Electronic Supplementary Information

Solvent- and Initiator-free Fabrication of Efficient and Stable Perovskite-Polystyrene Surface-Patterned Thin Films for LED Backlights

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Table S1 Optical properties and stability of PNC-polymer composite films obtained with different fabrication methods.

Preparation method	Perovskite	Polymer	Polymerization time	Emission peak (nm)	FWHM (nm)	PLQY (%)	Stability [keep% / time]	Ref.
Electrospinning	$CsPbBr_3$ NCs	PS	50°C 2 h	513	24	48	70% / 192 h, in water	1
Swelling-diswelling	$MAPbBr_3$ NCs	PS	30°C -80°C, 2-8 h	532	18	34	65% / 5h, 100°C, in water	2
In situ polymerization	$CsPbBr_3$ NCs	PS	14 h	-	-	44	81.8% / 24h, in water	3
Electrospinning	$CsPbBr_3$ NCs	PS	-	516	23	23	40% / 6h, under 405 nm LED; 83% / 3 months, in water	4
In situ recrystallization	$CsPbBr_3$ NCs	PS	12 h	523	-	0.7	-	5
Swelling-diswelling	$CsPbBr_3$ NCs	PS	24 h	519	-	43	Stable / 5 h, under 365 nm LED	6
Electrospinning	$CsPbBr_3$ NCs	PMMA	-	515	22	23.5	30% / 6h, under 405 nm LED; 50% / 3 months, in water	4
In situ polymerization	$CsPbBr_3$ NCs	PMMA	2 h	524	21	32.7	91%/7 days, in water	7
In situ recrystallization	$CsPbBr_3$ NCs	PVDF		537	16	30	90%/48h, Under UV light	8
In situ recrystallization	$CsPbBr_3$ NCs	EVA		527	19.7	40.5	54%/18h, under 460 nm LED	9
In situ hot injection	$CsPbBr_3$ NCs	PS	3-5 h	530	20	90	94% / 240 h, in water; 91.7%/ 100h, under 460 nm LED	This work

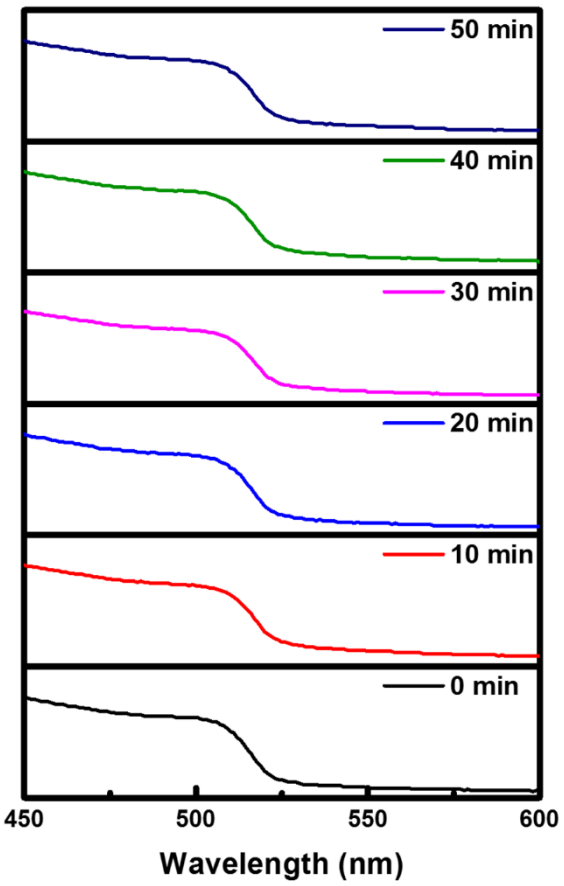

Fig. S1 UV-Vis absorption spectra of PNCs synthesized in styrene.

Table S2 PL decay data of PNC-styrene/PS mixture.

