Electronic Supplementary Material (ESI) for Materials Chemistry Frontiers.

Aggregation Induced Emission Enhancement by Plasmon Coupling of Noble Metal Nanoparticles

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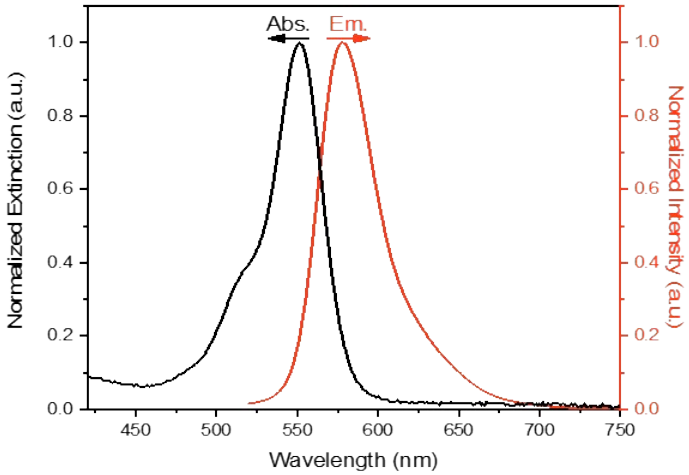

Figure S1 Absorption and fluorescence spectra of RiTC aqueous solution.

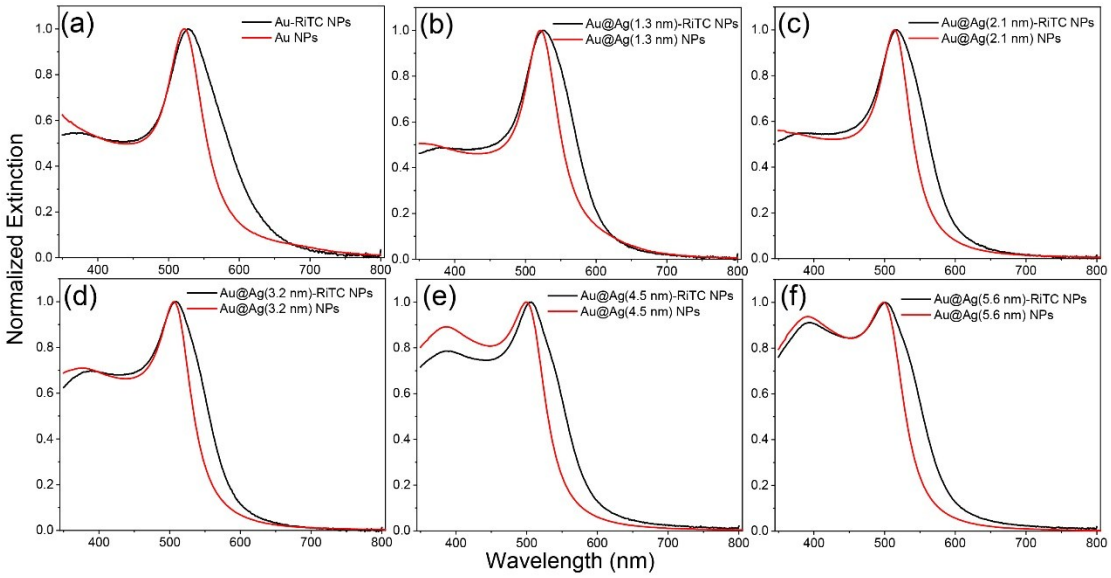

Figure S2: Extinction spectra of Au@Ag NPs and Au@Ag-RiTC NPs with different Ag shell thicknesses. Ag shell thicknesses is 0 nm (a), 1.3 nm (b), 2.1 nm (c), 3.2 nm (d), 4.5 nm (e), and 5.6 nm (f).

