Supplementary Information (SI) for Sustainable Energy & Fuels.

Supporting information

High Capacity Peanut-Shell based Hard Carbon as Negative Electrode for Sodium Ion Batteries

Hai-Lang Jia,[‡,*] Ke-Yang Chai,[‡] Peng-Cheng Ji, Yu-Jie Lu

School of Chemistry and Chemical Engineering, Jiangsu Key Laboratory of Clean Energy Storage and Conversion, Annlysis and Testing Center of Jiangsu University of Technology, Jiangsu University of Technology, Changzhou 213001, P. R. China.

Experimental

Chemicals

Hexadecyltrimethylammonium bromide (CTAB) was purchased from J&K CHEMICA Co., Ltd. Acetylene black conductive agent, polyvinylidene fluoride (PVDF), N-methylpyrrolidone (NMP), GF/D glass fiber and $NaClO_4$ were purchased from dodochem Co., Ltd. Sodium metal and anhydrous ethanol were purchased from Sinopharm Chemical Reagent Co., Ltd. Deionized water was self-made in the laboratory. Peanut shell was self-recycled in the laboratory.

Materials characterization

The material morphology was examined using Field Emission Scanning Electron Microscope (Sigma 500) with an accelerating voltage of 30 kV and a transmission electron microscope (TEM) (JEM-2100, JEOL, Japan) operating at 200 kV. X-ray diffraction patterns (XRD) were acquired on a PANalytical X'Pert Powder diffractometer with Cu-Kα radiation. The X-ray photoelectron spectroscopy (XPS) with an Al-Kα X-ray source (Themo Escalab 250Xi) was performed to determine the surface composition. N_2 adsorption-desorption data was detected by a physisorption analyzer (Tristar II 3020). Raman spectra were collected with a Renishaw RM2000 system. Raman spectrometer using a 632.8 nm He–Ne laser.

Electrochemical measurements

Cyclic voltammetry is a method of scanning the electrode potential at different scan rates to obtain a triangular waveform, analyze the current and potential related information. This work uses CHI760E electrochemical workstation to test hard carbon electrode, analyze the positions of oxidation peak and reduction peak in the CV curve of the prepared hard carbon material to determine the composite an appropriate voltage window and analysis of the diffusion dynamics of the material. Discharge/charge cycling performance was tested by Lanhe battery tester.

Fig. S1 The original morphology of peanut shell precursor.

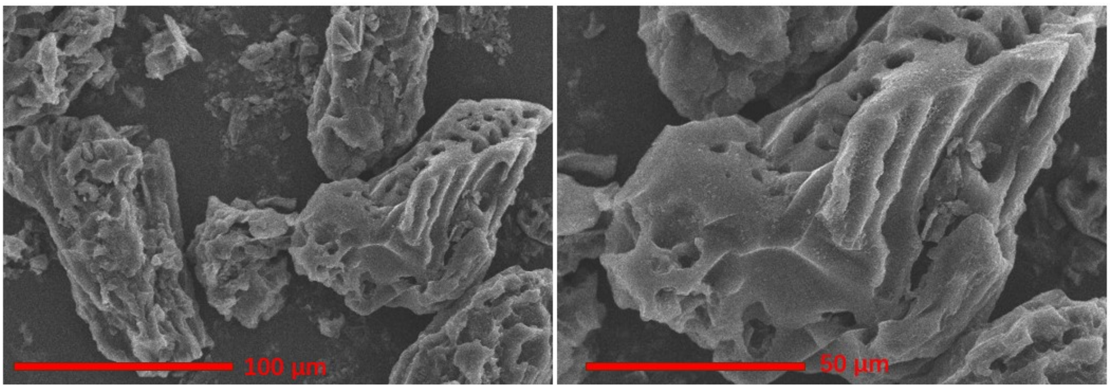

Fig. S2 SEM of PSHC-1.

