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**Supporting information:**

# N-dots as photoluminescent probe for rapid and selective detection of $Hg^{2+}$ and $Ag^{+}$ in aqueous solution.

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**Materials and Apparatus**

All chemicals were obtained from commercial suppliers and were used without further purification. The probe stock solutions were prepared in distilled water at a concentration of 2 mg·mL$^{-1}$. The stock solutions of various testing species were prepared from $CdCl_2$, $CrCl_3$, $MgCl_2$, $CaCl_2$, $FeCl_3$ $6H_2O$, NaCl, $CoCl_2$ $6H_2O$, KCl, $Hg(ClO_4)_2$ $3H_2O$, $AgNO_3$ at 10 mM in distilled water. PBS buffer was prepared using distilled water. Infrared spectra were obtained on a NEXUS-470 Fourier transform infrared (FTIR) spectrometer ranged from 4000 to 500 cm$^{-1}$. The measurement of C, H, and N elements was performed on Varo EL III elemental analyser. Atomic force microscope (AFM) image was recorded on a Bruker Multimode 8 atomic force microscope. The fluorescence (FL) spectra were measured on a fluorimeter (Cary Eclipse) equipped with an integrating sphere.

**Synthesis of N-dots**

Raw N-dots were prepared by heating 2-azidoimidazole (0.2g) in methanol (5 mL) at 50 ℃ for 60 hours. After cooling, methanol was removed under reduced pressure. The obtained residue was washed with ethyl acetate for 5 times. The supernatant was discarded and the obtained solid was dispersed in water (5 mL). After filtration with 0.22 μm filter, the solution was concentrated and vacuum-frozen-dried, yielding 22.3 mg solid, 11 % yield.

**Photoluminescence measurement**

All the fluorescence measurements were performed at room temperature using PBS buffer (pH 7.4) solution. In a typical assay, 10 μL N-dots stock solution (2 mg/mL) was diluted in PBS buffer at a final concentration of 20 μg/mL for photoluminescence spectra. For cation selectivity study, photoluminescence emission spectra were recorded after mixing with various metal ions ($Cd^{2+}$, $Cr^{3+}$, $Mg^{2+}$, $Ca^{2+}$, $Fe^{3+}$, $Na^{+}$, $Co^{2+}$, $K^{+}$, $Hg^{2+}$, $Ag^{+}$). In kinetic studies, photoluminescence intensity at 515 nm (excitation at 460 nm) against time was monitored in the presence and the absence of analytes ($Hg^{2+}$ or $Ag^{+}$) every 10 seconds. In sensitivity studies, different concentrations of $Hg^{2+}$ or $Ag^{+}$ (final concentration: 0~100 μM) were added to N-dots solutions (20

μg/mL), followed by photoluminescence measurement. To distinguish $Hg^{2+}$ from $Ag^{+}$, EDTA (30 μM) was added to N-dots-Hg or N-dots-Ag aqueous solutions and mix well for 1 min, followed by photoluminescence spectral measurement. In competitive binding experiments with biothiols, Cys, Hcy, GSH and $Na_2S$ at a final concentration 1 mM were added into Hg-N-dots or Ag-N-dots solutions, and the resulting solutions were shaken well and incubated for 1 min, followed by photoluminescence measurement.

**Limit of detection (LOD) and Stern-Volmer quenching constant:**

The detection limit was calculated using equation: LOD=3σ/K. (σ is the standard deviation of the control N-dots solutions, K is the slop of obtained linear curve in Fig. 3).

The quenching was also described by a modified Stern-Volmer equation:

$$F_0/ (F_0-F) =1/ (f_a K_a [Q]) +1/f_a$$

Where Q is the concentration of the quencher ($Hg^{2+}$ or $Ag^{+}$), $F_0$ is the photoluminescence intensity in the absence of the quencher, F is the observed intensity in the presence of the quencher, $f_a$ is the fraction of initial photoluminescence that is accessible to the quencher and $K_a$ is the Stern–Volmer quenching constant.

**Quautum Yield**

The quantum yield measurements were determined in PBS buffer using quinine sulfate (0.10 M $H_2SO_4$, Φ = 0.54) as a standard according to the following equation:

$\Phi_u=\Phi_s(Y_u/Y_s)(A_s/A_u)(n_u/n_s)$

Φ is quantum yield; Y is the measured integrated fluorescence emission intensity; A is the optical density measured at the excitation wavelength; n is the refractive index. The subscript "s" refers to the standard quantum yield of reference quinine sulfate. The subscript "u" refers to the unknown quantum yield of as-prepared N-dots. In order to minimize re-absorption effects, absorbance in the 1cm fluorescence cuvette were kept under 0.05 at the excitation wavelength.

