Electronic Supplementary Information

Fabrication of a LRET-based upconverting hybrid nanocomposite for turn-on sensing of H_2O_2 and glucose

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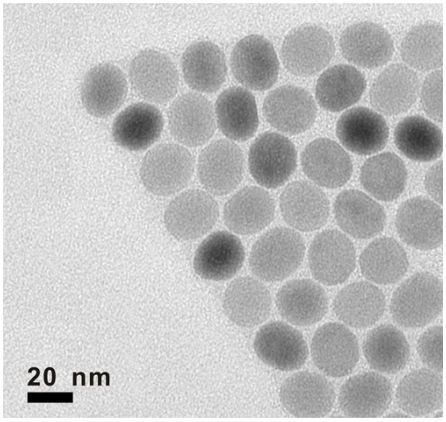

Fig. S1. TEM images of OA-capped $NaYF_4$:Yb/Tm.

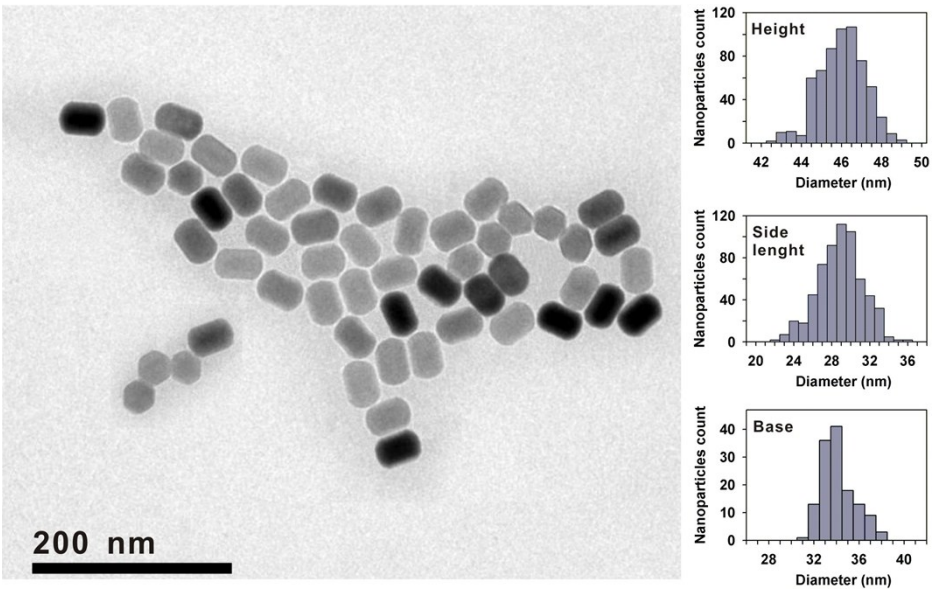

Fig. S2. TEM images and histograms of OA-capped $NaYF_4$:Yb/Tm@$NaYF_4$ core-shell nanocrystals.

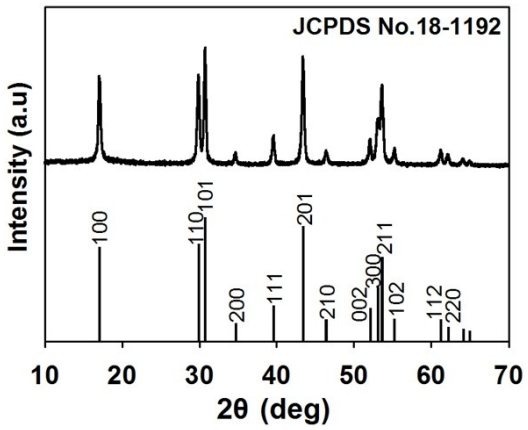

Fig. S3. XRD spectrum of OA-capped $NaYF_4$:Yb,Tm@$NaYF_4$ core−shell nanocrystals.