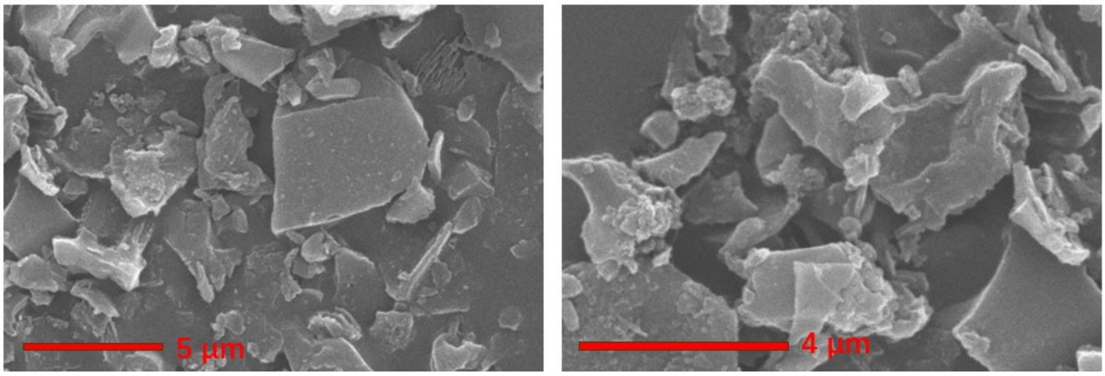

Fig. S3 SEM of PSHC-2.

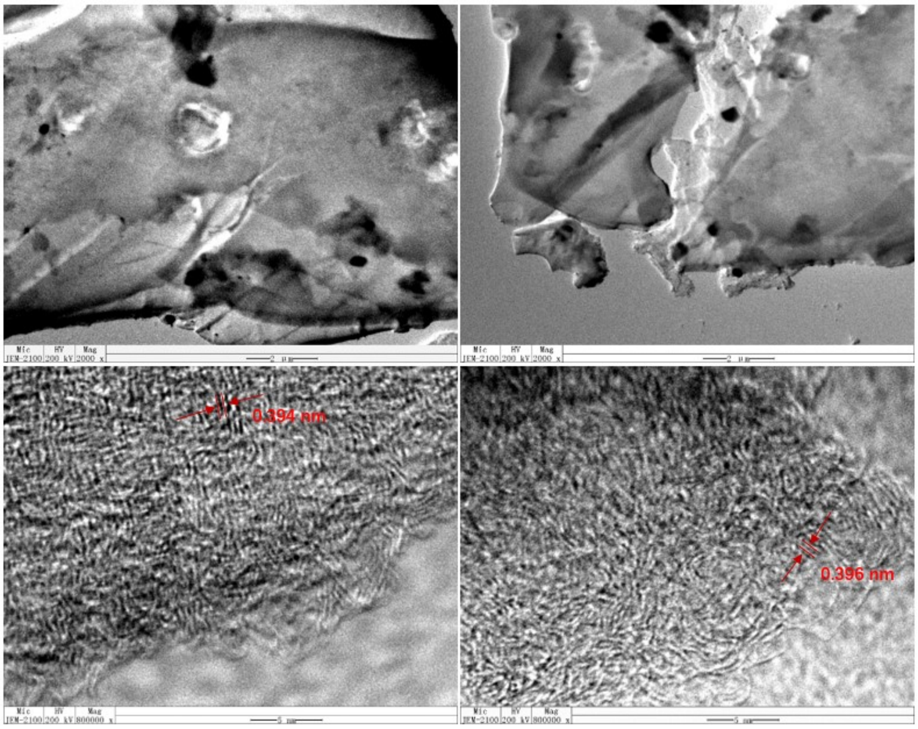

Fig. S4 TEM of PSHC-1.

