

**NaYF₄: Yb/Ho Upconversion nanoprobe incorporated gold nanoparticle (AuNP) based
FRET immunosensor for the “Turn-on” detection of Cardiac Troponin I**

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Supporting Information

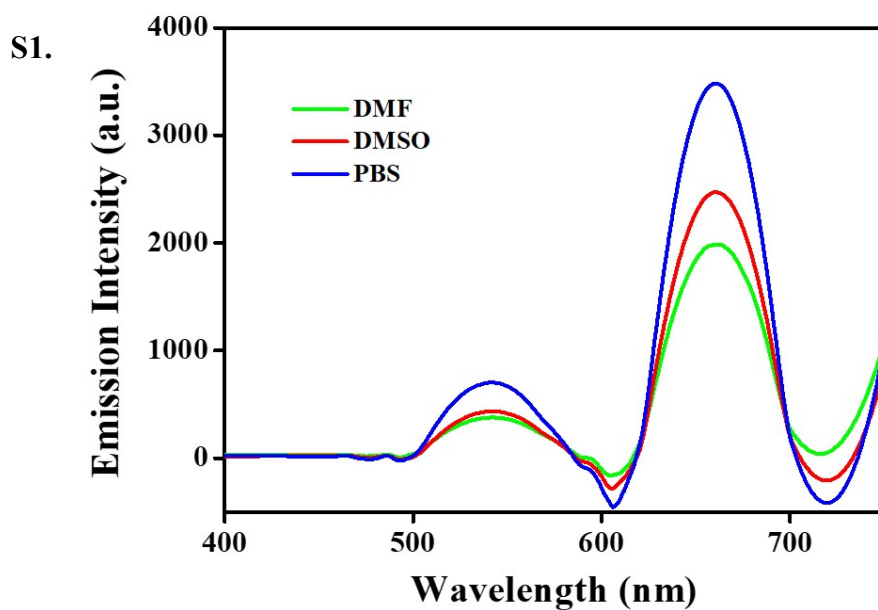


Figure S1. The emission spectra of synthesised NaYF₄: Yb/Ho UPNPs in different solvents : Dimethylformamide(DMF), Dimethyl sulphoxide (DMSO), Phosphate Buffer Saline (PBS)

S2.

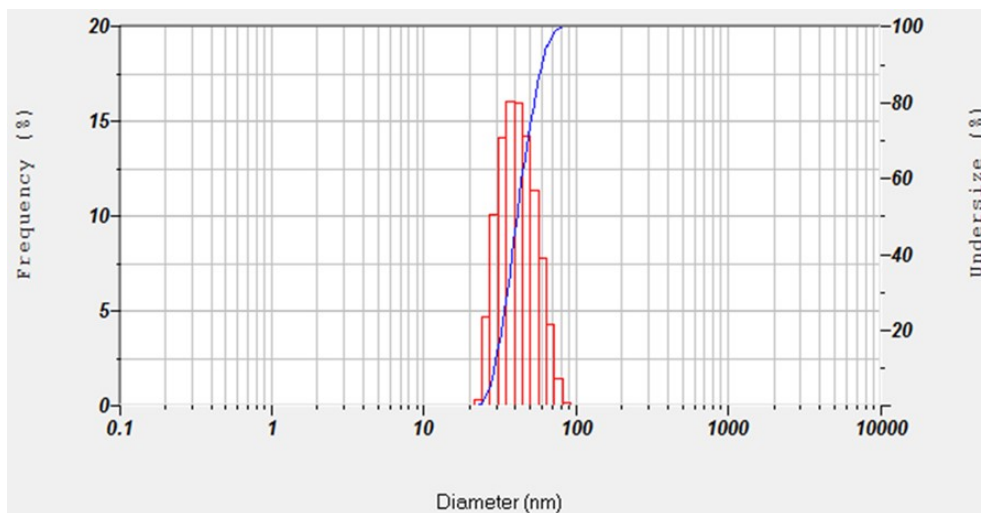


Figure S2. The DLS plot of synthesised Upconversion nanoparticle obtained as ~41.1 nm.

S3.

