

Gold nanoparticle etching induced by an enzymatic-like reaction for the colorimetric detection of hydrogen peroxide and glucose

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Preparation of mixed-valence MoO₃ nanosheets

Mixed-valence MoO₃ nanosheets were prepared by liquid exfoliation assisted by sonication followed by photochemical reduction¹. Briefly, 3.0 g of commercial MoO₃ powder was dispersed in 200 mL of an ethanol/water mixed solution (50:50 vol.%) and then sonicated for 180 min at a power of 380 W. Then, the transparent supernatant containing a high concentration MoO₃ nanosheets was obtained by filtration through a 0.25 μm nylon membrane filter. Next, a certain volume of the MoO₃ nanosheet solution was irradiated with a 19 W UV lamp for 20 min. The obtained solution, which was blue in colour, contained mixed-valence MoO₃ nanosheets.

Preparation of AuNPs using mixed-valence MoO₃ nanosheets

First, 10 mL of mixed-valence MoO₃ nanosheet solution and 5 mL of HAuCl₄ (0.2 wt.%) were mixed well. Then, this solution was allowed to stand for 20 min to trigger gold nucleation via the reduction of the MoO₃ nanosheets. The reaction was kept for another 12 h in a refrigerator at 4 °C to promote complete conversion for the formation of AuNPs. The final AuNP solution, which was burgundy in colour, was stored in a refrigerator at 4 °C without any washing or purification.

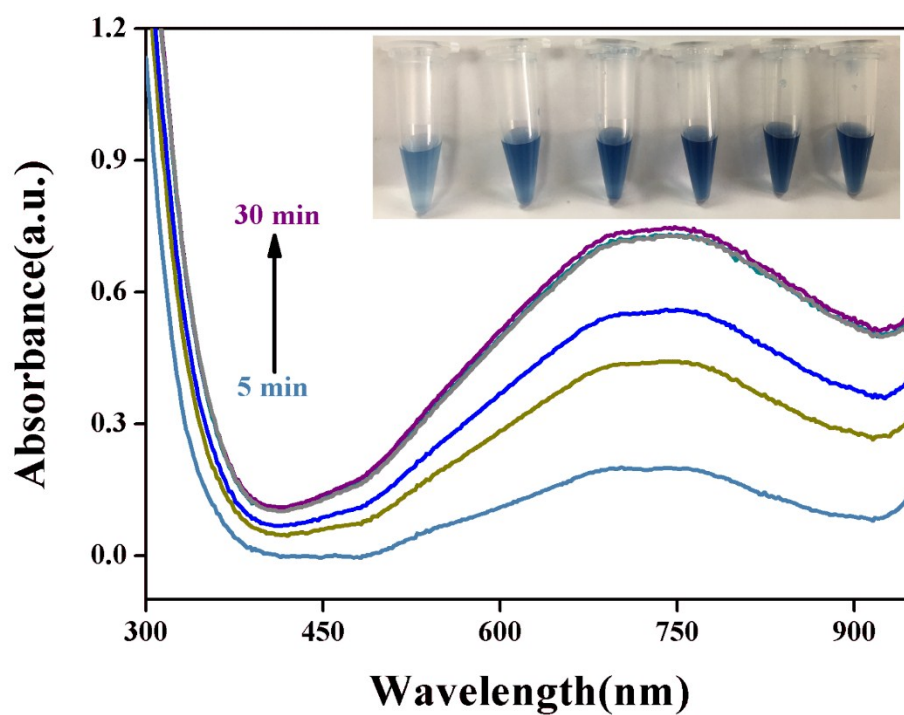


Fig. S1 UV-vis absorbance spectra of the MoO₃ nanosheets samples with different UV irradiation time. The inset shows the corresponding photograph.

