Supporting Information

Reusable and pH-Stable Luminescent Sensors for Highly Selective Detection of Phosphate

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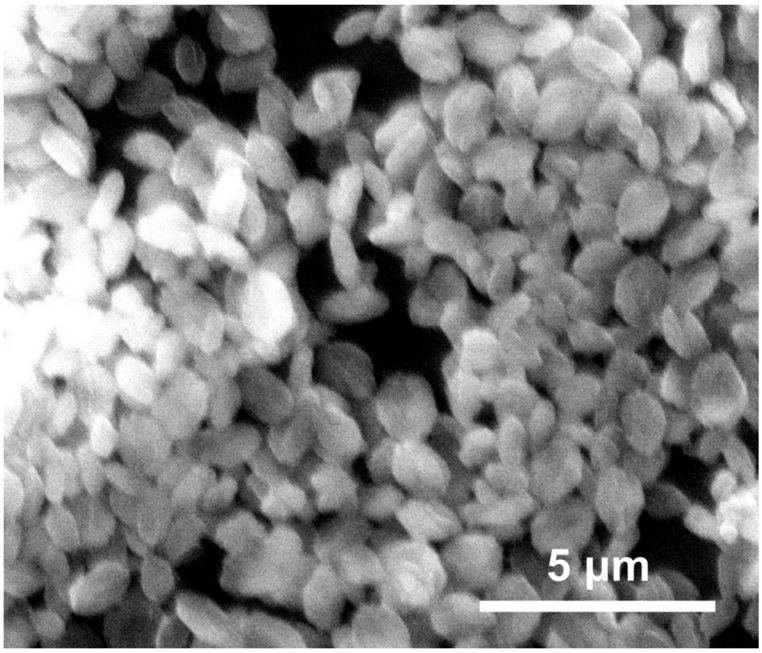

Figure S1. SEM image of Eu-TCA microcrystals.

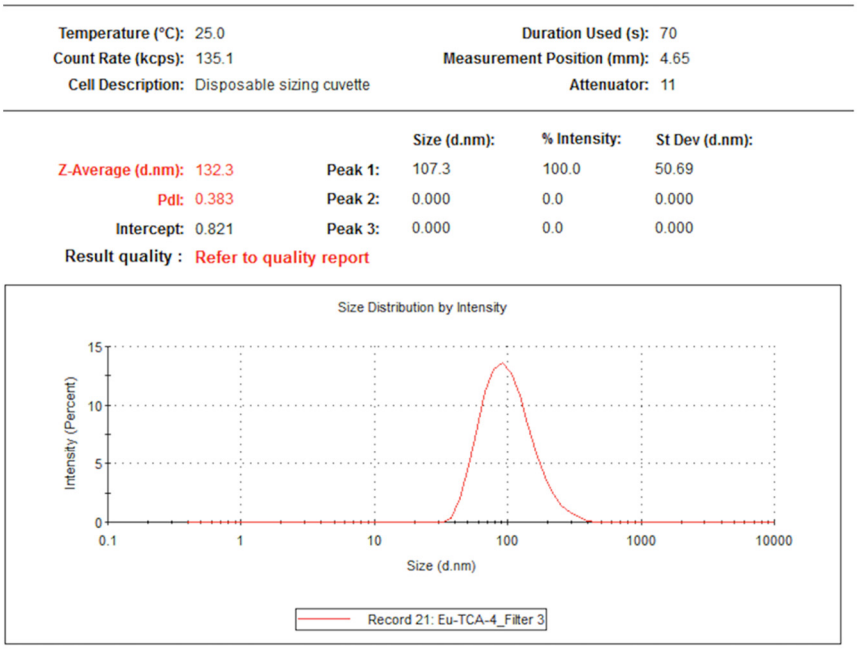

Figure S2. Dynamic light scattering analysis of Eu-TCA.

Synthesis of Eu-TCA microcrystals

$EuCl_3$ (235 mg, 0.64 mmol, 5.3 eq.), TCA ligand (60 mg, 0.12 mmol, 1 eq.), and polyvinylpyrrolidone (533 mg) were reacted under solvothermal conditions in a mixed solvent of dimethylformamide (32 mL) and ethanol (19 mL). The reaction was conducted at 150°C for 12 h. After the reaction, the reaction mixture was cooled to room temperature over the next 6 h, and colloidal particles were precipitated by centrifugation. Three cycles of washing with dry dimethylformamide and centrifugation were followed by a final wash with ethanol. The sample was dried in an oven at 70°C for 3 h.

