Electronic Supporting Materials

Light-accelerating oxidase-mimicking activity of black phosphorus quantum dots for colorimetric detection of acetylcholinesterase activity and inhibitor screening

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Preparation of BP QDs

The preparation of BP QDs follows a previous protocol [1]. Briefly, BP powder (10 mg) and NaOH (100 mg) were added into 100 mL of NMP. The mixture was heated up to 140 °C and allowed to react for 6 hours under the protection of nitrogen atmosphere. During the process, the mixture gradually changed into light yellow. After cooling down to ambient temperature, the supernatant was collected with centrifugation at 7000 rpm for 20 minutes. The BP QDs solution was placed in a 4 °C refrigerator when not used.

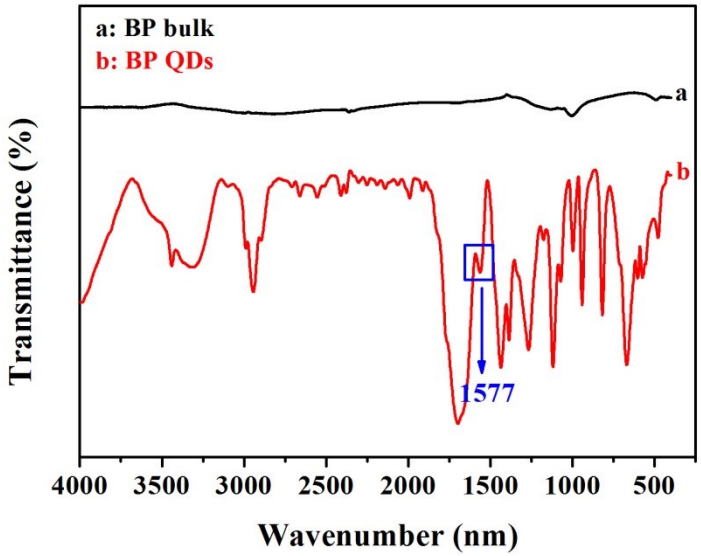

Fig. S1. FT-IR spectra of BP bulk (Black line) and the BP QDs (Red).

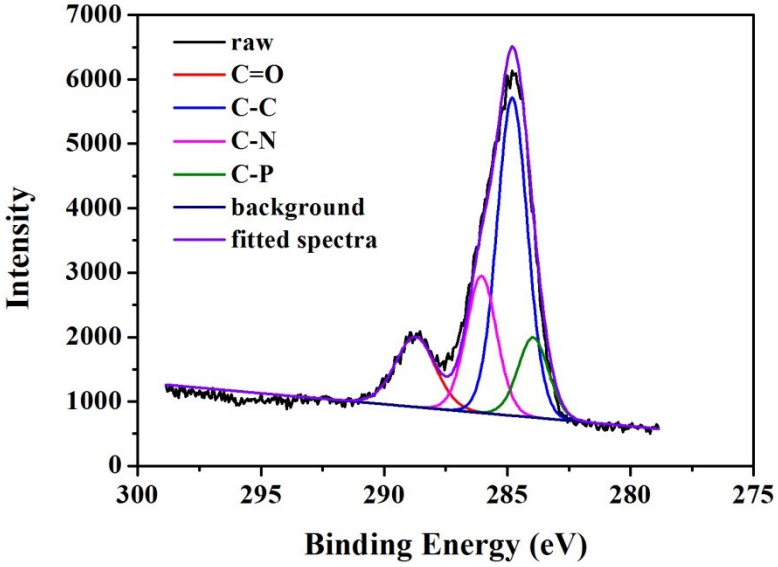

Fig. S2. XPS spectra of C1s peaks of the BP QDs.

