Supplementary Information

Covalently Bonded Si−SiOC−C Heterostructural Nanocomposites as Durable Anode Materials for High-Energy Lithium-Ion Batteries

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Supplementary Figures

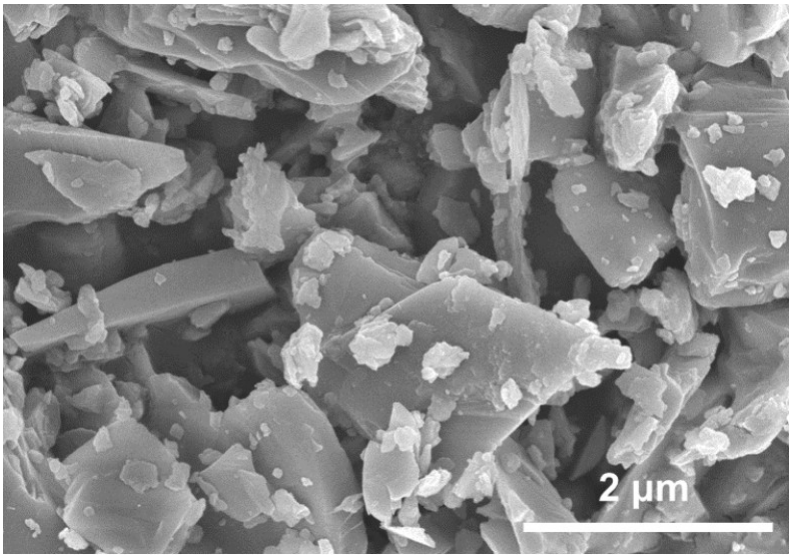

Figure S1 SEM image of the commercial pristine Si powder.

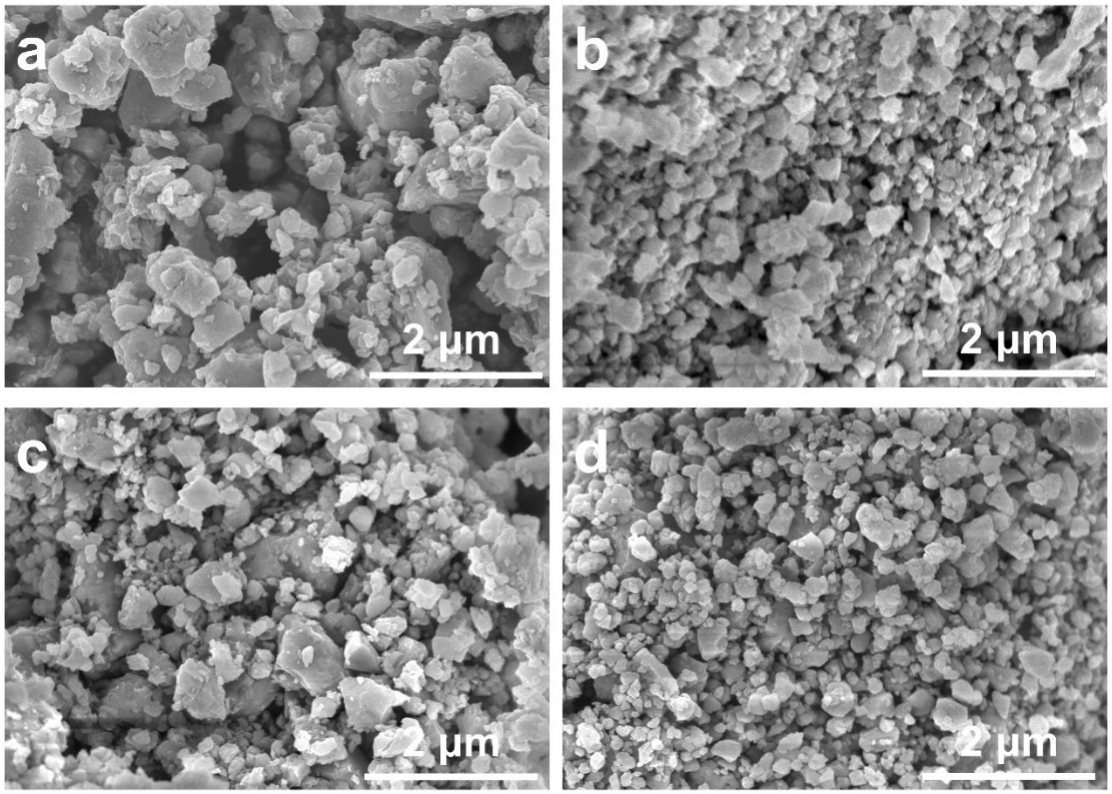

Figure S2 SEM images of (a) SSOCC5-8h, (b) SSOCC5-16h, (c) SSOCC5-300rpm and (d) SSOCC5-400rpm samples.

