

Supporting Information

Near-Infrared Light-driven Composite for Smart and Robust Adhesion based on Dynamic Photochemistry

Yuxian Su,^{a,b} Tianfu Song,^{* c} Li Liu,^{* a} Shipeng Wen^{* a}

Corresponding Authors

*E-mail: tfsong@pku.edu.cn (T.F. Song), liul@mail.buct.edu.cn (L. Liu) and wensp@mail.buct.edu.cn (S.P. Wen)

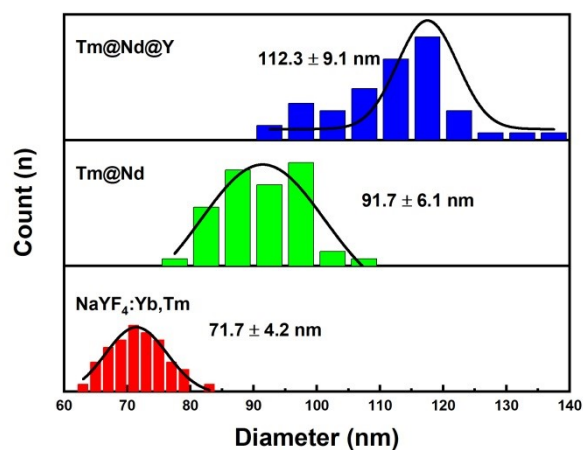


Figure S1. size distributions of NaYF₄:Yb,Tm, Tm@Nd and Tm@Nd@Y.

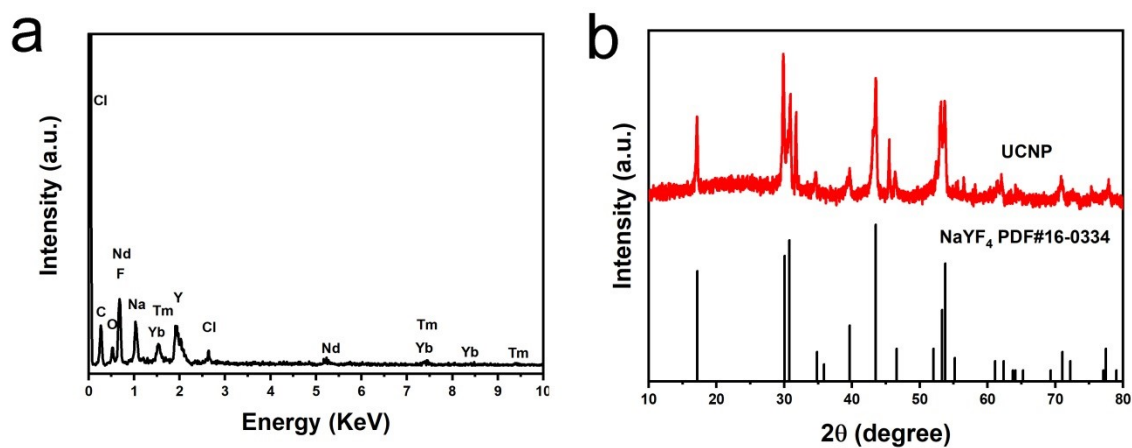


Figure S2. (a) EDS image and (b) XRD pattern of NaYF₄:Yb,Tm@NaYF₄:Yb,Nd@NaYF₄.

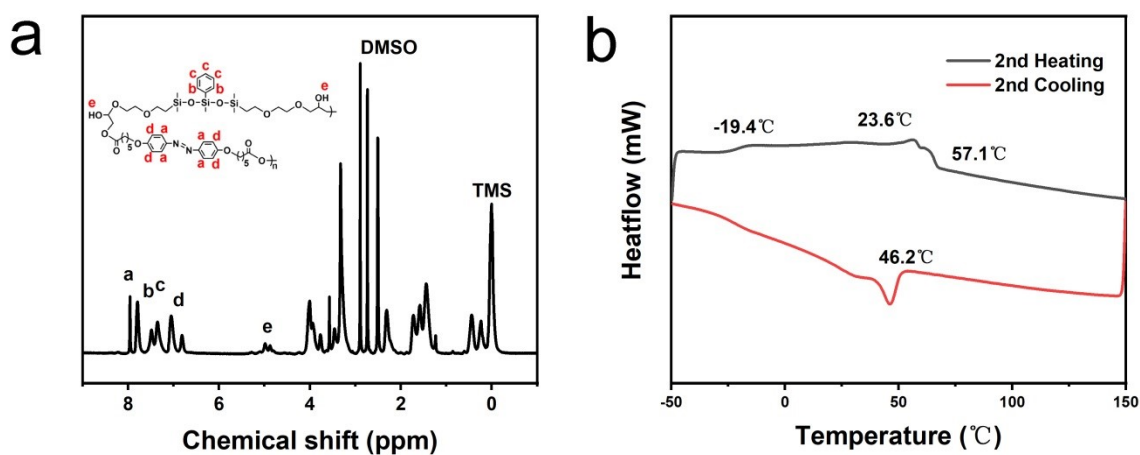


Figure S3. NMR hydrogen spectrum (a) and DSC curves (b) of azobenzene polymer with siloxane main chain.

