

**Modified Co<sub>4</sub>N by B-doping for high performances hybrid  
supercapacitors**

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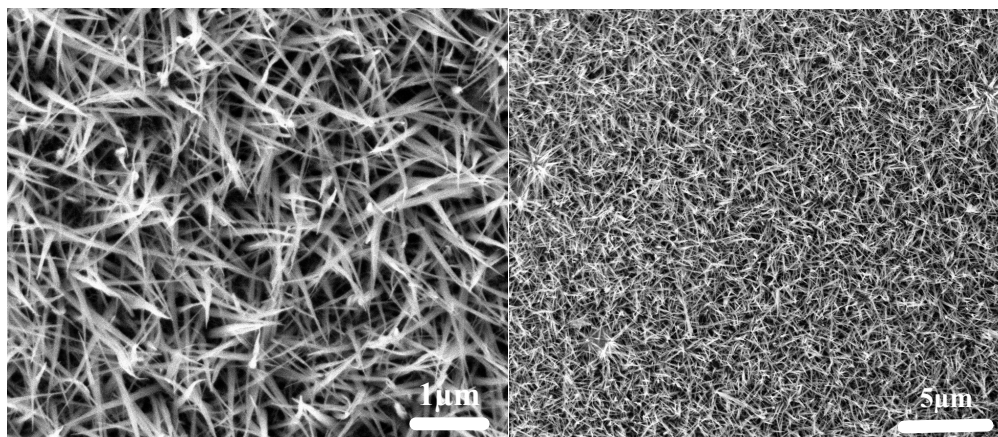


Fig. S1 SEM image of  $\text{Co(OH)}_2$ .

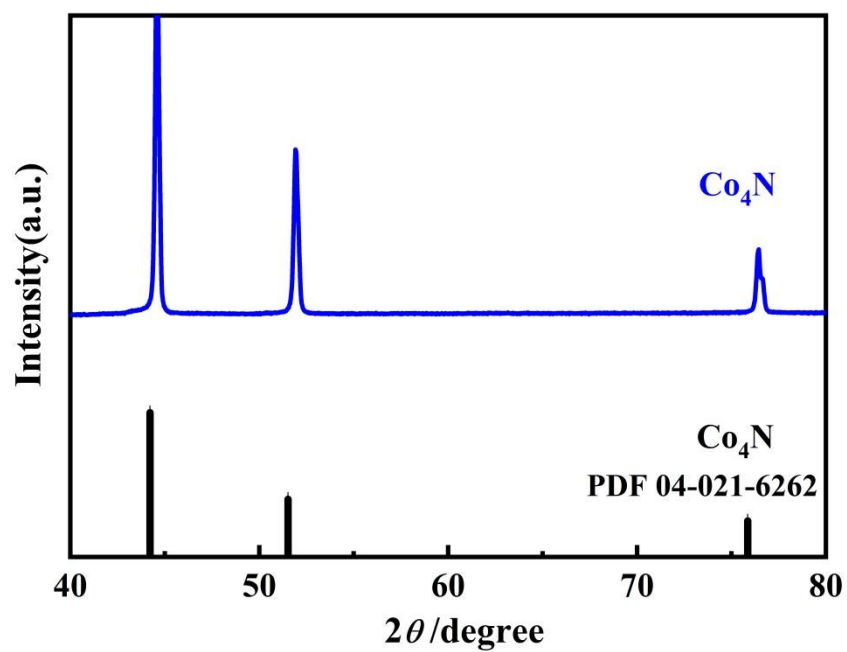


Fig. S2 XRD spectrum image of  $\text{Co}_4\text{N}$ .

