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Supporting Information

Ligand-free palladium catalyzed ullmann biaryl synthesis: 'household' reagents and mild reaction conditions

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1.General Information

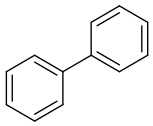
Column chromatography was generally performed on silica gel (200-300 mesh) and reactions were monitored by thin layer chromatography (TLC) using UV light to visualize the course of the reactions. The ^{1}H(400MHz) and ^{13}C NMR (100MHz) data were recorded on Bruker AVANCEII400MHz spectrometer using $CDCl_3$ as solvent. The chemical shifts (δ) are reported in ppm and coupling constants (J) in Hz. ^{1}H NMR spectra was recorded with tetramethylsilane (δ= 0.00 ppm) as internal reference; ^{13}C NMR spectra was recorded with $CDCl_3$ (δ = 77.00 ppm) as internal reference.

Microstructure of palladium nanoparticles (PdNPs) can be observed by Field Emission. Scanning Electron Microscope JSM-7800F.

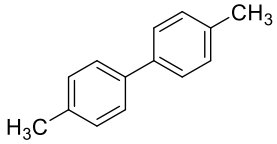
2.General procedures for synthesis of of 2a-2k and 4ah-4fi

An oven-dried flask tube was charged with aryl iodide(1mmol), catalyst $Pd(OAc)_2$(0.01mmol), base K_3PO_4(1mmol), DMSO(10mmol) and DMF (0.75mL), finally, $N_2H_4 \cdot H_2O$(4mmol) was added in the solution. The reaction mixture was stirred at room temperature under air atmosphere for 8h. The reaction was monitored by thin layer chromatography (TLC). When the reaction was completed, it was diluted with water and extracted with ethyl acetate 3 times. The organic phase was concentrated using the rotary evaporator. Removal of solvent followed by column chromatography afforded desired products.

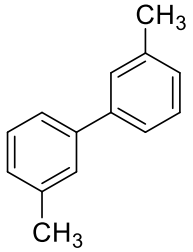
3. Compound characterizations



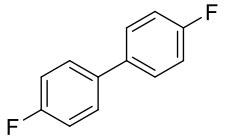
Diphenyl (2a)[1][2]**.** Petroleum ether, white solid. ^{1}H NMR(400 MHz, $CDCl_3$, TMS) δ(ppm)7.67-7.65(m, 4H), 7.44-7.40(m, 4H), 7.35-7.31(m, 2H); ^{13}C NMR(100 MHz, $CDCl_3$, TMS) (ppm) 141.3, 128.8, 127.3, 127.2.



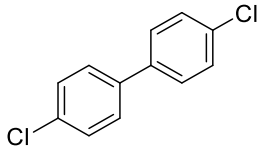
4, 4'-Dimethyldiphenyl (2b)[1][2]**.** Pure petroleum ether，white solid. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm) 7.48-7.46（d, *J*=8.0 Hz, 4H), 7.23-7.21 (d, *J*=8.0Hz, 4H), 2.38(s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) (ppm) 138.3, 136.7, 129.5, 126.9, 21.2.



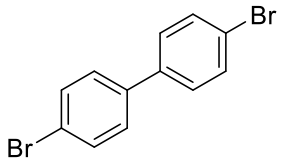
3, 3'-Dimethylbiphenyl (2c)[7]. Pure petroleum ether, colorless oil. ^{1}H NMR(400 MHz, CDCl3, TMS) δ (ppm) 7.54-7.51(m, 4H), 7.45(t, *J*=8.0Hz, 2H), 7.28(d, *J*=7.1Hz, 2H), 2.55(s, 6H); ^{13}C NMR(100 MHz, $CDCl_3$, TMS) δ(ppm) 141.7, 138.4, 128.7, 128.1, 128.0, 124.4, 21.7.



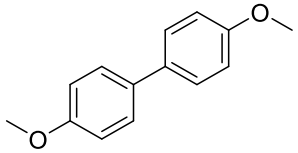
4, 4'-Difluorodiphenyl (2e)[1][2]**.** Pure petroleum ether，white solid. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm) 7.51-7.48 (m, 4H), 7.13 (t, *J*=8.6Hz, 4H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm) 162.4 (d, *J*=237.2Hz), 136.4 (d, *J*=3.2Hz), 128.6 (d, *J*=7.8Hz), 115.7(d, *J*=21.3Hz).



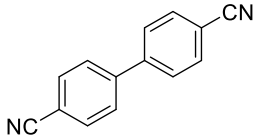
4, 4'-Dichlorobiphenyl (2f)[2]**.** Pure petroleum ether, white solid. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm) 7.46-7.49(m, 4H), 7.40-7.42 (m, 4H)； ^{13}C NMR (100 MHz, $CDCl_3$, TMS)δ (ppm) 138.4, 133.8, 129.1, 128.2.



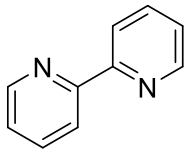
4, 4′-Dibromobiphenyl (2g)[1]**.** Pure petroleum ether, white solid. ^{1}H NMR(400 MHz, $CDCl_3$, TMS) δ(ppm) 7.56(m, 4H), 7.42(m, 4H); ^{13}C NMR(100 MHz, $CDCl_3$, TMS) δ (ppm) 138.9, 132.0, 128.5, 121.8.



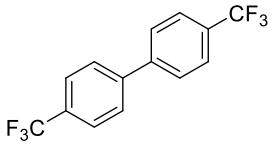
4, 4'-Dimethoxybiphenyl (2h)[1][2]**.** Pure petroleum ether, white solid. ^{1}H NMR(400 MHz, $CDCl_3$, TMS) δ(ppm) 7.49(d, *J*=8.6Hz, 4H), 6.97(d, *J*=8.6Hz, 4H), 3.86(s, 6H); ^{13}C NMR(100 MHz, $CDCl_3$, TMS) δ(ppm) 158.7, 133.5, 127.8, 114.2, 55.4.



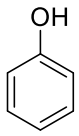
4, 4'-Biphenyldicarbonitrile (2i)[2]**.** Petroleum ether/Ethyl acetate=50:1, white solid. ^{1}H NMR(400 MHz, $CDCl_3$, TMS) δ(ppm) 7.74(q, J_1=8.2Hz, J_2=33.2Hz, 8H); ^{13}C NMR(100 MHz, $CDCl_3$, TMS) δ(ppm) 143.5, 132.9, 127.9, 118.4, 112.4.



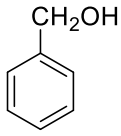
2, 2'-bipyridines (2j)[6]. Petroleum ether/Ethyl acetate=10:1, yellow solid. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm)8.67-8.68(m, 2H), 8.38-8.40(m, 2H), 7.79-7.83(m, 2H), 7.28-7.32(m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm)156.2, 149.2, 137.0, 123.7, 121.1.



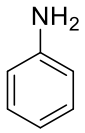
4, 4'-Bis(trifluoromethyl)biphenyl (2k)[1][2]**.** Petroleum ether, white solid. ^{1}H NMR(400 MHz, $CDCl_3$, TMS) δ(ppm)7.76-7.70(m, 8H); ^{13}C NMR(100 MHz, $CDCl_3$, TMS) δ(ppm) 143.2, 130.5(d, *J*=33.5Hz), 127.6, 125.9(q, *J*=4.1Hz), 124.1(d, *J*=272.9Hz).



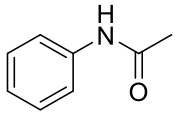
Benzenol (2l')[12]**.** Petroleum ether/Ethyl acetate=50:1, white solid. ^{1}H NMR(400 MHz, CDCl3, TMS) δ(ppm) 7.30-7.26(m, 2H), 6.98(t, *J*=7.3Hz, 1H), 6.90-6.87(m, 2H); ^{13}C NMR(100 MHz, CDCl3, TMS) δ (ppm) 155.1, 129.7, 120.9, 115.3.



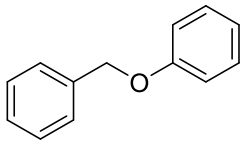
Benzenemethanol (2m')[13]**.** Petroleum ether/Ethyl acetate=50:1, colorless oil. ^{1}H NMR(400 MHz, CDCl3, TMS) δ(ppm) 7.42-7.32(m, 5H), 4.59(s, 2H), 3.88(s, 1H); ^{13}C NMR(100 MHz, CDCl3, TMS) δ (ppm) 140.7, 128.2, 127.2, 126.7, 64.4.



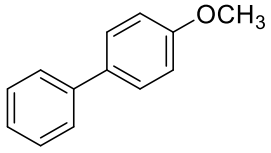
Benzenamine (2n') [12]**.** Petroleum ether/Ethyl acetate=50:1, colorless oil. ^{1}H NMR(400 MHz, CDCl3, TMS) δ(ppm) 7.21-7.18(m, 2H), 6.80(t, *J*=7.5Hz, 1H), 6.72-6.70(m, 2H); ^{13}C NMR(100 MHz, CDCl3, TMS) δ (ppm) 146.3, 129.2, 118.5, 115.0.



N-Phenylacetamide (2o') [14]**.** Petroleum ether/Ethyl acetate=5:1, white solid. ^{1}H NMR(400 MHz, CDCl3, TMS) δ(ppm) 8.28(s, 1H), 7.54(d, *J*=7.8Hz, 2H), 7.30(t, *J*=7.8Hz, 2H), 7.10(t, *J*=7.3Hz, 1H), 2.16(s, 3H); ^{13}C NMR(100 MHz, CDCl3, TMS) δ (ppm) 169.0, 138.0, 128.8, 124.2, 120.1, 24.3.

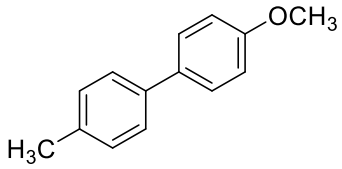


Benzyloxybenzene (2p') [15]**.** Petroleum ether, white solid. ^{1}H NMR(400 MHz, CDCl3, TMS) δ(ppm) 7.48(d, *J*=7.5Hz, 2H), 7.42(t, *J*=7.0Hz, 2H), 7.38-7.31(m, 3H), 7.03-6,98(m, 3H), 5.10(s, 2H); ^{13}C NMR(100 MHz, CDCl3, TMS) δ (ppm) 158.77, 137.06, 129.45, 128.54, 127.90, 127.44, 120.91, 114.83, 69.88.

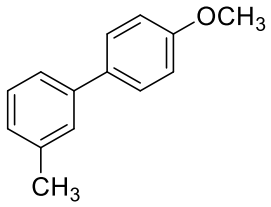


4-Methoxy-biphenyl (4ah)[4][7]**.** Pure petroleum ether, white solid**.** ^{1}H NMR (400 MHz, CDCl3, TMS) δ(ppm)7.58- 7.53(m, 4H), 7.43(t, *J*=7.9Hz, 2H), 7.33-7.31(m,

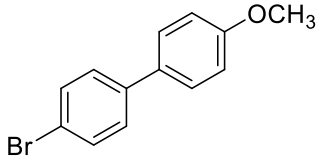
1H), 7.00(m, 2H), 3.86(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm)159.16, 140.85, 133.80, 128.74, 128.17, 126.76, 126.67, 114.22, 55.36.



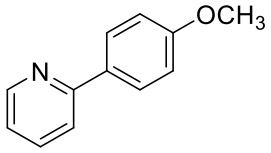
4-Methoxy-4'-methyl-biphenyl (4bh)[7]. Pure petroleum ether, white solid. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm)7.51(d, *J*=8.8Hz, 2H), 7.45(d, *J*=8.4Hz, 2H), 7.23(d, *J*=8.9Hz, 2H), 6.97(d, *J*=8.8Hz, 2H), 3.85(s, 3H), 2.39(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm)158.95, 137.98, 136.35, 133.77, 129.43, 127.95, 126.59, 114.17, 55.35, 21.04.



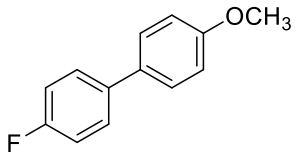
4-Methoxy-3'-methyl-biphenyl (4ch)[8]**.** Pure petroleum ether, Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm)7.54(d, *J*=7.8Hz, 2H), 7.39-7.31(m, 3H), 7.14(d, *J*=6.9Hz, 1H), 6.99(d, *J*=8.7Hz, 2H), 3.86(s, 3H), 2.43(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm)159.09, 140.84, 138.30, 133.92, 128.66, 128.19, 127.59, 127.44, 123.88, 114.16, 55.36, 21.59.



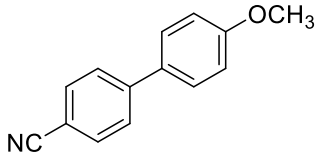
4-Bromo-4'-methoxy-biphenyl (4gh)[4]**.** Pure petroleum ether, white solid**.** ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm) 7.54-7.48(dd, *J*=8.1Hz, 4H), 7.41(d, *J*=8.7Hz, 2H), 6.98(d, *J*=8.2Hz, 2H), 3.85(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm) 159.4, 139.8, 132.5, 131.8, 128.3, 128.0, 120.8, 114.4, 55.4.



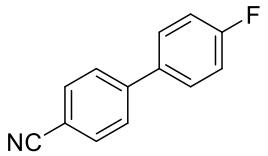
2-(4'-Methoxyphenyl) pyridine (2jh)[9]**.** Petroleum ether/Ethyl acetate=20:1, white solid**.** ^{1}H NMR (400 MHz, CDCl3, TMS) δ(ppm) 8.65(d, *J*=5.6Hz, 1H), 7.95(d, *J*=6.9Hz, 2H), 7.67-7.71(m, 2H), 7.15-7.18(m, 1H), 7.01(d, *J*=9.0Hz, 2H), 3.86(s, 3H); ^{13}C NMR (100 MHz, CDCl3, TMS) δ(ppm) 160.46, 157.14, 149.55, 136.67, 132.05, 128.17, 121.42, 119.82, 114.13, 55.36.



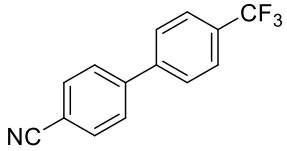
4-Fluoro-4'-methoxybiphenyl (4eh)[10]**.** Pure petroleum ether, white solid**.** ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm)7.52-7.46(m, 4H), 7.10(t, *J*=8.7Hz, 2H), 6.98(d, *J*=8.6Hz, 2H), 3.85(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm) 163.3(d, *J*=245.9Hz), 159.1, 137.0(d, *J*=2.9Hz), 132.9, 128.0, 115.6(d, *J*=21.5Hz), 114.3, 55.4.



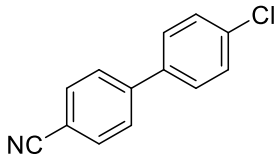
4'-Methoxy-biphenyl-4-carbonitrile (4hi)[3]**.** Petroleum ether/Ethyl acetate=30:1, white solid. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm) 7.67(q, J_1=7.9Hz, J_2=21.3Hz, 4H),7.54(d, *J*=8.8Hz, 2H), 7.01(d, *J*=8.8Hz, 2H), 3.86(s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm) 160.2, 145.2, 132.6, 131.5, 128.4, 127.1, 119.1, 114.6, 110.1, 55.4.



4'-Fluoro-biphenyl-4-carbonitrile (4ei)[3]**.** Petroleum ether/Ethyl acetate=50:1, white solid**.** ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm) 7.71-7.65(m, 4H), 7.58-7.53(m, 2H), 7.17(t, *J*=8.6Hz, 2H), ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm) 164.5, 162.0, 144.6, 135.3, 132.7, 128.9(d, *J*=8.1Hz), 127.6, 118.8, 116.0(d, *J*=21.6Hz), 111.0.



4'-Trifluoromethyl-biphenyl-4-carbonitrile (4ki)[11]**.** Petroleum ether/Ethyl acetate=50:1, white solid**.** ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm)7.69- 7.78(m, 8H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm) 144.1, 142.7, 132.8, 130.9(d, *J*=33.1Hz), 128.0, 127.6, 126.1(q, J_1=3.8Hz, J_2=7.8Hz), 125.4(d, *J*=253.6Hz), 118.6, 112.0.



4'-Chloro-biphenyl-4-ylcarbonitrile (4fi)[5]**.** Petroleum ether/Ethyl acetate=50:1, white solid**.** ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ(ppm) 7.69(q, J_1=8.5Hz, J_2=32.9Hz, 4H), 7.49(q, J_1=8.5Hz, J_2=27.1Hz, 4H); ^{13}C NMR (100 MHz, $CDCl_3$, TMS) δ(ppm)144.4, 137.6, 135.0, 132.7, 129.3, 128.5, 127.6, 118.8, 111.3.

4.General procedure for synthesis of PdNPs

To a 10 mL reaction tube was added 30 mg of palladium acetate, and then 1 mL of a solvent (DMF:DMSO=3:1) was added, and 0.2 mL of hydrazine hydrate was added dropwise to the reaction system while stirring. After sonication for 20 min, filter, it was washed for several times with water and acetone, and dried to give a dark grey powder 10mg, yield 71%（Figure 1）.

