Convenient colorimetric assay for Cr(VI) detection based on the nanozyme Cu-4PDA-NH_2 with oxidoreductase-like activity

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Supplementary Information

Materials and reagents

All chemicals were of analytical grade and were used without further purification. Potassium dichromate ($K_2Cr_2O_7$), sodium hypochlorite (NaClO), sodium nitrite ($NaNO_2$), sodium nitrate ($NaNO_3$), sodium sulfide (Na_2S), sodium sulfite (Na_2SO_3), sodium thiosulfate ($Na_2S_2O_3$), sodium hydroxide (NaOH), glacial acetic acid (CH_3COOH), sulfuric acid (H_2SO_4), sodium carbonate (Na_2CO_3), sodium hydrogen carbonate ($NaHCO_3$), sodium acetate (CH_3COONa) , potassium iodide (KI), potassium nitrate (KNO_3), potassium fluoride (KF), potassium bromide (KBr), Potassium permanganateiron ($KMnO_4$), trichloride ($FeCl_3$), iron(II) chloride ($FeCl_2$), aluminium potassium sulfate dodecahydrate ($Al_2(SO_4)_3$), manganese chloride ($MnCl_2$), zinc chloride ($ZnCl_2$), magnesium chloride hexahydrate ($MgCl_2$), cobalt (II) chloride hexahydrate ($CoCl_2$), copper (II) chloride dehydrate ($CuCl_2 \cdot 2H_2O$), potassium chloride (KCl), calcium chloride anhydrous ($CaCl_2$), mercury(II) chloride ($HgCl_2$), chromium(III) chloride hexahydrate ($CrCl_3$), nickel(II) chloride hexahydrate ($NiCl_2$), hydrochloric acid (HCl), cadmium chloride hemi(pentahydrate) ($CdCl_2$), 3,3′,5,5′-tetramethylbenzidine (TMB), 2,4-dichlorophenol (2,4-DP), 4-aminoantipyrine (4-AP), 2,2′-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), tert-Butanol, 1, 4-benzoquinone were purchased from Macklin Biochemical Technology Co., Ltd. (Shanghai,China). Sodium chloride (NaCl) were obtained from Sinopharm Chemical Reagent Co., Ltd (Shanghai, China). 3-Amino-4-pyridazinecarboxylic Acid (4PDA-

NH_2) were purchased from Bidepharm (Shanghai, China). The solution used in the experiment was Wahaha pure water.

Characterization

PH measurements were made using a PHS-3 C pH meter (Shanghai, China) following standard protocols. Scanning electron microscope (SEM) images were acquired using a field emission scanning electron microscope JSM-7900 F (Japan). UV-visible spectroscopic measurements were performed on a Mapada UV-670 spectrophotometer (Shanghai, China) following established procedures. Centrifugal processing was performed using a HC-2062 high-speed centrifuge (Hefei, China). The Fourier transform infrared (FTlR) spectra of the materials in the range of 4000-400 cm^{-1} were carried out on a SHlMADZU IRTracer-100 FTIR spectrometer (Japan). The zeta potential was collected from a Zetasizer Nano ZS (Malvern, UK).