Sample	A_1	τ_1 (ns)	A_2	τ_2 (ns)	τ_{ave} (ns)
Fresh synthesized PNC-styrene solution	2461.28	4.278	768.04	12.310	8.077
PNC-PS complex (heating treatment for 50 min)	2545.54	4.301	753.05	12.686	8.208

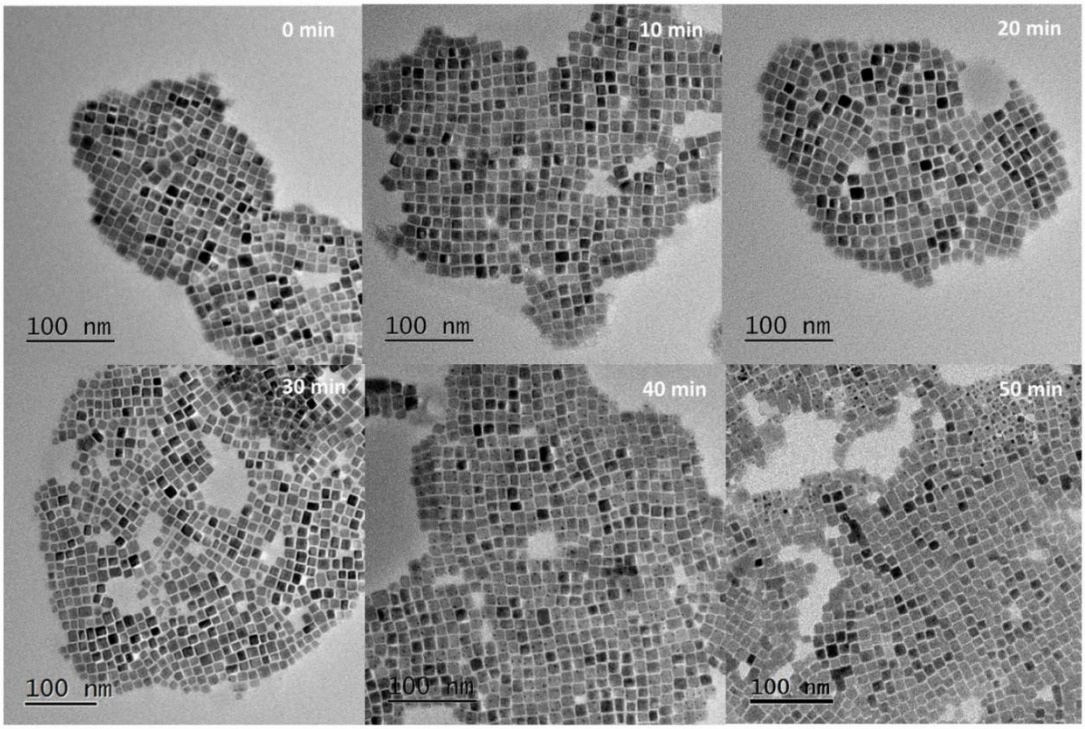

Fig. S2 TEM images of PNCs collected during the pre-polymerization process (synthesized in styrene).