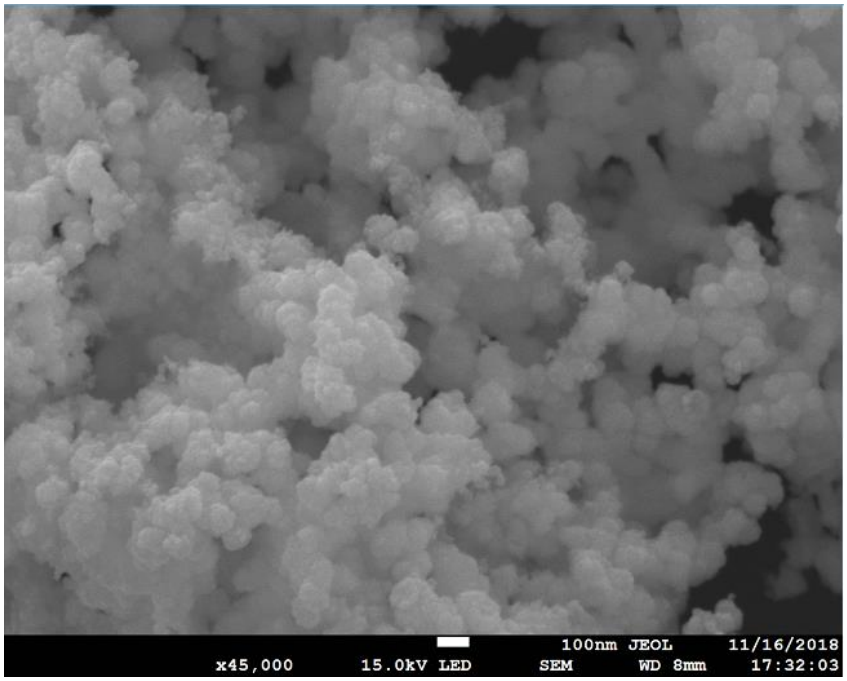


Figure 1

5.References

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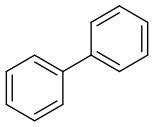
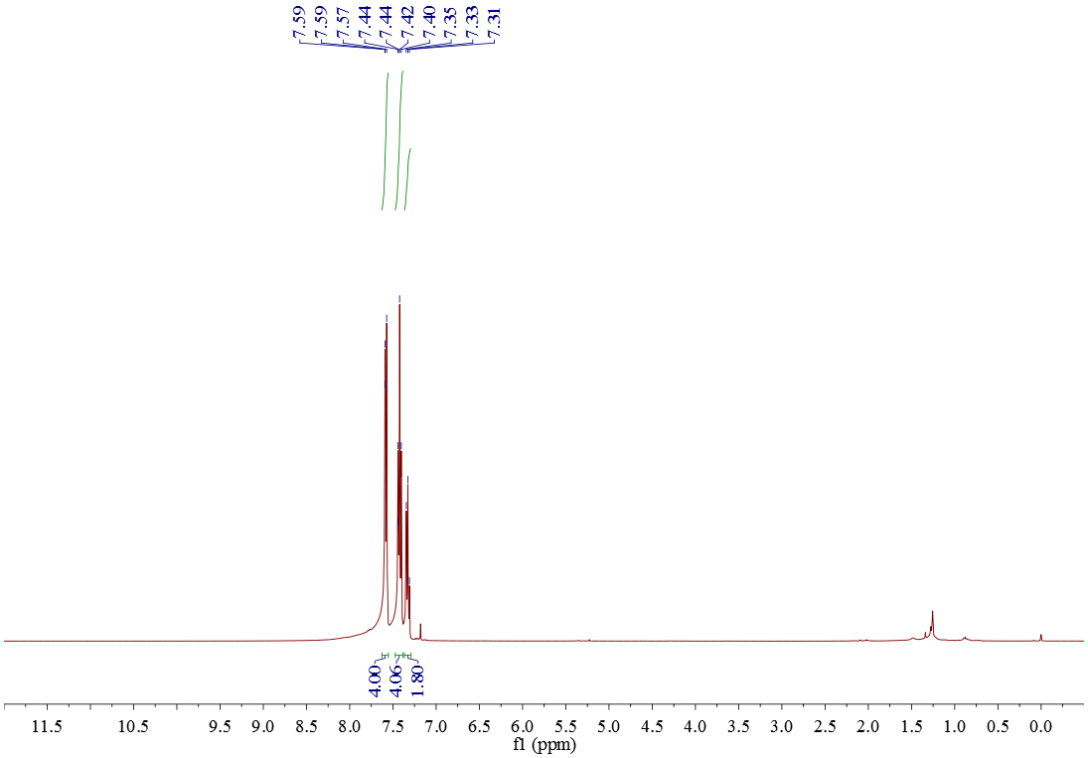
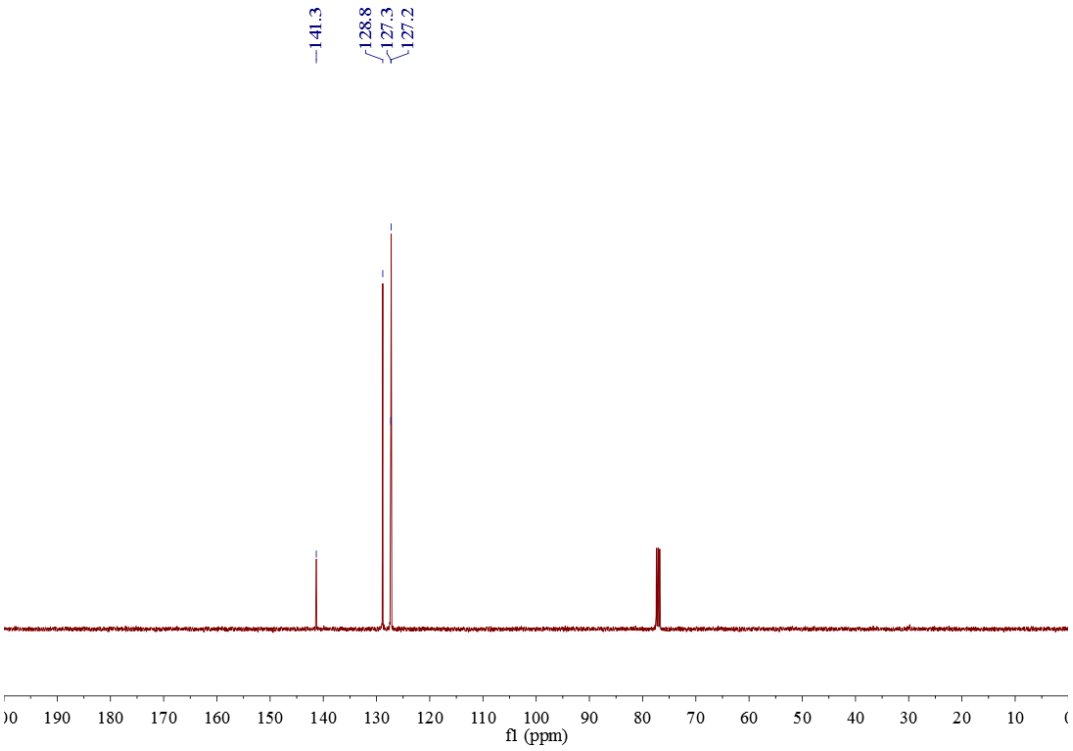
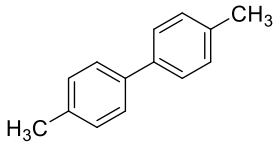
5. Spectroscopic Data for Products



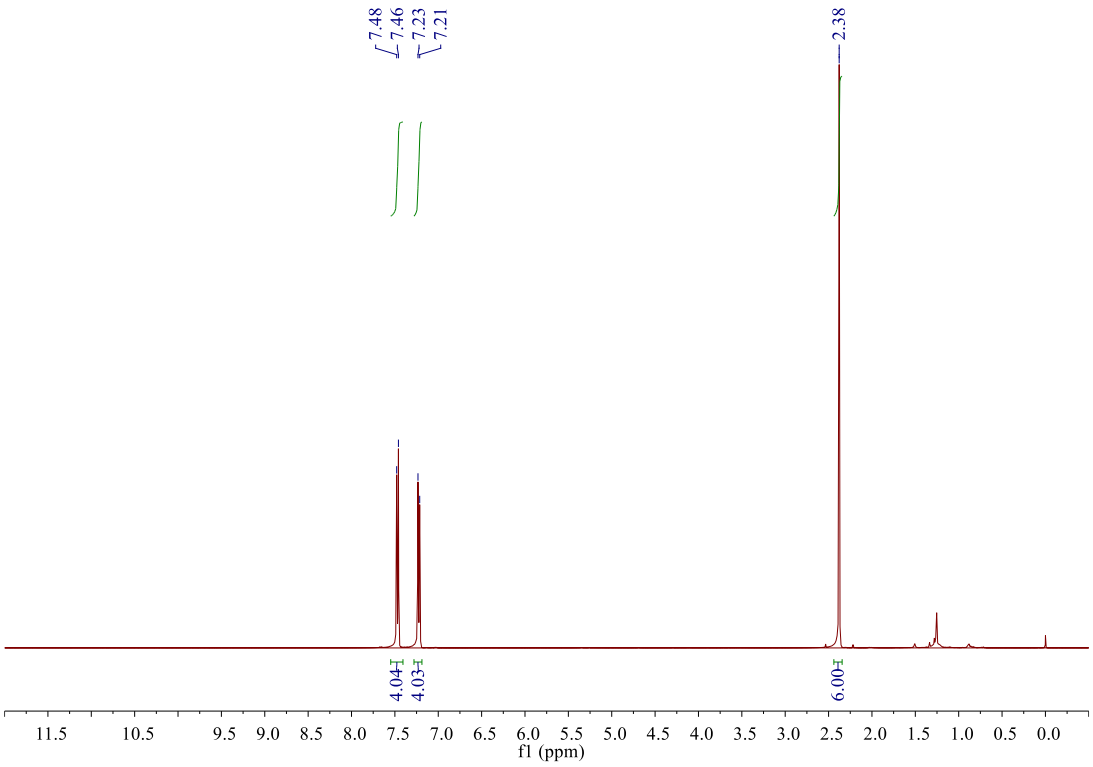
(2a)






CH3
H3C

(2b)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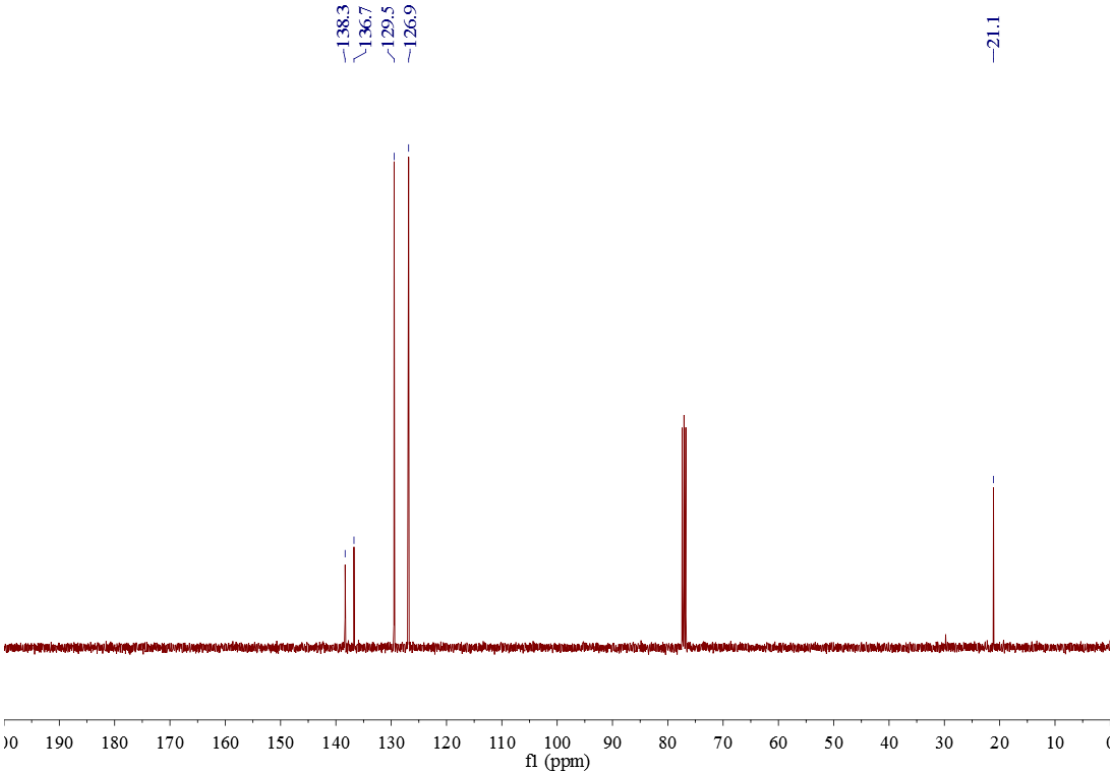
7.46
7.23
7.21
2.38
4.04
4.03
6.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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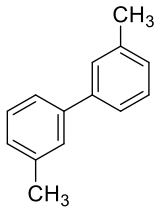
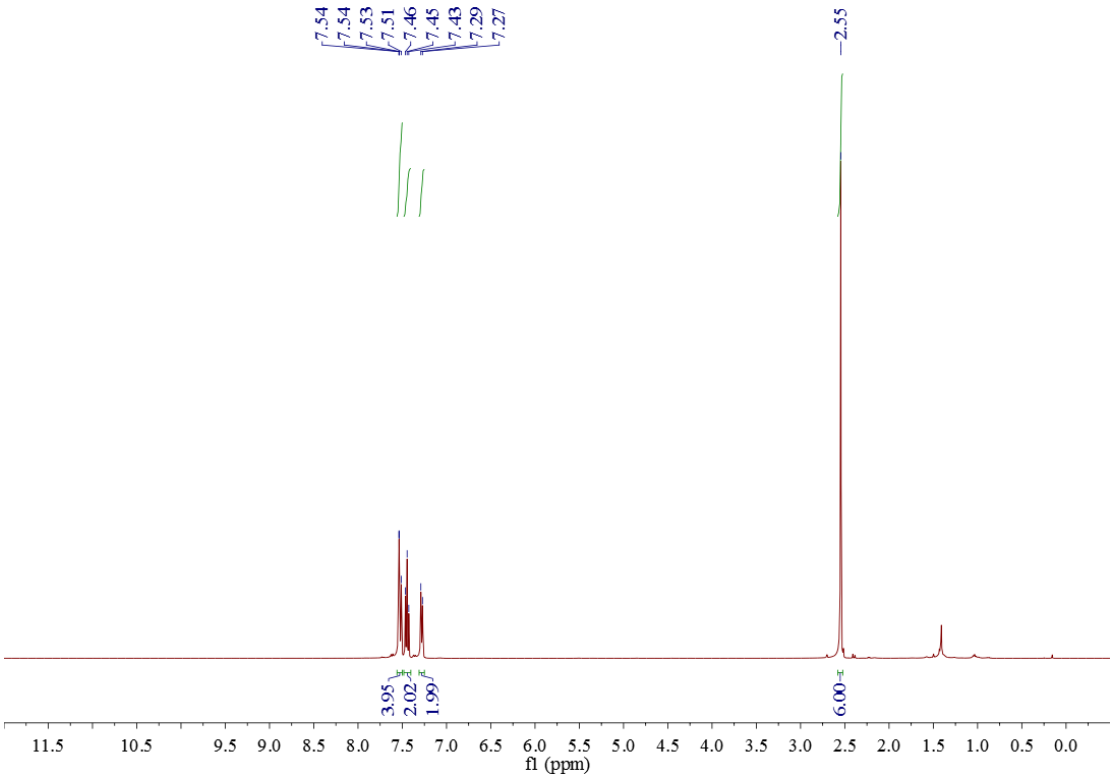
136.7
129.5
126.9
21.1
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


CH3
CH3

(2c)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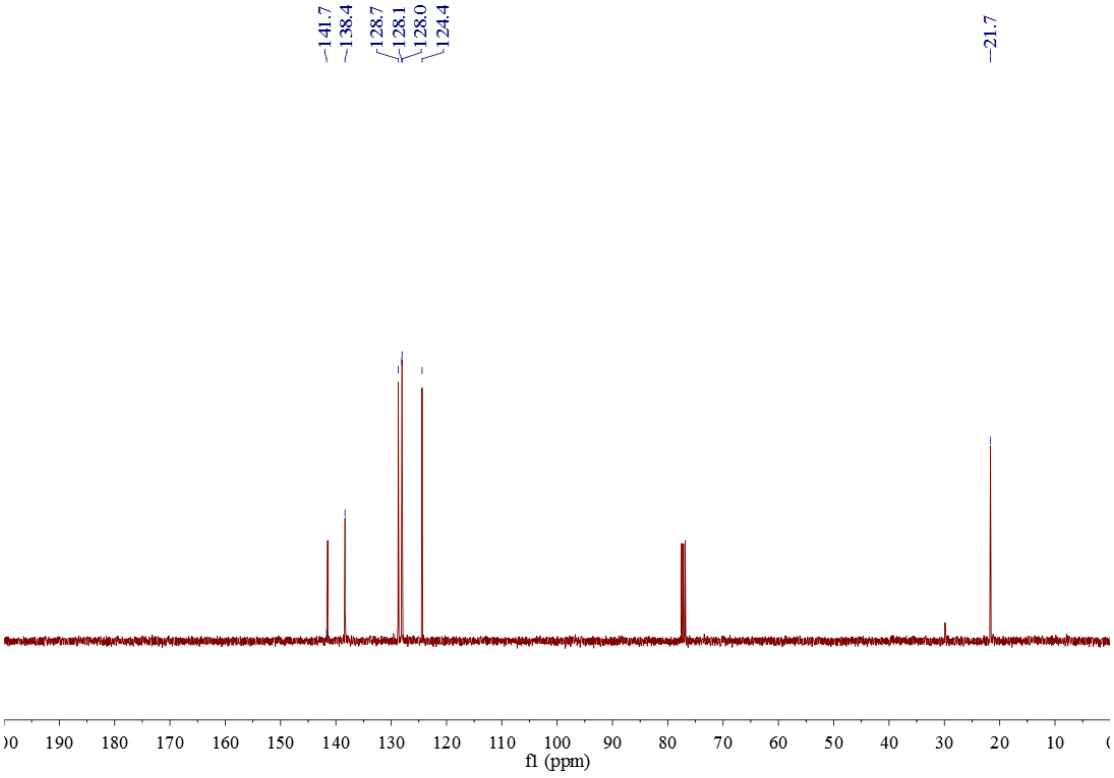
7.54
7.53
7.51
7.46
7.45
7.43
7.29
7.27
2.55
3.95
2.02
1.99
6.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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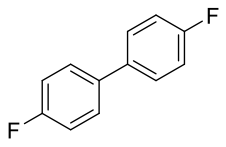
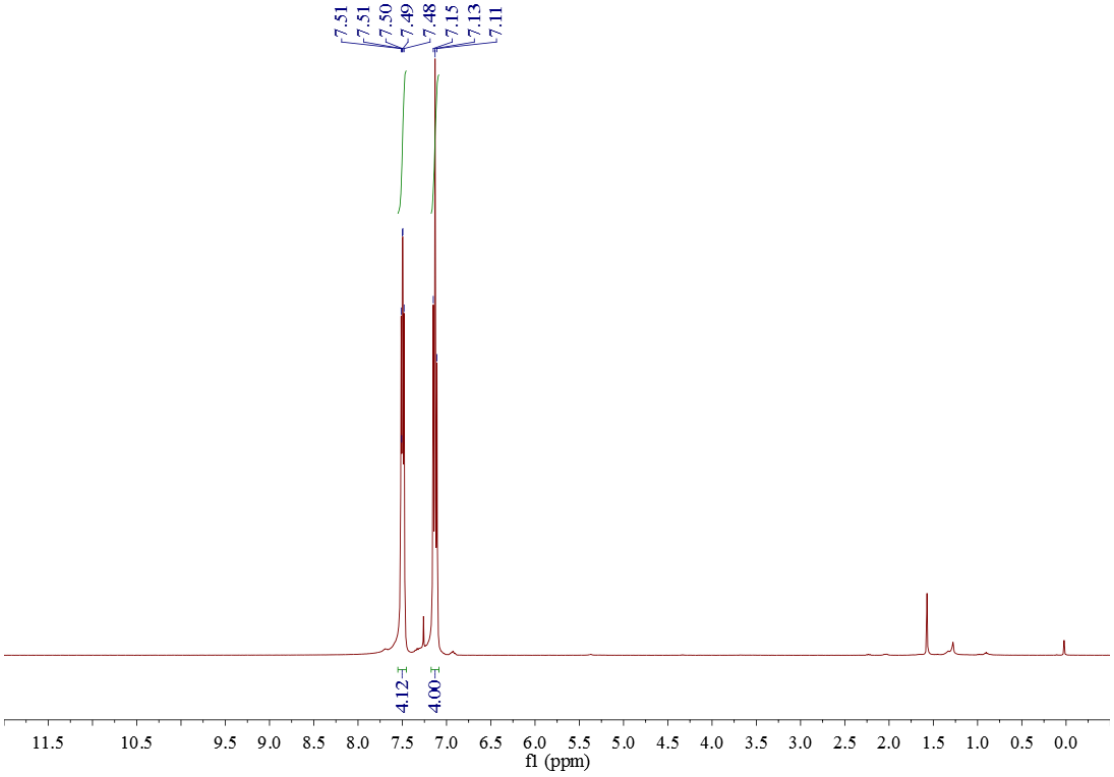
138.4
128.7
128.1
128.0
124.4
21.7
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


