

Electronic Supplementary Information (ESI)

Self-organized Helical Superstructure of Photonic Cellulose Loaded with Upconversion Nanoparticles Showing Modulated Luminescence

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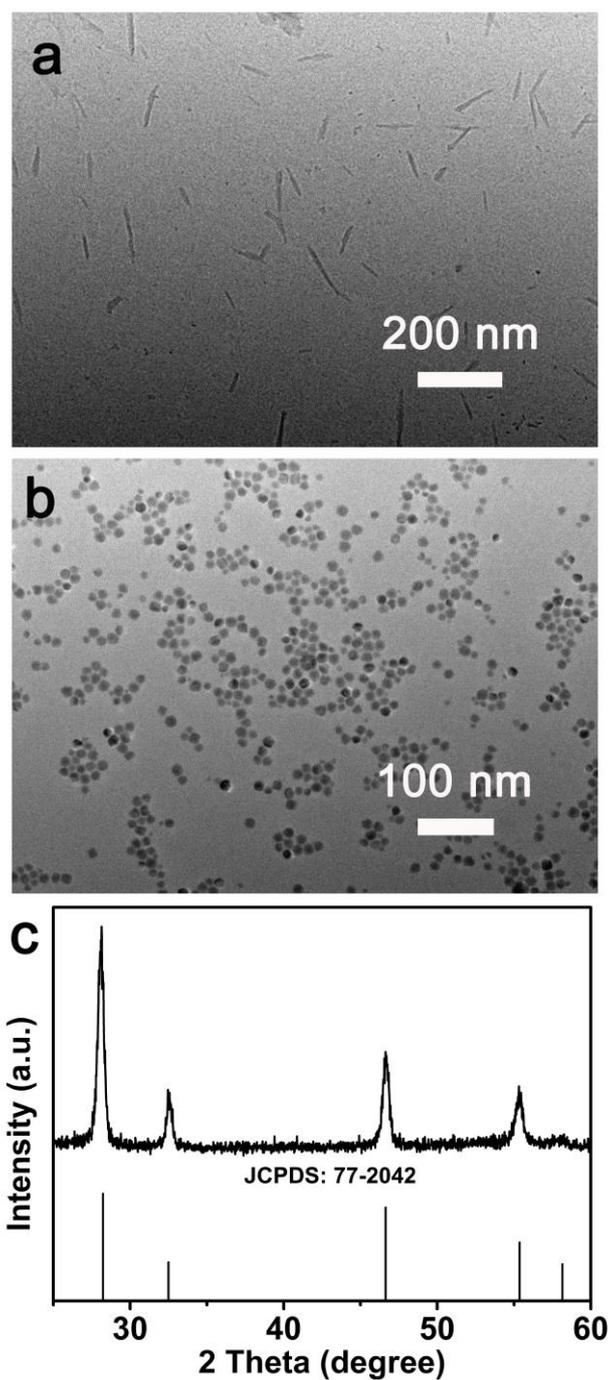


Figure S1 (a) TEM image of CNC suspension. (b) TEM image of NaYF₄:Yb,Er suspension. (c) XRD pattern of NaYF₄:Yb,Er showing the sole presence of cubic NaYF₄.

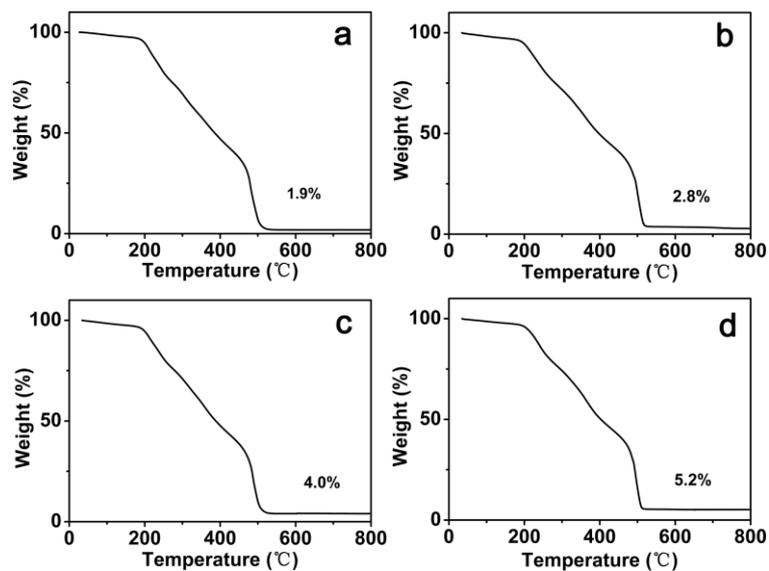


Figure S2 Thermogravimetric analysis of CNC-(NaYF₄:Yb,Er)_x: (a) x = 1.9%. (b) x = 2.8%. (c) x = 4.0%. (d) x = 5.2%.

