Electronic Supplementary Material (ESI) for ChemComm.

Highly regioselectively *meta* arylation of oxalyl amide-protected β-arylethylamine via catellani reaction

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Supporting Information

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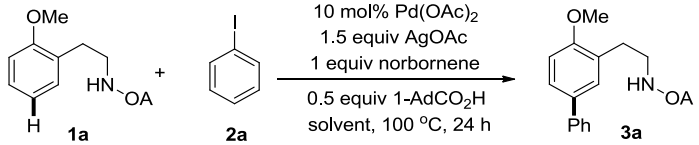
1. Reagents: Unless otherwise noted, all reagents were purchased from Acros, Alfa, Adamas and used without further purification. Column chromatography purifications were performed using 300–400 mesh silica gel.

2. Instruments: NMR spectra were recorded on Varian Inova-400 MHz, Inova-300 MHz, Bruker DRX-400 or Bruker DRX-500 instruments and calibrated using residual solvent peaks as internal reference. Multiplicities are recorded as: s = singlet, d = doublet, t = triplet, dd = doublet of doublets, br s= broad singlet, m = multiplet. HRMS analysis were carried out using TOF-MS instrument with EI source.

3. Optimization of reaction conditions

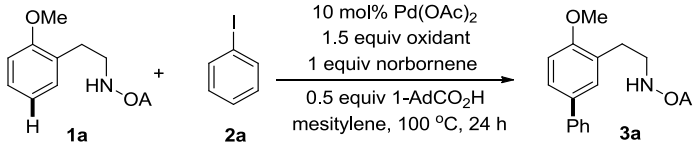
Table S1. Screening of solvent[a]



Entry	Solvent	Yield (%)[b]
1	DCE	36
2	t-AmylOH	10
3	HFIP	7
4	toluene	65
5	m-xylene	78
6	mesitylene	86
7	PhCl	75
8	1,4-dioxane	78

[a]**1a** (0.1 mmol), **2a** (0.3 mmol), $Pd(OAc)_2$ (10 mol%), AgOAc (0.15 mmol), norbornene (0.1 mmol), 1-$AdCO_2H$ (0.05 mmol), solvent (0.5 mL), 100 °C, 24 h. [b]Yields were based on LC-MS analysis using biphenyl as an internal standard.

Table S2. Screening of oxidant[a]

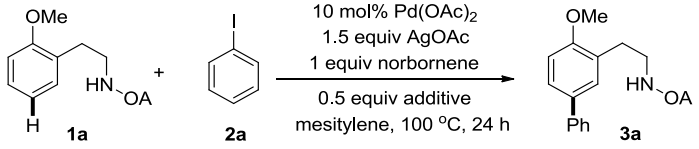


Entry	Oxidant	Yield (%)[b]
1	Ag_2CO_3	0
2	Ag_2O	79
3	AgOPiv	68
4	AgF	24
5	AgCl	0
6	$AgNO_3$	0

7	AgOTs	0
8	AgOTf	0
9	AgOAc (1 equiv)	62
10	AgOAc (1.5 equiv)	86
11	AgOAc (2 equiv)	80
12	BQ	0
13	$Cu(OAc)_2$	0
14	$K_2S_2O_8$	0

[a]**1a** (0.1 mmol), **2a** (0.3 mmol), $Pd(OAc)_2$ (10 mol%), oxidant (0.15 mmol), norbornene (0.1 mmol), 1-$AdCO_2H$ (0.05 mmol), mesitylene (0.5 mL), 100 ^oC, 24 h. [b]Yields were based on LC-MS analysis using biphenyl as an internal standard.

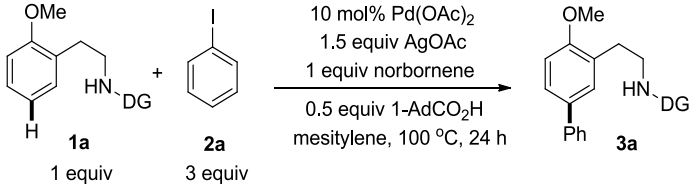
Table S3. Screening of additive[a]

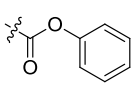
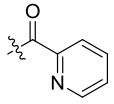
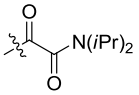


Entry	Additive	Yield (%)[b]
1	none	75
2	1-$AdCO_2H$	86
3	PivOH	79
4	$PhCO_2H$	65
5	$(n\text{-}BuO)_2PO_2H$	73
6	HOAc	52
7	Ac-Gly-OH	75
8	K_2CO_3	0
9	PivONa	78

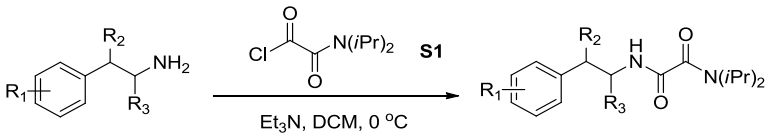
[a]**1a** (0.1 mmol), **2a** (0.3 mmol), $Pd(OAc)_2$ (10 mol%), AgOAc (0.15 mmol), norbornene (0.1 mmol), additive (0.05 mmol), mesitylene (0.5 mL), 100 ^oC, 24 h. [b]Yields were based on LC-MS analysis using biphenyl as an internal standard.

Table S4. Screening of directing group



DG:					
Yield	0	0	0	0	86%

4. Preparation of substrates

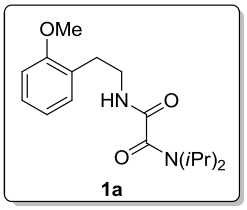


4.1. Preparation of N, N–Diisopropyloxamoyl chloride S1[1]

A solution of Diisopropylamine (7.01 mL, 50 mmol, 1.0 eq) in CH_2Cl_2 (50 mL) was added dropwise to a solution of oxalyl chloride (6.44 ml, 75 mmol, 1.5 eq) in CH_2Cl_2 (100 mL) at 0 ℃, after stirring for 5 min, triethylamine (7.30 mL, 52.5 mmol, 1.05 eq) was added dropwise. The solution was warmed to room temperature and stirred for 6 hours. The excess of oxalyl chloride and the solvent were removed under reduce pressure and CH_2Cl_2 (30 mL) was added and evaporated. This operation was performed twice to give **S1** as a pale yellow solid. The crude product was used in the next step without any purification.

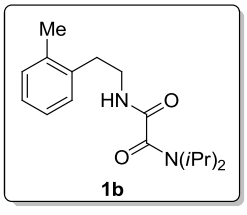
4.2. General procedures for the preparation of oxalamide substrates

A solution of amine (20 mmol, 1.0 eq) in CH_2Cl_2 (40 mL) was added dropwise to a solution of N,N–Diisopropyloxamoyl chloride **S1** (25 mmol, 1.25 eq) in CH_2Cl_2 (50 mL) at 0 ℃, after stirring for 5 min, triethylamine (2.92 mL, 21 mmol, 1.05 eq) was added dropwise and then the mixture was stirred for 6 hours at room temperature before quenched by water (50 mL). The organic layer was separated and the aqueous layer was extracted with CH_2Cl_2 (20 mL × 2). The combined organic phase was washed with brine (30 mL), and then dried over anhydrous Na_2SO_4. Evaporation and column chromatography on silica gel afforded corresponding amide substrates as white solid or colourless oil with >80% yield.



1a

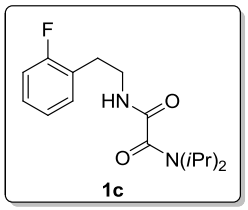
White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22–7.18 (m, 1H), 7.14–7.12 (m, 2H), 6.87 (dd, *J* = 17.7, 7.9 Hz, 2H), 4.64–4.57 (m, 1H), 3.82 (s, 3H), 3.53–3.43 (m, 3H), 2.86 (t, *J* = 6.9 Hz, 2H), 1.39 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.40, 156.56, 129.60, 126.95, 126.13, 119.65, 109.35, 54.26, 48.60, 45.39, 38.59, 29.10, 19.88, 19.08; IR ν 3265, 2966, 2935, 2882, 1667, 1616, 1542, 1510, 1486, 1459, 1447, 1437, 1390, 1367, 1350, 1280, 1247, 1236, 1197, 1159, 1137, 1061, 1042, 1020, 874, 823, 777, 759, 742, 693, 681, 632, 613 cm^{-1}.



1b

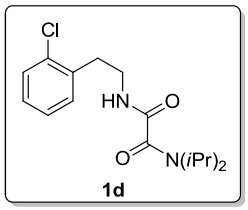
White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.17–7.12 (m, 5H), 4.69–4.62 (m, 1H), 3.54–3.46 (m,

3H), 2.88–2.85 (m, 2H), 2.35 (s, 3H), 1.41 (d, J = 6.8 Hz, 6H), 1.21 (d, J = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.41, 163.28, 136.77, 136.46, 130.55, 129.36, 126.78, 126.24, 49.75, 46.58, 39.47, 32.98, 20.96, 20.15, 19.45.



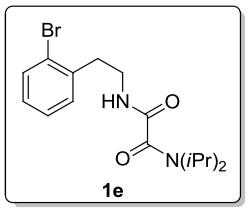
1c

White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.24–7,19 (m, 2H), 7.10–7.01 (m, 2H), 6.94 (br s, 1H), 4.68–4.61 (m, 1H), 3.58–3.53 (m, 2H), 3.51–3.46 (m, 1H), 2.91 (t, J = 7.1 Hz, 2H), 1.41 (d, J = 6.8 Hz, 6H), 1.20 (d, J = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.49, 163.27, 162.40 (d, J_{C-F} = 244.0 Hz), 131.18 (d, J_{C-F} = 5.0 Hz), 128.47 (d, J_{C-F} = 8.0 Hz), 125.63 (d, J_{C-F} = 16.0 Hz), 124.30 (d, J_{C-F} = 4.0 Hz), 115.48 (d, J_{C-F} = 22.0 Hz), 49.76, 46.55, 39.38, 29.03, 29.01, 20.93, 20.15.



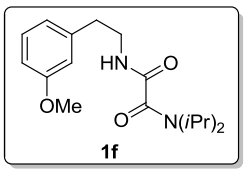
1d

White solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (dd, J = 7.5, 1.6 Hz, 1H), 7.28–7.14 (m, 4H), 4.63–4.57 (m, 1H), 3.60–3.55 (m, 2H), 3.52–3.45 (m, 1H), 3.00 (t, J = 7.2 Hz, 2H), 1.40 (d, J = 6.8 Hz, 6H), 1.20 (d, J = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.48, 162.33, 135.36, 133.23, 130.01, 128.68, 127.12, 126.04, 48.73, 45.50, 37.92, 32.25, 19.91, 19.12; HRMS Calcd for $C_{16}H_{23}ClN_2NaO_2$ [M+Na^+]: 333.1346; Found: 333.1352.



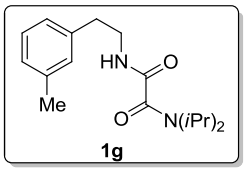
1e

White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 (d, J = 7.9 Hz, 1H), 7.32 (br s, 1H), 7.29–7.23 (m, 2H), 7.10–7.06 (m, 1H), 4.58–4.54 (m, 1H), 3.60–3.55 (m, 2H), 3.52–3.45 (m, 1H), 3.01 (t, J = 7.2 Hz, 2H), 1.40 (d, J = 6.8 Hz, 6H), 1.20 (d, J = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.49, 163.40, 138.04, 132.95, 130.97, 128.32, 127.65, 124.63, 49.73, 46.44, 38.96, 35.65, 20.87, 20.09 .



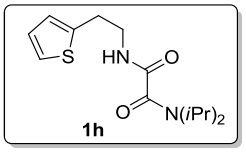
1f

White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22–7.18 (m, 1H), 7.10 (br s, 1H), 6.80 (d, *J* = 7.7 Hz, 1H), 6.76–6.75 (m, 2H), 4.58–4.52 (m, 1H), 3.78 (s, 3H), 3.56–3.51 (m, 2H), 3.49–3.44 (m, 1H), 2.82 (t, *J* = 7.2 Hz, 2H), 1.39 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.46, 159.87, 140.22, 129.68, 121.15, 114.36, 112.18, 55.25, 49.80, 46.50, 40.39, 35.57, 20.90, 20.14.



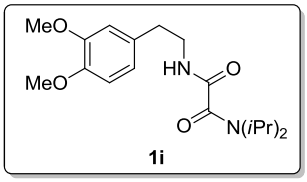
1g

White solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20–7.16 (t, *J* = 7.6 Hz, 2H), 7.03–7.00 (m, 3H), 4.58–4.51 (m, 1H), 3.56–3.51 (m, 2H), 3.49–3.44 (m, 1H), 2.81 (t, *J* = 7.3 Hz, 2H), 2.32 (s, 3H), 1.39 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.52, 162.48, 137.55, 137.22, 128.61, 127.54, 126.32, 124.81, 48.79, 45.45, 39.52, 34.41, 20.43, 19.88, 19.13; HRMS Calcd for $C_{17}H_{27}N_2O_2$ [M+H$^+$]: 291.2073; Found: 291.2076.



1h

White solid.[3] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 (br s, 1H), 7.13 (d, *J* = 4.9 Hz, 1H), 6.93–6.90 (m, 1H), 6.85 (s, 1H), 4.59–4.52 (m, 1H), 3.58–3.53 (m, 2H), 3.51–3.44 (m, 1H), 3.06 (t, *J* = 6.8 Hz, 2H), 1.39 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.6 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.50, 163.42, 140.98, 127.09, 125.47, 123.95, 49.81, 46.47, 40.69, 29.63, 20.88, 20.13.



1i

White solid. [2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.03 (br s, 1H), 6.80–6.78 (m, 1H), 6.74 (dd, *J* = 5.9, 1.8 Hz, 2H), 4.61–4.54 (m, 1H), 3.86 (s, 3H), 3.84 (s, 3H), 3.54–3.44 (m, 3H), 2.78 (t, *J* = 7.1 Hz, 2H), 1.38 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.41, 163.29, 149.09, 147.80, 131.16, 120.77, 112.02, 111.45, 56.00, 55.94, 49.76, 46.54, 40.60, 35.16, 20.91, 20.14

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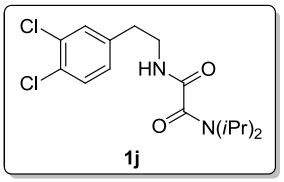
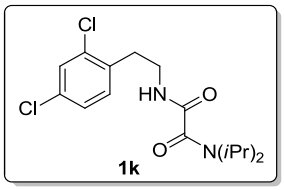


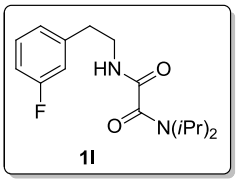
1j

White solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (br s, 1H), 7.33 (d, *J* = 8.2 Hz, 1H), 7.29 (d, *J* = 1.9 Hz, 1H), 7.05 (dd, *J* = 8.2, 2.0 Hz, 1H), 4.38–4.31 (m, 1H), 3.53–3.41 (m, 3H), 2.80 (t, *J* = 7.1 Hz, 2H), 1.35 (d, *J* = 6.8 Hz, 6H), 1.15 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.75, 162.68, 138.06, 131.42, 129.84, 129.55, 129.49, 127.34, 76.48, 49.00, 45.42, 38.90, 33.55, 19.81, 19.10; HRMS Calcd for $C_{16}H_{22}Cl_2N_2NaO_2$ [M+Na^+]: 367.0956; Found: 367.0966.



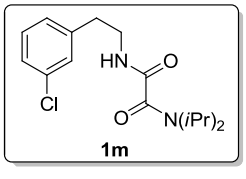
1k

White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (s, 1H), 7.26 (br s, 1H), 7.19–7.15 (m, 2H), 4.54–4.50 (m, 1H), 3.55–3.50 (m, 2H), 3.48–3.43 (m, 1H), 2.94 (t, *J* = 7.1 Hz, 2H), 1.37 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.52, 163.26, 134.99, 134.92, 133.12, 131.82, 129.45, 127.29, 49.81, 46.55, 38.71, 32.76, 20.90, 20.12.



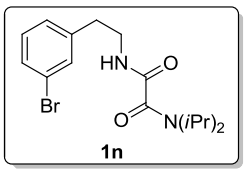
1l

White solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 (br s, 1H), 7.25–7.19 (m, 1H), 6.98 (d, *J* = 7.6 Hz, 1H), 6.91–6.85 (m, 2H), 4.45–4.38 (m, 1H), 3.55–3.50 (m, 2H), 3.46–3.41 (m, 1H), 2.83 (t, *J* = 7.2 Hz, 2H), 1.36 (d, *J* = 6.8 Hz, 6H), 1.15 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ162.75, 162.62, 161.94 (d, J_{C-F} = 244.0 Hz), 140.32 (d, J_{C-F} = 8.0 Hz), 129.04 (d, J_{C-F} = 8.0 Hz), 123.49 (d, J_{C-F} = 3.0 Hz), 114.70 (d, J_{C-F} = 21.0 Hz), 112.40 (d, J_{C-F} = 21.0 Hz), 48.89, 45.38, 39.11, 34.13, 34.12, 19.80, 19.09; HRMS Calcd for $C_{16}H_{23}FN_2NaO_2$ [M+Na^+]: 317.1641; Found: 317.1650.

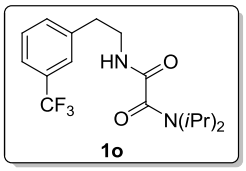


1m

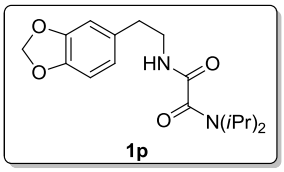
White solid. [2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.24–7.17 (m, 4H), 7.10 (d, *J* = 7.0 Hz, 1H), 4.53–4.46 (m, 1H), 3.56–3.50 (m, 2H), 3.49–3.44 (m, 1H), 2.83 (t, *J* = 7.2 Hz, 2H), 1.38 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.55, 163.45, 140.75, 134.40, 129.94, 128.99, 127.07, 126.83, 49.90, 46.54, 40.21, 35.16, 20.91, 20.15.



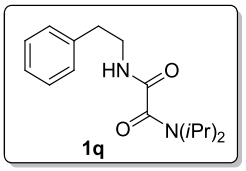
White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 (br s, 1H), 7.35 (s, 1H), 7.32–7.31 (m, 1H), 7.14 (d, *J* = 4.6 Hz, 2H), 4.43–4.38 (m, 1H), 3.54–3.49 (m, 2H), 3.47–3.42 (m, 1H), 2.81 (t, *J* = 7.2 Hz, 2H), 1.36 (d, *J* = 6.8 Hz, 6H), 1.16 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.65, 163.61, 141.08, 131.85, 130.15, 129.66, 127.49, 122.58, 49.93, 46.40, 40.11, 35.03, 20.85, 20.11.



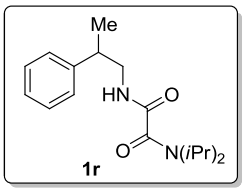
White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49–7.47 (m, 2H), 7.45–7.41 (m, 2H), 7.17 (br s, 1H), 4.63–4.58 (m, 1H), 3.59–3.54 (m, 2H), 3.52–3.45 (m, 1H), 2.92 (t, *J* = 7.2 Hz, 2H), 1.39 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.47, 163.16, 139.64, 132.33 (d, J_{C-F} = 1.0 Hz), 131.03 (q, J_{C-F} = 32.0 Hz), 129.19, 125.62 (q, J_{C-F} = 4.0 Hz), 124.23 (q, J_{C-F} = 270.0 Hz), 123.60 (q, J_{C-F} = 4.0 Hz), 49.82, 46.65, 40.29, 35.39, 20.91, 20.15.



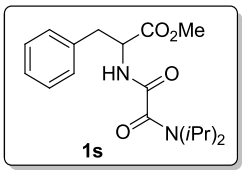
White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.08 (br s, 1H), 6.73 (d, *J* = 7.9 Hz, 1H), 6.69 (d, *J* = 1.4 Hz, 1H), 6.65 (dd, *J* = 7.9, 1.6 Hz, 1H), 5.91 (s, 2H), 4.62–4.55 (m, 1H), 3.51–3.44(m, 3H), 2.76 (t, *J* = 7.1 Hz, 2H), 1.39 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.41, 163.33, 147.87, 146.30, 132.39, 121.77, 109.18, 108.46, 100.99, 49.79, 46.54, 40.73, 35.24, 20.92, 20.15; HRMS Calcd for $C_{17}H_{23}N_2O_4$ [M-H$^+$]: 319.1658; Found: 319.1673.



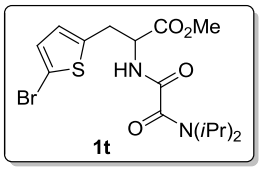
White solid.[4] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32–7.28 (m, 2H), 7.23–7.20 (m, 3H), 7.11 (br s, 1H), 4.60–4.53 (m, 1H), 3.58–3.53 (m, 2H), 3.52–3.45 (m, 1H), 2.86 (t, *J* = 7.2 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.45, 163.41, 138.68, 128.85, 128.70, 126.62, 49.78, 46.52, 40.53, 35.55, 20.92, 20.16.



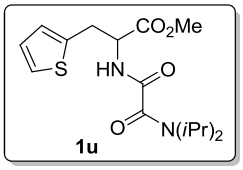
White solid.[4] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (t, *J* = 7.6 Hz, 2H), 7.23–7.19 (m, 3H), 6.94 (br s, 1H), 4.42–4.37 (m, 1H), 3.54–3.39 (m, 3H), 3.03–2.94 (m, 1H), 1.38–1.35 (m, 6H), 1.28 (d, *J* = 7.0 Hz, 3H), 1.16–1.12 (m, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.54, 143.93, 128.72, 127.28, 126.77, 49.83, 46.40, 45.86, 39.78, 20.88, 20.16, 20.14, 19.45.



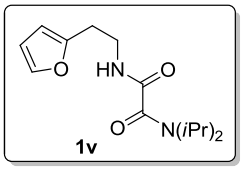
White solid.[2] ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30–7.24 (m, 4H), 7.17 (d, *J* = 7.1 Hz, 2H), 4.89–4.82 (m, 1H), 4.39–4.33 (m, 1H), 3.72 (s, 3H), 3.51–3.44 (m, 1H), 3.22–3.17 (m, 1H), 3.12–3.07 (m, 1H), 1.42–1.40 (m, 6H), 1.21–1.13 (m, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 184.72, 171.32, 162.95, 135.74, 129.34, 128.69, 127.21, 53.24, 52.52, 49.81, 46.50, 38.03, 20.90, 20.81, 20.10.



Pale yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 (br s, 1H), 6.88 (d, *J* = 3.7 Hz, 1H), 6.63 (d, *J* = 3.7 Hz, 1H), 4.83–4.78 (m, 1H), 4.53–4.47 (m, 1H), 3.77 (s, 3H), 3.54–3.47 (m, 1H), 3.39–3.26 (m, 2H), 1.42 (dd, *J* = 6.7, 5.3 Hz, 6H), 1.22 (dd, *J* = 6.6, 4.5 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.50, 162.09, 161.48, 137.88, 129.10, 126.73, 110.10, 51.97, 51.91, 48.92, 45.70, 31.41, 20.01, 19.94, 19.18; HRMS Calcd for $C_{16}H_{23}BrN_2NaO_4S$ [M+Na$^+$]: 441.0460; Found: 441.0468.

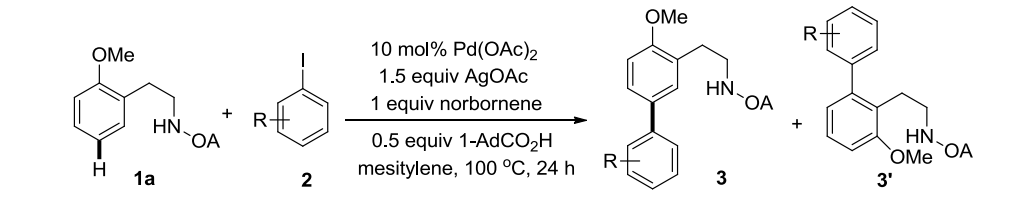


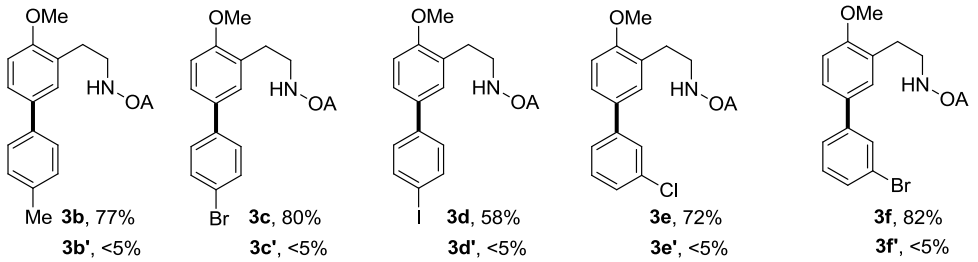
Pale yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 (br s, 1H), 7.15 (dd, *J* = 5.1, 1.1 Hz, 1H), 6.92 (dd, *J* = 5.1, 3.5 Hz, 1H), 6.84 (d, *J* = 3.1 Hz, 1H), 4.85–4.81 (m, 1H), 4.52–4.46 (m, 1H), 3.74 (s, 3H), 3.52–3.45 (m, 1H), 3.43–3.35 (m, 2H), 1.41 (dd, *J* = 6.7, 4.3 Hz, 6H), 1.20 (dd, *J* = 6.6, 3.3 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.69, 162.03, 161.58, 136.04, 126.25, 126.07, 124.01, 52.21, 51.70, 48.82, 45.58, 30.97, 19.95, 19.88, 19.13; HRMS Calcd for $C_{16}H_{25}N_2O_4S$ [M+H$^+$]: 341.1535; Found: 341.1536.

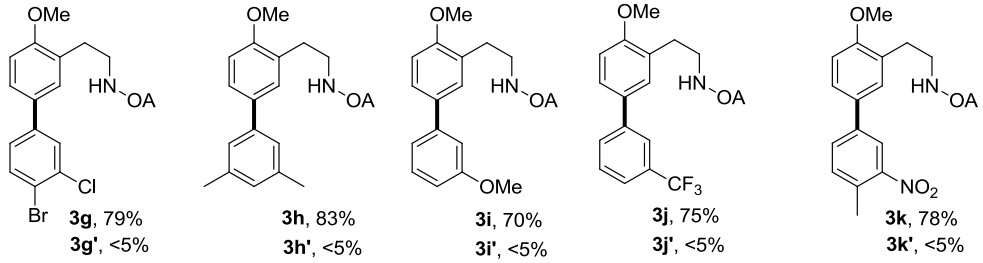


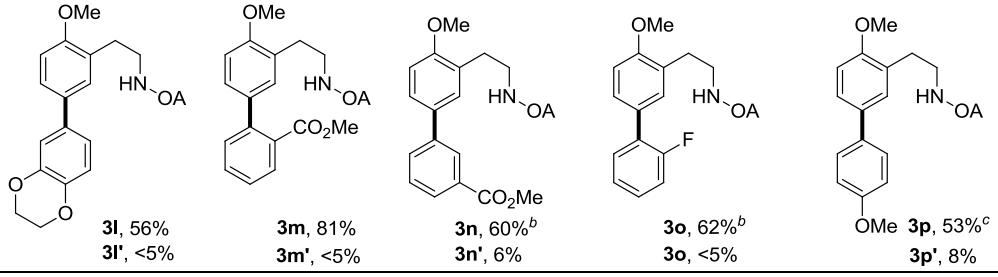
White solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 (d, *J* = 1.1 Hz, 1H), 7.14 (br s, 1H), 6.27 (dd, *J* = 3.0, 1.9 Hz, 1H), 6.08 (d, *J* = 3.1 Hz, 1H), 4.65–4.58 (m, 1H), 3.58–3.53 (m, 2H), 3.52–3.45 (m, 1H), 2.87 (t, *J* = 6.7 Hz, 2H), 1.39 (d, *J* = 6.8 Hz, 6H), 1.20 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.42, 163.23, 152.72, 141.69, 110.39, 106.51, 49.77, 46.57, 37.95, 27.98, 20.94, 20.16; HRMS Calcd for $C_{14}H_{22}N_2NaO_3$ [M+Na$^+$]: 289.1528; Found: 289.1530.

5. *Meta* arylation with different aryl iodides

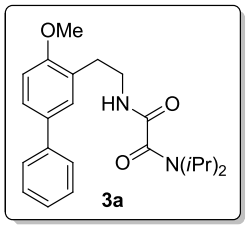






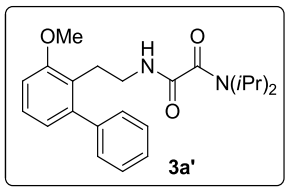


A mixture of **1a** (0.2 mmol, 61.3 mg), **2** (0.6 mmol, 3.0 eq), $Pd(OAc)_2$ (4.5 mg, 10 mol%), AgOAc (50 mg, 0.3 mmol, 1.5 eq), norbornene (18.8 mg, 0.2 mmol, 1.0 eq), 1-$AdCO_2H$ (18 mg, 0.1 mmol, 0.05 eq) and 1 mL mesitylene in a 15 mL glass vial was heated at 100 ^{o}C with vigorous stirring for 24 hours. The reaction mixture was cooled to room temperature, and diluted with ethyl acetate and filtered through celite. The filtrate was concentrated in vacuo and purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:15 to 1:3) to give product.



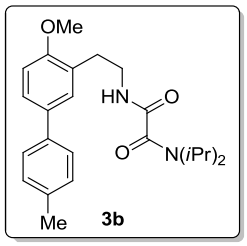
3a

Pale yellow oil; Yield (81%, 61.9 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 (d, *J* = 7.5 Hz, 2H), 7.46–7.40 (m, 4H), 7.29 (t, *J* = 7.3 Hz, 1H), 7.12 (br s, 1H), 6.93 (d, *J* = 8.4 Hz, 1H), 4.71–4.65 (m, 1H), 3.88 (s, 3H), 3.59–3.54 (m, 2H), 3.51–3.44 (m, 1H), 2.94 (t, *J* = 6.8 Hz, 2H), 1.40 (d, *J* = 6.7 Hz, 6H), 1.16 (d, *J* = 6.6 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.40, 162.19, 156.24, 139.82, 132.87, 128.54, 127.82, 126.49, 125.91, 125.81, 125.60, 109.77, 54.59, 48.64, 45.58, 38.72, 29.30, 19.94, 19.15; HRMS Calcd for $C_{23}H_{30}N_2NaO_3$ [M+Na^+]: 405.2154; Found: 405.2152; IR ν 3270, 3089, 2994, 2977, 2937, 2884, 2835, 1674, 1612, 1561, 1495, 1450, 1434, 1381, 1362, 1317, 1306, 1290, 1263, 1244, 1205, 1170, 1158, 1140, 1120, 1093, 1055, 1038, 1022, 988, 956, 925, 876, 805, 774, 752, 740, 728, 702, 675, 612 cm^{-1}.



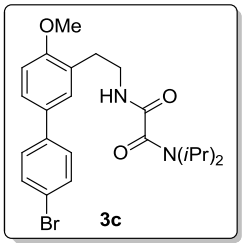
3a'

Pale yellow oil; Yield (83%, 63.4 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41–7.32 (m, 3H), 7.28–7.21 (m, 3H), 7.04 (br s, 1H), 6.89 (d, *J* = 8.1 Hz, 1H), 6.84 (d, *J* = 7.6 Hz, 1H), 4.71–4.64 (m, 1H), 3.89 (s, 3H), 3.51–3.44 (m, 1H), 3.38–3.33 (m, 2H), 2.83 (t, *J* = 7.0 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.05, 161.99, 156.87, 143.20, 140.49, 128.22, 127.28, 126.20, 126.16, 124.11, 121.77, 108.42, 54.64, 48.44, 45.55, 38.75, 25.41, 19.97, 19.12; HRMS Calcd for $C_{23}H_{31}N_2O_3$ [M+H^+]: 383.2335; Found: 383.2347.

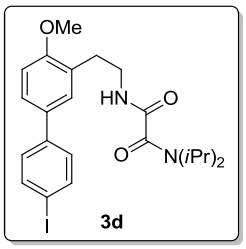


3b

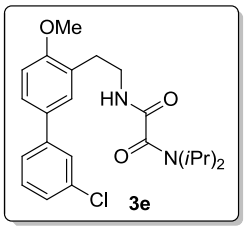
Pale yellow solid; Yield (77%, 61.0 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45–7.41 (m, 3H), 7.37 (d, *J* = 2.2 Hz, 1H), 7.21 (d, *J* = 7.9 Hz, 2H), 7.10 (br s, 1H), 6.92 (d, *J* = 8.5 Hz, 1H), 4.72–4.65 (m, 1H), 3.88 (s, 3H), 3.58–3.54 (m, 2H), 3.51–3.44 (m, 1H), 2.93 (t, *J* = 6.9 Hz, 2H), 2.38 (s, 3H), 1.41 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41, 162.20, 156.04, 136.95, 135.52, 132.87, 128.55, 128.38, 126.44, 125.76, 125.41, 109.77, 54.60, 48.66, 45.60, 38.79, 29.32, 20.19, 19.96, 19.17; HRMS Calcd for $C_{24}H_{33}N_2O_3$ [M+H^+]: 397.2491; Found: 397.2500.



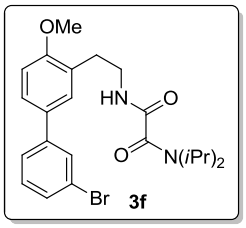
Yellow solid; Yield (80%, 73.6 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 (d, *J* = 8.5 Hz, 2H), 7.43–7.39 (m, 3H), 7.35 (d, *J* = 2.1 Hz, 1H), 7.10 (br s, 1H), 6.92 (d, *J* = 8.5 Hz, 1H), 4.72–4.65 (m, 1H), 3.88 (s, 3H), 3.58–3.53 (m, 2H), 3.51–3.45 (m, 1H), 2.93 (t, *J* = 6.9 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.38, 162.13, 156.51, 138.76, 131.57, 130.88, 128.37, 127.51, 126.69, 125.47, 119.94, 109.85, 54.63, 48.65, 45.62, 38.61, 29.29, 19.96, 19.16; HRMS Calcd for $C_{23}H_{30}BrN_2O_3$ [M+H$^+$]: 461.1440; Found: 461.1444.



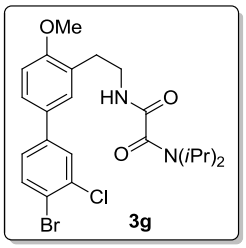
Yellow solid; Yield (58%, 58.9 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 (d, *J* = 8.5 Hz, 2H), ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.5 Hz, 2H), 7.40 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.35 (d, *J* = 2.3 Hz, 1H), 7.30 (d, *J* = 8.5 Hz, 2H), 7.10 (br s, 1H), 6.92 (d, *J* = 8.5 Hz, 1H), 4.73–4.66 (m, 1H), 3.88 (s, 3H), 3.57–3.52 (m, 2H), 3.51–3.45 (m, 1H), 2.92 (t, *J* = 6.9 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 206.11, 162.37, 162.11, 156.56, 139.34, 136.86, 131.59, 128.30, 127.79, 126.70, 125.43, 109.85, 91.31, 54.62, 48.63, 45.61, 38.60, 30.06, 29.29, 19.96, 19.16; HRMS Calcd for $C_{23}H_{29}IN_2NaO_3$ [M+Na$^+$]: 531.1121; Found: 531.1112.



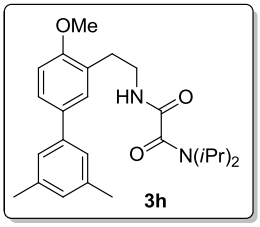
Pale yellow solid; Yield (72%, 59.9 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (t, *J* = 1.6 Hz, 1H), 7.44–7.40 (m, 2H), 7.36 (d, *J* = 2.2 Hz, 1H), 7.32 (t, *J* = 7.8 Hz, 1H), 7.27–7.25 (m, 1H), 7.10 (br s, 1H), 7.10 (s, 1H), 6.93 (d, *J* = 8.5 Hz, 1H), 4.72–4.66 (m, 1H), 3.88 (s, 3H), 3.58–3.53 (m, 2H), 3.51–3.44 (m, 1H), 2.93 (t, *J* = 6.9 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.39, 162.14, 156.67, 141.68, 133.71, 131.37, 129.04, 128.53, 126.70, 125.98, 125.78, 125.65, 124.04, 109.83, 54.63, 48.65, 45.62, 38.60, 29.32, 19.96, 19.16; HRMS Calcd for $C_{23}H_{30}ClN_2O_3$ [M+H$^+$]: 417.1945; Found: 417.1938.



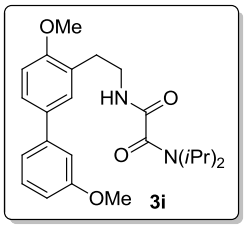
Yellow oil; Yield (82%, 75.4 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (t, *J* = 1.6 Hz, 1H), 7.47 (d, *J* = 7.6 Hz, 1H), 7.41 (dd, *J* = 8.5, 2.1 Hz, 2H), 7.35 (d, *J* = 2.2 Hz, 1H), 7.26 (d, *J* = 15.7 Hz, 1H), 7.09 (br s, 1H), 6.92 (d, *J* = 8.5 Hz, 1H), 4.72–4.66 (m, 1H), 3.58–3.53 (m, 2H), 3.51–3.45 (m, 1H), 2.93 (t, *J* = 6.9 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41, 162.15, 156.68, 141.97, 131.27, 129.32, 128.88, 128.71, 128.53, 126.71, 125.67, 124.51, 121.99, 109.83, 54.63, 48.66, 45.62, 38.60, 29.32, 19.96, 19.17; HRMS Calcd for $C_{23}H_{30}BrN_2O_3$ [M+H$^+$]: 461.1440; Found: 461.1448.



Pale yellow oil; Yield (81%, 80.0 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 2.0 Hz, 1H), 7.61 (d, *J* = 8.3 Hz, 1H), 7.39 (dd, *J* = 8.4, 2.2 Hz, 1H), 7.34 (d, *J* = 2.1 Hz, 1H), 7.30 (dd, *J* = 8.3, 2.0 Hz, 1H), 7.11 (br s, 1H), 6.92 (d, *J* = 8.5 Hz, 1H), 4.71–7.65 (m, 1H), 3.88 (s, 3H), 3.57–3.45 (m, 3H), 2.92 (t, *J* = 6.8 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41, 162.15, 156.86, 140.58, 133.79, 132.93, 130.24, 128.34, 127.53, 126.84, 125.49, 125.32, 119.53, 109.88, 54.63, 48.65, 45.60, 38.47, 29.28, 19.95, 19.15; HRMS Calcd for $C_{23}H_{29}BrClN_2O_3$ [M+H$^+$]: 495.1050; Found: 495.1040.

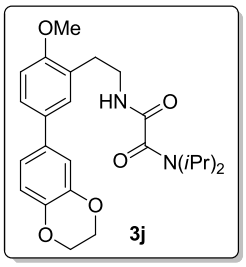


Pale yellow oil; Yield (83%, 68.1 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 (dd, *J* = 8.4, 2.3 Hz, 1H), 7.38 (d, *J* = 2.2 Hz, 1H), 7.17 (s, 2H), 7.09 (br s, 1H), 6.95 (s, 1H), 6.91 (d, *J* = 8.4 Hz, 1H), 4.71–4.64 (m, 1H), 3.88 (s, 3H), 3.58–3.53 (m, 2H), 3.51–3.44 (m, 1H), 2.93 (t, *J* = 6.9 Hz, 2H), 2.37 (s, 6H), 1.41 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.44, 162.22, 156.10, 139.80, 137.32, 133.13, 128.60, 127.49, 126.35, 125.61, 123.87, 109.68, 54.59, 48.66, 45.59, 38.81, 29.33, 20.53, 19.97, 19.17; HRMS Calcd for $C_{25}H_{35}N_2O_3$ [M+H$^+$]: 411.2648; Found: 411.2655.



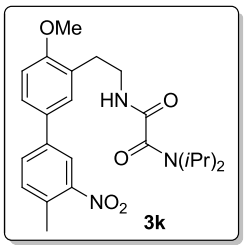
3i

Yellow oil; Yield (70%, 57.7 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.39 (d, *J* = 2.3 Hz, 1H), 7.31 (t, *J* = 7.9 Hz, 1H), 7.13 (d, *J* = 7.7 Hz, 1H), 7.09–7.06 (m, 2H), 6.93 (d, *J* = 8.5 Hz, 1H), 6.86–6.84 (m, 1H), 4.70–4.63 (m, 1H), 3.87 (d, *J* = 6.2 Hz, 6H), 3.59–3.54 (m, 2H), 3.51–3.44 (m, 1H), 2.93 (t, *J* = 6.9 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.16 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.43, 162.21, 159.08, 156.36, 141.37, 132.76, 128.81, 128.58, 126.48, 125.69, 118.48, 111.56, 111.39, 109.75, 54.61, 54.47, 48.68, 45.59, 38.72, 29.34, 19.96, 19.16; HRMS Calcd for $C_{24}H_{32}N_2NaO_4$ [M+Na^+]: 435.2260; Found: 435.2262.



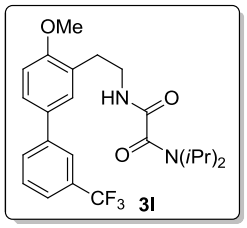
3j

Yellow oil; Yield (56%, 49.3 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.32 (d, *J* = 1.8 Hz, 1H), 7.10 (br s, 1H), 7.06–7.01 (m, 2H), 6.89 (d, *J* = 7.6 Hz, 2H), 4.72–4.65 (m, 1H), 4.28 (s, 4H), 3.86 (s, 3H), 3.57–3.52 (m, 2H), 3.51–3.44 (m, 1H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41, 162.21, 155.92, 142.77, 141.82, 133.51, 132.33, 128.19, 126.42, 125.18, 118.94, 116.58, 114.59, 109.75, 63.58, 63.57, 54.58, 48.65, 45.58, 38.79, 29.29, 19.96, 19.16; HRMS Calcd for $C_{25}H_{32}N_2NaO_5$ [M+Na^+]: 463.2209; Found: 463.2208.

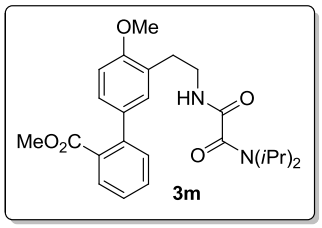


3k

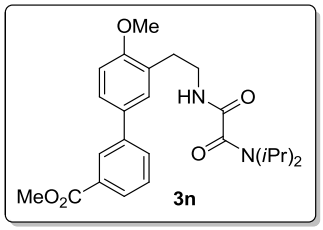
Yellow oil; Yield (79%, 69.7 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (d, *J* = 1.8 Hz, 1H), 7.70 (dd, *J* = 7.9, 1.9 Hz, 1H), 7.46 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.40 (d, *J* = 2.3 Hz, 1H), 7.36 (d, *J* = 8.0 Hz, 1H), 7.10 (br s, 1H), 6.95 (d, *J* = 8.5 Hz, 1H), 4.74–4.67 (m, 1H), 3.89 (s, 3H), 3.58–3.53 (m, 2H), 3.52–3.45 (m, 1H), 2.94 (t, *J* = 6.9 Hz, 2H), 2.61 (s, 3H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 206.12, 162.39, 162.10, 156.93, 148.72, 138.99, 132.24, 130.61, 130.13, 130.08, 128.35, 126.96, 125.57, 121.55, 109.97, 54.66, 48.63, 45.63, 38.57, 30.06, 29.35, 19.97, 19.22, 19.15; HRMS Calcd for $C_{24}H_{32}N_3O_5$ [M+H^+]: 442.2342; Found: 442.2339.



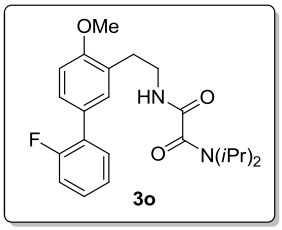
Pale yellow oil; Yield (75%, 67.5 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (s, 1H), 7.73 (d, *J* = 7.2 Hz, 1H), 7.56–7.49 (m, 2H), 7.45 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.39 (d, *J* = 2.3 Hz, 1H), 7.08 (br s, 1H), 6.95 (d, *J* = 8.5 Hz, 1H), 4.74–4.67 (m, 1H), 3.89 (s, 3H), 3.59–3.54 (m, 2H), 3.51–3.45 (m, 1H), 2.95 (t, *J* = 6.9 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41, 162.13, 156.80, 140.64, 131.35, 130.22 (q, J_{C-F} = 32.0 Hz) , 129.22 (d J_{C-F} = 1.0 Hz), 128.63, 128.28, 127.44, 126.85, 126.09 (q, J_{C-F} = 271.0 Hz), 125.80, 124.73, 122.62 (q, J_{C-F} = 4.0 Hz), 122.45 (q, J_{C-F} = 4.0 Hz), 109.93, 54.66, 48.65, 45.63, 38.59, 29.37, 19.95, 19.13; HRMS Calcd for $C_{24}H_{30}F_3N_2O_3$ [M+H$^+$]: 451.2209; Found: 451.2207.



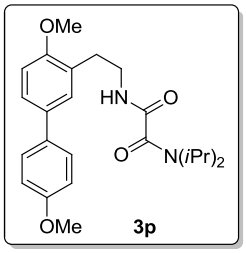
Pale yellow oil; Yield (81%, 71.3 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (d, *J* = 7.4 Hz, 1H), 7.51–7.47 (m, 1H), 7.36 (t, *J* = 7.3 Hz, 2H), 7.17–7.11 (m, 3H), 6.88 (d, *J* = 8.4 Hz, 1H), 4.71–4.64 (m, 1H), 3.87 (s, 3H), 3.67 (s, 3H), 3.56–3.44 (m, 3H), 2.90 (t, *J* = 6.9 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.40, 162.42, 162.23, 156.04, 141.01, 132.66, 130.32, 129.93, 129.84, 129.82, 128.80, 126.99, 125.91, 125.87, 109.06, 54.48, 51.16, 48.65, 45.53, 38.81, 29.16, 19.93, 19.14; HRMS Calcd for $C_{25}H_{32}N_2NaO_5$ [M+Na$^+$]: 463.2209; Found: 463.2217.



Yellow oil; Yield (60%, 52.8 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (s, 1H), 7.96 (d, *J* = 7.7 Hz, 1H), 7.75 (d, *J* = 7.8 Hz, 1H), 7.48 (dd, *J* = 12.8, 4.9 Hz, 2H), 7.42 (d, *J* = 2.2 Hz, 1H), 7.12 (br s, 1H), 6.94 (d, *J* = 8.5 Hz, 1H), 4.71–4.65 (m, 1H), 3.94 (s, 3H), 3.89 (s, 3H), 3.59–3.54 (m, 2H), 3.51–3.44 (m, 1H), 2.95 (t, *J* = 6.9 Hz, 2H), 1.39 (d, *J* = 6.8 Hz, 6H), 1.16 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.29, 162.41, 162.18, 156.61, 140.05, 131.68, 130.33, 129.73, 128.51, 127.93, 126.91, 126.85, 126.71, 125.71, 109.86, 54.62, 51.30, 48.65, 45.58, 38.72, 29.35, 19.94, 19.14; HRMS Calcd for $C_{25}H_{32}N_2NaO_5$ [M+Na$^+$]: 463.2209; Found: 463.2222.

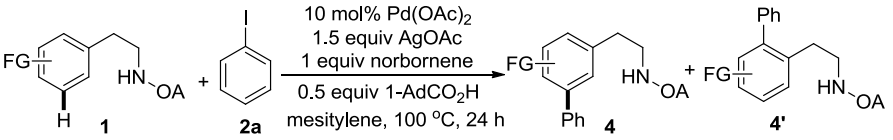


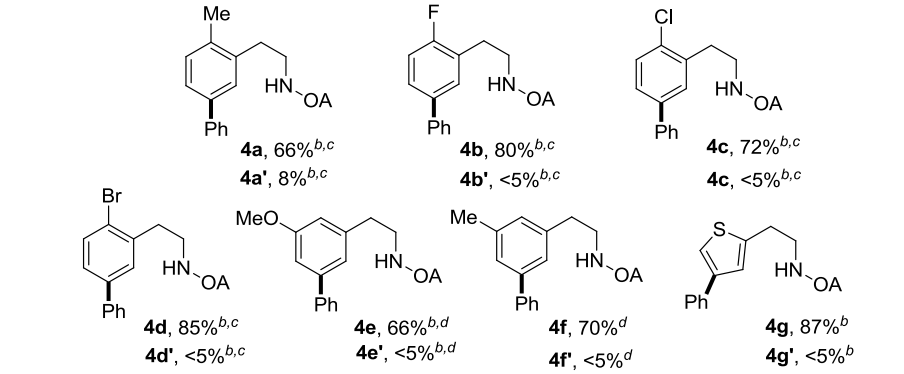
Pale yellow oil; Yield (62%, 49.6 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44–7.40 (m, 2H), 7.34 (s, 1H), 7.29–7.24 (m, 1H), 7.19–7.08 (m, 3H), 6.94 (d, J = 8.5 Hz, 1H), 4.71–4.64 (m, 1H), 3.88 (s, 3H), 3.58–3.53 (m, 2H), 3.51–3.44 (m, 1H), 2.93 (t, J = 6.9 Hz, 2H), 1.40 (d, J = 6.8 Hz, 6H), 1.17 (d, J = 6.7 Hz, 6H); 13C NMR (101 MHz, CDCl3) δ 162.41, 162.20, 160.07, 157.62, 156.34, 130.38 (d, J_{C-F} = 3.0 Hz), 129.72 (d, J_{C-F} = 3.0 Hz), 127.75 (d, J_{C-F} = 3.0 Hz), 127.62, 127.60, 127.52, 127.27 (d, J_{C-F} = 1.0 Hz), 126.26, 123.44 (d, J_{C-F} = 3.0 Hz), 115.14 (d, J_{C-F} = 23.0 Hz), 109.46, 54.58, 48.67, 45.59, 38.71, 29.24, 19.94, 19.15; HRMS Calcd for $C_{23}H_{29}FN_2NaO_3$ [M+Na^+]: 423.2060.; Found: 423.2068.



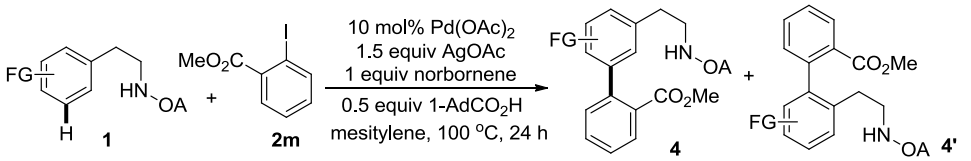
Yellow oil; Yield (53%, 43.7 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49–7.46 (m, 2H), 7.40–7.38 (dd, J = 8.4, 2.4 Hz, 1H), 7.34 (d, J = 2.3 Hz, 1H), 7.10 (br s, 1H), 6.95–6.90 (m, 3H), 4.71–4.64 (m, 1H), 3.87 (s, 3H), 3.84 (s, 3H), 3.58–3.53 (m, 2H), 3.51–3.44 (m, 1H), 2.93 (t, J = 6.9 Hz, 2H), 1.40 (d, J = 6.8 Hz, 6H), 1.16 (d, J = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41, 162.21, 157.85, 155.80, 132.58, 132.48, 128.19, 126.92, 126.43, 125.16, 113.27, 109.78, 54.59, 54.48, 48.65, 45.58, 38.77, 29.30, 19.96, 19.16; HRMS Calcd for $C_{24}H_{32}N_2NaO_4$ [M+Na^+]: 435.2260; Found: 435.2268.

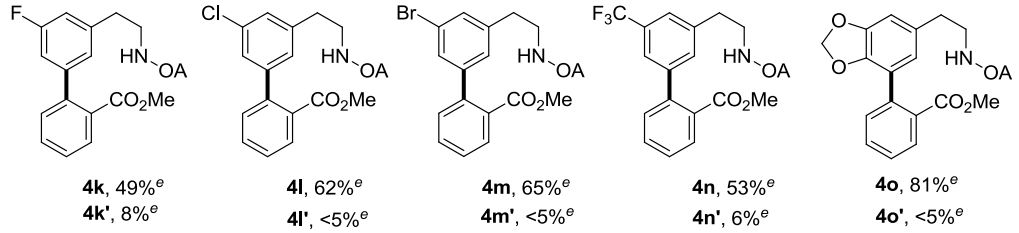
6. *Meta* arylation with different β–arylethyamides



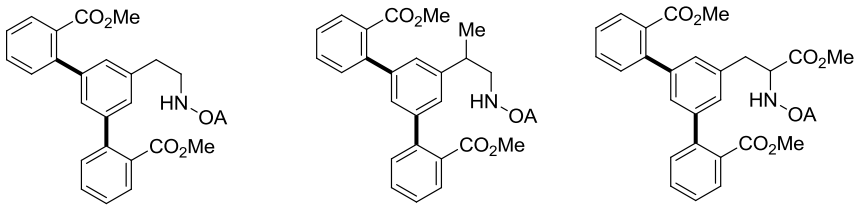


4a, 66%[b,c]
4a', 8%[b,c]
4b, 80%[b,c]
4b', <5%[b,c]
4c, 72%[b,c]
4c, <5%[b,c]
4d, 85%[b,c]
4d', <5%[b,c]
4e, 66%[b,d]
4e', <5%[b,d]
4f, 70%[d]
4f', <5%[d]
4g, 87%[b]
4g', <5%[b]
4h, 45%[e]
4h', 7%[e]
4i, 51%[e]
4i', 9%[e]
4j, 71%[b,f]
4j', <5%[b,f]

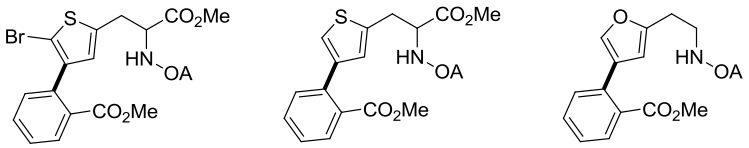




4k, 49%[e]
4k', 8%[e]
4l, 62%[e]
4l', <5%[e]
4m, 65%[e]
4m', <5%[e]
4n, 53%[e]
4n', 6%[e]
4o, 81%[e]
4o', <5%[e]

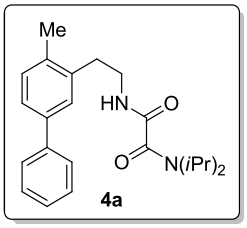


4p, 60%[g]
4p', <5%[g]
4q, 72%[g]
4q', <5%[g]
4r, 58%[g]
4r', <5%[g]



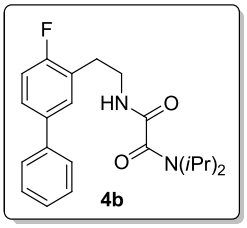
4s, 80%[b]
4s', <5%[b]
4t, 61%[b,h]
4t', <5%[b,h]
4u, 21%[b]
4u', 9%[b]

A mixture of oxalamide **1** (0.2 mmol, 1.0 eq), iodobenzene **2a** or methyl 2-iodobenzoate **2m** (0.6 mmol, 3.0 eq), $Pd(OAc)_2$ (4.5 mg, 10 mol%), AgOAc (50 mg, 0.3 mmol, 1.5 eq), norbornene (18.8 mg, 0.2 mmol, 1.0 eq), 1-$AdCO_2H$ (18 mg, 0.1 mmol, 0.05 eq) and 1 mL mesitylene in a 15 mL glass vial was heated at 100 ^oC with vigorous stirring for 24 hours. The reaction mixture was cooled to room temperature, and diluted with ethyl acetate and filtered through celite. The filtrate was concentrated in vacuo and purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:15 to 1:3) to give product.



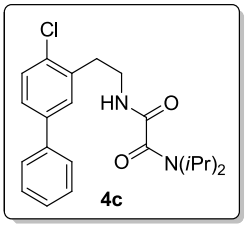
4a

Pale yellow solid; Yield (66%, 48.3 mg); ^1H NMR (400 MHz, $CDCl_3$) δ 7.60–7.58 (m, 2H), 7.43–7.37 (m, 4H), 7.32 (t, *J* = 7.3 Hz, 1H), 7.24 (d, *J* = 8.3 Hz, 1H), 7.08 (br s, 1H), 4.76–4.69 (m, 1H), 3.59–3.54 (m, 2H), 3.53–3.46 (m, 1H), 2.93 (t, *J* = 7.4 Hz, 2H), 2.39 (s, 3H), 1.41 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.34, 162.02, 140.06, 138.31, 136.15, 134.60, 130.07, 127.83, 127.20, 126.18, 126.15, 124.52, 48.71, 45.70, 38.53, 32.16, 19.96, 19.16, 18.17; HRMS Calcd for $C_{23}H_{30}N_2NaO_2$ [M+Na^+]: 389.2205; Found: 389.2207.



4b

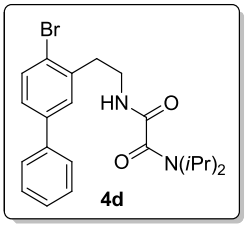
Pale yellow oil; Yield (80%, 59.2 mg); ^1H NMR (400 MHz, $CDCl_3$) δ 7.54 (d, *J* = 7.5 Hz, 2H), 7.42 (dd, *J* = 9.1, 6.8 Hz, 4H), 7.33 (t, *J* = 7.3 Hz, 1H), 7.12–7.07 (m, 2H), 4.68–4.61 (m, 1H), 3.63–3.58 (m, 2H), 3.51–3.45 (m, 1H), 2.96 (t, *J* = 7.0 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.16 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.43, 162.02, 161.27, 158.82, 139.24, 136.66 (d, J_{C-F} = 3.0 Hz), 128.98 (d, J_{C-F} = 5.0 Hz), 127.92, 126.41, 126.19, 126.18 (d, J_{C-F} = 8.0 Hz), 124.82 (d, J_{C-F} = 16.0 Hz), 114.83 (d, J_{C-F} = 22.0 Hz), 48.74, 45.66, 38.41, 28.46, 28.18, 19.93, 19.16; HRMS Calcd for $C_{22}H_{27}FN_2NaO_2$ [M+Na^+]: 393.1954; Found: 393.1960.



4c

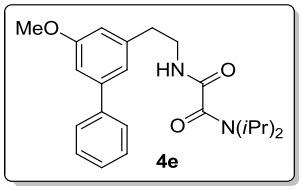
Pale yellow solid; Yield (72%, 55.6 mg);^1H NMR (400 MHz, $CDCl_3$) δ 7.58–7.56 (m, 2H), 7.47 (d, *J* = 1.7 Hz, 1H), 7.44–7.38 (m, 4H), 7.36–7.33 (m, 1H), 7.06 (br s, 1H), 4.74–4.67 (m, 1H), 3.65–

3.59 (m, 2H), 3.52–3.45 (m, 1H), 3.06 (t, *J* = 7.1 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.38, 161.92, 139.34, 138.97, 135.57, 132.38, 129.06, 128.80, 127.98, 126.75, 126.41, 126.21, 125.89, 48.70, 45.70, 38.01, 32.46, 28.46, 19.95, 19.16; HRMS Calcd for $C_{22}H_{27}ClN_2NaO_2$ [M+Na$^+$]: 409.1659; Found: 409.1672.



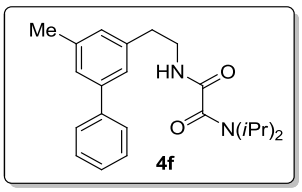
4d

Pale yellow oil; Yield (85%, 73.1 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (dd, *J* = 12.6, 7.9 Hz, 3H), 7.47–7.41 (m, 3H), 7.37–7.31 (m, 2H), 7.06 (br s, 1H), 4.75–4.69 (m, 1H), 3.64–3.59 (m, 2H), 3.52–3.45 (m, 1H), 3.07 (t, *J* = 7.1 Hz, 2H), 1.41 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.6 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.38, 161.91, 140.01, 138.95, 137.30, 132.38, 128.79, 127.99, 126.80, 126.18, 126.16, 122.70, 48.70, 45.70, 38.08, 34.88, 19.95, 19.16; HRMS Calcd for $C_{22}H_{27}BrN_2NaO_2$ [M+Na$^+$]: 453.1154; Found: 453.1136.



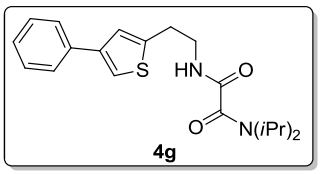
4e

Pale yellow oil; Yield (66%, 50.4 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 7.3 Hz, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.34 (t, *J* = 7.3 Hz, 1H), 7.04 (s, 1H), 6.99 (s, 2H), 6.76 (s, 1H), 4.68–4.62 (m, 1H), 3.86 (s, 3H), 3.63–3.58 (m, 2H), 3.52–3.45 (m, 1H), 2.90 (t, *J* = 7.1 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41, 162.13, 159.32, 142.14, 140.08, 139.51, 127.85, 126.61, 126.36, 119.32, 112.25, 110.35, 54.49, 48.78, 45.64, 39.43, 34.77, 19.95, 19.18; HRMS Calcd for $C_{23}H_{30}N_2NaO_3$ [M+Na$^+$]: 405.2154; Found: 405.2157.



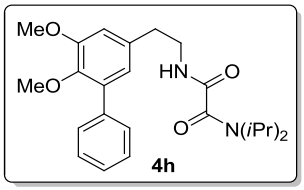
4f

Pale yellow solid; Yield (70%, 51.2 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 7.2 Hz, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.33 (t, *J* = 7.3 Hz, 1H), 7.27 (s, 1H), 7.24 (s, 1H), 7.03 (s, 1H), 6.98 (br s, 1H), 4.69–4.62 (m, 1H), 3.62–3.57 (m, 2H), 3.52–3.45 (m, 1H), 2.89 (t, *J* = 7.2 Hz, 2H), 2.40 (s, 3H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.39, 162.15, 140.75, 140.27, 138.02, 137.81, 127.81, 127.63, 126.36, 126.34, 125.45, 123.90, 48.76, 45.64, 39.57, 34.57, 20.58, 19.96, 19.18; HRMS Calcd for $C_{23}H_{30}N_2NaO_2$ [M+Na$^+$]: 389.2205; Found: 389.2206.



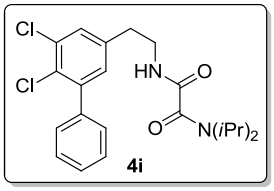
4g

Yellow solid; Yield (87%, 62.3 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 (d, *J* = 7.3 Hz, 2H), 7.37 (t, *J* = 7.6 Hz, 2H), 7.29–7.26 (m, 2H), 7.19 (br s, 1H), 7.17 (s, 1H), 4.66–4.59 (m, 1H), 3.65–3.60 (m, 2H), 3.52–3.45 (m, 1H), 3.10 (t, *J* = 6.9 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.51, 162.21, 141.31, 140.83, 134.95, 127.88, 126.21, 125.38, 123.95, 117.89, 48.84, 45.61, 39.60, 29.04, 19.93, 19.17; HRMS Calcd for $C_{20}H_{26}N_2NaO_2S$ [M+Na$^+$]: 381.1613; Found: 381.1626.



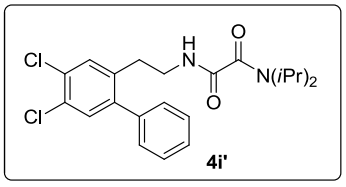
4h

Pale yellow solid; Yield (45%, 37.1 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55–7.53 (m, 2H), 7.42–7.38 (m, 2H), 7.35–7.31 (m, 1H), 7.00 (br s, 1H), 6.78 (s, 2H), 4.72–4.65 (m, 1H), 3.91 (s, 3H), 3.60–3.54 (m, 5H), 3.53–3.46 (m, 1H), 2.84 (t, *J* = 7.1 Hz, 2H), 1.40 (t, *J* = 6.2 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.35, 162.06, 152.22, 144.28, 137.25, 134.95, 133.43, 128.36, 127.22, 126.27, 121.87, 111.08, 59.73, 55.13, 48.75, 45.67, 39.55, 34.53, 19.96, 19.18; HRMS Calcd for $C_{24}H_{32}N_2NaO_4$ [M+Na$^+$]: 435.2260; Found: 435.2261.



4i

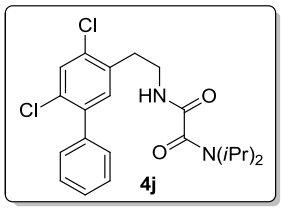
Pale yellow solid; Yield (51%, 42.8 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45–7.37 (m, 5H), 7.33 (d, *J* = 2.0 Hz, 1H), 7.14 (br s, 1H), 7.10 (d, *J* = 2.0 Hz, 1H), 4.63–4.56 (m, 1H), 3.59–3.53 (m, 2H), 3.52–3.46 (m, 1H), 2.85 (t, *J* = 7.2 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.41, 161.99, 141.90, 138.26, 137.20, 132.64, 129.23, 128.72, 128.41, 128.36, 127.25, 127.11, 48.84, 45.70, 39.10, 33.74, 19.94, 19.17; HRMS Calcd for $C_{22}H_{27}Cl_2N_2O_2$ [M+H$^+$]: 421.1450; Found: 421.1455.



