Electronic Supplementary Material (ESI) for RSC Advances.

Palladium nanoparticles supported on agarose functionalized magnetic nanoparticles of Fe_3O_4 as a recyclable catalyst for C-C bond formation via Suzuki-Miyaura, Heck-Mizoroki and Sonogashira-Haghihara coupling reactions

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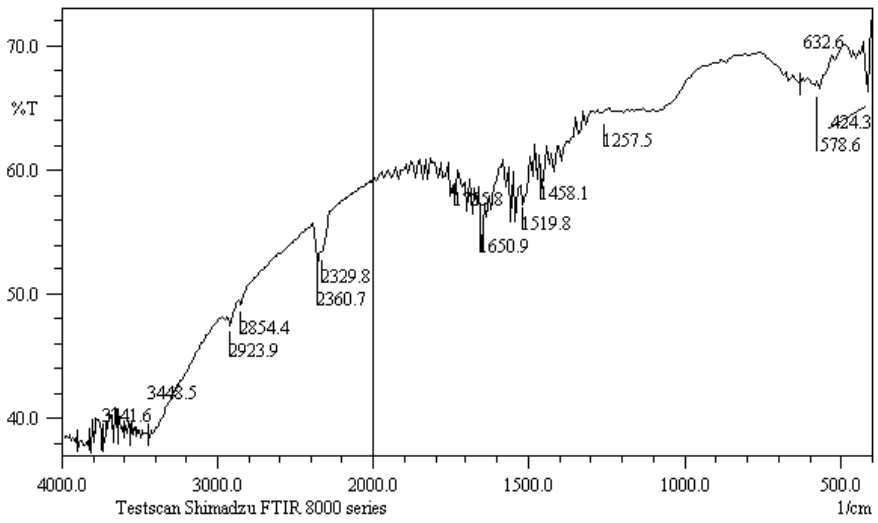
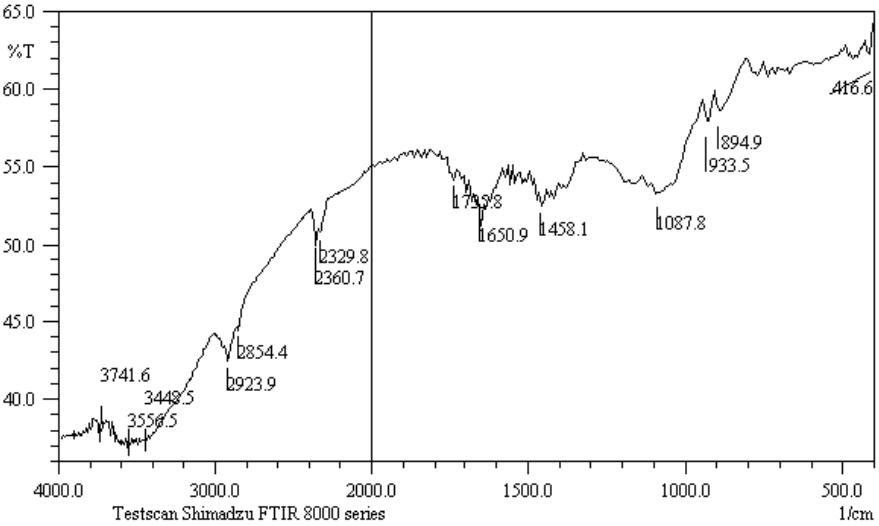
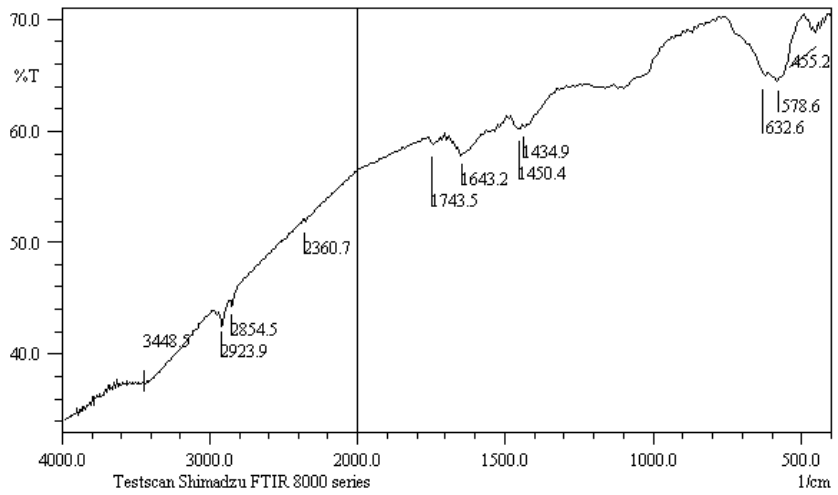


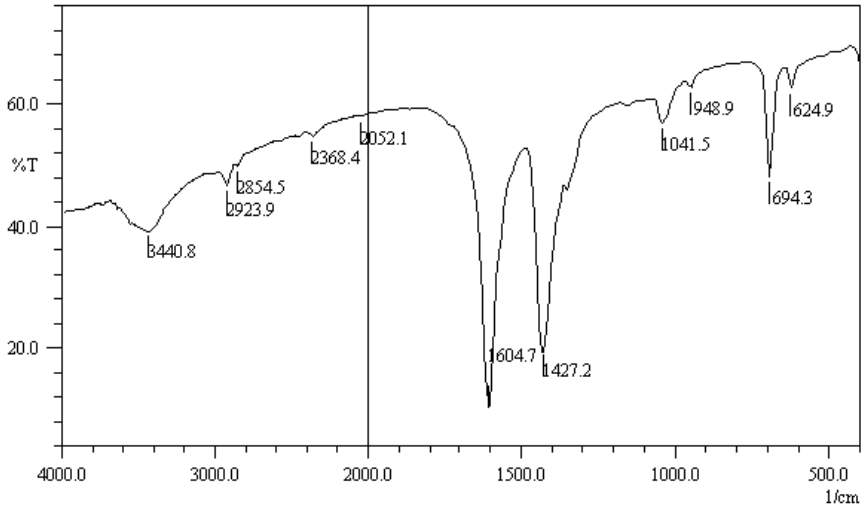
IR spectrum of Pd@agarose-Fe_3O_4



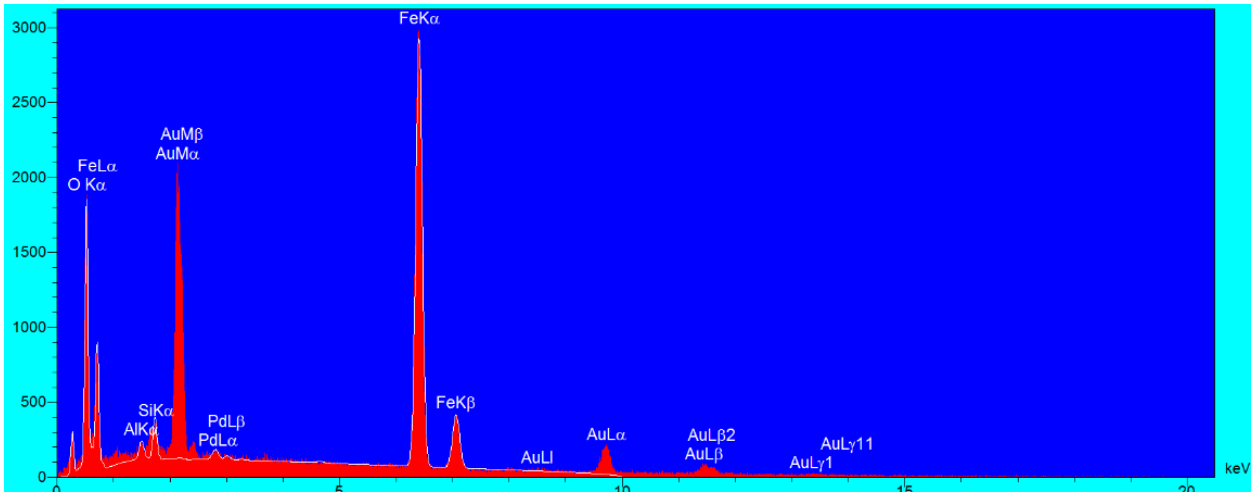
IR spectrum of agarose



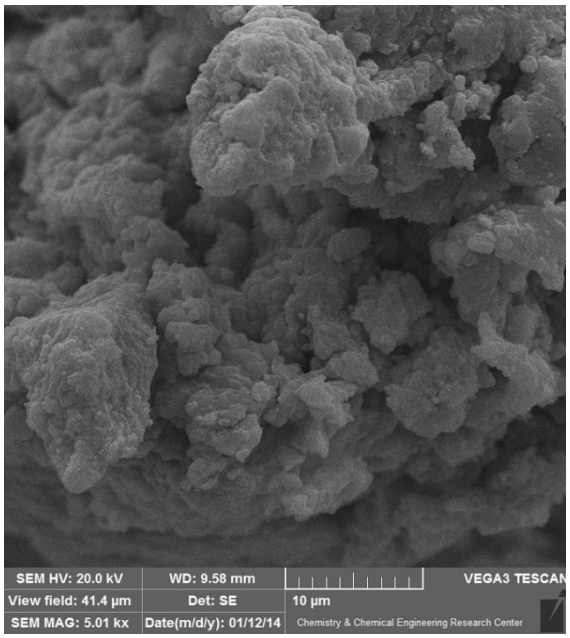
IR spectrum of nanoparticles Fe_3O_4



IR spectrum of $Pd(OAc)_2$

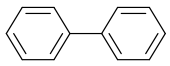


EDX analysis of catalyst

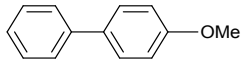


SEM image of catalyst

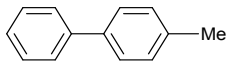
Characterizations of products



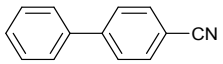
^{1}HNMR (250 MHz, $CDCl_3$) δ(ppm):7.85-7.80 (m, 4H), 7.69-7.52 (m, 6H); ^{13}C NMR (62.9 MHz, $CDCl_3$) δ(ppm): 141.21, 128.74, 127.23 127.15.



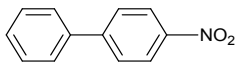
^{1}HNMR (400 MHz, $CDCl_3$) δ(ppm): 7.60-7.55(m, 4H), 7.47-7.43(m,3H), 7.36-7.32 (m, 1H); 3.89 (s, 3H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 159.11, 140.77, 133.70, 128.70, 128.11, 126.69, 126.63, 114.16, 55.25.



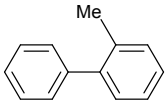
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm):7.75-7.38 (m, 9H), 2.54 (s, 3H), ^{13}C NMR (101 MHz, $CDCl_3$) δ(ppm): 141.33, 138.52, 137.16, 129.67, 128.90, 127.17, 127.15, 77.55, 77.23, 76.91, 21.28.



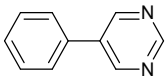
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.74-7.39 (m, 9H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 145.65, 139.15, 132.59, 129.11, 128.66, 127.72, 127.22, 118.94, 110.89.



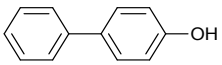
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 8.34-8.30 (d, *J*= 9.2, 2H), 7.77-7.74 (d, J= 8.8, 2H), 7.67-7.64 (m, 2H), 7.55-7.48 (m, 3H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 147.61, 138.74, 129.15, 128.92, 128.33, 127.79, 127.38, 124.10.



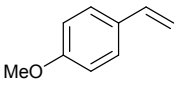
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.36-7.19 (m, 9H), 3.24 (s, 3H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 141.93, 141.89, 135.26, 130.26, 129.76, 129.15, 128.02, 127.21, 126.71, 125.73, 77.51, 77.00, 76.49, 20.43.



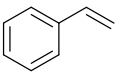
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 9.21 (s, 1H), 8.95 (s, 2H), 7.59-7.30 (m, 5H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 157.36, 154.85, 134.30, 134.17, 129.41, 129.01, 126.96.



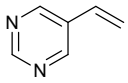
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.54-7.26 (m,7H), 6.92-6.86 (m, 2H),5.89(s,1H);



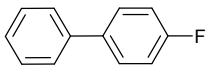
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.35-7.31(m, 2H), 6.87-6.82 (m, 2H), 6.71-6.59 (dd, *J*= 10.75, 7, 1H), 5.64-5.55 (d, *J*= 17.75, 1H), 5.14-5.08 (d, *J*=10.75, 1H), 3.77 (s, 3H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 159.36, 136.21, 130.41, 127.37, 113.89, 111.54, 55.23, -0.00.



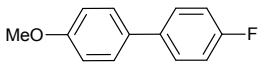
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.59-7.36 (m, 5H), 6.90-6.83 (dd, *J*= 10.75, 6.75), 5.96-5.88 (d, *J*= 17.75, 1H), 5.43-5.38 (d, *J*= 10.75, 1H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 137.58, 136.95, 128.51, 127.79, 126.25, 113.64.



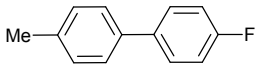
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 9.10 (s, 1H) 8.77 (s, 2H), 6.72-6.61 (dd, *J*= 11, 6.75, 1H), 5.97-5.89 (d, *J*= 17.75,1H), 5.55-5.50 (d, *J*= 11 ,1H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 157.57, 154.26, 130.95, 130.11, 118.69.



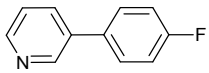
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.69-7.49 (m, 7H), 7.48-7.21 (m, 2H); ^{13}C NMR (63 MHz, $CDCl_3$) δ 164.60, 160.68, 140.36, 137.49, 137.44, 128.98, 128.88, 128.76, 127.42, 127.15, 115.93, 115.59.



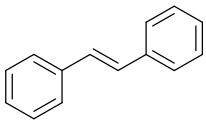
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.57-7.51(m, 4H), 7.20-7.17 (m, 2H), 7.05-7.01 (m, 2H), 3.89 (s, 3H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 164.12, 160.22, 159.22, 137.03, 136.98, 132.80, 128.31, 128.19, 128.07, 115.77, 115.43, 114.32, 55.29.



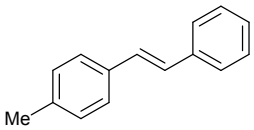
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.66-7.53 (m, 4H), 7.38-7.33 (d, *J*= 8, 2H), 7.25-7.18 (m, 2H), 2.51 (s, 3H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 164.39, 160.48, 137.49, 137.41, 137.36, 137.12, 129.67, 128.63, 128.50, 126.96, 115.83, 115.49.



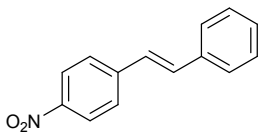
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 8.66 (s, 1H), 8.45-8.43 (d, *J*= 4.75, 1H), 7.68-7.64 (m, 1H), 7. 40-7.34 (m, 2H), 7.22-7.17 (m, 1H), 7.05-6.97 (m, 2H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 164.79, 160.85, 148.33, 147.95, 135.58, 134.14, 133.82, 133.77, 128.78, 128.65, 123.51, 116.14, 115.80.



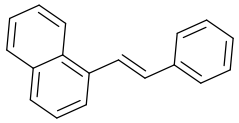
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 7.60-7.58 (m, 4H), 7.43-7.32 (m, 6H), 7.19, (s,2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ(ppm): 137.39, 128.75, 127.69, 126.59.



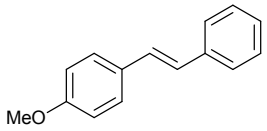
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 7.55-7.53 (d, 2H, *J*= 7.6), 7.46-7.44 (d , *J*= 8, 2H), 7.40-7.36 (m, 2H), 7.27-7.26 (d, *J*= 7.2,1H), 7.21-7.19 (d, *J*=7.6, 2H), 7.11-7.10 (m, 2H), 2.40 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ(ppm): 137.56, 129.42, 128.68, 128.61, 127.69, 127.44, 126.44, 126.41, 77.36, 77.25, 77.04, 76.73, 21.30.



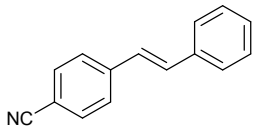
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 8.22-8.18 (d, *J*= 8.75, 1H), 7.63-7.59 (d, *J*=8.75, 2H), 7.55-7.53 (d, *J*= 7, 2H), 7.42-7.32 (m, 3H), 7.23-7.15 (m, 2H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 146.72, 143.83, 136.15, 133.28, 128.89, 128.84, 127.02, 126.84, 126.25, 124.13.



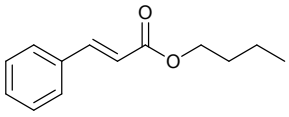
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 8.17-8.14 (m, 1H), 77.86-7.64 (m, 4H), 7.54-7.29 (m, 8H), 7.11-7.04 (d, J= 16, 1H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 137.52, 134.90, 133.65, 131.65, 131.32, 128.65, 128.54, 127.96, 127.68, 126.62, 126.00, 125.74, 125.69, 125.61, 123.70, 123.55.



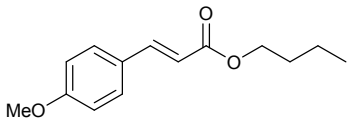
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 7.56-7.50 (m, 4H), 7.42-7.38 (m,2H), 7.31-7.27 (m, 1H), 7.14-7.09 (d, J= 16, 1H), 7.05-7.01(d, J= 16, 1H), 6.96-6.94 (d, J=8.8, 2H), 3.87 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.34, 137.68, 130.17, 128.70, 128.24, 127.78, 127.27, 126.64, 126.31, 114.17, 77.41, 77.10, 76.78, 55.36.



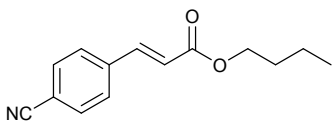
^{1}H NMR (400 MHz, $CDCl_3$) δ(ppm): 7.68-7.56 (m, 6H), 7.44-7.29 (m, 4H), 7.15-7.10 (d, 1H, *J*= 16.4).



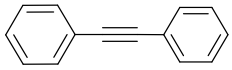
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.61-7.54 (d, *J*= 16, 1H), 7.40-7.38 (m, 2H), 7.26-7.23 (m, 3H), 6.36-6.30 (d, *J*= 16, 1H), 4.12-4.07 (m, 2H), 1.63-1.52 (m, 2H), 1.37-1.28 (m, 2H), 0.884-.826 (t, J= 7.25, 3H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 166.02, 143.51, 133.40, 129.16, 127.81, 126.99, 117.20, 63.35, 29.73, 18.16, 12.71.



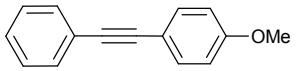
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.60-7.53 (d, *J*= 15.75, 1H), 7.42-7.38 (d, *J*=9, 2H), 6.84-6.81 (d, *J*= 8.75, 2H), 6.27-6.20 (d, *J*=16, 1H), 4.15-4.05 (m, 2H), 3.76 (s, 3H), 1.64-1.52 (m, 2H), 1.41-1.32 (m, 2H), 0.92-0.85 (t, J=7.25 , 3H); ^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 167.43, 161.30, 144.19, 129.67, 115.76, 114.28, 64.25, 55.35, 30.80, 19.19, 13.75.



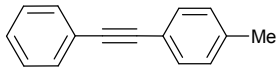
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.69-7.60 (m, 5H), 6.56-6.4(d, *J*= 16.251H,), 4.26-4.19 (m, 2H), 1.73-1.67 (m, 2H), 1.48-1.39 (m, 2H), 0.996-0.938 (t, *J*= 7.253H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 166.14, 142.03, 138.70, 132.57, 128.35, 121.84, 118.31, 113.27, 64.74, 30.64, 19.11, 13.67.



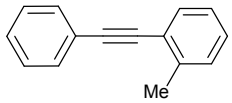
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 8.48-8.43(m, 4H), 7.29-7.23 (m, 6H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 131.61, 128.35, 128.26, 123.27, 89.37.



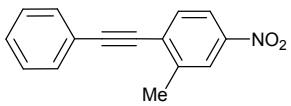
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.52-7.44(m, 4H), 7.32-7.29 (m, 3H), 6.68-6.83 (m, 2H), 3.78 (s, 3H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 159.59, 133.04, 131.43, 128.30, 127.92, 123.57, 115.33, 113.97, 89.39, 88.07, 77.55, 77.04, 76.53, 55.23.



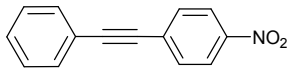
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.46-7.42 (m, 2H), 7.36-7.33 (d, *J*= 7.75, 2H), 7.27-7.21(m, 3H), 7.08-7.05 (d, *J*= 8, 2H), 2.28 (s, 3H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 138.39, 132.51, 131.56, 131.51, 129.13, 128.32, 128.08, 123.49, 120.20, 89.58, 88.73, 21.52.



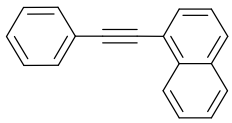
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 7.46-7.39 (m, 3H), 7.24-7.22 (m, 3H), 7.13-7.02 (m,3H), 2.44 (s, 3H); 13C NMR (63 MHz, $CDCl_3$) δ 140.19, 131.83, 131.51, 129.46, 128.35, 128.30, 128.17, 125.58, 123.54, 123.01, 20.75.



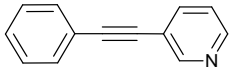
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 8.10-7.99 (m, 2H), 7.61-7.53 (m, 3H), 7.40-7.37 (m, 3H), 2.59 (s, 3H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 146.84, 141.67, 132.36, 131.74, 130.01, 129.22, 128.55, 124.25, 122.33, 120.83, 98.52, 86.64, 20.85.



^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 8.23-8.19 (d, *J*= 9, 2H,), 7.67-7.64 (d, *J*= 9, 2H), 7.58-7.53 (m, 2H), 7.42-7.36 (m, 3H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 146.94, 144.03, 132.26, 131.84, 130.25, 129.28, 128.54, 123.64, 122.08, 94.70, 87.55.

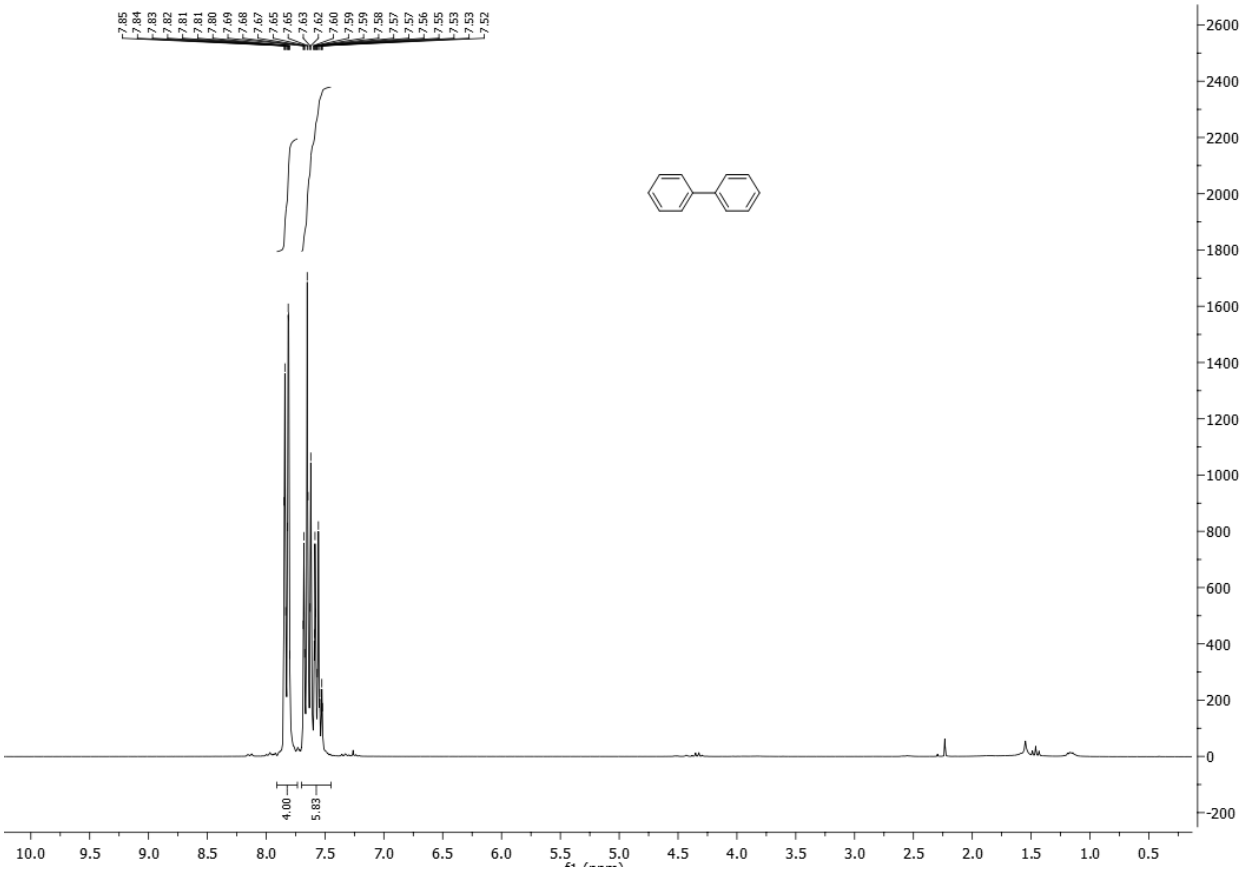


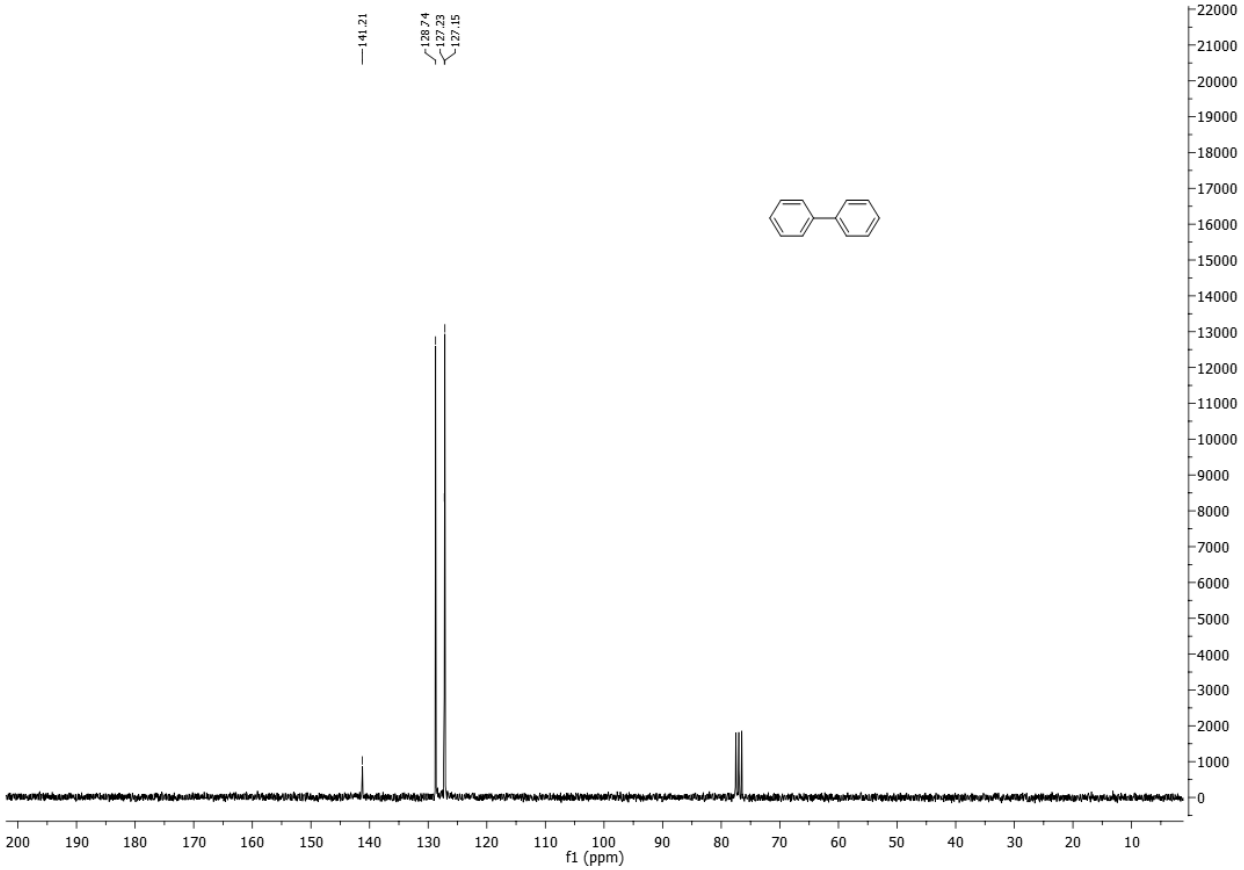
^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 8.46-8.43 (d, *J*= 8.25, 1H), 7.82-7.72 (m, 3H), 7.66-7.29 (m, 8H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 133.22, 133.16, 131.62, 130.33, 128.73, 128.39, 128.34, 128.28, 126.74, 126.39, 126.17, 125.23, 123.35, 120.85, 94.32, 87.55.



^{1}H NMR (250 MHz, $CDCl_3$) δ(ppm): 8.69 (s, 1H), 8.47-8.44 (m, 1H), 7.74-7.69 (m, 1H), 7.49-7.43 (m, 2H), 7.30-7.16 (m, 4H);^{13}C NMR (63 MHz, $CDCl_3$) δ(ppm): 152.14, 148.44, 138.49, 131.68, 128.82, 128.45, 123.06, 122.48, 120.50, 92.71, 85.90.

