Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Electronic Supplementary Information

Palladium-catalyzed C8–H arylation and annulation of 1-naphthalene carboxylic acid derivatives with aryl iodides

Min Zhang,[a] Zhangyi Fu,[a] Anping Luo,[a] Xingwen Pu,[a] Menglei Wang,[a] Ying Huang,[b] Yudong Yang*[a] and Jingsong You[a]

[a] *Key Laboratory of Green Chemistry and Technology of Ministry of Education, College of Chemistry, Sichuan University, 29 Wangjiang Road, Chengdu 610064, P. R. China.*

[b] *State Key Laboratory of Environment-friendly Energy Materials, School of Material Science and Engineering, Southwest University of Science and Technology, Mianyang 621010, P. R. China.*

E-mail: yangyudong@scu.edu.cn

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I. General Information

NMR spectra were obtained on an Agilent 400-MR DD2 spectrometer. The ^{1}H NMR (400 MHz) chemical shifts were measured relative to $CDCl_3$ and DMSO-d_6 as the internal reference ($CDCl_3$: δ = 7.26 ppm; DMSO-d_6: δ = 2.50 ppm). The ^{13}C NMR (100 MHz) chemical shifts were given using $CDCl_3$ or DMSO-d_6 as the internal standard ($CDCl_3$: δ = 77.16 ppm; DMSO-d_6: δ = 39.52 ppm). High-resolution mass spectra (HRMS) were obtained with a Shimadzu LCMS-IT-TOF (ESI). Unless otherwise noted, all reagents were obtained from commercial suppliers and used without further purification. Pd cataltst and Ag salts were purchased from Shanxi Kaida Chemical Engineering (China) CO., Ltd. 1-Naphthioc acids, arylboronic acids and aryl iodides were purchased from Energy Chemical (China) CO., Ltd. 1-Naphthamide derivatives were prepared according to literature procedures.[1-3] Solvents were dried with an innovative technology solvent purification system (model no.: PS-MD-5). All syntheses and manipulations were carried out under N_2 unless noted. Flash column chromatographic purification of products was accomplished using forced-flow chromatography on silica gel (200–300 mesh).

II. Preliminary Investigations on the Regioselectivity of C–H Arylation

2.1 Palladium-Catalyzed C7-Selective Arylation of 1-Naphthamide with Phenylboronic Acid in the Presence of NFSI

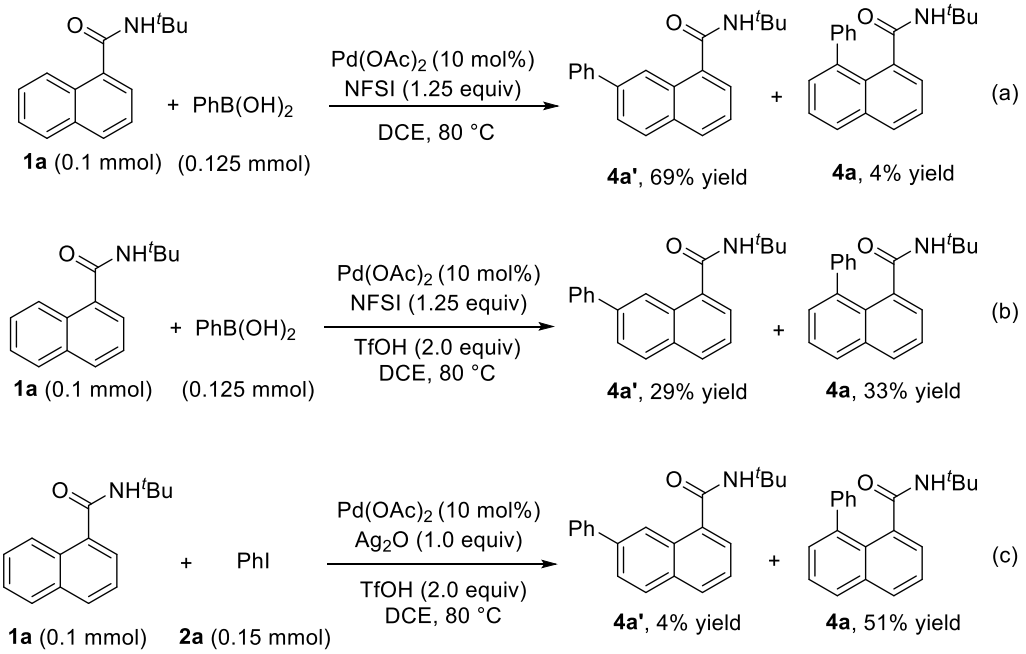
A Schlenk tube with a magnetic stir bar was charged with *N*-(*tert*-butyl)-1-naphthamide **1a** (22.7 mg, 0.1 mmol), $Pd(OAc)_2$ (2.2 mg, 10 mol%), phenylboronic acid (15.3 mg, 1.25 equiv), *N*-fluoro-*N*-(phenylsulfonyl)benzenesulfonamide (NFSI, 39.4 mg, 0.125 mmol, 1.25 equiv) and 1,2-dichloroethane (DCE, 1 mL) under N_2. The resulting mixture was stirred at 80 °C for 12 h and then diluted with 3 mL of dichloromethane (DCM). The mixture was filtered through a celite pad and washed with 10-20 mL of DCM. The filtrate was concentrated and the residue was purified by column chromatography on silica gel (petroleum ether (PE)/tetrahydrofuran (THF) = 20:1 to petroleum ether/ethyl acetate (EA) = 10:1, v/v) to provide **4a'** and **4a**.

2.2 Palladium-Catalyzed C–H Arylation of 1-Naphthamide with Phenylboronic Acid in the Presence of NFSI and Triflic Acid

A Schlenk tube with a magnetic stir bar was charged with *N*-(*tert*-butyl)-1-naphthamide **1a** (22.7 mg, 0.1 mmol), $Pd(OAc)_2$ (2.2 mg, 10 mol%), phenylboronic acid (15.3 mg, 1.25 equiv), *N*-fluoro-*N*-(phenylsulfonyl)benzenesulfonamide (NFSI, 39.4 mg, 1.25 equiv). The tube was evacuated and refilled with N_2 by three times. Then DCE (1 mL) and triflic acid (HOTf, 18 µL, 2.0 equiv) were added under N_2. The resulting mixture was stirred at 80 °C for 12 h and then diluted with 3 mL of DCM. The mixture was filtered through a celite pad and washed with 10-20 mL of DCM. The filtrate was concentrated and the residue was purified by column chromatography on silica gel (PE/EA = 20:1 to PE/EA= 10:1, v/v) to provide **4a'** and **4a**.

2.3 Palladium-Catalyzed C8-Selective Arylation of 1-Naphthamide with Iodobenzene in the Presence of Ag_2O

A Schlenk tube with a magnetic stir bar was charged with *N*-(*tert*-butyl)-1-naphthamide **1a** (22.7 mg, 0.1 mmol), $Pd(OAc)_2$ (2.2 mg, 10 mol%), Ag_2O (23.0 mg, 1.0 equiv). The tube was evacuated and refilled with N_2 by three times. Then iodobenzene **2a** (17 µL, 1.5 equiv), DCE (1 mL) and HOTf (18 µL, 2.0 equiv) were added under N_2. The reaction mixture was stirred at 80 °C for 24 h. The mixture was filtered through a celite pad and washed with 10-20 mL of DCM. The filtrate was concentrated and the residue was purified by column chromatography on silica gel (PE/THF = 20:1 to PE/EA = 10:1, v/v) to provide **4a** and **4a'**.

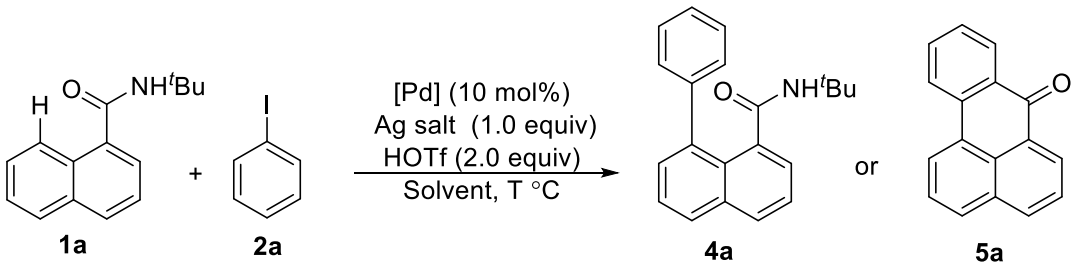


III. Optimization of the Reaction Conditions

3.1 General Procedure for C8-Arylation and Annulation of 1-Naphthioc Acid Derivative 1 or 4 with Iodobenzene 2a

A Schlenk tube with a magnetic stir bar was charged with *N*-(*tert*-Butyl)-1-naphthamide **1a** or 1-naphthioc acid **4a**, catalyst and additive. The tube was evacuated and refilled with N_2 by three times. Then iodobenzene, solvent (1 mL), HOTf (35μL, 0.4 mmol) was added under N_2. The reaction mixture was stirred at relevant temperature for 24 h. The mixture was filtered through a celite pad and washed with 10-20 mL of DCM. The filtrate was concentrated and the residue was purified by column chromatography on silica gel to provide corresponding 8-phenyl-1-naphthamide **4a** or benzanthrone **5a**.

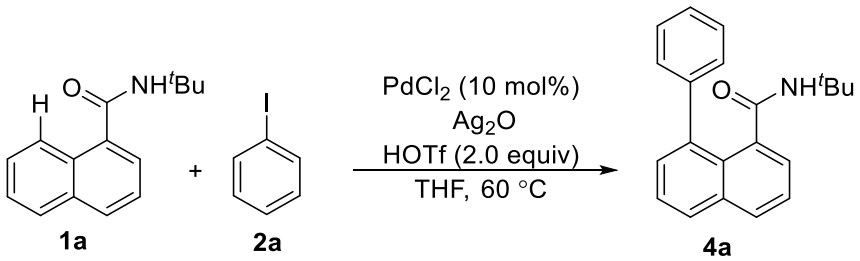
Table S1. Optimization of C8-Arylation of 1-Naphthamide 1a.[a]



Entry	[Pd]	Ag salt	Solvent	Temp. (°C)	Yield of **4a** [%][b]	Yield of **5a** [%][b]
1	$Pd(OAc)_2$	Ag_2O	DCE	80	51	---
2	$Pd(PPh_3)_2Cl_2$	Ag_2O	DCE	80	30	---
3	$Pd(acac)_2$	Ag_2O	DCE	80	44	---
4	$PdCl_2$	Ag_2O	DCE	80	59	---
5	$PdCl_2$	Ag_2CO_3	DCE	80	48	---
6[c]	$PdCl_2$	AgOAc	DCE	80	31	---
7[d]	$PdCl_2$	AgTFA	DCE	80	56	---
8	$PdCl_2$	Ag_2O	DCM	80	61	---
9	$PdCl_2$	Ag_2O	THF	80	68	---
10	$PdCl_2$	Ag_2O	DMF	80	---	---
11	$PdCl_2$	Ag_2O	toluene	80	26	---
12	$PdCl_2$	Ag_2O	HFIP	80	21	35
13	$PdCl_2$	Ag_2O	THF	60	74	---
14	$PdCl_2$	Ag_2O	THF	100	60	12
15[e]	$PdCl_2$	Ag_2O	THF	60	---	---
16[f]	$PdCl_2$	Ag_2O	THF	60	---	---
17	$PdCl_2$	---	THF	60	---	---

[a] Reaction conditions: **1a** (0.2 mmol), **2a** (0.3 mmol), [Pd] (10 mol%), Ag salt (0.2 mmol), and HOTf (2.0 equiv) in solvent (1 mL) at T °C under N_2 for 24 h. [b] Isolated yields. [c] AgOAc (0.4 mmol). [d] AgTFA (0.4 mmol). [e] without HOTf. [f] CH_3COOH instead of HOTf. AgOAc = CH_3COOAg. AgTFA = CF_3COOAg. THF = tetrahydrofuran. DMF = *N*,*N*-dimethylformamide. HFIP = 1,1,1,3,3,3-hexafluoro-2-propanol.

Table S2. Optimization of the Dosages of Iodobenzene 2a and Ag_2O for C8-Arylation of 1-Naphthamide.[a]

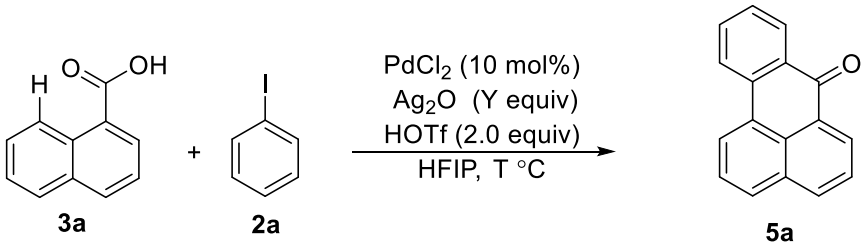


1a **2a** **4a**

Entry	**2a** (mmol)	Ag_2O (mmol)	Yield of **4a** [%][b]
1	0.3	0.2	74
2	0.35	0.2	66
3	0.3	0.18	73
4	0.26	0.18	78
5	0.26	0.16	82
6	0.24	0.16	76

[a] Reaction conditions: **1a** (0.2 mmol), **2a** (X mmol), $PdCl_2$ (10 mol%), Ag_2O (Y mmol), and HOTf (2.0 equiv) in THF (1 mL) at 60 °C under N_2 for 24 h. [b] Isolated yields. THF = tetrahydrofuran.

Table S3. Optimization of *peri*-Benzocyclization of 1-Naphthioc Acid [a]

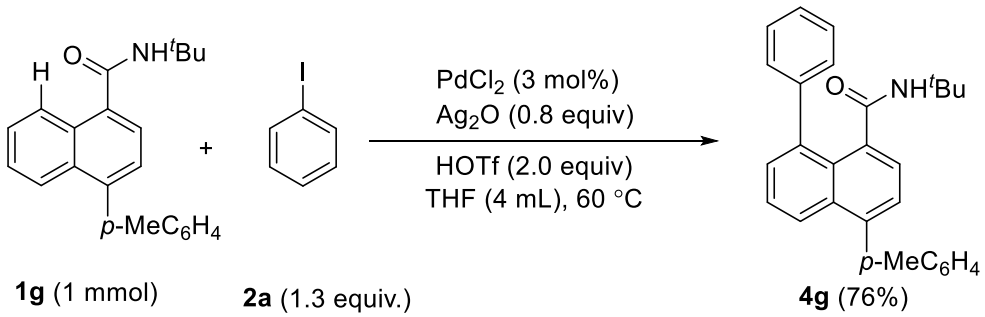


3a **2a** **5a**

Entry	Ag_2O	iodobenzene	Temp. (°C)	Yield of **5a** [%][b]
1	1.0 equiv	1.5 equiv	80	68
2	1.0 equiv	1.5 equiv	60	65
3	1.0 equiv	1.5 equiv	100	73
4	1.0 equiv	1.3 equiv	100	79
5	0.8 equiv	1.3 equiv	100	83
6	0.8 equiv	1.2 equiv	100	81
7	0.7 equiv	1.2 equiv	100	84

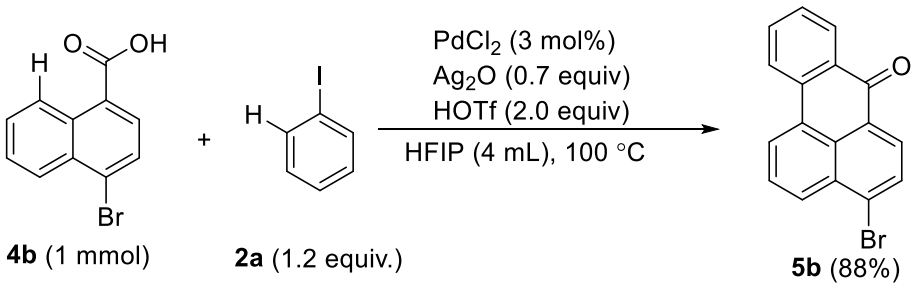
[a] Reaction conditions: **1a** (0.2 mmol), **2a** (X equiv), $PdCl_2$ (10 mol%), Ag_2O (Y equiv), and HOTf (2.0 equiv) in HFIP (1 mL) at T °C under N_2 for 24 h. [b] Isolated yields. HFIP = 1,1,1,3,3,3-hexafluoro-2-propanol.

IV. Scale-up Synthesis



1g (1 mmol) **2a** (1.3 equiv.) **4g** (76%)

A Schlenk tube with a magnetic stir bar was charged with *N*-(*tert*-Butyl)-4-(*p*-tolyl)-1-naphthamide **1g** (1.0 mmol, 317 mg), $PdCl_2$ (5.4 mg, 3 mol%) and Ag_2O (185 mg, 0.8 equiv). The tube was evacuated and refilled with N_2 by three times. Then iodobenzene **2a** (145 µL, 1.3 equiv), THF (4.0 mL), HOTf (175 µL, 2.0 equiv) was added under N_2. The reaction mixture was stirred at at 60 °C for 24 h. The mixture was filtered through a celite pad and washed with 40-60 mL of DCM. The filtrate was concentrated and the residue was purified by column chromatography on silica gel to provide a white solid **4g** in 76% yield (298 mg, eluent: DCM/EA = 50:1)

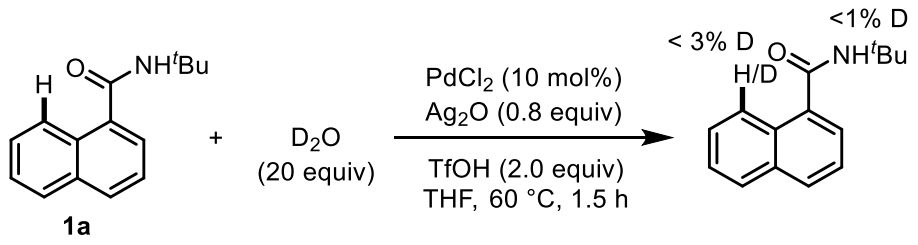


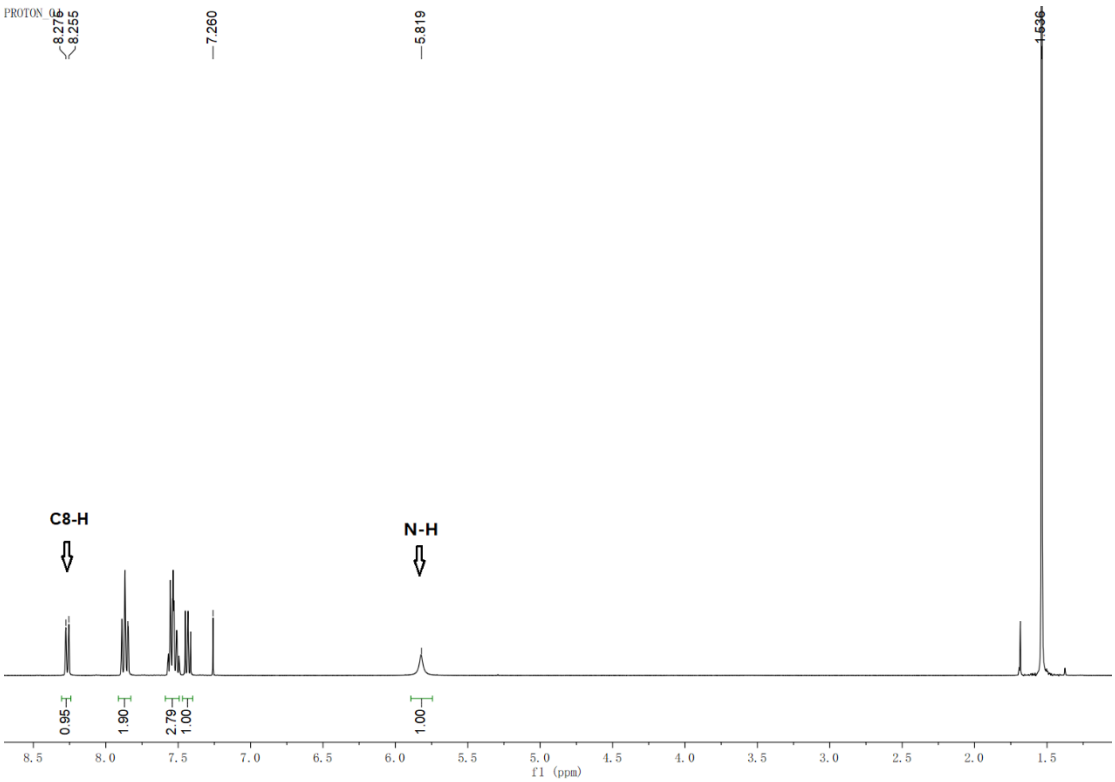
A Schlenk tube with a magnetic stir bar was charged with 4-bromo-1-naphthioc acid **4b** (1.0 mmol, 251 mg), $PdCl_2$ (3 mol%, 5.4 mg) and Ag_2O (161 mg, 0.7 equiv). The tube was evacuated and refilled with N_2 by three times. Then iodobenzene **2a** (131 µL, 1.2 equiv), HFIP (4.0 mL), HOTf (175 µL, 2.0 equiv) was added under N_2. The reaction mixture was stirred at relevant temperature for 24 h. The mixture was filtered through a celite pad and washed with 40-60 mL of DCM. The filtrate was concentrated and the residue was purified by column chromatography on silica gel to provide a yellow solid **5b** in 88% yield (270 mg, eluent: PE/EA = 40:1)

V. Mechanistic Study

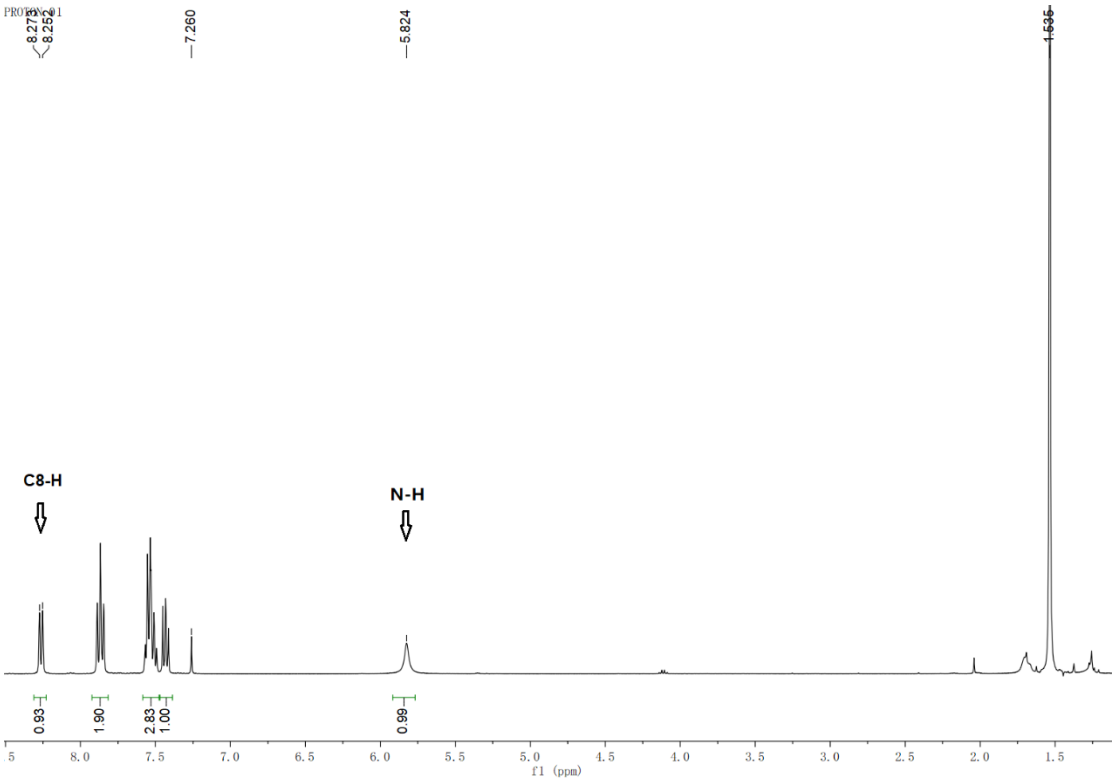
5.1 H/D Exchange Experiment

A Schlenk tube with a magnetic stir bar was charged with *N*-(*tert*-Butyl)-1-naphthamide **1a** (0.2 mmol, 45.4 mg), $PdCl_2$ (3.6 mg, 10 mol%) and Ag_2O (37 mg, 0.8 equiv). The tube was evacuated and refilled with N_2 by three times. Then THF (4.0 mL), D_2O (40 µL, 20 equiv), HOTf (35 µL, 2.0 equiv) was added under N_2. The reaction mixture was stirred at 60 °C for 1.5 h. The mixture was filtered through a celite pad and washed with 10-20 mL of DCM. To remove Ag salts, the filtrate was concentrated and the residue was purified by flash column chromatography on silica gel to provide a yellow solid for ^1H NMR analysis.





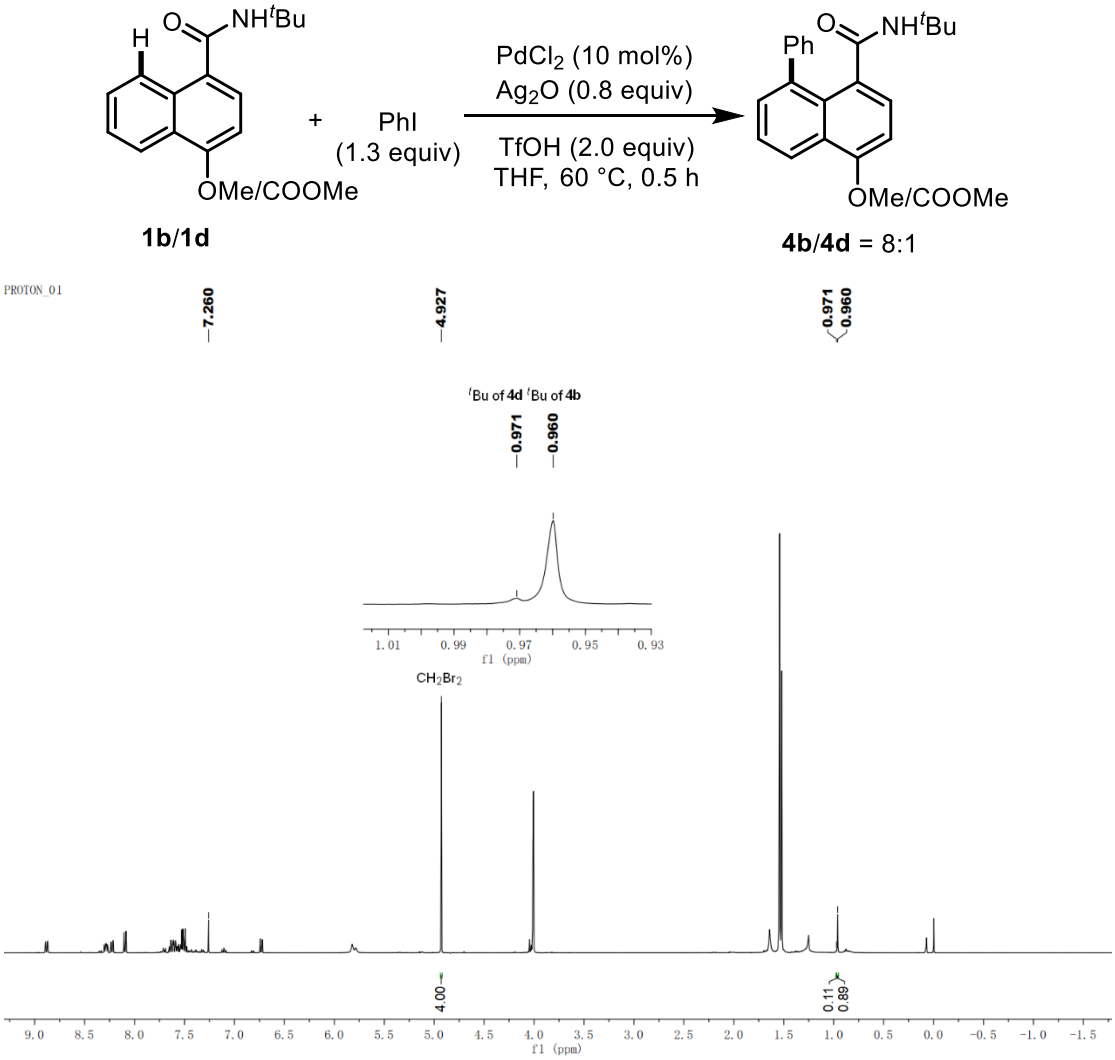
^{1}H NMR of 1a



^{1}H NMR of D_n-1a

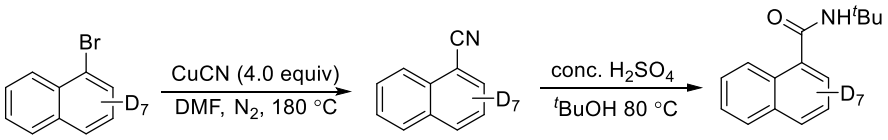
5.2 Competitive Experiment

A Schlenk tube with a magnetic stir bar was charged with 1-naphthamide derivative **1b** (0.1 mmol, 25.7 mg), **1d** (0.1 mmol, 28.5 mg), $PdCl_2$ (3.6 mg) and Ag_2O (37.0 mg). The tube was evacuated and refilled with N_2 by three times. Then THF (1.0 mL), iodobenzene **2a** (0.26 mmol, 29 µL), HOTf (0.4 mmol, 35 µL) was added under N_2. The reaction mixture was stirred at 60 °C for 0.5 h. The mixture was filtered through a celite pad and washed with 10-20 mL of DCM. To remove Ag salts, the filtrate was concentrated and the residue was purified by flash column chromatography on silica gel to provide yellow oil for ^{1}H NMR analysis using dibromomethane (0.2 mmol, 14 µL) as internal standard.

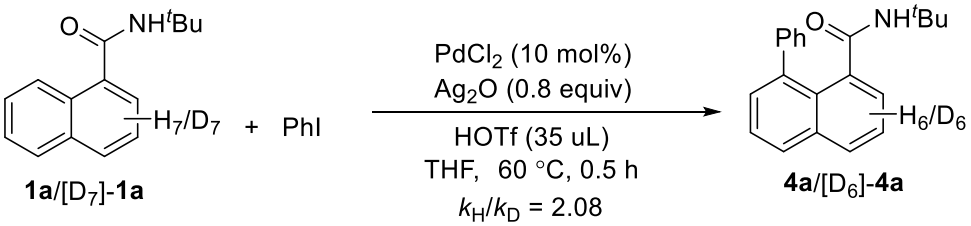


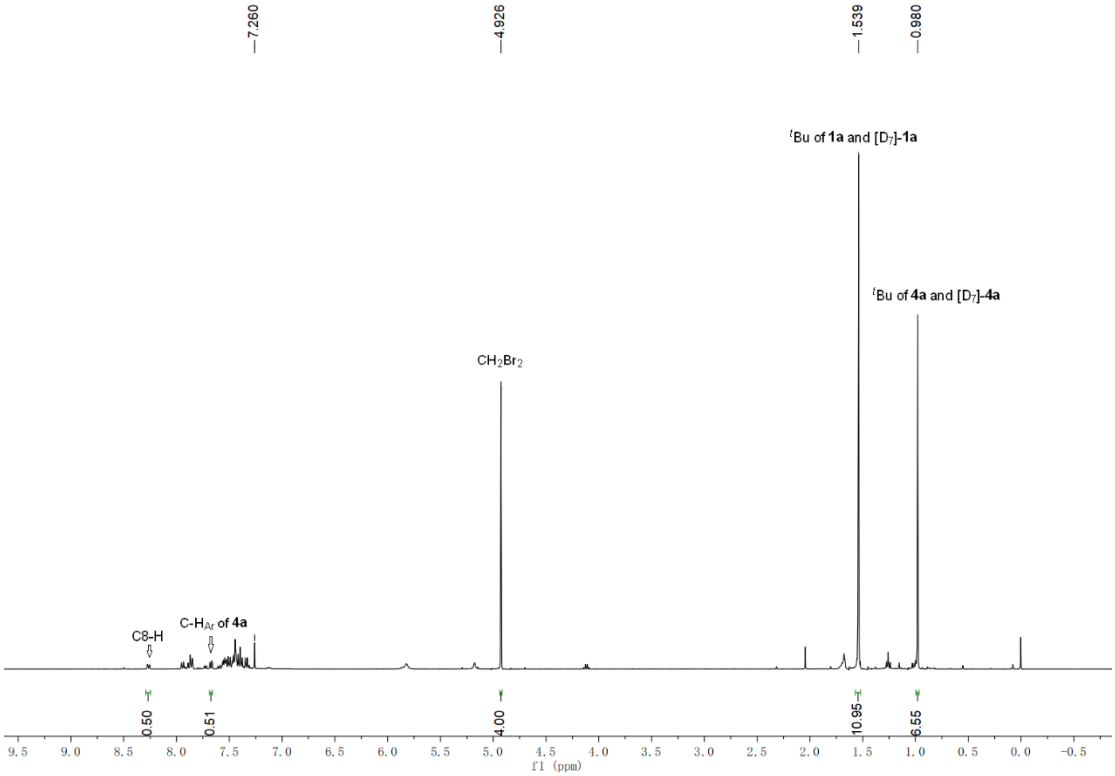
5.3 Kinetic Isotope Experiment

Deuterated *N*-(*tert*-Butyl)-1-naphthamide [D_7]-**1a** was prepared according to the literature.[1]



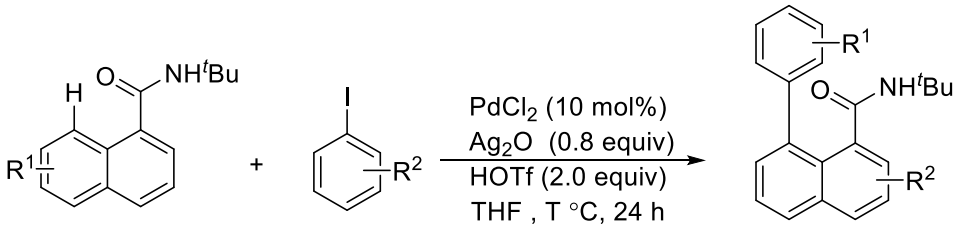
A Schlenk tube with a magnetic stir bar was charged with *N*-(*tert*-Butyl)-1-naphthamide **1a** (0.1 mmol, 22.7 mg), [D_7]-**1a** (0.1 mmol, 23.4 mg), $PdCl_2$ (3.6 mg) and Ag_2O (37.0 mg). The tube was evacuated and refilled with N_2 by three times. Then THF (1.0 mL), iodobenzene **2a** (0.26 mmol, 29 µL), HOTf (0.40 mmol, 35 µL) was added under N_2. The reaction mixture was stirred at 60 °C for 0.5 h. The mixture was filtered through a celite pad and washed with 10-20 mL of DCM. To remove Ag salts, the filtrate was concentrated and the the residue was purified by flash column chromatography on silica gel to provide yellow oil for ^{1}H NMR analysis using dibromomethane (0.2 mmol, 14 µL) as internal standard.





VI. General Procedure

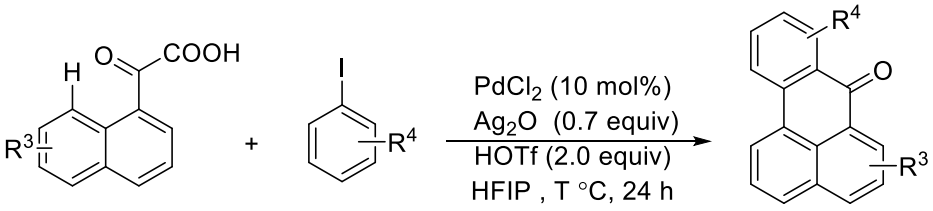
6.1 General Procedure A



1 **2** **4**

A Schlenk tube with a magnetic stir bar was charged with 1-naphthamide (0.2 mmol) derivatives **1**, $PdCl_2$ (10 mol%, 3.6 mg) and Ag_2O (0.8 equiv, 37 mg). The tube was evacuated and refilled with N_2 by three times. Then iodoarenes **2** (1.3 equiv), THF (1 mL), HOTf (0.4 mmol, 35 μL) was added under N_2. The reaction mixture was stirred at relevant temperature for 24 h. The mixture was filtered through a celite pad and washed with 10-20 mL of DCM. The filtrate was concentrated and the residue was purified by column chromatography on silica gel to provide corresponding 8-arylated 1-naphthamides **4**.

6.2 General Procedure B

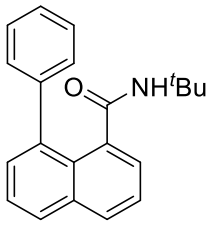


3 **2** **5**

A Schlenk tube with a magnetic stir bar was charged with 1-naphthioc acid derivatives **3** (0.2 mmol), $PdCl_2$ (10 mol%, 3.6 mg) and Ag_2O (0.7 equiv, 32 mg). The tube was evacuated and refilled with N_2 by three times. Then iodoarenes **2** (1.2 equiv), THF (1 mL), HOTf (0.4 mmol, 35 μL) was added under N_2. The reaction mixture was stirred at relevant temperature for 24 h. The mixture was filtered through a celite pad

and washed with 10-20 mL of DCM. The filtrate was concentrated and the residue was purified by column chromatography on silica gel to provide corresponding benzanthrones **5**.

VII. Spectral Data



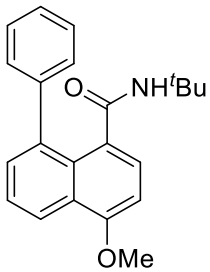
***N*-(tert-Butyl)-8-phenyl-1-naphthamide (4a):** The reaction was performed following the general procedure A at 60 °C, **4a** was obtained in 82% yield as a white solid (49.5 mg, eluent: DCM/ EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.94 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.86 (dd, *J* = 8.0, 0.8 Hz, 1H), 7. 68 (dd, *J* = 7.2, 1.6 Hz, 1H), 7.37-7.57 (m, 7H), 7.33 (tt, *J* = 7.2, 1.6 Hz, 1H), 5.17 (bs, 1H), 0.98 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.9, 142.9, 139.7, 136.8, 135.1, 131.2, 130.7, 129.0, 128.7, 128.5, 128.2, 127.3, 127.2, 125.7, 125.1, 51.3, 28.2 ppm.

HRMS (ESI) Calcd for $C_{21}H_{22}NO^+$ $[M+H]^+$ 304.1696 , found: 304.1695.

The analytical data matched those reported in the literature.[1]

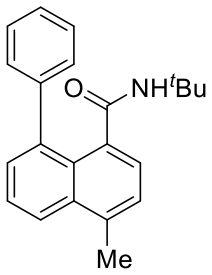


***N*-(*tert*-Butyl)-4-methoxy-8-phenyl-1-naphthamide (4b):** The reaction was performed following the general procedure A at 60 °C, **4b** was obtained in 78% yield as a white solid (52.0 mg, eluent: DCM/ EA = 20:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.35 (d, *J* = 8.4 Hz, 1H), 7.66 (d, *J* = 7.6 Hz, 1H), 7.55 (t, *J* = 8.4 Hz, 1H), 7.44-7.48 (m, 3H), 7.40 (t, *J* = 7.6 Hz, 2H), 7.30-7.33 (m, 1H), 6.82 (d, *J* = 8.0 Hz, 1H), 5.13 (bs, 1H), 4.05 (s, 3H), 0.96 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.9, 157.0, 143.4, 139.4, 131.9, 129.6, 129.3, 129.0, 128.7, 128.5, 127.3, 127.2, 125.4, 121.9, 102.9, 56.0, 51.2, 28.4 ppm.

HRMS (ESI) Calcd for $C_{22}H_{24}NO_2^+$ $[M+H]^+$ 334.1802 , found: 334.1801.

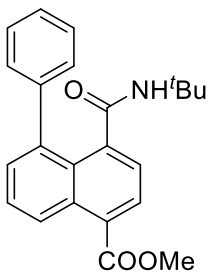


***N*-(*tert*-Butyl)-4-methyl-8-phenyl-1-naphthamide (4c):** The reaction was performed following the general procedure A at 60 °C, **4c** was obtained in 79% yield as a white solid (50.1 mg, eluent: DCM/ EA = 40:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.04 (d, *J* = 8.4 Hz, 1H), 7.57-7.61 (m, 2H), 7.44-7.47 (m, 3H), 7.30-7.41 (m, 4H), 5.16 (bs, 1H), 2.75 (s, 3H), 0.98 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.1, 143.4, 140.3, 137.0, 135.5, 134.4, 131.0, 129.2, 128.6, 128.5, 127.7, 127.2, 126.1, 125.8, 124.0, 51.3, 28.4, 20.5 ppm.

HRMS (ESI) Calcd for $C_{22}H_{24}NO^+$ $[M+H]^+$ 318.1852 , found: 318.1851.

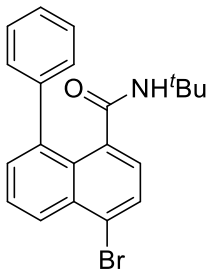


Methyl 4-(*tert*-butylcarbamoyl)-5-phenyl-1-naphthoate (4d): The reaction was performed following the general procedure A at 80°C, **4d** was obtained in 62% yield as a white solid (44.8 mg, eluent: DCM/ EA = 16:1).

^{1}H NMR (400 MHz, $CDCl_3$) ppm. δ = 8.82 (d, *J* = 8.8 Hz, 1H), 8.07 (d, *J* = 7.6 Hz, 1H), 7.63-7.67 (m, 2H), 7.49 (d, *J* = 7.2 Hz, 1H), 7.32-7.42 (m, 5H), 5.18 (bs, 1H), 4.03 (s, 3H), 0.97 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.2, 168.0, 142.7, 141.1, 140.2, 133.0, 131.6, 129.8, 129.4, 128.9, 128.7, 127.9, 127.6, 127.4, 127.3, 125.4, 52.7, 51.6, 28.3 ppm.

HRMS (ESI) Calcd for $C_{23}H_{24}NO_3^+$ $[M+H]^+$ 362.1751 , found: 362.1750.

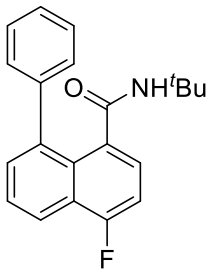


4-Bromo-*N*-(tert-butyl)-8-phenyl-1-naphthamide (4e): The reaction was performed following the general procedure A at 60 °C, **4c** was obtained in 76% yield as a white solid (58.4 mg, eluent: DCM/ EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.36 (d, *J* = 8.4 Hz, 1H), 7.81 (d, *J* = 7.6 Hz, 1H), 7.65 (t, *J* = 8.0 Hz, 1H), 7.49-7.67 (m, 2H), 7.32-7.43 (m, 5H), 5.16 (bs, 1H), 0.98 (s, 9H) ppm.

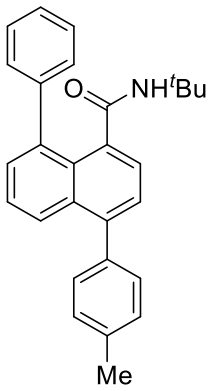
^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.2, 142.5, 140.4, 137.1, 133.5, 132.2, 129.5, 129.30, 128.8, 128.74, 128.67, 127.6, 127.4, 127.2, 125.6, 51.6, 28.3 ppm.

HRMS (ESI) Calcd for $C_{21}H_{21}{}^{79}BrNO^+$ $[M+H]^+$ 382.0801, found: 382.0803; Calcd for $C_{21}H_{21}{}^{81}BrNO^+$ $[M+H]^+$ 384.0781, found: 384.0785.

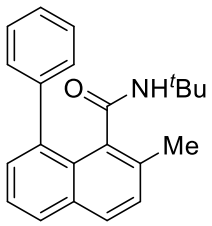


***N*-(*tert*-Butyl)-4-fluoro-8-phenyl-1-naphthamide (4f):** The reaction was performed following the general procedure A at 60 °C, **4f** was obtained in 70% yield as a white solid (45.0 mg, eluent: DCM/ EA = 45:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.16 (d, *J* = 8.4 Hz, 1H), 7.61 (t, *J* = 7.2 Hz, 2H), 7.50 (d, *J* = 7.2 Hz, 1H), 7.43-7.31 (m, 5H), 7.16 (t, *J* = 8.8 Hz, 1H), 5.19 (bs, 1H), 0.98 (s, 9H) ppm.
^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.3, 159.8 (d, *J* = 253 Hz), 142.6, 139.9 (d, *J* = 3 Hz), 133.3, (d, *J* = 4 Hz), 132.3, 129.1, 129.0 (d, *J* = 4 Hz), 128.9, 128.8 (d, *J* = 10 Hz), 127.5, 126.3 (d, *J* = 1 Hz), 125.4 (d, *J* = 15 Hz), 120.4 (d, *J* = 7 Hz), 108.7 (d, *J* = 21 Hz), 51.5, 28.3 ppm.
HRMS (ESI) Calcd for $C_{21}H_{21}FNO^+$ $[M+H]^+$ 322.1602, found: 322.1602.



***N*-(*tert*-Butyl)-8-phenyl-4-(*p*-tolyl)-1-naphthamide (4g):** The reaction was performed following the general procedure A at 60 °C, **4g** was obtained in 79% yield as a white solid (61.8 mg, eluent: DCM/ EA = 50:1).
^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.92 (dd, *J* = 7.6 Hz, 2.4 Hz, 1H), 7.70 (d, *J* = 7.2 Hz, 1H), 7.32-7.50 (m, 12H), 5.25 (bs, 1H), 2.48 (s, 3H), 1.01 (s, 9H) ppm.
^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.0, 143.3, 142.8, 140.0, 137.8, 137.5, 136.3, 133.7, 131.1, 130.0, 129.3, 129.2, 128.6, 128.2, 127.9, 127.3, 126.4, 126.3, 125.8, 51.4, 28.4, 21.4 ppm.
HRMS (ESI) Calcd for $C_{28}H_{28}NO^+$ $[M+H]^+$ 394.2165, found: 394.2160.



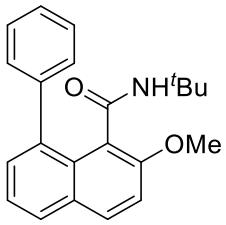
***N*-(*tert*-Butyl)-2-methyl-8-phenyl-1-naphthamide (4h):** The reaction was performed

following the general procedure A at 60 °C, **4h** was obtained in 70% yield as a white solid (44.3 mg, eluent: DCM/ EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.83 (d, *J* = 8.4 Hz, 1H), 7.80 (d, *J* = 8.0 Hz, 1H), 7.29-7.51 (m, 8H), 4.99 (bs, 1H), 2.50 (s, 3H), 0.95 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.8, 142.2, 139.7, 135.4, 134.7, 133.3, 132.2, 131.9, 129.5, 129.3, 128.9, 128.2, 127.5, 127.4, 124.7, 51.5, 28.5, 20.6 ppm.

HRMS (ESI): calcd for $C_{22}H_{24}NO^+$ $[M+H]^+$ 318.1852, found 318.1854.

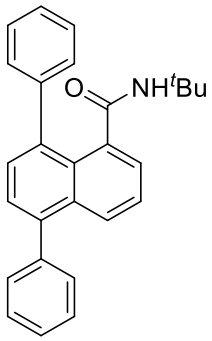


***N*-(*tert*-Butyl)-2-methoxy-8-phenyl-1-naphthamide (4i):** The reaction was performed following the general procedure A at 60 °C, **4i** was obtained in 92% yield as a white solid (61.3 mg, eluent: DCM/ EA = 16:1).

