

Supporting information

Upconversion Fluorescent Aptasensor for Polychlorinated Biphenyls Detection Based on Nicking Endonuclease and Hybridization Chain Reaction Dual-Amplification Strategy

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Supporting information included:

- 1) Circular dichroism (CD) spectroscopy of aptamer and PCB72/106
- 2) FT-IR spectra of UCNPs and UCNPs-PAA
- 3) SEM images of the MMPs
- 4) Polyacrylamide gel (12%) electrophoresis image of HCR products

- 5) Fluorescence recovery intensity of the aptasensor in the presence of PCB72/106 and other analogues
- 6) Comparison between this method and other methods in literatures
- 7) Recovery of PCB72/106 at different concentration levels in water and soil samples (n =4)

1) Circular dichroism (CD) spectroscopy of aptamer and PCB72/106

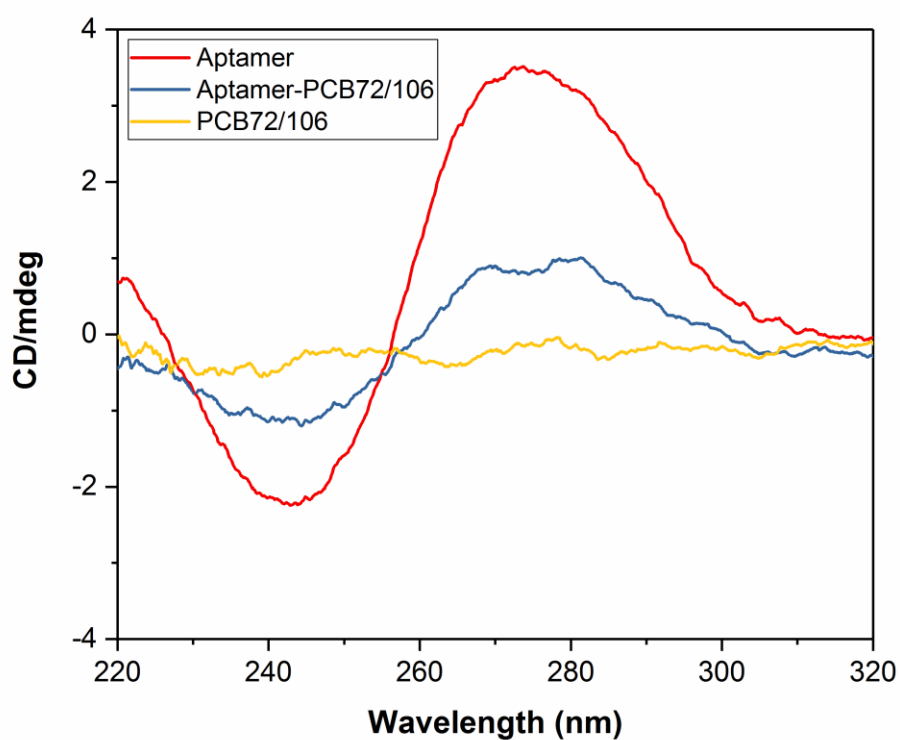


Figure S1. Circular dichroism (CD) spectroscopy of aptamer and PCB72/106.

2) FT-IR spectra of UCNPs and UCNPs-PAA

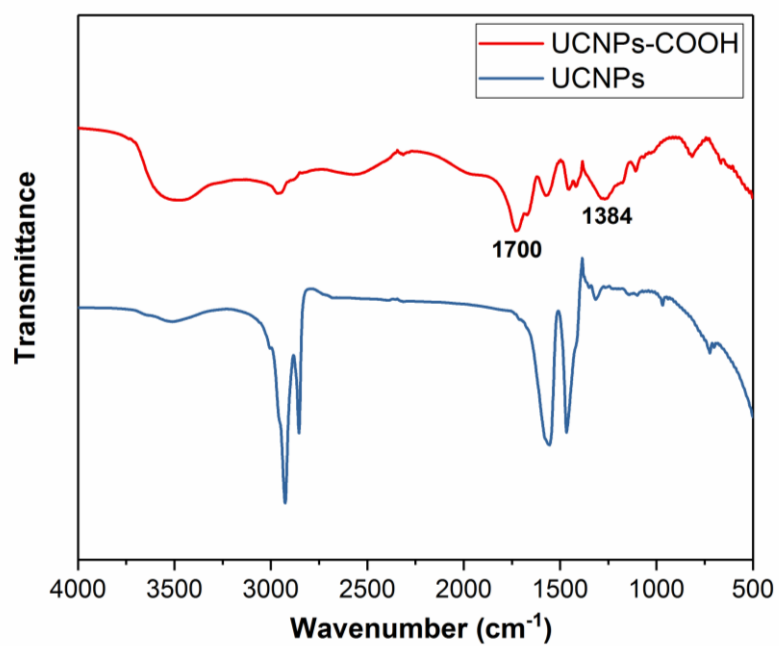


Figure S2. FT-IR spectra of UCNPs (blue line) and UCNPs-PAA (red line).