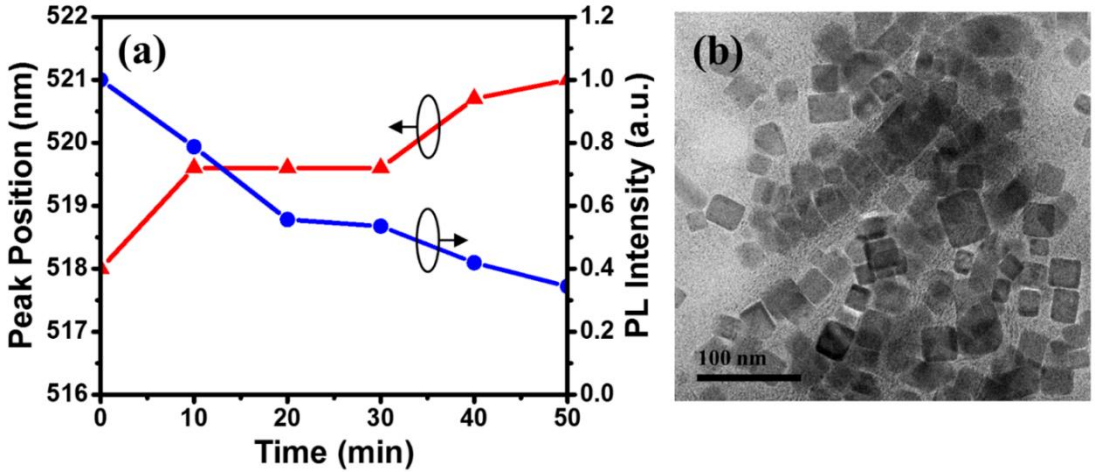

Fig. S3 (a) Peak position and PL intensity of PNCs collected during the pre-polymerization process (synthesized in ODE). (b) TEM image of PNCs obtained after heating treatment in ODE for 50 minutes.

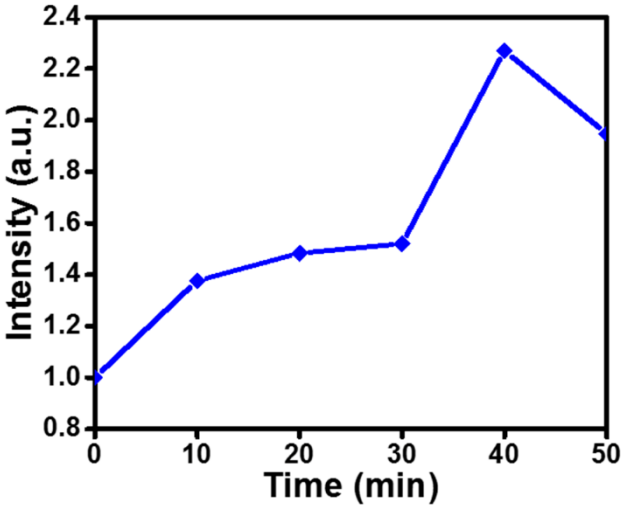

Fig. S4 Time-dependent intensity ratio of the peak at 698 cm^{-1} to 720 cm^{-1} in Fig. 4b.

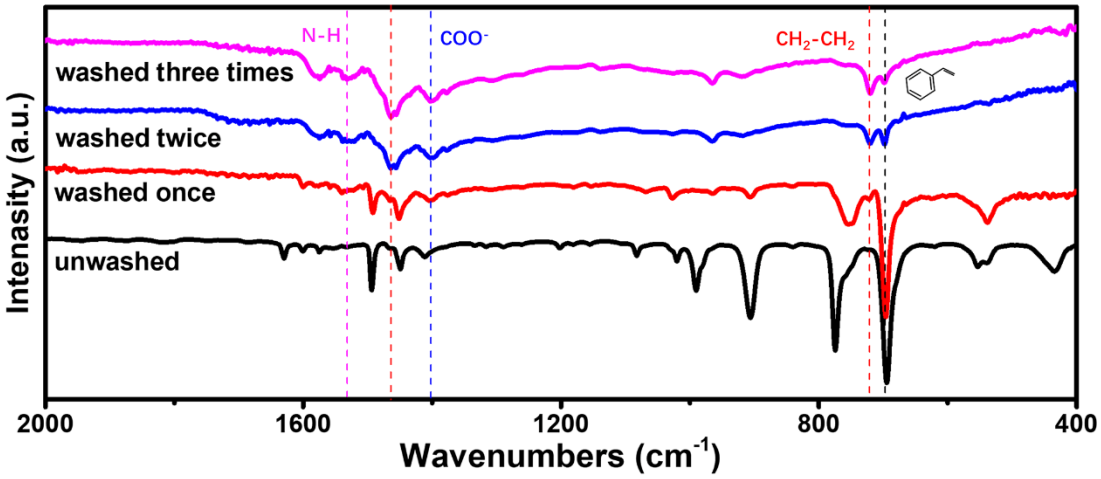

Fig. S5 FTIR spectra of the PNC powders after washing different times.

