Supporting Information

Keratin-derived S/N co-doped graphene-like nanobubble and nanosheet hybrids for highly efficient oxygen reduction

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Contents

Fig. S1

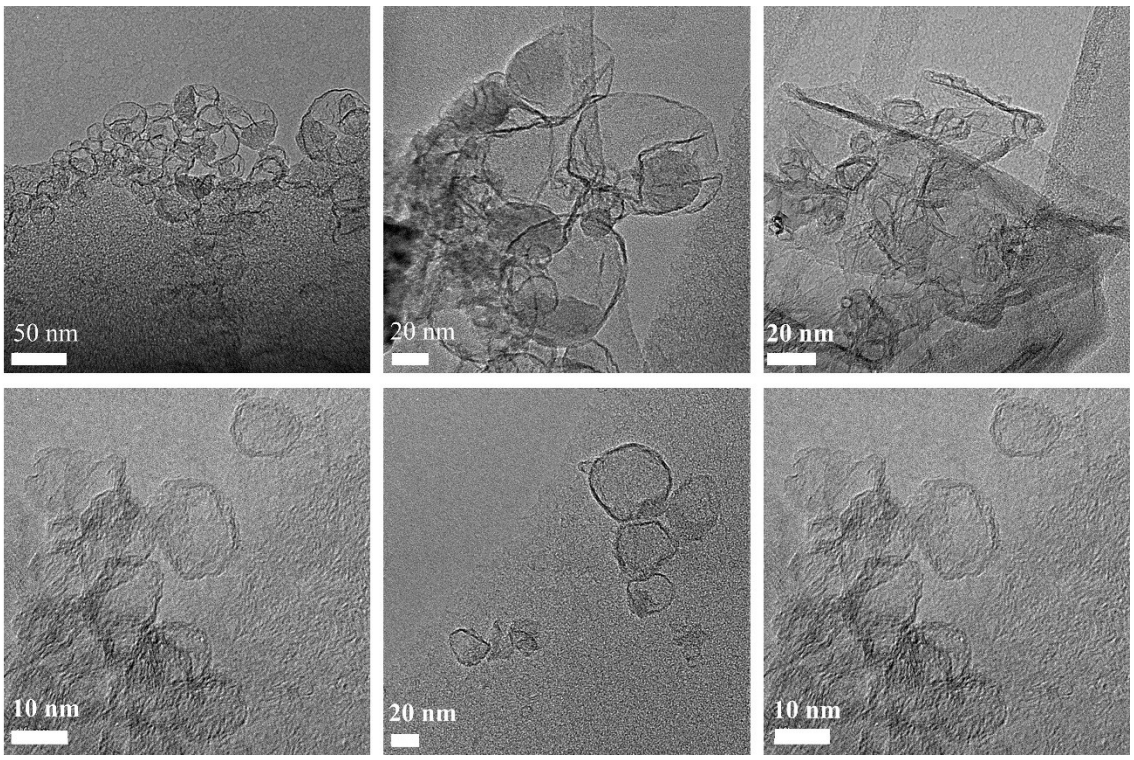

Fig. S1 TEM images of hybridized graphene-like nanobubbles and nanosheets (GLBS).