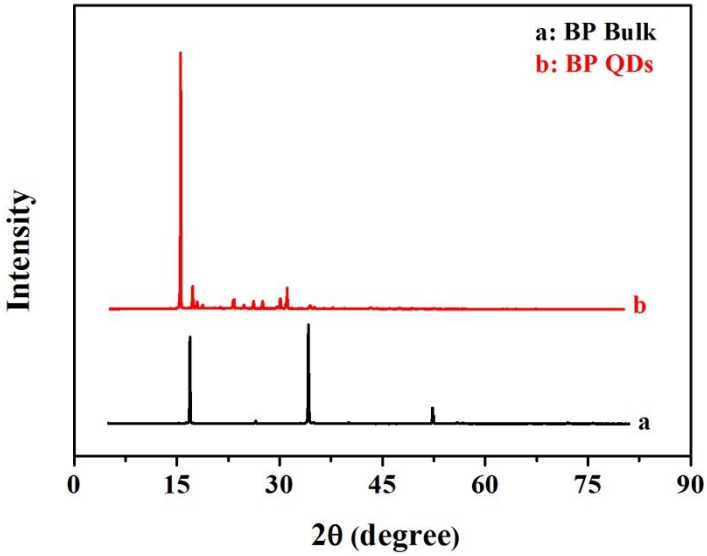

Fig. S3. XRD spectra of BP bulk (Black line) and the BP QDs (Red line).

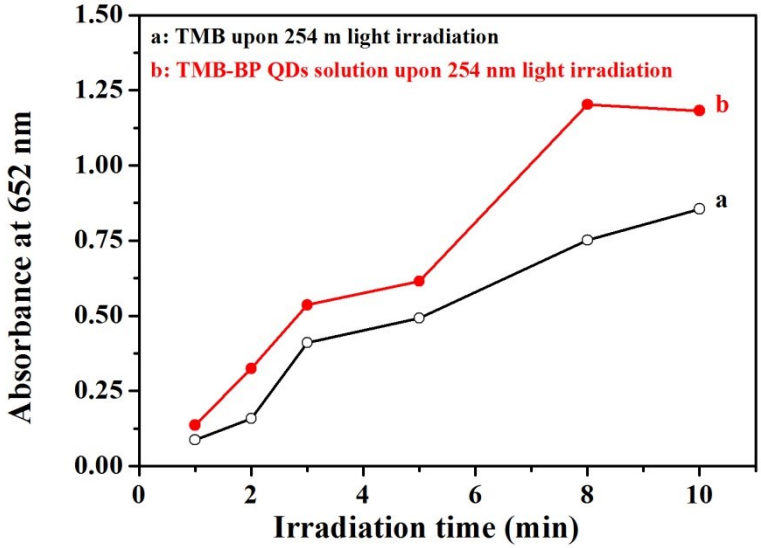

Fig. S4. The absorbance at 652 nm of the chromogenic reaction of 1.2 mmol/L TMB without and with the addition of 5.0 μg/mL BP QDs in HAc-NaAc buffer (pH 3.5) under 254 nm UV light illumination with exposure time ranging from 1 to 10 min.

