

Interface-homogenized Engineering of Red Phosphorus/Activated Carbon for High-Performance Lithium-Ion Battery Anodes

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To further evaluate the electronic conductivities, measurements were performed on commercial red phosphorus, P(H⁺) and P(H⁺)/C samples. Each solid powder was compressed into a pellet with a thickness of approximately 2 mm. The resulting pellet was then tightly sealed inside a 2025-type coin cell to ensure highly compact contact. Linear sweep voltammetry (LSV) was used to determine the resistance of each sample, with a voltage window of 0-1 V and a scan rate of 0.1 mV s⁻¹.¹ The electronic conductivity (σ) was subsequently calculated using Equation (1).

$$\sigma = L/(SR) \quad (1)$$

where σ is the conductivity, L and S is the thickness and the area of the sample disc respectively, and R is the resistance value.

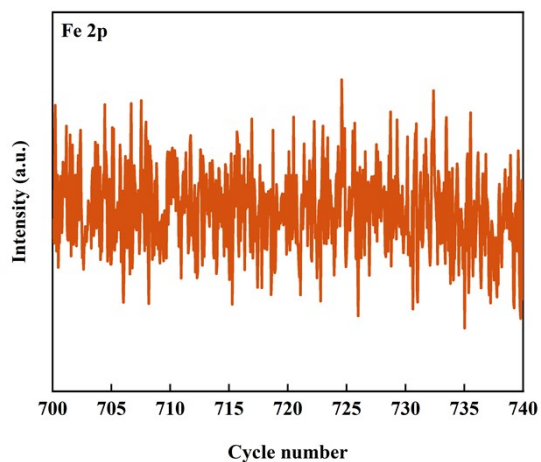


Fig. S1 The Fe 2p spectrum of the P(H⁺) sample.

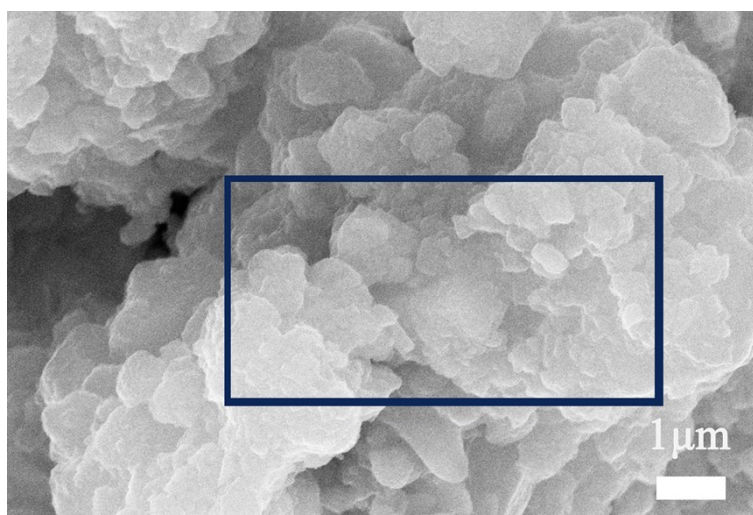


Fig. S2 EDS analysis regions of P(H⁺) sample.

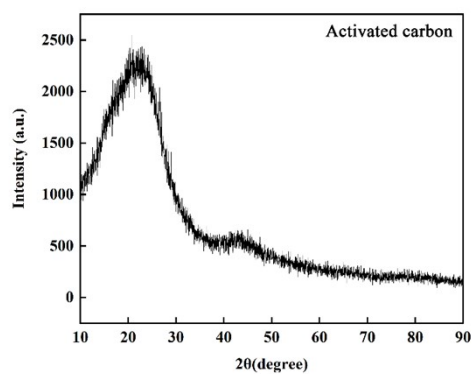


Fig. S3 The XRD pattern of activated carbon.

Tab. S1 Elemental composition of the P(H⁺) sample determined by EDS.

Element	wt.%	at.%
O	26.00	40.48
P	74.00	59.52
Fe	0.00	0.00
Total	100.00	100.00

Tab. S2 Comparison of the cycle performance of our work with other phosphorus-based anode materials for LIBs reported previously.

Materials	Current Density (mA g ⁻¹)	Cycle	Capacity (mAh g ⁻¹)	Reference
P/Se@C	200	350	592.6	2
CNFs/RP	100	20	~600	3
RP@HC	120	100	577	4
	100	100	292.22	5
P(H ⁺)/C	200	350	778	This work

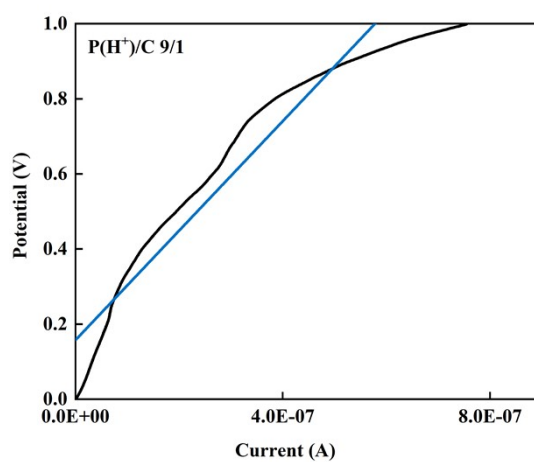


Fig. S4 LSV of P(H⁺)/C 9/1 sample.

Tab. S3 The electrical conductivities of the samples.

Samples	L (cm)	S (cm ²)	R (Ω)	σ (S cm ⁻¹)
Commercial P ¹	0.20	1.767	10440500.00	1.08E ⁻⁸
P(H ⁺) ¹	0.18	1.767	32634900.00	3.12E ⁻⁹
P(H ⁺)/C 9/1	0.20	1.5386	1457851.14	8.92E ⁻⁸

Reference

1 L. Zhao, W. Li, W. Kong, J. Guo, H. Zhu, W. Yu, S. Liu, X. Han, L. Cui and Z. Wen, *Chem. Eng. J.*, 2024, **491**, 151976.