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Supplementary Materials for

A "cation-anion regulation" synergistic anode host for dendrite-free lithium metal batteries

Weidong Zhang, Houlong L. Zhuang, Lei Fan, Lina Gao, Yingying Lu

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The PDF file includes:

Other Supplementary Material for this manuscript includes the following:

(available at advances.sciencemag.org/cgi/content/full/4/2/eaar4410/DC1)

- movie S1 (.mp4 format). Shape of a droplet (ether-based electrolyte) on the bare lithium foil.
- movie S2 (.mp4 format). Spreading behavior of a droplet (ether-based electrolyte) on the q-PET/Li composite anode.

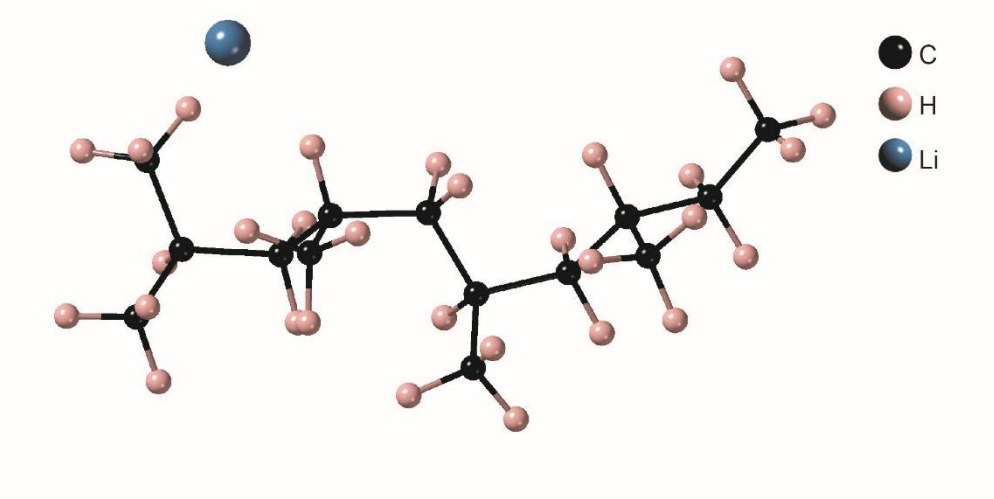

fig. S1. Sketch of the structures of PP separator and Li atom after geometry optimizations.