Copy of original ^{1}H NMR,^{13}C NMR of products

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12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
200
190
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140
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120
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100
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80
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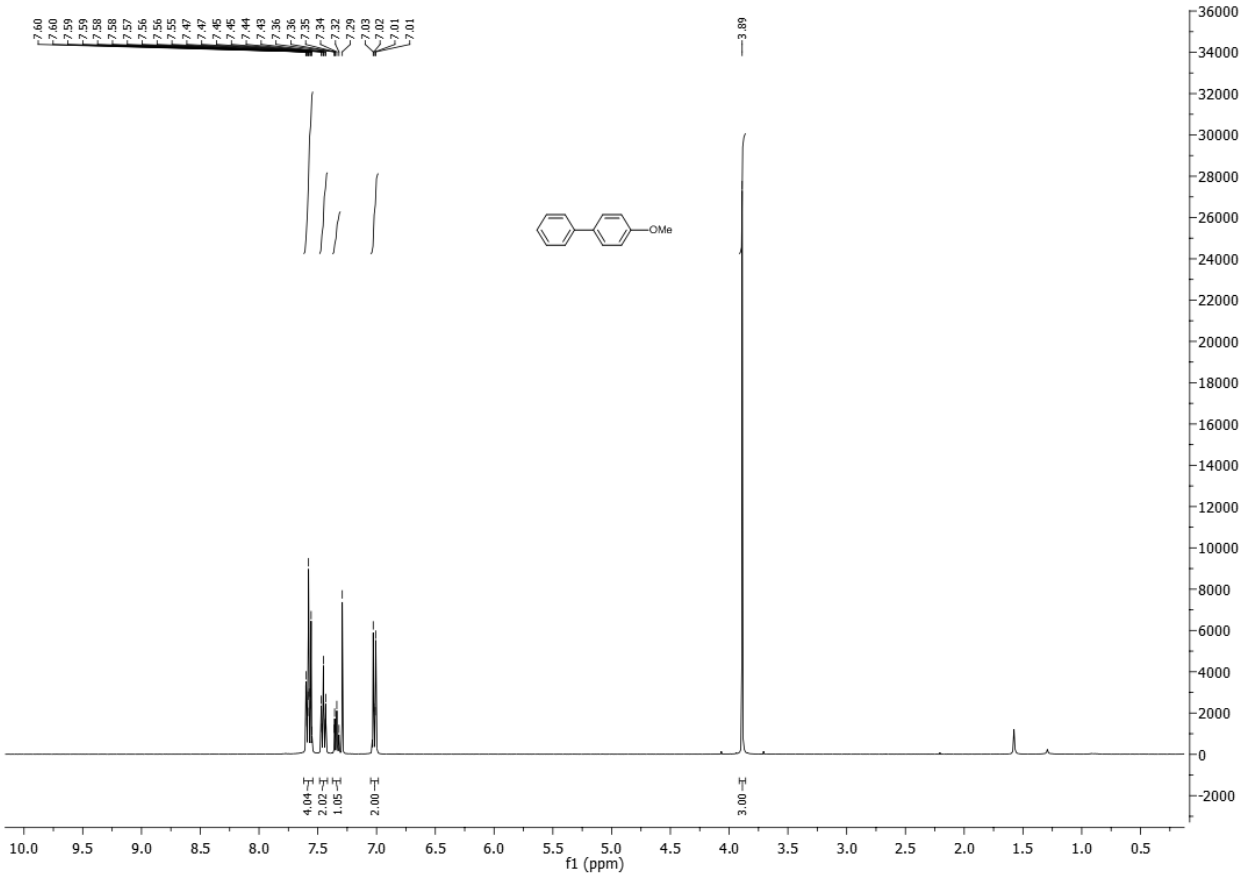
60
50
40
30
20
10
f1 (ppm)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7.36
7.35
7.34
7.32
7.29
7.03
7.02
7.01
7.01
3.89
OMe
4.04
2.02
1.05
2.00
3.00
36000
34000
32000
30000
28000
26000
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20000
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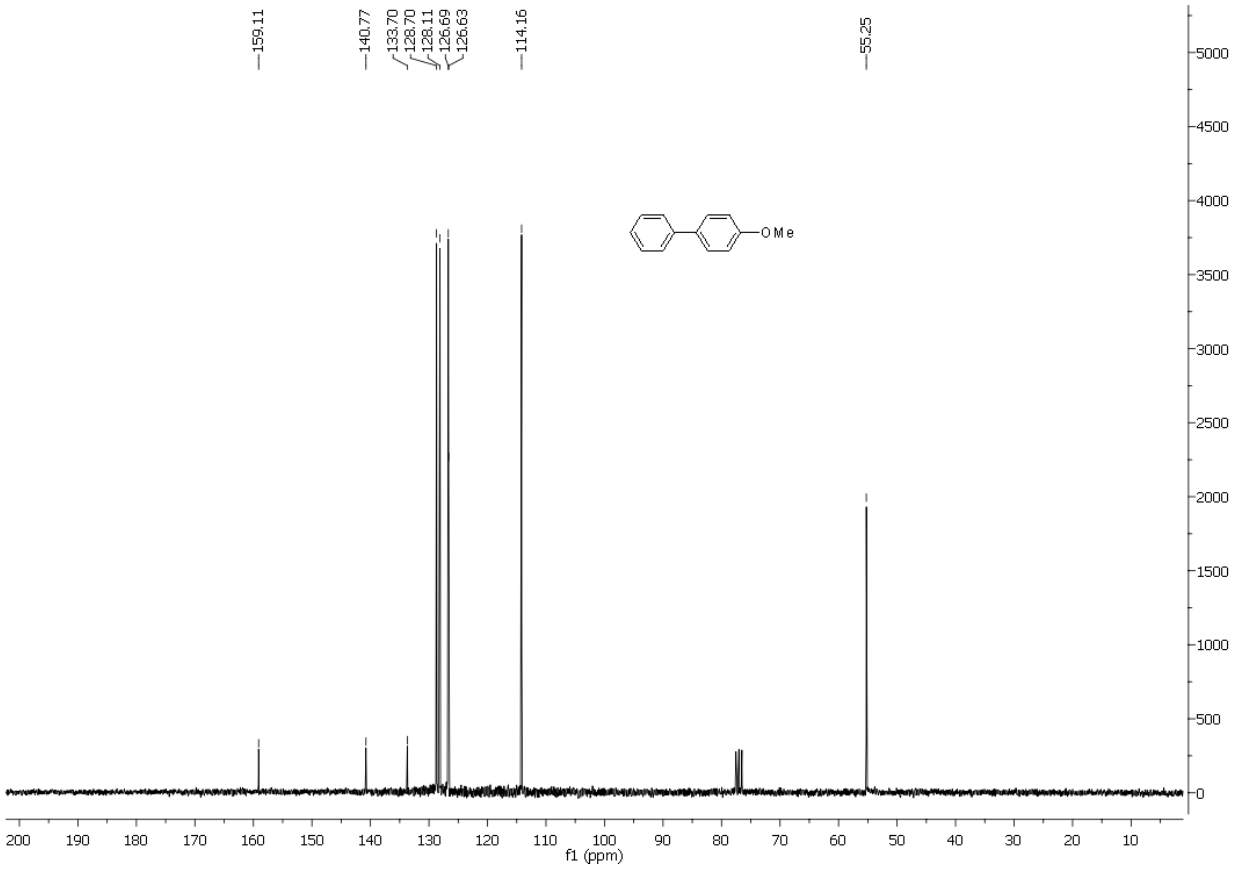
f1 (ppm)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114.16
55.25
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500
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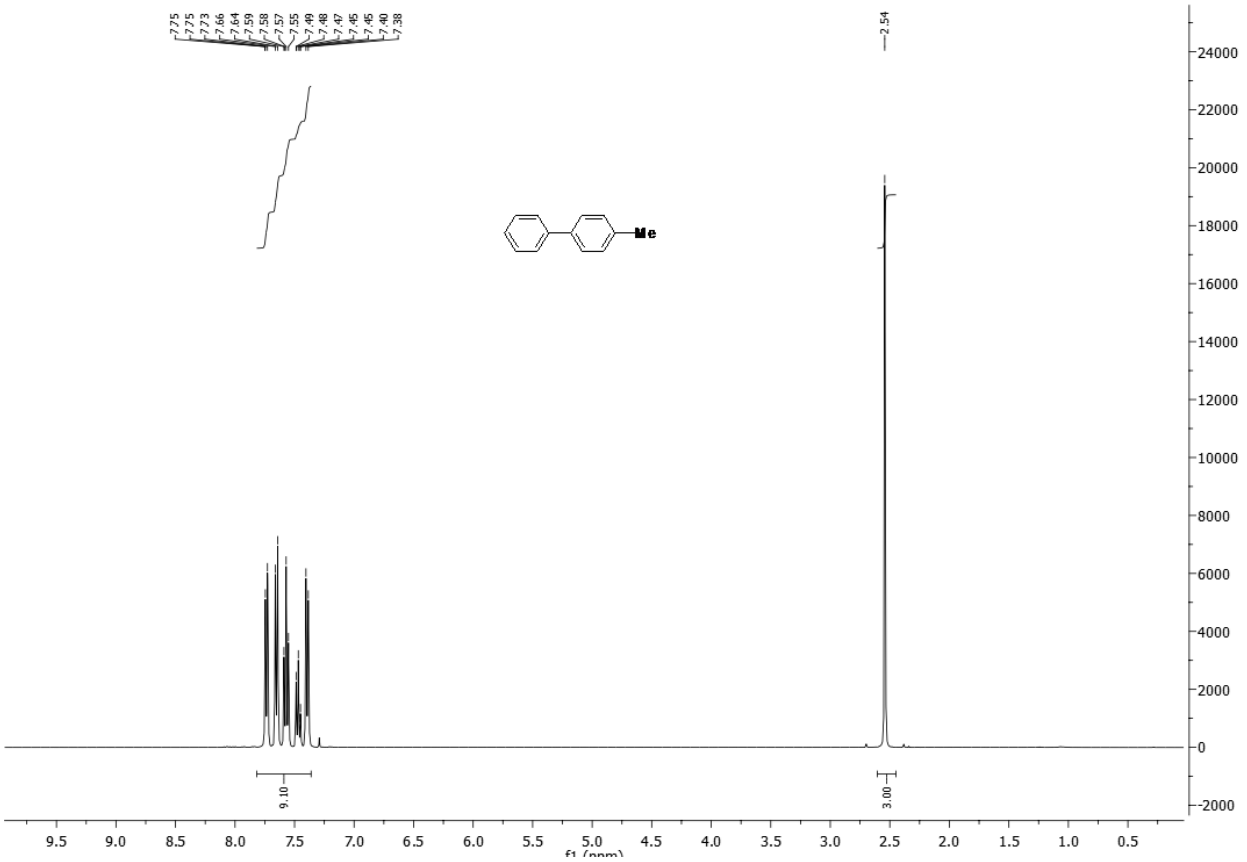
f1 (ppm)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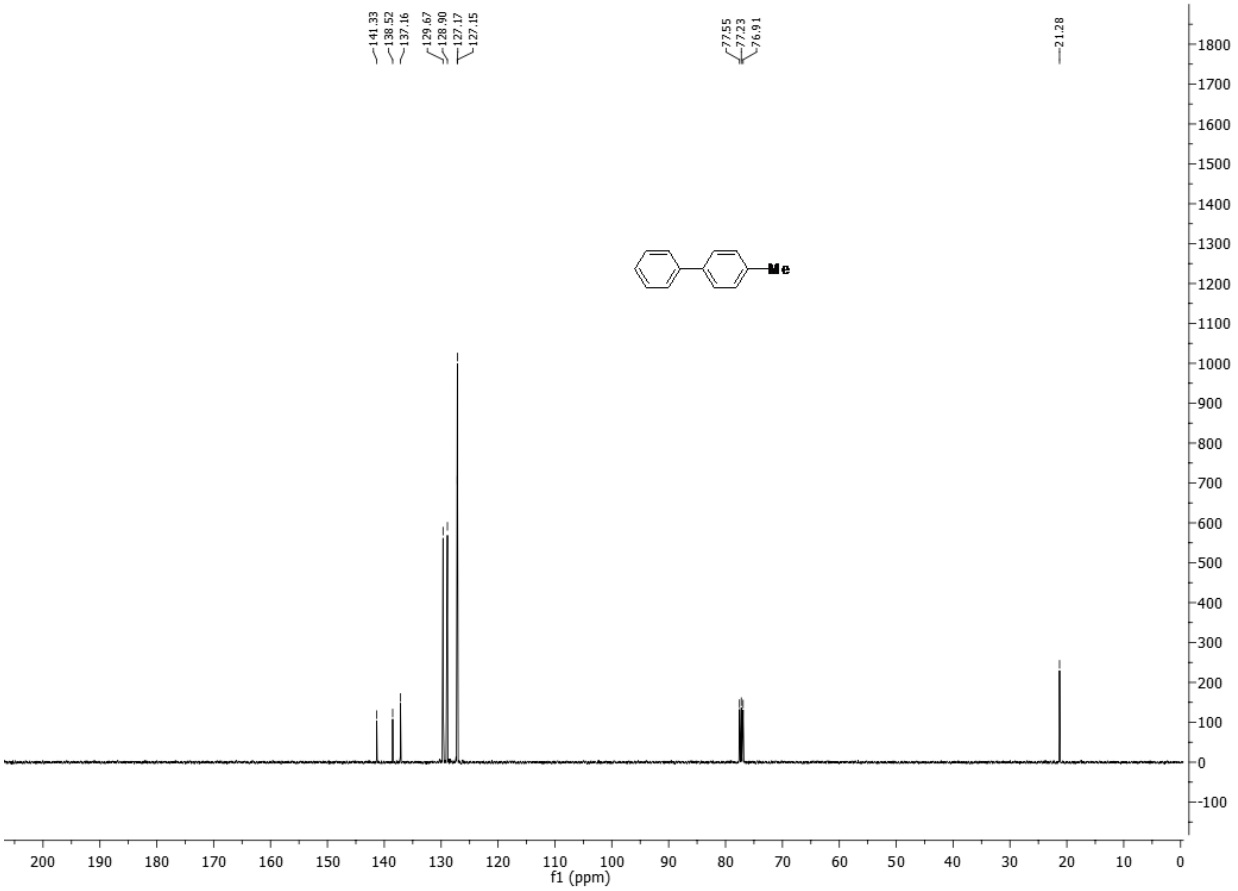
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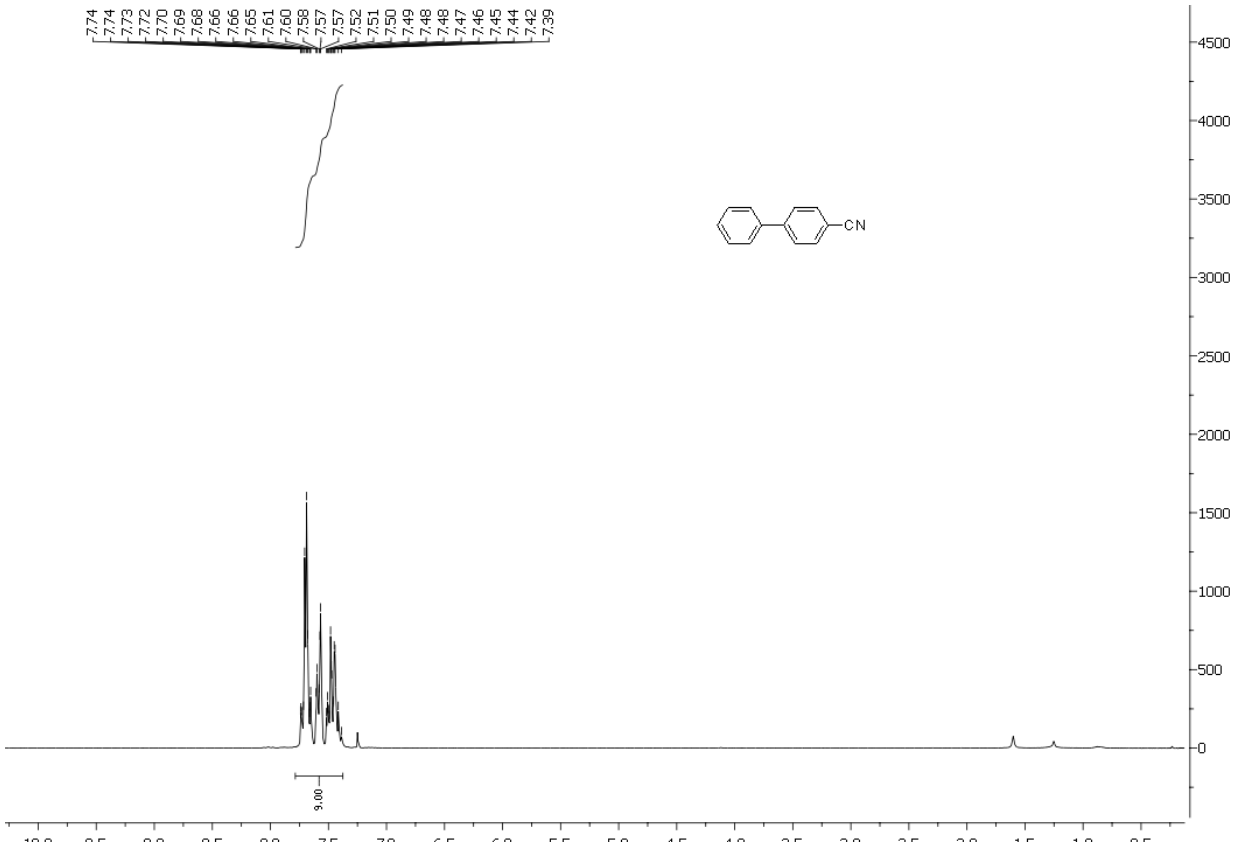
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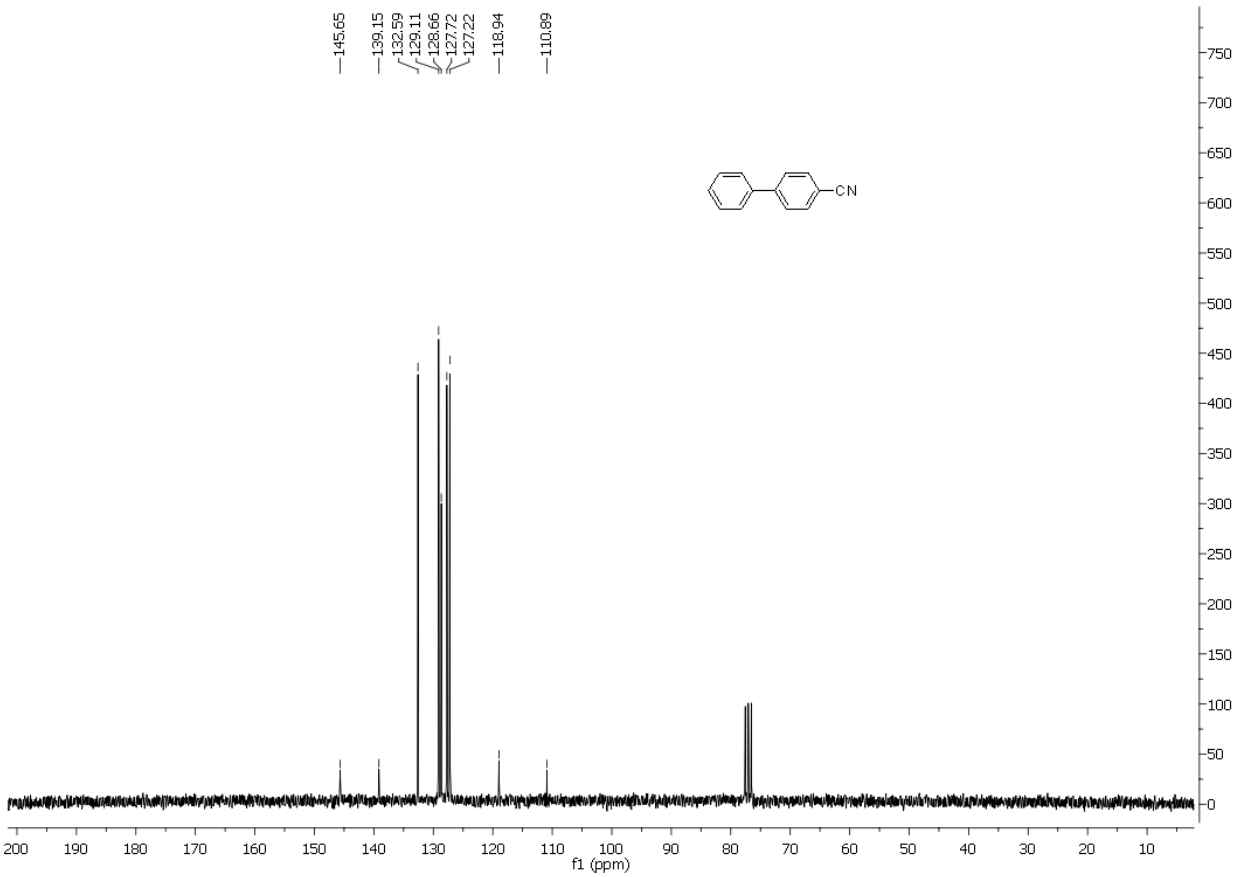
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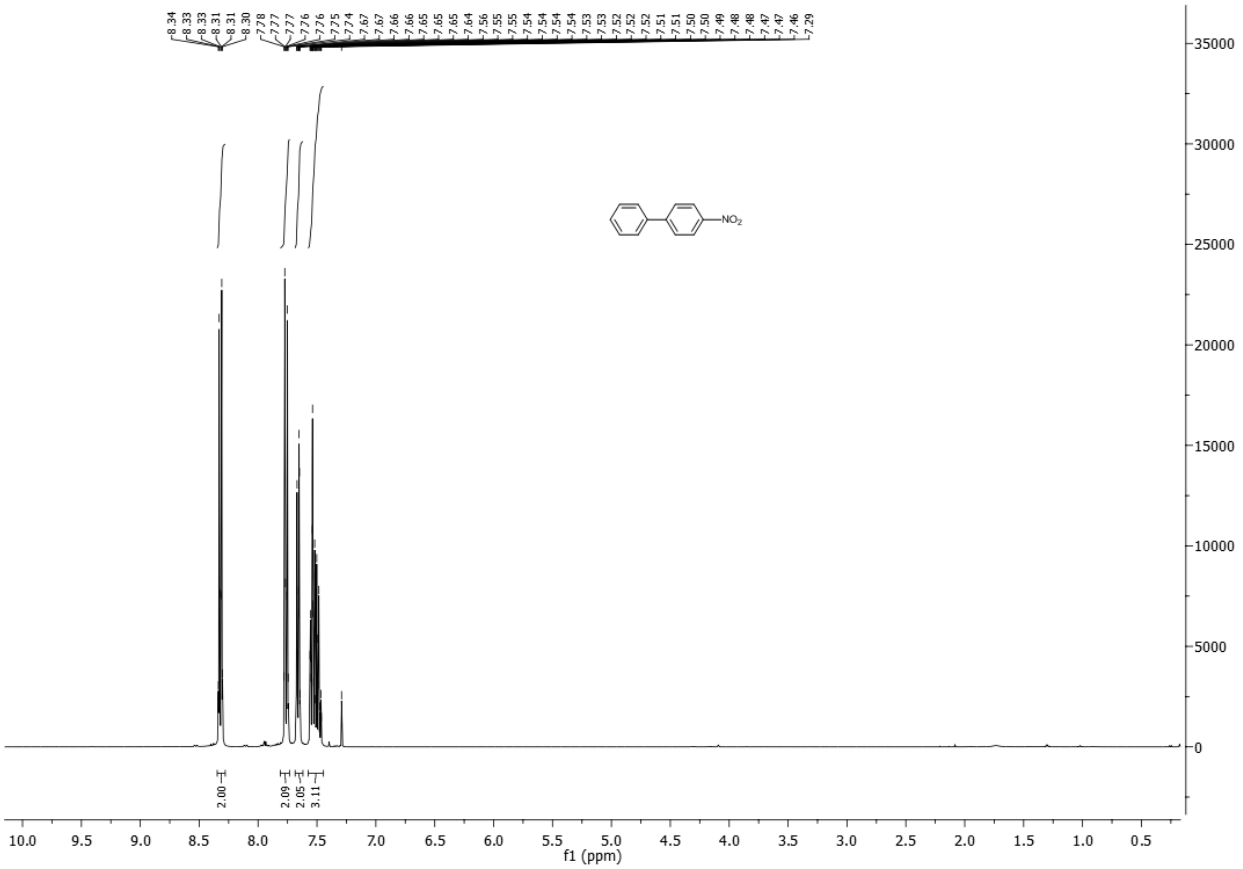
CN
f1 (ppm)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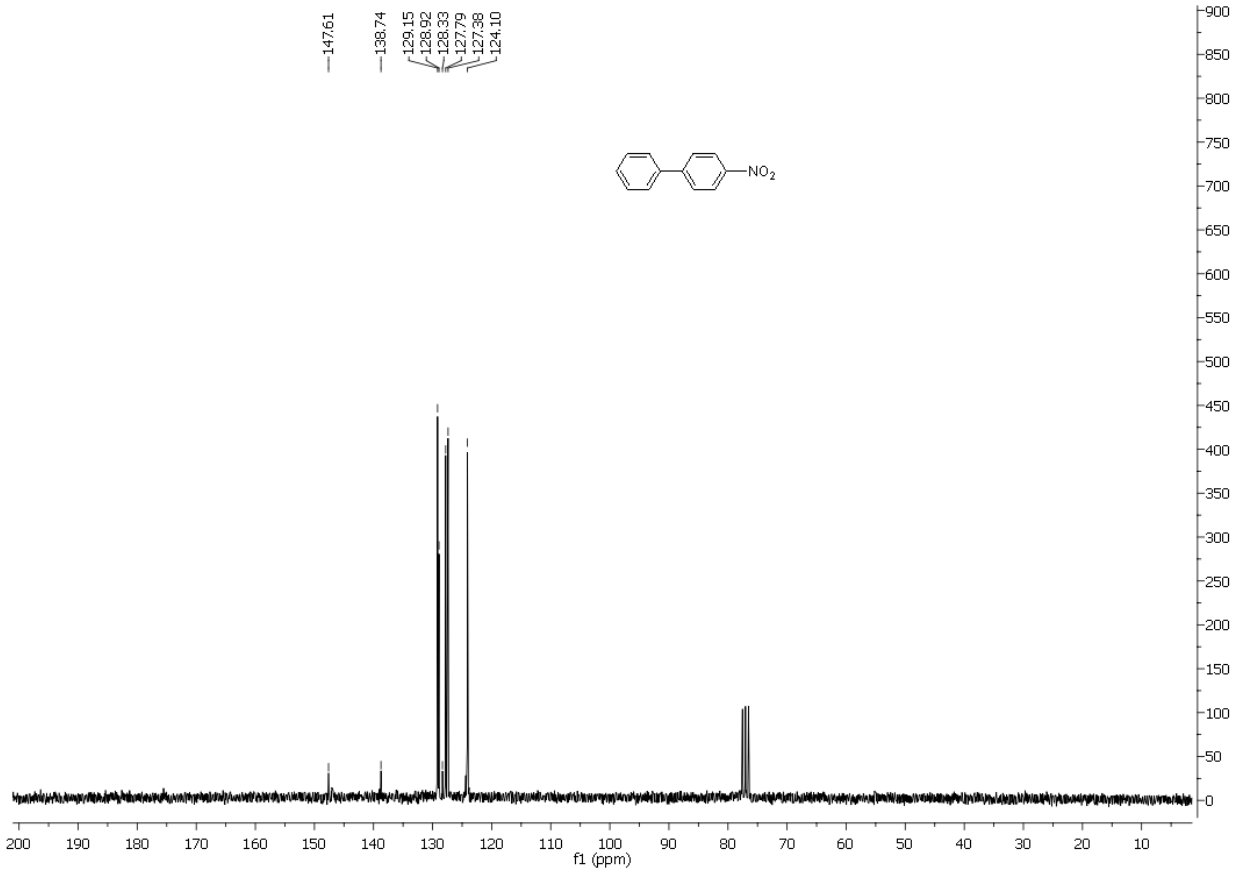
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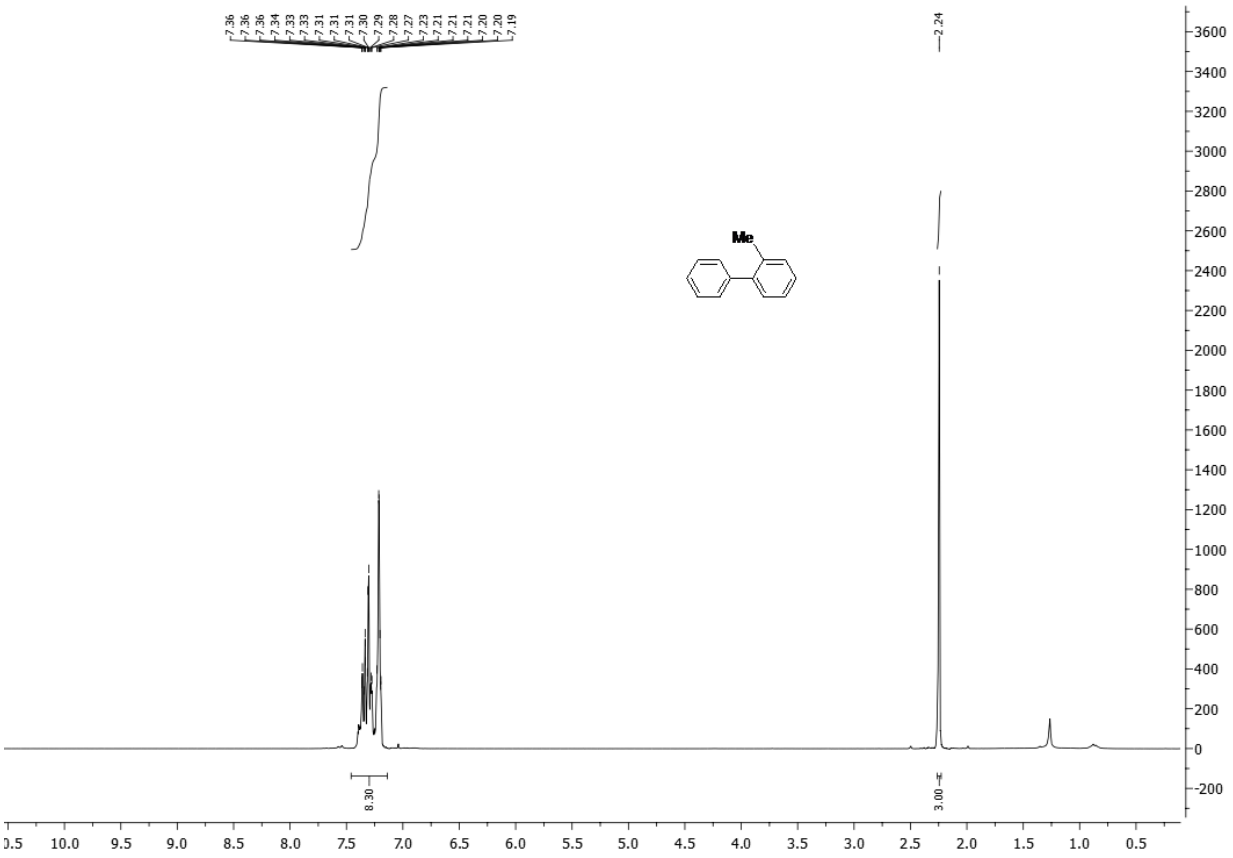
f1 (ppm)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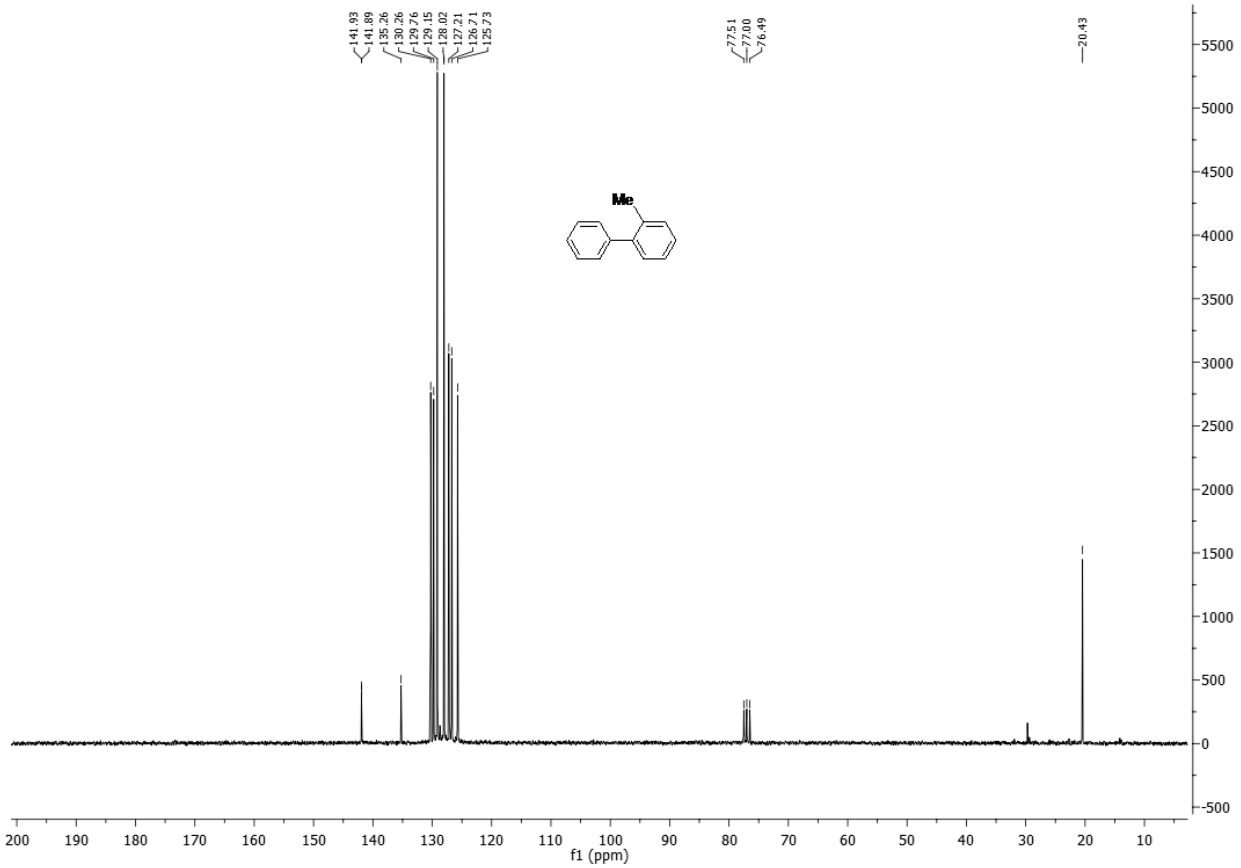
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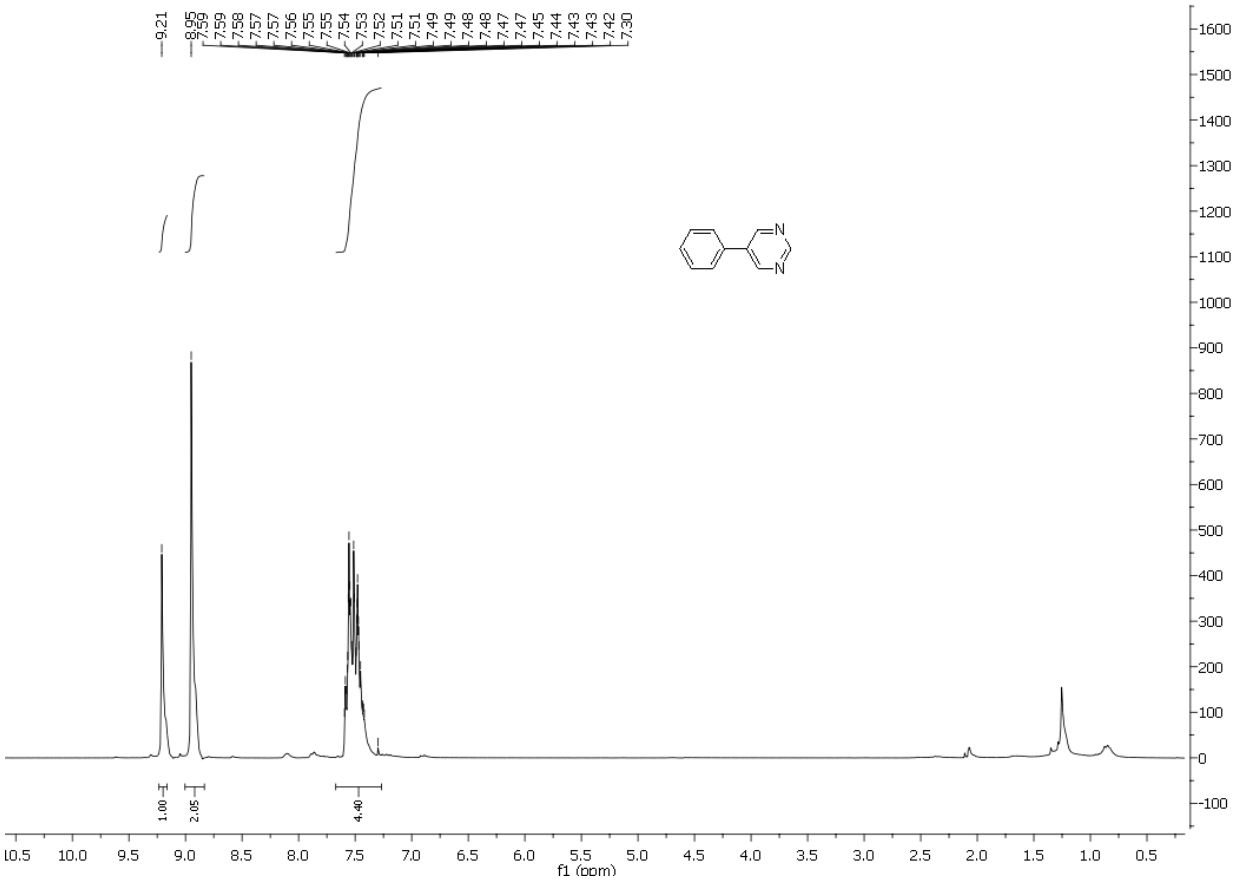
