Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Effect of N, S doping on graphene oxide aerogel for adsorption and photocatalytic reduction of carbon dioxide

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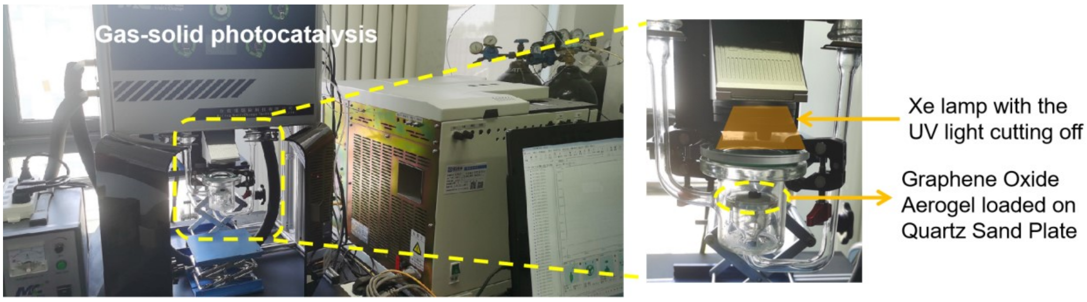

Fig.S1. Experimental setup of gas-solid CO_2 photocatalytic reduction.