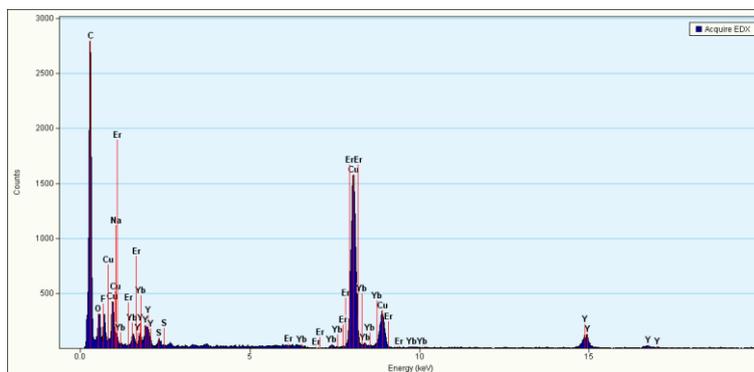


Figure S3 Energy-dispersive X-ray spectroscopy (EDX) elemental analysis of CNC-(NaYF₄:Yb,Er)_{2.8%}.

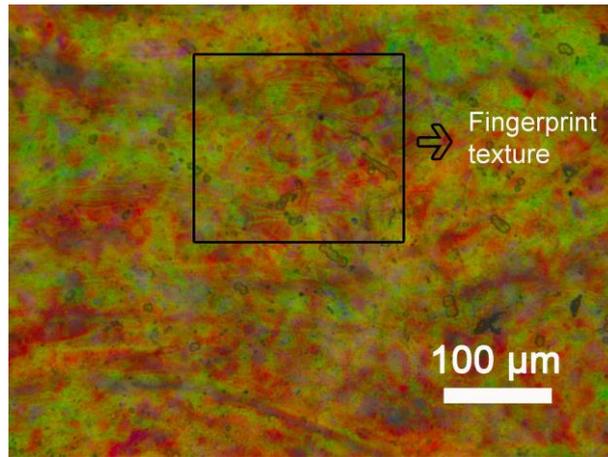


Figure S4 The POM of CNC-(NaYF₄:Yb,Er)_{2.8%} composite film showing the existence of fingerprint texture which demonstrate the formation of chiral nematic phase.

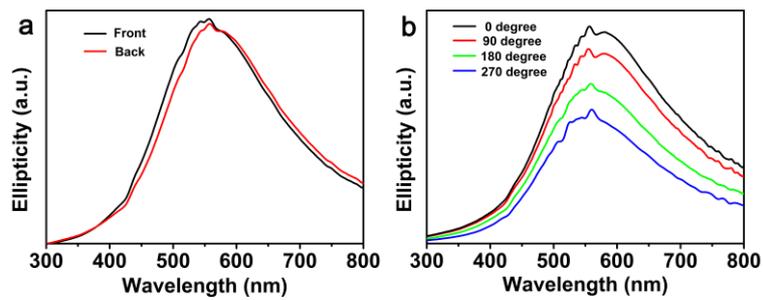


Figure S5 (a) The “front-and-back” CD measurements of the sample CNC-(NaYF₄:Yb,Er)_{2.8%} film. (b) the CD spectra rotated at different angles normal to the beam path.

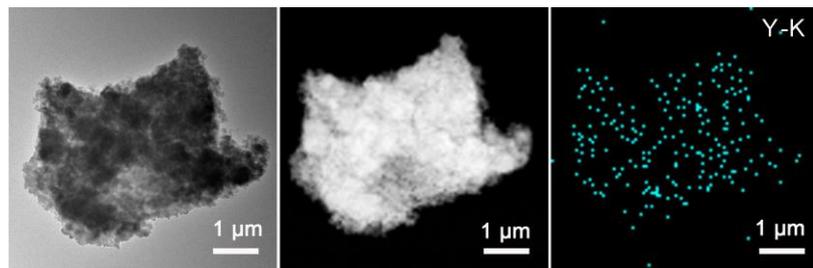


Figure S6 EDX elemental mapping of the CNC-(NaYF₄:Yb,Er)_{2.8%} film.

