Electronic Supplementary Material (ESI) for Nanoscale.
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Supporting Information

Silica-coated Triangular Gold Nanoprisms as Distance-dependent Plasmon-Enhanced Fluorescence-based Probes for Biochemical Applications

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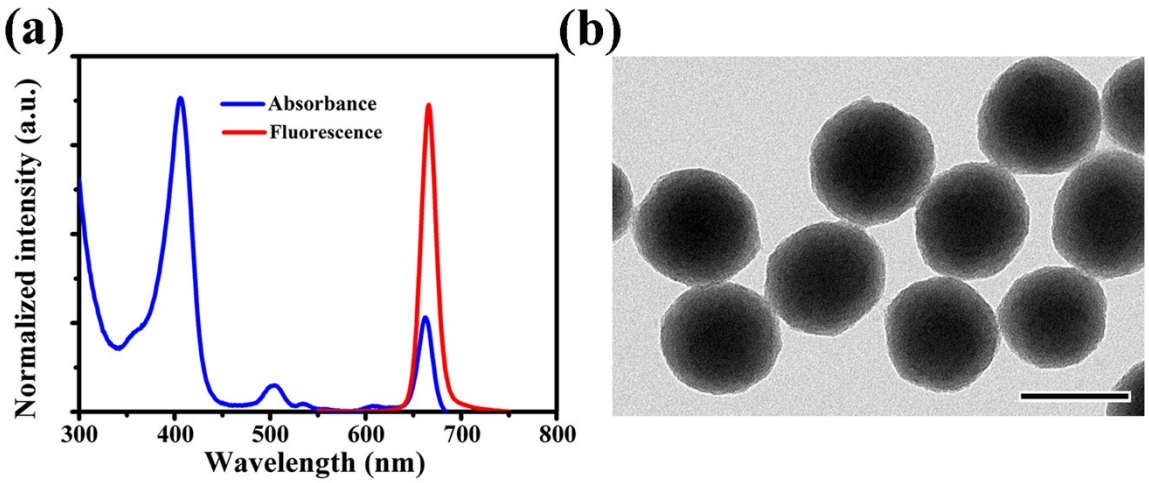

Fig. S1 (a) The absorbance and fluorescence spectra of SiO_2@Ce6(100 nm) nanoparticles. (b) The TEM image of SiO_2 nanoparticles. The scale bar is 100 nm.

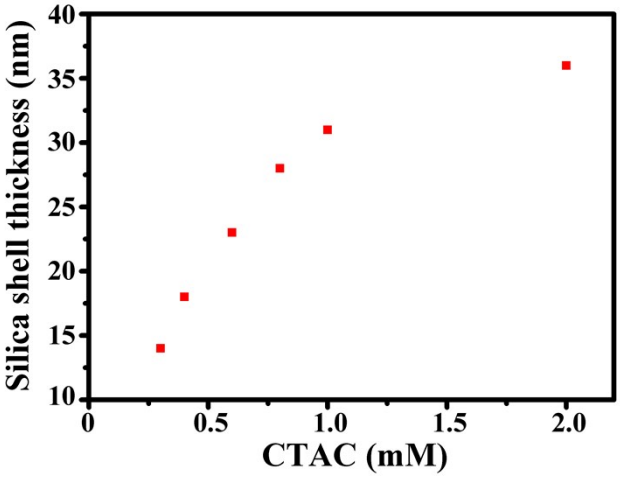

Fig. S2 Average silica shell thickness varied with CTAC concentration.

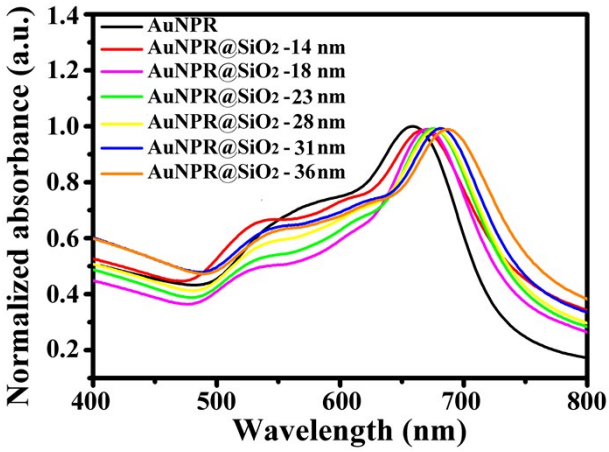

Fig. S3 UV-Vis absorbance spectra of AuNPR@SiO_2 with different thicknesses of silica shell.

