Supplementary information

A Novel Textile-like Carbon Wrapping for High-performance Silicon Anodes in Lithium-ion Batteries

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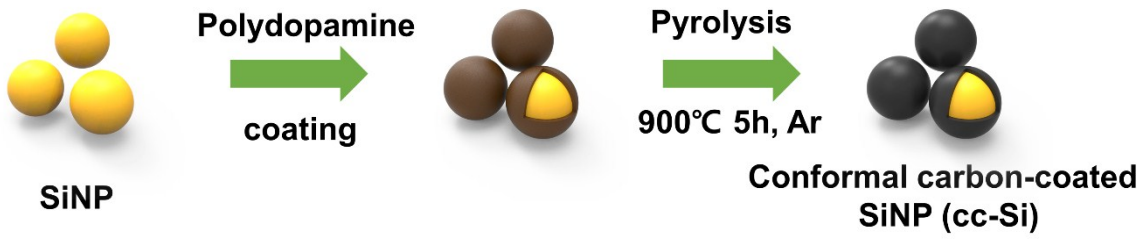


Fig. S1 A schematic illustration of cc-Si synthesis process.

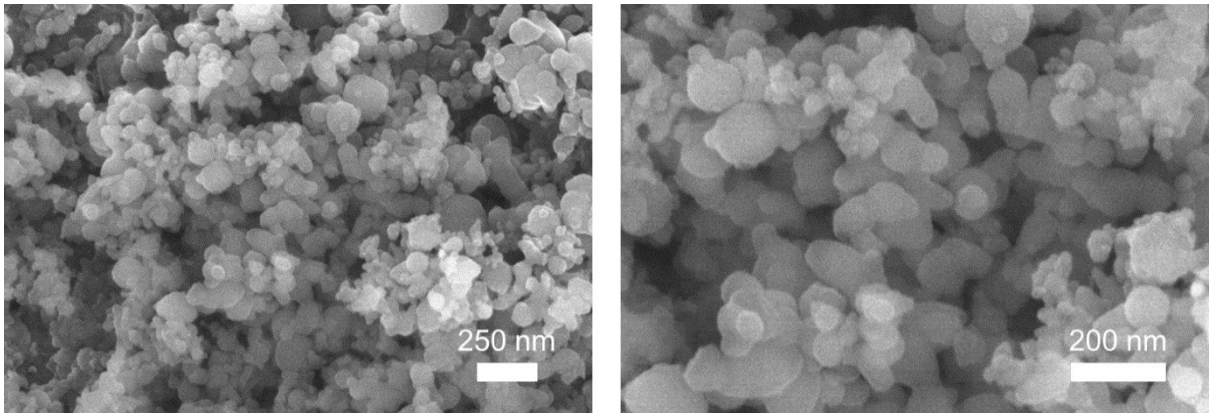


Fig. S2 SEM images of Bare-Si powder.

