

## Electronics Supplementary Information

### Lysozyme-Directed Synthesis of Platinum Nanoclusters as a Mimic Oxidase

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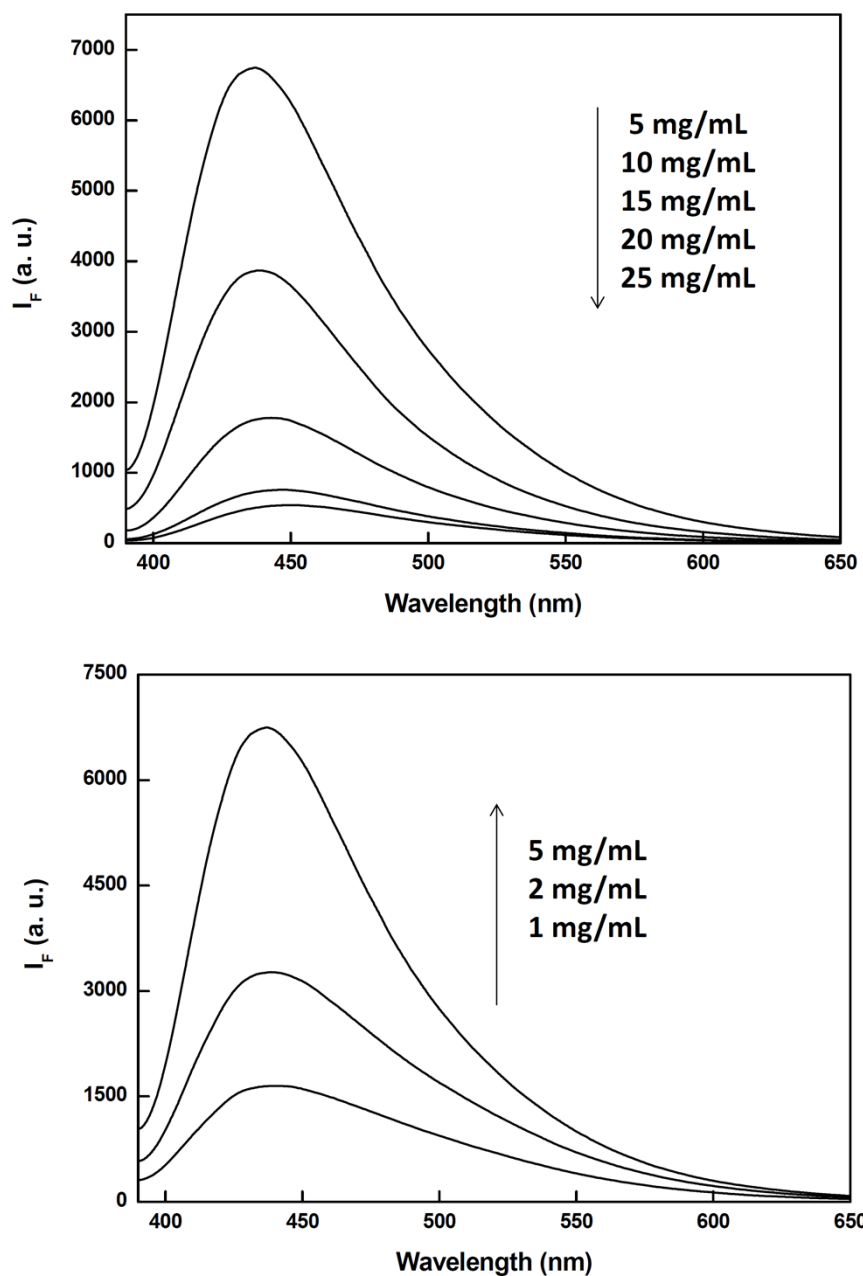
Fax: 011-886-7-3684046.

### Experimental Section

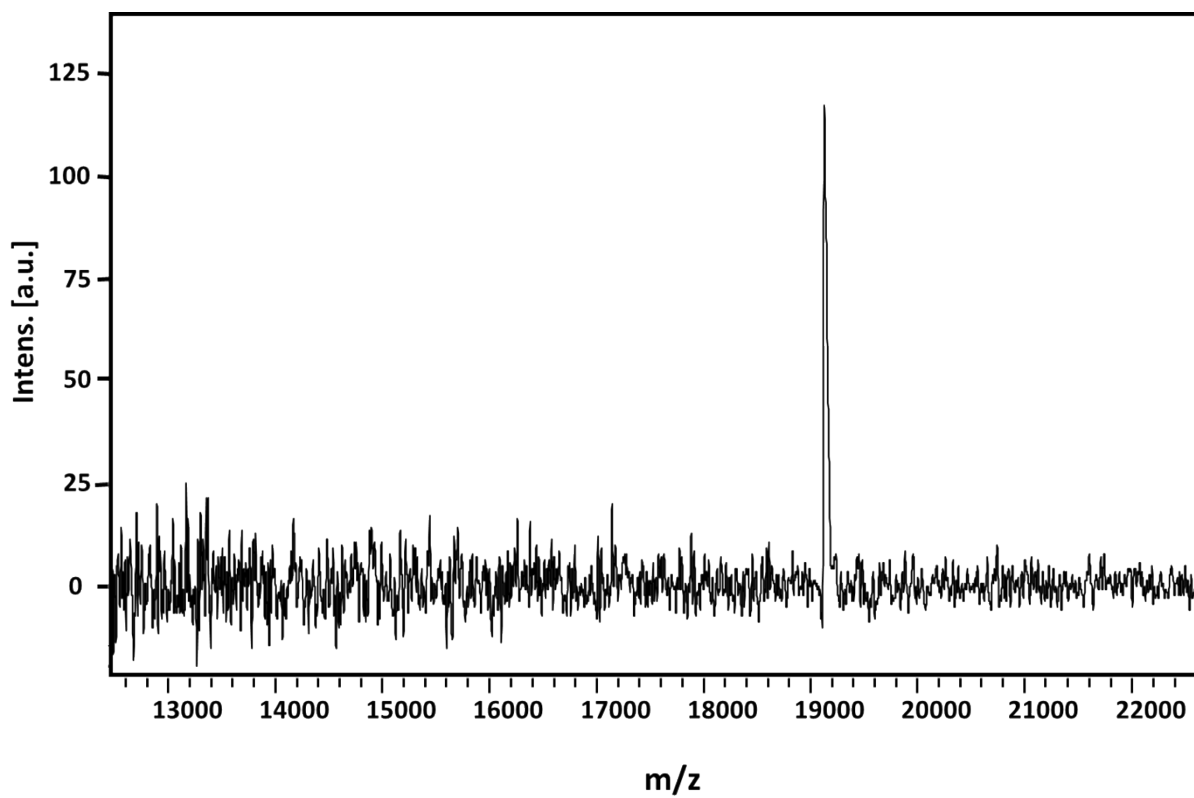
*Synthesis of the Fe<sub>3</sub>O<sub>4</sub> NPs.* FeCl<sub>3</sub>·6H<sub>2</sub>O (2.16 g) and FeCl<sub>2</sub>·4H<sub>2</sub>O (0.8 g) were dissolved in 20 ml of deionized water. The mixture was *deoxygenated by* bubbling with nitrogen gas for 10 min and then heated to 80 °C with stirring in a round-bottom flask. Subsequently, aqueous NH<sub>4</sub>OH (8M, 10 mL) was added rapidly to the heated solution, which was left to stir for 1 h. After cooling to room temperature, the formed NPs were rinsed four times with deionized water and then resuspended in N<sub>2</sub>-saturated water (100 mL). The concentration of Fe<sub>3</sub>O<sub>4</sub> NP was estimated to be ~10 mg/mL. TEM images displayed that the diameter of the Fe<sub>3</sub>O<sub>4</sub> NPs was 13 ± 2 nm (**Fig. S16**, ESI).