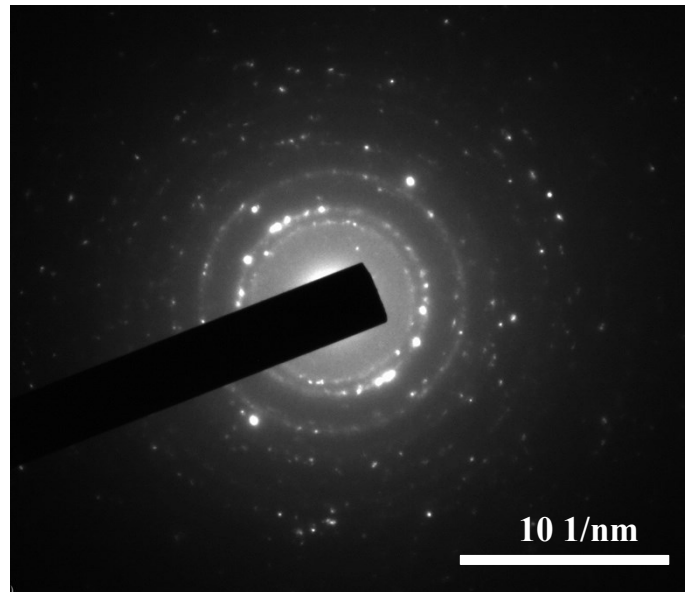


Fig. S3 SAED pattern of B-Co<sub>4</sub>N-20.

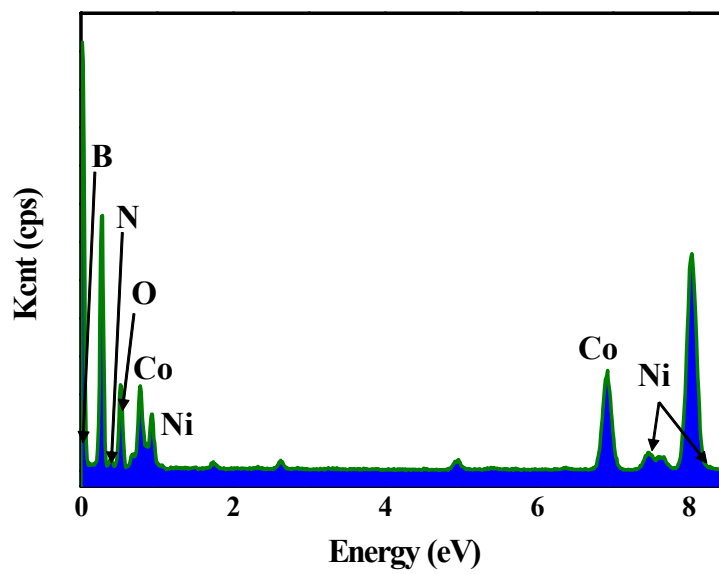


Fig. S4 EDS spectrum of B-Co<sub>4</sub>N-20.

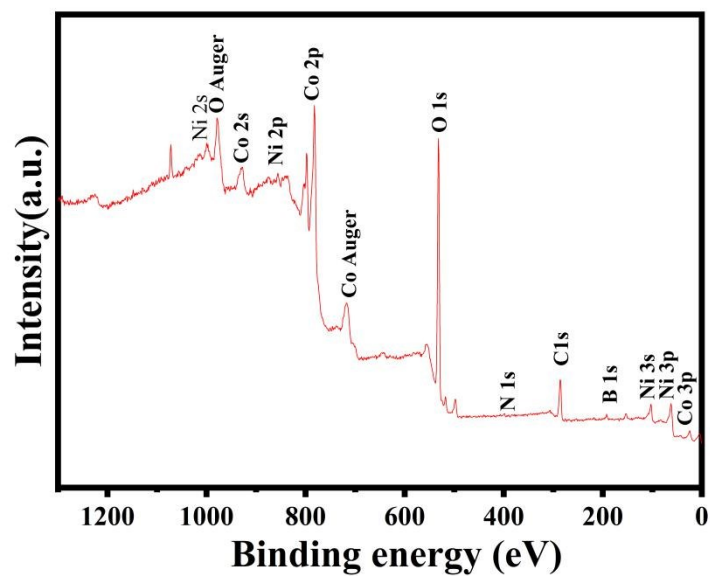


Fig. S5 XPS survey of B-Co<sub>4</sub>N-20.