4i'

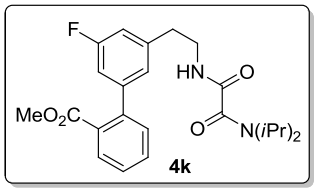
Pale yellow oil; Yield (9%, 7.6 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43–7.37 (m, 4H), 7.31 (s, 1H), 7.26–7.24 (m, 2H), 7.04 (br s, 1H), 4.60–4.53 (m, 1H), 3.51–3.44 (m, 1H), 3.33–3.28 (m, 2H), 2.77 (t, *J* = 7.4 Hz, 2H), 1.38 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101

MHz, $CDCl_3$) δ 163.18, 142.38, 139.15, 136.36, 131.93, 131.43, 131.41, 130.36, 129.00, 128.66, 127.94, 49.80, 46.66, 39.59, 38.82, 36.57, 32.15, 27.99, 20.93, 20.12; HRMS Calcd for $C_{22}H_{27}Cl_2N_2O_2$ [M+H^+]: 421.1450; Found: 421.1465.



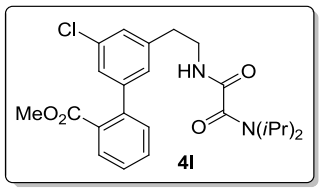
4j

Pale yellow oil; Yield (71%, 59.6 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (s, 1H), 7.44–7.36 (m, 5H), 7.23 (s, 1H), 7.10 (br s, 1H), 4.73–4.67 (m, 1H), 3.57–3.54 (m, 2H), 3.52–3.46 (m, 1H), 3.00 (t, *J* = 7.1 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 206.15, 162.33, 161.78, 138.48, 137.22, 134.15, 132.57, 132.51, 130.45, 129.52, 128.51, 127.25, 127.05, 48.69, 45.72, 37.84, 31.77, 30.06, 19.93, 19.14; HRMS Calcd for $C_{22}H_{27}Cl_2N_2O_2$ [M+H^+]: 421.1450; Found: 421.1457.



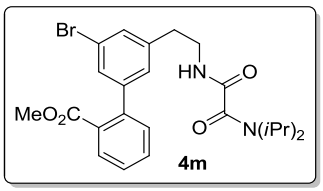
4k

Off-white solid; Yield (49%, 41.9 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (dd, *J* = 7.7, 1.2 Hz, 1H), 7.55–7.51 (m, 1H), 7.45–7.40 (m, 1H), 7.36 (dd, *J* = 7.6, 1.0 Hz, 1H), 7.01 (s, 1H), 6.95 (br s, 1H), 6.93–6.87 (m, 2H), 4.69–4.63 (m, 1H), 3.68 (s, 3H), 3.59–3.54 (m, 2H), 3.52–3.46 (m, 1H), 2.89 (t, *J* = 7.2 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.68, 162.42, 161.99, 161.65 (d, J_{C-F} = 244.0 Hz), 142.81 (d, J_{C-F} = 9.0 Hz), 140.35 (d, J_{C-F} = 2.0 Hz), 139.70 (d, J_{C-F} = 8.0 Hz), 130.58, 129.77, 129.68, 129.11, 126.82, 123.79 (d, J_{C-F} = 3.0 Hz), 113.56 (d, J_{C-F} = 21.0 Hz), 112.84 (d, J_{C-F} = 22.0 Hz), 51.24, 48.78, 45.66, 39.35, 34.36, 19.94, 19.17; HRMS Calcd for $C_{22}H_{27}FN_2NaO_2$ [M+Na^+]: 393.1954; Found: 393.1968.

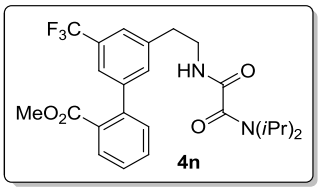


4l

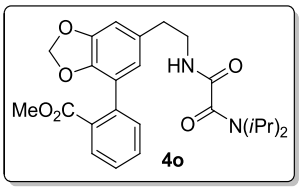
Pale yellow solid; Yield (62%, 55.1 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (dd, *J* = 7.7, 0.9 Hz, 1H), 7.55–7.51 (m, 1H), 7.45–7.41 (m, 1H), 7.35 (d, *J* = 7.6 Hz, 1H), 7.18 (d, *J* = 11.6 Hz, 2H), 7.05 (s, 1H), 7.02 (s, 1H), 4.67–4.60 (m, 1H), 3.68 (s, 3H), 3.59–3.54 (m, 2H), 3.52–3.45 (m, 1H), 2.87 (t, *J* = 7.2 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 206.13, 167.59, 162.48, 162.07, 142.42, 140.20, 139.20, 133.04, 130.64, 129.81, 129.56, 129.18, 126.87, 126.73, 126.37, 125.87, 51.24, 48.82, 45.63, 39.32, 34.24, 30.06, 19.93, 19.16; HRMS Calcd for $C_{24}H_{29}ClN_2NaO_4$ [M+Na^+]: 467.1714; Found: 467.1716.



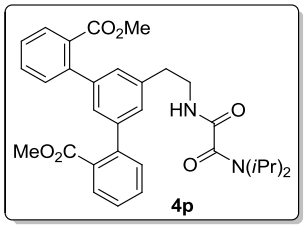
Pale yellow solid; Yield (65%, 63.4 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 7.7 Hz, 1H), 7.55–7.51 (m, 1H), 7.43 (dd, *J* = 7.5, 6.7 Hz, 1H), 7.34 (dd, *J* = 9.4, 4.3 Hz, 3H), 7.10 (s, 1H), 7.01 (br s, 1H), 4.67–4.61 (m, 1H), 3.68 (s, 3H), 3.59–3.54 (m, 2H), 3.52–3.46 (m, 1H), 2.87 (t, *J* = 7.2 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.58, 162.45, 161.99, 142.68, 140.09, 139.42, 130.65, 129.84, 129.63, 129.55, 129.21, 128.76, 126.90, 126.86, 121.24, 51.25, 48.82, 45.67, 39.36, 34.22, 19.97, 19.18; HRMS Calcd for $C_{24}H_{29}BrN_2NaO_4$ [M+Na^+]: 511.1208; Found: 511.1206.



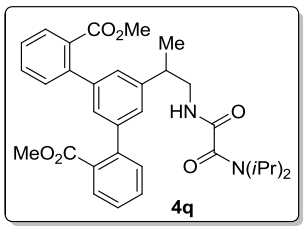
Yellow solid; Yield (53%, 50.7 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (d, *J* = 7.6 Hz, 1H), 7.56 (t, *J* = 7.4 Hz, 1H), 7.47–7.37 (m, 5H), 7.10 (br s, 1H), 4.68–4.62 (m, 1H), 3.66 (s, 3H), 3.62–3.57 (m, 2H), 3.52–3.46 (m, 1H), 2.96 (t, *J* = 7.1 Hz, 2H), 1.40 (d, *J* = 6.7 Hz, 6H), 1.18 (d, *J* = 6.6 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.45, 162.44, 161.90, 141.61, 140.18, 138.34, 131.41 (d, J_{C-F} = 1.0 Hz), 130.79, 129.94, 129.64, 129.54, 129.39, 127.07, 124.53, 123.38 (q, J_{C-F} = 4.0 Hz),123.18 (q, J_{C-F} = 270.0 Hz), 122.84 (q, J_{C-F} = 4.0 Hz), 51.20, 48.78, 45.70, 39.36, 34.40, 19.92, 19.15; HRMS Calcd for $C_{25}H_{29}F_3N_2NaO_4$ [M+Na^+]: 501.1977; Found: 501.1983.



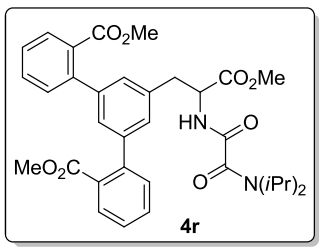
Off-white solid; Yield (81%, 73.5 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 (dd, *J* = 7.8, 1.1 Hz, 1H), 7.57–7.53 (m, 1H), 7.46–7.39 (m, 2H), 7.01 (br s, 1H), 6.70 (dd, *J* = 5.9, 1.5 Hz, 2H), 5.90 (s, 2H), 4.71–4.65 (m, 1H), 3.74 (s, 3H), 3.57–3.46 (m, 3H), 1.41 (d, *J* = 6.8 Hz, 6H), 1.19 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.51, 163.37, 163.11, 147.43, 143.57, 136.42, 132.37, 131.88, 131.20, 130.86, 130.22, 127.88, 122.85, 122.47, 108.51, 101.13, 52.23, 49.76, 46.64, 40.76, 35.39, 20.95, 20.18; HRMS Calcd for $C_{25}H_{30}N_2NaO_6$ [M+Na^+]: 477.2002; Found: 477.2000.



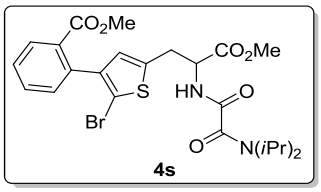
Pale yellow oil; Yield (60%, 65.3 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83–7.81 (m, 2H), 7.54–7.50 (m, 2H), 7.42–7.39 (m, 4H), 7.16 (d, *J* = 1.3 Hz, 2H), 7.12 (d, *J* = 1.4 Hz, 1H), 7.06 (br s, 1H), 4.70–4.64 (m, 1H), 3.67 (s, 6H), 3.62–3.57 (m, 2H), 3.51–3.44 (m, 1H), 2.93 (t, *J* = 7.2 Hz, 2H), 1.40 (d, *J* = 6.8 Hz, 6H), 1.17 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.15, 162.46, 162.10, 141.16, 140.62, 137.14, 130.41, 130.00, 129.91, 128.95, 126.86, 126.43, 125.91, 51.17, 48.76, 45.60, 39.68, 34.51, 19.92, 19.16; HRMS Calcd for $C_{32}H_{36}N_2NaO_6$ [M+Na$^+$]: 567.2471; Found: 567.2478.



Pale yellow oil; Yield (72%, 80.4 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82–7.80 (m, 2H), 7.54–7.50 (m, 2H), 7.40 (dd, *J* = 12.7, 4.9 Hz, 4H), 7.15 (d, *J* = 2.3 Hz, 3H), 6.94 (br s, 1H), 4.57–4.51 (m, 1H), 3.70– 3.61 (m, 7H), 3.48–3.41 (m, 1H), 3.39–3.33 (m, 1H), 3.09–3.03 (m, 1H), 1.38–1.33 (m, 9H), 1.16 (d, *J* = 6.6 Hz, 3H), 1.11 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.23, 162.65, 162.31, 142.41, 141.16, 140.58, 130.38, 130.08, 129.83, 128.92, 126.42, 125.93, 125.44, 51.16, 48.81, 45.45, 45.01, 38.69, 19.89, 19.82, 19.15, 19.13, 18.43; HRMS Calcd for $C_{33}H_{38}N_2NaO_6$ [M+Na$^+$]: 581.2628; Found: 581.2644.

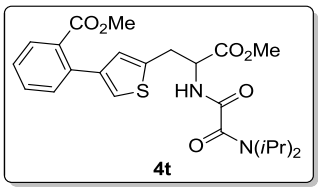


Pale yellow oil; Yield (58%, 69.8 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, *J* = 7.6 Hz, 2H), 7.51 (t, *J* = 7.1 Hz, 2H), 7.39 (t, *J* = 8.3 Hz, 5H), 7.09 (s, 3H), 4.90–4.85 (m, 1H), 4.59–4.53 (m, 1H), 3.69 (d, *J* = 17.4 Hz, 9H), 3.49–3.42 (m, 1H), 3.24 (d, *J* = 5.9 Hz, 2H), 1.39 (t, *J* = 6.8 Hz, 6H), 1.18 (d, *J* = 6.6 Hz, 3H), 1.07 (d, *J* = 6.6 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.27, 168.01, 161.95, 161.38, 141.07, 140.66, 134.30, 130.39, 129.97, 128.94, 127.32, 126.57, 126.46, 52.41, 51.61, 51.19, 48.76, 45.63, 36.93, 19.92, 19.76, 19.14, 19.11; HRMS Calcd for $C_{34}H_{38}N_2NaO_8$ [M+Na$^+$]: 625.2526; Found: 625.2542.



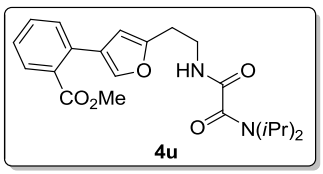
4s

Yellow oil; Yield (80%, 88.3 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (dd, *J* = 7.8, 1.1 Hz, 1H), 7.55–7.51 (m, 1H), 7.45–7.40 (m, 2H), 7.31–7.29 (m, 1H), 6.65 (s, 1H), 4.86–4.82 (m, 1H), 4.61–4.54 (m, 1H), 3.79 (s, 3H), 3.74 (s, 3H), 3.54–3.47 (m, 1H), 3.41–3.31 (m, 2H), 1.42 (dd, *J* = 6.8, 2.5 Hz, 6H), 1.21 (t, *J* = 6.3 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.52, 166.72, 162.13, 161.39, 140.37, 135.80, 135.04, 130.79, 130.33, 129.82, 129.48, 128.24, 127.16, 107.63, 52.04, 51.92, 51.45, 48.88, 45.70, 31.51, 20.00, 19.94, 19.19, 19.15; HRMS Calcd for $C_{24}H_{29}BrN_2NaO_6S$ [M+Na^+]: 575.0827; Found: 575.0810.



4t

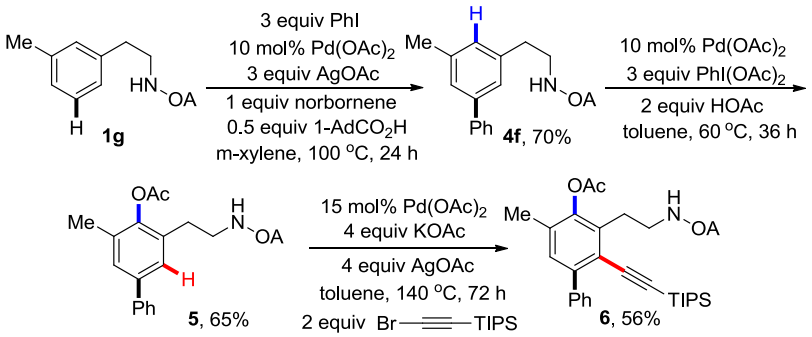
Yellow oil; Yield (61%, 57.8 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (dd, *J* = 7.5, 1.9 Hz, 1H), 7.49–7.45 (m, 1H), 7.38–7.33 (m, 3H), 7.06 (d, *J* = 1.4 Hz, 1H), 6.82 (d, *J* = 1.3 Hz, 1H), 4.88–4.84 (m, 1H), 4.61–4.54 (m, 1H), 3.78 (s, 3H), 3.73 (s, 3H), 3.53–3.46 (m, 1H), 3.42 (d, *J* = 5.3 Hz, 2H), 1.42 (dd, *J* = 6.8, 1.7 Hz, 6H), 1.20 (dd, *J* = 8.5, 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.70, 168.16, 162.08, 161.44, 140.46, 135.80, 135.72, 130.33, 129.99, 129.63, 128.66, 127.52, 126.40, 121.01, 52.26, 51.83, 51.31, 48.84, 45.67, 31.23, 19.97, 19.95, 19.18; HRMS Calcd for $C_{24}H_{31}N_2O_6S$ [M+H^+]: 475.1903; Found: 475.1918.



4u

Yellow oil; Yield (21%, 16.8 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (dd, *J* = 7.7, 1.0 Hz, 1H), 7.49–7.45 (m, 2H), 7.38–7.32 (m, 2H), 7.08 (br s, 1H), 6.20 (s, 1H), 4.75–4.69 (m, 1H), 3.81 (s, 3H), 3.63–3.58 (m, 2H), 3.53–3.47 (m, 1H), 2.91 (t, *J* = 6.7 Hz, 2H), 1.41 (d, *J* = 6.8 Hz, 6H), 1.21 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.23, 162.39, 161.97, 151.83, 137.94, 131.69, 130.39, 129.82, 129.41, 128.68, 126.22, 125.03, 107.50, 51.35, 48.78, 45.69, 37.00, 27.14, 19.98, 19.19; HRMS Calcd for $C_{22}H_{29}N_2O_5$ [M+H^+]: 401.2076; Found: 401.2085.

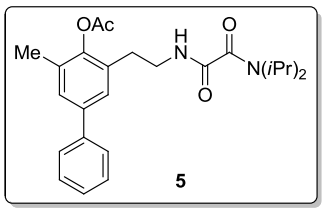
7. Pd-catalyzed trifunctionlization of presubstituted β-arylethamide



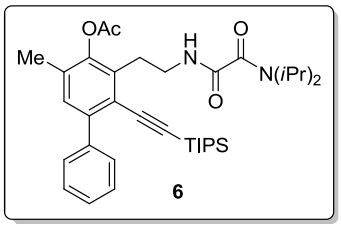
The first step: a mixture of oxalamide **1g** (0.2 mmol, 1.0 eq), iodobenzene (0.6 mmol, 3.0 eq), $Pd(OAc)_2$ (4.5 mg, 10 mol%), AgOAc (100 mg, 0.6 mmol, 3.0 eq), norbornene (18.8 mg, 0.2 mmol, 1.0 eq), 1-AdOH (18 mg, 0.1 mmol, 0.05 eq) and 1 mL m-xylene in a 15 mL glass vial was heated at 100 °C with vigorous stirring for 24 hours. The reaction mixture was cooled to room temperature, and diluted with ethyl acetate and filtered through celite. The filtrate was concentrated in vacuo and purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:8) to give product **4f**.

The second step: a mixture of presubstituted β-arylethamide **4f** (0.2 mmol, 1.0 eq), $Pd(OAc)_2$ (4.5 mg, 10 mol%), $PhI(OAc)_2$ (0.6 mmol, 3.0 eq), HOAc (0.4 mmol, 2.0 eq) and 1 mL toluene in a 15 mL glass vial was heated at 60 °C with vigorous stirring for 36 hours. The reaction mixture was cooled to room temperature, and diluted with ethyl acetate and filtered through celite. The filtrate was concentrated in vacuo and purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:4) to give product **5**.

The third step: a mixture of presubstituted β-arylethamide **5** (0.2 mmol, 1.0 eq), bromoalkyne (0.4 mmol, 2.0 eq), $Pd(OAc)_2$ (6.6 mg, 15 mol%), KOAc (0.8 mmol, 4.0 eq), AgOAc (0.8 mmol, 4.0 eq), and 1 mL toluene in a 15 mL glass vial was heated at 140 °C with vigorous stirring for 72 hours. The reaction mixture was cooled to room temperature, and diluted with ethyl acetate and filtered through celite. The filtrate was concentrated in vacuo and purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:20) to give product **6**.

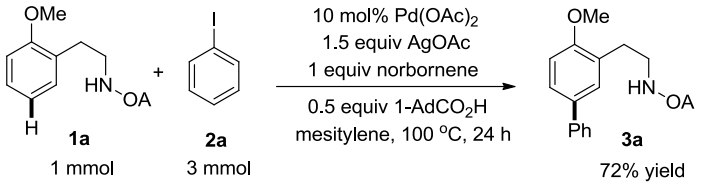


Yellow oil; Yield (65%, 55.1 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57–7.55 (m, 2H), 7.43–7.39 (m, 2H), 7.34–7.31 (m, 3H), 7.01 (br s, 1H), 4.66–4.59 (m, 1H), 3.57–3.44 (m, 2H), 3.47 (dd, *J* = 13.6, 6.8 Hz, 1H), 2.80 (t, *J* = 7.3 Hz, 2H), 2.41 (s, 3H), 2.22 (s, 3H), 1.41 (d, *J* = 6.8 Hz, 6H), 1.16 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.57, 162.50, 162.15, 146.72, 139.50, 138.47, 130.13, 129.97, 127.83, 127.59, 126.43, 126.31, 125.99, 48.75, 45.61, 38.39, 29.39, 19.92, 19.74, 19.16, 15.77; HRMS Calcd for $C_{25}H_{32}N_2NaO_4$ [M+Na$^+$]: 447.2260; Found: 447.2256.

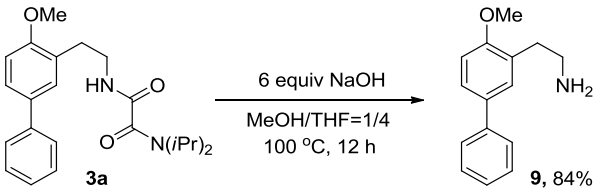


Yellow oil; Yield (56%, 67.6 mg); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 (d, *J* = 6.8 Hz, 2H), 7.37–7.28 (m, 3H), 7.10 (s, 1H), 6.98 (br s, 1H), 4.81–4.75 (m, 1H), 3.56–3.48 (m, 3H), 3.07 (s, 2H), 2.43 (s, 3H), 2.18 (s, 3H), 1.43 (d, *J* = 6.8 Hz, 6H), 1.22 (d, *J* = 6.7 Hz, 6H), 0.97 (d, *J* = 3.0 Hz, 21H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.66, 163.35, 162.90, 147.60, 143.42, 140.54, 133.64, 131.38, 130.72, 129.51, 127.96, 127.35, 121.26, 103.74, 98.70, 49.57, 46.64, 39.05, 29.36, 21.03, 20.71, 20.19, 18.68, 16.89, 11.33; HRMS Calcd for $C_{36}H_{52}N_2NaO_4Si$ [M+Na^+]: 627.3594; Found: 627.3597.

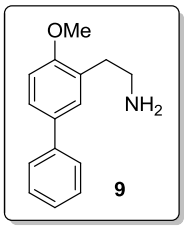
8. Scale up and removal of directing group



A mixture of **1a** (1 mmol, 306.4 mg), 2 (3 mmol, 3.0 eq), $Pd(OAc)_2$ (22.4 mg, 10 mol%), AgOAc (250 mg, 1.5 mmol, 1.5 eq), norbornene (94 mg, 1 mmol, 1.0 eq), 1-$AdCO_2H$ (90 mg, 0.5 mmol, 0.05 eq) and 5 mL mesitylene in a 15 mL glass vial was heated at 100 °C with vigorous stirring for 24 hours. The reaction mixture was cooled to room temperature, and diluted with ethyl acetate and filtered through celite. The filtrate was concentrated in vacuo and purified by column chromatography on silica gel to give product **3a**.



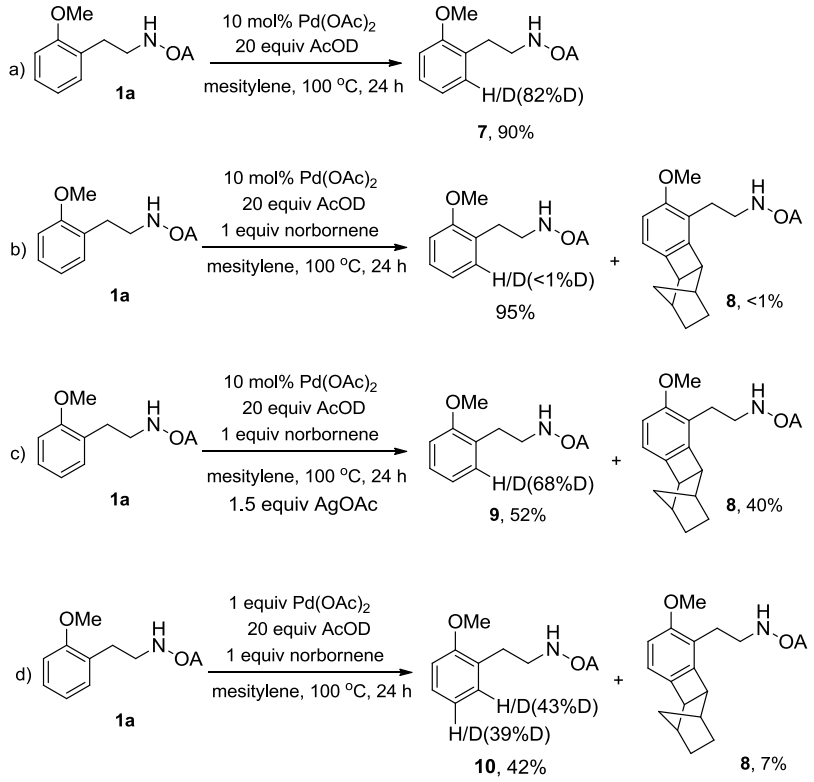
The compound **3a** (76.5 mg, 0.2 mmol) was dissolved in a mixture of MeOH/THF (0.2 mL /0.8 mL), NaOH (48 mg, 0.12 mmol, 6 eq) was then added. The mixture was heated to 100 °C and stirred for 12 hours. Water was added and the mixture was extracted with DCM. The combined organic layers was washed with water and brine, dried over anhydrous Na_2SO_4, and concentrated in vacuo. The residue was purified by column chromatography on silica gel (Methanol/DCM = 1:20) to give the desired product **9** as white solid in 38.1 mg, 84% yield.



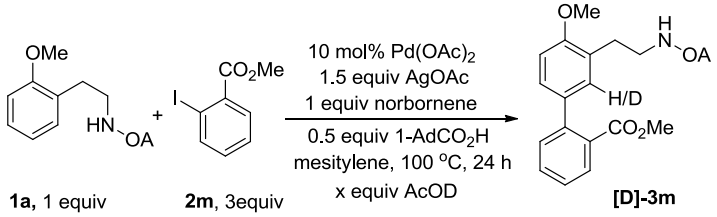
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56–7.54 (m, 2H), 7.45– 7.39 (m, 4H), 7.32–7.27 (m, 1H), 6.93 (d, *J* = 8.4 Hz, 1H), 3.86 (s, 3H), 2.98 (t, *J* = 6.9 Hz, 2H), 2.84 (t, *J* = 6.9 Hz, 2H), 2.03 (br s, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 157.39, 140.97, 133.60, 129.50, 128.82, 128.37, 126.87, 126.75, 126.19, 110.78, 55.57, 42.20, 34.83; HRMS Calcd for $C_{15}H_{18}NO$ [M+H$^+$]: 228.1388; Found: 228.1381.

9. Deuteration experiment

A: Deuteration study



B: *Meta* arylation with different amount of AcOD



	[D]-3m	
x	D	Yield
2	8%	63%
4	18%	50%
6	27%	44%
8	35%	40%
10	42%	38%

Procedure for A:

a) A mixture of compound **1a** (0.2 mmol), $Pd(OAc)_2$ (4.5 mg, 10 mol%), AcOD (4 mmol, 20.0 eq) and mesitylene (1 mL) was heated at 100 ^oC for 24 hours. The reaction mixture was cooled to room temperature, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:10) to give the deuterated product **7**.

b) A mixture of compound **1a** (0.2 mmol), $Pd(OAc)_2$ (4.5 mg, 10 mol%), AcOD (4 mmol, 20.0 eq), norbornene (18.8 mg, 1.0 eq) and mesitylene (1 mL) was heated at 100 ^oC for 24 hours. The reaction mixture was cooled to room temperature, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:10) to give the product.

c) A mixture of compound **1a** (0.2 mmol), $Pd(OAc)_2$ (4.5 mg, 10 mol%), AcOD (4 mmol, 20.0 eq), AgOAc (50 mg, 1.5 eq), norbornene (18.8 mg, 1.0 eq) and mesitylene (1 mL) was heated at 100 ^oC for 24 hours. The reaction mixture was cooled to room temperature, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:10) to give the product.

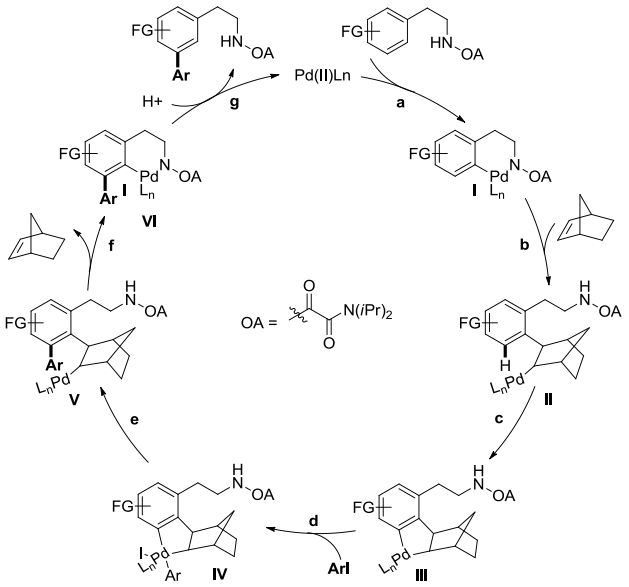
Procedure for B:

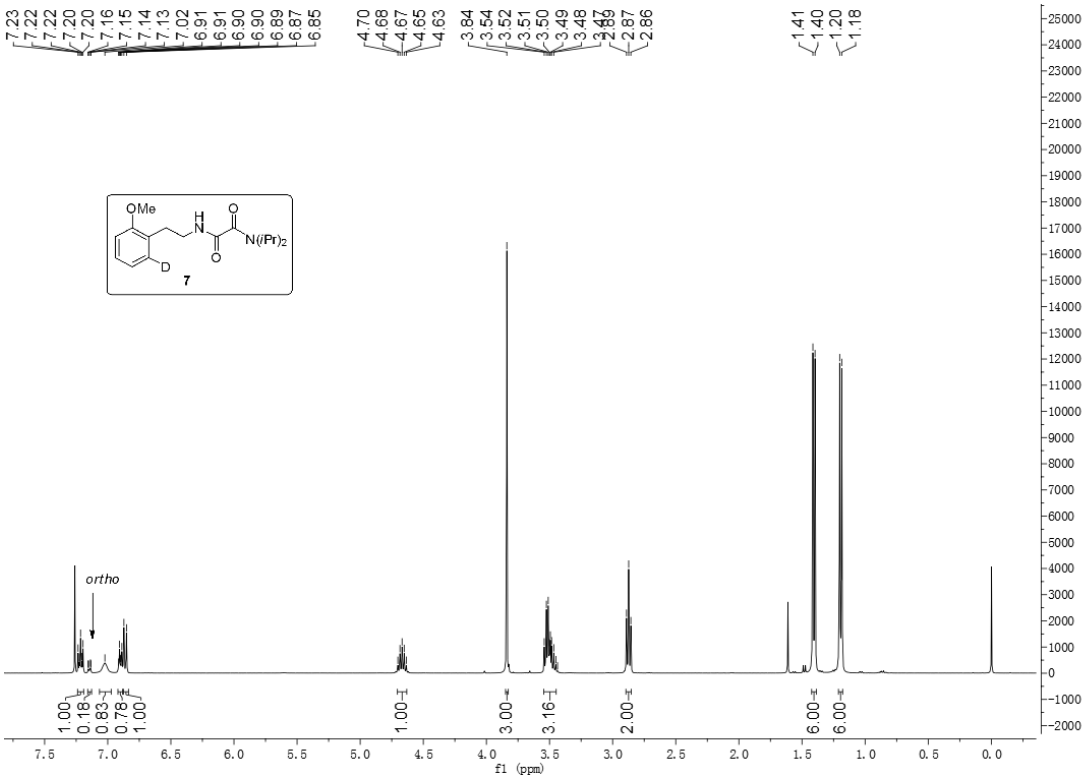
A mixture of compound **7** (0.2 mmol, 1.0 eq), **2m** (0.6 mmol, 3.0 eq), $Pd(OAc)_2$ (4.5 mg, 10 mol%), AgOAc (50 mg, 1.5 eq), norbornene (18.8 mg, 1.0 eq), 1-$AdCO_2H$ (18 mg, 0.5 eq) and mesitylene (1 mL) was heated at 100 ^oC for 4 hours. The reaction mixture was cooled to room temperature, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:3) to give the product.

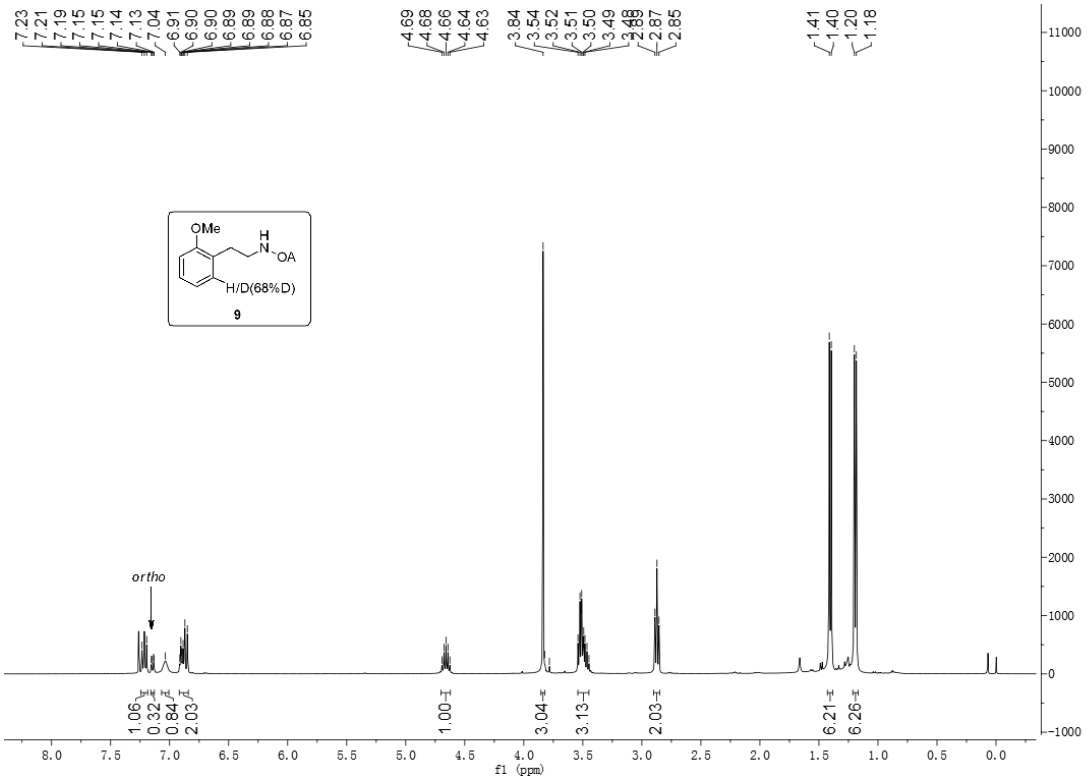
Procedure for C:

A mixture of compound **1a** (0.2 mmol, 1.0 eq), **2m** (0.6 mmol, 3.0 eq), $Pd(OAc)_2$ (4.5 mg, 10 mol%), AgOAc (50 mg, 1.5 eq), norbornene (18.8 mg, 1.0 eq), 1-$AdCO_2H$ (18 mg, 0.5 eq), AcOD (from 2.0 eq to 10.0 eq) and mesitylene (1 mL) was heated at 100 ^oC for 24 hours. The resulting residue was purified by column chromatography on silica gel (Ethyl acetate/Petroleum ether = 1:3) to give the product **[D]-3m**.

Plausible catalytic cycle for *meta* arylation




7.23
7.22
7.22
7.20
7.20
7.16
7.15
7.14
7.13
7.02
6.91
6.91
6.90
6.90
6.89
6.87
6.85
4.70
4.68
4.67
4.65
4.63
3.84
3.54
3.52
3.51
3.50
3.49
3.48
3.47
2.89
2.87
2.86
1.41
1.40
1.20
1.18
OMe
N(iPr)2
D
7
ortho
1.00
0.18
0.83
0.78
1.00
1.00
3.00
3.16
2.00
6.00
6.00
f1 (ppm)


7.23
7.21
7.19
7.15
7.15
7.14
7.13
7.04
6.91
6.90
6.90
6.89
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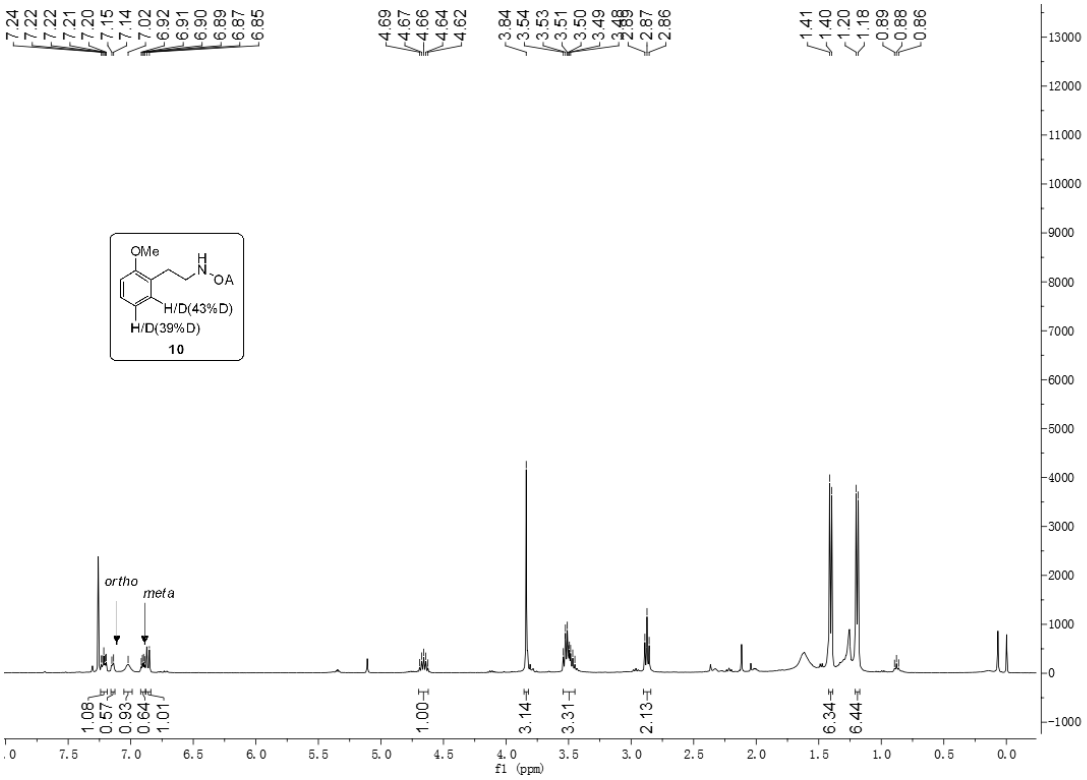
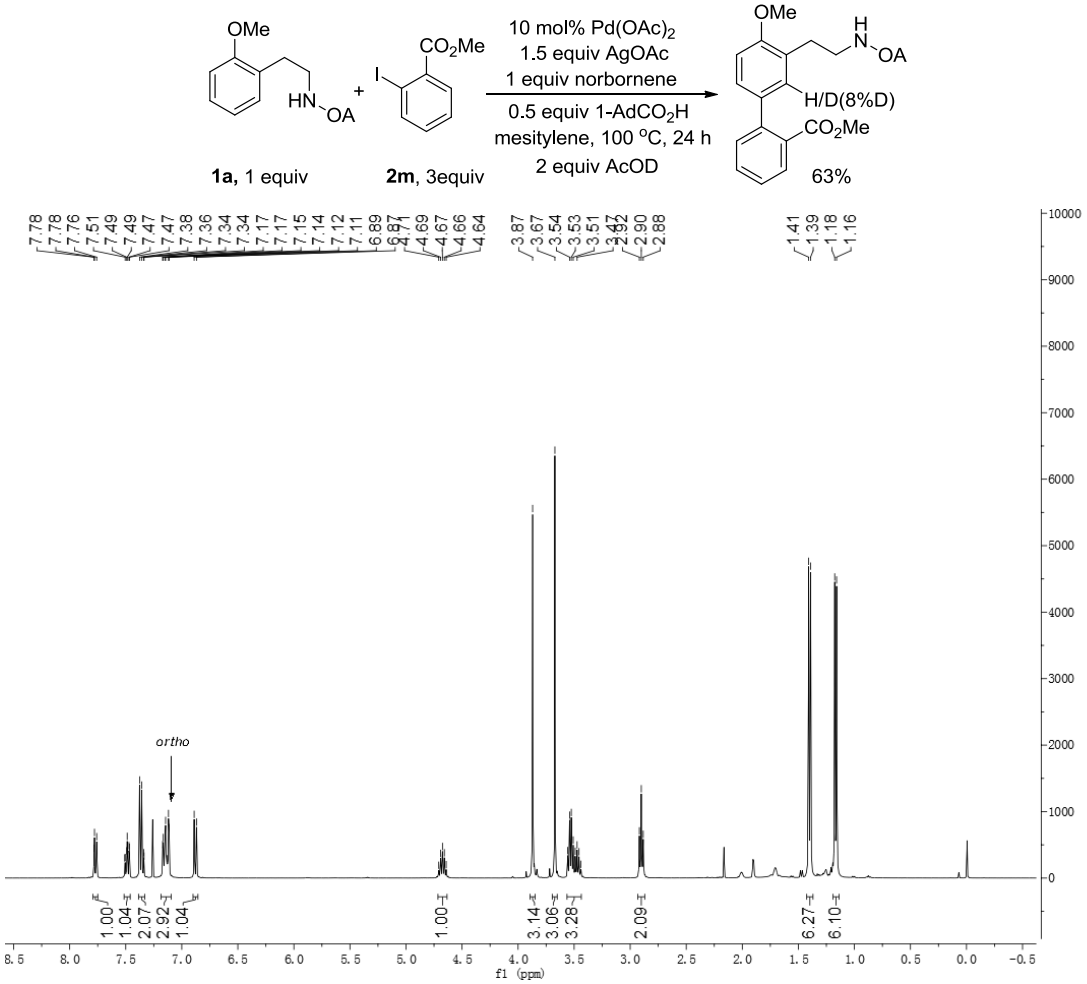
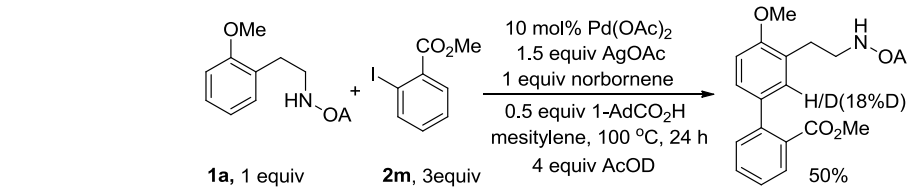
6.88
6.87
6.85
4.69
4.68
4.66
4.64
4.63
3.84
3.54
3.52
3.51
3.50
3.49
3.48
2.89
2.87
2.85
1.41
1.40
1.20
1.18
OMe
OA
H/D(68%D)
9
ortho
1.06
0.32
0.84
2.03
1.00
3.04
3.13
2.03
6.21
6.26
f1 (ppm)

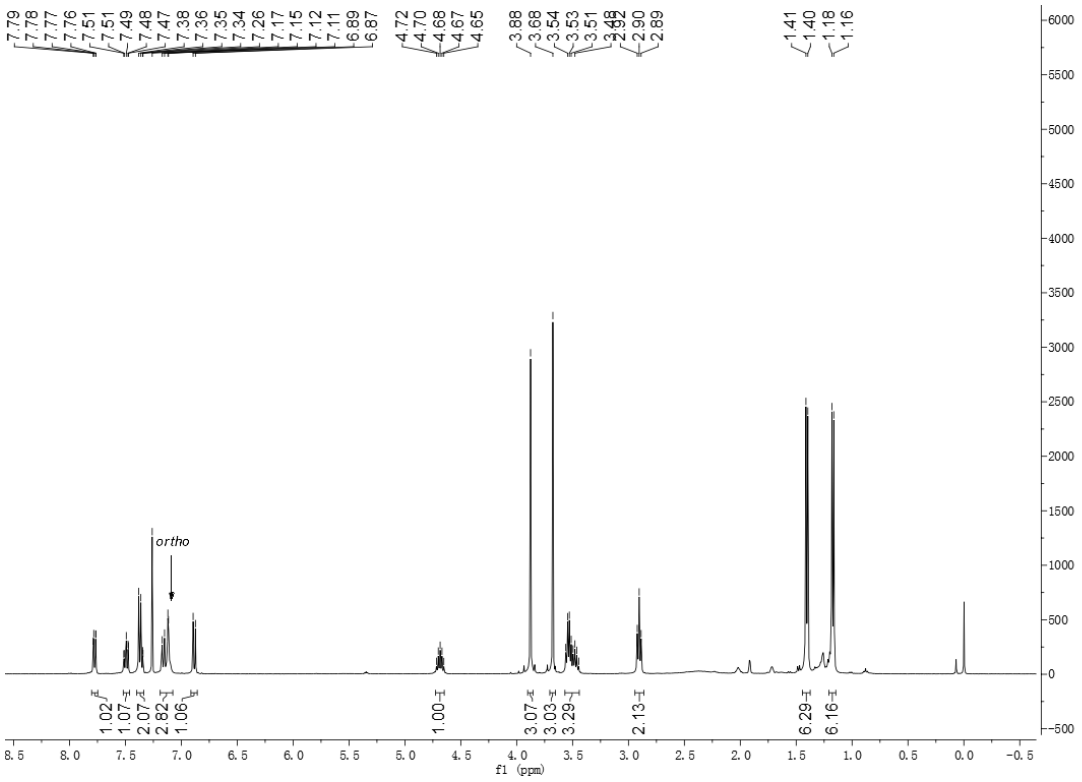


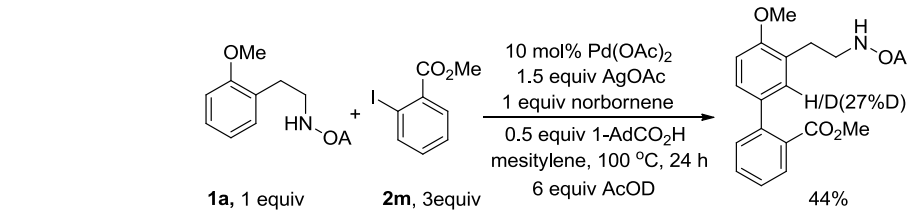
^{1}H NMR spectra of reaction with different amount fo AcOD



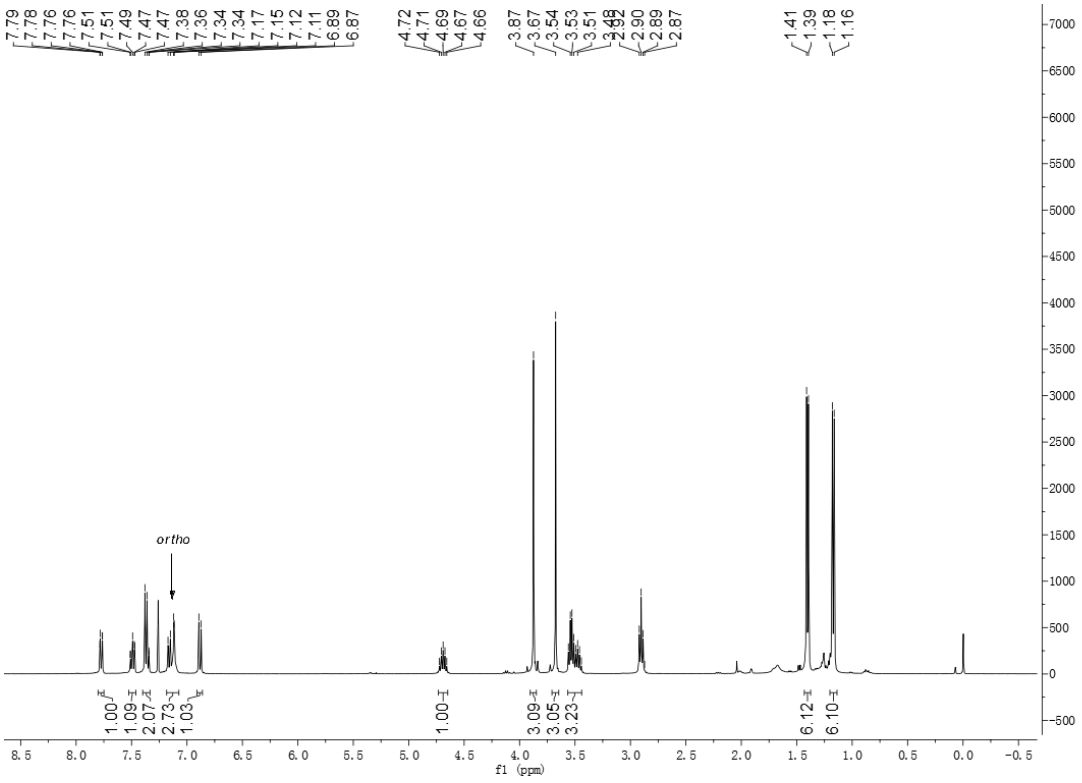


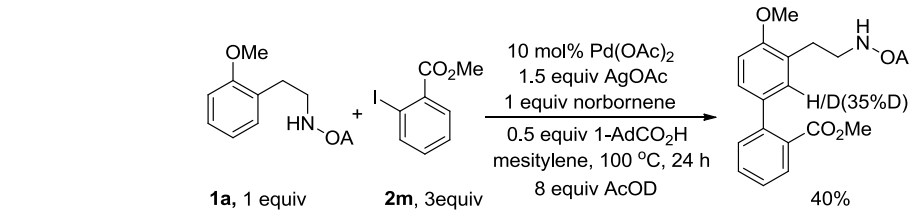
1a, 1 equiv **2m**, 3equiv



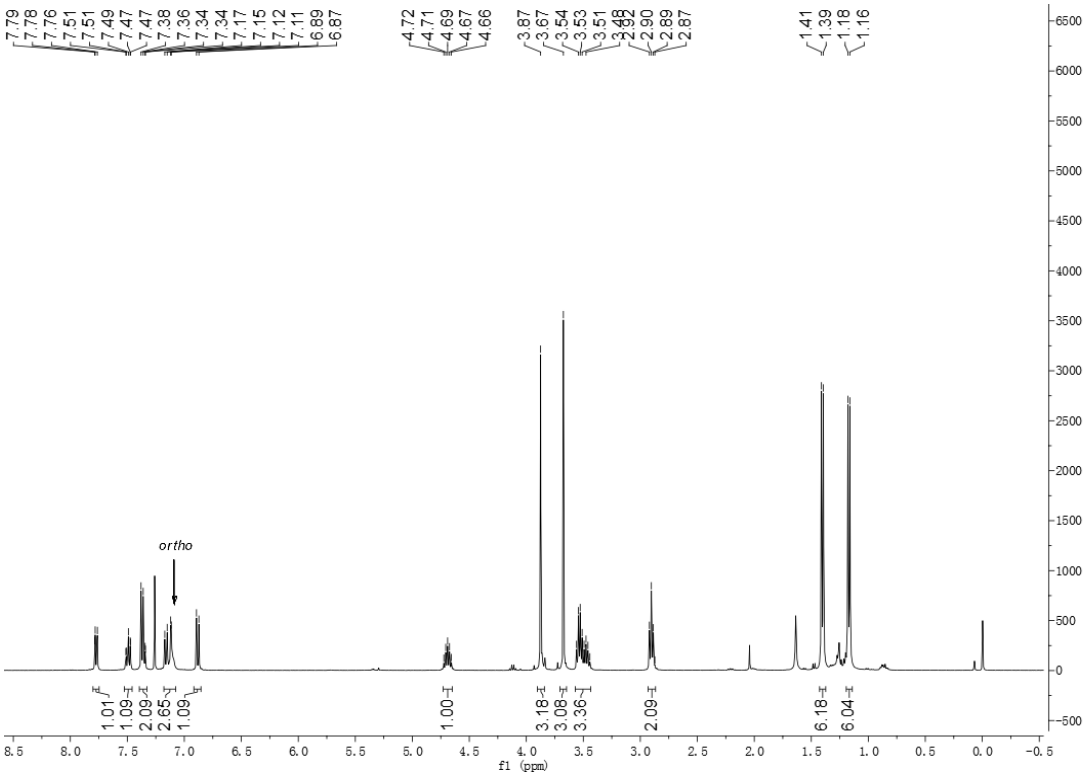


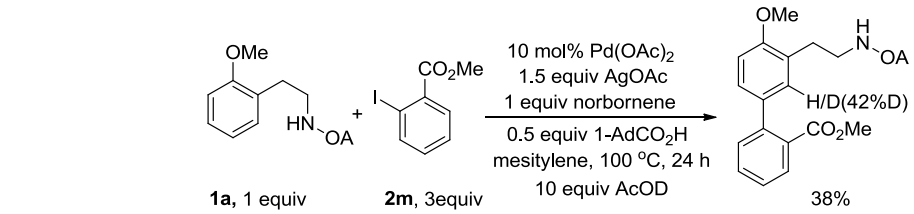
1a, 1 equiv **2m**, 3equiv 44%

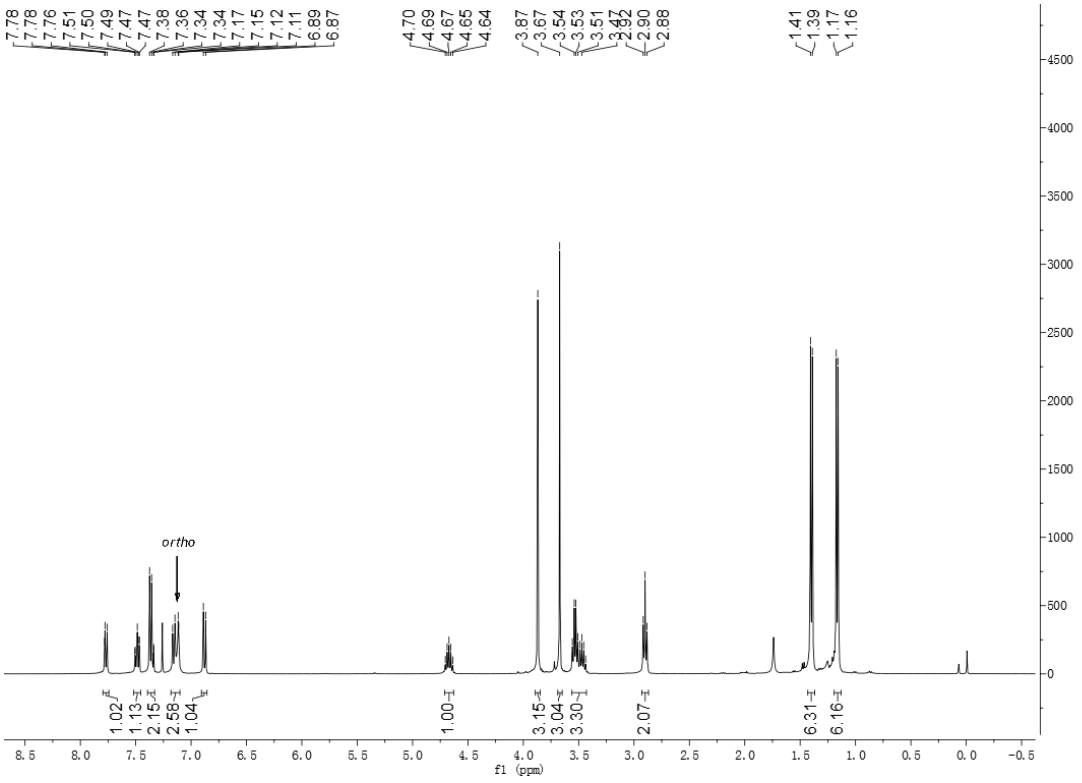




1a, 1 equiv **2m**, 3equiv 40%







10. References

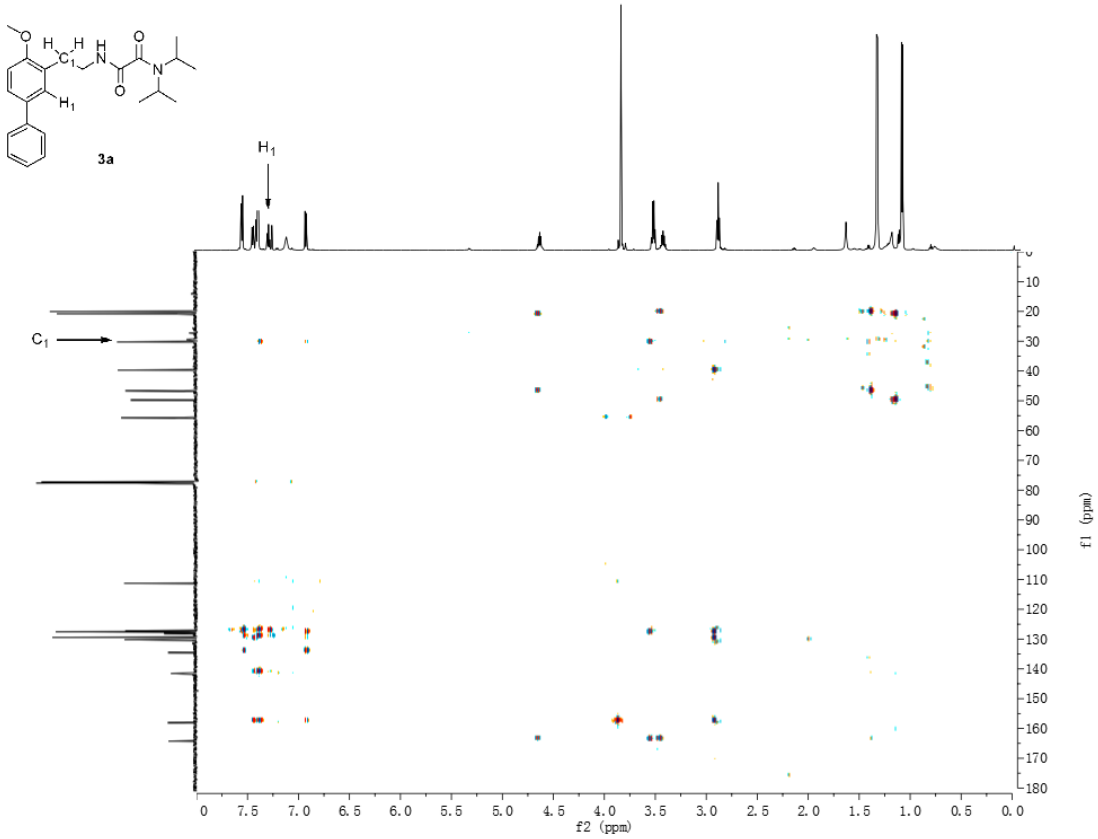
[1] G. Xu, S. R. Gilbertson, *Org. Lett.* 2005, *7*, 4605.

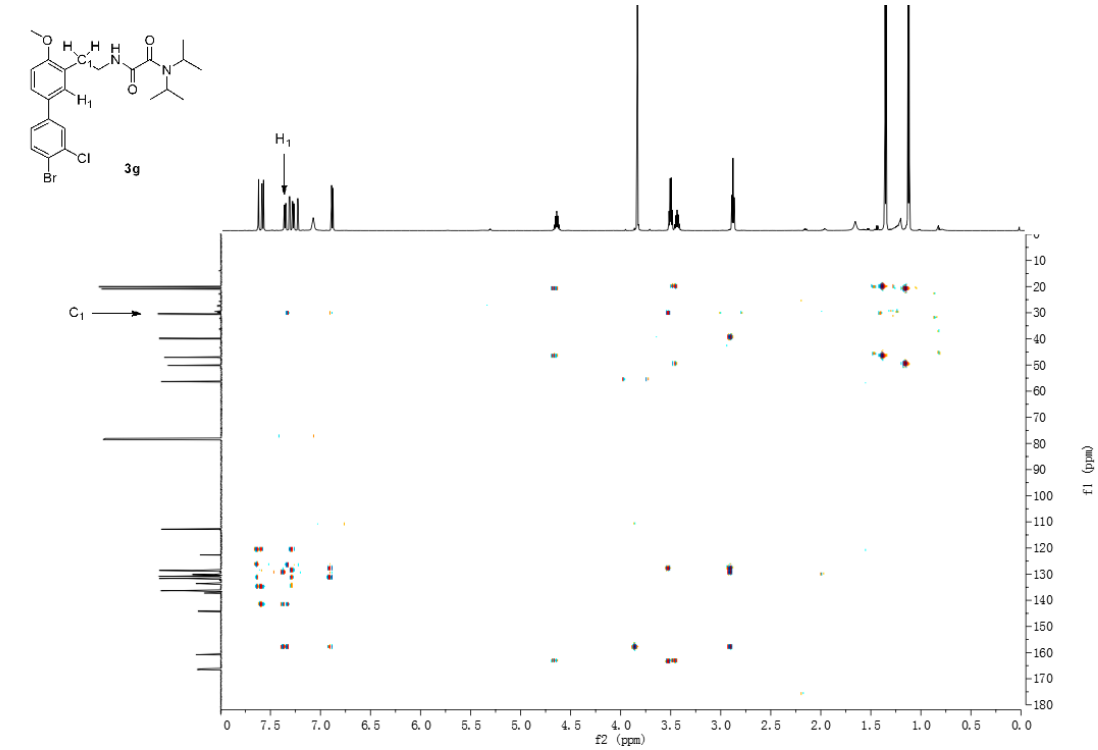
[2] J. Han, P. Liu, Wang, Q. Wang, J.-Y. Zhang, Y. Zhao, D.-Q, Shi, Z.-B. Huang, Y.-S. Zhao, *Org. Lett.* 2014, *16*, 5682

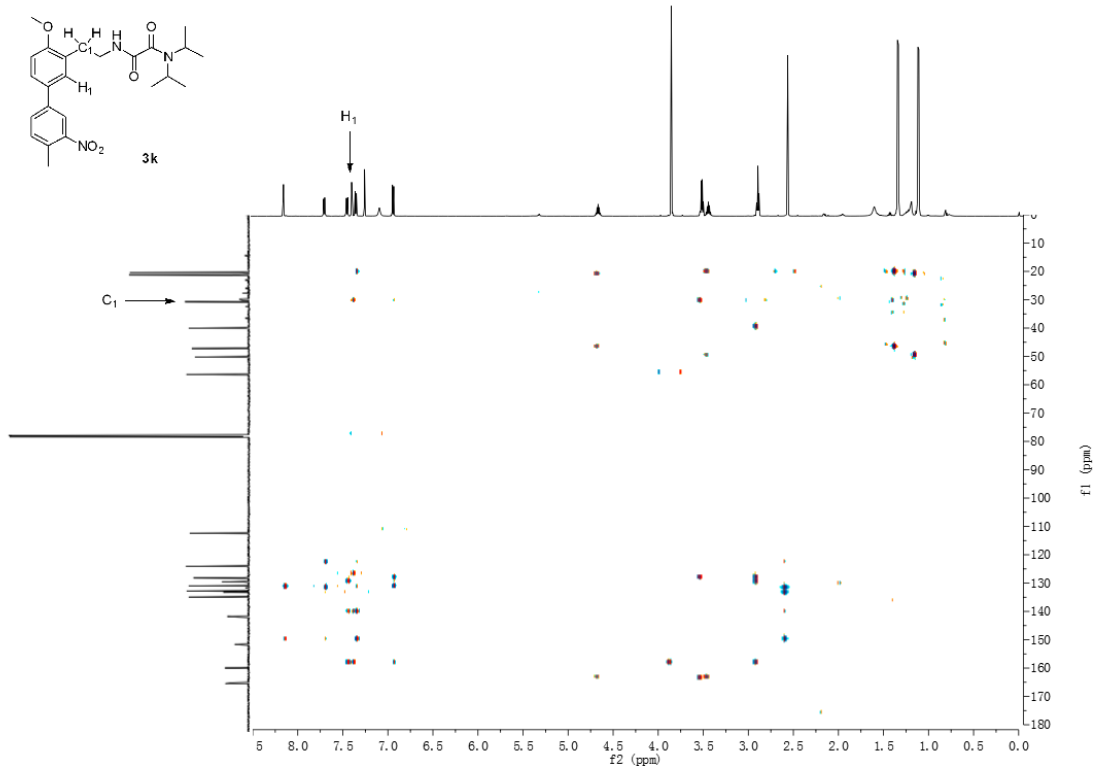
[3] M.-Y. Guan, C.-P. Chen, J.-Y. Zhang, R.-S. Zeng, Y.-S. Zhao, *Chem. Commun.* **2015**, *51*, 12103.

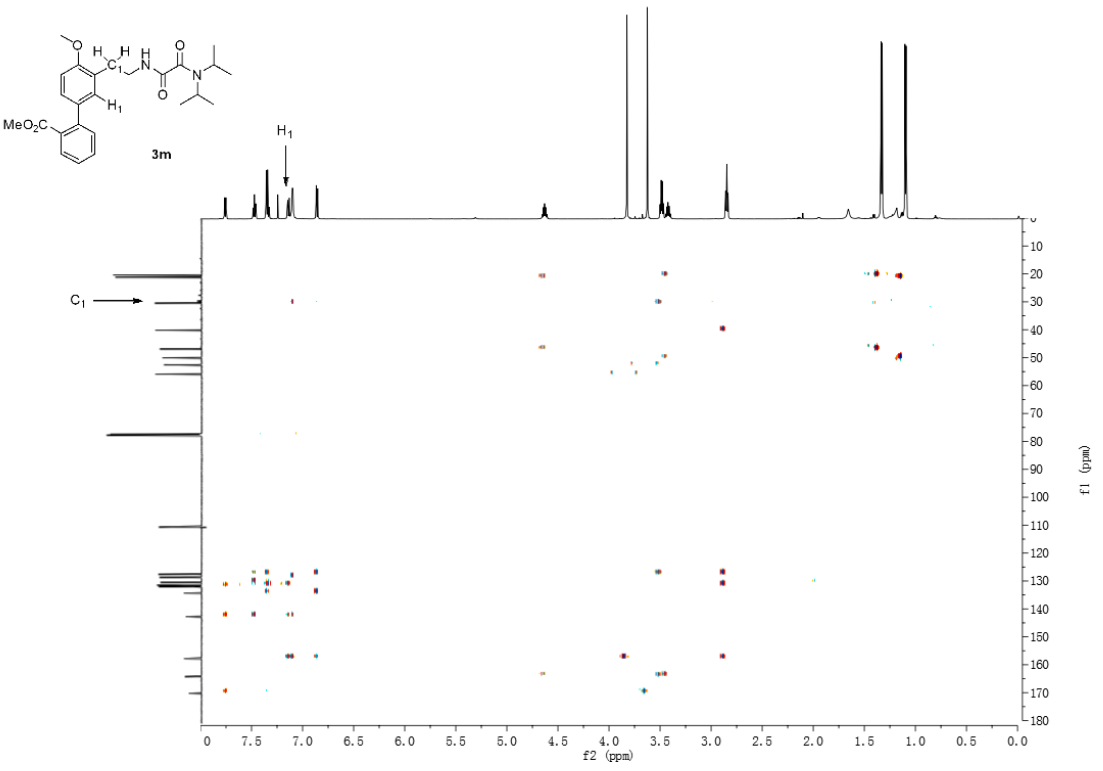
[4] C. Wang, C.-P. Chen, J.-Y. Zhang, J. Han,; Q. Wang, K. Guo, P. Liu, M.-Y. Guan, Y.-M. Yao, Y.-S. Zhao, *Angew. Chem., Int. Ed.* 2014, *53*, 9884.

