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Design, fabrication, luminescence and biomedical applications of UCNPs@mSiO$_2$-ZnPc-CDs-P(NIPAm-MAA) nanocomposite

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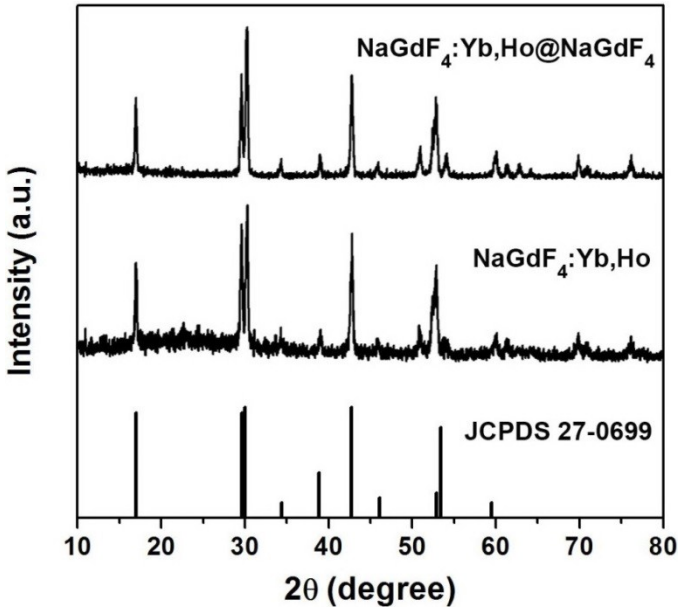

Fig. S1 XRD patterns of $NaGdF_4$:Yb,Ho core and $NaGdF_4$:Yb,Ho@$NaGdF_4$ core-shell structured nanoparticles. The standard data lines of $NaGdF_4$ (JCPDS No.27-0699) are given for comparison.

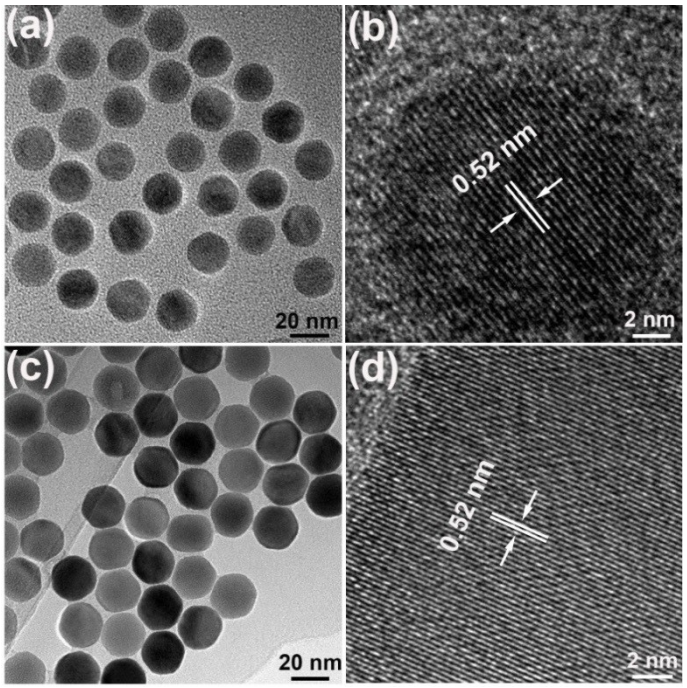

Fig. S2 TEM and HRTEM image of $NaGdF_4$:Yb,Ho (a, b) core and $NaGdF_4$:Yb,Ho@$NaGdF_4$ (c, d) core-shell structured nanoparticles.