Table S1. GPC data of PAzo.

Sample	M_n	M_w	PDI
PAzo	1.5×10^4	3.3×10^4	2.19

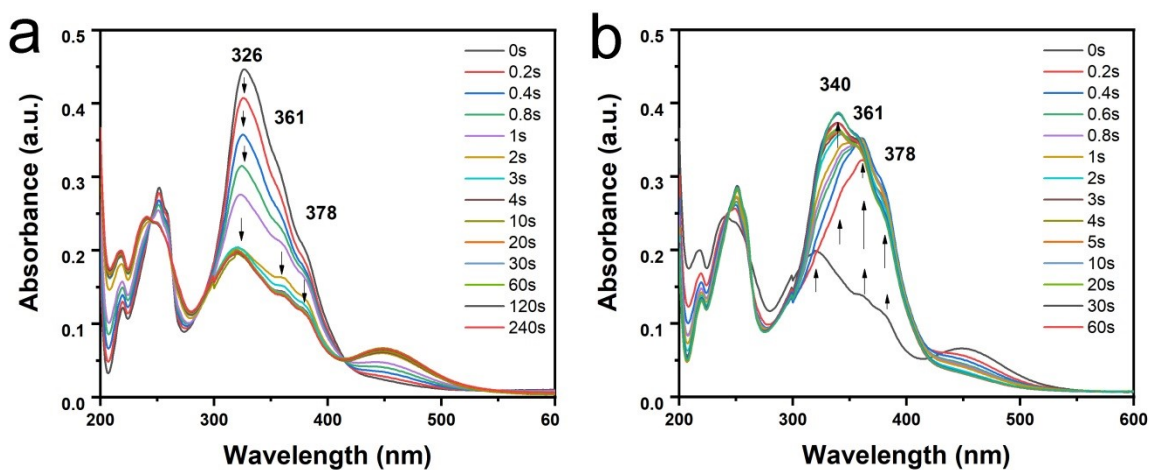


Figure S4. Absorption spectra of PAzo/5%UCNP composites under (a) 365 nm and (b) 460 nm irradiation at a power density of 100 mW cm^{-2} .

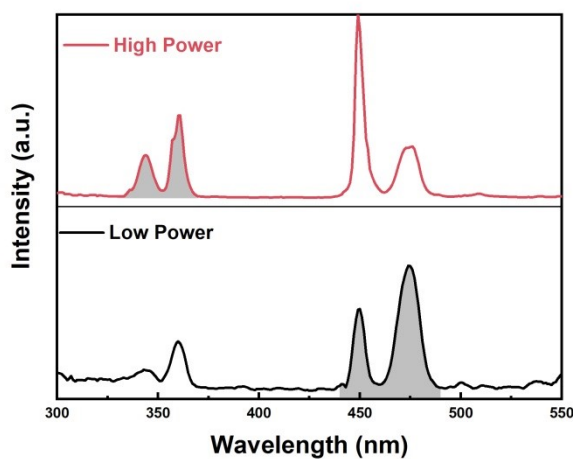


Figure S5. luminescence spectra of UCNPs at power densities of 5 W cm^{-2} and 0.5 W cm^{-2} under 808 nm irradiation.