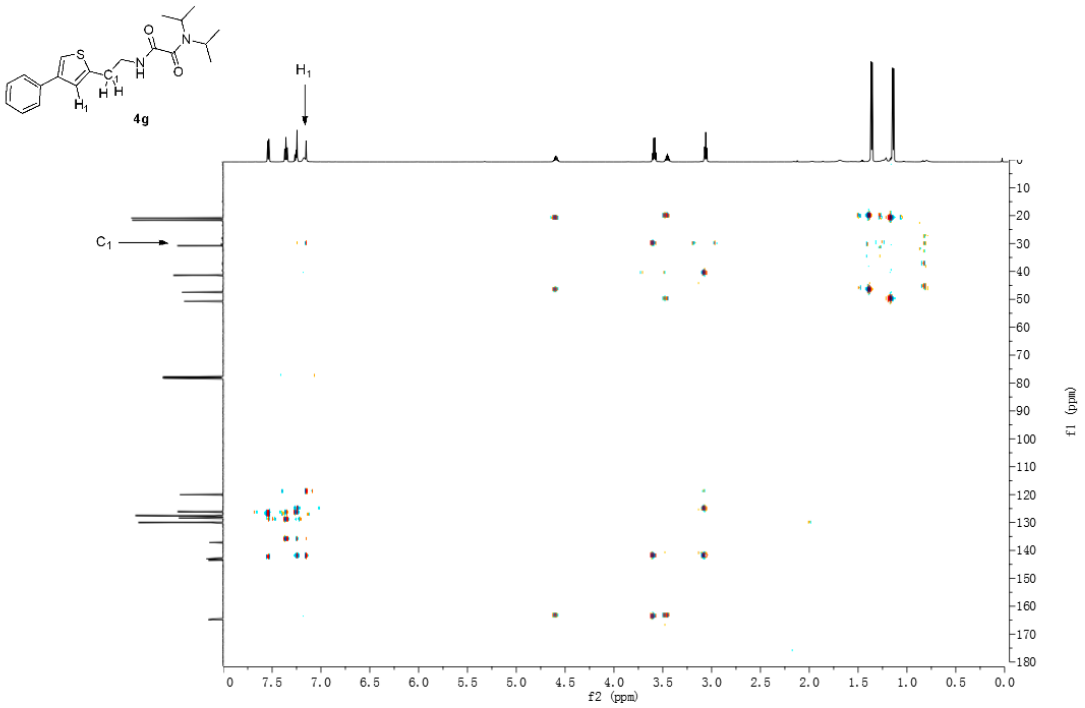
11. The structure determination of 3a, 3g, 3k, 3m, 4g, 4j and 5 according to HMBC spectrum

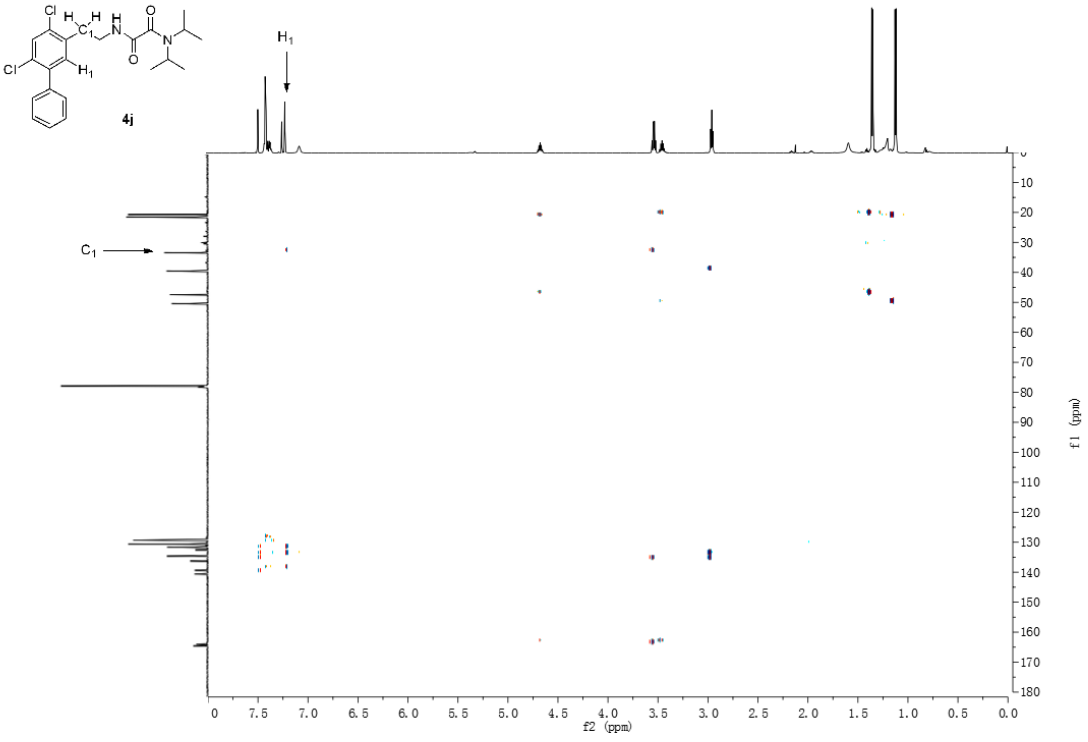


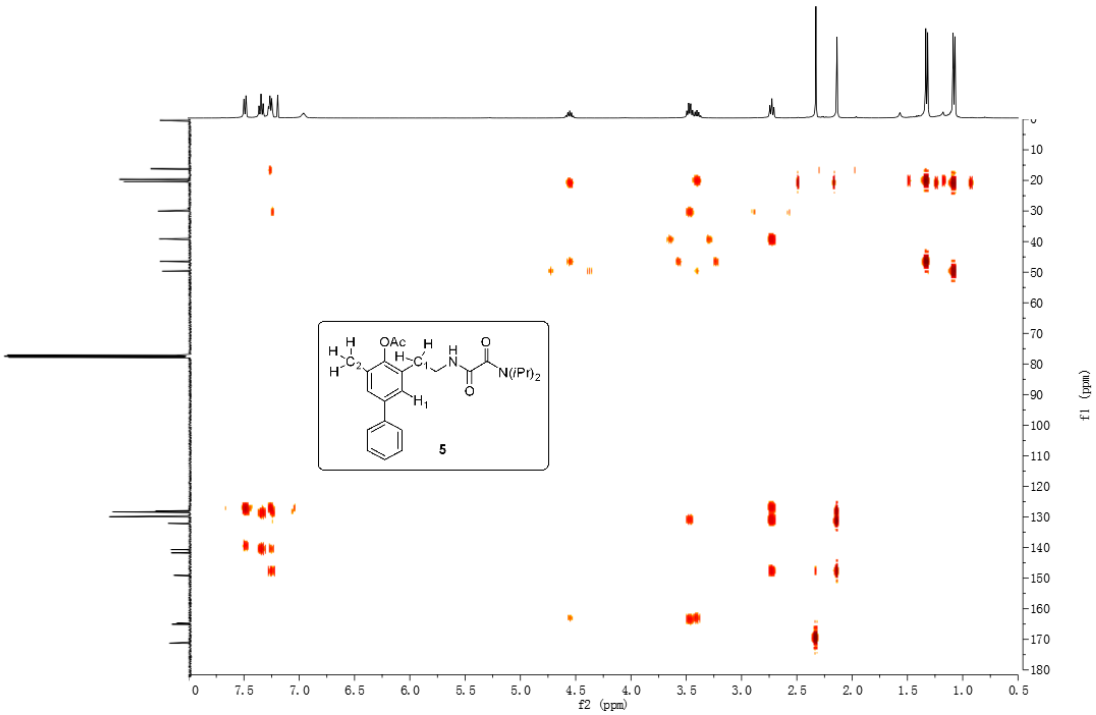


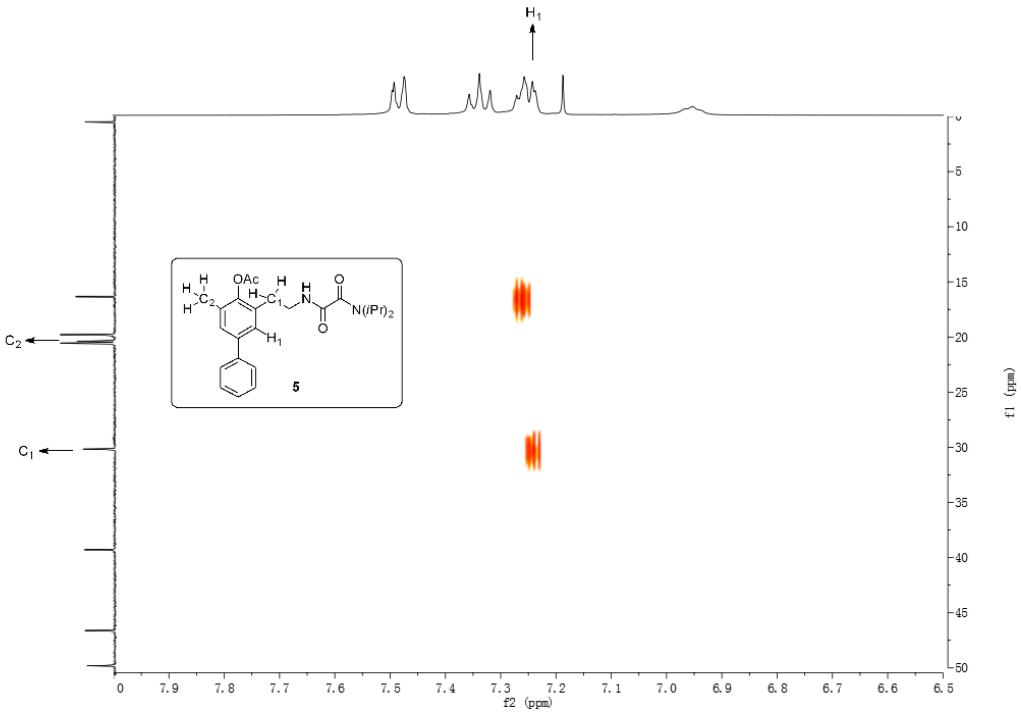

3k
H1
C1
f2 (ppm)
f1 (ppm)


3m
H1
C1
f2 (ppm)
f1 (ppm)

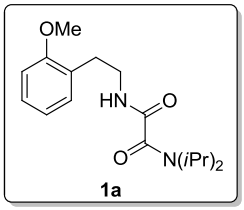

4g
H1
C1
f2 (ppm)
f1 (ppm)


4j
H1
C1
f2 (ppm)
f1 (ppm)

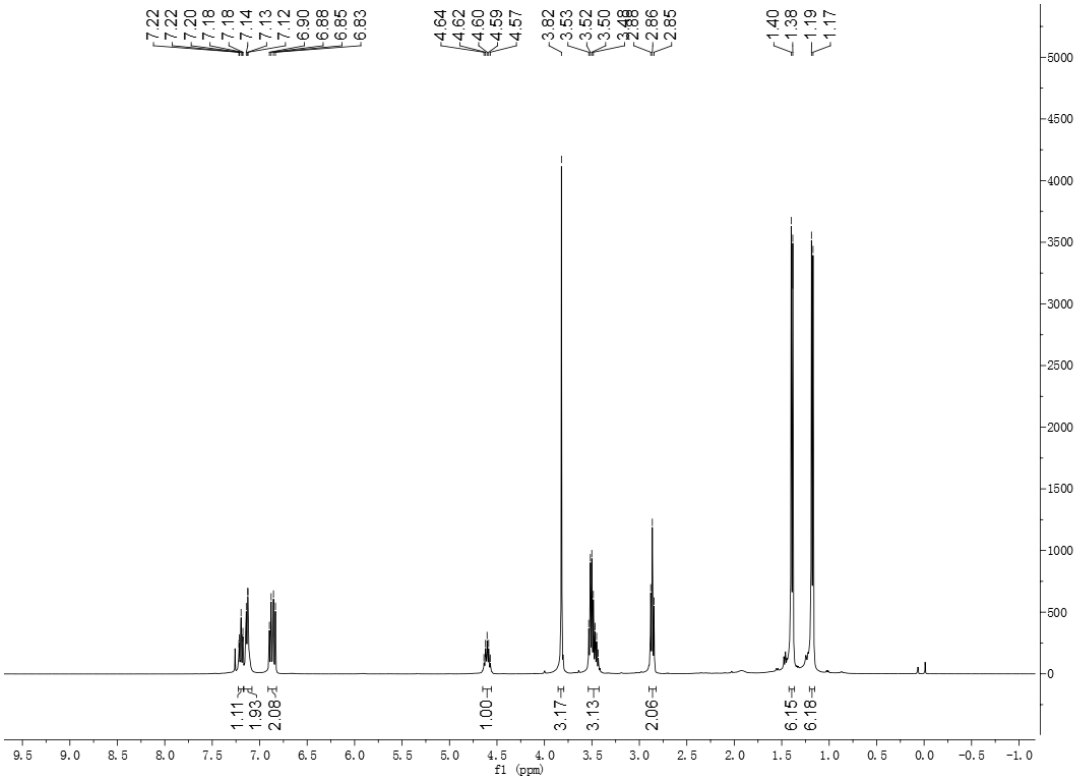


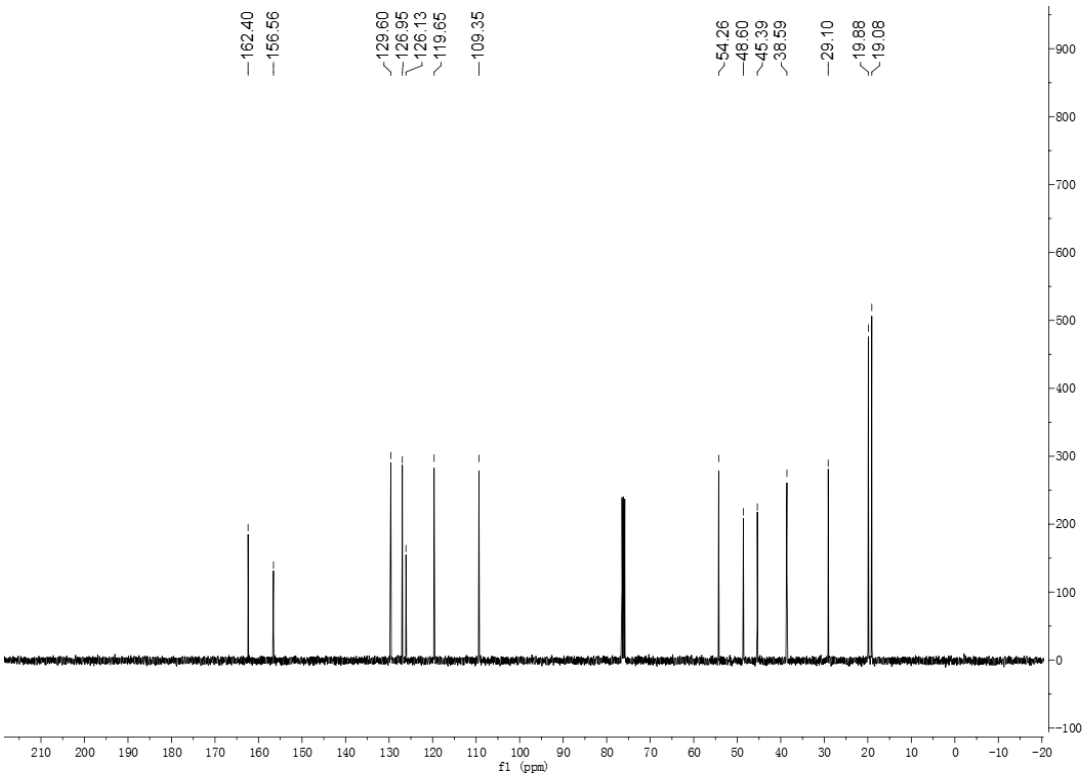


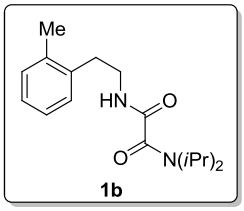
12. ^{1}H and ^{13}C NMR spectra


OMe
HN
O
O
N(iPr)2

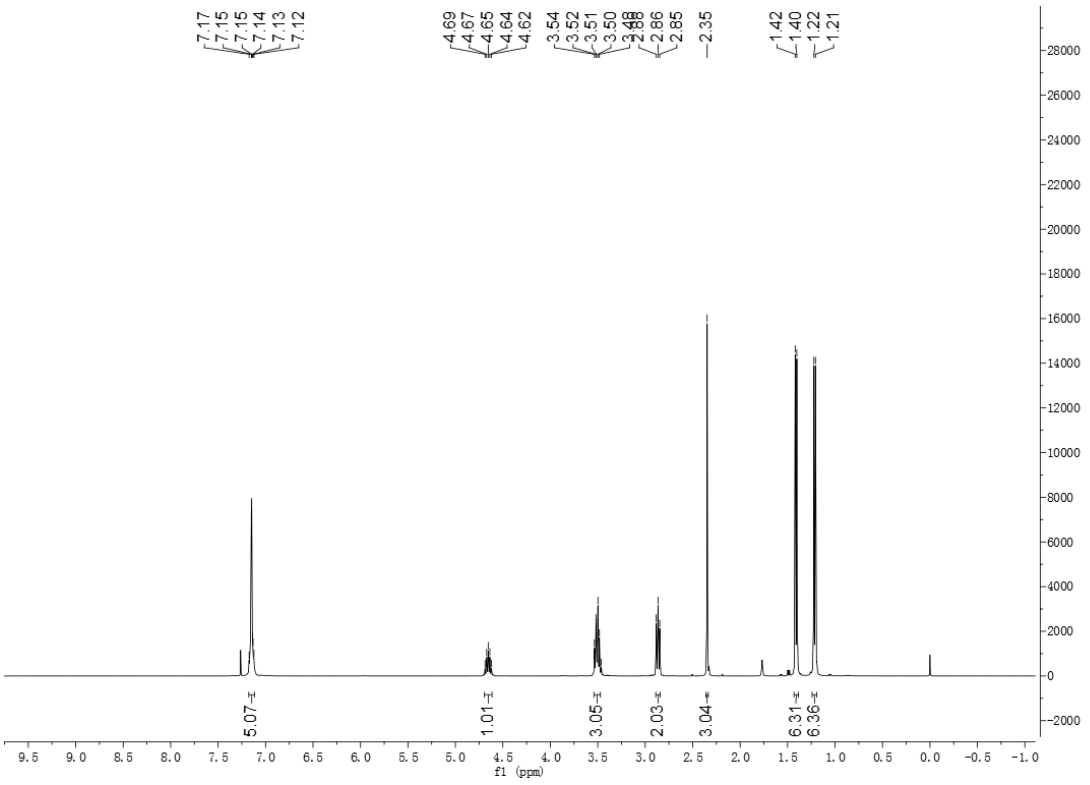
1a


7.22
7.22
7.20
7.18
7.18
7.14
7.13
7.12
6.90
6.88
6.85
6.83
4.64
4.62
4.60
4.59
4.57
3.82
3.53
3.52
3.50
2.88
2.86
2.85
1.40
1.38
1.19
1.17
1.11
1.93
2.08
1.00
3.17
3.13
2.06
6.15
6.18
f1 (ppm)


162.40
156.56
129.60
126.95
126.13
119.65
109.35
54.26
48.60
45.39
38.59
29.10
19.88
19.08
f1 (ppm)


Me
HN
O
O
N(iPr)2

1b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7.15
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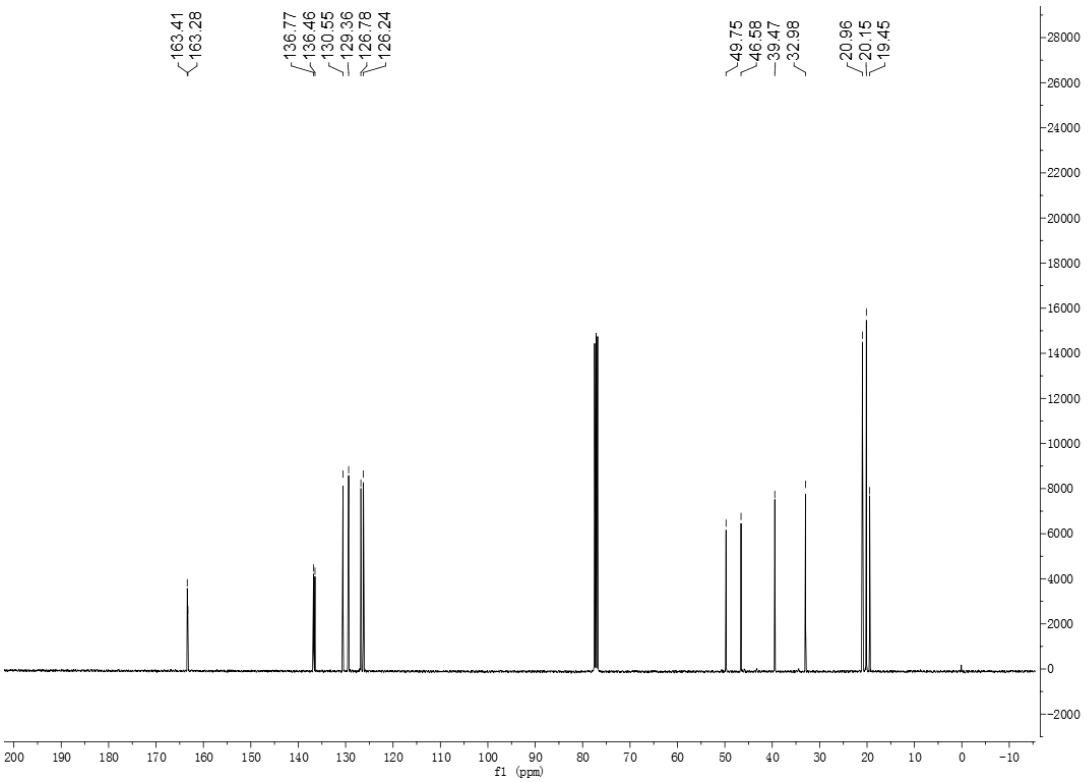
7.13
7.12
4.69
4.67
4.65
4.64
4.62
3.54
3.52
3.51
3.50
2.86
2.85
2.35
1.42
1.40
1.22
1.21
5.07
1.01
3.05
2.03
3.04
6.31
6.36
f1 (ppm)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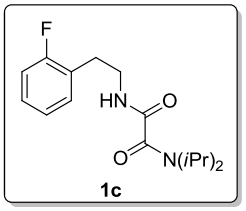
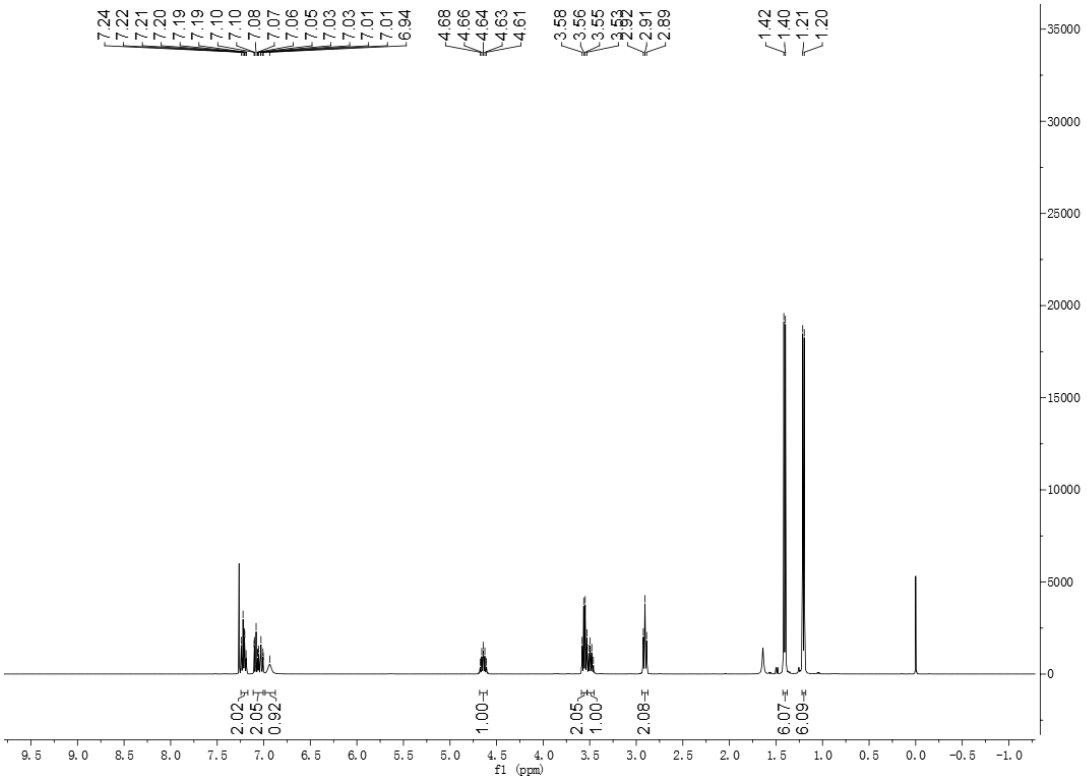
163.28
136.77
136.46
130.55
129.36
126.78
126.24
49.75
46.58
39.47
32.98
20.96
20.15
19.45
f1 (ppm)


F
HN
O
O
N(iPr)2

1c


7.24
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7.19
7.19
7.10
7.10
7.08
7.07
7.06
7.05
7.03
7.03
7.01
7.01
6.94
4.68
4.66
4.64
4.63
4.61
3.58
3.56
3.55
3.53
3.52
2.91
2.89
1.42
1.40
1.21
1.20
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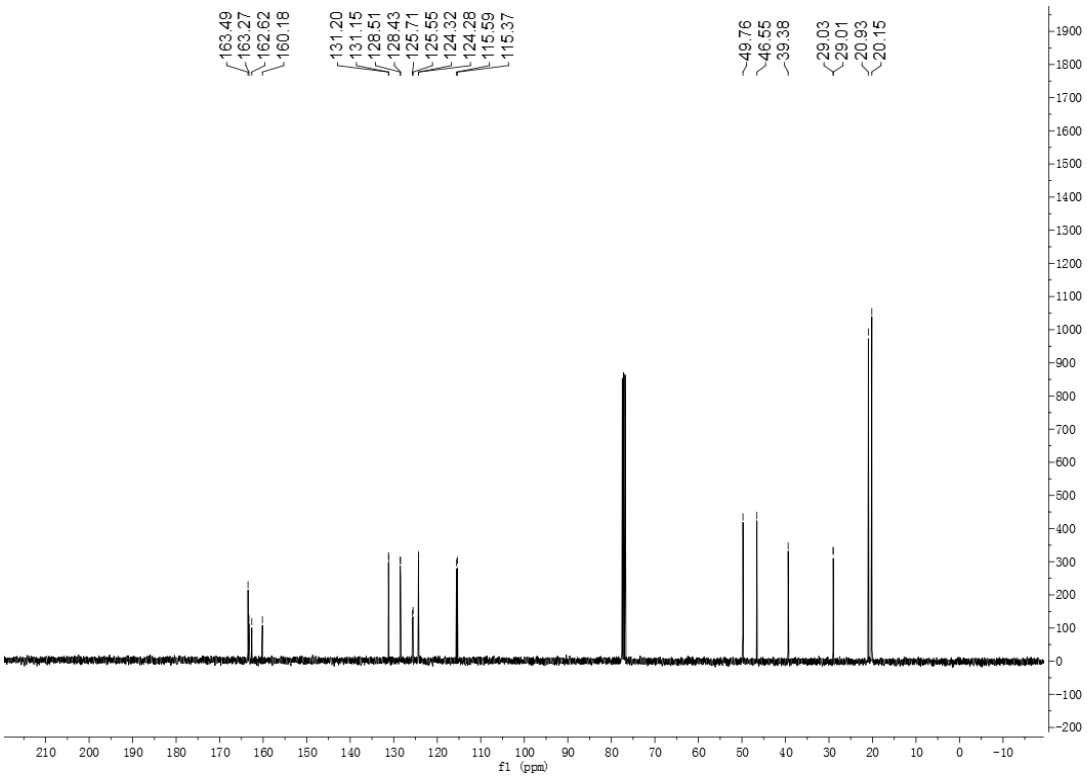
2.05
0.92
1.00
2.05
1.00
2.08
6.07
6.09
f1 (ppm)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163.27
162.62
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131.20
131.15
128.51
128.43
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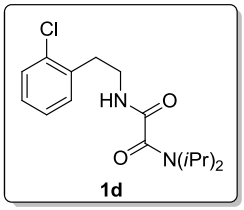
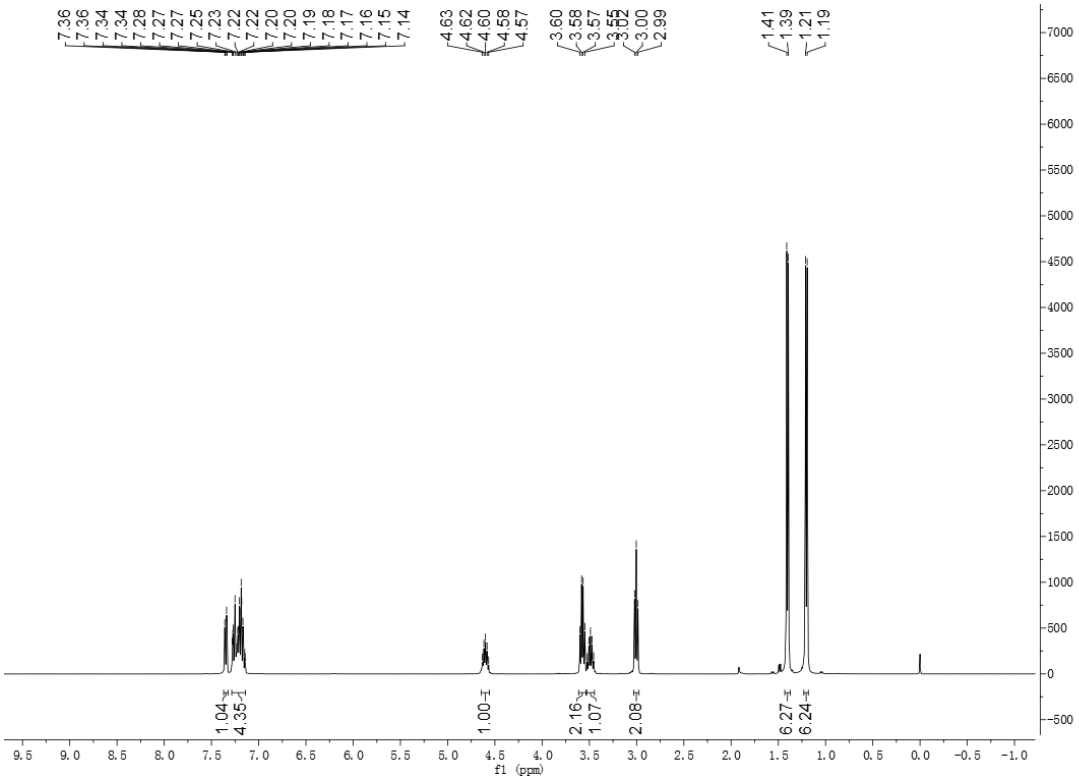
29.03
29.01
20.93
20.15
f1 (ppm)


Cl
HN
O
O
N(iPr)2

1d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7.22
7.22
7.20
7.20
7.19
7.18
7.17
7.16
7.15
7.14
4.63
4.62
4.60
4.58
4.57
3.60
3.58
3.57
3.55
3.02
3.00
2.99
1.41
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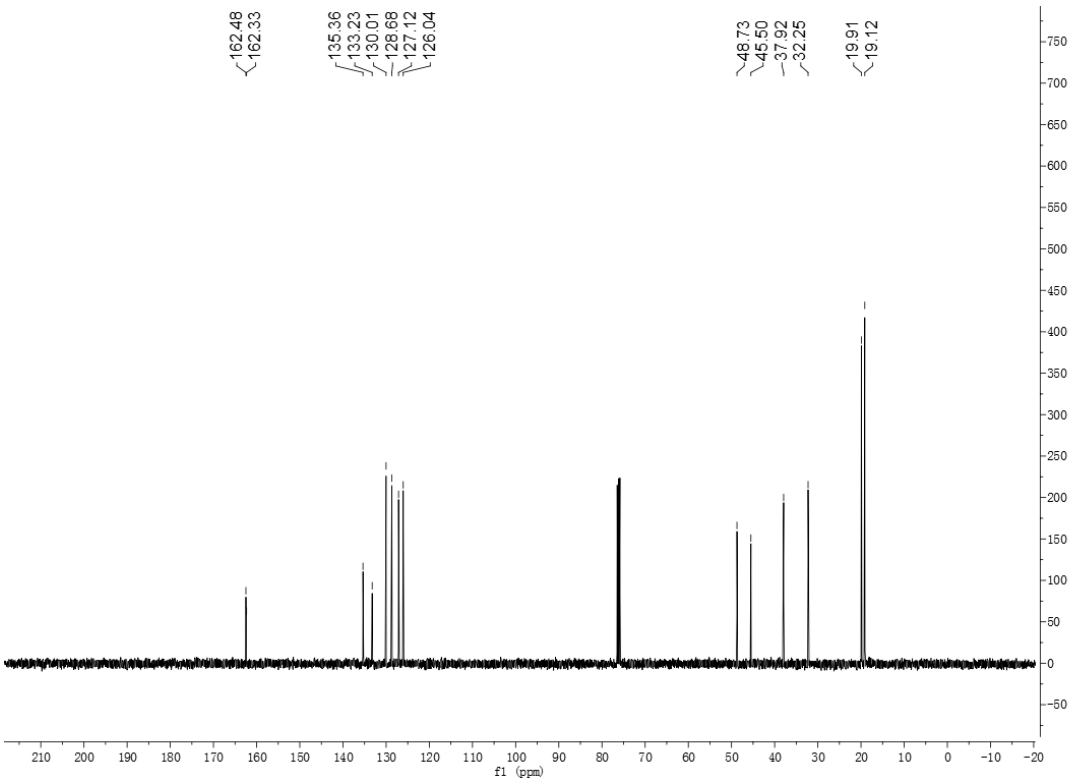
2.08
6.27
6.24
f1 (ppm)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128.68
127.12
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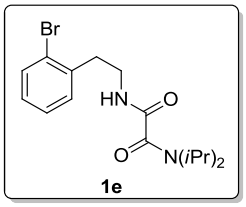
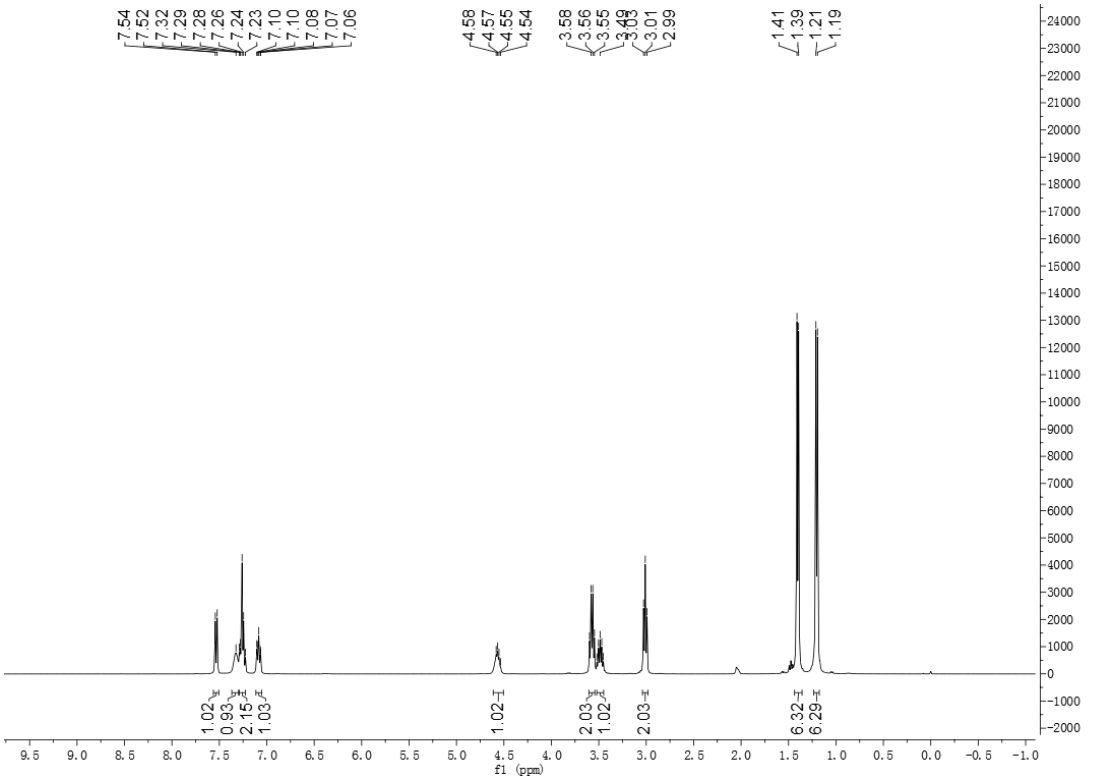
37.92
32.25
19.91
19.12
f1 (ppm)


Br
HN
O
O
N(iPr)2

1e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7.23
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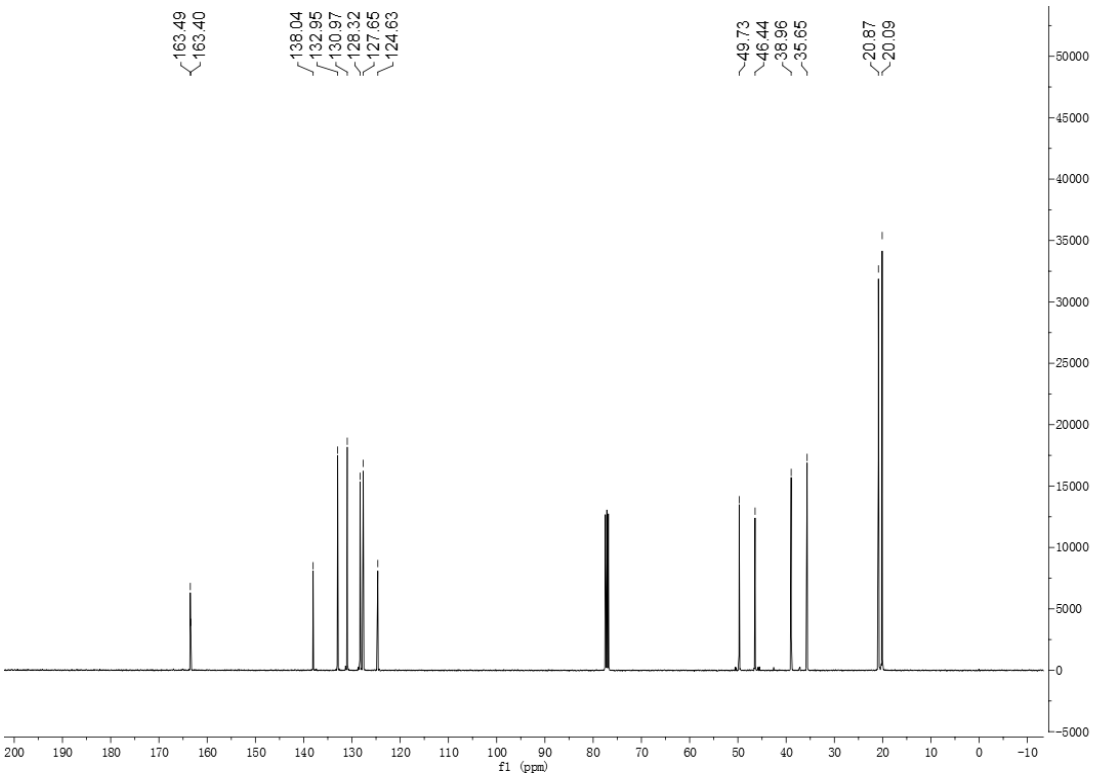
7.10
7.08
7.07
7.06
4.58
4.57
4.55
4.54
3.58
3.56
3.55
3.49
3.03
3.01
2.99
1.41
1.39
1.21
1.19
1.02
0.93
2.15
1.03
1.02
2.03
1.02
2.03
6.32
6.29
f1 (ppm)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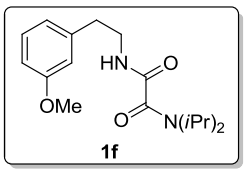
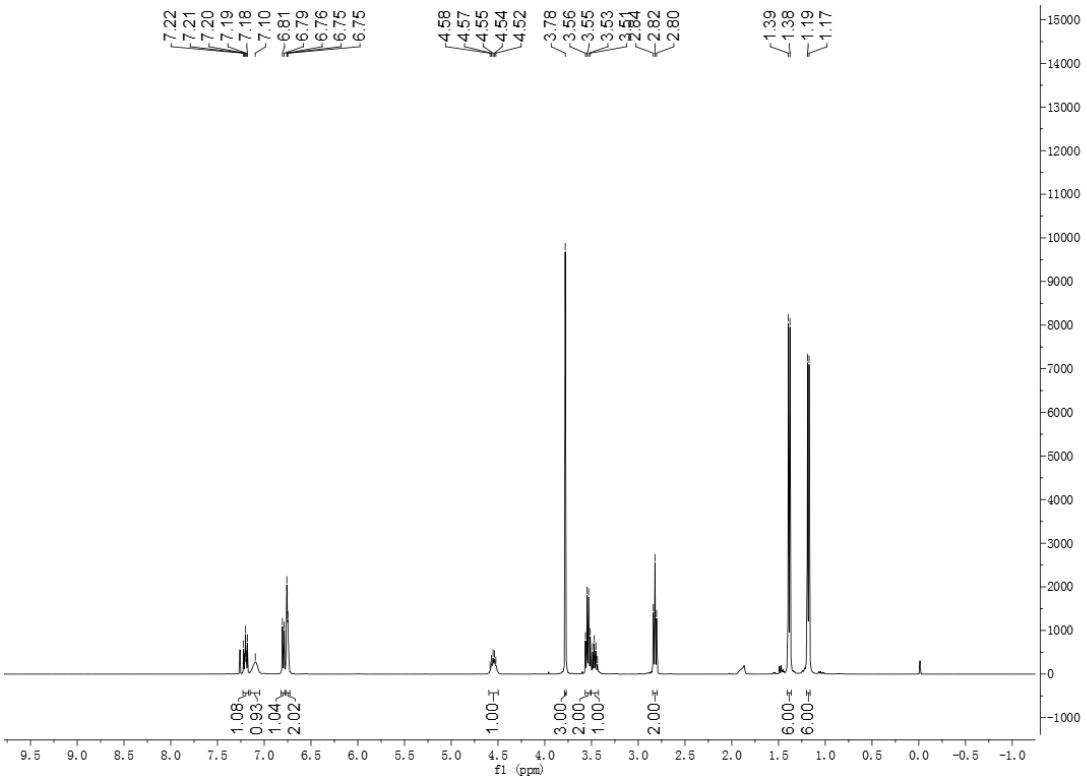
35.65
20.87
20.09
f1 (ppm)


HN
O
OMe
O
N(iPr)2

1f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6.75
6.75
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4.57
4.55
4.54
4.52
3.78
3.56
3.55
3.53
2.84
2.82
2.80
1.39
1.38
1.19
1.17
1.08
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2.02
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3.00
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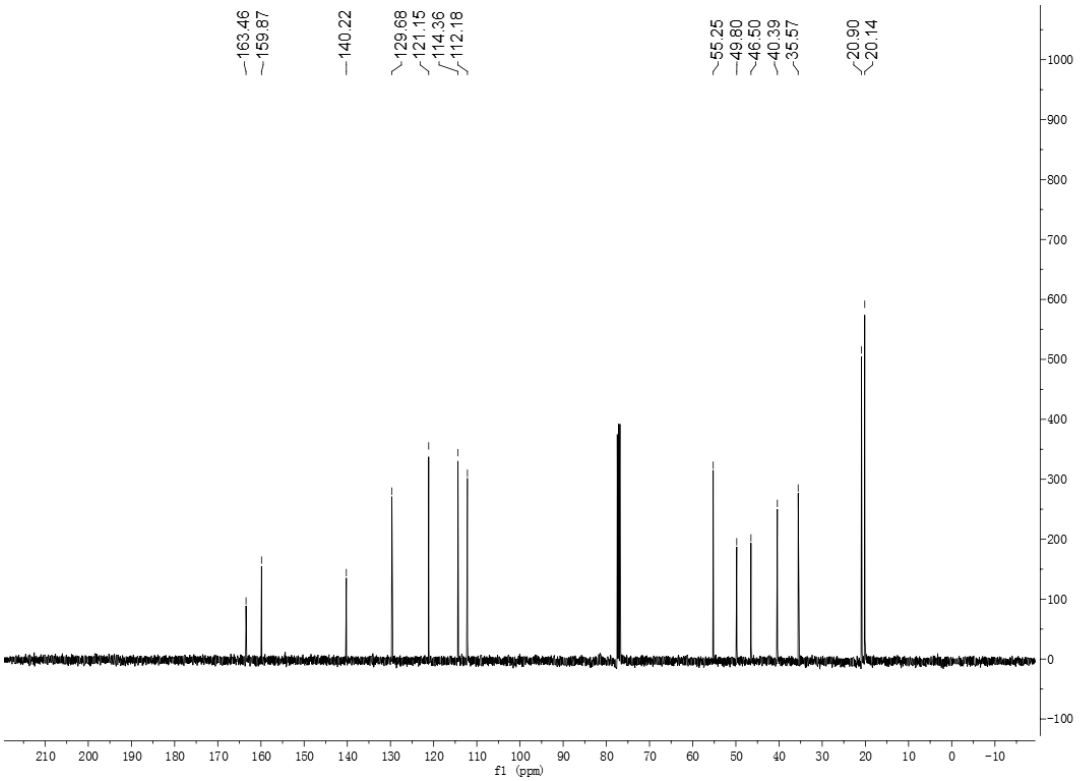
f1 (ppm)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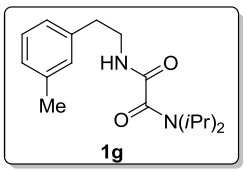
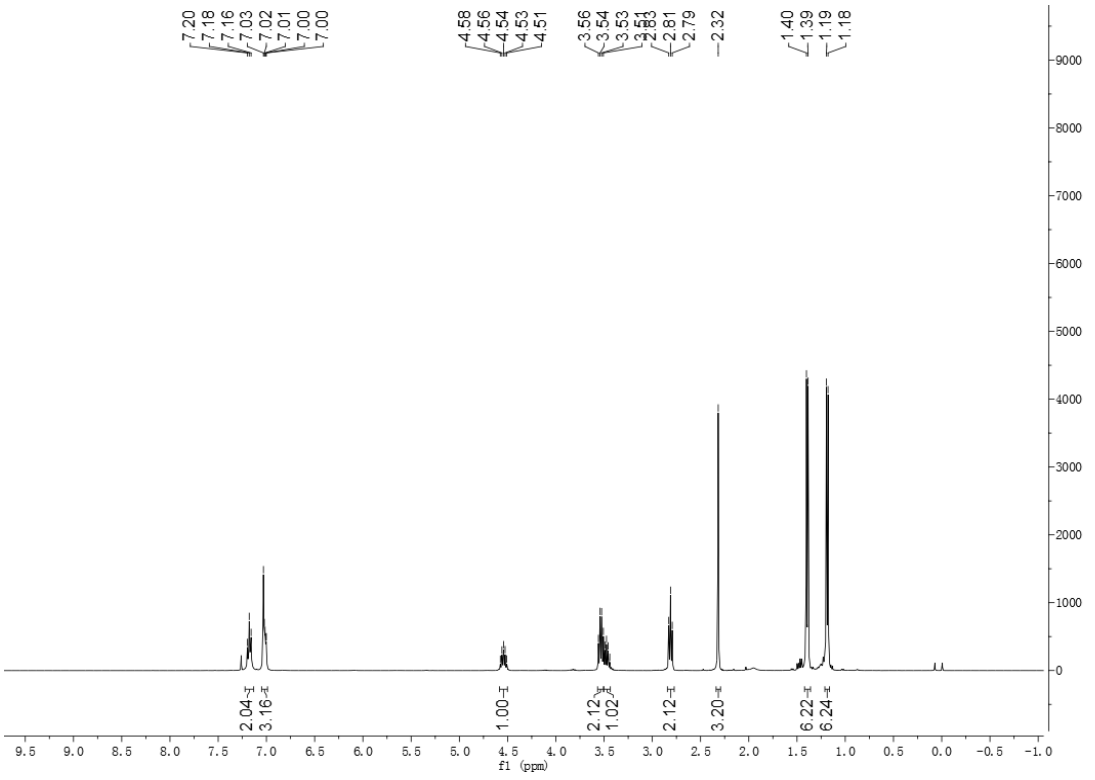
20.90
20.14
f1 (ppm)


HN
O
O
N(iPr)2
Me

1g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7.00
7.00
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4.56
4.54
4.53
4.51
3.56
3.54
3.53
2.83
2.81
2.79
2.32
1.40
1.39
1.19
1.18
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1.02
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3.20
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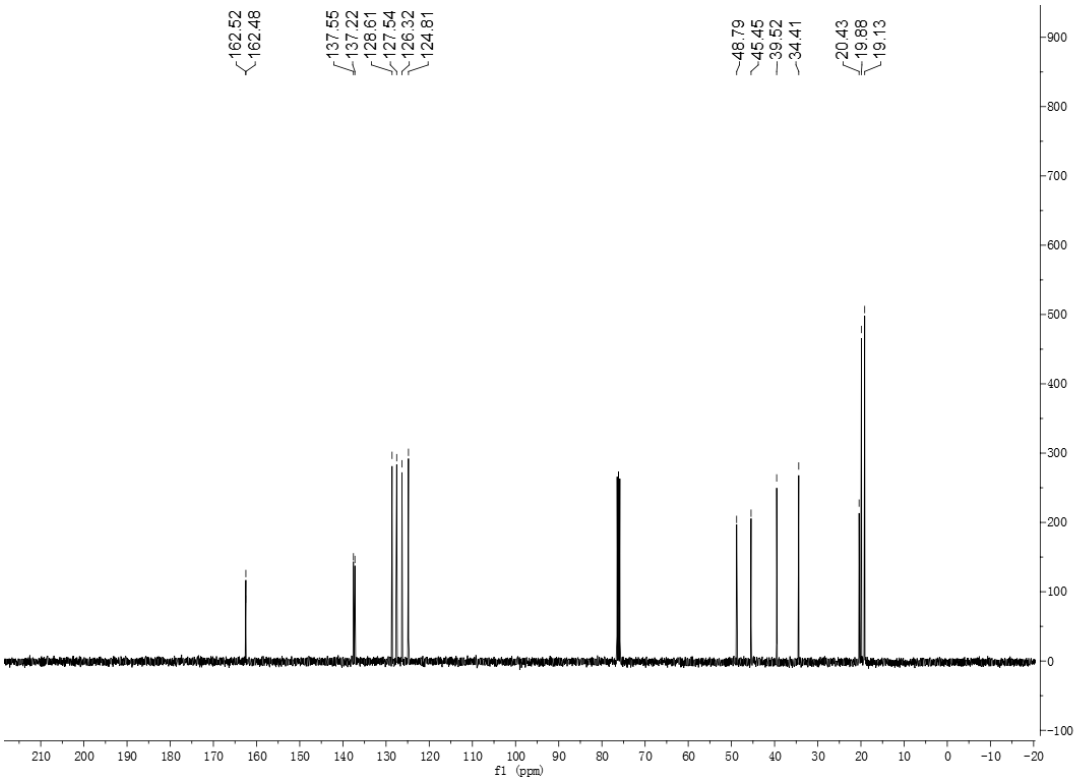
6.24
f1 (ppm)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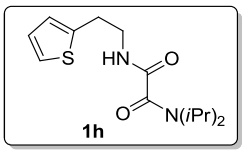
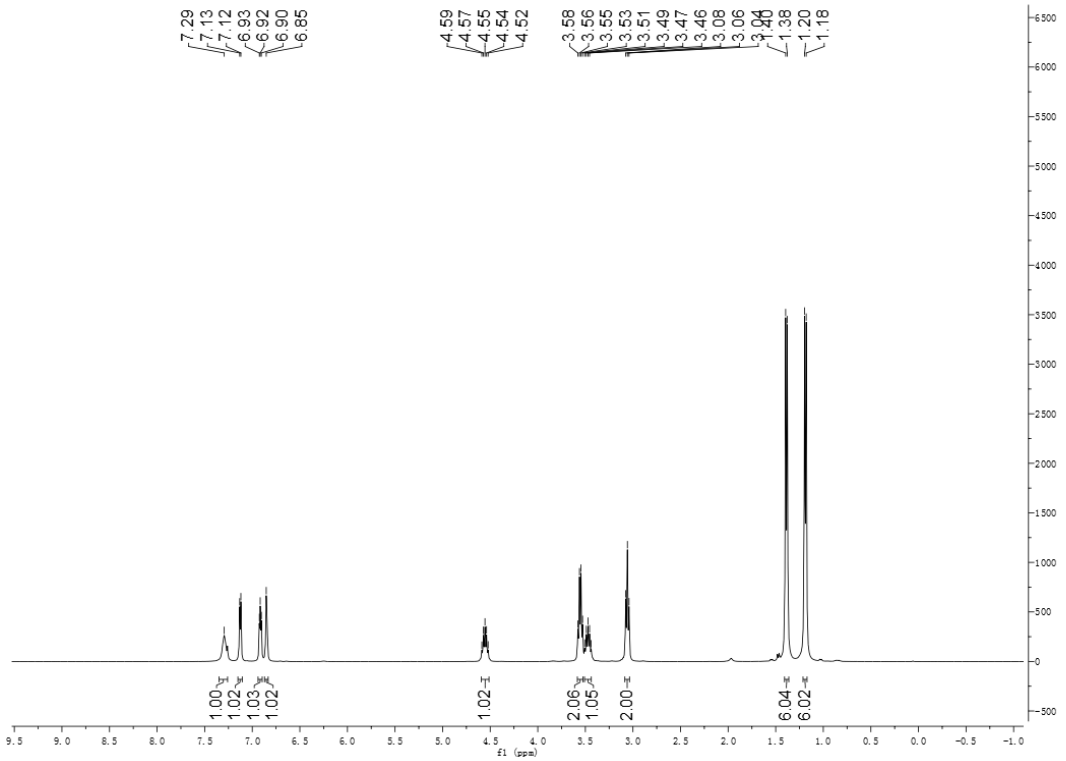
39.52
34.41
20.43
19.88
19.13
f1 (ppm)


S
HN
O
O
N(iPr)2
1h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6.90
6.85
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4.57
4.55
4.54
4.52
3.58
3.56
3.55
3.53
3.51
3.49
3.47
3.46
3.08
3.06
1.38
1.20
1.18
1.00
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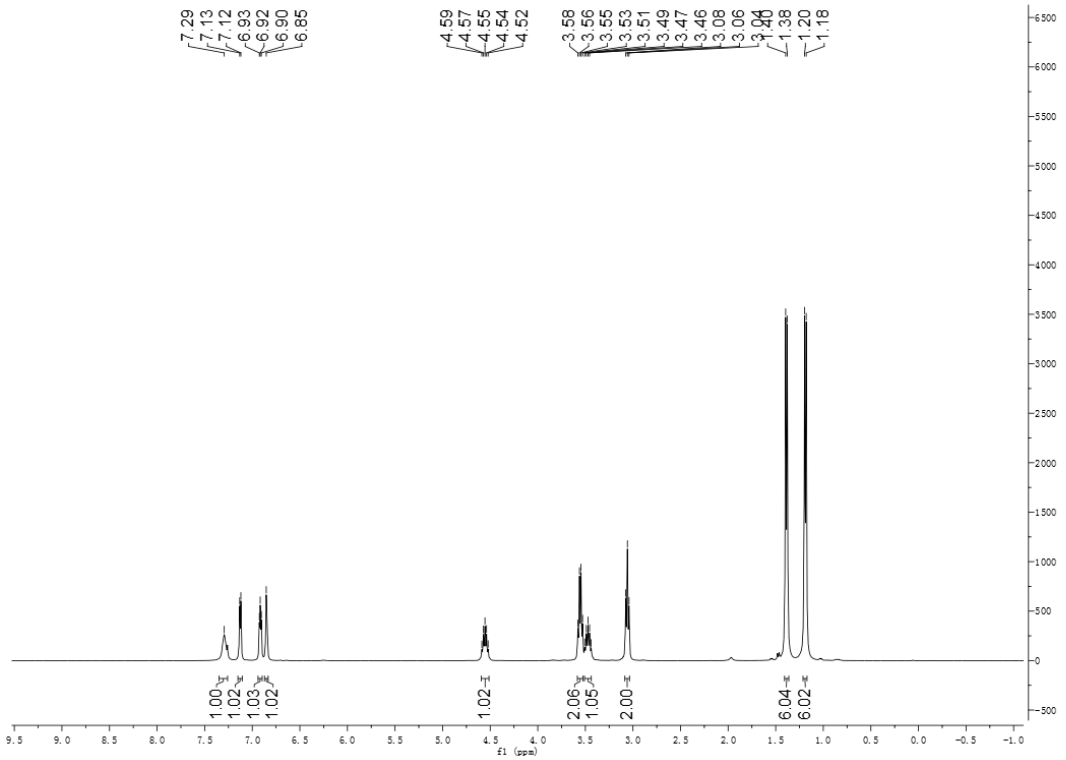
1.03
1.02
1.02
2.05
1.05
2.00
6.04
6.02
f1 (ppm)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4.59
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4.55
4.54
4.52
3.58
3.56
3.55
3.53
3.51
3.49
3.47
3.46
3.08
3.06
1.38
1.20
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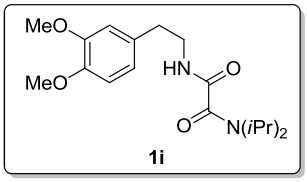
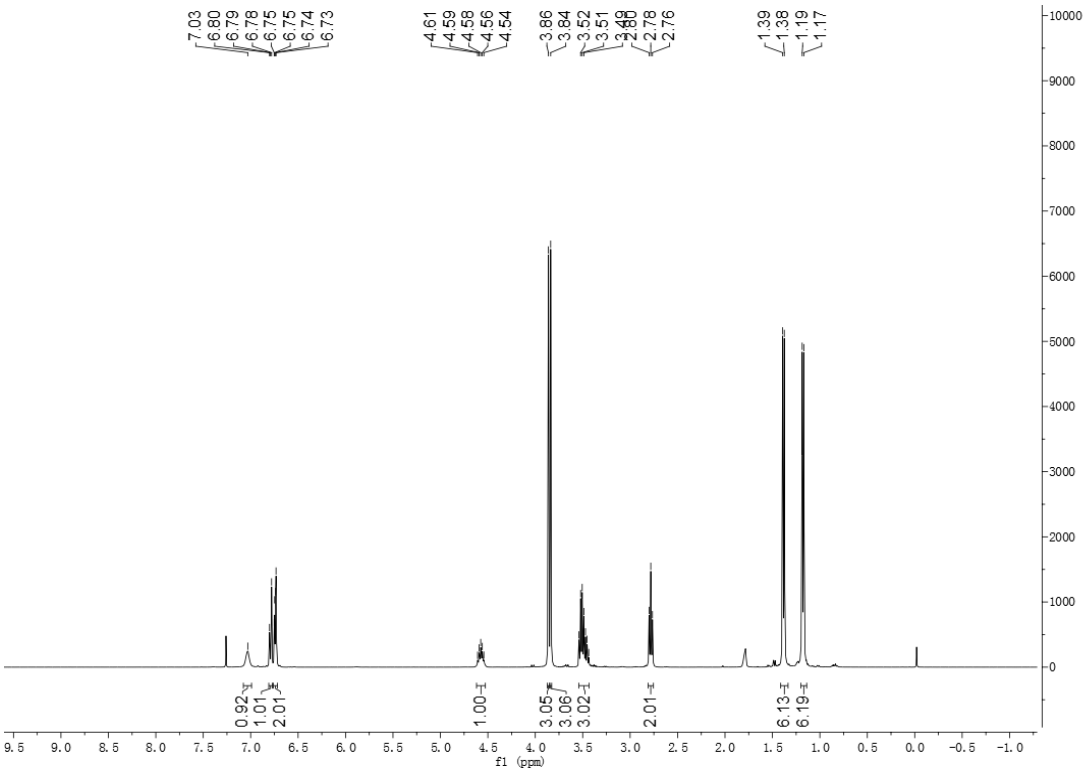
1.00
1.02
1.03
1.02
1.02
2.06
1.05
2.00
6.04
6.02
f1 (ppm)


MeO
MeO
HN
O
O
N(iPr)2

1i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4.58
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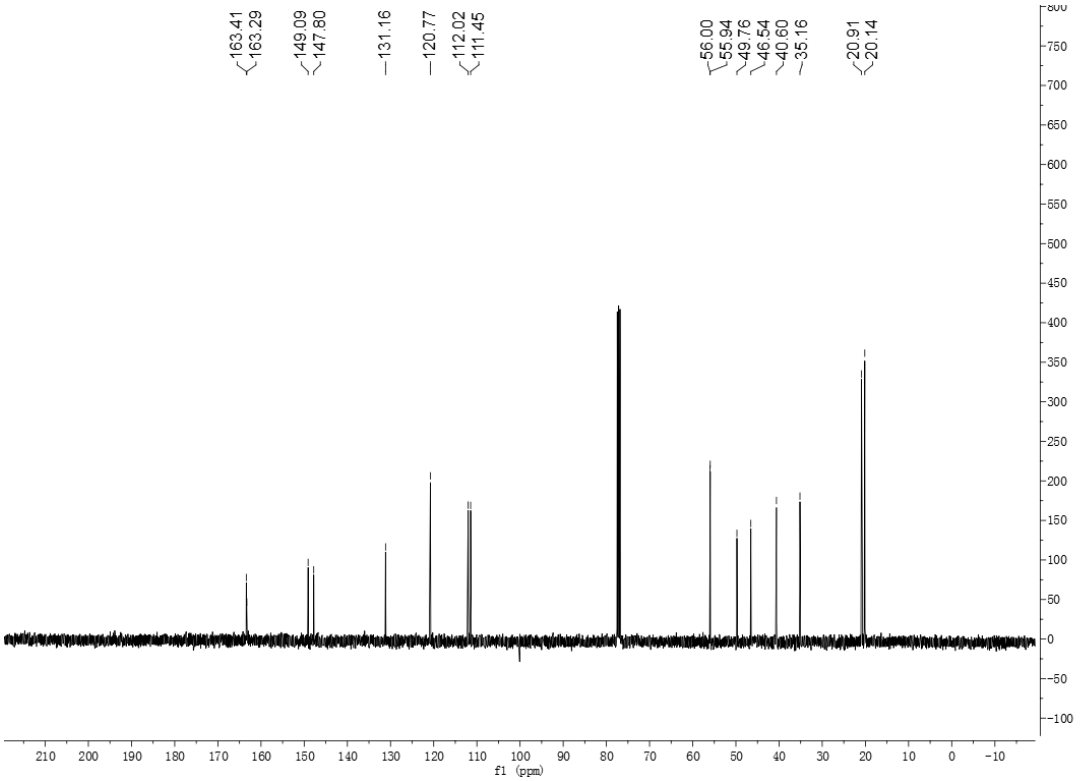
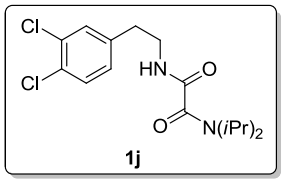
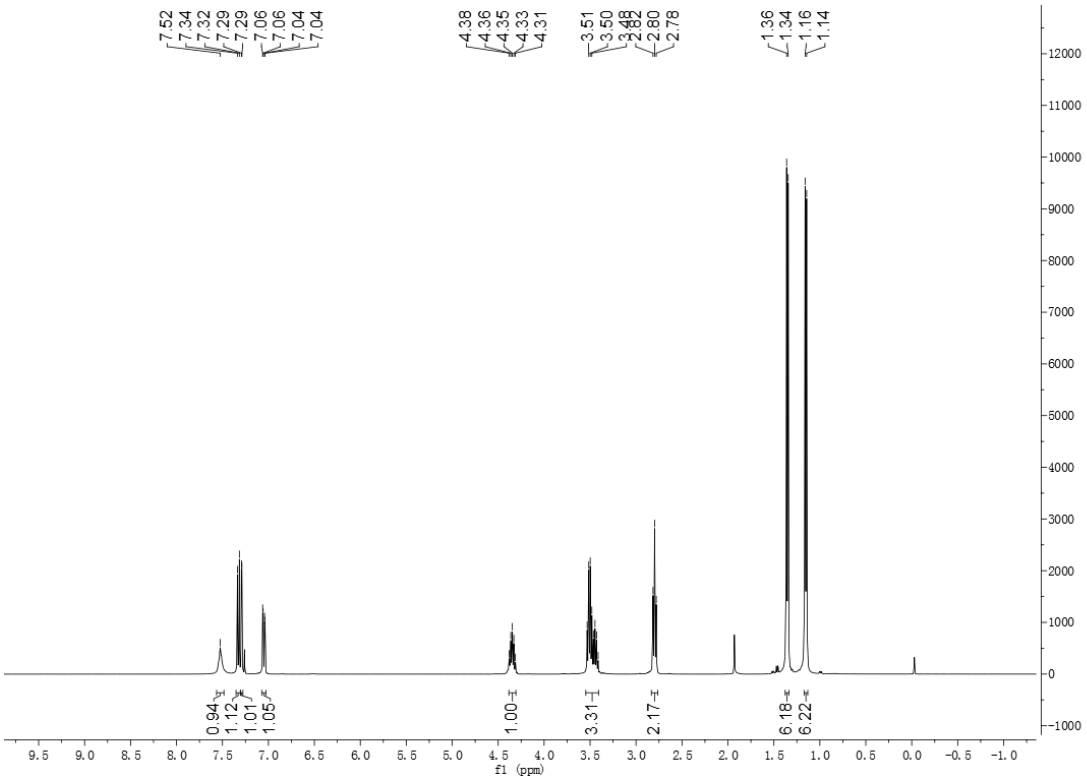
4.54
3.86
3.84
3.52
3.51
2.78
2.76
1.39
1.38
1.19
1.17
0.92
1.01
2.01
1.00
3.05
3.06
3.02
2.01
6.13
6.19
f1 (ppm)