*Synthesis of the Pt NPs.* A solution of  $\text{H}_2\text{PtCl}_6 \cdot (\text{H}_2\text{O})_6$  (0.2%, 36 mL) was added to boiling deionized water (464 mL) for 1 min. Subsequently, a mixture (11 mL) of 1% sodium citrate and 0.05% citric acid was added to a boiling solution of  $\text{H}_2\text{PtCl}_6 \cdot (\text{H}_2\text{O})_6$ . After 30 s, a freshly prepared  $\text{NaBH}_4$  (0.08%, 5.5 mL) solution containing 1% sodium citrate and 0.05% citric acid was rapidly injected to the resulting solution. After 10 min, a solution of the formed Pt NPs was cooled down to room temperature. TEM image show that the diameter of the Pt NPs was  $5 \pm 1$  nm (**Fig. S16**, ESI). To obtain 30 nm-sized Pt NPs, 1 mL of 5 nm-sized Pt NPs was diluted with 29 mL of deionized water. The diluted solution was mixed with  $\text{H}_2\text{PtCl}_6 \cdot (\text{H}_2\text{O})_6$  (0.045 mL, 0.4 M), followed by the addition of a solution (0.5 mL) containing 1% sodium citrate and 1.25% L-ascorbic acid. The resulting solution was slowly heated to boiling point. After 30 min, the product was cooled down to room temperature. As indicated in **Fig. S16** (ESI), the diameter of the product was  $30 \pm 4$  nm.

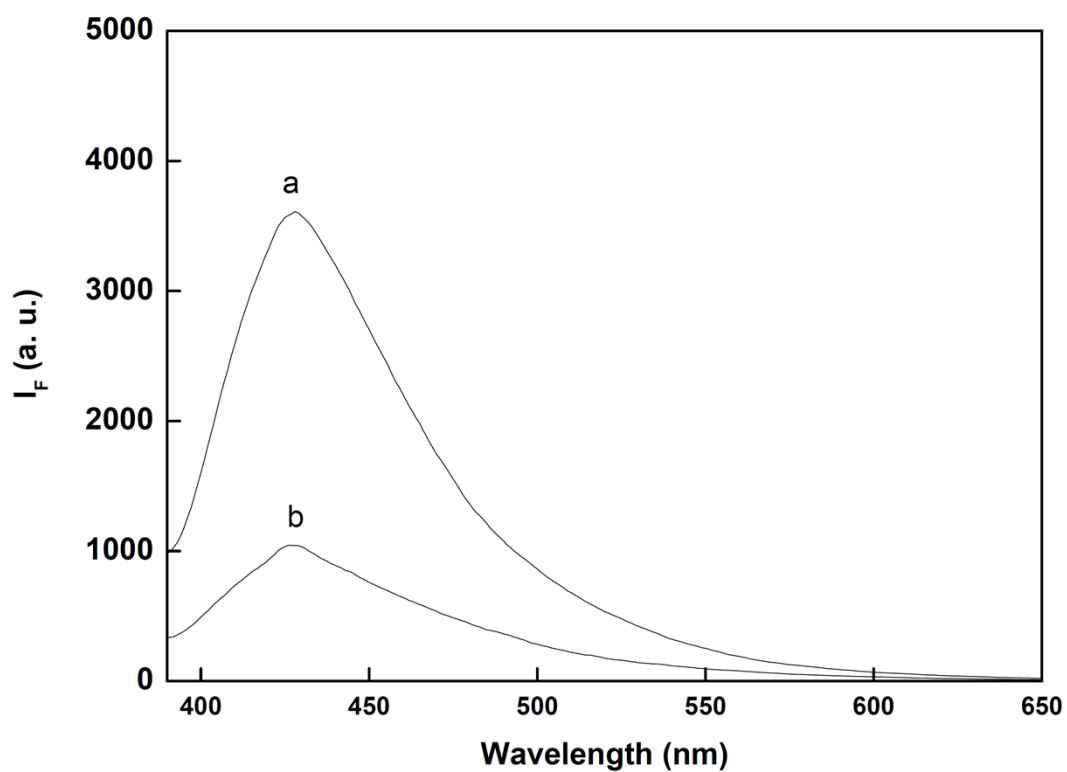
*Synthesis of the Au NPs.* Citrate-capped Au NPs are prepared by reducing metal salt precursor (hydrogen tetrachloroaurate,  $\text{HAuCl}_4$ ) in a liquid phase. Briefly, 10 mL of 38.8 mM trisodium citrate was added rapidly to 100 mL of 1 mM  $\text{HAuCl}_4$  that was heated under reflux. Heating under reflux was continued for an additional 15 min, during which time the color changed to deep red. TEM image confirmed that the size of the Au NPs is  $13 \pm 2$  nm (**Fig. S16**, ESI). The surface Plasmon resonance peak of 13 nm AuNPs was 520 nm, indicating that their extinction coefficient is  $2.78 \times 10^8 \text{ M}^{-1} \text{ cm}^{-1}$ . The particle concentration of the as-prepared Au NPs was estimated to be 10 nM using Beer's law.



