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Electronic Supplementary Information (ESI)

Circularly polarized luminescence from structurally coloured polymer films

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Table of Contents

Experimental Section

Fig. S1 Molecular structures of the compounds in the LC system.

Fig. S2 POM images of (a) C6M, (b) C6M with 1.75% S5011, (c-i) C6M with 2 wt% TPE, and 1.38, 1.50, 1.63, 1.75, 1.88, 2.00, 2.13 wt% S5011 at 90 °C.

Table S1 The mass percentages of compounds in the prepolymerized mixtures.

Table S2 Bragg reflection properties of *R*-/*S*-TPE-CLC films.

Fig. S3 (a) Photographs and (b) DRUV-vis spectra of *R*-TPE-CLC films.

Fig. S4 FESEM images of the cross-sections of the *S*-TPE-CLC films prepared using (a) 1.38 wt%, (b) 1.75 wt% and (c) 2.13 wt% of S5011.

Fig. S5 Photoluminescence spectra of (a and b) *S*-/*R*-TPE-CLC films and (c) CLC films without TPE.

Fig. S6 The g_{lum} values of the TPE-CLC films prepared using different R/S5011 weight ratios at the wavelength of 485 nm.

Fig. S7 FESEM images of the cross-sections of the *S*-TPE-CLC films prepared using 1.75 wt% of S5011 at the temperature of (a) 50, (b) 70, (c) 90, and (d) 98 °C.

Fig. S8 (a) CPL spectra and (b) g_{lum} values of *S*-TPE-CLC films prepared using 1.75 wt% of S5011 at different temperatures at the wavelength of 485 nm.

Fig. S9 CD spectra of the *S*-/*R*-TPE-CLC films prepared by using 1.75 wt% of S/R5011.

Fig. S10 The pictures of patterns of (a) star and (b) key shapes based on TPE-CLC films.

Experimental Section

General information

2-Methyl-1,4-phenylene bis(4-((6-(acryloyloxy)hexyl)oxy)benzoate) (C6M, >99% purity), 4-methoxyphenyl 4-((6-(acryloyloxy)hexyl)oxy)benzoate (RM105, >99% purity), (13bR)-5,6-Dihydro-5-(*trans*-4-propylcyclohexyl)-4*H*-dinaphtho[2,1-*f*:1',2'-*h*][1,5] dioxonin (R5011, >99% purity) and (13bS)-5,6-Dihydro-5-(*trans*-4-propylcyclohexyl)-4*H*-dinaphtho[2,1-*f*:1',2'-*h*][1,5]dioxonin (S5011, >99% purity) were purchased from Sanjiang advanced materials R&D Co., Ltd (Nanjing, China). Petroleum ether (PE, bp: 60-90 °C), ethyl acetate (EA), ethyl alcohol (EtOH), dichloromethane (CH₂Cl₂) and tetrahydrofuran (THF) were obtained from Shanghai Lingfeng Chemical Reagent Co., Ltd. THF was distilled from sodium benzophenone ketyl before use. BDK, Zinc, TiCl₄ and benzophenone was purchased from Adamas Chemical Co., Ltd. Tetraphenylethene was synthesized by the McMurry home-coupling of benzophenone.

¹H NMR spectra were recorded on an INOVA-400 spectrometer in CDCl₃ using tetramethylsilane (TMS) as an internal standard. High-resolution mass spectra (HRMS) were measured with an Ultraflex extreme MALDI TOF/TOF spectroscope (Bruker, USA). Elemental analysis was measured on a Vario EL III instrument. FT-IR spectra were performed on a VRETEX 70 spectrometer at 4.0 cm⁻¹ resolution by an averaging over 16 scans. Field-emission scanning electron microscopy (FE-SEM) images were obtained using a Hitachi S-4800 operating (Ibaraki prefecture, Japan) at 5.0 kV. To obtain good morphology, cross-sectional SEM samples were prepared in liquid nitrogen. The POM images of the target compounds were taken using a Leica Microsystems CMS GmbH fitted with a Linkam LTS420 hot stage. DRUV-*vis* reflectance spectra were measured by UV-VIS-NIR spectrophotometer (UV3600). Diffuse reflectance circular dichroism (DRCD) spectra were measured by using a JASCO 815 spectrometer (JASCO, Japan), and anhydrous barium sulfate dried at a high temperature was used as blank. Fluorescence spectra were measured by FLS 980 (Edinburgh Instrument, UK). Absolute fluorescence quantum yields were determined with FLS 980 using the integrating sphere method with a blank as a reference. CPL spectra were measured on JASCO CPL-300 (JASCO, Japan). In the CPL measurements, the excitation wavelength was 340 nm, scan speed was 200 nm/min, number of scans was 1, and slit width was 3000 μm. To eliminate the effect of

