

Colorimetric detection and separation of chiral tyrosine based on N-acetyl-L-cysteine modified gold nanoparticles

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Materials and reagents

All chemicals used were of analytical grade or of the highest purity available. $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ was purchased from Shang Hai Chemical Reagent CO., LTD., China. Sodium borohydride (NaBH_4 , 98%) was purchased from Tianjin Chemical Reagent Plant, China. N-acetyl-L-Cysteine was purchased from Shanghai Bio Science & Technology. Co., LTD, China. L-Tyrosine, D-Tyrosine and racemic Tyrosine were purchased from Shanghai Source poly Biotechnology Co., Ltd, China. Water used in this experiment was purified by distillation of deionized water.

Characterization

The morphology and size of Au NPs, NALC-Au NPs and after treatment with Tyr were characterized by transmission electron microscopy (TEM) by a Philips TecnaiG2 TEM using an accelerating voltage of 200kV. The UV-visible (UV-vis) absorption spectra were taken at room temperature on a UV-2501 spectrophotometer (SHIMADZU CORPORATION) with a variable

wavelength between 200 and 1000 nm using a glass cuvette with 0.5cm optical path. The infrared (IR) spectra were collected on a Thermo Nicolet NEXUS IR spectrometer in the wavenumber range 400-4000 cm^{-1} at a resolution of 4 cm^{-1} . The samples were prepared in the form of pellets together with KBr.

Synthesis of NALC-Au NPs

100 mL aqueous solution of $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ (0.089 mg/mL) and 0.2 mL 2×10^{-3} aqueous solution of N-acetyl-L-Cysteine were mixed stirring for 20 min, then 0.1 mL of 10^{-3} M fresh sodium borohydride was added and obtained N-acetyl-L-Cysteine modified Au NPs (NALC-Au NPs).

L-Tyr chiral recognition experiments by NALC-Au NPs

0.5 mL D- or L-tyrosine solution was respectively added in 1.5 mL NALC-Au solution and ultraviolet-visible spectroscopy were determined. Then centrifuge for 5 min in the speed 12000 r/min and take out the clear liquid to show color experiment by ninhydrin

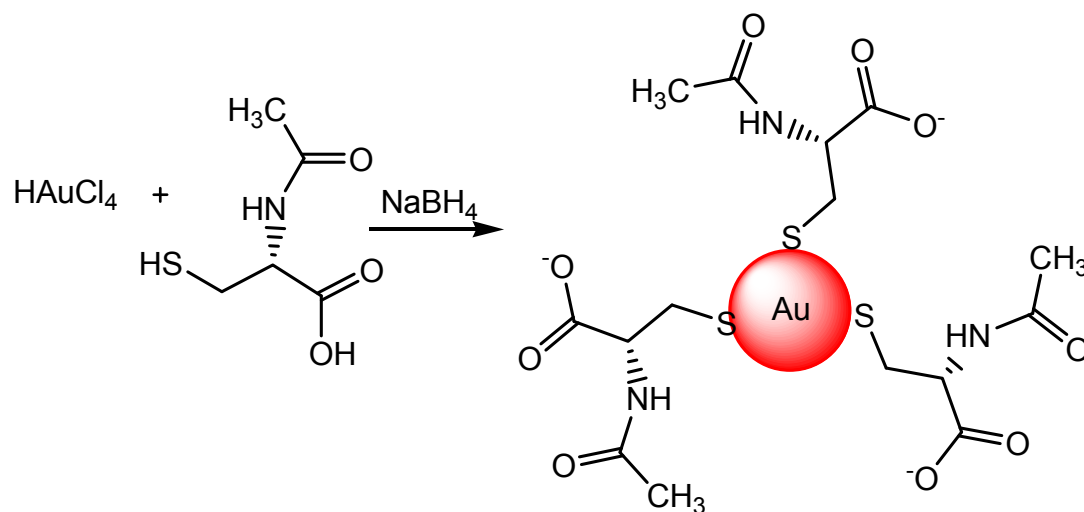
Tyr enantiomeric separation experiments by NALC-Au NPs

0.5 mL racemic tyrosine solution was added in 1.5 mL NALC-Au solution and ultraviolet-visible spectroscopy were determined. Then centrifuge for 5 min in the speed 12000 r/min and take out the clear liquid to show color experiment by ninhydrin.

Determination of Tyr content of the solution by ninhydrin before and after the separation

Two copies of 1.8 mL Tyr solution were respectively added to 0.2 mL 5×10^{-2} M ninhydrin solution before and after the separation, boiling for 10 min and cooling to room temperature, the UV - visible absorption spectroscopy were determined.

Supplementary Figures



Scheme S1 Synthesis of NALC-Au NPs.