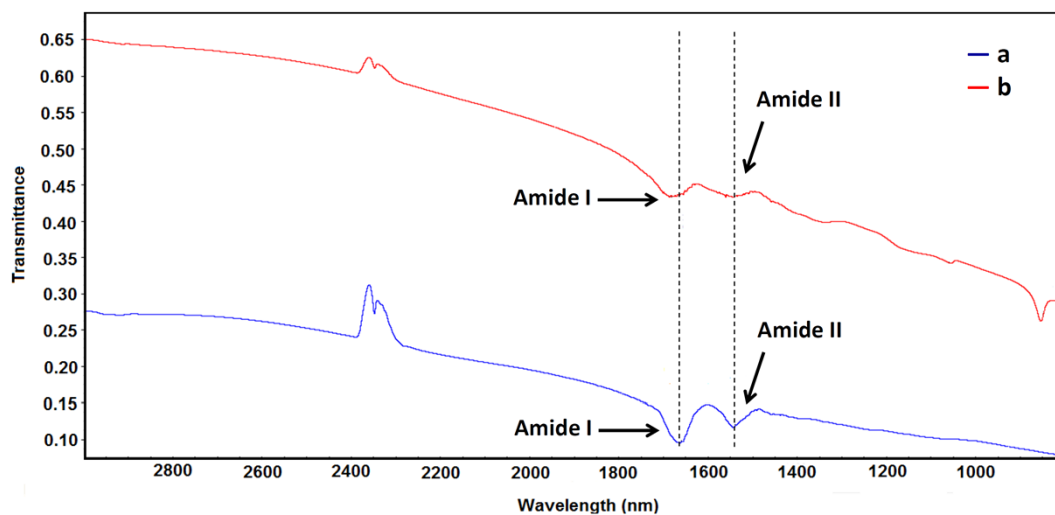
**Fig. S1.** Fluorescence spectra obtained from the reaction of  $\text{H}_2\text{PtCl}_6$  with 1–25 mg/mL Lys at 37 °C for 12 h.



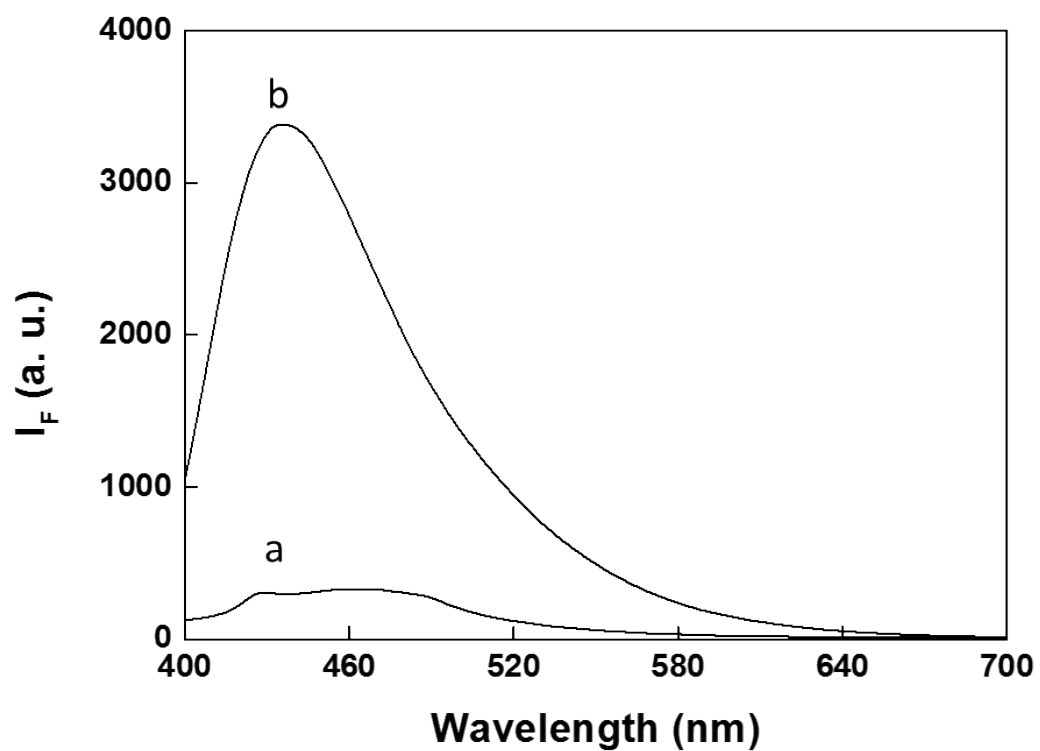
**Fig. S2.** MALDI-TOF-MS spectrum of Au<sup>+</sup>–Lys complexes.



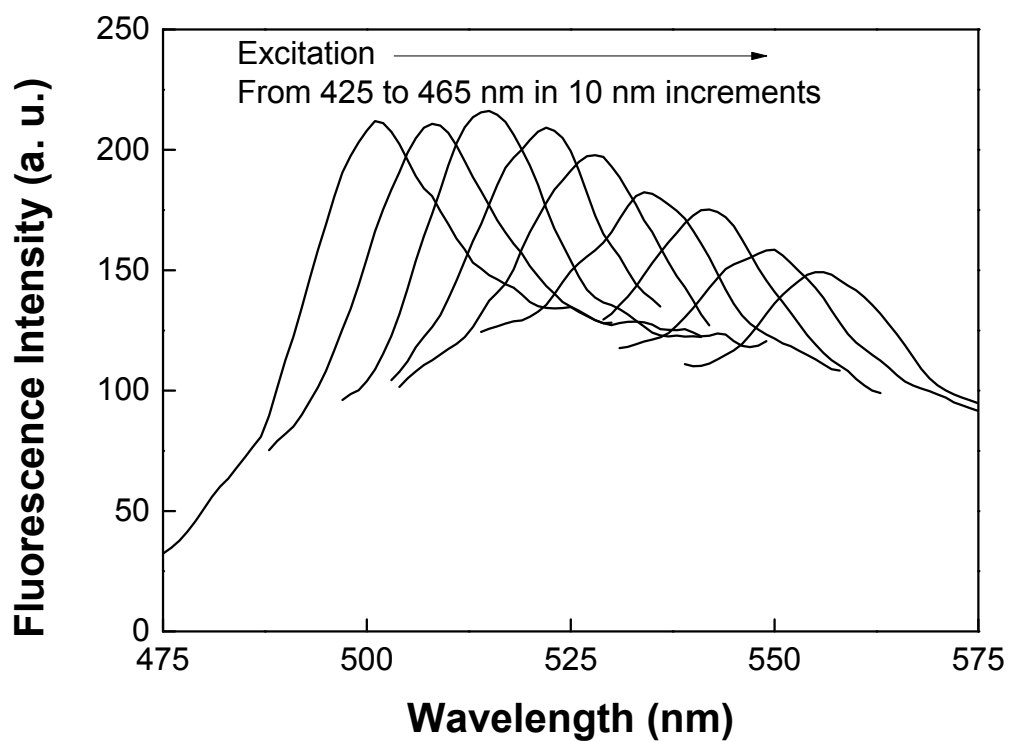
**Fig. S3.** Fluorescence spectra of a solution of Pt NCs in the (a) absence and (b) presence of  $\text{Hg}^{2+}$ .  $0.1\times$  Pt NCs were incubated with  $0.1\text{ mM Hg}^{2+}$  in a solution containing  $50\text{ mM}$  phosphate (pH 7.0) for 30 min.



