

## Supporting information

### **A fast phosphate colorimetric sensor based on MoS<sub>2</sub>/UiO-66 (Fe/Zr) nanocomposites as oxidase-/peroxidase-like nanoenzymes**

**Baocan Zhu, Fengyang Zhao, Pingping Hao, Hongguan Yu, Renxia Jiang\*,  
Qingyun Liu\* and Zhenxue Liu\***

*College of Chemical and Biological Engineering, Shandong University of Science and  
Technology, Qingdao 266590, China*

**\* Corresponding Author**

E-mail: skd994684@sdust.edu.cn; qyliu@sdust.edu.cn; liuzhx1982@163.com

Tel: +86 0532 86057757

## **Instruments**

The morphology, phase and chemical states of MoS<sub>2</sub>/UiO-66(Fe/Zr) were characterized by the transmission electron microscope (TEM) (JEM-2100, JEOL, Japan), X-ray diffractometer (Cu-K $\alpha$  radiation,  $2\theta = 5^\circ$ - $80^\circ$ ,  $5^\circ/\text{min}$ ) and X-ray photoelectron spectroscopy (XPS, Thermo ESCALAB 250Xi, USA). The Brunauer-Emmett-Teller surface areas of MoS<sub>2</sub>/UiO-66(Fe/Zr) were analyzed on a Micromeritics ASAP 2460 and the bath temperature was 77.3 K. Fluorescent spectra and UV-vis absorption spectra were recorded on a fluorescence spectrophotometer (FL, Hitachi F-4600, Japan) and a UV-8000PC spectrophotometer (Puxi, TU 1810, China), respectively.

## **Synthesis of MoS<sub>2</sub>/UiO-66(Fe/Zr) nanocomposites**

50 mg of (NH<sub>4</sub>)<sub>2</sub>MoS<sub>4</sub> was dissolved into 30 mL of DMF. The above solution was treated by ultrasonic to make its liquid phase uniform. Subsequently, this solution was moved into Teflon liner, then kept at 200 °C for 10 h. After the solution was cooled to room temperature naturally, the primary product was centrifuged and washed with DMF and ethanol several times. The final obtained MoS<sub>2</sub> was dried in an oven at 60 °C for 10 h.

