Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Trace fluorinated-carbon-nanotubes induced lithium dendrite elimination for high-performance lithium–oxygen cells

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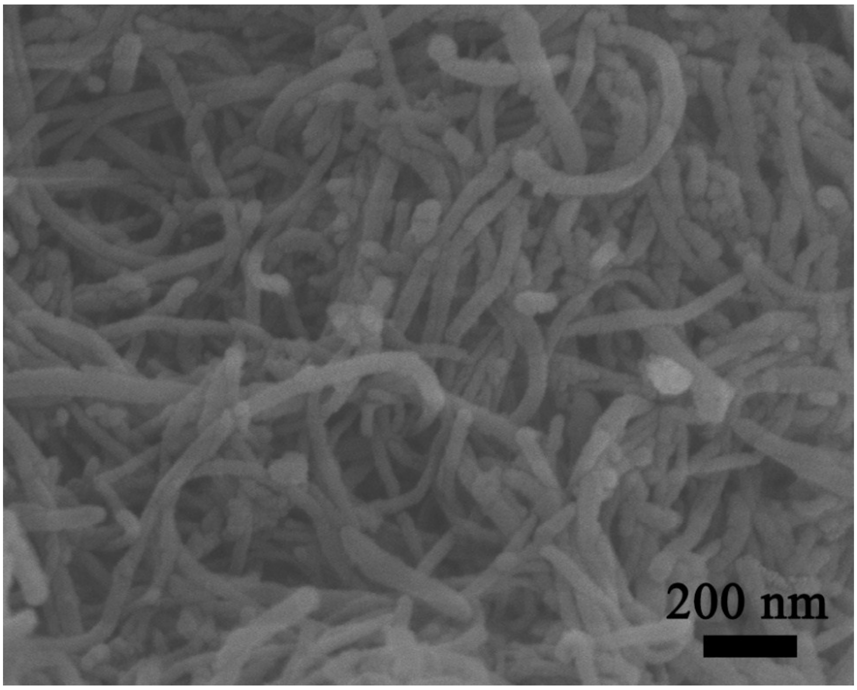

Fig. S1 SEM image of the commercial fluorinated carbon nanotubes.

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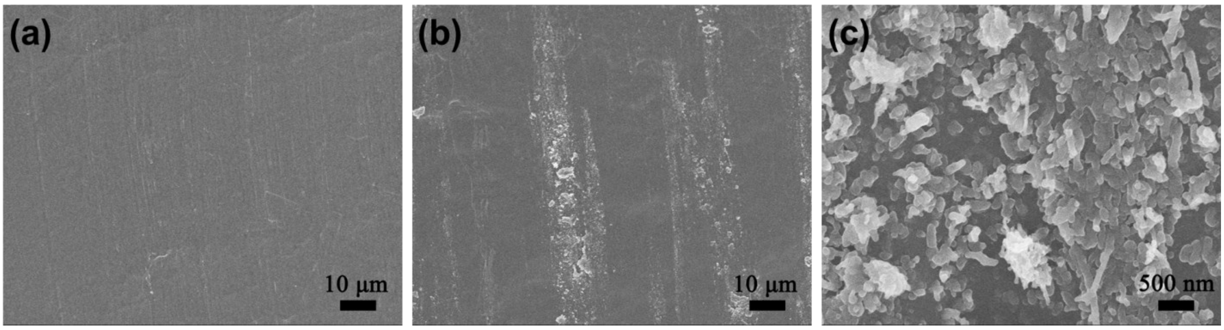

Fig. S2 Cross-sectional SEM images of (a) bare Liand (b, c) LFCNT electrodes.

