Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Support Information

Experimental Design and Theoretical Calculation for Sulfur-Doped Carbon Nanofibers as High Performance Sodium-Ion Battery Anode

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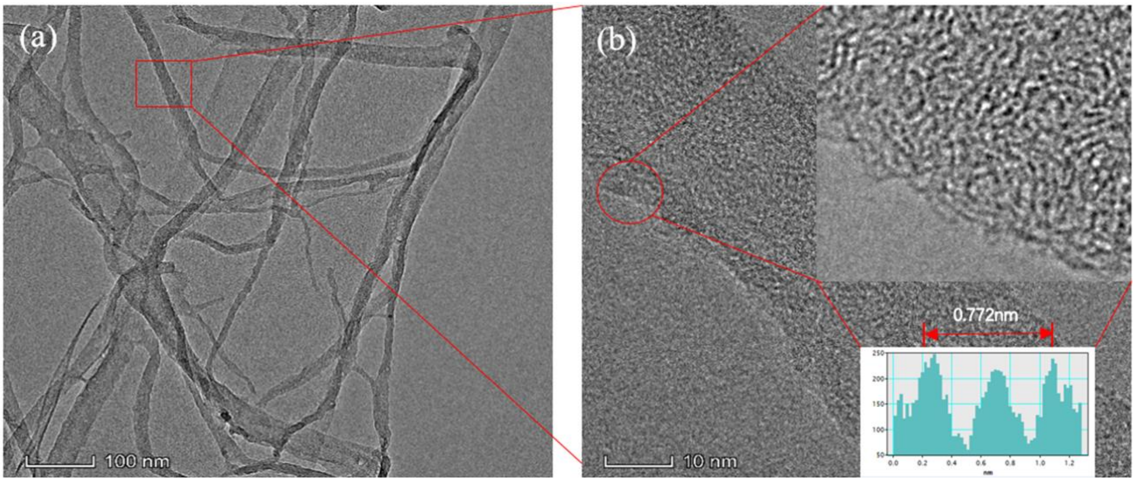

Figure S1. a) The transmission electron microscopy (TEM) of CNFs. b) The inserts are the high-resolution TEM image and lattice distance of S-CNFs in (a) with red rectangle.

Table S1. The surface analysis reports for CNFs and S-CNFs.

	Total surface area ($m^2\ g^{-1}$)	**Micropore surface area ($m^2\ g^{-1}$)**
CNFs	465	230
S-CNFs	669	439

Table S2. The carbon, sulfur and oxygen contents from XPS and element analysis.

		Chemical composition (wt%)		**Element content (wt%)**
		Atomic content	**Mass content**	
S-CNFs	C	84.34	76.31	76.31
	O	11.67	14.06	13
	S	7.98	15.00	17.44
CNFs	C	89.16	85.84	90
	O	10.63	13.63	14.16
	S	-	-	-

Table S3. The kinetic parameters obtained from equivalent circuit fitting of experimental data for CNFs, S-CNFs.

	R_s (Ω)	**R_{ct} (Ω)**
CNFs	3.488	460.7
S-CNFs	1.838	325.7

Noting: Randles equivalent circuit for CNFs, S-CNFs electrode/electrolyte interface. R_s is the electrolyte resistance. CPE_1 and R_{ct} are the capacitance and charge-transfer resistance, respectively. W_1 is the Warburg impedance related to the diffusion of sodium ions into the bulk electrodes.

