Electronic Supplementary Information

Three-dimensional nitrogen and phosphorus co-doped carbon quantum dots/reduced graphene oxide composite aerogels with hierarchical porous structure as superior electrode materials for supercapacitors

Jingying Li, Xiaoru Yun, Zhongliang Hu, Liujiang Xi, Na Li, Heng Tang, Pengcheng Lu, and Yirong Zhu*

College of Metallurgy and Material Engineering, Hunan University of Technology, Zhuzhou 412007, P. R. China.

*E-mail: zhuyirong2004@163.com.

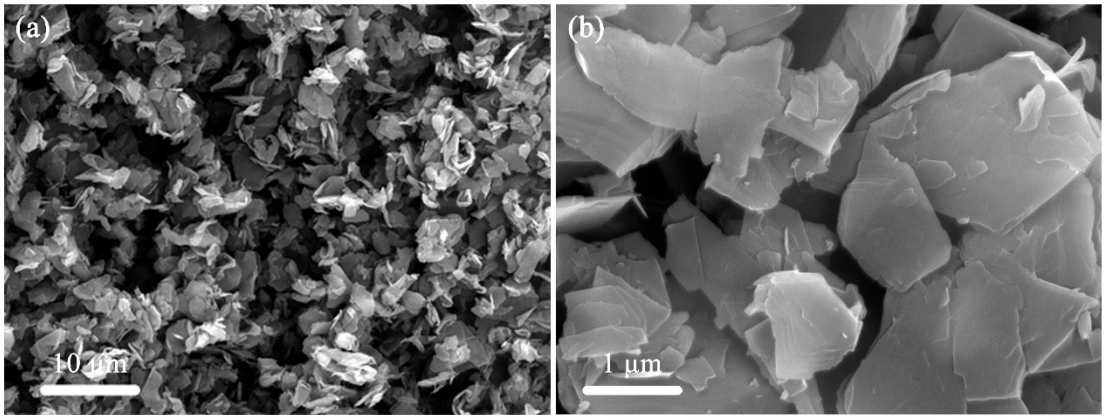

Fig. S1 FESEM images of graphite powders with different magnifications.

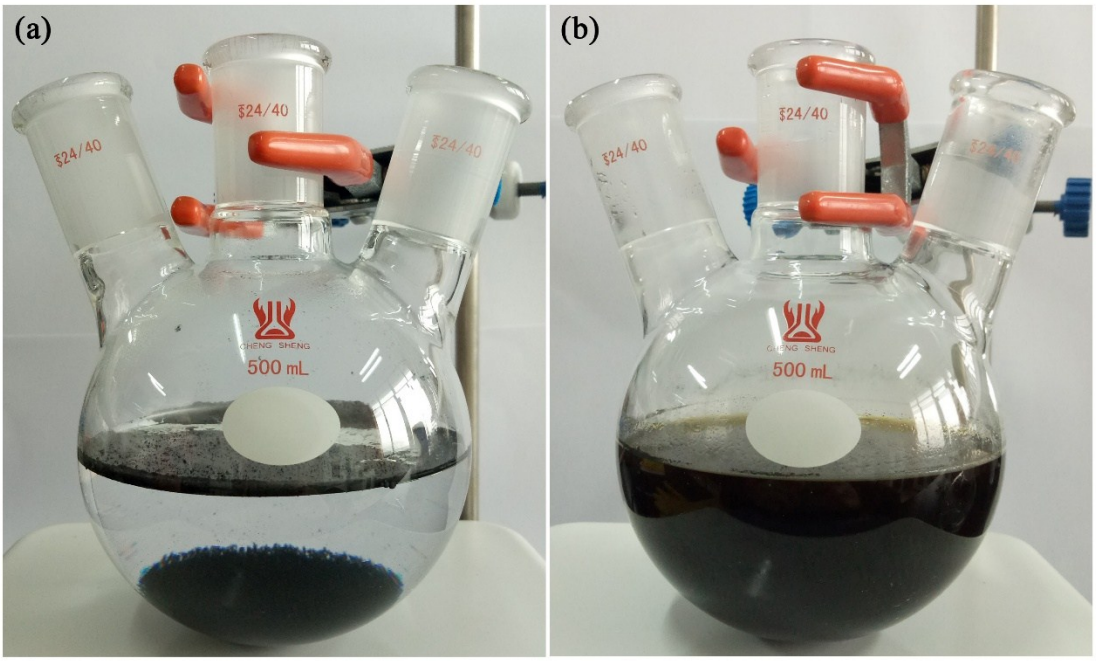

Fig. S2 (a) Graphite powders in concentrated H_2SO_4/HNO_3 mixed solution, and (b) CQDs aqueous solution.

