Electronic Supplementary Material (ESI) for Energy & Environmental Science.

Supporting Information for

"Exceptional Energy and New Insight with Sodium – Selenium Battery based on Carbon Nanosheet Cathode and Pseudographite Anode"

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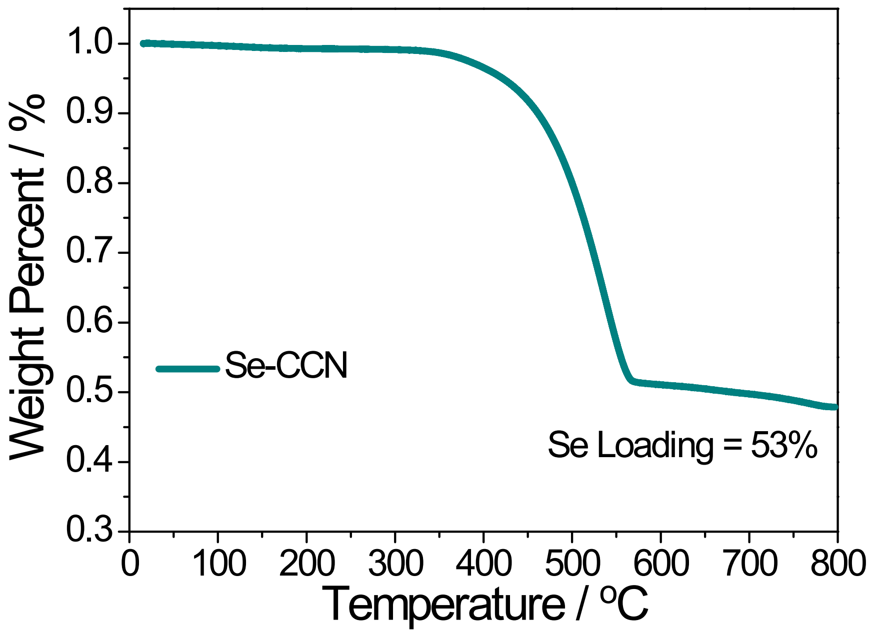

Figure S1: TGA curve of Se-CCN.

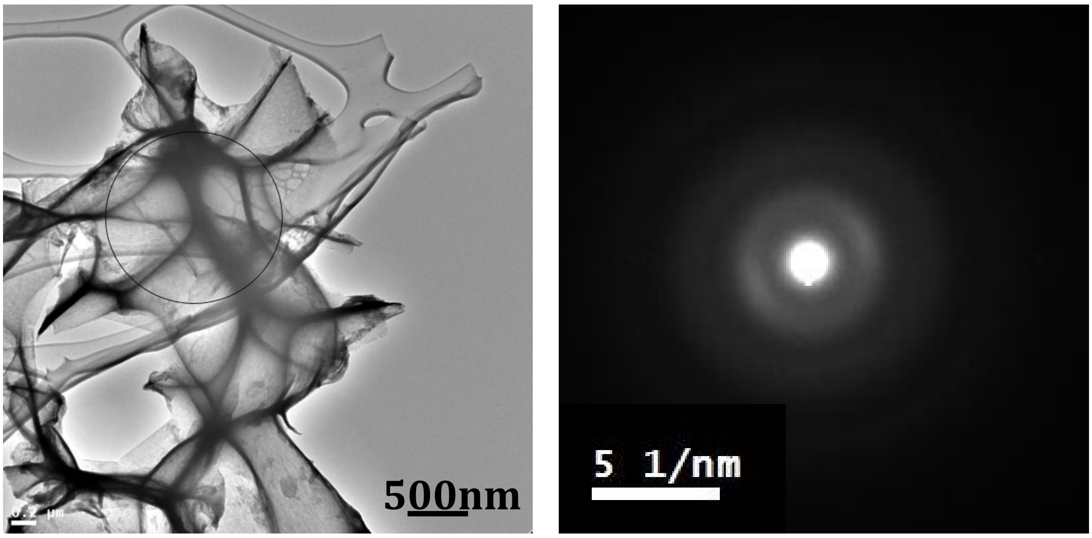

Figure S2: Bright field TEM micrograph of Se-CCN and the associated selected area electron diffraction (SAED) pattern.

