Supplementary Information

A low-cost assay for hydrogen peroxide using sewage sludge-based carbon nanodots

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Chemicals and instrumentations

Sewage sludge (water content is 76.87%, volatile suspended solid is 10372±318 mg/L, total suspended solids is 18614±437 mg/L) was obtained from Haitian Water Group Co., Ltd (Zigong, China). ABTS was purchased from Sangon Biotech Co., Ltd. (Shanghai, China). H_2O_2, cupric sulfate ($CuSO_4$), cobalt nitrate hexahydrate ($Co(NO_3)_2 \cdot 6H_2O$), aluminum chloride ($AlCl_3$), magnesium sulfate ($MgSO_4$), lanthanum trinitrate hexahydrate ($Fe(NO_3)_2 \cdot 6H_2O$), barium chloride ($BaCl_2$), nickel chloride ($NiCl_2$), zinc chloride ($ZnCl_2$), ferric nitrate nonahydrate ($Fe(NO_3)_2 \cdot 9H_2O$), and sodium hypochlorite (NaClO) were obtained from Kelong Chemical Co., Ltd. (Chengdu, China). Silver nitrate ($AgNO_3$), sodium bicarbonate ($NaHCO_3$), sodium chloride (NaCl), potassium chloride (KCl), calcium chloride ($CaCl_2$), and sodium sulphate (Na_2SO_4) were obtained from Jinshan Chemical Reagent Co., Ltd. (Chengdu, China). Boric acid (H_3BO_3), phosphoric acid (H_3PO_4), acetic acid, perchloric acid ($HClO_4$), and sodium hydroxide (NaOH) were obtained from Sinopharm Chemical Reagent (Shanghai, China).

Fourier Transform infrared (FT-IR) spectrum of ss-CNDs was recorded with a TENSOR FT-IR spectrum analyzer. Transmission electron microscopy (TEM) images were acquired by FEI Tecnai F20. Ultraviolet-visible (UV-vis) absorption spectra were measured by a spectrophotometer (Hach DR6000). Electron paramagnetic resonance spectrum (EPR) were recorded using a Bruker EMXplus-6/1 electron paramagnetic resonance spectrometer. X-ray photoelectron spectroscopy (XPS) spectra were recorded using a K-Alpha X-ray photoelectron spectrometer. The binding energies were calibrated with respect to the residual C (1s) peak at 284.6 eV.

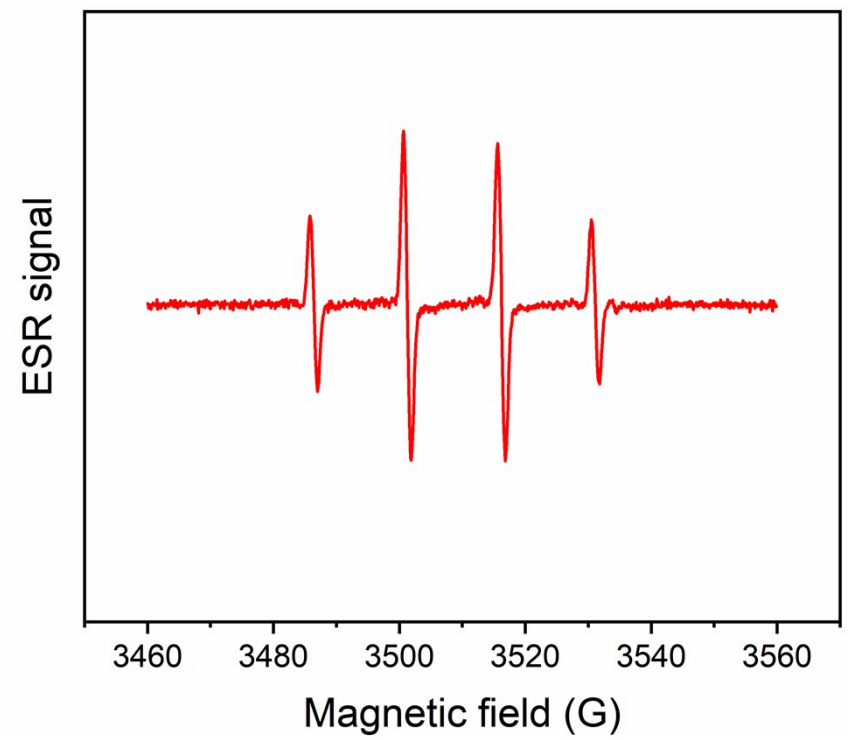

Fig. S1. EPR spectra obtained in the mixture of DMPO and H_2O_2 in the presence of ss-CNDs.

