Electronic Supplementary Material (ESI) for Analyst.

Supporting Information

Bimetallic metal-organic framework with high enzyme-mimicking activity for an integrated electrochemical immunoassay of carcinoembryonic antigen

Yun Shu*, Lu Yan, Mingli Ye, Long Chen, Qin Xu, Xiaoya Hu,*

School of Chemistry and Chemical Engineering, Yangzhou University, Yangzhou, China

**Corresponding author. Email: shuyun@yzu.edu.cn, xyhu@yzu.edu.cn*

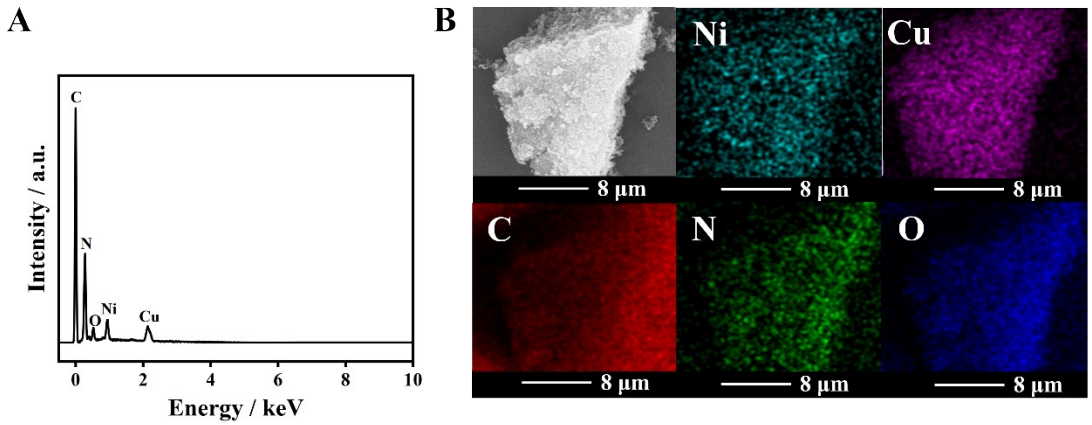

Fig. S1 (A) EDX analysis of Cu-Ni MOF. Corresponding elemental-mapping images of (B) Cu-Ni MOF (Ni, Cu, C, N, O).