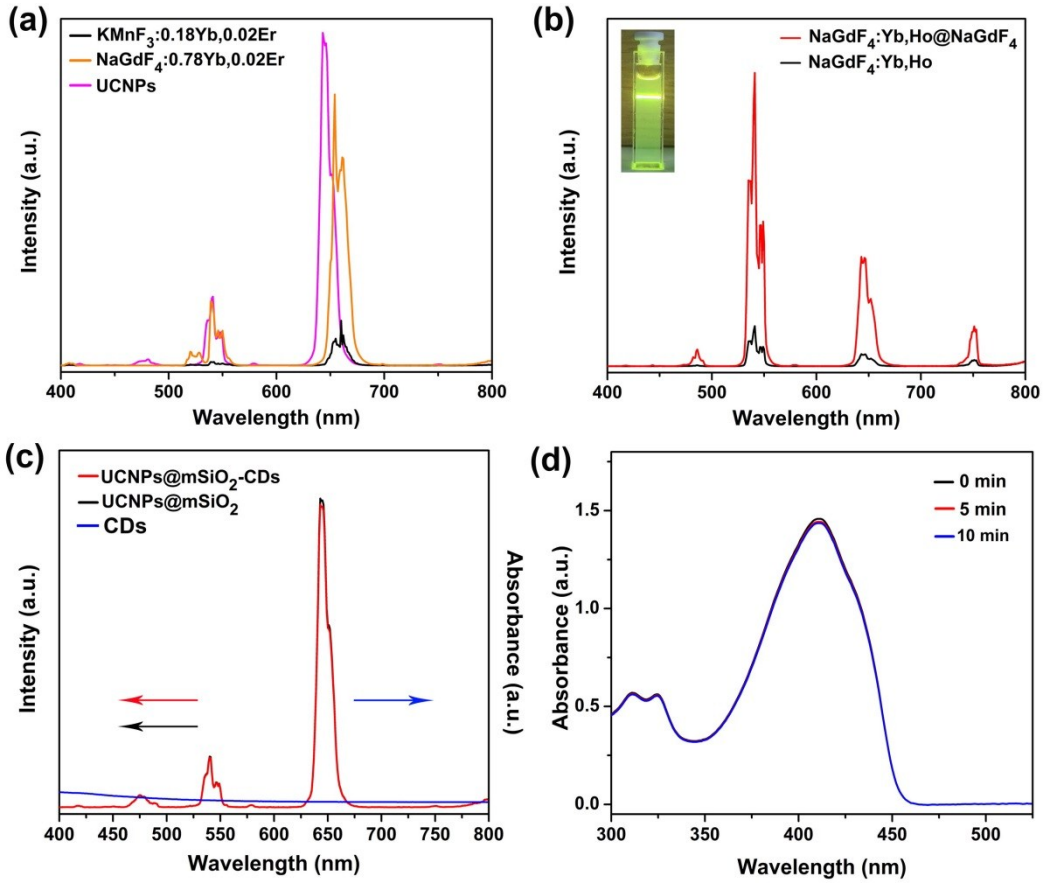

Fig. S3 UC emission spectra of $KMnF_3$:Yb,Er, $NaGdF_4$:Yb,Er and the UCNPs (a); UC emission spectra of $NaGdF_4$:Yb,Ho and $NaGdF_4$:Yb,Ho@$NaGdF_4$ core-shell nanoparticles (inset is the corresponding UCL images of core-shell nanoparticles); UC emission spectra of UCNPs@SiO_2 and UCNPs@SiO_2-CDs and UV-vis absorption spectrum of CDs (c); UV-vis absorption spectra of DPBF solutions mixed with UCNPs@mSiO_2-CDs under the irradiation of NIR laser with different times (d).

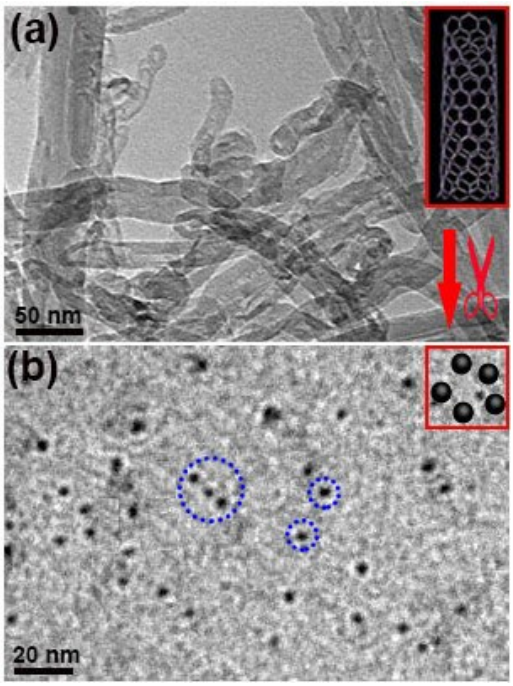

Fig. S4 TEM images of carbon nanotubes (a) and carbon dots (b). Inset is the simulative structure of carbon nanotubes and carbon dots respectively.