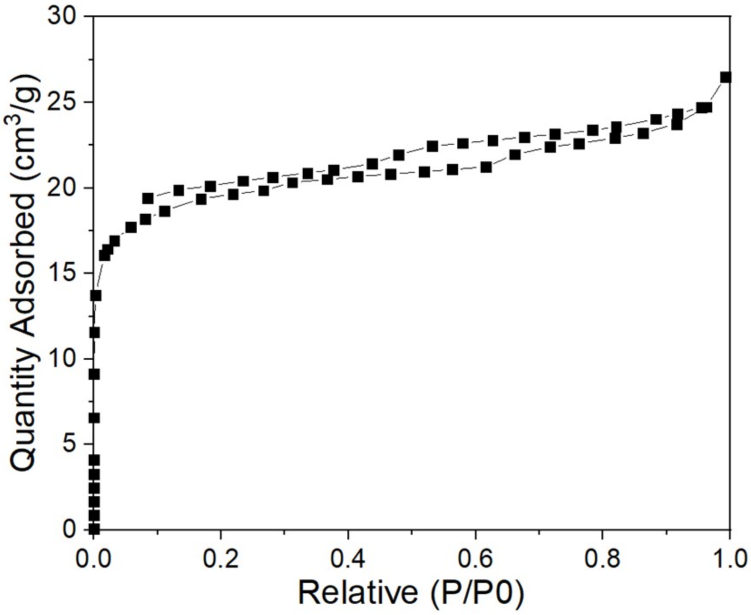

Fig. S5 N_2 adsorption isotherms of PSHC-1.

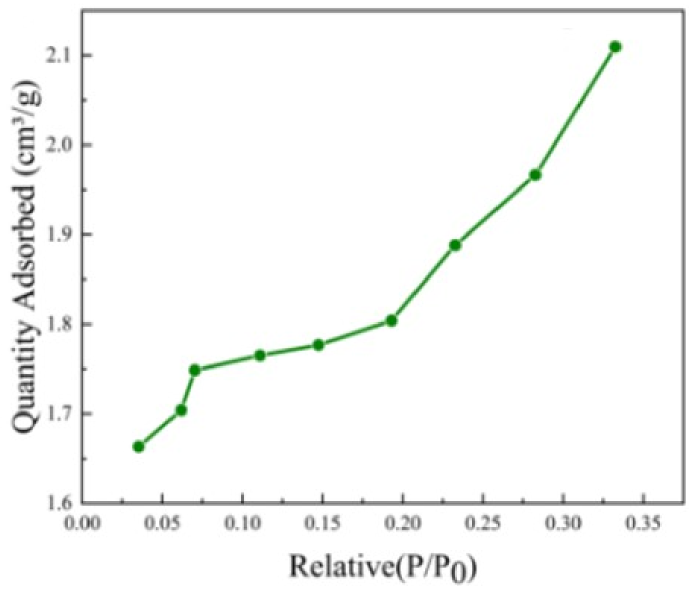

Fig. S6 N_2 adsorption isotherms of PSHC-2.

