

New Insight into Assembled Fe₃O₄@PEI@Ag Structure as Acceptable Agent with Enzymatic and Photothermal Properties

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Supporting Information

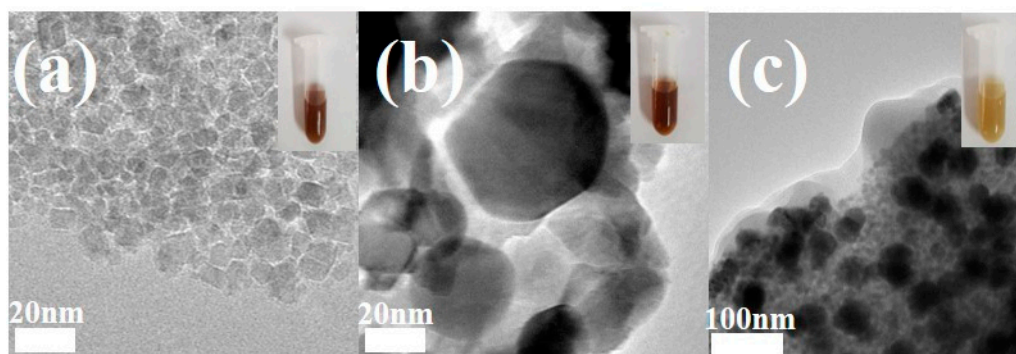


Figure S1 TEM images of (a) Fe₃O₄ NPs, (b) Ag NPs, (c) Fe₃O₄@PEI@Ag structure.

Supporting Information

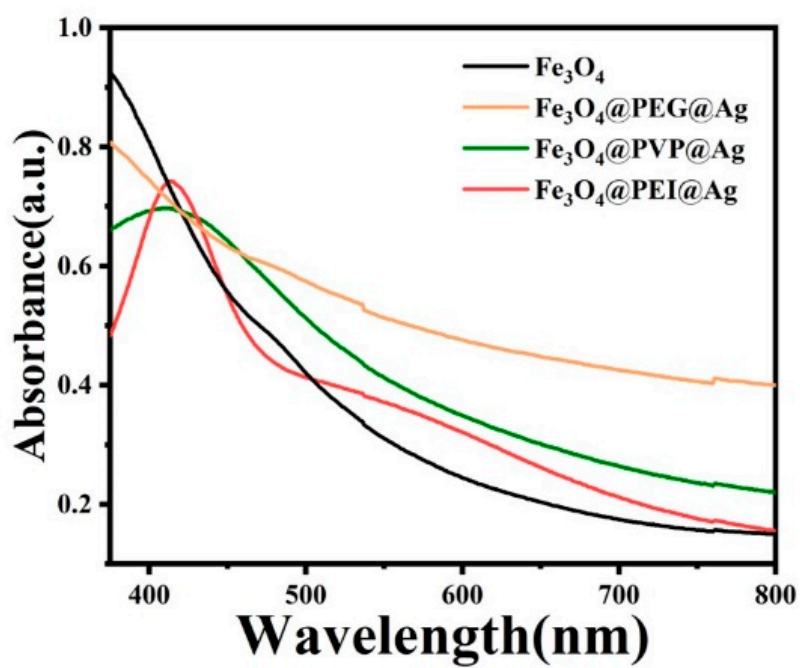


Figure S2 UV-vis absorbance spectra of Fe_3O_4 NPs, $\text{Fe}_3\text{O}_4@\text{PEG}@\text{Ag}$ structure, $\text{Fe}_3\text{O}_4@\text{PVP}@\text{Ag}$ structure and $\text{Fe}_3\text{O}_4@\text{PEI}@\text{Ag}$ structure.

