$In(OTf)_3$-Catalyzed reorganization/cycloaddition of two imine units and subsequently modular assembly of acridinium photocatalysts

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Supplementary information

Table of Contents:

A. General information 1
B. Optimization Studies 3
C. Preparation of substrates 4
D. Synthesis of dihydroacridines 4
E. Synthesis of acridinium photocatalysts 4
F. Mechanism studies 26
G. Synthetic transformation of products 28
H. References 31
I. Spectrophotometric and electrochemical data 32
J. NMR spectra 56

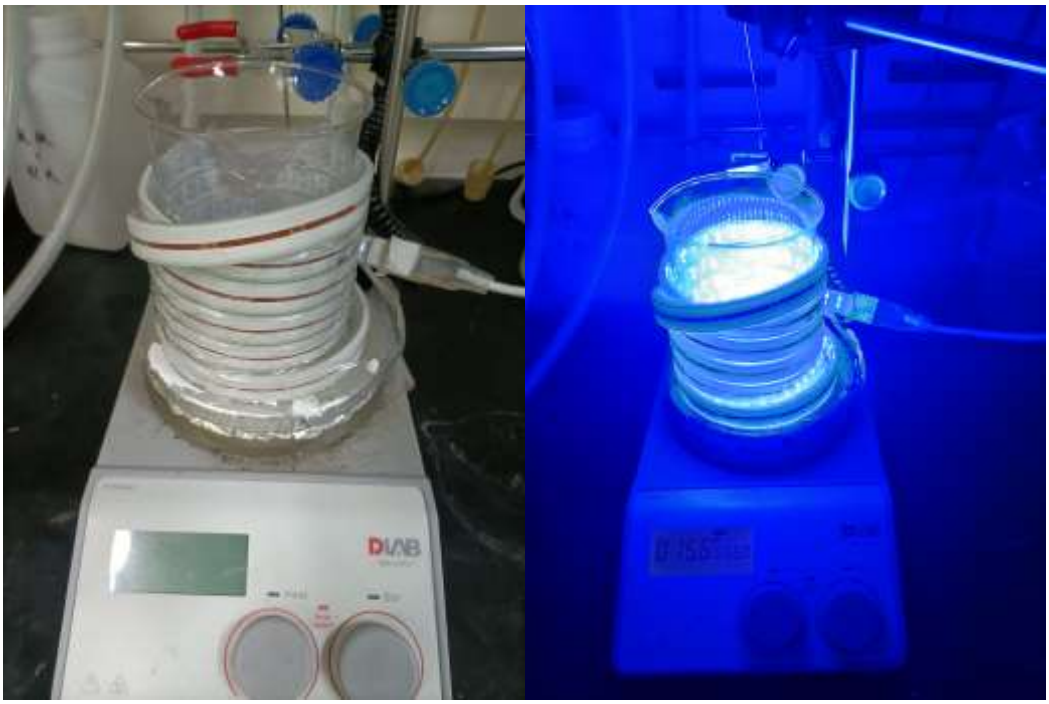
A. General information

All reagents were used as received unless otherwise noted. Analytical thin-layer chromatography was performed with 0.25 mm coated commercial silica gel plates (TLC Silica Gel 60 F_{254}); visualization of the developed chromatogram was performed by fluorescence. Flash Chromatography was performed with silica gel (300-400 mesh). Proton-1 nuclear magnetic

resonance (^{1}H NMR) data were acquired at 400 MHz on a Bruker Ascend 400 (400 MHz) spectrometer, and chemical shifts are reported in delta (δ) units, in parts per million (ppm) downfield from tetramethylsilane. Splitting patterns are designated as s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet, coupling constants *J* are quoted in Hz. Carbon-13 nuclear magnetic resonance (^{13}C NMR) data were acquired at 100 MHz on a Bruker Ascend 400 spectrometer, chemical shifts are reported in ppm relative to the center line of a triplet at 77.0 ppm for $CDCl_3$. Fluorine-19 nuclear magnetic resonance (^{19}F NMR) data were acquired at 376 MHz on a Bruker Ascend 400 spectrometer. Infrared spectra (IR) data were recorded on a TENSOR 27 FT-IR spectrometer and recorded in wave numbers (cm^{-1}). High resolution mass spectra were acquired on a Bruker Daltonics MicroTof-Q II mass spectrometer. UV-Vis spectra were determined on a Hitachi U-2900 spectrometer. Fluorescence spectra were acquired on a Hitachi F-4600 fluorescence spectrometer with a 10-mm quartz cuvette. The Substrates 1a-1z, 1a'-1i' [1] [2] [3] [4] was prepared according to the literature methods, Naphthylamines and aromatic aldehydes required for the synthesis of 1a can be directly purchased from Well-known chemical reagent companies such as Energy, Innochem, Sigma-Aldrich, Acros, Alfa Aesar, or TCI.

Photoreactor Configuration

The reaction device consists of a quartz beaker with a 240V blue LED lamp winding, a stirrer with a temperature detector and an external tin box. In order to control the reaction temperature, two high-power fans are installed on both sides of the reactor. Once reaction can accommodate 5 quartz sealing tubes.



B. Optimization Studies

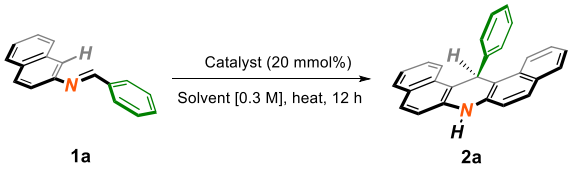


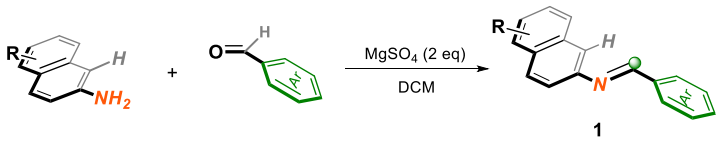
Table 1 Optimization of the Reaction Conditions[a]

Entry	Catalyst	Solvent	Temp/℃	yield (%)[b]
1	$Yb(OTf)_3$	EG	120	51
2	$Sc(OTf)_3$	EG	120	47
3	$Cu(OTf)_2$	EG	120	43
4	$Al(OTf)_3$	EG	120	77
5	**$In(OTf)_3$**	**EG**	**120**	**87**
6	$La(OTf)_3$	EG	120	trace
7	$BF_3{\cdot}OEt_2$	EG	120	trace
8	$FeCl_3$	EG	120	54
9	$ZnCl_2$	EG	120	trace
10	$TiCl_4$	EG	120	trace
11	$In(OTf)_3$	DCE	120	56
12	$In(OTf)_3$	THF	120	30
13	$In(OTf)_3$	HFIP	120	32
14	$In(OTf)_3$	MeOH	120	29
15	$In(OTf)_3$	EtOH	120	57
16	$In(OTf)_3$	EG	50	51
17	$In(OTf)_3$	EG	80	67
18	$In(OTf)_3$	EG	140	79
19[c]	$In(OTf)_3$	EG	120	80
20	none	EG	120	trace

[a]Reaction conditions: **1a** (0.4 mmol), catalyst (20 mmol%) in solvent (0.8 mL) were stirred at indicated temperatures for 12 h under Ar atmosphere. [b]Isolated yields. [c]Air

atmosphere.

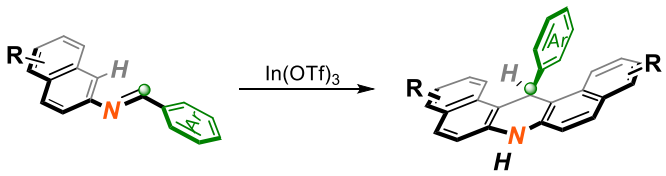
C. Preparation of substrates



1

A round bottom flask equipped with a stir bar was charged with the mixture of naphthalen-2-amine**s** (0.57 g, 4.0 mmol) and $MgSO_4$ (0.96 g, 2 equiv.), then added 15 mL CH_2Cl_2 and stirred the mixture for 5 minutes. After that, added benzaldehydes (0.43 g, 4.0 mmol) and stirred at room temperature overnight. When the starting materials were completely converted, the reaction mixture was filtered and concentrated in vacuo. Then the residue was recrystallized to afford the product **1**.

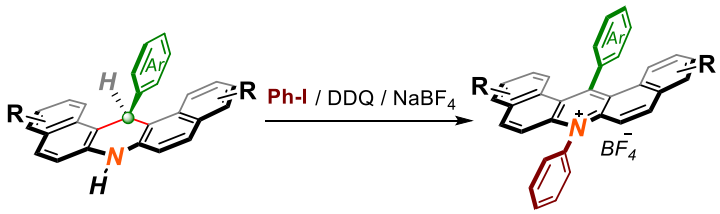
D. Synthesis of dihydroacridines



1 2

An oven-dried vial equipped with a stir bar was charged with N-(naphthalen-2-yl)-1-phenyl-methanimines **1** (0.4 mmol) and $In(OTf)_3$ (22.5 mg, 0.04 mmol). The reaction mixture was placed under a positive pressure of argon and subjected to three evacuation/backfilling cycles under high vacuum. Ethylene glycol (typically, 0.8 mL) was added and the reaction mixture was stirred at 120 °C for 12 hours in an oil bath. After the reaction was completed, it was cooled to room temperature. The mixture was diluted with EtOAc and washed with saturated aqueous $NaHCO_3$, then concentrated in vacuo. The residue was purified by silica gel chromatography to afford the dihydroacridine products **2**.

E. Synthesis of acridinium photocatalysts

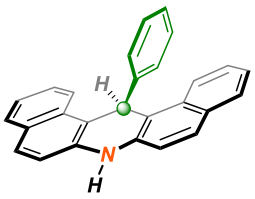


2 8

Under argon atmosphere, $Pd(OAc)_2$ (0.01 mmol), xantphos (0.02 mmol), ^tBuOK (2 equiv.) were added to the pressure tube equipped with a stir bar and dissolved with 1 mL toluene, then aryl iodides (0.3 mmol) was slowly added and the mixture stirred for 5 minutes. After that, product **2** (0.2 mmol) dissolved with 1 mL toluene was slowly added and the mixture stirred at 120 °C for 4 hours. After the reaction was completed, it was filtered and concentrated in vacuo.

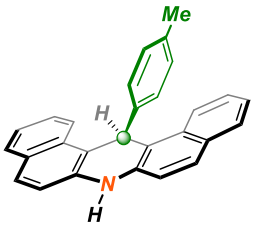
The residue from previous step was dissolved with 5 mL CH_3CN and added to a round

bottom flask equipped with a stir bar, it was stirred at 0 °C and 2,3-dichloro-5,6-dicyano-1,4-benz-oquinone (90.8 mg, 2 equiv.) was slowly added. The mixture was stirred at room temperature for 2 hours. After the reaction was completed, the mixture was diluted with CH_2Cl_2 and washed with pure water, then concentrated in vacuo. The residue was dissolved with 8 mL CH_2Cl_2 and added to a round bottom flask equipped with a stir bar, it was stirred with 10 mL $NaBF_4$ aqueous solution for 8 hours. After the reaction was completed, it was washed with pure water and the organic phase was concentrated in vacuo. The residue was purified by silica gel chromatography to afford the acridinium photocatalysts **8**.



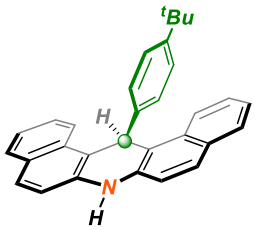
(6a*R*,14*R*)-14-Phenyl-6a,7,14,14a-tetrahydrodibenzo[*a*,*j*]acridine (2a)

White solid (62.1 mg, 87% yield). PE / EA = 10:1, R_f = 0.32. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.50 (d, *J* = 8.5 Hz, 2H), 7.85 (d, *J* = 8.1 Hz, 2H), 7.75 (d, *J* = 8.7 Hz, 2H), 7.65 (t, *J* = 7.8 Hz, 2H), 7.59 (d, *J* = 7.8 Hz, 2H), 7.42 (t, *J* = 7.6 Hz, 2H), 7.20 (t, *J* = 7.7 Hz, 2H), 7.12 (d, *J* = 8.7 Hz, 2H), 7.06 (t, *J* = 7.5 Hz, 1H), 6.80 (s, 1H), 6.46 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 146.1, 136.0, 132.2, 130.3, 128.8, 128.4, 128.3, 127.9, 126.9, 126.2, 123.0, 122.2, 116.8, 114.6, 39.1. IR (KBr): 3467, 3017, 1631, 1521, 1509, 1477, 1420, 1285, 1206, 1155，871 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{20}N$ $[M+H]^+$ 358.1596, found 358.1589.



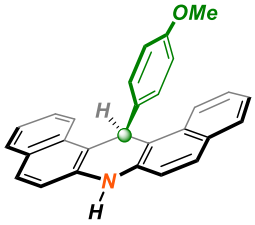
(6a*R*,14*R*)-14-(p-tolyl)-6a,7,14,14a-tetrahydrodibenzo[*a*,*j*]acridine (2b)

White solid (49.1 mg, 66% yield). PE / EA = 10:1, R_f = 0.28. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.47 (d, *J* = 8.5 Hz, 2H), 7.84 (d, *J* = 8.1 Hz, 2H), 7.75 (d, *J* = 8.6 Hz, 3H), 7.63 (t, *J* = 7.8 Hz, 3H), 7.45 (d, *J* = 7.8 Hz, 2H), 7.40 (t, *J* = 7.6 Hz, 2H), 6.99 (d, *J* = 7.7 Hz, 3H), 6.75 (s, 1H), 6.51 (s, 1H), 2.19 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 143.2, 135.9, 135.6, 132.1, 130.3, 129.0, 128.8, 128.2, 127.6, 126.8, 123.0, 122.1, 116.7, 114.8, 38.6, 20.9. IR (KBr): 3462, 3023, 2898, 1621, 1549, 1538, 1485, 1453, 1430, 1388, 1295, 1050 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{22}N$ $[M+H]^+$ 372.1752, found 372.1746.



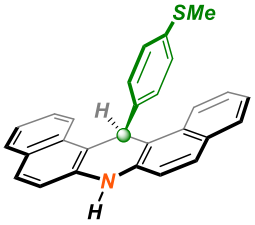
(6a*R*,14*R*)-14-(4-(tert-butyl)phenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2c)

White solid (56.9 mg, 69% yield). PE / EA = 10:1, R_f = 0.29. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.61 (s, 1H), 8.64 (d, *J* = 7.8 Hz, 2H), 7.91–7.80 (m, 4H), 7.67–7.55 (m, 4H), 7.54–7.45 (m, 2H), 7.41–7.30 (m, 2H), 7.21–7.06 (m, 2H), 6.78 (s, 1H), 1.11 (s, 9H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 148.5, 144.7, 136.9, 132.3, 130.0, 129.0, 128.3, 127.6, 127.0, 125.3, 122.9, 122.7, 117.7, 114.2, 38.3, 34.3, 31.4. IR (KBr): 3469, 3019, 2998, 1659, 1578, 1561, 1474, 1451, 1391, 1289, 1255, 729 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{31}H_{28}N$ $[M+H]^+$ 414.2222, found 414.2213.



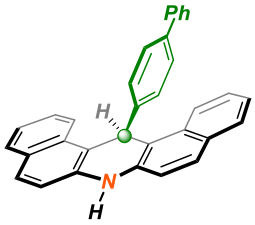
(6a*R*,14*R*)-14-(4-methoxyphenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2d)

White solid (48.8 mg, 63% yield). PE / EA = 8:1, R_f = 0.27. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.56 (s, 1H), 8.56 (d, *J* = 8.5 Hz, 2H), 7.85–7.71 (m, 4H), 7.57–7.46 (m, 4H), 7.38 (d, *J* = 8.7 Hz, 2H), 7.29 (t, *J* = 7.5 Hz, 2H), 6.71–6.59 (m, 3H), 3.52 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 157.7, 140.3, 136.7, 132.2, 129.9, 128.9, 128.3, 127.0, 122.9, 122.8, 117.7, 114.3, 113.9, 55.2, 37.9. IR (KBr): 3461, 3031, 2933, 1631, 1555, 1534, 1473, 1441, 1289, 1187, 746 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{22}NO$ $[M+H]^+$ 388.1701, found 388.1695.



(6a*R*,14*R*)-14-(4-(methylthio)phenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2e)

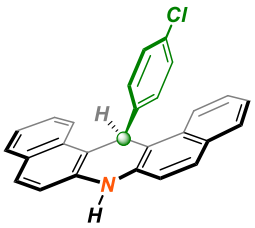
Yellow solid (45.2 mg, 56% yield). PE / EA = 10:1, R_f = 0.32. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.41 (d, *J* = 8.5 Hz, 2H), 7.82 (d, *J* = 8.0 Hz, 2H), 7.75 (d, *J* = 8.7 Hz, 2H), 7.60 (t, *J* = 7.1 Hz, 2H), 7.44 (d, *J* = 8.2 Hz, 2H), 7.38 (t, *J* = 7.5 Hz, 2H), 7.17 (d, *J* = 8.7 Hz, 2H), 7.04 (d, *J* = 8.5 Hz, 2H), 6.71 (s, 1H), 6.55 (s, 1H), 2.33 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 143.2, 135.9, 135.6, 132.0, 130.2, 128.8, 128.4, 128.2, 126.9, 126.8, 123.0, 122.0, 116.7, 114.4, 38.5, 15.9. IR (KBr): 3458, 3031, 1626, 1523, 1515, 1445, 1413, 1289, 1062, 745 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{22}NS$ $[M+H]^+$ 404.1473, found 404.1467.



(6a*R*,14*R*)-14-([1,1'-biphenyl]-4-yl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2f)

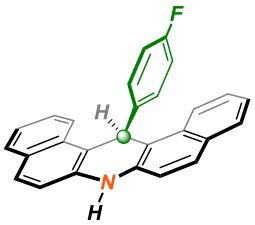
White solid (52.8 mg, 61% yield). PE / EA = 10:1, R_f = 0.32. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.56 (d, *J* = 8.6 Hz, 2H), 7.89 (d, *J* = 8.2 Hz, 2H), 7.78 (d, *J* = 8.7 Hz, 2H), 7.73–7.62 (m, 4H),

7.51–7.38 (m, 8H), 7.34 (d, *J* = 7.4 Hz, 1H), 7.14 (d, *J* = 8.7 Hz, 2H), 6.88 (s, 1H), 6.48 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 145.1, 140.9, 139.0, 136.1, 132.2, 130.4, 128.9, 128.6, 128.4, 128.2, 127.2, 127.1, 127.0, 127.0, 123.1, 122.2, 116.8, 114.6, 38.7. IR (KBr): 3451, 3021, 1642, 1577, 1518, 1470, 1422, 1268, 1042 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{33}H_{24}N$ $[M+H]^+$ 434.1909, found 434.1902.



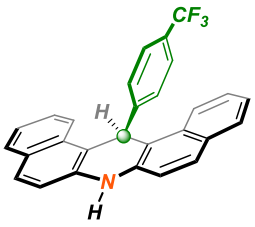
(6a*R*,14*R*)-14-(4-chlorophenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2g)

White solid (56.3 mg, 72% yield). PE / EA = 10:1, R_f = 0.28. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.37 (d, *J* = 8.4 Hz, 2H), 7.82 (d, *J* = 8.0 Hz, 2H), 7.75 (d, *J* = 8.7 Hz, 2H), 7.60 (t, *J* = 8.6 Hz, 2H), 7.44 (d, *J* = 7.4 Hz, 2H), 7.39 (t, *J* = 7.5 Hz, 2H), 7.17 (d, *J* = 8.6 Hz, 2H), 7.10 (d, *J* = 8.8 Hz, 2H), 6.72 (s, 1H), 6.55 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.5, 135.9, 131.9, 131.7, 130.2, 129.1, 128.9, 128.6, 128.4, 127.0, 123.1, 121.8, 116.7, 114.1, 38.4. IR (KBr): 3475, 3027, 1619, 1518, 1502, 1466, 1421, 1290, 733 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{19}ClN$ $[M+H]^+$ 392.1206, found 392.1198.



(6a*R*,14*R*)-14-(4-fluorophenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2h)

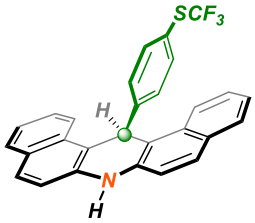
Yellow solid (49.6 mg, 66% yield). PE / EA = 10:1, R_f = 0.32. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.43 (d, *J* = 8.5 Hz, 2H), 7.86 (d, *J* = 8.1 Hz, 2H), 7.76 (d, *J* = 8.7 Hz, 2H), 7.64 (t, *J* = 7.9 Hz, 2H), 7.50 (t, *J* = 6.9 Hz, 2H), 7.43 (t, *J* = 7.6 Hz, 2H), 7.14 (d, *J* = 8.6 Hz, 2H), 6.86 (t, *J* = 8.6 Hz, 2H), 6.77 (s, 1H), 6.49 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.1 (d, *J* = 244.5 Hz), 141.9 (d, *J* = 3.5 Hz), 135.9, 132.0, 130.2, 129.2, 129.2, 128.9, 128.5, 127.0, 123.1, 121.9, 116.8, 115.1 (d, *J* = 21.3 Hz), 114.4, 38.2. ^{19}F NMR (376 MHz, d_6-DMSO): δ -116.9. IR (KBr): 3442, 3012, 1614, 1569, 1528, 1467, 1414, 1349, 1248, 1207 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{19}FN$ $[M+H]^+$ 376.1502, found 376.1443.



(6a*R*,14*R*)-14-(4-(trifluoromethyl)phenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2i)

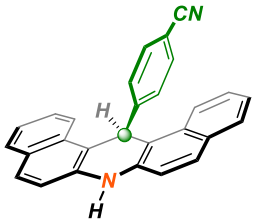
White solid (61.2 mg, 72% yield). PE / EA = 10:1, R_f = 0.33. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.42 (d, *J* = 8.4 Hz, 2H), 7.88 (d, *J* = 8.0 Hz, 2H), 7.80 (d, *J* = 8.6 Hz, 2H), 7.73–7.62 (m, 4H),

7.45 (d, *J* = 7.6 Hz, 4H), 7.19 (d, *J* = 8.5 Hz, 2H), 6.84 (s, 1H), 6.58 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.8, 136.0, 132.0, 130.3, 129.0, 128.8, 128.3 (q, *J* = 32.3 Hz), 128.0, 127.1, 125.4 (q, *J* = 3.8 Hz), 124.2 (q, *J* = 270.1 Hz), 123.3, 121.8, 116.8, 113.8, 39.0. ^{19}F NMR (376 MHz, $CDCl_3$): δ -62.4. IR (KBr): 3450, 3017, 1634, 1558, 1512, 1460, 1438, 1332, 1261, 1212, 1108 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{19}F_3N$ $[M+H]^+$ 426.1470, found 426.1466.



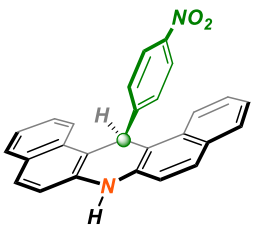
(6a*R*,14*R*)-14-(4-((trifluoromethyl)thio)phenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2j)

White solid (74.1 mg, 81% yield). PE / EA = 10:1, R_f = 0.32. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.38 (d, *J* = 8.5 Hz, 2H), 7.85 (d, *J* = 8.4 Hz, 2H), 7.77 (d, *J* = 8.6 Hz, 2H), 7.63 (t, *J* = 8.4 Hz, 2H), 7.55 (d, *J* = 8.2 Hz, 2H), 7.46–7.37 (m, 4H), 7.17 (d, *J* = 8.7 Hz, 2H), 6.79 (s, 1H), 6.55 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.8, 136.3, 136.1, 132.0, 130.2, 129.5 (q, *J* = 306.3 Hz), 128.9, 128.8, 128.7, 127.1, 123.2, 121.8, 121.6, 116.8, 113.7, 38.6. ^{19}F NMR (376 MHz, $CDCl_3$): δ -42.6. IR (KBr): 3469, 3018, 1623, 1562, 1254, 1229, 1038, 738 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{19}F_3NS$ $[M+H]^+$ 458.1190, found 458.1182.



4-((6a*R*,14*R*)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridin-14-yl)benzonitrile (2k)

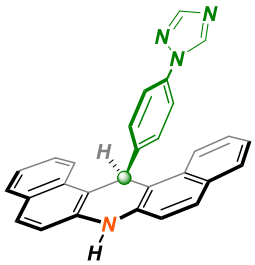
Yellow solid (53.4 mg, 70% yield). PE / EA = 7:1, R_f = 0.29. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.70 (s, 1H), 8.60 (d, *J* = 8.5 Hz, 2H), 7.86–7.80 (m, 6H), 7.63–7.54 (m, 4H), 7.41 (d, *J* = 8.8 Hz, 2H), 7.33 (t, *J* = 7.6 Hz, 2H), 6.87 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 152.9, 136.9, 132.7, 132.1, 129.9, 129.0, 128.9, 128.8, 127.3, 123.2, 122.5, 119.2, 117.7, 112.9, 109.3, 38.8. IR (KBr): 3479, 3020, 2237, 1616, 1541, 1517, 1441, 1420, 1260, 1197 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{19}N_2$ $[M+H]^+$ 383.1548, found 383.1542.



(6a*R*,14*R*)-14-(4-nitrophenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2l)

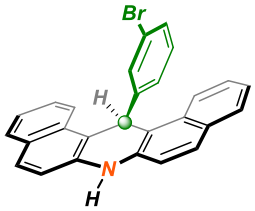
Yellow solid (57.0 mg, 71% yield). PE / EA = 4:1, R_f = 0.31. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.71 (s, 1H), 8.61 (d, *J* = 8.6 Hz, 2H), 8.03 (d, *J* = 8.5 Hz, 2H), 7.91 (d, *J* = 8.4 Hz, 2H), 7.87–7.78 (m, 4H), 7.57 (t, *J* = 7.9 Hz, 2H), 7.41 (d, *J* = 8.8 Hz, 2H), 7.34 (t, *J* = 7.6 Hz, 2H), 6.94 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 154.9, 146.1, 136.9, 132.0, 129.9, 129.0, 128.9, 127.3,

124.0, 123.2, 122.5, 117.7, 112.7, 38.7. IR (KBr): 3460, 3321, 3024, 1587, 1522, 1447, 1408, 1368, 1269, 1043 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{19}N_2O_2$ $[M+H]^+$ 403.1447, found 403.1441.



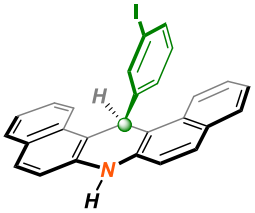
(6a*R*,14*R*)-14-(4-(1H-1,2,4-triazol-1-yl)phenyl)-6a,7,14,14a-tetrahydrodibenzo[*a*,*j*]acridine (2m)

Yellow solid (49.2 mg, 58% yield). PE / EA = 5:1, R_f = 0.30. ^1H NMR (400 MHz, d_6-DMSO): δ 9.67 (s, 1H), 9.06 (s, 1H), 8.65 (d, *J* = 8.6 Hz, 2H), 8.15 (s, 1H), 7.87–7.81 (m, 6H), 7.64–7.56 (m, 4H), 7.43 (d, *J* = 8.8 Hz, 2H), 7.34 (t, *J* = 7.7 Hz, 2H), 6.86 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 152.6, 147.6, 142.6, 136.8, 135.1, 132.1, 129.9, 129.0, 129.0, 128.7, 127.1, 123.0, 122.6, 120.1, 117.7, 113.5, 38.3. IR (KBr): 3916, 3022, 1756, 1588, 1524, 1472, 1402, 1277, 1147, 1020 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{21}N_4$ $[M+H]^+$ 425.1766, found 425.1752.



(6a*R*,14*R*)-14-(3-bromophenyl)-6a,7,14,14a-tetrahydrodibenzo[*a*,*j*]acridine (2n)

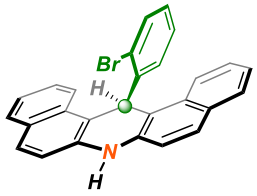
White solid (59.9 mg, 69% yield). PE / EA = 10:1, R_f = 0.31. ^1H NMR (400 MHz, $CDCl_3$): δ 8.41 (d, *J* = 8.5 Hz, 2H), 7.85 (d, *J* = 8.1 Hz, 2H), 7.76 (d, *J* = 8.7 Hz, 2H), 7.71–7.62 (m, 3H), 7.56 (d, *J* = 7.8 Hz, 1H), 7.43 (t, *J* = 7.5 Hz, 2H), 7.21–7.11 (m, 3H), 7.06 (t, *J* = 7.8 Hz, 1H), 6.74 (s, 1H), 6.51 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.3, 135.9, 131.9, 130.8, 130.2, 129.8, 129.4, 128.9, 128.6, 127.1, 126.3, 123.2, 122.8, 121.8, 116.8, 113.8, 38.9. IR (KBr): 3448, 3029, 1644, 1560, 1478, 1434, 1269, 1238, 578 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{19}BrN$ $[M+H]^+$ 436.0701, found 436.0696.



(6a*R*,14*R*)-14-(3-iodophenyl)-6a,7,14,14a-tetrahydrodibenzo[*a*,*j*]acridine (2o)

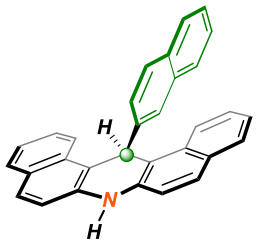
White solid (70.6 mg, 73% yield). PE / EA = 10:1, R_f = 0.30. ^1H NMR (400 MHz, $CDCl_3$): δ 8.37 (d, *J* = 8.5 Hz, 2H), 7.89–7.80 (m, 3H), 7.75 (d, *J* = 8.7 Hz, 2H), 7.62 (t, *J* = 7.4 Hz, 2H), 7.56 (d, *J* = 7.7 Hz, 1H), 7.44–7.32 (m, 3H), 7.14 (d, *J* = 8.6 Hz, 2H), 6.89 (t, *J* = 7.8 Hz, 1H), 6.68 (s, 1H), 6.52 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.4, 136.7, 135.9, 135.3, 131.9, 130.2, 123.0, 128.9, 128.6, 127.0, 127.0, 123.2, 121.8, 116.8, 113.9, 94.9, 38.9. IR (KBr): 3467,

3024, 1631, 1554, 1474, 1429, 1059, 637 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{19}IN$ $[M+H]^+$ 484.0562, found 484.0557.



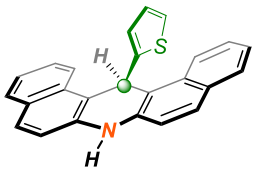
(6a*R*,14*S*)-14-(2-bromophenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2p)

White solid (59.2 mg, 68% yield). PE / EA = 10:1, R_f = 0.30. ^1H NMR (400 MHz, $CDCl_3$): δ 8.97 (d, *J* = 8.6 Hz, 2H), 7.84–7.73 (m, 5H), 7.65 (t, *J* = 7.7 Hz, 2H), 7.45–7.35 (m, 3H), 7.18 (d, *J* = 8.6 Hz, 2H), 6.99 (t, *J* = 7.6 Hz, 1H), 6.91 (s, 1H), 6.82 (t, *J* = 7.6 Hz, 1H), 6.58 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 147.8, 135.8, 132.9, 132.4, 132.0, 130.2, 128.6, 128.5, 127.9, 126.8, 123.6, 123.2, 119.7, 116.9, 115.9, 38.8. IR (KBr): 3451, 3031, 1616, 1529, 1511, 1478, 1434, 1264, 1220, 657 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{19}BrN$ $[M+H]^+$ 436.0701, found 436.0696.



(6a*R*,14*R*)-14-(naphthalen-2-yl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2q)

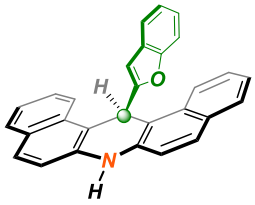
White solid (45.6 mg, 56% yield). PE / EA = 10:1, R_f = 0.32. ^1H NMR (400 MHz, $CDCl_3$): δ 8.54 (d, *J* = 8.5 Hz, 2H), 8.00 (s, 1H), 7.84–7.68 (m, 7H), 7.68–7.52 (m, 5H), 7.42–7.32 (m, 4H), 7.19 (d, *J* = 8.7 Hz, 2H), 6.92 (s, 1H), 6.61 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 143.4, 135.9, 133.1, 132.2, 132.0, 130.3, 128.8, 128.5, 128.4, 128.0, 127.4, 126.9, 126.7, 125.7, 125.6, 125.3, 123.0, 122.1, 116.8, 114.3, 39.4. IR (KBr): 3463, 3032, 1637, 1559, 1538, 1466, 1439, 1261, 1198 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{31}H_{22}N$ $[M+H]^+$ 408.1752, found 408.1744.



(6a*R*,14*S*)-14-(thiophen-2-yl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2r)

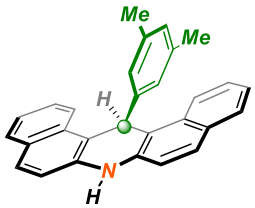
Yellow solid (50.8 mg, 70% yield). PE / EA = 10:1, R_f = 0.29. ^1H NMR (400 MHz, $CDCl_3$): δ 8.45 (d, *J* = 8.5 Hz, 2H), 7.87 (d, *J* = 8.0 Hz, 2H), 7.77 (d, *J* = 8.7 Hz, 2H), 7.66 (t, *J* = 8.6 Hz, 2H), 7.44 (t, *J* = 7.5 Hz, 2H), 7.13 (d, *J* = 8.7 Hz, 2H), 7.09 (s, 1H), 6.97 (d, *J* = 4.5 Hz, 1H), 6.78–6.70 (m, 2H), 6.59 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.2, 136.0, 131.9, 130.2, 128.8, 128.6, 127.1, 126.3, 124.1, 123.8, 123.2, 122.0, 116.7, 113.7, 33.8. IR (KBr): 3472, 3022, 2915,

1667, 1559, 1462, 1279, 1241, 688 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{25}H_{18}NS$ $[M+H]^+$ 364.1160, found 364.1153.



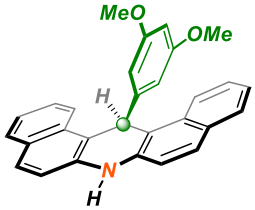
(6a*R*,14*R*)-14-(benzofuran-6-yl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2s)

White solid (41.2 mg, 52% yield). PE / EA = 10:1, R_f = 0.30. ^1H NMR (400 MHz, $CDCl_3$): δ 8.48 (d, *J* = 8.5 Hz, 2H), 7.84 (d, *J* = 8.1 Hz, 2H), 7.78 (d, *J* = 8.6 Hz, 2H), 7.64 (t, *J* = 8.4 Hz, 2H), 7.41 (t, *J* = 7.4 Hz, 2H), 7.35–7.24 (m, 2H), 7.16 (d, *J* = 8.7 Hz, 2H), 7.13–7.02 (m, 2H), 7.00 (s, 1H), 6.63 (s, 1H), 6.15 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.2, 136.2, 132.3, 130.1, 128.8, 128.6, 127.0, 123.1, 122.3, 122.2, 120.4, 116.6, 111.1, 110.7, 103.2, 33.5. IR (KBr): 3461, 2979, 1633, 1523, 1466, 1400, 1259, 1065, 742 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{20}NO$ $[M+H]^+$ 398.1545, found 398.1537.



(6a*R*,14*R*)-14-(3,5-dimethylphenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2t)

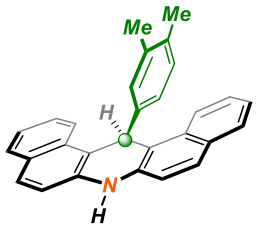
White solid (57.8 mg, 75% yield). PE / EA = 10:1, R_f = 0.33. ^1H NMR (400 MHz, $CDCl_3$): δ 8.47 (d, *J* = 8.6 Hz, 2H), 7.81 (d, *J* = 8.0, 1.2 Hz, 2H), 7.73 (d, *J* = 8.6 Hz, 2H), 7.60 (t, *J* = 8.2 Hz, 2H), 7.38 (t, *J* = 8.2 Hz, 2H), 7.19–7.14 (m, 4H), 6.67 (d, *J* = 8.2 Hz, 2H), 6.49 (s, 1H), 2.19 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 146.1, 137.5, 135.9, 132.2, 130.3, 128.7, 128.2, 128.0, 126.7, 125.7, 122.9, 122.2, 116.8, 114.9, 39.1, 21.5. IR (KBr): 3461, 3015, 2989, 1642, 1543, 1519, 1451, 1384, 1266, 998 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{24}N$ $[M+H]^+$ 386.1909, found 386.1903.



(6a*R*,14*R*)-14-(3,5-dimethoxyphenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2u)

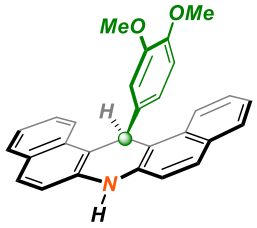
Yellow solid (64.2 mg, 77% yield). PE / EA = 10:1, R_f = 0.29. ^1H NMR (400 MHz, $CDCl_3$): δ 8.49 (d, *J* = 8.5 Hz, 2H), 7.81 (d, *J* = 8.0 Hz, 2H), 7.70–7.57 (m, 4H), 7.40 (t, *J* = 7.4 Hz, 2H), 6.99 (d, *J* = 8.7 Hz, 2H), 6.79 (s, 2H), 6.73 (s, 1H), 6.50 (s, 1H), 6.19 (s, 1H), 3.67 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.6, 148.4, 136.0, 132.2, 130.3, 128.8, 128.3, 126.8, 123.0, 122.2, 116.8, 114.2, 106.9, 97.2, 55.1, 39.2. IR (KBr): 3455, 3010, 2987, 1661, 1579, 1460, 1429, 1278,

1219, 1088 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{24}NO_2$ $[M+H]^+$ 418.1807, found 418.1801.



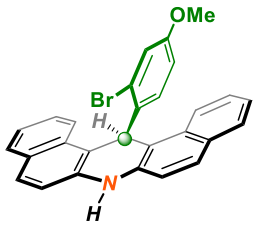
(6a*R*,14*R*)-14-(3,4-dimethylphenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2v)

White solid (54.6 mg, 71% yield). PE / EA = 10:1, R_f = 0.31. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.56–8.44 (m, 2H), 7.84 (t, *J* = 7.7 Hz, 2H), 7.77 (t, *J* = 7.6 Hz, 2H), 7.70–7.57 (m, 2H), 7.46–7.36 (m, 2H), 7.36–7.26 (m, 2H), 7.25–7.13 (m, 2H), 7.01–6.90 (m, 1H), 6.73 (s, 1H), 6.51 (s, 1H), 2.21–2.06 (m, 6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 143.6, 136.3, 135.9, 134.3, 132.2, 130.3, 129.4, 129.1, 128.7, 128.1, 126.8, 125.2, 122.9, 122.2, 116.7, 115.0, 38.7, 19.9, 19.1. IR (KBr): 3459, 3008, 2989, 1645, 1533, 1520, 1454, 1382, 1280, 1048 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{24}N$ $[M+H]^+$ 386.1909, found 386.1901.



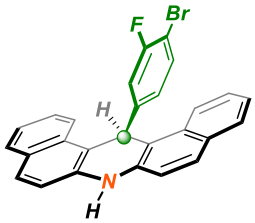
(6a*R*,14*R*)-14-(3,4-dimethoxyphenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2w)

White solid (65.1 mg, 78% yield). PE / EA = 10:1, R_f = 0.27. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.48 (d, *J* = 8.6 Hz, 2H), 7.84 (d, *J* = 8.1 Hz, 2H), 7.72 (d, *J* = 8.7 Hz, 2H), 7.62 (t, *J* = 7.8 Hz, 2H), 7.40 (t, *J* = 7.5 Hz, 2H), 7.13 (d, *J* = 8.7 Hz, 2H), 7.10–6.99 (m, 2H), 6.75 (s, 1H), 6.66 (d, *J* = 8.1 Hz, 1H), 6.59 (s, 1H), 3.72 (s, 3H), 3.70 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.0, 147.4, 138.8, 136.1, 132.2, 130.3, 128.8, 128.2, 126.8, 123.0, 122.1, 119.8, 116.7, 114.7, 111.8, 111.0, 55.7, 55.7, 38.3. IR (KBr): 3445, 3023, 2966, 1654, 1545, 1532, 1473, 1424, 1257, 1206, 1169 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{24}NO_2$ $[M+H]^+$ 418.1807, found 418.1802.



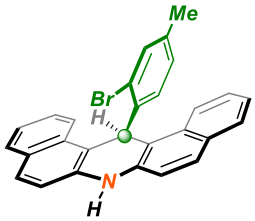
(6a*R*,14*S*)-14-(2-bromo-4-methoxyphenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2x)

White solid (50.2 mg, 54% yield). PE / EA = 10:1, R_f = 0.27. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.70 (s, 1H), 8.76 (d, *J* = 8.6 Hz, 2H), 7.81 (t, *J* = 9.0 Hz, 4H), 7.62–7.48 (m, 3H), 7.42 (d, *J* = 8.7 Hz, 2H), 7.32 (t, *J* = 7.4 Hz, 2H), 6.96 (s, 1H), 6.72–6.59 (m, 2H), 3.54 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 158.5, 140.6, 137.0, 132.4, 132.3, 129.9, 129.1, 128.7, 126.9, 123.1, 123.0, 119.3, 118.0, 117.1, 116.2, 114.4, 55.7, 37.8. IR (KBr): 3458, 3014, 2987, 1671, 1568, 1531, 1466, 1418, 1281, 1234, 1045, 949, 641 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{21}BrNO$ $[M+H]^+$ 486.0807, found 486.0802.



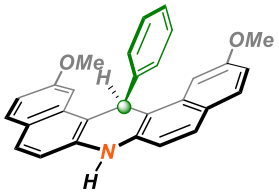
(6a*R*,14*R*)-14-(4-bromo-3-fluorophenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2y)

White solid (56.2 mg, 62% yield). PE / EA = 7:1, R_f = 0.29. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.68 (s, 1H), 8.62 (d, *J* = 8.5 Hz, 2H), 7.85–7.78 (m, 4H), 7.69 (d, *J* = 10.1 Hz, 1H), 7.58 (t, *J* = 7.7 Hz, 2H), 7.46–7.30 (m, 6H), 6.82 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 158.4 (d, *J* = 245.1 Hz), 150.0 (d, *J* = 5.3 Hz), 136.8, 133.7, 132.0, 129.9, 129.0, 128.9, 127.3, 125.7 (d, *J* = 3.0 Hz), 123.2, 122.5, 117.7, 115.8 (d, *J* = 21.9 Hz), 113.0, 105.6 (d, *J* = 20.7 Hz), 38.1. ^{19}F NMR (376 MHz, d_6-DMSO): δ -107.3. IR (KBr): 3471, 3007, 1626, 1541, 1511, 1474, 1445, 1333, 1261, 1234, 652 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{18}BrFN$ $[M+H]^+$ 454.0607, found 454.0602.



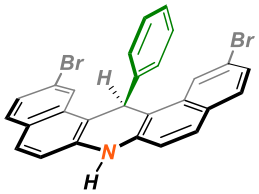
(6a*R*,14*S*)-14-(2-bromo-4-methylphenyl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2z)

Yellow solid (49.4 mg, 55% yield). PE / EA = 10:1, R_f = 0.29. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.95 (d, *J* = 8.6 Hz, 2H), 7.78 (d, *J* = 8.0 Hz, 2H), 7.71 (d, *J* = 8.7 Hz, 2H), 7.67–7.58 (m, 3H), 7.38 (t, *J* = 7.5 Hz, 2H), 7.23 (s, 1H), 7.12 (d, *J* = 8.6 Hz, 2H), 6.86 (s, 1H), 6.76 (d, *J* = 8.2 Hz, 1H), 6.51 (s, 1H), 2.06 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.8, 137.9, 135.8, 133.1, 132.4, 131.5, 130.2, 129.6, 128.5, 128.5, 126.7, 123.7, 123.1, 119.4, 116.9, 115.9, 38.4, 20.2. IR (KBr): 3479, 3018, 2972, 1664, 1528, 1466, 1422, 1387, 1228, 1014, 677 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{21}BrN$ $[M+H]^+$ 450.0857, found 450.0849.



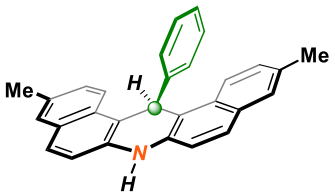
(6a*R*,14*R*)-2,12-dimethoxy-14-phenyl-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2a')

White solid (50.8 mg, 61% yield). PE / EA = 7:1, R_f = 0.28. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.76–7.69 (m, 4H), 7.69–7.64 (m, 2H), 7.60 (d, *J* = 7.5 Hz, 2H), 7.20 (t, *J* = 7.5 Hz, 2H), 7.09–7.03 (m, 3H), 7.04–6.98 (m, 2H), 6.50 (s, 1H), 6.44 (s, 1H), 4.09 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 158.4, 146.1, 136.1, 133.4, 130.2, 128.3, 128.1, 128.0, 126.1, 125.5, 114.3, 114.1, 113.8, 102.5, 55.4, 40.3. IR (KBr): 3455, 3009, 2986, 1654, 1545, 1473, 1424, 1257, 1206, 1109 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{24}NO_2$ $[M+H]^+$ 418.1807, found 418.1799.



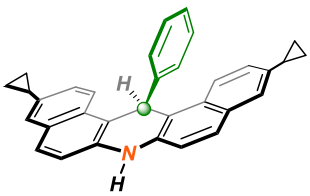
(6a*R*,14*R*)-2,12-dibromo-14-phenyl-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2b')

White solid (68.6 mg, 67% yield). PE / EA = 8:1, R_f = 0.31. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.82 (s, 1H), 8.90 (s, 2H), 7.79 (d, *J* = 8.8 Hz, 2H), 7.75 (d, *J* = 8.6 Hz, 2H), 7.59 (d, *J* = 7.1 Hz, 2H), 7.45–7.35 (m, 4H), 7.15 (t, *J* = 7.6 Hz, 2H), 6.98 (t, *J* = 7.4 Hz, 1H), 6.73 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 147.6, 137.5, 133.7, 131.1, 128.8, 128.6, 127.9, 126.6, 126.1, 125.3, 121.2, 118.2, 113.5, 38.4. IR (KBr): 3465, 3010, 1679, 1519, 1485, 1453, 1276, 1227, 689 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{18}Br_2N$ $[M+H]^+$ 513.9806, found 513.9801.



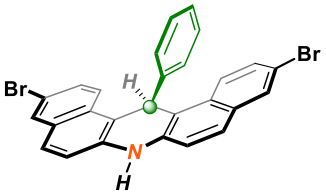
(6a*R*,14*R*)-3,11-dimethyl-14-phenyl-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2c')

White solid (44.5 mg, 58% yield). PE / EA = 8:1, R_f = 0.31. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.34 (d, *J* = 8.6 Hz, 2H), 7.66 (d, *J* = 8.6 Hz, 2H), 7.59 (s, 2H), 7.50 (d, *J* = 7.7 Hz, 2H), 7.43 (d, *J* = 8.7 Hz, 2H), 7.17–7.10 (m, 4H), 7.01 (t, *J* = 7.2 Hz, 1H), 6.70 (s, 1H), 6.44 (s, 1H), 2.52 (s, 6H).^{13}C NMR (100 MHz, $CDCl_3$): δ 146.2, 135.4, 132.3, 130.4, 130.3, 128.9, 128.2, 127.9, 127.8, 127.6, 126.0, 122.0, 116.8, 114.6, 39.1, 21.3. IR (KBr): 3463, 3011, 2991, 1625, 1568, 1525, 1431, 1377, 1278, 1225, 994 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{29}H_{24}N$ $[M+H]^+$ 386.1909, found 386.1901.



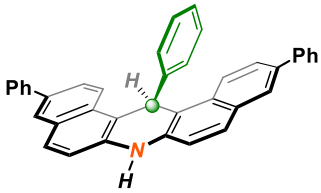
(6a*R*,14*R*)-3,11-dicyclopropyl-14-phenyl-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2d')

White solid (68.2 mg, 78% yield). PE / EA = 10:1, R_f = 0.32. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.30 (d, *J* = 8.7 Hz, 2H), 7.62 (d, *J* = 8.7 Hz, 2H), 7.52–7.44 (m, 4H), 7.29 (s, 2H), 7.16–7.07 (m, 4H), 6.98 (t, *J* = 7.4 Hz, 1H), 6.64 (s, 1H), 6.44 (s, 1H), 2.11–1.98 (m, 2H), 1.08–0.98 (m, 4H), 0.85–0.74 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 146.2, 138.2, 135.3, 130.5, 130.3, 128.2, 127.8, 127.6, 126.0, 125.6, 124.8, 122.2, 116.9, 114.6, 39.2, 15.3, 9.0, 8.8. IR (KBr): 3545, 3401, 3003, 2922, 1599, 1520, 1485, 1401, 943 804, 749, 510 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{33}H_{28}N$ $[M+H]^+$ 438.2222, found 438.2218.



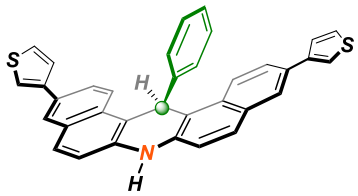
(6a*R*,14*R*)-3,11-dibromo-14-phenyl-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2e')

White solid (69.6 mg, 68% yield). PE / EA = 8:1, R_f = 0.28. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.74 (s, 1H), 8.52 (d, *J* = 9.1 Hz, 2H), 8.04 (s, 2H), 7.75 (d, *J* = 8.7 Hz, 2H), 7.59 (d, *J* = 9.1 Hz, 2H), 7.53 (d, *J* = 7.7 Hz, 2H), 7.38 (d, *J* = 8.8 Hz, 2H), 7.09 (t, *J* = 7.7 Hz, 2H), 6.95 (t, *J* = 7.5 Hz, 1H), 6.67 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 152.1, 141.7, 136.0, 135.5, 135.4, 134.4, 133.4, 132.6, 132.5, 131.2, 123.0, 123.6, 120.6, 118.8, 43.2. IR (KBr): 3462, 3032, 1618, 1555, 1528, 1461, 1421, 1266, 1212, 677 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{18}Br_2N$ $[M+H]^+$ 513.9806, found 513.9798.



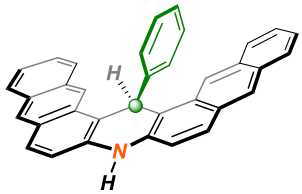
(6a*R*,14*R*)-3,11,14-triphenyl-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2f')

Yellow solid (60.9 mg, 60% yield). PE / EA = 8:1, R_f = 0.31. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.52 (d, *J* = 8.8 Hz, 2H), 8.02 (d, *J* = 2.0 Hz, 2H), 7.88 (d, *J* = 8.6 Hz, 2H), 7.80 (d, *J* = 8.7 Hz, 2H), 7.76 (d, *J* = 9.6 Hz, 4H), 7.57 (d, 2H), 7.52 (t, *J* = 7.7 Hz, 4H), 7.44–7.37 (m, 2H), 7.22–7.15 (m, 4H), 7.04 (t, *J* = 6.9 Hz, 1H), 6.79 (s, 1H), 6.56 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 146.0, 141.1, 135.9, 135.7, 131.4, 130.6, 128.8, 128.7, 128.4, 127.8, 127.1, 127.0, 126.6, 126.4, 126.2, 122.7, 117.1, 114.6, 39.3. IR (KBr): 3451, 3019, 1638, 1559, 1541, 1477, 1438, 1409, 1259, 1223 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{39}H_{28}N$ $[M+H]^+$ 510.2222, found 510.2218.



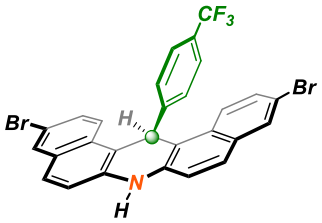
(6a*R*,14*R*)-14-phenyl-3,11-di(thiophen-3-yl)-6a,7,14,14a-tetrahydrodibenzo[*a,j*]acridine (2g')

Yellow solid (84.4 mg, 83% yield). PE / EA = 10:1, R_f = 0.29. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.81 (s, 1H), 8.72 (d, *J* = 9.0 Hz, 2H), 8.26 (s, 2H), 8.07–7.98 (m, 4H), 7.93 (d, *J* = 8.8 Hz, 2H), 7.80–7.66 (m, 6H), 7.53 (d, *J* = 8.8, 1.9 Hz, 2H), 7.17 (t, *J* = 7.7 Hz, 2H), 7.00 (t, *J* = 7.4 Hz, 1H), 6.87 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 148.0, 141.9, 136.7, 131.4, 130.3, 129.8, 128.8, 128.6, 128.1, 127.5, 126.7, 126.4, 125.8, 125.6, 123.6, 120.9, 118.2, 114.2, 39.0. IR (KBr): 3467, 3031, 2955, 1704, 1561, 1518, 1444, 1408, 1272, 1230, 1015, 655 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{35}H_{24}NS_2$ $[M+H]^+$ 522.1350, found 522.1342.



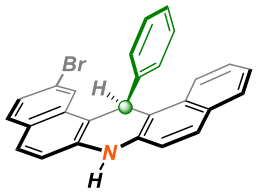
(7a*R*,17*R*)-17-phenyl-7a,8,17,17a-tetrahydrodinaphtho[2,3-*a*:2',3'-*j*]acridine (2h')

Yellow solid (70.4 mg, 77% yield). PE / EA = 7:1, R_f = 0.27. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.79 (s, 1H), 9.17 (s, 2H), 8.43 (s, 2H), 8.19 (d, *J* = 8.5 Hz, 2H), 7.97 (t, *J* = 9.6 Hz, 4H), 7.80 (d, *J* = 7.7 Hz, 2H), 7.52 (t, *J* = 7.6 Hz, 2H), 7.46–7.38 (m, 4H), 7.08 (t, *J* = 7.6 Hz, 2H), 6.98 (s, 1H), 6.87 (t, *J* = 7.4 Hz, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 148.1, 135.5, 132.4, 130.7, 129.6, 129.4, 129.0, 128.5, 128.3, 128.3, 127.3, 126.2, 126.2, 124.8, 120.3, 119.4, 111.7, 39.1. IR (KBr): 3451, 3031, 1644, 1558, 1511, 1470, 1438, 1280, 1231 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{35}H_{24}N$ $[M+H]^+$ 458.1909, found 458.1903.



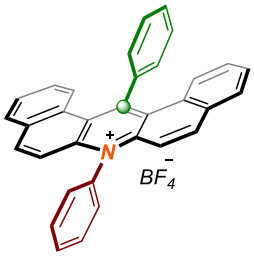
(6a*R*,14*R*)-3,11-dibromo-14-(4-(trifluoromethyl)phenyl)-6a,7,14,14a-tetrahydrodibenzo[*a*,*j*]acridine (2i')

Yellow solid (98.6 mg, 85% yield). PE / EA = 7:1, R_f = 0.31. ^{1}H NMR (400 MHz, d_6-DMSO): δ 9.62 (s, 1H), 8.25 (d, *J* = 9.2 Hz, 2H), 7.74 (s, 2H), 7.55–7.44 (m, 4H), 7.35 (d, *J* = 9.2 Hz, 2H), 7.21 (d, *J* = 8.8 Hz, 2H), 7.10 (d, *J* = 8.0 Hz, 2H), 6.55 (s, 1H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 151.4, 137.1, 131.3, 130.7, 130.7, 129.9, 128.4, 128.2, 127.3 (q, *J* = 31.7 Hz), 125.6 (q, *J* = 4.5 Hz), 124.9, 124.5 (q, *J* = 270.3 Hz), 119.0, 116.1, 113.2, 38.6. ^{19}F NMR (376 MHz, d_6-DMSO): δ -61.1. IR (KBr): 3463, 3023, 1631, 1518, 1477, 1422, 1324, 1285, 1206 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{28}H_{17}Br_2FN$ $[M+H]^+$ 581.9680, found 581.9672.



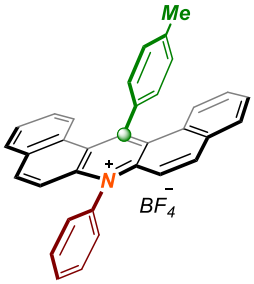
(*R*)-2-bromo-14-phenyl-7,14-dihydrodibenzo[*a*,*j*]acridine (2l')

White solid (38.3 mg, 44% yield). PE / EA = 10:1, R_f = 0.34. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.54 (s, 1H), 8.42 (d, *J* = 8.6 Hz, 1H), 7.81 (d, *J* = 8.1 Hz, 1H), 7.74 (d, *J* = 8.7 Hz, 1H), 7.70–7.58 (m, 3H), 7.49 (d, *J* = 9.3 Hz, 2H), 7.43–7.35 (m, 2H), 7.20–7.12 (m, 4H), 7.03 (t, *J* = 7.4 Hz, 1H), 6.58 (d, *J* = 12.0 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 145.7, 136.7, 135.5, 133.5, 132.0, 130.3, 128.8, 128.6, 128.5, 128.5, 128.2, 127.7, 127.0, 126.3, 126.2, 124.6, 123.2, 122.2, 121.5, 117.2, 116.6, 114.5, 113.7, 39.1. IR (KBr): 3458, 3012, 1669, 1513, 1477, 1448, 1271, 1224, 682 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{27}H_{19}BrN$ $[M+H]^+$ 436.0717, found 436.0711.



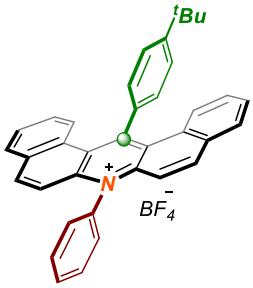
7,14-diphenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8a)

Yellow solid (81.8 mg, 79% yield). DCM / MeOH = 100:1, R_f = 0.24. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.26 (d, *J* = 9.3 Hz, 2H), 8.00 (d, *J* = 7.8 Hz, 2H), 7.94–7.82 (m, 4H), 7.79–7.70 (m, 4H), 7.68–7.57 (m, 4H), 7.39–7.22 (m, 6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.2, 142.7, 140.7, 140.4, 138.3, 132.4, 132.0, 131.7, 131.5, 130.7, 129.9, 129.4, 129.3, 129.1, 128.9, 128.3, 128.0, 125.0, 117.1. ^{19}F NMR (376 MHz, d_6-DMSO): δ -154.2. IR (KBr): 3465, 3048, 1586, 1461, 1345, 1221, 1084 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{33}H_{22}N^+$ $[M]^+$ 432.1747 found 432.1744.



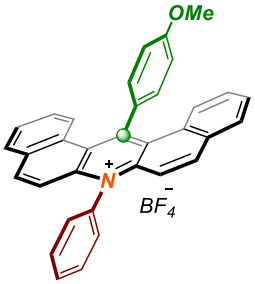
7-phenyl-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8b)

Red solid (76.6 mg, 72% yield). DCM / MeOH = 100:1, R_f = 0.25. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.56 (d, *J* = 9.4 Hz, 2H), 8.24 (d, *J* = 7.8 Hz, 2H), 8.05–7.98 (m, 3H), 7.94–7.88 (m, 2H), 7.78 (t, *J* = 7.9 Hz, 2H), 7.70 (d, *J* = 7.8 Hz, 2H), 7.49 (d, *J* = 7.8 Hz, 2H), 7.45–7.30 (m, 6H), 2.68 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 155.9, 143.0, 141.3, 140.5, 139.0, 138.1, 132.6, 132.3, 132.0, 131.9, 130.5, 129.4, 129.3, 129.2, 129.2, 128.8, 128.8, 128.3, 124.8, 117.9, 21.8. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.4. IR (KBr): 3661, 2981, 1686, 1531, 1371, 1242, 1072, 752 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{34}H_{24}N^+$ $[M]^+$ 446.1903 found 446.1898.



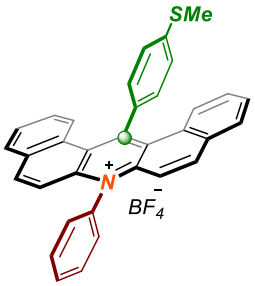
14-(4-(tert-butyl)phenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8c)

Yellow solid (82.9 mg, 72% yield). DCM / MeOH = 100:1, R_f = 0.27. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.28 (d, *J* = 9.4 Hz, 2H), 8.02 (d, *J* = 7.9 Hz, 2H), 7.94–7.89 (m, 3H), 7.80 (d, *J* = 8.1 Hz, 2H), 7.71–7.63 (m, 4H), 7.51 (d, *J* = 8.1 Hz, 2H), 7.36 (t, *J* = 9.1 Hz, 4H), 7.24 (t, *J* = 8.2 Hz, 2H), 1.59 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.6, 155.0, 142.6, 140.6, 138.3, 137.9, 132.5, 132.1, 131.8, 130.0, 129.3, 129.3, 129.0, 128.9, 128.5, 128.3, 127.9, 125.1, 117.1, 35.3, 31.6. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3463, 2959, 1634, 1520, 1371, 1213, 1055, 827, 758 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{37}H_{30}N^+$ $[M]^+$ 488.2373 found 488.2369.



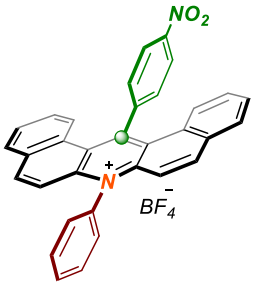
14-(4-methoxyphenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8d)

Yellow solid (64.8 mg, 59% yield). DCM / MeOH = 100:1, R_f = 0.23. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.23 (t, *J* = 8.0 Hz, 2H), 8.06–7.81 (m, 7H), 7.65 (d, *J* = 7.4 Hz, 2H), 7.53–7.24 (m, 10H), 4.09 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.8, 156.3, 142.6, 140.2, 138.3, 132.6, 132.4, 131.9, 131.6, 130.9, 129.8, 129.3, 129.0, 128.9, 128.5, 128.0, 125.2, 117.2, 117.1, 55.7. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3671, 2897, 1669, 1534, 1361, 1254, 1206, 1102, 742 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{34}H_{24}NO^+$ $[M]^+$ 462.1852 found 462.1843.



14-(4-(methylthio)phenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8e)

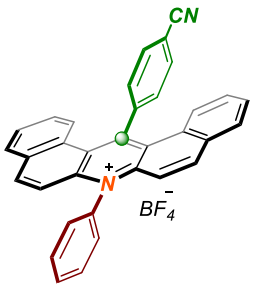
Yellow solid (76.8 mg, 68% yield). DCM / MeOH = 100:1, R_f = 0.28. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.53 (d, *J* = 9.7 Hz, 2H), 8.23 (d, *J* = 7.5 Hz, 2H), 8.02–7.67 (m, 9H), 7.50 (d, *J* = 7.3 Hz, 2H), 7.46–7.37 (m, 4H), 7.33 (d, *J* = 9.3 Hz, 2H), 2.70 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 155.1, 143.0, 142.9, 140.5, 138.9, 136.9, 132.6, 132.3, 131.9, 130.5, 130.1, 129.4, 129.1, 128.8, 128.3, 124.8, 117.8, 15.1. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.4. IR (KBr): 3471, 3056, 1750, 1590, 1519, 1371, 1052, 821, 755 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{34}H_{24}NS^+$ $[M]^+$ 478.1624 found 478.1605.



14-(4-nitrophenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8f)

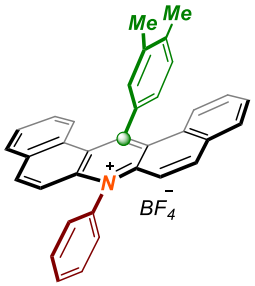
Yellow solid (64.3 mg, 57% yield). DCM / MeOH = 100:1, R_f = 0.23. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.72 (d, *J* = 8.2 Hz, 2H), 8.61 (d, *J* = 9.4 Hz, 2H), 8.29 (d, *J* = 7.8 Hz, 2H), 8.10–8.02 (m, 3H), 7.98 (d, *J* = 8.2 Hz, 2H), 7.95–7.88 (m, 2H), 7.82 (t, *J* = 7.5 Hz, 2H), 7.48 (t, *J* = 8.0 Hz, 2H), 7.41 (d, *J* = 9.4 Hz, 2H), 7.23 (d, *J* = 8.7 Hz, 2H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 152.9, 149.3, 147.2, 143.1, 140.8, 138.8, 132.7, 132.4, 132.0, 131.7, 130.7, 129.7, 129.2, 128.7, 128.5, 127.0, 124.4, 117.9. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.2. IR (KBr): 3688, 3049, 1636,

1514, 1371, 1216, 751 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{33}H_{21}N_2O_2^+$ $[M]^+$ 477.1598 found 477.1589.



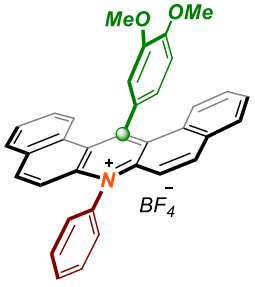
14-(4-cyanophenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8g)

Yellow solid (69.6 mg, 64% yield). DCM / MeOH = 100:1, R_f = 0.27. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.21 (d, *J* = 9.4 Hz, 2H), 7.99 (d, *J* = 7.8 Hz, 4H), 7.92–7.83 (m, 5H), 7.74 (d, *J* = 6.2 Hz, 2H), 7.65 (t, *J* = 7.4 Hz, 2H), 7.33–7.25 (m, 4H), 7.21 (d, *J* = 8.7 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 153.2, 145.4, 142.9, 140.2, 138.3, 134.6, 132.6, 131.9, 131.5, 131.2, 130.1, 129.3, 129.0, 128.6, 128.4, 127.9, 124.7, 118.1, 117.2, 114.2. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3918, 3068, 1733, 1521, 1371, 1052, 758 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{34}H_{21}N_2^+$ $[M]^+$ 457.1699 found 457.1694.



14-(3,4-dimethylphenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8h)

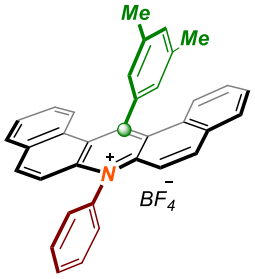
Yellow solid (68.9 mg, 63% yield). DCM / MeOH = 100:1, R_f = 0.28. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.30 (d, *J* = 9.3 Hz, 2H), 8.04 (d, *J* = 7.9 Hz, 2H), 7.94 (d, *J* = 6.1 Hz, 3H), 7.74–7.65 (m, 4H), 7.55 (d, *J* = 7.7 Hz, 1H), 7.45 (d, *J* = 8.7 Hz, 2H), 7.38–7.27 (m, 6H), 2.62 (s, 3H), 2.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.7, 142.5, 140.5, 139.8, 138.2, 138.0, 132.7, 132.4, 132.0, 131.8, 129.9, 129.3, 129.2, 129.0, 128.2, 127.9, 126.4, 125.0, 117.0, 20.0, 19.9. ^{19}F NMR (376 MHz, d_6-DMSO): δ -154.4. IR (KBr): 3669, 3050, 2991, 1673, 1562, 1370, 1276, 1033, 759 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{35}H_{26}N^+$ $[M]^+$ 460.2060 found 460.2055.



14-(3,4-dimethoxyphenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8i)

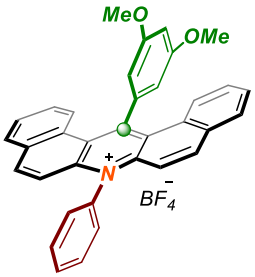
Yellow solid (68.4 mg, 59% yield). DCM / MeOH = 100:1, R_f = 0.23. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.57 (d, *J* = 9.6 Hz, 2H), 8.26 (d, *J* = 7.9 Hz, 2H), 8.07–7.77 (m, 7H), 7.53–7.42 (m, 5H), 7.37 (d, *J* = 9.5 Hz, 2H), 7.19–7.08 (m, 2H), 4.07 (s, 3H), 3.63 (s, 3H). ^{13}C NMR (100 MHz,

d_6-DMSO): δ 155.8, 152.1, 151.6, 142.9, 140.5, 138.9, 132.9, 132.5, 132.3, 132.0, 130.4, 129.4, 129.3, 128.8, 128.3, 125.0, 122.1, 117.7, 115.1, 113.1, 56.6. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3677, 3049, 2889, 1724, 1643, 1551, 1326, 1224, 1022, 741 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{35}H_{26}NO_2^+$ $[M]^+$ 492.1958 found 492.1952.



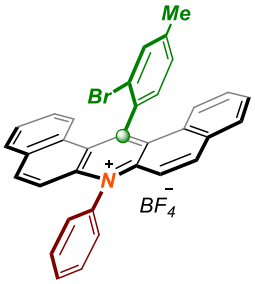
14-(3,5-dimethylphenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8j)

Yellow solid (83.2 mg, 76% yield). DCM / MeOH = 100:1, R_f = 0.24. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.27 (d, *J* = 9.3 Hz, 2H), 8.01 (d, *J* = 7.8 Hz, 2H), 7.94–7.86 (m, 3H), 7.71–7.61 (m, 4H), 7.46 (s, 1H), 7.42 (d, *J* = 8.7 Hz, 2H), 7.36–7.26 (m, 4H), 7.16 (s, 2H), 2.43 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.8, 142.5, 141.7, 140.6, 140.4, 138.2, 132.4, 132.3, 132.0, 131.8, 130.0, 129.4, 129.2, 129.1, 128.2, 128.0, 126.4, 124.8, 117.0, 21.5. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.2. IR (KBr): 3647, 2977, 1633, 1551, 1370, 1249, 1208, 805 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{35}H_{26}N^+$ $[M]^+$ 460.2060 found 460.2049.



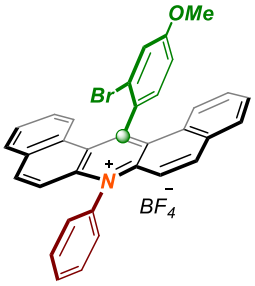
14-(3,5-dimethoxyphenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8k)

Yellow solid (71.6 mg, 69% yield). DCM / MeOH = 100:1, R_f = 0.25. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.28 (d, *J* = 9.5 Hz, 2H), 8.03 (d, *J* = 7.8 Hz, 2H), 7.97–7.87 (m, 3H), 7.74–7.64 (m, 6H), 7.46–7.33 (m, 4H), 6.92 (s, 1H), 6.80 (d, *J* = 2.2 Hz, 2H), 3.82 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 163.7, 156.1, 142.6, 142.1, 140.4, 138.4, 132.3, 131.9, 131.7, 129.9, 129.3, 129.1, 129.0, 128.3, 128.1, 124.8, 117.0, 106.9, 103.0, 56.0. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.5. IR (KBr): 3675, 3061, 2878, 1641, 1553, 1338, 1239, 1055, 776 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{35}H_{26}NO_2^+$ $[M]^+$ 492.1958 found 492.1951.



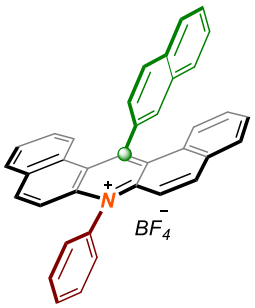
14-(2-bromo-4-methylphenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8l)

Yellow solid (68.3 mg, 56% yield). DCM / MeOH = 100:1, R_f = 0.27. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.27 (d, *J* = 9.3 Hz, 2H), 8.03 (d, *J* = 7.9 Hz, 2H), 7.95–7.86 (m, 4H), 7.79 (s, 1H), 7.70 (t, *J* = 7.4 Hz, 2H), 7.62–7.52 (m, 3H), 7.43 (d, *J* = 8.7 Hz, 2H), 7.36 (t, *J* = 8.1 Hz, 4H), 2.68 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 154.1, 143.3, 142.7, 140.5, 138.3, 138.2, 135.4, 132.3, 132.1, 132.0, 131.7, 131.6, 131.3, 130.2, 129.1, 129.0, 128.7, 128.0, 127.6, 125.0, 122.0, 117.2, 21.4. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.4. IR (KBr): 3654, 3031, 2978, 1664, 1527, 1370, 1221, 648 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{34}H_{23}BrN^+$ $[M]^+$ 524.1008 found 524.1003.



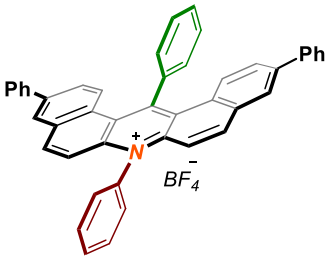
14-(2-bromo-4-methoxyphenyl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8m)

Yellow solid (52.6 mg, 42% yield). DCM / MeOH = 100:1, R_f = 0.24. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.27 (d, *J* = 9.2 Hz, 2H), 8.03 (d, *J* = 7.9 Hz, 2H), 7.94–7.88 (m, 4H), 7.71 (t, *J* = 7.4 Hz, 2H), 7.59 (d, *J* = 7.8 Hz, 2H), 7.51–7.40 (m, 6H), 7.32–7.24 (m, 2H), 4.07 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 162.2, 154.0, 142.6, 140.5, 138.3, 133.2, 132.7, 132.2, 132.1, 132.0, 131.3, 130.1, 129.3, 129.1, 128.9, 128.7, 127.9, 127.6, 125.3, 122.8, 120.6, 117.1, 116.7, 56.1. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3663, 3048, 2878, 1674, 1537, 1280, 1209, 1064 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{34}H_{23}BrNO^+$ $[M]^+$ 540.0958 found 540.0951.



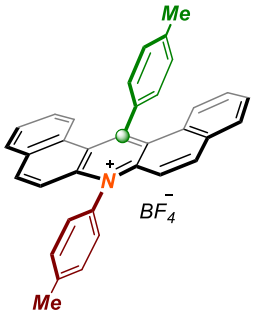
14-(naphthalen-2-yl)-7-phenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8n)

Yellow solid (49.8 mg, 44% yield). DCM / MeOH = 100:1, R_f = 0.28. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.28 (d, *J* = 8.7 Hz, 3H), 8.15 (d, *J* = 8.3 Hz, 1H), 8.10 (s, 1H), 8.00 (d, *J* = 7.9 Hz, 2H), 7.96–7.90 (m, 3H), 7.87 (d, *J* = 8.2 Hz, 1H), 7.80–7.64 (m, 5H), 7.57 (t, *J* = 7.5 Hz, 2H), 7.37 (d, *J* = 9.3 Hz, 2H), 7.29 (d, *J* = 8.8 Hz, 2H), 7.05 (t, *J* = 7.9 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.0, 142.7, 140.4, 138.3, 137.8, 134.5, 133.8, 132.5, 132.0, 131.7, 131.5, 129.9, 129.3, 129.2, 129.2, 128.9, 128.3, 128.1, 127.9, 127.5, 126.3, 125.2, 117.1. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.2. IR (KBr): 3662, 3048, 1666, 1540, 1347, 1261, 1206 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{37}H_{24}N^+$ $[M]^+$ 482.1904 found 482.1898.



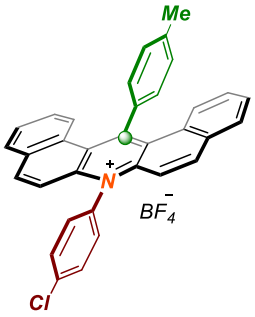
3,7,11,14-tetraphenyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8o)

Yellow solid (95.1 mg, 71% yield). DCM / MeOH = 100:1, R_f = 0.28. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.67–8.56 (m, 4H), 8.07–7.92 (m, 8H), 7.88 (d, *J* = 7.6 Hz, 4H), 7.75–7.64 (m, 4H), 7.55 (t, *J* = 7.5 Hz, 4H), 7.51–7.39 (m, 4H), 7.36 (d, *J* = 9.1 Hz, 2H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 155.4, 142.9, 140.8, 140.8, 140.4, 139.0, 138.3, 133.3, 132.4, 132.2, 132.0, 131.5, 129.6, 129.5, 129.0, 128.7, 128.1, 127.8, 127.5, 126.4, 124.8, 118.3. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3665, 3049, 1581, 1473, 1331, 1251, 1043 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{45}H_{30}N^+$ $[M]^+$ 584.2373 found 584.2367.



7,14-di-p-tolyldibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8p)

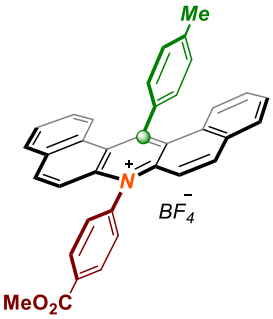
Yellow solid (81.1 mg, 74% yield). DCM / MeOH = 100:1, R_f = 0.29. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.56 (d, *J* = 9.4 Hz, 2H), 8.24 (d, *J* = 7.8 Hz, 2H), 7.85–7.74 (m, 6H), 7.70 (d, *J* = 7.7 Hz, 2H), 7.49 (d, *J* = 7.7 Hz, 2H), 7.44–7.35 (m, 6H), 2.68 (s, 6H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 155.8, 143.1, 142.3, 141.2, 140.4, 138.1, 136.5, 132.6, 132.6, 132.3, 130.5, 129.4, 129.2, 128.8, 128.5, 128.2, 124.8, 117.9, 21.8, 21.5. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3673, 3051, 2959, 1737, 1541, 1373, 1241, 752 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{35}H_{26}N^+$ $[M]^+$ 460.2060 found 460.2053.



7-(4-chlorophenyl)-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8q)

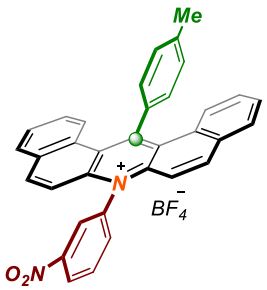
Yellow solid (75.8 mg, 67% yield). DCM / MeOH = 100:1, R_f = 0.27. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.57 (d, *J* = 9.4 Hz, 2H), 8.27 (d, *J* = 7.9 Hz, 2H), 8.10 (d, *J* = 8.3 Hz, 2H), 7.96 (d, *J* = 8.4 Hz, 2H), 7.78 (t, *J* = 7.5 Hz, 2H), 7.70 (d, *J* = 7.7 Hz, 2H), 7.5–7.34 (m, 8H), 2.68 (s, 3H).

^{13}C NMR (100 MHz, d_6-DMSO): δ 156.0, 143.0, 141.3, 140.6, 138.0, 137.7, 137.1, 132.6, 132.1, 130.8, 130.5, 129.4, 129.4, 129.2, 128.8, 128.3, 124.8, 117.9, 21.8. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.2. IR (KBr): 3917, 3060, 1734, 1520, 1370, 1051, 824, 757 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{34}H_{23}ClN^+$ $[M]^+$ 480.1514 found 480.1505.



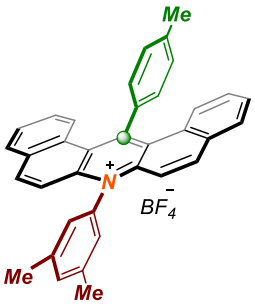
7-(4-(methoxycarbonyl)phenyl)-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8r)

Yellow solid (68.6 mg, 58% yield). DCM / MeOH = 100:1, R_f = 0.27. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.53 (d, *J* = 8.8 Hz, 4H), 8.24 (d, *J* = 7.9 Hz, 2H), 8.06 (d, *J* = 8.0 Hz, 2H), 7.76 (t, *J* = 7.4 Hz, 2H), 7.68 (d, *J* = 7.8 Hz, 2H), 7.46 (d, *J* = 7.7 Hz, 2H), 7.43–7.32 (m, 6H), 4.04 (s, 3H), 2.66 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 165.8, 156.2, 142.7, 142.6, 141.3, 140.7, 138.0, 133.1, 132.7, 132.6, 130.6, 129.6, 129.4, 129.3, 129.2, 128.8, 128.3, 124.8, 117.8, 53.3, 21.7. ^{19}F NMR (376 MHz, d_6-DMSO): δ -143.7. IR (KBr): 3364, 2921, 2853, 1722, 1642, 1517, 1371, 1214, 1054, 531 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{36}H_{26}NO_2^+$ $[M]^+$ 504.1958 found 504.1949.



