

Supporting information

Supercapacitors based on nitrogen-enriched crumpled graphene with a high volumetric capacitance and high-mass-loading per area of the electrode

Qiong YU, Yong-zhi WANG, Meng MENG, Shu-ling SHEN, Zhi-hong TANG, Jun-he YANG

School of Materials Science and Engineering, University of Shanghai for Science and Technology, Shanghai 200093, China

E-mail: zhtang@usst.edu.cn

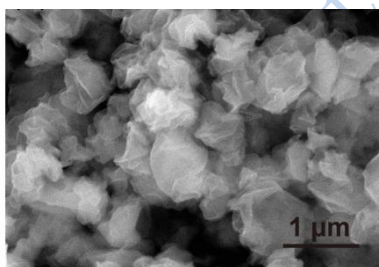


Fig. S1 SEM image of CGU.

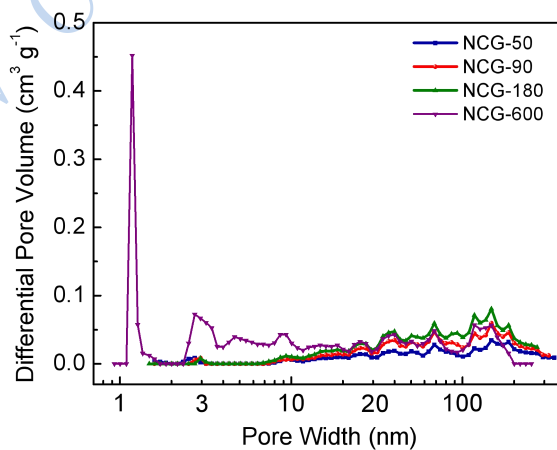


Fig. S2 Pore size distribution curves of NCG.

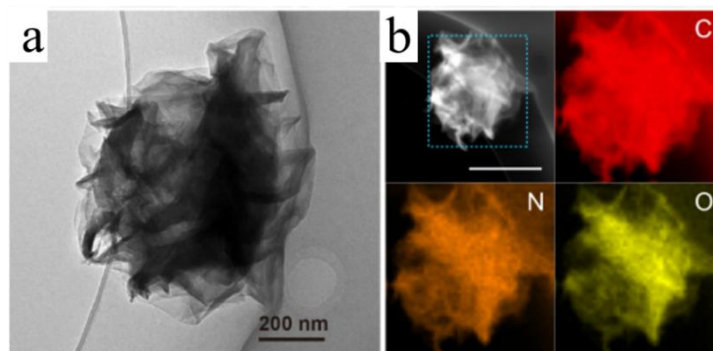


Fig. S3 (a) TEM image of NCG-90; (b) A high-angle annular (HAADF)-STEM images of the NCG-90, and the corresponding elemental mapping of C, N, and O (scale bar: 500 nm)

