Supporting Information

L-Arginine-Modified Gold Nanoclusters for Rapid and Visual Quantification of Bacterial Infection

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Table S1. LB Medium Core Component List.

Ingredient	Content (/ L)	Function	Relevance to This Study
Tryptone	10 g	Provide nitrogen sources such as amino acids and peptides	Contains multiple natural amino acids, simulating the coexisting environment of biomolecules
Yeast Extract	5 g	Provides vitamins, growth factors, and micronutrients	Contains trace amounts of peptides and metabolic intermediates, simulating the coexisting environment of biomolecules
NaCl	10g	Maintain the osmotic pressure of the culture medium	Inorganic ions do not participate in fluorescence signal-related reactions
Deionized Water	1L	Solvent, maintaining system homogeneity	No additional interfering components

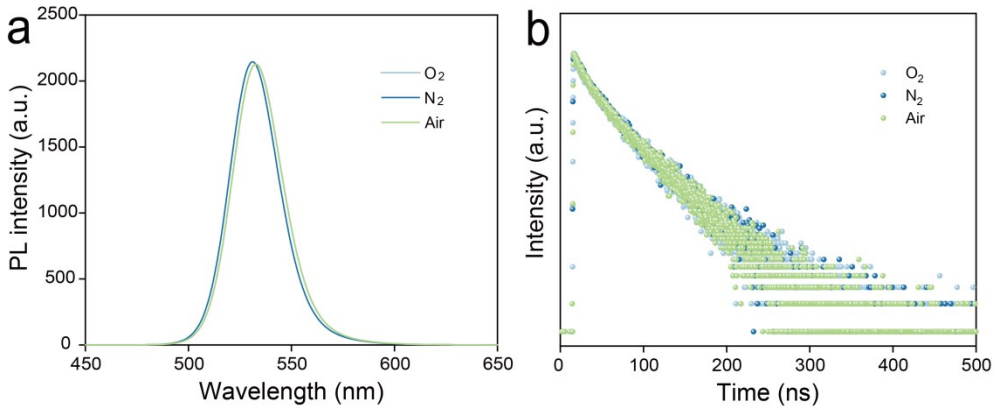

Fig. S1. PL spectra of Arg-ATT-Au NCs under O_2, N_2, Air. (b) PL decay traces of Arg-ATT-Au NCs under O_2, N_2, Air.

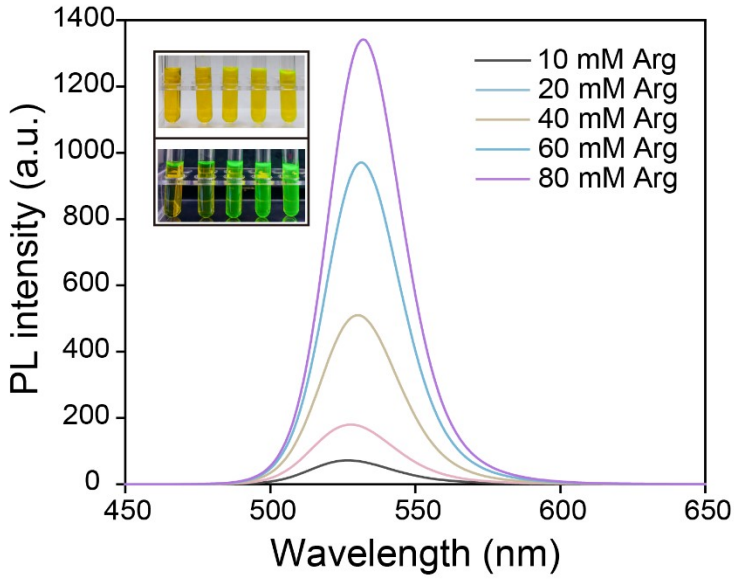

Fig. S2. PL spectra of Arg-ATT-Au NCs with varying Arg ligand concentrations (10 mM, 20 mM, 40 mM, 60 mM, 80 mM) under identical experimental conditions. (The pictures were captured at room temperature under non-excited conditions and 365 nm UV light excitation, respectively.)