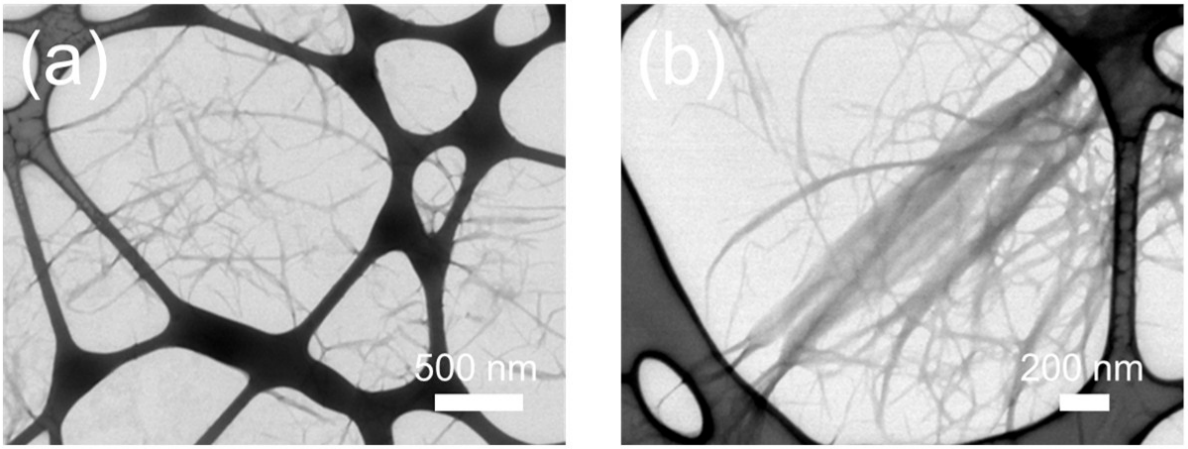


Fig. S3 STEM images of (a) dispersed and (b) agglomerated enzymatically hydrolyzed cellulose nanofibers.

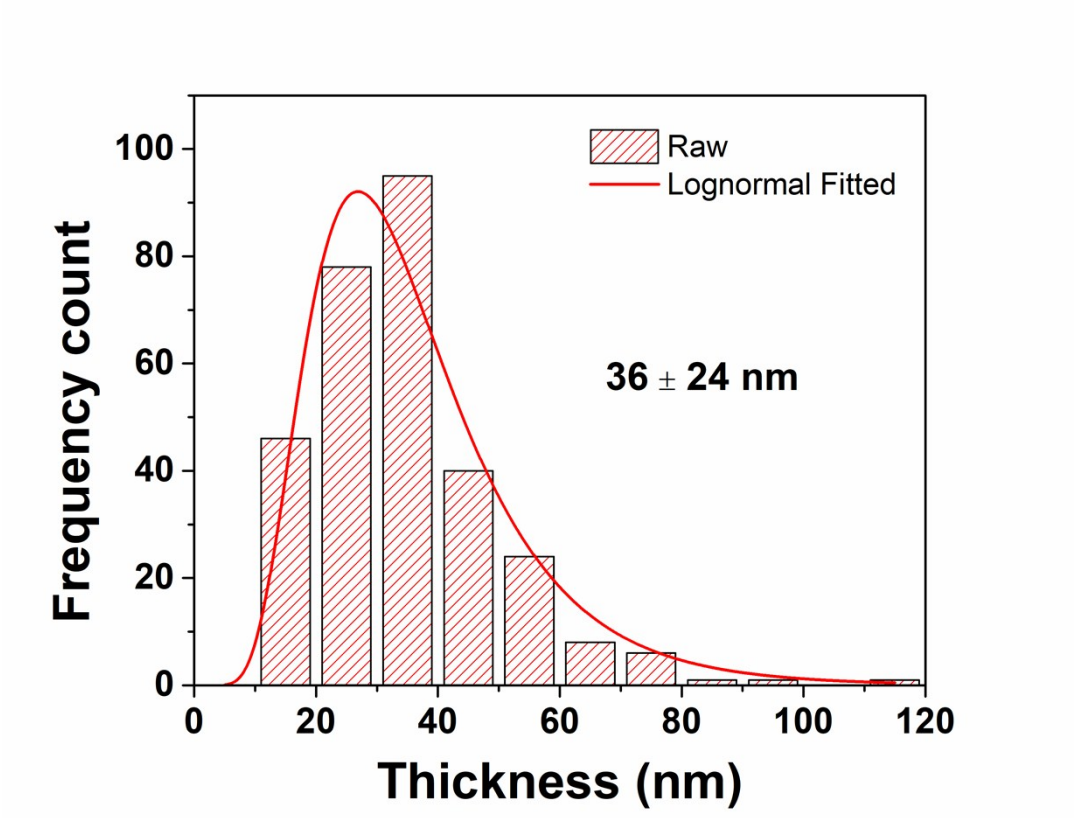


Fig. S4 The thickness of enzymatically hydrolyzed cellulose nanofibers.