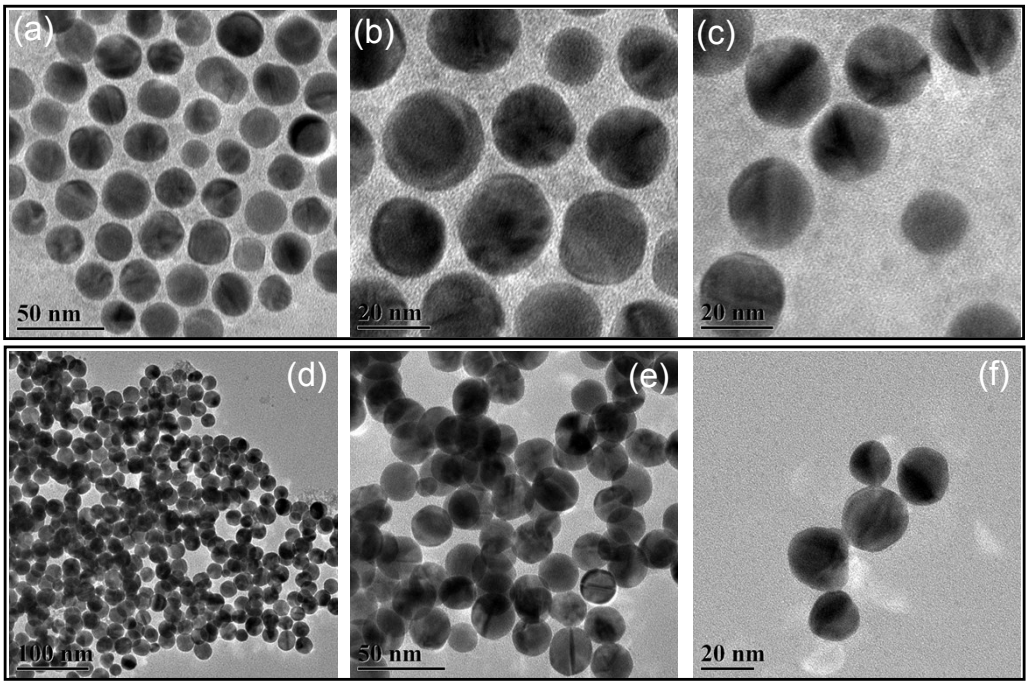

Figure S3 (a-c) and (d-f) Typical TEM images of monodisperse Au-RiTC NPs and aggregated Au-RiTC NPs at different magnifications, respectively.

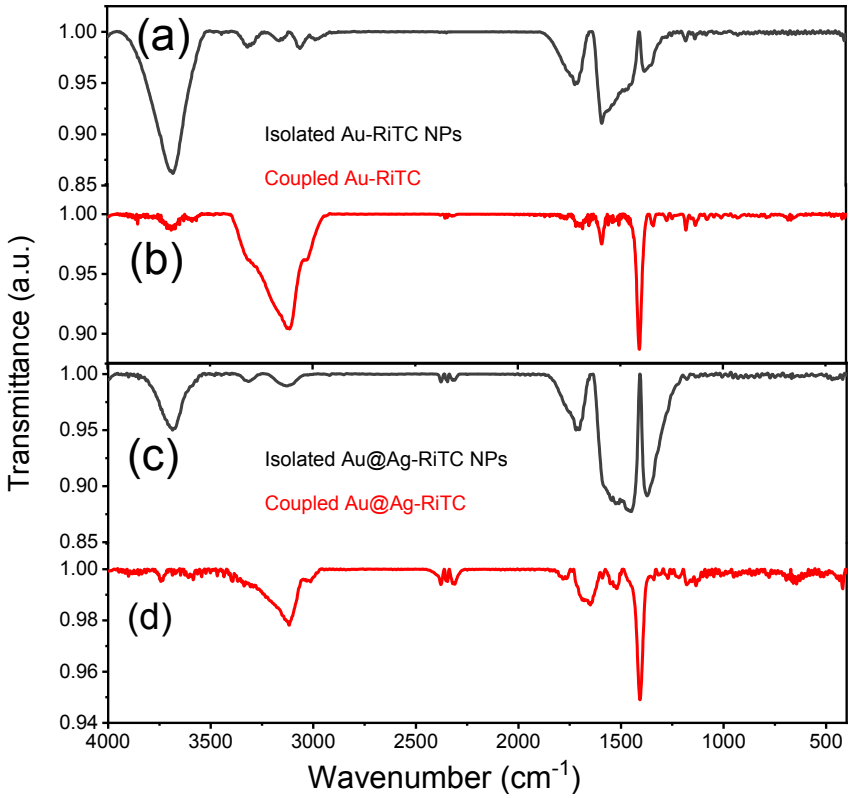

Figure S4 FT-IR spectra of (a-b) Au-RiTC NPs and (c-d) Au@Ag(5.6 nm)-RiTC NPs before and after aggregations, respectively.