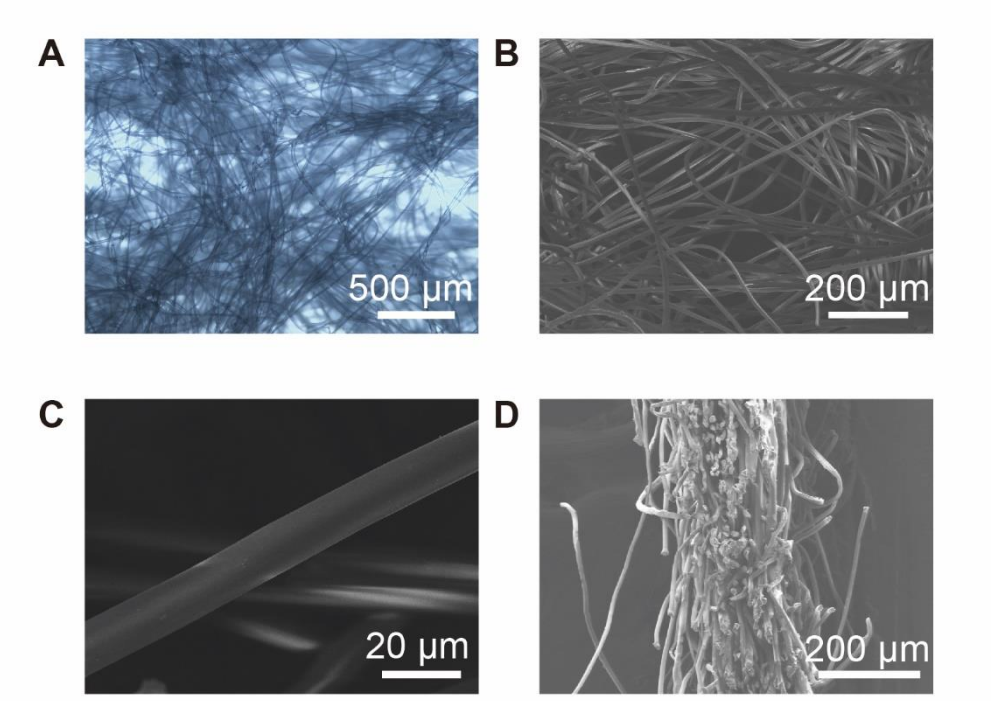

fig. S2. Images of q-PET nonwoven fabric. (**A**) The optical microscopy image q-PET nonwoven fabric. (**B**) SEM images of q-PET nonwoven fabric. (**C**) SEM images of individual q-PET fiber. (**D**) The cross-sectional SEM image of q-PET nonwoven fabric.

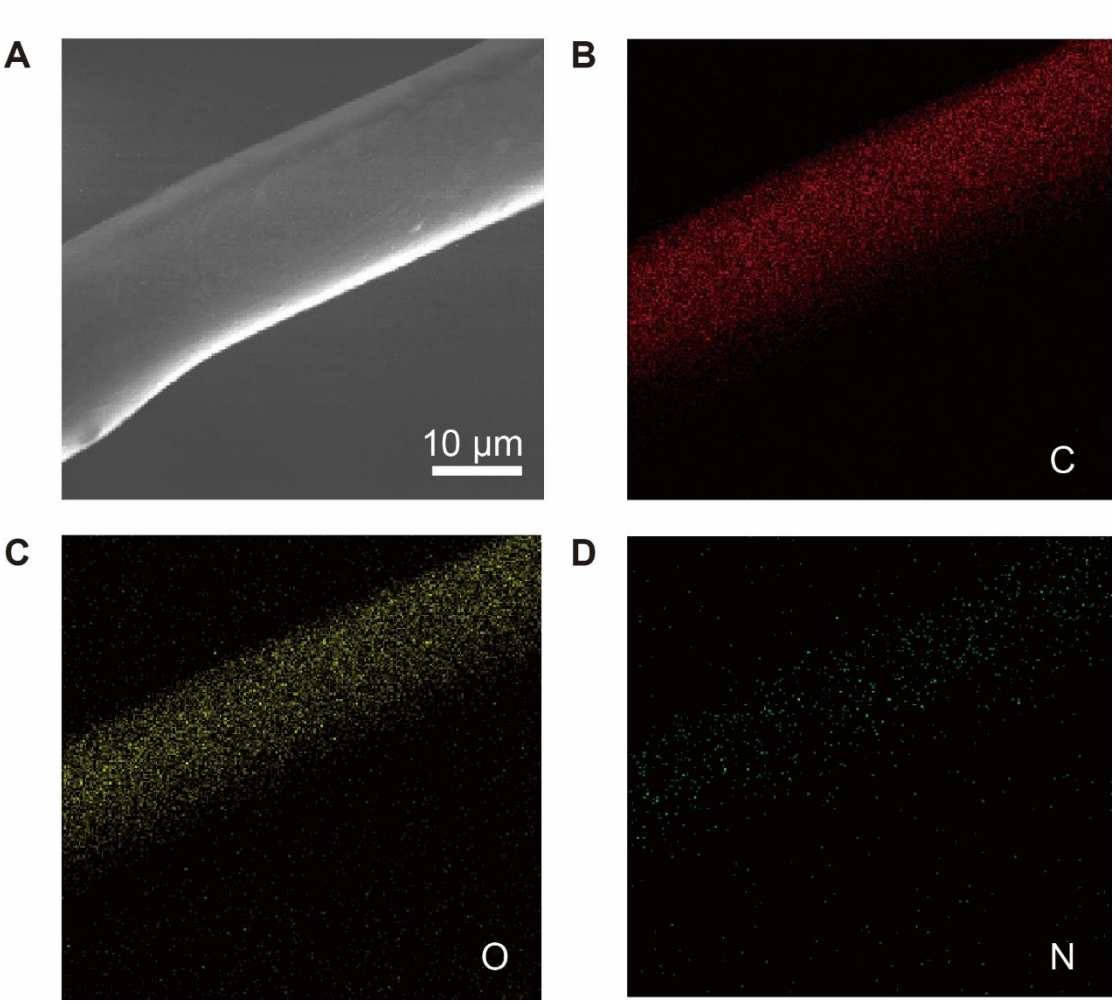

fig. S3. SEM and elemental mapping images showing the homogenous distribution of C, N, and O in the q-PET fiber.

