Electronic Supplementary Material (ESI) for Analyst.

Upconversion fluorescent lateral flow immunochromatographic strip for rapid determination of serum amyloid A

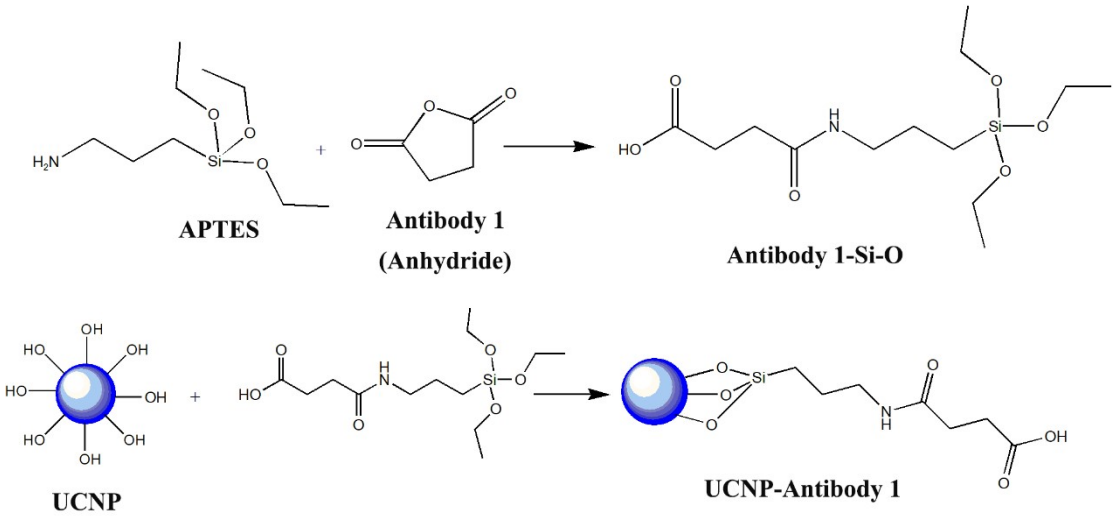

Figure. S1 The coupling principle of carboxy modified fluorescent microspheres and antibodies

Activation of luminescent nanoparticles

Take 1 mg of UCNP and add them to the EP tube. Centrifugate for 20 minutes (15000 rpm) to remove the supernatant. Add 1 ml buffer solution (borax solution: pH = 8.5), ultrasonic dispersion (ice bath ultrasound twice, 1 s/time, 5 s interval each time). Then 1 mg EDAC (1- (3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride), 1 mg sulfo-NHS (N-hydroxysuccinimide) and 200 μl deionized water were added to UCNP, and the mixture of UCNP was placed on a rotating wheel and incubated at room temperature for 1 h. Centrifugation for 20 minutes (15000 rpm), removal of supernatant and addition of 1 ml buffer, ultrasonic dispersion and standby.

Coupling

The ratio of UCNP to mAb was 8:1. The mixture was then placed on a rotating pusher, incubated at room temperature for 4 hours, centrifuged for 20 minutes (15000 rpm). After the supernatant was removed, 1 ml buffer was added, and then 200 μl ethanolamine was added after ultrasonic dispersion. The mixture of UCNP-mAb was placed on a rotating wheel and incubated at room temperature for 1 hour. Centrifugation for 20 minutes (15000 rpm) to remove supernatant. Then add 1 ml of sealing solution (borax-Casin) and disperse by ultrasound. Finally, the mixture of UCNP-mAb was placed on a rotating wheel and incubated at room temperature for 12 hours. Centrifugation for 20 min (15000 rpm) to remove supernatant. Add 1 ml buffer and disperse by ultrasound.

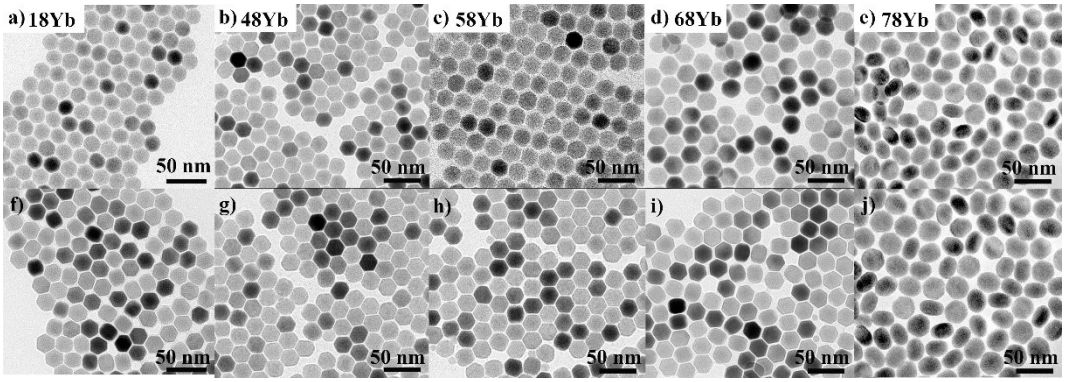

Figure. S2 TEM images of the (a-e) $NaYF_4$: x%Yb/8%Er (x=18, 48, 58, 68 and 78) and (f-j) $NaYF_4$: x%Yb/8%Er (x=18, 48, 58, 68 and 78) @$NaYF_4$ nanoparticles.