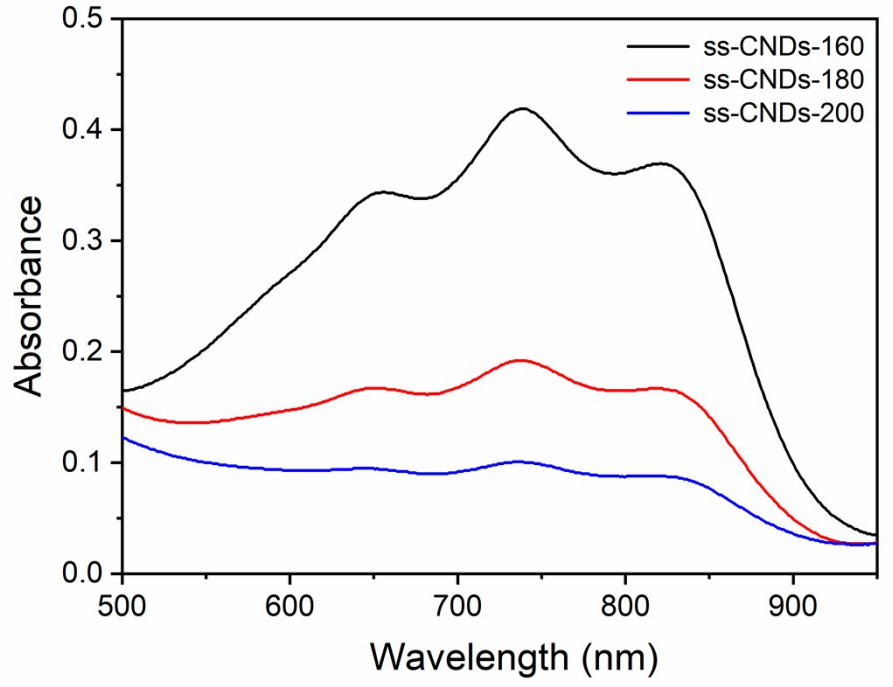

Fig. S2. UV-vis absorption spectra of the sensing system for H_2O_2 by using ss-CNDs synthesized at three different carbonization temperatures (160℃, 180℃, and 200 ℃) as colorimetric probe.

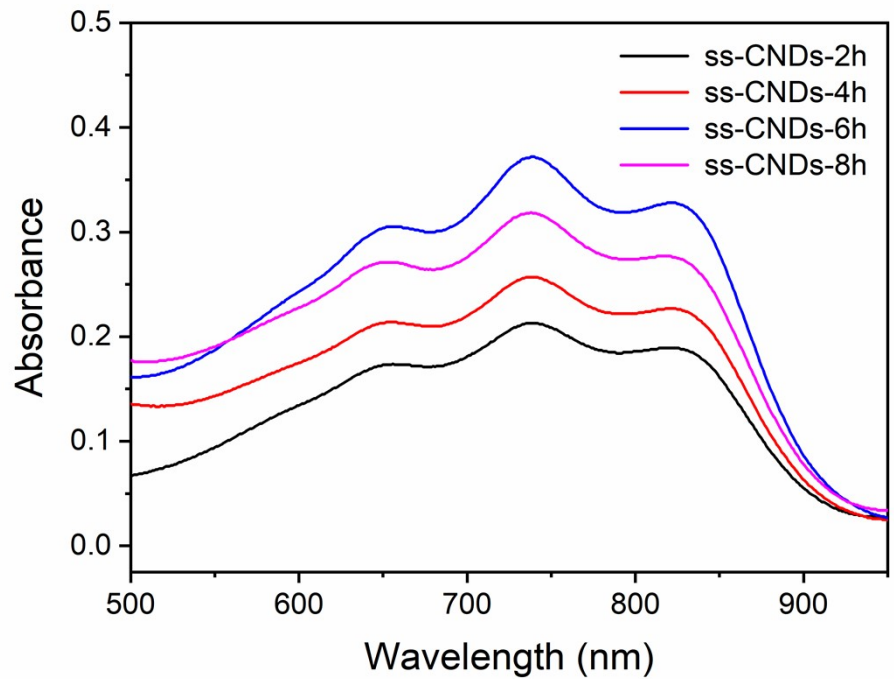

Fig. S3. UV-vis absorption spectra of the sensing system for H_2O_2 by using ss-CNDs synthesized at four different carbonization times (2h, 4h, 6h, and 8h) as colorimetric probe.