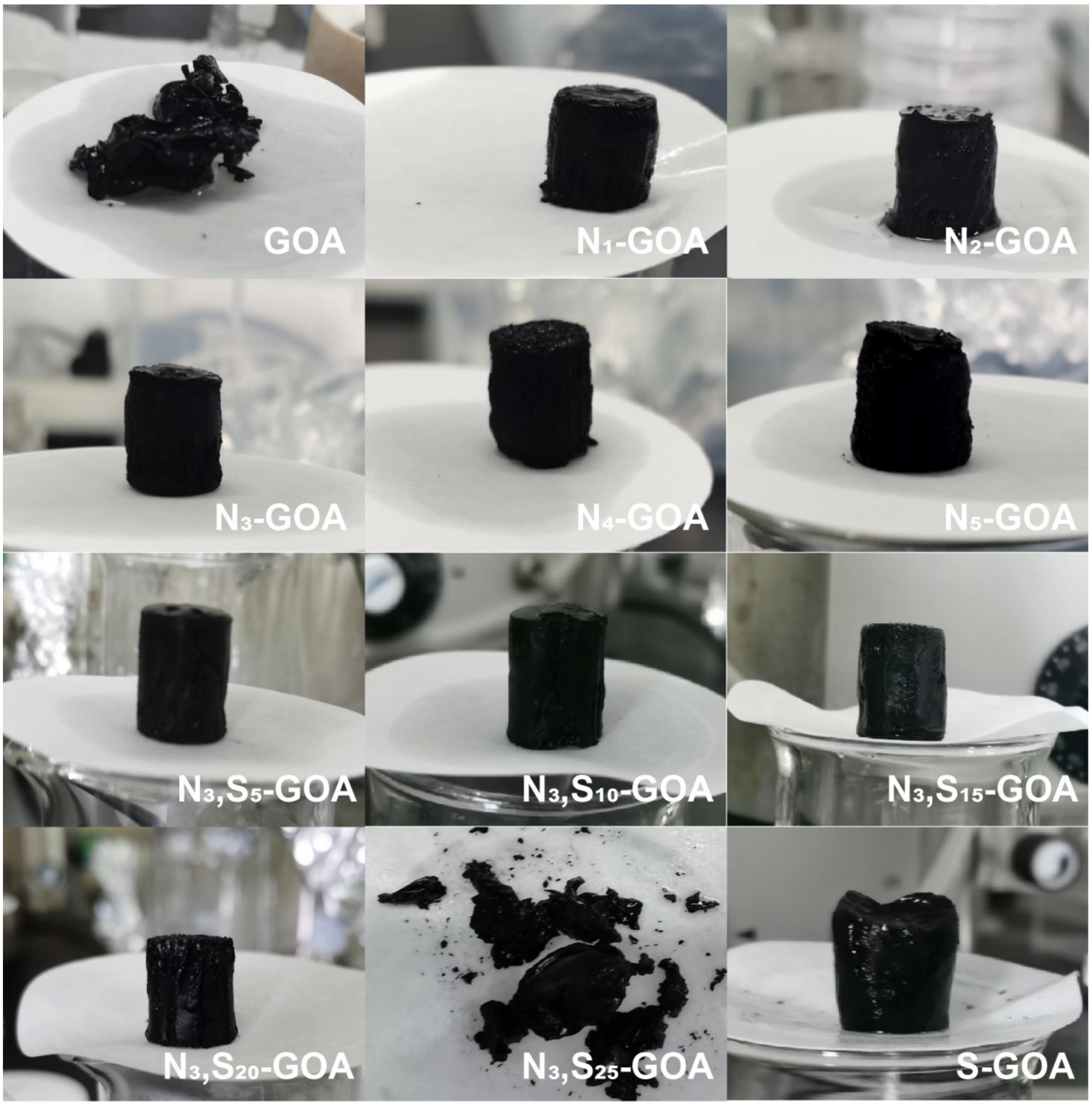

Fig.S2. The appearance of GOA obtained by different doping.

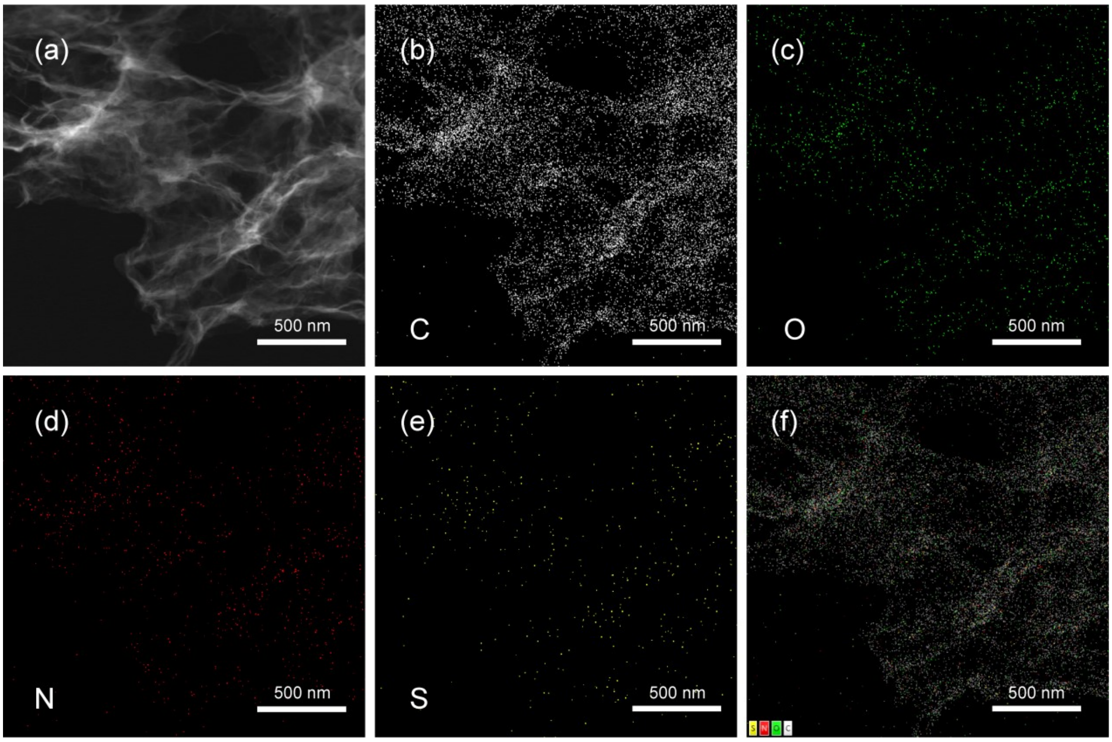

Fig. S3 The TEM image (a) of N,S-GOA with its corresponding EDS elemental mappings of carbon (b), oxygen (c), nitrogen (d) and sulfur (e).