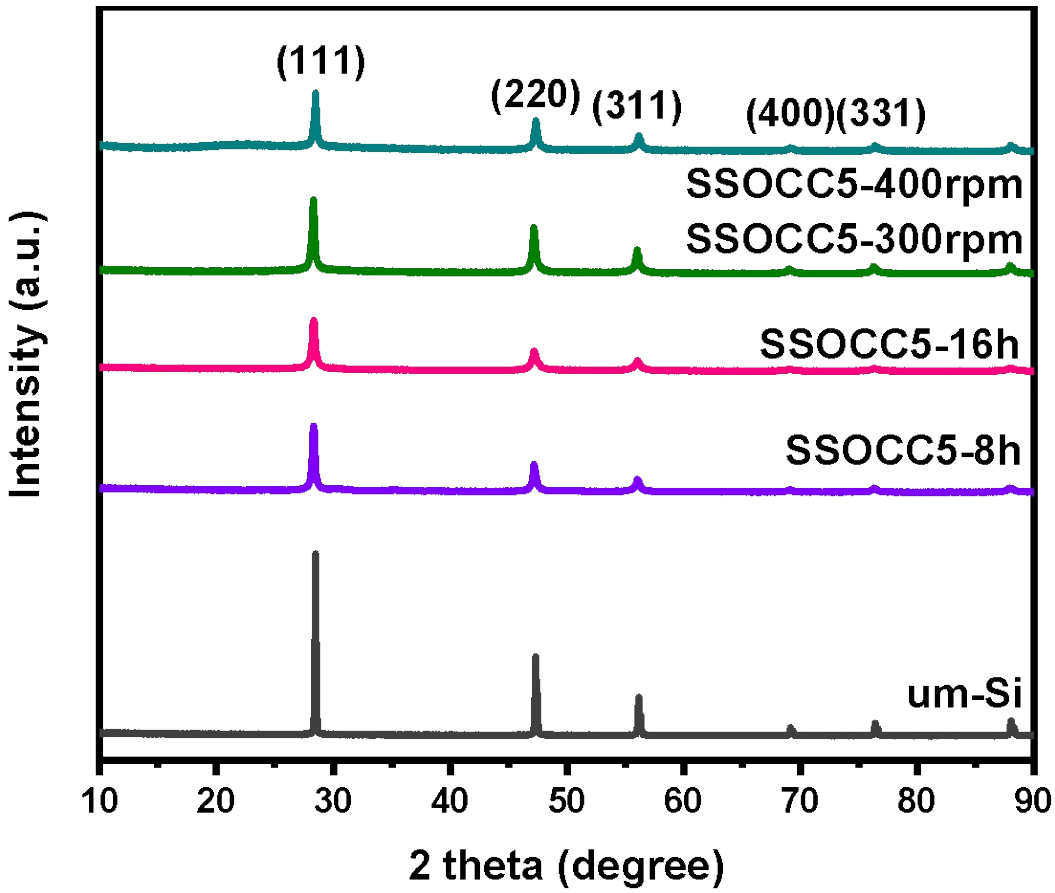

Figure S3 XRD patterns of um-Si, SSOCC5-8h, SSOCC5-16h, SSOCC5-300rpm and SSOCC5-400rpm samples.

