Electronic Supplementary Information (ESI) for

Tri-functional Fe-Zr bi-metal–organic frameworks enable high-performance phosphate ion ratiometric fluorescent detection

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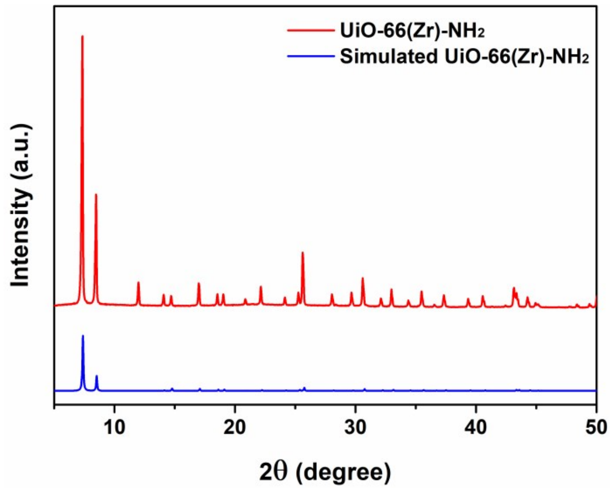

Figure S1. XRD pattern of UiO-66(Zr)-NH_2.

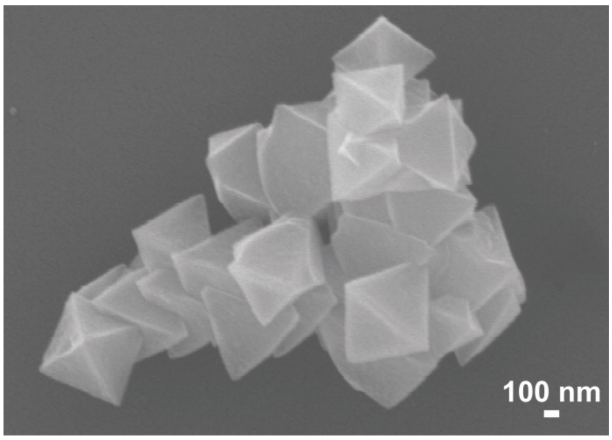

Figure S2. SEM image of UiO-66(Zr)-NH_2.

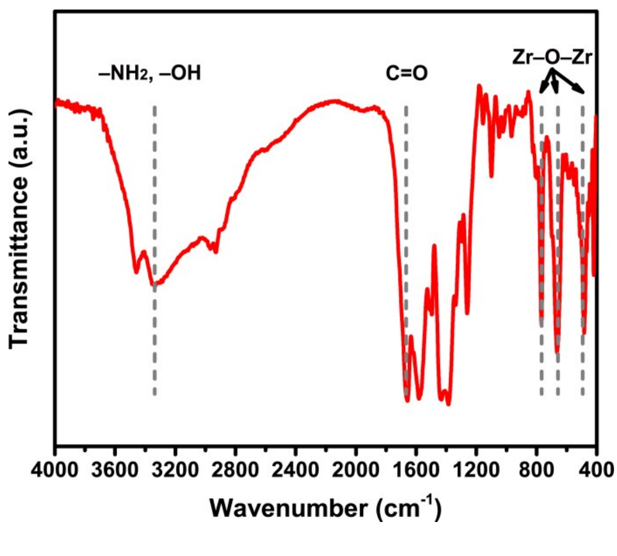

Figure S3. FTIR spectrum of UiO-66(Zr)-NH_2.

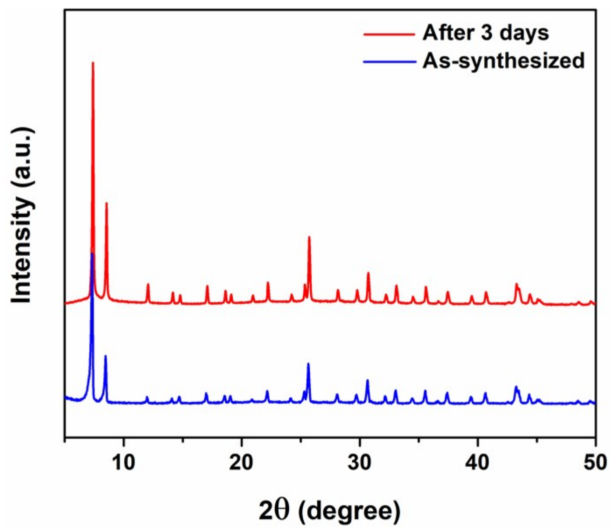

Figure S4. XRD pattern of UiO-66(Fe/Zr)-NH_2 after suspension in NaAc-HAc buffer (pH 4.0) for three days.