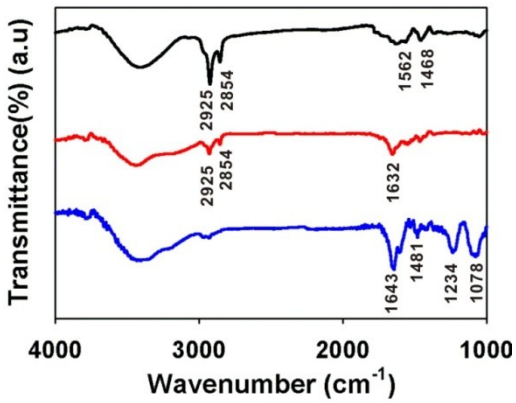

Fig. S4. FTIR spectrum of the OA-UCNPs (black), bared UCNPs (red) and DNA-AgNPs/UCNP (blue). As for OA-UCNPs, the absorption bands at 2925, 2854, 1562 and 1468 cm^{-1} could identify the existence of the OA ligands. After the removal of OA molecules via acid treatment, Y^{3+} ions are exposed on UCNPs surface. Obviously, the above characteristic bands weakened in the bared UCNPs, indicating the successful removal of OA ligands from the surface of UCNPs. After the assembly of DNA-AgNPs, the absorption bands at 1234 cm^{-1} attributed to the stretch of PO^{2-} and the band at 1078 cm^{-1} assigned to C-O stretch of deoxyribose appeared in DNA-AgNPs/UCNP, suggesting the conjugation of DNA-AgNPs on the surface of bared UCNP.

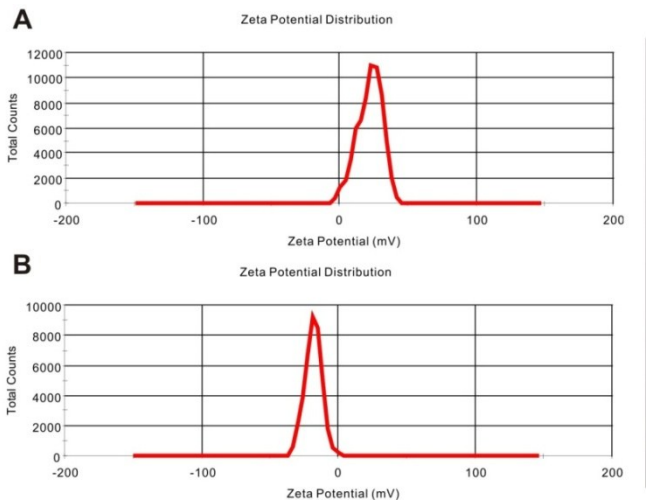

Fig. S5. ζ- potential analysis of (A) the bared UCNPs and (B) DNA-AgNPs/UCNP. After the attachment of DNA-AgNPs, the ζ-potentials of the bared UCNPs changed from +22.5 mV to -18 mV (pH 7.0), as a result of increased number of DNA-AgNPs on the UCNPs surface.

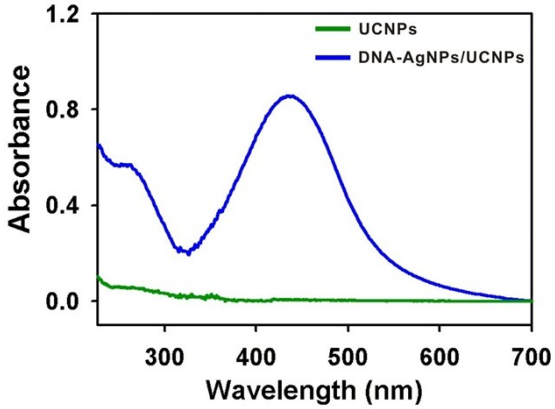

Fig. S6. UV-vis absorption spectra of the bared UCNPs (green) and DNA-AgNPs/UCNP nanocomposite (blue).

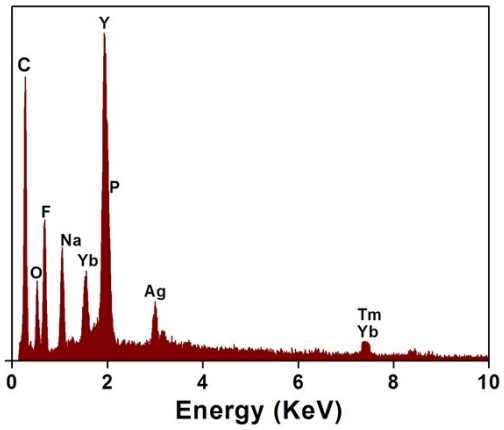

Fig. S7. EDS spectrum of DNA-AgNPs/UCNP nanocomposite.

