Supporting Information

Nonmetallic plasmon assisted upconversion fluorescence for ultrasensitive hydrogen peroxide detection from nM to μM

Juan Li, Xingwu Huang, Jiangyi Chen, Zaizhu Lou,* and Baojun Li*

Guangdong Provincial Key Laboratory of Nanophotonic Manipulation, Institute of Nanophotonics, College of Physics & Optoelectronic Engineering, Jinan University, Guangzhou, 511443, China

Corresponding Authors: zzlou@jnu.edu.cn; baojunli@jnu.edu.cn;

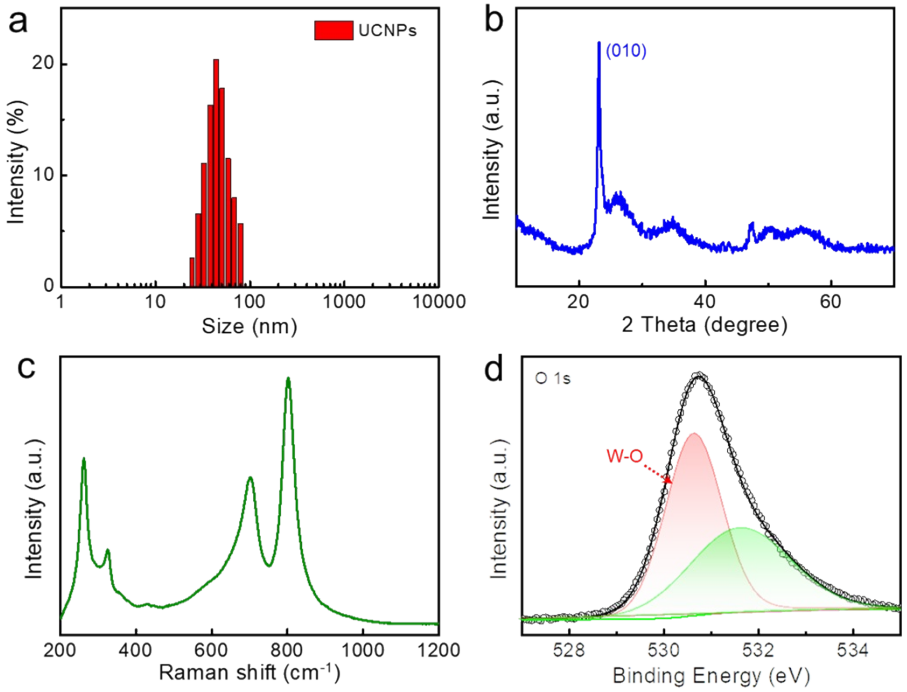

Figure S1 DLS size distribution (a) of UCNPs. XRD pattern (b), Raman spectrum (c), O 1s XPS spectrum (d) of plasmonic WO_{3-x}.

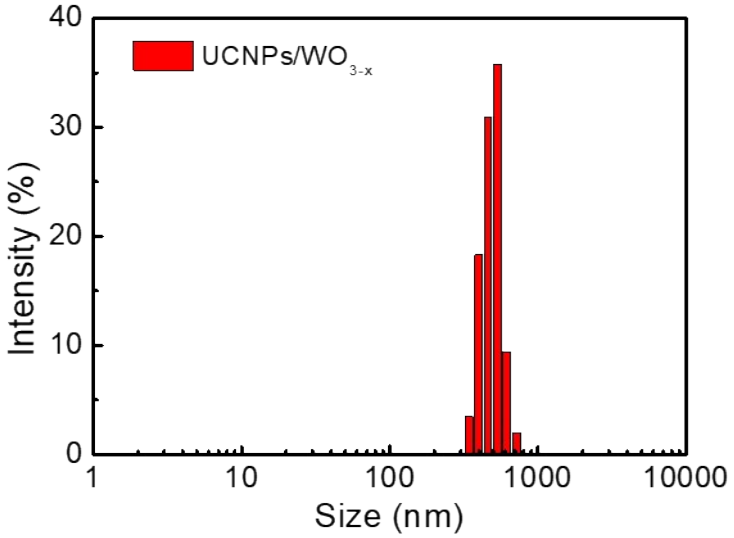

Figure S2 DLS data of the UCNPs/WO_{3-x} hybrid.