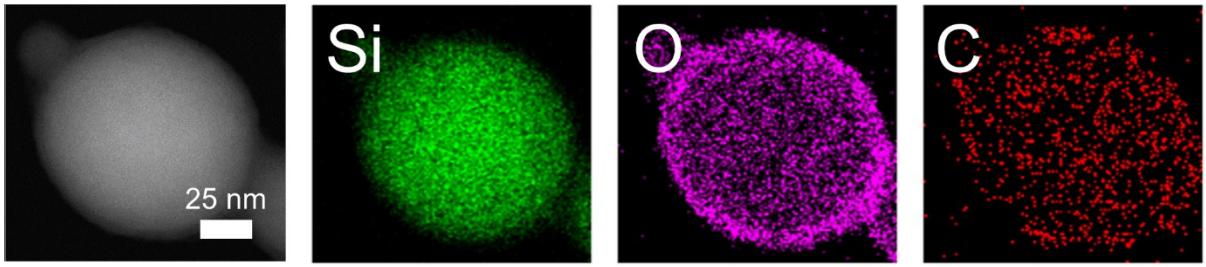


Fig. S5 EDS analysis images of cc-Si with the element mapping of silicon, oxygen and carbon.

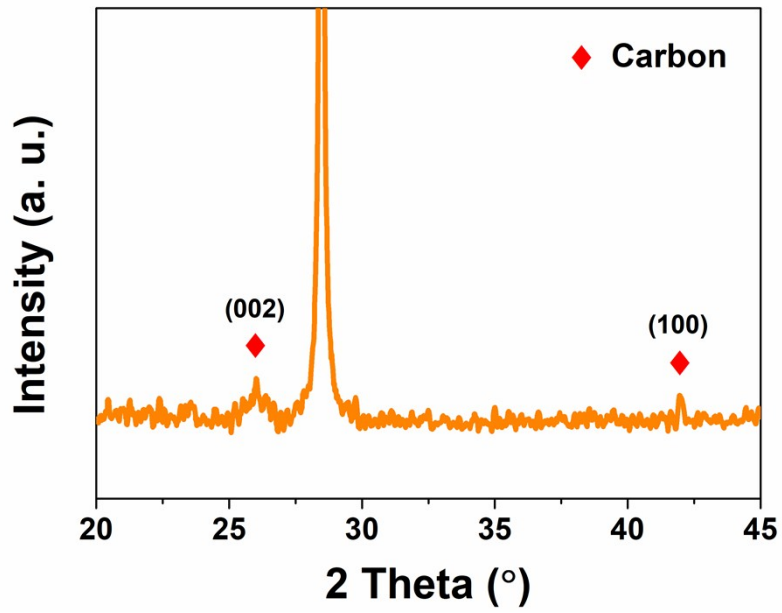


Fig. S6 Local XRD pattern of ctex-Si.