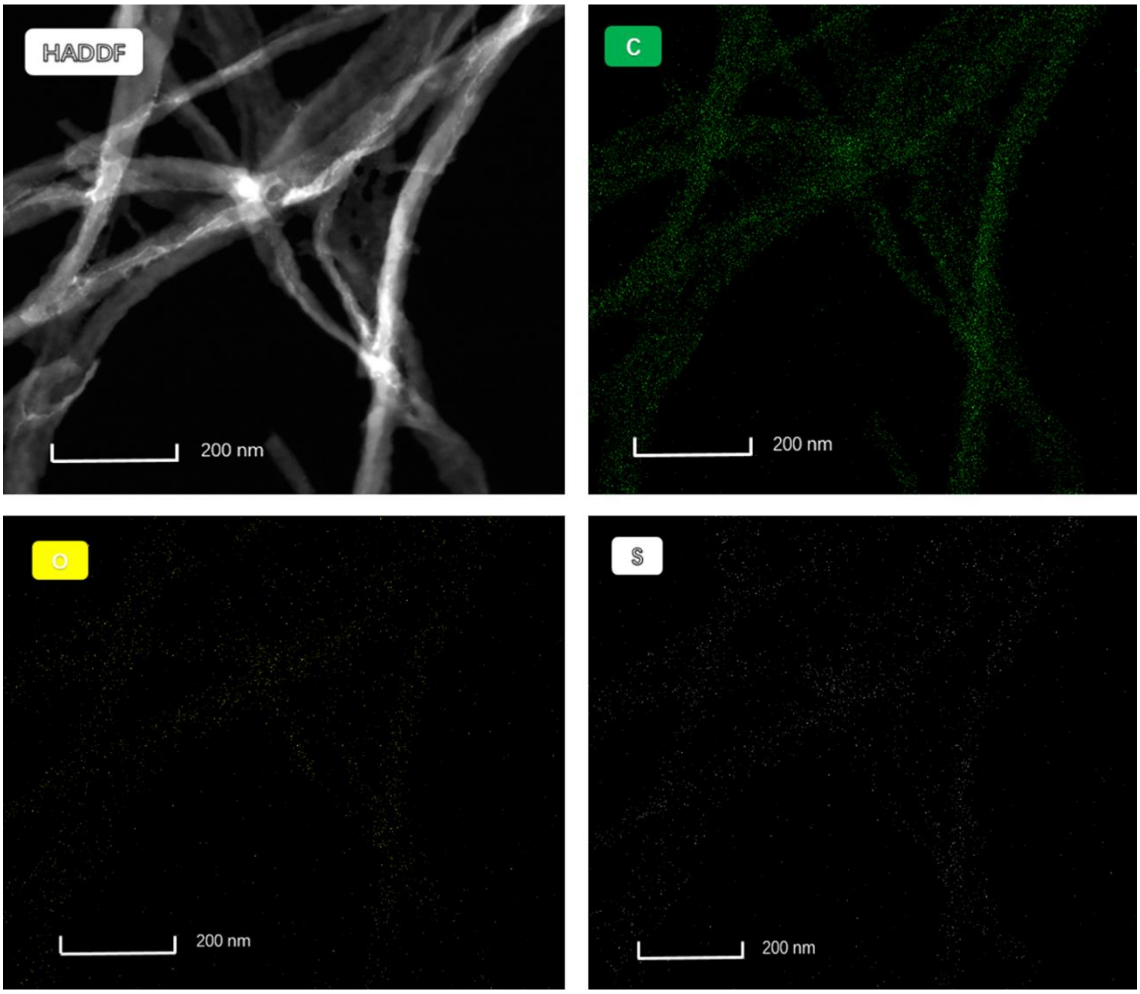

Figure S2. The HADDF (High-Angle Annular Dark Field) image and Mappings of element C, O, S by STEM for S-CNFs.