f1 (ppm)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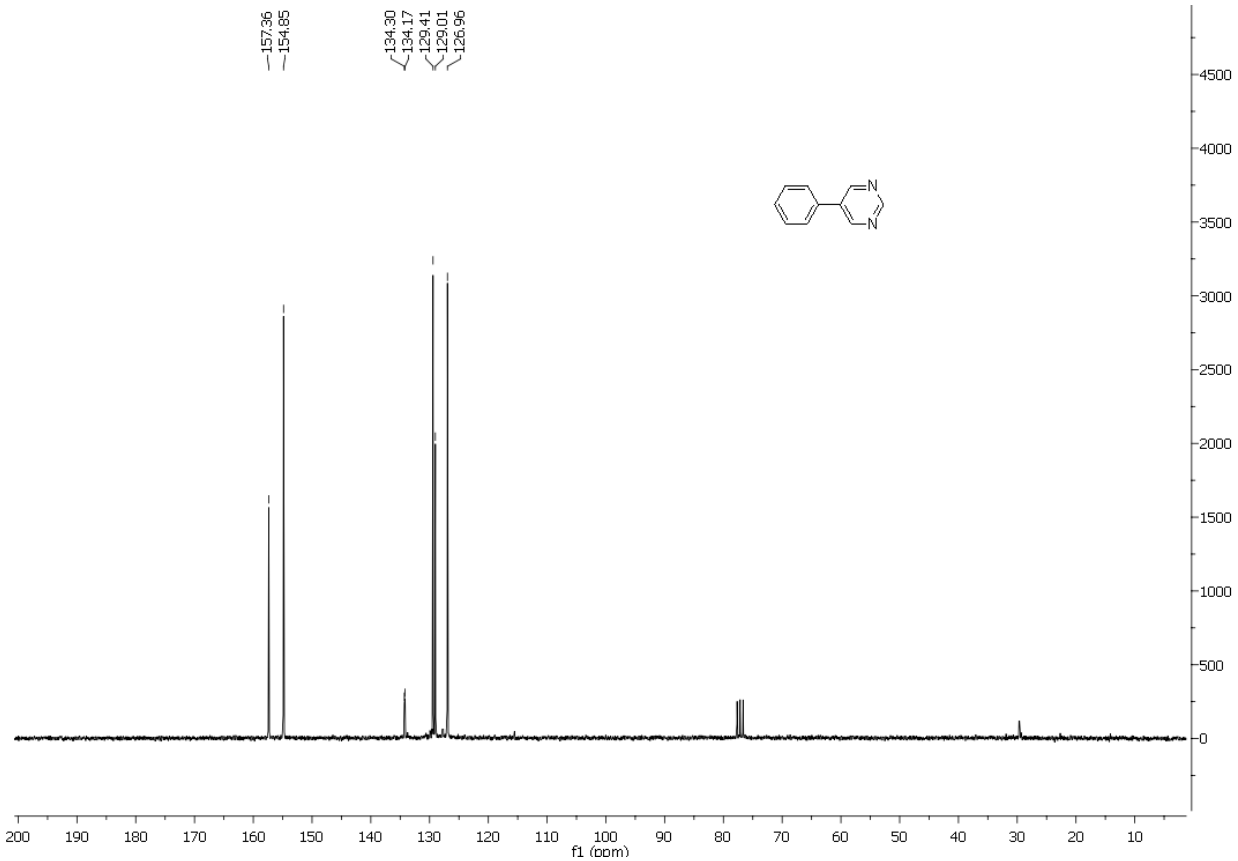
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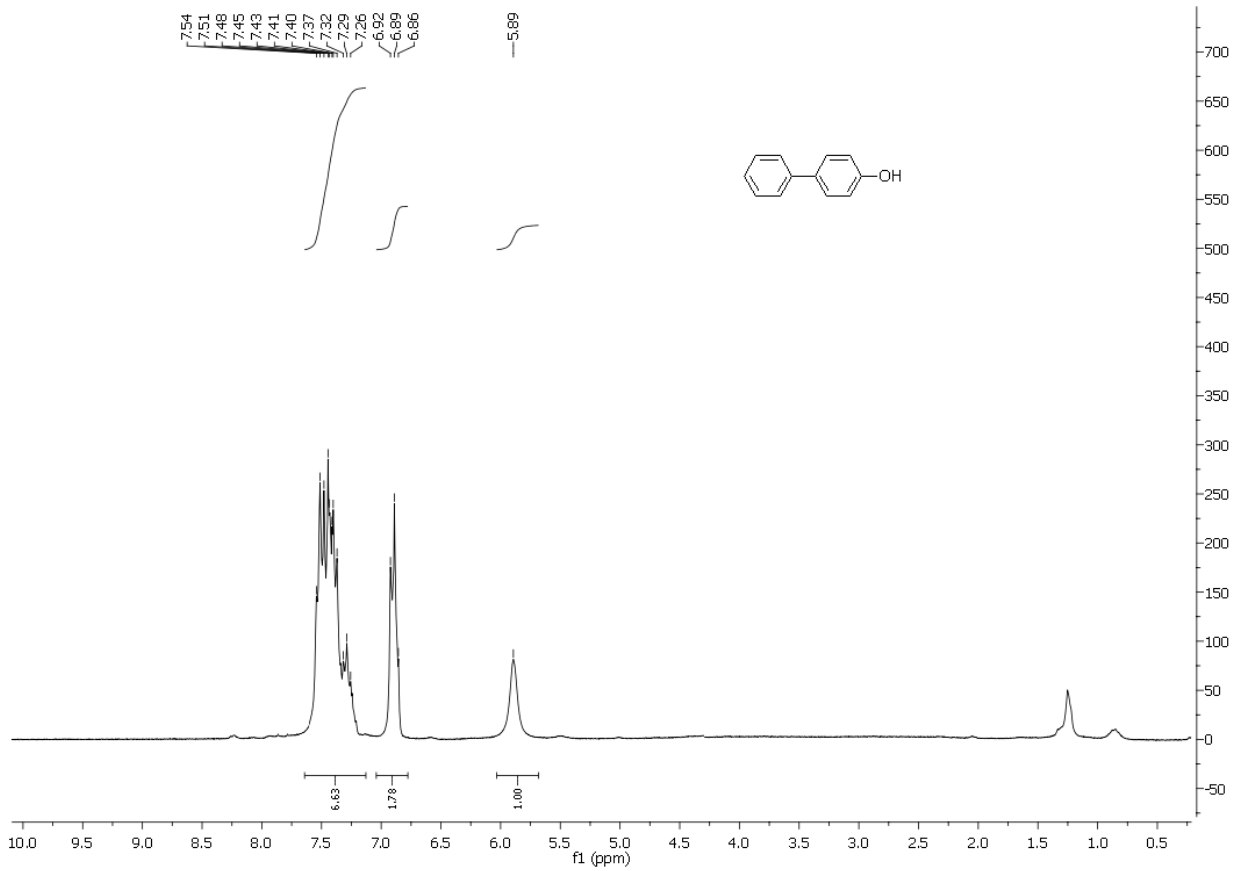
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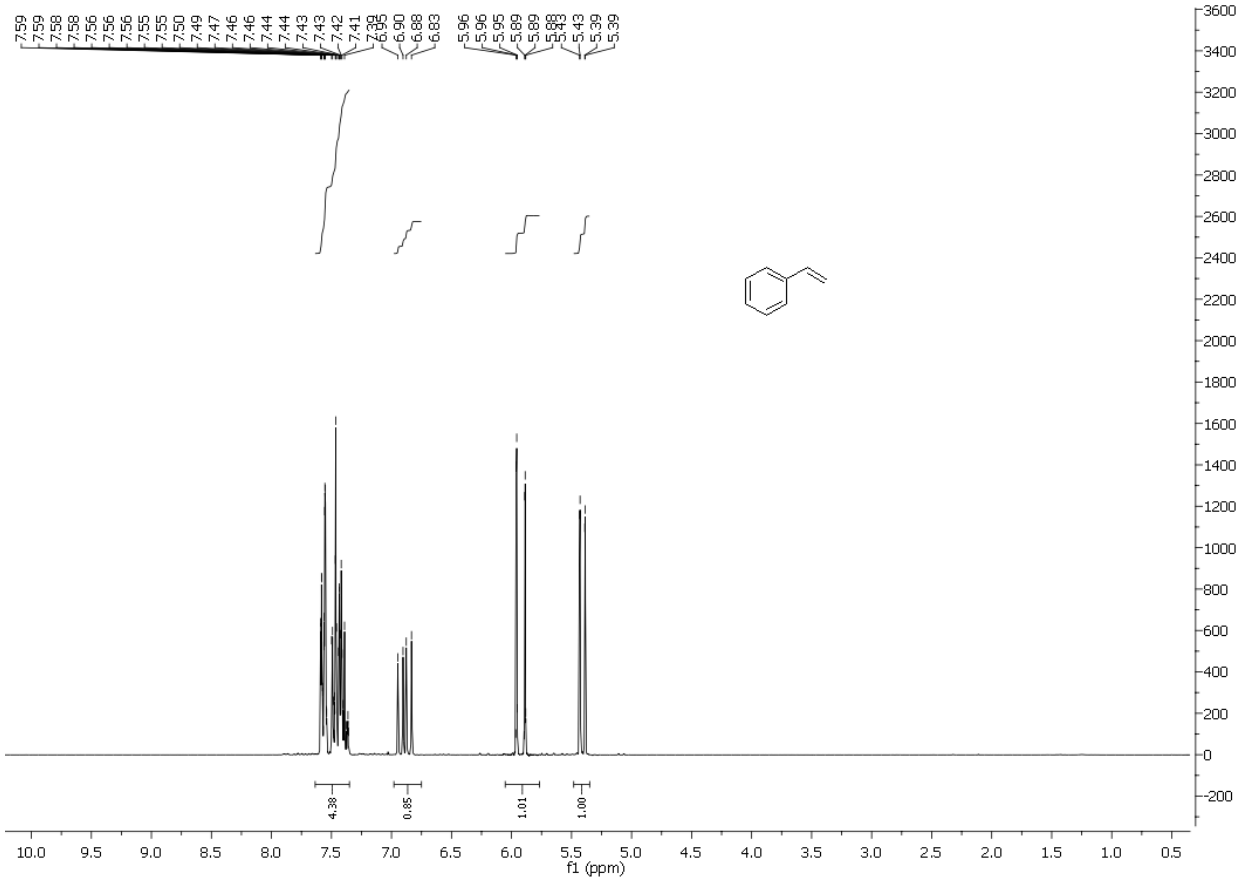
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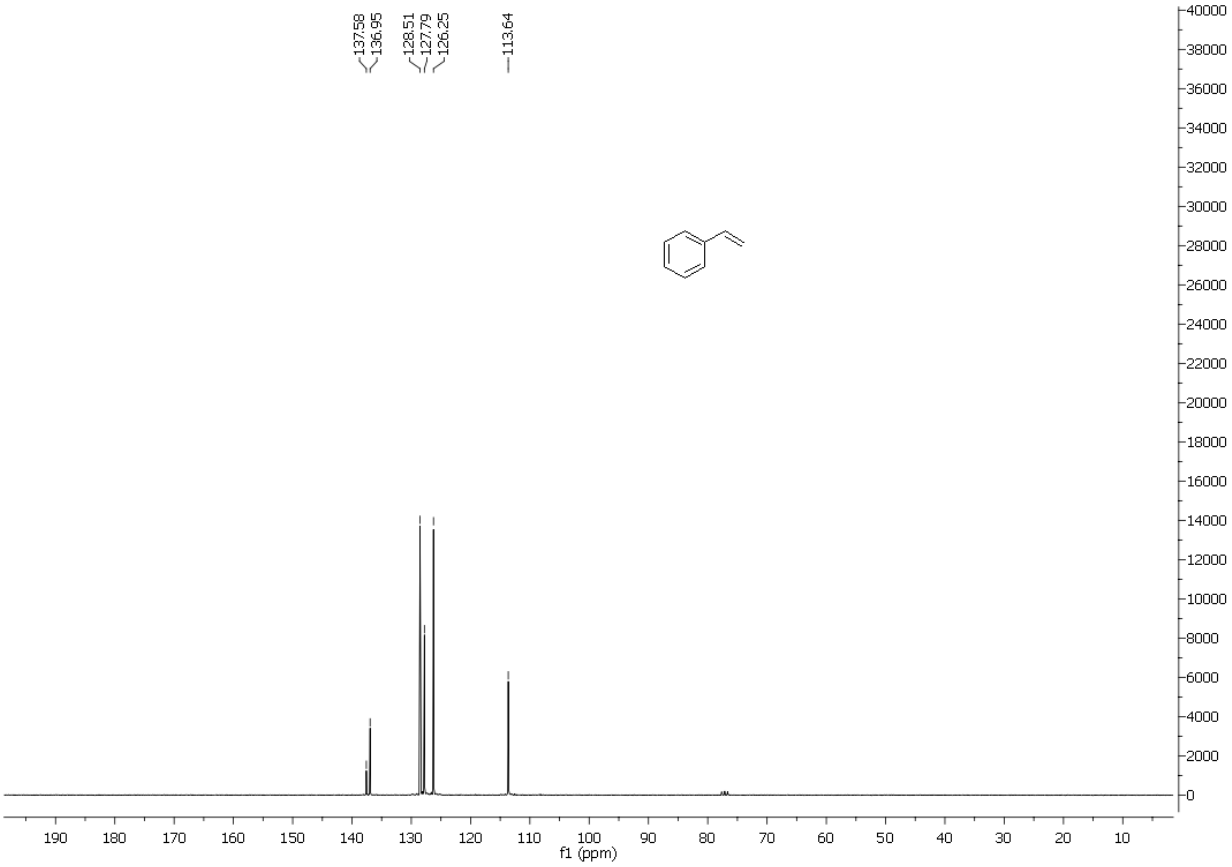
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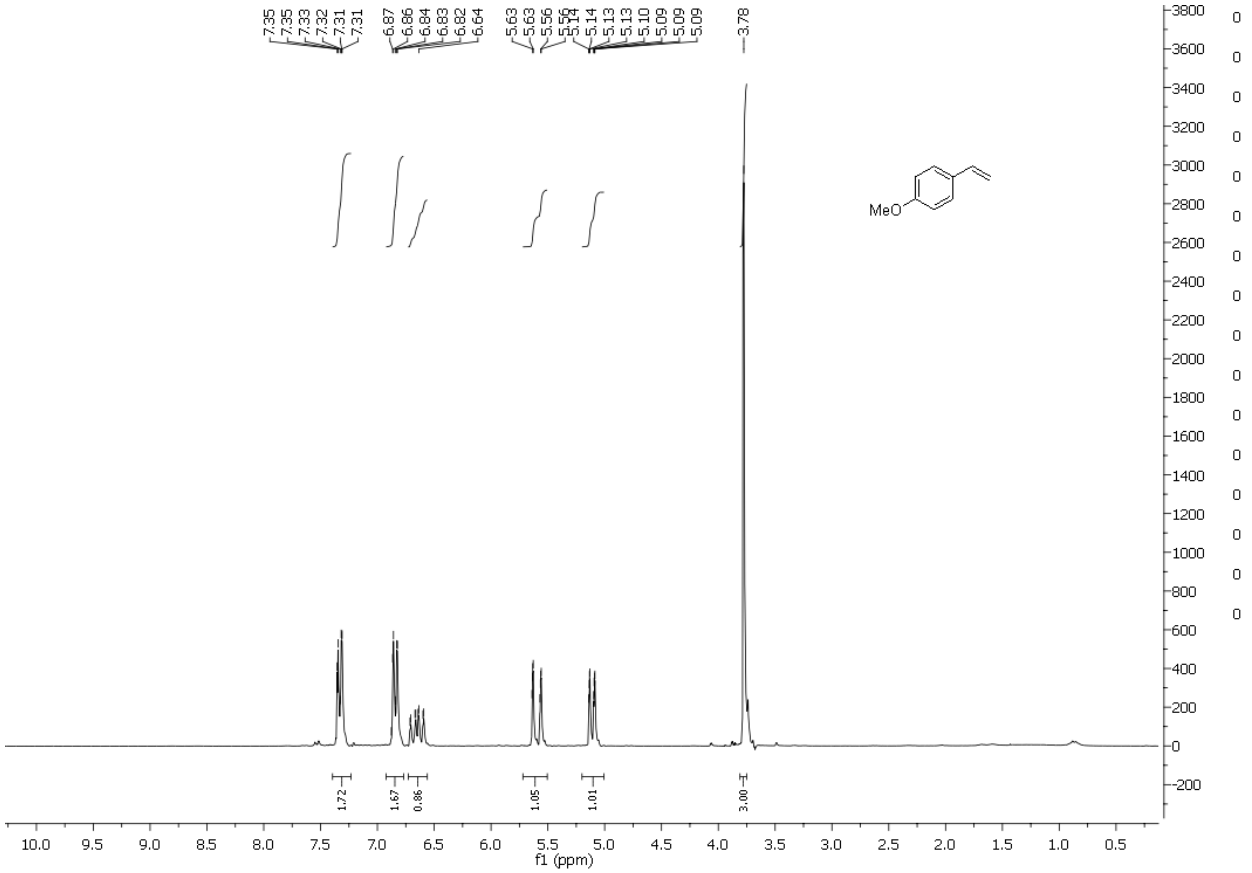
f1 (ppm)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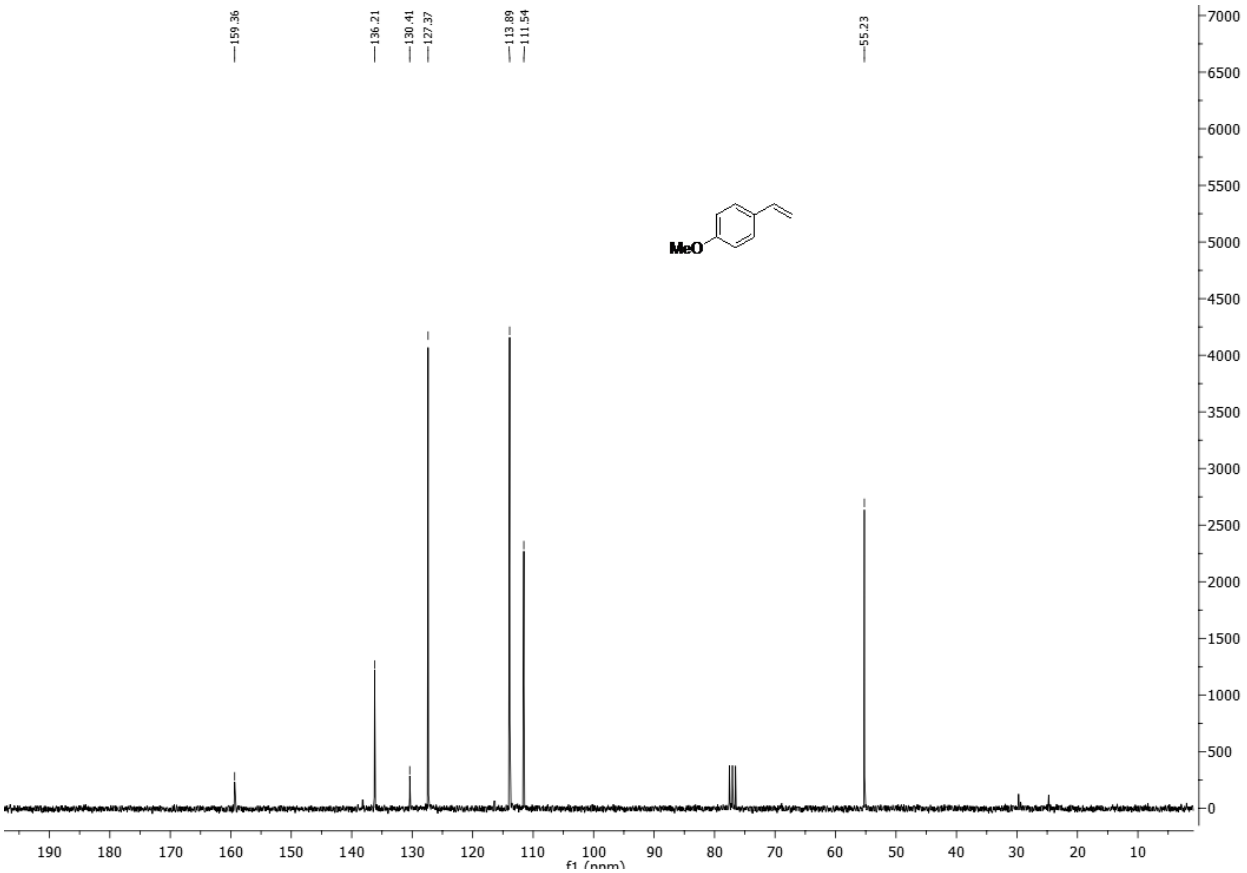
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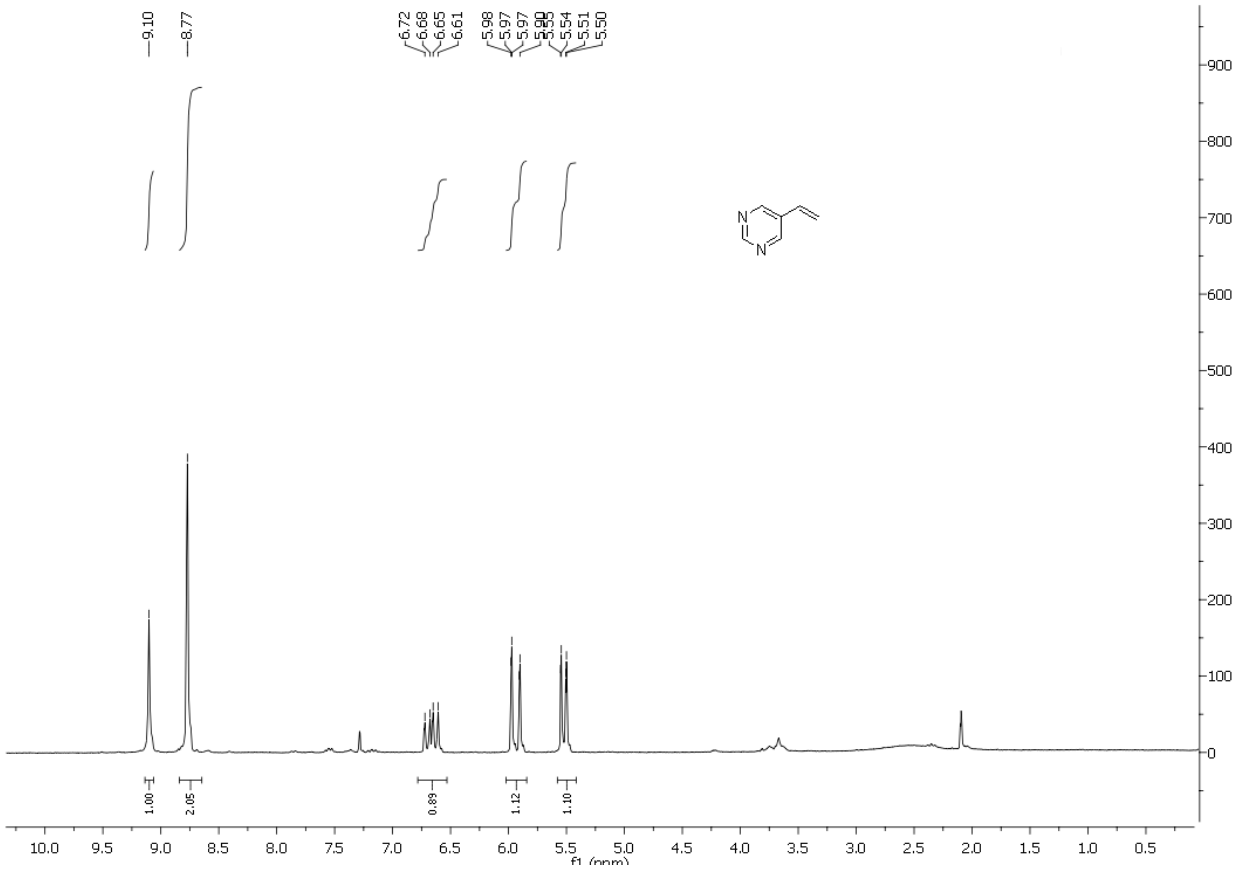
f1 (ppm)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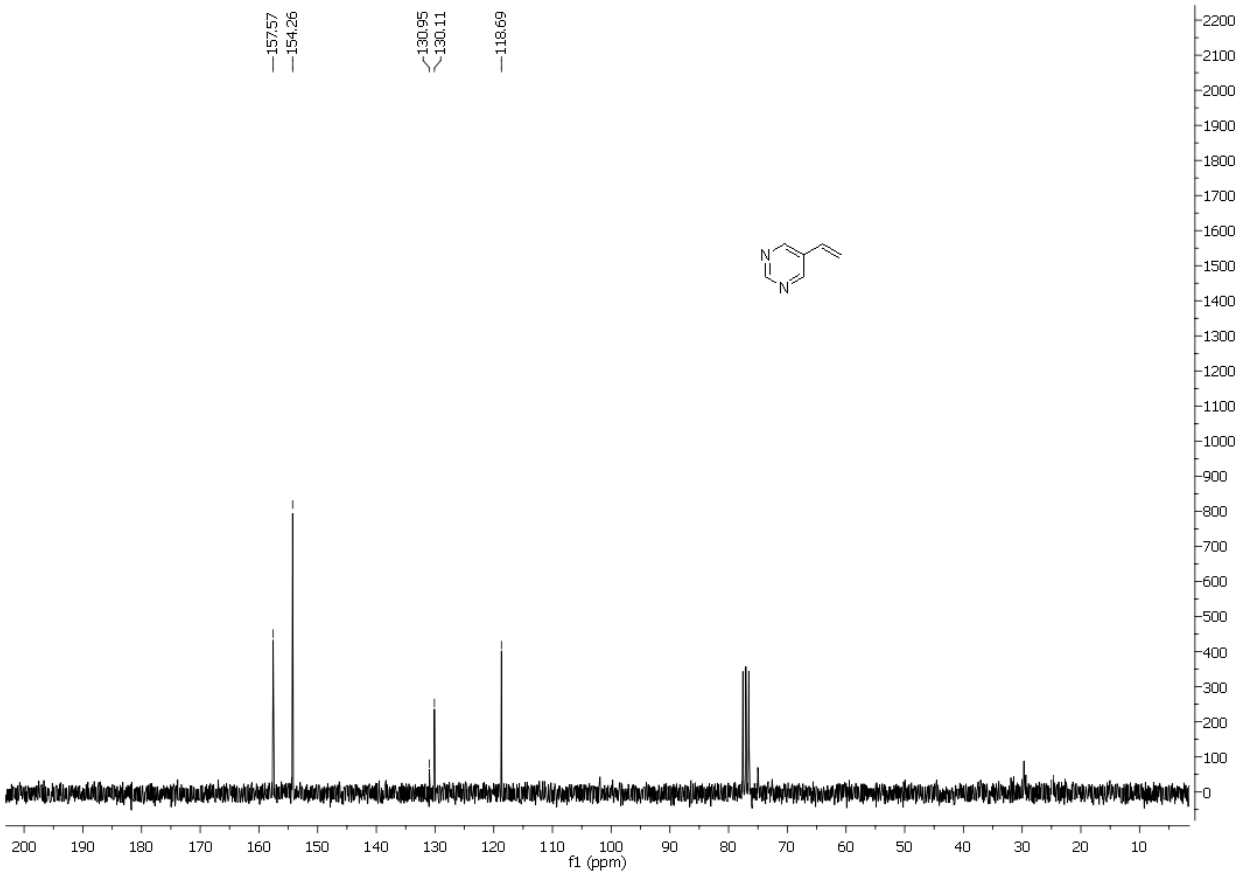
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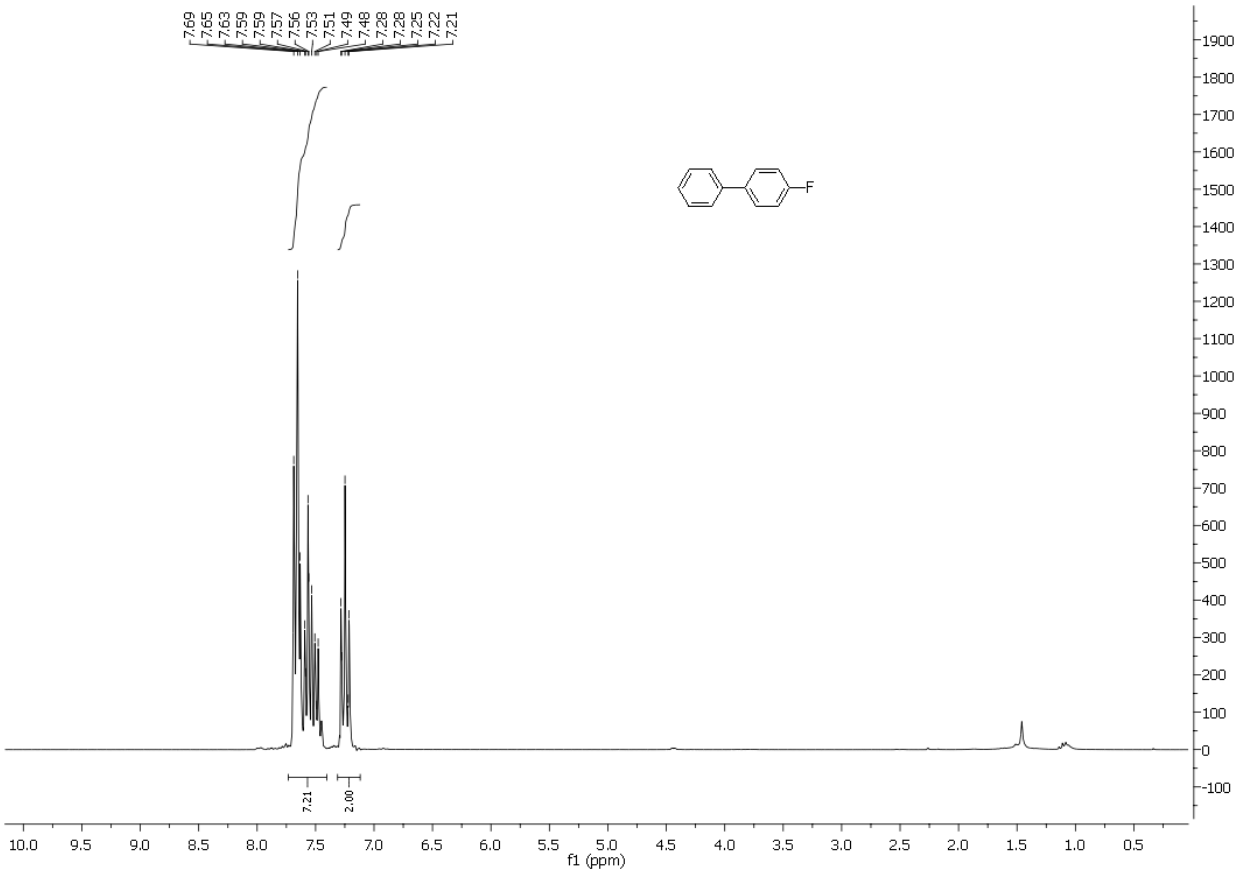
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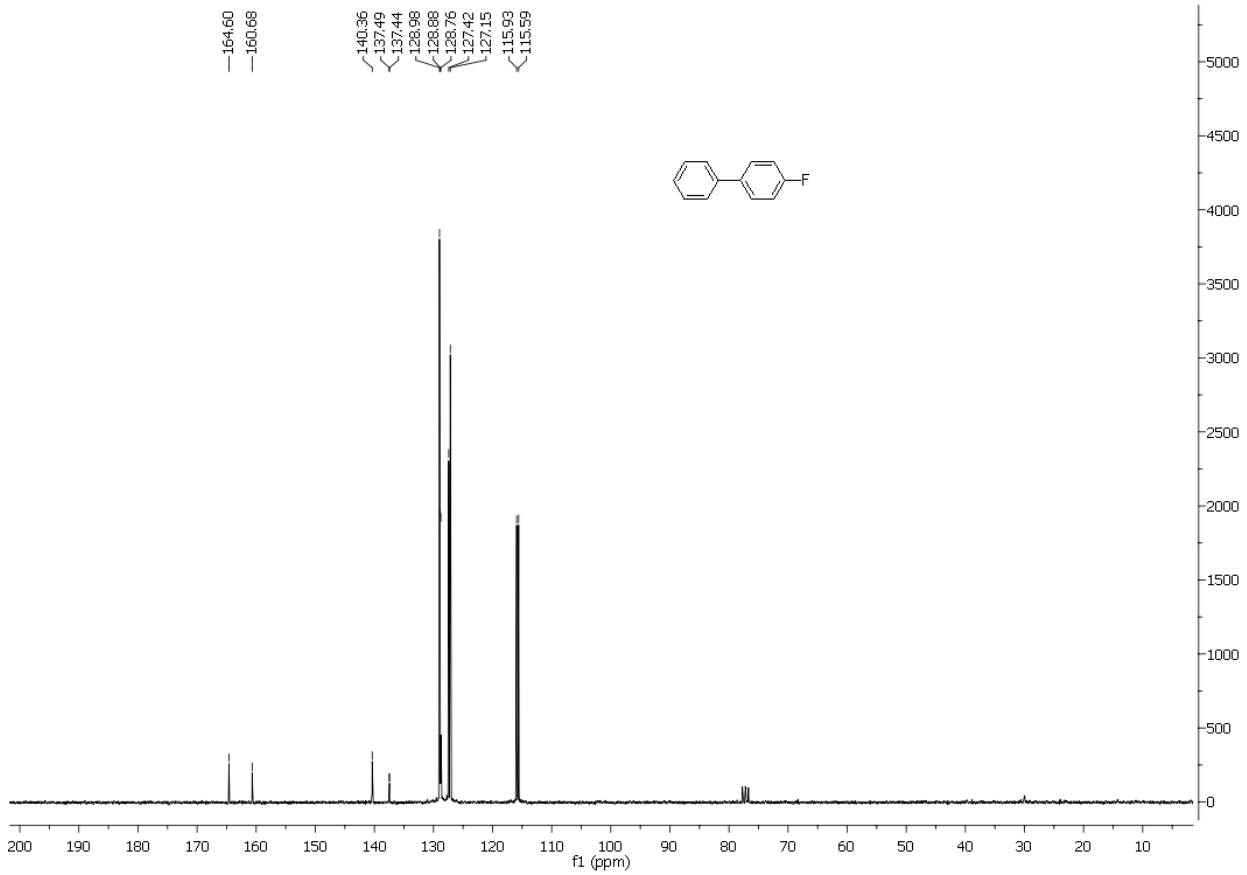
F
7.21
2.00
f1 (ppm)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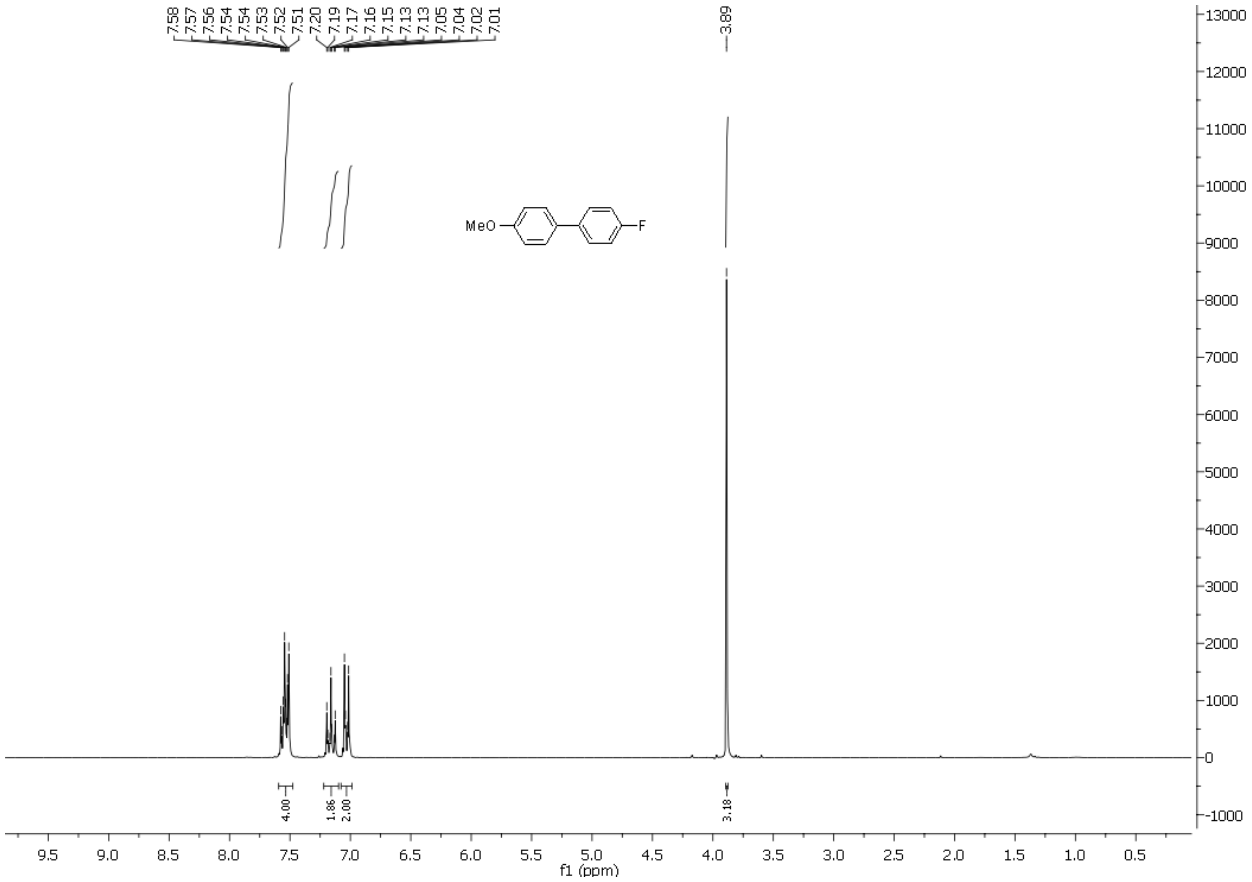
140.36
137.49
137.44
128.98
128.88
128.76
127.42
127.15
115.93
115.59
F
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)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7.51
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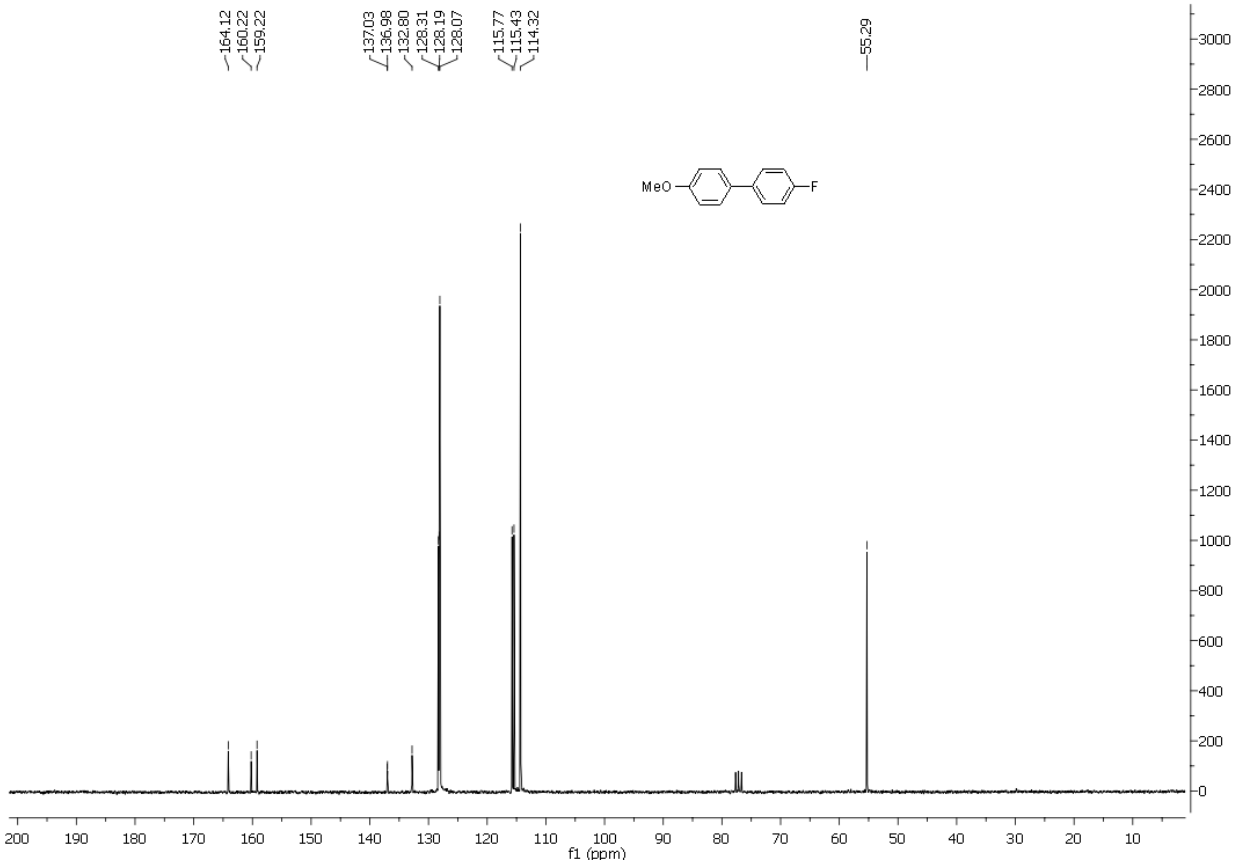
7.17
7.16
7.15
7.13
7.13
7.05
7.04
7.02
7.01
3.89
MeO
F
4.00
1.86
2.00
3.18
f1 (ppm)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160.22
159.22
137.03
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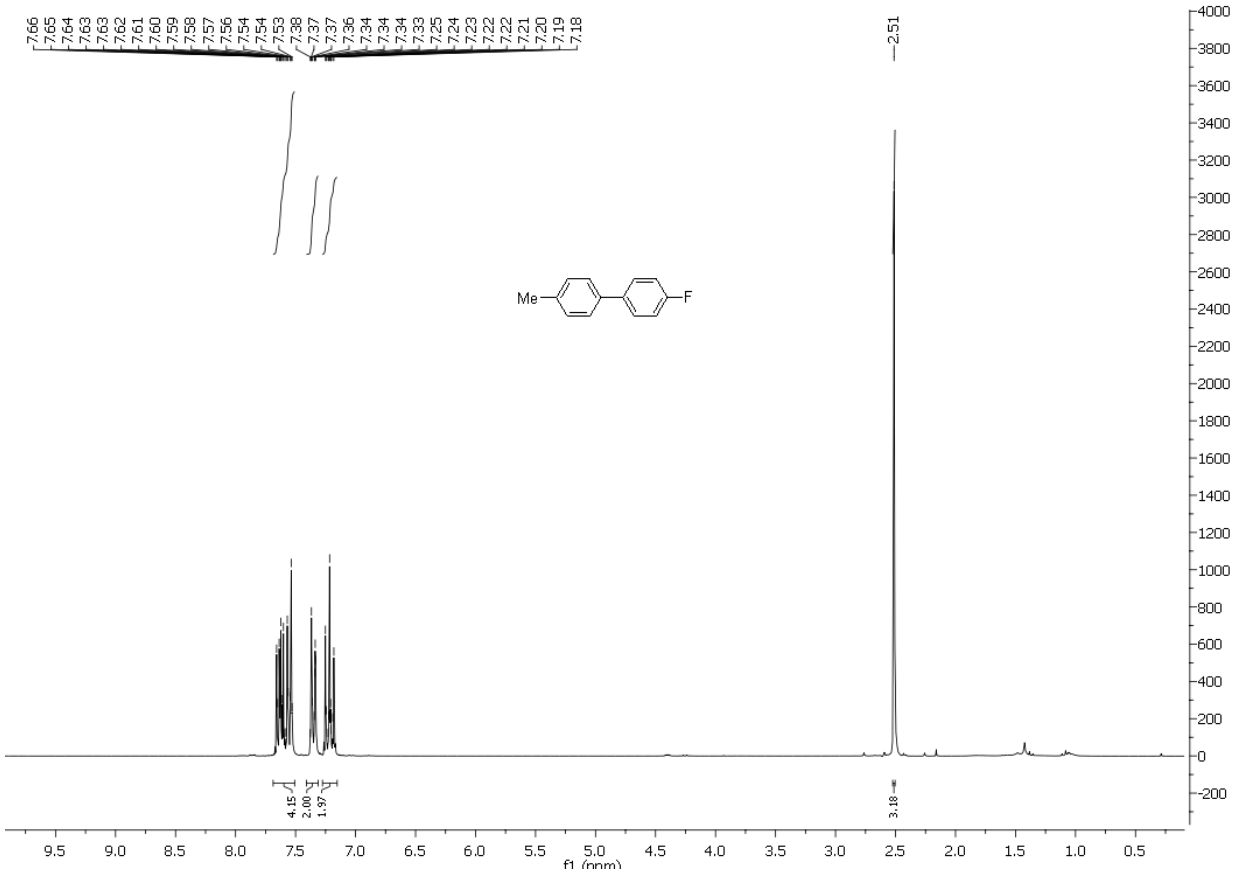
132.80
128.31
128.19
128.07
115.77
115.43
114.32
55.29
MeO
F
f1 (ppm)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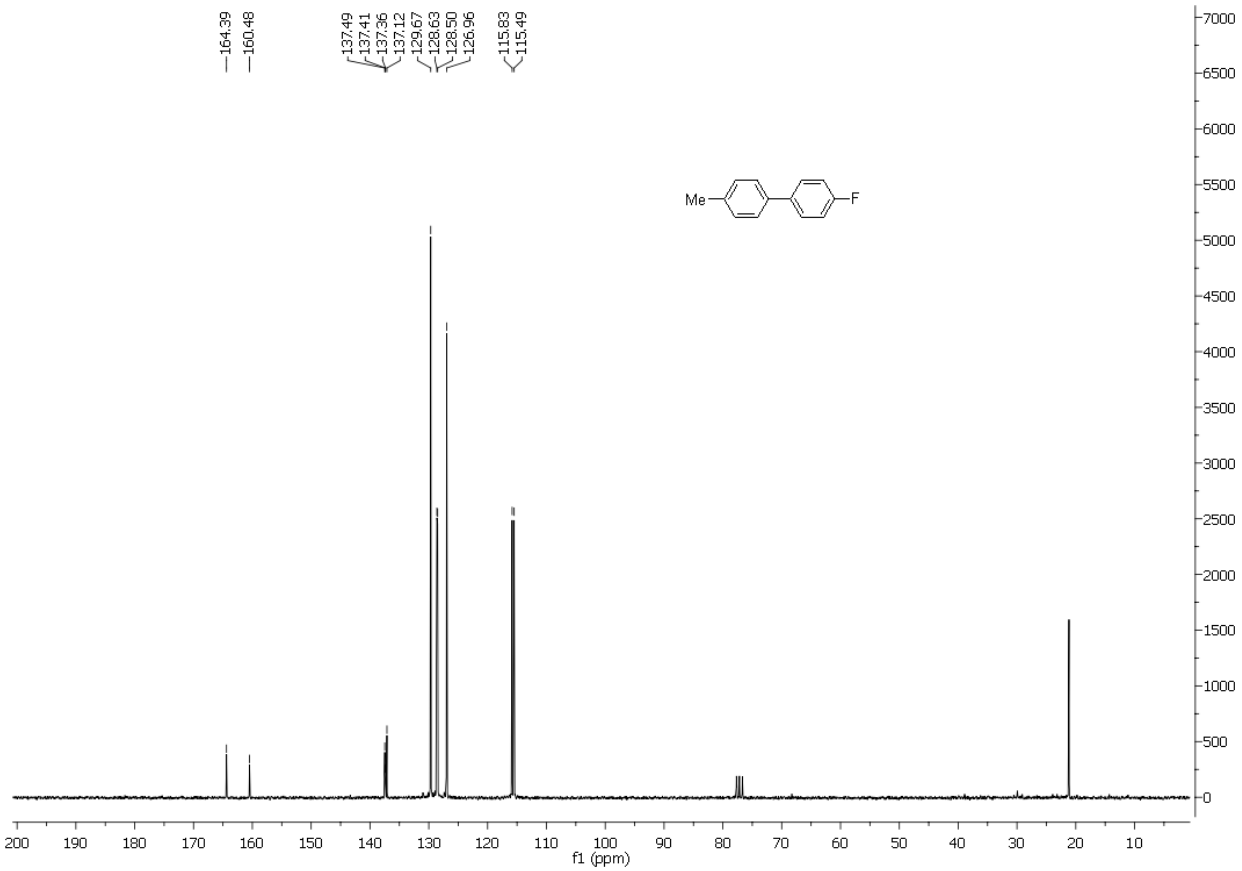
7.56
7.54
7.54
7.53
7.38
7.37
7.37
7.36
7.34
7.34
7.34
7.33
7.25
7.24
7.23
7.22
7.22
7.21
7.20
7.19
7.18
2.51
Me
F
4.15
2.00
1.97
3.18
f1 (ppm)