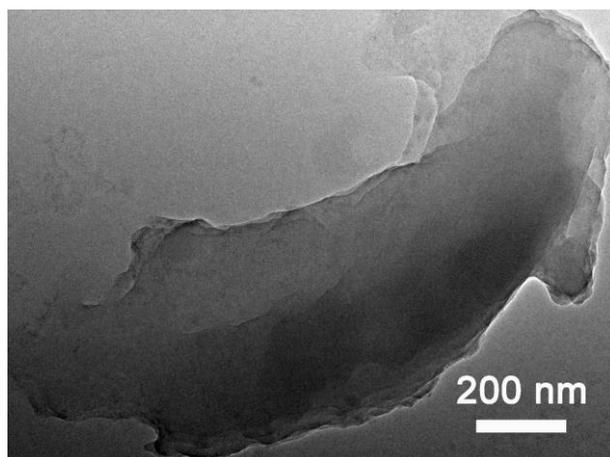


Figure S7 The TEM image of CNC film without NaYF₄:Yb,Er nanoparticles.

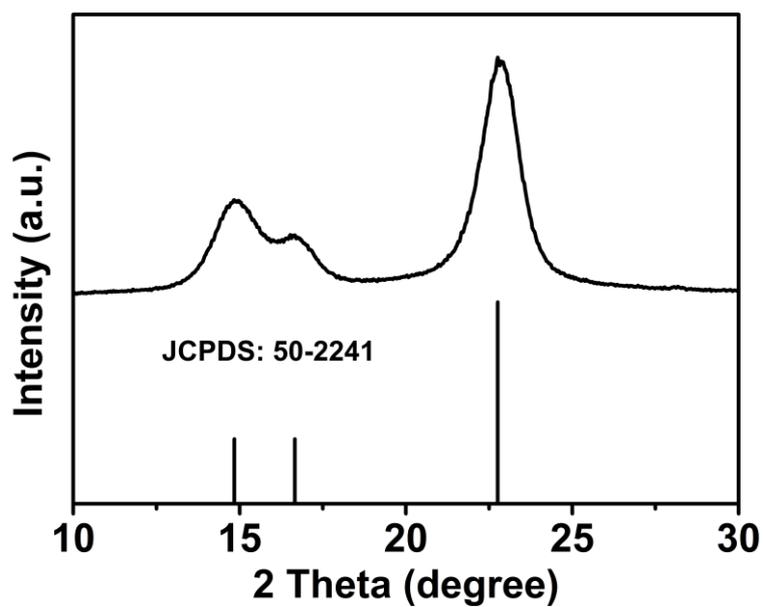


Figure S8 The XRD pattern of CNC film without NaYF₄:Yb,Er upconversion nanoparticles.