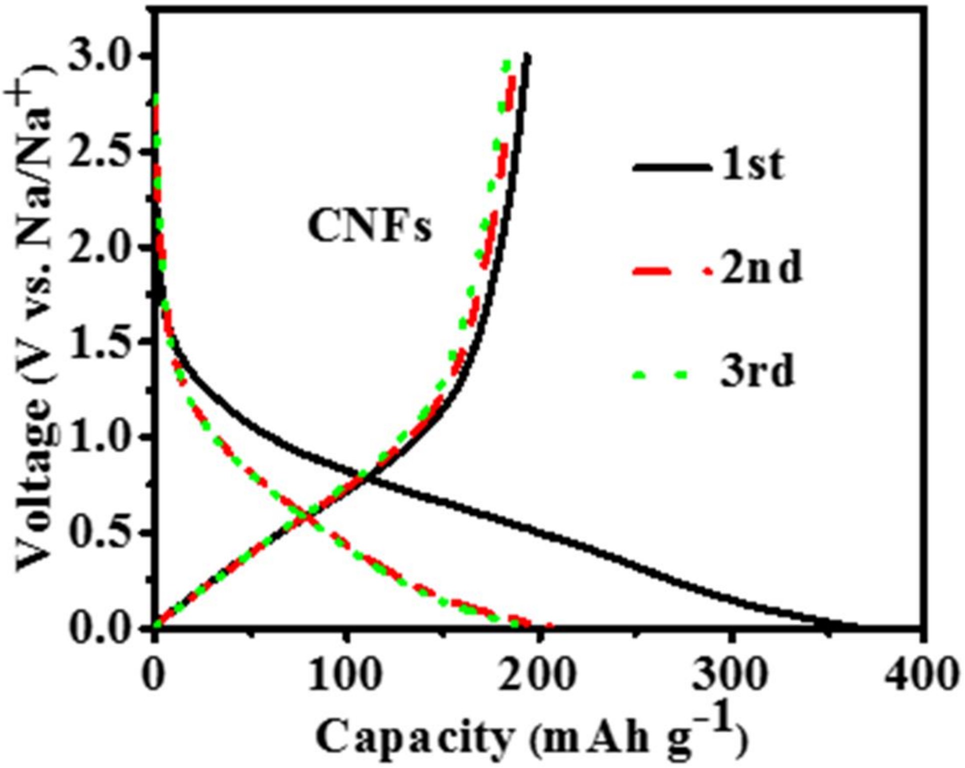

Figure S3. The discharge/charge curves at 50 A g^{-1} for CNFs.

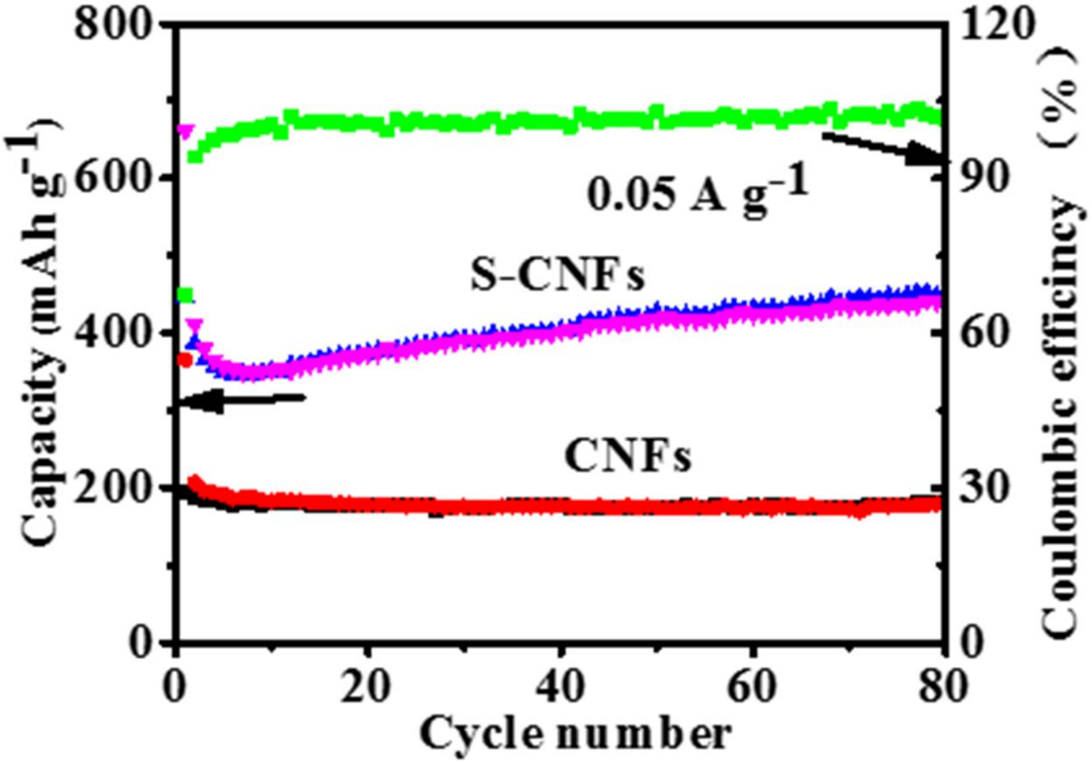

Figure S4. The cycling performances of CNFs and S-CNFs at 0.05 A g^{-1}.