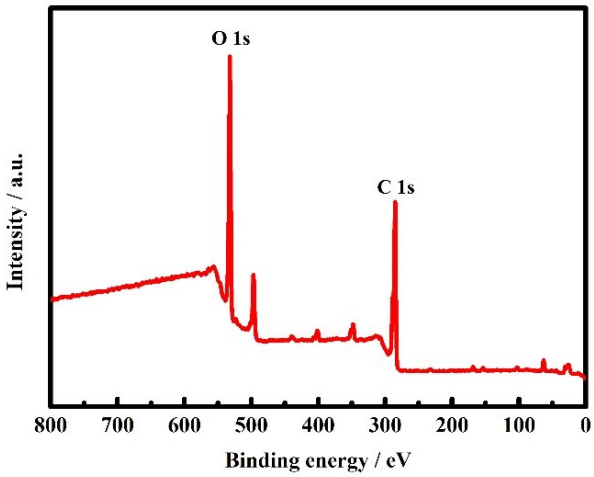

Fig. S3 XPS survey spectrum of CQDs.

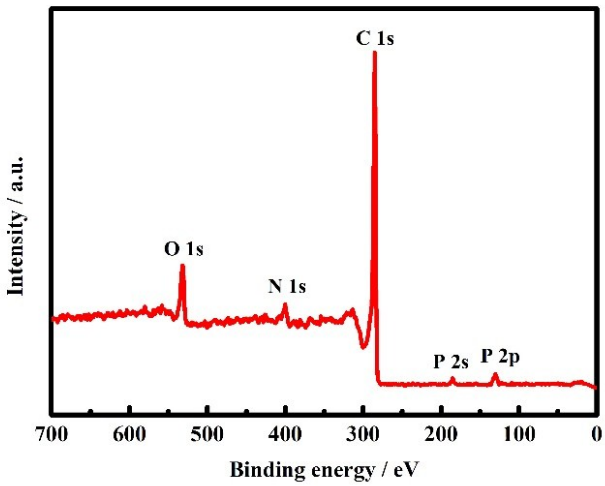

Fig. S4 XPS survey spectrum of N, P-CQDs/rGO.

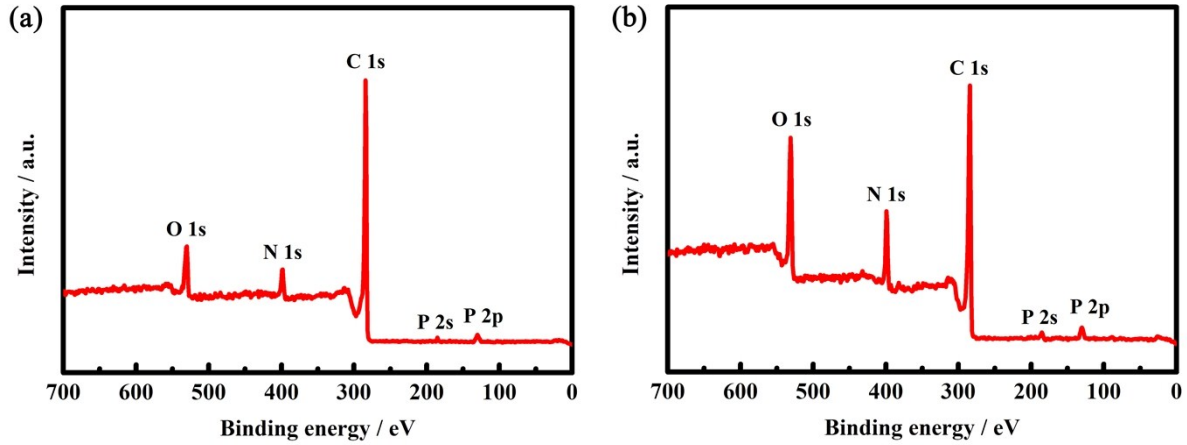

Fig. S5 XPS survey spectra of (a) N, P-rGO, and (b) N, P-CQDs.