Supplementary Figures

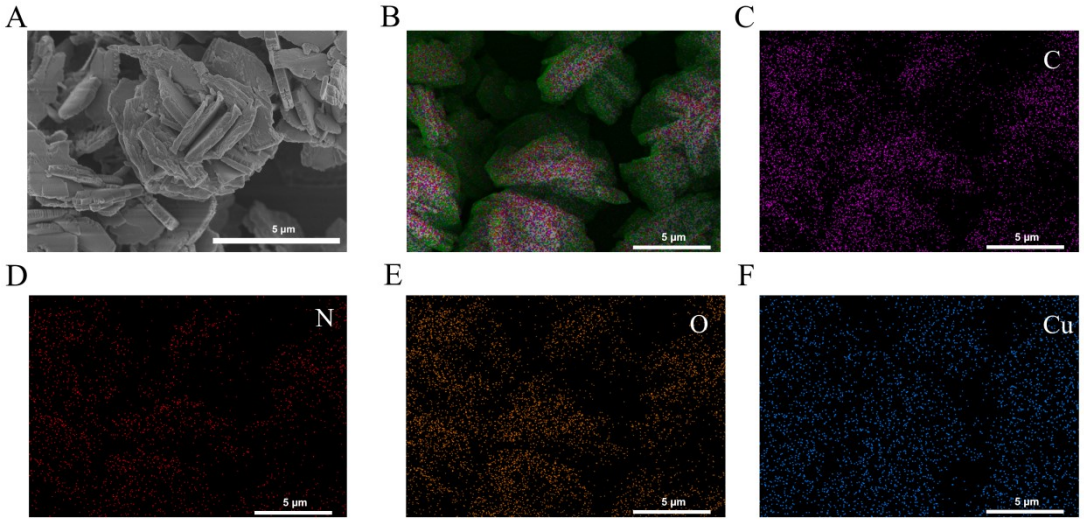

Fig. S1. (A) SEM image; (B) EDS layered images; (C-F) elemental mapping of Cu-

4PDA-NH_2. [C (pink), N (red), O (orange), and Cu (blue)]

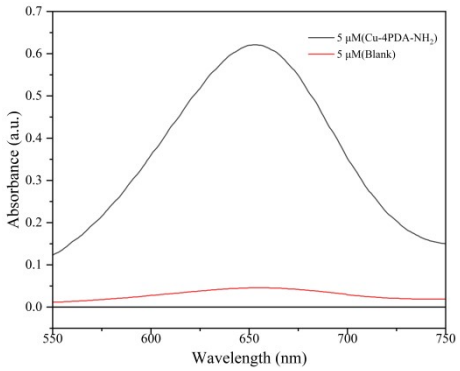

Fig. S2. Comparison of catalytic activity between the presence and absence of Cu-4PDA-NH_2.

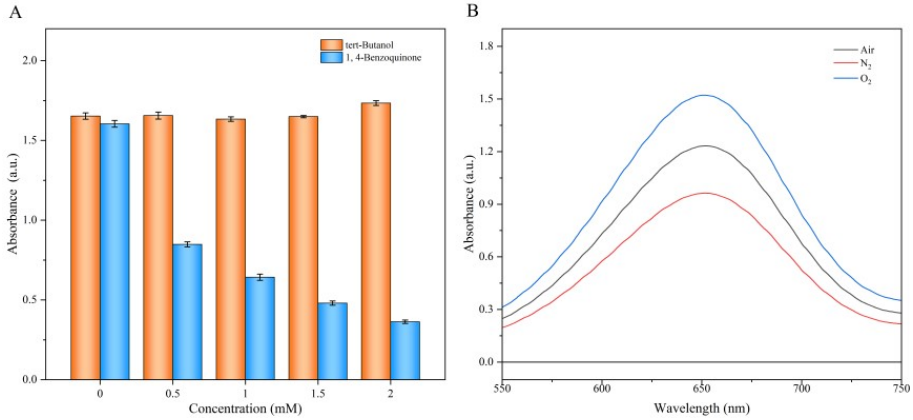

Fig. S3. (A) The effect of 1, 4-Benzoquinone and tert-Butanol on the reaction system. (B) Catalytic reaction of Cu-4PDA-NH_2 in air, N_2, and O_2.

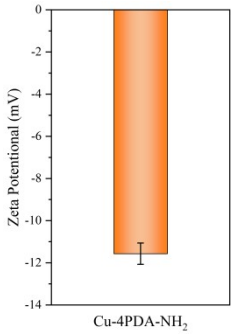

Fig. S4. Zeta potential measurements of Cu-4PDA-NH_2.

