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Plasmonic Nanometal Surface Energy Transfer-based Dual Excitation Biosensing of Pathogens

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Table S 1. NSET-based sensors for target detection in the literature.

Target Pathogen(s)	Donor	Acceptor	LOD	Ref.
DNA	SiO_2 coated CdTe ($CdTe/SiO_2$) core/shell nanoparticles	AuNPs	0.106 nmol/L	[1]
hepatitis C virus (HCV) RNA	Cy3 dye	AuNPs	300 fM	[2]
Cu^{2+} and Hg^{2+}	Ring-open structured rhodamine spirolactam	AuNPs	----	[3]
Mercury(II)	DNA-conjugated QDs	AuNPs	1.2 ppb	[4]
Hg(II)	Rhodamine B (RhB) dye	AuNPs	2 ppt	[5]
Glutathione	5-aminofluorescein (Fl-NH_2)	AuNPs	----	[6]
C-Reactive protein	Fluorescein	AuNPs	----	[7]
Prostate specific antigen (PSA)	QD labeled PSA aptamer	Graphene oxide	0.05 fg mL^{-1}	[8]
Hg^{2+}	S,N co-doped carbon dots (S,N-CDs)	AgNPs	0.51 nM	[9]
Heparin	Near-infrared fluorophore	AuNRs	6.7 ng/mL	[10]

Table S 2. Aptamers and complementary DNA sequences used in this study.

Target	Aptamers (5′-NH_2-C6)	cDNAs (5′-NH_2-C6)	Ref.
Salmonella typhimurium (ATCC® 14028™)	TATGGCGGCGTCA**CCCGACGGGGACTTGACATTAT**GACAG	ATAATGTCAAGTCCCCGTCGGG	[11, 12]
Escherichia coli O157:H7 (ATCC® 25922™)	CCGGACGCTTAT**GCCTTGCCATCTACAGAGCAGG**TGTGACGG	CCTGCTCTGTAGATGGCAAGGC	[11, 12]

Table S 3. The hydrodynamic size of the NPs utilized in this assay.

Samples	Hydrodynamic size (nm)
CdSe/ZnS core/shell QDs	25.93
EC-Aptamer-QDs	61.76
$NaYF_4$:Yb/Er UCNPs	41.8
ST-Aptamer-UCNPs	87.7
AuNR	55.7
EC-cDNA-AuNR	66.2
AuNU	91.3
ST-cDNA-AuNU	105.8

Table S 4. Zeta potential of the unmodified and aptamer capped NPs.

Samples	Zeta Potential (mV)
CdSe/ZnS core/shell QDs	-32.5
EC-Aptamer-QDs	-12.9
$NaYF_4$:Yb/Er UCNPs	-30.7
ST-Aptamer-UCNPs	-14.3
AuNR	-20.8
EC-cDNA-AuNR	-8.27
AuNU	-22.2
ST-cDNA-AuNU	-9.73

Table S 5. LOD values and calibration curve details for detection of *S. typhimurium* and *E. coli* using UCNP and QD- based aptasensor.

Bacteria	Linear Equation	R^2	Linear Range (CFU mL^{-1})	LOD (CFU mL^{-1})
S. typhimurium	y=76.15x+113.81	0.9913	10^2-10^6	7.55

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E. coli	y=97.301x+128.96	0.9743	10^2-10^6	4.94

Table S 6. LOD values and calibration curve parameters for simultaneous detection of *S. typhimurium* and *E. coli* using dual excitation luminescence nanoprobe.

Bacteria	Linear Equation	R^2	Linear Range (CFU mL^{-1})	LOD (CFU mL^{-1})
S. typhimurium	y=40.54x+46.67	0.994	10^2-10^5	9.313
E. coli	y=64.36x+60.93	0.972	10^3-10^5	7.38

Table S 7. Multiplexed sensing of *S. typhimurium* and *E. coli* in spiked lake water samples.

