Electronic Supplementary Information

Rhodium-Catalyzed Oxidative Decarbonylative Heck-type Coupling of Aromatic Aldehydes with Terminal Alkenes

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Table of Contents

1. General information

Thin-layer chromatography (TLC) was performed using E. Merck Silica Gel 60 F254 precoated plates (0.25 mm). The developed chromatography was analyzed by UV lamp (254 nm). Nuclear magnetic resonance (NMR) spectra were recorded on a Bruker Avance 400 spectrometer at ambient temperature. Chemical shifts for ^{1}H NMR spectra are reported in parts per million (ppm) from tetramethylsilane with the solvent resonance as the internal standard (chloroform: δ 7.26 ppm). Chemical shifts for ^{13}C NMR spectra are reported in parts per million (ppm) from tetramethylsilane with the solvent as the internal standard ($CDCl_3$: δ 77.16 ppm). Data are reported as following: chemical shift, multiplicity (s = singlet, d = doublet, dd = doublet of doublets, t = triplet, q = quartet, m = multiplet, br = broad signal), coupling constant (Hz), and integration. The (*E*) to (*Z*) ratios were determined from the relative integration of the crude ^{1}H NMR spectra of the resolved olefinic protons.

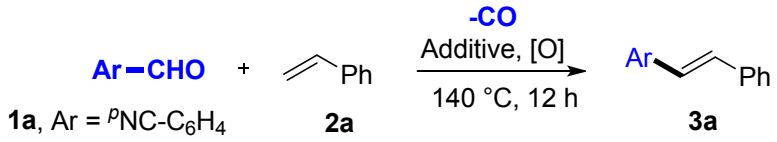
2. General experimental procedures

A general experimental procedure is described as following:

An oven-dried reaction vessel was charged with $[Rh(COD)Cl]_2$ (0.01 mmol, 2.4 mg, 5 mol%), styrene (0.8 mmol, 83.3 mg), *p*-cyanobenzaldehyde (**1a**, 0.2 mmol, 26.2 mg), benzoyl chloride (0.04 mmol, 5.6 mg, 20 mol%), chlorobenzene (0.5 mL), and TBP (2.5 equiv, 0.5 mmol, 94μL) under air. The vessel was sealed and heated at 140 °C (oil bath temperature) for 12 h. The resulting mixture was cooled to room temperature, transferred to silica gel column directly and eluted with petroleum ether and ethyl acetate (30:1) to give products **3a** (34.0 mg, 83 % yield).

3. Condition optimization

Table S1. Optimization of the oxidants



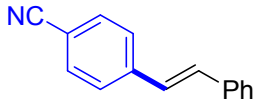
1a, Ar = $^{p}NC\text{-}C_6H_4$ **2a** **3a**

Entry	Oxidant (equiv)	Yield (%)[b]
1	**TBP**	**83**
2	TBHP	< 5
3	$K_2S_2O_8$	< 5
4	BPO (benzoyl peroxide)	trace
5	DCP (dicumyl peroxide)	< 5
6	H_2O_2	trace

To a solution of **1a** (0.2 mmol, 1 equiv.) and **2a** (0.8 mmol, 4 equiv.) in chlorobenzene (0.5 mL), oxidant (0.5 mmol, 2.5 equiv.) was added with vigorous stirring. The reaction mixture was stirring at 140°C for 12 h under argon. [b] Isolated yields.

4. Spectra data of products 3a-3t

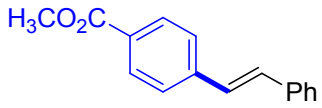
(3a) [1]



Yellow solid, mp 116-118 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.64 (d, *J* = 8.4 Hz, 2H), 7.59 (d, *J* = 8.4 Hz, 2H), 7.54 (d, *J* = 7.6 Hz, 2H), 7.41 (t, *J* = 7.2 Hz, 2H), 7.33 (t, *J* = 7.2 Hz, 1H), 7.22 (d, *J* = 16.4 Hz, 1H), 7.095 (d, *J* = 16 Hz, 1H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 141.78, 136.25, 132.46, 132.35, 128.87, 128.67, 126.94, 126. 86, 126.67, 119.10, 110.47; MS (EI) m/z (%): 205(100)$[M]^+$, 190(26), 177(12), 165(8), 152(6).

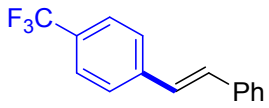
(3b) [1]



White solid, mp 157-159 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 8.03 (d, *J* = 7.2 Hz, 2H) , 7.53 - 7.58 (m, 4H), 7.38 (t, *J* = 6.4 Hz, 2H), 7.31 (d, *J* = 6.4 Hz, 1H), 7.23 (d, *J* = 16.8 Hz, 1H), 7.13 (d, *J* = 16.4 Hz, 1H) , 3.93 (s, 3H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 166.97, 141.89, 136.81, 131.30, 130.12, 128.96, 128.87, 128.33, 127.62, 126.89 126.41, 52.18; MS (EI) m/z (%): 238(90)$[M]^+$, 207(55), 178(100), 165(4), 152(18).

(3c) [2]



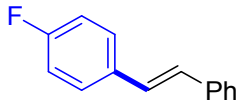
White solid, mp 133-135 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.60 (s, 4H), 7.54 (d, *J* = 7.2 Hz,2H) , 7.39 (t, *J* = 6.8 Hz, 2H), 7.31 (t, *J* = 6.8 Hz, 1H), 7.20 (d, *J* = 16.4 Hz, 1H), 7.12 (d, *J* = 16 Hz, 1H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 140.88, 136.72, 131.28, 129.32 (d, J = 32 Hz), 128.93,

[1] Sugihara T., Satoh T., Miura M., et al. *Advanced Synthesis & Catalysis*, **2004**, *346(13‐15)*: 1765-1772.
[2] Chen Z., Luo M., Wen Y., et al. *Organic letters*, **2014**, *16(11)*: 3020-3023.

128.42, 127.20, 126.90, 126.69, 125.74 (q, J = 4 Hz), 123.03. MS (EI) m/z (%): 248(100)$[M]^+$, 233(18), 227(16), 179(76), 152(9).

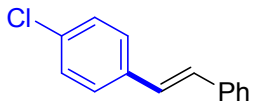
(**3d**) [2]



White solid, mp 124-126 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.51 - 7.49 (m, 4H) , 7.36 (t, J = 7.2 Hz, 2H), 7.27 (t, J = 7.2 Hz, 1H), 7.00 - 7.12 (m, 4H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 162.42 (d, J = 246 Hz) , 137.24, 133.59 (d, J = 3 Hz) , 128.82, 128.57, 128.09 (d, J = 8 Hz), 127.78, 127.55, 126.56,115.72 (d, J = 22 Hz). MS (EI) m/z (%): 198(100)$[M]^+$, 183(42), 177(21), 165(7), 152(5).

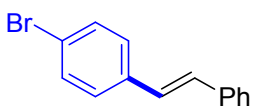
(**3e**) [2]



White solid, mp 126-128 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.51 (d, J = 6.8 Hz, 2H) , 7.45 (d, J = 8 Hz, 2H), 7.28 - 7.39 (m, 5H), 7.07 (dd, J = 16.4 Hz, J = 18.4 Hz, 2H,);

^{13}C NMR (100 MHz, $CDCl_3$) δ 137.05, 135.91, 133.25, 129.37, 128.94, 128.85, 127.98, 127.77, 127.43,126.66; MS (EI) m/z (%): 214(79)$[M]^+$, 199(6), 178(100), 163(4), 152(13).

(**3f**) [1]

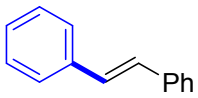


White solid, mp 137-139 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.47-7.52 (m, 4H) , 7.37 - 7.39 (m, 4H), 7.26 - 7.30 (m, 1H), 7.11 (d, J = 16.4 Hz, 1H),7.04 (d, J = 16.4 Hz, 1H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 137.03, 136.36, 131.89, 129.50, 128.87, 128.09, 128.03, 127.49, 126.68, 121.42; MS (EI) m/z (%): 258(75)$[M-1]^+$, 243(4), 178(100),

165(4), 152(10).

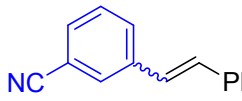
(**3g**) [1]



White solid, mp 123-125 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.52 (d, J = 7.6 Hz, 4H) , 7.36 (t, *J* =8.0 Hz, 4H), 7.24 - 7.28 (m, 2H), 7.12 (s, 2H);

^{13}C NMR (100 MHz, $CDCl_3$) δ137.43, 128.81, 128.80, 127.75, 126.64. MS (EI) m/z (%): 180(100)$[M]^+$, 165(60), 152(16).

(**3h**) [3]

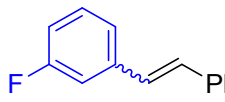


(E:Z=94:6)

Yellow solid, mp 62-64 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.78 (s, 1H), 7.72 (m, 1H), 7.24 - 7.54 (m, 7H), 7.17 (d, *J* = 16.4 Hz, 1H), 7.06 (d, *J* = 16.4 Hz, 1H),;

^{13}C NMR (100 MHz, $CDCl_3$) δ 138.75, 136.50, 130.84, 130.67, 130.00, 129.61, 128.98, 128.59, 126.92, 126.33, 118.93, 113.09. MS (EI) m/z (%): 204(100)$[M-1]^+$, 190(35), 176(15), 165(10), 152(9).

(**3i**) [4]



(E:Z=85:15)

White solid, mp 69-71 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.52 (d, *J* = 6.8 Hz, 2H), 7.21 - 7.39 (m, 6H), 7.05 - 7.14 (m, 2H), 6.96 - 6.98 (m, 1H);

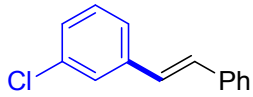
^{13}C NMR (100 MHz, $CDCl_3$) δ 163.33 (d, *J* = 244.0 Hz), 139.50 (d, *J* = 7.0 Hz), 136.96, 130.26, 130.18, 130.15, 128.88, 128.82, 128.14, 127.76, 127.62, 127.59, 126.79, 126.65, 122.61, 122.58, 114.51(d, *J* = 22.0 Hz), 112.91 (d, *J* = 21.0 Hz). MS

[3] Cui X., Zhou Y., Wang N., et al. *Tetrahedron Letters*, **2007**, *48(1)*: 163-167.

[4] Zhu X., Liu J., Chen T., et al. *ChemInform*, **2012**, *43(31)*: no.

(EI) m/z (%): 198(100)$[M]^+$, 183(50), 178(30), 170(8), 152(5).

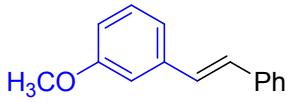
(**3j**) [5]



White solid, mp 73-75 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.51 (m, 3H) , 7.37 (m, 3H), 7.24 - 7.31 (m, 3H), 7.12 (d, J = 16 Hz, 1H), 7.04 (d, J = 16 Hz, 1H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 124.86, 126.39, 126.77, 127.27, 127.59, 128.15, 128.86, 129.98, 130.17, 134.72, 136.88, 139.30. MS (EI) m/z (%): 214(61)$[M]^+$, 199(8), 178(100), 163(5), 152(10).

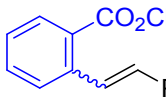
(**3k**) [6]



Yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.52 (d, J = 7.2 Hz, 2H) , 7.35 - 7.38 (m, 2H), 7.29 (d, J = 7.2 Hz, 2H), 7.05 - 7.13 (m, 4H), 6.83 (d, J = 8 Hz, 1H), 3.85 (s, 3H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 159.98, 138.88, 137.31, 129.76, 129.10, 128.81, 128.67, 127.81, 126.66, 119.35, 113.40, 111.83, 55.36. MS (EI) m/z (%): 210(100)$[M]^+$, 194(25), 179(40), 165(50), 152(24).

(**3l**) [7]



(E:Z=75:25)

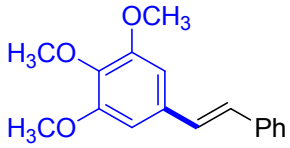
Yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.52 (d, J = 7.2 Hz, 1H) , 7.00 - 7.39 (m, 9H), 6.65 (d, J = 12.4, 1H), 3.89 (s, 3H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 167.61, 139.77, 136.77, 132.11, 131.21, 130.54,

[5] Zhang Y.-G., Liu X.-L., He Z.-Y., et al. *Chemistry-A European Journal*, **2014**, *20(10)*: 2765-2769.
[6] Pavia C., Giacalone F., Bivona L. A., et al. *Journal of Molecular Catalysis A: Chemical*, **2014**, 387: 57-62.
[7] Shahzad S. A., Wirth T., *Angewandte Chemie International Edition*, **2009**, *48(14)*: 2588-2591.

129.66, 129.34, 128.79, 128.13, 127.53, 127.22, 127.05, 52.15. MS (EI) m/z (%): 238(92)$[M]^+$, 206(33), 195(13), 178(100), 165(13), 152(20).

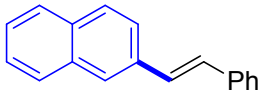
(3m) [8]



Light yellow solid, mp 105-107 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.51 (d, *J* = 7.2 Hz, 2H) , 7.37 (t, *J* = 7.2 Hz, 2H), 7.27 (t, *J* = 7.6 Hz, 1H), 6.99 - 7.08 (dd, *J* = 17.2 Hz, *J* = 17.6 Hz, 2H), 6.75 (s, 2H), 3.93 (s, 6H), 3.87 (s, 3H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 56.24, 61.12, 103.60, 126.56, 127.75, 128.32, 128.74, 128.84, 133.21, 137.31, 137.97, 153.51. MS (EI) m/z (%): 270(100)$[M]^+$, 255(88), 195(18), 180(11), 165(19) , 152(20).

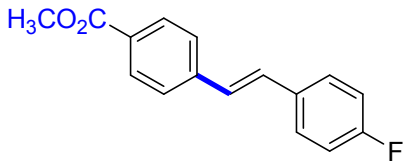
(3n) [1]



White solid, mp 147-149 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.82 - 7.86 (m, 4H) , 7.75 (d, *J* = 8.4 Hz, 1H), 7.57 (d, *J* = 7.2 Hz, 2H), 7.46 (t, *J* = 6.4 Hz, 2H), 7.39 (t, *J* = 6.8 Hz, 2H), 7.22 - 7.30 (m, 3H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 137.46, 134.92, 133.82, 133.15, 129.12, 128.88, 128.86, 128.44, 128.13, 127.83, 127.82, 126.78, 126.67, 126.47, 126.03, 123.61. MS (EI) m/z (%): 230(100)$[M]^+$, 215(24), 202(12), 189(5), 152(10).

(3o) [9]



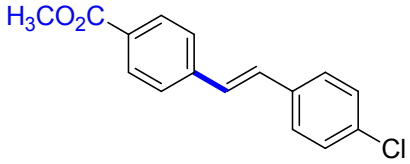
White solid, mp 144-146 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 7.03 (d, *J* = 8.4 Hz,

[8] McNulty J., Das P. *European Journal of Organic Chemistry*, **2009**, *2009(24)*: 4031-4035.
[9] Palmer B. D., Sutherland H. S., Blaser A., et al. *Journal of Medicinal Chemistry*, **2015**, *58(7)*: 3036-3059.

2H) , 7.55 (d, J = 8.0 Hz, 2H), 7.49 - 7.53 (dd, J = 5.6 Hz, J = 5.6 Hz, 2H), 7.18 (d, J = 16.4 Hz, 1H), 7.02 - 7.09 (dd, J = 16.4 Hz, J = 8.4 Hz, 3H), 3.93 (s, 3H);

^{13}C NMR (100 MHz, $CDCl_3$) δ 166.94, 162.74 (d, J = 247 Hz), 141.71, 133.02 (d, J = 3 Hz), 130.13, 129.00, 128.43 (d, J = 8 Hz), 127.40, 127.38, 126.34, 115.86 (d, J = 21 Hz), 52.19. MS (EI) m/z (%): 256(100)$[M]^+$, 225(75), 207(4), 196(70), 177(20) , 151(4).

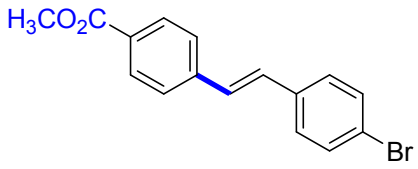
(3p) [6]



White solid, mp 161-163 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 8.03 (d, J = 7.2 Hz, 2H) , 7.56 (d, J = 7.2 Hz, 2H), 7.46 (d, J = 6.8 Hz, 2H), 7.35 (d, J = 7.6 Hz, 2H), 7.17 (d, J = 16.4 Hz, 1H), 7.09 (d, J = 16.4 Hz, 1H), 3.93 (s, 3H) ;

^{13}C NMR (100 MHz, $CDCl_3$) δ 166.92, 141.51, 133.94, 130.16, 129.93, 129.21, 129.06, 128.22, 128.03, 126.46, 52.23. MS (EI) m/z (%): 272(85)$[M]^+$, 241(47), 213(9), 178(100), 152(12).

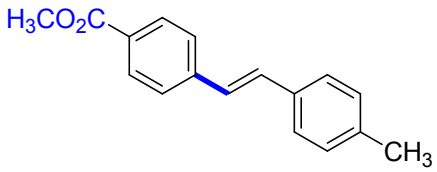
(3q) [6]



Yellow solid, mp 179-181°C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 8.03 (d, J = 7.6 Hz, 2H) , 7.56 (d, J = 8.0 Hz, 2H), 7.51 (d, J = 8.0 Hz, 2H), 7.40 (d, J = 8.0 Hz, 2H), 7.09 - 7.18 (dd, J = 18.4 Hz, J = 16.4 Hz, 2H), 3.93 (s, 3H) ;

^{13}C NMR (100 MHz, $CDCl_3$) δ 166.97, 141.55, 135.84, 132.07, 130.22, 130.06, 129.32, 128.42, 128.37, 126.53, 122.20, 52.26. MS (EI) m/z (%): 316(58)$[M-1]^+$, 285(29), 258(4), 205(4), 192(4) , 178(100), 152(15).

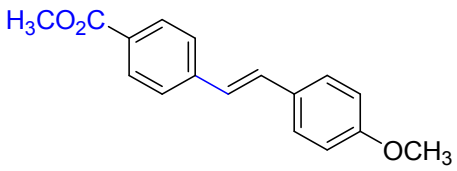
(3r) [6]



White solid, mp 163-165 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 8.02 (d, *J* = 8.0 Hz, 2H) , 7.55 (d, *J* = 7.6 Hz, 2H), 7.43 (d, *J* = 7.6 Hz, 2H), 7.18 - 7.22 (m, 3H), 7.08 (d, *J* = 16.4 Hz, 1H), 3.92 (s, 3H), 2.37 (s, 3H) ;

^{13}C NMR (100 MHz, $CDCl_3$) δ 167.01, 142.13, 138.36, 134.05, 131.26, 130.10, 129.60, 128.74, 126.82, 126.62, 126.28, 52.16,21.46. MS (EI) m/z (%): 252(100)$[M]^+$, 221(36), 193(37), 178(94), 152(10).