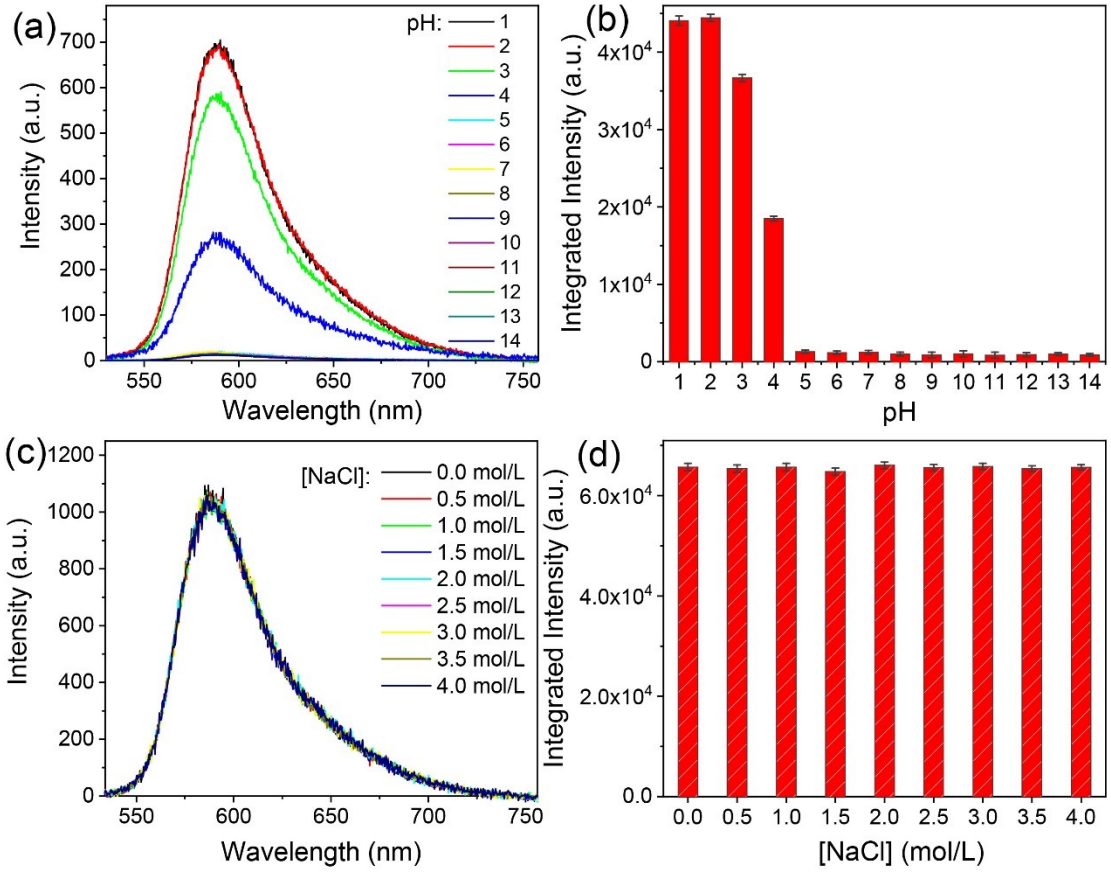

Figure S5 (a) and (c) Emission spectra of as-prepared Au@Ag(5.6 nm)-RiTC sample after introduction of cysteine molecules at various pH values and various NaCl concentrations (mol/L), respectively. (b) and (d) Integrated fluorescence intensity of this sample versus pH values and versus [NaCl], respectively.

