

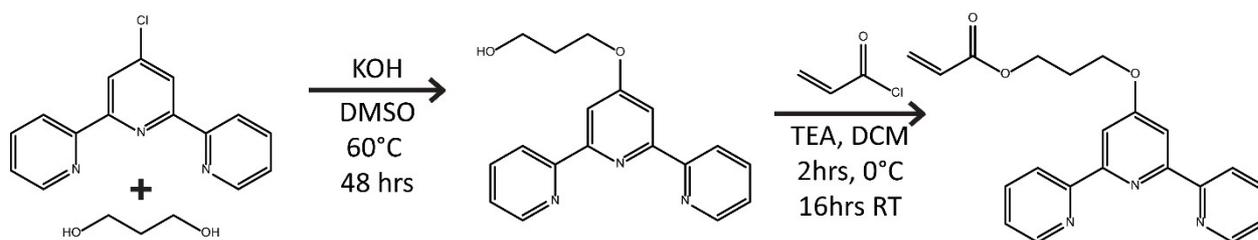
Supplementary Data

Molecular engineering of the polymer stabilizing network to enhance the electro-optic response of cholesteric liquid crystals

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Scheme S1: Synthetic scheme for 4-acryloxypropyl-terpyridine (TPy-Ac).

1. Synthesis of 4-acryloxypropyl-terpyridine (TPy-Ac)

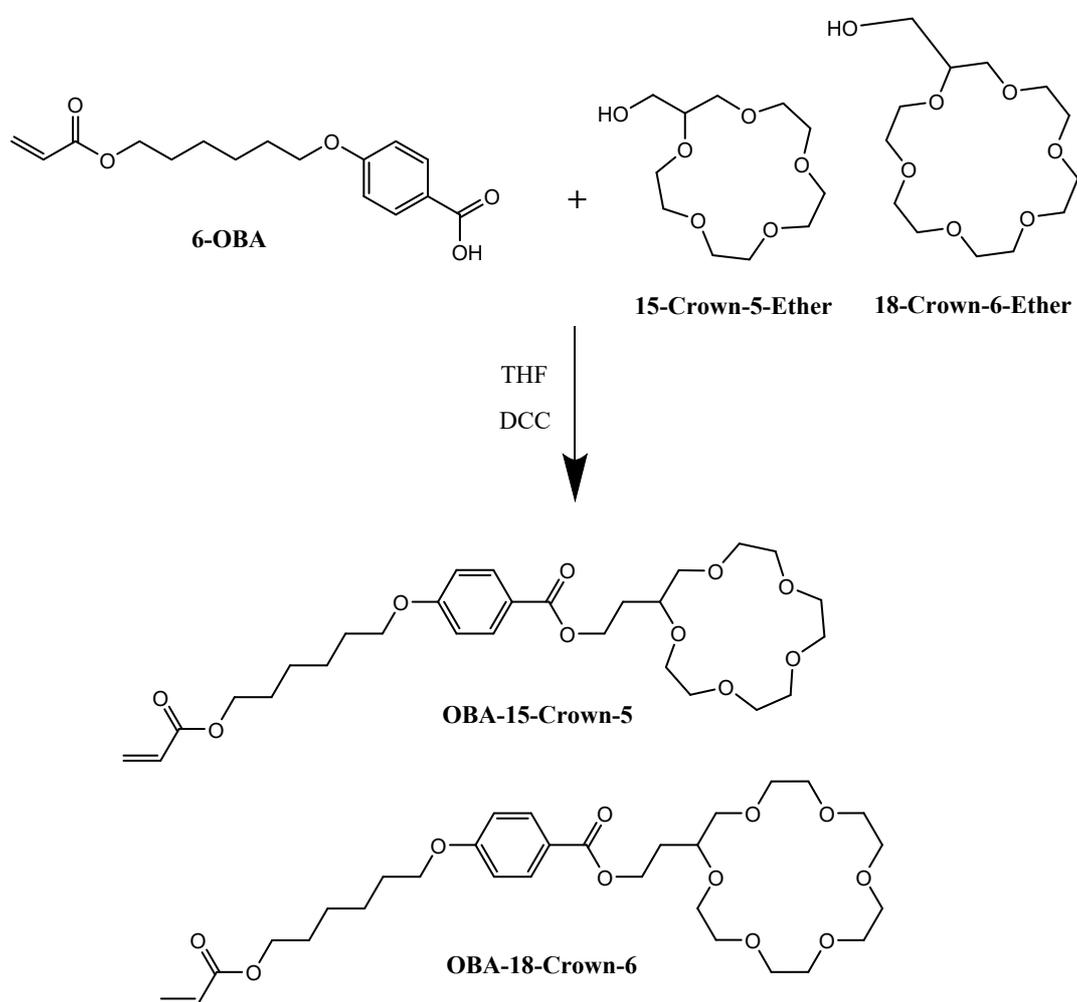
1.1. Synthesis of 4'-hydroxypropyl-2,2':6',2''-terpyridine