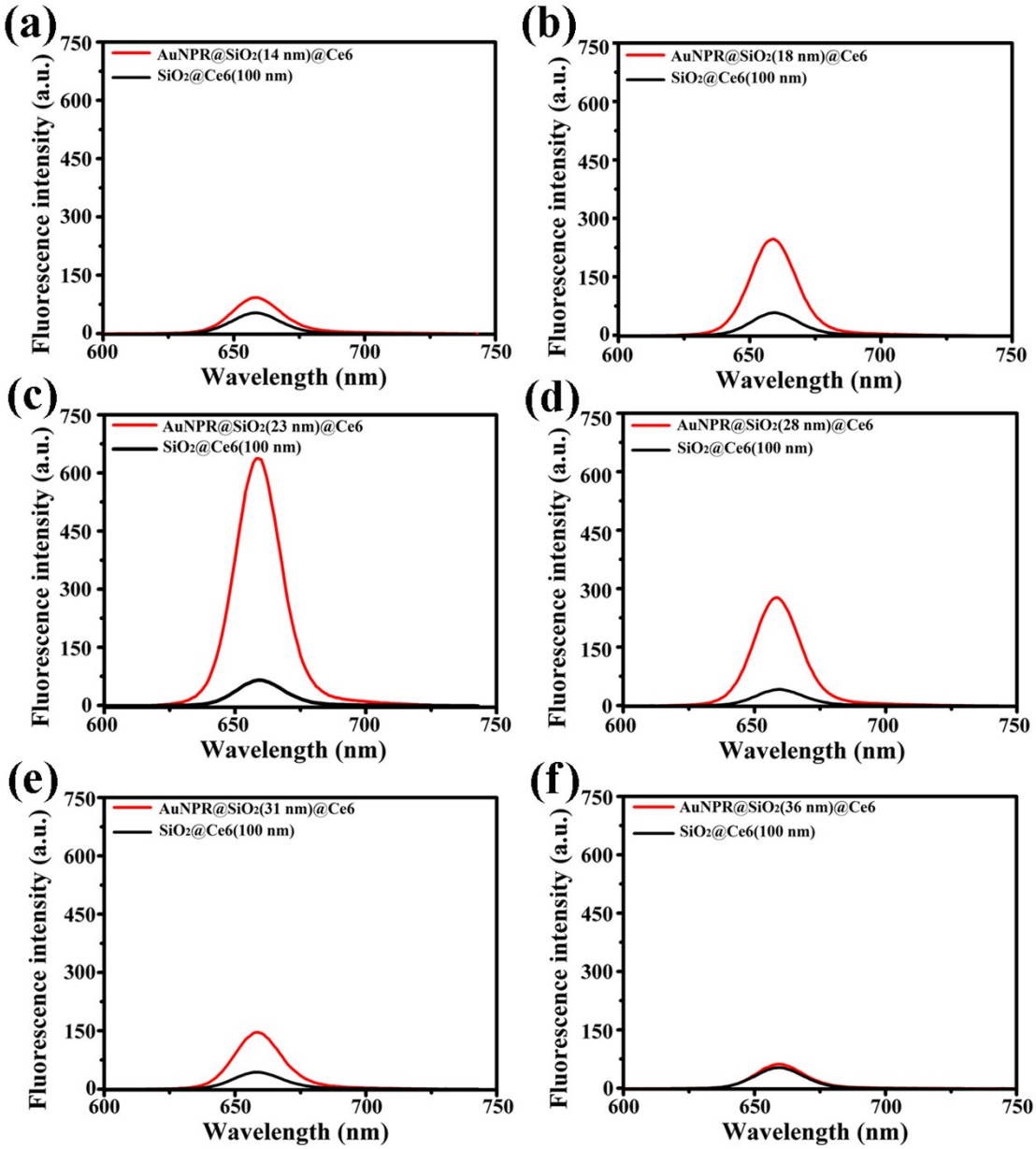

Fig. S4 Fluorescence spectra of AuNPR@SiO_2@Ce6 coated with varying thicknesses of silica shell (a-f: 14, 18, 23, 28, 31, 36 nm). Emission spectra of SiO_2@Ce6(100 nm) as the control are also include.

