

Supporting Information

Decoration of upconversion nanoparticles@mSiO₂ core-shell nanostructures
with CdS nanocrystals for excellent infrared triggered photocatalysis

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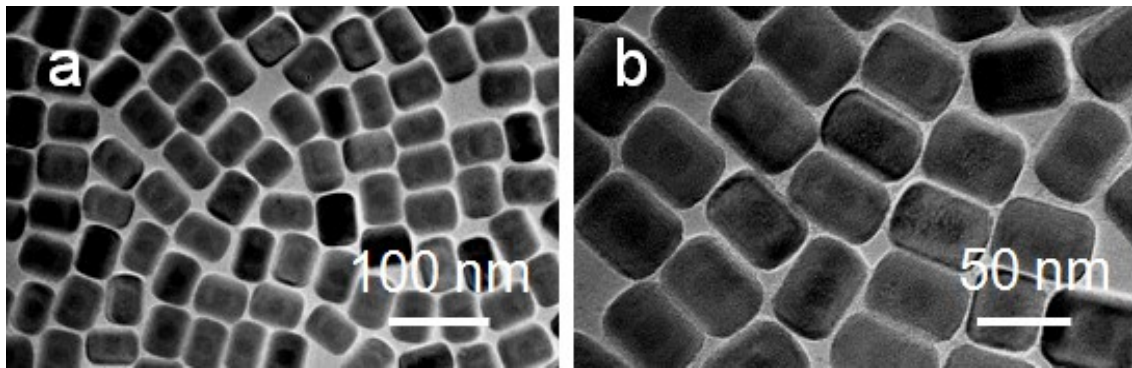


Fig. S1. (a, b) TEM images of NaYF₄:Yb/Tm@NaYF₄ core-shell nanoparticles.

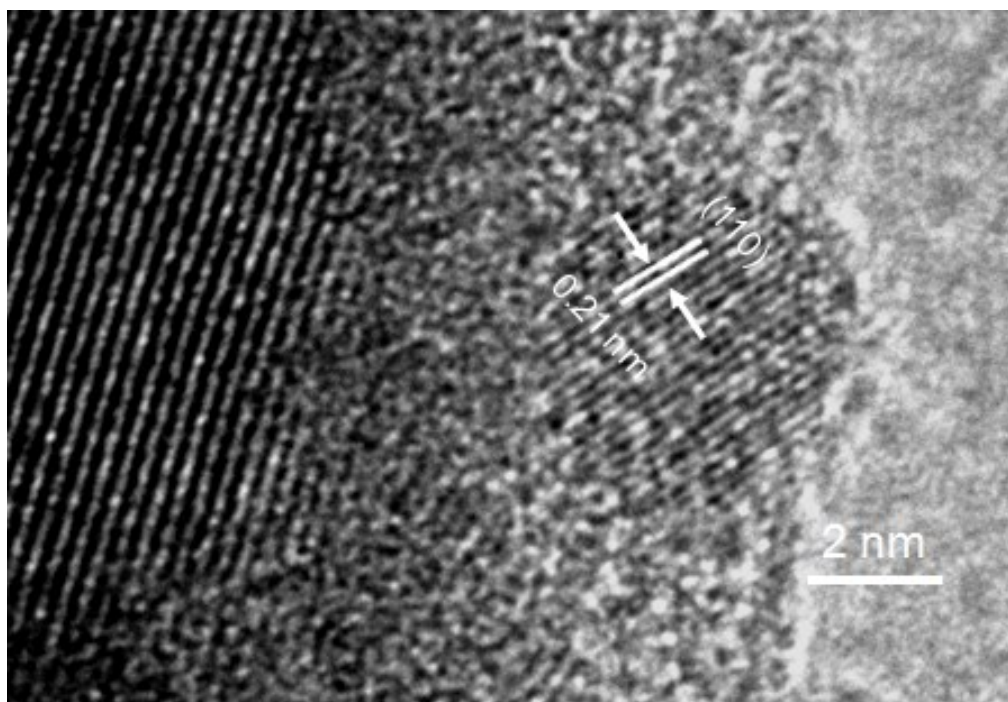


Fig. S2. High resolution transmission electron microscopy (HRTEM) images of selected edge of the $\text{NaYF}_4:\text{Yb/Tm}@\text{NaYF}_4@\text{mSiO}_2/\text{CdS}$ nanoparticle shown in Fig. 1d.

