

**Electronic supporting information**

# **Cane Molasses Graphene Quantum Dots Passivated by PEG Functionalization for Detection of Metal Ions**

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GQDs fluorescence probe for the detection of metal ions at different conditions; optimum synthesis conditions of GQDs; excitation wavelength dependence of GQDs, the degree of fluorescence quenching varies with the concentration of  $\text{Cu}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Mn}^{2+}$ , and  $\text{Pb}^{2+}$  for PEG-GQDs; fluorescence decay curve of the GQDs, PEG-GQDs, and PEG-GQDs in the presence of  $\text{Fe}^{3+}$ , UV-vis absorption spectra of PEG-GQDs the presence of  $\text{Fe}^{3+}$ , and the superposition of the UV-vis absorption spectra of PEG-GQDs and  $\text{Fe}^{3+}$  solution.

#### **Fluorescence detection of single metal ions at room temperature.**

For the quenching experiment of PEG-GQDs by  $\text{Fe}^{3+}$ , 200 mL of different concentrations of  $\text{Fe}^{3+}$  solution were mixed with 100  $\mu\text{L}$  of GQDs primary solution and then diluted to 5 mL with PEG-200 for fluorescence emission spectra test at room temperature. Similarly, the fluorescence response of different concentrations of  $\text{Cu}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Mn}^{2+}$  and  $\text{Pb}^{2+}$  to PEG-GQDs is also respectively performed using the above steps.

#### **Fluorescence detection of $\text{Fe}^{3+}$ at 40 °C**

In order to examine the effect of temperature on the fluorescence emission spectra of PEG-GQDs by  $\text{Fe}^{3+}$ , 100  $\mu\text{L}$  of GQDs primary solution was heated to 40 °C in a thermostatic water bath and diluted to 5 mL with PEG after adding 200  $\mu\text{L}$  of  $\text{Fe}^{3+}$  solutions of different concentrations.

#### **Fluorescence selectivity detection of $\text{Fe}^{3+}$ in multiple metal ions**

To demonstrate the selectivity of PEG-GQDs toward  $\text{Fe}^{3+}$ , 200  $\mu\text{L}$  of different

concentrations of  $\text{Fe}^{3+}$  solutions were added to a mixed solution of 100  $\mu\text{L}$  GQDs primary solution, 200  $\mu\text{L}$  EDTA(0.1M) and 200  $\mu\text{L}$  multiple metal ions solutions( $\text{Cr}^{3+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Ag}^{+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Ni}^{2+}$ , 0.01 M) and diluted to final volume of 5 mL with PEG-200. The fluorescence emission spectra should be performed after the solutions were kept for 10 minutes.

The  $\text{Fe}^{3+}$  detection limit was defined as  $\text{LOD} = 3\sigma/m$  where  $\sigma$  is the standard deviation,  $m$  is the slope of the straight line in linear response region of the calibration curve. Similarly, the detection limit of other metal ions including  $\text{Cu}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Pb}^{2+}$  etc. are also determined using the above method.