**Table S1.** Elemental composition percentage of N-dots prepared at 50 ℃.

| Elemental analysis | Composition percentage (%) |
|---|---|
| C | 36.47 |
| H | 5.14 |
| N | 36.27 |

**Fig. S1** Fluorescence images (top) and digital images (bottom) of reaction solutions after heating different time at 50 $^{o}$C.

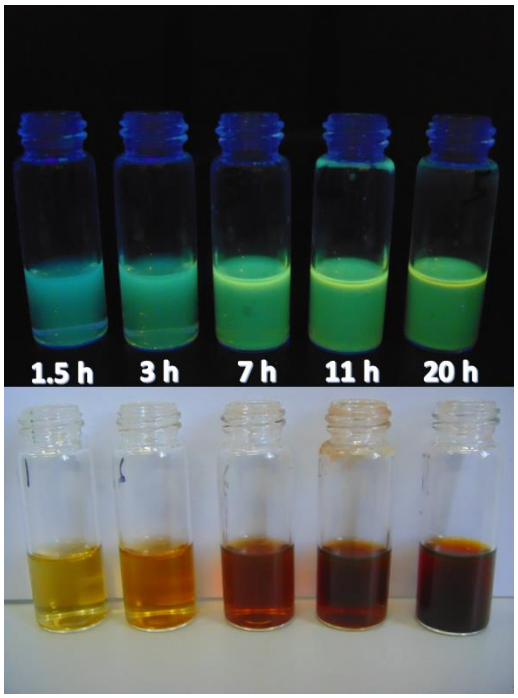

**Fig. S2** Atomic force microscopy (AFM) image and size profile of as-prepared N-dots.

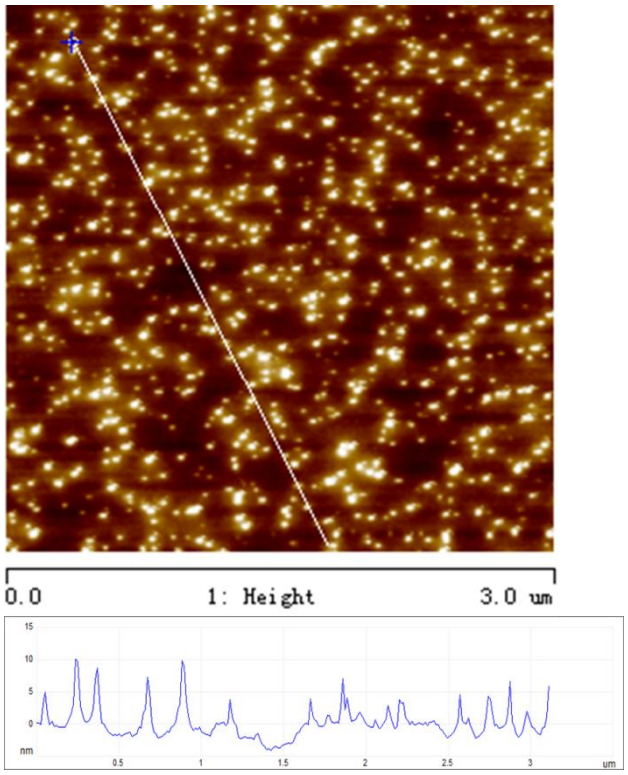


**Fig. S3** FTIR spectra of N-dots prepared at 50 °C.

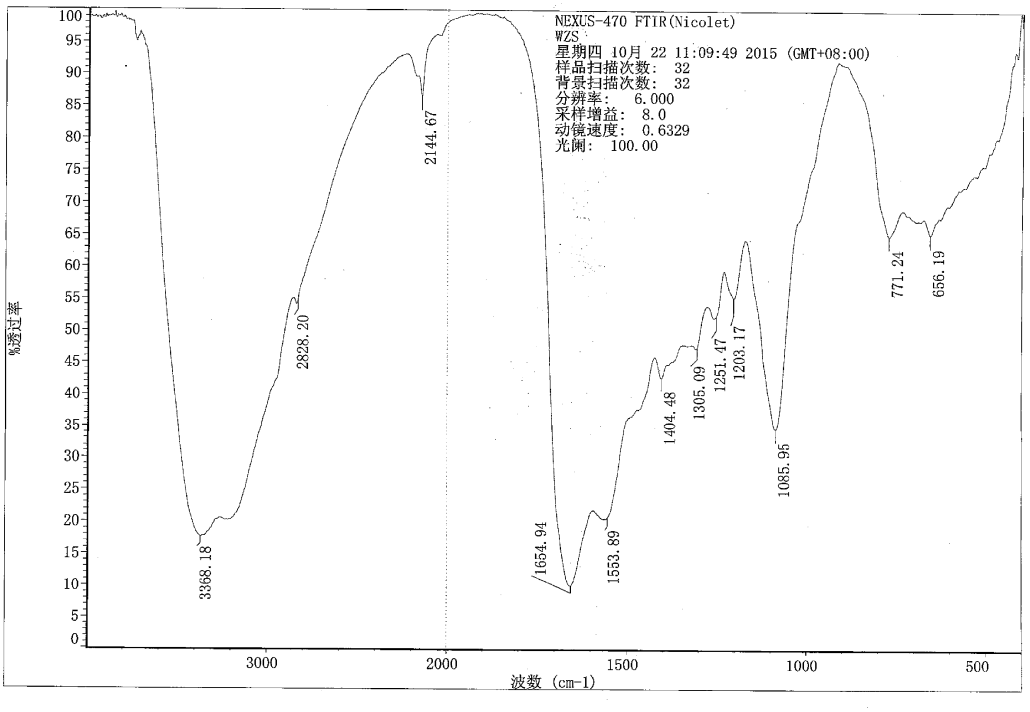