linearly polarized luminescence, CPL spectra of the films were measured by using a plate holder allowing the samples to be rotated through 360° at 45° increments.

Preparation of TPE-CLC films

A typical preparation procedure is shown as following. C6M, R/S5011, RM105, TPE and the photoinitiator BDK were dissolved in anhydrous THF according to the weight ratio shown in Table S1. Then, the solvent was evaporated on the surface of a quartz plate at 120 °C for 5 min. The thickness of the obtained liquid film was kept at 11 μm thickness by the sandwich structure (quartz plates with 11 μm spacer in the middle). After the liquid film was cooled down to 90 °C, photopolymerization was carried out under UV irradiation using a 365 nm-xenon lamp for 10 seconds. Then, the TPE-CLC films were obtained. Free-standing films can be obtained by peeling the films off the quartz plates with a blade.

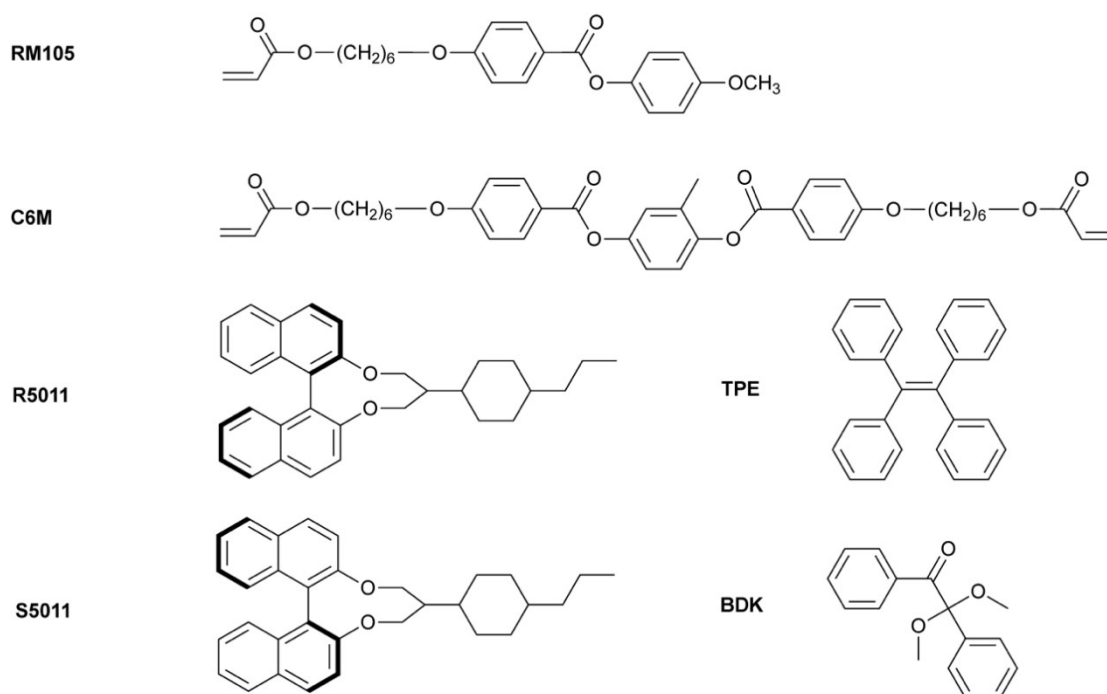
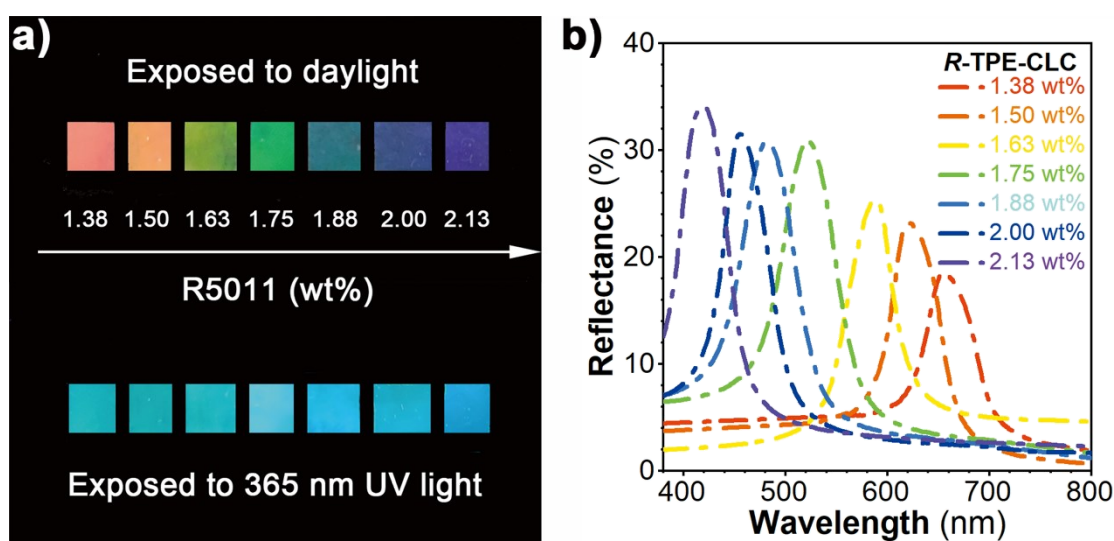
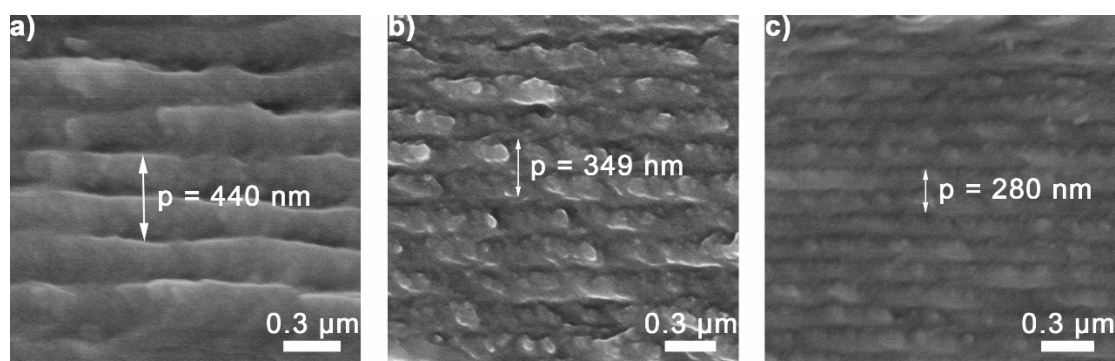


Fig. S1 Molecular structures of the compounds in the LC system.

Table S2. Bragg reflection properties of *R/S*-TPE-CLC films

Films	λ (nm) ^[a]	n ^[b]	c ^[c]	p (nm) ^[d]	β_m (μm^{-1}) ^[e]
<i>R/S</i> -R	658/656	1.48	0.014	445/443	161/161
<i>R/S</i> -O	618/613	1.48	0.015	418/414	159/161
<i>R/S</i> -Y	570/568	1.48	0.016	385/384	162/163
<i>R/S</i> -G	524/524	1.48	0.018	354/354	157/157
<i>R/S</i> -C	485/484	1.48	0.019	328/327	160/161
<i>R/S</i> -B	457/460	1.48	0.020	309/311	162/161
<i>R/S</i> -P	422/420	1.48	0.021	285/284	167/168

The [a] λ_{max} values and [b] refractive indices of the TPE-CLC films. [c] The mass ratio of the chiral dopants in the TPE-CLC films. [d] Helical pitches of the TPE-CLC films. [e] The calculated HTP values of R/S5011 ($\beta_m = p^{-1}c^{-1}$).