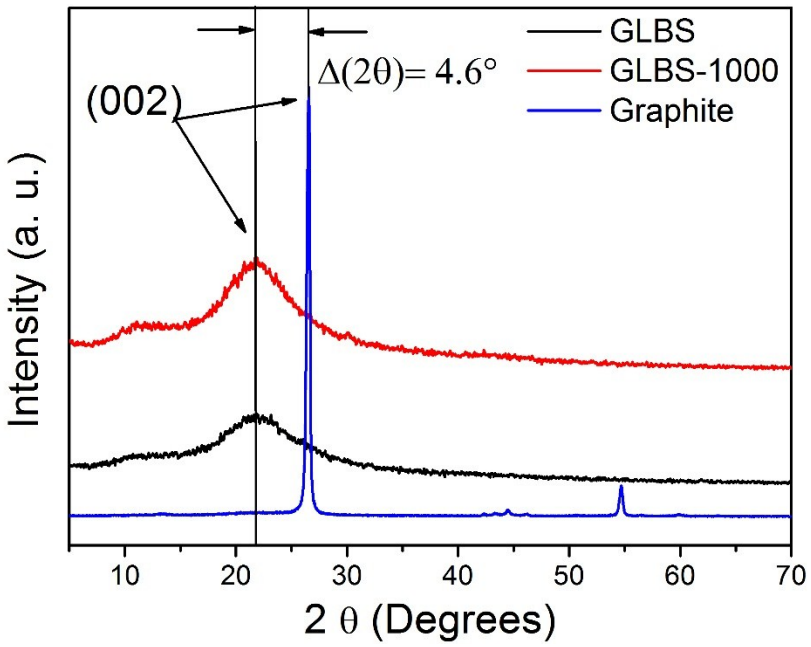

Fig. S2 XRD patterns of GLBS, GLBS-1000 and graphite.

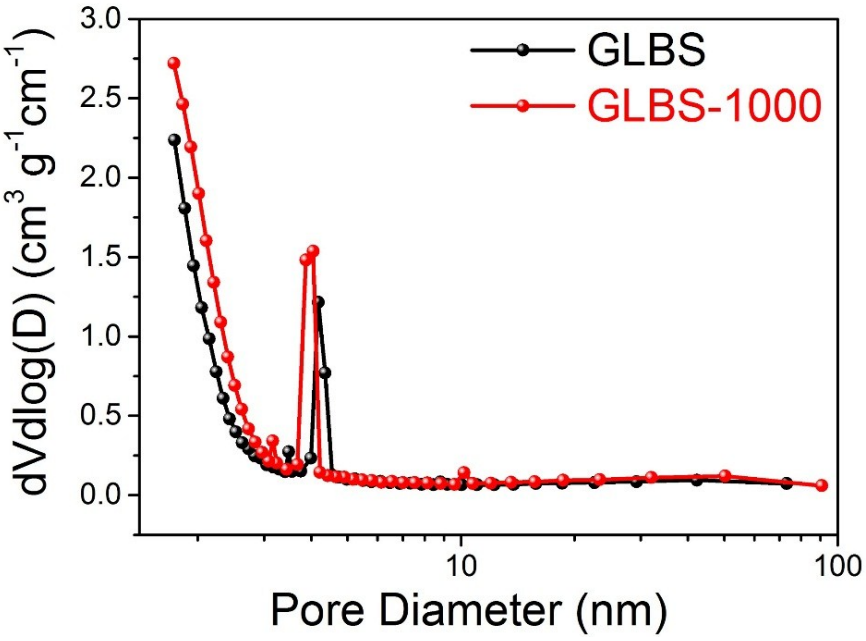

Fig. S3 The pore size distribution of GLBS and GLBS-1000.

