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Supporting Information

Title (Cholesteric Liquid Crystal with Electrically Controllable Reflection Bandwidth based on Ionic Polymer Network and Chiral ion**)**

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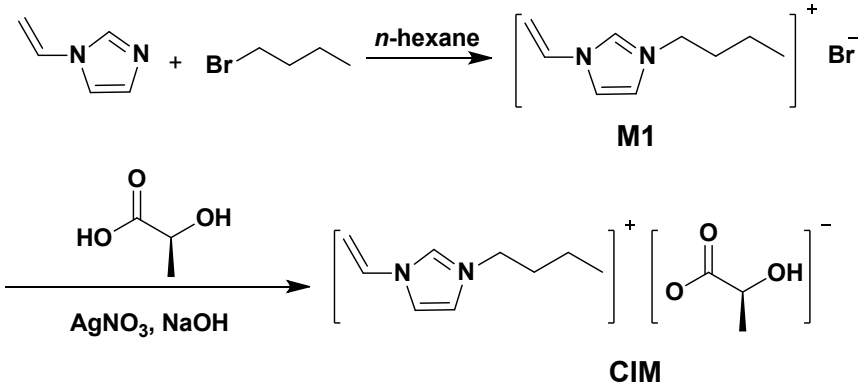
1. Synthetic procedures of the CIM

The CIM was synthesized in our laboratory. All chemical reagents and solvents were commercially available and used without further purification.

Chiral ionic monomer, **CIM** was prepared by following the synthetic route shown in Scheme S1.



Scheme S1. Synthetic route of CIM

1.1 Synthesis of 1-vinyl-3-butylimidazolium bromide (M1)

1-Vinyl-3-butylimidazolium bromide (M1) was prepared from 1-vinylimidazole using alkylation reaction with 1-bromobutane. 1-Bromobutane (5.05 g, 33.43 mmol) was added dropwise to 1-vinylimidazole (2.65 g, 28.16 mmol) with moderate n-hexane used as the solvent under nitrogen environment. The reaction temperature was 70 ^{o}C while the times of reaction was 24 hours. The mixture continues to be stirred until cooling to room temperature

when the reaction ended. Then *n*-hexane was evaporated at 35 ^{o}C. Next 25 mL ethyl acetate was added to this reaction mixture, and it was stirred vigorously. The mixture was then filtered to remove excess 1-bromobutane. That was product remained, which was dried in vacuum for about 24 hours at 40 ^{o}C. The product was obtained as a brown sticky liquid (5.96 g, 86.4% yield).

^{1}H NMR (600 MHz, $CDCl_3$, δ ppm): 0.84-0.87 (3H, t, CH_2CH_3), 1.26-1.32 (2H, m, $CH_2CH_2CH_3$), 1.82-1.87 (2H, m, $CH_2CH_2CH_2$), 4.32-4.34 (2H, t, $CH_2CH_2CH_2$), 5.28 (1H, d, $CH=CH_2$), 5.98 (1H, d, $CH=CH_2$), 7.38-7.42 (1H, m, $CH=CH_2$), 7.67 (1H, s, CH), 7.97 (1H, s, CH), 10.73(1H, s, CH).

1.2 Synthesis of 1-vinyl-3-butylimidazolium L lactic acid (CIM)

Silver lactate was prepared from replacement reaction for many times. Sodium hydroxide (2 g, 50 mmol) aqueous solution and silver nitrate (4.5 g, 26.5 mmol) aqueous solution was added to a dried flask at room temperature. The mixture was then filtered to get silver hydroxide sediments, which was washed several times using deionized water. L-lactic was added to dissolve the above silver hydroxide sediments while pH test paper was used to demarcate the reaction. The last aqueous solution was silver lactate. The above 1-vinyl-3-butylimidazolium bromide was added dropwise to silver lactate aqueous solution until no more sediments appeared. The mixture here was filtered to remove sediments. And the filtrate was evaporated to remove water. The final product was dried in vacuum for about 24 hours at 60 ^{o}C (5.52 g, 89.3% yield).

^{1}H NMR (600 MHz, CD_3OD, δ ppm): 0.92-0.94 (3H, t, CH_2CH_3), 1.27-1.28 (3H, d, $CHCH_3$),1.30-1.37 (2H, m, $CH_2CH_2CH_3$), 1.81-1.86 (2H, m, $CH_2CH_2CH_2$), 3.24 (1H, s, OH),

4.00-4.04 (1H, m, $CHCH_3$), 4.20-4.22 (2H, t, $CH_2CH_2CH_2$), 5.37 (1H, d, $CH=CH_2$), 5.85 (1H, d, $CH=CH_2$), 7.18-7.23 (1H, m, $CH=CH_2$), 7.71 (1H, s, CH), 7.95 (1H, s, CH), 9.32 (1H, s, CH).