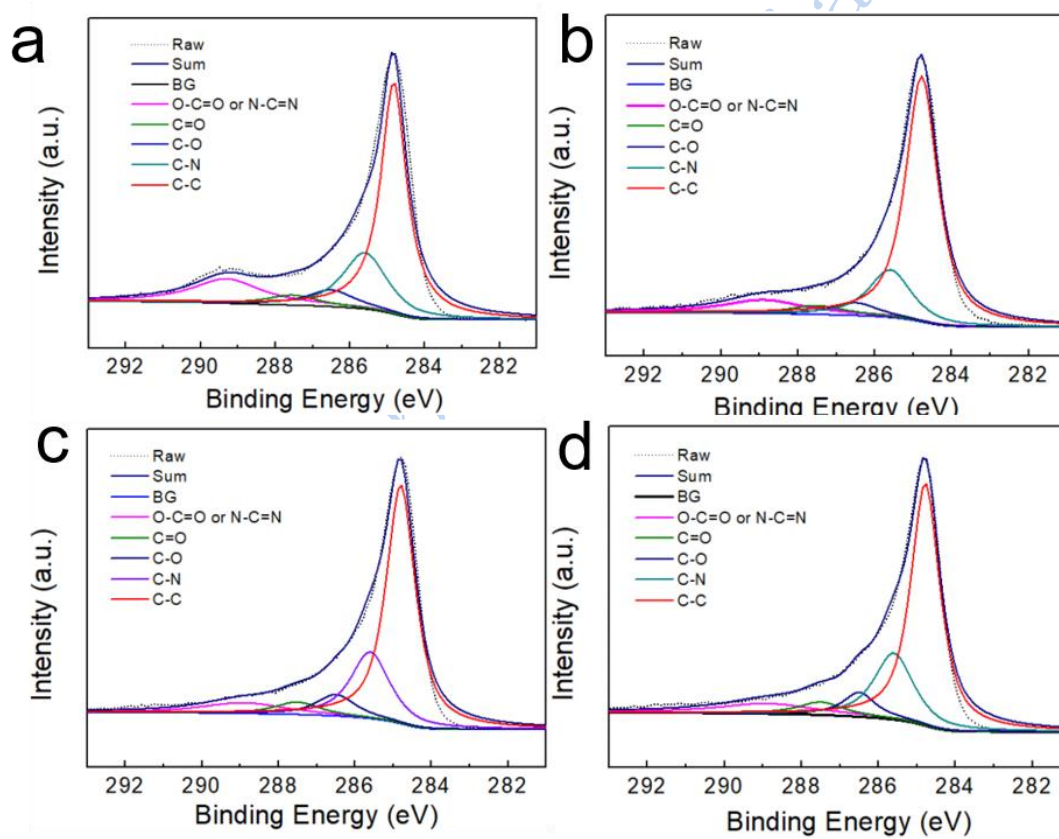


Fig. S4 XPS high-resolution C 1s spectra of (a) NCG-50; (b) NCG-90; (c) NCG-180 and (d) NCG-600.

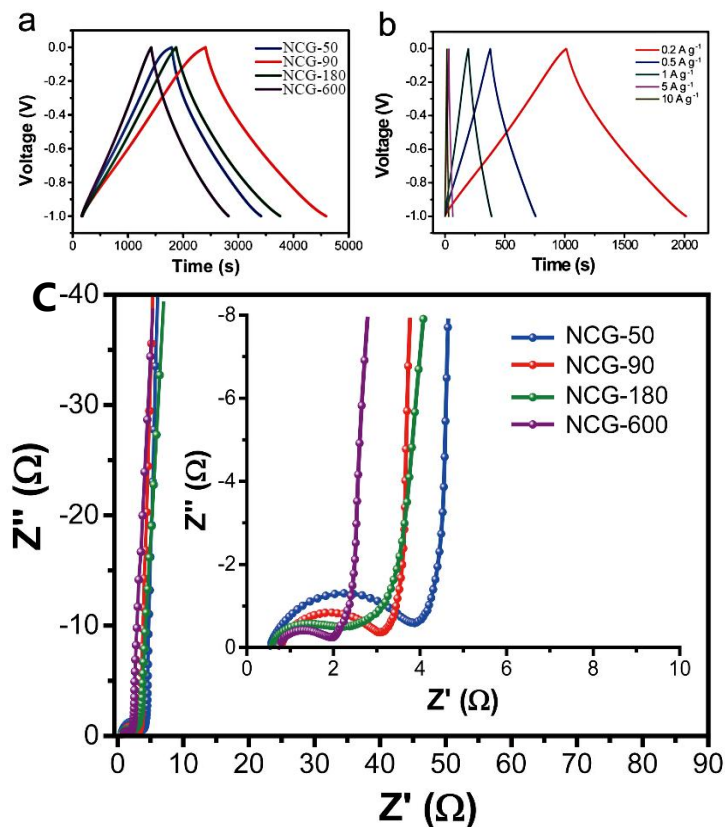


Fig. S5 (a) Galvanostatic charge–discharge curves of NCG (NCG -50, NCG-90, NCG -180 and NCG -600) at current densities of 0.1 A g^{-1} , (b) galvanostatic charge–discharge curves of NCG -90 at different current densities, (c) Nyquist plots of the four samples with different heat shock time at 600°C .