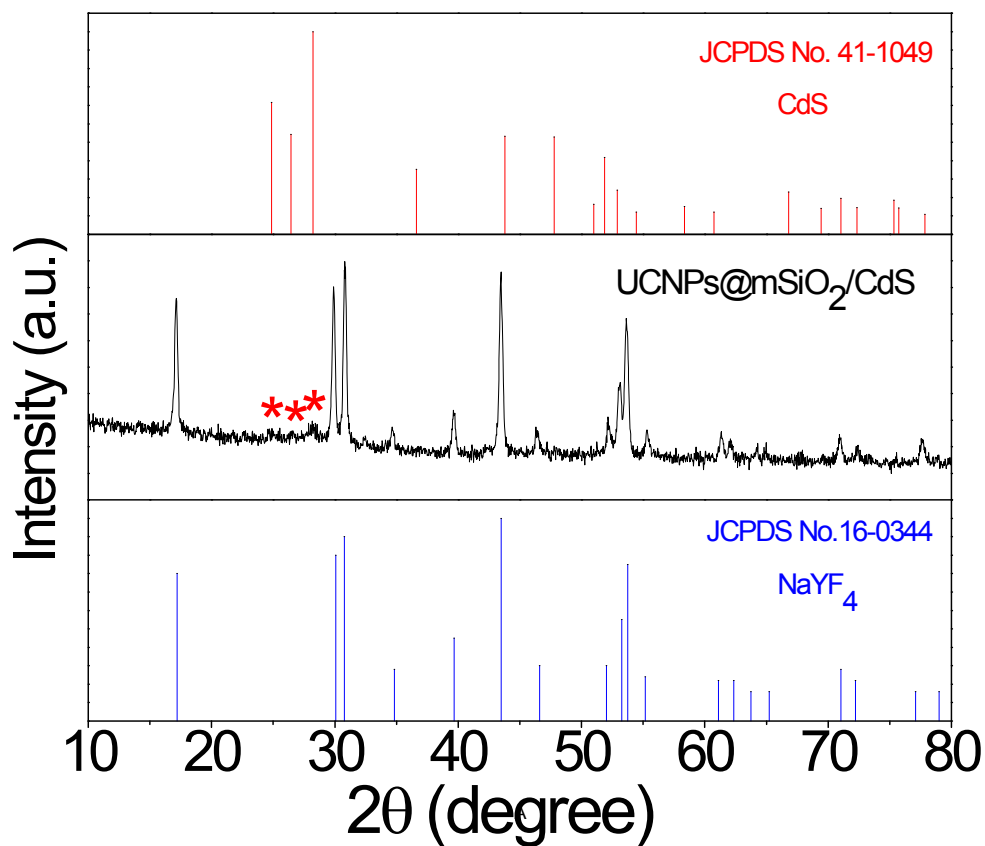


Fig. S3. X-rays diffraction pattern of the as-prepared NaYF₄:Yb/Tm@NaYF₄@mSiO₂/CdS nanoparticles obtained from the reaction of 0.16 mmol cadmium acetate and 0.32 mmol thiourea in the presence of 0.045 g NaYF₄:Yb/Tm@NaYF₄@SiO₂ after calcination at 500 °C for 2 h.