1,3-propanediol (4.26g, 56mmol), and KOH (3.14g, 56 mmol) were mixed in a round bottom flask under nitrogen in 25mL of DMSO at 65°C for 30 min. 4'-Chloro-2,2':6',2''-terpyridine (3g, 11.2 mmol) was added to the reaction mixture and stirred for 48hrs at 65°C. After cooling to room temperature the mixture was poured into 30mL of room temperature DI water. The pH of the solution was adjusted to 6 using diluted hydrochloric acid. The precipitate was vacuum filtered and washed with DI water. The collected precipitate was dried for 3 days under vacuum, then recrystallized in methanol. After drying under vacuum 2.56g (76% yield) of 4'-hydroxypropyl-2,2':6',2''-terpyridine was obtained as an off-white powder. ¹H-NMR (CDCl₃, 400 MHz): 8.74 (d, 2H), 8.68 (d, 2H), 8.12 (s, 2H), 7.93 (t, 2H), 7.40 (t, 2H), 4.48 (t, 2H), 3.93 (t, 2H), 2.16 (p, 2H).

1.2. Synthesis of Acrylic acid 3-(2,2':6',2''-terpyridine-4'-yloxy)propyl ester (Typ-Ac)

4'-hydroxypropyl-2,2':6',2''-terpyridine (1g, 3.25 mmol) was dissolved in 60mL of DCM. TEA (0.49g, 4.88mmol) was added and the mixture was cooled to 0°C under nitrogen for 30 min. Acryloyl chloride (320mg, 3.54 mmol) was added dropwise over 15 min. The reaction was allowed to warm to room temperature and kept in the dark overnight. The solution

was diluted with 30mL of DCM and washed 3 times with K_2CO_3 (5% w/v) and 3 times with DI water. The solution was dried with $MgSO_4$. After filtering out the solids, the solvent was removed under vacuum at room temperature. The product was recrystallized with methanol twice, after drying under vacuum 0.66g (56% yield) of Acrylic acid 3-(2,2':6',2''-terpyridine-4'-yloxy)propyl ester was obtained as an off-white powder. 1H -NMR ($CDCl_3$, 400 MHz): 8.73 (d, 2H), 8.66 (d, 2H), 8.08 (s, 2H), 7.90 (t, 2H), 7.38 (t, 2H), 6.45 (dd, 1H), 6.17 (dd, 1H), 5.86 (dd, 1H), 4.42 (m, 4H), 2.28 (p, 2H).



Scheme S2: Synthetic scheme for OBA-15-crown-5 and OBA-18-crown-6.

2. Synthesis of for 4-((6-(Acryloyloxy) hexyl) oxy) benzoic-crown ether molecules

Dicyclohexylcarbodiimide (0.29 g, 1.4 mmol) was added to a solution of 4-((6-(Acryloyloxy) hexyl) oxy) benzoic acid (OBA) (0.29 g, 1 mmol), 2-(hydroxymethyl)-15-crown-5 or 2-(hydroxymethyl)-18-crown-6 (0.35 g, 0.0012 mol), and 4-dimethylaminopyridine (0.02 g) in anhydrous THF (30 mL) cooled with ice water for 1.5 h. The reaction mixture was kept at ~ 20 °C for 24 h. The progress of the reaction was monitored by TLC. After completion of the reaction, the precipitate of dicyclohexylurea that formed was filtered off, and THF was evaporated. The product was purified by column chromatography (toluene-ethyl acetate, 1:1, as the eluent). The yield was 0.34 g (66%). IR, ν/cm^{-1} : 2936, 2856 (CH_2), 1720 ($\text{C}=\text{O}$), 1632 ($\text{CH}_2=\text{CH}-$), 1600, 1512 ($\text{C}=\text{C}$, Ar), 1256 ($\text{C}-\text{O}-\text{C}$, ArOR), 1168 ($\text{C}-\text{O}-\text{C}$). ^1H NMR (400 MHz, CDCl_3 , TMS, δ): 1.26-1.87 (m, 8 H, 4 CH_2), 3.38-3.75 (m, 21 H, CH, 10 CH_2O), 4.05-4.52 (m, 8 H, 4 CH_2O), 5.77 and 6.35 (both d, 1 H each, $\text{CH}_2=\text{CH}-$), 6.14 (dd, 1 H, $\text{CH}_2=\text{CH}-$), 6.91 (d, 2 H, Ar), 7.9 (d, 2 H, Ar).