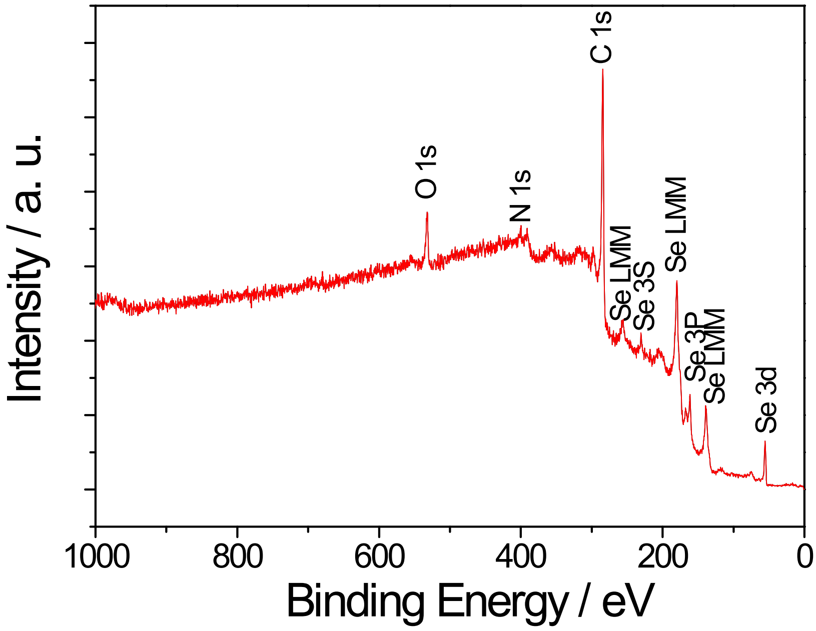

Figure S3: XPS spectrum of Se-CCN.

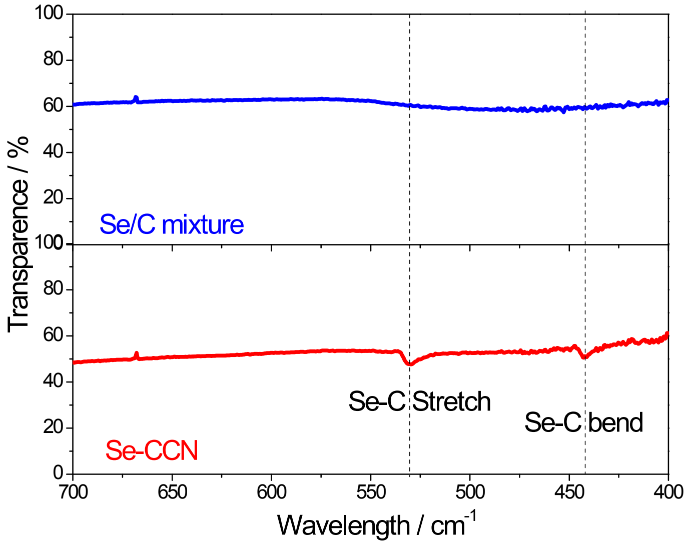

Figure S4: The FT-IR spectra for Se-CCN and Se/C mixture.

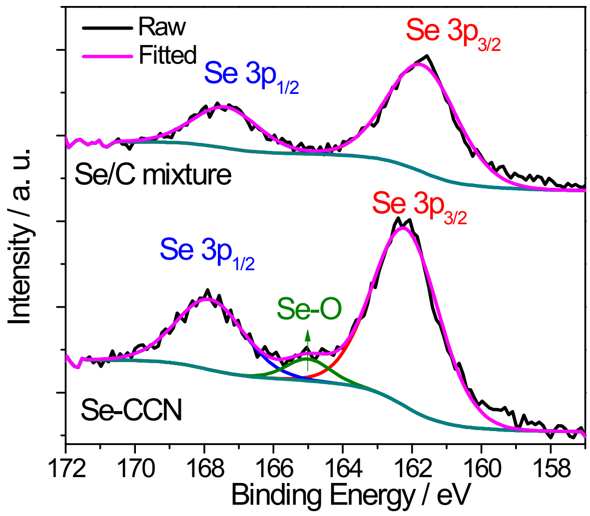

Figure S5: High resolution XPS spectra of Se 3p for Se-CCN and Se/C mixture.

Table S1: Electrochemical characteristics comparison between Se-CCN and traditional ceramic cathodes.