^{1}H NMR (400 MHz, DMSO-d_6): δ = 8.02 (d, *J* = 9.2 Hz, 1H), 7.88 (d, *J* = 8.0 Hz, 1H), 7.49 (d, *J* = 9.2 Hz, 1H), 7.28-7.39 (m, 7H), 7.09 (d, *J* = 6.8 Hz, 1H), 3.83 (s, 3H), 0.91 (s, 9H) ppm.

^{13}C NMR (100 MHz, DMSO) δ = 165.3, 155.1, 142.0, 139.0, 131.2, 130.5, 130.4, 129.6, 128.2, 128.0, 127.1, 126.6, 124.1, 122.9, 114.6, 56.9, 50.3, 28.3 ppm.

HRMS (ESI) Calcd for $C_{22}H_{23}NO_2Na^+$ $[M+Na]^+$ 356.1621 , found: 356.1623.



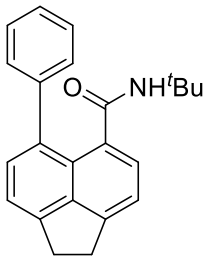
***N*-(*tert*-Butyl)-5,8-diphenyl-1-naphthamide (4j):** The reaction was performed following the general procedure A at 60 °C, **4j** was obtained in 79% yield as a white

solid (60.1 mg, eluent: DCM/ EA = 40:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.00 (d, *J* = 8.4 Hz, 1H), 7.69 (d, *J* = 6.8 Hz, 1H), 7.40-7.54 (m, 12H), 7.33-7.36 (m, 1H), 5.25 (bs, 1H), 1.00 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.0, 143.1, 140.7, 140.2, 139.3, 137.2, 133.5, 130.7, 130.3, 129.2, 128.9, 128.73, 128.66, 128.5, 127.8, 127.6, 127.4, 127.1, 125.2, 51.4, 28.4 ppm.

HRMS (ESI) Calcd for $C_{27}H_{26}NO^+$ $[M+H]^+$ 380.2009 , found: 380.2006.

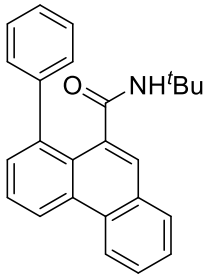


***N*-(*tert*-Butyl)-6-phenyl-1,2-dihydroacenaphthylene-5-carboxamide (4k):** The reaction was performed following the general procedure A at 60 °C, **4k** was obtained in 69% yield as a white solid (45.6 mg, eluent: DCM/ EA = 30:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.69 (d, *J* = 6.8 Hz, 1H), 7.47 (d, *J* = 7.2 Hz, 2H), 7.43-7.37 (m, 4H), 7.33 (t, *J* =7.2 Hz, 2H), 5.12 (bs, 1H), 3.45 (s, 4H), 0.96 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.0, 148.8, 146.1, 142.8, 140.5, 135.5, 132.9, 132.5, 130.8, 128.8, 128.7, 127.2, 125.6, 119.9, 119.2, 51.3, 30.5, 30.1, 28.3 ppm.

HRMS (ESI) Calcd for $C_{23}H_{24}NO^+$ $[M+H]^+$ 330.1852, found: 330.1852.

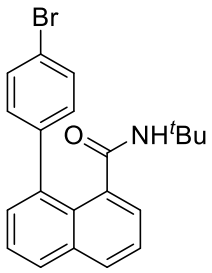


***N*-(*tert*-Butyl)-8-phenylphenanthrene-9-carboxamide (4l):** The reaction was performed following the general procedure A at 60 °C, **4l** was obtained in 82% yield as a white solid (58.0 mg, eluent: DCM/ EA = 40:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.73 (d, *J* = 8.4 Hz, 1H), 8.69 (d, *J* = 8.4 Hz, 1H), 7.98 (s, 1H), 7.92 (d, *J* = 8.0 Hz, 1H), 7.69-7.75 (m, 2H), 7.64 (t, *J* = 7.2 Hz, 1H), 7.57 (d, *J* = 7.2 Hz, 1H), 7.48 (d, *J* = 7.2 Hz, 2H), 7.42 (t, *J* = 7.6 Hz, 2H), 7.34 (t, *J* = 7.2 Hz, 1H), 5.29 (bs, 1H), 1.01 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.7, 143.2, 140.8, 135.2, 132.5, 131.4, 131.2, 130.7, 130.2, 129.2, 128.7, 128.1, 127.40, 127.37, 126.7, 126.0, 123.0, 122.3, 51.4, 28.4. ppm.

HRMS (ESI) Calcd for $C_{25}H_{23}NONa^+$ $[M+Na]^+$ 376.1672, found: 376.1669.

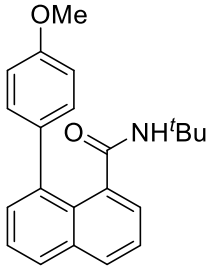


8-(4-Bromophenyl)-*N*-(*tert*-butyl)-1-naphthamide (4m): The reaction was performed following the general procedure A at 80 °C, **4m** was obtained in 68% yield as a white solid (52.0 mg, eluent: DCM/ EA = 80:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.94 (d, *J* = 8.0 Hz, 1H), 7.87 (d, *J* = 8.0 Hz, 1H), 7.62 (d, *J* = 7.2 Hz, 1H), 7.56-7.47 (m, 4H), 7.39 (d, *J* = 7.2 Hz, 1H), 7.31 (d, *J* = 7.2 Hz, 2H), 5.27 (bs, 1H), 1.06 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.0, 141.9, 138.7, 136.8, 135.2, 131.6, 131.0, 130.9, 128.8, 128.7, 127.4, 125.9, 125.3, 121.5, 51.6, 28.4. ppm.

HRMS (ESI) Calcd for $C_{21}H_{21}{}^{79}BrNO^+$ $[M+H]^+$ 382.0801, found: 382.0802; Calcd for $C_{21}H_{21}{}^{81}BrNO^+$ $[M+H]^+$ 384.0781, found: 384.0779.

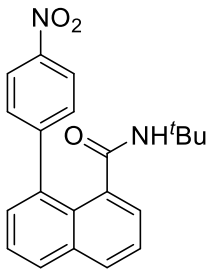


8-(4-Methoxyphenyl)-*N*-(*tert*-butyl)-1-naphthamide (4n): The reaction was performed following the general procedure A at 80 °C, **4n** was obtained in 72% yield as a white solid (48.1 mg, eluent: DCM/ EA = 20:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.92 (d, *J* = 8.4 Hz, 1H), 7.84 (d, *J* = 7.2 Hz, 1H), 7.66 (d, *J* = 7.2 Hz, 1H), 7.53 (t, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 1H), 7.42 (dd, *J* = 7.2 Hz, 1.2Hz, 1H), 7.37 (d, *J* = 8.4 Hz, 2H), 6.95 (d, *J* = 8.8 Hz, 2H), 5.15 (bs, 1H), 3.84 (s, 3H), 1.02 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.2, 159.3, 139.4, 137.1, 135.6, 135.3, 131.0, 130.7, 130.2, 128.8, 127.9, 127.6, 125.9, 125.2, 114.2, 55.5, 51.4, 28.4 ppm.

HRMS (ESI) Calcd for $C_{22}H_{24}NO_2^+$ $[M+H]^+$ 334.1802 , found: 334.1802.

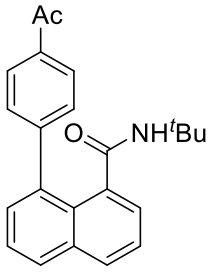


8-(4-Nitrophenyl)-*N*-(*tert*-butyl)-1-naphthamide (4o): The reaction was performed following the general procedure A at 80 °C, **4o** was obtained in 78% yield as a white solid (53.9 mg, eluent: DCM/ EA = 20:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.26 (d, *J* = 8.8 Hz, 2H), 7.99 (d, *J* = 7.6 Hz, 1H), 7.94 (d, *J* = 8.0 Hz, 1H), 7.64 (d, *J* = 7.2 Hz 1H), 7.60-7.56 (m, 3H), 7.52 (t, *J* = 7.6 Hz, 1H), 7.41 (d, *J* = 7.2 Hz, 1H), 5.45 (bs, 1H), 1.03 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.9, 150.0, 146.9, 137.8, 136.3, 135.3, 131.3, 131.2, 129.8, 129.6, 128.9, 127.3, 125.9, 125.5, 123.8, 51.7, 28.4 ppm.

HRMS (ESI) Calcd for $C_{21}H_{21}N_2O_3^+$ $[M+H]^+$ 349.1547 , found: 349.1547.

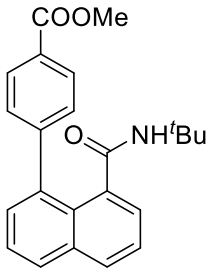


8-(4-Acetylphenyl)-*N*-(*tert*-butyl)-1-naphthamide (4p): The reaction was performed following the general procedure A at 80 °C, **4p** was obtained in 77% yield as a white solid (53.0 mg, eluent: DCM/ EA = 12:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.99 (d, *J* = 8.8 Hz, 2H), 7.96 (d, *J* = 8.4 Hz, 1H), 7.90 (d, *J* = 8.0 Hz, 1H), 7.65 (d, *J* = 6.8 Hz 1H), 7.59-7.48 (m, 4H), 7.43 (d, *J* = 6.8 Hz, 1H), 5.32 (bs, 1H), 2.62 (s, 3H), 0.98 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 198.1, 168.9, 148.0, 138.7, 136.6, 135.8, 135.2, 131.2, 131.1, 129.3, 129.1, 128.9, 128.7, 127.3, 125.9, 125.4, 51.6, 28.3, 26.9 ppm.

HRMS (ESI) Calcd for $C_{23}H_{24}NO_2^+$ $[M+H]^+$ 346.1802, found: 346.1802.

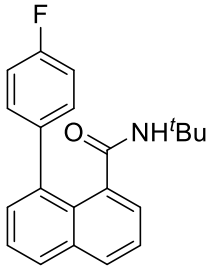


Methyl 4-(8-(*tert*-butylcarbamoyl)naphthalen-1-yl)benzoate (4q): The reaction was performed following the general procedure A at 80 °C, **4q** was obtained in 83% yield as a white solid (59.9 mg, eluent: DCM/ EA = 15:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.07 (d, *J* = 8.4 Hz, 2H), 7.96 (dd, *J* = 8.4 Hz, 1.6 Hz, 1H), 7.90 (dd, *J* = 8.0 Hz, 1.6 Hz, 1H), 7.65 (dd, *J* = 7.2 Hz, 1.6 Hz, 1H), 7.58-7.48 (m, 4H), 7.42 (dd, *J* = 7.2 Hz, 1.6 Hz, 1H), 5.29 (bs, 1H), 3.94 (s, 3H), 0.98 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.9, 167.2, 147.8, 138.9, 136.7, 135.3, 131.2, 131.0, 129.9, 129.1, 129.0, 128.9, 128.8, 127.4, 125.9, 125.4, 52.2, 51.6, 28.3 ppm.

HRMS (ESI) Calcd for $C_{22}H_{24}NO_3^+$ $[M+H]^+$ 362.1751 , found: 362.1751.

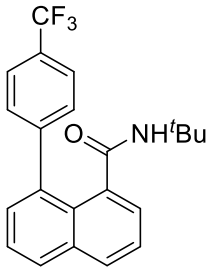


***N*-(*tert*-Butyl)-8-(4-fluorophenyl)-1-naphthamide (4r):** The reaction was performed following the general procedure A at 80 °C, **4r** was obtained in 71% yield as a white solid (45.5 mg, eluent: DCM/ EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.94 (d, *J* = 8.0 Hz, 1H), 7.87 (d, *J* = 8.0 Hz, 1H), 7.63 (d, *J* = 6.8 Hz, 1H), 7.55 (t, *J* = 7.6 Hz, 1H), 7.49 (t, *J* = 8.0 Hz, 1H), 7.42-7.38 (m, 3H), 7.09 (t, *J* = 8.4 Hz, 2H), 5.23 (bs, 1H), 1.05 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.1, 162.5 (d, *J* = 245 Hz), 139.0 (d, *J* = 4 Hz), 138.8, 136.9, 135.2, 131.2, 130.9, 130.7, 128.8, 128.5, 127.6, 125.9, 125.2, 115.4 (d, *J* = 21 Hz), 51.5, 28.4 ppm.

HRMS (ESI) Calcd for $C_{21}H_{21}FNO^+$ $[M+H]^+$ 322.1602, found: 322.1600.

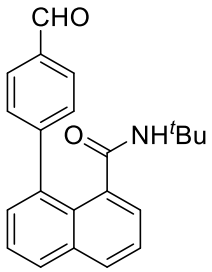


***N*-(*tert*-Butyl)-8-(4-(trifluoromethyl)phenyl)-1-naphthamide (4s):** The reaction was performed following the general procedure A at 80 °C, **4s** was obtained in 62 % yield as a white solid (46.3 mg, eluent: DCM/ EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.97 (d, *J* = 8.0 Hz, 1H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.67-7.62 (m, 3H), 7.59-7.48 (m, 4H), 7.40 (d, *J* = 7.2 Hz, 1H), 5.34 (bs, 1H), 1.01 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.9, 146.7, 138.5, 136.6, 135.2, 131.3, 131.1, 129.4, 129.1, 128.8, 127.4, 125.9, 125.4 (q, *J* = 3 Hz), 125.3, 124.6 (q, *J* = 277 Hz), 51.6, 28.3 ppm.

HRMS (ESI) Calcd for $C_{22}H_{21}F_3NO^+$ $[M+H]^+$ 372.1570, found: 372.1561.

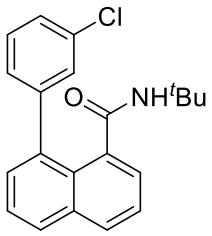


***N*-(*tert*-Butyl)-8-(4-formylphenyl)-1-naphthamide (4t):** The reaction was performed following the general procedure A at 80 °C, **4s** was obtained in 61 % yield as a white solid (41.0 mg, eluent: DCM/ EA = 15:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 10.04 (s, 1H), 7.97 (d, *J* = 8.4 Hz, 1H), 7.93-7.89 (m, 3H), 7.66 (d, *J* = 7.2 Hz, 1H), 7.62-7.55 (m, 3H), 7.51 (t, *J* = 7.6 Hz, 1H), 7.43 (d, *J* = 7.2 Hz, 1H), 5.36 (bs, 1H), 0.98 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.1, 168.8, 149.4, 138.4, 136.4, 135.1, 135.0, 131.1, 131.0, 129.9, 129.6, 129.1, 128.8, 127.1, 125.8, 125.3, 51.5, 28.2 ppm.

HRMS (ESI) Calcd for $C_{22}H_{21}NO_2Na^+$ $[M+Na]^+$ 354.1465, found: 354.1467.

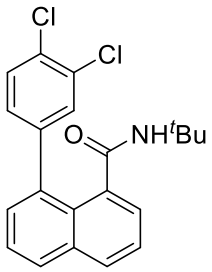


***N*-(*tert*-Butyl)-8-(3-chlorophenyl)-1-naphthamide (4u):** The reaction was performed following the general procedure A at 80 °C, **4u** was obtained in 85% yield as a white solid (57.6 mg, eluent: DCM/ EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.94 (d, *J* = 8.0 Hz, 1H), 7.88 (d, *J* = 8.0 Hz, 1H), 7.62 (d, *J* = 6.8 Hz, 1H), 7.54 (t, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 1H), 7.42-7.27 (m, 5H), 5.39 (bs, 1H), 1.08 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.9, 144.8, 138.5, 136.7, 135.2, 131.1, 131.0, 130.0, 128.8, 128.7, 127.5, 127.3, 125.9, 125.2, 51.6, 28.4 ppm.

HRMS (ESI) Calcd for $C_{21}H_{21}NO^{35}Cl^+$ $[M+H]^+$ 338.1306, found: 338.1301, Calcd for $C_{21}H_{21}NO^{37}Cl^+$ $[M+H]^+$ 340.1277, found: 340.1284.

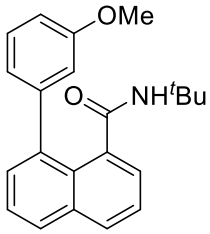


***N*-(*tert*-Butyl)-8-(3,4-dichlorophenyl)-1-naphthamide (4v):** The reaction was performed following the general procedure A at 80 °C, **4v** was obtained in 71% yield as a white solid (53.0 mg, eluent: DCM/ EA = 100:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.94 (d, *J* = 8.0 Hz, 1H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.59-7.46 (m, 4H), 7.40-7.34 (m, 3H), 5.50 (bs, 1H), 1.12 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.0, 142.9, 137.5, 135.2, 131.3, 131.1, 130.8, 130.6, 129.0, 128.8, 128.6, 127.6, 125.9, 125.3, 124.5, 51.8, 28.3 ppm.

HRMS (ESI) Calcd for $C_{21}H_{19}NO^{35}Cl_2Na^+$ $[M+Na]^+$ 394.0736, found: 394.0734, Calcd for $C_{21}H_{19}NO^{35}Cl^{37}ClNa^+$ $[M+Na]^+$ 396.0706, found: 396.0704, Calcd for $C_{21}H_{19}NO^{37}Cl_2Na^+$ $[M+Na]^+$ 398.0677, found: 398.0676.

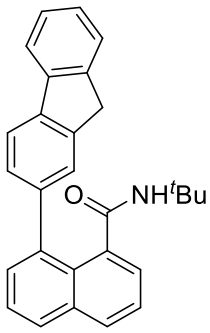


***N*-(*tert*-Butyl)-8-(3-methoxyphenyl)-1-naphthamide (4w):** The reaction was performed following the general procedure A at 80 °C, **4w** was obtained in 90% yield as a white solid (60.0 mg, eluent: DCM/ EA = 30:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.95 (d, *J* = 8.0 Hz, 1H), 7.87 (d, *J* = 8.0 Hz, 1H), 7.68 (d, *J* = 7.2 Hz, 1H), 7.57-7.47 (m, 3H), 7.33 (t, *J* = 8.0 Hz, 1H), 7.09 (d, *J* = 7.6 Hz, 1H), 6.97 (s, 1H), 6.89 (dd, *J* = 8.4 Hz, 1.6 Hz, 1H), 5.17 (bs, 1H), 3.84 (s, 3H), 1.02 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.1, 159.4, 144.3, 139.6, 137.0, 135.2, 131.2, 130.9, 129.7, 129.0, 128.5, 127.3, 125.9, 125.3, 114.6, 55.4, 51.4, 28.3 ppm.

HRMS (ESI) Calcd for $C_{22}H_{24}NO_2^+$ $[M+H]^+$ 334.1802 , found: 334.1803.

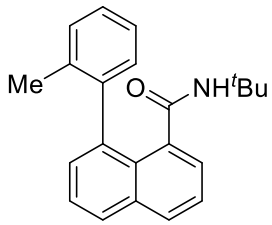


***N*-(*tert*-Butyl)-8-(*9H*-fluoren-2-yl)-1-naphthamide (4x):** The reaction was performed following the general procedure A at 100 °C, **4x** was obtained in 66% yield as a white solid (51.4 mg, eluent: DCM/ EA = 80:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.96 (d, *J* = 8.0 Hz, 1H), 7.88 (dd, *J* = 8.0 Hz, 1.6 Hz, 1H), 7.85-7.80 (m, 2H), 7.71 (d, *J* = 6.8 Hz, 1H), 7.62 (s, 1H), 7.59-7.50 (m, 5H), 7.39 (t, *J* = 7.2 Hz, 1H), 7.32 (t, *J* = 7.2 Hz, 1H), 5.17 (bs, 1H), 3.94 (dd, *J* = 32.0 Hz, 20.8 Hz, 2H), 0.87 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.1, 143.6, 143.4, 141.6, 141.1, 140.0, 137.1, 135.3, 131.2, 130.8, 128.9, 128.2, 127.5, 126.8, 126.7, 125.9, 125.3, 125.1, 120.2, 120.0, 51.4, 37.1, 28.2 ppm.

HRMS (ESI) Calcd for $C_{28}H_{26}NO^+[M+H]^+$: 392.2009, found: 392.2008.

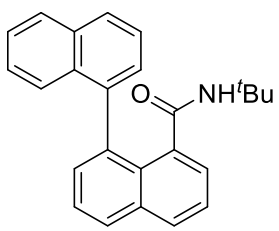


***N*-(*tert*-Butyl)-8-(*o*-tolyl)-1-naphthamide (4y):** The reaction was performed following the general procedure A at 80 °C, **4y** was obtained in 74% yield as a white solid (47.0 mg, eluent: DCM/ EA = 80:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.94 (dd, *J* = 7.6, 2.0 Hz, 1H), 7.86 (d, *J* = 8.0 Hz, 1H), 7.52 (t, *J* = 7.6 Hz, 1H), 7.48-7.42 (m, 2H), 7.28-7.14 (m, 5H), 5.26 (bs, 1H), 2.15 (s, 3H), 1.05 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.3, 141.9, 139.3, 137.5, 134.9, 130.9, 130.7, 130.3, 128.3, 128.2, 127.9, 127.6, 125.7, 125.3, 124.8, 51.4, 28.6, 20.7 ppm.

HRMS (ESI): calcd for $C_{22}H_{24}NO^+$ $[M+H]^+$ 318.1852, found 318.1850.

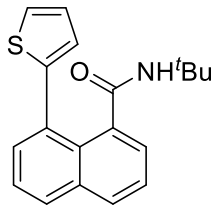


***N*-(*tert*-Butyl)-[1,1'-binaphthalene]-8-carboxamide (4z):** The reaction was performed following the general procedure A at 80 °C, **4z** was obtained in 65% yield as a white solid (46.0 mg, eluent: DCM/ EA = 80:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.99 (dd, *J* = 6.8, 2.8 Hz, 1H), 7.95 (d, *J* = 8.0 Hz, 1H), 7.90 (d, *J* = 8.4 Hz, 1H), 7.86 (d, *J* = 8.4 Hz, 1H), 7.62-7.43 (m, 8H), 7.32 (t, *J* 7.6 Hz, 1H), 4.81 (bs, 1H), 0.62 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.3, 137.6, 135.0, 134.2, 132.8, 132.0, 130.7, 128.9, 128.7, 128.6, 128.3, 127.9, 126.2, 125.9, 125.8, 125.7, 125.6, 125.1, 50.9, 28.0 ppm.

HRMS (ESI): calcd for $C_{25}H_{24}NO^+$ $[M+H]^+$ 354.1852, found 354.1848.

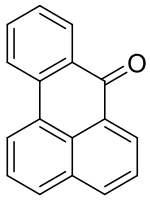


***N*-(*tert*-Butyl)-8-(thiophen-2-yl)-1-naphthamide (4aa):** The reaction was performed following the general procedure A at 80 °C, **4aa** was obtained in 52% yield as a grey solid (32.3 mg, eluent: DCM/ EA = 40:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.92 (d, *J* = 8.0 Hz, 1H), 7.86 (d, *J* = 8.4 Hz, 1H), 7.72 (d, *J* = 7.2 Hz, 1H), 7.61 (dd, *J* = 7.2 Hz, 1.2 Hz, 1H), 7.54-7.48 (m, 2H), 7.31 (dd, *J* = 5.6 Hz, 1.2 Hz, 1H), 7.08-7.03(m, 2H), 5.19 (bs, 1H), 1.11 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.0, 143.8, 136.9, 135.3, 132.1, 131.7, 130.7, 129.4, 128.9, 128.0, 127.9, 125.8, 125.5, 125.2, 51.5, 28.6 ppm.

HRMS (ESI) Calcd for $C_{19}H_{20}NOS^+[M+H]^+$: 310.1260, found: 310.1261.



***7H*-Benzo*[de]*anthracen-7-one (5a):** The reaction was performed following the general procedure B at 100 °C, **5a** was obtained in 84% yield as a yellow solid (38.9 mg, eluent: PE/EA = 40:1). Methyl 1-naphthoate instead of 1-naphthoic acid, **5a** was

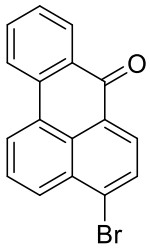
obtained in 76% yield. **1a** instead of 1-naphthoic acid, **5a** was obtained in 62% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.77 (d, *J* = 6.8 Hz, 1H), 8.51 (d, *J* = 8.0 Hz, 1H), 8.46 (d, *J* = 7.2 Hz, 1H), 8.34 (d, *J* = 8.4 Hz, 1H), 8.22 (d, *J* = 8.0Hz, 1H), 8.00 (d, *J* = 8.0 Hz, 1H), 7.80-7.65 (m, 3H), 7.56 (t, *J* = 7.6, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 184.0, 136.3, 135.3, 133.5, 133.1, 131.3, 130.4, 130.0, 128.7, 128.4, 128.3, 128.0, 127.0, 126.74, 126.70, 124.3, 123.2 ppm.

HRMS (ESI): calcd for $C_{17}H_{10}ONa^+$ $[M+Na]^+$ 253.0624, found 253.0622.

The analytical data matched those reported in the literature.[4]



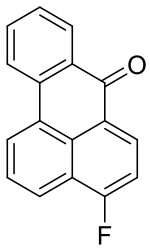
4-Bromo-*7H*-benzo*[de]*anthracen-7-one (5b): The reaction was performed following the general procedure B at 100 °C, **5b** was obtained in 93% yield as a yellow solid (58.2 mg, eluent: PE/EA = 40:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.49 (d, *J* = 7.6 Hz, 1H), 8.45-8.42 (m, 2H), 8.34 (d, *J* = 8.4 Hz, 1H), 8.26 (d, *J* = 8.0 Hz, 1H), 8.02 (d, *J* = 7.6 Hz, 1H), 7.75-7.68 (m, 2H), 7.54 (t, *J* = 7.2, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.4, 135.9, 133.8, 131.9, 131.6, 131.2, 130.8, 129.9, 129.5, 128.9, 128.7, 128.2, 128.1, 127.8, 127.4, 125.0, 123.3 ppm.

HRMS (ESI): Calcd for $C_{17}H_{10}{}^{79}BrO^+$ $[M+H]^+$ 308.9910, found: 308.9900, Calcd for $C_{17}H_{10}{}^{81}BrO^+$ $[M+H]^+$310.9889, found: 310.9889.

The analytical data matched those reported in the literature.[4]



4-Fluoro-*7H*-benzo*[de]*anthracen-7-one (5c): The reaction was performed following

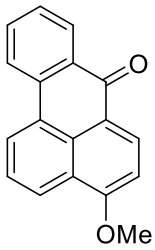
the general procedure B at 100 °C, **5c** was obtained in 82% yield as a yellow solid (40.2 mg, eluent: PE/EA = 40:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.73 (dd, *J* = 8.0 Hz, 5.6 Hz, 1H), 8.50-8.46 (m, 2H), 8.31 (d, *J* = 8.4 Hz, 1H), 8.23 (d, *J* = 8.4 Hz, 1H), 7.76-7.69 (m, 2H), 7.56 (t, *J* = 8.0 Hz, 1H), 7.44-7.38 (m, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 182.8, 163.4 (d, *J* = 260 Hz), 136.0, 133.5, 131.5 (d, *J* = 11 Hz), 131.2, 129.6 (d, *J* = 5 Hz), 128.8, 128.3, 127.1 (d, *J* = 2 Hz), 127.0 (d, *J* = 2 Hz), 125.2 (d, *J* = 4 Hz), 125.0, 123.2, 123.1, 129.9 (d, *J* = 5 Hz), 111.5 (d, *J* = 21 Hz) ppm.

HRMS (ESI): calcd for $C_{17}H_{10}FO^+$ $[M+H]^+$ 249.0710, found 249.0703.

The analytical data matched those reported in the literature.[4]



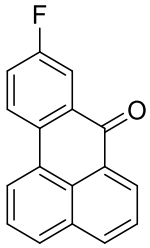
4-Methoxy-*7H*-benzo*[de]*anthracen-7-one (5d): The reaction was performed following the general procedure B at 60 °C, **5d** was obtained in 56% yield as a yellow solid (29.0 mg, eluent: PE/EA = 20:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.78 (d, *J* = 8.4 Hz, 1H), 8.53-8.48 (m, 2H), 8.42 (d, *J* = 8.4 Hz, 1H), 8.36 (d, *J* = 8.0 Hz, 1H), 7.75-7.70 (m, 1H), 7.67 (t, *J* = 8.0, 1H), 7.55 (t, *J* = 7.6, 1H), 7.12 (d, *J* = 8.4, 1H), 4.14 (s, 3H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.0, 161.7, 136.4, 133.0, 132.6, 131.5, 129.2, 128.3, 128.1, 126.7, 125.7, 124.7, 124.6, 124.5, 123.1, 122.1, 105.7 ppm.

HRMS (ESI): calcd for $C_{18}H_{13}O_2^+$ $[M+H]^+$ 261.0910, found 261.0907.

The analytical data matched those reported in the literature.[4]



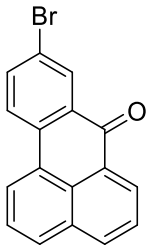
9-Fluoro-*7H*-benzo*[de]*anthracen-7-one (5e): The reaction was performed following the general procedure B at 60 °C, **5e** was obtained in 83% yield as a yellow solid (41.1 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.76 (d, *J* = 7.6 Hz, 1H), 8.37 (d, *J* = 7.6 Hz, 1H), 8.31 (dd, *J* = 8.8 Hz, 4.8 Hz, 1H), 8.23 (d, *J* = 8.0 Hz, 1H), 8.13 (dd, *J* = 9.2 Hz, 3.2 Hz, 1H), 8.00 (d, *J* = 8.0 Hz, 1H), 7.78 (t, *J* = 7.6 Hz, 1H), 7.68 (t, *J* = 8.0 Hz, 1H), 7.43 (td, *J* = 8.8 Hz, 2.8 Hz, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.0, 162.8 (d, *J* = 248 Hz), 135.7, 133.2 (d, *J* = 6 Hz), 133.1, 132.7 (d, *J* = 3 Hz), 130.33, 130.32 (d, *J* = 1 Hz), 128.3, 127.6, 126.83, 126.76, 126.3, 125.6 (d, *J* = 8 Hz), 124.3 (d, *J* = 1 Hz), 121.2 (d, *J* = 23 Hz), 113.8 (d, *J* = 22 Hz) ppm.

HRMS (ESI): calcd for $C_{17}H_{10}FO^+$ $[M+H]^+$ 249.0710, found 249.0708.

The analytical data matched those reported in the literature.[4]



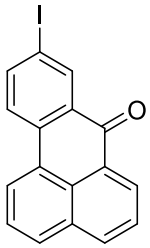
9-Bromo-*7H*-benzo*[de]*anthracen-7-one (5f): The reaction was performed following the general procedure B at 100 °C, **5f** was obtained in 81% yield as a yellow solid (49.8 mg, eluent: PE/EA = 40:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.75 (dd, *J* = 7.2 Hz, 1.2 Hz, 1H), 8.59 (d, *J* = 2.4 Hz, 1H), 8.40 (d, *J* = 7.6 Hz, 1H), 8.24 (dd, *J* = 8.4 Hz, 1.2 Hz, 1H), 8.17 (d, *J* = 8.4 Hz, 1H), 8.03 (d, *J* = 8.0 Hz, 1H), 7.83-7.76 (m, 2H), 7.68 (t, *J* = 8.0, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 182.7, 136.3, 135.7, 135.1, 133.1, 132.6, 131.0, 130.8, 130.3, 128.3, 127.8, 126.9, 126.8, 126.1, 125.1, 124.6, 122.9 ppm.

HRMS (ESI): calcd for $C_{17}H_{10}{}^{79}BrO^+$ $[M+H]^+$ 308.9910, found: 308.9911, calcd for $C_{17}H_{10}{}^{81}BrO^+$ $[M+H]^+$310.9889, found: 310.9877.

The analytical data matched those reported in the literature.[4]

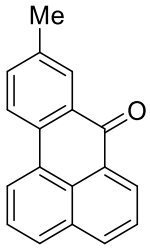


9-Iodo-*7H*-benzo*[de]*anthracen-7-one (5g): The reaction was performed following the general procedure B at 100 °C, **5g** was obtained in 46% yield as a yellow solid (32.8 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.76 (s, 1H), 8.71 (d, *J* = 7.2 Hz, 1H), 8.36 (d, *J* = 7.6 Hz, 1H), 8.21 (d, *J* = 8.0 Hz, 1H), 8.02-7.95 (m, 3H), 7.77 (t, *J* = 8.0 Hz, 1H), 7.67 (t, *J* = 8.0, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 182.6, 142.0, 137.1, 135.6, 135.5, 133.1, 132.4, 130.9, 130.3, 128.2, 127.8, 126.9, 126.7, 126.1, 124.9, 124.5, 94.2 ppm.

HRMS (ESI): calcd for $C_{17}H_{10}IO^+$ $[M+H]^+$ 356.9771, found 356.9773.



9-Methyl-*7H*-benzo*[de]*anthracen-7-one (5h): The reaction was performed following the general procedure B at 100 °C, **5h** was obtained in 75% yield as a yellow solid (36.6 mg, eluent: PE/EA = 50:1).

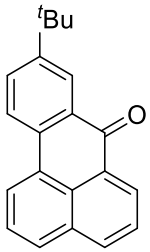
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.76 (d, *J* = 7.2 Hz, 1H), 8.41 (d, *J* = 7.6 Hz, 1H), 8.30 (s,

1H), 8.24-8.20 (m, 2H), 7.98 (d, *J* = 8.0 Hz, 1H), 7.77 (t, *J* = 8.0 Hz, 1H), 7.67 (t, *J* = 8.0, 1H), 7.55 (d, *J* = 8.0 Hz, 1H), 2.51 (s, 3H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 184.2, 138.5, 135.2, 134.7, 133.8, 133.1, 131.1, 129.9, 128.8, 128.2, 127.8, 127.1, 126.69, 126.66, 123.9, 123.2, 21.4 ppm.

HRMS (ESI): calcd for $C_{18}H_{12}ONa^+$ $[M+Na]^+$ 267.0780, found 267.0781.

The analytical data matched those reported in the literature.[4]



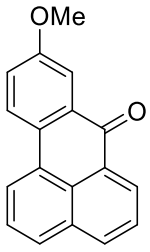
9-(*tert*-Butyl)-*7H*-benzo*[de]*anthracen-7-one (5i): The reaction was performed following the general procedure B at 60 °C, **5i** was obtained in 70% yield as a yellow solid (40.3 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.77 (d, *J* = 7.2 Hz, 1H), 8.54 (d, *J* = 2.4 Hz, 1H), 8.43 (d, *J* = 7.6 Hz, 1H), 8.28 (d, *J* = 7.6 Hz, 1H), 8.21 (t, *J* = 8.0 Hz, 1H), 7.98 (t, *J* = 8.0 Hz, 1H), 7.82-7.75 (m, 2H), 7.68 (t, *J* = 8.0 Hz, 1H), 1.44 (s, 9H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 184.4, 151.7, 135.2, 133.9, 133.1, 130.9, 129.9, 128.9, 127.9, 127.1, 126.71, 126.68, 124.6, 124.0, 123.2, 35.1, 31.4 ppm.

HRMS (ESI): calcd for $C_{21}H_{19}O^+$ $[M+H]^+$ 287.1430, found 287.1429.

The analytical data matched those reported in the literature.[4]



9-(Methoxy)-*7H*-benzo*[de]*anthracen-7-one (5j): The reaction using 1-iodo-4-methoxybenzene (0.2 mmol) and 1-naphthioc acid (0.3 mmol) was performed

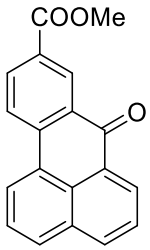
following the general procedure B at 60 °C, **5j** was obtained in 54% yield as a yellow solid (28.2 mg, eluent: PE/EA = 25:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.78 (dd, *J* = 7.6 Hz, 1.6 Hz, 1H), 8.37 (d, *J* = 7.2 Hz, 1H), 8.27 (d, *J* = 8.8 Hz, 1H), 8.23 (d, *J* = 8.0 Hz, 1H), 7.98-7.95 (m, 2H), 7.79 (t, *J* = 8.0 Hz, 1H), 7.68 (t, *J* = 8.0 Hz, 1H), 7.33 (dd, *J* = 8.8 Hz, 2.8 Hz, 1H), 3.99 (s, 3H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.9, 159.9, 135.5, 133.1, 132.6, 130.1, 129.8, 129.5, 128.6, 127.3, 127.1, 126.8, 126.7, 125.0, 123.6, 122.5, 109.3, 55.8 ppm.

HRMS (ESI): calcd for $C_{18}H_{13}O_2^+$ $[M+H]^+$ 261.0910, found 261.0901.

The analytical data matched those reported in the literature.[4]



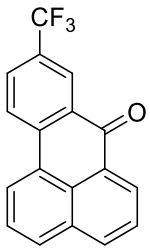
Methyl 7-oxo-*7H*-benzo[*de*]anthracene-9-carboxylate (5k): The reaction was performed following the general procedure B at 100 °C, **5k** was obtained in 74% yield as a yellow solid (43.0 mg, eluent: PE/EA = 10:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 9.09 (s, 1H), 8.75 (dd, *J* = 7.6 Hz, 1.6 Hz, 1H), 8.46 (d, *J* = 7.6 Hz, 1H), 8.37-8.31 (m, 2H), 8.23 (dd, *J* = 8.0 Hz, 1.2 Hz, 1H), 8.04 (d, *J* = 7.6 Hz, 1H), 7.78 (t, *J* = 7.6 Hz, 1H), 7.69 (t, *J* = 8.0 Hz, 1H), 4.00 (s, 3H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.2, 166.5, 139.9, 135.5, 133.7, 133.1, 131.5, 131.1, 130.4, 129.9, 129.8, 128.4, 128.3, 126.9, 126.7, 126.0, 125.5, 123.5, 52.5 ppm.

HRMS (ESI): calcd for $C_{19}H_{13}O_3^+$ $[M+H]^+$ 289.0859, found 289.0860.

The analytical data matched those reported in the literature.[4]



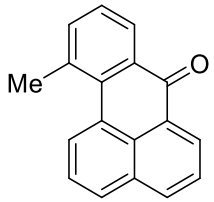
9-(Trifluoromethyl)-*7H*-benzo*[de]*anthracen-7-one (5l): The reaction was performed following the general procedure B at 80 °C, **5l** was obtained in 78% yield as a yellow solid (46.5 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.73-8.70 (m, 2H), 8.41 (d, *J* = 7.6 Hz, 1H), 8.36 (d, *J* = 8.4 Hz, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.02 (d, *J* = 8.4 Hz, 1H), 7.90 (dd, *J* = 8.4 Hz, 1.6 Hz, 1H), 7.77 (t, *J* = 8.0 Hz, 1H), 7.69 (t, *J* = 8.0 Hz, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 182.7, 139.0, 135.8, 133.0, 131.6, 131.1, 130.5, 130.4, 130.1, 129.4 (q, *J* = 3 Hz), 128.11, 128.08, 127.0, 126.7, 125.5 (q, *J* = 4 Hz), 125.4, 124.0 (q, *J* = 275 Hz), 123.9 ppm.

HRMS (ESI): calcd for $C_{18}H_{10}F_3O^+$ $[M+H]^+$ 299.0678, found 299.0675.

The analytical data matched those reported in the literature.[4]



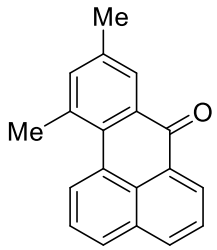
11-Methyl-*7H*-benzo*[de]*anthracen-7-one (5m): The reaction was performed following the general procedure B at 100 °C, **5m** was obtained in 76% yield as a yellow solid (36.9 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.73 (dd, *J* = 7.2 Hz, 1.6 Hz, 1H), 8.53 (d, *J* = 8.4 Hz, 1H), 8.48 (d, *J* = 7.6 Hz, 1H), 8.22 (d, *J* = 7.6 Hz, 1H), 7.98 (d, *J* = 8.0 Hz, 1H), 7.77 (t, *J* = 8.0 Hz, 1H), 7.67 (t, *J* = 8.0, 1H), 7.62 (d, *J* = 7.2 Hz, 1H), 7.45 (t, *J* = 7.6, 1H), 2.96 (s, 3H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 184.5, 138.4, 136.1, 136.0, 135.4, 133.08, 133.06, 129.7, 129.5, 129.4, 128.9, 128.4, 128.3, 127.6, 127.0, 126.5, 126.1, 26.6 ppm.

HRMS (ESI): calcd for $C_{18}H_{12}ONa^+$ $[M+Na]^+$ 267.0780, found 267.0780.

The analytical data matched those reported in the literature.[4]



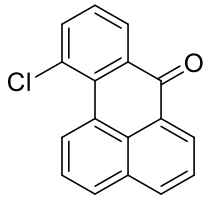
9,11-Dimethyl-*7H*-benzo*[de]*anthracen-7-one (5n): The reaction was performed following the general procedure B at 100 °C, **5n** was obtained in 66% yield as a yellow solid (34.4 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.72 (dd, *J* = 7.2 Hz, 1.2 Hz, 1H), 8.48 (d, *J* = 7.6 Hz, 1H), 8.27 (s, 1H), 8.20 (d, *J* = 8.0 Hz, 1H), 7.94 (d, *J* = 8.0 Hz, 1H), 7.75 (t, *J* = 7.6 Hz, 1H), 7.64 (t, *J* = 8.0, 1H), 7.41 (s, 1H), 2.91 (s, 3H), 2.46 (s, 3H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 184.7, 139.5, 137.5, 135.9, 135.4, 133.5, 133.0, 132.9, 129.4, 129.2, 129.0, 128.6, 128.5, 128.4, 127.1, 126.3, 126.2, 26.5, 21.1 ppm.

HRMS (ESI): calcd for $C_{19}H_{15}O^+$ $[M+H]^+$ 259.1117, found 259.1120.

The analytical data matched those reported in the literature.[4]



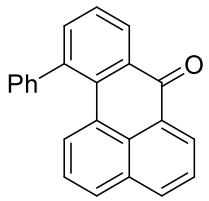
11-Chloro-*7H*-benzo*[de]*anthracen-7-one (5o): The reaction was performed following the general procedure B at 100 °C, **5o** was obtained in 67% yield as a yellow solid (35.4 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 9.65 (dd, *J* = 8.8 Hz, 1.2 Hz, 1H), 8.75 (dd, *J* = 7.2 Hz, 1.2 Hz, 1H), 8.56 (dd, *J* = 7.6 Hz, 1.6 Hz, 1H), 8.26 (dd, *J* = 8.0 Hz, 1.2 Hz, 1H), 8.04 (d, *J* = 8.0 Hz, 1H), 7.81 (dd, *J* = 8.0 Hz, 1.6 Hz, 1H), 7.78 (t, *J* = 7.6 Hz, 1H), 7.71 (t, *J* = 8.0, 1H), 7.45 (t, *J* = 8.0, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.3, 137.6, 136.0, 134.4, 133.8, 133.0, 131.9, 130.9, 130.1, 129.9, 128.7, 128.2, 127.8, 127.7, 126.5, 126.3, 125.7 ppm.

HRMS (ESI): calcd for $C_{17}H_{10}{}^{35}ClO^+$ $[M+H]^+$ 265.0415, found 265.0419, calcd for $C_{17}H_{10}{}^{37}ClO^+$ $[M+H]^+$ 267.0835, found: 267.0835.

The analytical data matched those reported in the literature.[5]

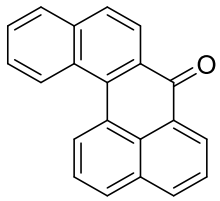


11-Phenyl-*7H*-benzo*[de]*anthracen-7-one (5p): The reaction was performed following the general procedure B at 100 °C, **5p** was obtained in 72% yield as a yellow solid (44.0 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.77 (dd, *J* = 7.2 Hz, 1.2 Hz, 1H), 8.61 (dd, *J* = 6.8 Hz, 2.4 Hz, 1H), 8.19 (dd, *J* = 8.0 Hz, 1.2 Hz, 1H), 7.83 (d, *J* = 8.0 Hz, 1H), 7.77 (t, *J* = 7.6 Hz, 1H), 7.63-7.54 (m, 3H), 7.50-7.42 (m, 3H), 7.41-7.38 (m, 2H), 7.17 (t, *J* = 8.0 Hz, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 184.1, 144.2, 141.2, 137.6, 135.6, 134.9, 133.1, 133.0, 131.0, 129.8, 129.7, 129.4, 129.0, 128.8, 128.3, 127.9, 127.6, 127.5, 126.7, 126.3, 125.8 ppm.

HRMS (ESI): calcd for $C_{23}H_{15}O^+$ $[M+H]^+$ 307.1117, found 307.1112.



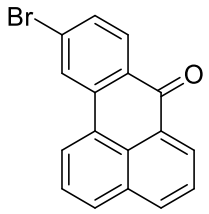
***7H*-benzo[*no*]tetraphen-7-one (5q):** The reaction was performed following the general procedure B at 80 °C, **5q** was obtained in 45% yield as a yellow solid (25.1 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.79-8.74 (m, 2H), 8.63 (d, *J* = 7.6 Hz, 1H), 8.51 (d, *J* = 8.8 Hz, 1H), 8.27 (d, *J* = 8.0 Hz, 1H), 8.05 (d, *J* = 8.4 Hz, 1H), 7.99-7.96 (m, 1H), 7.93 (d, *J* = 8.8 Hz, 1H), 7.82 (t, *J* = 7.6 Hz, 1H), 7.73 (t, *J* = 8.0 Hz, 1H), 7.68-7.61 (m, 2H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.8, 137.3, 136.6, 135.3, 133.0, 131.6, 130.3, 130.2, 130.0, 129.8, 129.03, 129.00, 128.8, 128.5, 128.04. 128.00, 127.2, 126.84, 126.78, 126.2, 123.3 ppm.

HRMS (ESI): calcd for $C_{21}H_{13}O^+$ $[M+H]^+$ 281.0961, found 281.0956.

The analytical data matched those reported in the literature.[6]

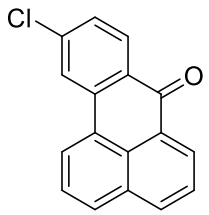


10-Bromo-*7H*-benzo*[de]*anthracen-7-one (5r): The reaction was performed following the general procedure B at 100 °C, **5r** was obtained in 68% yield as a yellow solid (42.1 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.74 (dd, *J* = 7.6 Hz, 1.2 Hz, 1H), 8.44 (d, *J* = 1.6 Hz, 1H), 8.37 (d, *J* = 7.6 Hz, 1H), 8.34 (d, *J* = 8.4 Hz, 1H), 8.23 (d, *J* = 8.0 Hz, 1H), 8.03 (d, *J* = 8.0 Hz, 1H), 7.78 (t, *J* = 8.0, 1H), 7.70-7.63 (m, 2H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.2, 137.9, 135.5, 133.1, 131.6, 131.1, 130.2, 130.0, 129.9, 129.1, 128.3, 128.0, 126.9, 126.7, 126.3, 125.7, 124.8 ppm.