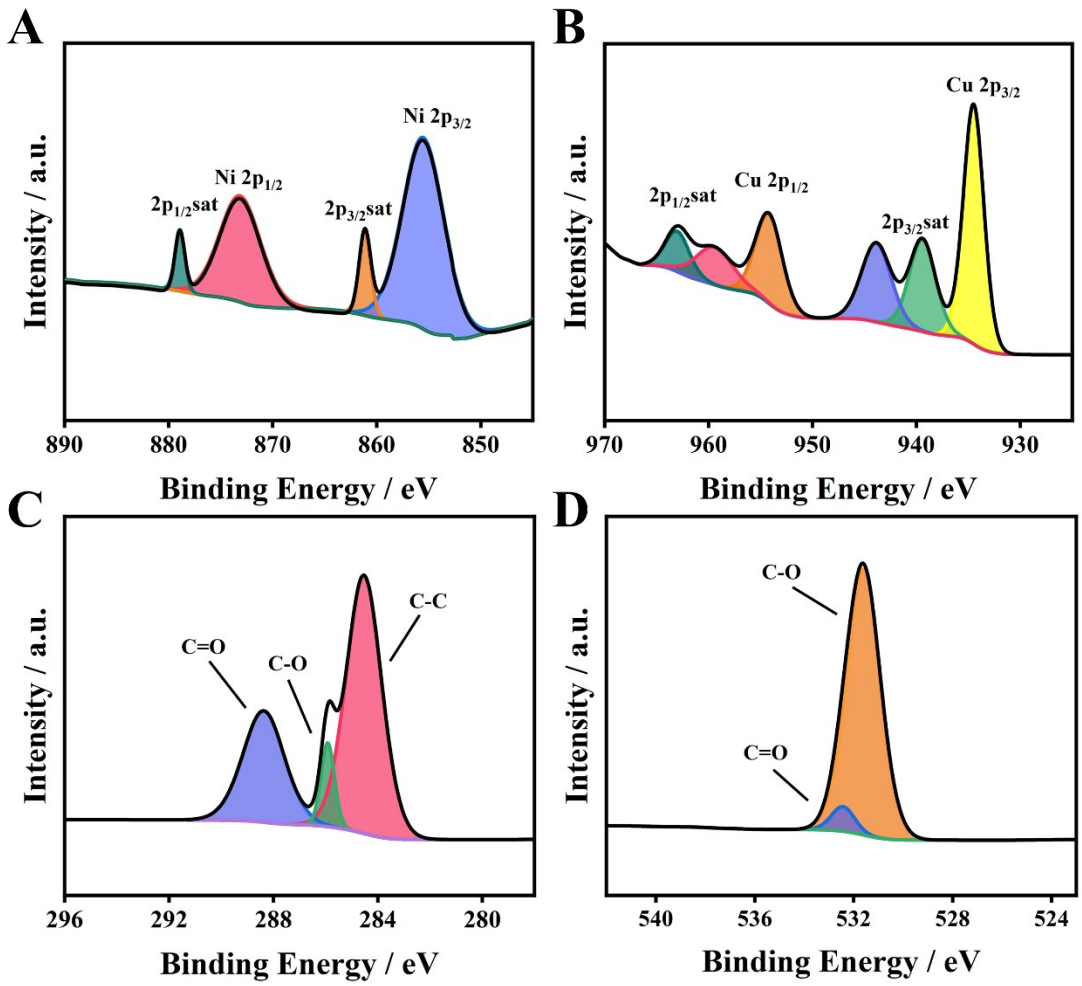

Fig. S2 XPS spectra of (A) Ni 2p, (B) Cu 2p, (C) C 1s and (D) O 1s in Cu-Ni MOF.

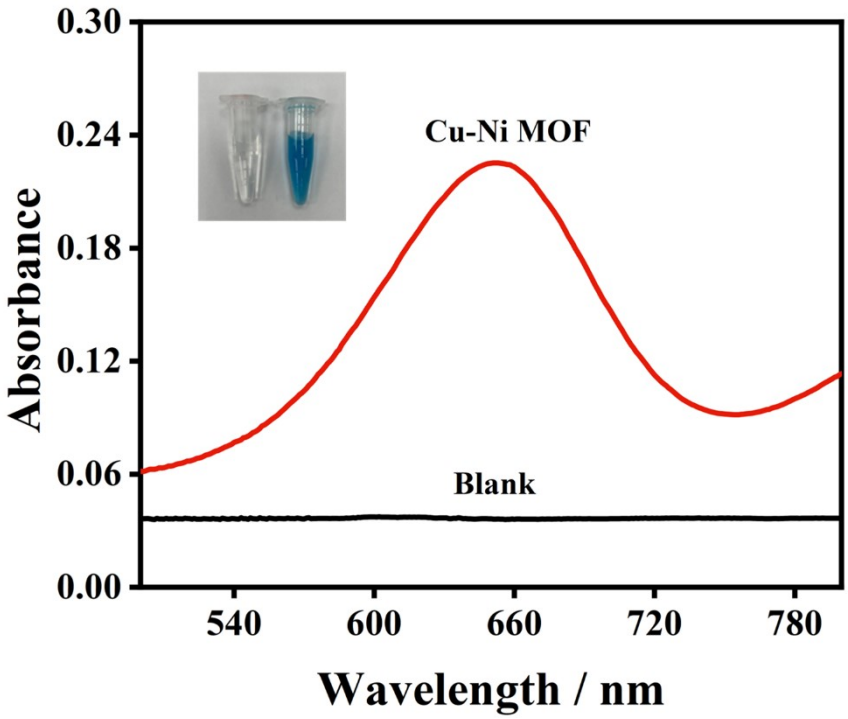

Fig. S3 UV-vis spectra of TMB/H_2O_2 solution before (blank sample) and after addition of Cu-Ni MOF. Inset: the color change of TMB/H_2O_2 solution before (transparent) and after (blue) addition of Cu-Ni MOF.