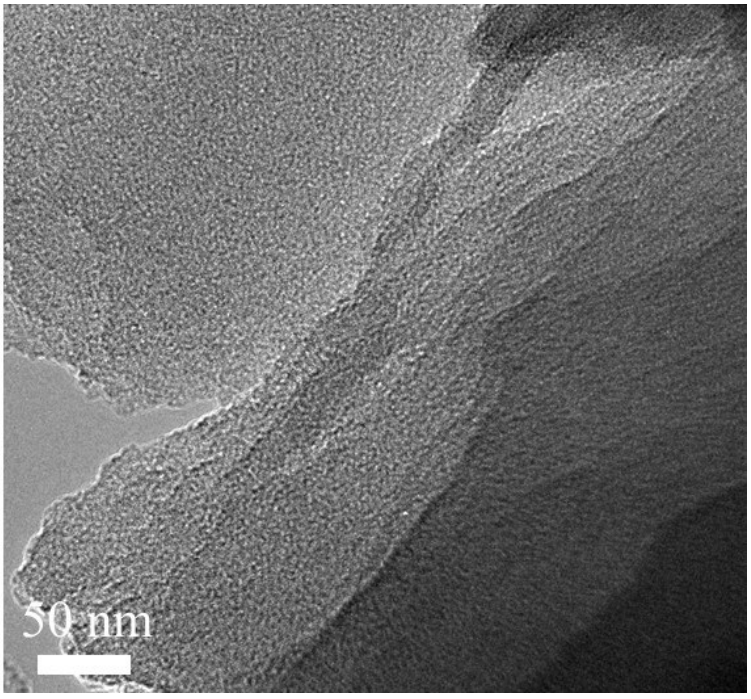

Fig. S4 TEM image of the flake-shaped carbon.

Fig. S5 The optical photo of the residual carbon.

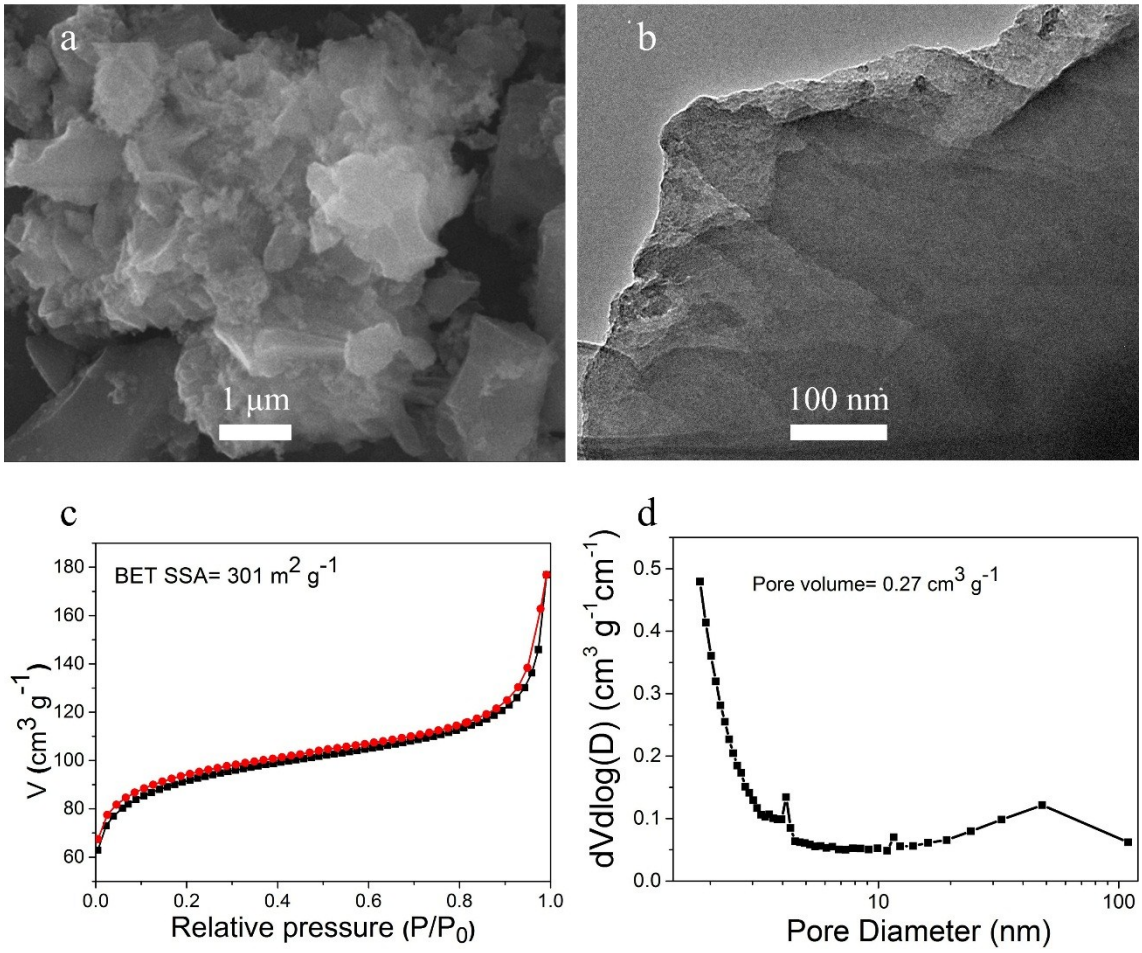

Fig. S6 SEM, TEM, N_2 adsorption-desorption isotherms and pore size distribution of keratin derived carbon (KDC) without KOH activation.