**Fig. S4.** FT-IR spectra of (a) Lys and (b) Lys-stabilized Pt NCs

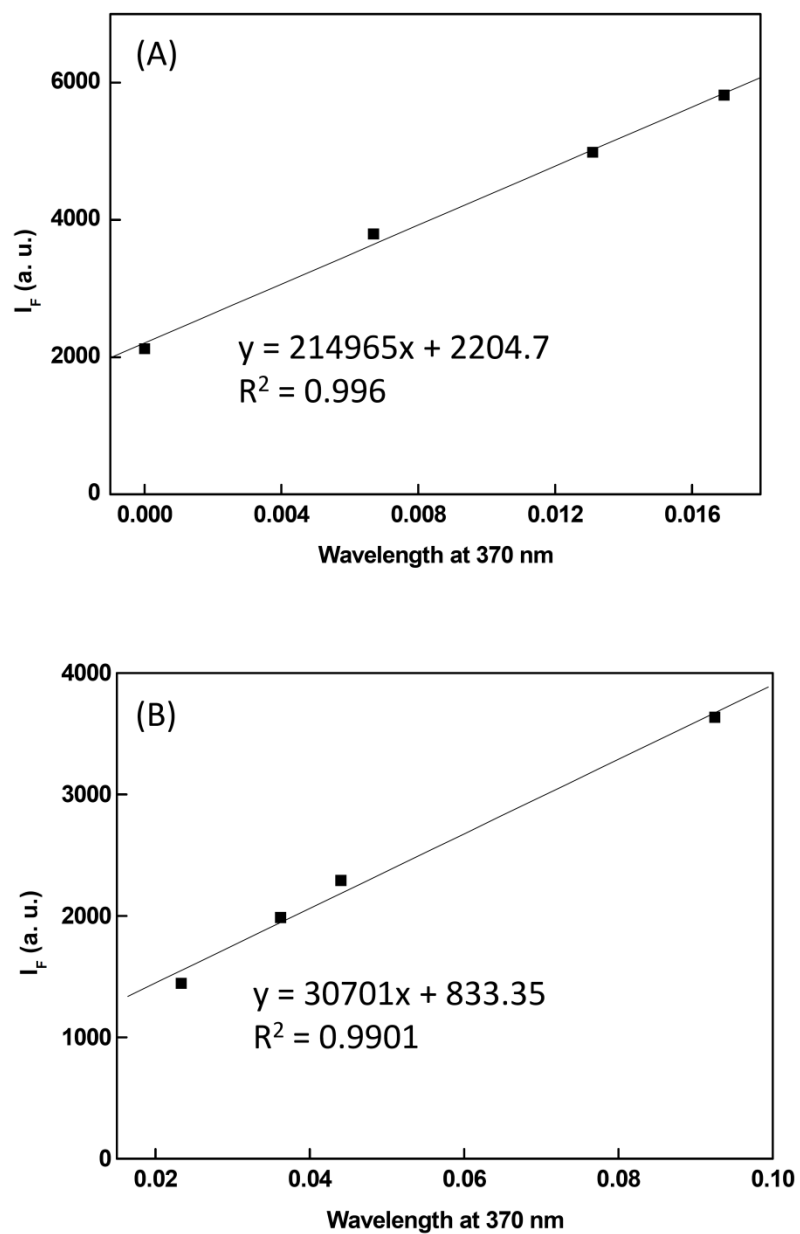


**Fig. S5.** The fluorescence spectrum of (a) 5 mg/mL Lys and (b) Lys-stabilized Pt NCs.

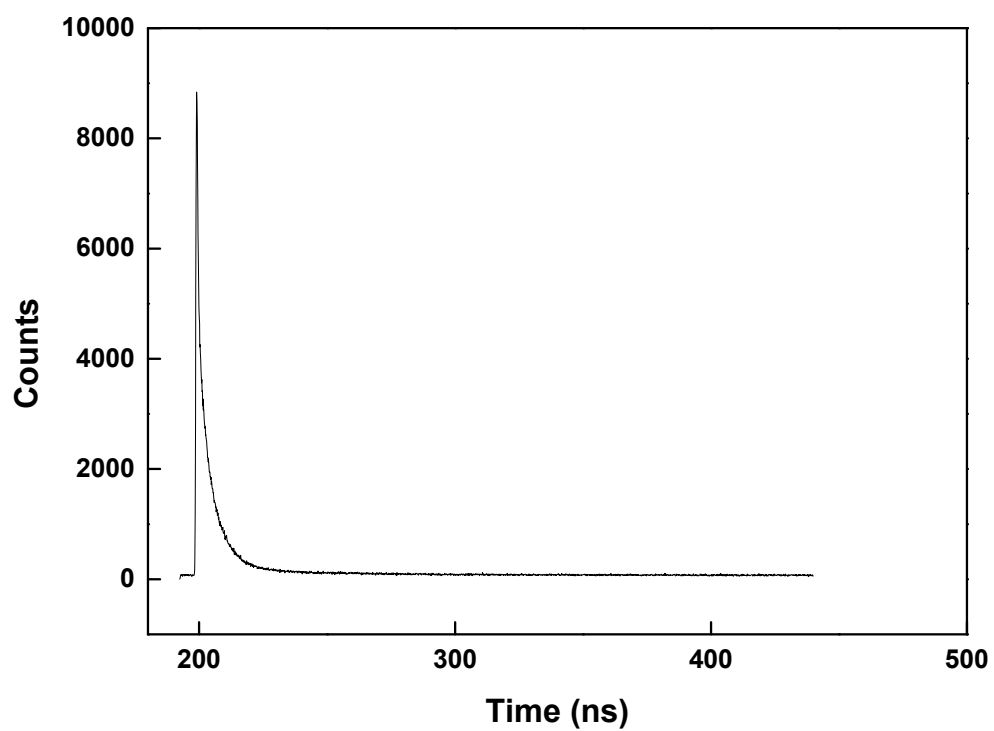


**Fig. S6.** Fluorescence spectra of Pt NCs with excitation of different wavelength. The cut-off filter (475 nm) was placed in the front of the detection when the excitation wavelength changed from 425 to 465 nm.

