coatings

Supplementary Materials: A Hollow Silicon Nanosphere/ Carbon Nanotube Composite as an Anode Material for Lithium-Ion Batteries

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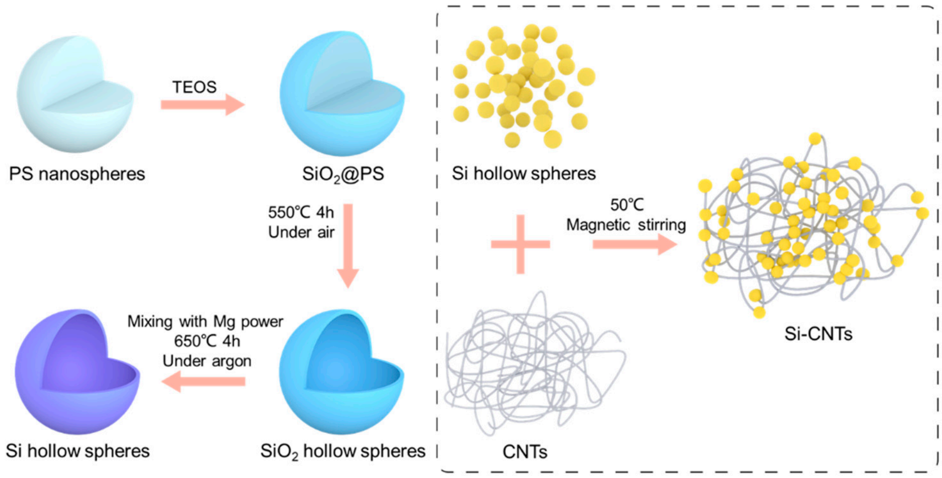

Figure S1. Synthesis method of Si-CNTs composite material.

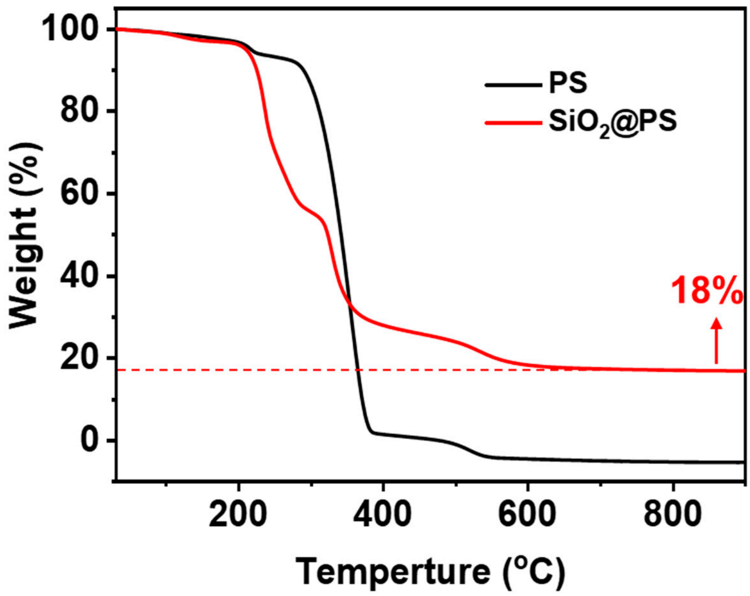

Figure S2. Thermogravimetric curves of PS and SiO2@PS in an air atmosphere.

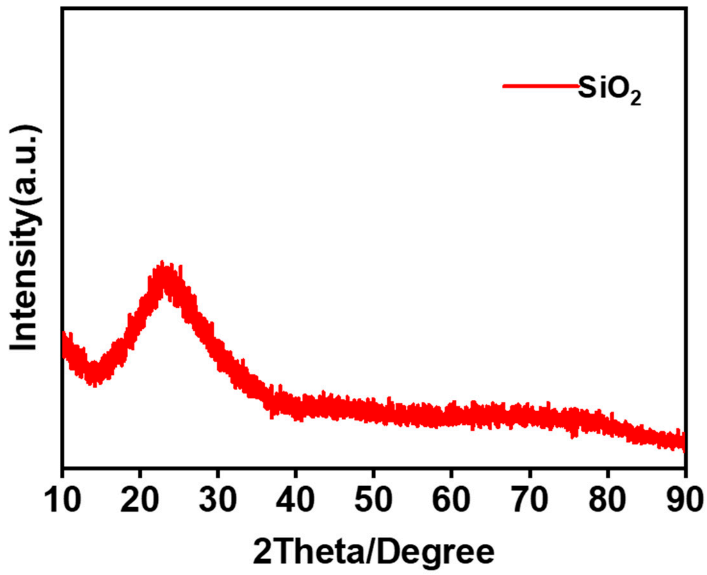

Figure S3. XRD patterns of hollow SiO_2.