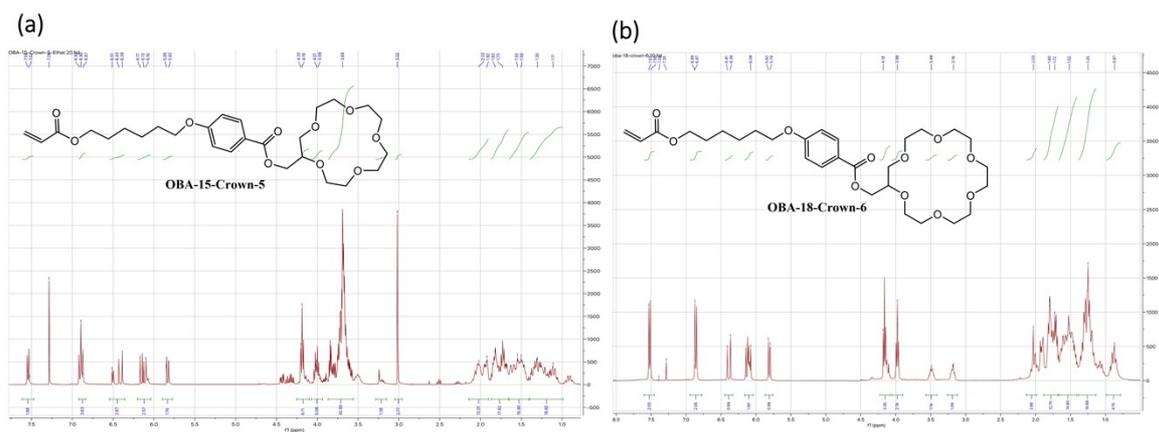


Figure S1: ^1H NMR of OBA-Crown molecules (a) OBA-15-Crown-5 (b) OBA-18-Crown-6

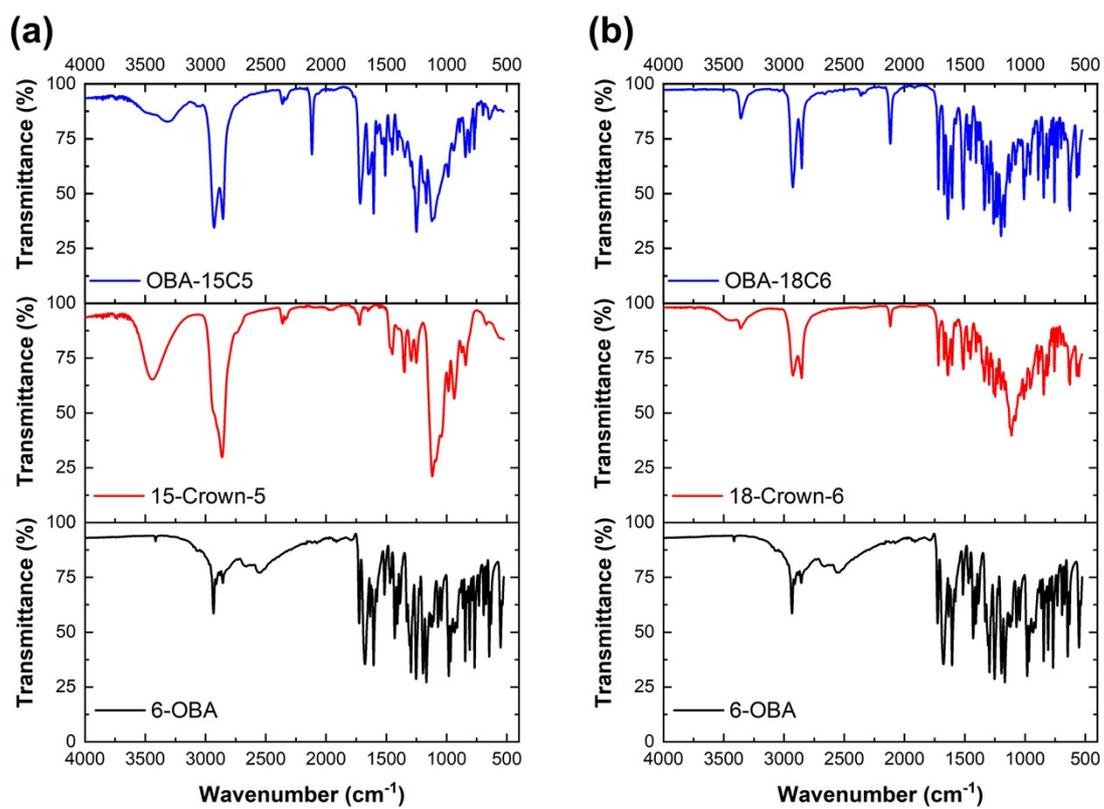


Figure S2: Fourier-transform infrared spectra for (a) OBA-15-Crown-5 (b) OBA-18-Crown-6

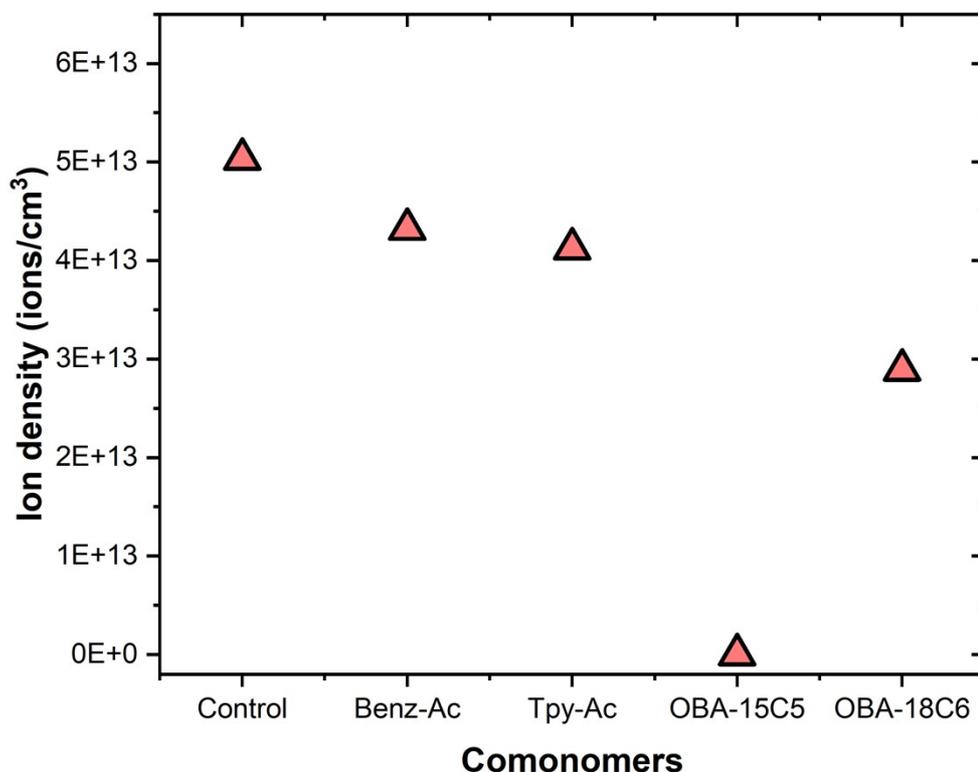


Figure S3: Change in average ion densities of PSCLC formulations with addition of comonomers after polymerization. PSCLC's samples were prepared using RM82 (6 wt.%), chiral dopants S1011, S811 (5 wt.%), photo initiators I-369 (1 wt.%), and 5 wt.% weight percent loading of comonomer's in MLC-2079. Polymerization was initiated by UV light (50 mW/cm², 365 nm) for 10 min. A transient current method was used with a condition of 1Vp, 3 Hz. The value of the ion density is an average of 5 distinct measurements.

Table S1: Summarized ionic conductivity of charge trap based PSCLC

Devices	CLC's Conductivity (S/cm)	PSCLC's Conductivity (S/cm)
Control	6.88×10^{-10}	2.2×10^{-9}
Benz-Ac	4.43×10^{-9}	2.42×10^{-9}
Tpy-Ac	8.08×10^{-9}	6.67×10^{-9}
OBA-15C5	6.24×10^{-8}	9.65×10^{-10}
OBA-18C6	4.41×10^{-8}	1.28×10^{-8}