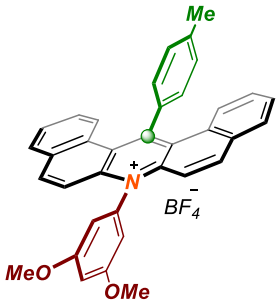
7-(3-nitrophenyl)-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8s)

Yellow solid (78.5 mg, 68% yield). DCM / MeOH = 100:1, R_f = 0.25. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.96 (s, 1H), 8.84 (d, *J* = 8.4 Hz, 1H), 8.58 (d, *J* = 9.5 Hz, 2H), 8.40 (d, *J* = 8.0 Hz, 1H), 8.34–8.24 (m, 3H), 7.80 (t, *J* = 7.3 Hz, 2H), 7.73 (d, *J* = 7.7 Hz, 2H), 7.50 (d, *J* = 8.6 Hz, 4H), 7.46–7.36 (m, 4H), 2.69 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 156.3, 150.2, 143.1, 141.4, 140.8, 139.5, 138.0, 135.4, 133.5, 132.7, 132.7, 130.6, 129.4, 129.3, 129.3, 128.8, 128.4, 127.1, 124.9, 124.8, 118.0, 21.8. ^{19}F NMR (376 MHz, $CDCl_3$): δ -153.7. IR (KBr): 3467, 3087, 1602, 1529, 1359, 1214, 1055, 822, 744 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{34}H_{23}N_2O_2^+$ $[M]^+$ 491.1754 found 491.1744.



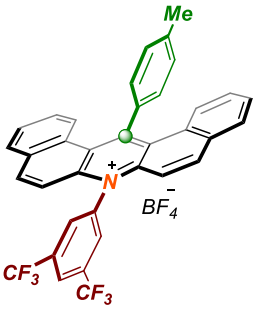
7-(3,5-dimethylphenyl)-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8t)

Yellow solid (81.8 mg, 73% yield). DCM / MeOH = 100:1, R_f = 0.29. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.58 (d, *J* = 9.4 Hz, 2H), 8.25 (d, *J* = 7.8 Hz, 2H), 7.82–7.64 (m, 5H), 7.57–7.38 (m, 10H), 2.69 (s, 3H), 2.56 (s, 6H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 155.8, 142.9, 141.6, 141.3, 140.4, 138.8, 138.1, 133.6, 132.7, 132.6, 130.5, 129.4, 129.4, 129.2, 128.9, 128.2, 126.1, 124.8, 118.0, 21.8, 21.4. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3475, 2922, 1605, 1519, 1370, 1212, 1053, 823, 756 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{36}H_{28}N^+$ $[M]^+$ 474.2216 found 474.2207.



7-(3,5-dimethoxyphenyl)-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8u)

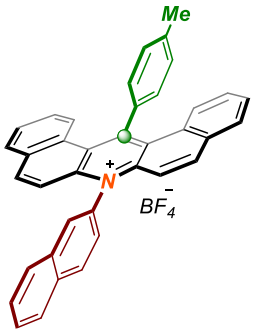
Yellow solid (66.5 mg, 56% yield). DCM / MeOH = 100:1, R_f = 0.26. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.61 (d, *J* = 9.4 Hz, 2H), 8.28 (d, *J* = 7.8 Hz, 2H), 7.80 (t, *J* = 7.2 Hz, 2H), 7.73 (d, *J* = 7.7 Hz, 2H), 7.59 (d, *J* = 9.4 Hz, 2H), 7.51 (d, *J* = 7.6 Hz, 2H), 7.45–7.37 (m, 4H), 7.22 (s, 2H), 7.12 (s, 1H), 3.94 (s, 6H), 2.70 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 162.7, 155.9, 142.8, 141.3, 140.5, 140.3, 138.0, 132.7, 132.7, 130.5, 129.4, 129.3, 129.2, 128.8, 128.3, 124.7, 118.1, 107.3, 103.7, 56.5, 21.8. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.3. IR (KBr): 3661, 3057, 2899, 1728, 1553, 1326, 1218, 1035, 754 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{36}H_{28}NO_2^+$ $[M]^+$ 506.2115 found 506.2107.



7-(3,5-bis(trifluoromethyl)phenyl)-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8v)

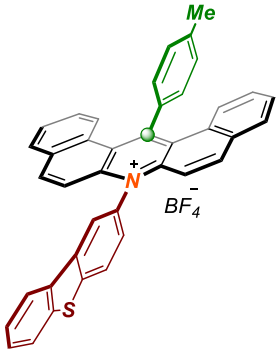
Yellow solid (85.5 mg, 64% yield). DCM / MeOH = 100:1, R_f = 0.28. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.82 (s, 3H), 8.58 (d, *J* = 9.5 Hz, 2H), 8.30 (d, *J* = 7.9 Hz, 2H), 7.80 (t, *J* = 7.4 Hz,

2H), 7.72 (d, *J* = 7.6 Hz, 2H), 7.53 (d, *J* = 9.4 Hz, 2H), 7.48 (d, *J* = 7.6 Hz, 2H), 7.46–7.36 (m, 4H), 2.69 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 156.3, 143.2, 141.5, 141.1, 140.4, 137.9, 134.0 (q, *J* = 34.2 Hz), 132.7, 132.7, 130.7, 129.5, 129.3, 129.2, 128.7, 128.5, 126.8 (q, *J* = 3.7 Hz), 124.8, 123.2 (q, *J* = 271.6 Hz), 118.0, 21.8. ^{19}F NMR (376 MHz, $CDCl_3$): δ -62.7, -154.2. IR (KBr): 3468, 2980, 1612, 1521, 1369, 1278, 1186, 1053, 747 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{36}H_{22}F_6N^+$ $[M]^+$ 582.1651 found 582.1648.



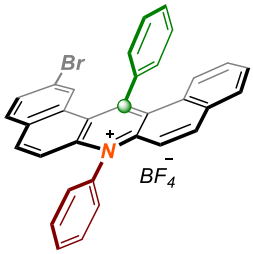
7-(naphthalen-2-yl)-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8w)

Yellow solid (71.2 mg, 61% yield). DCM / MeOH = 100:1, R_f = 0.27. ^{1}H NMR (400 MHz, d_6-DMSO): δ 8.62–8.49 (m, 4H), 8.37 (d, *J* = 8.2 Hz, 1H), 8.26 (d, *J* = 7.8 Hz, 2H), 8.21 (d, *J* = 7.9 Hz, 1H), 8.00 (d, *J* = 8.1 Hz, 1H), 7.95–7.83 (m, 2H), 7.83–7.76 (m, 2H), 7.74 (d, *J* = 7.3 Hz, 2H), 7.54 (d, *J* = 7.3 Hz, 2H), 7.49–7.40 (m, 6H), 2.71 (s, 3H). ^{13}C NMR (100 MHz, d_6-DMSO): δ 156.0, 143.2, 141.3, 140.5, 138.1, 136.3, 134.3, 133.7, 132.7, 132.6, 132.2, 130.5, 129.4, 129.3, 129.2, 128.9, 128.7, 128.6, 128.3, 125.3, 124.9, 118.1, 21.8. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.2. IR (KBr): 3648, 3039, 2931, 1674, 1528, 1370, 1216, 749 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{38}H_{26}N^+$ $[M]^+$ 496.2060 found 496.2052.



7-(dibenzo[*b,d*]thiophen-2-yl)-14-(p-tolyl)dibenzo[*a,j*]acridin-7-ium tetrafluoroborate (8x)

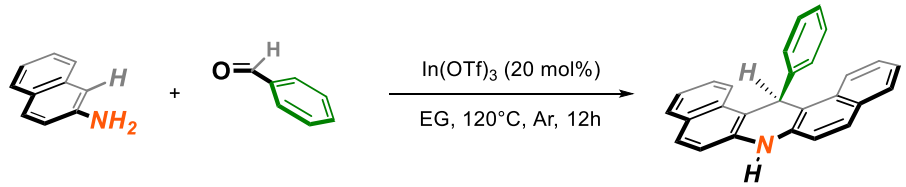
Yellow solid (70.2 mg, 55% yield). DCM / MeOH = 100:1, R_f = 0.26. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.61 (s, 1H), 8.35 (d, *J* = 8.4 Hz, 1H), 8.27 (d, *J* = 7.9 Hz, 1H), 8.17 (d, *J* = 9.5 Hz, 2H), 8.02–7.93 (m, 3H), 7.74 (d, *J* = 8.5 Hz, 1H), 7.66–7.56 (m, 5H), 7.53–7.48 (m, 3H), 7.45 (d, *J* = 8.8 Hz, 2H), 7.37 (d, *J* = 9.4 Hz, 2H), 7.30 (d, *J* = 7.6 Hz, 2H), 2.70 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.7, 143.0, 142.7, 141.0, 140.5, 140.2, 138.0, 137.8, 135.0, 134.3, 132.4, 132.1, 129.8, 129.4, 129.3, 129.3, 128.8, 128.4, 127.9, 125.7, 125.6, 125.4, 125.2, 123.0, 122.9, 121.8, 117.2, 21.7. ^{19}F NMR (376 MHz, $CDCl_3$): δ -154.2. IR (KBr): 3468, 2924, 1723, 1600, 1519, 1473, 1370, 1216, 1055, 823, 602 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{40}H_{26}NS^+$ $[M]^+$ 552.1780 found 552.1774.



2-bromo-7,14-diphenyldibenzo[*a*,*j*]acridin-7-ium tetrafluoroborate (8y)

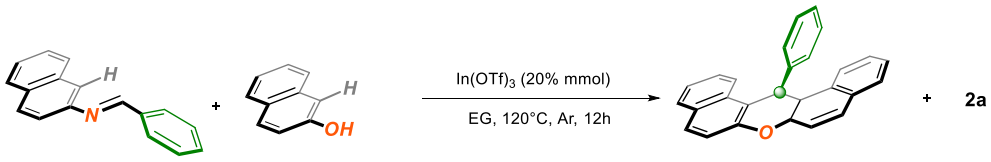
Yellow solid (93.1 mg, 78% yield). DCM / MeOH = 100:1, R_f = 0.32. ^{1}H NMR (400 MHz, d6-DMSO): δ 8.65–8.51 (m, 2H), 8.26 (d, *J* = 7.9 Hz, 1H), 8.20 (d, *J* = 8.5 Hz, 1H), 8.05–7.88 (m, 9H), 7.79 (t, *J* = 7.4 Hz, 1H), 7.63 (d, *J* = 7.4 Hz, 2H), 7.44–7.35 (m, 4H), 7.30 (s, 1H). ^{13}C NMR (100 MHz, d6-DMSO): δ 155.9, 143.5, 143.1, 141.1, 140.5, 139.8, 138.9, 132.7, 132.4, 132.3, 132.0, 131.7, 131.7, 131.3, 130.8, 130.4, 129.6, 129.3, 129.1, 128.9, 128.7, 128.5, 124.8, 123.7, 122.5, 118.6, 118.0. ^{19}F NMR (376 MHz, d6-DMSO): δ -148.2. IR (KBr): 3657, 3032, 2973, 1658, 1519, 1365, 1217, 677 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{33}H_{21}BrN^+$ $[M]^+$ 510.0852, found 510.0847.

F. Mechanism studies



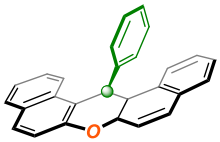
3 **4** **2a 45%**

An oven-dried vial equipped with a stir bar was charged with naphthalen-2-amine **3** (28.6 mg, 0.2 mmol), In(OTf)$_3$ (11.2 mg, 0.02 mmol) and dissolved with 1 mL ethylene glycol, then stirred the mixture for 5 minutes. After that, benzaldehyde **4** (10.6 mg, 0.1 mmol) was slowly added. Under argon atmosphere, the mixture was stirred at 120 °C for 12 hours in an oil bath. After the reaction was completed, it was cooled to room temperature. The mixture was diluted with 25 mL CH_2Cl_2 and washed with saturated aqueous $NaHCO_3$, then concentrated in vacuo. The residue was purified by silica gel chromatography to afford the product **2a** (16.1 mg, 45% yield).



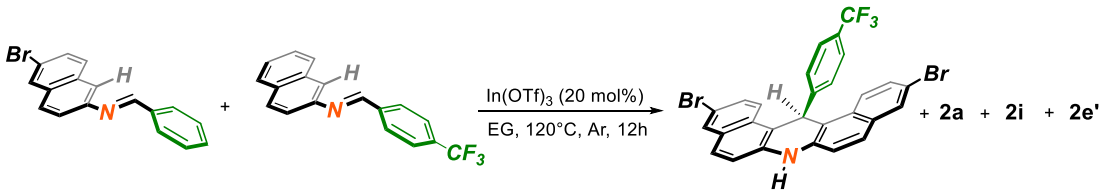
1a **6** **7**

An oven-dried vial equipped with a stir bar was charged with N-(naphthalen-2-yl)-1-phenylm-ethanimine **1a** (46.2 mg, 0.2 mmol), In(OTf)$_3$ (11.2 mg, 0.02 mmol), naphthalen-2-ol **6** (28.8 mg, 0.2 mmol) and dissolved with 1.5 mL ethylene glycol. Under argon atmosphere, the mixture was stirred at 120 °C for 12 hours in an oil bath. After the reaction was completed, The mixture was diluted with 25 mL EtOAc and washed with saturated aqueous $NaHCO_3$, then concentrated in vacuo. The residue was purified by silica gel chromatography to afford the product **2a** (23.2 mg, 65% yield) and product **7** (6.2 mg, 17% yield).



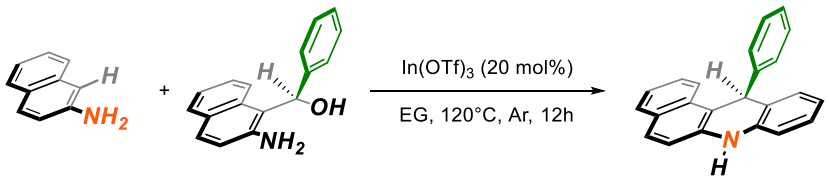
14-phenyl-14H-dibenzo[*a,j*]xanthene (7)

White solid (12.2 mg, 17% yield). PE / EA = 50:1, R_f = 0.34. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.49 (d, *J* = 7.4 Hz, 2H), 7.98–7.78 (m, 4H), 7.74–7.41 (m, 8H), 7.24 (t, *J* = 7.4 Hz, 2H), 7.08 (t, *J* = 7.4 Hz, 1H), 6.58 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.8, 145.1, 131.5, 131.1, 128.9, 128.8, 128.5, 128.3, 126.8, 126.4, 124.3, 122.8, 118.1, 117.4, 38.1. The identity of **10** was confirmed based on reported NMR spectra.[5]



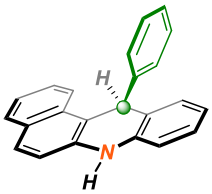
1e' **1i** **2i'**

An oven-dried vial equipped with a stir bar was charged with (E)-N-(6-bromonaphthalen-2-y -l)-1-phenylmethanimine **1e'** (30.9 mg, 0.1 mmol), (E)-N-(naphthalen-2-yl)-1-(4-(trifluoromethyl) -phenyl)methanemine **1i** (29.9 mg, 0.1 mmol), $In(OTf)_3$ (5.7 mg, 0.02 mmol) and dissolved with 0.4 mL ethylene glycol. Under argon atmosphere, the mixture was stirred at 120 °C for 12 hours in an oil bath. After the reaction was completed, it was cooled to room temperature. The mixture was diluted with 25 mL EtOAc and washed with saturated aqueous $NaHCO_3$, then concentrated in vacuo. The residue was purified by silica gel chromatography to afford the product **2a** (2.9 mg, 8% yield), **2i** (13.6 mg, 32% yield), **2e'** (9.4 mg, 24% yield), **2i'** (11.1 mg, 19% yield).



3 **5** **2j'**

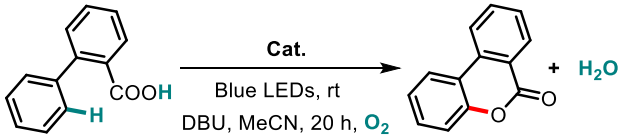
An oven-dried vial equipped with a stir bar was charged with naphthalen-2-amine **3** (14.1 mg, 0.1 mmol), $In(OTf)_3$ (11.2 mg, 0.02 mmol), (2-aminophenyl)(phenyl)methanol **5** (20.0 mg, 0.1 mmol) and dissolved with 0.4 mL ethylene glycol. Under argon atmosphere, the mixture was stirred at 120 °C for 12 hours in an oil bath. After the reaction was completed, the mixture was diluted with 25 mL EtOAc and washed with saturated aqueous $NaHCO_3$, then concentrated in vacuo. The residue was purified by silica gel chromatography to afford the product **2j'** (23.6 mg, 77% yield).



(*S*)-12-phenyl-7,12-dihydrobenzo[*a*]acridine (2j')

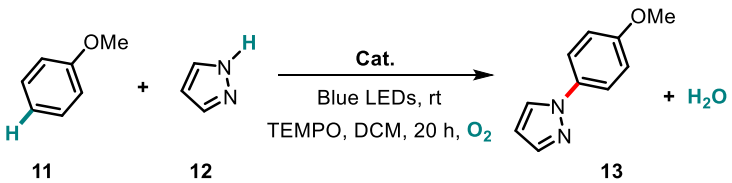
White solid (23.6 mg, 77% yield). PE / DCM = 8:1, R_f = 0.31. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.01 (d, *J* = 8.5 Hz, 1H), 7.81 (d, *J* = 8.1 Hz, 1H), 7.76 (d, *J* = 8.7 Hz, 1H), 7.51–7.44 (m, 2H), 7.40–7.30 (m, 3H), 7.26–7.08 (m, 5H), 6.99 (t, *J* = 7.4 Hz, 1H), 6.86 (d, *J* = 7.9 Hz, 1H), 6.33 (s, 1H), 6.03 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 147.1, 137.8, 136.8, 132.2, 129.8, 129.4, 128.7, 128.6, 128.6, 127.1, 127.1, 126.8, 126.2, 123.9, 122.8, 122.3, 121.5, 116.7, 114.1, 113.6, 44.1. IR (KBr): 3448, 3015, 1629, 1519, 1467, 1420, 1285, 1206, 1155 cm^{-1}. HRMS (ESI) m/z Calcd for $C_{31}H_{20}N$ $[M+H]^+$ 308.1439, found 308.1433.

G. Synthetic transformation of products



9 **10**

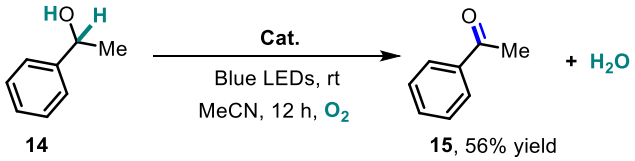
An oven-dried vial equipped with a stir bar was charged with photoredox catalyst **8c** (5.8 mg, 10 mmol%), [1,1'-biphenyl]-2-carboxylic acid **9** (19.8 mg, 0.1 mmol) and dissolved with 1 mL MeCN. Under oxygen atomsphere, 1,8-Diazabicyclo[5.4.0]-undec-7-ene was slowly added to the tube(3.1 mg, 0.02 mmol) and the mixture was stirred in photoreactor at room temperature for 20 hours. After the reaction was completed, the reaction mixture was concentrated in vacuo. The residue was purified by silica gel chromatography to afford the product **10** (12.5 mg, 64% yield). White solid (12.5 mg, 64% yield). PE/ EA = 20:1, R_f = 0.34. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.41 (dd, *J* = 8.0, 1.6 Hz, 1H), 8.12 (d, *J* = 8.1 Hz, 1H), 8.06 (d, *J* = 7.9 Hz, 1H), 7.83 (t, *J* = 8.3 Hz, 1H), 7.59 (t, *J* = 7.7 Hz, 1H), 7.49 (t, *J* = 8.5 Hz, 1H), 7.41–7.32 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.1, 151.3, 134.8, 134.7, 130.5, 130.4, 128.8, 124.5, 122.7, 121.6, 121.3, 118.0, 117.7. The identity of **10** was confirmed based on reported NMR spectra.[6]



11 **12** **13**

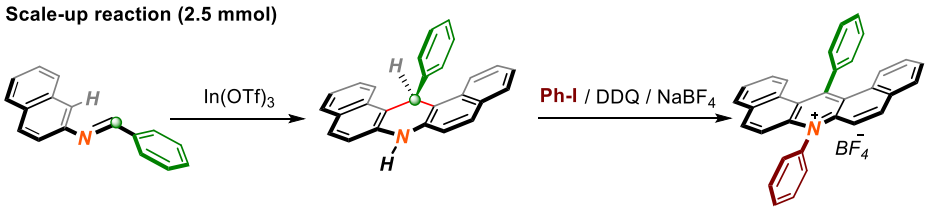
An oven-dried vial equipped with a stir bar was charged with photoredox catalyst **8c** (5.8 mg, 10 mmol%), pyrazole **12** (13.6 mg, 0.2 mmol) and 2,2,6,6-Tetramethylpiperidine-1-oxyl (3.1 mg, 0.02 mmol). Under oxygen atomsphere, Anisole **11** (10.8 mg, 0.1 mmol) dissolved with 1 mL CH_2Cl_2 and slowly added to the tube and the mixture was stirred in photoreactor at room temperature for 20 hours. After the reaction was completed, the reaction mixture concentrated in vacuo. The residue was purified by silica gel chromatography to afford the product **13** (9.5 mg, 54% yield). Yellow oil (9.5 mg, 54% yield). PE / EA = 10:1, R_f = 0.32. ^{1}H NMR (400 MHz,

$CDCl_3$): δ 7.91 (d, *J* = 2.7 Hz, 1H), 7.84–7.64 (m, 3H), 7.07 (d, *J* = 9.4 Hz, 2H), 6.53 (s, 1H), 3.94 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 158.3, 140.6, 126.8, 120.9, 114.5, 107.1, 55.5. The identity of **13** was confirmed based on reported NMR spectra.[7]



14 **15**, 56% yield

A quartz tube was charged with **8c** (11.6 mg, 10 mmol%), 1-phenylethan-1-ol (24.4 mg, 0.2 equiv.) was diluted with 1 mL MeCN and added to the tube. The mixture was stirred in photoreactor at room temperature for 20 hours under O_2. After the reaction was completed, the reaction mixture was diluted with 5.0 mL DCM and concentrated in vacuo. The residue was purified by silica gel chromatography to afford the product **15** (13.4 mg, 56% yield). Colorless solid (13.4 mg, 56% yield). PE/EA = 30:1, R_f = 0.32. ^1H NMR (400 MHz, $CDCl_3$): δ 8.01 (d, *J* = 7.6 Hz, 2H), 7.60 (t, *J* = 7.3 Hz, 1H), 7.56–7.45 (m, 2H), 2.65 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.0, 137.2, 133.0, 128.5, 128.3, 26.5.



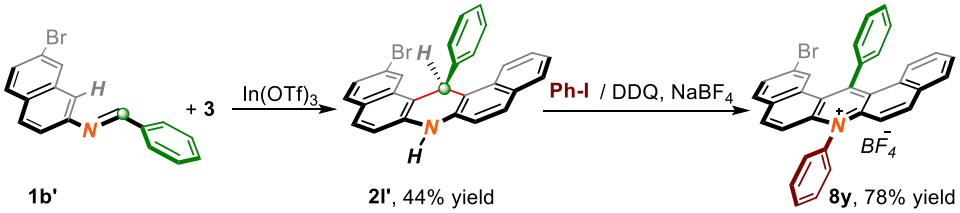
1a **2a**, 82% yield **8a**, 76% yield

An oven-dried vial equipped with a stir bar was charged with N-(naphthalen-2-yl)-1-phenyl-methanimines **1a** (1.16 g, 5.0 mmol) and $In(OTf)_3$ (281.0 mg, 0.5 mmol). The reaction mixture was placed under a positive pressure of argon and subjected to three evacuation/backfilling cycles under high vacuum. Ethylene glycol (typically, 15 mL) was added and the reaction mixture was stirred at 120 °C for 12 hours in an oil bath. After the reaction was completed, it was cooled to room temperature. The mixture was diluted with EtOAc and washed with saturated aqueous $NaHCO_3$, then concentrated in vacuo. The residue was purified by silica gel chromatography to afford the dihydroacridine products **2a** (731.8 mg, 82% yield).

Under an Ar atomsohere, $Pd(OAc)_2$ (23.9 mg, 0.1 mmol), xantphos (115.8 mg, 0.2 mmol) and t-BuOK (459.2 mg, 2 equiv.) were added to the pressure tube equipped with a stir bar and dissolved with 15 mL toluene, then iodobenzene(611.1 mg, 3.0 mmol) was slowly added and the mixture stirred for 10 minutes. After that, product **2a** (731.3 mg, 2.0 mmol) dissolved with 10 mL toluene was slowly added and the mixture stirred at 120 °C for 4 hours. After the reaction was completed, the reaction mixture was filtered and concentrated in vacuo.

The residue from previous step was dissolved with 30 mL CH_3CN and added to a round bottom flask equipped with a stir bar, it was stirred at 0 °C and 2,3-dichloro-5,6-dicyano-1,4-benz-oquinone (926.6 mg, 2 equiv.) was slowly added at 0 °C. The reaction was stirred at room temperature for 2 hours. After the reaction was completed, the mixture concentrated in vacuo, the mixture was diluted with 50 mL CH_2Cl_2 and washed with pure water, the organic phases were dried over anhydrous $MgSO_4$ and concentrated in vacuo. The residue was dissolved in CH_2Cl_2 (50

mL) and added to a round bottom flask equipped with a stir bar, it was stirred with $NaBF_4$ aqueous solution (40 mL) for 8 hours. After the reaction was completed, it was washed with pure water. The organic phase was dried over anhydrous $MgSO_4$ and concentrated in vacuo. The residue was purified by silica gel chromatography to afford the product **8a** (789.2 mg, 76% yield).



An oven-dried vial equipped with a stir bar was charged with (E)-N-(7-bromonaphthale -n-2-yl)-1-phenylmethanimine **1b'** (61.8 mg, 0.2 mmol), 2-Naphthylamine **3** (28.6 mg, 0.2 mmol) and $In(OTf)_3$ (22.5 mg, 0.04 mmol). The reaction mixture was placed under a positive pressure of argon and subjected to three evacuation/backfilling cycles under high vacuum. Ethylene glycol (typically, 0.8 mL) was added and the reaction mixture was stirred at 120 °C for 12 hours in an oil bath. After the reaction was completed, it was cooled to room temperature. The mixture was diluted with EtOAc and washed with saturated aqueous $NaHCO_3$, then concentrated in vacuo. The residue was purified by silica gel chromatography to afford the dihydroacridine products **2l'** (38.3 mg, 44% yield).

Under argon atmosphere, $Pd(OAc)_2$ (0.01 mmol), xantphos (0.02 mmol), ^{t}BuOK (2 equiv.) were added to the pressure tube equipped with a stir bar and dissolved with 1 mL toluene, then aryl iodobenzene (61.2 mg, 0.3 mmol) was slowly added and the mixture stirred for 5 minutes. After that, product **2l'** (87.1 mg, 0.2 mmol) dissolved with 1 mL toluene was slowly added and the mixture stirred at 120 °C for 4 hours. After the reaction was completed, it was filtered and concentrated in vacuo.

The residue from previous step was dissolved with 5 mL CH_3CN and added to a round bottom flask equipped with a stir bar, it was stirred at 0 °C and 2,3-dichloro-5,6-dicyano -1,4-benz-oquinone (90.8 mg, 2 equiv.) was slowly added. The mixture was stirred at room temperature for 2 hours. After the reaction was completed, the mixture was diluted with CH_2Cl_2 and washed with pure water, then concentrated in vacuo. The residue was dissolved with 8 mL CH_2Cl_2 and added to a round bottom flask equipped with a stir bar, it was stirred with 10 mL $NaBF_4$ aqueous solution for 8 hours. After the reaction was completed, it was washed with pure water and the organic phase was concentrated in vacuo. The residue was purified by silica gel chromatography to afford the acridinium photocatalysts **8y** (93.1 mg, 78% yield).

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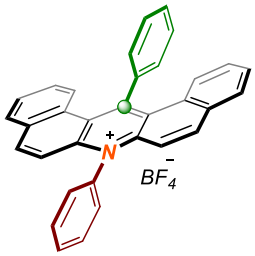
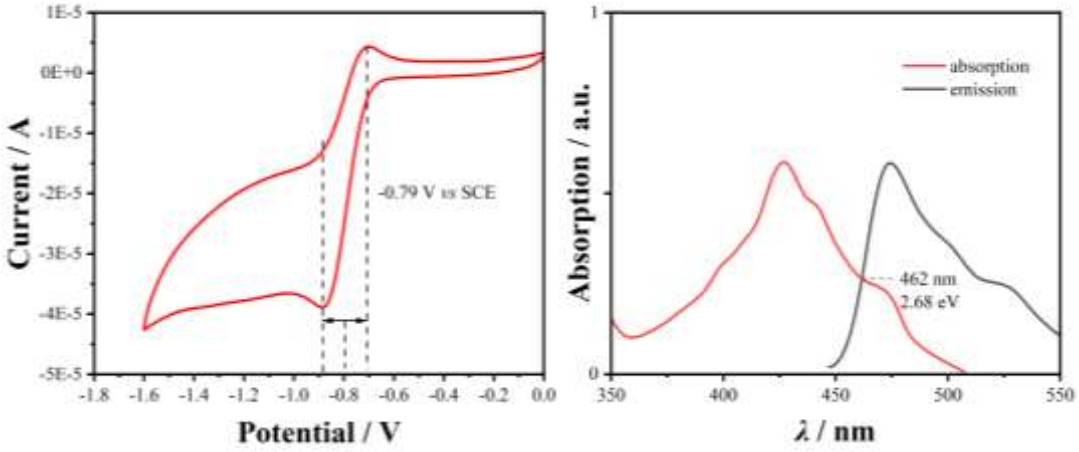
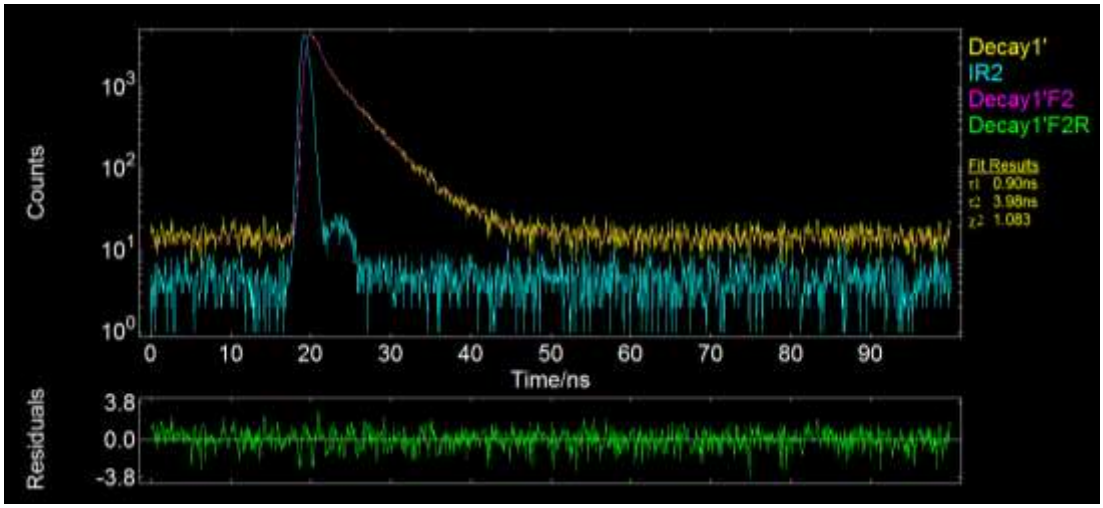
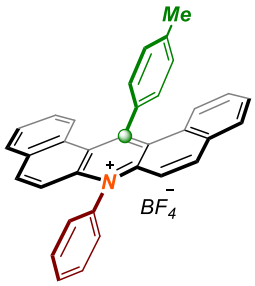
I. Spectrophotometric and electrochemical data

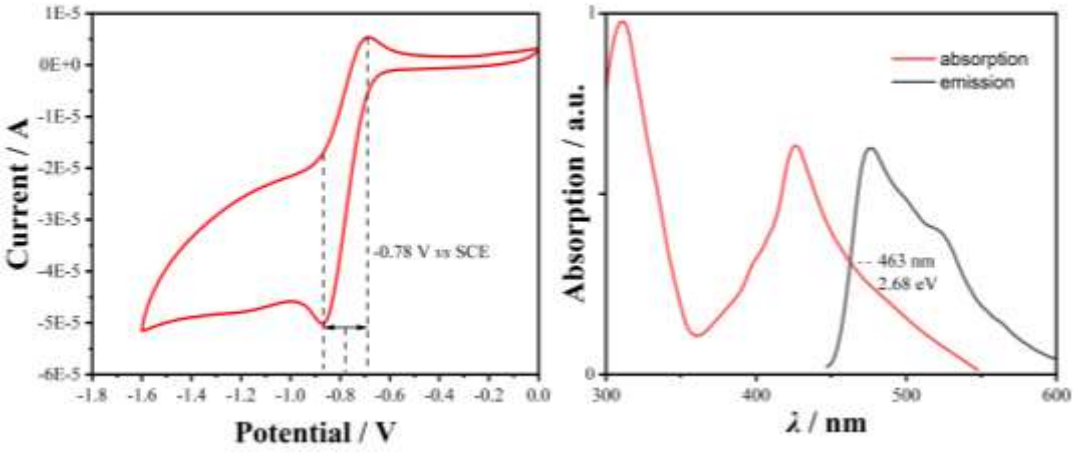






Spectrophotometric and electrochemical data of **8a** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N \cdot PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.





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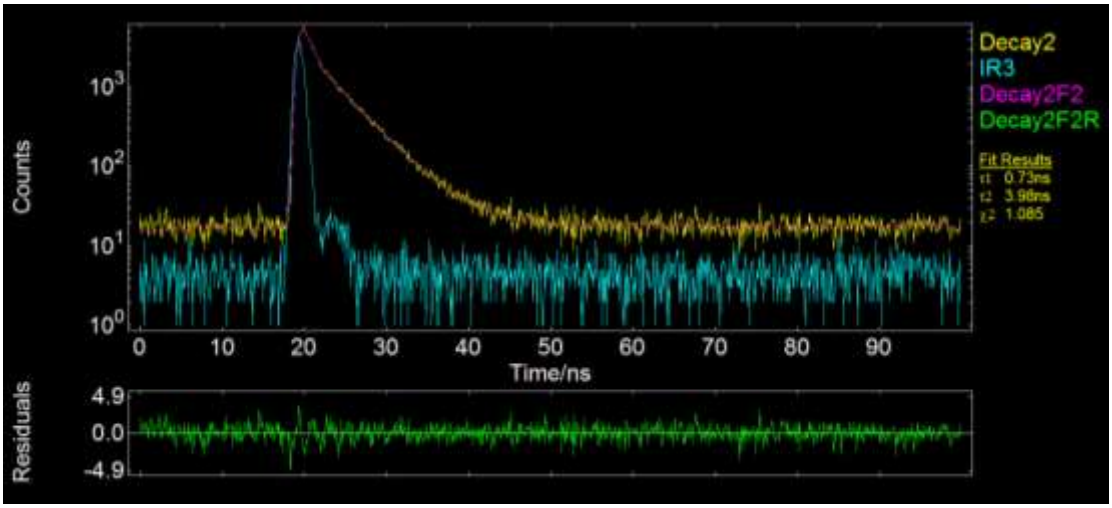
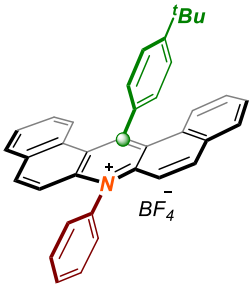
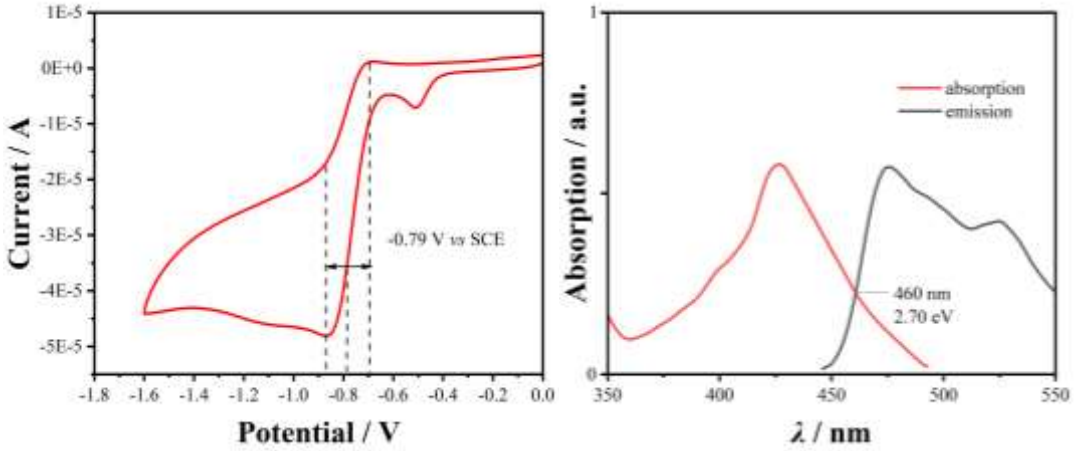
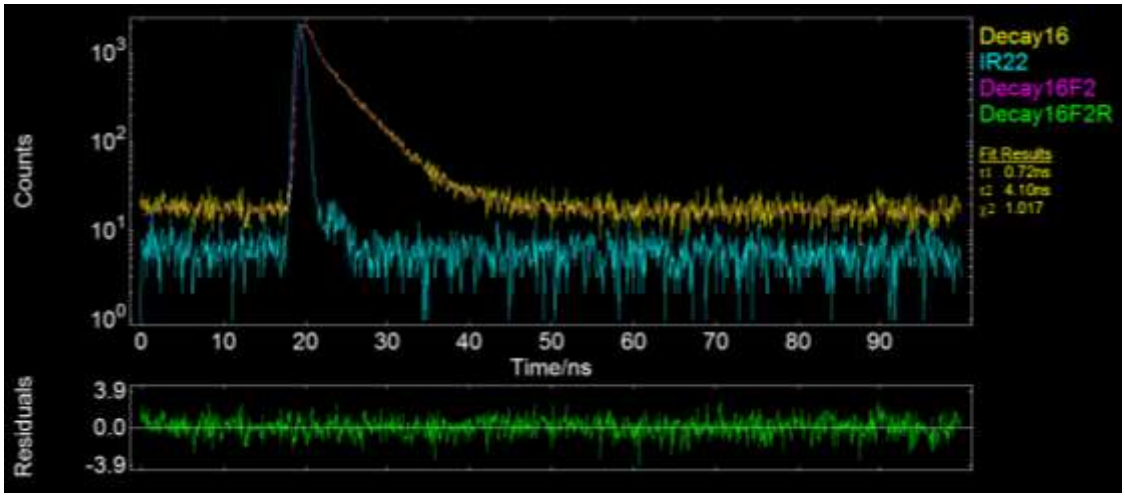


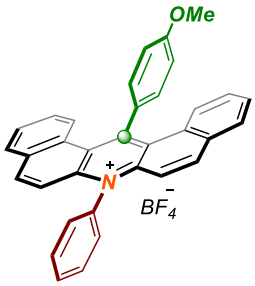
Spectrophotometric and electrochemical data of **8b** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N \cdot PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

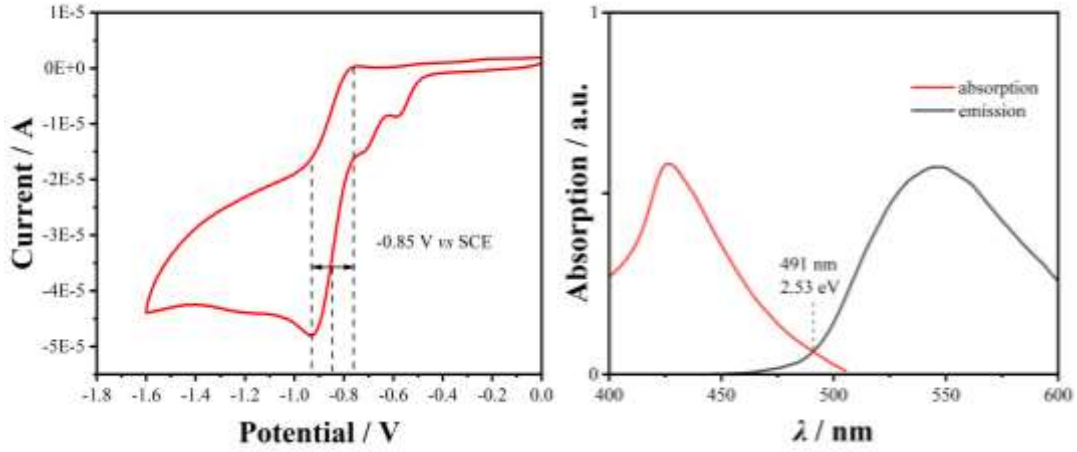


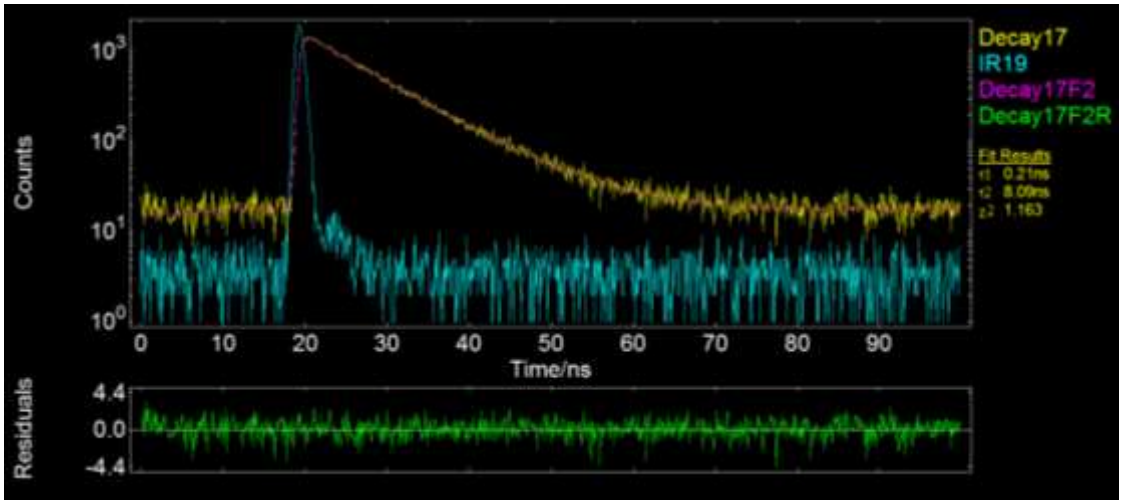




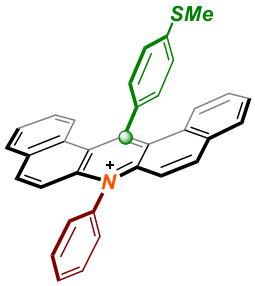
Spectrophotometric and electrochemical data of **8c** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

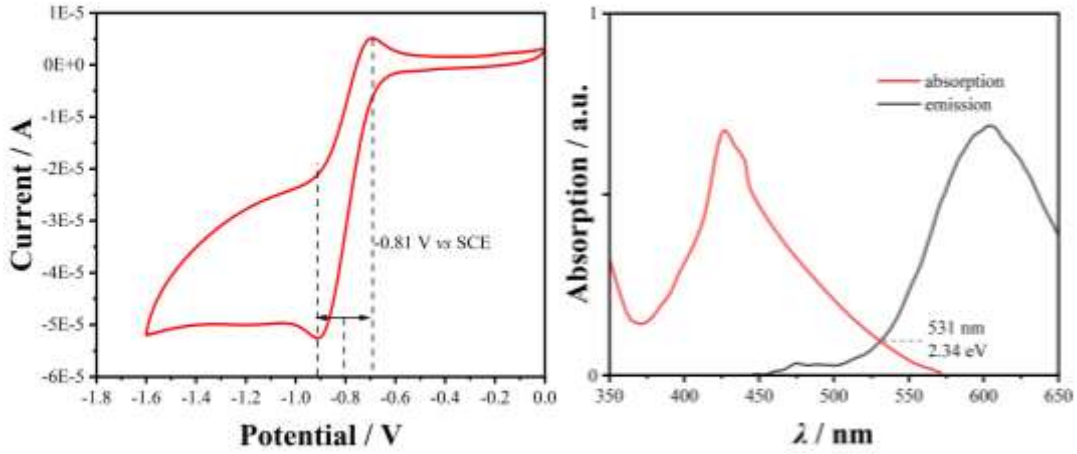


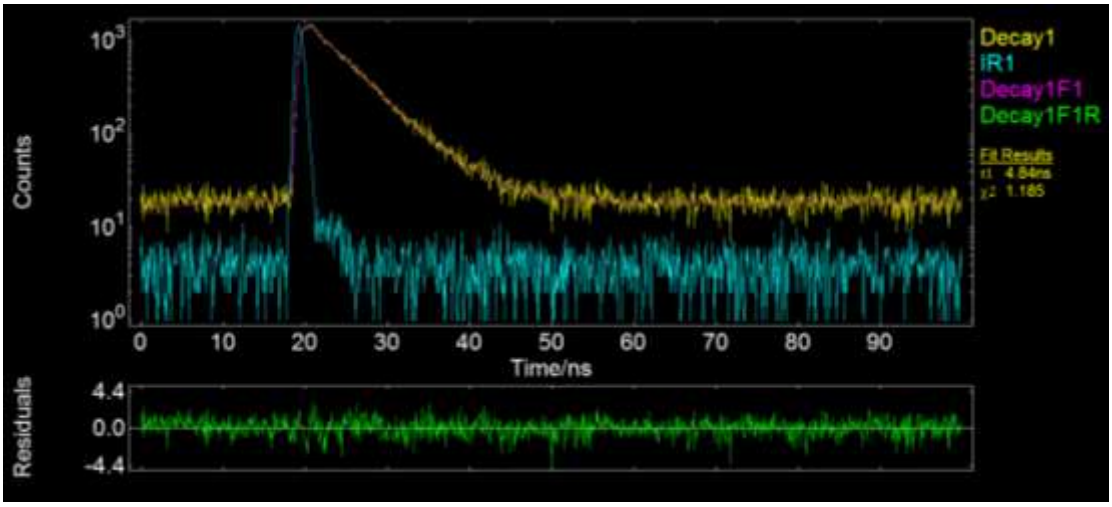




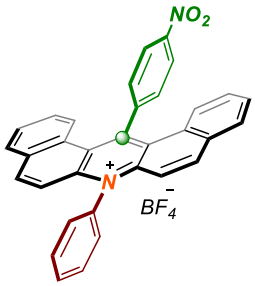
Spectrophotometric and electrochemical data of **8d** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

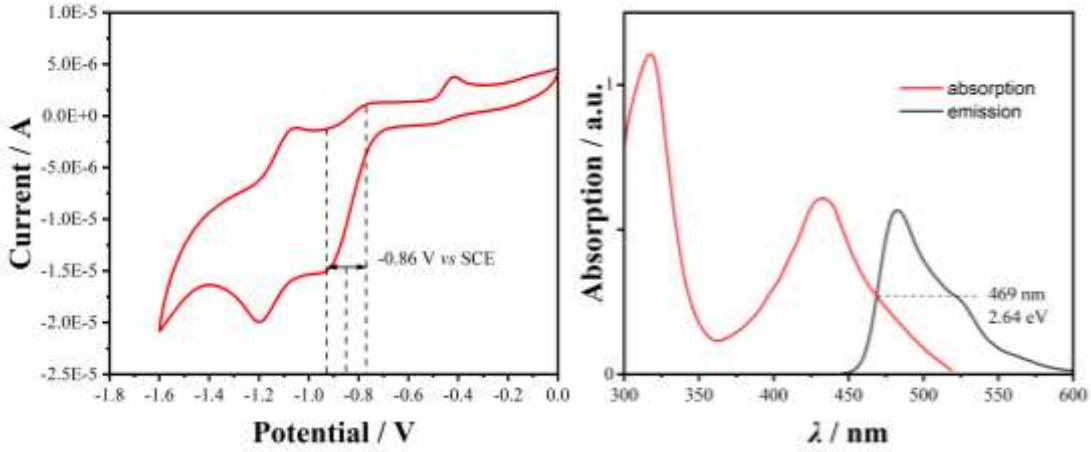


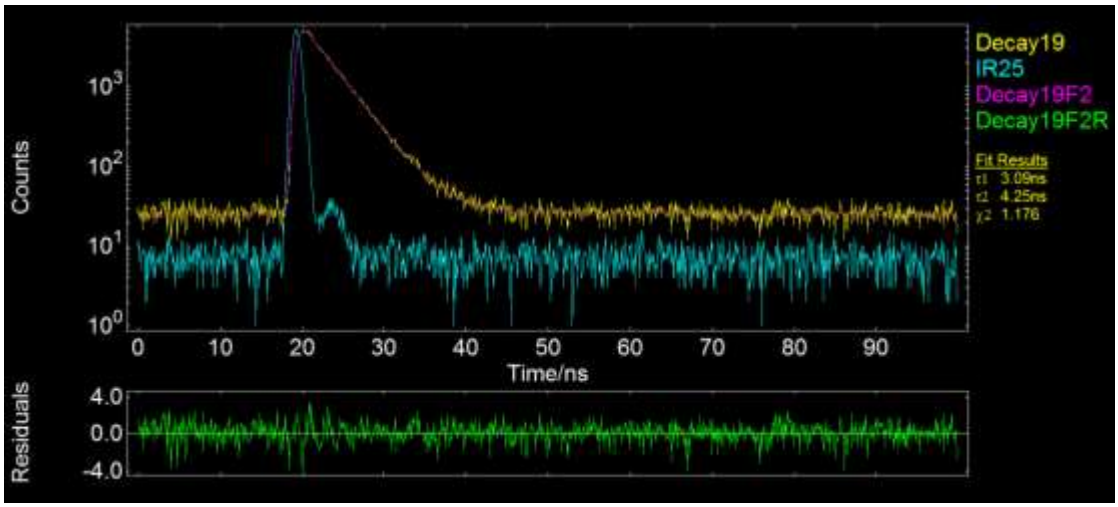




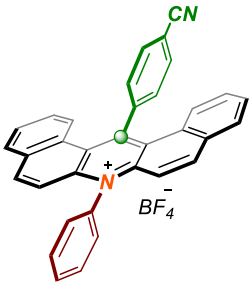
Spectrophotometric and electrochemical data of **8e** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

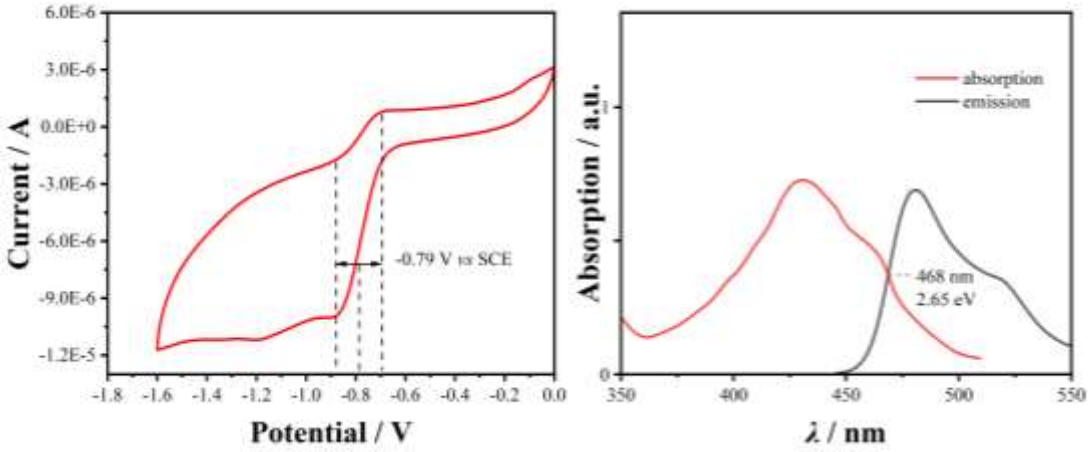


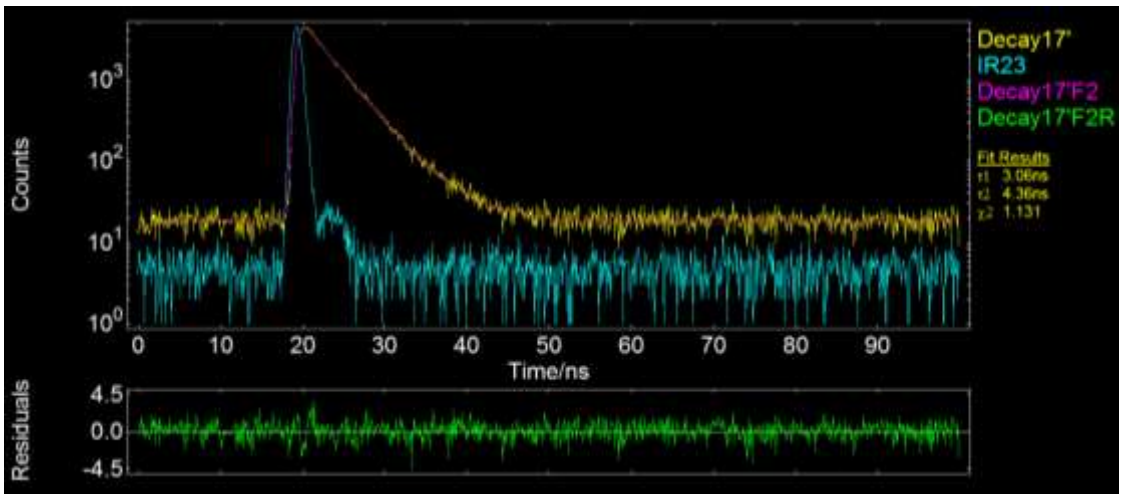




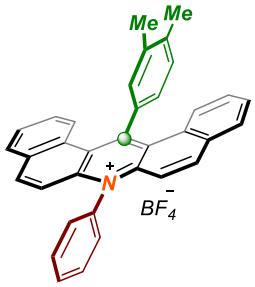
Spectrophotometric and electrochemical data of **8f** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N \cdot PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

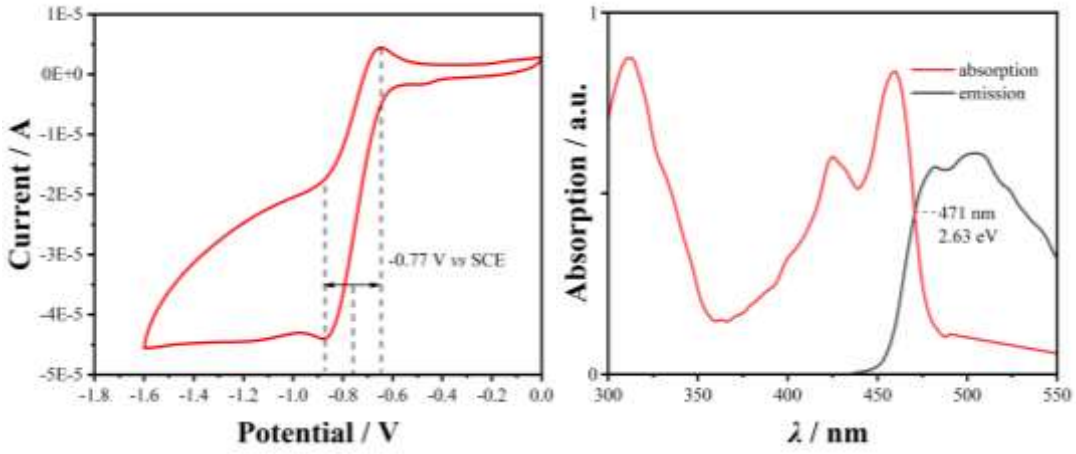


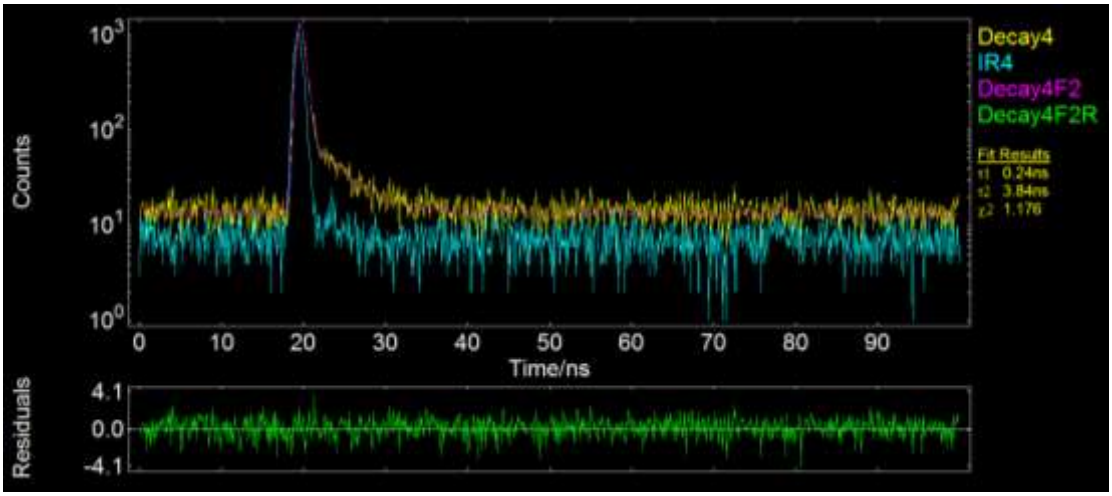




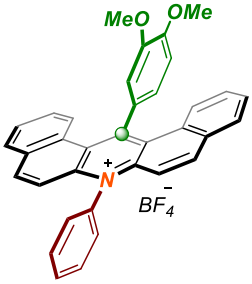
Spectrophotometric and electrochemical data of **8g** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N \cdot PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

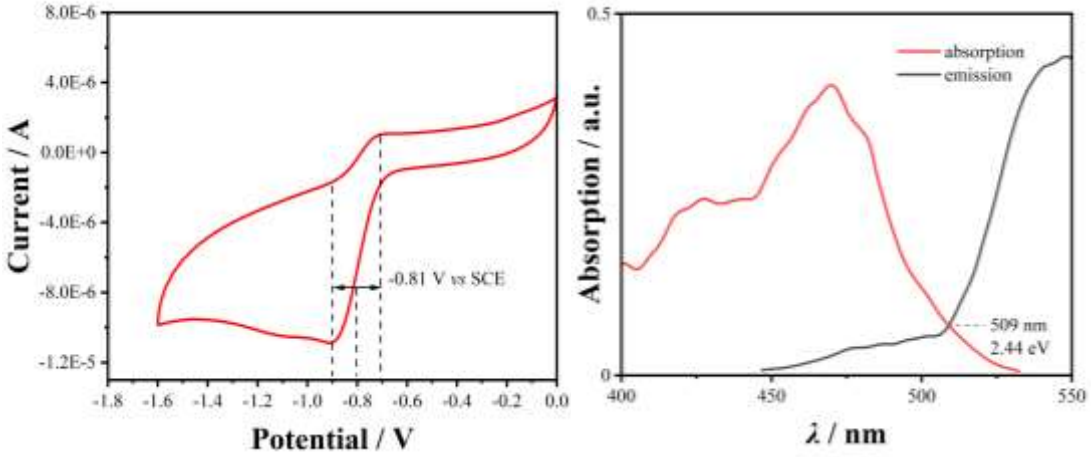


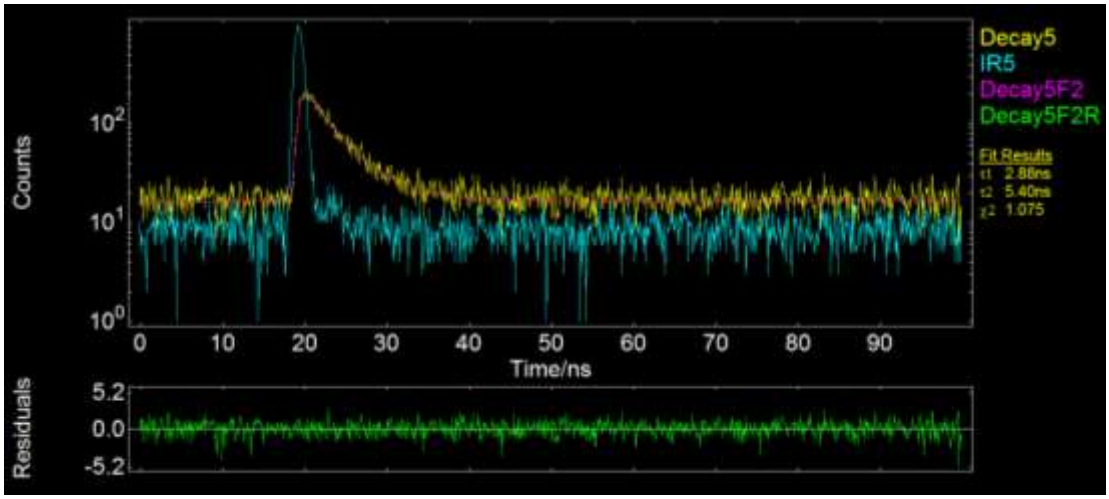




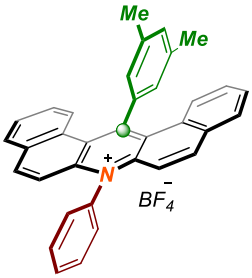
Spectrophotometric and electrochemical data of **8h** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N \cdot PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

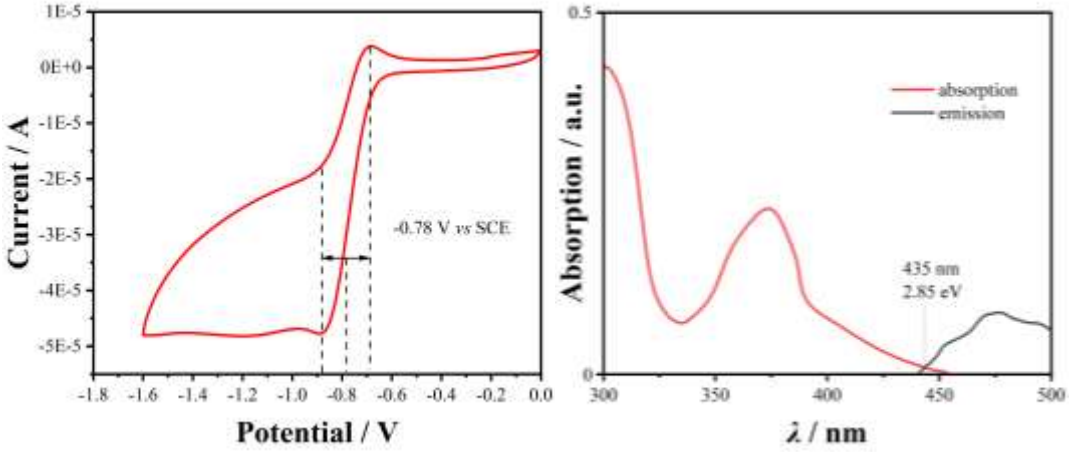


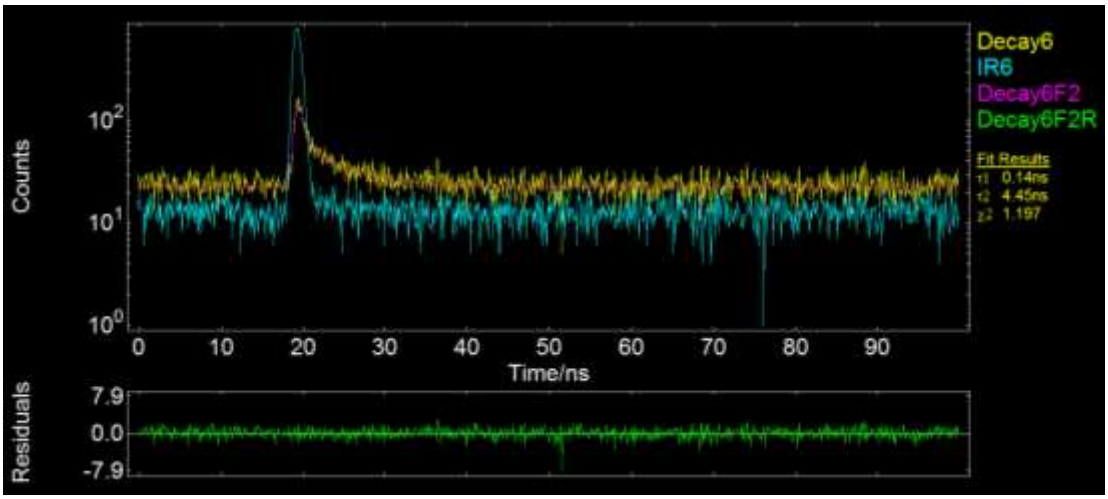




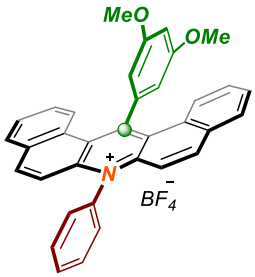
Spectrophotometric and electrochemical data of **8i** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K (c ≈ 10^{-5} M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

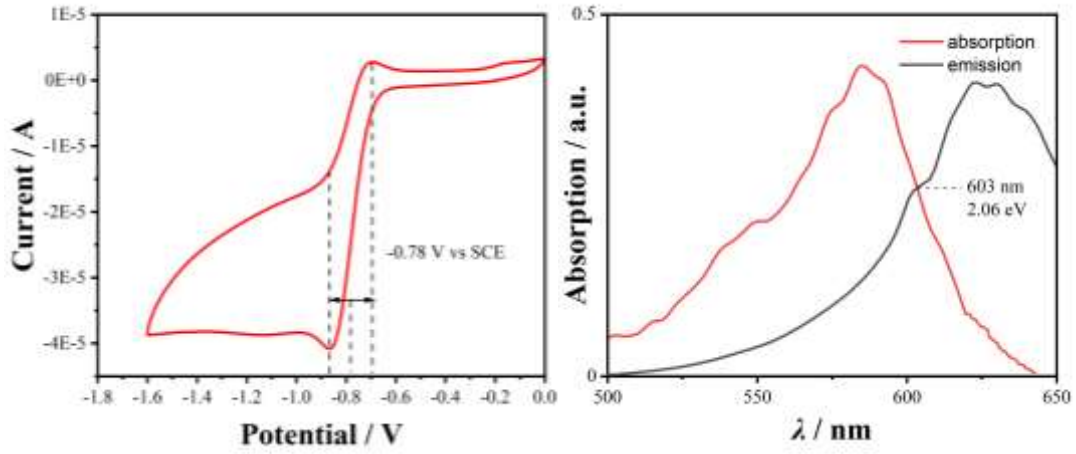


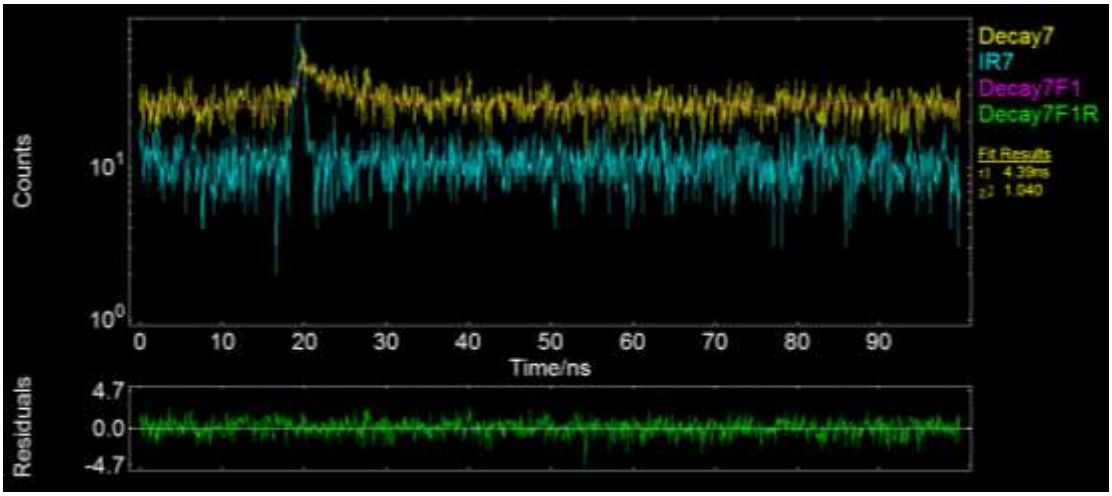




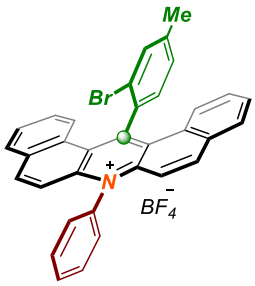
Spectrophotometric and electrochemical data of **8j** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

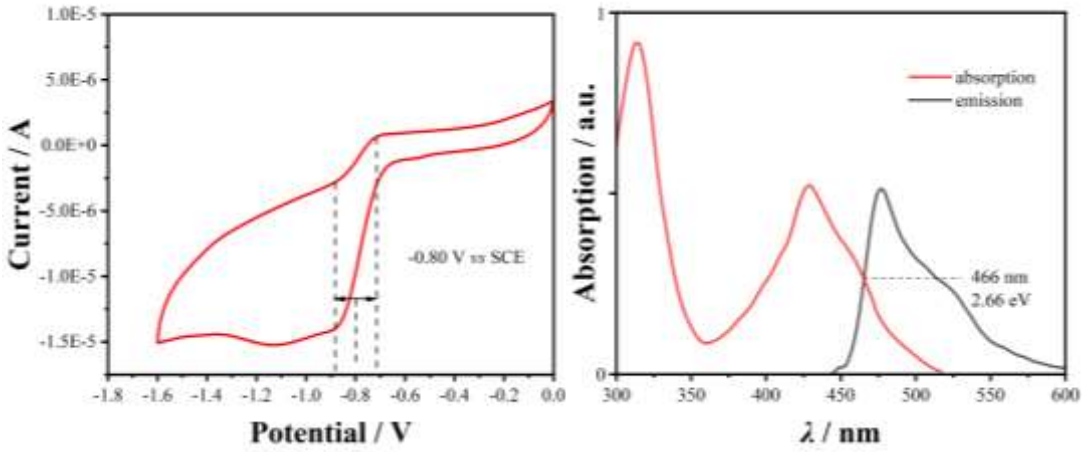


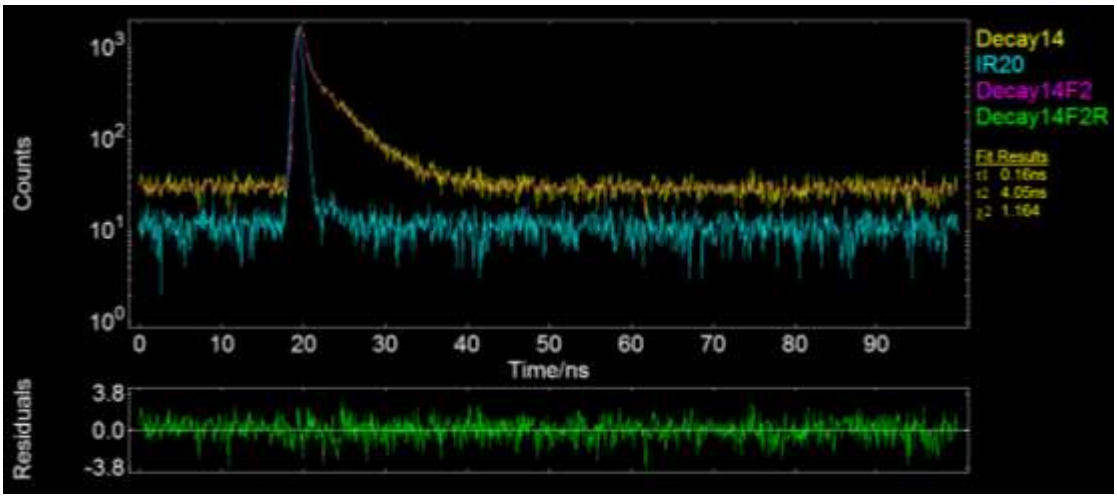




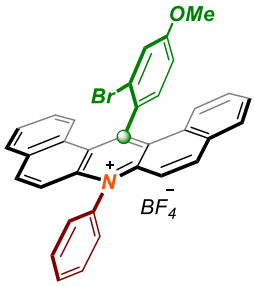
Spectrophotometric and electrochemical data of **8k** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

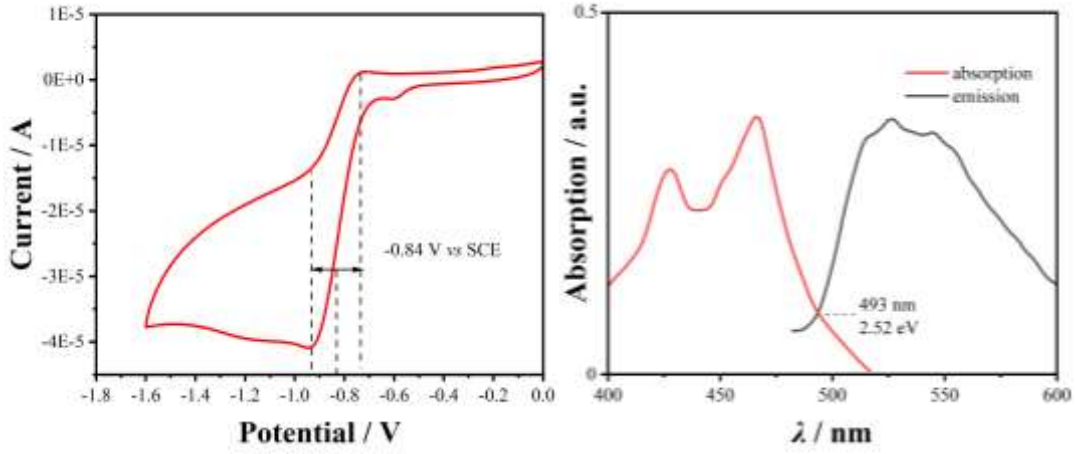


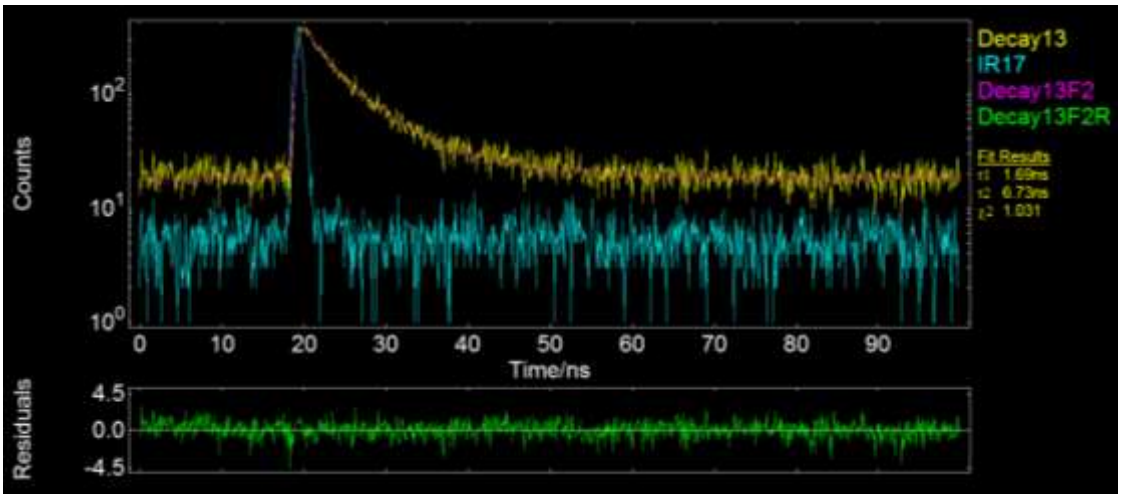




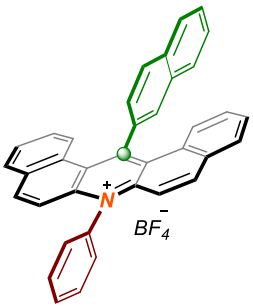
Spectrophotometric and electrochemical data of **8l** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N \cdot PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

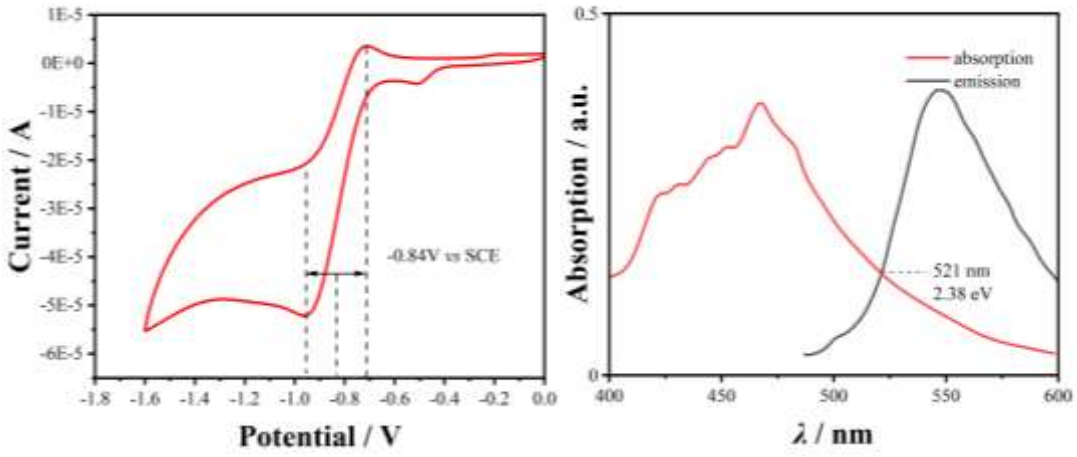


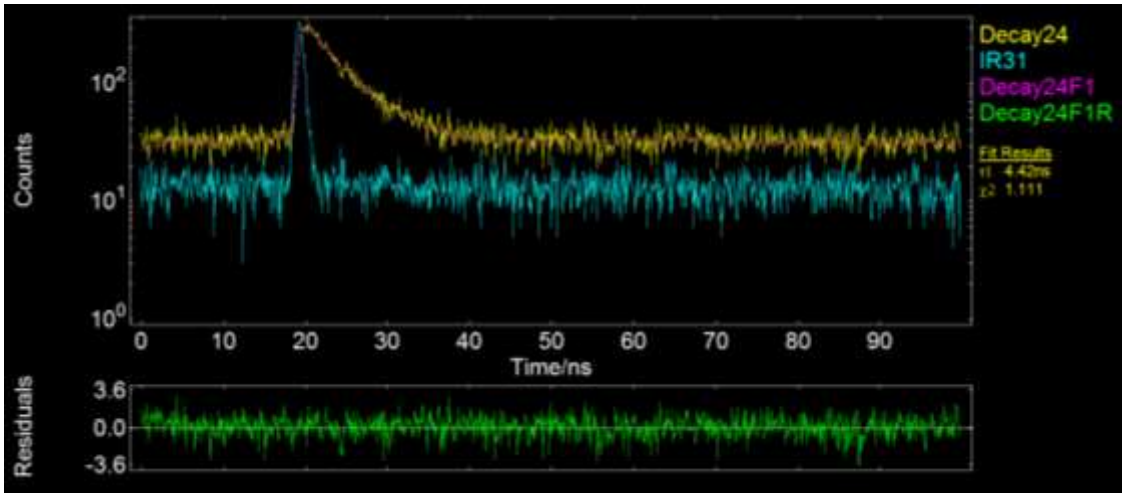




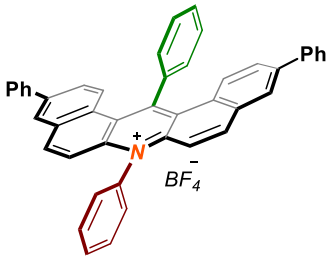
Spectrophotometric and electrochemical data of **8m** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N \cdot PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 485 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