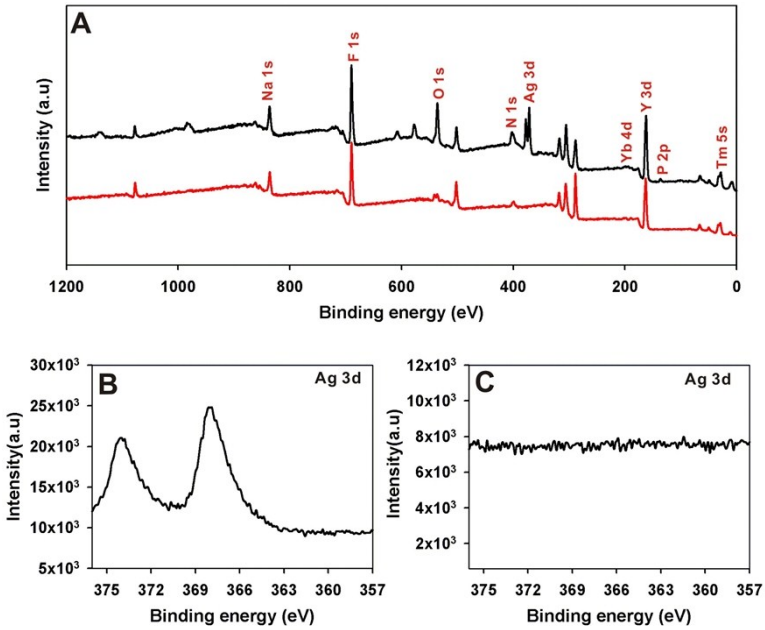

Fig. S8. (A) XPS spectrum of OA-UCNPs (red) and DNA-AgNPs/UCNP nanocomposite (black). (B) High resolution Ag (3d) XPS spectrum of DNA-AgNPs/UCNP nanocomposite. (C) High resolution Ag (3d) XPS spectrum of OA-UCNPs.

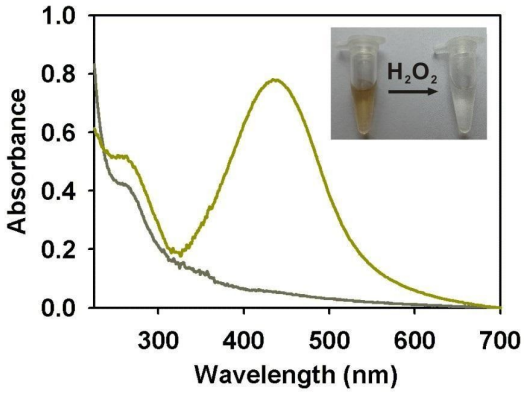

Fig. S9. Absorption spectra of DNA-templated AgNPs before (yellow) and after (grey) addition of 500 μM H_2O_2.

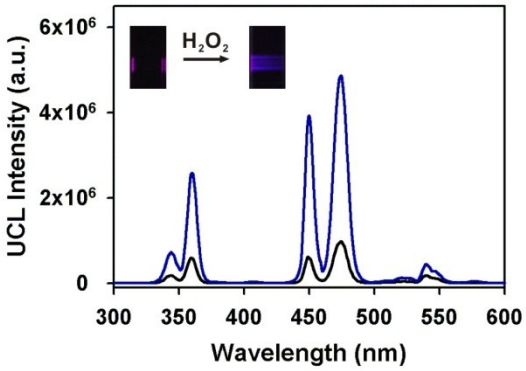

Fig. S10. UCL spectrum of DNA-AgNPs/UCNP before (black) and after (blue) incubation with 500 μM H_2O_2 for 80 min. The photos displaying change in the blue UCL emissions under the 980 nm excitation.

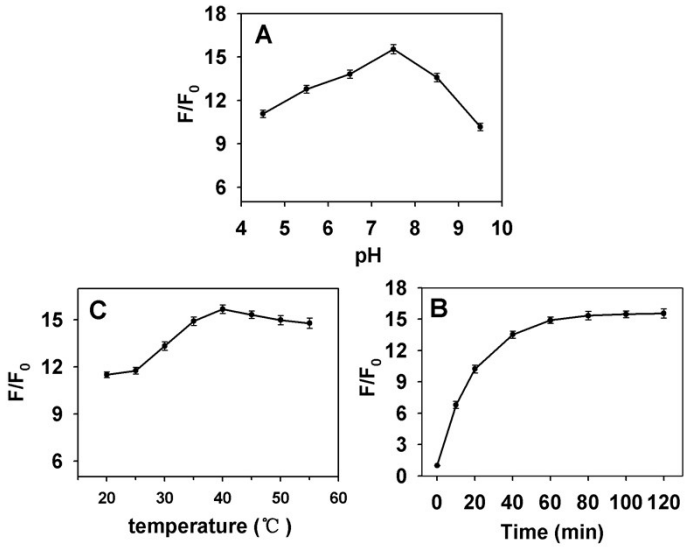

Fig. S11. Effects of pH value (A), temperature (B) and incubation time (C) on the upconversion fluorescence enchancement of DNA-AgNPs/UCNP in the absence and presence of 500 μM H_2O_2. F_0 and F represent the UCL intensity of nanocomposite before and after mixing with H_2O_2, respectively. Error bars signify standard deviation (SD) of three independent measurement.