3) SEM images of the MMPs

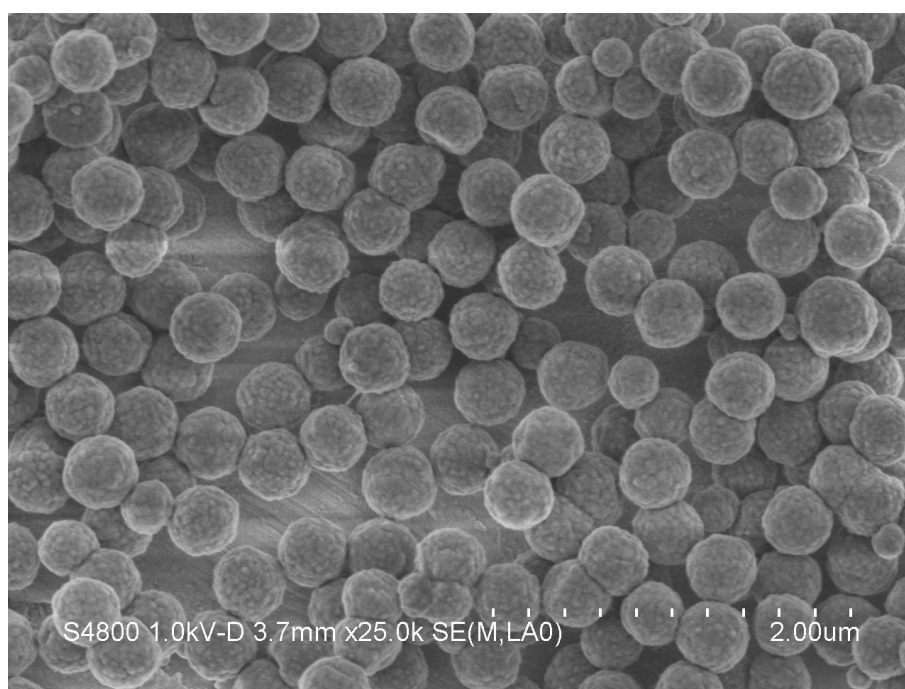


Figure S3. SEM images of the MMPs.

4) Polyacrylamide gel (12%) electrophoresis image of HCR products.

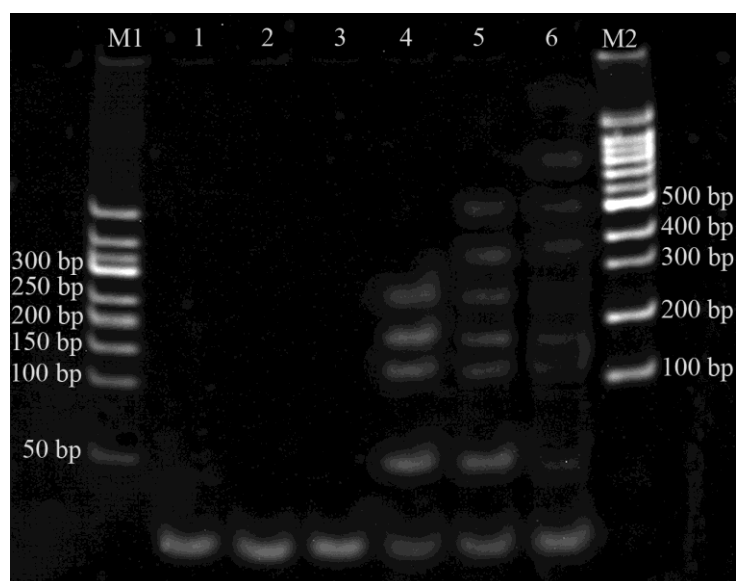


Figure S4. Polyacrylamide gel (12%) electrophoresis image of HCR products. Lane M1 and M2: two kinds of DNA marker; lane 1: H1; lane 2: H2; lane 3: H1+H2; lane 4-6: H1+H2+H0 (3.33, 0.84, 0.21 μM).

5) Fluorescence recovery intensity of the aptasensor in the presence of PCB72/106 and other analogues

