Supporting Information for

Nitrogen and Phosphorus Dual-Doped Multilayer Graphene as Universal Anode for Full Carbon-Based Lithium and Potassium Ion Capacitors

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Supplementary Figures and Tables

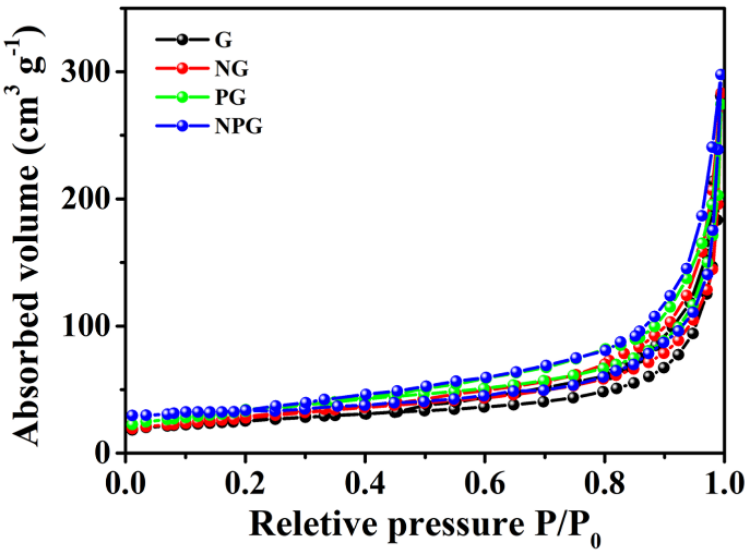

Fig. S1 BET and pore size of G, NG, PG, and NPG

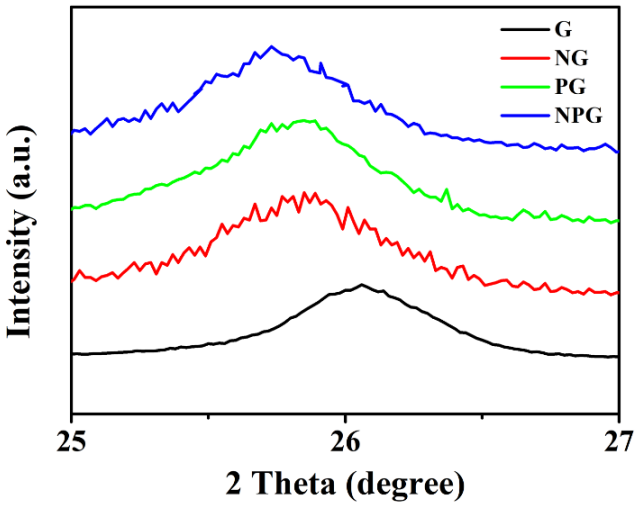

