

## Electronic Supplementary Information

### Wavelength-Tunable Linearly Polarized Luminescence Film Constructed by Highly Efficient Luminescent Liquid Crystal with Stimuli-Responsive Property

Lei Tao,<sup>a</sup> Kai Lan,<sup>a</sup> Cheng-Long Zhong,<sup>a</sup> Ying-Jie Zhou,<sup>b</sup> Ping Wang,<sup>a</sup> Fan Fan,<sup>b</sup>  
Zhihao Shen,<sup>c</sup> He-Lou Xie <sup>a\*</sup>

<sup>a</sup> *Key Lab of Environment-friendly Chemistry and Application in Ministry of Education, and Key Laboratory of Advanced Functional Polymer Materials of Colleges, Universities of Hunan Province and College of Chemistry, Xiangtan University, Xiangtan Hunan, 411105, China.*

<sup>b</sup> *Key Laboratory for Micro/Nano Optoelectronic Devices of Ministry of Education & Hunan Provincial Key Laboratory of Low-Dimensional Structural Physics and Devices, School of Physics and Electronics, Hunan University, Changsha 410082, China*

<sup>c</sup> *Beijing National Laboratory for Molecular Sciences, Key Laboratory of Polymer Chemistry and Physics of Ministry of Education, Center for Soft Matter Science and Engineering, College of Chemistry and Molecular Engineering, Peking University, Beijing 100871, China*

*\*To whom the correspondence should be addressed.*

E-mail: xhl20040731@163.com (HLX)

#### 1. Materials.

4-Hydroxyphenylacetonitrile (98%, Energy Chemical), 4-bromobenzaldehyde (98%, Energy Chemical), potassium tert-butanolate (98%, Energy Chemical), 1,6-dibromohexane (98%, Energy Chemical), methacrylic acid (99%, Alfa Aesar), pyridine-4-boronic acid (98%, Energy Chemical), and tetrakis(triphenylphosphine) palladium (99%, Energy Chemical) were directly used without any treatment.

Photoinitiator bis(2,6-difluoro-3-(1-hydroxypropyl)-phenyl)titanocene (IRG-784) and the reactive monomer 1,4-bis[4-(6-acryloyloxyhexyloxy)benzoyloxy]-2-methylbenzene (C6M) were purchased from Hua Teng Pharma. All the materials were directly used without any treatment.

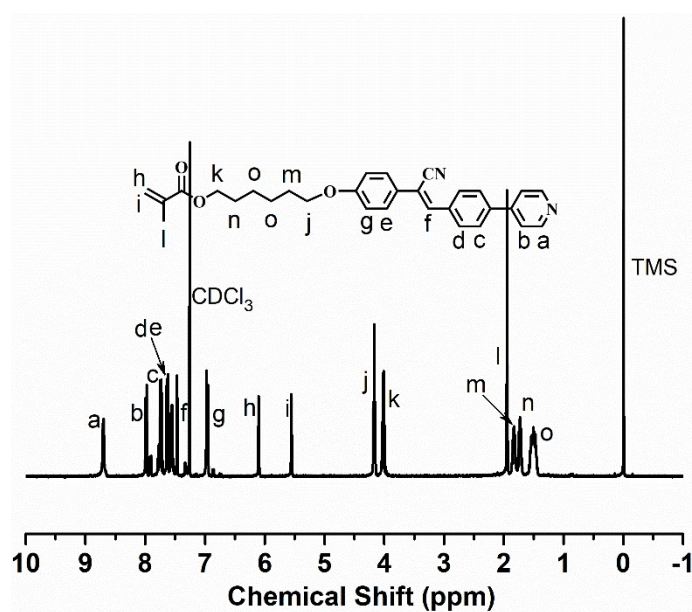
## **2. Instruments and Measurements.**

$^1\text{H}$  and  $^{13}\text{C}$  NMR spectra were obtained by using Bruker ARX 400 MHz nuclear magnetic resonance spectrometer, with  $\text{CDCl}_3$  as the solvent and tetramethylsilane (TMS) as the internal standard. Matrix assisted laser desorption ionization tandem time-of-flight (MALDI-TOF) mass spectrometry was conducted on a Bruker Daltonics BIFLEX III MALDI-TOF analyzer. Fourier-transform infrared spectroscopy (FT-IR) experiments were performed by a PE Spectrum One FT-IR spectrometer with the wave number from 4000 to 500  $\text{cm}^{-1}$ . The white light source of the photopolymerization experiment was a 470 nm LED (FUWO, F7BB20 800W  $\text{m}^{-2}$ ).