Sample	Spiked Concentration (CFU mL^{-1})		Measured Concentration (CFU mL^{-1})	
	E. coli	*S. typhimurium*	*E. coli*	*S. typhimurium*
Lake water 1	1.0×10^2	1.0×10^2	$(1.1462\pm0.13)\times10^2$	$(0.9112\pm0.07)\times10^2$
Lake water 2	1.0×10^3	1.0×10^3	$(1.0762\pm0.10)\times10^3$	$(0.9860\pm0.12)\times10^3$
Lake water 3	1.0×10^4	1.0×10^4	$(1.0288\pm0.11)\times10^4$	$(1.113\pm0.09)\times10^4$

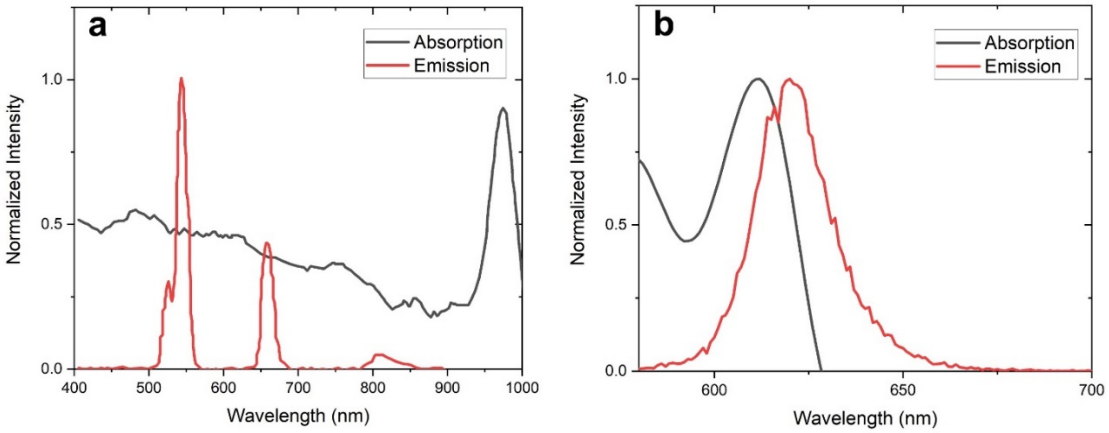

Figure S 1. Absorption and emission spectra related to a) UCNPs, and b) QDs.

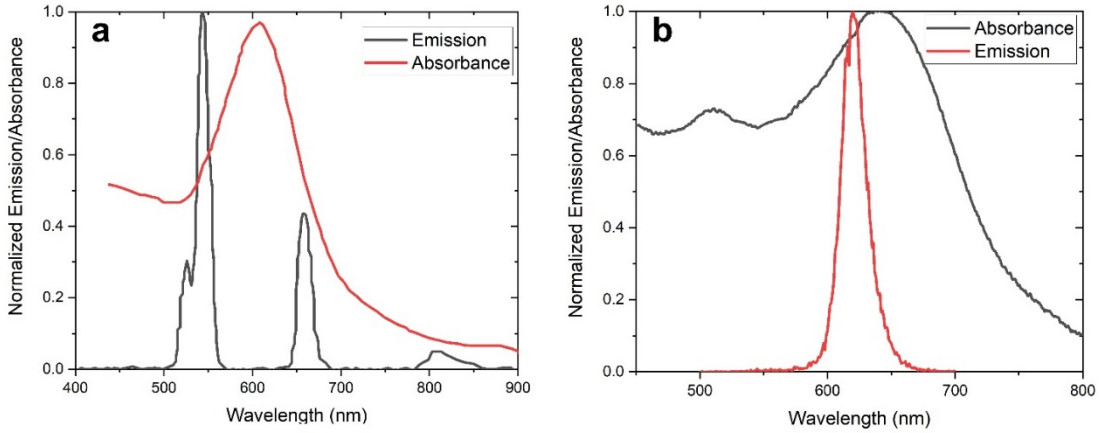

Figure S 2. Emission/absorption spectra of a) $NaYF_4$: Yb, Er UCNPs/AuNUs, and b) CdSe/ZnS core/shell QDs/AuNRs.

