Electronic Supplementary Information

A high performance lithium-selenium batteries using microporous carbon confined selenium cathode and compatible electrolyte

Jingjing Zhou, Jun Yang, Zhixin Xu, Tao Zhang, Zhenying Chen and Jiulin Wang**

Shanghai Electrochemical Energy Devices Research Center,

School of Chemistry and Chemical Engineering, Shanghai Jiao Tong University,

Shanghai 200240, P. R. China

*To whom all correspondence should be addressed. Email: yangj723@sjtu.edu.cn (J. Yang); wangjiulin@sjtu.edu.cn (J.L. Wang)

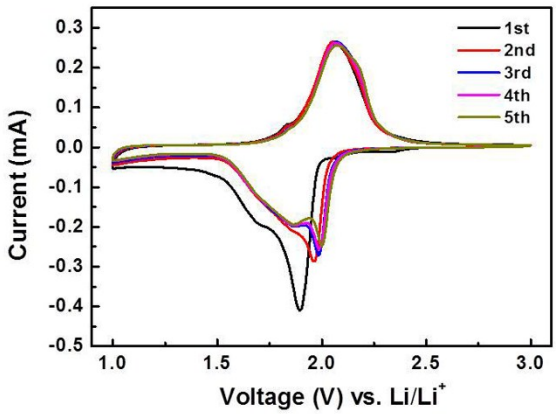

Figure S1. CV curves of the Se/MC electrode in LiDFOB/EC-DMC-FEC electrolyte at 0.1 mV s^{-1}

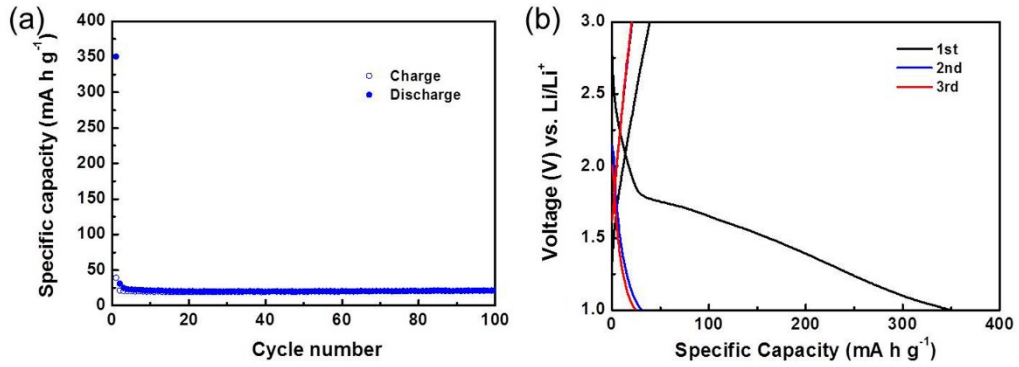

Figure S2. (a) Cycling performance and (b) galvanostatic charge-discharge profiles for the initial three cycles of MC at 0.1 C (67.8 mA g^{-1}) in the voltage range of 1.0-3.0 V vs. Li/Li^+.

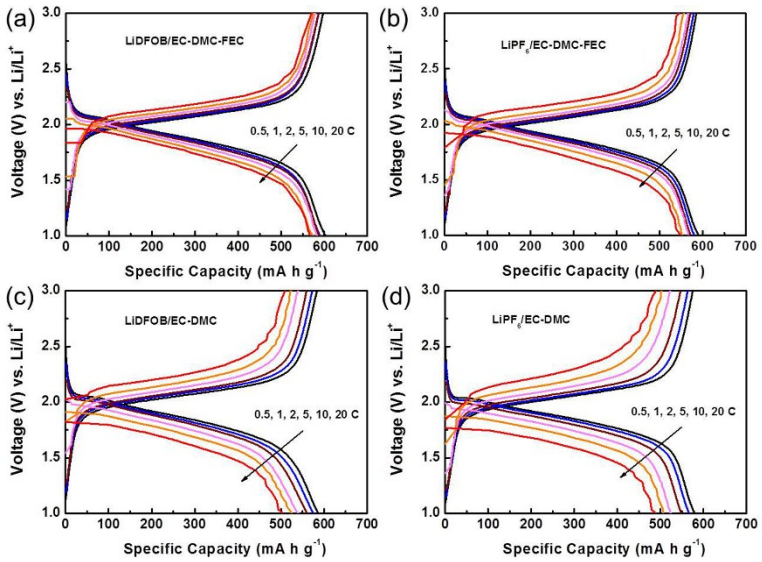

Figure S3. Galvanostatic charge-discharge profiles of Se/MC electrodes in (a) LiDFOB/EC-DMC-FEC, (b) $LiPF_6$/EC-DMC-FEC, (c) LiDFOB/EC-DMC and (d) $LiPF_6$/EC-DMC electrolytes at different currents.

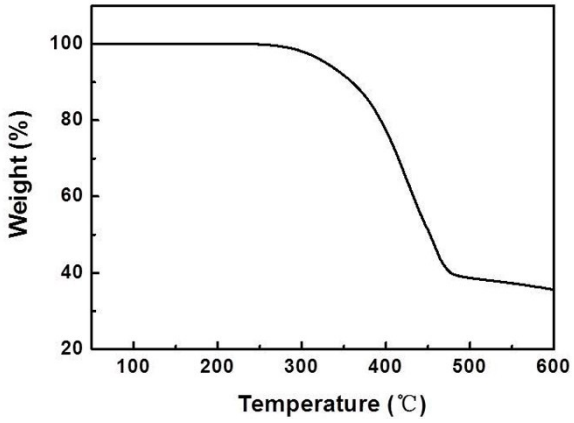

Figure S4. TGA curve of Se/MC composite with a high Se content of 64.7 wt%.

