# Electronic supplementary information

## A novel colorimetric assay based on the peroxidase-like properties of amino functionalized copper metal-organic frameworks nanoparticles for ascorbic acid sensing

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**Synthesis of Cu-BDC-$NH_2$ NPs**

Typically, the precursors of $(CuNO_3)_2$ᔓ$3H_2O$ (36.3 mg, 0.15 mmol) and 2-$NH_2$-BDC (8.15 mg, 0.045 mmol) were dissolved into 6 mL DMF, followed by adding the mixed homogeneous solution including 0.30 g PVP, 6 mL ethanol and 6 mL DMF, then the mixed solution was treated with ultrasonication for 20 min. Next, the mixture was poured into a teflon-lined autoclave for sealing and heated up to 100℃ and kept for 8 h in the temperature, then cooled down to ambient temperature naturally. The obtained products were collected by centrifugal separation at 4000 rpm for 10 min. Subsequently, the precipitated products were cleaned three times using ethanol and ultrapure water separately and put into a vacuum freeze drier for 12 h.

**Preparation of Cu-BDC NPs**

Firstly, 0.7248 g (3 mmol) $(CuNO_3)_2 \cdot 3H_2O$ and 0.4984 g (3mmol) $H_2BDC$ were dissolved in 45 mL DMF, and then the mixed solution was treated with ultrasonication for 10 min. Next, the mixture was poured into a teflon-lined autoclave for sealing and heated up to 110℃ and kept for 21 h in the temperature, then cooled down to ambient temperature naturally. The obtained products were collected by centrifugal separation at 6000 rpm for 20 min. Subsequently, the precipitated blue products were washed by DMF and ethanol, followed by heating at 100℃ under vacuum for 12 h and stored in a desicator.

**Figure captions**

**Fig. S1** FT-IR spectrum of $H_2BDC$, Cu-BDC NPs, Cu-BDC-$NH_2$ NPs and 2-$NH_2$-BDC.

**Fig. S2** Effect of the pH value on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of 0.2 mg $mL^{-1}$ Cu-BDC-$NH_2$ NPs, 200 μL of 5 mM TMB, 200 μL of 0.5 M $H_2O_2$ and 100 μL of 0.5 mM AA; room temperature; reaction time, 10 min. The error bars represent the standard deviations of three replicate measurements.

**Fig. S3** Effect of the reaction time on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of 0.2 mg $mL^{-1}$ Cu-BDC-$NH_2$ NPs, 200 μL of 5 mM TMB, 200 μL of 0.5 M $H_2O_2$ and 100 μL of 0.5 mM AA; pH, 4.0; room temperature. The error bars represent the standard deviations of three replicate measurements.

**Fig. S4** Effect of the concentration of Cu-BDC-$NH_2$ NPs on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of different concentrations of Cu-BDC-$NH_2$ NPs, 200 μL of 5 mM TMB, 200 μL of 0.5 M $H_2O_2$ and 100 μL of 0.5 mM AA; pH, 4.0; room temperature; reaction time, 10 min. The error bars represent the standard deviations of three replicate measurements.

**Fig. S5** Effect of the concentration of $H_2O_2$ on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of 0.2 mg $mL^{-1}$ Cu-BDC-$NH_2$ NPs, 200 μL of 0.5 mM TMB, 200 μL of different concentrations of $H_2O_2$ and 100 μL of 0.5 mM AA; pH, 4.0; room temperature; reaction time, 10 min. The error bars represent the standard deviations of three replicate measurements.

**Fig. S6** Effect of the concentration of TMB on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of 0.2 mg$\backsim$$mL^{-1}$ Cu-BDC-$NH_2$ NPs, 200 μL of different concentrations of TMB, 200 μL of 0.5 M $H_2O_2$ and 100 μL of 0.5 mM AA; pH, 4.0; room temperature; reaction time, 10 min. The error bars represent the standard deviations of three replicate measurements.

