Electronic Supplementary Information

Bamboo Leaves Derived Ultrafine Si Nanoparticles and Si/C Nanocomposites for High-performance Li-ion Battery Anodes

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Figure S1. Optical photograph of HC-leached dead bamboo leaves (BLs).

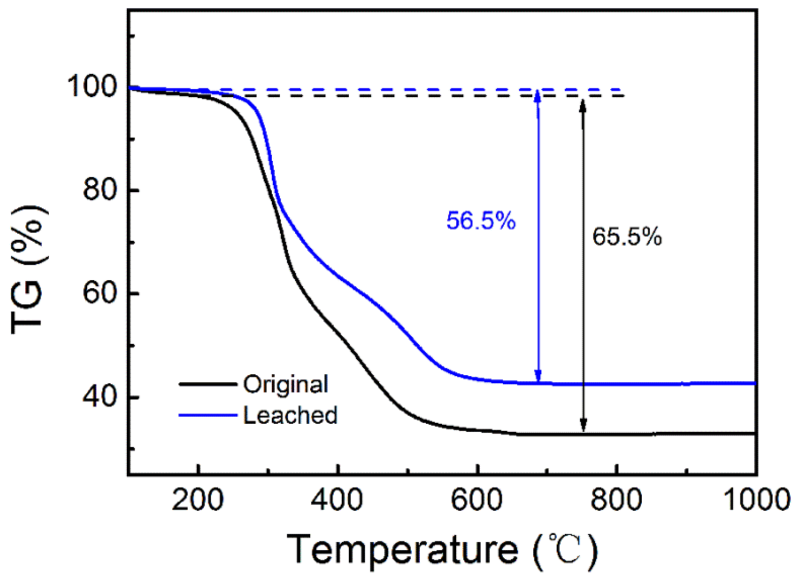

Figure S2. TG Curves for original BLs and HCl-leached BLs, suggesting the carbon weighs about 56.5% of HCl-leached BLs.

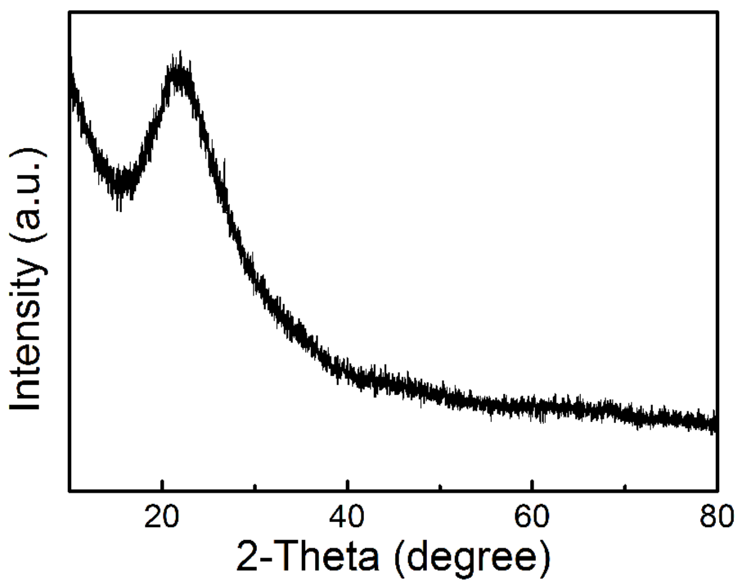

Figure S3. XRD pattern for SiO2. A broad peak at around 22.5° indicates the amorphous characteristic of silica derived from BLs

