Supplementary material

Facile synthesis of a zeolitic imidazolate framework-8 with reduce graphene oxide hybrid material as an efficient electrocatalyst for nonenzymatic H_2O_2 sensing

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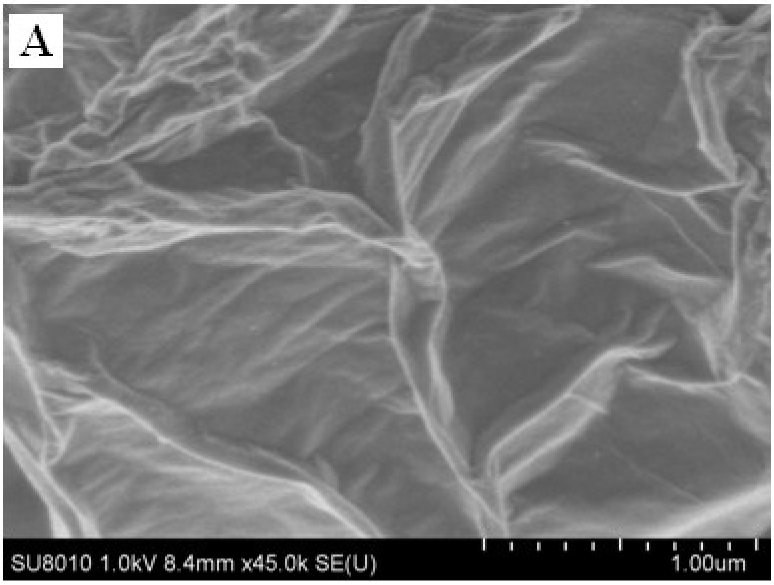
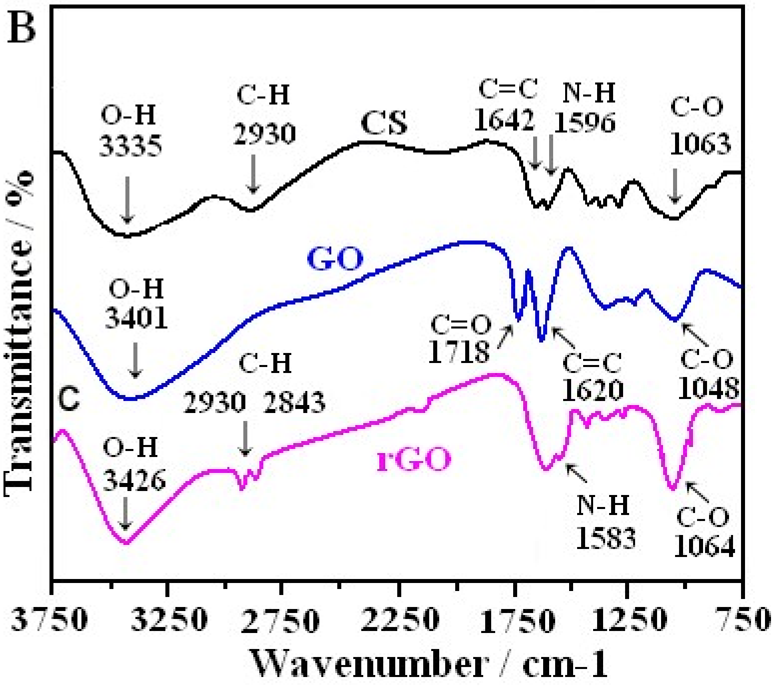

A
SU8010 1.0kV 8.4mm x45.0k SE(U)
1.00um


B
CS
O-H
3335
C-H
2930
C=C
1642
N-H
1596
C-O
1063
GO
O-H
3401
C=O
1718
C=C
1620
C-O
1048
C
rGO
O-H
3426
C-H
2930 2843
N-H
1583
C-O
1064
Transmittance / %
3750
3250
2750
2250
1750
1250
750
Wavenumber / cm-1