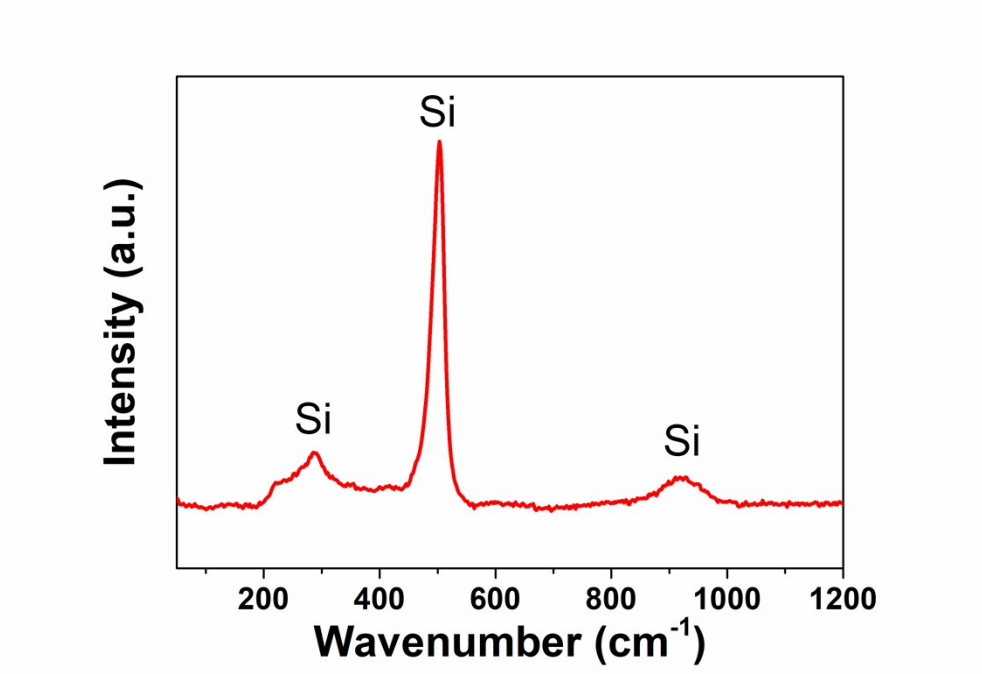
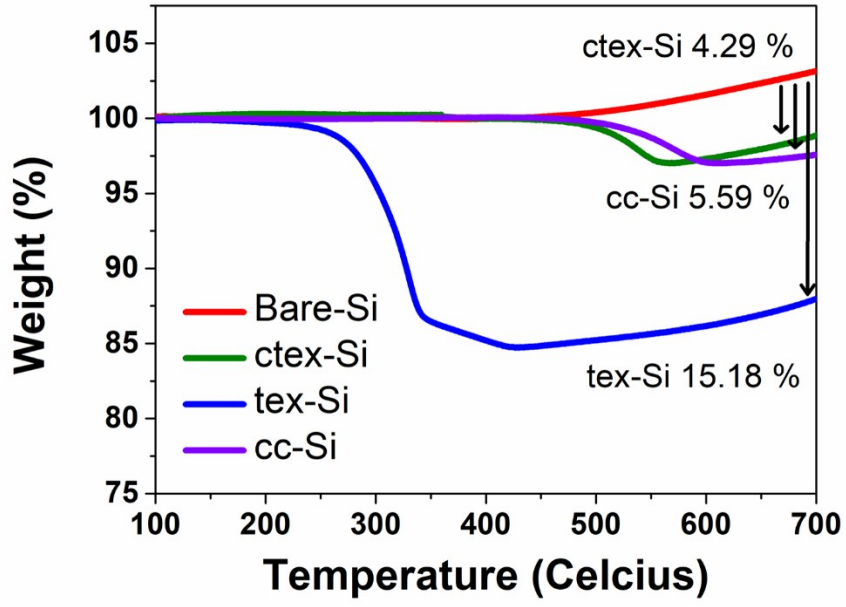


Fig. S7 Raman spectrum of ctex-Si.



C content (%) = The weight of Bare-Si at 700 ℃
– The weight of a sample at 700 ℃

Fig. S8 TGA graph of Bare-Si, cc-S, tex-Si and ctex-Si. The equation for C content calculation.

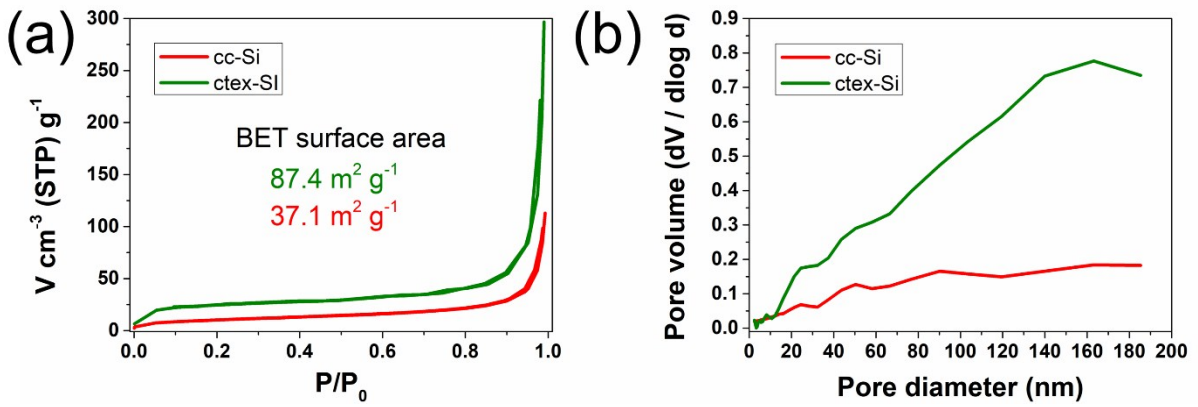


Fig. S9 (a) N_2 adsorption/desorption isotherms of cc-Si and ctex-Si. (b) BJH pore distribution diagrams of cc-Si and ctex-Si.