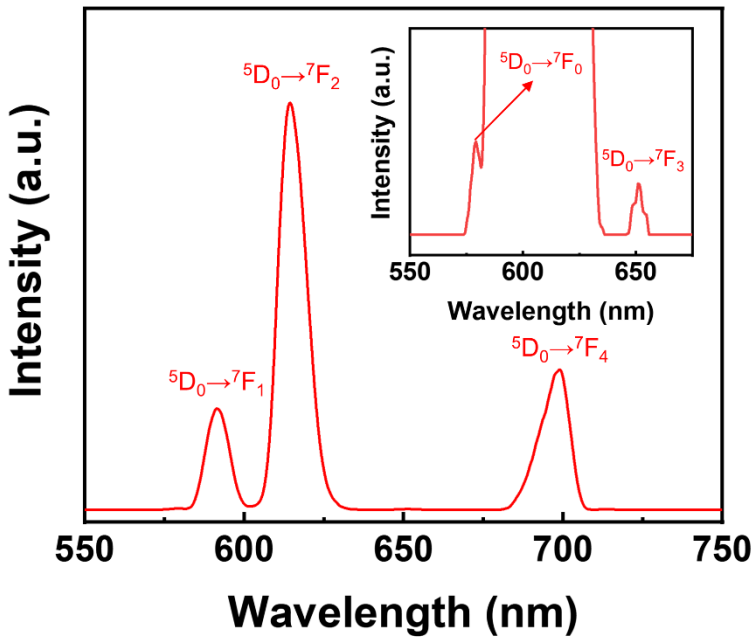

Figure S3. Emission spectrum of Eu-TCA dispersion (λ_{ex} = 260 nm). The inset shows enlarged emission spectrum.

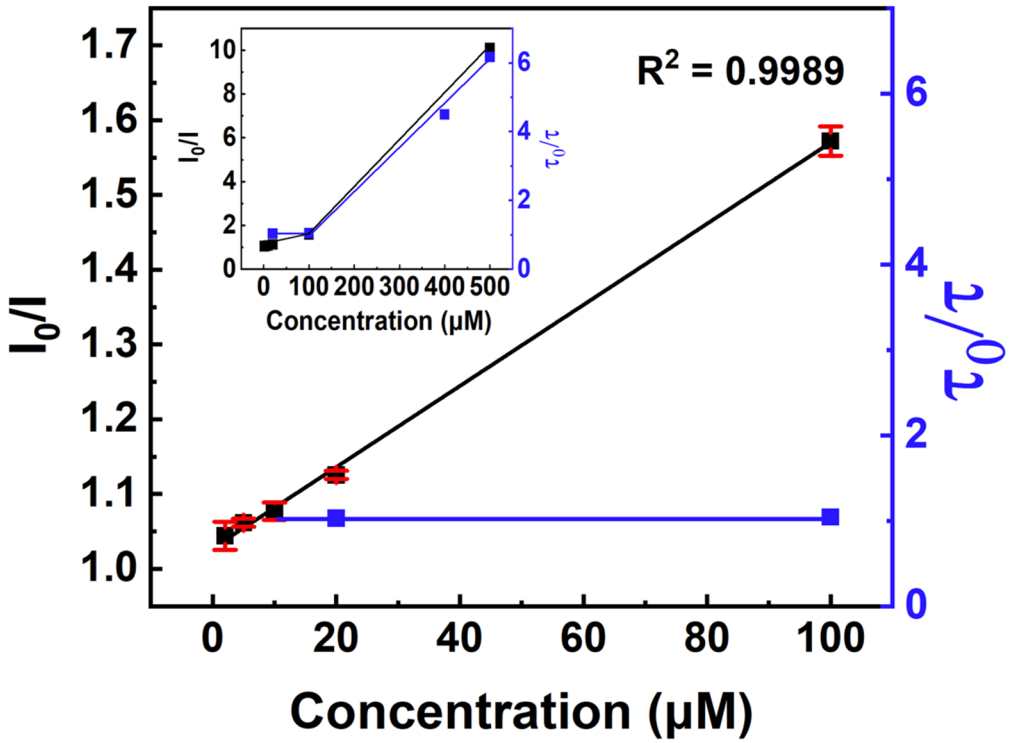

Figure S4. *Stern-Volmer* plot for the luminescence quenching of Eu-TCA dispersion upon addition of different concentrations of phosphate. Inset shows the *Stern-Volmer* plot in the concentration range of 2–500 μM.

