Supporting Information

Electrochemical Modification of Methane Plasma-Derived Recovered Carbon by Phosphorus Doping as an Anode Material for Sodium-Ion Batteries

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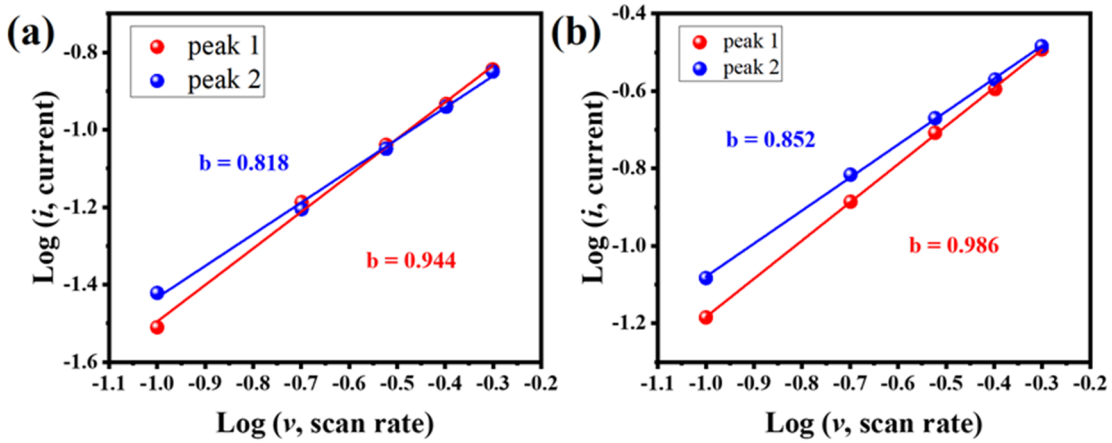

Figure S1. (a-b) Fitted slope *b* value for RC and PRC at different peaks.

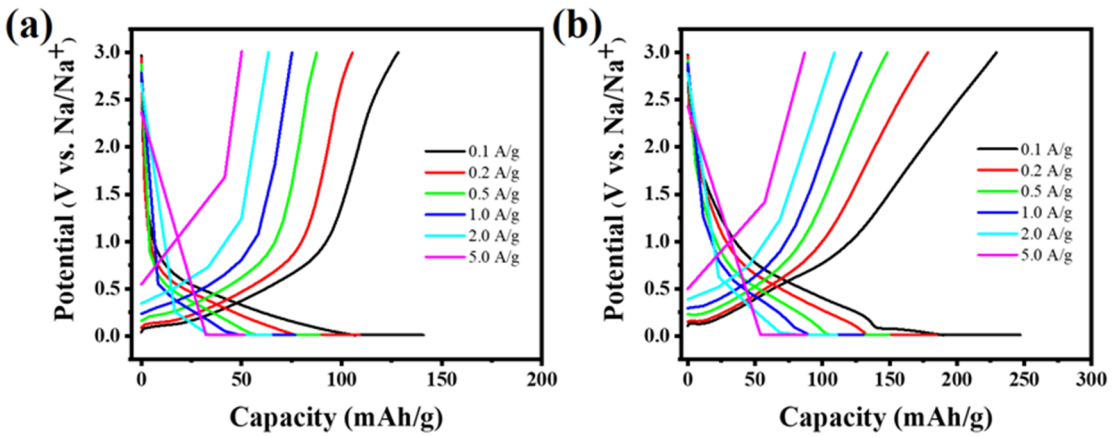

Figure S2. (a-b) Charge/discharge curves of RC and PRC at different current densities.