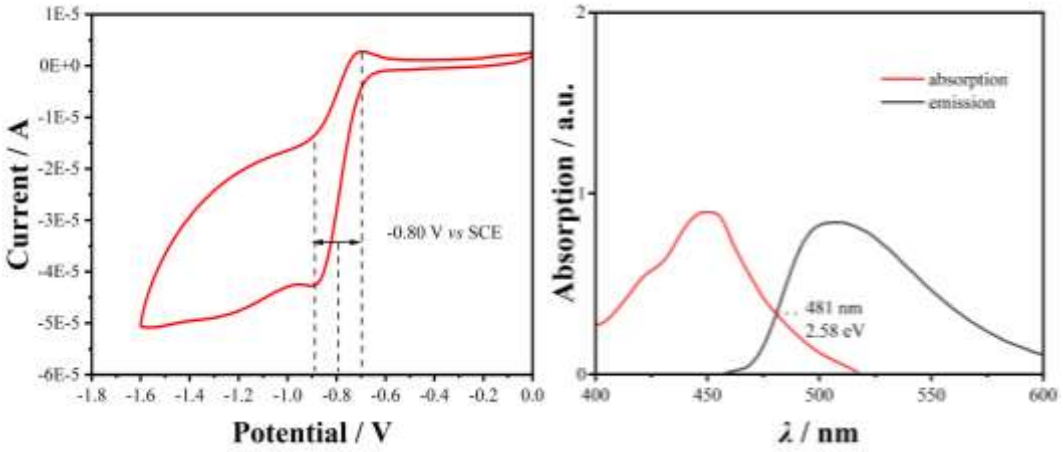


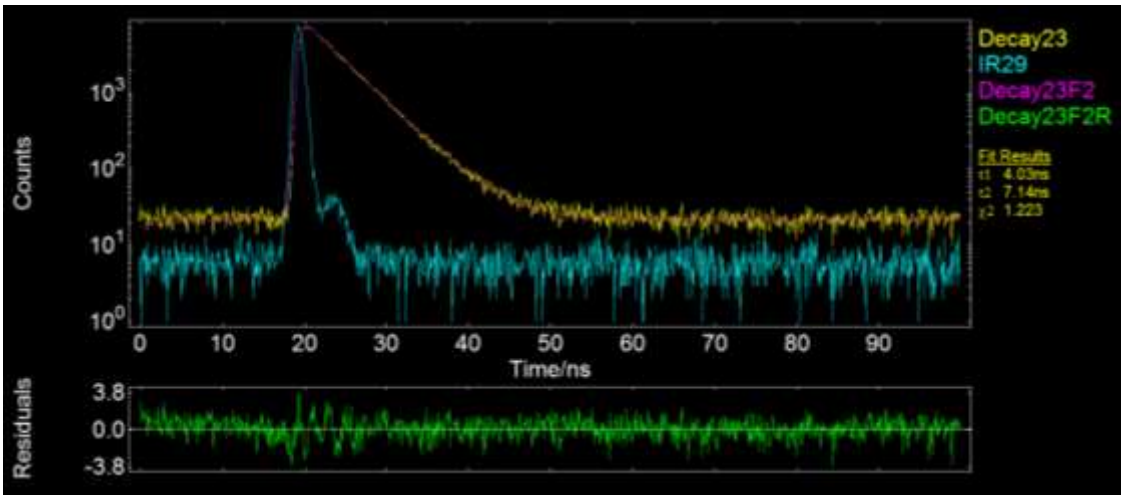




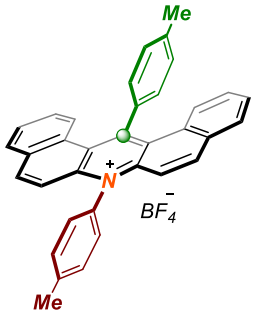
Spectrophotometric and electrochemical data of **8n** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 485 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K (c ≈ 10^{-5} M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

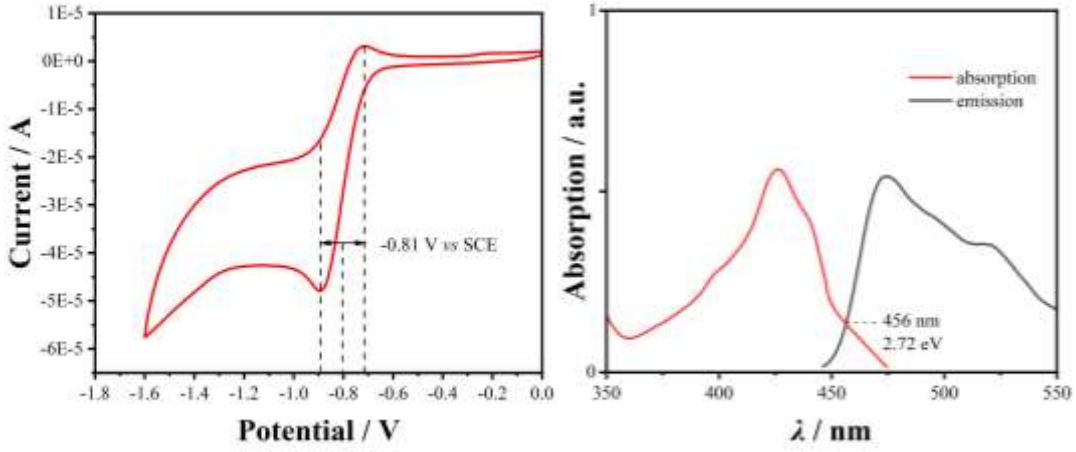


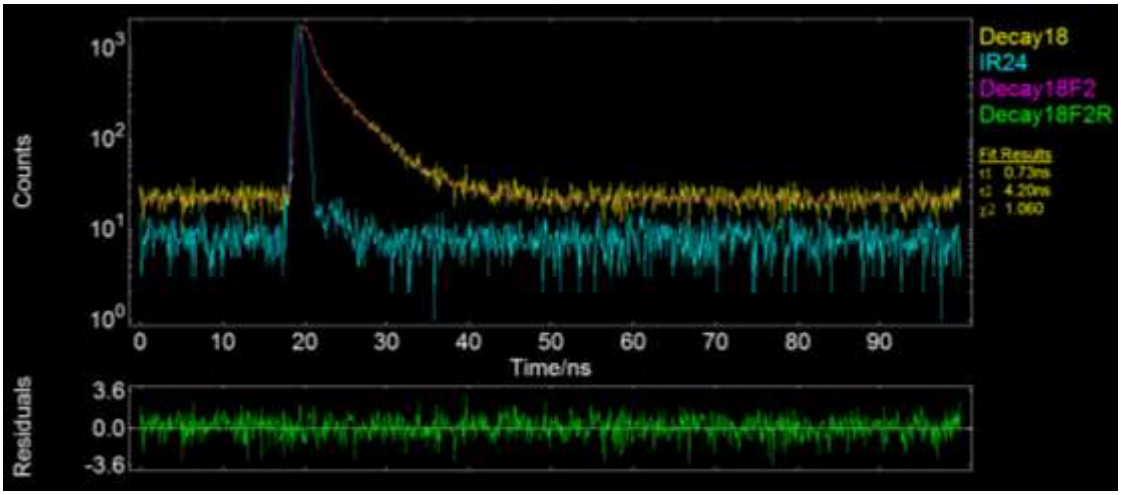




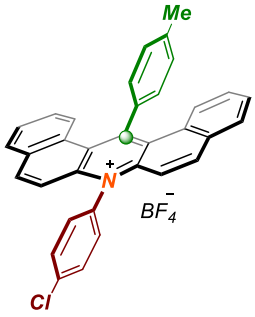
Spectrophotometric and electrochemical data of **8o** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N \cdot PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

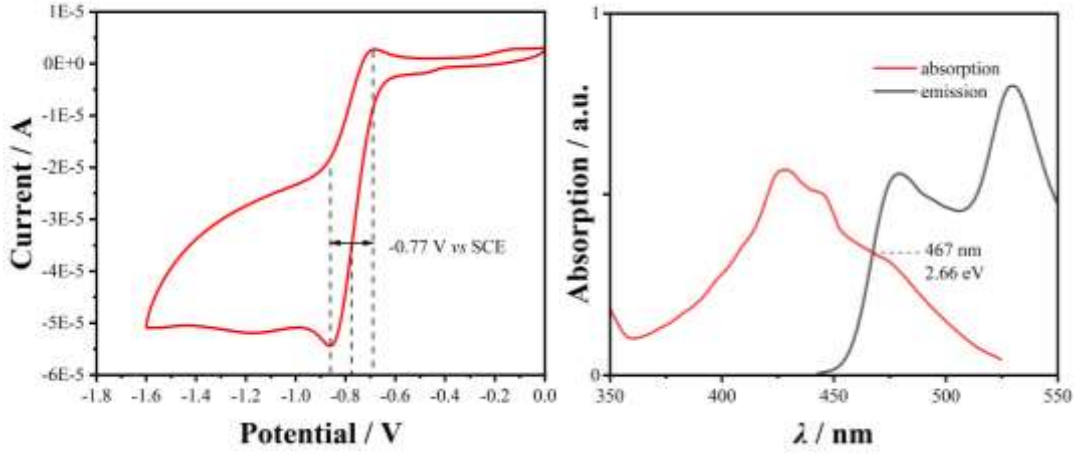


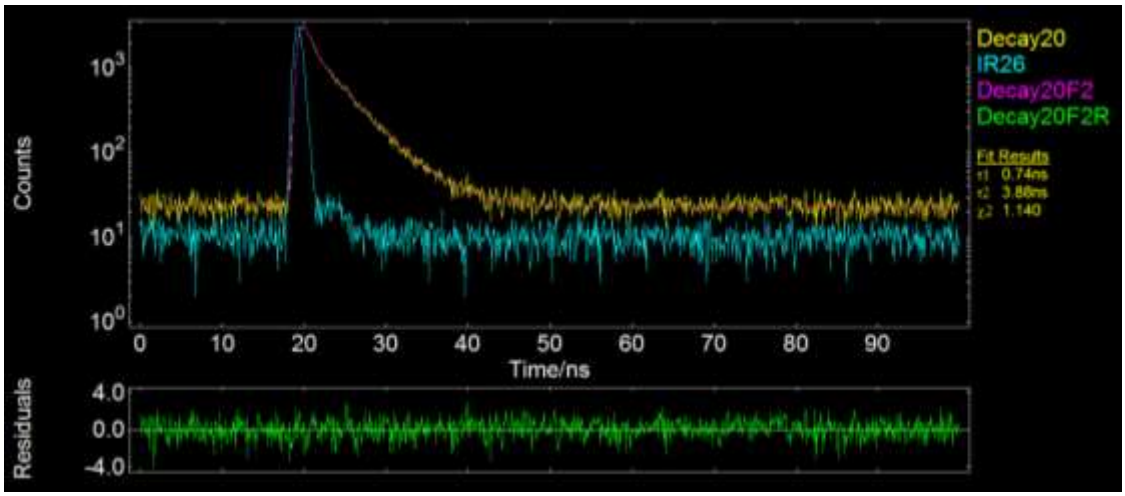




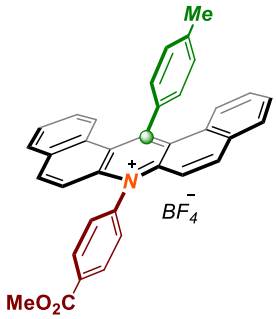
Spectrophotometric and electrochemical data of **8p** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

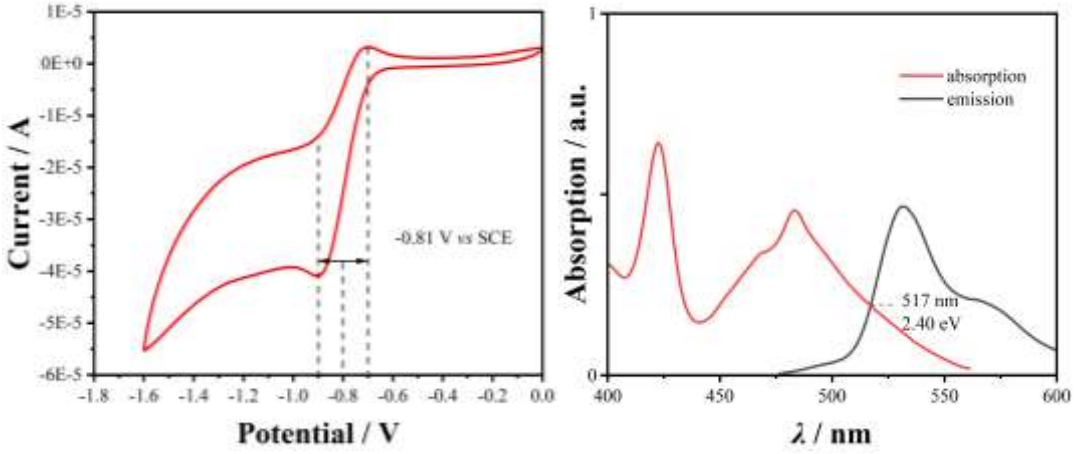


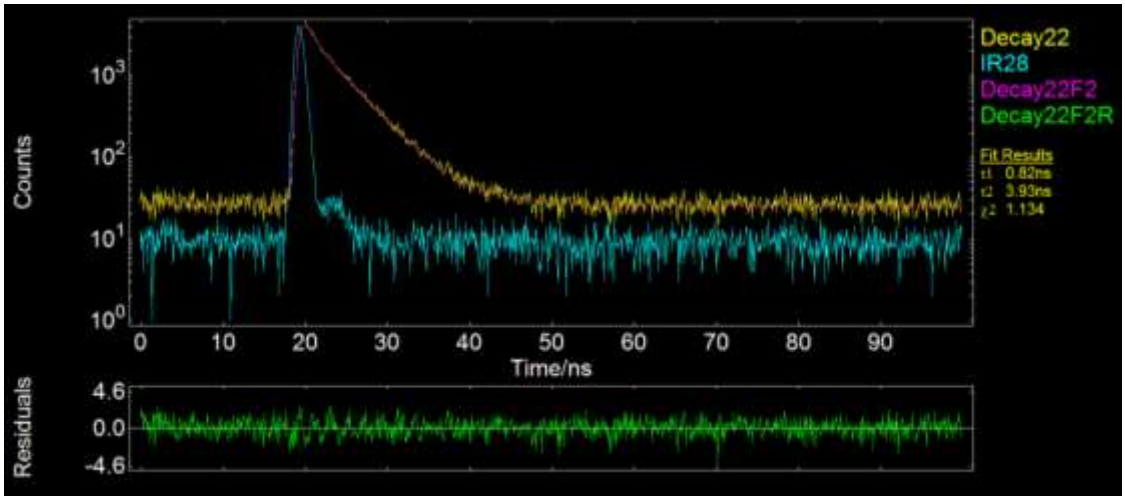




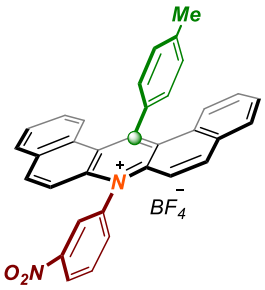
Spectrophotometric and electrochemical data of **8q** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

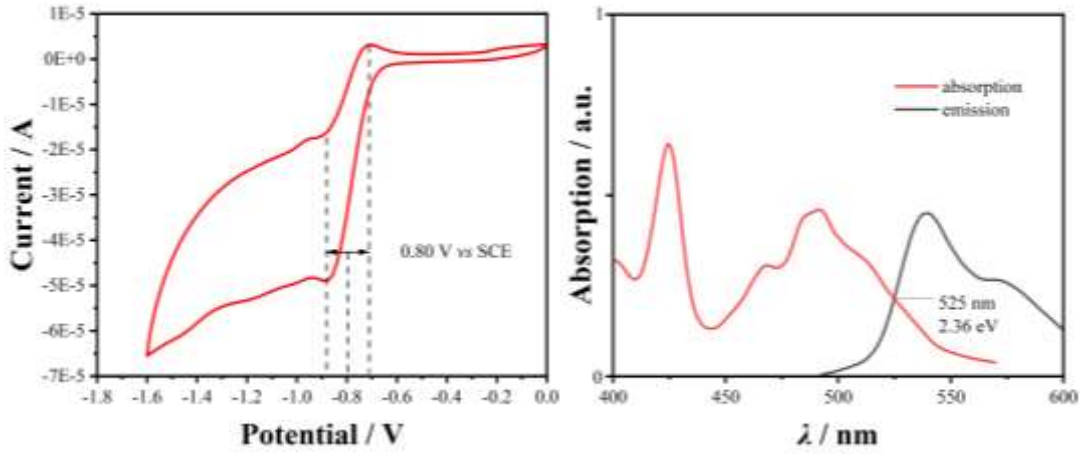


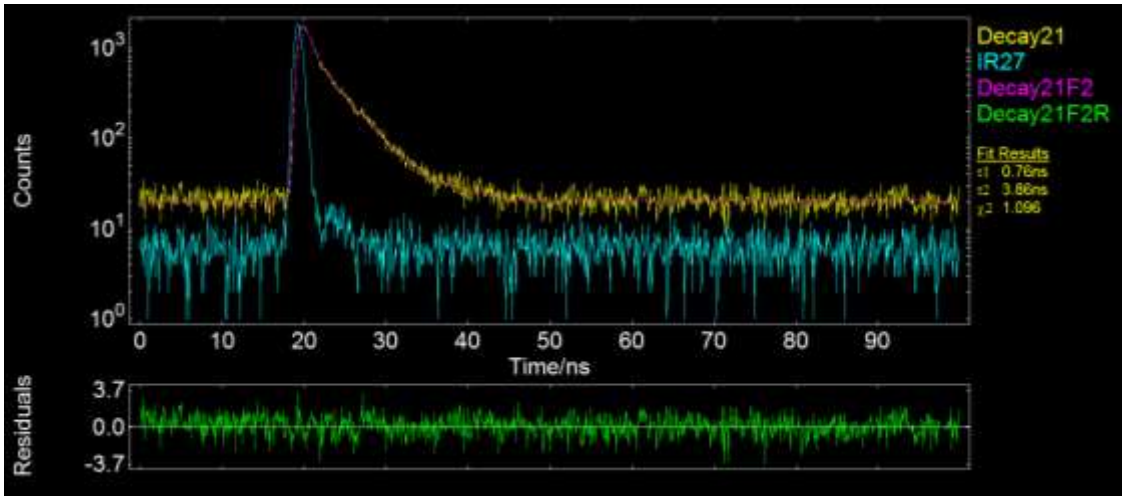




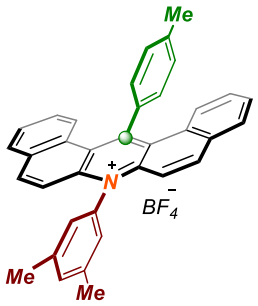
Spectrophotometric and electrochemical data of **8r** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

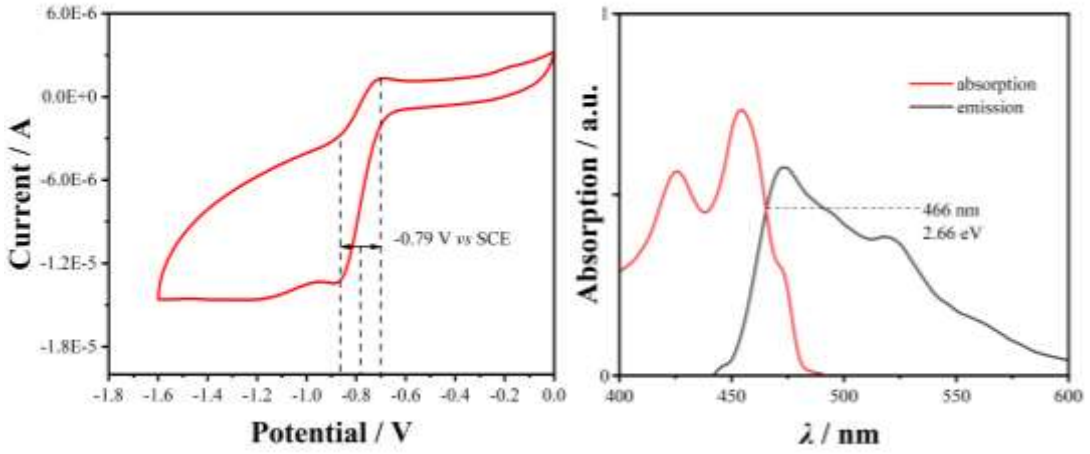


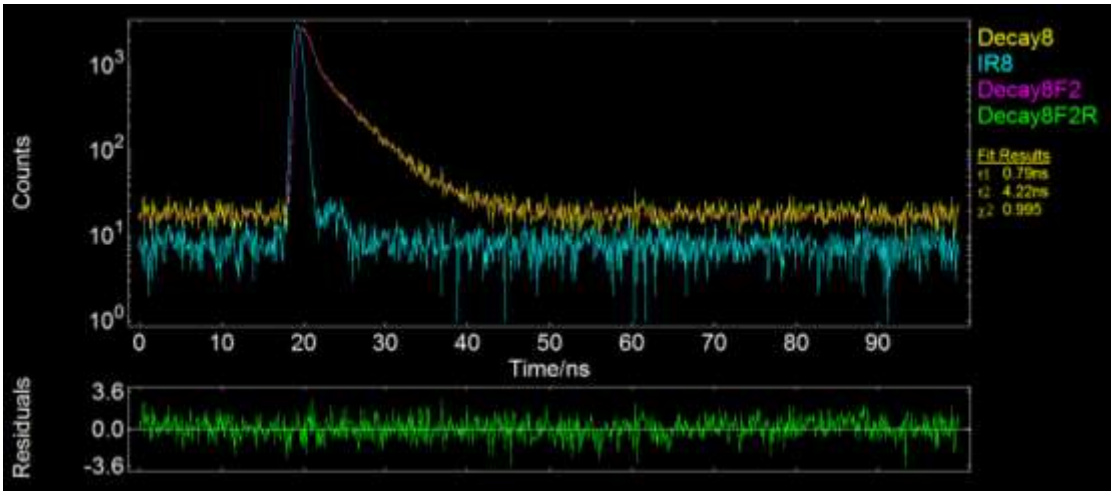




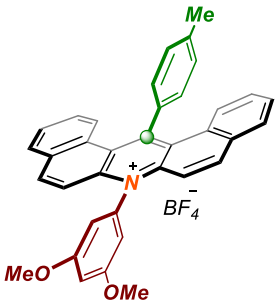
Spectrophotometric and electrochemical data of **8s** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 485 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

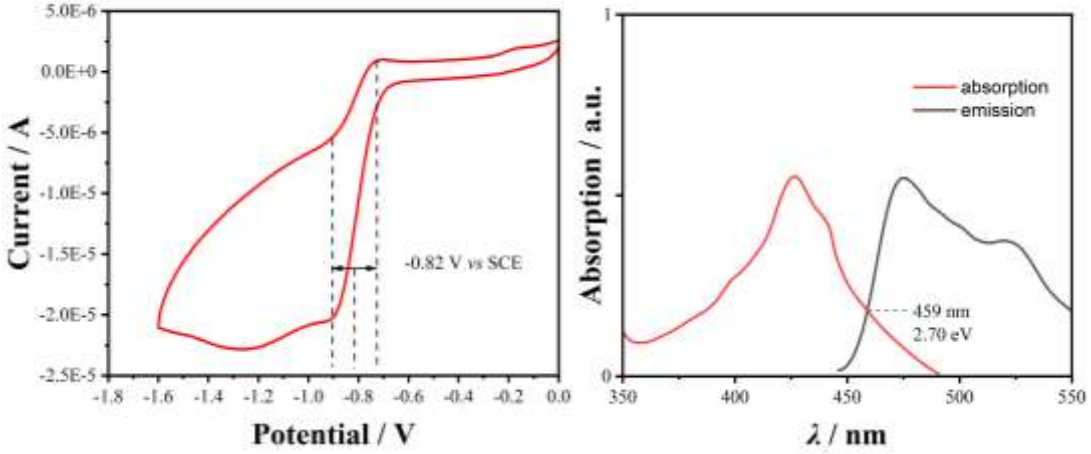


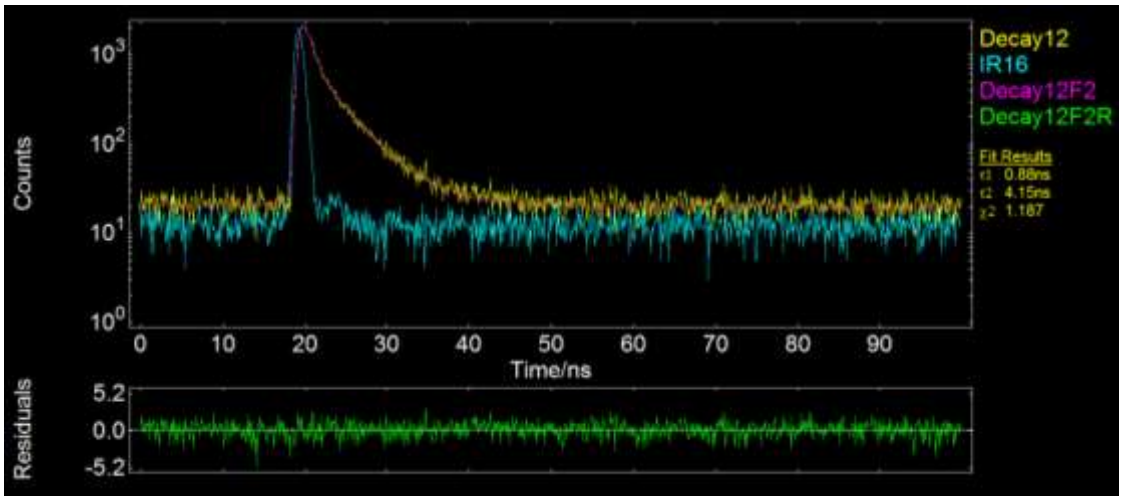




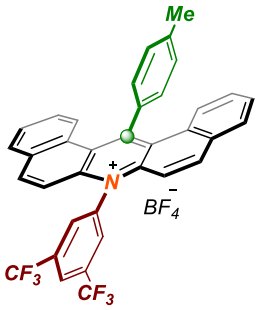
Spectrophotometric and electrochemical data of **8t** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

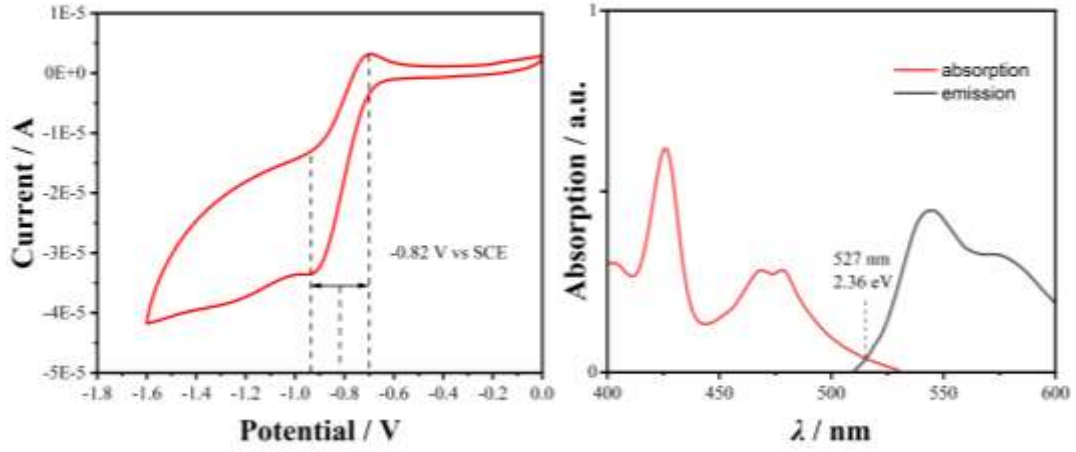


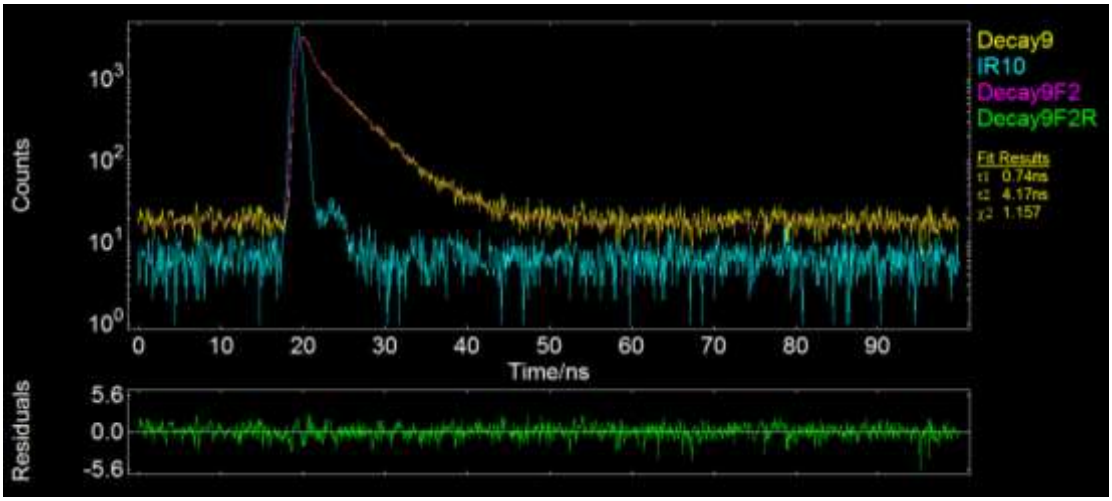




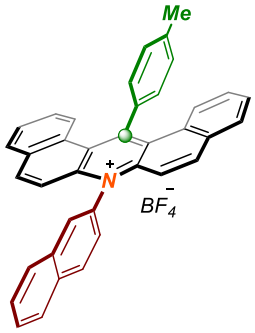
Spectrophotometric and electrochemical data of **8u** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

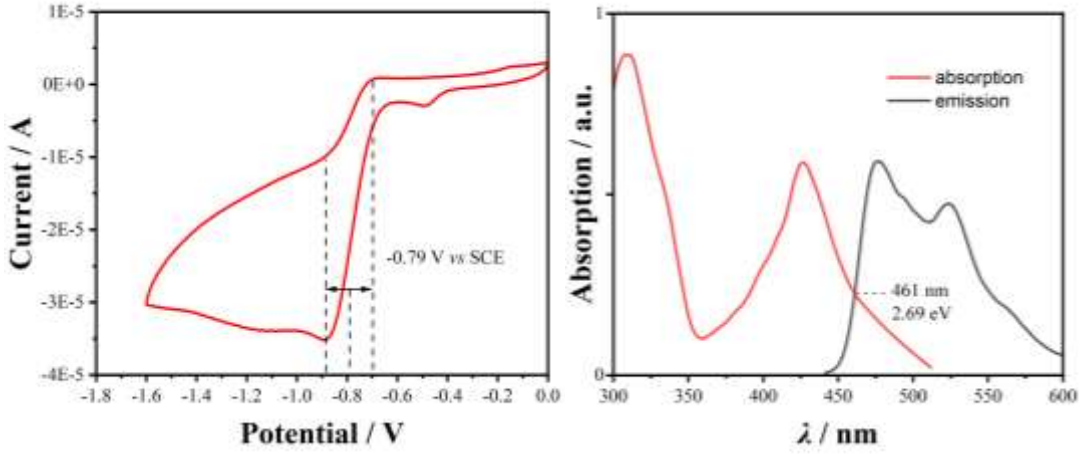


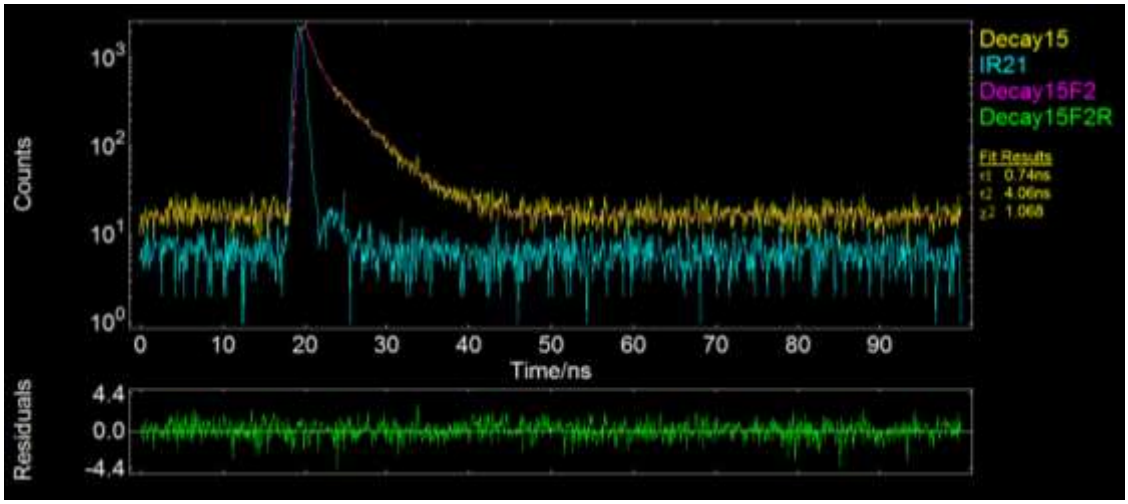




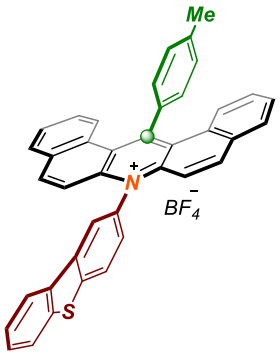
Spectrophotometric and electrochemical data of **8v** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 485 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

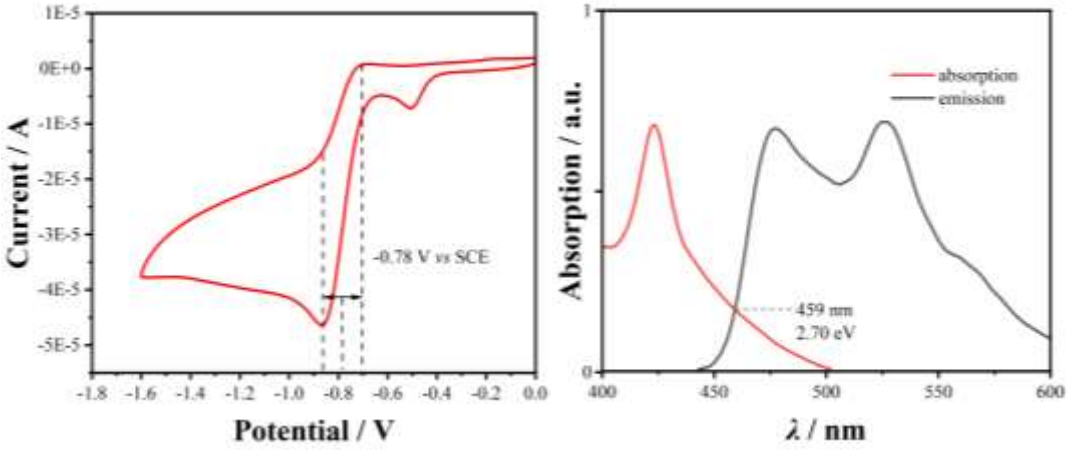


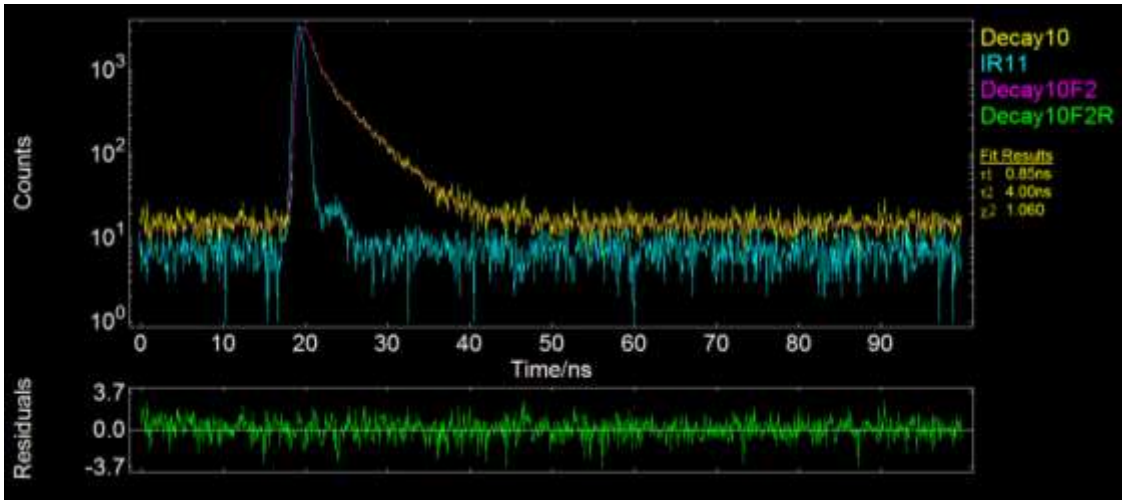




Spectrophotometric and electrochemical data of **8w** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.



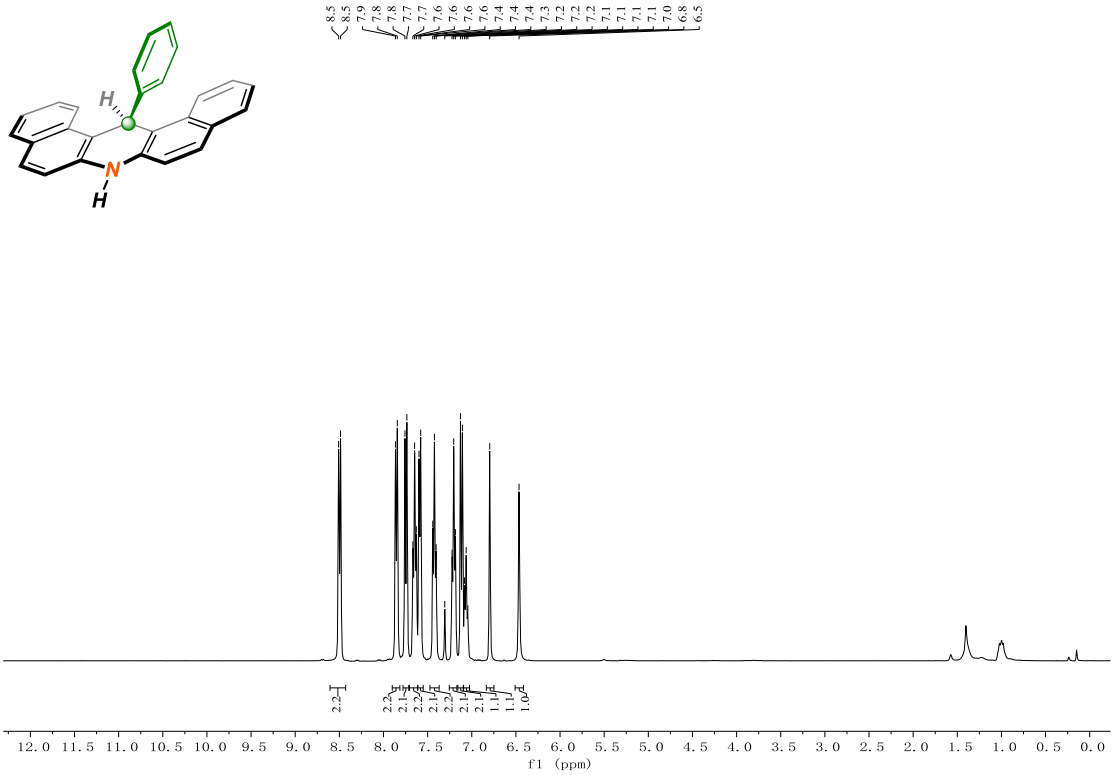




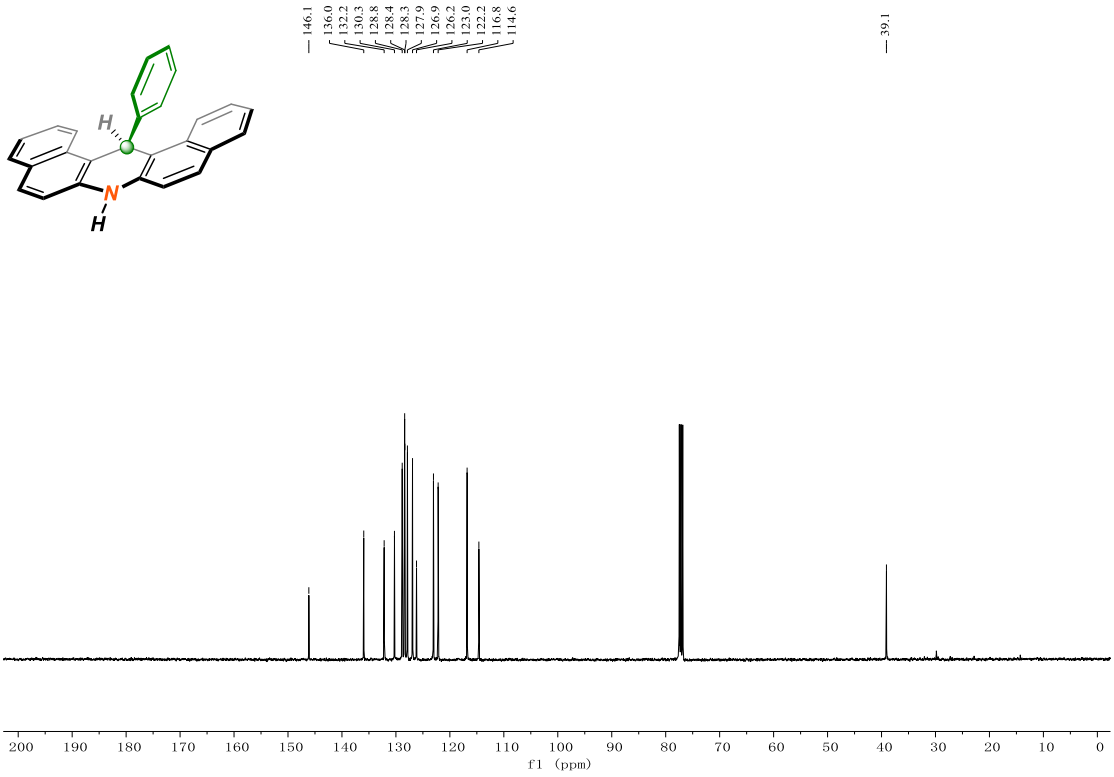
Spectrophotometric and electrochemical data of **8x** top left: Cyclic voltammograms measured in a deaerated DCM with 0.1 M $nBu_4N{\cdot}PF_6$ with a scan rate of 100 mV/s, a platinum working electrode and with ferrocene as the internal reference (Fc/Fc^+ = 0.38 V *vs* SCE in DCM). top right: UV-visible absorption (red line) and emission (λ_{ex} = 447 nm, black line) spectra, in DCM. bottom: Fitting of luminescence decays in DCM at 298 K ($c \approx 10^{-5}$ M, λ_{ex} = 340 nm). Experimental decays in yellow, exponential fits in red, residual traces in green.

J. NMR spectra

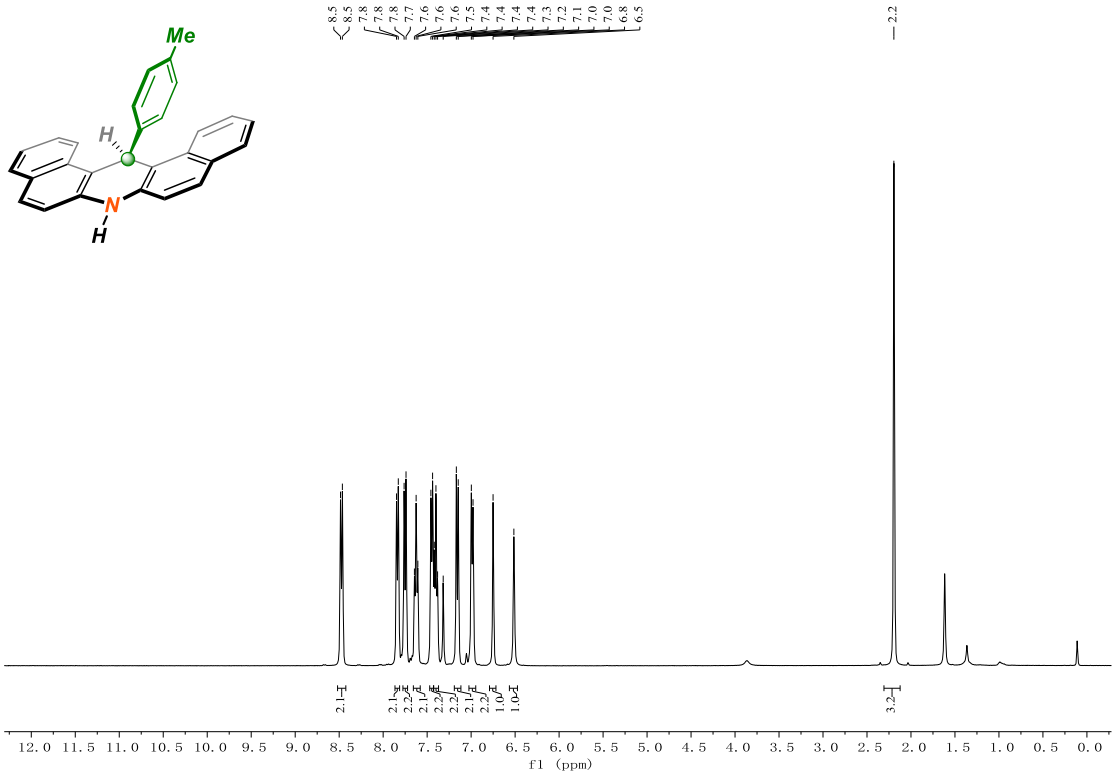
^{1}H NMR of **2a** (400 MHz, $CDCl_3$)



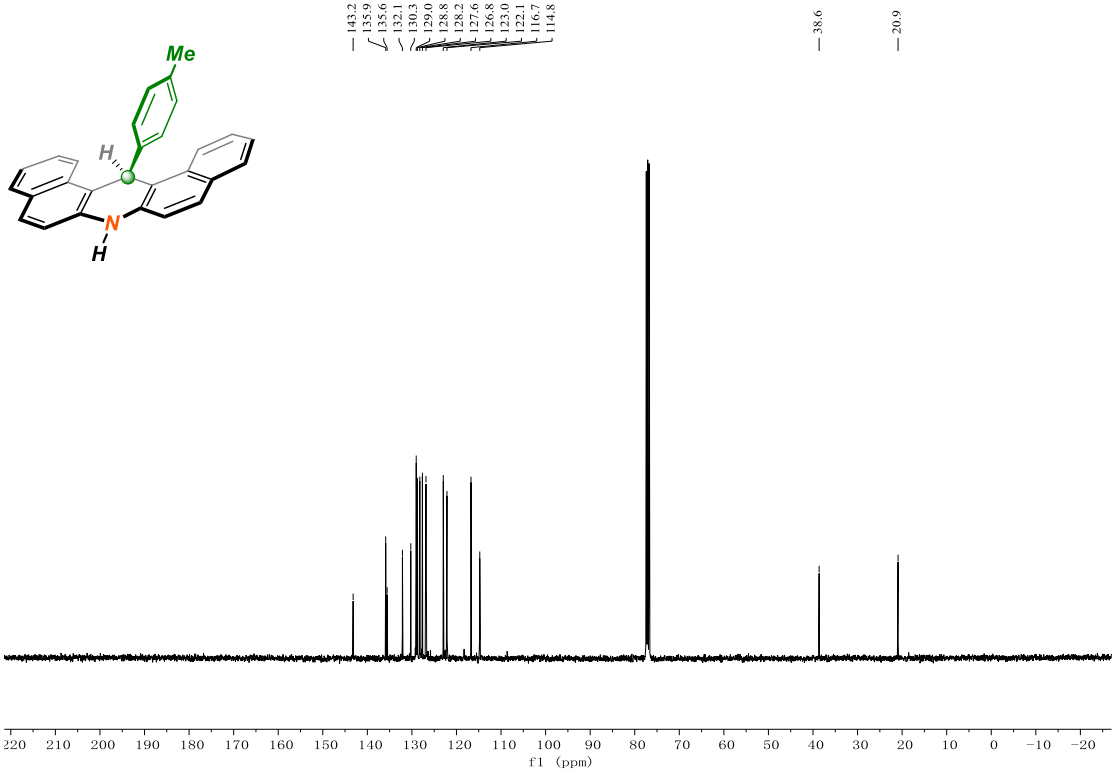
^{13}C NMR of **2a** (100 MHz, $CDCl_3$)



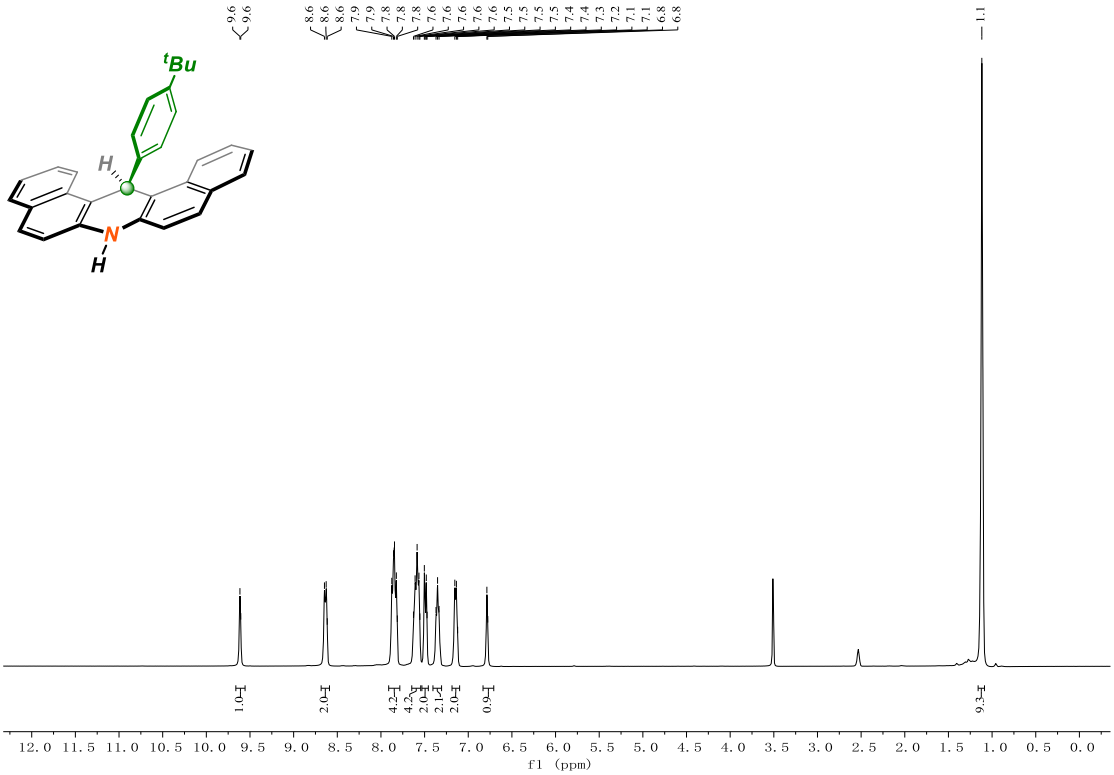
^{1}H NMR of **2b** (400 MHz, $CDCl_3$)



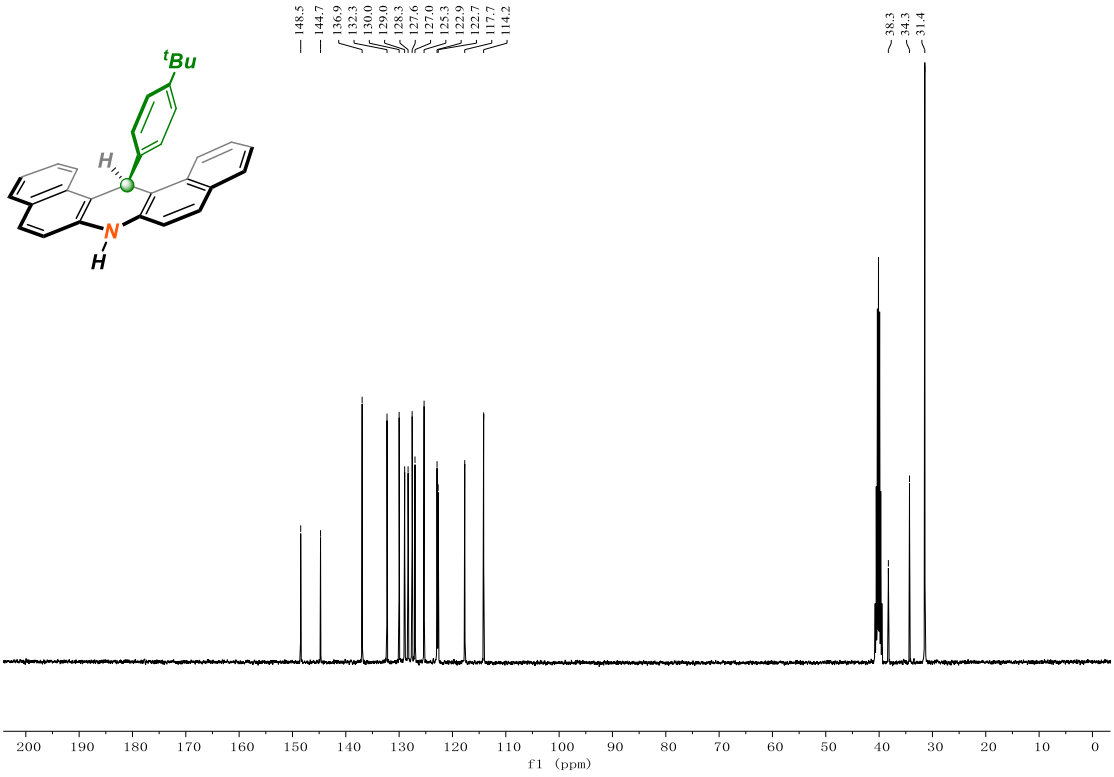
^{13}C NMR of **2b** (100 MHz, $CDCl_3$)



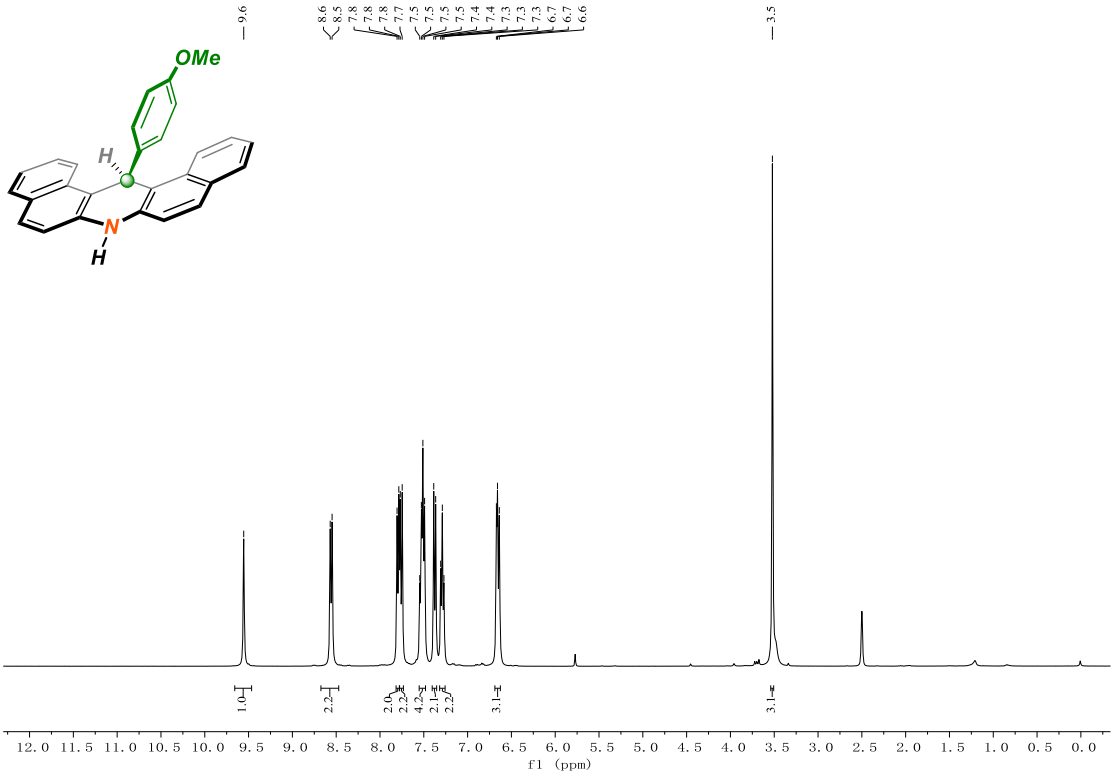
^{1}H NMR of **2c** (400 MHz, d_6-DMSO)



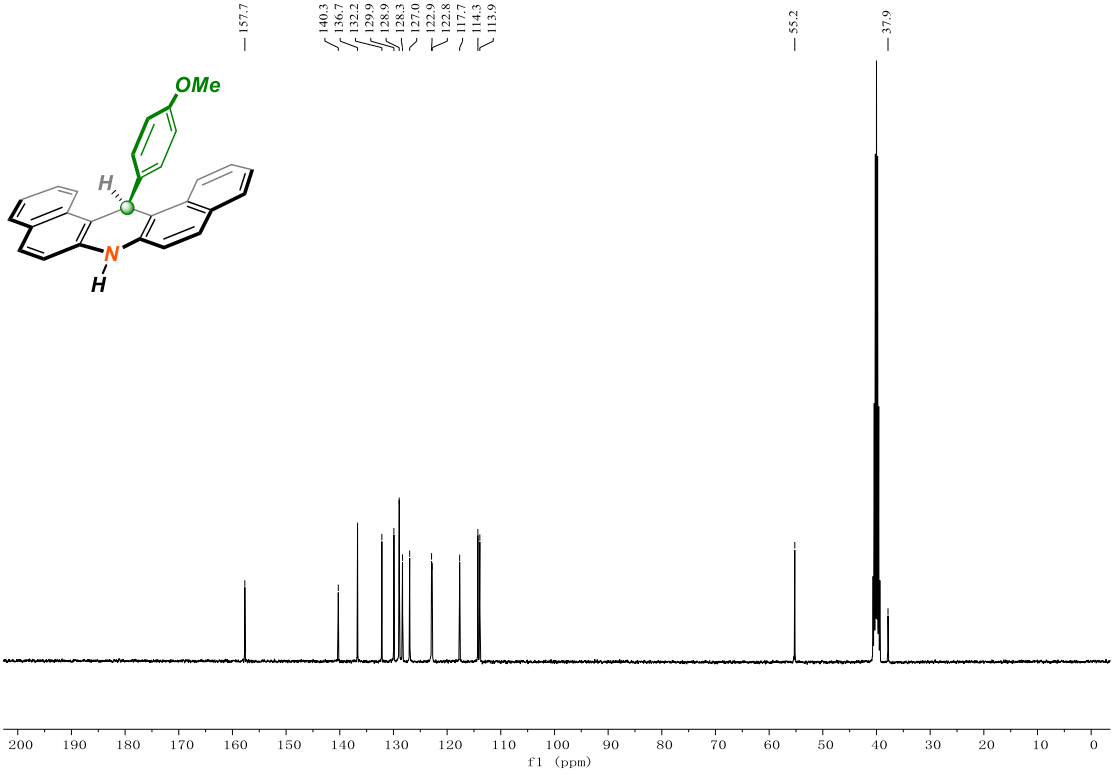
^{13}C NMR of **2c** (100 MHz, d_6-DMSO)



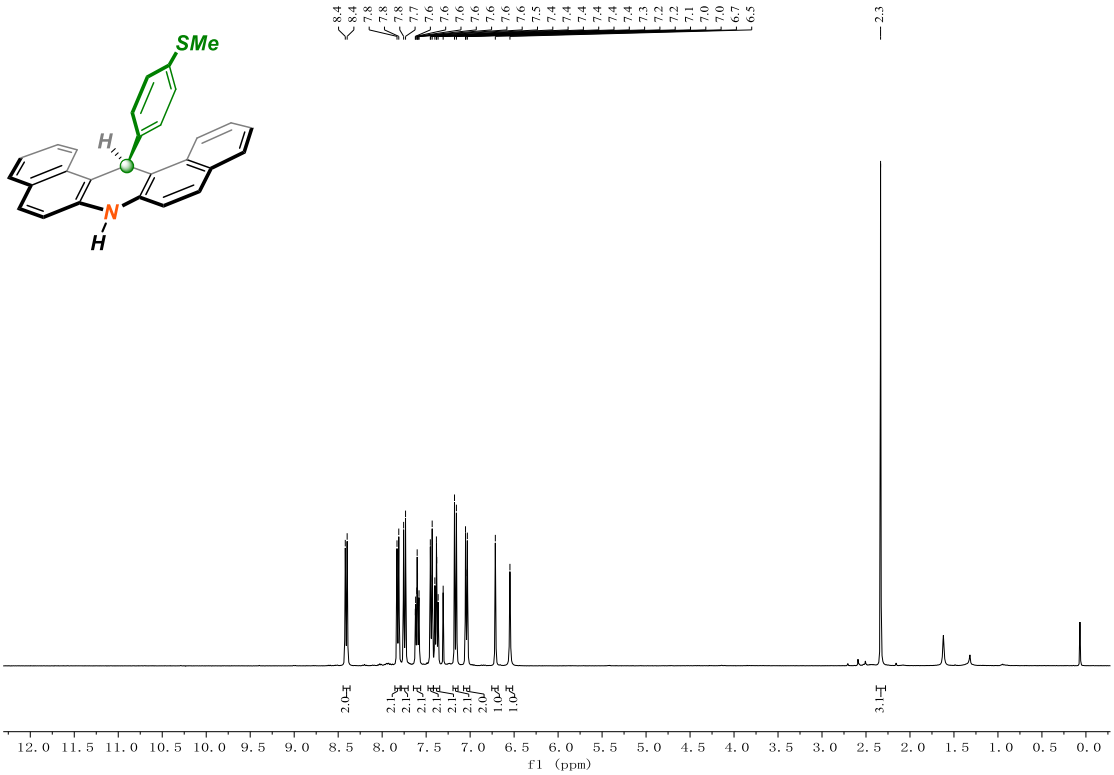
^{1}H NMR of **2d** (400 MHz, d_6-DMSO)



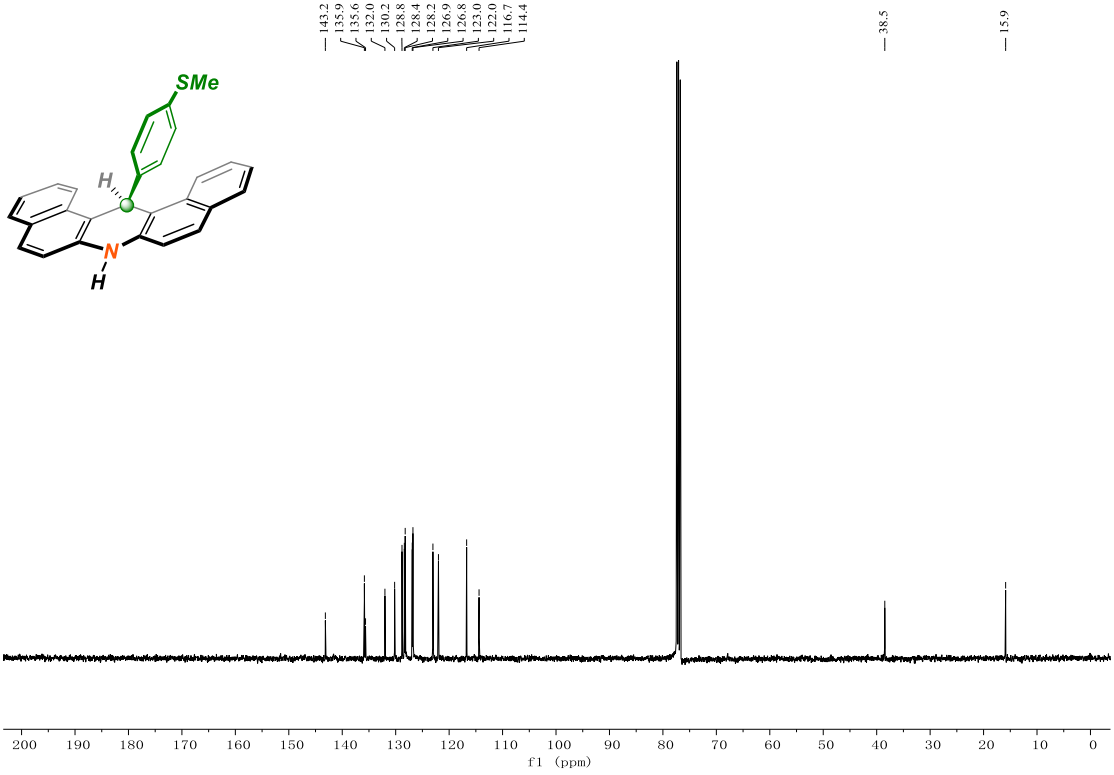
^{13}C NMR of **2d** (100 MHz, d_6-DMSO)



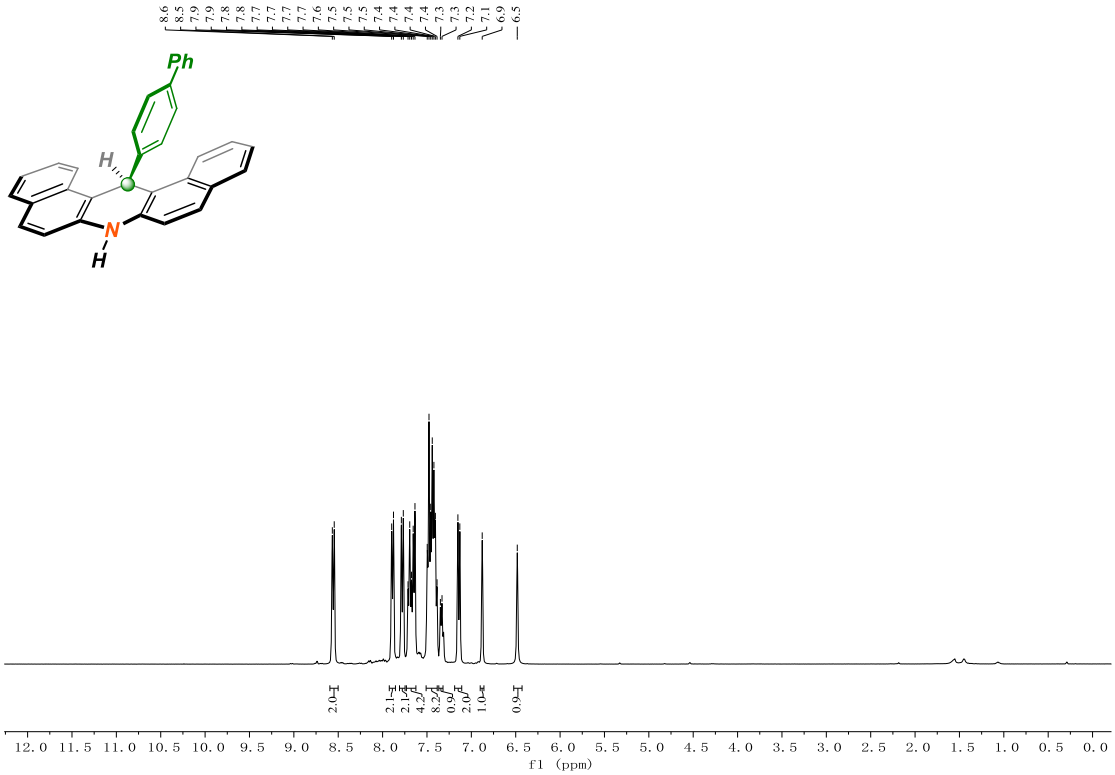
^{1}H NMR of **2e** (400 MHz, $CDCl_3$)



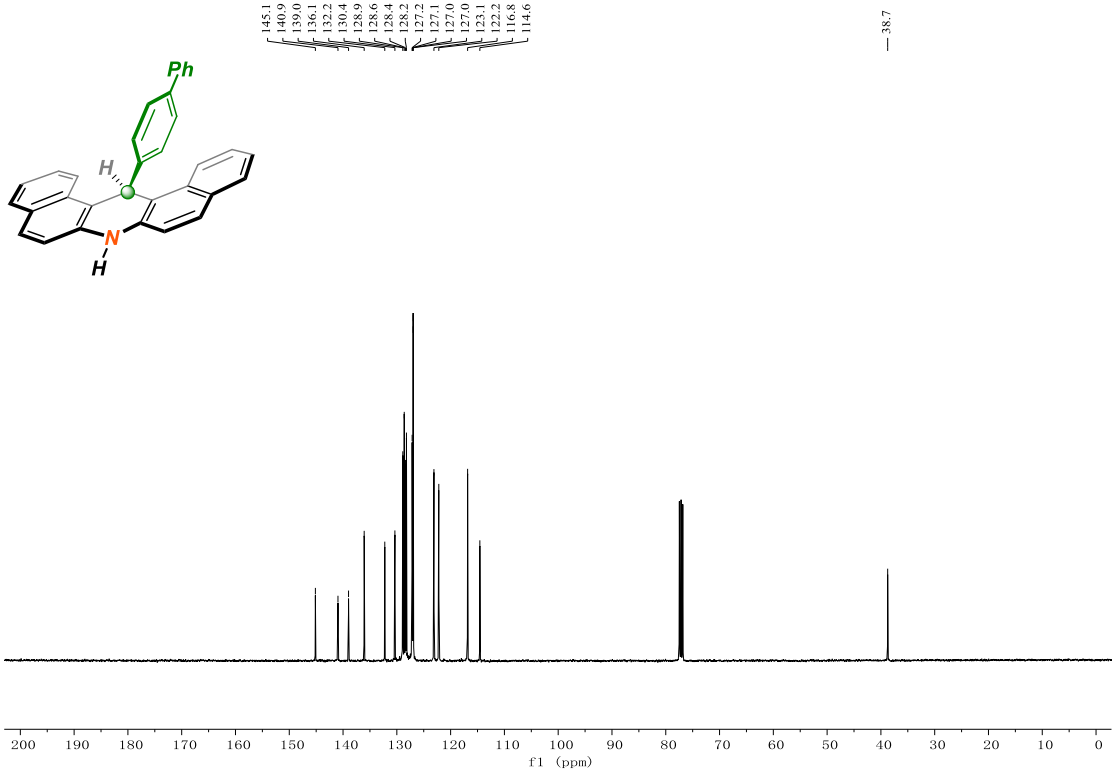
^{13}C NMR of **2e** (100 MHz, $CDCl_3$)



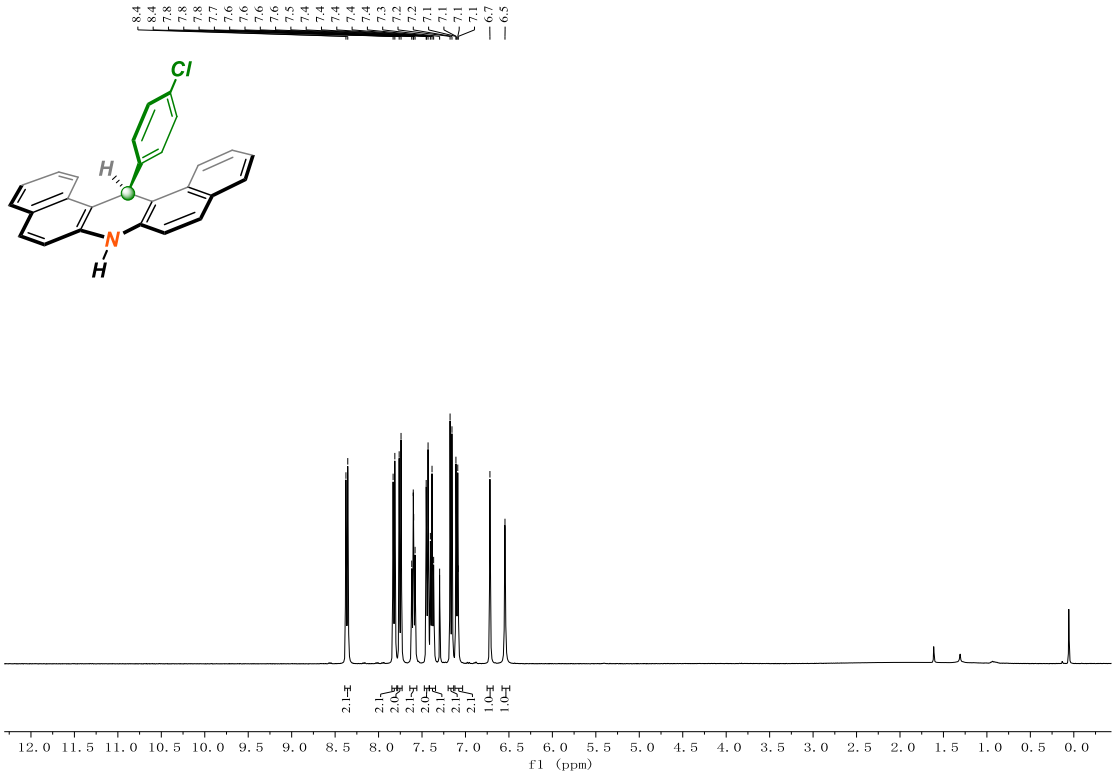
^{1}H NMR of **2f** (400 MHz, $CDCl_3$)



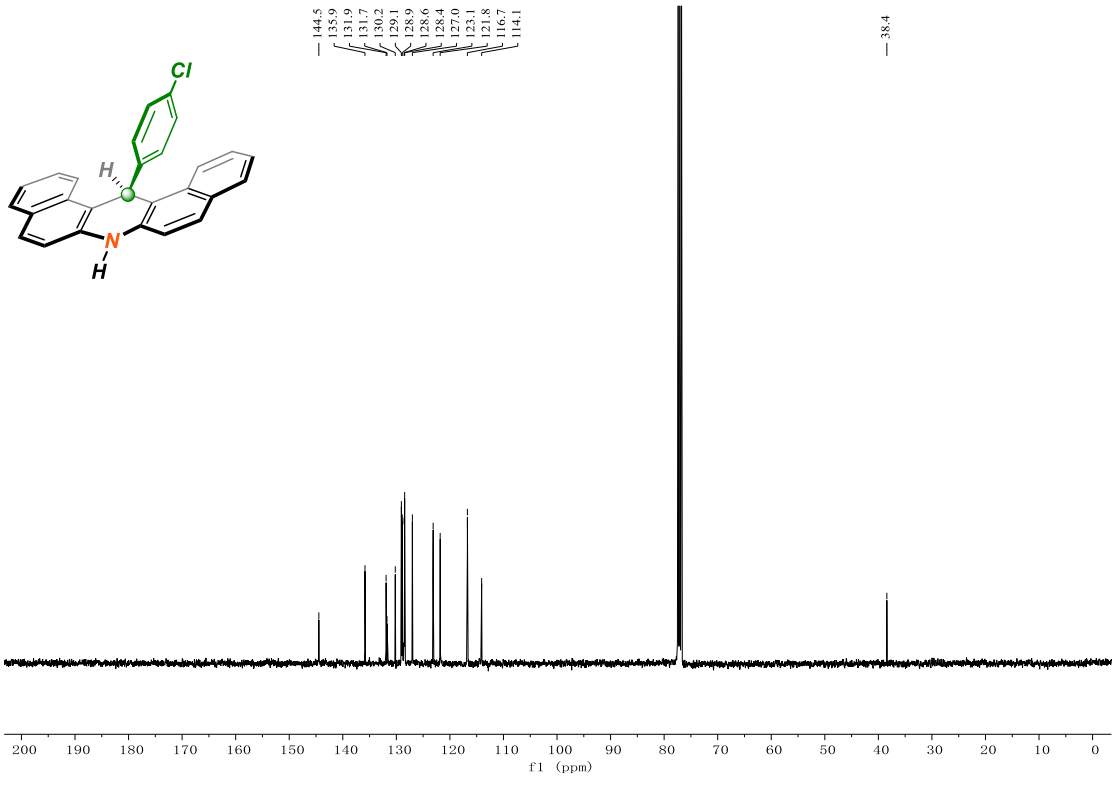
^{13}C NMR of **2f** (100 MHz, $CDCl_3$)



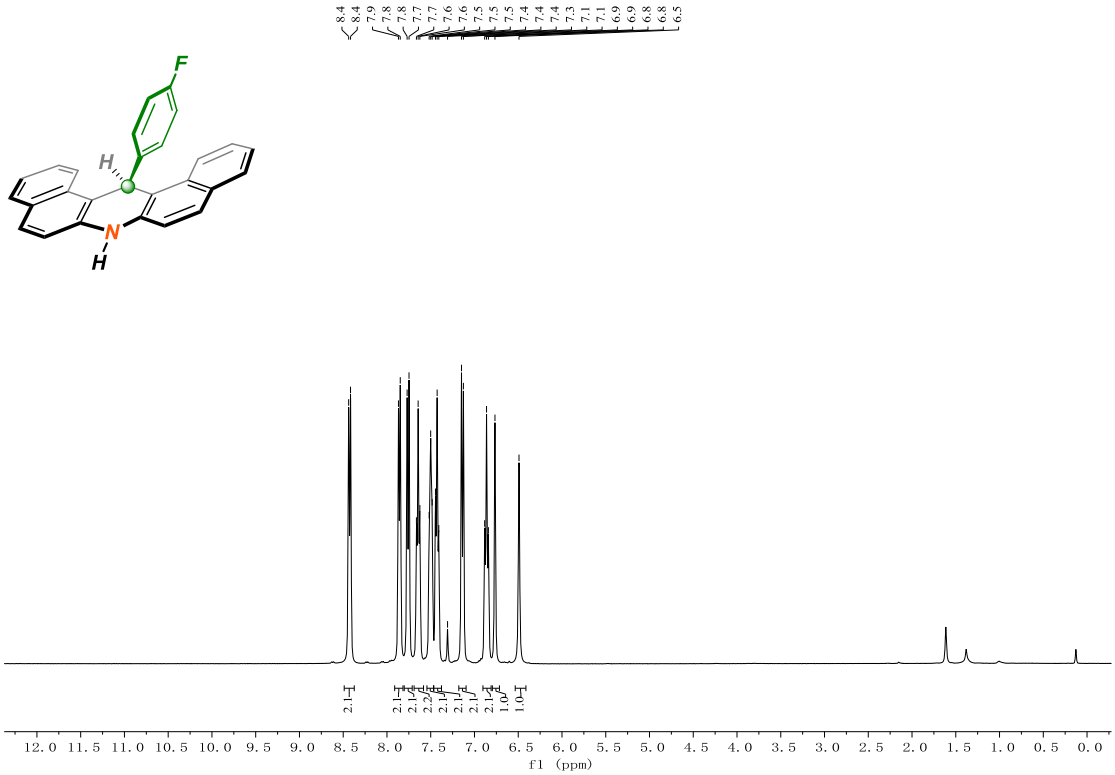
^{1}H NMR of **2g** (400 MHz, $CDCl_3$)



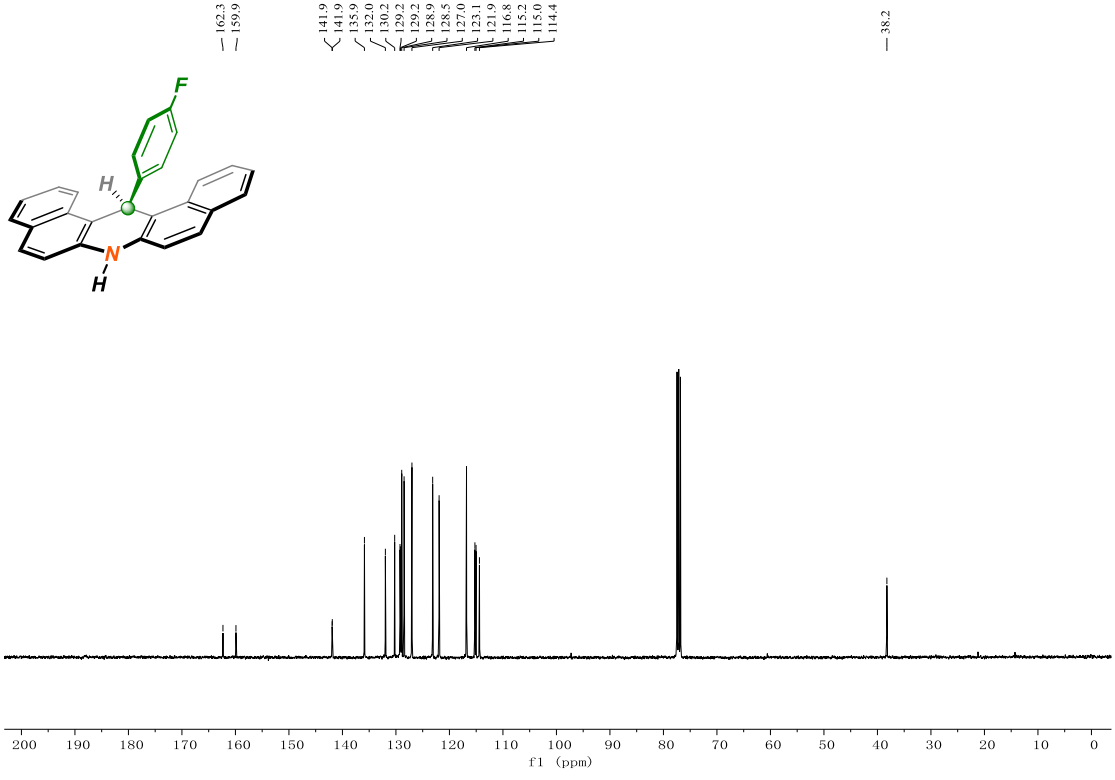
^{13}C NMR of **2g** (100 MHz, $CDCl_3$)