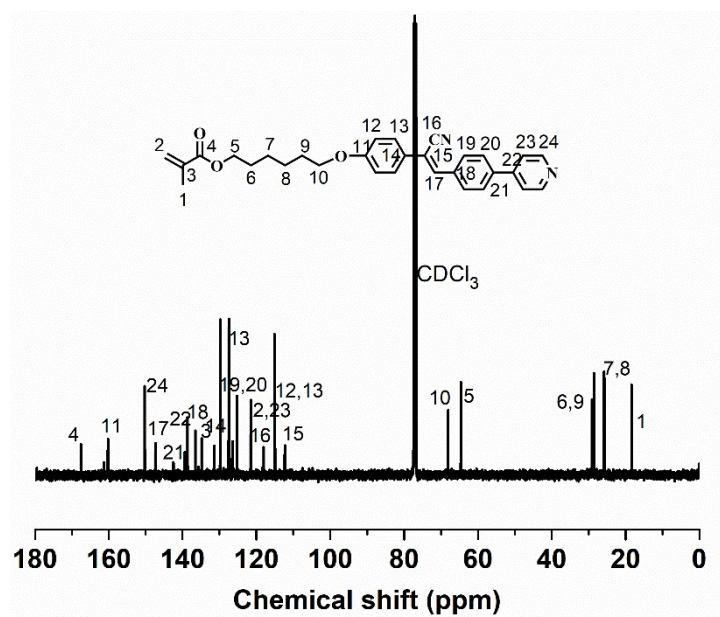
The thermal stability of the samples was determined by thermogravimetric analysis (TGA), which was performed by STD Q600 instrument with a heating rate of 20  $^\circ\text{C}/\text{min}$  under a nitrogen atmosphere. Polarized optical microscopy (POM, Leica DM-LM-P) with a Mettler FP82HT heating plate was used to obtain the structure and molecular orientation of the samples. Differential scanning calorimetry (DSC) traces were measured by a TA-Q10 calorimeter in nitrogen with a rate of 10  $^\circ\text{C}/\text{min}$ . One-dimensional (1D) and two-dimensional (2D) wide-angle X-ray diffraction (WAXD) results were recorded on a Bruker D8 Advance diffractometer. The horizontal

placement of samples and reflecting peaks on the stage were calibrated with silver behenate.

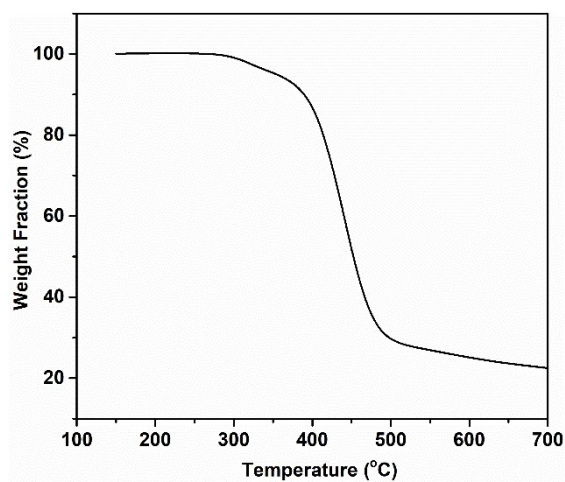
UV-vis absorption spectra were measured by a Cary 60, with a flashing xenon lamp as the light source. Emission experiments were performed by using an F-4600 spectrofluorometer with quartz cuvettes. The linearly polarized luminescence (LPL) property of the film was studied using a F-4600 spectrofluorometer with a polarizer between the film and detector. The quantum yields ( $\Phi_{F_s}$ ) were determined by a Nanolog FL3-2iHR infrared fluorescence spectrometer by using the integrating sphere, with a R928 photomultiplier as the detector. A fluorescence microscope (Carl Zeiss) was employed to investigate the polarized fluorescence with X-cite as the light source.