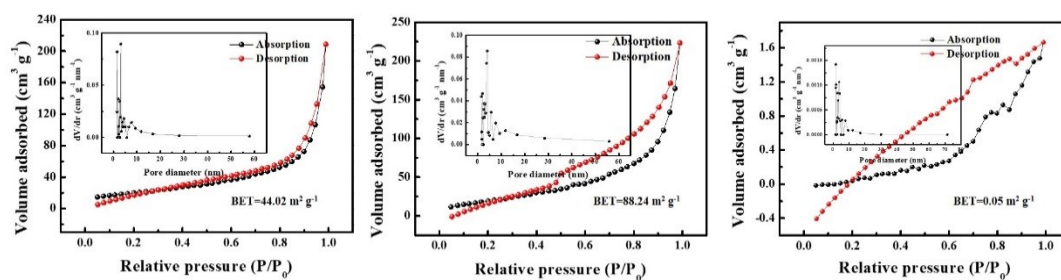
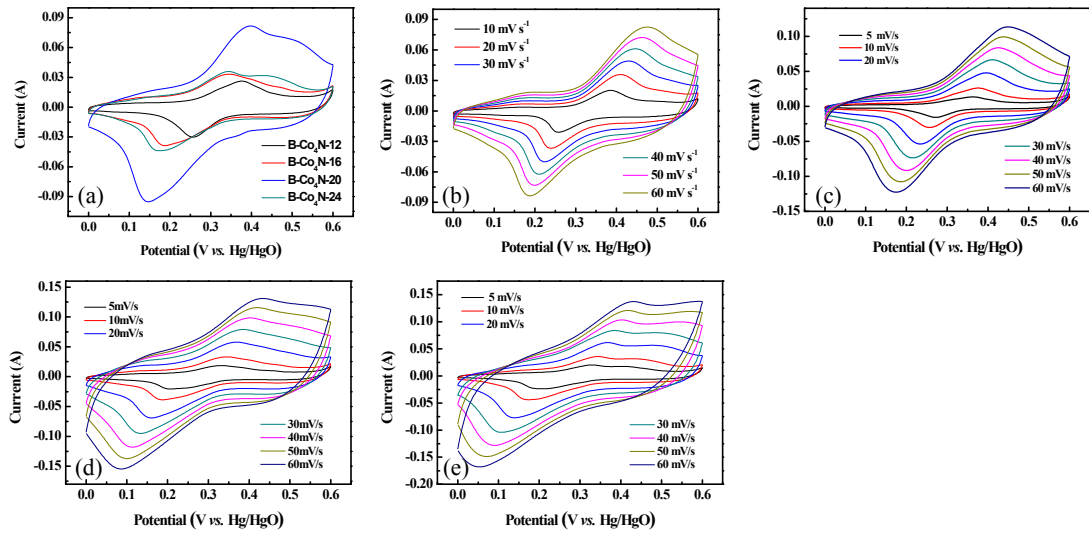
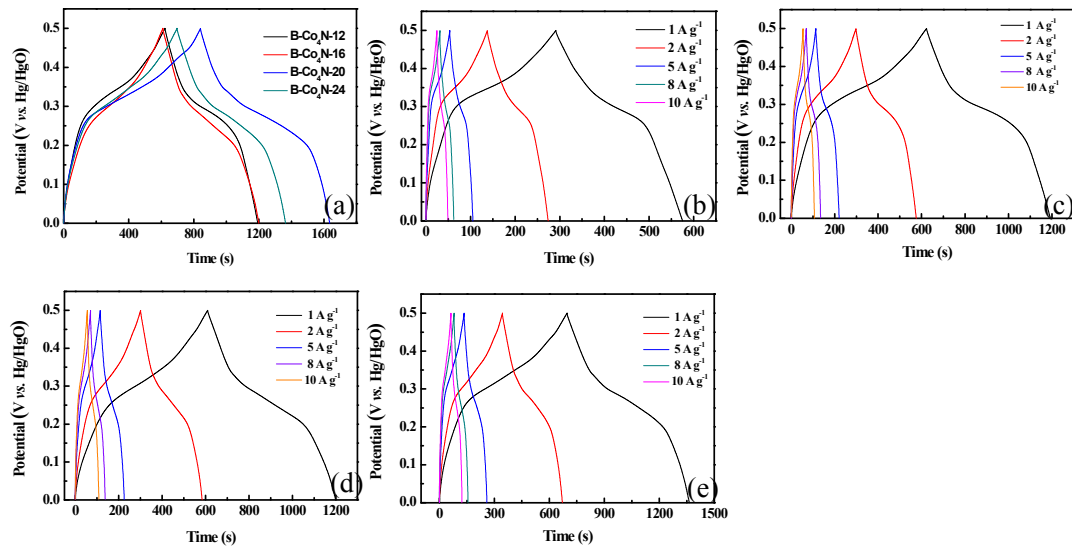


Fig. S6 Plots of N<sub>2</sub> adsorption-desorption isotherm and pore size distribution of (a) Co<sub>4</sub>N/NF (b) B-Co<sub>4</sub>N-20/NF (c) pure Ni foam



**Fig. S7** CV curves of (a) B-Co<sub>4</sub>N at 10 mV/s (b) Co<sub>4</sub>N (c) B-Co<sub>4</sub>N-12 (d) B-Co<sub>4</sub>N-16 (e) B-Co<sub>4</sub>N-24.