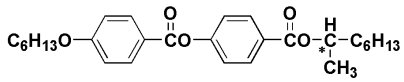
A) Nematic Liquid Crystal: HNG715600-100 (HCCH, China)

Mixture of liquid crystals with negative dielectric anisotropy

n_e = 1.646, Δn = 0.153 (589 nm, 20 °C), Δε= -12.2 (1 KHz,25 °C)

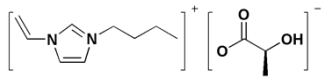
B) Chiral Dopant: S811 (HCCH, China)

Left-hand

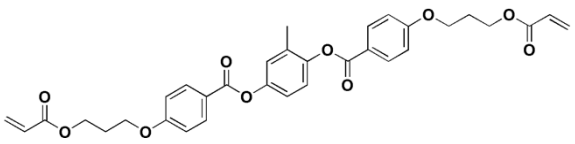


C) Chiral ionic monomer: CIM

Left-hand



D) Photo-polymerizable liquid crystal monomer: RM257 (HCCH, China)



E) Photoinitiator: benzoin methyl ether (TCI Co., Ltd.)

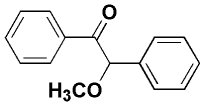


Figure S1. Chemical structures of the materials used in this study.

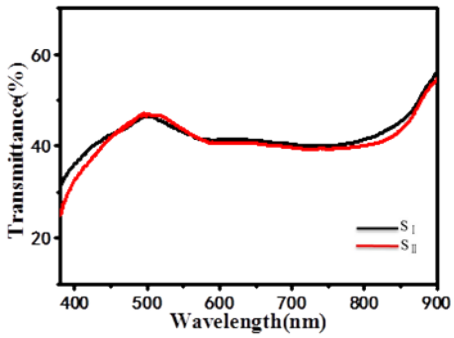


Figure S2. The transmittance of side s_I and side s_{II} in CLC cell.

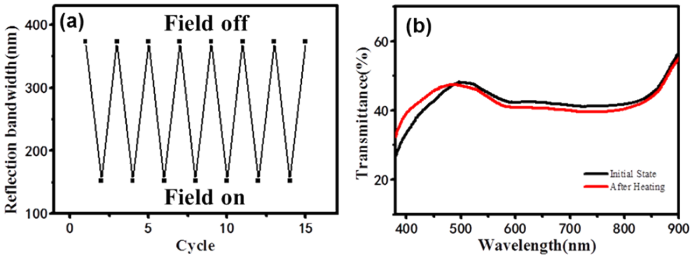


Figure S3. (a) Repeated switching of reflection bandwidth between the field-off and field-on states. (b) The transmission spectra the PSCLC before and after the annealing (90 °C).

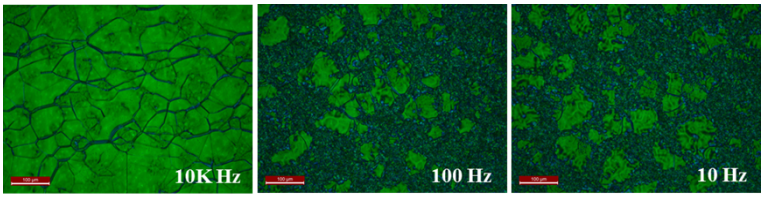


Figure S4: The POM of the PSCLC under high AC electric fields (2.1 V/μm) with different frequency.

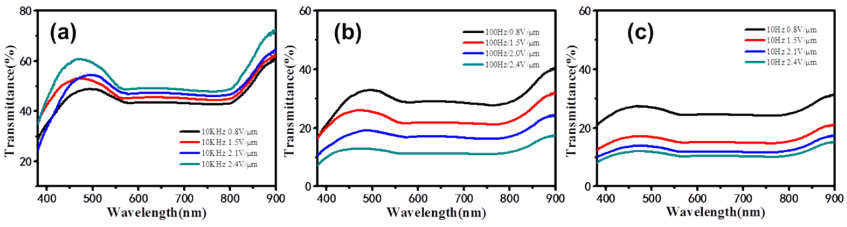


Figure S5: Transmission spectra of the PSCLC under AC electric fields.

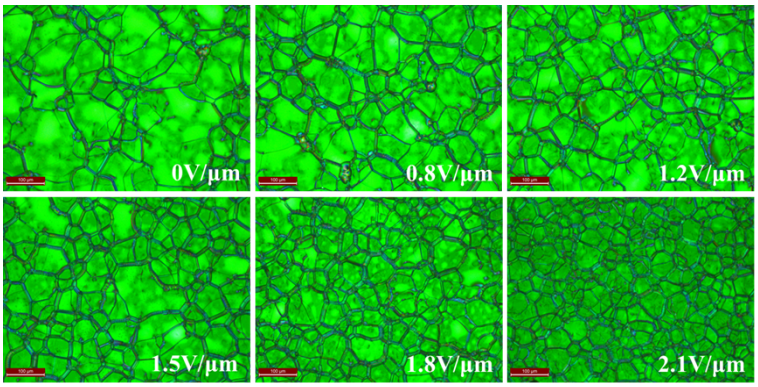


Figure S6: POM of the PSCLC under positive DC electric fields.