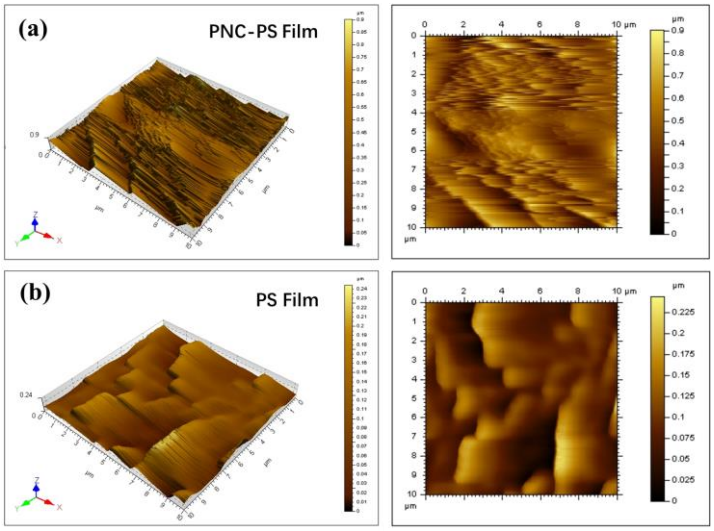

Fig. S6 AFM image of PNCs-PS film made by one pot synthesis method (Film 1) and pure PS film.

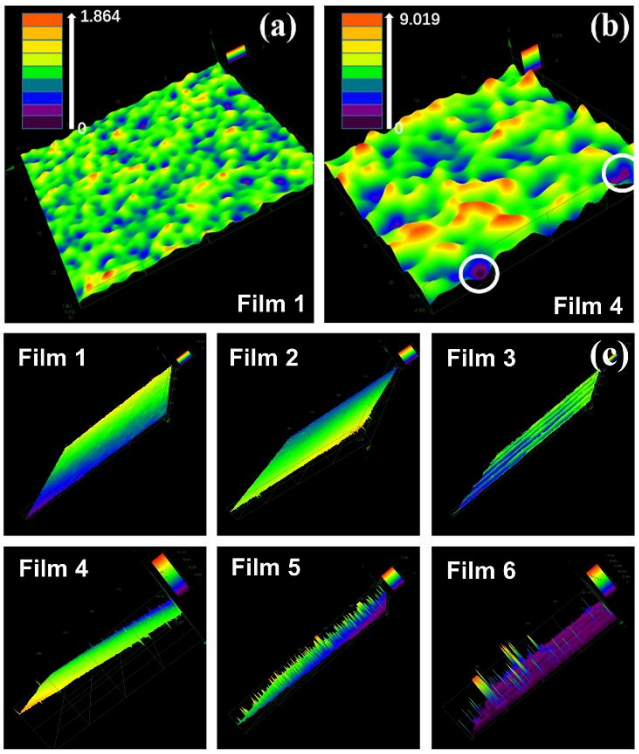

Fig. S7 3D depth-of-field microscope photos of PNCs-PS film made by one pot synthesis method (Film 1) (a), and directly mix PNCs with PS in toluene (Film 4) (b). Other PNC-PS films in (c) include: Films 2 and 3 (synthesized by one-pot method followed by initiator-assisted thermal polymerization and UV polymerization), Films 5 and 6 (synthesized in ODE and re-dispersed in styrene, followed by initiator-assisted thermal polymerization and UV polymerization), The unit of the scale is set as micrometer.

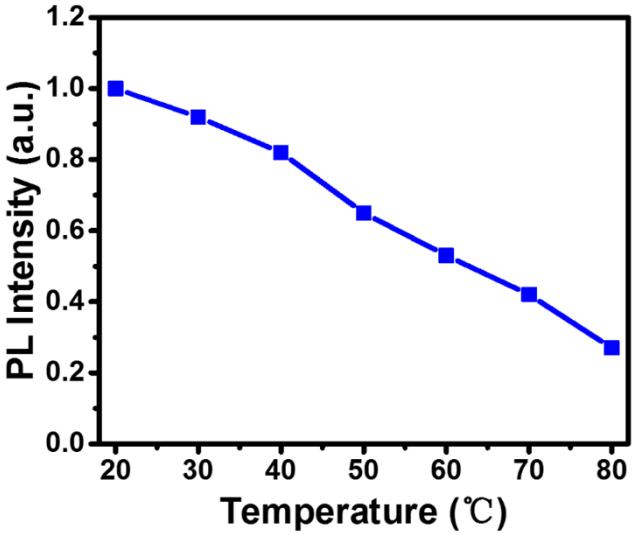

Fig. S8 Thermal quenching of traditional PNC powders synthesized in ODE.