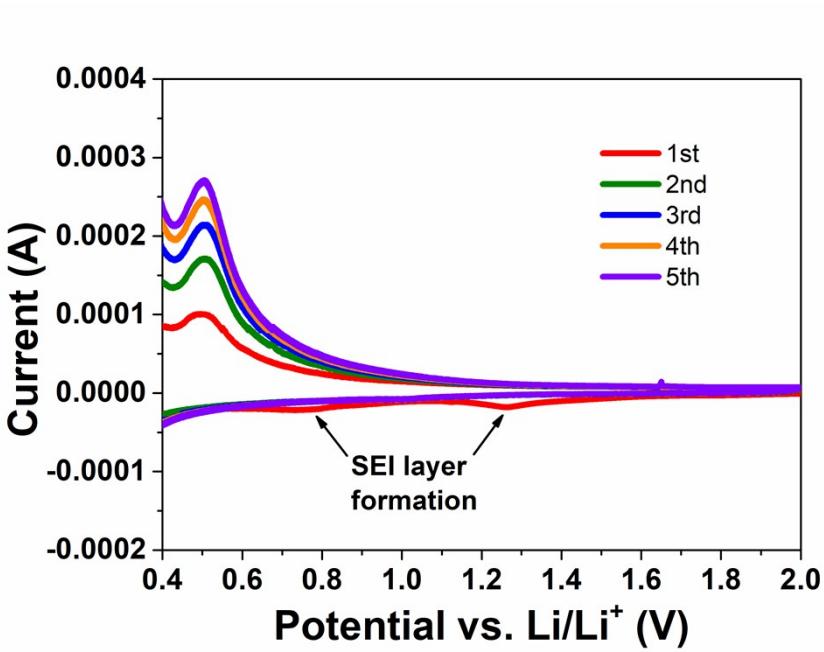


Fig. S10 A magnified CV curve of ctex-Si.

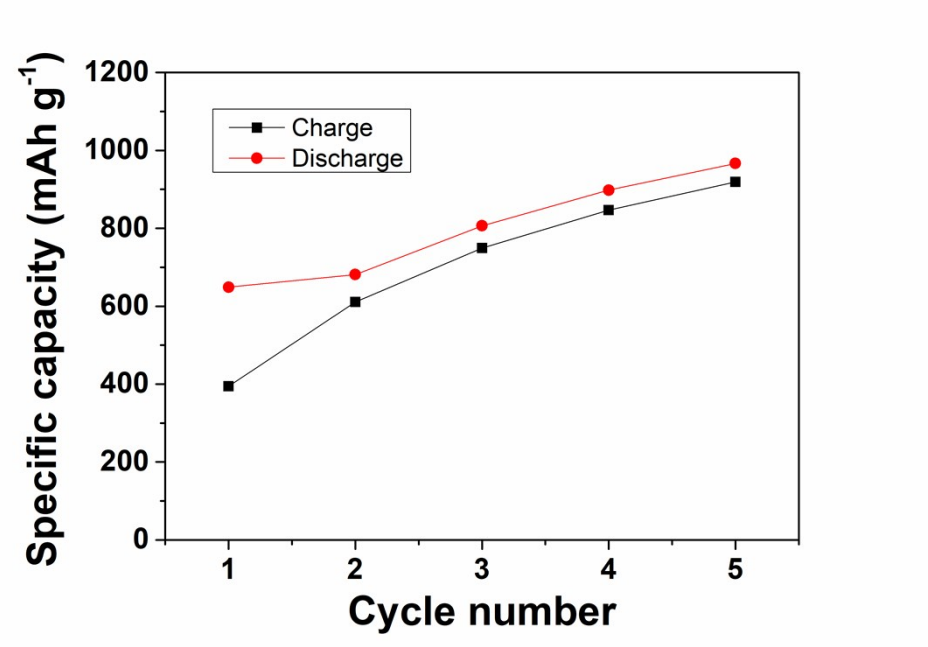


Fig. S11 Specific capacity of ctex-Si during CV with a scan rate of 0.1 mV s^{-1}.