Cathode Type	Selenium based	Layered oxide	Tunnel oxide	Bilayered oxide	Olivine	Pyrophosphates	NASICONS	Fluorophosp-hates
Example	Se-CCN	$Na_{0.85}Li_{0.17}Ni_{0.21}Mn_{0.64}O_2$	$Na_{0.44}MnO_2$	V_2O_5	$FePO_4$	$Na_2FeP_2O_7$	$Na_3V_2(PO_4)_3$	$Na_3V_2(PO_4)_2F_3$
Profile shape	Plateau	Slope	Slope	Slope	Slope	Plateau	Plateau	Plateau
Average Voltage (V)	1.5	3.4	3.0	3.0	2.5	3.1	3.3	4.25
Capacity ($mAhg^{-1}$)	613	~185	~140	~250	~65	~90	~140	~110
Ref.	This work	78	82	79	80	83	81	84

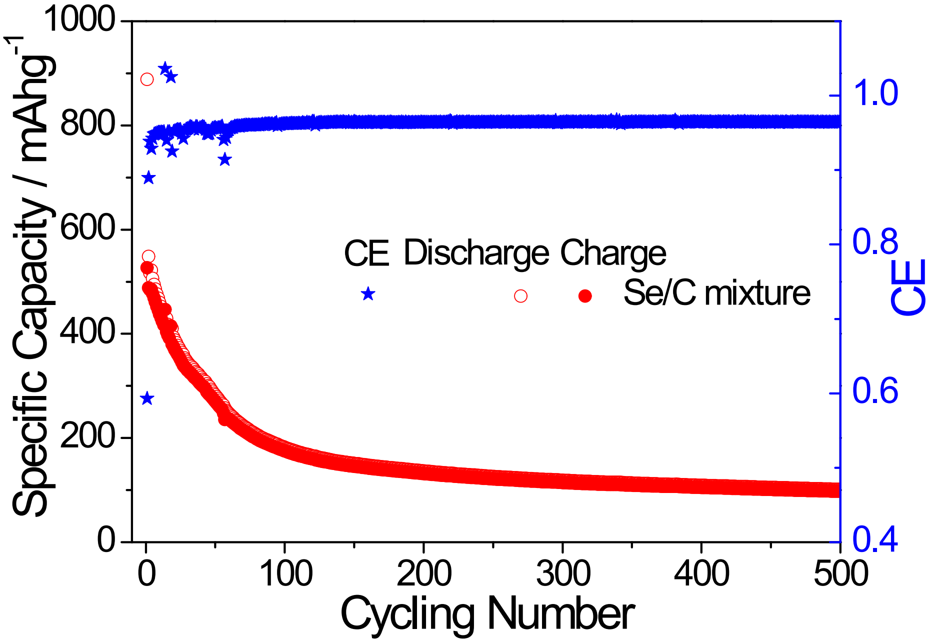

Figure S6: Cyclability of Se/C mixture in sodium half-cell at 0.2C.

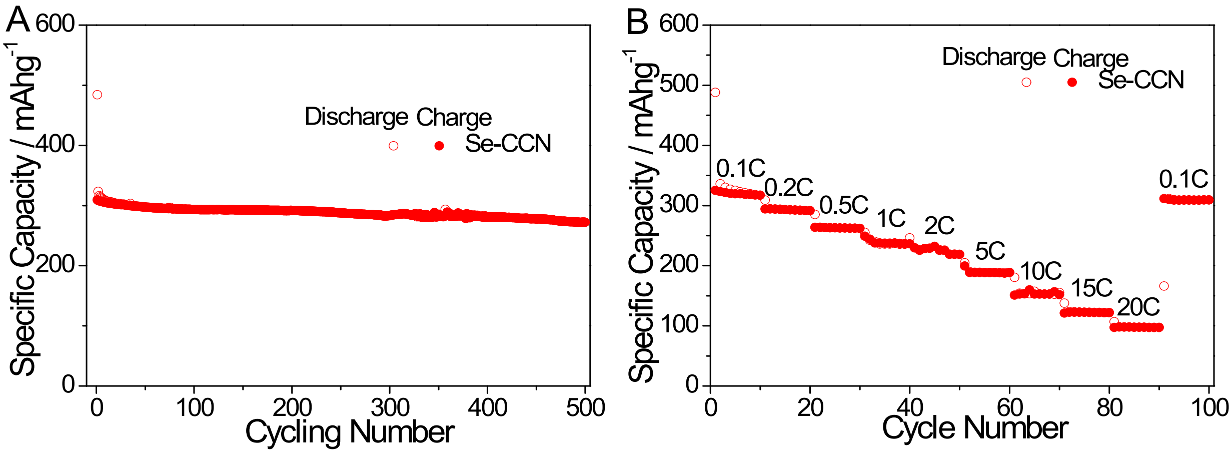

Figure S7: (A) and (B) Cycling capacity retention and rate capability values for Se-CCN, based on the combined mass of the Se and of the CCN matrix.