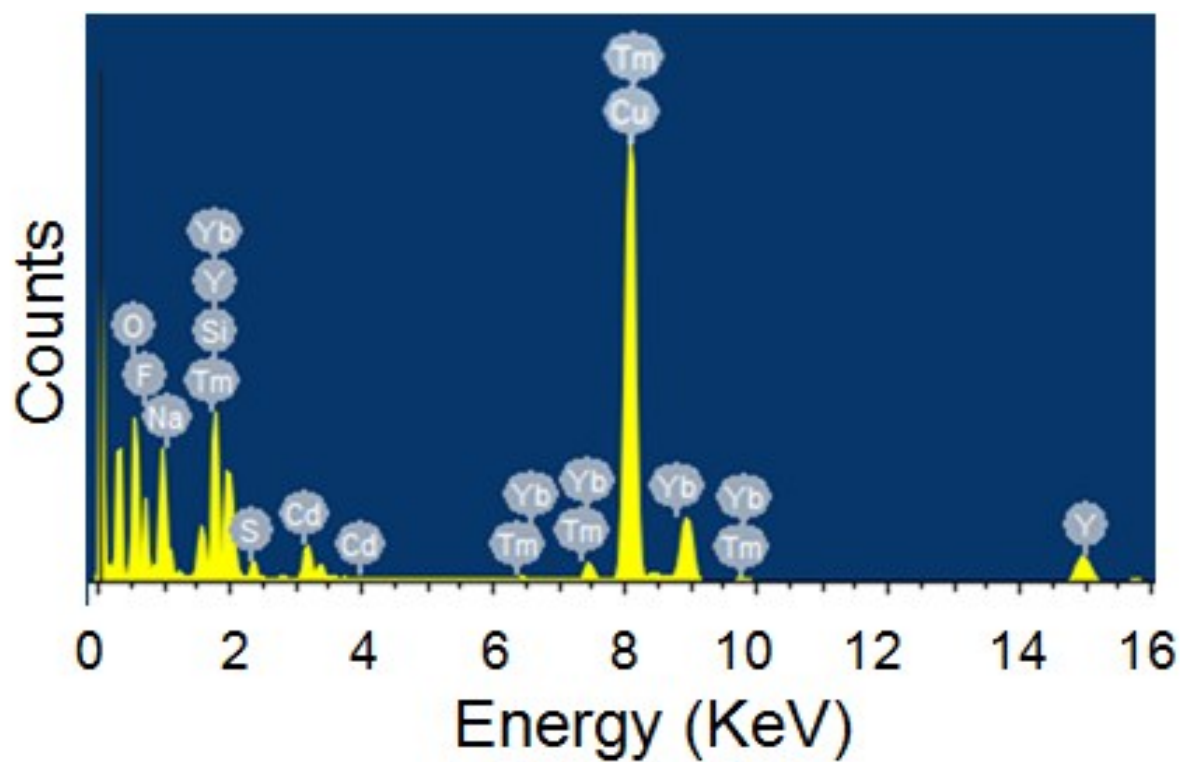


Fig. S4. Energy Dispersive X-ray analysis (EDX) of the as-prepared $\text{NaYF}_4:\text{Yb}/\text{Tm}@ \text{NaYF}_4@m\text{SiO}_2/\text{CdS}$ nanoparticles.