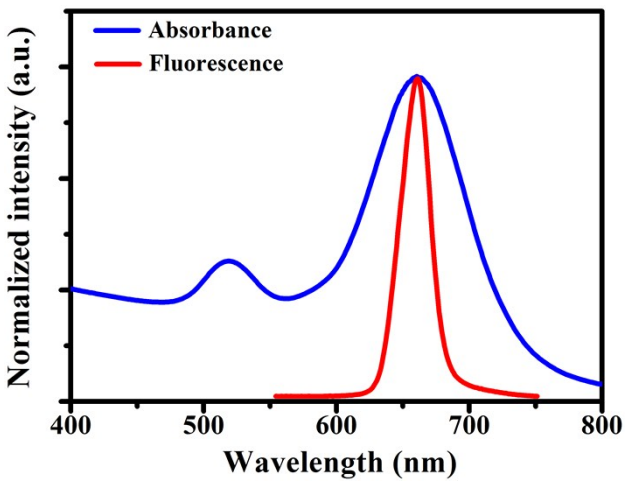

Fig. S5 Fluorescence spectrum of AuNR and absorbance spectrum of Ce6.

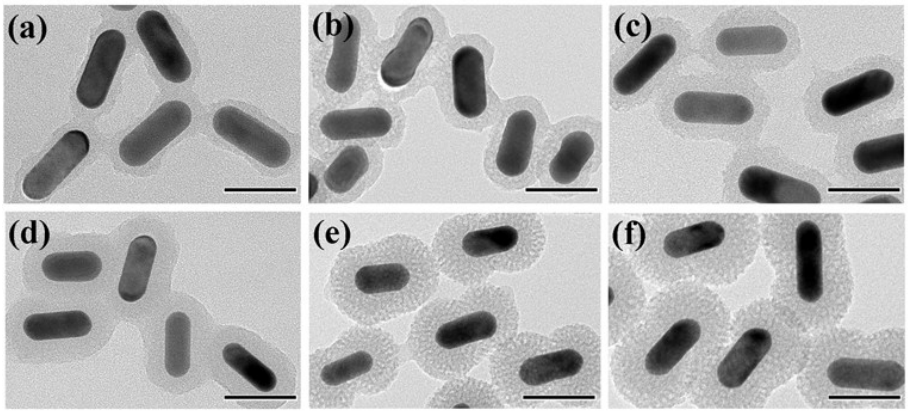

Fig. S6 TEM micrographs of AuNPR@SiO_2 coated with different thicknesses of silica shell (a-f: 6, 10, 13, 15, 19, 24 nm). The scale bar is 50 nm.

