Electronic Supplementary Information

Ultrabright, highly heat-stable gold nanoclusters by functional ligands and hydrothermal-induced luminescence enhancement

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Scheme 2

Trp (tryptophan)  cAMP (adenosine 1,6-cyclic monophosphate)

AMP (adenosine monophosphate)

ADP (adenosine diphosphate)  ATP (adenosine triphosphate)
Scheme 2. Structure of compounds.
Figure S1

Figure S1. Energy-dispersive X-ray spectra (EDS) of cAMP-AuNCs and Trp-cAMP-AuNCs.
Figure S2

Figure S2. FT-IR spectra of Trp-cAMP-AuNCs, cAMP-AuNCs, cAMP, Trp (tryptophan) and citrate. V: stretching vibration, ρ: bending vibration.
Figure S3. Fluorescence intensity of Trp-cAMP-AuNCs (a, solid line) and Trp (b, dash line) before (red) and after (black) a dialysis purification.
Figure S4

Figure S4. Comparison of the solubility of cAMP-AuNCs and Trp-cAMP-AuNCs in a solution of 8:1 ratio (v/v) of ethanol to water. Trp-cAMP-AuNCs solution is almost transparent whereas cAMP-AuNCs solution became sedimentary.
Figure S5. Emission (black) and excitation (red) spectra of cAMP-AuNCs solution (50 µM=50×197=9850 µg/L) (upper). Fluorescence intensity of cAMP-AuNCs solution increased with its concentration (lower).
Figure S6

Figure S6. Emission (black) and excitation (red) spectra of tryptophan (Trp) solution (2.5 μM). Excitation wavelength for the emission spectrum and observed wavelength for the excitation spectrum are 277 and 360 nm, respectively.

Figure S7

Figure S7. Fluorescence lifetime of Trp (black) and Trp-cAMP-AuNCs (red) in which Trp as a donor and cAMP-AuNCs as an acceptor. The excitation wavelength is 279 nm and the observation wavelength is 360 nm.
Figure S8

Figure S8. Stability of the fluorescence of Trp-cAMP-AuNCs solution.

Figure S9

Figure S9. Effect of hydrothermal reaction time on the fluorescence of Trp-cAMP-AuNCs.
Figure S10

Figure S10. Effect of the concentration of tryptophan on the fluorescence of Trp-cAMP-AuNCs solution.
Figure S11

Figure S11. Effect of the concentration of cAMP on the fluorescence of Trp-cAMP-AuNCs solution.

Figure S12

Figure S12. TEM images of BSA-Au NCs (a) and GSH-Au NCs (b).
Figure S13

Figure S13. Fluorescence lifetime of Trp-cAMP-AuNCs (red) and cAMP-AuNCs (black). The excitation wavelength is 258 nm and the observation wavelength is 360 nm.
Figure S14

![Fluorescence Intensity vs Wavelength Graph](image)

**Figure S14**

A. **Fluorescence Intensity vs Wavelength Graph**

- **a** — AMP-AuNCs
- **b** — Trp (5 µM) + AMP-AuNCs
- **c** — Trp-AMP-AuNCs
- **d** — Trp-AMP-AuNCs after 120

![Graph A](image)

B. **Fluorescence Intensity vs Wavelength Graph**

- **a** — ADP-AuNCs
- **b** — Trp (5 µM) + ADP-AuNCs
- **c** — Trp-ADP-AuNCs
- **d** — Trp-ADP-AuNCs after 120

![Graph B](image)
Figure S14. Fluorescence spectra of Trp-AMP-AuNCs (A), Trp-ADP-AuNCs (B) and Trp-ATP-AuNCs (C) before (b) and after (c) a hydrothermal reaction, and after a treatment of 120 °C (d). The concentrations of these AuNC solutions: In A: AMP-AuNCs (985 μg/L), Trp (5 μM) + AMP-AuNCs (49.25 μg/L), Trp-AMP-AuNCs (49.25 μg/L); In B: ADP-AuNCs (985 μg/L), Trp (5 μM) + ADP-AuNCs (49.25 μg/L), Trp-ADP-AuNCs (49.25 μg/L); In C: ATP-AuNCs (985 μg/L), Trp (5 μM) + ATP-AuNCs (49.25 μg/L), Trp-ATP-AuNCs (49.25 μg/L).
Figure S15

Figure S15. Emission (black) and excitation (red) spectra of tyrosine solution (40 μM). Excitation wavelength for the emission spectrum and observed wavelength for the excitation spectrum are 275 and 306 nm, respectively.

Figure S16

Figure S16. Emission (black) and excitation (red) spectra of tryptamine solution (2.5 μM). Excitation wavelength for the emission spectrum and observed wavelength for the excitation spectrum are 277 and 358 nm, respectively.
Figure S17

![XPS spectra of cAMP-AuNCs and Trp-cAMP-AuNCs.](image)

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Figure S17. XPS spectra of cAMP-AuNCs and Trp-cAMP-AuNCs.