**Fig. S3** (a) Photographs and (b) DRUV-vis spectra of *R*-TPE-CLC films.**Fig. S4** FESEM images of the cross-sections of the *S*-TPE-CLC films prepared using (a) 1.38 wt%, (b) 1.75 wt% and (c) 2.13 wt% of S5011.

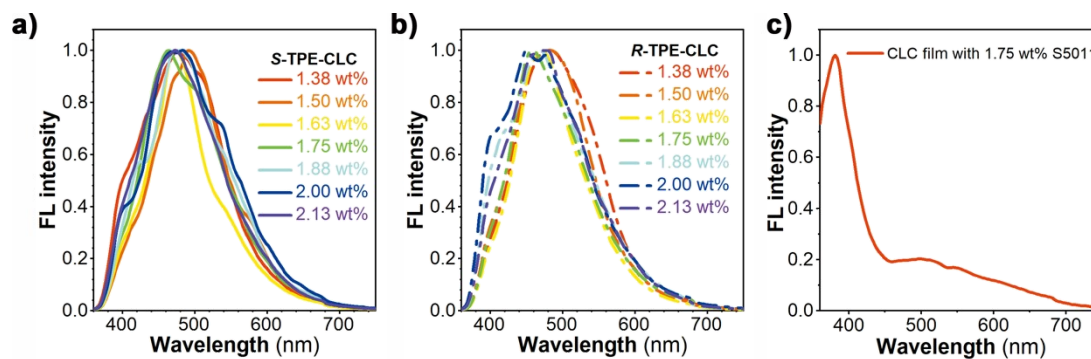


Fig. S5 Photoluminescence spectra of (a and b) *S*-/*R*-TPE-CLC films and (c) CLC film without TPE.

