Supporting Information

Construction of hollow double shell NiMn PBA nanozymes for sensitive sarcosine detection via a cascade strategy

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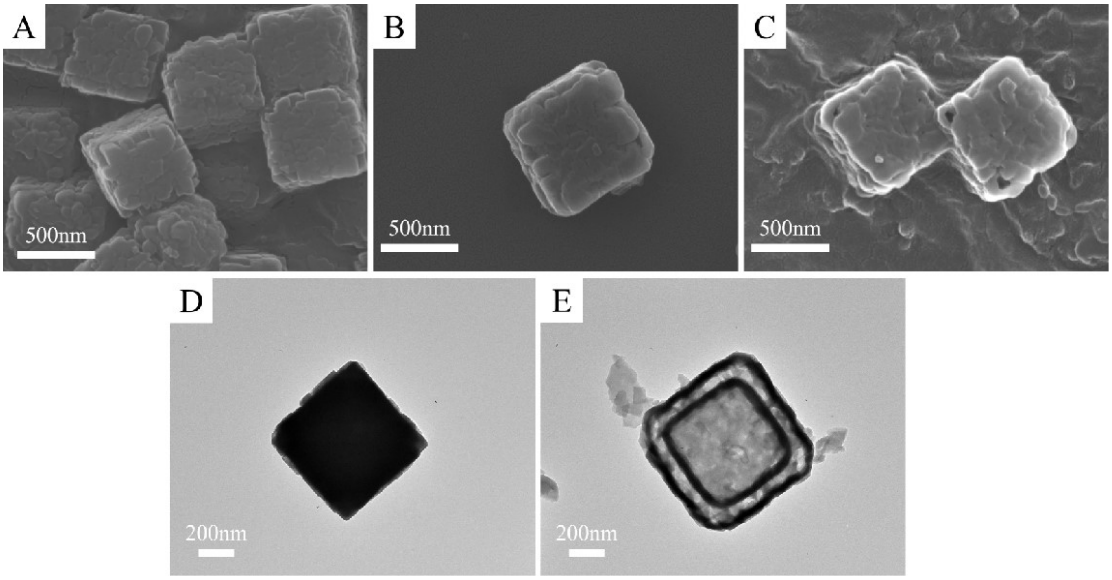

Fig. S1 SEM images of (A) Mn-PBA, (B) Mn-PBA-DSNB and (C) NiMn-PBA-DSNB (5f).

TEM images of (D) Mn-PBA, (E) Mn-PBA-DSNB

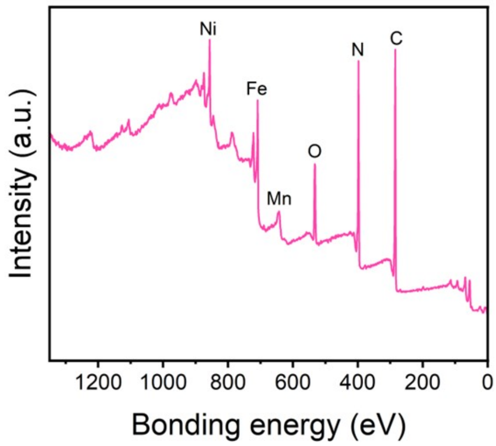

Fig. S2 XPS spectra of NiMn-PBA-DSNB (5f).

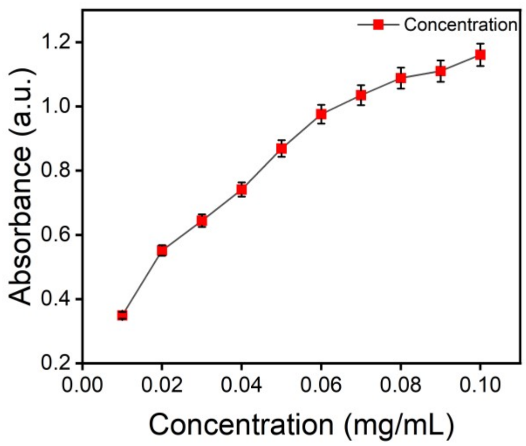

Fig. S3 Optimization of NiMn-PBA-DSNB (5f) Concentration

Table S1. Comparison of the kinetic parameters based on different nanozymes.