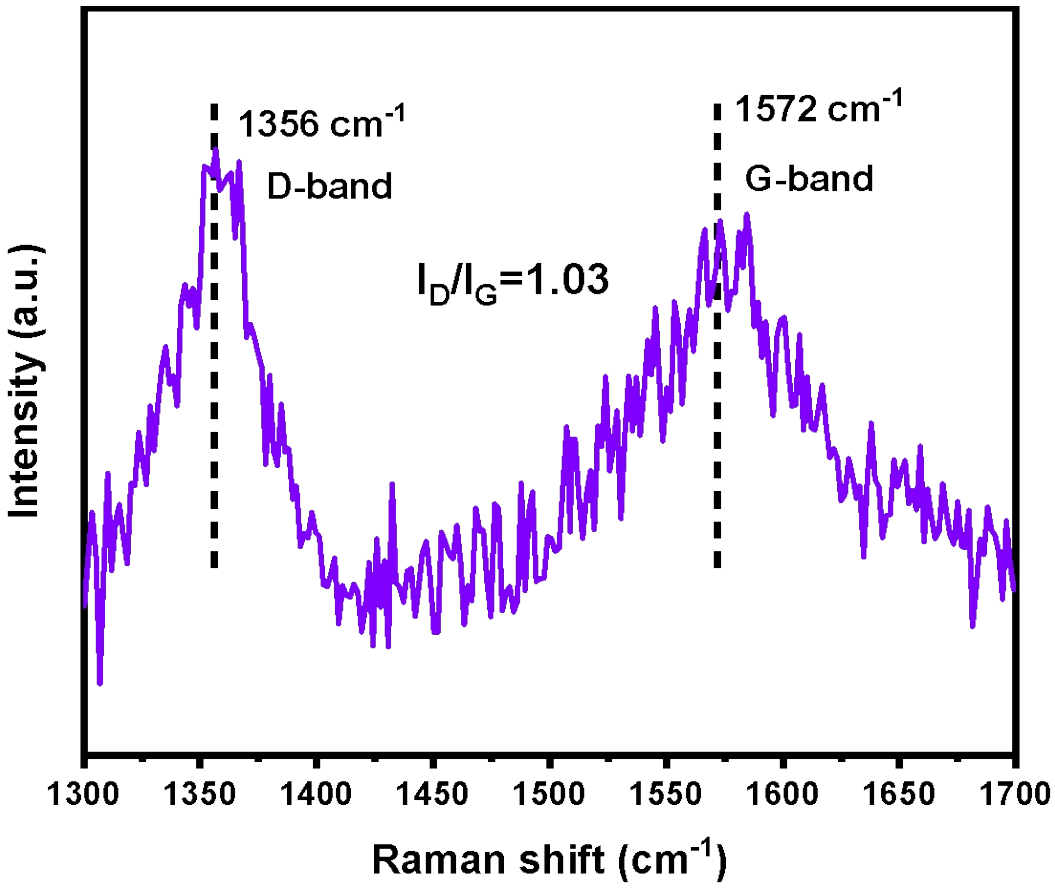

Figure S4 Raman spectrum of SSOCC5 in the wavelength range of 1300-1700 cm^{-1}.

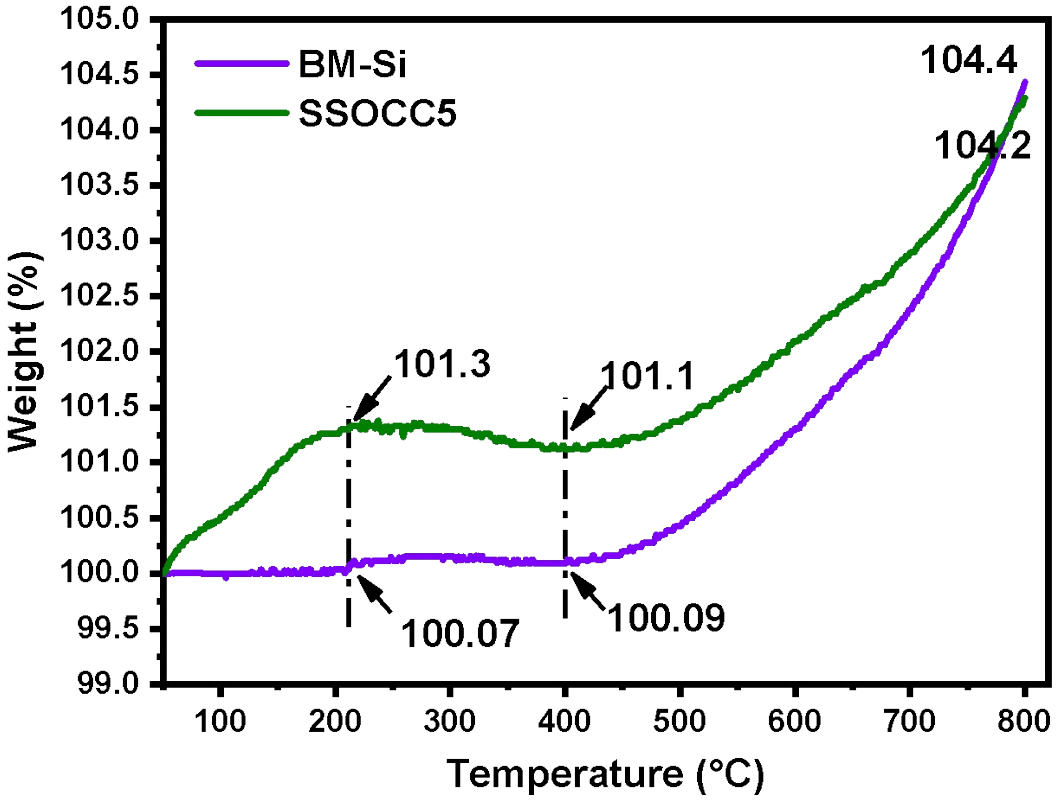

Figure S5 TGA curves of BM-Si and SSOCC5 samples measured in air atmosphere.