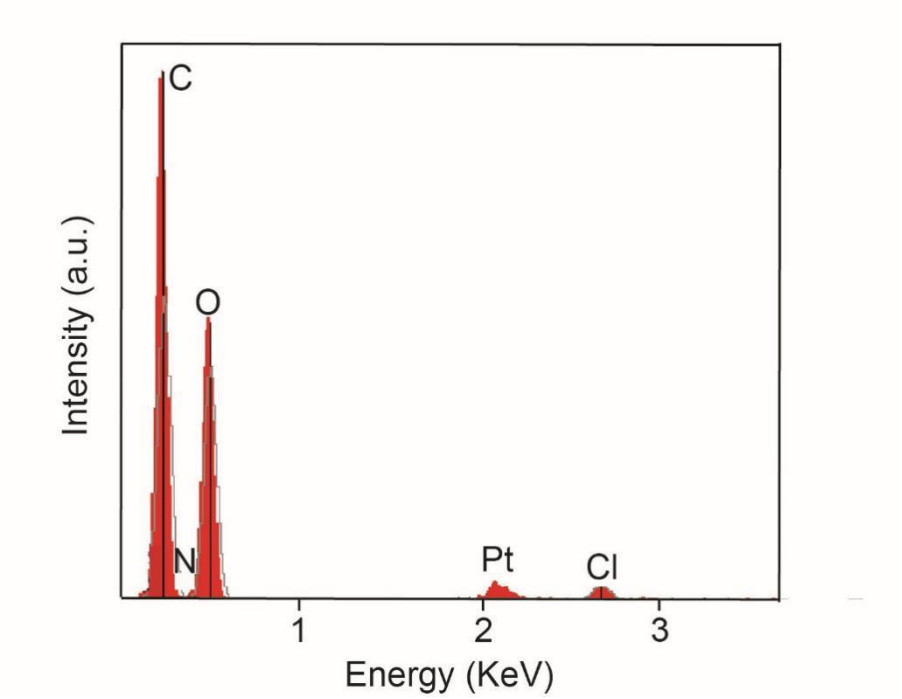

fig. S4. EDX spectrum under SEM mode.