F
F

(2e)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7.51
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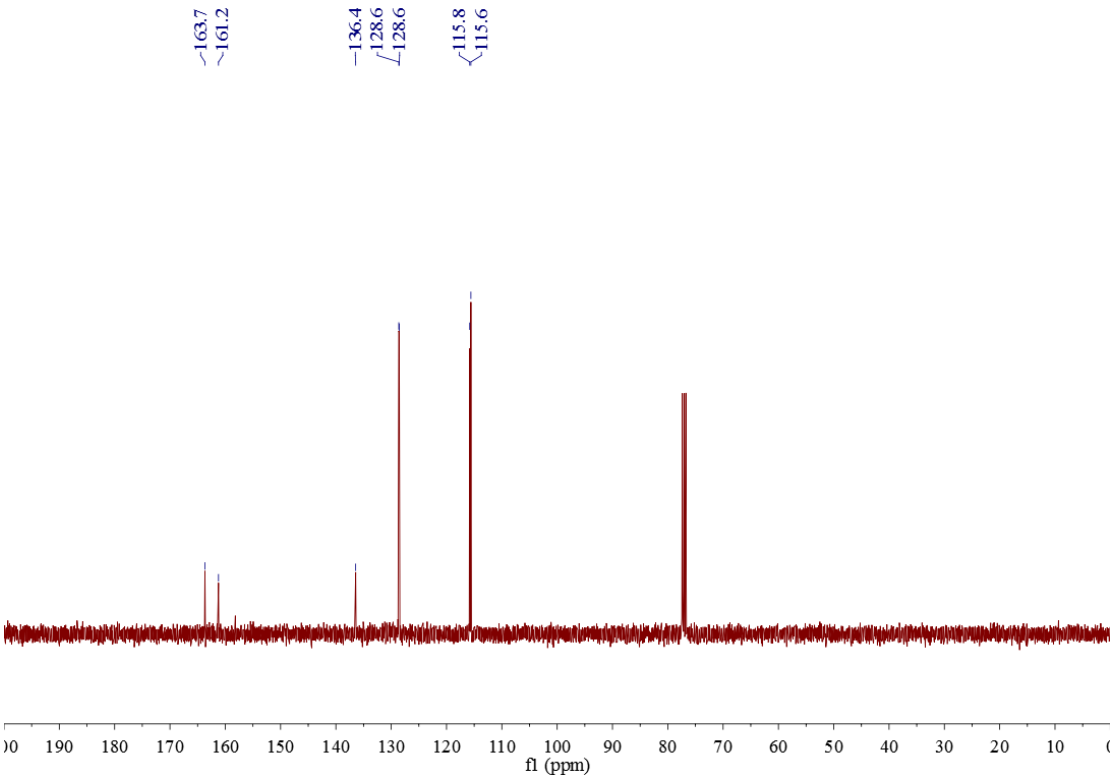
7.48
7.15
7.13
7.11
4.12
4.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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128.6
128.6
115.8
115.6
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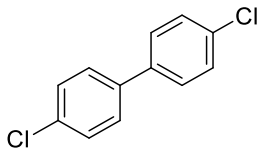
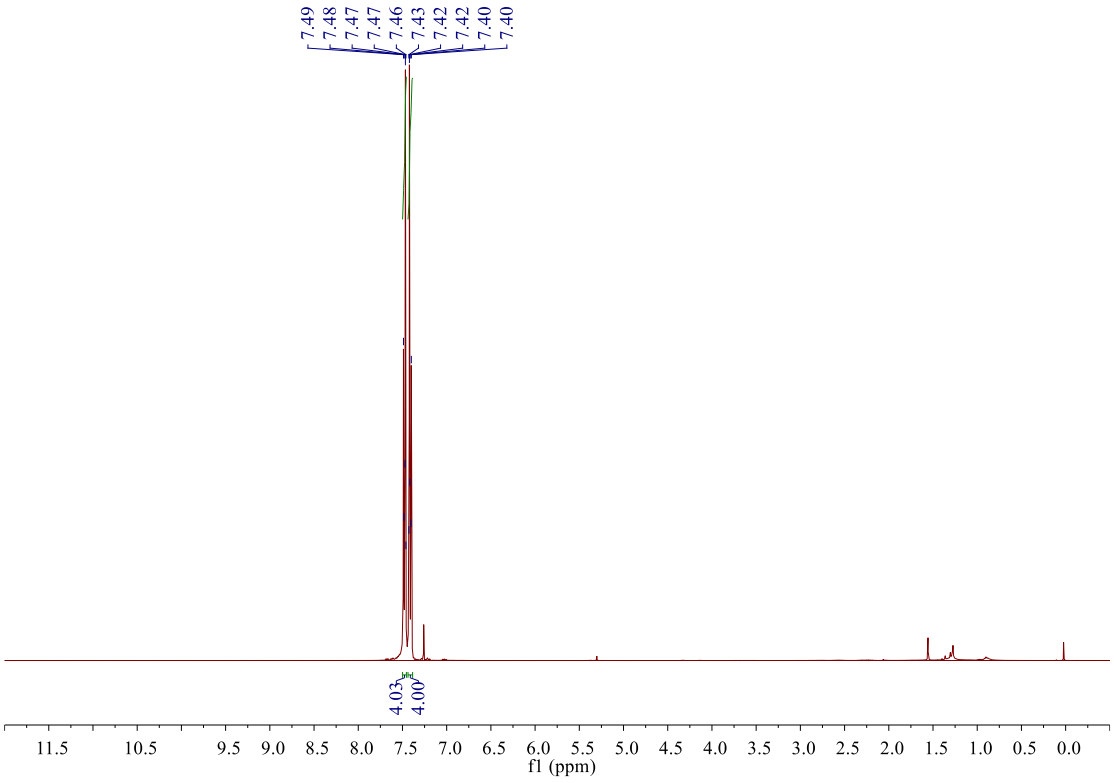
f1 (ppm)


Cl
Cl

(2f)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7.40
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4.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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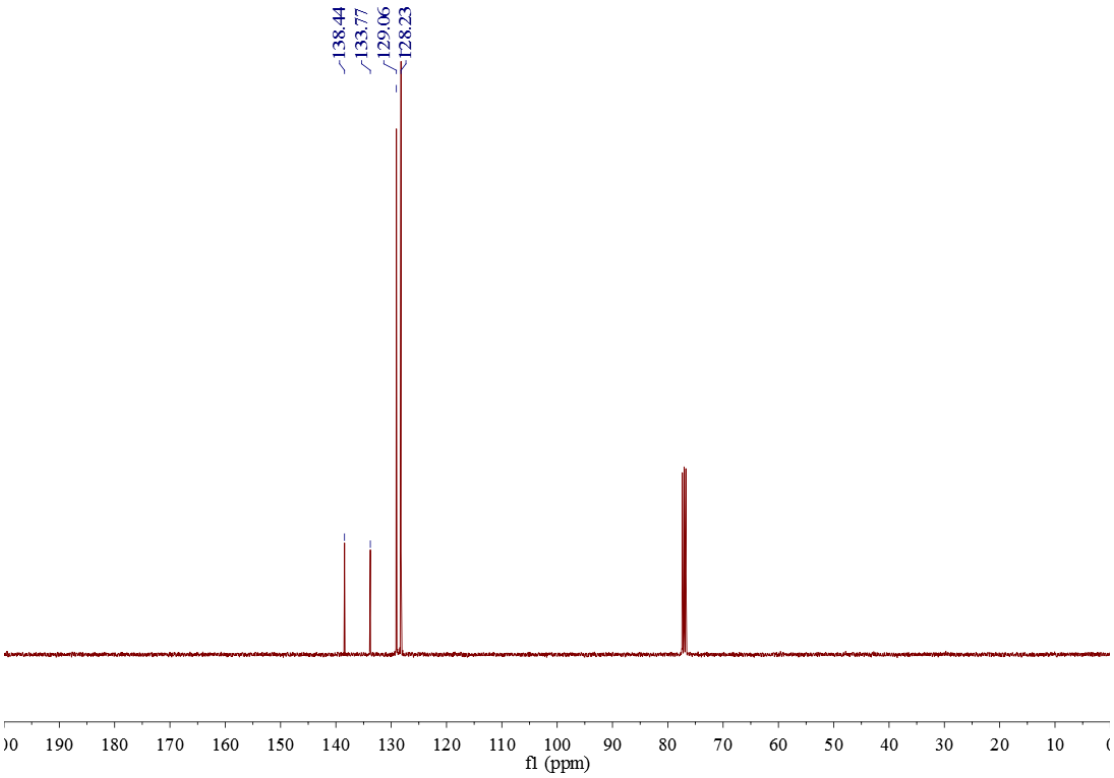
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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140
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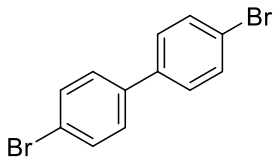
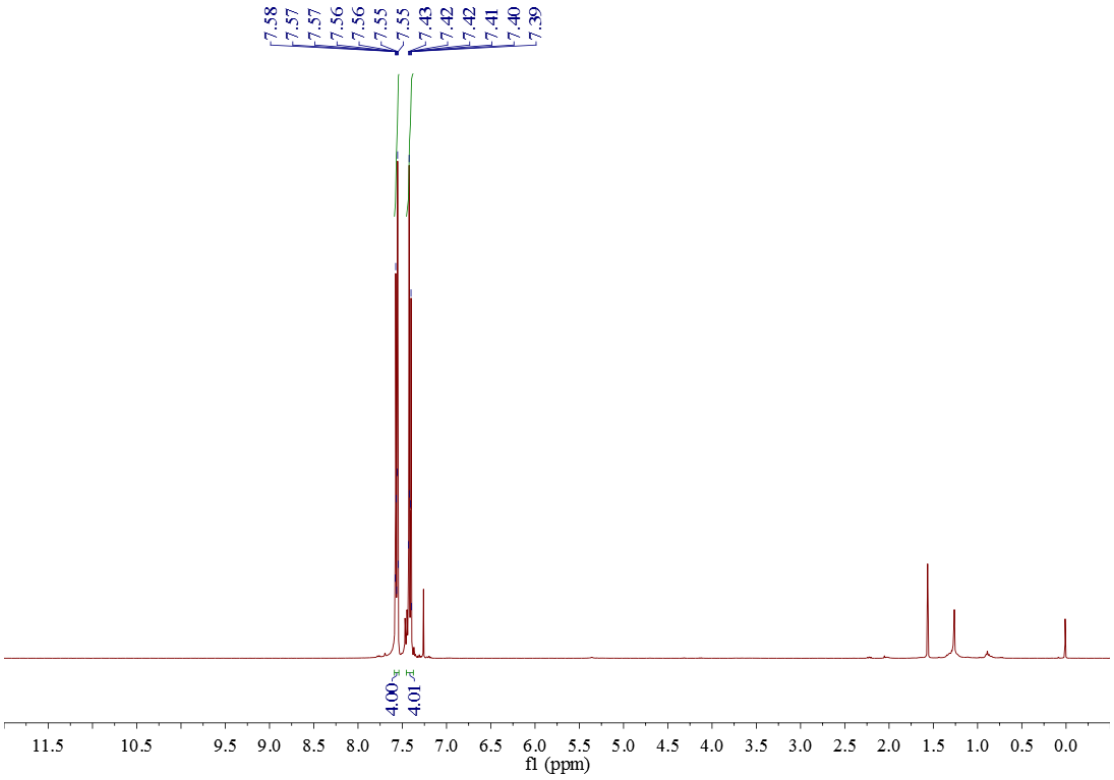
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


Br
Br

(2g)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7.41
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7.39
4.00
4.01
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
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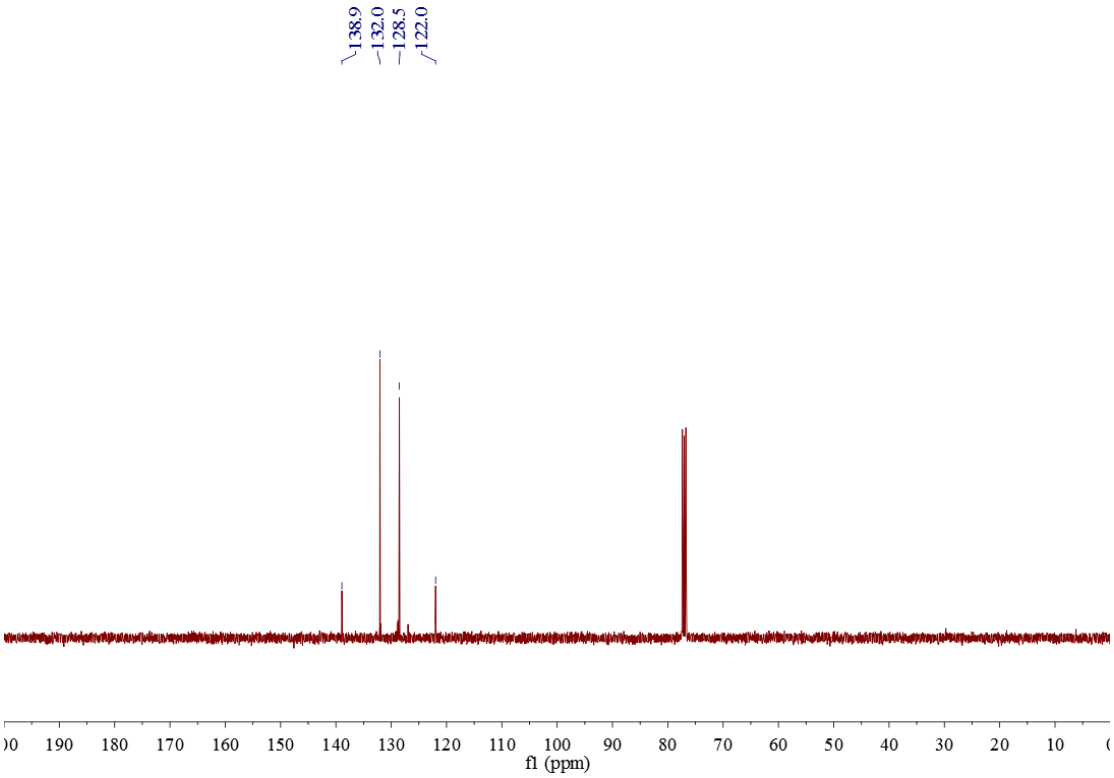
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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122.0
190
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170
160
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140
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80
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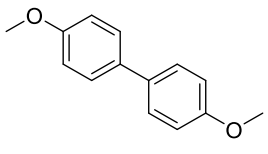
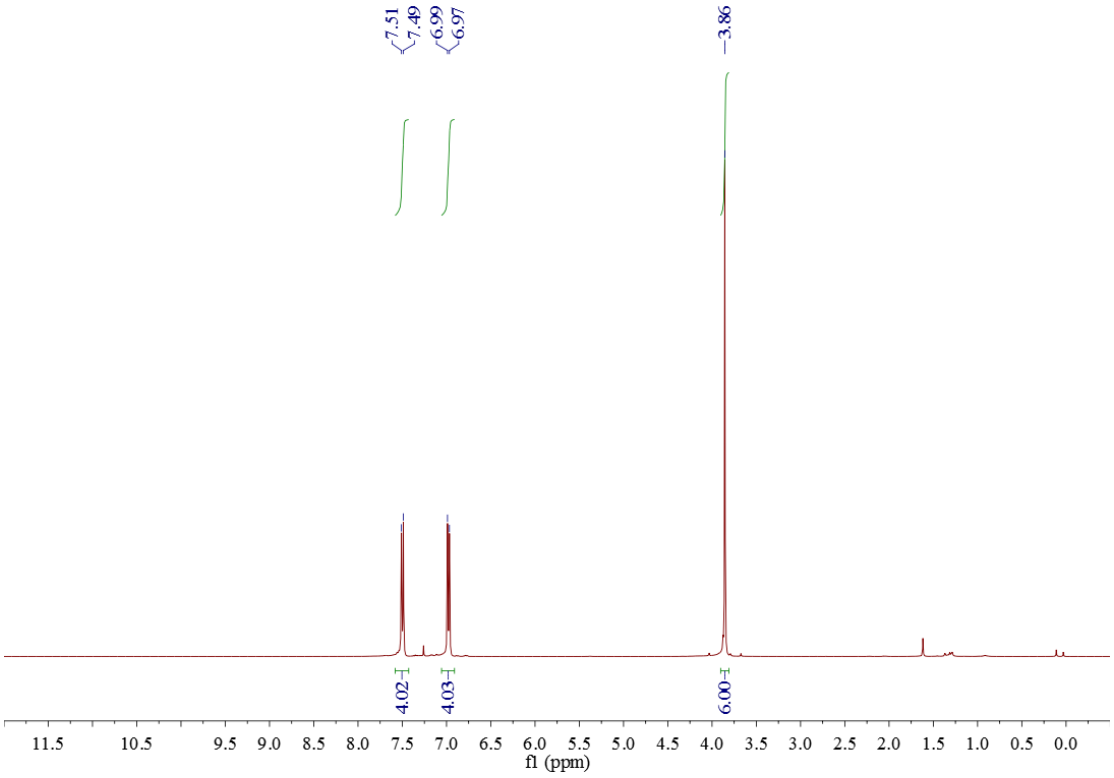
60
50
40
30
20
10
f1 (ppm)


O
O

(2h)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6.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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3.5
3.0
2.5
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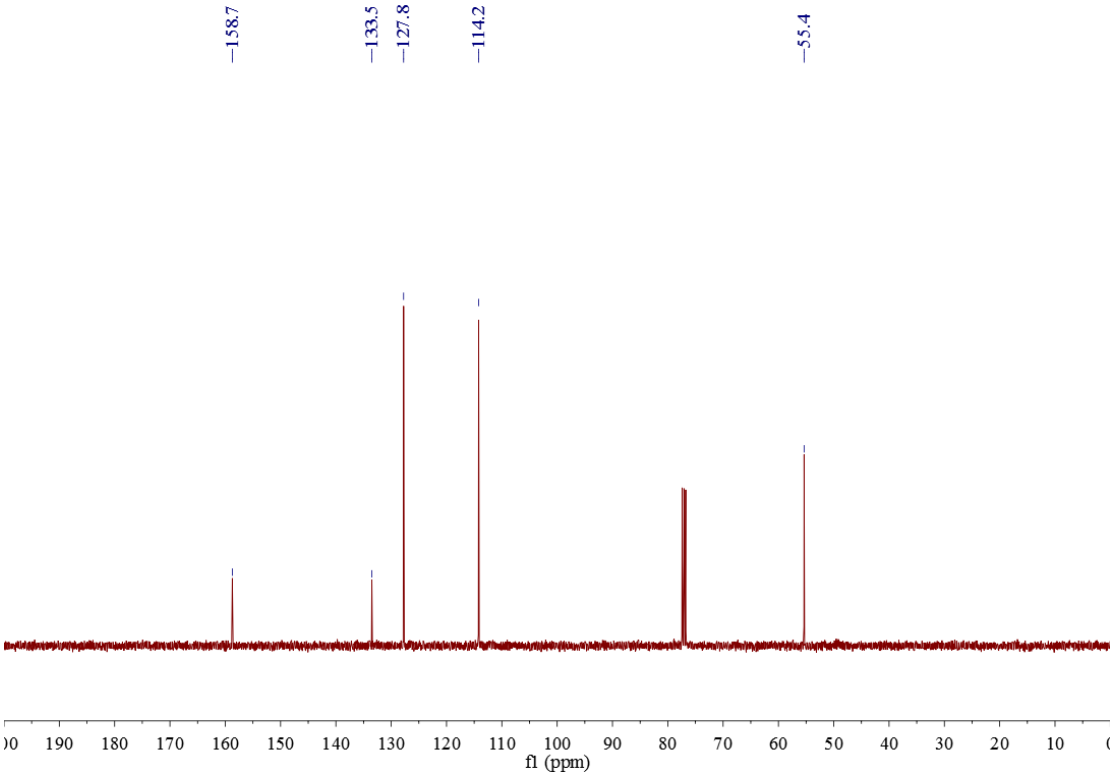
1.5
1.0
0.5
0.0
f1 (ppm)


158.7
133.5
127.8
114.2
55.4
190
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140
130
120
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100
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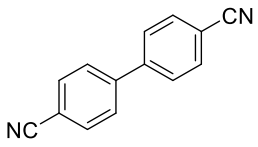
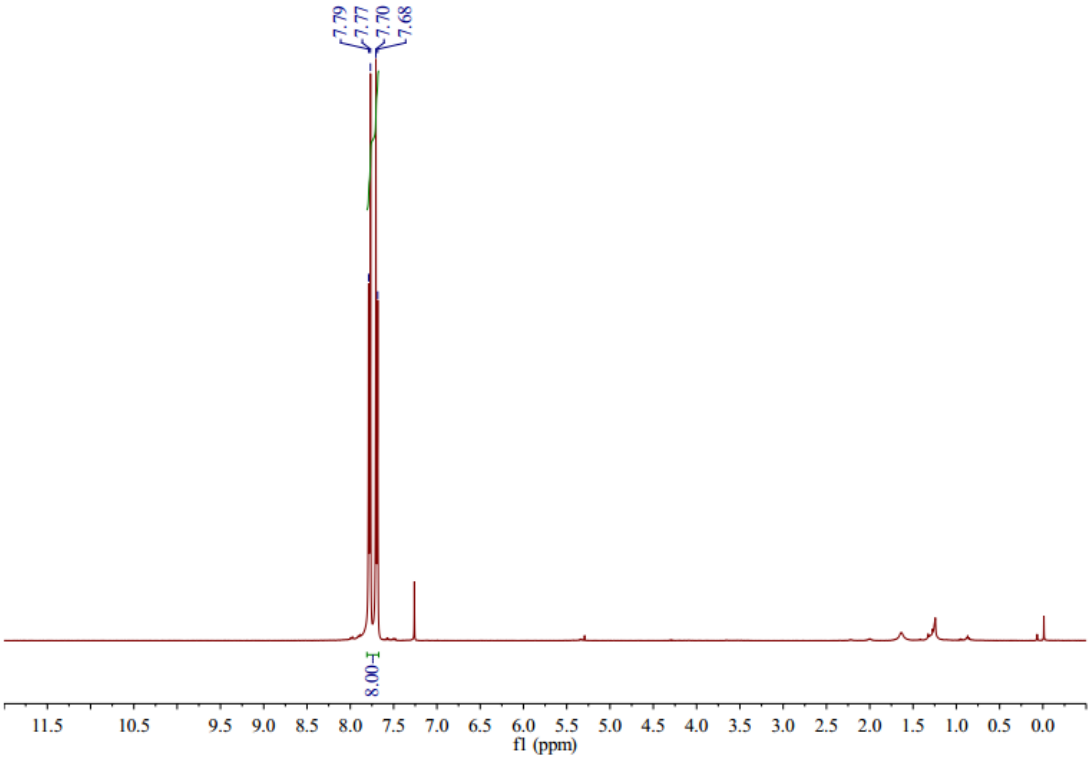
80
70
60
50
40
30
20
10
f1 (ppm)