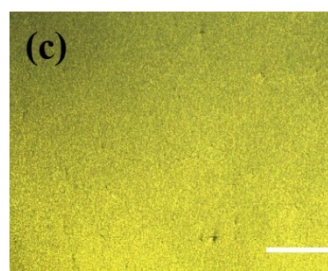
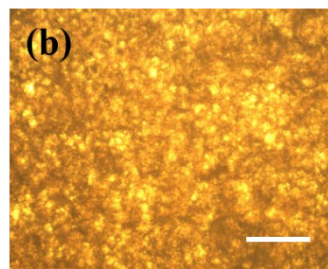
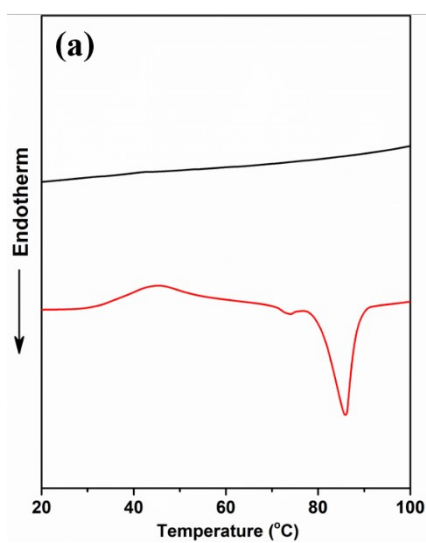
**Figure S1.** <sup>1</sup>H NMR spectrum of M6BP.



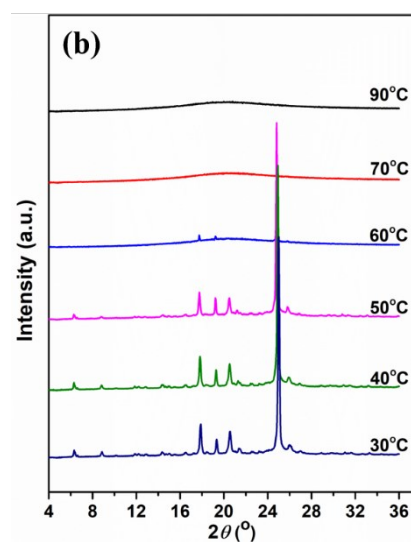
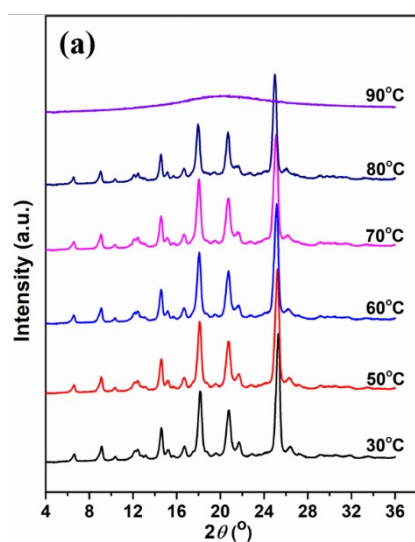
**Figure S2.** <sup>13</sup>C NMR spectrum of M6BP.