**Fig. S8** GCD curves of a) B-Co<sub>4</sub>N at 1 A g<sup>-1</sup> (b) Co<sub>4</sub>N (c) B-Co<sub>4</sub>N-12 (d) B-Co<sub>4</sub>N-16 (e) B-Co<sub>4</sub>N-24.

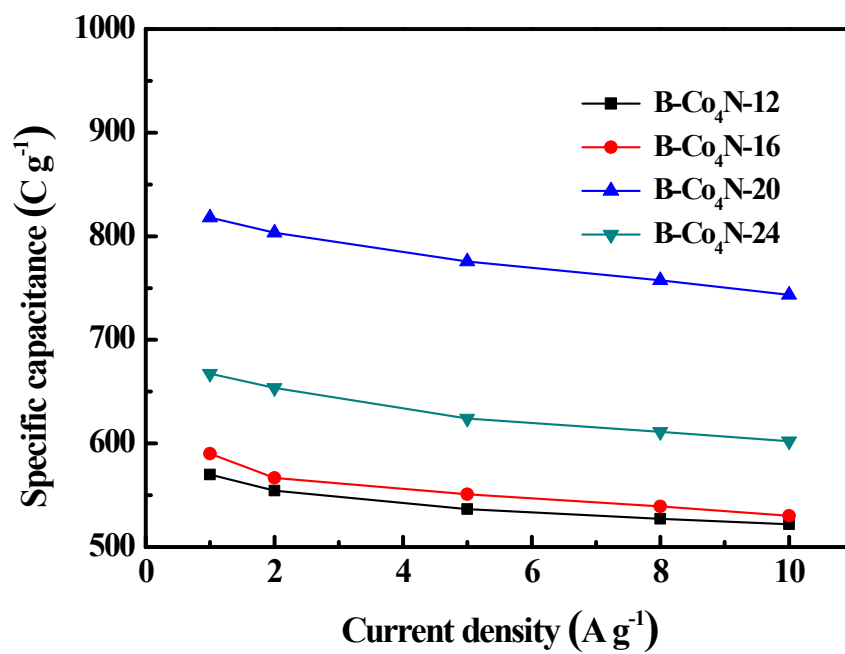


Fig. S9 Ratio image of B-Co<sub>4</sub>N.

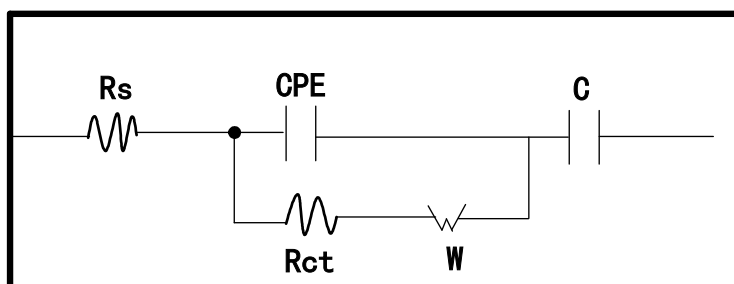
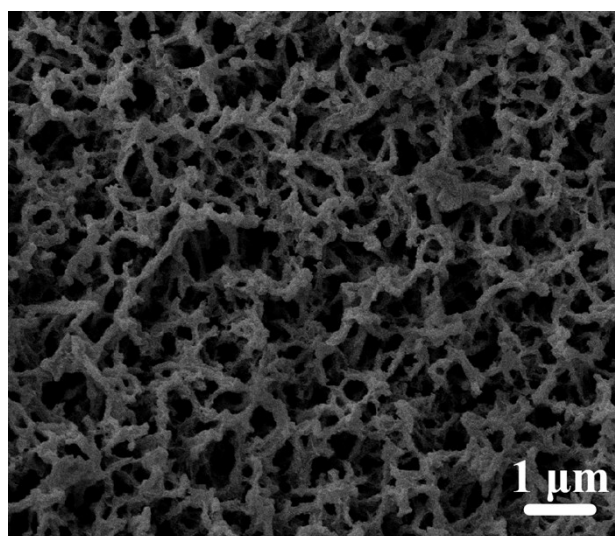
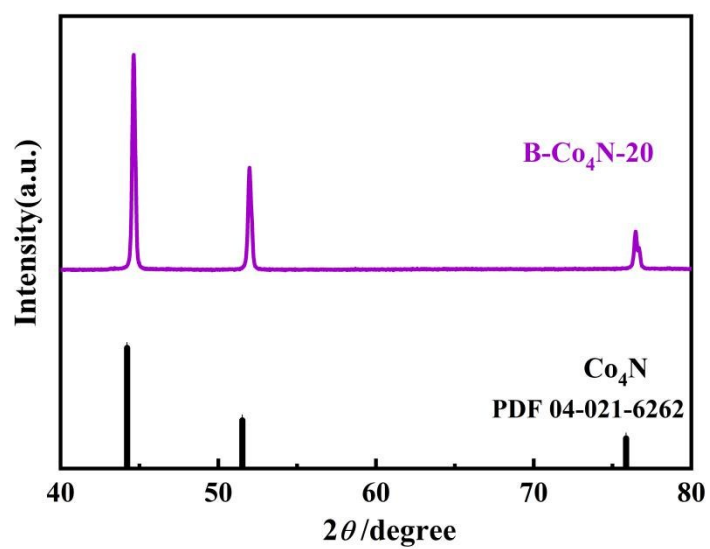