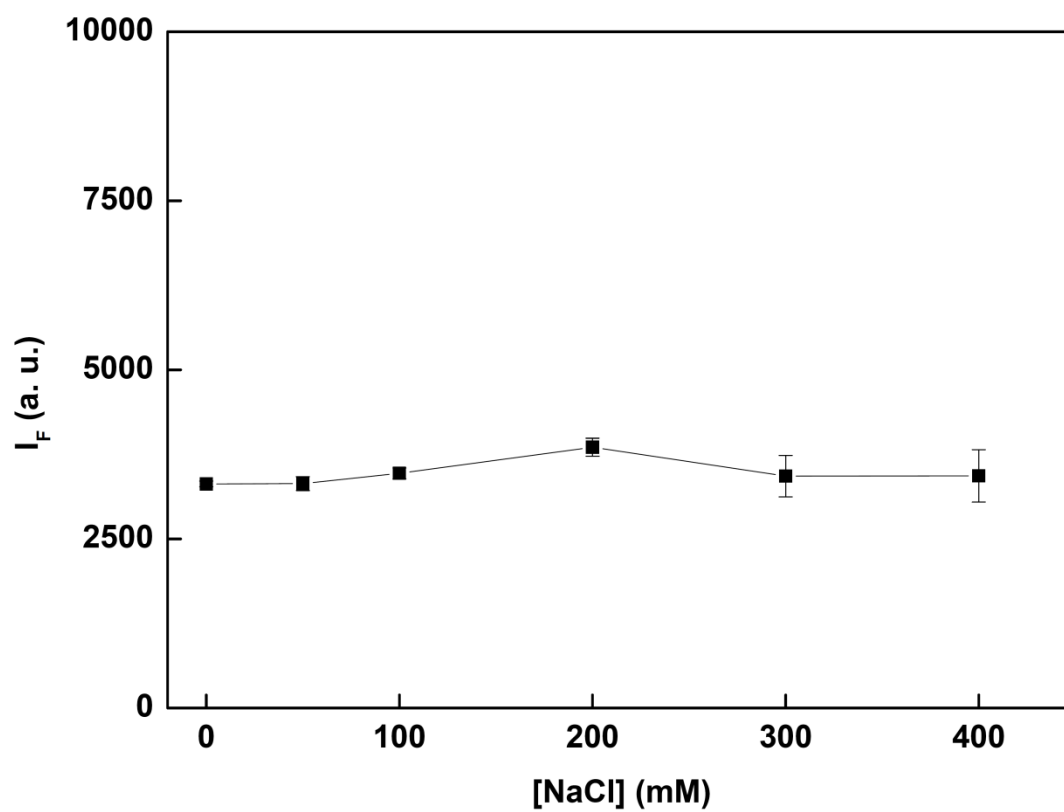




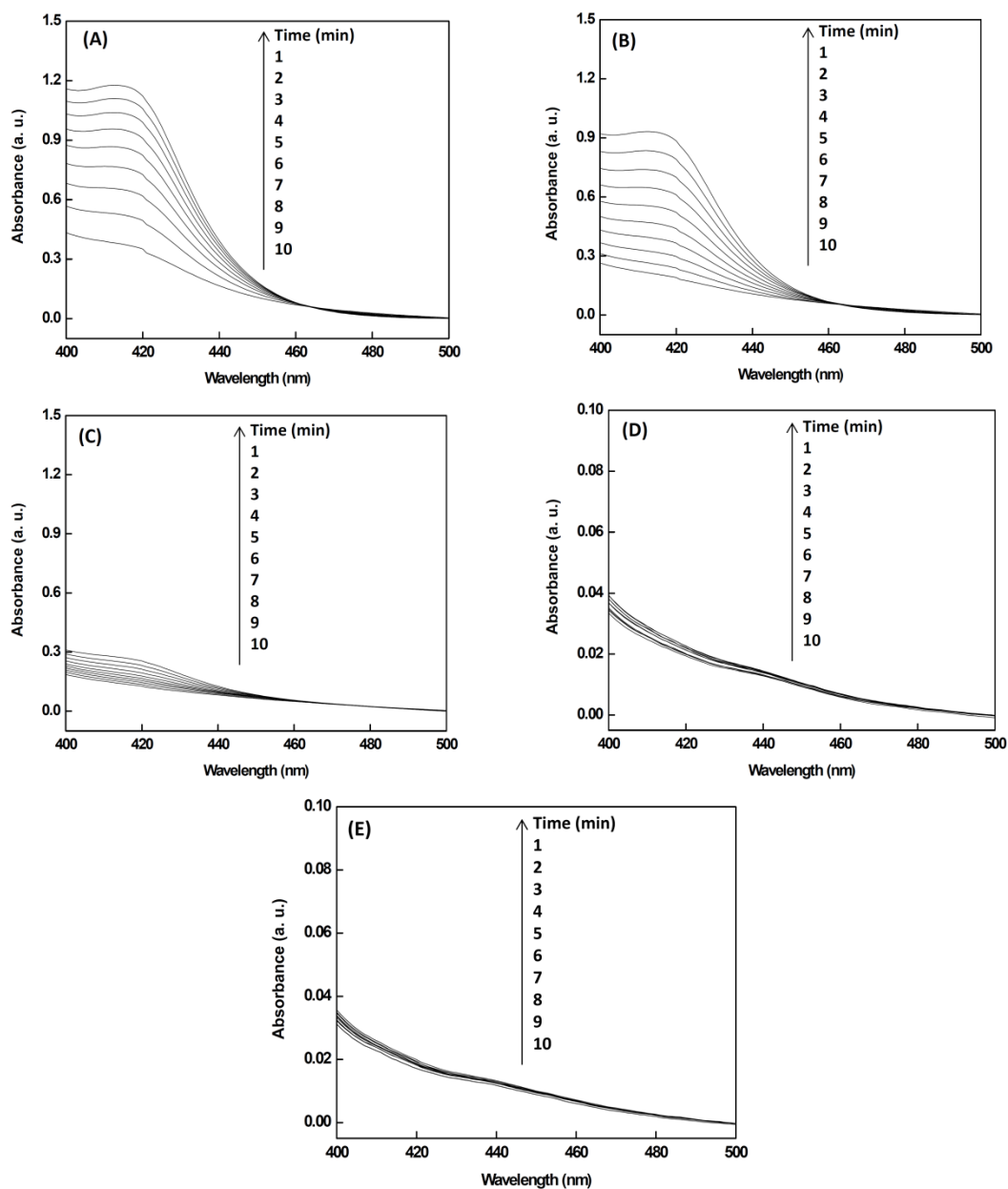
**Fig. S7.** Plots of fluorescence intensity ( $I_F$ ) versus absorbance: (A) 0.7–5  $\mu$ M quinine sulfate and (B) 0.06–0.2 $\times$  Pt NCs