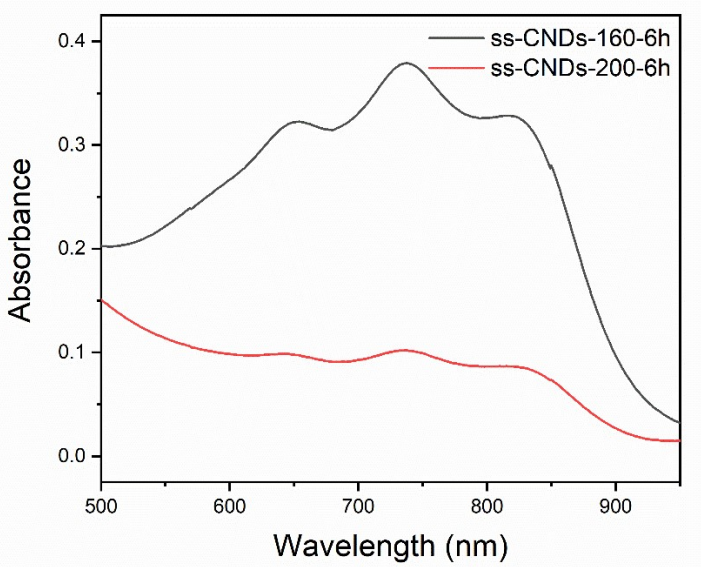

Fig. S4. UV-vis absorption spectra of the sensing system for H_2O_2 by using ss-CNDs synthesized at different carbonization temperatures and time (160 ℃ for 6 h and 200 ℃ for 6 h) as colorimetric probe.

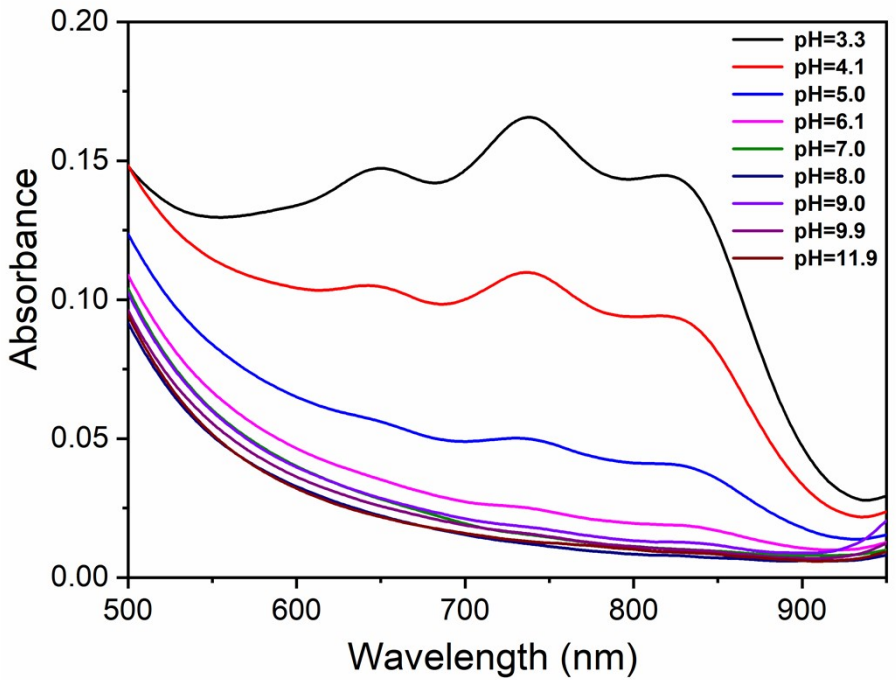

Fig. S5. UV-vis absorption spectra of sensing system for H_2O_2 at different pH (3.3-11.9).