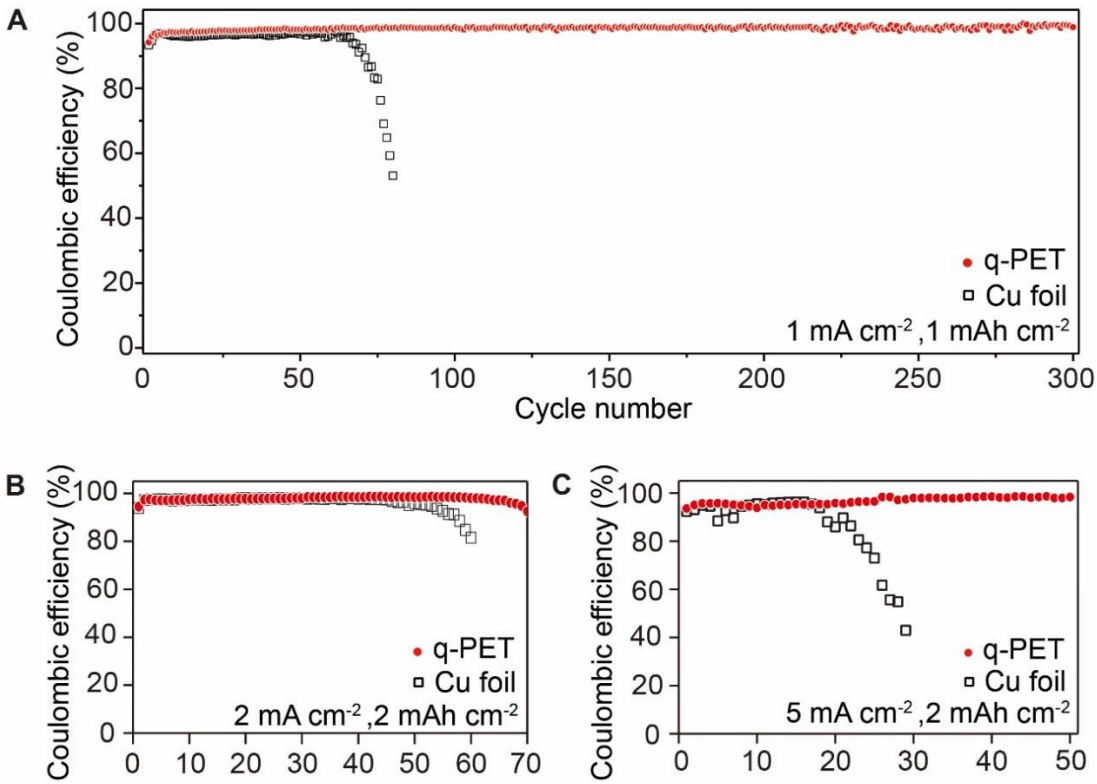

fig. S5. Cycling performances of Li/Cu cells. (**A**) Long-term electrochemical performance of Li/Cu cells at 1 mA cm^{-2} with a capacity of 1 mAh cm^{-2}. (**B** and **C**) Comparison of Coulombic efficiency of Cu foil with and without q-PET fabric at various current rates of (**B**) 2 mA cm^{-2} and (**C**) 5.0 mA cm^{-2} with the same areal capacity of 2.0 mAh cm^{-2}.

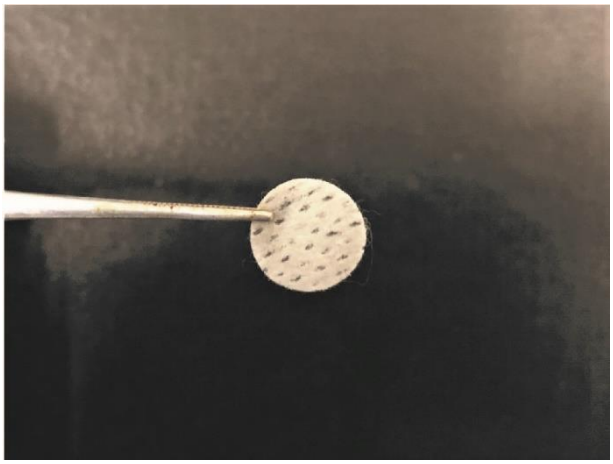

fig. S6. Digital picture of q-PET interlayer after 30 cycles.