**Figure S3.** TGA curve of M6BP in the N<sub>2</sub> atmosphere with a heating rate of 20 °C/min.



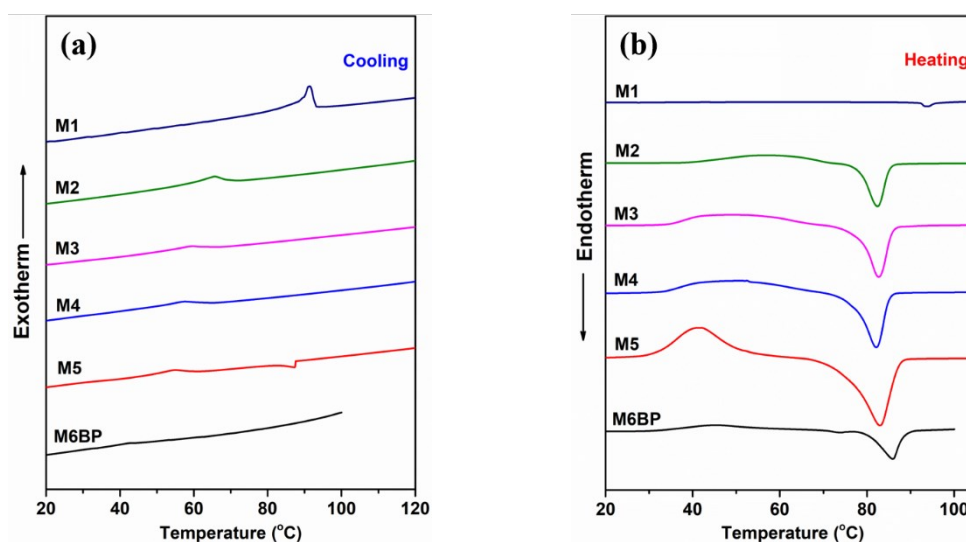
**Figure S4.** DSC traces of M6BP in the first cooling and second heating processes (a), POM images of M6BP on heating at 80 °C (b) and at 30 °C during the cooling process (c). The scale bar is 50  $\mu\text{m}$ .



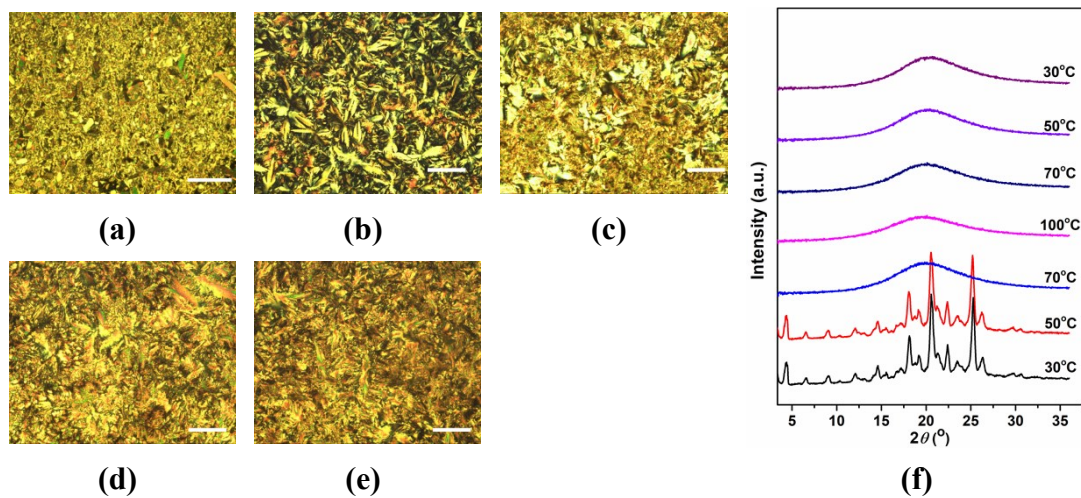
**Figure S5.** Variable-temperature 1D WAXD traces of M6BP during the heating (a) and cooling (b) processes.