CN
NC

(2i)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8.00
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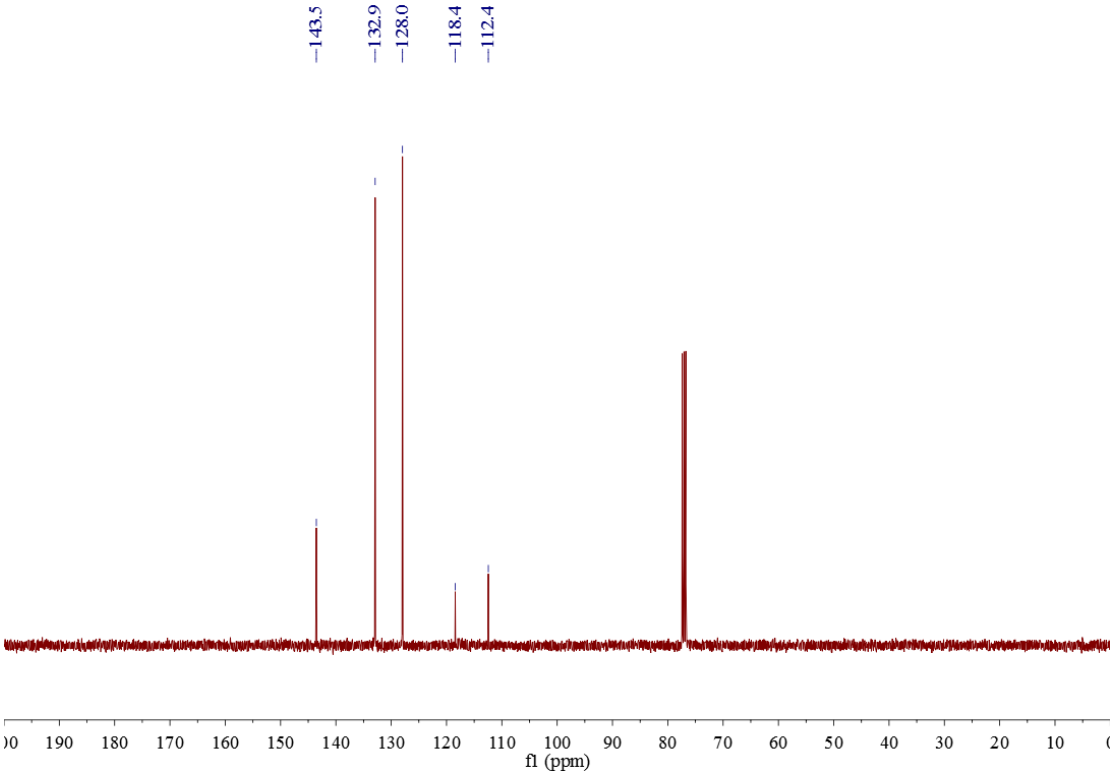
f1 (ppm)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128.0
118.4
112.4
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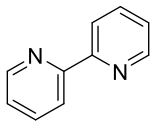
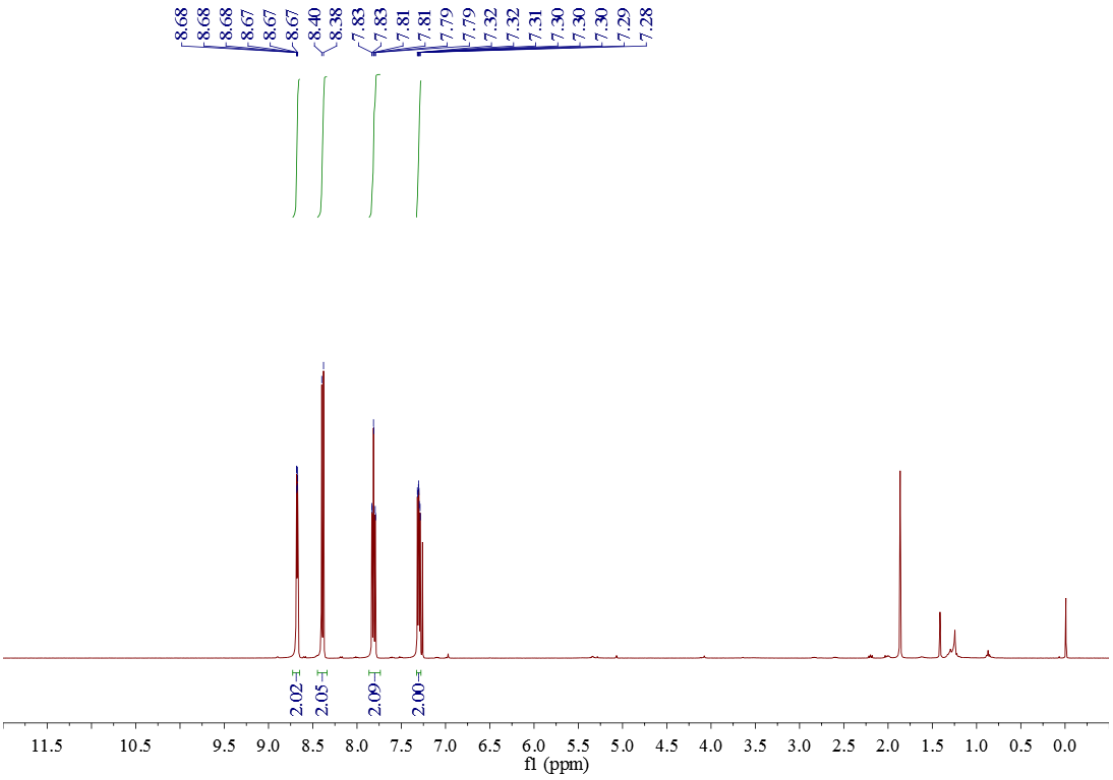
f1 (ppm)



(2j)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8.68
8.68
8.67
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8.38
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7.83
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7.81
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7.79
7.32
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7.31
7.30
7.30
7.30
7.29
7.28
2.02
2.05
2.09
2.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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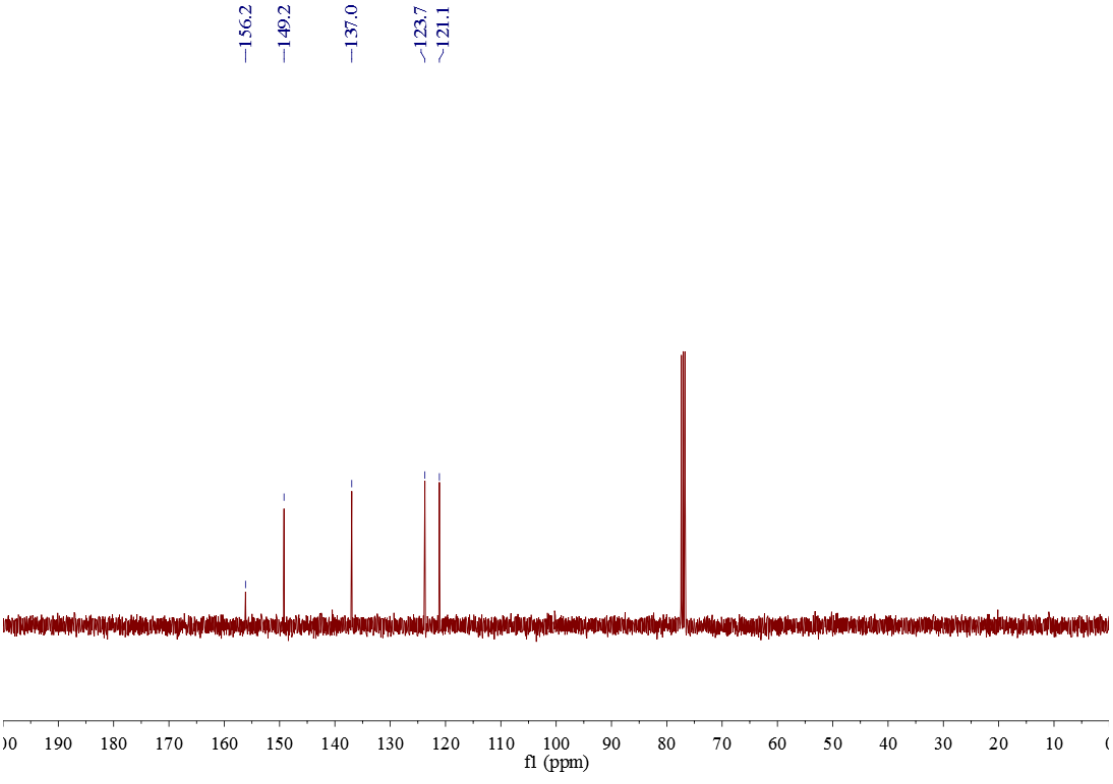
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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149.2
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123.7
121.1
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160
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100
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60
50
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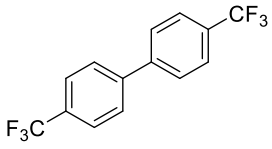
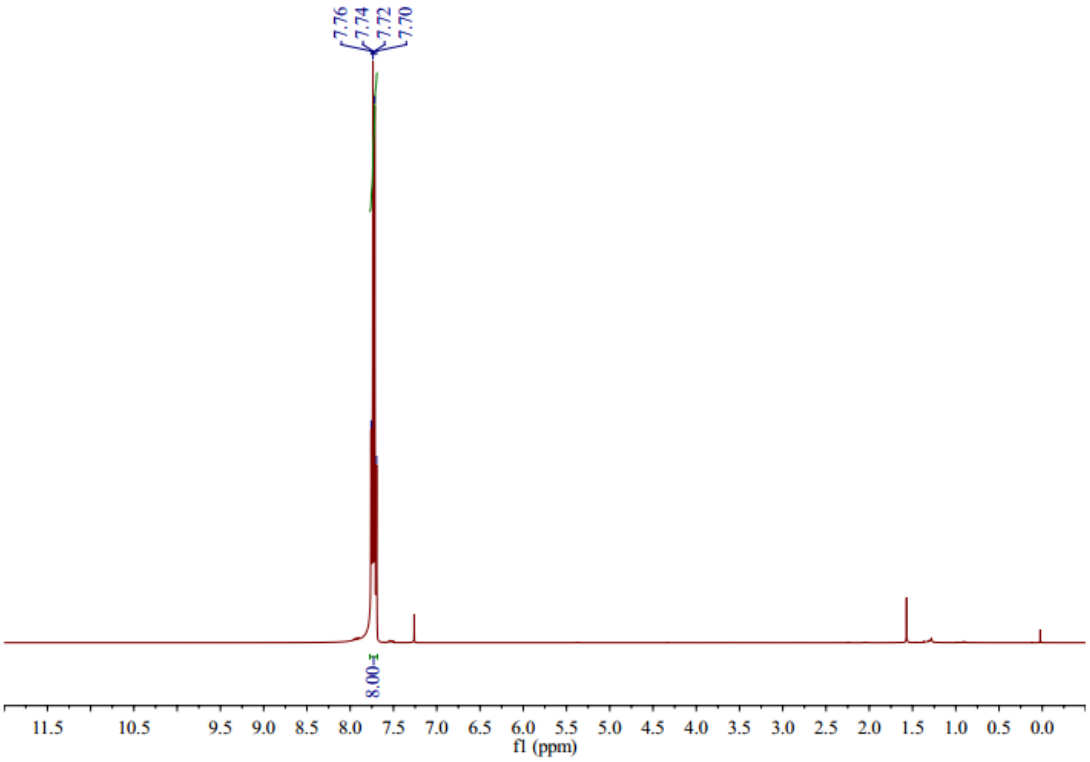
30
20
10
f1 (ppm)


CF3
F3C

(2k)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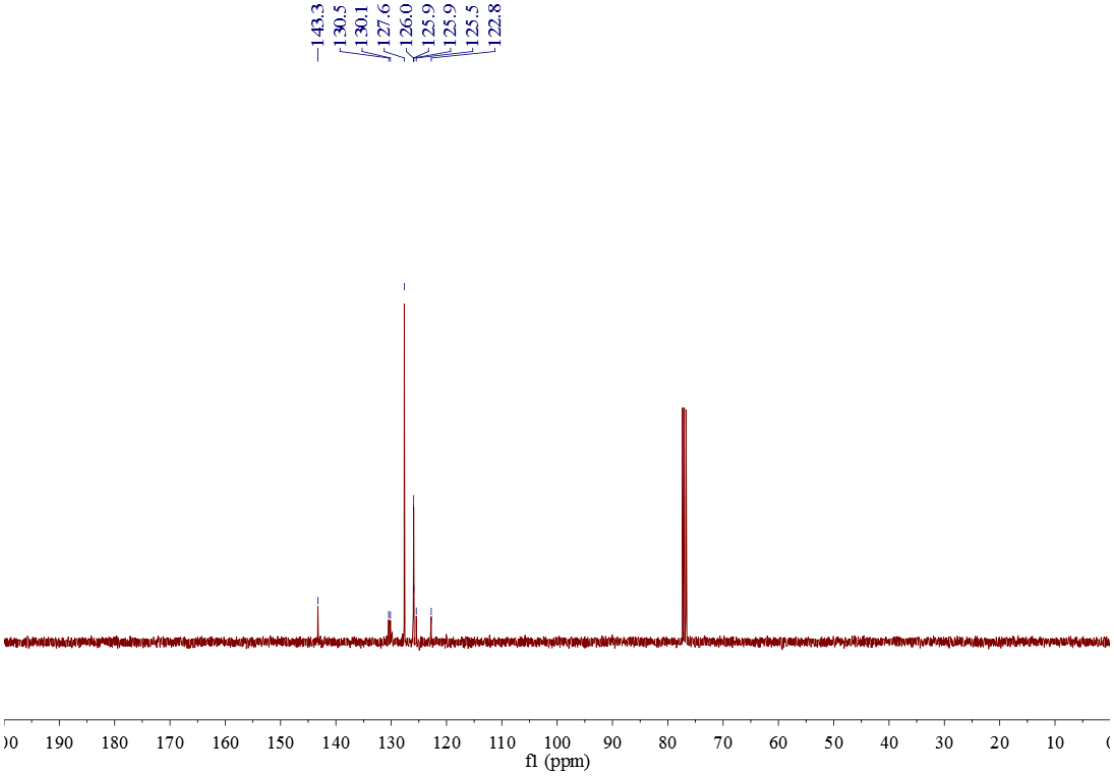
f1 (ppm)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125.9
125.5
122.8
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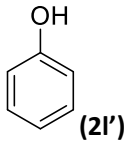
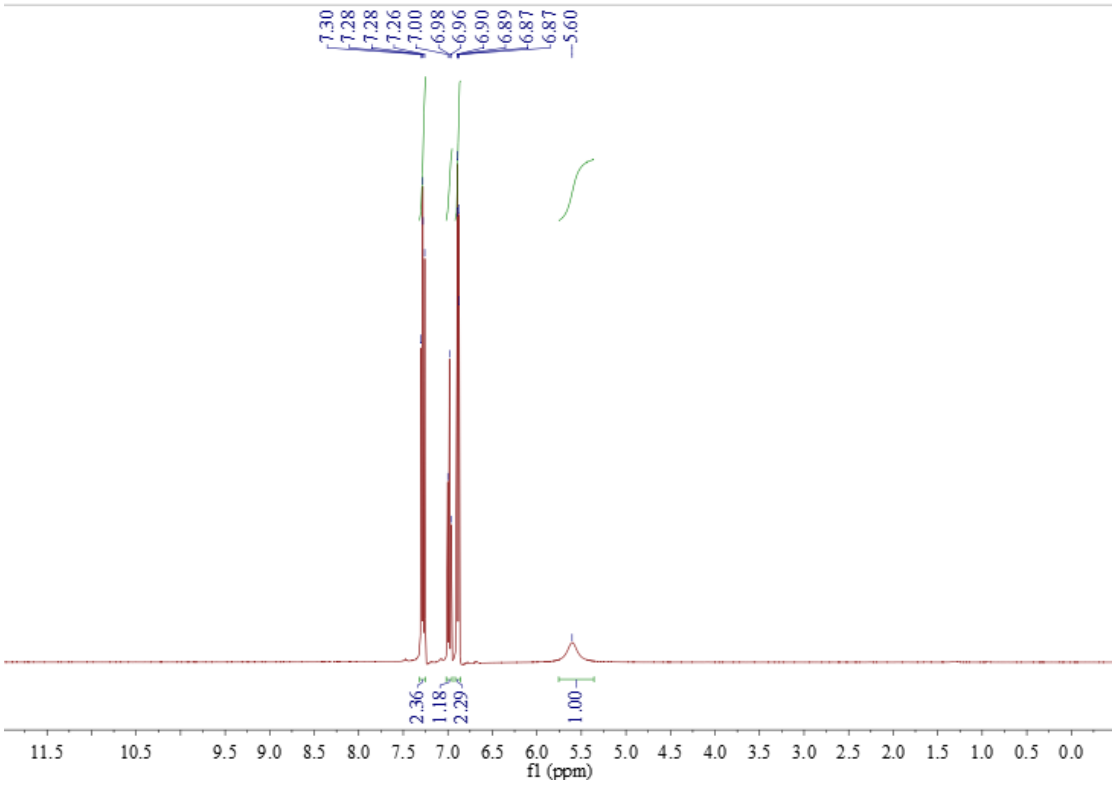
f1 (ppm)


OH

(2l')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6.87
6.87
5.60
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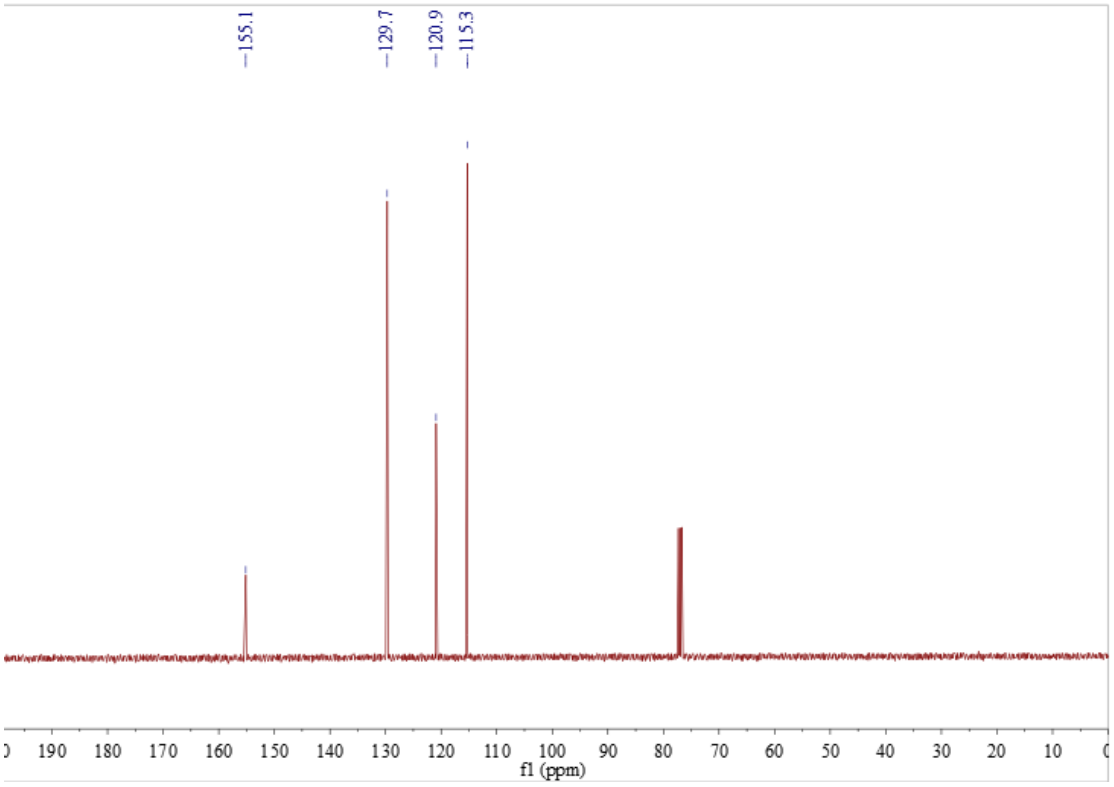
1.18
2.29
1.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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129.7
120.9
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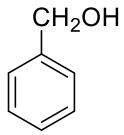
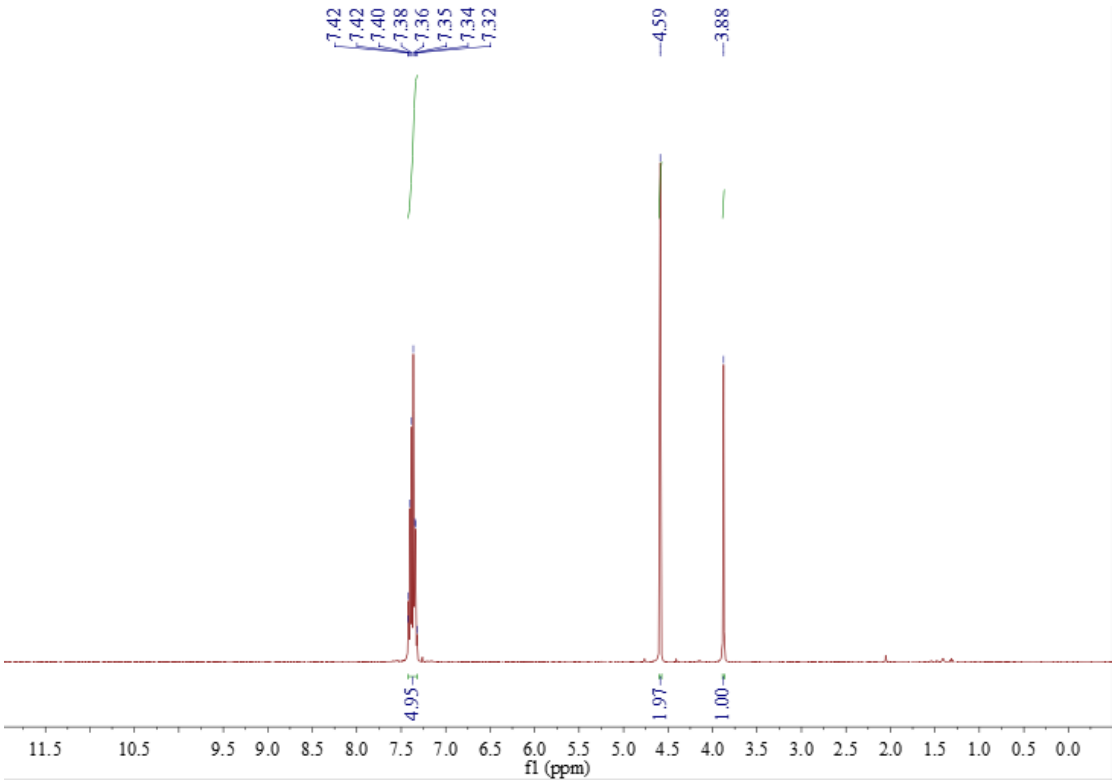
f1 (ppm)