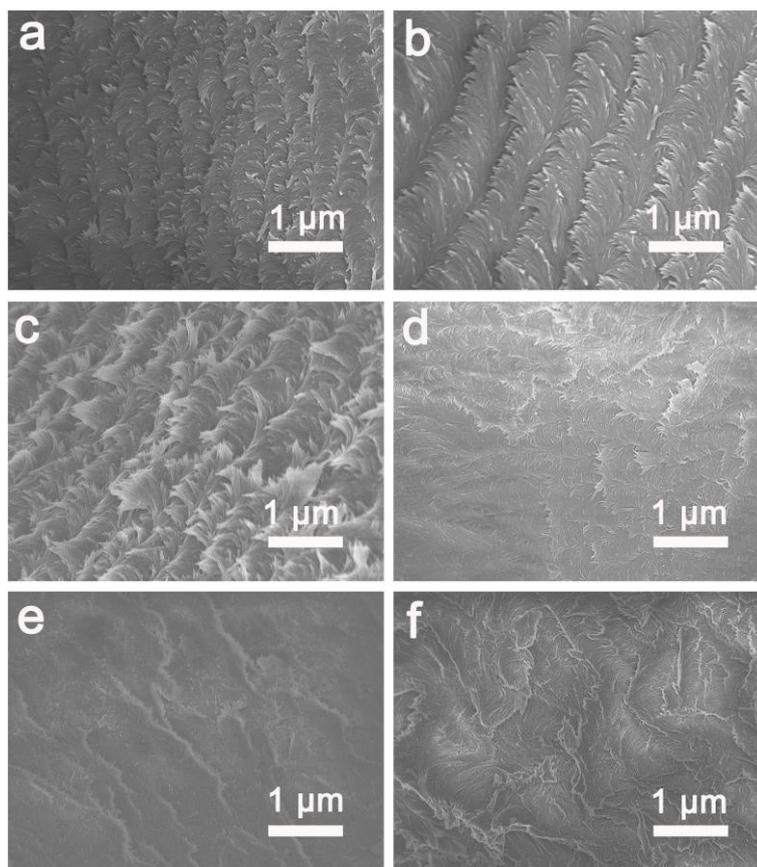


Figure S9 Composite films loaded with different amount of NaYF₄:Yb,Er: (a) CNC-(NaYF₄:Yb,Er)_{1.9%}. (b) CNC-(NaYF₄:Yb,Er)_{2.8%}. (c) CNC-(NaYF₄:Yb,Er)_{4.0%}. (d) CNC-(NaYF₄:Yb,Er)_{5.2%}. (e) CNC-(NaYF₄:Yb,Er)_{6.4%}. (f) CNC-(NaYF₄:Yb,Er)_{7.5%}.

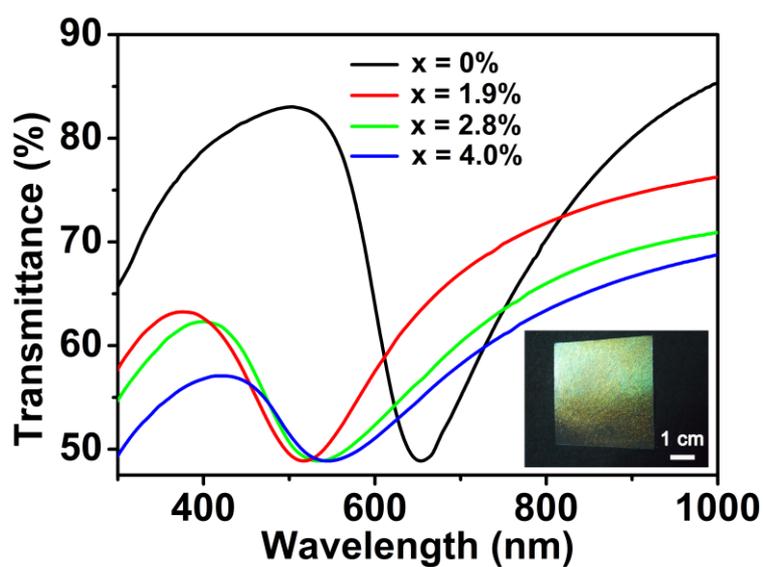


Figure S10 UV-vis spectra of CNC-(NaYF₄:Yb,Er)_{2.8%} with the PBG of CNC at 650 nm. Inset is the photograph of the CNC-(NaYF₄:Yb,Er)_{2.8%} film.

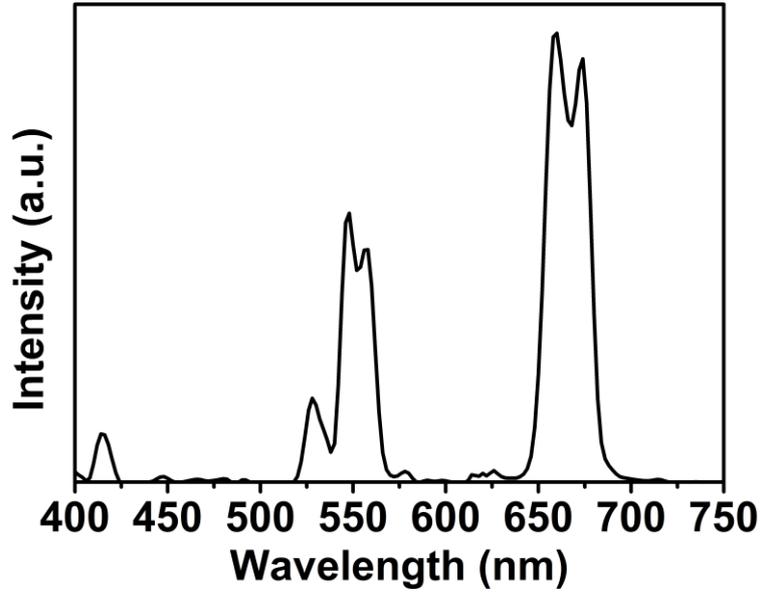


Figure S11 Room temperature emission spectrum of the NaYF₄:Yb,Er suspension.