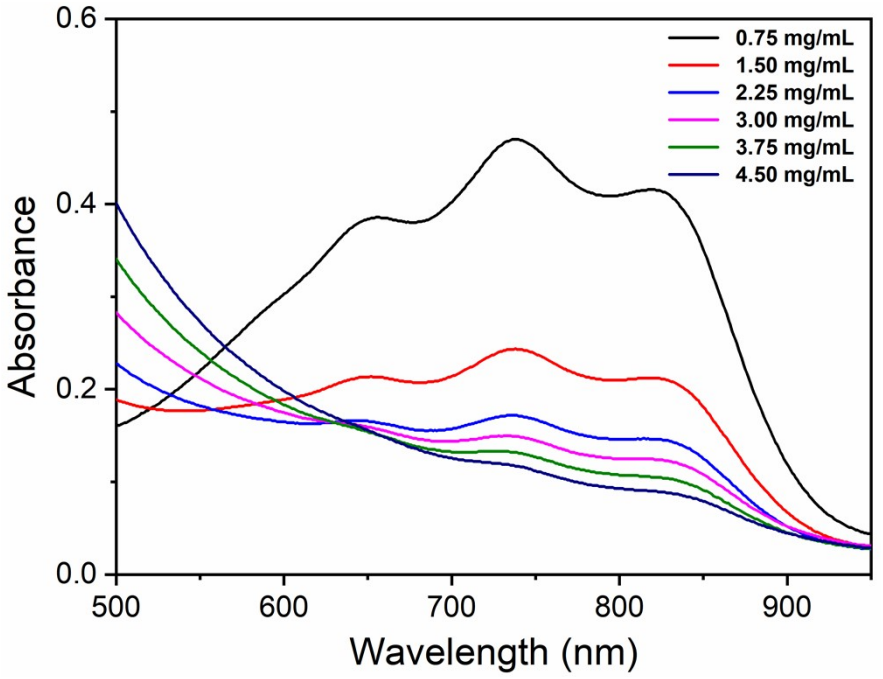

Fig. S6. UV-vis absorption spectra of sensing system for H_2O_2 at different concentrations of ss-CNDs (0.75-4.50 mg·mL^{-1}).

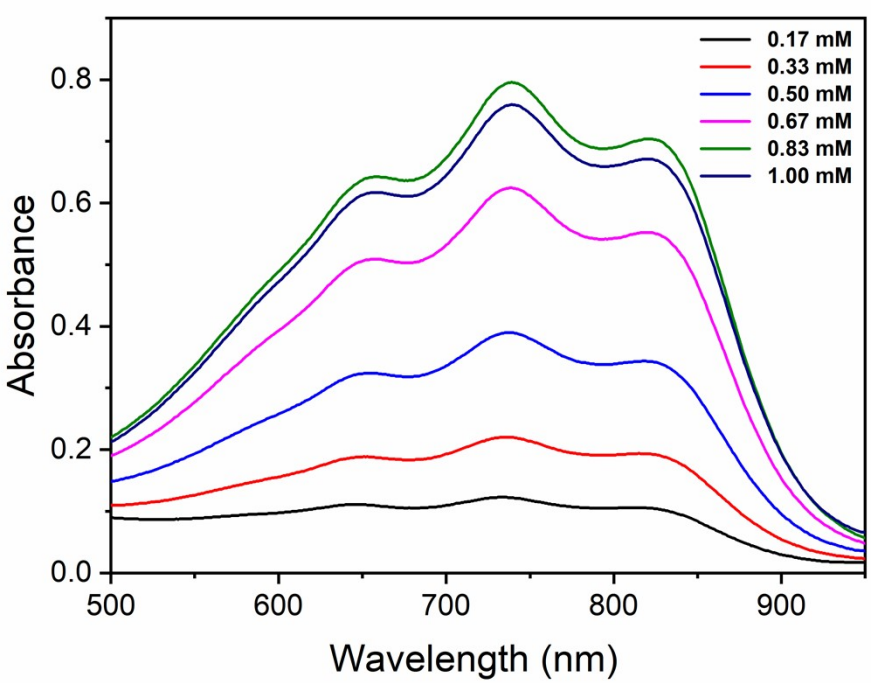

Fig. S7. UV-vis absorption spectra of sensing system for H_2O_2 at different concentrations of ABTS (0.17-1.00 mM).