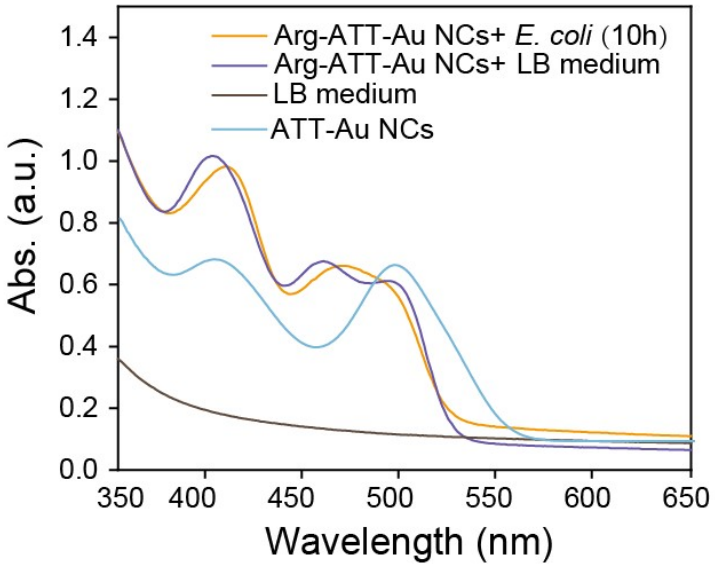

Fig. S3. UV - vis absorbance spectra of Arg-ATT-Au NCs with *E. coli*, Arg-ATT - Au NCs in LB Medium, ATT - Au NCs in LB Medium, and LB Medium alone.

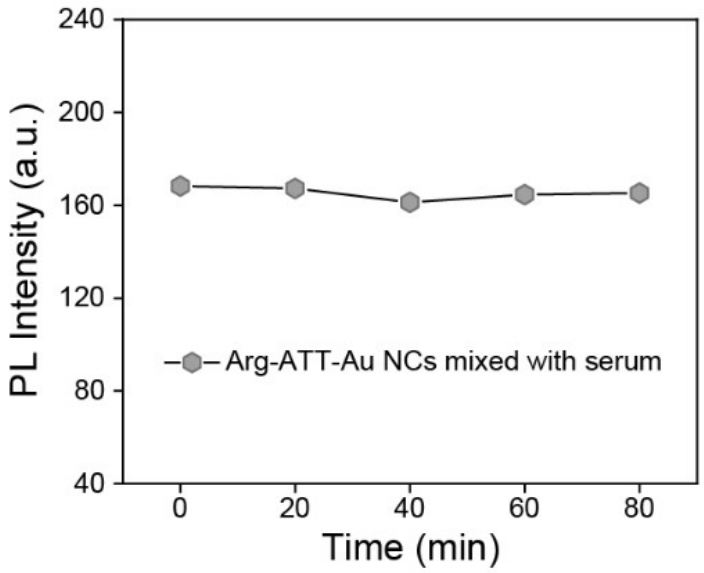

Fig. S4. PL spectra of Arg-ATT-Au NCs with serum were measured every 20 min.

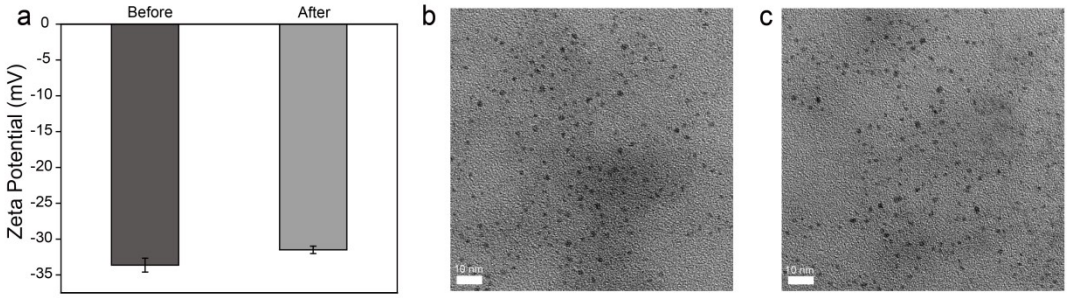

Fig. S5. (a) ZETA of Arg-ATT-Au NCs (Before and after co-culture with serum). (b) TEM images and size of Arg-ATT-Au NCs (Before co-culture with serum) (c). After co-culture with serum for 80 min. (Scale bar: 10 nm.)

