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R-Phycoerythrin Proteins@ZIF-8 Composite Thin Film for Mercury Ions Detection

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Abstract: Mercury, as one of the most prevalent toxic metals released by various natural and anthropogenic processes, causes severe pollution of soil and groundwater. In this work, R-Phycoerythrin (R-PE) proteins encapsulated in ZIF-8 composite thin films were prepared via a solid-confinement conversion process and applied as fluorescent sensor for mercury ions detection. The R-PE proteins encapsulated in ZIF-8 exhibit dual colors emission including green (518 nm) and red (602, 650 nm) fluorescence, while the original orange emission (578 nm) of pure R-PE is significantly suppressed. R-PE@ZIF-8 presents excellent selectivity and sensitivity for mercury detection in a large pH range without buffer solution. Under the optimal conditions, there is a good linear relationship for mercury ions in the range of 0.001-50 μM with the detection limit (LOD) of 6.7 nM much lower than the guideline value given by the World Health Organization. Furthermore, multi-peak detection of R-PE@ZIF-8 improves the detecting accuracy of Hg^{2+} concentration.

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Table S1 Linear regression equations and the detection limits (LODs) of R-PE@ZIF-8 for Hg²⁺

Wavelength (nm)	Equation	R ²	LOD (nM)
518	$y = 15.1x + 39.3$	0.968	6.7
602	$y = 13.6x + 51.2$	0.983	7.4
650	$y = 14.3x + 60.4$	0.964	7.1

concentration detection.

Table S2 Brief specifications of the previously reported fluorometric mercury sensors.

Strategies	Linear range	Detection limit (nM)	Reaction time (min)	References
Rhodamine-based fluorescent probe	0.001-0.1 μ M	0.1	2	1
Gold nanoparticles	0.02-1.0 μ M	16	30	2
DNA-based fluorogenic probe	0-0.05 μ M	2.1	30	3
GSH-capped CdS nanoparticles	0.015-1.25 μ M	4.5	5	4
R-PE solution	0.001-25 μ M	13	10	5
CdTe quantum dots	0.006-0.45 μ M	4.0	5	6
R-PE@ZIF-8 thin films	0.001-50 μ M	6.7	5	This work

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