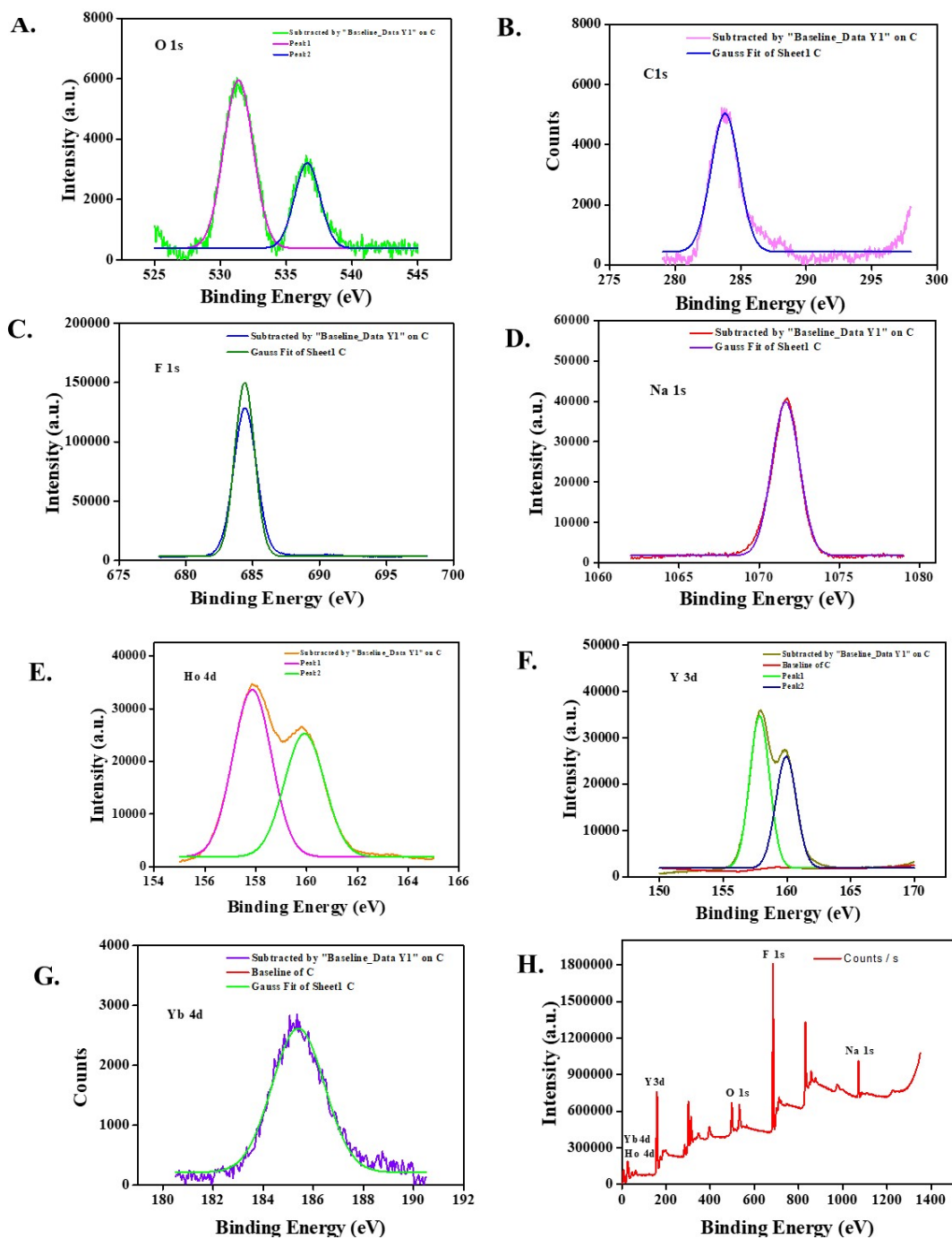


Figure S3. High resolution X-ray photoelectron spectra (XPS) of NaYF₄:Yb/Ho UPNPs recovoluted spectrum of **a.**O1s,**b.**C 1s,**c.**F 1s, **d.**Na 1s,**e.**Ho 3d,**f.**Y 3d,**g.**Yb 4d, **h.** Survey spectrum of XPS data.

S4.