CH2OH

(2m')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7.42
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7.35
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7.32
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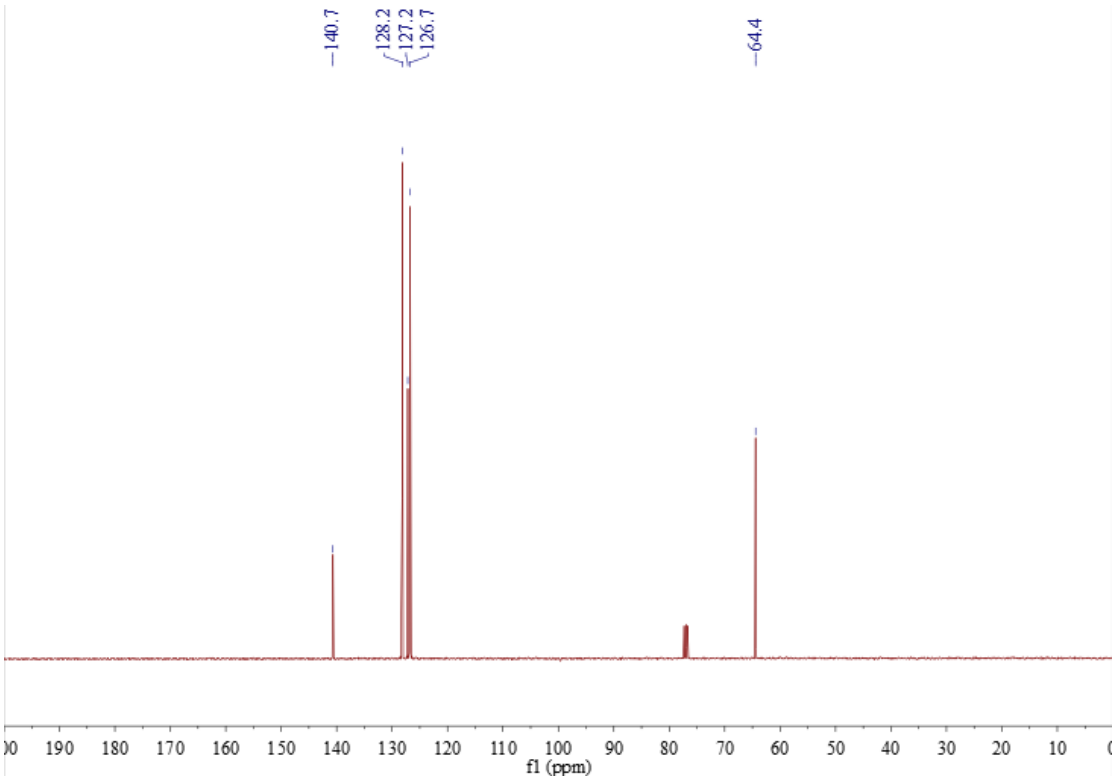
3.88
4.95
1.97
1.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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127.2
126.7
64.4
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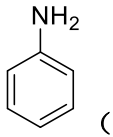
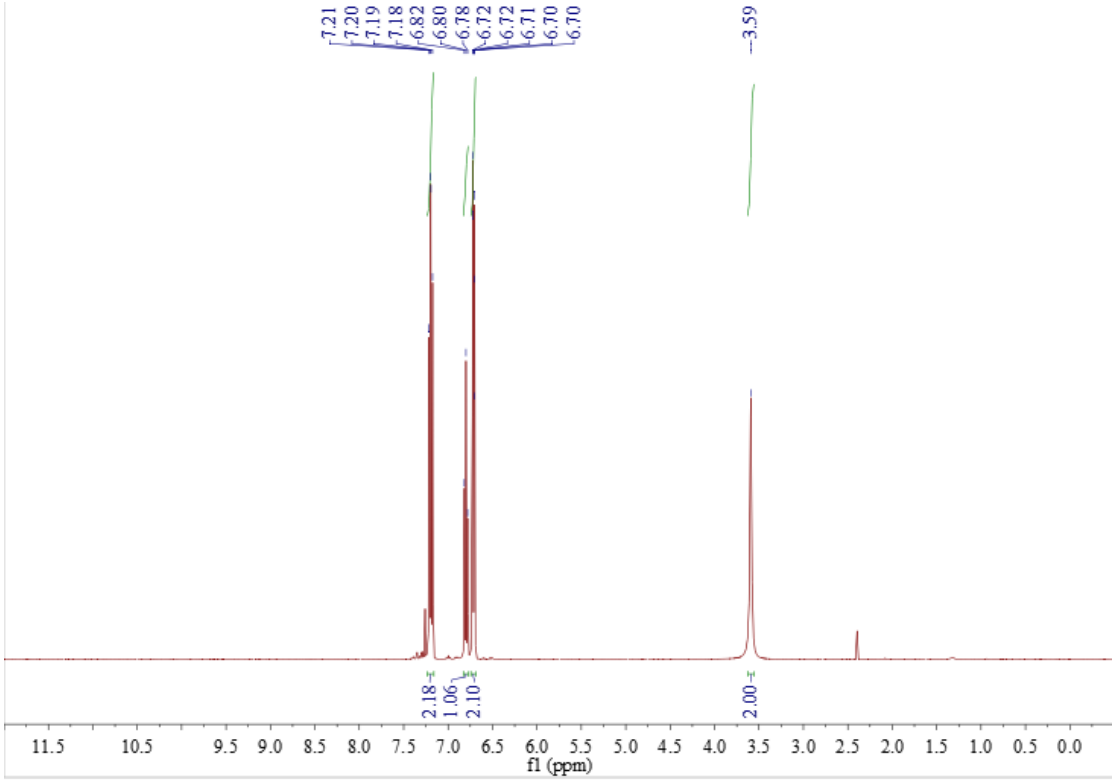
f1 (ppm)


NH2

（2n’）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7.20
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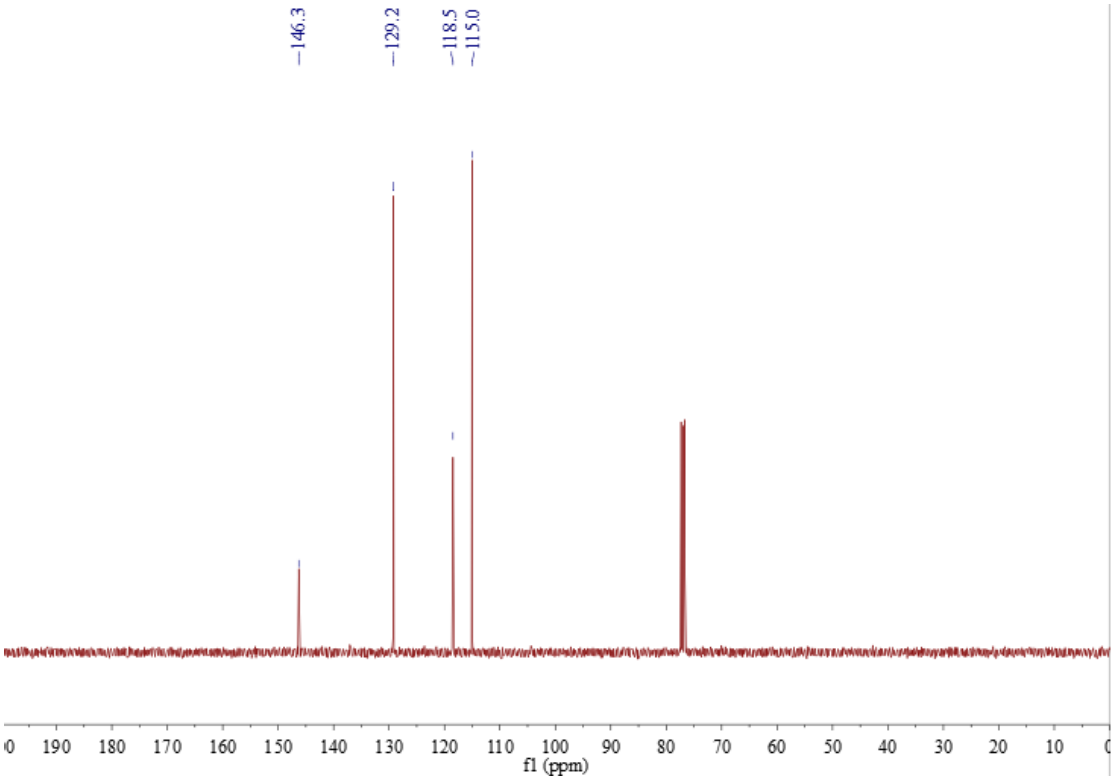
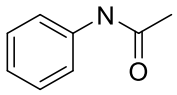
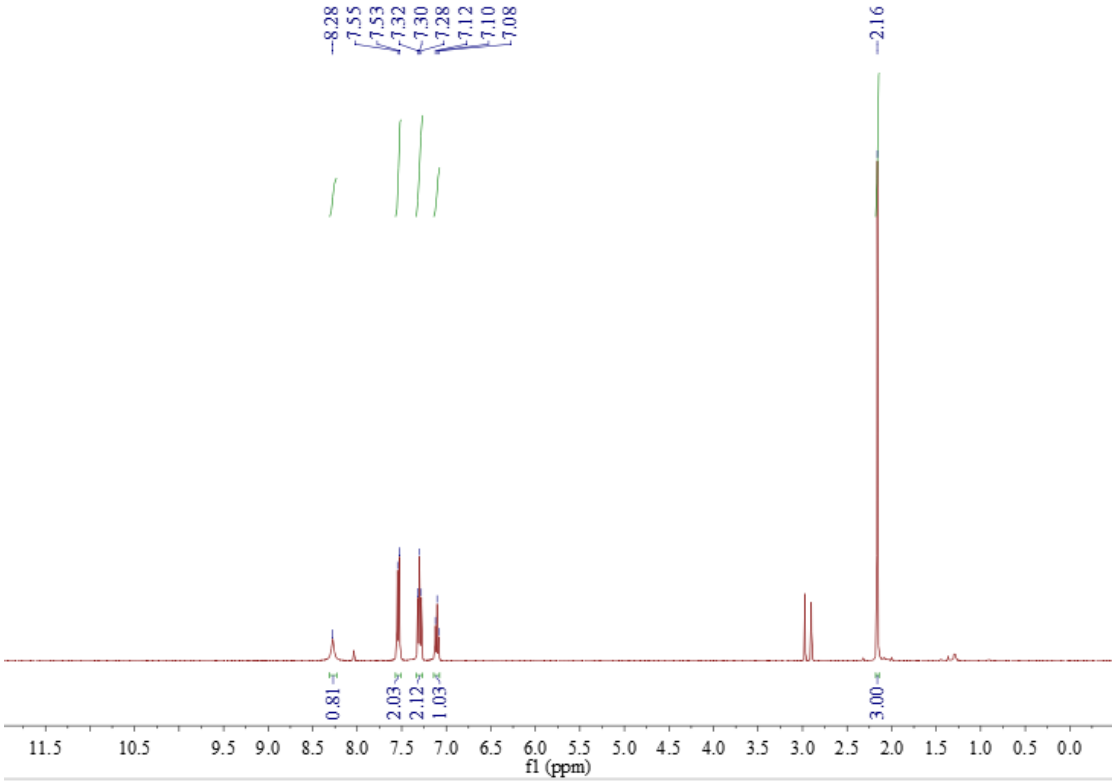
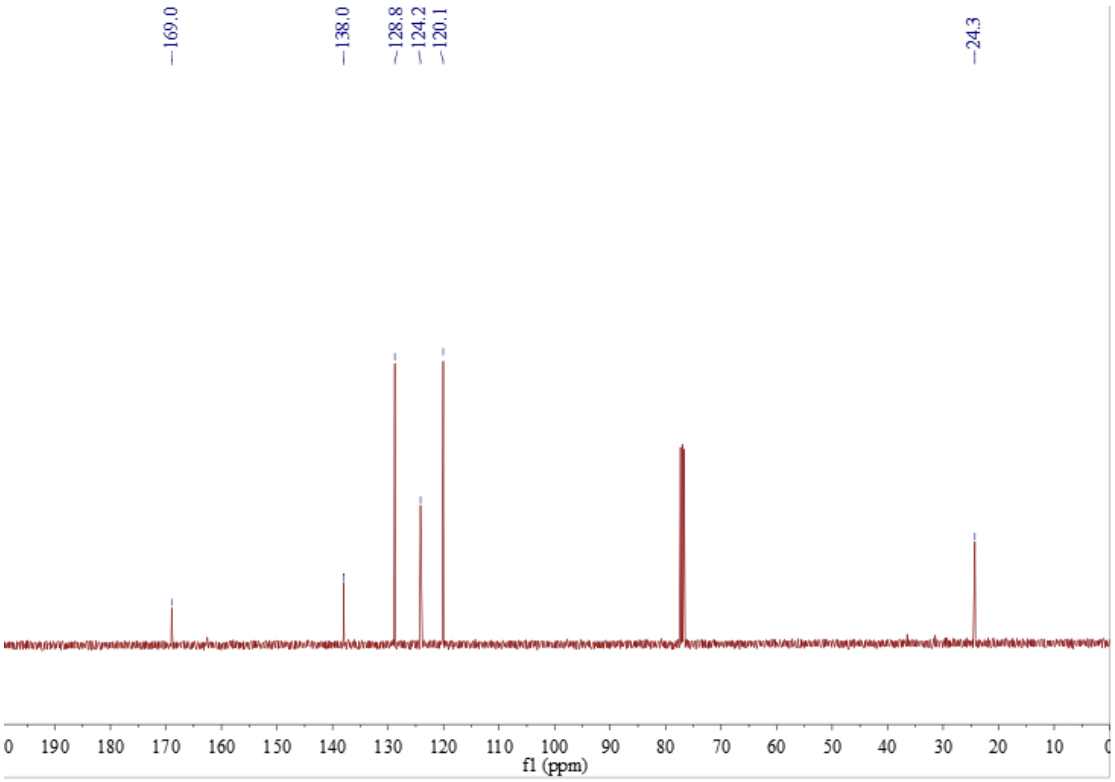
6.80
6.78
6.72
6.72
6.71
6.70
6.70
3.59
2.18
1.06
2.10
2.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

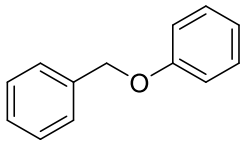

146.3
129.2
118.5
115.0
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



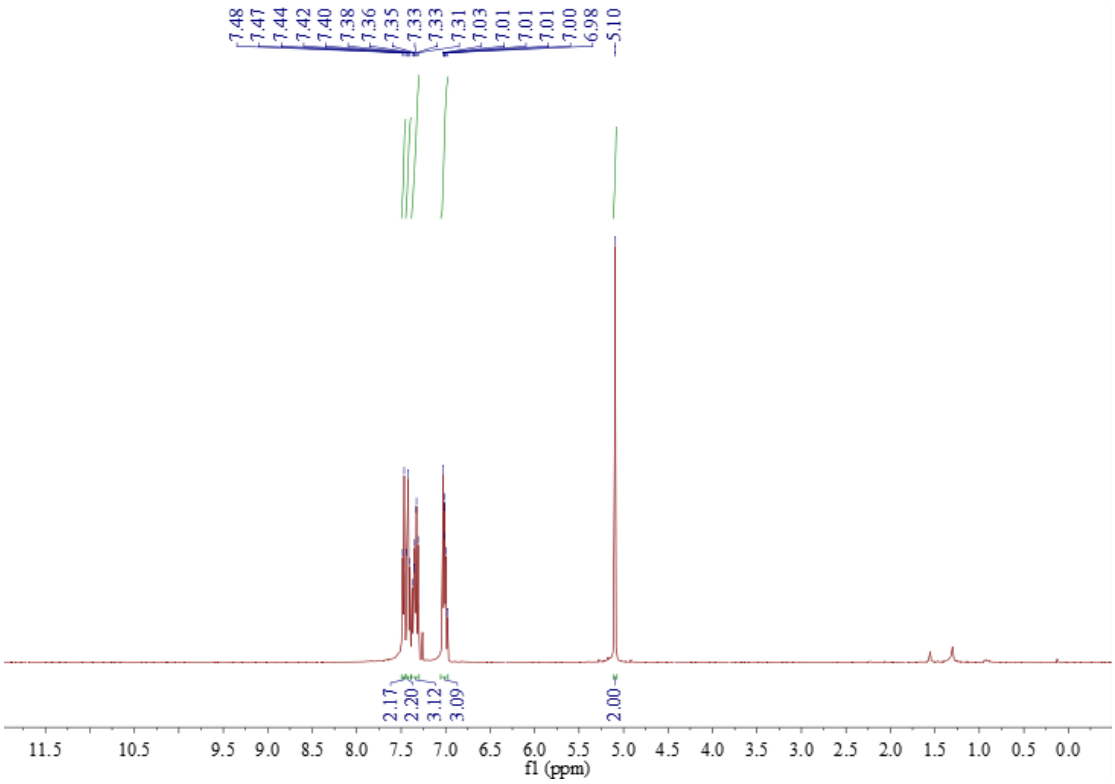
(2o')