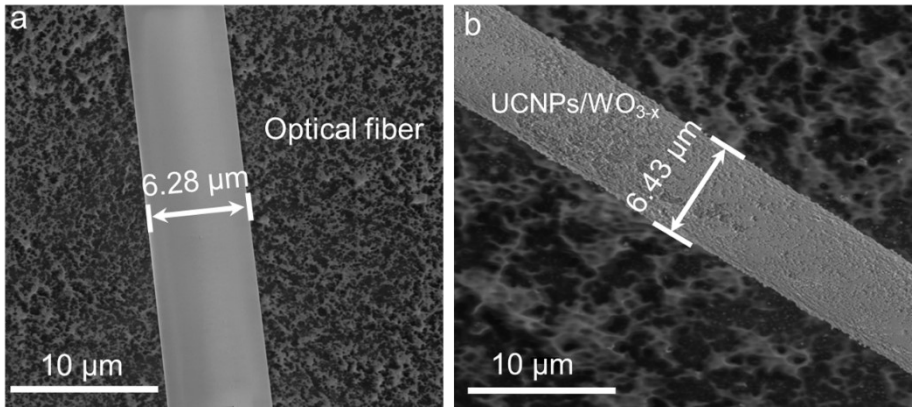

Figure S3 Typical SEM images of optical fiber (a) and optical fiber coated with UCNPs/WO_{3-x} (b).

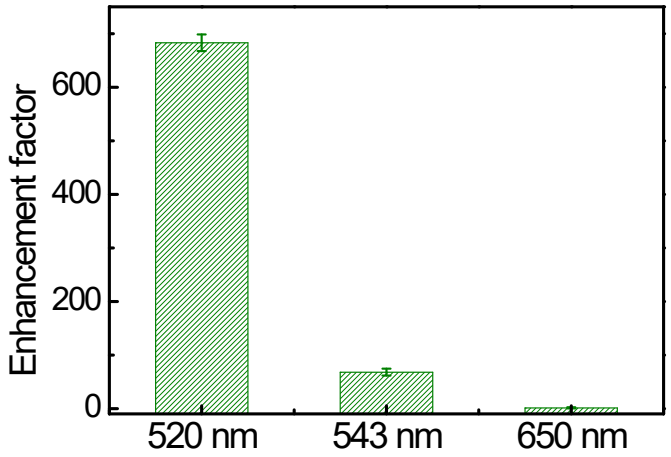

Figure S4 The enhancement factors diagram of UCNPs/WO_{3-x} for 520, 543, and 650-nm emission bands.

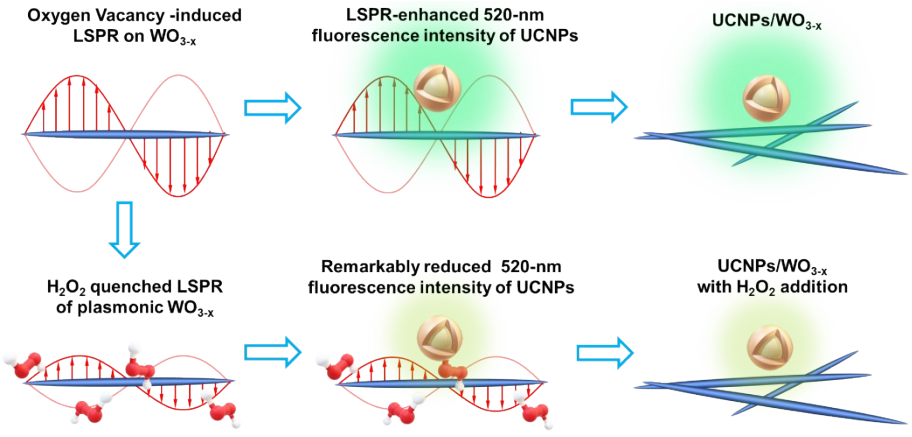

Figure S5 The illustrated principle diagram of $UCNPs/WO_{3-x}$ probe for H_2O_2 detection.