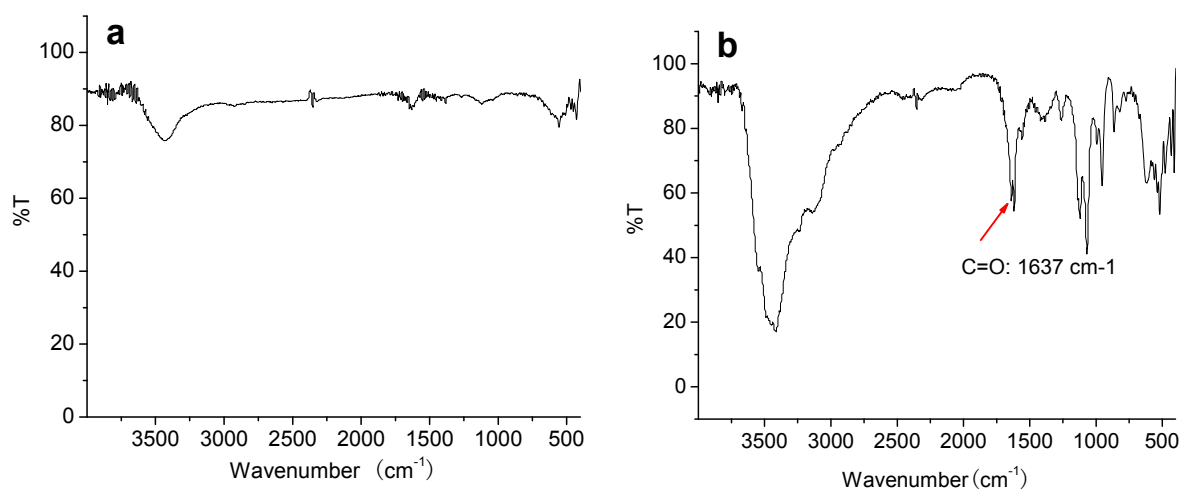


Fig. S1 The FT-IR spectrum of unmodified Au NPs (a) and NALC-Au NPs (b).

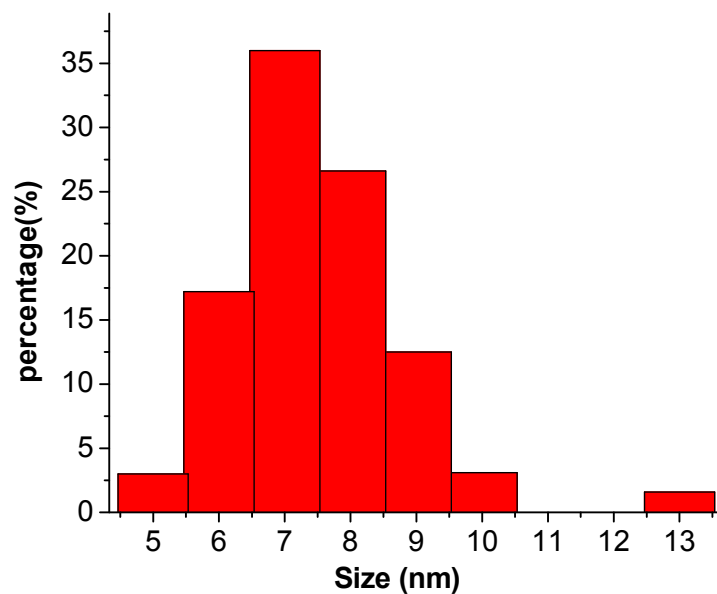


Fig. S2 The size distribution of NALC-Au NPs. 100 particles are measured to get the size distribution. According to the size distribution, the diameter of NALC-Au NPs is about 7 nm.

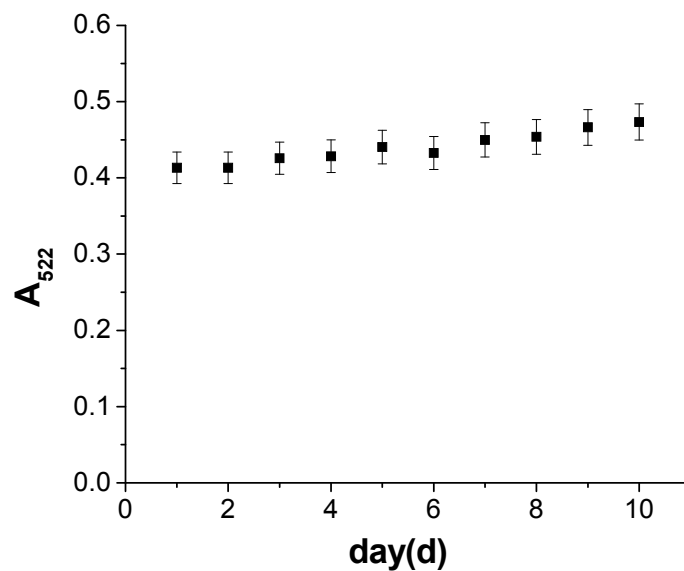


Fig. S3 UV-vis absorption spectra of NALC-Au NPs affected by day at 522 nm.