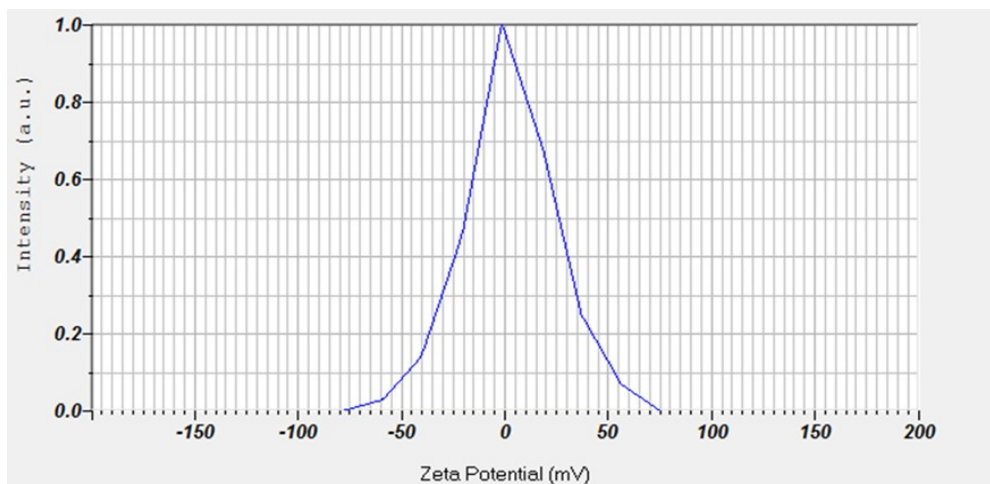


Figure S4. The zeta potential plot of synthesised amino functionalised APTES@SiO₂-NaYF₄:Yb,Ho UCNPs obtained as +2.7 mV.

S5.

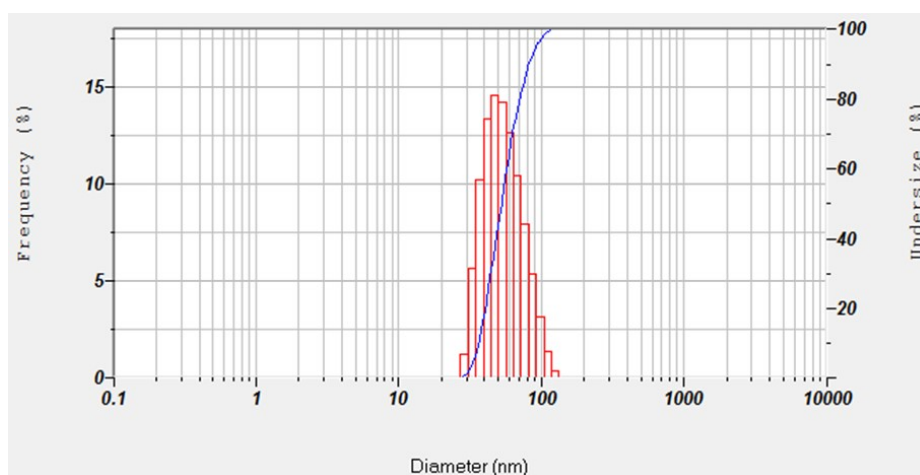


Figure S5. The DLS plot of synthesised gold nanoparticle (AuNPs) obtained as ~52.8 nm

S6.

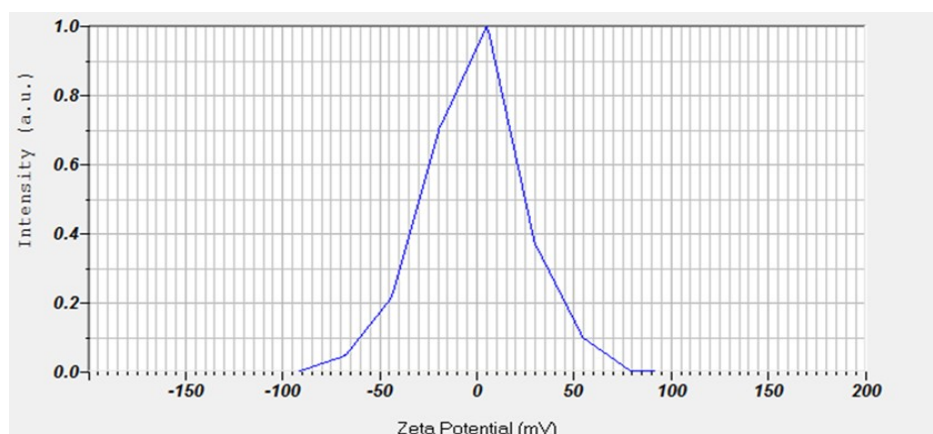


Figure S6. The zeta potential graph of synthesised gold nanoparticle (AuNPs) obtained as -1.7mV.