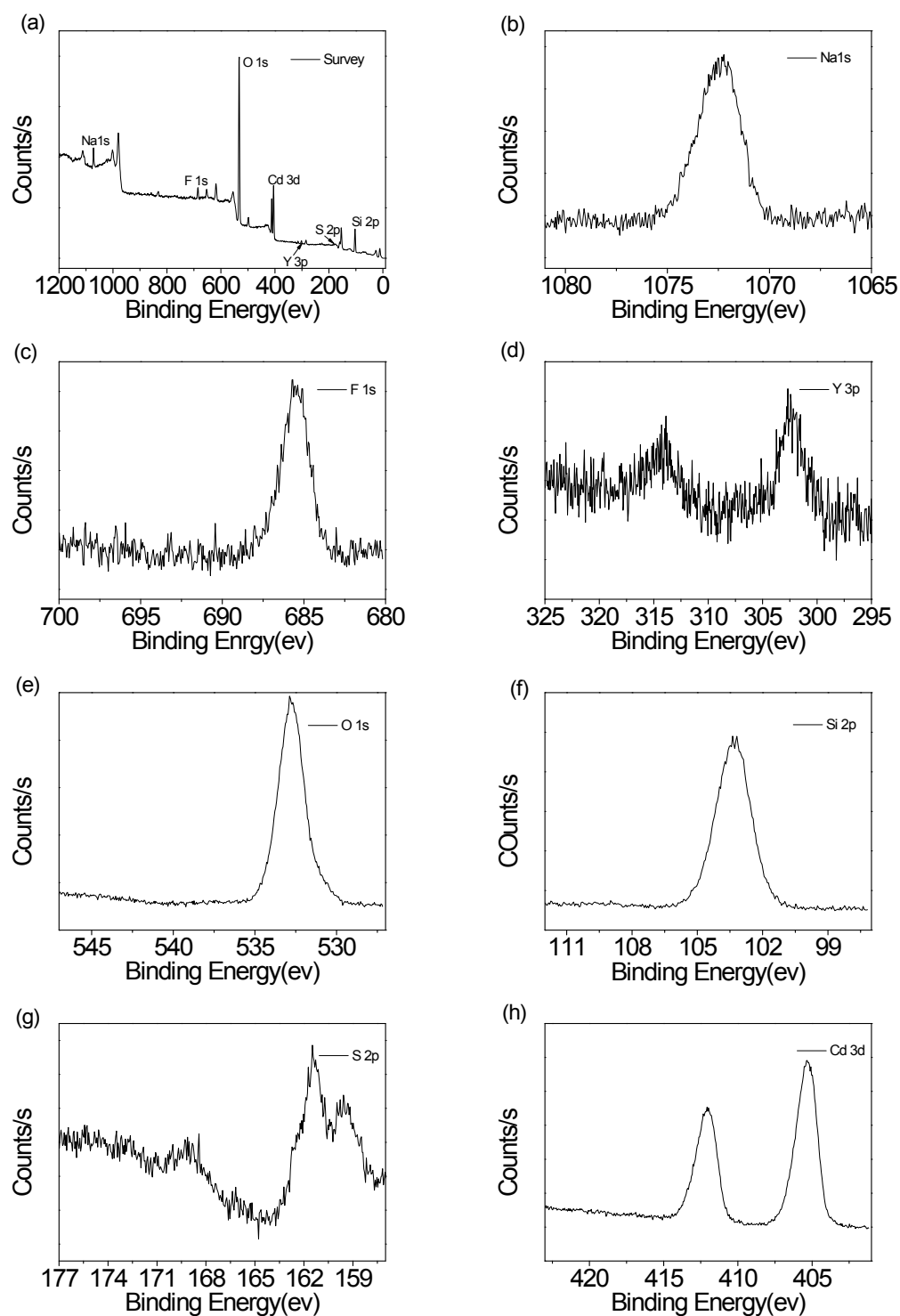


Fig. S5. X-ray photoelectron spectra (XPS) of the as-prepared $\text{NaYF}_4:\text{Yb/Tm}@m\text{SiO}_2/\text{CdS}$ obtained from the reaction of 0.16 mmol cadmium acetate and 0.32 mmol thiourea in the presence of 0.045 g $\text{NaYF}_4:\text{Yb/Tm}@m\text{SiO}_2$ after calcination at 500 °C for 2 h : (a) survey spectrum; (b) Na 1s; (c) F 1s; (d) Y 3p; (e) O 1s; (f) Si 2p; (g) S 2p; (h) Cd 3d.

