Supporting information

Three-dimensional mesoporous graphene-like carbons derived from biomolecule exhibiting high-performance oxygen reduction activity

Baobing Huang, Yuchuan Liu, Zailai Xie*

State Key Laboratory of Photocatalysis on Energy and Environment, College of Chemistry, Fuzhou University, 2 Xueyuan Road, Fuzhou 350016

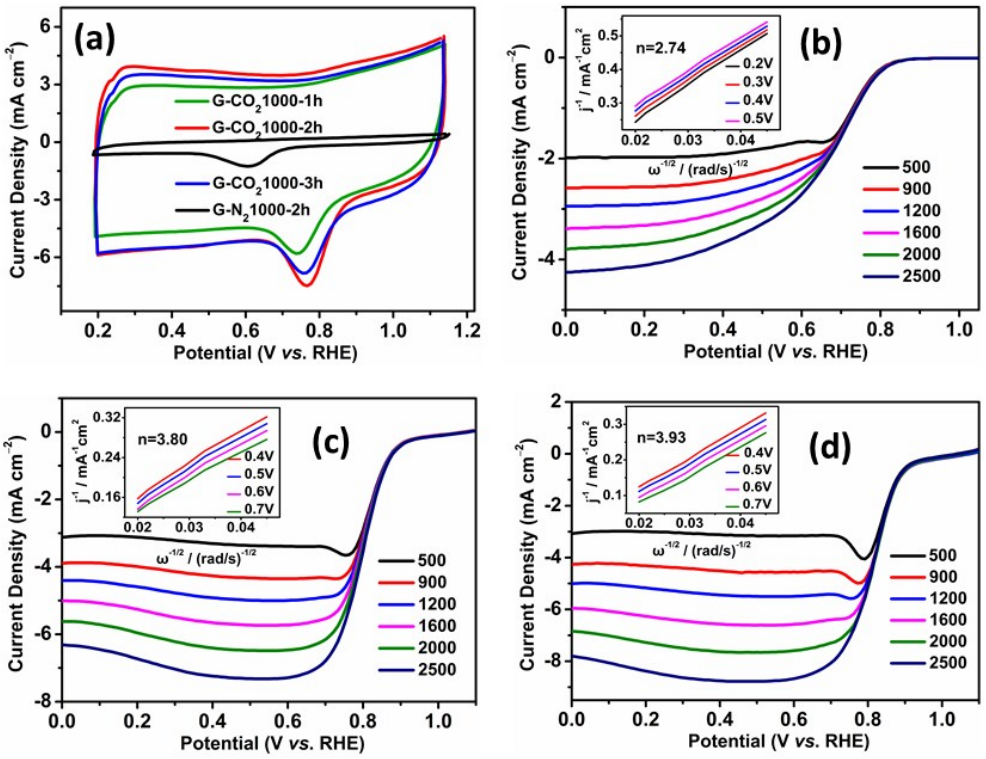

Figure S1. (a) CV curves of different samples in O_2-saturated 0.1 M KOH with 50 mV s^{-1}. LSV curves at different rotating speeds in O_2-saturated 0.1 M KOH: (b) G-$N_2$1000-2h, (c) G-$CO_2$1000-1h, (d) G-$CO_2$1000-3h.