164.39
160.48
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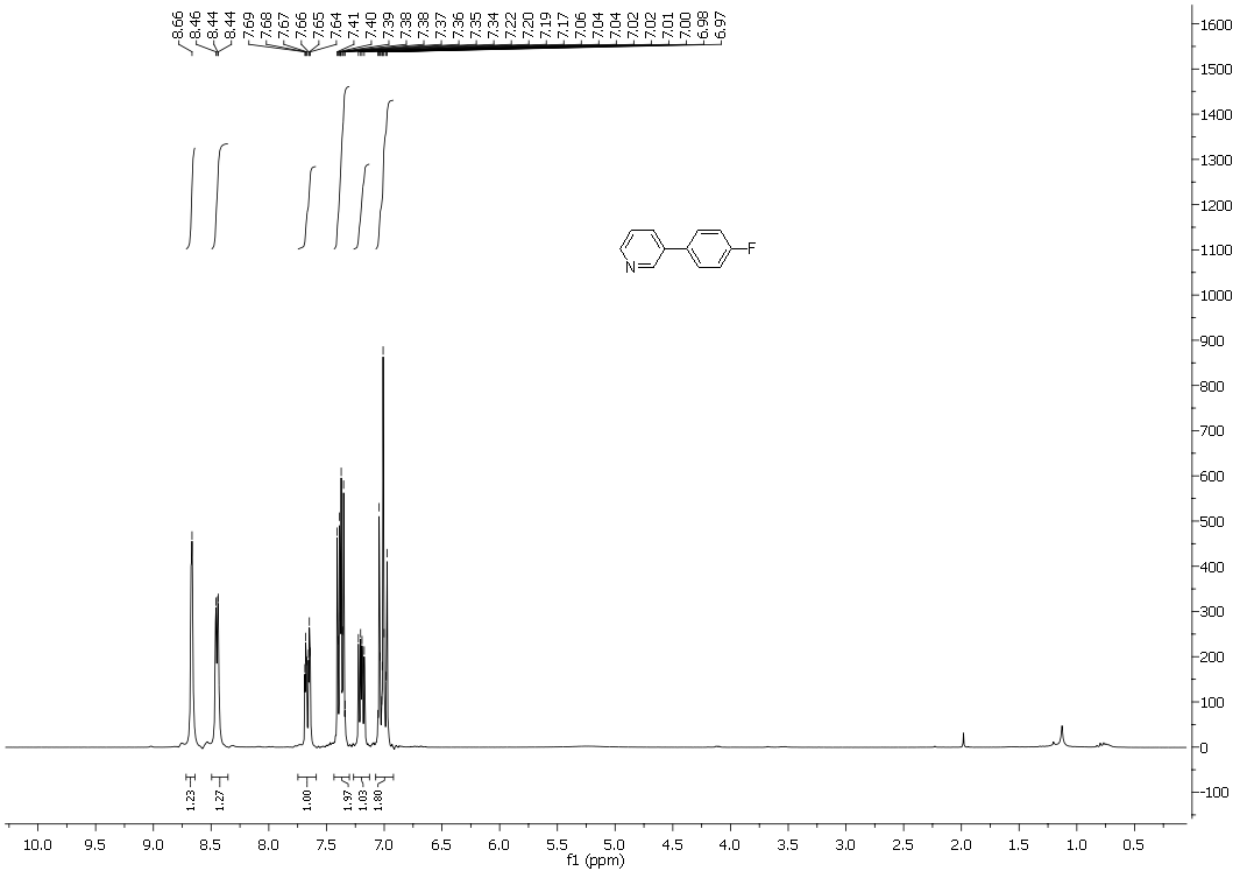
137.36
137.12
129.67
128.63
128.50
126.96
115.83
115.49
Me
F
f1 (ppm)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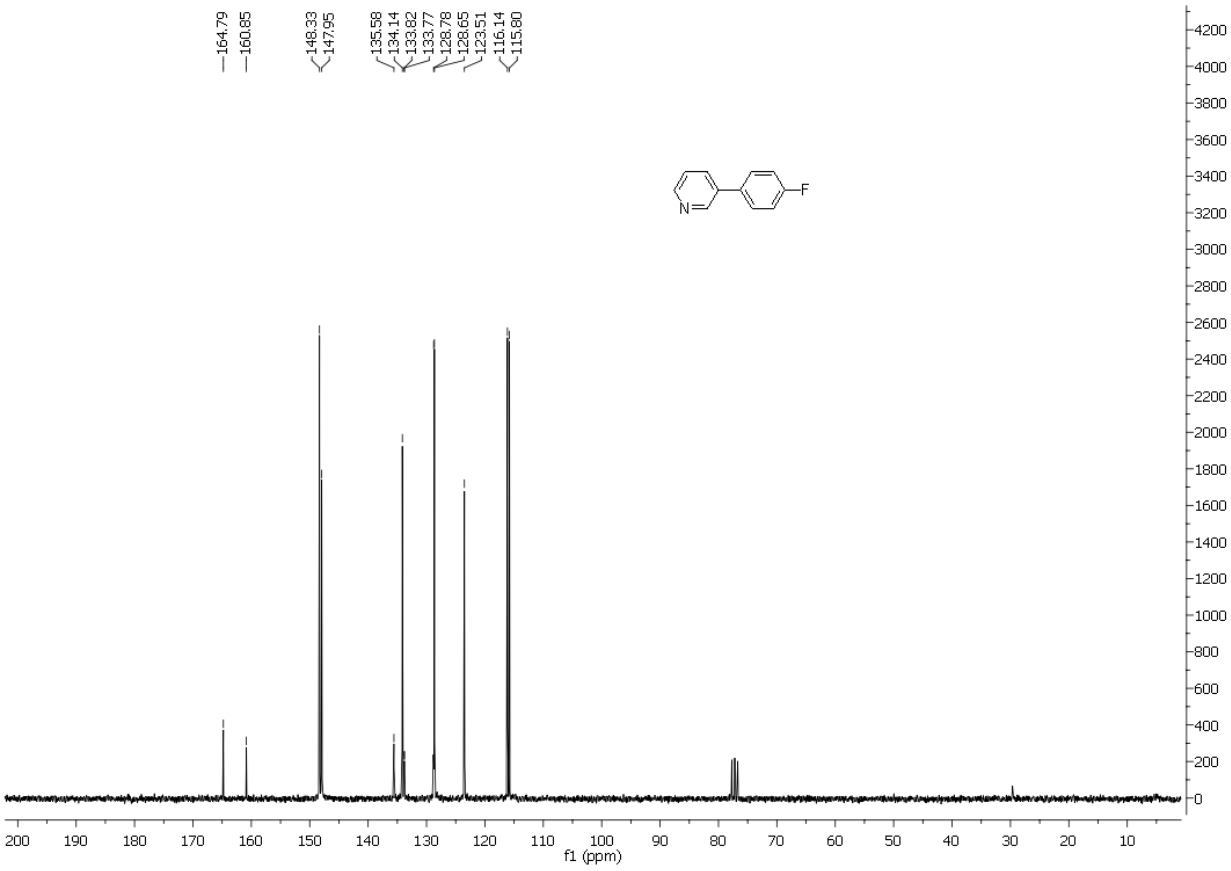
7.68
7.67
7.66
7.65
7.64
7.41
7.40
7.39
7.38
7.38
7.37
7.36
7.35
7.34
7.22
7.20
7.19
7.17
7.06
7.04
7.04
7.02
7.02
7.01
7.00
6.98
6.97
N
F
1.23
1.27
1.00
1.97
1.03
1.80
f1 (ppm)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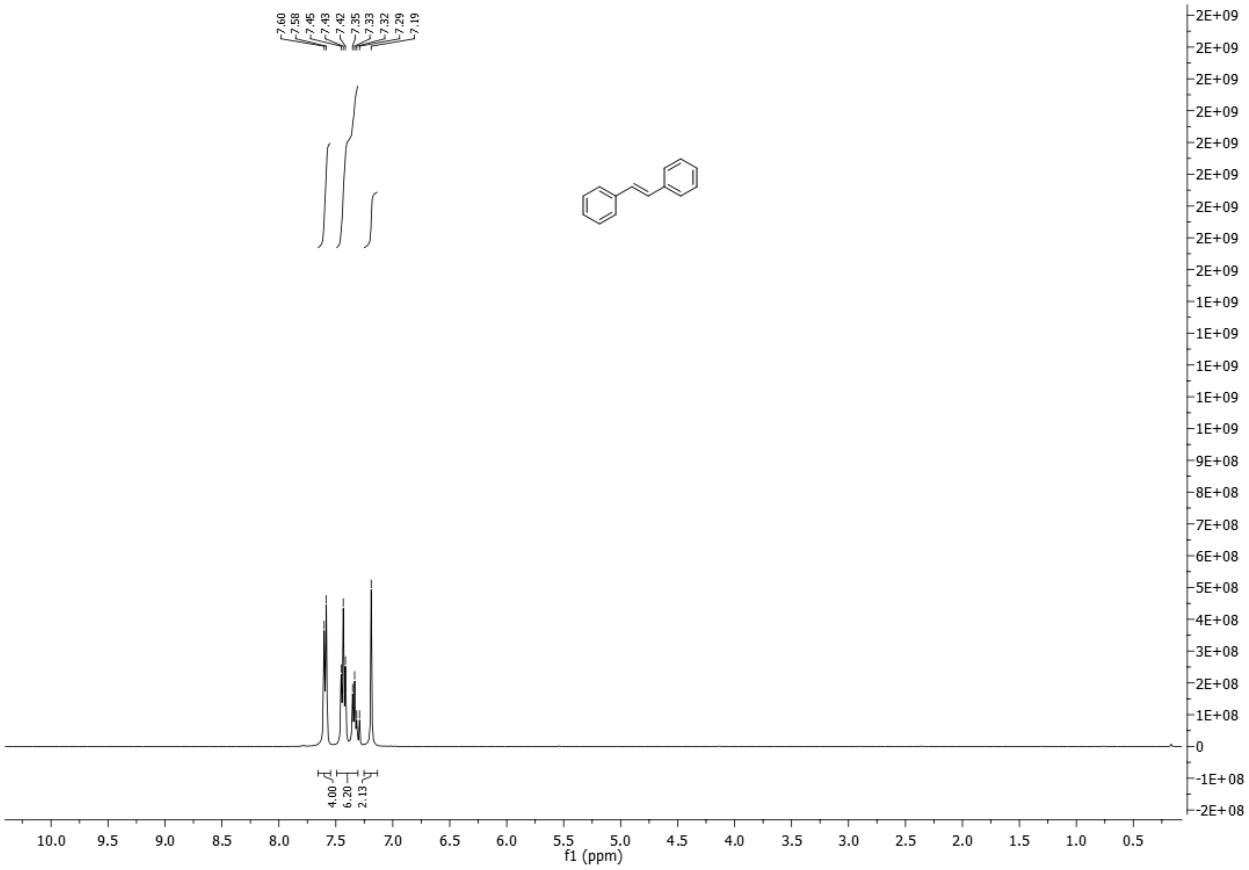
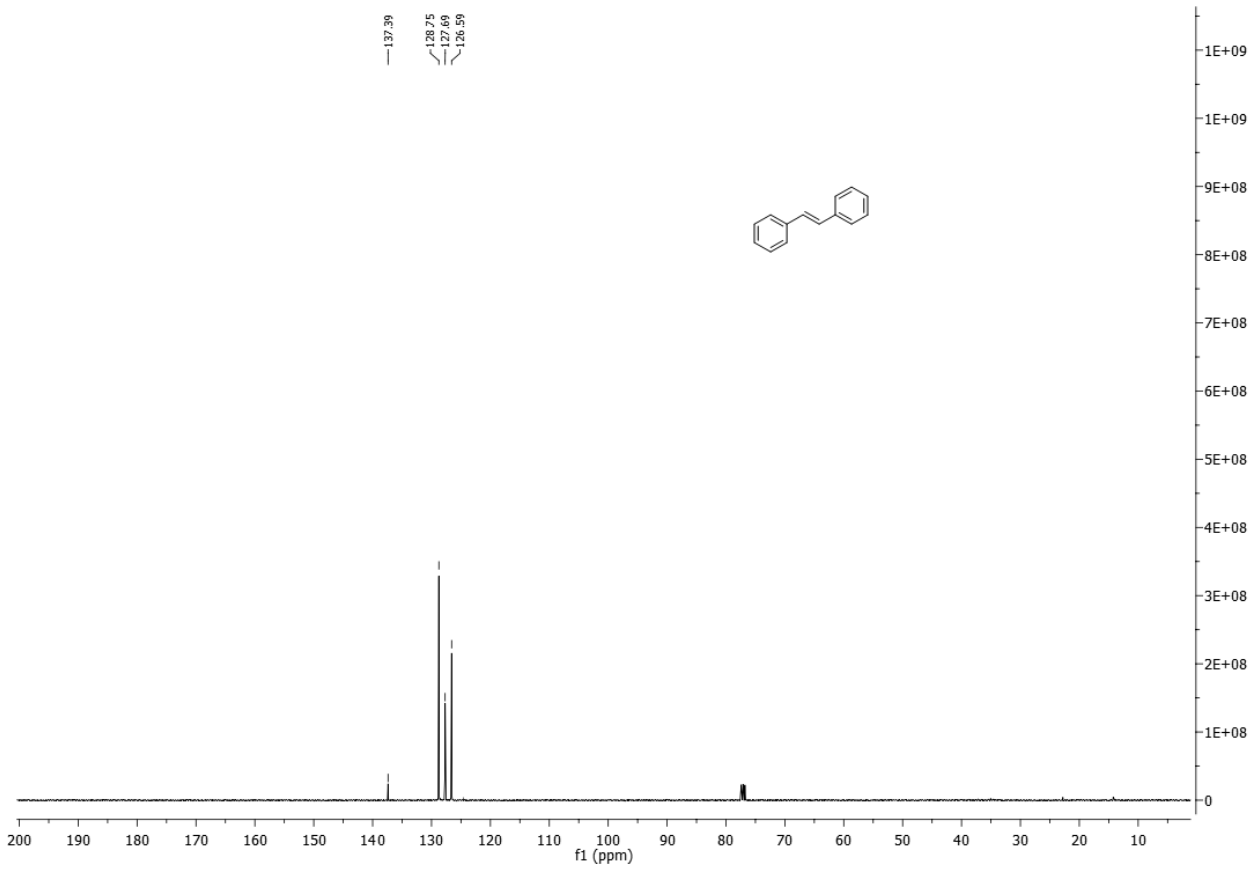
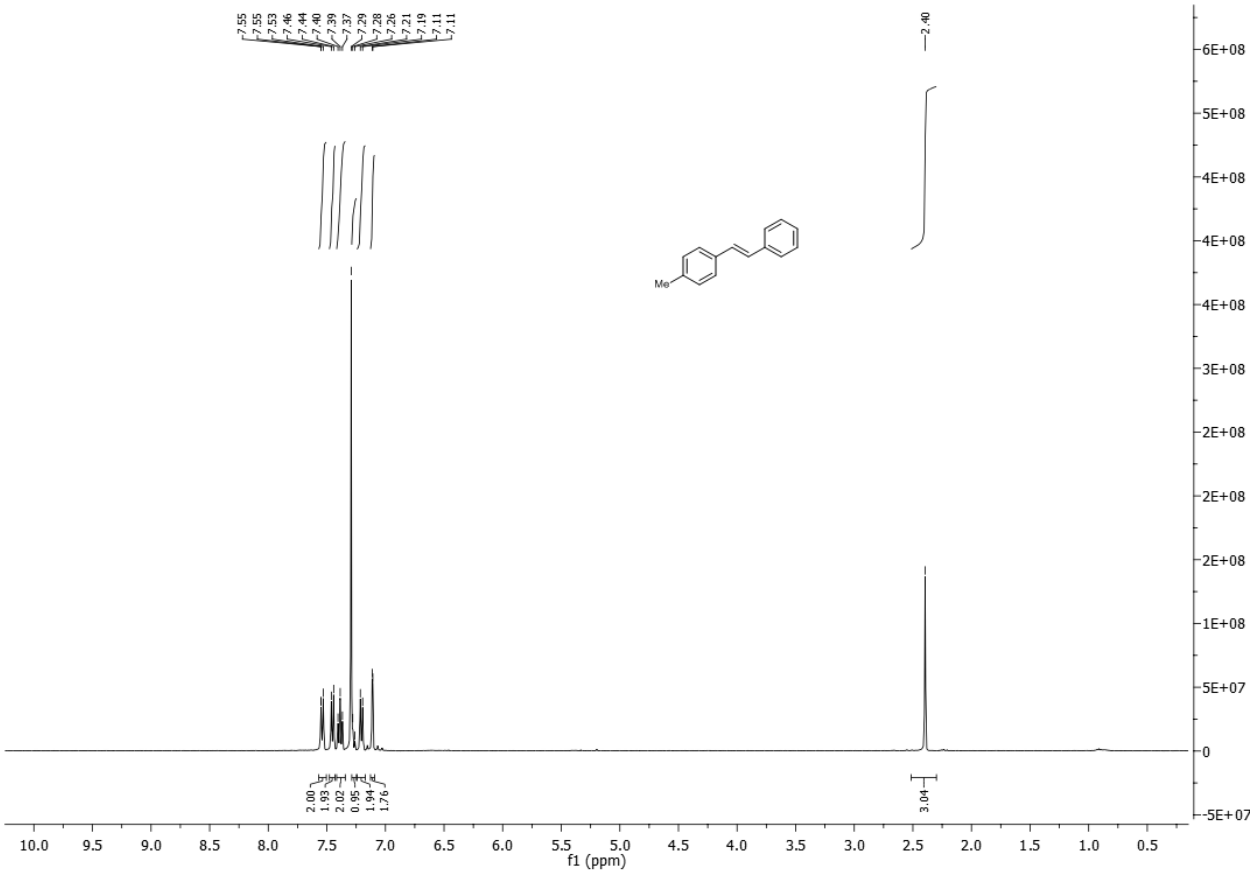
148.33
147.95
135.58
134.14
133.82
133.77
128.78
128.65
123.51
116.14
115.80
N
F
f1 (ppm)