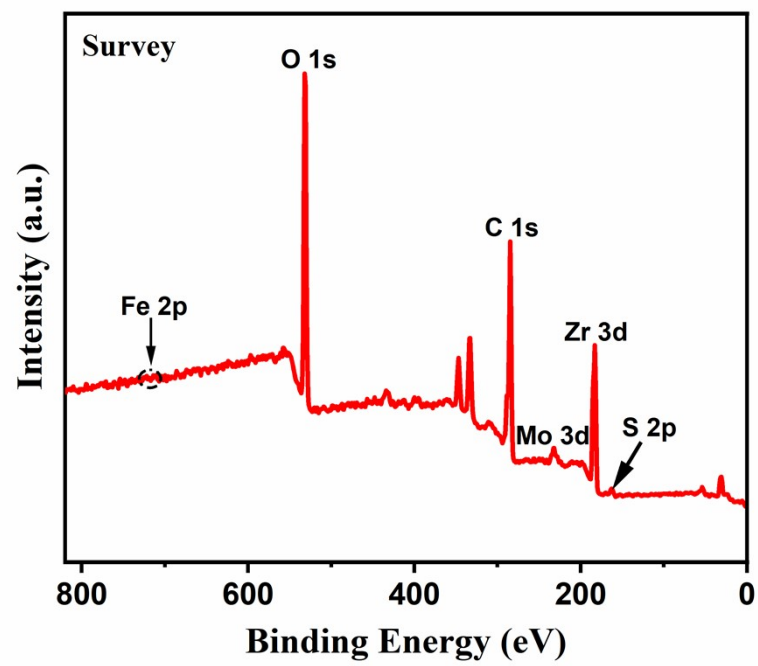
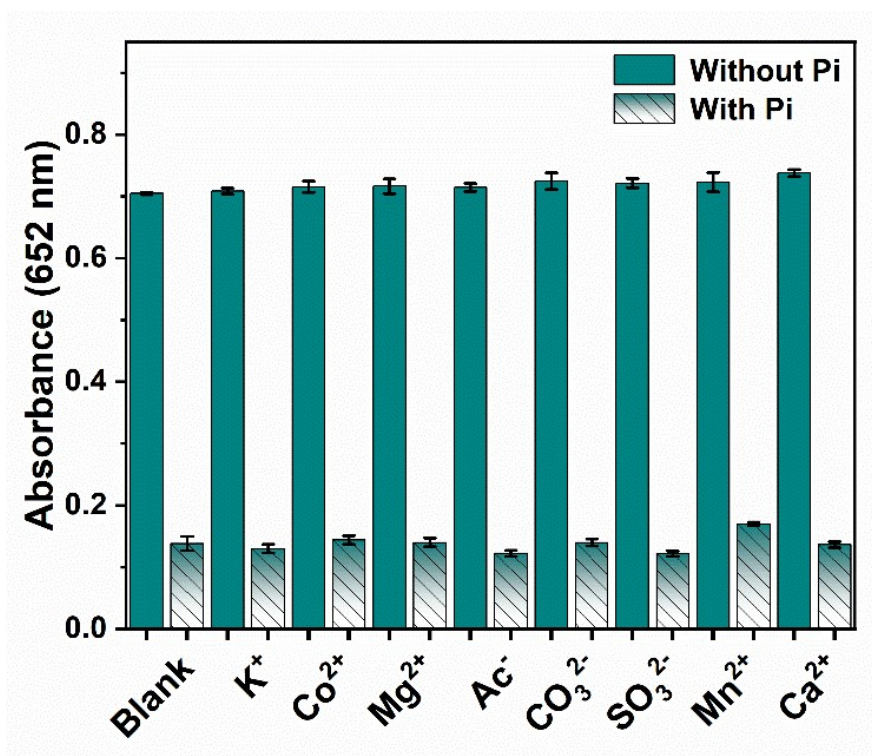
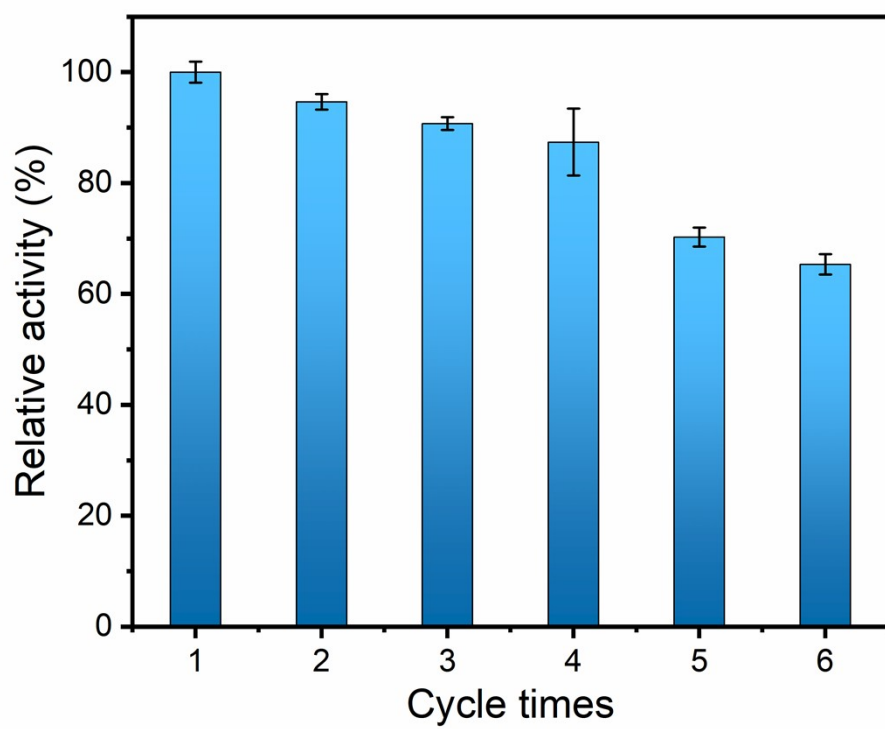


Fig. S1 The survey XPS spectrum of MoS<sub>2</sub>/UiO-66.



