LiFePO₄ full cell under different current densities.

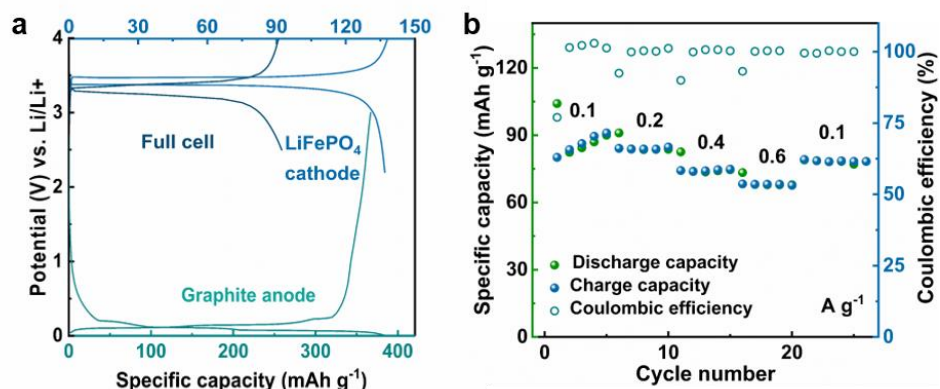


Figure S12. (a) GCD curves of LiFePO₄ cathode, graphite anode, and graphite//LiFePO₄ full cell. (b) The rate capability of graphite//LiFePO₄ full cell.

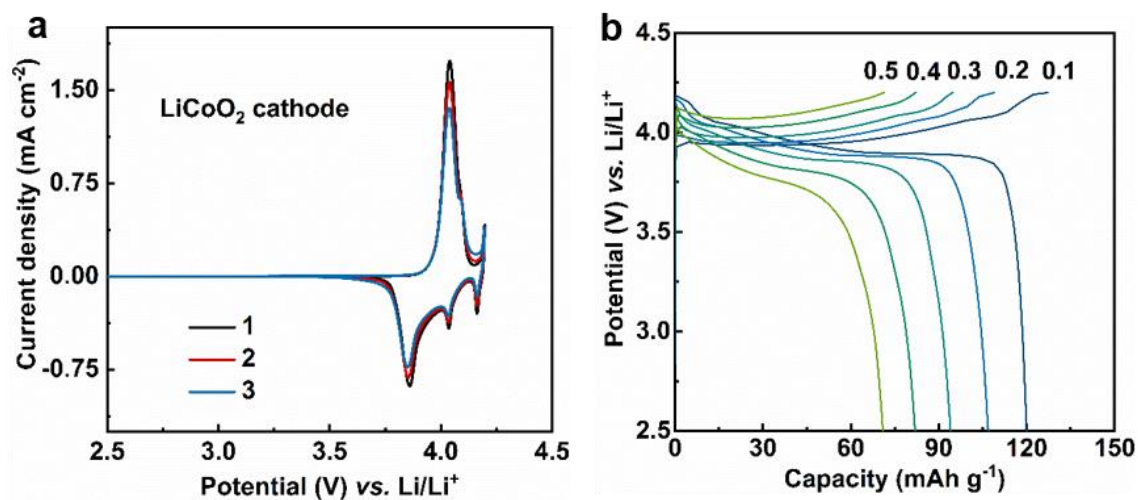


Figure S13. (a) CV curves and (b) GCD curves of LiCoO_2 cathode.

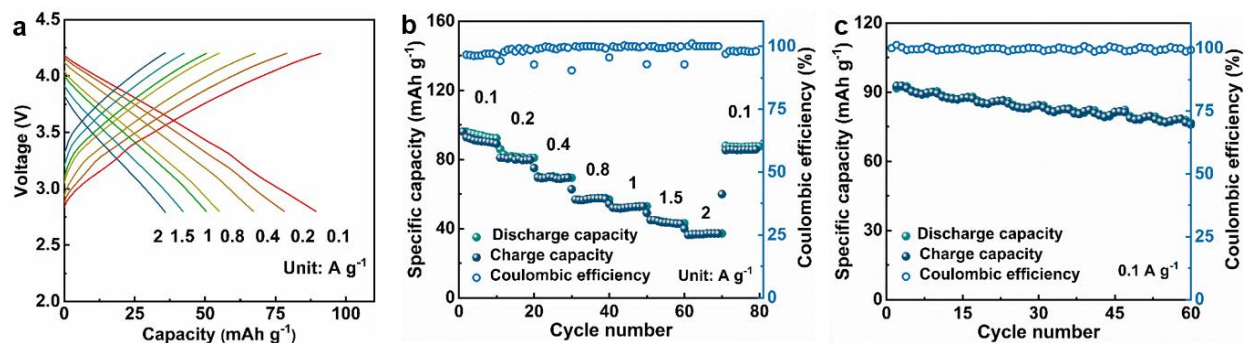


Figure S14. (a) GCD curves FAC//LiCoO₂ full cell. (b) Rate capability of FAC//LiCoO₂ full cell. (c) Cycling performance of the FAC//LiCoO₂ full cell of 0.1 A g⁻¹ (Capacity is calculated with the total weight of cathode and anode).

2. Supplementary Tables

Table S1 Elemental contents of FAC and FACT tested by ICP.

Element	FAC	FACT
	Mass percentage	Mass percentage
	wt. %	wt. %
V	0.122	0.135
Na	0.017	0.018
Al	0.060	0.066
Fe	0.047	0.051
Si	0.177	0.196

Table S2 Atomic fraction of FAC anode with different etching time.

Elemental fraction (at%)		Li	C	O	P	F
Charge state	Etching time					
3 V	0	34.82	30.39	21.42	0.78	10.59
	10 min	33.59	33.90	21.24	0.47	10.80
	20 min	34.95	34.12	19.22	0.45	11.26
	30 min	31.98	37.14	18.40	-	12.47
0.01 V	0	43.20	22.88	27.35	0.37	6.19
	10 min	42.23	27.78	27.55	0.45	6.00
	20 min	46.22	22.27	25.40	0.31	5.80
	30 min	47.96	21.76	23.98	0.45	5.85