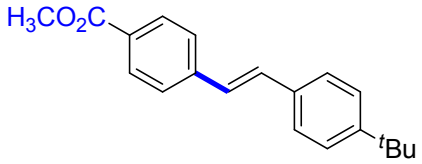
(**3s**) [10]



White solid, mp 170-172 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 8.01 (d, *J* = 8.0 Hz, 2H), 7.54 (d, *J* = 8 Hz, 2H,), 7.48 (d, *J* = 8.4 Hz, 2H), 7.18 (d, *J* = 16.4 Hz, 1H), 6.91 - 7.02 (dd, *J* = 8 Hz, *J* = 16.4 Hz, 3H), 3.92 (s, 3H), 3.84 (s, 3H),;

^{13}C NMR (100 MHz, $CDCl_3$) δ 167.08, 159.92, 142.35, 130.92, 130.15, 129.68, 128.60, 128.23, 126.15, 125.55, 114.37, 55.48, 52.18,. MS (EI) m/z (%): 268(100)$[M]^+$, 273(19), 209(10), 194(20), 178(18) , 165(50) , 152(5).

(3t) [11]



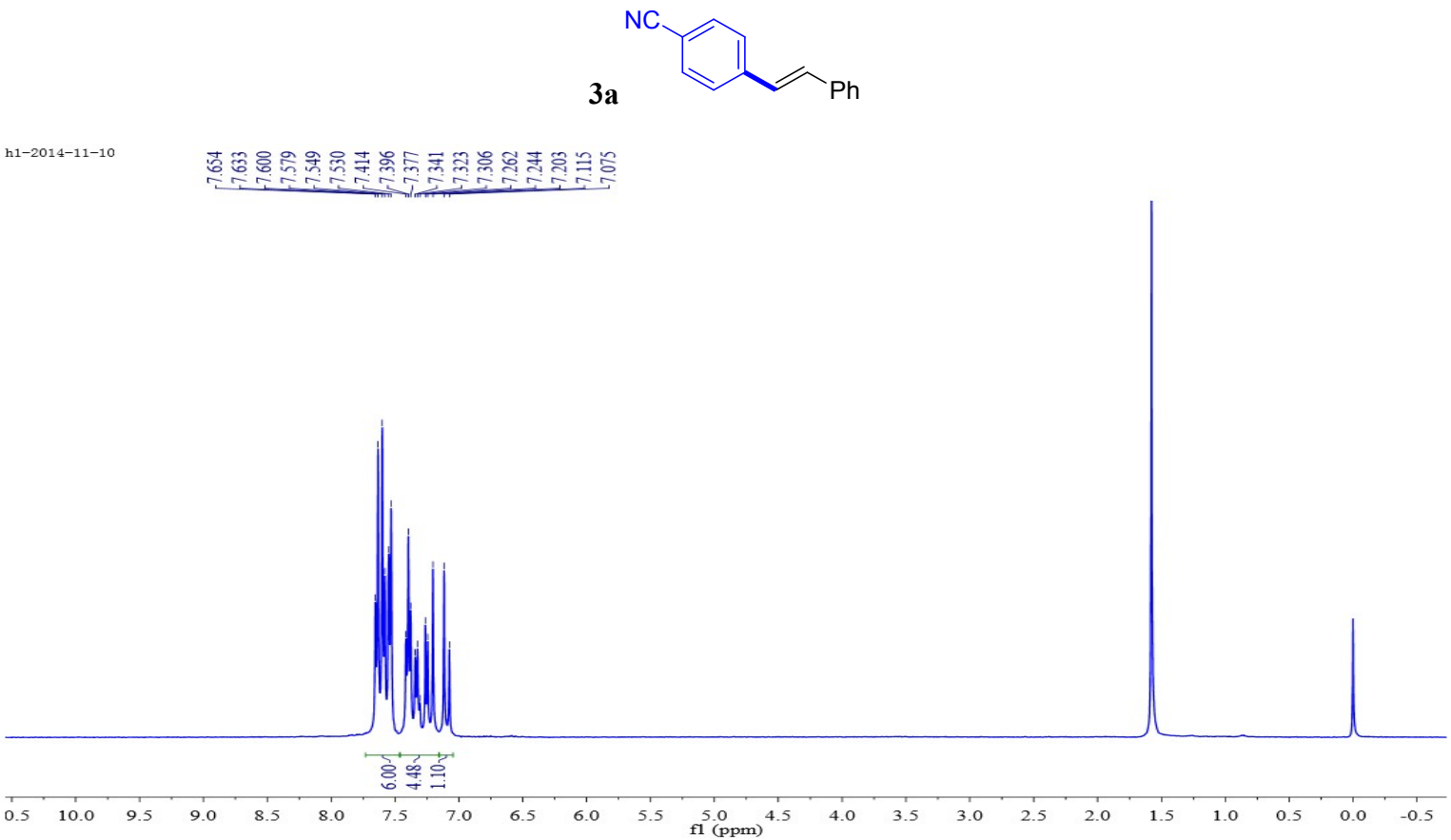
White solid, mp 102-104 °C. ^{1}H NMR (400 MHz, $CDCl_3$, TMS) δ 8.02 (d, *J* = 8.0 Hz, 2H), 7.56 (d, *J* = 8.4 Hz, 2H), 7.48 (d, *J* = 8.0 Hz, 1H), 7.41 (d, *J* = 8.0 Hz, 2H), 7.20

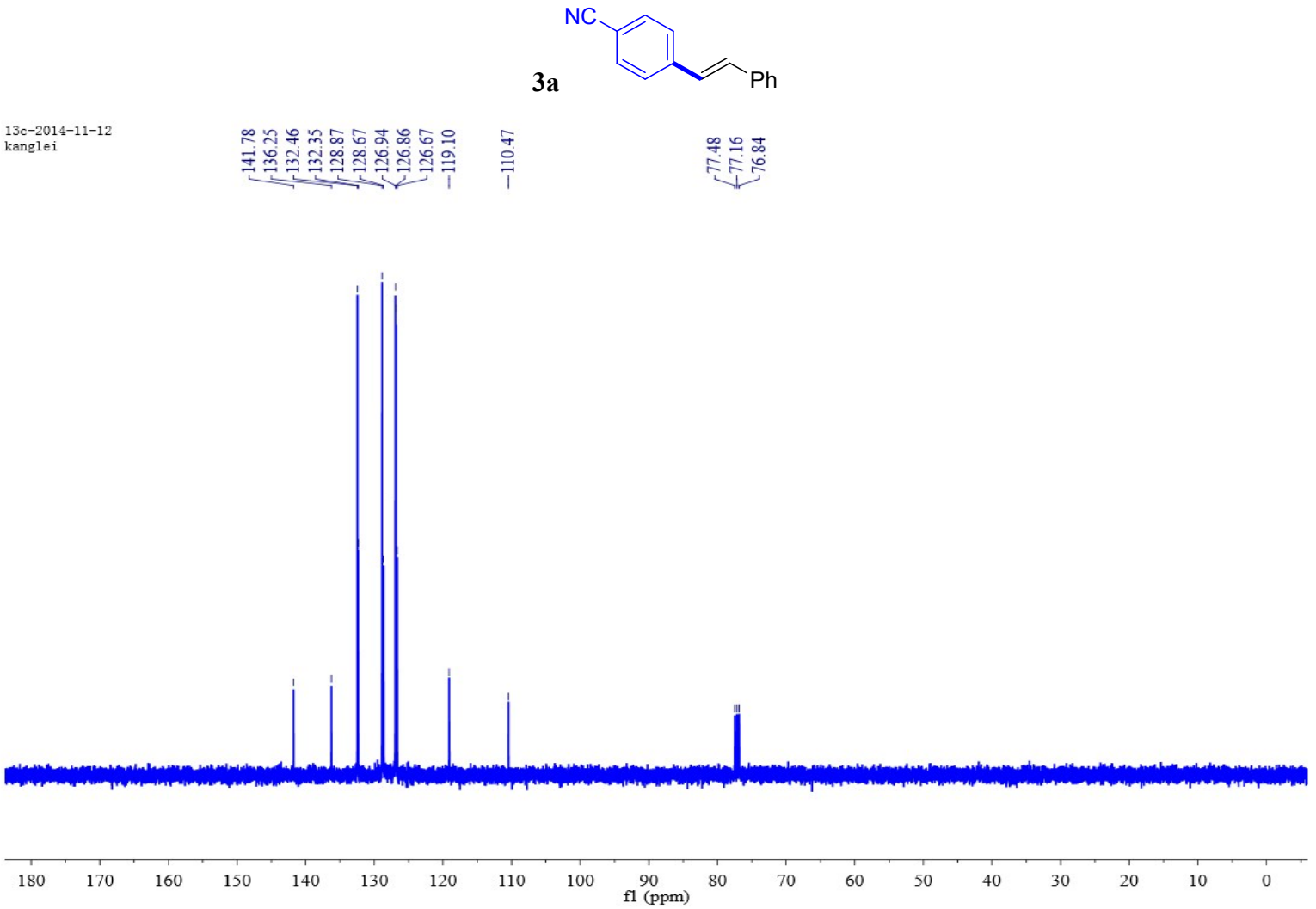
[10] Hong F.-J., Low Y. Y., Chong K. W., et al. *The Journal of Organic Chemistry*, **2014**, *79(10)*: 4528-4543.
[11] Jana D., Ghorai B. K. *Tetrahedron*, **2012**, *68(36)*: 7309-7316.

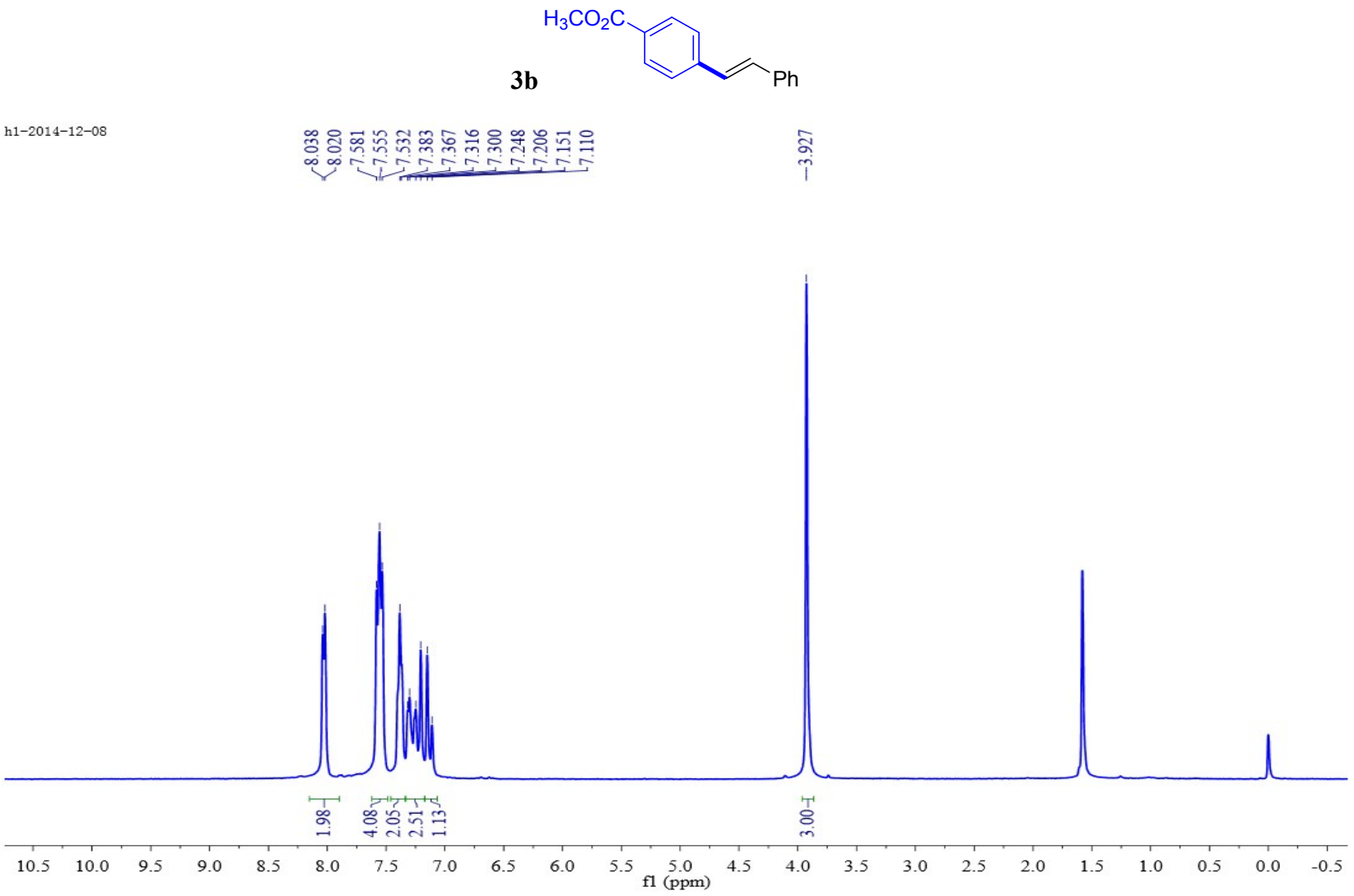
(d, J = 16.4 Hz, 1H), 7.09 (d, J = 16.4 Hz, 1H), 3.92 (s, 3H), 1.34 (s, 9H);

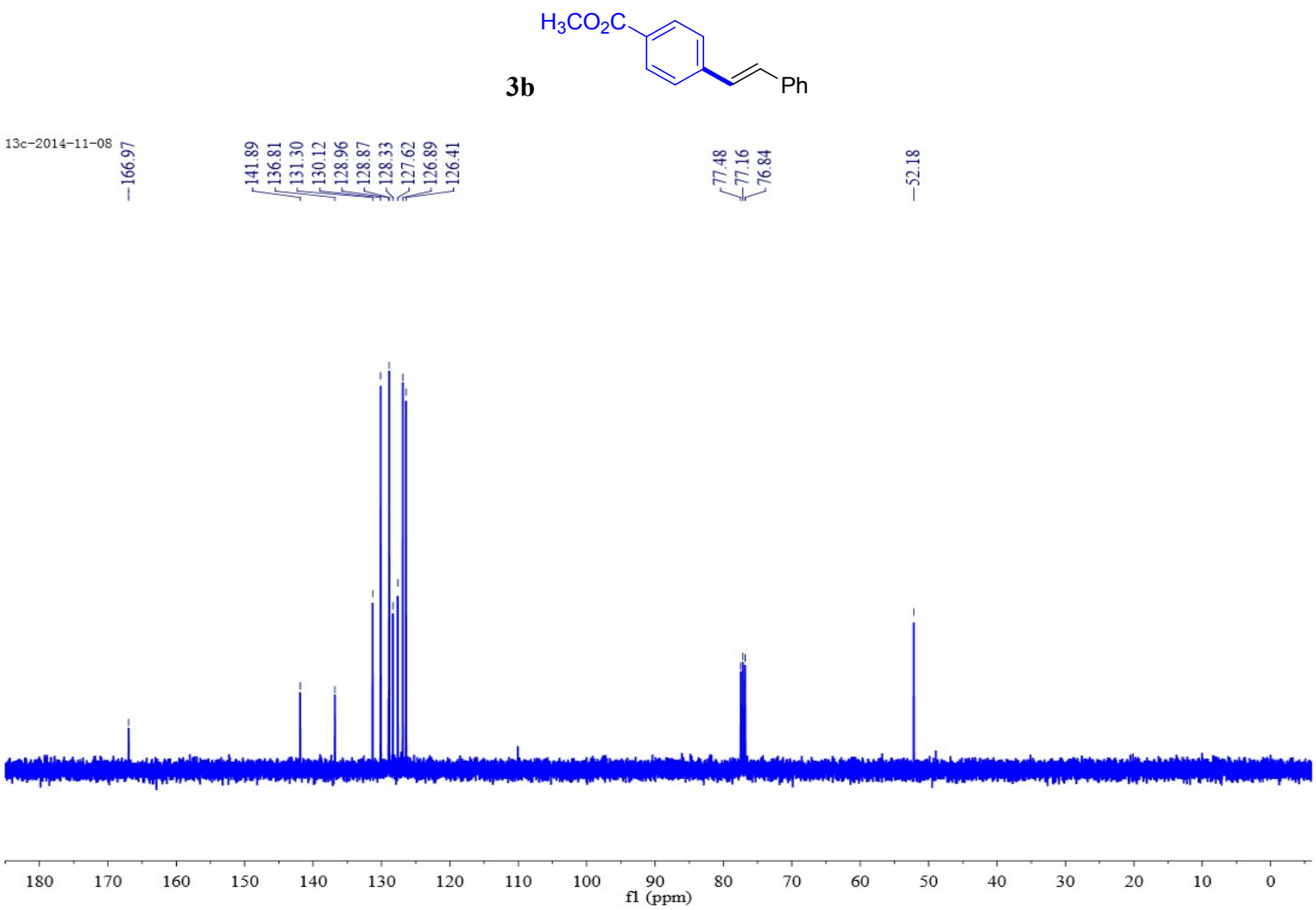
^{13}C NMR (100 MHz, $CDCl_3$) δ 167.06, 151.65, 142.20, 134.12, 130.14, 128.81, 126.91, 126.69, 126.34, 125.86, 52.20, 34.83, 31.40. MS (EI) m/z (%): 294(155)$[M]^+$, 279(100), 263(5), 247(15), 220(5) , 191(5) , 178(20).