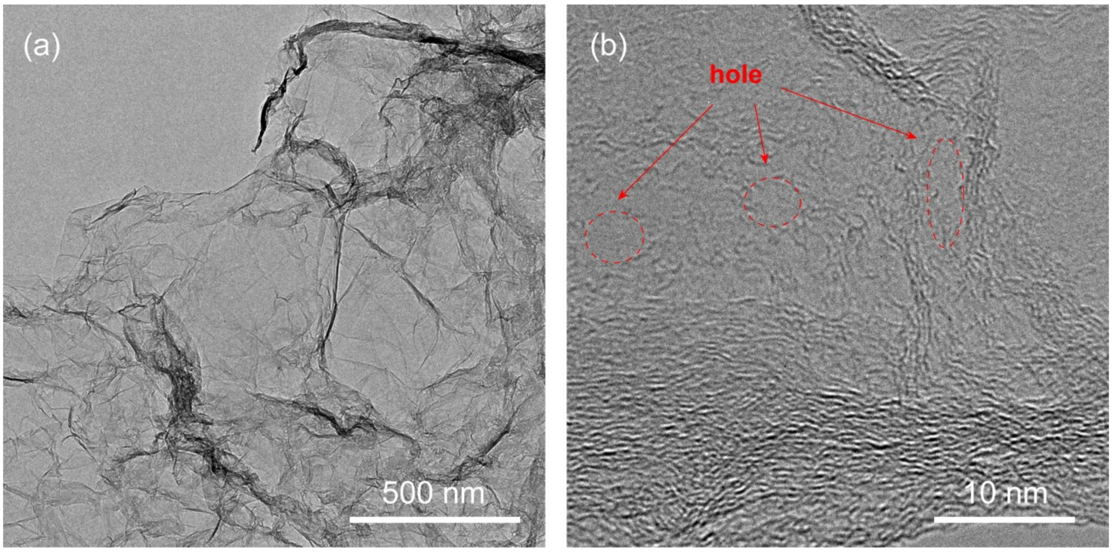

Fig. S4 Low-magnification (a) and high-resolution (b) TEM images of N,S-GOA.

