Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.
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Supporting Information

Selenium Infiltrated Hierarchical Hollow Carbon Spheres Display Rapid Kinetics and Extended Cycling as Lithium Metal Battery (LMB) Cathodes

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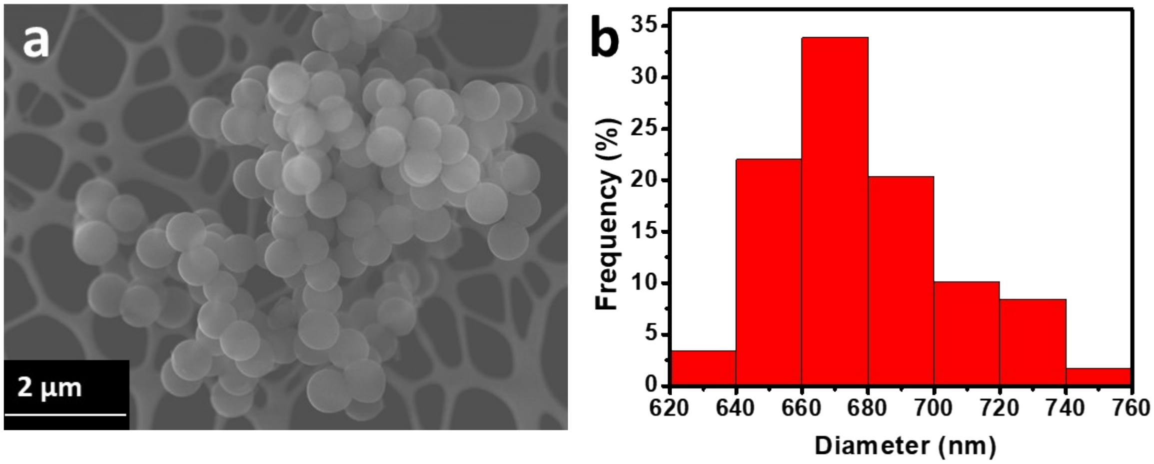

Figure S1. (a) SEM image and **(b)** size distribution of MCS.