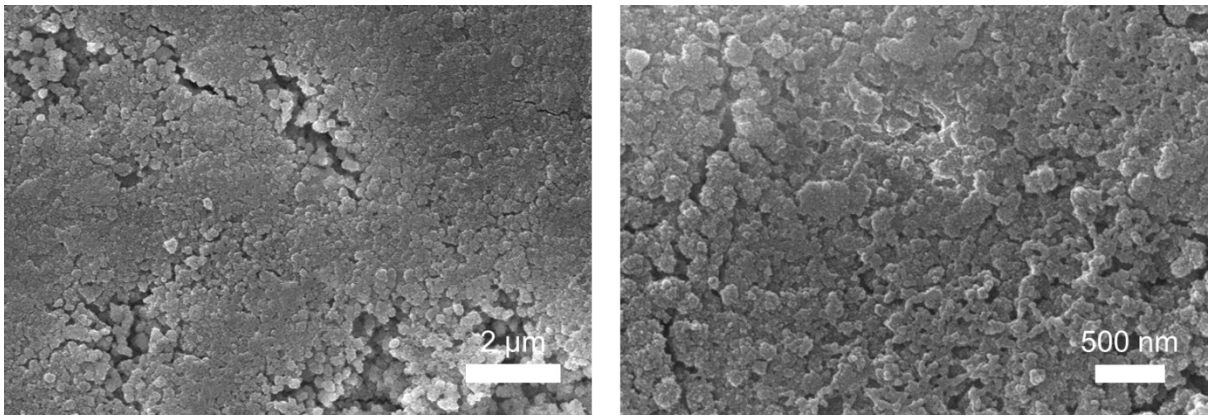


Fig. S12 SEM images of a ctex-Si electrode after 500 cycles at 2.0 A g^{-1}.

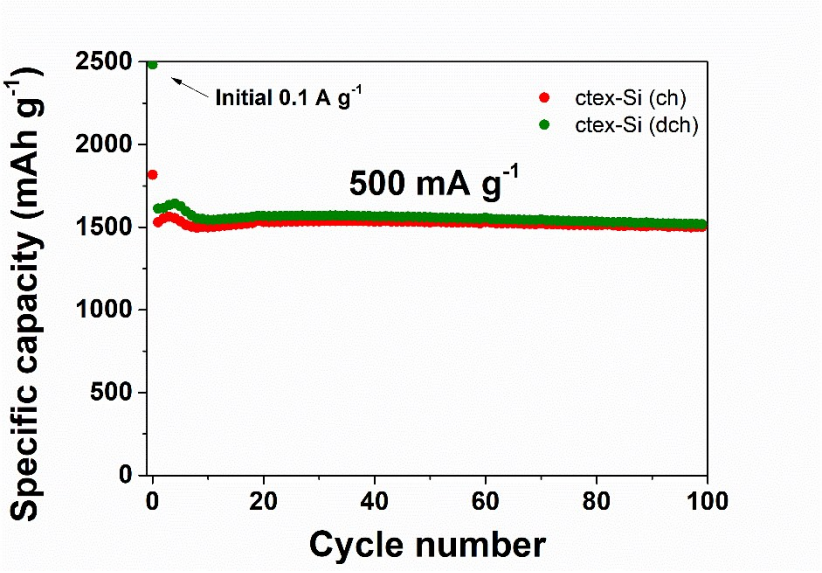


Fig. S13 Cycling performance of ctex-Si for 100 cycles at 500 mA g^{-1}.