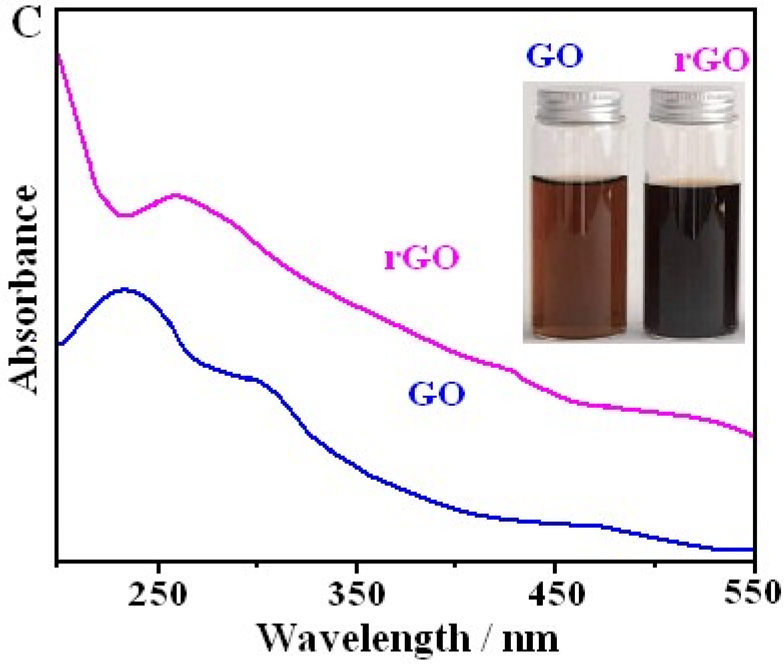
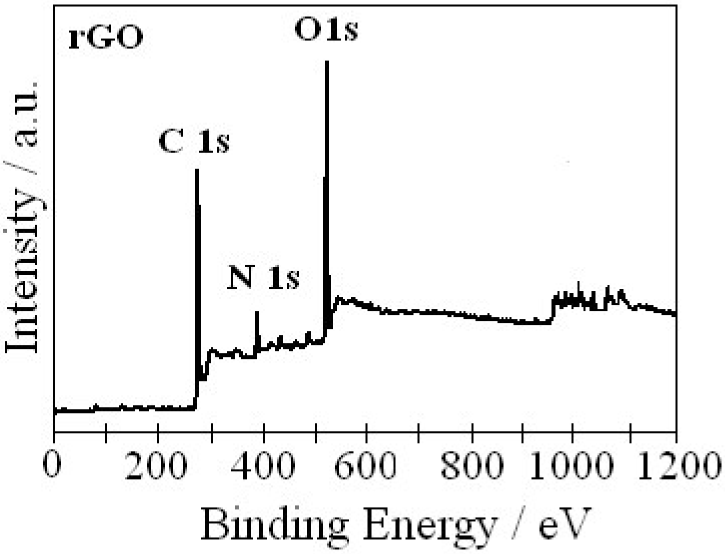


Fig. S1. (A) SFM image of rGO; (B) FT-IR spectra of CS, GO and rGO; **(**C**)** UV-vis spectra of GO and rGO. Insets are the color change of GO suspension (yellow) and rGO suspension (black) after reduction.