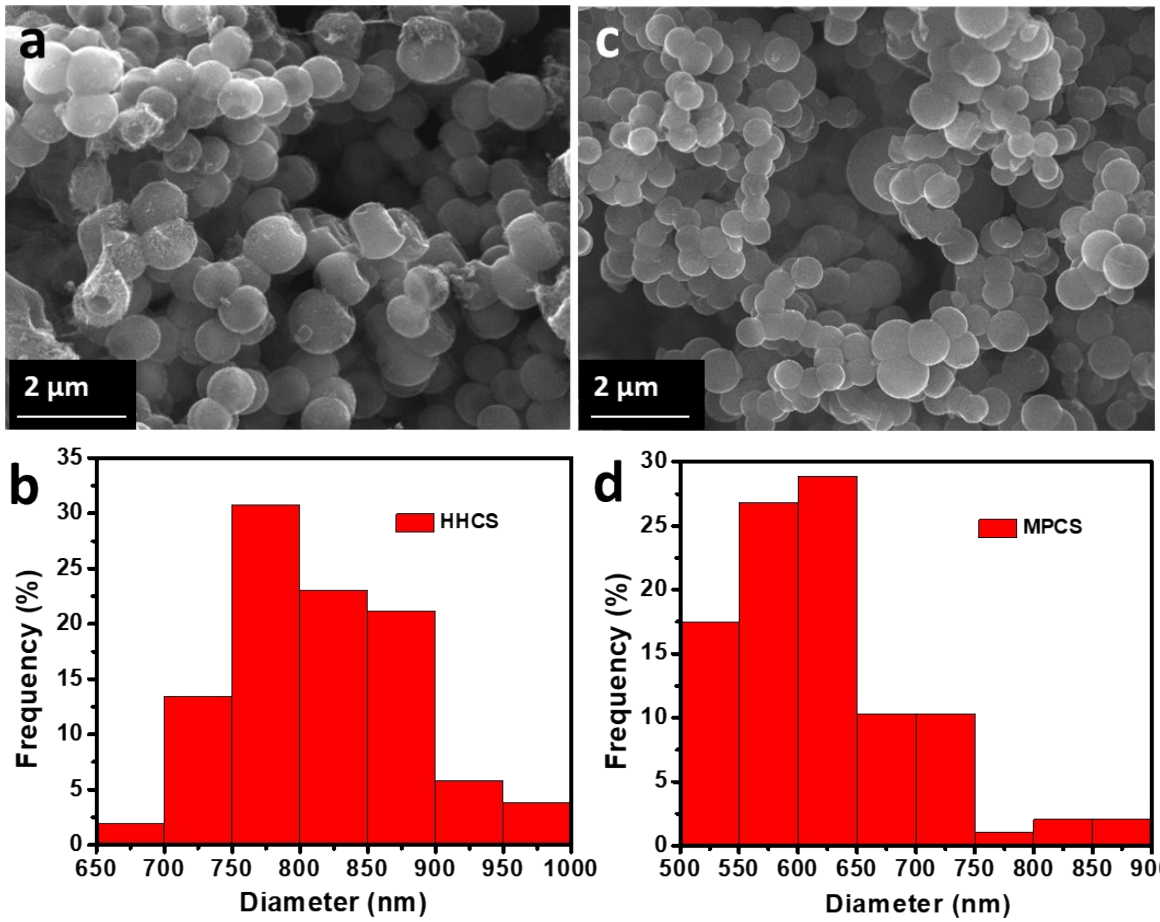

Figure S2. SEM images of **(a)** HHCS and **(b)** MPCS. Size distribution of **(c)** HHCS and **(d)** MPCS.

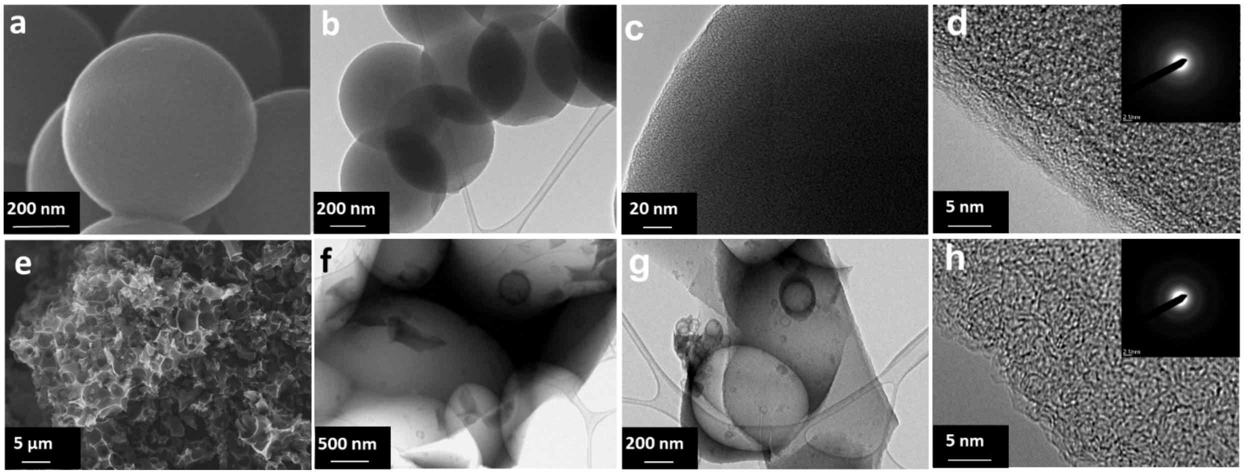

Figure S3. SEM images of **(a)** MPCS and **(c)** MPCP. TEM images of **(b, c)** MPCS and **(f, g)** MPCP. HRTEM images with SAED insets of **(d)** MPCS and **(i)** MPCP.

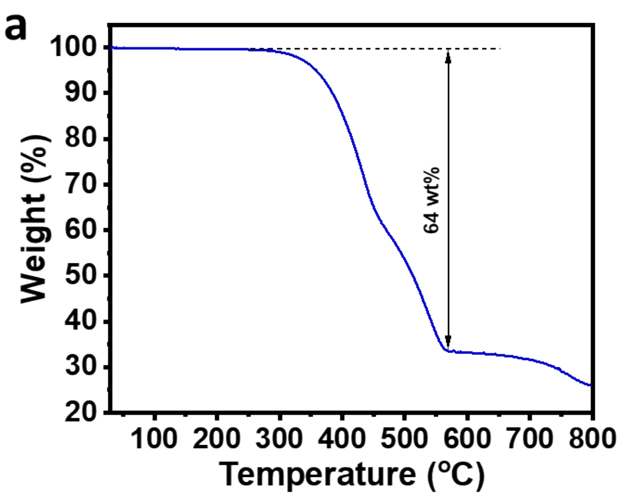

Figure S4. **(a)** TGA curve of Se_{HL}@HHCS from room temperature to 800 °C, tested in Ar. **(b)** Nitrogen absorption-desorption isotherm of Se_{HL}@HHCS