163.41
163.29
149.09
147.80
131.16
120.77
112.02
111.45
56.00
55.94
49.76
46.54
40.60
35.16
20.91
20.14
f1 (ppm)


Cl
Cl
HN
O
O
N(iPr)2

1j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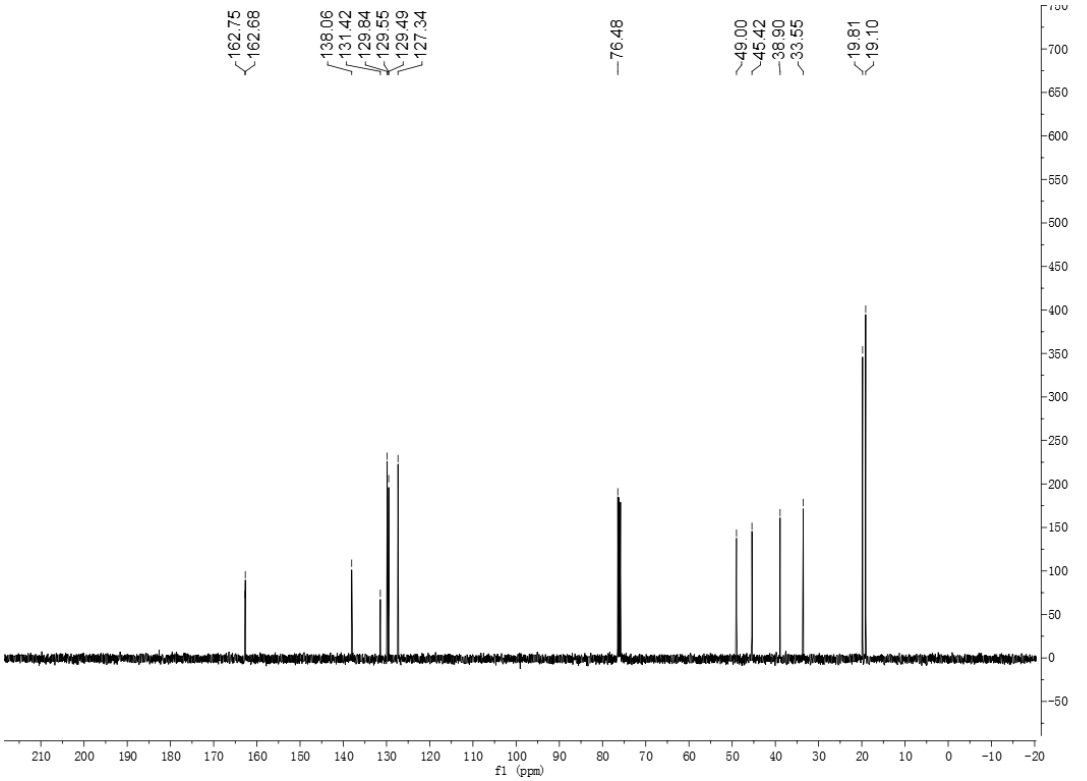
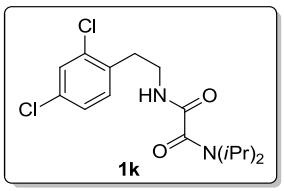
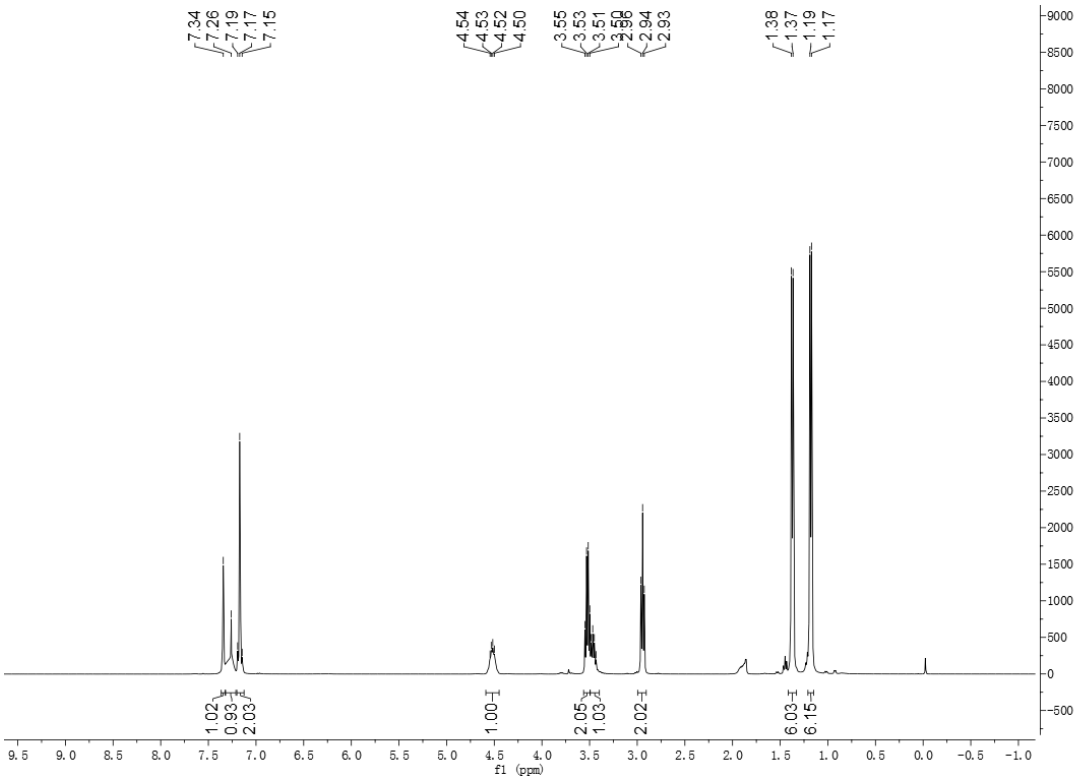
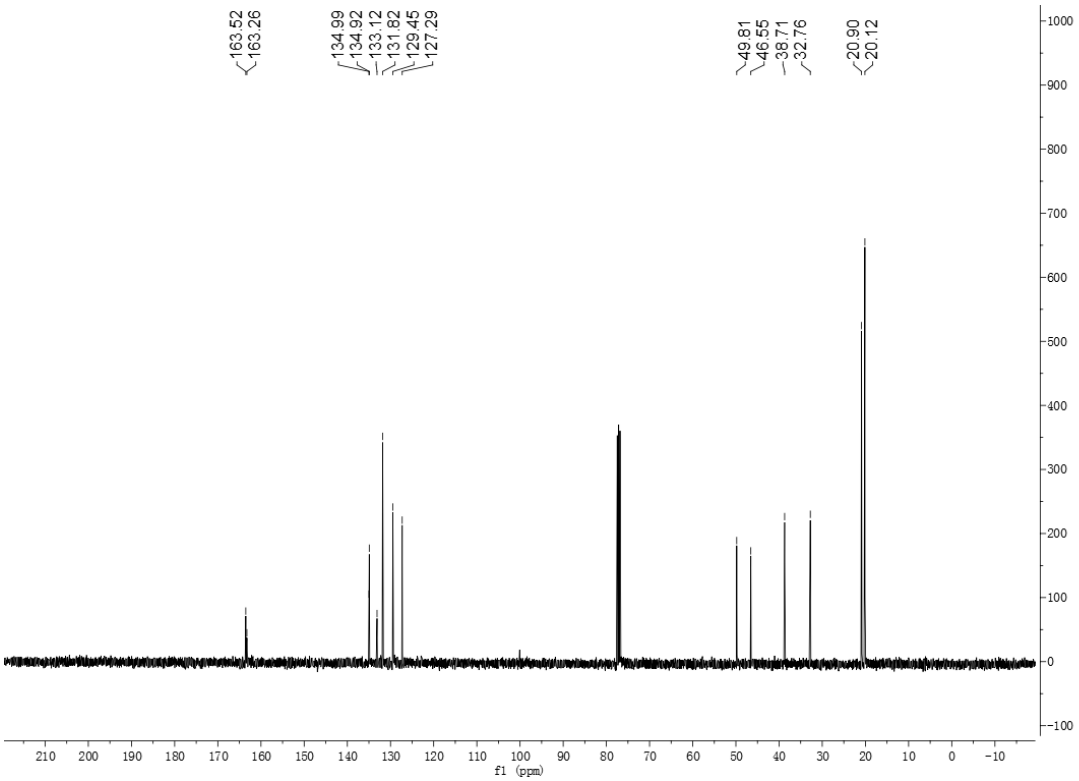
7.34
7.32
7.29
7.29
7.06
7.06
7.04
7.04
4.38
4.36
4.35
4.33
4.31
3.51
3.50
2.82
2.80
2.78
1.36
1.34
1.16
1.14
0.94
1.12
1.01
1.05
1.00
3.31
2.17
6.18
6.22
f1 (ppm)

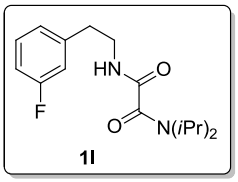

162.75
162.68
138.06
131.42
129.84
129.55
129.49
127.34
76.48
49.00
45.42
38.90
33.55
19.81
19.10
f1 (ppm)


Cl
Cl
HN
O
O
N(iPr)2

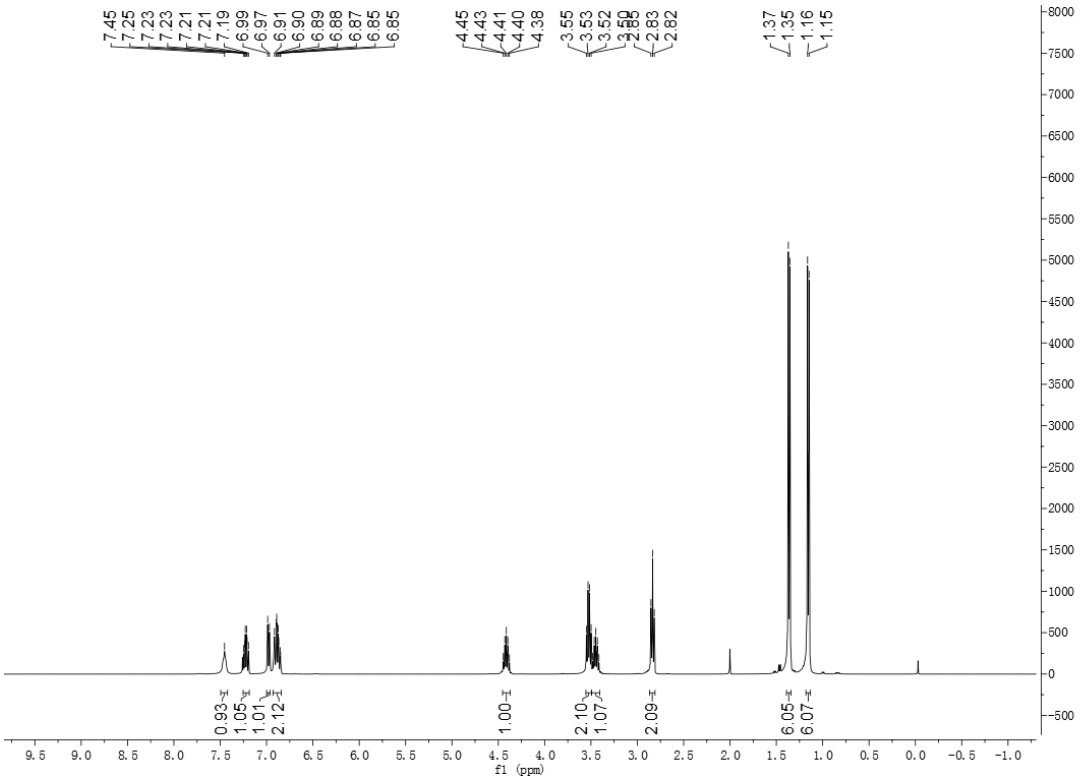
1k

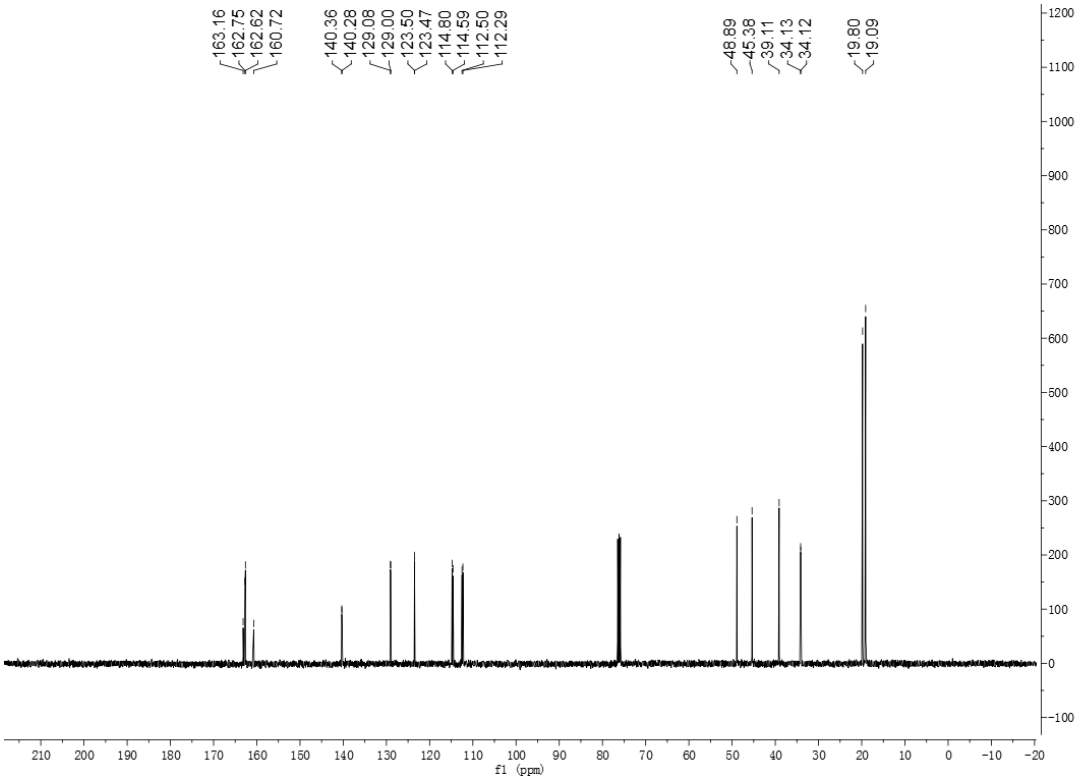

7.34
7.26
7.19
7.17
7.15
4.54
4.53
4.52
4.50
3.55
3.53
3.51
2.94
2.93
1.38
1.37
1.19
1.17
1.02
0.93
2.03
1.00
2.05
1.03
2.02
6.03
6.15
f1 (ppm)


163.52
163.26
134.99
134.92
133.12
131.82
129.45
127.29
49.81
46.55
38.71
32.76
20.90
20.12
f1 (ppm)


HN
O
O
N(iPr)2
F

1l


7.45
7.25
7.23
7.23
7.21
7.21
7.19
6.99
6.97
6.91
6.90
6.89
6.88
6.87
6.85
6.85
4.45
4.43
4.41
4.40
4.38
3.55
3.53
3.52
2.85
2.83
2.82
1.37
1.35
1.16
1.15
0.93
1.05
1.01
2.12
1.00
2.10
1.07
2.09
6.05
6.07
f1 (ppm)


163.16
162.75
162.62
160.72
140.36
140.28
129.08
129.00
123.50
123.47
114.80
114.59
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112.29
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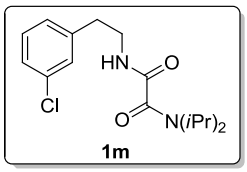
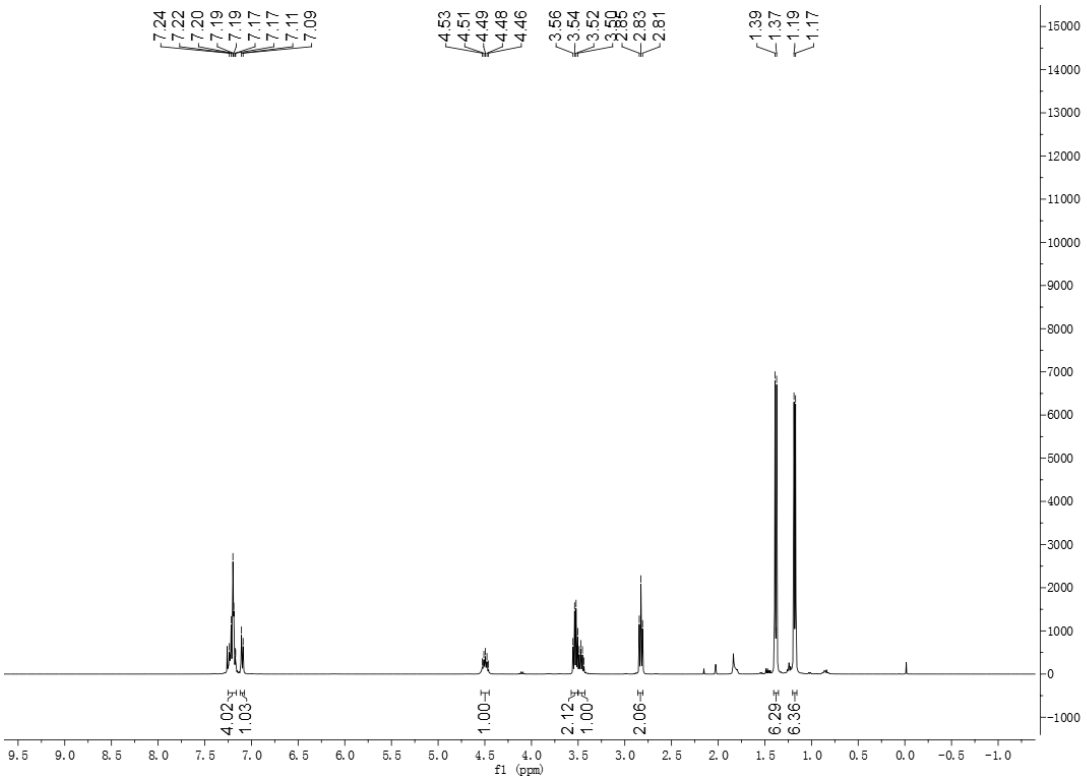
39.11
34.13
34.12
19.80
19.09
f1 (ppm)


HN
O
Cl
O
N(iPr)2

1m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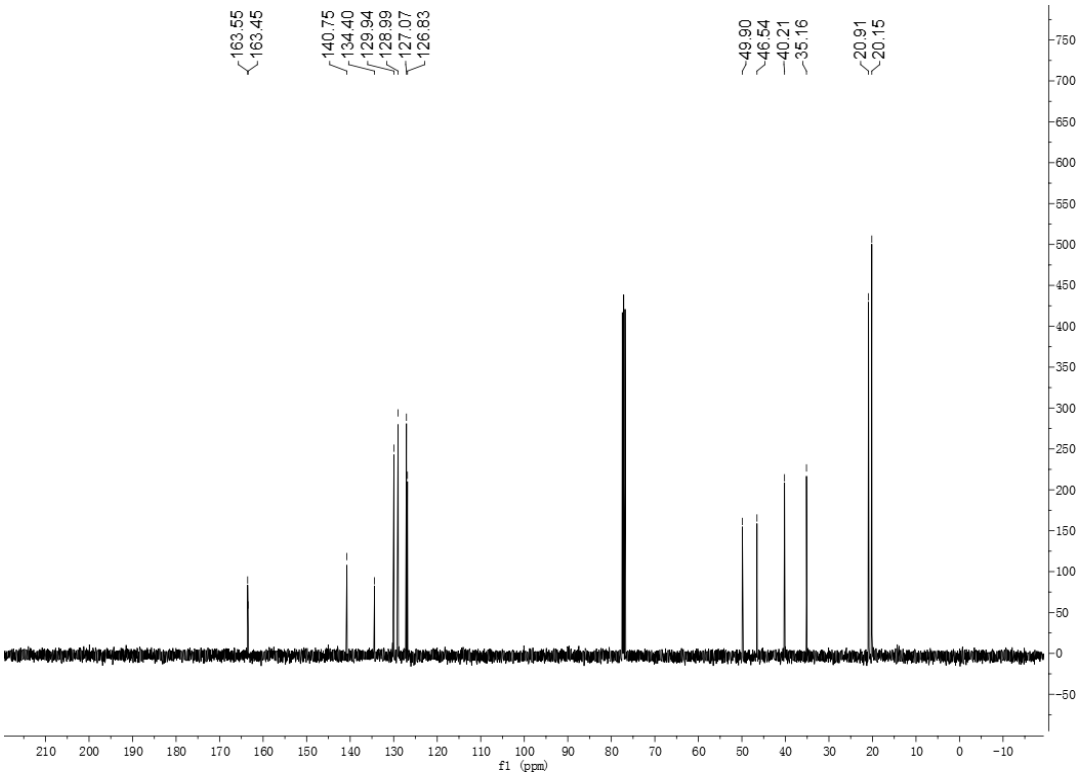
7.22
7.20
7.19
7.19
7.17
7.17
7.11
7.09
4.53
4.51
4.49
4.48
4.46
3.56
3.54
3.52
3.50
2.85
2.83
2.81
1.39
1.37
1.19
1.17
4.02
1.03
1.00
2.12
1.00
2.06
6.29
6.36
f1 (ppm)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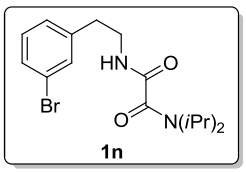
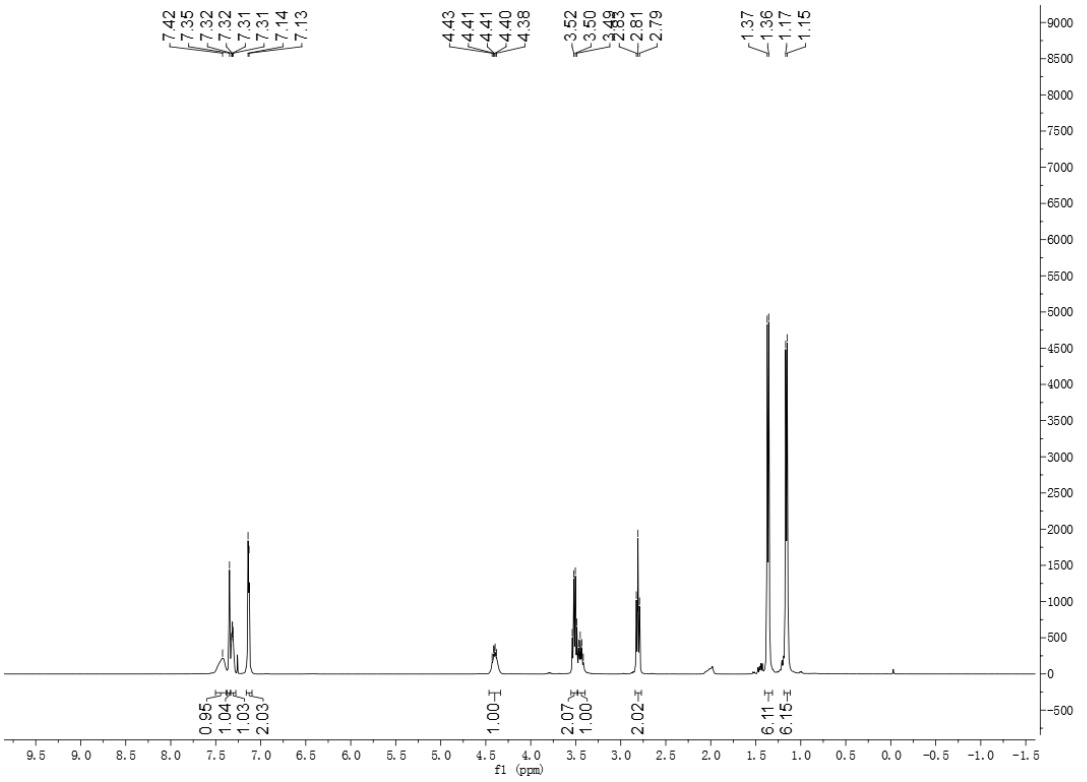
163.45
140.75
134.40
129.94
128.99
127.07
126.83
49.90
46.54
40.21
35.16
20.91
20.15
f1 (ppm)


HN
O
O
N(iPr)2
Br
1n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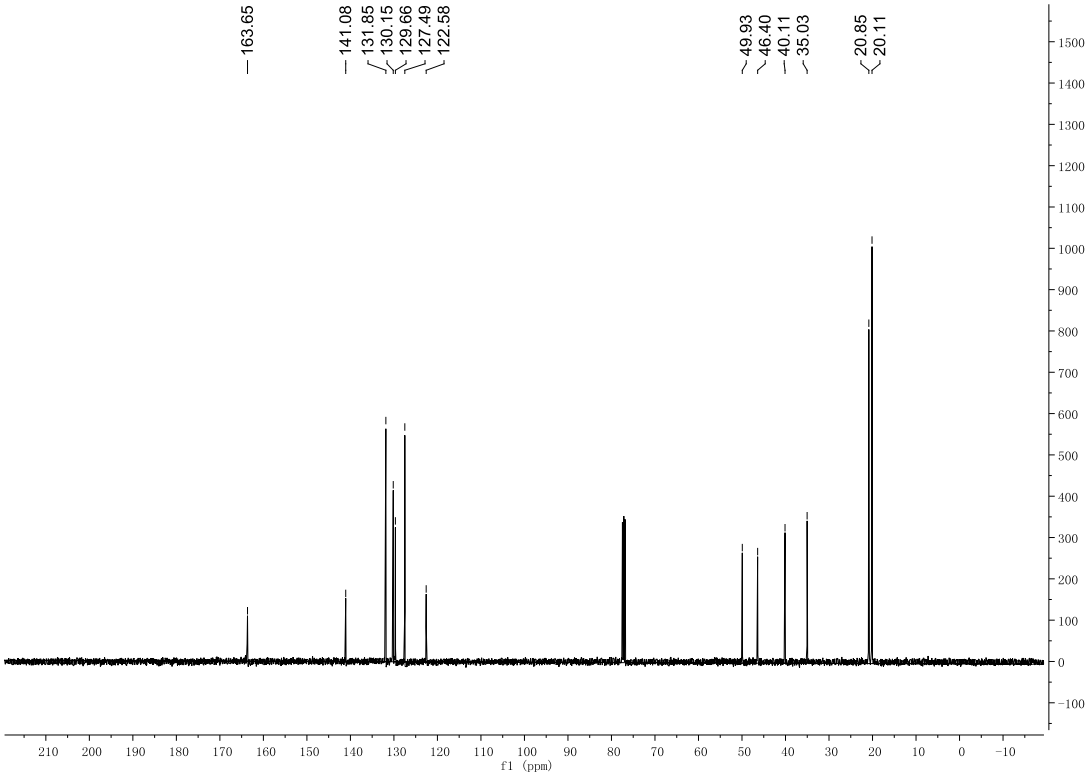
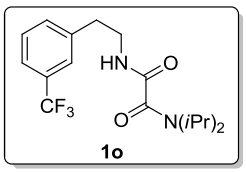
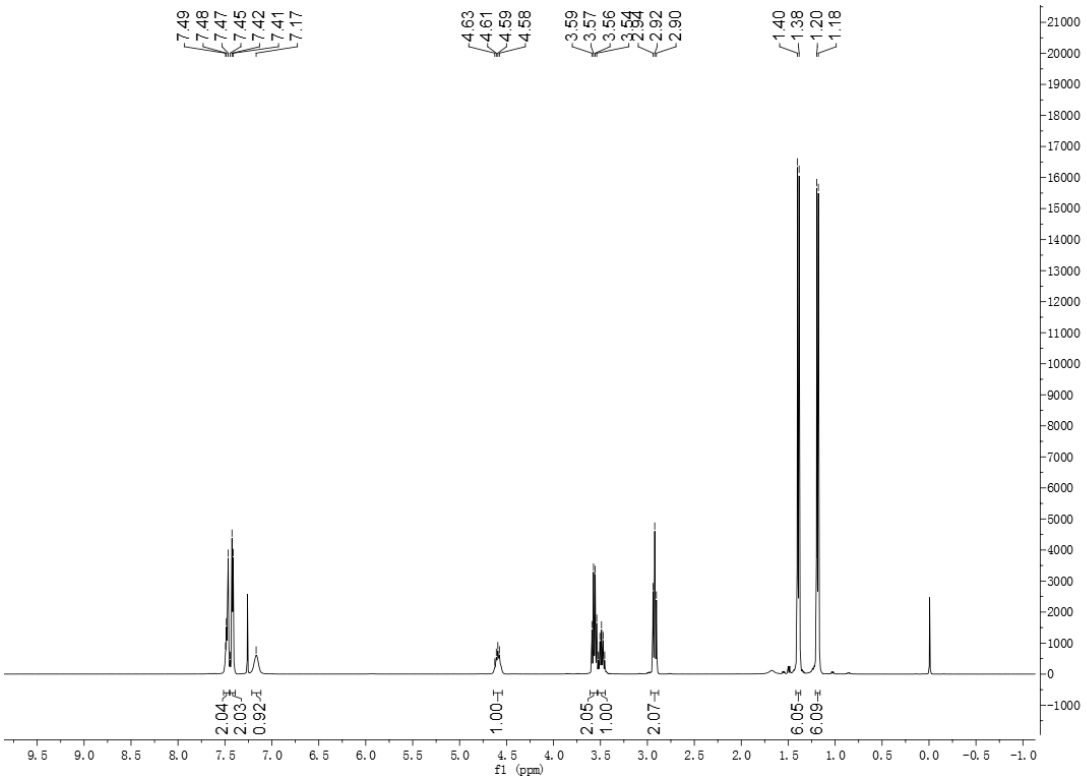
7.35
7.32
7.32
7.31
7.31
7.14
7.13
4.43
4.41
4.41
4.40
4.38
3.52
3.50
2.83
2.81
2.79
1.37
1.36
1.17
1.15
0.95
1.04
1.03
2.03
1.00
2.07
1.00
2.02
6.11
6.15
f1 (ppm)


163.65
141.08
131.85
130.15
129.66
127.49
122.58
49.93
46.40
40.11
35.03
20.85
20.11
f1 (ppm)


HN
O
O
N(iPr)2
CF3
1o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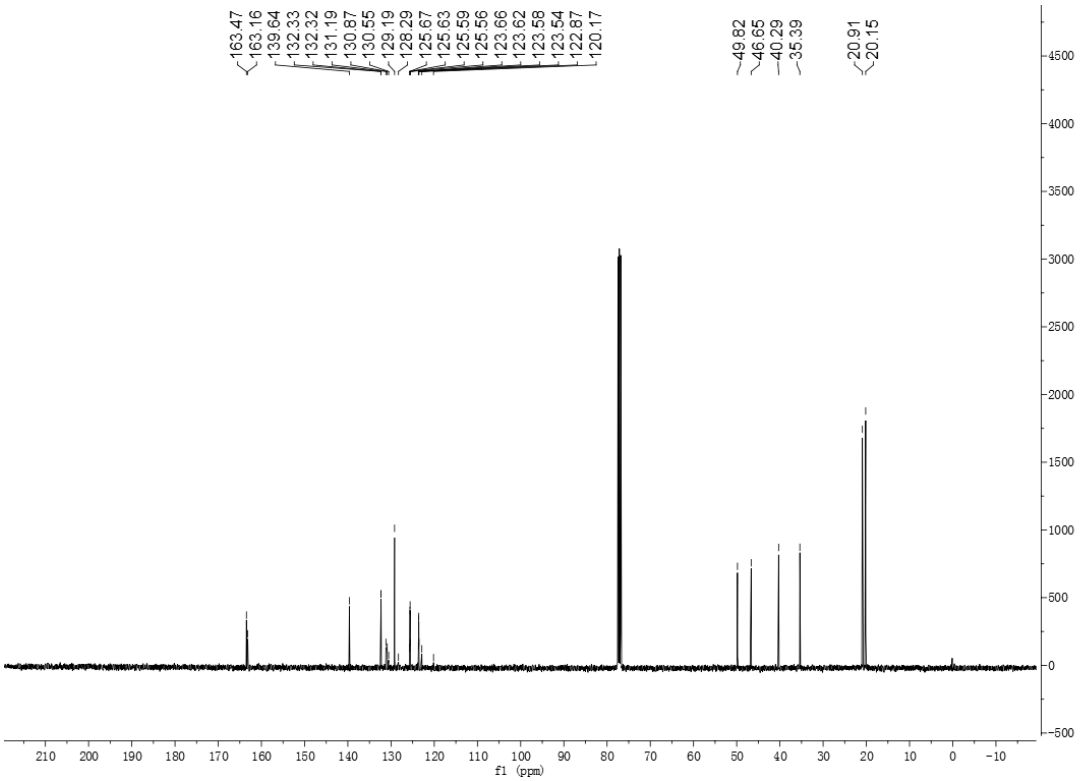
7.48
7.47
7.45
7.42
7.41
7.17
4.63
4.61
4.59
4.58
3.59
3.57
3.56
3.54
2.94
2.92
2.90
1.40
1.38
1.20
1.18
2.04
2.03
0.92
1.00
2.05
1.00
2.07
6.05
6.09
f1 (ppm)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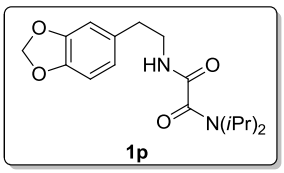
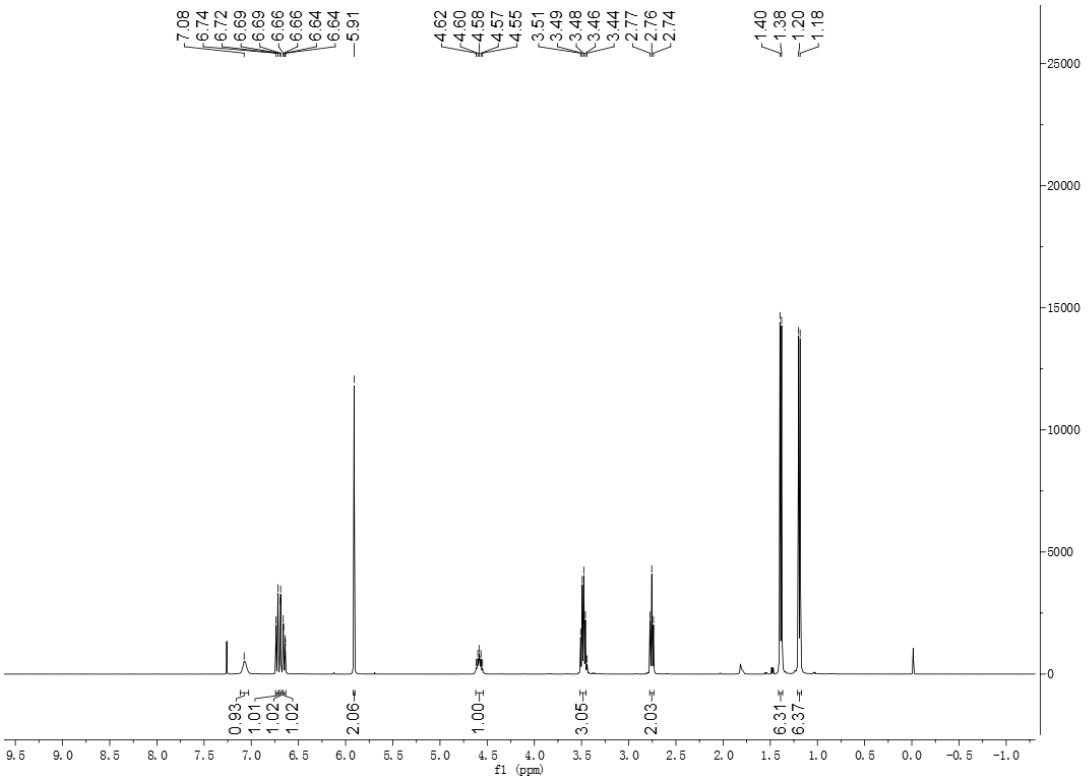
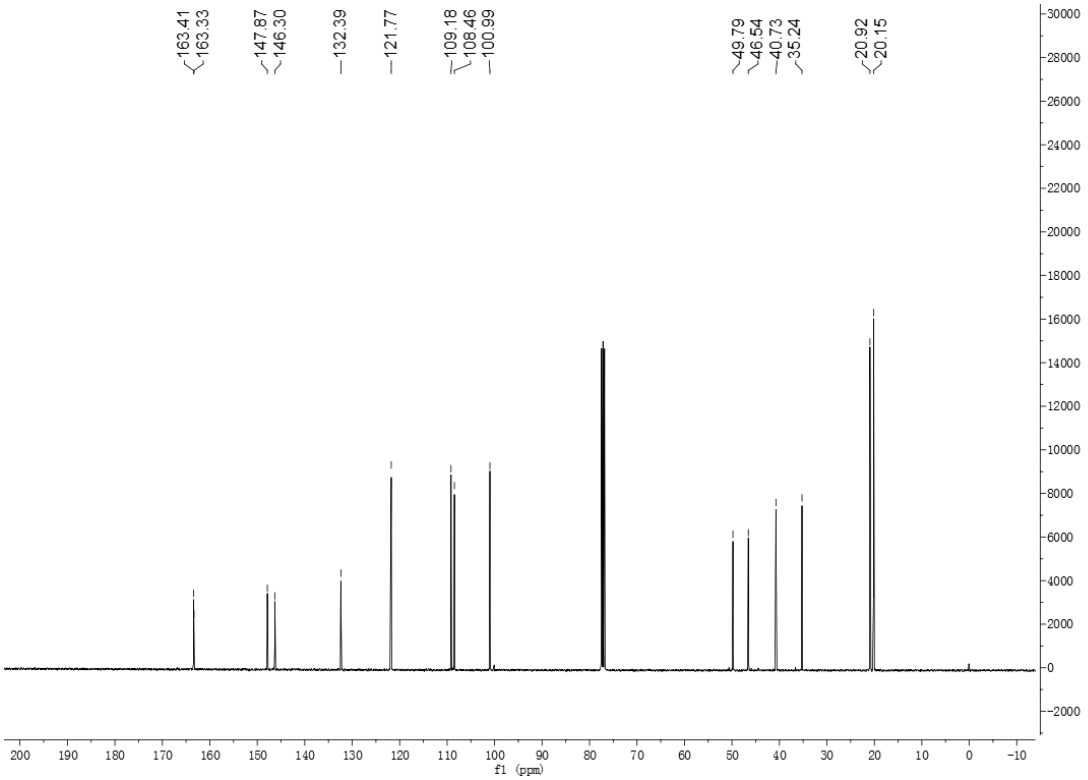
163.16
139.64
132.33
132.32
131.19
130.87
130.55
129.19
128.29
125.67
125.63
125.59
125.56
123.66
123.62
123.58
123.54
122.87
120.17
49.82
46.65
40.29
35.39
20.91
20.15
f1 (ppm)


O
O
HN
O
O
N(iPr)2

1p


7.08
6.74
6.72
6.69
6.69
6.66
6.66
6.64
6.64
5.91
4.62
4.60
4.58
4.57
4.55
3.51
3.49
3.48
3.46
3.44
2.77
2.76
2.74
1.40
1.38
1.20
1.18
0.93
1.01
1.02
1.02
2.06
1.00
3.05
2.03
6.31
6.37
f1 (ppm)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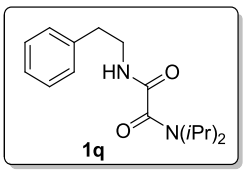
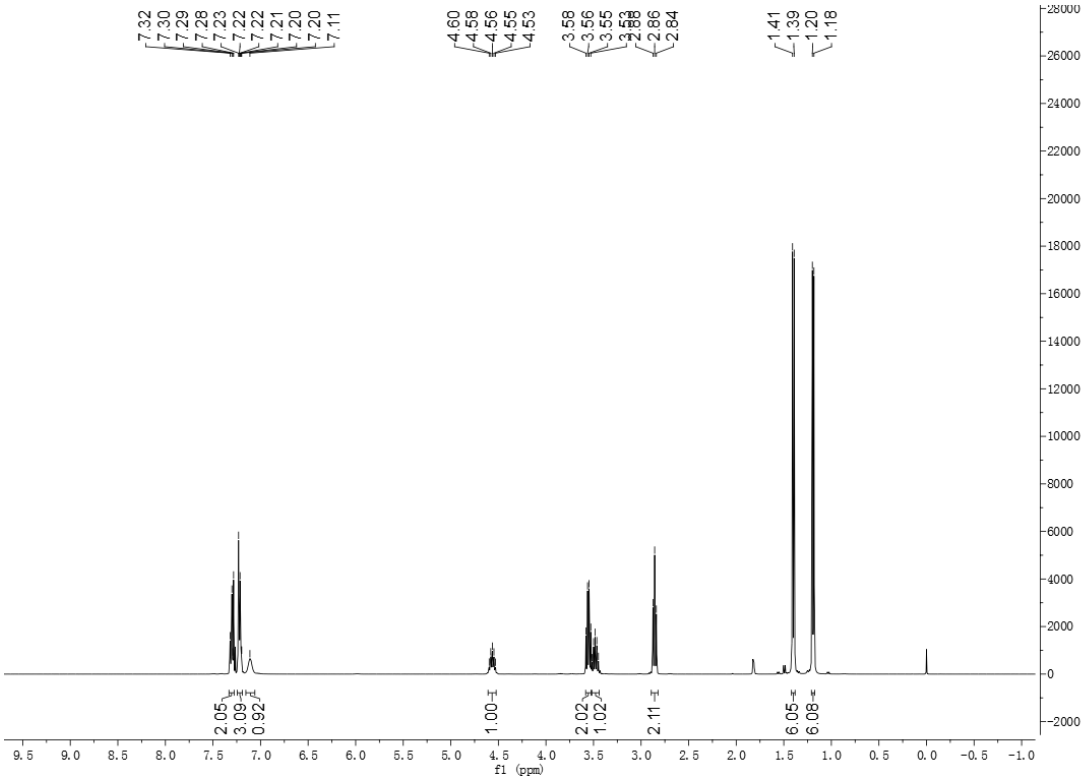
163.33
147.87
146.30
132.39
121.77
109.18
108.46
100.99
49.79
46.54
40.73
35.24
20.92
20.15
f1 (ppm)


HN
O
O
N(iPr)2
1q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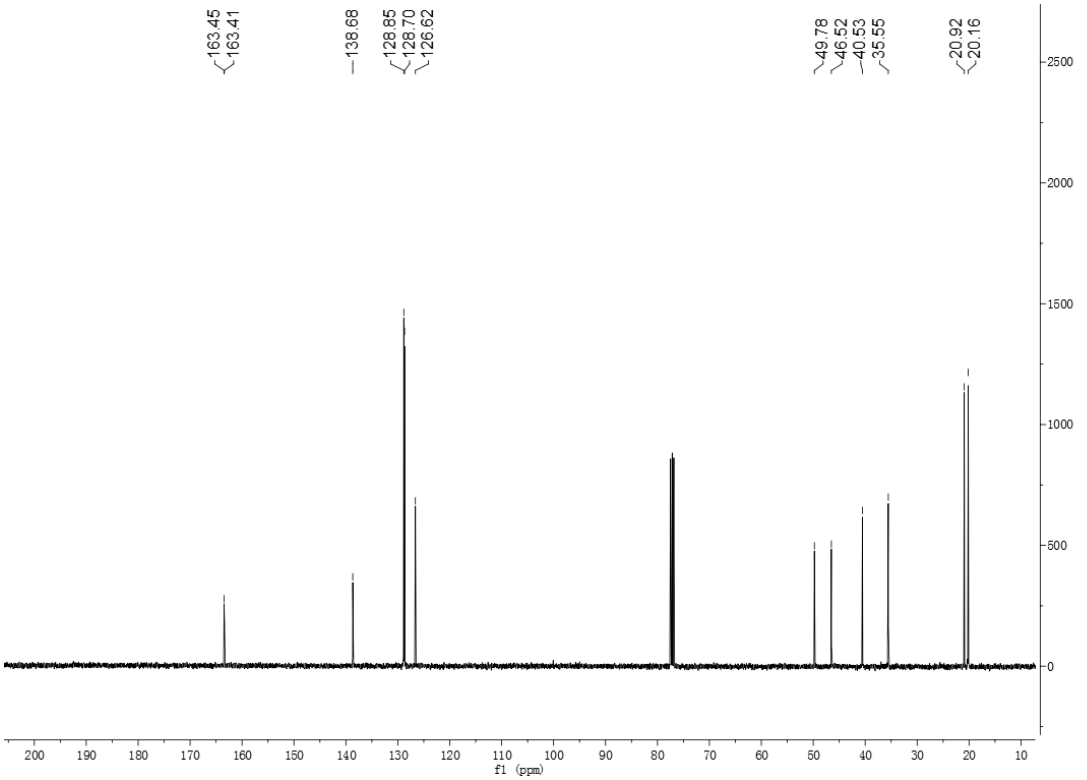
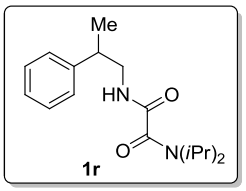
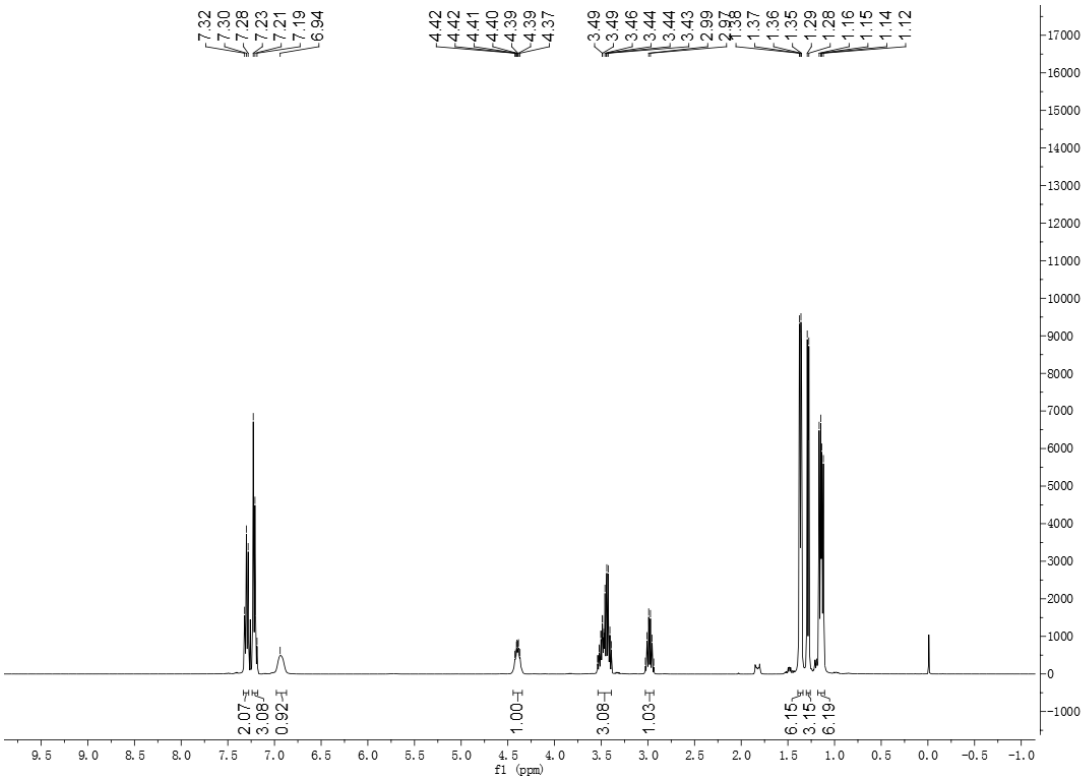
7.30
7.29
7.28
7.23
7.22
7.22
7.21
7.20
7.20
7.11
4.60
4.58
4.56
4.55
4.53
3.58
3.56
3.55
2.86
2.84
1.41
1.39
1.20
1.18
2.05
3.09
0.92
1.00
2.02
1.02
2.11
6.05
6.08
f1 (ppm)


163.45
163.41
138.68
128.85
128.70
126.62
49.78
46.52
40.53
35.55
20.92
20.16
f1 (ppm)


Me
HN
O
O
N(iPr)2

1r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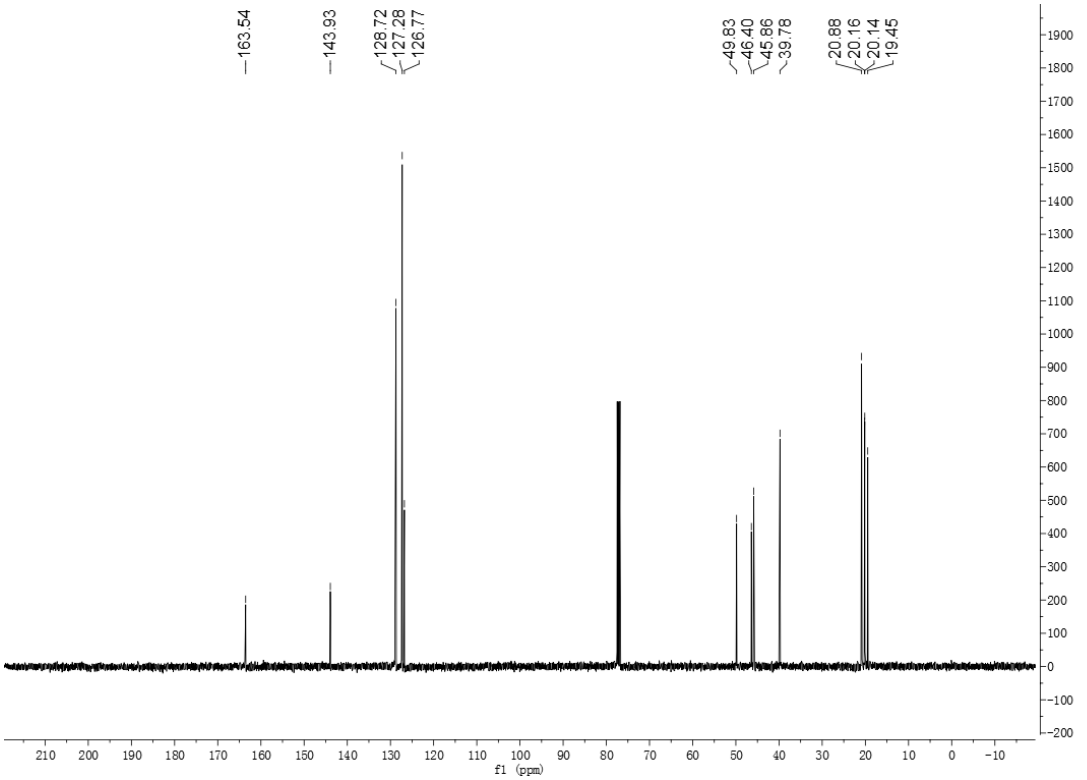
7.30
7.28
7.23
7.21
7.19
6.94
4.42
4.42
4.41
4.40
4.39
4.39
4.37
3.49
3.49
3.46
3.44
3.44
3.43
2.99
2.97
1.38
1.37
1.36
1.35
1.29
1.28
1.16
1.15
1.14
1.12
2.07
3.08
0.92
1.00
3.08
1.03
6.15
3.15
6.19
f1 (ppm)


163.54
143.93
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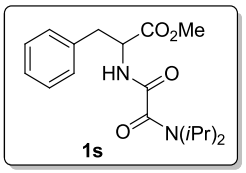
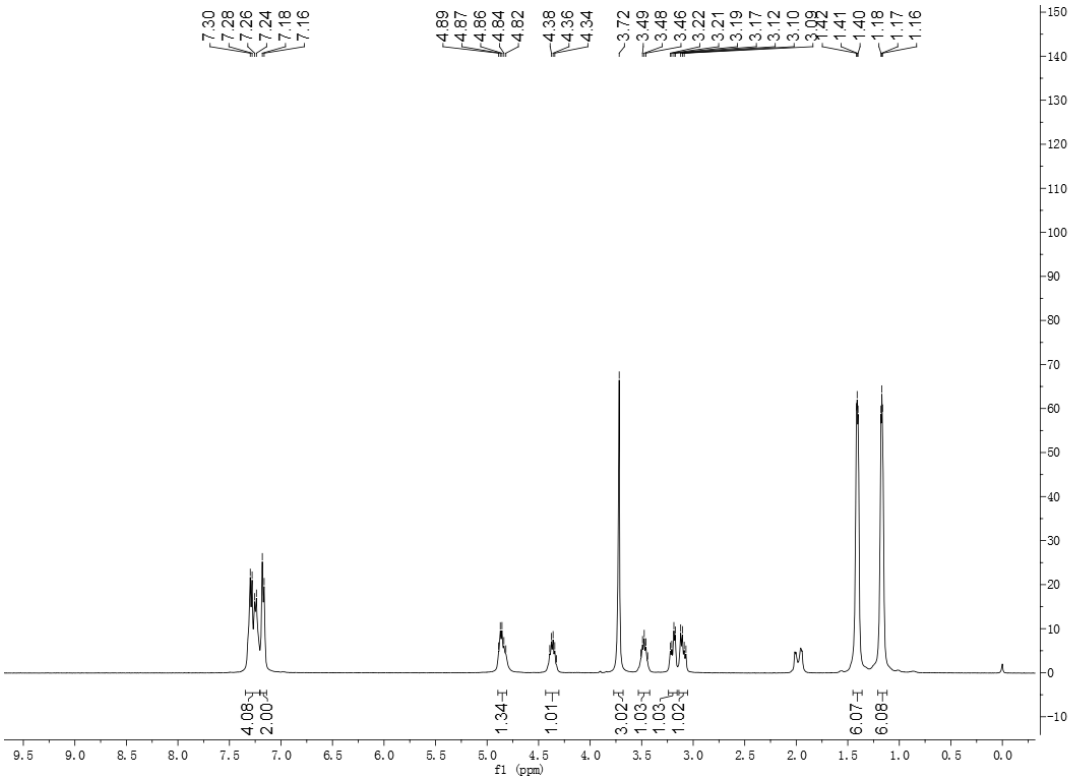
127.28
126.77
49.83
46.40
45.86
39.78
20.88
20.16
20.14
19.45
f1 (ppm)


CO2Me
HN
O
O
N(iPr)2

1s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7.18
7.16
4.89
4.87
4.86
4.84
4.82
4.38
4.36
4.34
3.72
3.49
3.48
3.46
3.22
3.21
3.19
3.17
3.12
3.10
3.09
1.41
1.40
1.18
1.17
1.16
4.08
2.00
1.34
1.01
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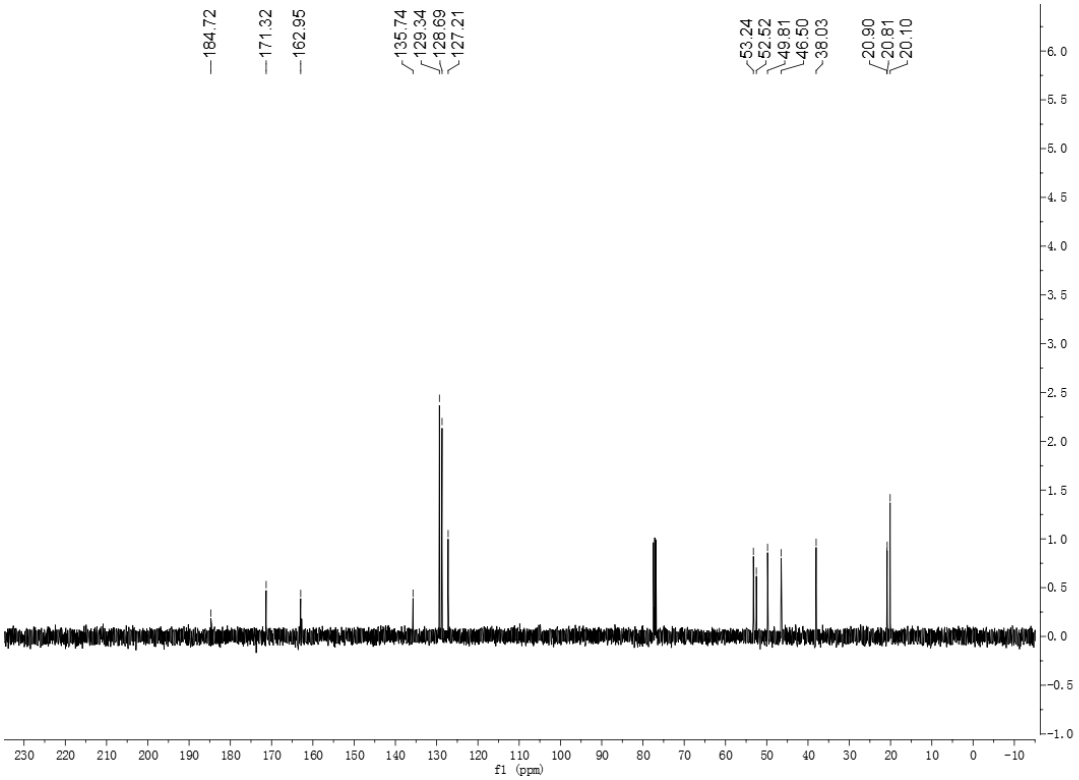
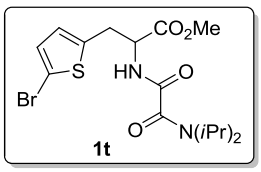
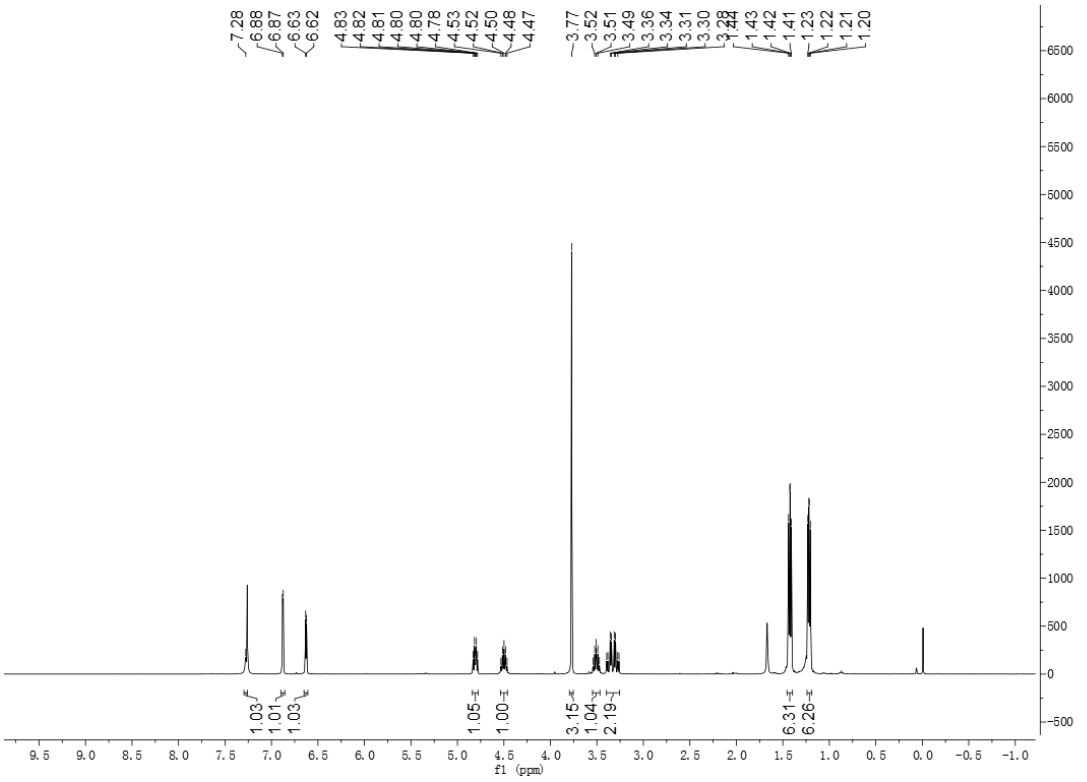
1.03
1.03
1.02
6.07
6.08
f1 (ppm)


184.72
171.32
162.95
135.74
129.34
128.69
127.21
53.24
52.52
49.81
46.50
38.03
20.90
20.81
20.10
f1 (ppm)