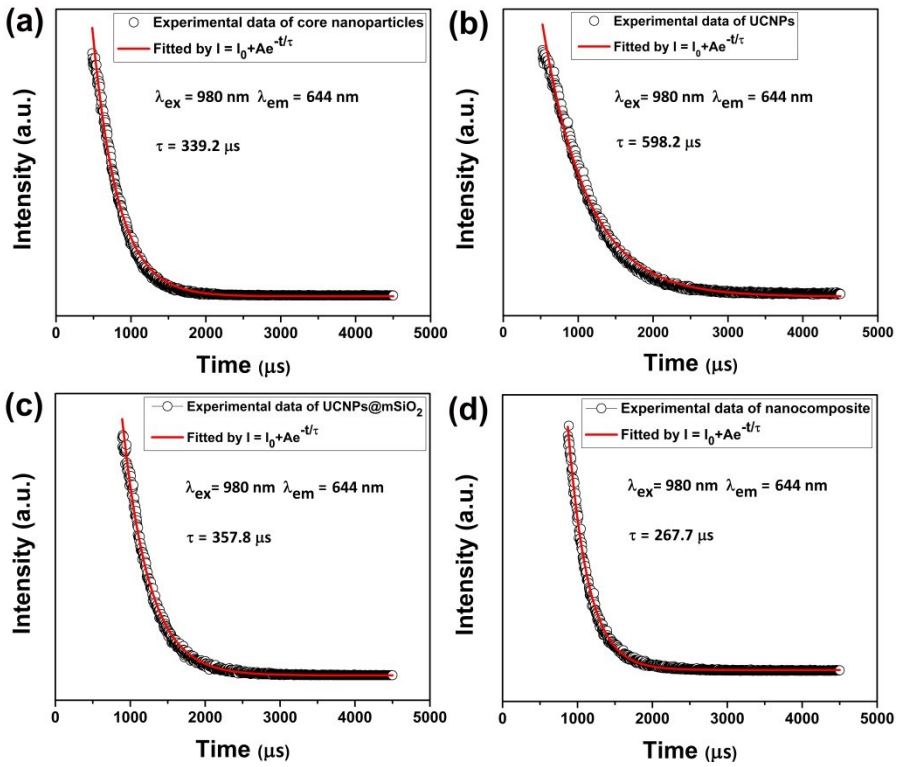

Fig. S5 Decay curves of Ho^{3+} at 644 nm in core nanoparticles (A); core-shell structured UCNPs (B); UCNPs@$mSiO_2$ (C); UCNPs@$mSiO_2$ -ZnPc (D) under 980 nm NIR light excitation.

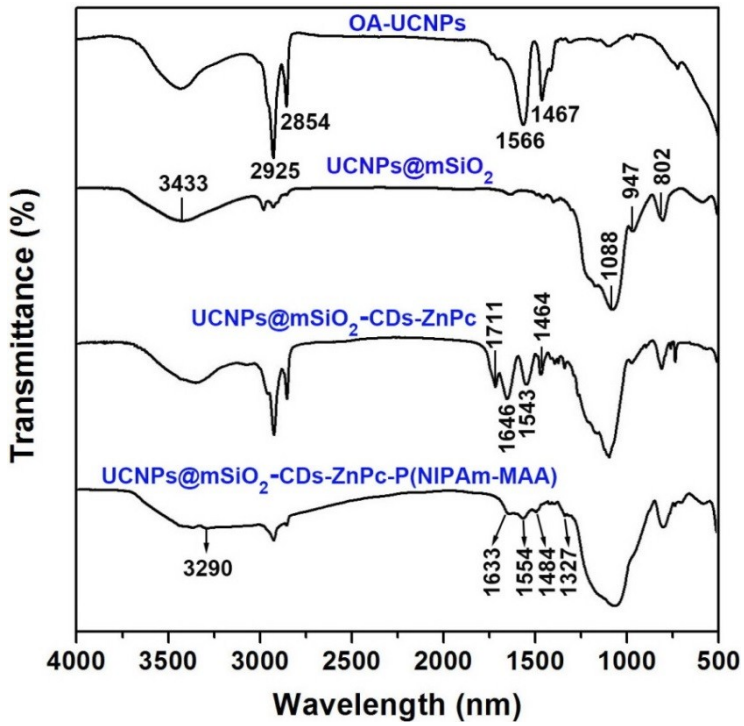

Fig. S6 FT-IR spectra of OA-UCNPs, UCNPs@$mSiO_2$, UCNPs@$mSiO_2$-CDs-ZnPc, and UCNPs@$mSiO_2$-CDs-ZnPc -P(NIPAm-MAA).

