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Supporting Information for

Carbon quantum dots synthesis of Ag/PCQDs composite for Hg^{2+} visual detection in dH_2O solution and seawater samples

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Material and methods

Chemicals/reagents

palm mane (from Guiyang, Guizhou), $AgClO_4$ ·H_2O, $Hg(ClO_4)_2$ ·H_2O, $Hg(NO_3)_2$ ·$2H_2O$, $HgCl_2$, $Hg(OAc)_2$ ·H_2O, CH_3HgCl, $Al(ClO_4)3$ ·$9H_2O$, $Ca(ClO_4)_2$ ·$4H_2O$, $Cd(ClO_4)_2$ ·$4H_2O$, $Co(ClO_4)_2$ ·$6H_2O$, $Cu(ClO_4)_2$ ·$6H2O$, $Mg(ClO_4)_2$ ·$6H_2O$, $Mn(ClO_4)_2$ ·$4H_2O$, $Fe(ClO_4)_3$ ·$9H_2O$, $Ni(ClO_4)_2$ ·$6H_2O$, $Pb(ClO_4)_2$ ·$3H_2O$, $Zn(ClO_4)_2$ ·$6H_2O$, $BaCl_2$ ·$2H_2O$ 、$Cr(NO_3)_3$ ·$9H_2O$, $FeCl_2$, $Ga(NO_3)_3$ ·xH_2O, $GdCl_3$ ·$6(H_2O)$, $RuCl_3.H_2O$, CH_3COONa, NaCl, NaF, Na_2CO_3, Na_3PO_4 ·$12H_2O$, ethyl piperazine ethanesulfonic acid (HEPES) and Na_2SO_4 were of analytical reagent grade and were purchased from SIGMA-ALDRICH. Certified reference material (CRM) of coastal seawater Hg^{2+} was purchased from LGC Standards (UK). Hg^{2+} in the following experiments was all based on $Hg(ClO_4)_2$. The tap water comes from the girls' dormitory of our university without any pretreatment. The river water obtained from Nanming River from Fenghuang Bay. Coastal seawater Hg^{2+} certified reference material (CRM) was purchased from LGC Standards (UK).

Characterization of PCQDs, Ag/PCQDs composite and AgHg amalgam

The crystal structure and surface morphology of the PCQDs, Ag/PCQDs, AgHg

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amalgam were measured by a transmission electron microscope JEM-F200 (TEM, JEOL, Tokyo, Japan) with an accelerating voltage of 200 kV. The XPS data were collected with an X-ray photoelectron spectrometer (Thermo Scientific K-Alpha+, ThermoFisher, USA) with a mono Al-Kα excitation source (1486.6eV). The UV-Vis absorption spectra of the PCQDs, Ag/PCQDs, AgHg amalgam were achieved via a UV-Vis spectrometer (Shimadzu, Kyoto, Japan) over the wavelength range from 250 nm to 700 nm (1 nm interval). The fluorescence spectrum of the sample was recorded using a fluorescence spectrophotometer (F-320 Gangdong, Tianjin). The DLS size distribution and zeta potential were collected with a nanometer particle size and Zeta potential analyzer (Malvern Zetasizer Nano ZS90). To prove the accuracy of the method, the concentration of Hg^{2+} in real water samples, saline solution and Hg^{2+} seawater CRM were determined by cold vapour atomic absorption spectrometry (CVAAS) using DMA–80 (Milestone, Italy). Compared with the Ag/PCQDs composite method, the concentration of Hg^{2+} in water samples was determined by CVAAS using DMA-80 (ThermoFisher, USA).