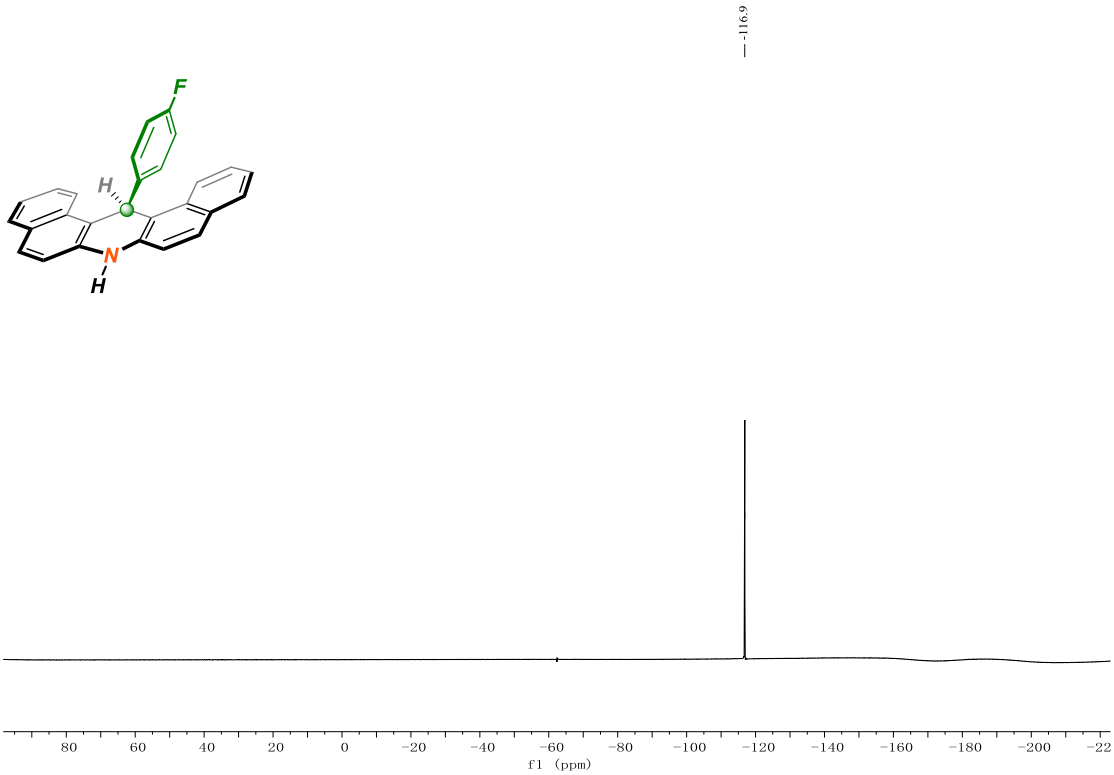
^{1}H NMR of **2h** (400 MHz, $CDCl_3$)



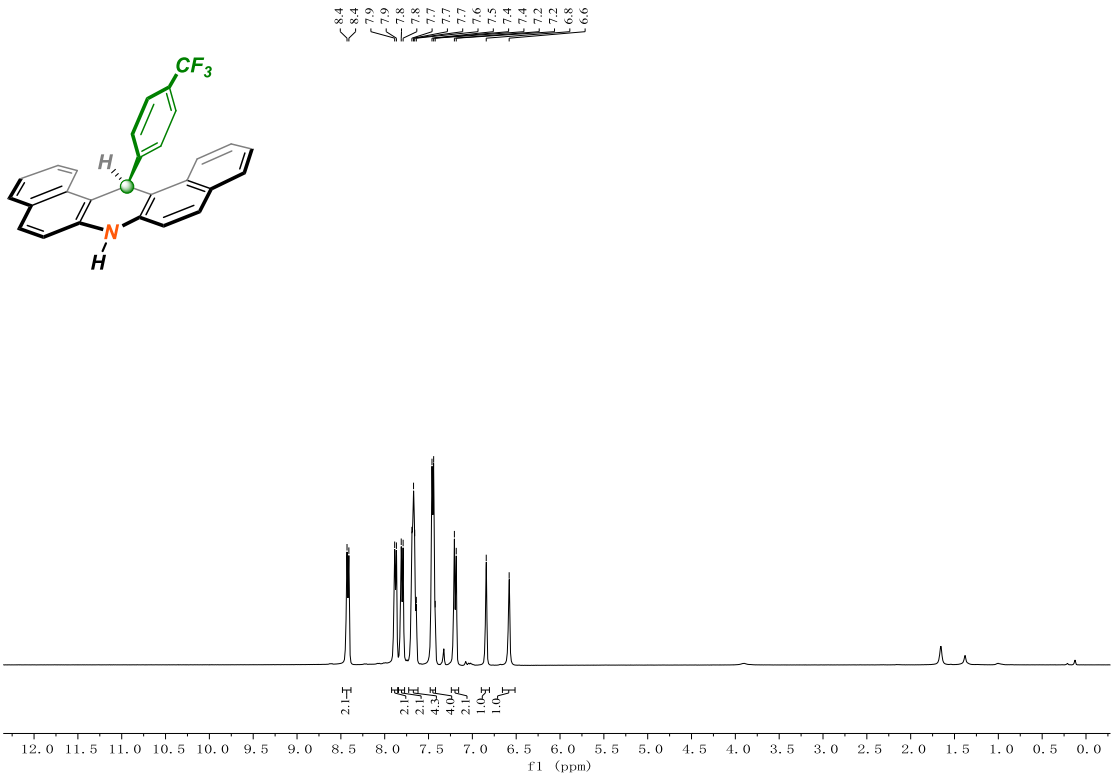
^{13}C NMR of **2h** (100 MHz, $CDCl_3$)



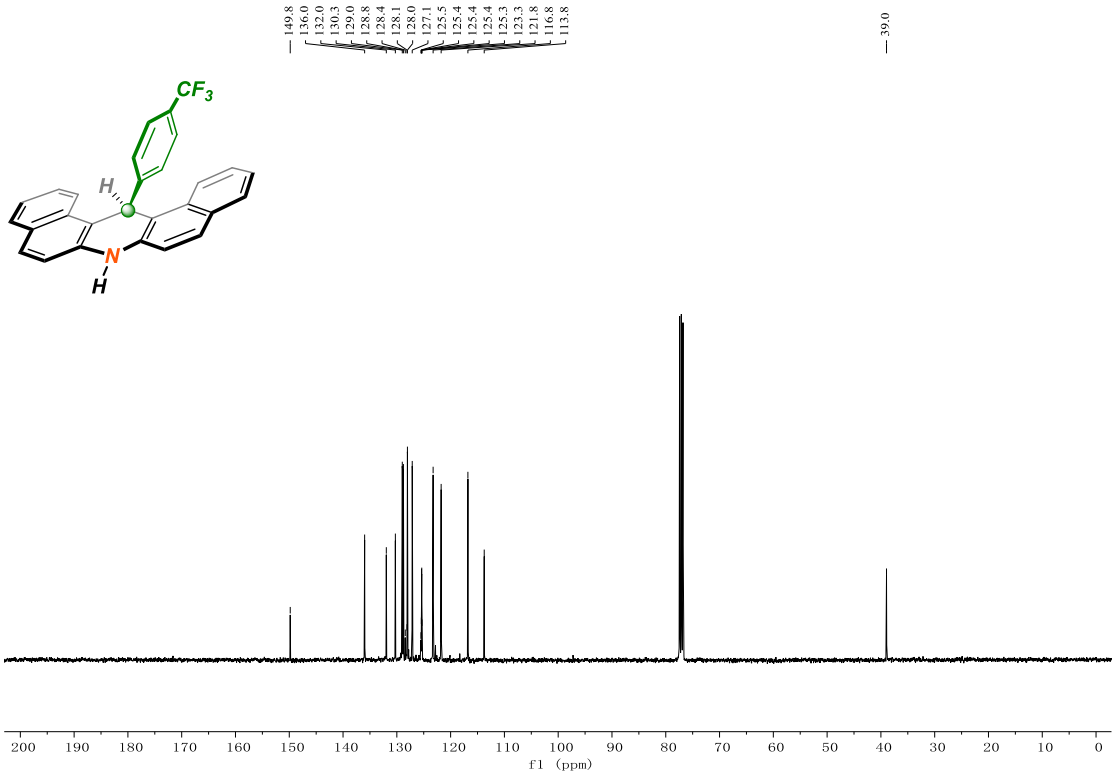
^{19}F NMR of **2h** (376 MHz, $CDCl_3$)



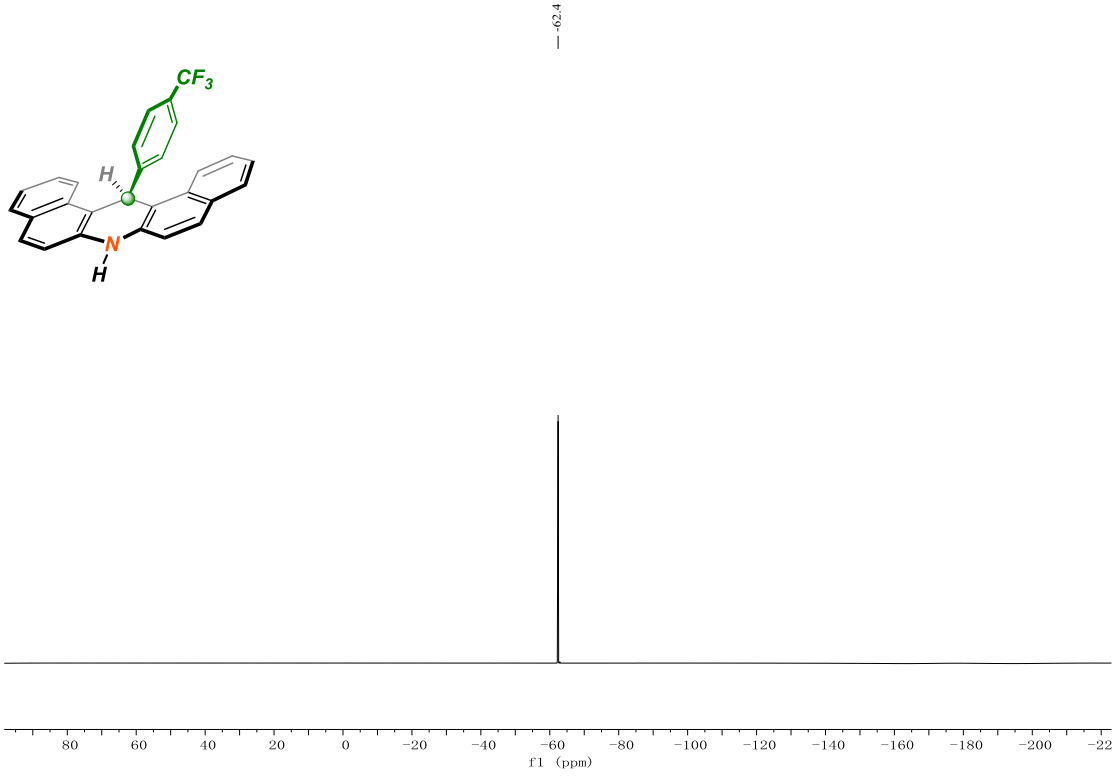
^{1}H NMR of **2i** (400 MHz, $CDCl_3$)



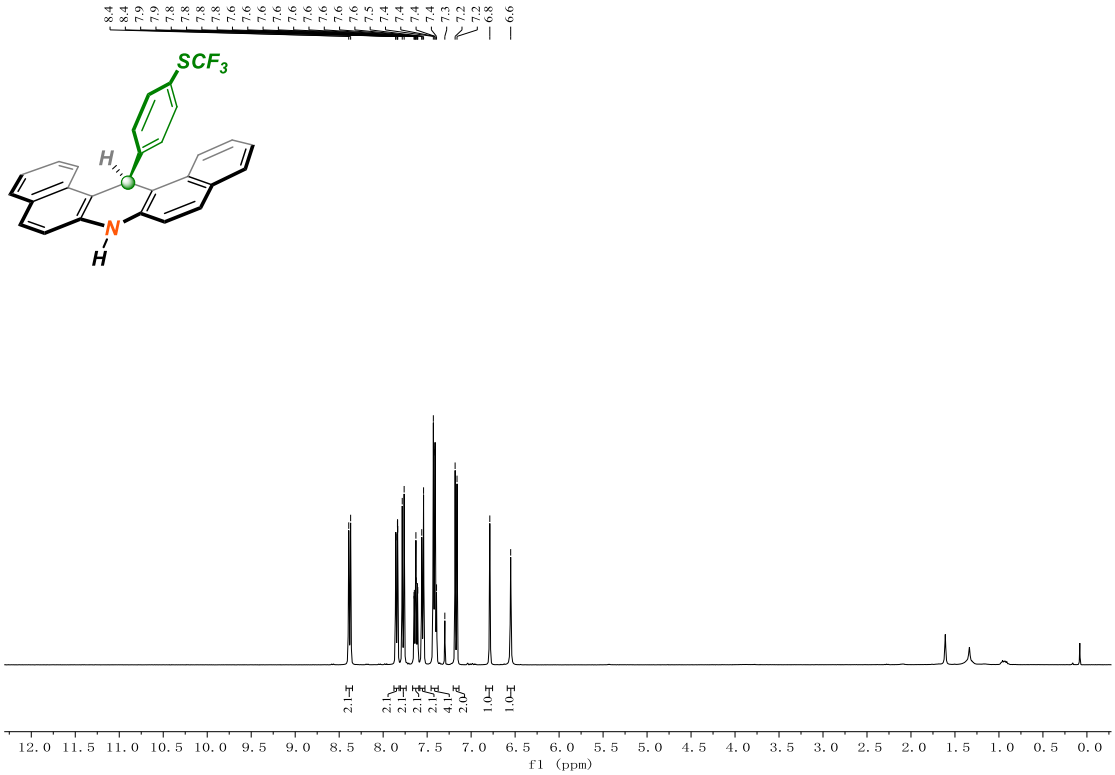
^{13}C NMR of **2i** (100 MHz, $CDCl_3$)



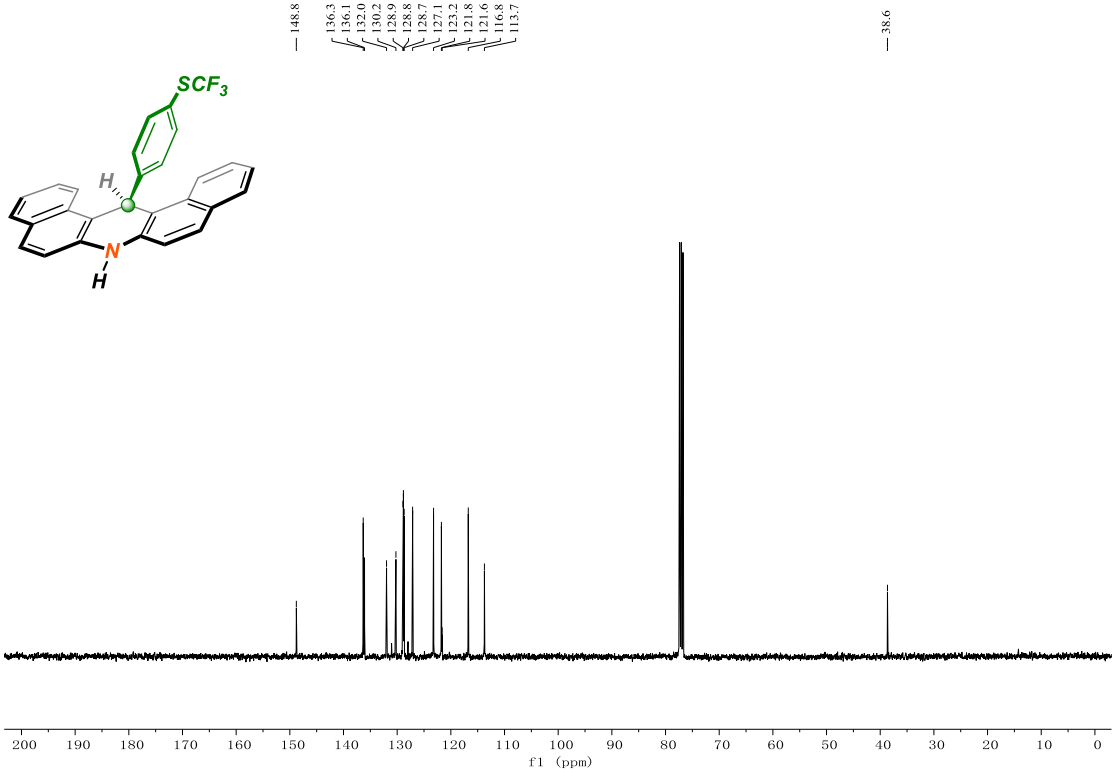
^{19}F NMR of **2i** (376 MHz, $CDCl_3$)



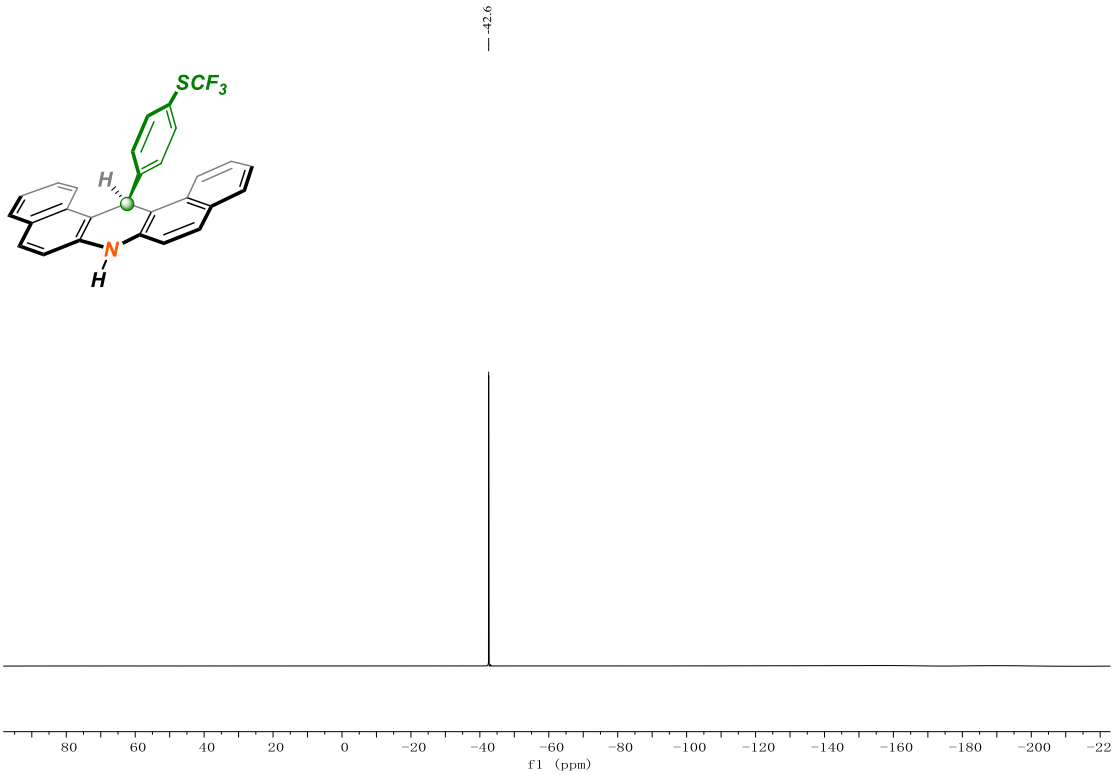
^{1}H NMR of **2j** (400 MHz, $CDCl_3$)



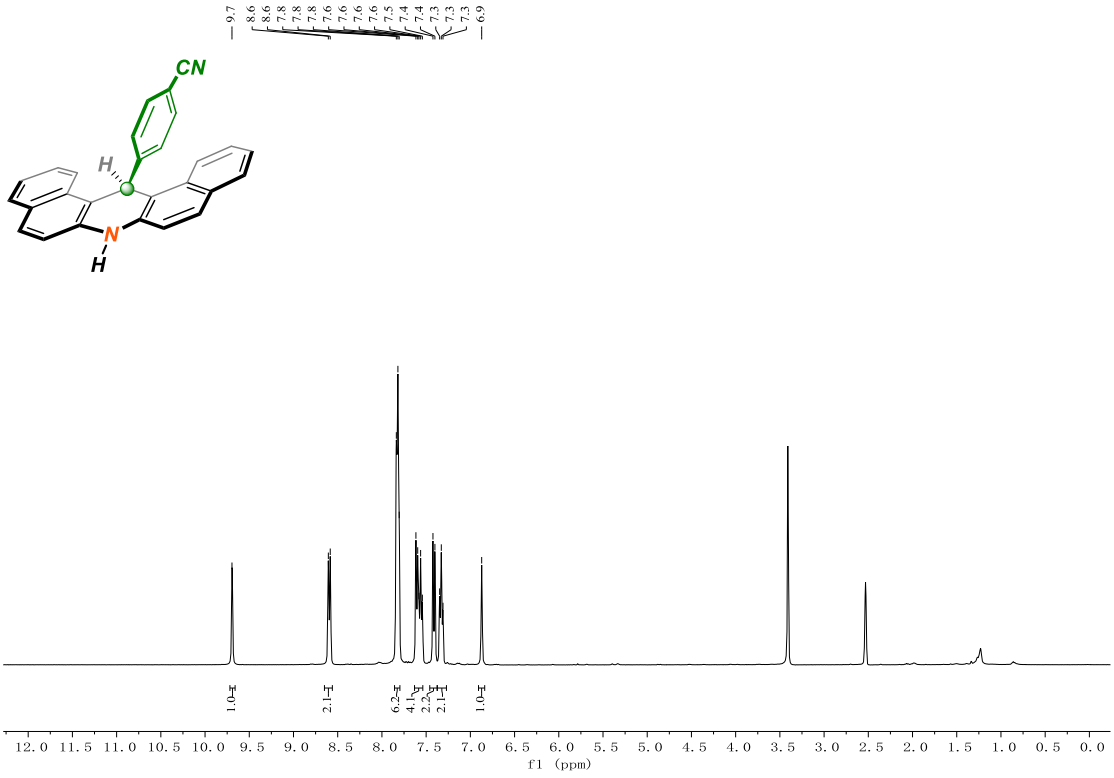
^{13}C NMR of **2j** (100 MHz, $CDCl_3$)



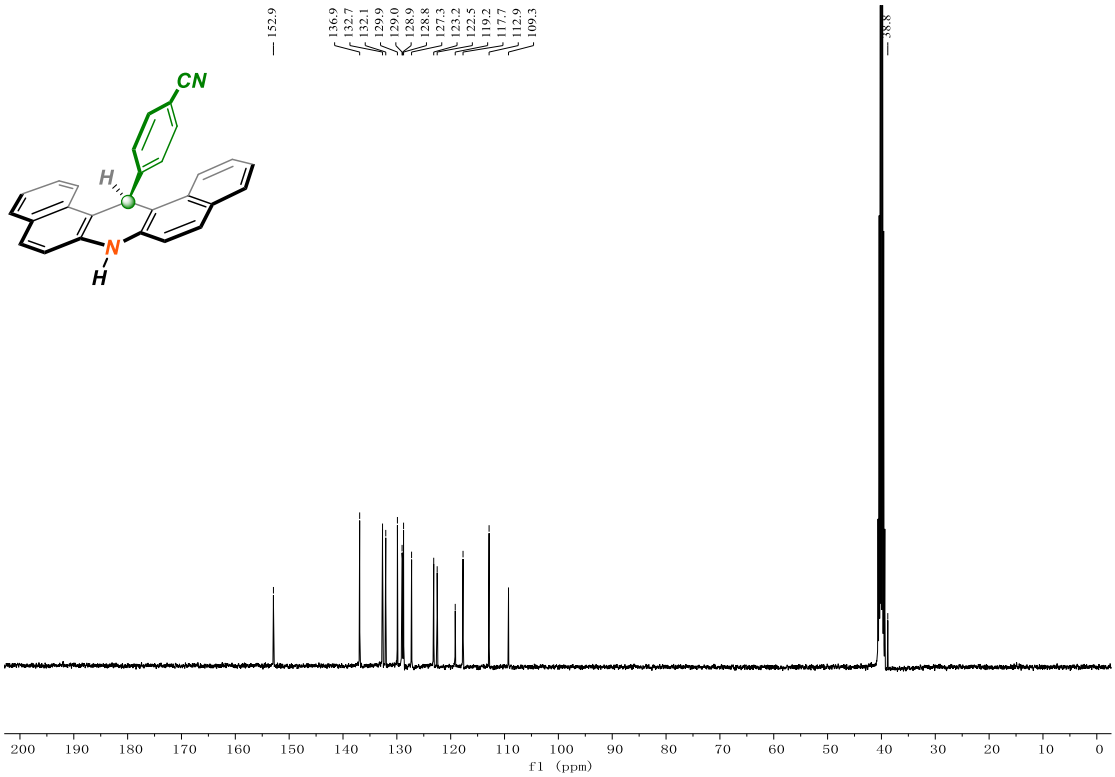
^{19}F NMR of **2j** (376 MHz, $CDCl_3$)



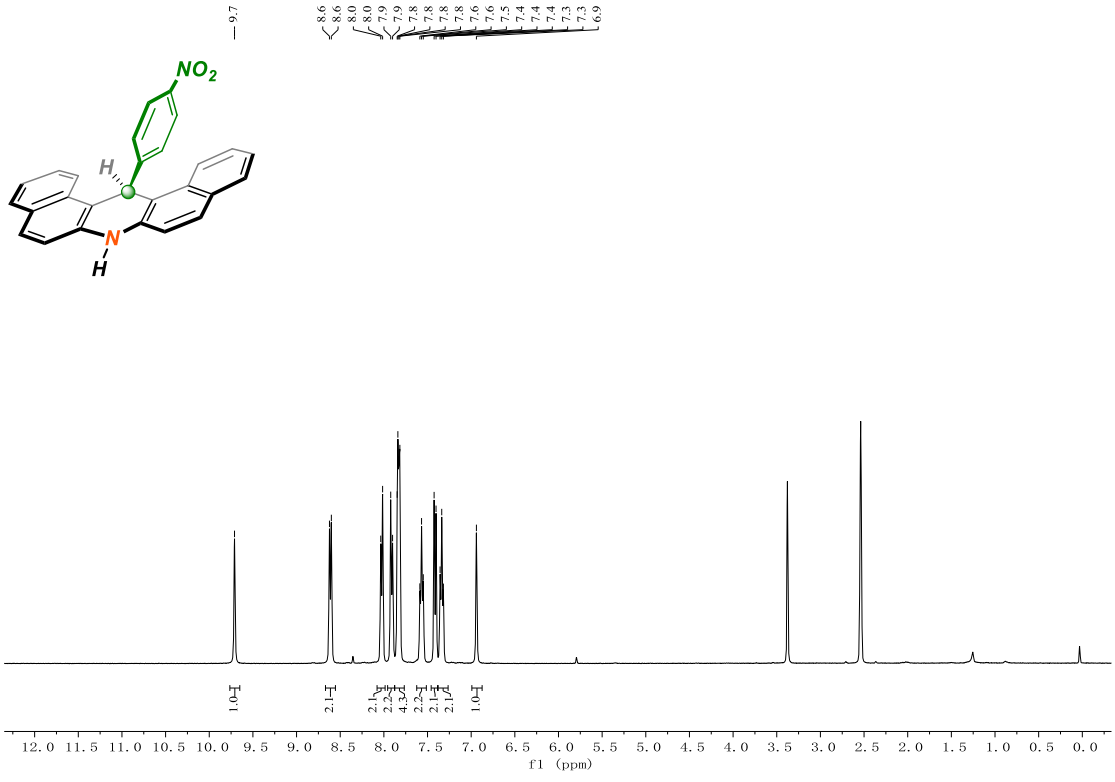
^{1}H NMR of **2k** (400 MHz, d_6-DMSO)



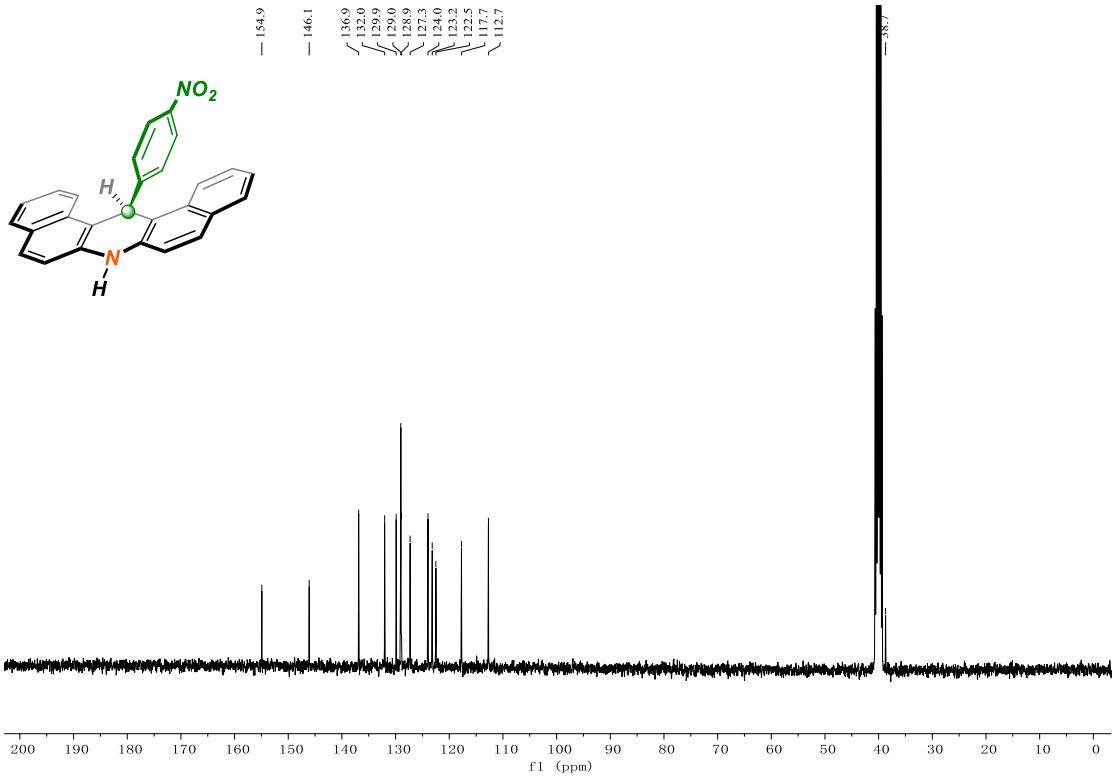
^{13}C NMR of **2k** (100 MHz, d_6-DMSO)



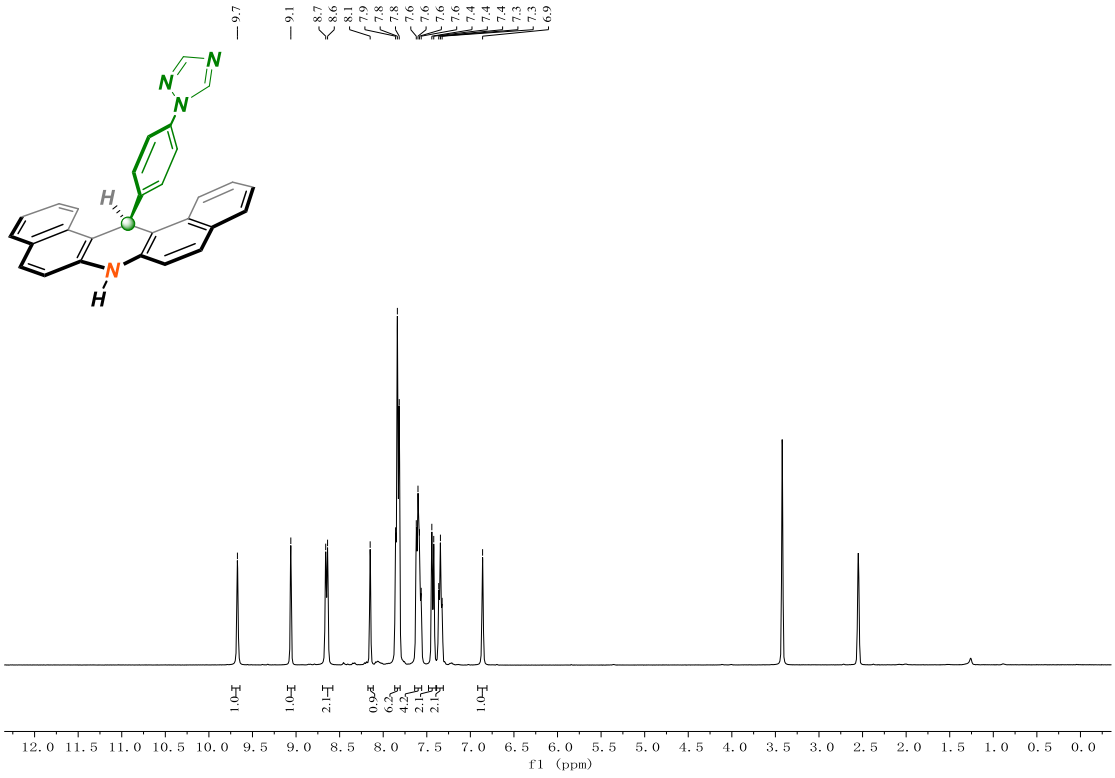
^{1}H NMR of **2l** (400 MHz, d_6-DMSO)



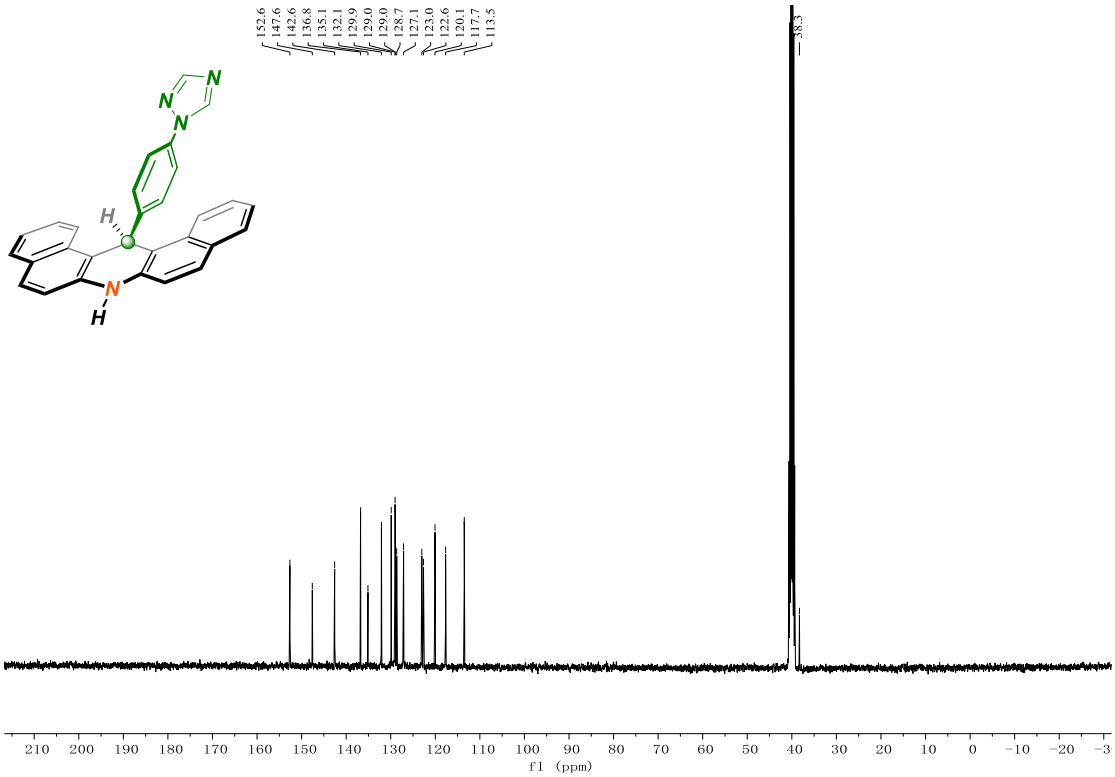
^{13}C NMR of **2l** (100 MHz, d_6-DMSO)



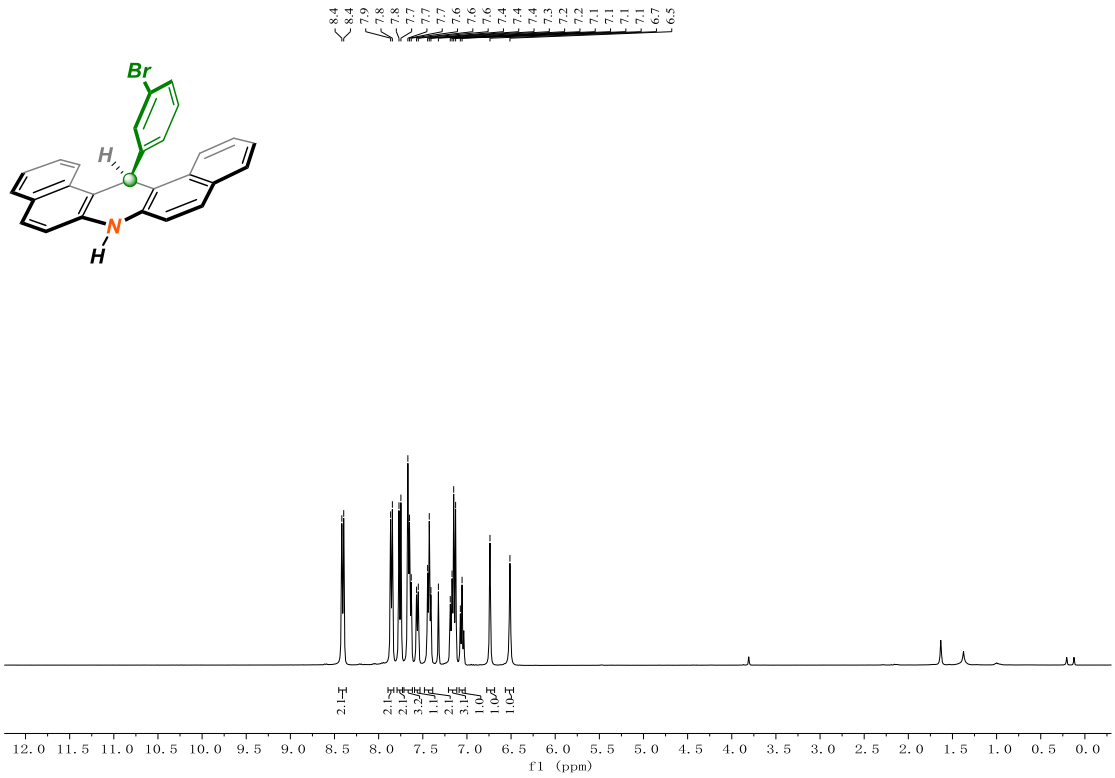
^{1}H NMR of **2m** (400 MHz, d_6-DMSO)



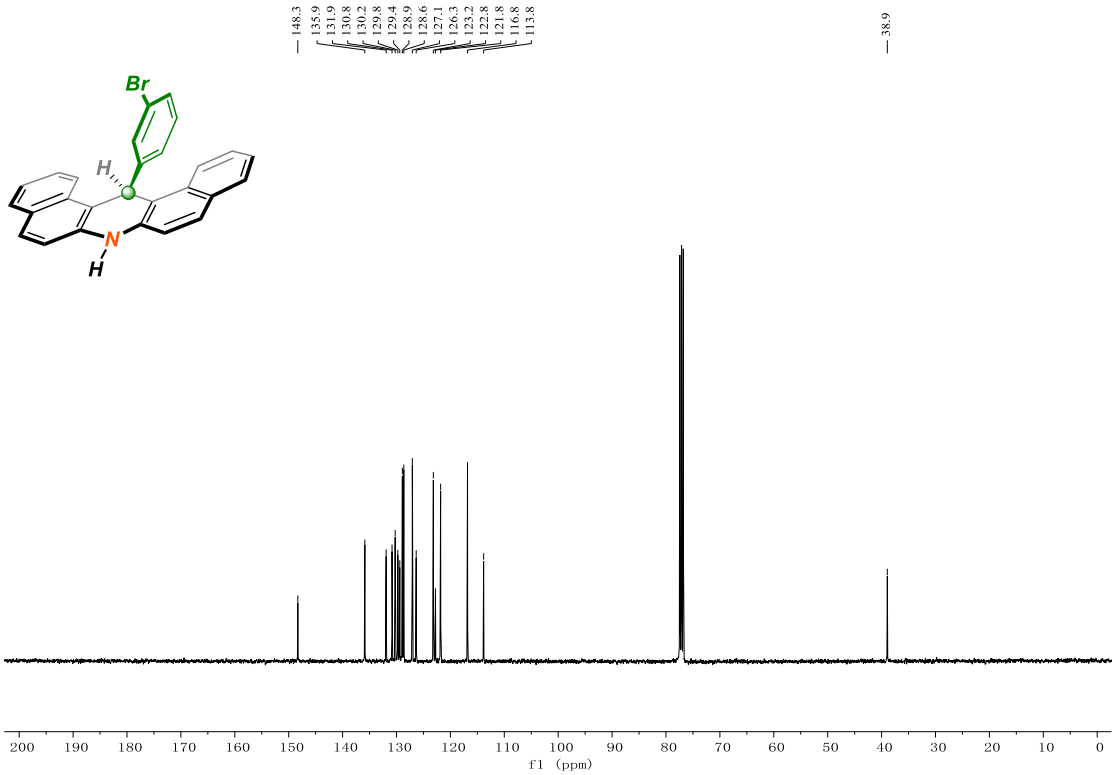
^{13}C NMR of **2m** (100 MHz, d_6-DMSO)



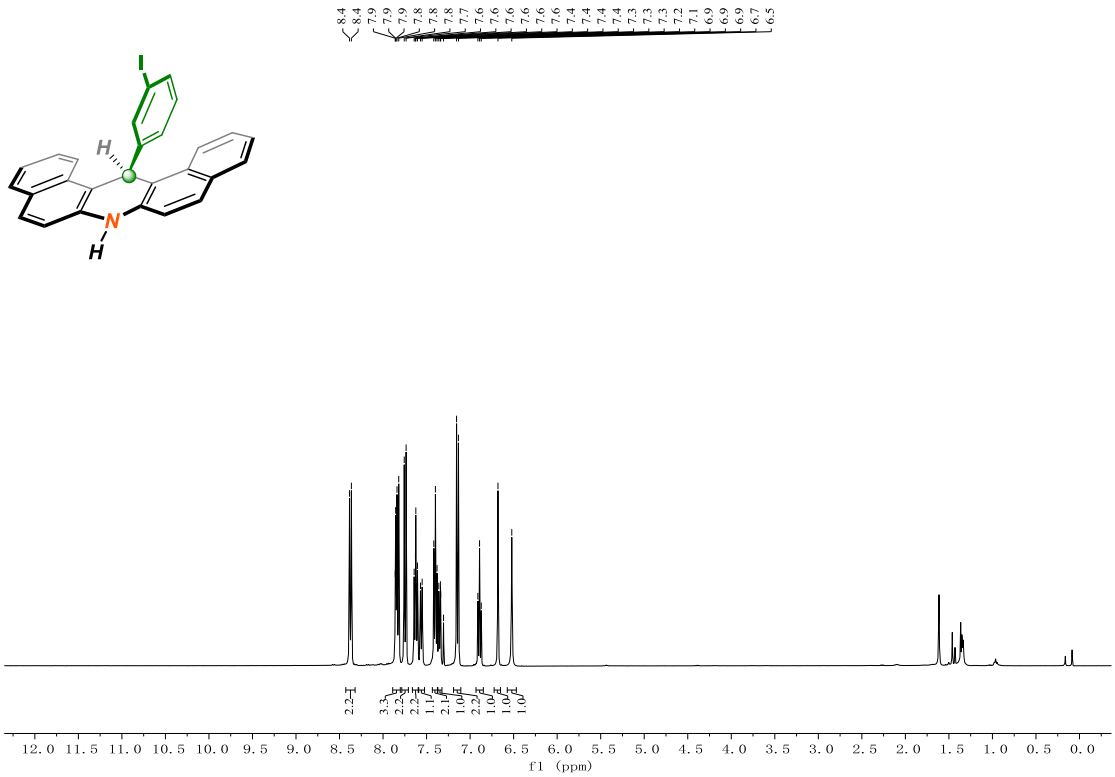
^{1}H NMR of **2n** (400 MHz, $CDCl_3$)



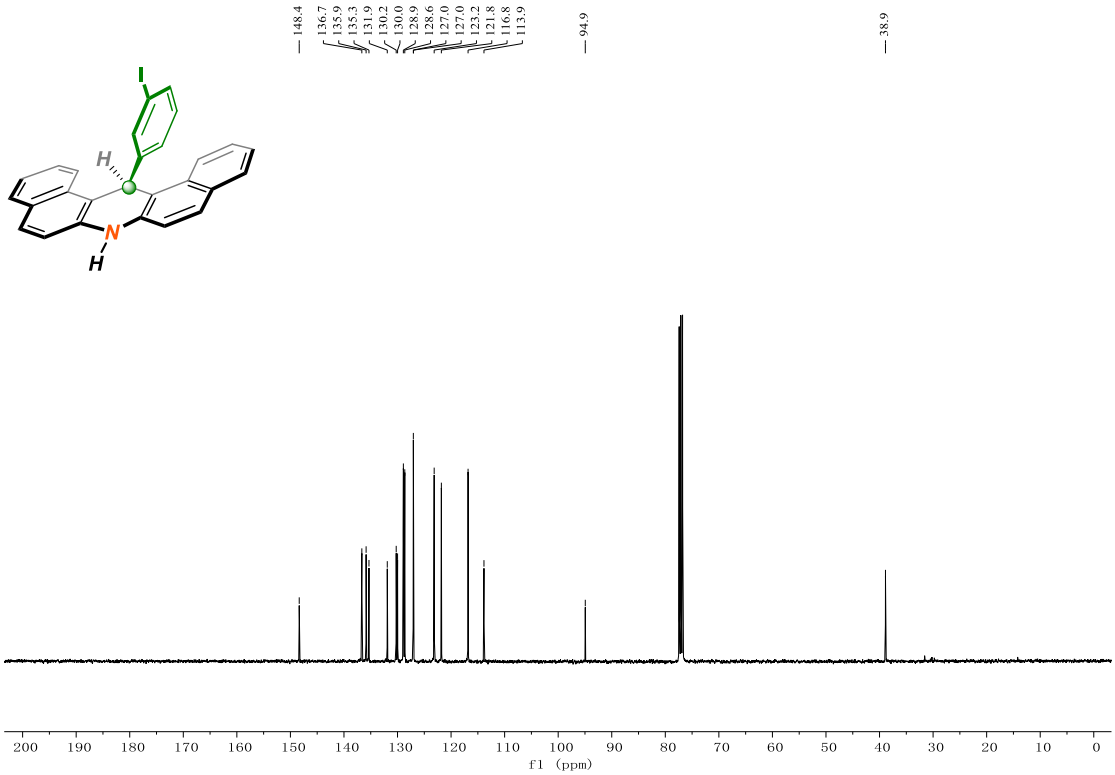
^{13}C NMR of **2n** (100 MHz, $CDCl_3$)



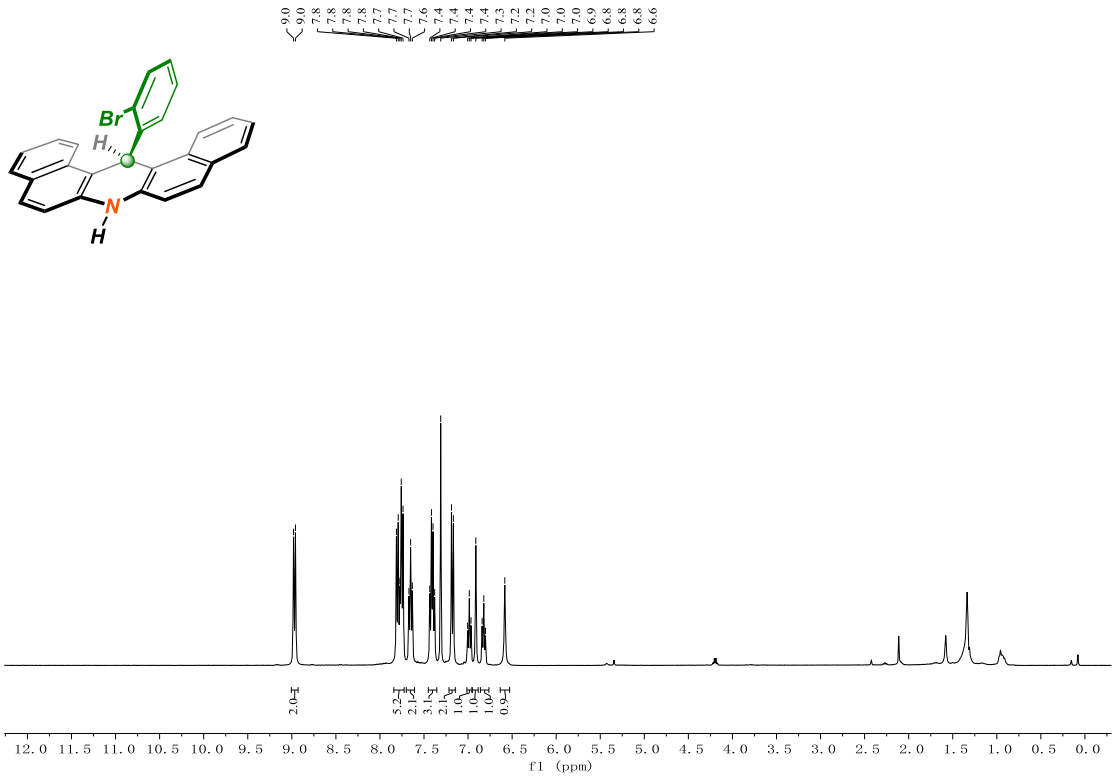
^{1}H NMR of **2o** (400 MHz, $CDCl_3$)



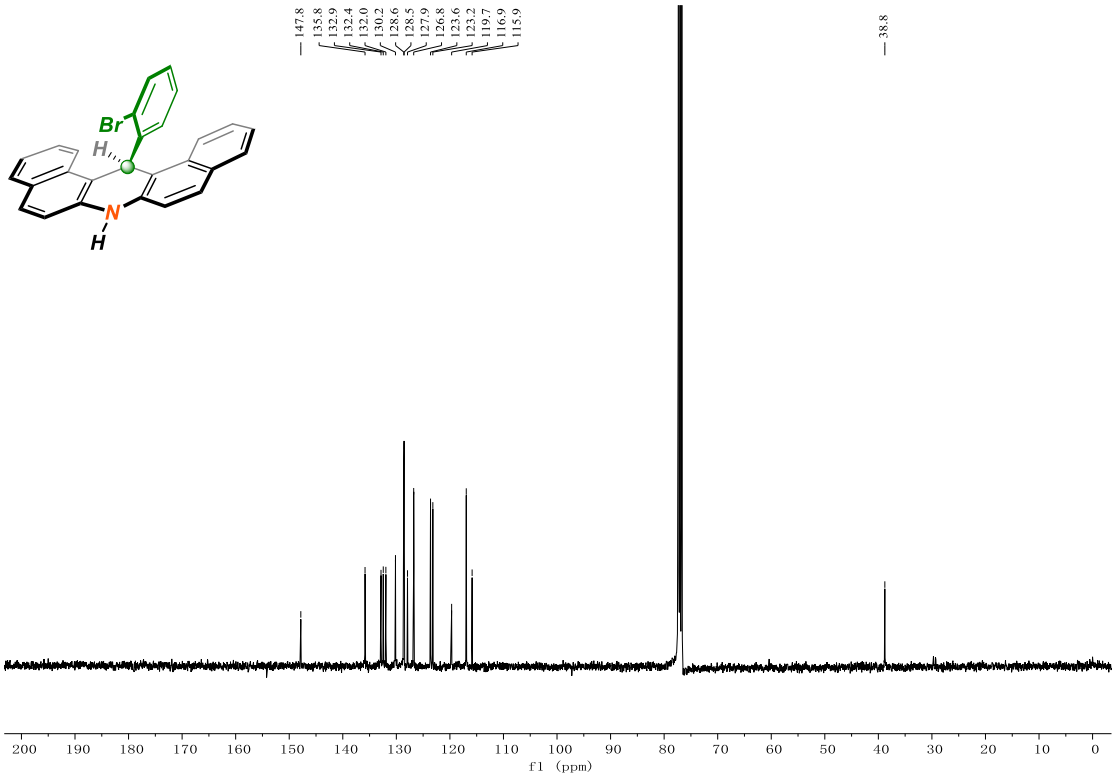
^{13}C NMR of **2o** (100 MHz, $CDCl_3$)



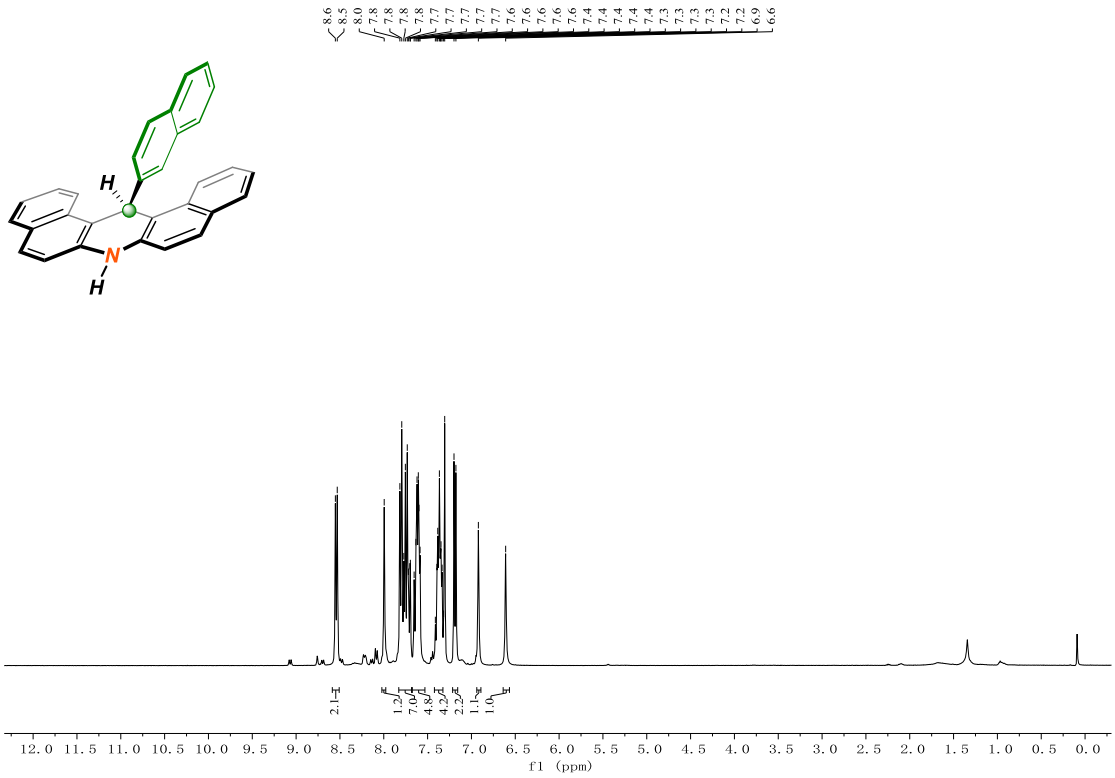
^{1}H NMR of **2p** (400 MHz, $CDCl_3$)



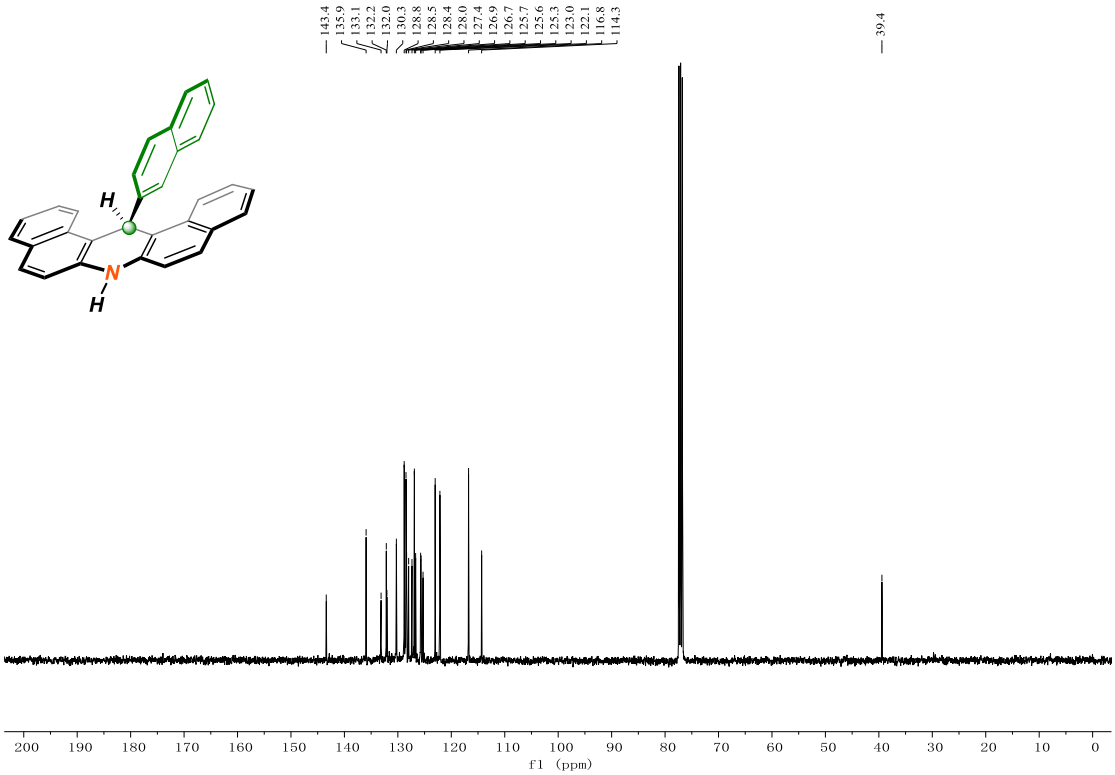
^{13}C NMR of **2p** (100 MHz, $CDCl_3$)



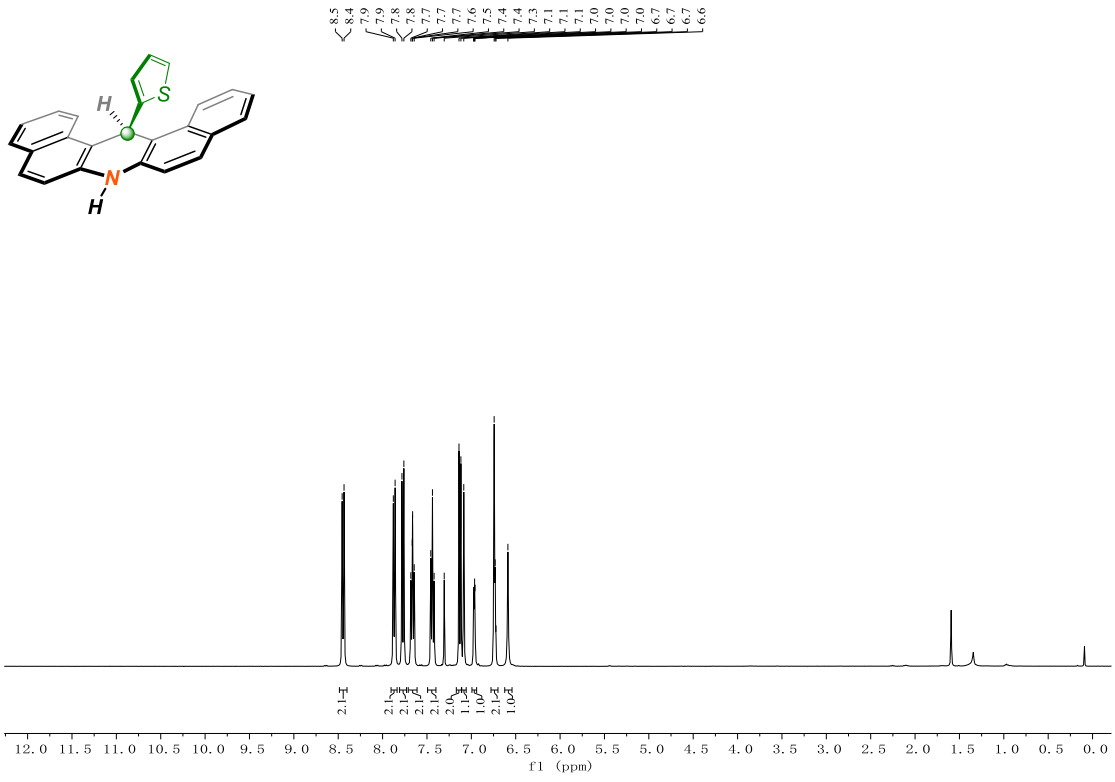
^{1}H NMR of **2q** (400 MHz, $CDCl_3$)



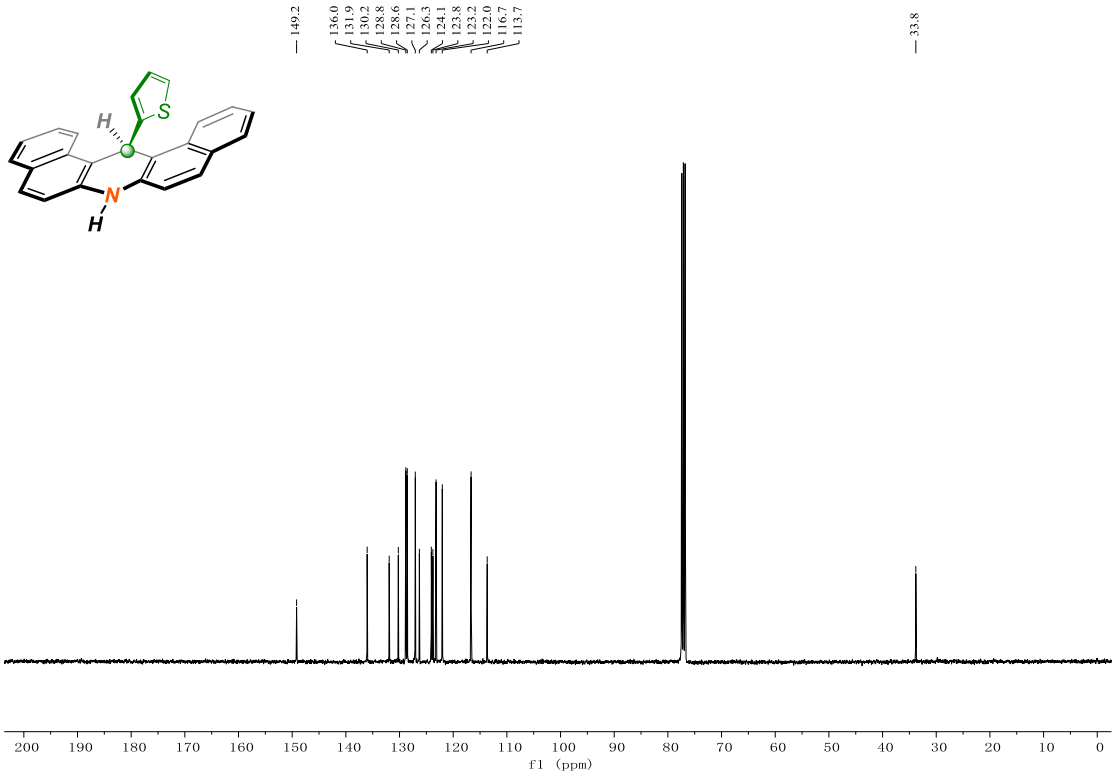
^{13}C NMR of **2q** (100 MHz, $CDCl_3$)



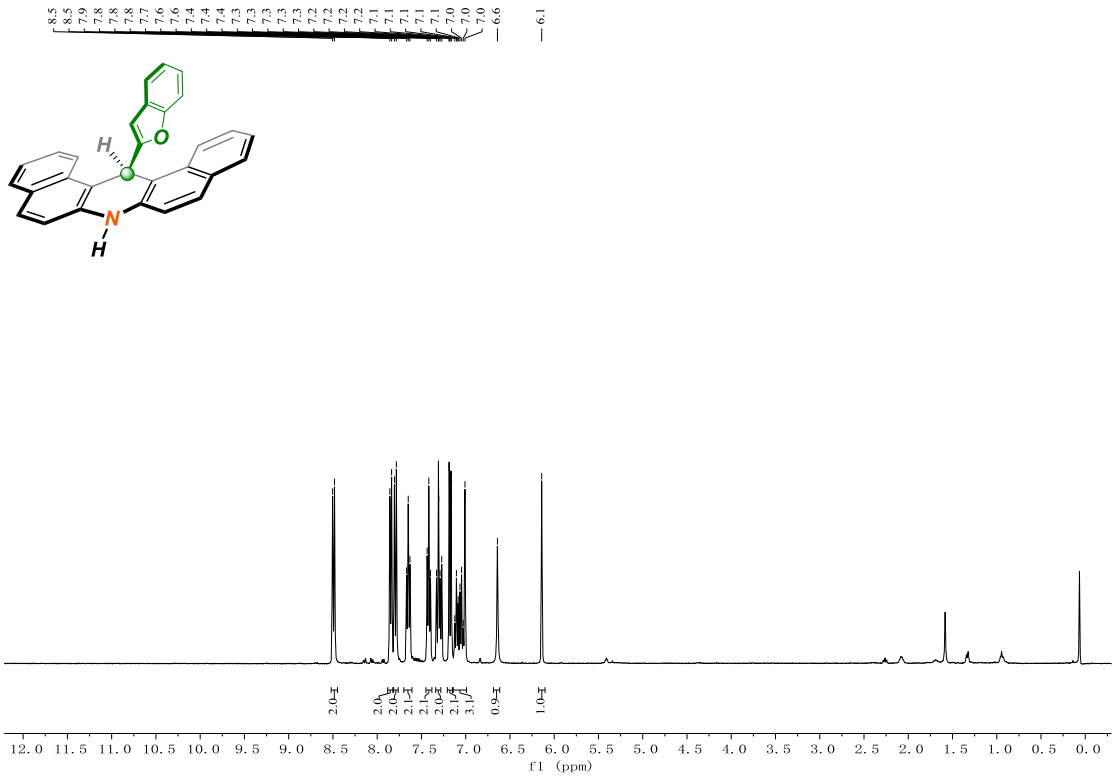
^{1}H NMR of **2r** (400 MHz, $CDCl_3$)



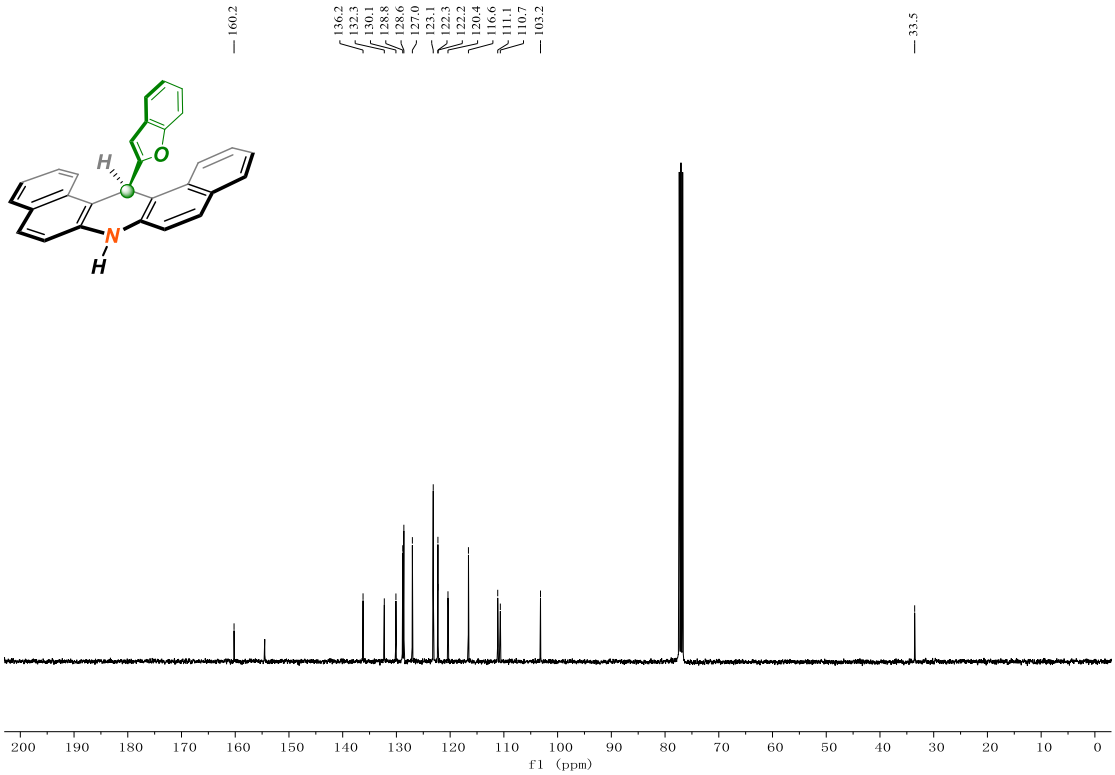
^{13}C NMR of **2r** (100 MHz, $CDCl_3$)



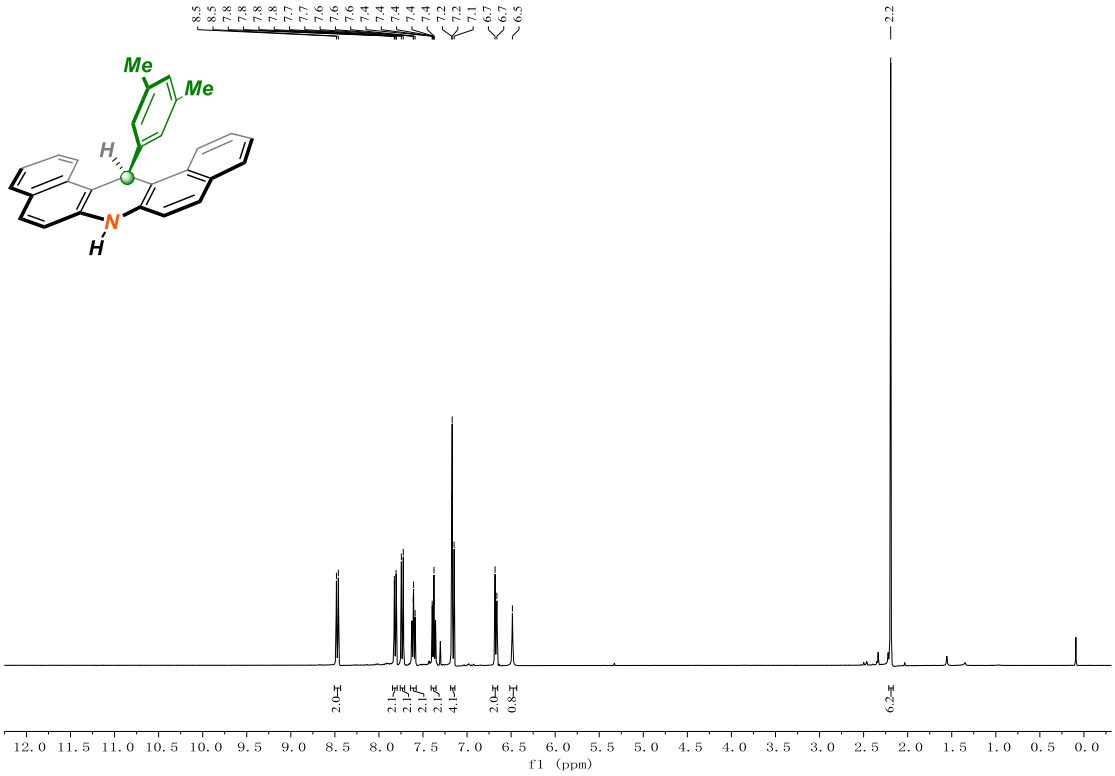
^{1}H NMR of **2s** (400 MHz, $CDCl_3$)



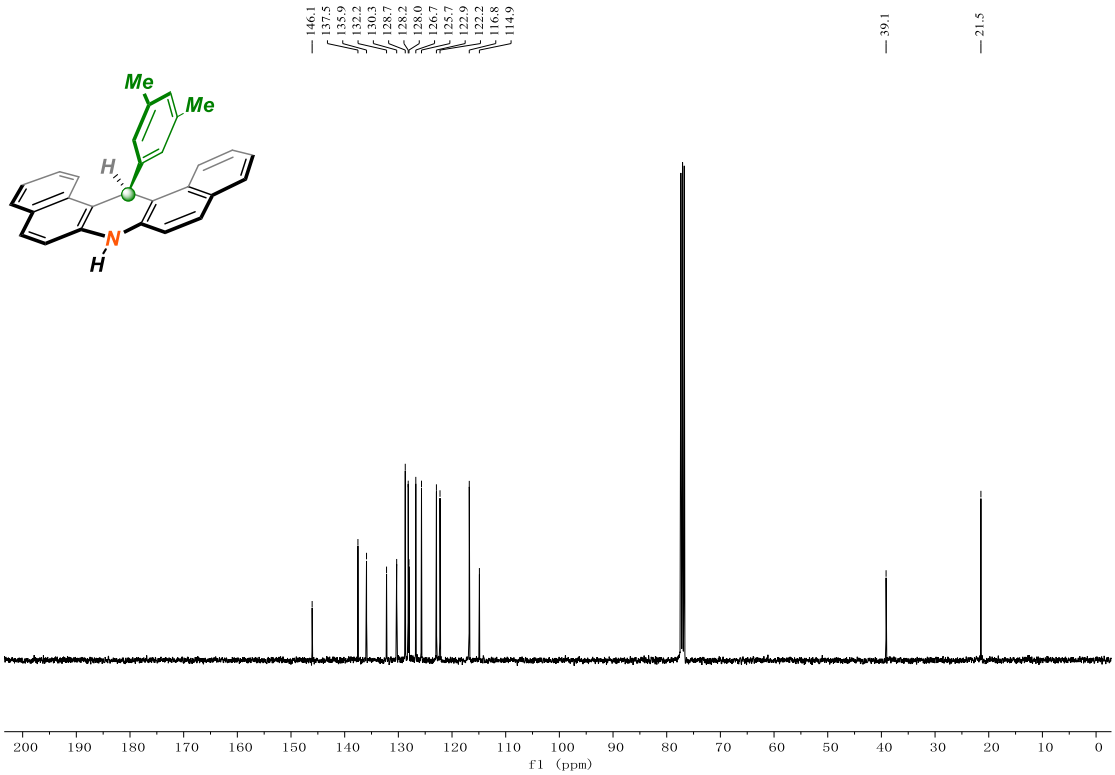
^{13}C NMR of **2s** (100 MHz, $CDCl_3$)



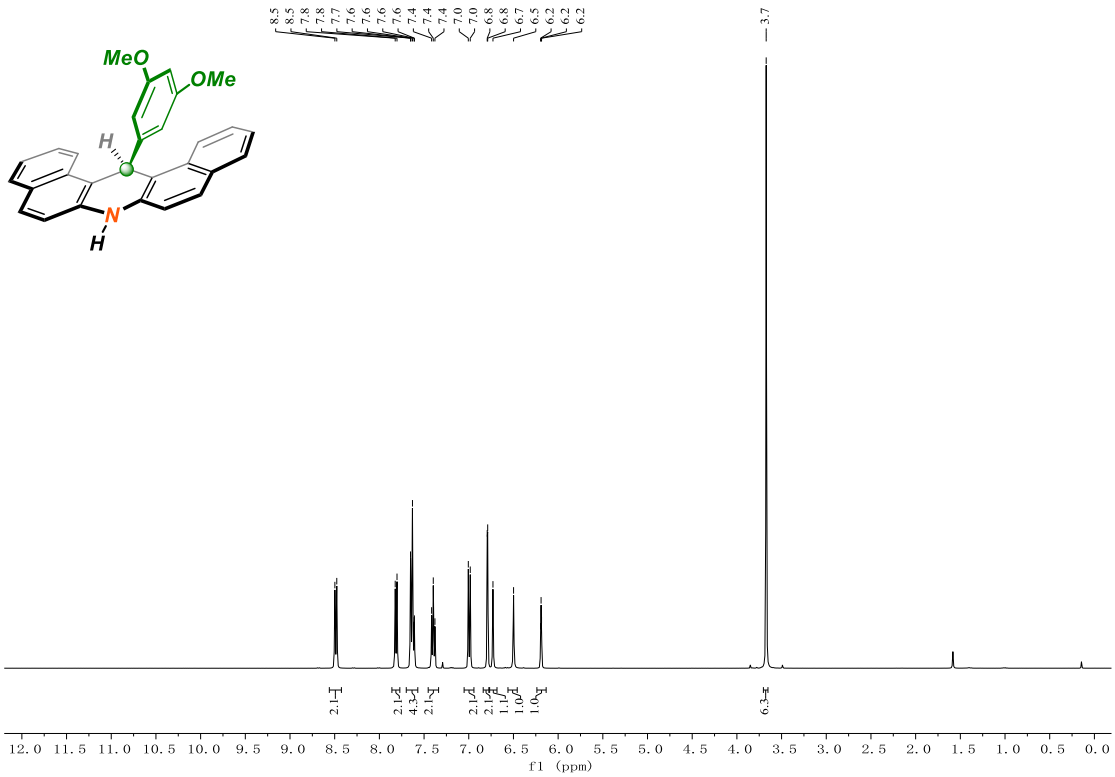
^{1}H NMR of **2t** (400 MHz, $CDCl_3$)



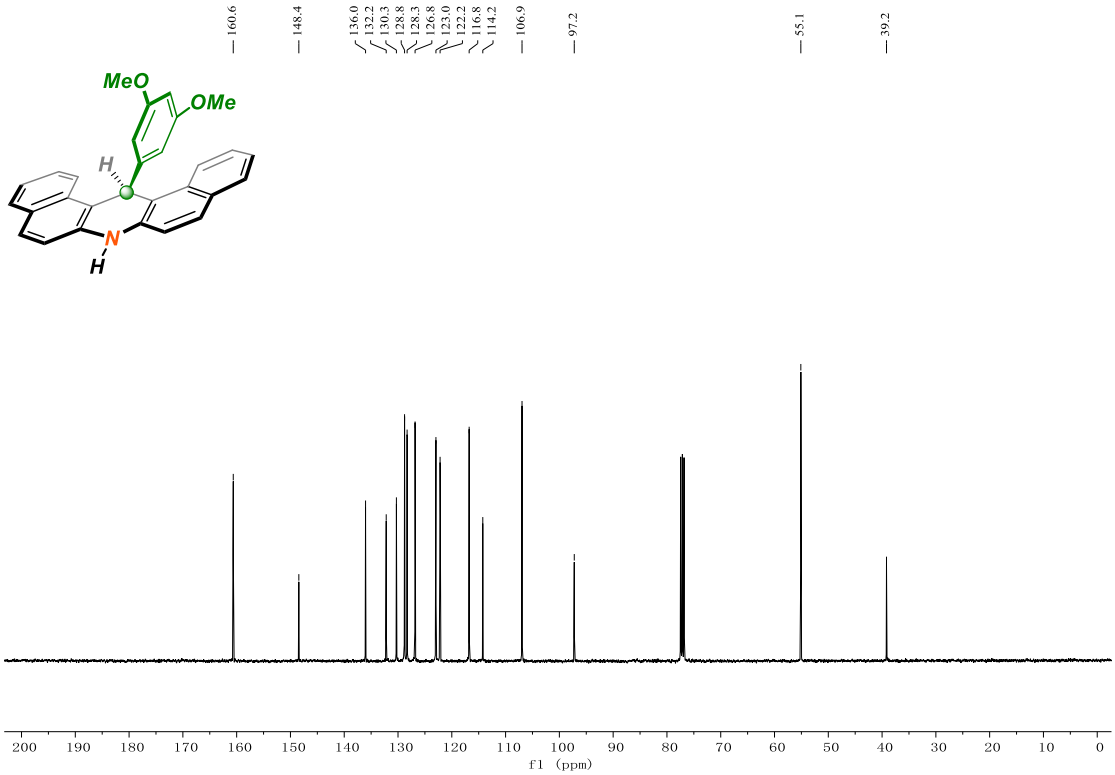
^{13}C NMR of **2t** (100 MHz, $CDCl_3$)