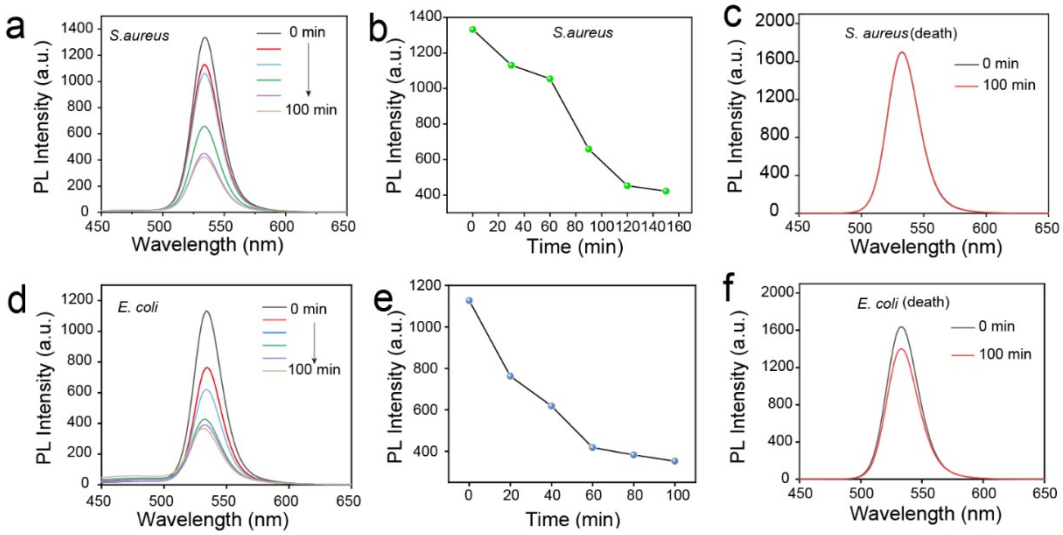

Fig. S6. Time-dependent photoluminescence spectra of a mixed solution with bacteria at a concentration of 10^7 (CFU mL^{-1}) and Arg-ATT-Au NCs.

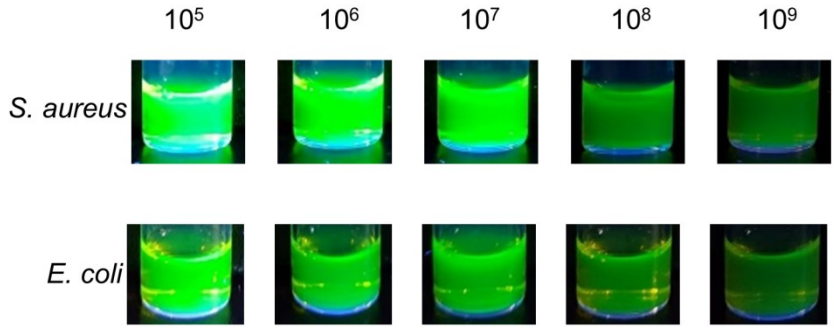

Fig. S7. Digital images of concentration-dependent fluorescence intensity of different bacterial concentrations.

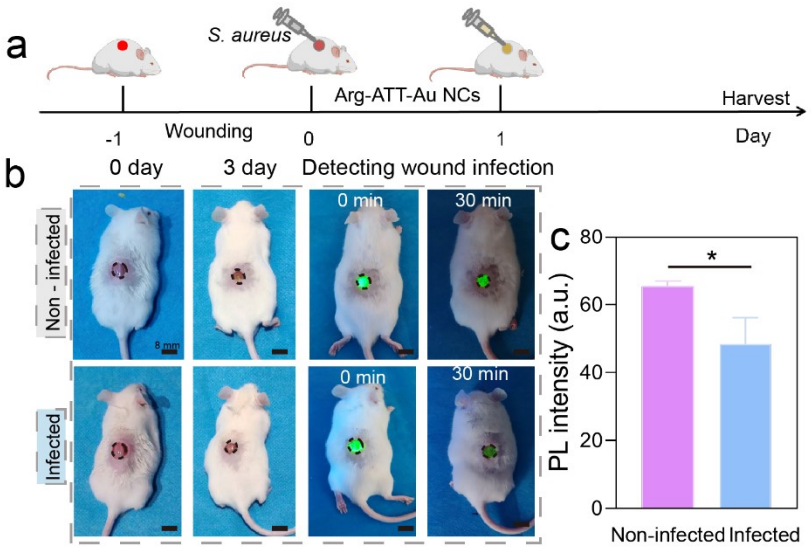

Fig. S8. Detection of back skin infected wounds in mice with Arg-ATT-Au NCs. (a) Scheme of detecting *S. aureus* infected dorsal wounds using Arg-ATT-Au NCs. (b) Representative images of skin wounds were captured at -1, 0, and 3 days for the group of non-infected wounds and the infected wound groups. Scale bar: 8 mm. (c) The average PL intensity of the fluorescent area of the dorsal wound after 30 min (excitation wavelength 365 nm) was determined using Image J software. ($n = 3$, $p < 0.05$, error bars indicate means± standard deviations.)