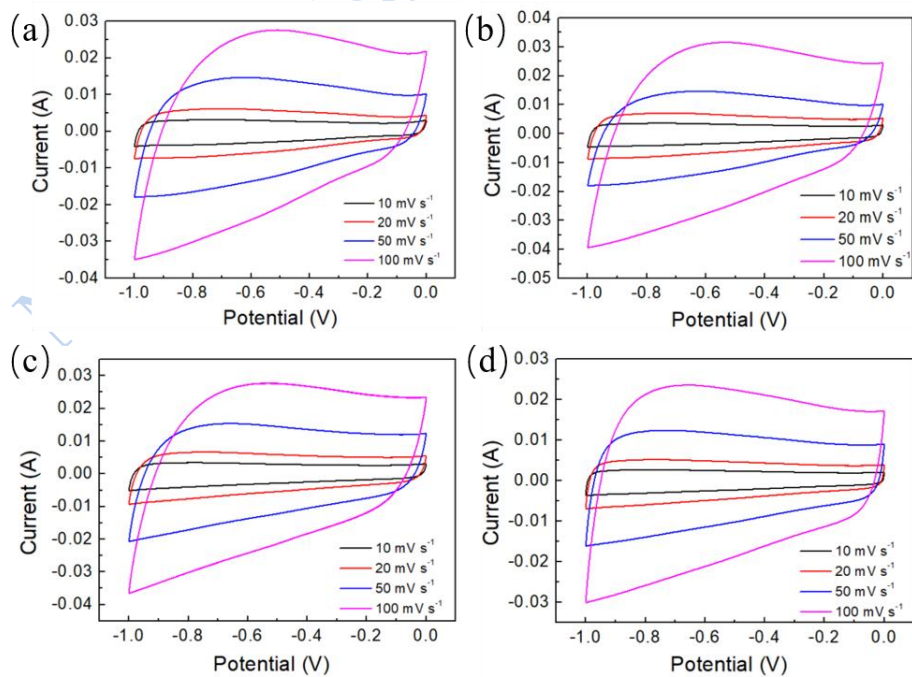


Fig. S6 CV curves of (a) NCG-50; (b) NCG-90; (c) NCG-180 and (d) NCG-600 at different scan rates.

Table S1 N 1s core level peak analyses of all studied NCG.

Sample	Nitrogen content (atm%)	Nitrogen Type		
		-N=	-NH-	-NH ⁺ =
NCG-50	11.38	23.30%	61.19%	15.51%
NCG -90	9.62	14.67%	51.74%	33.59%
NCG -180	6.61	15.73%	34.46%	52.81%
NCG -600	5.56	14.40%	33.28%	52.32%

Table S2 Comparison of the volumetric and gravimetric capacitances of the NCG-90 with other reported materials in an aqueous electrolyte.

Materials	Electrolyte	Current Density (A g ⁻¹)	Cs (F g ⁻¹)	Cv (F cm ⁻³)	Capacity Retention	Ref
Porous Carbon layer/Graphene	6 M KOH	0.5/20	481/ 313	212/138	65.1%	1
GCS-1000	0.1 M KOH	1/5	166/132		79%	2
CNT@N-PC	6 M KOH	1/10	180/120		66.7%	3
CHPC-0.50	6 M KOH	1/10	331/241		73%	4
PANI/graphene composite	1 M H ₂ SO ₄	0.1/10	546/360	802/529	66%	5
RGO-F/PANI 5	1 M H ₂ SO ₄	1/10	725/598	174/150	82.5%	6
RGO/SWCNT fiber	1 M H ₂ SO ₄	73.5 mA cm ⁻³	-	305	-	7
FMG-300	6 M KOH	0.5/20	326/191	-	58.9%	8
GO-AC-KOH 1-4-4	7 M KOH	0.05/15	265/215		81%	9
Crumpled graphene balls	5 M KOH	0.1/2	150/118	75/59	78.7%	10
NCG-90	6 M KOH	0.1/10	218.2/170.2	384.0/299.6	78.0%	This work

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