Supporting Information

Si/graphene nanocomposite anode: massive production and stable high capacity for lithium ion batteries

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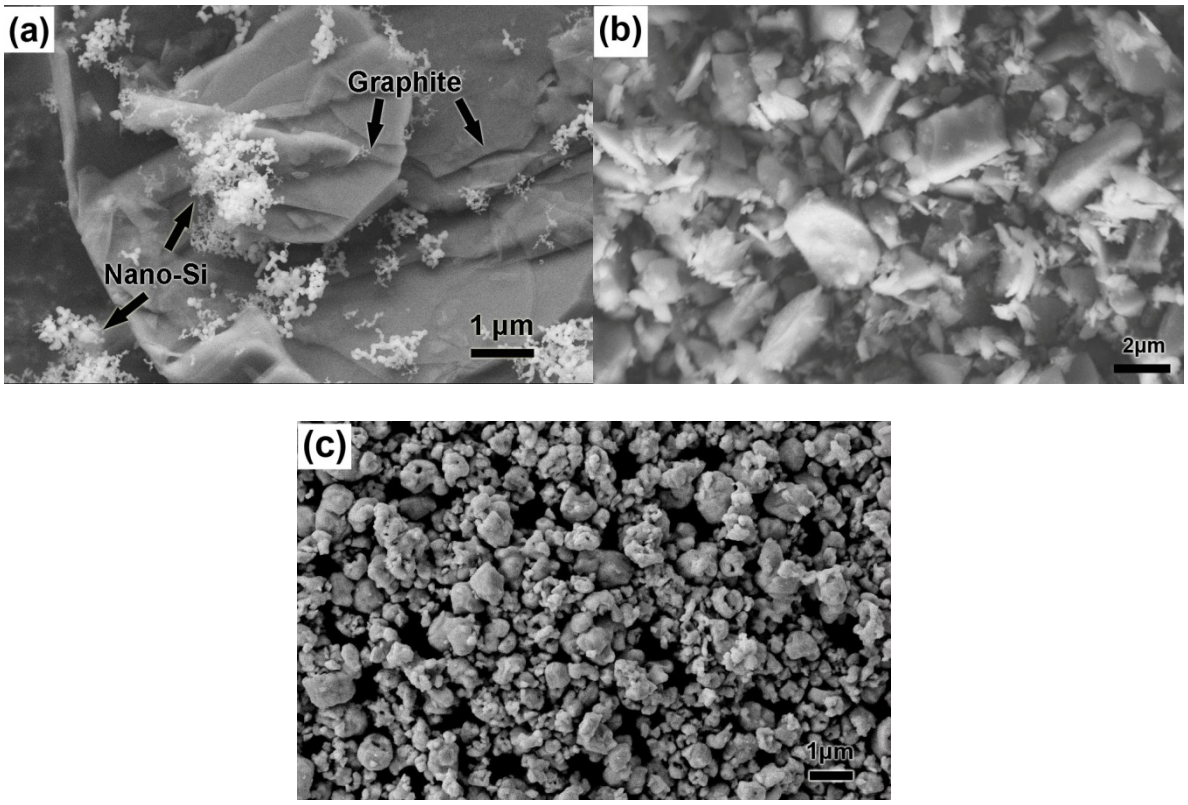


FigureS1. (a) SEM image of the nano-Si/graphite composite before milling. Initial morphologies of the large (~30μm) graphite particles with flat cleavage surfaces, and the nano-sized nature (~100nm) of the spherical Si particles could be clearly seen. The nano-Si particles agglomerated and randomly dispersed on the graphite surfaces; (b) SEM image of micro-sized Si powder (1~3μm, 99% pure); (c) SEM image of WC powder (1~2μm, 99% pure).

