Supporting information

Significant impact of polydopamine on catalytic performance of the carried Au nanoparticles

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Experimental details:

Materials. Hydrogen tetrachloroaurate hydrate (99.9%, metal basis) was purchased from Alfa Aesar. Silver nitrate (99.9%), trisodium citrate dihydrate (99%), dopamine hydrochloride, NaOH, methylene blue, 4-nitrophenol and sodium borohydrate ($NaBH_4$) were purchased from Sigma-Aldrich and used without purification. Milli-Q water used has a resistance of 18.2 MΩ cm^{-1}.

Preparation of Au NPs. The Au NPs were synthesized via the modified Turkevich method reported previously.[9] In brief, 0.5 mL of $HAuCl_4$ solution (1 wt%) and 42.5 μL of $AgNO_3$ solution (0.1 wt%) were added into 1.5 mL of a citrate aqueous solution (1 wt%) under stirring. Milli-Q water was then added to bring the volume of the solution to 2.5 mL. After 5 min of incubation, the solution was quickly poured into 47.5 mL of boiling water in a 100 mL flask. The reaction solution was refluxed for 1 h under stirring. Then, the as-prepared Au NP dispersion was cooled to room temperature. Milli-Q water was added to bring the volume of the solution to 50 mL.

Preparation of PDA particles. The PDA particles were synthesized by self-polymerization of dopamine in basic solutions according to the literature.[5a] In brief, 5 mg of dopamine was dissolved in 10 mL of NaOH (0.6 mM) solution. The resulting solution was then shaken for 18 h. The solution gradually turned into black, yielding PDA particles. The PDA particles were separated by centrifugation and washed by water for several times. The obtained particles were re-dispersed in 10 mL of water as PDA suspension.

Preparation of catalyst suspension. Two sets of catalyst suspension were prepared. (1) 5 mL of Au NPs dispersion was added into 10 mL of water, resulting in 15 mL diluted Au NPs

suspension. (2) 5 mL of Au NPs dispersion was added into 10 mL of above PDA suspension. The mixture was stirred for 24 h, allowing the adsorption of Au NPs onto the surfaces of PDA particles. As a result 15 mL of PDA-Au particles suspension was prepared.

Catalytic reduction MB. The catalytic reaction was carried out in quartz cuvette. 0.4 mL of catalyst suspensions (PDA-Au particles and Au NPs) or PDA suspension was mixed with 2 mL of MB solution (80 mg/L). The pH of the solution is 5.7. Then 0.1 mL of fresh $NaBH_4$ solution (0.1 M) was injected into the solution to initiate the catalytic reduction. The pH of the solution is increased to 9.5. The quartz cuvette is placed in the chamber of UV-vis spectrophotometer for direct time-dependent characterization.

Catalytic reduction of 4-NP. First, 0.1 mL of 4-NP solution (2.5 mM) was mixed with 1 mL of fresh prepared $NaBH_4$ solution (0.1 M) in quartz cuvette. The yellow 4-nitrophenoate was observed. 40 μL of the above catalyst suspensions (PDA-Au particles and Au NPs) or PDA suspension were further diluted to 1 mL via adding water, and then added into the as prepared 4-nitrophenoate solution to trigger the catalytic reduction. The quartz cuvette is placed in the chamber of UV-vis spectrophotometer for direct time-dependent characterization.

Characterization. UV-Vis adsorption spectra were recorded with Shimadzu UV-2600 UV-Vis spectrophotometer. Transmission electron microscope (TEM) images were implemented with FEI Tecnai G2 Sprit TEM at an operated voltage of 120 kV. Zeta potential of PDA particles was measured on Malvern Zetasizer nano ZS.