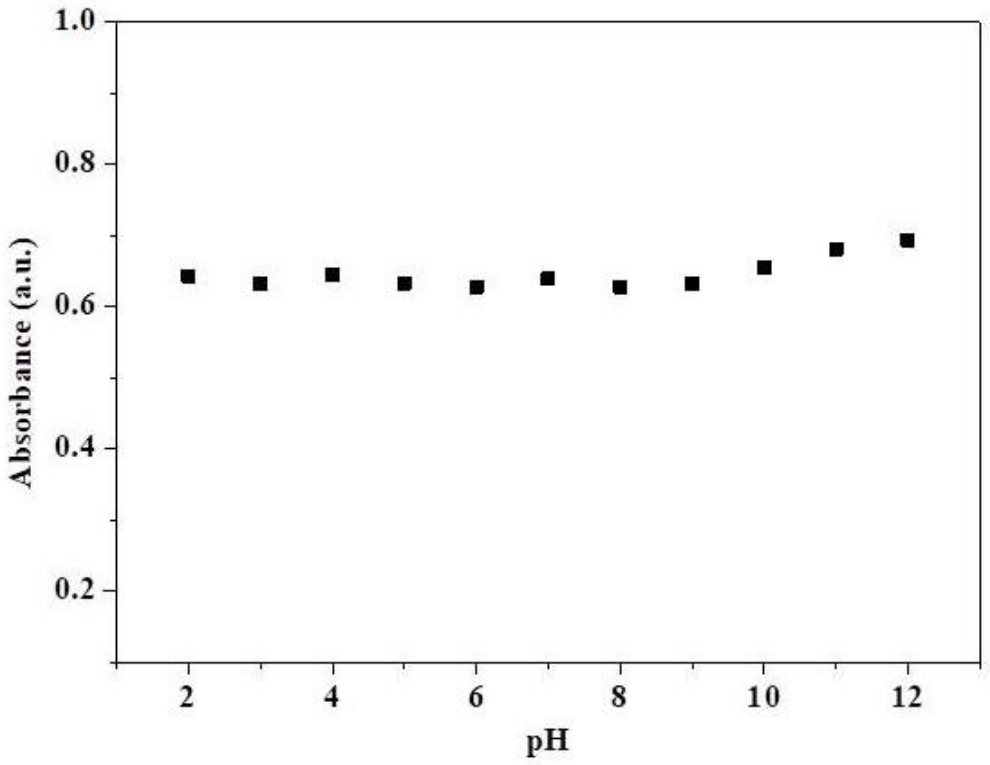


Figure 1S. Effect of pH value of Ag/PCQDs composite to Hg^{2+} detection

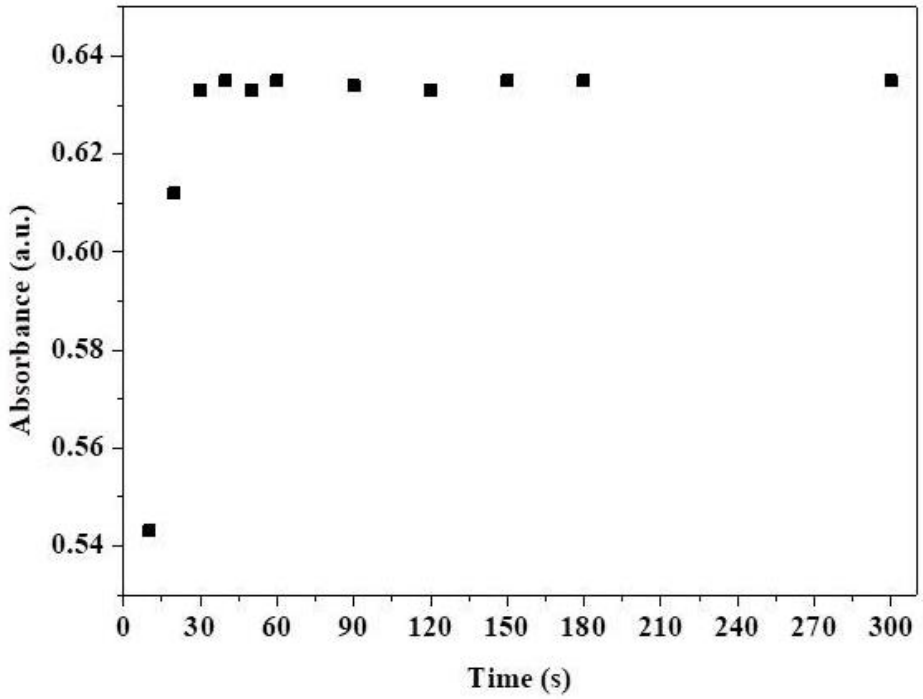


Figure 2S. Effect of time of Ag/PCQDs composite to Hg^{2+} detection

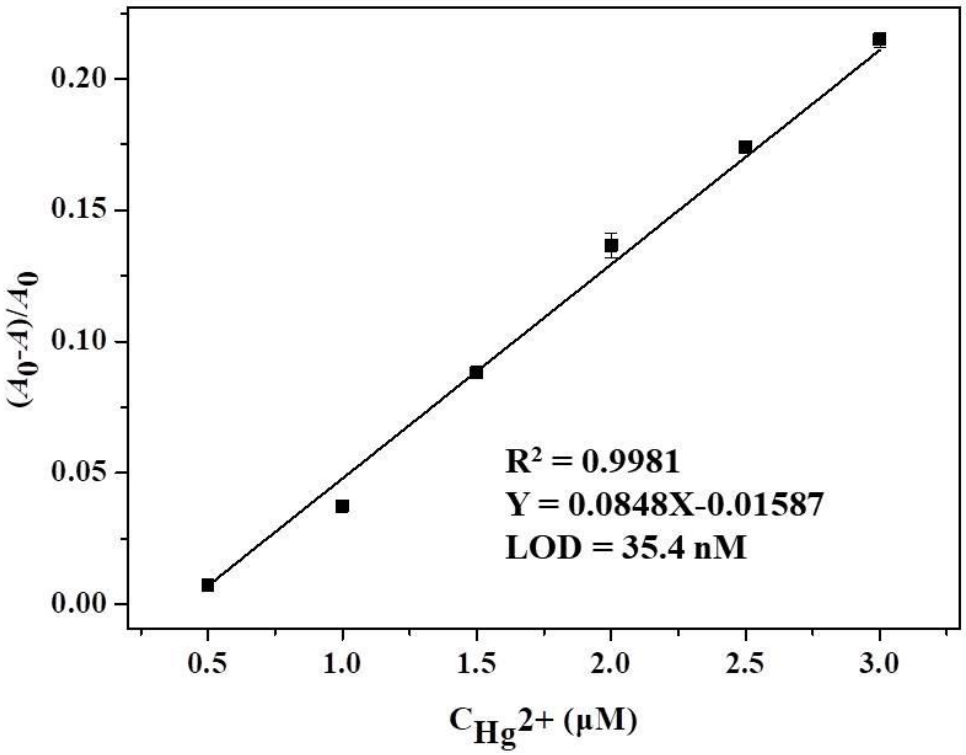


Figure 3S. Plot of the intensity for the relative absorption intensity $(A_0 - A)/A_0$ over the concentration of Hg^{2+} in dH_2O solution (λ= 426 nm).

The result of the analysis as follows:

Equation: Y = A +B × X

Y = 0.0848 ×X– 0.01587

R = 0.9981

S = 0.0848 $\times 10^6$ K = 3

$\delta = \sqrt{\frac{\sum (A_0 - \bar{A}_0)^2}{N-1}}$ = 0.00102 (N = 10)

$LOD = \frac{3\delta}{slope}$, LOD = K × δ / S = 3.54 $\times 10^{-8}$ M = 35.4 nM

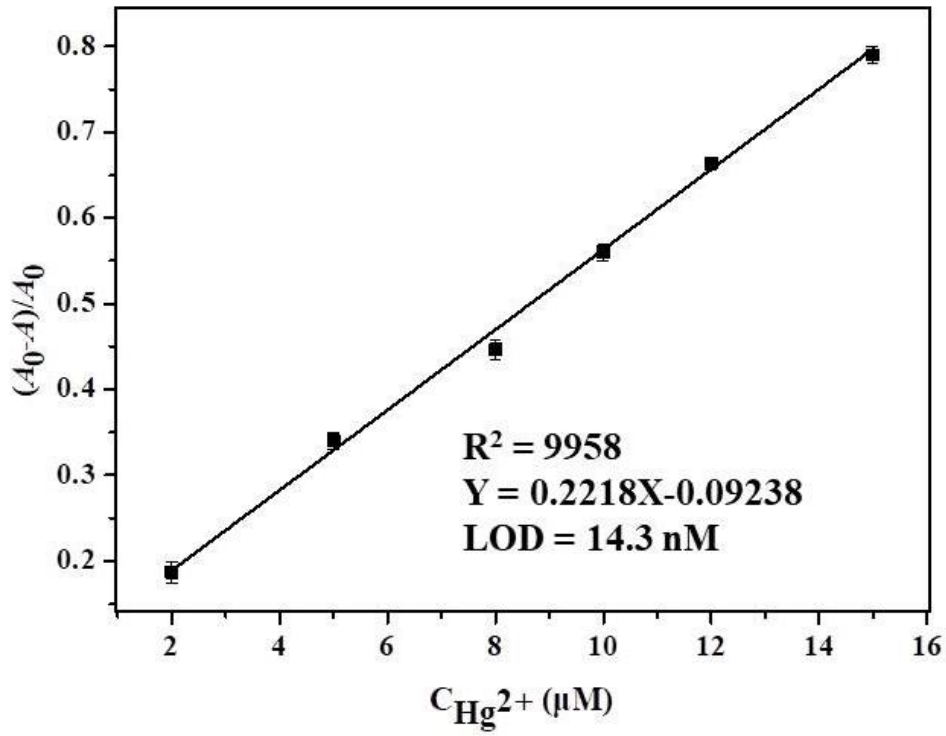


Figure 4S. Plot of the intensity for the relative absorption intensity $(A_0 - A)/A_0$ over the concentration of Hg^{2+} in 0.6 M NaCl solutions (λ= 426 nm).