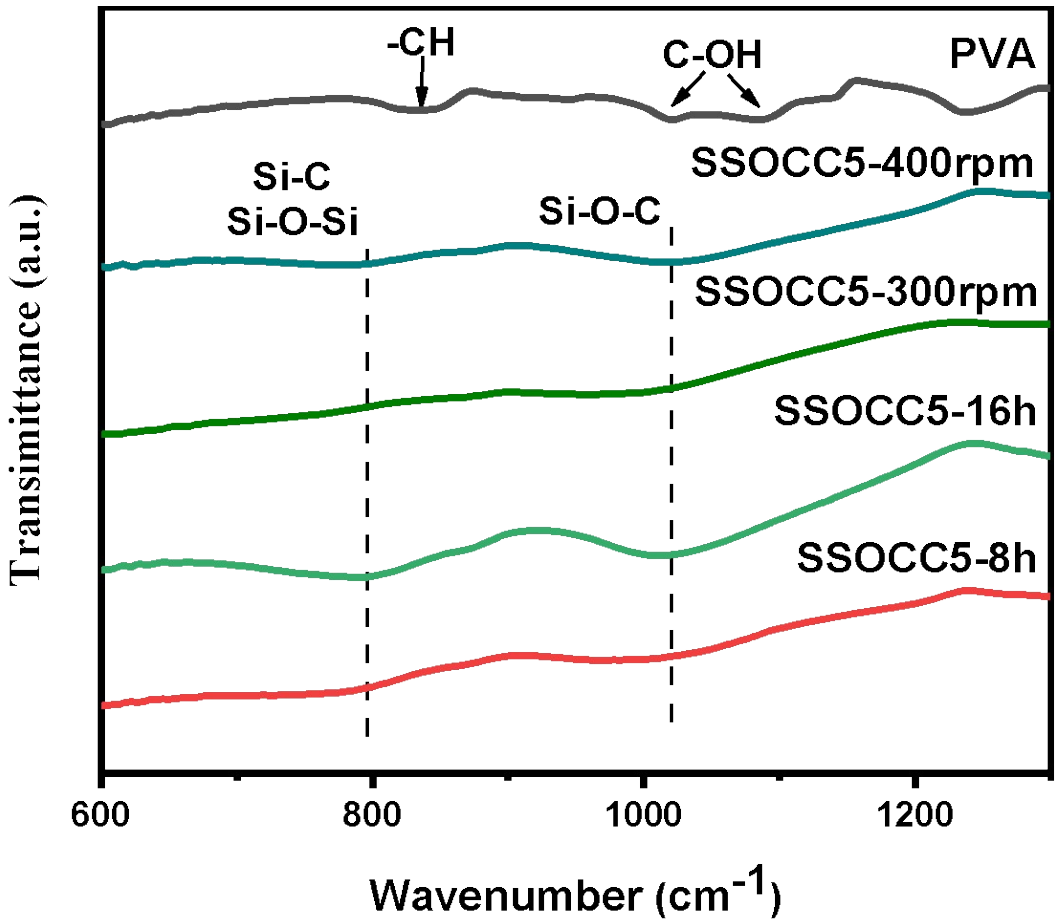

Figure S6 FTIR spectra of pure PVA, SSOCC5-8h, SSOCC5-16h, SSOCC5-300rpm and SSOCC5-400rpm samples.

