Supporting information

Glycine-derived nitrogen-doped ordered mesoporous carbons with a bimodal mesopore size distribution for supercapacitors and oxygen reduction

SHAO Ying, HU Zeyu, YAO Yan, WEI Xiangru, GAO Xingmin, WU Zhangxiong*

Particle Engineering Laboratory, School of Chemical and Environmental Engineering, College of Chemistry, Chemical Engineering and Materials Science, Soochow University, Suzhou, Jiangsu 215123, P. R. China

**Corresponding author: zhangwu@suda.edu.cn*

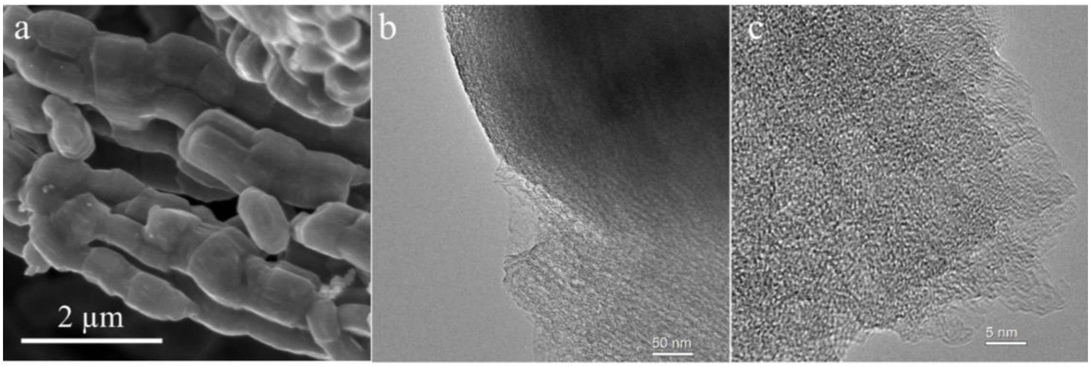

Fig. S1 SEM (a), TEM (b) and HRTEM image of the N-OMC@SBA-15 composite obtained at 900 °C with a Gly/SBA-15 mass ratio of 2.5.

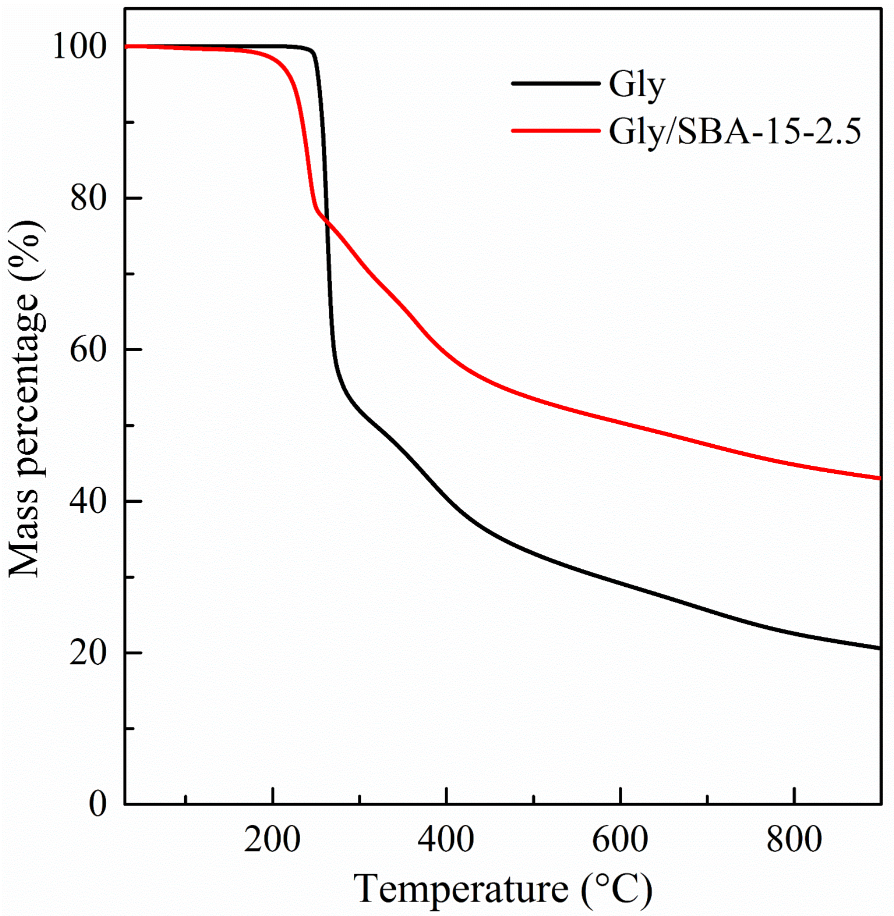

Fig. S2 TG curves in a N_2 flow of pure Gly and Gly/SBA-15 mixture with a mass ratio of 2.5.

