Dichroic Dyes Mediated Mirrored Full-Color and White Circularly Polarized Luminescence in Natural Cholesteric Liquid Crystals Systems

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1. Experimental Procedures

Materials: All chemicals and reagents were purchased from Aladdin, Bidepharm and used as received without further purification. Nematic liquid crystal E7 and the 15 μm LC cells were purchased from Suzhou King Optonics CO. Ltd.

Characterizations: The ^{1}H NMR (400 MHz) and ^{13}C NMR (100 MHz) spectra were record on a 400 MHz Bruker AVANCE III-400 spectrometer by using $CDCl_3$ as solvent and the TMS as internal standard. Fluorescence (FL) spectra were measured by using a HORIBA Scientific Fluoromax-4 Spectrofluorometer. The UV-visible (UV-vis) absorption spectra were recorded Hitachi U-3900 spectrophotometer. Circular dichroism (CD) spectra and circularly polarized luminescence (CPL) spectra were recorded by using JASCO J-810 spectropolarimeter and JASCO CPL-300 spectrofluoropolarimeter in quartzose cells (the thickness of the LC cell is 15 μm), respectively. The liquid crystalline textures were investigated and photographed using liquid crystal cells and wedge cells with a polarized optical microscope (POM) equipped with aLeitz-350 heating stage and an associated Nikon (D3100) digital camera. The response of CLC to the electrical field experiments were carried out in three-electrode liquid crystal cell with protective electrode, the ITO glass were evaporated as anode; Soda-lime glass was evaporated as cathode; homeotropic alignment layer cell gap 15um cell active area 100 (10 ×10 mm).

Detailed measurement parameters: Fluorescence spectra (λ_{ex} = 380 nm, Scanning speed = 400 nm/min, Voltage = 600 V, Response = 0.5 s). Circular dichroism spectra (Scanning speed = 200 nm/min, Response = 2 s, Band Width = 5). Circularly polarized luminescence spectra (λ_{ex} = 380 nm and 425 nm, Scanning speed = 200 nm/min, Ex slit width = 3000 μm, Em slit width = 3000 μm).

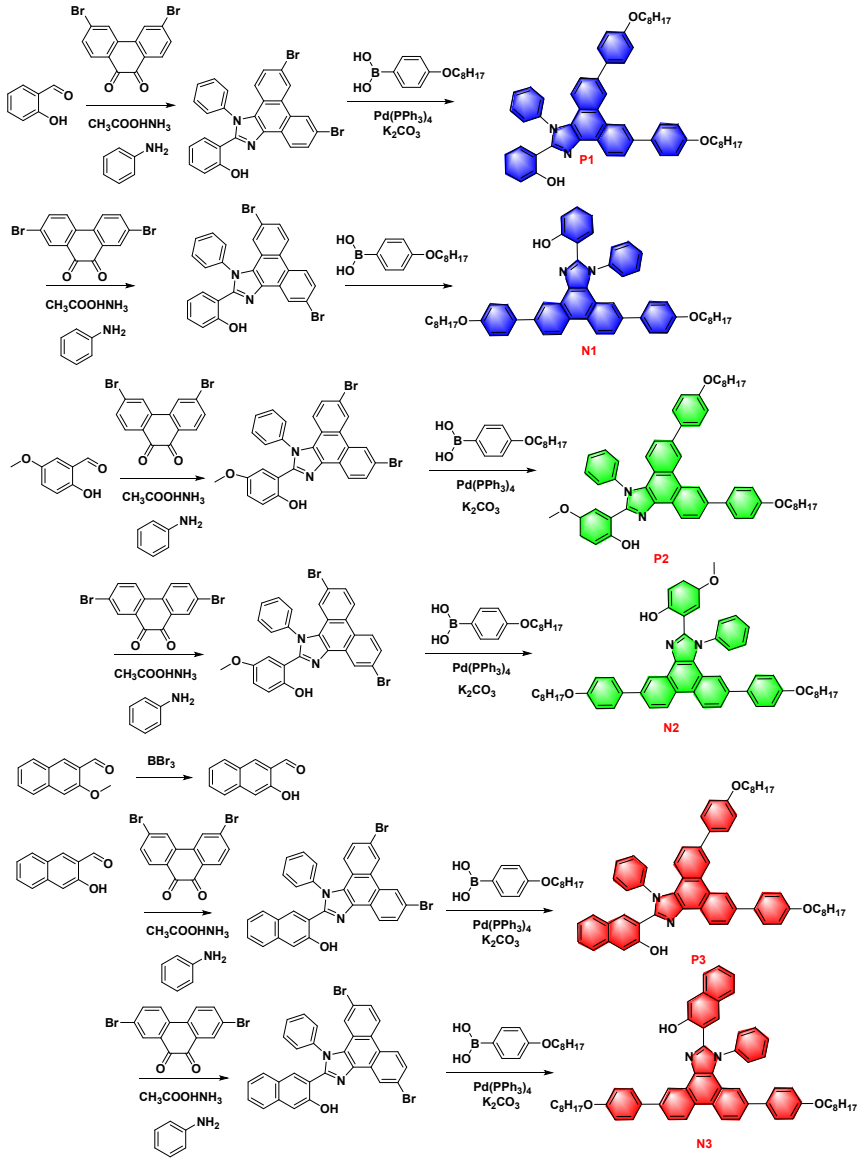
Preparation of CLC: First, different weight ratio of *R/S*-1 and achiral dyes in CH_2Cl_2 were doped into the NLCs E7. The mixtures were heated and stirred on a heating stage for 24 h to volatilize the CH_2Cl_2. Thereafter the mixtures of liquid crystals were injected into a wedge cell or into a flat LCs cell with two sandwiched quartz slides comprising a 15 μm spacer.

The calculation of S_F value based on polarized FL spectra.

$$S_F = \frac{F_{\parallel} - F_{\perp}}{F_{\parallel} + 2F_{\perp}} \text{ -------- Equation S1}$$

where $F_{\parallel}$ is the fluorescent component polarized parallel to the excitation polarization and $F_{\perp}$ is from the perpendicular polarization.

Synthesis of P1, P2, P3 and N1, N2, N3.



Scheme S1. Synthesis of P1, P2, P3 and N1, N2, N3.

Synthesis and characterizations of P1

3,6-Dibromophenanthrene-9,10-dione (1.0 g, 2.73 mmol, 1.0 eq) and ammonium acetate (1.05 g, 13.65 mmol, 5.0 eq) were added to a 100 mL Schlenk flask. The system was purged with N_2 three times. Acetic acid (15 mL) was added to the flask, followed by aniline (0.50 mL, 5.46 mmol, 2.0 eq) and salicylaldehyde (0.30 mL, 2.73 mmol, 1.0 eq). The reaction vessel was heated to 120 °C and refluxed for 12 h. After cooling to room temperature, the reaction was quenched with water, and the resulting precipitate was collected by vacuum filtration and washed with water. The green precipitate was isolated via vacuum filtration and rinsed with 40% aqueous acetic acid and deionized water. The crude product was dissolved in CH_2Cl_2, washed with brine, dried over anhydrous Na_2SO_4, and filtered through a silica gel plug to remove insoluble brown impurities. The filtrate was concentrated using a rotary evaporator, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to afford intermediate **M1**.

Subsequently, **M1** (0.54 g, 1.00 mmol, 1.0 eq) was added to a 50 mL Schlenk flask, followed by (4-(octyloxy)phenyl)boronic acid (0.75 g, 3.00 mmol, 3.0 eq), K_2CO_3 (0.55 g, 4.00 mmol, 4.0 eq), and $Pd(PPh_3)_4$ (58.30 mg, 50 μmol, 0.05 eq). The flask was degassed and purged with N_2 three times, and a mixed solvent of toluene/H_2O (25 / 2.5 mL) was added. The mixture was heated to reflux for 12 h and then cooled to room temperature. The combined organic layers were washed with water and brine, and dried over anhydrous Na_2SO_4. The solvent was removed under reduced pressure, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to yield the target product **P1**. Yield:76.6%.^{1}H NMR (400 MHz, Chloroform-d) δ 8.93 (s, 1H), 8.86 (s, 1H), 8.71-8.74 (m, 1H), 7.93-7.96 (m, 1H), 7.71-7.81 (m, 5H), 7.60-7.67 (m, 4H), 7.46-7.48 (m, 1H), 7.20-7.24 (m, 1H), 7.13-7.16 (m, 1H), 7.06-7.08 (m, 3H), 7.00-7.03 (m, 2H), 6.75-6.78 (m, 1H), 6.50-6.54 (m, 1H), 4.00-4.07 (m, 4H), 1.79-1.88 (m, 4H), 1.45-1.54 (m, 4H), 1.28-1.42 (m, 16H), 0.88-0.93 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.10, 158.96, 158.90, 148.37, 137.75, 133.92, 133.27, 130.88, 130.80, 130.65, 129.98, 129.11, 128.87, 128.58, 128.37, 127.03, 126.78, 126.26,

125.62, 123.13, 121.97, 121.30, 121.26, 121.17, 118.15, 115.08, 115.01, 114.98, 113.10, 68.22, 68.18, 31.86, 31.84, 29.42, 29.40, 29.35, 29.32, 29.29, 29.27, 26.12, 26.09, 22.69, 14.13.

HRMS (ESI) for $C_{55}H_{60}N_2O_3$ (P1)$[M+H]^+$: calcd 795.4520, found 795.4517.

