

**Upconversion luminescent logic gates and turn-on sensing of glutathione based on two-photon excited quantum dots conjugated with dopamine**

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**Part S1. Preparation procedures of MPA-CdTe QDs and QDs-MPA-DA<sub>b</sub>**

**1.1 Preparation of NaHTe precursor**

Typically, 0.5 mmol Te and 2 mmol NaBH<sub>4</sub> were loaded in a three-necked flask. The air was pumped off and replaced with N<sub>2</sub>. Then, 10 mL of ultrapure water was added with a syringe and reaction mixture was heated at 80 °C for 30 min to obtain a deep-red and clear solution. The as-prepared NaHTe solution was immediately used or stored for further use under the ambience of N<sub>2</sub>.

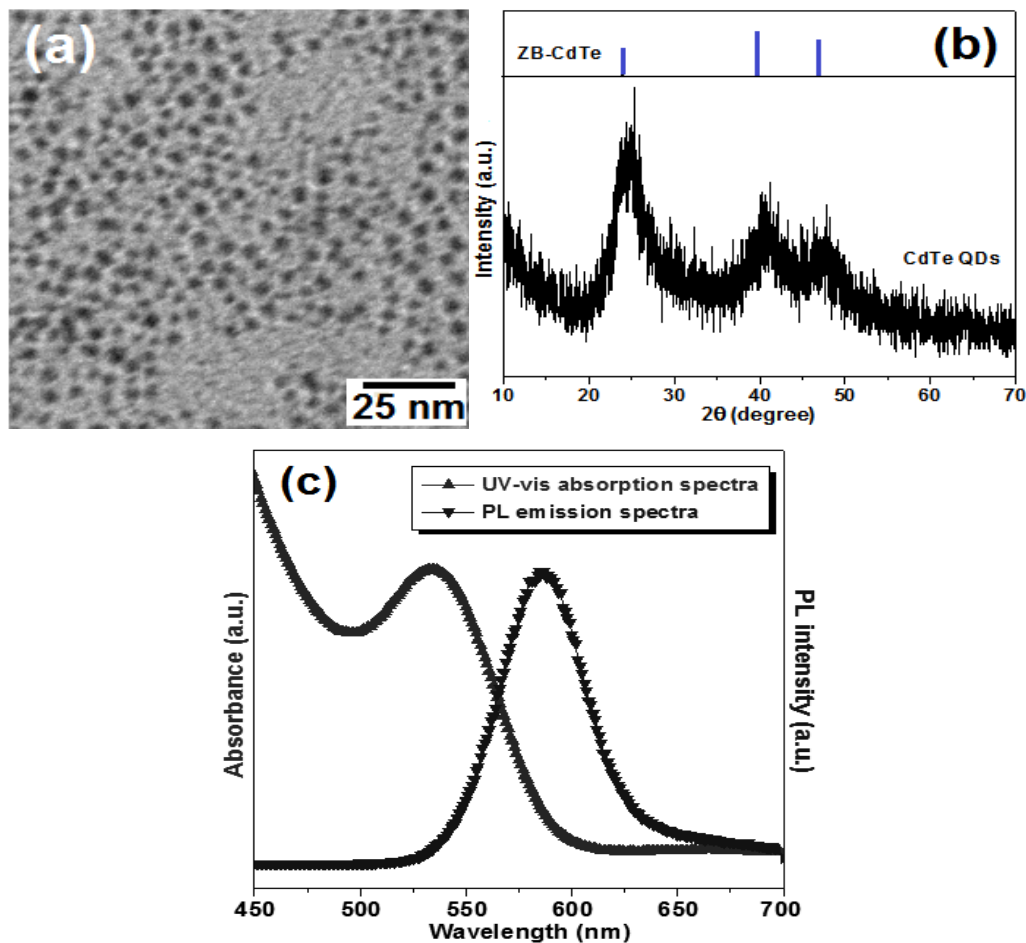
**1.2 Preparation of MPA-CdTe QDs**

MPA-capped CdTe QDs were prepared as below; 0.25 mmol Cd<sup>2+</sup> and 0.45 mmol MPA were placed into a three-necked flask to form 50 mL of homogeneous aqueous solution, adjusting pH of the solution to 12.0 by dropwise addition of 1.0 M NaOH. Under the protection of N<sub>2</sub>, freshly prepared 0.025 mmol of NaHTe was swiftly injected into this solution at room temperature. Afterward, this solution was heated to reflux with a condenser attached at 100 °C. Aliquots of reaction solution were taken out at different time intervals to record temporal evolution of UV-vis and PL spectra. When the reaction time reached 6 h, the expected PL wavelength was observed. Following operation was to remove the heating source and cool this solution to room temperature. After that, the as-prepared CdTe QDs was concentrated by circumrotate evaporation, precipitated with 2-propanol and collected by centrifugation. Colloidal precipitates were dried in vacuum at 60 °C, and re-dispersed in aqueous solution for subsequent experiments.

