Sulfur-doped porous reduced graphene oxide hollow nanospheres framework as metal-free electrocatalysts for oxygen reduction reaction and supercapacitor electrode materials

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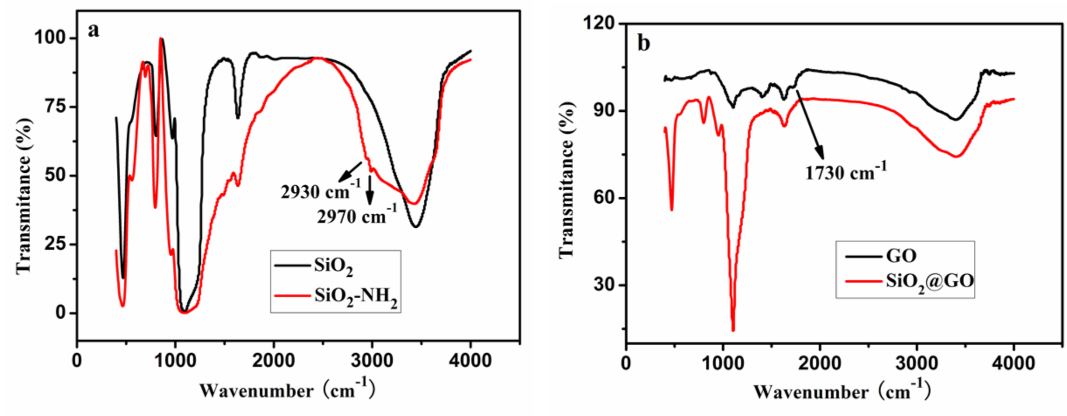

Fig. S1 FT-IR spectra of SiO_2 and SiO_2-NH_2 (a), GO and SiO_2@GO (b).

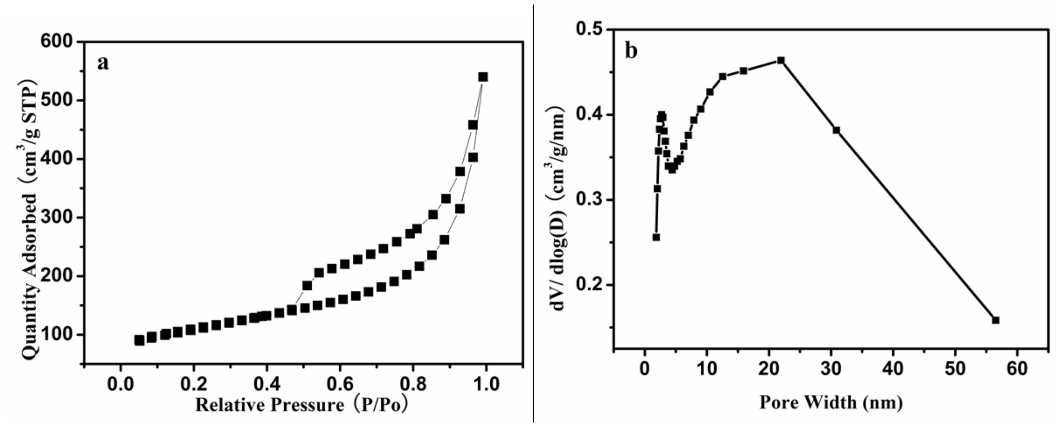

Fig. S2 (a) N_2 sorption isotherm; (b) pore size distribution of S-PGHS-900 sample.