Synthesis of N1

2,7-Dibromophenanthrene-9,10-dione (1.0 g, 2.73 mmol, 1.0 eq) and ammonium acetate (1.05 g, 13.65 mmol, 5.0 eq) were placed into a 100 mL Schlenk flask. The flask was evacuated and backfilled with N_2 three times. Acetic acid (15 mL) was then added to the reaction vessel, followed by aniline (0.50 mL, 5.46 mmol, 2.0 eq) and salicylaldehyde (0.30 mL, 2.73 mmol, 1.0 eq). The mixture was heated to 120 °C and refluxed for 12 h. After cooling to ambient temperature, the reaction was quenched with water, and the resulting precipitate was collected by vacuum filtration and washed with water. The green solid was isolated via vacuum filtration and rinsed sequentially with 40% aqueous acetic acid and deionized water. The crude product was dissolved in CH_2Cl_2, washed with brine, dried over anhydrous Na_2SO_4, and filtered through a silica gel plug to remove insoluble brown impurities. The filtrate was concentrated under reduced pressure using a rotary evaporator, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to afford intermediate **M2**. Subsequently, **M2** (0.54 g, 1.00 mmol, 1.0 eq) was added to a 50 mL Schlenk flask, together with (4-(octyloxy)phenyl)boronic acid (0.75 g, 3.00 mmol, 3.0 eq), K_2CO_3 (0.55 g, 4.00 mmol, 4.0 eq), and $Pd(PPh_3)_4$ (58.30 mg, 50 μmol, 0.05 eq). The flask was purged with N_2 three times, and a mixed solvent of toluene/H_2O (25/2.5 mL) was introduced. The reaction system was heated to reflux for 12 h and then cooled to room temperature. The organic layer was washed with water and brine, and dried over anhydrous Na_2SO_4. The solvent was evaporated under reduced pressure, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to yield the final product **N1**. Yield:71.7%. ^{1}H NMR (400 MHz, Chloroform-d) δ 8.78-8.79 (m, 1H), 8.49-8.54 (m, 2H), 7.72-7.77 (m, 4H), 7.64-7.69 (m, 2H), 7.54-7.59 (m, 3H), 7.15-7.22 (m, 2H), 7.10-7.13 (m, 3H), 7.00 (d, J = 8.0 Hz, 2H), 6.78-6.83 (m, 3H), 6.50 (d, J = 8.0 Hz, 1H), 4.00 (t, J = 6.4 Hz, 2H), 3.93 (t, J = 6.4 Hz, 2H), 1.76-1.87

(m, 4H), 1.43-1.52 (m, 4H), 1.27-1.41 (m, 16H), 0.90-0.93 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.14, 159.05, 158.88, 148.17, 139.35, 139.24, 137.74, 132.71, 132.19, 130.89, 130.77, 130.41, 129.16, 128.34, 127.85, 127.68, 127.37, 126.89, 126.15, 125.80, 124.73, 124.52, 123.72, 123.53, 122.60, 119.56, 118.32, 118.10, 118.06, 114.95, 114.66, 113.08, 68.15, 68.07, 31.90, 29.49, 29.46, 29.40, 29.38, 29.33, 29.31, 26.15, 26.12, 22.72, 14.16. HRMS (ESI) for $C_{55}H_{60}N_2O_3$ (N1)$[M+H]^+$ calcd 795.4520, found 795.4520.

Synthesis of P2

3,6-Dibromophenanthrene-9,10-dione (1.0 g, 2.73 mmol, 1.0 eq) and ammonium acetate (1.05 g, 13.65 mmol, 5.0 eq) were added to a 100 mL two-necked flask equipped with a magnetic stir bar. The flask was purged with N_2 three times, followed by the addition of acetic acid (15 mL), aniline (0.50 mL, 5.46 mmol, 2.0 eq), and 2-hydroxy-5-methoxybenzaldehyde (0.34 mL, 2.73 mmol, 1.0 eq). The resulting mixture was heated to 120 °C and stirred for 12 h. After cooling to room temperature, the reaction was quenched with water. The precipitate was collected via vacuum filtration and washed with 40% aqueous acetic acid and deionized water. The crude product was dissolved in CH_2Cl_2, washed with brine, dried over anhydrous Na_2SO_4, and filtered through a silica gel plug to remove insoluble brown impurities. The filtrate was concentrated under reduced pressure using a rotary evaporator, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to afford intermediate **M3**.

Subsequently, **M3** (0.57 g, 1.00 mmol, 1.0 eq), 4-octyloxybenzeneboronic acid (0.75 g, 3.00 mmol, 3.0 eq), $Pd(PPh_3)_4$ (58.30 mg, 50 μmol, 0.05 eq), and K_2CO_3 (0.55 g, 4.00 mmol, 4.0 eq) were added to a mixed solvent system of toluene (25 mL) and water (2.5 mL). The mixture was heated to reflux under a nitrogen atmosphere for 12 h. After cooling to ambient temperature, the organic phase was extracted with chloroform, washed with water, and dried over anhydrous $MgSO_4$. The solvent was removed under reduced pressure, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to yield the target product **P2**. Yield:75.3%. ^{1}H NMR (400 MHz, Chloroform-d) δ 8.88-8.89 (m, 1H), 8.81-8.82 (m, 1H), 8.63-8.67 (m, 1H),

7.87-7.91 (m, 1H), 7.72-7.77 (m, 3H), 7.67-7.70 (m, 4H), 7.59-7.62 (m, 2H), 7.44-7.46 (m, 1H), 6.99-7.07 (m, 6H), 6.80-6.83 (m, 1H), 6.31-6.33 (m, 1H), 4.00-4.06 (m, 4H), 3.27 (s, 3H), 1.79-1.89 (m, 4H), 1.46-1.54 (m, 4H), 1.27-1.44 (m, 16H), 0.89-0.93 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 158.95, 158.88, 153.30, 151.18, 148.14, 139.24, 138.55, 137.64, 134.17, 133.90, 133.26, 130.91, 130.58, 129.94, 129.32, 128.79, 128.55, 128.35, 127.00, 126.64, 125.53, 124.44, 123.04, 121.96, 121.35, 121.22, 121.09, 118.82, 118.66, 114.99, 114.97, 112.48, 109.52, 68.21, 68.18, 55.11, 31.87, 31.85, 29.44, 29.41, 29.37, 29.34, 29.30, 29.28, 26.13, 26.11, 22.70, 14.13. HRMS (ESI) for $C_{56}H_{62}N_2O_4$ (P2)$[M+H]^+$: calcd 825.4626, found 825.4625.

Synthesis of N2

2,7-Dibromophenanthrene-9,10-dione (1.0 g, 2.73 mmol, 1.0 eq) and ammonium acetate (1.05 g, 13.65 mmol, 5.0 eq) were added to a 100 mL two-necked flask equipped with a magnetic stir bar. The flask was purged with N_2 three times, followed by the addition of acetic acid (15 mL), aniline (0.50 mL, 5.46 mmol, 2.0 eq), and 2-hydroxy-5-methoxybenzaldehyde (0.34 mL, 2.73 mmol, 1.0 eq). The mixture was heated to 120 °C and stirred for 12 h. After cooling to room temperature, the reaction was quenched with water. The green precipitate was collected by vacuum filtration and washed with 40% aqueous acetic acid and deionized water. The crude product was dissolved in CH_2Cl_2, washed with brine, dried over anhydrous Na_2SO_4, and filtered through a silica gel plug to remove insoluble brown impurities. The filtrate was concentrated under reduced pressure using a rotary evaporator, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to afford intermediate **M4**. Subsequently, **M4** (0.57 g, 1.00 mmol, 1.0 eq), 4-octyloxybenzeneboronic acid (0.75 g, 3.00 mmol, 3.0 eq), $Pd(PPh_3)_4$ (58.30 mg, 50 μmol, 0.05 eq), and K_2CO_3 (0.55 g, 4.00 mmol, 4.0 eq) were added to a mixed solvent system of toluene (25 mL) and water (2.5 mL). The mixture was heated to reflux under a nitrogen atmosphere for 12 h. After cooling to ambient temperature, the reaction mixture was washed with water, and the organic phase was extracted with chloroform and dried over anhydrous $MgSO_4$. The solvent was removed under reduced pressure, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to yield the target product

N2. Yield:75.7%. ^{1}H NMR (400 MHz, Chloroform-d) δ 8.77-8.78 (m, 1H), 8.47-8.53 (m, 2H), 7.68-7.76 (m, 6H), 7.56-7.60 (m, 3H), 7.17-7.17 (m, 1H), 7.09-7.13 (m, 2H), 7.04-7.06 (m, 1H), 6.98-7.03 (m, 2H), 6.80-6.84 (m, 3H), 6.36-6.37 (m, 1H), 4.01 (t, *J* = 6.4 Hz, 2H), 3.94 (t, *J* = 8.0 Hz, 2H), 3.26 (s, 3H), 1.77-1.88 (m, 4H), 1.45-1.56 (m, 4H), 1.30-1.43 (m, 16H), 0.91-0.95 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.05, 158.88, 153.27, 151.19, 147.94, 139.44, 139.32, 137.72, 134.61, 132.69, 132.20, 130.91, 130.34, 129.34, 128.37, 128.32, 127.85, 127.65, 127.34, 126.88, 125.80, 124.71, 124.52, 123.70, 123.53, 122.55, 119.53, 118.80, 118.65, 118.26, 114.95, 114.67, 112.46, 109.57, 68.15, 68.08, 55.08, 31.90, 29.49, 29.46, 29.41, 29.39, 29.33, 29.31, 26.16, 26.13, 22.72, 14.15. HRMS (ESI) for $C_{56}H_{62}N_2O_4$ (N2)$[M+H]^+$: calcd 825.4626, found 825.4626

Synthesis of P3

A 50 mL round-bottom flask equipped with a magnetic stir bar and a nitrogen inlet was charged with a solution of 3-methoxy-2-naphthaldehyde (1.5 mmol) in dry dichloromethane (20 mL). The mixture was cooled to 0 °C, and BBr_3 (6.0 mL, 1.0 M solution in dichloromethane) was added dropwise under a nitrogen atmosphere. Subsequently, the reaction mixture was stirred at 0 °C for 15 min and then warmed to room temperature for further stirring over 20 h. The reaction was quenched by pouring the mixture into ice water followed by 1.0 M HCl (10 mL), and the resulting solution was stirred for 20 min before extraction with dichloromethane (2 × 30 mL). The combined organic extracts were dried over anhydrous $MgSO_4$. The solvent was removed under reduced pressure using a rotary evaporator, and the residue was purified by column chromatography (eluent: petroleum ether/EtOAc, v/v = 5:1) to afford 3-hydroxy-2-naphthaldehyde.