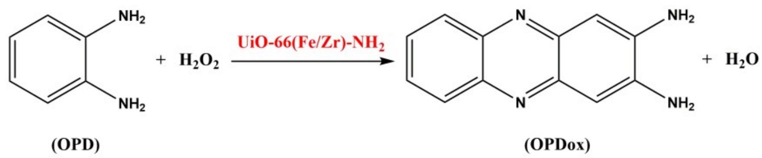

Figure S5. H_2O_2-assisted oxidation of OPD to OPDox under the peroxidase-mimetic catalysis of UiO-66(Fe/Zr)-NH_2.

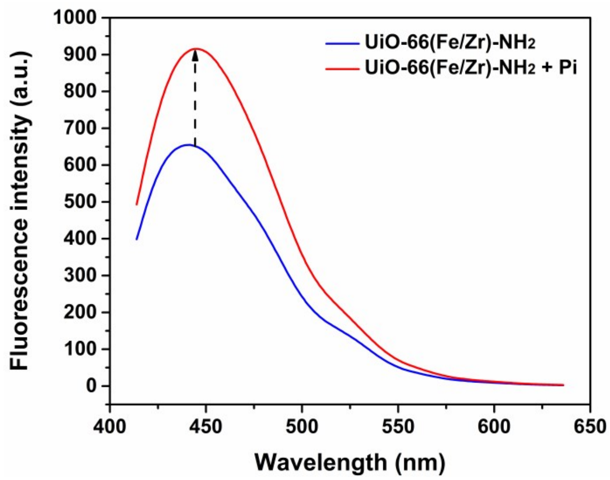

Figure S6. Impact of Pi on the intrinsic fluorescent property of UiO-66(Fe/Zr)-NH_2.

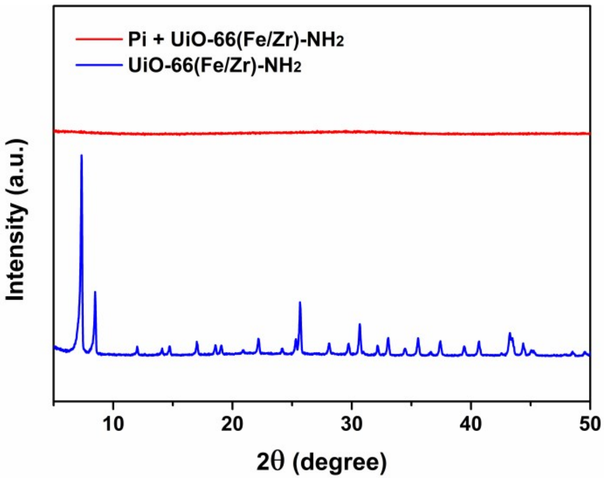

Figure S7. XRD comparison of UiO-66(Fe/Zr)-NH_2 before and after Pi adsorption.

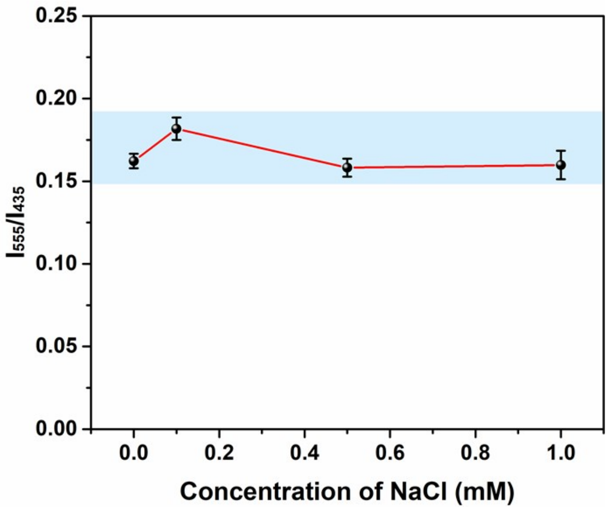

Figure S8. Influence of ionic strength on the I_{555}/I_{435} value of the UiO-66(Fe/Zr)-NH_2+H_2O_2+OPD+Pi system (Pi concentration: 0.33 mM).