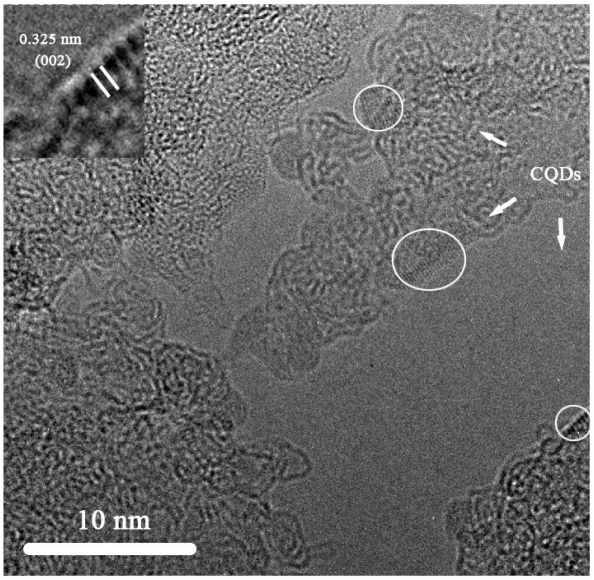

Fig. S6 HRTEM image of N, P-CQDs/rGO.

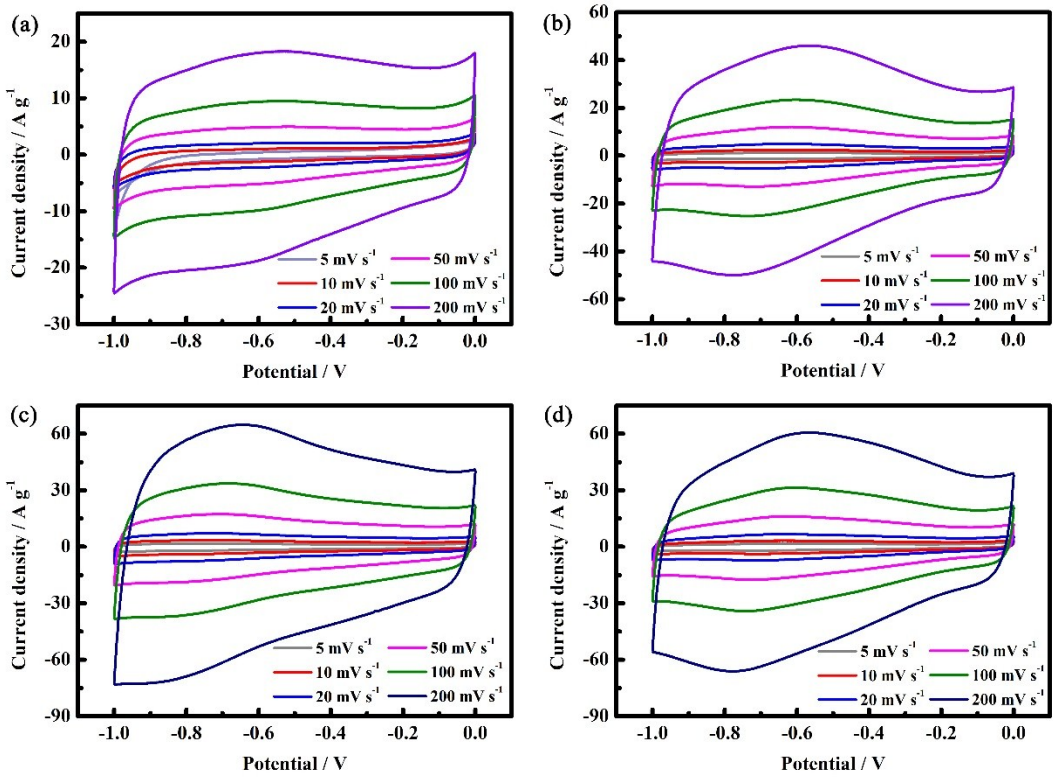

Fig. S7 CV curves of the (a) GO, (b) rGO, (c) N, P-rGO, and (d) CQDs/rGO electrodes at various scan rates.