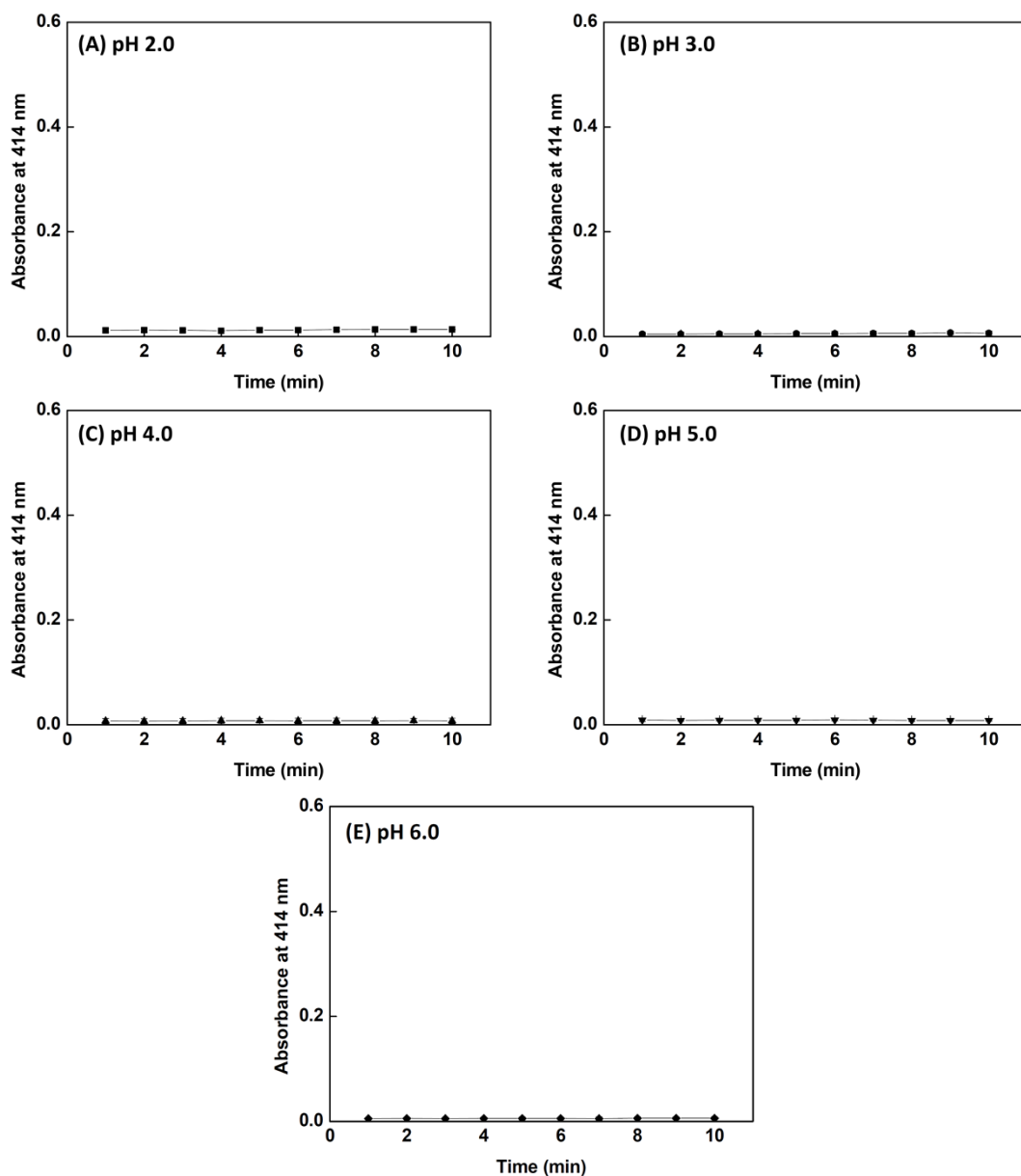
**Fig. S8.** Fluorescence lifetime decay of Pt NCs (excitation at 485 nm).



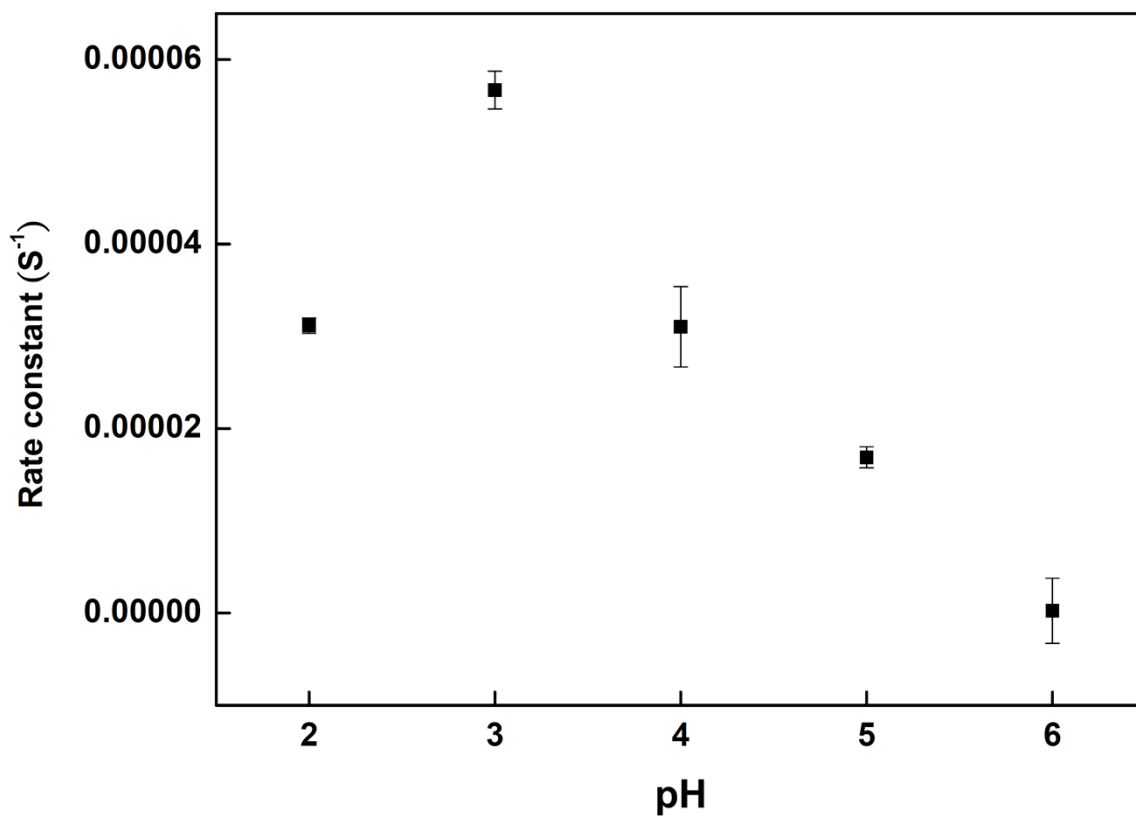
**Fig. S9.** Effect of NaCl concentration on the fluorescence intensity of a solution containing  $0.1 \times$  Pt NCs and 50 mM phosphate.