7.60
7.58
7.45
7.43
7.42
7.35
7.33
7.32
7.29
7.19
4.00
6.20
2.13
10.0
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
f1 (ppm)
2E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
-1E+08
-2E+08


137.39
128.75
127.69
126.59
1E+09
1E+09
9E+08
8E+08
7E+08
6E+08
5E+08
4E+08
3E+08
2E+08
1E+08
0
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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7.55
7.53
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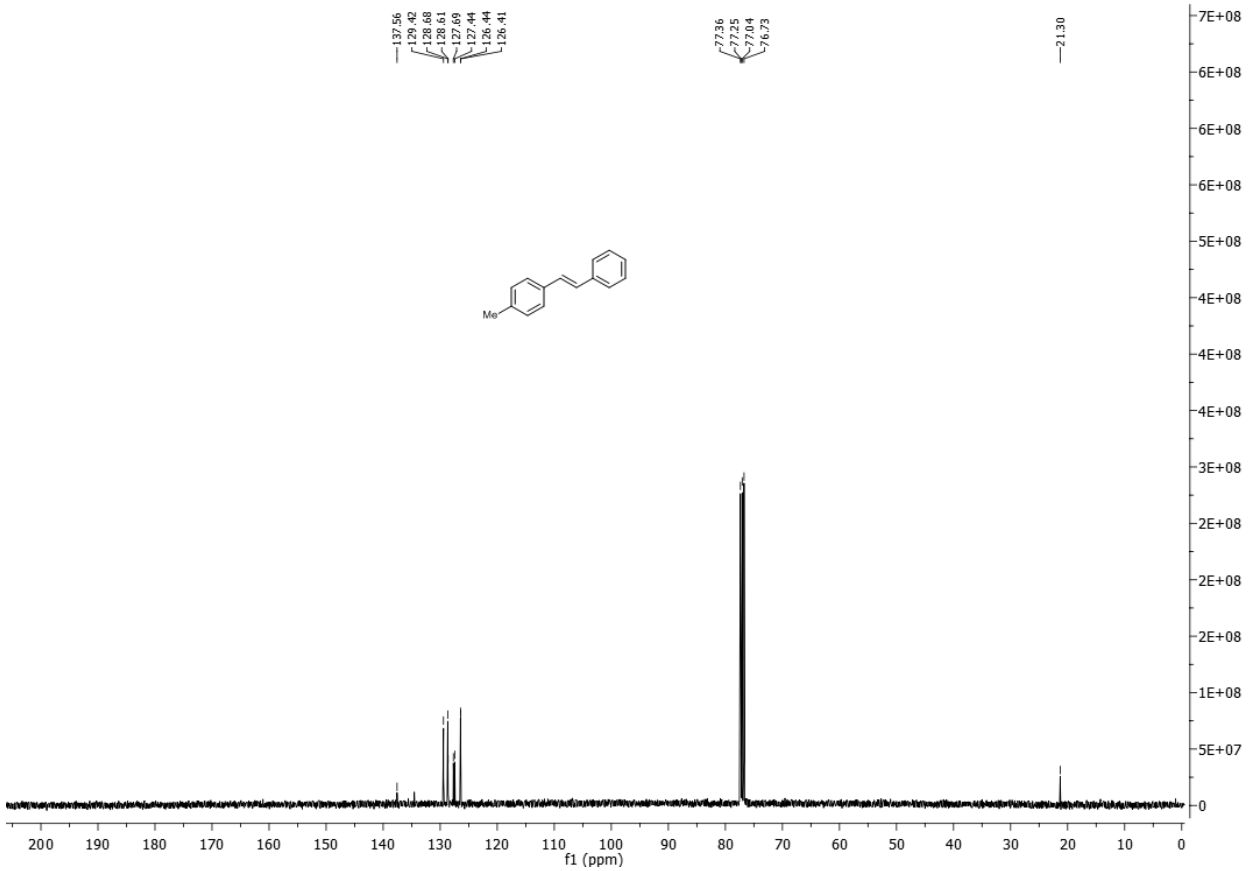
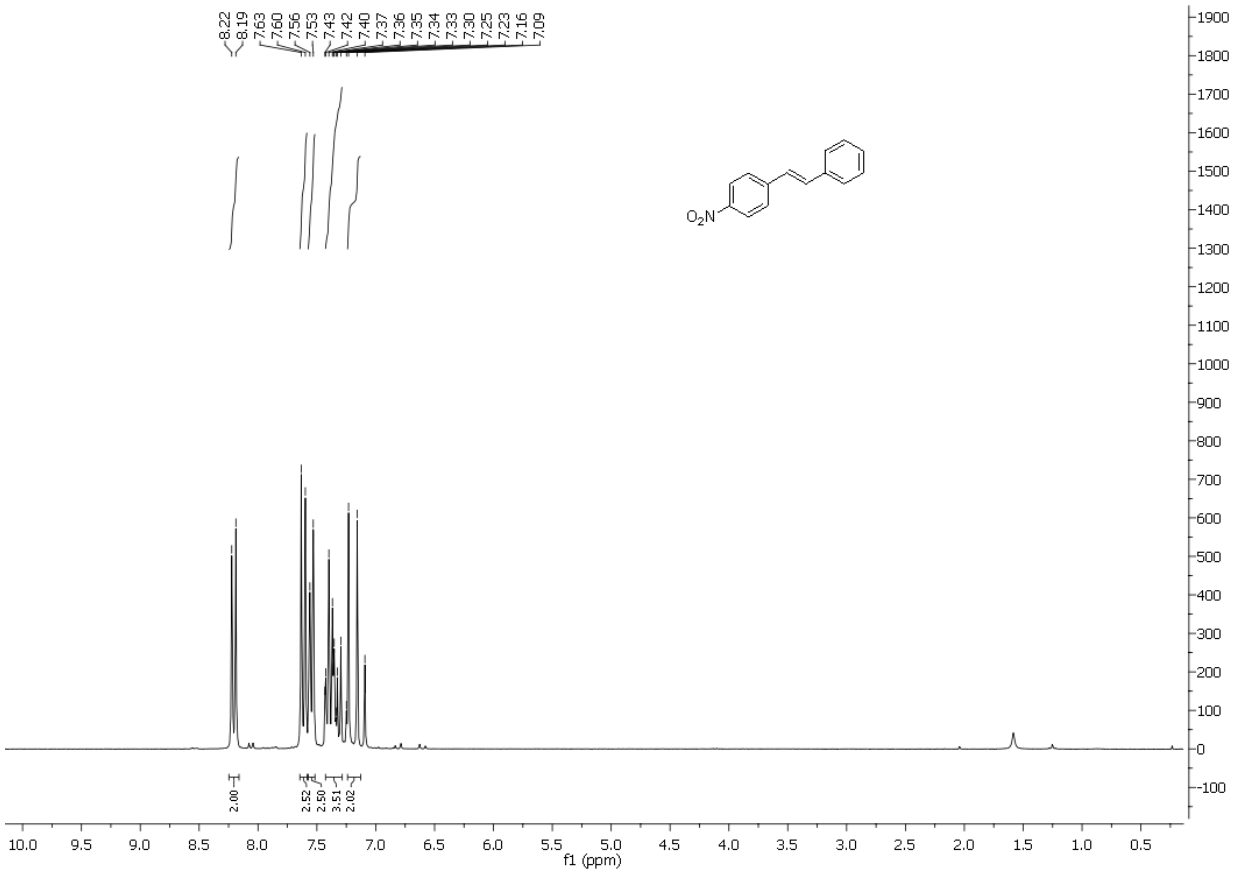
7.44
7.40
7.39
7.37
7.29
7.28
7.26
7.21
7.19
7.11
7.11
2.40
Me
2.00
1.93
2.02
0.95
1.94
1.76
3.04
6E+08
5E+08
4E+08
4E+08
4E+08
3E+08
2E+08
2E+08
2E+08
1E+08
5E+07
0
-5E+07
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)


137.56
129.42
128.68
128.61
127.69
127.44
126.44
126.41
77.36
77.25
77.04
76.73
21.30
Me
7E+08
6E+08
6E+08
6E+08
5E+08
4E+08
4E+08
4E+08
3E+08
2E+08
2E+08
2E+08
1E+08
5E+07
0
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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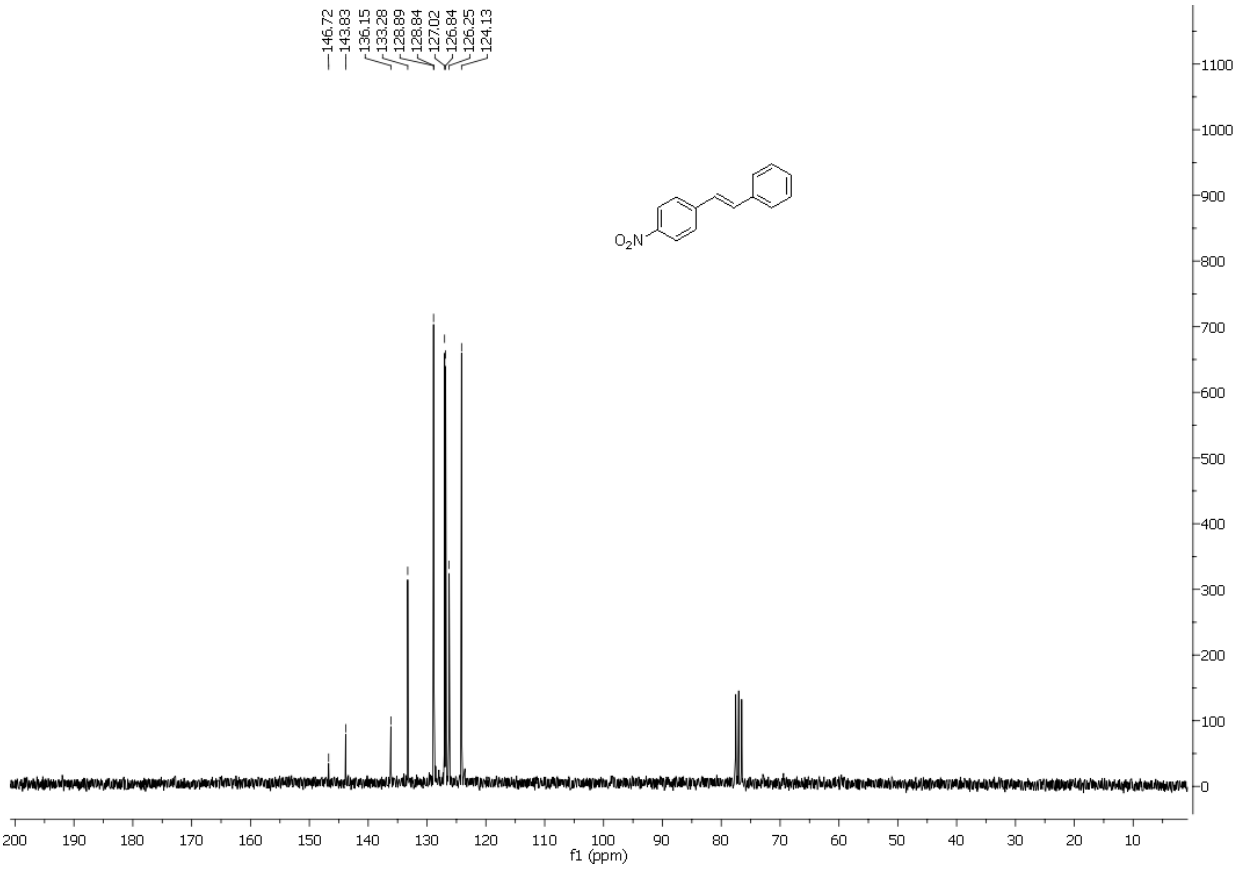
7.63
7.60
7.56
7.53
7.43
7.42
7.40
7.37
7.36
7.35
7.34
7.33
7.30
7.25
7.23
7.16
7.09
O2N
2.00
2.52
2.50
3.51
2.02
f1 (ppm)