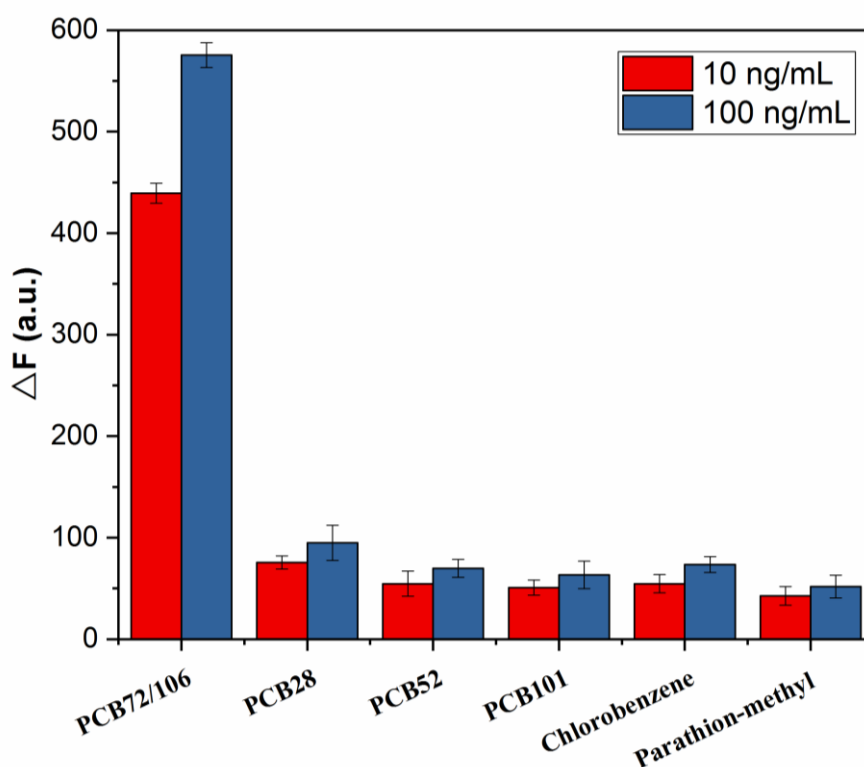


Figure S5. Fluorescence recovery intensity of the aptasensor in the presence of PCB72/106 and other analogues.

6) Comparison between this method and other methods in literatures

Tab. S1 Comparison between this method and other methods in literatures.

Methods	Linear range (ng/mL)	LODs (ng/mL)	Sample	Measure process	Ref.
GC-MS	0.02-250	0.003	Fish	Complex	[1]
ZnO SPV-Based Sensor	3.3×10^2 - 3.3×10^3	326	-	Complex	[2]
SERS	1.4×10 - 1.4×10^6	2.9	-	Complex	[3]
Electrochemical immunosensors	1.0×10 - 1.0×10^4	10	-	Complex	[4]
FITC-modified PPy Nanotubes	0.1-10	0.1	-	Complex	[5]
UCNPs-HCR aptasensor	0.004-800	0.0035	Water and soil	Simple	This work

7) Recovery of PCB72/106 at different concentration levels in water and soil samples (n =4)

Tab. S2 Recovery of PCB72/106 at different concentration levels in water and soil samples (n =4)

Category	Samples	Spiking levels (ng/mL or ng/g)	F (a.u.)	Amount measured (ng/mL or ng/g)	Recovery (%)	RSD (%)
Water	1	0.1	522.9	0.1578	96.6	1.9
		1	622.8	1.0794	101.8	2.5
		10	741.2	10.6425	105.8	2.1
		100	862.3	108.4169	108.4	1.6
	2	0.1	504	0.1097	109.7	2.8
		1	615.3	0.9343	93.4	1.7
		10	737.2	9.7595	97.6	1.9
		100	854.8	93.8441	93.84	2.3
	3	0.1	490.6	0.0988	98.9	2.9
		1	615.9	0.9452	94.5	2.2
		10	743.1	10.9331	109.3	1.8
		100	862.2	108.2084	108.2	2.6
Soil	A	0.1	555.4	0.2950	107.7	3.0
		1	631.6	1.2786	109.1	2.8
		10	737.1	9.7408	95.5	2.3
		100	862.4	108.6258	108.4	2.9
	B	0.1	502.1	0.1057	105.8	2.1
		1	610.8	0.8568	85.7	2.5
		10	746.7	11.7176	117.2	2.7
		100	849.3	84.4179	84.4	3.2
	C	0.1	508	0.1185	118.5	2.6
		1	625.6	1.1392	113.9	2.4
		10	728.9	8.3187	83.2	2.2
		100	866.1	116.6433	116.6	2.1

REFERENCES

- (1) Lin, S.; Gan, N.; Zhang, J.; Qiao, L.; Chen, Y.; Cao, Y. Aptamer-functionalized stir bar sorptive extraction coupled with gas chromatography-mass spectrometry for selective enrichment and determination of polychlorinated biphenyls in fish samples. *Talanta* **2016**, 149, 266-274.
- (2) Li, M.; Meng, G.; Huang, Q.; Yin, Z.; Wu, M.; Zhang, Z.; Kong, M. Prototype of a porous ZnO SPV-based sensor for PCB detection at room temperature under visible light illumination. *Langmuir* **2010**, 26, 13703-13706.
- (3) Rindzevicius, T.; Barten, J.; Vorobiev, M.; Schmidt, M. S.; Castillo, J. J.; Boisen, A. Detection of surface-linked polychlorinated biphenyls using surface-enhanced Raman scattering spectroscopy. *Vib. Spectrosc.* **2017**, 90, 1-6.
- (4) Laschi, S.; Fránek, M.; Mascini, M. Screen - Printed Electrochemical Immunosensors for PCB Detection. *Electroanalysis* **2015**, 12, 1293-1298.
- (5) Wang, M.; Meng, G.; Huang, Q.; Xu, Q.; Chu, Z.; Zhu, C. FITC-modified PPy nanotubes embedded in nanoporous AAO membrane can detect trace PCB20 via fluorescence ratiometric measurement. *Chem. Commun.* **2011**, 47, 3808-3810.