3,6-Dibromophenanthrene-9,10-dione (1.0 g, 2.73 mmol, 1.0 eq), 3-hydroxy-2-naphthaldehyde (0.47 g, 2.73 mmol, 1.0 eq), and ammonium acetate (1.05 g, 13.65 mmol, 5.0 eq) were added to a 100 mL Schlenk flask equipped with a magnetic stir bar. The flask was purged with N_2 three times, followed by the addition of acetic acid (15 mL) and aniline (0.50 mL, 5.46 mmol, 2.0 eq). The reaction mixture was heated to 120 °C and refluxed for 12 h. After cooling to ambient temperature, the reaction was

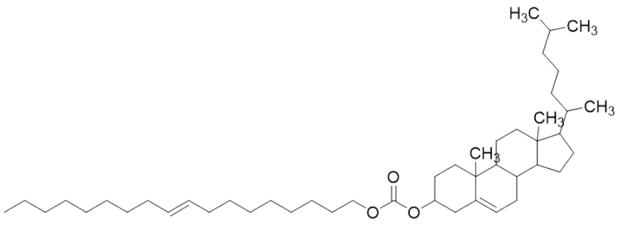
quenched with 40% aqueous acetic acid and deionized water. The crude product was dissolved in CH_2Cl_2, washed with brine, dried over anhydrous Na_2SO_4, and filtered through a silica gel plug to remove insoluble brown impurities. The filtrate was concentrated under reduced pressure, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to afford intermediate **M5**. Subsequently, **M5** (0.84 g, 1.00 mmol, 1.0 eq), 4-octyloxybenzeneboronic acid (0.75 g, 3.00 mmol, 3.0 eq), $Pd(PPh_3)_4$ (58.30 mg, 50 μmol, 0.05 eq), and K_2CO_3 (0.55 g, 4.00 mmol, 4.0 eq) were added to a mixed solvent system of toluene (25 mL) and water (2.5 mL). The mixture was heated to reflux under a nitrogen atmosphere for 12 h. After cooling to room temperature, the organic phase was extracted with chloroform, washed with water, and dried over anhydrous $MgSO_4$. The solvent was evaporated under reduced pressure, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to yield the target product **P3**. Yield:72.8%. ^{1}H NMR (400 MHz, Chloroform-d) δ 8.92 (s, 1H), 8.84 (s, 1H), 8.72-8.74 (d, *J* = 8.0 Hz, 1H), 7.91-7.94 (m, 1H), 7.81-7.83 (m, 1H), 7.75-7.79 (m, 2H), 7.69-7.74 (m, 4H), 7.60-7.63 (m, 3H), 7.48-7.50 (m, 1H), 7.44 (s, 1H), 7.32-7.37 (m, 1H), 7.23 (s, 1H), 7.13-7.18 (m, 3H), 7.04-7.08 (m, 2H), 7.00-7.03 (m, 2H), 4.00-4.06 (m, 4H), 1.79-1.86 (m, 4H), 1.45-1.53 (m, 4H), 1.29-1.41 (m, 16H), 0.88-0.93 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.01, 158.93, 147.75, 138.85, 138.02, 135.00, 133.83, 133.21, 130.97, 130.72, 130.17, 129.19, 128.94, 128.58, 128.38, 127.39, 127.29, 126.82, 126.75, 125.84, 125.69, 123.18, 122.00, 121.47, 121.14, 115.01, 114.99, 111.77, 68.22, 68.19, 31.87, 29.43, 29.40, 29.36, 29.33, 29.29, 26.12, 26.10, 22.70, 14.13. HRMS (ESI) for $C_{59}H_{60}N_2O_4$ (P3)$[M+H]^+$: calcd 845.4677, found 845.4678.

Synthesis of N3

2,7-Dibromophenanthrene-9,10-dione (1.0 g, 2.73 mmol, 1.0 eq), 3-hydroxy-2-naphthaldehyde (0.47 g, 2.73 mmol, 1.0 eq), and ammonium acetate (1.05 g, 13.65 mmol, 5.0 eq) were added to a 100 mL Schlenk flask equipped with a magnetic stir bar. The flask was purged with N_2 three times, followed by the addition of acetic acid (15 mL) and aniline (0.50 mL, 5.46 mmol, 2.0 eq). The mixture was heated to 120 °C and stirred for 12 h. After cooling to room temperature, the reaction was quenched with

water. The precipitate was collected by vacuum filtration and washed with 40% aqueous acetic acid and deionized water. The crude product was dissolved in CH_2Cl_2, washed with brine, dried over anhydrous Na_2SO_4, and filtered through a silica gel plug to remove insoluble brown impurities. The filtrate was concentrated under reduced pressure using a rotary evaporator, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to afford intermediate **M6**. Subsequently, **M6** (0.84 g, 1.00 mmol, 1.0 eq), 4-octyloxybenzeneboronic acid (0.75 g, 3.00 mmol, 3.0 eq), $Pd(PPh_3)_4$ (58.30 mg, 50 μmol, 0.05 eq), and K_2CO_3 (0.55 g, 4.00 mmol, 4.0 eq) were added to a mixed solvent system of toluene (25 mL) and water (2.5 mL). The mixture was heated to reflux under a nitrogen atmosphere for 12 h. After cooling to ambient temperature, the reaction mixture was washed with water, and the organic phase was extracted with chloroform and dried over anhydrous $MgSO_4$. The solvent was removed under reduced pressure, and the residue was purified by column chromatography (eluent: petroleum ether/DCM, v/v = 5:1) to yield the target product **N3**. Yield:71.1%. ^{1}H NMR (400 MHz, Chloroform-d) δ 8.81 (s, 1H), 8.46-8.52 (m, 2H), 7.68-7.81 (m, 6H), 7.55-7.61 (m, 4H), 7.41 (s, 1H), 7.31-7.35 (m, 1H), 7.23-7.25 (m, 2H), 7.10-7.12 (m, 4H), 7.00 (d, *J* = 8.4 Hz, 2H), 6.81 (d, *J* = 8.4 Hz, 2H), 3.88-4.01 (m, 4H), 1.75-1.85 (m, 4H), 1.44-1.52 (m, 4H), 1.29-1.42 (m, 16H), 0.90-0.93 (m, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.07, 158.91, 155.52, 147.56, 139.40, 139.27, 137.78, 134.95, 133.85, 132.66, 132.15, 130.95, 130.45, 129.23, 128.41, 128.34, 128.00, 127.66, 127.50, 127.35, 126.94, 126.72, 125.79, 124.81, 124.53, 123.72, 123.13, 122.49, 119.56, 118.42, 115.23, 114.96, 114.69, 111.62, 68.15, 68.06, 31.91, 31.89, 29.49, 29.46, 29.41, 29.37, 29.33, 29.31, 26.15, 26.12, 22.72, 14.16. HRMS (ESI) for $C_{59}H_{60}N_2O_3$ (N3)$[M+H]^+$: calcd 845.4677, found 845.4675.

2. Supplementary Fig.s and Tables.



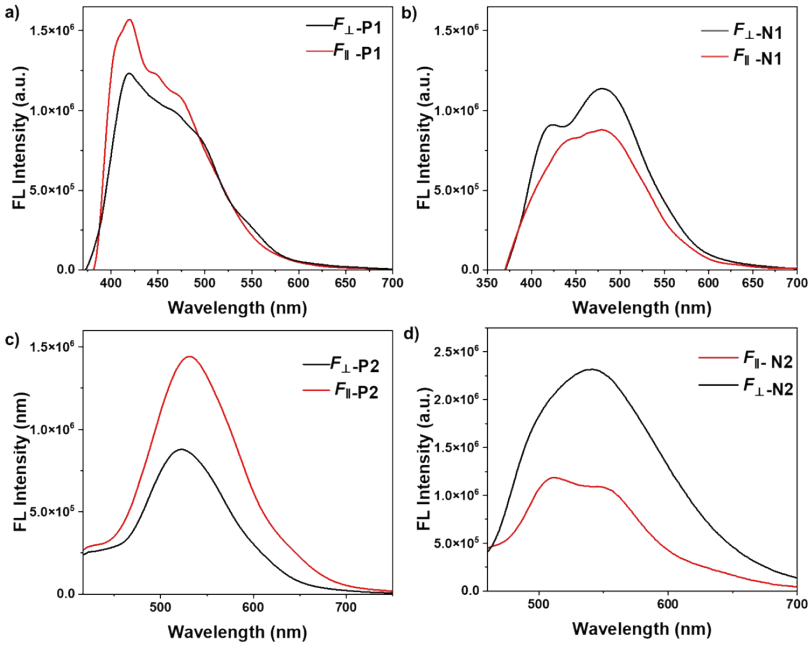


Fig.S1. a) polarized FL spectra of the NLC-P1 and b) NLC-N2; c) polarized FL spectra of the NLC-P2 and d) NLC-N2.