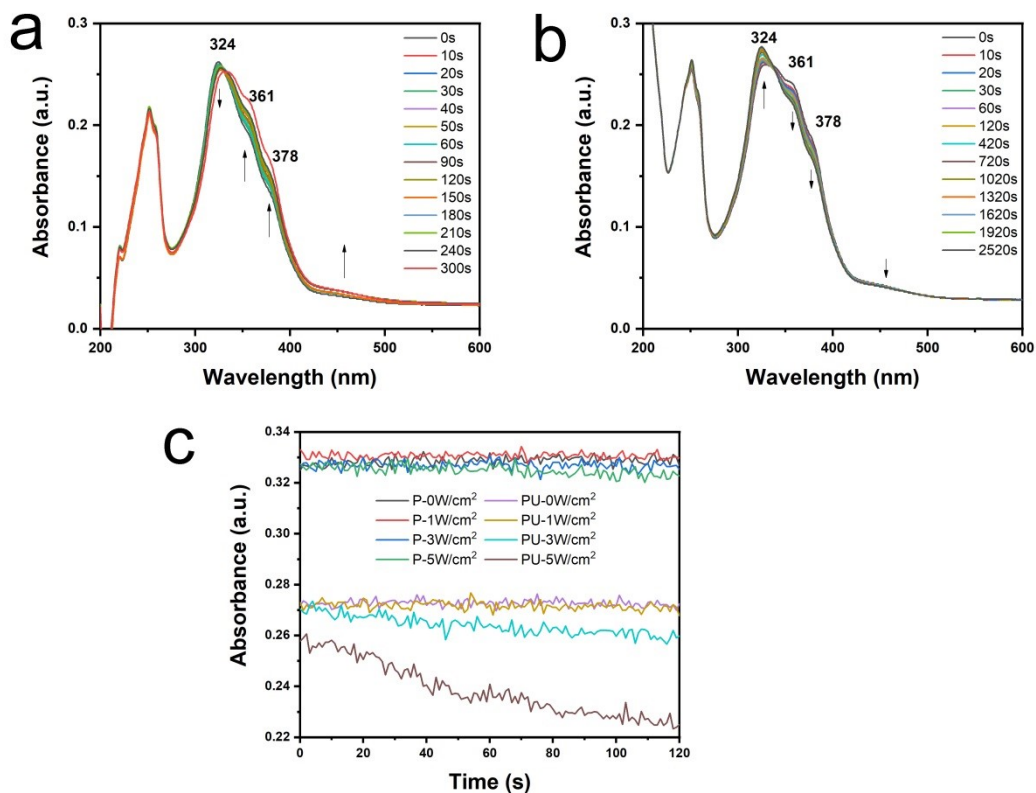


Figure S6. Photoisomerization of PAzo/5%UCNP under 808 nm irradiation at power densities of (a) 5 W cm⁻² and (b) 0.5 W cm⁻². (c) Time-resolved absorption spectra of PAzo (P) and PAzo/5%UCNP (PU) at 328 nm under 808 nm irradiation (5 W cm⁻²).

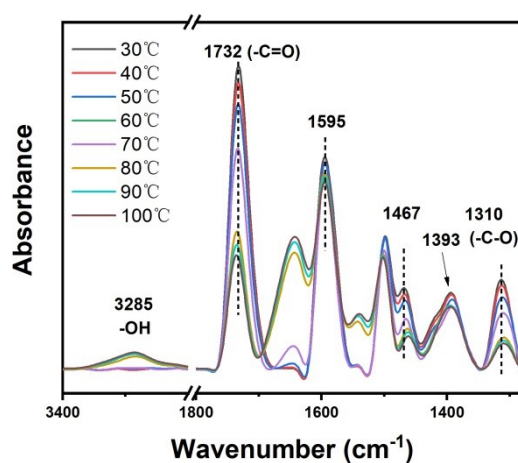


Figure S7. FTIR spectra of PAzo/5%UCNP at different temperatures.

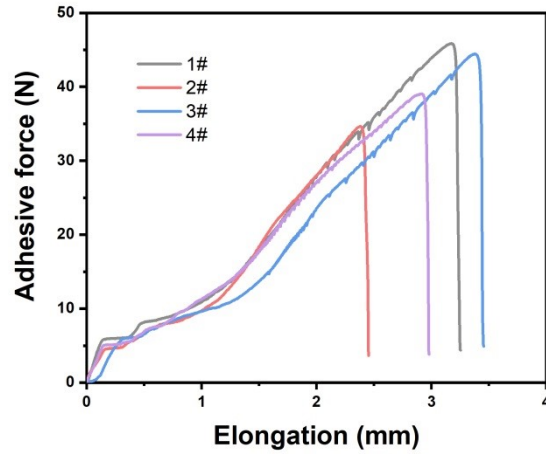


Figure S8. adhesion-elongation curves of different composite films.

Note: PAzo (1#), PAzo/1%UCNP (2#), PAzo/5%UCNP (3#), and PAzo/20%UCNP (4#)

Table S2. Parameters of the adhesion-elongation curves.