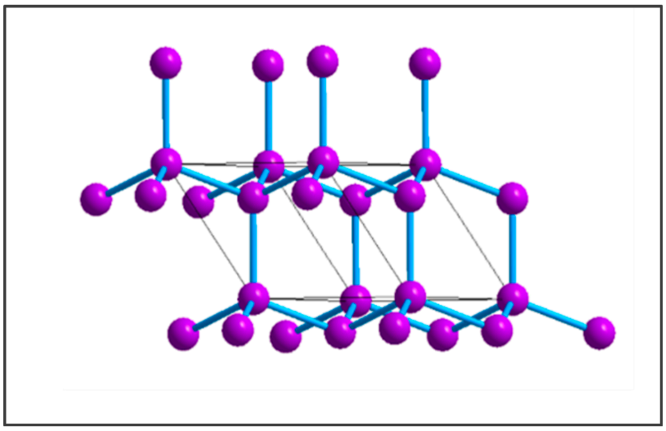

Figure S4. A model of the silicon crystal structure.

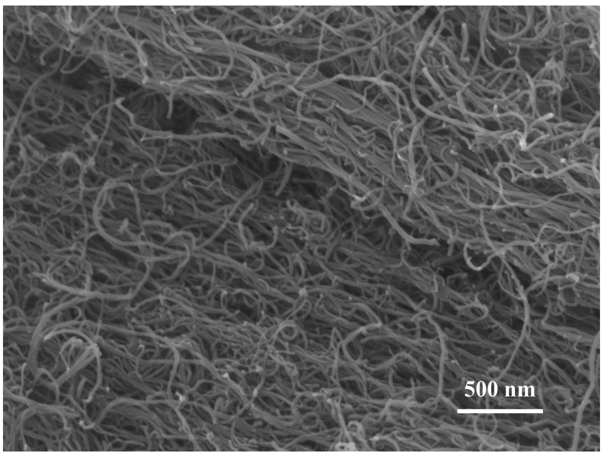

Figure S5. SEM image of CNTs.

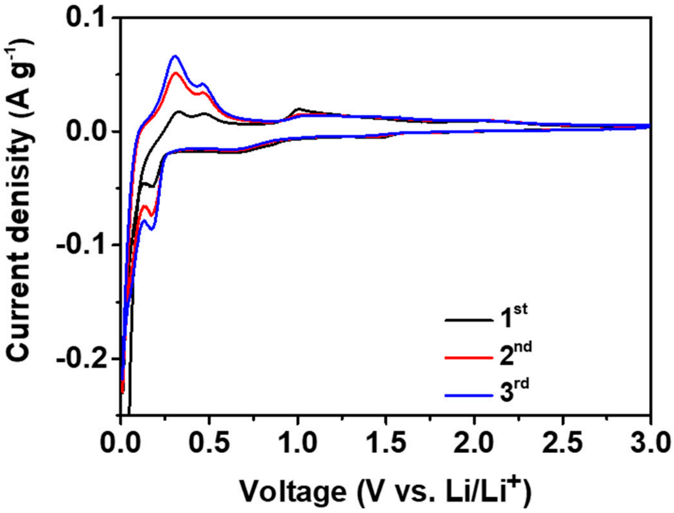

Figure S6. CV of the 50 nm hollow Si for the first three cycles at a scan rate of 0.1 mV/s.

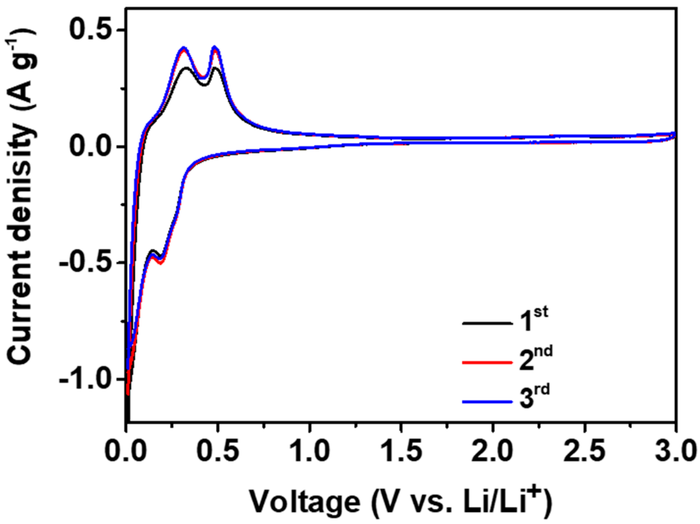

Figure S7. CV curves of the first three cycles of the Si-CNTs at a scan rate of 0.1mV/s.