Fig. S10 Equivalent circuit image of EIS fitting.



**Fig. S11** SEM images of B-Co<sub>4</sub>N-20/NF after 5000 cycles.



**Fig. S12** XRD spectrum of B-Co<sub>4</sub>N-20/NF after 5000 cycles.

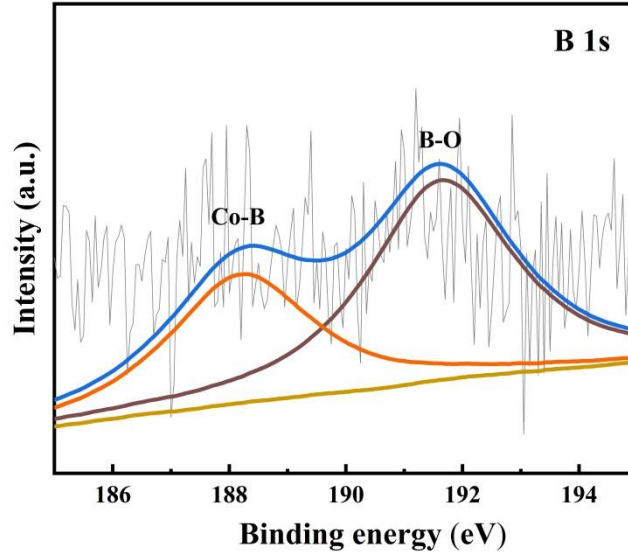


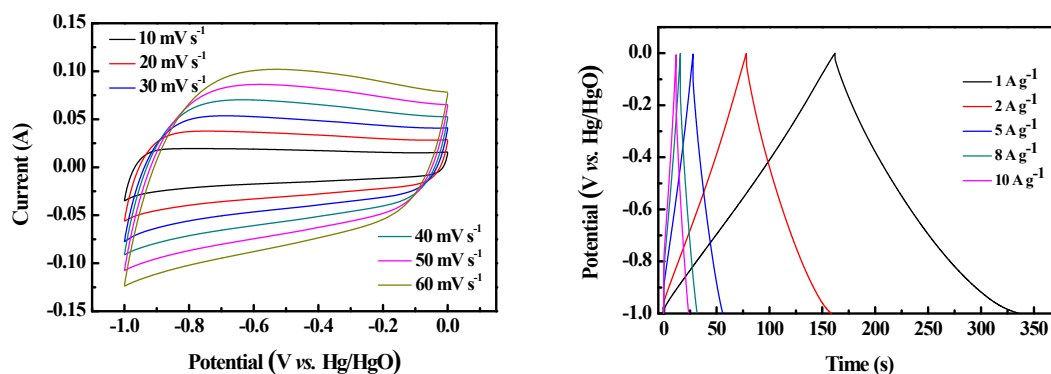
Fig. S13 XPS B1s spectrum of B-Co<sub>4</sub>N-20/NF after 5000 cycles.

Table S1. The summary of some recent similar works.