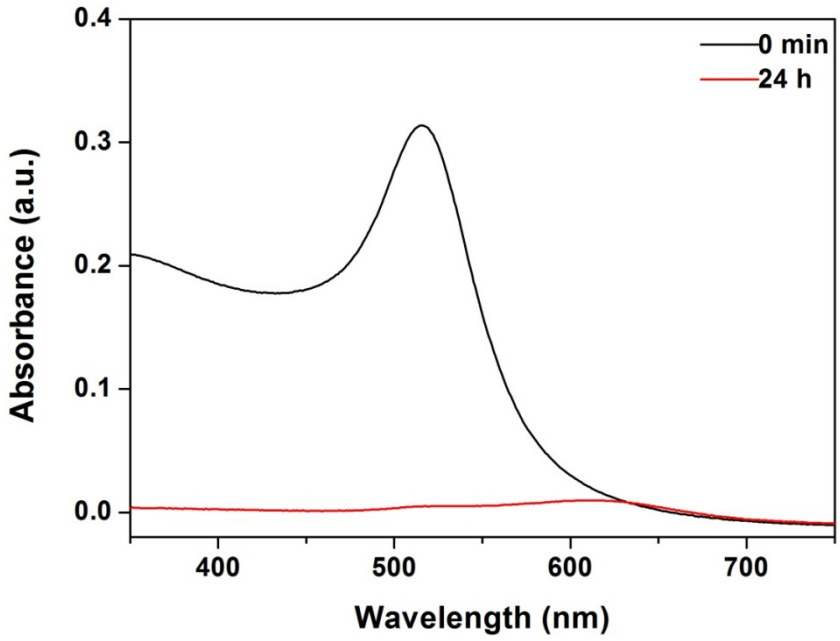

Fig. S1 UV-vis spectra of Au NPs suspension (a) before and (b) after 24 h PDA adsorption.

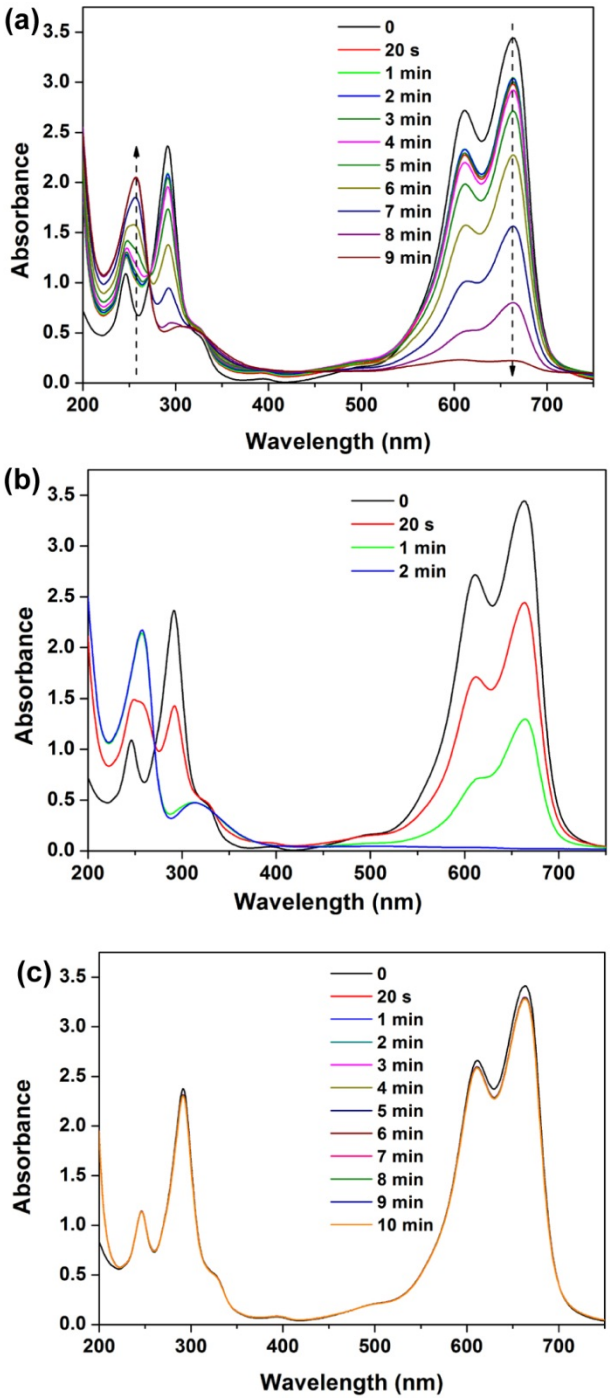

Fig. S2 UV-vis spectra for the successive evolution of MB solution in the presence of (a) freely dispersed Au NPs, (b) PDA carried Au NPs and (c) PDA particles.