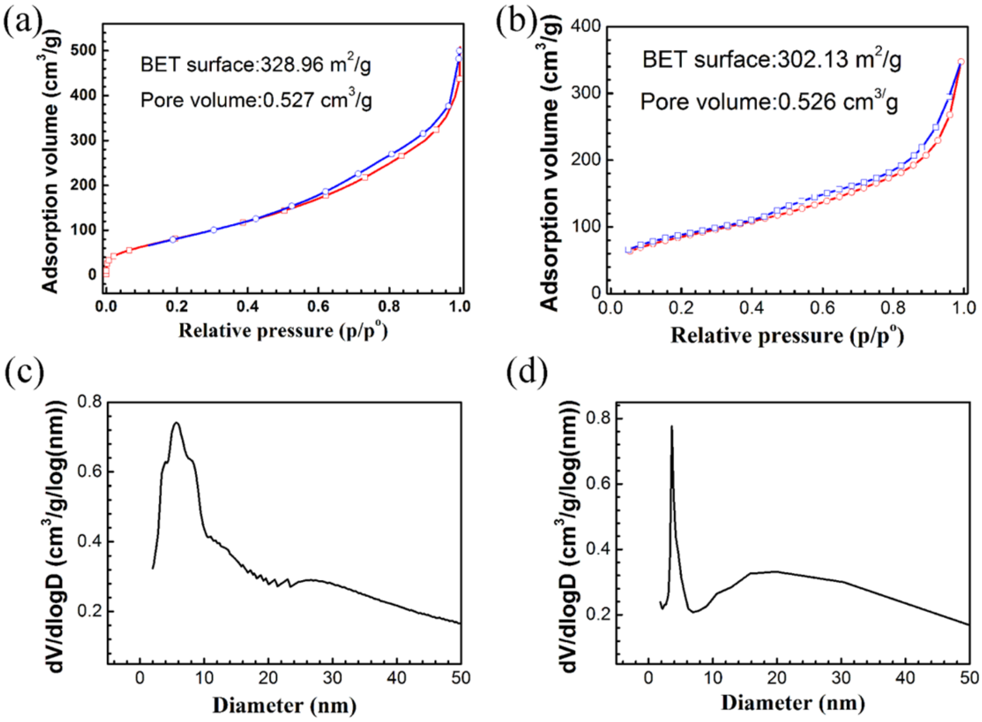

Figure S4. BET results for silica and silicon. (a-b) Isothermal of BLs derived SiO_2 and Si NPs. (c-d) pore distribution for BLs derived SiO_2 and Si NPs.

Assuming that the silicon NPs are absolute spherical particles with radius r and density ρ.

The mass : $m = \rho V = \rho \frac{4\pi r^3}{3}$

The surface area : $S = 4\pi r^2$

The surface area could be calculated:

$$S_{bet} = \frac{S}{m} = \frac{4\pi r^2}{\rho \frac{4\pi r^3}{3}} = \frac{3}{\rho r}$$

Since the density of crystalline silicon is 2.33 g cm^{-3} and testing results showed the BET surface is 302 m^2/g, thus, the radius is calculated:

$$r = \frac{3}{\rho S_{bet}} = 4.2\ (nm)$$

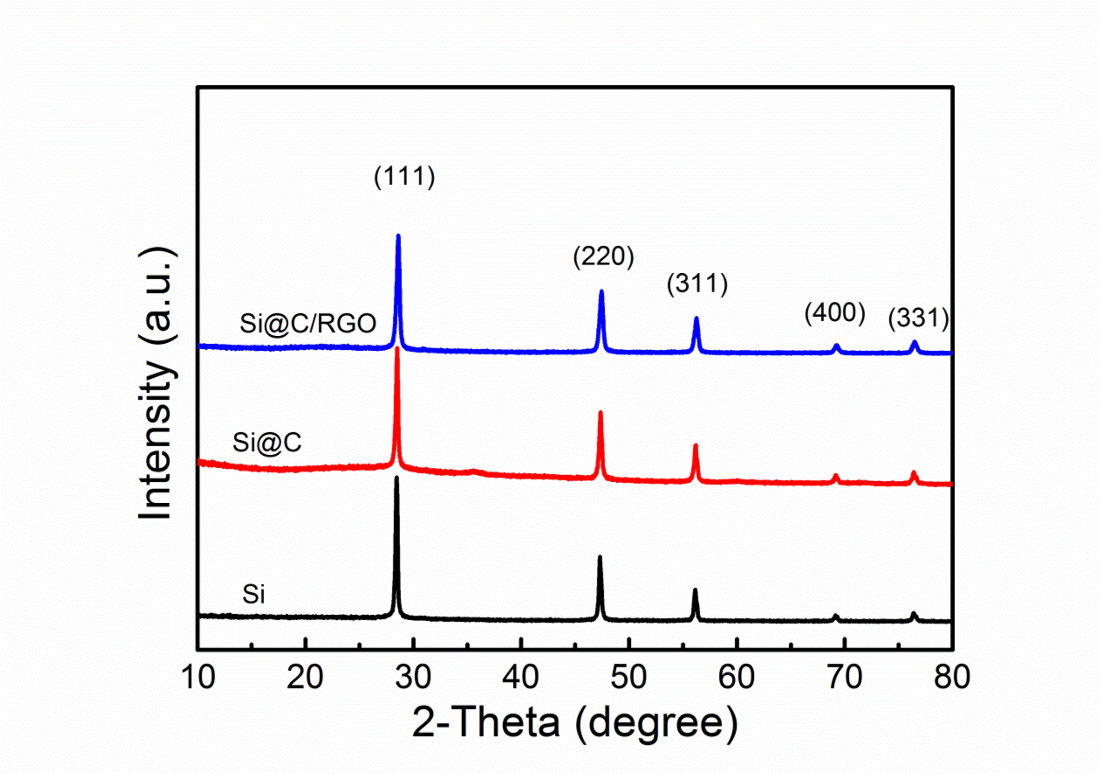

Figure S5. XRD patterns for Si, Si@C and Si@C/RGO, suggesting that the Si in Si@C and Si@C/RGO composite remain crystalline structure.

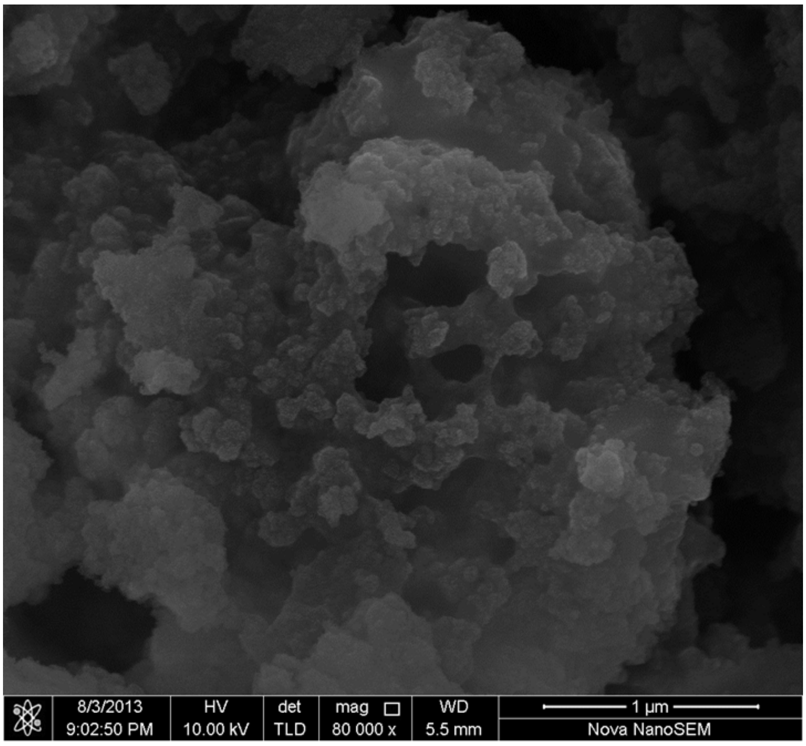

Figure S6. BLs derived Si produced by magnesiothermic reduction of BLs derived SiO_2 without adding NaCl as the heat-scavenger. Only large Si particles sintered together with a size of ten micrometers are prepared due to the large heat release from the highly exothermic reaction. The high local temperature (over 1720 ^{o}C) can collapse the architecture of the nanosized SiO_2 precursor and fuse and agglomerate the as-synthesized Si into large crystals, resulting in the formation of bulk Si.