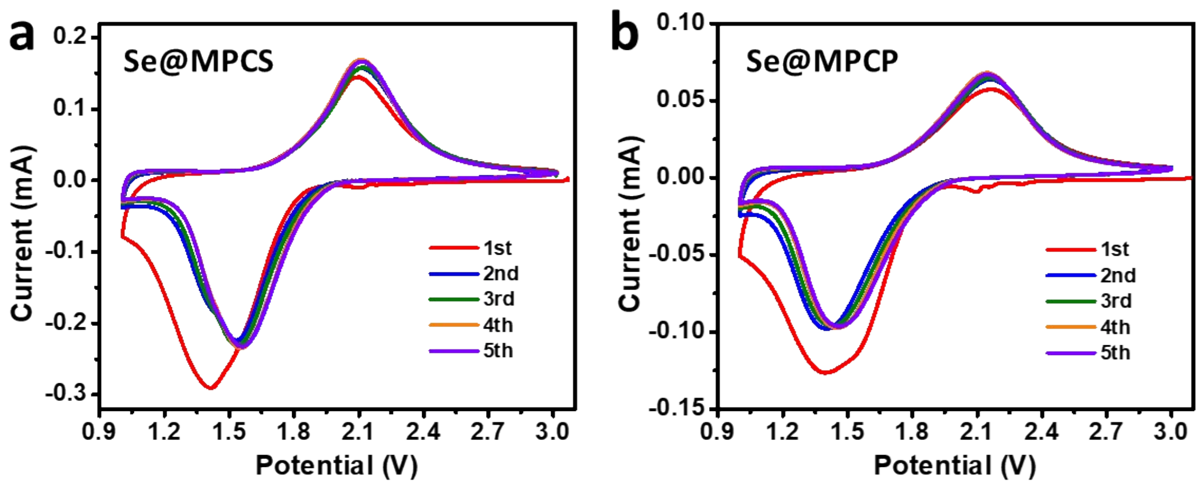

Figure S5. CV curves of **(a)** Se@MPCS and **(b)** Se@MPCP at a scan rate of 0.1 mV s^{-1}

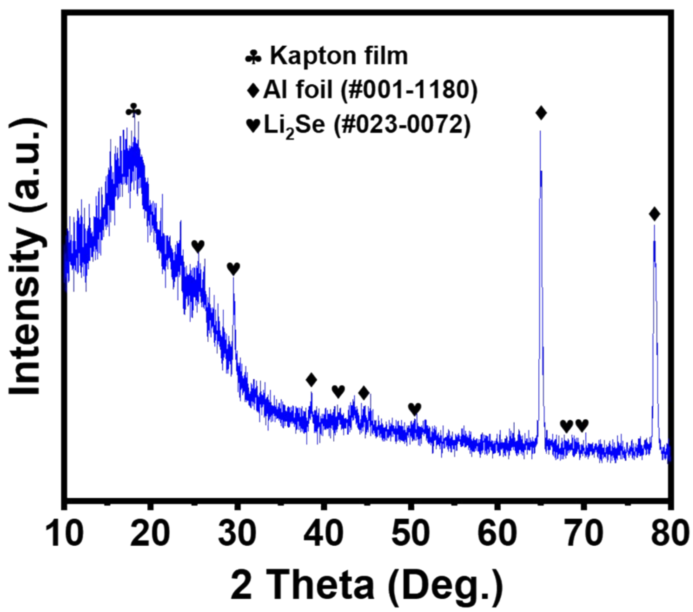

Figure S6. XRD profile of Se@HHCS discharged to 1 V at cycle 1.