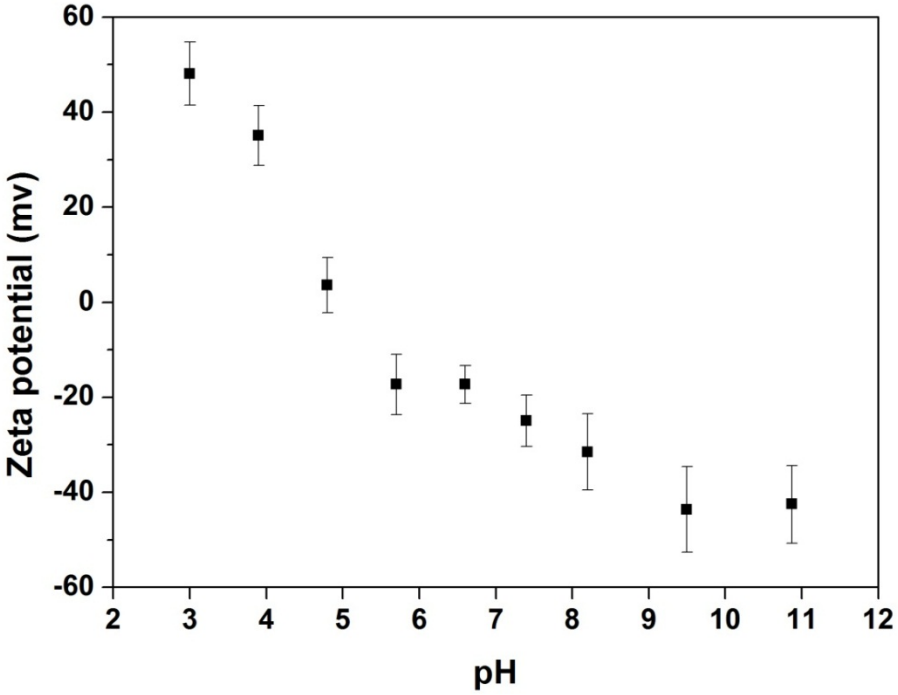

Fig. S3. Zeta potential of PDA particles as a function of pH.

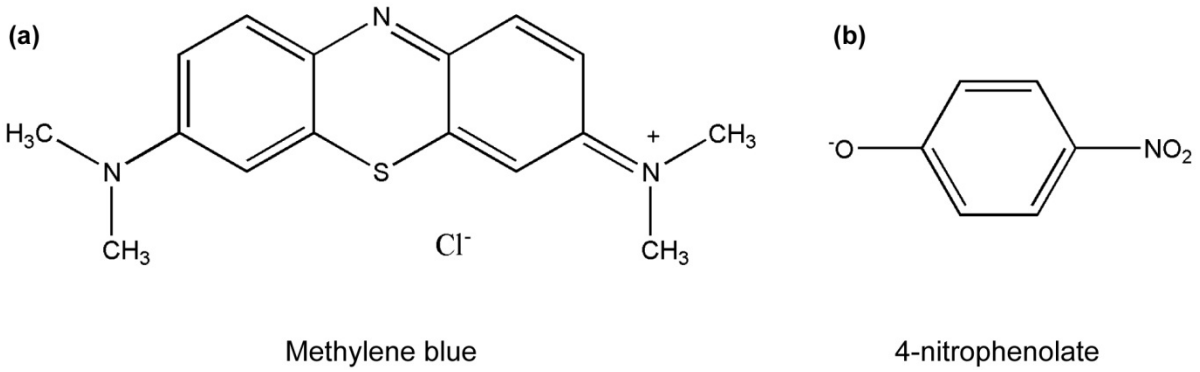

Fig. S4. Molecular structure of (a) methylene blue (positive charge) and (b) 4-nitrophenolate (negative charge).