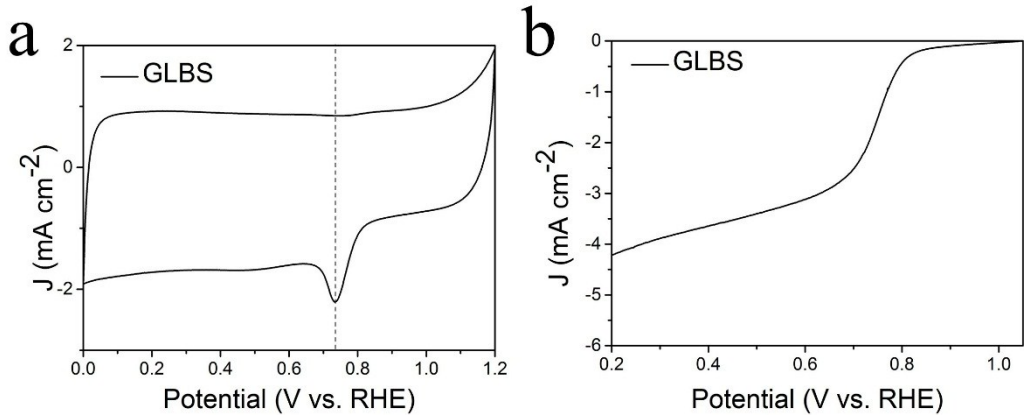

Fig. S7 CV and LSV curve for GLBS catalyst.

The Koutecky-Levich (K-L) equation as given below:

$$\frac{1}{J} = \frac{1}{J_L} + \frac{1}{J_K} = \frac{1}{B\omega^{1/2}} + \frac{1}{J_K} \quad (1)$$

$$B = 0.62\mathrm{n}FC_0(D_0)^{2/3}\upsilon^{-1/6} \quad (2)$$

where J denotes the measured current density, J_K is the kinetic current density, J_L is the diffusion-limited current density, ω is the electrode rotation rate, F is the Faraday constant (96485 C mol^{-1}), C_0 is the bulk concentration of O_2 (1.2×10^{-3} mol L^{-1}), D_0 is the diffusion coefficient of O_2 (1.9×10^{-5} cm^2 s^{-1}) and v is the kinetic viscosity of the electrolyte (1.0×10^{-2} cm^2 s^{-1}).