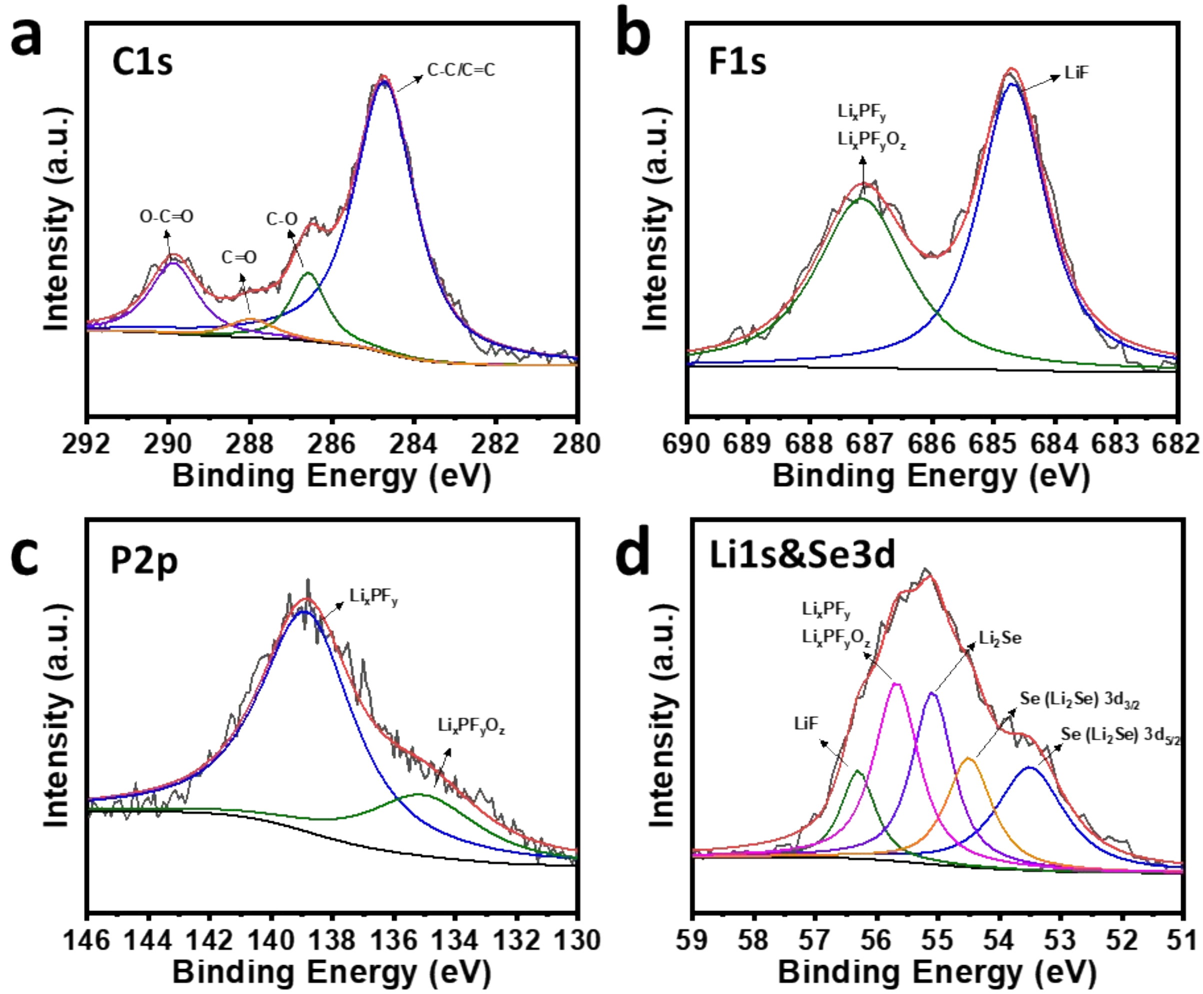

Figure S7. High-resolution XPS spectra of **(a)** C1s, **(b)** F1s, **(c)** P2p and **(d)** Li1s & Se3d of Se@HHCS discharged to 1 V at cycle 1.