**Fig. S2** The responses of the MoS<sub>2</sub>/UiO-66(Fe/Zr)+TMB+H<sub>2</sub>O<sub>2</sub> system toward various interferents (Pi concentration: 100 μM; the concentrations of all the interfering ions are 1 mM).



**Fig. S3** The Reusability of MoS<sub>2</sub>/UiO-66(Fe/Zr).

**Table S1** Kinetic parameters of MoS<sub>2</sub>/UiO-66, HRP and other nanoperoxidases.

Catalyst	K <sub>m</sub> (mM)		V <sub>max</sub> (10 <sup>-8</sup> Ms <sup>-1</sup> )		Ref.
	H <sub>2</sub> O <sub>2</sub>	TMB	H <sub>2</sub> O <sub>2</sub>	TMB	
HRP	3.7	0.434	8.71	10	1
MoS <sub>2</sub>	1.809	2.668	1.642	1.501	2
Fe-loaded MOF-545(Fe)	1.69	2.34	12	85.4	3
CeO <sub>2</sub> /C nanowire	2.61	0.12	3.31	2.08	4
Ni-MOF nanosheet	2.49	0.365	130	6.53	5
MoS <sub>2</sub> /UiO-66(Fe/Zr)	<b>1.231</b>	<b>0.255</b>	<b>3.185</b>	<b>7.732</b>	<b>This work</b>

**Table S2** Comparison of Pi detection limit of different sensing platforms.

Materials	Linear range ( $\mu\text{M}$ )	LOD ( $\mu\text{M}$ )	Method	Ref.
Pt/Au Nanowire	248-1456	45	Electrochemical	6
Eu-BTB	1-100	10	Optical method	7
DQS/Sn <sup>4+</sup> complex	30.2-45.7	47.1	Fluorescent	8
Tb(H <sub>2</sub> O)BTB MOF	40-400	35	Fluorescent	9
Molybdenum blue	0-1000	13	Colorimetric	10
MoS <sub>2</sub> /UiO-66(Fe/Zr)	<b>10-100</b>	<b>6.4</b>	<b>Colorimetric</b>	This work

**Table S3** Analytical results of Pi in real water samples.

Samples	Added ( $\mu\text{M}$ )	Determined by the colorimetric ( $\mu\text{M} \pm \text{SD}$ )	Recovery (%) (n = 3)	RSD (%)
1	60	$61.34 \pm 0.01$	102.23	0.51
2	70	$73.43 \pm 0.01$	104.90	1.11



**Table S4.** The comparison of response time of different nanozymes in detecting phosphate.

nanozymes	response time (min)	Ref.
Oxidized UiO-66(Ce/Zr)	5	11
Fe <sub>3</sub> O <sub>4</sub> -DHCA	5	12
Fe/NC-SAs	10	13
Ce <sub>x</sub> Zr <sub>1-x</sub> O <sub>2</sub>	5	14
MoS <sub>2</sub> /UiO-66(Fe/Zr)	3	<b>This work</b>

**Table S5.** The comparison of reaction time of different nanozymes with TMB.

Nanozymes	reaction time (min)	conditions	Ref.
Ni-MOF	30	pH=3.5 T=50°C	5
2D Fe-BTC	15	pH=3.5 T=45°C	15
CeO <sub>2</sub> /C	20	pH=4 T=45°C	16
NiS/MMT/GO	3	pH=4 T=55°C	17
H <sub>2</sub> TCPP–CeO <sub>2</sub>	15	pH=3.8 T=50°C	18
MoS <sub>2</sub> /UiO-66(Fe/Zr)	3	pH=4 T=50°C	<b>This work</b>

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