CO2Me
S
HN
O
Br
O
N(iPr)2

1t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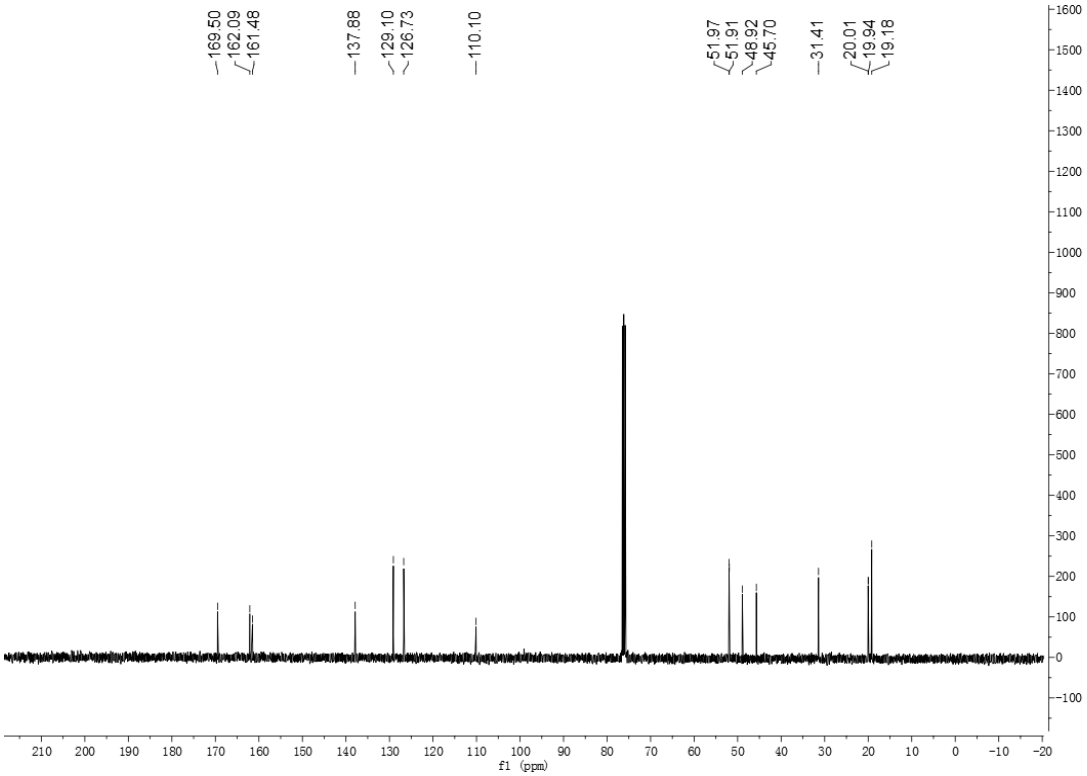
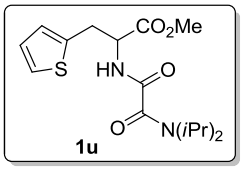
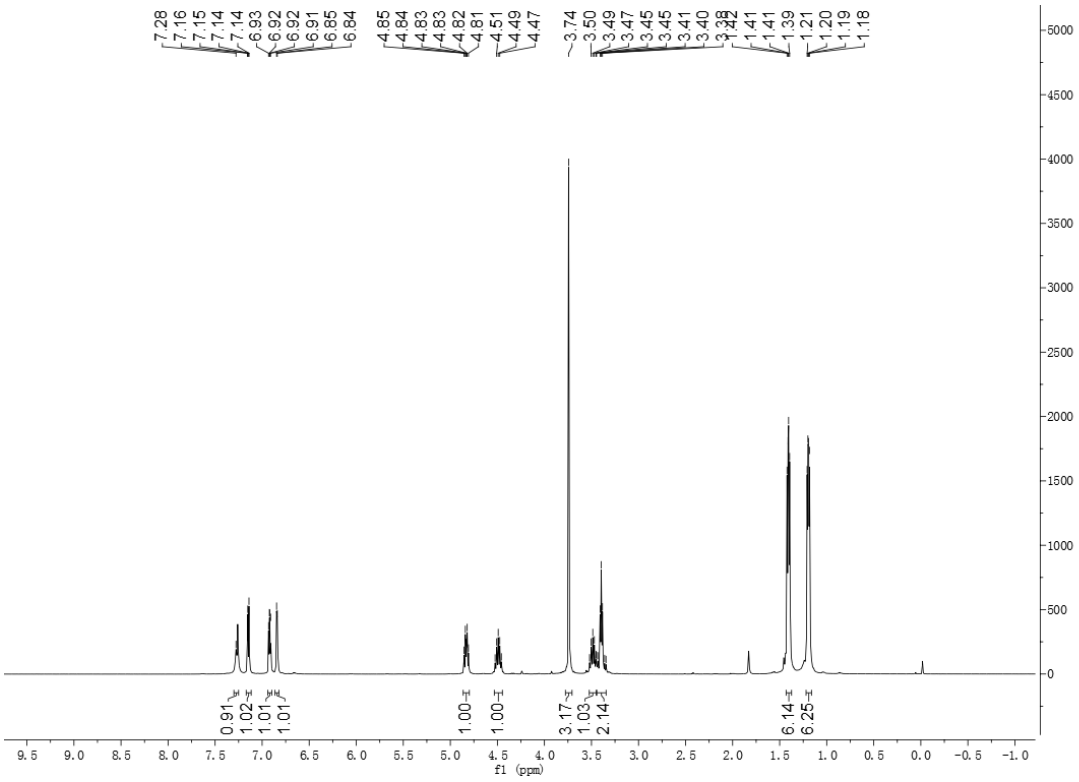
6.87
6.63
6.62
4.83
4.82
4.81
4.80
4.80
4.78
4.53
4.52
4.50
4.48
4.47
3.77
3.52
3.51
3.49
3.36
3.34
3.31
3.30
1.43
1.42
1.41
1.23
1.22
1.21
1.20
1.03
1.01
1.03
1.05
1.00
3.15
1.04
2.19
6.31
6.26
f1 (ppm)


169.50
162.09
161.48
137.88
129.10
126.73
110.10
51.97
51.91
48.92
45.70
31.41
20.01
19.94
19.18
f1 (ppm)


CO2Me
HN
O
O
N(iPr)2
S

1u


7.28
7.16
7.15
7.14
7.14
6.93
6.92
6.92
6.91
6.85
6.84
4.85
4.84
4.83
4.83
4.82
4.81
4.51
4.49
4.47
3.74
3.50
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3.47
3.45
3.45
3.41
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1.41
1.41
1.39
1.21
1.20
1.19
1.18
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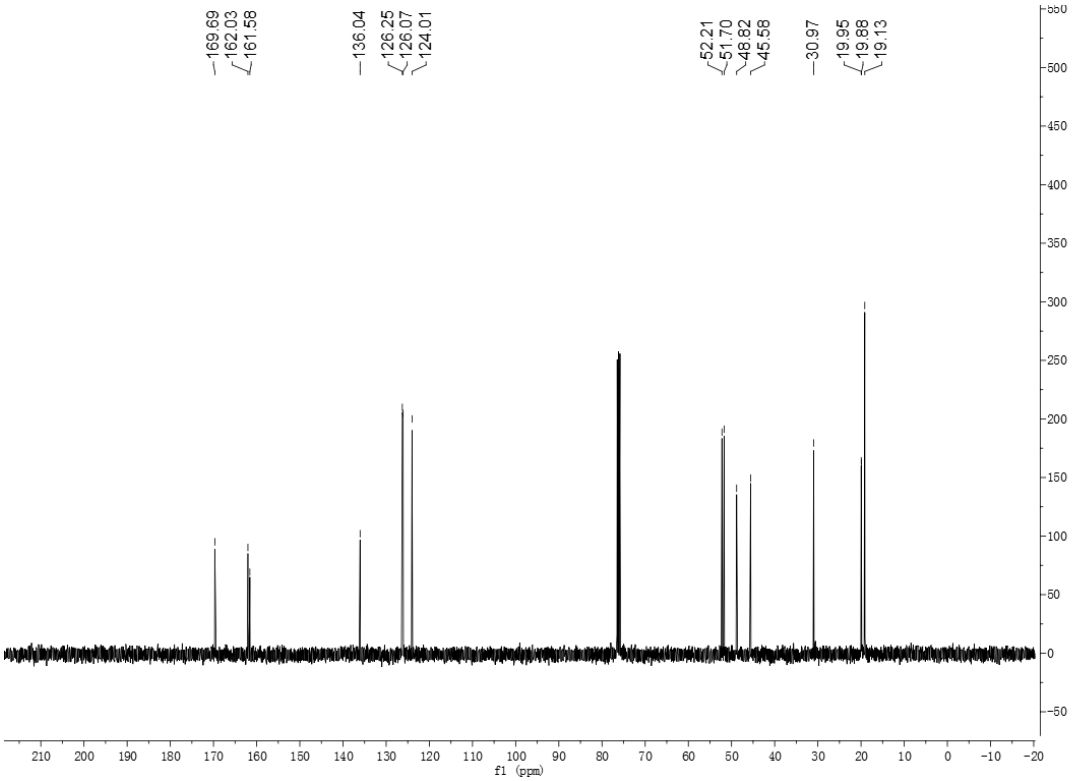
1.00
3.17
1.03
2.14
6.14
6.25
f1 (ppm)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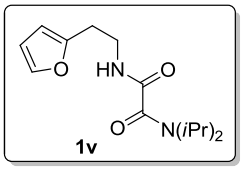
45.58
30.97
19.95
19.88
19.13
f1 (ppm)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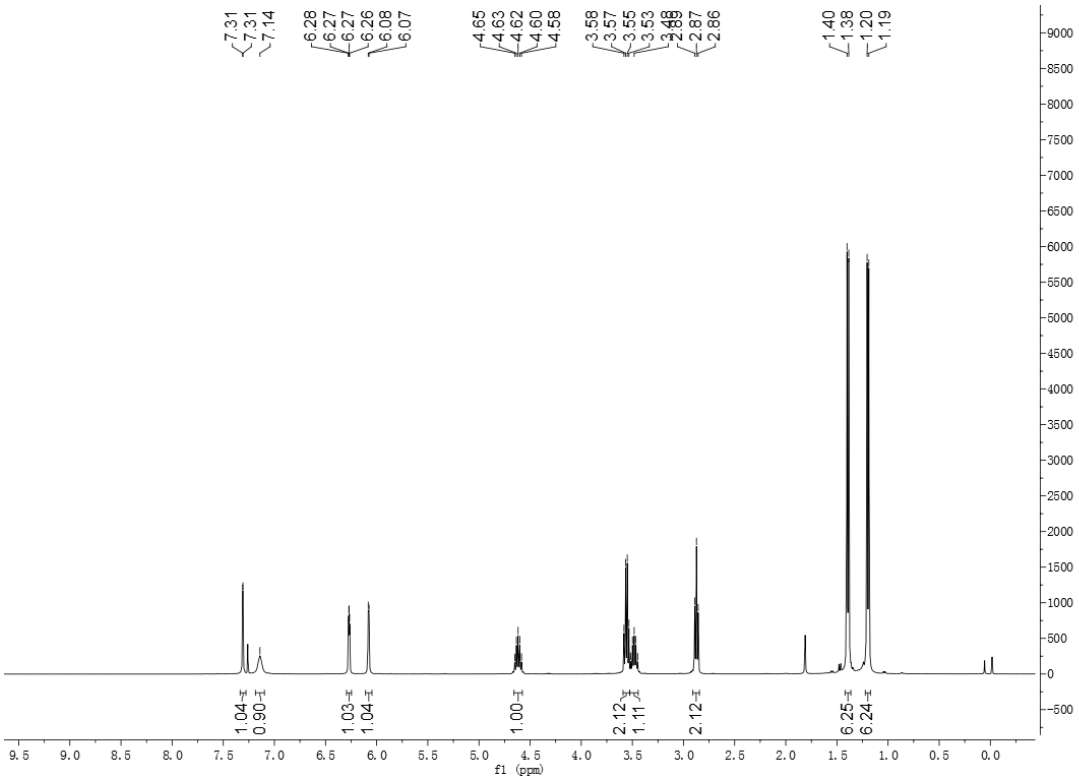
N(iPr)2
1v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4.58
3.58
3.57
3.55
3.53
2.89
2.87
2.86
1.40
1.38
1.20
1.19
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1.04
1.00
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2.12
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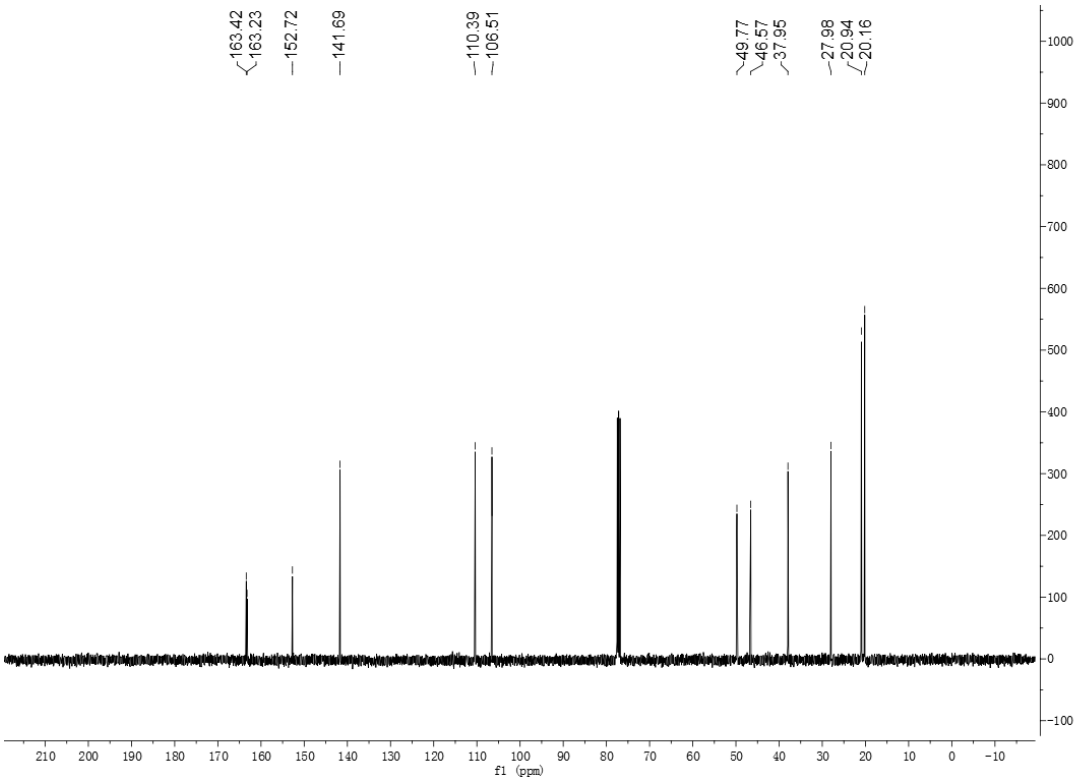
6.24
f1 (ppm)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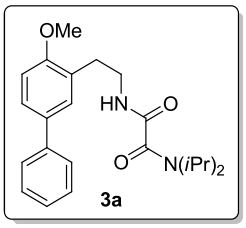
46.57
37.95
27.98
20.94
20.16
f1 (ppm)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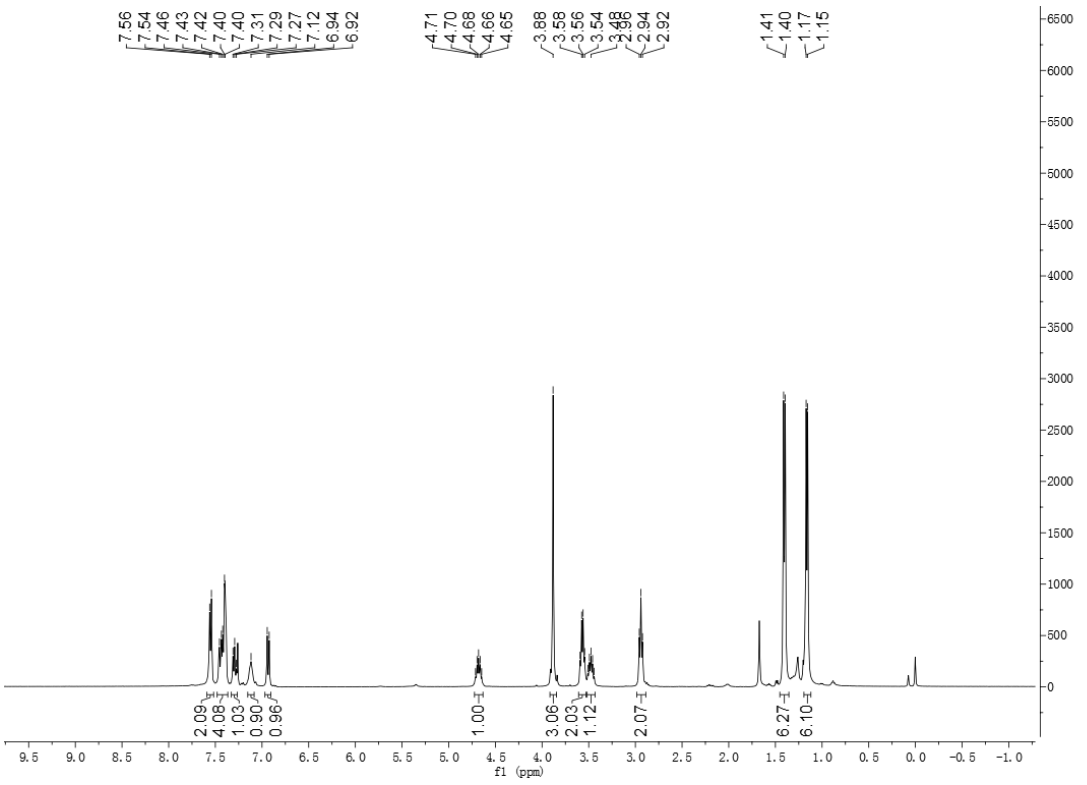
O
N(iPr)2
3a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7.12
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6.92
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4.70
4.68
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4.65
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3.58
3.56
3.54
3.48
2.98
2.94
2.92
1.41
1.40
1.17
1.15
2.09
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0.96
1.00
3.06
2.03
1.12
2.07
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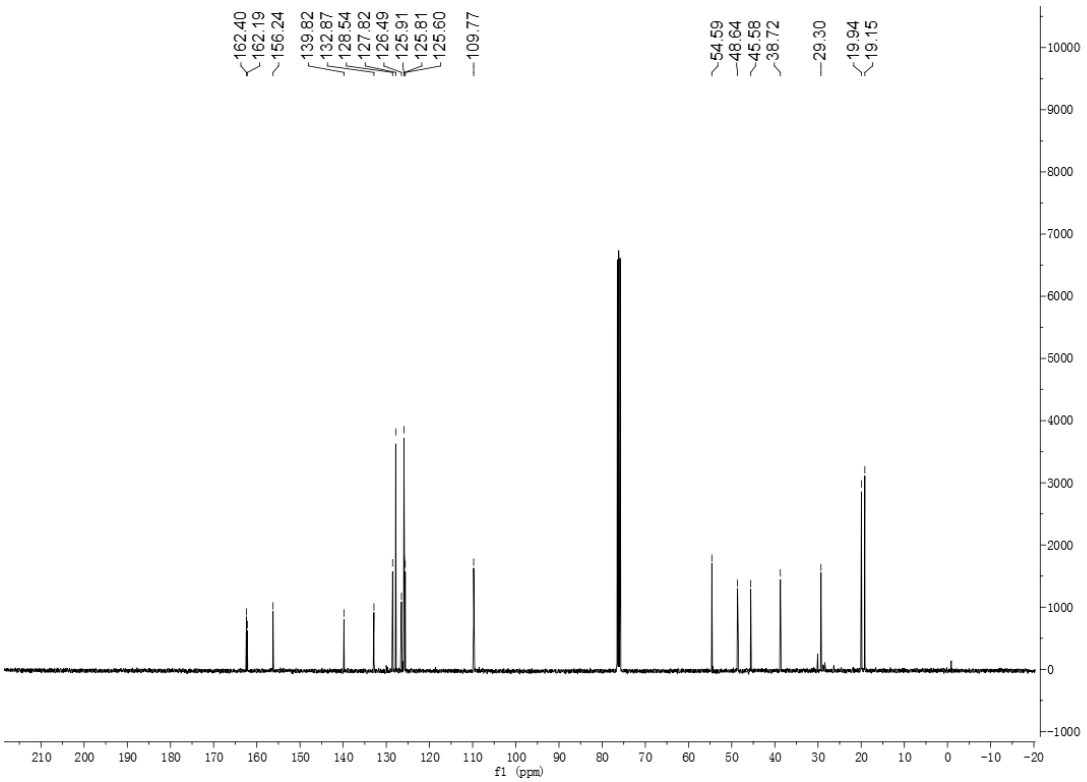
6.10
f1 (ppm)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126.49
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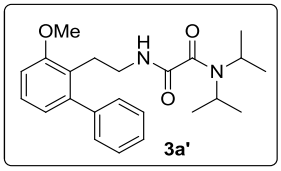
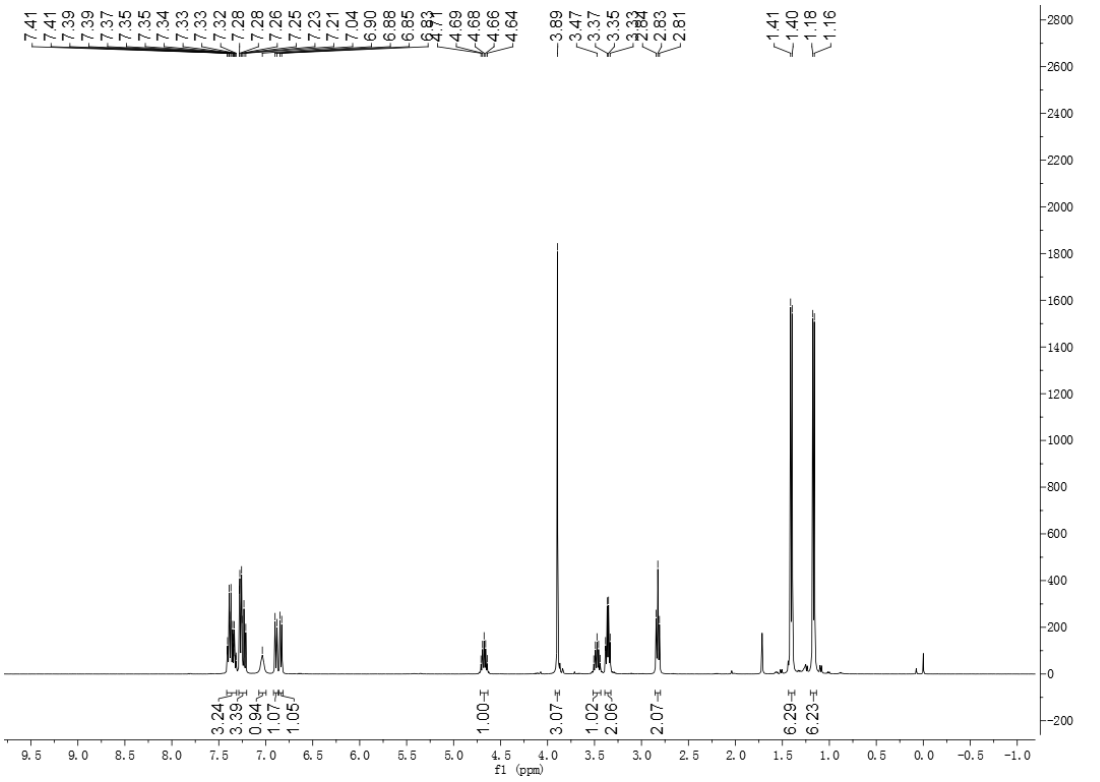
45.58
38.72
29.30
19.94
19.15
f1 (ppm)


OMe
H
N
O
O
N
3a'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7.28
7.26
7.25
7.23
7.21
7.04
6.90
6.88
6.85
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4.68
4.66
4.64
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2.81
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1.16
3.24
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2.06
2.07
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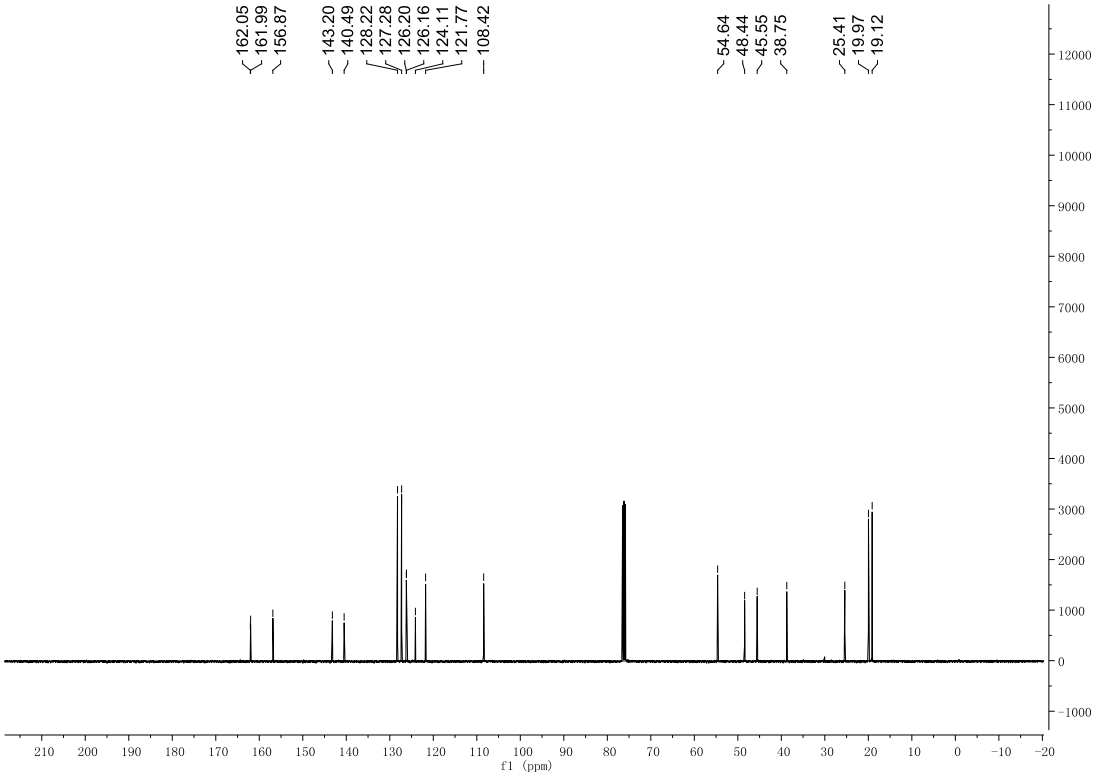
6.23
f1 (ppm)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128.22
127.28
126.20
126.16
124.11
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108.42
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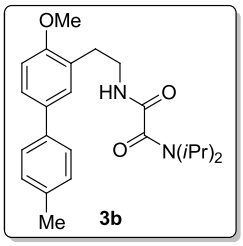
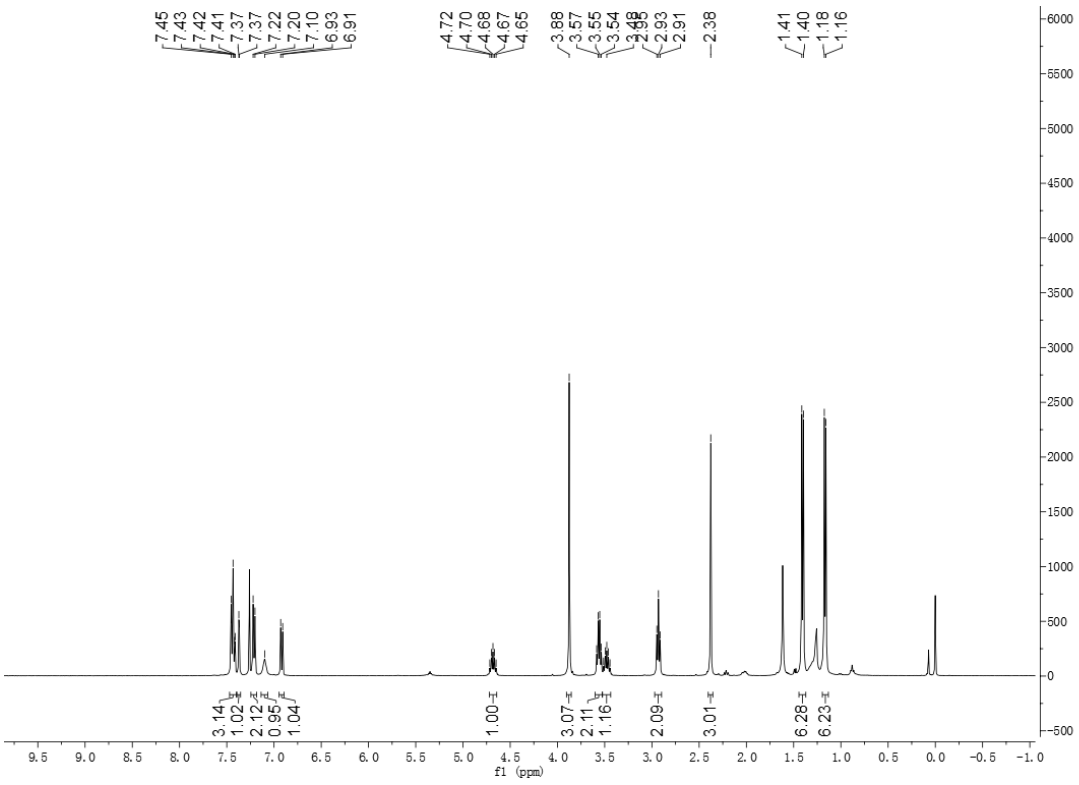
48.44
45.55
38.75
25.41
19.97
19.12
f1 (ppm)


OMe
HN
O
O
N(iPr)2
Me

3b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7.37
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7.10
6.93
6.91
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4.67
4.65
3.88
3.57
3.55
3.54
2.93
2.91
2.38
1.41
1.40
1.18
1.16
3.14
1.02
2.12
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1.04
1.00
3.07
2.11
1.16
2.09
3.01
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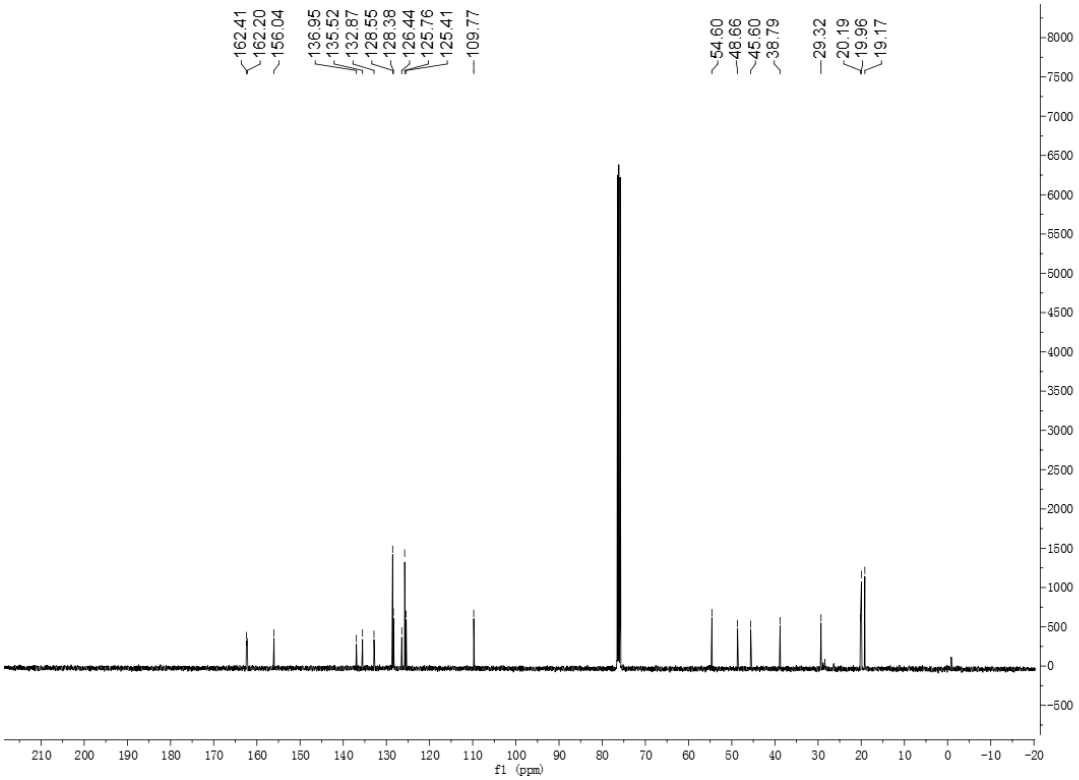
6.23
f1 (ppm)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45.60
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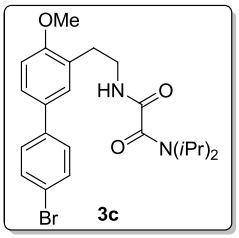
20.19
19.96
19.17
f1 (ppm)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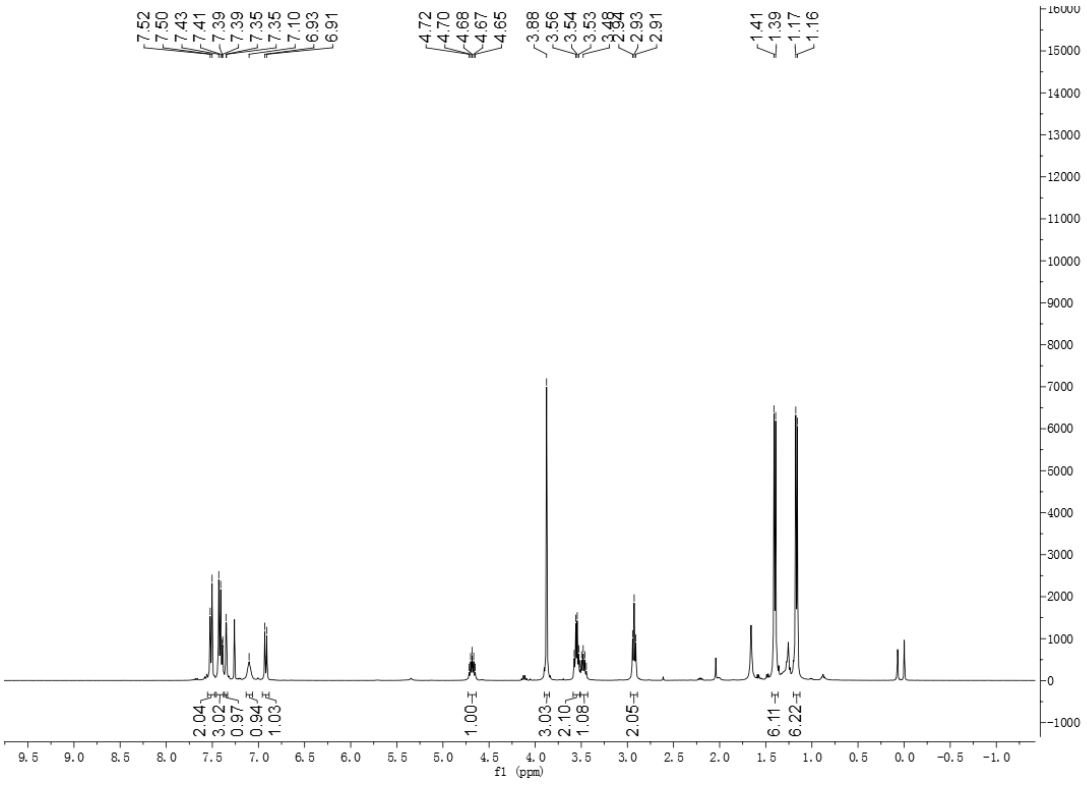
HN
O
O
N(iPr)2
Br
3c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4.67
4.65
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3.56
3.54
3.53
3.48
3.44
2.93
2.91
1.41
1.39
1.17
1.16
2.04
3.02
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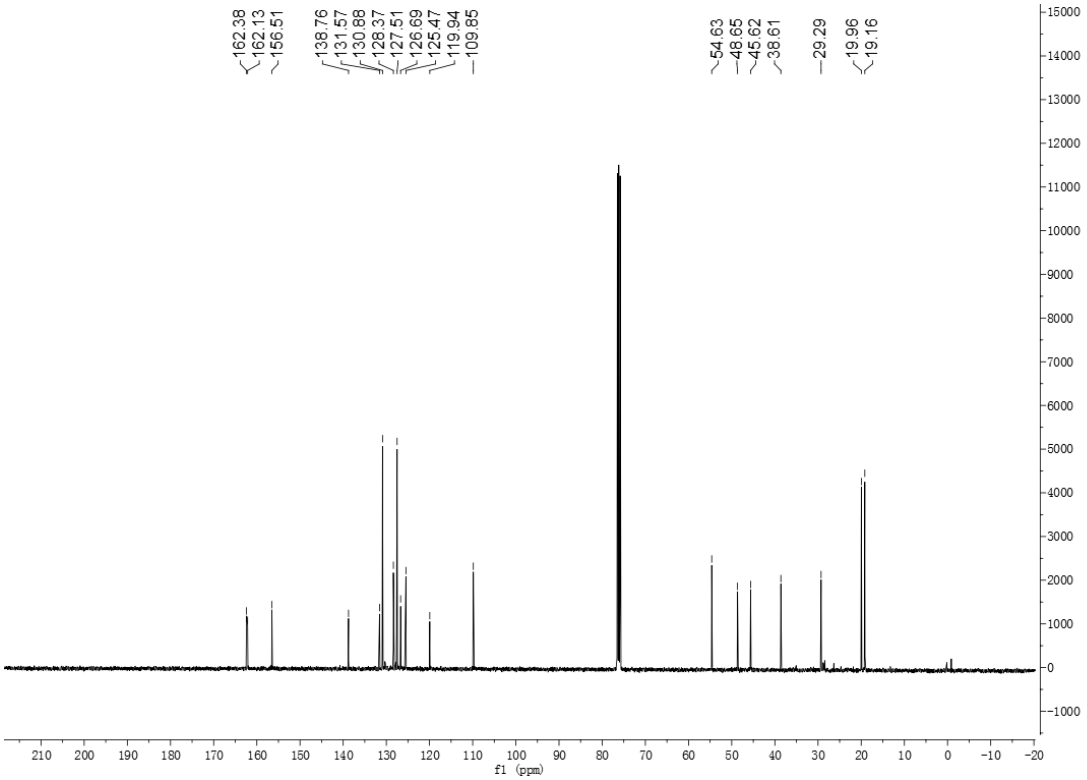
0.94
1.03
1.00
3.03
2.10
1.08
2.05
6.11
6.22
f1 (ppm)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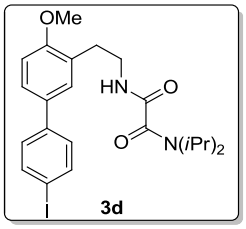
19.96
19.16
f1 (ppm)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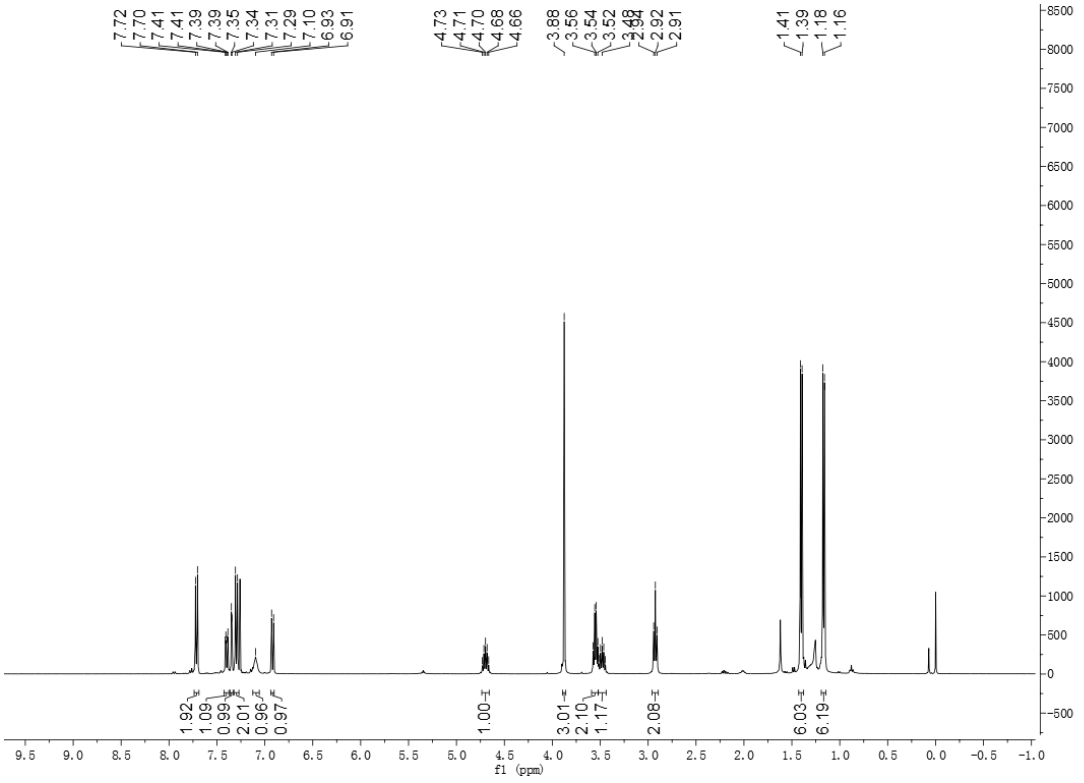
HN
O
O
N(iPr)2
I
3d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3.52
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2.91
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1.18
1.16
1.92
1.09
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0.97
1.00
3.01
2.10
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2.08
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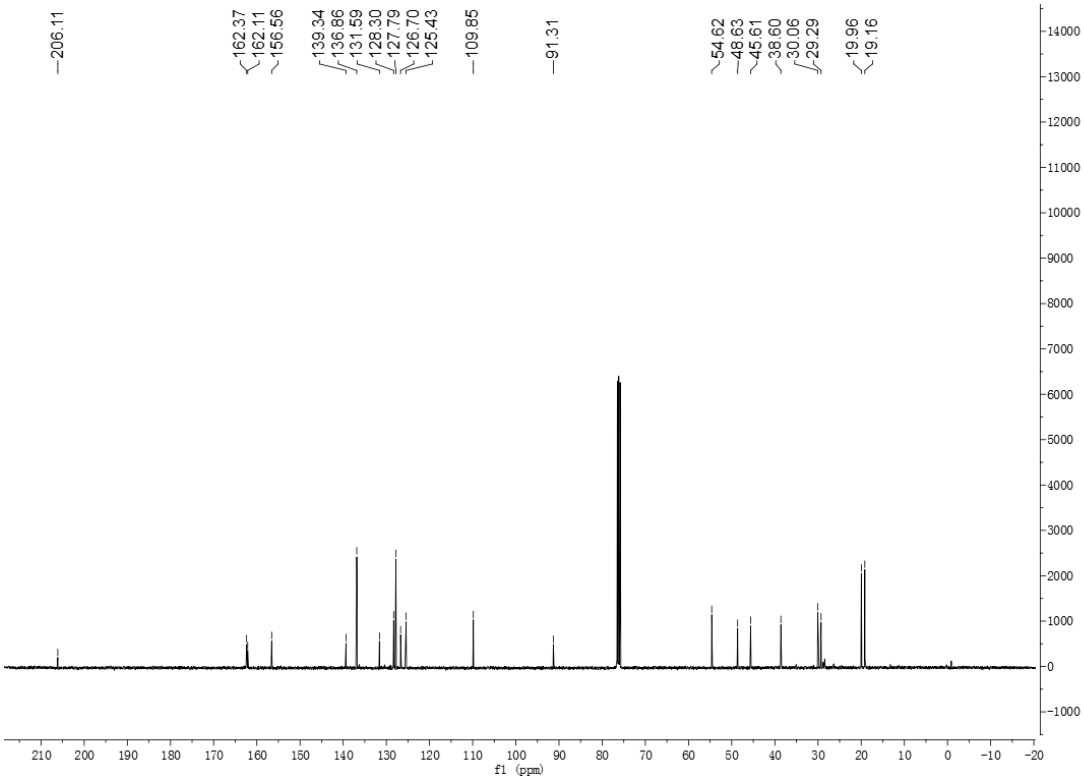
6.19
f1 (ppm)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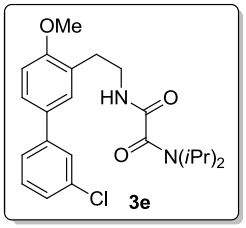
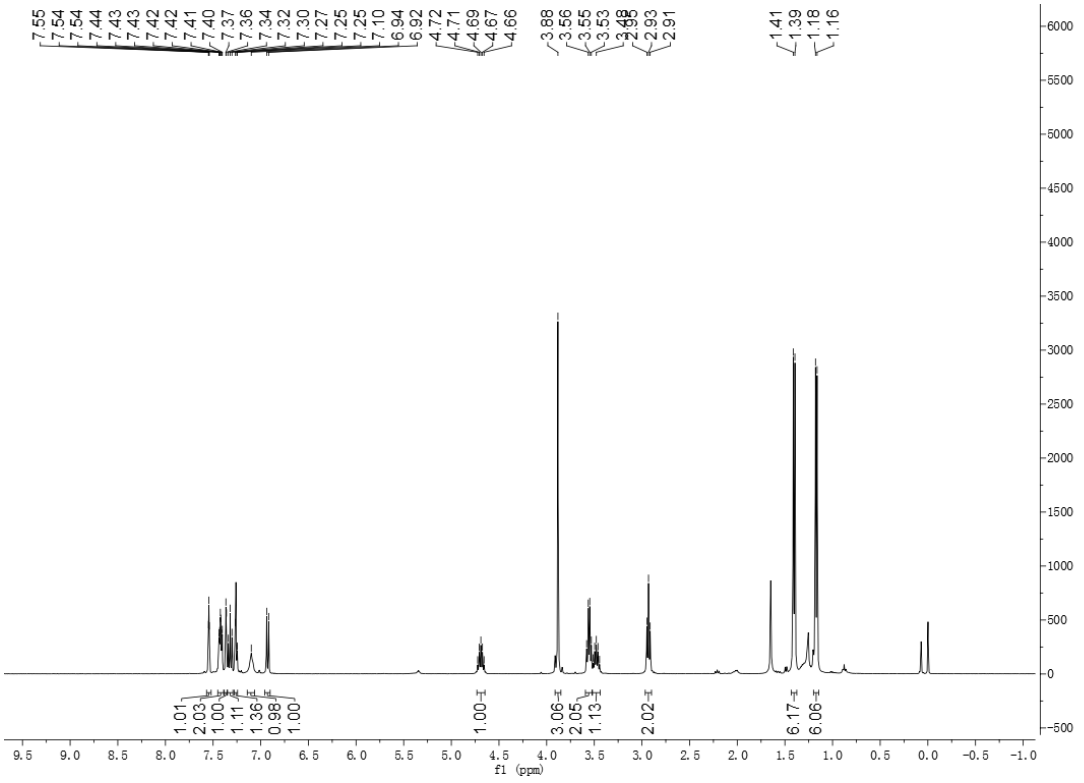
19.96
19.16
f1 (ppm)


OMe
HN
O
O
N(iPr)2
Cl
3e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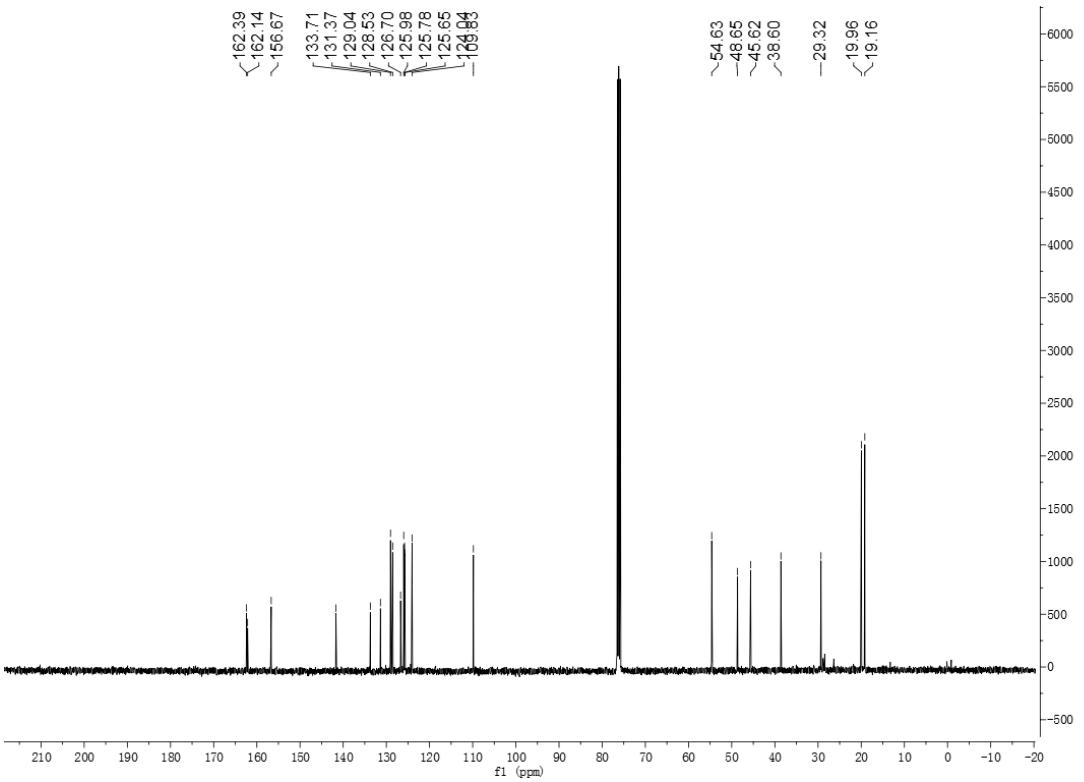
6.06
f1 (ppm)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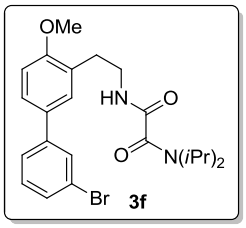
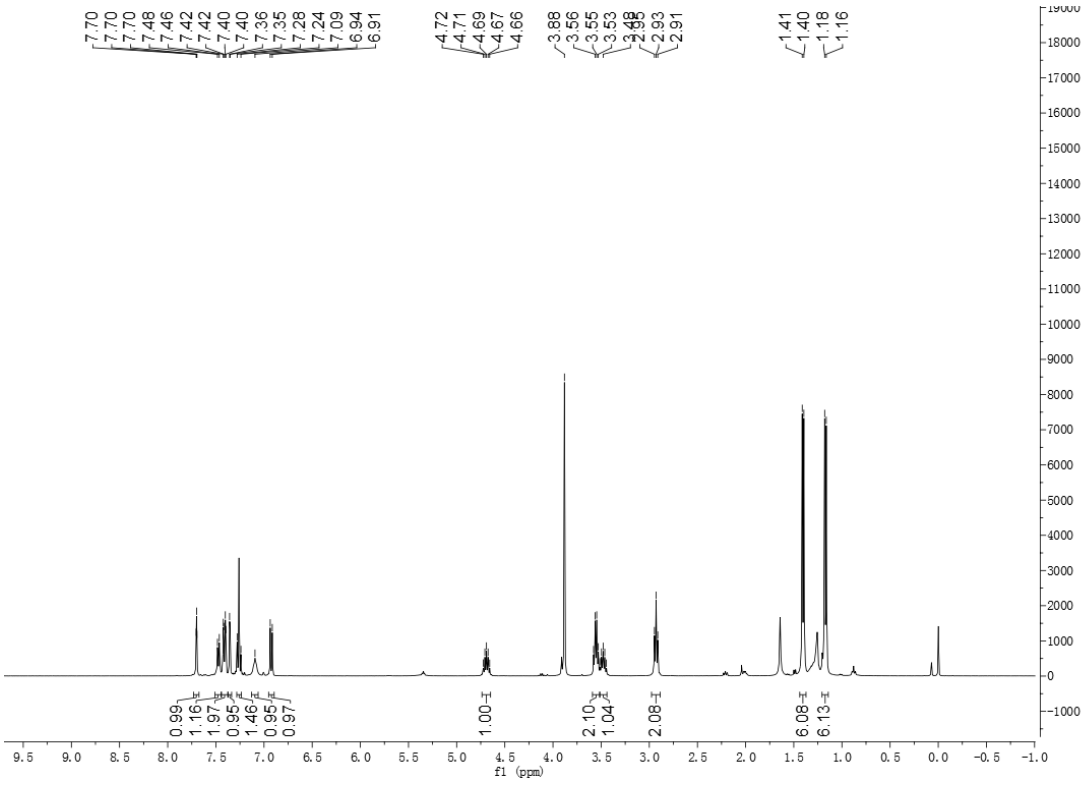
19.96
19.16
f1 (ppm)


OMe
HN
O
O
N(iPr)2
Br
3f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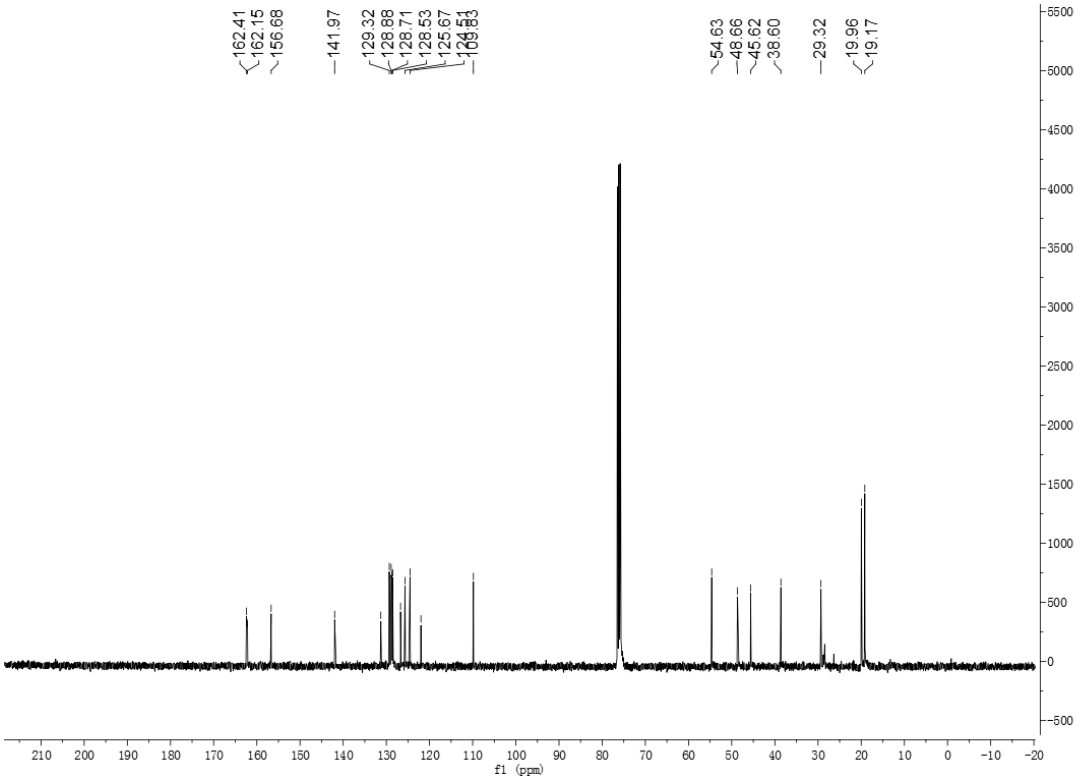
6.13
f1 (ppm)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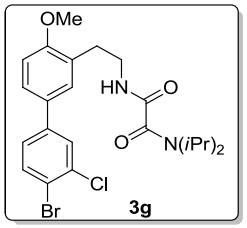
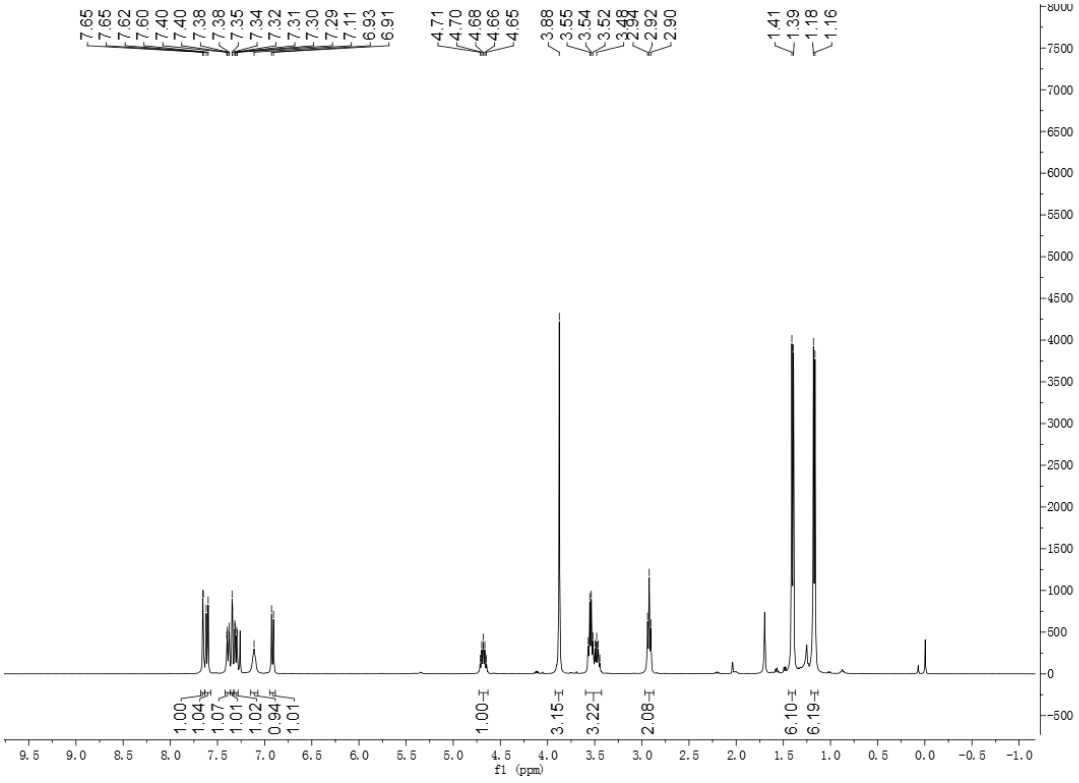
29.32
19.96
19.17
f1 (ppm)


OMe
HN
O
O
N(iPr)2
Cl
Br
3g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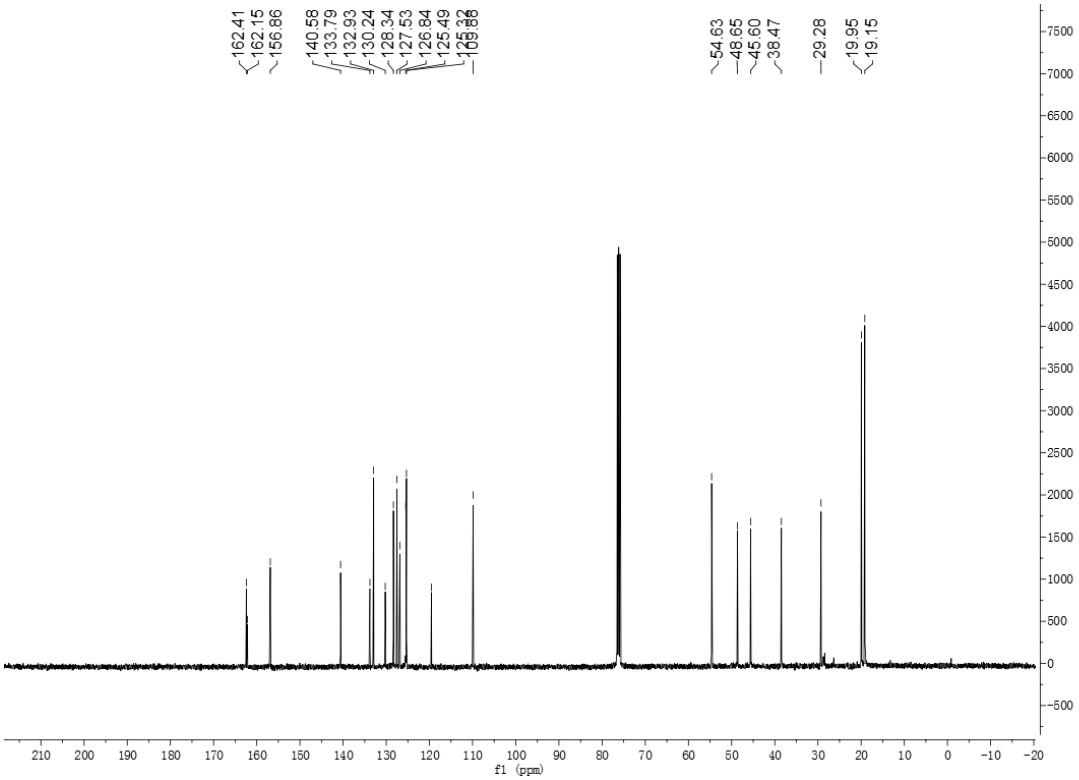
f1 (ppm)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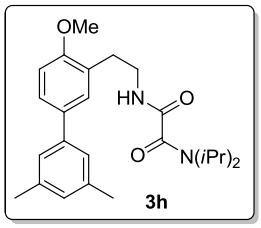
19.15
f1 (ppm)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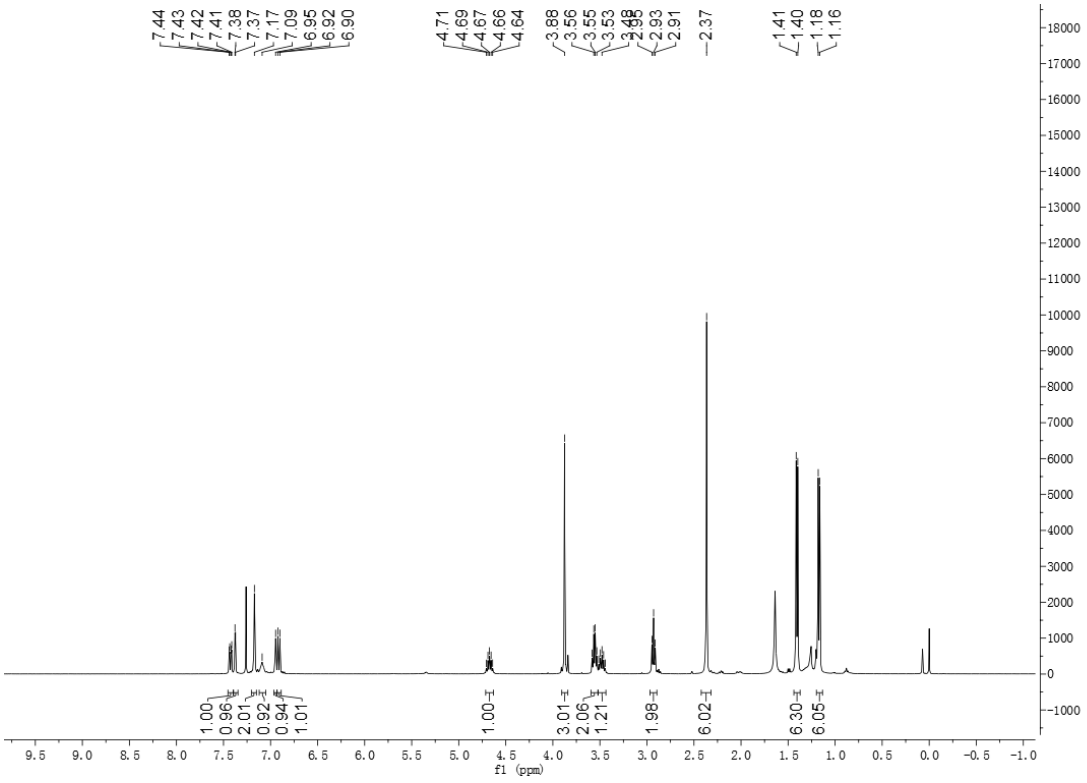
O
O
N(iPr)2

3h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2.01
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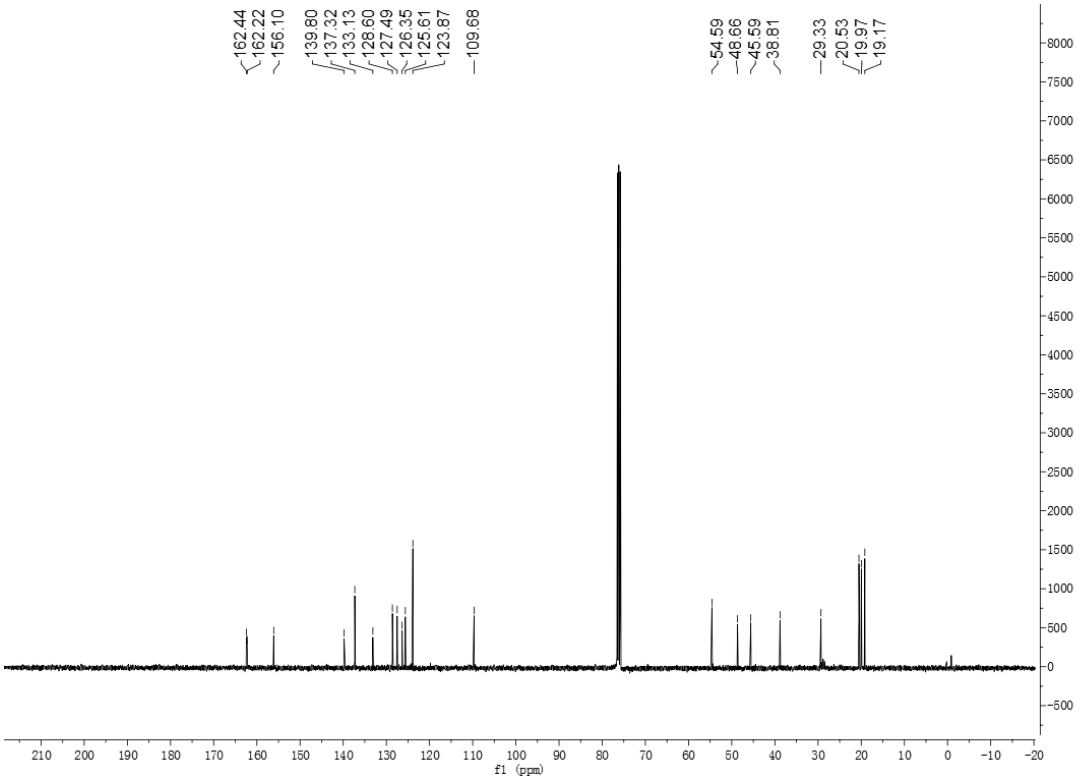
f1 (ppm)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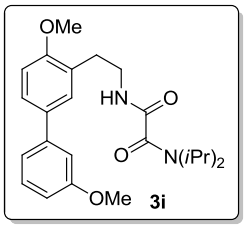
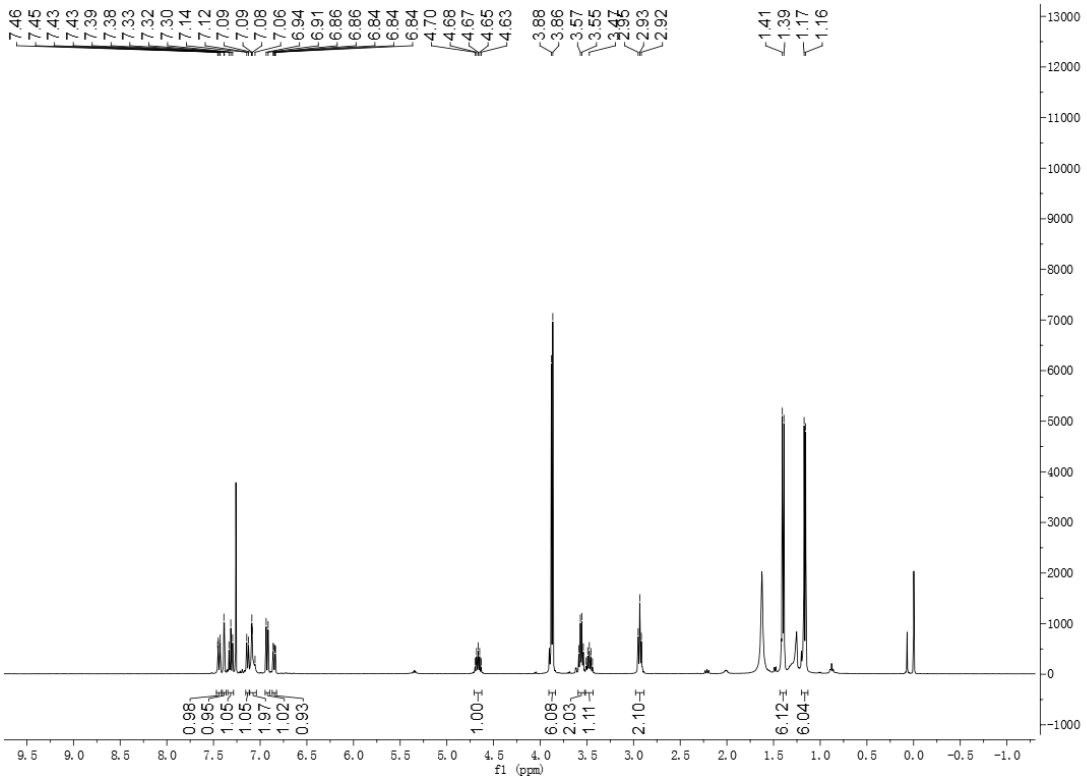
20.53
19.97
19.17
f1 (ppm)