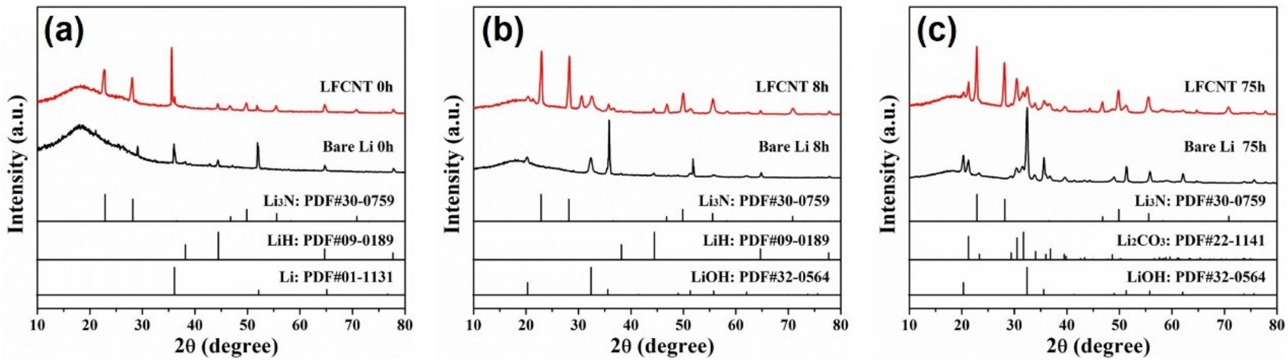

Fig. S3 XRD patterns of LFCNT and bare Li in open air from 0 to 75 h.

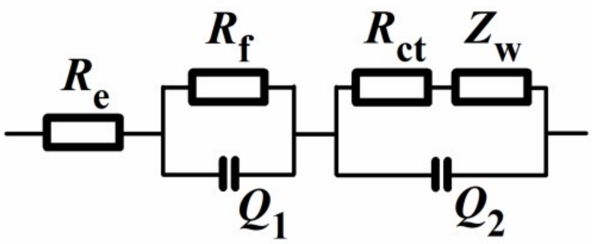

Fig. S4 Equivalent circuit for the fitting of the electrochemical impedance, where R_e is determined by the ionic conductivity of electrolyte, R_f and Q_1correspond tothe surface film resistance and relaxation capacitance, R_{ct} and Q_2 correspond to the charge transfer resistance and double-layer capacitance, and Z_w is related tothe bulk diffusion of Li ions.

Table S1 Fitting results of the Nyquist plots in Fig. 2b and c using the equivalent circuit in Fig. S4.

Sample	$R_e(\Omega)$	R_f (Ω)	R_{ct} (Ω)	$R_{interface}$ (Ω)
LFCNT, 0 h	7.0	22.5	124.3	146.8
LFCNT, 20 h	4.8	33.9	216.9	250.8
LFCNT, 50 h	5.2	42.0	299.9	341.9
LFCNT, 100 h	9.5	49.0	349.1	398.1
LFCNT, 200 h	6.1	52.8	369.4	422.2
LFCNT, after cycling	7.9	20.2	21.0	41.2
Bare Li, 0 h	3.0	101.6	198.4	300.0
Bare Li, 20 h	3.2	188.0	272.1	460.1
Bare Li, 50 h	4.3	253.5	361.2	614.7
Bare Li, 100 h	2.6	336.9	402.2	739.1
Bare Li, 200 h	3.3	353.0	403.3	756.3
Bare Li, after cycling	3.9	32.6	48.5	81.1

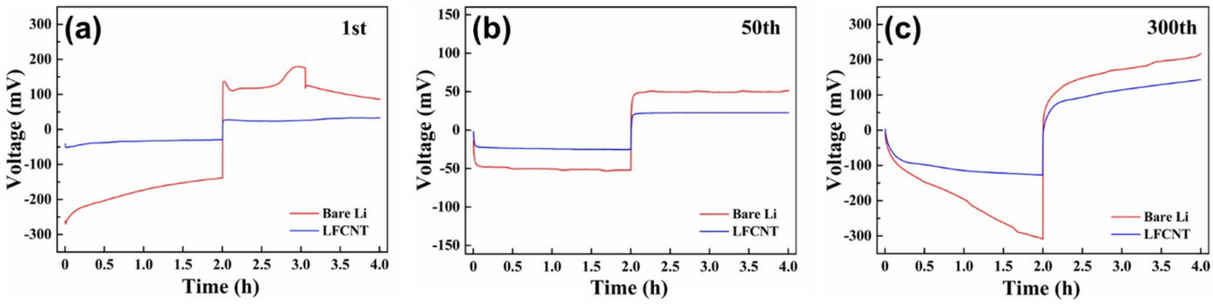

Fig. S5 Voltage profiles of LFCNT and bare Li electrode in symmetric cells at 0.5 mA cm^{-2} with a capacity of 1 mAh cm^{-2} in the (a) 1st cycle, (b) 50th cycle, and (c) 300th cycle.