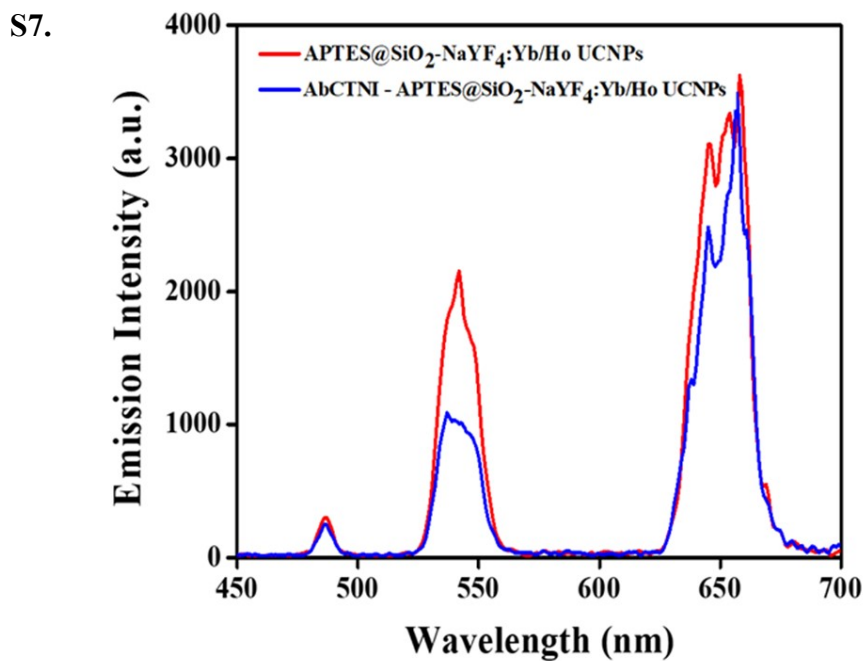


Figure S7. The emission spectra of amino-functionalised APTES@SiO₂ NaYF₄: Yb,Ho upconversion nanoparticles (red), and the antibody-CTnI conjugated APTES@SiO₂ NaYF₄:Yb,Ho upconversion nanophosphors.(blue) dissolved in PBS medium. (λ_{ex} =980 nm, λ_{em} =540 nm,655 nm)

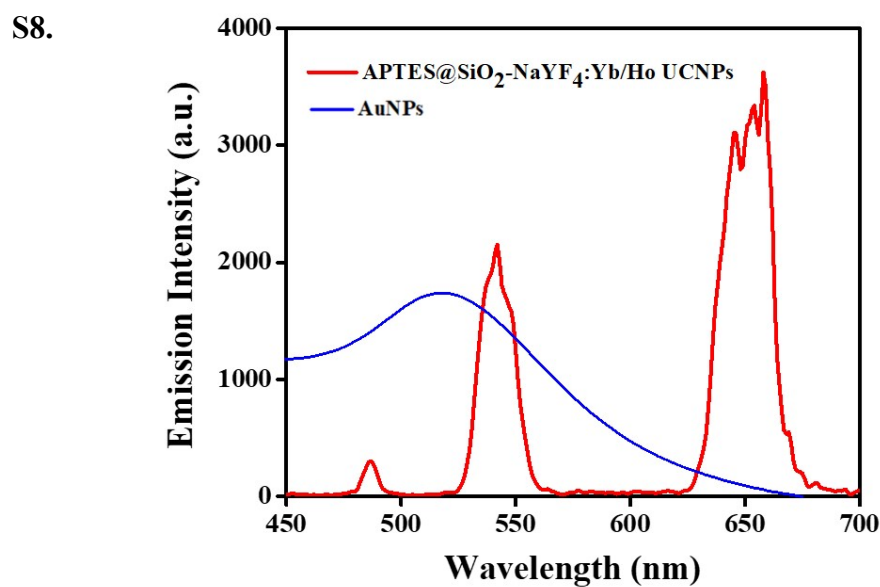


Figure S8. The spectral overlap of UV Visible absorption spectra of synthesised gold nanoparticle (AuNPs) and amino functionalised APTES@SiO₂-NaYF₄: Yb/Ho UCNP system.

S9.