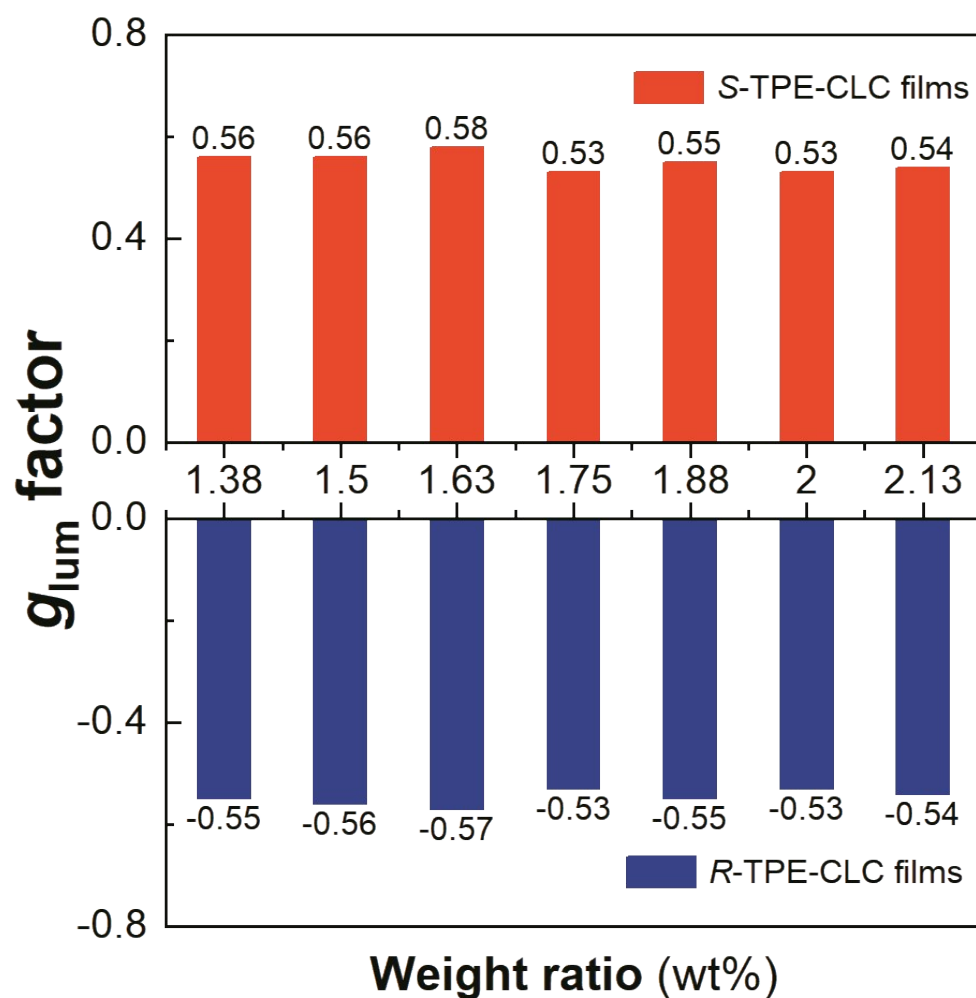


Fig. S6 The g_{lum} values of the *R*/*S*-TPE-CLC films prepared using different R/S5011 weight ratios at the wavelength of 485 nm.

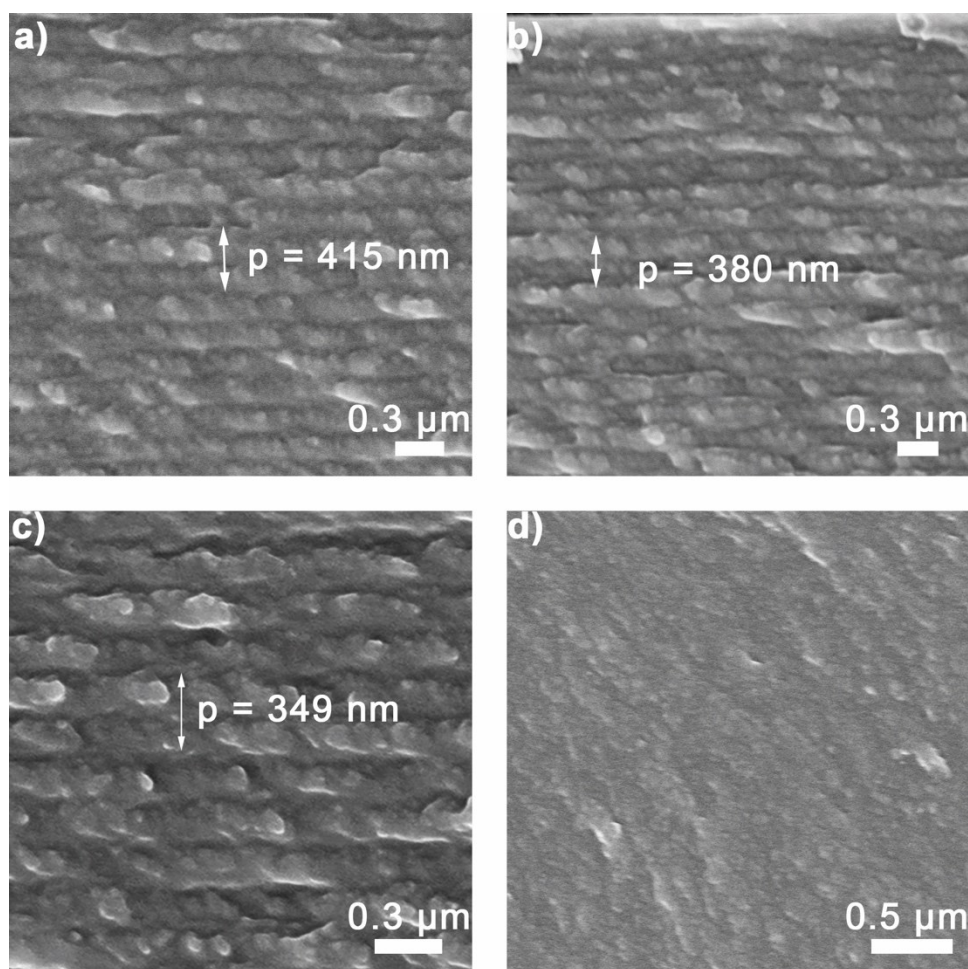


Fig. S7 FESEM images of the cross-sections of the *S*-TPE-CLC films prepared using 1.75 wt% of S5011 at the temperature of (a) 50, (b) 70, (c) 90, and (d) 98 °C.