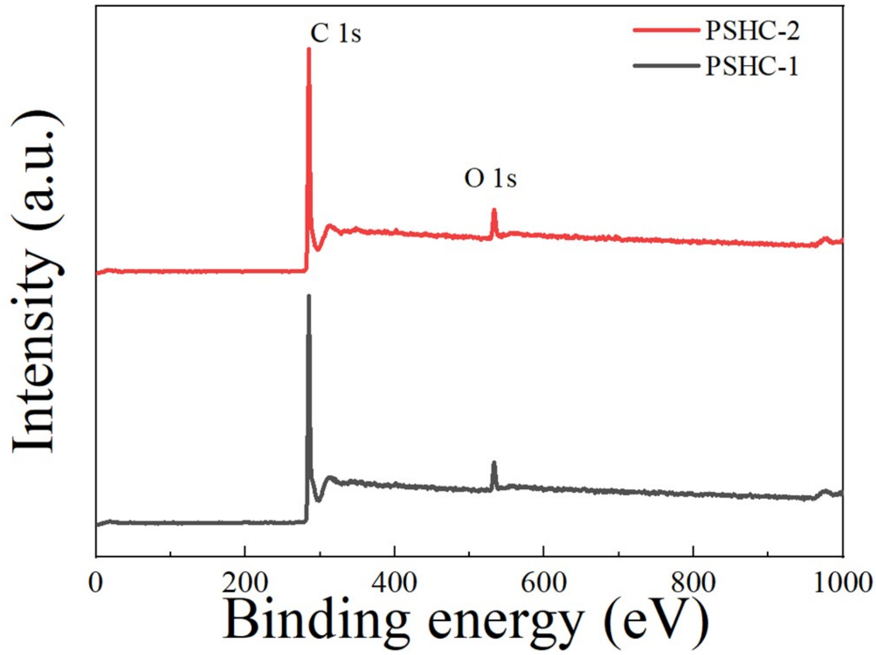

Fig. S7 XPS of PSHC-2.

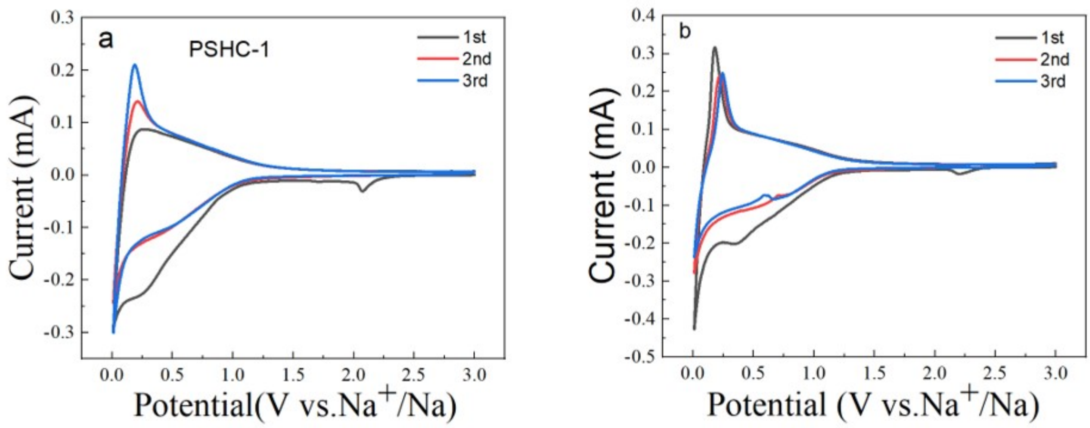

Fig. S8 (a) CV curves of PSHC-1, (b) CV curves of PSHC-2.

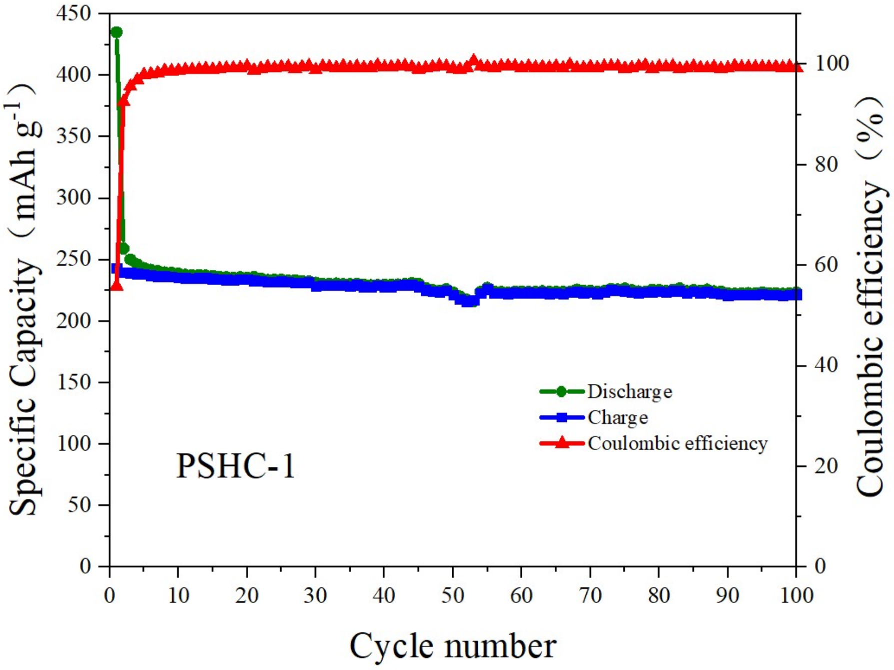

Fig. S9 the cyclic performance of PSHC-1 at 30 mA g^{-1}.