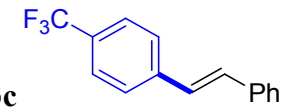
5. Copies of 1H and 13C NMR spectra of products 3a-3t



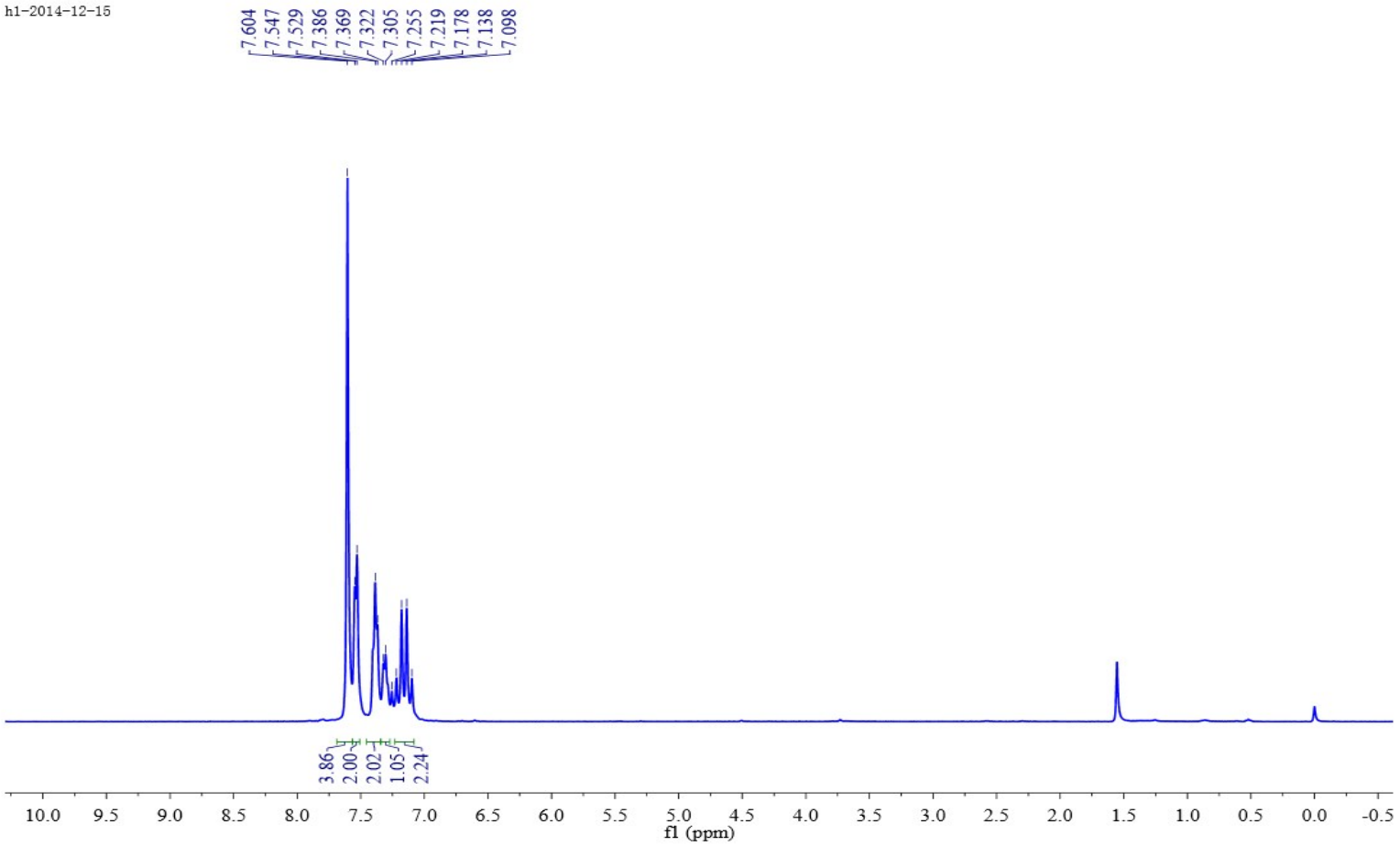

NC
Ph
3a
13c-2014-11-12
kanglei
141.78
136.25
132.46
132.35
128.87
128.67
126.94
126.86
126.67
119.10
110.47
77.48
77.16
76.84
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

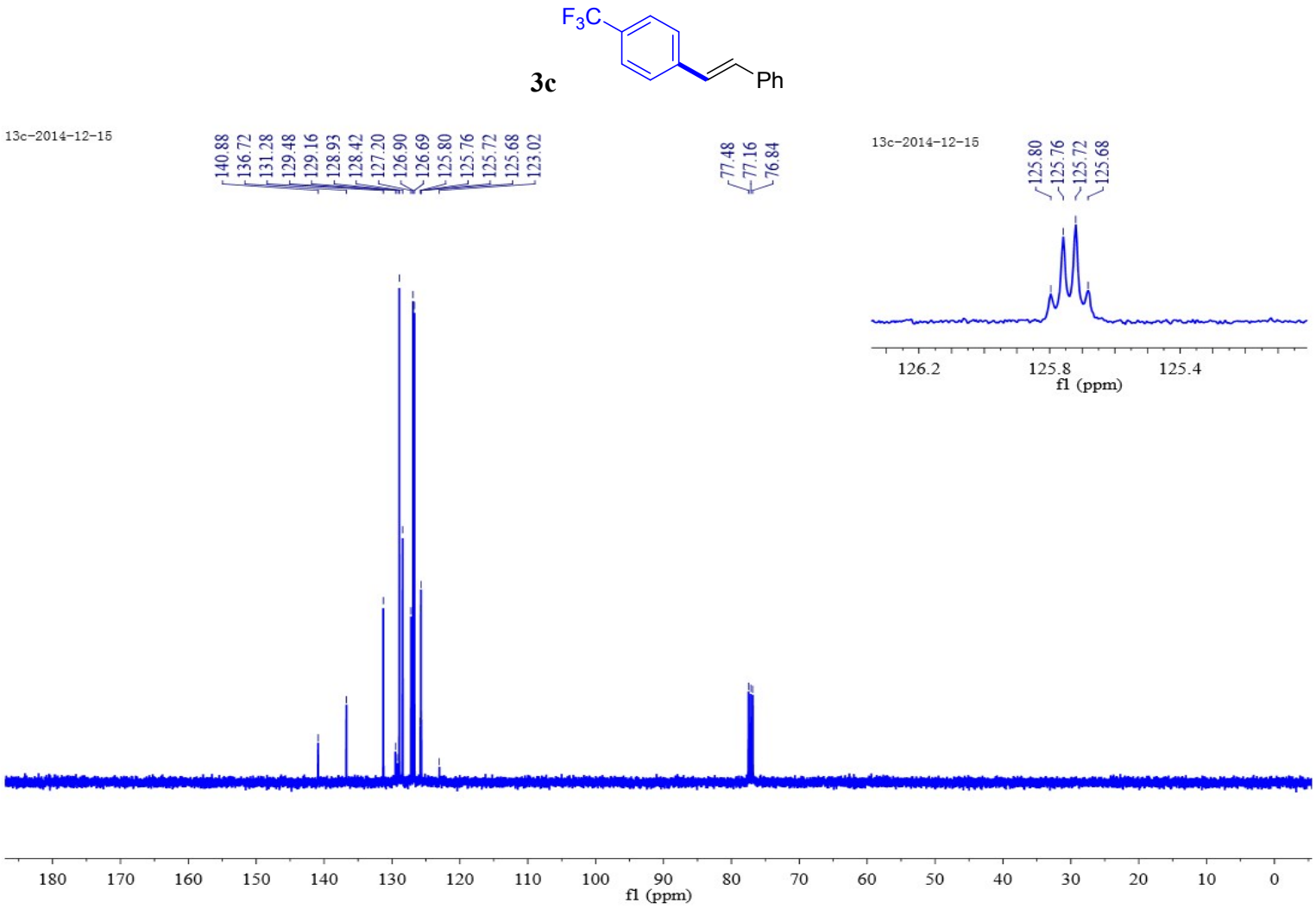

H3CO2C
Ph
3b
h1-2014-12-08
8.038
8.020
7.581
7.555
7.532
7.383
7.367
7.316
7.300
7.248
7.206
7.151
7.110
3.927
1.98
4.08
2.05
2.51
1.13
3.00
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

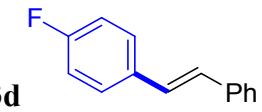

H3CO2C
Ph
3b
13c-2014-11-08
166.97
141.89
136.81
131.30
130.12
128.96
128.87
128.33
127.62
126.89
126.41
77.48
77.16
76.84
52.18
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


F3C
Ph

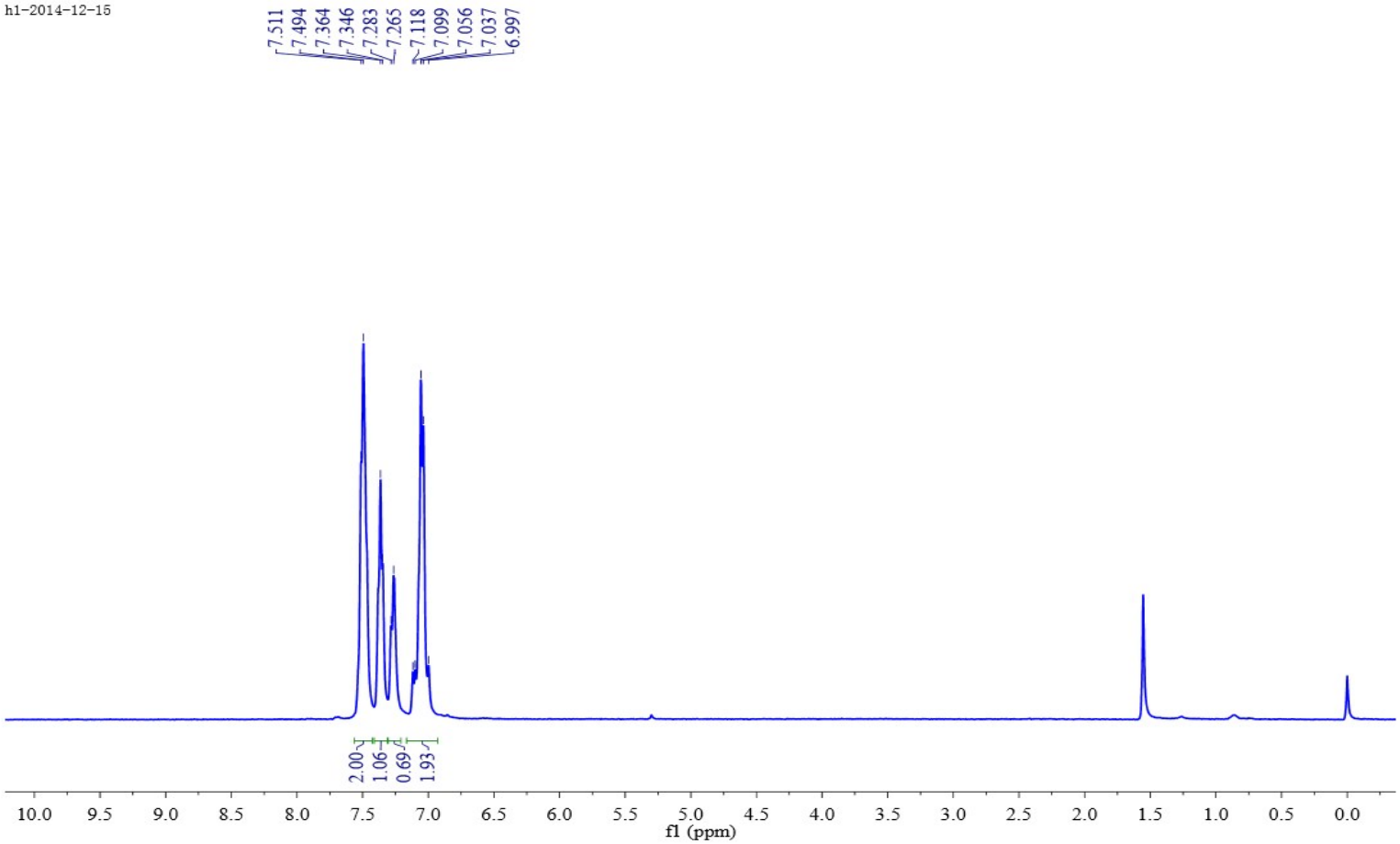
3c

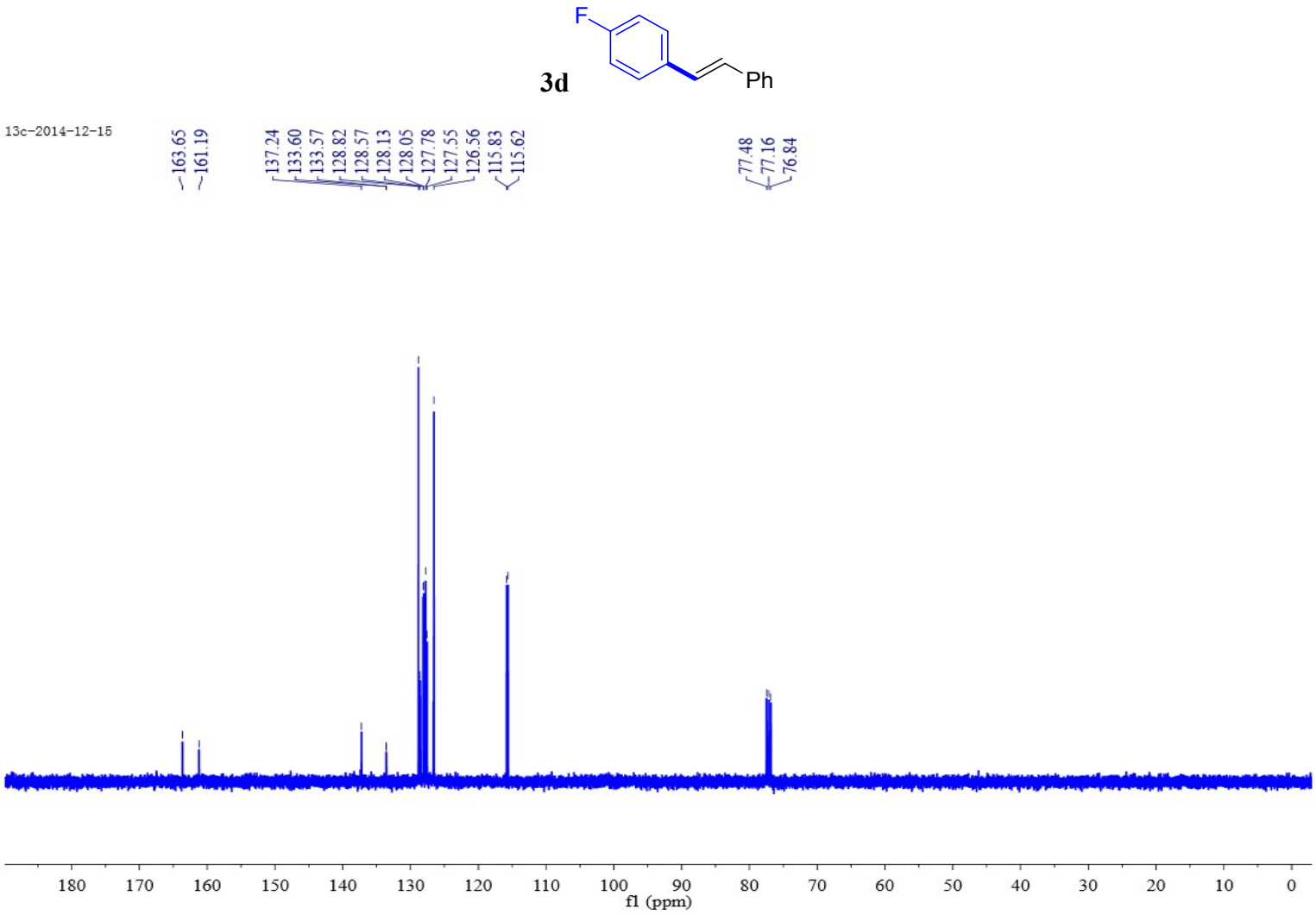

h1-2014-12-15
7.604
7.547
7.529
7.386
7.369
7.322
7.305
7.255
7.219
7.178
7.138
7.098
3.86
2.00
2.02
1.05
2.24
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

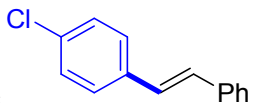

F3C
Ph
3c
13c-2014-12-15
140.88
136.72
131.28
129.48
129.16
128.93
128.42
127.20
126.90
126.69
125.80
125.76
125.72
125.68
123.02
77.48
77.16
76.84
13c-2014-12-15
125.80
125.76
125.72
125.68
126.2
125.8
125.4
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


F
Ph

3d

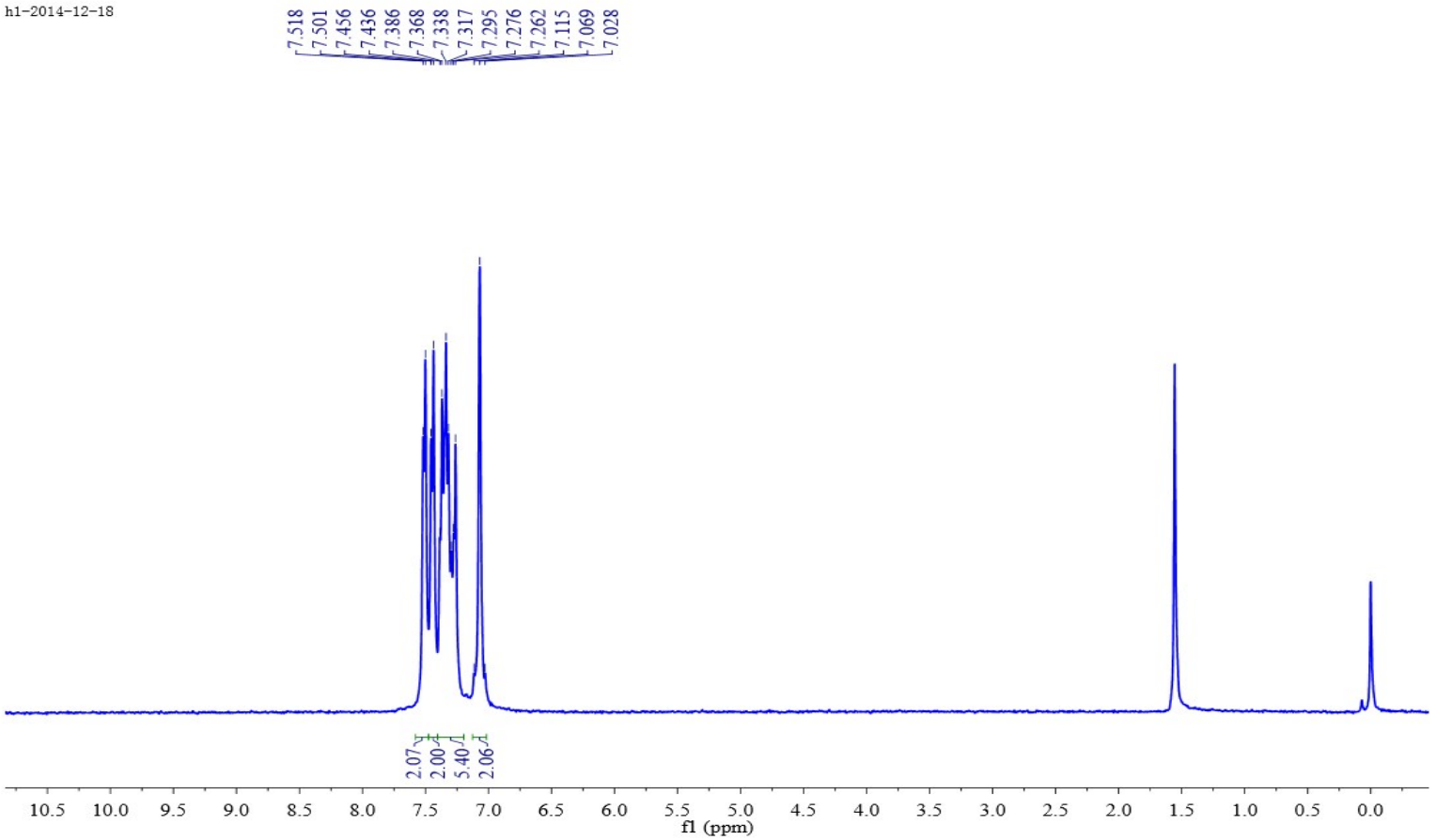

h1-2014-12-15
7.511
7.494
7.364
7.346
7.283
7.265
7.118
7.099
7.056
7.037
6.997
2.00
1.06
0.69
1.93
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

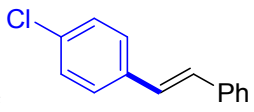

F
Ph
3d
13c-2014-12-15
163.65
161.19
137.24
133.60
133.57
128.82
128.57
128.13
128.05
127.78
127.55
126.56
115.83
115.62
77.48
77.16
76.84
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)