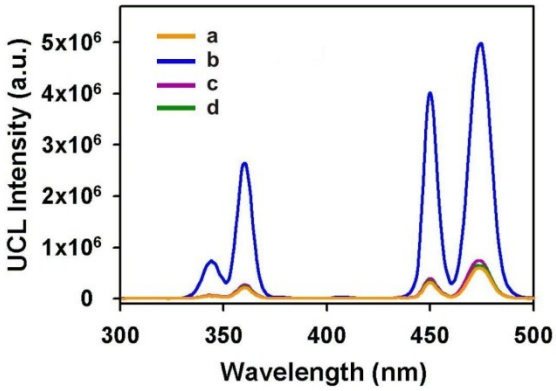

Fig. S12. UCL spectrum of (a) DNA-AgNPs/UCNP in the presence of (b) glucose + GOx; (c) GOx; (d) glucose. Conditions: glucose, 400 μM; GOx, 25 μg/mL; DNA-AgNPs/UCNP, 0.05 mg/mL.

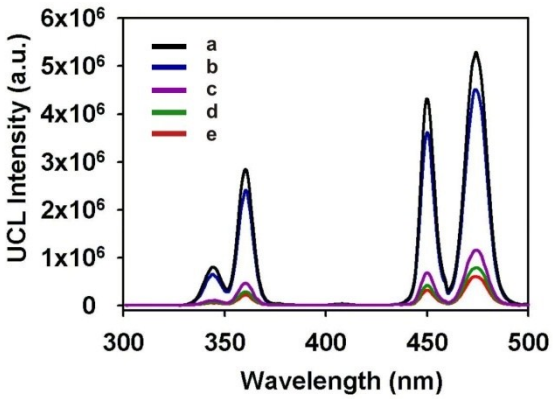

Fig. S13. UCL spectrum of DNA-AgNPs/UCNP nanocomposite under different conditions. (a) 2 μL human serum + 8 μL 250 μg/mL GOx + 90 μL nanocomposite; (b) 2 μL human serum pretreated with 0.1 mM NEM + 8 μL 250 μg/mL GOx + 90 μL nanocomposite; (c) 2 μL human serum + 8 μL Tris-HNO_3 buffer + 90 μL nanocomposite; (d) 2 μL human serum pretreated with 0.1 mM NEM + 90 μL nanocomposite; (e) 10 μL Tris-HNO_3 buffer + 90 μL nanocomposite. Note that the human serum (100 μL) were pretreated with an equal volume of Zn^{2+} solution (3 mM), and centrifugated to remove the precipitation. After all, the supernatant was collected for subsequent analysis.

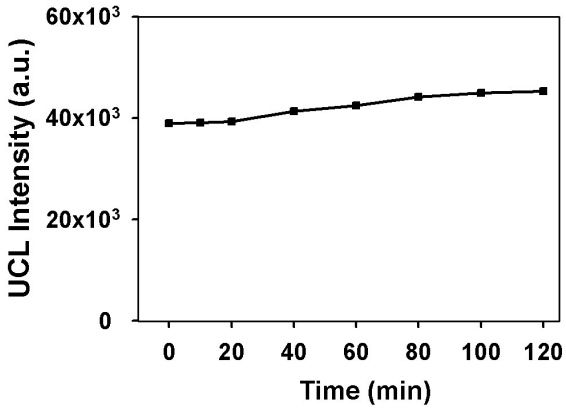

Fig. S14. UCL intensity changes of DNA-AgNPs/UCNP nanocomposite incubated in human serum at 37 ℃ as a function of different incubation time. Note that the human serum sample was premixed with an equal volume of solution containing Zn^{2+} (3 mM), followed by centrifugation. The above supernate (2 μL) was then added into the sensing system (100 μL) containing 0.1 mM NEM.

Table 1. Determination of the glucose levels in three human serum samples

Sample[a]	Local Hospital (mM)	Proposed method (mM)	Added (mM)	Total founded (mM)	Recovery (%)	RSD (%,n=3)
1	4.91	5.12	2	7.15	101.5	3.5
2	5.31	5.46	2	7.53	103.5	4.6
3	6.28	6.47	2	8.55	104.0	4.1

Samples 1-3 were human serum.