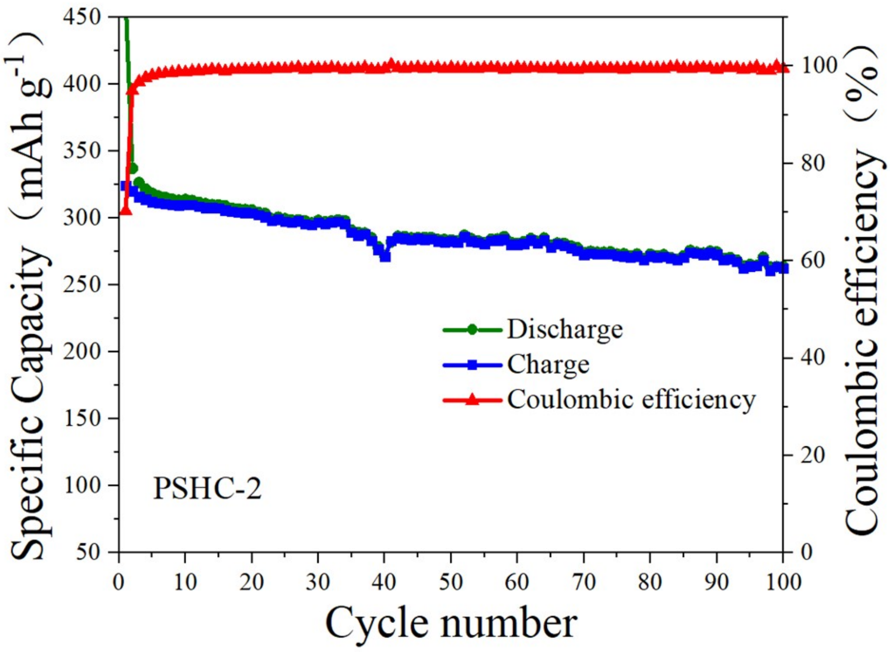

Fig. S10 the cyclic performance of PSHC-2 at 30 mA g^{-1}.

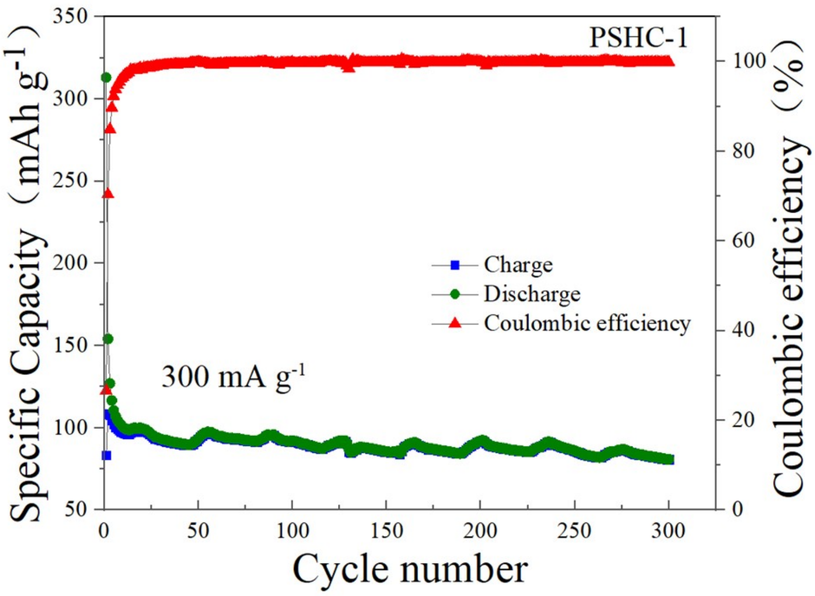

Fig. S11 the cyclic performance of PSHC-1 at 300 mA g^{-1}.