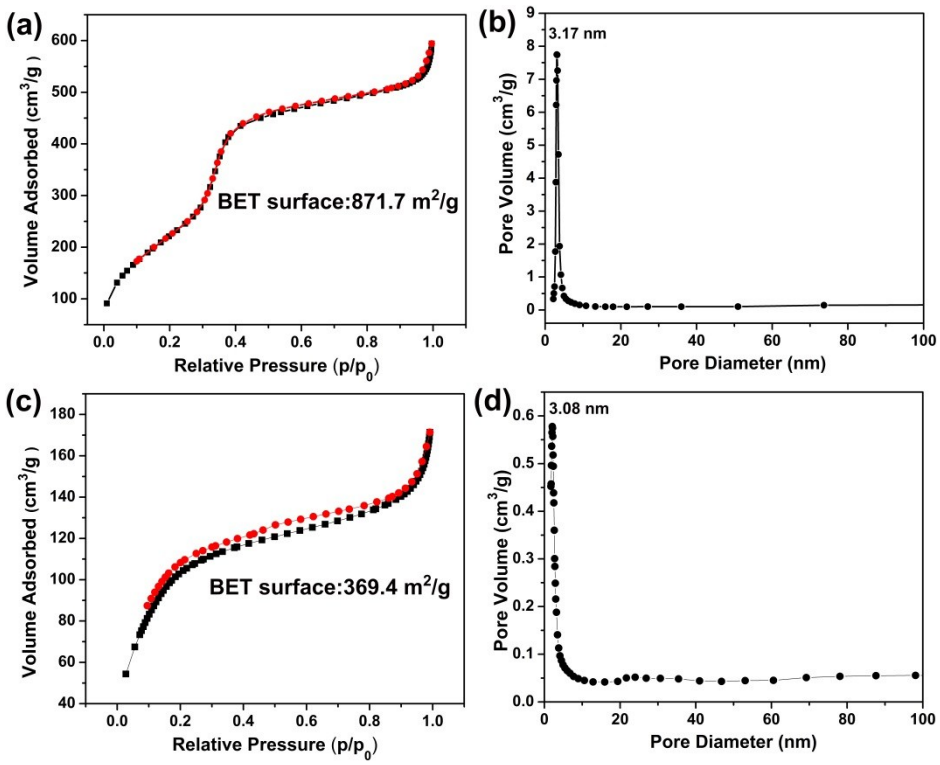

Fig. S7 N_2 adsorption/desorption isotherms and corresponding pore size distribution curves of UCNPs@$mSiO_2$ (a, b) and UCNPs@$mSiO_2$-CDs-ZnPc spheres (c, d).

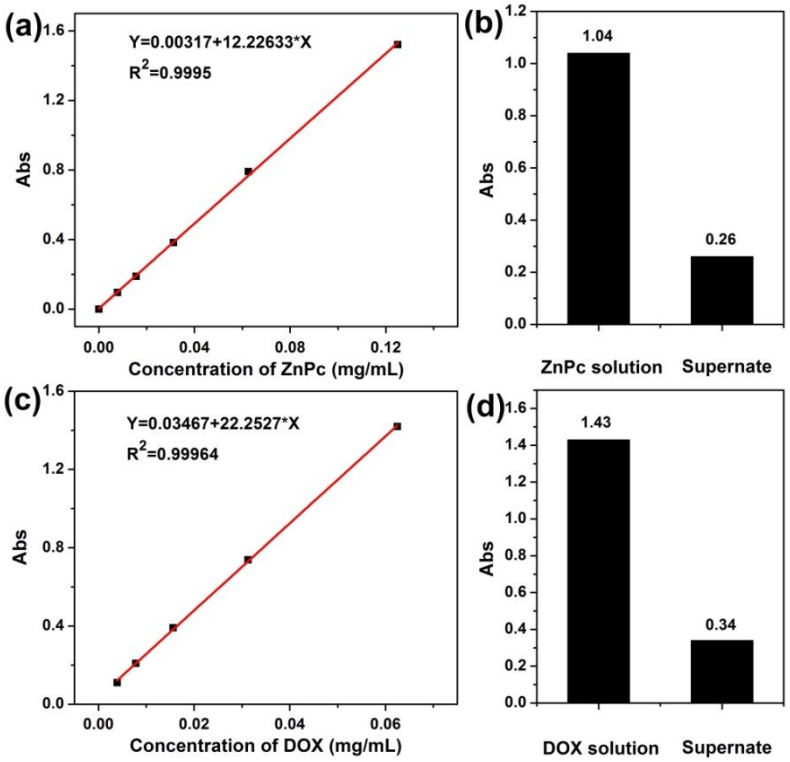

Fig. S8 The standard curve for ZnPc (a) and DOX (c) detection at the absorbance wavelength of 665 nm and 480 nm respectively; the absorbance intensity for their initial solution and supernate before and after drug loading process (b, d)