Fig. S2 Partial enlarged drawing of the XRD from the degree from 25 to 27

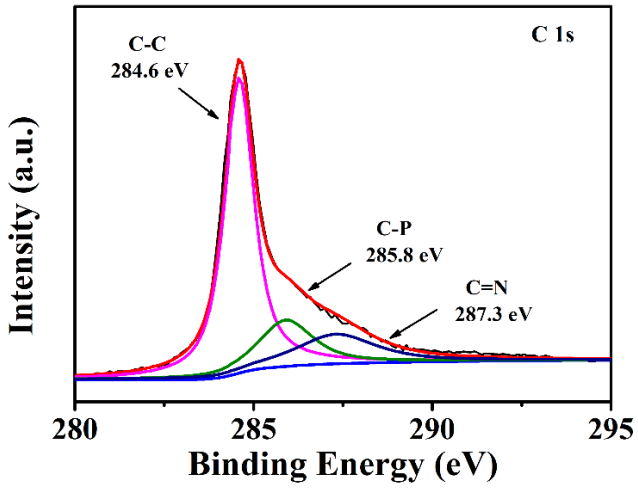

Fig. S3 XPS spectra of C 1s of NPG

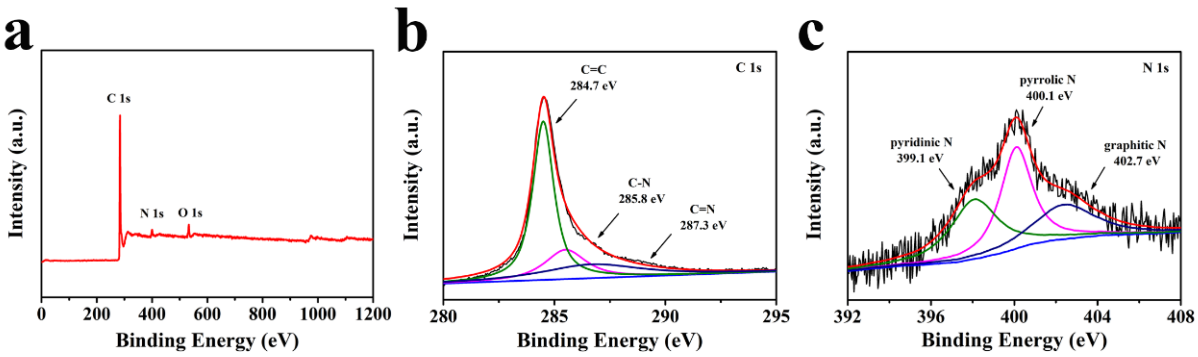

Fig. S4 a Full spectrum and high-resolution XPS spectra of **b** C 1s and **c** N 1s of NG

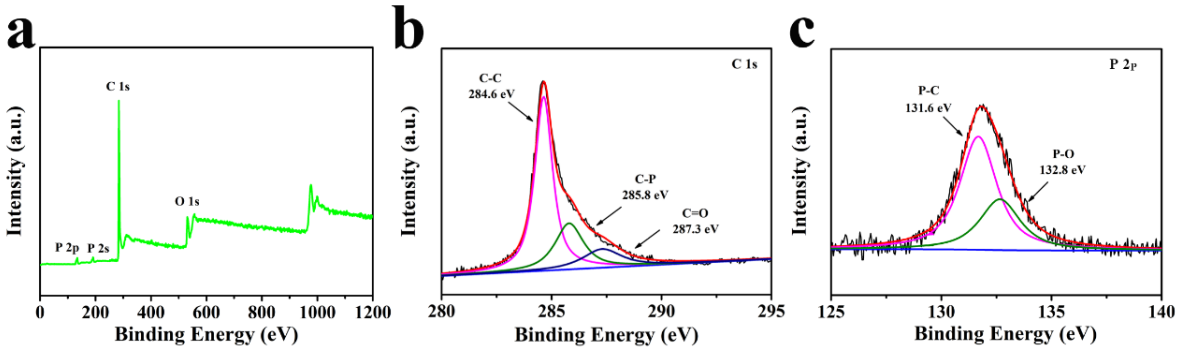

Fig. S5 a Full spectrum and high-resolution XPS spectra of **b** C1s, **c** P 2p and of NPG