HRMS (ESI): calcd for $C_{17}H_9{}^{79}BrONa^+$ $[M+Na]^+$ 330.9729, found 330.9727, calcd for $C_{17}H_9{}^{81}BrONa^+$ $[M+Na]^+$332.9709, found: 332.9709.



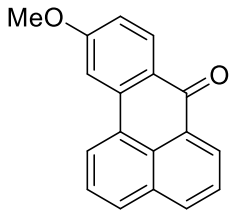
10-Chloro-*7H*-benzo*[de]*anthracen-7-one (5s): The reaction was performed following the general procedure B at 100 °C, **5s** was obtained in 76% yield as a yellow solid (40.1 mg, eluent: PE/EA = 50:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.68 (d, *J* = 7.6 Hz, 1H), 8.36 (d, *J* = 8.4 Hz, 1H), 8.27 (d, *J* = 7.2 Hz, 1H), 8.18-8.15 (m, 2H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.74 (t, *J* = 8.0 Hz, 1H), 7.62 (t, *J* = 8.0, 1H), 7.45 (dd, *J* = 8.4 Hz, 1.6 Hz, 1H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 182.9, 140.1, 137.6, 135.4, 133.0, 131.0, 130.1, 129.9, 129.5, 128.6, 128.2, 128.0, 126.8, 126.6, 125.6, 124.6, 123.2 ppm.

HRMS (ESI): calcd for $C_{17}H_{10}{}^{35}ClO^+$ $[M+H]^+$ 265.0415, found 265.0414, calcd for $C_{17}H_{10}{}^{37}ClO^+$ $[M+H]^+$ 267.0385, found: 267.0389.

The analytical data matched those reported in the literature.[5]



10-Methoxy-*7H*-benzo*[de]*anthracen-7-one (5t): The reaction was performed following the general procedure B at 80 °C, **5t** was obtained in 71% yield as a yellow solid (37.0 mg, eluent: PE/EA = 20:1).

^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.71 (dd, *J* = 7.2 Hz, 1.2 Hz,1H), 8.44 (d, *J* = 8.8 Hz, 1H), 8.33 (d, *J* = 7.2 Hz, 1H), 8.16 (d, *J* = 8.0 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.74 (t, *J* = 7.6 Hz, 1H), 7.68 (d, *J* = 2.4 Hz, 1H), 7.63 (t, *J* = 8.0, 1H), 7.06 (dd, *J* = 8.4 Hz, 2.8 Hz, 1H), 3.98 (s, 3H) ppm.

^{13}C NMR (100 MHz, $CDCl_3$) δ = 183.0, 163.9, 138.4, 134.8, 133.0, 130.7, 130.5, 129.6, 128.7, 128.3, 126.9, 126.6, 126.5, 125.2, 124.1, 55.7 ppm.

HRMS (ESI): calcd for $C_{18}H_{13}O_2^+$ $[M+H]^+$ 261.0910, found 261.0906.

The analytical data matched those reported in the literature.[7]

VIII. Single Crystal X-ray Structures of 4g and 5g

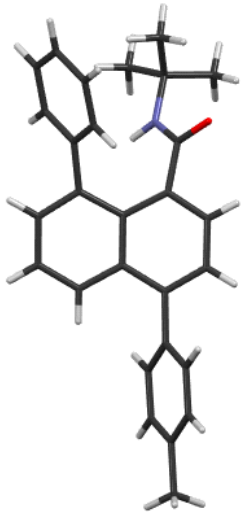


Figure S1. ORTEP diagram of **4g**. CCDC 2060396 (**4g**) contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data request/cif.

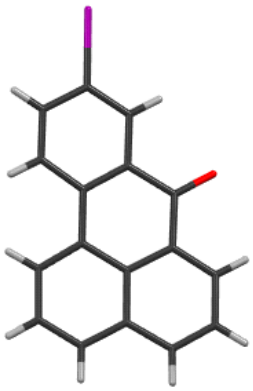


Figure S2. ORTEP diagram of **5g**. CCDC 2060393 (**5g**) contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data request/cif.

IX. Reference

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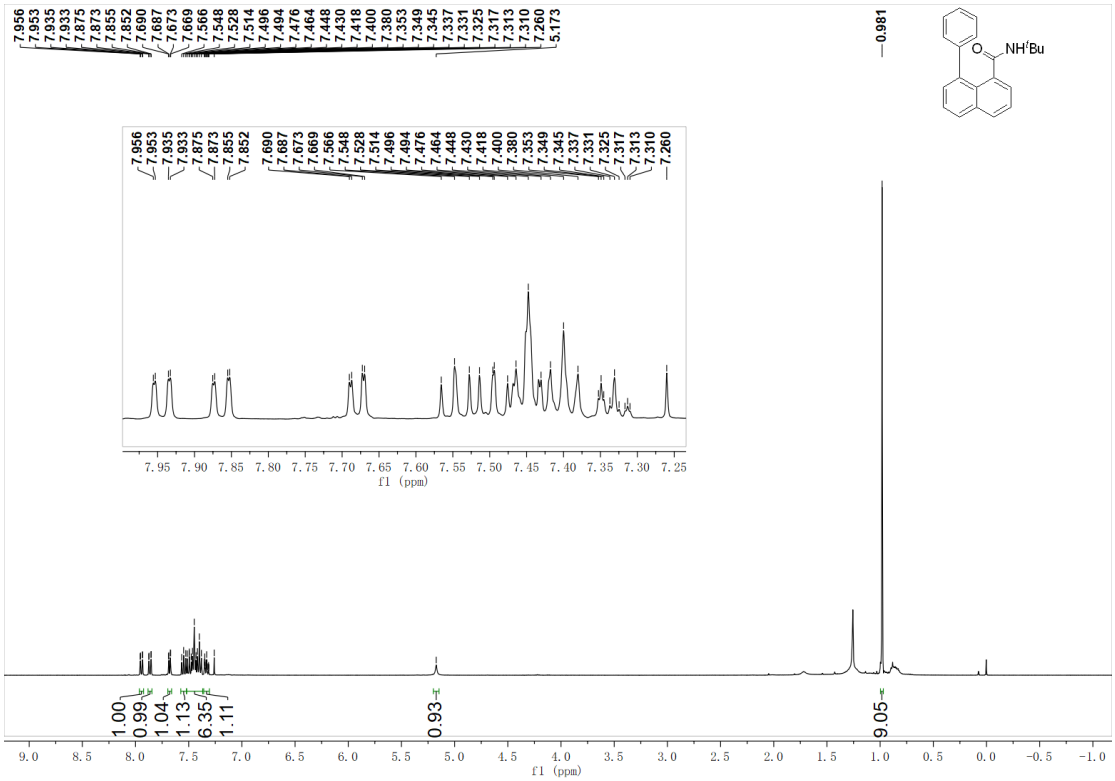
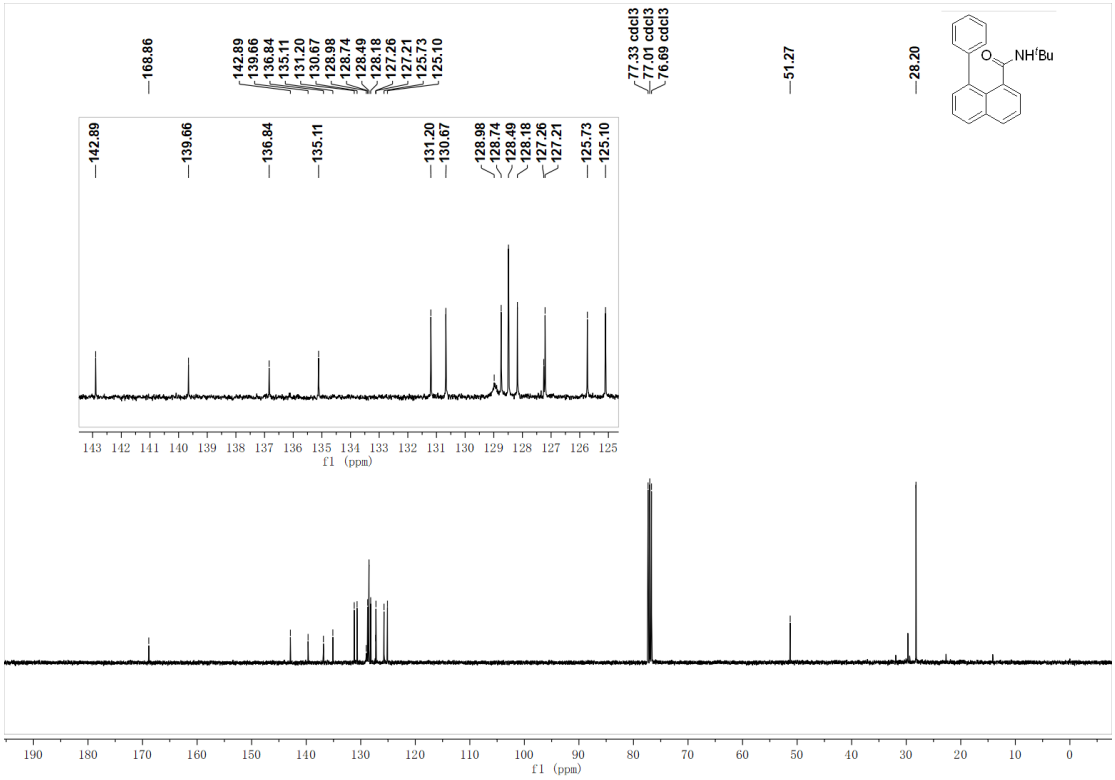
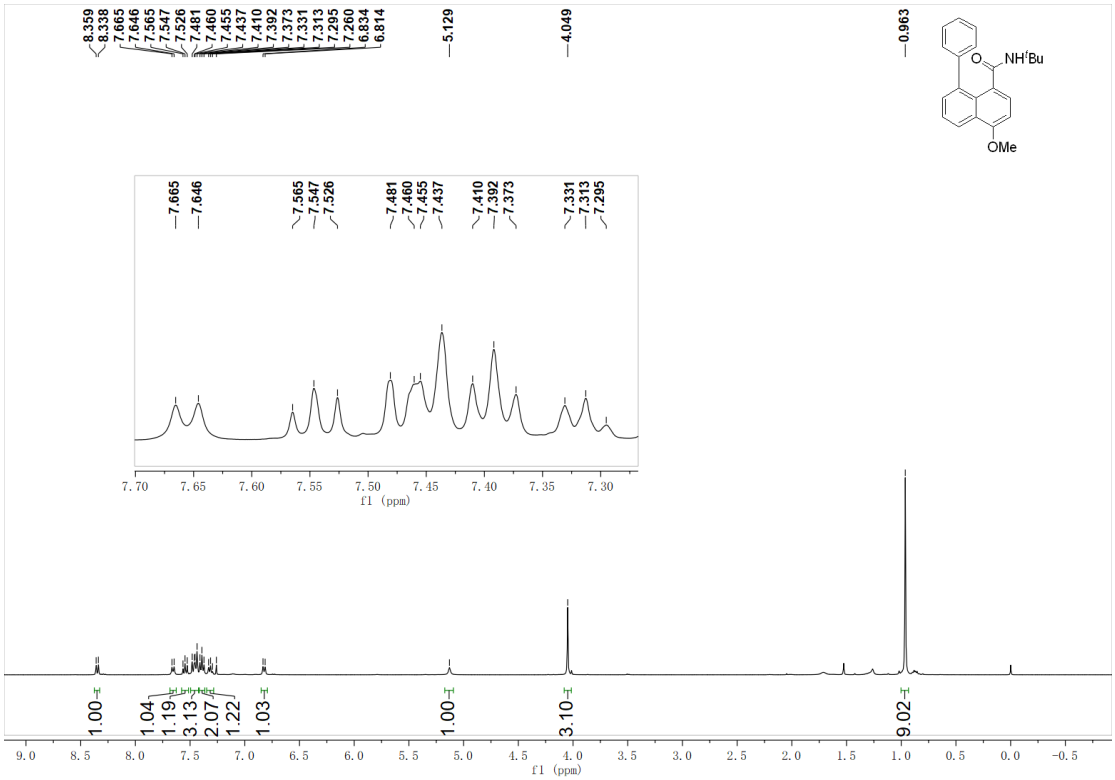
X. NMR Spectra



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7.460
7.455
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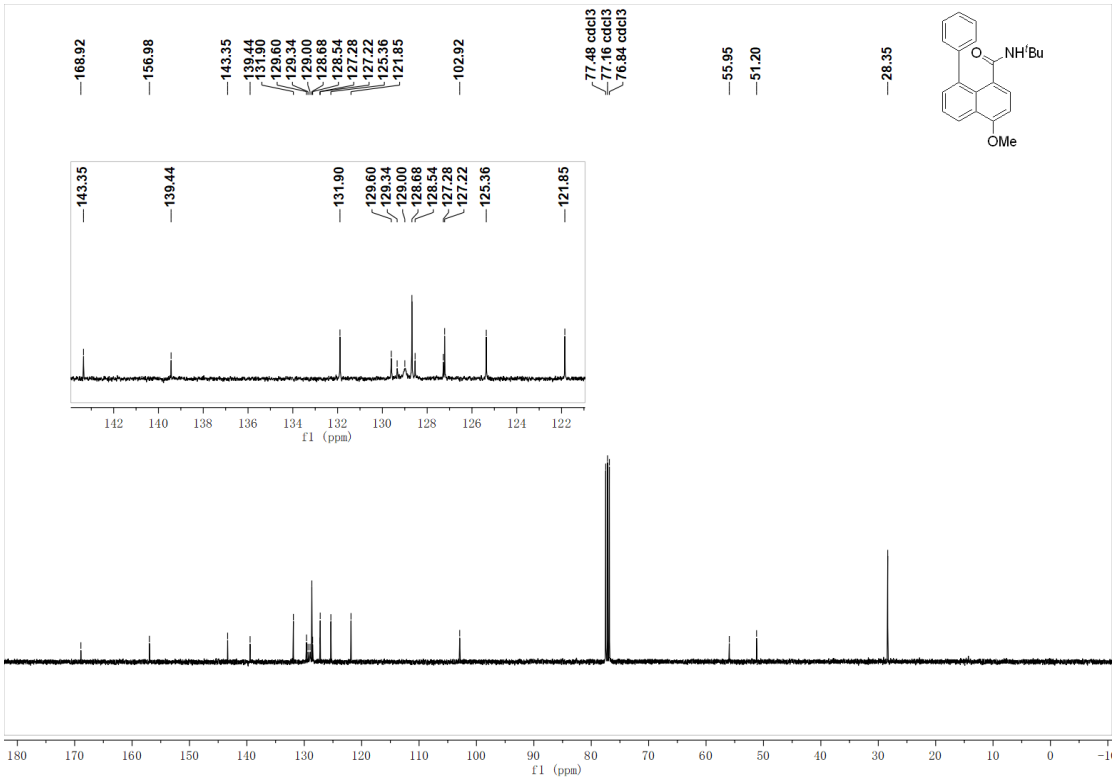
7.410
7.392
7.373
7.331
7.313
7.295
7.260
6.834
6.814
5.129
4.049
0.963
NH^{t}Bu
OMe
1.00
1.04
1.19
3.13
2.07
1.22
1.03
1.00
3.10
9.02
f1 (ppm)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129.34
129.00
128.68
128.54
127.28
127.22
125.36
121.85
102.92
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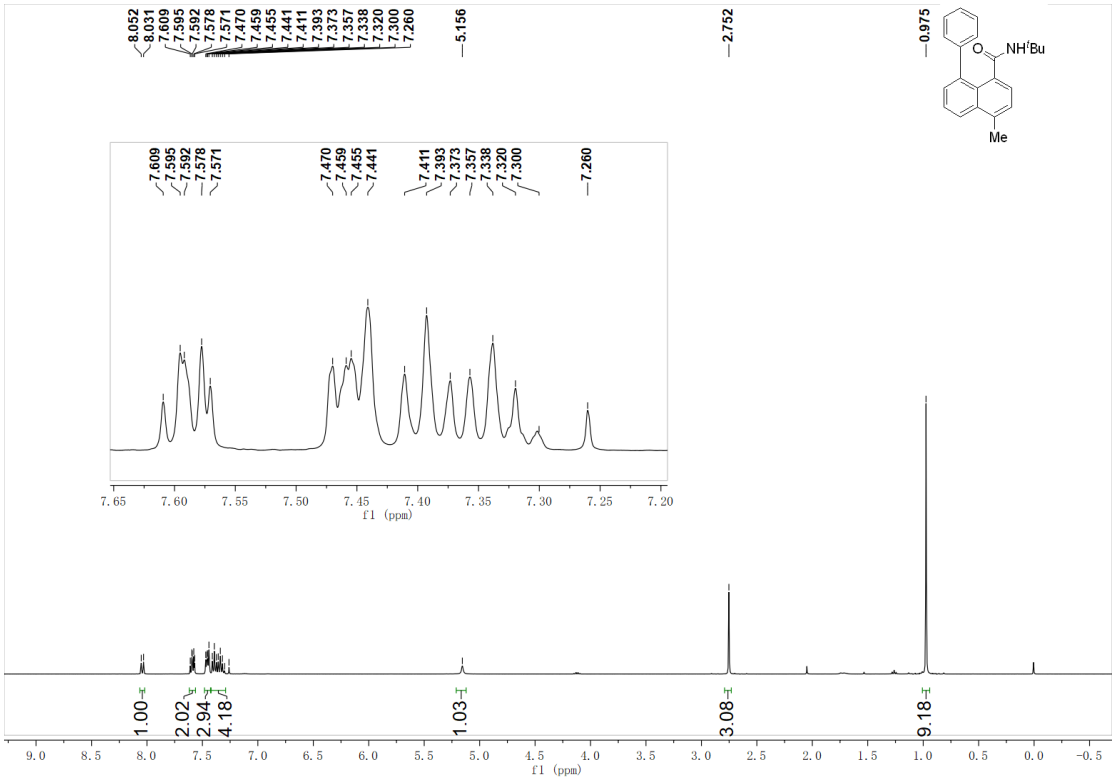
77.16 cdcl3
76.84 cdcl3
55.95
51.20
28.35
NH^{t}Bu
OMe
f1 (ppm)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7.578
7.571
7.470
7.459
7.455
7.441
7.411
7.393
7.373
7.357
7.338
7.320
7.300
7.260
5.156
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Me
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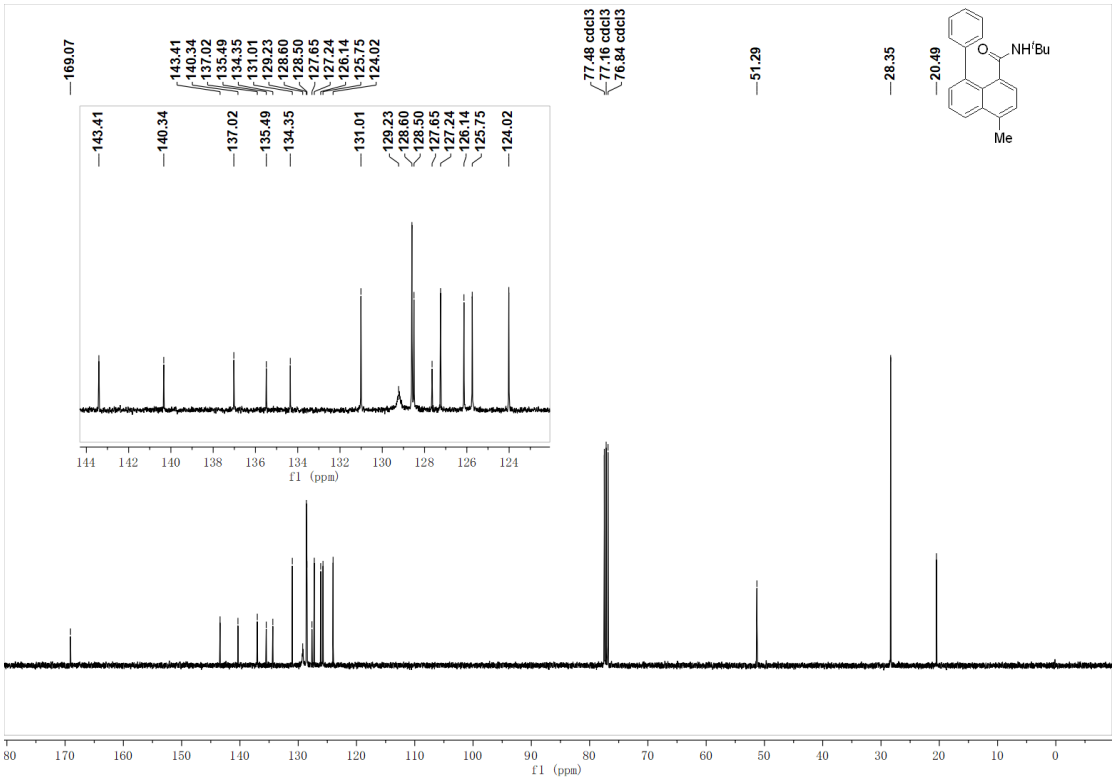
2.02
2.94
4.18
1.03
3.08
9.18
f1 (ppm)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131.01
129.23
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128.50
127.65
127.24
126.14
125.75
124.02
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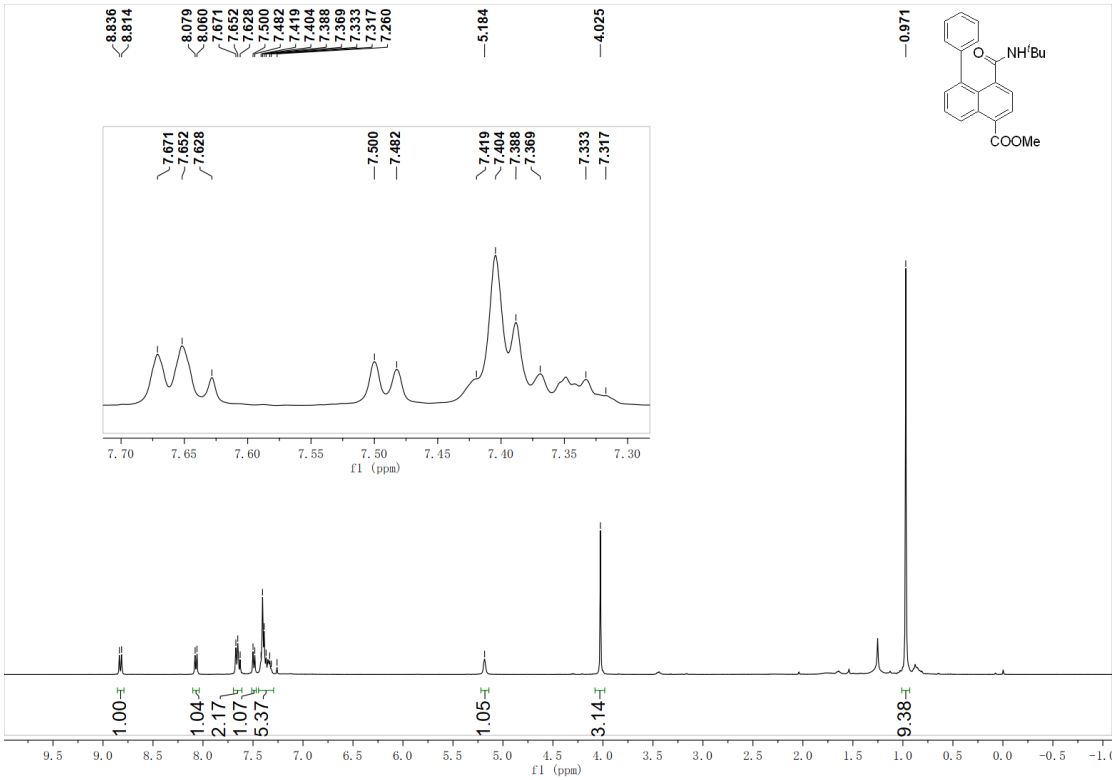
77.16 cdcl3
76.84 cdcl3
51.29
28.35
20.49
NH^{t}Bu
Me
f1 (ppm)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8.814
8.079
8.060
7.671
7.652
7.628
7.500
7.482
7.419
7.404
7.388
7.369
7.333
7.317
7.260
5.184
4.025
0.971
NH^{t}Bu
COOMe
7.70
7.65
7.60
7.55
7.50
7.45
7.40
7.35
7.30
f1 (ppm)
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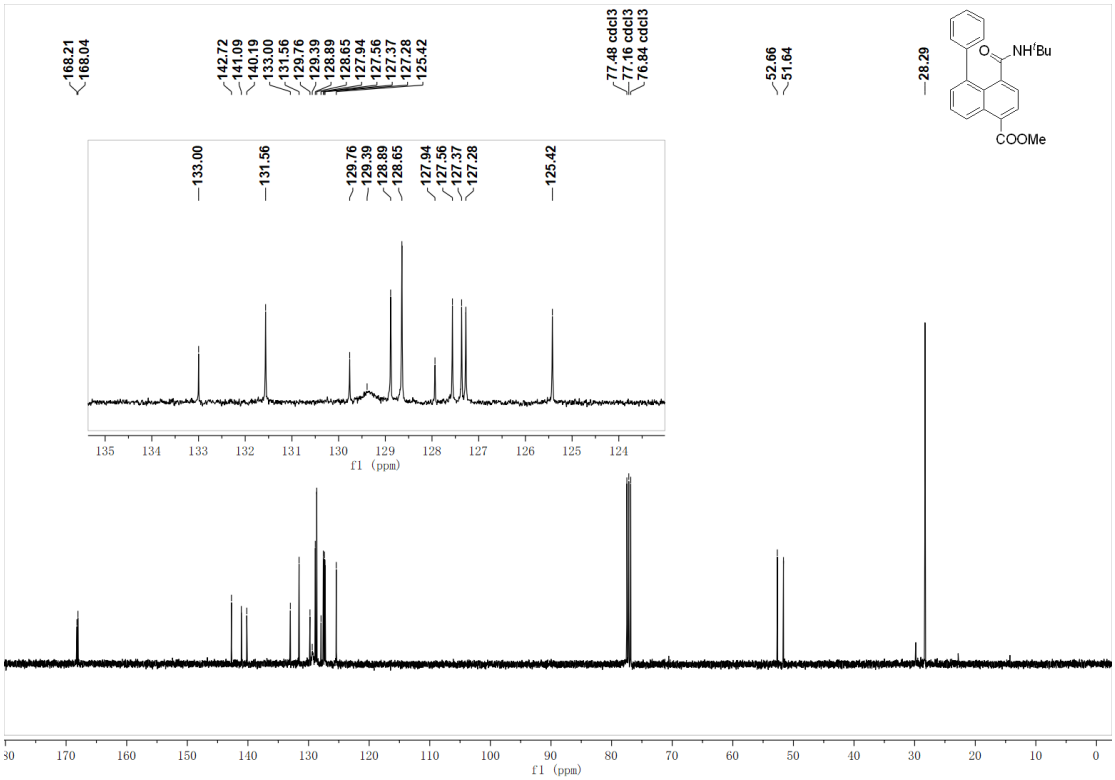
1.04
2.17
1.07
5.37
1.05
3.14
9.38
f1 (ppm)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129.39
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128.65
127.94
127.56
127.37
127.28
125.42
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
52.66
51.64
28.29
NH^{t}Bu
COOMe
133.00
131.56
129.76
129.39
128.89
128.65
127.94
127.56
127.37
127.28
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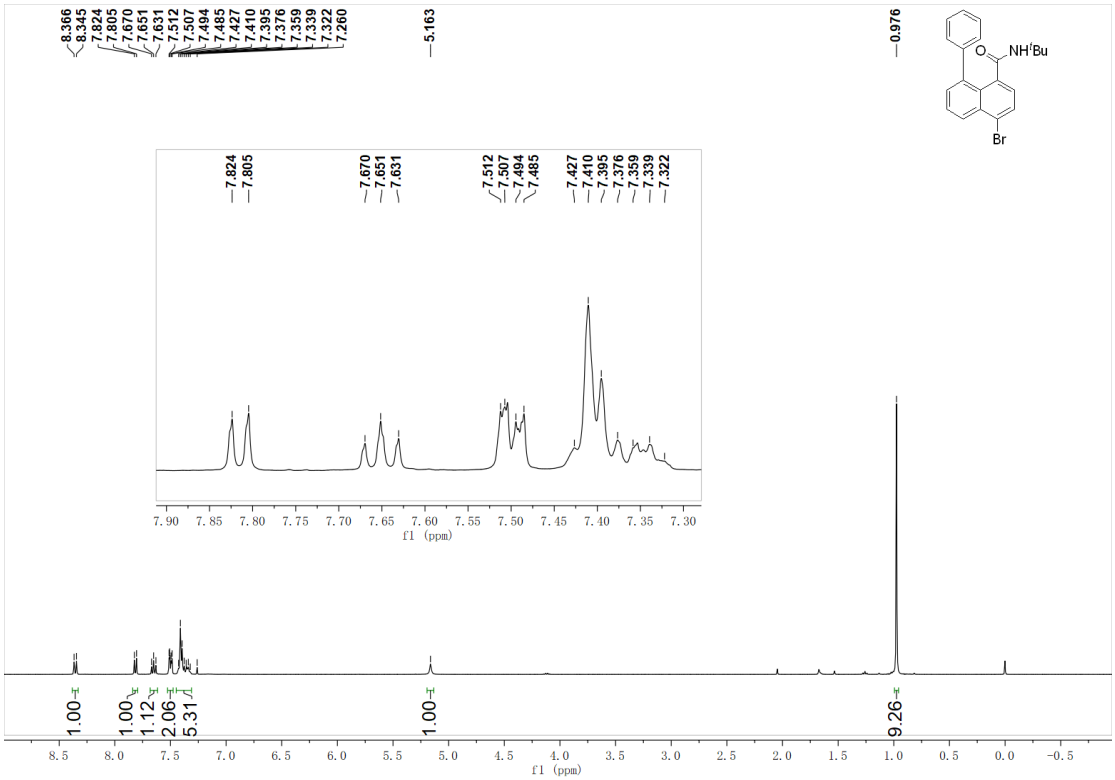
135
134
133
132
131
130
129
128
127
126
125
124
f1 (ppm)
f1 (ppm)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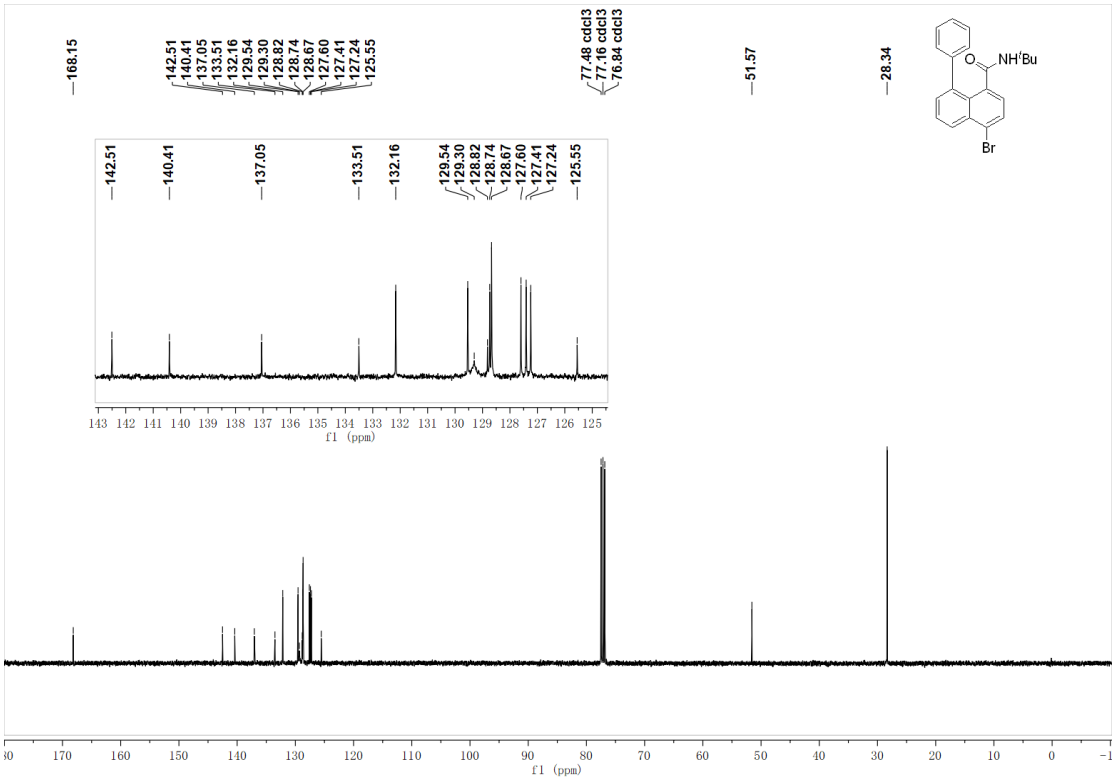
7.651
7.631
7.512
7.507
7.494
7.485
7.427
7.410
7.395
7.376
7.359
7.339
7.322
7.260
5.163
0.976
NH^{t}Bu
Br
1.00
1.00
1.12
2.06
5.31
1.00
9.26
f1 (ppm)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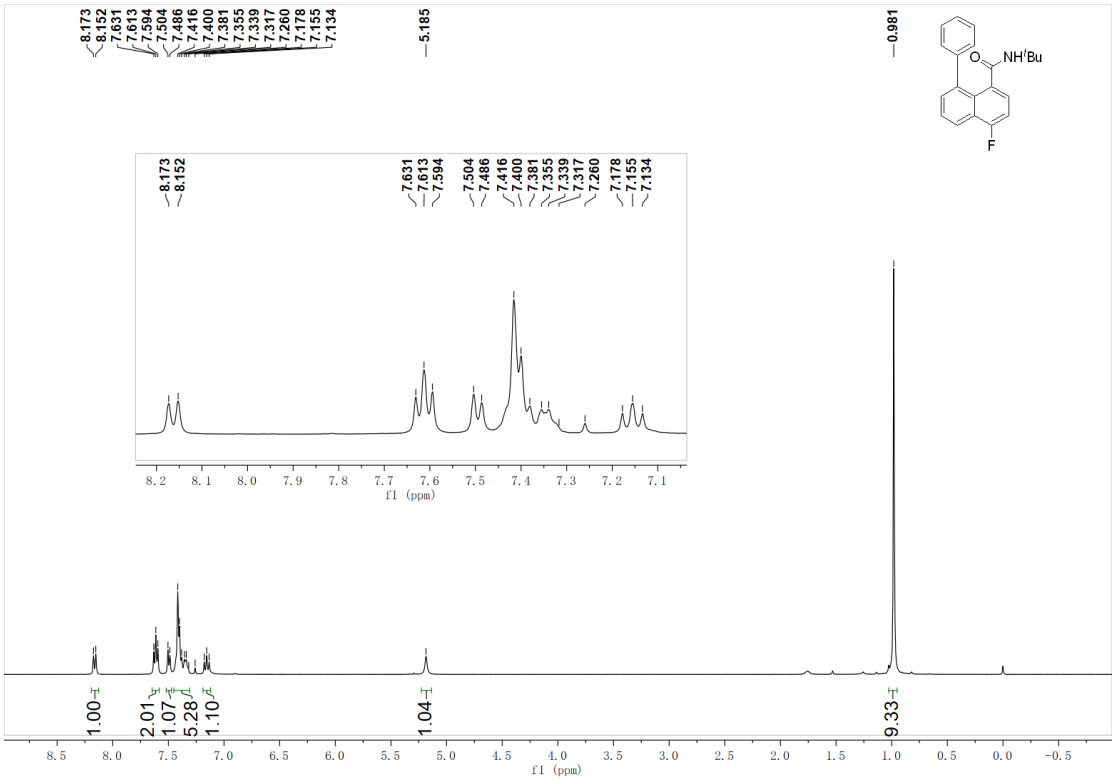
140.41
137.05
133.51
132.16
129.54
129.30
128.82
128.74
128.67
127.60
127.41
127.24
125.55
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.57
28.34
NH^{t}Bu
Br
f1 (ppm)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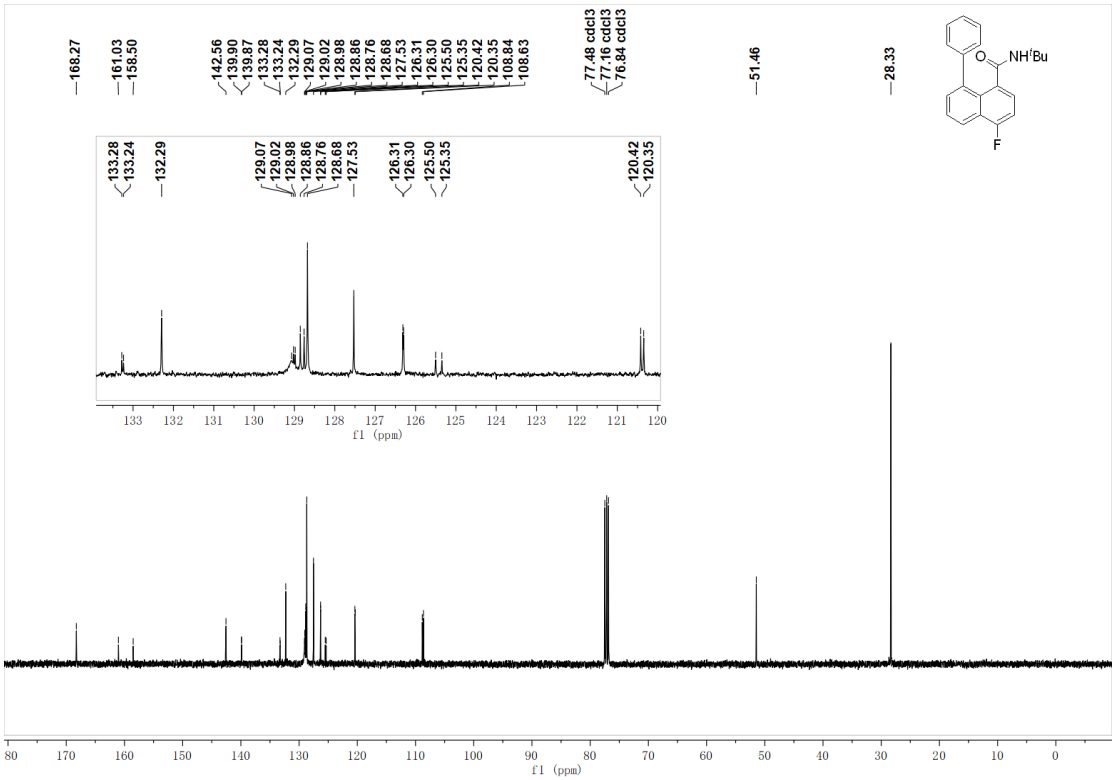
7.594
7.504
7.486
7.416
7.400
7.381
7.355
7.339
7.317
7.260
7.178
7.155
7.134
5.185
0.981
NH^{t}Bu
O
F
1.00
2.01
1.07
5.28
1.10
1.04
9.33
f1 (ppm)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158.50
142.56
139.90
139.87
133.28
133.24
132.29
129.07
129.02
128.98
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128.68
127.53
126.31
126.30
125.50
125.35
120.42
120.35
108.84
108.63
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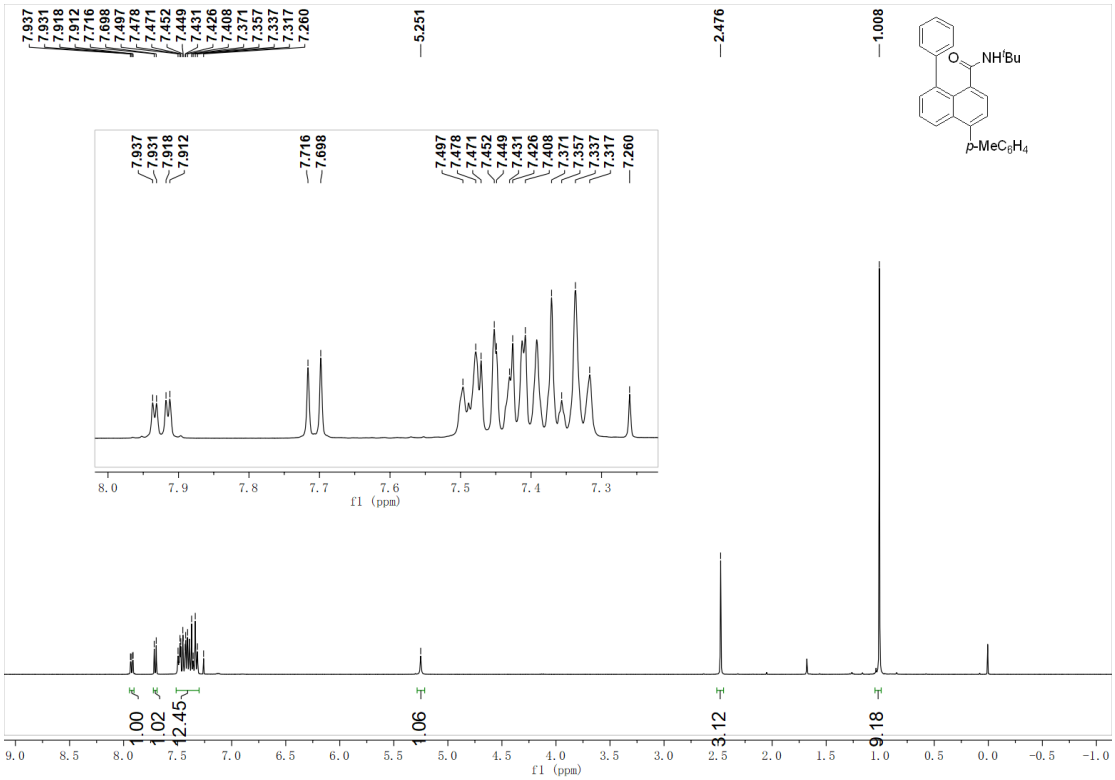
77.16 cdcl3
76.84 cdcl3
51.46
28.33
NH^{t}Bu
O
F
f1 (ppm)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7.912
7.716
7.698
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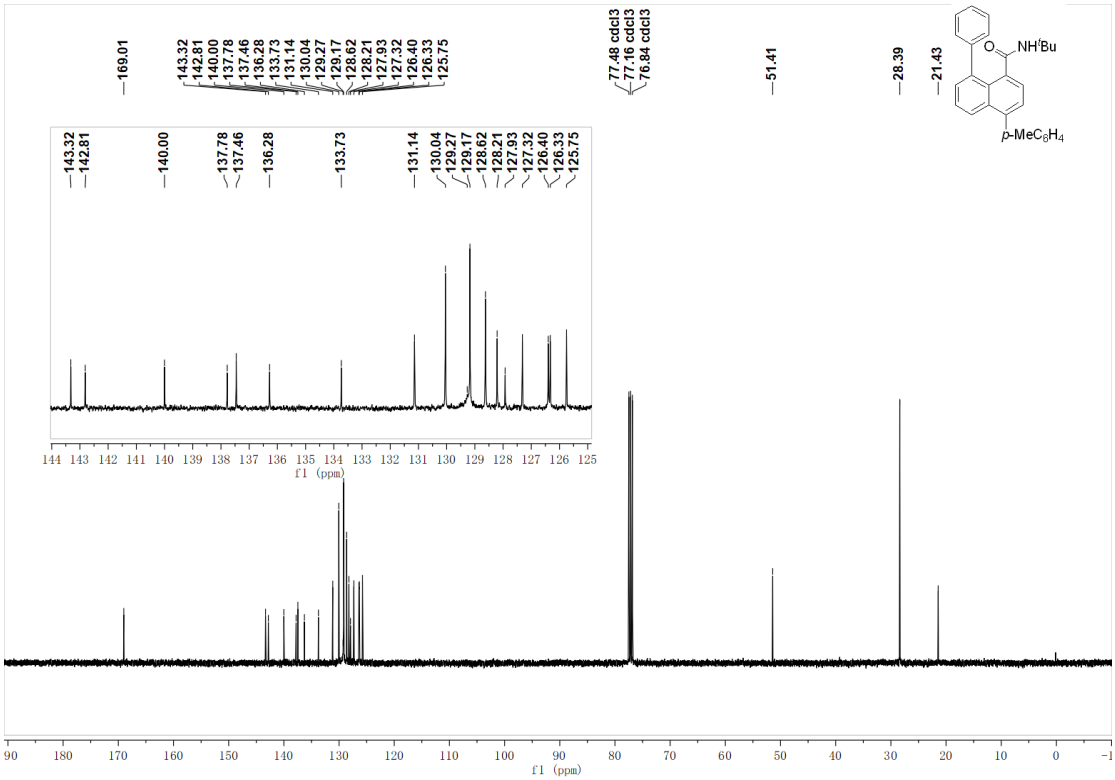
7.471
7.452
7.449
7.431
7.426
7.408
7.371
7.357
7.337
7.317
7.260
5.251
2.476
1.008
NH^{t}Bu
p-MeC$_6$H$_4$
f1 (ppm)
1.00
1.02
12.45
1.06
3.12
9.18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140.00
137.78
137.46
136.28
133.73
131.14
130.04
129.27
129.17
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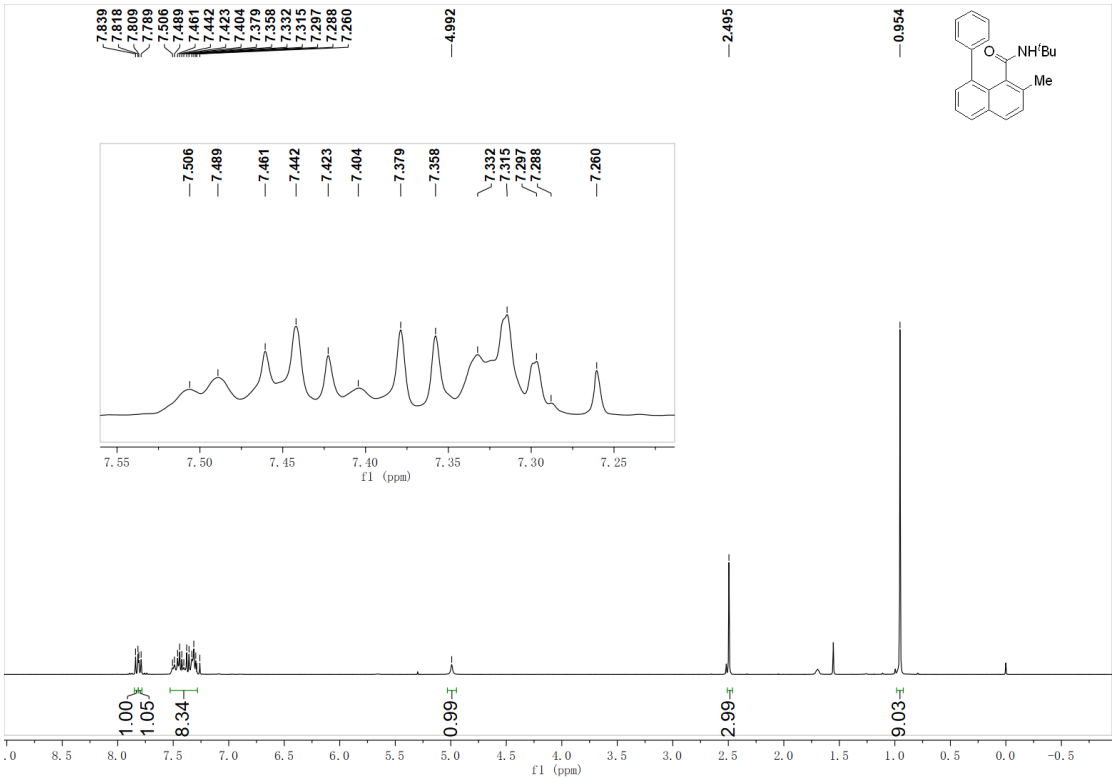
128.21
127.93
127.32
126.40
126.33
125.75
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.41
28.39
21.43
NH^{t}Bu
p-MeC$_6$H$_4$
f1 (ppm)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7.789
7.506
7.489
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7.442
7.423
7.404
7.379
7.358
7.332
7.315
7.297
7.288
7.260
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NH^{t}Bu
Me
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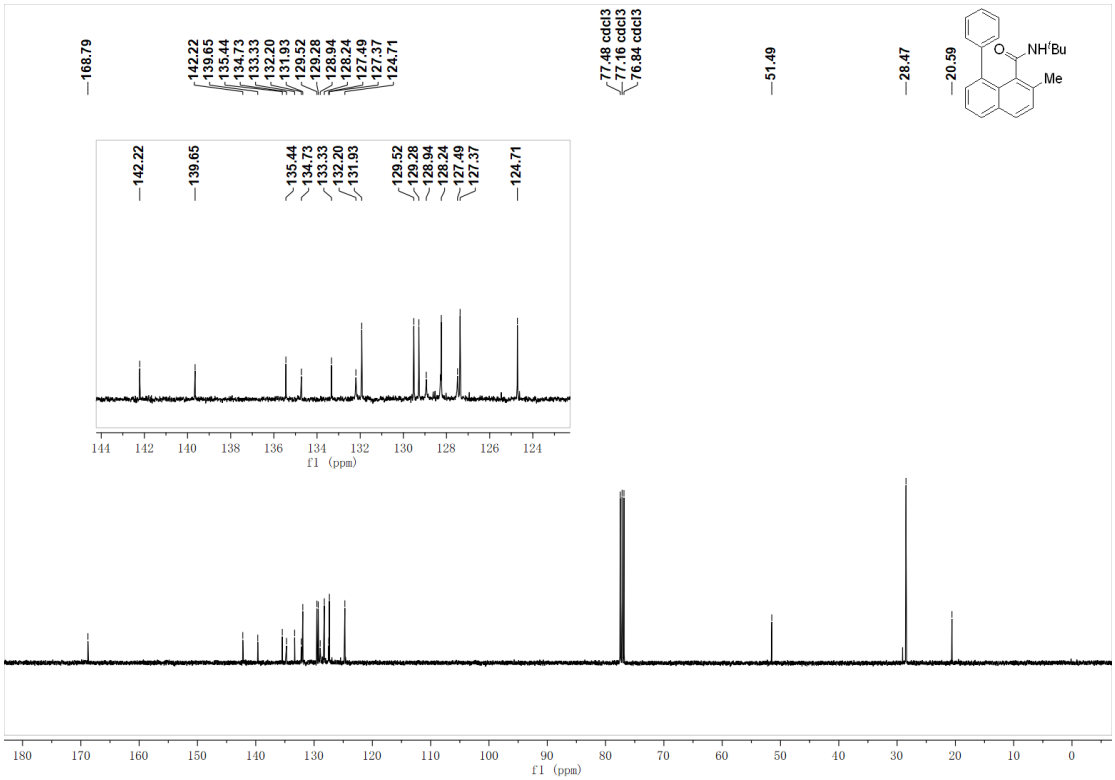
1.05
8.34
0.99
2.99
9.03
f1 (ppm)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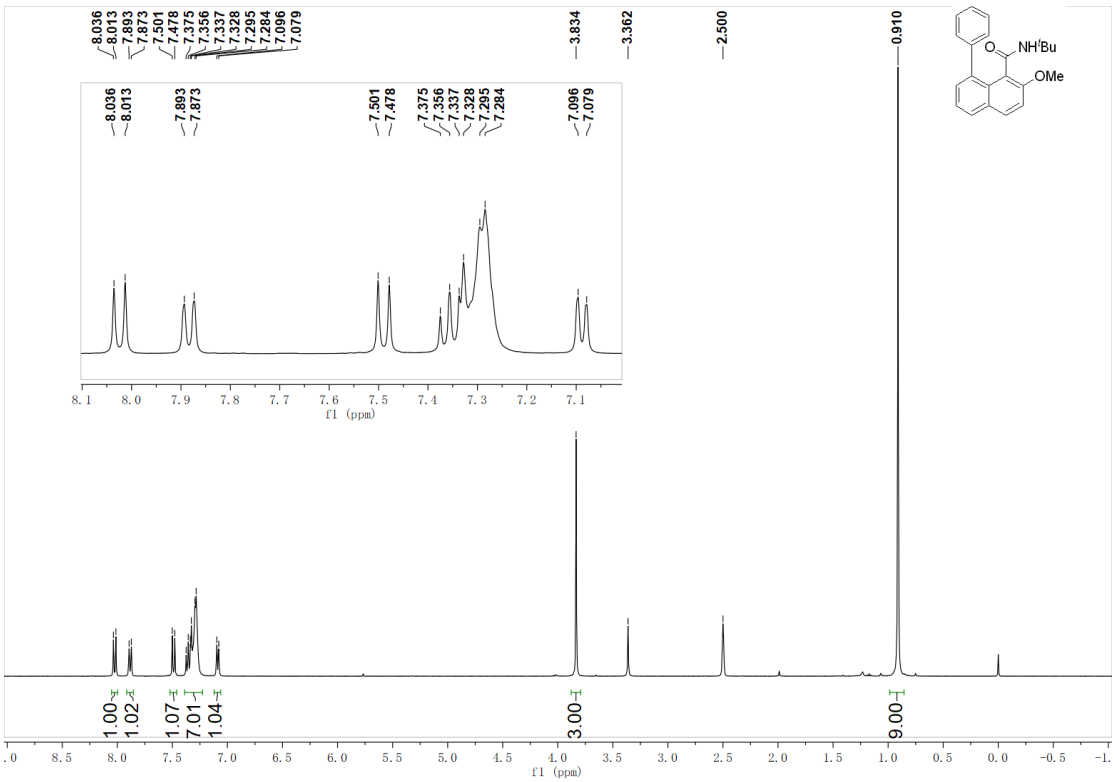
135.44
134.73
133.33
132.20
131.93
129.52
129.28
128.94
128.24
127.49
127.37
124.71
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.49
28.47
20.59
NH^{t}Bu
Me
f1 (ppm)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7.478
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7.337
7.328
7.295
7.284
7.096
7.079
3.834
3.362
2.500
0.910
NH'Bu
OMe
f1 (ppm)
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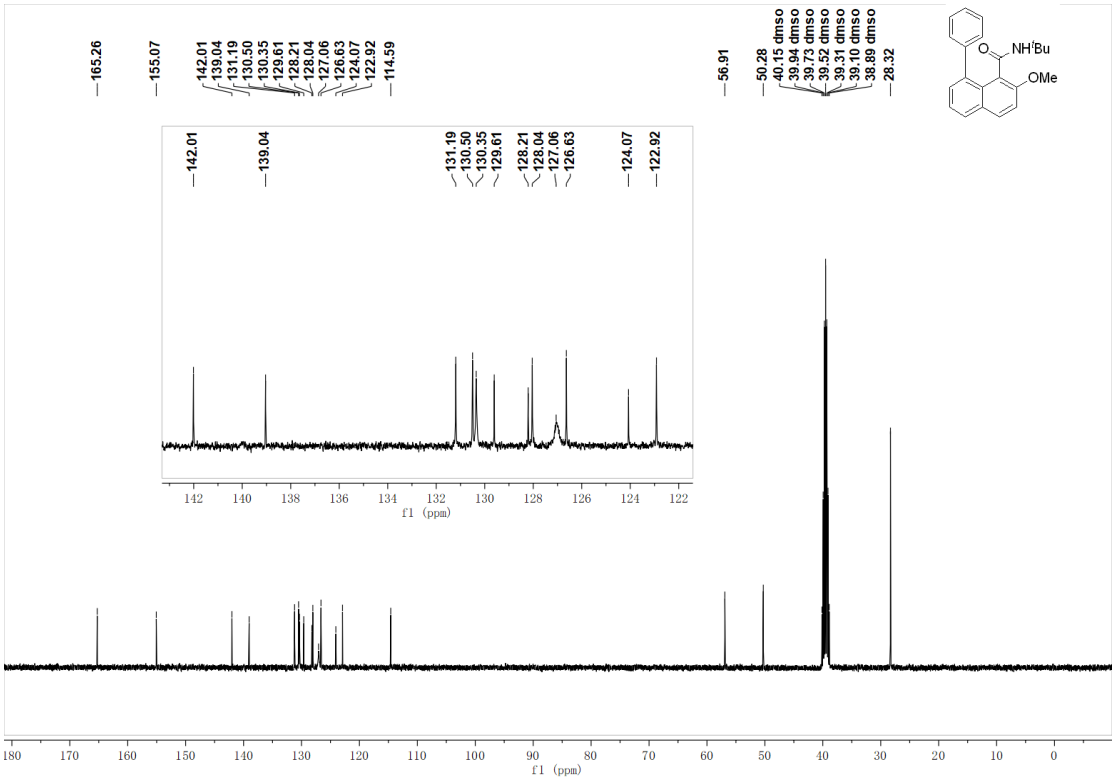
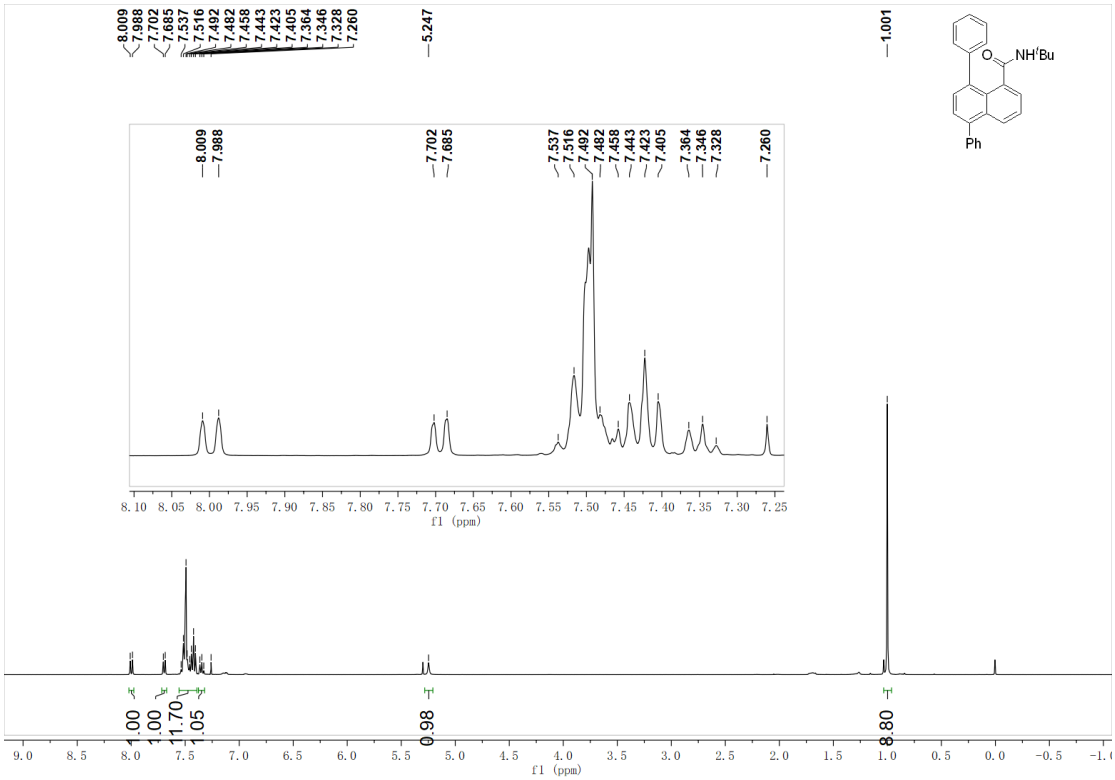
1.02
1.07
7.01
1.04
3.00
9.00