146.72
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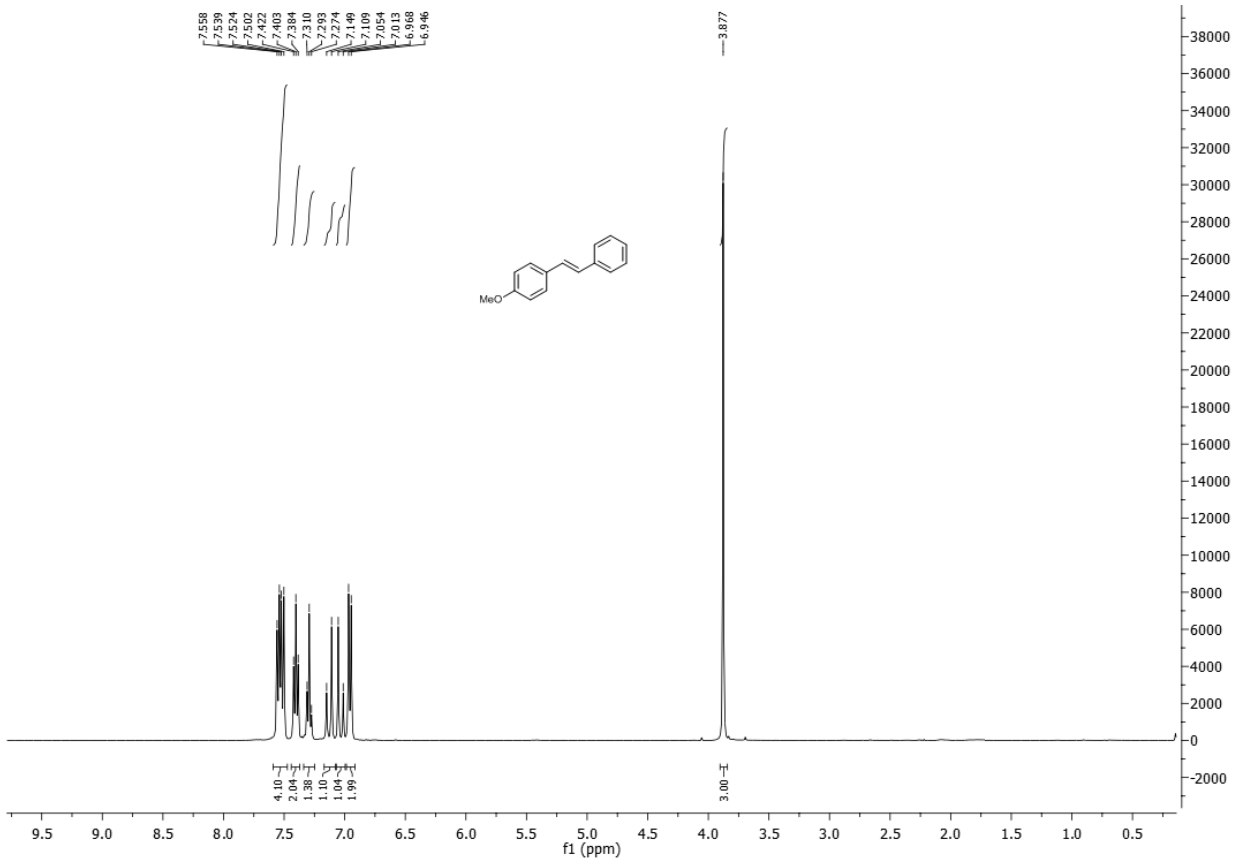
133.28
128.89
128.84
127.02
126.84
126.25
124.13
O_2N
f1 (ppm)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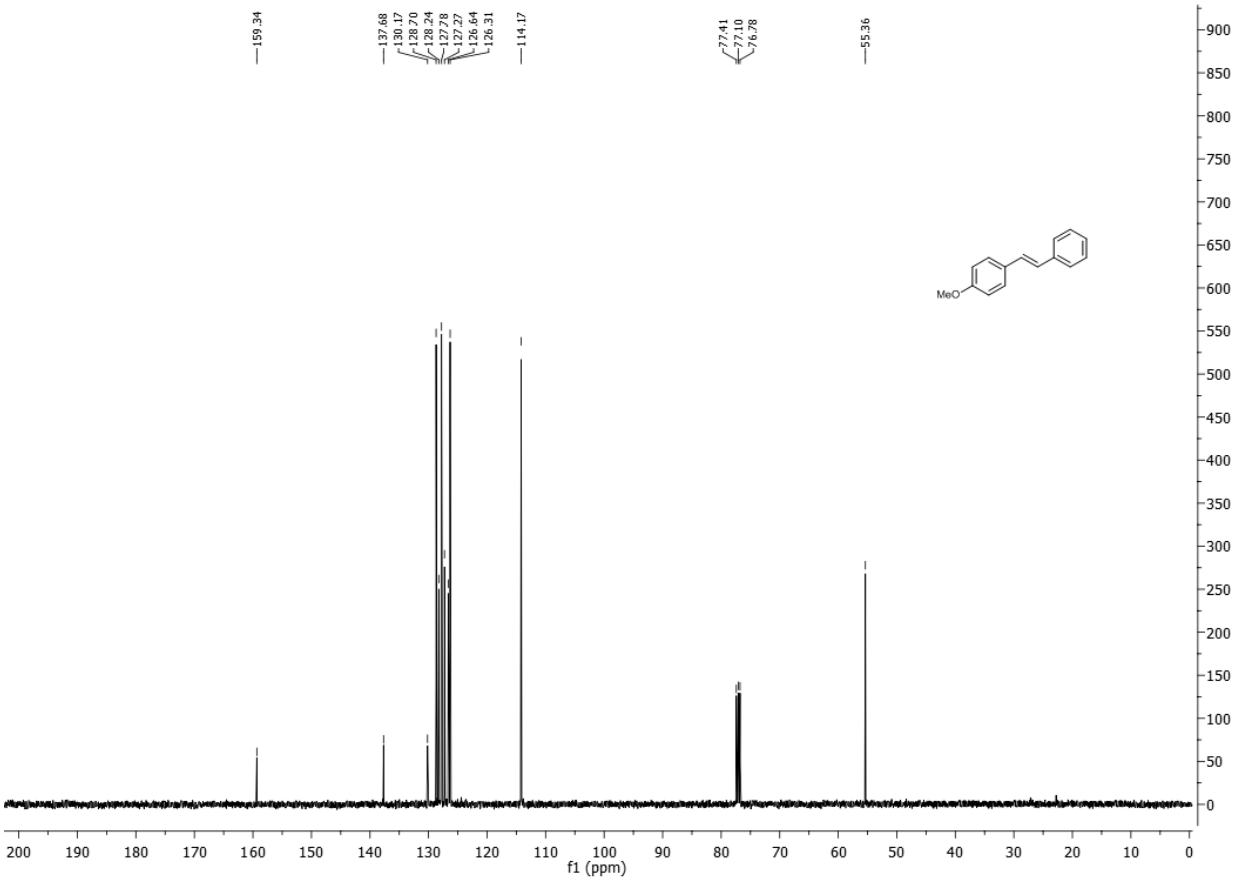
7.403
7.384
7.310
7.293
7.274
7.149
7.109
7.054
7.013
6.968
6.946
3.877
MeO
4.10
2.04
1.38
1.10
1.04
1.99
3.00
f1 (ppm)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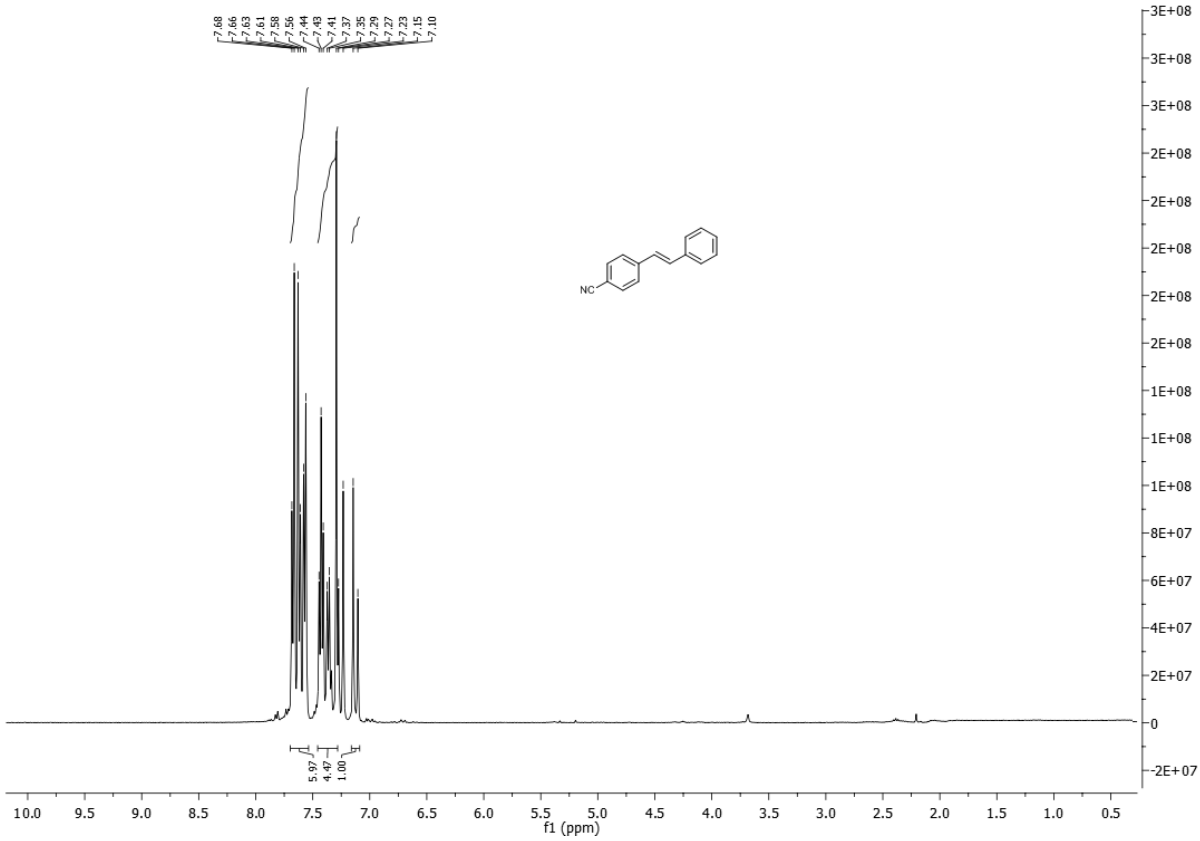
127.78
127.27
126.64
126.31
114.17
77.41
77.10
76.78
55.36
MeO
f1 (ppm)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7.61
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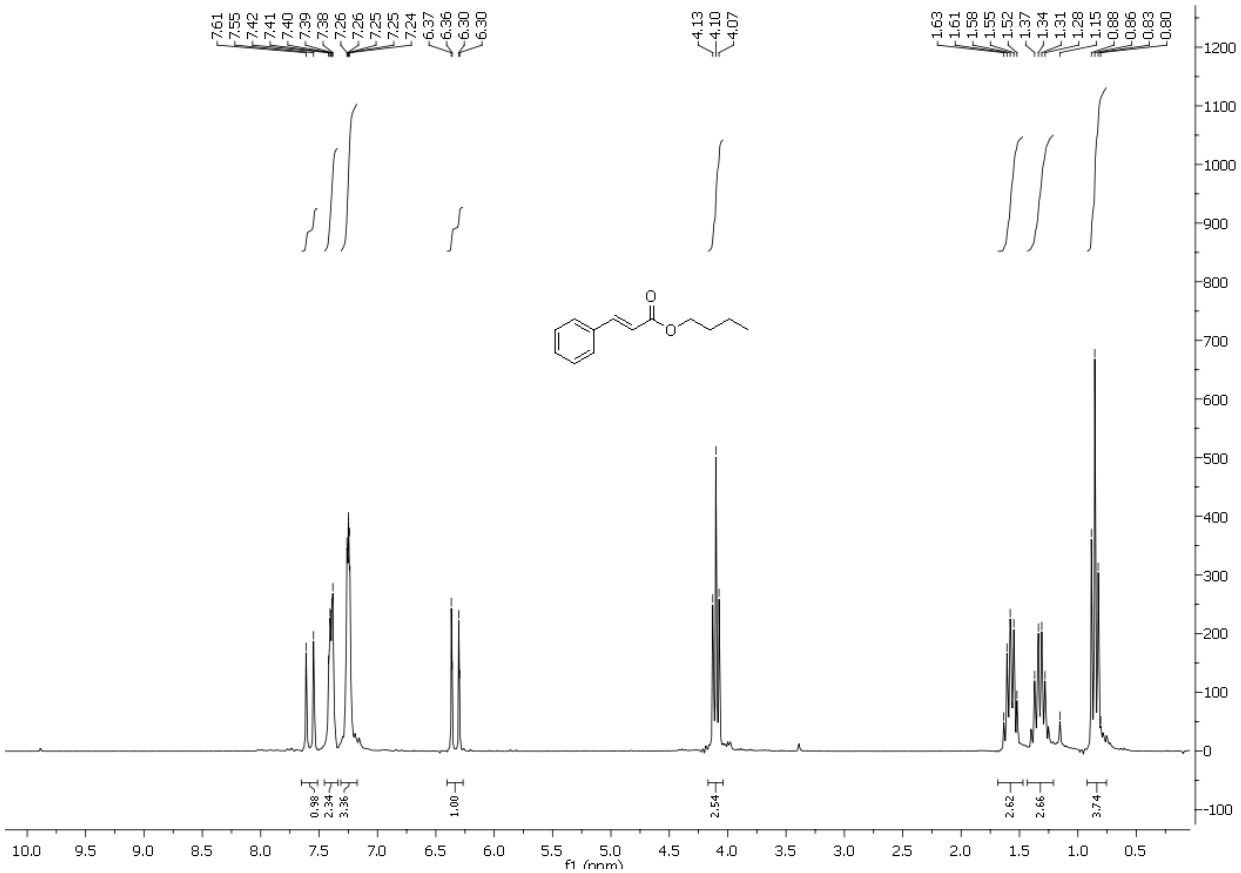
7.44
7.43
7.41
7.37
7.35
7.29
7.27
7.23
7.15
7.10
NC
5.97
4.47
1.00
3E+08
2E+08
1E+08
8E+07
6E+07
4E+07
2E+07
0
-2E+07
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)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7.41
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7.38
7.26
7.26
7.25
7.25
7.24
6.37
6.36
6.30
6.30
4.13
4.10
4.07
1.63
1.61
1.58
1.55
1.52
1.37
1.34
1.31
1.28
1.15
0.88
0.86
0.83
0.80
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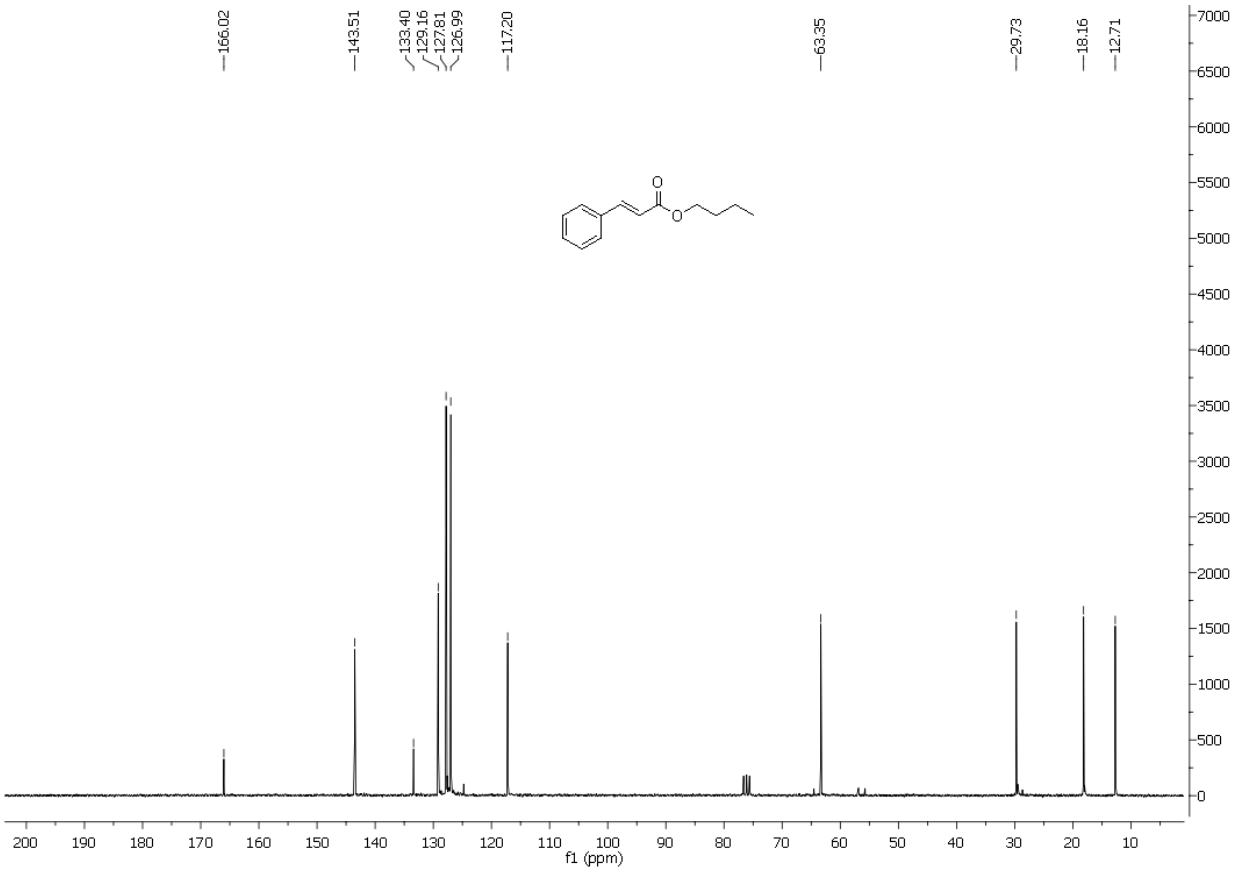
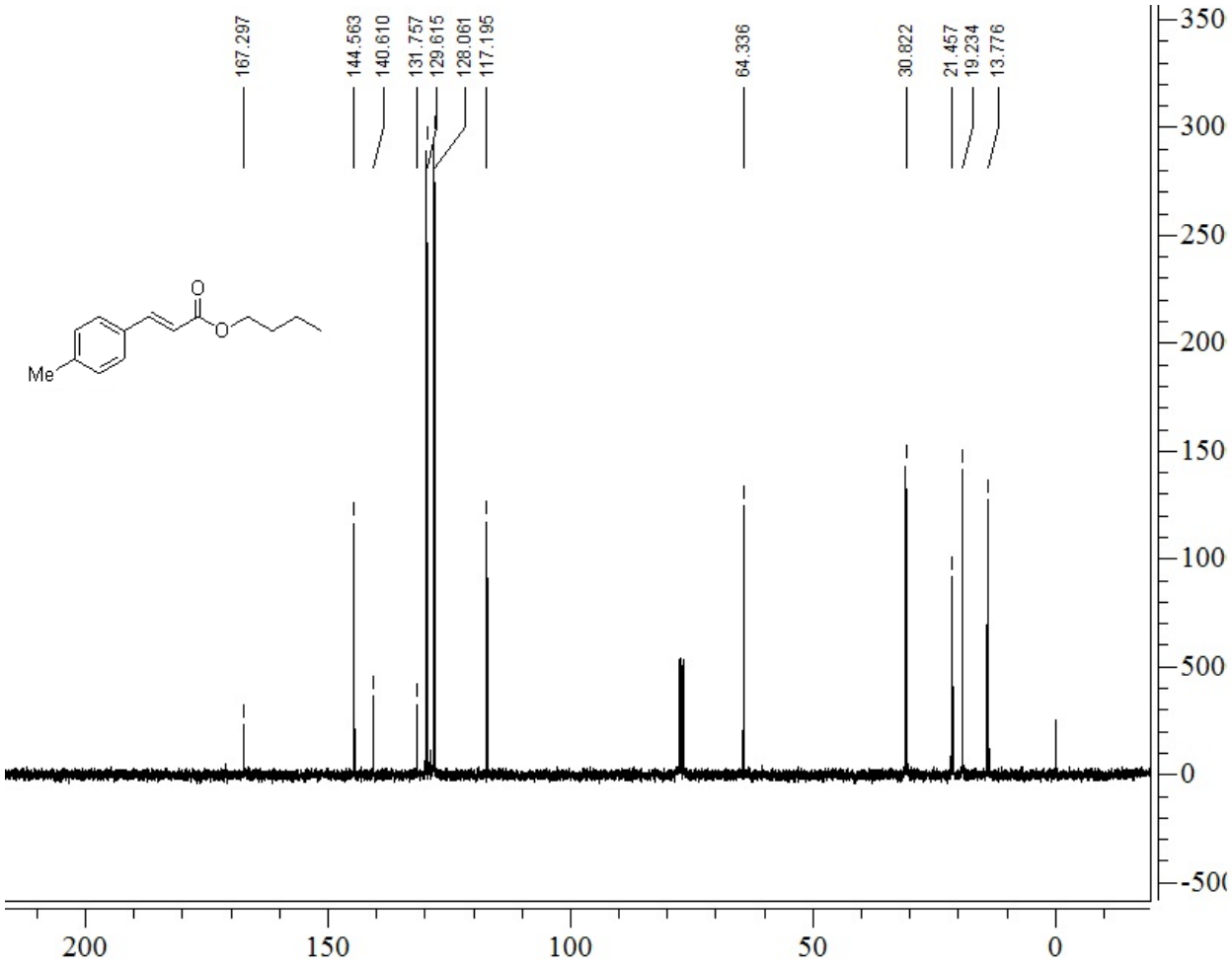
O
0.98
2.34
3.36
1.00
2.54
2.62
2.66
3.74
f1 (ppm)


166.02
143.51
133.40
129.16
127.81
126.99
117.20
63.35
29.73
18.16
12.71
O
O
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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140.610
131.757
129.615
128.061
117.195
64.336
30.822
21.457
19.234
13.776
Me
O
O
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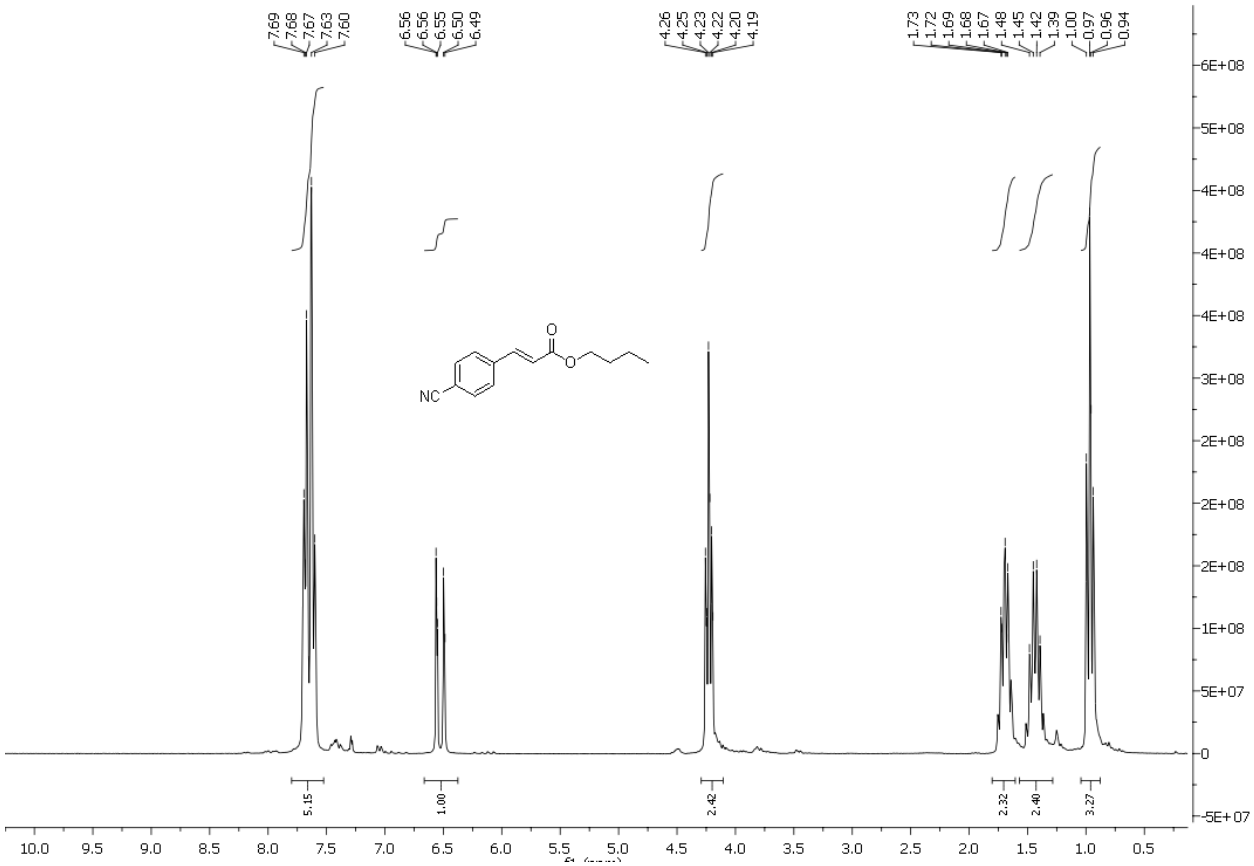
300
250
200
150
100
500
0
-50
200
150
100
50
0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7.67
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6.56
6.56
6.55
6.50
6.49
4.26
4.25
4.23
4.22
4.20
4.19
1.73
1.72
1.69
1.68
1.67
1.48
1.45
1.42
1.39
1.00
0.97
0.96
0.94
NC
O
O
6E+08
5E+08
4E+08
4E+08
4E+08
3E+08
2E+08
2E+08
2E+08
1E+08
5E+07
0
-5E+07
5.15
1.00
2.42
2.32
2.40
3.27
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
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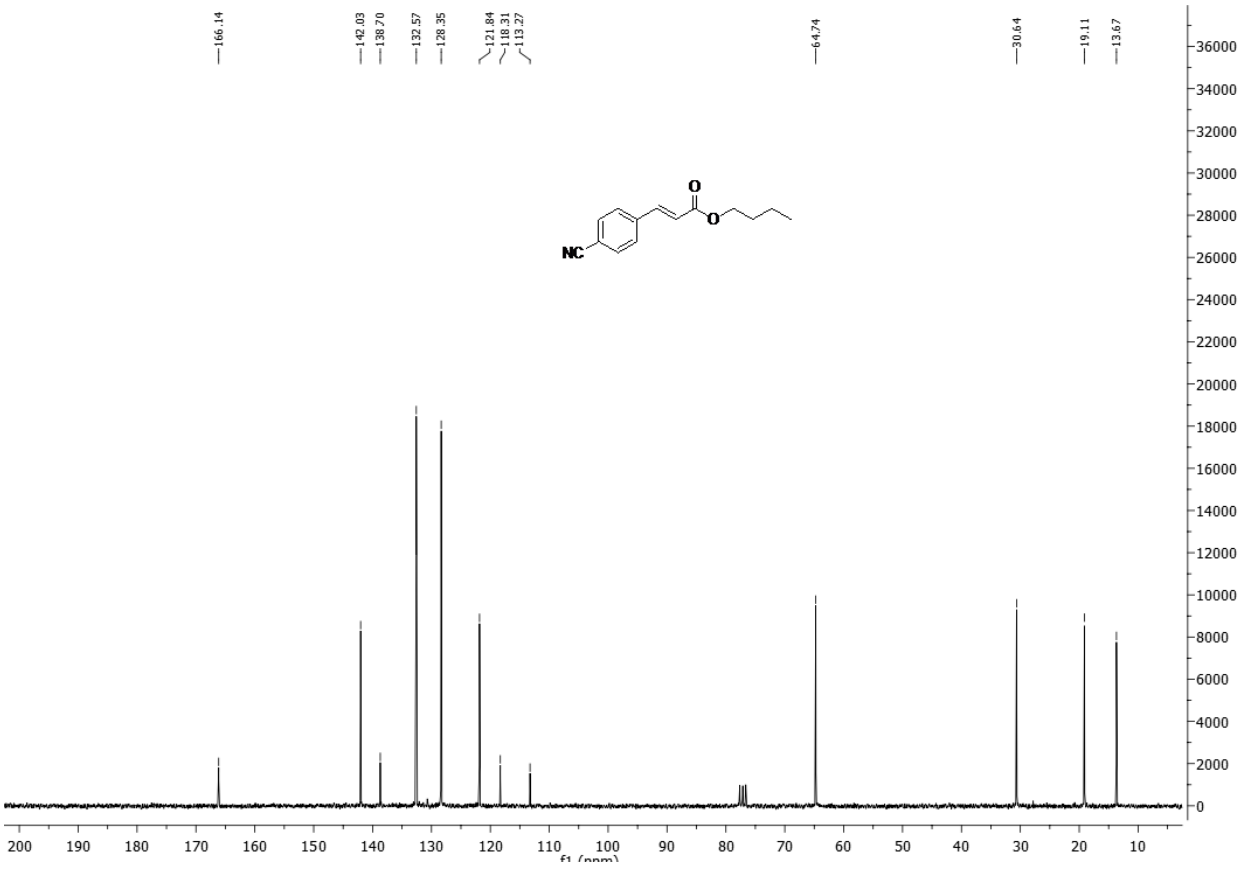
0.5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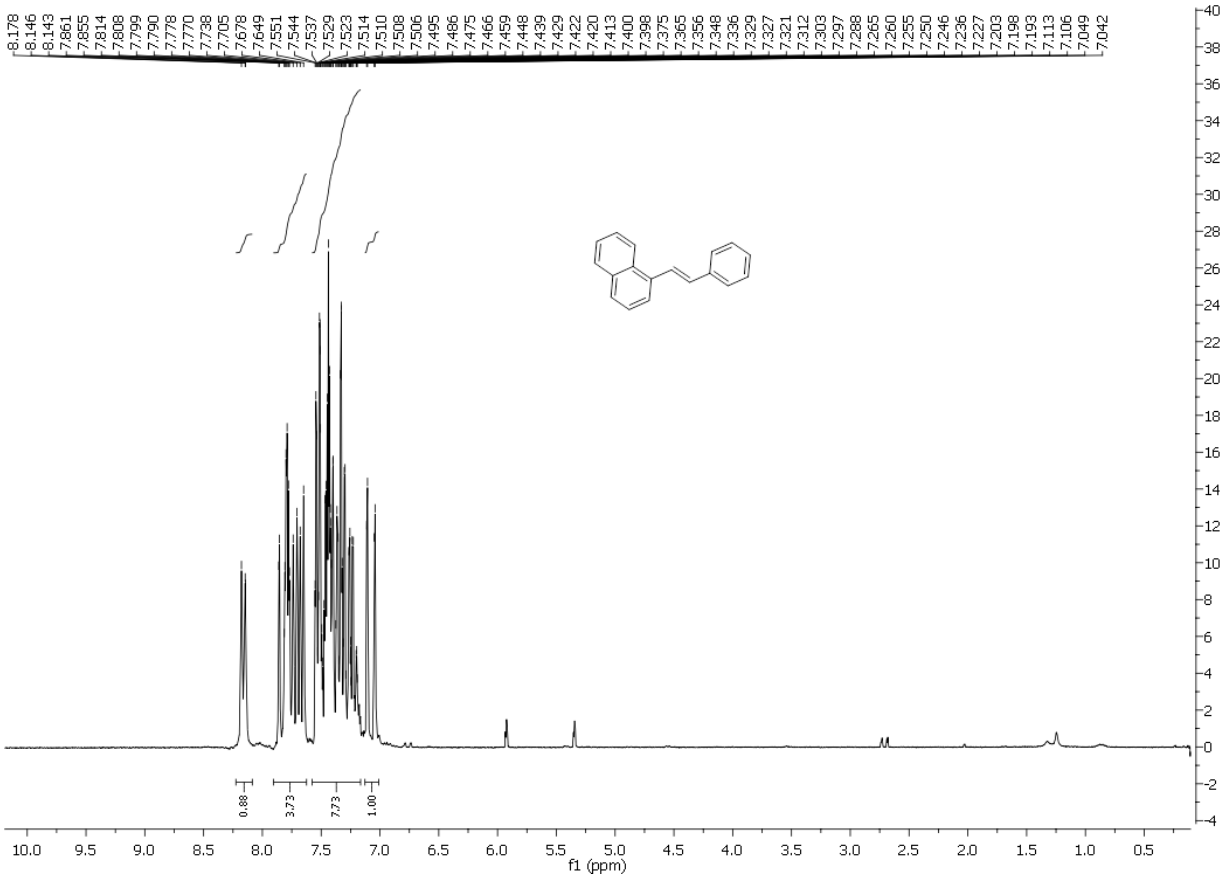
121.84
118.31
113.27
64.74
30.64
19.11
13.67
O
O
NC
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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7.738
7.705
7.678
7.649
7.551
7.544
7.537
7.529
7.523
7.514
7.510
7.508
7.506
7.495
7.486
7.475
7.466
7.459
7.448
7.439
7.429
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7.420
7.413
7.400
7.398
7.375
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7.356
7.348
7.336
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7.321
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7.303
7.297
7.288
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7.260
7.255
7.250
7.246
7.236
7.227
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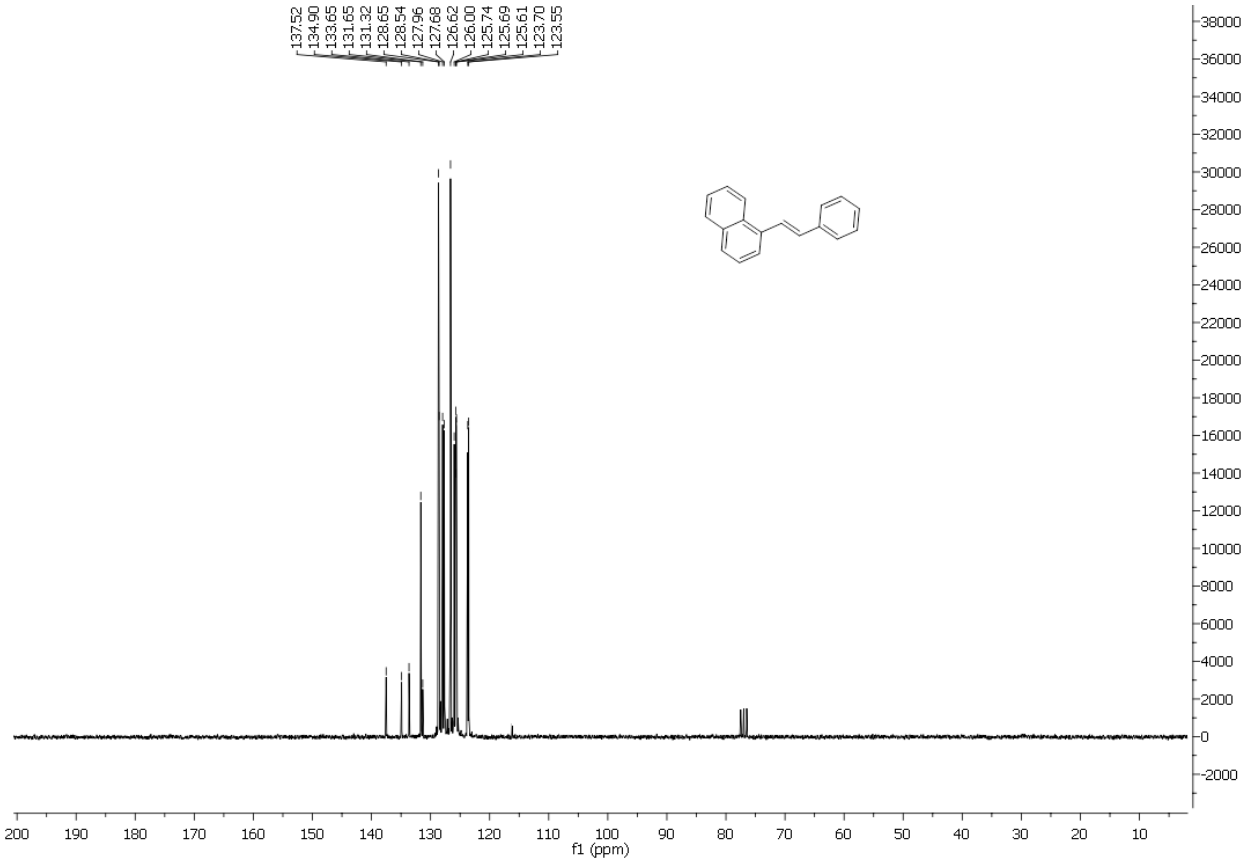
7.113
7.106
7.049
7.042
0.88
3.73
7.73
1.00
f1 (ppm)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127.96
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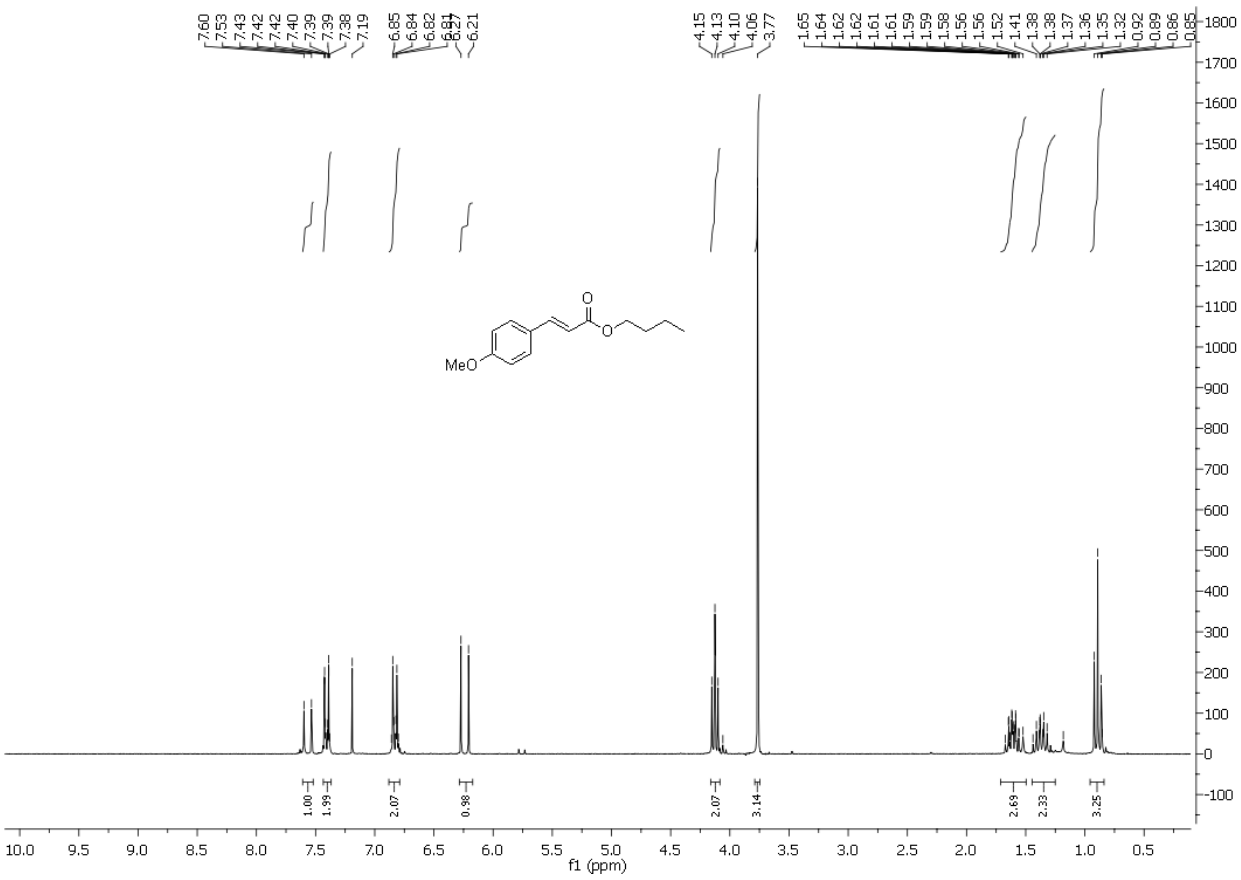
126.62
126.00
125.74
125.69
125.61
123.70
123.55
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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7.39
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6.84
6.82
6.81
6.27
6.21
4.15
4.13
4.10
4.06
3.77
1.65
1.64
1.62
1.62
1.61
1.61
1.59
1.59
1.58
1.56
1.56
1.52
1.41
1.38
1.38
1.37
1.36
1.35
1.32
0.92
0.89
0.86
0.85
O
O
MeO
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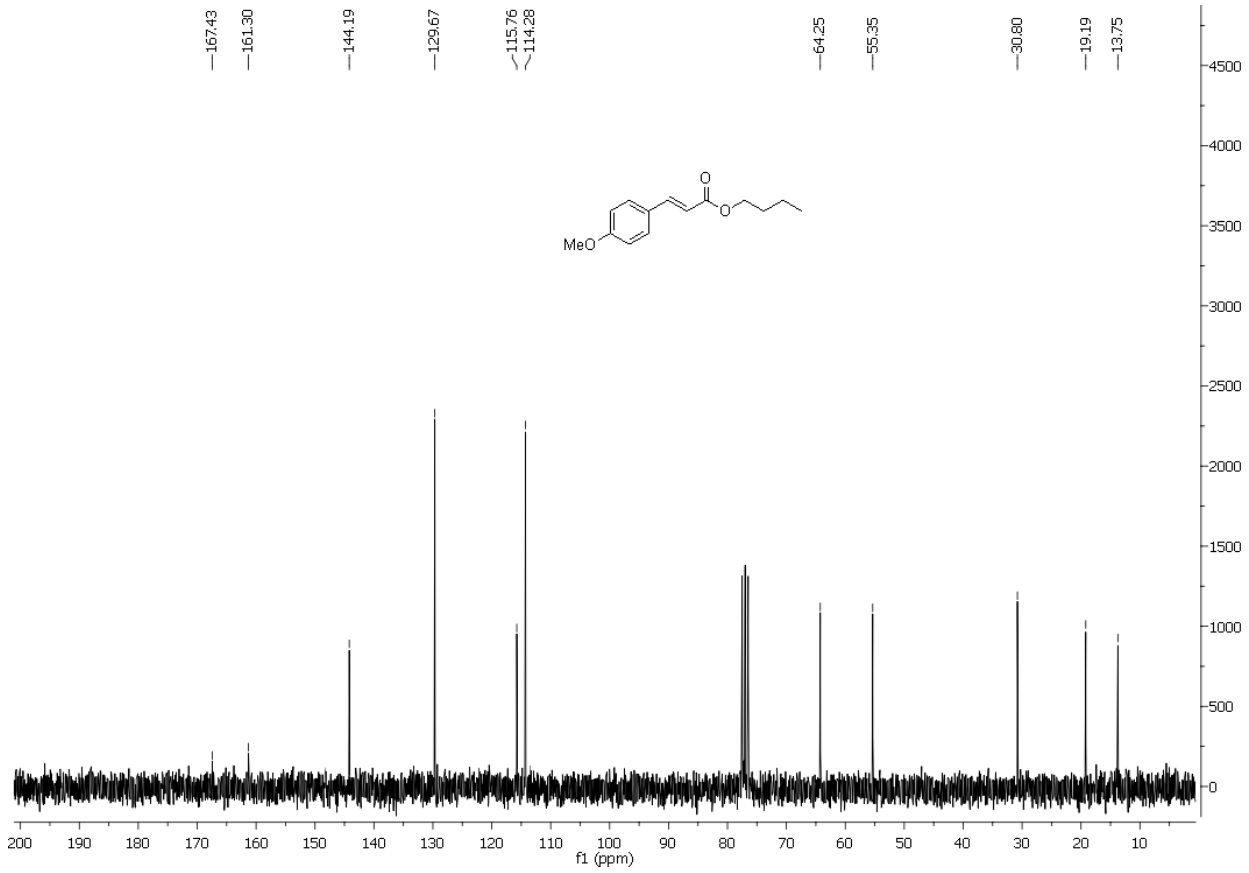
1.99
2.07
0.98
2.07
3.14
2.69
2.33
3.25
f1 (ppm)


