

## Supplementary Material

*For*

**Aptamer and flower-shaped AuPtRh nanoenzyme-based colorimetric biosensor  
for the detection of profenophos**

Xin Tan<sup>a</sup>, Xie Wancui<sup>b</sup>, Fangyuan Zhao<sup>a</sup>, Wei Wu<sup>a</sup>, ,

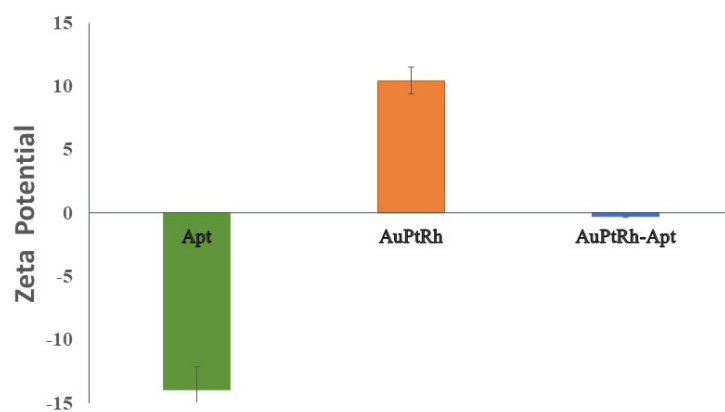
Qingli Yang<sup>a,\*</sup>, Xiudan Hou<sup>a,\*</sup>

*<sup>a</sup>College of Food Science and Engineering, Qingdao Agricultural University, Qingdao, Shandong  
Province 266109, China*

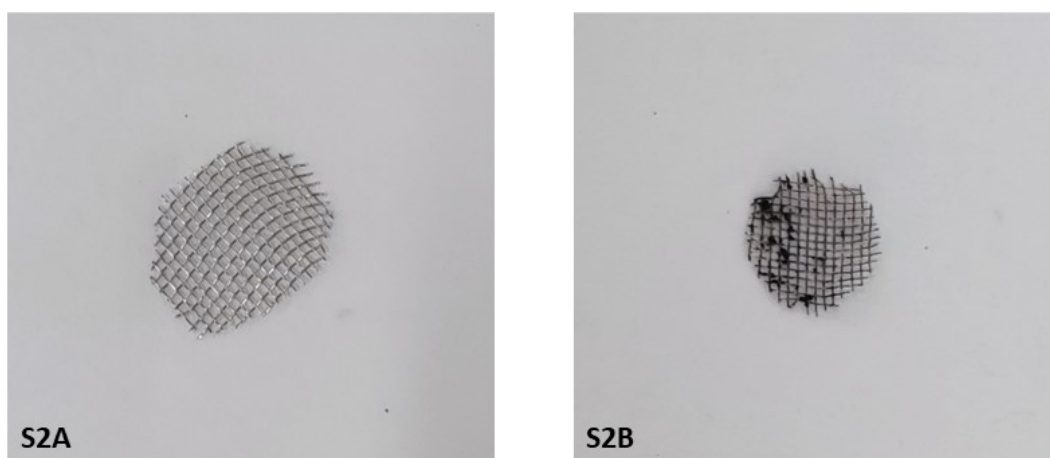
*<sup>b</sup>College of Marine Science and Biological Engineering, Qingdao University of Science and  
Technology, Shandong Qingdao, 266042 China*

## **Table of Contents**

- 1.** Zeta potential of Apt, AuPtRh and Apt-AuPtRh. **(Fig. S1)**
- 2.** Metal mesh (SSM) image, Metal mesh bonded graphene oxide (SSM-GO) image. **(Fig. S2A, S2B)**
- 3.** Supernatant with different amount of aptamer. **(Fig. S3)**
- 4.** Incubation time of metal mesh-GO with Apt-AuPtRh NPs was optimized. The fluorescence intensity of SSM-GO/Apt-AuPtRh NPs was measured in the remaining solution at different adsorption times. 20 min later, the fluorescence intensity decreased significantly, and after 30 min of adsorption, the decrease of fluorescence intensity in the solution tended to level off, thus 30 min of adsorption was chosen.**(Fig. S4)**
- 5.** Comparison of kinetic parameters by different catalysts. **(Table S1)**
- 6.** Comparison of different detection methods. **(Table S2)**