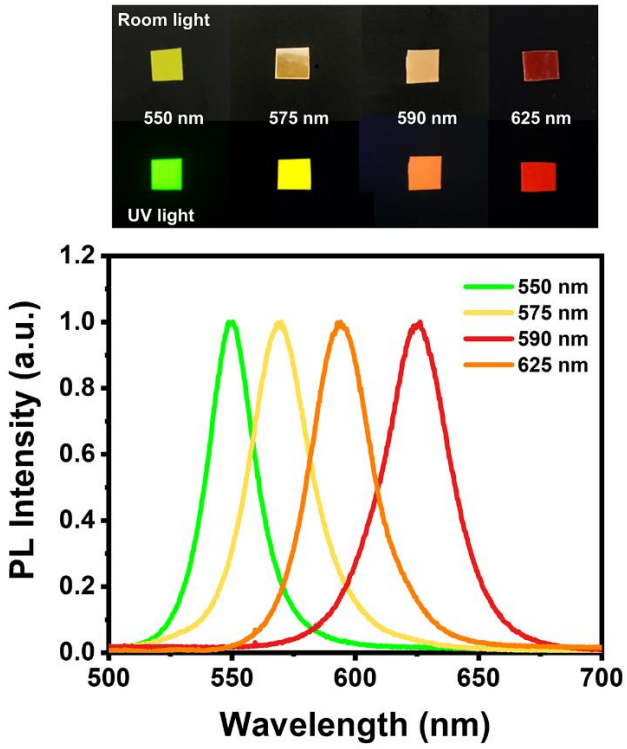

Fig. S9 Pictures of PNC-PS films under room light and UV light, and the corresponding PL spectra.