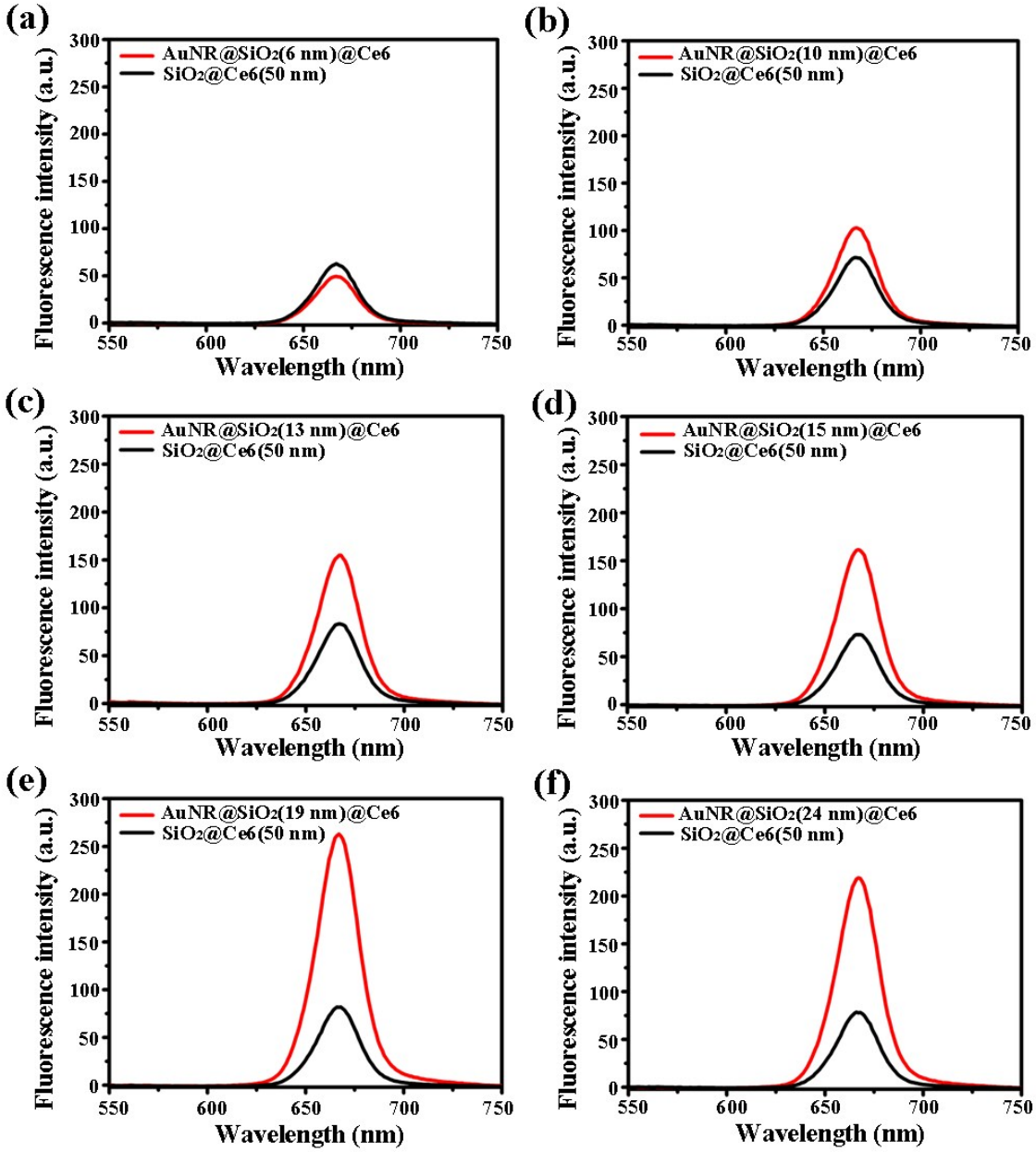

Fig. S7 Fluorescence spectra of AuNR@SiO_2@Ce6 and SiO_2@Ce6(50 nm) with various thicknesses of silica shell (a-f: 6, 10, 13, 15, 19, 24 nm).

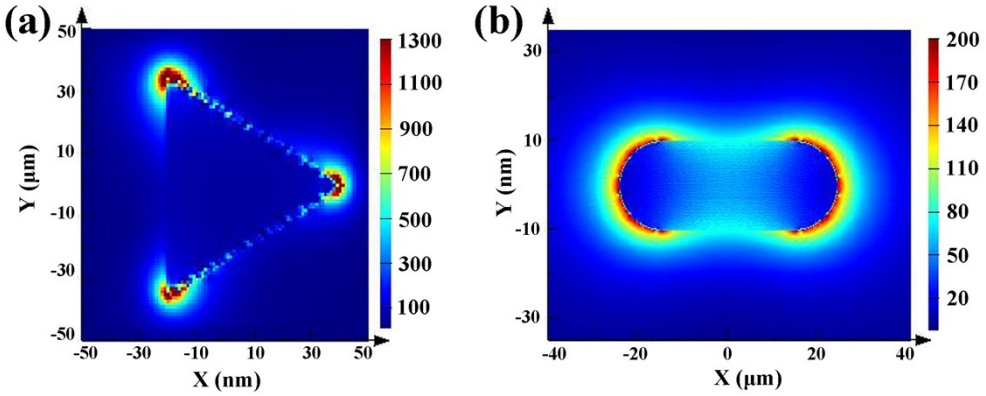

Fig. S8 The simulated electric field distributions of (a) AuNPR and (b) AuNR as obtained by FDTD simulations.

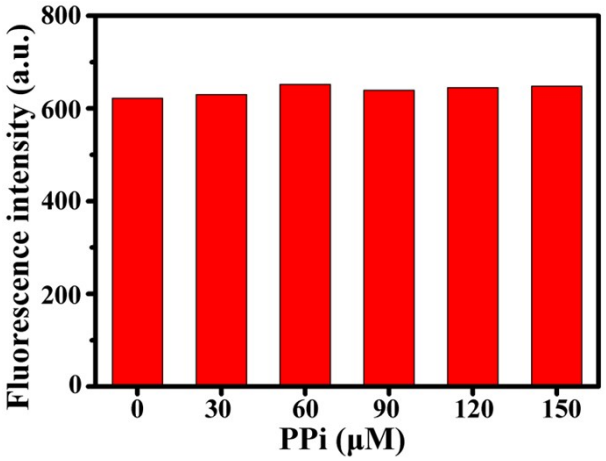

Fig. S9 Fluorescence intensity of AuNPR@SiO_2@Ce6 upon introduction of various PPi concentrations.