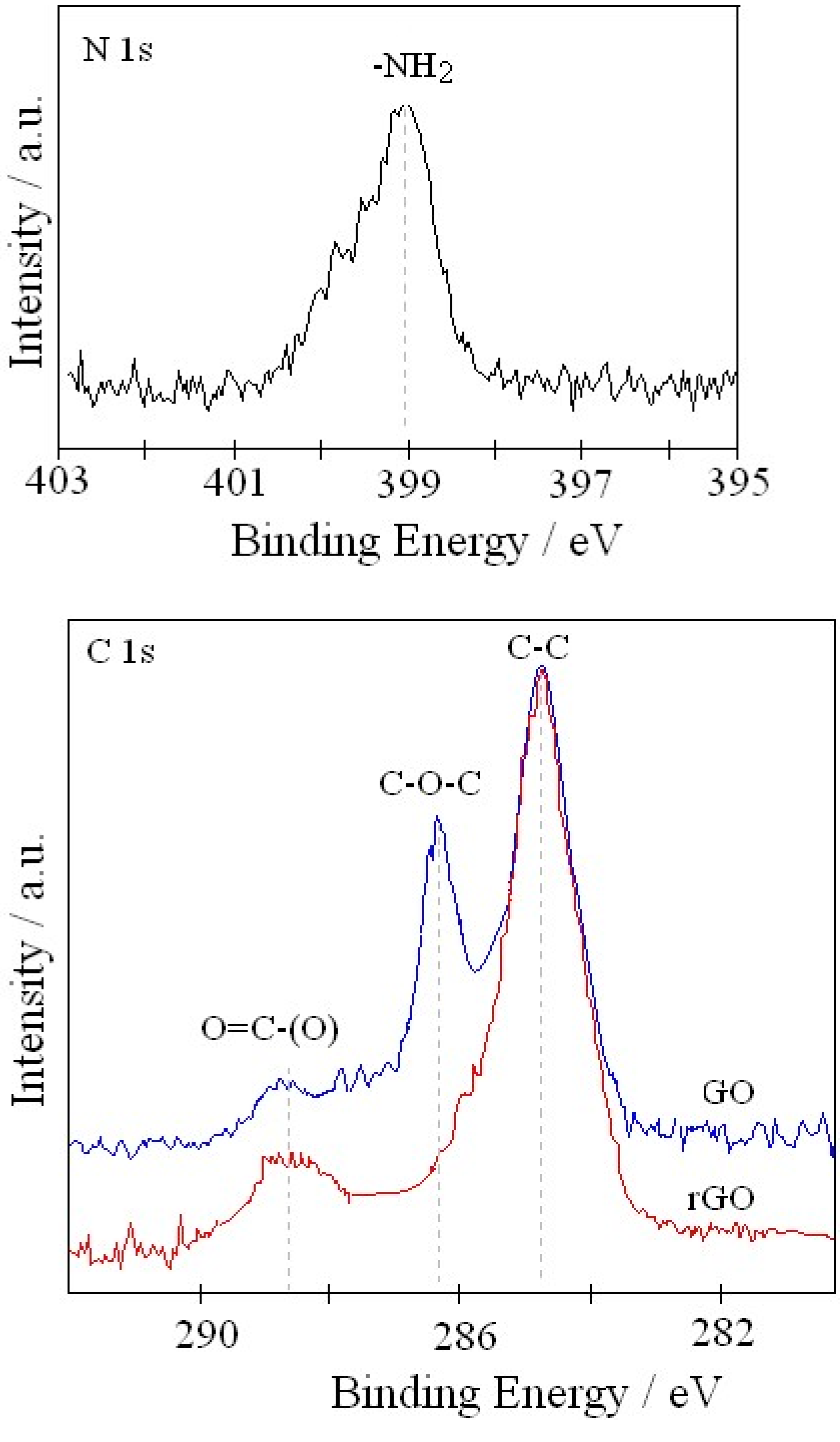
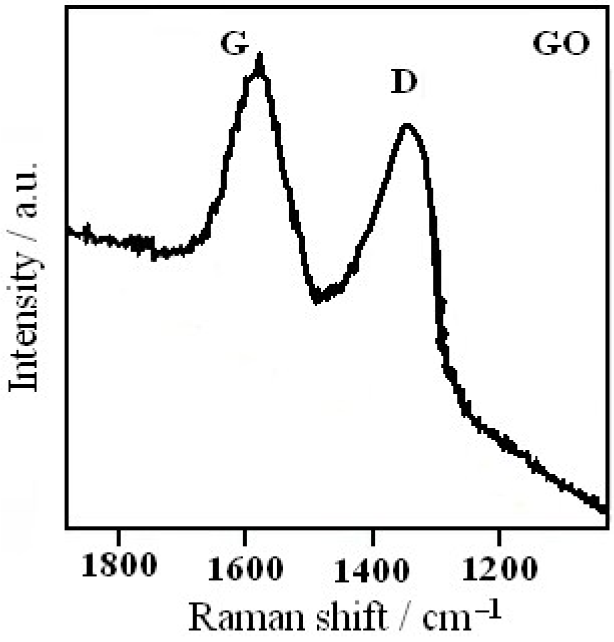
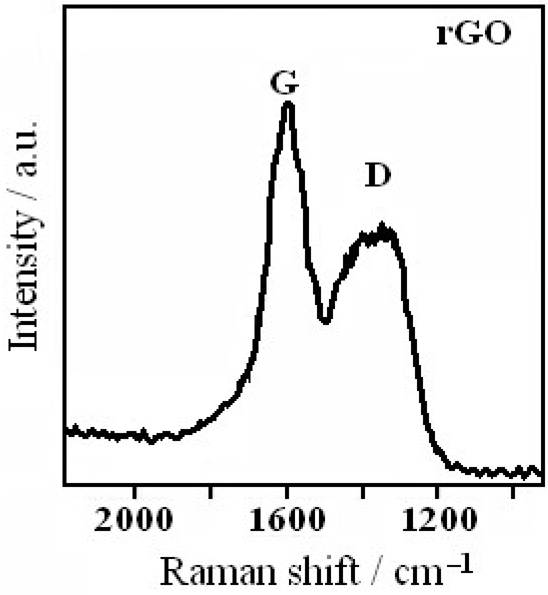