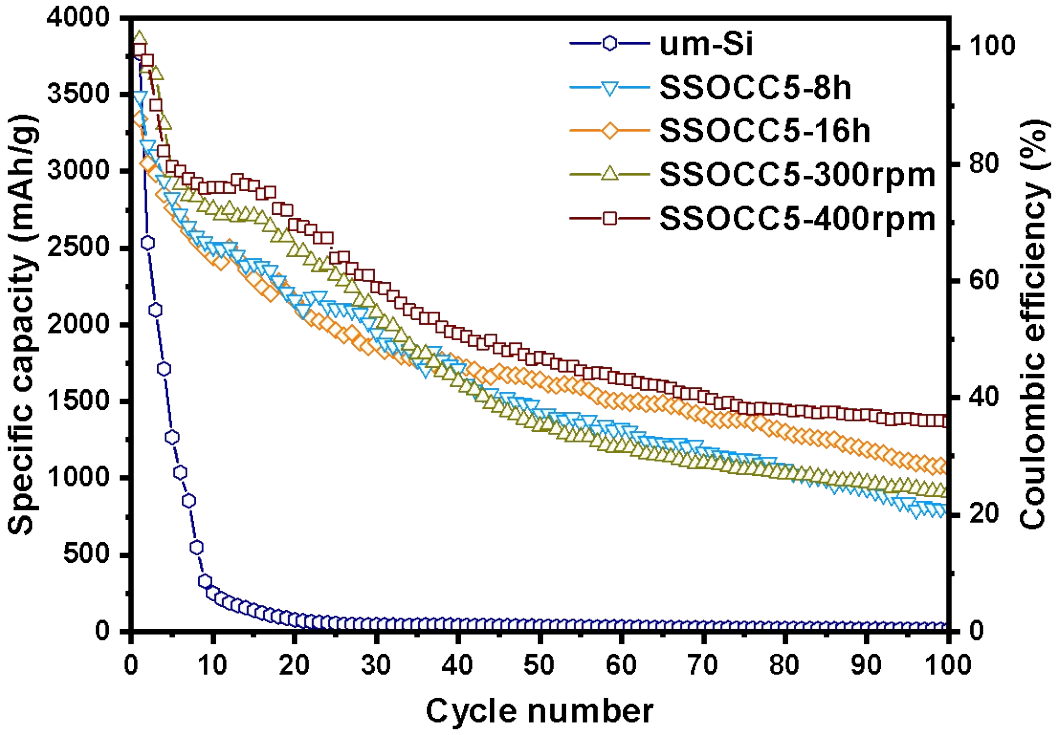

Figure S7 Cycle performance of SSOCC5-8h, SSOCC5-16h, SSOCC5-300rpm and SSOCC5-400rpm electrodes at 0.2 A/g.

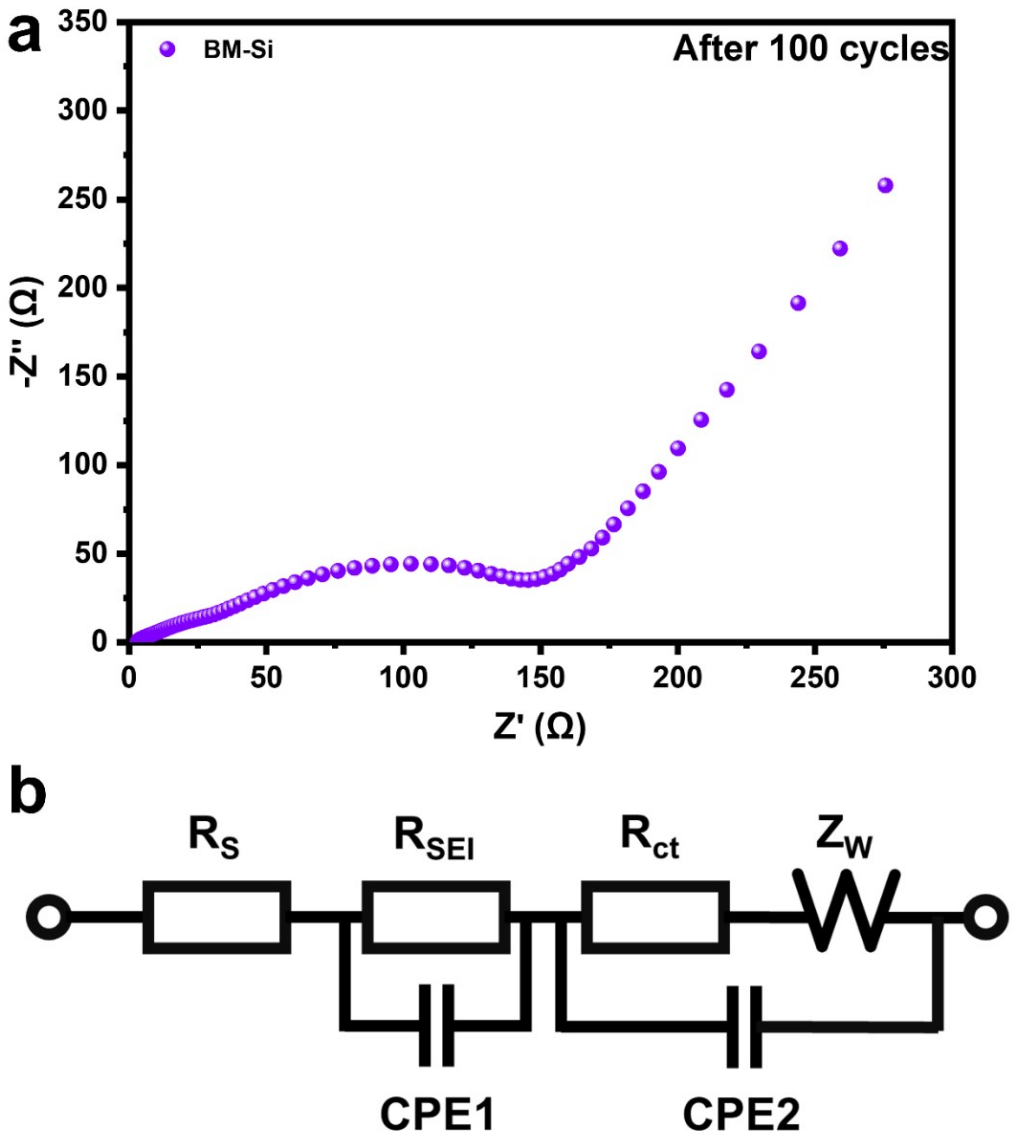

Figure S8 (a) EIS profile of BM-Si electrode after 100 cycles. (b) Equivalent circuit for the EIS fitting.