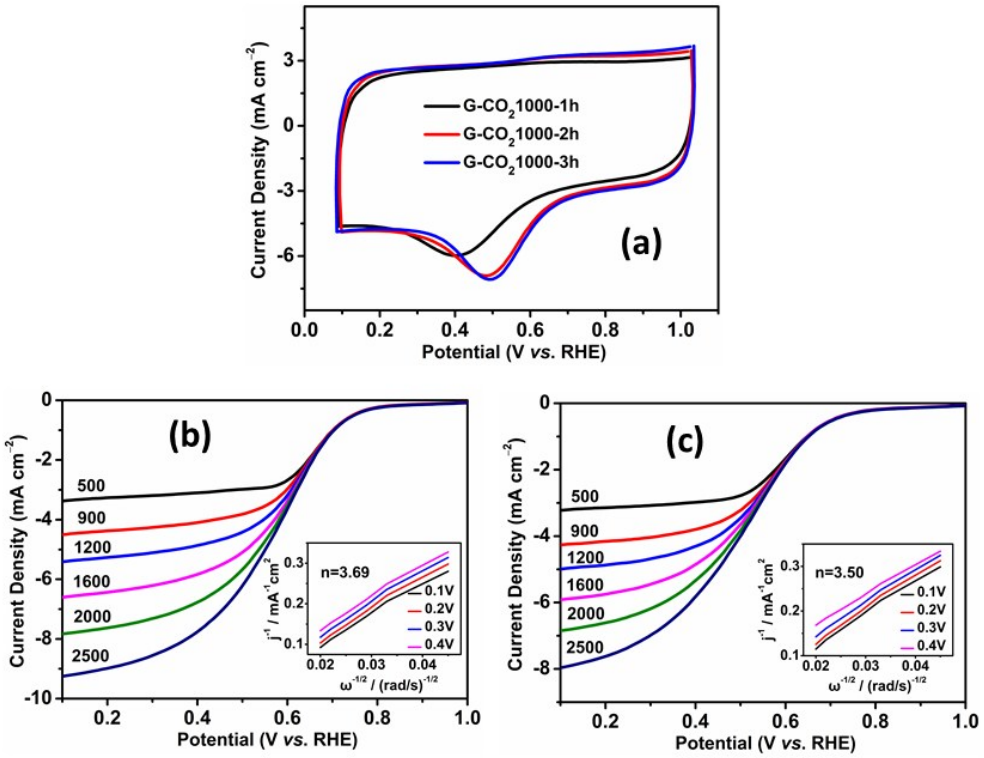

Figure S2. (a) CV curves of different samples in O_2-saturated 0.1 M $HClO_4$ with 50 mV s^{-1}. LSV curves at different rotating speeds in O_2-saturated 0.1 M $HClO_4$: (b) G-$CO_2$1000-2h, (C) G-$CO_2$1000-1h.

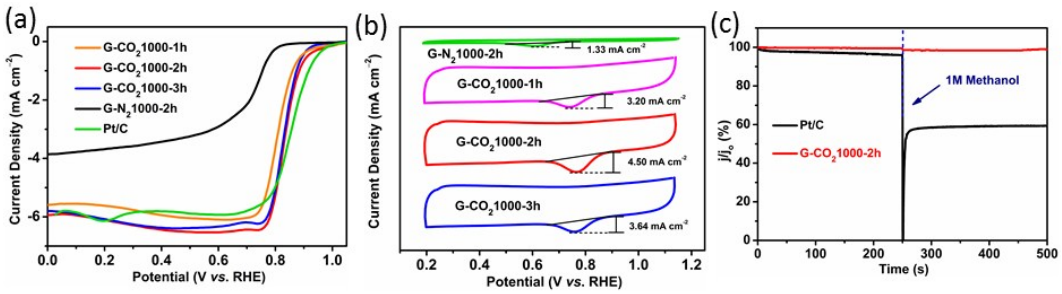

Figure S3. (a) LSV curves, (b) CV curves and (c) The anti-methanol ability testing under different loadings in 0.1 M KOH solution.