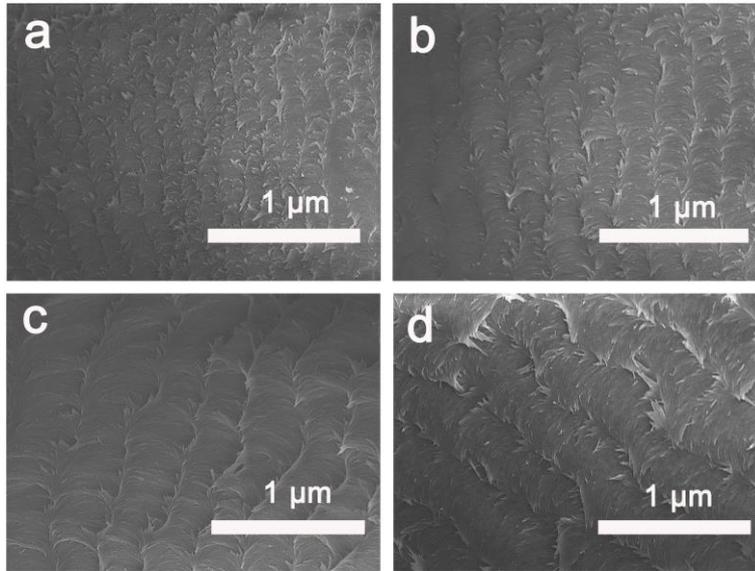


Figure S12 The SEM images showing the variation of pitch lengths by ultrasonic treatment.

Table S1 The variation of the helical pitch and the reflected wavelength of the chiral nematic film when treated by different ultrasonic time, which correspond to the SEM image a-d in Figure S12.

Initial Pitch (nm)	Ultrasonic time (s)	Pitch (nm)	The reflected wavelength (nm)
308	0	308	474
308	20	455	700
308	40	611	940
308	60	758	1167

The original CNC suspension was 40mL. The amplitude was set 20%. The ultrasonication was carried out with no pause.

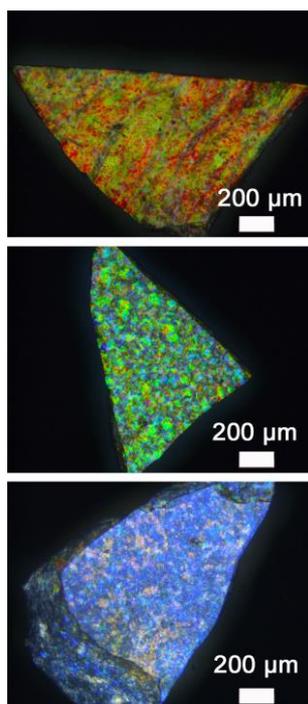


Figure S13 The low magnification POM of $\text{CNC}_{650}\text{-(NaYF}_4\text{:Yb,Er)}_{2.8\%}$, $\text{CNC}_{550}\text{-(NaYF}_4\text{:Yb,Er)}_{2.8\%}$ and $\text{CNC}_{340}\text{-(NaYF}_4\text{:Yb,Er)}_{2.8\%}$ films.

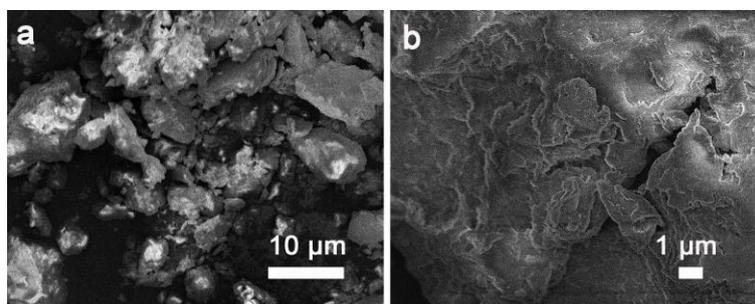


Figure S14 SEM Ref₅₅₀, prepared by grinding $\text{CNC}_{550}\text{-(NaYF}_4\text{:Yb,Er)}_{2.8\%}$, showing loss of the chiral nematic ordering. (a) Low magnification SEM. (b) High magnification.