Supporting Information

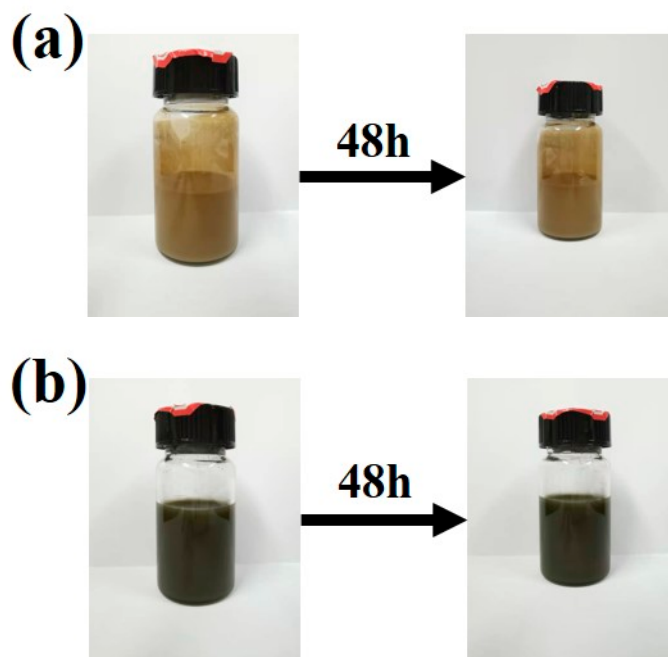


Figure S3 (a) The stability of $\text{Fe}_3\text{O}_4@\text{PEI}@\text{Ag}$ structure after standing 48h; (b) The stability of $\text{Fe}_3\text{O}_4@\text{PEI}@\text{Ag}@\text{ICG}$ structure after standing 48h

Supporting Information

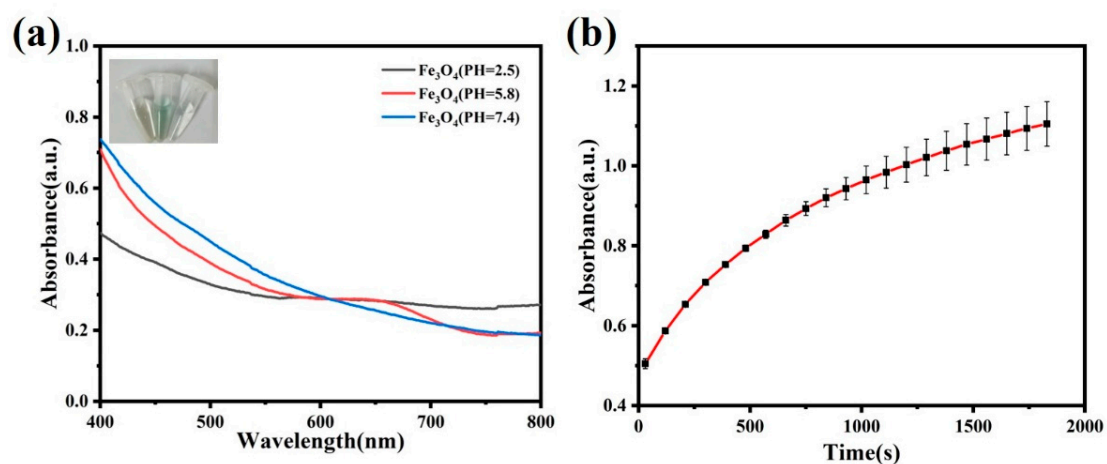


Figure S4 (a) Effect of pH on the peroxidase-like activity of Fe₃O₄ NPs; (b) Peroxidase-like activity of Fe₃O₄@PEI@Ag structure during 30 min.

Supporting Information

Table S1 Comparison of the kinetic data of Fe₃O₄@PEI@Ag structure with that of HRP in the previous literature

Nanozymes	K _m (mM)		V _{max} (×10 ⁻⁷ M s ⁻¹)	
	H ₂ O ₂	TMB	H ₂ O ₂	TMB
Fe ₃ O ₄ @PEI@Ag structure	1.192	0.302	1.299	1.163
HRP[1]	3.7	0.434	0.87	1
CiCo ₂ O ₄ MS[2]	9.41	0.14	2.58	0.223
Ni-MOF nanosheet[3]	6.53	0.36	13	0.249
ZnFe ₂ O ₄ MNPs[4]	1.66	0.85	0.774	1.331
Fe-Mil-88NH ₂ [5]	2.06	0.028	1.047	0.704
Pd/Fe ₃ O ₄ -PEI-RGO[6]	3.66		0.4	
PdNPs[7]	0.21		0.021	