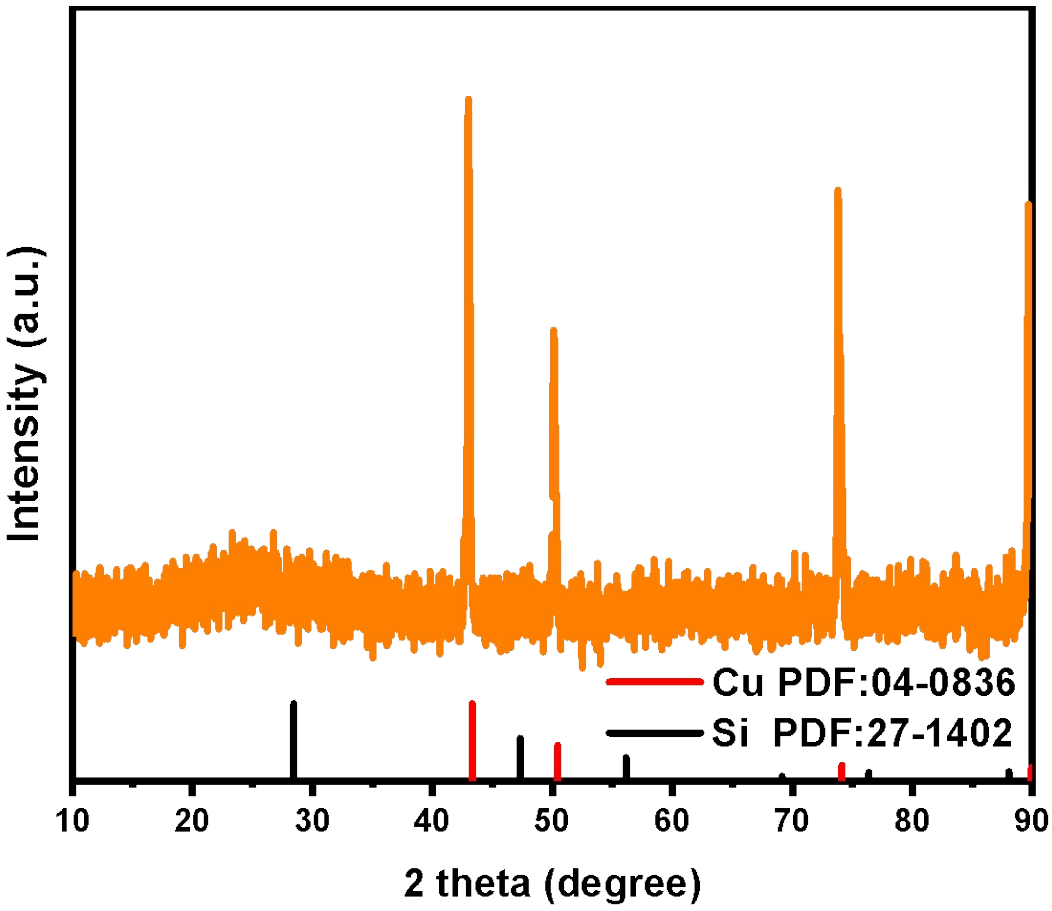

Figure S9 XRD pattern of the cycled SSOCC5 electrode after 100 cycles.