OMe
HN
O
O
N(iPr)2
OMe
3i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2.10
6.12
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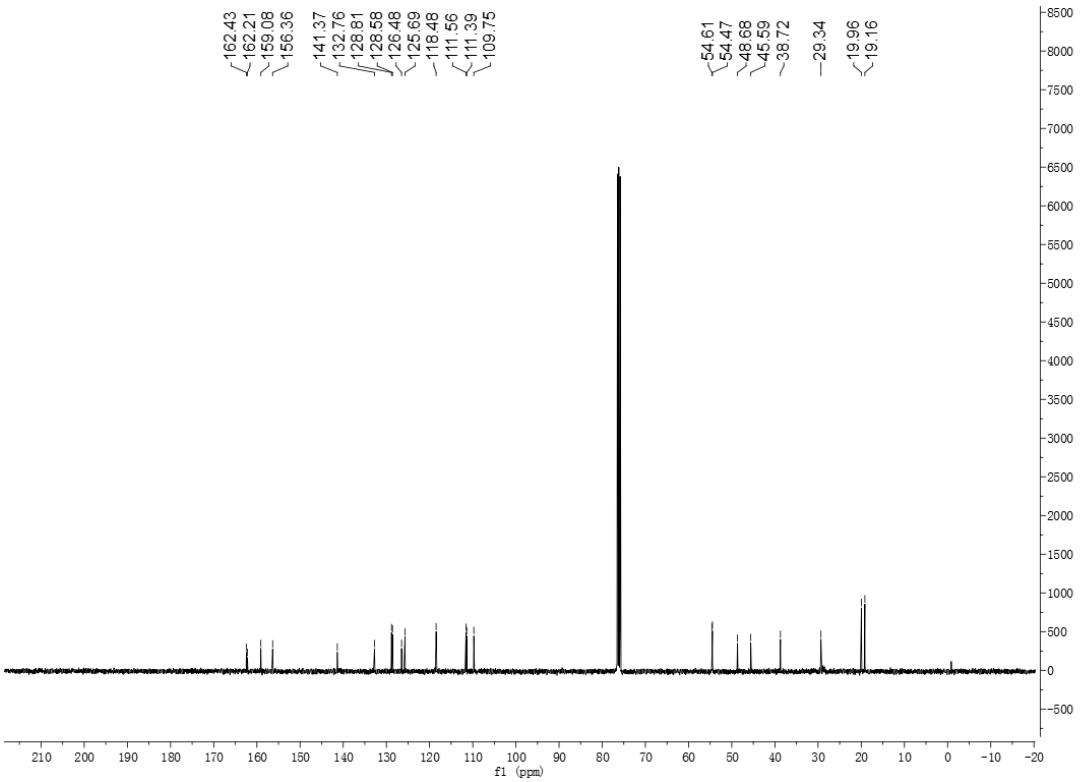
f1 (ppm)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128.58
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125.69
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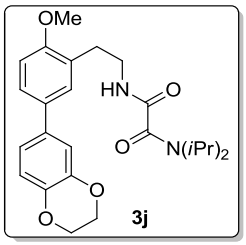
48.68
45.59
38.72
29.34
19.96
19.16
f1 (ppm)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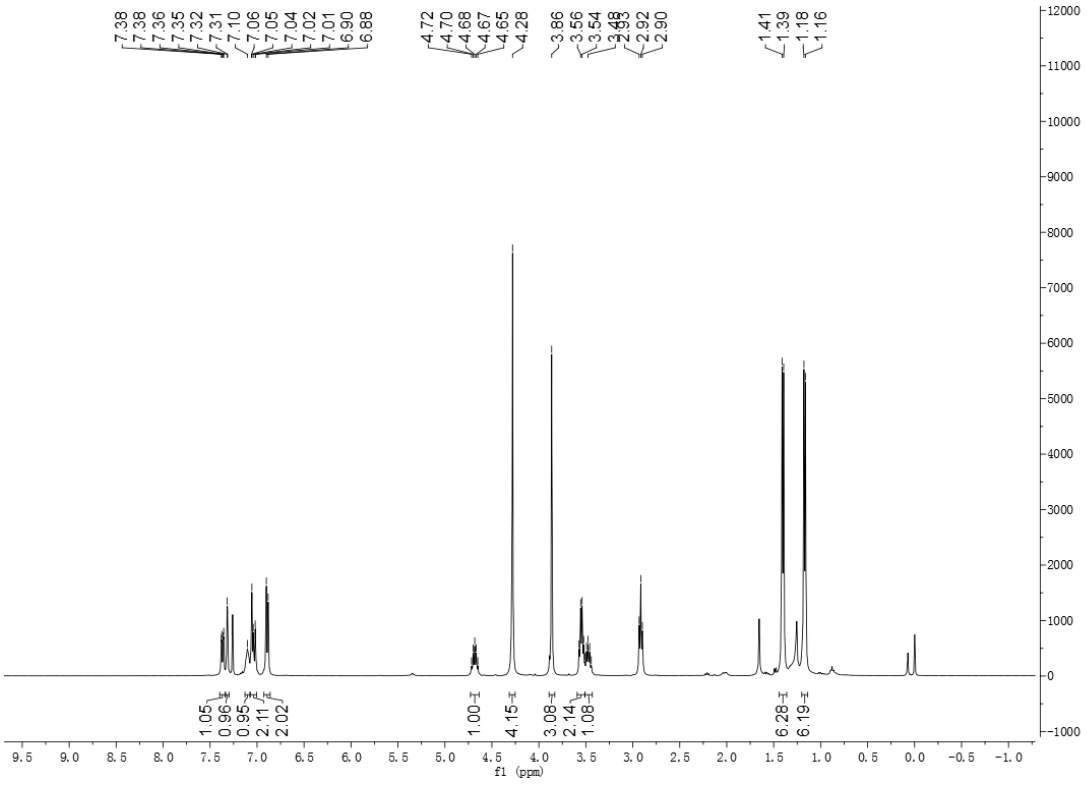
O
N(iPr)2
O
O
3j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7.02
7.01
6.90
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4.70
4.68
4.67
4.65
4.28
3.86
3.56
3.54
3.48
3.43
2.92
2.90
1.41
1.39
1.18
1.16
1.05
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0.95
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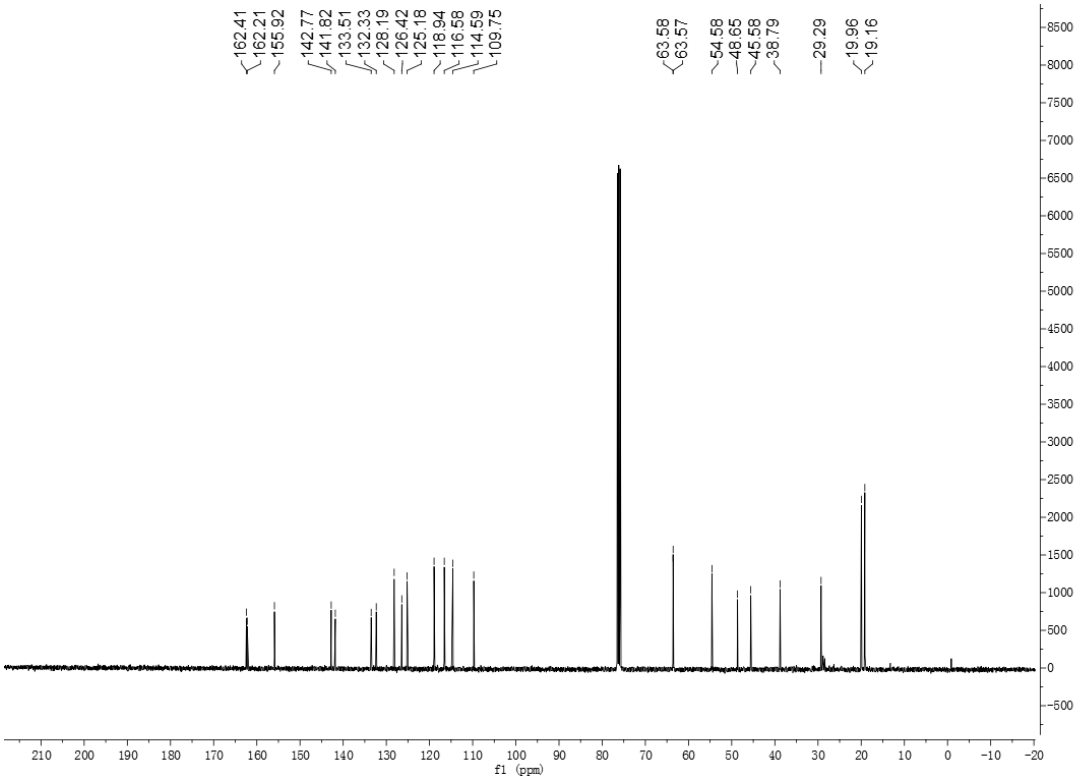
2.02
1.00
4.15
3.08
2.14
1.08
6.28
6.19
f1 (ppm)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125.18
118.94
116.58
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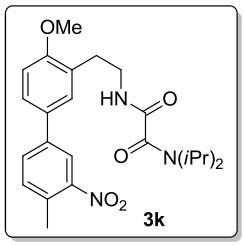
63.57
54.58
48.65
45.58
38.79
29.29
19.96
19.16
f1 (ppm)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HN
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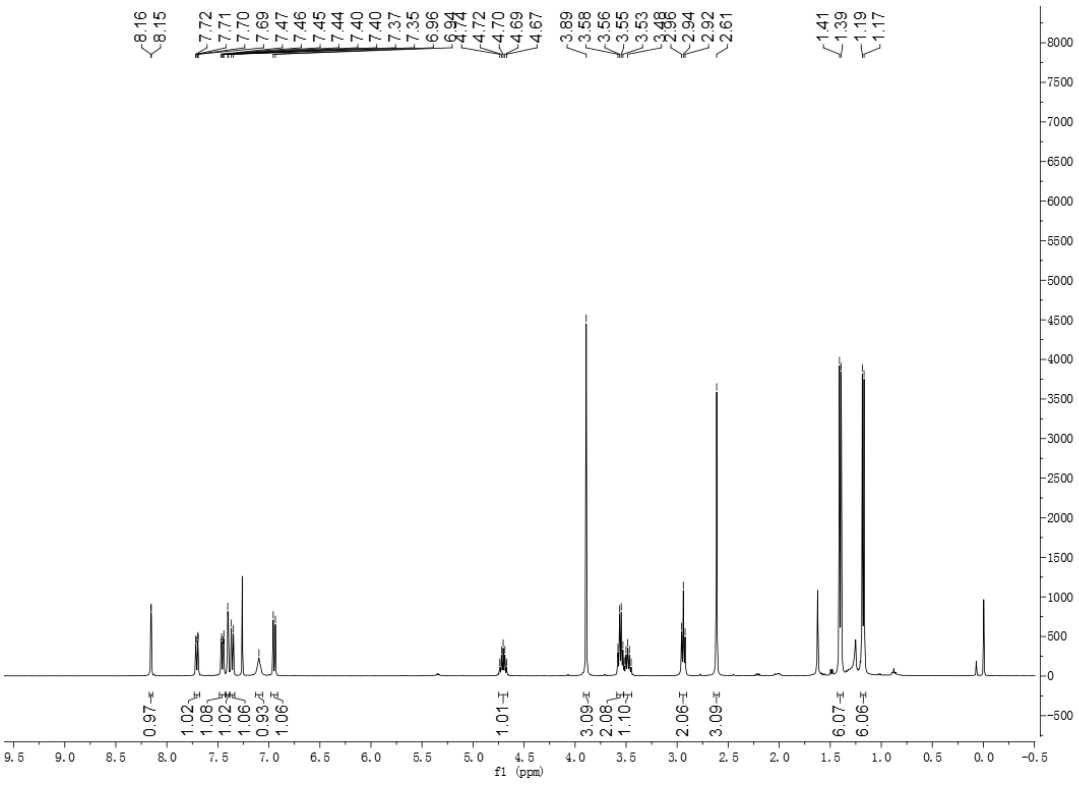
O
N(iPr)2
NO2

3k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7.40
7.37
7.35
6.96
4.72
4.70
4.69
4.67
3.89
3.58
3.56
3.55
3.53
2.94
2.92
2.61
1.41
1.39
1.19
1.17
0.97
1.02
1.08
1.02
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0.93
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1.01
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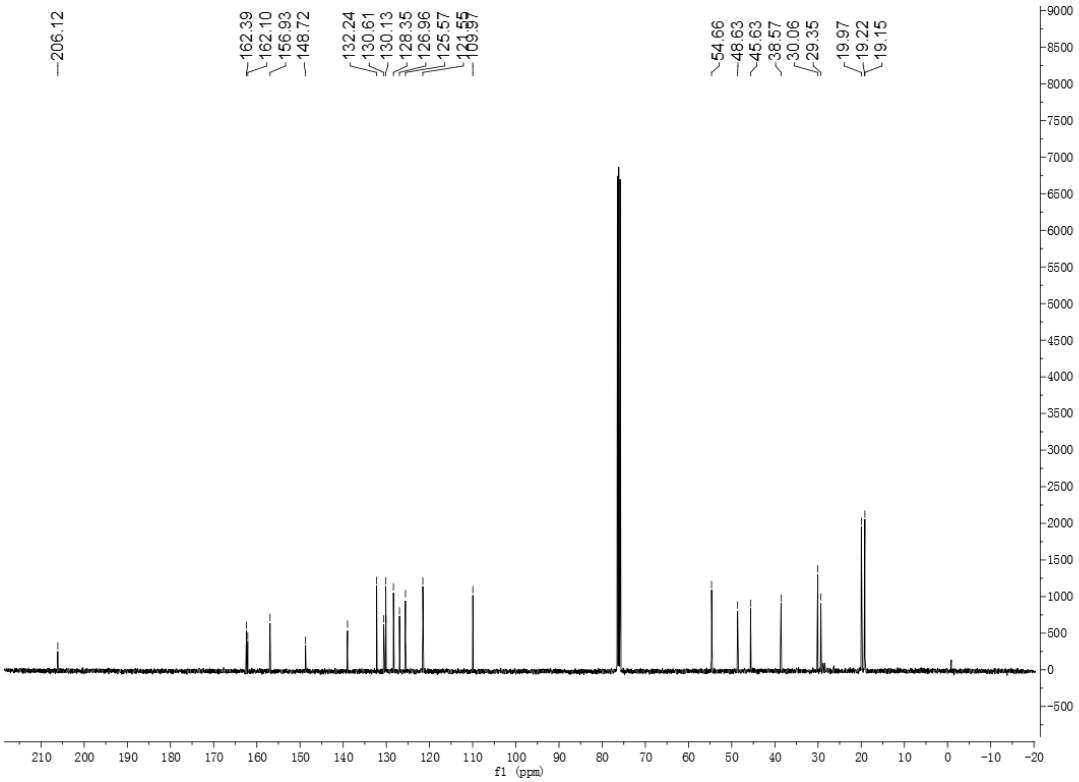
2.08
1.10
2.06
3.09
6.07
6.06
f1 (ppm)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130.13
128.35
126.96
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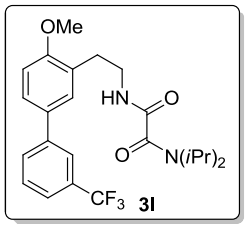
38.57
30.06
29.35
19.97
19.22
19.15
f1 (ppm)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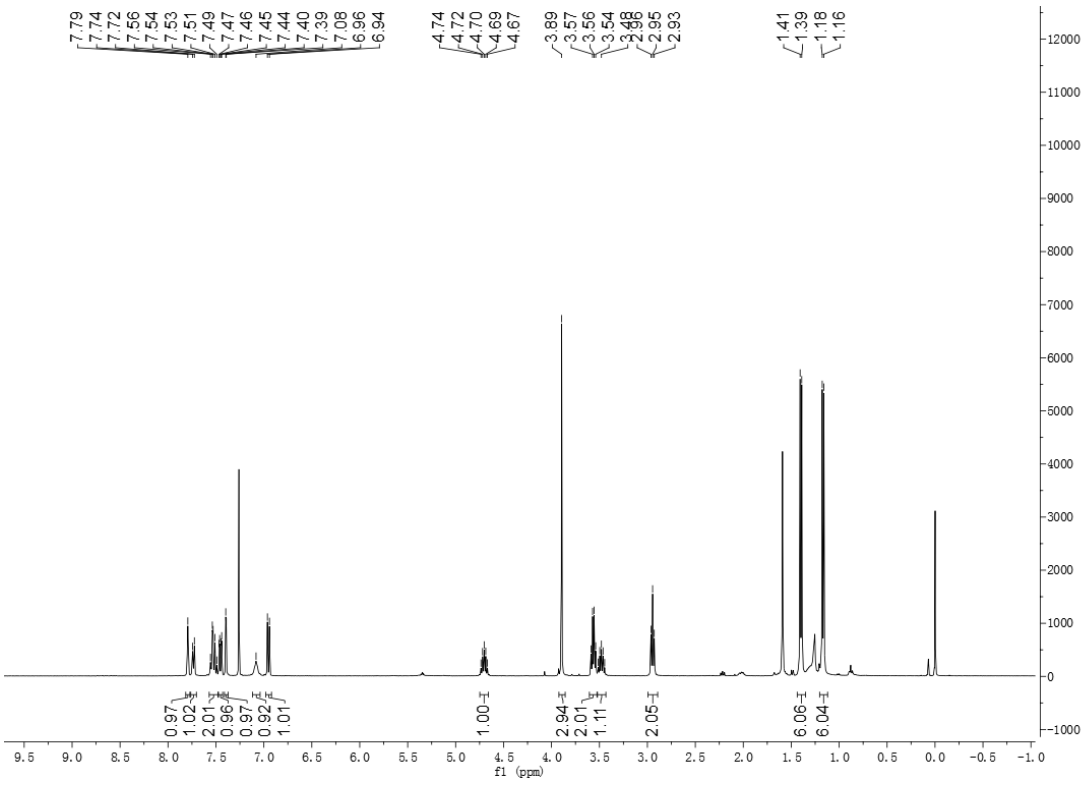
HN
O
O
N(iPr)2
CF3
3l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7.46
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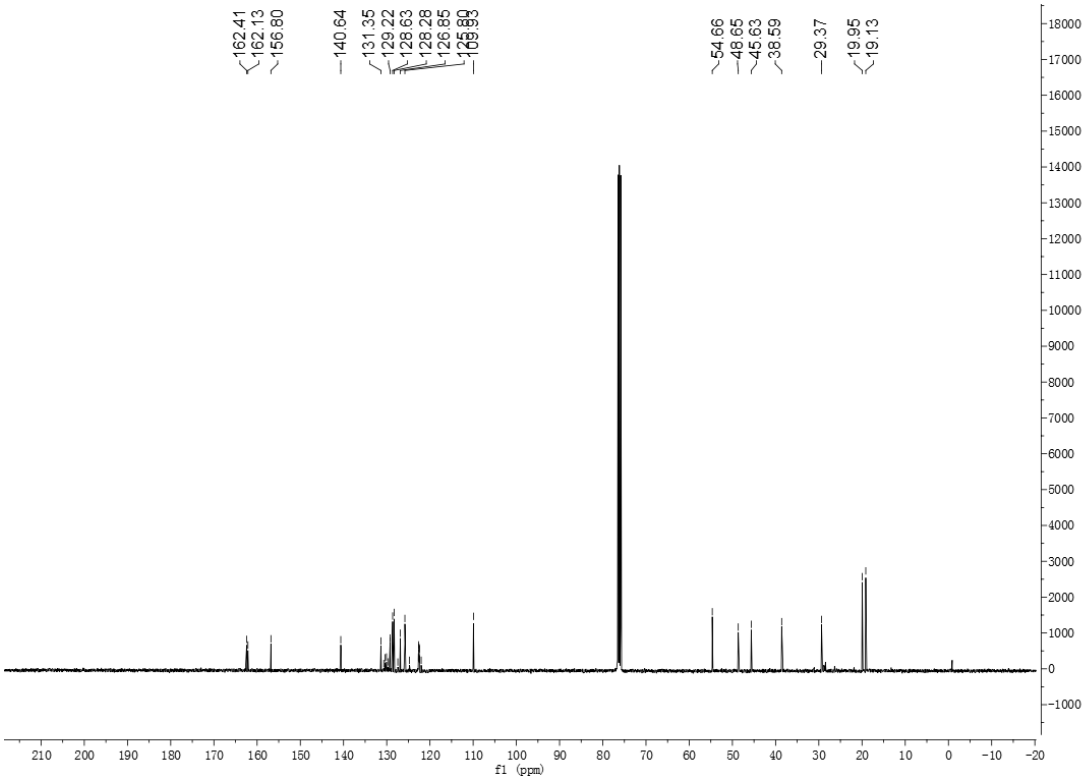
7.44
7.40
7.39
7.08
6.96
6.94
4.74
4.72
4.70
4.69
4.67
3.89
3.57
3.56
3.54
2.95
2.93
1.41
1.39
1.18
1.16
0.97
1.02
2.01
0.96
0.97
0.92
1.01
1.00
2.94
2.01
1.11
2.05
6.06
6.04
f1 (ppm)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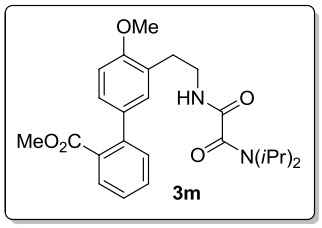
48.65
45.63
38.59
29.37
19.95
19.13
f1 (ppm)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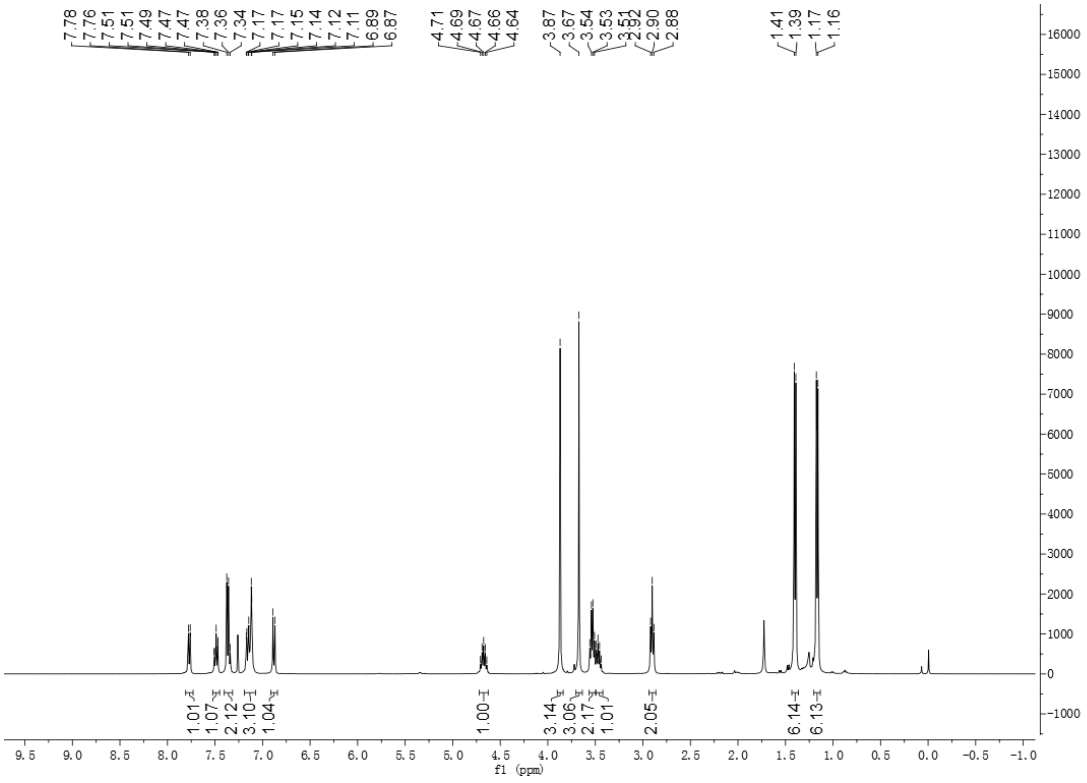
HN
O
MeO2C
O
N(iPr)2

3m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7.15
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7.12
7.11
6.89
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4.71
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4.67
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4.64
3.87
3.67
3.54
3.53
3.51
2.92
2.90
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1.41
1.39
1.17
1.16
1.01
1.07
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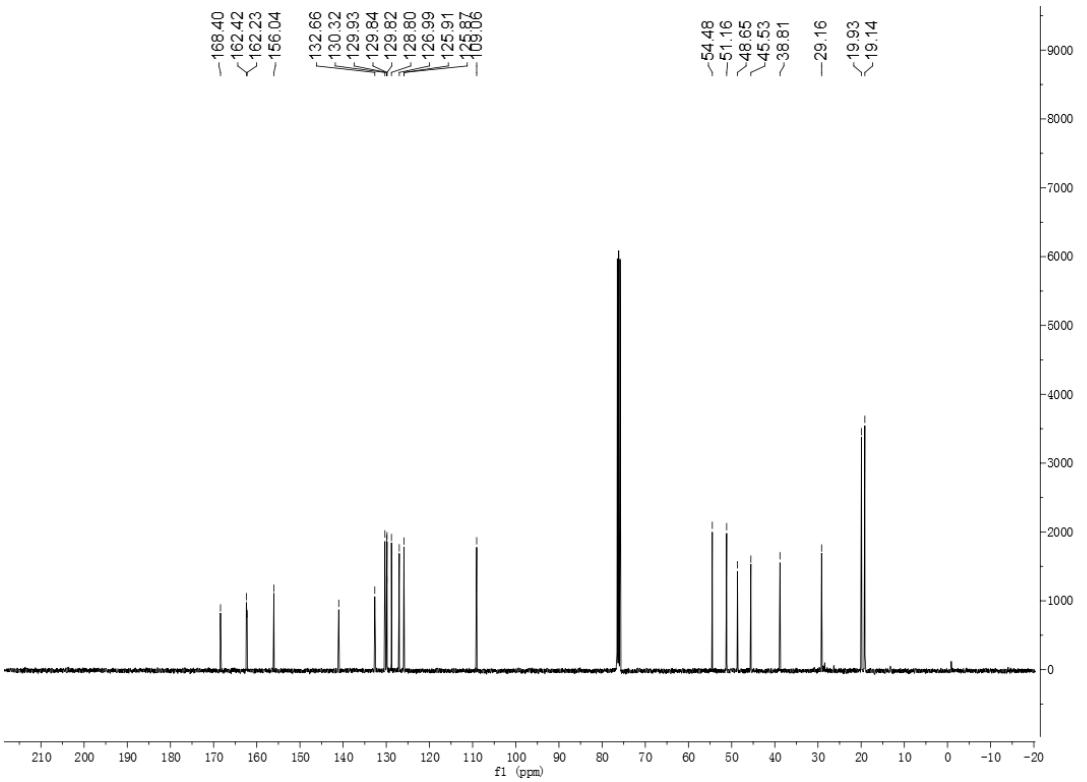
3.06
2.17
1.01
2.05
6.14
6.13
f1 (ppm)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129.82
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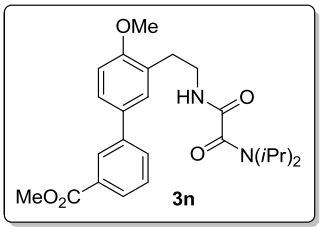
48.65
45.53
38.81
29.16
19.93
19.14
f1 (ppm)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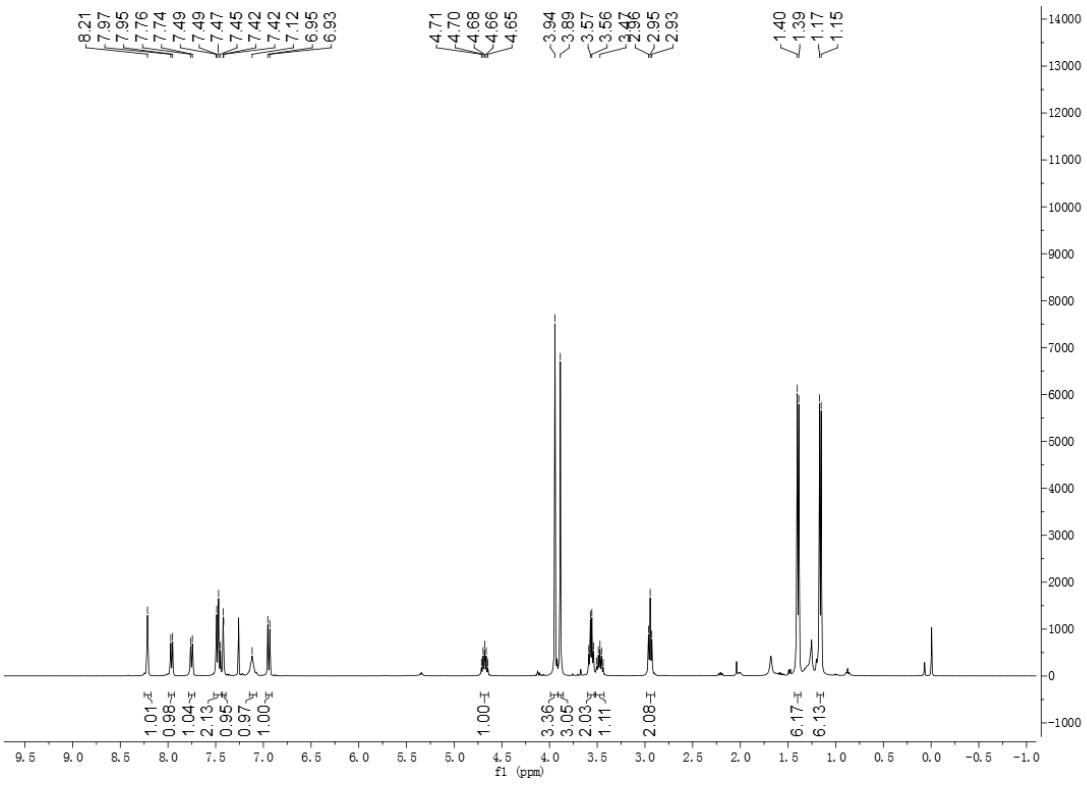
HN
O
O
N(iPr)2
MeO2C
3n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7.42
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4.68
4.66
4.65
3.94
3.89
3.57
3.56
2.96
2.95
2.93
1.40
1.39
1.17
1.15
1.01
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1.04
2.13
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0.97
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1.00
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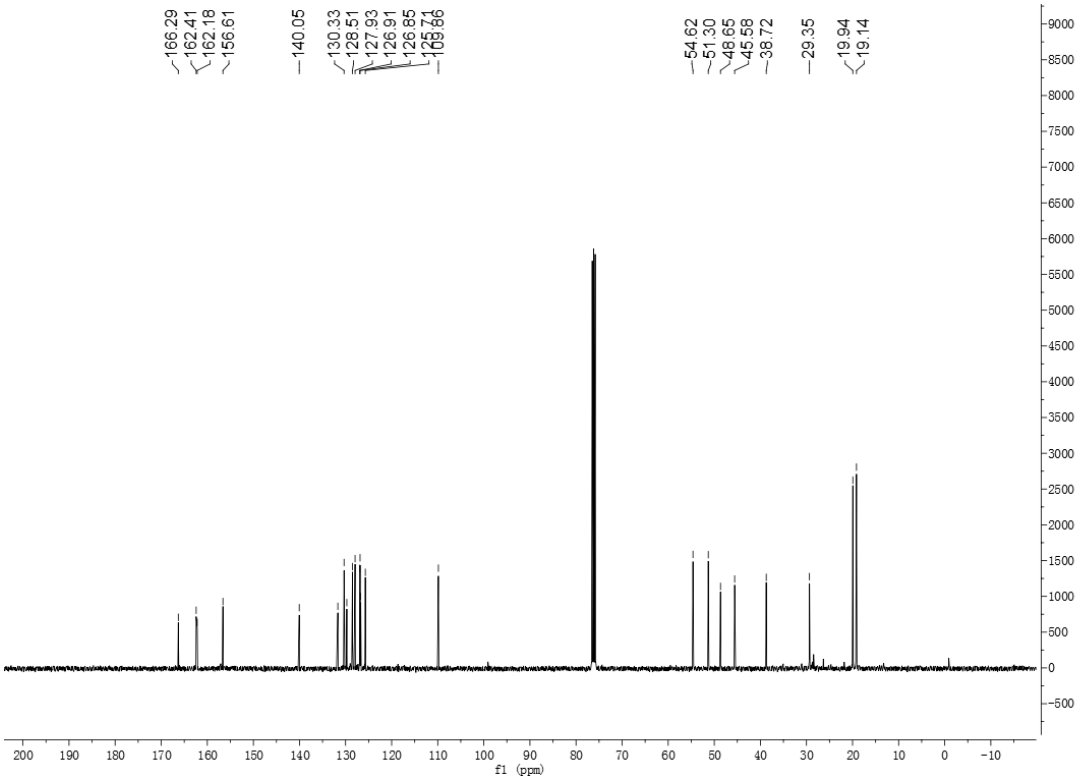
3.05
2.03
1.11
2.08
6.17
6.13
f1 (ppm)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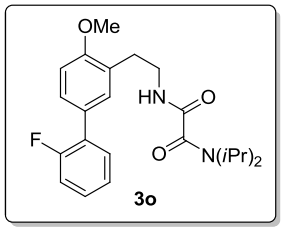
38.72
29.35
19.94
19.14
f1 (ppm)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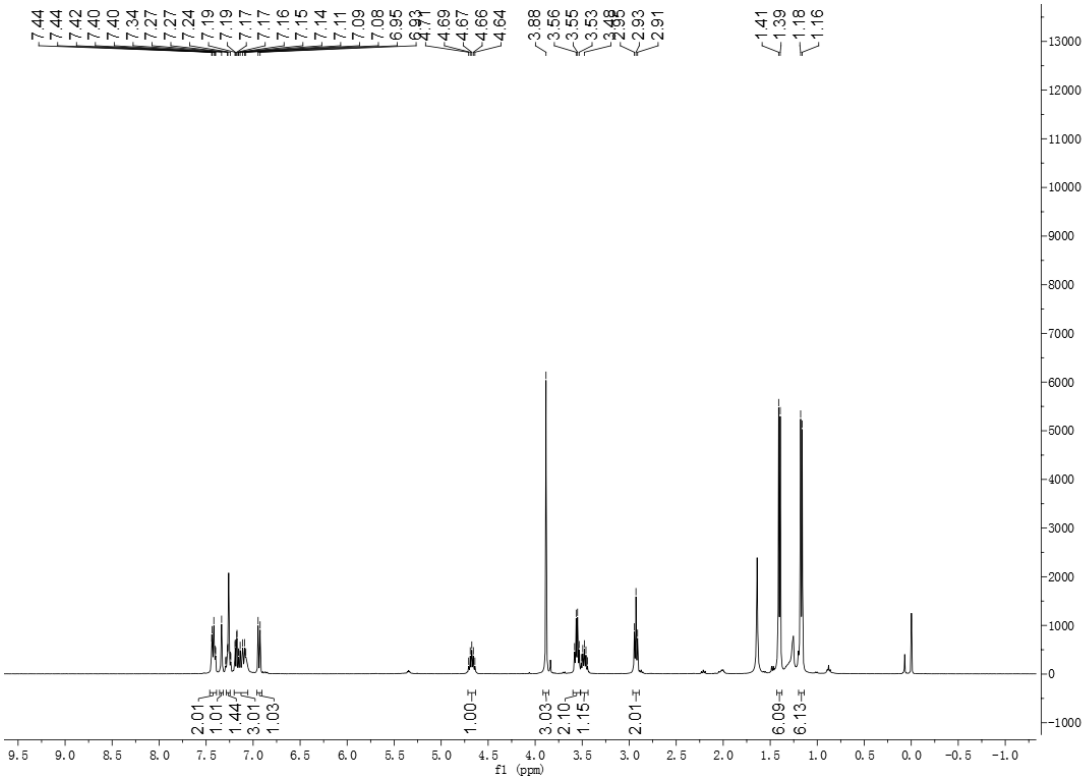
HN
O
F
O
N(iPr)2

3o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2.91
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1.39
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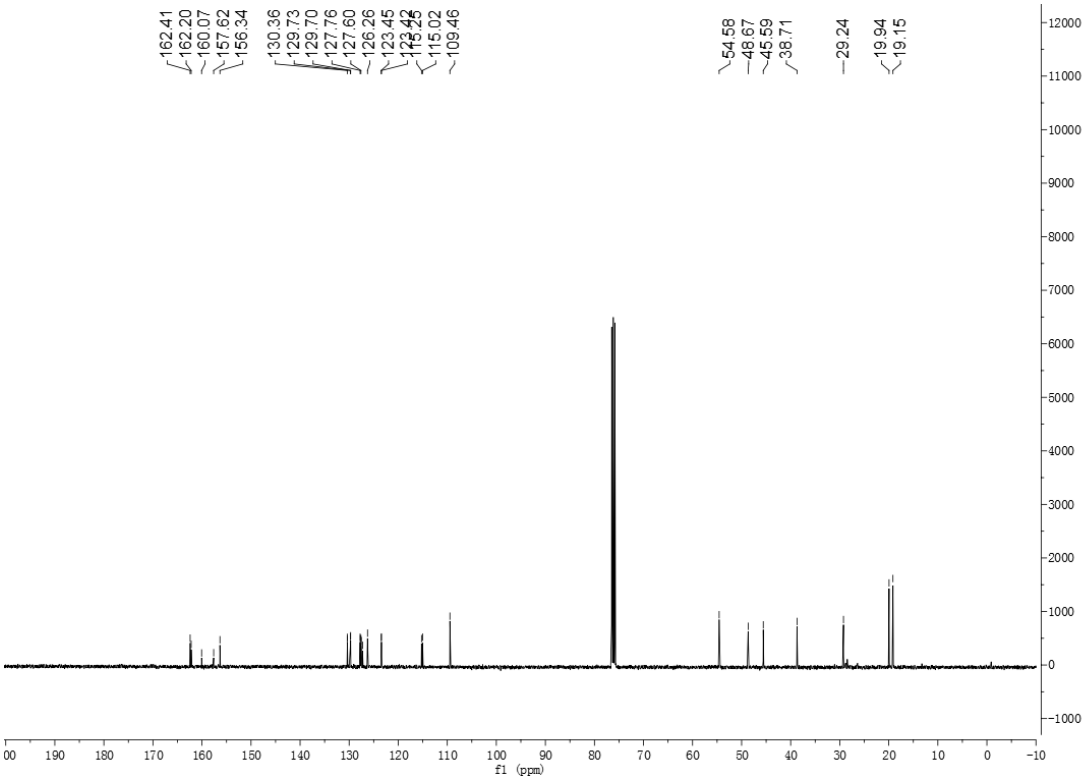
1.15
2.01
6.09
6.13
f1 (ppm)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127.76
127.60
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109.46
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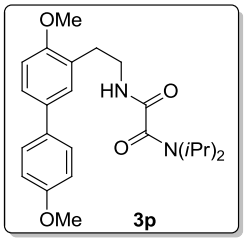
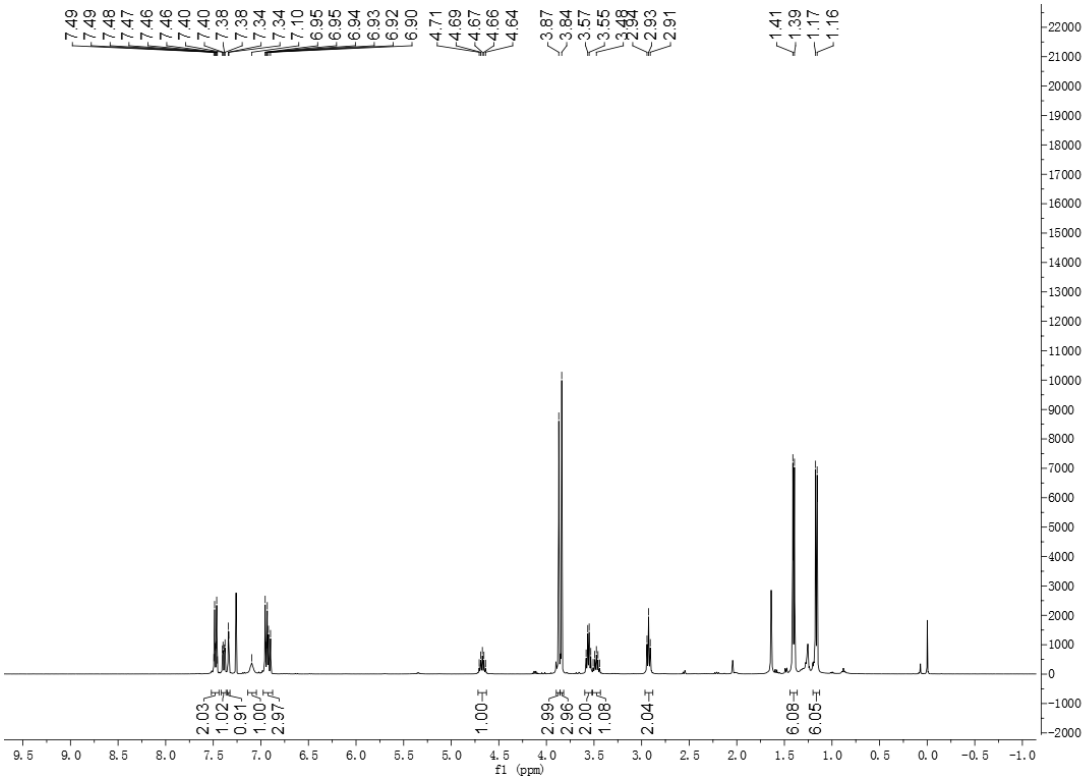
45.59
38.71
29.24
19.94
19.15
f1 (ppm)


OMe
HN
O
O
N(iPr)2
OMe
3p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2.91
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1.16
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2.04
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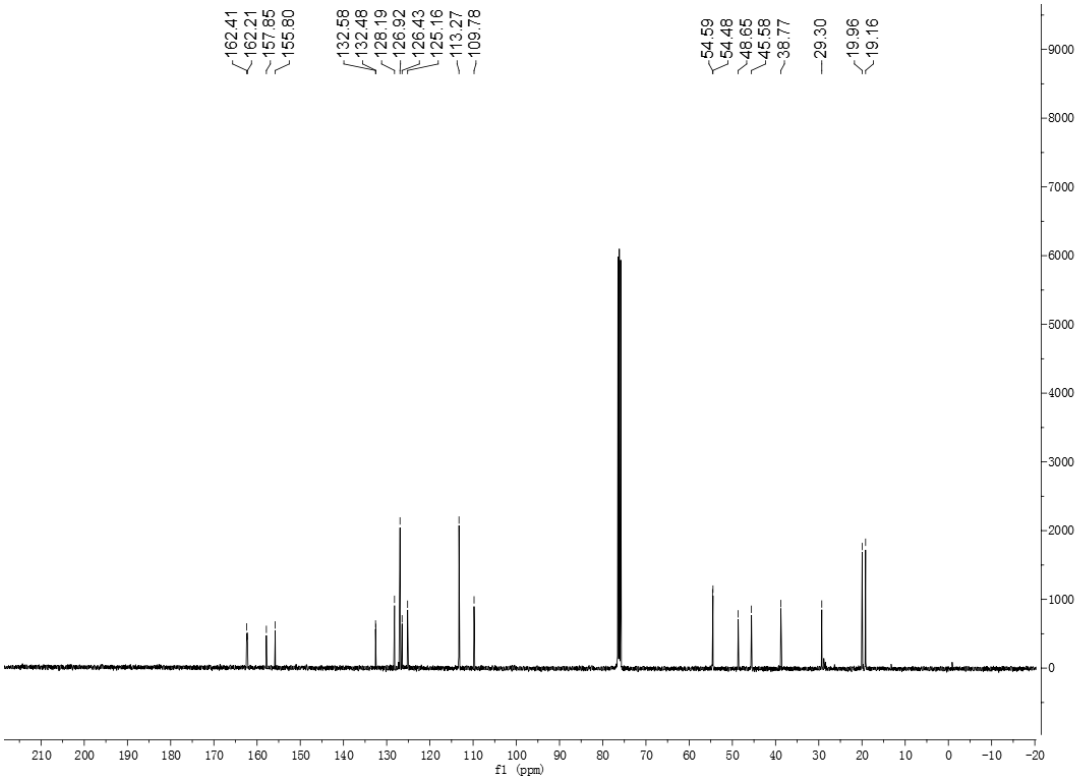
6.05
f1 (ppm)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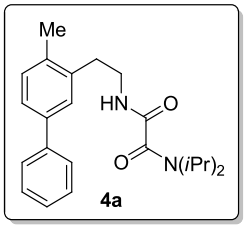
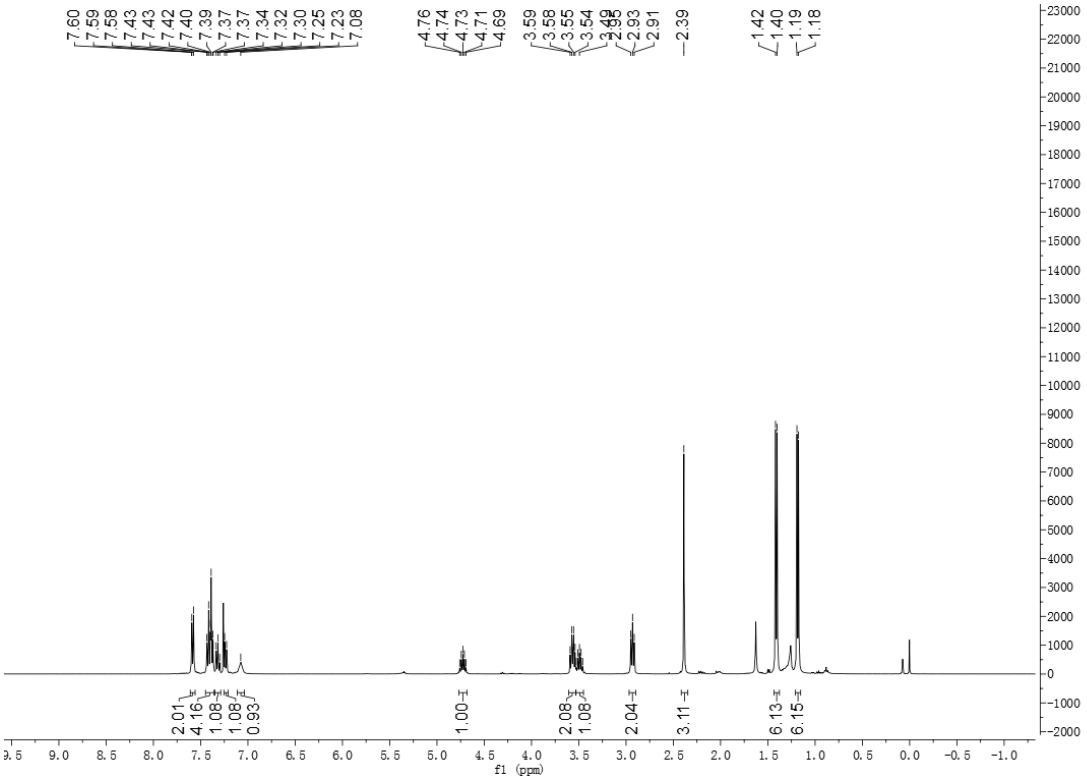
38.77
29.30
19.96
19.16
f1 (ppm)


Me
HN
O
O
N(iPr)2

4a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7.32
7.30
7.25
7.23
7.08
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4.74
4.73
4.71
4.69
3.59
3.58
3.55
3.54
2.95
2.93
2.91
2.39
1.42
1.40
1.19
1.18
2.01
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1.08
1.08
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2.08
1.08
2.04
3.11
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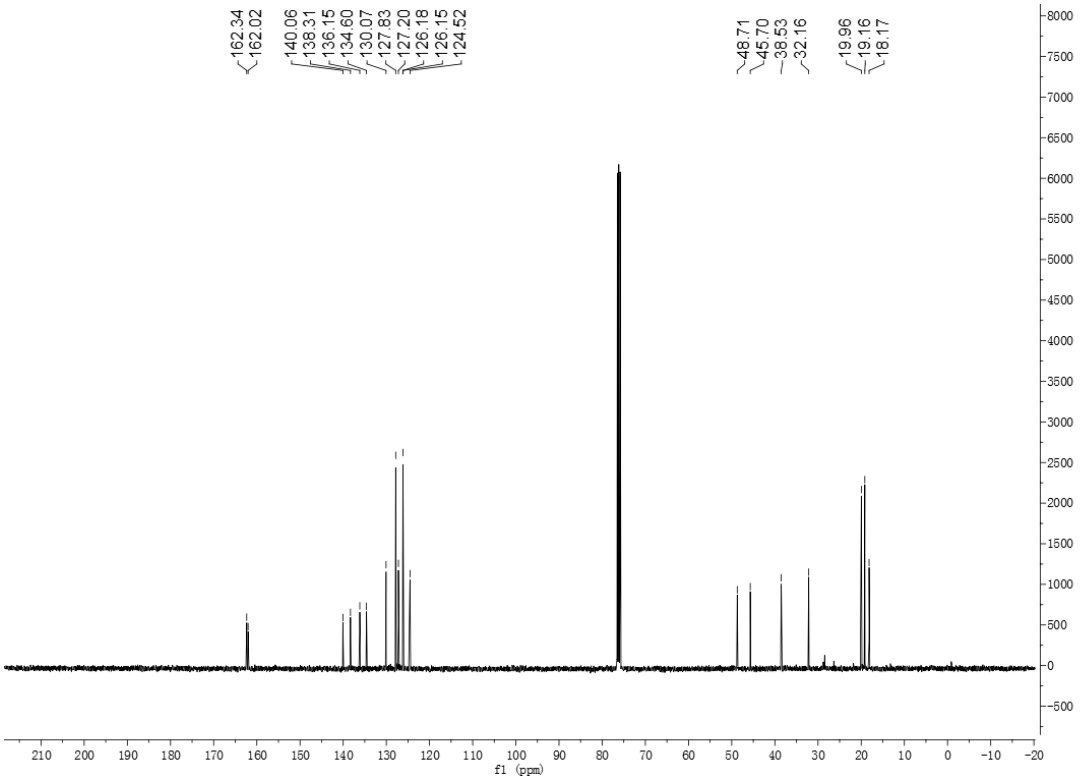
6.15
f1 (ppm)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130.07
127.83
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126.18
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124.52
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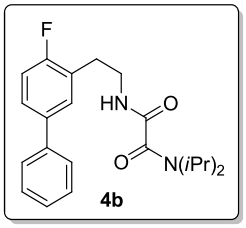
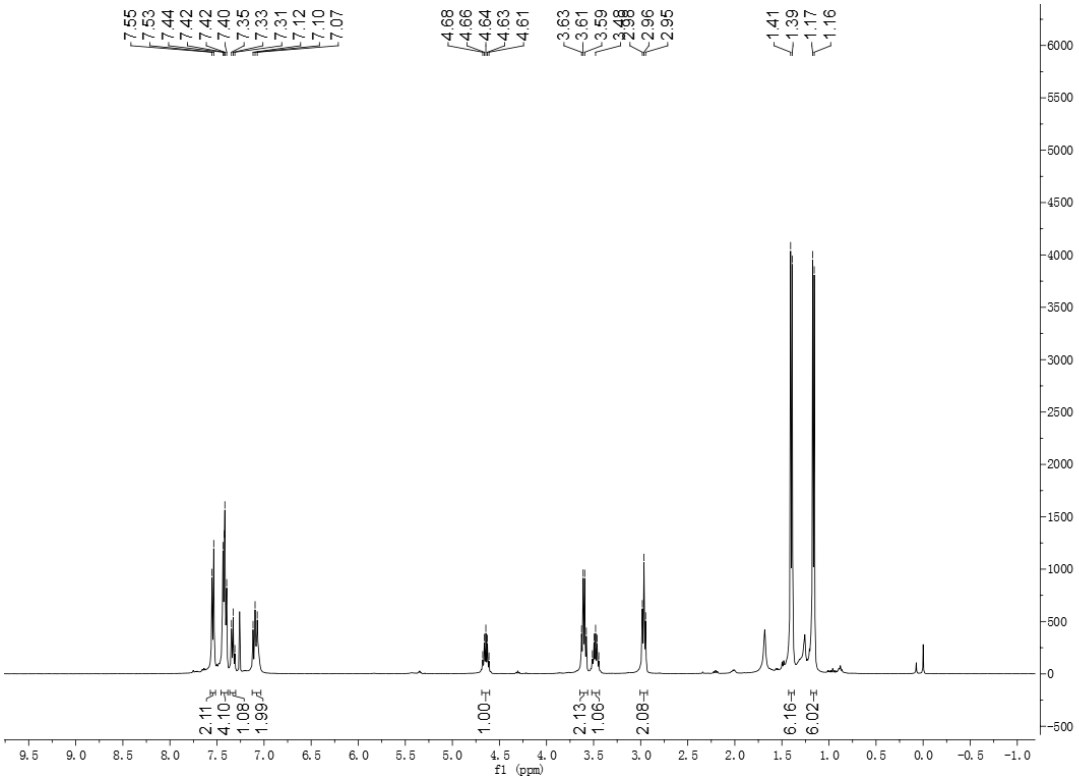
45.70
38.53
32.16
19.96
19.16
18.17
f1 (ppm)


F
HN
O
O
N(iPr)2

4b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4.63
4.61
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3.61
3.59
2.96
2.95
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1.39
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1.08
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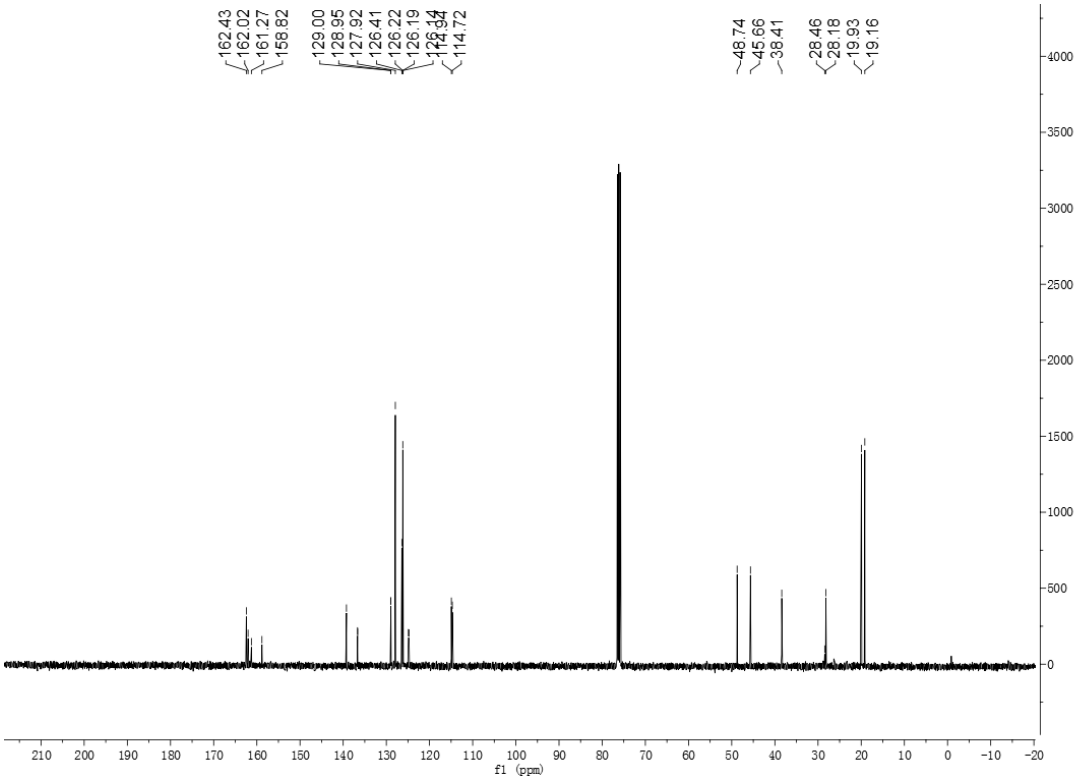
1.06
2.08
6.16
6.02
f1 (ppm)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127.92
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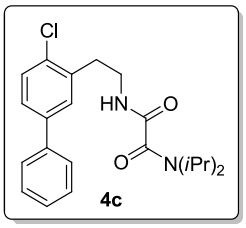
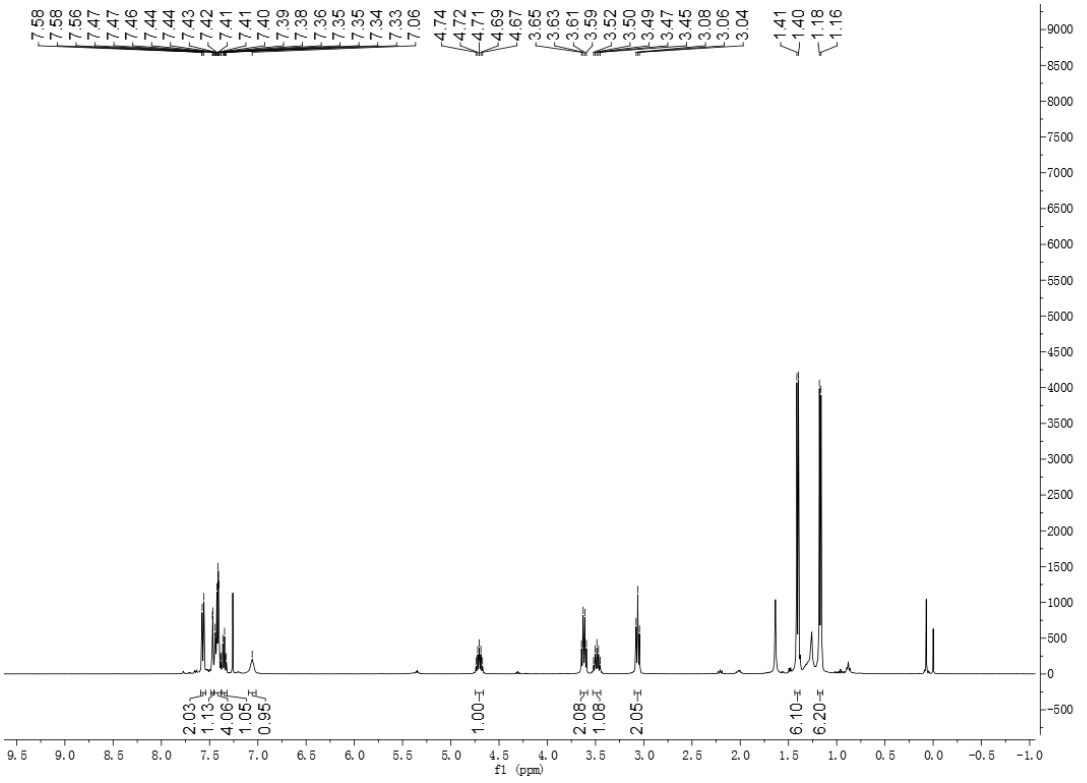
114.72
48.74
45.66
38.41
28.46
28.18
19.93
19.16
f1 (ppm)


Cl
HN
O
O
N(iPr)2

4c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2.05
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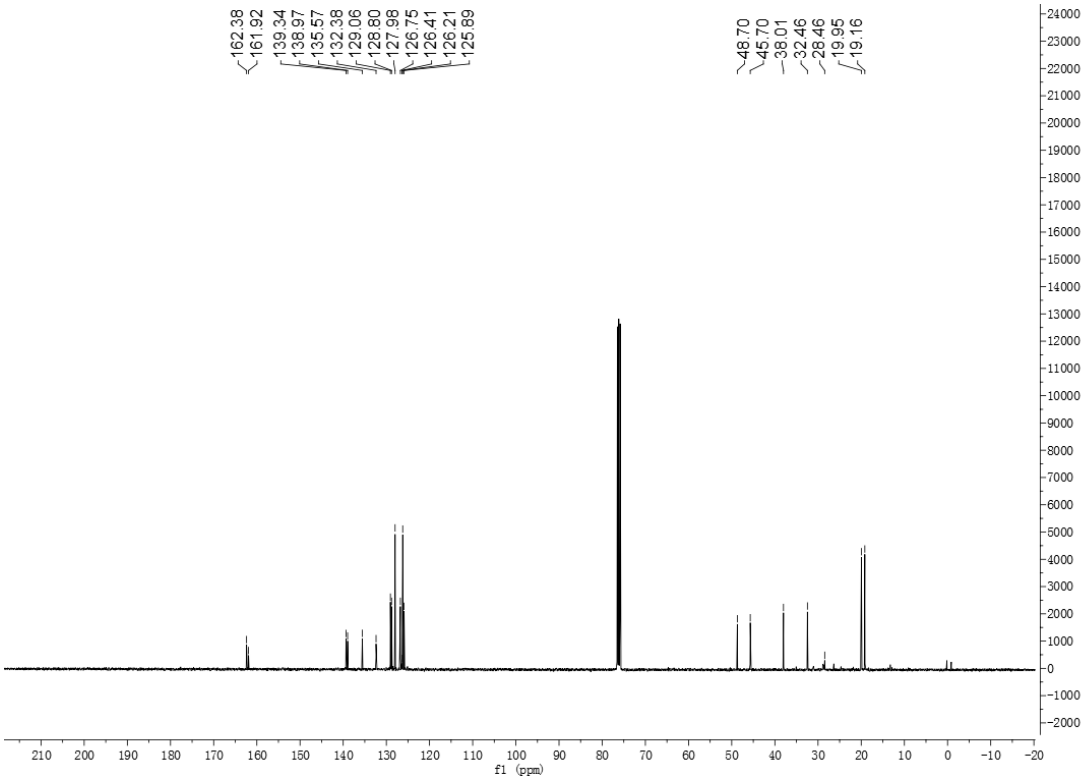
6.20
f1 (ppm)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127.98
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126.41
126.21
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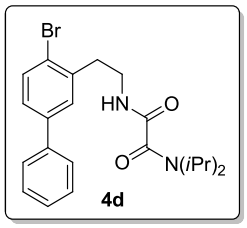
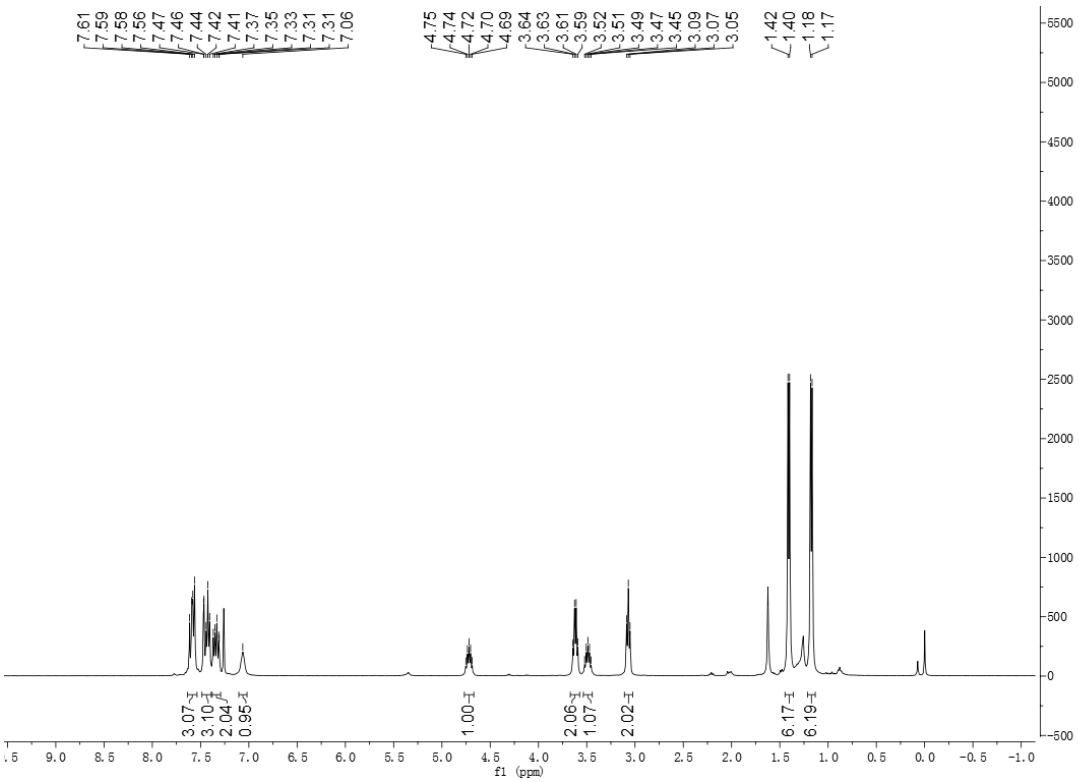
32.46
28.46
19.95
19.16
f1 (ppm)