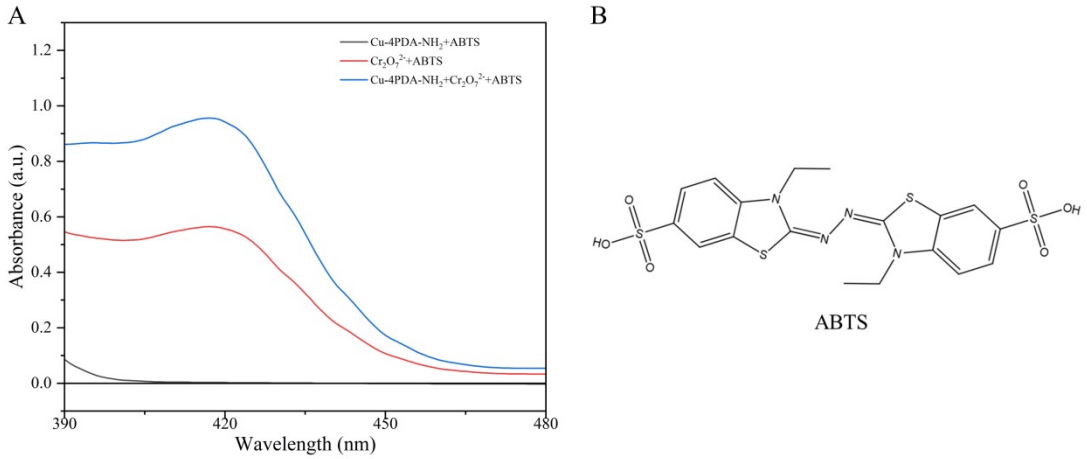

Fig. S5. (A) UV-vis absorption spectra of catalytic activity of ABTS in different reaction systems; (B) Chemical structure of ABTS.

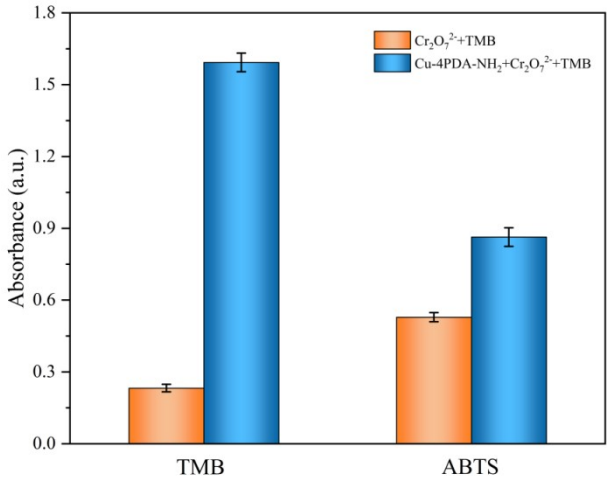

Fig. S6. Comparison of TMB and ABTS catalyzed by Cu-4PDA-NH_2.

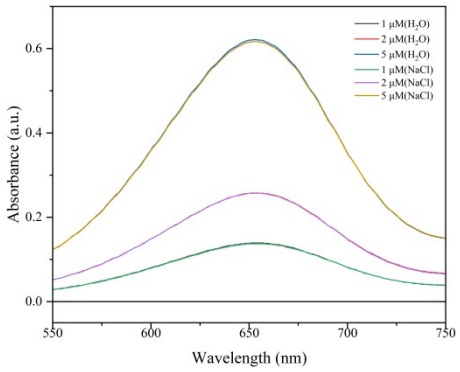

Fig. S7. Relative activity of different concentrations of Cu-4PDA-NH_2 in 500 mM NaCl and pure water.

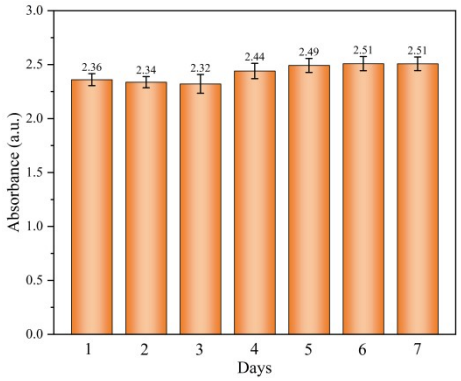

Fig. S8. The change in catalytic activity of Cu-4PDA-NH_2 over a 7-day period.