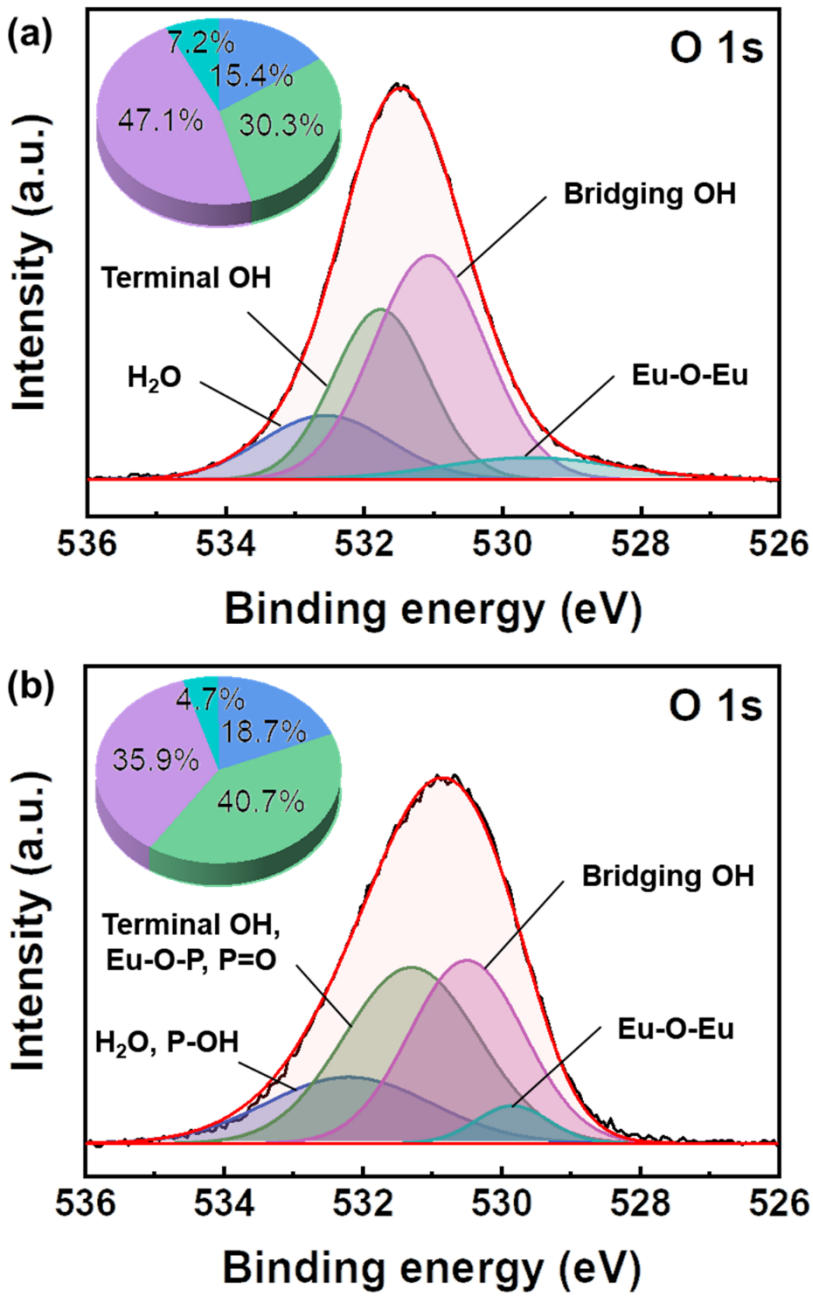

Figure S5. Experimental fit performed on O 1s XPS spectra before (a) and after (b) incubation with phosphate.