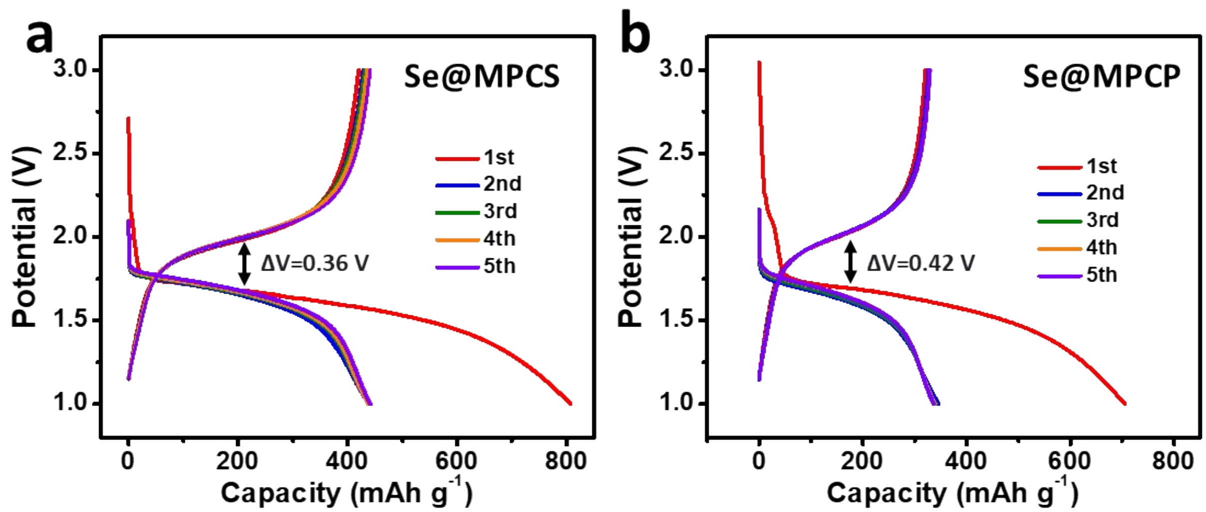

Figure S8. Galvanostatic profiles of **(a)** Se@MPCS and **(b)** Se@MPCP at 0.2C.

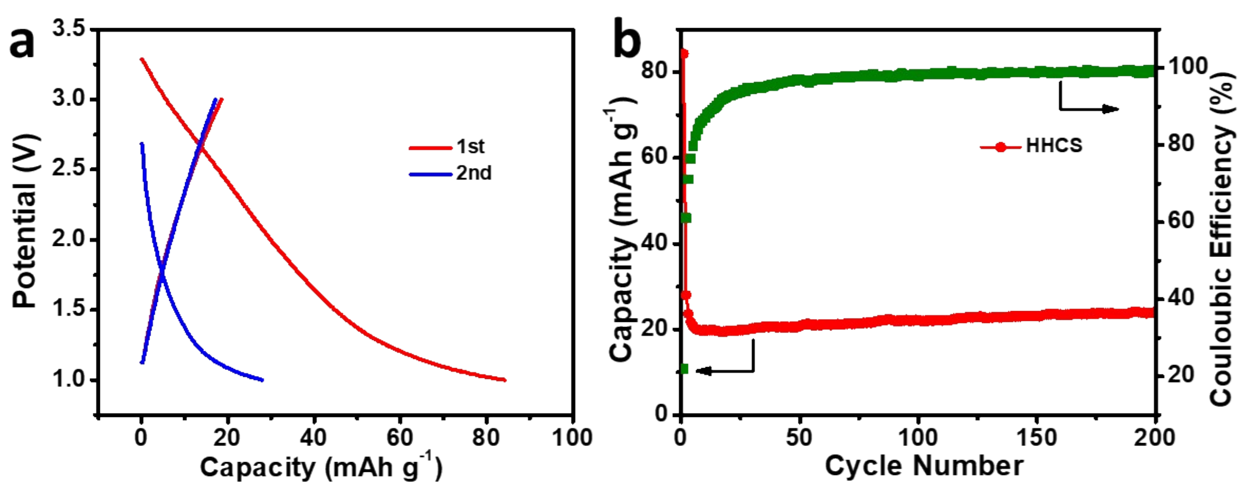

Figure S9. **(a)** Galvanostatic profiles and **(b)** cycling performance of HHCS at 0.2C.

