Supporting Information

A double responsive fluorescent platform for sensing heavy metal ions based on a dual-emitting fluorescent covalent organic framework hydrogel film

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Scheme S1. The chemical structural formula of 7-amino-4-methyl coumarin.

Supporting Figures

Fig. S1 SEM images of TpDq.

Fig. S2 SEM images of Dye@TpDq.
Fig. S3 EDX spectrum of TpDq.

Fig. S4 EDX spectrum of Dye@TpDq.

Fig. S5 Picture of 1.
Fig. S6 XPS spectra of pristine TpDq, Dye@TpDq and 1.

Fig. S7 XPS spectra of 1 and Eu(NO$_3$)$_3$·6H$_2$O for the Eu 3d electron.
Fig. S8 The luminescence spectrum of 1.

Fig. S9 Excitation and emission spectra of Dye@TpDq in aqueous solution.
**Fig. S10** Changes of CIE coordinates of emitted light after detection of Cu$^{2+}$.

**Fig. S11** Comparison of emission spectra of Eu@blank SA film and 1.
**Fig. S12** Time-dependent emission intensities ratio ($I_{616\text{nm}}/I_{440\text{nm}}$) of 1 soaking in aqueous solution.

**Fig. S13** The emission intensities ratio ($I_{616\text{nm}}/I_{440\text{nm}}$) of 1 immersed in different pH solutions for 30 min.
**Fig. S14** The emission intensities ratio ($I_{616\text{nm}}/I_{440\text{nm}}$) of 1 added $10^{-2}$ M Cu$^{2+}$ in aqueous solution set aside with different times. The emission of blank was used as a reference for other samples.

**Fig. S15** Lifetime decay curve of 1 ($\lambda_{\text{ex}} = 345$ nm, $\lambda_{\text{em}} = 616$ nm).
Fig. S16 Lifetime decay curve of 1 added with $10^{-2}$ M Cu$^{2+}$ ($\lambda_{ex} = 345$ nm, $\lambda_{em} = 616$ nm).

Fig. S17 S–V intensity plot of Cu$^{2+}$. 
Fig. S18 UV-vis absorption spectra of Cu$^{2+}$ solutions before (a) and after (b) soaking 1.

Fig. S19 Luminescence spectra of 1 after immersion in 10$^{-6}$-10$^{-2}$ M Cu$^{2+}$ drinking water solution ($\lambda_{ex} = 345$ nm)
Fig. S20 The corresponding calibration curves ($I_{616\text{nm}}/I_{440\text{nm}}$).

Fig. S21 Histogram of the 616 nm emission intensities of 1 in various anion solutions before and after the addition of $\text{Cr}_2\text{O}_7^{2-}$ and $\text{CrO}_4^{2-}$ ($10^{-2}$ M).
**Fig. S22** Lifetime decay curve of 1 added with $10^{-2}$ M Cr$_2$O$_7^{2-}$ and CrO$_4^{2-}$ ($\lambda_{\text{ex}} = 345$ nm, $\lambda_{\text{em}} = 616$ nm).

**Fig. S23** UV-vis absorption spectra of Cr(VI) and dye.
Table S1 The weight percentage of all elements in TpDq, Dye@TpDq and 1 determined by Energy dispersive X-ray (EDX).
Table S2 Responses of luminescence lifetimes of 1 towards various concentrations of Cu²⁺.

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<thead>
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<th>Concentration (mol/L)</th>
<th>τ (μs)</th>
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<td>10⁻⁶</td>
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Table S3 Responses of luminescence lifetimes of 1 towards various concentrations of Cr₂O₇²⁻ (top) and CrO₄²⁻ (bottom).

<table>
<thead>
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<th>Concentration (mol/L)</th>
<th>τ (μs)</th>
</tr>
</thead>
<tbody>
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<td>10⁻²</td>
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The detection limit (LOD) can be calculated by the following equation:

\[
\frac{3.3\sigma}{LOD} = \frac{\text{Signal intensity (A)}}{\text{Concentration (A)}}
\]

\(\sigma\) is the standard deviation of luminescent intensity for 20 replicating fluorescence measurements of blank solutions,

\(A\) is the minimum concentration in the linear relationship.