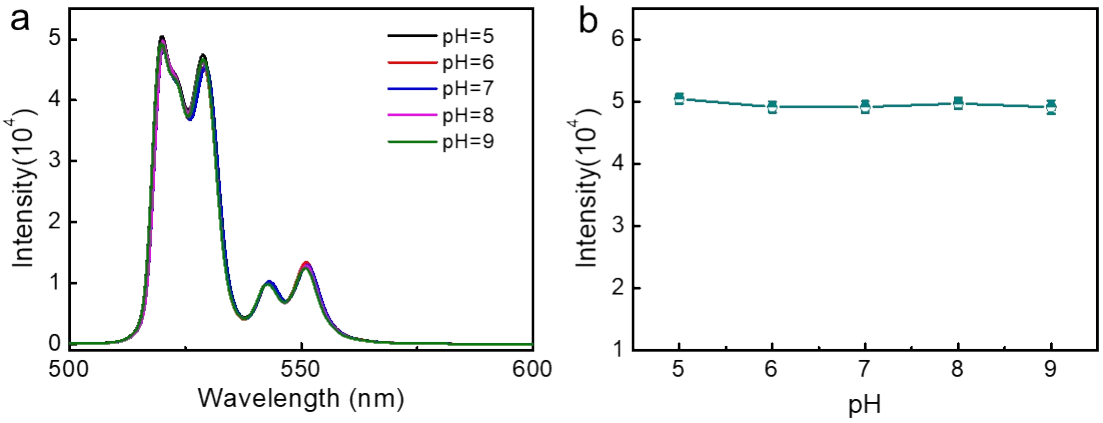

Figure S6 The fluorescence spectra (a) of $UCNPs/WO_{3-x}$ probe under different PH conditions. Dependence of 520-nm fluorescence intensity of $UCNPs/WO_{3-x}$ probe on pH (b).

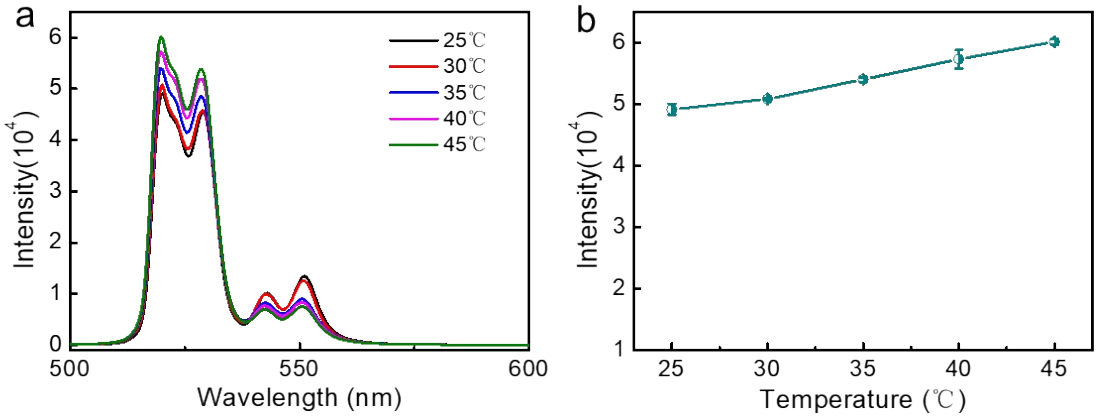

Figure S7 The fluorescence spectra of $UCNPs/WO_{3-x}$ probe under different temperature (a). Dependence of 520-nm fluorescence intensity of $UCNPs/WO_{3-x}$ probe on the temperature (b).

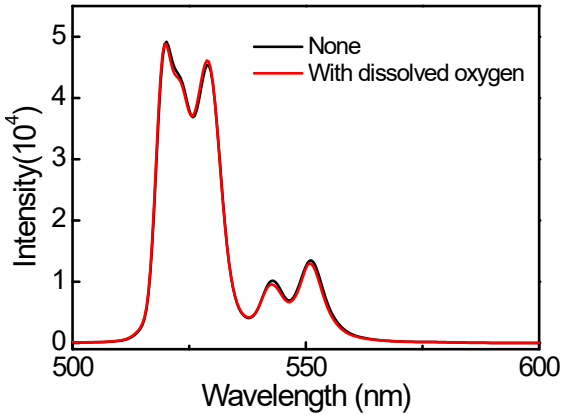

Figure S8 The fluorescence spectra of UCNPs/WO_{3-x} probe in fresh ultrapure water solution with dissolved oxygen.

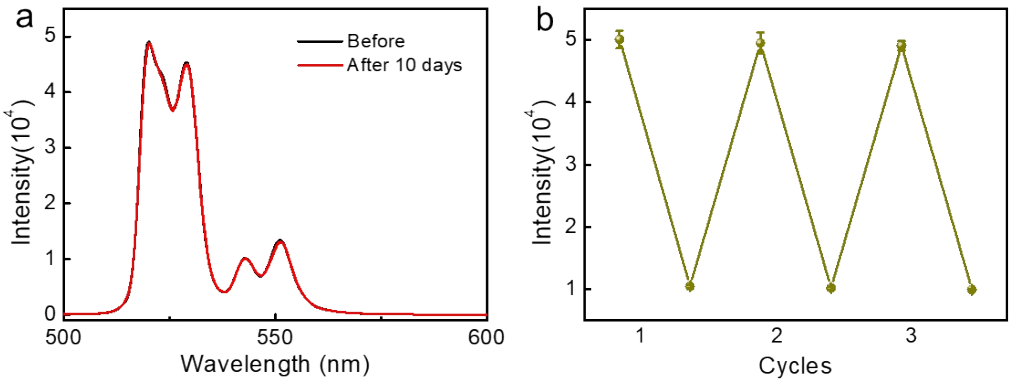

Figure S9 The fluorescence spectra of UCNPs/WO_{3-x} probe before and after 10 days (a). Repeated H_2O_2 detection cycles (c) from 0 to 10 μM of UCNPs/WO_{3-x} probe.