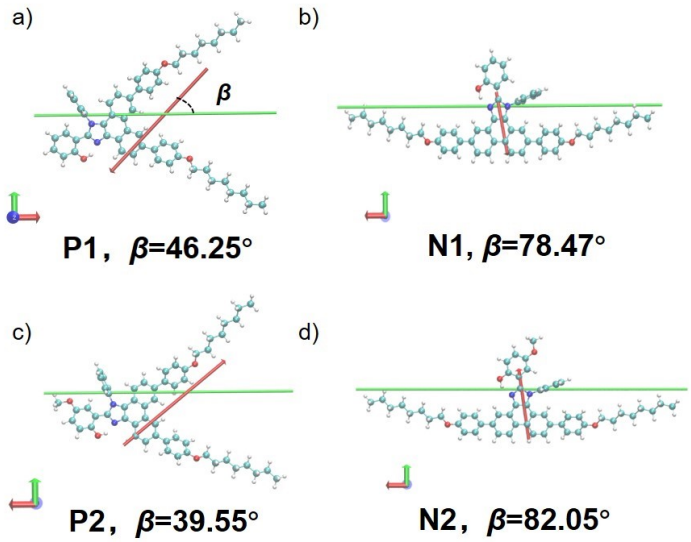


Fig.S2. DFT calculation of the molecules a) P1, b) N1, c) P2 and d) N2 (red arrow indicates the TDM vector and green rod indicates the MOI axis).

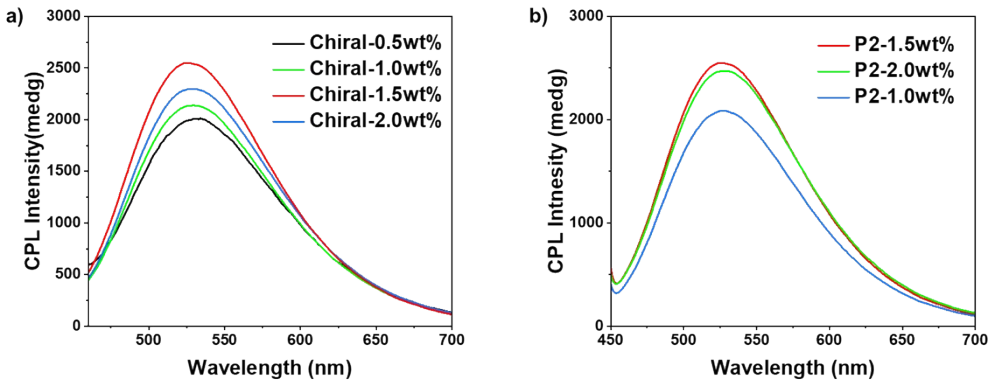


Fig. S3. Concentration optimization of CLC-P2.

Table S2. The PLQY of **P1**, **N1**, **P2**, **N2**, **P3**, and **N3**.

Compounds	Φ_{PL} [a] (%)	Φ_{PL} [b] (%)
P1	18.21	20.15
N1	5.79	6.98
P2	1.81	3.66
N2	1.08	2.95
P3	1.21	3.34
N3	8.44	10.68
W1	-	6.52
W2	-	5.87

[a] The PLQY measured in THF solutions (1×10^{-5} M). [b] The PLQY measured in CLCs (1 wt%).

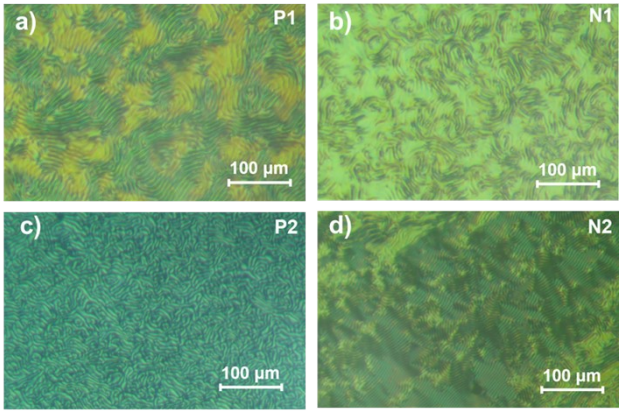


Fig. S4. POM images of a) CLC-P1, b) CLC-N1, c) CLC-P2, d) CLC-N2,

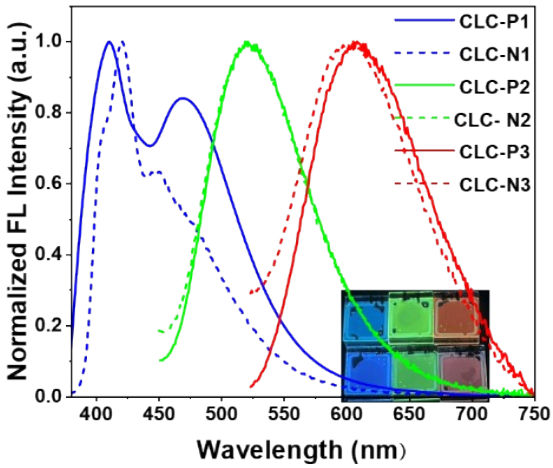


Fig. S5. FL spectra of CLC.

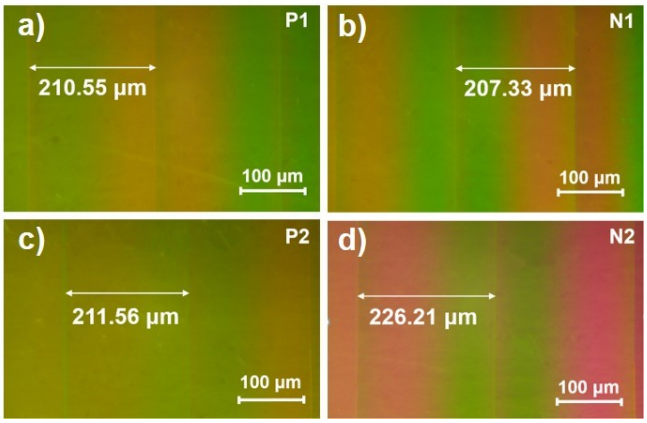


Fig. S6. POM images of a) *S*-CLC-P1, b) *S*-CLC-N1, c) *S*-CLC-P2 and d) *S*-CLC-N2 in wedge LC cells.

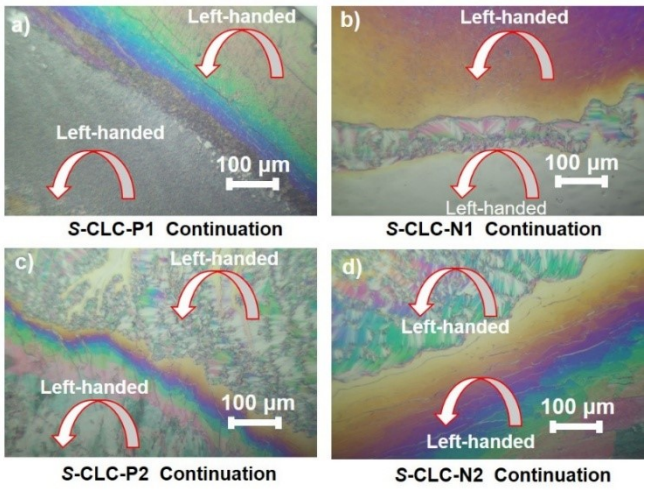


Fig. S7. Miscibility test induced a) *S*-CLC-P1, b) *S*-CLC-N1, c) *S*-CLC-P2 and d) *S*-CLC-N2 with a cholesteryl oleyl carbonate.

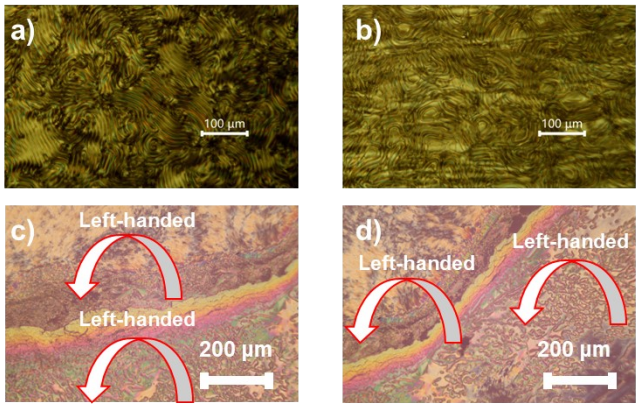


Fig. S8. POM images of a) *S*-CLC-W1 and b) *S*-CLC-W2; Miscibility test induced c) CLC-W1 and d) CLC-W2 with a cholesteryl oleyl carbonate.

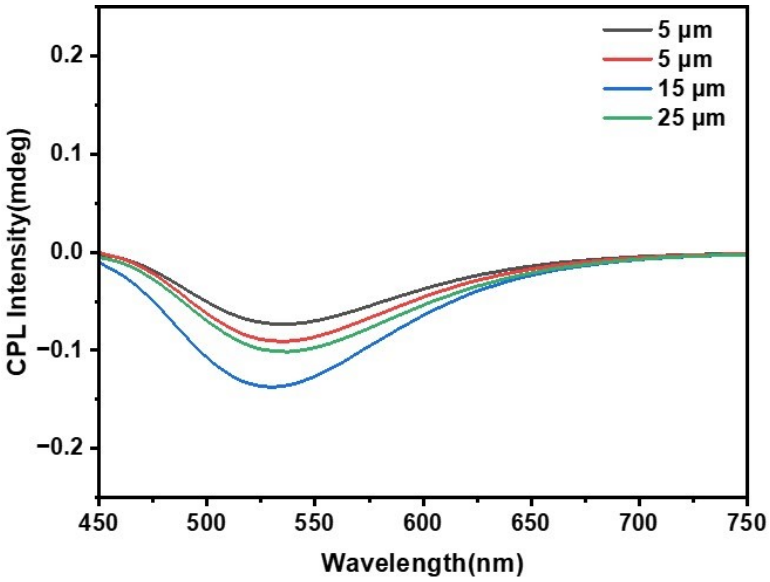


Fig. S9. CPL spectra of *S*-CLC-P2 at different thicknesses.