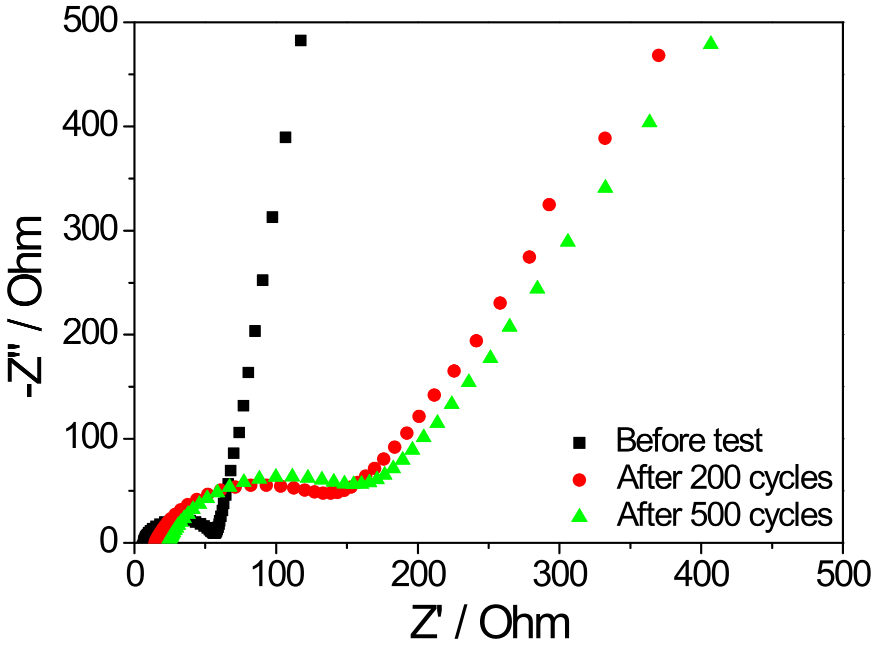

Figure S8: Nyquist plots of Se-CCN cathodes in sodium cells before tests, after 200 cycles and after 500 cycles.

Table S2: Resistance values simulated from modeling the experimental impedance (Figure S8) of Se-CCN.

	Before test	After 200 cycles	After 500 cycles
R_{el} (Ω)	7.1	13.6	23.9
R_{ct} (Ω)	57.1	157.4	168.3

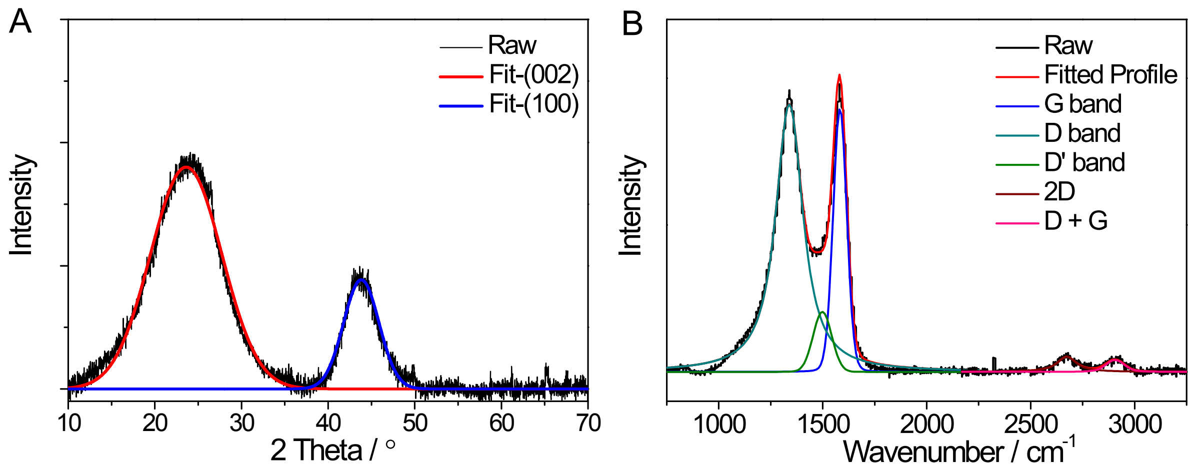

Figure S9: (A) XRD pattern of the in-house fabricated pseudographitic carbon (PGC) employed as the anode in the full sodium ion battery, showing the (002) and (100) reflections of the ordered graphene domains, but a distinct lack of equilibrium graphite. (B) Raman spectrum of the pseudographitic carbon (PGC), highlighting the material's G, D and second order 2D and D + G bands.