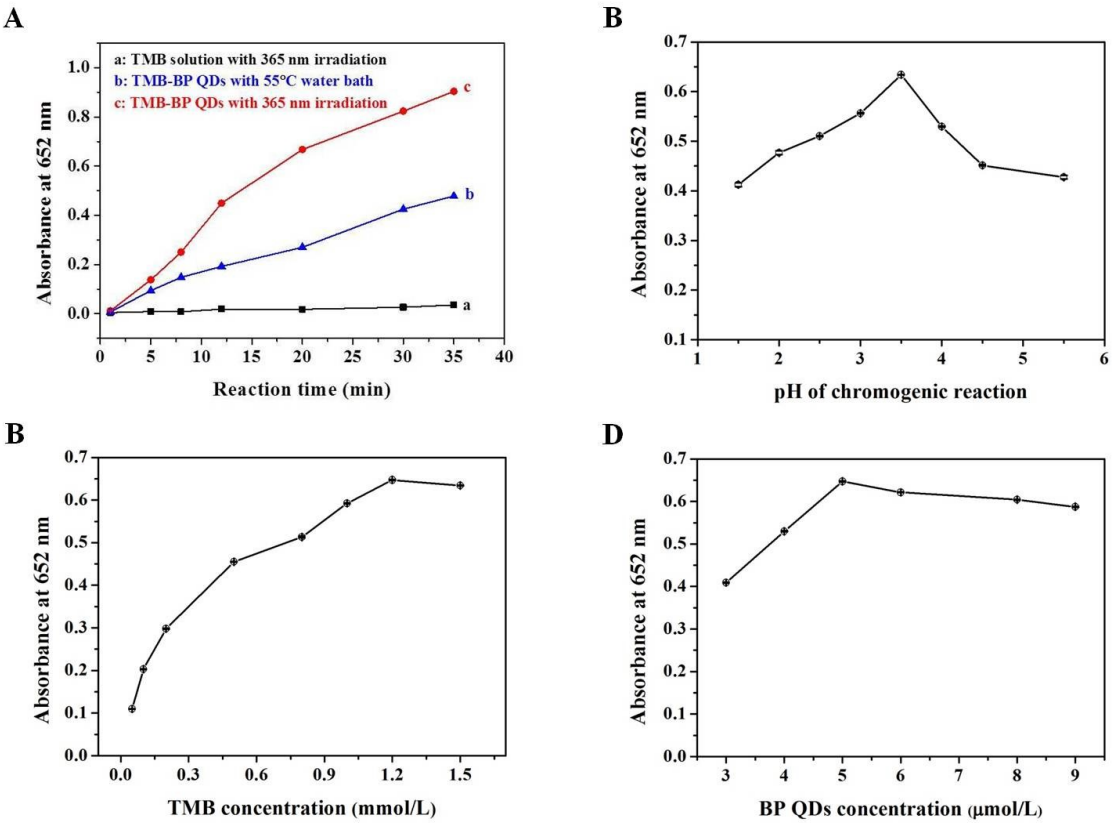

Fig. S5. Effect of the (A) irradiation time, (B) pH of chromogenic reaction, (C) TMB concentration, and (D) BP QDs concentration towards the oxidase-mimicking activity of BP QDs under 365 nm light irradiation. Error bars present the standard deviations of three replicate measurements.