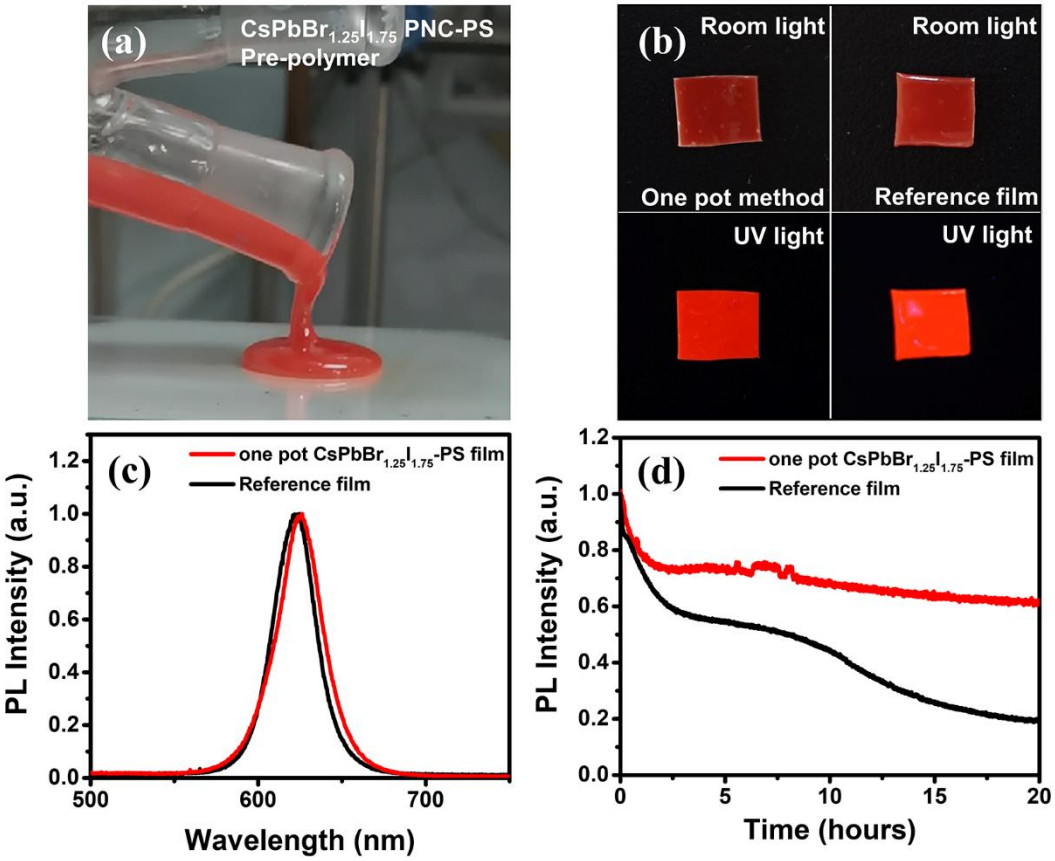

Fig. S10 Pictures of red emission PNCs-PS prepolymer (a) and films (b) made by one pot synthesis method (left) and directly mix PNCs with PS in toluene (right). PL spectra (c) and stability trend (d) of the red emission PNC- PS composite film made by one pot synthesis method (red) and directly mix PNCs with PS in toluene (black).

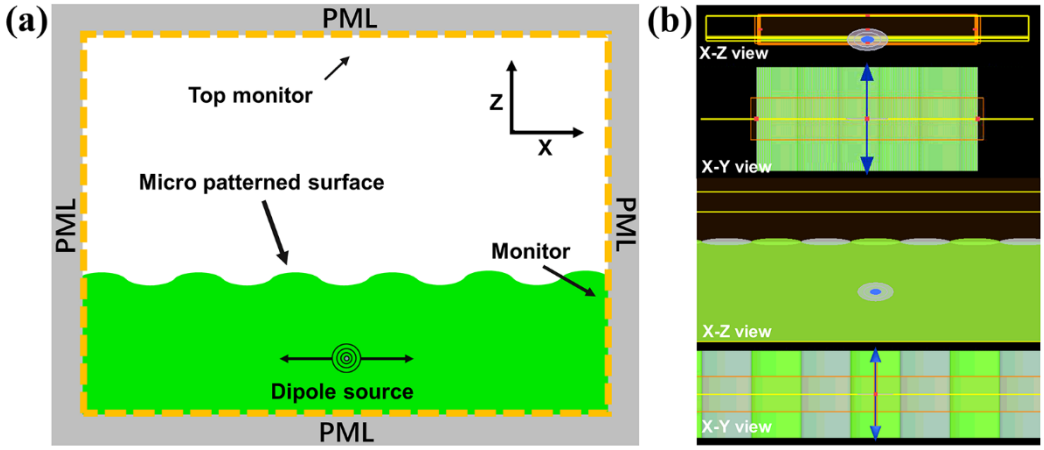

Fig. S11 (a) A schematic diagram of FDTD simulation model for micropatterned film. (b) the simulation model on X-Z view and X-Y view. The two pictures above are the overall view and the other two pictures below are the zoomed-in view.