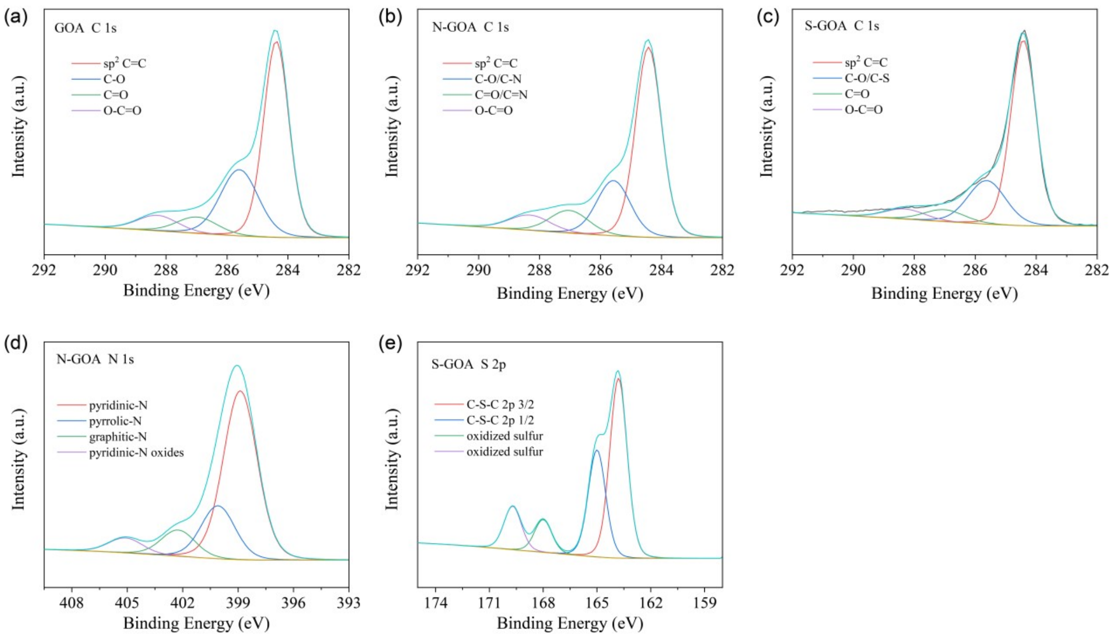

Fig. S5. XPS C 1s spectra of (a) GOA, (b) N-GOA, and (c) S-GOA. (d) XPS N 1s spectra of N-GOA. (e) XPS S 2p spectra of S-GOA.

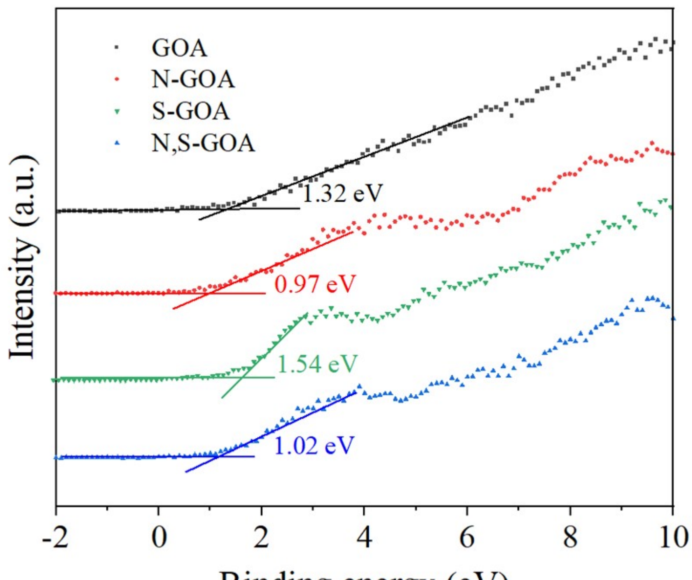

Fig. S6. XPS valence band potentials of GOA, N-GOA, S-GOA, and N,S-GOA.

After eliminating the measurement error by the formula (1) with the work function (Φ) of XPS analyzer and vacuum level to be 4.39 and 4.44 eV (vs. NHE),[1] the calculated valence band (VB) positions (vs. NHE) of GOA, N-GOA, S-GOA, and N,S-GOA are 1.27, 0.92, 1.49, and 0.97 eV, respectively.