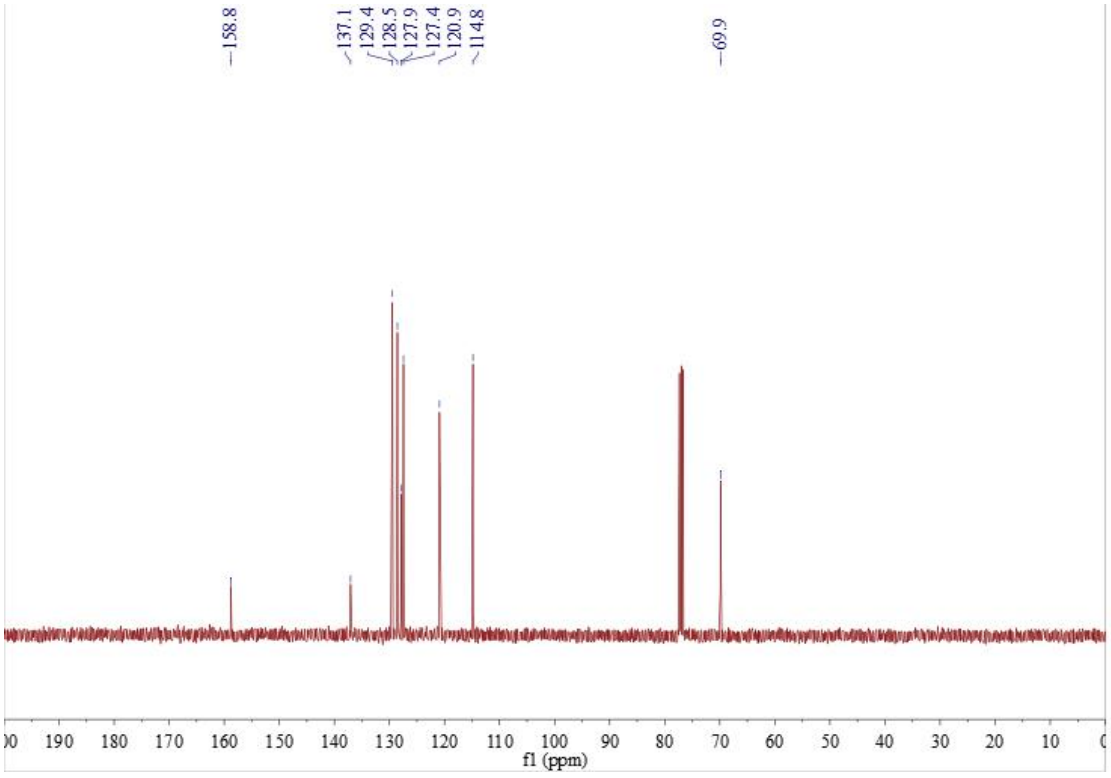

8.28
7.55
7.53
7.32
7.30
7.28
7.12
7.10
7.08
2.16
0.81
2.03
2.12
1.03
3.00
f1 (ppm)

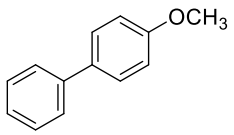

169.0
138.0
128.8
124.2
120.1
24.3
f1 (ppm)



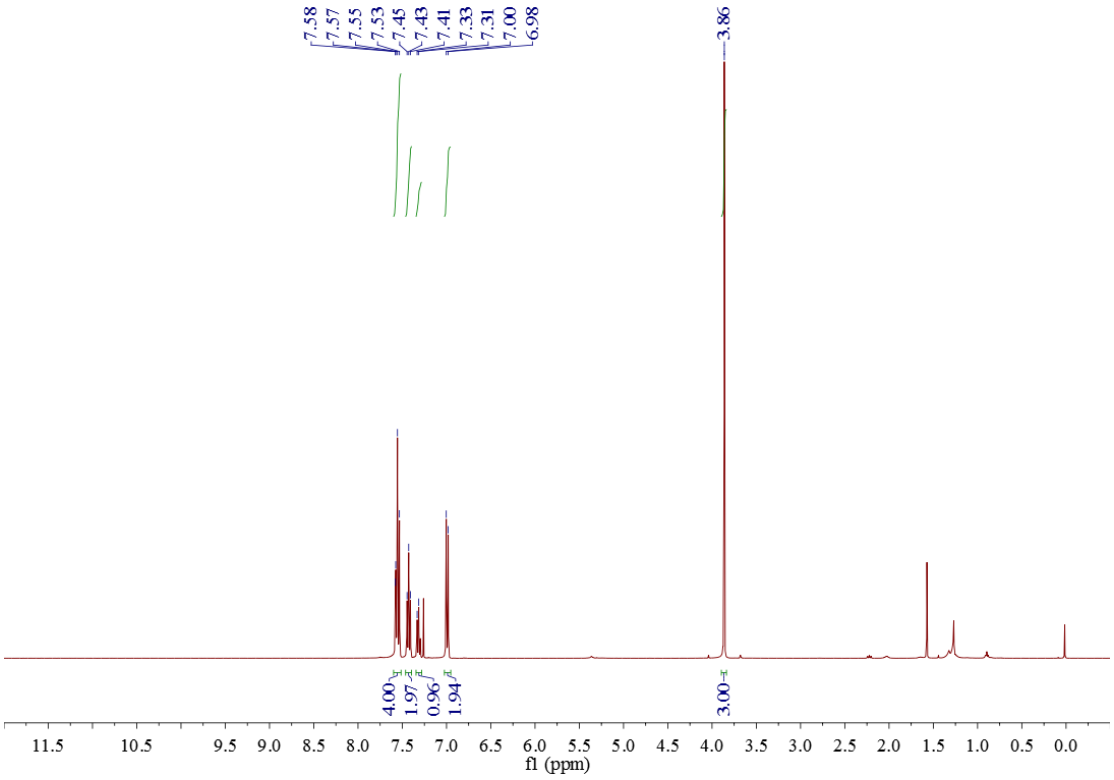
(2p')

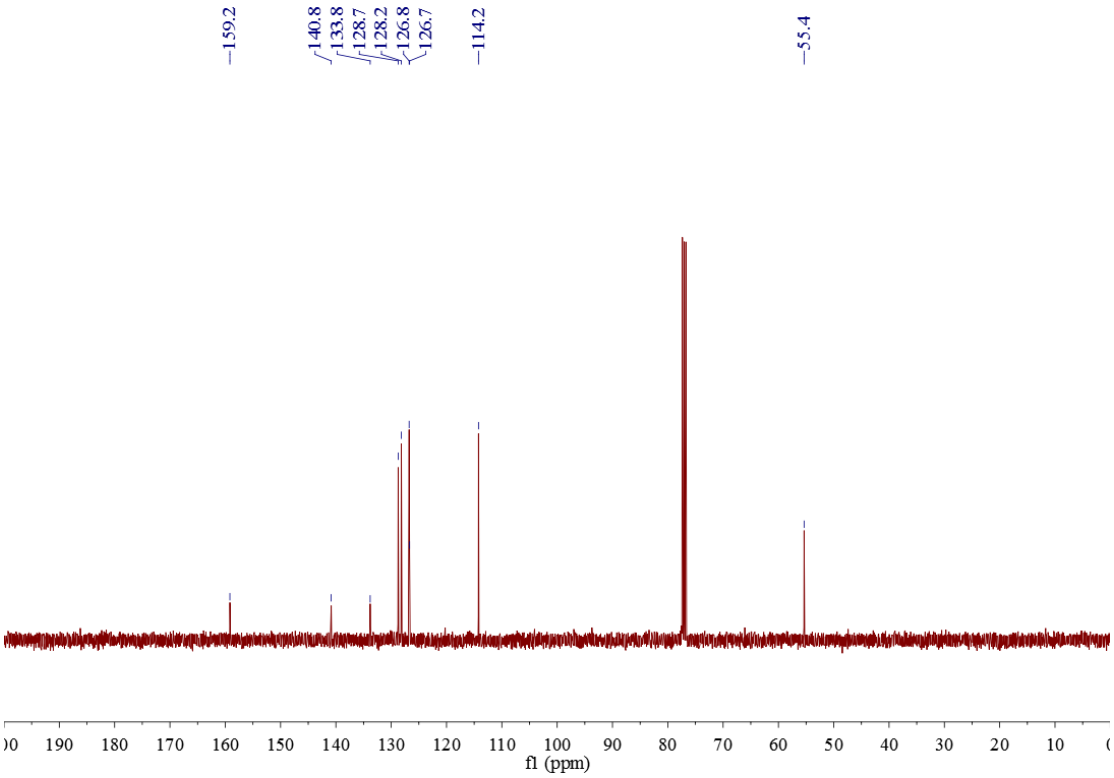

7.48
7.47
7.44
7.42
7.40
7.38
7.36
7.35
7.33
7.33
7.31
7.03
7.01
7.01
7.01
7.00
6.98
5.10
2.17
2.20
3.12
3.09
2.00
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

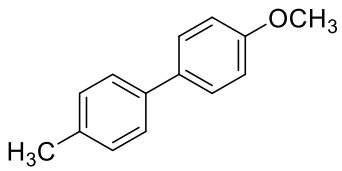

158.8
137.1
129.4
128.5
127.9
127.4
120.9
114.8
69.9
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


OCH3

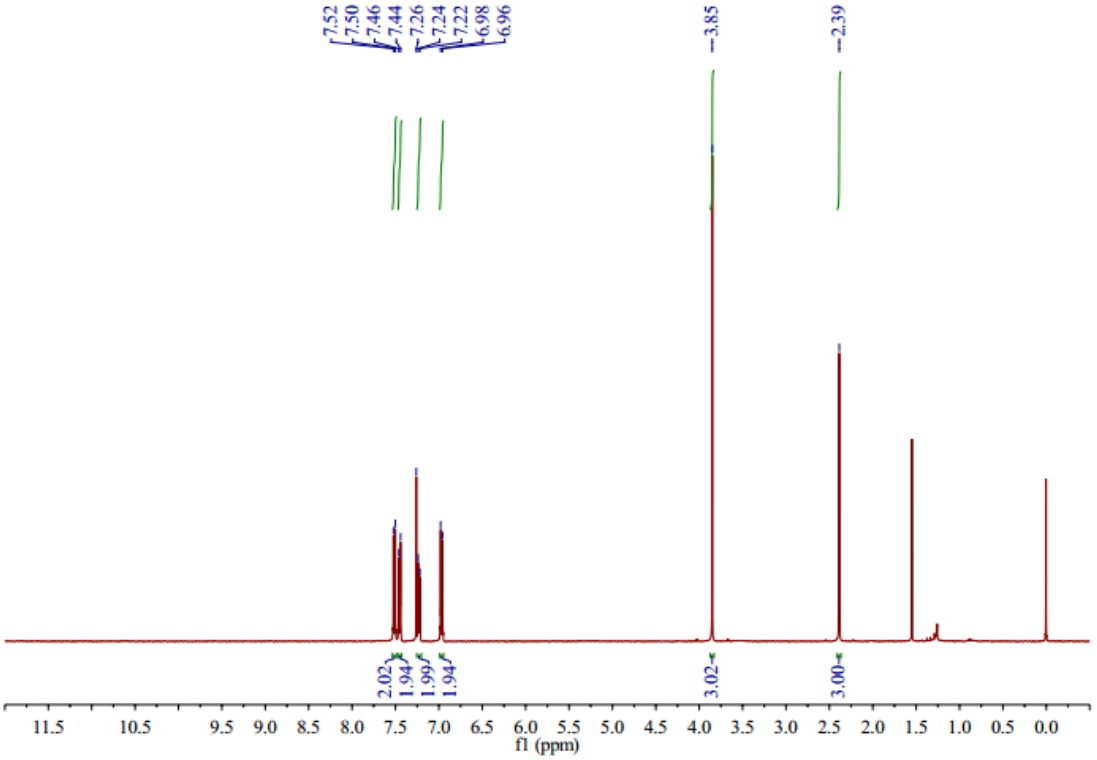
(4ah)

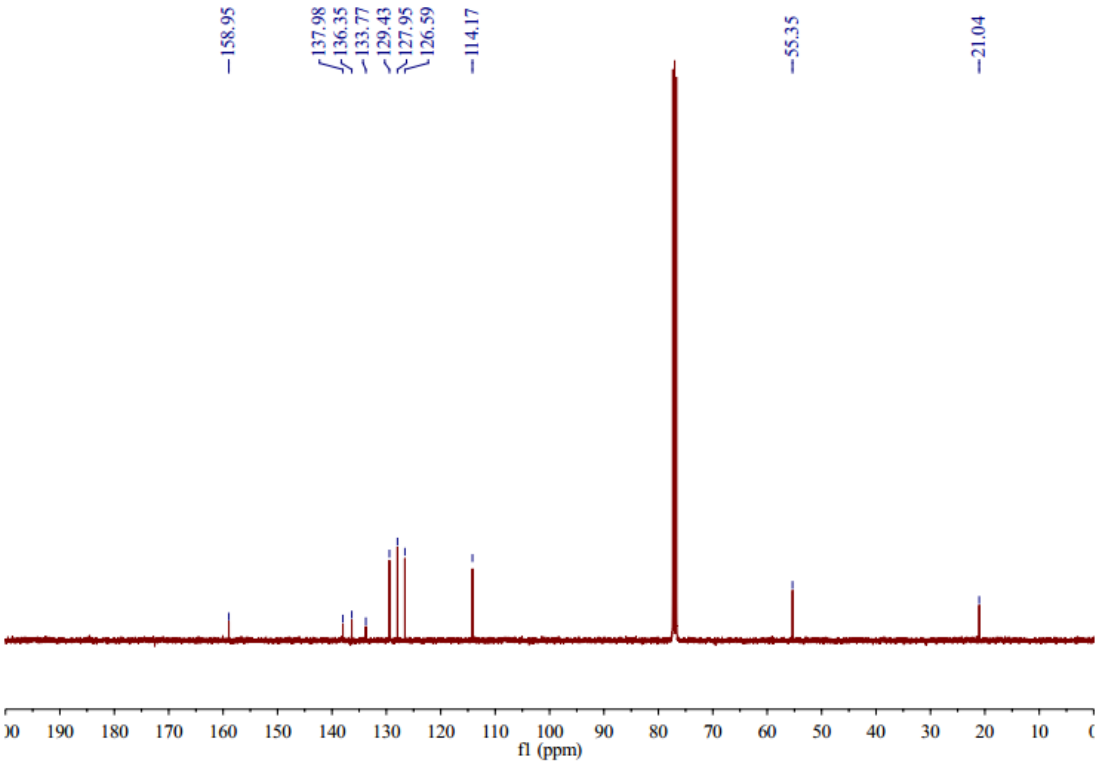

7.58
7.57
7.55
7.53
7.45
7.43
7.41
7.33
7.31
7.00
6.98
3.86
4.00
1.97
0.96
1.94
3.00
f1 (ppm)

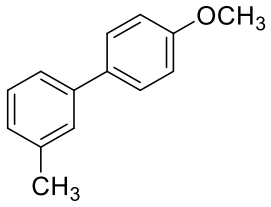

159.2
140.8
133.8
128.7
128.2
126.8
126.7
114.2
55.4
f1 (ppm)


OCH3
H3C

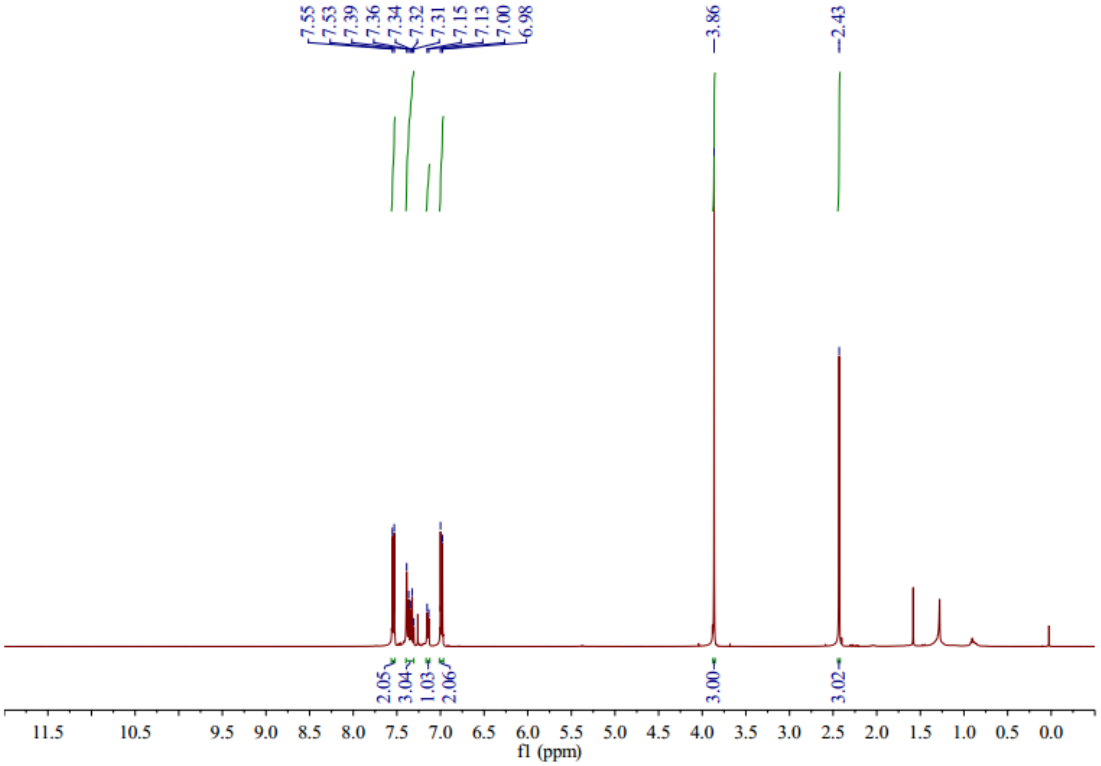
(4bh)

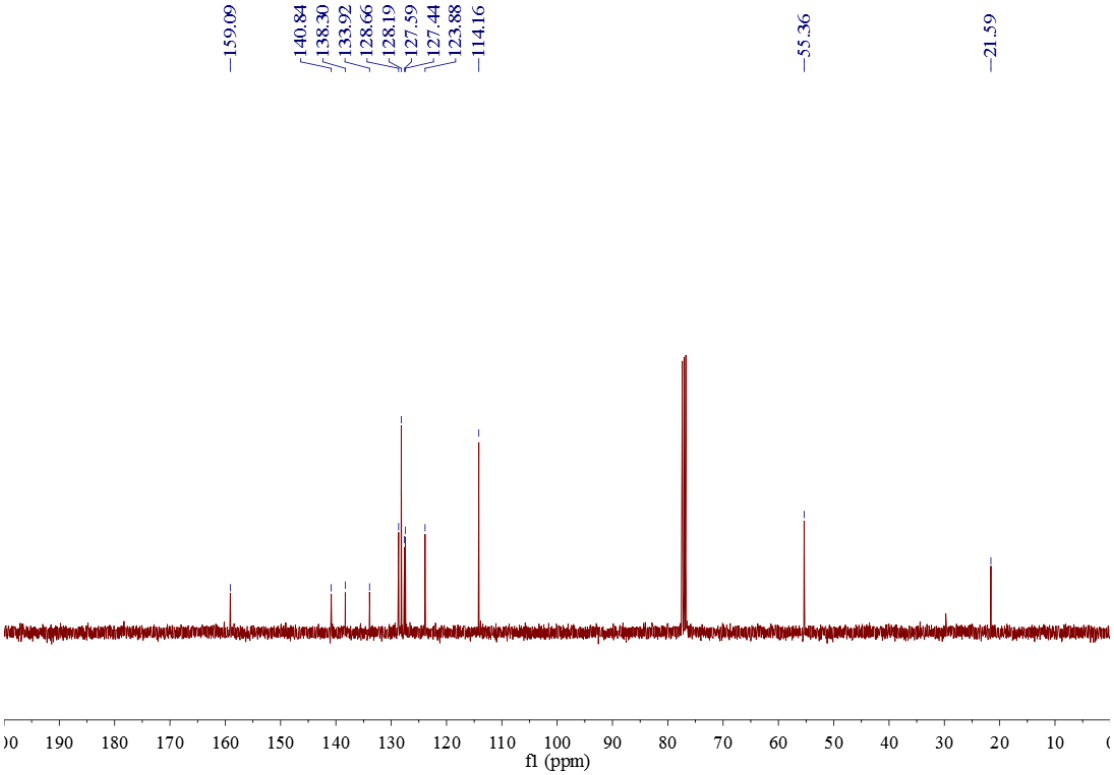

7.52
7.50
7.46
7.44
7.26
7.24
7.22
6.98
6.96
3.85
2.39
2.02
1.94
1.99
1.94
3.02
3.00
f1 (ppm)

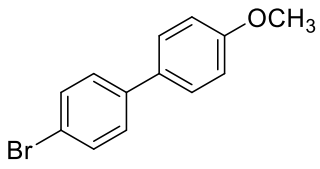

158.95
137.98
136.35
133.77
129.43
127.95
126.59
114.17
55.35
21.04
f1 (ppm)