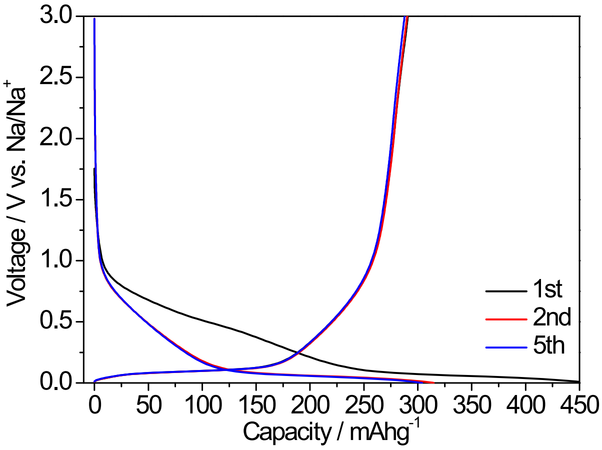

Figure S10: Galvanostatic charge/discharge profiles of PGC anode within 0 - 3V vs. Na/Na^+ at current of 100 mAg^{-1}.

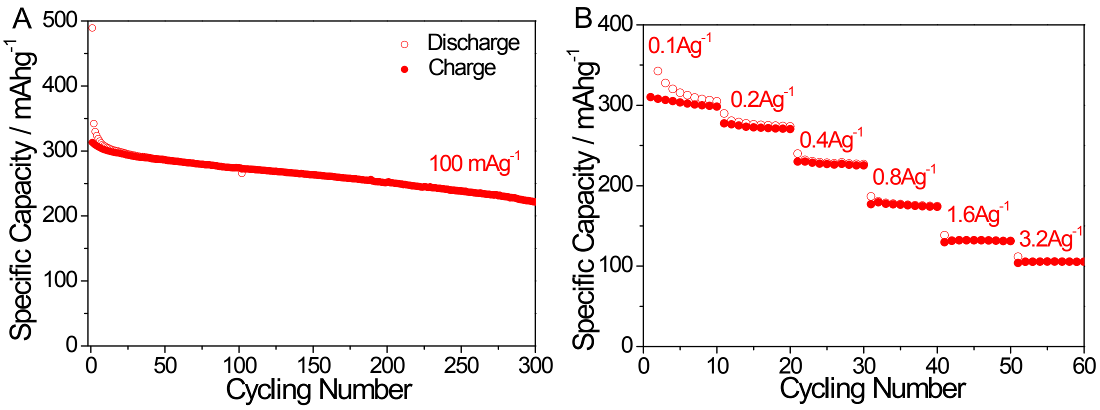

Figure S11: (A) Cyclability of PGC anode in half cell at current density of 100 mAg^{-1}. (B) Rate performance of PGC anode in half cell.

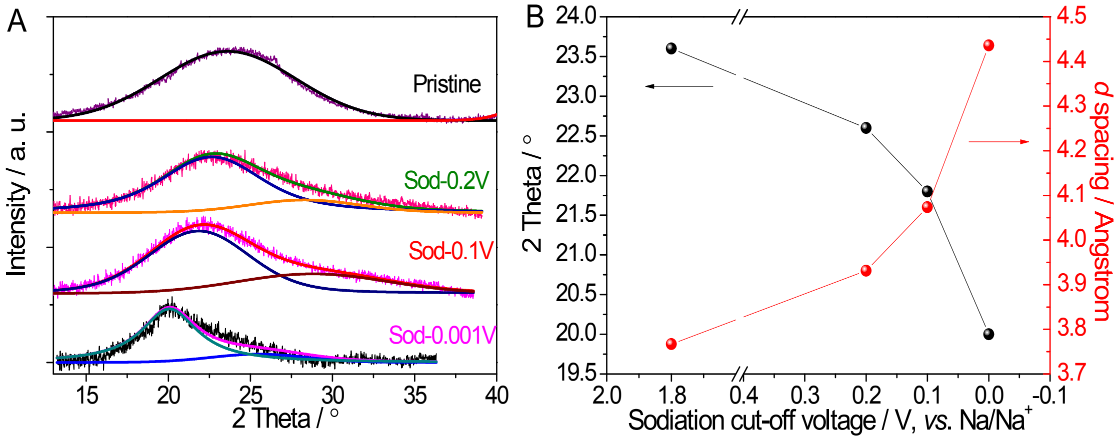

Figure S12: (A) XRD patterns of the PGC electrodes analyzed after being disassembled from their half cells at different terminal sodiation voltages. (B) The center position of (002) peak (left) and the corresponding calculated graphene interlayer spacing within the material (right).