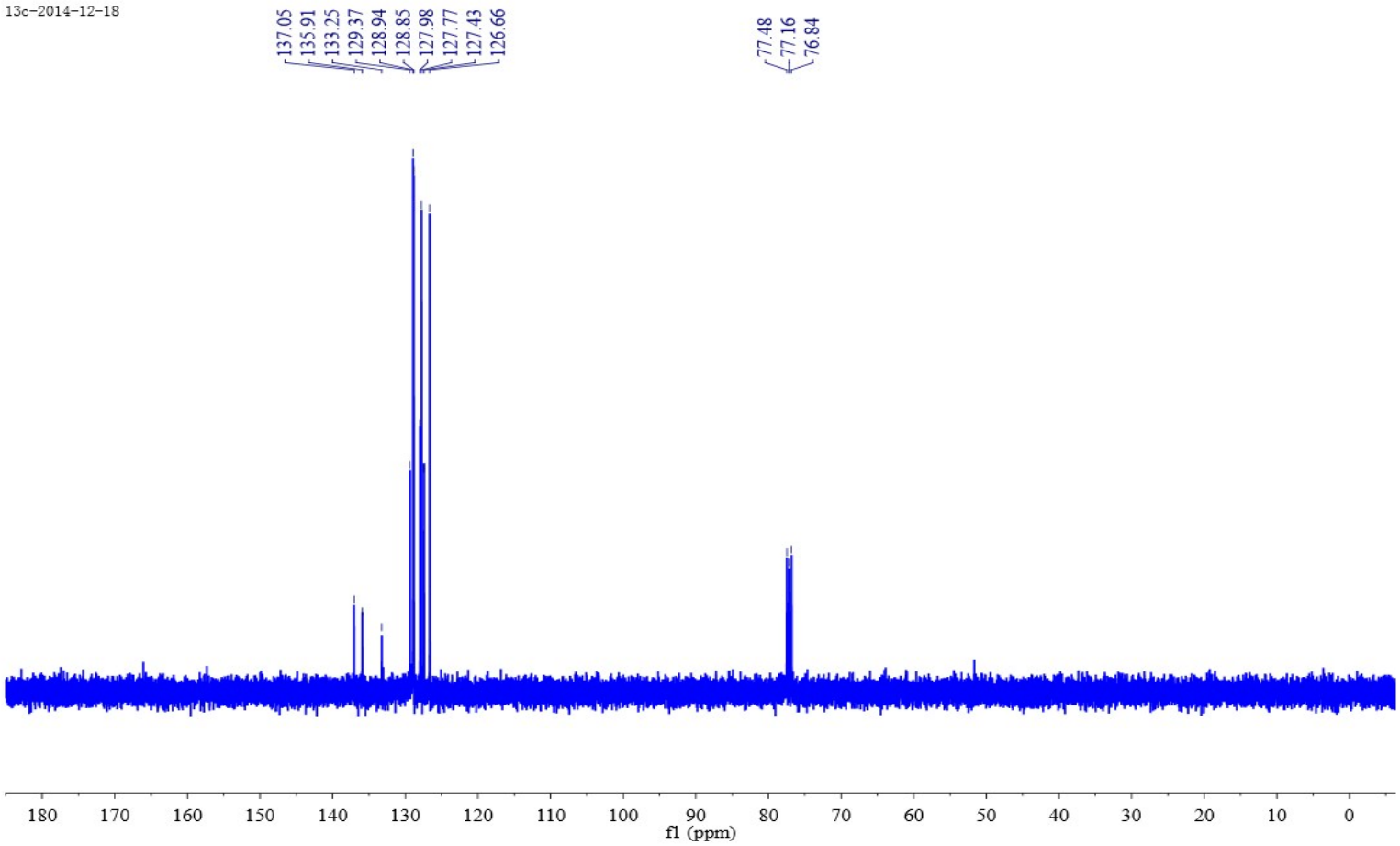
3e

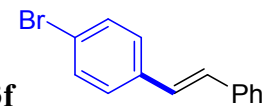
h1-2014-12-18



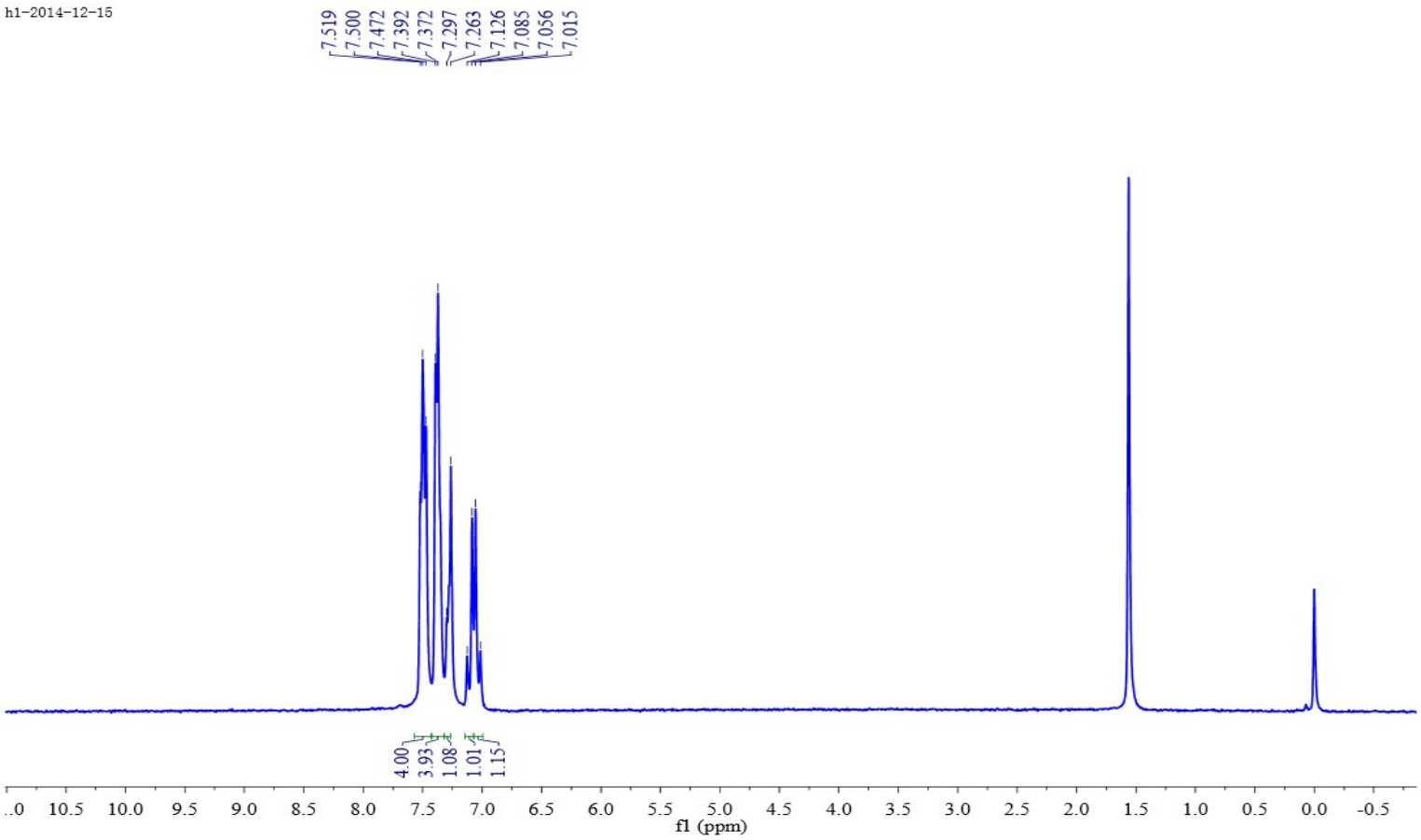

Cl
Ph

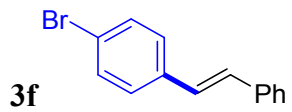
3e


13c-2014-12-18
137.05
135.91
133.25
129.37
128.94
128.85
127.98
127.77
127.43
126.66
77.48
77.16
76.84
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


Br
Ph

3f


h1-2014-12-15
7.519
7.500
7.472
7.392
7.372
7.297
7.263
7.126
7.085
7.056
7.015
4.00
3.93
1.08
1.01
1.15
f1 (ppm)

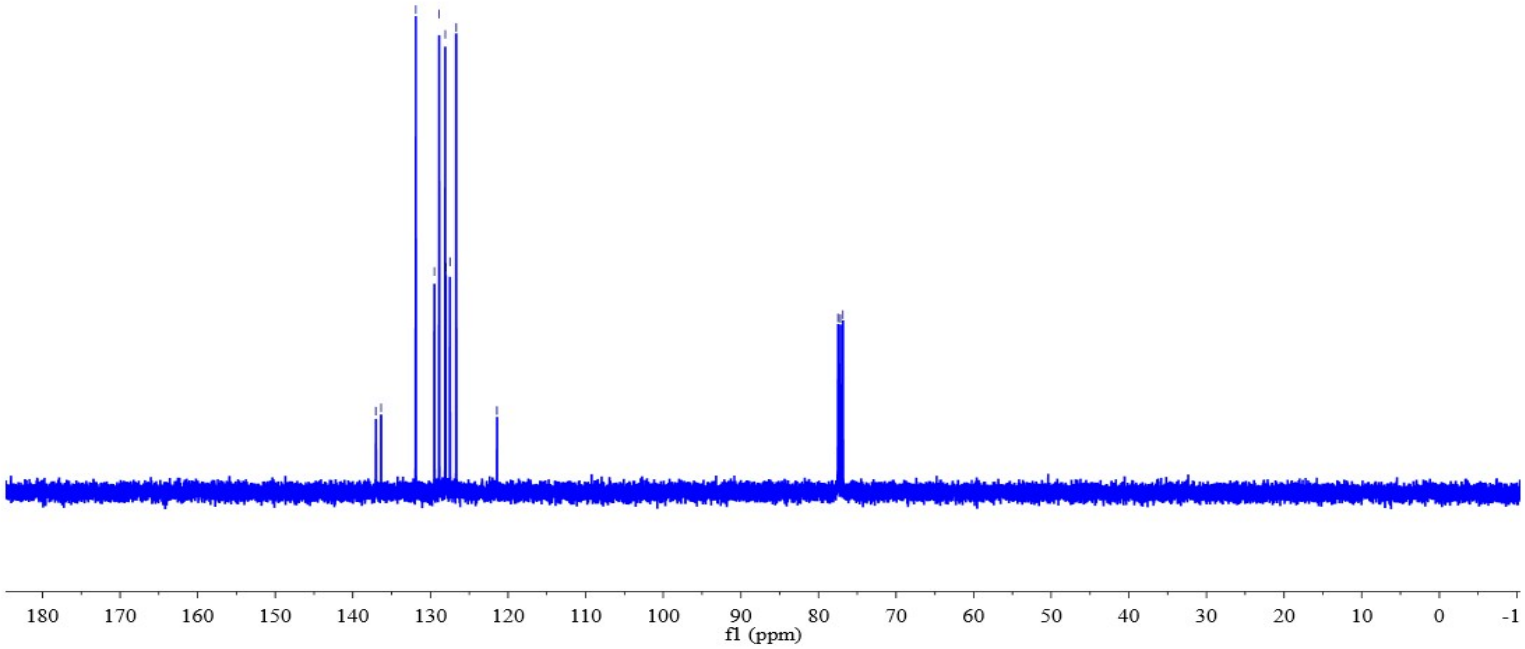


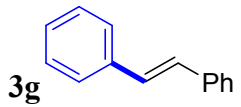
3f

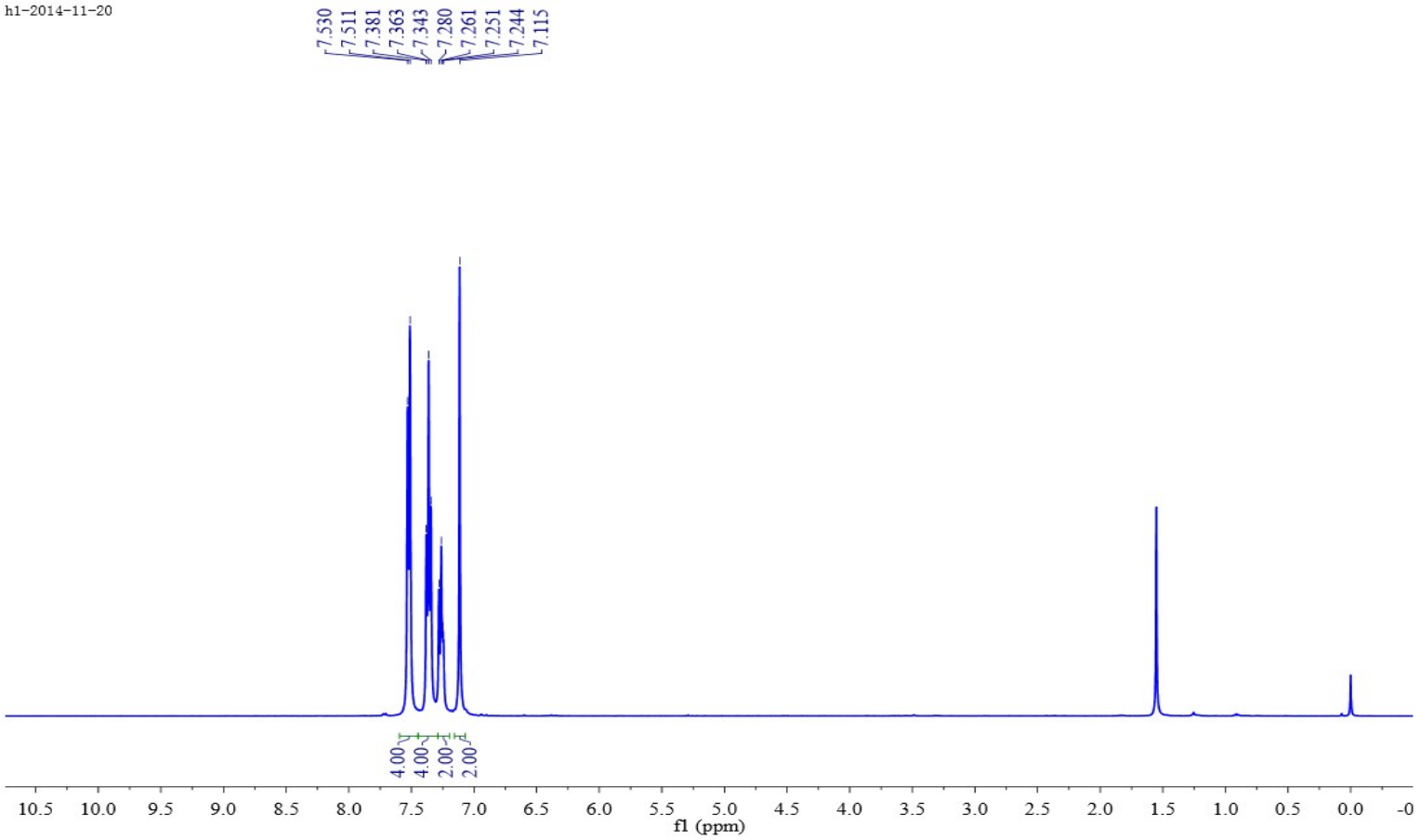
13c-2014-12-15

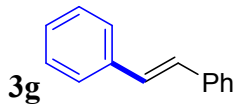
137.03
136.36
131.89
129.50
128.87
128.09
128.03
127.49
126.68
121.42