**Table S1.** The compositions of M6BP and C6M in the mixtures.

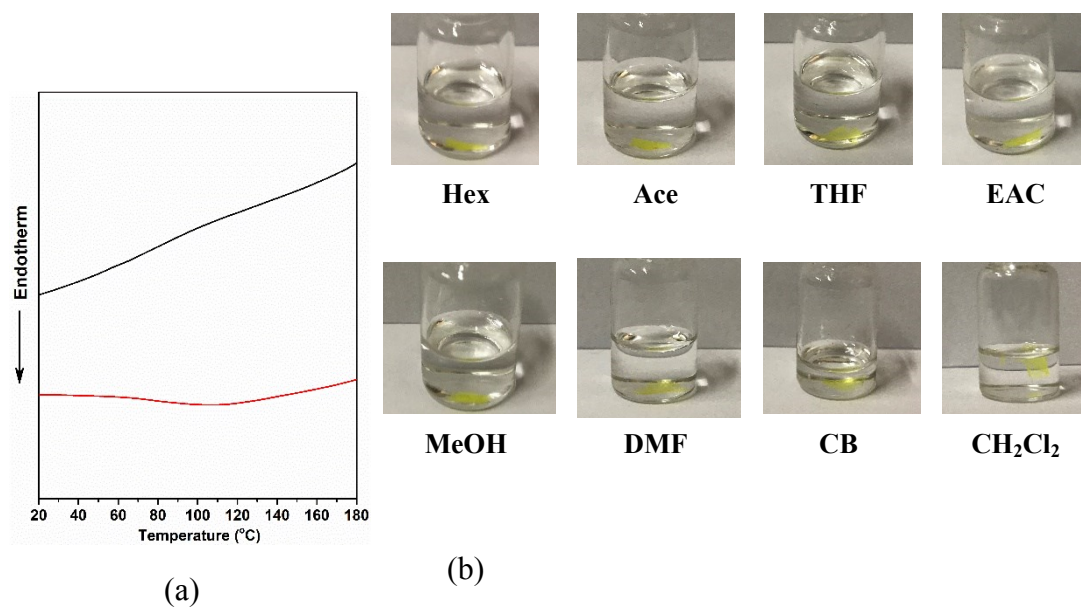
Mixture composition (mol %)			
	M6BP	C6M	Irgacure 784
M5	90	8	2
M4	80	18	2
M3	70	28	2
M2	60	38	2
M1	50	48	2



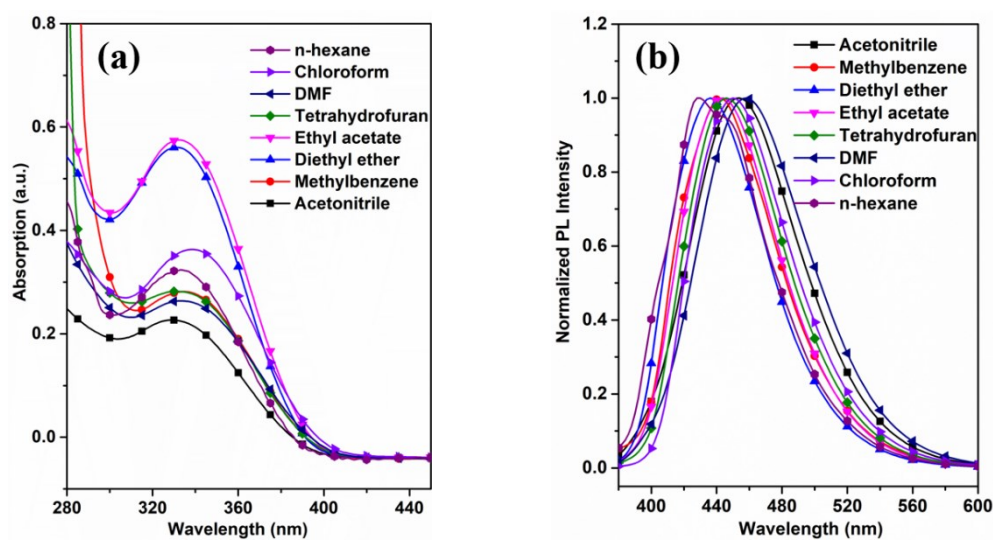
**Figure S6.** DSC traces of the mixtures during the first cooling (a) and the second heating (b) processes in the nitrogen atmosphere with a rate of 10°C/min.



