Supporting information

Decorating Ag_3PO_4 Nanodots on Mesoporous Silica-functionalized $NaYF_4$:Yb,Tm@$NaLuF_4$ for Efficient Sunlight-driven Photocatalysis: Synergy of Broad Spectrum Absorption and Pollutant Adsorption-Enrichment

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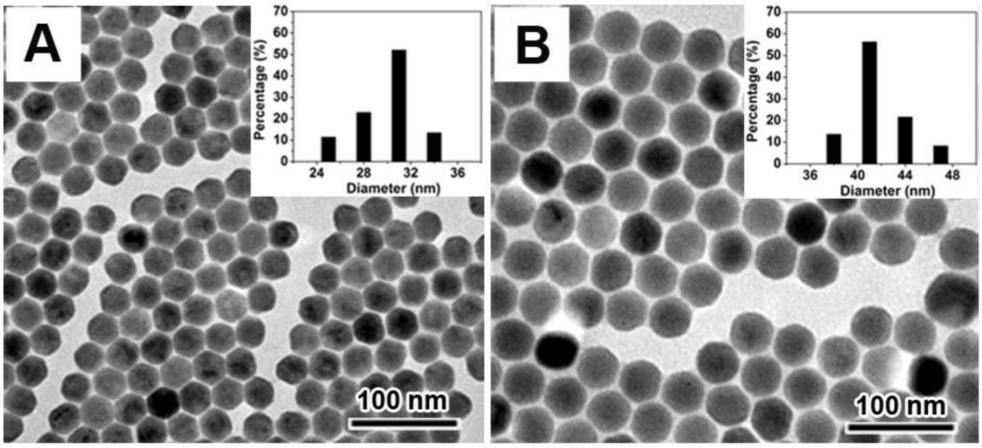

Fig. S1. TEM images of (A) $NaYF_4$:Yb,Tm and (B) $NaYF_4$:Yb,Tm@$NaLuF_4$. Insets are the corresponding particle size distribution.

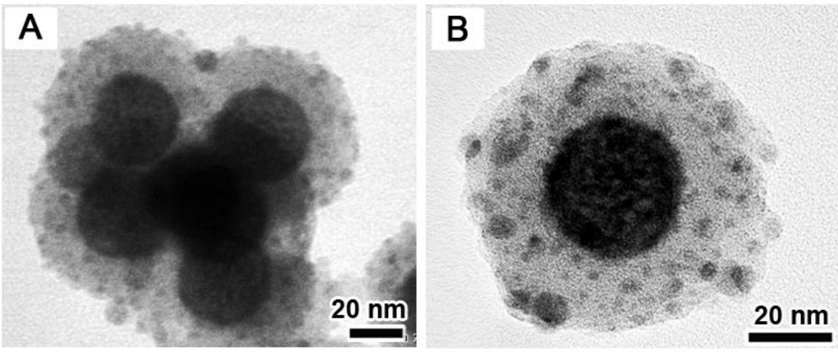

Fig. S2. (A) TEM image and (B) enlarged TEM image of UCNP@$mSiO_2$-Ag_3PO_4.

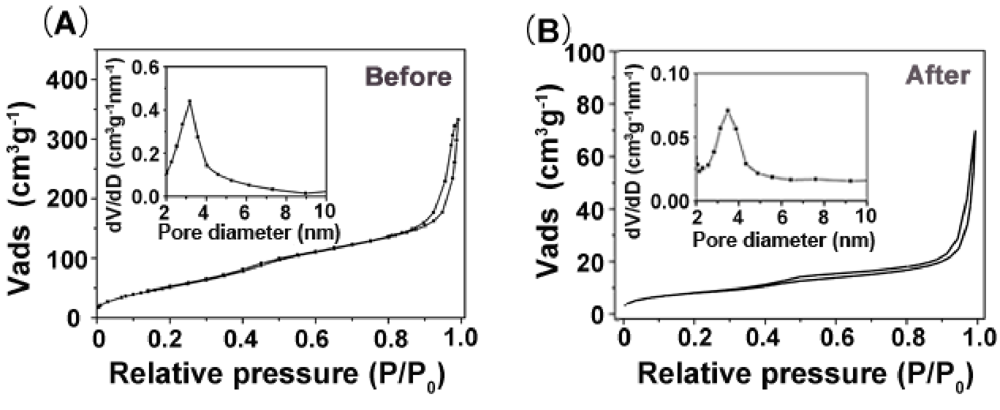

Fig. S3. N_2 adsorption/desorption isotherms and pore size distribution (inset) of as-synthesized UCNP@$mSiO_2$ before (A) and after (B) Ag_3PO_4 deposition.

