Electronic Supplementary Material (ESI) for Nanoscale.

Electronic Supplementary Information

Confining SnO_2 Nanoparticles Between Multi-layered and Interconnected Graphene Spheres as Binder-free Anodes for High-capacity Lithium-ion Batteries

Qingguo Shao,[a,b] Jie Tang,[a,b,]* Yige Sun,[a,b] Jing Li,[a,b] Kun Zhang,[a] Jinshi Yuan,[a] Da-Ming Zhu,[c] Lu-Chang Qin[d,*]

[a] *National Institute for Materials Science, 1-2-1 Sengen, Tsukuba 305-0047, Japan.*

[b] *Doctoral Program in Materials Science and Engineering, University of Tsukuba, 1-1-1 Tennodai, Tsukuba 305-8577, Japan.*

[c] *Department of Physics and Astronomy, University of Missouri-Kansas City, Kansas City, MO 64110, USA*

[d] *Department of Physics and Astronomy, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3255, USA.*

E-mail: tang.jie@nims.go.jp ; lcqin@unc.edu

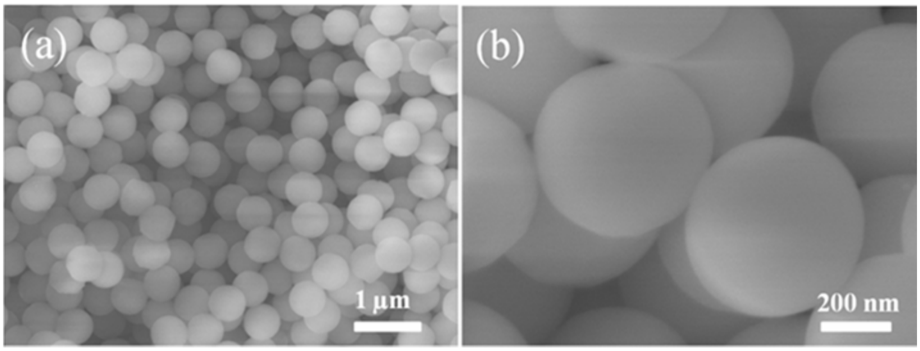

Figure S1. SEM images of PS spheres.

Fig S1 shows the SEM images of as prepared PS templates. The PS templates show a typical sphere structure with rather smooth surface and a diameter of 300 nm. Besides, the spheres are mono-dispersed, which is crucial for the uniform coating of GO/SnO_2 composite sheets in the following step.

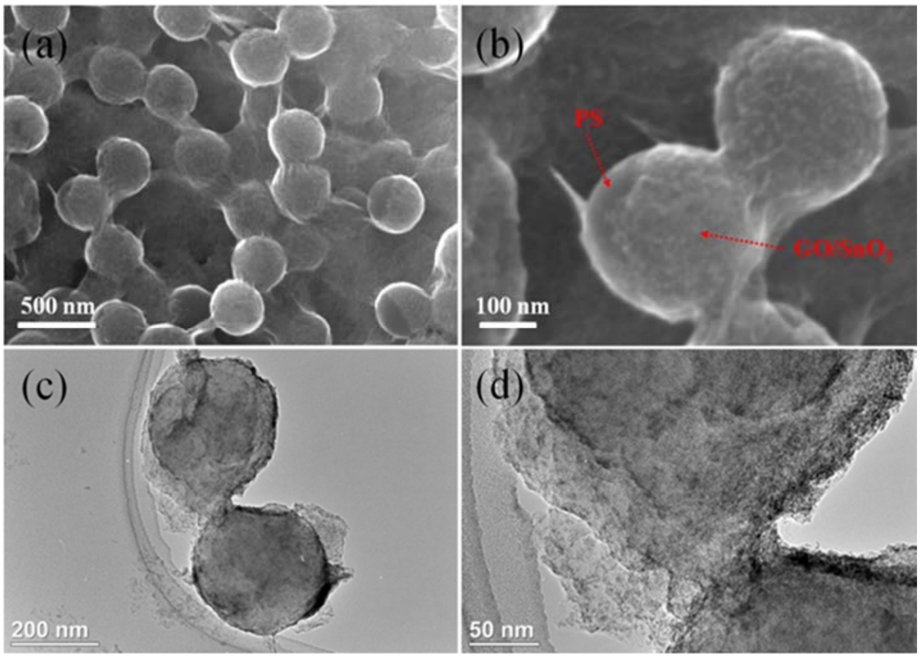

Figure S2. SEM and TEM images of $PS@GO/SnO_2$ interconnected composite spheres.

Fig S3a and b display the SEM images of the PS@GO/SnO_2 oxide interconnected composite spheres. As can be observed, the surface of the PS spheres is no longer smooth but coated with a composite sheet. In addition, the mono-dispersed PS spheres are linked together by the composite sheet. TEM images also confirm this core-shell structure. The ultra-fine SnO_2 nanoparticles are uniformly anchored on the graphene oxide sheets and the composite sheets wrap around on the PS spheres.

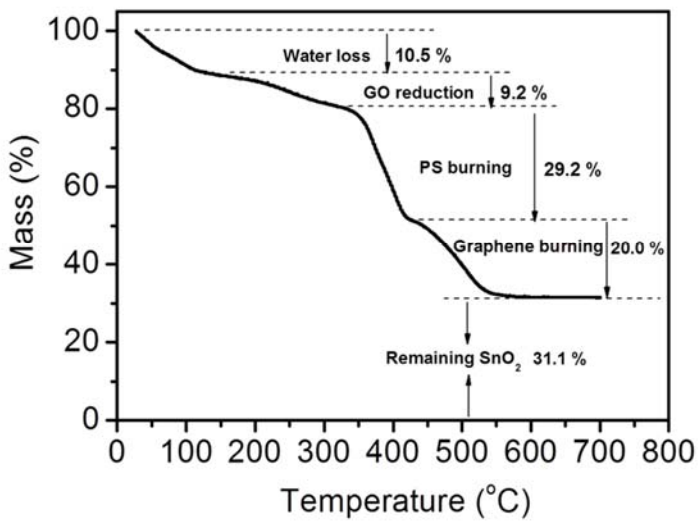

Figure S3. TGA curve of PS@GO/SnO_2 composite interconnected composite spheres.

In order to find the suitable heating temperature, TGA was performed with the PS@GO/SnO_2 composite interconnected composite spheres and its weight loss curve was shown in Fig S3. As can be seen, the TGA curve shows a multi-step weight loss process. From the beginning to 100 ℃ is the weight loss of absorbed water. The weight loss from 200 to 300℃ should be ascribed to the reduction of GO. From 300 to 380 ℃ is the burning of PS. From 420 to 550℃ is the burning of graphene. So, in order to get the Graphene/SnO2 composite, the heating temperature was determined at 400℃, where PS can be burned out and graphene and SnO_2 was retained. Besides, the weight ratio of graphene and SnO_2 (2:3) in the final composite can also be identified from the TGA curve.