Supplementary Information

One-step synthesis of red/green dual-emission carbon dots for ratiometric sensitive ONOO⁻ probing and cell imaging

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Scheme S1. Structural formulas of 2,5-diaminotoluene sulfate, 2,5-diaminotoluene and methylhydrazine sulfate.
**Table S1.** Comparation of the properties of the RGDE CDs with other CDs.

<table>
<thead>
<tr>
<th>Synthetic raw material</th>
<th>Single/dual emission</th>
<th>Excitation wavelength (nm)</th>
<th>Emission wavelength (nm)</th>
<th>QY (%)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>citric acid, urea, sodium fluoride</td>
<td>single</td>
<td>530</td>
<td>600</td>
<td>1.20</td>
<td>1</td>
</tr>
<tr>
<td>citric acid, neutral red</td>
<td>single</td>
<td>530</td>
<td>632</td>
<td>12.1</td>
<td>2</td>
</tr>
<tr>
<td>p-phenylenediamine</td>
<td>single</td>
<td>470</td>
<td>620</td>
<td>15.0</td>
<td>3</td>
</tr>
<tr>
<td>ascorbic acid, ethylene glycol</td>
<td>dual</td>
<td>365</td>
<td>435/538</td>
<td>not mentioned</td>
<td>4</td>
</tr>
<tr>
<td>m-phenylenediamine, sulfuric acid</td>
<td>dual</td>
<td>300</td>
<td>360/520</td>
<td>43.0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(460 nm excitation)</td>
<td></td>
</tr>
<tr>
<td>citric acid, urea</td>
<td>dual</td>
<td>380</td>
<td>455/520</td>
<td>14.0</td>
<td>6, 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(420 nm excitation)</td>
<td></td>
</tr>
<tr>
<td>2,5-diaminotoluene sulfate</td>
<td>dual</td>
<td>380</td>
<td>525/603</td>
<td>9.00</td>
<td>this work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(380 nm excitation)</td>
<td></td>
</tr>
</tbody>
</table>
Fig. S1. Effect of ethanol volume on the fluorescence intensity (603 nm) of the RGDE CDs.
Fig. S2. Effect of reaction temperature on the fluorescence intensity (603 nm) of the RGDE CDs.
Fig. S3. Effect of reaction time on the fluorescence intensity (603 nm) of the RGDE CDs.
Fig. S4. XPS full-scan spectrum of the RGDE CDs.
Fig. S5. Fluorescence excitation spectrum of the RGDE CDs.
**Fig. S6.** Fluorescence excitation and emission spectra of the CDs prepared through using 2,5-diaminotoluene as carbon source.
**Fig. S7.** Fluorescence excitation and emission spectra of the CDs prepared through using methylhydrazine sulfate as carbon source.
**Fig. S8.** Confocal microscopy fluorescence images of HeLa cells treated with the RGDE CDs (30 μg/mL) in green channel, red channel and merged image of green and red channel. Scale bar is 10 μm.
Fig. S9. Effect of light illumination time on the fluorescence intensity of the RGDE CDs.
Fig. S10. Effect of concentration of NaCl solution on the fluorescence intensity of the RGDE CDs.
**Fig. S11.** Effect of environmental temperature on the fluorescence intensity of the RGDE CDs.
Fig. S12. Effect of pH of buffer solution on the fluorescence intensity of the RGDE CDs.
Fig. S13. Effect of pH of buffer solution on $(F_{525}/F_{603})_0$ and $(F_{525}/F_{603})$. $(F_{525}/F_{603})_0$ and $(F_{525}/F_{603})$ were the fluorescence intensity ratios of the RGDE CDs solution in the absence and presence of 22 μM ONOO$^-$, respectively.
Fig. S14. Time-dependent fluorescence intensity of the RGDE CDs with the addition of 22 μM ONOO⁻ at room temperature.
Fig. S15. FT-IR spectrum of the RGDE CDs in the presence of ONOO⁻.
**Fig. S16.** Cyclic voltammograms of the RGDE CDs in the solution state (solvent: freshly dried dimethylformamide).
**Fig. S17.** Cyclic voltammograms of $\text{ONOO}^-$ in the solution state (solvent: freshly dried dimethylformamide).
Fig. S18. UV-vis absorption spectrum of ONOO⁻, inset was the photograph of ONOO⁻ solution under visible light.
Fig. S19. Time-resolved decays of the RGDE CDs in the absence (black line) and presence (red line) of ONOO−.
Fig. S20. Cell viability of HeLa cells with different concentrations of the RGDE CDs.
Quantum yield (QY) measurements.

QY of the obtained RGDE CDs was determined by the method mentioned in our previous work. The absolute photoluminescence quantum yield can be represented simple in the equation below:

\[
QY = \frac{\int L_{\text{emission}}}{\int E_{\text{solvent}} - \int E_{\text{sample}}} \quad (1)
\]

where QY was the absolute quantum yield, \( L_{\text{emission}} \) was the fluorescence (FL) emission spectrum of the RGDE CDs sample, collected using the sphere; \( E_{\text{sample}} \) was the spectrum of the light used to excite the sample, collected using the sphere; \( E_{\text{solvent}} \) was the spectrum of the light used for excitation with only the solvent in the sphere, collected using the sphere. The solvent in this experiment was deionized water.
References