Br
HN
O
O
N(iPr)2
4d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7.42
7.41
7.37
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7.33
7.31
7.31
7.06
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4.74
4.72
4.70
4.69
3.64
3.63
3.61
3.59
3.52
3.51
3.49
3.47
3.45
3.09
3.07
3.05
1.42
1.40
1.18
1.17
3.07
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2.04
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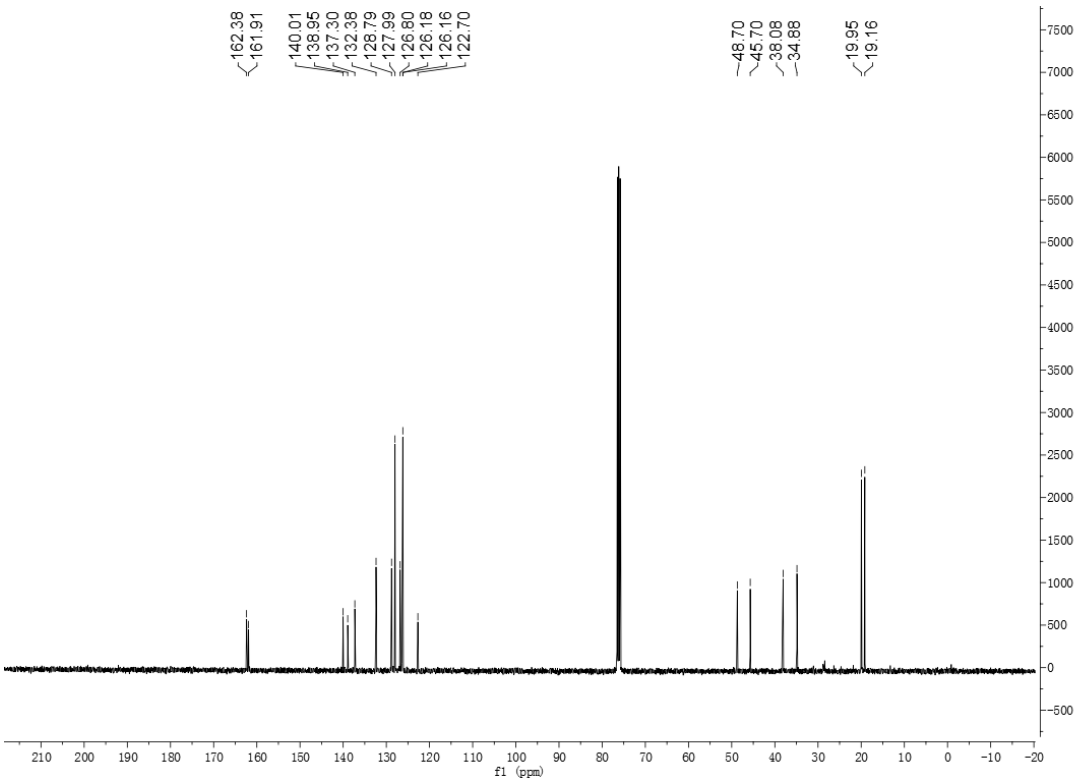
1.00
2.06
1.07
2.02
6.17
6.19
f1 (ppm)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132.38
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126.16
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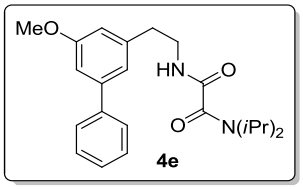
38.08
34.88
19.95
19.16
f1 (ppm)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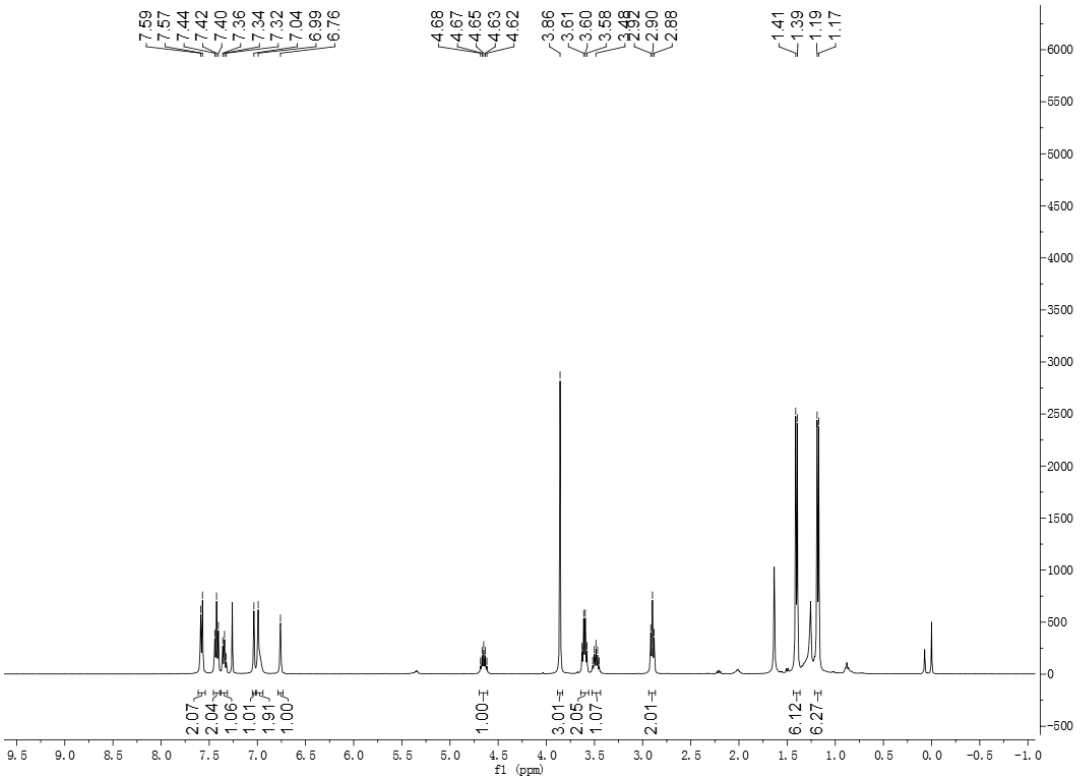
HN
O
O
N(iPr)2

4e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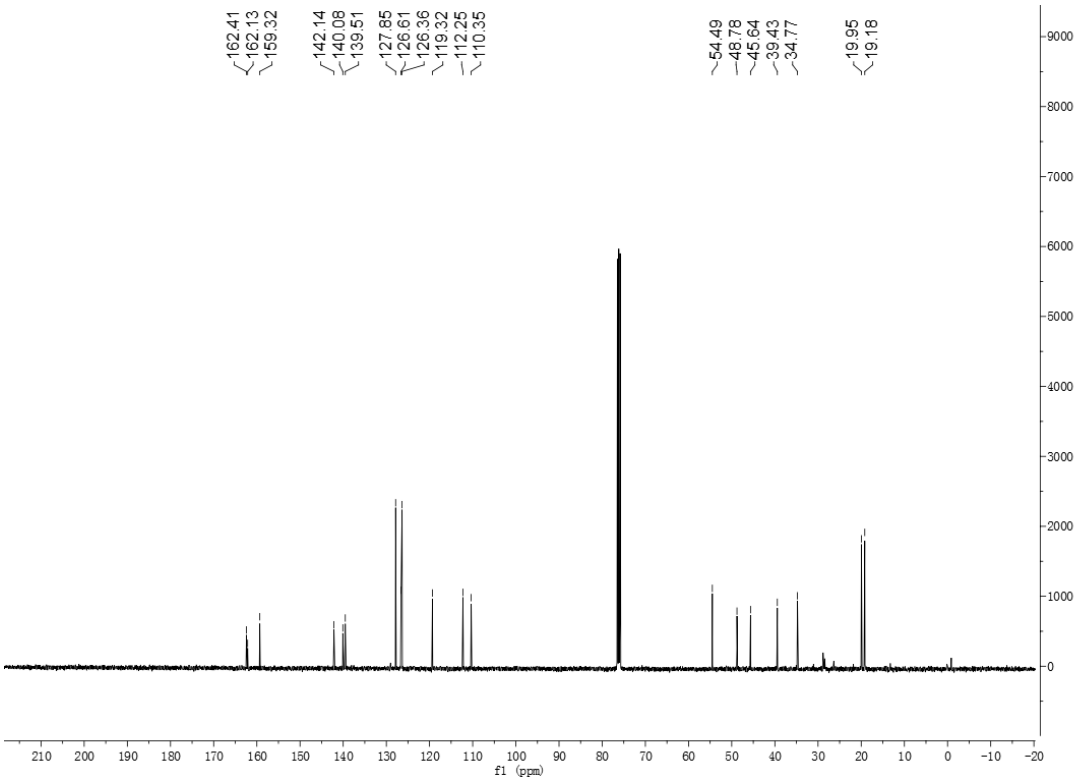
4.67
4.65
4.63
4.62
3.86
3.61
3.60
3.58
2.92
2.90
2.88
1.41
1.39
1.19
1.17
2.07
2.04
1.06
1.01
1.91
1.00
1.00
3.01
2.05
1.07
2.01
6.12
6.27
f1 (ppm)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139.51
127.85
126.61
126.36
119.32
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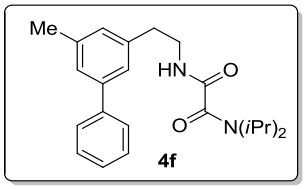
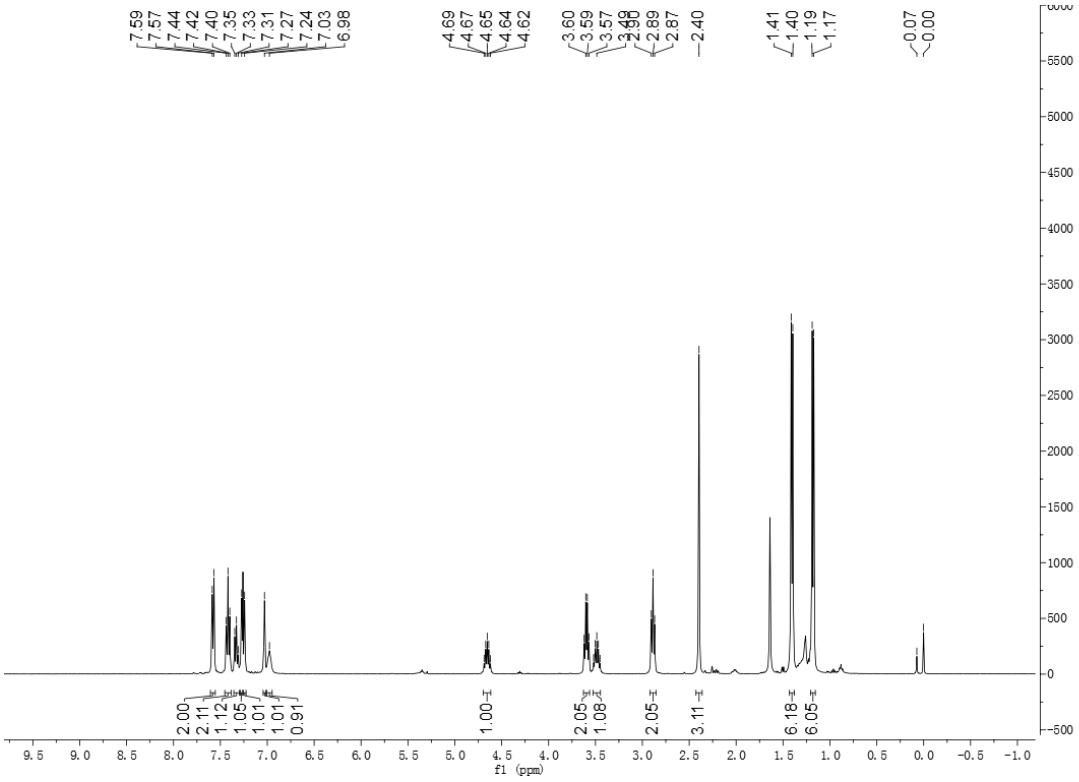
110.35
54.49
48.78
45.64
39.43
34.77
19.95
19.18
f1 (ppm)


Me
HN
O
O
N(iPr)2

4f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7.31
7.27
7.24
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6.98
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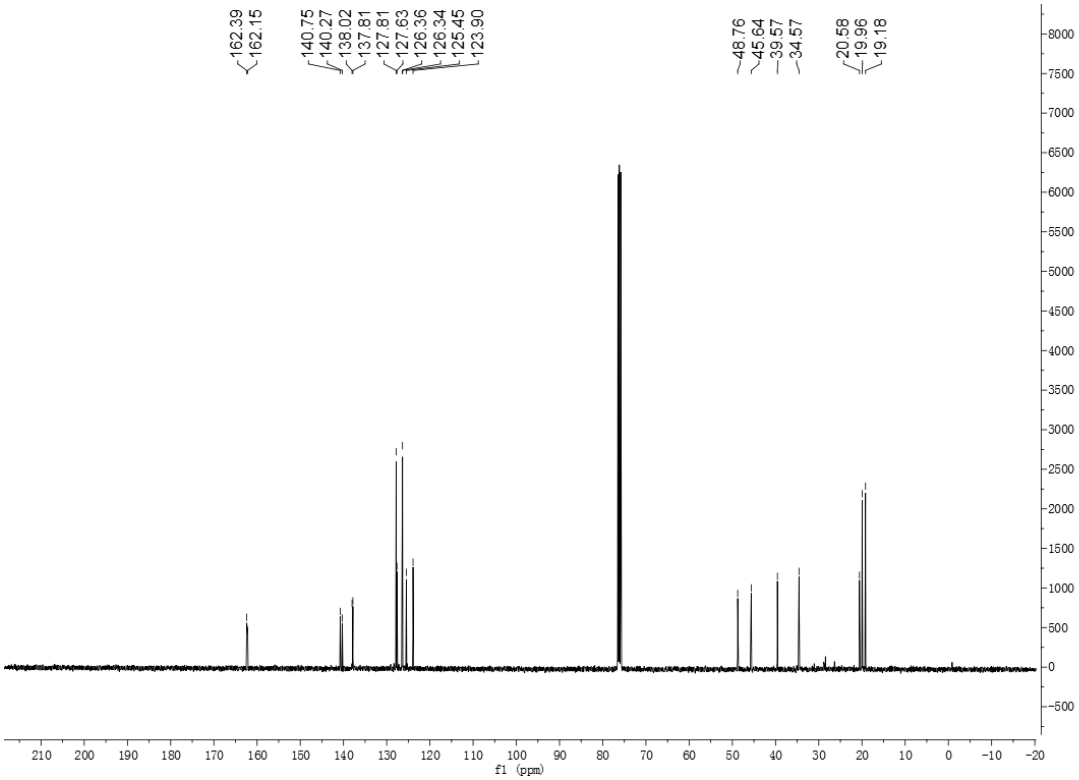
4.67
4.65
4.64
4.62
3.60
3.59
3.57
2.89
2.87
2.40
1.41
1.40
1.19
1.17
0.07
0.00
2.00
2.11
1.12
1.05
1.01
1.01
0.91
1.00
2.05
1.08
2.05
3.11
6.18
6.05
f1 (ppm)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137.81
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127.63
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126.34
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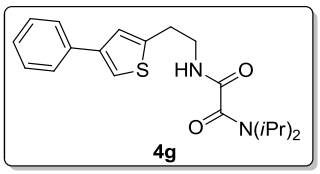
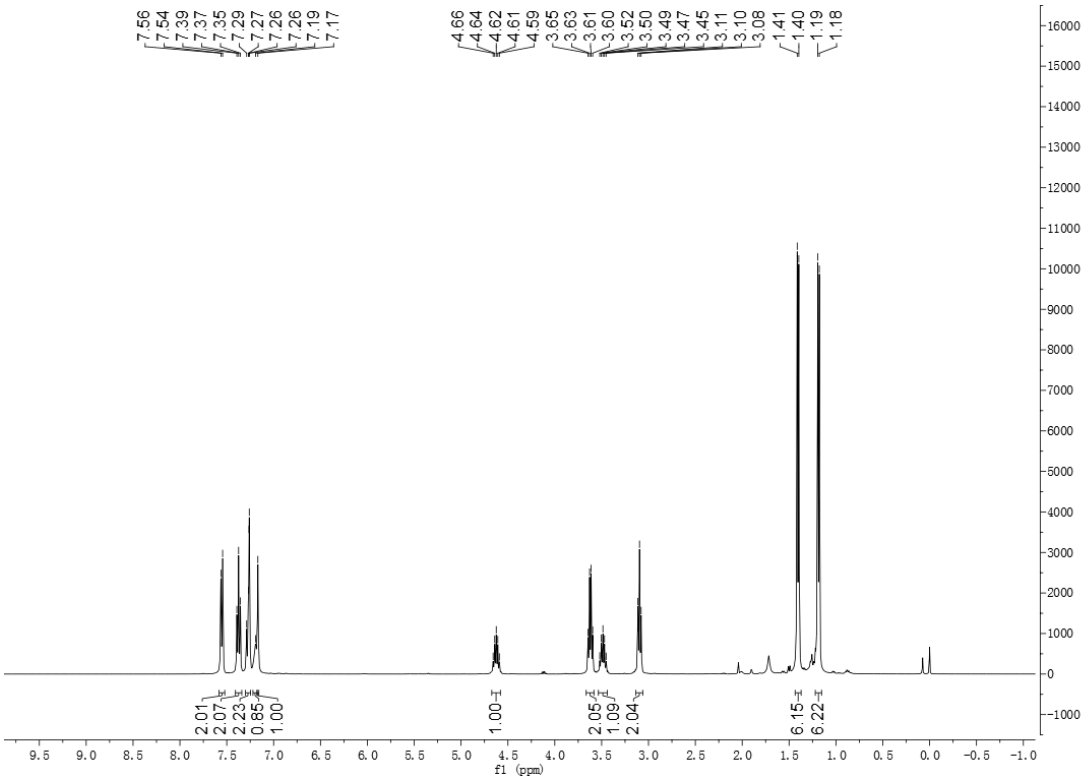
123.90
48.76
45.64
39.57
34.57
20.58
19.96
19.18
f1 (ppm)


S
HN
O
O
N(iPr)2

4g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7.26
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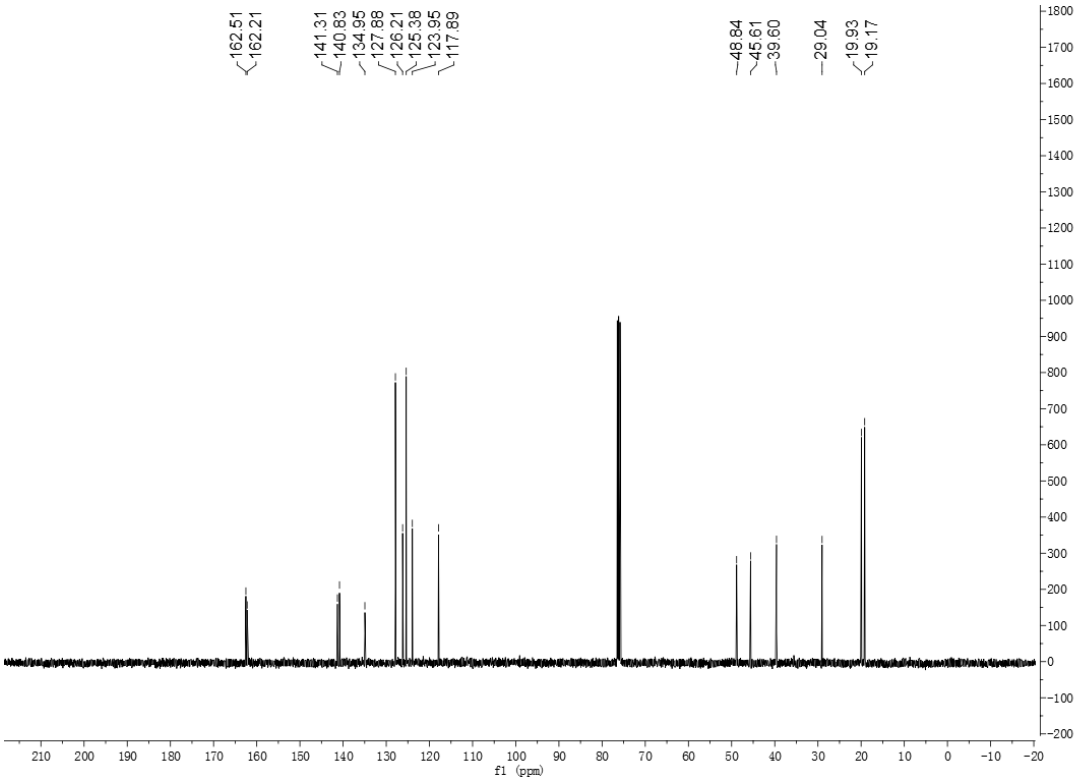
7.19
7.17
4.66
4.64
4.62
4.61
4.59
3.65
3.63
3.61
3.60
3.52
3.50
3.49
3.47
3.45
3.11
3.10
3.08
1.41
1.40
1.19
1.18
2.01
2.07
2.23
0.85
1.00
1.00
2.05
1.09
2.04
6.15
6.22
f1 (ppm)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141.31
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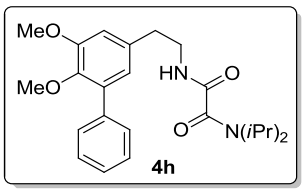
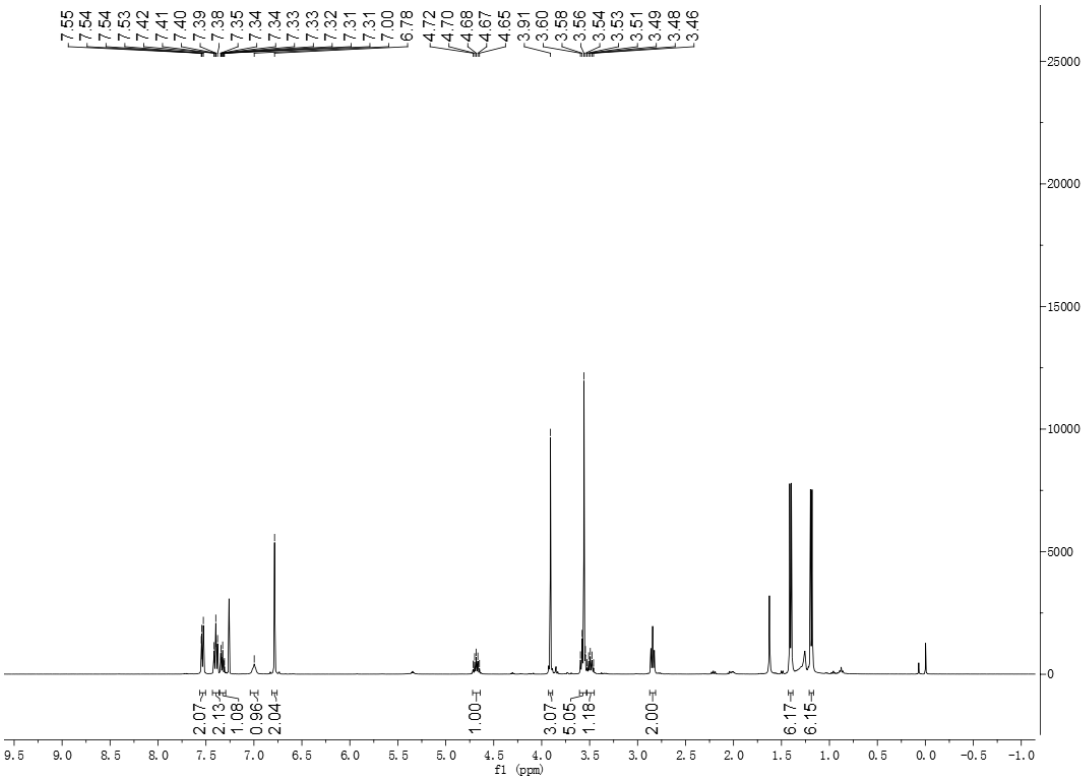
134.95
127.88
126.21
125.38
123.95
117.89
48.84
45.61
39.60
29.04
19.93
19.17
f1 (ppm)


MeO
MeO
HN
O
O
N(iPr)2

4h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7.35
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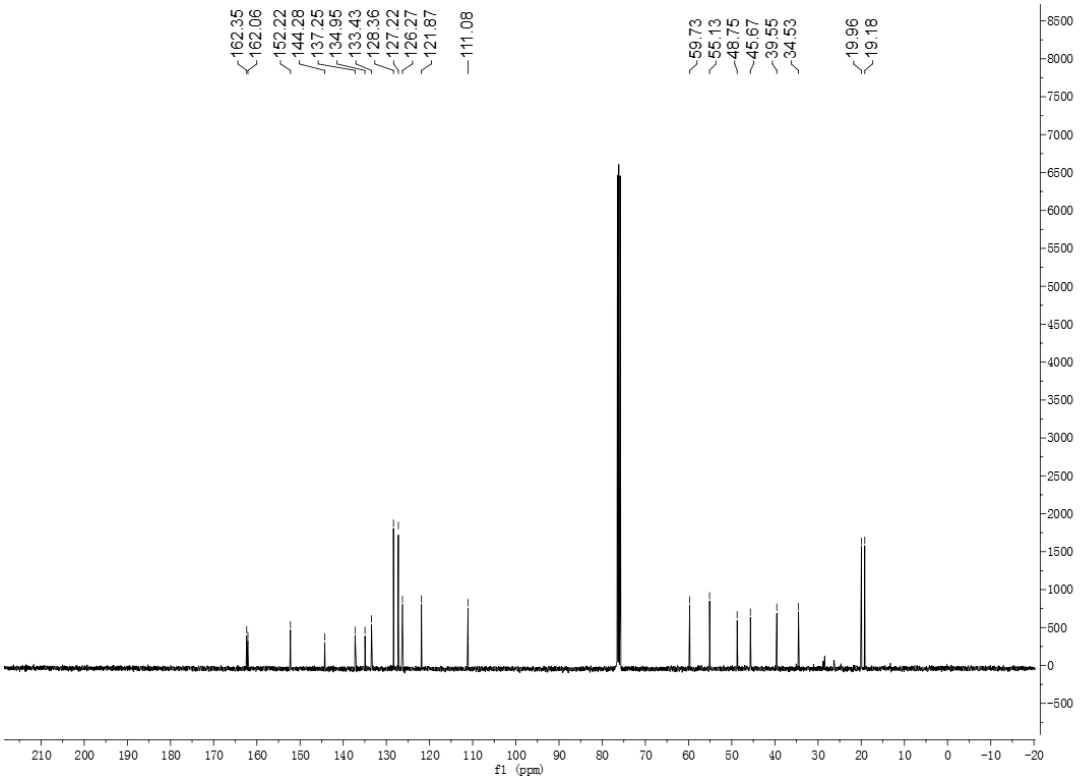
7.34
7.33
7.33
7.32
7.31
7.31
7.00
6.78
4.72
4.70
4.68
4.67
4.65
3.91
3.60
3.58
3.56
3.54
3.53
3.51
3.49
3.48
3.46
2.07
2.13
1.08
0.96
2.04
1.00
3.07
5.05
1.18
2.00
6.17
6.15
f1 (ppm)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162.06
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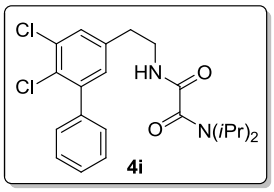
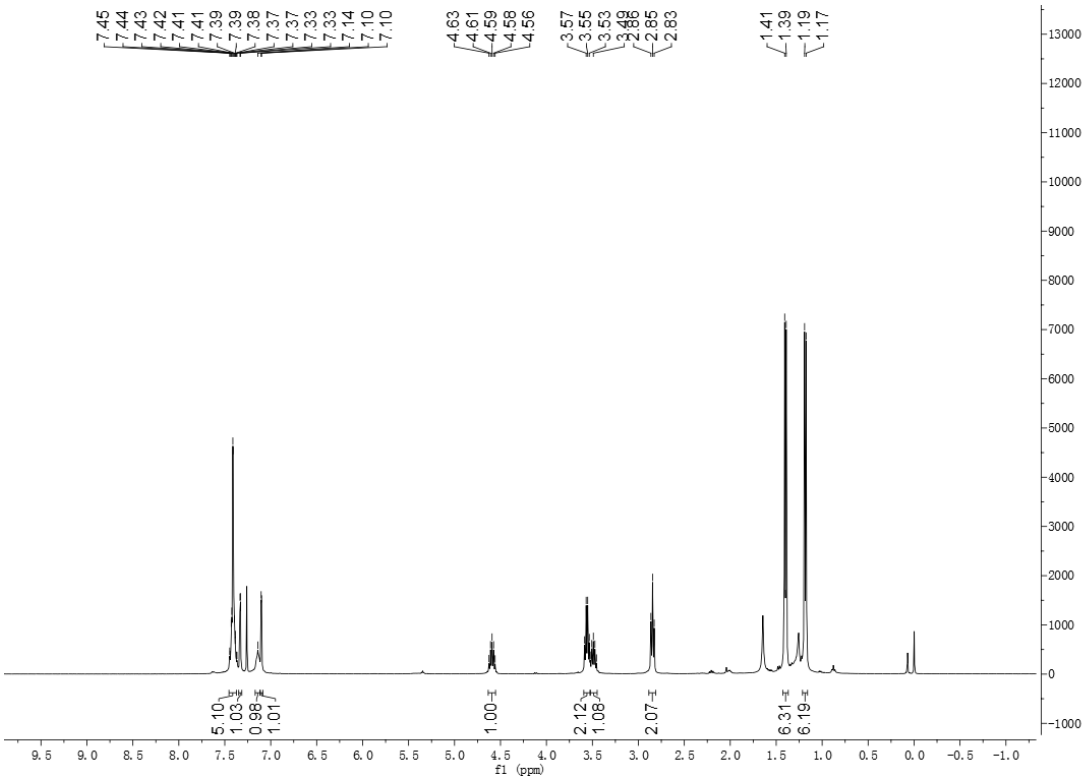
144.28
137.25
134.95
133.43
128.36
127.22
126.27
121.87
111.08
59.73
55.13
48.75
45.67
39.55
34.53
19.96
19.18
f1 (ppm)


Cl
Cl
HN
O
O
N(iPr)2

4i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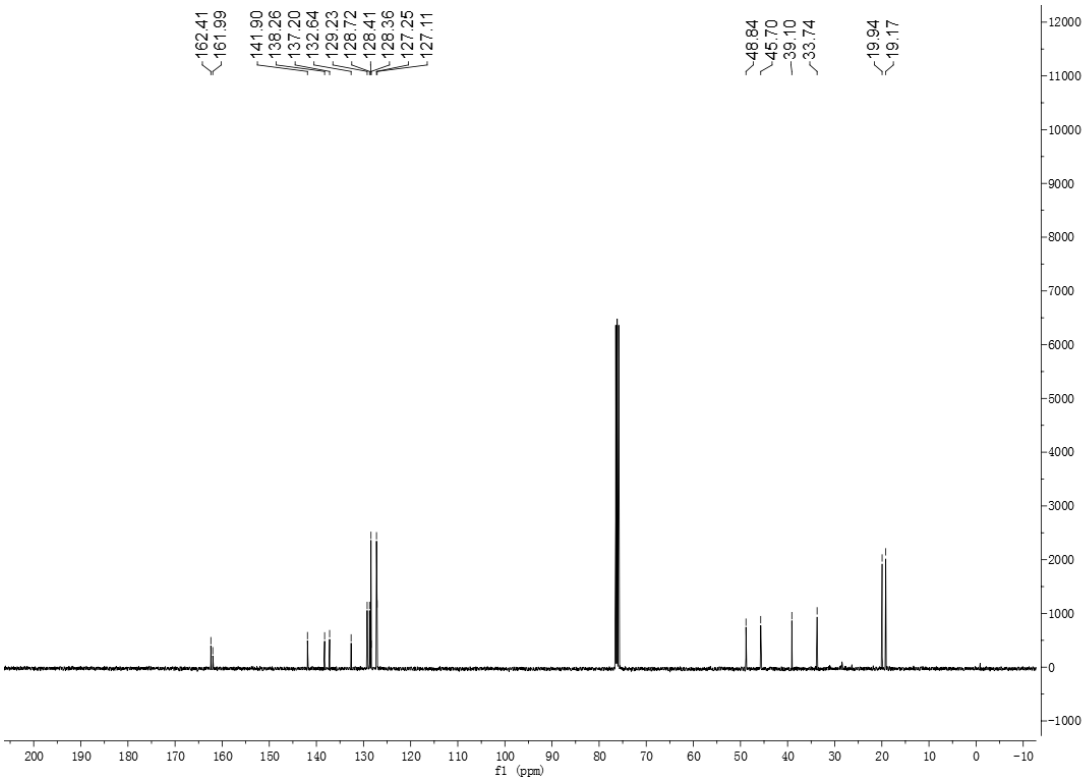
7.37
7.33
7.33
7.14
7.10
7.10
4.63
4.61
4.59
4.58
4.56
3.57
3.55
3.53
3.49
3.46
2.85
2.83
1.41
1.39
1.19
1.17
5.10
1.03
0.98
1.01
1.00
2.12
1.08
2.07
6.31
6.19
f1 (ppm)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128.41
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127.25
127.11
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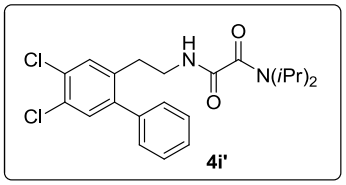
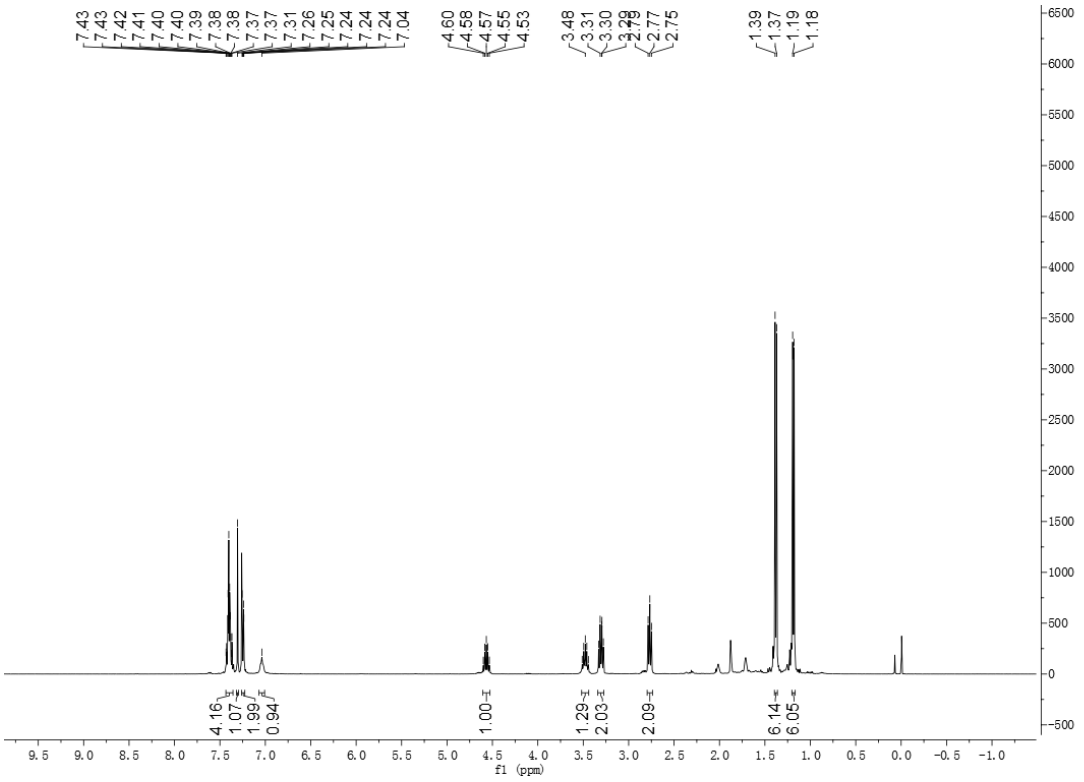
39.10
33.74
19.94
19.17
f1 (ppm)


Cl
Cl
H
N
O
O
N(iPr)2

4i'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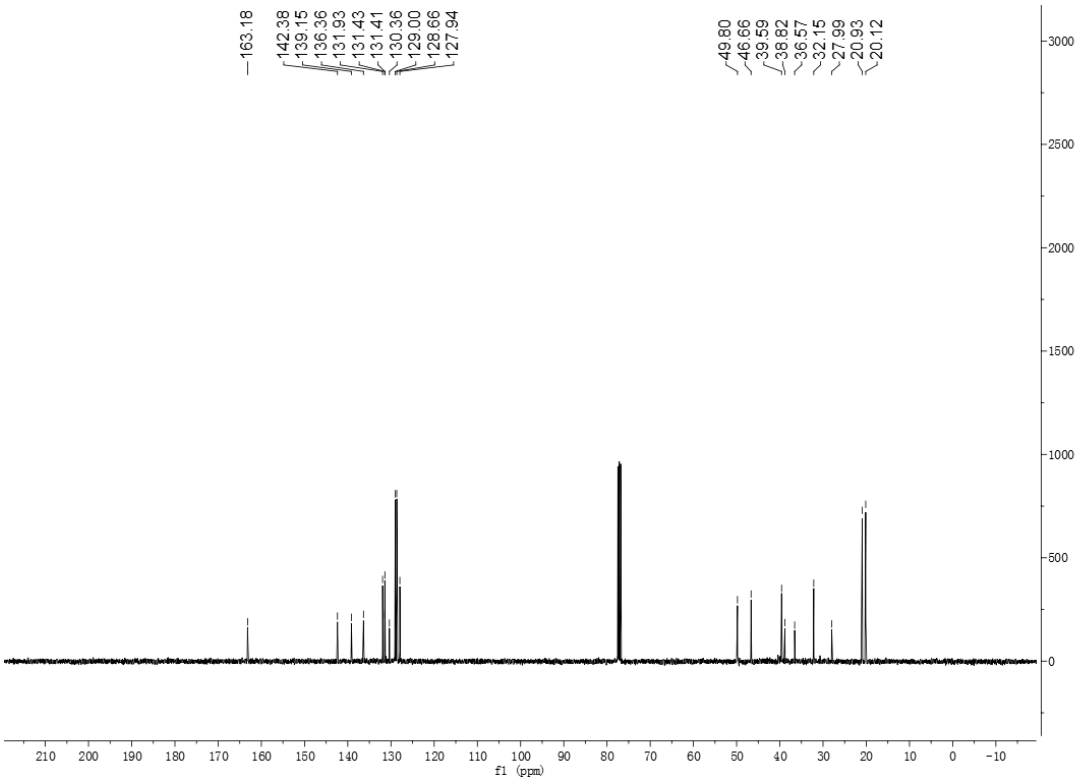
7.26
7.25
7.24
7.24
7.24
7.04
4.60
4.58
4.57
4.55
4.53
3.48
3.31
3.30
2.77
2.75
1.39
1.37
1.19
1.18
4.16
1.07
1.99
0.94
1.00
1.29
2.03
2.09
6.14
6.05
f1 (ppm)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127.94
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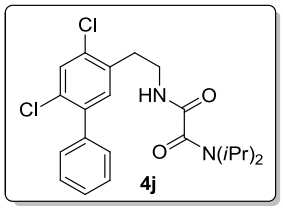
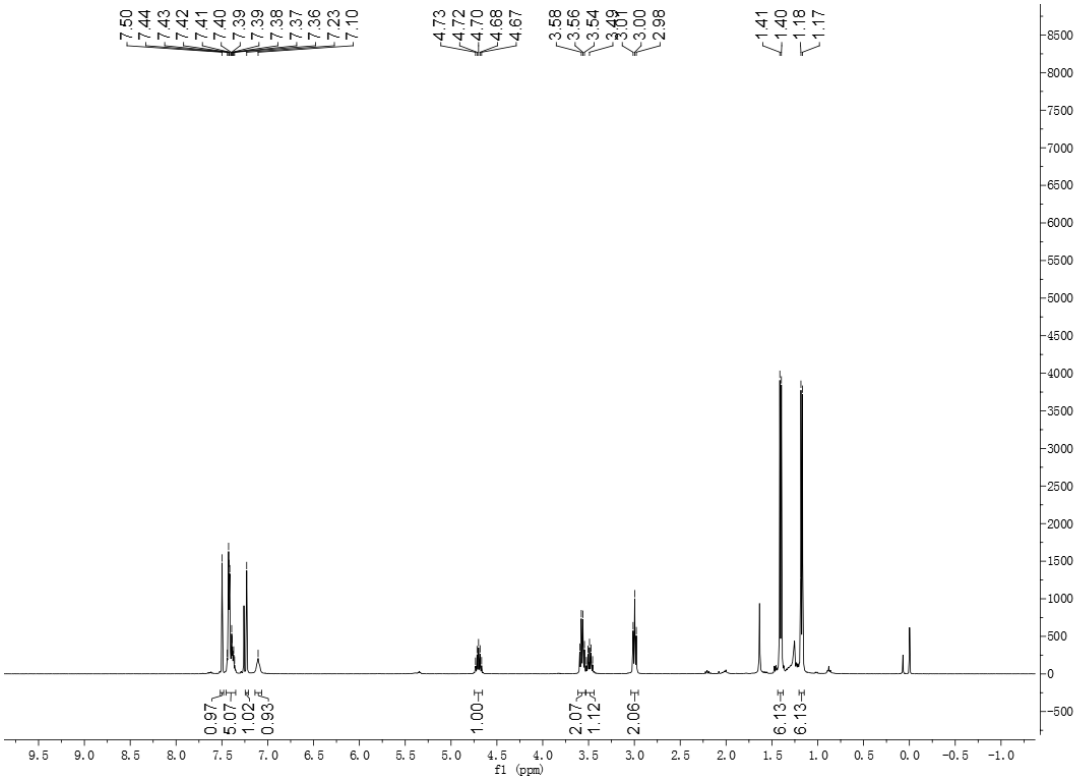
46.66
39.59
38.82
36.57
32.15
27.99
20.93
20.12
f1 (ppm)


Cl
Cl
HN
O
O
N(iPr)2

4j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7.37
7.36
7.23
7.10
4.73
4.72
4.70
4.68
4.67
3.58
3.56
3.54
3.49
3.01
3.00
2.98
1.41
1.40
1.18
1.17
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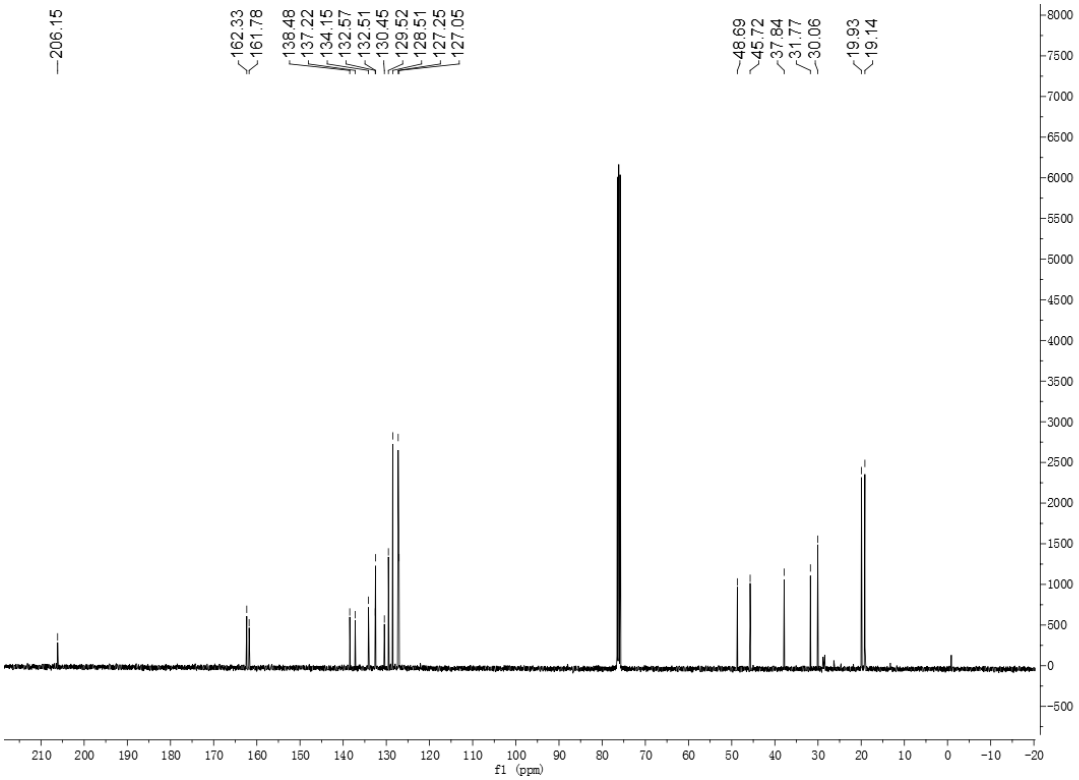
1.02
0.93
1.00
2.07
1.12
2.06
6.13
6.13
f1 (ppm)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127.05
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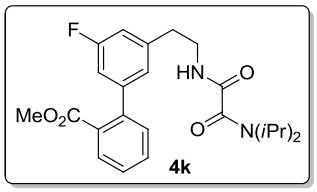
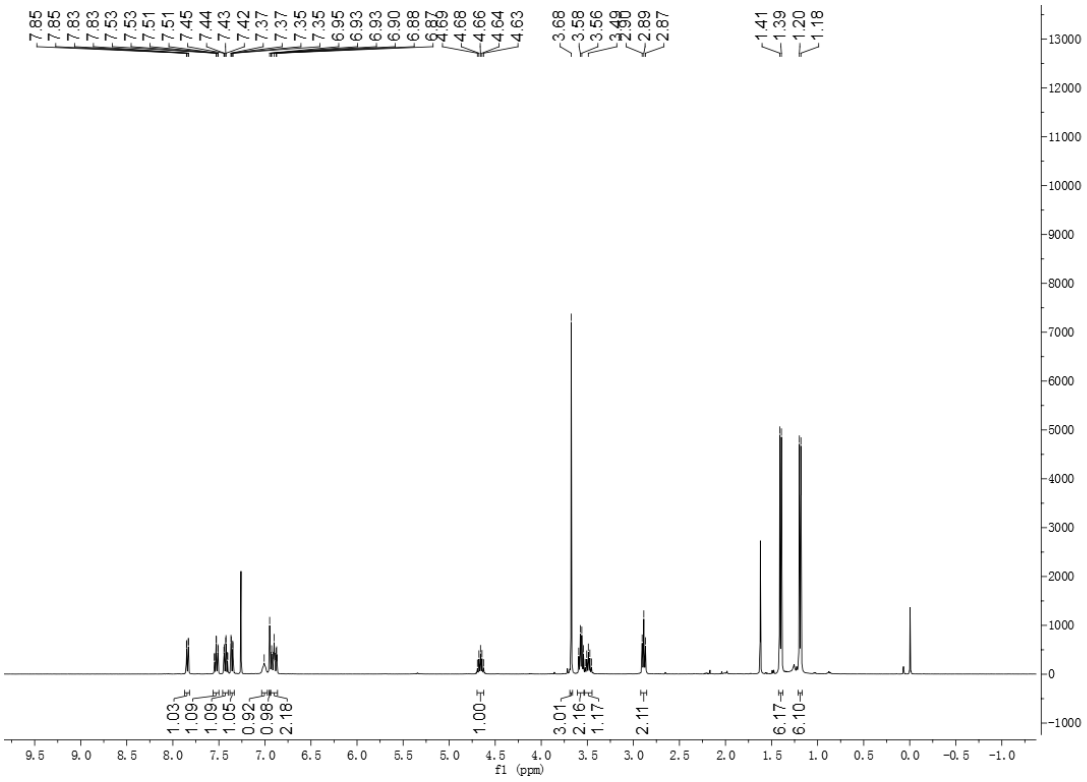
45.72
37.84
31.77
30.06
19.93
19.14
f1 (ppm)


F
HN
O
MeO2C
O
N(iPr)2
4k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7.43
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7.37
7.35
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6.95
6.93
6.93
6.90
6.88
6.87
4.69
4.68
4.66
4.64
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2.90
2.89
2.87
1.41
1.39
1.20
1.18
1.03
1.09
1.09
1.05
0.92
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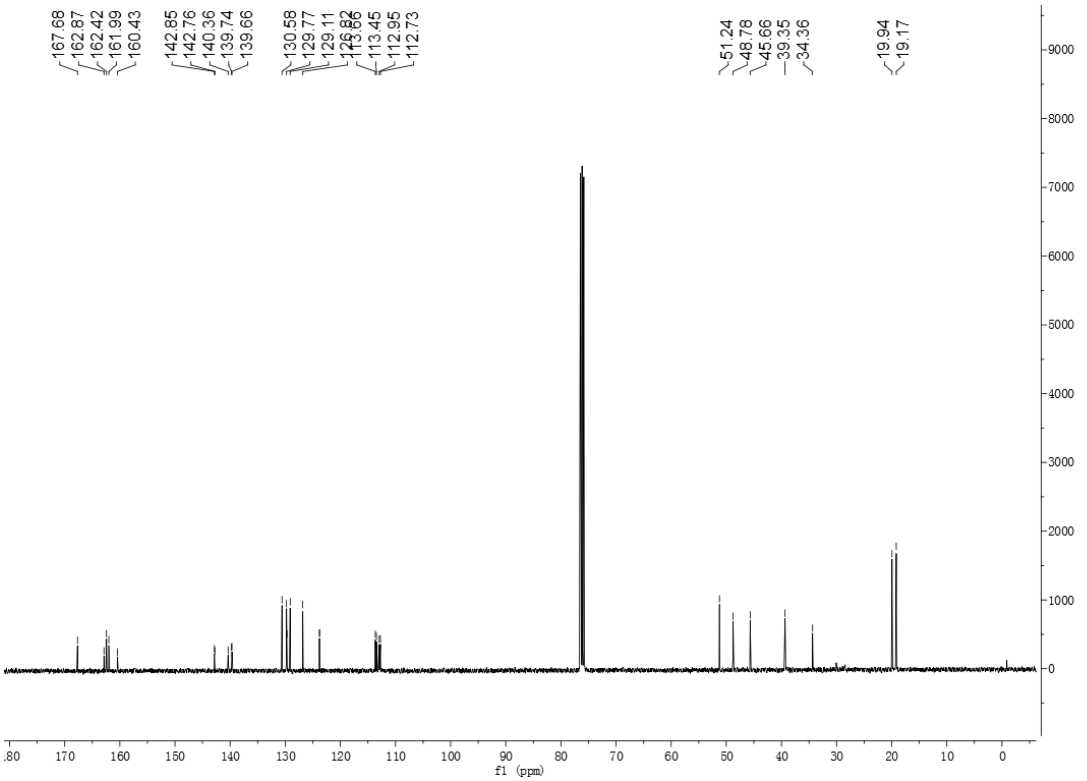
2.18
1.00
3.01
2.16
1.17
2.11
6.17
6.10
f1 (ppm)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130.58
129.77
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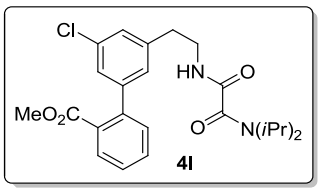
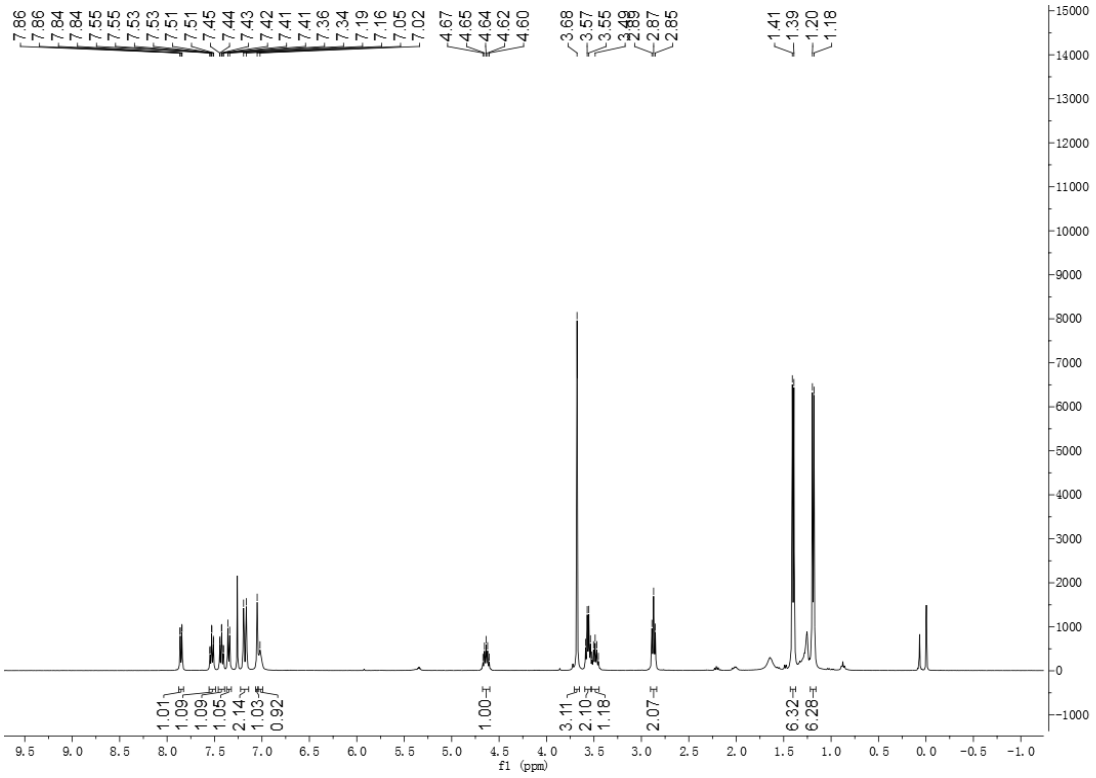
39.35
34.36
19.94
19.17
f1 (ppm)


Cl
HN
O
MeO2C
O
N(iPr)2

4l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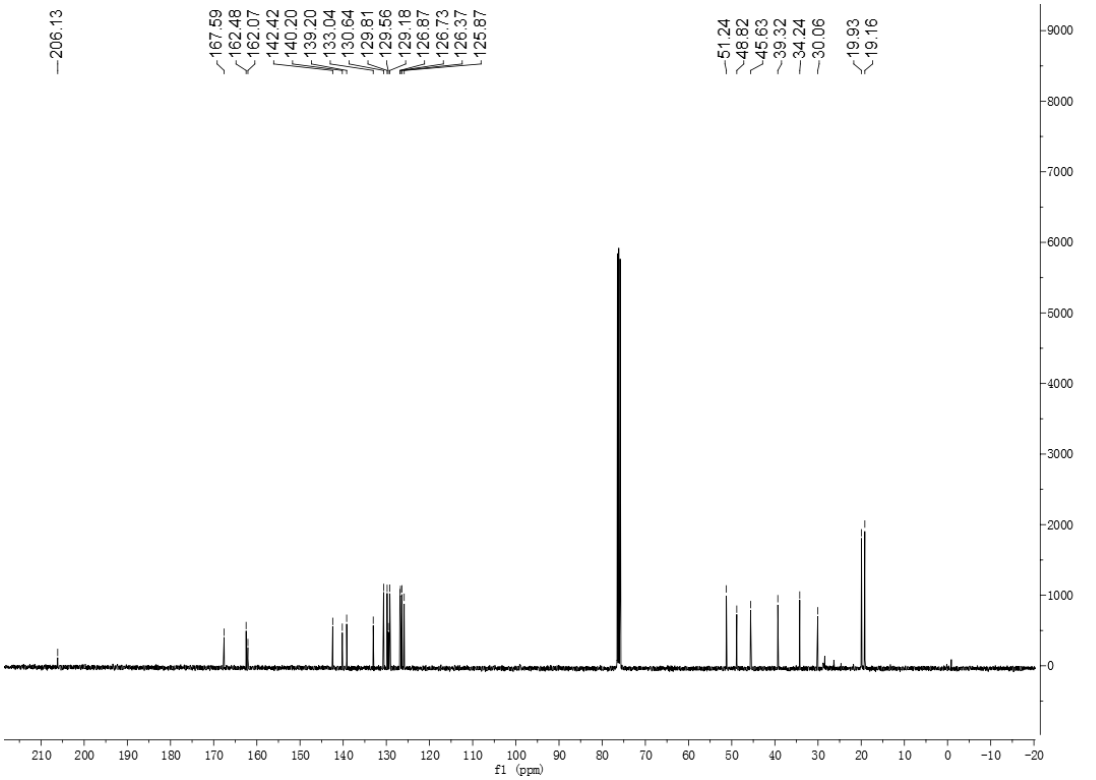
7.42
7.41
7.41
7.36
7.34
7.19
7.16
7.05
7.02
4.67
4.65
4.64
4.62
4.60
3.68
3.57
3.55
2.87
2.85
1.41
1.39
1.20
1.18
1.01
1.09
1.09
1.05
2.14
1.03
0.92
1.00
3.11
2.10
1.18
2.07
6.32
6.28
f1 (ppm)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133.04
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129.81
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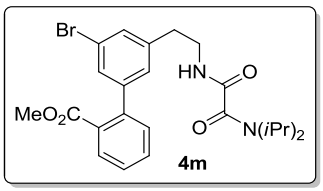
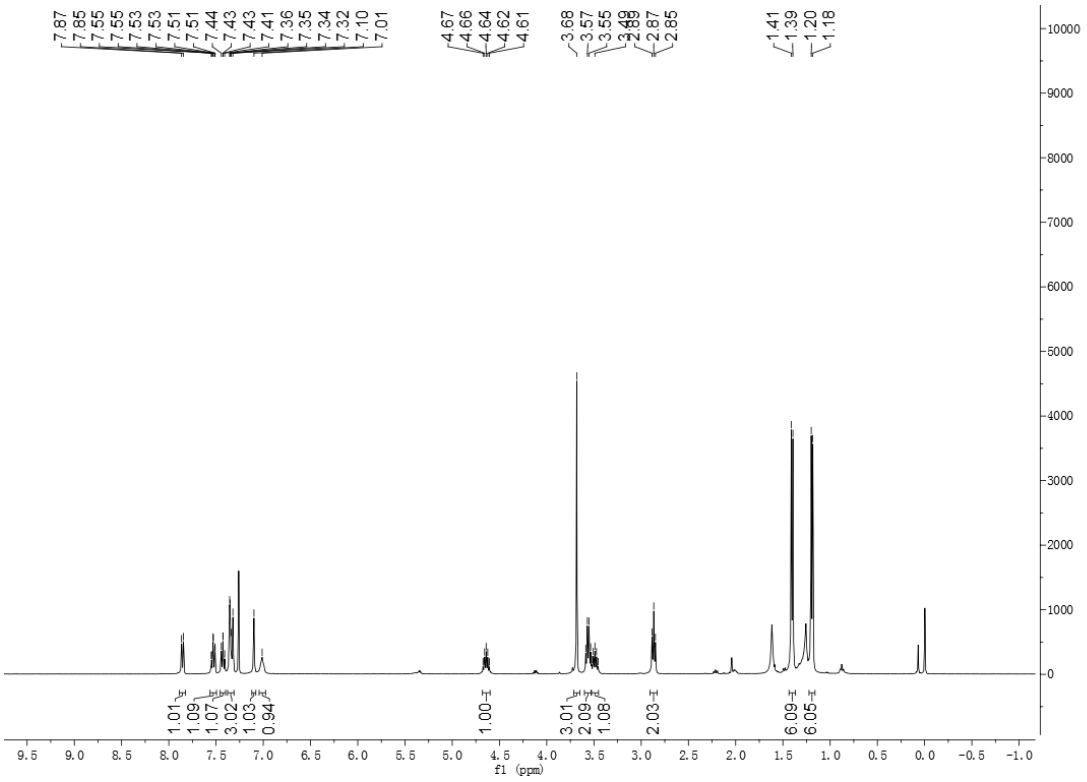
129.18
126.87
126.73
126.37
125.87
51.24
48.82
45.63
39.32
34.24
30.06
19.93
19.16
f1 (ppm)


Br
HN
O
MeO2C
O
N(iPr)2
4m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7.35
7.34
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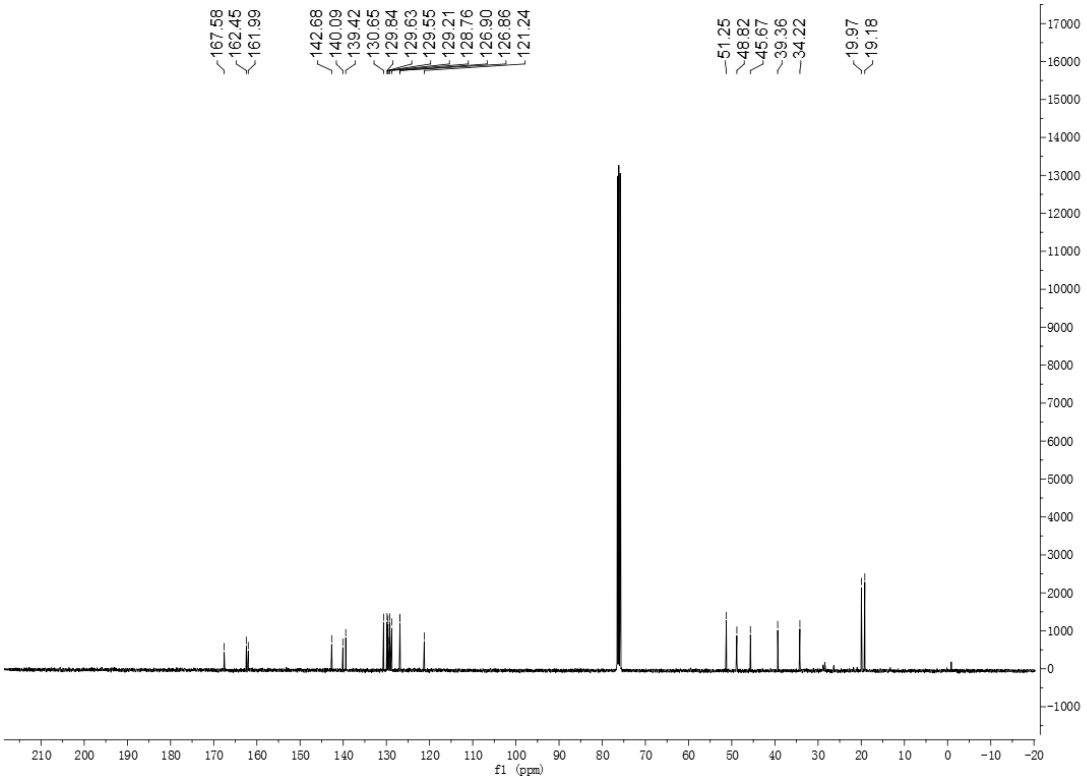
4.67
4.66
4.64
4.62
4.61
3.68
3.57
3.55
2.87
2.85
1.41
1.39
1.20
1.18
1.01
1.09
1.07
3.02
1.03
0.94
1.00
3.01
2.09
1.08
2.03
6.09
6.05
f1 (ppm)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128.21
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121.24
51.25
48.82
45.67
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34.22
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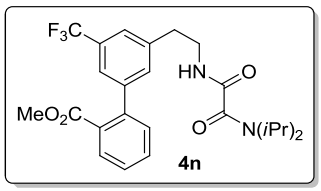
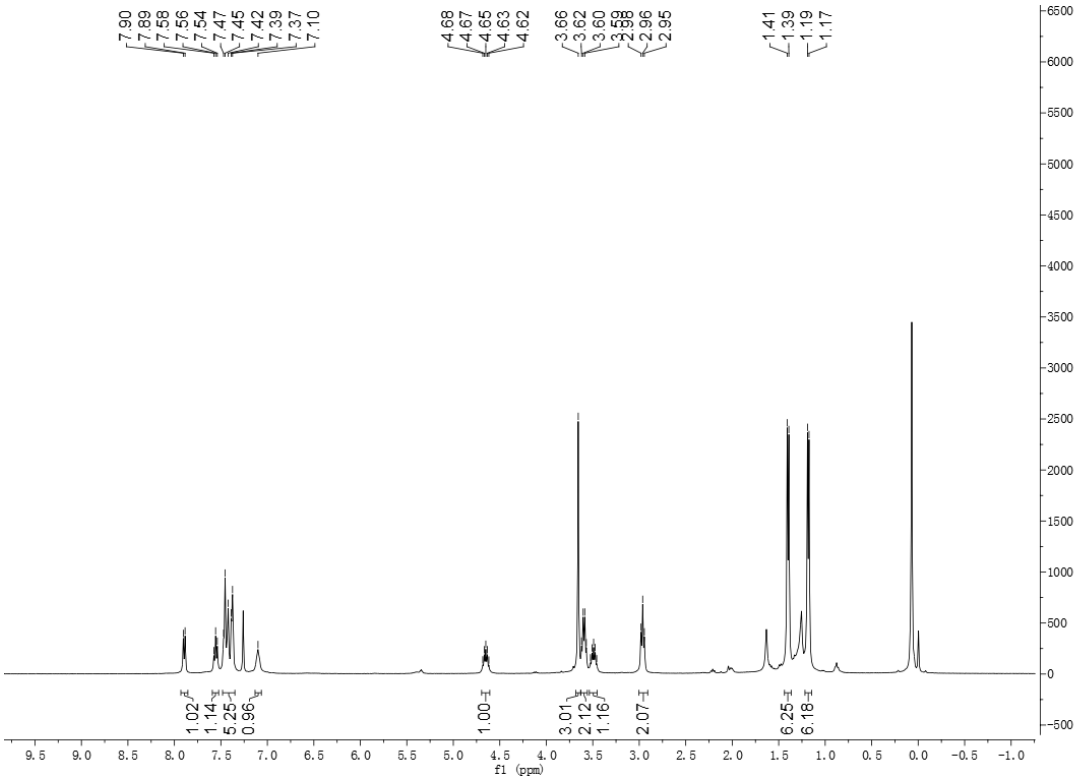
19.18
f1 (ppm)