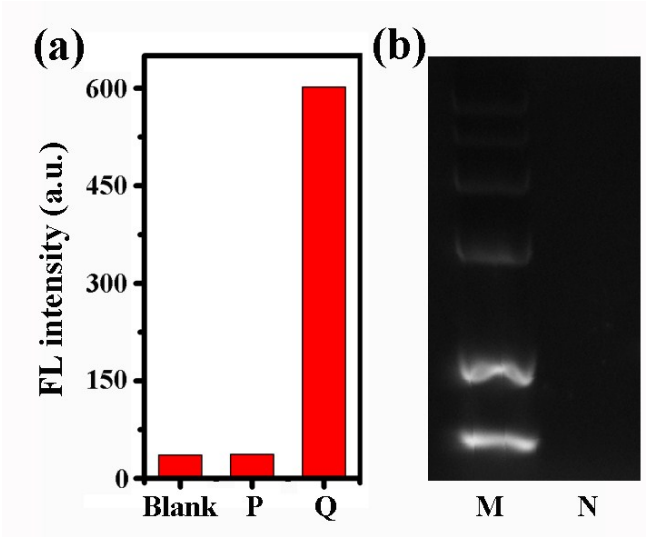

Fig. S10 (a) Fluorescence intensity of AuNPR@SiO_2@Ce6-Cu^{2+} upon introduction of finished PCR mixtures amplified in presence (Q) and absence (P) of template DNA with 20 cycles. (b) Agarose gel electrophoresis of finished PCR mixtures amplified in presence (Q) and absence (P) of template DNA with 20 cycles.