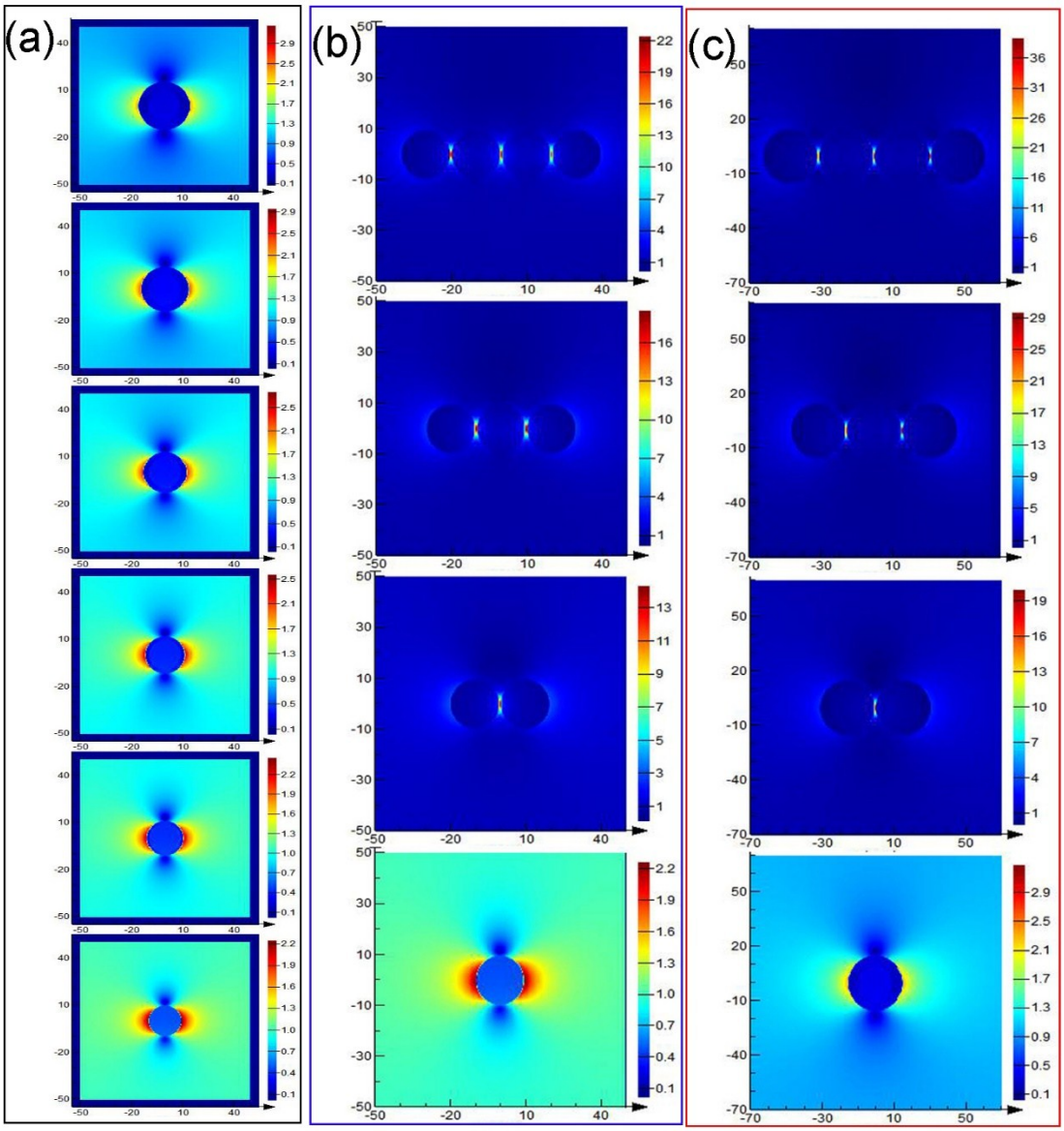

Figure S6 (a) Simulated electric field of Au@Ag NPs with shell thicknesses of 0, 1.3, 2.1, 3.2, 4.5, and 5.6 nm from bottom to top. (b) and (c) Simulated electric field of Au NPs (19 nm) and Au@Ag(5.6 nm) NPs monomer, dimmer, trimer, and tetramer, respectively. The wavelength of 520 nm was chosen to mimic the experimental results.

Finite-Difference Time-Domain (FDTD) simulation: The numerical simulations were conducted by Lumerical FDTD solution. The optical materials of Au and Ag were taken from Au (Gold)-Palik and Ag (Siliver)-Palik (0-2 μm), respectively. The gap between metal NPs was 1 nm. The background refractive index was set to 1.0 representing aqueous solution, and Boundary condition was stretched coordinate PML, Total-field Scattered-field Source (TFSF Source) was used as source.