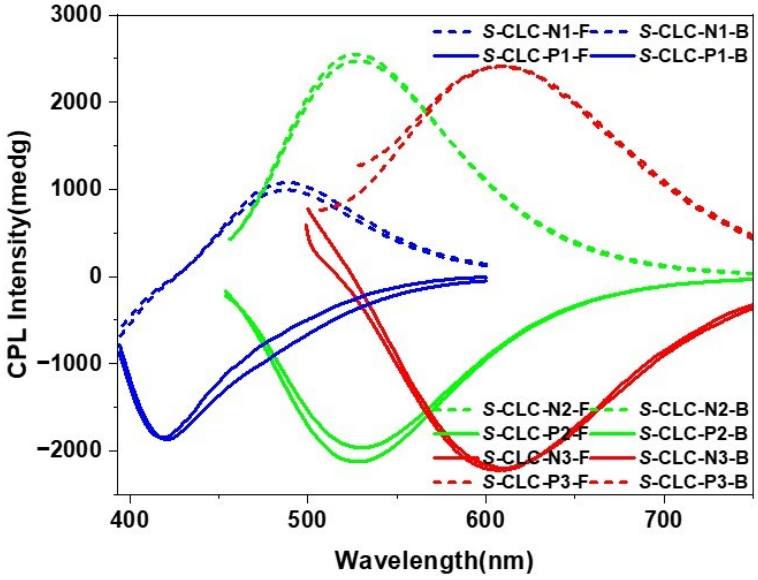


Fig. S10. CPL spectra of the CLCs from the front side and back side.

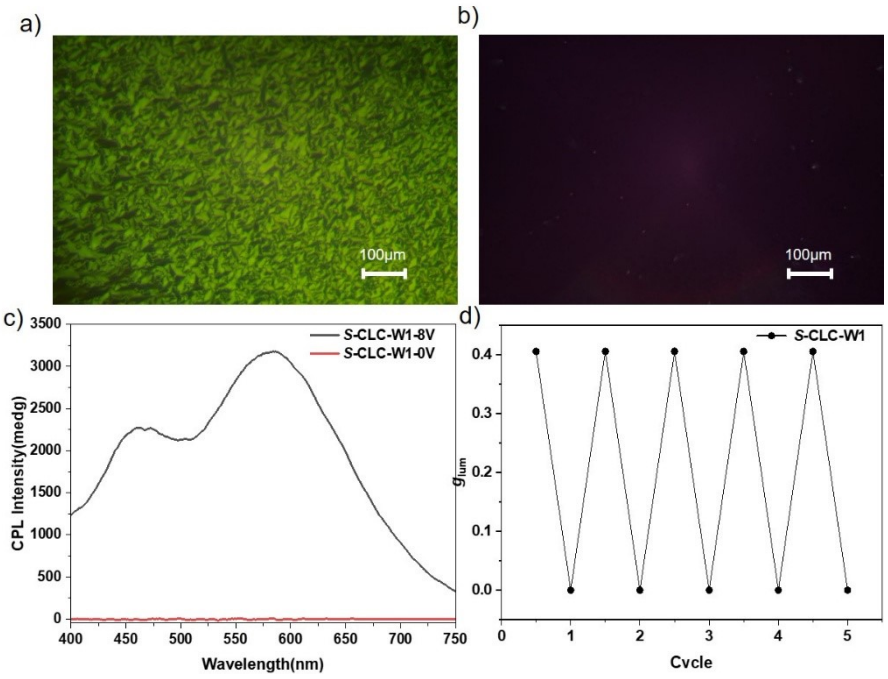


Fig.S11. a), b) POM images of *S*-CLC-W1 at different DC voltages of 0 V and 8V. c) CPL of *S*-CLC-W1 under DC electric field. d) g_{lum} values of *S*-CLC-W1 at 585 nm as a function of the number of cycles

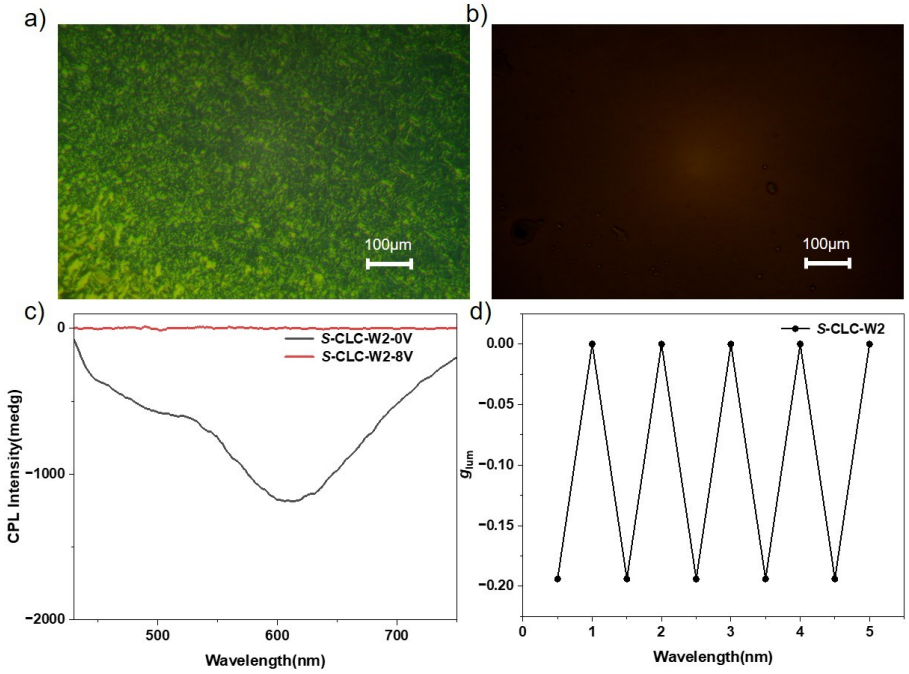


Fig.S12. a), b) POM images of *S*-CLC-W1 at different DC voltages of 0 V and 8V. c) CPL of *S*-CLC-W2 under DC electric field. d) g_{lum} values of *S*-CLC-W1 at 608 nm as a function of the number of cycles

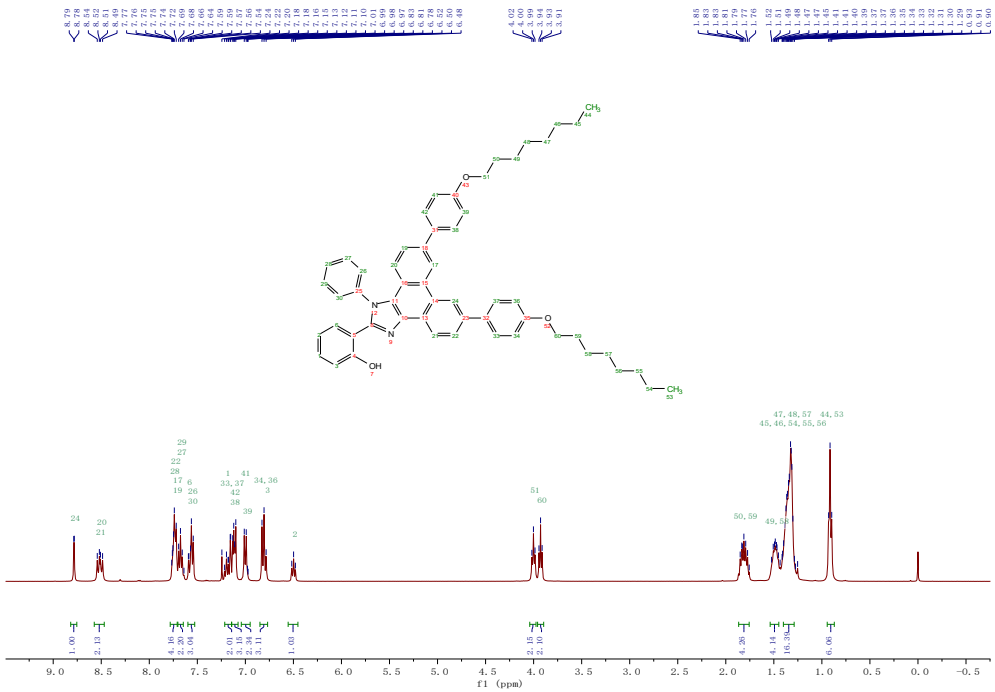


Fig. S13. ^{1}H NMR of P1 (400 MHz, $CDCl_3$)

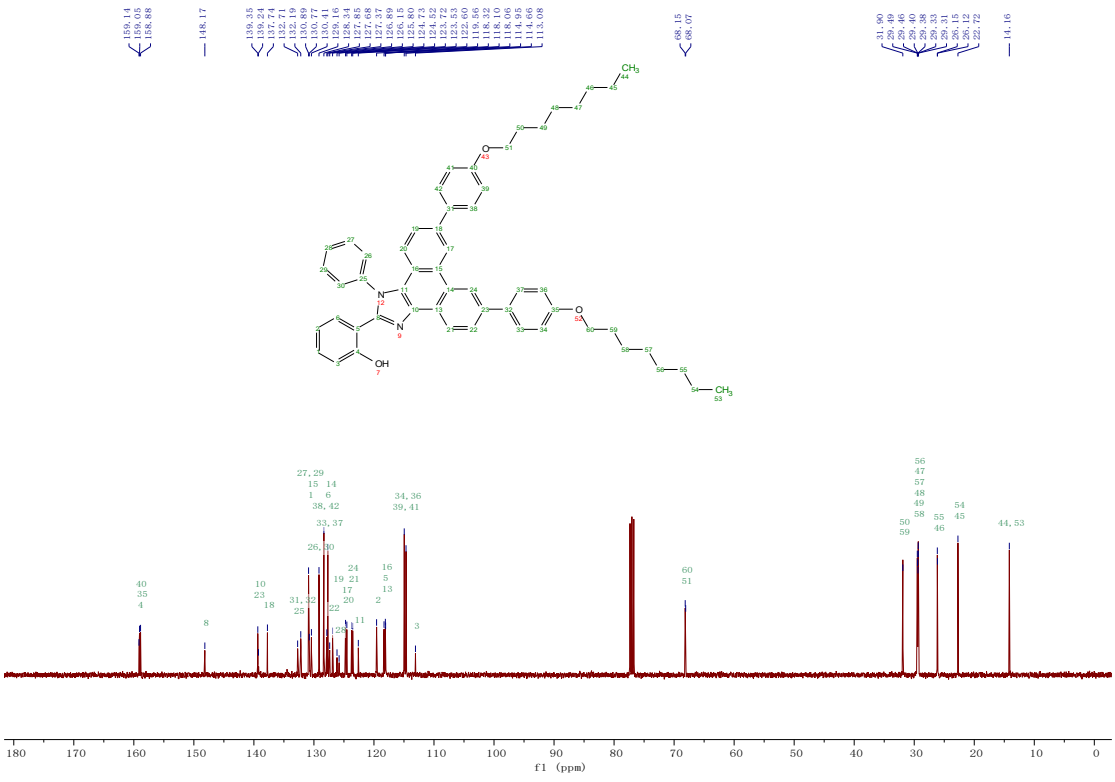


Fig. S14. ^{13}C NMR of P1 (100 MHz, $CDCl_3$)