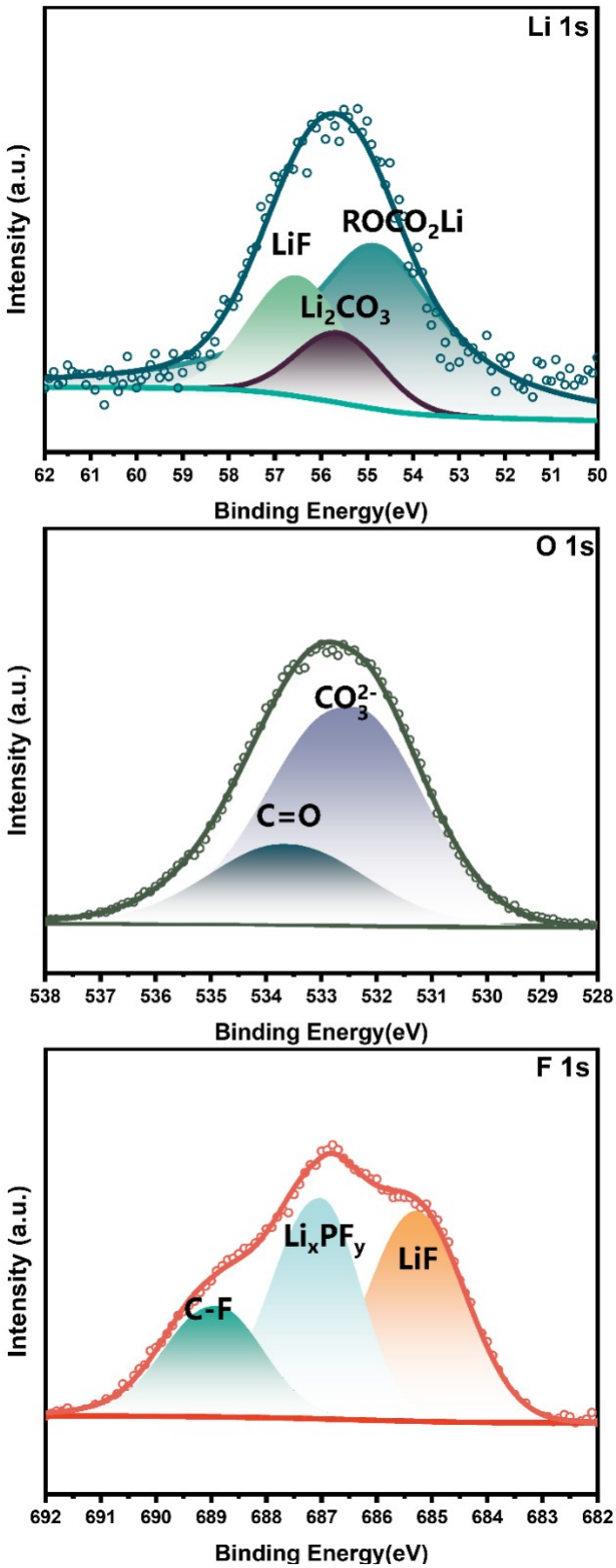

Figure S10 Li1s, O1s and F1s XPS spectrum of the cycled SSOCC5 after 100 cycles.

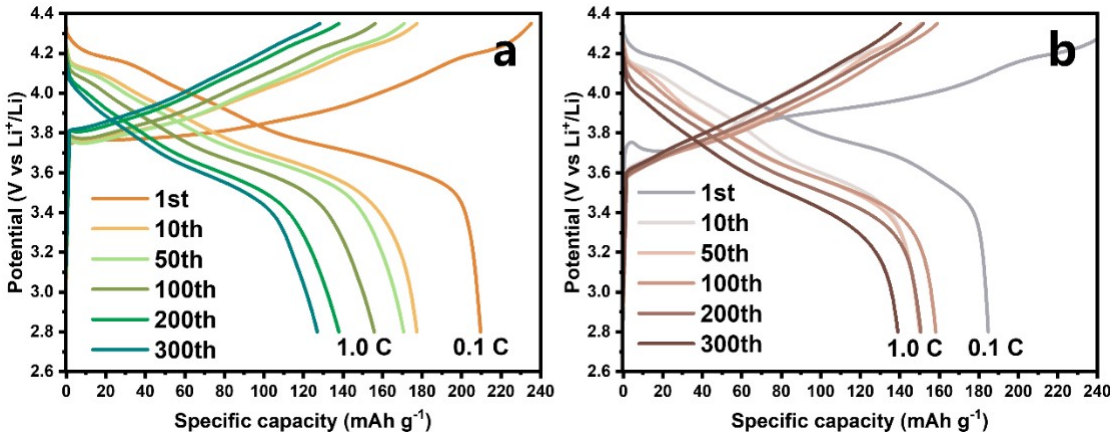

Figure S11 Voltage profiles of (a) Li//NCM811 and (b) Gr//NCM811 cells at 1 C rate.