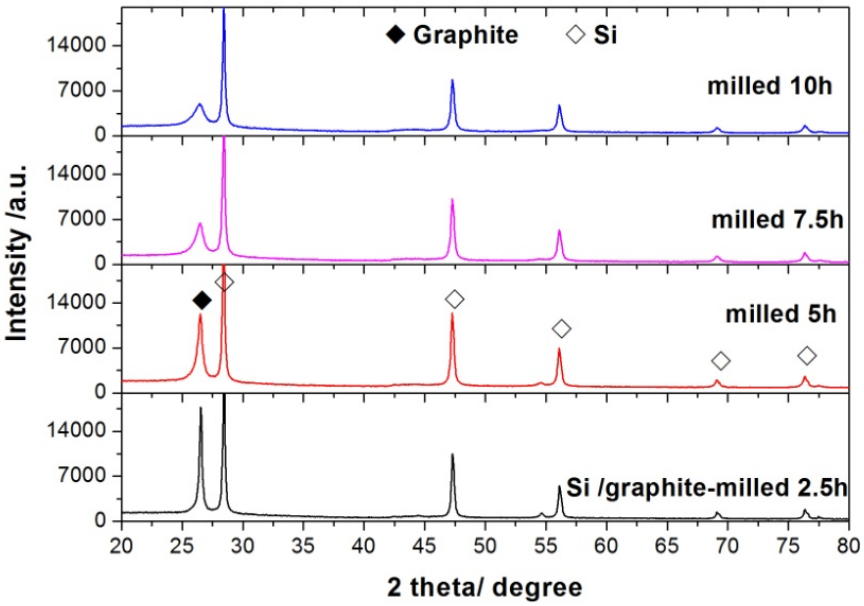


Figure S2. XRD patterns of the nano-Si/graphite composite treated by plasma-assisted milling with various durations (2.5, 5, 7.5, and 10h). They indicate that increasing milling time evidently caused broadening of the (002) peak of graphite. However, there is no visible change in the characteristic peaks for the Si phase.

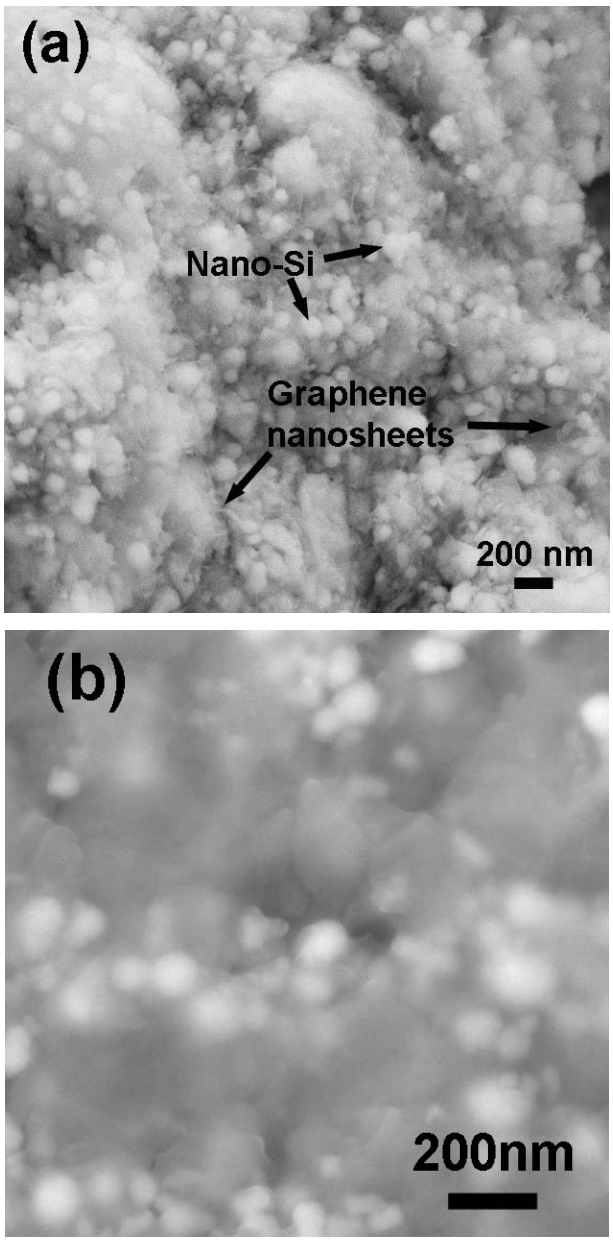
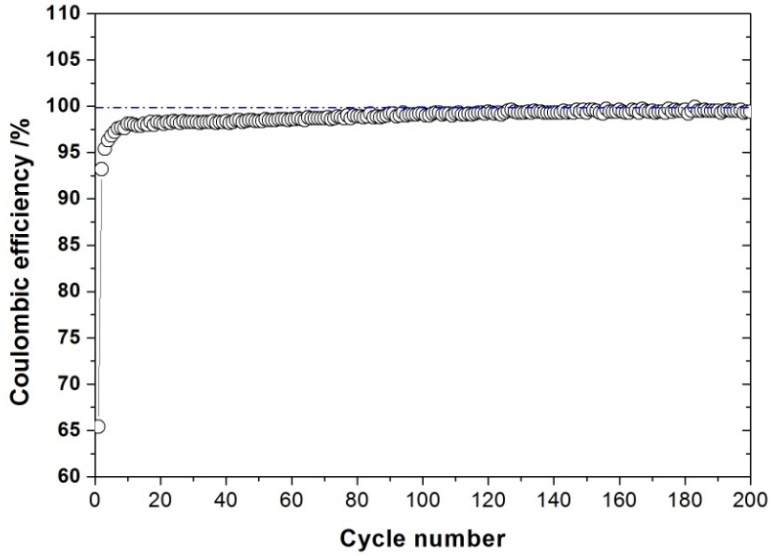
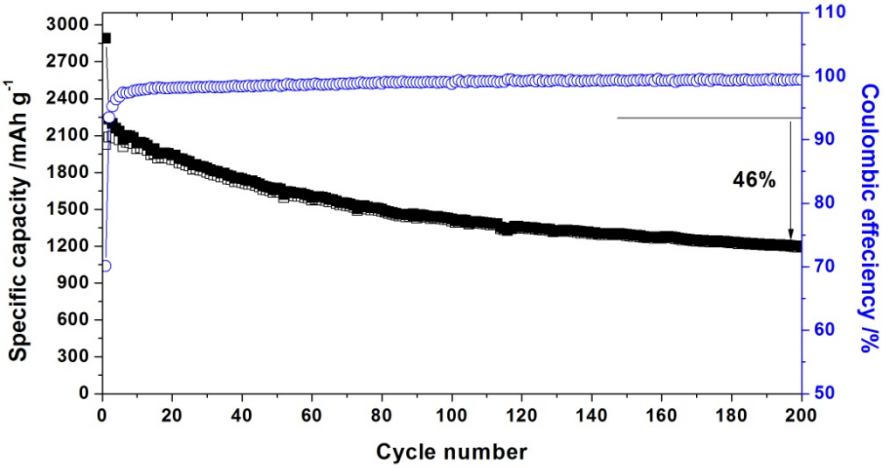