**Fig. S1 Zeta potential of Apt, AuPtRh and Apt-AuPtRh**



**Fig. S2A: Metal mesh (SSM) image, S2B: Metal mesh bonded graphene oxide (SSM-GO) image**

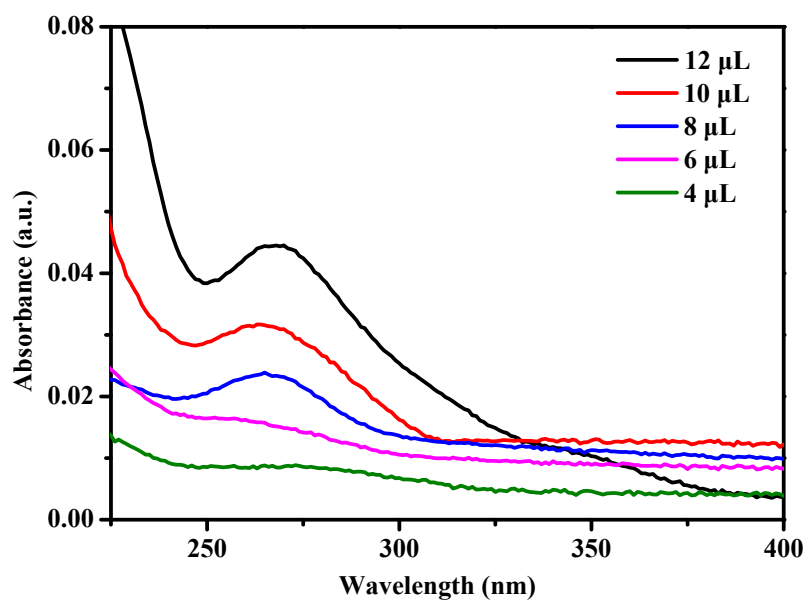


Fig. S3 : Supernatant with different amount of aptamer

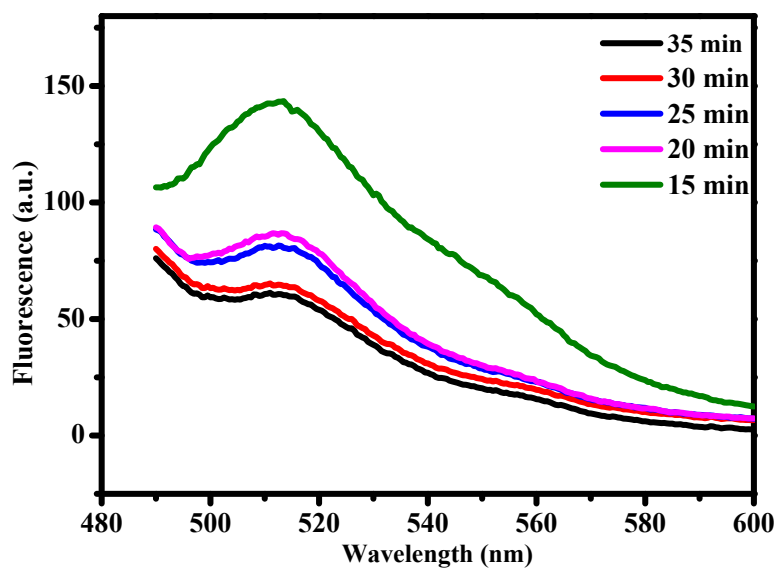


Fig. S4: The incubation time of GO-SSM with Apt-AuPtRh

**Table S1 Comparison of kinetic parameters by different catalysts.**

Catalyst	Substrate	$K_m$ (mM)	$V_{max}$ ( $10^{-8} \text{ M s}^{-1}$ )	Ref.
AuPtRh	TMB	0.6632	22.27	This work
	H <sub>2</sub> O <sub>2</sub>	11.74	14.35	
HRP	TMB	0.434	10	[1]
	H <sub>2</sub> O <sub>2</sub>	3.7	8.71	
Fe <sub>3</sub> O <sub>4</sub> NPs	TMB	0.098	3.44	[1]
	H <sub>2</sub> O <sub>2</sub>	154	9.78	
2.6Pt/EMT	TMB	0.16	4.72	[2]
	H <sub>2</sub> O <sub>2</sub>	0.58	11.6	
Au@Pt	TMB	0.158	38.43	[3]
	H <sub>2</sub> O <sub>2</sub>	6.794	132.62	

**Table S2 Comparison of different detection methods**

Method	Analyte	Detection range	Detection limit	Ref.
Colorimetric detection	Profenophos	1-300 ng L <sup>-1</sup>	0.725 ng L <sup>-1</sup>	This work
Colorimetric detection	Omethoate	100–500 ng mL <sup>-1</sup>	0.35 ng mL <sup>-1</sup>	[4]
Electrochemistry	Malathion	10 pM-1 $\mu$ M	4 pM	[5]
Color-coded detection of enzyme inhibition colorimetry visual	Malathion	0.001-0.1 ng/mL	0.82 pg mL <sup>-1</sup>	[6]
detection with Au@Au - Ag	cyanide	4–15 $\mu$ M	2 $\mu$ M	[7]

