Silicon Nanoparticles Encapsulated in Hollow Graphitized Carbon Nanofibers for Lithium Ion Battery Anode

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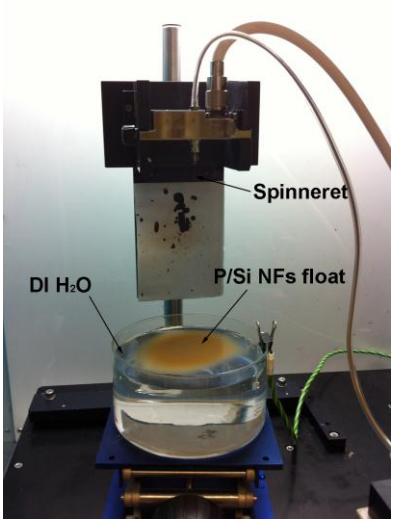

Fig. S1. The electrospinning setup with liquid collector.

Fig. S2. The pictures of (a) electrospun PAN nanofibrous mat obtained using plate collector and (b) the above mat after 8-times PDA in-situ deposition under the same condition as that for the loose lump of PAN/Si nanofibers collected using water collector.

The coating is fairly uneven since the monomer can hardly diffuse into the compact mat during polymerization; the PDA was coated only on those nanofibers which are located on the surface of the mat.

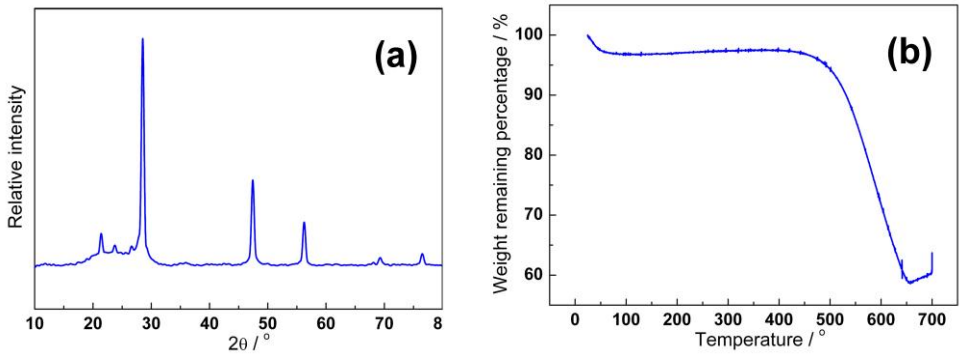

Fig. S3. (a) XRD pattern and (b) TGA profile of carbonized PAN/Si hybrid nanofibers (C-P/Si NFs). It is confirmed that the Si nanoparticles are in face-centered cubic crystalline form, and the content of Si in C-P/Si NFs is about 58.7 wt%.

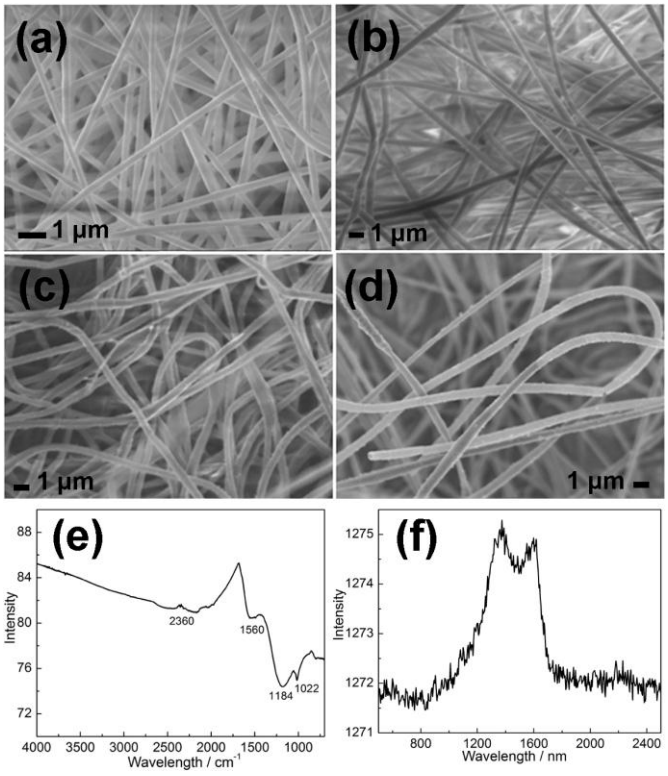

Fig. S4. SEM micrographs of (a) the electrospun pure PAN nanofibers, (b) electrospun PAN nanofibers coated with PDA before removal of PAN. Due to the good adhesion of PDA to PAN surface, the coatings replicate the shape of the nanofibers very well so that no significant morphological change can be observed after multiple depositions of PDA. (c) SEM micrographs of hollow PDA nanofibers after removing PAN. After leaching out the PAN with DMF, the resultant hollow PDA nanofibers show good structural stability without collapsing of the hollow nanostructure. (d) SEM micrograph of the carbonized hollow PDA nanofibers. The structural stability is well retained even after the calcination at 700°C, where hollow C-PDA nanofibers are formed. The diameter of the hollow C-PDA nanofibers is approximately 350 nm. (e) FTIR spectra and (f) Raman spectra of the carbonized hollow C-PDA nanofibers. The FTIR and Raman spectra of the carbonized hollow nanofibers closely resemble that of C-PDA coatings reported previously,[1] confirming that PAN has been successfully leached out after being treating in DMF for 24 hrs and the hollow nanofibers are composed of C-PDA.

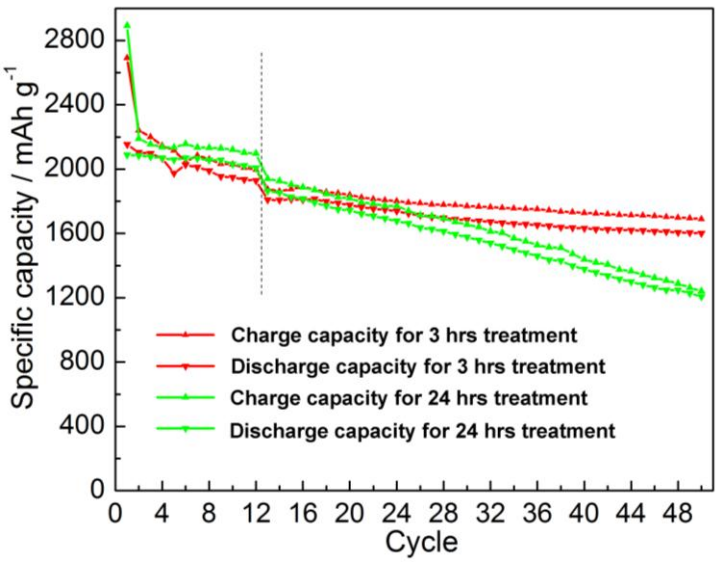

Fig. S5. Specific capacity of C-PDA/Si NFs and C-PDA/Si-24 NFs, which were prepared by treatment in DMF for 3 and 24 hrs, respectively, measured in cycling tests. It shows that the cyclability of C-PDA/Si NFs is better than that of C-PDA/Si-24 NFs, signifying the buffering effect of the remaining PAN-derived carbon around the Si nanoparticles.

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[1] J. Kong, W. A. Yee, L. Yang, Y. Wei, S. L. Phua, H. G. Ong, J. M. Ang, X. Li, X. Lu, *Chem. Commun.* **2012,** *48,* 10316.