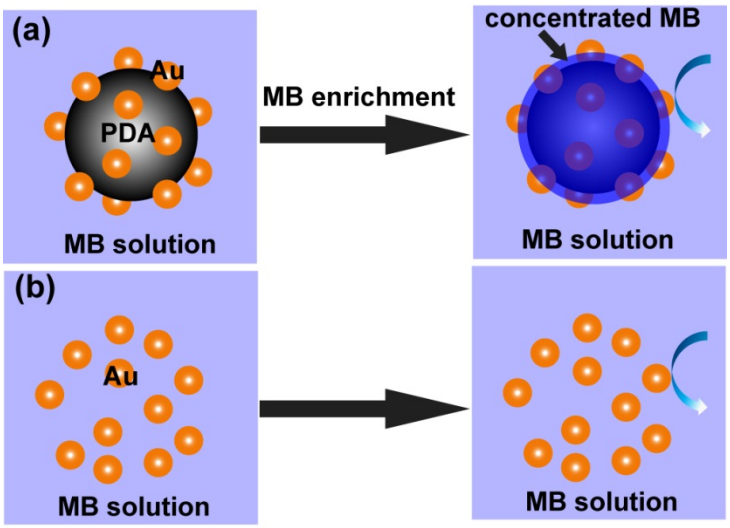

Fig. S5 Schematic illustration of the catalytic reduction of MB by (a) PDA carried Au NPs and (b) freely dispersed Au NPs. The MB rapidly enriches on the surface of PDA particles, rendering a localized concentrated MB layer for catalytic reaction.

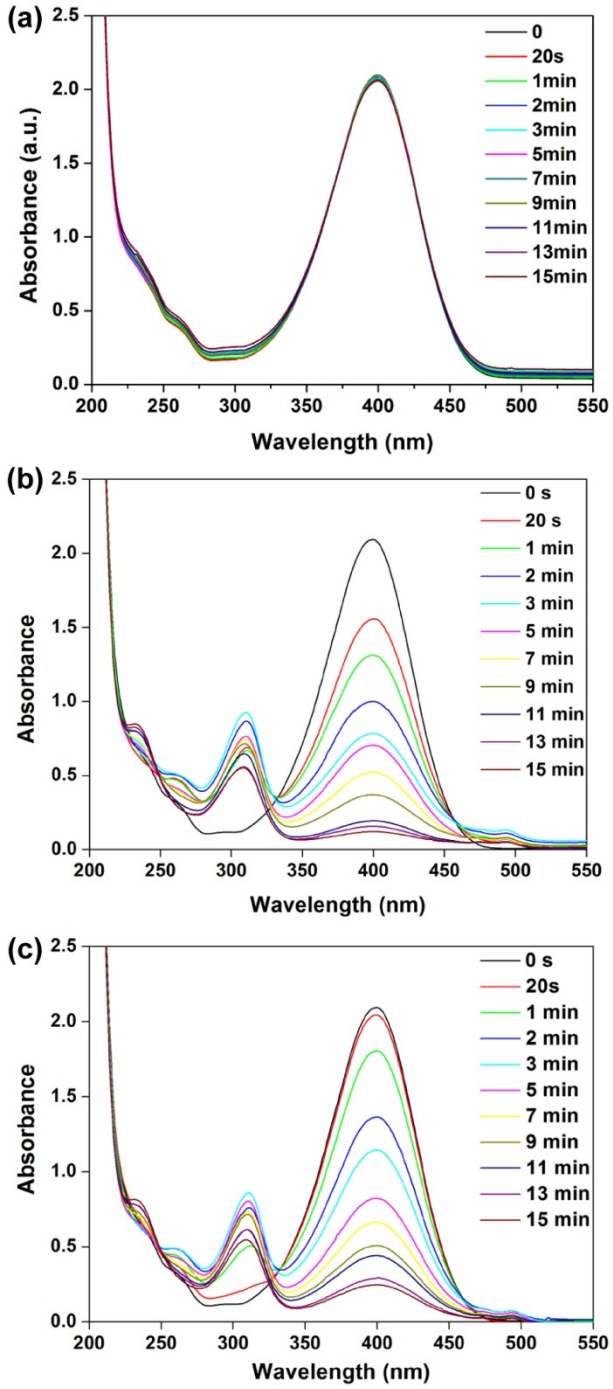

Fig. S6 UV-vis spectra for the successive evolution of 4-NP solution in the presence of (a) PDA particles, (b) freely dispersed Au NPs and (c) PDA carried Au NPs.