165.26
155.07
142.01
139.04
131.19
130.50
130.35
129.61
128.21
128.04
127.06
126.63
124.07
122.92
114.59
56.91
50.28
40.15 dmso
39.94 dmso
39.73 dmso
39.52 dmso
39.31 dmso
39.10 dmso
38.89 dmso
28.32
NH'Bu
OMe
f1 (ppm)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7.482
7.458
7.443
7.423
7.405
7.364
7.346
7.328
7.260
5.247
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NH'Bu
Ph
f1 (ppm)
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1.00
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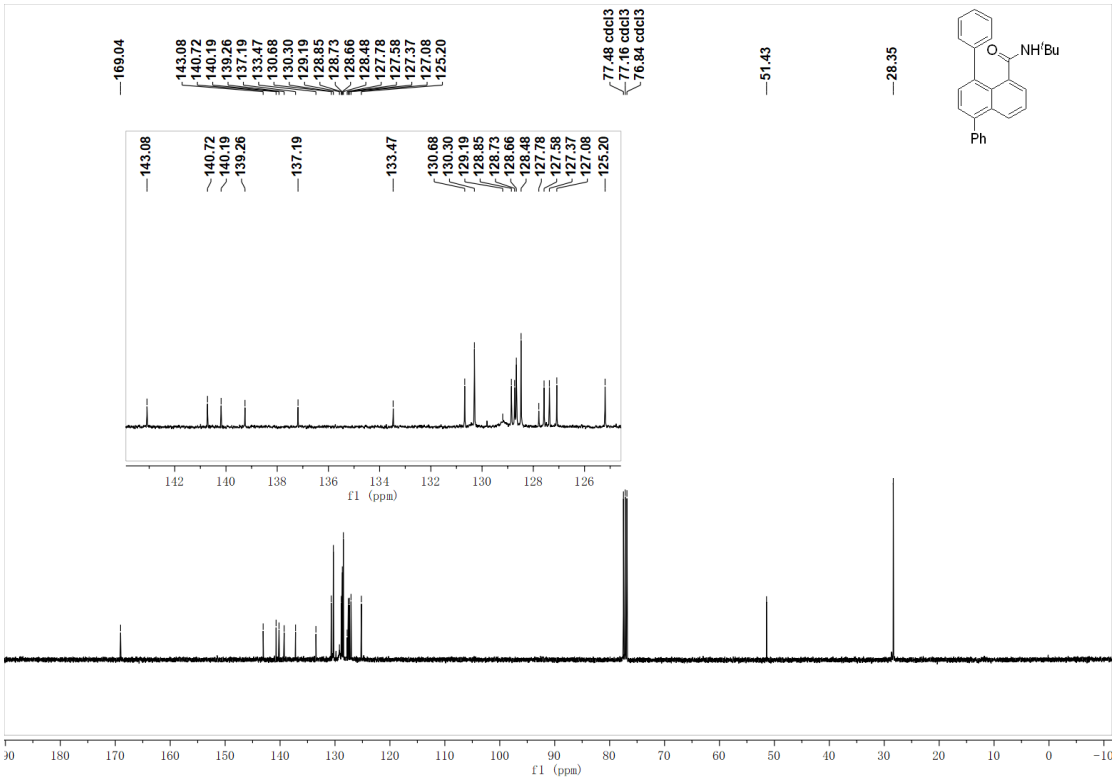
0.98
8.80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139.26
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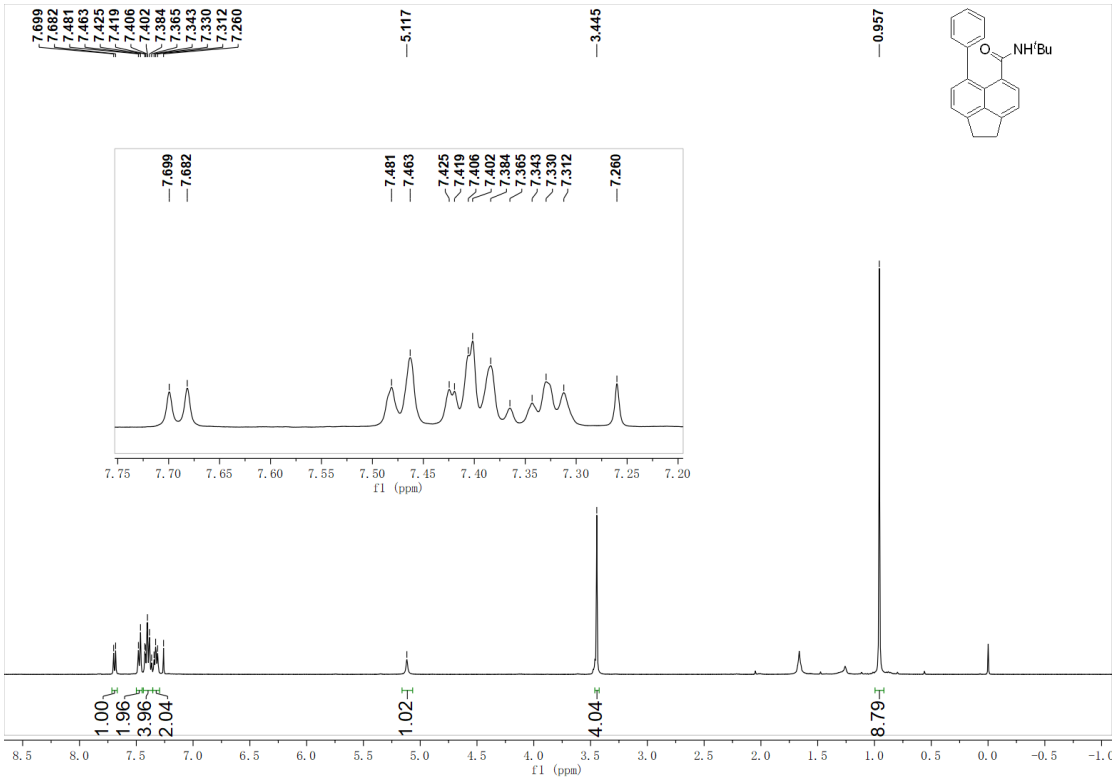
133.47
130.68
130.30
129.19
128.85
128.73
128.66
128.48
127.78
127.58
127.37
127.08
125.20
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.43
28.35
NH'Bu
Ph
f1 (ppm)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7.425
7.419
7.406
7.402
7.384
7.365
7.343
7.330
7.312
7.260
5.117
3.445
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NH^{t}Bu
f1 (ppm)
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1.96
3.96
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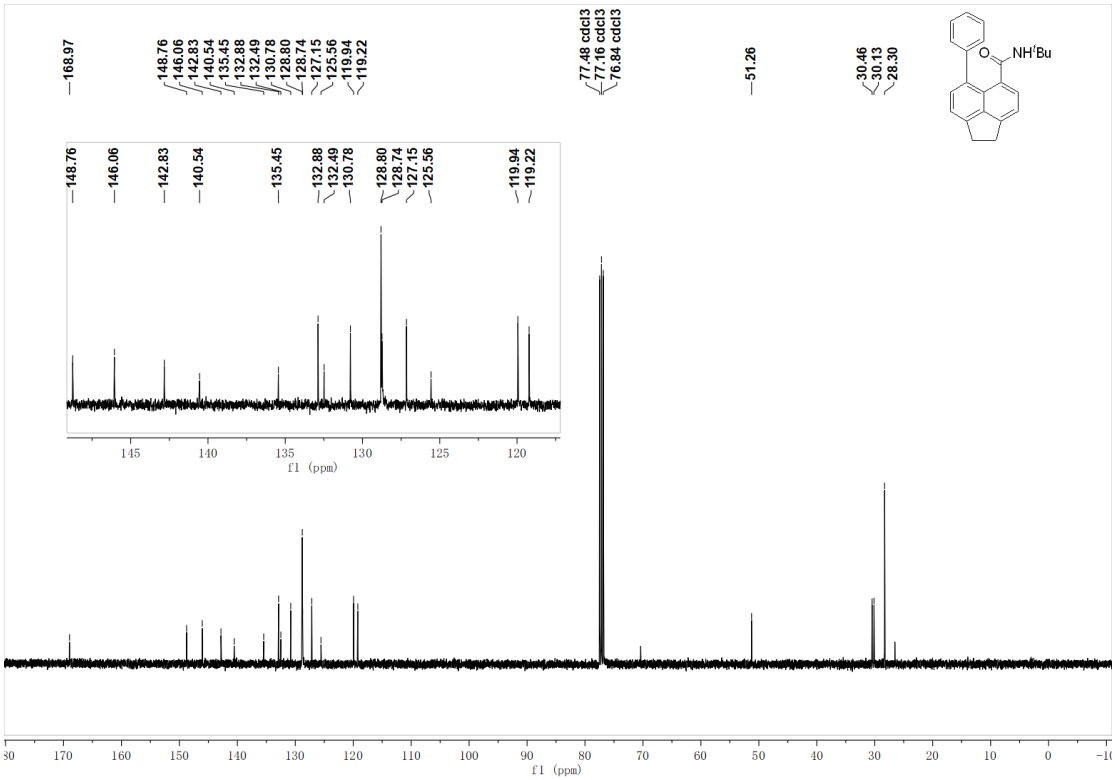
1.02
4.04
8.79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132.49
130.78
128.80
128.74
127.15
125.56
119.94
119.22
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77.16 cdcl3
76.84 cdcl3
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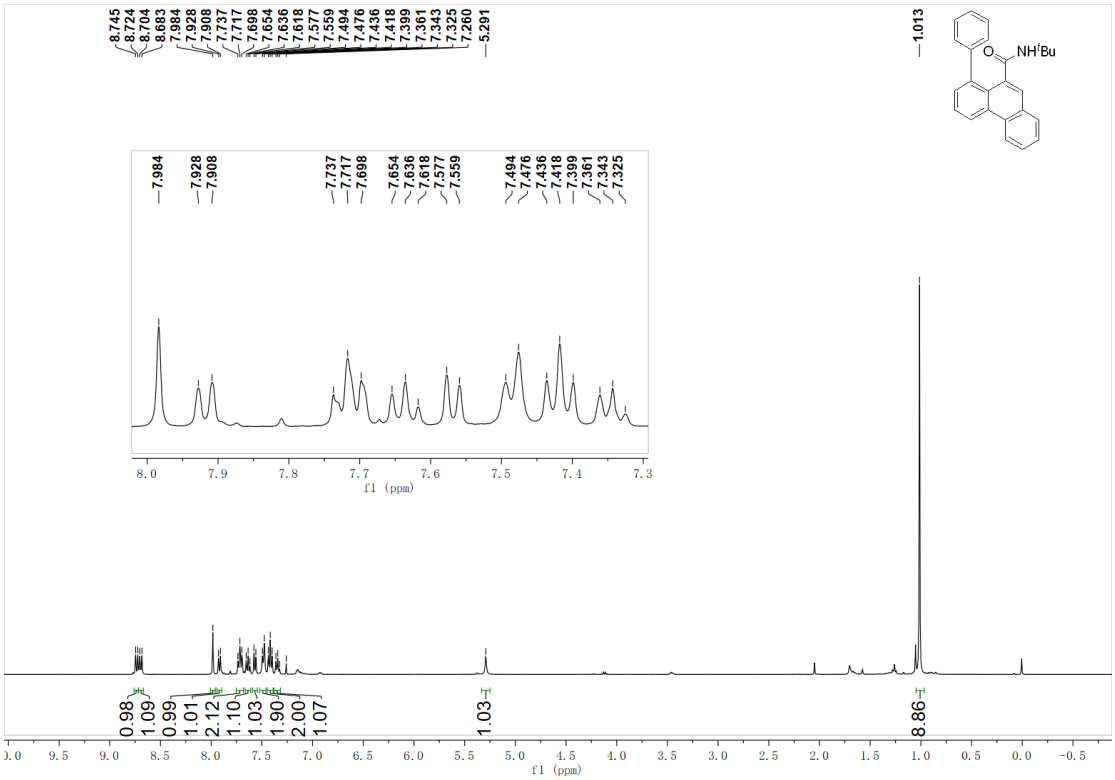
30.46
30.13
28.30
NH^{t}Bu
f1 (ppm)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7.737
7.717
7.698
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7.636
7.618
7.577
7.559
7.494
7.476
7.436
7.418
7.399
7.361
7.343
7.325
7.260
5.291
1.013
NH'Bu
f1 (ppm)
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1.01
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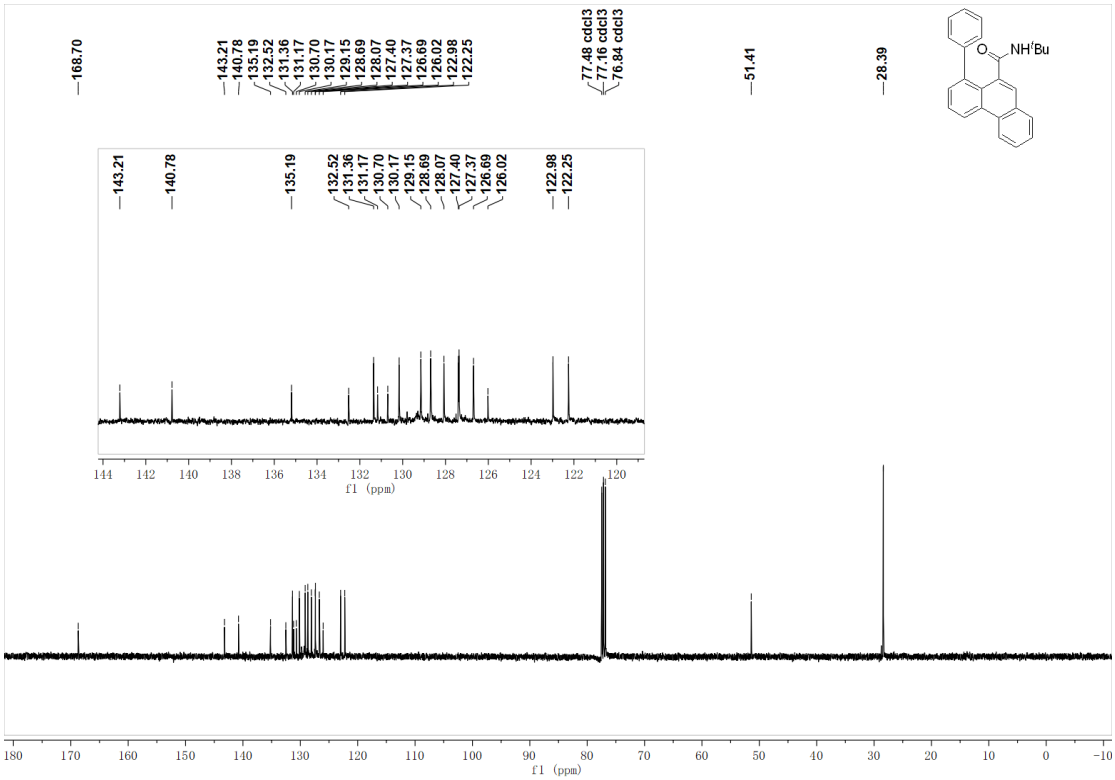
1.10
1.03
1.90
2.00
1.07
1.03
8.86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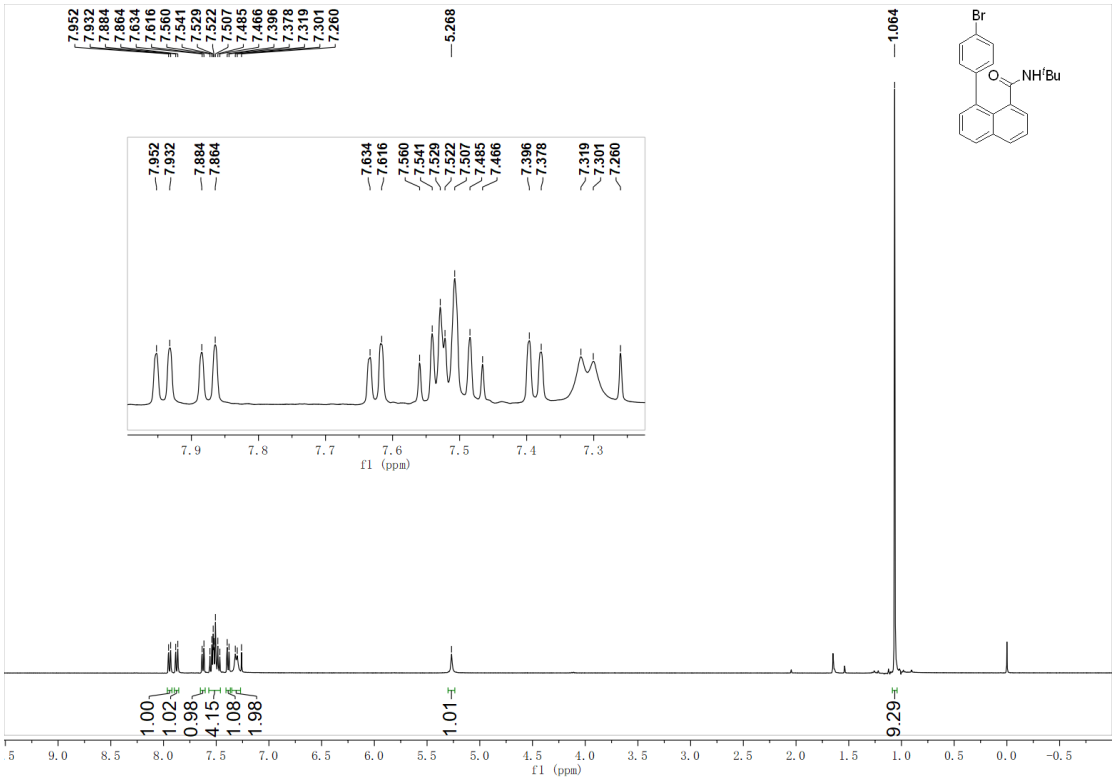
130.70
130.17
129.15
128.69
128.07
127.40
127.37
126.69
126.02
122.98
122.25
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.41
28.39
NH'Bu
f1 (ppm)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7.541
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7.522
7.507
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7.466
7.396
7.378
7.319
7.301
7.260
5.268
1.064
Br
O
NH^{t}Bu
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1.02
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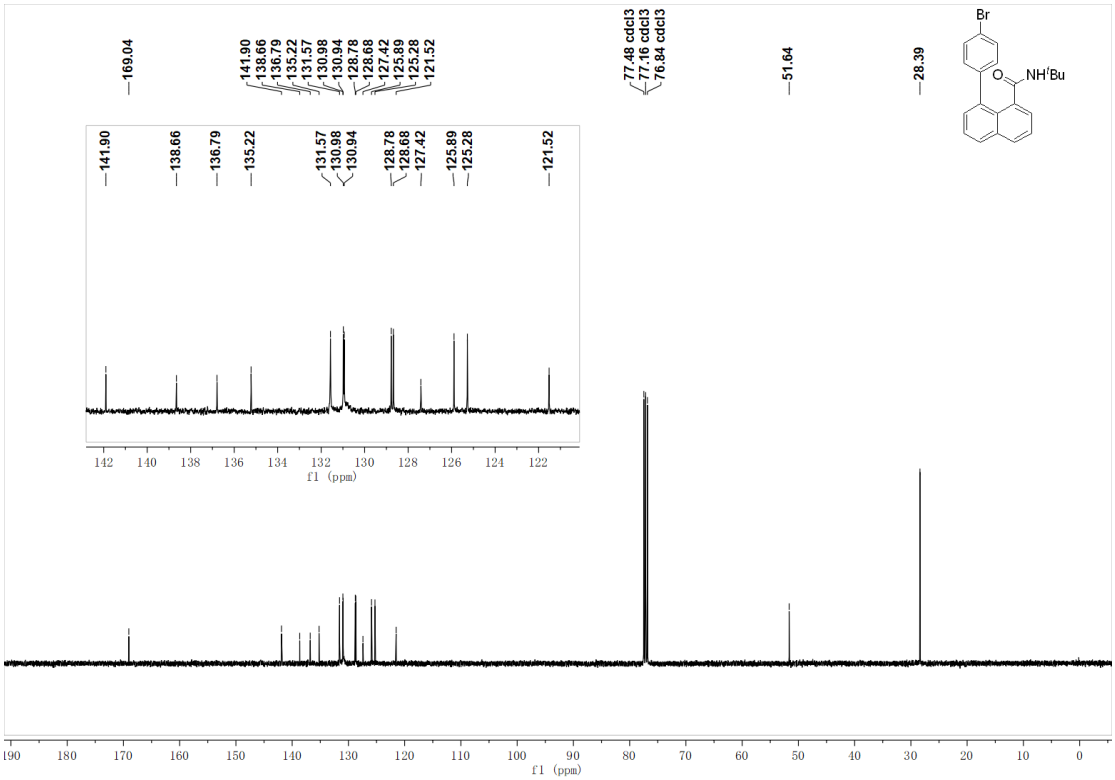
4.15
1.08
1.98
1.01
9.29
f1 (ppm)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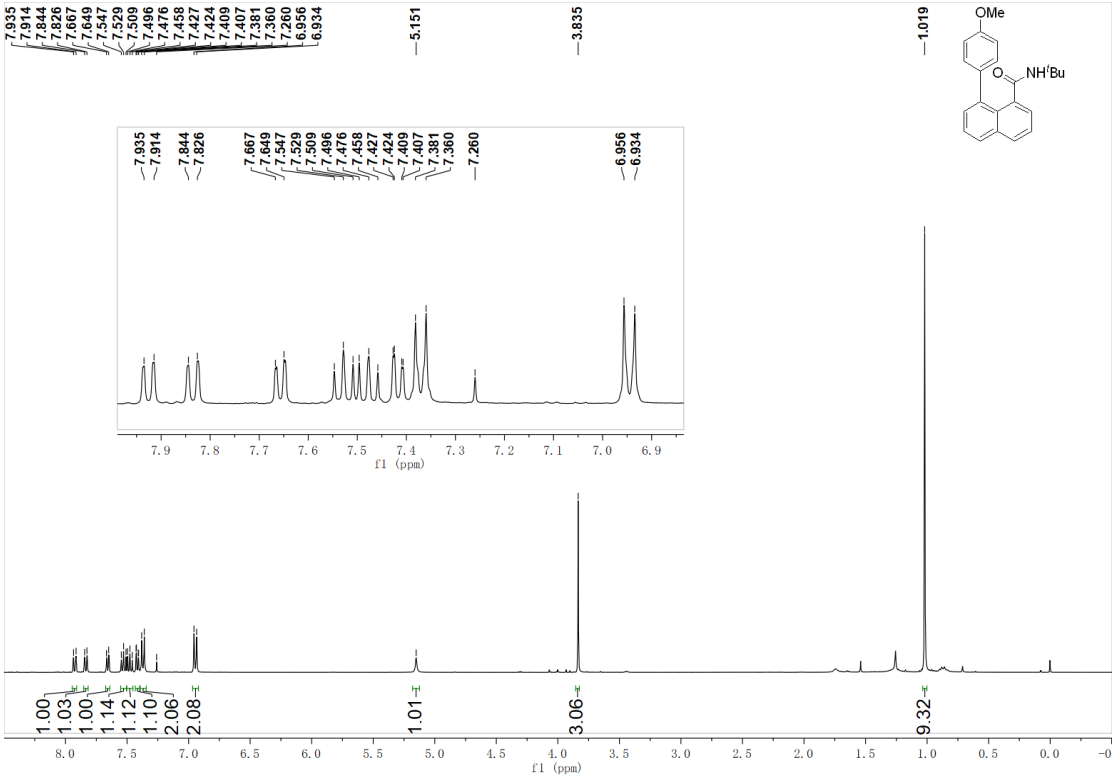
131.57
130.98
130.94
128.78
128.68
127.42
125.89
125.28
121.52
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.64
28.39
Br
O
NH^{t}Bu
f1 (ppm)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7.826
7.667
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7.509
7.496
7.476
7.458
7.427
7.424
7.409
7.407
7.381
7.360
7.260
6.956
6.934
5.151
3.835
1.019
OMe
O
NH^{t}Bu
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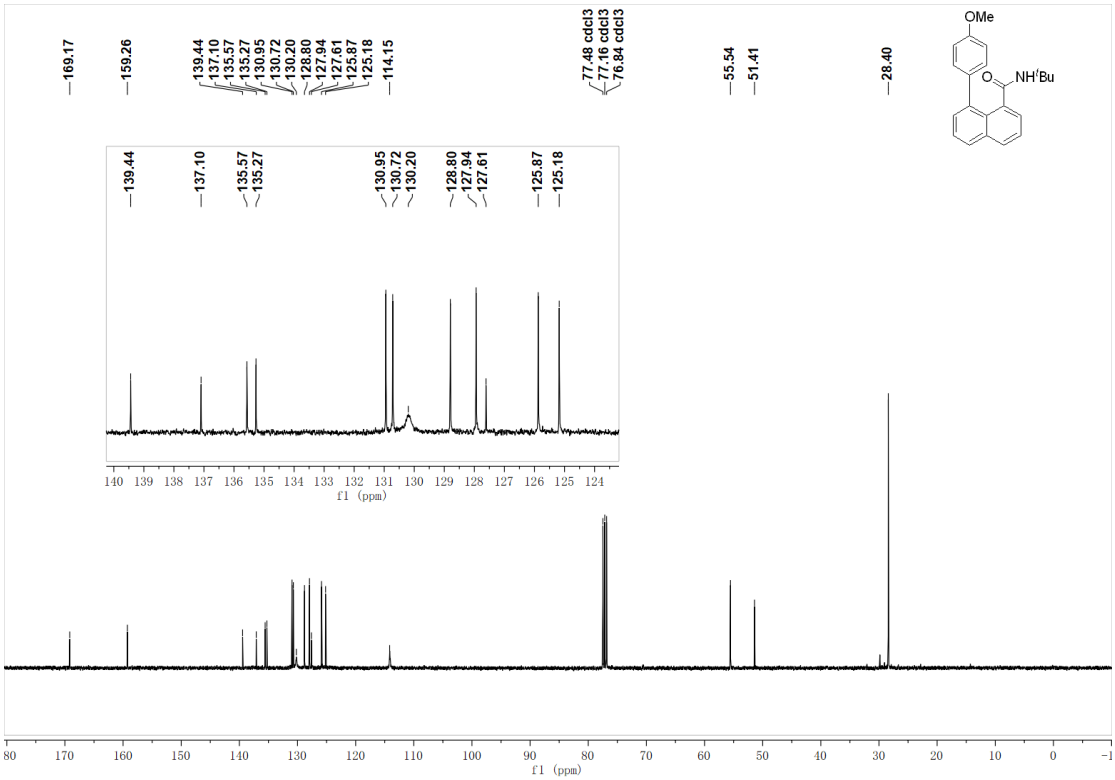
1.00
1.14
1.12
1.10
2.06
2.08
1.01
3.06
9.32
f1 (ppm)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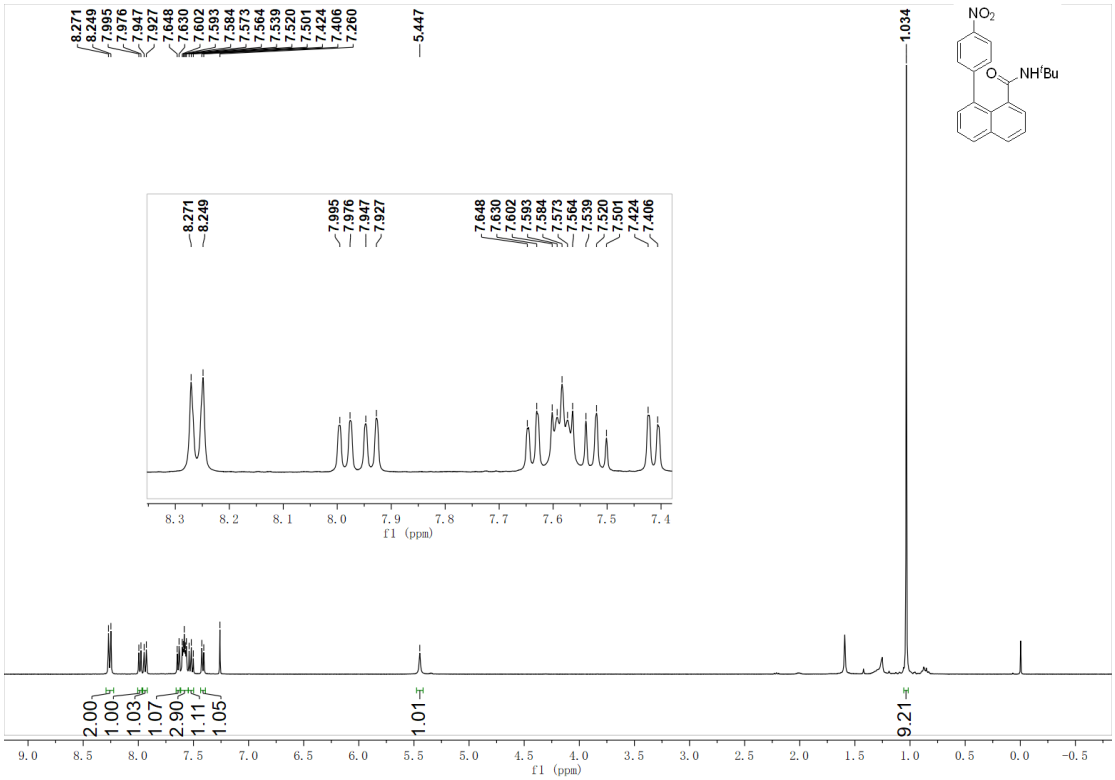
135.57
135.27
130.95
130.72
130.20
128.80
127.94
127.61
125.87
125.18
114.15
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
55.54
51.41
28.40
OMe
O
NH^{t}Bu
f1 (ppm)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7.947
7.927
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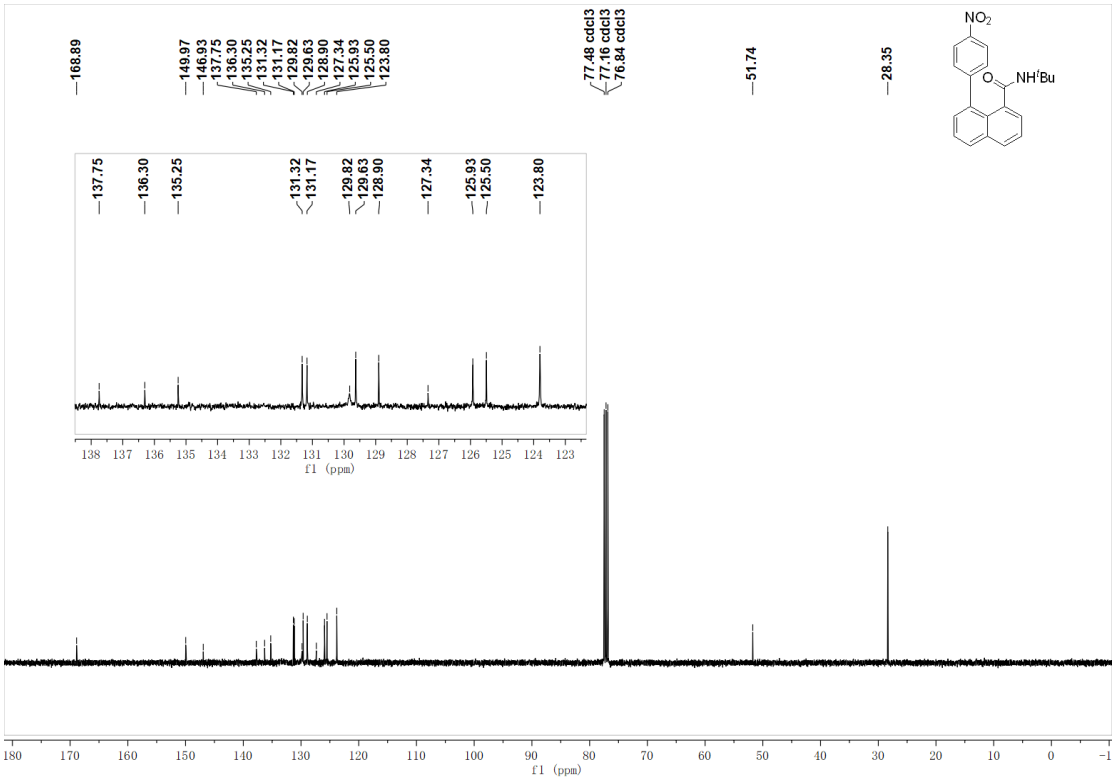
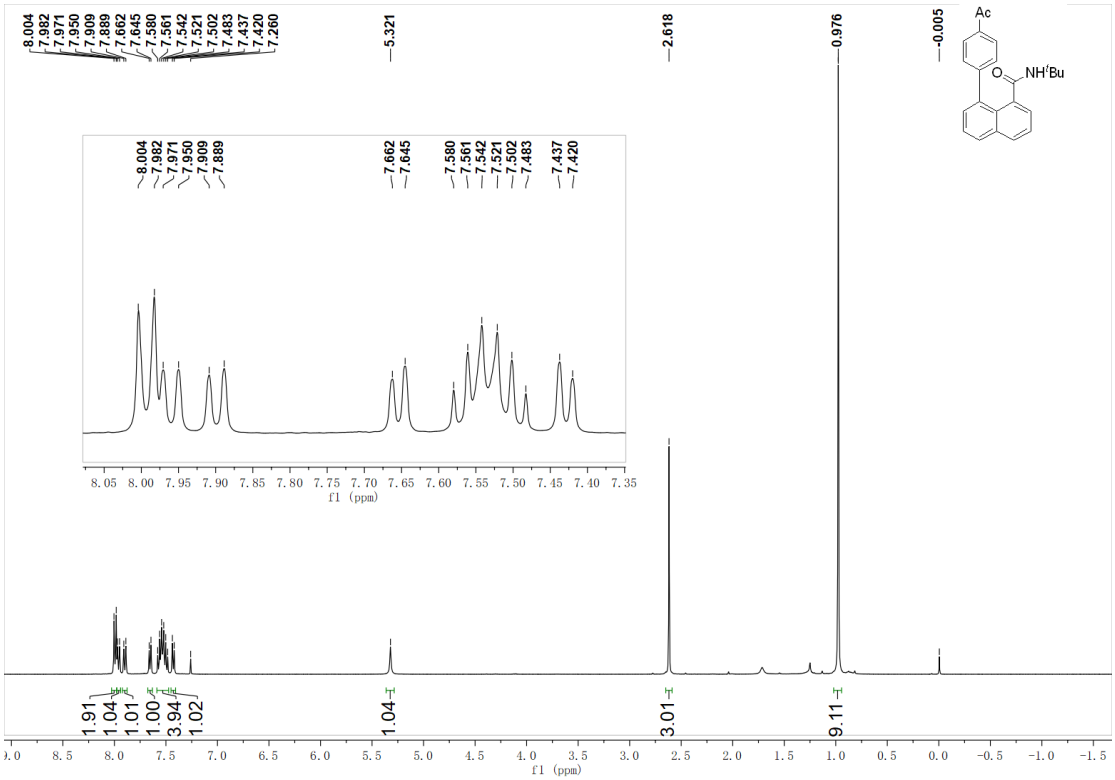
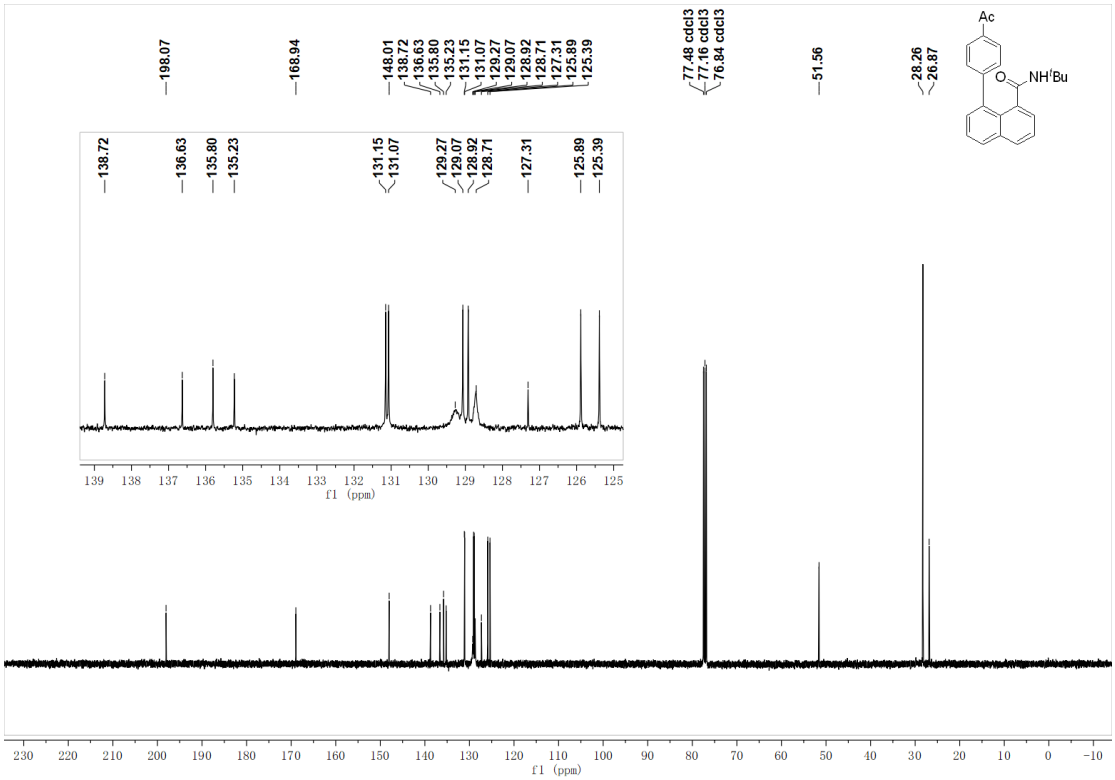
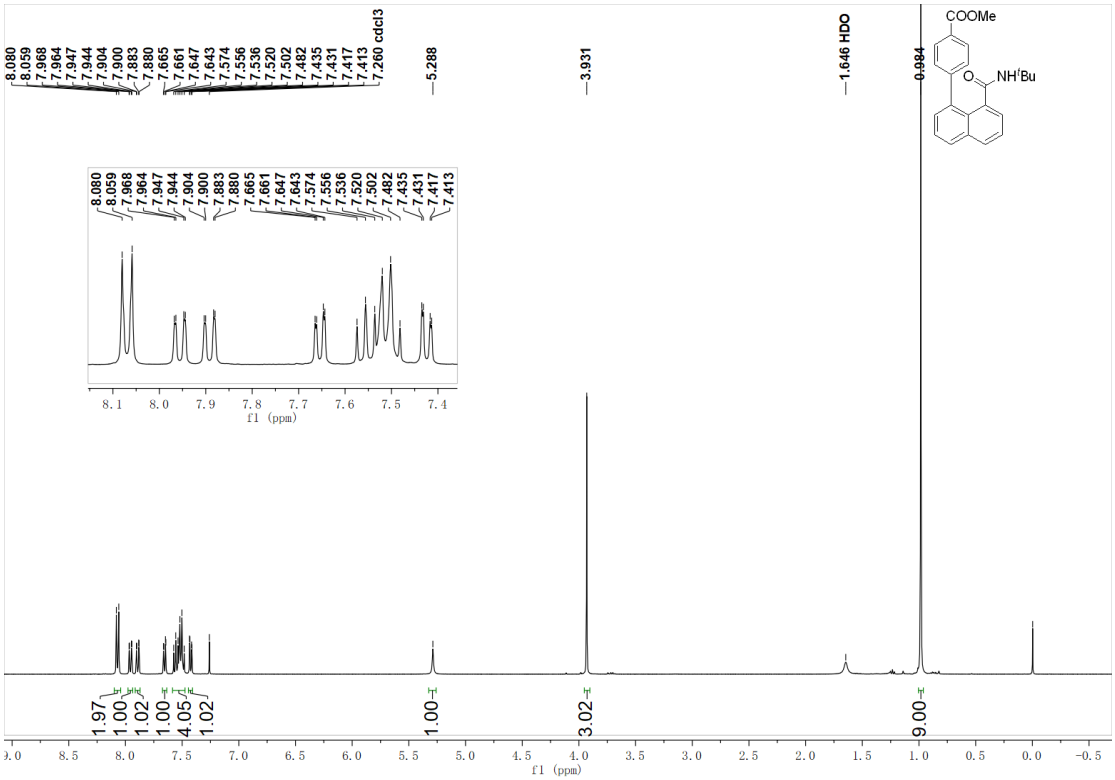
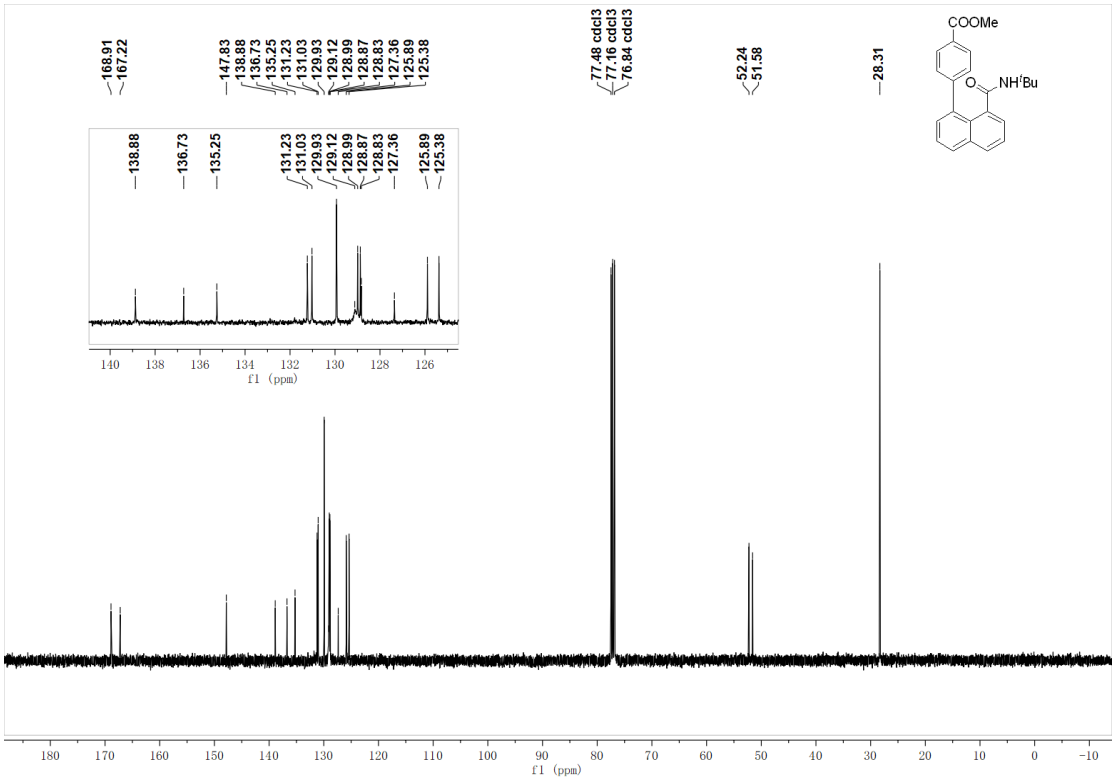
7.630
7.602
7.593
7.584
7.573
7.564
7.539
7.520
7.501
7.424
7.406
7.260
5.447
1.034
NO2
O
NH^{t}Bu
2.00
1.00
1.03
1.07
2.90
1.11
1.05
1.01
9.21
f1 (ppm)