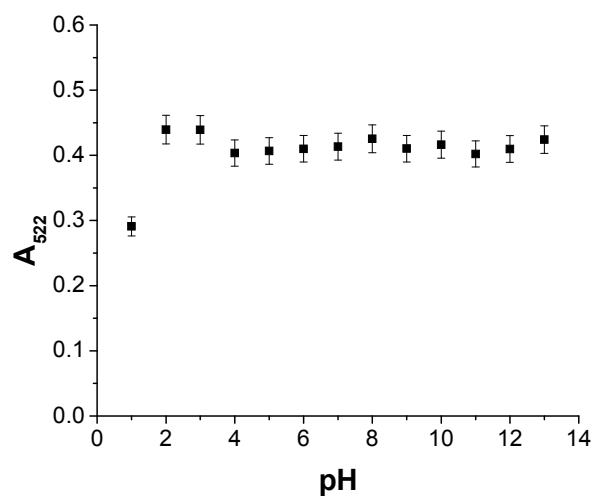


Fig. S4 UV-vis absorption spectra of NALC-Au NPs affected by pH at 522 nm.

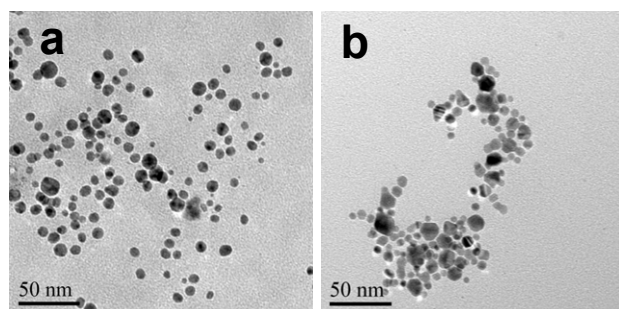


Fig. S5 TEM images of NALC-Au NPs before (a) and after (b) treatment with racemic tyrosine.

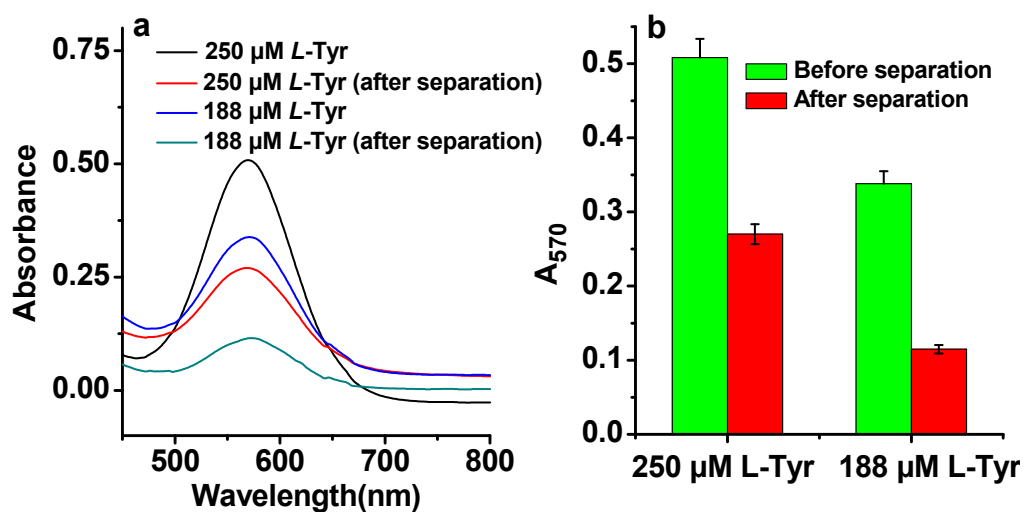


Fig. S6 The UV-vis absorption spectra of the systems that Ninhydrin solution reacted with L-Tyr solutions (250 and 188 μM, respectively) before and after separation (a) and the corresponding absorption value at 570 nm (b).