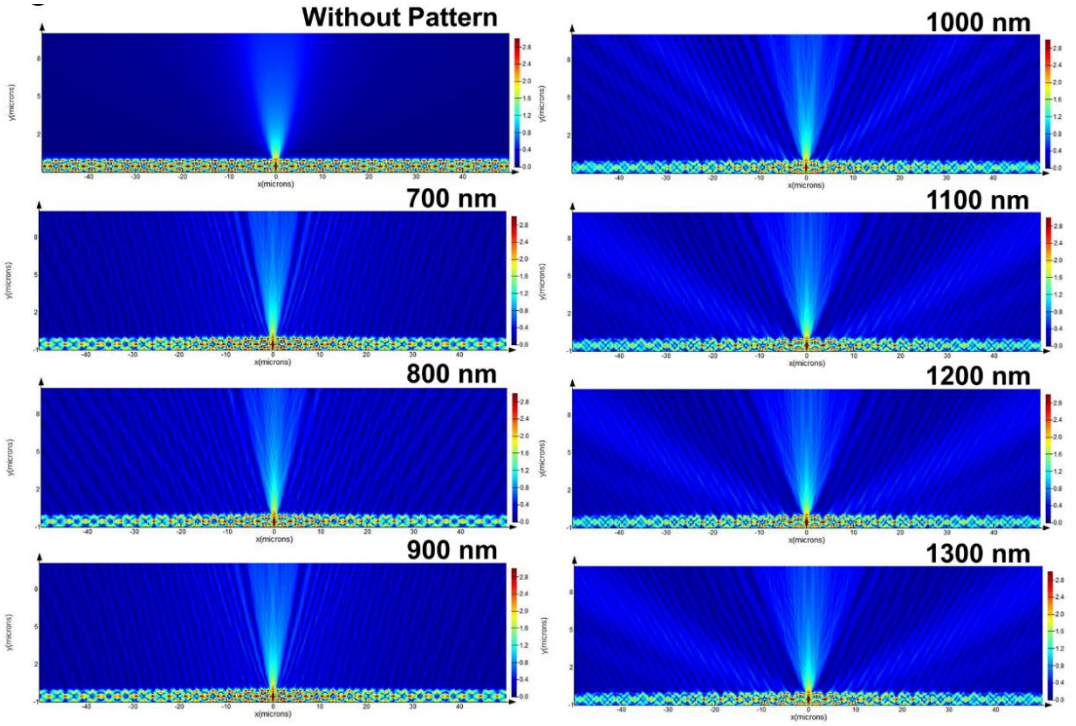

Fig. S12 The cross-sectional view of electromagnetic field about the PNC-PS film with different period pattern.

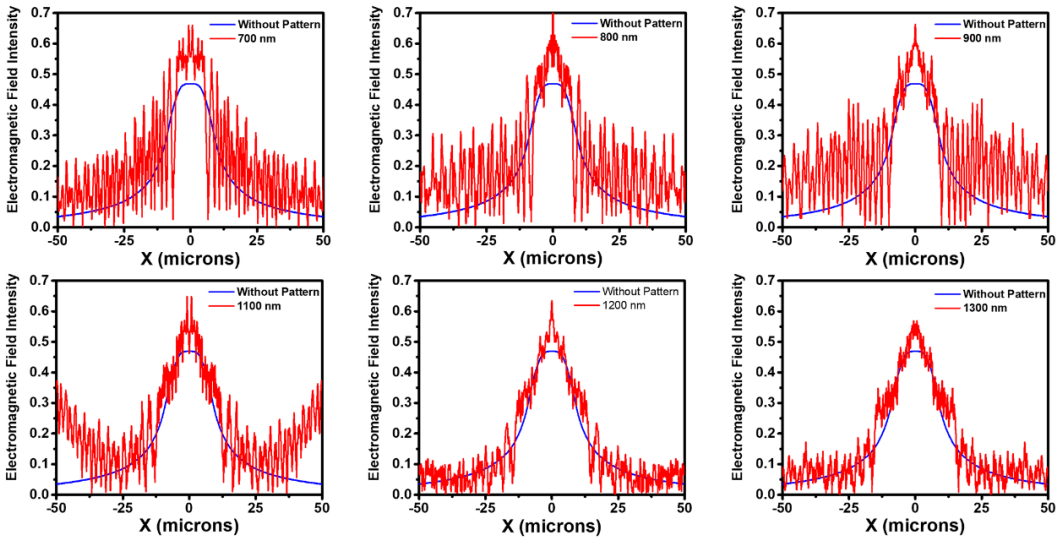

Fig. S13 The electromagnetic field intensity about the PNC-PS film with different period pattern.

