Supporting Information

Multi-emitting fluorescence sensor of MnO$_2$-OPD-QDs for the multiplexed and visual detection of ascorbic acid and alkaline phosphatase

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1. Related descriptions

**Synthesis of red-fluorescent CdTe/ZnS QDs (r-QDs)**

Red-fluorescent CdTe QDs were firstly synthesized according to the previous work. In brief, 68.4 mg of CdCl$_2$·5H$_2$O and 78.5 μL of MPA were mixed in 75 mL of ultrapure water to form the cadmium precursor, with pH adjusted to 9.0 and stirring under N$_2$ for 30 min. Then, 1 mL of freshly prepared NaHTe aqueous solution (with 40 mg of NaBH$_4$ and 38.3 mg of tellurium powder reacting in ethanol-water solution (1.5mL/0.5mL) at 40 °C for 4 h) was expeditiously injected into the above reaction system under stirring. The solution was heated and refluxed for 24 h to obtain the red-fluorescent CdTe QDs. Next, the red-fluorescent CdTe/ZnS QDs were prepared by the situ growth of ZnS shell onto the red-fluorescent CdTe QDs. Briefly, 8 mL of as-prepared red-fluorescent CdTe QDs was added to 25 mL solution containing 1 mmol·L$^{-1}$ ZnCl$_2$ and 4 mmol·L$^{-1}$ GSH. After being adjusted to pH 8, the mixture was heated to 100 °C under open-air conditions and refluxed for 30 min. (Reagents and materials) Tellurium and sodium borohydride (NaBH$_4$) were offered by Sigma-Aldrich (Shanghai, China). 3-Mercaptopropionic acid (MPA) and reduced glutathione (GSH) was supplied by Aladdin (Shanghai, China). Cadmium chloride pentahydrate (CdCl$_2$·5H$_2$O), zinc chloride (ZnCl$_2$), sodium hydroxide (NaOH) and ethanol were provided by Sinopharm Chemical Reagent Co. Ltd. (Shanghai, China).

**References**


2. Figures

![Fig. S1 Chromaticity diagram](image1)

**Fig. S1** Chromaticity diagram to indicate the color variation ranges of (a) green- and blue-emission, (b) yellow- and blue-emission, and (c) yellow-, red- and blue-emission based fluorescence sensors.

![Fig. S2 Fluorescence spectra](image2)

**Fig. S2** Fluorescence spectra of OPD (black line), OPDox (red line) and its mixture with r-QDs in the absence (blue line) or presence (green and purple lines) of AA. Inset: fluorescence spectra of r-QDs after eliminating the spectral overlap effect of yellow emission peak, of the mixture of OPDox and r-QDs in the absence (blue line) or presence (green and purple lines) of AA, respectively. Right: fluorescence images of mixture of OPDox and r-QDs in the absence (a) and presence (b, c) of AA, respectively.
**Fig. S3** Absorbance spectrum of OPDox (black line), fluorescence excitation spectrum (green line) and emission spectrum (red line) of r-QDs, and the spectral overlap between OPDox’s absorbance and r-QDs’ excitation.

**Fig. S4** Fluorescence intensity of OPDox prepared with different concentrations of OPD.
**Fig. S5** Reaction time-dependent fluorescence intensity change of OPDox synthesized at different reaction temperature of (A) 30 °C, (B) 40 °C, (C) 50 °C and (D) 60 °C.

**Fig. S6** Fluorescence colors of MnO$_2$-OPD-QDs sensors containing different volumes of r-QDs before and after interaction with AA.
Fig. S7 Fluorescence intensity of OPDox provided by the MnO$_2$-OPD-QDs sensor with increasing concentration of AA2P.

Fig. S8 (A) Fluorescence spectra and (B) intensities of r-QDs after eliminating the effect of spectral overlap with increasing concentration of AA (from 0 to 30 μM).

Fig. S9 Fluorescence intensity decreasing effect of OPDox in the MnO$_2$-OPD-QDs sensor with increasing activity of ALP and increasing concentration of AA2P (5, 10, 20, 30, 40 and 50 mM).
3. Table

Table S1 The nonlinear fitting curves for the ratiometric fluorescence intensity change of blue- and yellow-emission peaks in Fig. 4, i.e., \((I_{441}/I_{569})/(I_{441}/I_{569})_0\), and the related parameter values

<table>
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<th>line A (ternary-emission)</th>
<th>line B (dual-emission)</th>
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</thead>
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<td>model</td>
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<td>logistic</td>
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<tr>
<td>equation</td>
<td>(y = A2 + (A1 - A2) / (1 + (x / x0)^p))</td>
<td>(y = A2 + (A1 - A2) / (1 + (x / x0)^p))</td>
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<tr>
<td>A1</td>
<td>2.23564 ± 0.92572</td>
<td>2.65482 ± 1.07491</td>
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<td>A2</td>
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<td>x0</td>
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<td>p</td>
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