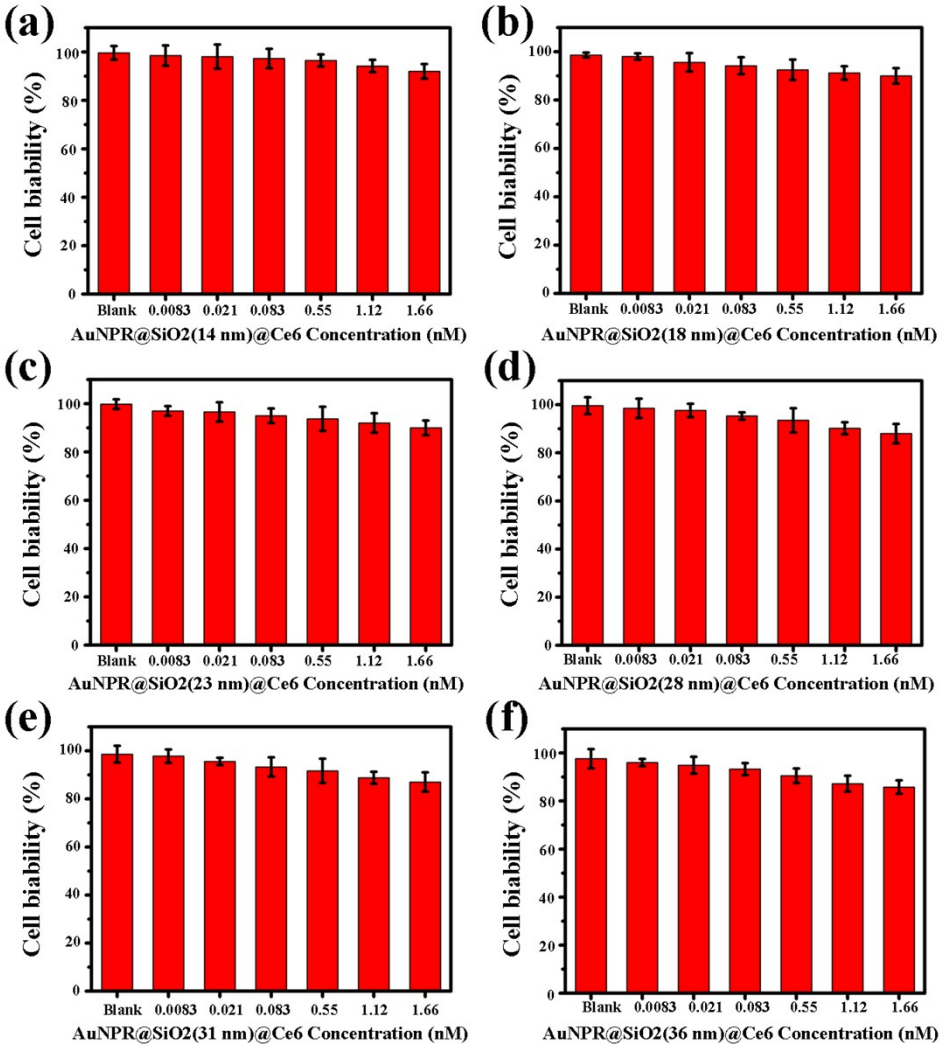

Fig. S11 Cell viability of Hela cells after treated with different concentration of (a) AuNPR@SiO_2@Ce6(14 nm), (b) AuNPR@SiO_2@Ce6(18 nm), (c) AuNPR@SiO_2@Ce6(23 nm), (d) AuNPR@SiO_2@Ce6(28 nm), (e) AuNPR@SiO_2@Ce6(31 nm), (f) AuNPR@SiO_2@Ce6(36 nm) for 24 h, respectively.

1 **Table S1.** Lifetime and enhancement factor of AuNPR@SiO_2@Ce6 with various silica shell
2 thicknesses in ethanol.

samples	silica shell thickness [nm]	τ_A [ns]	Enhancement factor (ft)
AuNPR@SiO_2@Ce6 (1)	14	0.81	2.2
AuNPR@SiO_2@Ce6 (2)	18	1.29	4.0
AuNPR@SiO_2@Ce6 (3)	23	1.71	9.8
AuNPR@SiO_2@Ce6 (4)	28	2.89	6.5
AuNPR@SiO_2@Ce6 (5)	31	3.35	3.4
AuNPR@SiO_2@Ce6 (6)	36	4.48	1.1
Ce6	--	4.69	--

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6 **Table S2.** Summary of detection performance of proposed PPi probe in recent reports.

Method	Tool	NIR probe	Detection limit (μM)	Reference
fluorescence	organic molecular probe-Zn(II) ensemble	No	0.85	31
colorimetric	organic molecular probe-Cu(II) ensemble	Yes	2.02	32
fluorescence	cysteine stabilized gold nanoclusters-Cu(II) ensemble	No	2.00	33
fluorescence	ratiometric fluorescent-based organic molecular probe-Cu(II) ensemble	No	3.39	50
fluorescence	Glutathione-bound gold nanoclusters-Fe(III) ensemble	Yes	28	51
fluorescence	Plasmon enhanced fluorescence	Yes	0.20	This work

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Table S3. The determination of PPi in urine and DMED medium with different concentration.

sample	Original PPi (μM)	Added PPi (μM)	Found PPi (μM)	Recovery (%)	RSD (n=3, %)
urine	0.60	20	20.21	98.11	1.62
	0.60	60	64.17	101.9	2.08
DMEM medium	0	20	19.74	98.70	4.91
	0	60	57.83	96.38	3.54

Preparation of AuNRs

AuNPs were synthesized with a modified seed-mediated growth method as previous reported.[37] Firstly, the seed solution was prepared as follows. 0.25 mL of 10 mM $HAuCl_4$ was dissolved into 10 mL of 0.1 M CTAB and the solution was allowed to stir for 1 h. 0.6 mL of freshly prepared, ice-cold $NaBH_4$ (0.01 M) was added into the solution. After stirring for 10 min, the obtained seed solution was kept without any alteration for half an hour. The growth solution was prepared by mixing 5 mL of 10 mM $HAuCl_4$ and 80 μL of 0.1 M $AgNO_3$ in 100 mL of 0.1 M CTAB solution, Then 0.7 mL of 0.1 M AA acting as a reducing agent was added into the mixture. 0.1 mL of seed solution was injected into the growth solution and shaken for 10 s. The solution was kept in 29.8 ℃ for 15 h.

Preparation of AuNR@SiO_2, AuNR@SiO_2@Ce6 and SiO_2@Ce6

The methods for preparation of AuNR@SiO_2 and AuNR@SiO_2@Ce6 were as the same as that of AuNPR@SiO_2 and AuNPR@SiO_2@Ce6.

Synthesis of SiO_2@Ce6 (50 nm)

Silica nanoparticles were synthesized with a modified Stöber method. In brief, 300 μL of 0.1 M NaOH and 600 μL of 20% TEOS were added into 50 mL of 0.001 M CTAB solution. It was allowed to stir for 12 h in room temperature.