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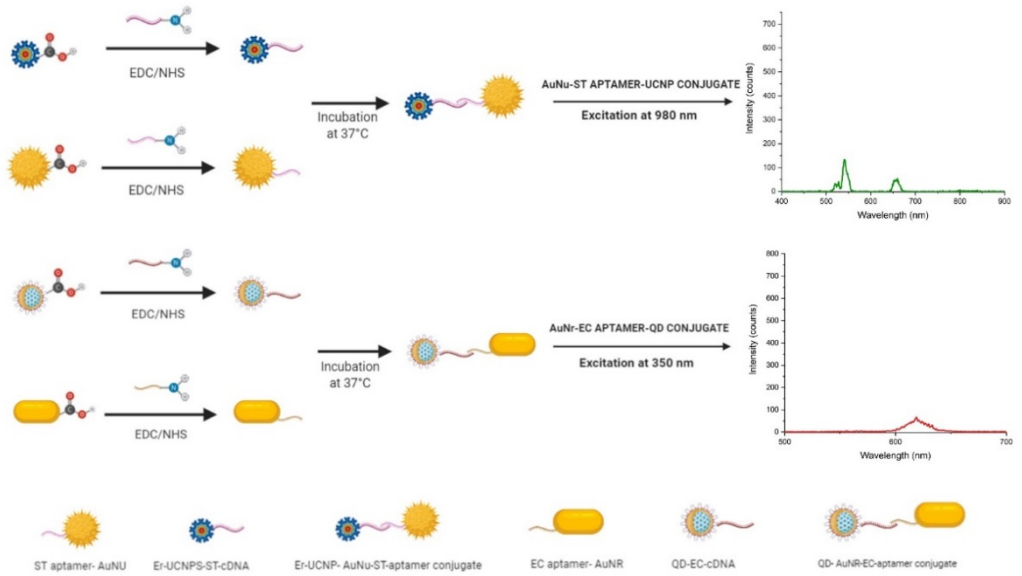

Figure S 3. Preparation of the AuNS-aptamer-cDNA-LNP conjugates.

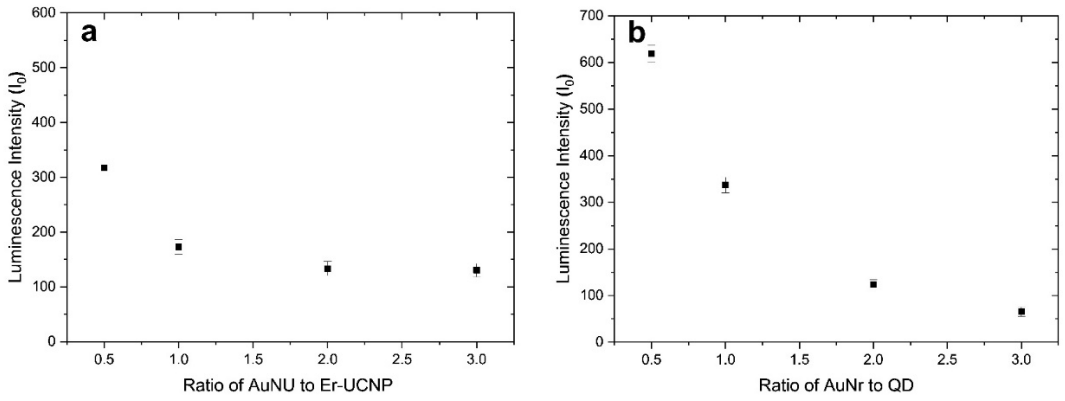

Figure S 4. The luminescence intensity of the a) UCNP-AuNU conjugates at 545 nm b) QD-AuNR conjugates at 620 nm in terms of various initial acceptor/donor ratios in 1x PBS.

