Supporting information

Polymer Configuration Conversion Mechanism in Dynamically Stable Interface of Silicon Anodes

Qiaoqiao Ye,^a Miaomiao Jiang,^a Yingbing Zhang,^a Lei Chen,^b Yuanyuan Ma,^{*a} Jianping Yang^{*a}

^aState Key Laboratory for Modification of Chemical Fibers and Polymer Materials,

College of Materials Science and Engineering, Donghua University, Shanghai 201620,

China. Email: yyma@dhu.edu.cn; jianpingyang@dhu.edu.cn

^bCollege of Materials Engineering, Henan University of Engineering, Henan Zhuogu

Technology Co., Ltd. Henan 450000, China

*Email: yyma@dhu.edu.cn; jianpingyang@dhu.edu.cn

Experiment Section

Characterizations: Field emission scanning electron microscopy (FESEM) images were obtained using a Hitachi SU8010 (Japan) field-emission scanning electron microscope. Transmission electron microscopy (TEM) measurements were conducted using a JEOL JEM-2100 F microscope (Japan) operated at 200 kV. Field emission transmission electron microscopy (FETEM) was conducted using a Talos F200S microscope operated at 200 kV. Raman spectra were obtained using a Dilor LabRam-1B microscopic Raman spectrometer (France), equipped with a He-Ne laser and an excitation wavelength of 632.8 nm. Thermal gravimetric analysis (TGA) was conducted on a TG 209F1 apparatus under air atmosphere in the temperature range of 50-900 °C with a heating rate of 5 °C/min.

Electrochemical measurements: The working electrode was prepared by mixing the active materials (70 wt.%), super P (15 wt.%), and sodium alginate (15 wt.%) in deionized water. The resulting slurry was uniformly cast on copper foil and dried in a vacuum oven overnight. The mass loading of the active material was 1.0-1.5 mg cm⁻². CR2032 coin cells were assembled in an argon-filled glove box with a tiny (<0.1 ppm) H₂O and O₂ content, using Li foil as the counter electrode, in order to investigate the electrochemical performance. The electrolyte was a 1.0 M solution of LiPF6 in a 3:4:3 (weight ratio) mixture of ethylene carbonate, dimethyl carbonate and diethylene carbonate, with the addition of 5 wt.% fluoroethylene carbonate. Galvanostatic discharge-charge (GCD) experiments were conducted on a New Battery Measurement System at various current rates in a cut-off voltage range between 0.01 and 2.0 V. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) measurements were performed using an electrochemical workstation (VMP3). The CV scanning rate was 0.1 mV s⁻¹. Electrochemical impedance spectroscopy (EIS) was conducted in a frequency range of 0.01-100 kHz and a potential amplitude of 5 mV. All electrochemical measurements were performed at 25 °C.

Supplementary Figures



Fig. S1. FESEM images of 5%B-SiOC@PHATN and 15%B-SiOC@PHATN.



Fig. S2. (a) Dark-field TEM image. (b) EDS line mapping profiles along the direction indicated by the red arrow in (a).



Fig. S3. a) N₂ adsorption/desorption isotherm of 10% B-SiOC@PHATN and B-SiOC.
b) N₂ adsorption/desorption isotherm and c) the surface area of 5%, 10% and 15% B-SiOC@PHATN.



Fig. S4. Characterization of the B-SiOC and the B-SiOC@PHATN nanocomposite. a) TGA and DSC curves of the two samples under an air atmosphere, b) ¹H NMR spectrum of PHATN, c) C 1s region of the high-resolution XPS spectrum of the B-SiOC@PHATN nanocomposite.



Fig. S5. (a) N₂ adsorption/desorption isotherm of PHATN. (b) FTIR spectra of PHATN. (c) CV curves of B-SiOC.



Fig. S6. The full XPS spectra of B-SiOC@PHATN, and O 1s region, N 1s region, C1s region, B 1s region, Si 2p region of the high-resolution XPS spectrum.



Fig. S7. cycling performance of 5% and 15% B-SiOC@PHATN.



Fig. S8. The capacitive contribution of B-SiOC (a, b) and B-SiOC@PHATN (c, d) electrode.



Fig. S9. EIS spectra of the electrodes of (a) B-SiOC@PHATN and (b) B-SiOC. the equivalent circuit for (c) B-SiOC@PHATN and (d) B-SiOC.



Fig. S10. Cross-sectional SEM images of B-SiOC a) at pristine and c) after 500 cycles. Cross-sectional SEM images of B-SiOC@PHATN b) at pristine and d) after 500

cycles.