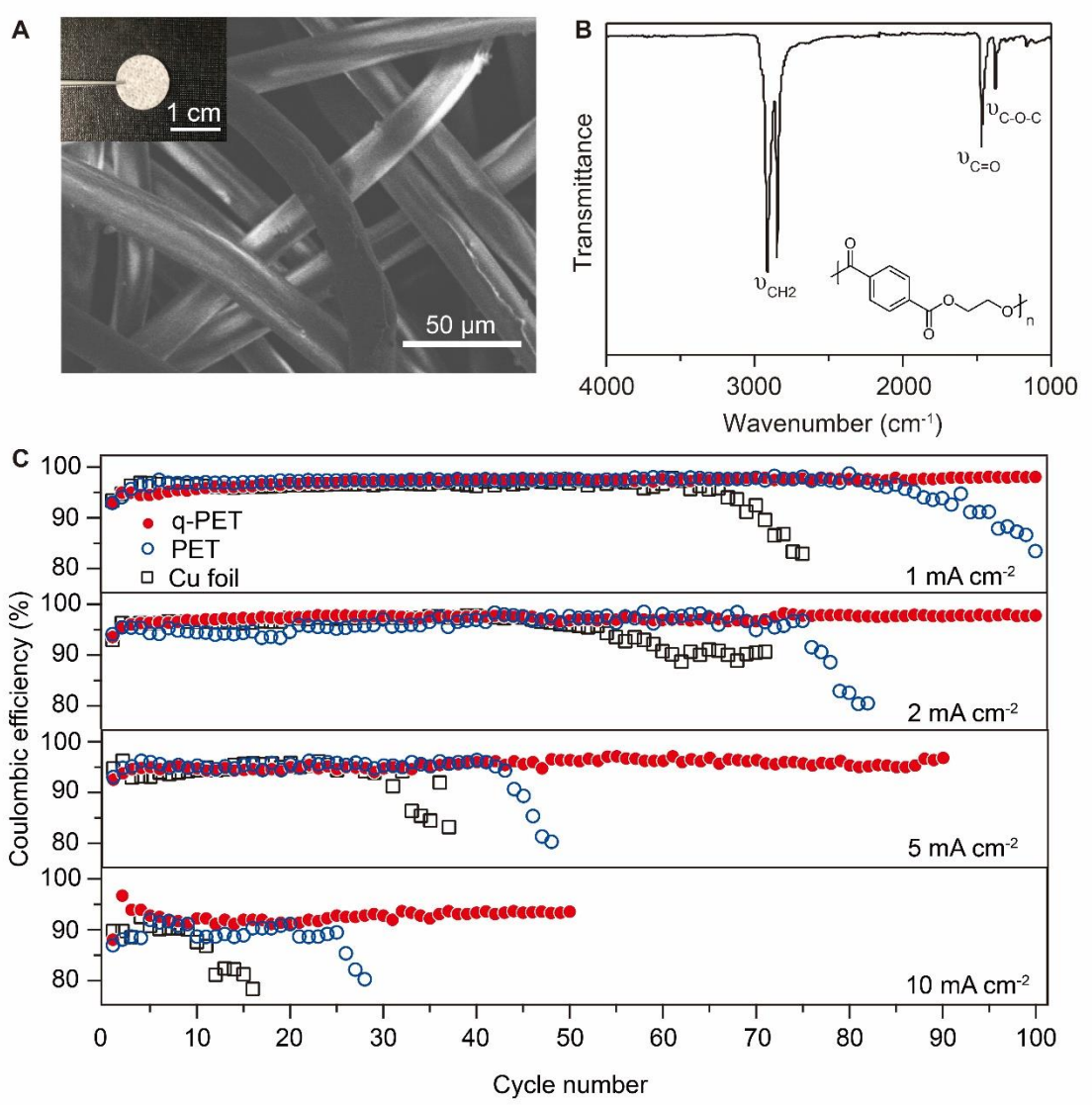

fig. S7. Effectiveness of lithiophilic effect only. (**A**) SEM image of poly (ethylene terephthalate) (PET) fiber network. The inset shows the digital picture of PET fabric.

(**B**) FTIR spectrum of PET. **(C)** Lithium Coulombic efficiencies of cells with bare Cu foil, with PET ("lithiophilic effect only"), or with q-PET ("lithiophilic-anionphilic synergistic effect") at various current densities with the same areal capacity of 1.0 mAh cm^{-2}.