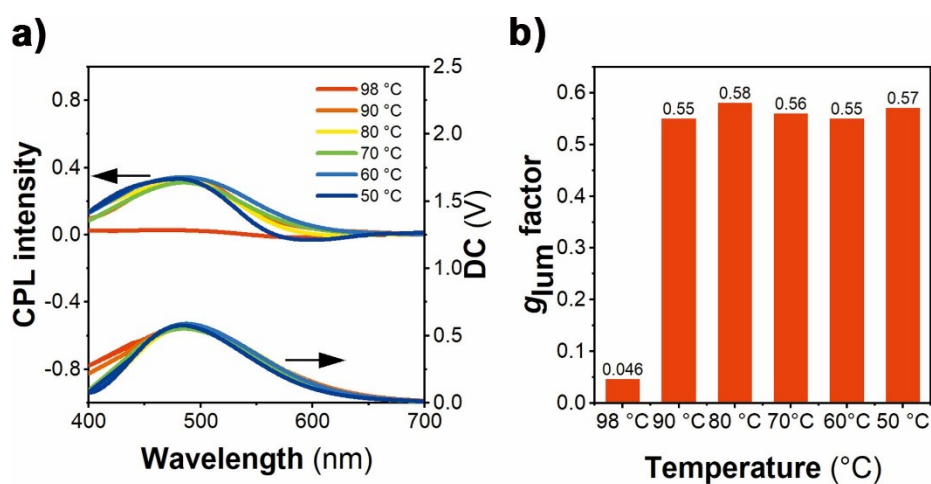


Fig. S8 (a) CPL spectra and (b) g_{lum} values of *S*-TPE-CLC films prepared using 1.75 wt% of S5011 at different temperatures at the wavelength of 485 nm.

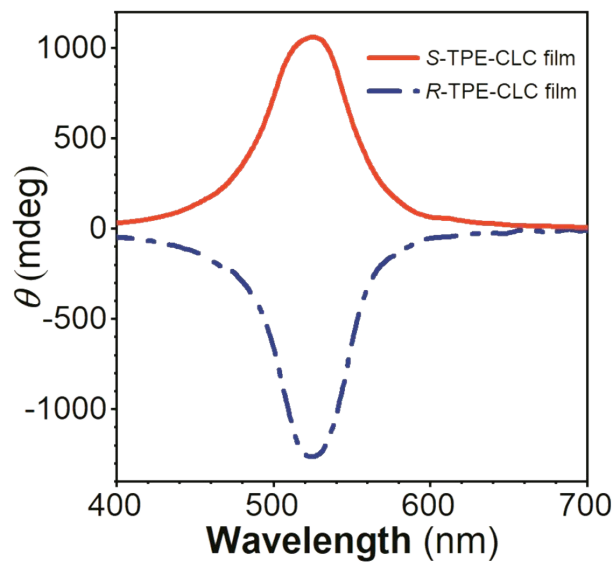


Fig. S9 CD spectra of the *S*-/*R*-TPE-CLC films prepared by using 1.75 wt% of S/R5011.

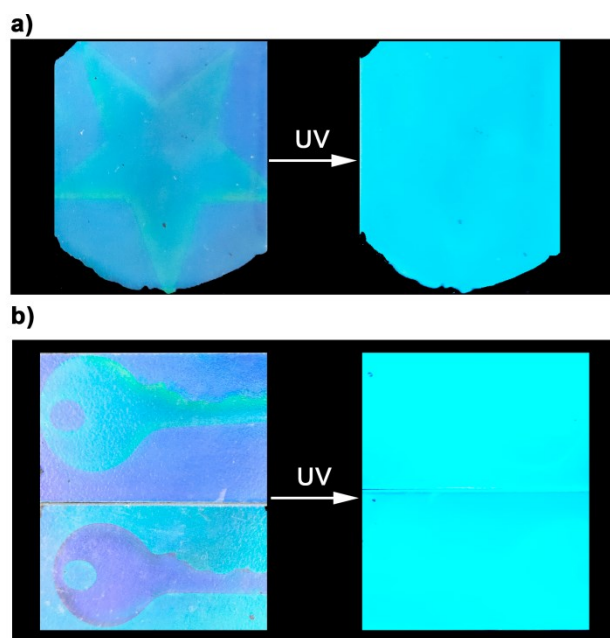


Fig. S10 The pictures of patterns of (a) star and (b) key shapes based on TPE-CLC films.