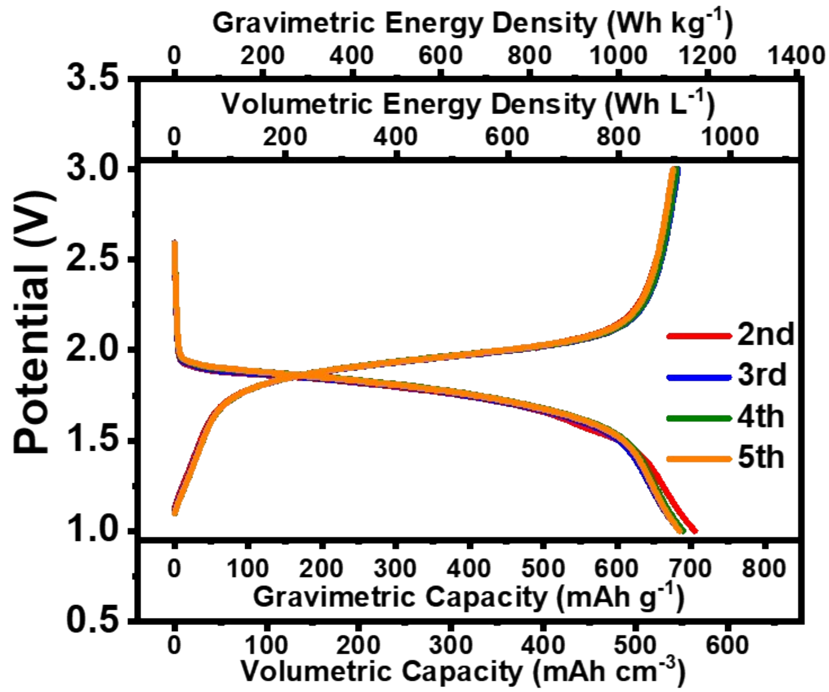

Figure S10. Galvanostatic profiles of Se_{HL}@HHCS at 0.2C.

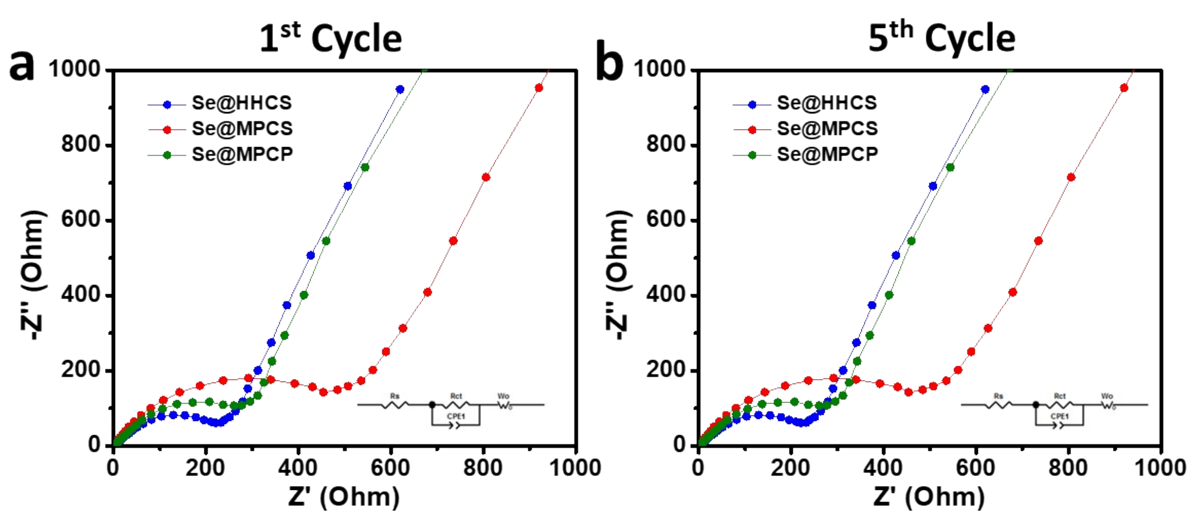

Figure S11. Nyquist plots of Se@MPCS and Se@MPCP: **(a)** after 1st cycle and **(b)** after 5th cycle.