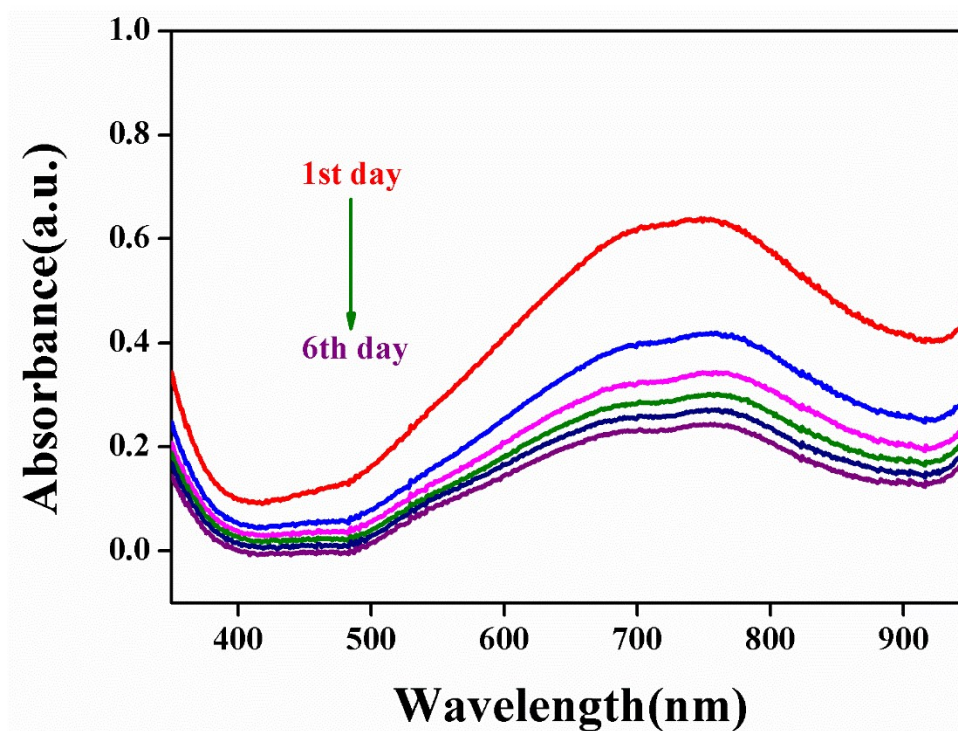


Fig. S2 UV-vis absorbance spectra of blue color mixed valence state MoO₃ nanosheets with different preservation time.

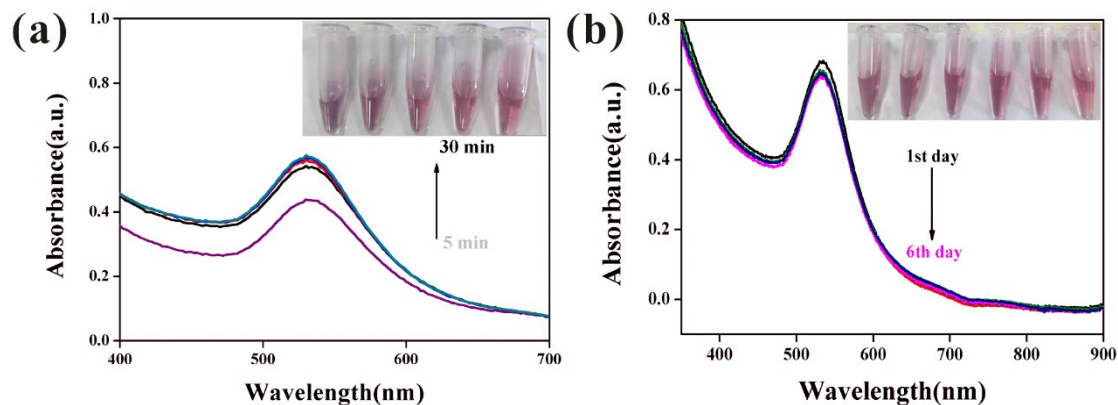


Fig. S3 (a) UV-vis absorbance spectra of HAuCl₄/ mixed valence state MoO₃ nanosheets solution at different time, (b) UV-vis absorbance spectra of obtained AuNPs solution with different preservation time. The inset shows the corresponding photographs.