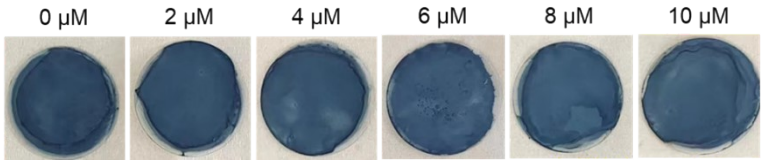

Figure S10 The photographs of WO_{3-x} samples with different H_2O_2 concentration addition.

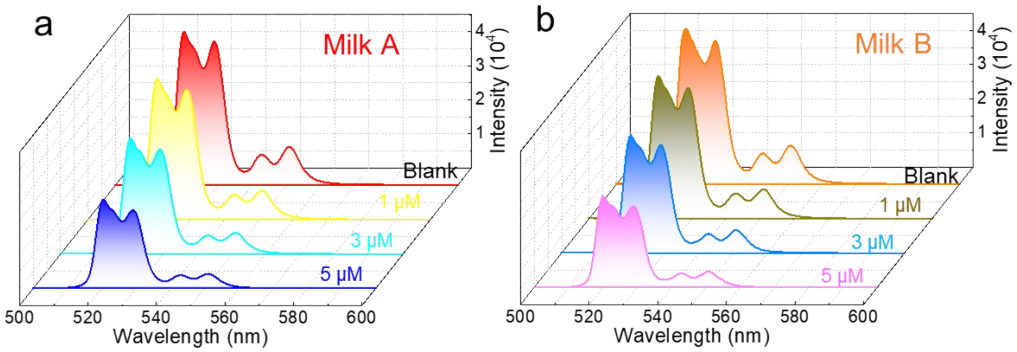

Figure S11 The fluorescence spectra of UCNPs/WO_{3-x} probe with addition of different milk samples.

Table S1 Comparison of detection performance of various methods

Method	Materials	Detection range (μM)	Detection limit (μM)	Emission	Response time	Application	Ref.
Colorimetric assay	NiFe-LDHNS	10–500	4.4	/	10 min	Glucose and H_2O_2	[1] 2018
	α-AgVO3 rods	60–200	2	/	2 min	Commercial antiseptic sample	[2] 2017
Electrochemical assay	CoS/RGO nanohybrids	0.1–2542.4	0.042	/	3 s	Biological samples	[3] 2018
	Pt-NPs/EC	0.05–2220	0.01	/	/	Non-enzymatic determination	[4] 2017
	PB/PEDOT	0.5–46	0.17	/	/	H_2O_2 Upon NADH Treatment	[5] 2023
Chemiluminescent	Co(II)-monoethanolamine	1.0–154	0.2	/	12.5s		[6] 2024
Fluorometric assay	C-dots	0.1–40	0.05	/	10 min	Choline and acetylcholine	[7] 2014
	AIEgen TPE-M-L	0.01–1.0	0.01	460 nm	30 min	Human serum samples	[8] 2018
	MIL-101(Fe)	0.1–130	0.0011	430 nm	90 min	Choline and acetylcholine	[9] 2020
	Sulfur dope CDs	0–100	0.05	830 nm	200 s	Cell Mitosis and Mouse Brain	[10] 2018
	Coumarin pyran+galactose	1.0–50	0.33	706 nm	15 min	Zebrafish	[11] 2020
	MoO_{3-x} QDs	0–1	0.003	770 nm	/	/	[12] 2021
	BTFMB+ESIPT	0–20	0.109	542 nm	0-45 min	Ferroptosis process	[13] 2021
	Dicyanoisophorone	0–30	0.35	657 nm	15-20 min	Milk samples and in vivo	[14] 2023
	UCNPs	0.25–5	0.1	800 nm	/	Choline and H_2O_2	[15] 2019
	UCNPs/B-R-COOH	0–70	0.00434	478 nm	/	Gold pigment	[16] 2024
	UCNPs-DCM	0–10	0.168	660 nm	/	Hydrogen Peroxide in Vivo	[17] 2019
This work	**UCNPs/WO_{3-x}**	**0–50**	**0.001**	**520 nm**	/	**Human serum and milk**	

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