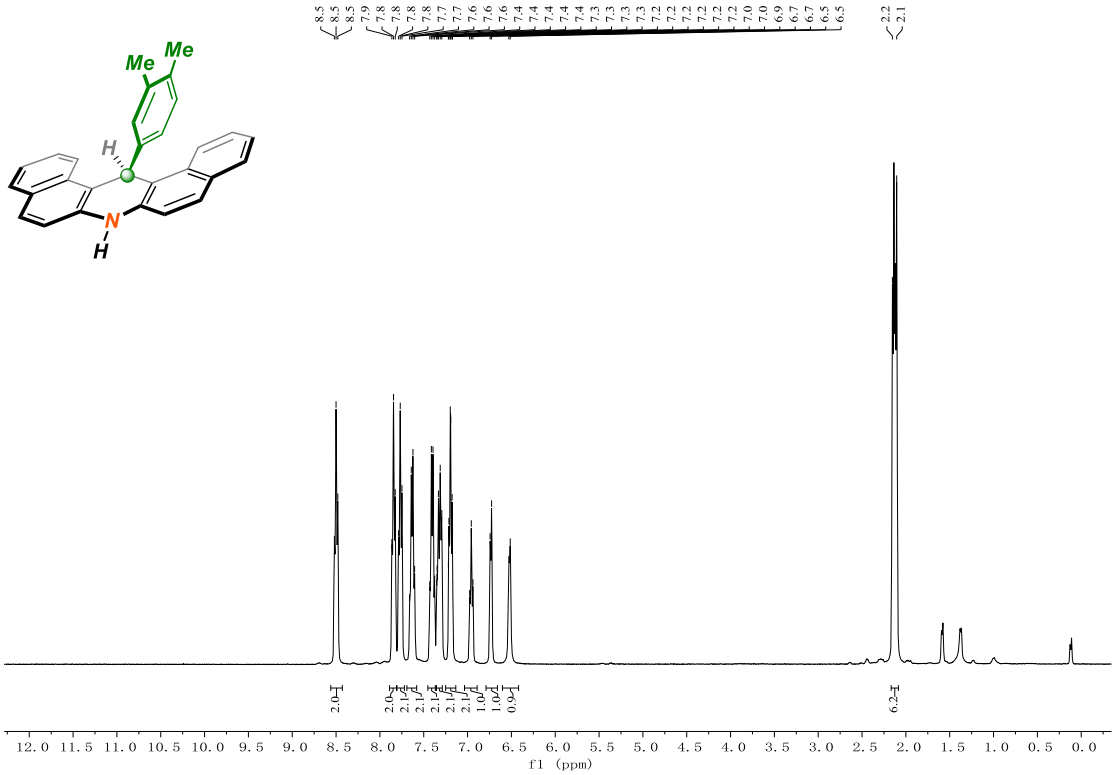
^{1}H NMR of **2u** (400 MHz, $CDCl_3$)



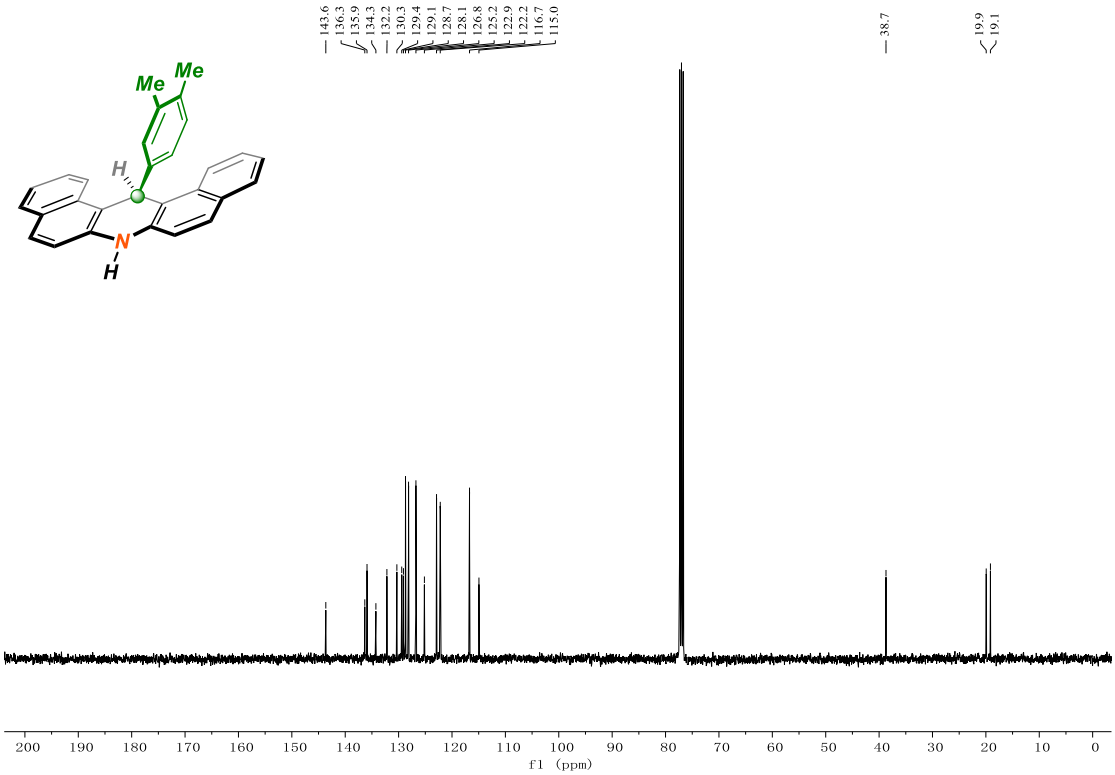
^{13}C NMR of **2u** (100 MHz, $CDCl_3$)



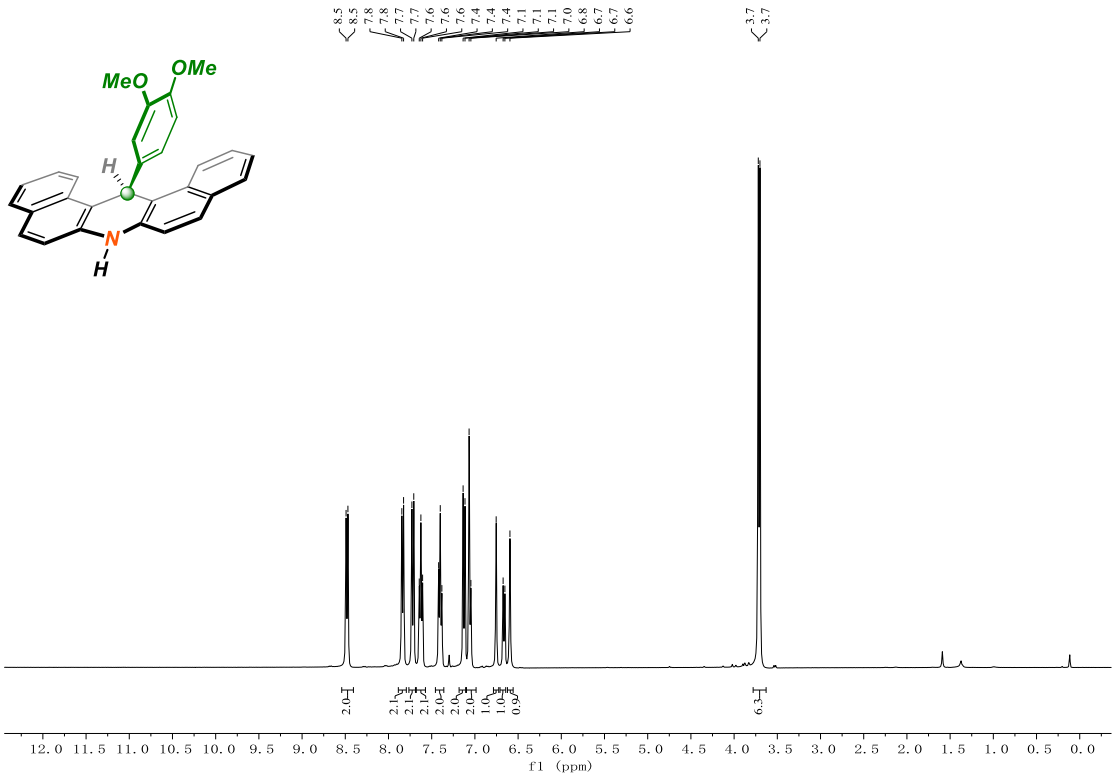
^{1}H NMR of **2v** (400 MHz, $CDCl_3$)



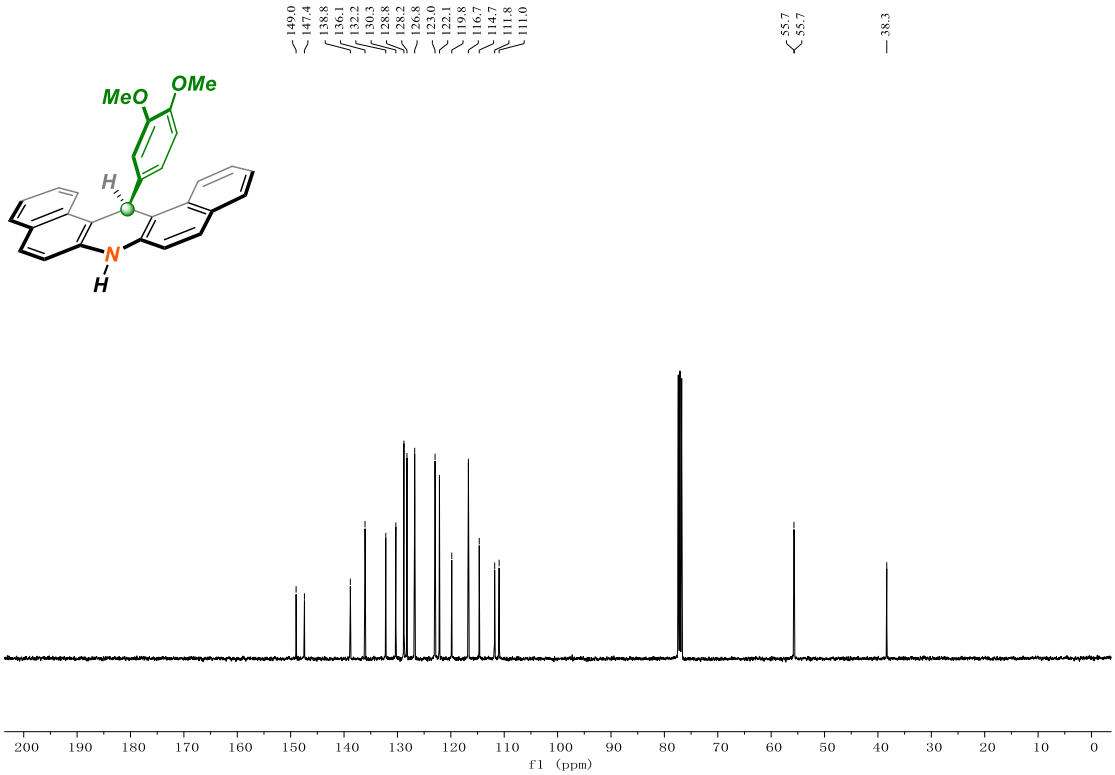
^{13}C NMR of **2v** (100 MHz, $CDCl_3$)



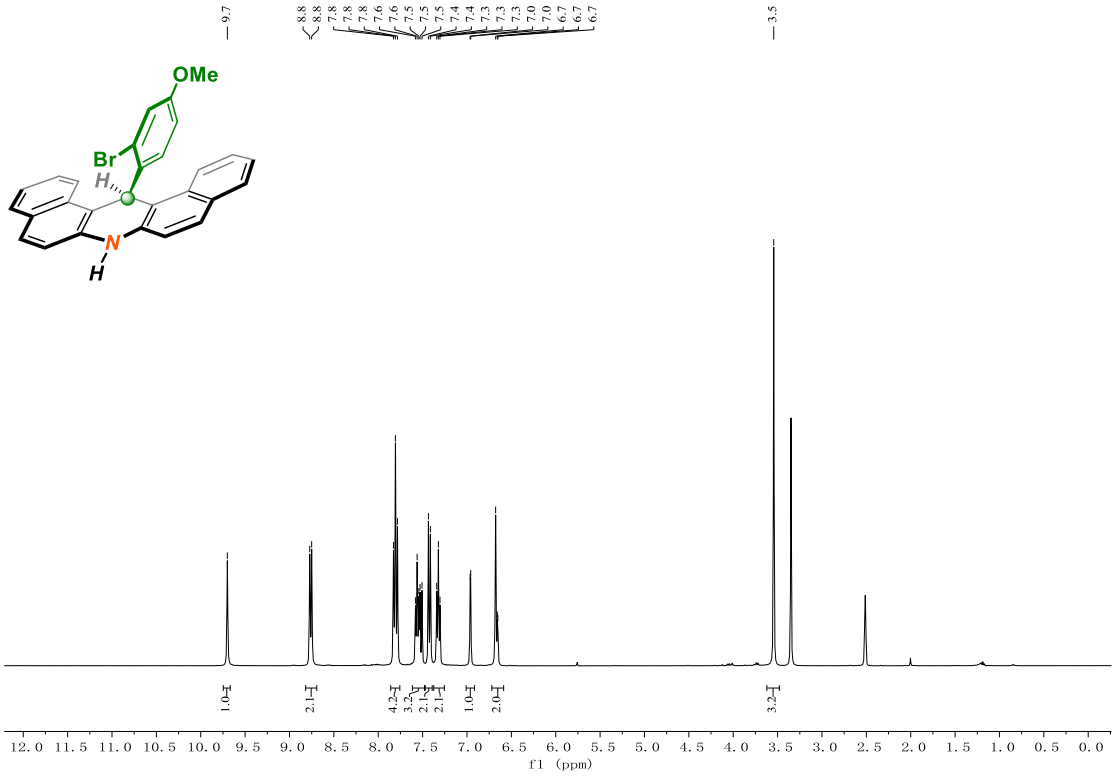
^{1}H NMR of **2w** (400 MHz, $CDCl_3$)



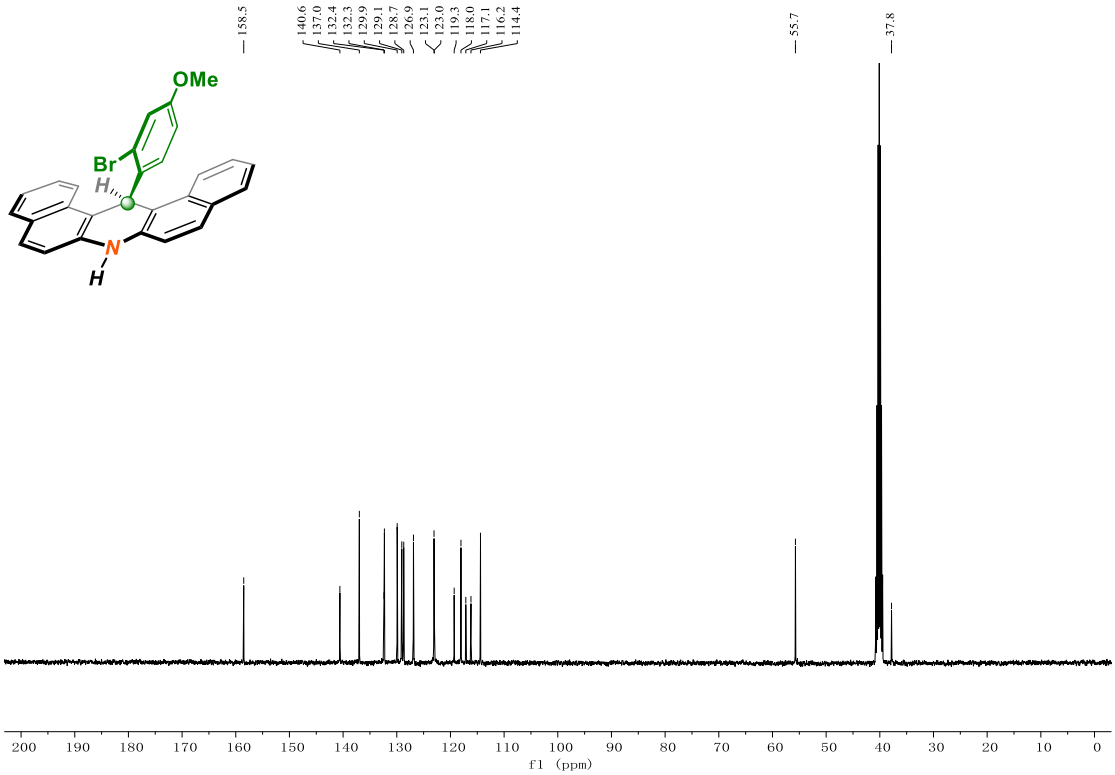
^{13}C NMR of **2w** (100 MHz, $CDCl_3$)



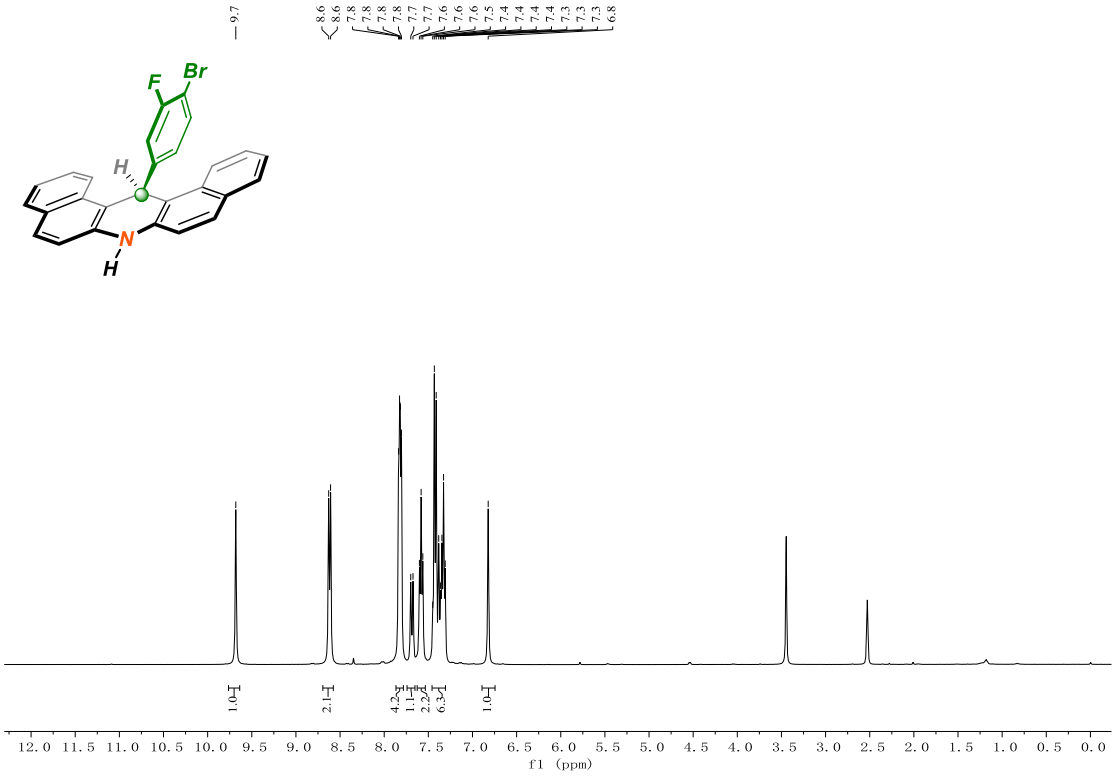
^{1}H NMR of **2x** (400 MHz, d_6-DMSO)



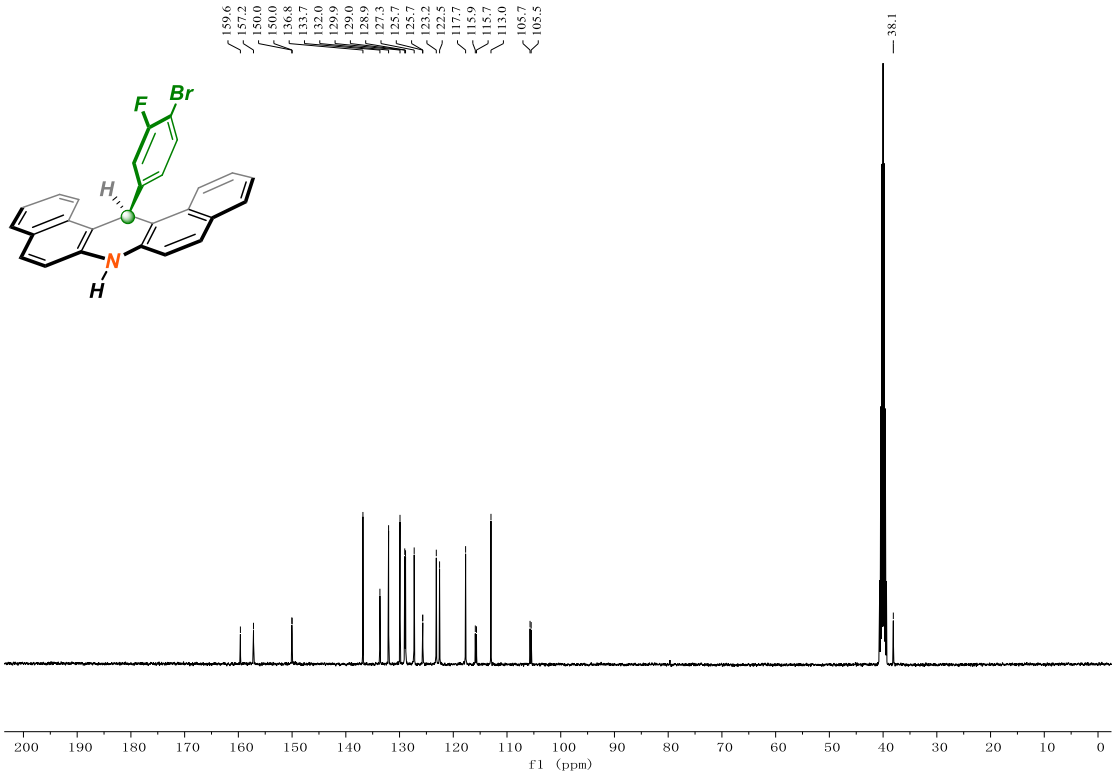
^{13}C NMR of **2x** (100 MHz, d_6-DMSO)



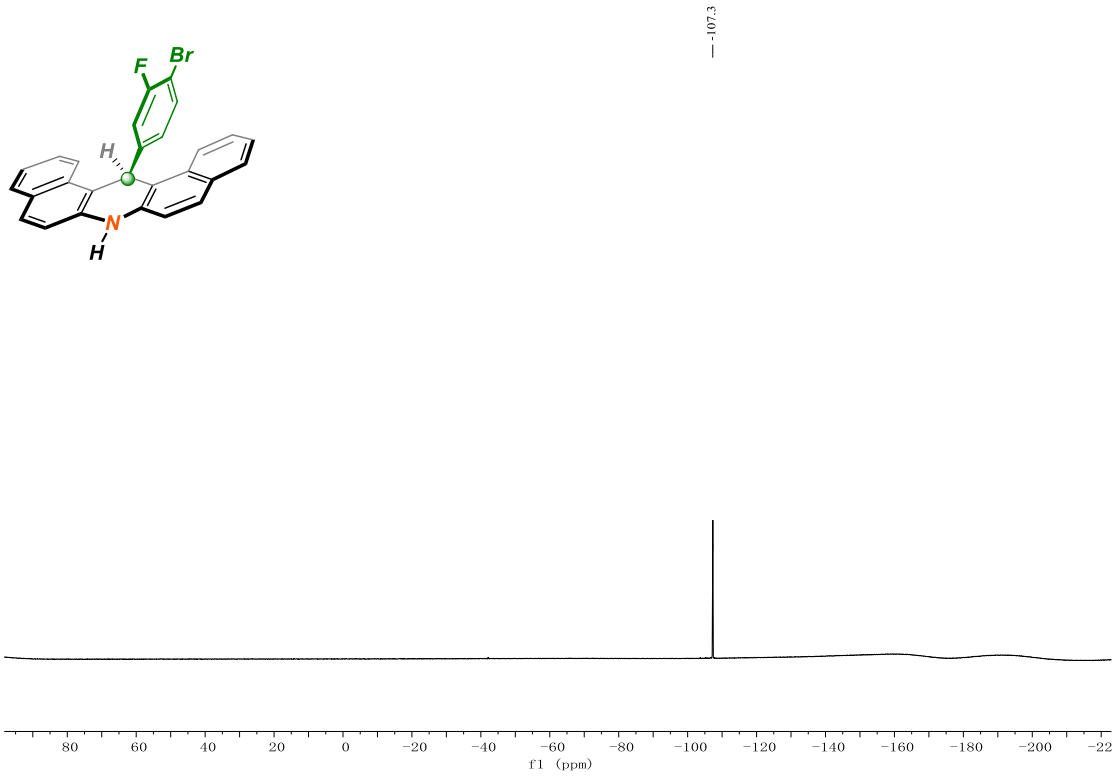
^{1}H NMR of **2y** (400 MHz, d_6-DMSO)



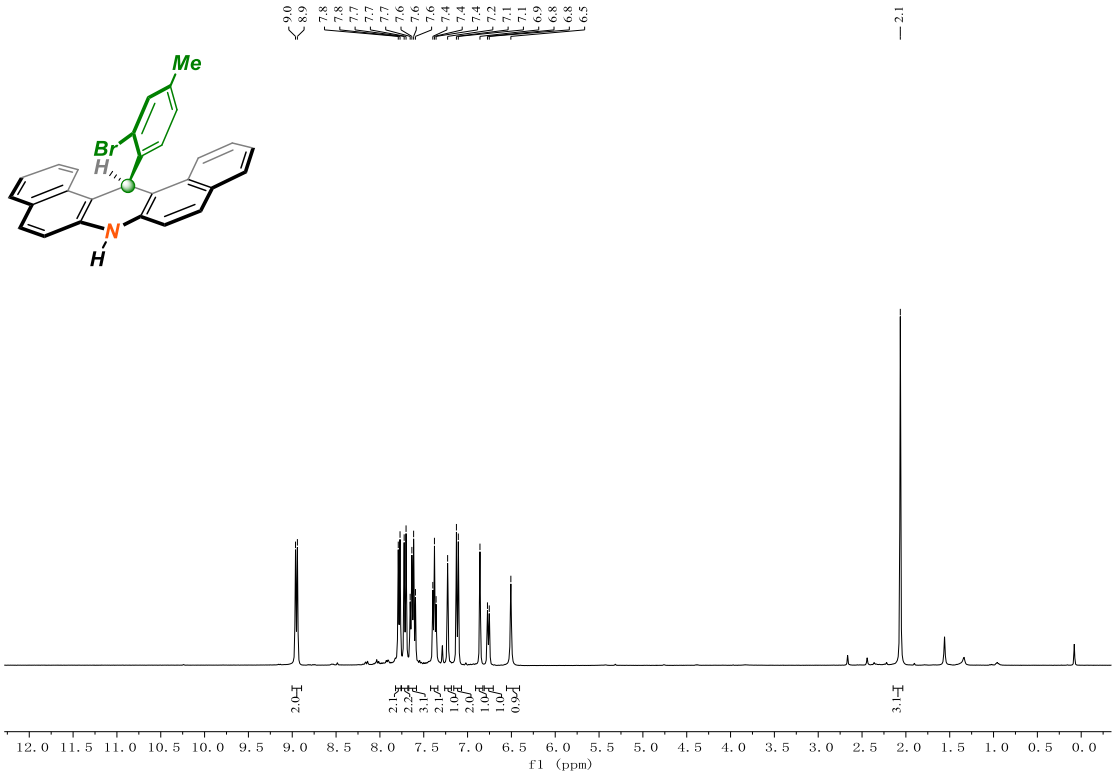
^{13}C NMR of **2y** (100 MHz, d_6-DMSO)



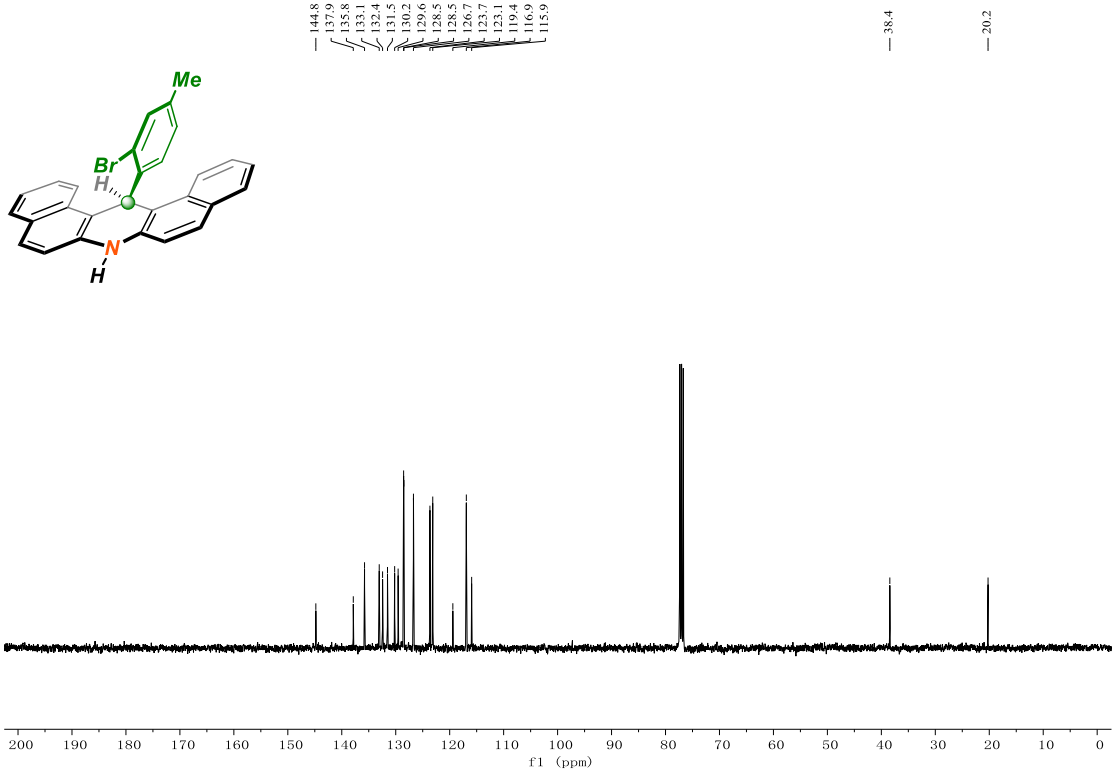
^{19}F NMR of **2y** (376 MHz, d_6-DMSO)



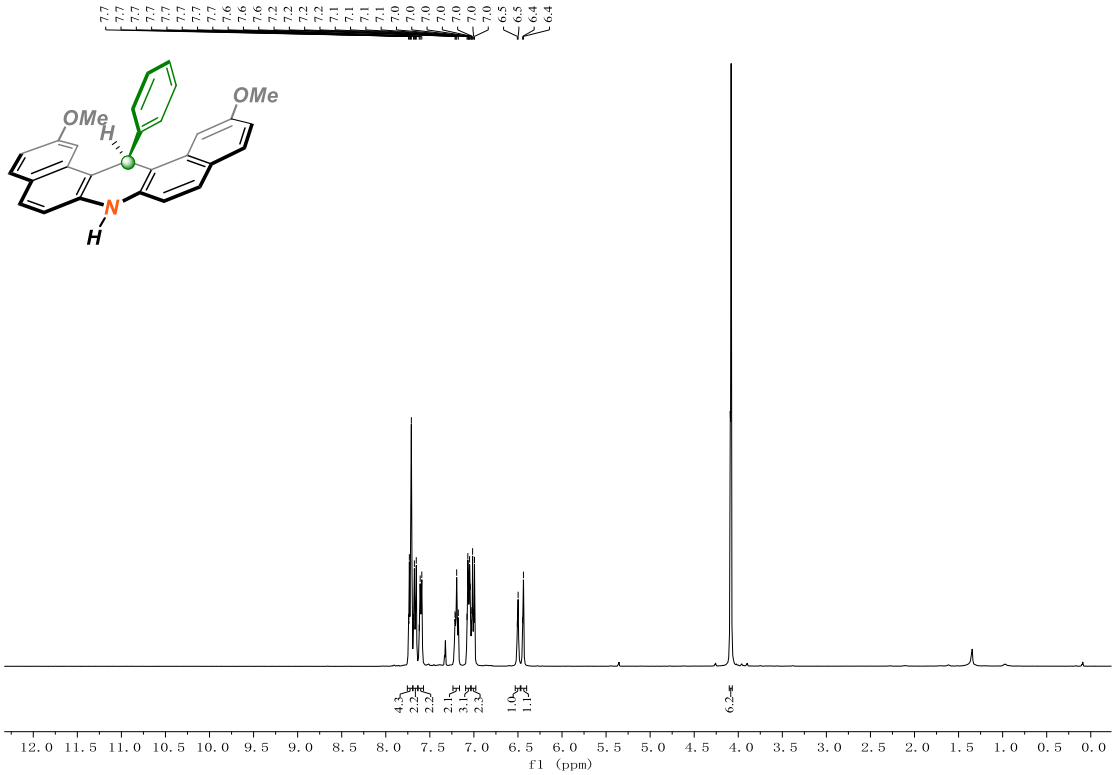
^{1}H NMR of **2z** (400 MHz, $CDCl_3$)



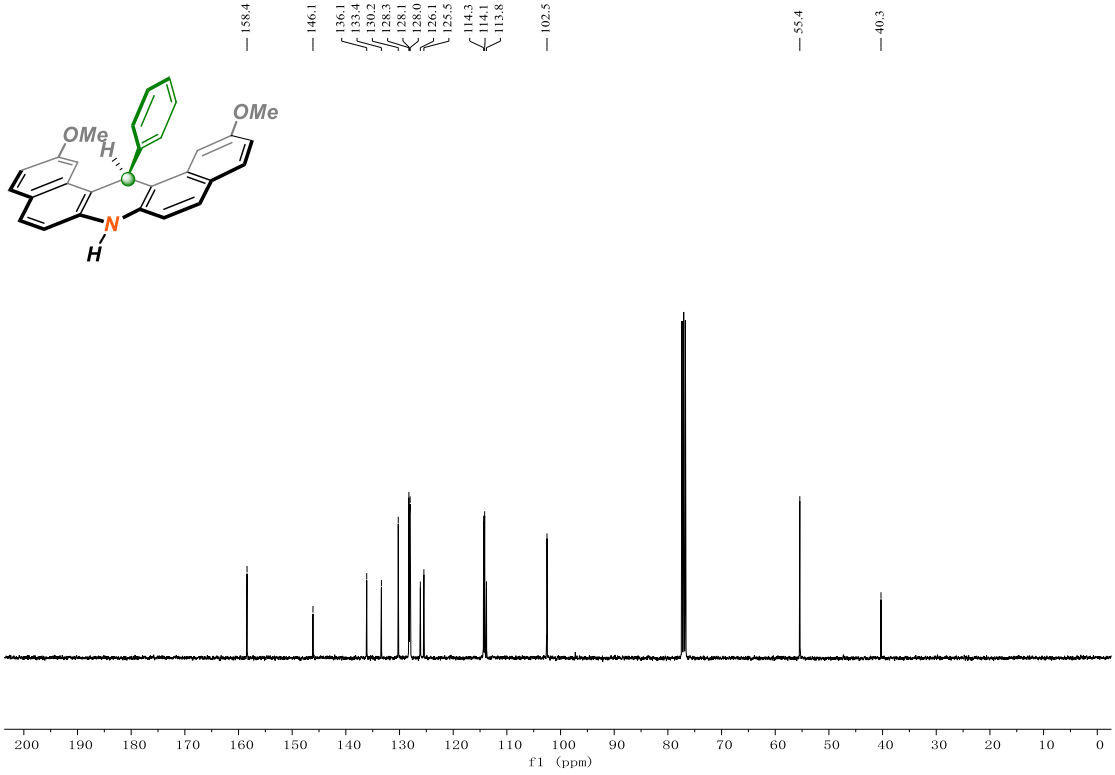
^{13}C NMR of **2z** (100 MHz, $CDCl_3$)



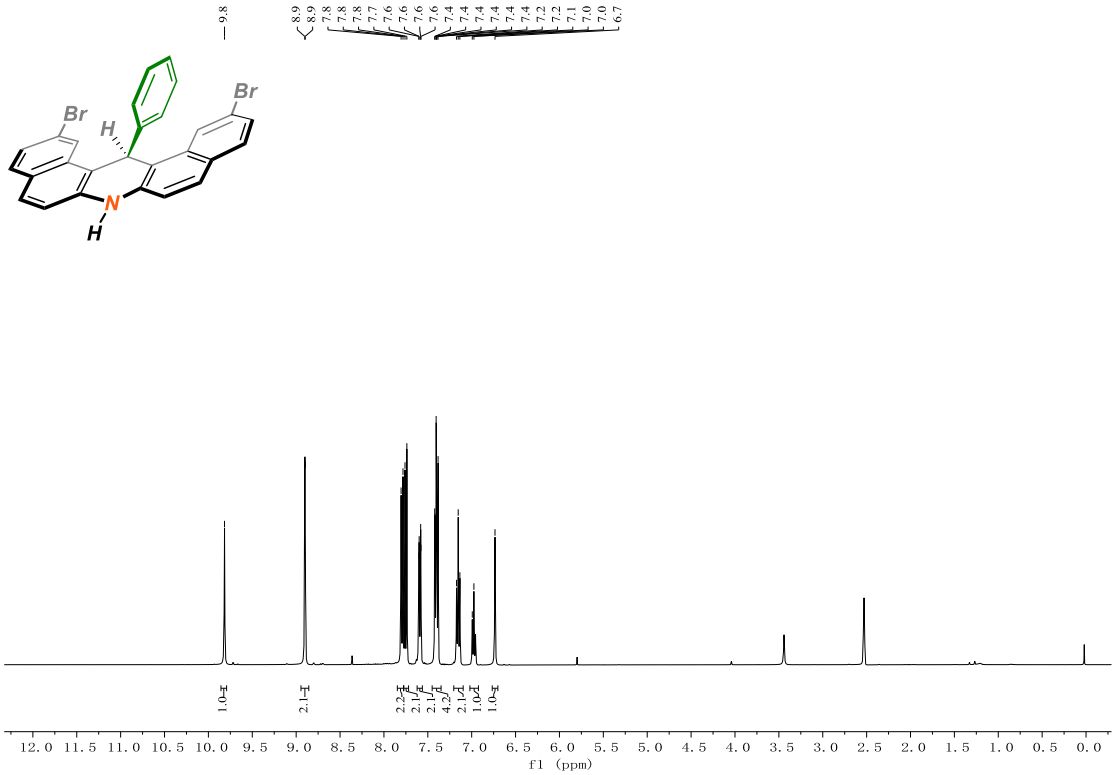
^{1}H NMR of **2a'** (400 MHz, $CDCl_3$)



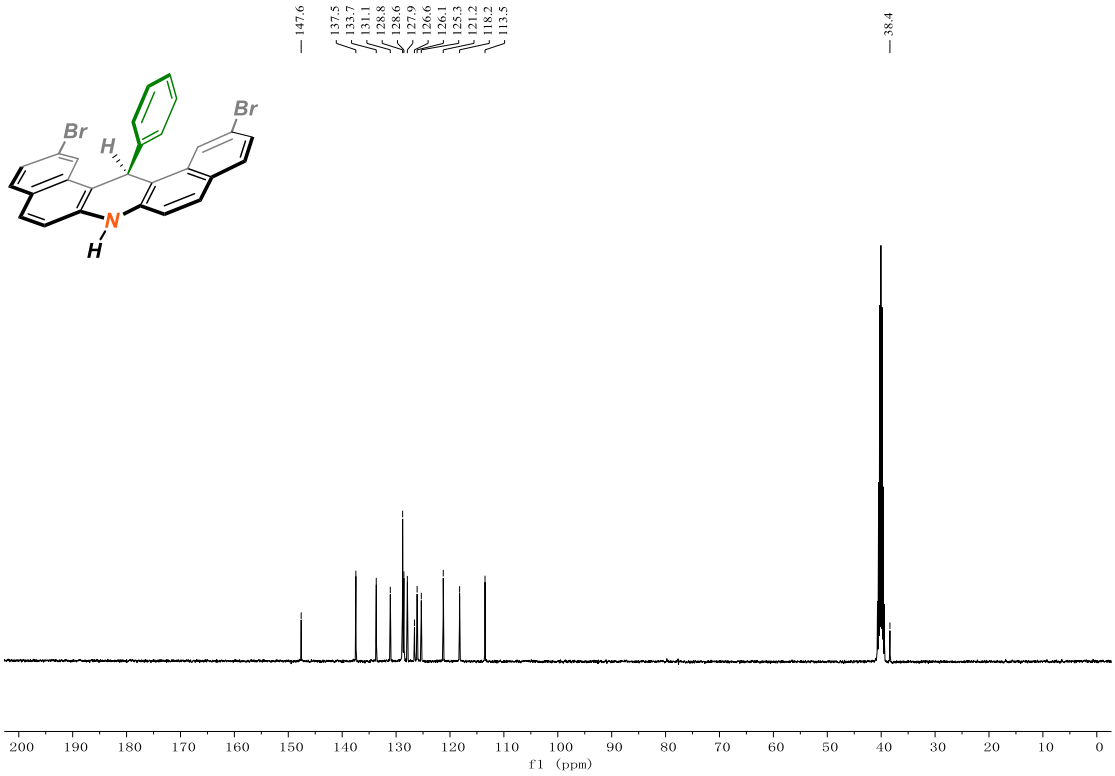
^{13}C NMR of **2a'** (100 MHz, $CDCl_3$)



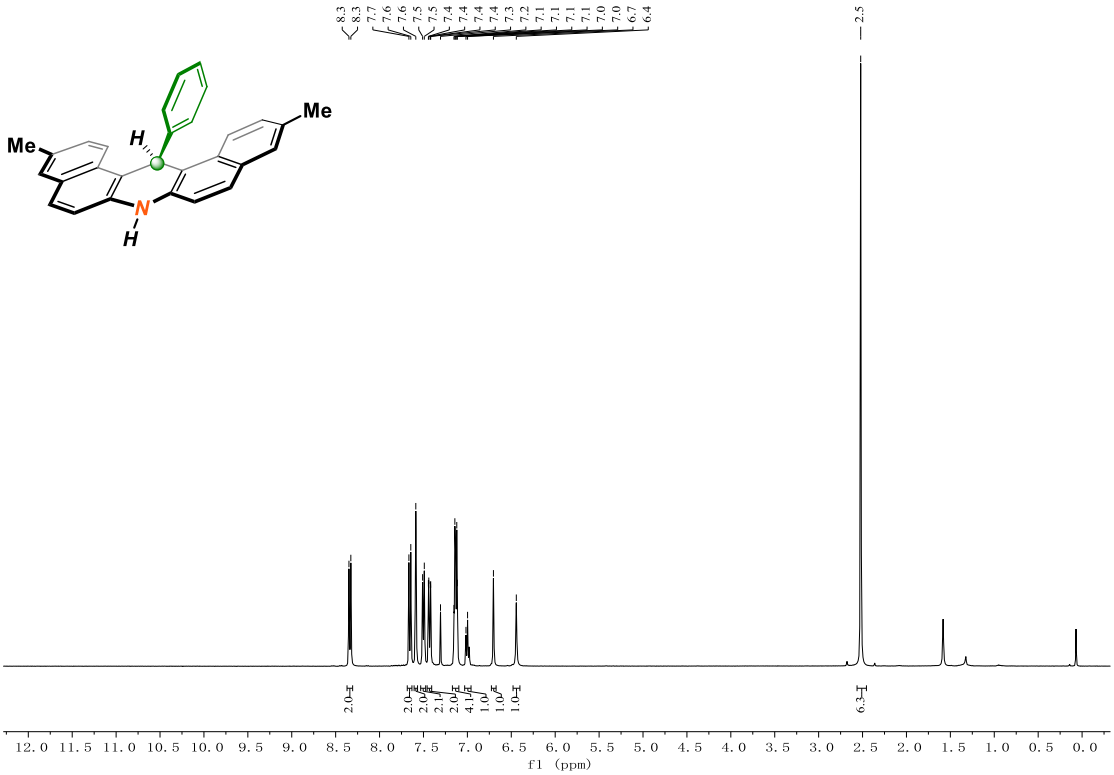
^{1}H NMR of **2b'** (400 MHz, d_6-DMSO)



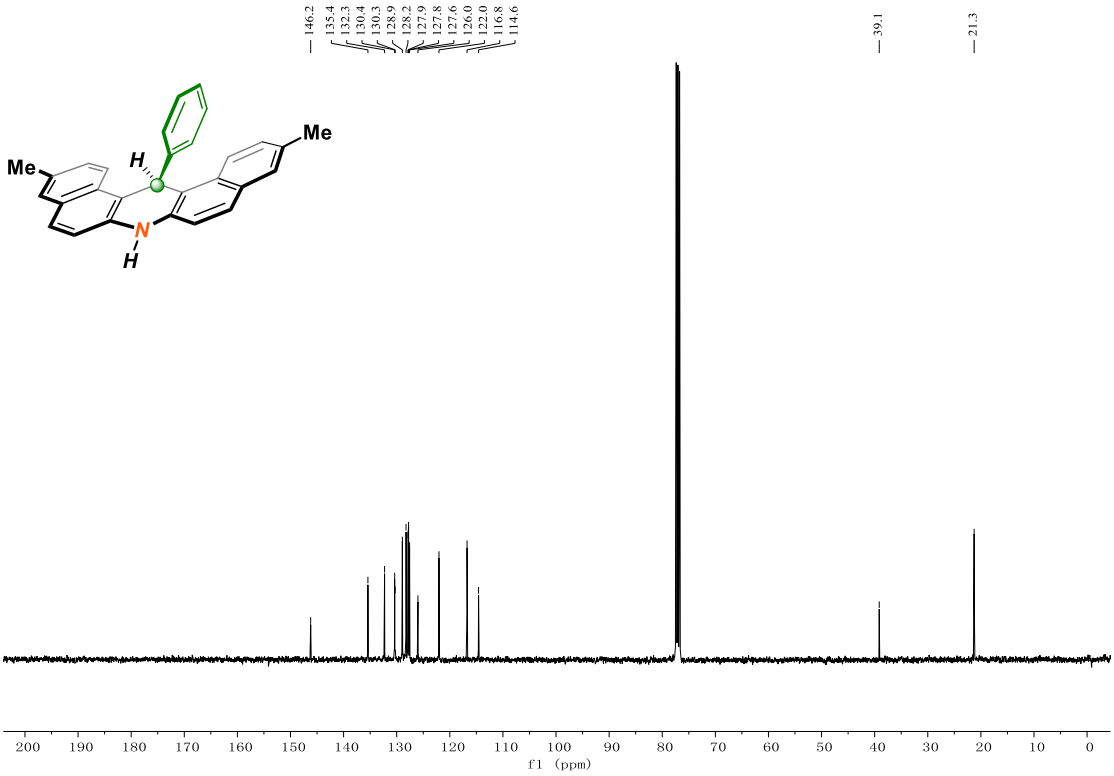
^{13}C NMR of **2b'** (100 MHz, d_6-DMSO)



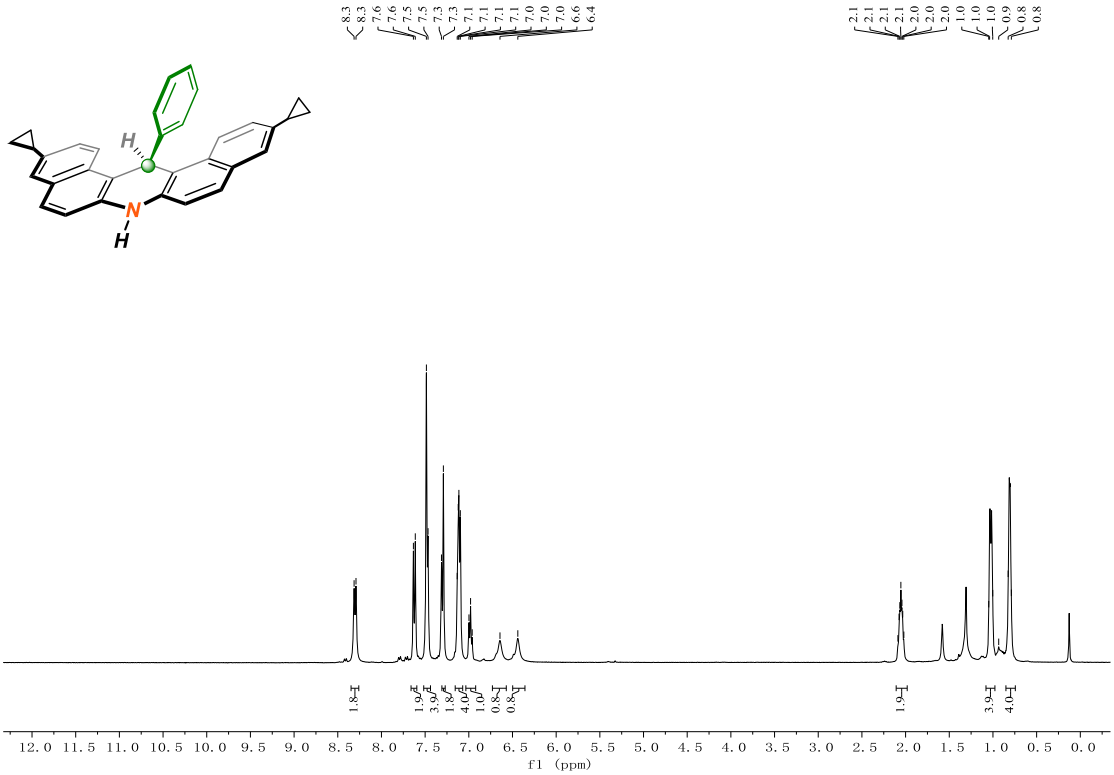
^{1}H NMR of **2c'** (400 MHz, $CDCl_3$)



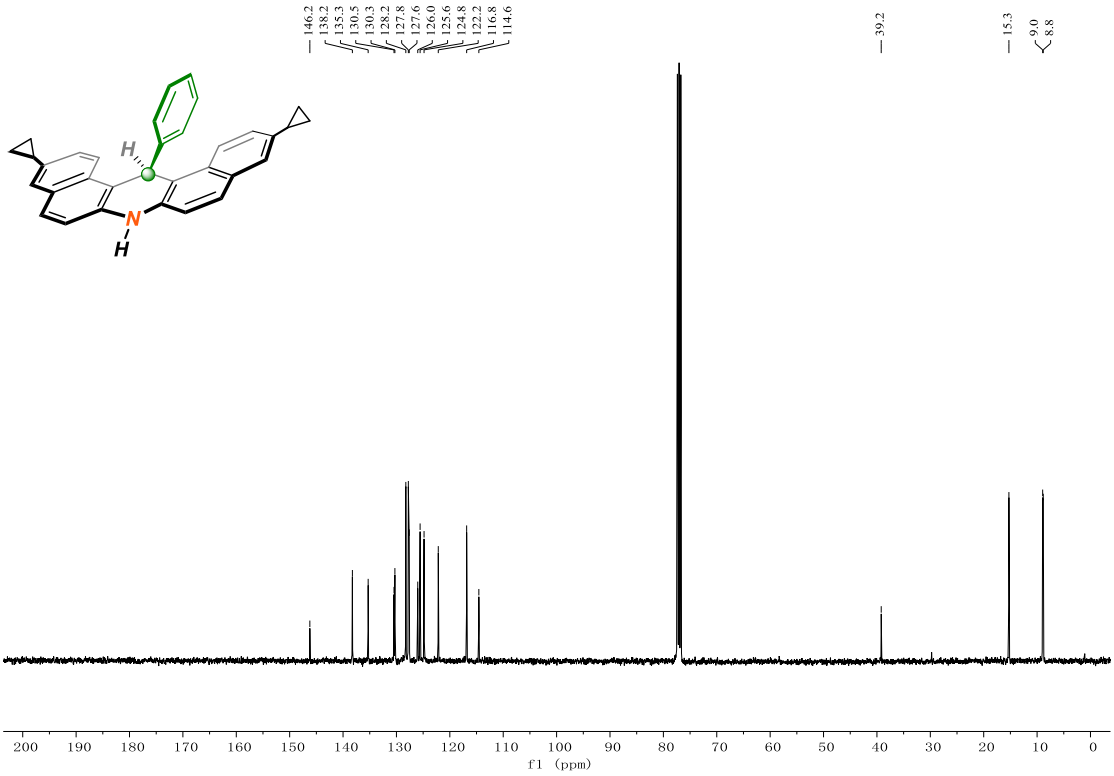
^{13}C NMR of **2c'** (100 MHz, $CDCl_3$)



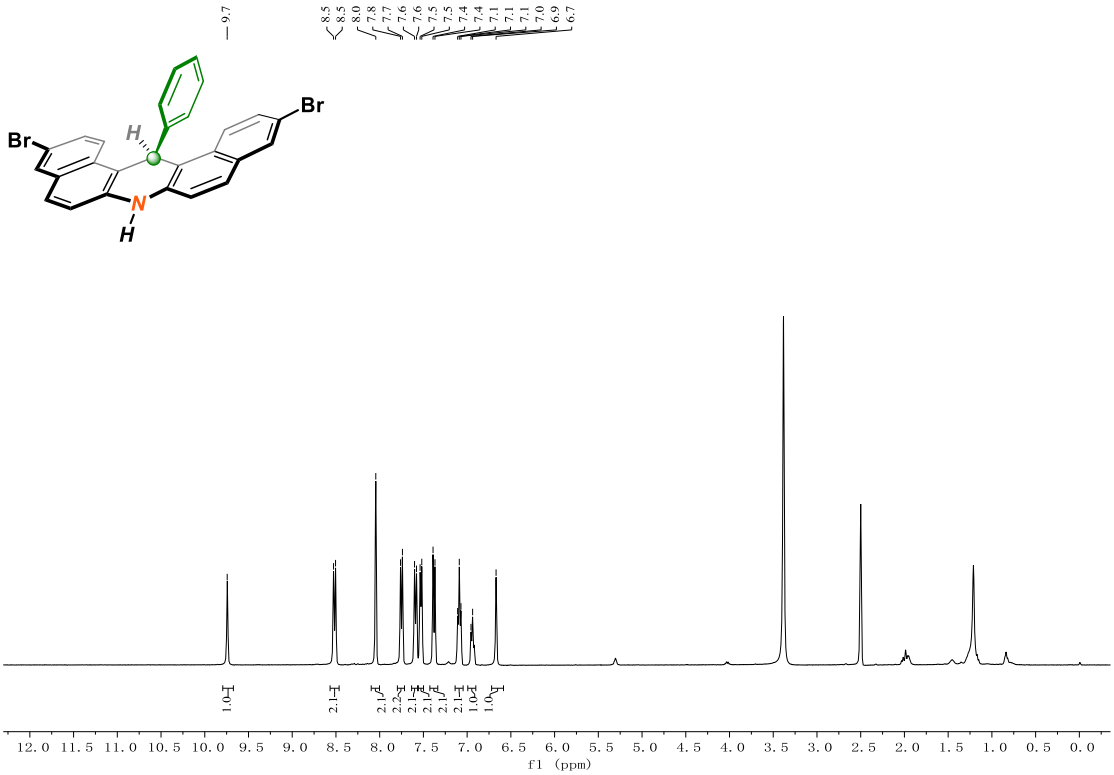
^{1}H NMR of **2d'** (400 MHz, $CDCl_3$)



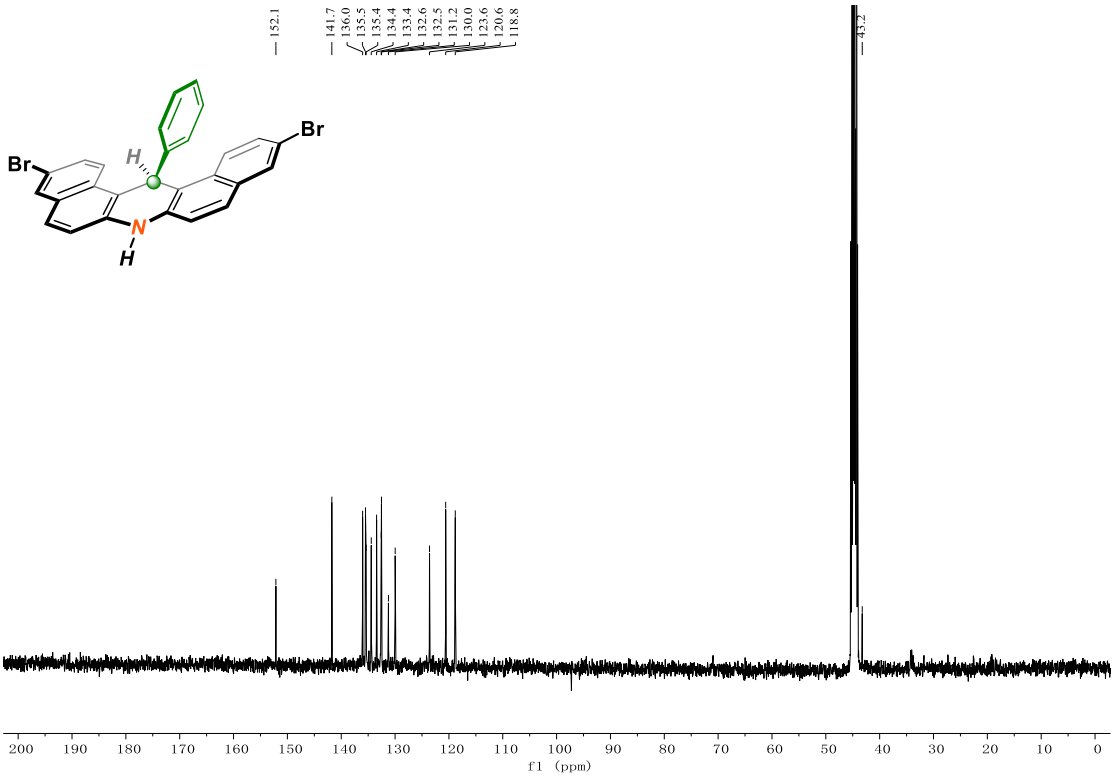
^{13}C NMR of **2d'** (100 MHz, $CDCl_3$)



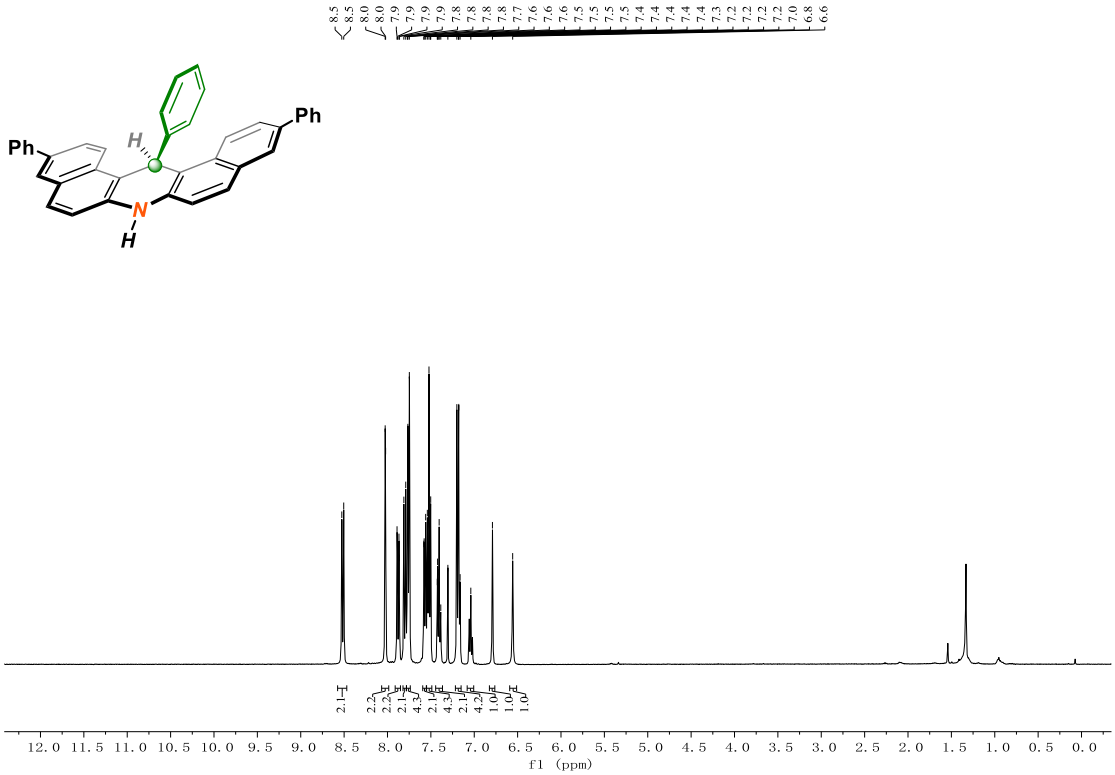
^{1}H NMR of **2e'** (400 MHz, d6-DMSO)



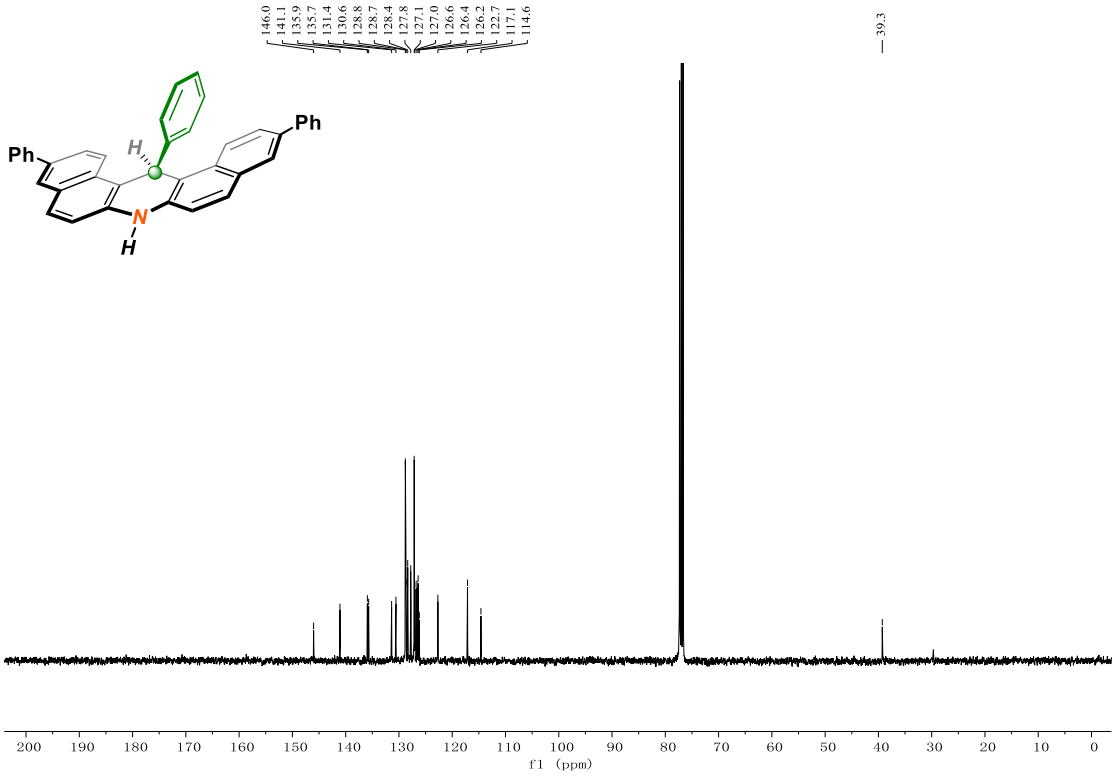
^{13}C NMR of **2e'** (100 MHz, d_6-DMSO)



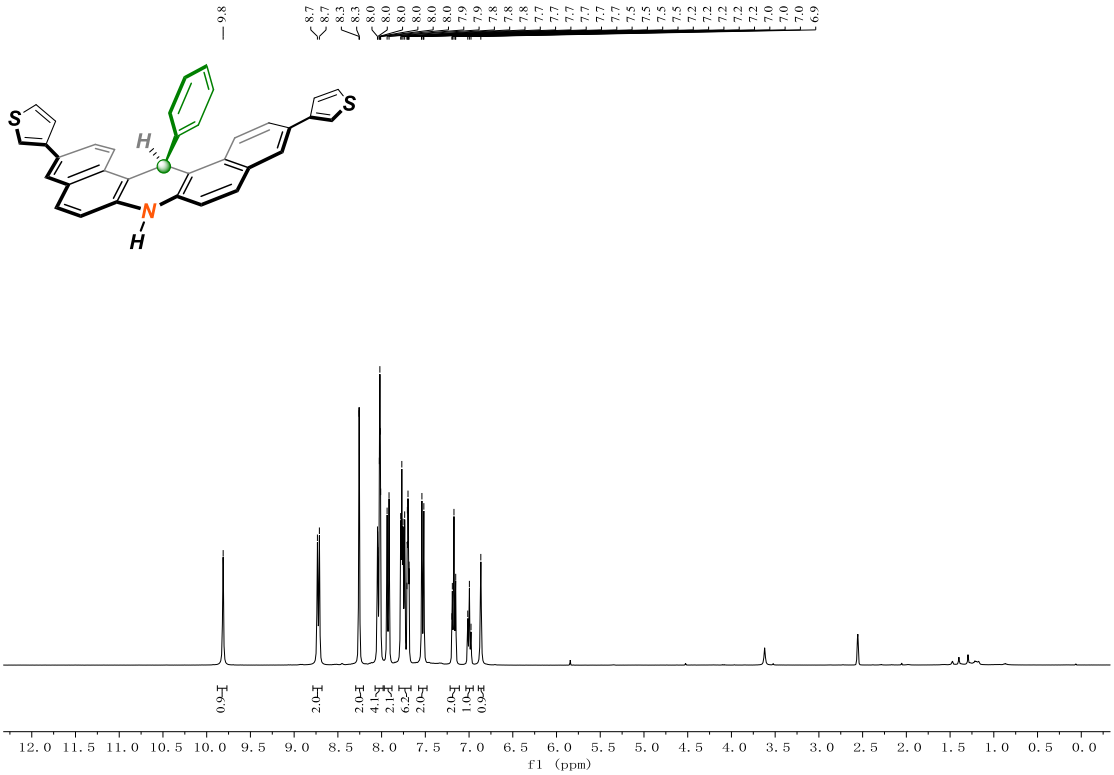
^{1}H NMR of **2f'** (400 MHz, $CDCl_3$)



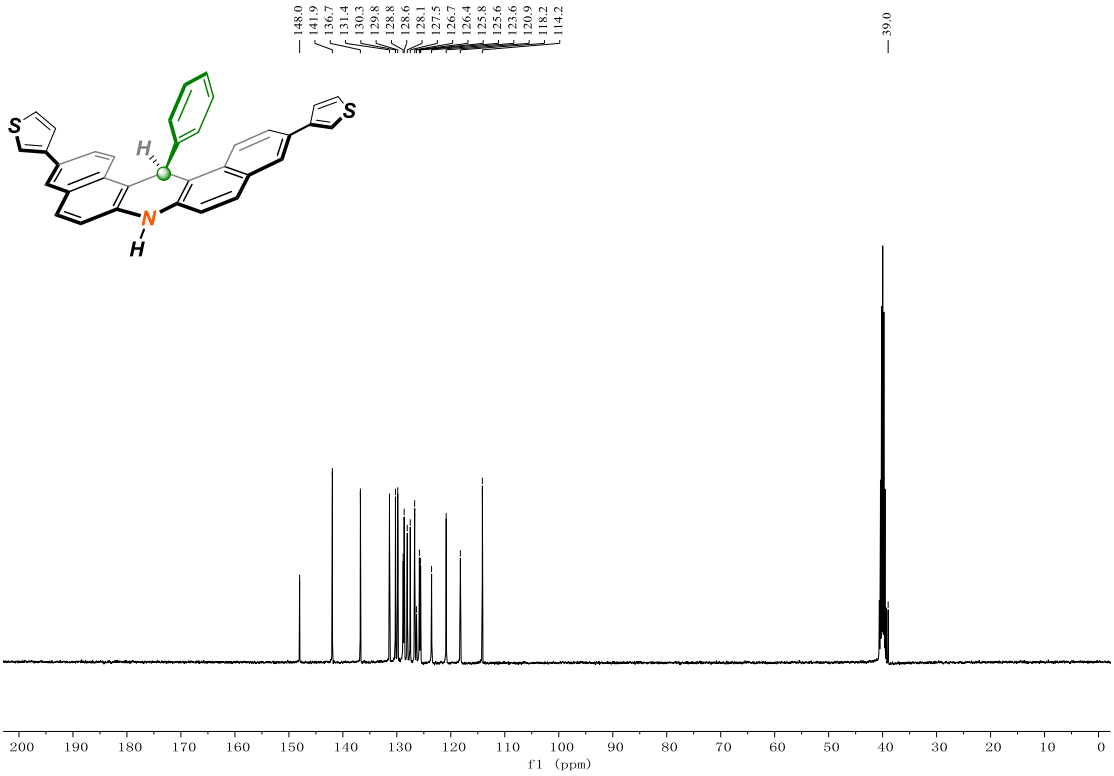
^{13}C NMR of **2f'** (100 MHz, $CDCl_3$)



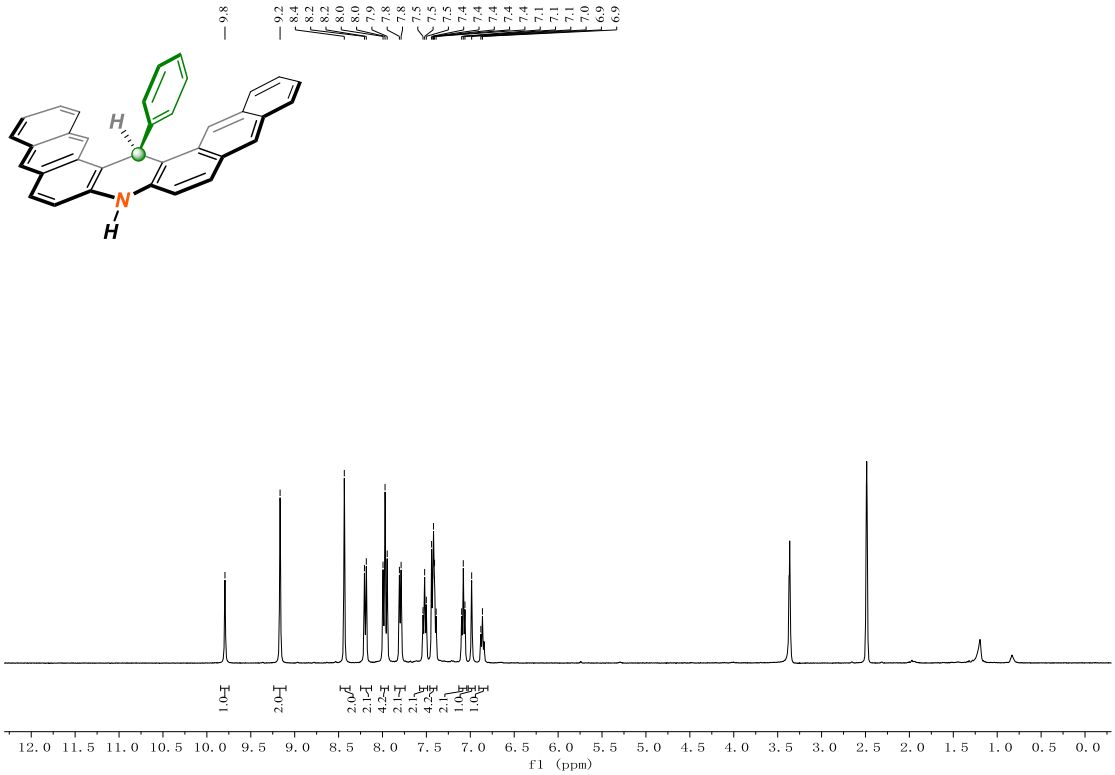
^{1}H NMR of **2g'** (400 MHz, d_6-DMSO)



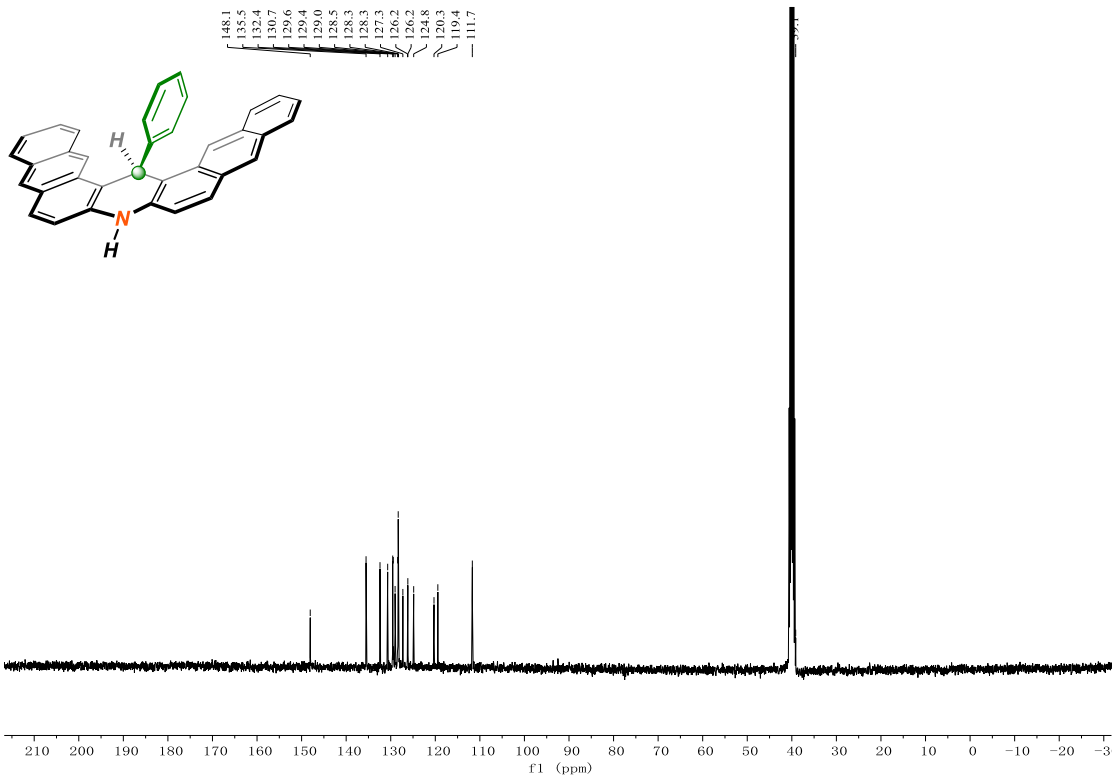
^{13}C NMR of **2g'** (100 MHz, d_6-DMSO)



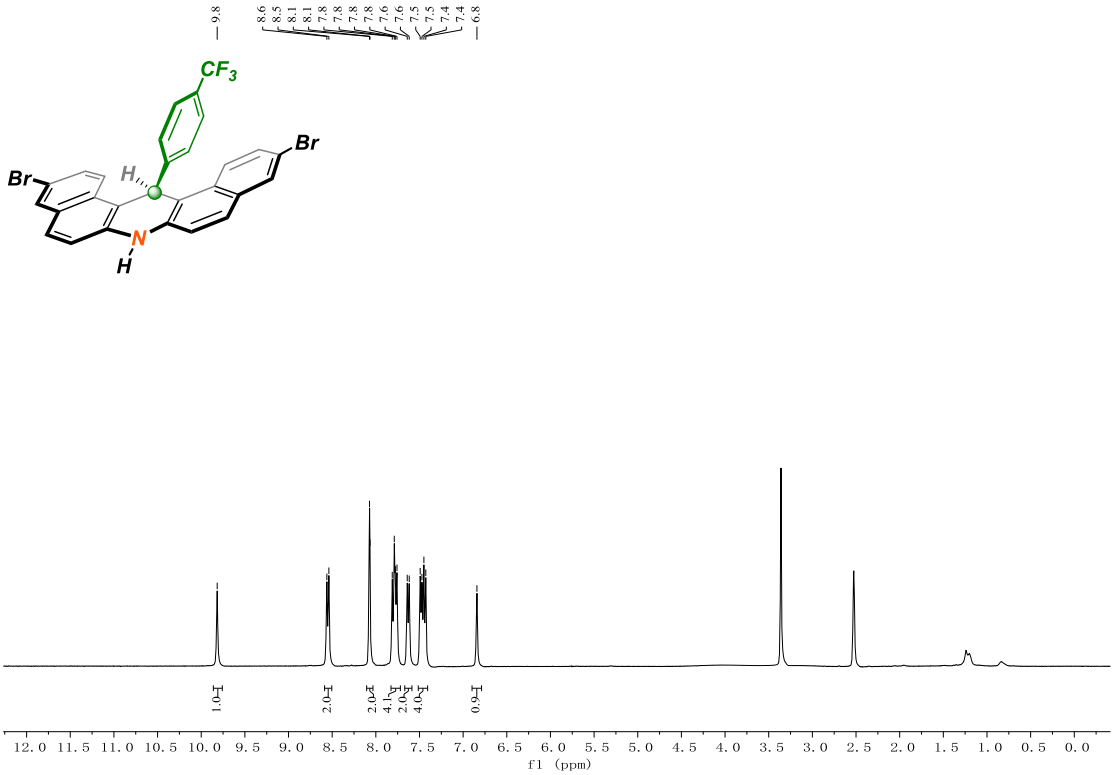
^{1}H NMR of **2h'** (400 MHz, d_6-DMSO)



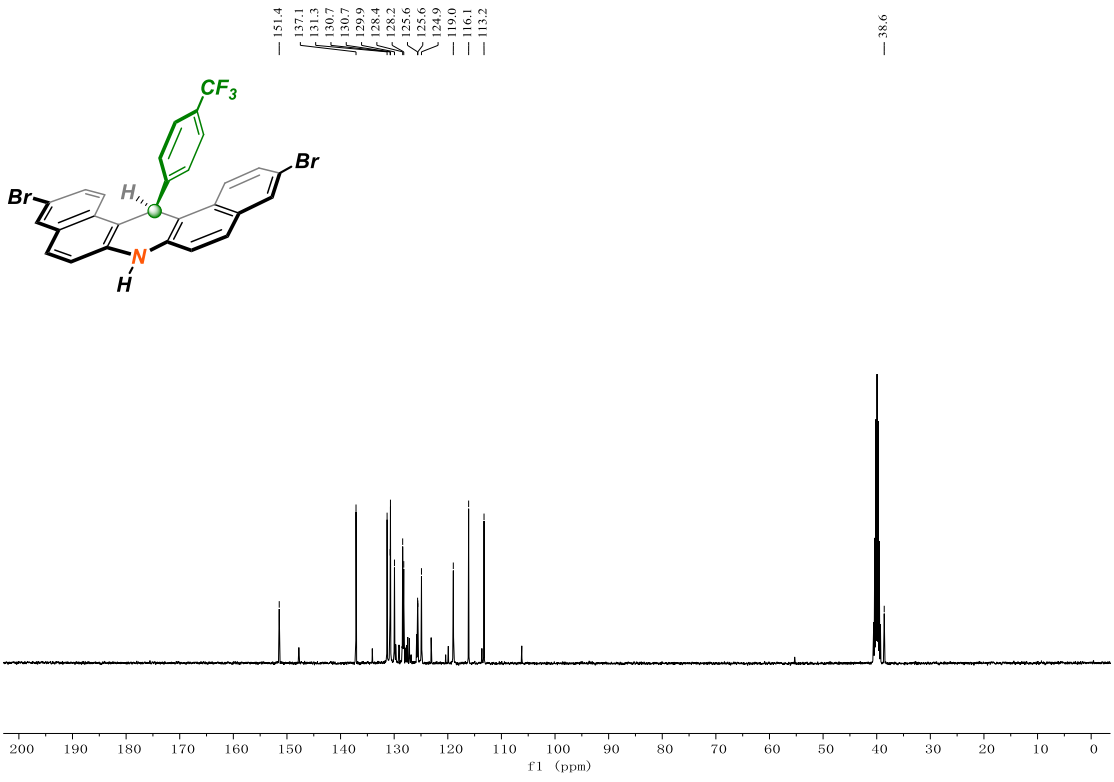
^{13}C NMR of **2h'** (100 MHz, d_6-DMSO)