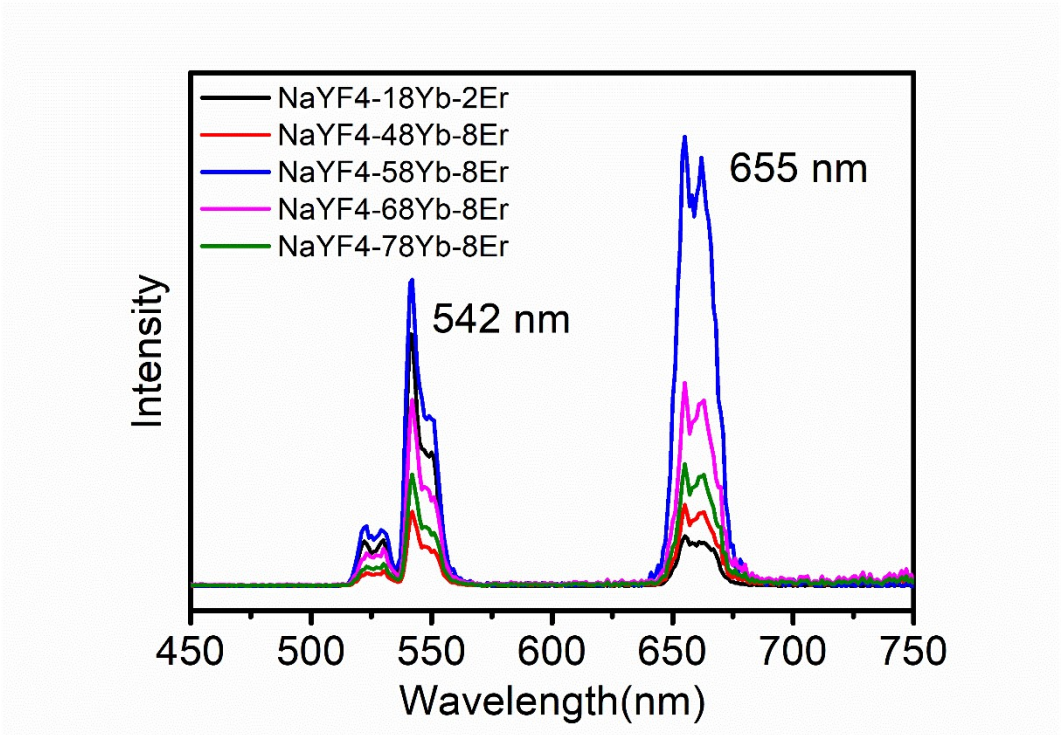

Figure. S3 Emission spectra of the $NaYF_4$: 18%Yb/2%Er and the $NaYF_4$: x%Yb/8%Er (x= 48, 58, 68 and 78) nanoparticles.