The result of the analysis as follows:

Equation: Y = A +B × X

Y = 0.2218 ×X– 0.09238

R = 0.9958

S = 0.2218 $\times 10^6$ K = 3

$$\delta = \sqrt{\frac{\sum (A_0 - \bar{A}_0)^2}{N-1}} = 0.00106 \text{ (N = 10)}$$

$$LOD = \frac{3\delta}{slope}, \text{ LOD} = \text{K} \times \delta / \text{S} = 14.3 \times 10^{-8} \text{ M} = 14.3 \text{ nM}$$

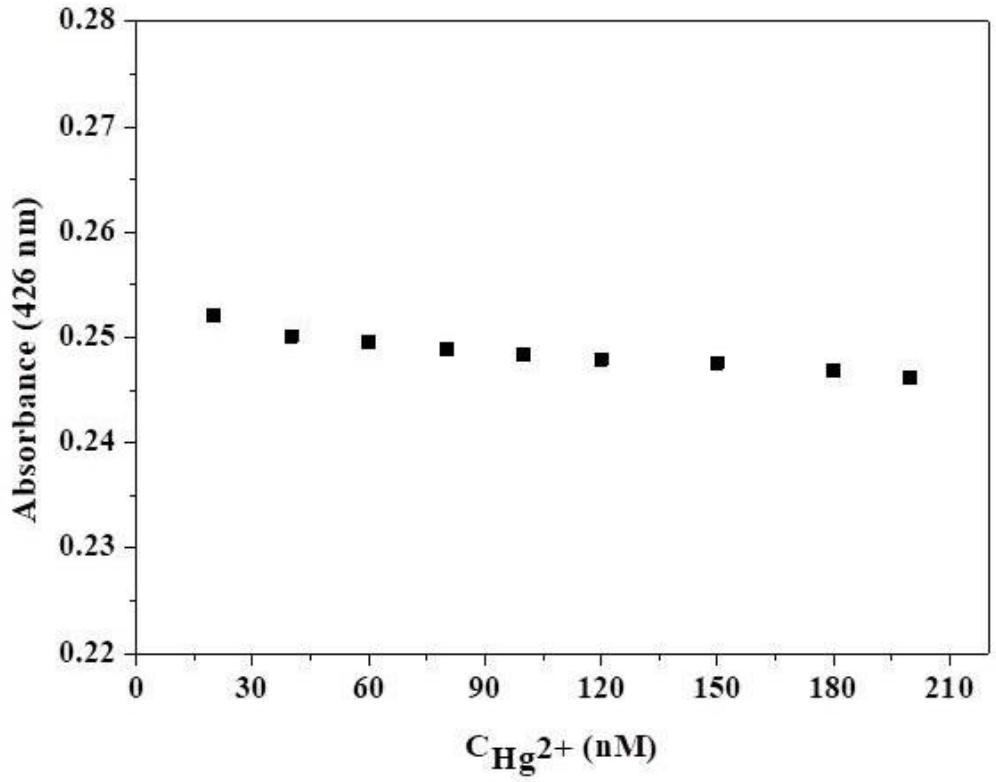
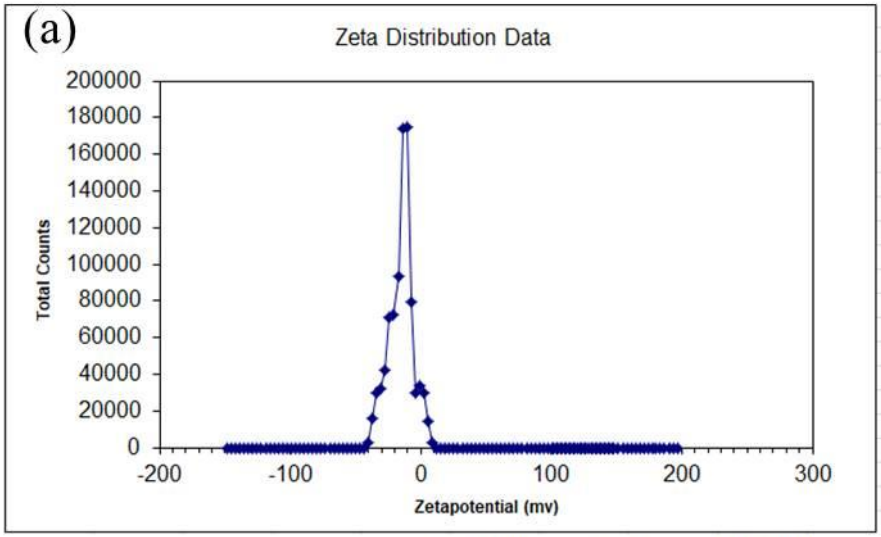
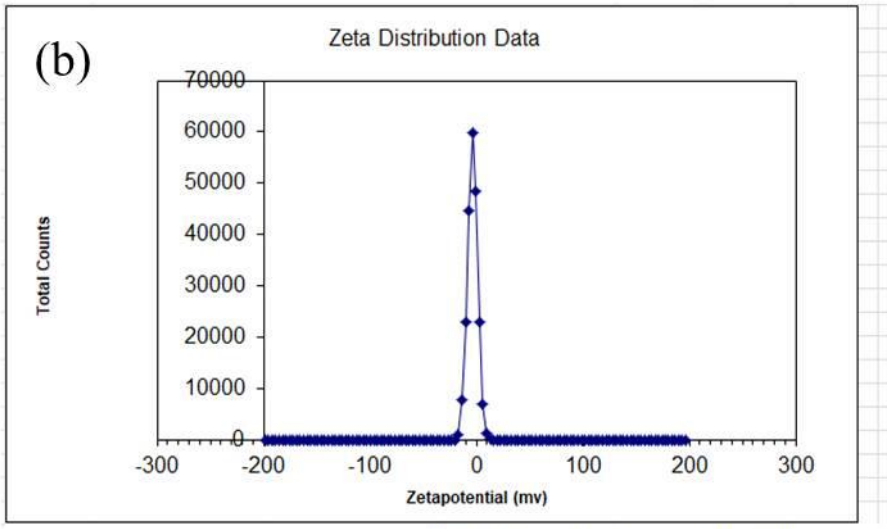