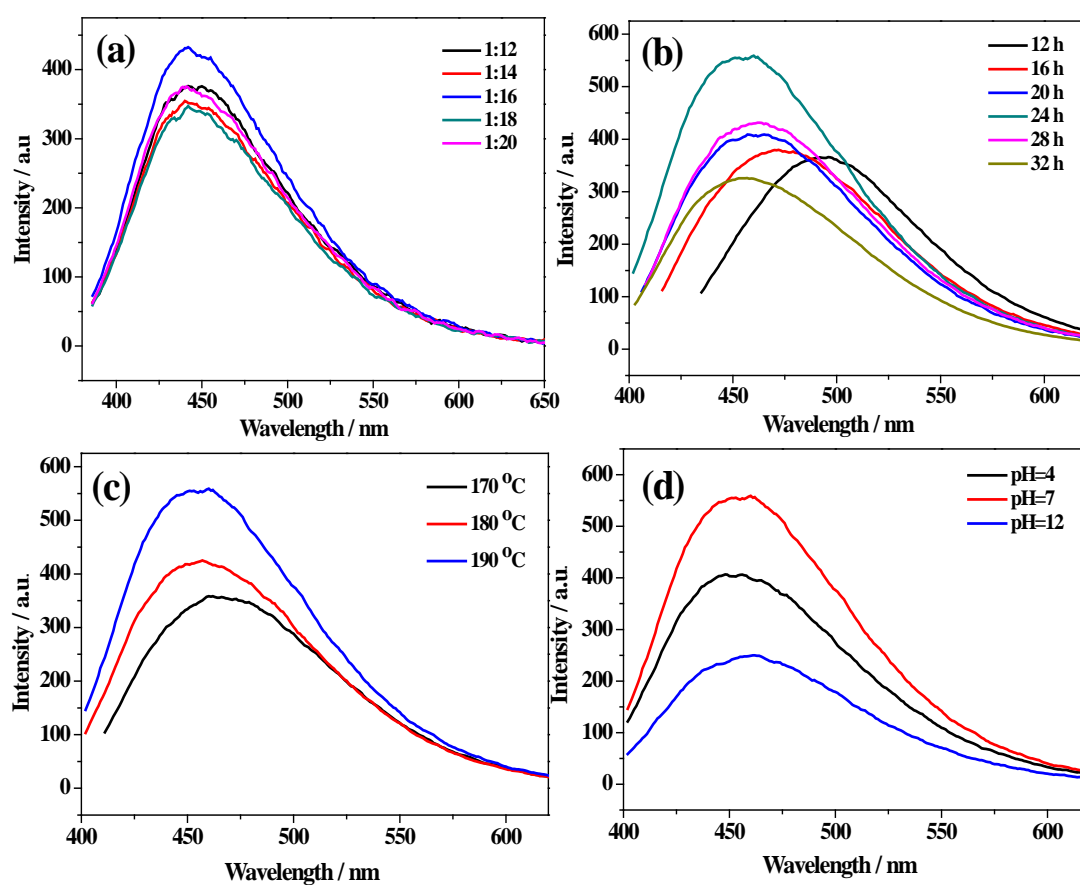


Figure S1 Effects of the volume ratio of cane molasses to ultrapure water(a), reaction time(b), reaction temperature(c) and pH value of the reaction system (d) on the fluorescence of GQDs, respectively.