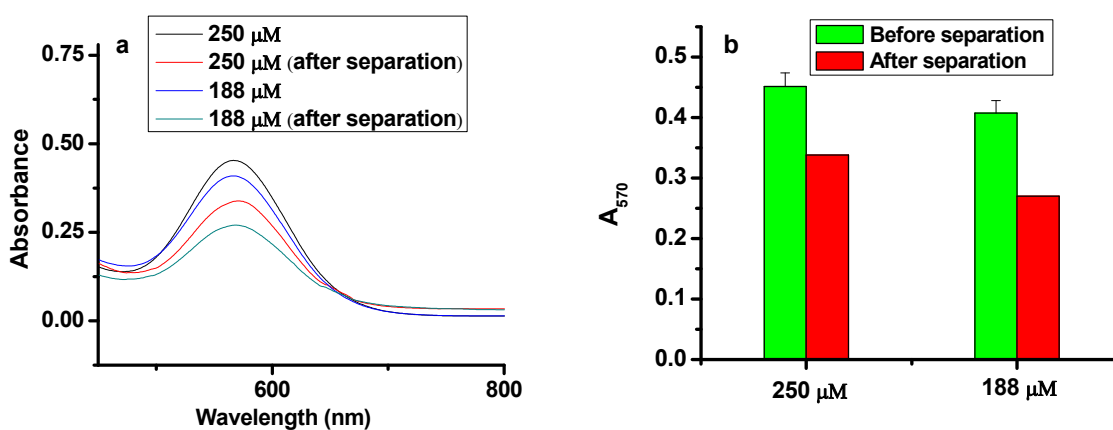


Fig. S7 The UV-vis absorption spectra of the systems that Ninhydrin solutions reacted with racemic Tyr solution (500 and 188 μM, respectively) before and after separation (a) and the corresponding absorption value at 570 nm (b).

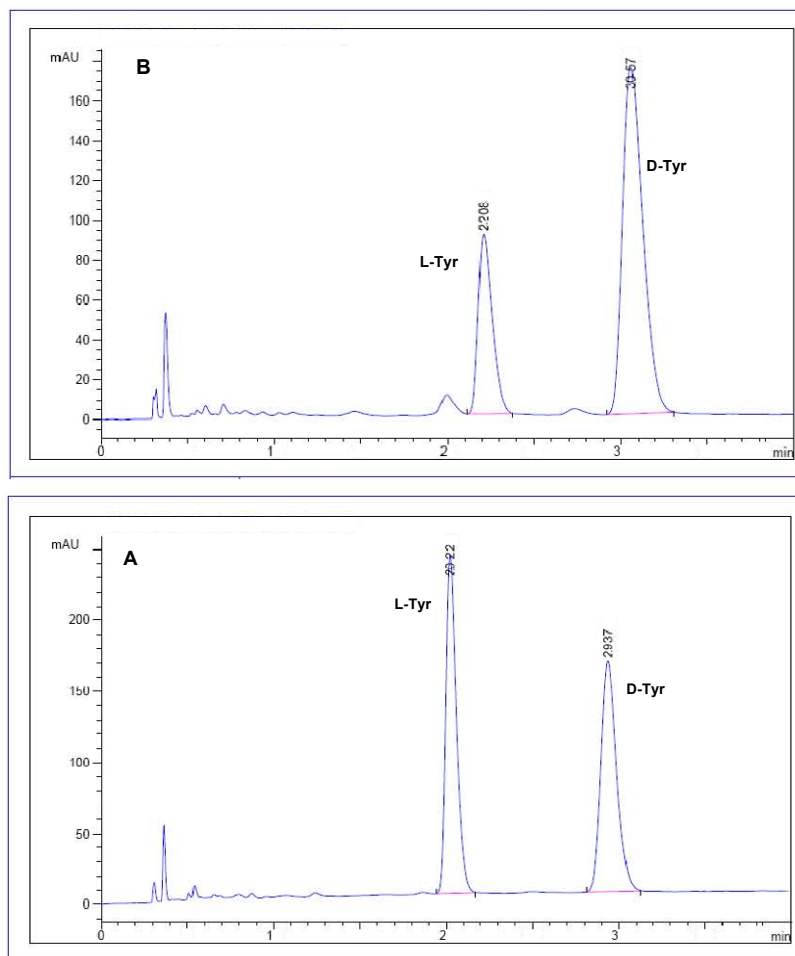


Fig. S8 Chiral HPLC system used for confirming the separation of racemic Tyr mixture, (A) before aggregation with the nanoparticles, the ration of [D-Tyr] to [L-Tyr] concentration was about 0.5. (B) after aggregation, the ration increased to 0.73, which could be seen from the integration area in the above graph.

References

- [1] M. M. Maye, L. Han, N. N. Kariuki, N. K. Ly, W. B. Chan, J. Luo, C. J. Zhong, *Anal. Chim. Acta.*, 2003, **496**, 17-27.