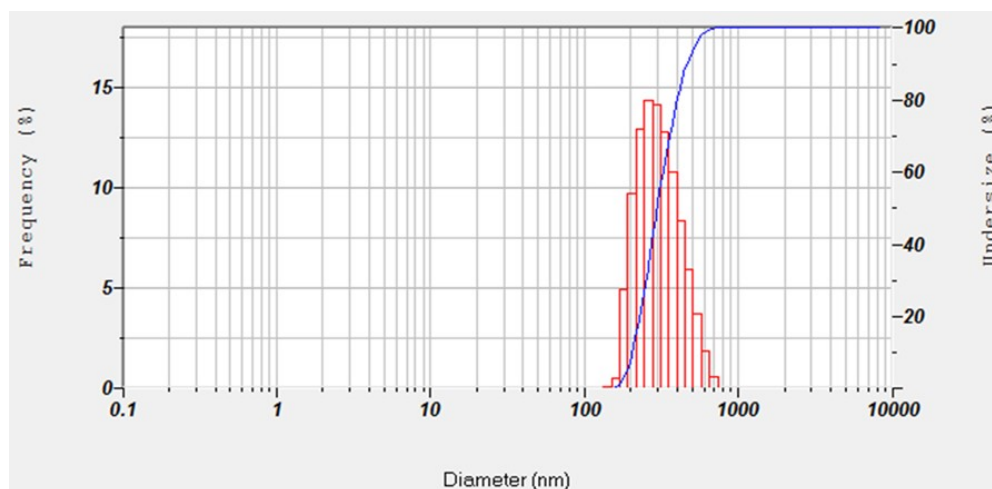


Figure S9. The DLS plot of synthesised Antibody conjugated APTES@SiO₂ NaYF₄: Yb,Ho Upconversion nanoparticle obtained as ~238.6 nm.

S10.

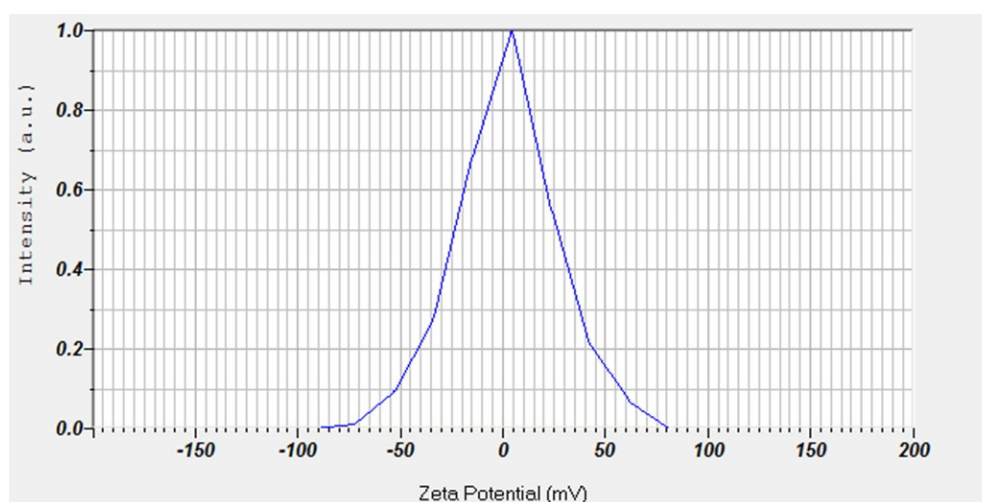


Figure.S10. The zeta potential analysis of Antibody conjugated APTES@SiO₂ NaYF₄: Yb,Ho Upconversion nanoparticle was obtained as +2 mV.

S11.

