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Photoluminescent hydrogel/carbon quantum dots nanocomposite for Fe^{3+} ions sensing: selectivity and recovery

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Evaluation of the limit of the Fe^{3+} ions detection (LOD)

For evaluation of the PL quenching, we used the Stern–Volmer equation:

$$\frac{F_0}{F} = 1 + K_{SV}[Fe^{3+}] = 1 + k_q\tau_0[Fe^{3+}] \quad \text{(S1)}$$

where F_0 and F are the PL intensity of PAA@CQDs in the absence and in the presence of the Fe^{3+} quencher, respectively,

K_{SV} is the Stern–Volmer quenching constant,

$[Fe^{3+}]$ is the Fe^{3+} ions (quencher) concentration in water solutions (μM),

k_q is the rate constant of the bimolecular quenching process, and τ_0 is the fluorescence lifetime in the absence of the Fe^{3+} ions.

Following Equation (S1), we plotted the PL quenching parameter, $1–(F/F_0)$, against [Fe3+] (see Figure S1) and concluded that the PL quenching of PAA@CQDs increased with increasing $[Fe^{3+}]$. Furthermore, as follows from the inset, linearity between $1–(F/F_0)$ and $[Fe^{3+}]$ could be clearly recognized when $[Fe^{3+}]$ varies from 0 to 600 μM, thus confirming validation of the Stern–Volmer equation. The limit of the Fe^{3+} ions detection (LOD) was estimated as $3\sigma/k = 0.763$ nM, where $\sigma = 2.3 \times 10^{-4}$ is the standard deviation of 6 blank experiments and $k = 1.62 \times 10^{-3}$ l μmol^{-1} is the slope of the calibration relationship.

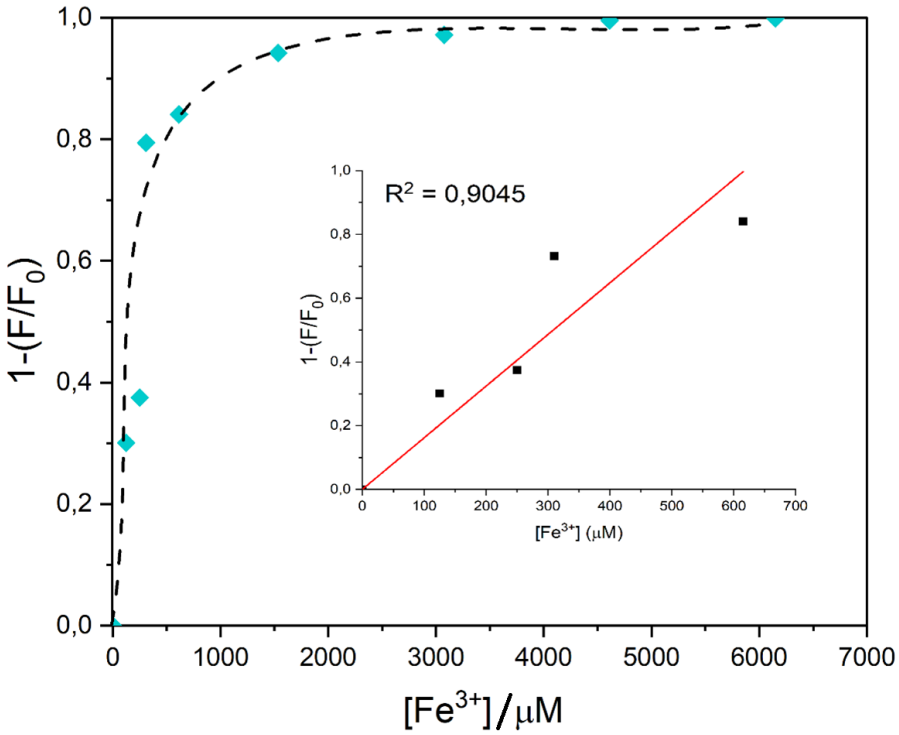

Figure S1 Quenching parameter, 1-(F/F_0), as a function of [Fe^{3+}] for PAA@CQDs. The inset shows its linearity when [Fe^{3+}] varies from 0 to 600 μM according to Equation (S1).

Table S1 Comparison of the fluorescence probes for the detection of Fe^{3+}.

Sensors	Linear range (μM)	Limit of detection (μM)	Reference
N-doped CQDs	100–1000	0.3	[S1]
N-doped CQDs	0–110	0.177	[S2]
Hydrogel@CQDs	10–100	0.065	[S3]
Hydrogel@CQDs	1–1000	0.27	[S4]
Boron-dipyrromethene-based probe	0–22.4	0.16	[S5]
Metal doped GO	0.1–1	0.0345	[S6]
Hydrogel@CQDs	0–250	0.115	[S7]
Functionalized AA HG	0–50	1.1	[S8]
Eu^{3+} doped nanoparticles	10–90	0.0632	[S9]
PAA@CQDs	0–600	0.124	This work

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