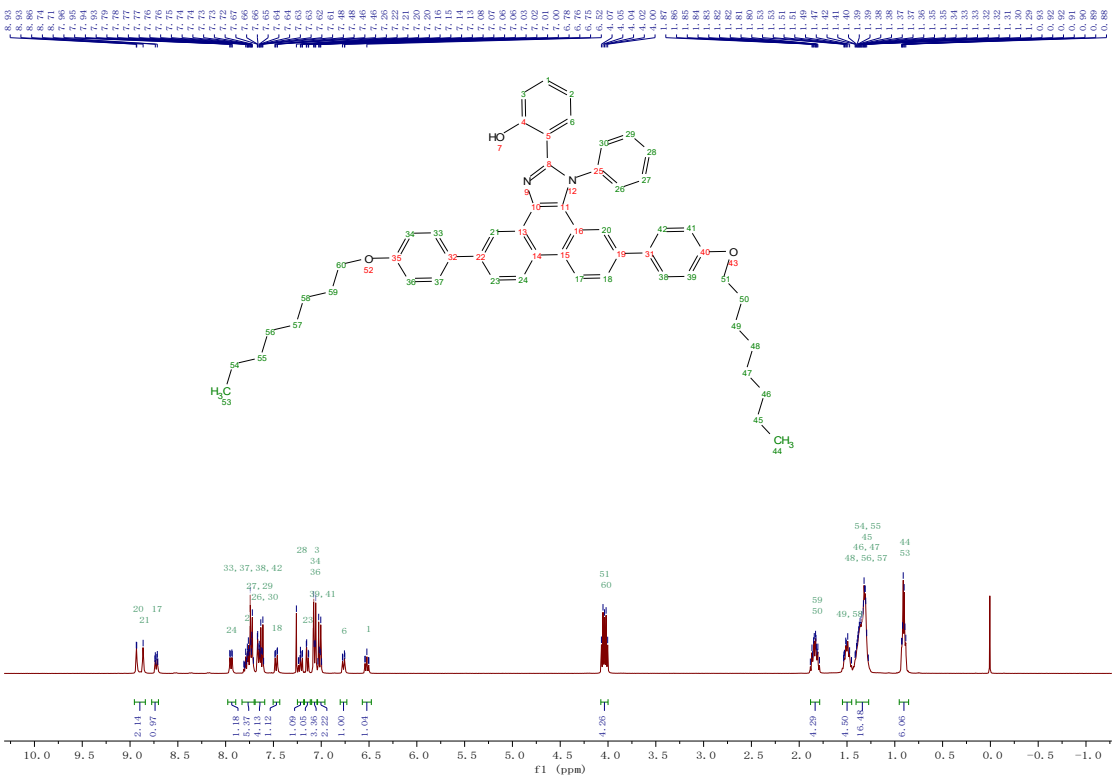


Fig. S15. ^{1}H NMR of N1 (400 MHz, $CDCl_3$)

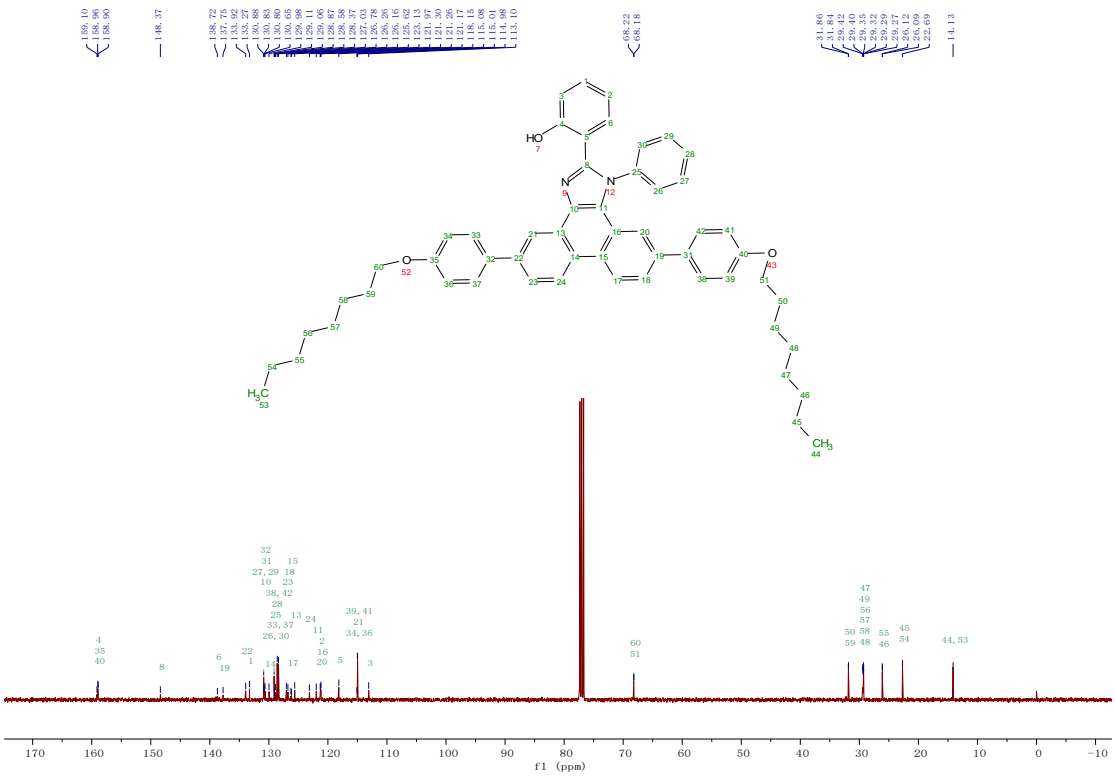


Fig. S16. ^{13}C NMR of N1 (100 MHz, $CDCl_3$)

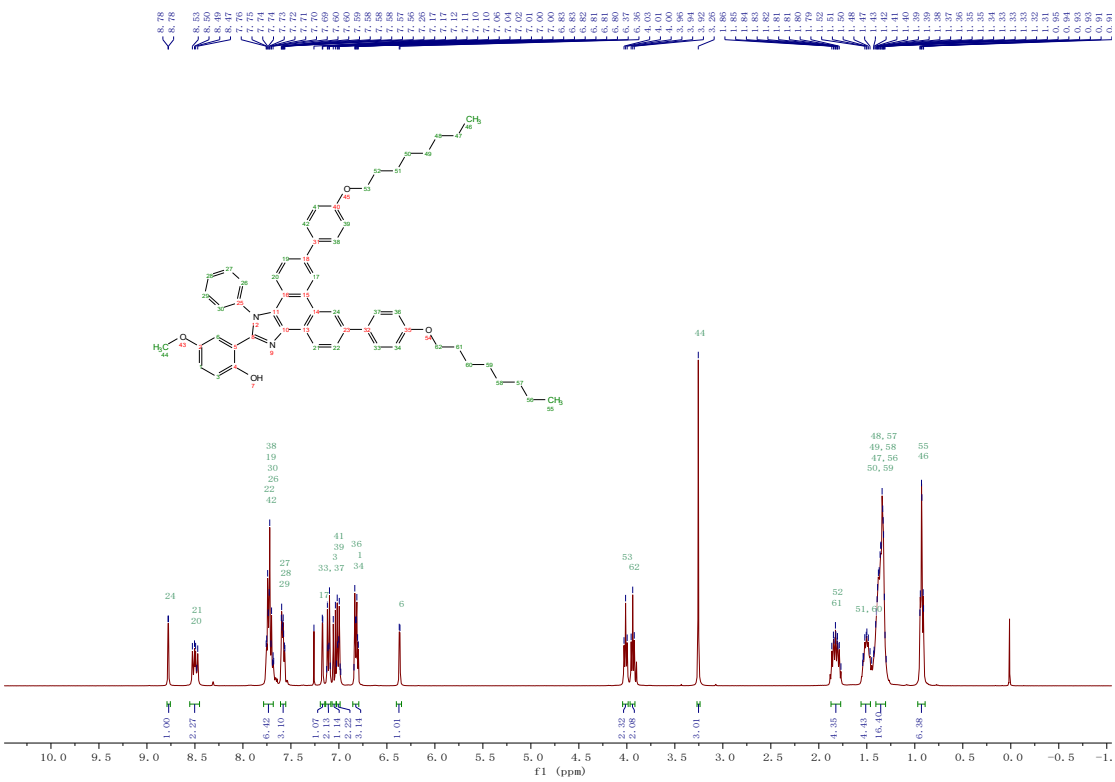


Fig. S17. ^{1}H NMR of P2 (400 MHz, $CDCl_3$)