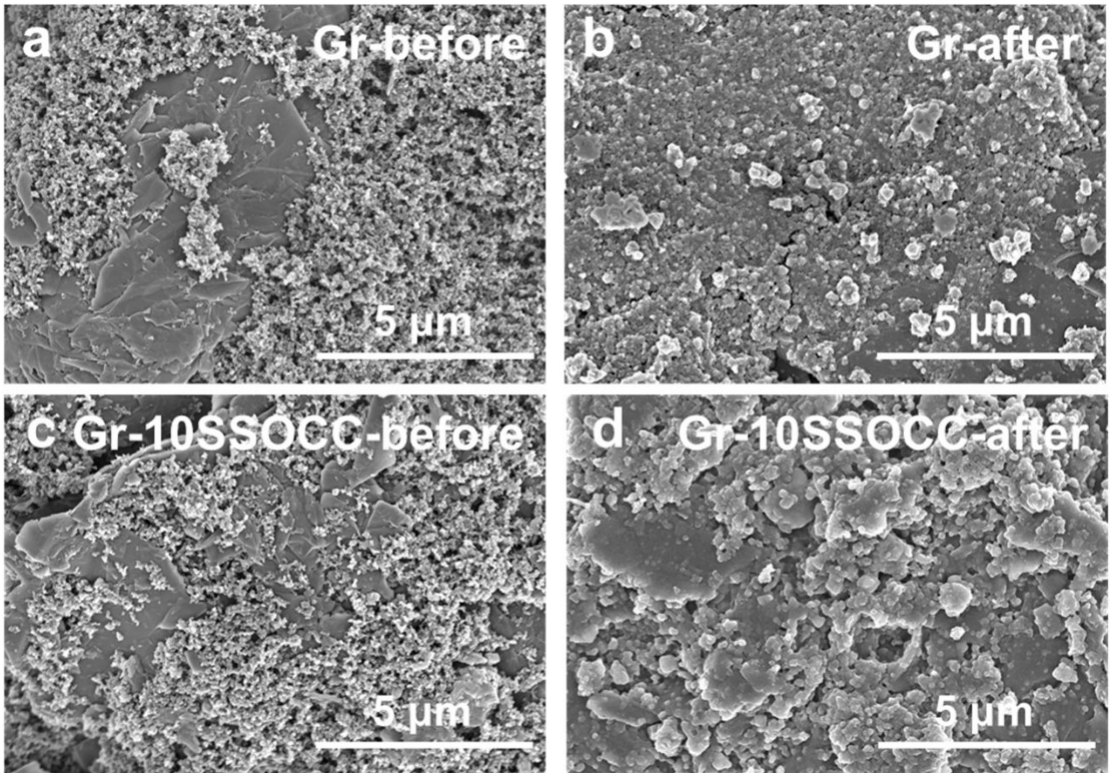

Figure S12 SEM images of (a, b) Gr and (c, d) Gr-10SSOCC5 electrodes before and after cycling.

Supporting Tables

Table S1 Sintering experiments of BM-Si and SSOCC5

Samples	Sample 1		Sample 2		Sample 3	
	BM-Si	SSOCC5	BM-Si	SSOCC5	BM-Si	SSOCC5
Before treatment weight (mg)	347.9	366.0	441.0	463.7	534.5	558.1
After treatment weight (mg)	370.7	378.2	469.2	478.6	569.4	576.4
Weight gain (wt%)	6.55	3.33	6.40	3.21	6.53	3.28
Weight gain difference (wt%)	3.22		3.19		3.25	

Carbon content equals to Weight gain difference, so the calculated average carbon content is ~3.22 wt%. The sintering experiments were carried out in air atmosphere.

Table S2 Etching experiments of SSOCC5

Samples	Sample 1	Sample 2	Sample 3
Before etching weight (mg)	200.0	300.0	400.0
After etching weight (mg)	193.35	293.39	393.43
Weight loss (wt%)	6.65	6.61	6.57

SiOC content equals to Weight loss, so the calculated average SiOC content is ~ 6.61 wt%. The etching experiments were carried out by using 20% hydrofluoric acid solution.

Table S3 Comparison of electrochemical performance for various Si-based anodes

References	Samples	Capacity (mAh g^{-1})	Current density (A g^{-1})	Cycles	ICE (%)
S1	MPSi@RTiO_2@FG	1014	1.0	800	81.2
S2	SiMPs@GO/ssDNA	1658	0.42	140	74.0
S3	MBPS/c-PAN	2126	0.2	50	92.0
S4	Si/C@NGs	1524	0.1	100	82.8
S5	MSi/C/RGO	1572	0.2	157	91.7
S6	Si/CNT	1275	0.2	100	60.2
S7	d-SiO@vG	1600	0.32	100	95.0
S8	nc-Si@HCS	1570	0.25	250	69.0
S9	Spherical Si/C	1391	0.2	400	84.5
S10	Si-MWCNT	1556	0.2	100	60.6
This work	SSOCC5	2130	0.2	100	90.2

Table S4 The fitted impedance parameters of all samples

	before cycle			after 100 cycles		
Samples	R_s (Ω)	R_{SEI} (Ω)	R_{ct} (Ω)	R_s (Ω)	R_{SEI} (Ω)	R_{ct} (Ω)
BM-Si	3.8	5.4	343.6	4.2	15.2	137.8
SSOCC3	2.1	3.0	303.1	3.8	14.0	21.3
SSOCC5	2.0	2.0	108.8	4.0	5.2	7.6
SSOCC8	1.8	2.3	174.9	4.0	12.6	15.6

Supporting References

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