## References

- [1] L. Gao, J. Zhuang, L. Nie, J. Zhang, Y. Zhang, N. Gu, T. Wang, J. Feng, D. Yang, S. Perrett, X. Yan, Intrinsic peroxidase-like activity of ferromagnetic nanoparticles, *Nat. Nanotechnol.* 2 (2007) 577–583.
- [2] X. Li, X. Yang, X. Cheng, Y. Zhao, W. Luo, A.A. Elzatahry, A. Alghamdi, X. He, J. Su, Y. Deng, Highly dispersed Pt nanoparticles on ultrasmall EMT zeolite: A peroxidase-mimic nanoenzyme for detection of H<sub>2</sub>O<sub>2</sub> or glucose, *J. Colloid Interface Sci.* 570 (2020) 300–311.
- [3] Z. Fu, W. Zeng, S. Cai, H. Li, J. Ding, C. Wang, Y. Chen, N. Han, R. Yang, Porous Au@Pt nanoparticles with superior peroxidase-like activity for colorimetric detection of spike protein of SARS-CoV-2, *J. Colloid Interface Sci.* 604 (2021) 113–121.
- [4] D.-L. Liu, Y. Li, R. Sun, J.-Y. Xu, Y. Chen, C.-Y. Sun, Colorimetric Detection of Organophosphorus Pesticides Based on the Broad-Spectrum Aptamer, *J. Nanosci. Nanotechnol.* 20 (2019) 2114–2121.
- [5] R. v. Shamgsumova, D.N. Shurpik, V.G. Evtugyn, I.I. Stoikov, G.A. Evtugyn, Electrochemical Determination of Malathion on an Acetylcholinesterase-Modified Glassy Carbon Electrode, *Anal. Lett.* 51 (2018) 1911–1926.
- [6] M. Huang, Y. Fan, X. Yuan, L. Wei, Color-coded detection of malathion based on enzyme inhibition with dark-field optical microscopy, *Sensors Actuators B Chem.* 353 (2022).
- [7] C.Y. Wen, Y. Chen, R.S. Liu, J. Huang, D. Wang, Z. Cao, B. Meteku, J. Zeng, Matrix colorimetry for high-resolution visual detection of free cyanide with Au@Au-Ag yolk-shell nanoparticles, *J. Mater. Chem. C* 9 (2021) 4661–4669.