**Table S1** Analytical results of the detection of AA in pharmaceutical vitamin C tablets.

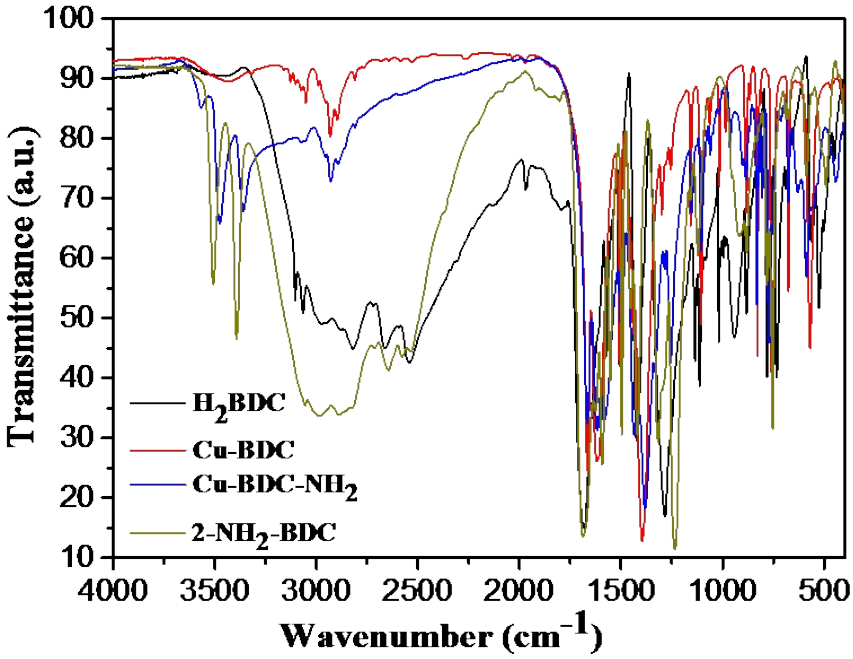


**Fig. S1** FT-IR spectrum of $H_2BDC$, Cu-BDC NPs, Cu-BDC-$NH_2$ NPs and 2-$NH_2$-BDC.

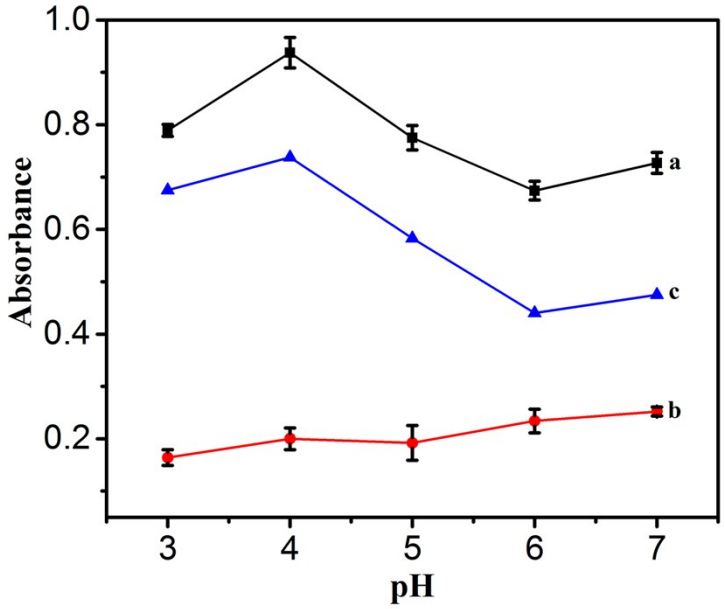


**Fig. S2** Effect of the pH value on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of 0.2 mg $mL^{-1}$ Cu-BDC-$NH_2$ NPs, 200 μL of 5 mM TMB, 200 μL of 0.5 M $H_2O_2$ and 100 μL of 0.5 mM AA; room temperature; reaction time, 10 min. The error bars represent the standard deviations of three replicate measurements.