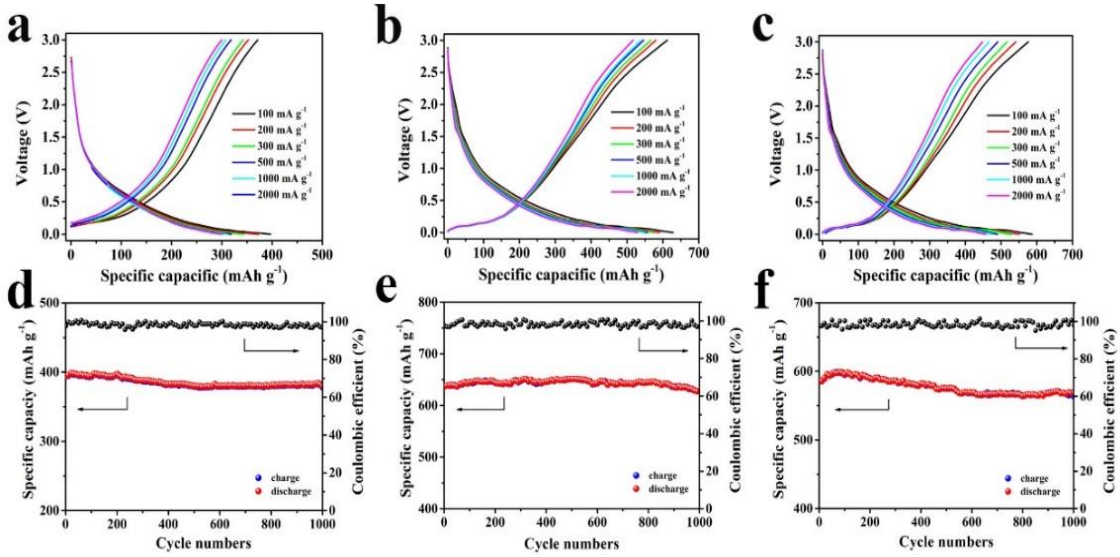

Fig. S6 Typical galvanostatic lithiation/delithiation curves of **a** G, **b** NG, and **c** PG electrodes at different current densities. Cycling stability of **d** G, **e** NG, and **f** PG electrode at the current density of 100 mA g^{-1}

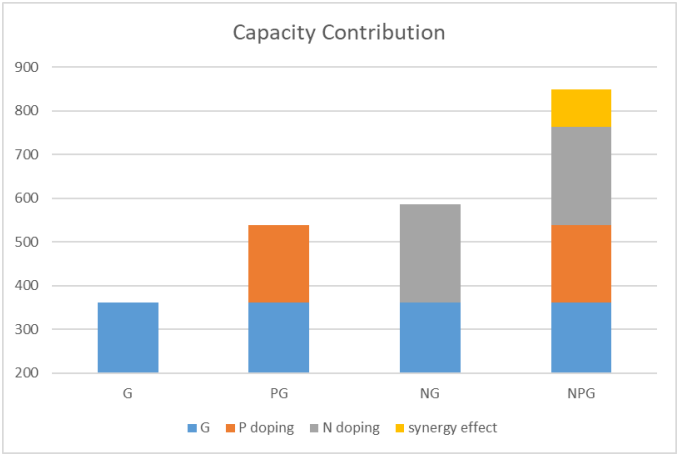

Fig. S7 Qualitative analysis of capacity contribution of G, PG, NG, and NPG at the current density of 0.2 A g

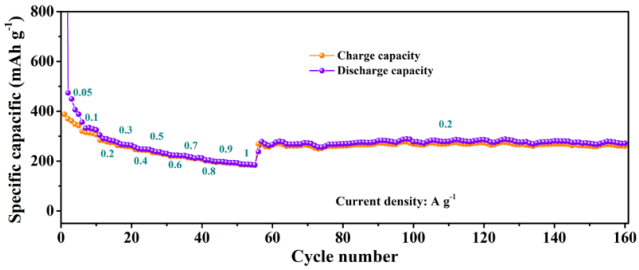

Fig. S8 Rate capabilities of NPG electrodes at different current densities and cycling performance in the potassium battery

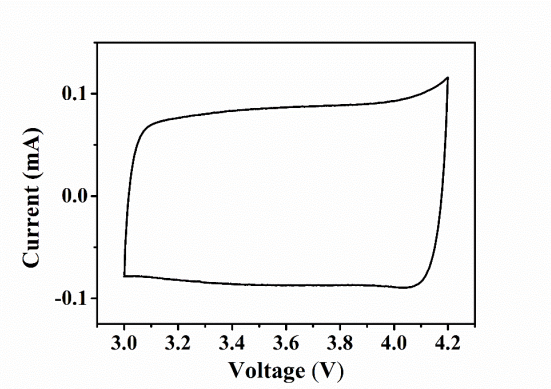

Fig. S9 Electrochemical performance characteristics of AC in a half-cell configuration