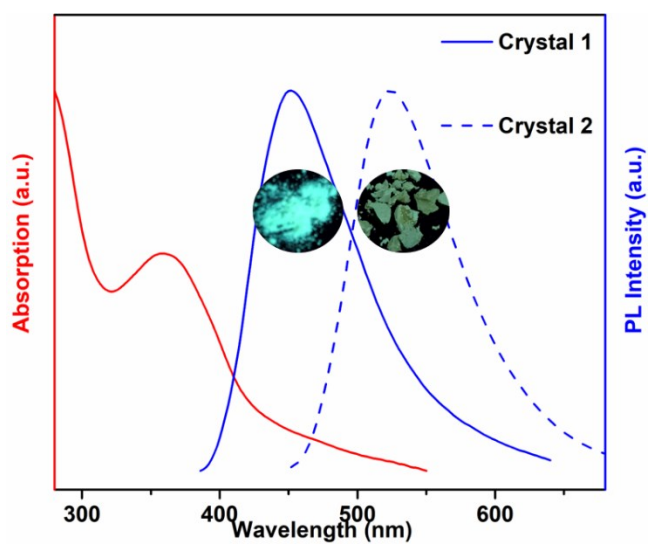
**Figure S7.** POM images of M1 (a), M2 (b), M3 (c), M4 (d), and M5 (e) during the cooling process. The variable-temperature 1D WAXD of M1 (f). The scale bar is 50  $\mu\text{m}$ .



**Figure S8.** DSC curve of the free-standing film (a) and the chemical stability test of the free-standing film in different organic solvents (b).