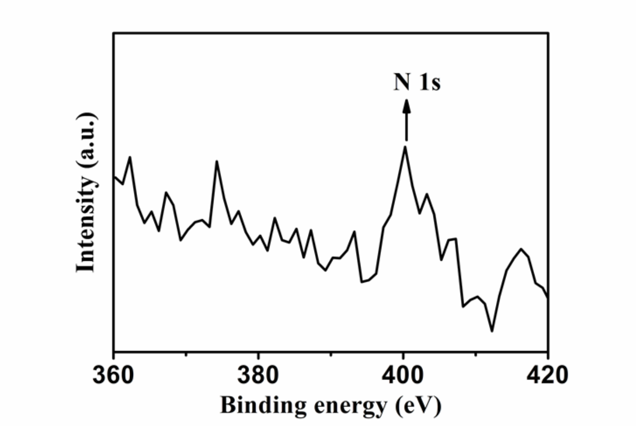

Fig. S3 XPS N1s spectrum of S-PGHS-900

Table S1 Elemental analysis of the S-PGHS-900

elements	C	H	S	N
content	80.65	2.082	3.028	0.14

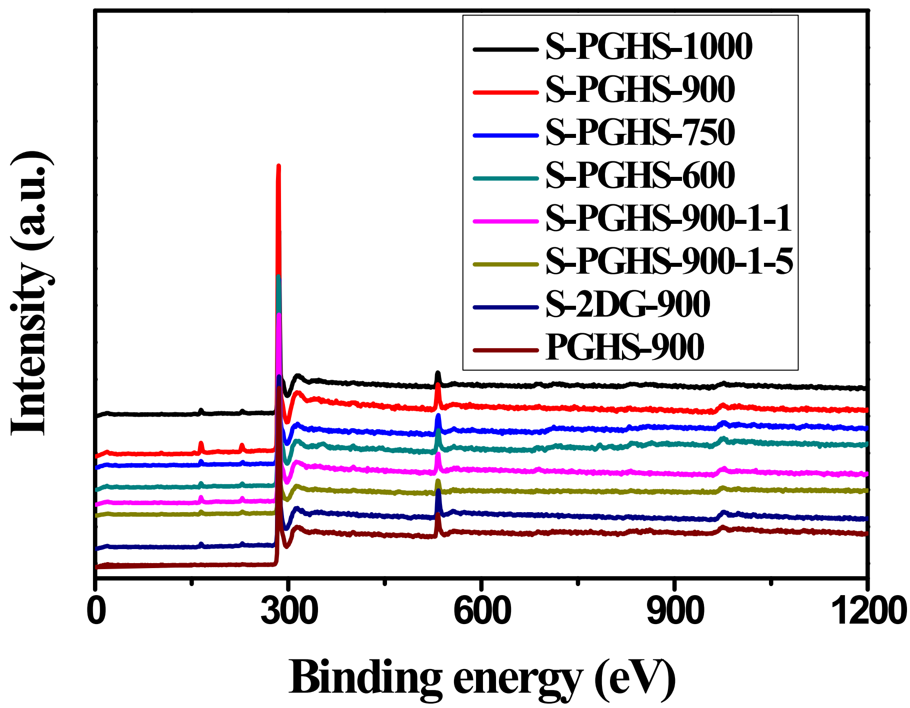

Fig. S4 XPS spectra of the different samples.

Table S2 The corresponding S content calculated from the XPS spectra of the different samples (Fig. S4).

Samples	S-PGHS-1000	S-PGHS-900	S-PGHS-750	S-PGHS-600	S-PGHS-900-1-1	S-PGHS-900-5-1	S-2DG-900	PGHS-900
S content wt%	1.19	1.99	1.01	0.78	1.23	1.14	1.1	0