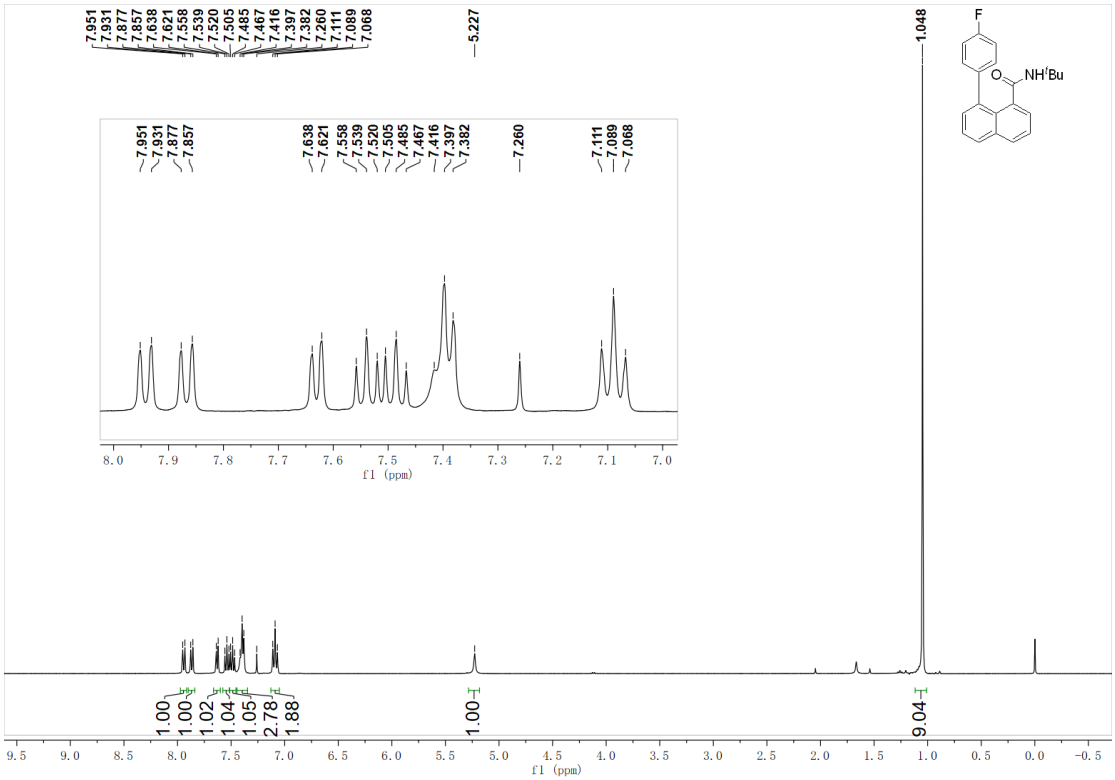

168.89
149.97
146.93
137.75
136.30
135.25
131.32
131.17
129.82
129.63
128.90
127.34
125.93
125.50
123.80
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.74
28.35
NO2
O
NH^{t}Bu
f1 (ppm)

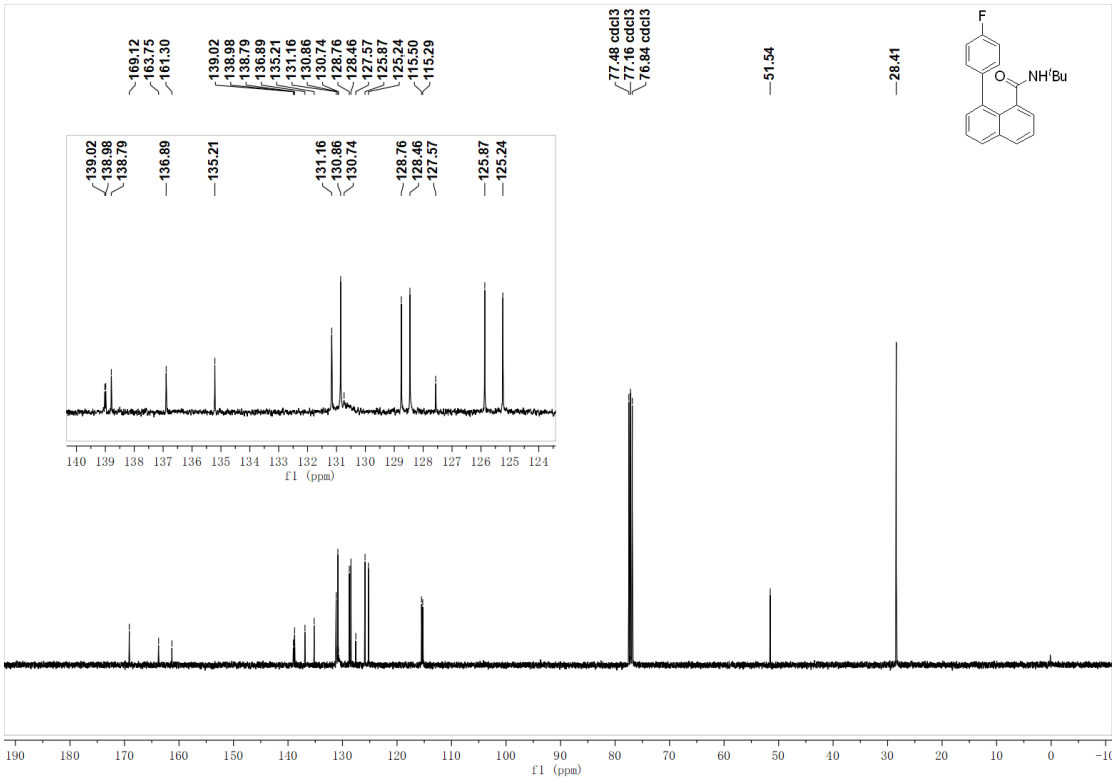

8.004
7.982
7.971
7.950
7.909
7.889
7.662
7.645
7.580
7.561
7.542
7.521
7.502
7.483
7.437
7.420
7.260
5.321
2.618
0.976
-0.005
Ac
O
NH^{t}Bu
1.91
1.04
1.01
1.00
3.94
1.02
1.04
3.01
9.11
f1 (ppm)

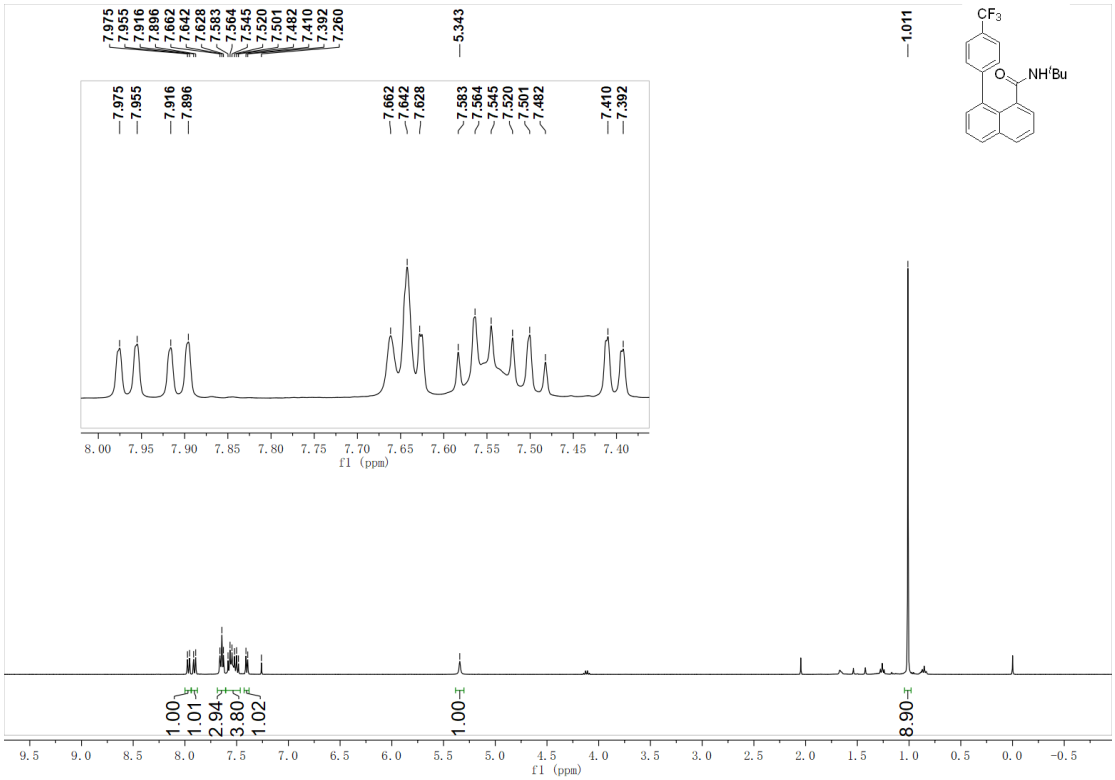

198.07
168.94
148.01
138.72
136.63
135.80
135.23
131.15
131.07
129.27
129.07
128.92
128.71
127.31
125.89
125.39
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.56
28.26
26.87
Ac
O
NH^{t}Bu
f1 (ppm)

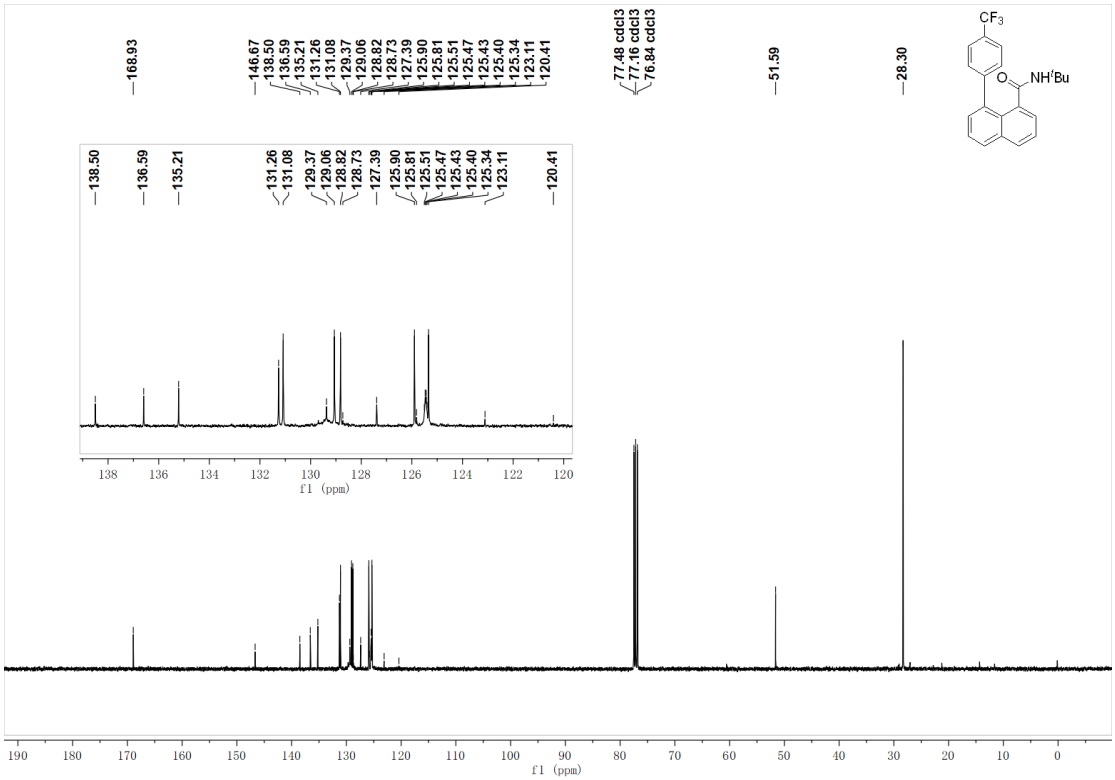

8.080
8.059
7.968
7.964
7.947
7.944
7.904
7.900
7.883
7.880
7.665
7.661
7.647
7.643
7.574
7.556
7.536
7.520
7.502
7.482
7.435
7.431
7.417
7.413
7.260 cdcl3
5.288
3.931
1.646 HDO
0.984
COOMe
NH^{t}Bu
f1 (ppm)
1.97
1.00
1.02
1.00
4.05
1.02
1.00
3.02
9.00

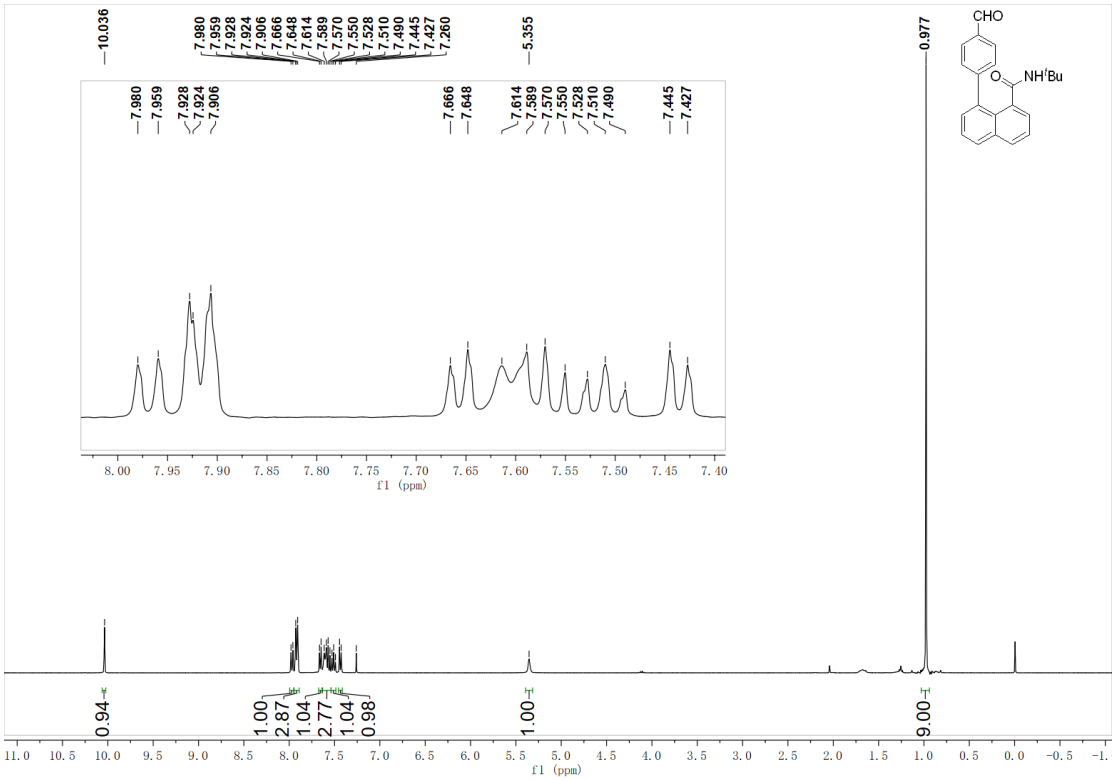

168.91
167.22
147.83
138.88
136.73
135.25
131.23
131.03
129.93
129.12
128.99
128.87
128.83
127.36
125.89
125.38
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
52.24
51.58
28.31
COOMe
NH^{t}Bu
f1 (ppm)

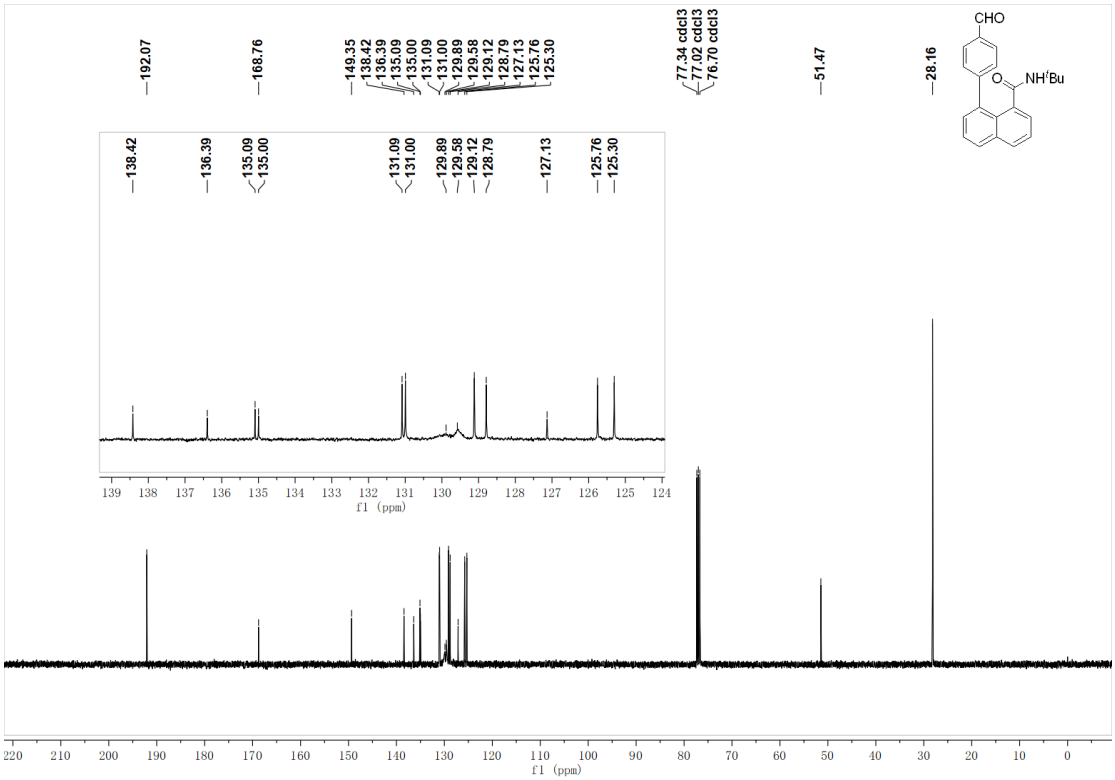

7.951
7.931
7.877
7.857
7.638
7.621
7.558
7.539
7.520
7.505
7.485
7.467
7.416
7.397
7.382
7.260
7.111
7.089
7.068
5.227
1.048
F
O
NH^{t}Bu
f1 (ppm)
1.00
1.00
1.02
1.04
1.05
2.78
1.88
1.00
9.04

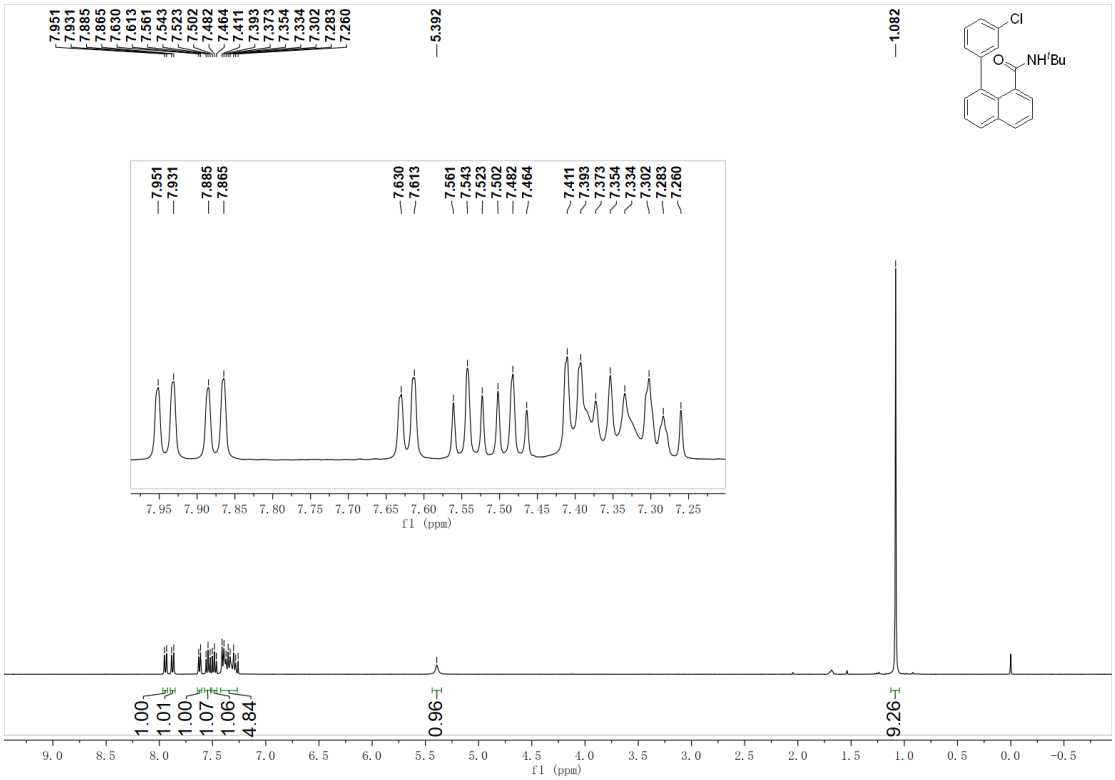

169.12
163.75
161.30
139.02
138.98
138.79
136.89
135.21
131.16
130.86
130.74
128.76
128.46
127.57
125.87
125.24
115.50
115.29
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.54
28.41
F
O
NH^{t}Bu
f1 (ppm)

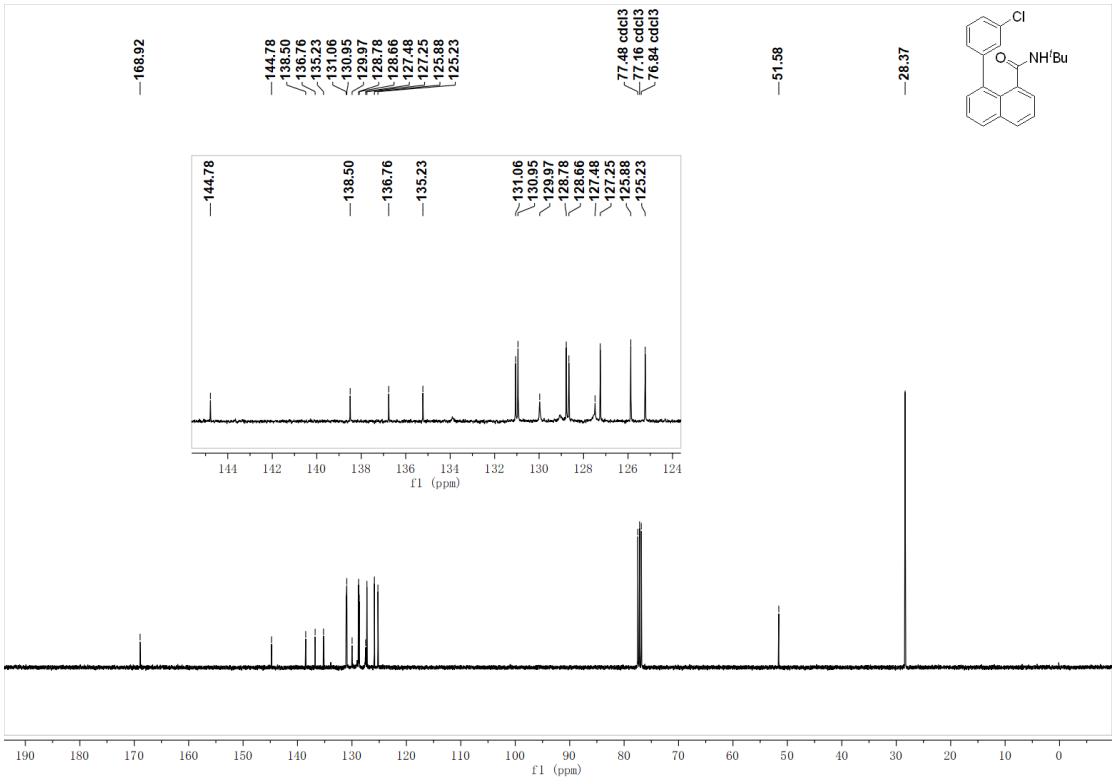

7.975
7.955
7.916
7.896
7.662
7.642
7.628
7.583
7.564
7.545
7.520
7.501
7.482
7.410
7.392
7.260
5.343
1.011
CF3
O
NH^{t}Bu
1.00
1.01
2.94
3.80
1.02
1.00
8.90
f1 (ppm)

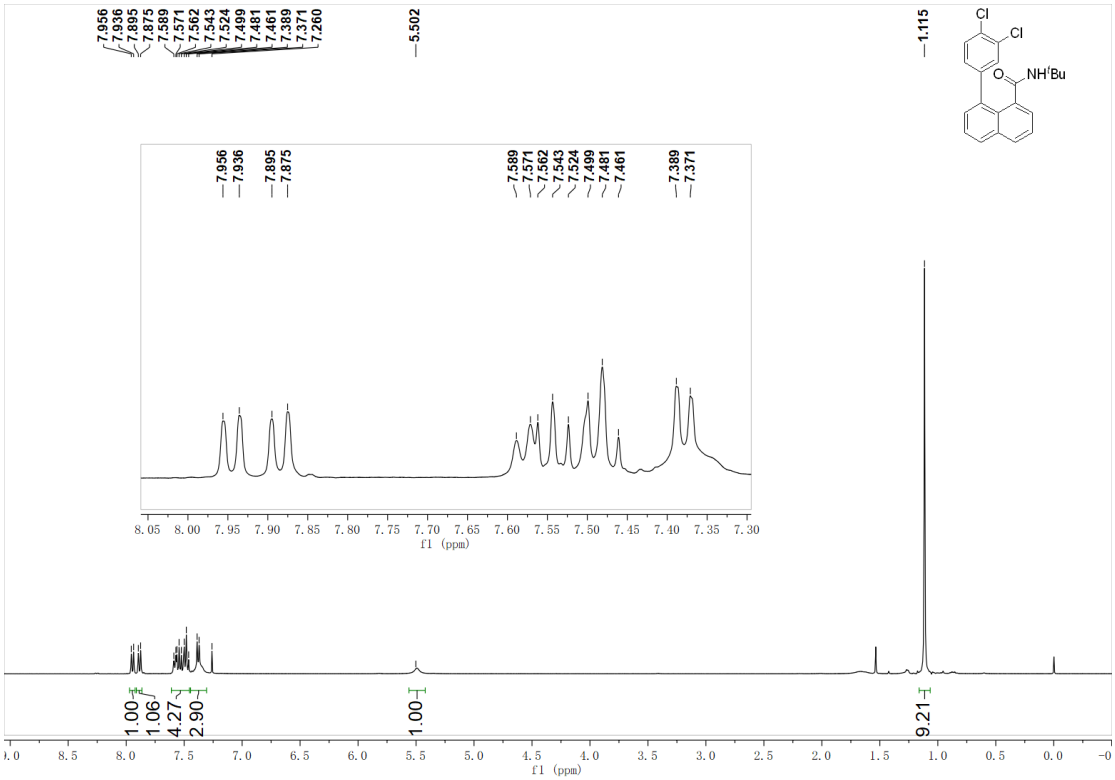

168.93
146.67
138.50
136.59
135.21
131.26
131.08
129.37
129.06
128.82
128.73
127.39
125.90
125.81
125.51
125.47
125.43
125.40
125.34
123.11
120.41
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.59
28.30
CF3
O
NH^{t}Bu
f1 (ppm)

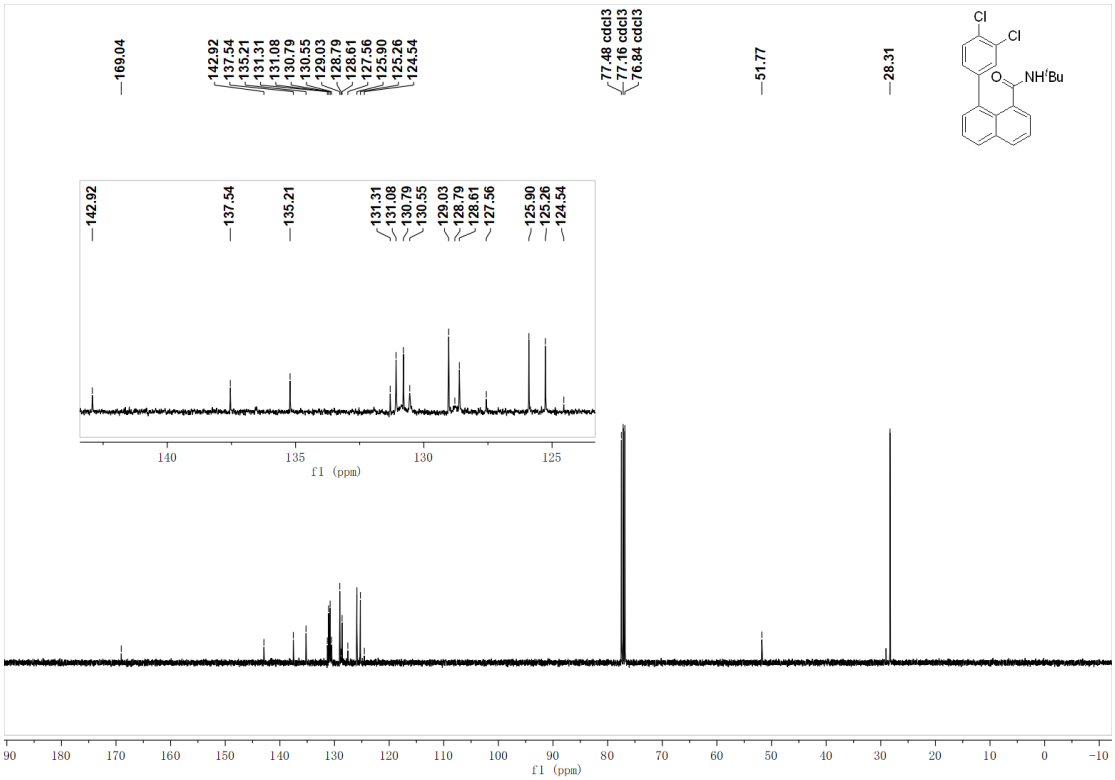

10.036
7.980
7.959
7.928
7.924
7.906
7.666
7.648
7.614
7.589
7.570
7.550
7.528
7.510
7.490
7.445
7.427
7.260
5.355
0.977
CHO
NH^{t}Bu
f1 (ppm)
0.94
1.00
2.87
1.04
2.77
1.04
0.98
1.00
9.00

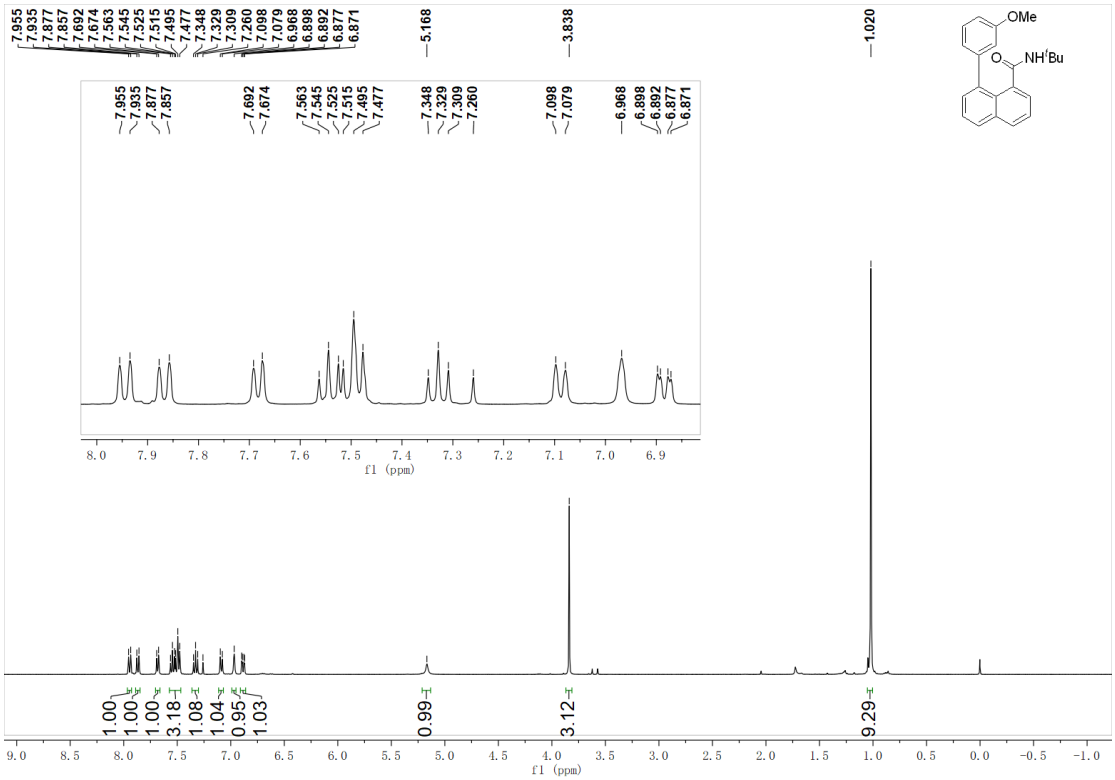

192.07
168.76
149.35
138.42
136.39
135.09
135.00
131.09
131.00
129.89
129.58
129.12
128.79
127.13
125.76
125.30
77.34 cdcl3
77.02 cdcl3
76.70 cdcl3
51.47
28.16
CHO
NH^{t}Bu
f1 (ppm)

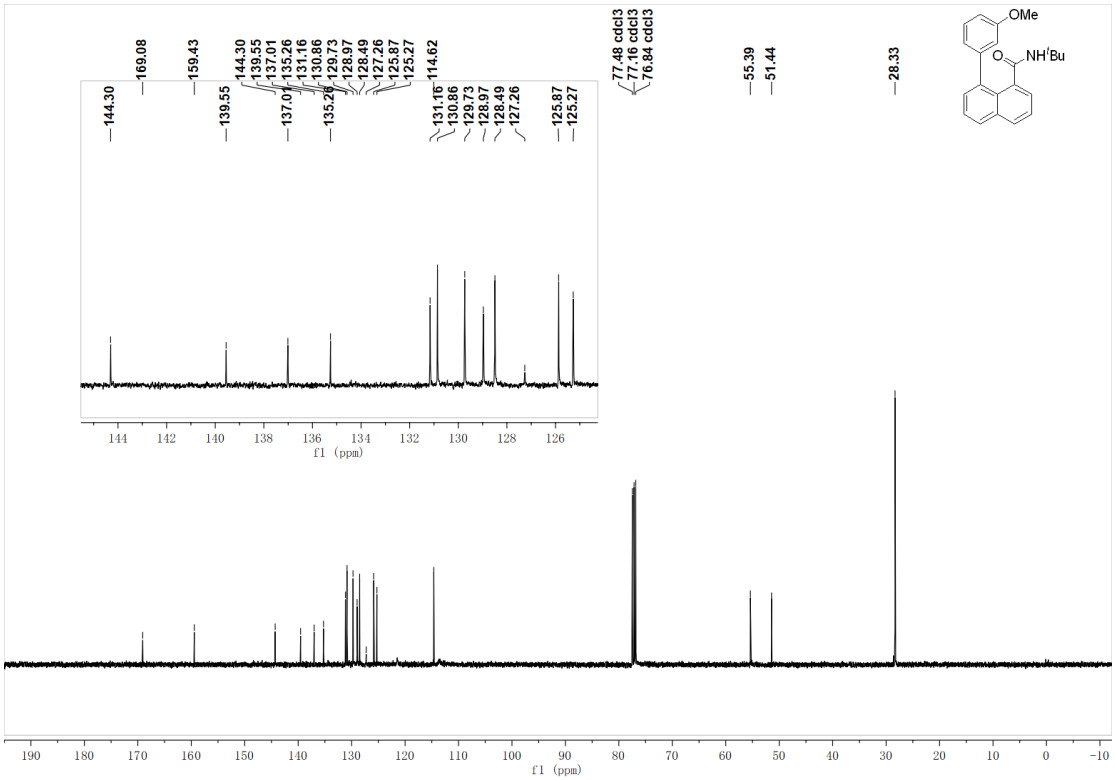

7.951
7.931
7.885
7.865
7.630
7.613
7.561
7.543
7.523
7.502
7.482
7.464
7.411
7.393
7.373
7.354
7.334
7.302
7.283
7.260
5.392
1.082
Cl
O
NH^{t}Bu
1.00
1.01
1.00
1.07
1.06
4.84
0.96
9.26
f1 (ppm)

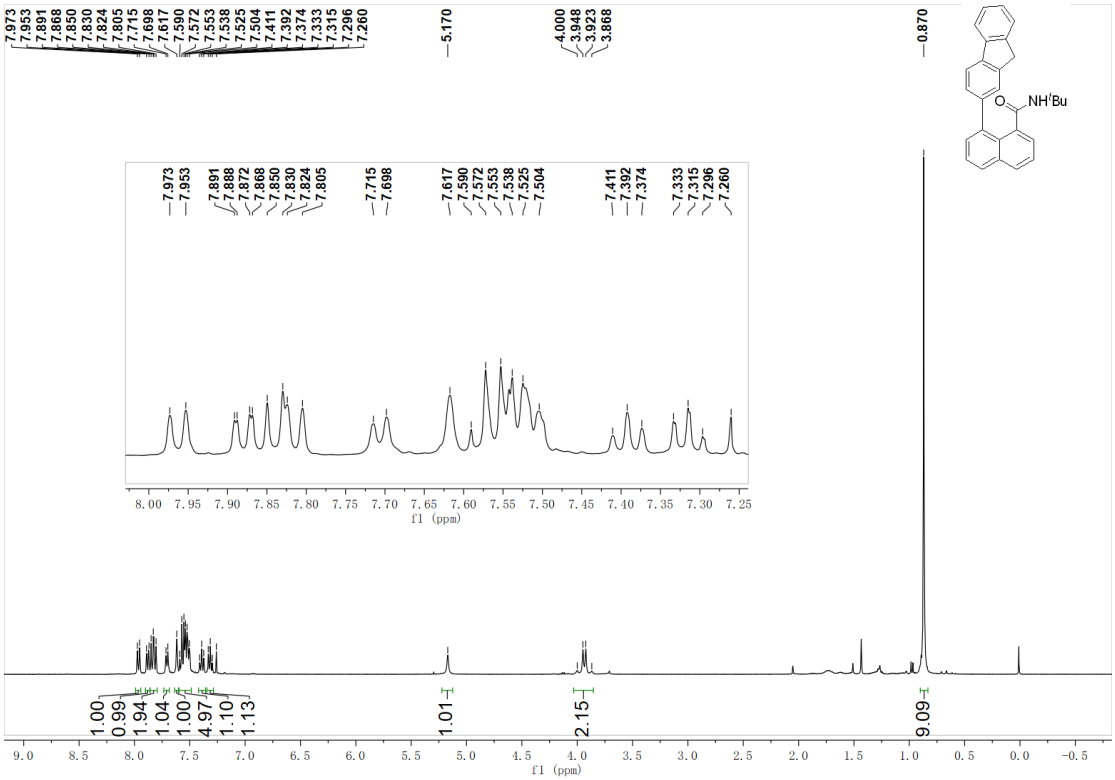

168.92
144.78
138.50
136.76
135.23
131.06
130.95
129.97
128.78
128.66
127.48
127.25
125.88
125.23
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.58
28.37
Cl
O
NH^{t}Bu
f1 (ppm)