167.43
161.30
144.19
129.67
115.76
114.28
64.25
55.35
30.80
19.19
13.75
MeO
O
O
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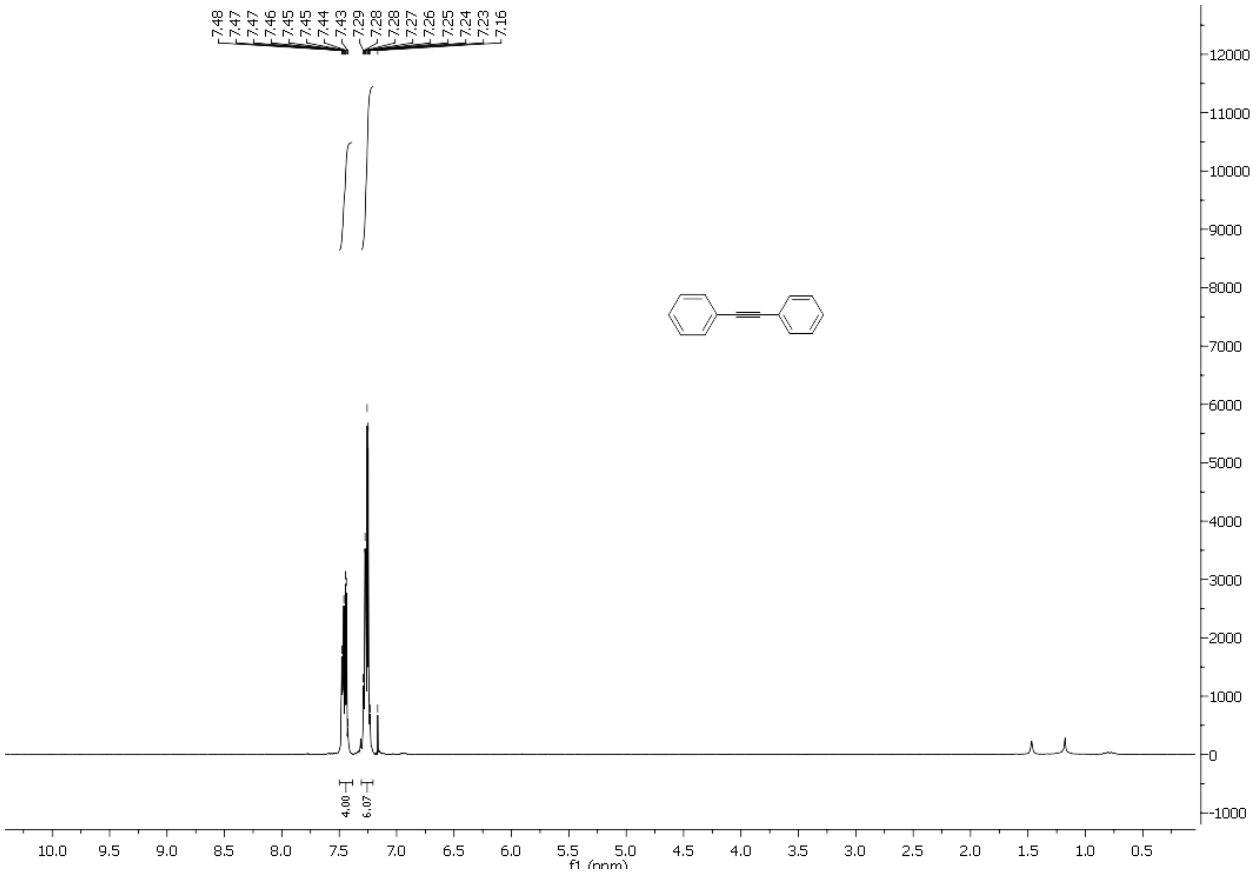
4000
3500
3000
2500
2000
1500
1000
500
0
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)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7.25
7.24
7.23
7.16
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
4.00
6.07
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
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3.5
3.0
2.5
2.0
1.5
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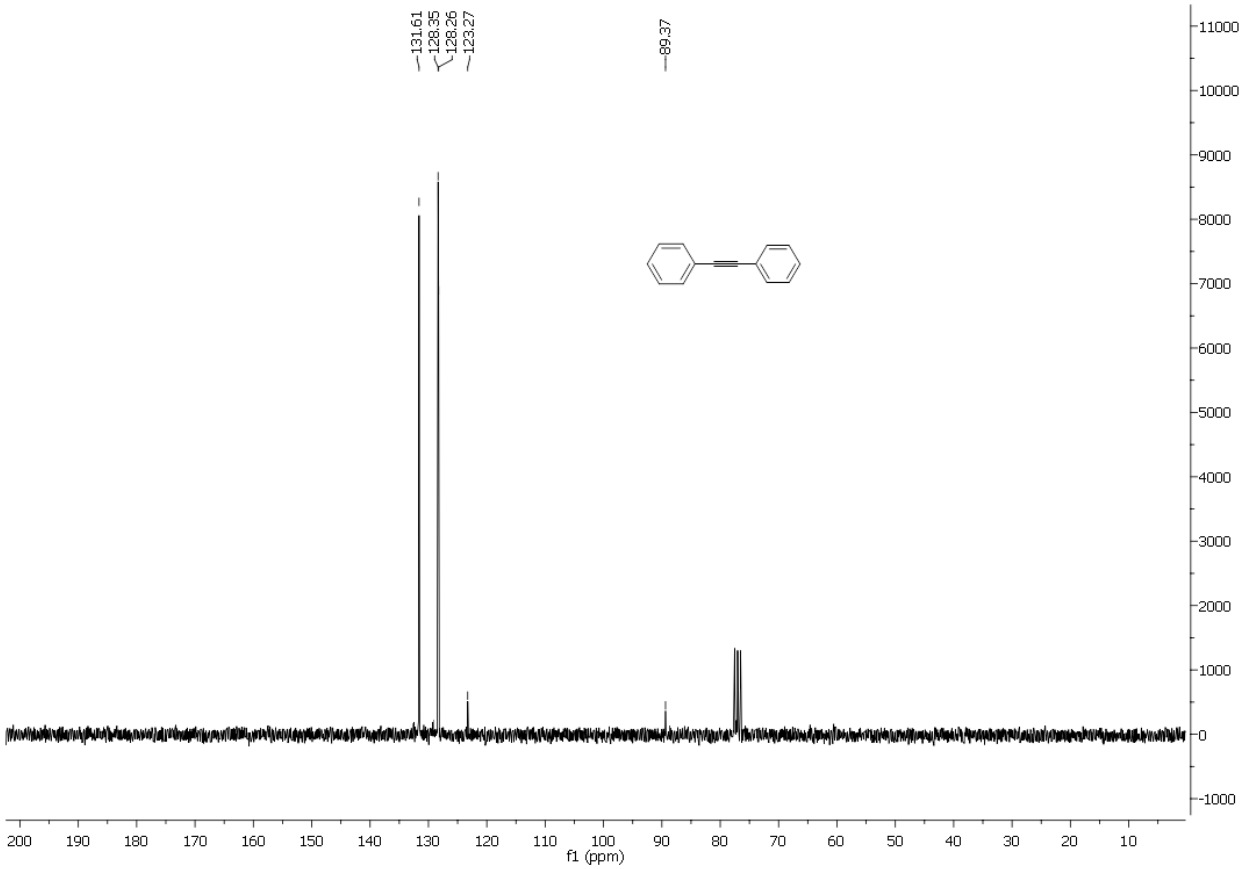
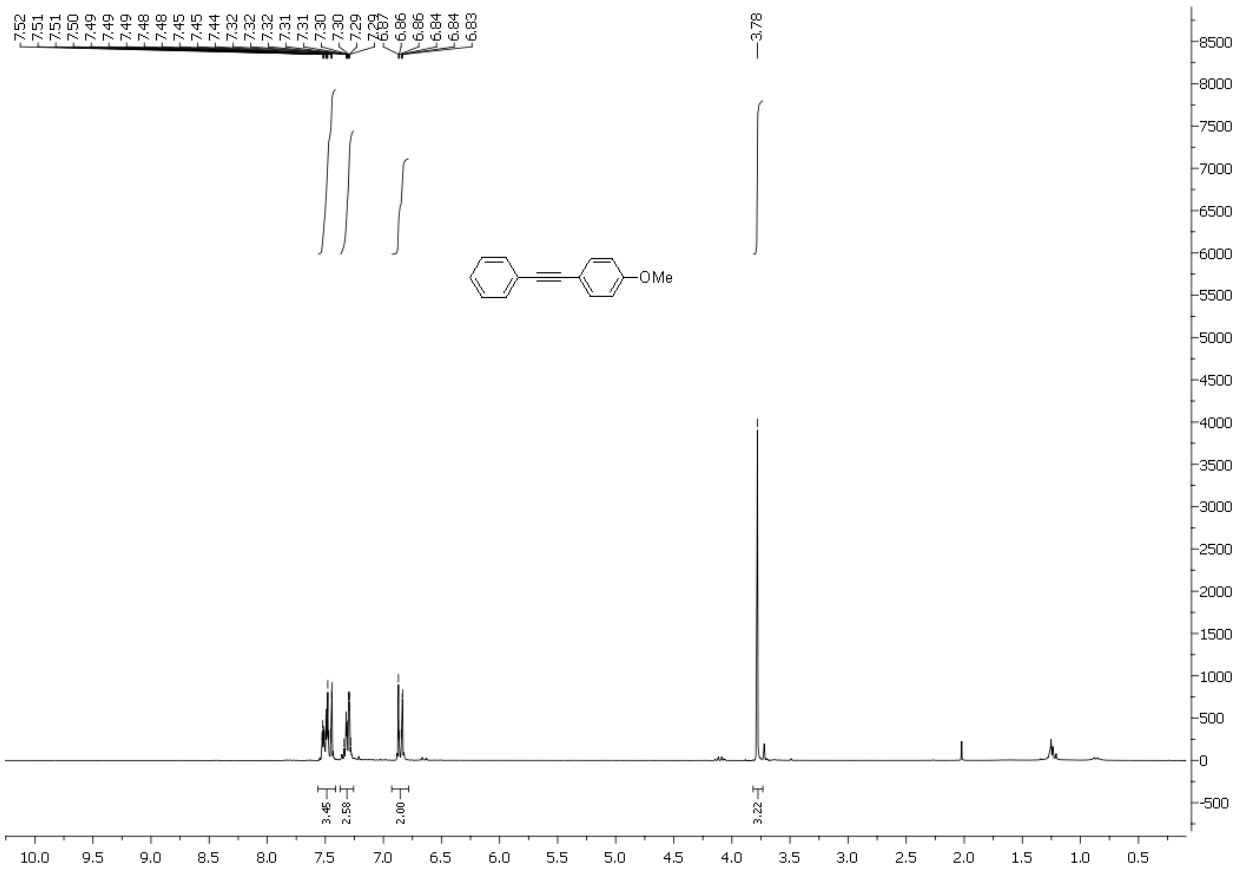
0.5
f1 (ppm)



^{13}C NMR (63 MHz, $CDCl_3$) δ 131.61, 128.35, 128.26, 123.27, 89.37.

7.67-7.64 (d, 2H, J= 9), 7.58-7.54 (m, 2H), 7.40-7.37 (m,3H).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7.51
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7.48
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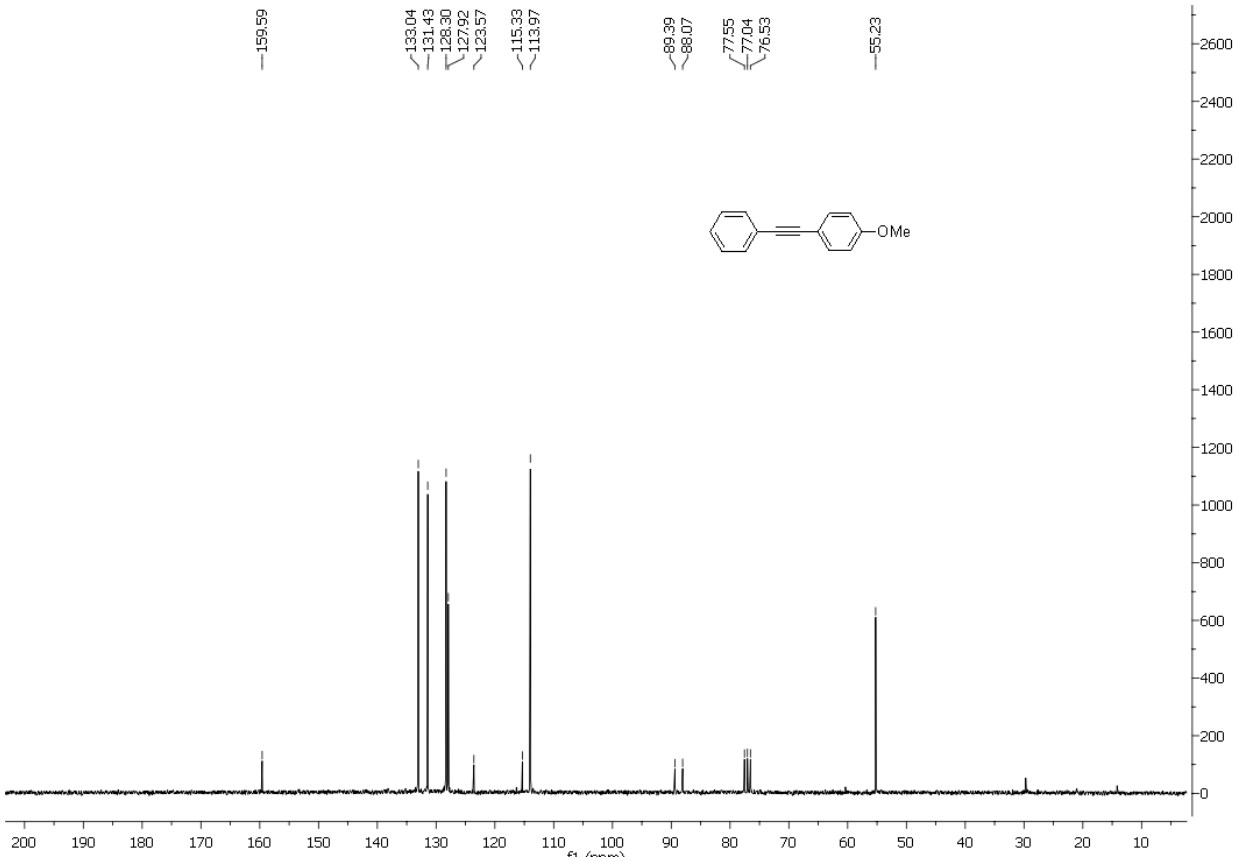
7.45
7.44
7.32
7.32
7.32
7.31
7.31
7.30
7.30
7.29
7.29
6.87
6.86
6.86
6.84
6.84
6.83
3.78
OMe
3.45
2.58
2.00
3.22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133.04
131.43
128.30
127.92
123.57
115.33
113.97
89.39
88.07
77.55
77.04
76.53
55.23
OMe
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
200
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120
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80
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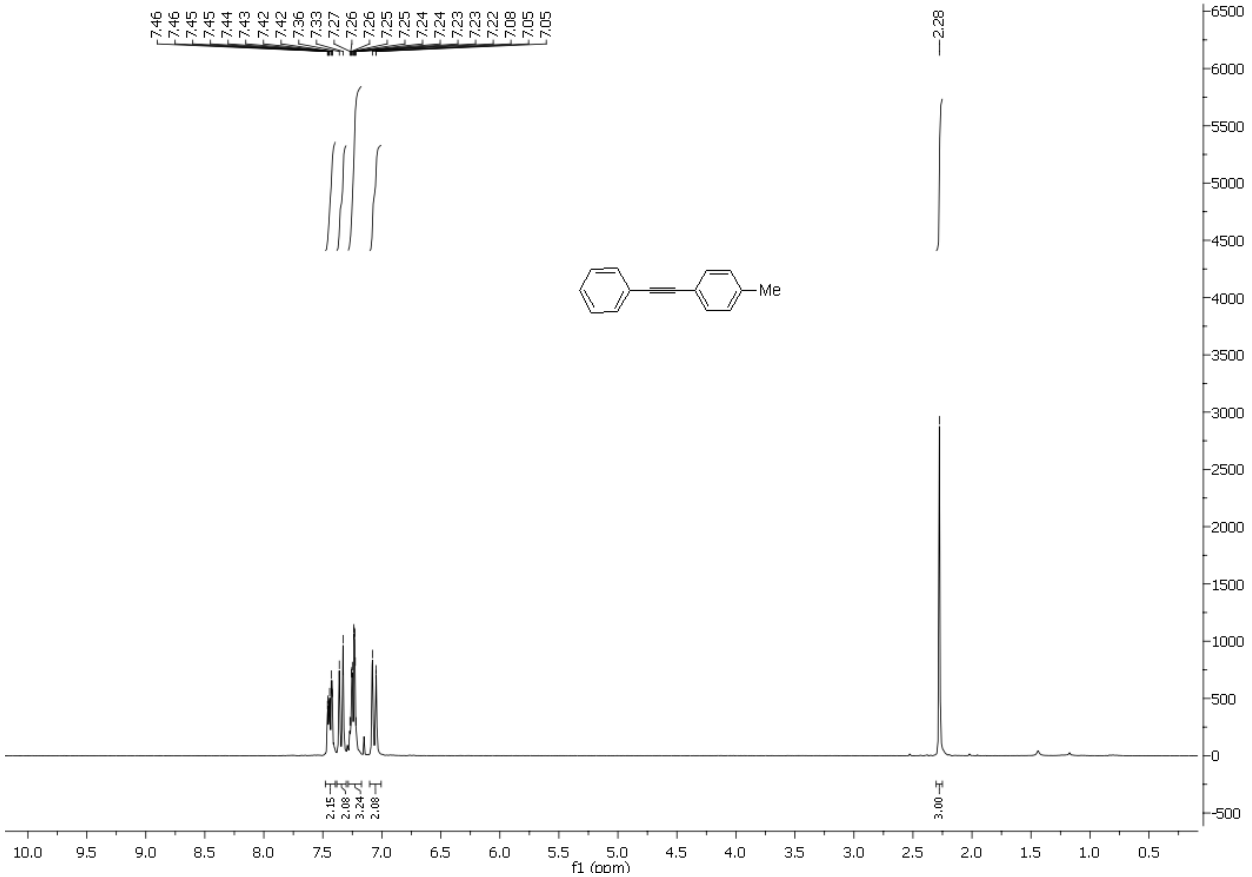
50
40
30
20
10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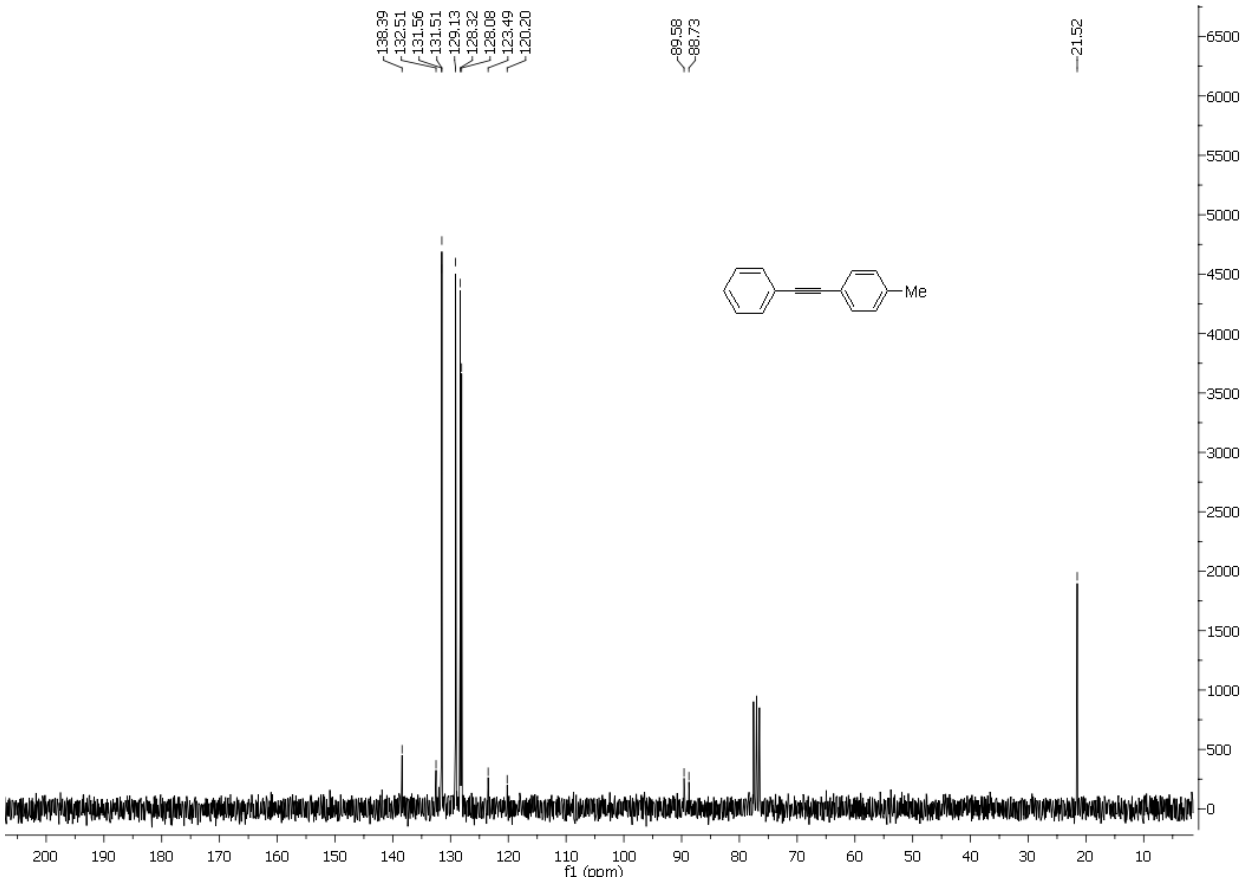
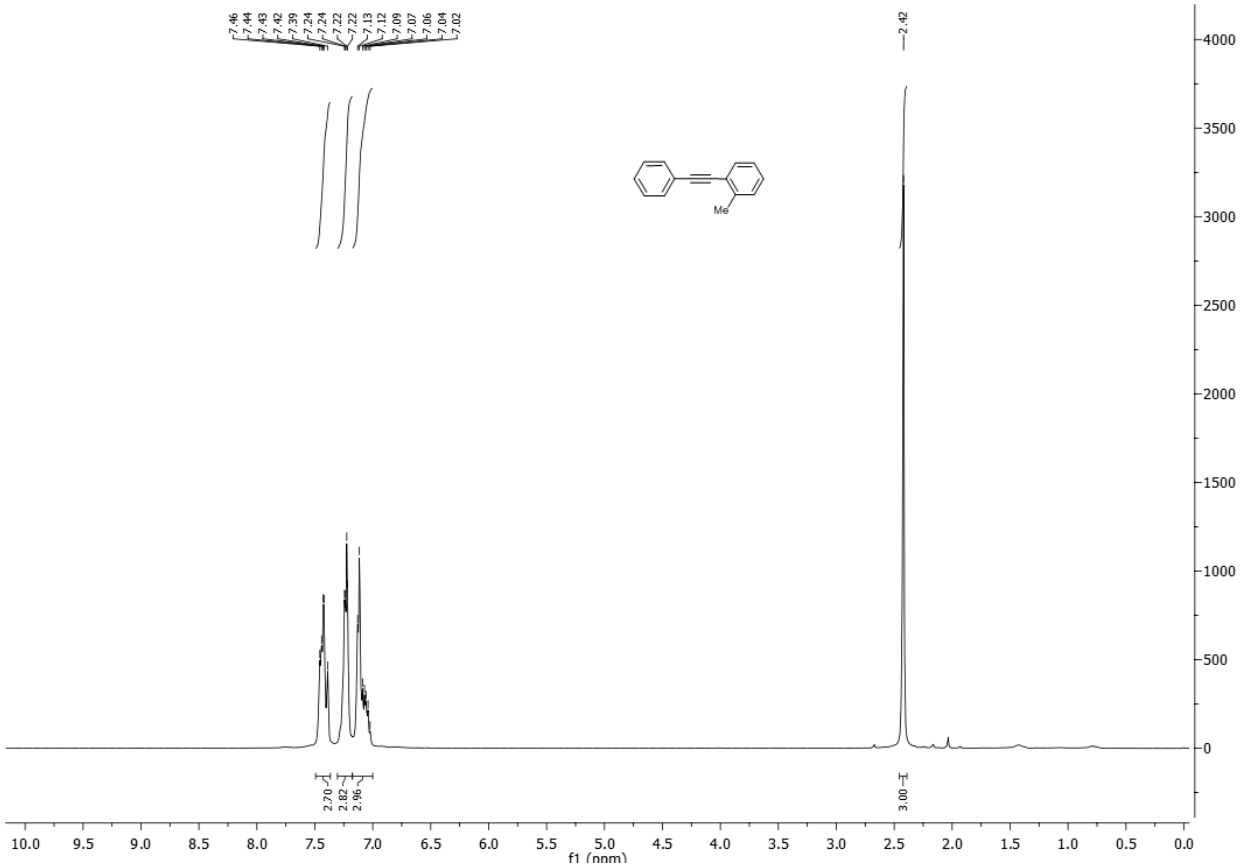
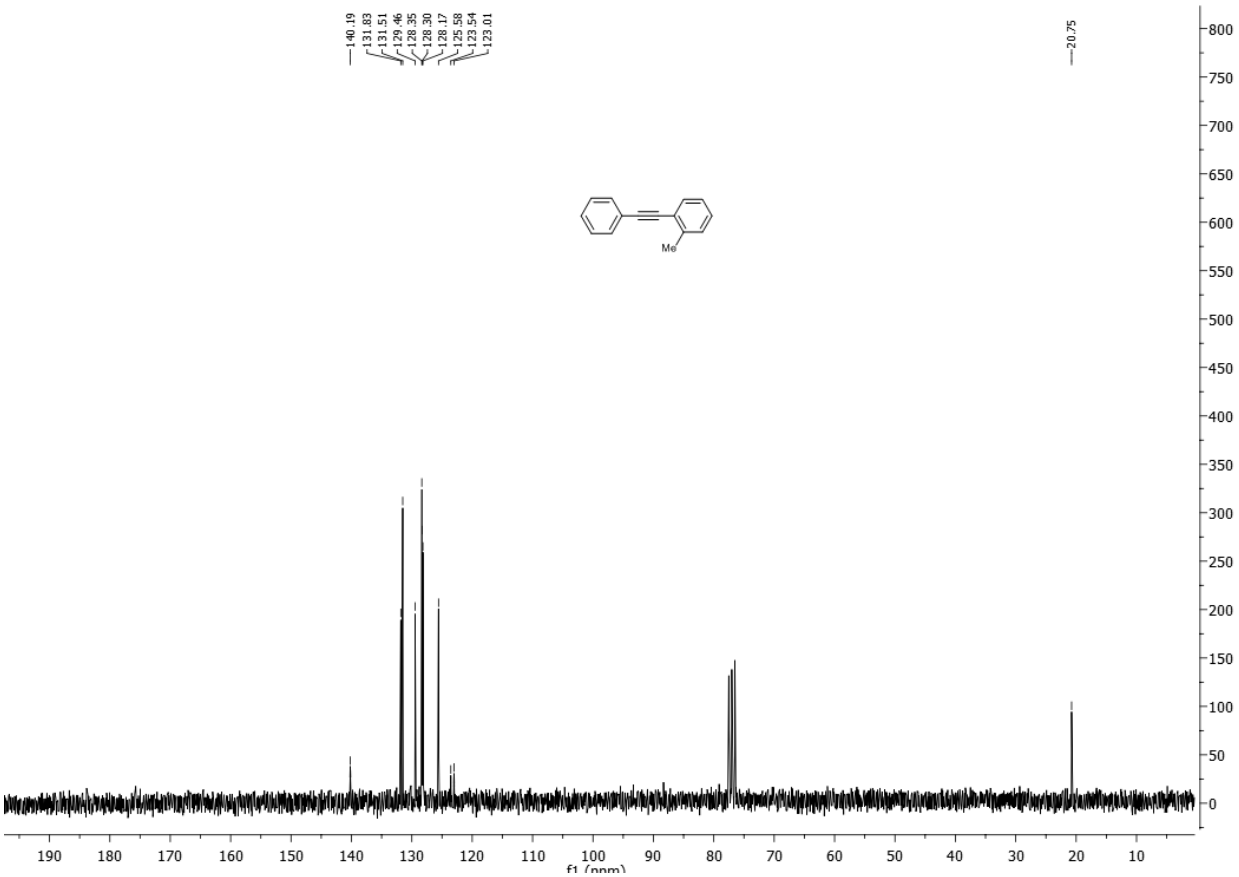
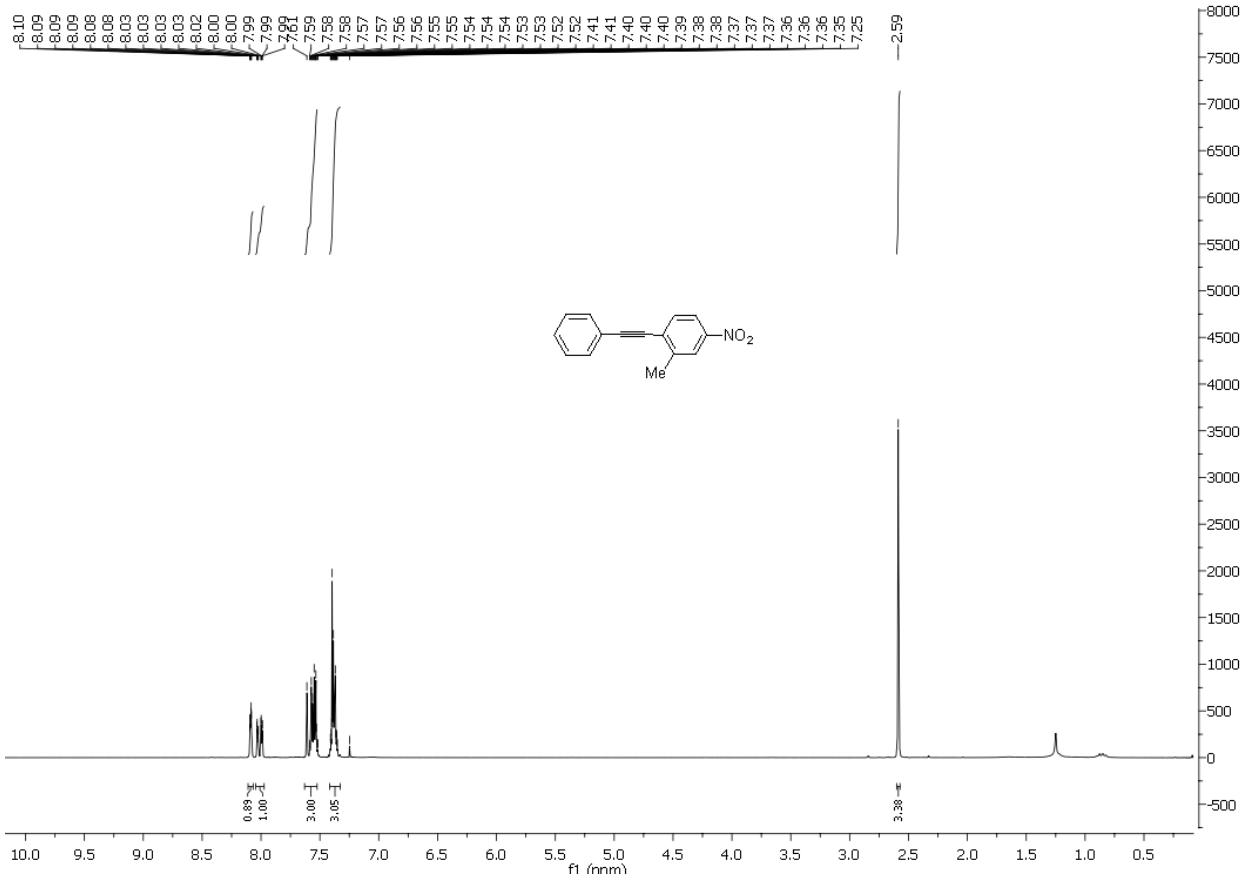
7.46
7.45
7.45
7.44
7.43
7.42
7.42
7.36
7.33
7.27
7.26
7.26
7.25
7.25
7.24
7.24
7.23
7.23
7.22
7.08
7.05
7.05
2.28
Me
2.15
2.08
3.24
2.08
3.00
f1 (ppm)