$$VB\ (vs. NHE) = \phi + VB_{XPS} - 4.44\ eV \quad (1)$$

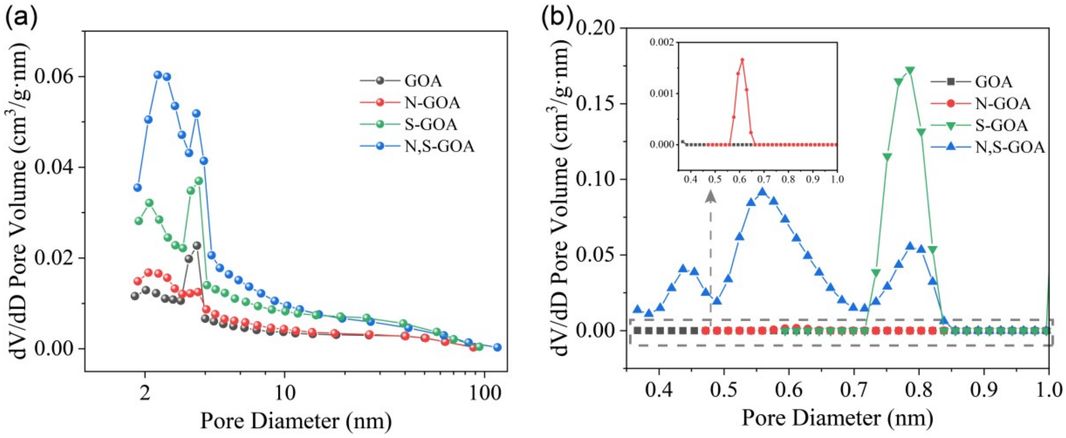

Fig. S7. (a) Pore volume distribution of GOA, N-GOA, S-GOA, and N,S-GOA by (a) N_2 adsorption-desorption test and (b) CO_2 adsorption-desorption test (inset is an enlarged view of the GOA and N-GOA curves).

Table S1. Contents of major elements of samples based on XPS analyses.

Sample	C（at.%)	O (at.%)	O/C ratio (%)	N (at.%)	S (at.%)
GOA	87.21	12.43	14.25	0.36	/
N-GOA	84.56	9.28	10.97	6.16	/
S-GOA	88.26	9.25	10.48	0.25	2.24
N,S-GOA	85.01	7.66	9.01	5.97	1.36

Table S2. Assigned C 1s, N 1s, and S 2p peaks of samples based on XPS analyses.

	GOA	N-GOA	S-GOA	N,S-GOA
C=C (284.4 eV)	56.68	59.32	63.33	62.23
sp^2 carbon bonded with heteroatoms (285.6 eV)	28.69	22.44	22.82	24.27
C=O/C=N (287.0 eV)	7.57	10.61	7.17	8.06
O-C=O (288.3 eV)	7.16	7.63	6.68	5.44
pyridinic-N (398.1-399.3 eV)	/	64.18	/	48.22
pyrrolic-N (399.8-401.2 eV)	/	20.15	/	35.04
graphitic-N (401.1-402.7 eV)	/	9.97	/	12.06
pyridinic-N oxides (402-406 eV)	/	5.70	/	4.68
Thiophenic(C-S-C) (163.8-165.2 eV)	/	/	72.05	79.04
Oxidized sulfur (167.4-170.0 eV)	/	/	27.95	20.96

Table S3. Surface area and CO_2 uptake capacity for the samples.

Sample	S_{BET} [a] (m^2/g)	S_L [b] (m^2/g)	PV [c] (cm^3/g)	Quantity Adsorbed CO_2 [d] (cm^3/g STP)
GOA	79	189	0.246	1.04
N-GOA	88	210	0.256	2.72
S-GOA	172	402	0.507	56.55
N,S-GOA	257	575	0.568	20.62

[a]Surface area calculated from N_2 adsorption isotherms at 77.5 K using BET equation. [b]Surface area calculated from N_2 adsorption isotherms at 77.5 K using Langmuir equation. [c]Pore volume calculated from nitrogen isotherm at p/p_0=0.986, 77.5 K. [d]Quantity Adsorbed CO_2 determined volumetrically using a Micromeritics TriStar II Plus analyzer at 1.00 bar and 273.15 K.

Table S4. Comparison of CO_2 capture capacity on various nanoamaterials.

Nanoamaterials	Exp. Cond.	Capacity (mmol/g)	Ref.
S-GOA	273.15 K, 1 bar	2.52	This work
MgO/GO	60 ℃, 1 bar	2.79	2
Mo/g-C_3N_4	273.15 K, 1 bar	0.07	3
N,O-codoped microporous carbon	25 ℃, 1 atm	3.05	4
Triethylamine/rice husk silica	600 ℃, 1 atm	0.75	5
70T-MM-550	75 ℃, 1 atm	3.43	6
HPSA	25 ℃, 1 bar	2.07	7
$Zn_2(TRZ)_2$(Fuma)	298 K, 101 kPa	2.78	8

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