Electronic Supplementary Information (ESI)

A FRET-based ratiometric fluorescent aptasensor for rapid and onsite visual detection of ochratoxin A

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Synthesis of the gQDs and rQDs. 0.0449 g of $NaBH_4$ and 0.0638 g of tellurium powder were mixed with 4 mL of ultrapure water and bubbled with high-purity nitrogen for 15 min. This mixture was conducted for 2 h in a 10 mL glass tube. Subsquently, 0.1142 g of $CdCl_2 \cdot 2.5H_2O$ and 75 μL of MPA were added into 50 mL of ultrapure water and the pH of the mixing solution was adjusted to 9.0 with NaOH solution under nitrogen atmosphere. Then, 2 mL of freshly prepared NaHTe solution was added into the above solution immediately and stirring for 10 min. The reaction mixture was refluxed at a temperature of 100 ^oC for 0.5 h and 10 h to obtain gQDs and rQDs, respectively. The reaction mixture was treated with 50 mL of ethanol, and then purified by centrifugation and washed with water and ethanol. Finally, the resulting gQDs and rQDs were finally dispersed in 10 mL of water, respectively.

Synthesis of the AuNPs. All glassware was thoroughly cleaned with aqua regia (3:1 HCl/HNO_3), then extensively rinsed with water and dried in an oven for later use. In a typical procedure, 3 mL of 1% $HAuCl_4$ solution and 1 mL of 0.2 M K_2CO_3 were added to 200 mL of water which cooled to 4 ◦C in a fridge. Subsequently, 9 mL of freshly prepared $NaBH_4$ aqueous solution (0.5 mg mL^{-1}) was added to above mixture with rapid stirring. The solution turned a color change from orange to wine red as the additions take place. After the solution was stirred for 5 min; it was cooled to room temperature and stored at 4 °C for further use.

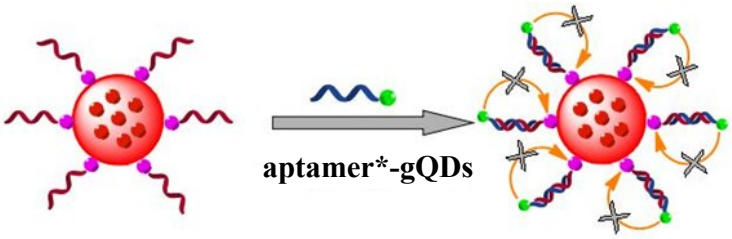
Preparation of rQDs@SiO_2@AuNPs hybrid spheres. 40 mL of ethanol, 0.5 mL of rQDs solution and 100 μL of APTS were mixed in a 100 mL flask and stirred for 6 h. Then, 0.5 mL of TEOS and 0.5 mL of $NH_3 \cdot H_2O$ was added to the system and stirred for 12 h. After centrifugation and washing with ethanol and water, the as-obtained rQDs@SiO_2 nanospheres were dispersed into a 0.4 wt % PDDA salt solution (0.02 M NaCl, 30 mL) and stirred for 1 h to give a homogeneous suspension. Residual PDDA was removed by centrifugation, and the precipitate was washed with water for several times. Subsequently, the obtained PDDA-functionalized rQDs@SiO_2 was redispersed in 10 mL of the resulting AuNPs solution. After stirring for 1 h, the resulted rQDs@SiO_2@AuNPs hybrid spheres were collected by centrifugation and washing, and redispersed in 10 mL of water for later use.

Synthesis of the aptamer*-coupled gQDs. 1 mL of MPA-capped gQDs was mixed with 40 μL of EDC (1 mM) and 40 μL of NHS (1 mM) and gently stirred for 2 h at room temperature. To immobilize of the amino-modified aptamer*, 40 μL of 100 μM aptamer* was added to above mixture, followed by gentle shaking overnight. After centrifugation, the as-obtained aptamer*-coupled gQDs (aptamer*-gQDs) were redispersed in 1 mL of Tris-HCl buffer solution (pH 7.4, 10 mM) containing 120 mM NaCl, 20 mM $CaCl_2$, and 5 mM KCl.