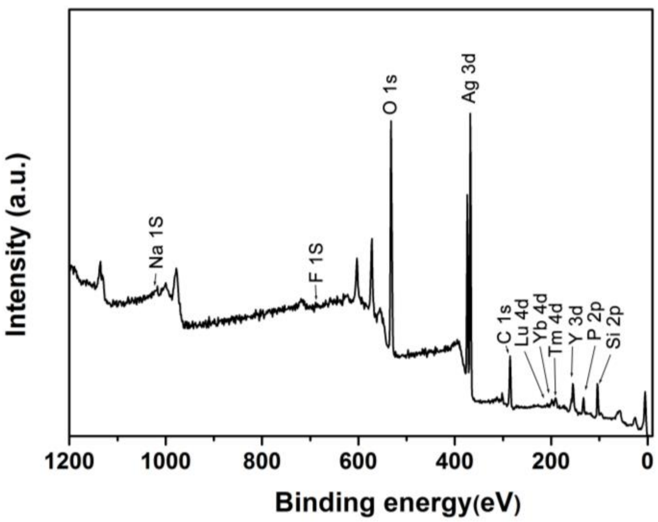

Fig. S4. The XPS spectra of the UCNP@mSiO_2-Ag_3PO_4 nanocomposite.

Table S1. The content of different elements in UCNP@mSiO_2-Ag_3PO_4 using XPS analysis.

Element	Si	O	P	Ag	Y	Na	F	Tm	Yb	Lu
Proportion %	14.61	45.55	5.18	8.96	2.70	0.53	1.59	0.04	0.26	0.24

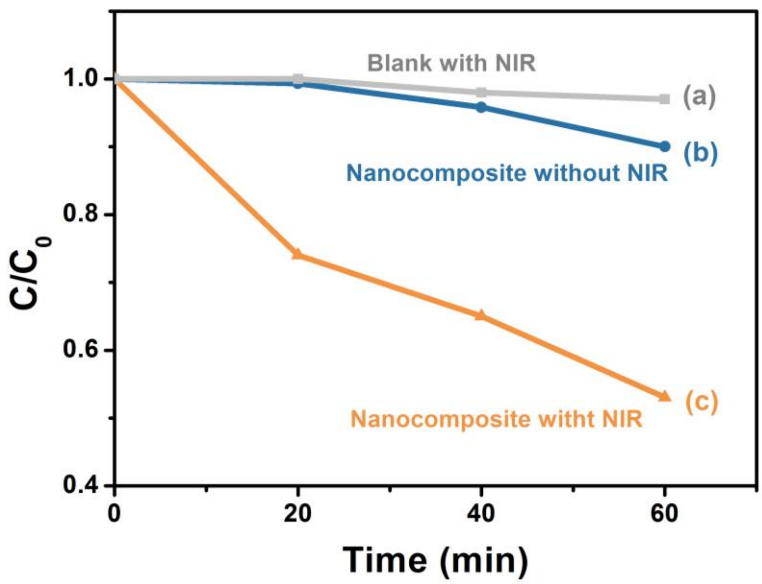

Fig. S5. The photocatalytic degradation rates of RhB in the presence of UCNP@mSiO_2-Ag_3PO_4 with (a) and without (b) 980 nm NIR, (c) is blank test with NIR irradiation.

Table S2. Comparison of NIR light-driven photocatalytic activity of UCNP@mSiO_2-Ag_3PO_4 composite with other UCNP-based photocatalysts. MB: methylene blue; RhB: rhodamine B; MO: methyl orange.

Photocatalyst	Dye, Volume	Light, Intensity	Degrading Efficiency	References
$NaYF_4$:Yb,Tm/TiO_2	MB, 15 mg/L	980 nm, 10 W/cm^2	14 h: 65%	(1)
$NaYF_4$:Yb,Tm/TiO_2	RhB, 10 mg/L	980 nm, 1 W	24 h: 75.7%	(2)
NaYF4:Yb,Tm/CdS	RhB, 10 mg/L	980 nm, 2 W	3 h: 24%	(3)
$NaYF_4$:Yb,Tm/ CNX	RhB, 10 mg/L	980 nm, 1 W	6 h: 57.6%	(4)
CaF_2:Er,Tm,Yb/ $BiVO_4$	MO, 10 mg/L	980 nm, 2 W	6 h: ~10%	(5)
$NaYF_4$:Yb,Tm/CdS/TiO_2	MB, 15 mg/L	980 nm, 2 W/cm^2	20 h:~70%	(6)
MoS_2–$NaYF_4$: Yb^{3+}/Er^{3+}	RhB, 25 mg/L	980 nm, -	12 h: ~61%	(7)
$NaYF_4$:Yb,Tm@mSiO_2-Ag_3PO_4	RhB, 3 mg/L	980 nm, 3 W	1 h:~45%	In this work