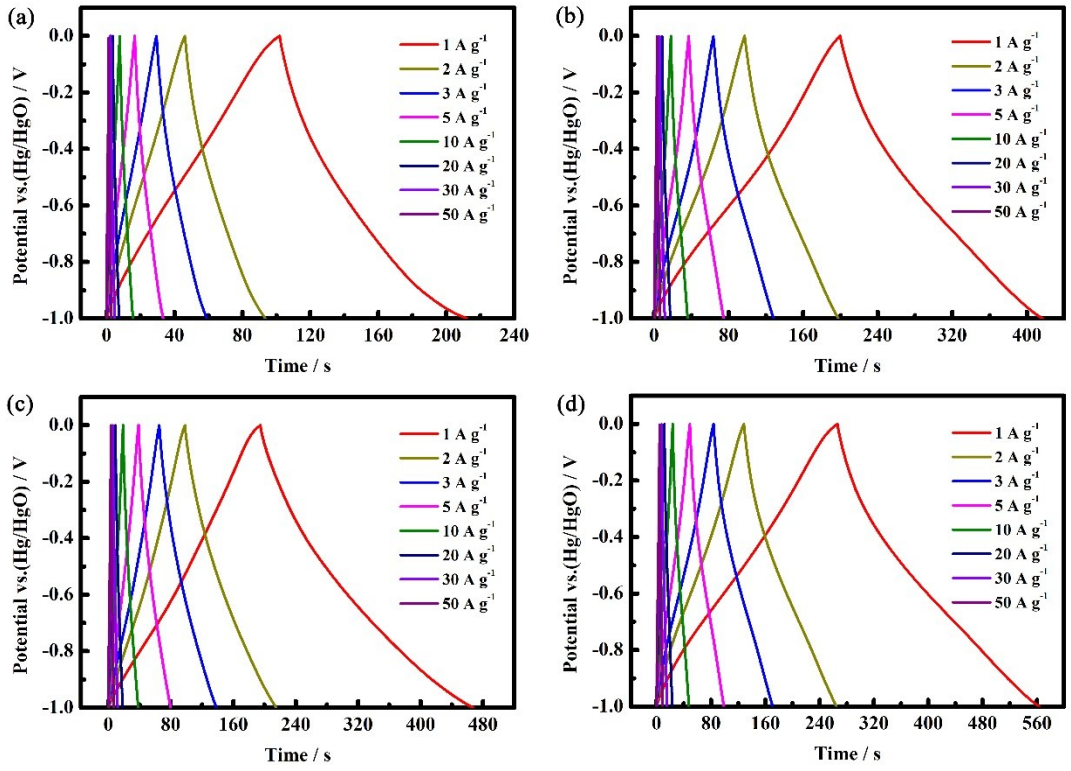

Fig. S8 GCD curves of the (a) GO, (b) rGO, (c) N, P-rGO, and (d) CQDs/rGO electrodes at various current densities.

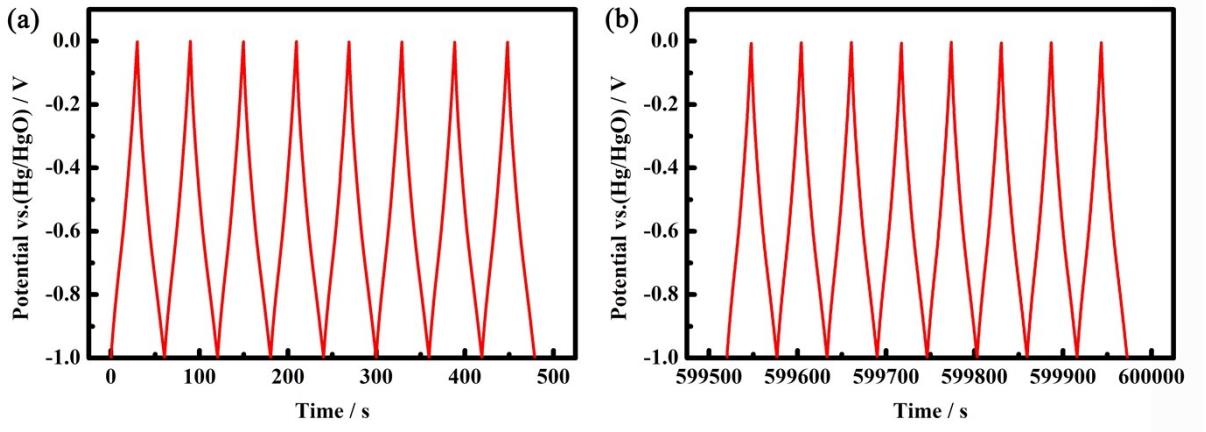

Fig. S9 (a) The first 8 cycles, and (b) the last 8 cycles of the charge-discharge curves at 10 A g^{-1} of the N, P-CQDs/rGO electrode.