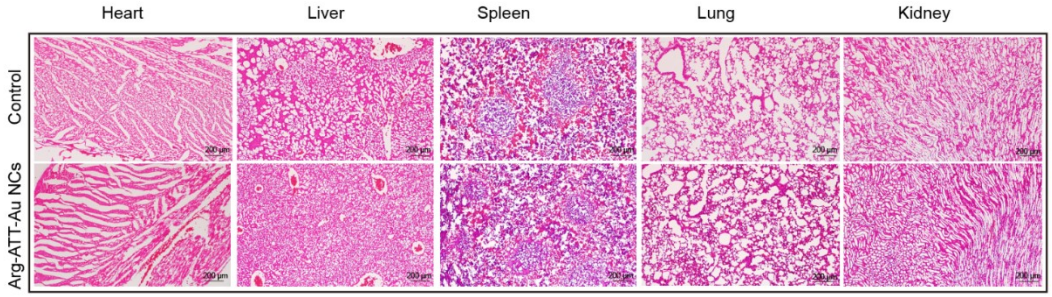

Fig. S9. Images of H&E staining of heart, liver, spleen, lung, and kidney from the control group, Arg-ATT-Au NCs, and ATT-Au NCs group. Scale bar: 200 μm. (n = 3 independent experiments).

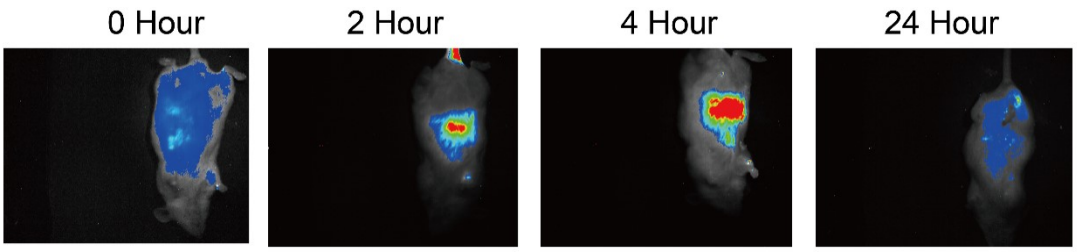

Fig. S10. *In vivo* imaging in BALB mice of Arg-ATT-Au NCs metabolism at various time points (0, 1, 2, and 24 hours).

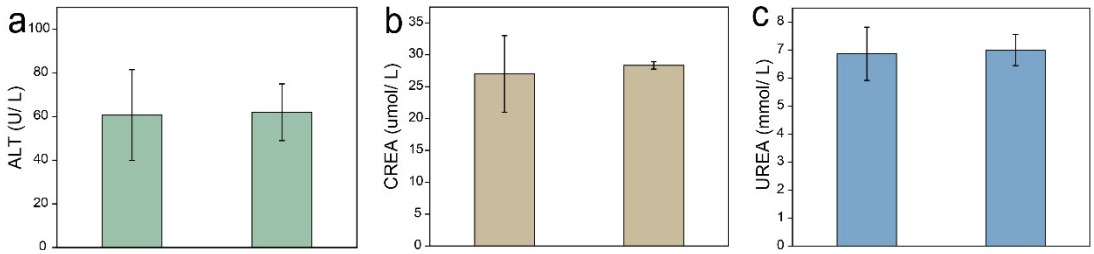

Fig. S11. The effects of Arg-ATT-Au NCs and ATT-Au NCs on the liver and kidney function. The blood levels of ALT (a), CREA (b), and UREA (c) were measured by biochemical methods (n = 3, error bars indicate means±standard deviations).