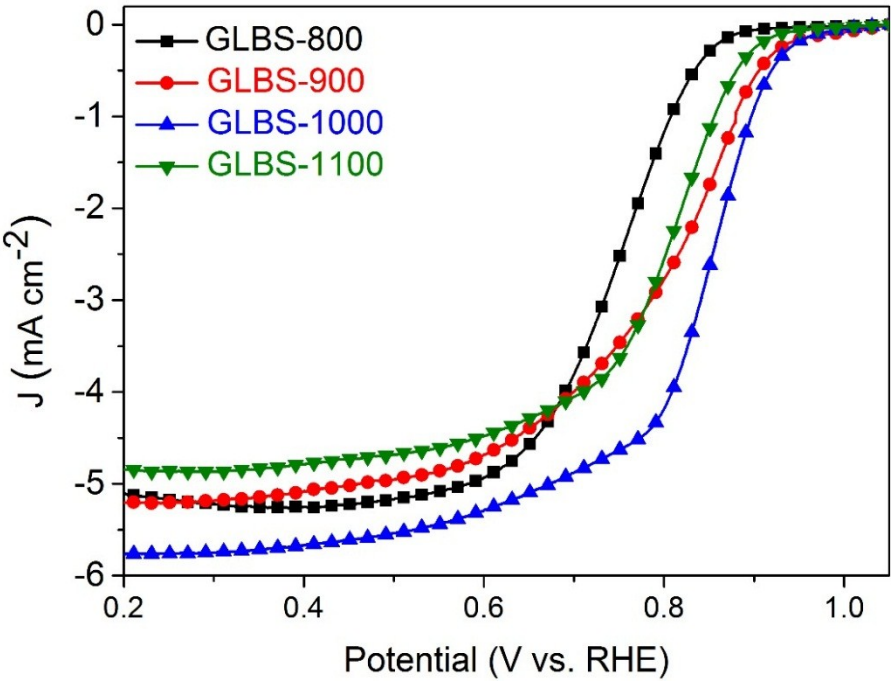

Fig. S8 LSV curves for GLBS-800, GLBS-900, GLBS-1000 and GLBS-1000 catalyst.

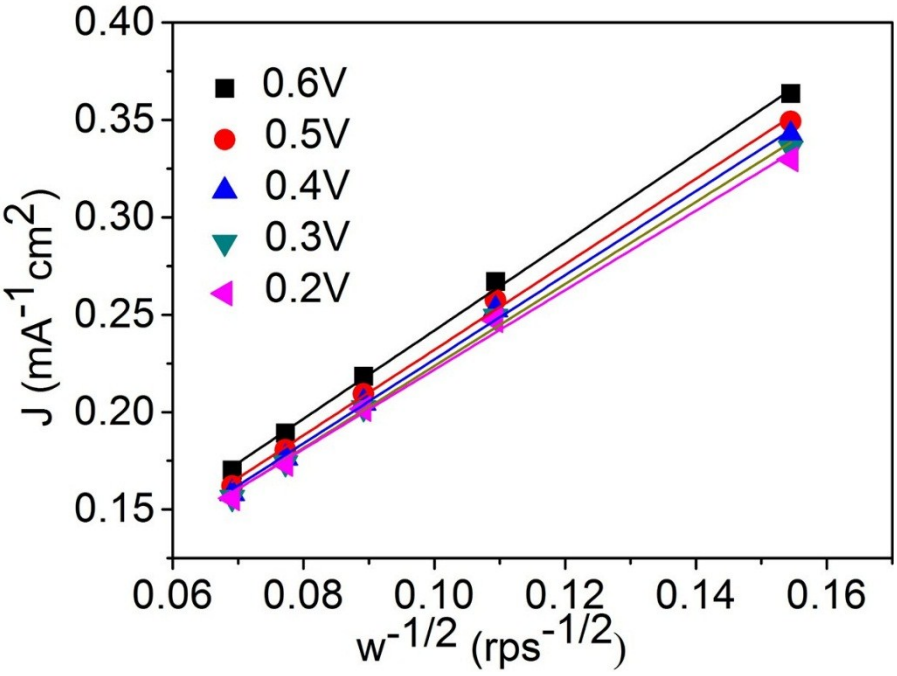

Fig. S9 The K-L plots at the range potential from 0.2 to 0.6 V.