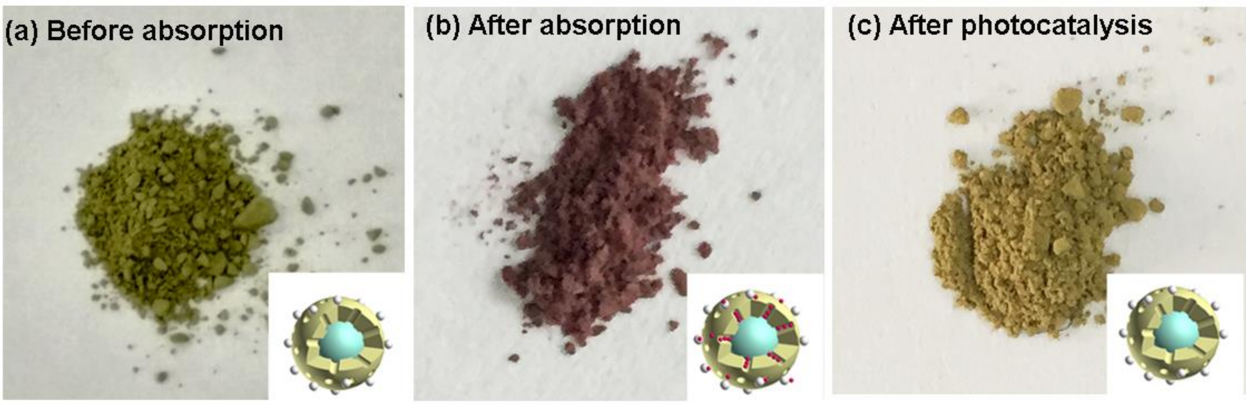

Fig. S6 Photos showing the colour change of UCNP@mSiO_2-Ag_3PO_4 before (a) and after (b) RhB absorption and after photocatalysis (c). To observe the colour change more clearly, a high RhB concentration of 100 mg/L was used in this study.

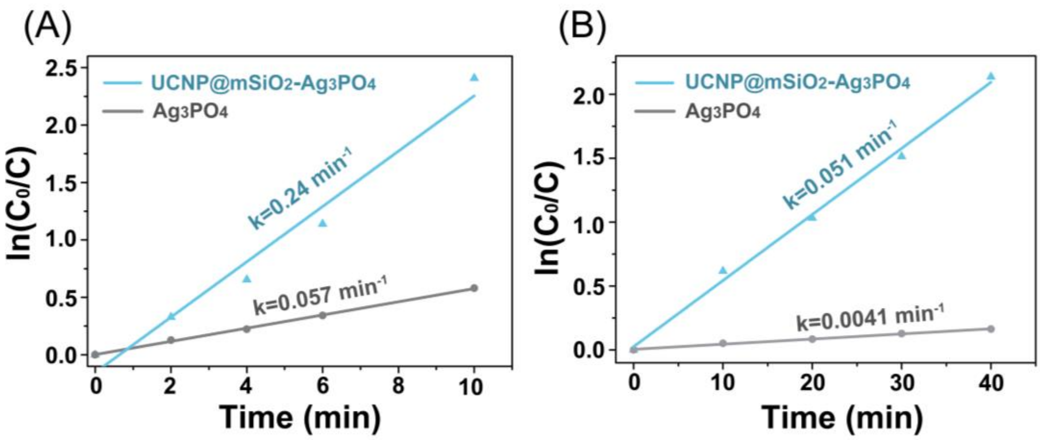

Fig. S7. Apparent rate constants of Ag_3PO_4 and UCNP@mSiO_2-Ag_3PO_4 on the degradation of RhB solution under natural sunlight irradiation under dynamic condition (A) and static condition (B). The reaction kinetics was fitted using a Langmuir-Hinshelwood kinetic model with a first-order rate equation. C is the concentration of pollutants at given irradiation time and C_0 is the concentration after the absorption equilibrium.

References

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