7.956
7.936
7.895
7.875
7.589
7.571
7.562
7.543
7.524
7.499
7.481
7.461
7.389
7.371
7.260
5.502
1.115
Cl
Cl
O
NH^{t}Bu
1.00
1.06
4.27
2.90
1.00
9.21
f1 (ppm)


169.04
142.92
137.54
135.21
131.31
131.08
130.79
130.55
129.03
128.79
128.61
127.56
125.90
125.26
124.54
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.77
28.31
Cl
Cl
O
NH^{t}Bu
f1 (ppm)


7.955
7.935
7.877
7.857
7.692
7.674
7.563
7.545
7.525
7.515
7.495
7.477
7.348
7.329
7.309
7.260
7.098
7.079
6.968
6.898
6.892
6.877
6.871
5.168
3.838
1.020
OMe
NH^{t}Bu
f1 (ppm)
1.00
1.00
1.00
3.18
1.08
1.04
0.95
1.03
0.99
3.12
9.29


169.08
159.43
144.30
139.55
137.01
135.26
131.16
130.86
129.73
128.97
128.49
127.26
125.87
125.27
114.62
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
55.39
51.44
28.33
OMe
NH^{t}Bu
f1 (ppm)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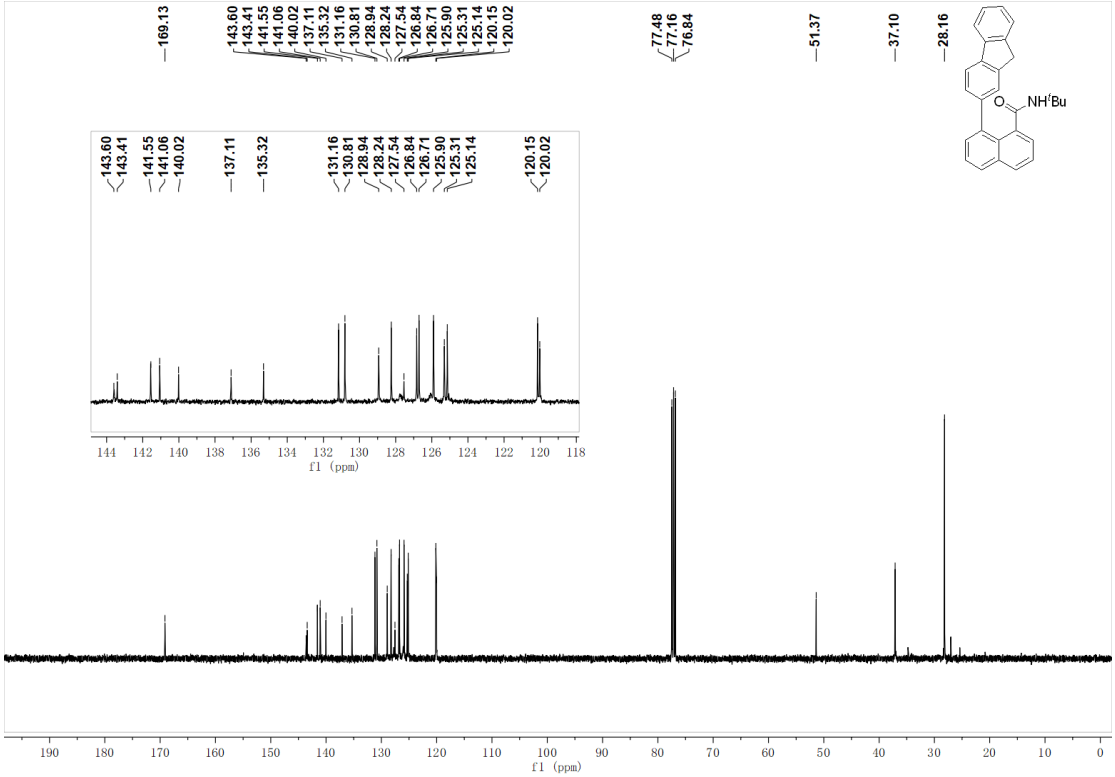
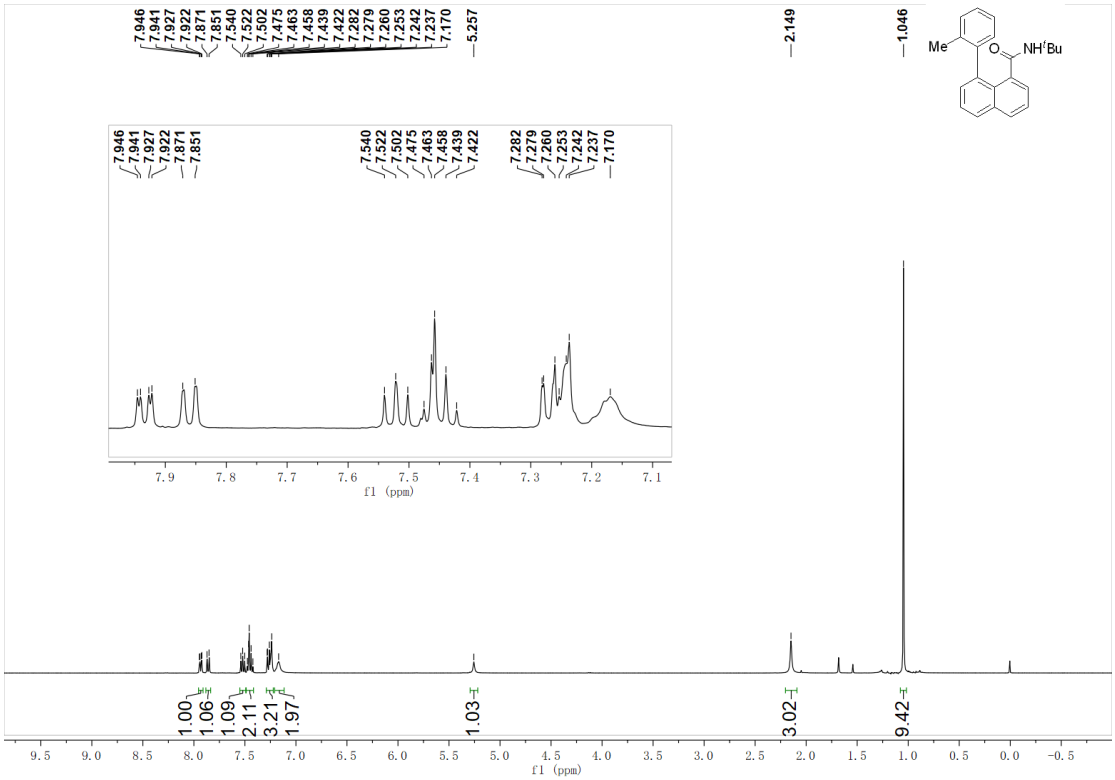
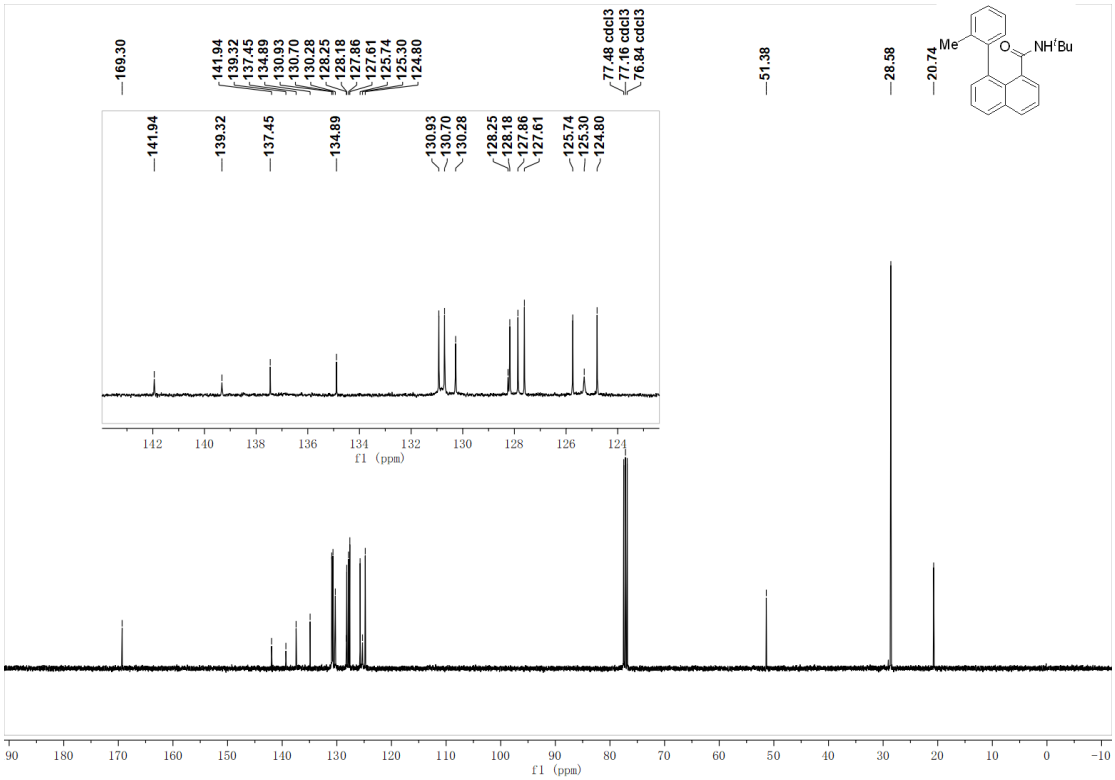
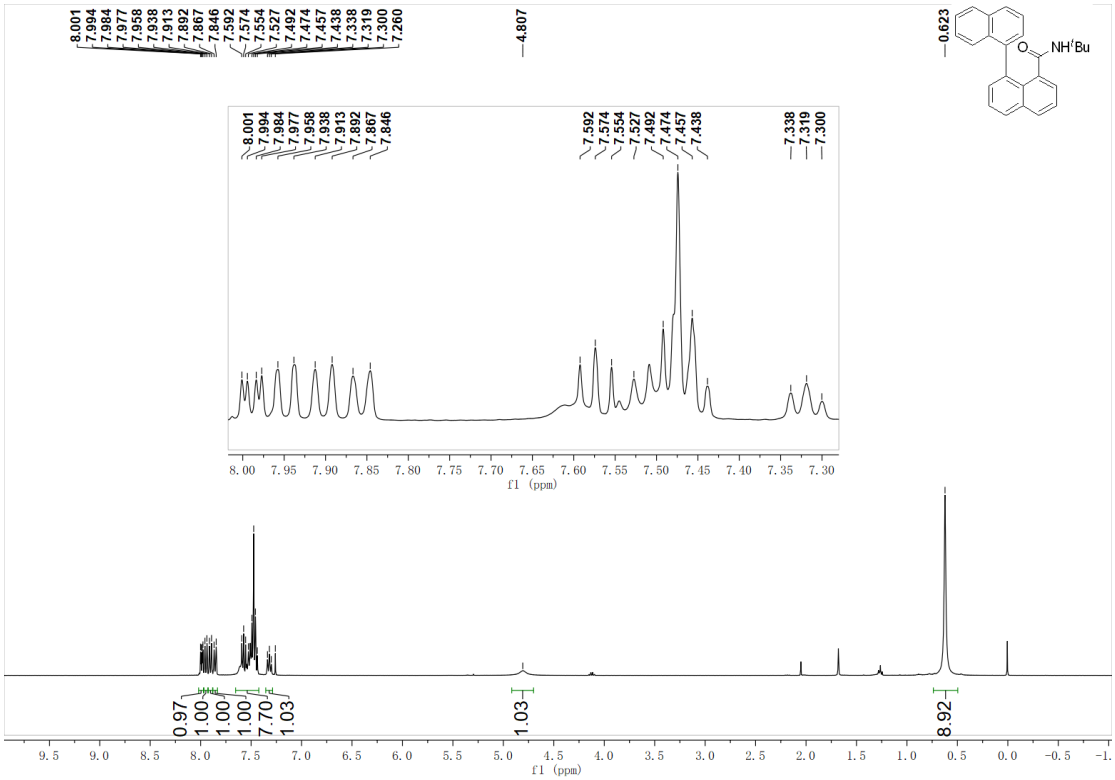
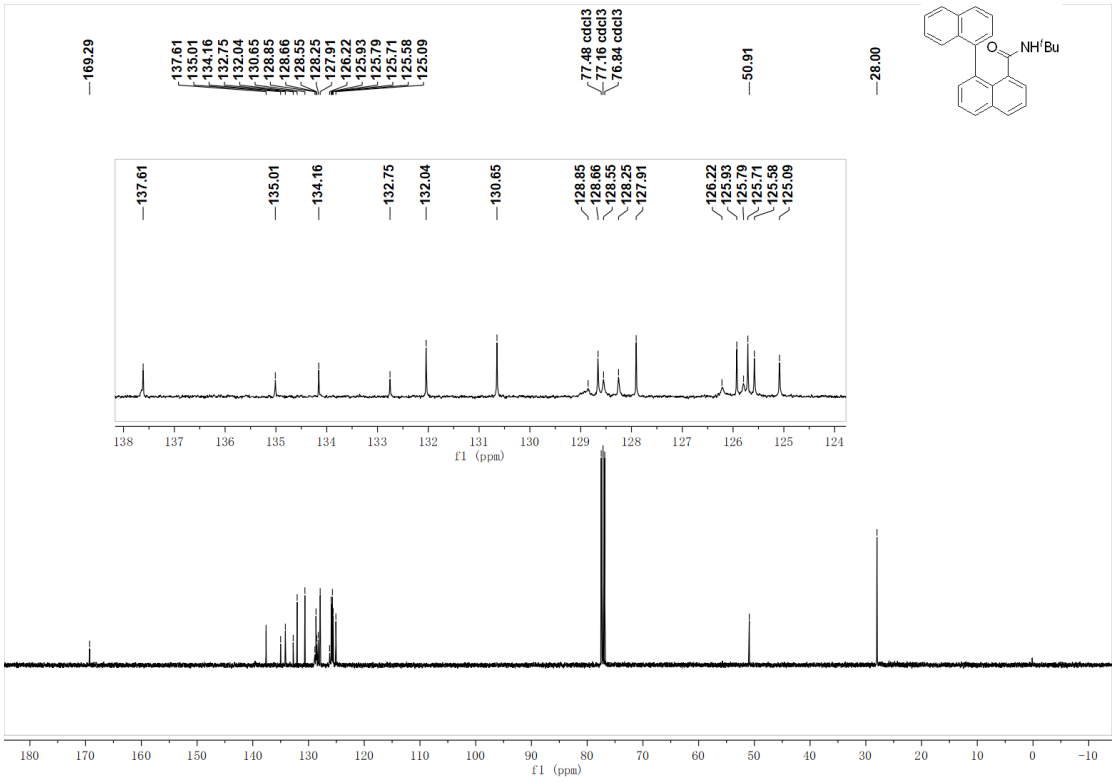
7.891
7.868
7.850
7.830
7.824
7.805
7.715
7.698
7.617
7.590
7.572
7.553
7.538
7.525
7.504
7.411
7.392
7.374
7.333
7.315
7.296
7.260
5.170
4.000
3.948
3.923
3.868
0.870
NH^{t}Bu
f1 (ppm)
1.00
0.99
1.94
1.04
1.00
4.97
1.10
1.13
1.01
2.15
9.09

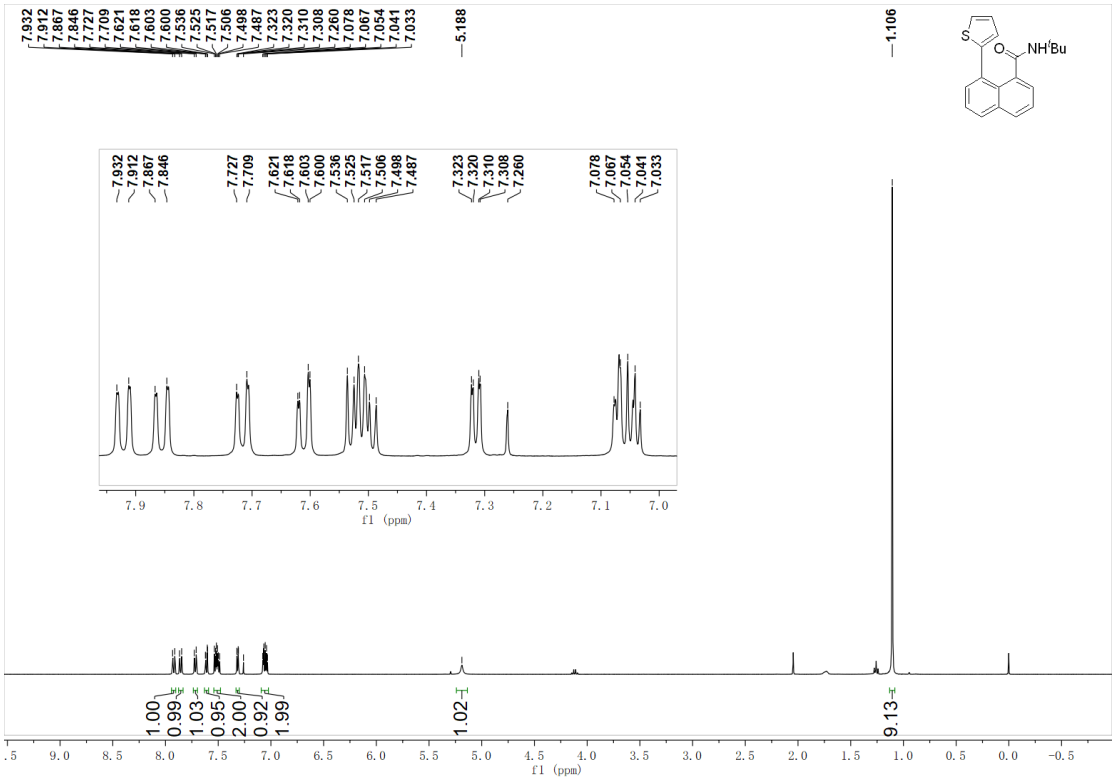

169.13
143.60
143.41
141.55
141.06
140.02
137.11
135.32
131.16
130.81
128.94
128.24
127.54
126.84
126.71
125.90
125.31
125.14
120.15
120.02
77.48
77.16
76.84
51.37
37.10
28.16
NH^{t}Bu
f1 (ppm)

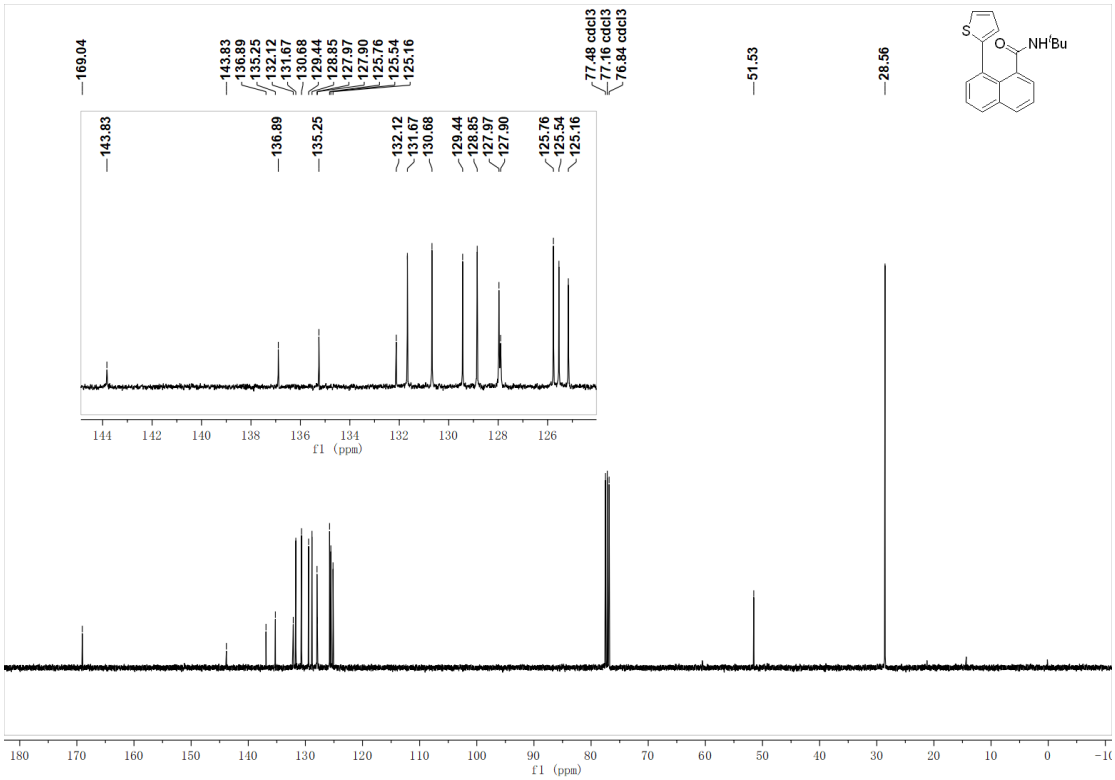

7.946
7.941
7.927
7.922
7.871
7.851
7.540
7.522
7.502
7.475
7.463
7.458
7.439
7.422
7.282
7.279
7.260
7.253
7.242
7.237
7.170
5.257
2.149
1.046
Me
O
NH^{t}Bu
f1 (ppm)
1.00
1.06
1.09
2.11
3.21
1.97
1.03
3.02
9.42

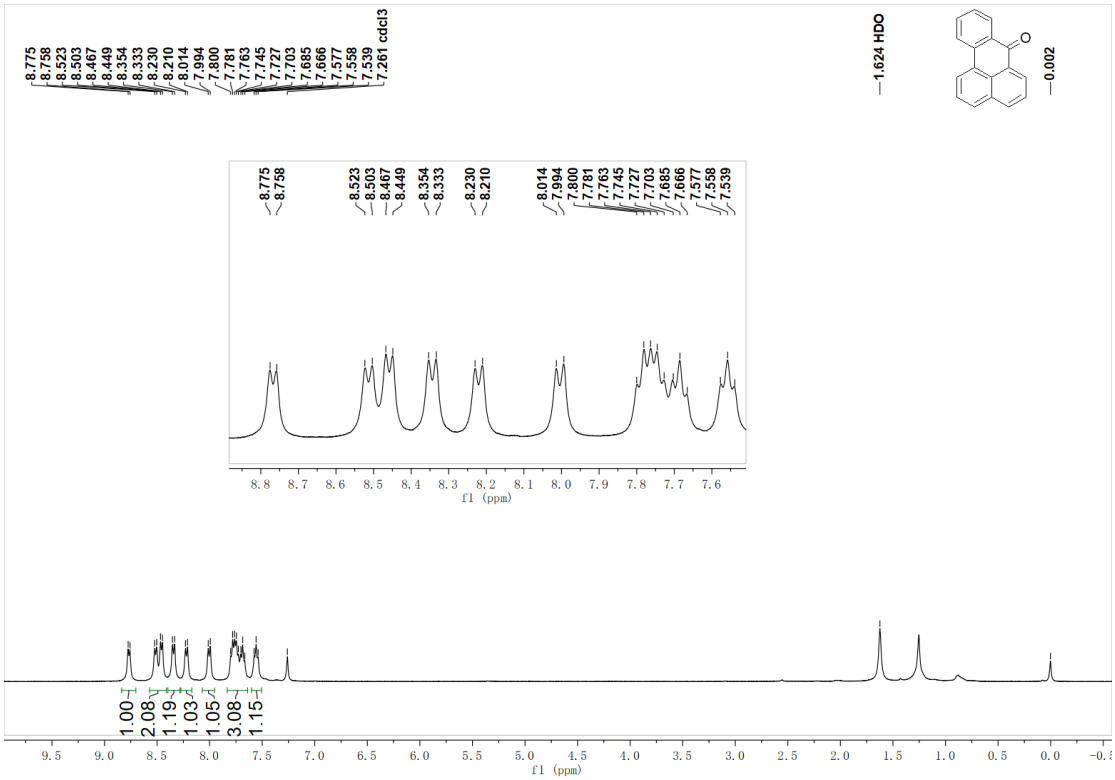

169.30
141.94
139.32
137.45
134.89
130.93
130.70
130.28
128.25
128.18
127.86
127.61
125.74
125.30
124.80
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.38
28.58
20.74
Me
O
NH^{t}Bu
f1 (ppm)

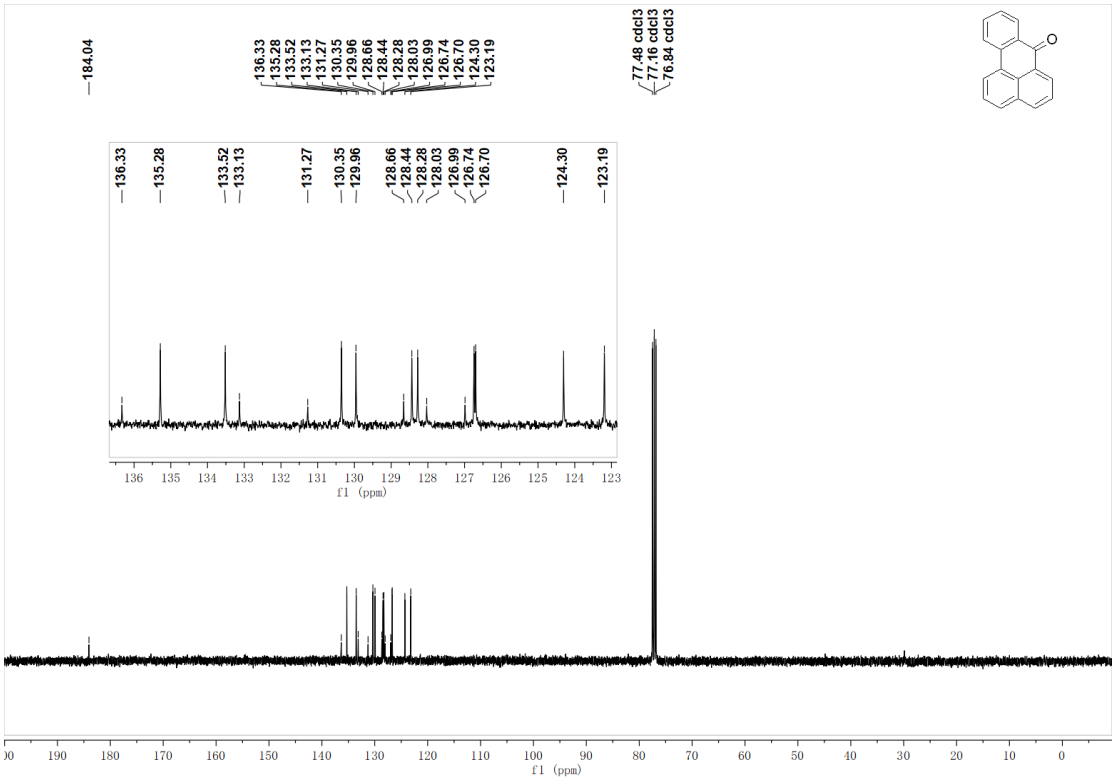

8.001
7.994
7.984
7.977
7.958
7.938
7.913
7.892
7.867
7.846
7.592
7.574
7.554
7.527
7.492
7.474
7.457
7.438
7.338
7.319
7.300
7.260
4.807
0.623
NH^{t}Bu
f1 (ppm)
0.97
1.00
1.00
1.00
7.70
1.03
1.03
8.92

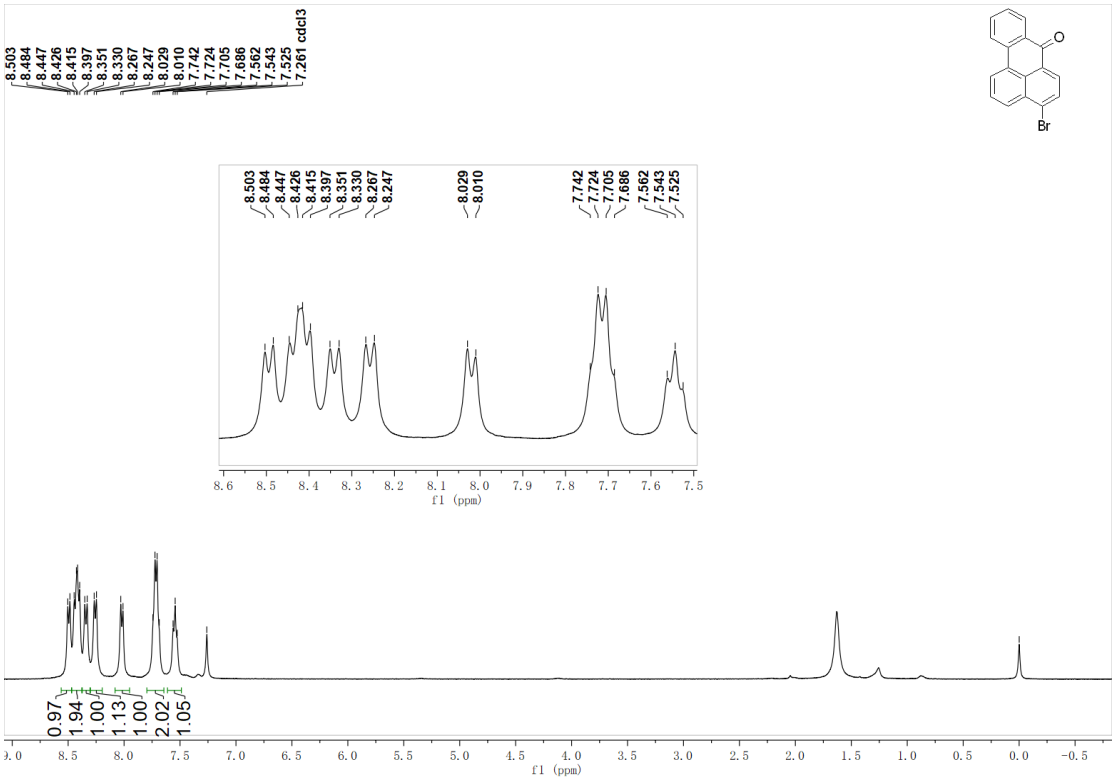

169.29
137.61
135.01
134.16
132.75
132.04
130.65
128.85
128.66
128.55
128.25
127.91
126.22
125.93
125.79
125.71
125.58
125.09
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
50.91
28.00
NH^{t}Bu
f1 (ppm)

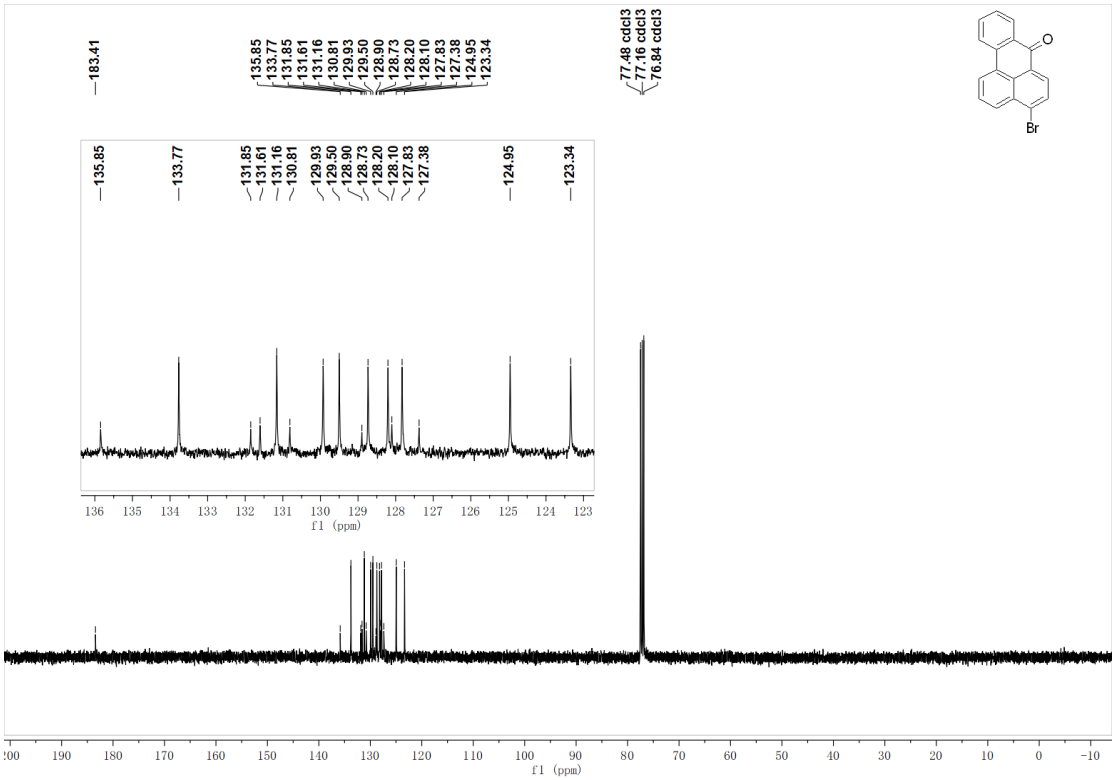

7.932
7.912
7.867
7.846
7.727
7.709
7.621
7.618
7.603
7.600
7.536
7.525
7.517
7.506
7.498
7.487
7.323
7.320
7.310
7.308
7.260
7.078
7.067
7.054
7.041
7.033
5.188
1.106
S
O
NH^{t}Bu
1.00
0.99
1.03
0.95
2.00
0.92
1.99
1.02
9.13
f1 (ppm)


169.04
143.83
136.89
135.25
132.12
131.67
130.68
129.44
128.85
127.97
127.90
125.76
125.54
125.16
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
51.53
28.56
S
O
NH^{t}Bu
f1 (ppm)


8.775
8.758
8.523
8.503
8.467
8.449
8.354
8.333
8.230
8.210
8.014
7.994
7.800
7.781
7.763
7.745
7.727
7.703
7.685
7.666
7.577
7.558
7.539
7.261 cdcl3
1.624 HDO
0.002
f1 (ppm)
1.00
2.08
1.19
1.03
1.05
3.08
1.15


184.04
136.33
135.28
133.52
133.13
131.27
130.35
129.96
128.66
128.44
128.28
128.03
126.99
126.74
126.70
124.30
123.19
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
f1 (ppm)


8.503
8.484
8.447
8.426
8.415
8.397
8.351
8.330
8.267
8.247
8.029
8.010
7.742
7.724
7.705
7.686
7.562
7.543
7.525
7.261 cdcl3
O
Br
f1 (ppm)
0.97
1.94
1.00
1.13
1.00
2.02
1.05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131.16
130.81
129.93
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128.90
128.73
128.20
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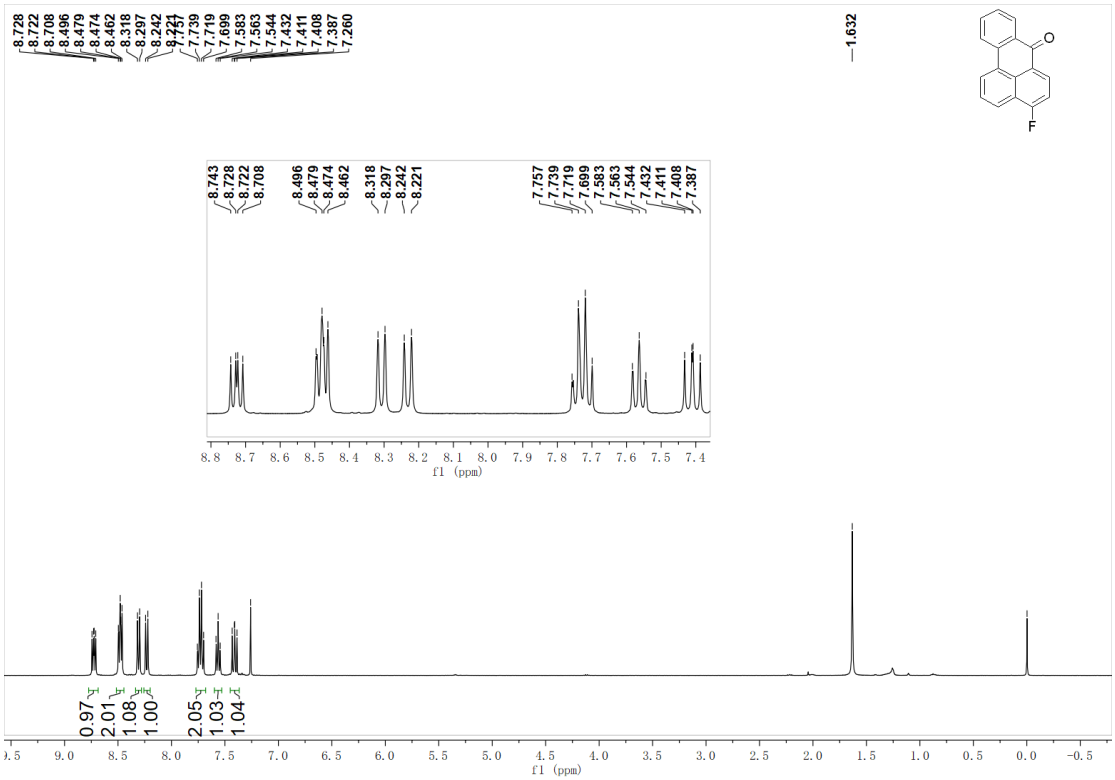
127.38
124.95
123.34
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
O
Br
f1 (ppm)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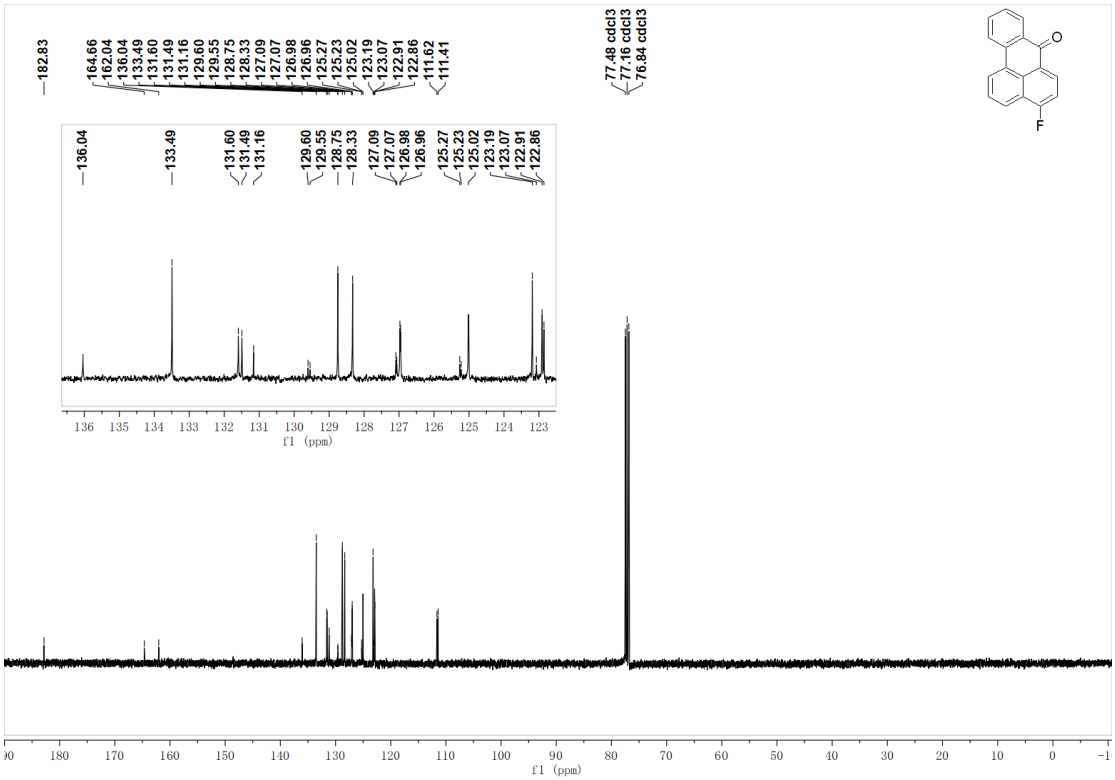
8.242
8.221
7.757
7.739
7.719
7.699
7.583
7.563
7.544
7.432
7.411
7.408
7.387
7.260
1.632
O
F
f1 (ppm)
0.97
2.01
1.08
1.00
2.05
1.03
1.04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131.16
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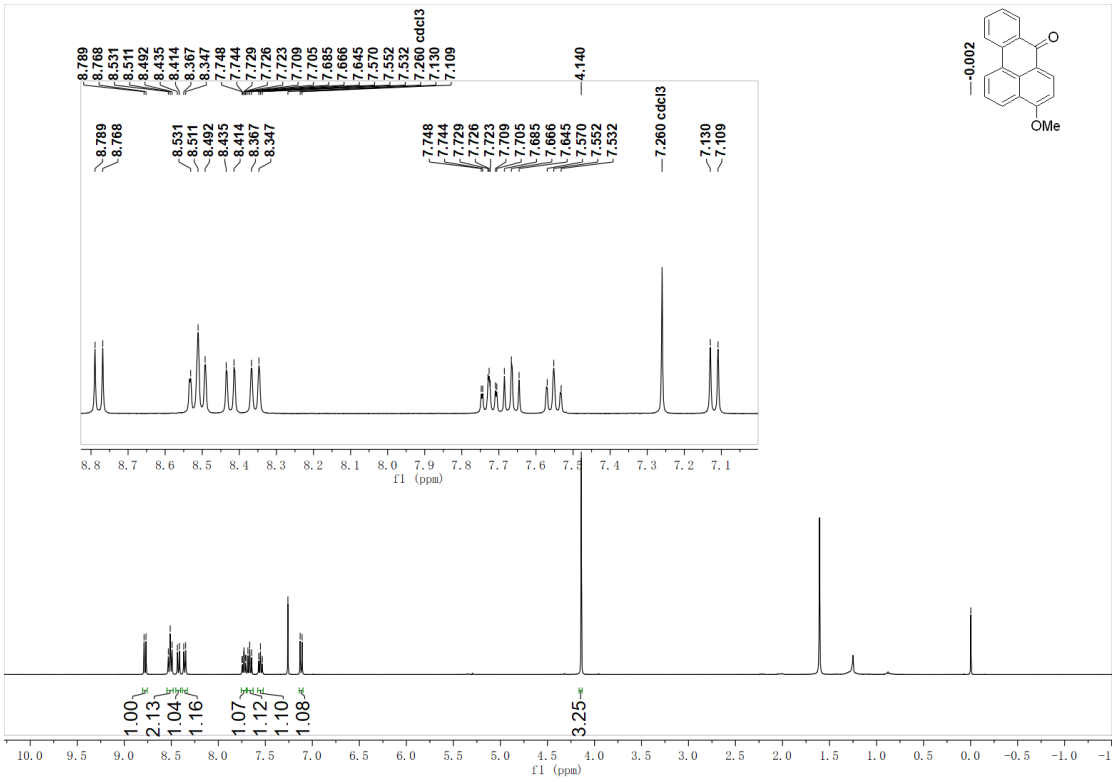
128.75
128.33
127.09
127.07
126.98
126.96
125.27
125.23
125.02
123.19
123.07
122.91
122.86
111.62
111.41
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
O
F
f1 (ppm)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8.367
8.347
7.748
7.744
7.729
7.726
7.723
7.709
7.705
7.685
7.666
7.645
7.570
7.552
7.532
7.260 cdcl3
7.130
7.109
4.140
-0.002
OMe
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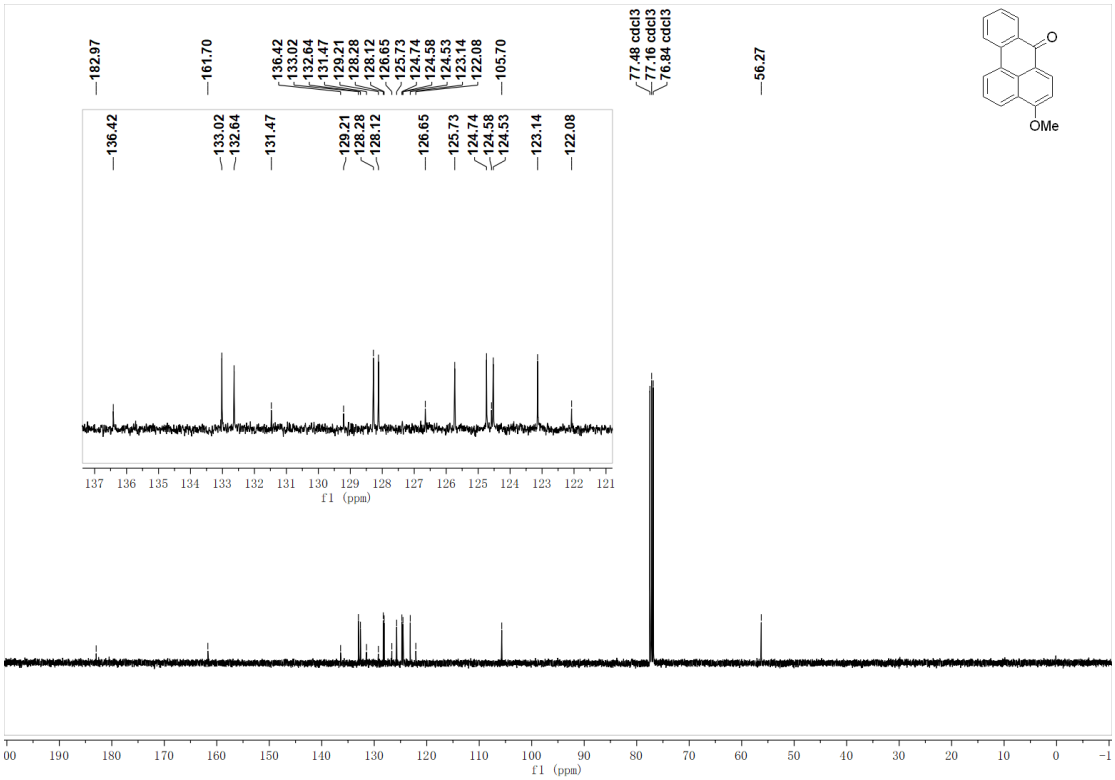
2.13
1.04
1.16
1.07
1.12
1.10
1.08
3.25
f1 (ppm)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131.47
129.21
128.28
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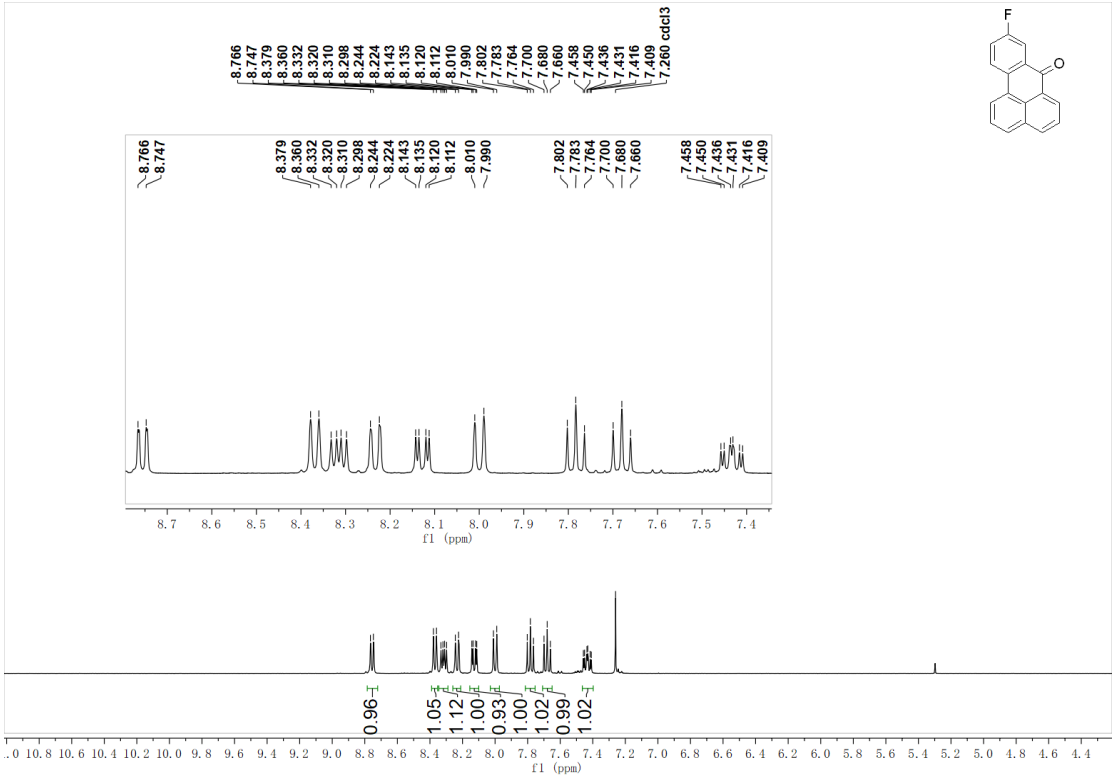
126.65
125.73
124.74
124.58
124.53
123.14
122.08
105.70
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
56.27
OMe
f1 (ppm)