Film	Maximum adhesion (F_m , N)	Tensile shear strength (MPa)	Thickness (mm)	Overlapping area (mm ²)
1#	44.8 ± 1.5	0.64 ± 0.07	0.091 ± 0.01	71.1 ± 10.5
2#	33.1 ± 1.5	0.66 ± 0.03	0.117 ± 0.01	50.3 ± 0.0
3#	41.6 ± 2.6	0.81 ± 0.03	0.120 ± 0.02	51.5 ± 1.3
4#	37.8 ± 1.9	0.71 ± 0.03	0.107 ± 0.02	53.5 ± 0.0

Table S3. Parameters of the force-elongation curves of composite films under 808 nm irradiation.

Condition	Film	Maximum adhesion (F_m , N)	Tensile shear strength (MPa)	Thickness (mm)	Overlapping area (mm ²)
5 W cm ⁻²	1#	34.9 ± 1.1	0.44 ± 0.01	0.100 ± 0.00	78.5 ± 0.0
5 W cm ⁻²	2#	24.9 ± 1.9	0.44 ± 0.02	0.167 ± 0.02	56.9 ± 6.9

5 W cm ⁻²	3#	22.8 ± 0.8	0.38 ± 0.02	0.160 ± 0.03	60.2 ± 4.9
5 W cm ⁻²	4#	25.3 ± 1.5	0.40 ± 0.02	0.116 ± 0.00	63.6 ± 0.0
0.5 W cm ⁻²	1#	30.8 ± 2.2	0.39 ± 0.03	0.104 ± 0.02	78.5 ± 0.0
0.5 W/cm ²	2#	38.9 ± 6.8	0.61 ± 0.05	0.158 ± 0.03	64.1 ± 14.1
0.5 W cm ⁻²	3#	34.7 ± 6.5	0.49 ± 0.02	0.113 ± 0.04	71.1 ± 10.5
0.5 W cm ⁻²	4#	35.8 ± 1.8	0.54 ± 0.07	0.126 ± 0.00	67.2 ± 5.1

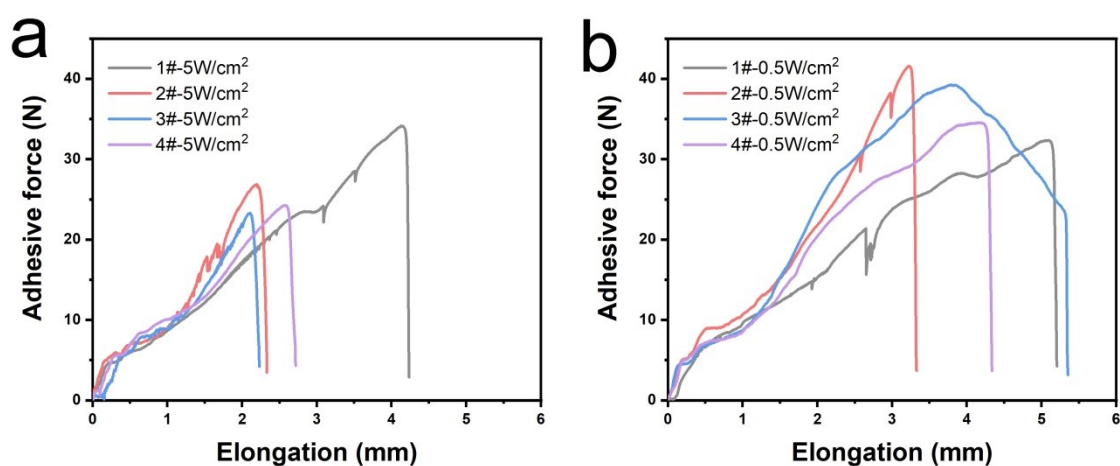


Figure S9. Adhesion-elongation curves of different composite films under 808 nm irradiation at power densities of (a) 5 W cm⁻² and (b) 0.5 W cm⁻².

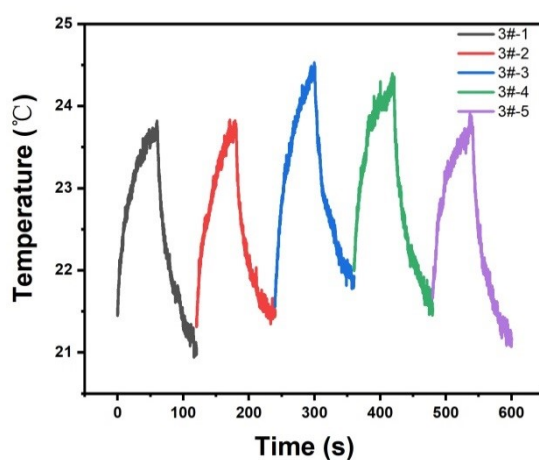


Figure S10. Surface temperature change of PAzo/5%UCNP during 5 cycles under 808 nm irradiation at a power density of 5 W cm⁻².