138.39
132.51
131.56
131.51
129.13
128.32
128.08
123.49
120.20
89.58
88.73
21.52
Me
f1 (ppm)


7.46
7.44
7.43
7.42
7.39
7.24
7.22
7.22
7.13
7.12
7.09
7.07
7.06
7.04
7.02
2.42
Me
2.70
2.82
2.96
3.00
4000
3500
3000
2500
2000
1500
1000
500
0
10.0
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)


140.19
131.83
131.51
129.46
128.35
128.30
128.17
125.58
123.54
123.01
20.75
Me
f1 (ppm)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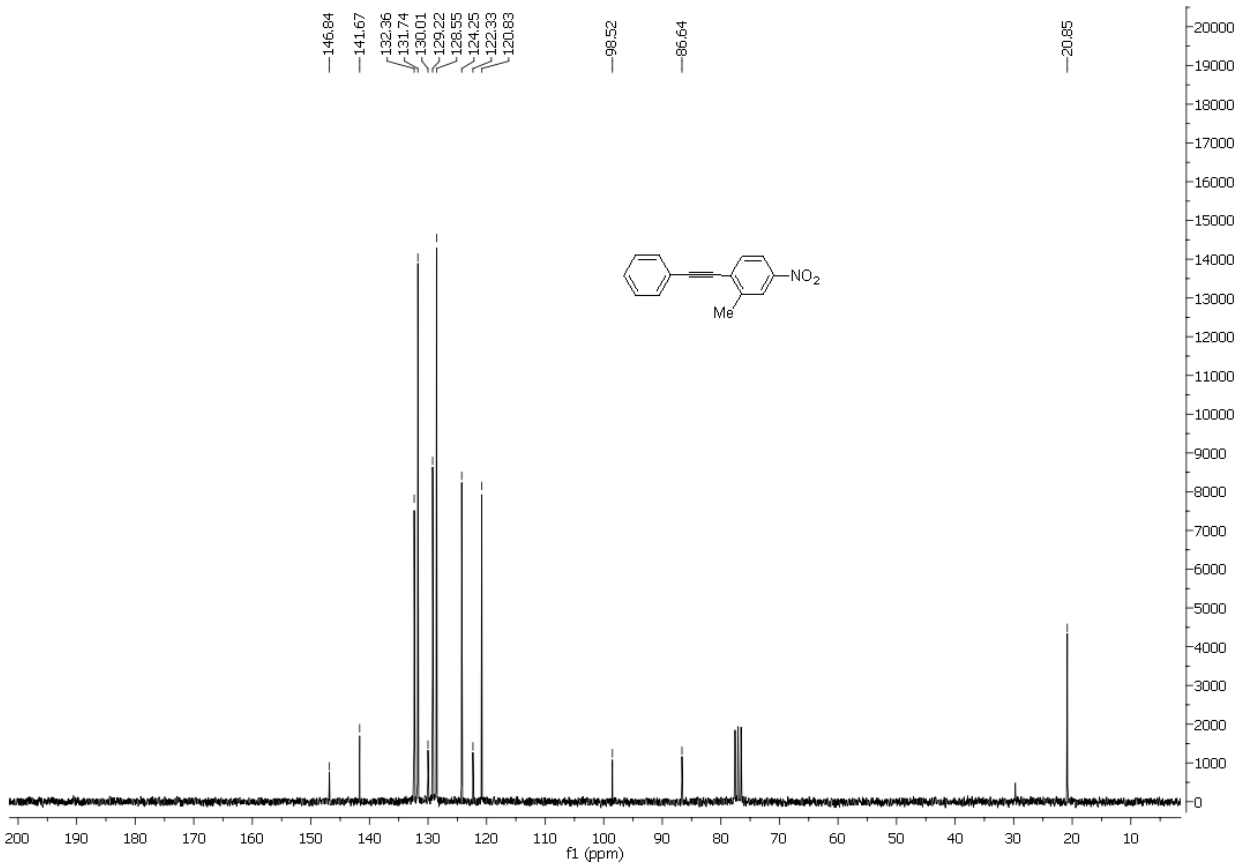
2.59
NO2
Me
0.89
1.00
3.00
3.05
3.38
f1 (ppm)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141.67
132.36
131.74
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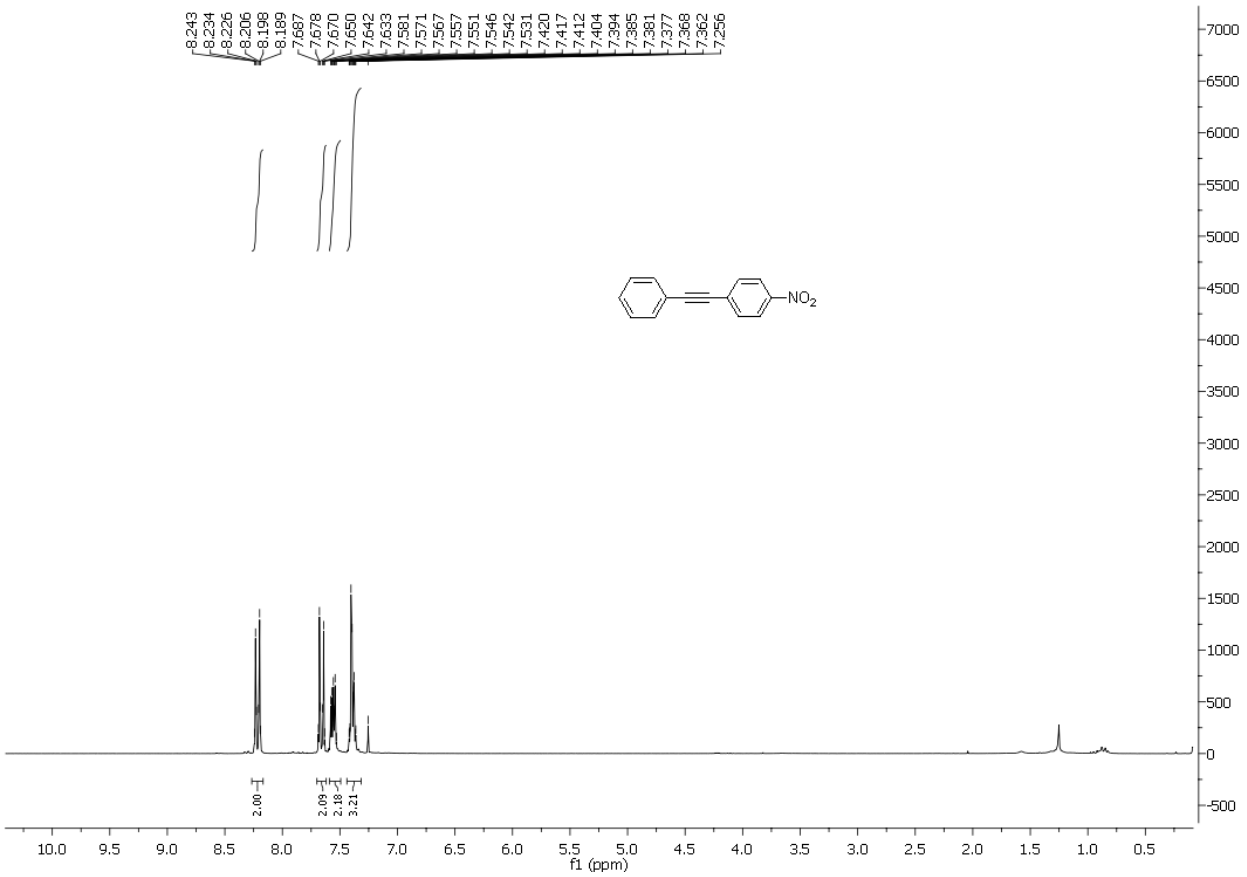
128.55
124.25
122.33
120.83
98.52
86.64
20.85
NO2
Me
f1 (ppm)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8.234
8.226
8.206
8.198
8.189
7.687
7.678
7.670
7.650
7.642
7.633
7.581
7.571
7.567
7.557
7.551
7.546
7.542
7.531
7.420
7.417
7.412
7.404
7.394
7.385
7.381
7.377
7.368
7.362
7.256
NO2
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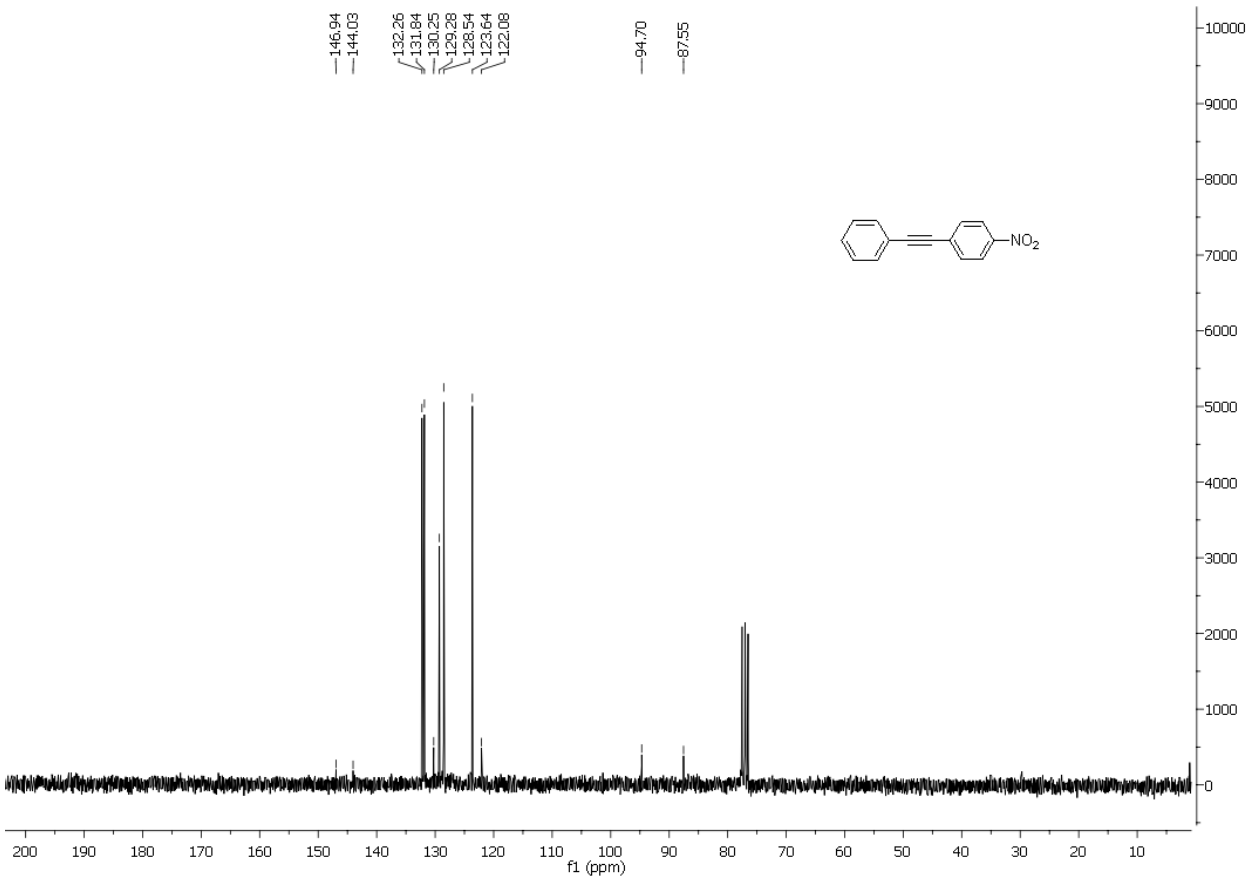
2.09
2.18
3.21
f1 (ppm)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144.03
132.26
131.84
130.25
129.28
128.54
123.64
122.08
94.70
87.55
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8000
7000
6000
5000
4000
3000
2000
1000
0
200
190
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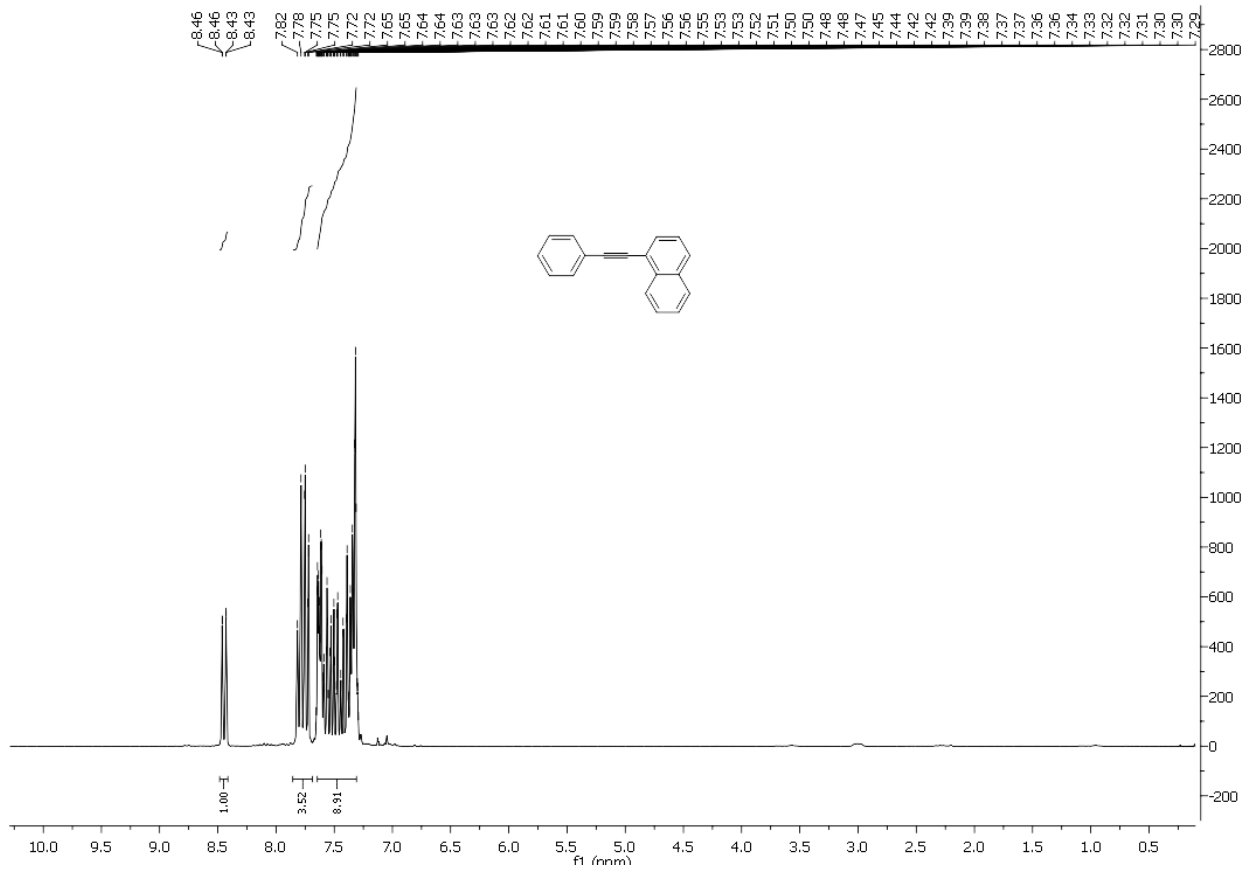
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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7.75
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7.72
7.65
7.64
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7.63
7.63
7.63
7.62
7.62
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7.60
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7.50
7.50
7.48
7.48
7.47
7.45
7.44
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7.38
7.37
7.37
7.36
7.36
7.34
7.33
7.32
7.32
7.31
7.30
7.30
7.29
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
1.00
3.52
8.91
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
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3.0
2.5
2.0
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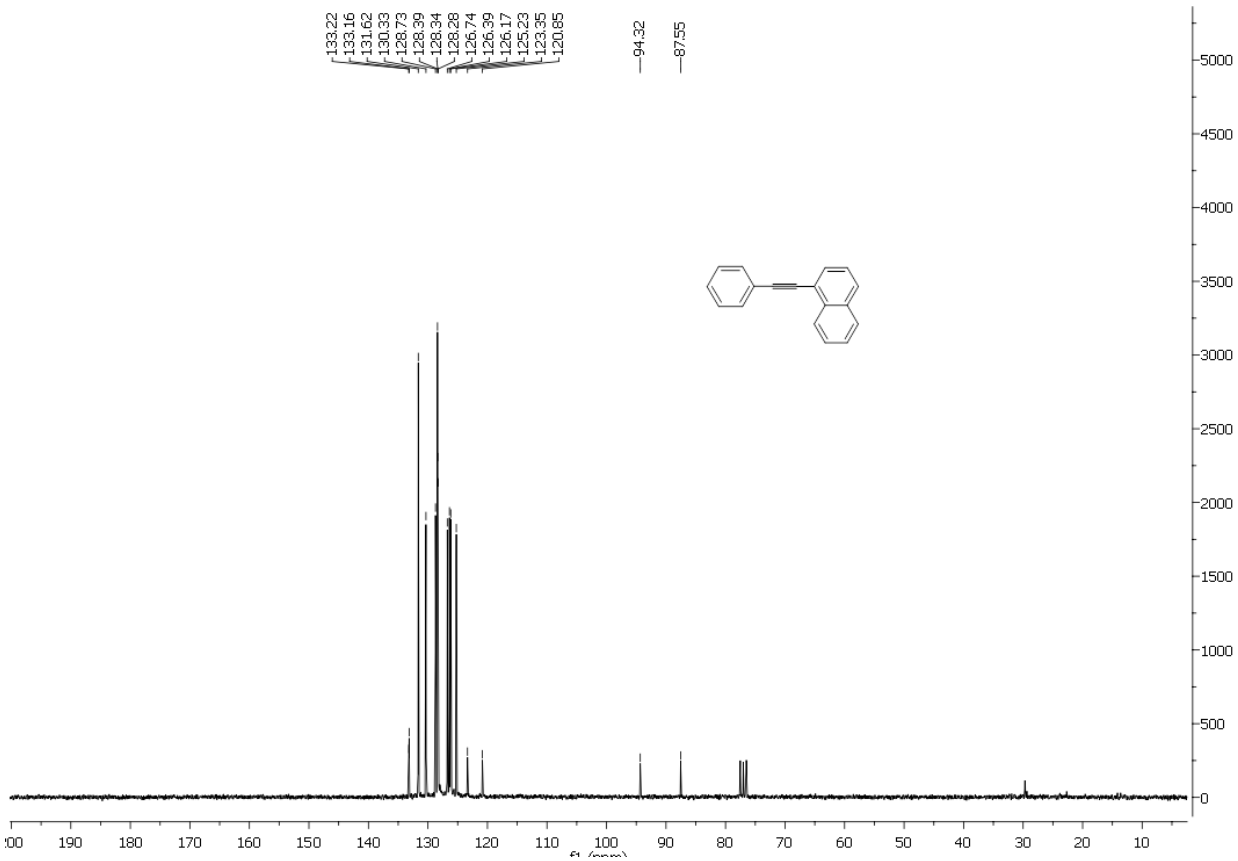
1.0
0.5
f1 (ppm)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131.62
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128.39
128.34
128.28
126.74
126.39
126.17
125.23
123.35
120.85
94.32
87.55
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
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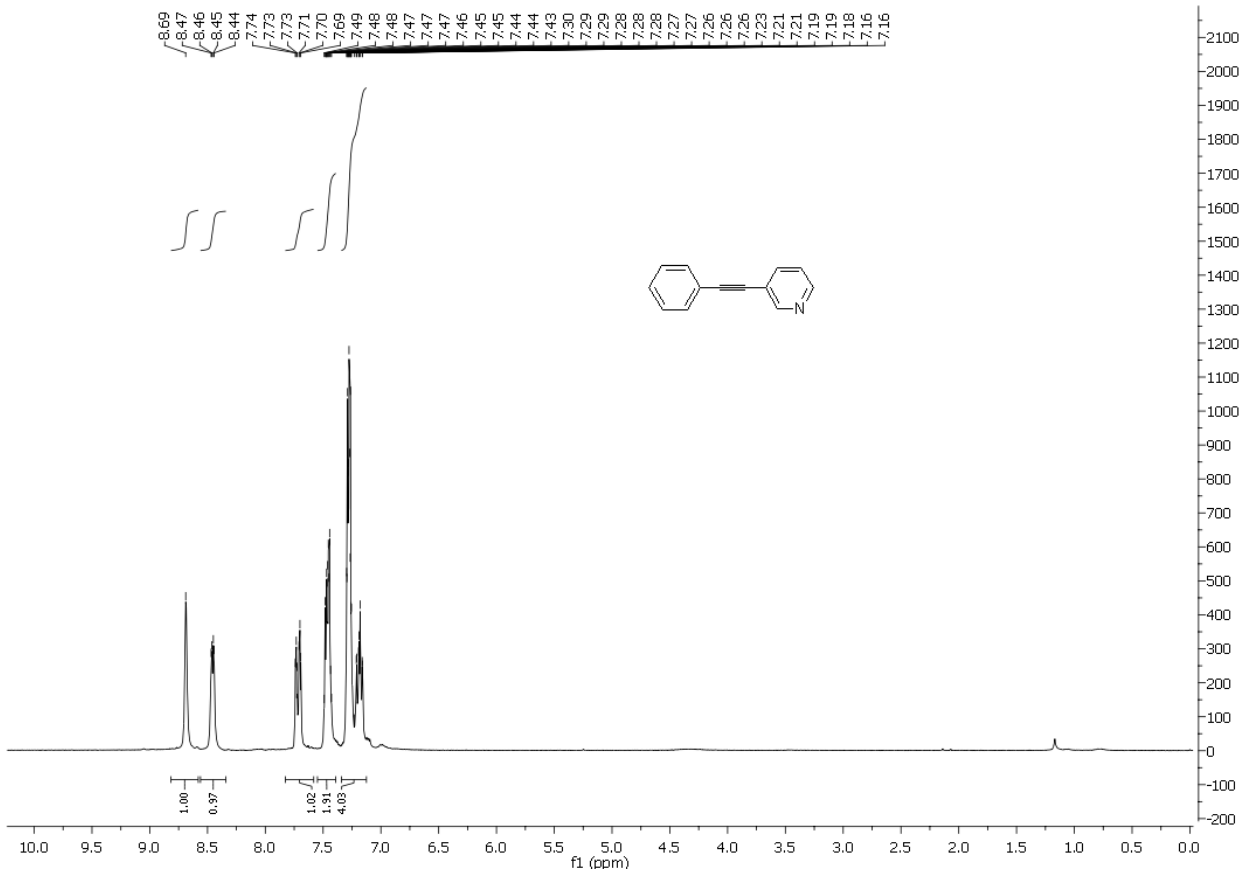
20
10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7.26
7.26
7.23
7.21
7.21
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7.16
7.16
N
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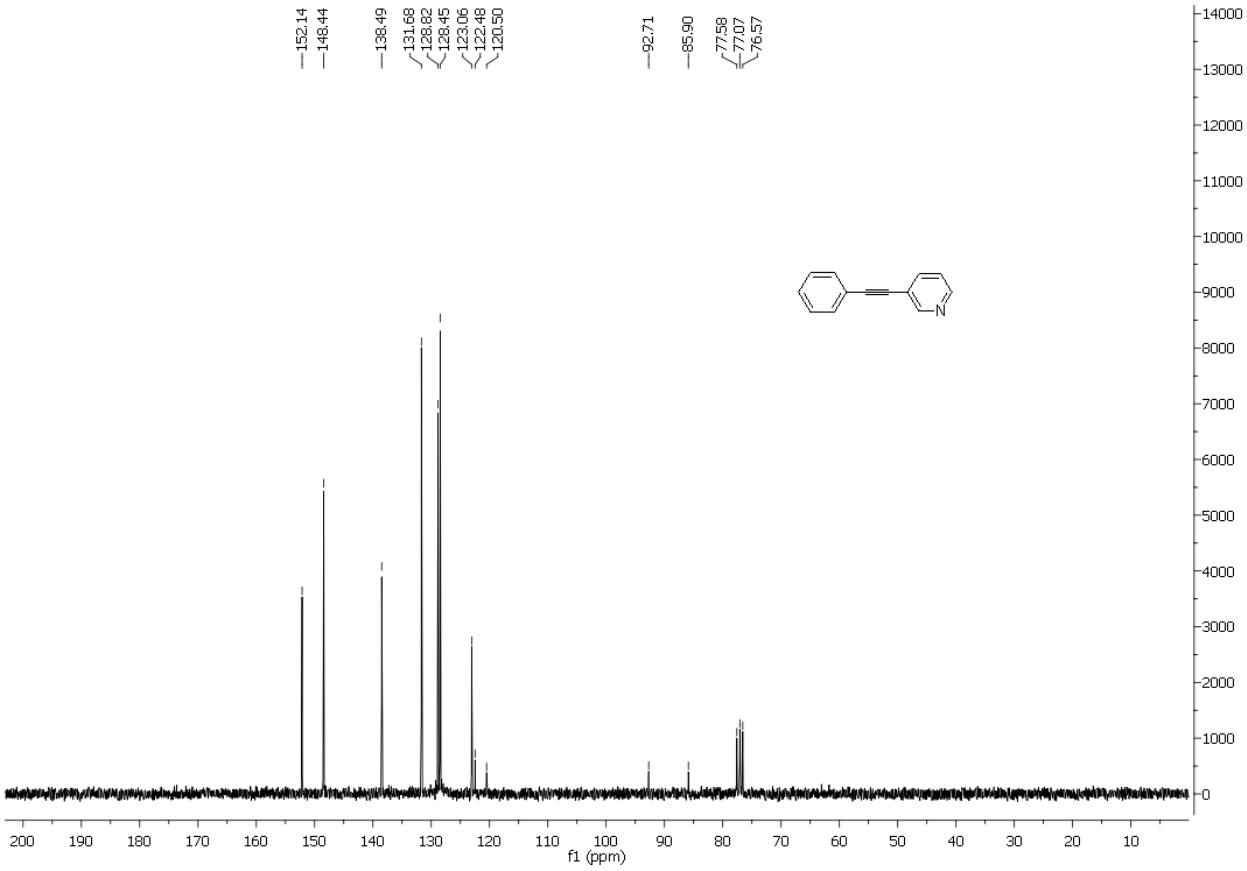
0.97
1.02
1.91
4.03
f1 (ppm)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131.68
128.82
128.45
123.06
122.48
120.50
92.71
85.90
77.58
77.07
76.57
N
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)