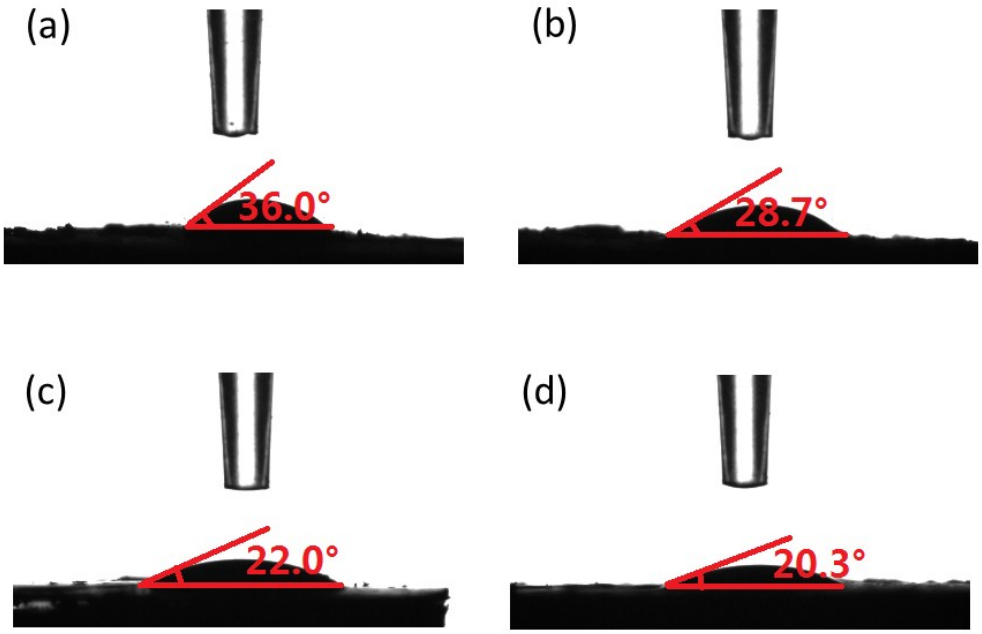

Figure S4. Contact angle measurement of (a) G-$N_2$1000-2h, (b) G-$CO_2$1000-1h, (c) G-$CO_2$1000-2h and (d) G-$CO_2$1000-3h.

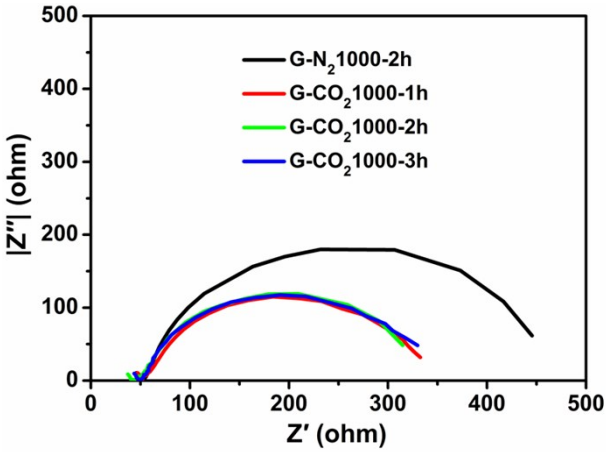

Figure S5. Nyquist plots of serial samples.

Analysis: The conductivity/resistivity and hydrophilicity of the materials are additionally crucial for enhanced electrochemical activity. The surface hydrophobicity/hydrophilicity of the materials can be expressed by the water contact angle, as smaller contact angle means better wettability. The electrochemical impedance spectrum (EIS) of the serial materials was also studied. It can be observed that the contact angle was gradually decreasing (i.e. increasing hydrophilicity) with

prolonging the annealing time, which was likely related to increasing amounts of oxygen functional groups (Figure S4). Additionally, the EIS spectra revealed that the CO_2 activated serial samples all showed lower interfacial charge transfer resistances (i.e. smaller semicircle diameters) than that of G-$N_2$1000-2h (without CO_2 activation, Figure S5), which was possibly related to porous difference, hydrophilicity, etc. These distinct parameters combined with heteroatoms likely synergistically facilitated ORR performance.

Table S1. ORR performances of the prepared samples in 0.1 M KOH electrolyte.

Catalysts	E_{onset} (V *vs.* RHE)	$E_{1/2}$ (V *vs.* RHE)	$\|j_L\|$ (mA cm^{-2})
G-$N_2$1000-2h	0.87	0.693	3.36
G-$CO_2$1000-1h	0.95	0.819	5.06
G-$CO_2$1000-2h	0.98	0.841	6.03
G-$CO_2$1000-3h	0.98	0.838	6.05
Pt/C	1.03	0.855	5.90

j_L is determined at 0.1 V (*vs.* RHE).