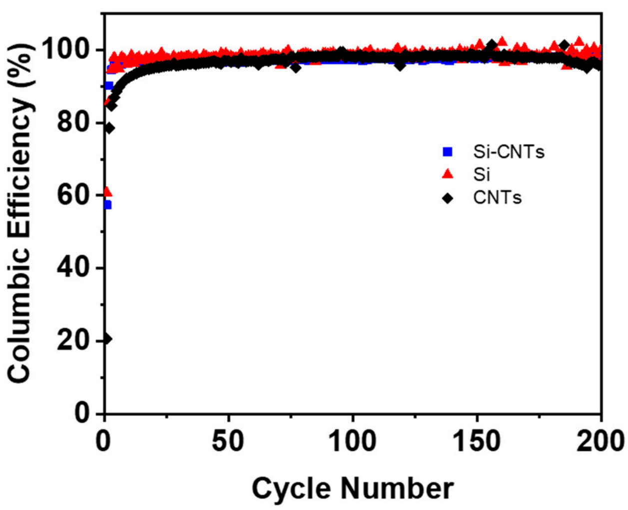

Figure S8. Columbic efficiency of these electrodes at 0.2A g^{-1}.

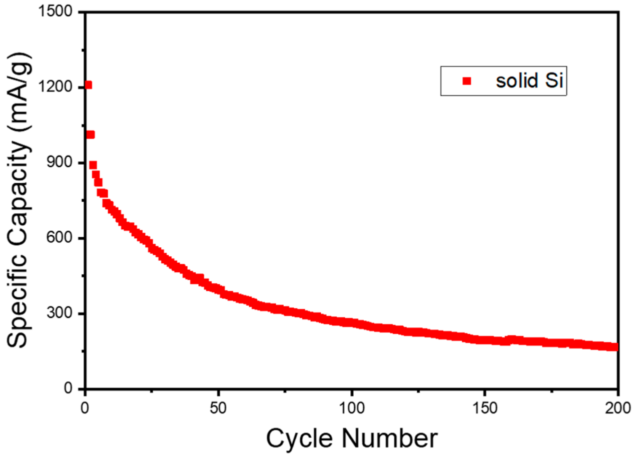

Figure S9. Cycling performance for solid nano-silicon spheres.

Table S1. Comparison of cycle performance of different silicon-based anodes.

sample	Reversible capacity (mAh g^{-1})	Capacity Retention (%)	Ref.
Hollow Si/CNTs	1526(0.2A/g 200cycles)	77.9	This work
Si/C	584 (0.2 A/g, 200 cycles)	61.5	[59]
Si/CNT/C	772(0.1C,100cycles)	97.1	[60]
Si/nano-Cu/CNTs/C	984 (0.2 A/g, 180 cycles)	53.6	[61]
g-Si/CNTs	895 (0.1 A/g, 200 cycles)	84.3	[62]

Reference

59. Zhu, G.; Luo, W.; Wang, L.; Jiang, W.; Yang, J. Silicon: toward eco-friendly reduction techniques for lithium-ion battery applications. *J. Mater. Chem. A* **2019**, *7*, 24715–24737.
60. Hu, L.; Luo, B.; Wu, C.; Hu, P.; Wang, L.; Zhang, H. Yolk-shell Si/C composites with multiple Si nanoparticles encapsulated into double carbon shells as lithium-ion battery anodes. *J. Energy Chem.* **2019**, *32*, 124–130.
61. Sakuma, R.; Hashimoto, H.; Kobayashi, G.; Fujii, T.; Nakanishi, M.; Kanno, R.; Takano, M.; Takada, J. High-rate performance of a bacterial iron-oxide electrode material for lithium-ion battery. *Materials Letters* **2015**, *139*, 414–417.
62. Chen, D.; Liao, W.; Yang, Y.; Zhao, J. Polyvinyl alcohol gelation: A structural locking-up agent and carbon source for Si/CNT/C composites as high energy lithium ion battery anode. *J. Power Sources* **2016**, *315*, 236–241.