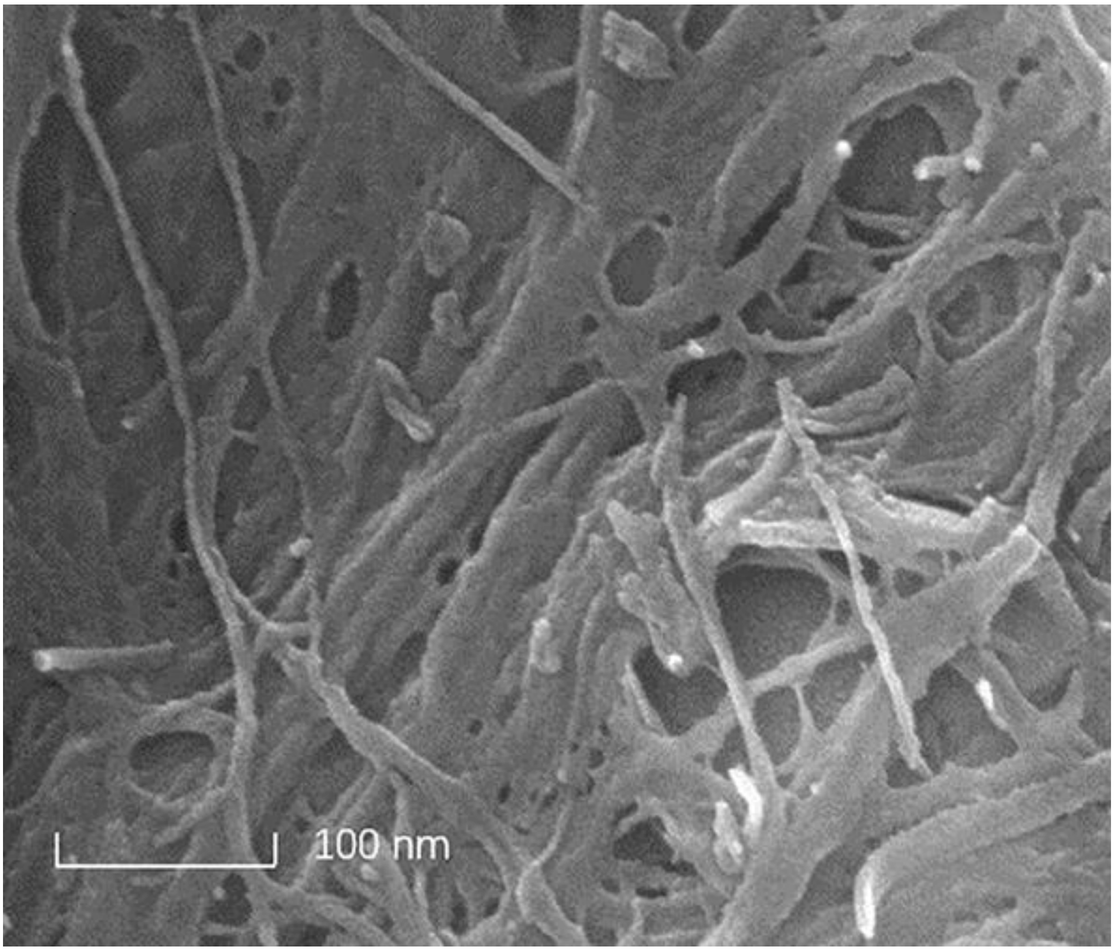

Figure S5. The SEM image of after 1000 cycles for S-CNFs.