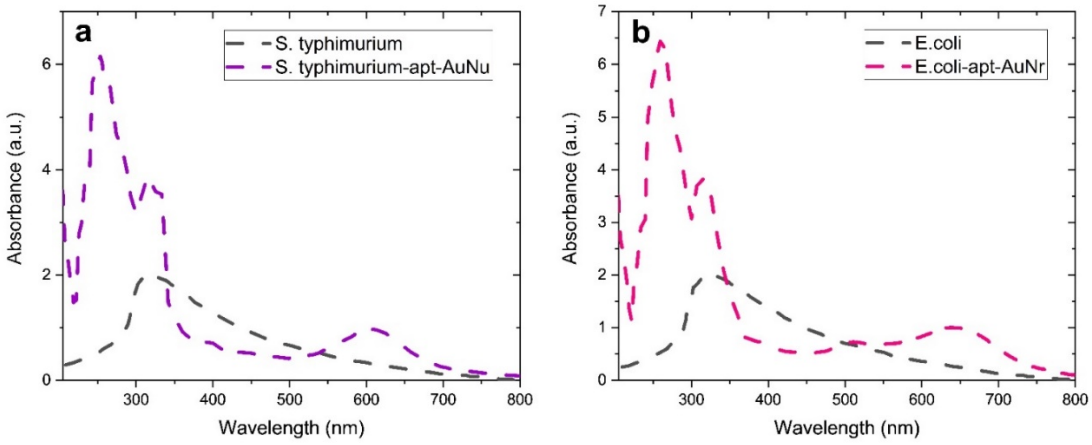

Figure S 5. UV-vis absorption spectra of a) *S. typhimurium* with and without related AuNu-aptamer, b) *E. coli* with and without AuNr-aptamer.

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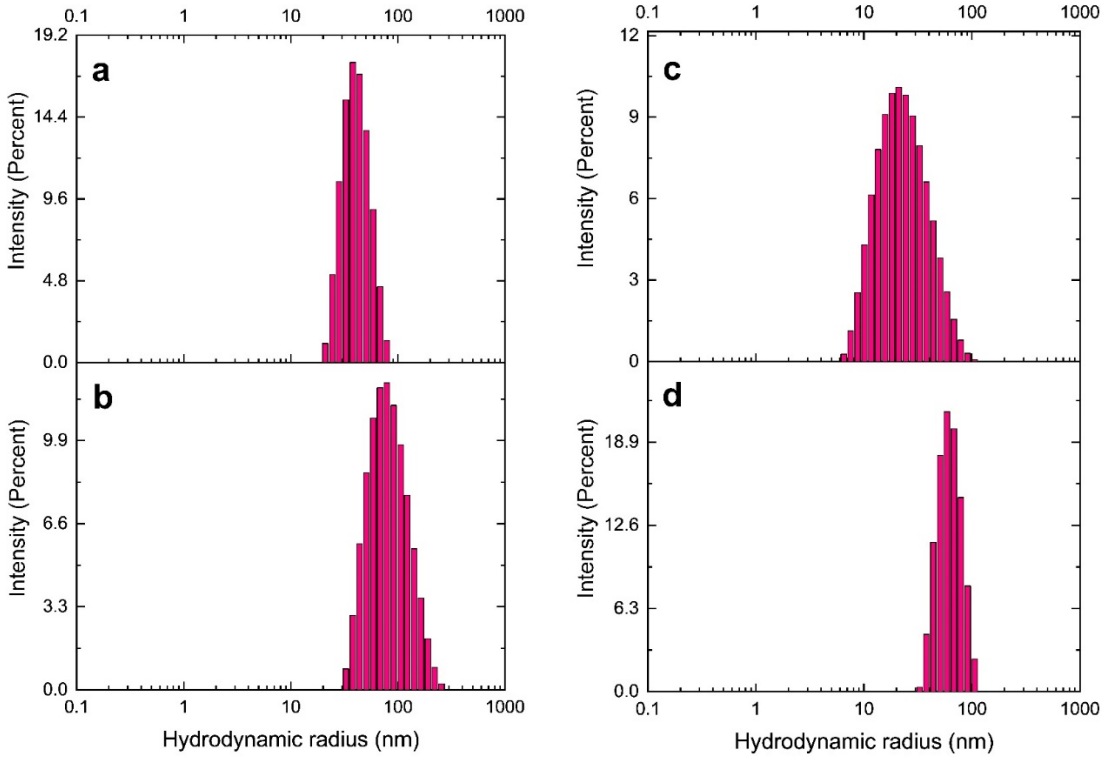

Figure S 6. Hydrodynamic size distribution of a) unmodified UCNP and b) ST cDNA-coupled UCNP, c) unlabeled QD, and d) EC cDNA-modified QDs.