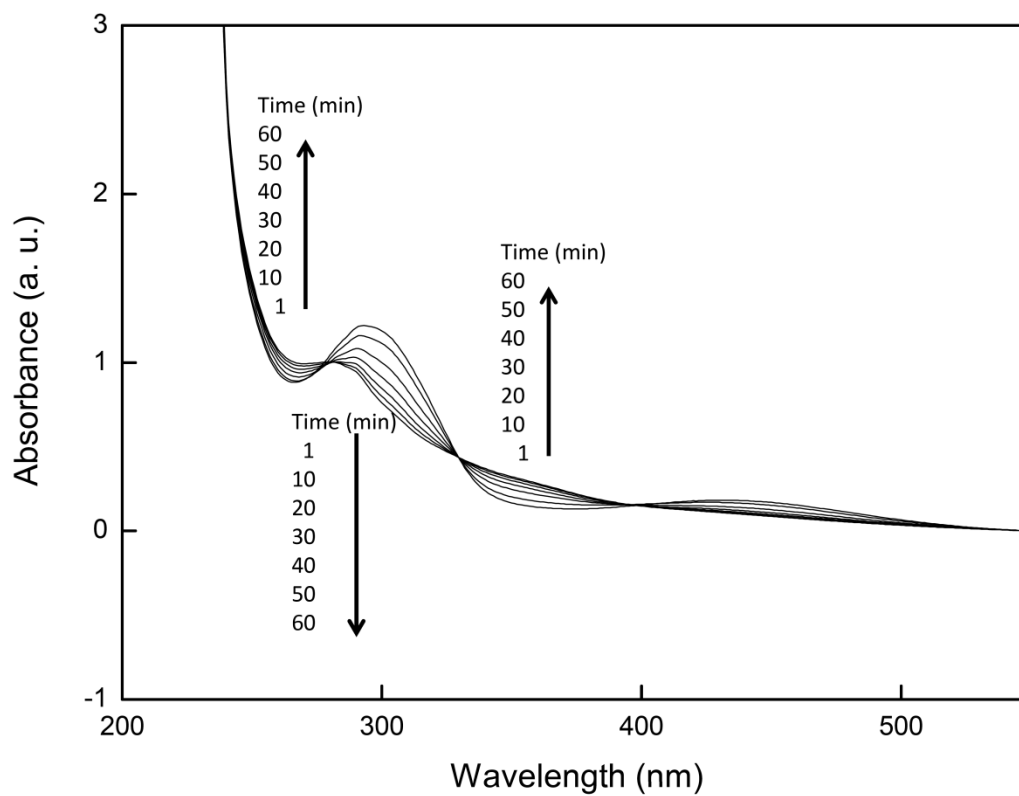
**Fig. S10.** Time course of Pt NC-induced oxidation of ABTS at pH (A) 2.0, (B) 3.0, (C) 4.0, (D) 5.0, and (E) 6.0. The spectra were obtained from a solution containing  $0.05\times$  Pt NCs, 0.1 mM ABTS, and 50 mM sodium acetate (pH 2.0–6.0).



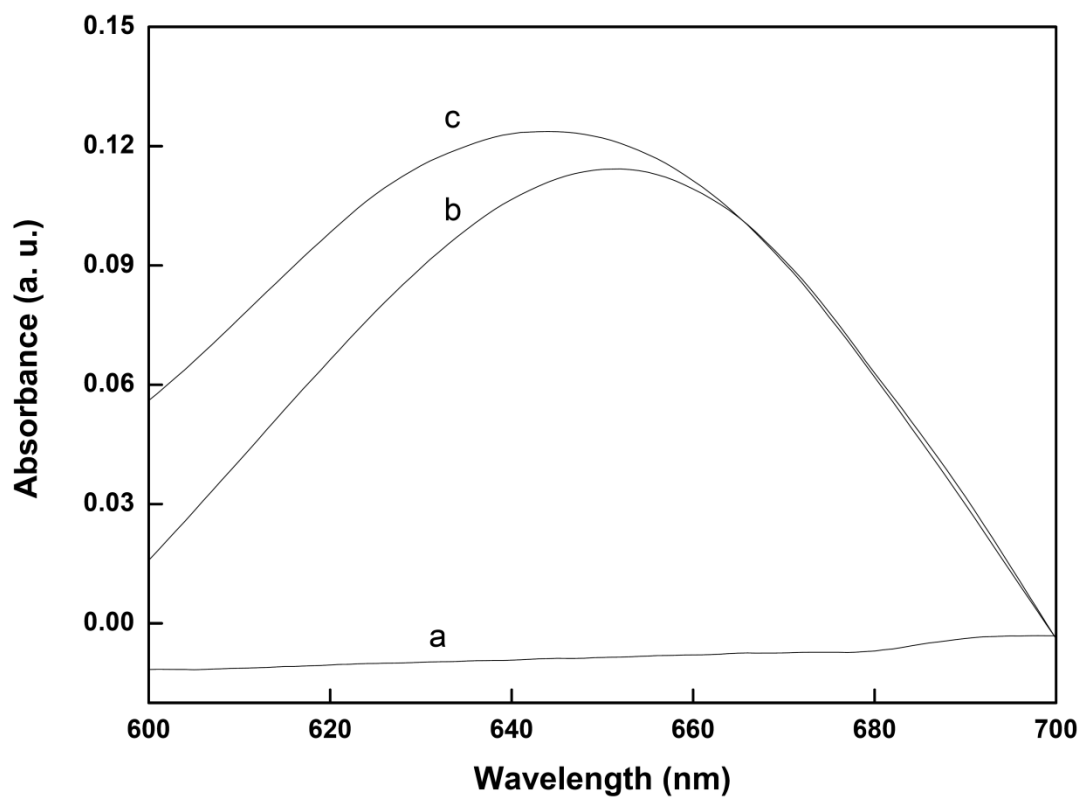
**Fig. S11.** The absorbance at 414 nm of oxidized ABTS as a function of time at pH (A) 2.0, (B) 3.0, (C) 4.0, (D) 5.0, and (E) 6.0. The spectra were obtained from a solution containing 0.1 mM ABTS and 50 mM sodium acetate.



**Fig. S12.** Effect of solution pH on the catalytic rate of Pt NCs. 0.05× Pt NCs were incubated with a solution containing 0.1 mM TMB and 50 mM sodium acetate.

