Supplementary Information

Optical-magnetic bifunctional property and mechanistic insight on upconversion of NaYF₄: Yb, Ho, Tm @ NaGdF₄ with a tunable nanodumbbell morphology

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Figure S1 Schematic illustration of the core and core-shell nanoparticles with different mole ratio as well as the statistical average size: a) the core nanoparticles; b) core-shell with the mole ratio of 4:1; c) core-shell with the mole ratio of 1:1; d) core-shell with the mole ratio of 2:3; e) core-shell with the mole ratio of 1:2.

Figure S2 UC emission spectra ($\lambda_{ex}=980\text{nm}, \ 150 \ \text{mW}$) of NaYF$_4$@NaGdF$_4$ (1:1) coating with different time at 300 °C.
Figure S3 UCL emission spectra ($\lambda_{ex} = 980$ nm, 150 mW) of images of the core and core-shell NaYF$_4$@NaGdF$_4$ with the different molar ratio of 4:1, 1:1, 2:3 and 1:2.

Figure S4 (a) Dynamic light scatter and (b) zeta potential measurements of CTAB-NDSPs (1:1) in water with pH value of 7.50.
Figure S5 UCL emission spectra ($\lambda_{ex} = 980$ nm, 50mW) of the NDSPs (1:1) in toluene and CTAB-NDSPs in water with the concentration of 0.1mg mL$^{-1}$; The inset shows the Digital photograph of the solution in toluene (a) and water (b).

Figure S6 Digital photograph of NDSPs (1:1) under external magnetic field.