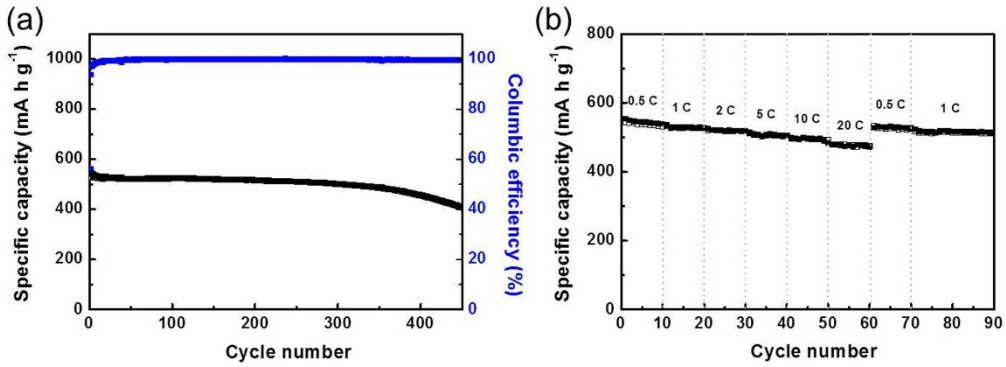

Figure S5. (a) Cycling at 1 C and (b) rate performance of Se/MC electrode with Se content of 64.7 wt% in LiDFOB/EC-DMC-FEC.

.

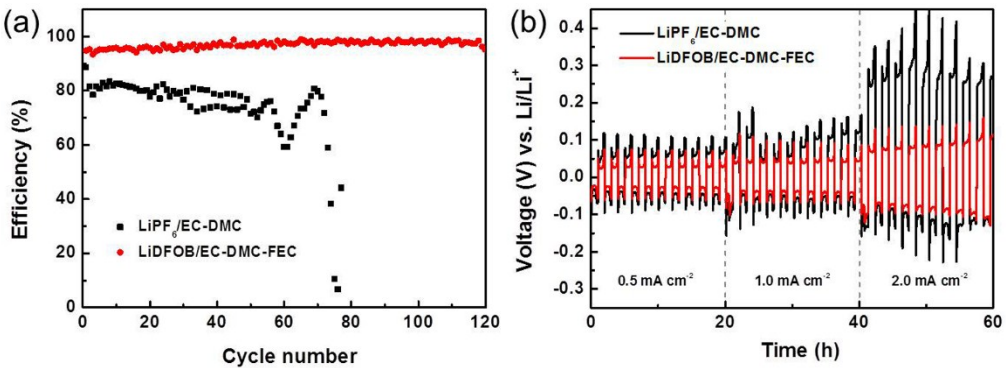

Figure S6. (a) Efficiency *vs.* cycle number for $LiPF_6$/EC-DMC and LiDFOB/EC-DMC-FEC electrolytes at current density of 0.5 mA cm^{-2} (The cycle condition: the constant Li deposition amount and complete Li striping up to 1.0 V vs. Li/Li^+). (b) Galvanostatic voltage-time curves for Li | Li symmetric cells in $LiPF_6$/EC-DMC and LiDFOB/EC-DMC-FEC at constant current density of 0.5, 1.0 and 2.0 mA cm^{-2} for 1 h per process.

Table S1. Comparison of cycling and rate performance of Li-Se batteries reported in the literatures with this work

Cathode material	Se content (wt%)	Cycling performance		Rate performance		Ref.
		Current density	Final discharge capacity (mA h g^{-1}_{Se})/cycle number	Current density	Average discharge capacity (mA h g^{-1}_{Se})	
Se/N-containing hierarchical porous carbon	56.2	2 C	305/60	5 C	261	18
Se/hollow carbon	59.5	500 mA g^{-1} (0.74 C)	525/1000	2.0 A g^{-1} (2.9 C)	496	21
Se/carbonized polyacrylonitrile	36	1.5 C	~400/1000	3 C	290	25
carbon bonded and encapsulated Se composites	54	100 mA g^{-1}	430/250 (charge)	1.2 A g^{-1}	280	27
graphene/Se/poly aniline nanowires	66.18	0.2 C	567.1/200	2 C	510.9	28
Se@CN_x nanobelts	62.5	800 mA g^{-1} (1.2 C)	453.2/400	1.6 A g^{-1}	474	26
Se/porous carbon	72	5 C	~417/1000	20 C	510	11
Se/porous carbon nanofibers	52.3	500 mA g^{-1}	516/900	4.0 A g^{-1}	306	22
Se/porous carbon nanofiber webs	33.2	675 mA g^{-1}	323.7/300	-	-	23
Se/N-doped carbon tubes	48	1 C	365/100	3 C	271	35
Se/macro and micro-porous carbon	56.1	0.2 C	466.8/300	2 C	421.0	43
Se/mesoporous carbon	30	0.25 C	480/1000	5 C	229	16
Se/N-doped carbon sponges	50	0.5 C	443.2/200	5 C	286.6	46
Se/microporous carbon	51.4	5 C	511/1000	20 C	569	This work

Table S2. The fitting values of the R2 shown in Fig. 6

Parameter		LiDFOB/ EC-DMC-FEC	$LiPF_6$/ EC-DMC-FEC	LiDFOB/ EC-DMC	$LiPF_6$/ EC-DMC
Fresh	R2(ohm)	43.6	54.2	86.5	87.4
2nd	R2(ohm)	22.2	39.2	54.4	76.4
20th	R2(ohm)	12.4	12.5	17.0	19.5