Table S1. Performance comparison of our sensing platform with other methods for Pi detection.

Material	Function	Measurement method	Detection range (μM)	LOD (μM)	Ref.
Fe_3O_4 MNPs	Peroxidase mimic	Colorimetric	0.2—200	0.11	[1]
UiO-66(Zr)-NH_2	Fluorescent label	Fluorescent	5—150	1.25	[2]
CBNPs	Electrode modifier	Electrochemical	Up to 80	6	[3]
GODs	Fluorescent label	Fluorescent	0.5—190	0.1	[4]
Mn-ZnS-QDs	Phosphorescent label	Phosphorescent	8—320	2.71	[5]
s-GQDs	Fluorescent label	Fluorescent	0.25—7.5	0.1	[6]
UiO-66(Fe/Zr)-NH_2	Recognition motif, fluorescent label, and peroxidase mimic	Ratiometric fluorescent	0.2—266.7	0.085	This work

Table S2. Results of our sensing platform for Pi determination in real samples.

Sample	**Pi in original samples detected by our sensor (μM, N = 3)**	**Spiked (μM)**	**Pi in spiked samples detected by our sensor (μM, N = 3)**	**Recovery rate (%)**
Drinking water	Not detected	33.3	34.6	103.9
		133.3	136.2	102.2
		200.0	203.9	102.0
Tap water	Not detected	33.3	34.0	102.1
		133.3	132.3	99.2
		200.0	203.8	101.9
River water 1#	Not detected	66.7	65.8	98.6
		133.3	137.1	102.8
		200.0	195.9	98.0
River water 2#	19.4	66.7	86.7	100.9
		100.0	116.6	97.2
		133.3	157.1	103.3
River water 3#	98.0	33.3	136.9	116.8
		66.7	161.8	95.6
		100.0	196.5	98.5

References

[1] C.X. Chen, L.X. Lu, Y. Zheng, D. Zhao, F. Yang, X.R. Yang, A new colorimetric protocol for selective detection of phosphate based on the inhibition of peroxidase-like activity of magnetite nanoparticles, Anal. Methods, 7 (2015) 161-167.

[2] J. Yang, Y. Dai, X.Y. Zhu, Z. Wang, Y.S. Li, Q.X. Zhuang, J.L. Shi, J.L. Gu, Metal–organic frameworks with inherent recognition sites for selective phosphate sensing through their coordination-induced fluorescence enhancement effect, J. Mater. Chem. A, 3 (2015) 7445-7452.

[3] D. Talarico, S. Cinti, F. Arduini, A. Amine, D. Moscone, G. Palleschi, Phosphate detection through a cost-effective carbon black nanoparticle-modified screen-printed electrode embedded in a continuous flow system, Environ. Sci. Technol., 49 (2015) 7934-7939.

[4] J.M. Bai, L. Zhang, R.P. Liang, J.D. Qiu, Graphene quantum dots combined with europium ions as photoluminescent probes for phosphate sensing, Chem. Eur. J., 19 (2013) 3822-3826.

[5] J. Qin, D.X. Li, Y.M. Miao, G.Q. Yan, Detection of phosphate based on phosphorescence of Mn doped ZnS quantum dots combined with cerium(III), RSC Adv., 7 (2017) 46657-46664.

[6] B.B. Chen, R.S. Li, M.L. Liu, H.Y. Zou, H. Liu, C.Z. Huang, Highly selective detection of phosphate ion based on a single-layered graphene quantum dots-Al^{3+} strategy, Talanta, 178 (2018) 172-177.