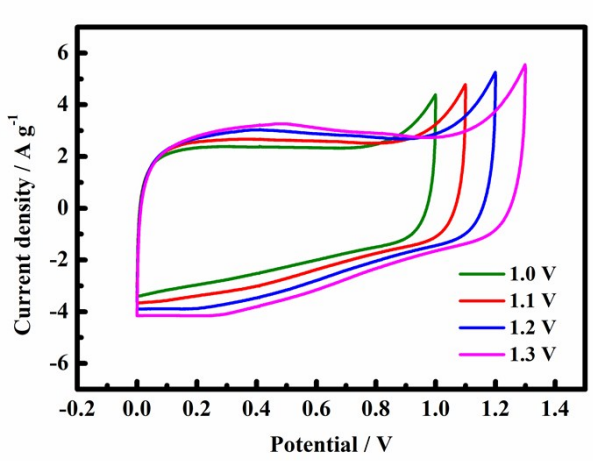

Fig. S10 CV curves of the N, P-CQDs/rGO//N, P-CQDs/rGO symmetrical device with different voltage windows at 50 mV^{-1}.

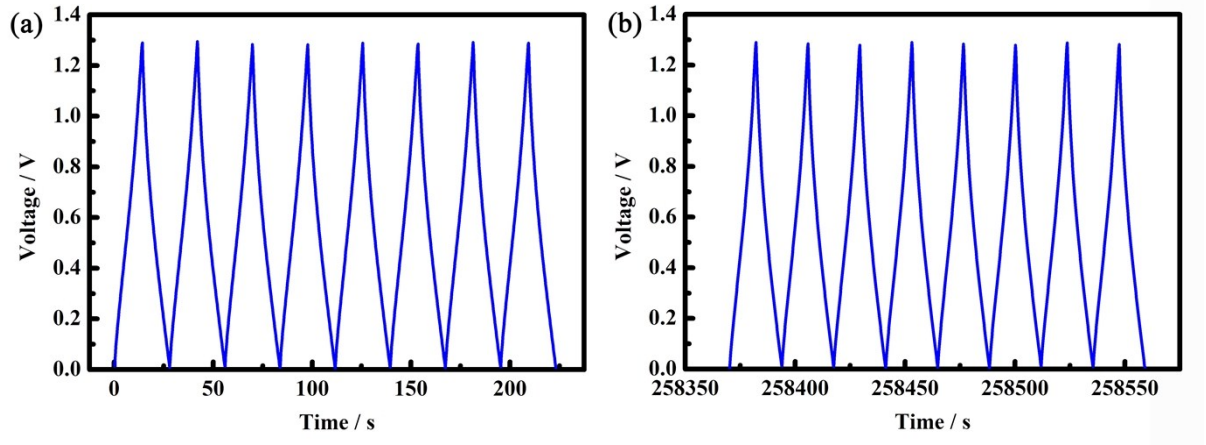

Fig. S11 (a) The first 8 cycles, and (b) the last 8 cycles of the charge-discharge curves at 5 A g^{-1} of the N, P-CQDs/rGO//N, P-CQDs/rGO symmetrical device.

Table S1 Comparison of the specific capacitance and cycling stability of the as-prepared N, P-CQDs/rGO with previously reported graphene-based electrode materials.

Samples	Specific capacitance	Cycling stability	Reference
GQD/3D graphene	268 F g^{-1} at 1.25 A g^{-1}	90 % after 5000 cycles at 5 A g^{-1}	1
N-P-O co-doped 3D graphene	426 F g^{-1} at 0.5 A g^{-1}	/	2
rGO/CDs	308 F g^{-1} at 0.5 A g^{-1}	92 % after 20000 cycles at 10 A g^{-1}	3
N, S co-doped graphene hydrogel	251 F g^{-1} at 0.5 A g^{-1}	96.8 % after 2000 cycles at 20 A g^{-1}	4
N, S co-doped graphene aerogel	566 F g^{-1} at 0.5 A g^{-1}	95 % after 2000 cycles at 3 A g^{-1}	5
N doped graphene hydrogel	388 F g^{-1} at 0.5 A g^{-1}	92 % after 1000 cycles at 3 A g^{-1}	6
N, P co-doped graphene	219 F g^{-1} at 0.25 A g^{-1}	/	7
N, S co-doped graphene/ porous carbon foam	405 F g^{-1} at 1 A g^{-1}	98.8 % after 10000 cycles at 10 A g^{-1}	8
N-doped rGO foams	260 F g^{-1} at 0.1 A g^{-1}	92.8 % after 5000 cycles at 10 A g^{-1}	9
N-doped porous graphene	390 F g^{-1} at 1 A g^{-1}	/	10
3D graphene hydrogel	248.8 F g^{-1} at 1 A g^{-1}	94.6 % after 5000 cycles at 5 A g^{-1}	11
N, P-CQDs/rGO	453.7 F g^{-1} at 1 A g^{-1}	93.5 % after 10000 cycles at 10 A g^{-1}	This work

Notes and references

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