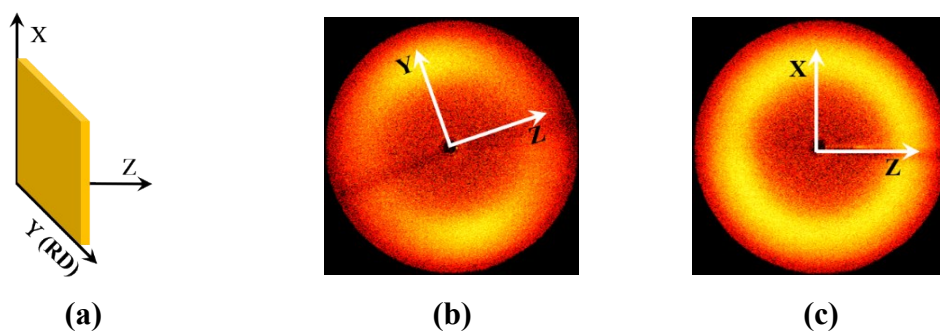


**Figure S9.** UV-vis (a) and PL (b) results of M6BP in different polar solvents.

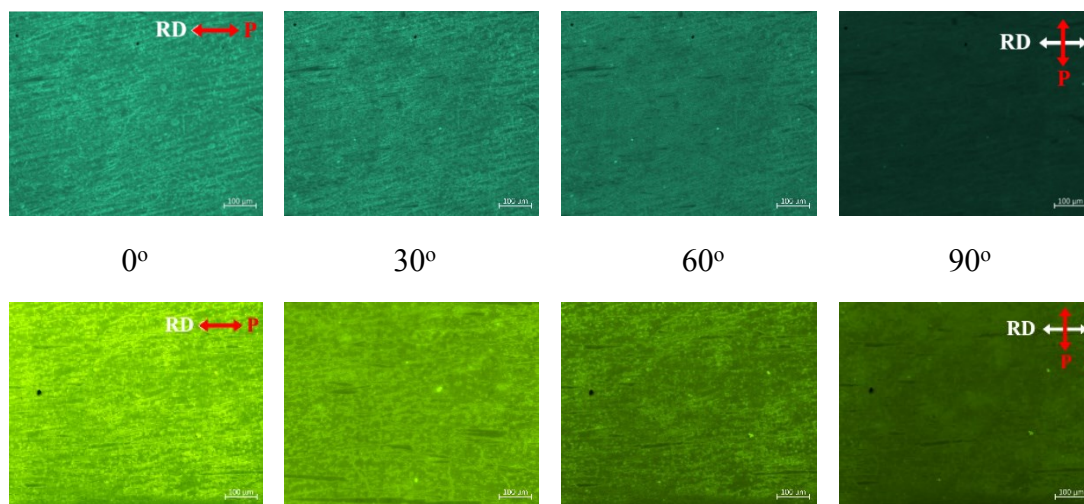


**Figure S10.** UV-vis and PL results of M6BP in the film.

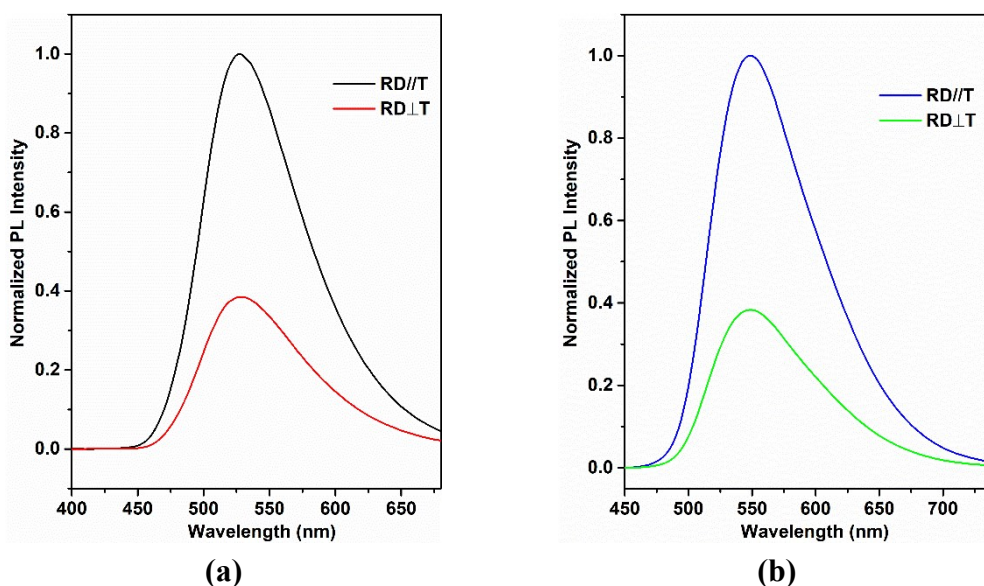




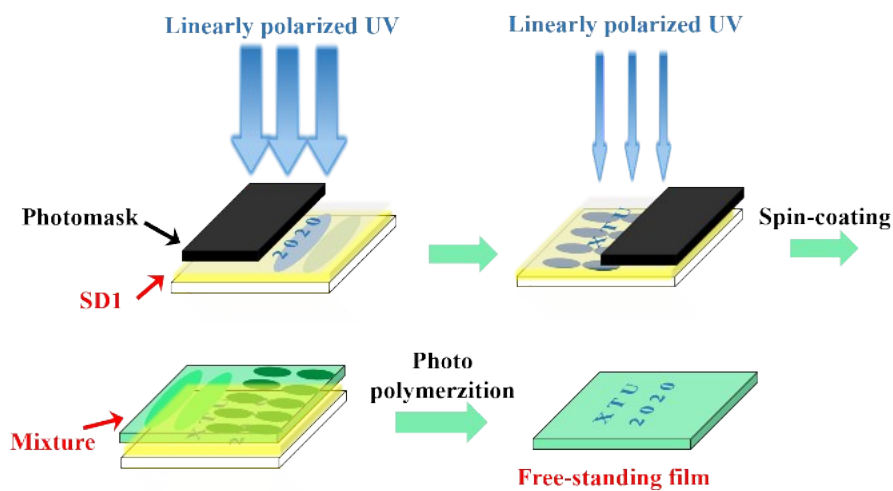
**Figure S11.** Schematic drawing of the free-standing film in 2D WAXD experiments (a), and the 2D WAXD patterns of the free-standing film after exposure to TFA vapor (b-c).



**Figure S12.** Fluorescence microscope photos of the film under the TFA and TEA vapors with different angles between RD and polarizer, where p represents the polarizer axis.



**Figure S13.** PL spectra of the free-standing film with the RD parallel and perpendicular to the polarizer axis after 10 cycles of TEA/TFA vapors. PL spectra of the free-standing film with TEA (a) and TFA (b) vapor.



**Figure S14.** Production process of the film with a special orientation by patterned photoalignment.