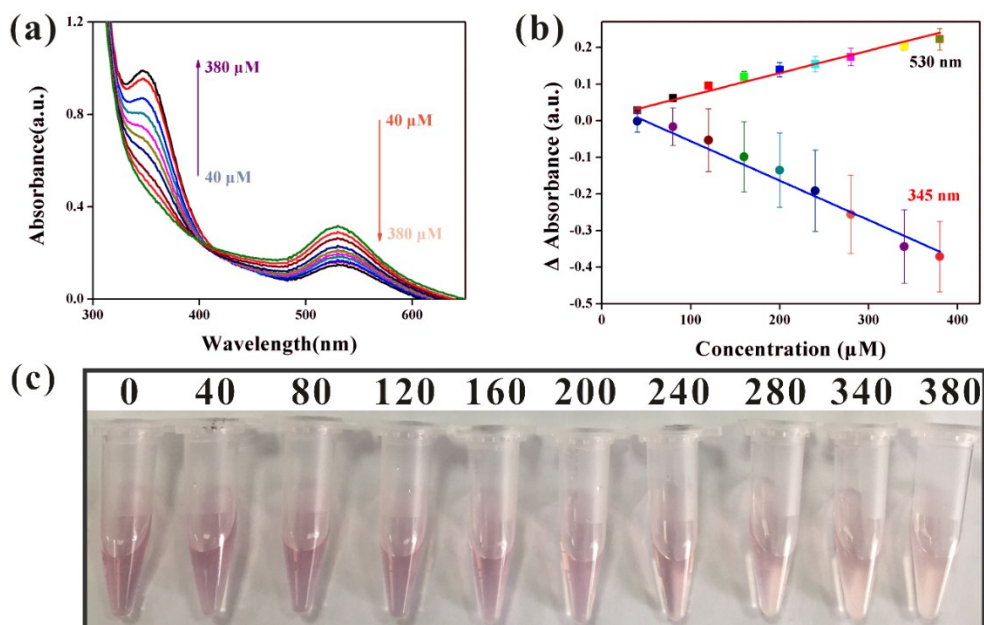


Fig. S4 (a) UV-vis absorption spectra, (b) linear calibration plots for H₂O₂ detection (the vertical coordinates $\Delta A = A_0 - A$, where A_0 and A are the absorbance intensities in the absence and presence of H₂O₂, respectively.) and (c) corresponding color change photograph.

Table S1 Comparative analysis of various colorimetric sensors employed for glucose detection

Materials used	Signal probe	One-pot of detection	Linear range (μM)	Detection limit (μM)	References
$\text{Fe}_3\text{O}_4\text{-Au@SiO}_2$	TMB	No	10-130	0.5	[2]
FeWO_4	TMB	No	4-60	0.67	[3]
Fe-MIL-88NH ₂	TMB	No	2-300	0.48	[4]
Au@Ag	C-dots	No	0.5-300	0.2	[5]
Gold nanorods	Gold nanorods	Yes	0.1-1,1-10	0.1	[6]
Gold nanobipyramids	Gold nanobipyramids	Yes	0.05-90	0.02	[7]
Silver Nanoprism	Silver Nanoprism	Yes	0.2-100	0.2	[8]
AuNPs	AuNPs	Yes	1-10	0.45	This work

Table S2 Recovery experiments of glucose detection

Sample	Initial amount (mM)	Added (mM)	Found (μg)	Recovery (%)	RSD (n=5) (%)
Water chestnut	0.1	0.01	0.11	100	1.6
		0.5	0.64	108	2.0
		1.0	1.12	102	2.3

References:

1. L. Su, Y. Xiong, Z. Chen, Z. Duan, Y. Luo, D. Zhu and X. Ma, *Sen. Actuat. B-Chem.*, 2019, 279, 320-326.
2. X. He, L. Tan, D. Chen, X. Wu, X. Ren, Y. Zhang, X. Meng and F. Tang, *Chem. Commun.*, 2013, **49**, 4643-4645.
3. T. Tian, L. Ai, X. Liu, L. Li, J. Li and J. Jiang, *Ind. Eng. Chem. Res.*, 2015, **54**, 1171-1178.
4. Y.L. Liu, X.J. Zhao, X.X. Yang and Y.F. Li, *Analyst*, 2013, **138**, 4526-4531.
5. W. Liu, F. Ding, Y. Wang, L. Mao, R. Liang, P. Zou, X. Wang, Q. Zhao and H. Rao, *Sen. Actuat. B-Chem.*, 2018, **265**, 310-317.
6. Z. Zhang, Z. Chen, F. Cheng, Y. Zhang and L. Chen, *Biosens. Bioelectron.*, 2017, **89**, 932-936.
7. S. Xu, L. Jiang, Y. Liu, P. Liu, W. Wang and X. Luo, *Anal. Chim. Acta*, 2019, **1071**, 53-58.
8. Y. Xia, J. Ye, K. Tan, J. Wang and G. Yang, *Anal. Chem.*, 2013, **85**, 6241-6247.