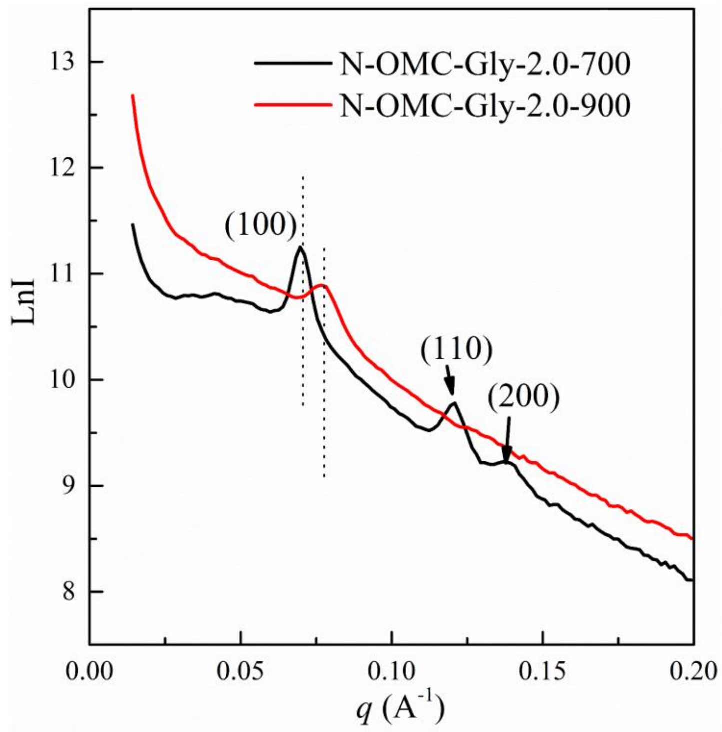

Fig. S3 SAXS patterns of two N-OMCs obtained with a Gly/SBA-15 mass ratio of 2.0 at 700 and 900 °C.

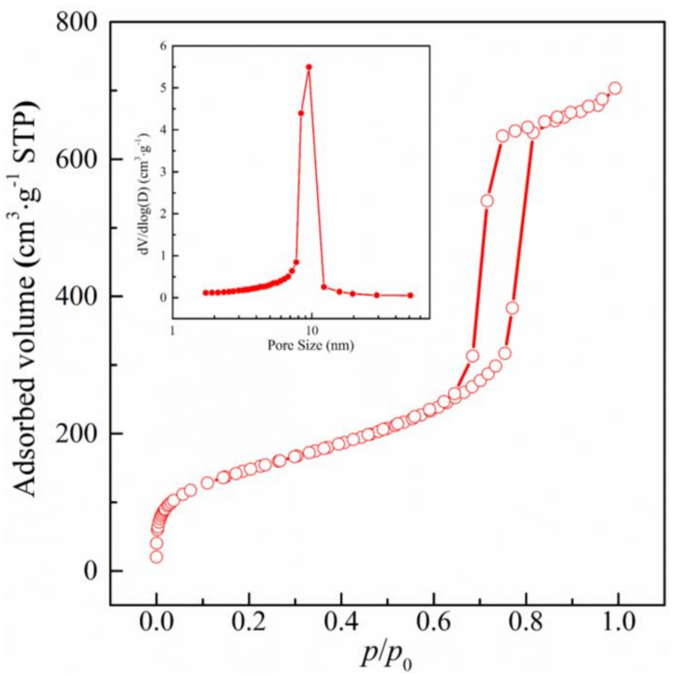

Fig. S4 N_2 adsorption-desorption isotherms and the inset pore size distribution curve of the SBA-15 template.