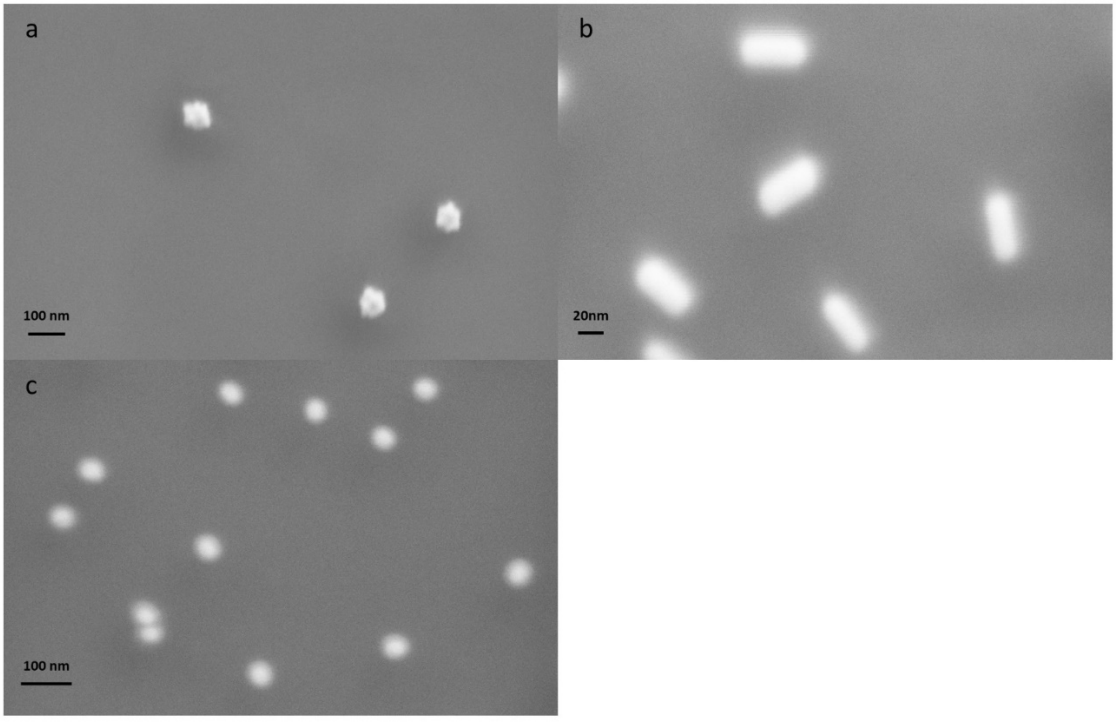

Figure S 7. SEM images of a) ST-aptamer-functionalized AuNU and b) EC-aptamer-functionalized AuNR, and c) ST-cDNA-modified UCNP.

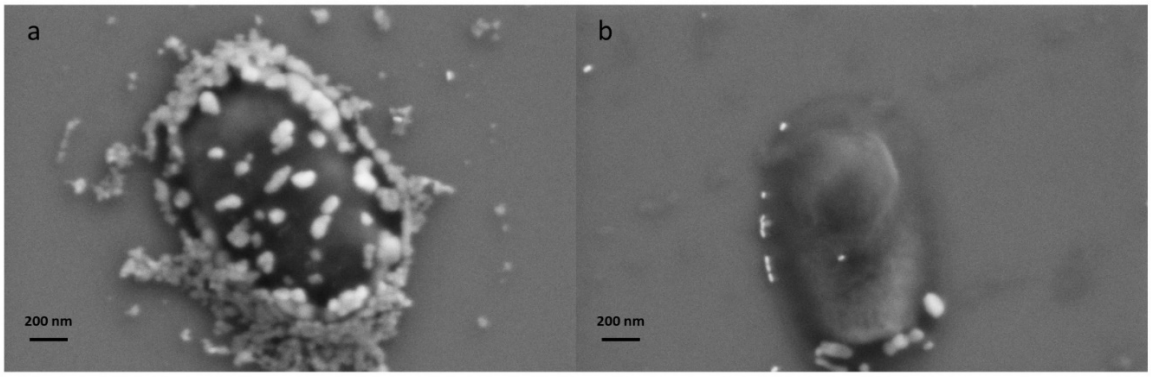

Figure S 8. SEM images of a) ST-AuNU nanoprobe with *S. typhimurium*, and b) EC-AuNR nanoprobe with *E. coli*.