77.48
77.16
76.84

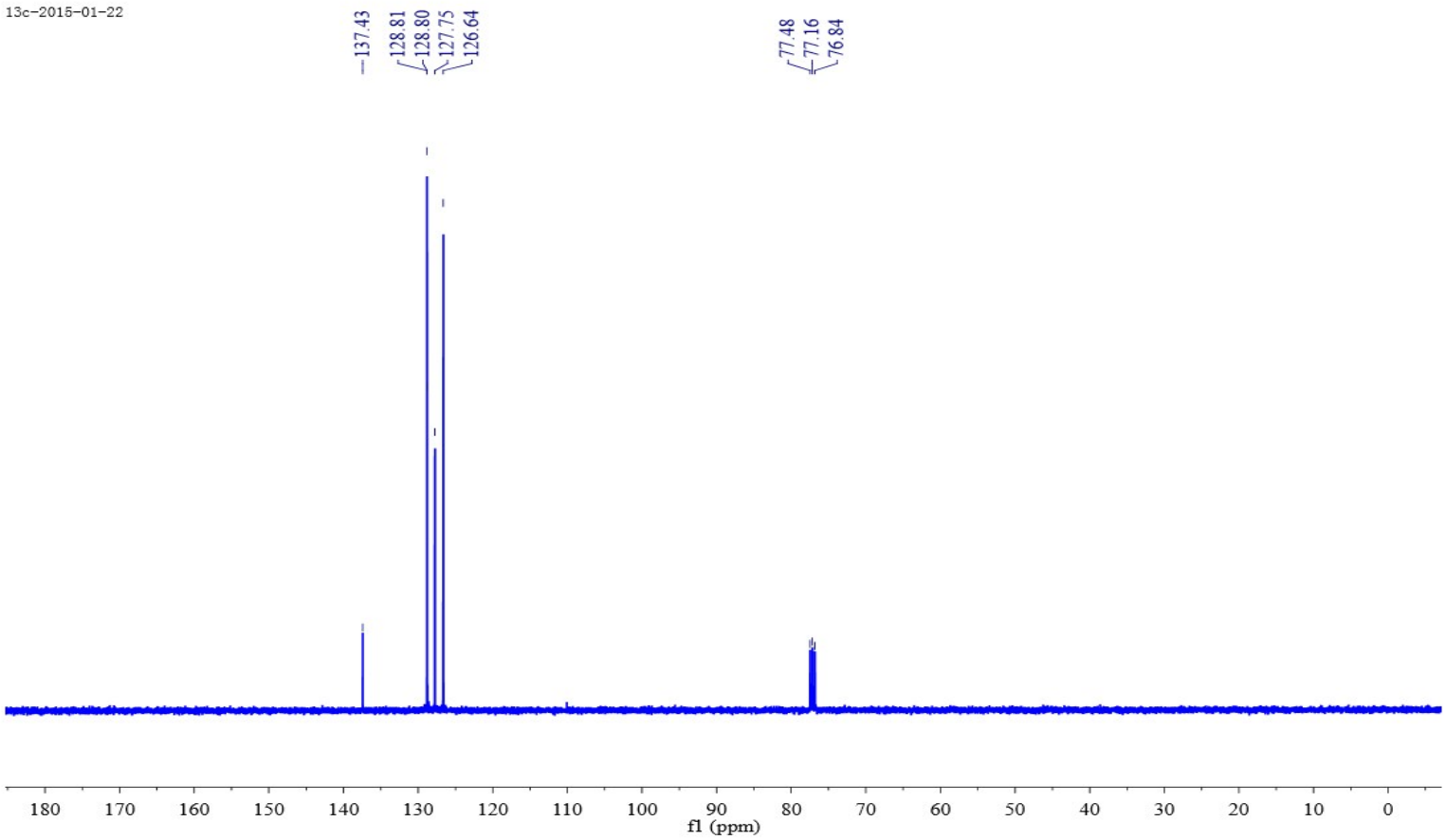


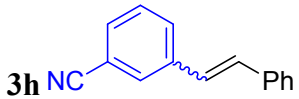

3g
Ph

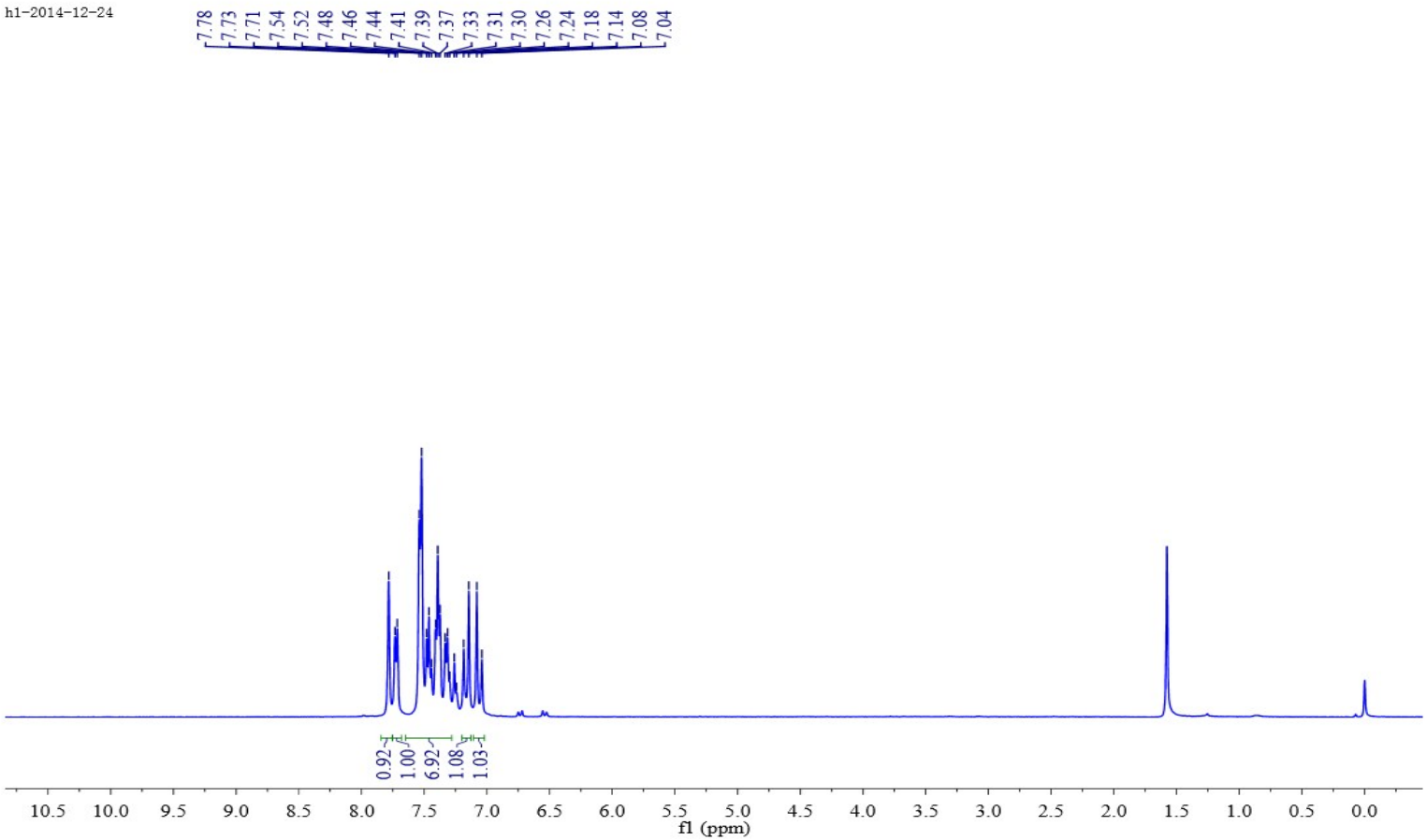

h1-2014-11-20
7.530
7.511
7.381
7.363
7.343
7.280
7.261
7.251
7.244
7.115
4.00
4.00
2.00
2.00
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

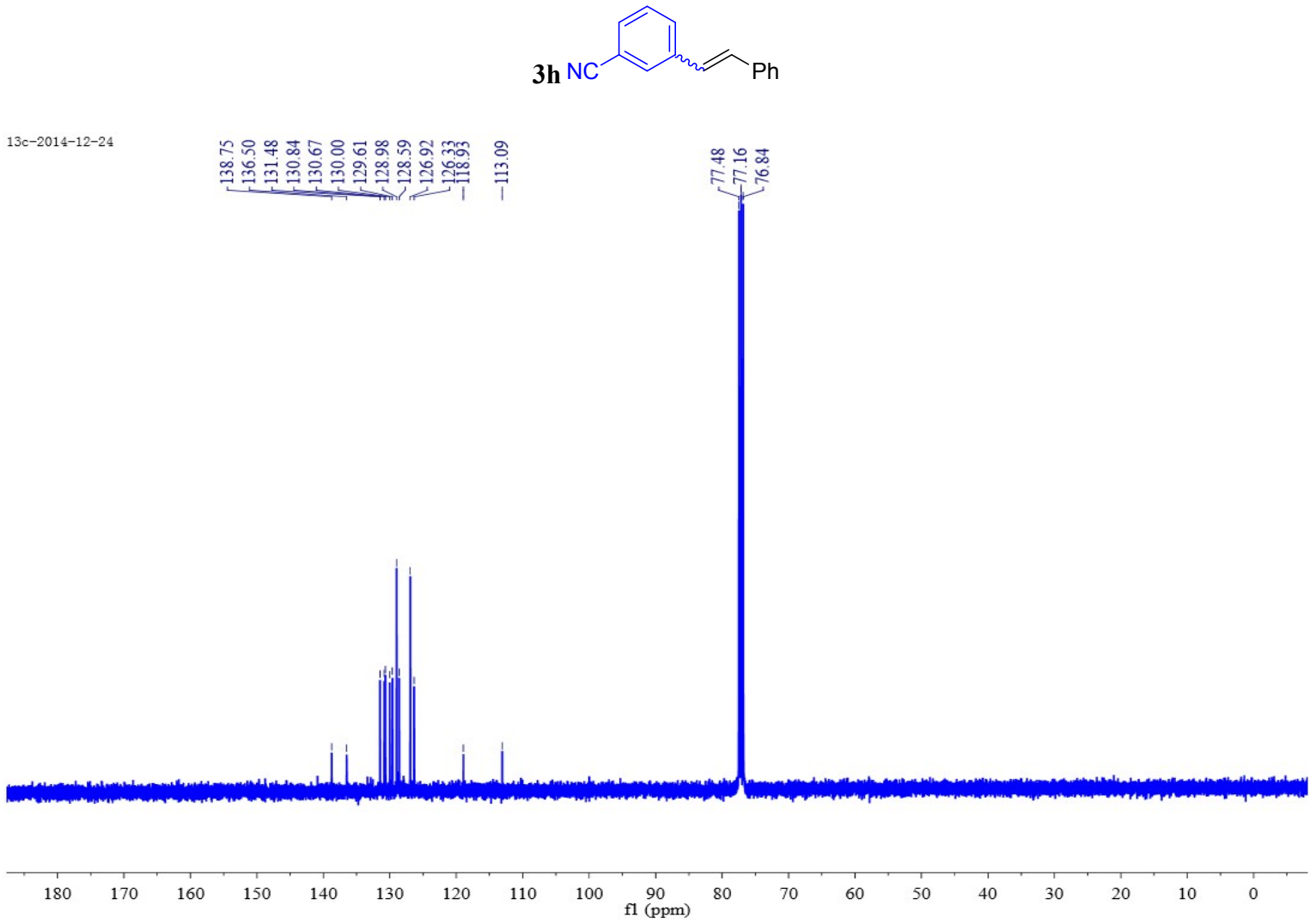

Ph

3g


13c-2015-01-22
137.43
128.81
128.80
127.75
126.64
77.48
77.16
76.84
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


3h
NC
Ph


h1-2014-12-24
7.78
7.73
7.71
7.54
7.52
7.48
7.46
7.44
7.41
7.39
7.37
7.33
7.31
7.30
7.26
7.24
7.18
7.14
7.08
7.04
0.92
1.00
6.92
1.08
1.03
10.5
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)


3h
NC
Ph
13c-2014-12-24
138.75
136.50
131.48
130.84
130.67
130.00
129.61
128.98
128.59
126.92
126.33
118.93
113.09
77.48
77.16
76.84
180
170
160
150
140
130
120
110
100
90
80
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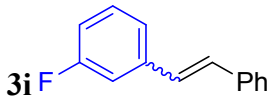
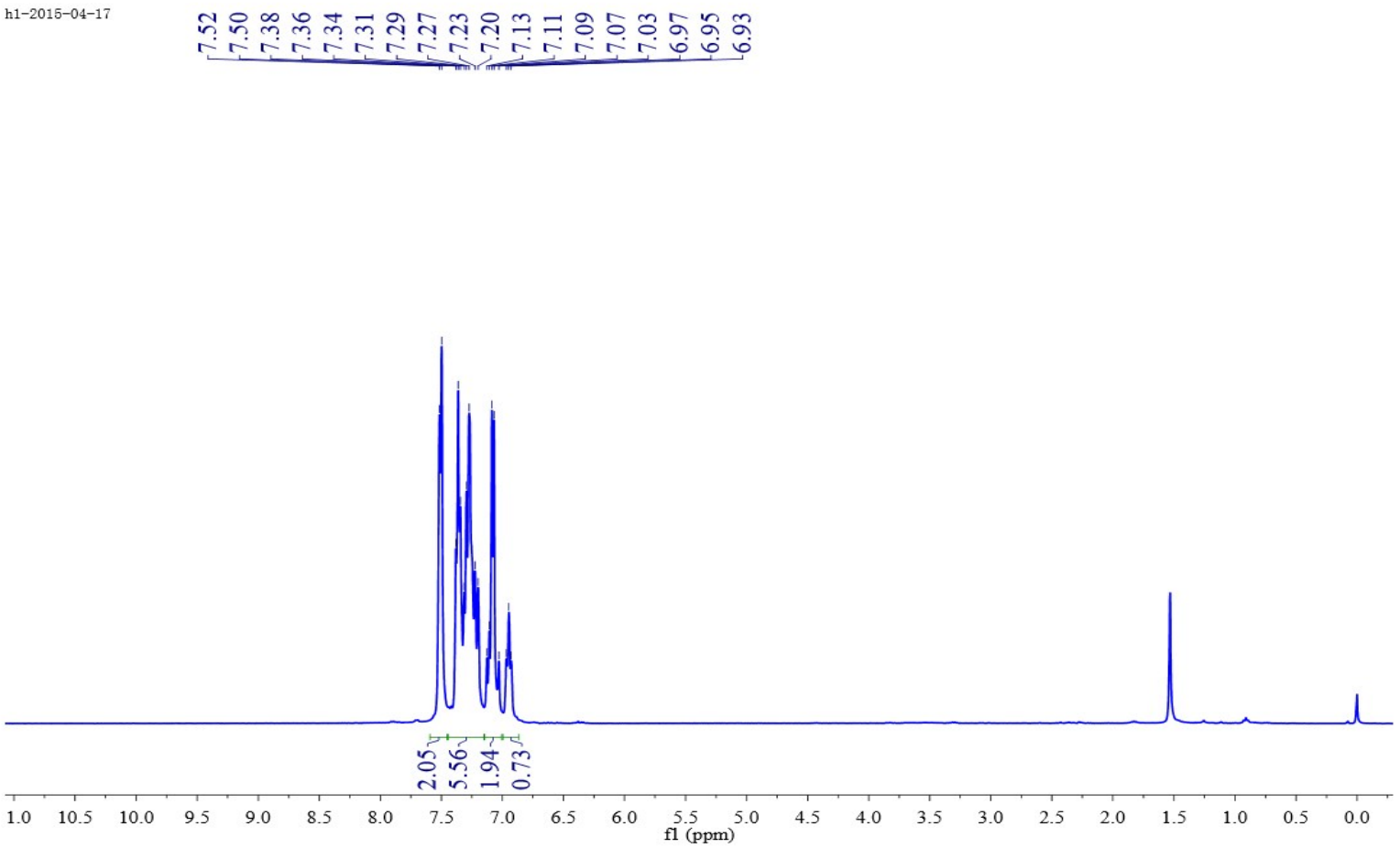
50
40
30
20
10
0
f1 (ppm)


3i
F
Ph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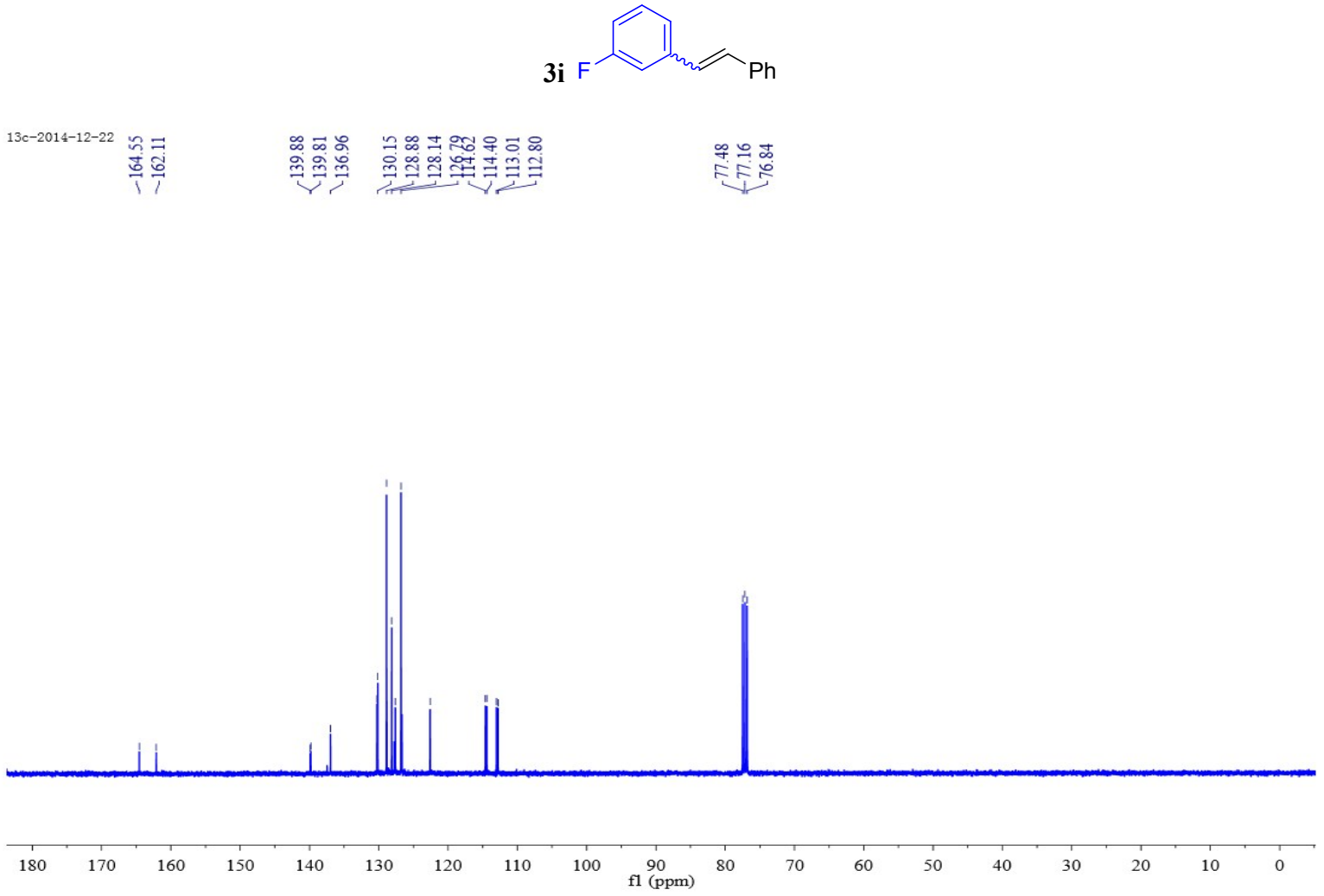
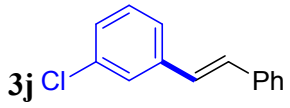
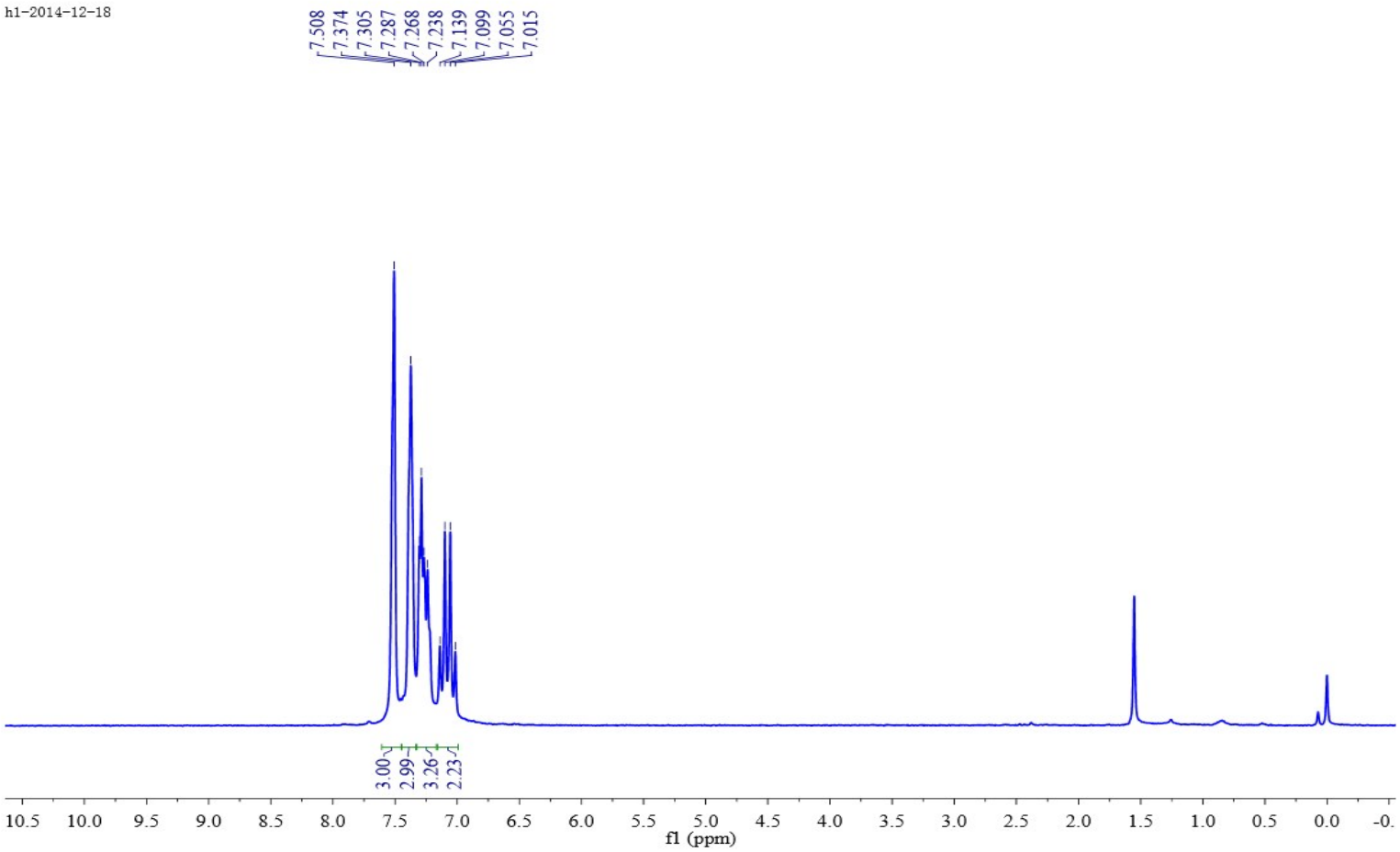
7.52
7.50
7.38
7.36
7.34
7.31
7.29
7.27
7.23
7.20
7.13
7.11
7.09
7.07
7.03
6.97
6.95
6.93
2.05
5.56
1.94
0.73
1.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