Fig. S2. XPS survey scan, N 1s spectrum, C 1s spectrum rGO.


G
GO
D
Intensity / a.u.
1800
1600
1400
1200
Raman shift / cm^{-1}


rGO
G
D
Intensity / a.u.
2000
1600
1200
Raman shift / cm^{-1}

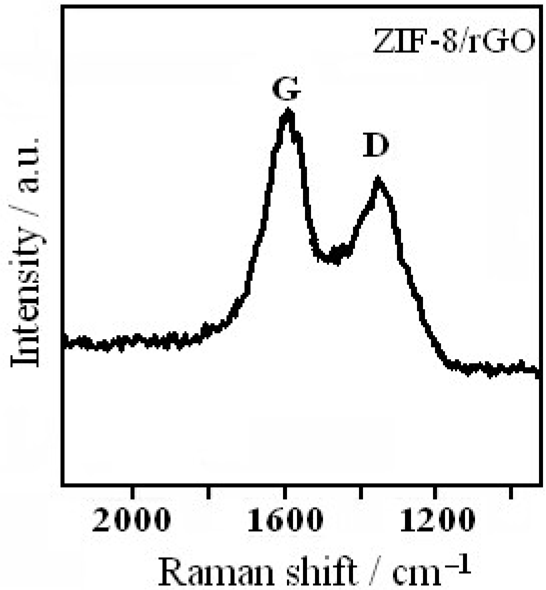


Fig. S3. Raman spectra of GO, rGO and ZIF-8/rGO.

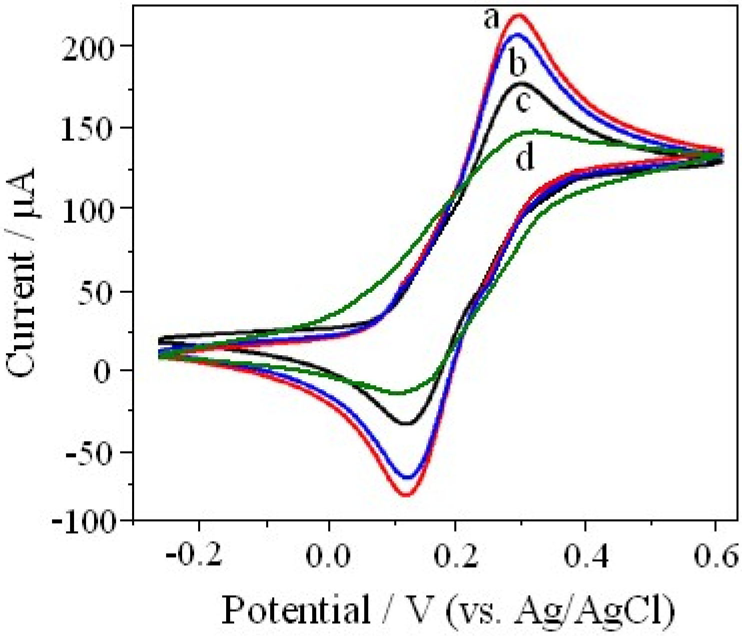


Fig. S4. CVs obtained for the ZIF-8/rGO/CPE (a), rGO/CPE (b), CPE (c) and ZIF-8/CPE (d) in 5.0 mM $[Fe(CN)_6]^{3-}$/ $[Fe(CN)_6]^{4-}$ and 0.1 M KCl solutions. The scan rate was 100 mV/s.