Nanozyme	Substrate	K_m (mM)	V_m (10^{-8} Ms^{-1})	Reference
HRP	TMB	0.434	10	[1]
	H_2O_2	3.7	8.71	
PtTeNi	TMB	32.877	2676	[2]
	H_2O_2	3.14	5020	
AgPd nanoclusters	TMB	2.63	1.304	[3]
	H_2O_2	104	1.198	
Mn-CeO_2	TMB	0.25	8.45	[4]
	H_2O_2	8.67	7.52	
AuNPs/Cit-GNs	TMB	2.63	1.304	[3]
	H_2O_2	104	1.198	
Fe,NA-CDs/PB	TMB	2.3	7.2	[5]
	H_2O_2	3.1	6.3	
Co_3O_4/CeO_2	TMB	0.36	16.66	[6]
	H_2O_2	132.21	4.34	
Ni-Pt@PSS	TMB	0.832	6.4	[7]
	H_2O_2	1.211	8.0	
Ni-Cu_2O	TMB	1.8	15.2	[8]
	H_2O_2	0.8	8.6	
Mn-PBA	TMB	0.662	39.2	[9]
	H_2O_2	8.22	23.3	
Mn-PBA DSNB@Au	TMB	0.94	12	[10]
	H_2O_2	1.34	14	
NiMn-PBA DSNB	TMB	0.53	5.21	this work
	H_2O_2	0.25	4.22	

Table S2 Comparison of reported SA detection methods.

Material	Method	linear range (μM)	LOD (μM)	Reference
Cellulose/PVA/CMC GO/NQS	Colorimetric	0-100	10	[11]
$CuInS_2$	Colorimetric	10-1000	8	[12]
Ag NCs	Fluorescent	200-1600	10.33	[13]
CeO_2/GC	Electrochemi-luminescent	50-5000	45.90	[14]
CNF/PAA	Colorimetry	0-100	10	[15]
Fe-doped g-C_3N_4	Colorimetric	10-500	8.6	[16]
NiMn-PBA-DSNB	Colorimetric	8-500	1.75	this work

References

[1] L. Gao, J. Zhuang, L. Nie, J. Zhang, Y. Zhang, N. Gu, T. Wang, J. Feng, D. Yang, S. Perrett and X. Yan, *Nat. Nanotechnol.*, 2007, **2**, 577 - 583.

[2] Z. Ye, C. Shang, Y. Wang, Z. Liu, C. Gong, X. Ge, W. Zhang, J. Li and Z. Guo, *Microchem. J.*, 2024, **207**, 111919.

[3] X. Chen, X. Tian, B. Su, Z. Huang, X. Chen and M. Oyama, *Dalton Trans.*, 2014, **43**, 7449 - 7454.

[4] R. Wang, B. Guan, W. Wang, H. Yan, J. Jin, Y. Yang, L. Li, L. Guo and Y. Zeng, *Sens. Actuators B: Chem.*, 2025, **427**, 137178.

[5] Y. Cui, Q. Li, D. Yang and Y. Yang, *Spectrochim. Acta Part A*, 2024, **313**, 124100.

[6] N. Alizadeh, A. Salimi and R. Hallaj, *Sens. Actuators B: Chem.*, 2019, **288**, 44 - 52.

[7] S. Mu, Y. Yang, T. Han, J. Liu, Z. Zhu, H. Zheng and H. Zhang, *Sens. Actuators B: Chem.*, 2025, **423**, 136724.

[8] R. Cheng, Z. Xiao, X. Tang, P. Xu and P. Qiu, *Colloids Surf. B: Biointerfaces*, 2025, **245**, 114347.

[9] Y. Qian, Y. Chen and G. Yang, *Colloids Surf. A: Physicochem. Eng. Asp.*, 2023, **665**, 131223.

[10] Z. Yuan, Y. Zhu, L. Xue, D. Ge, S. Xue, Y. Xie, W. Zhang and X. Chen, *Microchem. J.*, 2025, **213**, 113799.

[11] T. Phookum, S. Boobphahom, T. Siripongpreda, S. Ummartyotin and N. Rodthongkum, *Cellulose*, 2024, **31**, 8555 - 8568.

[12] X. Jiang, L. Zhang, Y. Liu, X. Yu, Y. Liang, P. Qu, W. Zhao, J. Xu and H. Chen, *Biosens. Bioelectron.*, 2018, **107**, 230 - 236.

[13] Y. Zhao, H. Liu, Y. Jiang, S. Song, Y. Zhao, C. Zhang, J. Xin, B. Yang and Q. Lin, *Anal. Chem.*, 2018, **90**, 14578 - 14585.

[14] H. Bahrami, Y. Kosto, C. Santo, Y. Yakovlev, I. Khalakhan, M. Mousavi, V. Matolin, I. Matolinová, F. Paolucci, G. Valenti, N. Tsud and A. Zanut, *Microchem. J.*, 2023, **187**, 108362.

[15] N. Passornraprasit, J. Hinestroza, N. Rodthongkum and P. Potiyaraj, *Carbohydr. Polym.*, 2025, **352**, 123134.

[16] X. Xi, X. Peng, C. Xiong, D. Shi, J. Zhu, W. Wen, X. Zhang and S. Wang, *Microchim. Acta*, 2020, **187**, 1 - 11.