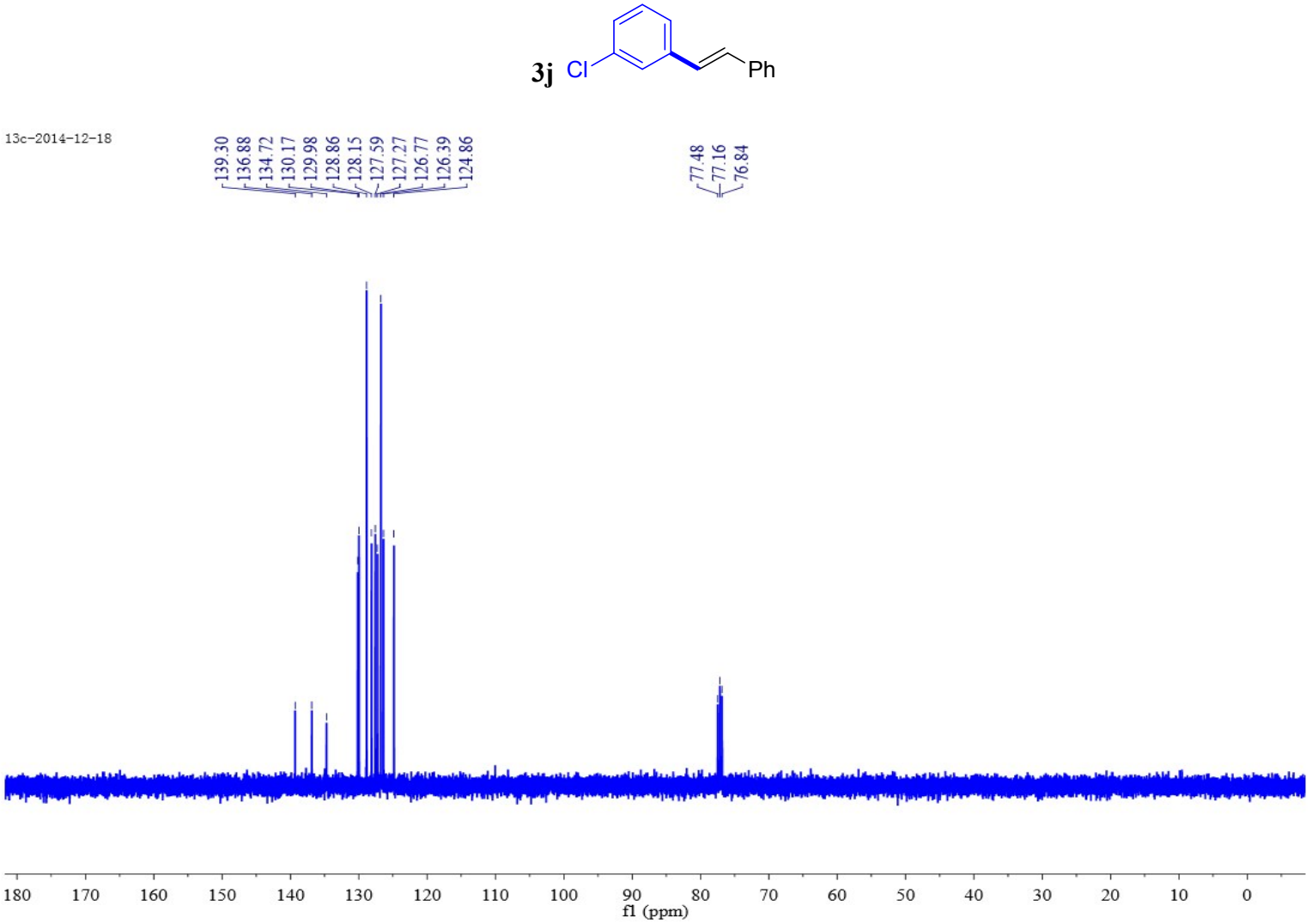
3i

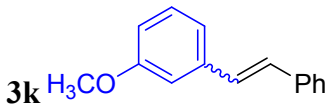

13c-2014-12-22
164.55
162.11
139.88
139.81
136.96
130.15
128.88
128.14
126.79
114.62
114.40
113.01
112.80
77.48
77.16
76.84
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

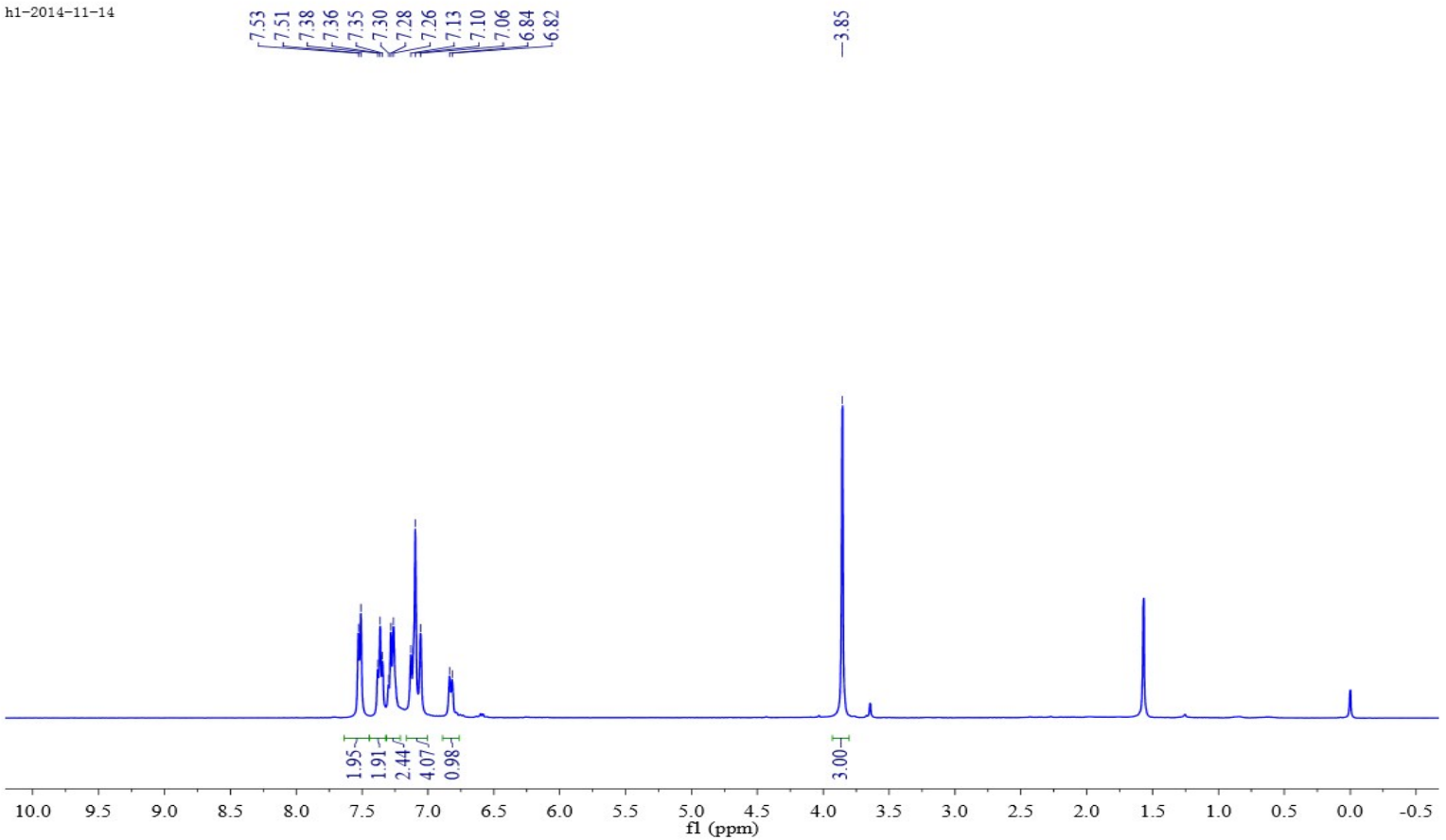

3j
Cl
Ph


h1-2014-12-18
7.508
7.374
7.305
7.287
7.268
7.238
7.139
7.099
7.055
7.015
3.00
2.99
3.26
2.23
10.5 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 -0.
f1 (ppm)

3j

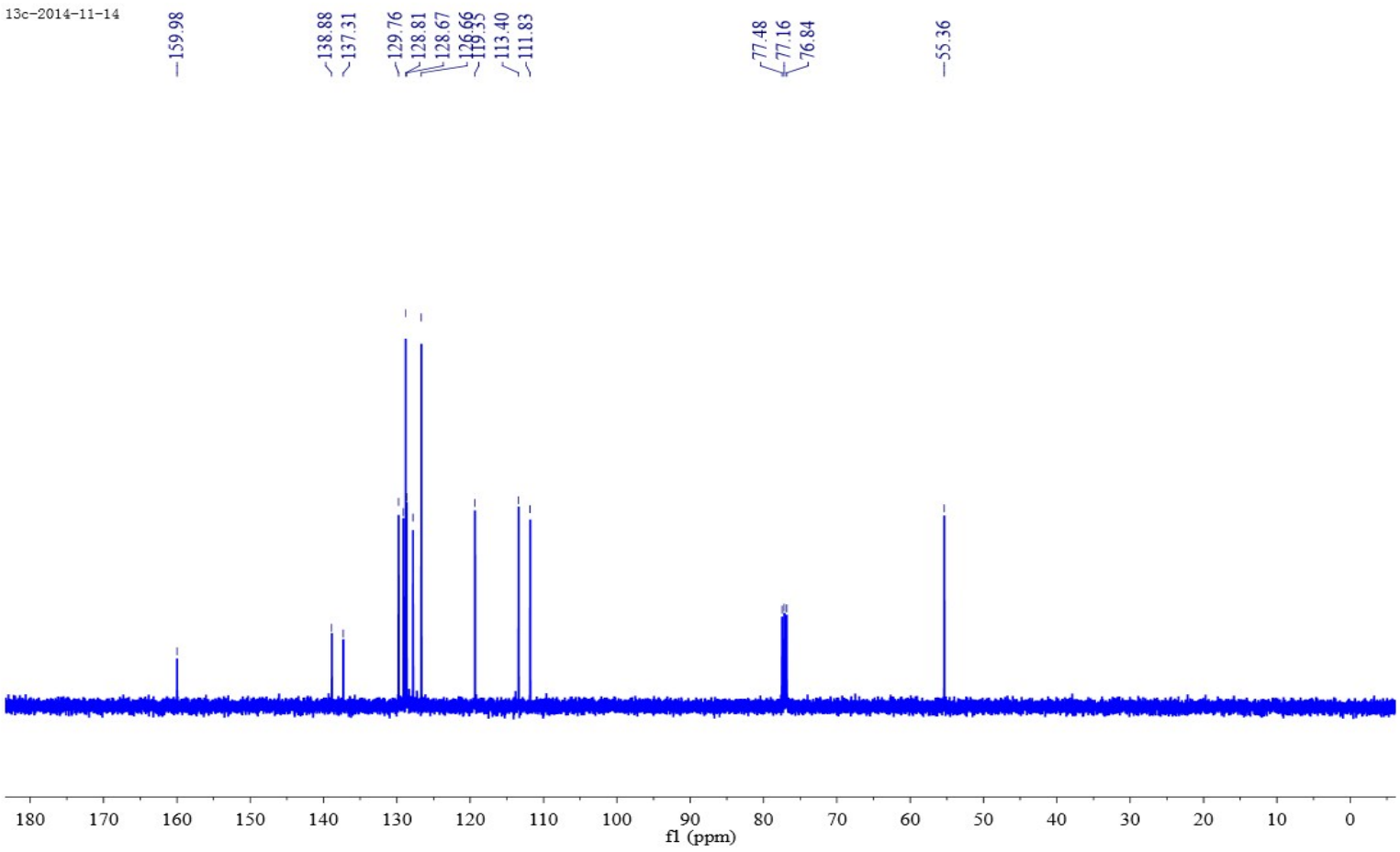

Cl
Ph
13c-2014-12-18
139.30
136.88
134.72
130.17
129.98
128.86
128.15
127.59
127.27
126.77
126.39
124.86
77.48
77.16
76.84
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

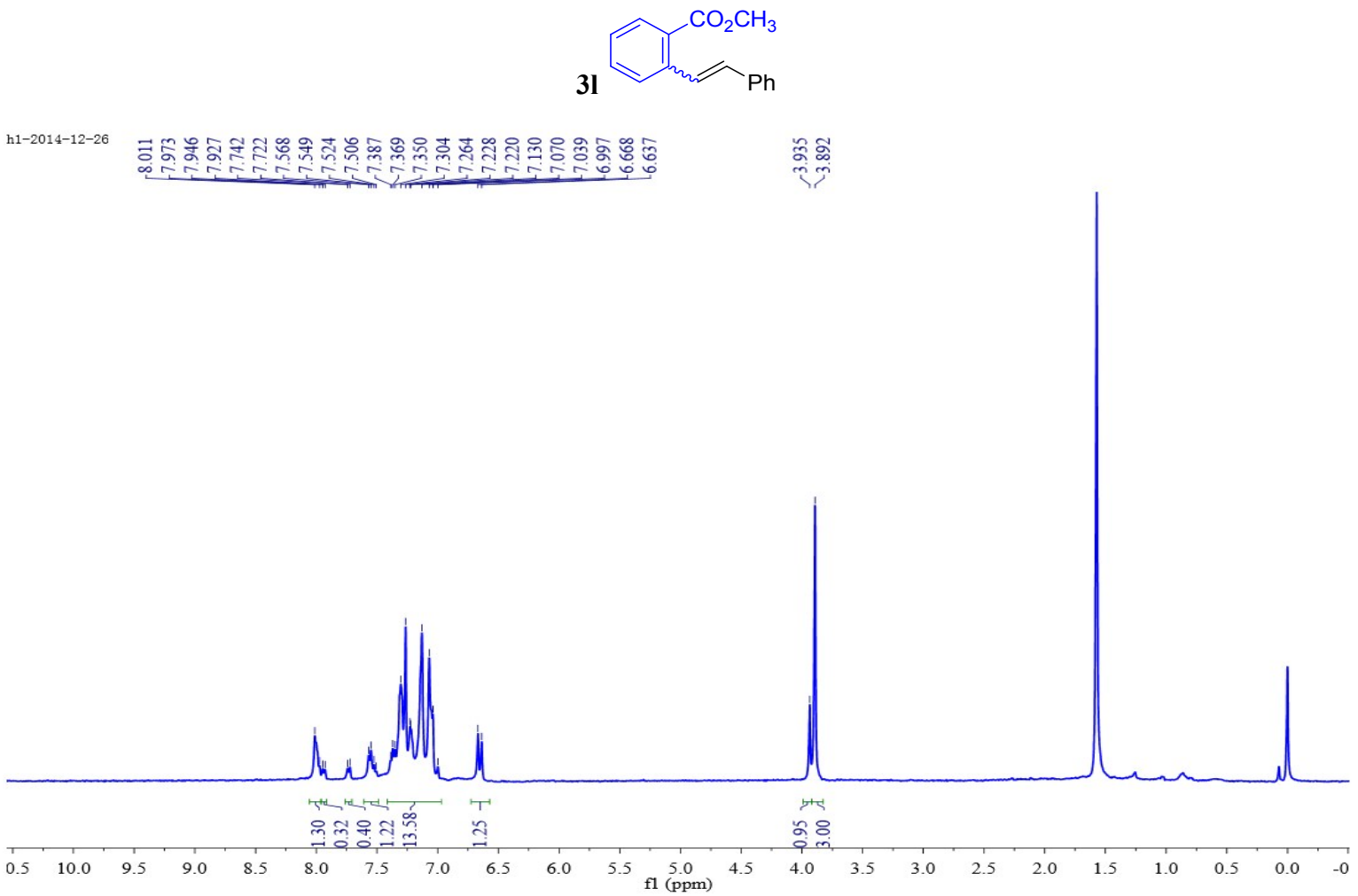

3k
H3CO
Ph

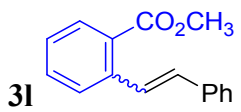

h1-2014-11-14
7.53
7.51
7.38
7.36
7.35
7.30
7.28
7.26
7.13
7.10
7.06
6.84
6.82
3.85
1.95
1.91
2.44
4.07
0.98
3.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