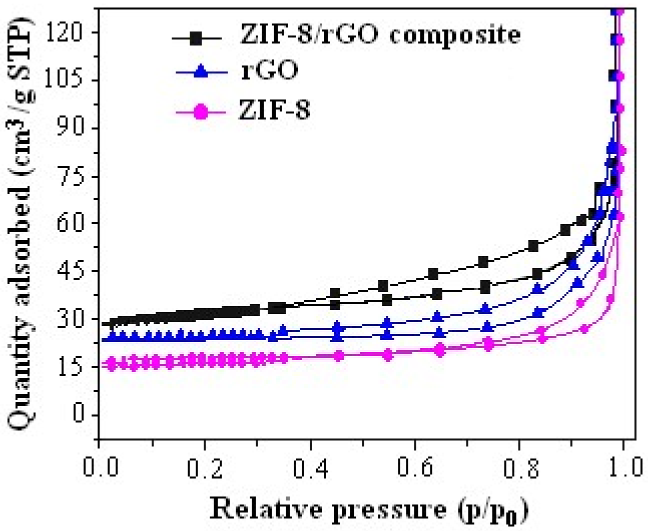


Fig. S 5. N_2 adsorption–desorption isotherms for ZIF-8, rGO and ZIF-8/rGO composite.

Apparatus. The surface morphology were characterized with a field emission scanning electron microscopy (FE-SEM, JEOL 7401 F). UV-vis absorption spectra were recorded on a Lambda 35 UV-vis Spectrophotometer. Fourier transform-infrared (FT-IR) spectra were carried out on a Thermo Scientific Nicolet iS50 FTIR spectrometer (Thermo Fisher Scientific, USA).

Characterization

Typical SEM images of rGO was presented in Figure S1A. rGO showed wrinkled-shaped thin nanosheets, which was consistent with the previously reported GO. The result also demonstrated that the CS functionalized rGO had excellent dispersion.

FT-IR spectra (Figure S1B) were carried out to prove that GO was reduced by CS into rGO. The CS have peaks at 2930 cm^{-1} ($\nu_{C\text{–}H}$), 1642 cm^{-1} ($\nu_{C=C}$) and 1063 cm^{-1} ($\nu_{C\text{–}O}$) from the carbon skeleton of CS. The peaks at 3335 cm^{-1} and 1596 cm^{-1} were attributed to the –OH and –NH_2 groups on macromolecular chains of CS, and the groups can form electrostatic interactions with the GO and reduce it under high temperature. At FT-IR spectrum of rGO, the stretching vibrations in carboxylic acid at 1718 cm^{-1} ($\nu_{C=O}$) disappeared and N-H bending vibration due to amide II band at 1583cm-1 obtained, which showed that GO was successfully reduced by CS and realized functionalized rGO.

UV-vis spectra were monitored to further verify the synthesis process (Figure S1C). GO expressed two strong absorption peaks at 232 nm and 305 nm, corresponding to $\pi \rightarrow \pi^*$ transitions of C=C band and $n \rightarrow \pi^*$ transitions of C=O band, respectively. After GO was reduced by CS, π-π^* of C=C red shifted at 264 nm and the absorption peak at 300 nm for n-π^* of C=O disappeared. All the results confirmed that CS functionalized rGO was obtained. Inset of Figure S1C exhibited the color change of GO suspension from yellow to black after the reduction. It is noteworthy that the dispersion of CS functionalized rGO is very stable.

To further certify the chemical structure of CS-functionalized rGO, XPS survey scan, C1s and N1s peaks of XPS spectra are shown in Fig. S2. For the CS-functionalized rGO, it is found that the $-NH_2$ peak at ~ 399 eV is clearly detected. The result deeply proves the chemical reaction occurrence during the chemical functionalized process. In the C1s XPS spectra for CS-Functionalized rGO (red line) and GO (blue line), the pronounced decrease in the C 1s signal at ~ 286.3 eV, which is assigned to epoxide groups, is a manifestation of the loss of epoxides through functionalized reaction with CS. This interpretation is supported by the appearance of the N 1s signal at ~399 eV, which is assigned to primary amines ($-NH_2$) bonded to the surface of rGO [1].

References

[1] H. Tetsuka, R. Asahi, A. Nagoya, K. Okamoto, I. Tajima, R. Ohta, A. Okamoto, *Adv. Mater.,* 2012, 24, 5333–5338.