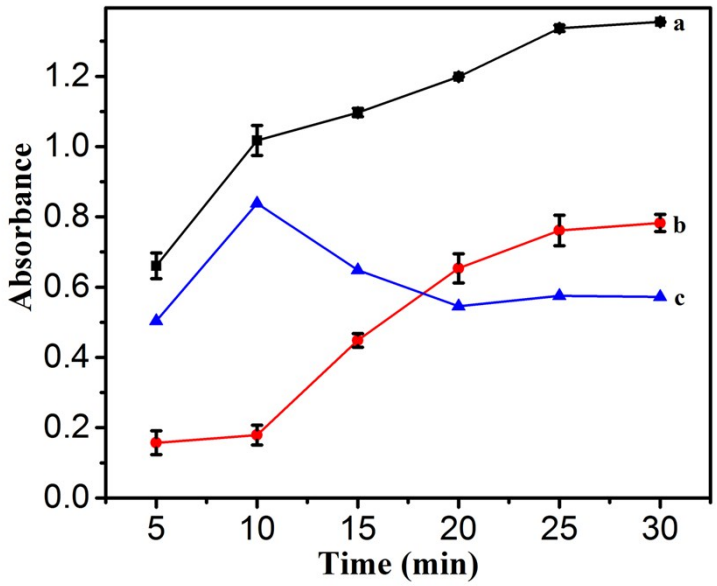


**Fig. S3** Effect of the reaction time on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of 0.2 mg $mL^{-1}$ Cu-BDC-$NH_2$ NPs, 200 μL of 5 mM TMB, 200 μL of 0.5 M $H_2O_2$ and 100 μL of 0.5 mM AA; pH, 4.0; room temperature. The error bars represent the standard deviations of three replicate measurements.

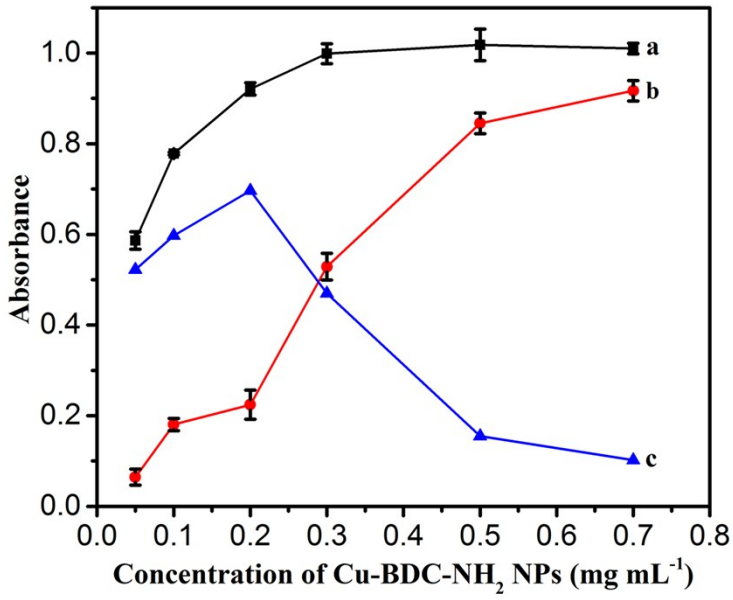


**Fig. S4** Effect of the concentration of Cu-BDC-$NH_2$ NPs on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of different concentrations of Cu-BDC-$NH_2$ NPs, 200 μL of 5 mM TMB, 200 μL of 0.5 M $H_2O_2$ and 100 μL of 0.5 mM AA; pH, 4.0; room temperature; reaction time, 10 min. The error bars represent the standard deviations of three replicate measurements.

