

Bituminous Coal-Derived Carbon Anode: Molten Salt-Assisted Synthesis and Enhanced Performance in Sodium-Ion Battery

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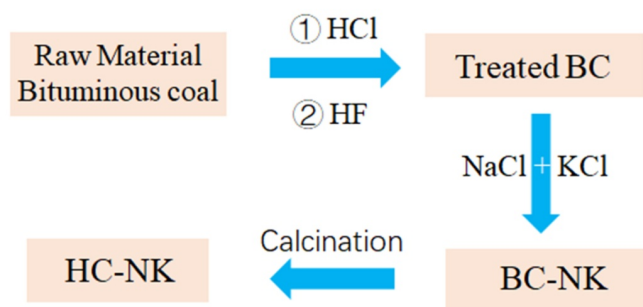


Figure S1 Preparation flowchart of bituminous coal-derived hard carbon

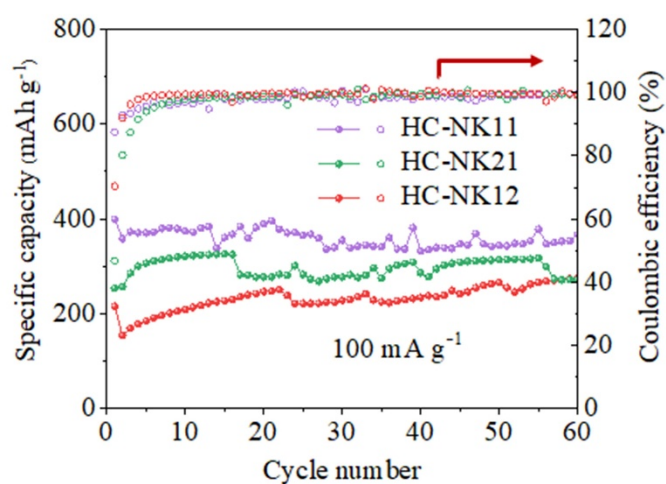


Figure S2 Cycling performance of different HC materials prepared by changing salt ratios.

Table S1 Composition, elemental, and ICP test of hard carbon based on molten salt-modified bituminous coal

Composition (%)				Element (%)					ICP (%)	
M_{ad}	A_d	V_{daf}	FC_{daf}	C	H	O	N	S	Na^+	K^+
3.26	11.0	29.5	54.2	82.3	3.44	11.1	1.35	1.59	0.03	0.02

Notes: M_{ad} , A_{ad} , and V_{daf} are air-dried basis moisture content, ash content, and volatile matter. FC_{daf} is dry ash-free basis fixed carbon.

Table S2 Calculation of lattice spacing by XRD results.

Materials	Crystal plane	2-Theta (°)	Lattice spacing d (nm)
HC-N	(002)	24.6	0.362
HC-K	(002)	24.8	0.360
HC-NK11	(002)	23.6	0.377

Table S3 Comparisons of raw materials, methods, layer spacing, and specific capacity of hard carbon.

Raw material	Methods	d-spacing (nm)	Specific capacity (mAh g ⁻¹)	Refs.
Anthracite	Pre-activation and carbonization (1300 °C)	0.405	231.2	[S1]
Anthracite	Ball-milled treatment and carbonization (900 °C)	0.40	243	[S2]
Anthracite	Salt (NaCl) assisted ball milling and carbonization (1200 °C)	0.376	332.1	[S3]
Coal	Pre-oxidation and carbonization (1300 °C)	0.392	201	[S4]
Charred coal	Molten salt assisted carbonization (700 °C)	0.395	286.5	[S5]
Coal tar pitch	Pre-oxidation and carbonization (1000 °C)	-	250	[S6]
β -cyclodextrin	Salt (NaCl) assisted hydrothermal and carbonization (1300 °C)	0.405	360	[S7]
Subbituminous coal	Ball-milled treatment and carbonization (1300 °C)	-	291	[S8]
Subbituminous coal	Pre-oxidation and carbonization (1000 °C)	0.371	284.4	[S9]
Bituminous coal	Molten salt assisted carbonization (1300 °C)	0.389	303.6	[S10]
Bituminous coal	Glucose-assisted Carbonization (1300 °C)	0.385	413.1	[S11]
Bituminous coal	Pre-oxidation and carbonization (1400 °C)	-	303.1	[S12]
Bituminous coal	Molten salt assisted carbonization (900 °C)	0.377	366.7	This work

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