Table S1 Characteristics of the present sensor along with others reported in the literatures.

Analytical Method	Linear ange (ng mL^{-1})	Detection Limit (pg mL^{-1})	Reference
HPLC[a]	0.1-8	100	5
MS[b]	—	300	6
GC[c]	⩾0.1	100	7
ELISA[d]	0.5-100	850	9
EC[e]	4.04-404	5.65	19
	0-200	1000	20
ECL[f]	0.02-3	7	21
CM[g]	8-252	8000	22
FL[h]	1.2-1200	1200	17
	0.01-0.3	2	18
	0.005-10	1.67	This work

[a]HPLC, high performance liquid chromatography;
[b]MS, mass spectrometry;
[c]GC, gas chromatography;
[d]ELISA, enzyme-linked immunosorbent assays;
[e]EC, electrochemistry;
[f]ECL, electrochemiluminescence;
[g]CM, colorimetry;
[h]FL, fluorescence.



Scheme S1. Schematic illustration of the unavailable FRET of the rQDs@SiO_2@AuNPs-cDNA/aptamer*-gQDs.

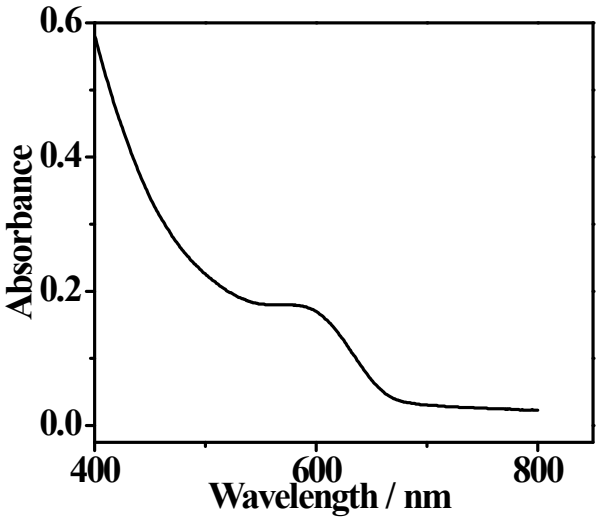


Fig. S1. UV-vis spectrum of rQDs.

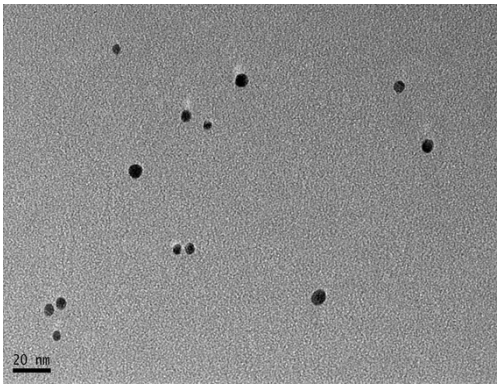


Fig. S2. TEM image of AuNPs.

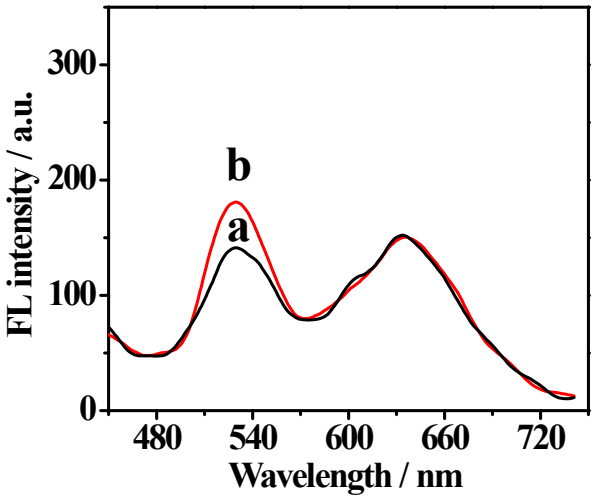


Fig. S3. Fluorescence spectra of the rQDs@SiO_2@AuNPs-cDNA/aptamer*-gQDs bioconjugations when 0.2 (a) and 0.4 (b) mL of aptamer*-gQDs was reacted with 3 mL of rQDs@SiO_2@AuNPs-cDNA.