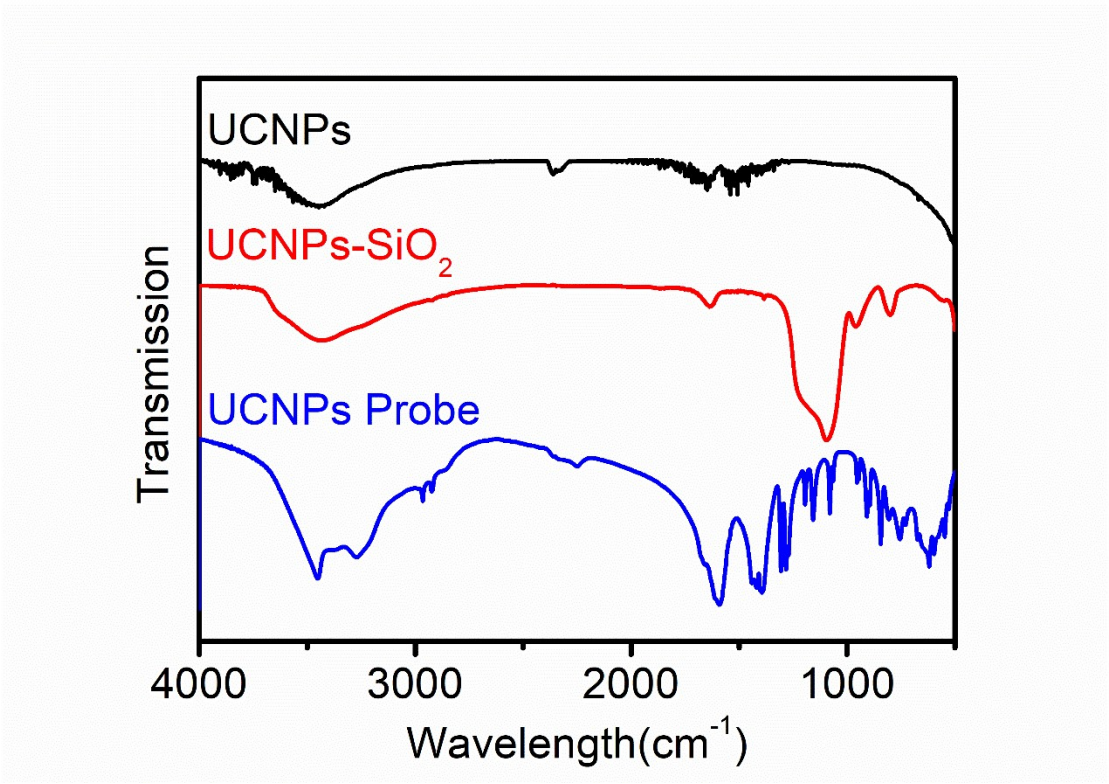

Figure. S4 FTIR spectrum of $NaYF_4$: Yb, Er UCNPs, UCNPs-SiO_2 and UCNPs Probe.

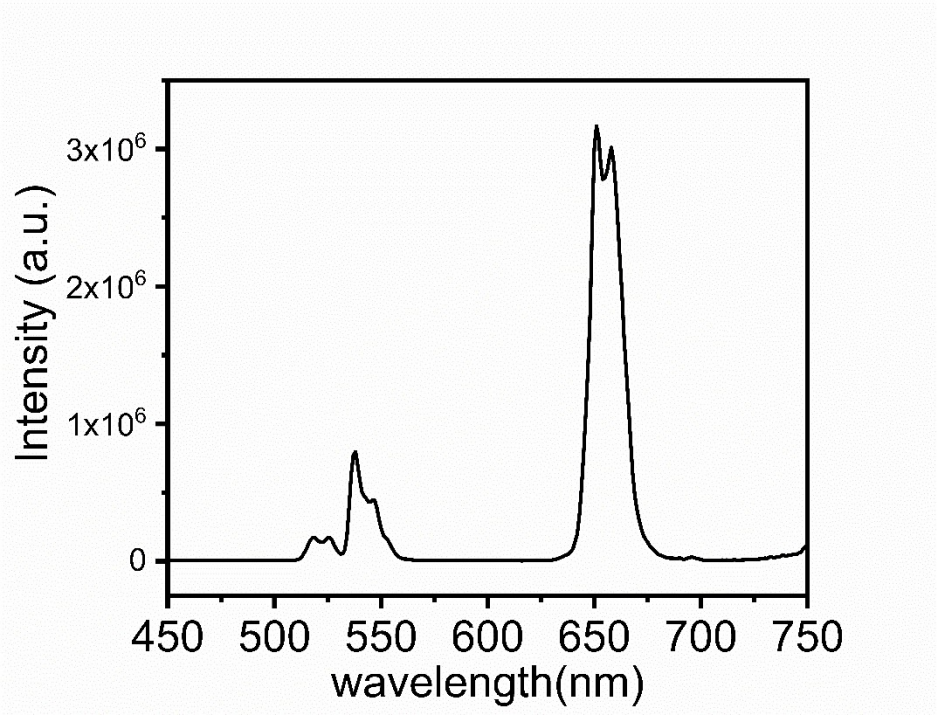

Figure. S5 Emission spectra of test lines of LFIS after 120 days.

Table 1 Experiment design for the preparation of UCNPs@SiO_2 core shell particle using cyclohexane as reaction solvent

Batch	NH_4OH (ml)	UCNPs ($mmol \cdot L^{-1}$)	TEOS (ml)	Igepal CO520 (ml)
A	0.08	0.01	0.02	0.2
B	0.08	0.01	0.04	0.2
C	0.08	0.01	0.04	0.5
D	0.08	0.01	0.06	0.5

Table S2. Characteristics of the UCNP-LFIS compared with other reported CVD detection methods.

Detection method	Target	Detection limit	Total time	Reference
Protein microarrays	SAA	5.9 ng/mL	>2.5 h	[1]
Antibody microarrays	SAA	0.9 μg/ml	>2.5 h	[1]
CG-LFIS	CPR	1 μg/ml	15 min	[2]
UCNP-LFIS	SAA	0.1 μg/ml	15 min	This work

References

[1] O. Gul, E. Calay, U. Sezerman, H. Basaga, Y. Gurbuz. *Sens. Actuators B-Chem.*, 2007, **125**, 581-588.

[2] W. Leung, C. P. Chan, M. Leung, K. Lehmann, I. Renneberg, M. Lehmann, A. Hempel, J. F. C. Glatz, R. Renneberg. *Analytical Letters*, 2005, 38, 423-439.