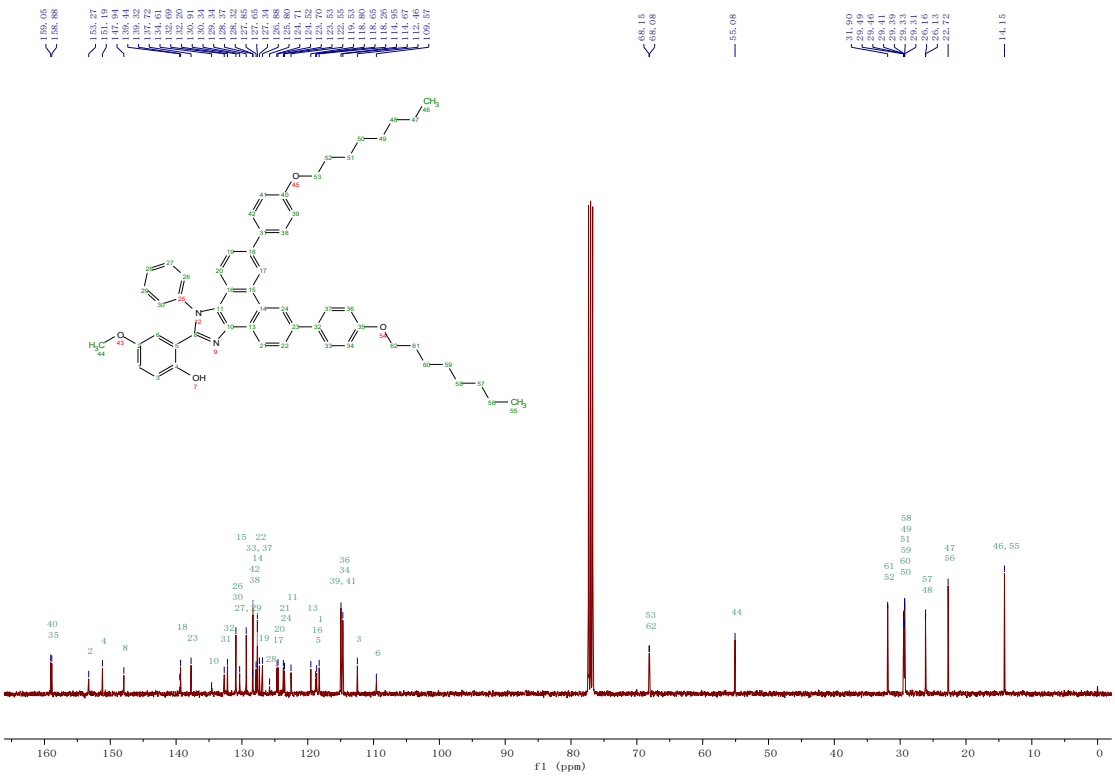


Fig. S18. ^{13}C NMR of P2 (100 MHz, $CDCl_3$)

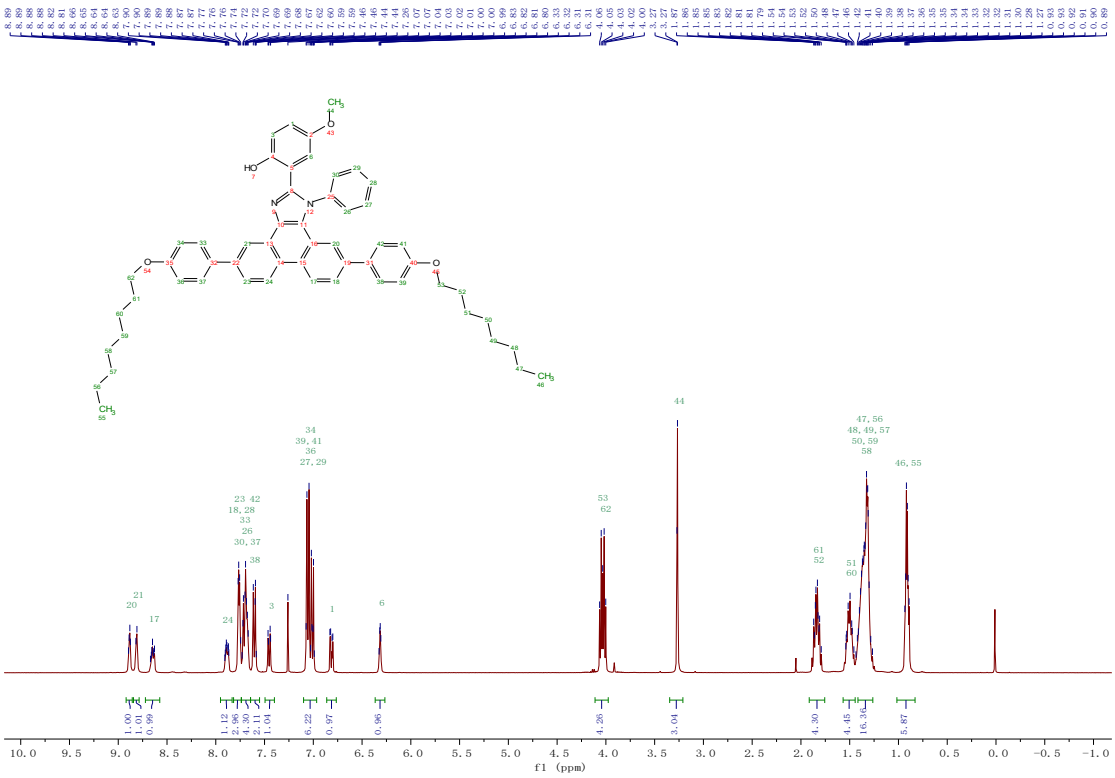


Fig. S19. ^{1}H NMR of N2 (400 MHz, $CDCl_3$)

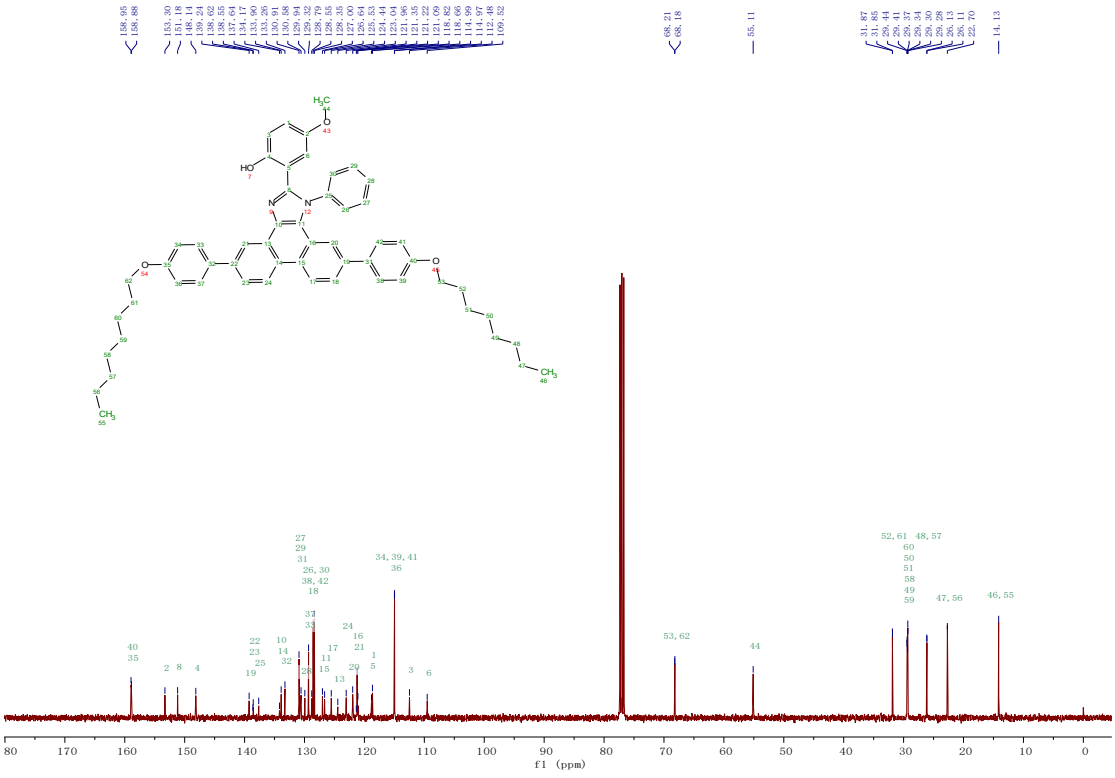


Fig. S20. ^{13}C NMR of N2 (100 MHz, $CDCl_3$)

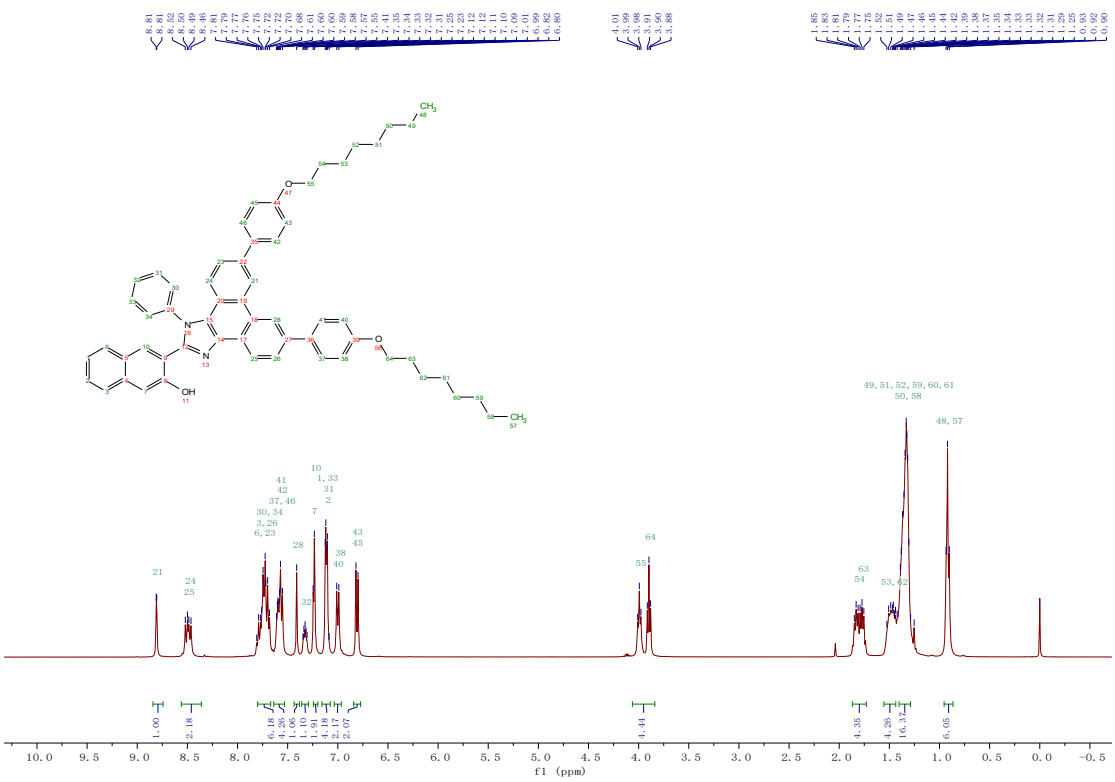


Fig. S21. ^{1}H NMR of P3 (400 MHz, $CDCl_3$)