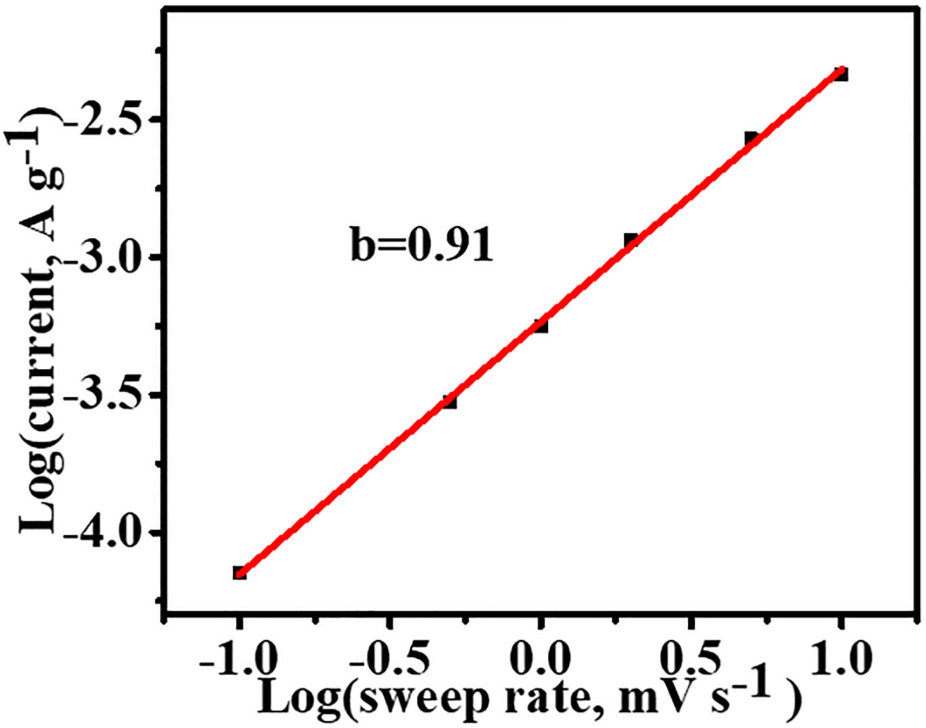

Figure S6. The b-value calculated by log (sweep rate)-log (peak current) curve at anode peak.

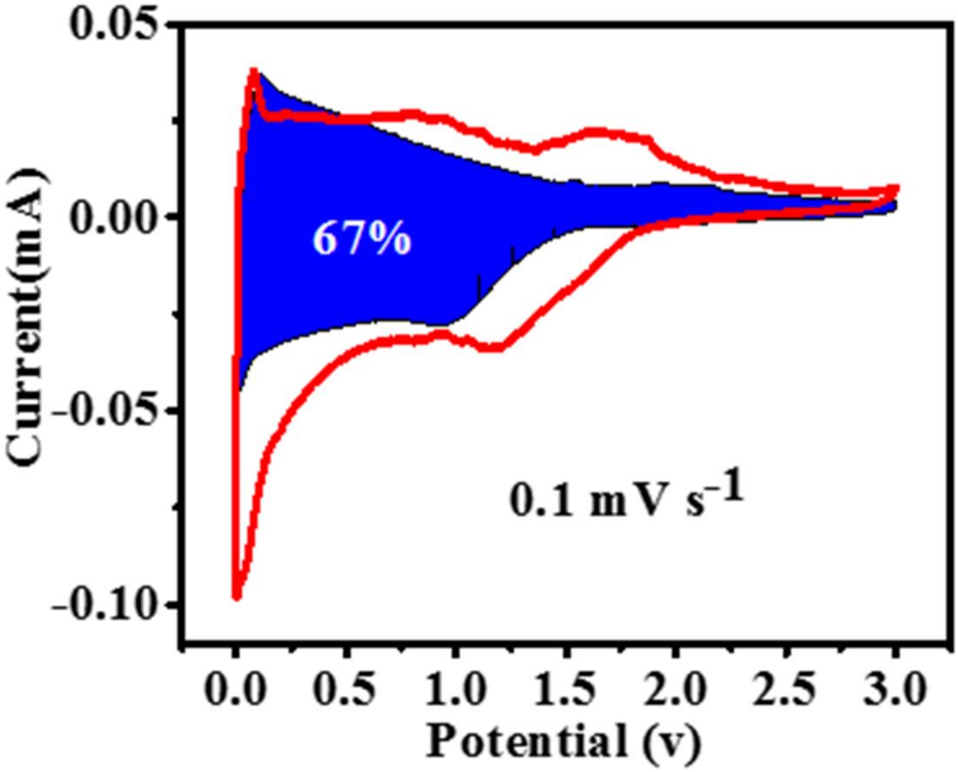

Figure S7. The contribution and distribution of the electrochemical capacitance at 0.1 mV s^{-1}.

Supplementary method. In order to obtain the contributions of capacitance and diffusion, various cyclic voltammetry measurements (CVs) were performed at range of 0.1-10 mV s^{-1}. Firstly, according to the $I(\nu) = a\nu^b$, the controlled process was determined by the b value. Then, the individual capacity was separated by the formula: $I(\nu) = k_1\nu^{1/2} + k_2\nu$. The current values at a fixed voltage were calculated by CVs at sweep rates of 0.1-10 mV s^{-1}. Consequently, the k_1 and k_2 at a fixed voltage were obtained by drawing plots of $I/\nu^{1/2}$ vs. $\nu^{1/2}$. Finally, the k_1 and k_2 at different voltages could be obtained, and the capacitive induced and diffusion induced contributions were determined, respectively.

Table S4. The energy values at different doping sites.

Doping sites	**D_1**	**D_2**	**D_3**	**D_4**
Energy values (eV)	-10402.087	-10402.595	-10402.003	-10402.663