Figure 5S. UV–vis absorption values of Ag/PCQDs composite upon different concentrations of Hg^{2+} in the range of 20-200 nM.



		Mean (mV)	Area (%)	St Dev (mV)
Zeta Potential (mV): -15.0	Peak 1:	-16.6	88.1	7.88
Zeta Deviation (mV): 9.23	Peak 2:	0.229	11.9	3.56
Conductivity (mS/cm): 0.128	Peak 3:	0.00	0.0	0.00



		Mean (mV)	Area (%)	St Dev (mV)
Zeta Potential (mV): -3.58	Peak 1:	-3.59	100.0	4.76
Zeta Deviation (mV): 4.59	Peak 2:	0.00	0.0	0.00
Conductivity (mS/cm): 1.39	Peak 3:	0.00	0.0	0.00

Figure 6S. (a) The Zeta potential distribution data of Ag/PCQDs composite (b) Ag/PCQDs composite after addition of Hg^{2+}

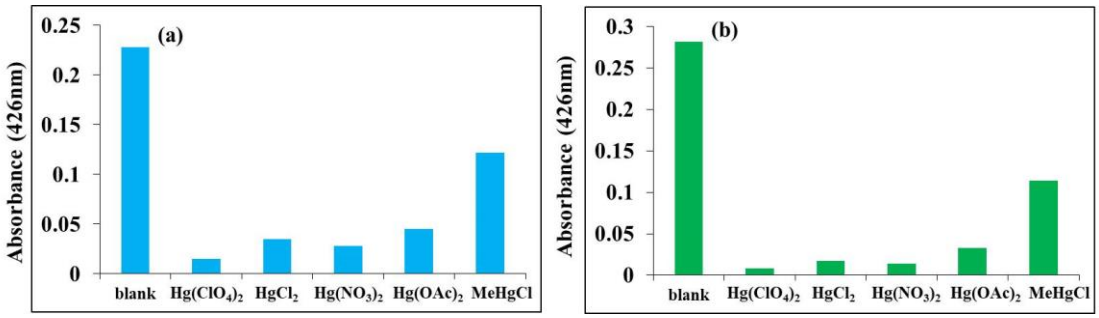


Figure 7S. The Ag/CQDs upon different mercury sources (50 μM) (a) in dH_2O solution (b) in seawater samples