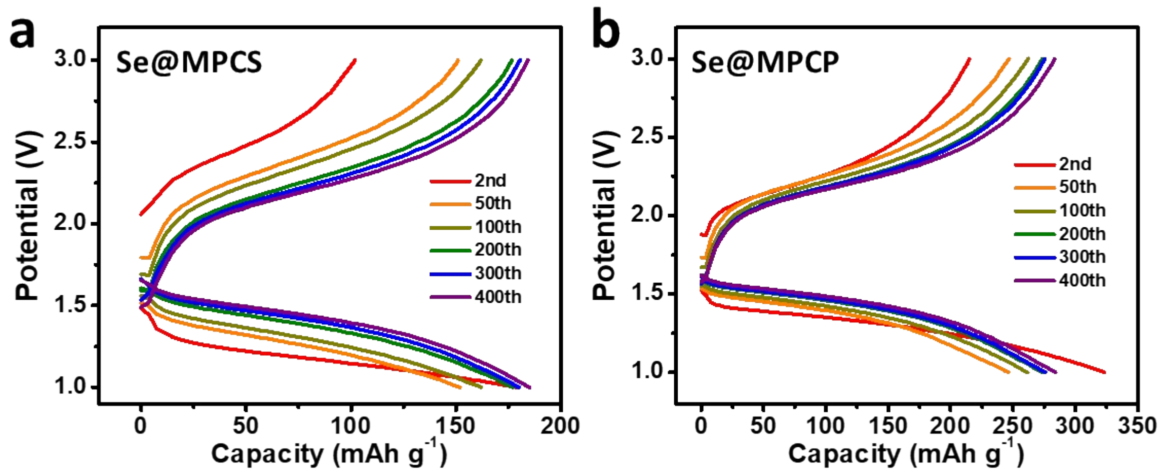

Figure S12. Galvanostatic profiles of **(a)** Se@MPCS and **(b)** Se@MPCP at 2C after 2^{nd}, 50^{th}, 100^{th}, 200^{th}, 300^{th} and 400^{th} cycles.