Table S3 ICP analysis on the S-PGHS-900

Elements	Fe	Mn
Content (mass fraction)	0.043%	0.0097%

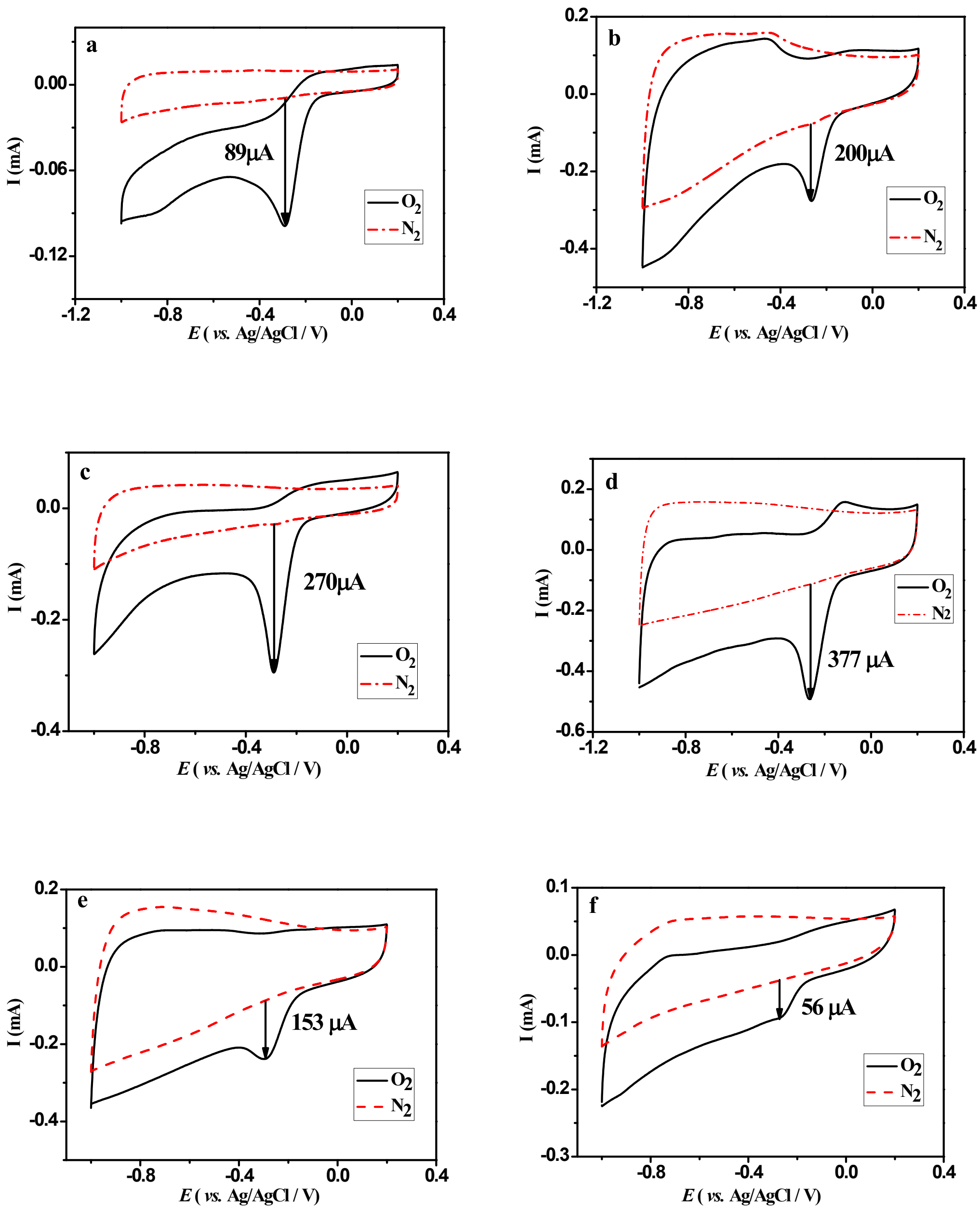

Fig. S5 CVs for the ORR of S-2DG-900 (a), S-PGHS-1-1-900 (b), S-PGHS-5-1-900 (c), S-PGHS-1000 (d), S-PGHS-750 (e) and S-PGHS-600 (f).