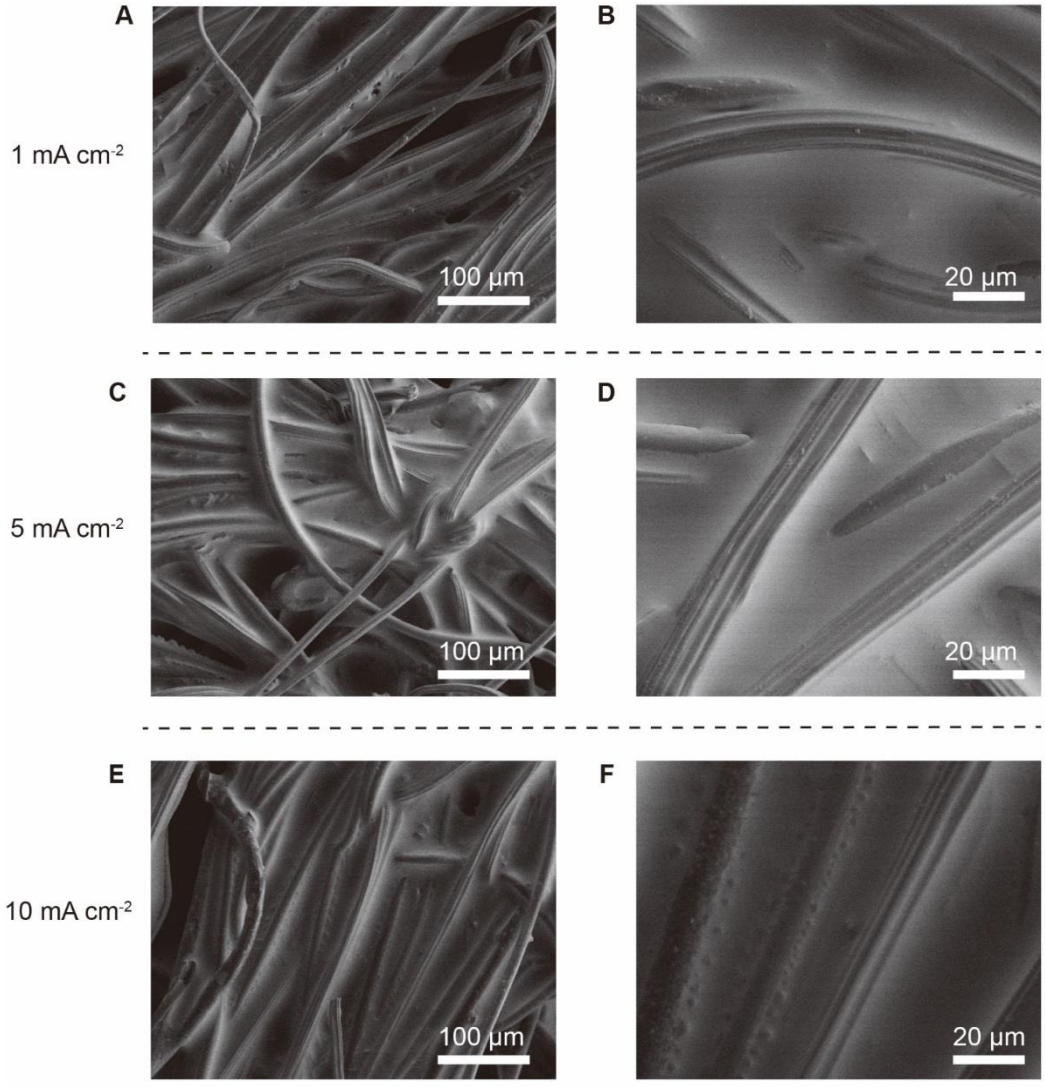

fig. S8. SEM images of Li deposition on q-PET fiber–modified electrodes after 10 cycles.

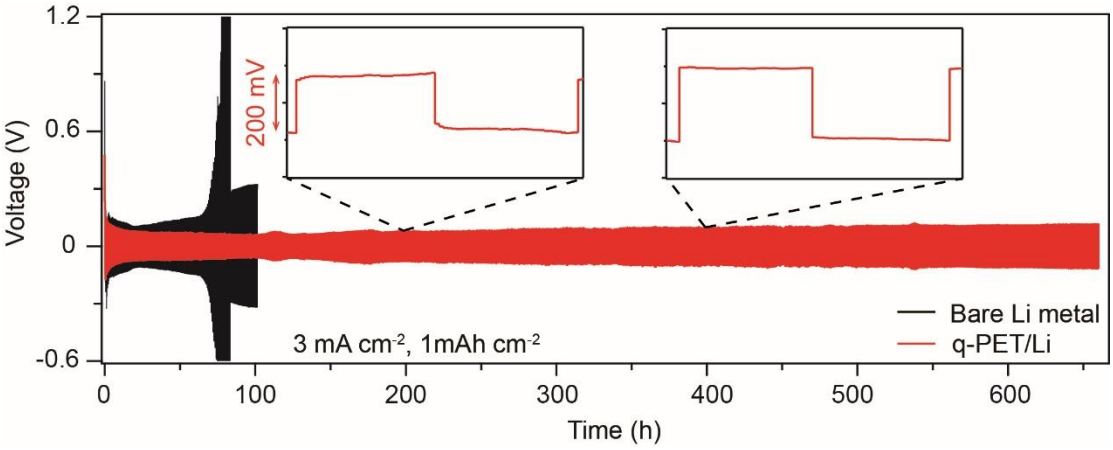

fig. S9. Galvanostatic cycling performance of symmetrical cells.