Materials	Morphology	Electrolyte	Capacitance	Cycle retention	Ref.
CoS/N-doped C dots	Flower-like	3.0M KOH	697 F g <sup>-1</sup> (1A g <sup>-1</sup> )	80.3% (10000 th)	1
CoS	Flower-like	6.0M KOH	348 F g <sup>-1</sup> (1A g <sup>-1</sup> )	97.2% (1000 th)	2
Co <sub>9</sub> S <sub>8</sub>	Nanosheets	1.0M KOH	954.5 F g <sup>-1</sup> (1A g <sup>-1</sup> )	87.4% (1000th)	3
Co <sub>3</sub> O <sub>4</sub>	Nanocrystals	0.5M H <sub>3</sub> PO <sub>4</sub>	1049 F g <sup>-1</sup> (1mV s <sup>-1</sup> )	100%(20000th)*	4
CoP	Hollow microspheres	6.0M KOH	449.4 F g <sup>-1</sup> (1A g <sup>-1</sup> )	80.9%(3000th)	5
CoP	Microcubes	6.0M KOH	560 F g <sup>-1</sup> (1A g <sup>-1</sup> )	91.2%(10000th)	6
CoSe	Nanosheets	2.0M KOH	70.6 (1A g <sup>-1</sup> )	95.4%(20000th)	7
CoSe <sub>2</sub>	Nanoparticles	6.0M KOH	120.2 mAh g <sup>-1</sup> (1A g <sup>-1</sup> )	92 % (10000th)	8
Co <sub>0.85</sub> Se	Hollow spheres	2.0M KOH	1220 F g <sup>-1</sup> (1A g <sup>-1</sup> )	88.8 % (10000th)*	9
CoS <sub>2</sub>	Hollow dodecahedrons	2.0M KOH	375.2 C g <sup>-1</sup> (1A g <sup>-1</sup> )	92.1 % (5000th)*	10
CoNi-MOF	Nanosheets	1.0M KOH	1044 F g <sup>-1</sup> (1A g <sup>-1</sup> )	94 % (5000th)	11
Co <sub>5</sub> O <sub>4</sub> /Co(OH) <sub>2</sub>	Nanopolyhedron	1.0M KOH	184.9 mAh g <sup>-1</sup> (1A g <sup>-1</sup> )	91 % (5000th)	12
VN	Nano-tree-like	0.5M K <sub>2</sub> SO <sub>4</sub>	37.5 mF cm <sup>-2</sup>	85 % (20000th)	13
TiN/MoN <sub>x</sub>	Moss-like nanosheet	1.0M KOH	174.83 F g <sup>-1</sup> (1.5A g <sup>-1</sup> )	93.8 % (1000th)	14
C/Mo <sub>x</sub> N	Nanofibers	1.0M H <sub>2</sub> SO <sub>4</sub>	251 F g <sup>-1</sup> (1A g <sup>-1</sup> )	78.6 % (15000th)*	15
W <sub>2</sub> N	Film	1.0M H <sub>2</sub> SO <sub>4</sub>	163 F g <sup>-1</sup> (0.5 mA cm <sup>-2</sup> )	94 % (10000th)	16
CrN	Nanoparticles	1.0M LiPF <sub>6</sub>	75 F g <sup>-1</sup> (30 mA g <sup>-1</sup> )	100 % (120th)	17
TiN	Nano-pyramid	1.0M KOH	385 F g <sup>-1</sup> (1A g <sup>-1</sup> )	92.6 % (30000th)*	18
Ni <sub>3</sub> N	Nanosheets	1.0M KOH	845 F g <sup>-1</sup> (10 mV s <sup>-1</sup> )	50 % (2000th)	19
<i>h</i> -BN/C	Nanosheets	2.0M KOH	250 F g <sup>-1</sup> (0.5A g <sup>-1</sup> )	86 % (1000th)	20
TiN	Nanoparticles	1.0M H <sub>2</sub> SO <sub>4</sub>	120 F cm <sup>-3</sup> (0.83mA cm <sup>-3</sup> )	99 % (3000th)	21
<b>B-Co<sub>4</sub>N-20/NF</b>	<b>Nanoneedles</b>	<b>3.0M KOH</b>	<b>817.9 C g<sup>-1</sup> (1A g<sup>-1</sup>)</b> <b>743.5 C g<sup>-1</sup> (1A g<sup>-1</sup>)</b>	<b>93.06% (5000th)</b> <b>98.59% (5000th)*</b>	<b>This work</b>

\*corresponding two-electrode device





**Fig. S14** CV curves and GCD curves of AC/CF.

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