**Fig. S4** Time-dependent photoluminescence intensity (515 nm) change upon the addition of analytes (100 μM) to N-dots solutions (20 μg $mL^{-1}$). $F_0$ is the initial intensity. $\lambda_{ex}$ = 460 nm.

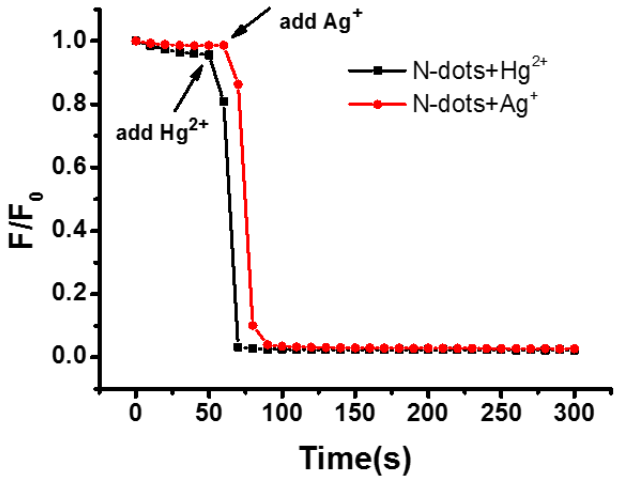


**Fig. S5** A linear plot of $F_0$/ ($F_0$-F) versus 1/ [$Hg^{2+}$] and 1/ [$Ag^{+}$].

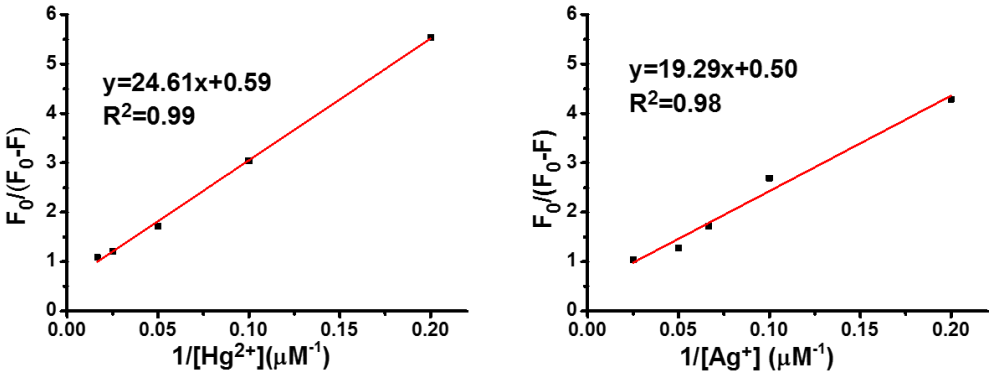


**Fig. S6** Photoluminescence emission of N-dots in the presence of analytes (100 μM), followed by the addition of biothiols (1 mM) in 20 mM PBS buffer (pH=7.4). $\lambda_{ex}$ = 460 nm.