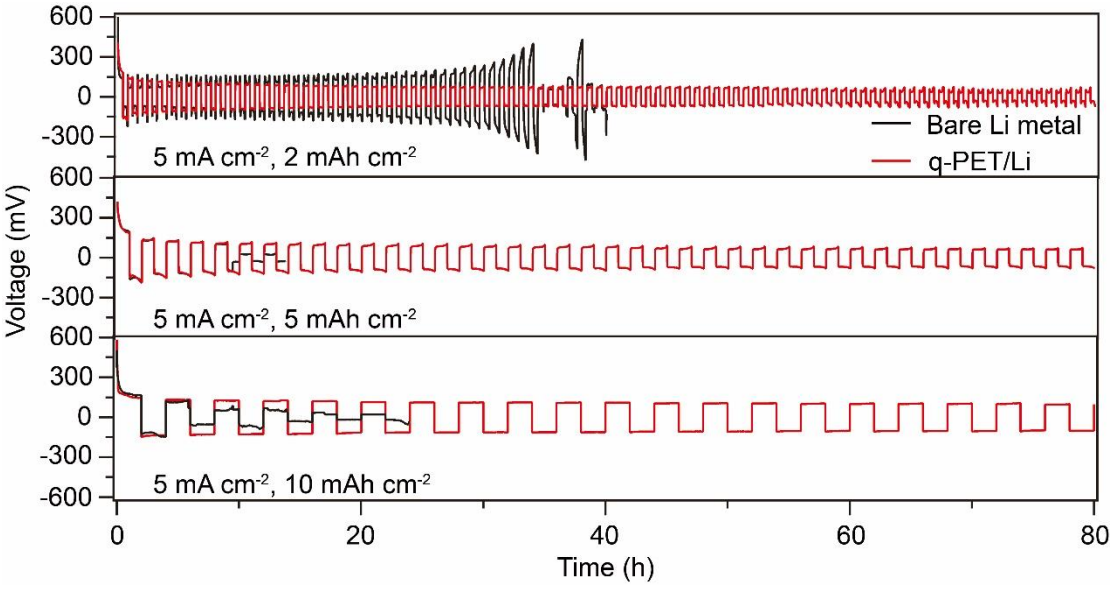

fig. S10. Galvanostatic cycling performance of symmetrical cells at 5 mA cm^{-2} with high areal capacities of 2, 5, or 10 mA·hour cm^{-2}.

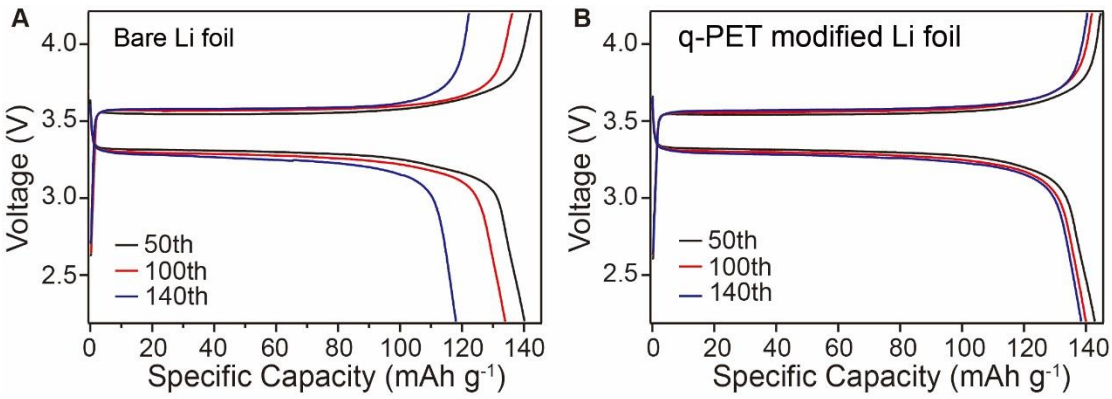

fig. S11. Charge-discharge profiles of the Li/LFP cells at different cycles. (A) Charge–discharge profiles of the Li/$LiFePO_4$ cells at 0.5 C using bare Li foil, and (**B**) using q-PET modified Li foil.