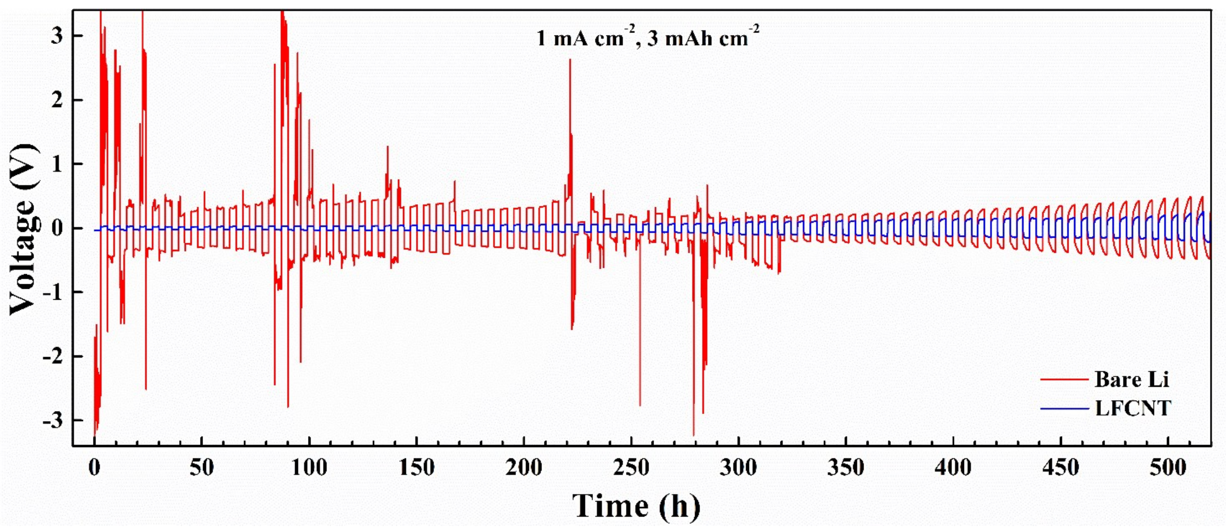

Fig. S6 Galvanostatic discharge/charge profiles of LFCNT and bare Li electrodes in symmetric cells at 1 mA cm^{-2} with a capacity of 3 mAh cm^{-2}.

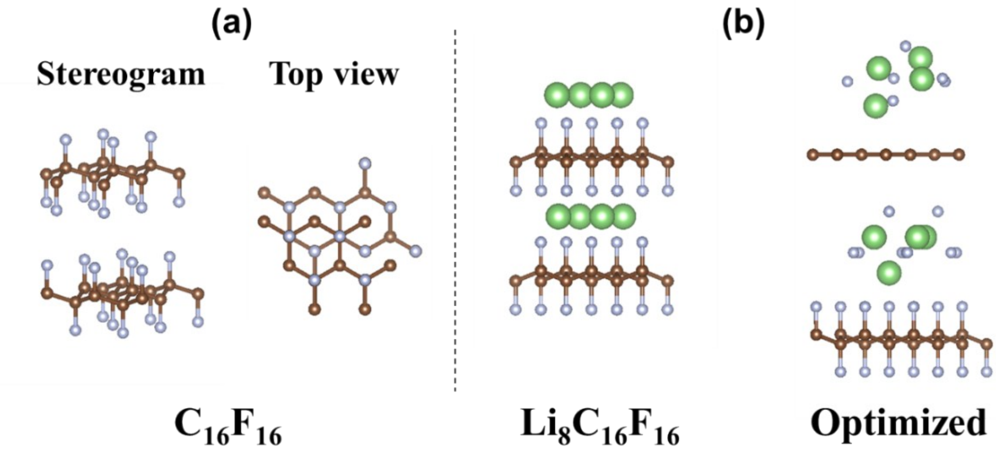

Fig. S7 (a) Model of the bilayer fluorinated graphene, and (b) the corresponding side view of Fig. 4g.