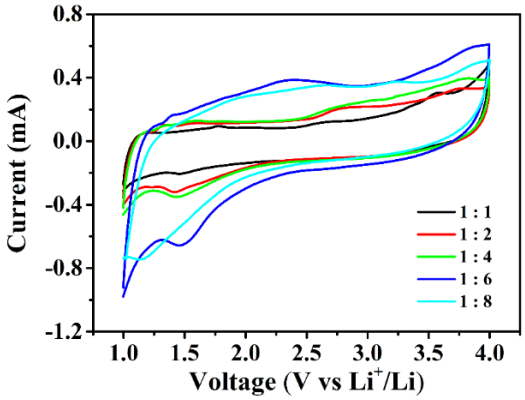

Fig. S10 CV curves of NPG//AC LIC in various weight ratio (Scan rate of 5 mV s^{-1})

Table S1 Nitrogen adsorption isotherms for G, NG, PG, and NPG

Samples	BET ($m^2 g^{-1}$)
G	410.9
NG	435.7
PG	463.7
NPG	457.9

Table S2 Calculated R_e and R_{ct} via fitting of the impedance spectra

	R_e (Ω)	R_{ct} (Ω)
Before	2.511	140.7
After	5.461	58.3

Table S3 Comparison of the electrochemical performance of various N-doped carbon, P-doped carbon, and N, P co-doped carbon anodes

Material	Methods	N content	P content	Electrode loading	Current density (mA g^{-1})	Capacity (mAh g^{-1})/cycle	Refs.
N-doped porous graphene	Mix and pyrolysis	12 at%	---	1mg	74.4	900/150	[S1]
N-doped graphene sheets	Mix and pyrolysis	19.5 at%	---	Thickness 20 mm on Cu foils	100	751/108	[S2]
N-doped graphene	Mix and pyrolysis	2.1 at%	---	Disk pieces with diameter of 1.4 cm	50	682/95	[S3]
N-doped graphene sheets	Mix and pyrolysis	13.1 at%	---	0.3-0.5 mg cm^{-2}	100	1050/185	[S4]
P-doped graphene	Mix and pyrolysis	---	1.81 at%	1mg	100	460/80	[S5]
Phosphorus Particles Embedded in Graphene	Mix and pyrolysis	---	35.09 at%	---	500	247/500	[S6]
Graphite/phosphorus	Mixed by grinding	---	28.6 wt%	6 mg cm^{-2}	100	485/50	[S7]
Phosphorus-graphene nanosheet hybrids	Ball-milling	---	70 wt%	0.8-1.5 mg cm^{-2}	260	1570/300	[S8]
Phosphorus/nitrogen-doped graphene paper	Mix and pyrolysis	4.8 wt%	66 wt%	1-3 mg cm^{-2}	1500	809/350	[S9]
P and N dual-doped few-layered porous graphene	Chemical vapor deposition	2.6 at%	0.6 at%	1 mg	1500	750/1000	[S10]
Porous P and N dual doped graphene	Mix and pyrolysis	4.38 at%	1.93 at%	1.5 mg	1675	638/500	[S11]
N and P Dual-Doped Graphene Aerogel	Mix and pyrolysis	4.54 at%	6.72 at%	0.9-1.0 mg cm^{-2}	50	260/50	[S12]
N-doped graphene sheets	**Arc-discharge**	**3.31 at%**	**---**	**1 mg cm^{-2}**	**100**	**627/1000**	**This work**
P-doped graphene sheets	**Arc-discharge**	**---**	**1.18 at%**	**1 mg cm^{-2}**	**100**	**570/1000**	**This work**
N, P-co-doped graphene sheets	**Arc-discharge**	**3.2 at%**	**1.3 at%**	**1 mg cm^{-2}**	**1000**	**787/1000**	**This work**

Supplementary References

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