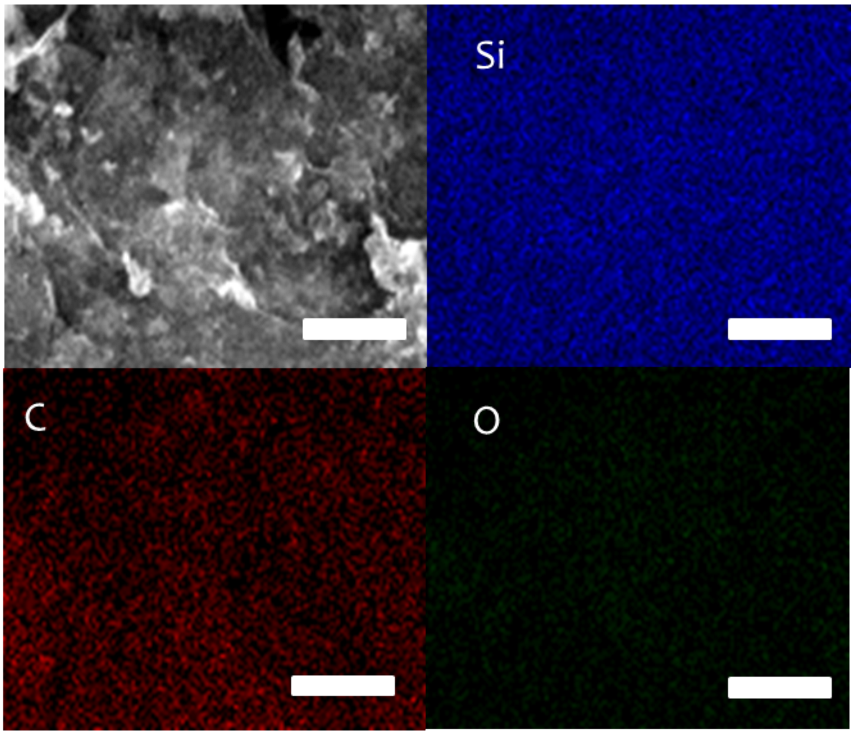

Figure S7. EDS Mapping for the sample of Si@C/RGO nanocomposites. The scale bar is 30 μm. The C and Si are well dispersed in the whole image, indicating the Si were well dispersed in Si@C/RGO nanocomposites

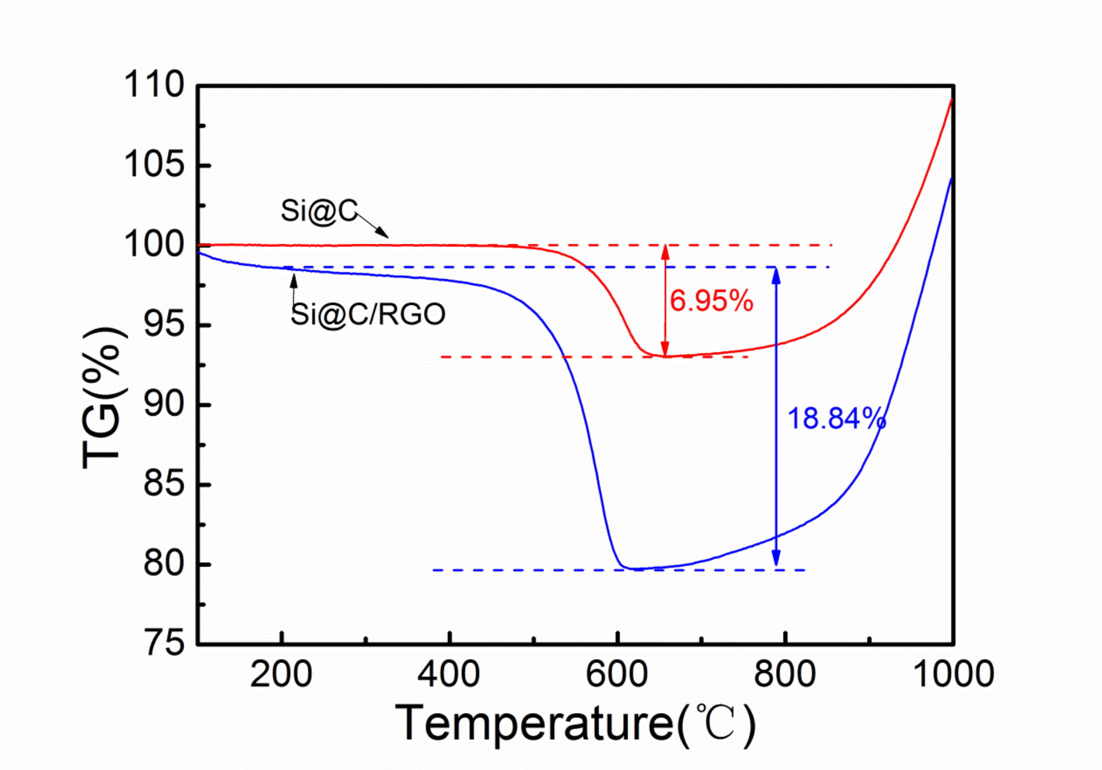

Figure S8. TG curves for Si@C and Si@C/RGO, indicate that the C coating and RGO contribute about 6.9% and 11.9%, respectively, and so the weight of Si in Si@C/RGO nanocomposites is 82.2%