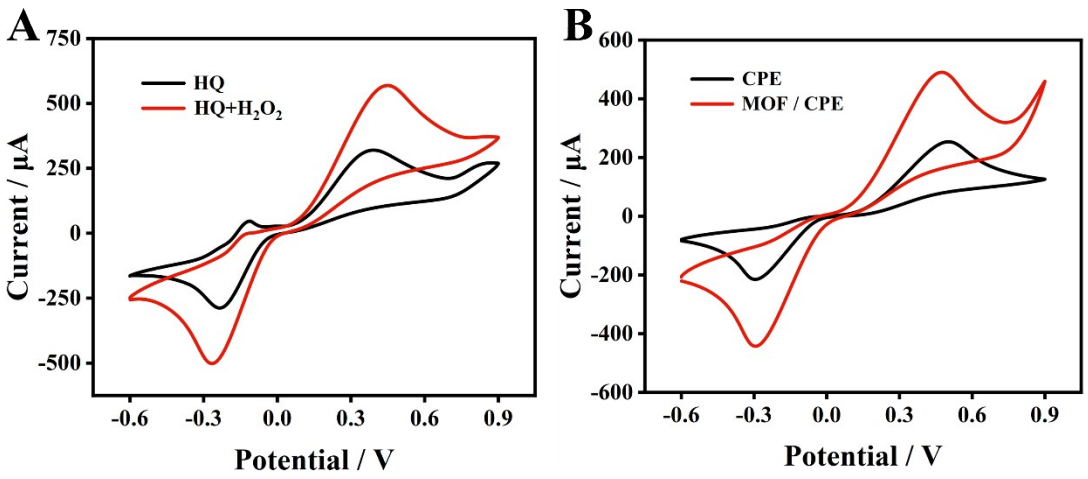

Fig. S4 (A) Comparison of CV curves of Cu-Ni MOF/CPE before and after the addition of H_2O_2 in 0.1 M N_2-saturated PBS (pH 7.5) containing HQ. (B) CV curves of Cu-Ni MOF/CPE and CPE in 0.1 M N_2-saturated PBS (pH 7.5) containing H_2O_2 and HQ.

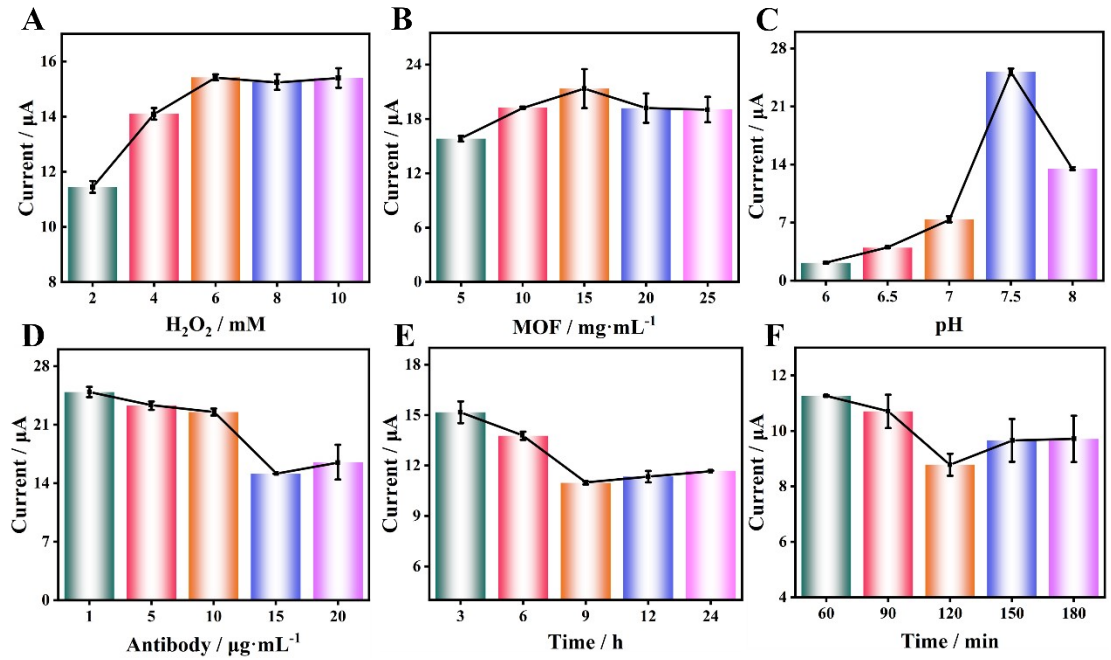

Fig. S5 Effects of H_2O_2 concentration (A), MOF concentration (B), pH (C), antibody concentration (D), antibody incubation time (E) and CEA incubation time (F) on the current signal. Error bars indicated the standard deviation of three measurements.