Supporting Information

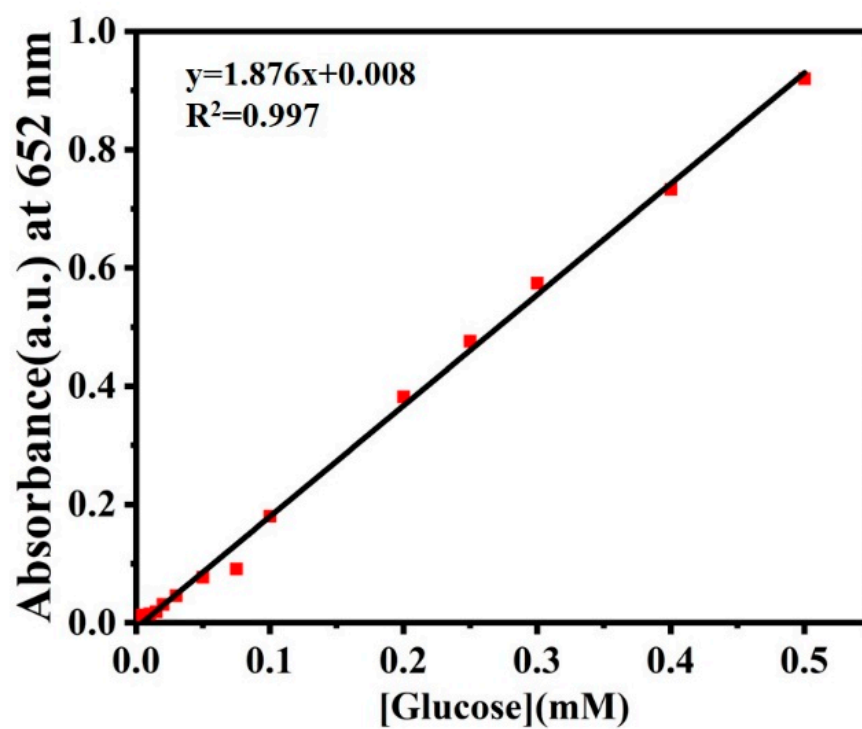


Figure S5 The linear relationship between the absorbance intensity and the concentration of glucose.