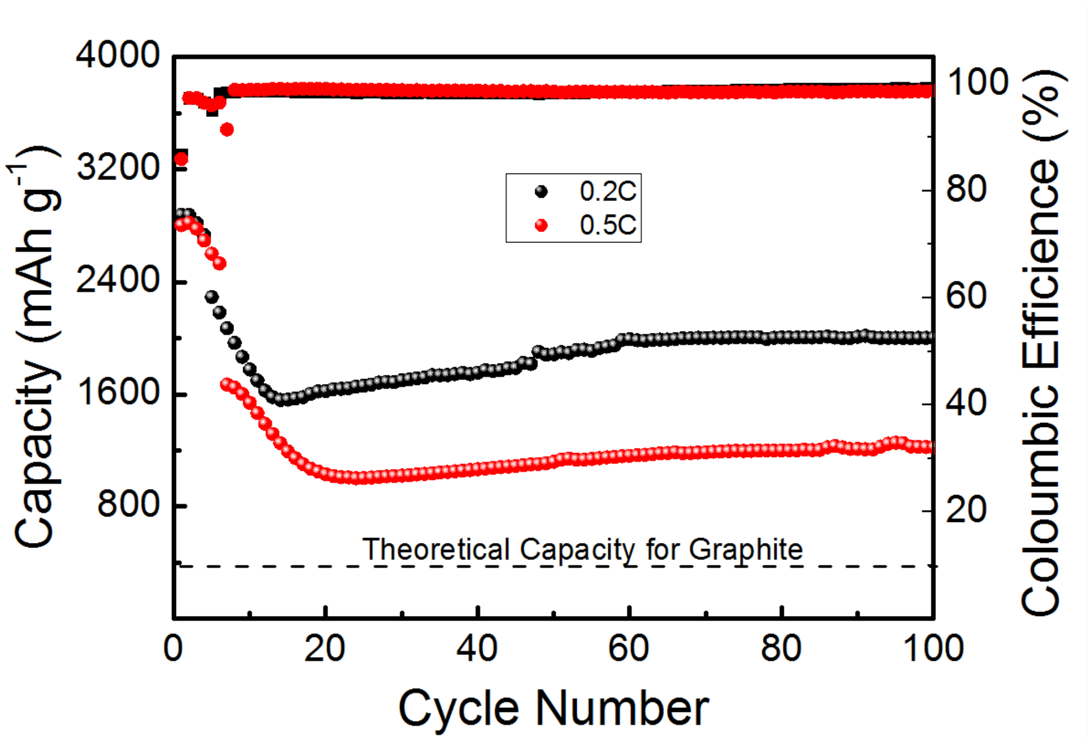

Figure S9. Discharging capacity curves of the Si NPs versus cycle number at 0.2C and 0.5C rates. The BLs-derived Si NPs exhibit good cycle stability and high specific capacity of 1,800 and 1,200 mAh/g at 0.2 C and 0.5 C rates after 100 cycles, which are 4.8 and 3.2 times larger than the theoretical capacity of graphite.