**1.3 Preparation of QDs-MPA-DA<sub>b</sub>**

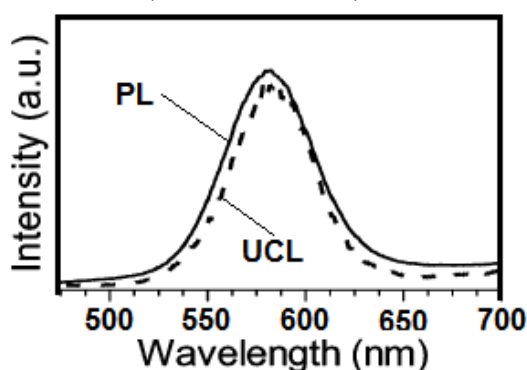
The as-prepared MPA-CdTe QDs were modified by coupling DA on the surface of QDs directly. Briefly, under the action of ultrasonic, 1.0 mg mL<sup>-1</sup> of QDs dispersed in PBS (10 mM, pH 9.0) was treated with 1.0 mg mL<sup>-1</sup> of DA for 10 min. Then, 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide (EDC) hydrochloride was added (10 mM). The resulting mixture solution was sonicated for another 1 h, followed by the addition of EDC (40 mM) and N-hydroxysuccinimide (NHS, 20 mM), stirring for 24 h. The reaction was terminated by adding mercaptoethanol. Final reaction solution was further purified by centrifugation (12 000 rpm) for

1 1 h. The supernatant was collected to obtain products, which were diluted with PBS to prepare the surface  
2 modified CdTe QDs (QDs-MPA-DA<sub>b</sub>) aqueous suspension for following experiments.

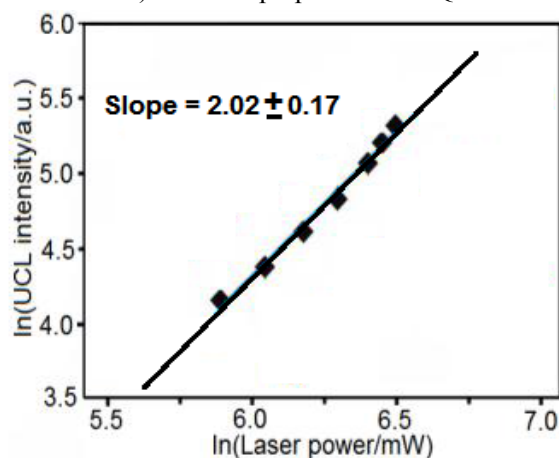


**Fig. S1** (a) TEM images, (b) XRD patterns, (c) UV-vis absorption and PL emission spectra of the as-prepared MPA-CdTe QDs.

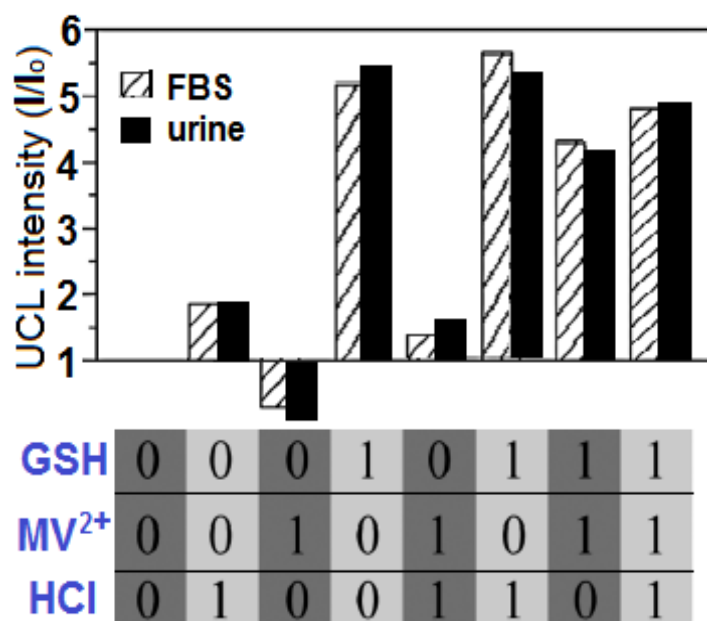
The as-prepared MPA-CdTe QDs were characterized by transmission electron microscopy (TEM), X-ray powder diffraction (XRD), UV-vis absorption and PL emission spectra. As exhibited in Fig. S1a, these QDs were quasi-spherical particles, with a uniform and average diameter of ~4.8 nm. XRD patterns (in Fig. S1b) indicated that the lattice parameters of QDs fitted well to zinc-blende (ZB) structure of bulk CdTe crystal. Fig. S1c showed that the first excitation absorption weak appeared at ~530 nm, and the maximum emission wavelength occurred at ~585 nm (excited at 530 nm).



**Fig. S2** PL spectrum (excited at 530 nm) and UCL spectrum upon the excitation with an 800 nm fs laser (6 mW) of the as-prepared CdTe QDs



**Fig. S3** The ln-ln plot of the integral intensity from UCL (excited with an 800 nm fs laser) of QDs vs. the pump power of the fs laser.



**Fig. S4** Relative UCL intensity of the QDs-MPA-DA<sub>b</sub> logic-gate system in FBS and human urine samples (with 100-fold dilution) under different input conditions (as indicated in the inserted table).