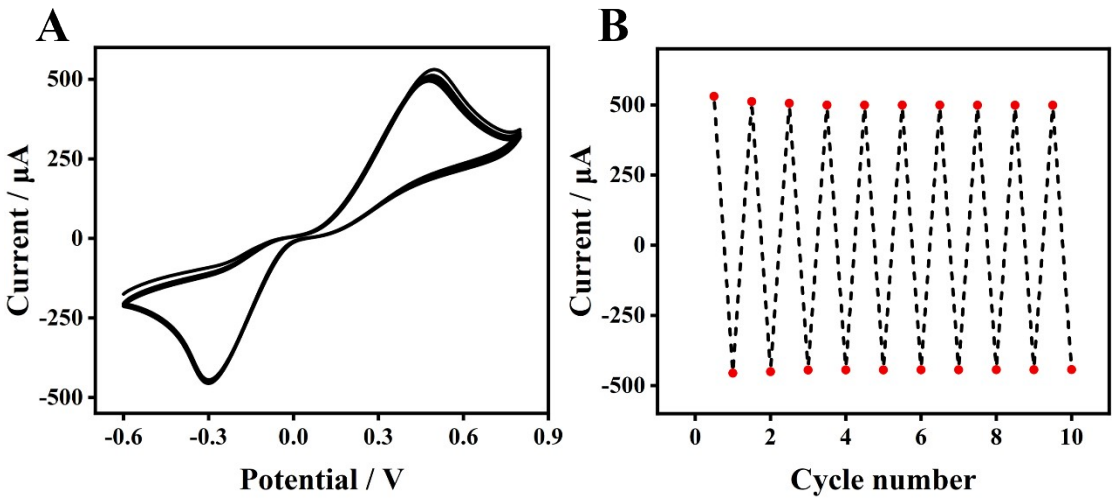

Fig. S6 (A) Cyclic voltammograms of the proposed electrochemical immunosensor in 0.1 M N_2-saturated PBS (pH 7.5) containing 10 mM H_2O_2 and 6 mM HQ under ten cycles at the scan rate of 100 mV/s, and (B) the corresponding peak current changes of the redox peak.

Table S1 Comparison of the proposed Cu-Ni MOF/CPE based electrochemical immunosensor and other methods for detection of CEA.

Signal strategies	Linear range	Detection limit	Reference
COFTFPB-Thi	0.11-80 ng/mL	0.03 ng/mL	[1]
AuNPs-Fc	0.05-20 ng/ml	0.20 ng/mL	[2]
Streptavidin-functionalized nitrogen-doped graphene	0.02-12 ng/ml	0.01 ng/mL	[3]
Horseradish peroxidase @AuNPs-PAN@CNTs	0.02-80 ng/mL	8.00 pg/mL	[4]
PtNPs @rGO@PS NSs	0.05-70 ng/mL	0.01 ng/mL	[5]
MoS_2-PBNCs	0.005-10 ng/mL	0.54 pg/mL	[6]
Cu-Ni MOF	0.5 pg/mL-500 ng/mL	0.16 pg/mL	This work

Table S2 The proposed electrochemical method for detection of CEA in clinical human serum samples.

Sample	Standard method (ng/mL)	Our method (ng/mL)	Avg value (ng/mL)	Relative error (%)
1	6.96	7.29, 6.72, 6.17	6.73	3.34
2	4.00	3.74, 3.90, 4.14	3.93	1.83
3	6.81	7.02, 6.60, 6.53	6.72	1.37

Table S3 Analysis results of CEA detection in human serum.

Sample	Spiked (ng/mL)	Found(ng/mL)	Avg value (ng/mL)	RSD (%)	Recovery (%)
-	-	3.74, 3.90, 4.14	3.93	5.13	0
1	5.00	9.23, 8.76, 9.75	9.25	5.36	106.30
2	10.00	14.46, 14.22, 14.33	14.34	8.37	104.10
3	20.00	22.47, 22.76, 21.93	22.40	1.94	92.30

References

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