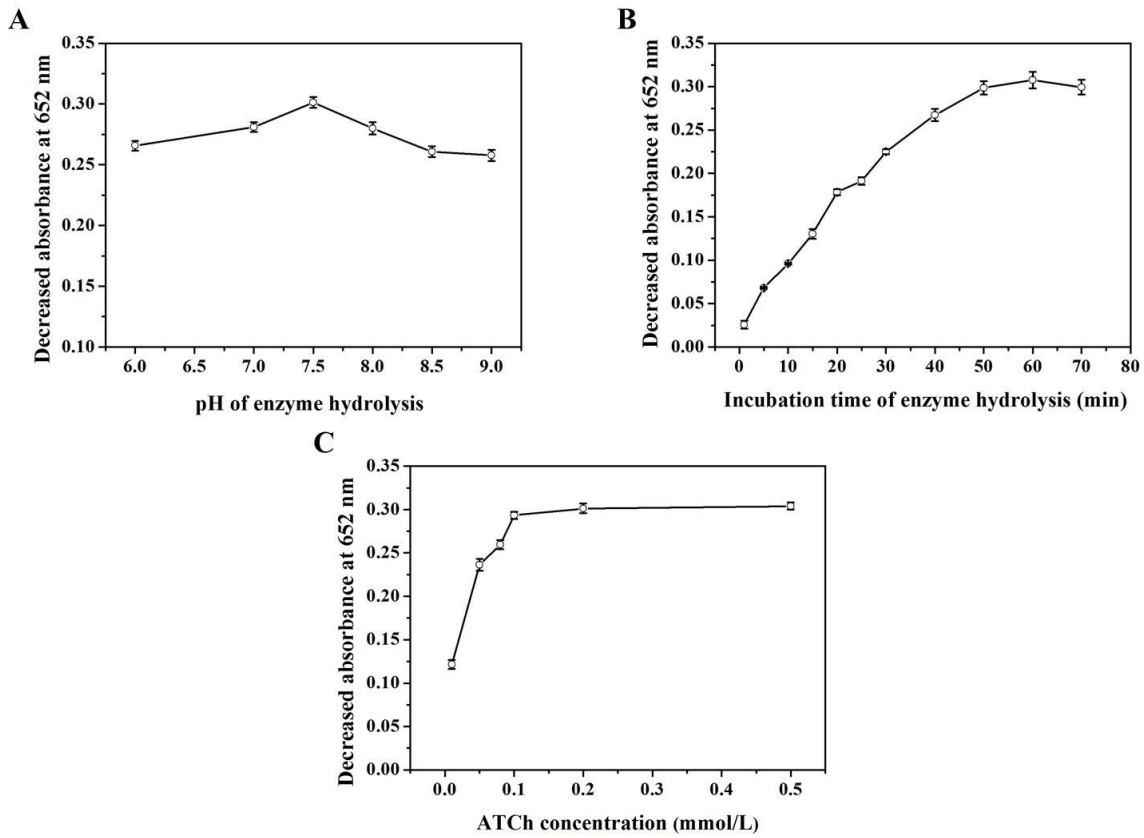

Fig. S6. Effects of (A) pH, (B) incubation time, and (C) ATCh concentration of the enzyme hydrolysis reaction on the decreased absorbance at 652 nm. Chromogenic reaction was conducted in HAc-NaAc buffer (pH 3.5) with 1.2 mmol/L TMB and 5.0 μg/mL BP QDs under 365 nm light irradiation for 20 min. Error bars present the standard deviations of three replicate measurements.

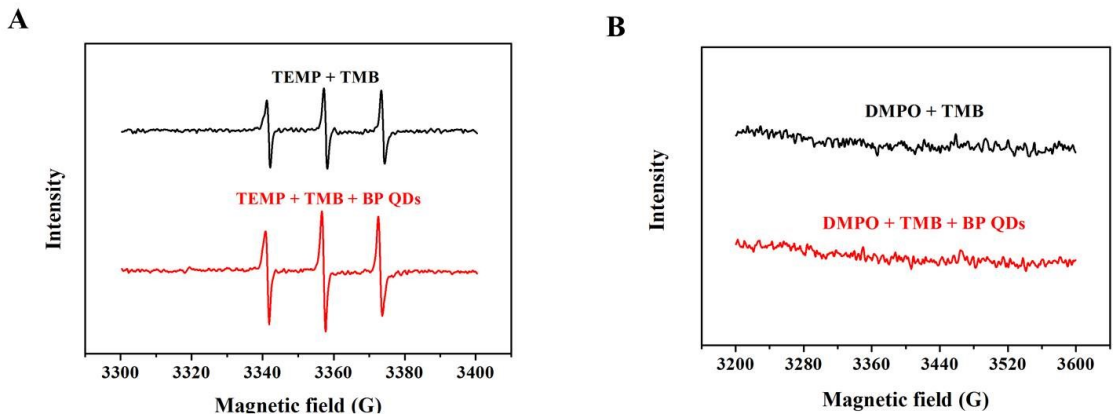

Fig. S7. Electron spin resonance spectra of the solutions of (A) TEMP+TMB (black) and TEMP+TMB+BP QDs (red), (B) DMPO+TMB (black) and DMPO+TMB+BP QDs (red). The concentrations were 3.0 mmol/L TMB, 10.0 μg/mL BP QDs, 100.0 mmol/L TEMP and 4.88 mol/L DMPO.

Table S1. Comparison of various methods for determination of acetylcholinesterase activity.

Methods	Materials based	Linear range	Detection limit	Refs
Electrochemical	L–Cys–Ag(I)	0.001-1.0 mU/mL	0.0006 mU/mL	[2]
Electrochemical	CdS	0.01-1.0 mU/mL	0.01 mU/mL	[3]
Fluorescence	Coronene, dopamine	0.05-10 mU/mL	0.05 mU/mL	[4]
Fluorescence	Alkynylplatinum(II) Complexes	–	18.5 mU/mL	[5]
Fluorescence	PEI–CuNCs	3.0-200 mU/mL	1.38 mU/mL	[6]
Fluorescence	CdS QDs	1-10 mU/mL	–	[7]
Colorimetry	Au NPs	0.6-2.0 mU/mL	0.6 mU/mL	[8]
Colorimetry	Amine-terminated polydiacetylene vesicles	–	10.0 mU/mL	[9]
Colorimetry	Water-soluble polythiophene derivative	–	200 mU/mL	[10]
Colorimetry	PB NCs-H_2O_2-TMB	0.1-5.0 mU/mL	0.04 mU/mL	[11]
Colorimetry	MnO_2-OPD	7.35-98 mU/mL	0.13 mU/mL	[12]
Colorimetry	H_2O_2-TMB	2-14 mU/mL	0.5 mU/mL	[13]
Colorimetry	AuNRs-H_2O_2-HRP	–	0.04 mU/mL	[14]
Ellman	Dithiobisnitrobenzoate	3-83 mU/mL	–	[15]
Colorimetry	BP QDs-TMB	0.5–10.0 mU/mL	0.17 mU/mL	This work

References

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