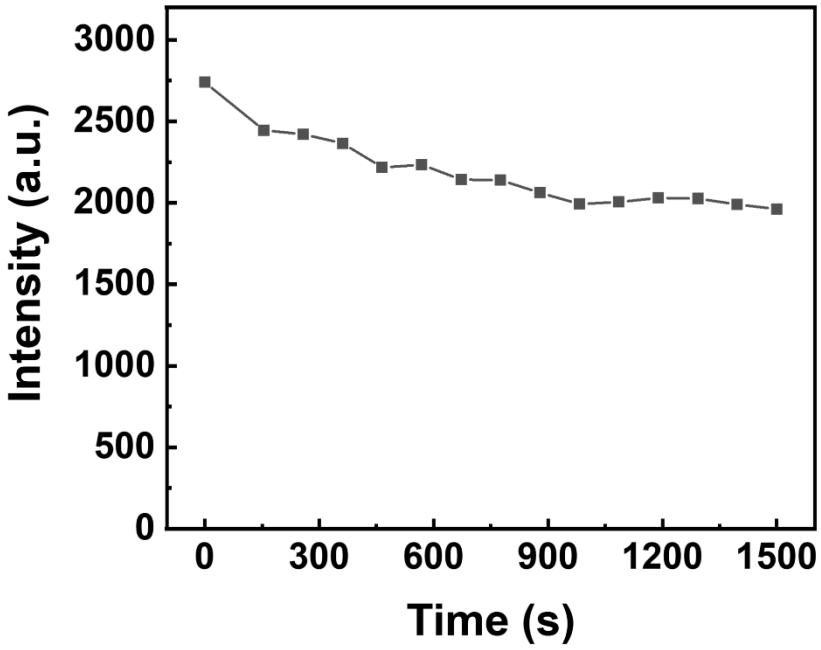

Figure S6. Time-dependent luminescence intensity of the Eu-TCA/GMF upon the addition of 100 μM of phosphate.

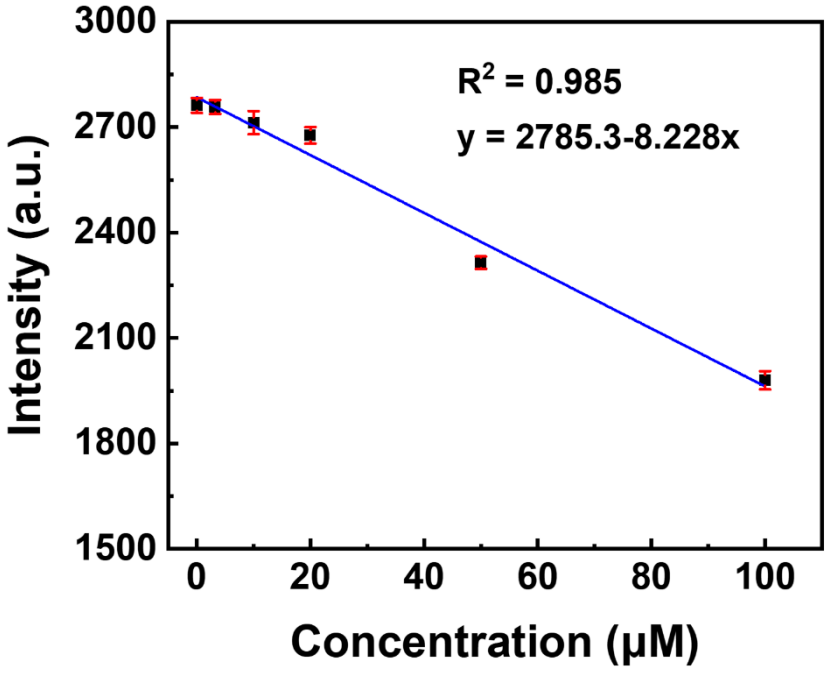

Figure S7. The luminescence intensity of Eu-TCA/GMF under various phosphate concentrations and their linear fit curve for the estimation of LOD.

Table S1. Comparison of various analytical methods for phosphate detection.

Analytical methods	Sensing element/structure	Linear range (μM)	LOD (μM)	Reusable [1]	pH range [2]	Ref.
Potentiometry	Mo-based electrode	10–10^5	1.9	O	pH-unstable [3]	S1
	W-based electrode	1–10^5	0.4	O	pH-unstable [3]	S2
	Polymeric membrane electrode	32–10^5	10	O	pH-unstable [3]	S3
Voltammetry	Screen-printed electrodes modified with carbon black nanoparticles	0.5–100	0.1	O	pH-unstable [3]	S4
I-V measurement	Ag/graphene composite-based field-effect transistor	5–6000	1.2	O	–	S5
Colorimetric probe	Au nanoparticles/Eu^{3+}	0.5–30	0.076	X	–	S6
	Functionalized Au nanoparticles	80–200	120	X	7–8	S7
Luminescent probe	Eu@BUC-14	5–150	0.88	X	4–8	S8
	UiO-66-NH_2 MOF [4]	5–150	1.25	X	–	S9
	Eu-triazole MOF [4]	3–30	6.62	X	–	S10
	Tb-MOF [4]	40–400	35	X	–	S11
	Eu-based nanospheres	2–100	0.83	X	5–9	S12
	Eu-TCA/GMF	3–500	1.52	O	3–10	This work

[1] The term "reusable" means the sensing material can be easily reused without complex processes such as centrifugation or drying. [2] pH range that does not affect the sensor performance. [3] Needs pH compensation model. [4] MOF: metal-organic framework.

References

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