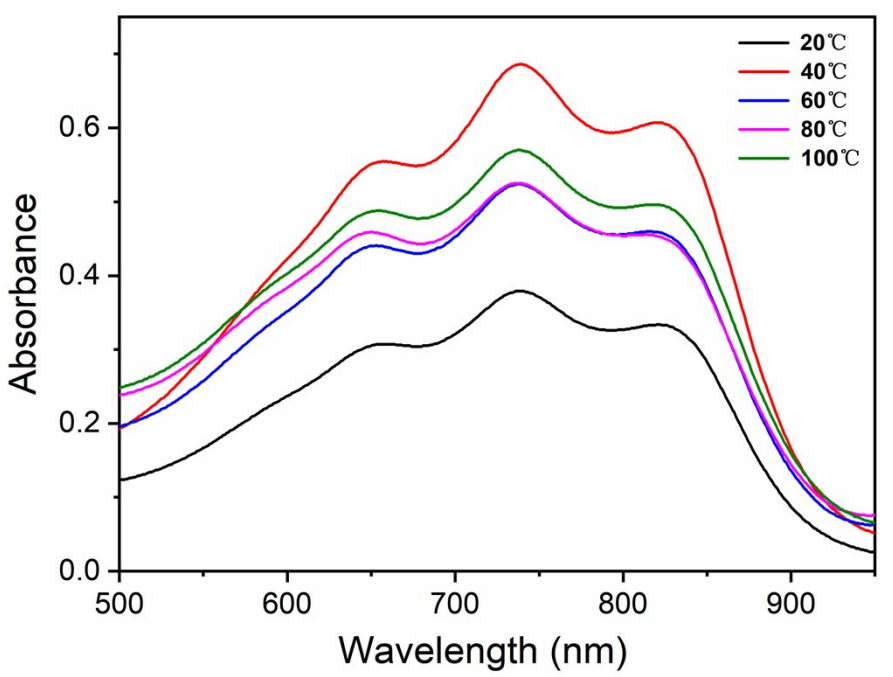

Fig. S8. UV-vis absorption spectra of sensing system for H_2O_2 at different reaction temperature (20-100 ℃).

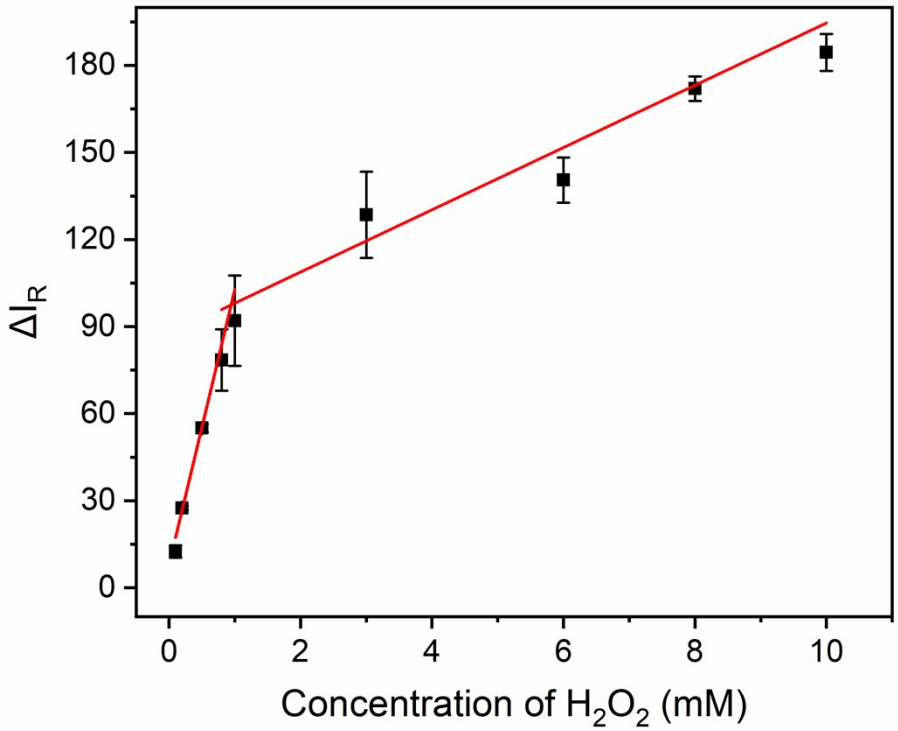

Fig. S9. The linear relationship between the change of R value (ΔI_R) of solution and H_2O_2 concentrations from 0 mM to 10 mM.

Table S1 Summary of recently reported detection methods for the quantitation of H_2O_2

Methods	Materials	Linear range (mM)	LOD (μM)	Reference
Fluorometry	Si-O QDs-Ag NCs	0.08-60	6.5	S1
Fluorometry	BSA-AuNCs	0.001-50	0.7	S2
Fluorometry	CDs-OPD	0.001-0.2	0.42	S3
Colorimetry	4,5-diazafluorene	0.0005-0.5	0.0038	S4
Colorimetry	Au/Co_3O_4-CeO_x NCs-TMB	0.01-1	5.29	S5
Colorimetry	V_2O_5-Mt-TMB	0.03-0.4	4.0	S6
Colorimetry	CQDs-TMB	0.005-0.06	0.86	S7
Colorimetry	ss-CNDs-ABTS	0.05-10	9.53	This work

Table S2 Determination of H_2O_2 in water samples by this colorimetric assay

Samples	Added (mM)	Found (mM)	Recovery (%)	RSD (%)
Water 1	5	5.15	103.1	2.54
Water 2	10	9.01	90.1	5.41

References

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