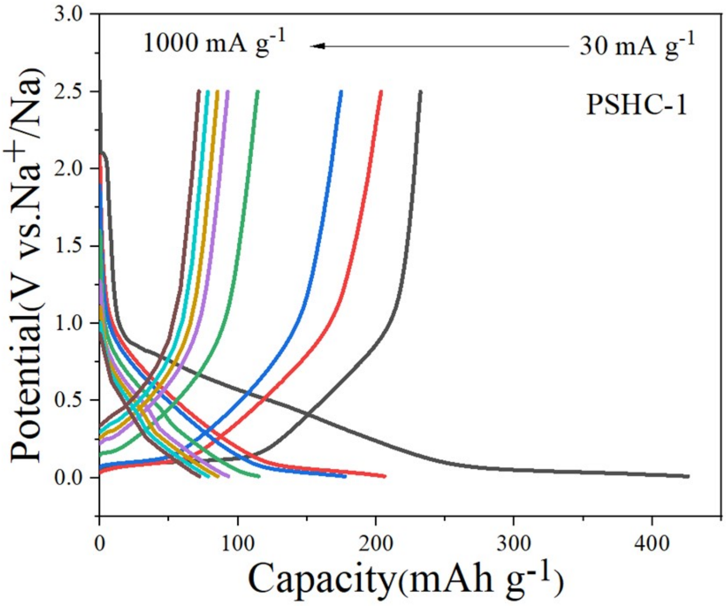

Fig. S12 rate charge discharge curve of PSHC-1.

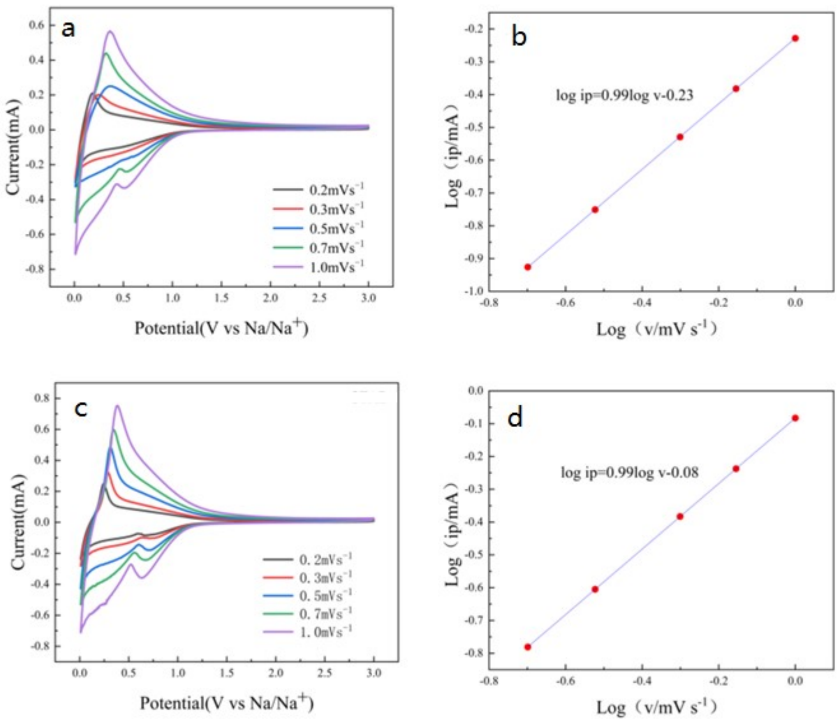

Fig. S13 (a) CV curves at different scanning speeds of PSHC-1, (b) the linear relationship between log (i_p) and log (v) of PSHC-1, (c) CV curves at different scanning speeds of PSHC-2, (d) the linear relationship between log (i_p) and log (v) of PSHC-2.