F3C
HN
O
MeO2C
O
N(iPr)2
4n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4.65
4.63
4.62
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3.62
3.60
3.59
3.58
2.96
2.95
1.41
1.39
1.19
1.17
1.02
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3.01
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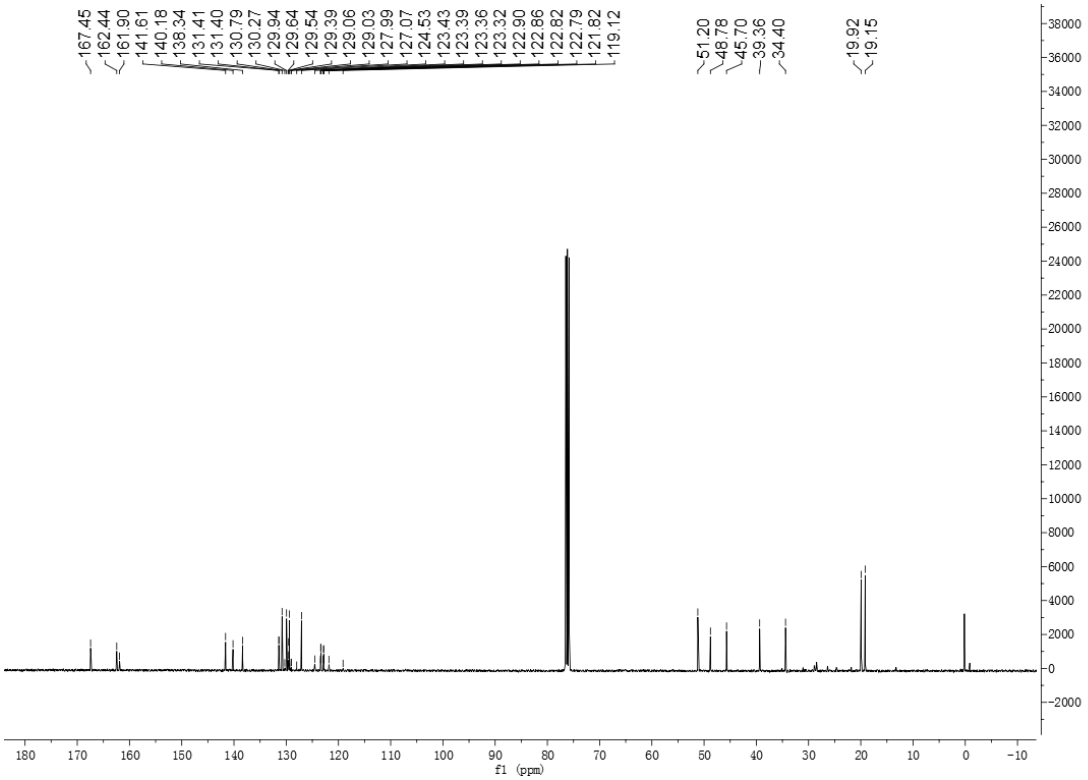
2.07
6.25
6.18
f1 (ppm)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130.27
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129.64
129.54
129.39
129.06
129.03
127.99
127.07
124.53
123.43
123.39
123.36
123.32
122.90
122.86
122.82
122.79
121.82
119.12
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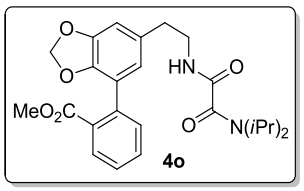
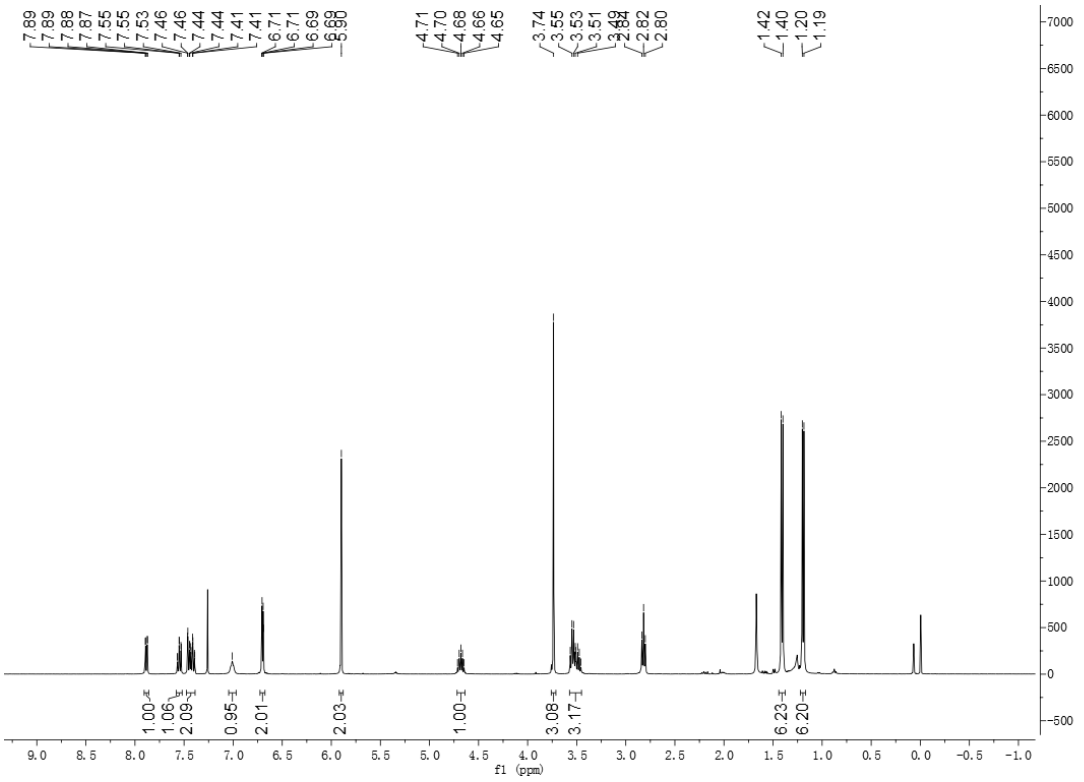
48.78
45.70
39.36
34.40
19.92
19.15
f1 (ppm)


O
O
HN
O
MeO2C
O
N(iPr)2

4o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7.44
7.41
7.41
6.71
6.71
6.69
6.69
5.90
4.71
4.70
4.68
4.66
4.65
3.74
3.55
3.53
3.51
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2.82
2.80
1.42
1.40
1.20
1.19
1.00
1.06
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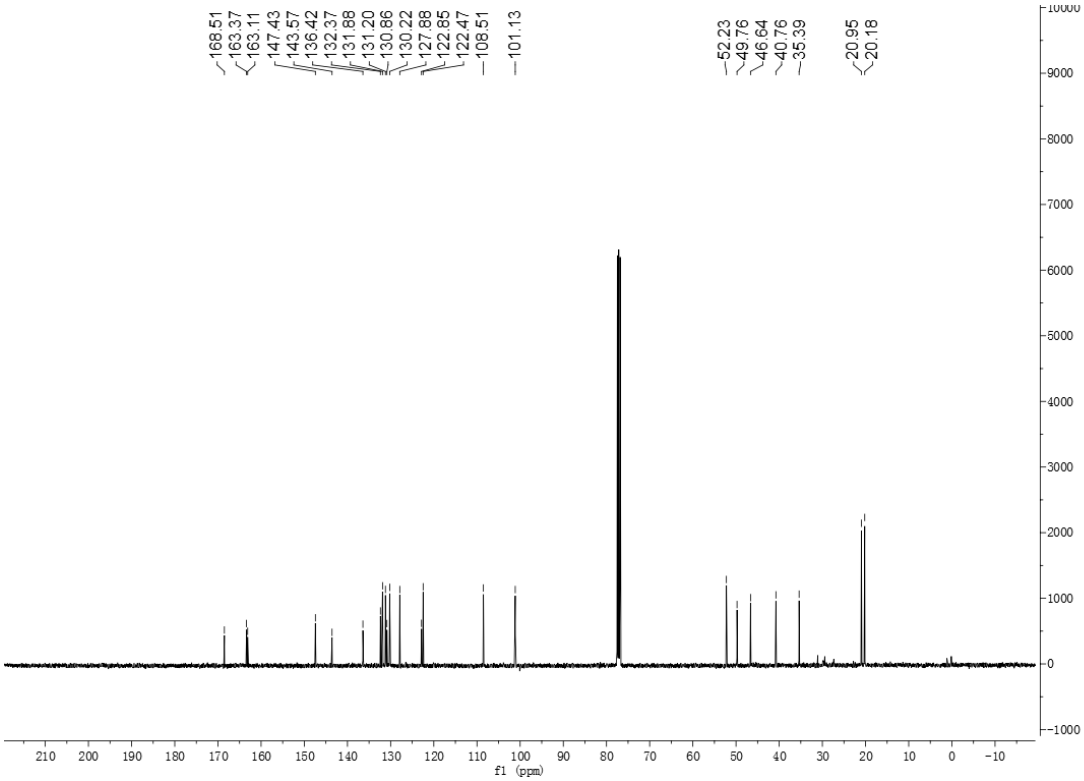
2.01
2.03
1.00
3.08
3.17
6.23
6.20
f1 (ppm)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130.22
127.88
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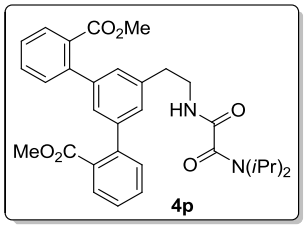
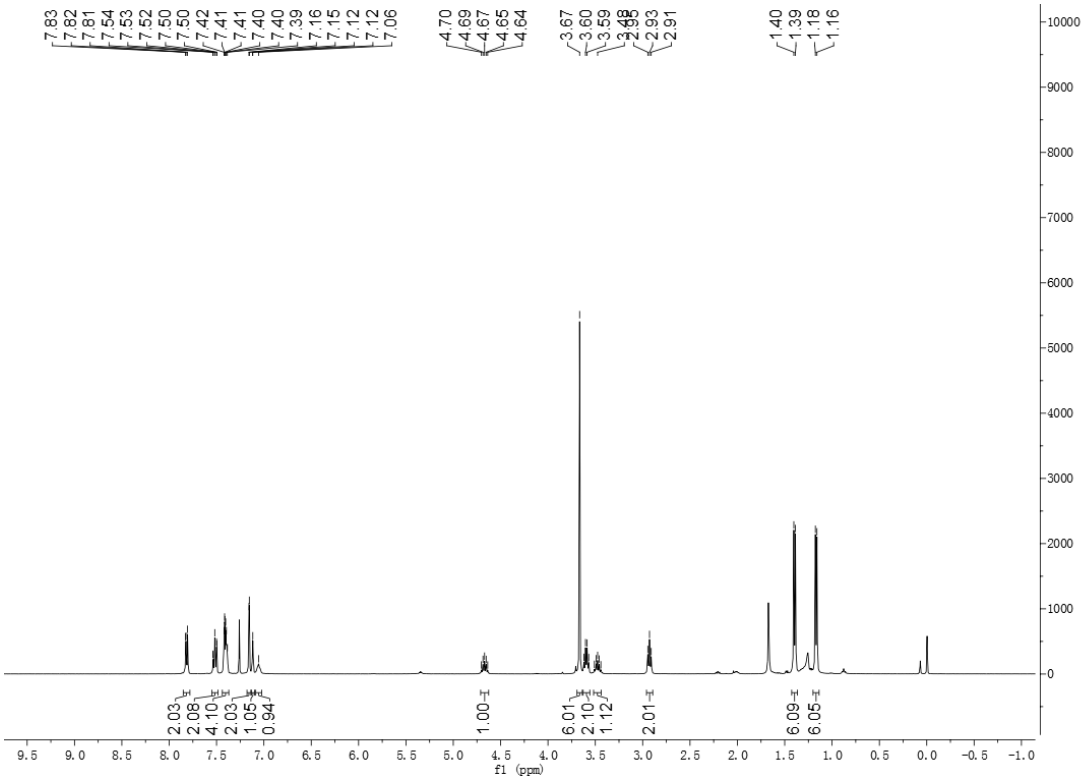
122.47
108.51
101.13
52.23
49.76
46.64
40.76
35.39
20.95
20.18
f1 (ppm)


CO2Me
HN
O
MeO2C
O
N(iPr)2
4p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7.50
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7.41
7.40
7.40
7.39
7.16
7.15
7.12
7.12
7.06
4.70
4.69
4.67
4.65
4.64
3.67
3.60
3.59
2.95
2.93
2.91
1.40
1.39
1.18
1.16
2.03
2.08
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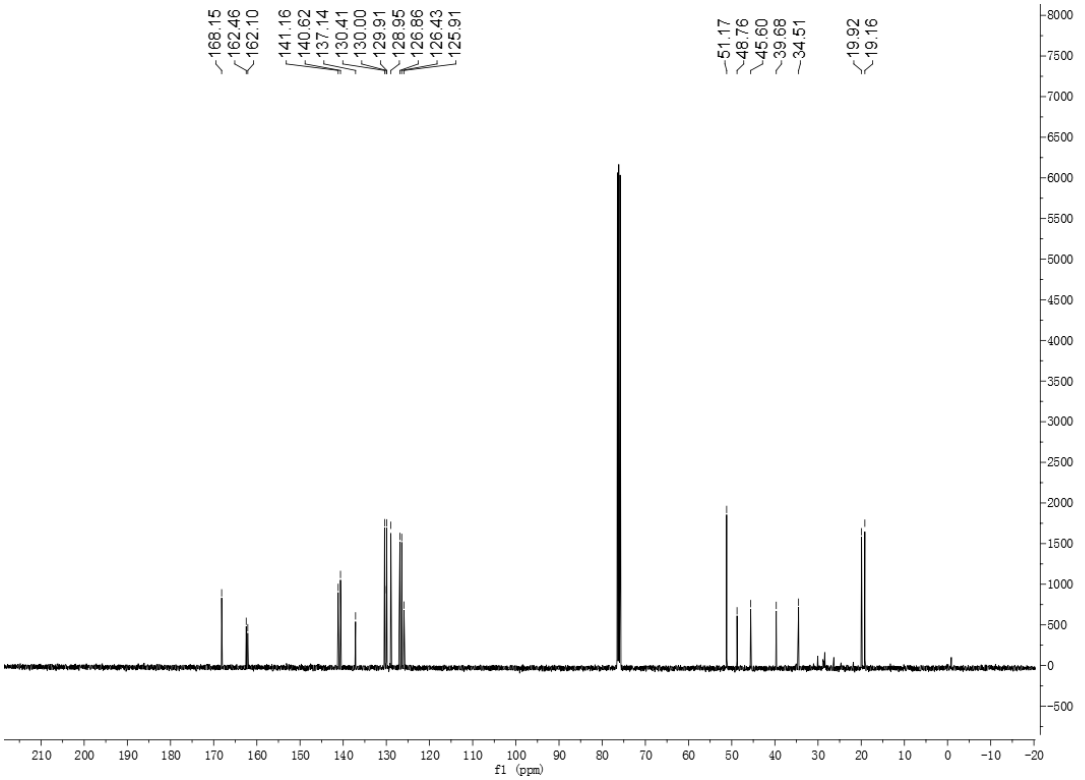
2.03
1.05
0.94
1.00
6.01
2.10
1.12
2.01
6.09
6.05
f1 (ppm)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137.14
130.41
130.00
129.91
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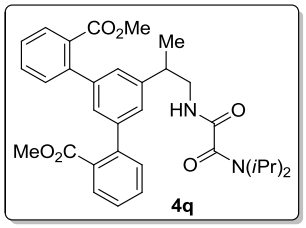
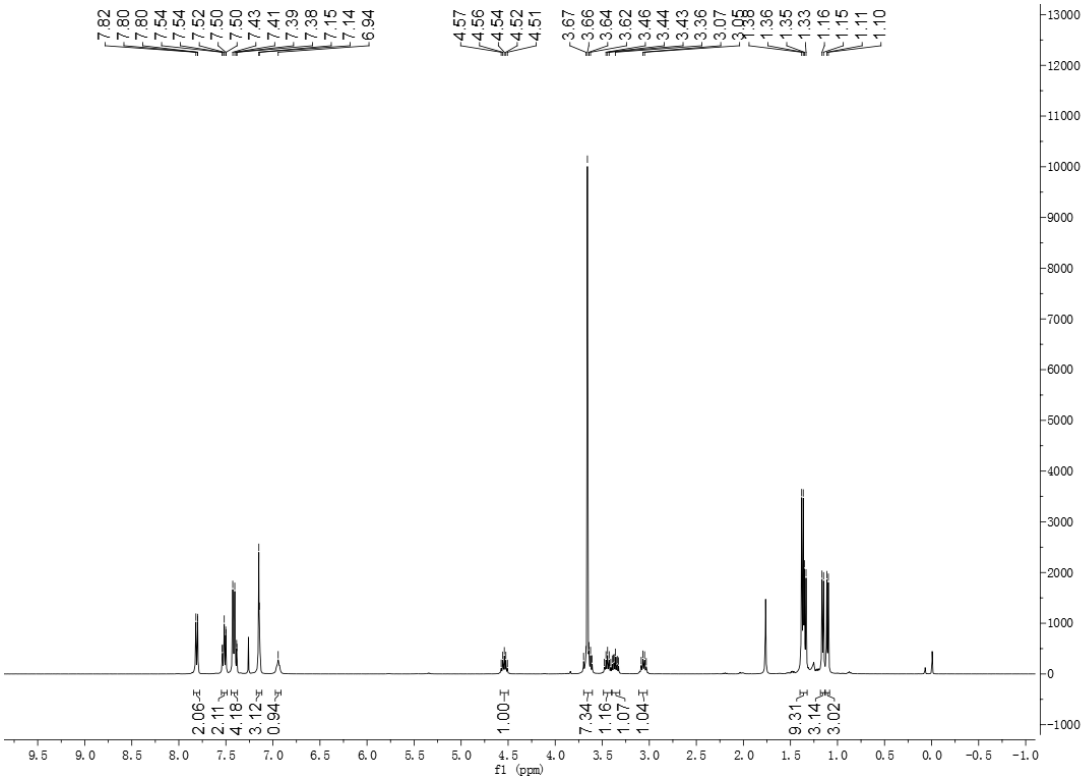
126.43
125.91
51.17
48.76
45.60
39.68
34.51
19.92
19.16
f1 (ppm)


CO2Me
Me
HN
O
MeO2C
O
N(iPr)2

4q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7.54
7.52
7.50
7.50
7.43
7.41
7.39
7.38
7.15
7.14
6.94
4.57
4.56
4.54
4.52
4.51
3.67
3.66
3.64
3.62
3.46
3.44
3.43
3.36
3.07
3.05
1.38
1.36
1.35
1.33
1.16
1.15
1.11
1.10
2.06
2.11
4.18
3.12
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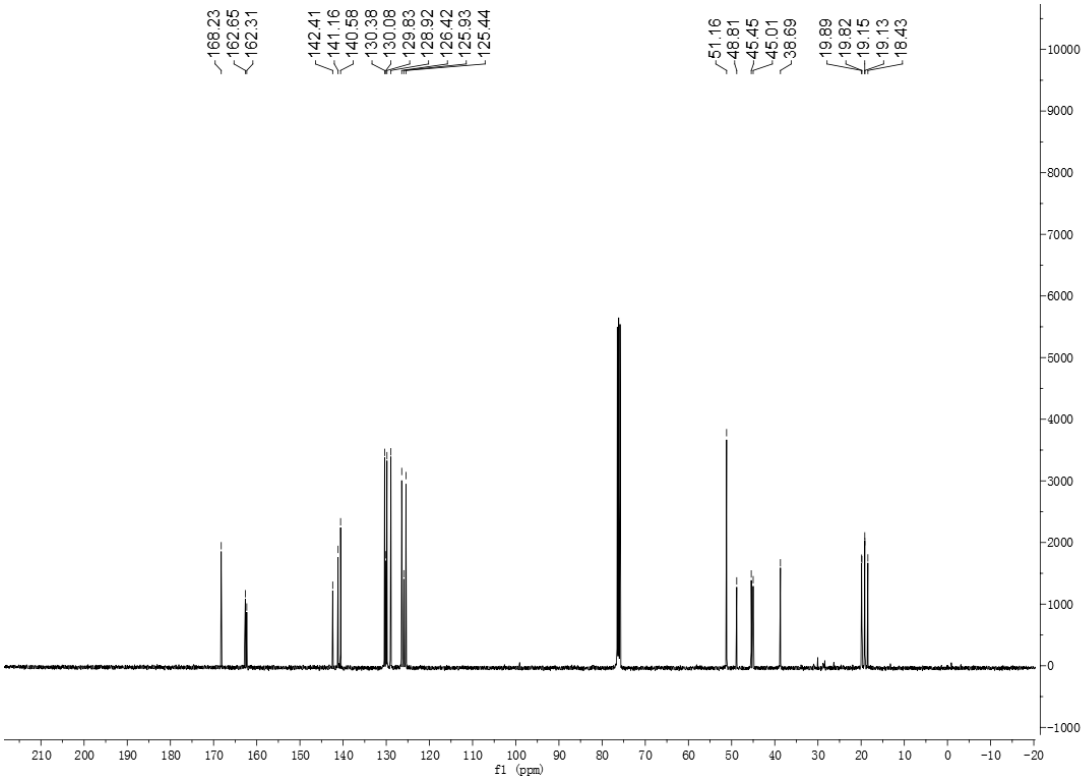
1.00
7.34
1.16
1.07
1.04
9.31
3.14
3.02
f1 (ppm)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128.92
126.42
125.93
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38.69
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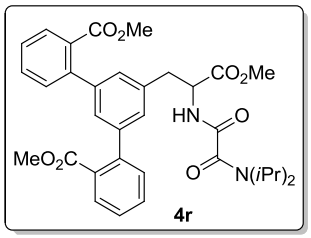
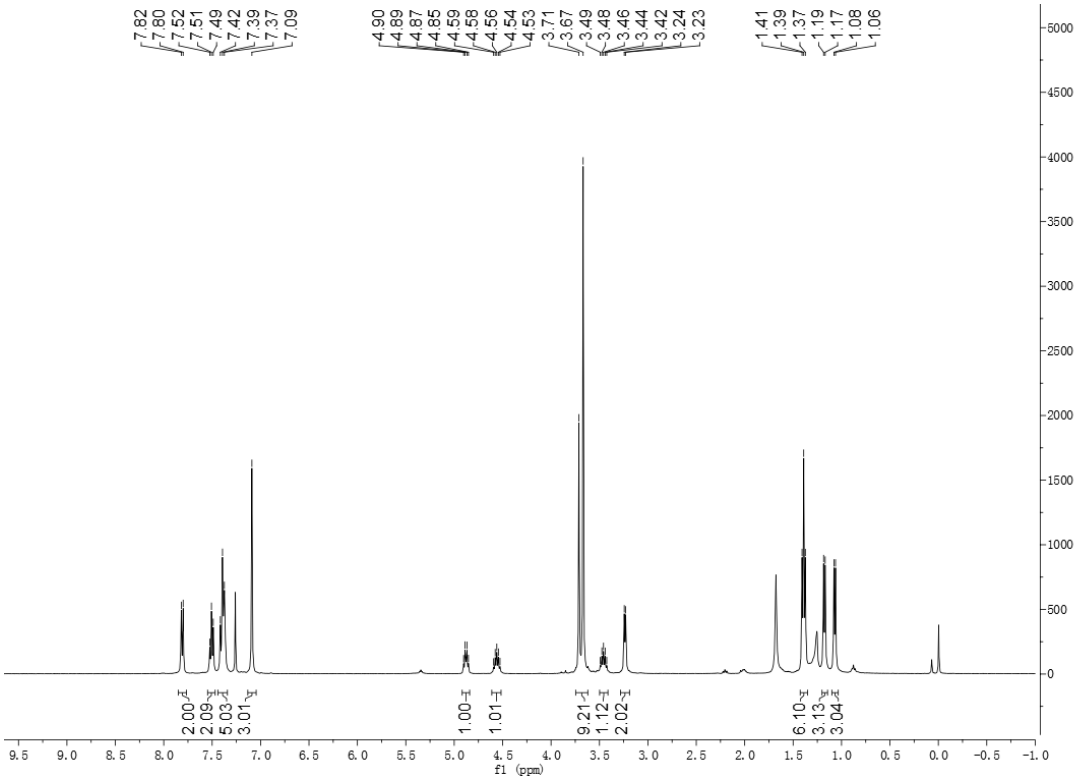
19.82
19.15
19.13
18.43
f1 (ppm)


CO2Me
CO2Me
HN
O
MeO2C
O
N(iPr)2

4r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4.85
4.59
4.58
4.56
4.54
4.53
3.71
3.67
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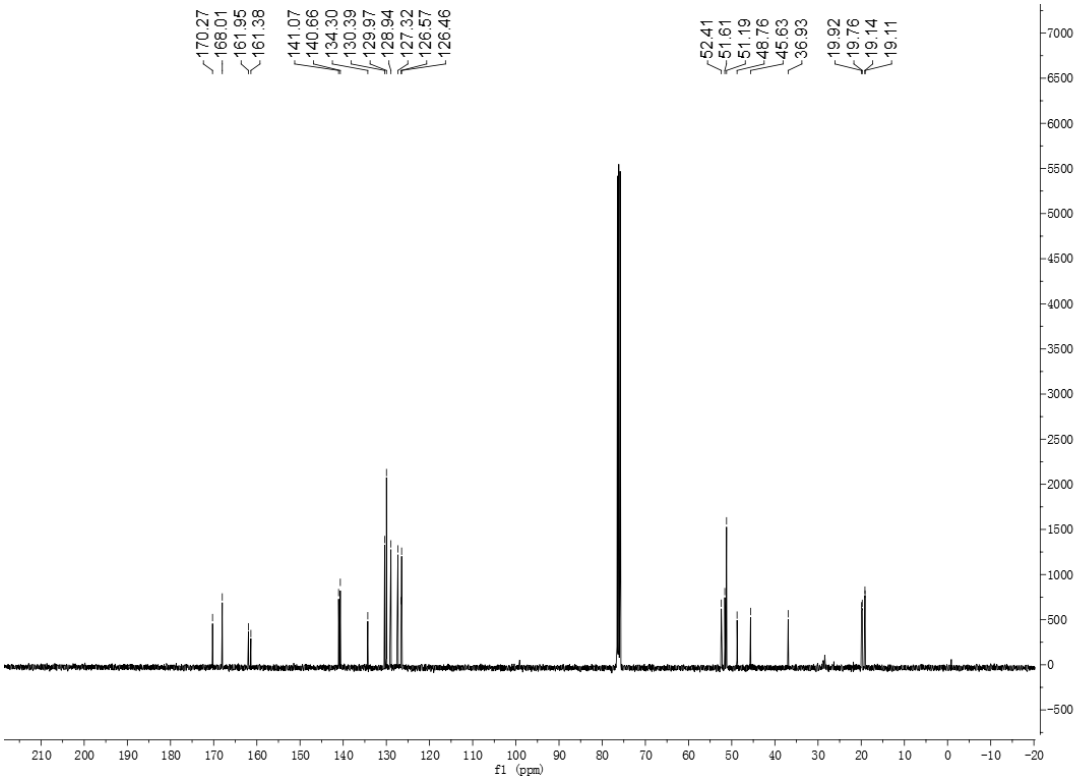
3.48
3.46
3.44
3.42
3.24
3.23
1.41
1.39
1.37
1.19
1.17
1.08
1.06
2.00
2.09
5.03
3.01
1.00
1.01
9.21
1.12
2.02
6.10
3.13
3.04
f1 (ppm)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140.66
134.30
130.39
129.97
128.94
127.32
126.57
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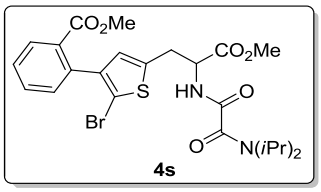
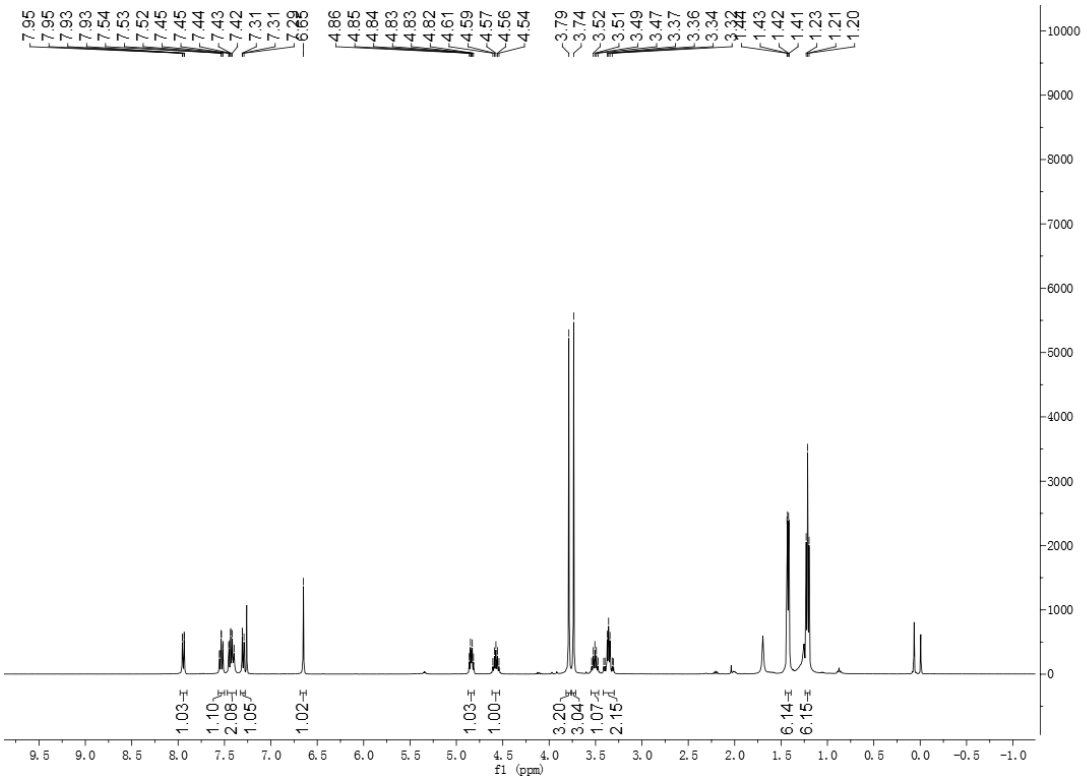
19.92
19.76
19.14
19.11
f1 (ppm)


CO2Me
CO2Me
S
HN
O
Br
O
N(iPr)2

4s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7.31
7.31
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4.83
4.83
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4.61
4.59
4.57
4.56
4.54
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3.74
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3.51
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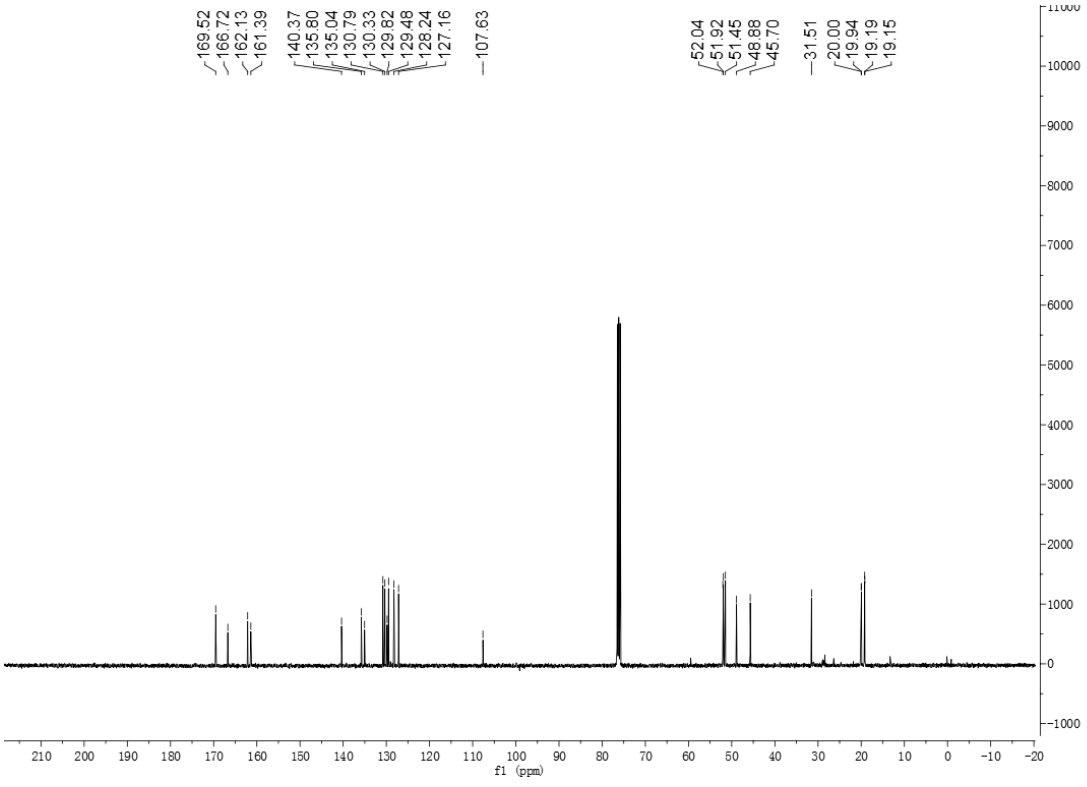
3.47
3.37
3.36
3.34
1.43
1.42
1.41
1.23
1.21
1.20
1.03
1.10
2.08
1.05
1.02
1.03
1.00
3.20
3.04
1.07
2.15
6.14
6.15
f1 (ppm)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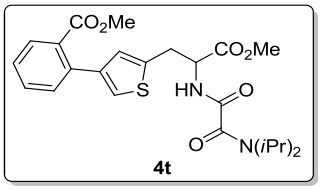
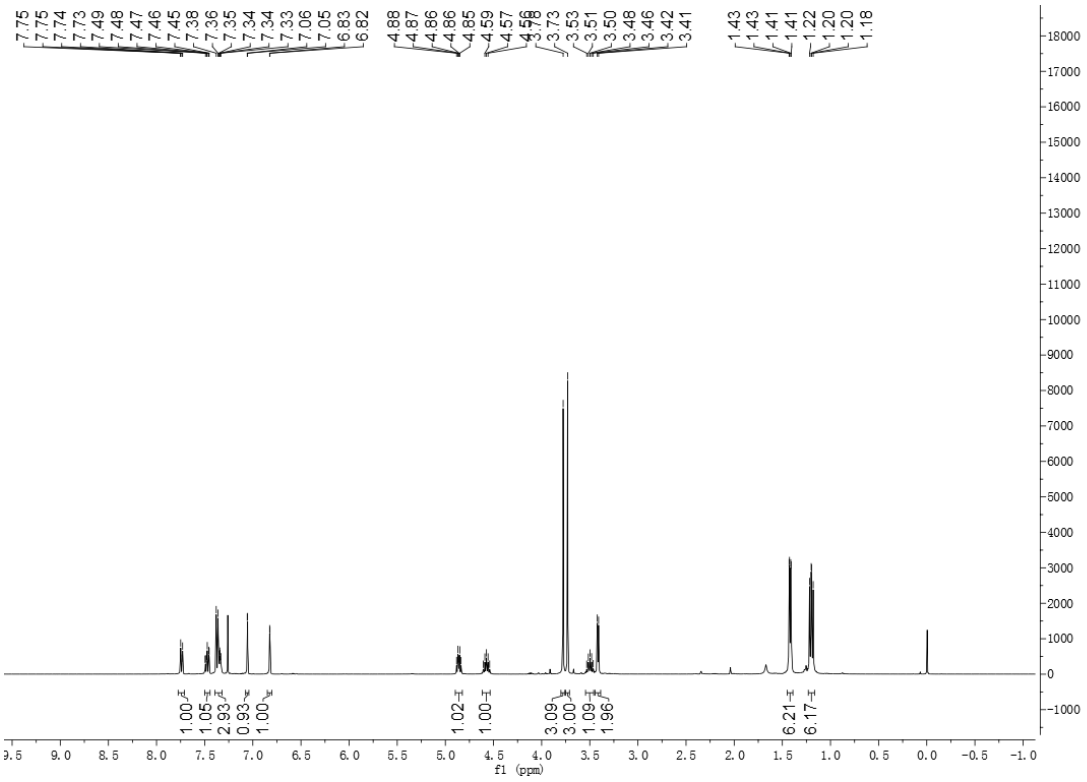
161.39
140.37
135.80
135.04
130.79
130.33
129.82
129.48
128.24
127.16
107.63
52.04
51.92
51.45
48.88
45.70
31.51
20.00
19.94
19.19
19.15
f1 (ppm)


CO2Me
CO2Me
S
HN
O
O
N(iPr)2

4t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7.34
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7.05
6.83
6.82
4.88
4.87
4.86
4.86
4.85
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4.57
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3.46
3.42
3.41
1.43
1.43
1.41
1.41
1.22
1.20
1.20
1.18
1.00
1.05
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0.93
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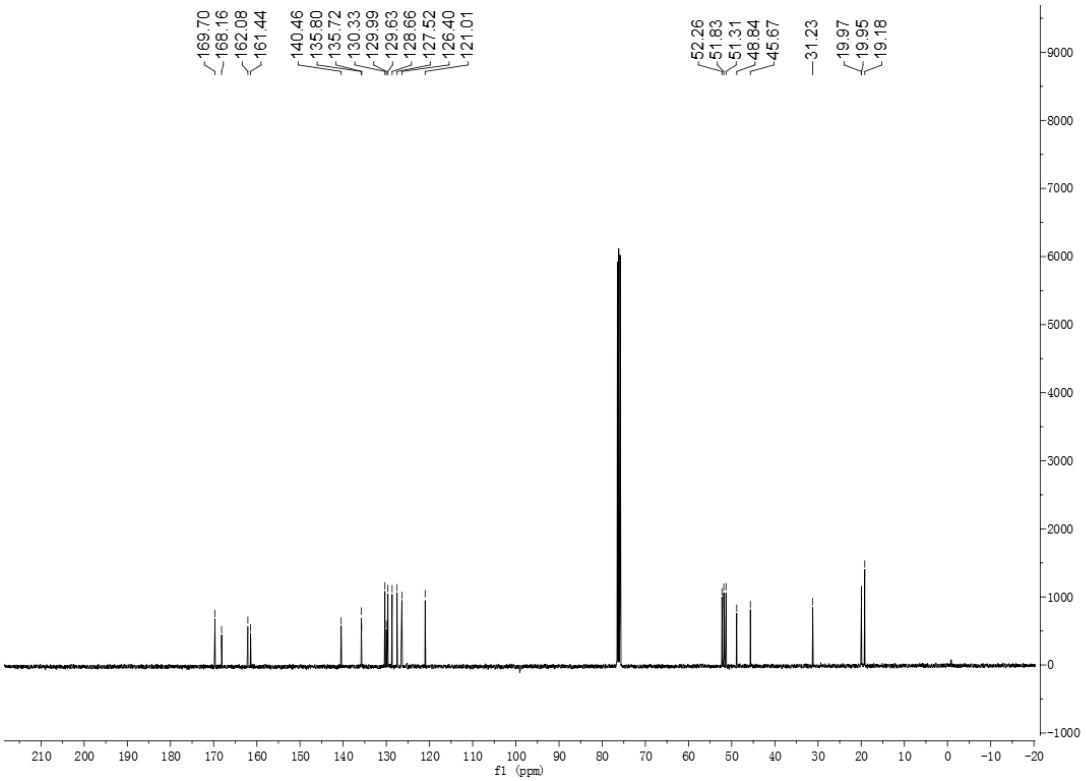
1.02
1.00
3.09
3.00
1.09
1.96
6.21
6.17
f1 (ppm)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135.80
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130.33
129.99
129.63
128.66
127.52
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121.01
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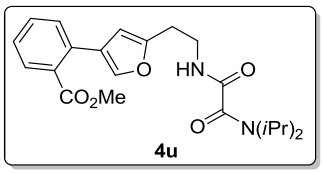
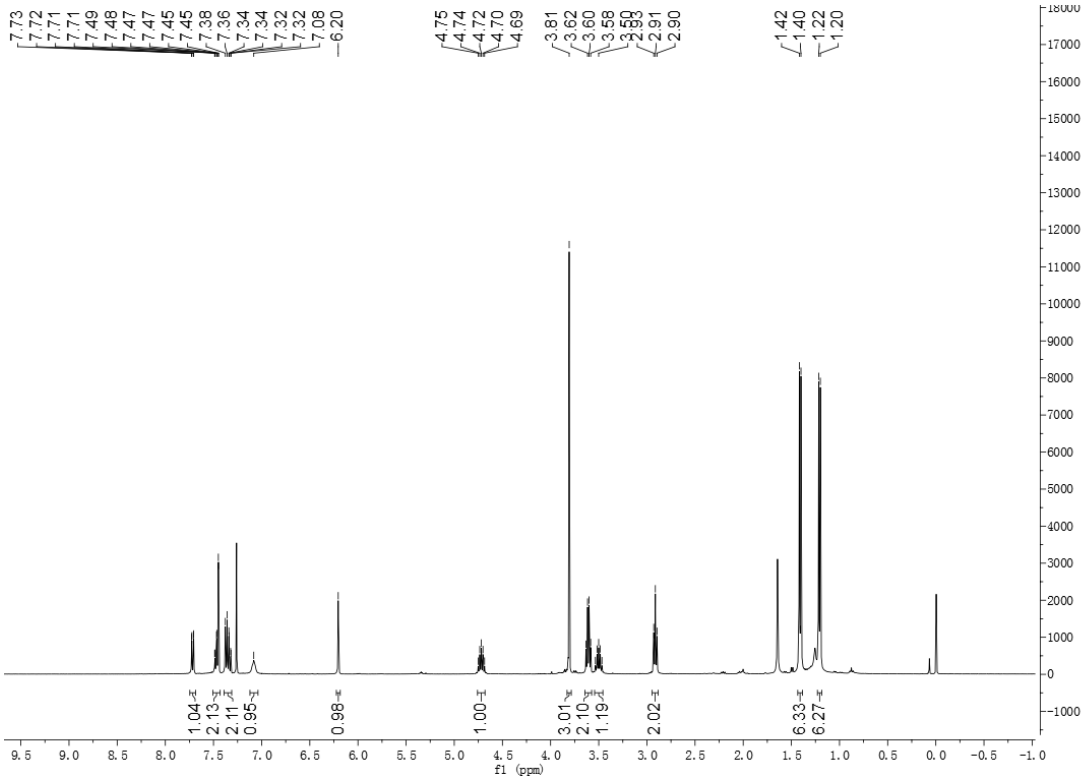
51.83
51.31
48.84
45.67
31.23
19.97
19.95
19.18
f1 (ppm)


HN
O
O
O
O
CO2Me
N(iPr)2

4u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7.34
7.34
7.32
7.08
6.20
4.75
4.74
4.72
4.70
4.69
3.81
3.62
3.60
3.58
3.50
2.93
2.91
2.90
1.42
1.40
1.22
1.20
1.04
2.13
2.11
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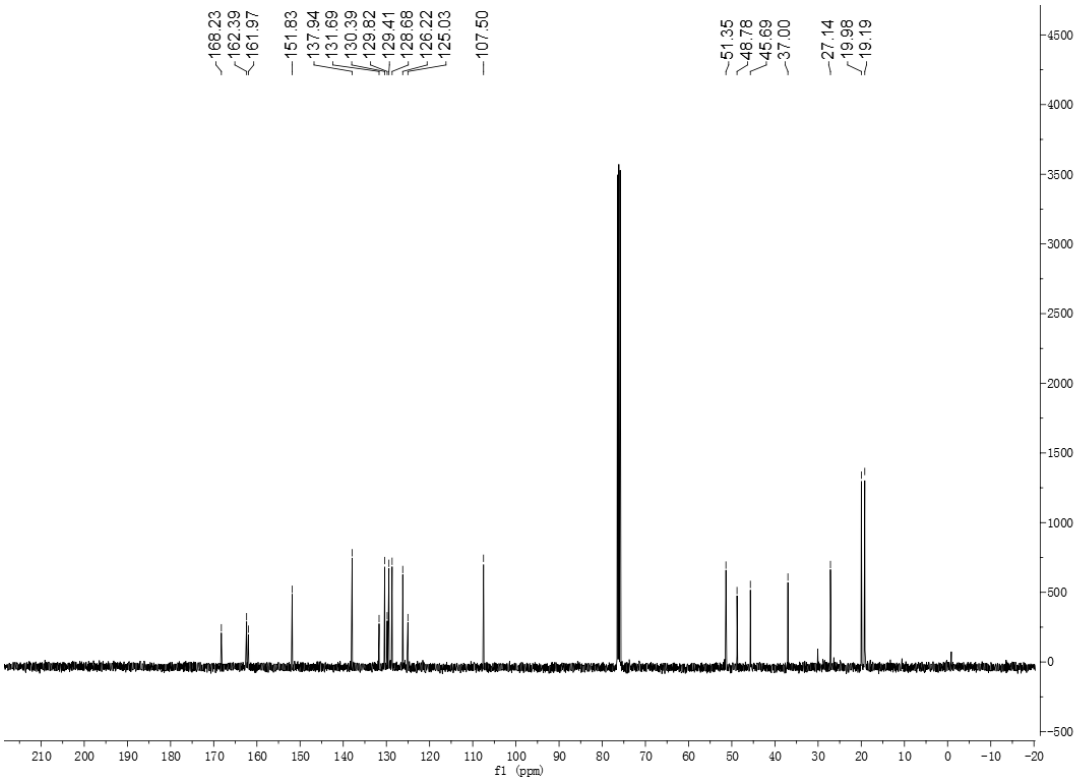
0.98
1.00
3.01
2.10
1.19
2.02
6.33
6.27
f1 (ppm)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137.94
131.69
130.39
129.82
129.41
128.68
126.22
125.03
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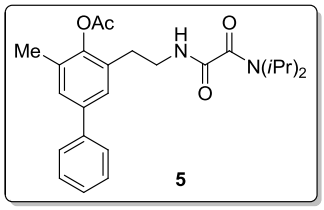
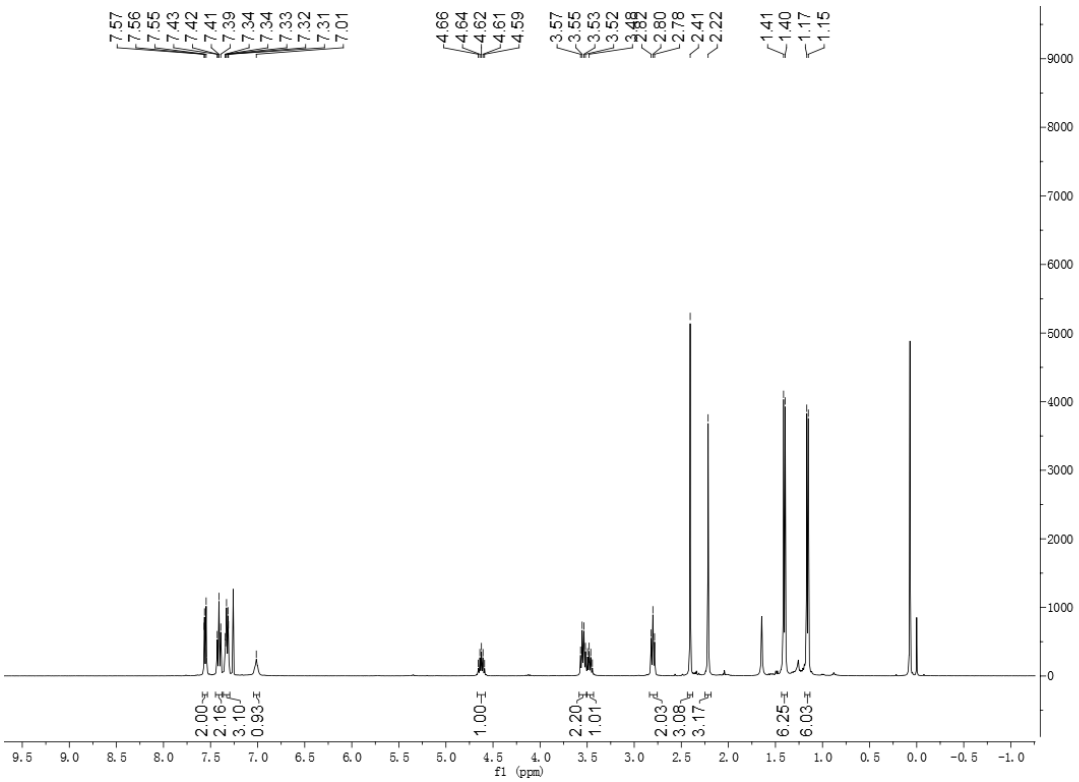
45.69
37.00
27.14
19.98
19.19
f1 (ppm)


OAc
Me
H
N
O
O
N(iPr)2
5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7.32
7.31
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3.52
2.80
2.78
2.41
2.22
1.41
1.40
1.17
1.15
2.00
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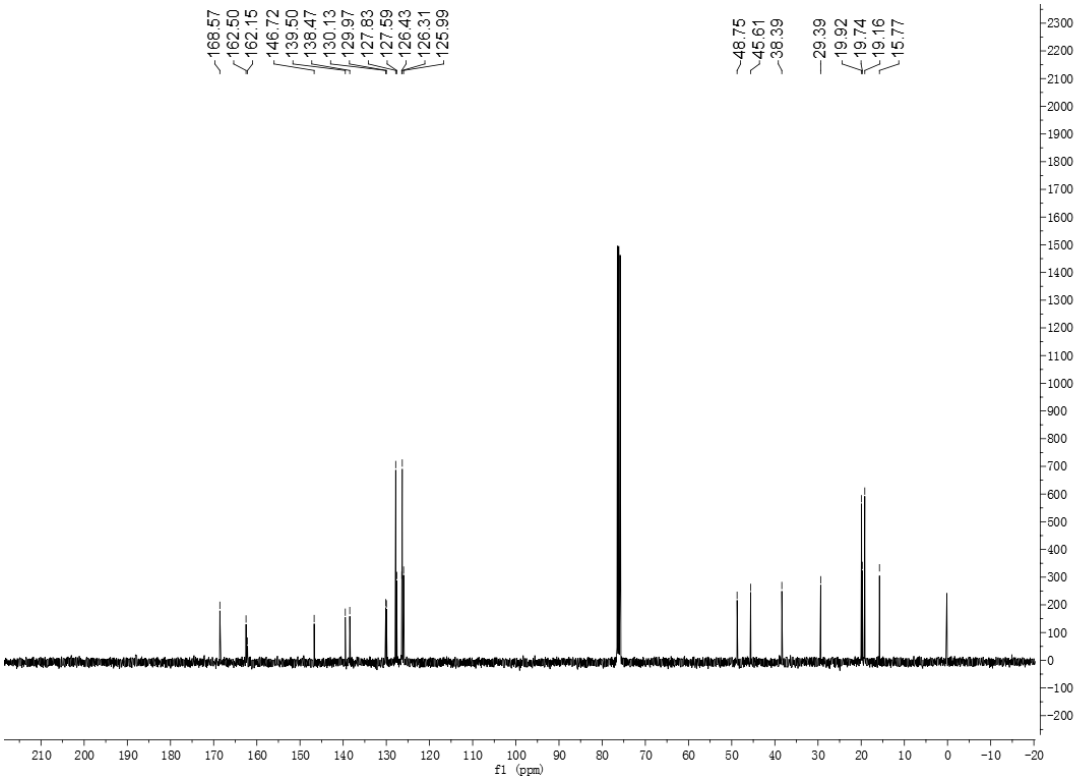
1.00
2.20
1.01
2.03
3.08
3.17
6.25
6.03
f1 (ppm)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129.97
127.83
127.59
126.43
126.31
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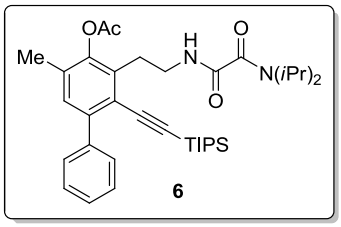
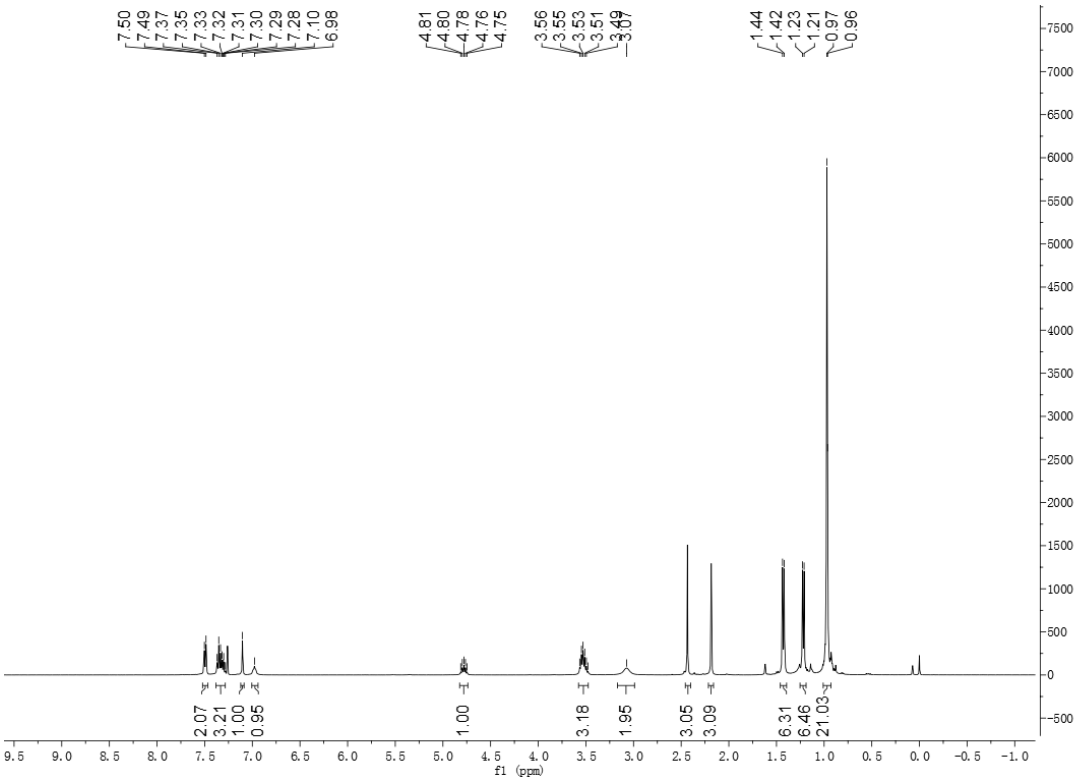
29.39
19.92
19.74
19.16
15.77
f1 (ppm)


OAc
Me
H
N
O
N(iPr)2
O
TIPS

6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7.30
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7.28
7.10
6.98
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4.80
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4.76
4.75
3.56
3.55
3.53
3.51
3.49
3.07
1.44
1.42
1.23
1.21
0.97
0.96
2.07
3.21
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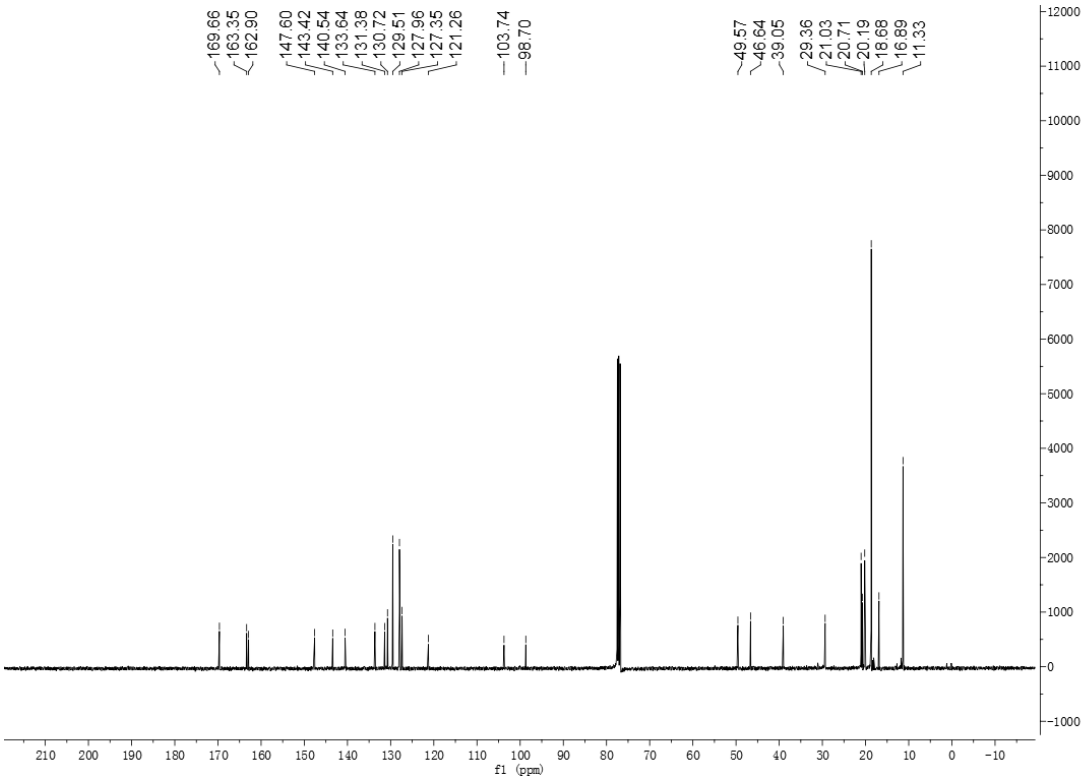
1.00
3.18
1.95
3.05
3.09
6.31
6.46
21.03
f1 (ppm)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147.60
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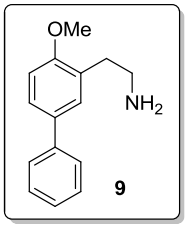
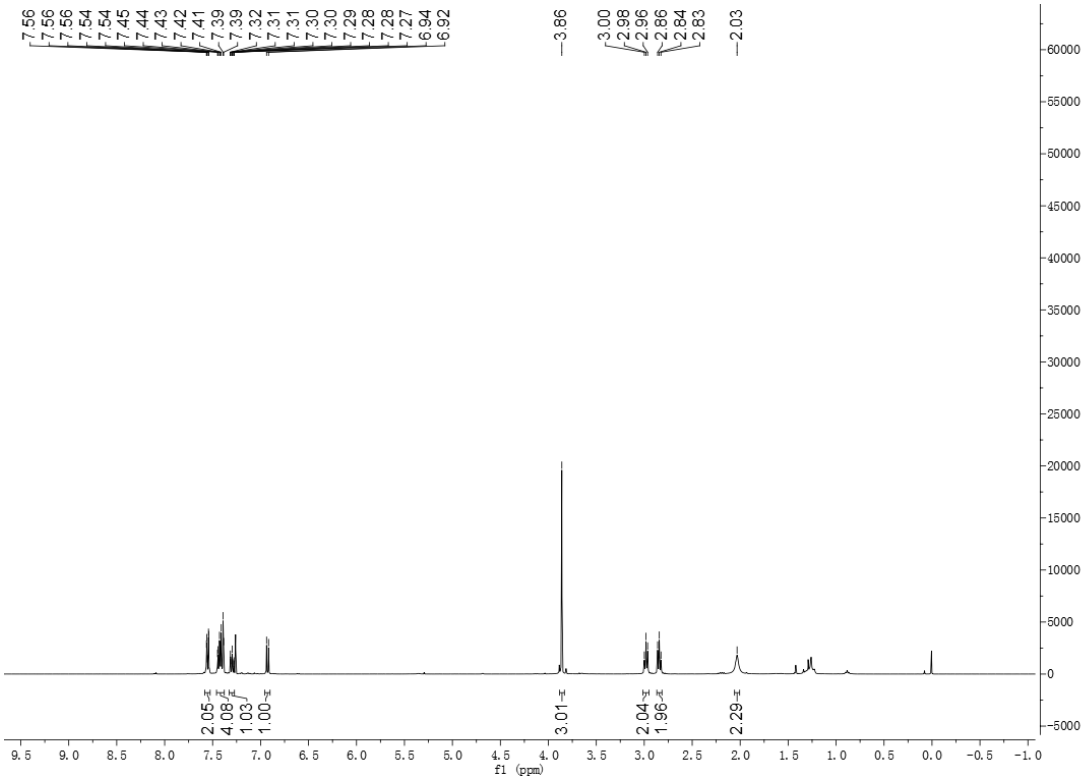
140.54
133.64
131.38
130.72
129.51
127.96
127.35
121.26
103.74
98.70
49.57
46.64
39.05
29.36
21.03
20.71
20.19
18.68
16.89
11.33
f1 (ppm)


OMe
NH2
9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7.56
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7.32
7.31
7.31
7.30
7.30
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7.28
7.27
6.94
6.92
3.86
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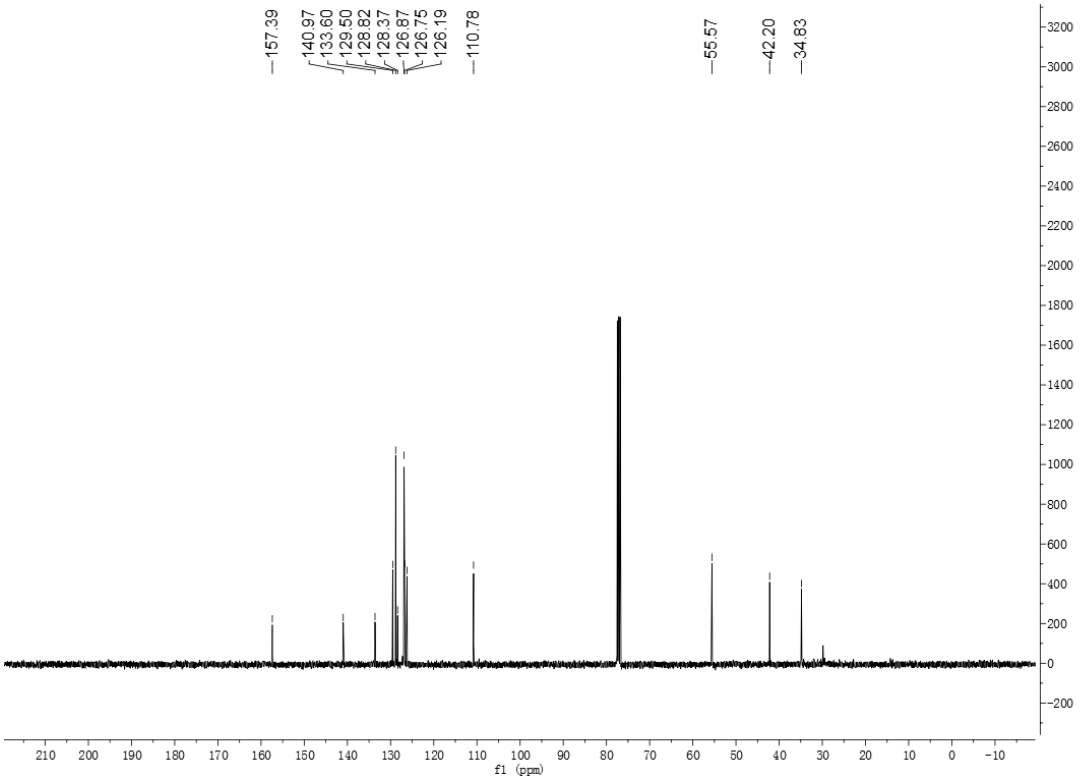
2.98
2.96
2.86
2.84
2.83
2.03
2.05
4.08
1.03
1.00
3.01
2.04
1.96
2.29
f1 (ppm)


157.39
140.97
133.60
129.50
128.82
128.37
126.87
126.75
126.19
110.78
55.57
42.20
34.83
f1 (ppm)