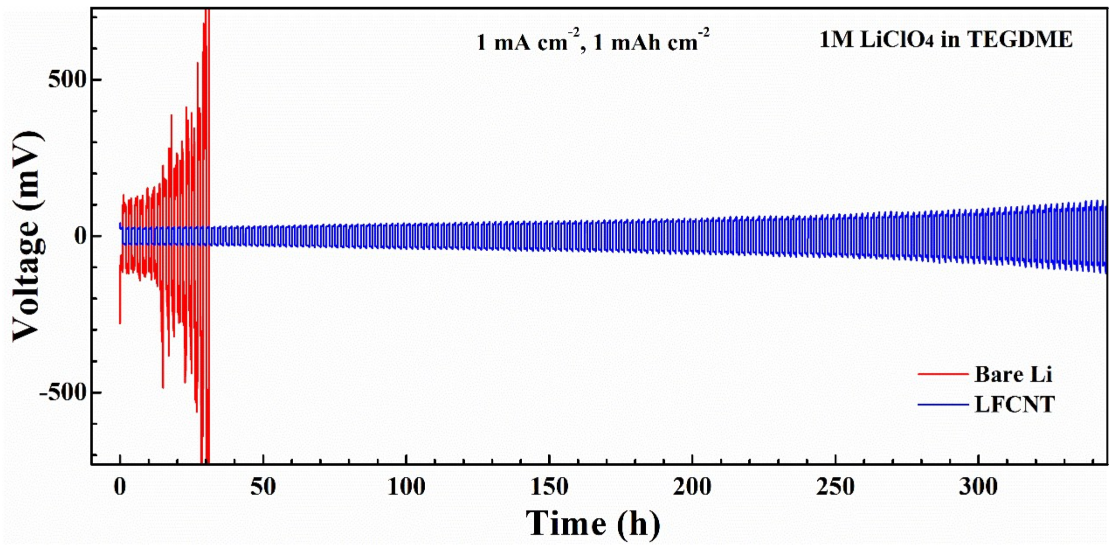

Fig. S8 Galvanostatic discharge/charge profiles of LFCNT and bare Li electrodes in symmetric cells based on 1 M $LiClO_4$/TEGDME tested in O_2 atmosphere at 1 mA cm^{-2} with a capacity of 1 mAh cm^{-2}.

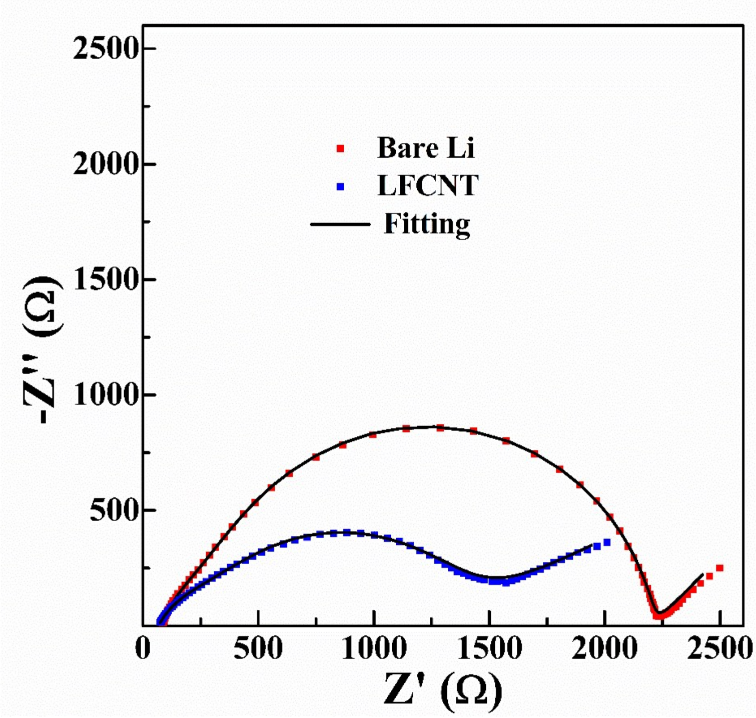

Fig. S9 Nyquist plots of the Li–O_2 cells with bare Li and LFCNT electrode.

Table S2 Fitting results of the Nyquist plots in Fig. S9 using the equivalent circuit in Fig. S4.

Sample	R_e(Ω)	R_f (Ω)	Q_1		R_{ct} (Ω)	Q_2	
			Y	n		Y	n
Cell with bare Li	83.4	243.5	4.6×10^{-6}	0.79	1878.0	2.3×10^{-6}	0.92
Cell with LFCNT	68.3	241.0	5.7×10^{-6}	0.72	932.0	1.3×10^{-5}	0.77