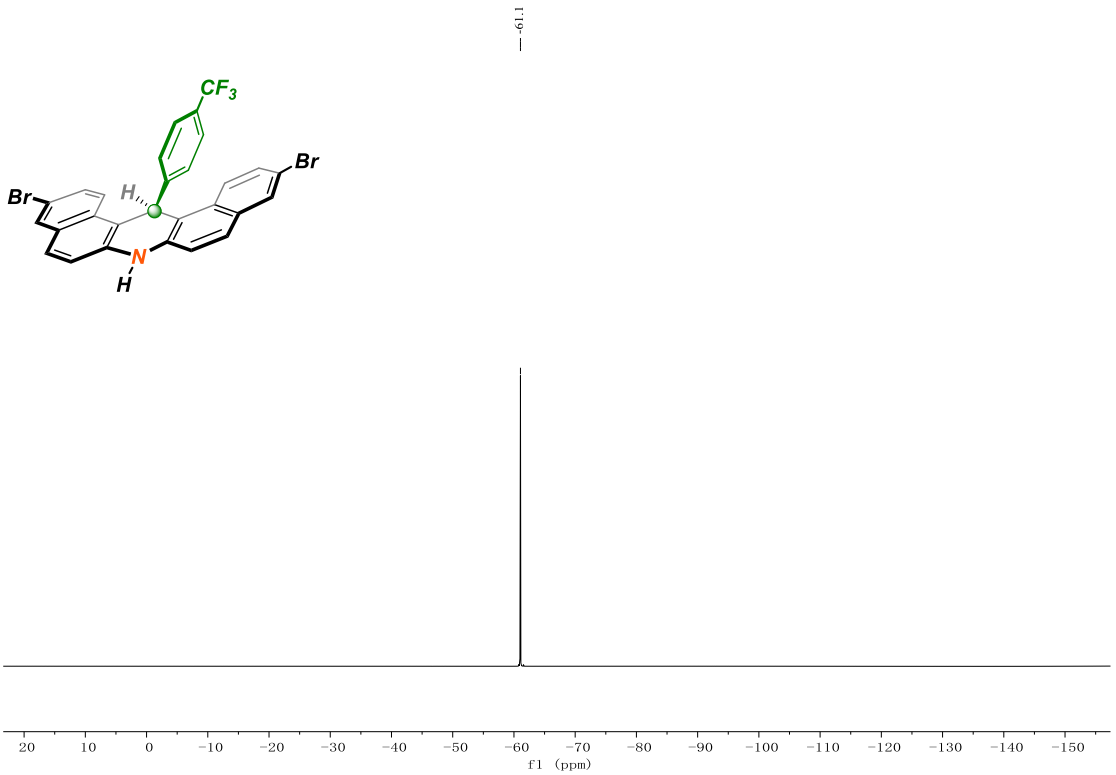
^{1}H NMR of **2i'** (400 MHz, d_6-DMSO)



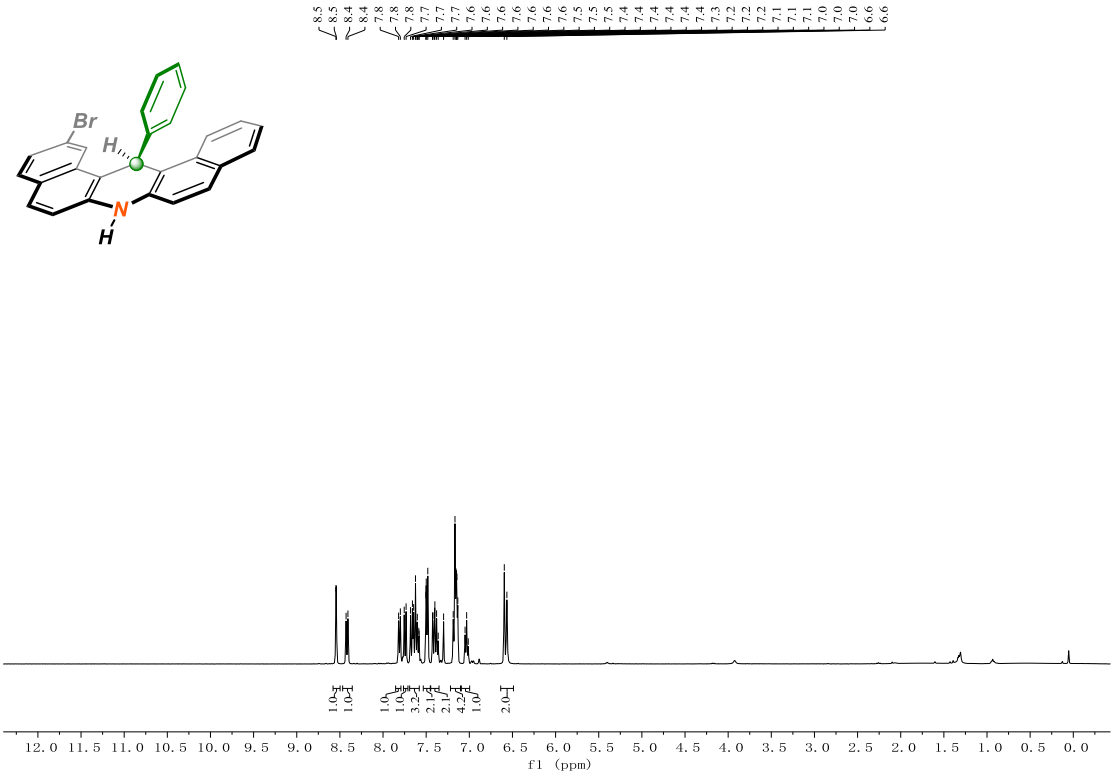
^{13}C NMR of **2i'** (100 MHz, d_6-DMSO)



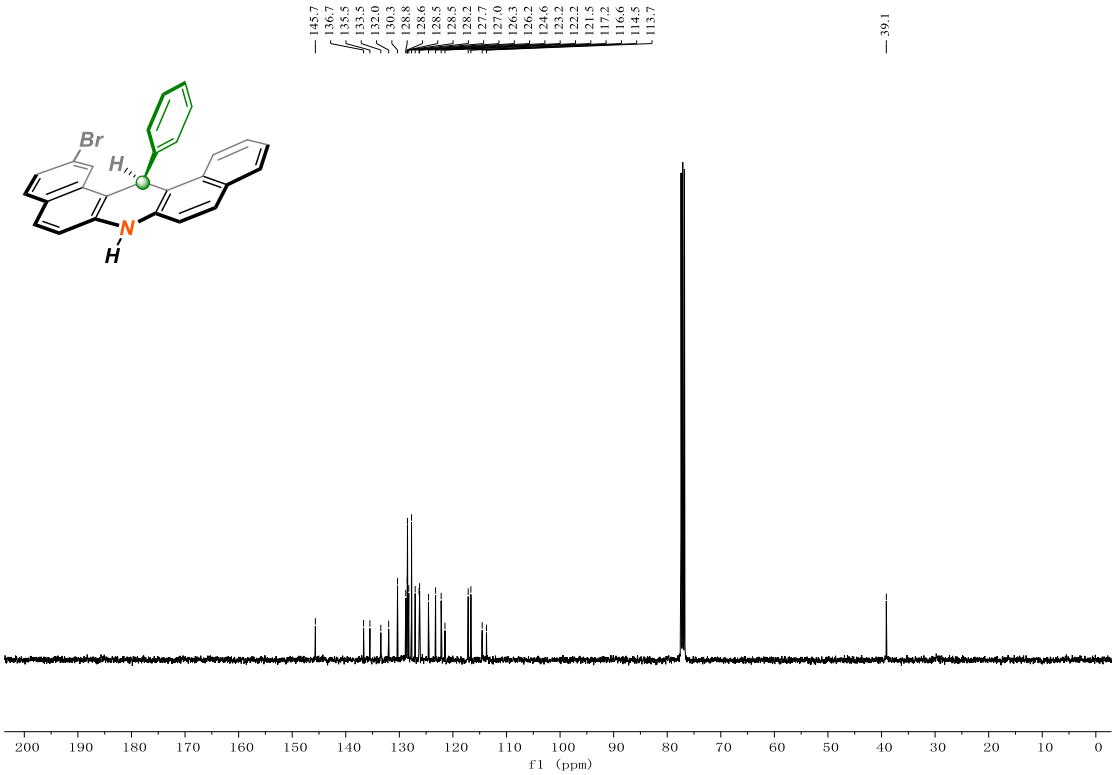
^{19}F NMR of **2i'** (376 MHz, d_6-DMSO)



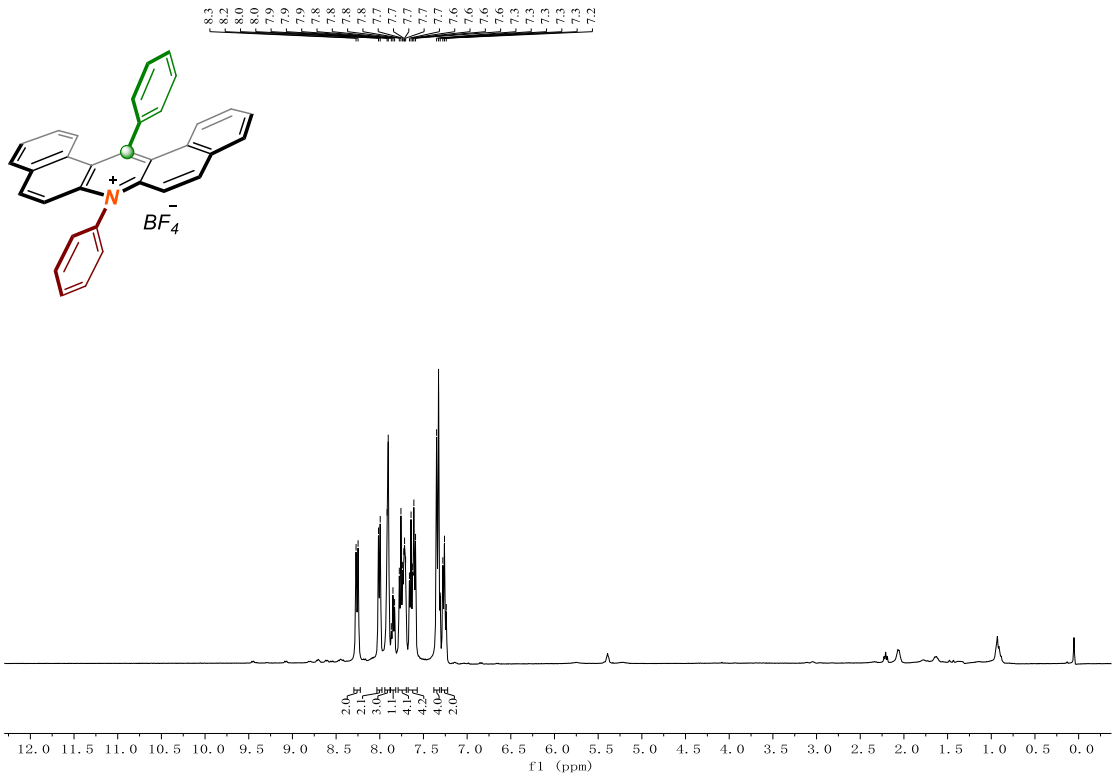
^{1}H NMR of **2l'** (400 MHz, $CDCl_3$)



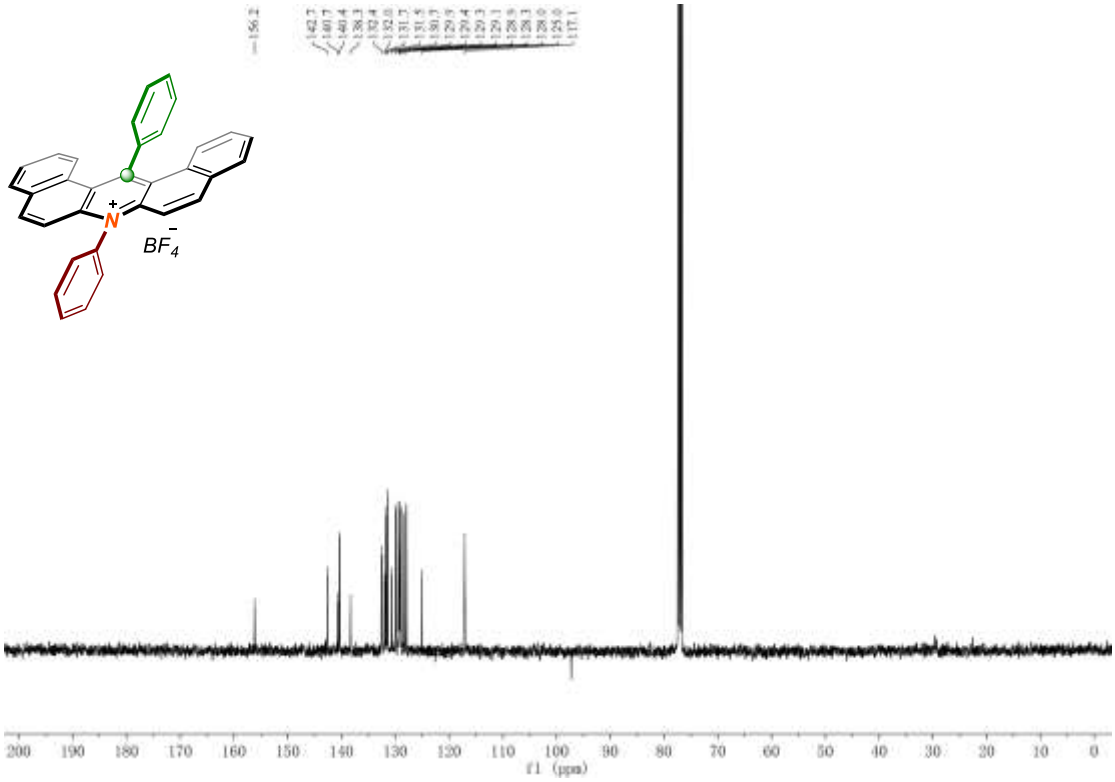
^{13}C NMR of **2l'** (100 MHz, $CDCl_3$)



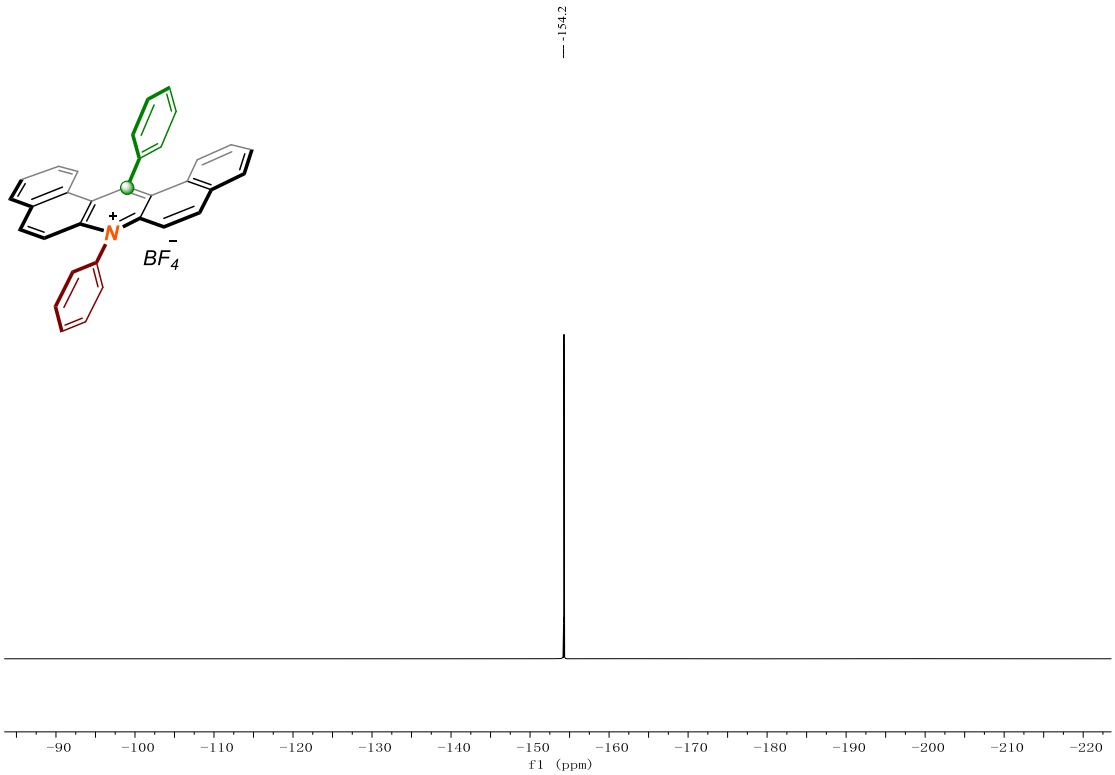
^{1}H NMR of **8a** (400 MHz, $CDCl_3$)



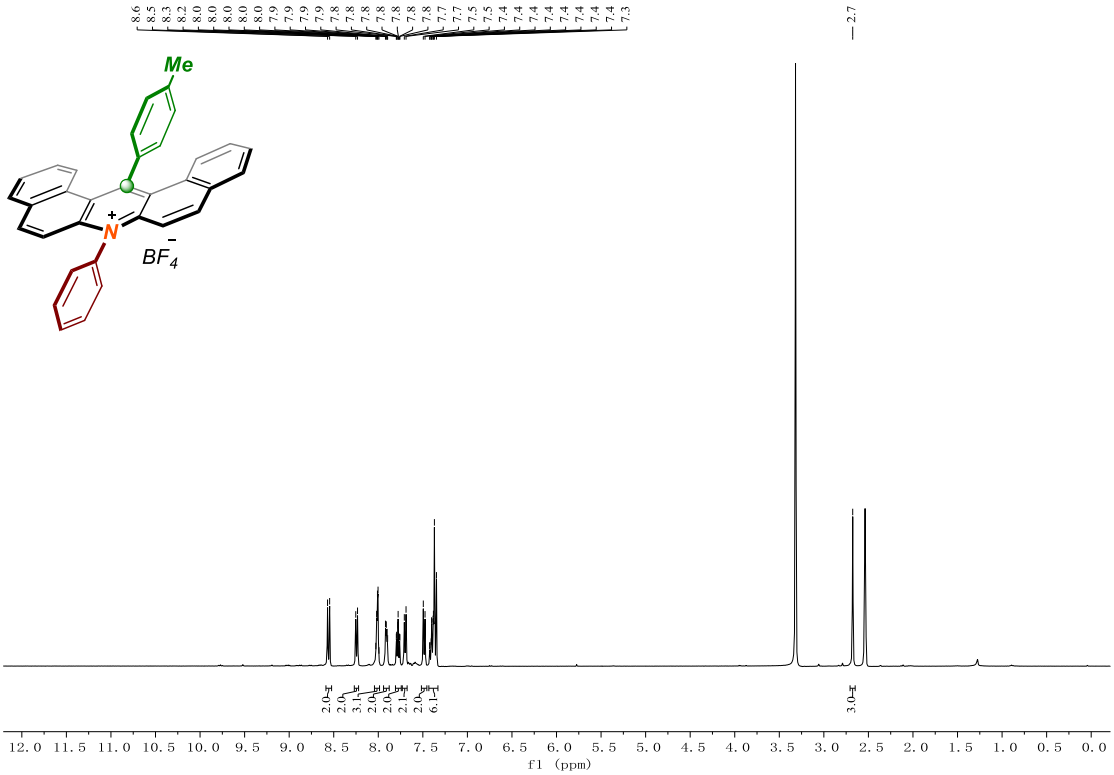
^{13}C NMR of **8a** (100 MHz, $CDCl_3$)



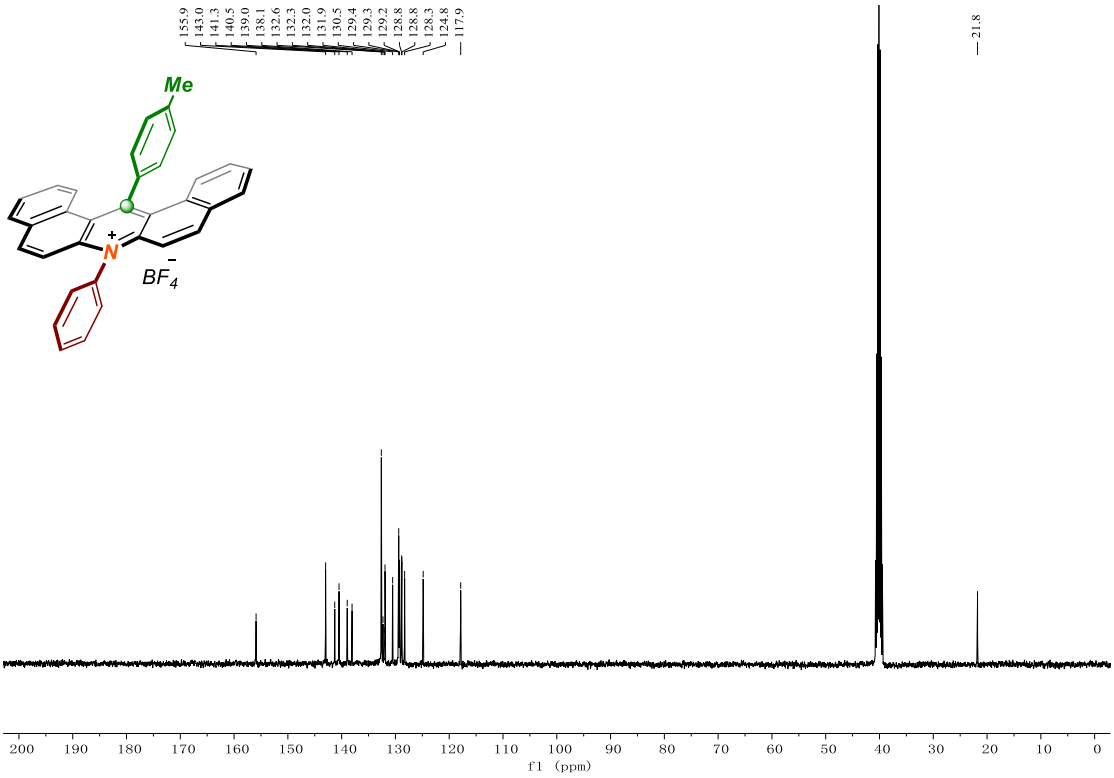
^{19}F NMR of **8a** (376 MHz, $CDCl_3$)



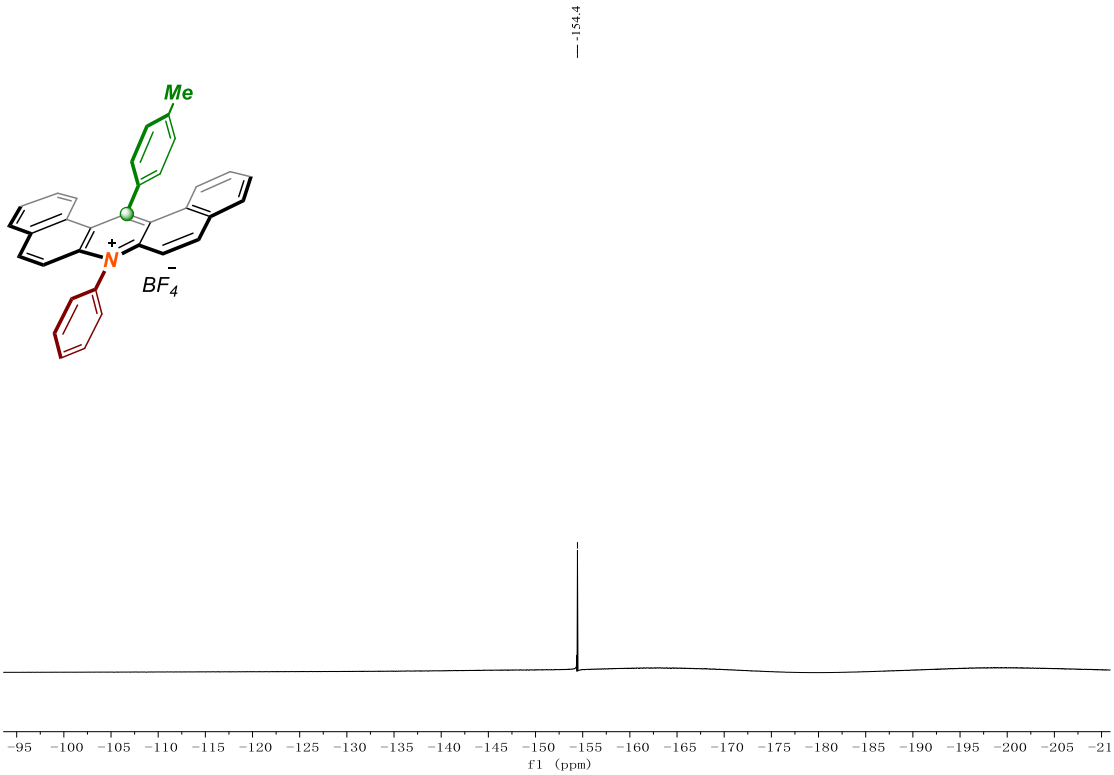
^{1}H NMR of **8b** (400 MHz, d_6-DMSO)



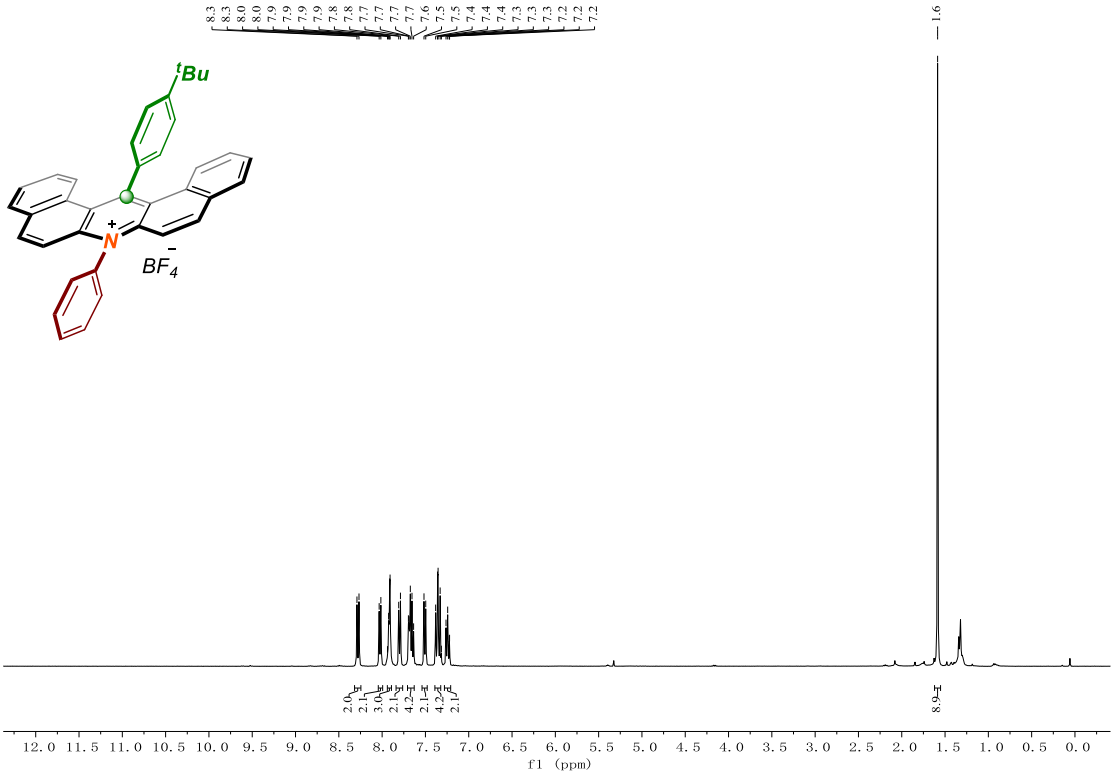
^{13}C NMR of **8b** (100 MHz, d_6-DMSO)



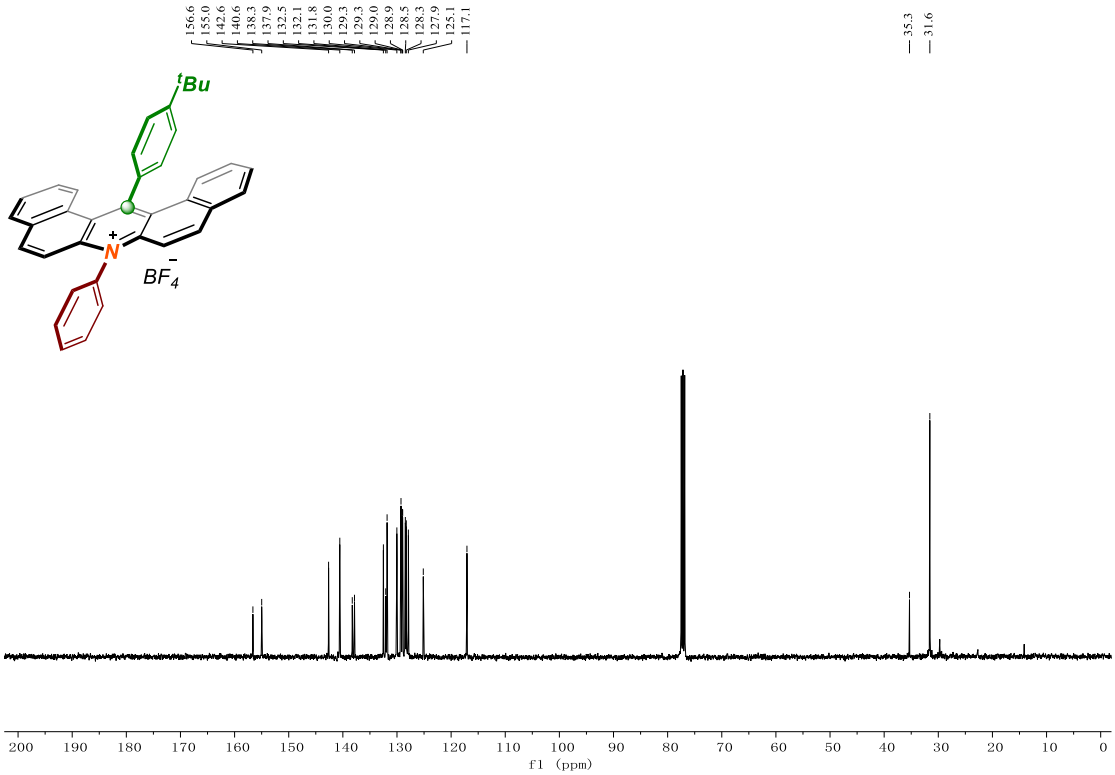
^{19}F NMR of **8b** (376 MHz, $CDCl_3$)



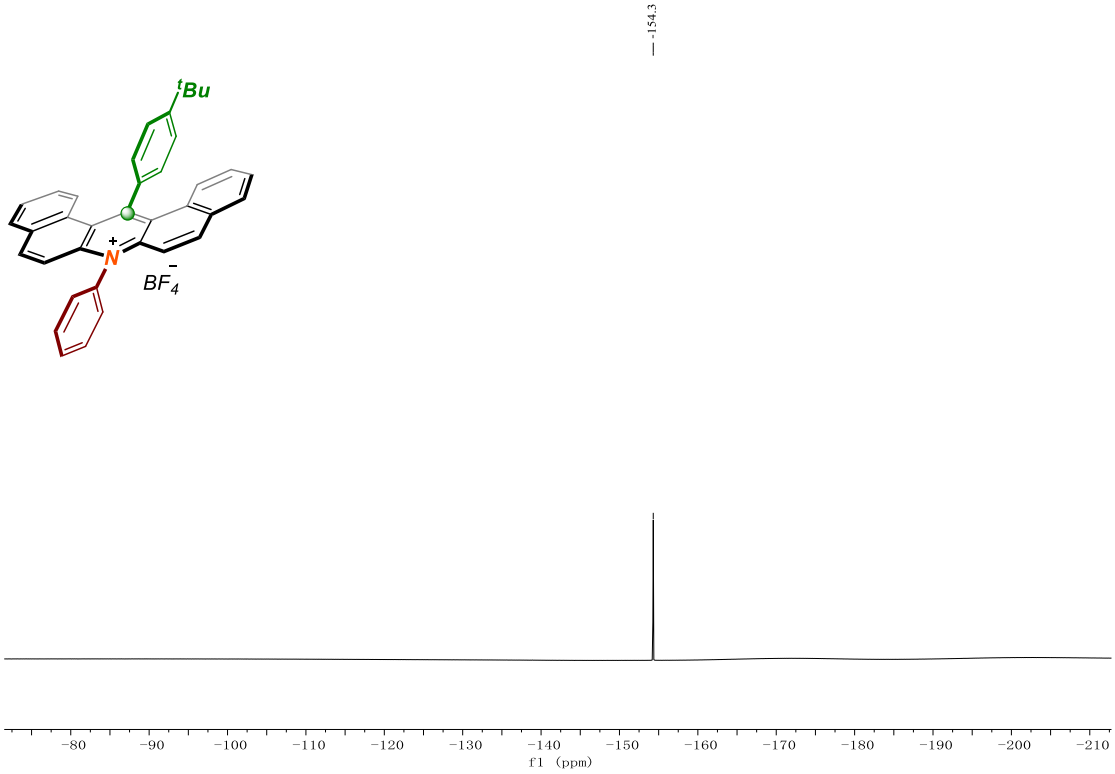
^{1}H NMR of **8c** (400 MHz, $CDCl_3$)



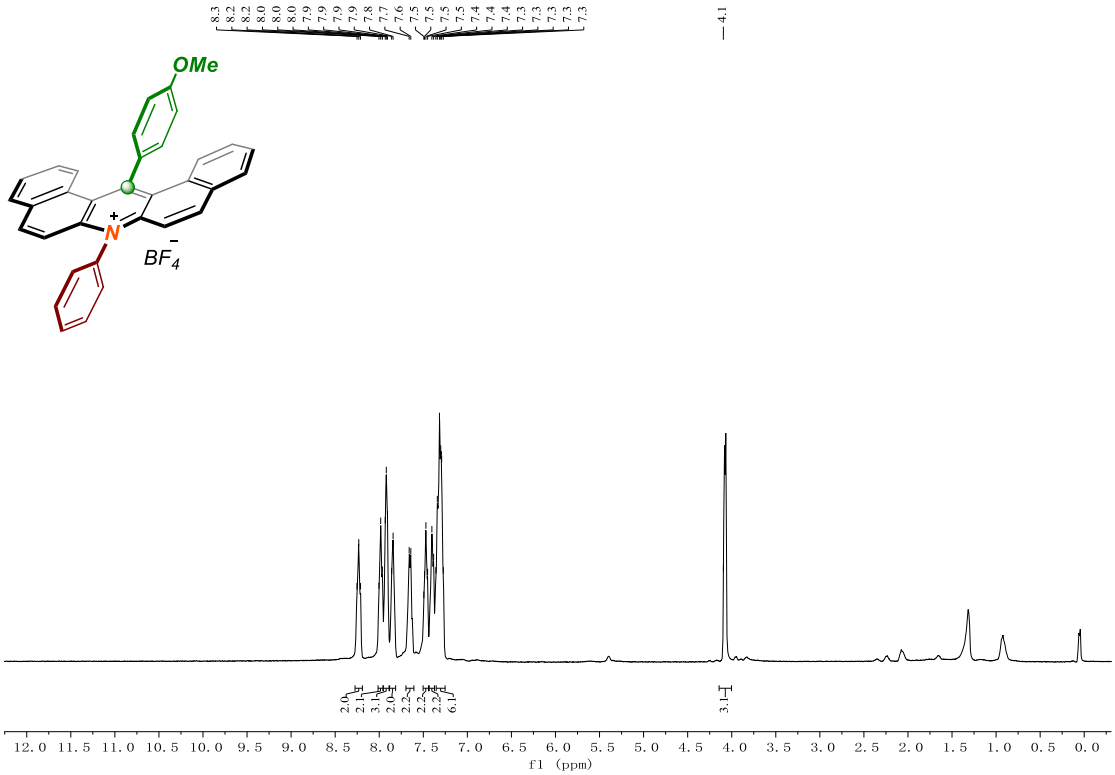
^{13}C NMR of **8c** (100 MHz, $CDCl_3$)



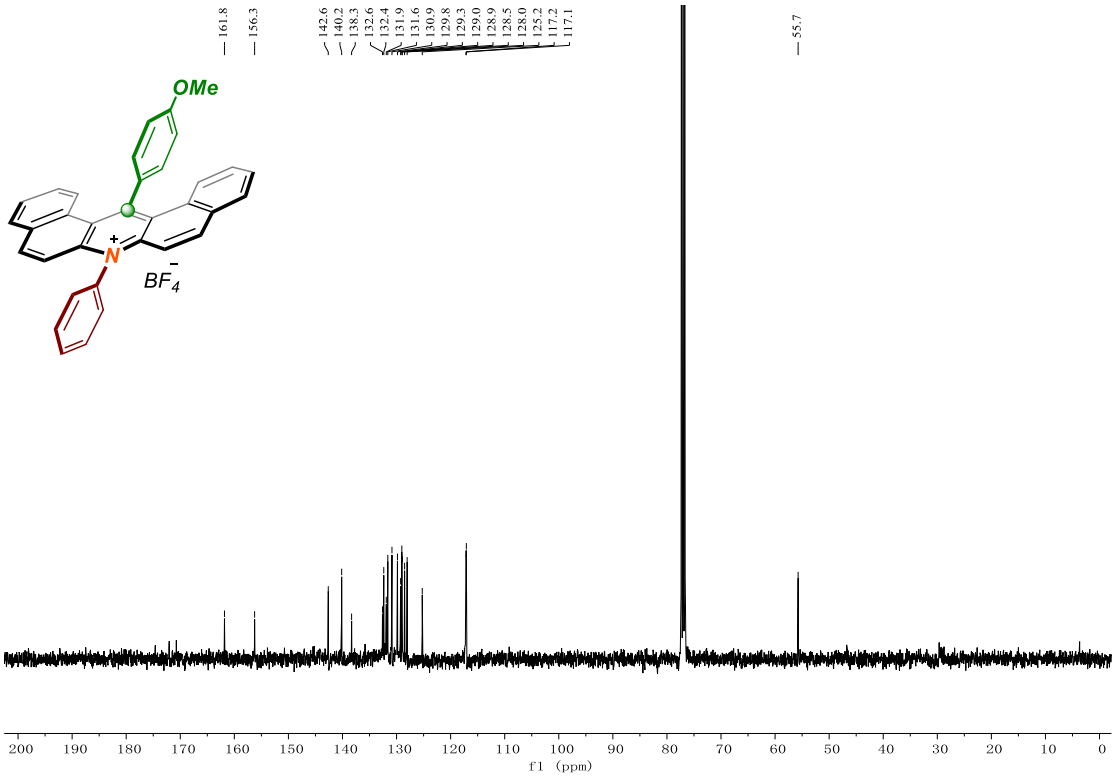
^{19}F NMR of **8c** (376 MHz, $CDCl_3$)



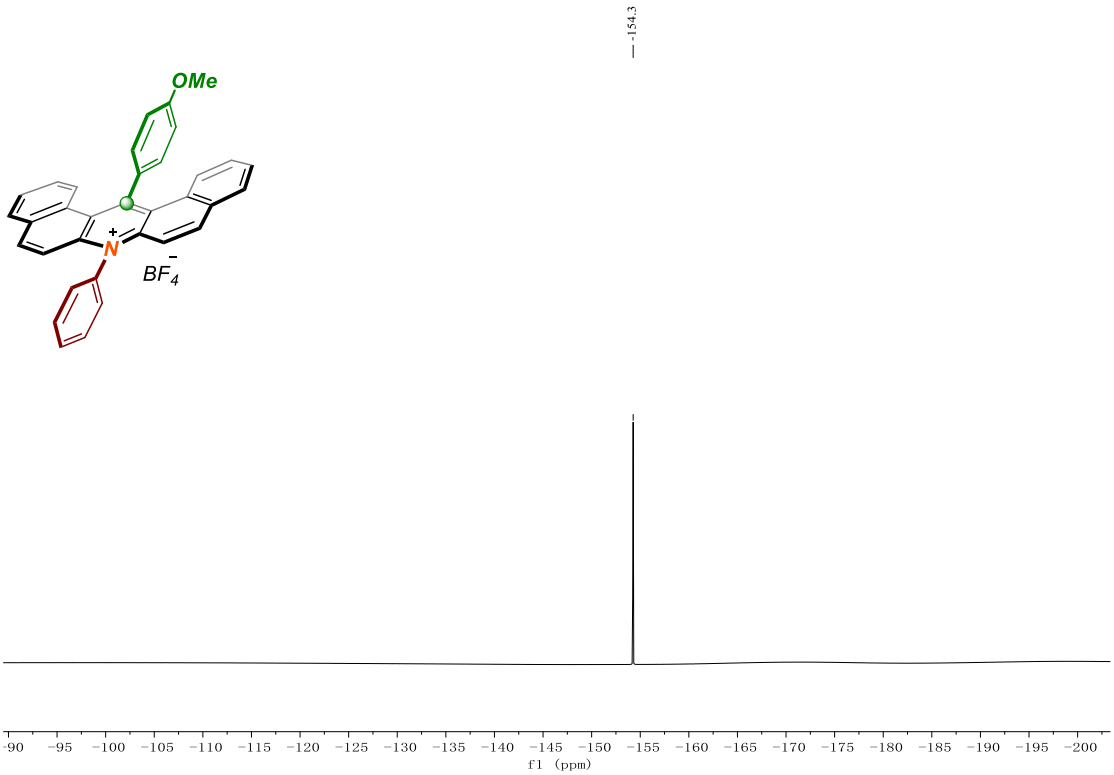
^{1}H NMR of **8d** (400 MHz, $CDCl_3$)



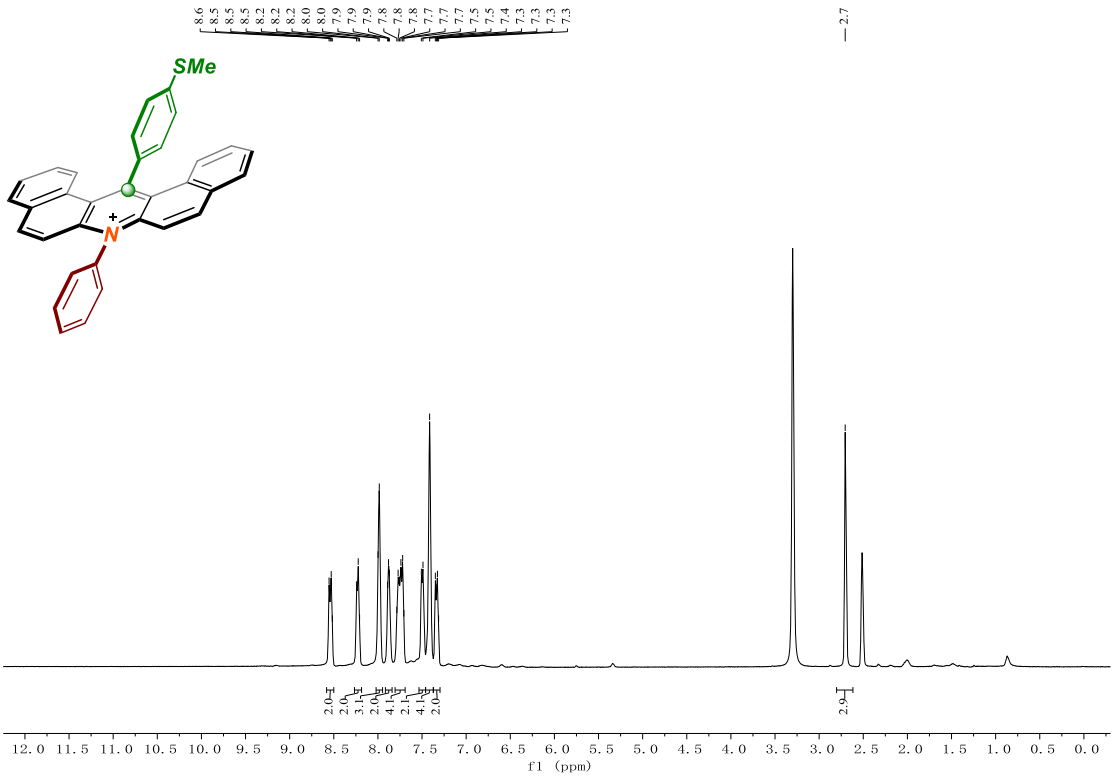
^{13}C NMR of **8d** (100 MHz, $CDCl_3$)



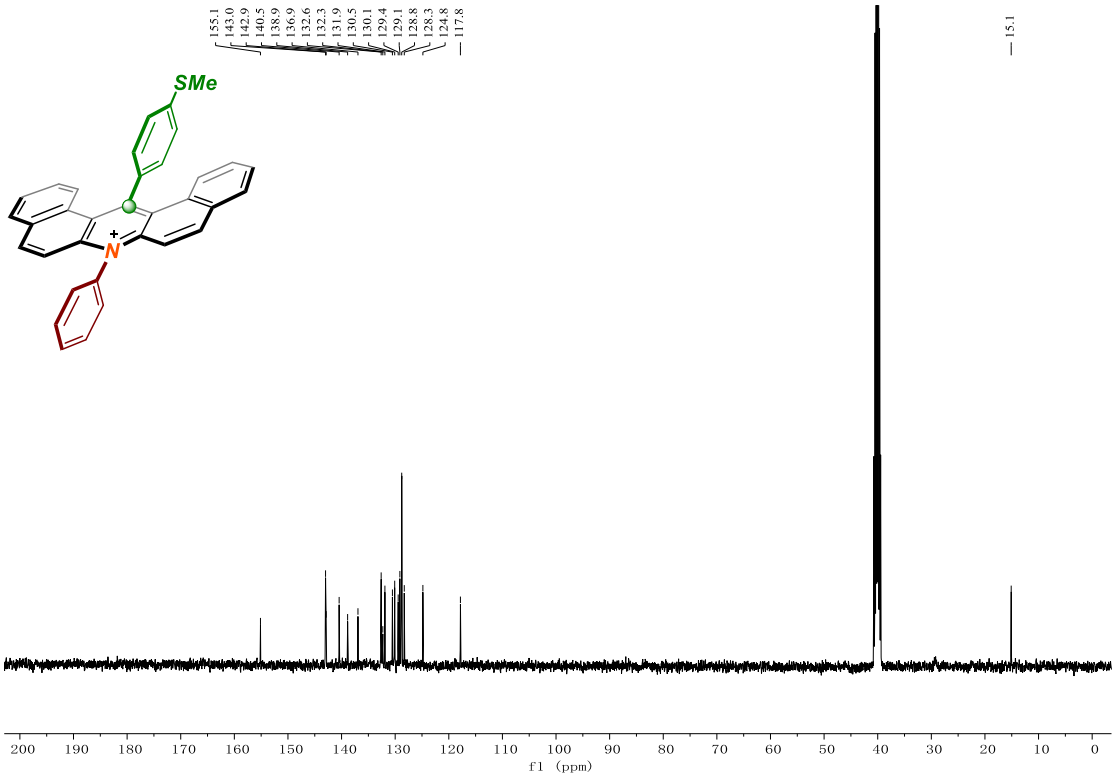
^{19}F NMR of **8d** (376 MHz, $CDCl_3$)



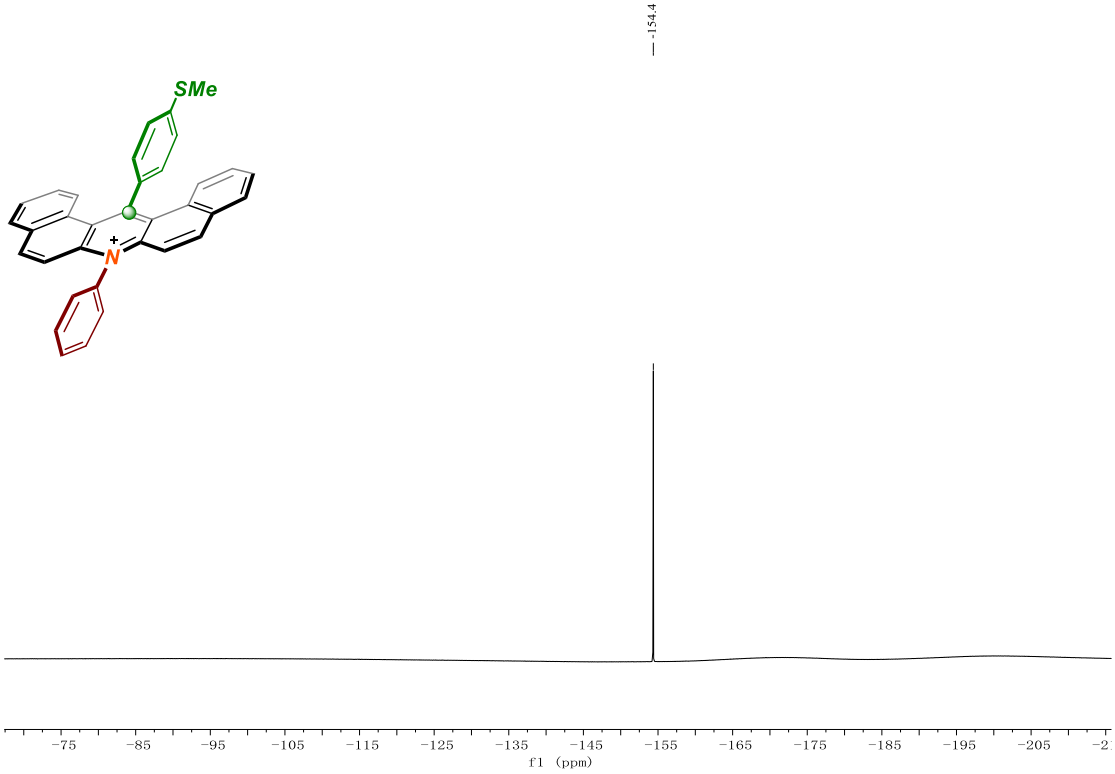
^{1}H NMR of **8e** (400 MHz, d_6-DMSO)



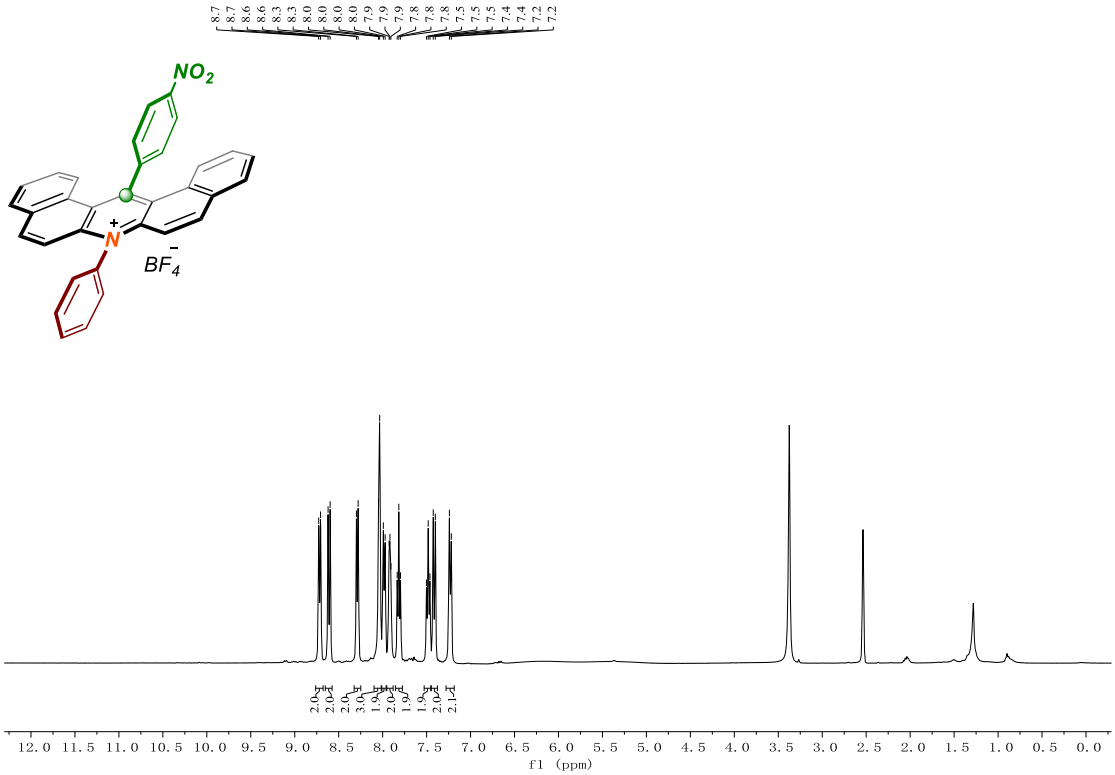
^{13}C NMR of **8e** (100 MHz, d_6-DMSO)



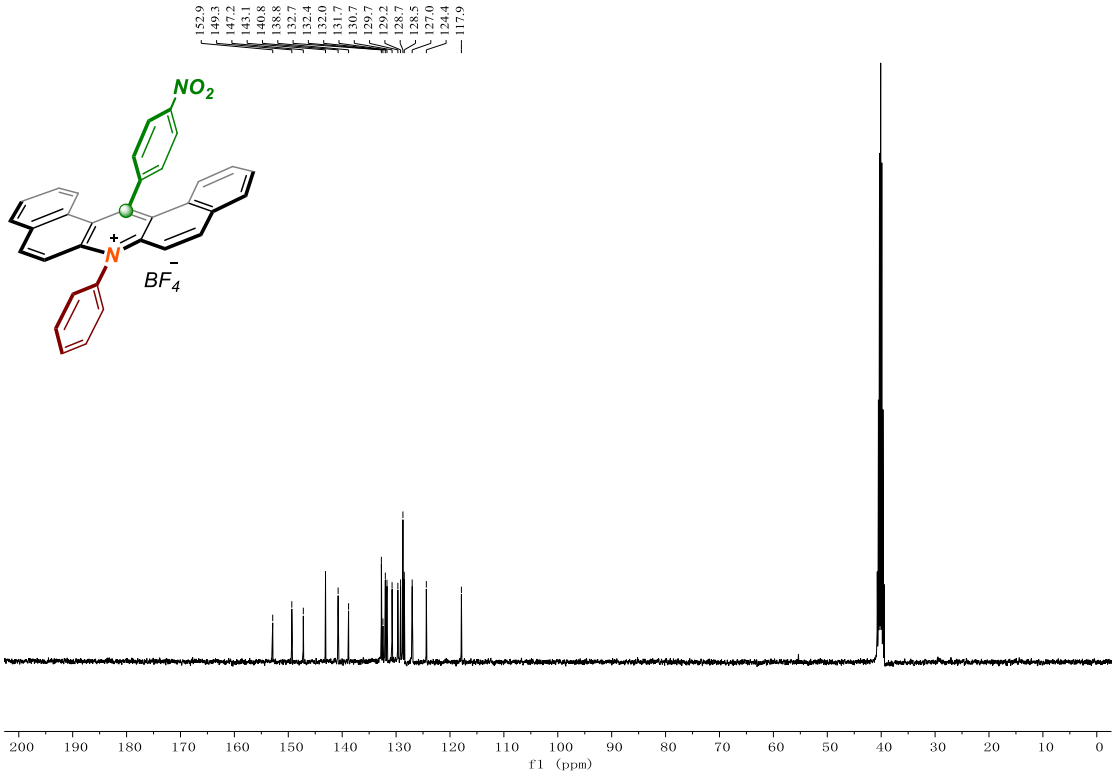
^{19}F NMR of **8e** (376 MHz, $CDCl_3$)



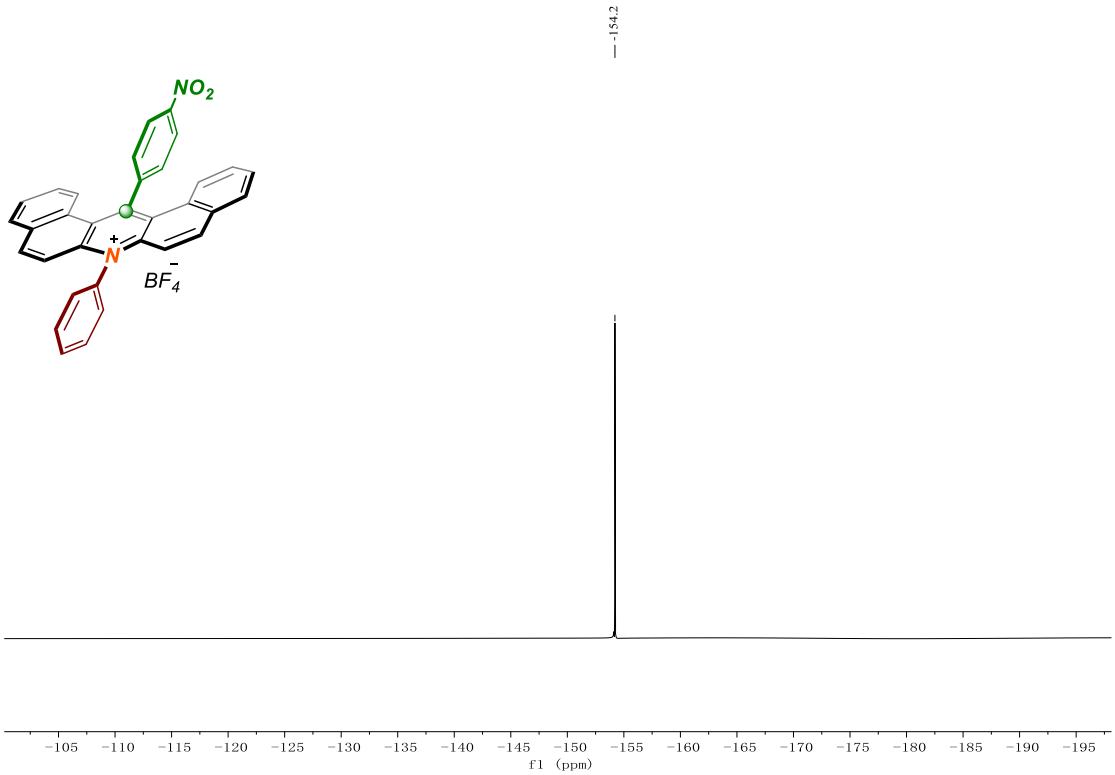
^{1}H NMR of **8f** (400 MHz, d_6-DMSO)



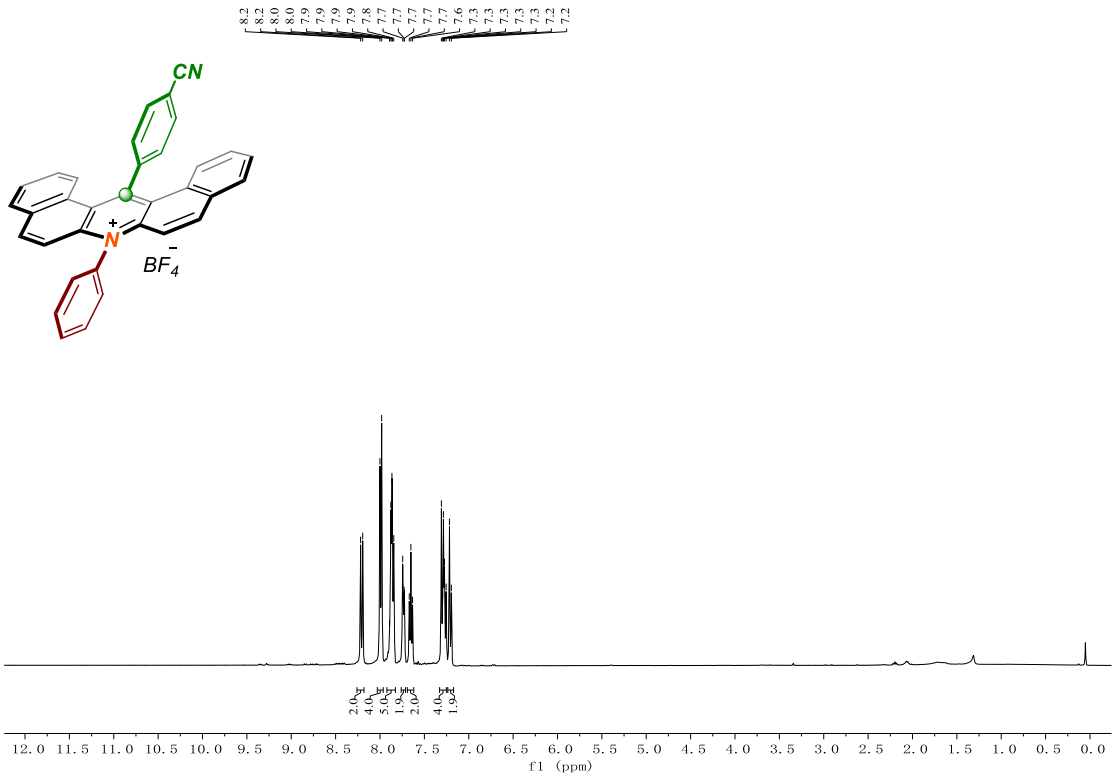
^{13}C NMR of **8f** (100 MHz, d_6-DMSO)



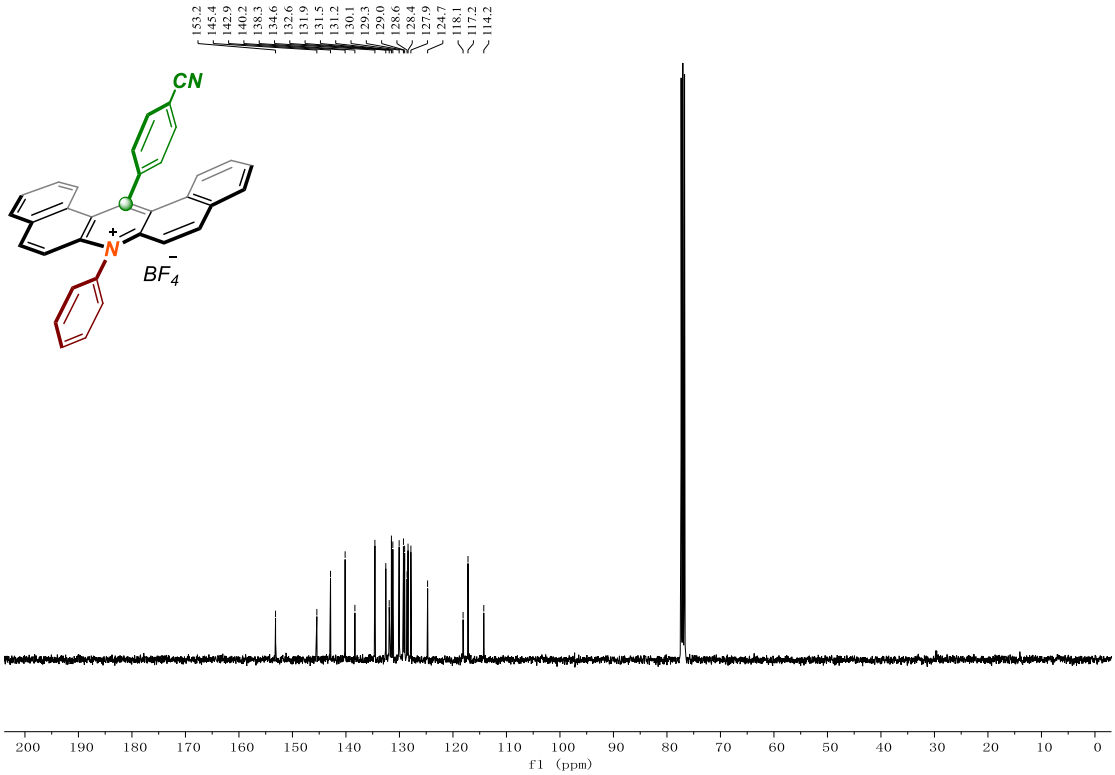
^{19}F NMR of **8f** (376 MHz, $CDCl_3$)



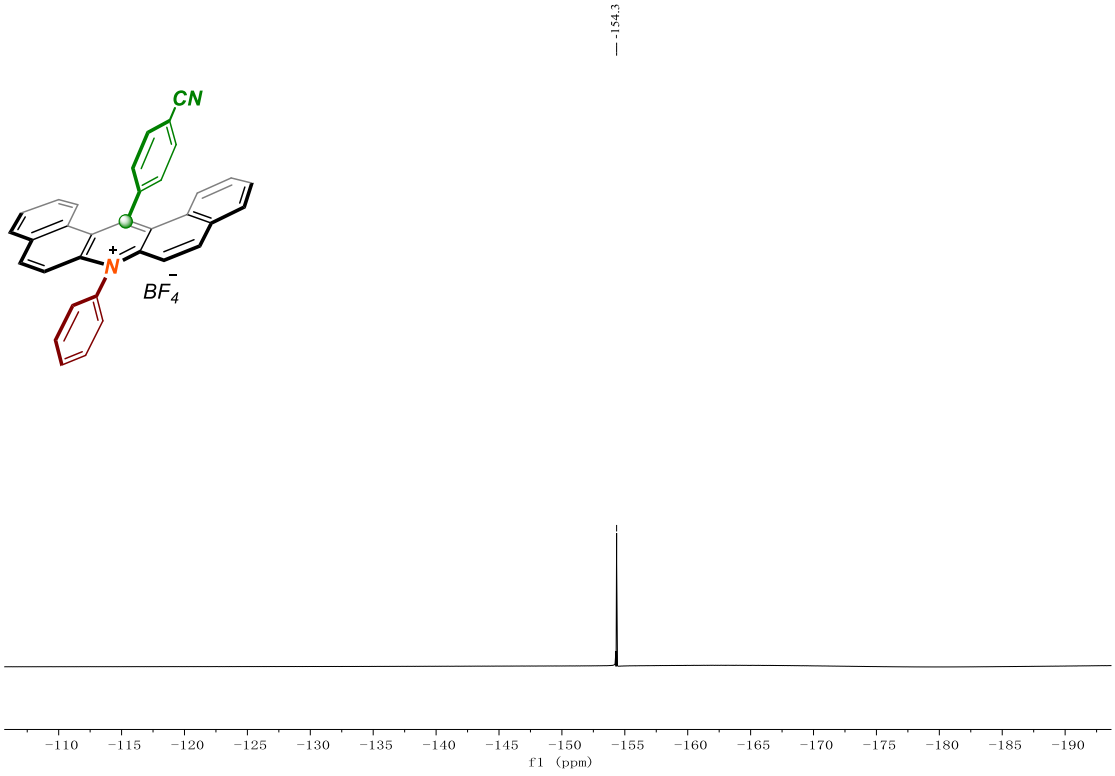
^{1}H NMR of **8g** (400 MHz, $CDCl_3$)



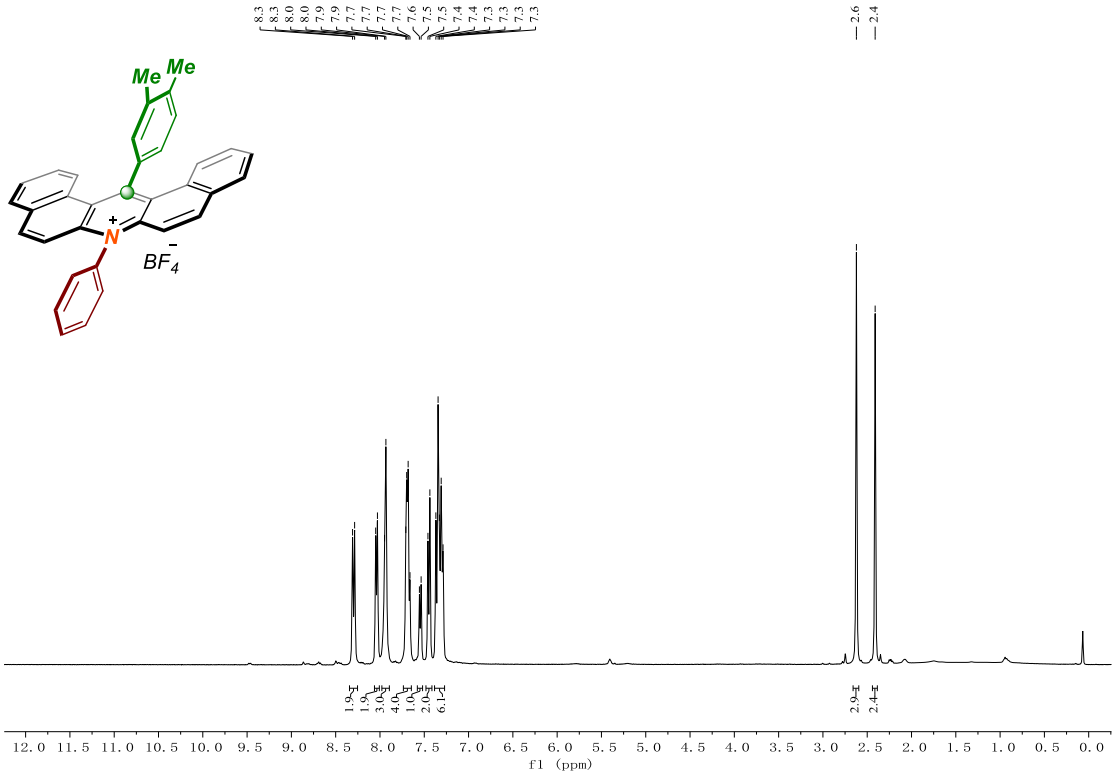
^{13}C NMR of **8g** (100 MHz, $CDCl_3$)



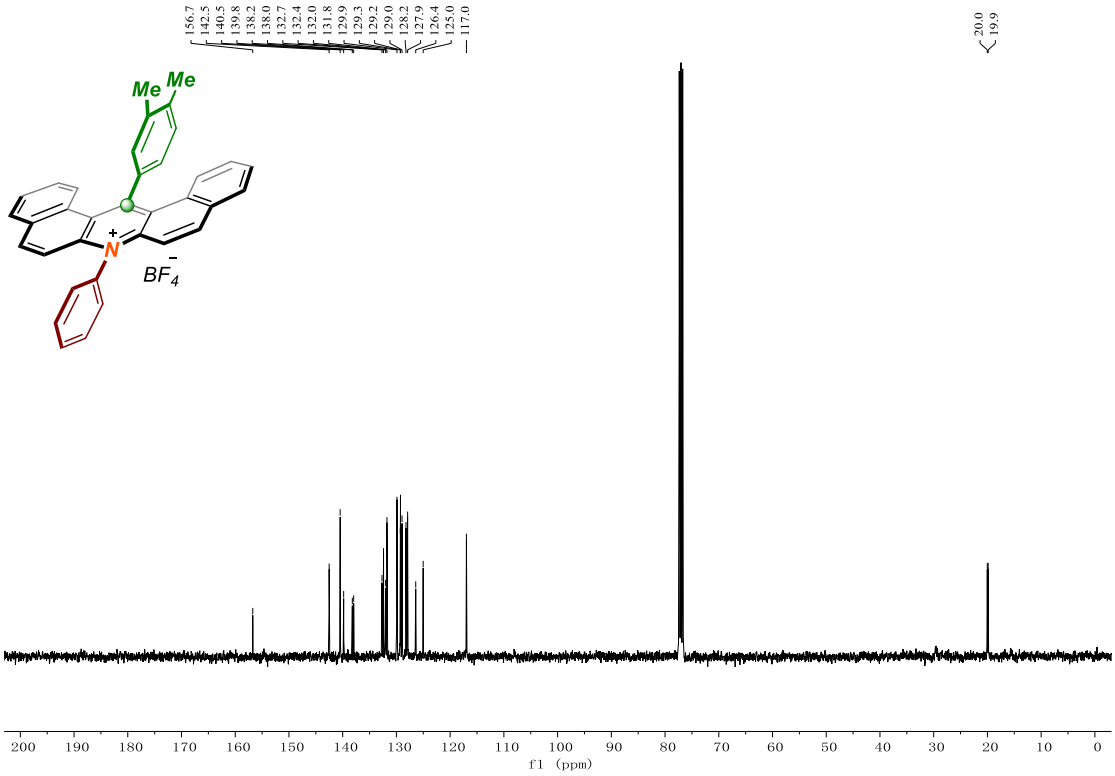
^{19}F NMR of **8g** (376 MHz, $CDCl_3$)



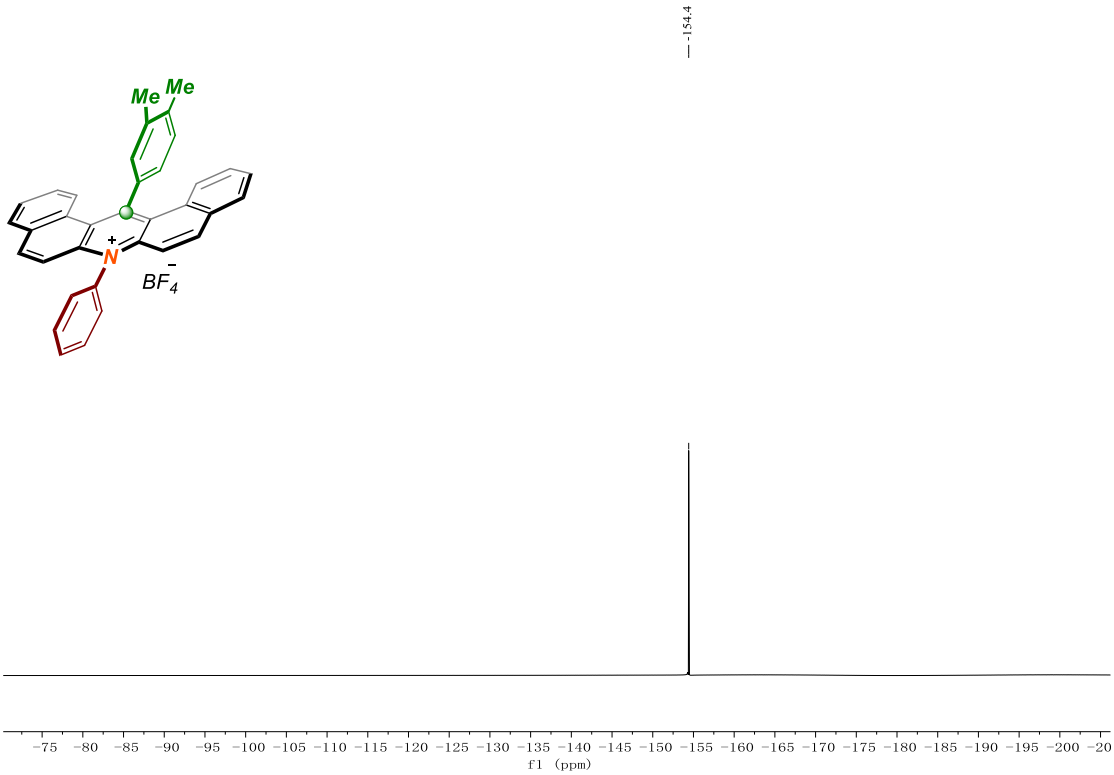
^{1}H NMR of **8h** (400 MHz, $CDCl_3$)



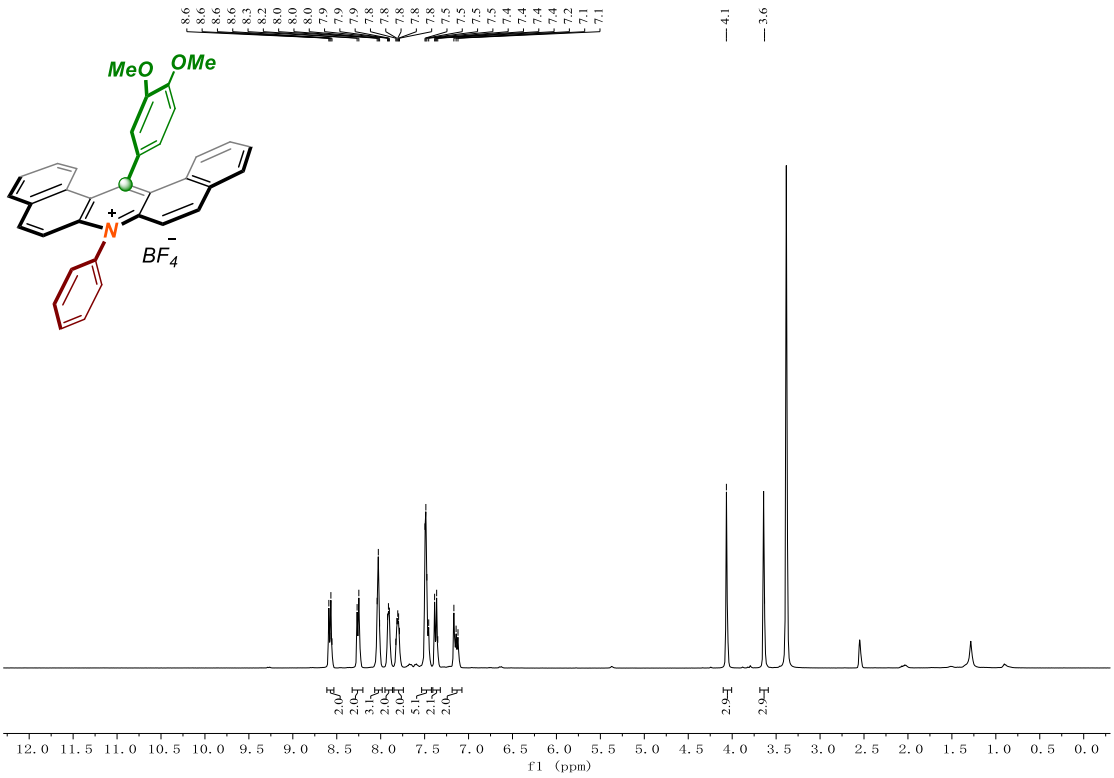
^{13}C NMR of **8h** (100 MHz, $CDCl_3$)



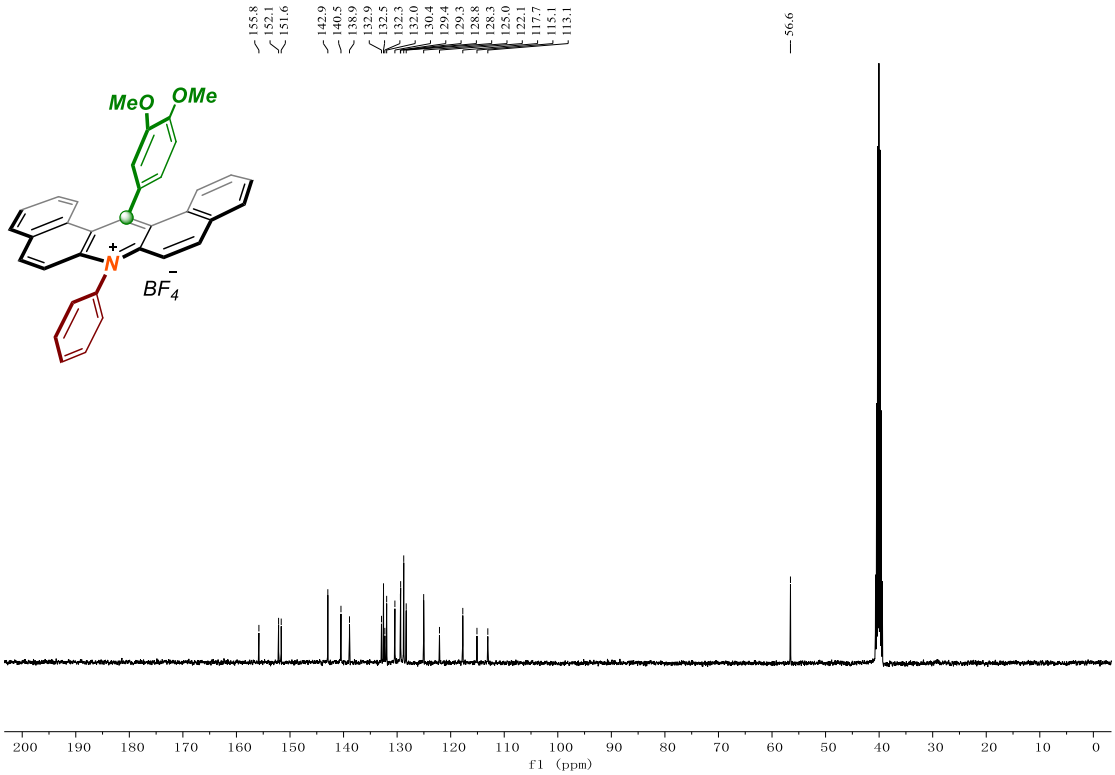
^{19}F NMR of **8h** (376 MHz, $CDCl_3$)