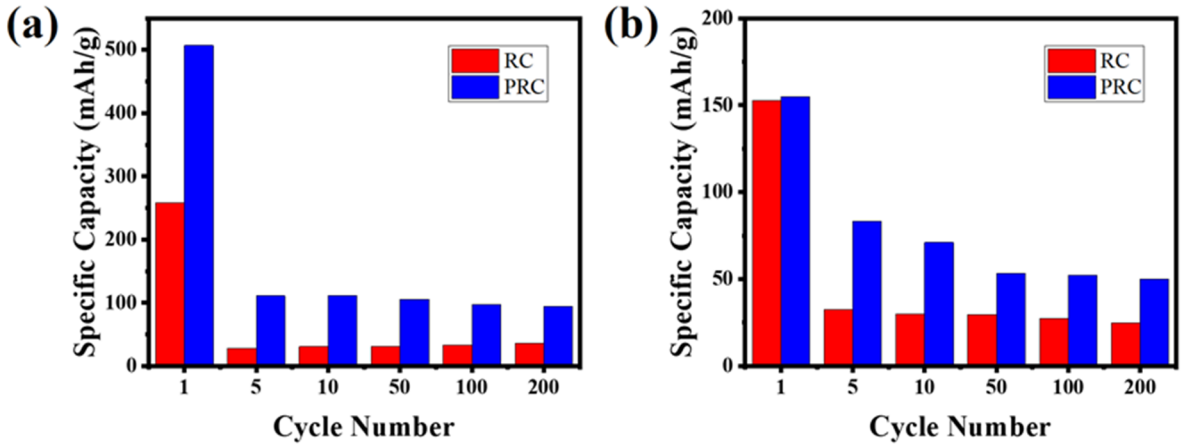

Figure S3. Capacity contribution of RC and PRC at different cycles: (a) Capacity contribution from slope region and (b) Capacity contribution from plateaus region.

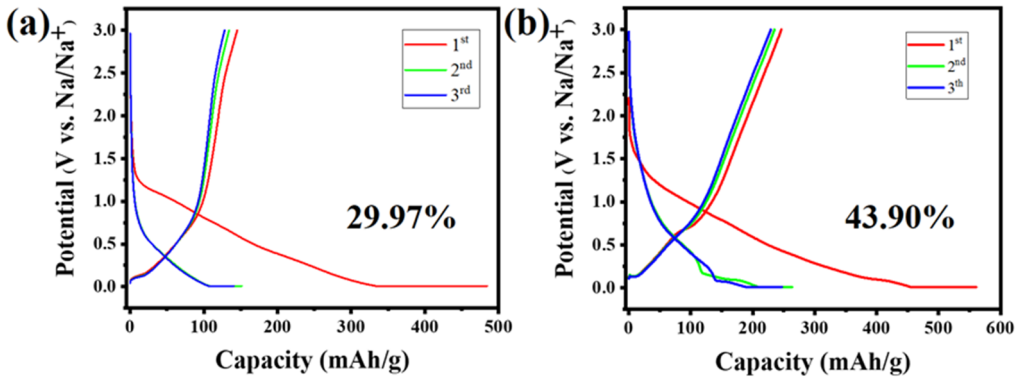

Figure S4. (a-b) Charge/discharge curves of RC and PRC at the first three cycles under a current density of 0.1 A g^{-1}.

Table S1. Equivalent circuit and D_{Na^+} fitting calculation results from the EIS analyses.

Samples	R_s (Ω)	R_{SEI}(Ω)	R_{ct}(Ω)	D_{Na^+} (cm^2/s)
RC	2.9	429.5	27.27	7.9 x 10^{-14}
PRC	4.4	271.03	12.9	3.5 x 10^{-13}

Table S2. Comparison of phosphorus-containing hard-carbon anodes reported in the literature and PRC, including phosphorus source, electrochemical testing conditions, electrode composition, specific capacity, and initial coulombic efficiency.

Material	PRC, this work	HC@PC-P	PHC-1300	Composite C-1/C-2
P source	Red P	Soy lecithin	Polyphosphoric acid	Red phosphorus powder
Current density	0.1 A g^{-1}	0.1 A g^{-1}	(15 mA g^{-1})	0.1 A g^{-1}
Voltage	0.01–3 V	0.01–2.5 V	0–2.5 V	2.0–0.01 V
Electrolyte	1M $NaClO_4$/PC + 5% FEC	1M NaClO4 in PC + 5% FEC	1.0 M $NaPF_6$ in EC:DEC (1:1)	Na-cell: 1 M $NaClO_4$ in PC + 2% FEC
Ratio	7:2:1	8:1:1	8:1:1	8:1:1
Capacity	250	350 mAh g^{-1}	359.9 mAh g^{-1}	1322 mAh g^{-1}
ICE	43.90%	89.60%	72.68%	86.4%