F
O
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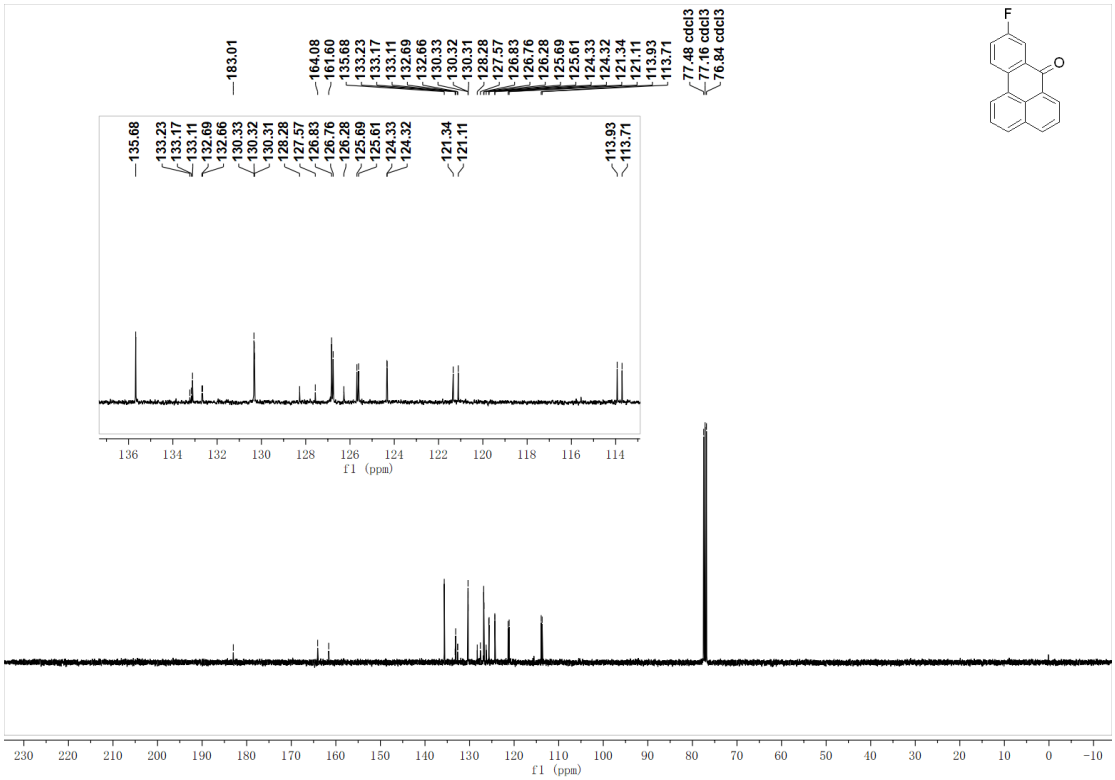
8.747
8.379
8.360
8.332
8.320
8.310
8.298
8.244
8.224
8.143
8.135
8.120
8.112
8.010
7.990
7.802
7.783
7.764
7.700
7.680
7.660
7.458
7.450
7.436
7.431
7.416
7.409
7.260 cdcl3
f1 (ppm)
0.96
1.05
1.12
1.00
0.93
1.00
1.02
0.99
1.02


F
O
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164.08
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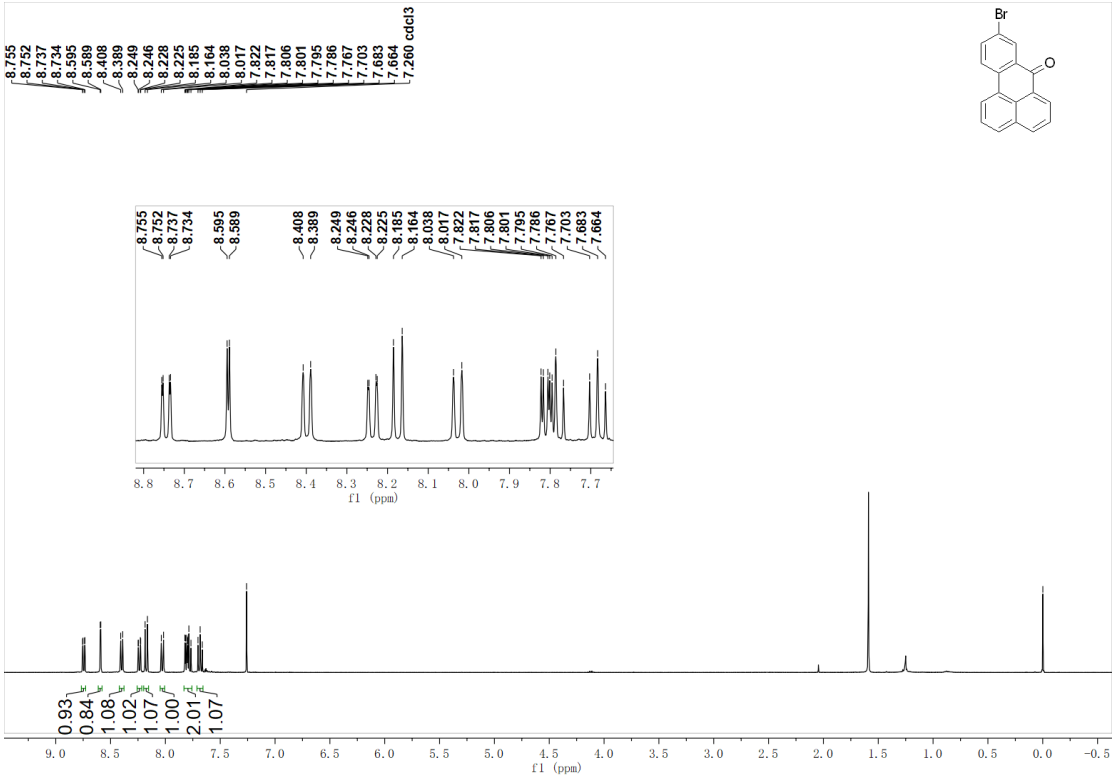
133.11
132.69
132.66
130.33
130.32
130.31
128.28
127.57
126.83
126.76
126.28
125.69
125.61
124.33
124.32
121.34
121.11
113.93
113.71
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
f1 (ppm)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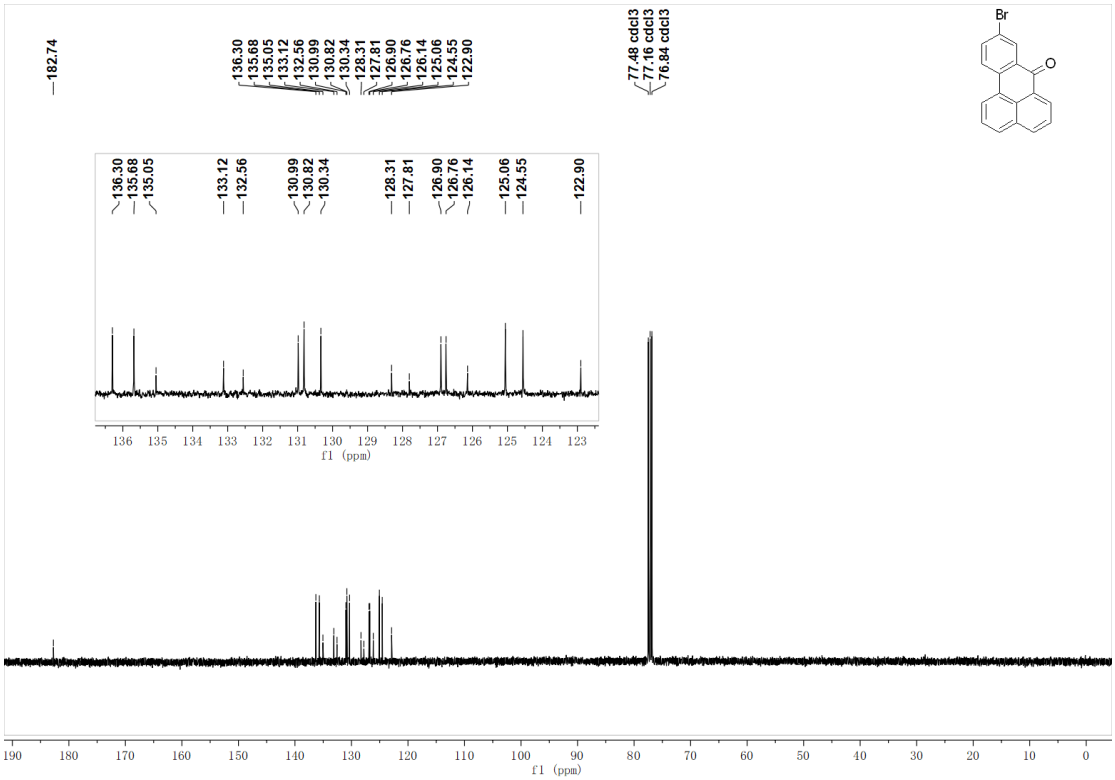
8.737
8.734
8.595
8.589
8.408
8.389
8.249
8.246
8.228
8.225
8.185
8.164
8.038
8.017
7.822
7.817
7.806
7.801
7.795
7.786
7.767
7.703
7.683
7.664
7.260 cdcl3
Br
O
0.93
0.84
1.08
1.02
1.07
1.00
2.01
1.07
f1 (ppm)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135.68
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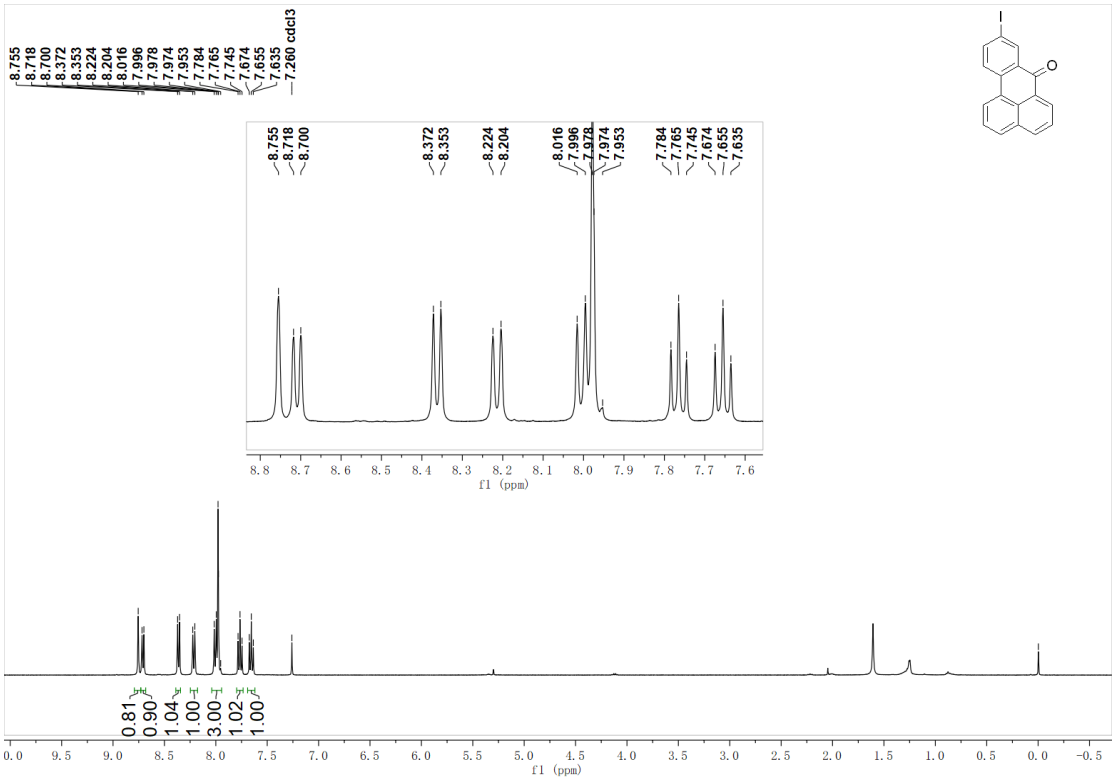
133.12
132.56
130.99
130.82
130.34
128.31
127.81
126.90
126.76
126.14
125.06
124.55
122.90
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
Br
O
f1 (ppm)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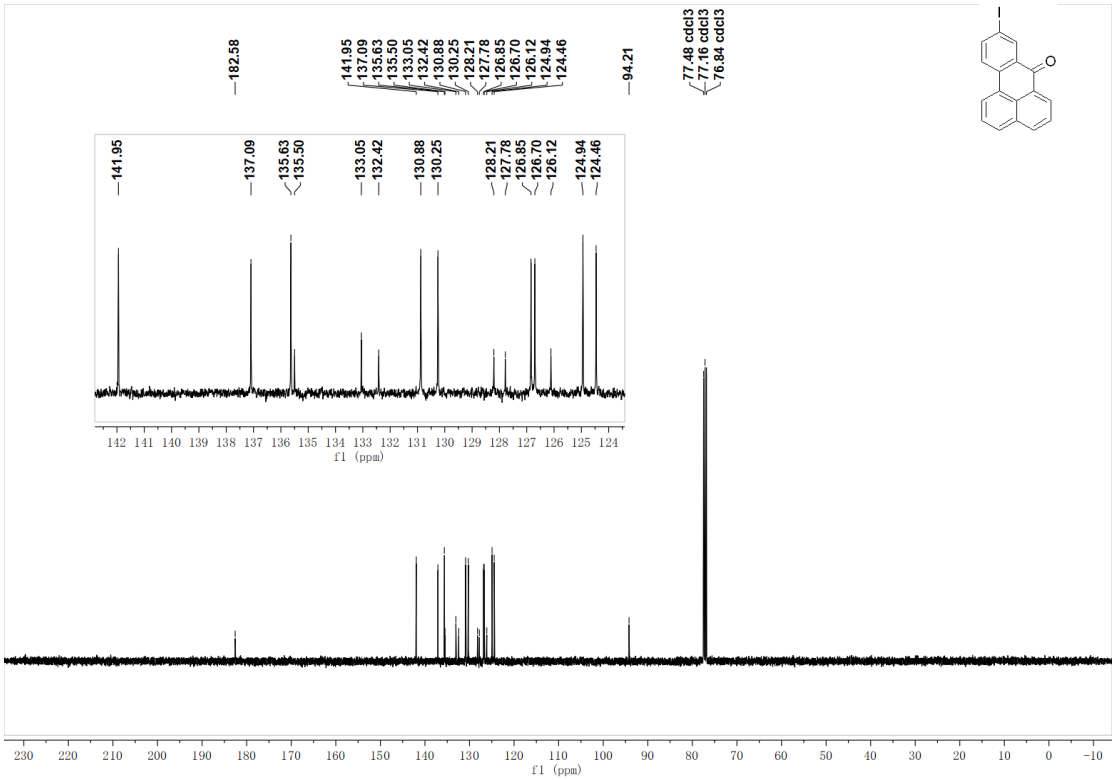
8.718
8.700
8.372
8.353
8.224
8.204
8.016
7.996
7.978
7.974
7.953
7.784
7.765
7.745
7.674
7.655
7.635
7.260 cdcl3
0.81
0.90
1.04
1.00
3.00
1.02
1.00
f1 (ppm)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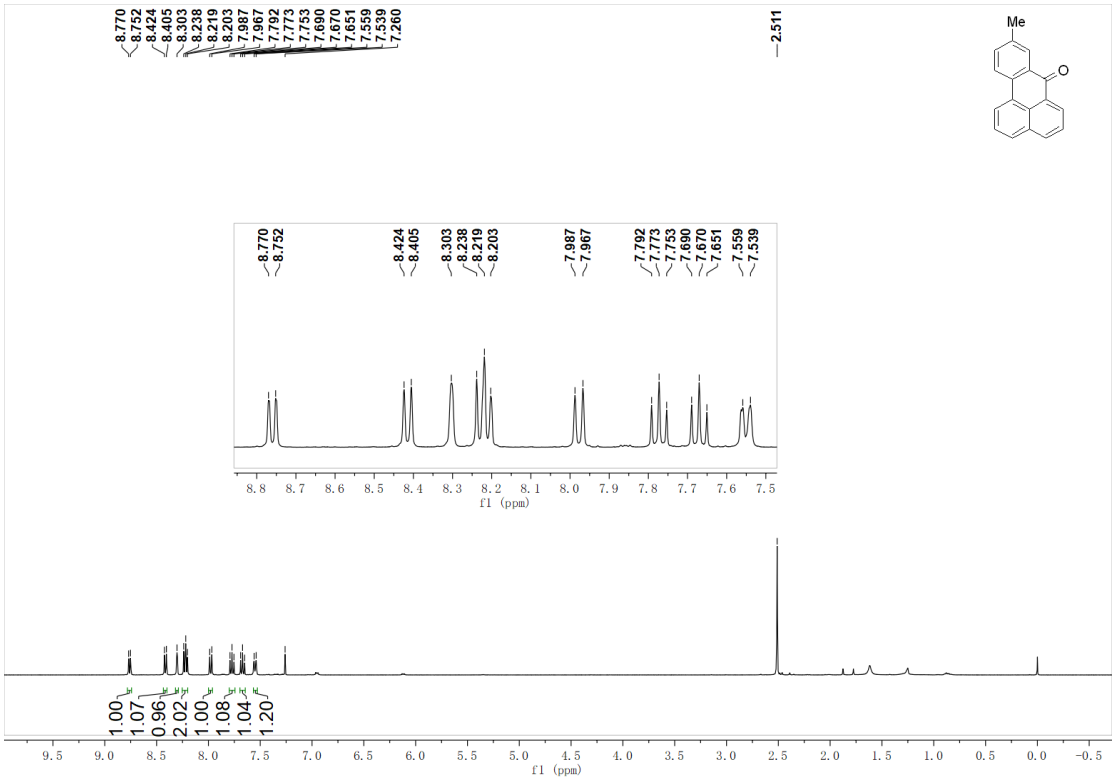
135.63
135.50
133.05
132.42
130.88
130.25
128.21
127.78
126.85
126.70
126.12
124.94
124.46
94.21
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
f1 (ppm)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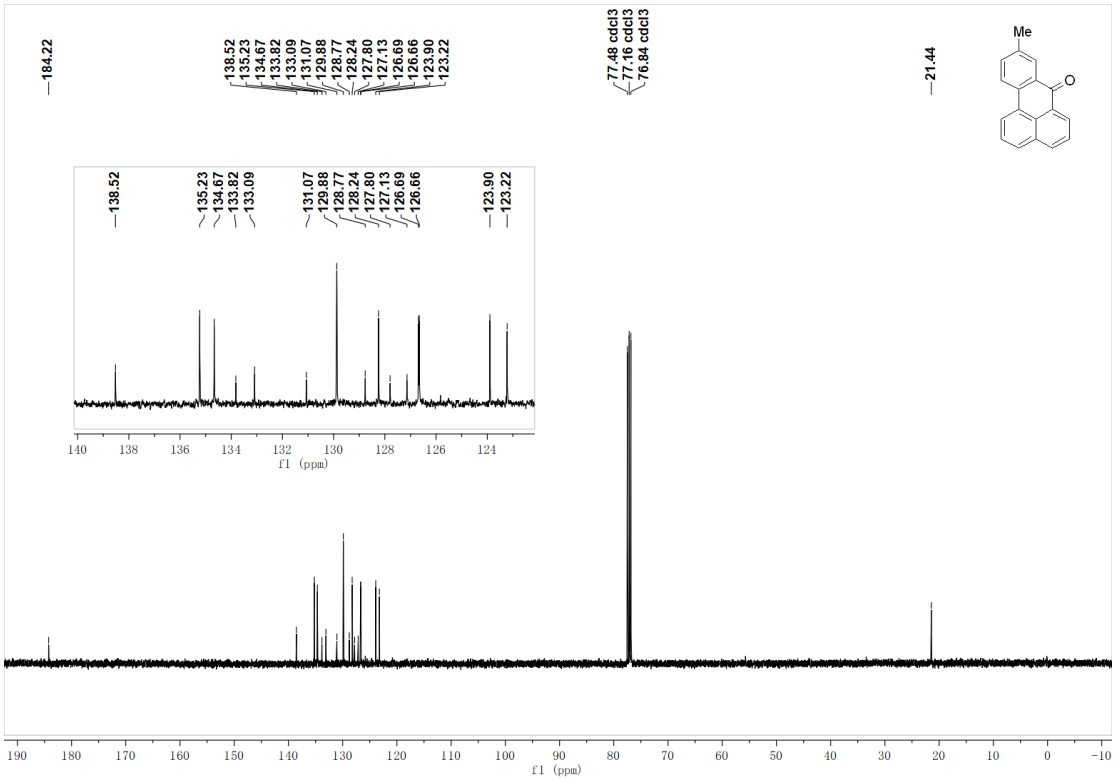
8.752
8.424
8.405
8.303
8.238
8.219
8.203
7.987
7.967
7.792
7.773
7.753
7.690
7.670
7.651
7.559
7.539
7.260
2.511
Me
O
1.00
1.07
0.96
2.02
1.00
1.08
1.04
1.20
f1 (ppm)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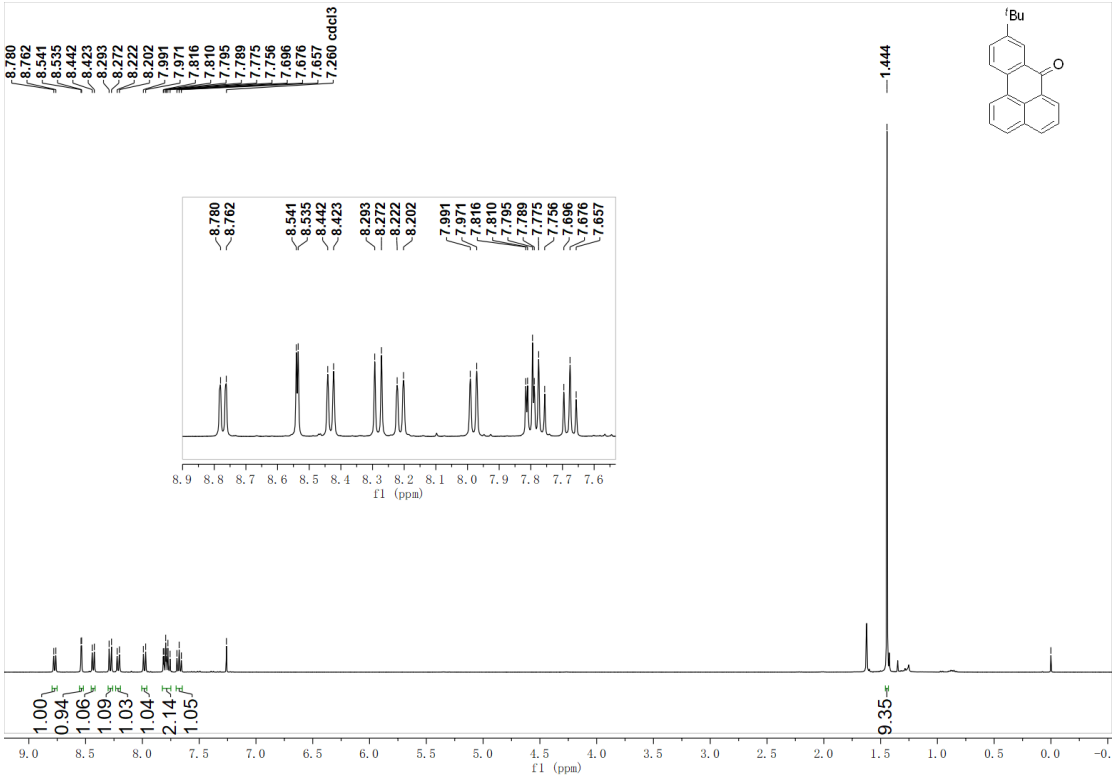
135.23
134.67
133.82
133.09
131.07
129.88
128.77
128.24
127.80
127.13
126.69
126.66
123.90
123.22
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
21.44
Me
O
f1 (ppm)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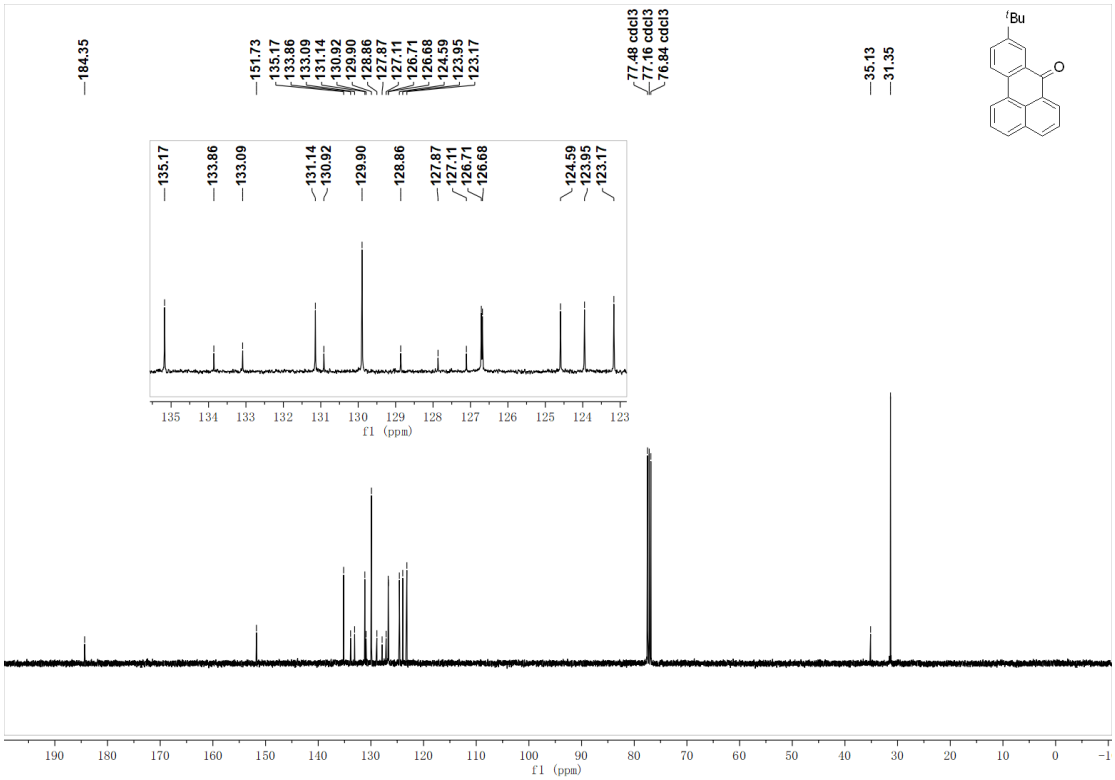
8.535
8.442
8.423
8.293
8.272
8.222
8.202
7.991
7.971
7.816
7.810
7.795
7.789
7.775
7.756
7.696
7.676
7.657
7.260 cdcl3
1.444
tBu
O
1.00
0.94
1.06
1.09
1.03
1.04
2.14
1.05
9.35
f1 (ppm)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135.17
133.86
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130.92
129.90
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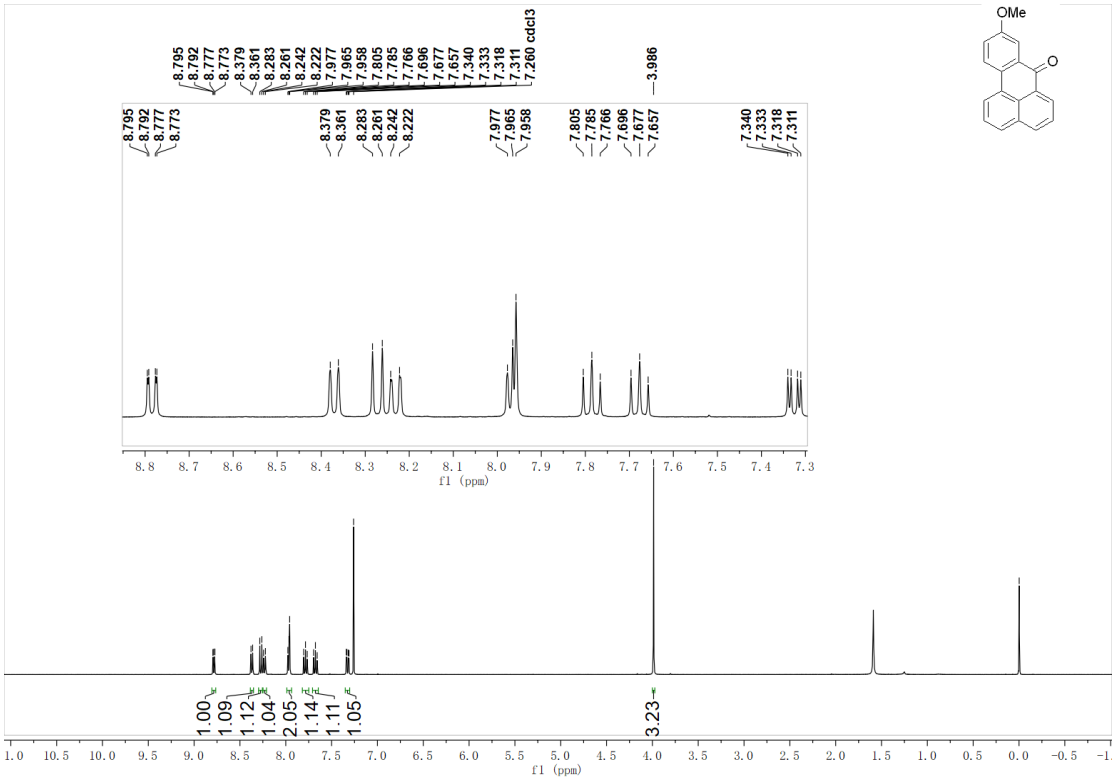
127.87
127.11
126.71
126.68
124.59
123.95
123.17
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
35.13
31.35
tBu
O
f1 (ppm)


OMe
O
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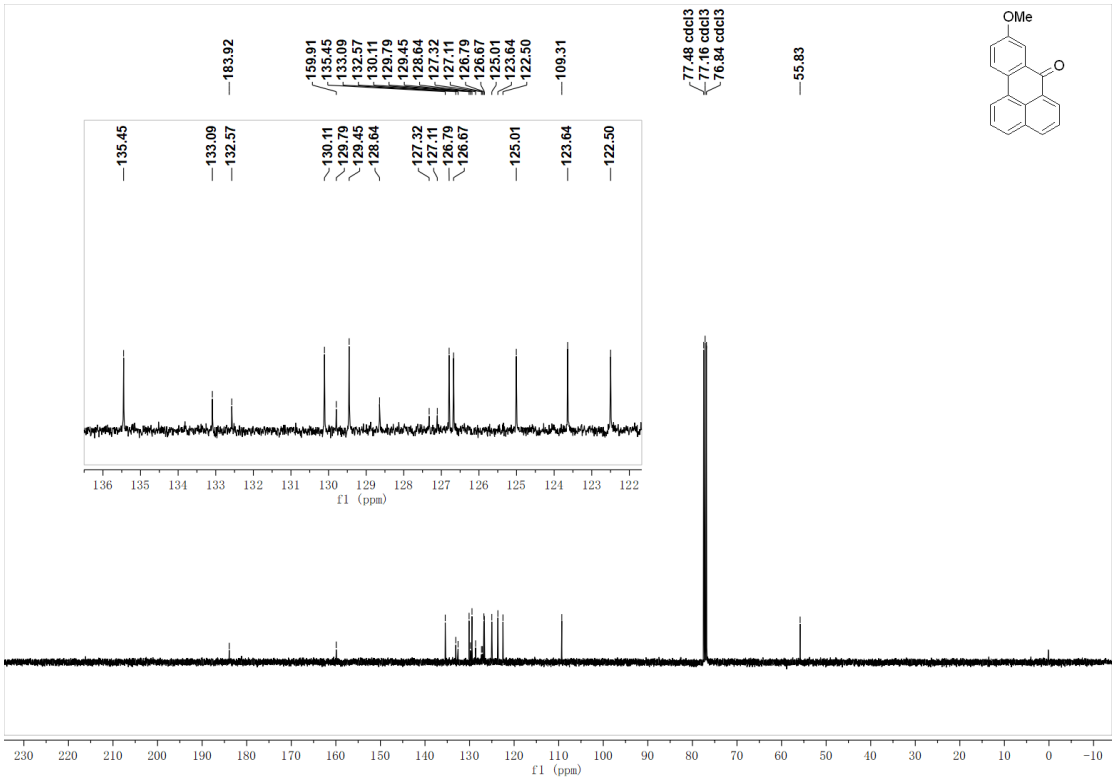
8.261
8.242
8.222
7.977
7.965
7.958
7.805
7.785
7.766
7.696
7.677
7.657
7.340
7.333
7.318
7.311
7.260 cdcl3
3.986
f1 (ppm)
1.00
1.09
1.12
1.04
2.05
1.14
1.11
1.05
3.23