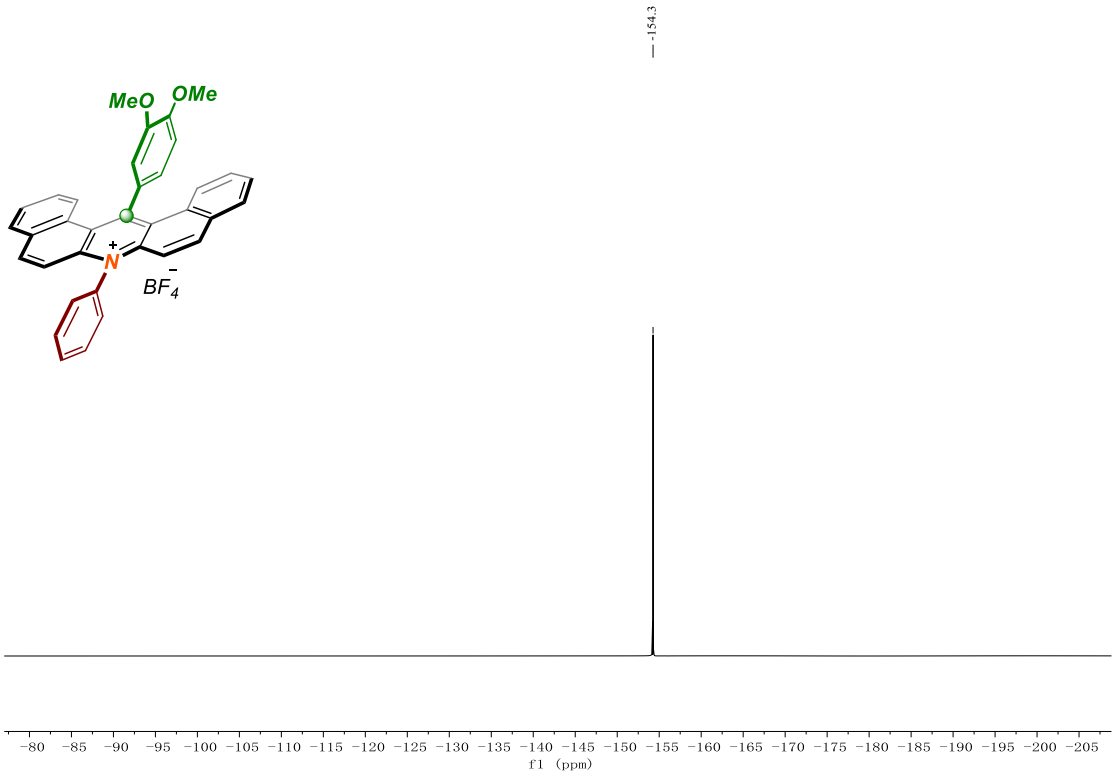
^{1}H NMR of **8i** (400 MHz, d_6-DMSO)



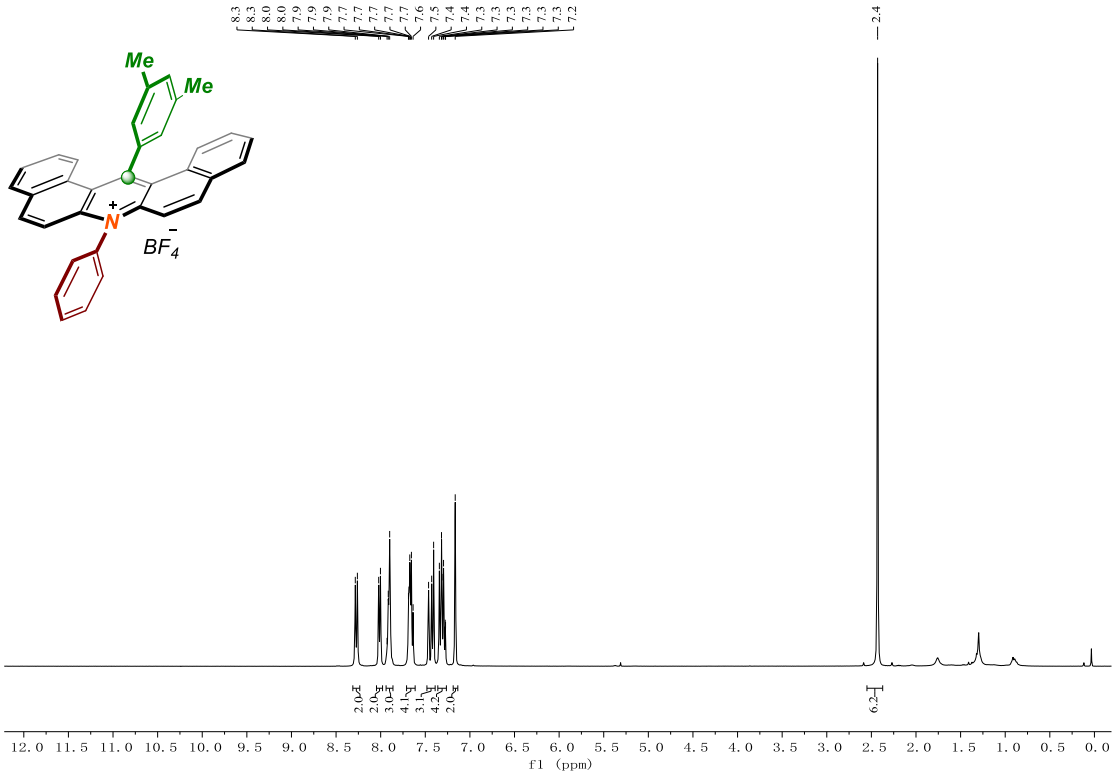
^{13}C NMR of **8i** (100 MHz, d_6-DMSO)



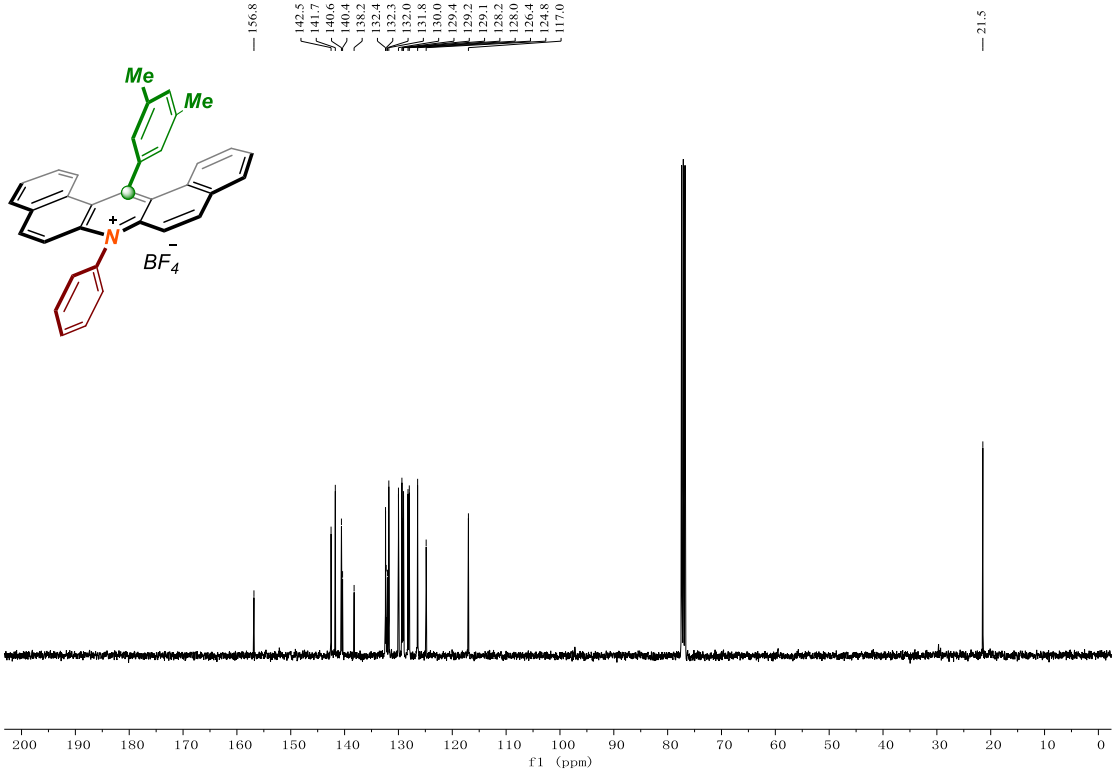
^{19}F NMR of **8i** (376 MHz, $CDCl_3$)



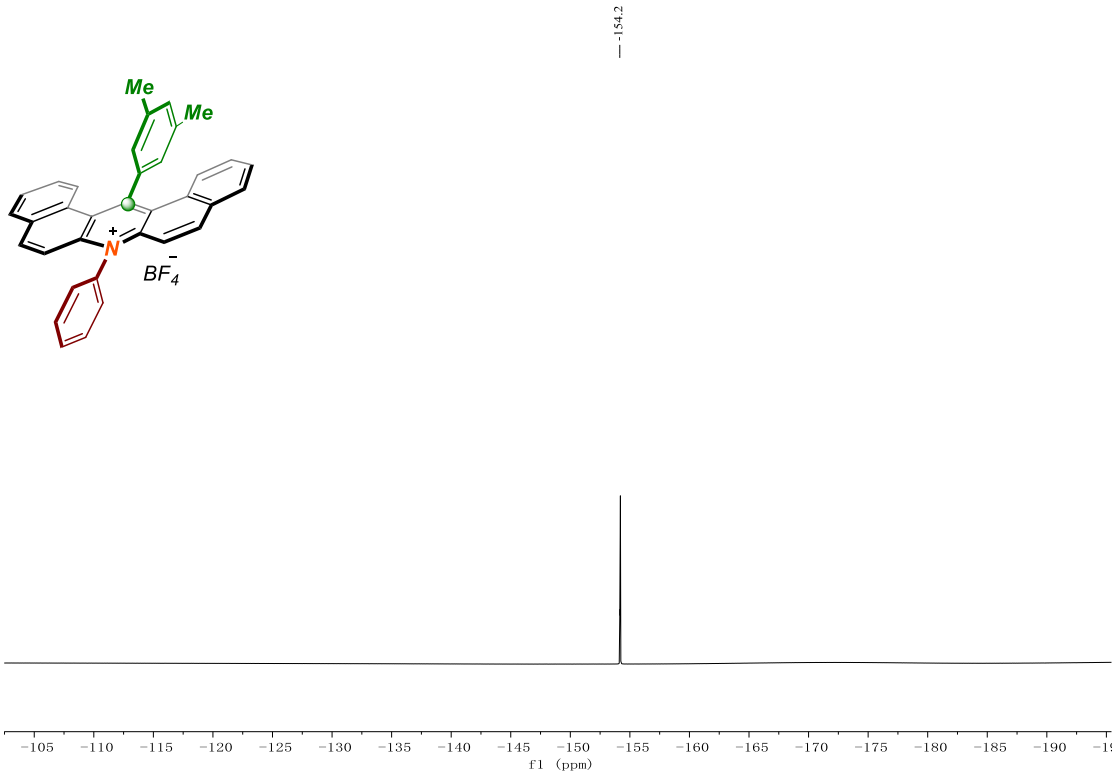
^{1}H NMR of **8j** (400 MHz, $CDCl_3$)



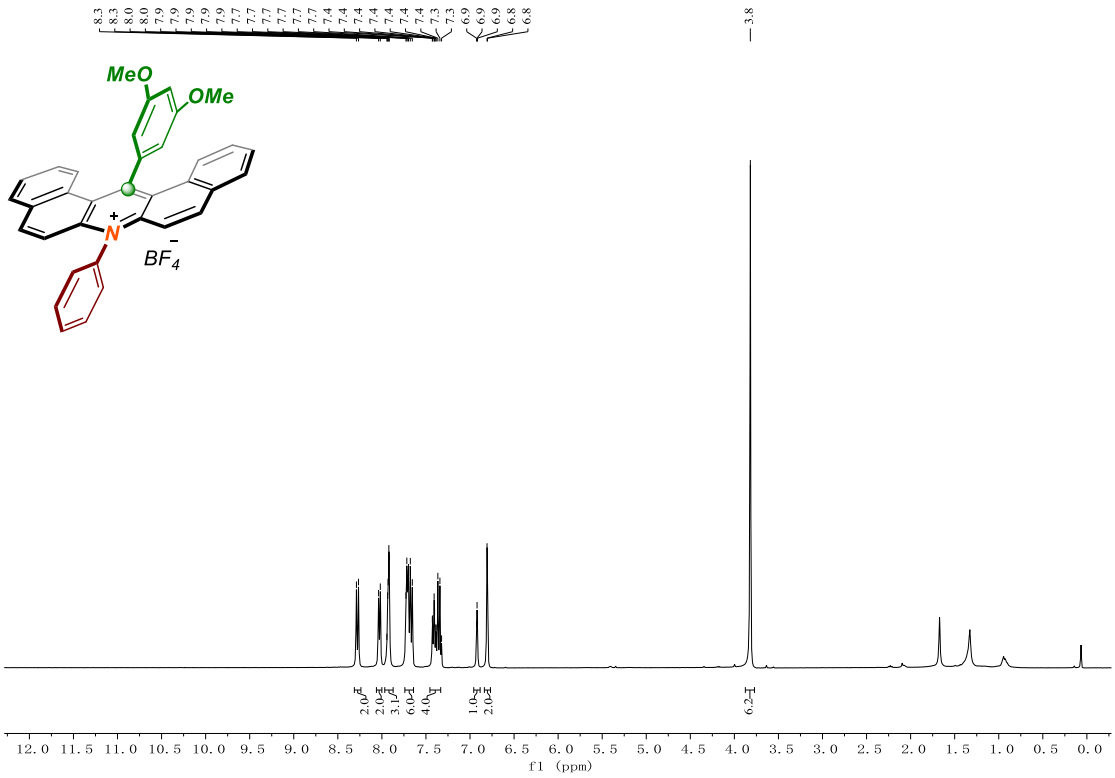
^{13}C NMR of **8j** (100 MHz, $CDCl_3$)



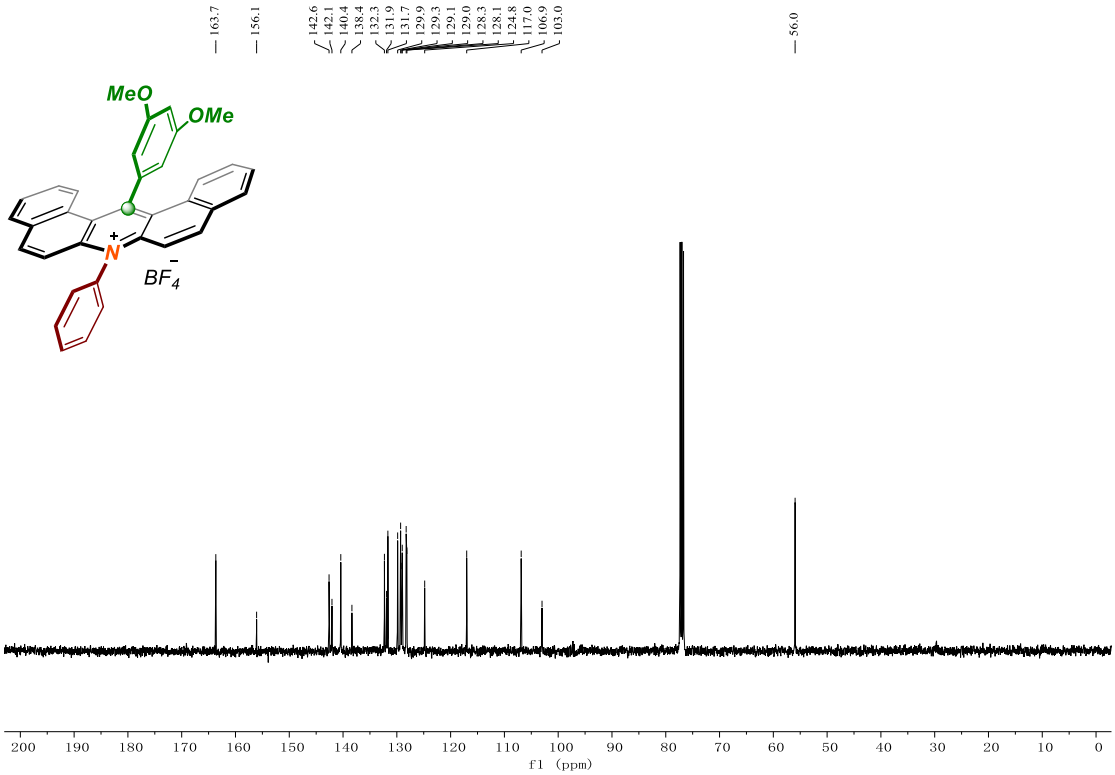
^{19}F NMR of **8j** (376 MHz, $CDCl_3$)



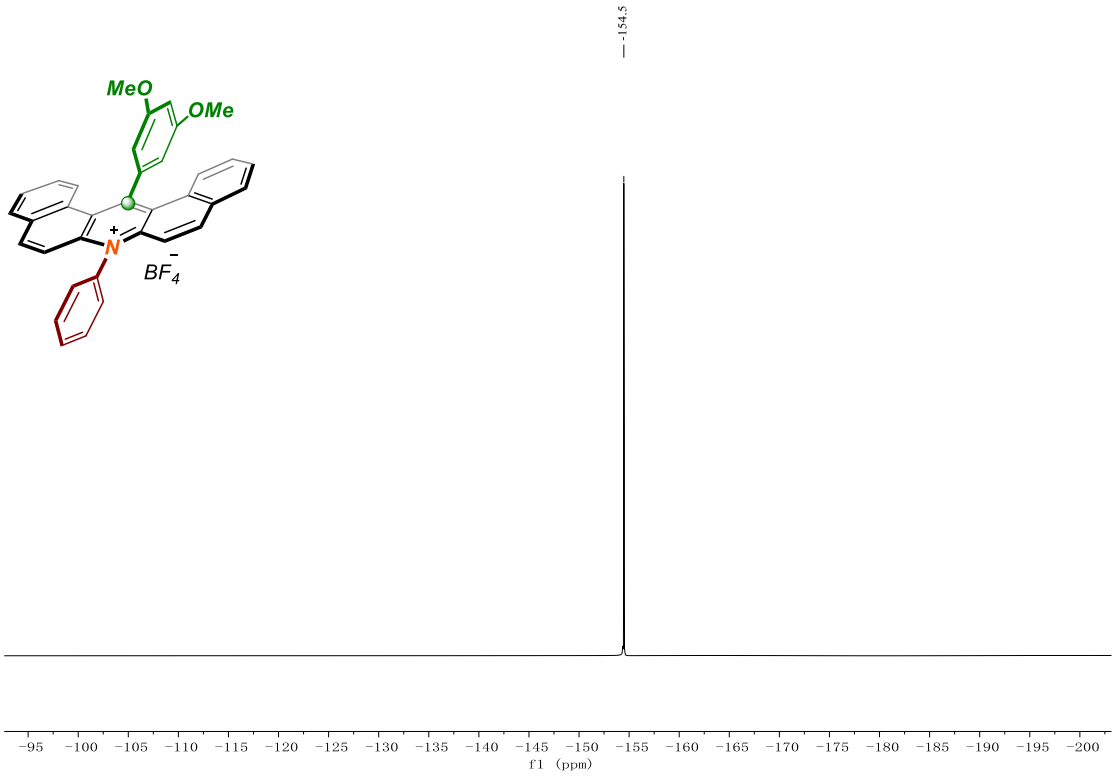
^{1}H NMR of **8k** (400 MHz, $CDCl_3$)



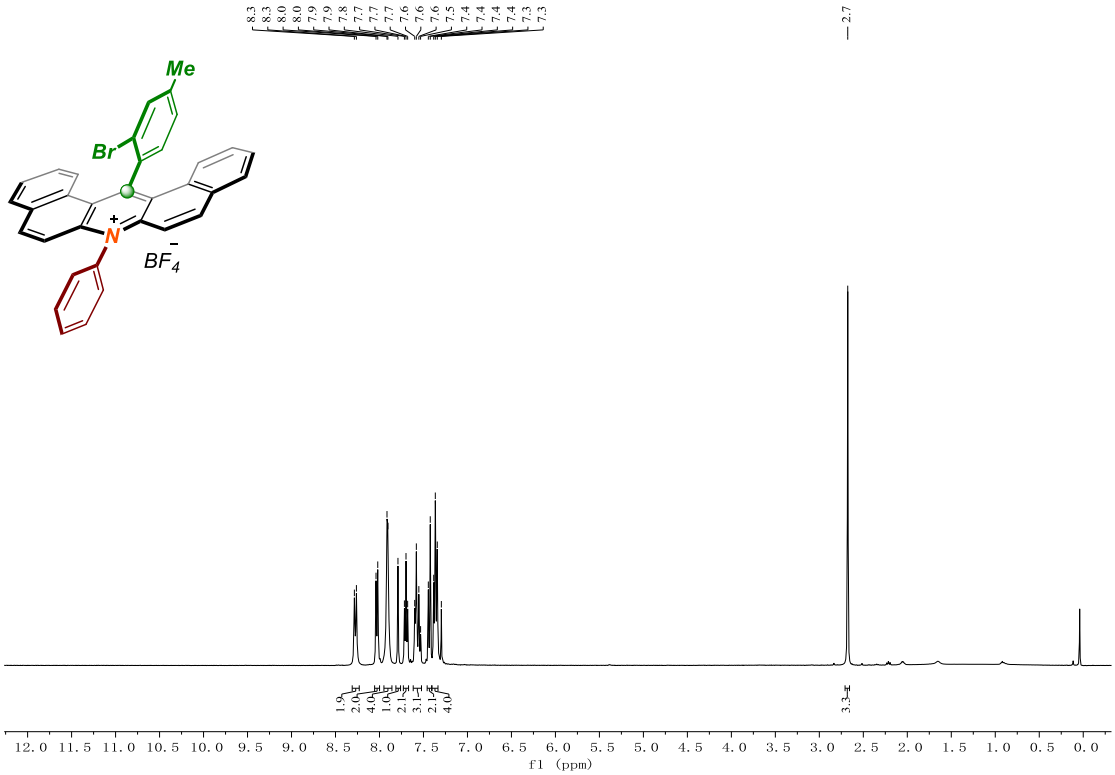
^{13}C NMR of **8k** (100 MHz, $CDCl_3$)



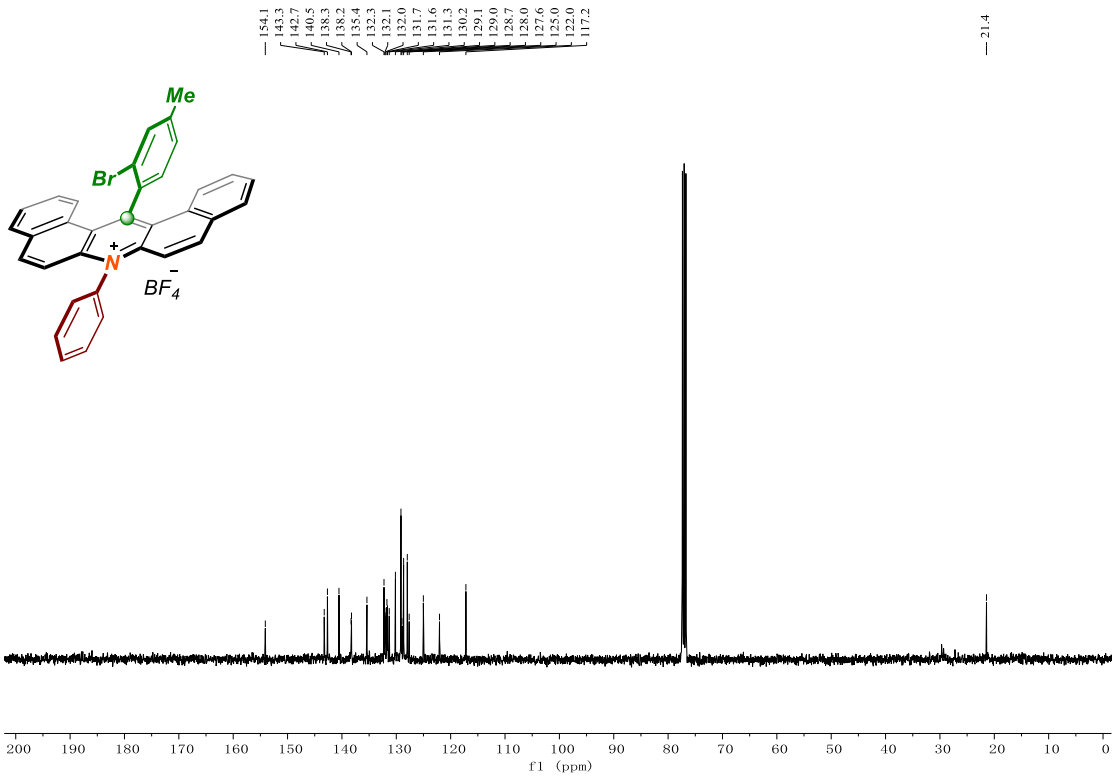
^{19}F NMR of **8k** (376 MHz, $CDCl_3$)



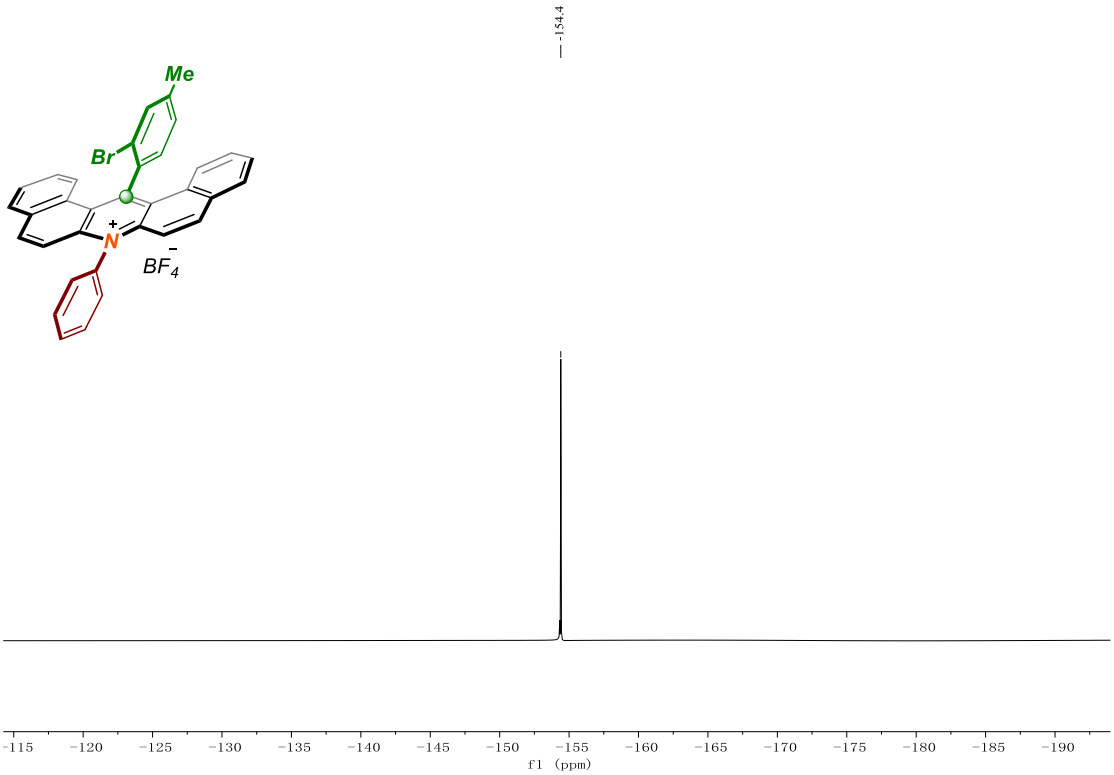
^{1}H NMR of **8l** (400 MHz, $CDCl_3$)



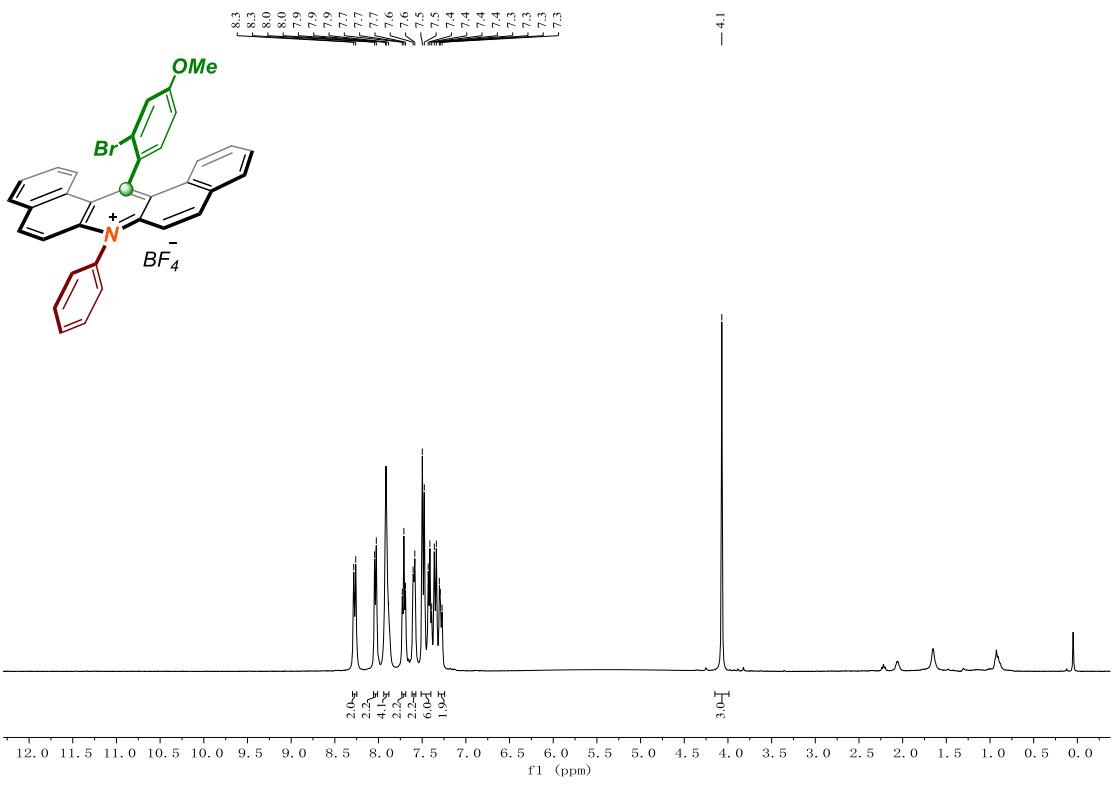
^{13}C NMR of **8l** (100 MHz, $CDCl_3$)



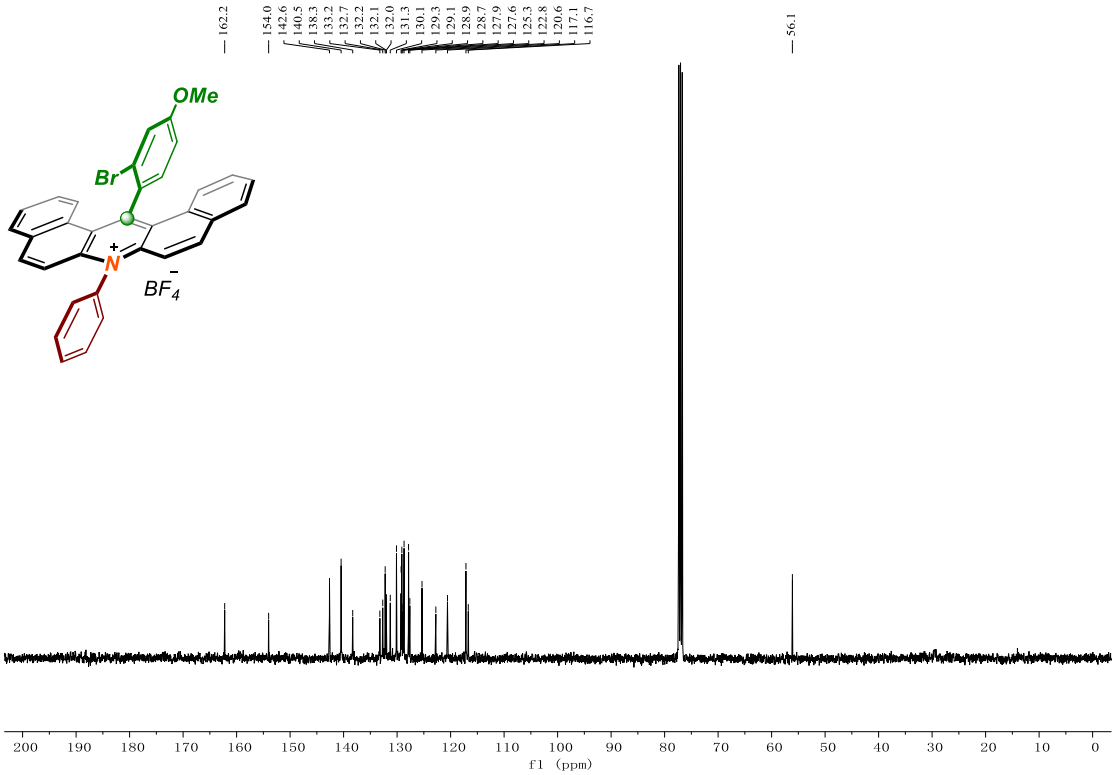
^{19}F NMR of **8l** (376 MHz, $CDCl_3$)



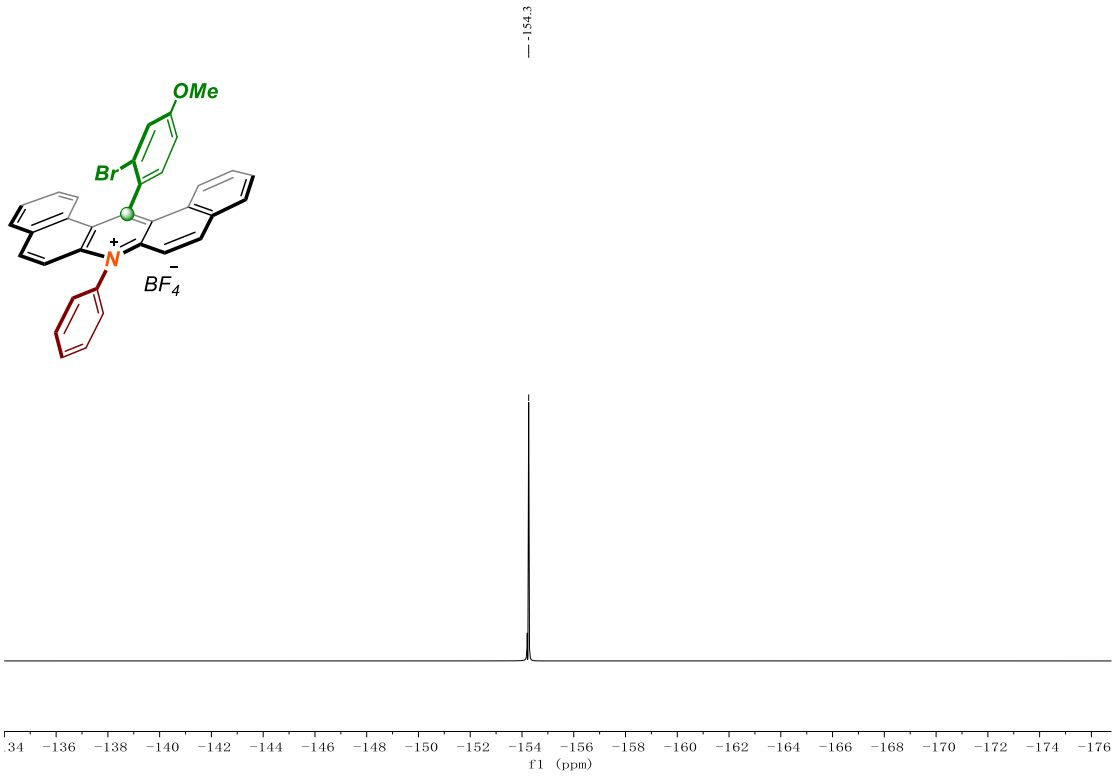
^{1}H NMR of **8m** (400 MHz, $CDCl_3$)



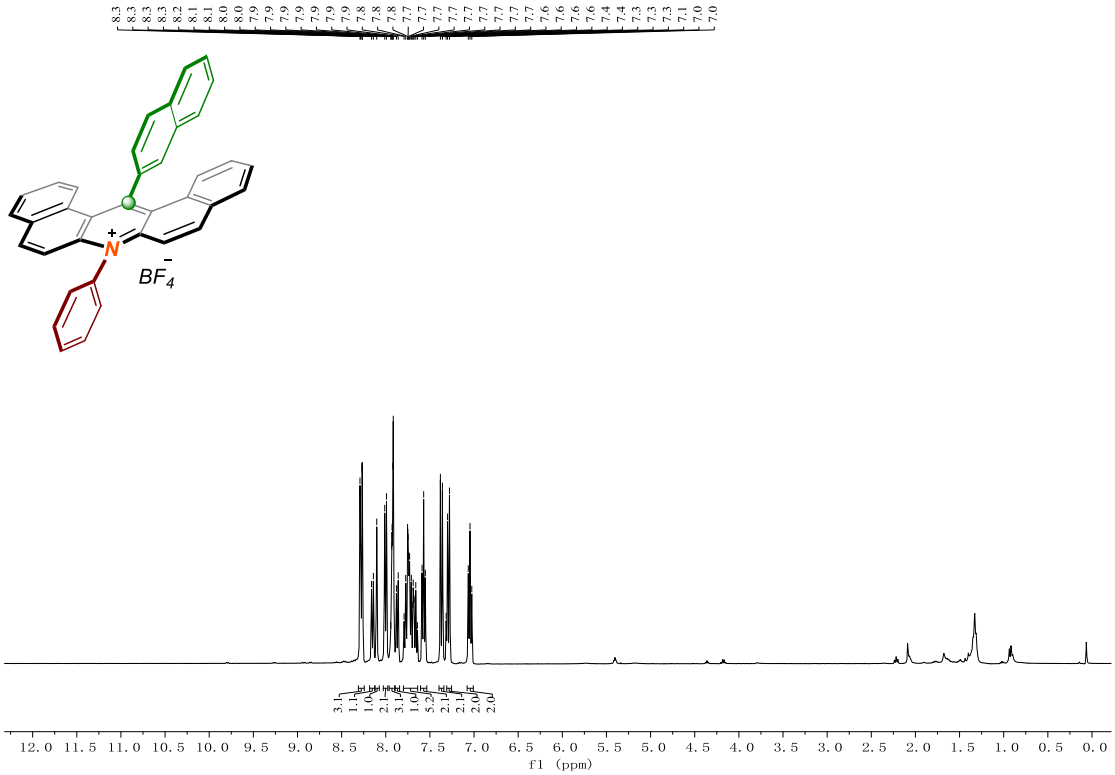
^{13}C NMR of **8m** (100 MHz, $CDCl_3$)



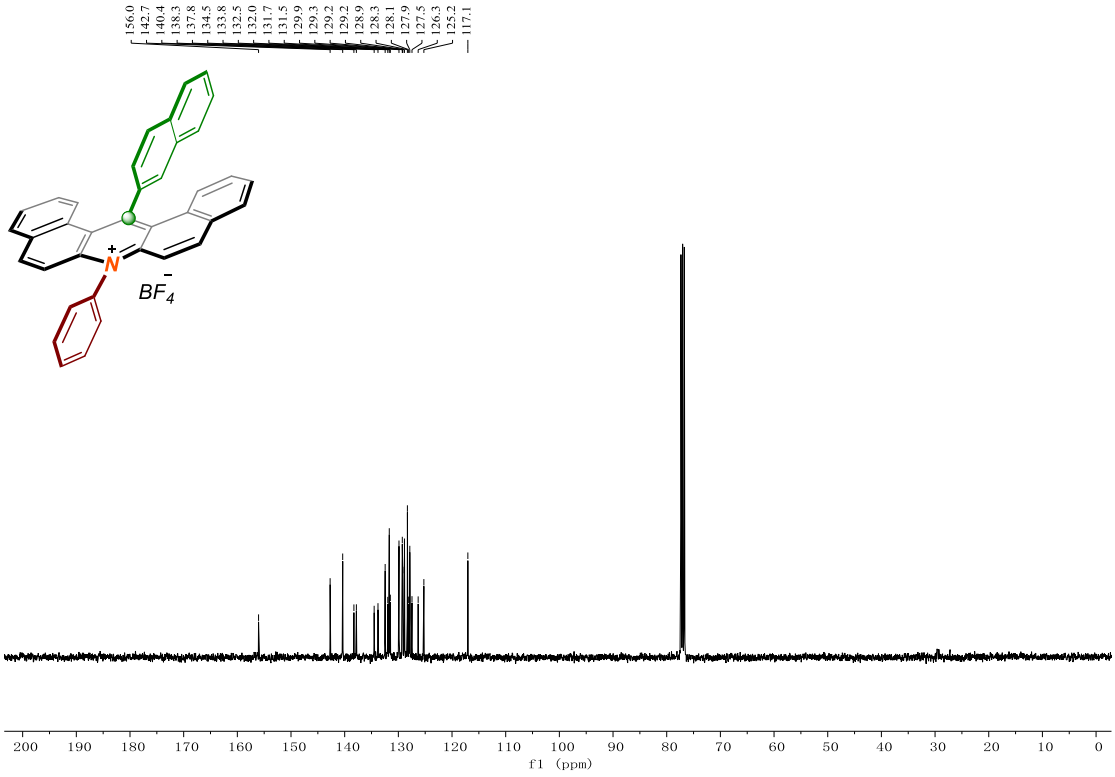
^{19}F NMR of **8m** (376 MHz, $CDCl_3$)



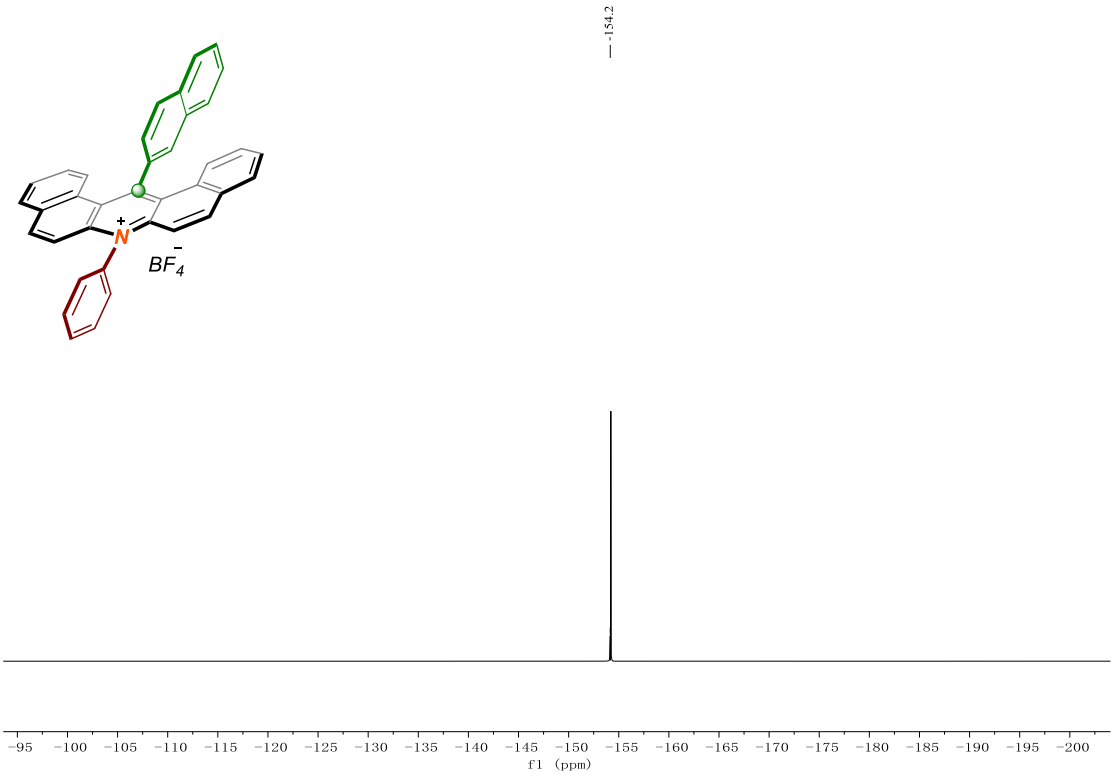
^{1}H NMR of **8n** (400 MHz, $CDCl_3$)



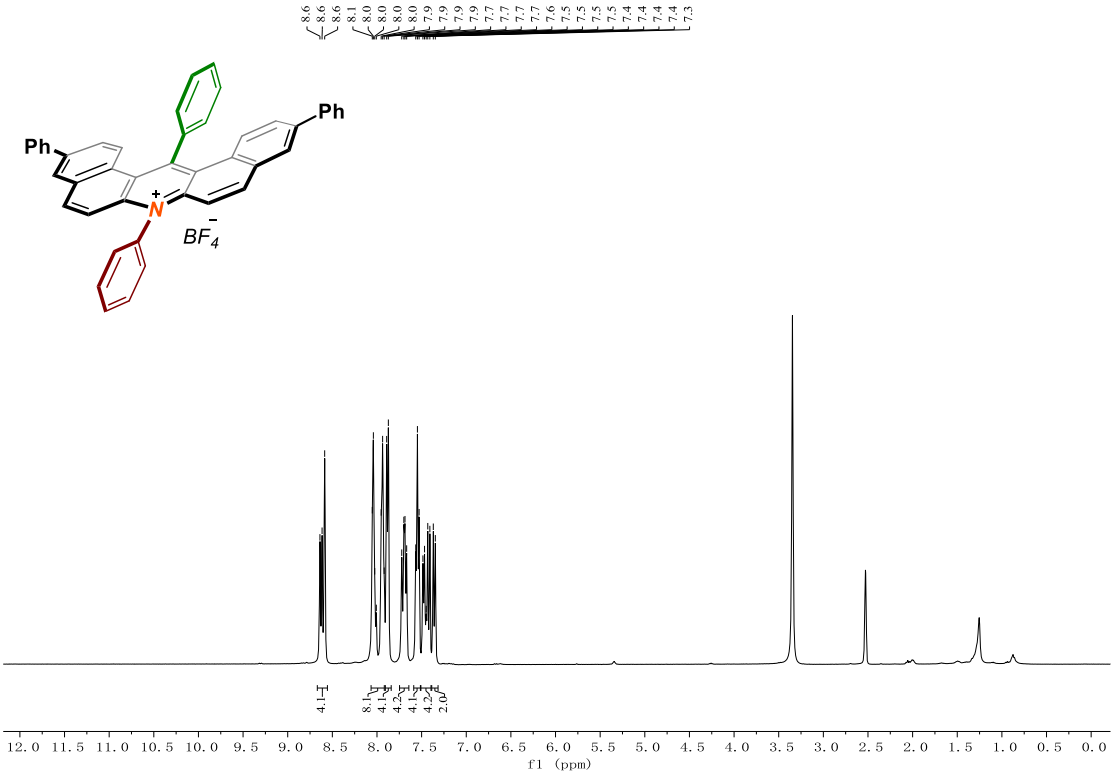
^{13}C NMR of **8n** (100 MHz, $CDCl_3$)



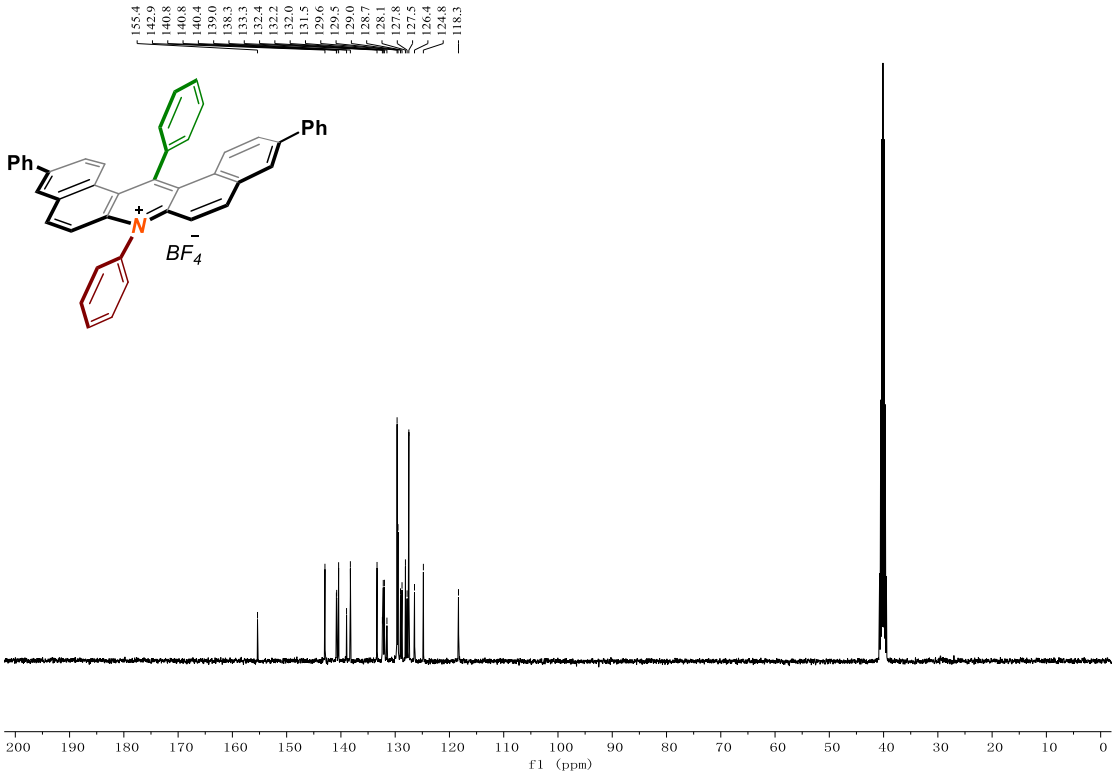
^{19}F NMR of **8n** (376 MHz, $CDCl_3$)



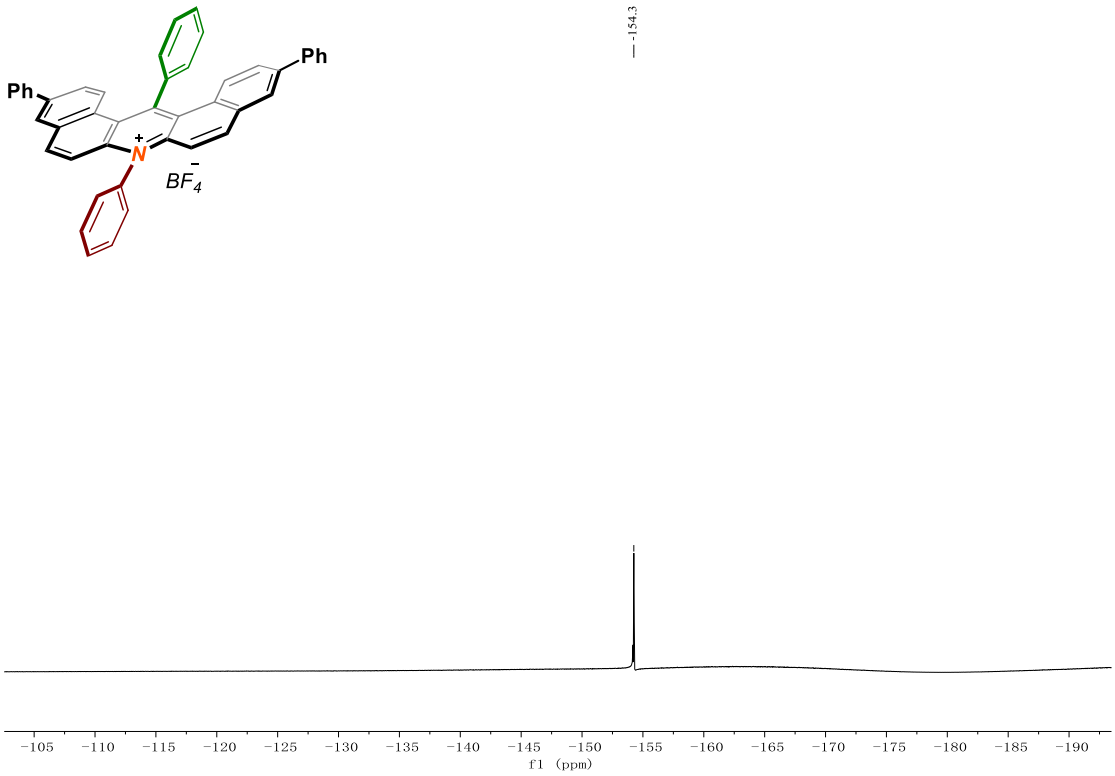
^{1}H NMR of **8o** (400 MHz, d_6-DMSO)



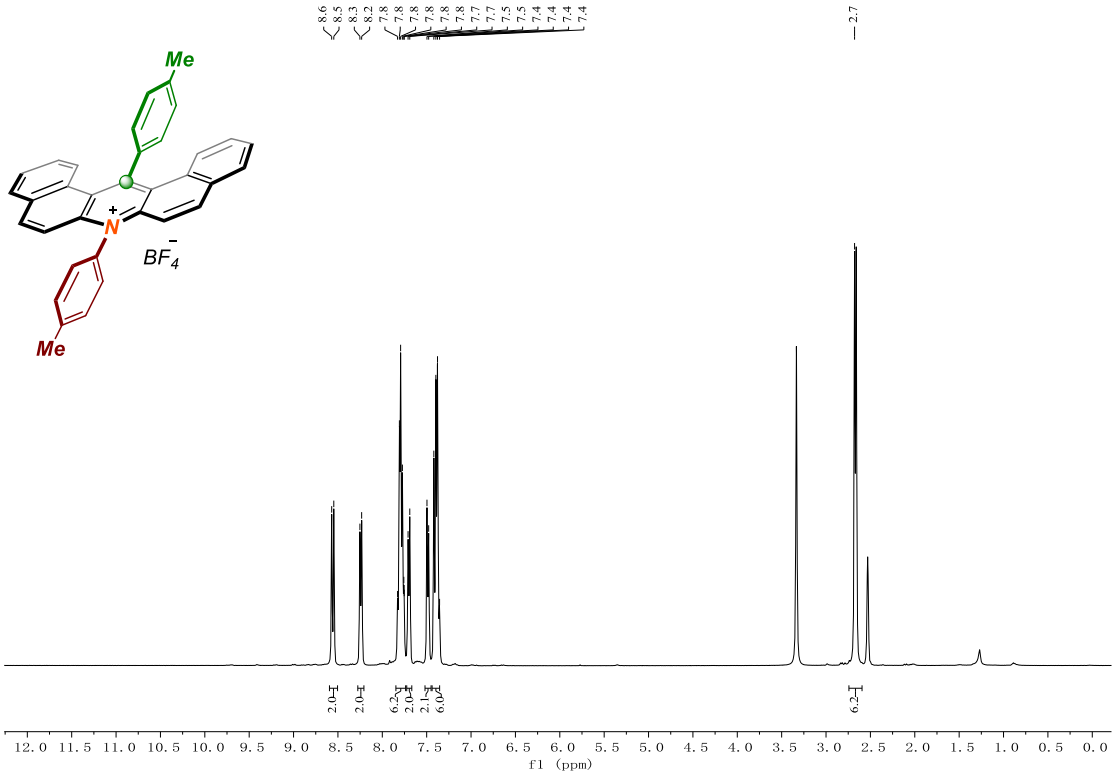
^{13}C NMR of **8o** (100 MHz, d_6-DMSO)



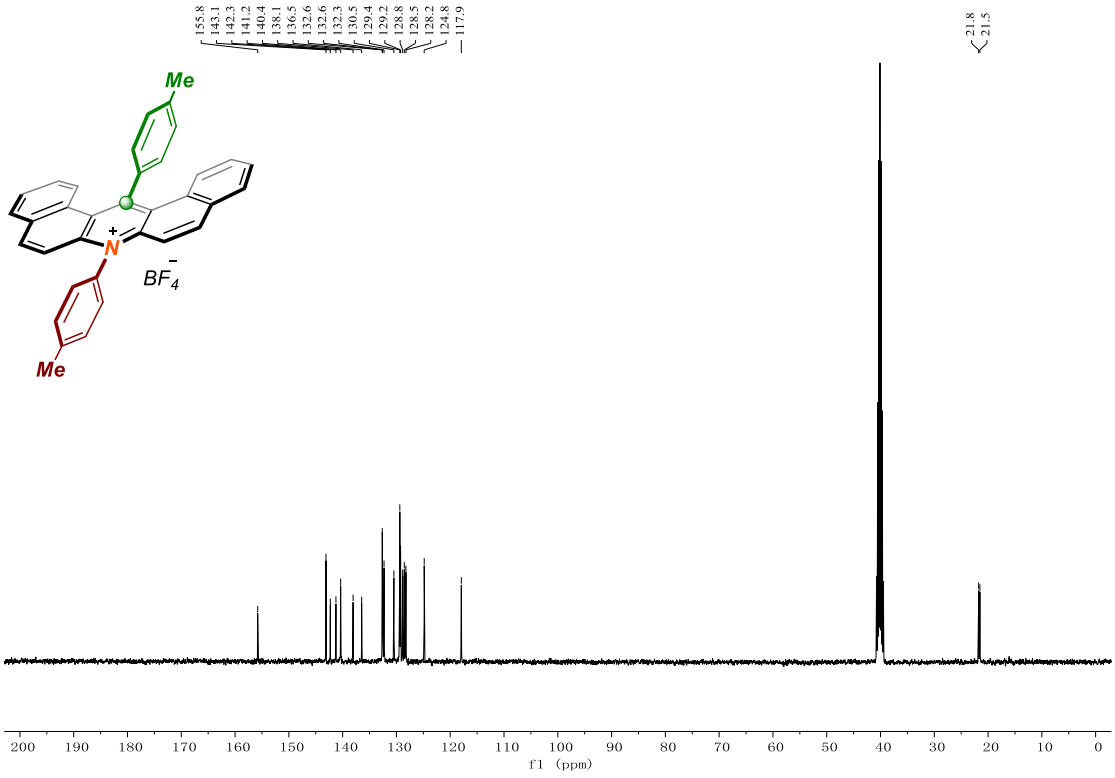
^{19}F NMR of **8o** (376 MHz, $CDCl_3$)



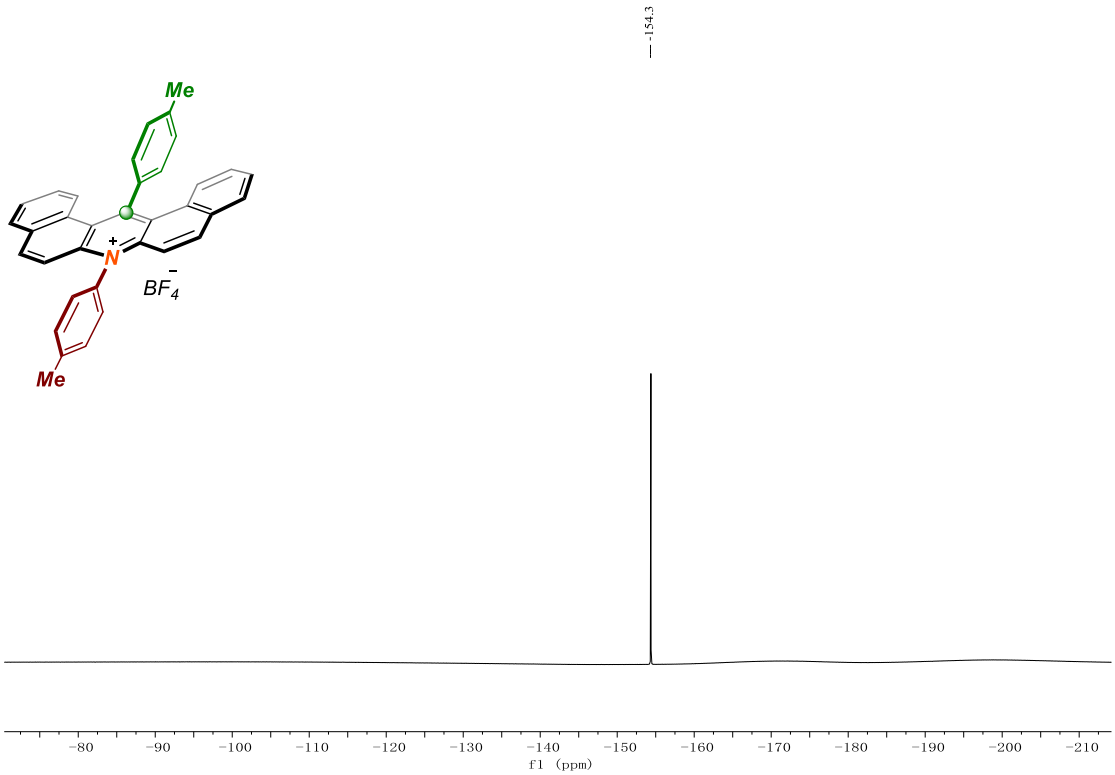
^{1}H NMR of **8p** (400 MHz, d_6-DMSO)



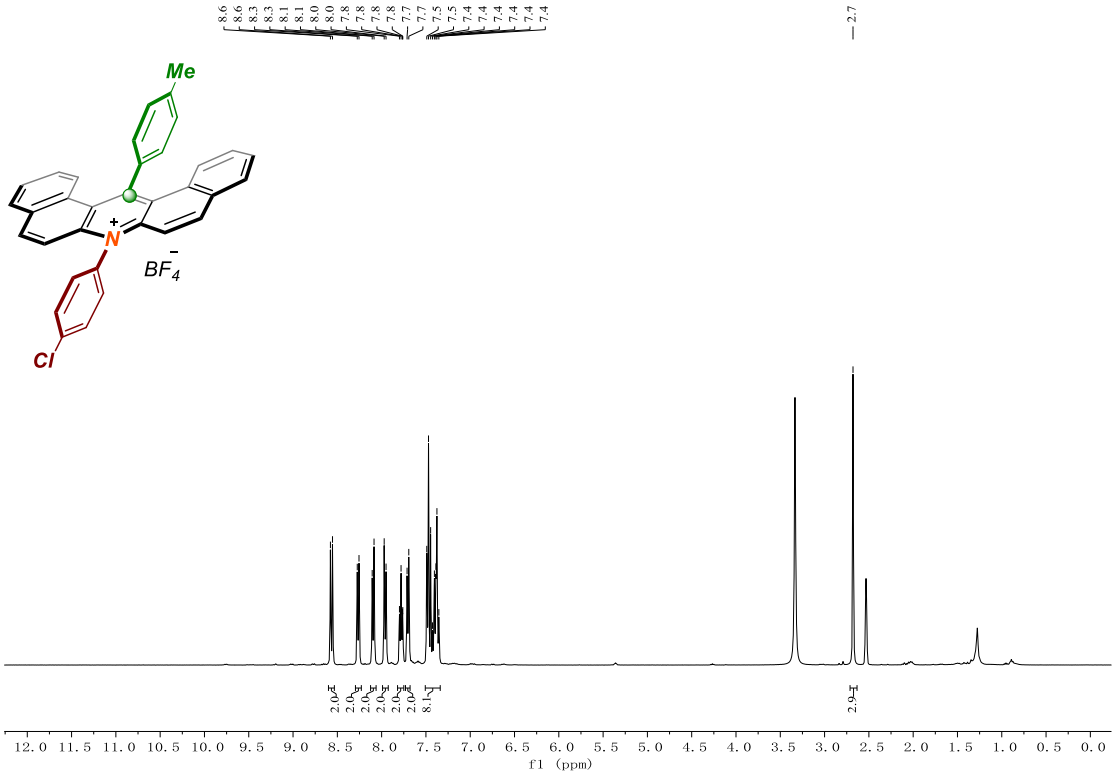
^{13}C NMR of **8p** (100 MHz, d_6-DMSO)



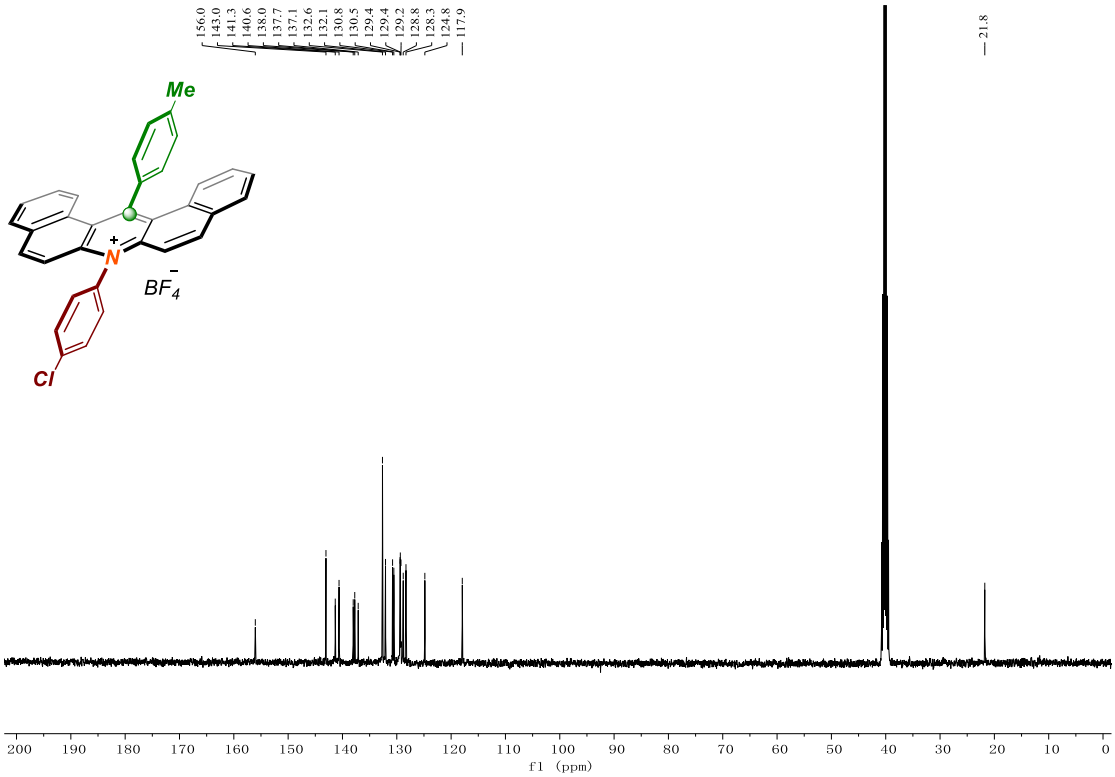
^{19}F NMR of **8p** (376 MHz, $CDCl_3$)



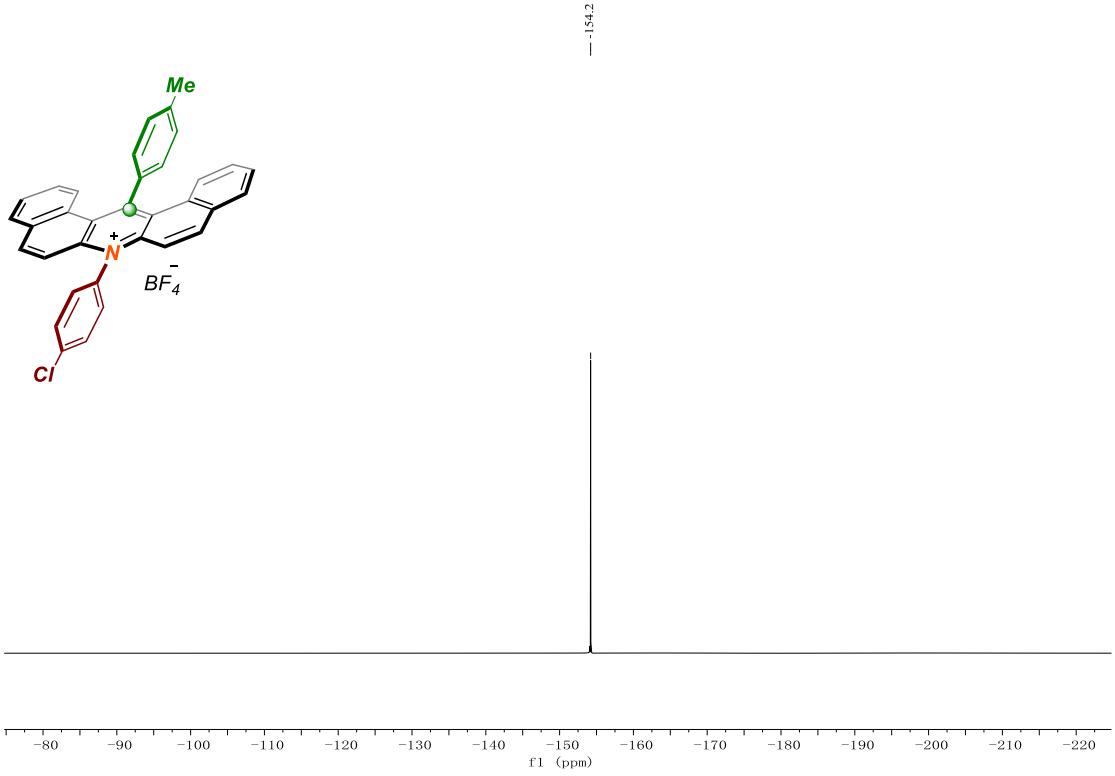
^{1}H NMR of **8q** (400 MHz, d_6-DMSO)



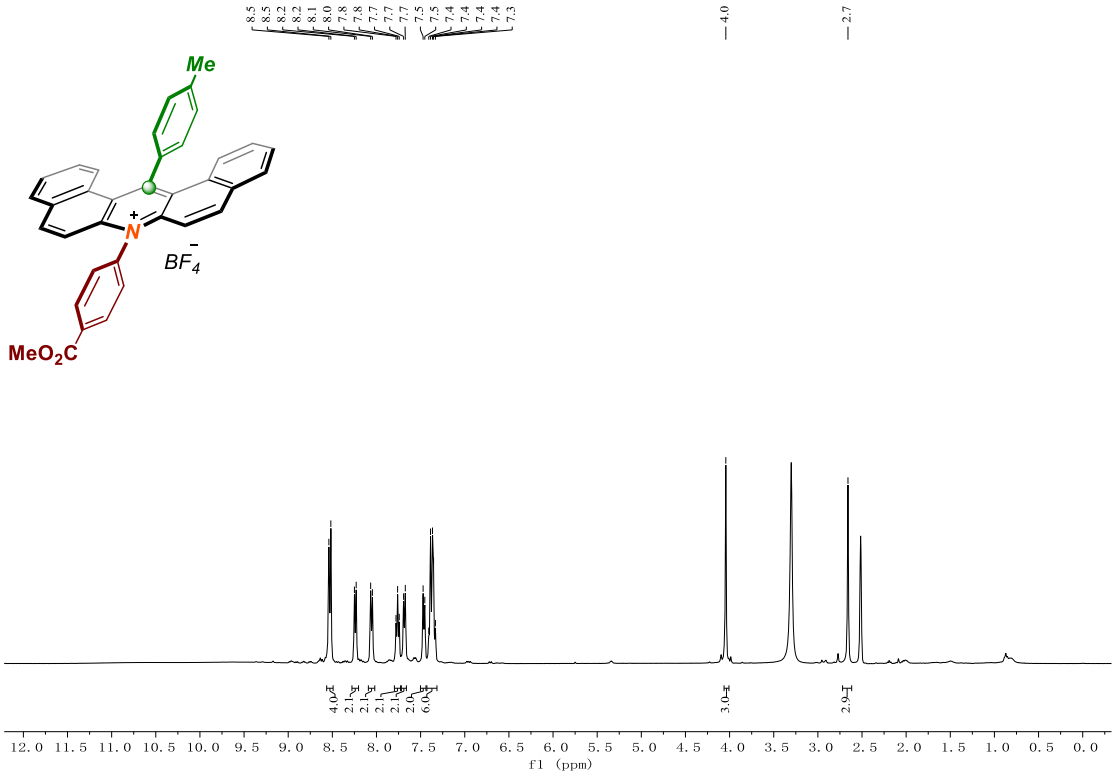
^{13}C NMR of **8q** (100 MHz, d_6-DMSO)



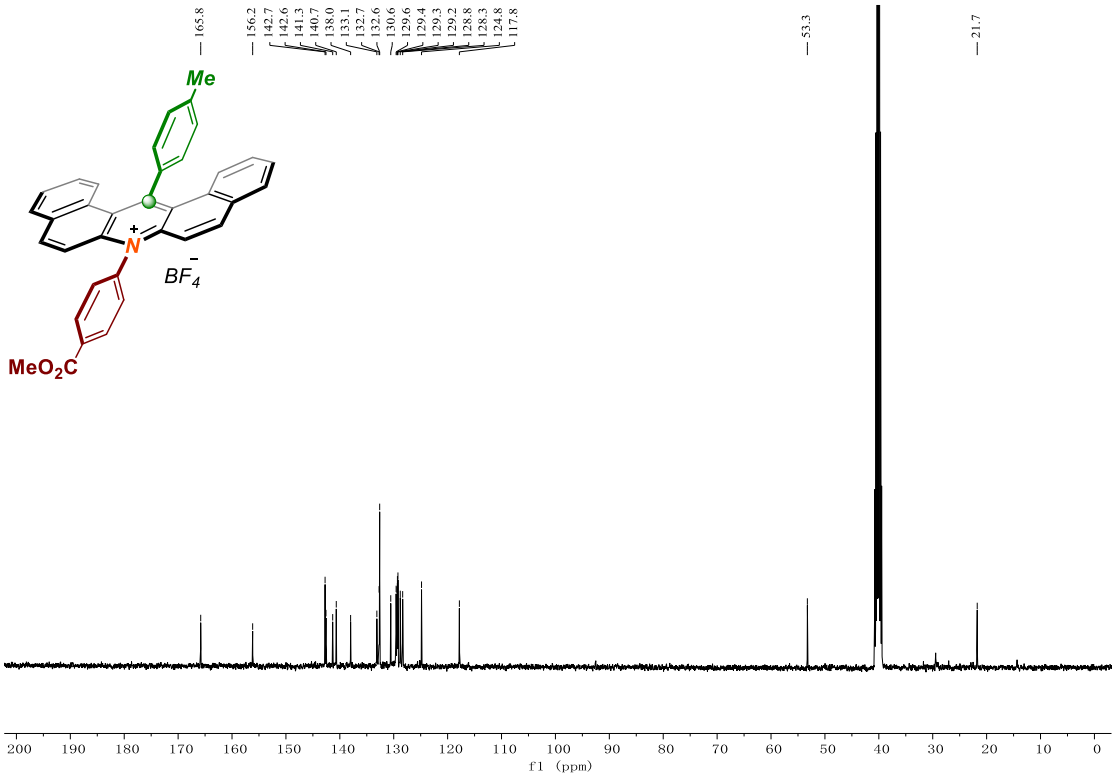
^{19}F NMR of **8q** (376 MHz, $CDCl_3$)



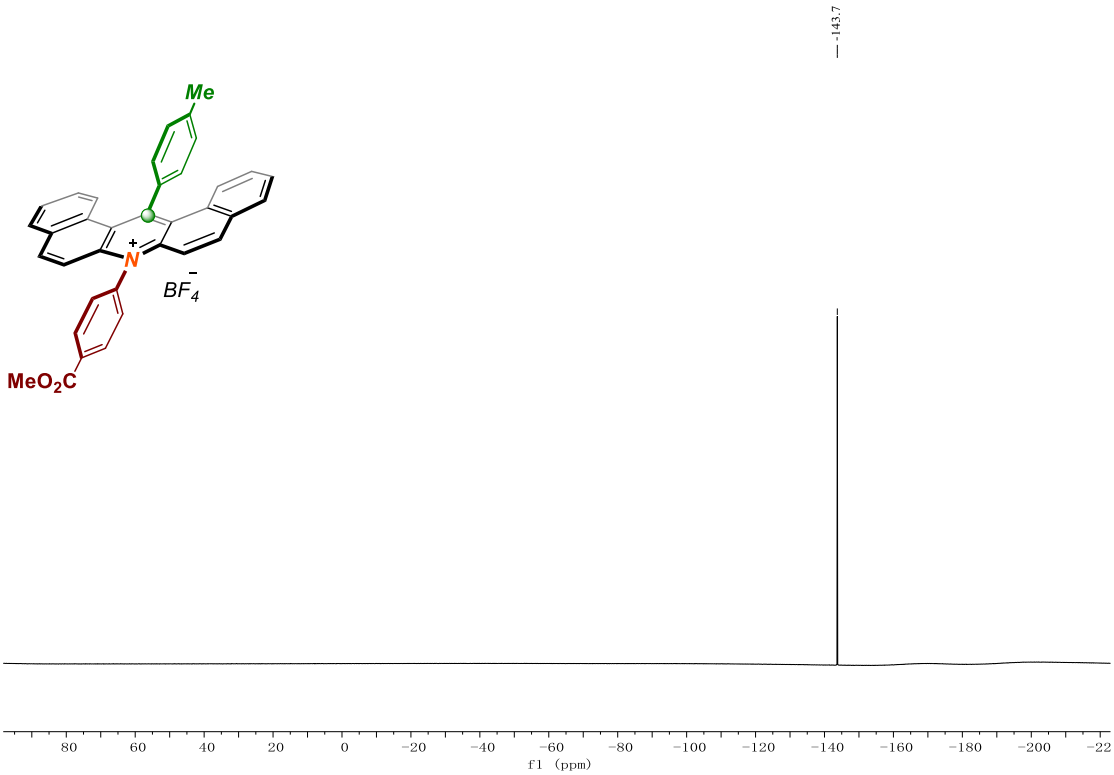
^{1}H NMR of **8r** (400 MHz, d_6-DMSO)



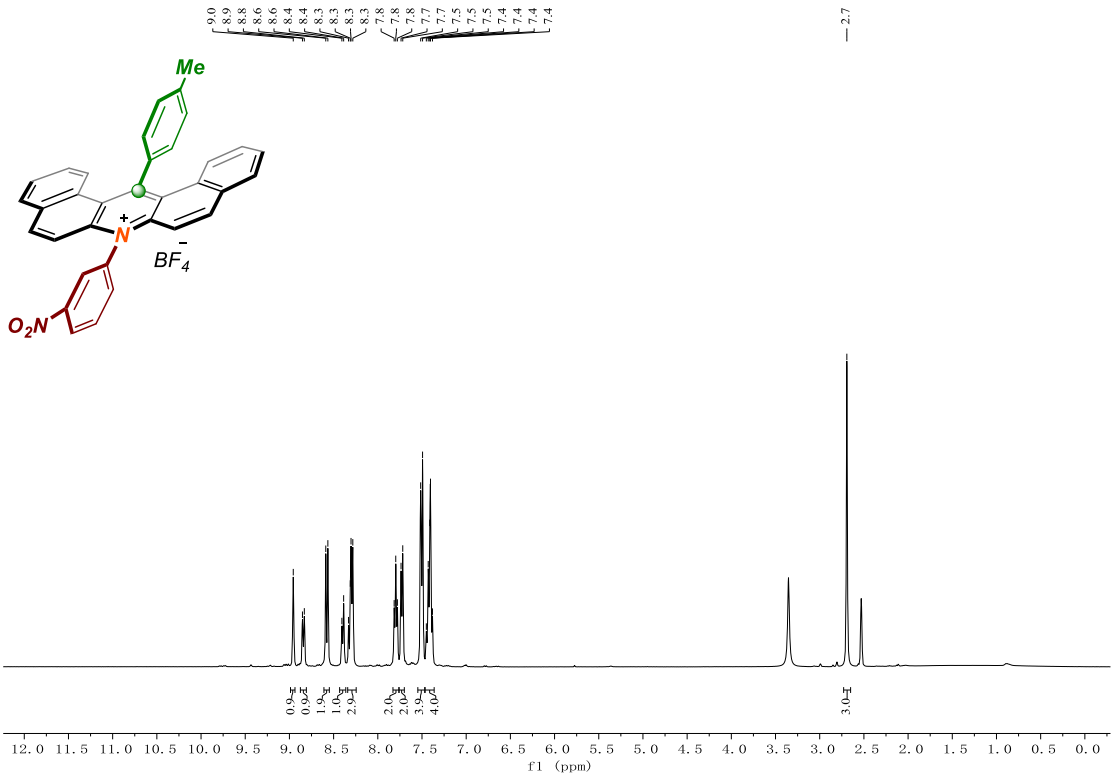
^{13}C NMR of **8r** (100 MHz, d_6-DMSO)