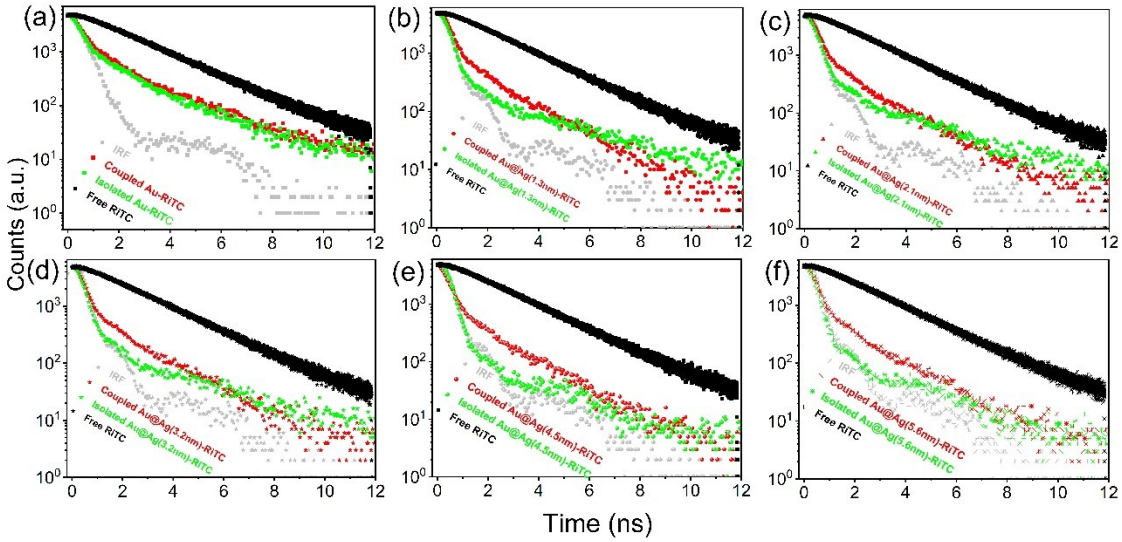

Figure S7 (a)-(f) Exhibit fluorescence lifetime curves of free RiTC, isolated Au@Ag-RiTC NPs and coupled Au@Ag-RiTC NPs with different Ag shell thicknesses: 0 nm (a), 1.3 nm (b), 2.1 nm (c), 3.2 nm (d), 4.5 nm (e), and 5.6 nm (f).

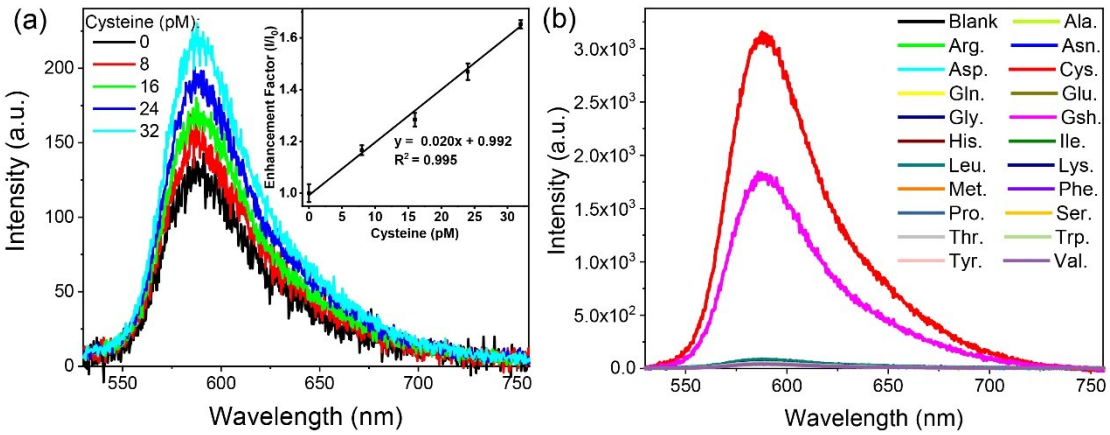

Figure S8 (a) Fluorescence emission spectra of Au@Ag-RiTC NPs solution upon addition of different concentrations of cysteine in the low concentration range. Inset is the corresponding enhancement factor I/I_0 versus [cysteine], where I_0 and I represent the fluorescence intensity of Au@Ag-RiTC NPs without and with addition of cysteine. (b) Emission spectra of as-presented method to couple Au@Ag-RiTC NPs with addition of different coupling agents. All these measurements were conducted in the laboratory tap water.

Table S1 Optimum enhancements factor of Coupled Au@Ag NPs with different Ag shell (0, 1.3, 2.1, 3.2, 4.5, and 5.6 nm) versus pre-quenched and free RiTC molecules

Ag shell thickness (nm)	0	1.3	2.1	3.2	4.5	5.6
Quenching ratio	8.1	5.8	4.6	5.6	5.8	5.9
Compared to free RiTC	3.0	5.6	6.8	7.1	7.3	7.6
Compared to pre-quenched	24.3	32.0	31.3	39.6	42.8	44.8