OCH3
CH3

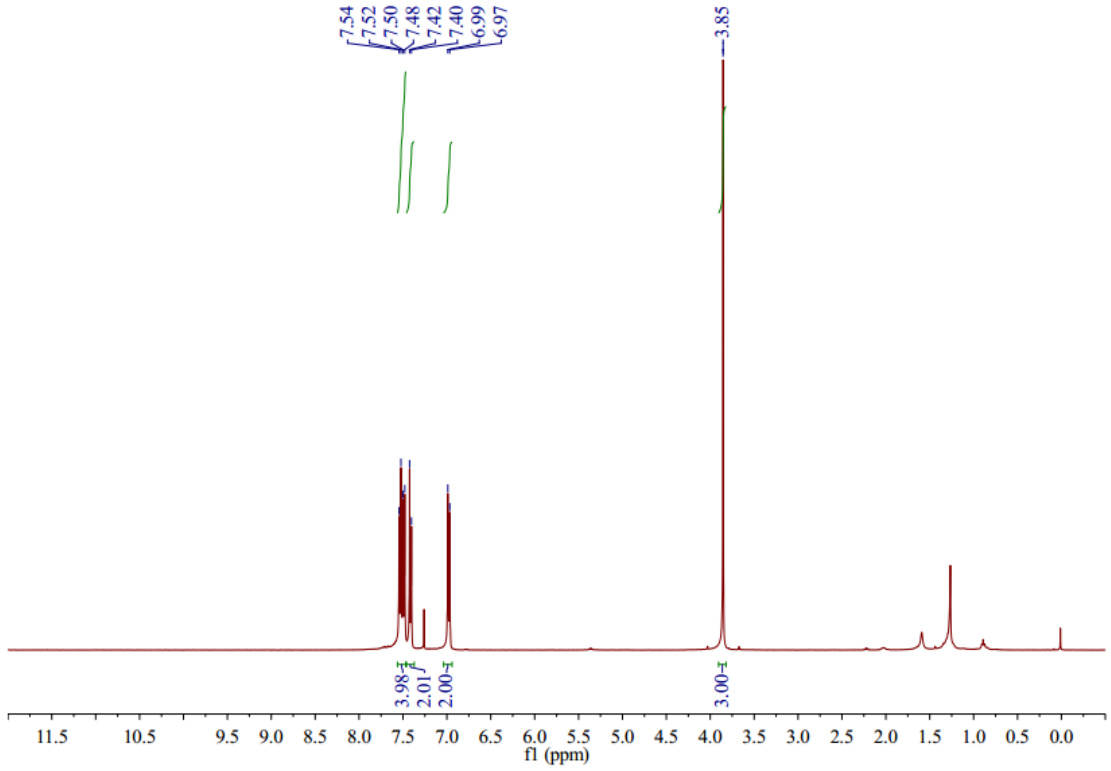
(4ch)

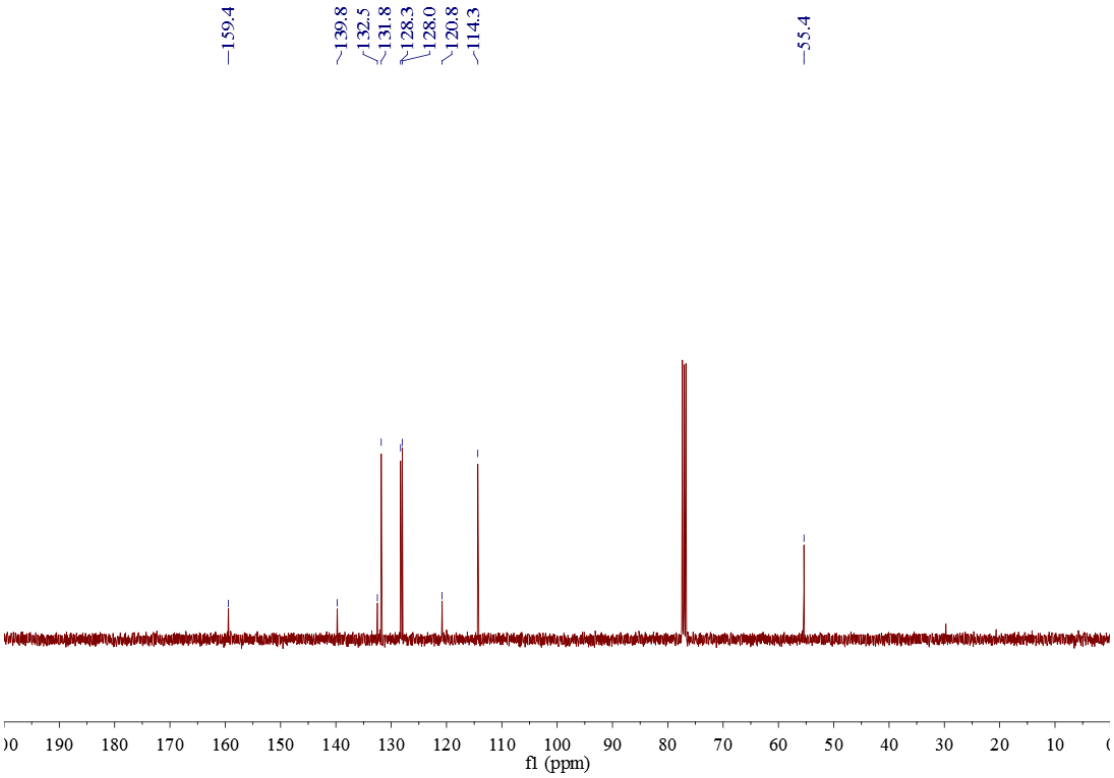

7.55
7.53
7.39
7.36
7.34
7.32
7.31
7.15
7.13
7.00
6.98
3.86
2.43
2.05
3.04
1.03
2.06
3.00
3.02
fl (ppm)

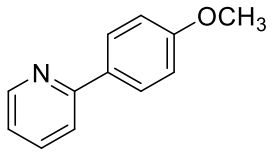

159.09
140.84
138.30
133.92
128.66
128.19
127.59
127.44
123.88
114.16
55.36
21.59
fl (ppm)


OCH3
Br

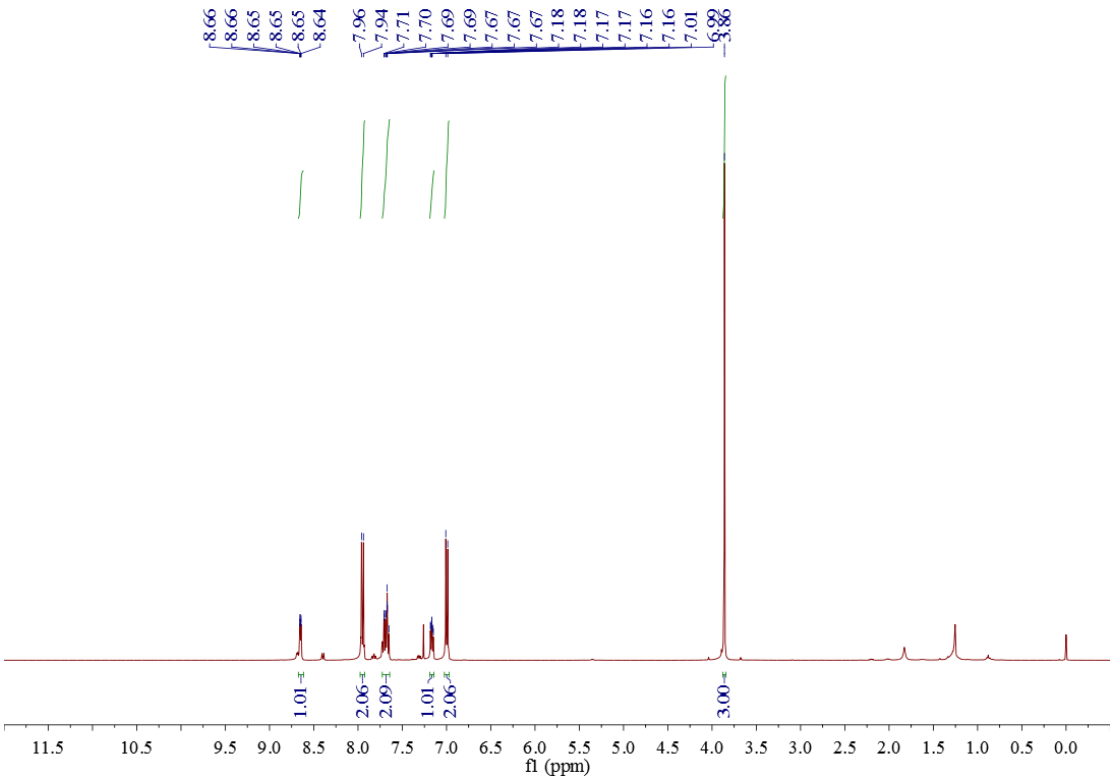
(4gh)

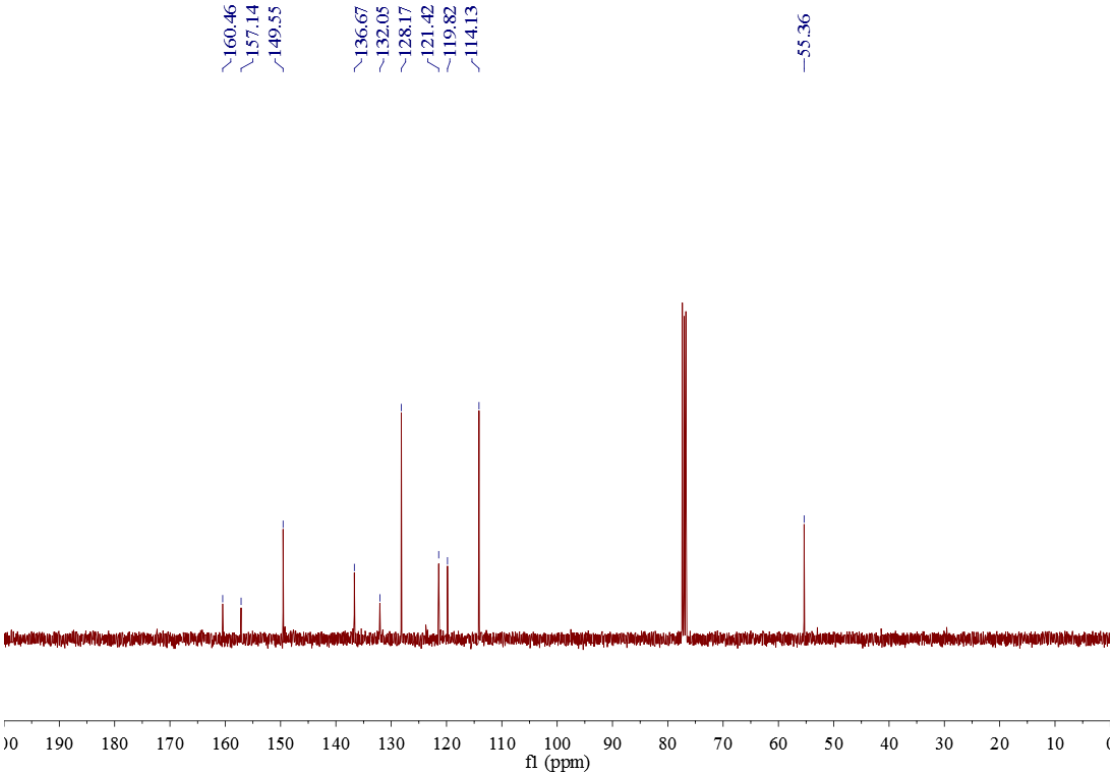

7.54
7.52
7.50
7.48
7.42
7.40
6.99
6.97
3.85
3.98
2.01
2.00
3.00
f1 (ppm)

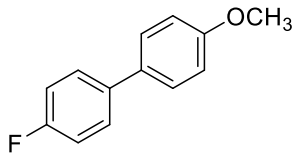

159.4
139.8
132.5
131.8
128.3
128.0
120.8
114.3
55.4
f1 (ppm)


OCH3
N

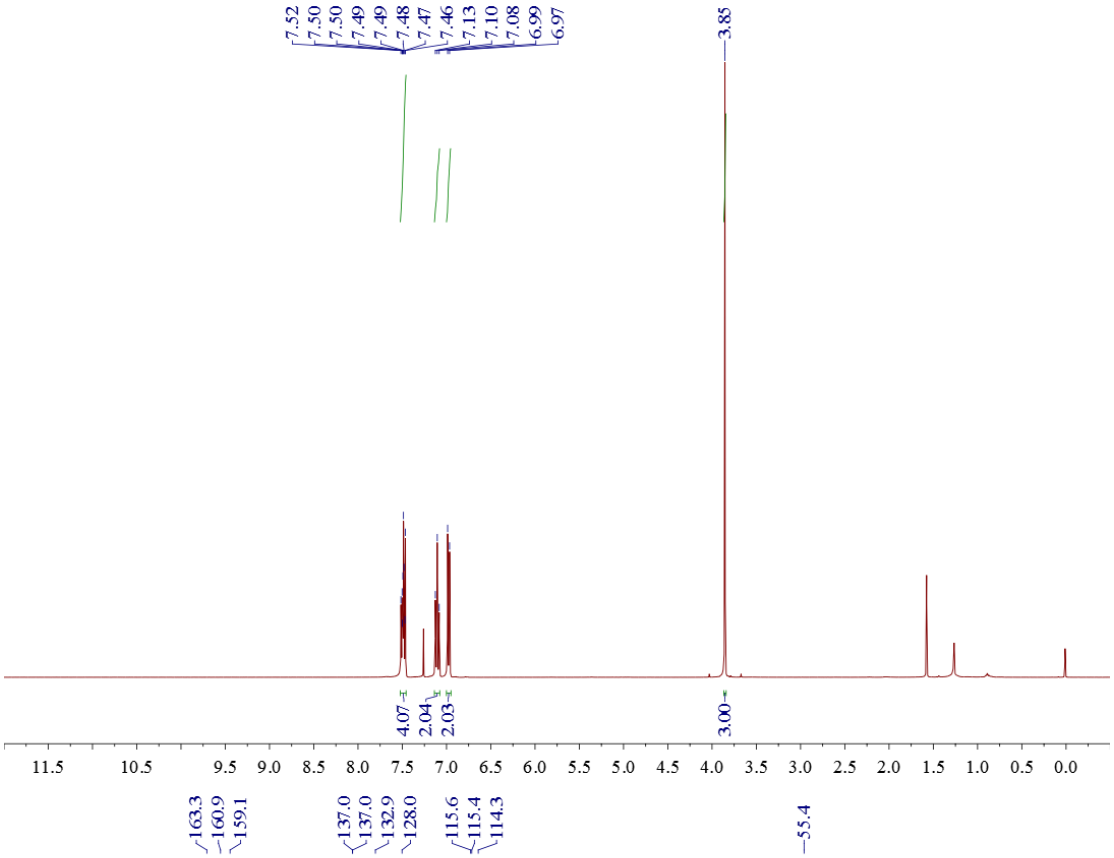
(2jh)

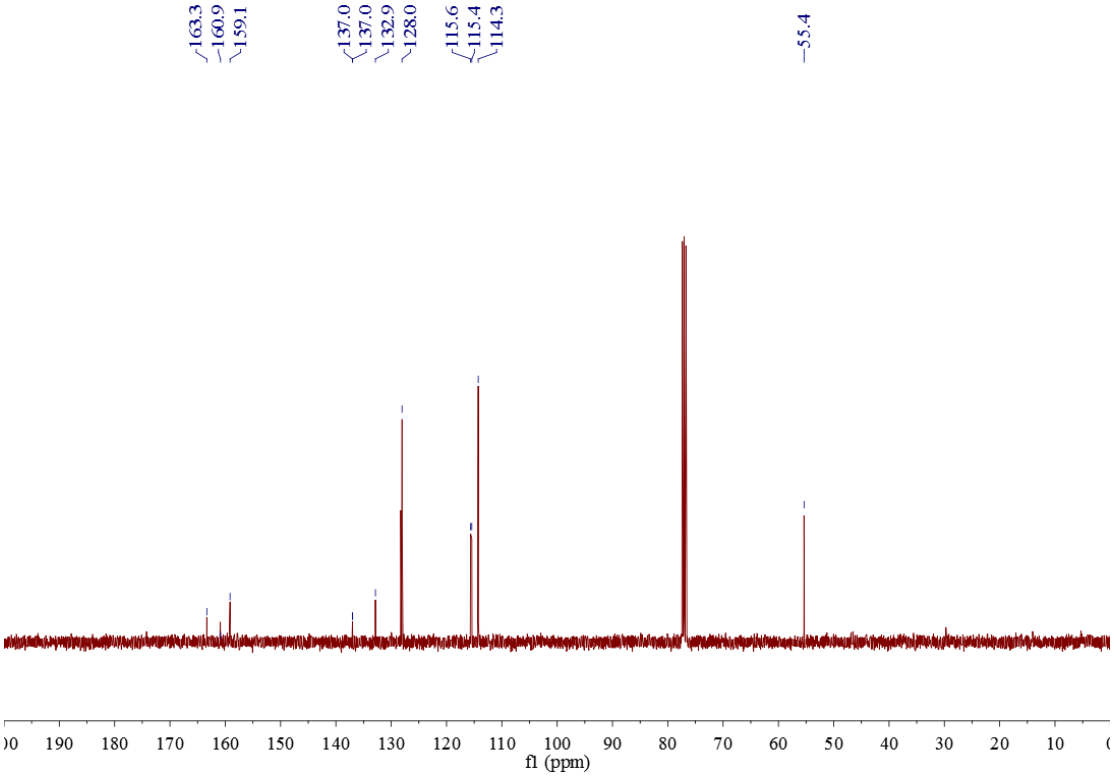

8.66
8.66
8.65
8.65
8.64
7.96
7.94
7.71
7.70
7.69
7.69
7.67
7.67
7.67
7.18
7.17
7.17
7.16
7.16
7.01
6.99
3.88
1.01
2.06
2.09
1.01
2.06
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

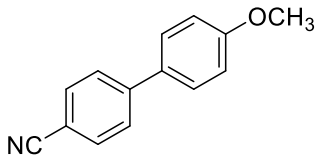

160.46
157.14
149.55
136.67
132.05
128.17
121.42
119.82
114.13
55.36
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


OCH3
F

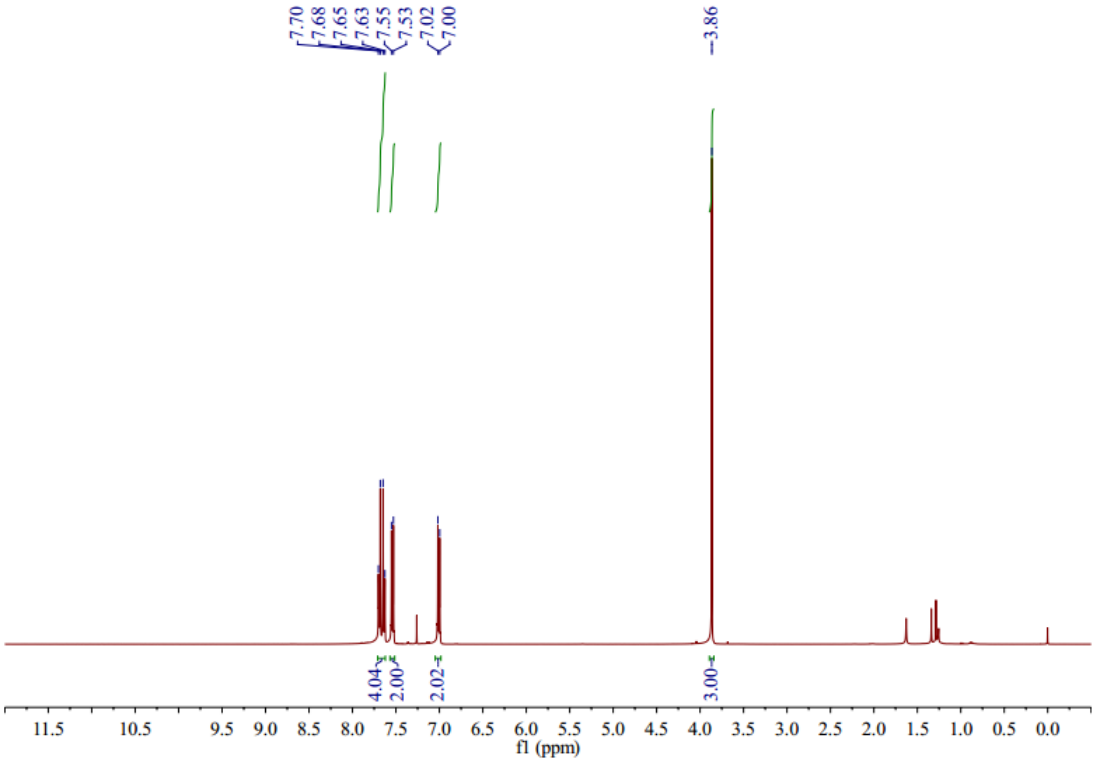
(4eh)


7.52
7.50
7.50
7.49
7.49
7.48
7.47
7.46
7.13
7.10
7.08
6.99
6.97
3.85
4.07
2.04
2.03
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0


163.3
160.9
159.1
137.0
137.0
132.9
128.0
115.6
115.4
114.3
55.4
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


OCH3
NC

(4hi)