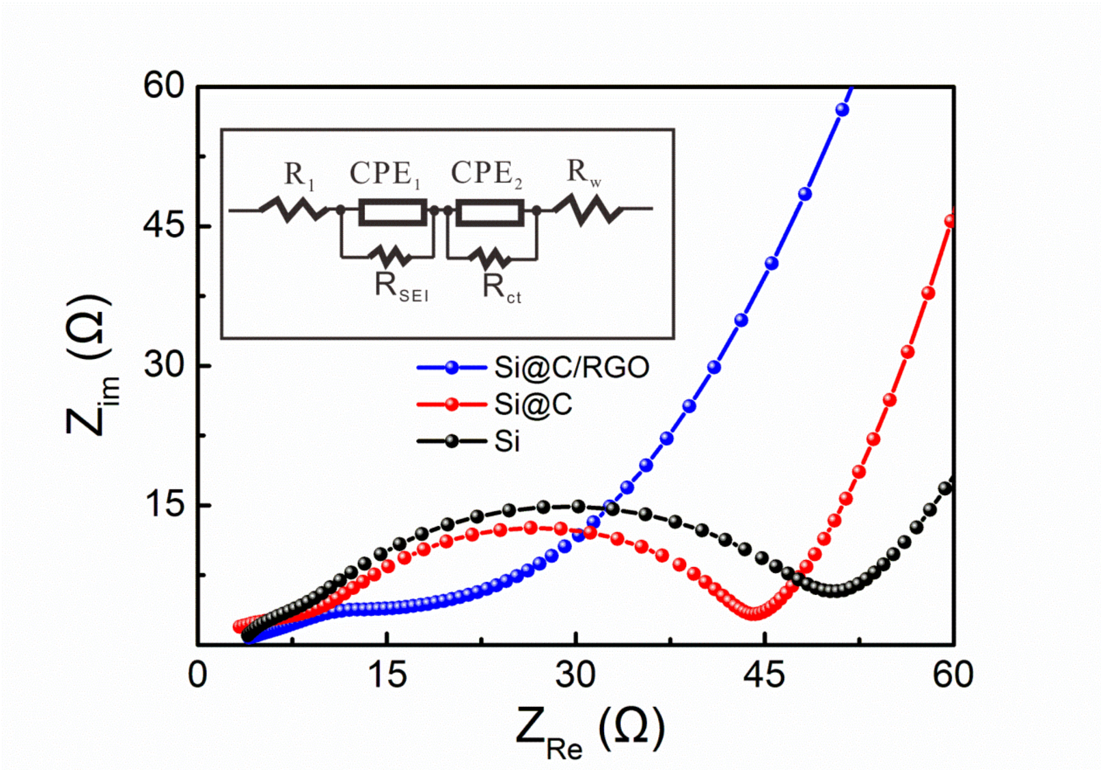

Figure S10. The Nyquist plots the equivalent circuit for the Si, Si@C and Si@C/RGO electrodes.

In the equivalent circuit, R1 is composed of electrolyte resistance (Rs) and electrode resistance (Re); R_{SEI} represents the SEI resistance; Rct represents the charge–transfer resistance across the electrode–electrolyte interface; CPE1 is the constant-phase element which represents the diffusion capacitance attributed to Li-ion diffusion in SEI film and CPE2 is the electric double-layer capacitance of electrode–solution interface. The Warburg element represents impedance due to diffusion of ions into the active material of the electrode

The Capacity contributed by the Carbonaceous Components:

The capacity contributions from carbonized PDA, Carbon Black and RGO were calculated on the following procedure:

Capacity contribution of carbon black in Si@C electrode(%):

Weight content of carbon black× Capacity of carbon black/Capacity of Si@C electrode=0.2×170/1850×100%=1.8%

Capacity contribution of carbonized PDA in Si@C electrode(%):

Weight content of carbonized PDA× Capacity of carbonized PDA /(Capacity of Si@C electrode- Weight content of carbon black× Capacity of carbon black)=0.069*196/(1850-0.018*170)*100%=0.7%

Capacity contribution of RGO in Si@C/RGO electrode(%):

Weight content of RGO× Capacity of RGO /(Capacity of Si@C/RGO electrode-Weight content of carbon black× Capacity of carbon black)=0.119*524/(1900-0.018*170)*100%=3.28%

Capacity contribution of carbonized PDA in Si@C/RGO electrode(%):

Weight content of carbonized PDA× Capacity of carbonized PDA /(Capacity of Si@C/RGO electrode- Weight content of carbon black× Capacity of carbon black)=0.069*196/(1900-0.018*170)*100%=0.7%

*The capacity of carbon black and carbonized PDA is based on *Proc. Natl. Acad. Sci. U. S. A.*, 2013,**110**, 12229-12234

*The capacity of RGO is based on *Electrochem. Commun.*, 2011, **13**, 1332-1335.