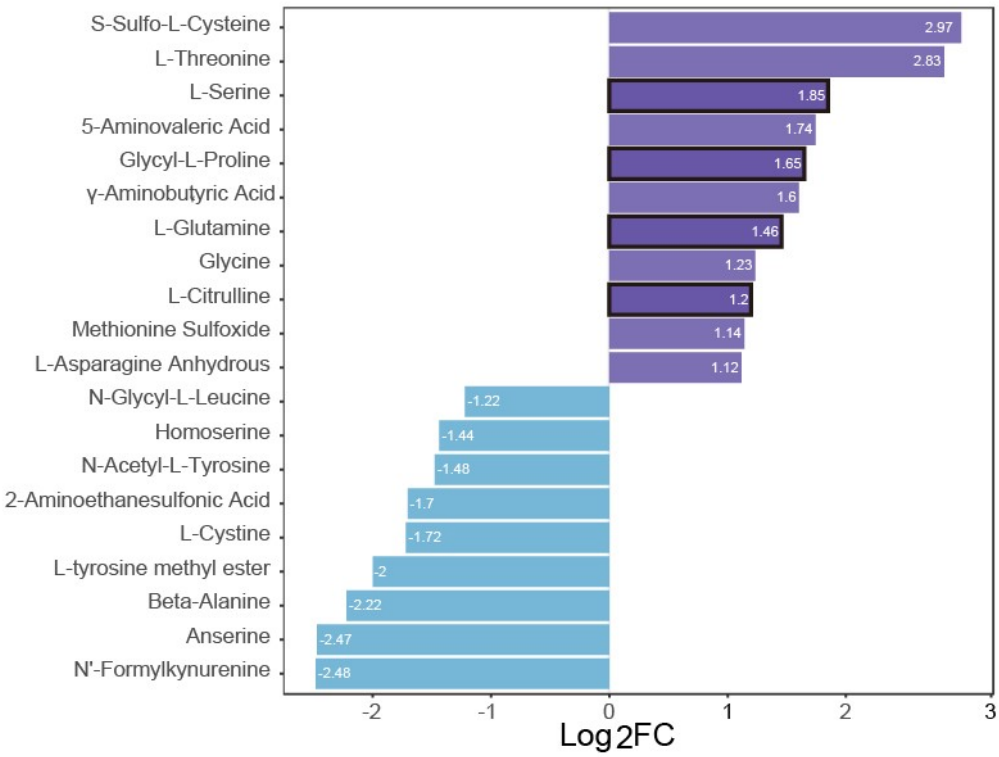

Fig. S12. Differential amino acid metabolites of *S. aureus* between the group of control and the Arg-ATT-Au NCs.

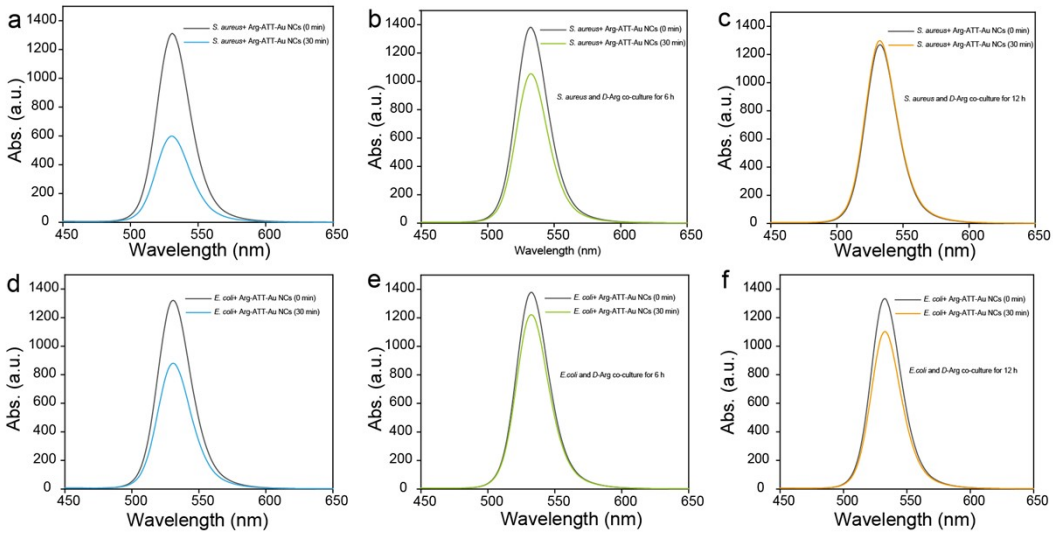

Fig. S13. (a) The PL spectrum of Arg-ATT-Au NCs for detection of *S. aureus*. (b, c) The PL spectrum of Arg-ATT-Au NCs for detection of *S. aureus* co-culture with *D*-Arg after 6 h (b) and 12 h (c). (d) The PL spectrum of Arg-ATT-Au NCs for the detection of *E. coli*. (e, f) The PL spectrum of Arg-ATT-Au NCs for detection of *E. coli* co-culture with *D*-Arg after 6 h (e) and 12 h (f).