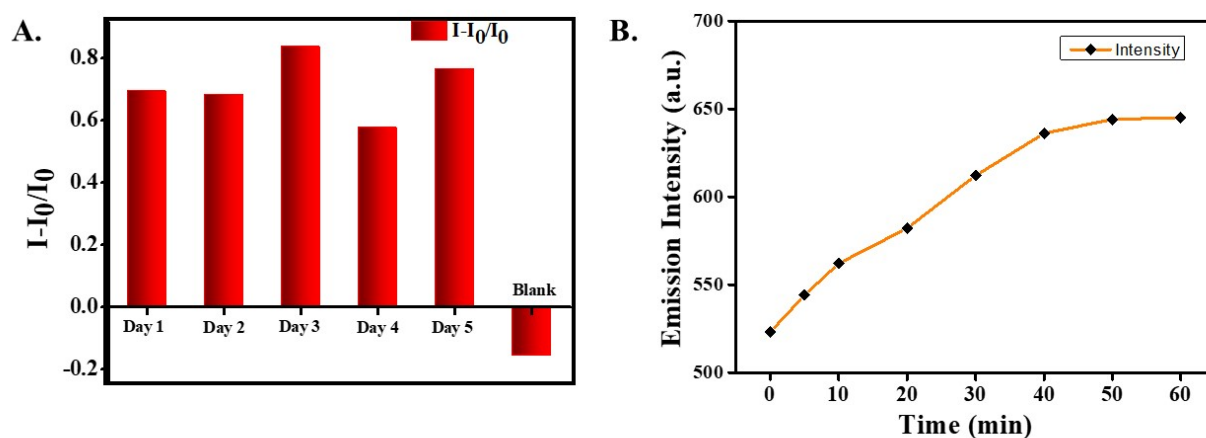


Figure S11. A. The bar diagram depicting the turn-on response of synthesised Antibody conjugated AuNP-APTES@SiO₂ NaYF₄: Yb, Ho UCNPs on addition of antigen cTnI (1.9 ng/mL) at different days (from Day 1-5) and blank experiment with PBS buffer is also noted. **B.** The time dependent response of Antibody conjugated AuNP-APTES@SiO₂ NaYF₄: Yb, Ho UCNPs towards 1.9 ng/mL of Anti-cTnI.

S12.

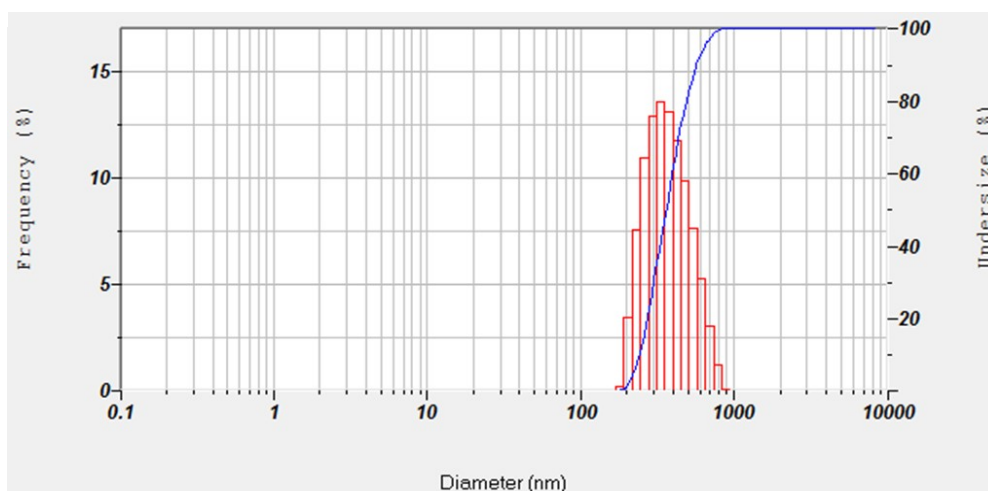


Figure S12. The DLS plot of synthesised Antibody conjugated APTES@SiO₂ NaYF₄: Yb, Ho UCNPs on addition of cTnI is obtained as ~361.5 nm.

Table S1.

Sample	Added concentration. (ng/mL)	Found concentration (ng/mL)	Recovery percentage (%)
Concentrated serum	0.65	0.641	98.61
	0.97	1.00	103.9
	1.28	1.54	120
10 times diluted serum	0.65	0.72	111.6
	0.97	1.44	148
	1.32	0.25	76.8
100 times diluted serum	1.32	0.34	104
	0.97	0.87	90.1
	1.28	1.25	97.8

Table S1. The cTnI content of spiked human serum samples**Table S2.**

SL. No	Sensing Probe	Signal	LoD	Reference
1.	Gold nanorod-heparin system	Colorimetry	0.4 ng/mL	¹
2.	Gold nanoparticle system	Colorimetry	0.2 ng/mL	²
3.	Graphene Quantum dot	Fluorescence	0.19 ng/mL	³
4.	Europium chelate nanoparticle	Fluorescence	2 ng/mL	⁴
5.	NaYF ₄ : Yb, Er heterogenous UC immunoassay	Upconversion	3.14 ng/mL	⁵
6.	NaYF ₄ : Yb, Er UCNPs immunoassay	Upconversion	0.13 ng/mL	⁶
7.	NaYF ₄ : Yb, Er UCNPs based lateral flow immunoassay (LFIA)	Upconversion	30 ng/L	⁷
8.	APTES@SiO ₂ NaYF ₄ : Yb, Ho UCNPs/AuNP system	Upconversion	0.05 ng/mL	This work

Table S2. The comparison table depicting the previous reports for the detection of cTnI

References

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