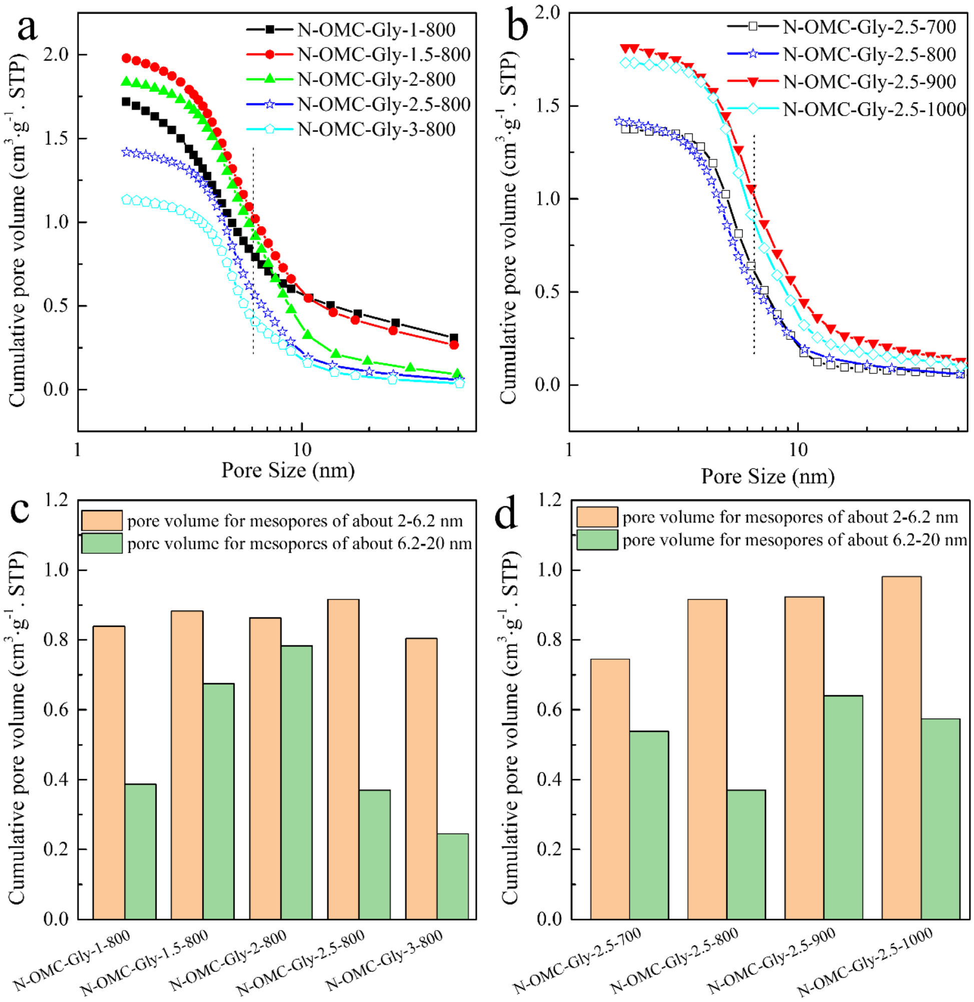

Fig. S5 Plots of cumulative pore volumes as a function of pore sizes for the N-OMCs obtained at different Gly/SBA-15 mass ratios (a) and temperatures (b). Cumulative pore volumes for the two types of mesopores for the N-OMCs obtained at different Gly/SBA-15 mass ratios (c) and temperatures (d).

Table S1. Comparison of the supercapacitor performance between the typical sample N-OMC-Gly-2.5-800 and materials from some previous reports.

Sample	Specific capacitance ($F\cdot g^{-1}$)	Rate capability (%)	Electrolyte	Ref
N-OMC-Gly-2.5-800	298@ 0.5 $A\cdot g^{-1}$	70@ 30 $A\cdot g^{-1}$	6.0 M KOH	This work
PAN-b-PMMA-CFs	360@ 1 $A\cdot g^{-1}$	56@ 100 $A\cdot g^{-1}$	6.0 M KOH	[1]
PFC-1	282@ 0.5 $A\cdot g^{-1}$	60@ 20 $A\cdot g^{-1}$	6.0 M KOH	[2]
NMCS-3-A	170@ 1 $A\cdot g^{-1}$	40@ 10 $A\cdot g^{-1}$	1.0 M TEA BF_4/AN	[3]
MCNS-60	350@ 0.1 $A\cdot g^{-1}$	50@ 10 $A\cdot g^{-1}$	1.0 M H_2SO_4	[4]
NM-CMK-3	260@ 0.1 $A\cdot g^{-1}$	52@ 20 $A\cdot g^{-1}$	3.0 M H_2SO_4	[5]
NCSs-20-800	278@ 0.2 $A\cdot g^{-1}$	76@ 10 $A\cdot g^{-1}$	1.0 M H_2SO_4	[6]
N-OMCN@GN	242@ 1 $A\cdot g^{-1}$	69@ 10 $A\cdot g^{-1}$	6.0 M KOH	[7]
NOMC973-C1N4	385@ 0.5 $A\cdot g^{-1}$	61@ 20 $A\cdot g^{-1}$	1.0 M H_2SO_4	[8]
N-OMCSs	288@ 0.1 $A\cdot g^{-1}$	66@ 50 $A\cdot g^{-1}$	6.0 M KOH	[9]

Table S2. Comparison of the ORR performance between the typical sample N-OMC-Gly-2.5-1000 and materials from some previous reports.