OMe
O
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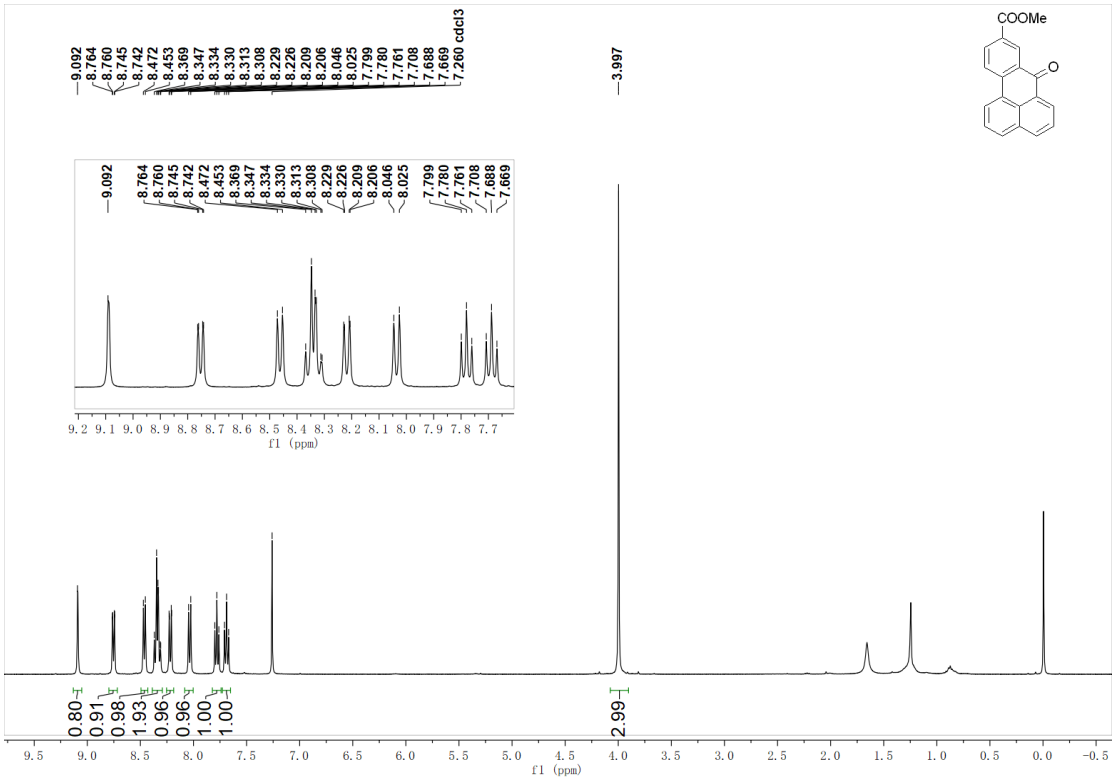
130.11
129.79
129.45
128.64
127.32
127.11
126.79
126.67
125.01
123.64
122.50
109.31
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
55.83
f1 (ppm)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8.742
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8.369
8.347
8.334
8.330
8.313
8.308
8.229
8.226
8.209
8.206
8.046
8.025
7.799
7.780
7.761
7.708
7.688
7.669
7.260 cdcl3
3.997
COOMe
O
f1 (ppm)
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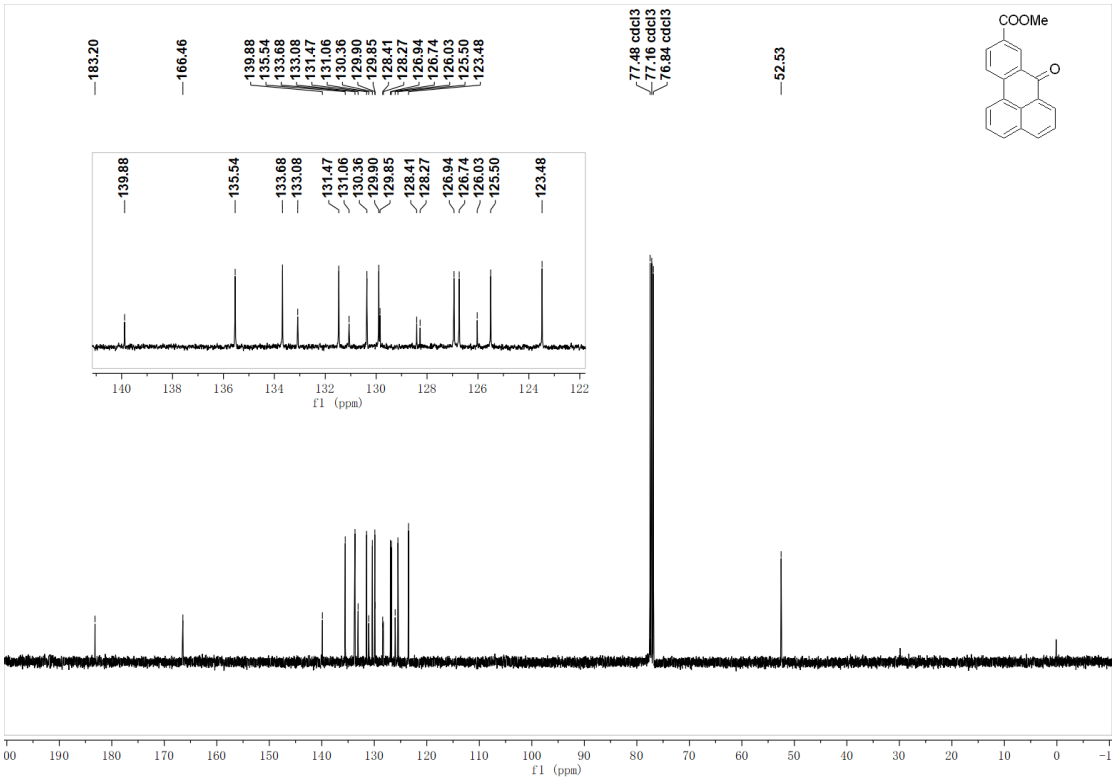
0.91
0.98
1.93
0.96
0.96
1.00
1.00
2.99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131.06
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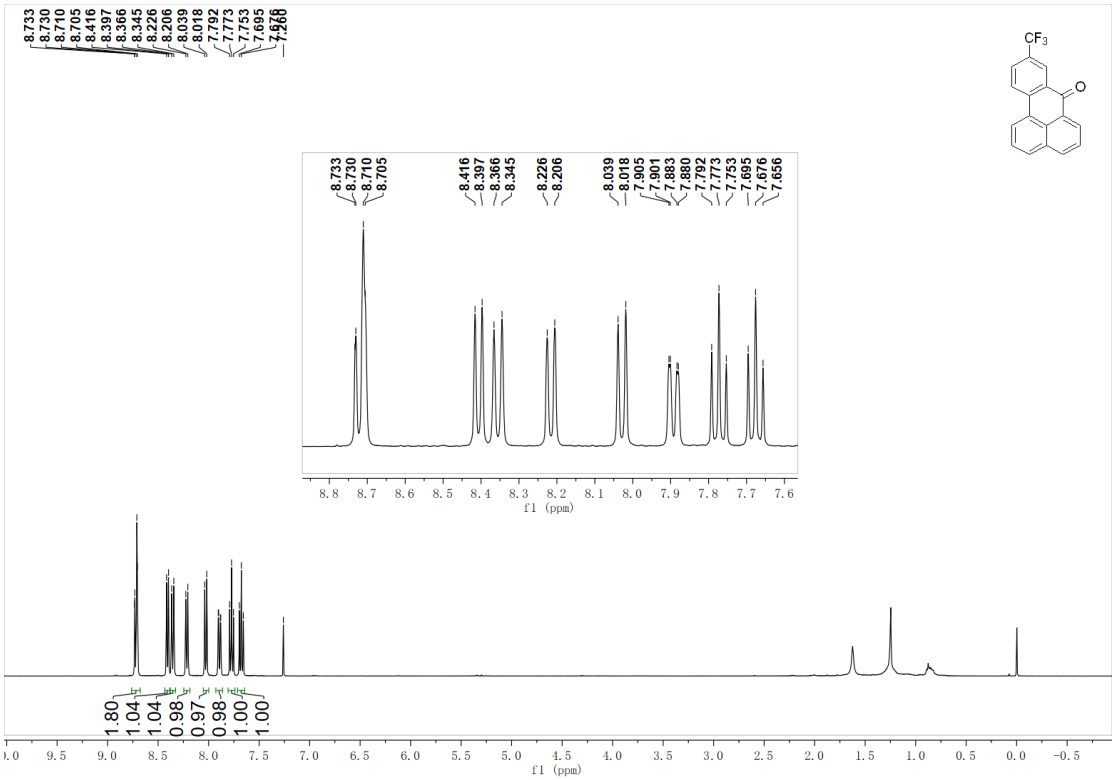
129.85
128.41
128.27
126.94
126.74
126.03
125.50
123.48
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
52.53
COOMe
O
f1 (ppm)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8.705
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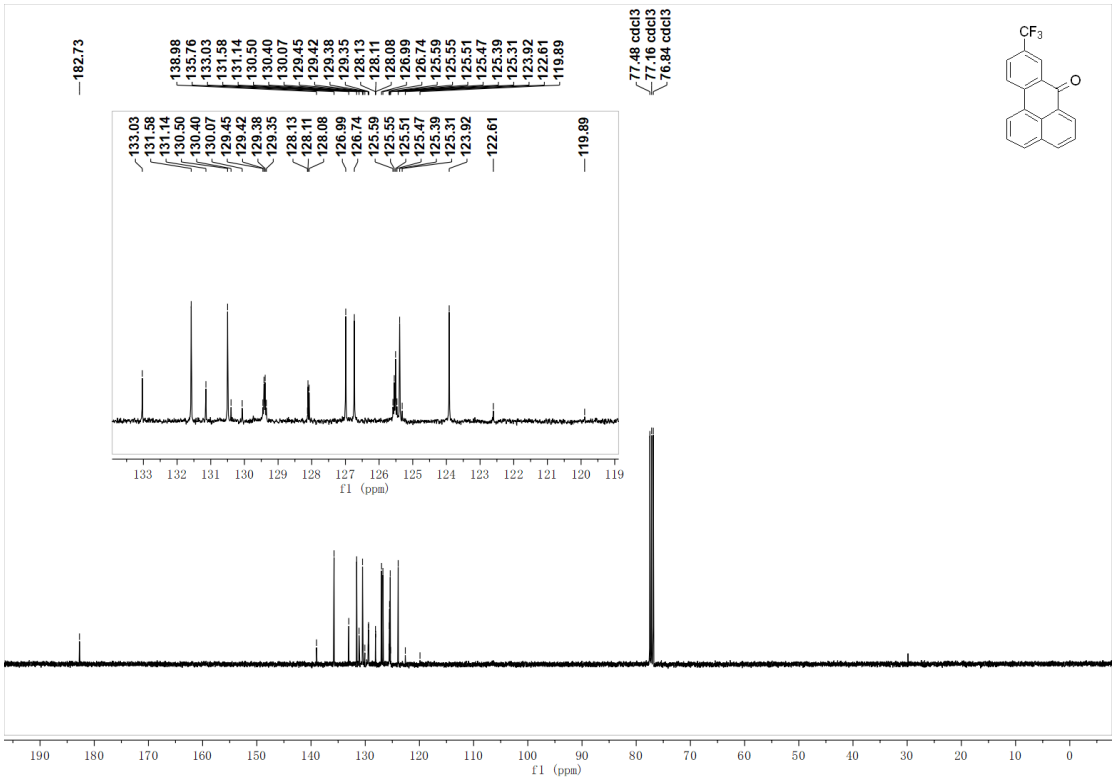
8.345
8.226
8.206
8.039
8.018
7.792
7.773
7.753
7.695
7.676
7.656
7.260
CF3
O
1.80
1.04
1.04
0.98
0.97
0.98
1.00
1.00
f1 (ppm)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130.40
130.07
129.45
129.42
129.38
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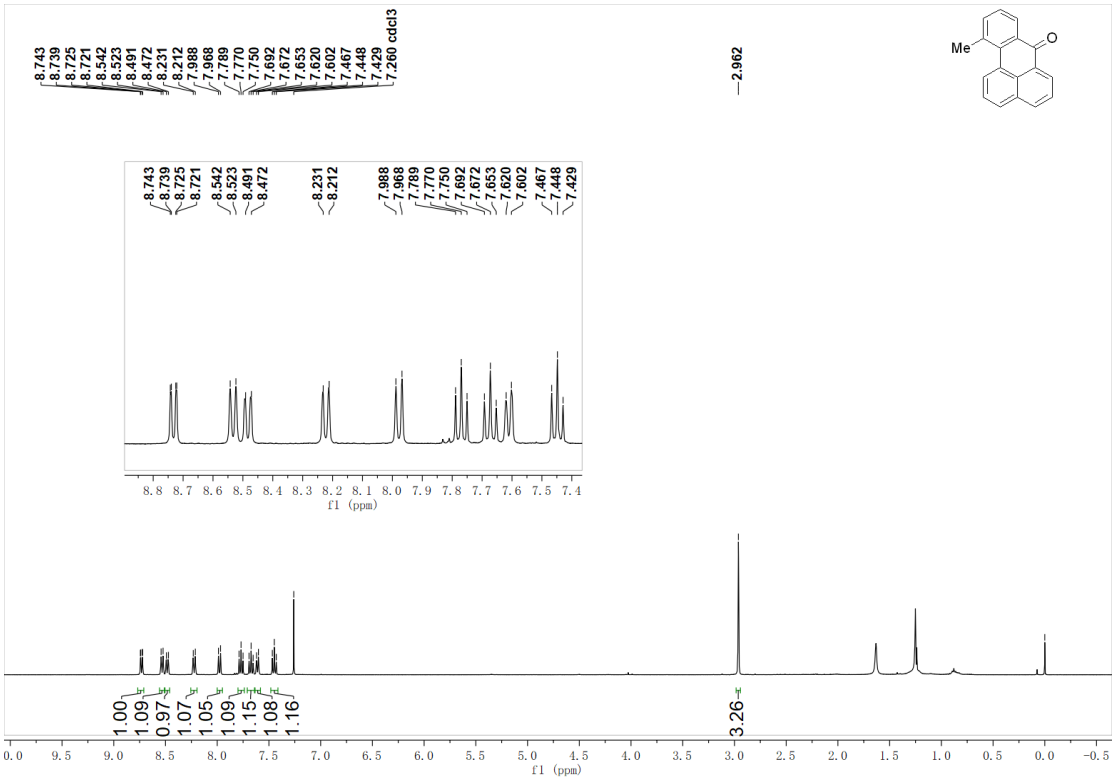
128.13
128.11
128.08
126.99
126.74
125.59
125.55
125.51
125.47
125.39
125.31
123.92
122.61
119.89
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
CF3
O
f1 (ppm)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8.725
8.721
8.542
8.523
8.491
8.472
8.231
8.212
7.988
7.968
7.789
7.770
7.750
7.692
7.672
7.653
7.620
7.602
7.467
7.448
7.429
7.260 cdcl3
2.962
Me
O
f1 (ppm)
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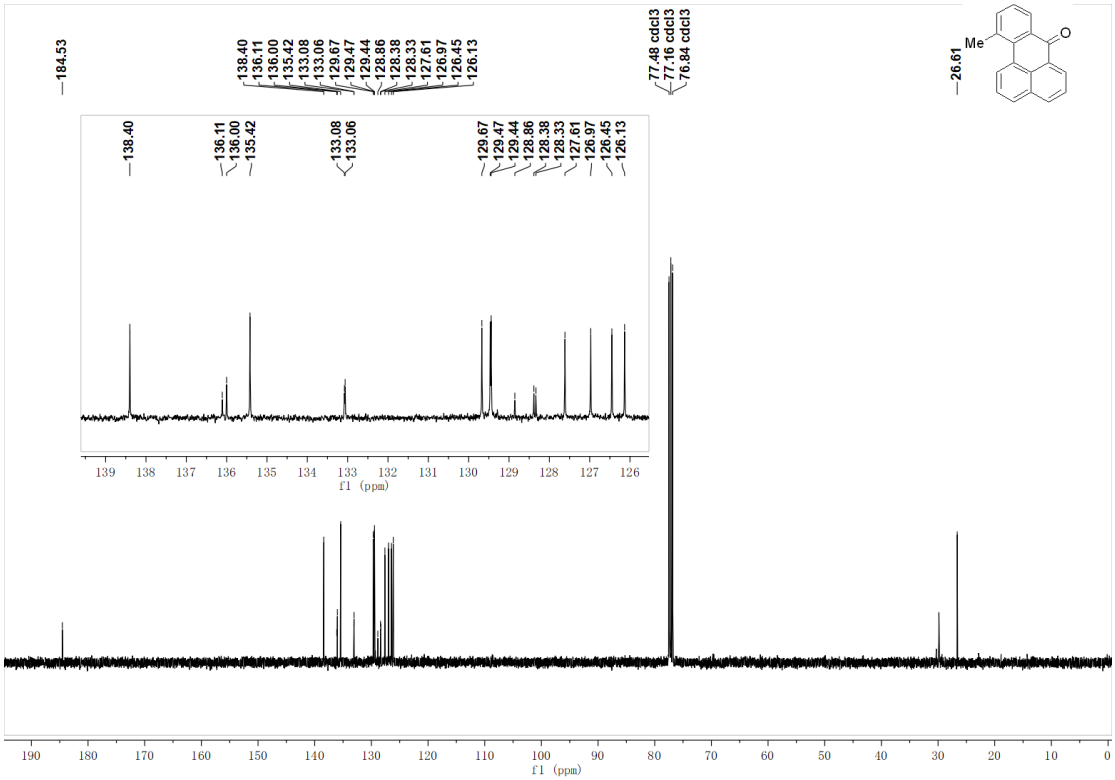
1.09
0.97
1.07
1.05
1.09
1.15
1.08
1.16
3.26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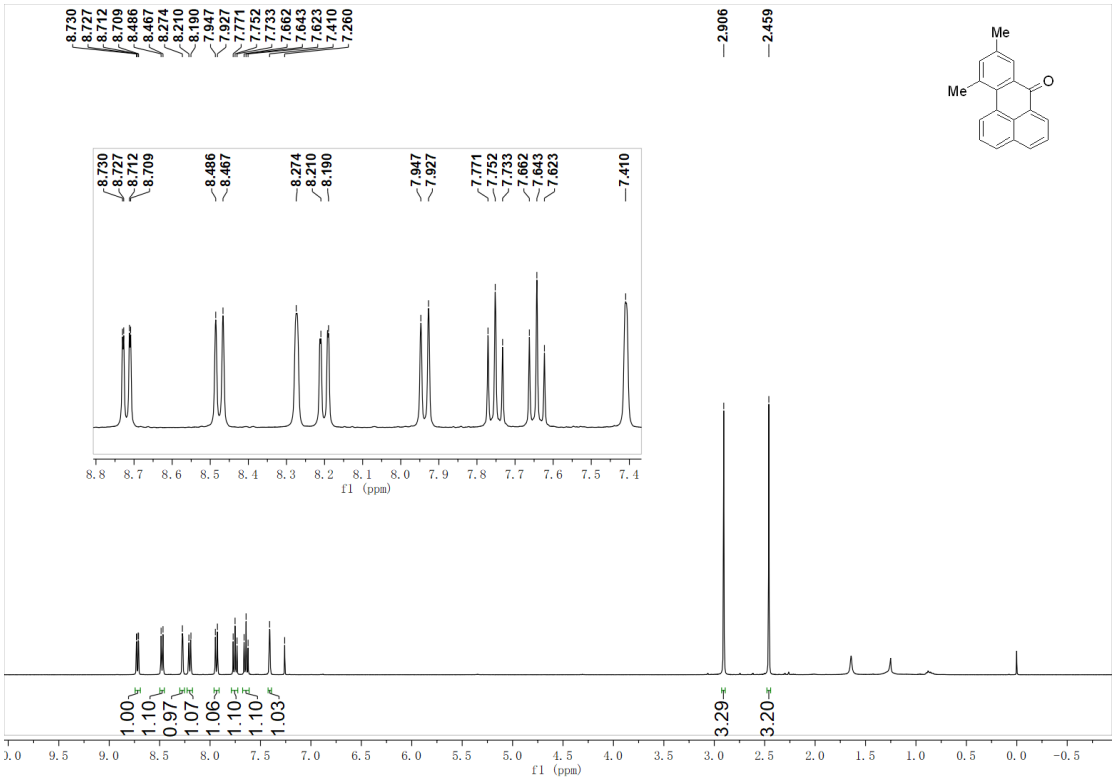
133.08
133.06
129.67
129.47
129.44
128.86
128.38
128.33
127.61
126.97
126.45
126.13
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
26.61
Me
O
f1 (ppm)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8.486
8.467
8.274
8.210
8.190
7.947
7.927
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7.752
7.733
7.662
7.643
7.623
7.410
7.260
2.906
2.459
Me
Me
O
f1 (ppm)
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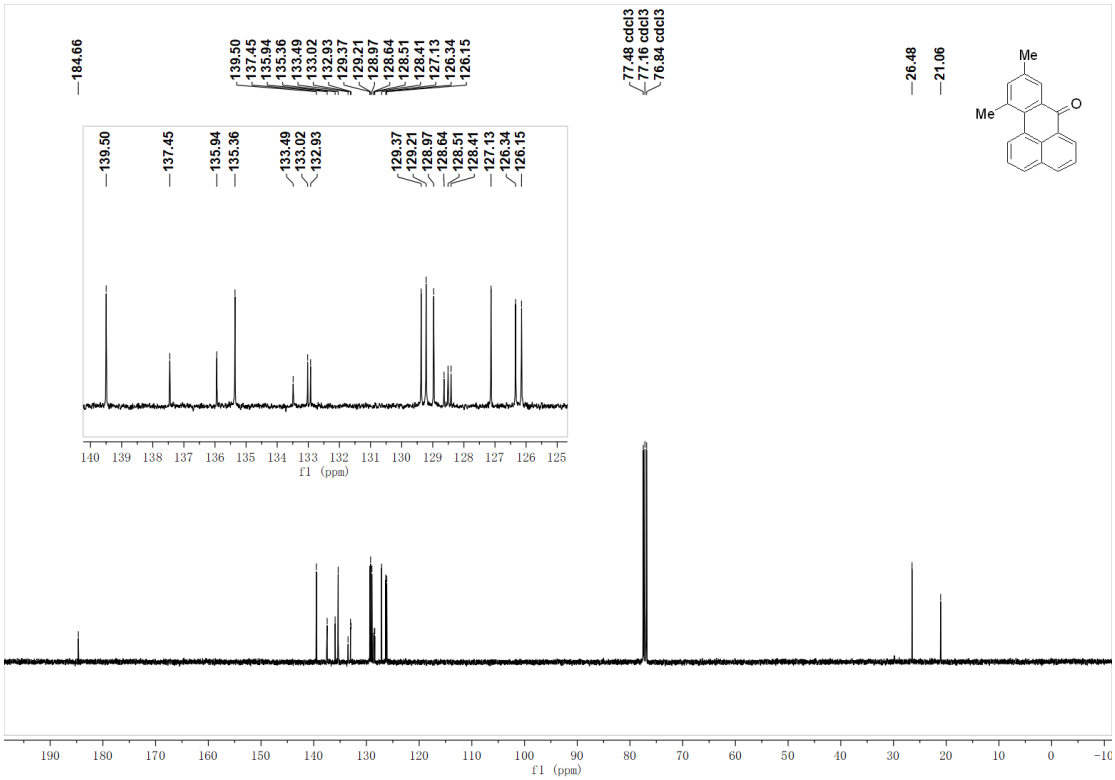
1.10
0.97
1.07
1.06
1.10
1.10
1.03
3.29
3.20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139.50
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135.94
135.36
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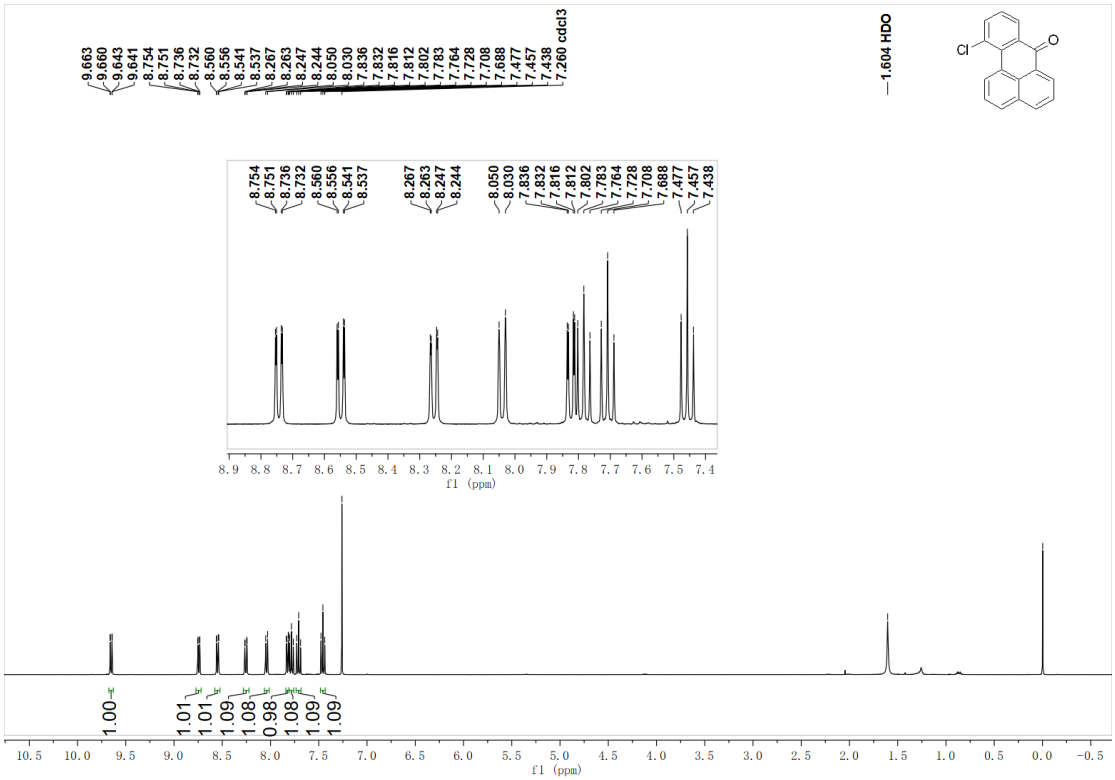
133.02
132.93
129.37
129.21
128.97
128.64
128.51
128.41
127.13
126.34
126.15
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
26.48
21.06
Me
Me
O
f1 (ppm)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9.660
9.643
9.641
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8.732
8.560
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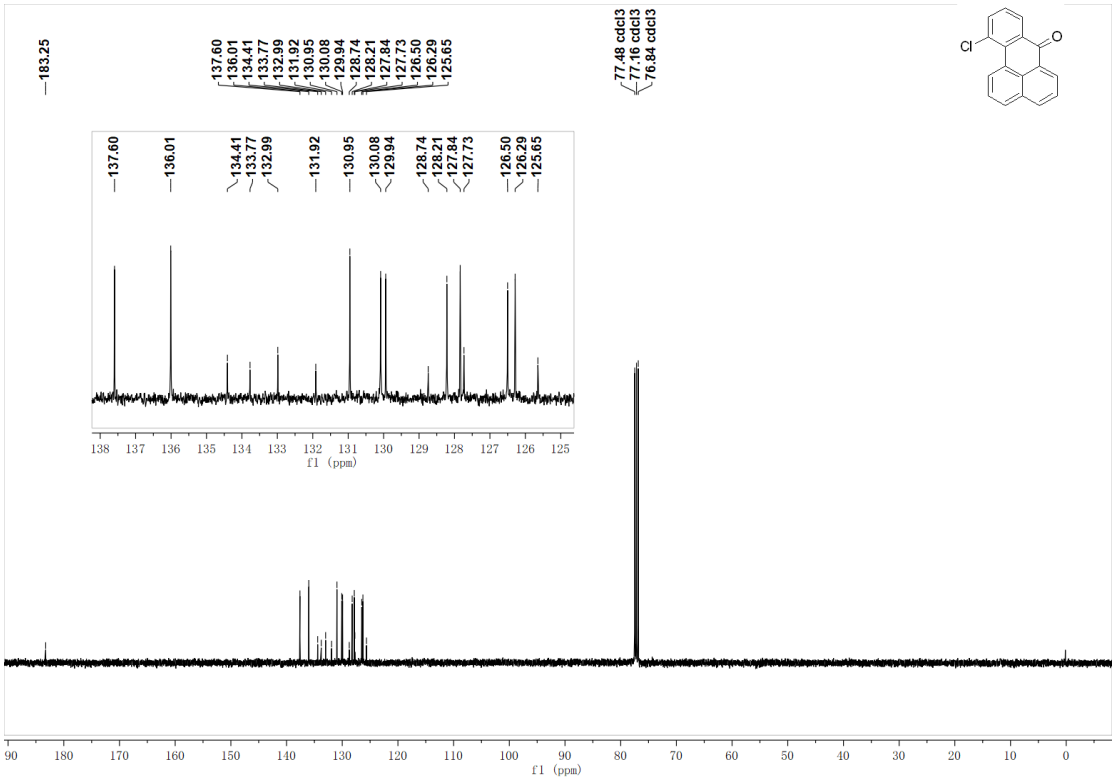
8.541
8.537
8.267
8.263
8.247
8.244
8.050
8.030
7.836
7.832
7.816
7.812
7.802
7.783
7.764
7.728
7.708
7.688
7.477
7.457
7.438
7.260 cdcl3
1.604 HDO
Cl
O
f1 (ppm)
1.00
1.01
1.01
1.09
1.08
0.98
1.08
1.09
1.09


183.25
137.60
136.01
134.41
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128.74
128.21
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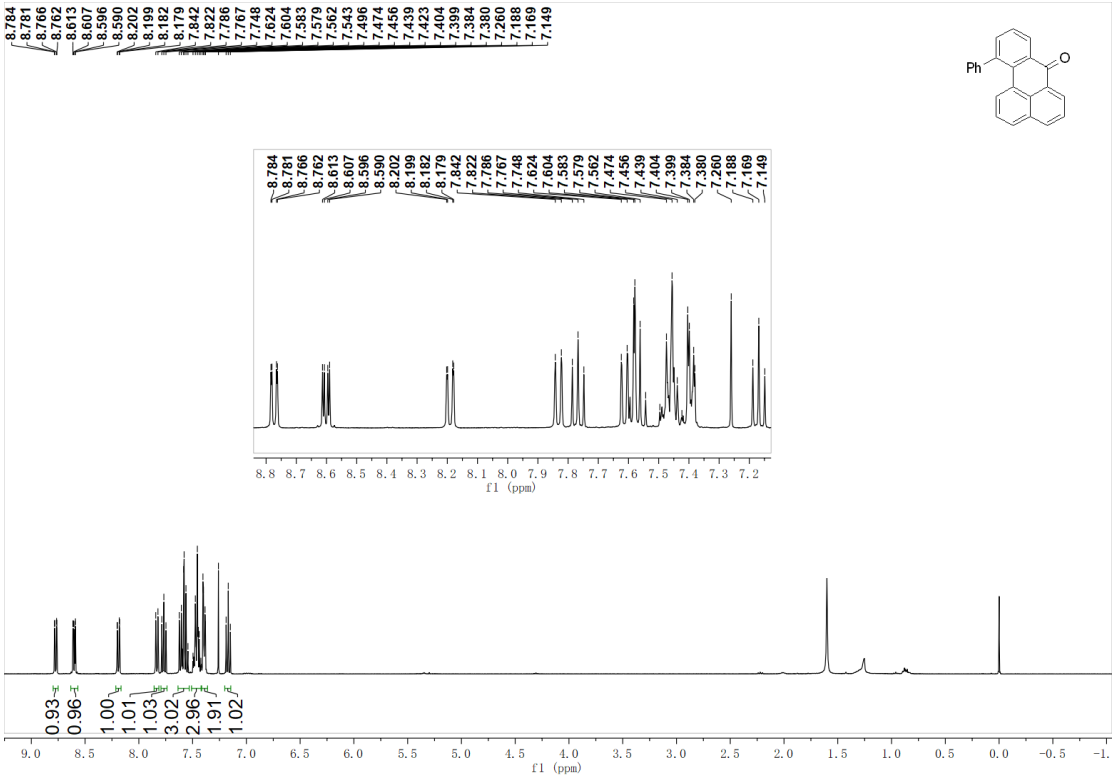
77.16 cdcl3
76.84 cdcl3
Cl
O
f1 (ppm)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8.607
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8.590
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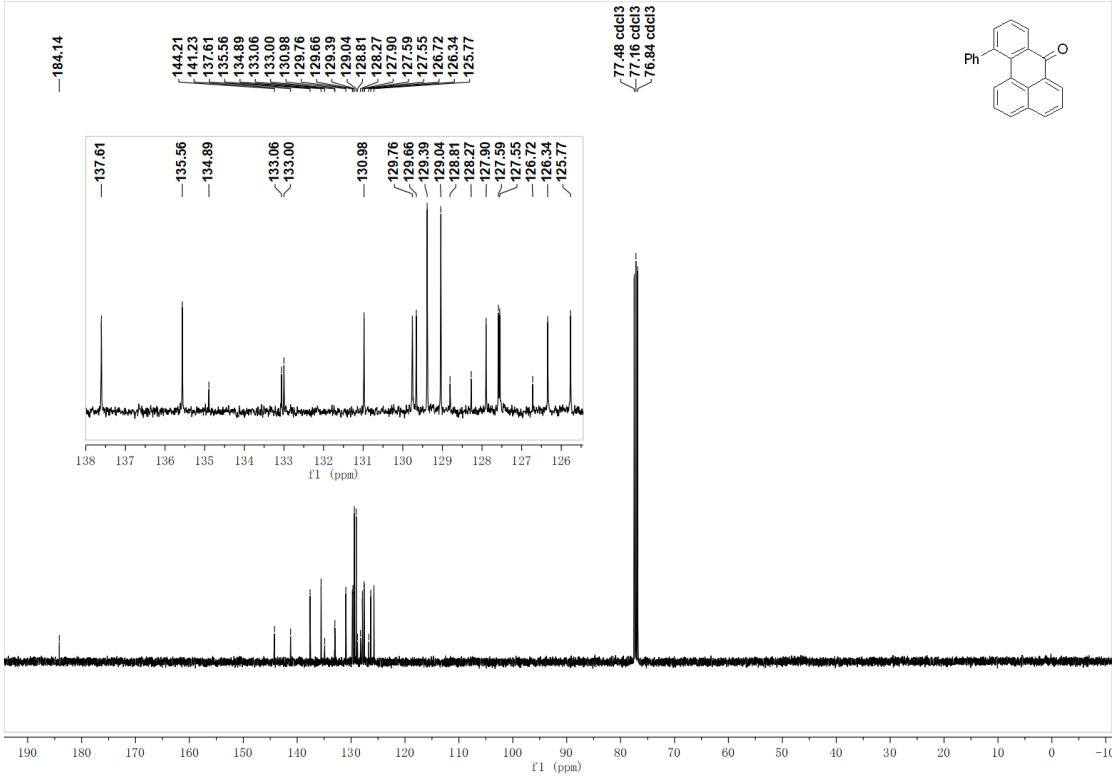
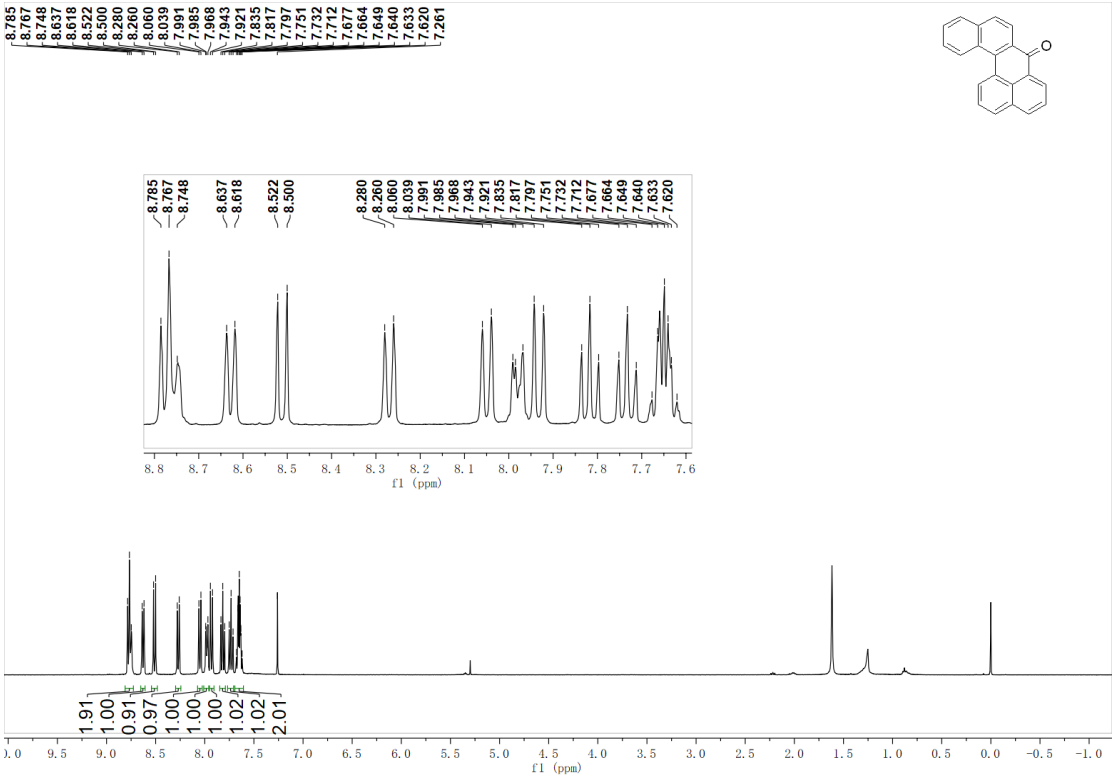
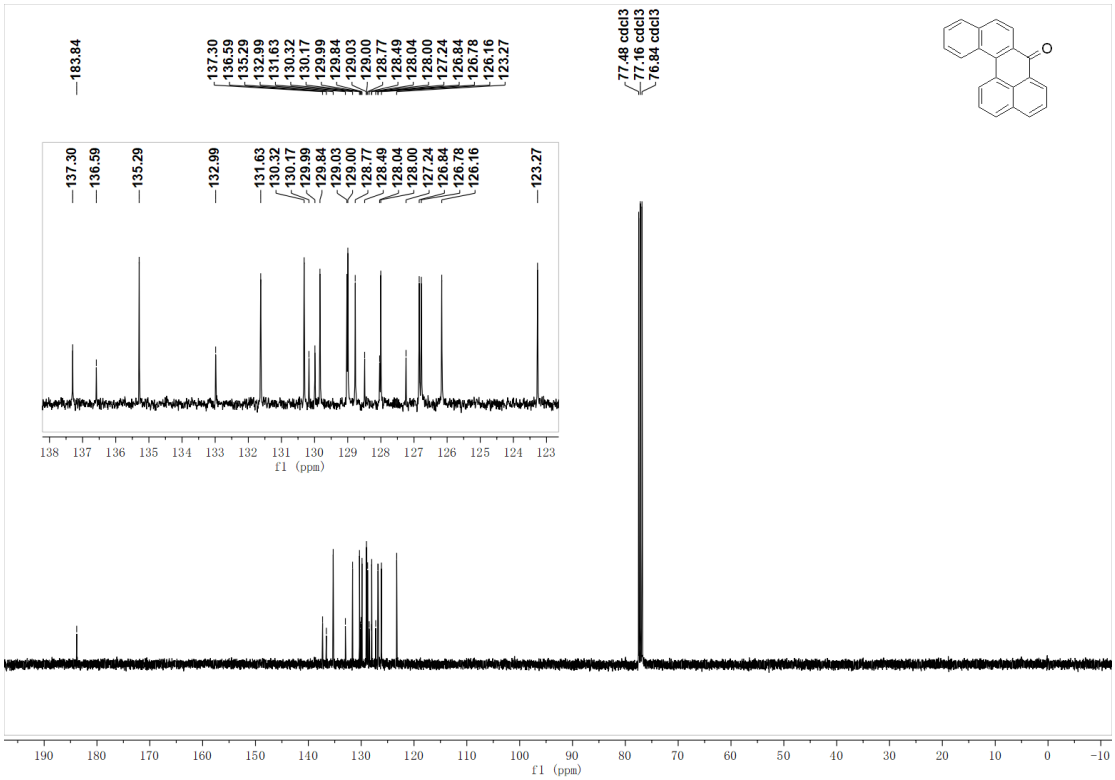
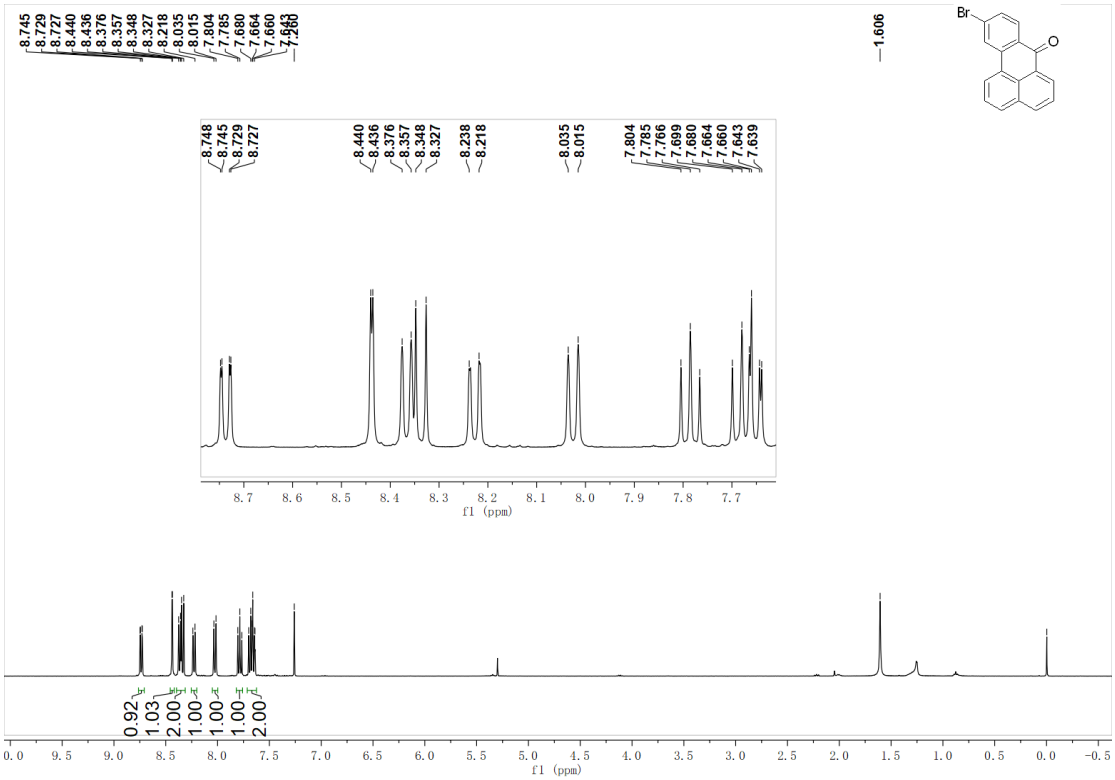
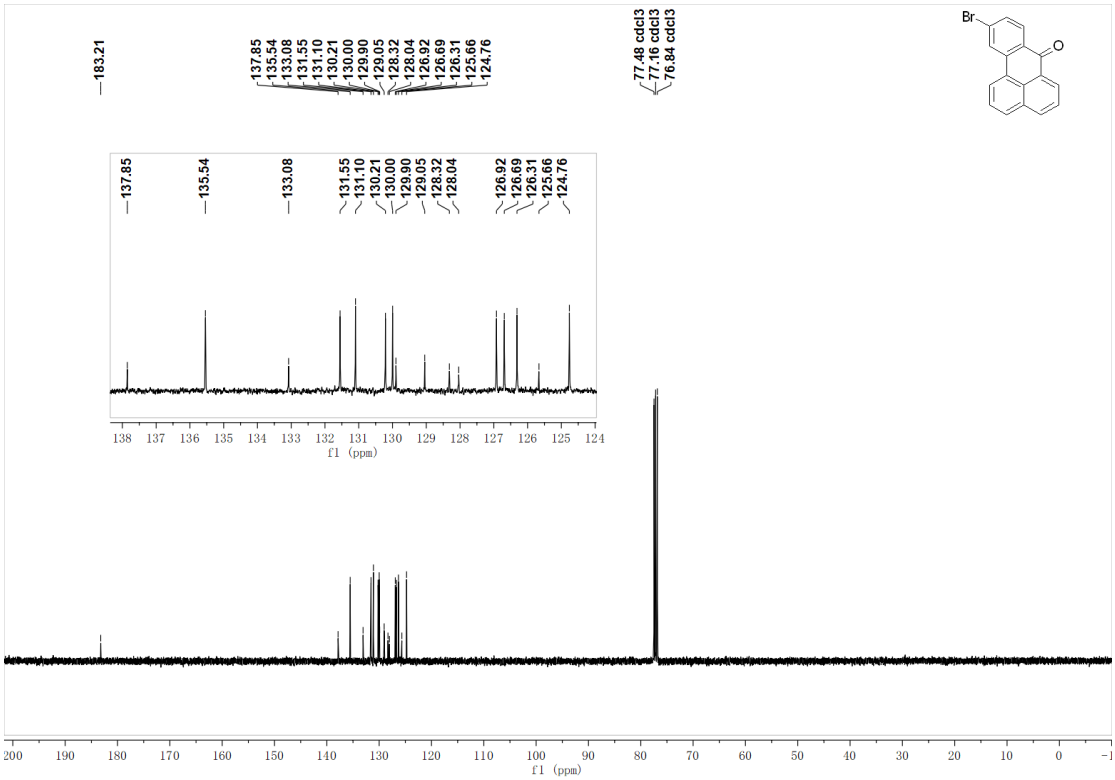
8.199
8.182
8.179
8.842
8.822
7.786
7.767
7.748
7.624
7.604
7.583
7.579
7.562
7.543
7.496
7.474
7.456
7.439
7.423
7.404
7.399
7.384
7.380
7.260
7.188
7.169
7.149
Ph
O
f1 (ppm)
0.93
0.96
1.00
1.01
1.03
3.02
2.96
1.91
1.02

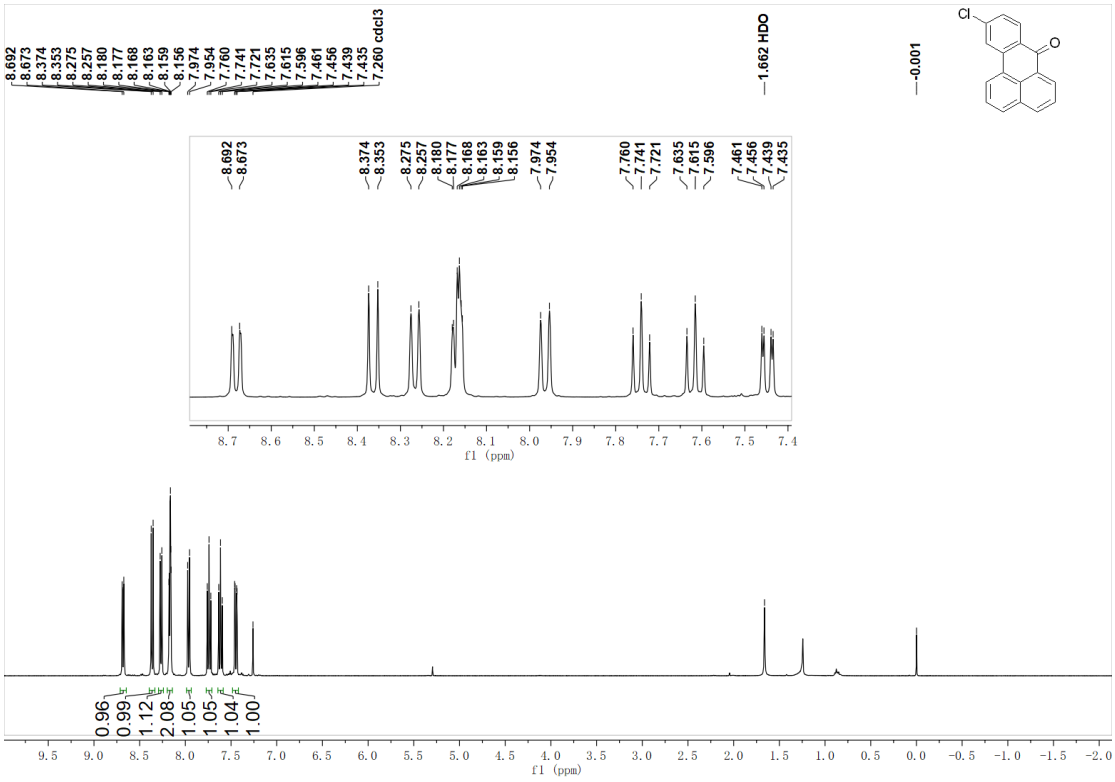

184.14
144.21
141.23
137.61
135.56
134.89
133.06
133.00
130.98
129.76
129.66
129.39
129.04
128.81
128.27
127.90
127.59
127.55
126.72
126.34
125.77
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
Ph
O
f1 (ppm)


8.785
8.767
8.748
8.637
8.618
8.522
8.500
8.280
8.260
8.060
8.039
7.991
7.985
7.968
7.943
7.921
7.835
7.817
7.797
7.751
7.732
7.712
7.677
7.664
7.649
7.640
7.633
7.620
7.261
1.91
1.00
0.91
0.97
1.00
1.00
1.00
1.02
1.02
2.01
f1 (ppm)


183.84
137.30
136.59
135.29
132.99
131.63
130.32
130.17
129.99
129.84
129.03
129.00
128.77
128.49
128.04
128.00
127.24
126.84
126.78
126.16
123.27
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
f1 (ppm)


8.745
8.729
8.727
8.440
8.436
8.376
8.357
8.348
8.327
8.218
8.035
8.015
7.804
7.785
7.680
7.664
7.660
1.606
Br
O
8.748
8.745
8.729
8.727
8.440
8.436
8.376
8.357
8.348
8.327
8.238
8.218
8.035
8.015
7.804
7.785
7.766
7.699
7.680
7.664
7.660
7.643
7.639
f1 (ppm)
0.92
1.03
2.00
1.00
1.00
1.00
2.00
f1 (ppm)


183.21
137.85
135.54
133.08
131.55
131.10
130.21
130.00
129.90
129.05
128.32
128.04
126.92
126.69
126.31
125.66
124.76
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
Br
O
f1 (ppm)
f1 (ppm)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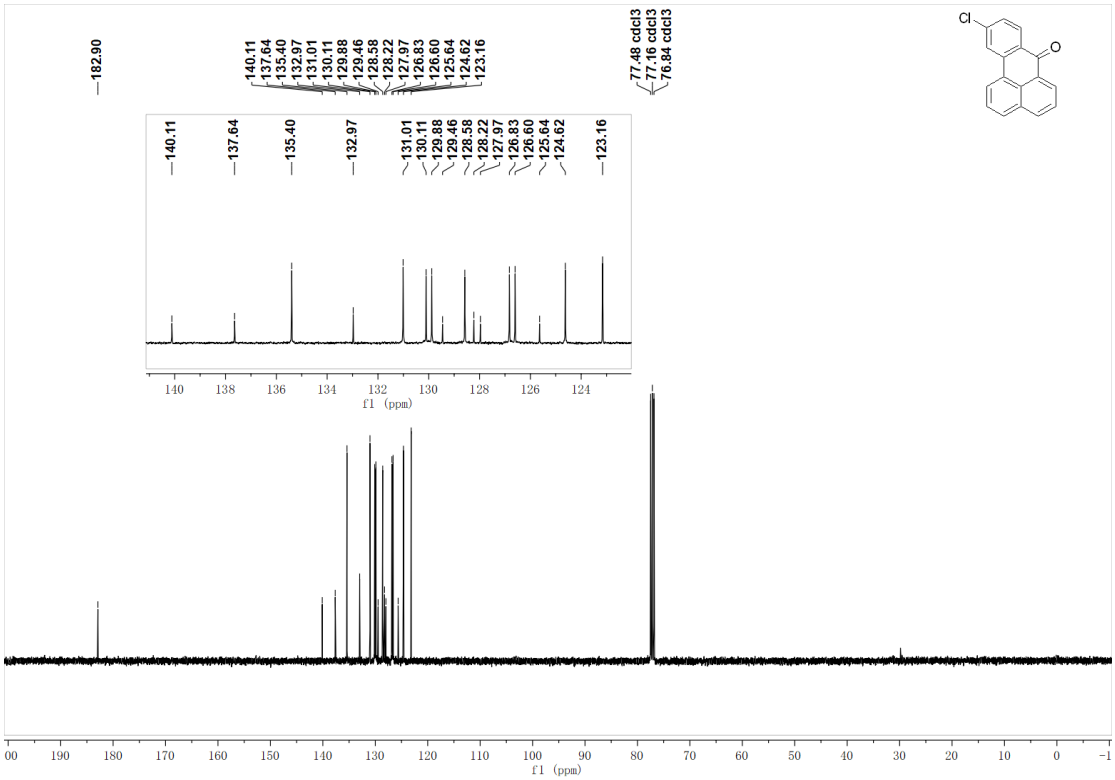
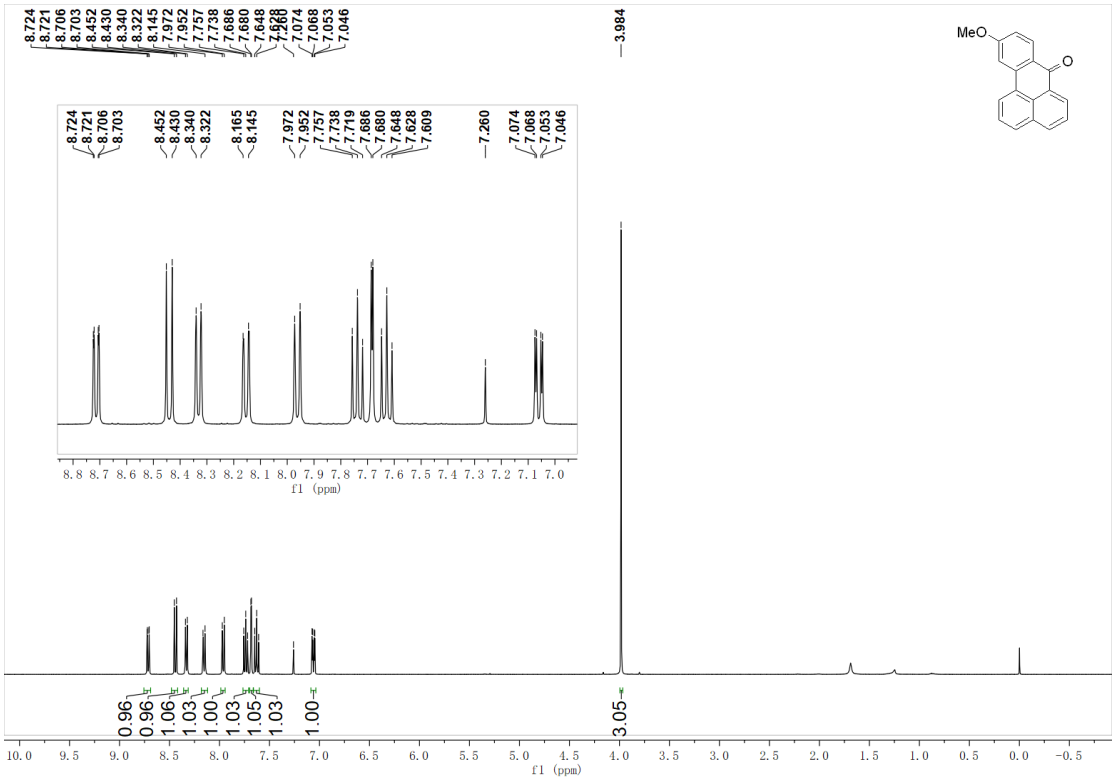
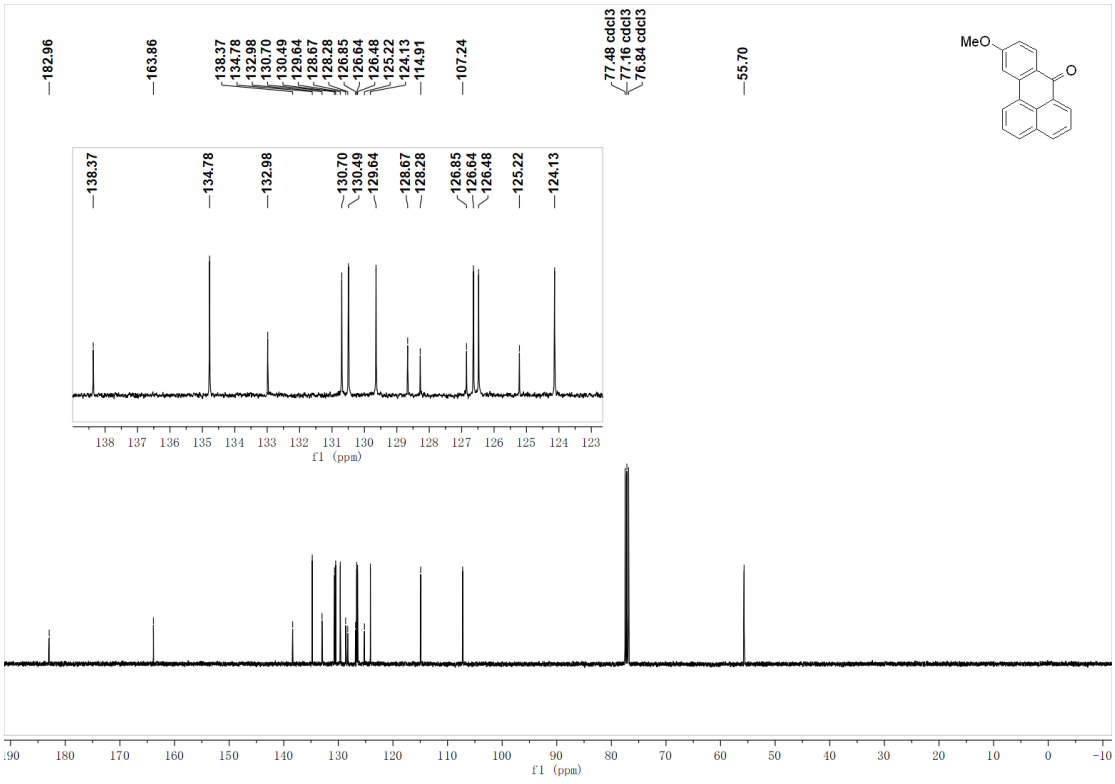
8.673
8.374
8.353
8.275
8.257
8.180
8.177
8.168
8.163
8.159
8.156
7.974
7.954
7.760
7.741
7.721
7.635
7.615
7.596
7.461
7.456
7.439
7.435
7.260 cdcl3
1.662 HDO
-0.001
Cl
O
f1 (ppm)
0.96
0.99
1.12
2.08
1.05
1.05
1.04
1.00


182.90
140.11
137.64
135.40
132.97
131.01
130.11
129.88
129.46
128.58
128.22
127.97
126.83
126.60
125.64
124.62
123.16
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
Cl
O
f1 (ppm)


8.724
8.721
8.706
8.703
8.452
8.430
8.340
8.322
8.145
7.972
7.952
7.757
7.738
7.686
7.680
7.648
7.628
7.609
7.260
7.074
7.068
7.053
7.046
3.984
MeO
O
f1 (ppm)
0.96
0.96
1.06
1.03
1.00
1.03
1.05
1.03
1.00
3.05


182.96
163.86
138.37
134.78
132.98
130.70
130.49
129.64
128.67
128.28
126.85
126.64
126.48
125.22
124.13
114.91
107.24
77.48 cdcl3
77.16 cdcl3
76.84 cdcl3
55.70
MeO
O
f1 (ppm)