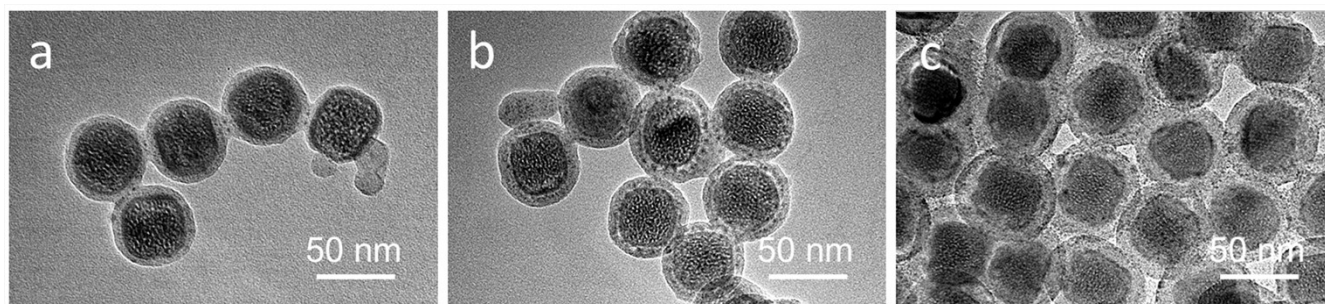


Fig. S6. TEM images of NaYF₄:Yb/Tm@NaYF₄@mSiO₂/CdS nanoparticles with different thickness of silica layers: 3 nm (a); 7 nm (b); (c) TEM images of the NaYF₄:Yb/Tm@NaYF₄@mSiO₂/CdS obtained from 0.32 mmol cadmium acetate and 0.64 mmol thiourea.

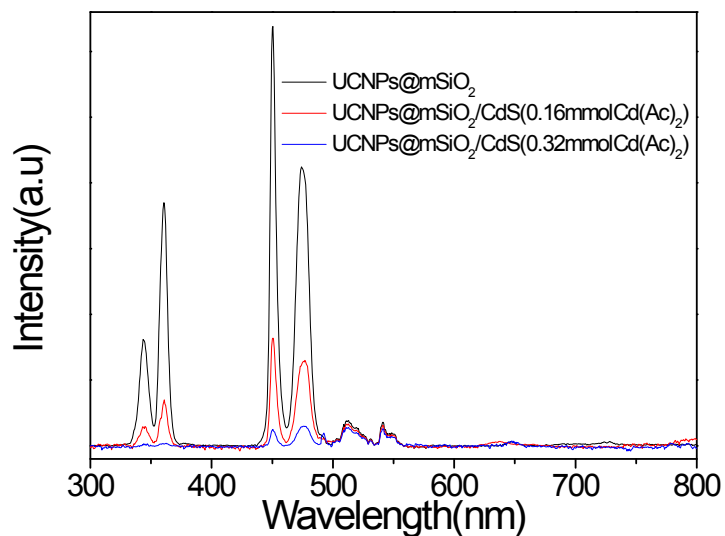


Fig. S7. Fluorescence spectra of the as-prepared NaYF₄:Yb/Tm@NaYF₄@mSiO₂, NaYF₄:Yb/Tm@NaYF₄@mSiO₂/CdS obtained from 0.16 mmol Cd(Ac)₂ and 0.32 mmol thiourea and NaYF₄:Yb/Tm@NaYF₄@mSiO₂/CdS obtained from 0.32 mmol Cd(Ac)₂ and 0.64 mmol thiourea.

Table S1.Element composition of the as-prepared NaYF₄:Yb/Tm@NaYF₄@mSiO₂/CdS nanoparticles from EDX analyses.

Element	Weight %	Atomic %
C	14.64	36.73
O	11.10	20.91
F	6.31	10.02
Na	2.42	3.18
S	3.15	2.96
Si	25.56	16.09
Y	15.86	5.38
Cd	11.51	3.09
Tm	2.01	0.36
Yb	7.44	1.30
Totals	100	