3k

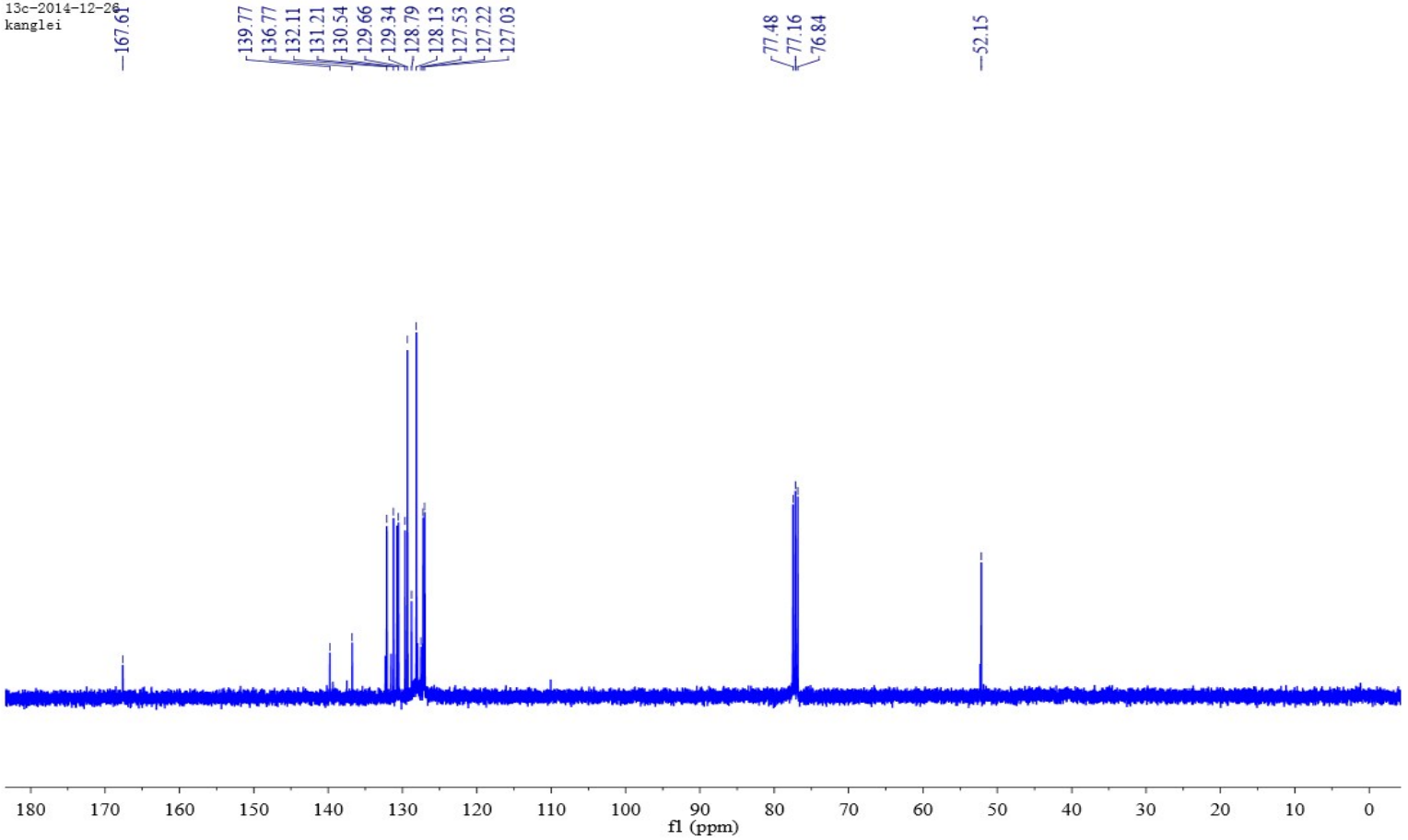

H3CO
Ph

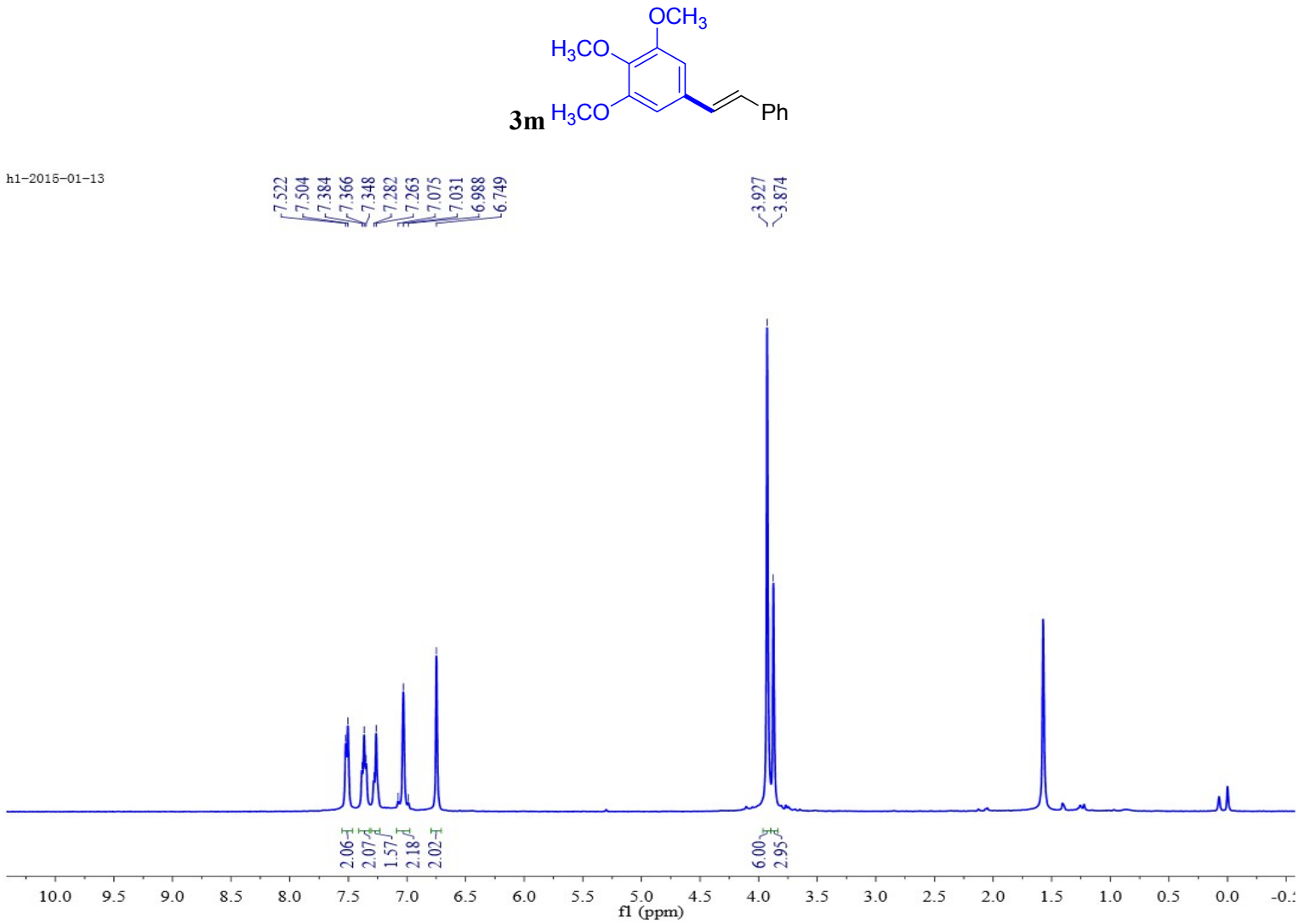

13c-2014-11-14
159.98
138.88
137.31
129.76
128.81
128.67
126.66
119.55
113.40
111.83
77.48
77.16
76.84
55.36
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

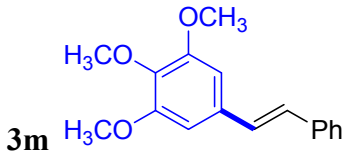

3l
CO2CH3
Ph
h1-2014-12-26
8.011
7.973
7.946
7.927
7.742
7.722
7.568
7.549
7.524
7.506
7.387
7.369
7.350
7.304
7.264
7.228
7.220
7.130
7.070
7.039
6.997
6.668
6.637
3.935
3.892
1.30
0.32
0.40
1.22
13.58
1.25
0.95
3.00
0.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)


CO2CH3
Ph

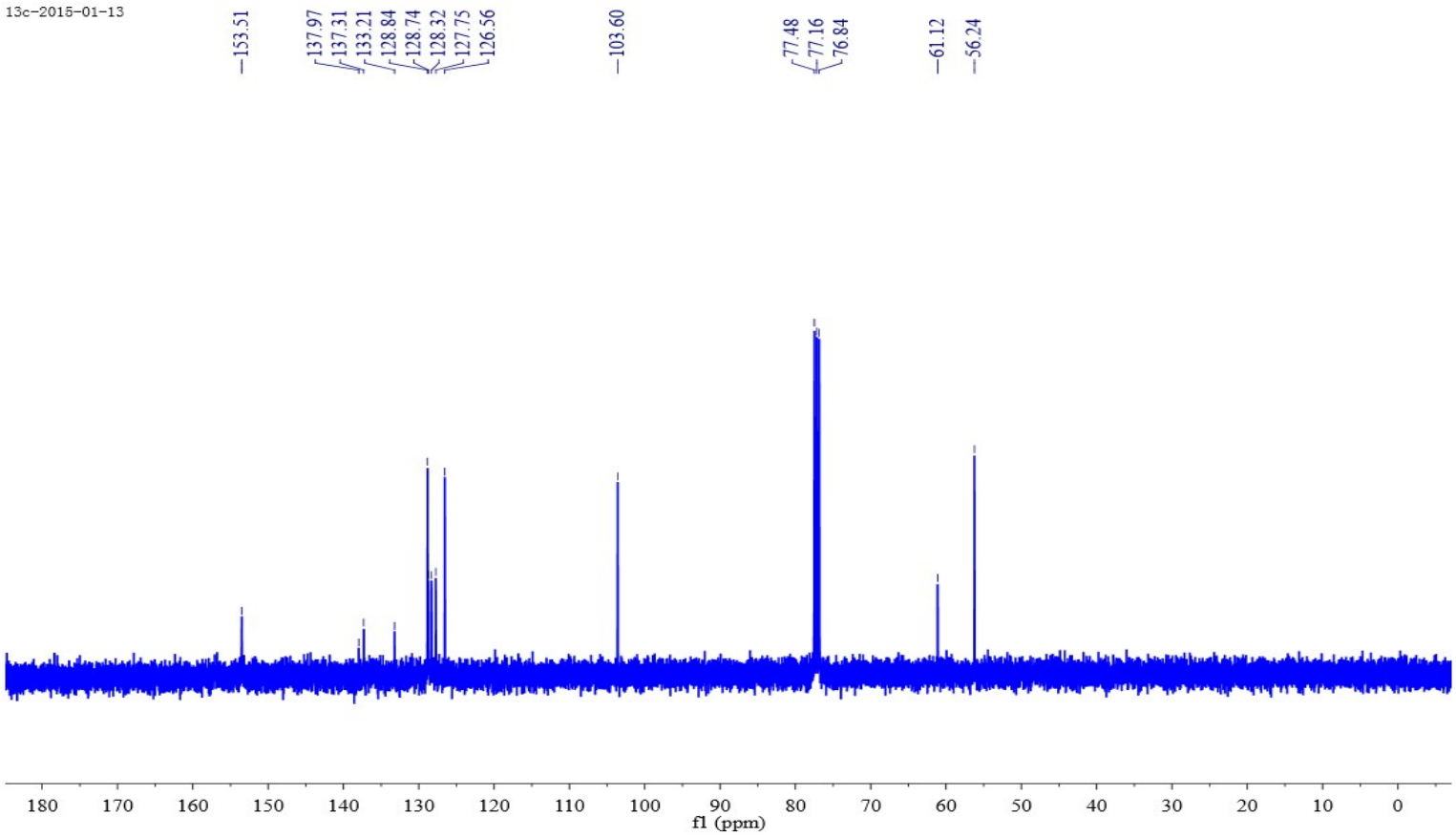
3l

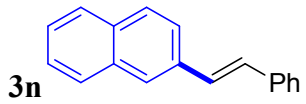

13c-2014-12-26
kanglei
167.61
139.77
136.77
132.11
131.21
130.54
129.66
129.34
128.79
128.13
127.53
127.22
127.03
77.48
77.16
76.84
52.15
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

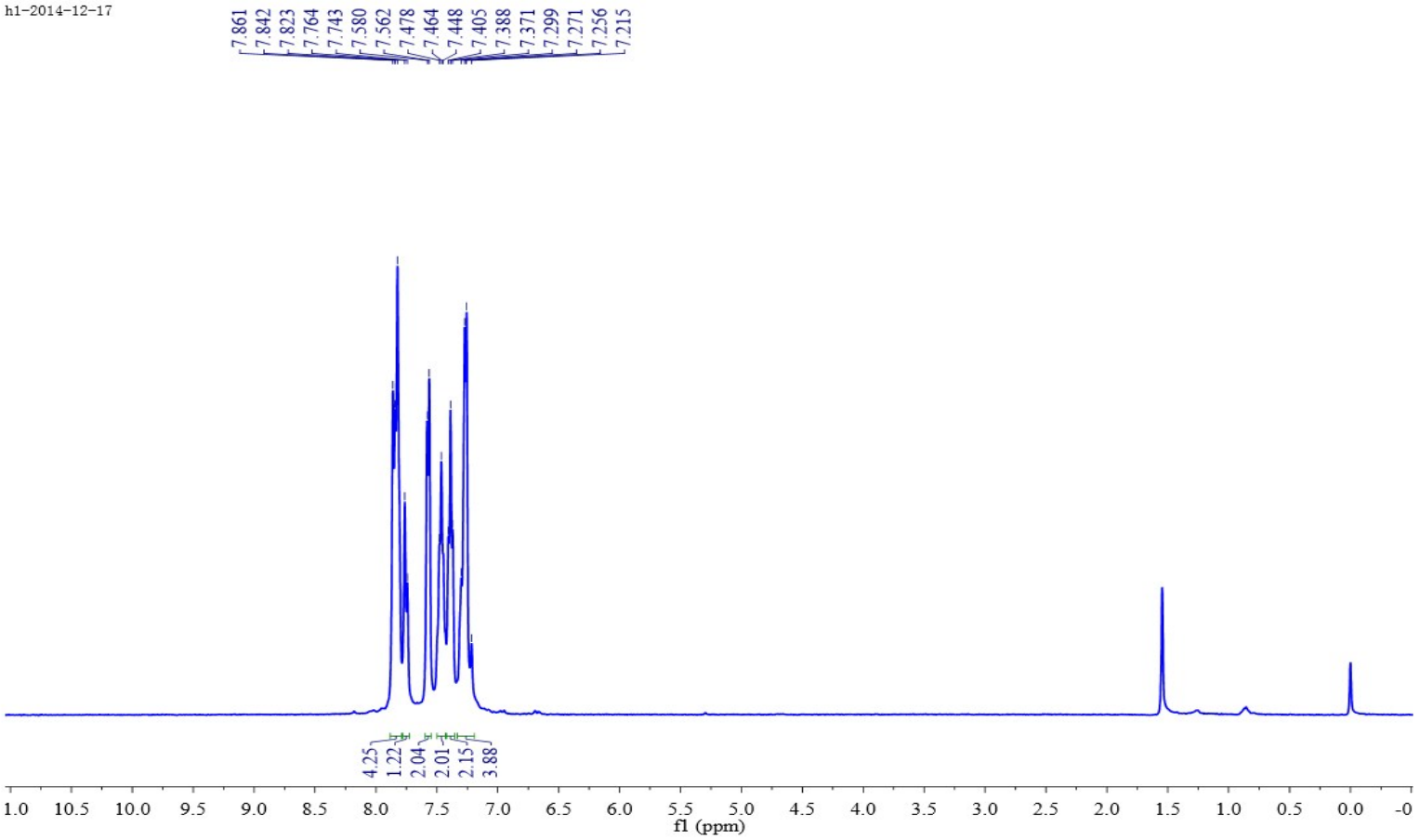

3m
OCH3
H3CO
H3CO
Ph
h1-2015-01-13
7.522
7.504
7.384
7.366
7.348
7.282
7.263
7.075
7.031
6.988
6.749
3.927
3.874
2.06
2.07
1.57
2.18
2.02
6.00
2.95
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

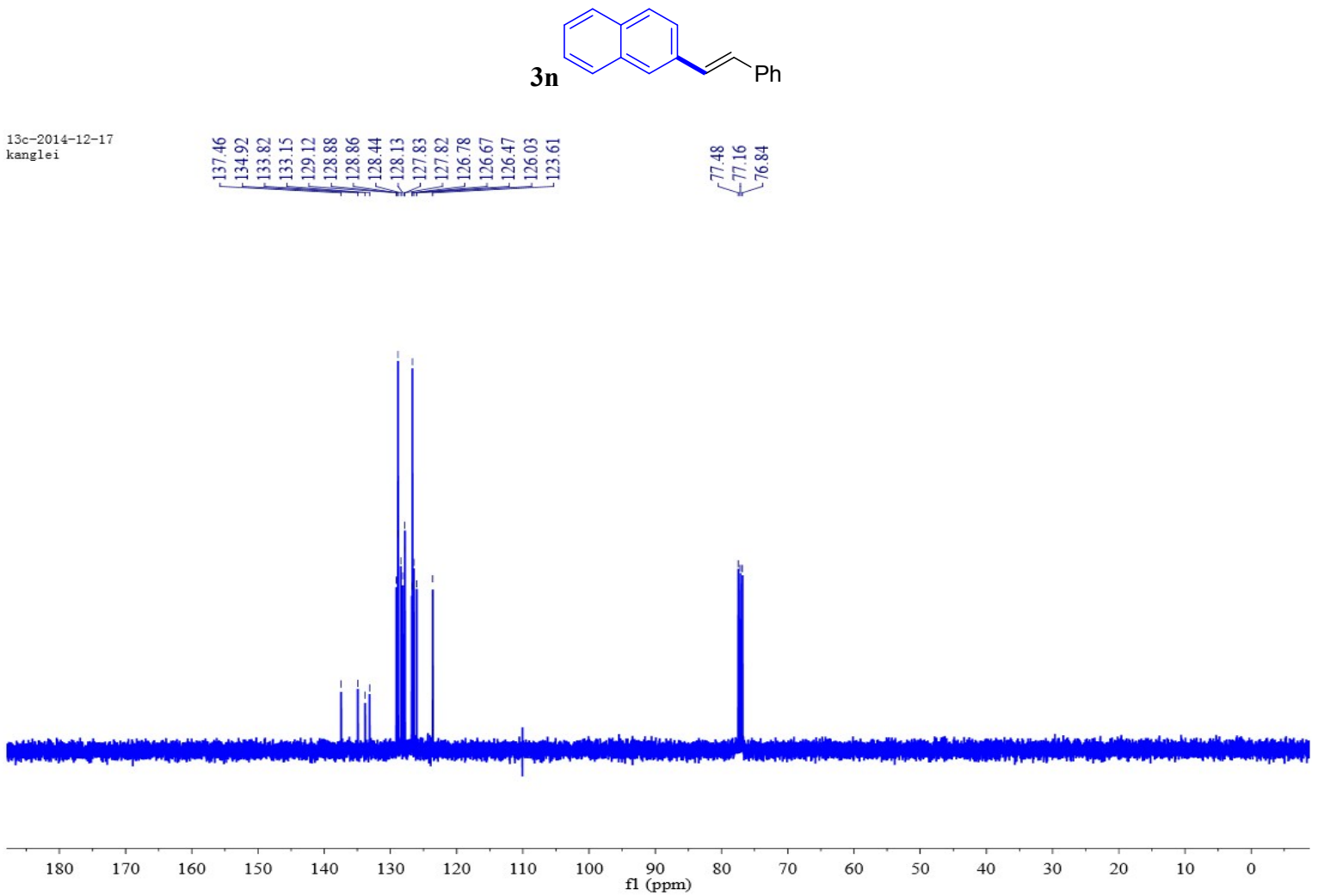

OCH3
H3CO
H3CO
Ph

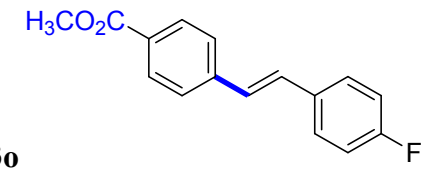
3m


13c-2015-01-13
153.51
137.97
137.31
133.21
128.84
128.74
128.32
127.75
126.56
103.60
77.48
77.16
76.84
61.12
56.24
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

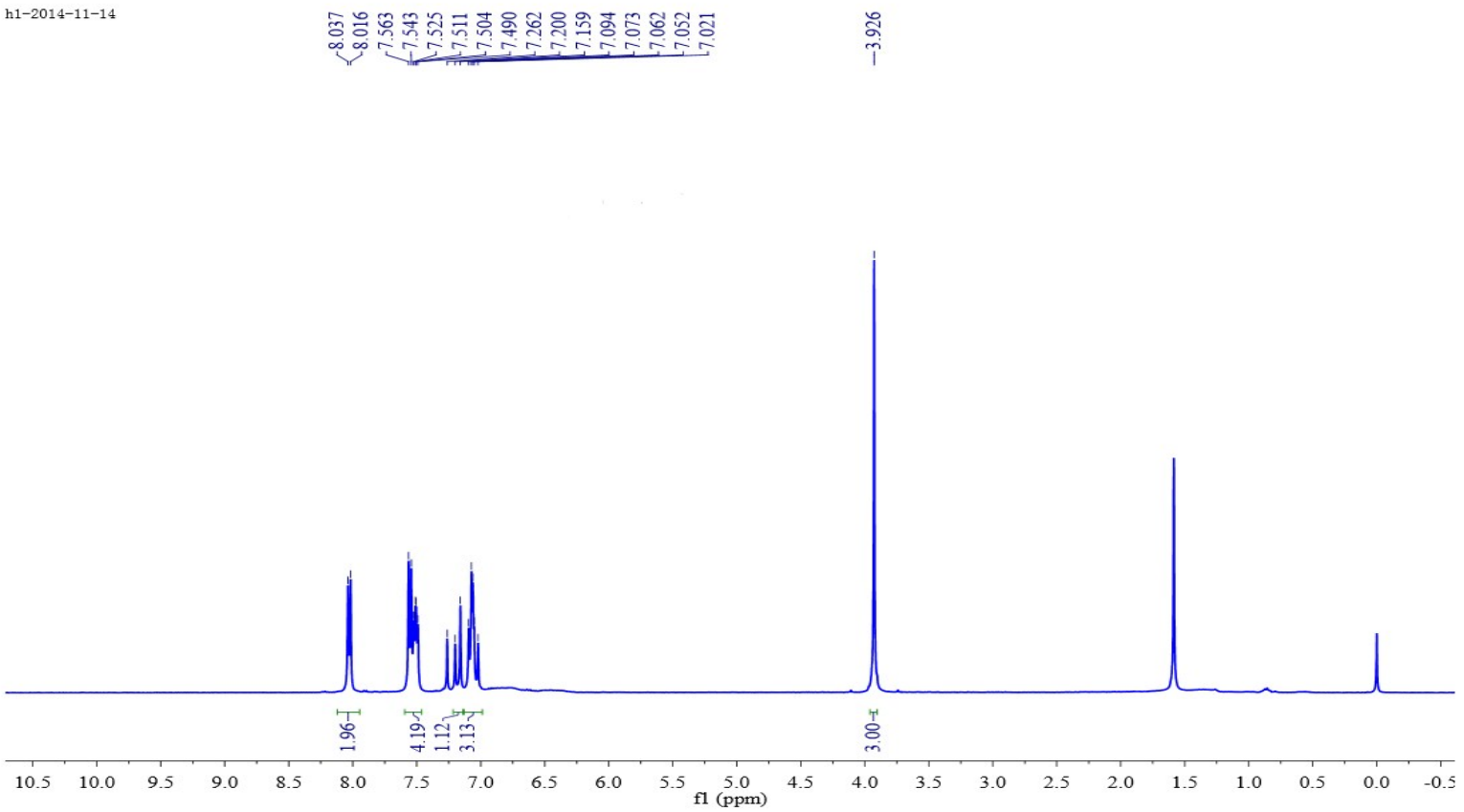

3n
Ph


h1-2014-12-17
7.861
7.842
7.823
7.764
7.743
7.580
7.562
7.478
7.464
7.448
7.405
7.388
7.371
7.299
7.271
7.256
7.215
4.25
1.22
2.04
2.01
2.15
3.88
f1 (ppm)