Figure S3. (a) Magnified SEM image of the nano-Si/graphite composite after 10h P-milling, showing a morphology different from that of the composite before milling (see Figure S1).The large graphite sheets were completely disintegrated, and the nano-Si particles dispersed uniformly in the graphene nanosheets matrix; **(b)** Higher magnification SEM image clear shows the complete coating of nano-Si particles by the thinned graphite flakes.



FigureS4. Coulombic efficiency vs cycle number of the P-milled Si/graphene nanocomposite at 0.4mAcm^{-2} between 0.01 and 1.5V. The coulombic efficiency increased from 65.4% to 98.1% and 99.0% at the 1st,10th, and 80th cycle, respectively, and stayed above 99.0% at higher number of cycles.



FigureS5. Long-term cycle performance of the P-milled Si/graphene nanocomposite at lower current density (0.2mAcm^{-2}) between 0.01 and 1.5V. It can be seen that the anode also showed good cyclability. However, it showed higher reversible capacity (1195 mAhg^{-1}) with slightly lower capacity retention after 200cycles (53.5%) compared with that at 0.4mAcm^{-2}.

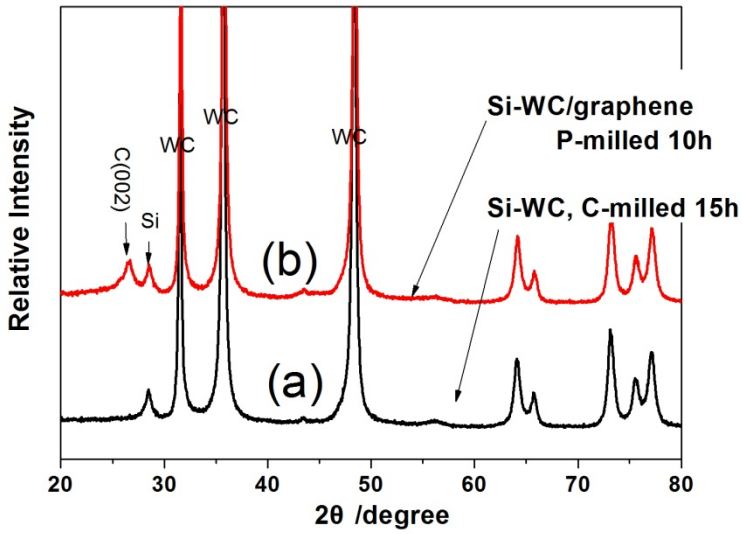


Figure S6 (a) XRD pattern for the mixture of micro-sized Si (1~3μm) powder and microsized WC powder (Si:WC=2:3wt%) after C-milling 15h; (b) XRD pattern of the Si-WC/graphene nanocomposite formed after P-milling of Si-WC mixture and graphite for 10h,revealing the dramatically refinement of Si and graphite after P-milling treatment.