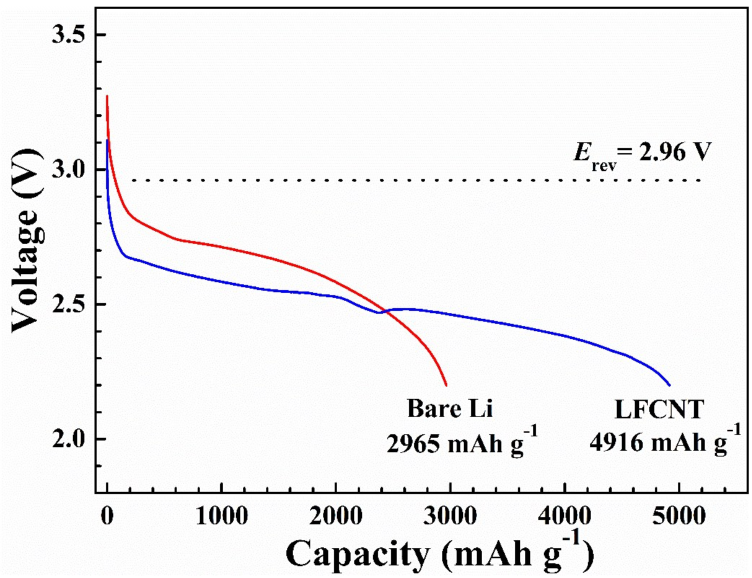

Fig. S10 Discharge profiles of Li–O_2 cells with bare Li and LFCNT electrode at 100 mA g^{-1}.

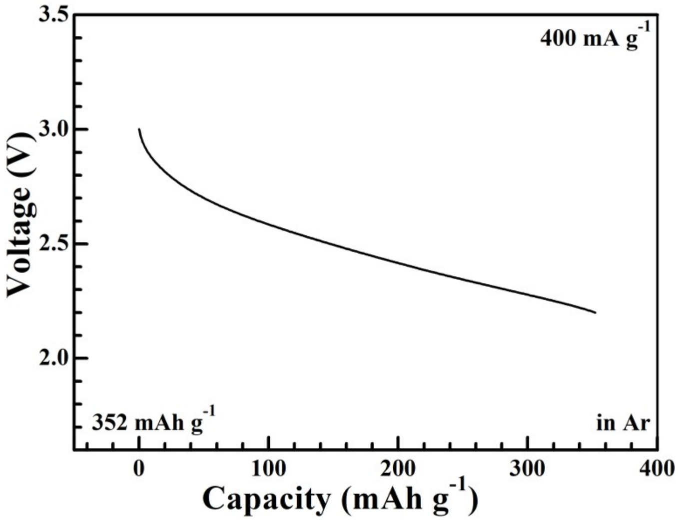

Fig. S11 Discharge profile of Li/MnO_2 cell in pure Ar.

Table S3 Comparison of electrochemical performance of Li–O_2 cells with various Li anodes.

Cathode	Anode	Currentdensity	Specific capacity	Cycle number	Reference
δ-MnO_2	**LFCNT**	**400 mA g^{-1} (0.2 mA cm^{-2})**	**1000 mAh g^{-1}**	**135**	**This work**
Ketjen black carbon	Li stabilized by LiTNFSI	500 mA g^{-1}	500 mAh g^{-1}	49	[1]
Ketjen black carbon	phosphorene-coated Li	250 mA g^{-1}	1000 mAh g^{-1}	50	[2]
CNT-Based Air Electrode	Li with highly concentrated electrolyte	0.1 mA cm^{-2}	1000 mAh g^{-1}	55	[3]
MWCNTs electrode	CPL-Coated Li	250 mA g^{-1}	1000 mAh g^{-1}	60	[4]
Ketjen black carbon	DOA-treated Li	100 mA g^{-1}	500 mAh g^{-1}	65	[5]
CNT-based air electrode	Li stabilized by highly-concentrated electrolyte	0.1 mA cm^{-2}	600 mAh g^{-1}	90	[6]
Porous graphene cathode	porous graphene/Li anode.	1000 mA g^{-1}	1000 mAh g^{-1}	100	[7]
Super P	FEC-treated Li	300 mA g^{-1}	1000 mAh g^{-1}	106	[8]

References

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Information for videos

Video 1 Dynamic changes of the LFCNT electrodeat 1 mA cm^{-2} without separator.

Video 2 Dynamic changes of the bare Li electrodeat 1 mA cm^{-2} without separator.

Video 3 Dynamic changes of the LFCNT electrode at 1 mA cm^{-2} with separator.

Video 4 Dynamic changes of the bare Li electrodeat 1 mA cm^{-2} with separator.