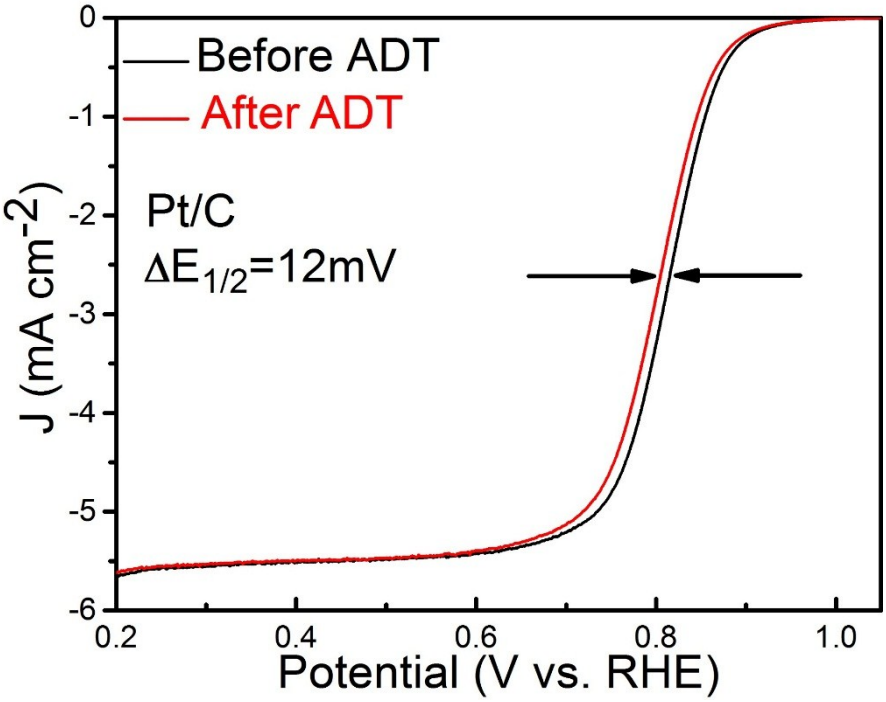

Fig. S10 The stability of Pt/C catalyst before and after accelerated durability test (ADT) of 3,000 cycles from 0.4 to 1.0 V.

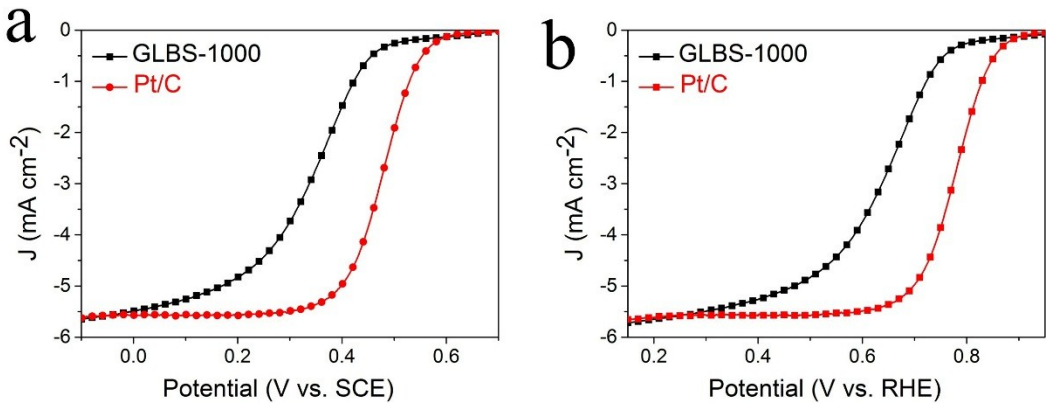

Fig. S11 LSV curves of GLBS-1000 and Pt/C catalysts in acidic media (a); i–t chronoamperometric response of GLBS-1000 and Pt/C catalysts in acidic media under a constant potential at 0.3 V at a rotation rate of 1600 rpm; inset: the ratio of J/J_0 (b).

Table S1 The content of C, N, O, S and the possible metal in GLBS and GLBS-1000.

Sample	Content (%)			
	C	N	O	S
GLBS	75.4	4.9	19.2	0.5
GLBS-1000	95.9	1.5	2.5	0.1

Table S2 Comparison of the Tafel slopes between GLBS-1000 and other reported carbon based catalysts under 0.1 M KOH conditions in literature.

Reference	Tafel slope (mV per decade)	Catalyst name
This work	68	GLBS-1000
1	72	N-PANn-1000
2	69	(GO 8 wt%) Cu.MOF
3	69	Fe/N-gCB
4	75	Co SAs/N-C(900)
5	103	WHC-700
6	85	BP350@C-1000
7	67	Fe3C/NG-800
8	105	Fe/C-SOYB
9	84	BP1000

Reference

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