Supporting Information

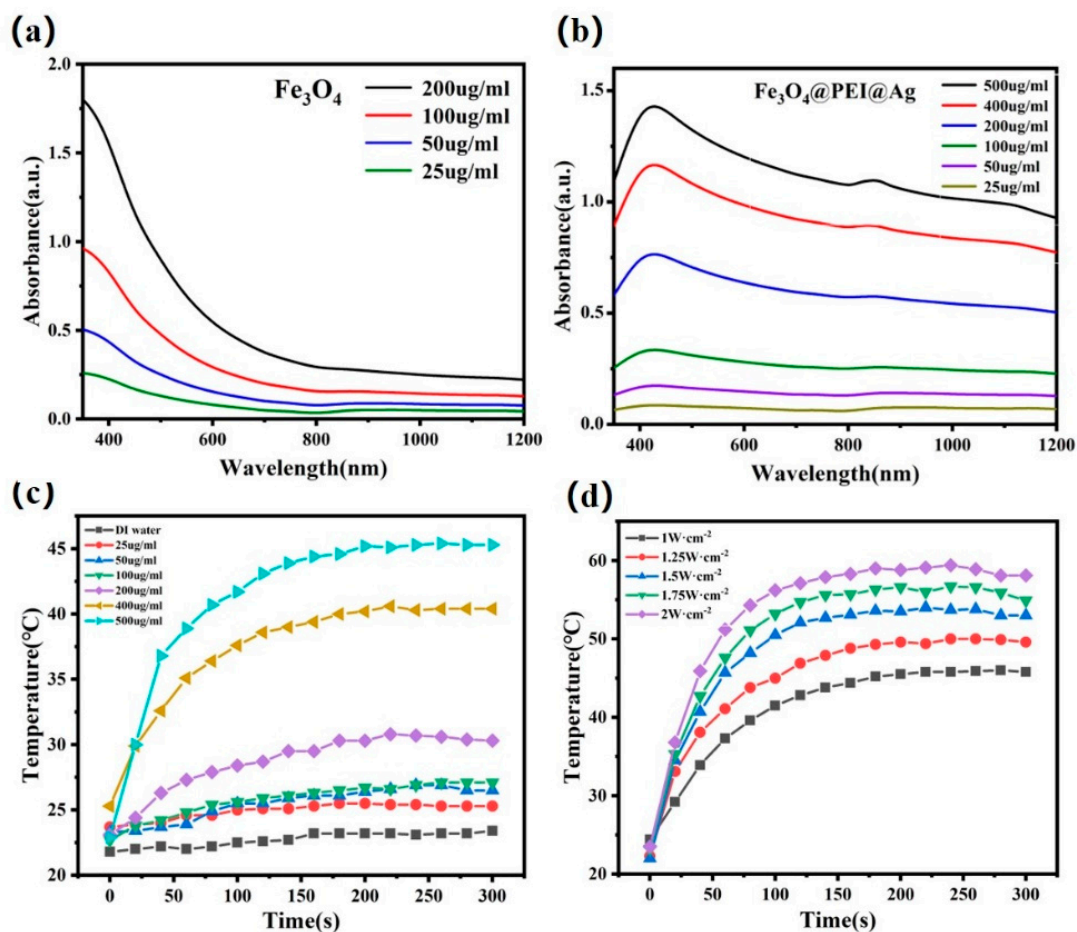


Figure S6 (a) Vis-NIR absorbance spectral of Fe₃O₄ NPs dispersions with different concentrations; (b) Vis-NIR absorbance spectral of Fe₃O₄@PEI@Ag structure dispersions with different concentrations; (c) Temperature increase of Fe₃O₄@PEI@Ag structure dispersion with gradient concentrations under 808 nm NIR laser irradiation; (d) Temperature increase of Fe₃O₄@PEI@Ag@ICG structure dispersion exhibited laser power density-dependent profiles.

Supporting Information

References

1. Gao, L.; Zhuang, J.; Nie, L.; Zhang, J.; Zhang, Y.; Gu, N.; Wang, T.; Feng, J.; Yang, D.; Perrett, S.; Yan, X., Intrinsic peroxidase-like activity of ferromagnetic nanoparticles. *Nat Nanotechnol* **2007**, 2, (9), 577-83.
2. Huang, W.; Lin, T. Y.; Cao, Y.; Lai, X. Y.; Peng, J.; Tu, J. C., Hierarchical NiCo₂O₄ Hollow Sphere as a Peroxidase Mimetic for Colorimetric Detection of H₂O₂ and Glucose. *Sensors-Basel* **2017**, 17, (1).
3. Chen, J.; Shu, Y.; Li, H.; Xu, Q.; Hu, X., Nickel metal-organic framework 2D nanosheets with enhanced peroxidase nanozyme activity for colorimetric detection of H₂O₂. *Talanta* **2018**, 189, 254-261.
4. Su, L.; Feng, J.; Zhou, X.; Ren, C.; Li, H.; Chen, X., Colorimetric detection of urine glucose based ZnFe₂O₄ magnetic nanoparticles. *Anal Chem* **2012**, 84, (13), 5753-8.
5. Tan, H.; Li, Q.; Zhou, Z.; Ma, C.; Song, Y.; Xu, F.; Wang, L., A sensitive fluorescent assay for thiamine based on metal-organic frameworks with intrinsic peroxidase-like activity. *Anal Chim Acta* **2015**, 856, 90-5.
6. Li, S. L.; Li, H.; Chen, F. J.; Liu, J.; Zhang, H. L.; Yang, Z. Y.; Wang, B. D., Strong coupled palladium nanoparticles decorated on magnetic graphene nanosheets as enhanced peroxidase mimetics for colorimetric detection of H₂O₂. *Dyes Pigments* **2016**, 125, 64-71.
7. Kuo, C. H.; Lamontagne, L. K.; Brodsky, C. N.; Chou, L. Y.; Zhuang, J.; Sneed, B. T.; Sheehan, M. K.; Tsung, C. K., The effect of lattice strain on the catalytic properties of Pd nanocrystals. *ChemSusChem* **2013**, 6, (10), 1993-2000.