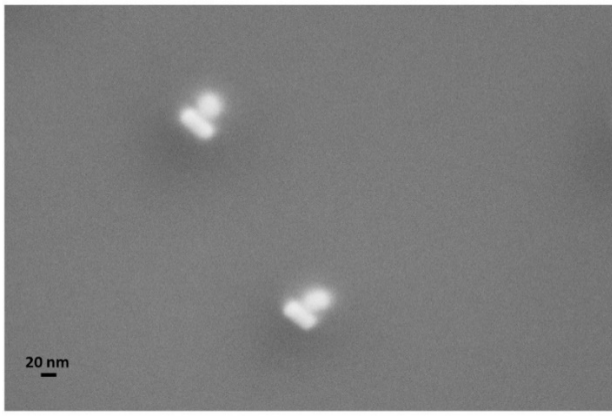

Figure S 9. SEM images of UCNP-AuNR conjugate.

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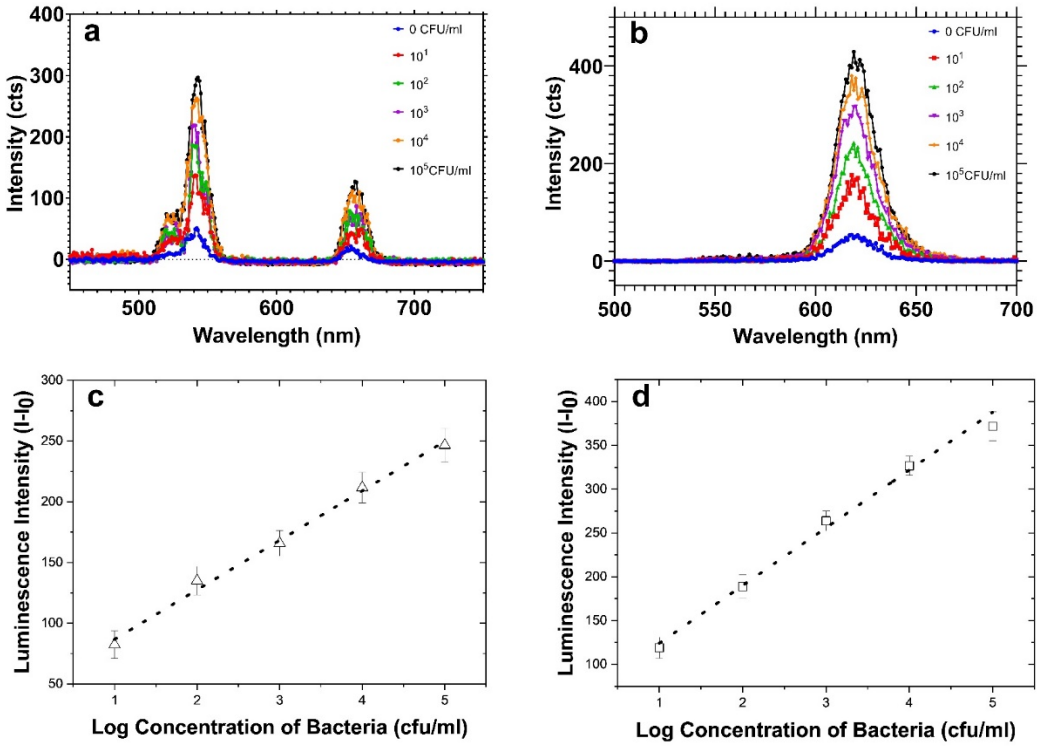

Figure S 10. The luminescence intensity increase of a) UCNP and b) QD nanoprobes versus the logarithmically increased concentrations of S. typhimurium and E. coli, respectively. The Calibration curves for multiplex sensing of c) S. typhimurium and d) E. coli are also provided.

Reference

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