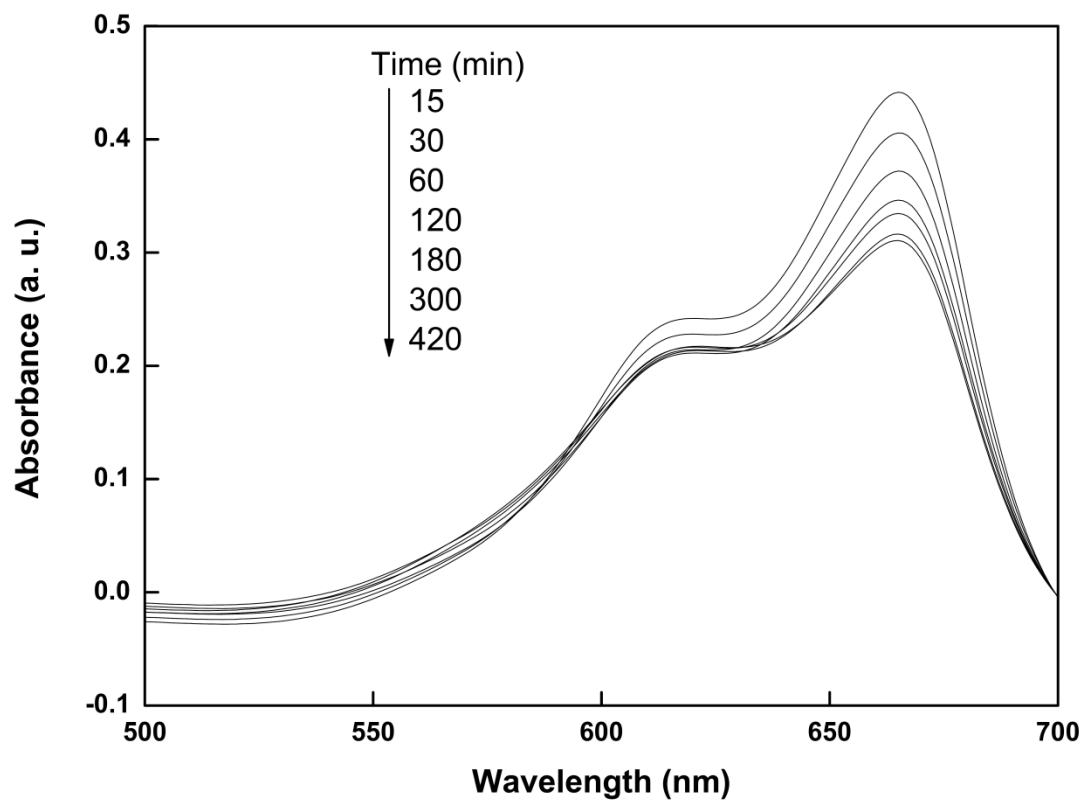


**Fig. S13.** Reaction of dopamine with Pt NCs as a function of time at pH 7.0. The spectra were obtained from a solution containing  $0.05\times$  Pt NCs, 1 mM dopamine, and 50 mM sodium acetate.

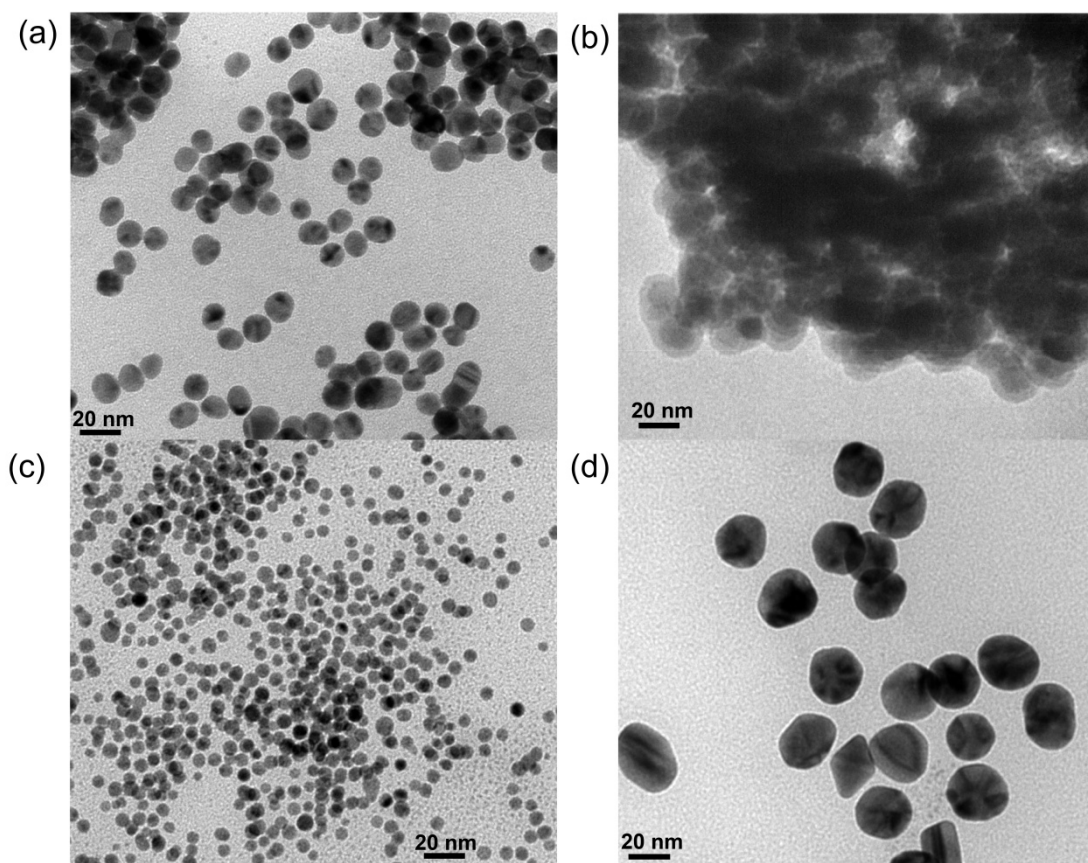


**Fig. S14.** Absorption spectra of a solution containing (a) 0.1 mM TMB, (b) 0.1 mM TMB and 0.05 $\times$  Pt NCs, and (c) 0.1 mM TMB, 0.05 $\times$  Pt NCs, and 270 units/mL catalase. The reaction was performed in 50 mM sodium acetate (pH 3.0).





**Fig. S15.** Reaction of 0.01 mM methylene blue with 0.2× Pt NCs as a function of time. The reaction was performed in lake water.



**Fig. S16.** TEM images of (a) 13 nm-sized Au NPs, (b) 13 nm-sized  $\text{Fe}_3\text{O}_4$  NPs, (c) 5 nm-sized Pt NPs, (d) 30 nm-sized Pt NPs