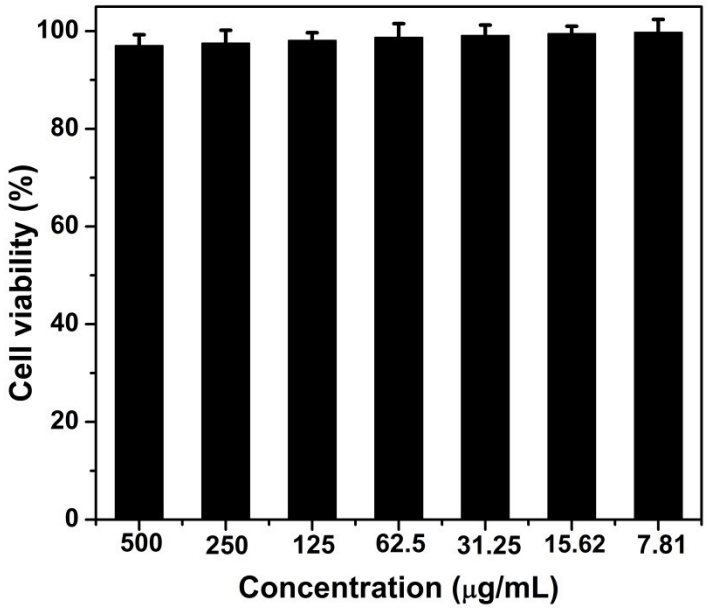

Fig. S9 L929 fibroblast cell viability after incubating with UCNPs@mSiO$_2$-P(NIPAm-MAA) nanocomposite for 24 h and quantitative assays by standard MTT method.

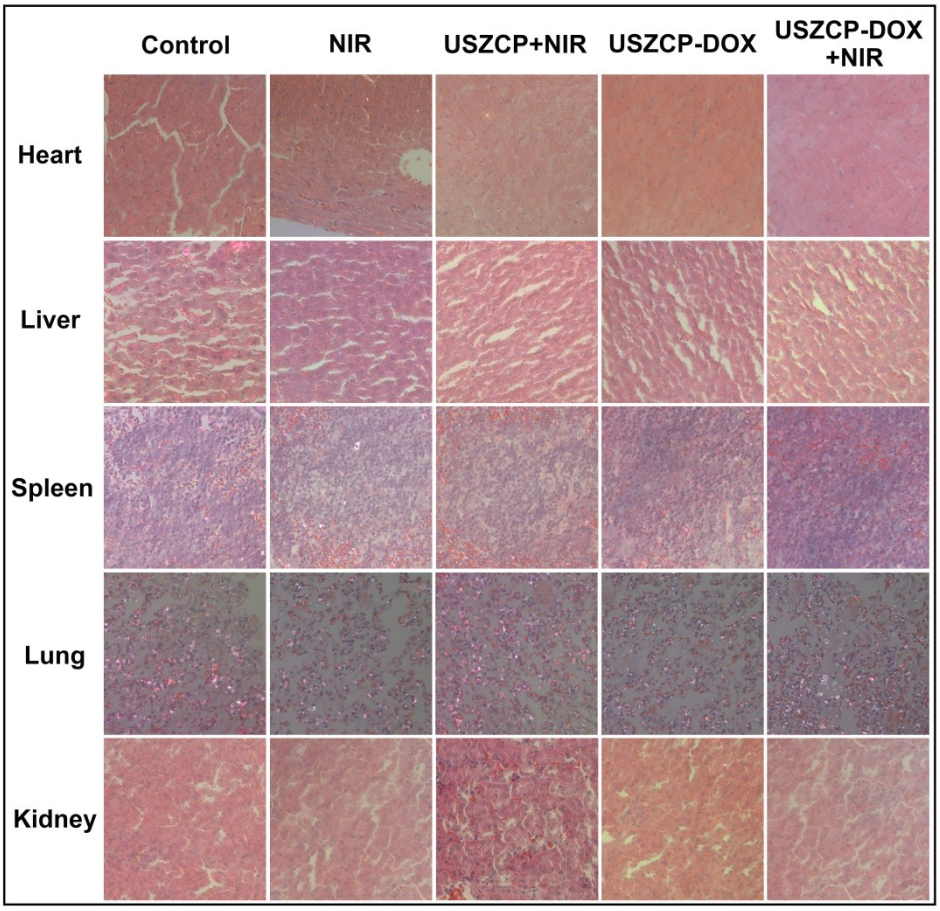

Fig. S10 H&E stained images of heart, liver, spleen, lung, and kidney from different groups after 14 days treatment by USZCP nanocomposite.