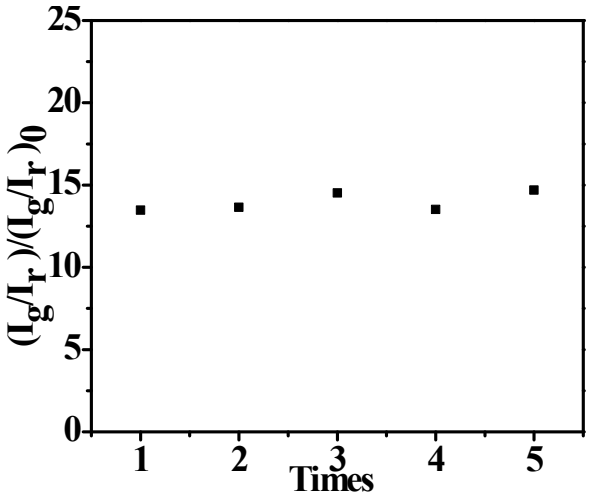


Fig. S4. Primary data of the relative intensity ratio of the aptasensor for five independent measurements at the OTA concentration of 10 ng mL^{-1}.

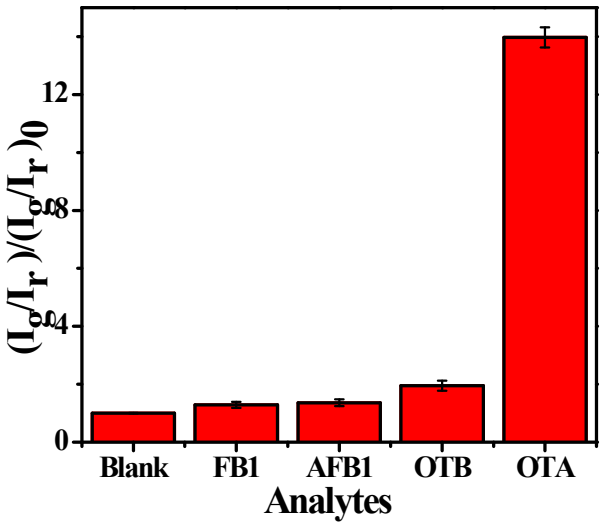


Fig. S5. The relative intensity ratio of the aptasensor in the presence of 10 ng mL^{-1} OTA and 100 ng mL^{-1} of related substance (FB1, AFB1, and OTB).

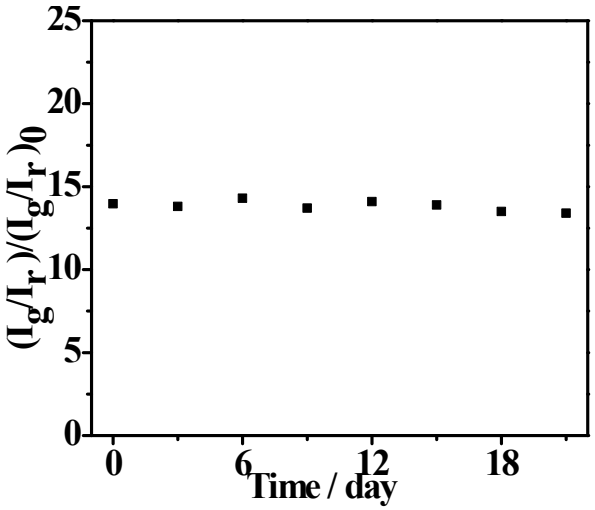


Fig. S6. The relative intensity ratio of the aptasensor versus time at the OTA concentration of 10 ng mL^{-1}.