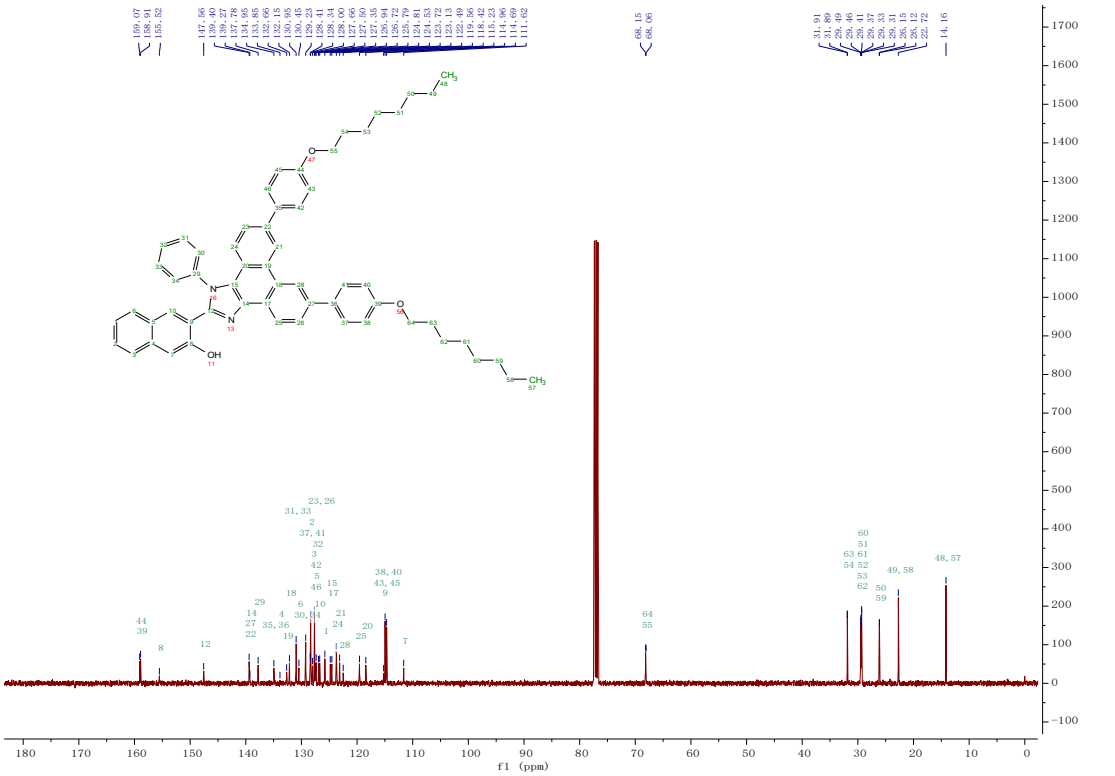


Fig. S22. ^{13}C NMR of P3 (100 MHz, $CDCl_3$)

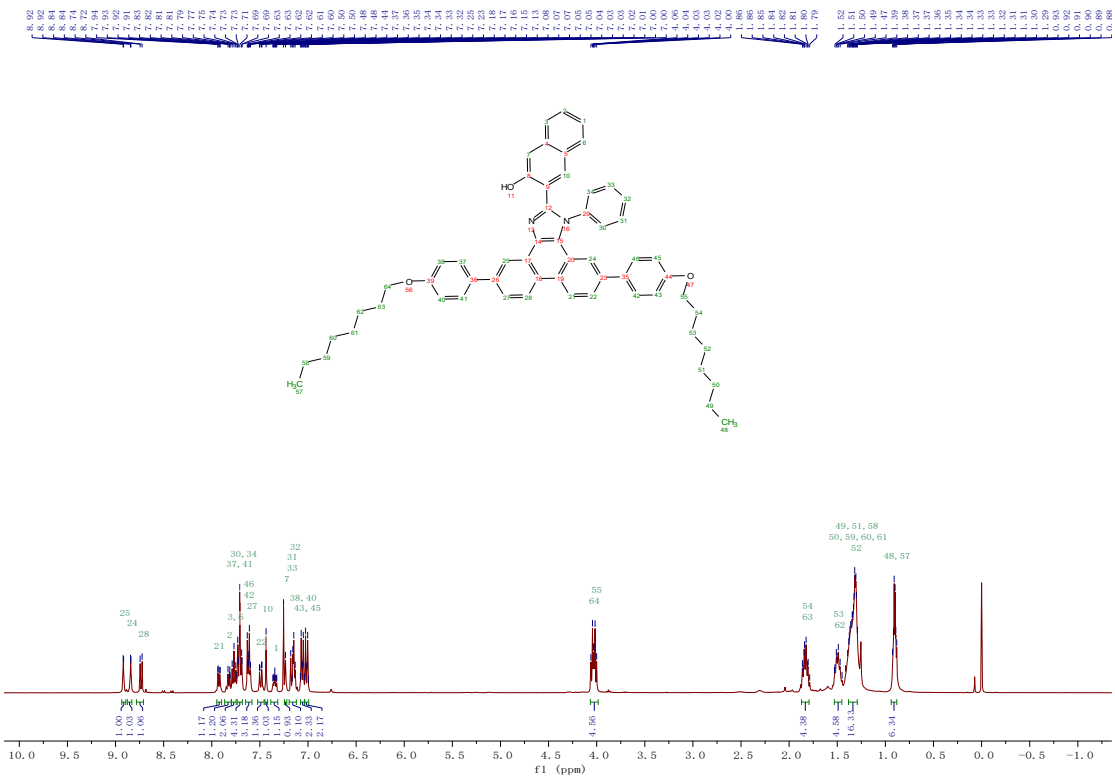


Fig. S23. ^{1}H NMR of N3 (400 MHz, $CDCl_3$)

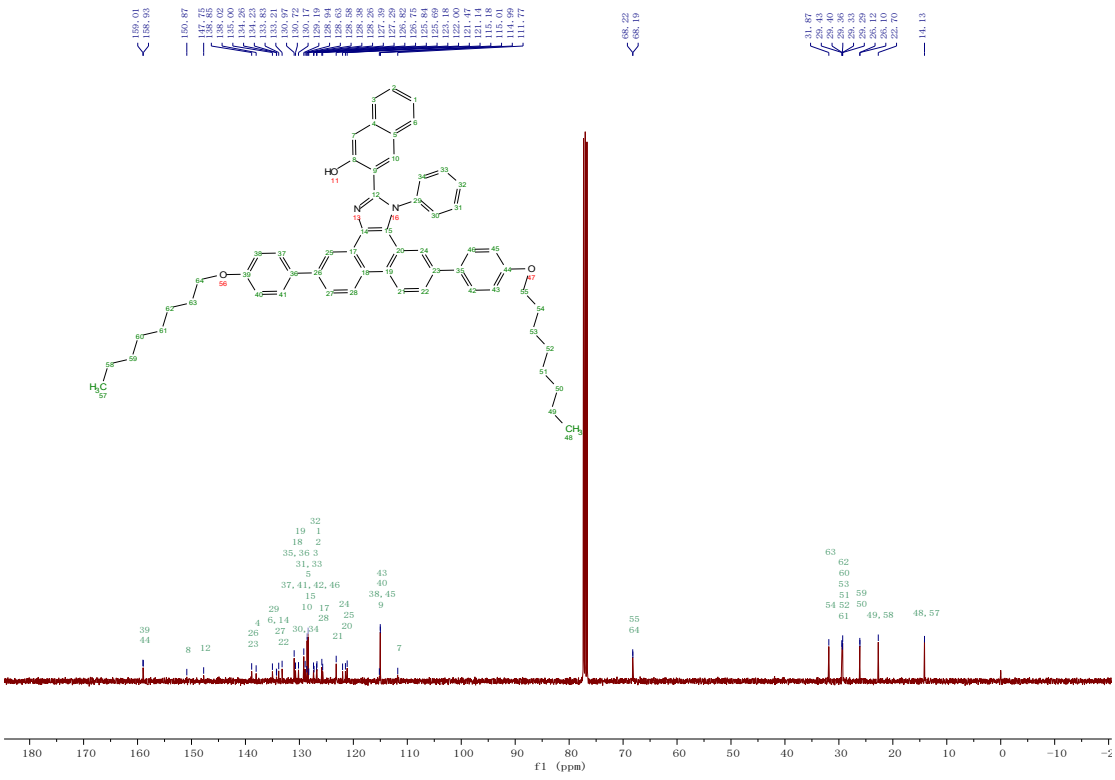


Fig. S24. ^{13}C NMR of N3 (100 MHz, $CDCl_3$)