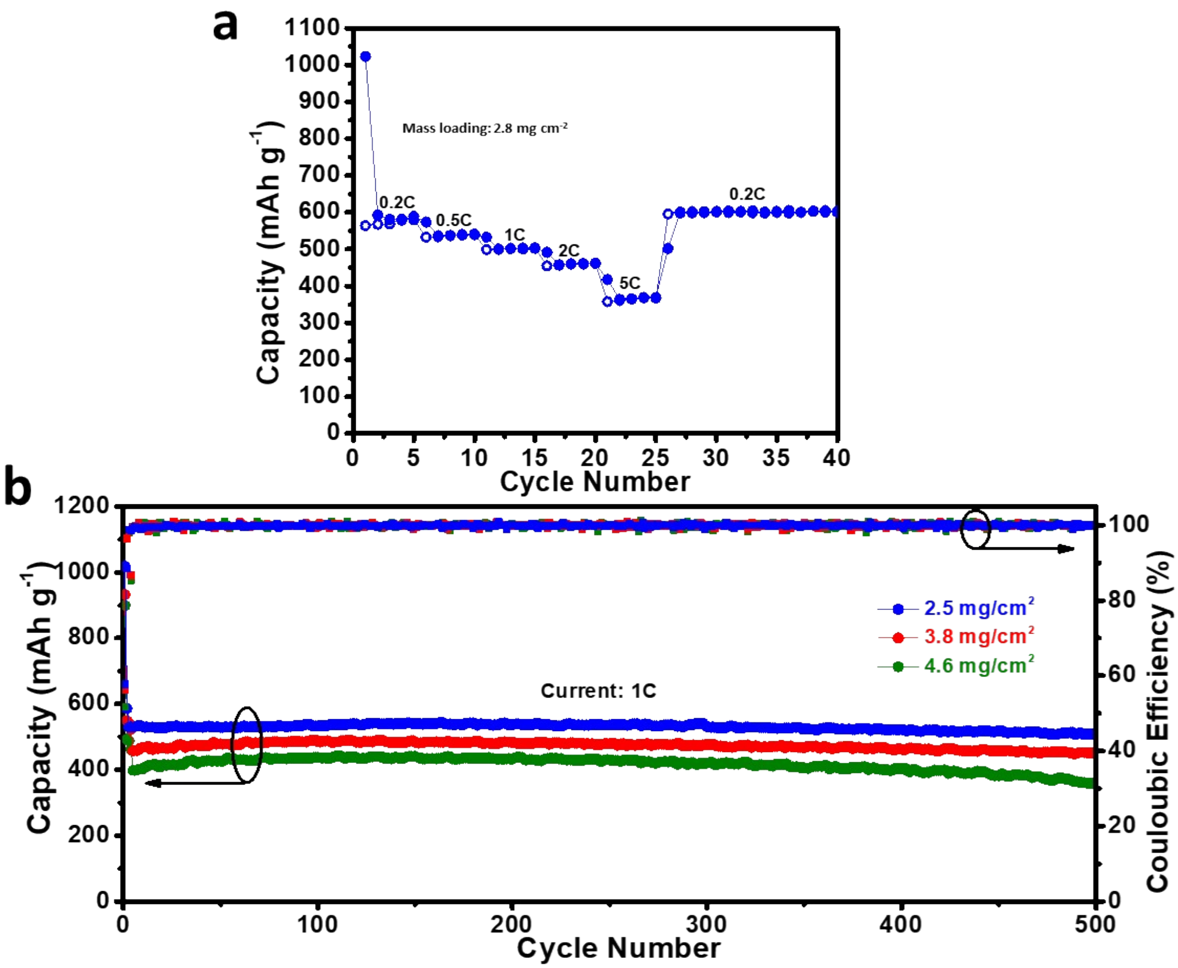

Figure S13. (a) Rate capability and **(b)** cycling performance of Se@HHCS at high electrode mass loadings.

Table S1. Comparison of cycling performance of Se@HHCS with Se-based cathodes from previously published reports.

Materials	Se loading (wt.%)	Current density (C)	Reversible capacity ($mAh\ g^{-1}$) after (x) cycles	Reference
Se@HHCS	**48**	**2**	**558 (500^{th})**	**This work**
		5	**442 (1500^{th})**	
		10	**357 (2000^{th})**	
	64	**5**	**356 (600^{th})**	
		10	**290 (800^{th})**	
Se/N-CSHPC	54	1	425 (200^{th})	1
PCNS/Se	58	5	147 (750^{th})	2
Se@HCS200	49	5	105 (100^{th})	3
C/Se composite	55	2	363 (500^{th})	4
Selenium nanowires/CNT composite	60	1	401 (500^{th})	5
MPC/Se	50	0.5	354 (200^{th})	6
Se@$CoSe_2$-PC	43	1	408 (100^{th})	7
PANI@Se/C-G	52	5	403 (500^{th})	8
NPC/CGB-Se	60	1	462 (1000^{th})	9
Se/CMK-3	49	0.1	600 (50^{th})	10
Se/CNSs	60	0.5	376 (1000^{th})	11
Se@MICP	51	1	249 (3000^{th})	12
Se-NCSs	56	1	301 (500^{th})	13
Se/CMCs	50	2	166 (460^{th})	14

HPTCs/Se	53	2	317 (900^{th})	15
Se/(CNT@MPC)	50	1	352 (100^{th})	16
MHPCS/Se	48	1	200 (100^{th})	17
MiC/Se	44	0.5	400 (500^{th})	18
Se/MCNF	50	1	403 (2000^{th})	19
Se/MCN-RGO	62	1	400 (1300^{th})	20
MWCNT/Se	60	4	231 (100^{th})	21
Se–BPC	45	2	216 (80^{th})	22
meso-C@Se composite	48	3	417 (100^{th})	23
MCMs/Se	50	0.5	300 (100^{th})	24
NCS/Se-50	50	5	287 (60^{th})	25
HCPS/Se	41	0.5	299 (100^{th})	26
PCM/Se	52	2	230 (510^{th})	27
PCNFW/Se	33	1	324 (300^{th})	28
Se–NCHPC	56	2	305 (60^{th})	29
Graphene-Se@CNT	30	0.1	315 (100^{th})	30
Se@3D MIL-68(Al)@MWCNTs	50	0.2	453 (200^{th})	31
Se/SO-HPC	50	0.5	394 (400^{th})	32
3DG-CNT@Se	51	0.2	504 (150^{th})	33
Se@HPCNB	60	2	400 (1000^{th})	34
Se-HPCF	50	5	202 (2000^{th})	35
FNDPC@Se-1	40	~3	446 (500^{th})	36

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