Sample	E_{onset} (V)	$E_{1/2}$ (V)	j@0.8 V ($mA\cdot cm^{-2}$)	j_L@0.8 V ($mA\cdot cm^{-2}$)	Ref
N-OMC-Gly-2.5-1000	0.92	0.83	4.43	5.06	This work
Me/HNMK-5	0.92	0.82	2.47	~5	[10]
NHMC	0.91	0.76	~1	4.88	[11]
N-OMC-800	1.00	0.86	~3.9	~4.6	[12]
C-PY-1000	0.96	~0.86	~3.8	~4.1	[13]
CN_X-CMK-3	0.96	0.83	~3	~5	[14]

References

[1] Zhou Z P, Liu T Y, Khan A U, et al. Block copolymer-based porous carbon fibers [J]. Science Advances, 2019, 5(2): eaau6852.

[2] Yu Q, Guan D, Zhuang Z, et al. Mass Production of Monodisperse Carbon Microspheres with Size-Dependent Supercapacitor Performance via Aqueous Self-Catalyzed Polymerization [J]. ChemPlusChem, 2017, 82(6): 872-878.

[3] Tang J, Wang J, Shrestha L K, et al. Activated Porous Carbon Spheres with Customized Mesopores through Assembly of Diblock Copolymers for Electrochemical Capacitor [J]. ACS Applied Materials & Interfaces, 2017, 9(22):18986-18993.

[4] Tian H, Lin Z, Xu F, et al. Quantitative Control of Pore Size of Mesoporous Carbon Nanospheres through the Self-Assembly of Diblock Copolymer Micelles in Solution [J]. Small, 2016, 12(23): 3155-3163.

[5] Chen H, Li Q, Teng N, et al. Simultaneous micropore development and nitrogen doping of ordered mesoporous carbons for enhanced supercapacitor and Li-S cathode performance [J]. Electrochimica Acta, 2016, 214: 231-240.

[6] Fan L, Sun P, Yang L, et al. Facile and scalable synthesis of nitrogen-doped ordered mesoporous carbon for high performance supercapacitors[J]. Korean Journal of Chemical Engineering, 2020, 37: 166-175.

[7] Zhao M, Cui X, Xu Y, et al. An ordered mesoporous carbon nanosphere-encapsulated graphene network with optimized nitrogen doping for enhanced supercapacitor performance [J]. Nanoscale, 2018, 10(32): 15379-15386.

[8] Xie M, Meng H, Chen J, et al. High-Volumetric Supercapacitor Performance of Ordered Mesoporous Carbon Electrodes Enabled by the Faradaic-Active Nitrogen Doping and Decrease of Microporosity [J]. ACS Applied Energy Materials, 2021, 4(2): 1840-1850.

[9] Wang J G, Liu H, Sun H, et al. One-pot synthesis of nitrogen-doped ordered mesoporous carbon spheres for high-rate and long-cycle life supercapacitors [J]. Carbon, 2018, 127: 85-92.

[10] Zhong H, Zhang S, Jiang J, et al. Improved Electrocatalytic Performance of Tailored Metal-Free Nitrogen-Doped Ordered Mesoporous Carbons for the Oxygen Reduction Reaction [J]. ChemElectroChem, 2018, 5(14): 1899-1904.

[11] Deng C, Pan L, Ji F, et al. Hybrid dual-template induced nitrogen-doped hierarchically porous carbon as highly efficient oxygen reduction electrocatalyst [J]. International Journal of Hydrogen Energy, 2021, 46(73): 36167-36175.

[12] Liu X, Zhou Y, Wang C L, et al. Solvent-free self-assembly synthesis of N-doped ordered mesoporous carbons as effective and bifunctional materials for CO2 capture and oxygen reduction reaction [J]. Chemical Engineering Journal, 2022, 427: 130878.

[13] Wan K, Long G F, Liu M Y, et al. Nitrogen-doped ordered mesoporous carbon: synthesis and active sites for electrocatalysis of oxygen reduction reaction [J]. Applied Catalysis B: Environmental, 2015, 165: 566-571.

[14] Xiao C, Chen X, Fan Z, et al. Surface-nitrogen-rich ordered mesoporous carbon as an efficient metal-free electrocatalyst for oxygen reduction reaction [J]. Nanotechnology, 2016, 27(44): 445402.