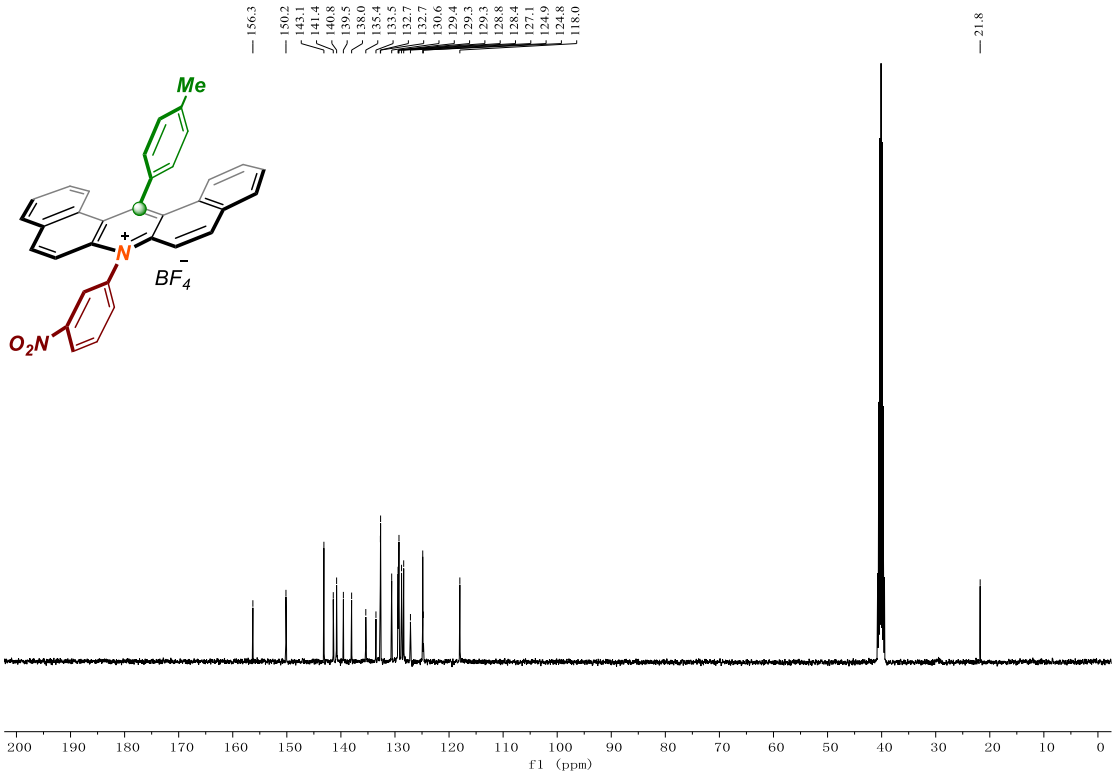
^{19}F NMR of **8r** (376 MHz, d_6-DMSO)



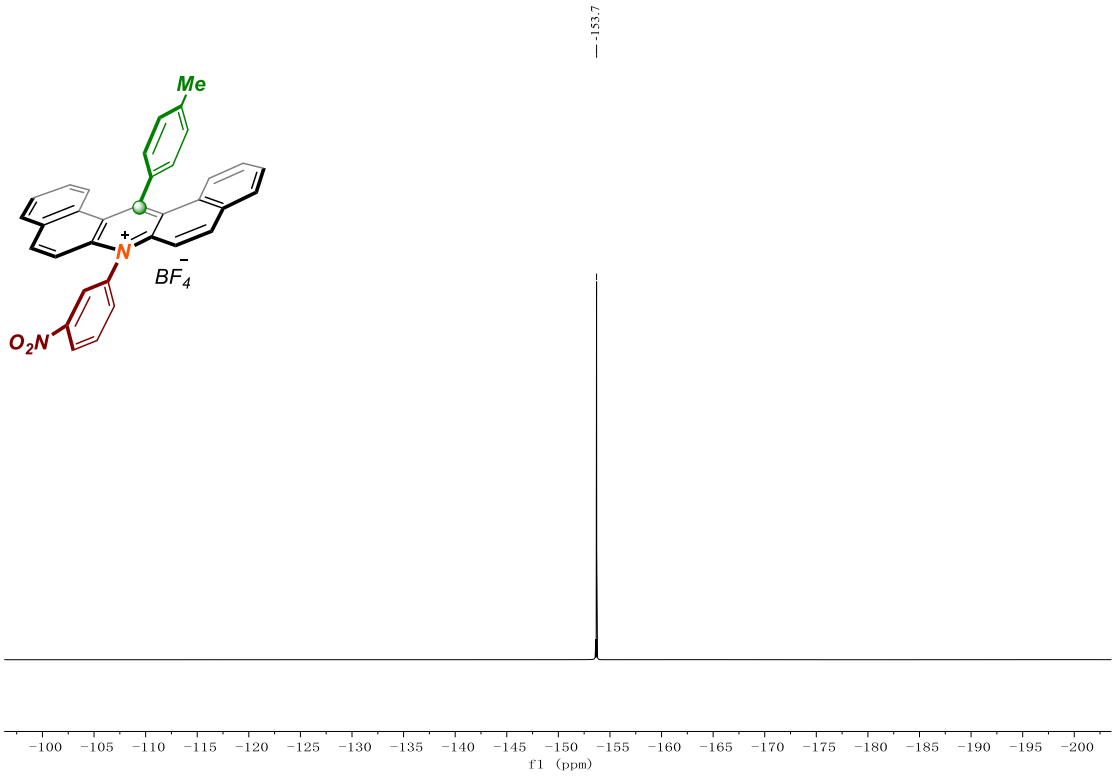
^{1}H NMR of **8s** (400 MHz, d_6-DMSO)



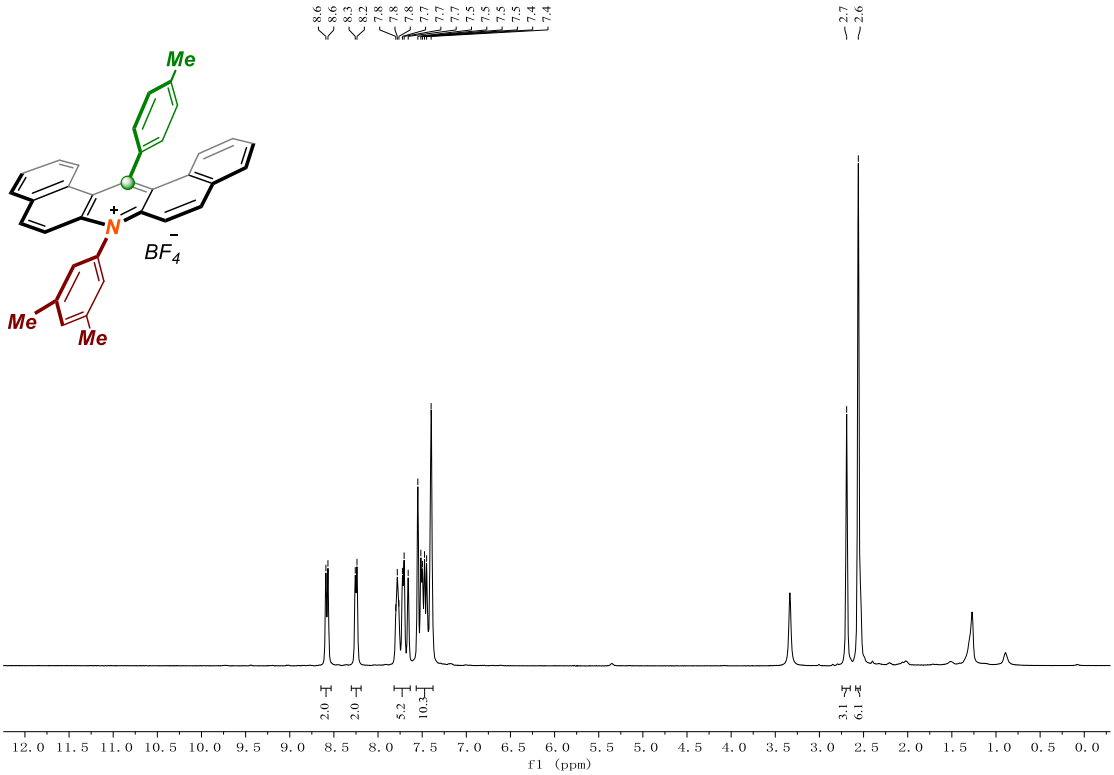
^{13}C NMR of **8s** (100 MHz, d_6-DMSO)



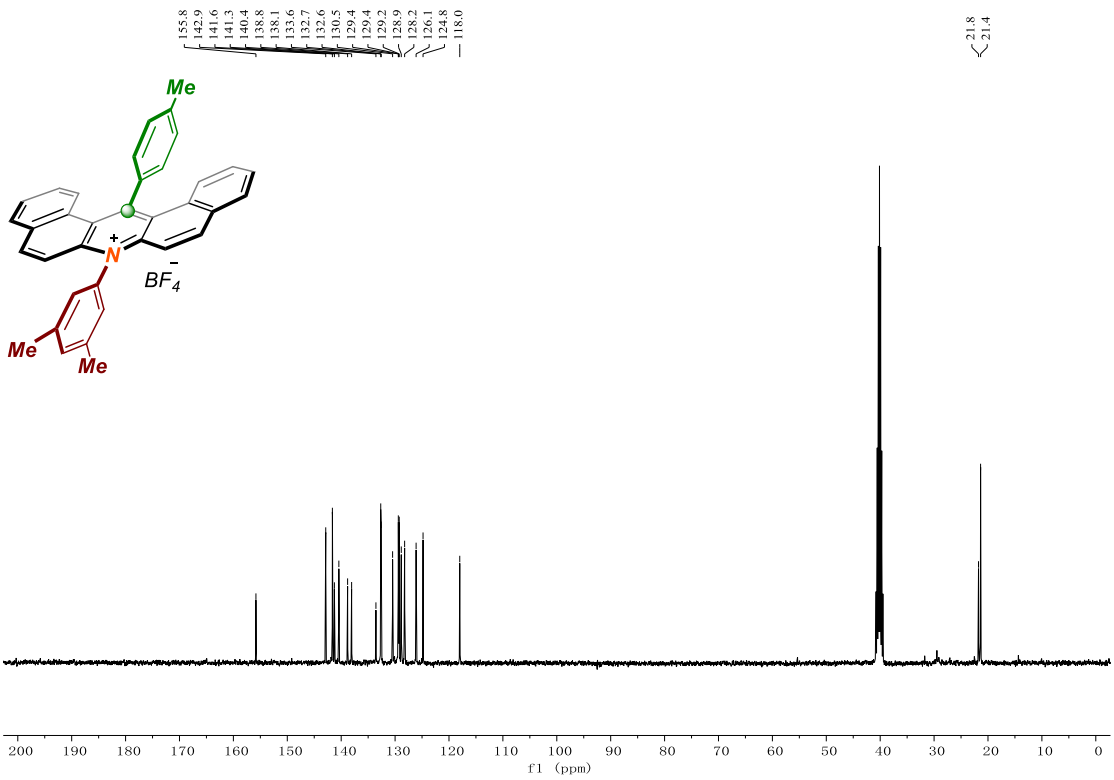
^{19}F NMR of **8s** (376 MHz, $CDCl_3$)



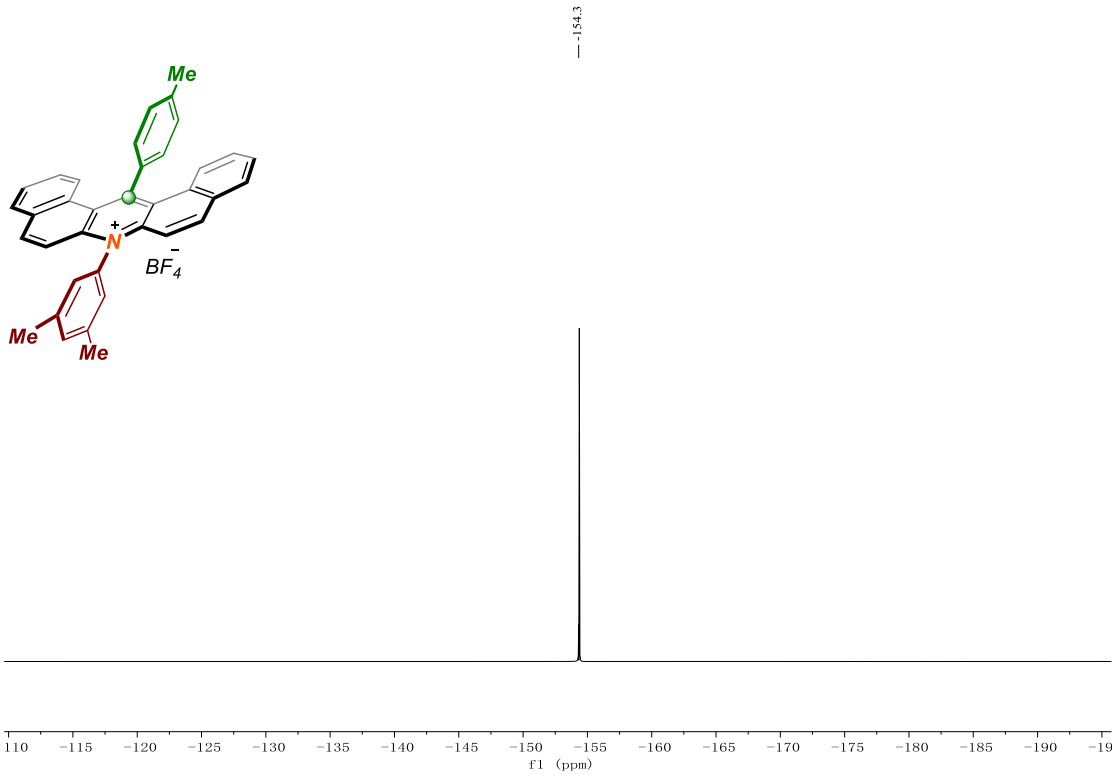
^{1}H NMR of **8t** (400 MHz, d_6-DMSO)



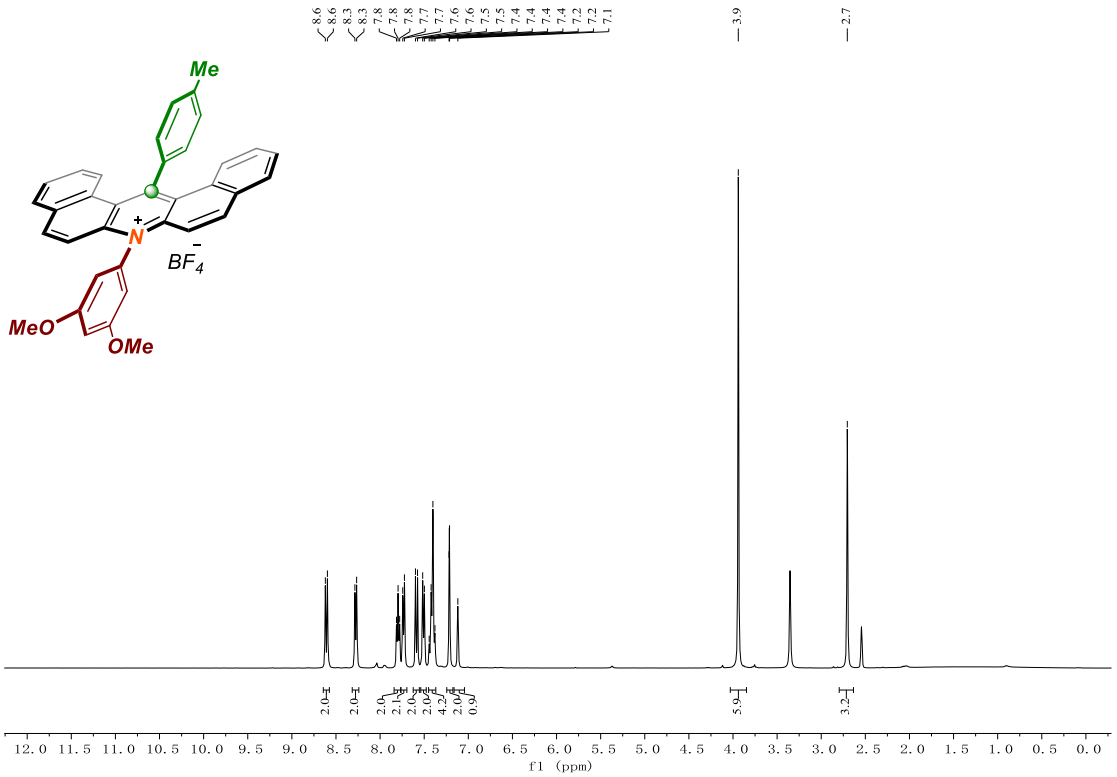
^{13}C NMR of **8t** (100 MHz, d_6-DMSO)



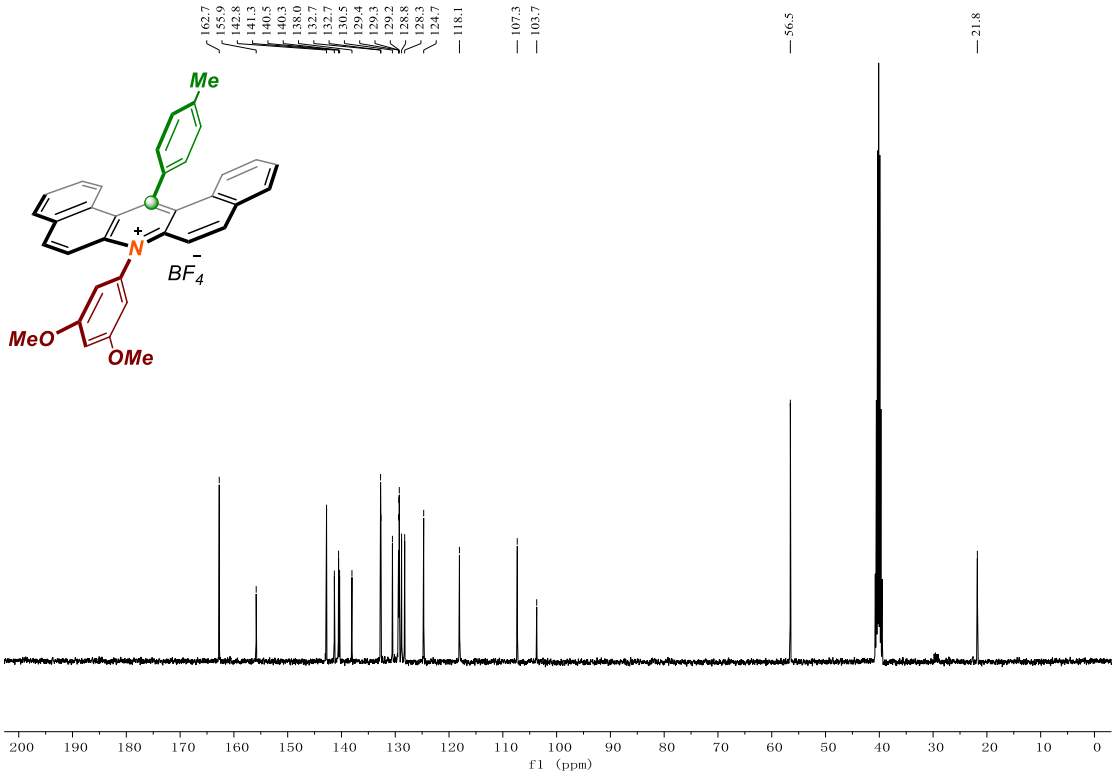
^{19}F NMR of **8t** (376 MHz, $CDCl_3$)



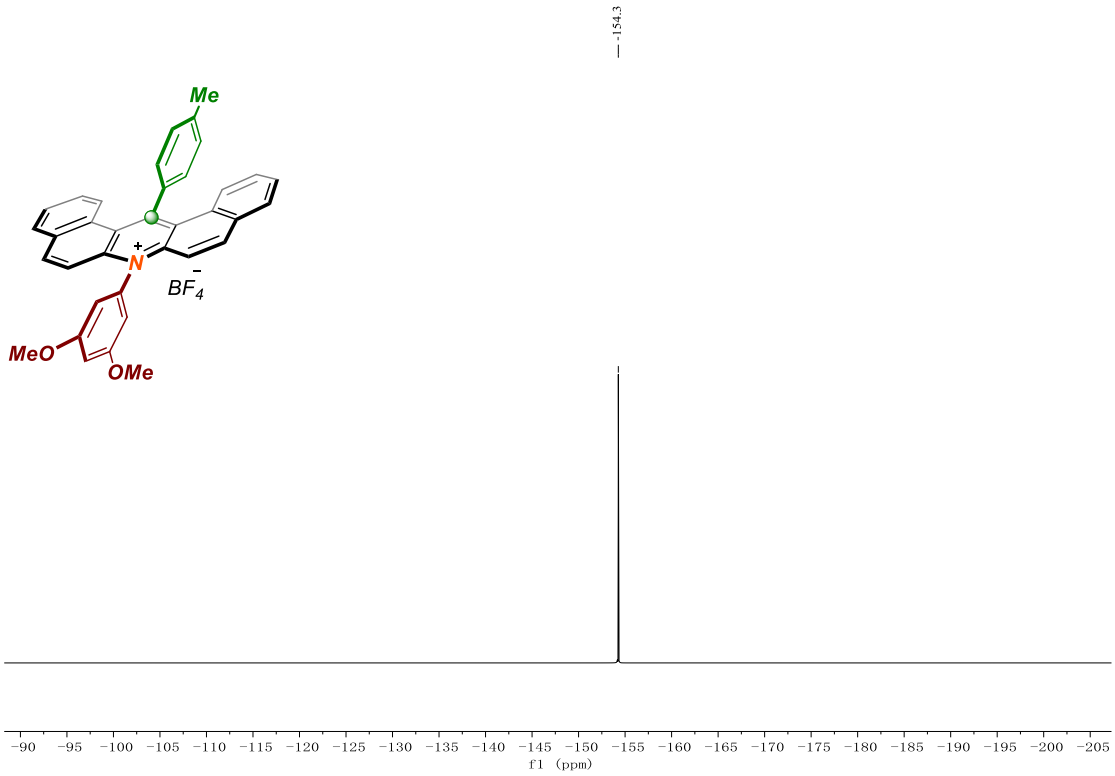
^{1}H NMR of **8u** (400 MHz, d_6-DMSO)



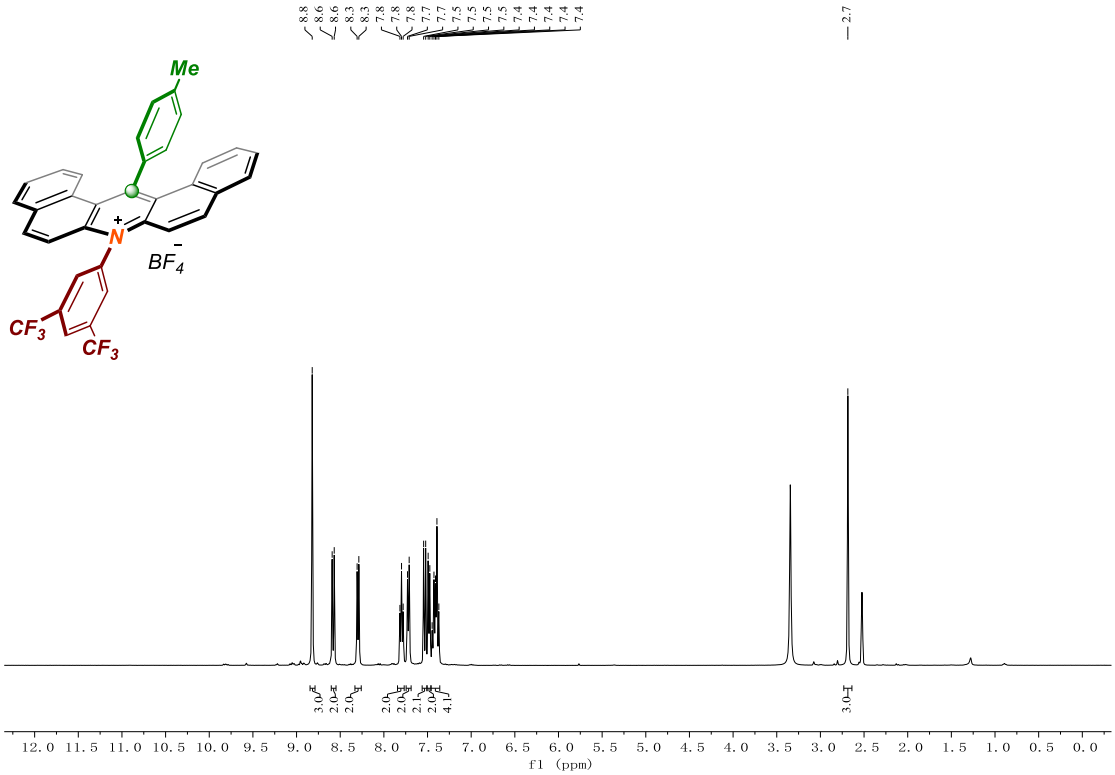
^{13}C NMR of **8u** (100 MHz, d_6-DMSO)



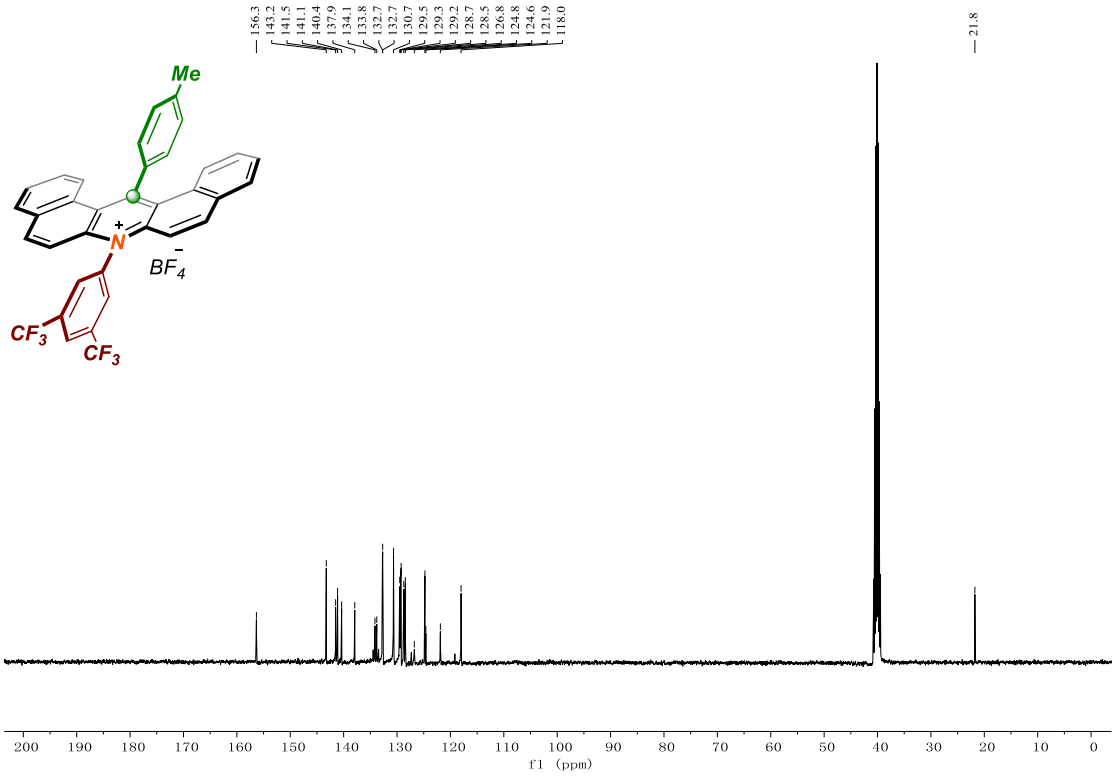
^{19}F NMR of **8u** (376 MHz, $CDCl_3$)



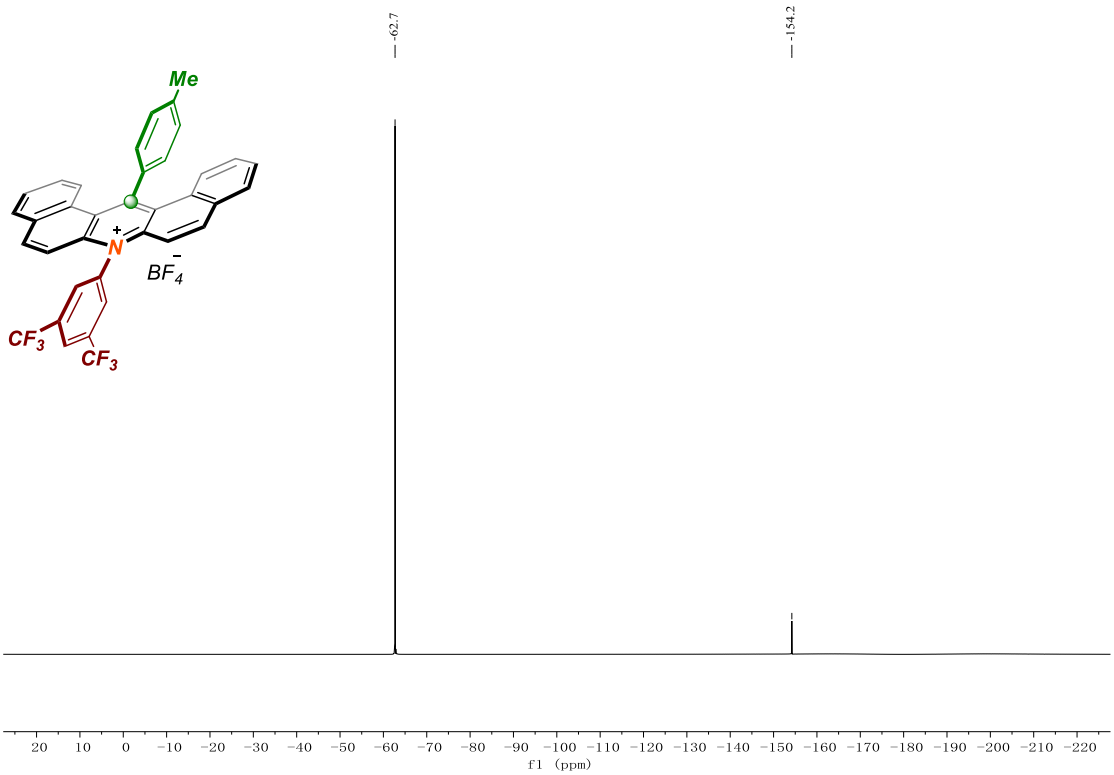
^{1}H NMR of **8v** (400 MHz, d_6-DMSO)



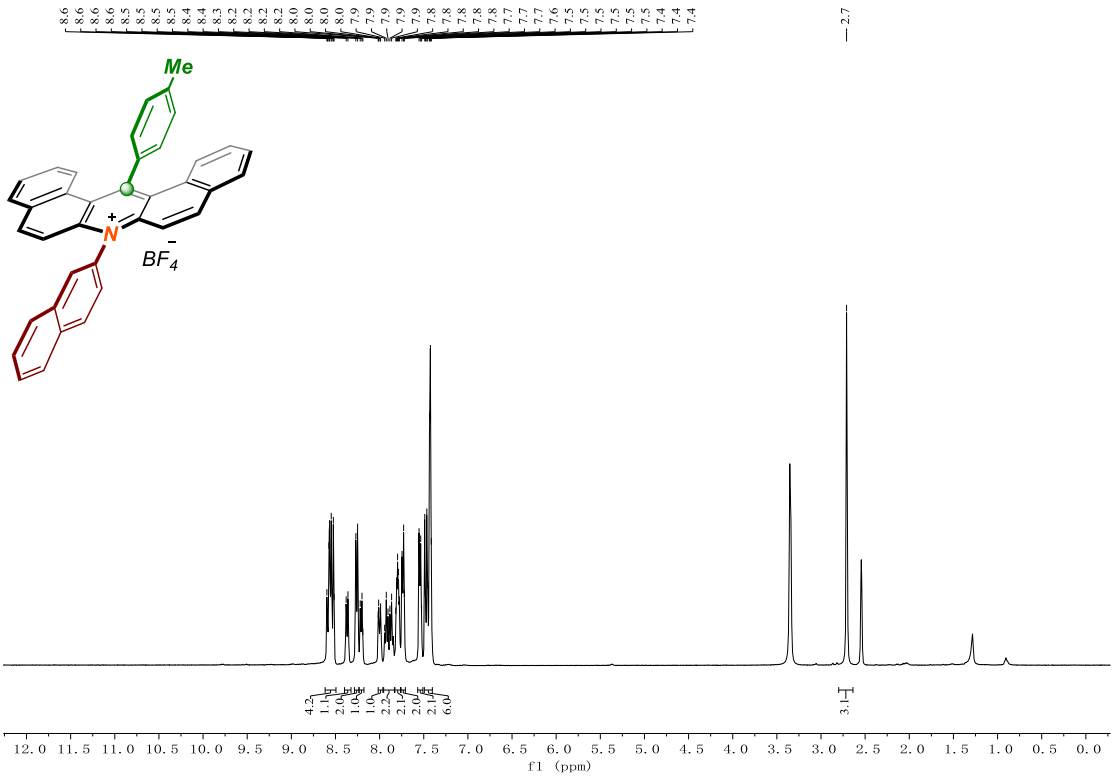
^{13}C NMR of **8v** (100 MHz, d_6-DMSO)



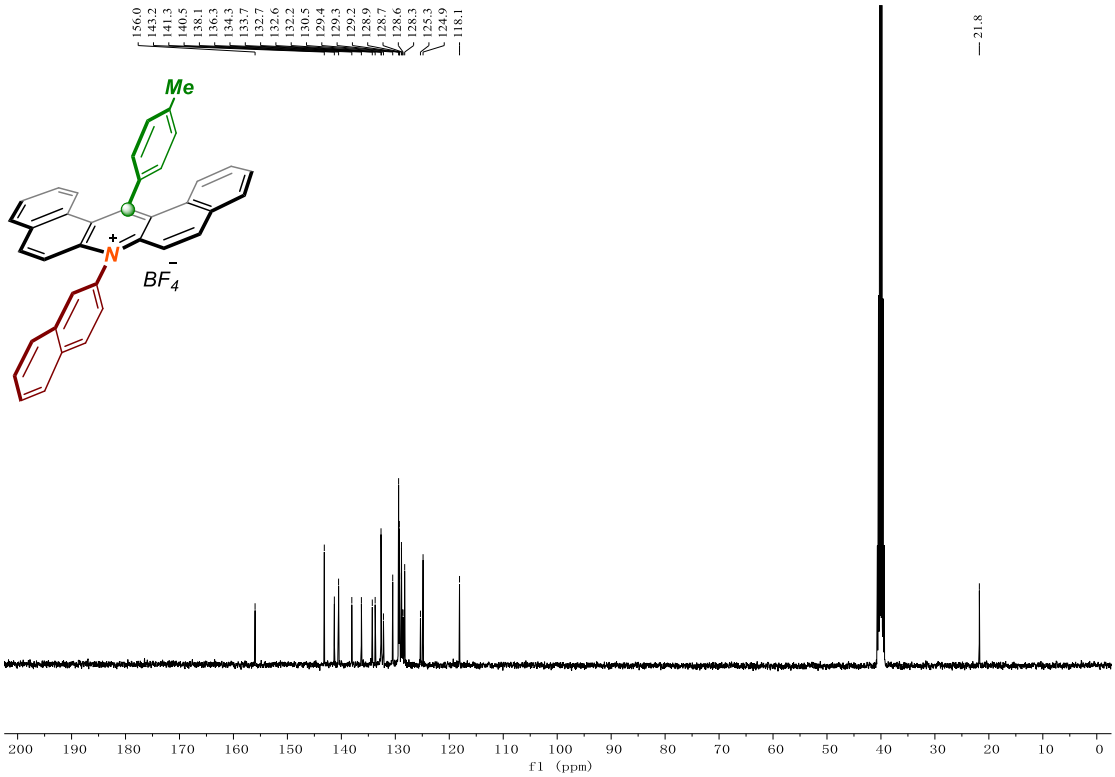
^{19}F NMR of **8v** (376 MHz, $CDCl_3$)



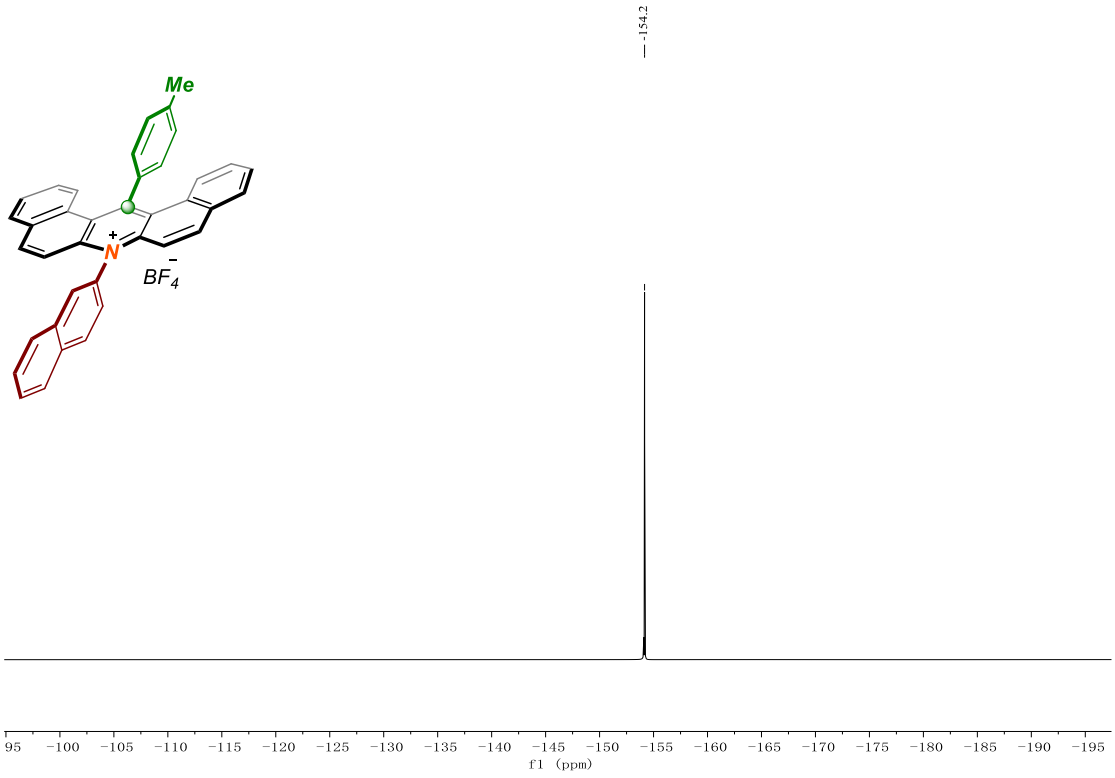
^{1}H NMR of **8w** (400 MHz, d_6-DMSO)



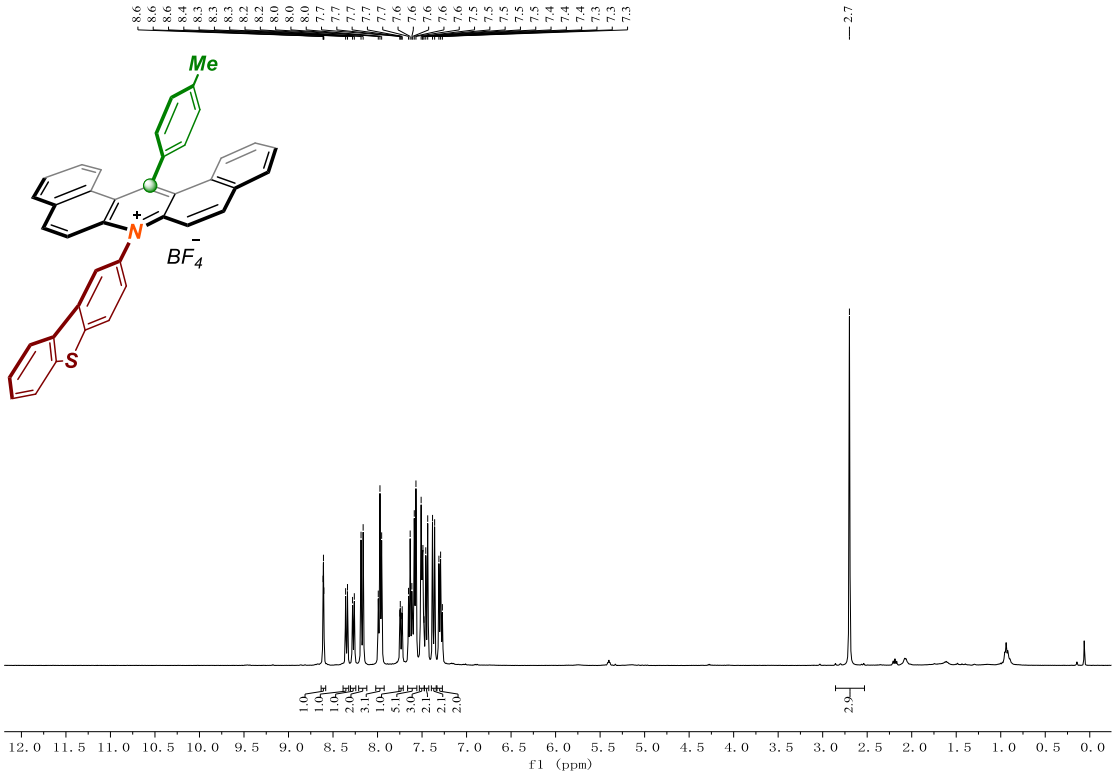
^{13}C NMR of **8w** (100 MHz, d_6-DMSO)



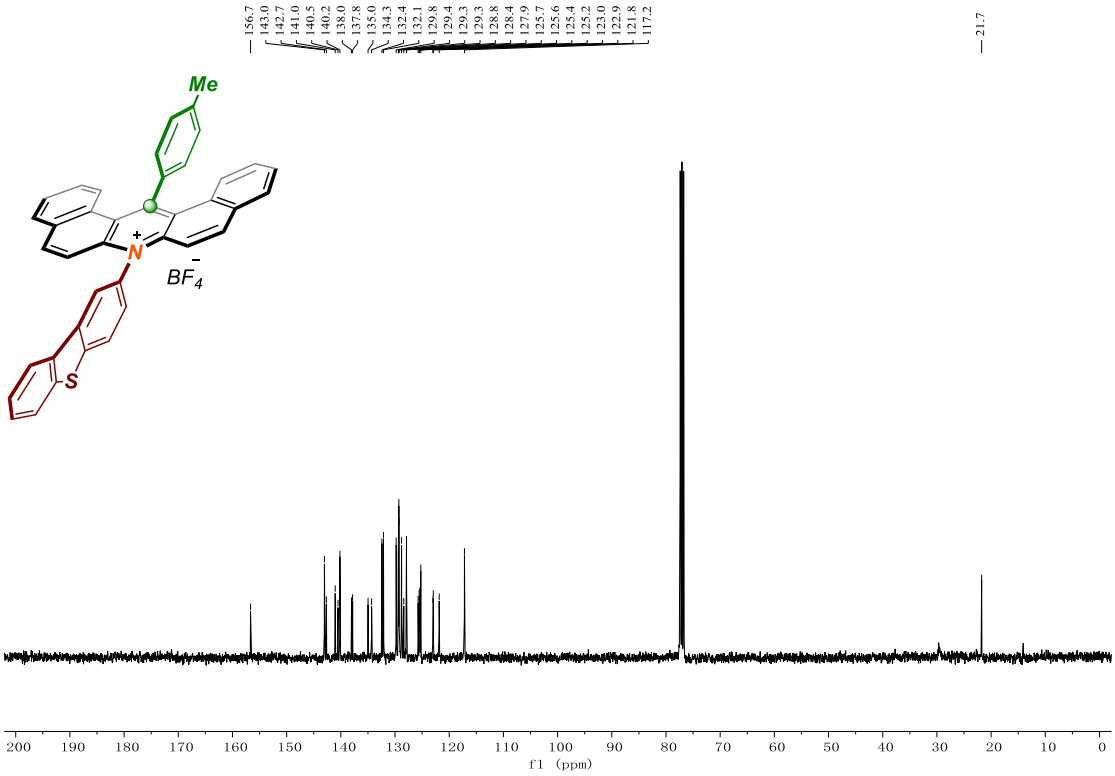
^{19}F NMR of **8w** (376 MHz, $CDCl_3$)



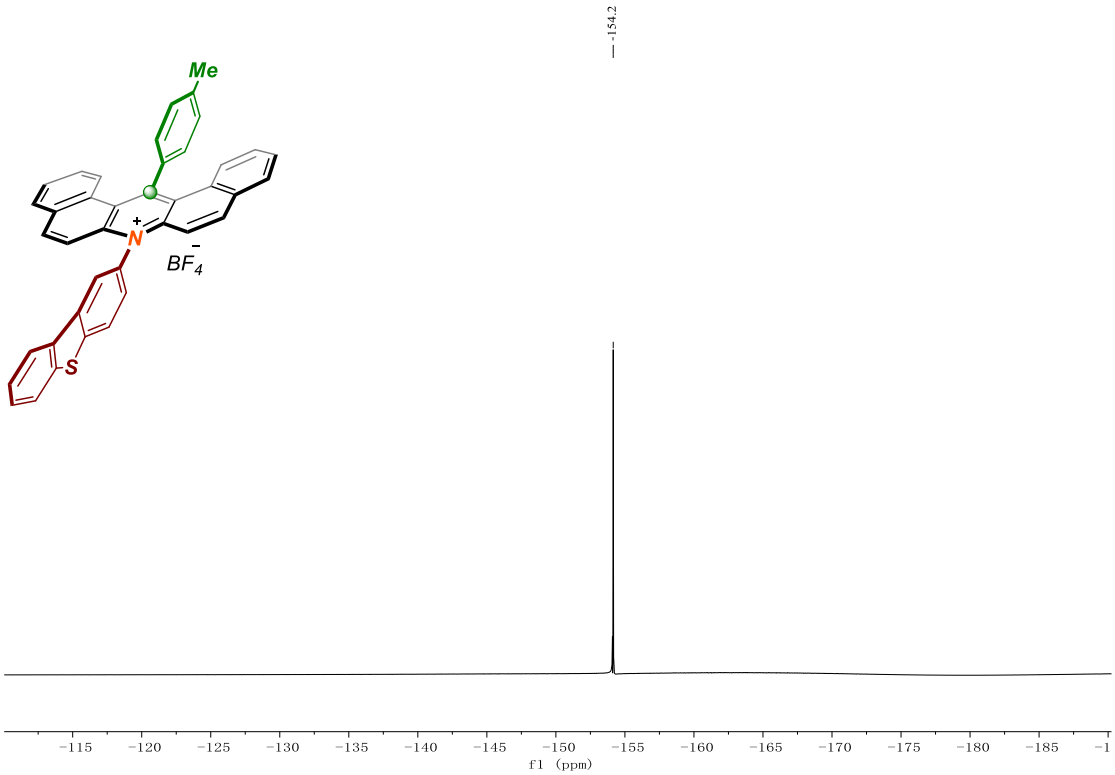
^{1}H NMR of **8x** (400 MHz, $CDCl_3$)



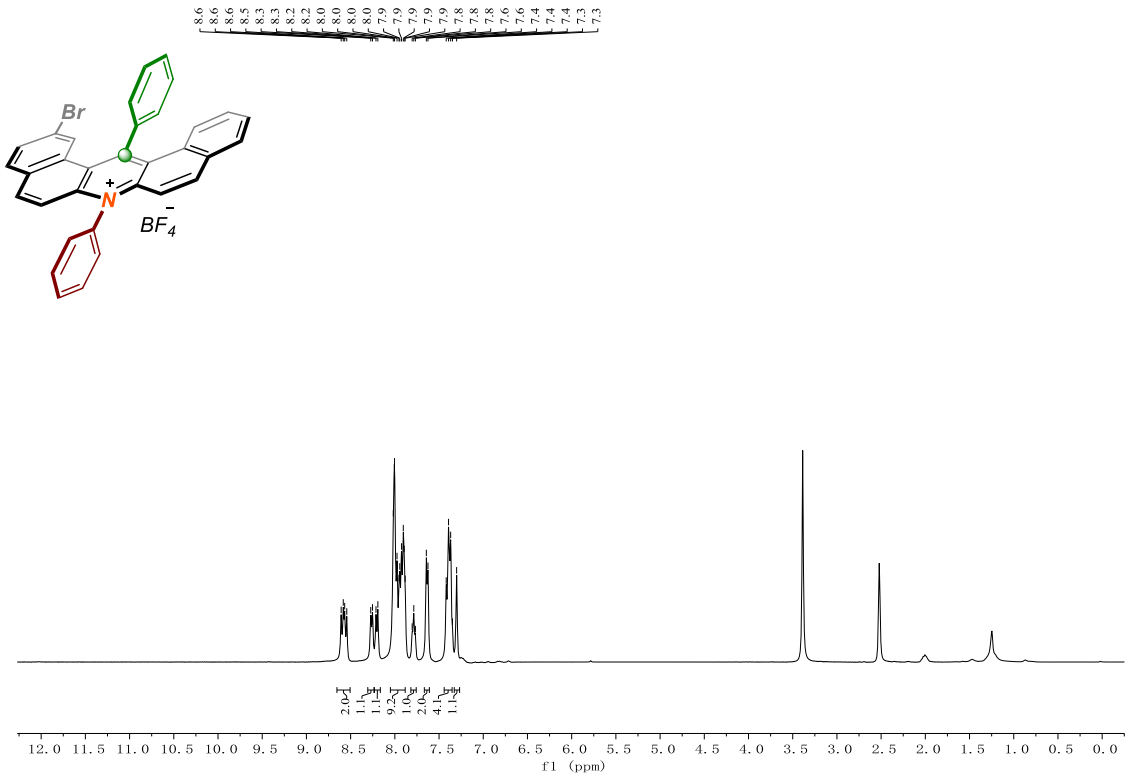
^{13}C NMR of **8x** (100 MHz, $CDCl_3$)



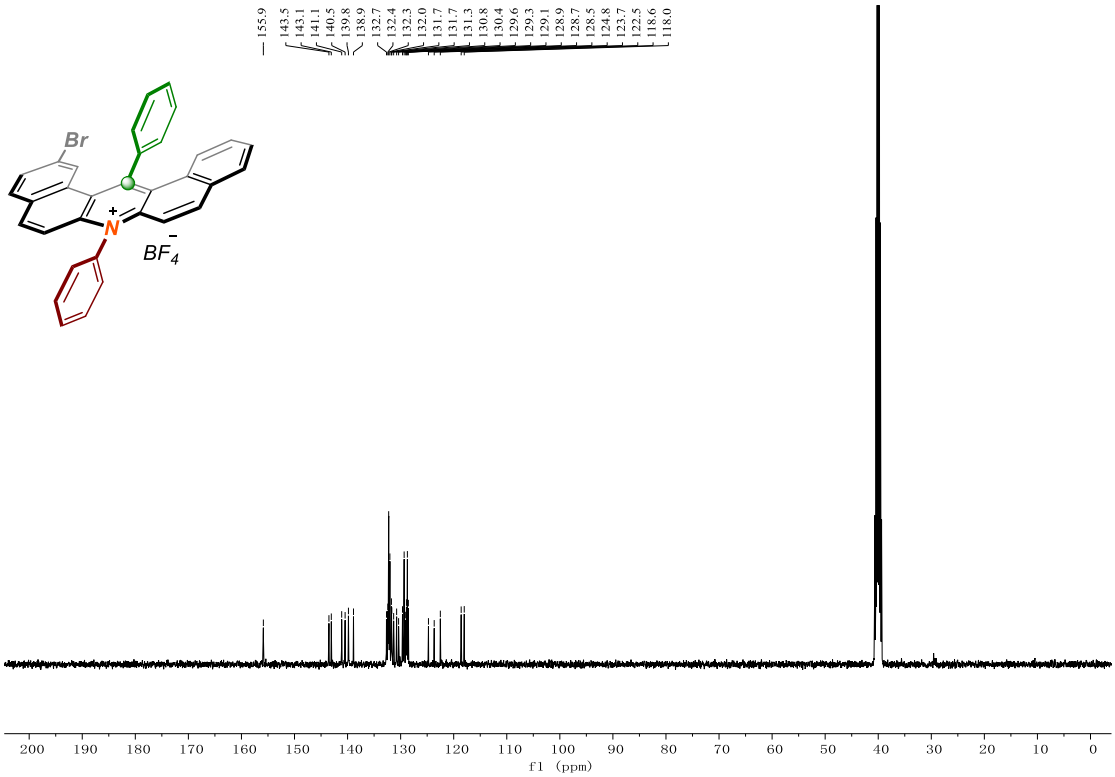
^{19}F NMR of **8x** (376 MHz, $CDCl_3$)



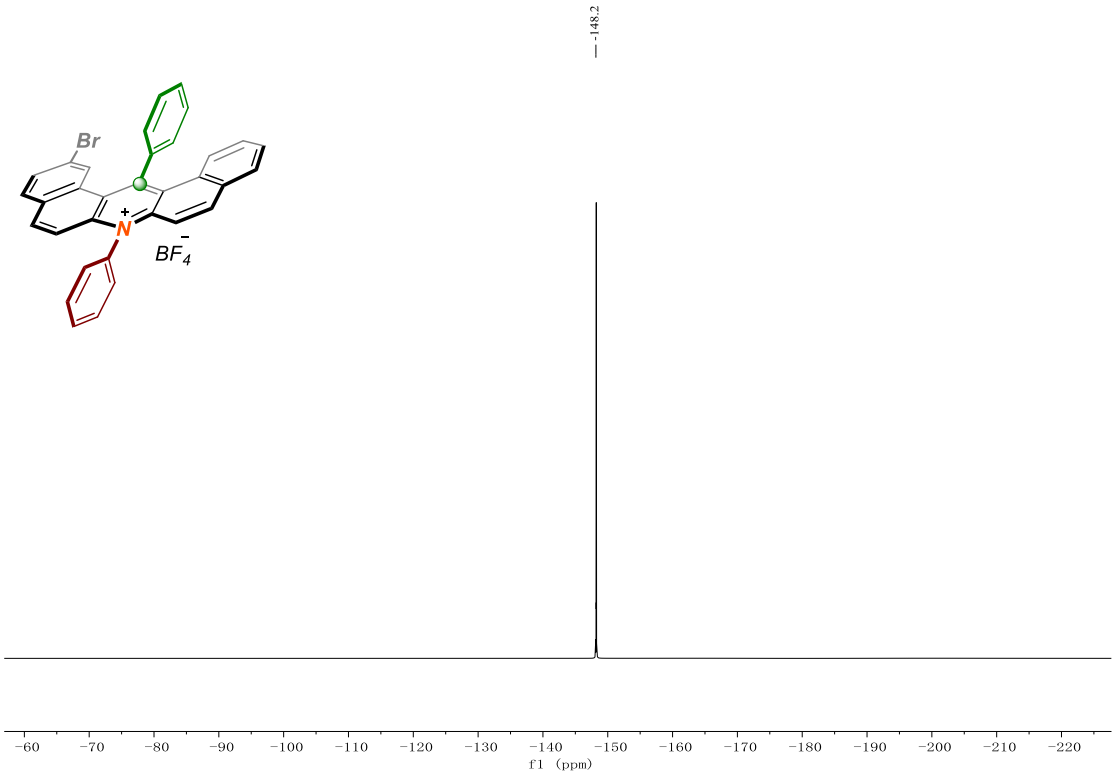
^{1}H NMR of **8y** (400 MHz, d_6-DMSO)



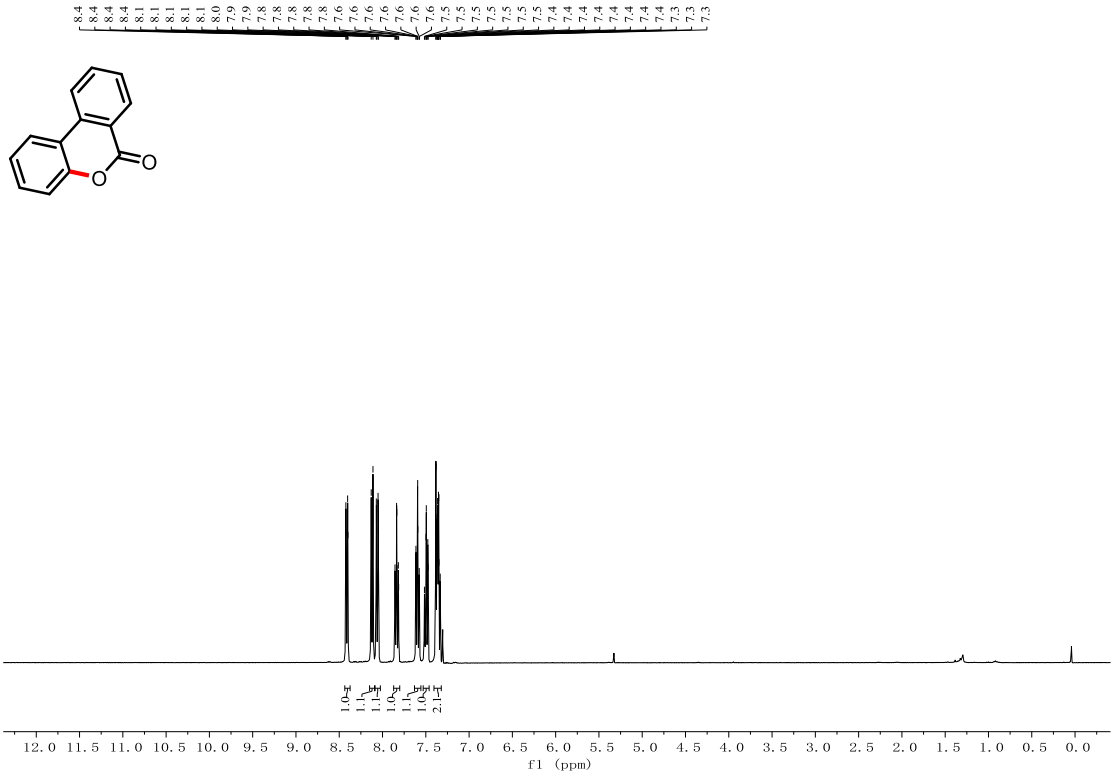
^{13}C NMR of **8y** (100 MHz, d_6-DMSO)



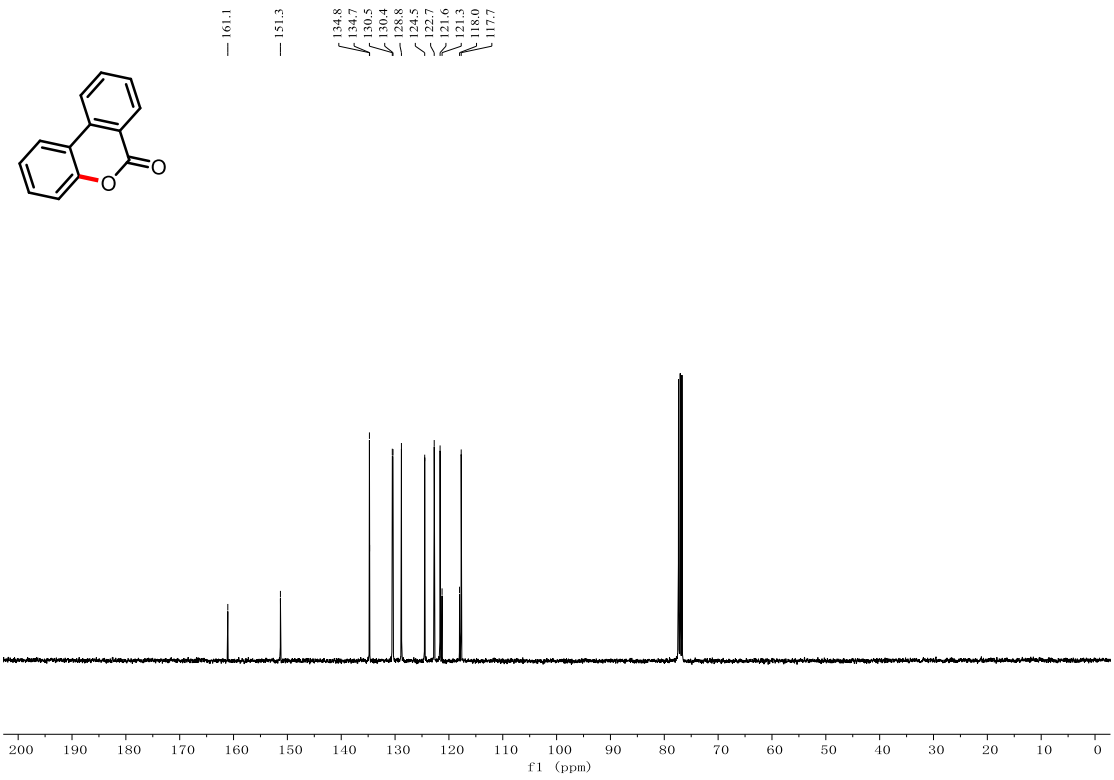
^{19}F NMR of **8y** (376 MHz, d_6-DMSO)



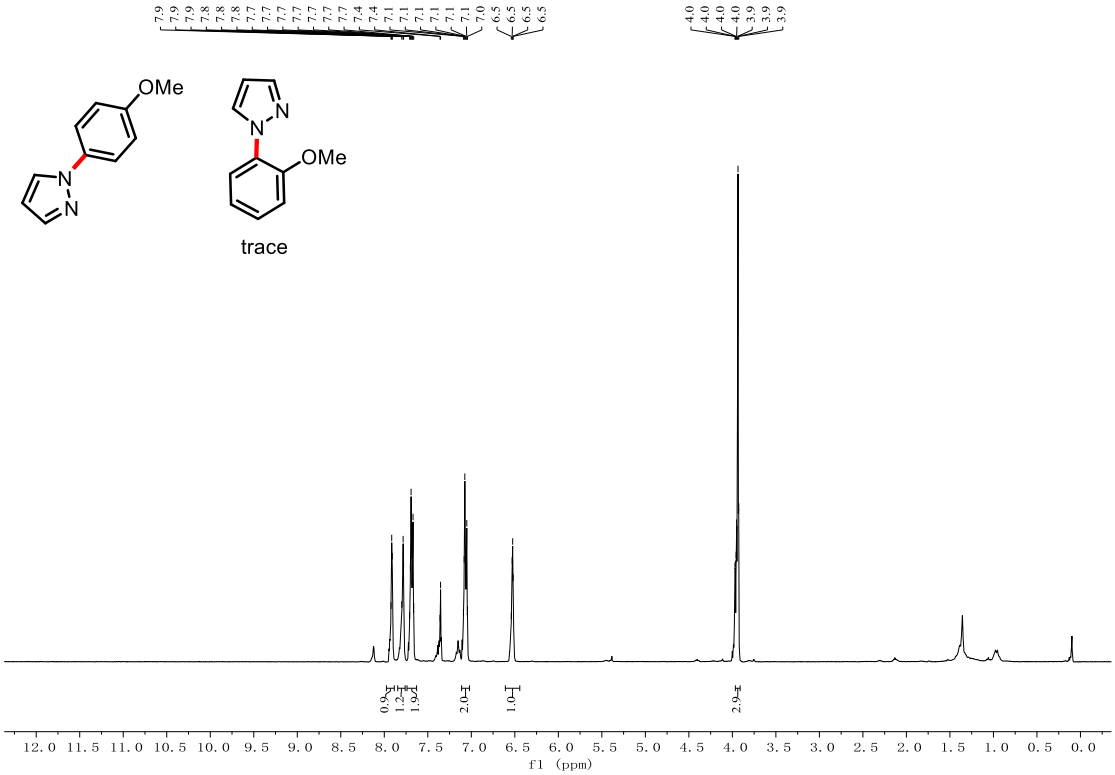
^{1}H NMR of **10** (400 MHz, $CDCl_3$)



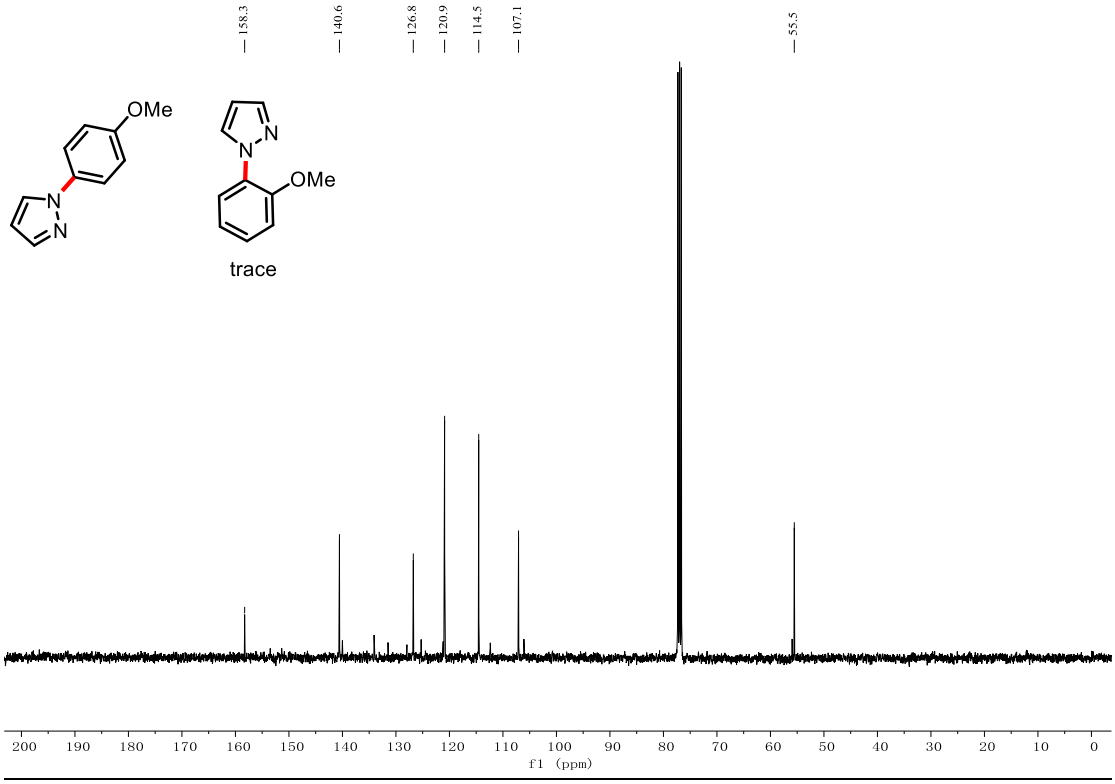
^{13}C NMR of **10** (100 MHz, $CDCl_3$)



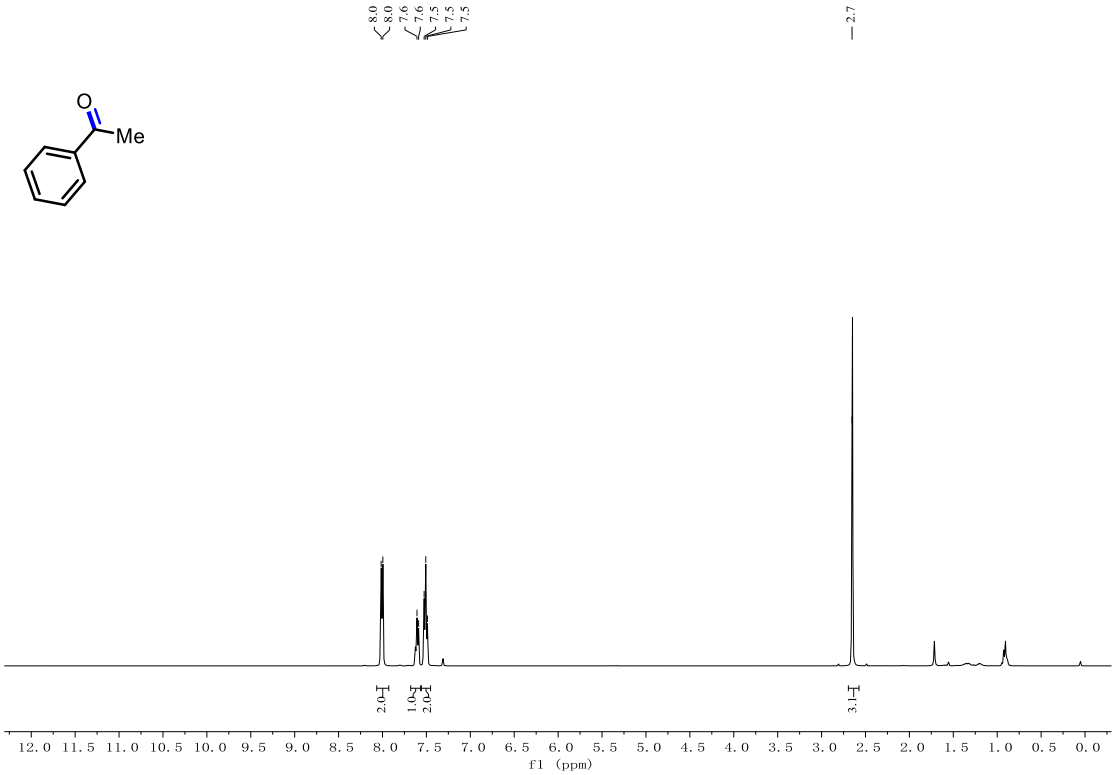
^{1}H NMR of **13** (400 MHz, $CDCl_3$)



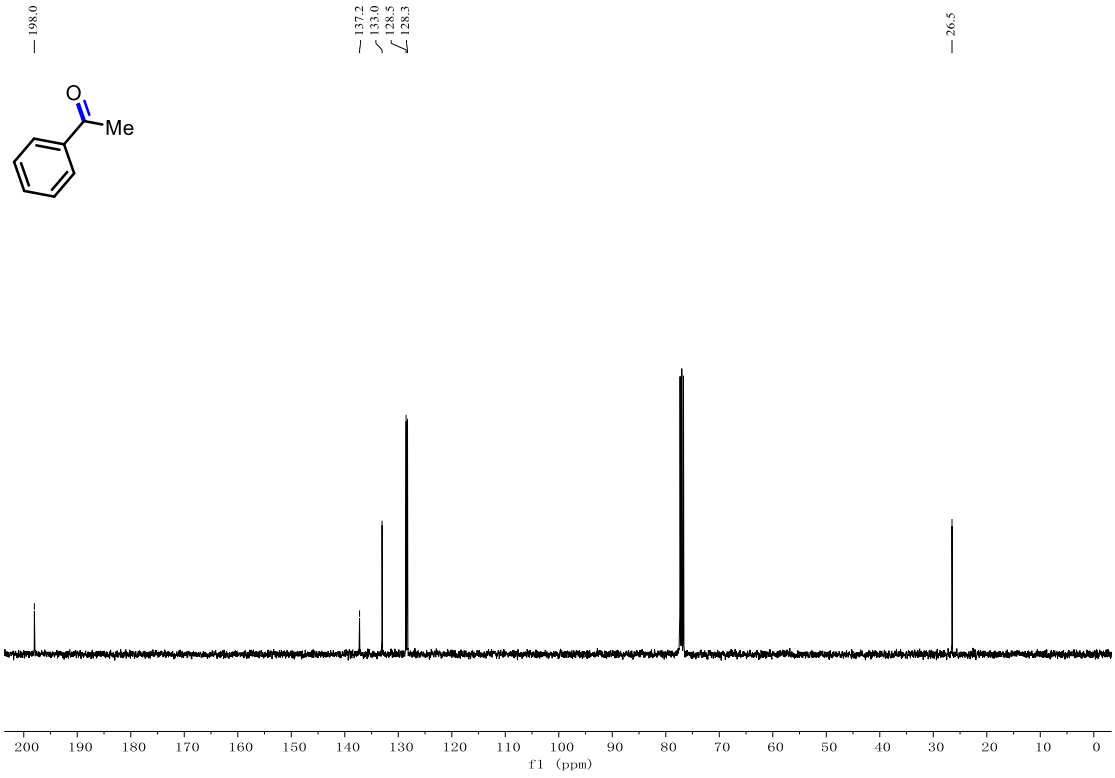
^{13}C NMR of **13** (100 MHz, $CDCl_3$)



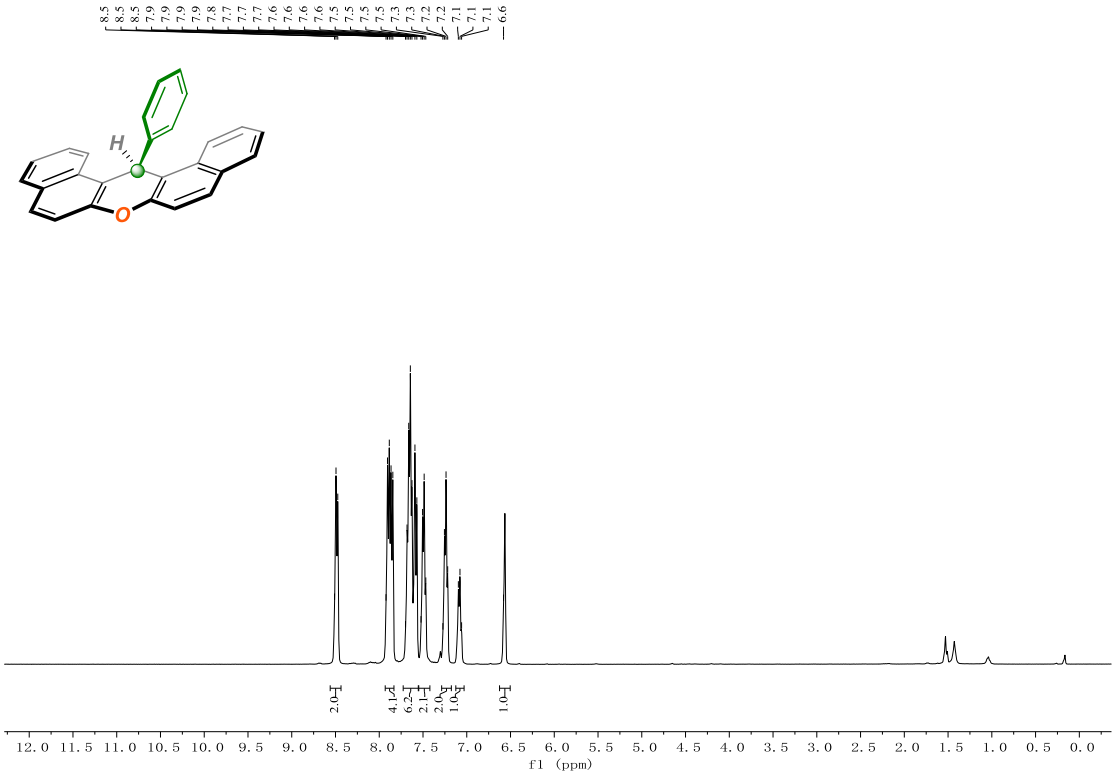
^{1}H NMR of **15** (400 MHz, $CDCl_3$)



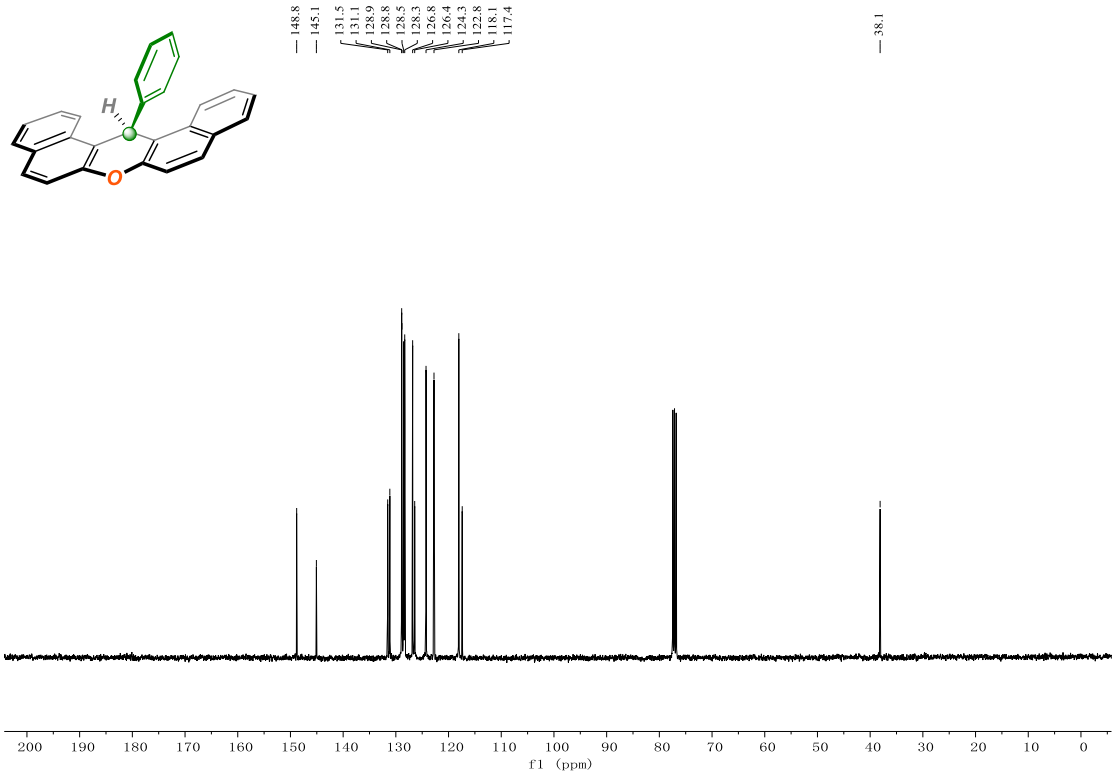
^{13}C NMR of **15** (100 MHz, $CDCl_3$)



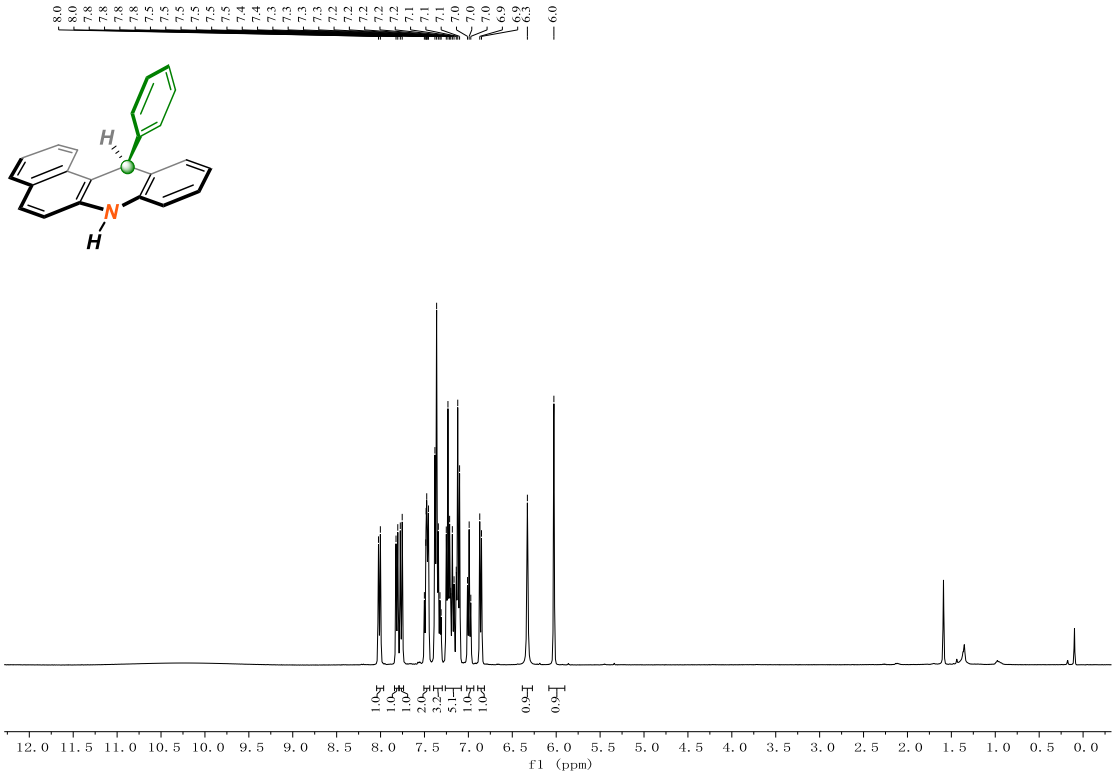
^{1}H NMR of **7** (400 MHz, $CDCl_3$)



^{13}C NMR of **7** (100 MHz, $CDCl_3$)



^{1}H NMR of **2j'** (400 MHz, $CDCl_3$)



^{13}C NMR of **2j'** (100 MHz, $CDCl_3$)