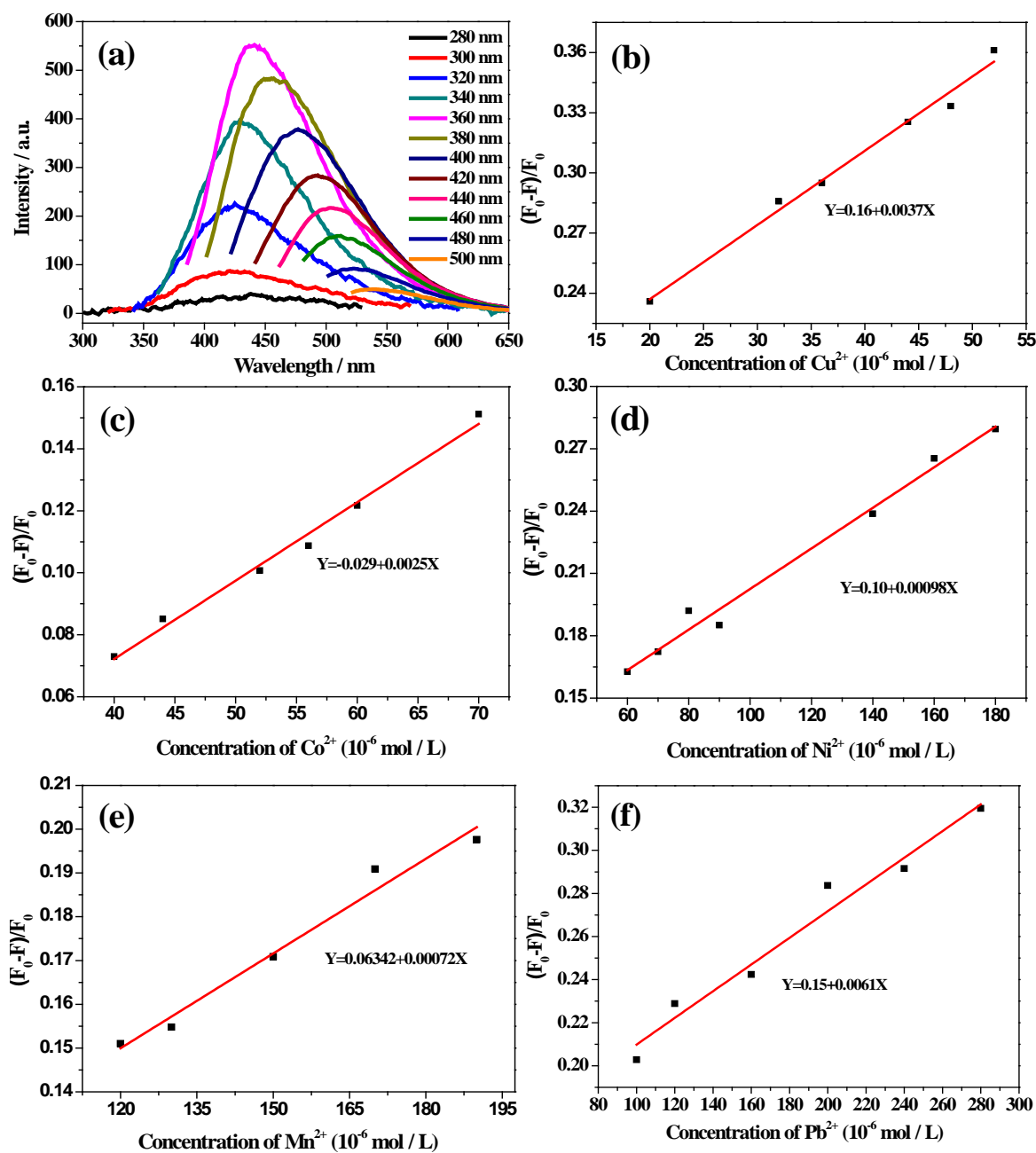
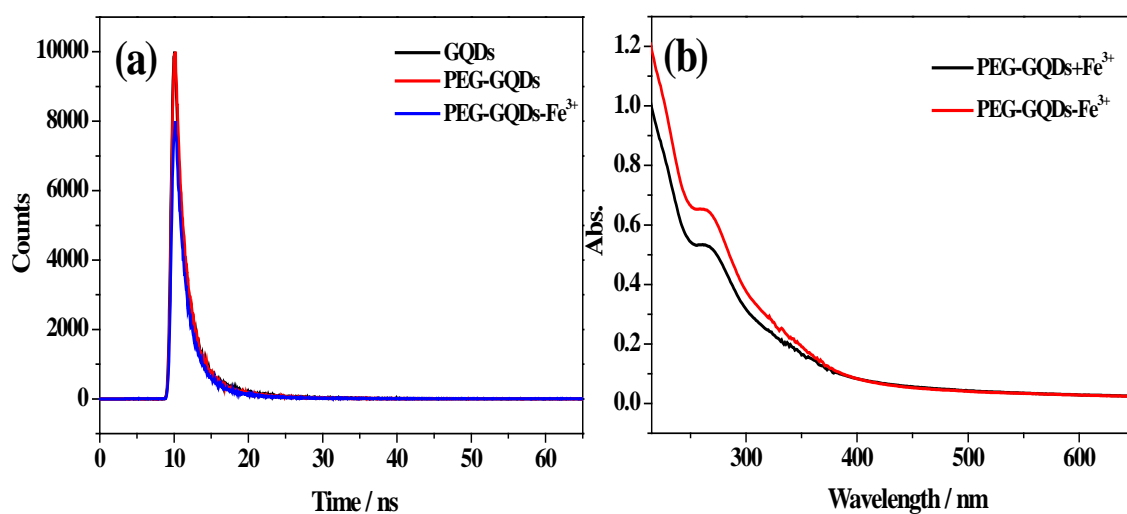


Figure S2 PL spectra of GQDs recorded for progressively longer excitation wavelengths from 280 to 500 nm (a); Calibration curves of the degree of fluorescence quenching  $[(F_0 - F)/F_0]$  of PEG-GQDs versus the concentrations of  $\text{Cu}^{2+}$ (b),  $\text{Co}^{2+}$ (c),  $\text{Ni}^{2+}$ (d),  $\text{Mn}^{2+}$  (e) and  $\text{Pb}^{2+}$ (f) ions, respectively.



Figures S3 Time-resolved fluorescence decay curve of the GQDs, PEG-GQDs and PEG-GQDs in the presence of Fe<sup>3+</sup> (a); the UV-vis absorption spectra of PEG-GQDs in the presence of Fe<sup>3+</sup> (red curve) and the superposition of the UV-vis absorption spectra of PEG-GQDs and Fe<sup>3+</sup> solutions (black curve) (b).