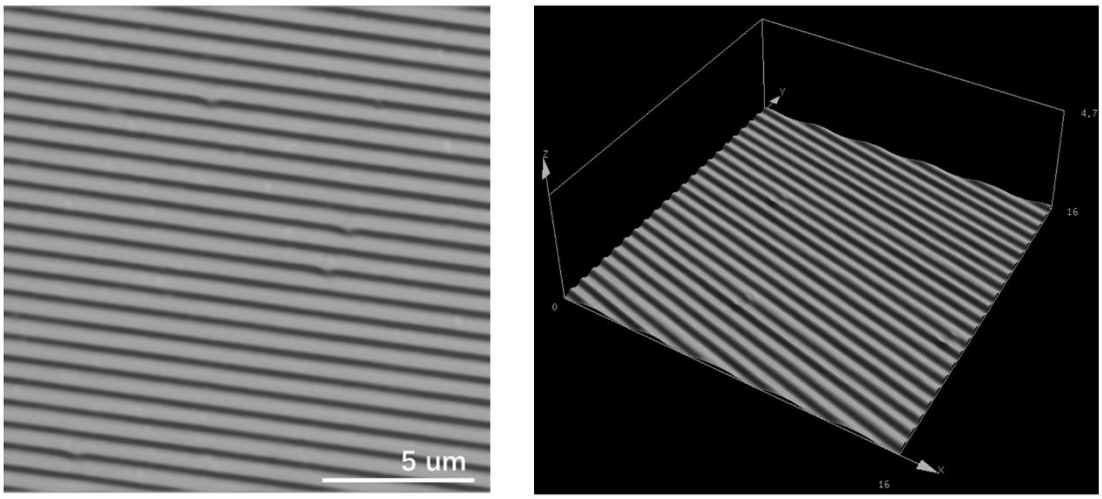

Fig. S14 Top (left) and 3D (right) view of the PDMS template.

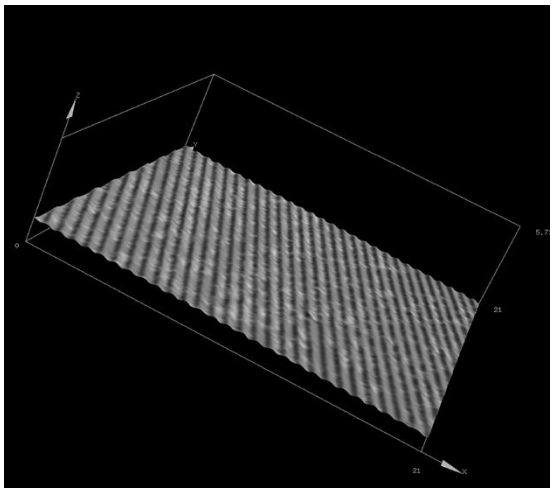

Fig. S15 3D surface view of the micropatterned film.

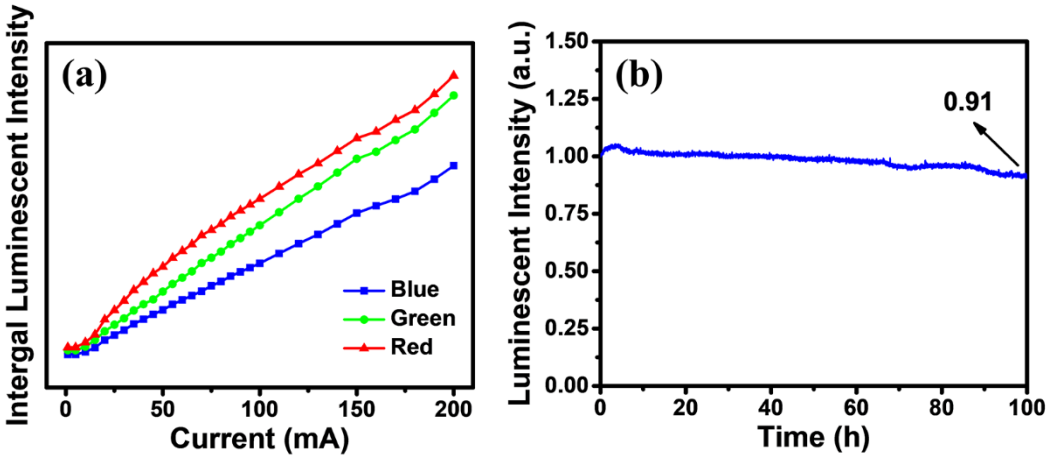

Fig. S16 (a) The spectral integral ratio of blue, green and red under different drive currents. (b) Luminous stability of the backlight sample under continuously operate.

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