**Supporting Information**

**Photoresponsive oxidase-like phosphorescent carbon dots in colorimetric Hg2+ detection**

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**Table of Contents**

**Experimental procedures**

**Materials**

**Instruments**

**Figure and table captions**

**Fig. S1** (A) The hydrodynamic size and (B) zeta potential of P-NCDs.

**Fig. S2** (A) 3D fluorescence spectrum of the P-NCDs solution. (B) fluorescence attenuation spectrum and fitted curve of the P-NCDs solution.

**Fig. S3** Effect of storage time on oxidase activity of P-NCDs (n=3).

**Fig. S4** (A) Selectivity of detection systems over Hg2+. (B) sheltering of Cu2+ (a: TMB/P-NCDs + Cys; b: TMB/P-NCDs + Cys + Cu2+; c: TMB/P-NCDs + Cys + Hg2+; d: TMB/P-NCDs + Cys + Cu2+ + EDTA and chloride ions; e: TMB/P-NCDs + Cys + Hg2+ + EDTA and chloride ions) (n=3).

**Table S1.** *Km* and *Vmax* of different nanozymes with TMB as the substrate.

**Table S2.** Comparison of performances among different nanozyme-based colorimetric Hg2+ detection methods.

**Table S3.** The detected Hg2+ concentrations in real samples (n = 3).

**Experimental procedures**

**Materials**

TTHA (Aladdin, US), TMB (Sangon Biotech, China), l-cysteine (Cys, Tianjin Guangfu Fine Chemicals Institute, China), HgCl2 (Sinopharm Chemical Reagent Co.), superoxide dismutase and catalase (Yuanye Biotech Co., Ltd., China), tryptophane and mannitol (Tianjin Shentai Chemical Reagent Co., Ltd., China) were used here. All reagents were of analytical grade. Ultrapure water (18.2 MΩ·cm) was produced from a WaterPro ultrapure water system (Labconco, US).

**Instruments**

Fluorescence and phosphorescence spectra were recorded on a Cary Eclipse fluorescence spectrophotometer (Varian Co. Ltd., USA). Ultraviolet-visible (UV-vis) spectra were observed under a UV-29100 UV-vis spectrophotometer (Shimadzu, Japan). Morphological structures of P-NCDs were characterized using a JEM-2100 transmission electron microscope (TEM; JEOL, Japan). Fluorescence lifetime and phosphorescence lifetime were tested using an FLS 980 fluorescence spectrometer (Edinburgh Company, UK). X-ray photoelectron spectroscopy (XPS) was recorded on a Thermo escalab 250Xi XPS instrument (Thermo Fisher Scientific, US). X-ray diffraction (XRD) was tested on a D8 ADVANCE powder XRD device (Bruker, Germany). Fourier transform infrared (FT-IR) spectra were recorded on a Nicolet IS10 infrared spectrometer (Thermo Nicolet Corporation, USA). Electron paramagnetic resonance (EPR) was tested on an A300-10/12 EPR meter (Bruker, Germany).

**Figure and table captions**

 

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**Table S1.** *Km* and *Vmax* of different nanozymes with TMB as the substrate.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Catalyst | Substrate | *Km* (mM) | *Vmax* (×10-8 M s-1) | Ref. |
| HRP | TMB | 0.434 | 10 | (Gao et al., 2007) |
| Carbon nitride nanozyme | TMB | 0.6 | 4.22 | (Zhang et al., 2019) |
| CS-Se NPs | TMB | 0.852 | 2.38 | (Cao et al., 2019) |
| Fe/NPC | TMB | 0.59 | 12.7 | (Wang et al., 2021a) |
| Fe-N-C SAzyme | TMB | 1.81 | 0.0601 | (Wu et al., 2019) |
| CMP-LS9 | TMB | 0.24 | 4.21 | (Wang et al., 2021b) |
| TiO2/C-QDs | TMB | 0.16 | 2.5 | (Jin et al., 2020) |
| P-NCDs | TMB | 0.19 | 4.67 | This work |

**Table S2.** Comparison of performances among different nanozyme-based colorimetric Hg2+ detection methods.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Materials | Linear range(μM) | Detection limit | Nanozymes | Ref. |
| Fe3O4@ZnO | 0-0.01 | 23 nM | Peroxidase | (Christus et al., 2018) |
| Carbon nanodots | 0-0.31 | 23 nM | Peroxidase | (Mohammadpour et al., 2014) |
| MoS2 -Au | 0.02-20 | 5 nM | Peroxidase | (Ma et al., 2019) |
| BSA-Pt NPs | 0-0.12 | 7.2 nM | Peroxidase | (Li et al., 2015) |
| DNAzymes | 0.05-2.5 | 50 nM | Peroxidase | (Li et al., 2009) |
| CoS | 0.25-3.0 | 100 nM | Peroxidase | (Yang et al., 2016) |
| GO-Au hybrids | 0-50 | 300 nM | Peroxidase | (Chen et al., 2015) |
| CS-MoSe2 NS | 0-2.5 | 3.5 nM | Peroxidase | (Huang et al., 2019) |
| Cit-Ag NPs | 0.1-10 | 28 nM | Oxidase | (Wang et al., 2014) |
| CS/Cu/Fe | 0.04-8.0 | 8.9 nM | Oxidase | (Zou et al., 2022) |
| P-NCDs | 0.01-14 | 3.1 nM | Oxidase | This work |

**Table S3.** The detected Hg2+ concentrations in real samples (n = 3).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Samples | Added (μM) | Determined (μM) | Recovery (%) | RSD (%) |
| Urine | 0 | Not detected |  |  |
|  | 1 | 1.08 | 108.0 | 1.73 |
|  | 6 | 6.57 | 109.5 | 3.52 |
|  | 8 | 8.05 | 100.6 | 2.76 |
| Tap water | 0 | Not detected |  |  |
|  | 1 | 1.05 | 105.0 | 2.42 |
|  | 6 | 5.95 | 99.2 | 3.58 |
|  | 8 | 8.13 | 101.6 | 3.92 |
| Lake water | 0 | Not detected |  |  |
|  | 1 | 0.986 | 98.6 | 2.10 |
|  | 6 | 5.53 | 92.2 | 3.00 |
|  | 8 | 8.09 | 101.1 | 4.12 |

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