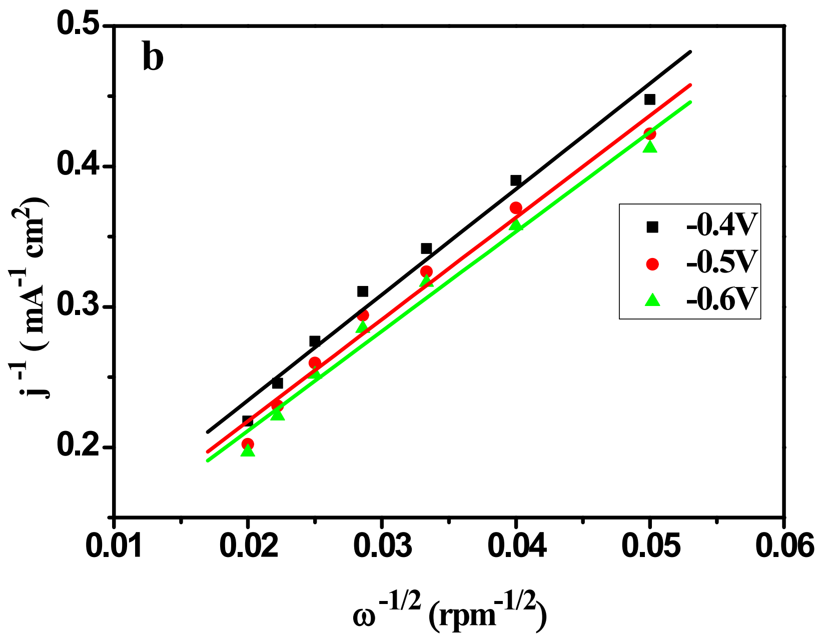

Fig. S6 Koutecky–Levich plot of J^{-1} *vs* $\omega^{-1/2}$ at different electrode potentials. The experimental data were obtained from (Fig. 6 a); the lines are linear regressions.

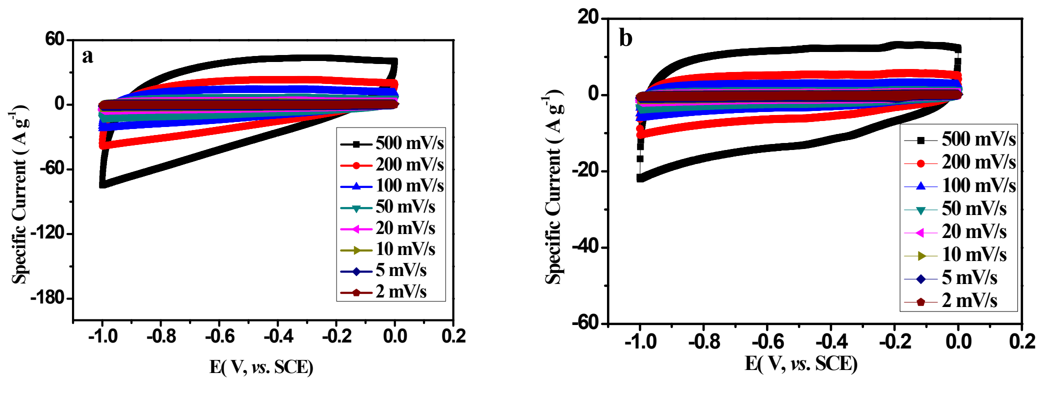

Fig. S7 CV curves of PGHS-900 (a) and S-2DG-900 (b) at different scan rates.

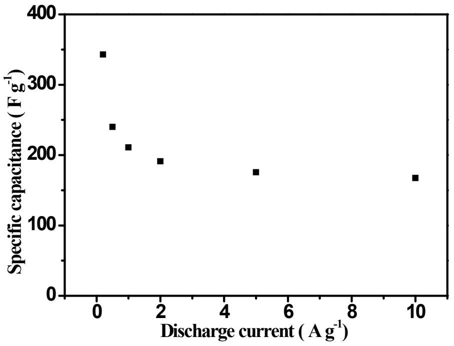

Fig. S8 Specific capacitance calculated from the corresponding discharge curves of S-PGHS-900 (Fig. 8e) for each current density.