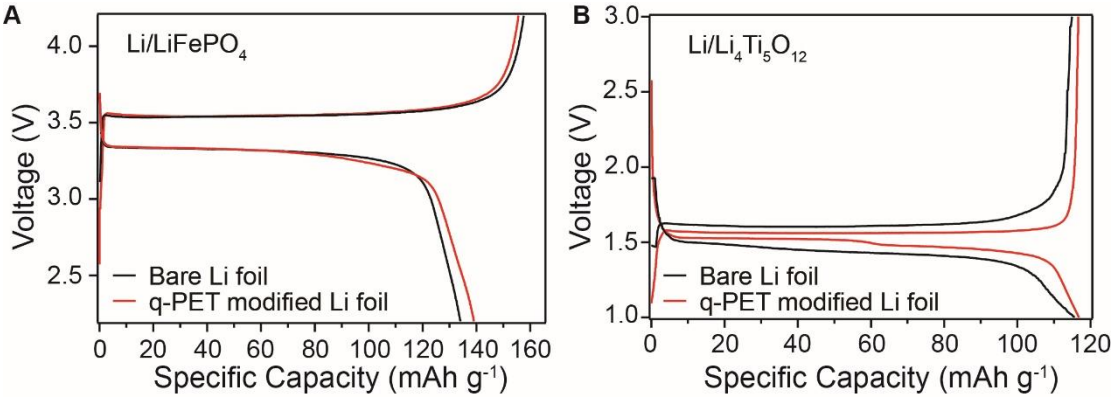

fig. S12. Voltage profiles of Li/LFP and Li/LTO half cells with or without q-PET (first cycle).

table S1. Binding energies using DFT calculations.

Materials	Binding energy E_b
q-PET with TFSI anion	3.93 eV
q-PET with Li-ion	0.69 eV
Polypropylene separator with Li-ion	-0.35 eV

table S2. Elemental analysis (Dumas combustion).

Sample Name	N content (wt%)	C content (wt%)	H content (wt%)
q-PET fiber	0.52	58.57	7.72

table S3. Li CE of q-PET–modified cells compared with other state-of-the-art modifications.

Current / Capacity ($mAh\ cm^{-2}$ / $mAh\ m^{-2}$)	CE / Lifespan (%/cycles)	Modifications	ref
0.5 / 0.5	98 / 90	glass fiber	(*18*)
	98.7 / 120	LiF protected	(*38*)
0.5 / 1.0	97.5 / 100	3D Cu current collector/Li	(*39*)
	99 / 100	LiF artificial SEI	(*26*)
	97.6 /120	silly putty	(*40*)
1.0 / 0.5	97 / 67	glass fiber	(*18*)
	97.6 / 240	polyimide coating	(*41*)
1.0 / 1.0	97.0 / 120	silly putty	(*40*)
	97.9 / 120	polymer nanofiber	(*17*)
	98 / 200	nirtrogen doped graphene	(*42*)
	97.4 / 100	Cu_3N artificial SEI	(*43*)
	95 /120	$In(TFSI)_3$ additive	(*8*)
	98.2 /100	PDMS coating	(*44*)
	98 / 300	this work	
2.0 / 0.5	96 / 63	glass fiber	(*18*)
	96.5 / 60	β-PVDF coating	(*45*)
	92.9 / 150	polyimide coating	(*41*)
2.0 / 1.0	93 / 60	PDMS coating	(*44*)

	96 / 100	nirtrogen doped graphene	(*42*)
	97 / 100	this work	
5.0 / 0.5	93 / 48	glass fiber	(*18*)
	92.5 / 60	β-PVDF coating	(*45*)
5.0 / 1.0	95 / 90	this work	
10 / 0.5	91 / 40	glass fiber	(*18*)
10 / 1.0	93 / 50	this work	

movie S1. Shape of a droplet (ether-based electrolyte) on the bare lithium foil.
movie S2. Spreading behavior of a droplet (ether-based electrolyte) on the q-PET/Li composite anode.