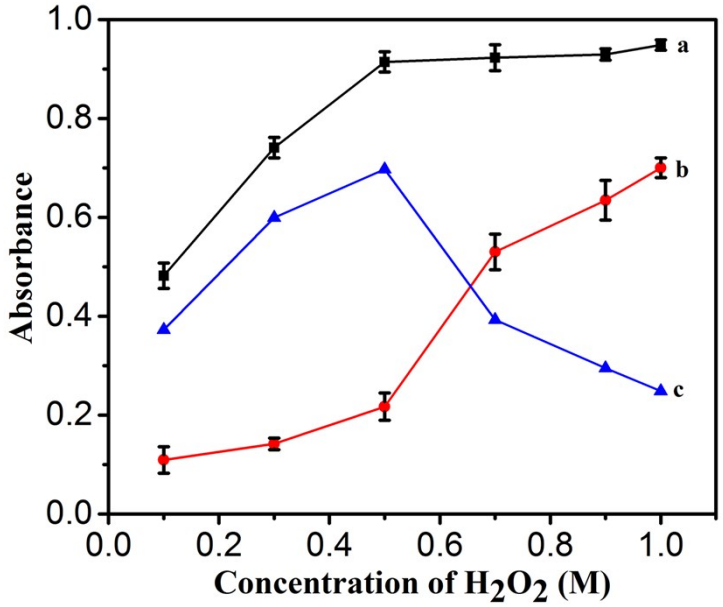


**Fig. S5** Effect of the concentration of $H_2O_2$ on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of 0.2 mg $mL^{-1}$ Cu-BDC-$NH_2$ NPs, 200 μL of 0.5 mM TMB, 200 μL of different concentrations of $H_2O_2$ and 100 μL of 0.5 mM AA; pH, 4.0; room temperature; reaction time, 10 min. The error bars represent the standard deviations of three replicate measurements.

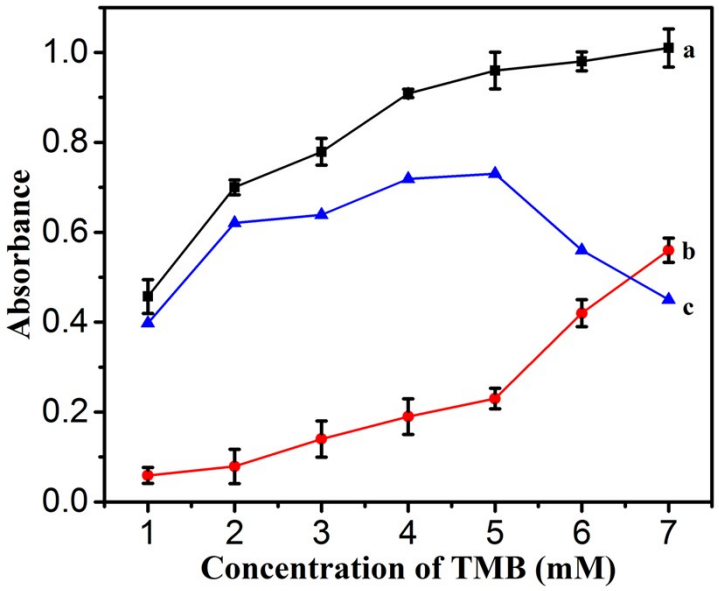


**Fig. S6** Effect of the concentration of TMB on the absorbance at 655 nm of the system solution in the absence (a) and presence (b) of AA, and the ΔA (c). 100 μL of 0.2 mg∽mL$^{-1}$ Cu-BDC-$NH_2$ NPs, 200 μL of different concentrations of TMB, 200 μL of 0.5 M $H_2O_2$ and 100 μL of 0.5 mM AA; pH, 4.0; room temperature; reaction time, 10 min. The error bars represent the standard deviations of three replicate measurements.

**Table S1** Analytical results of the detection of AA in pharmaceutical vitamin C tablets.

| Sample | Labeled (μ M) | Found [a] (μ M) | Recovery (%) | RSD (%) |
|---|---|---|---|---|
| 1 | 50 | 52.12±0.85 | 104.24 | 1.63 |
| 2 | 50 | 52.83±1.15 | 105.66 | 2.18 |
| 3 | 50 | 52.25±1.28 | 104.50 | 2.45 |

[a] Average of three determinations ± standard deviation.