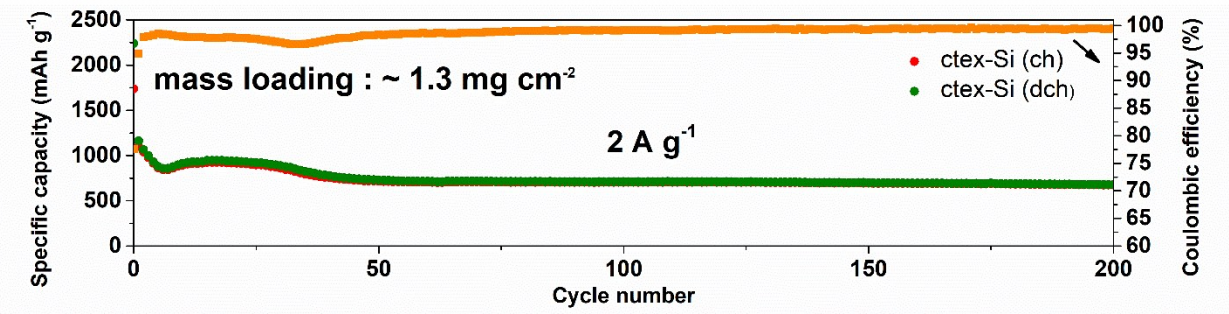


Fig. S14 Cycling performance of ctex-Si with higher active material mass loading (~ 1.3 mg cm^{-2}) for 200 cycles at 2 A g^{-1}.

Table S1. EIS parameters for the fresh and 100 cycled cell of cc-Si and ctex-Si.

Sample	R_S (Ω)	R_{SEI} (Ω)	R_{ct} (Ω)	Reduced Chi-square
Fresh cc-Si	4.26 ± 0.06	-	6.37 ± 0.57	1.01 x 10^{-4}
Fresh ctex-Si	4.53 ± 0.05	-	3.84 ± 0.14	1.17 x 10^{-4}
Cycled cc-Si	3.09 ± 0.04	19.34 ± 0.14	17.83 ± 0.36	4.79 x 10^{-5}
Cycled ctex-Si	3.89 ± 0.05	11.54 ± 0.14	4.85 ± 0.31	1.23 x 10^{-4}

Table S2. Comparison table with other carbon-coated silicon, yolk-shell structured silicon and silicon-carbon composite.

Sample	Synthesis Method	Carbon source	Si (wt%) In active	Active: conductive additive: binder	Total carbon content (%)	Retention (%) (Cycle)	A g^{-1}	Ref
Textile-like carbon wrapped silicon	**Pyrolysis**	**Cellulose nanofiber**	**95.71**	**70:15:15**	**18.0**	**94.5 (500)**	**2**	**Our work**
Yolk-shell Si@void@C	Sol-gel / HF etching	Polydopamine	71	65:20:15	38.8	74 (1000)	4.2	Ref S1
Yolk-shell silicon-mesoporous carbon	Sol-gel / HF etching	Phenolic resin	73.3 42.2	60:20:20	36.02 54.6	~ 29 (400) 63 (400)	0.42	Ref S2
Nonfilling carbon-coated porous silicon	Pyrolysis / HF etching	Resorcinol-formaldehyde resin	89	80:10:10	18.8	100 (1000)	1.05	Ref S3
a phenolic resin-based carbon interfacial coated silicon	Sol-gel / Pyrolysis	Resorcinol-formaldehyde resin	81.7	60:20:20	30.9	69 (200)	0.5	Ref S4
Nanosized core/shell silicon@carbon	Pyrolysis	Polyvinylidene fluoride	95.7	60:16:24	18.6	97 (30)	0.05	Ref S5
Cocoon-like silicon based composite (porous Si@void@N-doped C)	Magnesio-thermic reduction / CVD	Pyridine vapor	79.3	85:0:15	18.1	84.9 (300) 100 (300)	2 16	Ref S6
Silicon Nanoparticles Embedded in Micro-Carbon	Hydro-thermal / Pyrolysis	Sucrose	30.5	60:20:20	61.4	93.5 (500)	0.8	Ref S7
double-shelled–yolkstructured silicon (carbon@void@ silicon)	CVD / HCl etching	Acetylene	60 (Carbon =24)	60:20:20	34.4	84.6 (1000)	5	Ref S8

References

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