7.70
7.68
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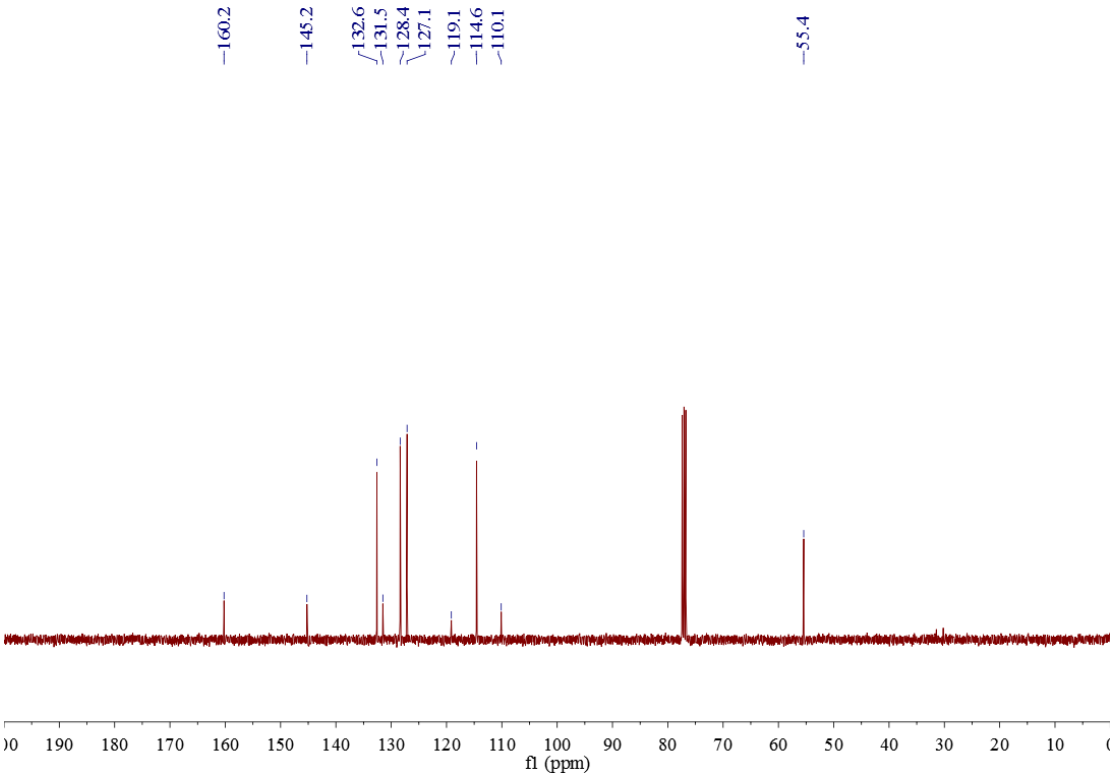
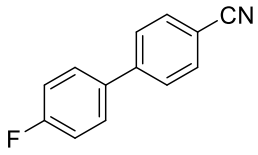
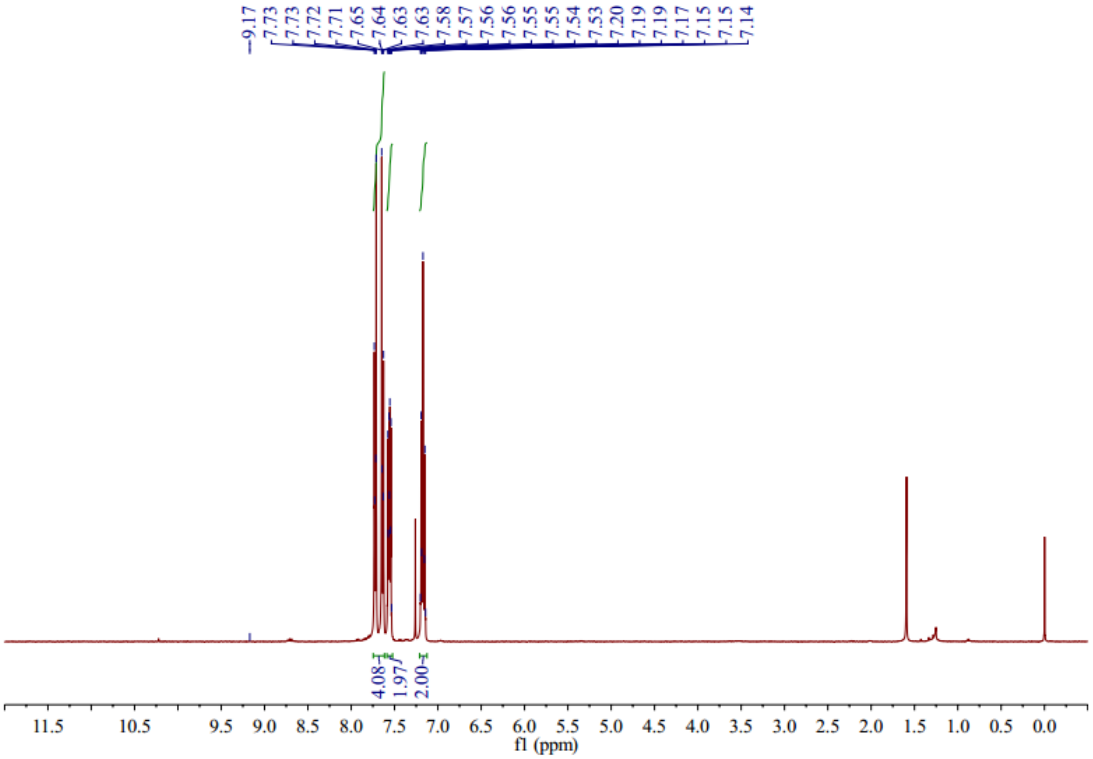
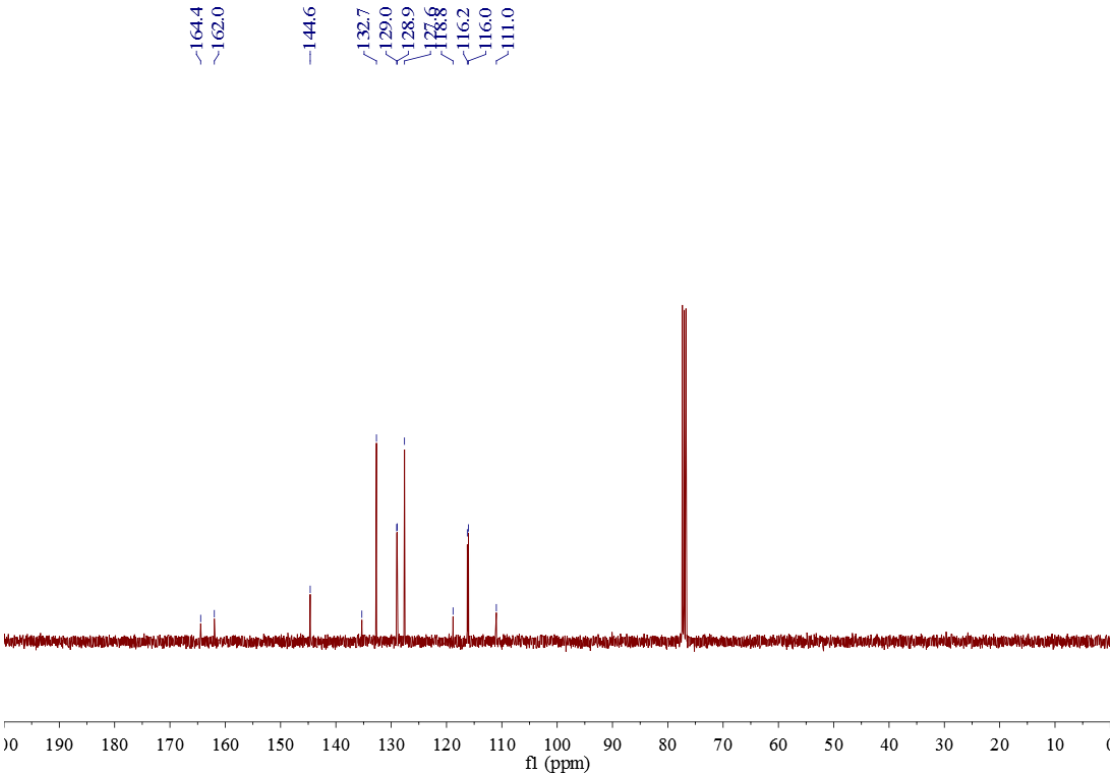
7.63
7.55
7.53
7.02
7.00
3.86
4.04
2.00
2.02
3.00
f1 (ppm)

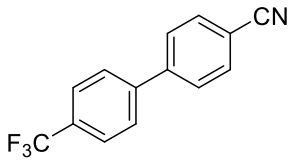

160.2
145.2
132.6
131.5
128.4
127.1
119.1
114.6
110.1
55.4
f1 (ppm)


CN
F

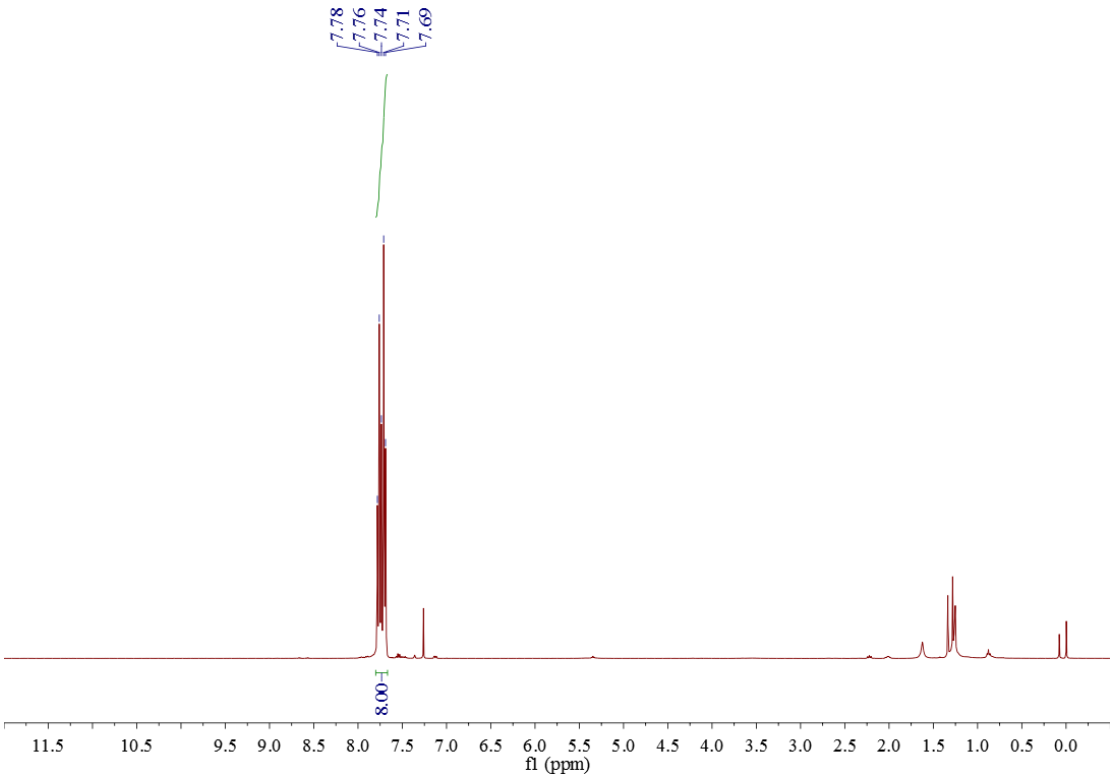
(4ei)

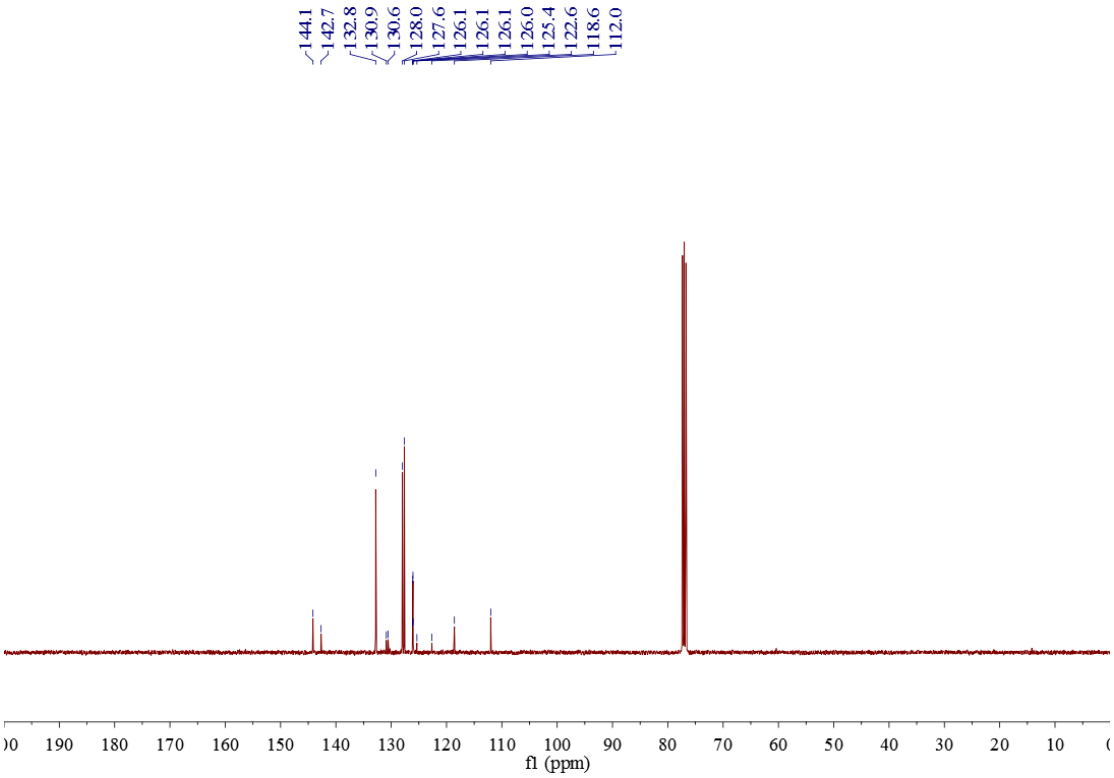

9.17
7.73
7.73
7.72
7.71
7.65
7.64
7.63
7.63
7.58
7.57
7.56
7.56
7.55
7.55
7.54
7.53
7.20
7.19
7.19
7.17
7.15
7.15
7.14
4.08
1.97
2.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

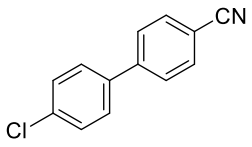

164.4
162.0
144.6
132.7
129.0
128.9
127.6
118.8
116.2
116.0
111.0
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


CN
F3C

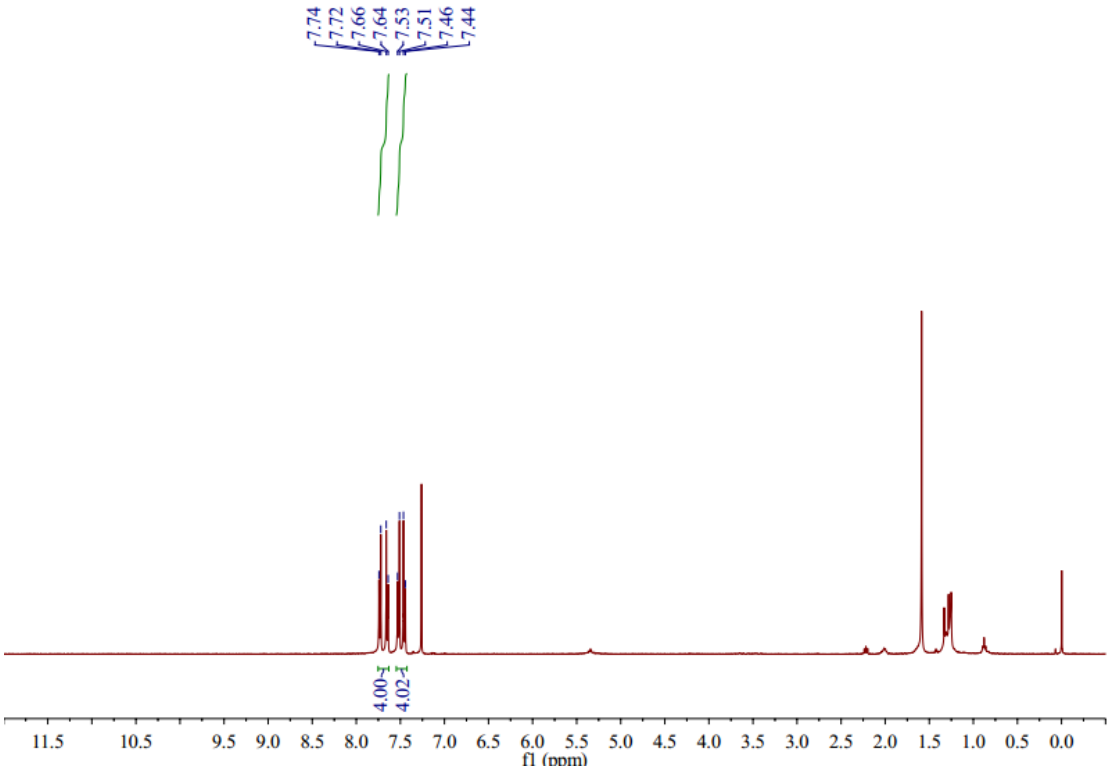
(4ki)

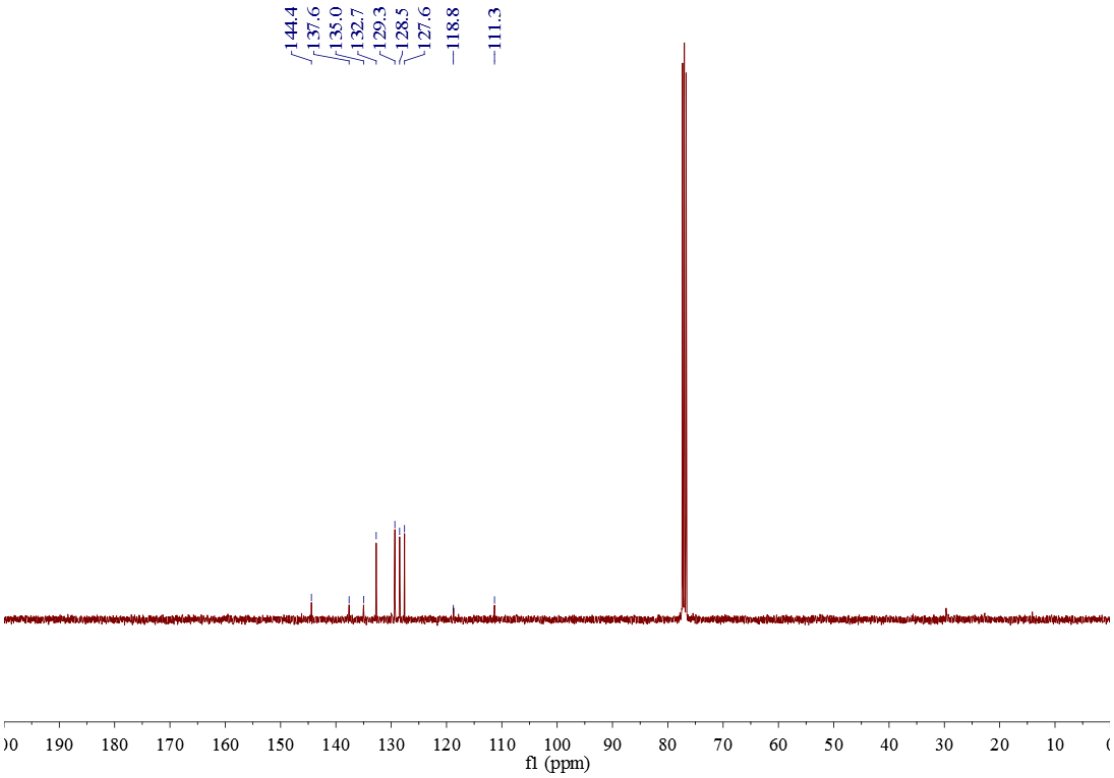

7.78
7.76
7.74
7.71
7.69
8.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


144.1
142.7
132.8
130.9
130.6
128.0
127.6
126.1
126.1
126.1
126.0
125.4
122.6
118.6
112.0
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


CN
Cl

(4fi)


7.74
7.72
7.66
7.64
7.53
7.51
7.46
7.44
4.00
4.02
11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


144.4
137.6
135.0
132.7
129.3
128.5
127.6
118.8
111.3
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)