3n
Ph
13c-2014-12-17
kanglei
137.46
134.92
133.82
133.15
129.12
128.88
128.86
128.44
128.13
127.83
127.82
126.78
126.67
126.47
126.03
123.61
77.48
77.16
76.84
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

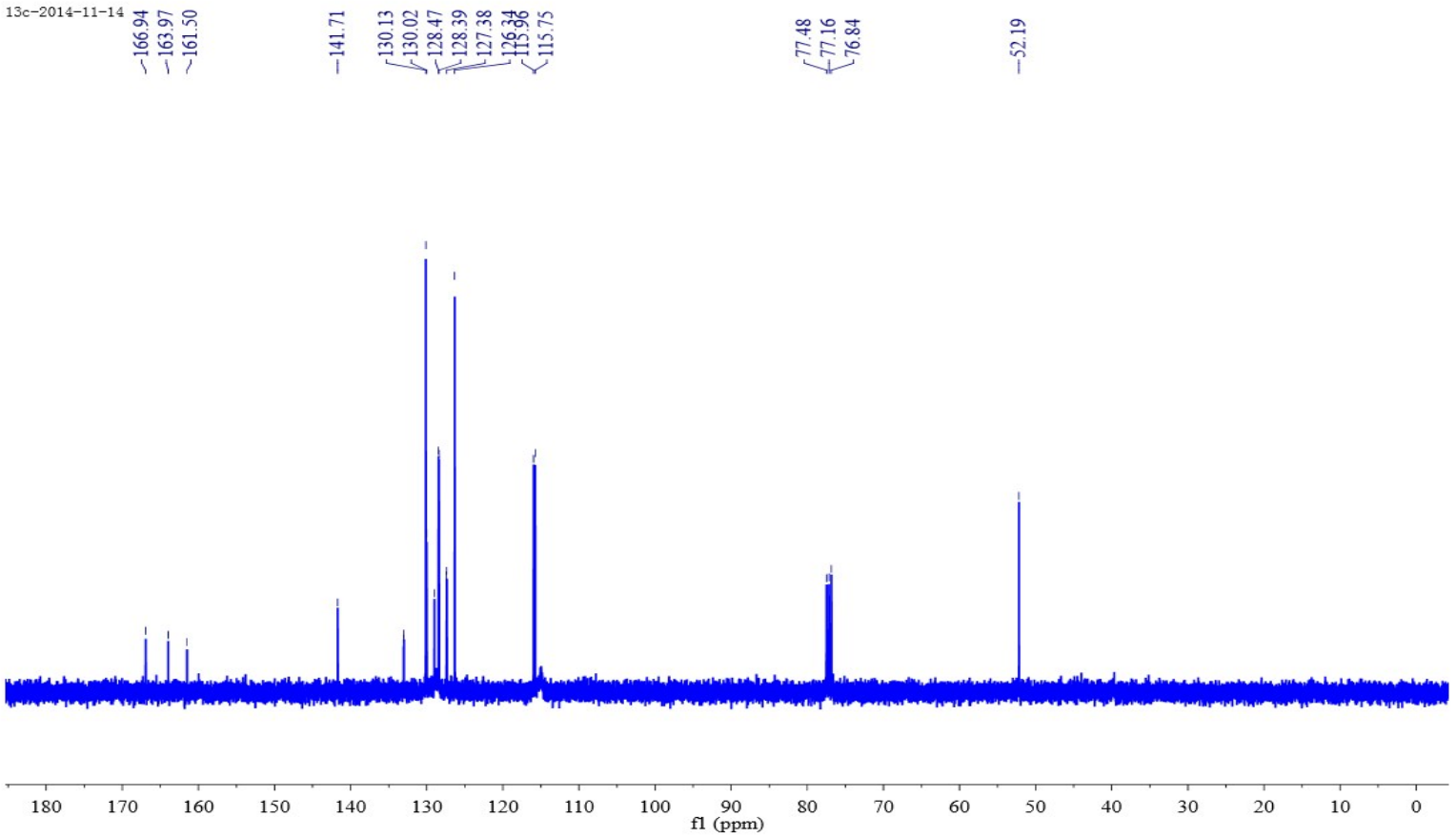

H_3CO_2C
F

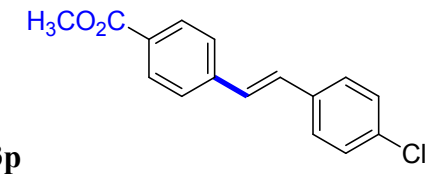
3o


h1-2014-11-14
8.037
8.016
7.563
7.543
7.525
7.511
7.504
7.490
7.262
7.200
7.159
7.094
7.073
7.062
7.052
7.021
3.926
1.96
4.19
1.12
3.13
3.00
10.5 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 -0.5
f1 (ppm)

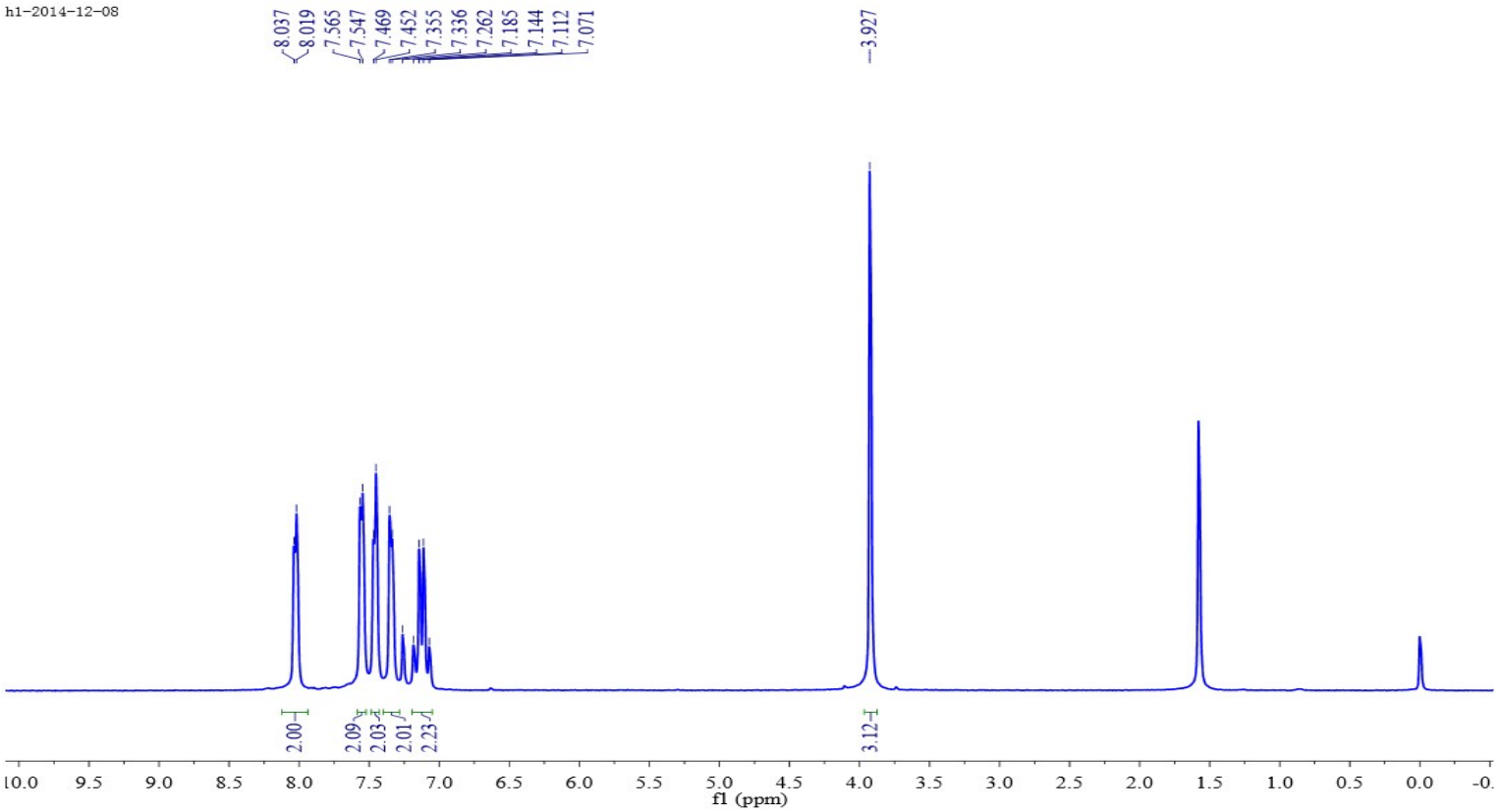

H_3CO_2C
F

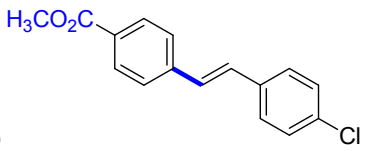
3o


13c-2014-11-14
166.94
163.97
161.50
141.71
130.13
130.02
128.47
128.39
127.38
126.34
115.96
115.75
77.48
77.16
76.84
52.19
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

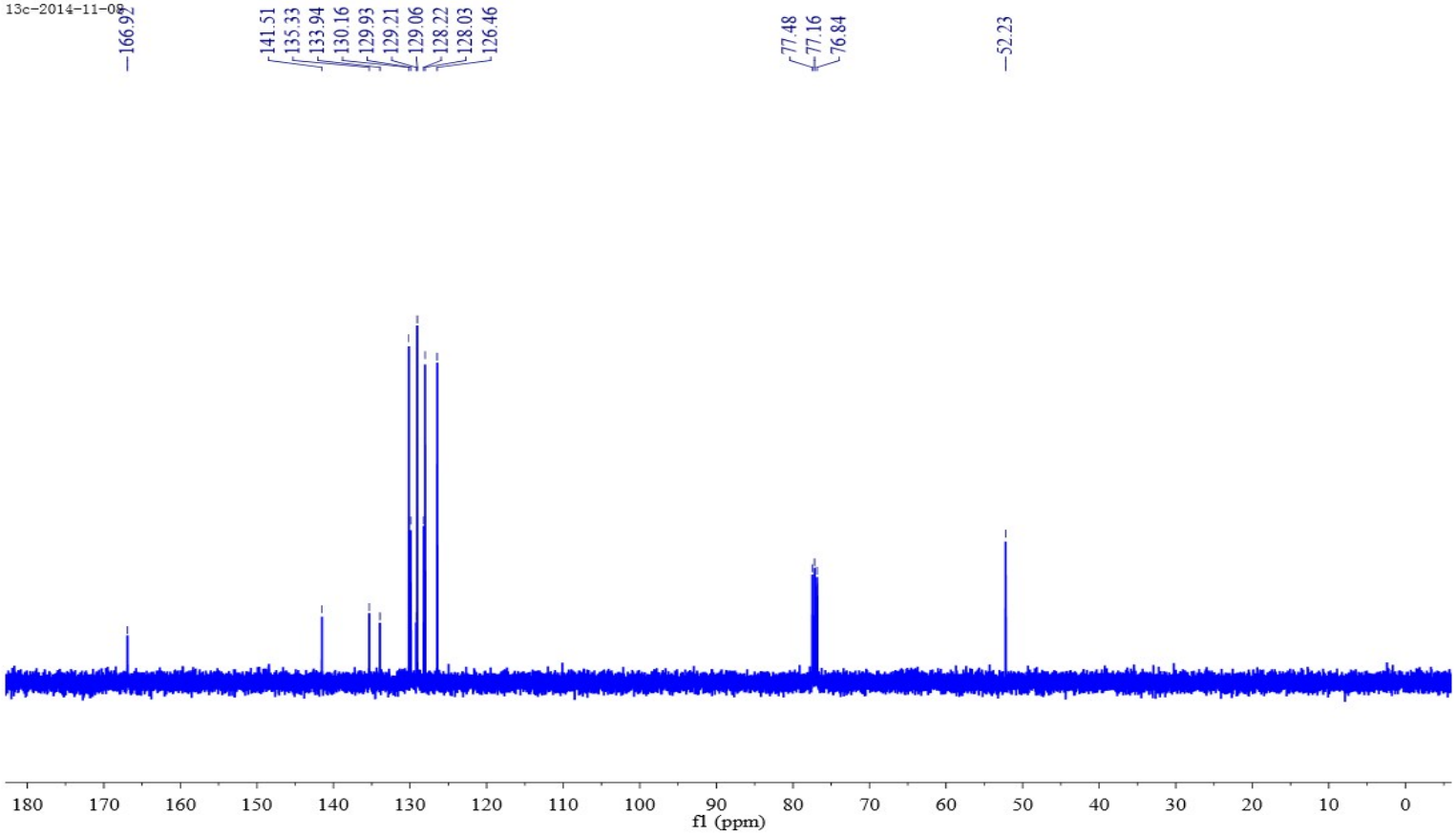

H_3CO_2C
Cl

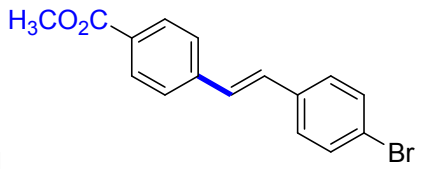
3p


h1-2014-12-08
8.037
8.019
7.565
7.547
7.469
7.452
7.355
7.336
7.262
7.185
7.144
7.112
7.071
3.927
2.00
2.09
2.03
2.01
2.23
3.12
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)

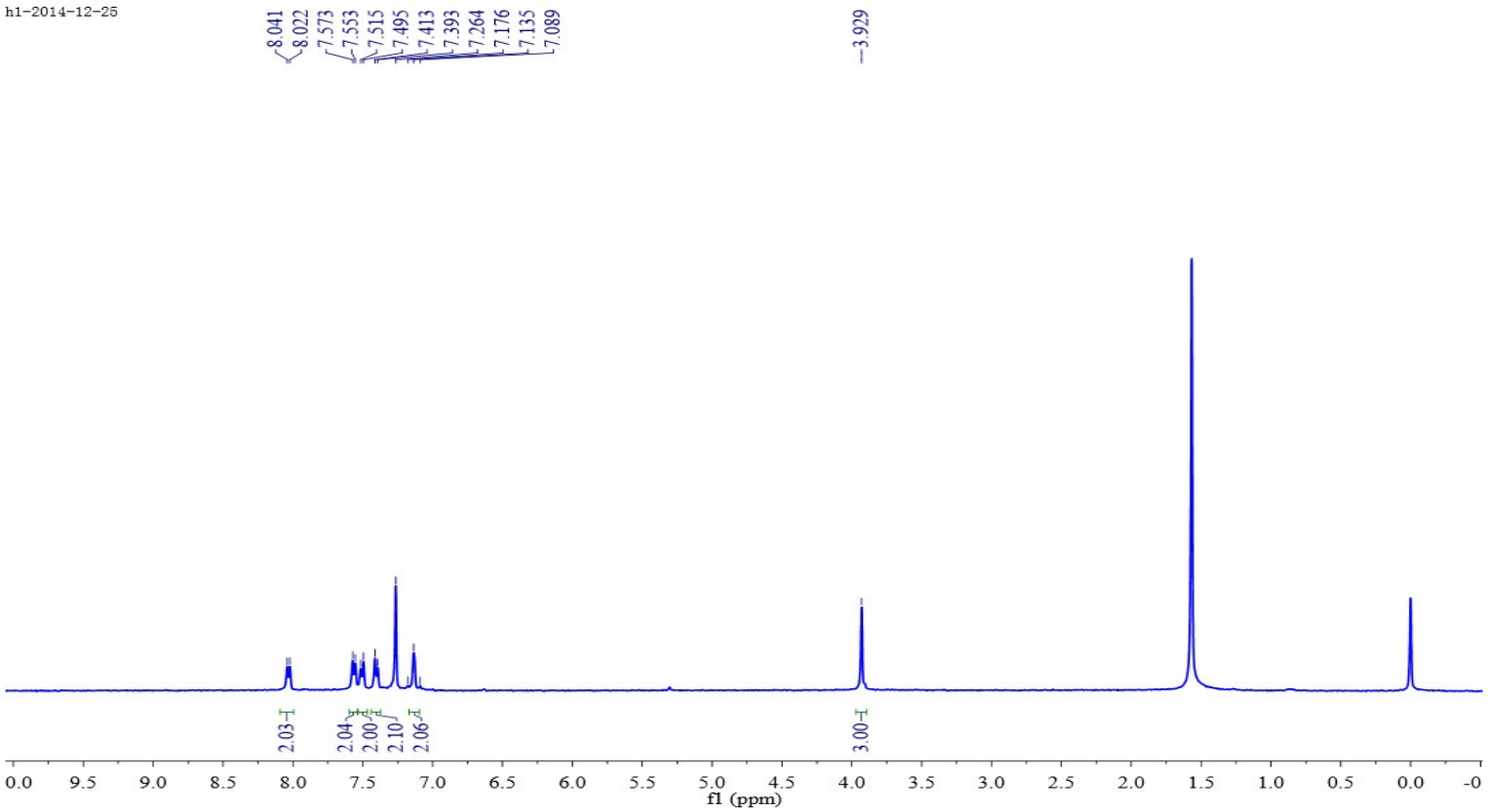

H3CO2C
Cl

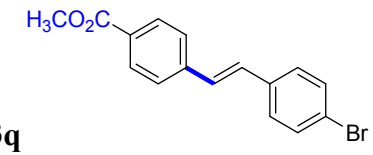
3p


13c-2014-11-08
166.92
141.51
135.33
133.94
130.16
129.93
129.21
129.06
128.22
128.03
126.46
77.48
77.16
76.84
52.23
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

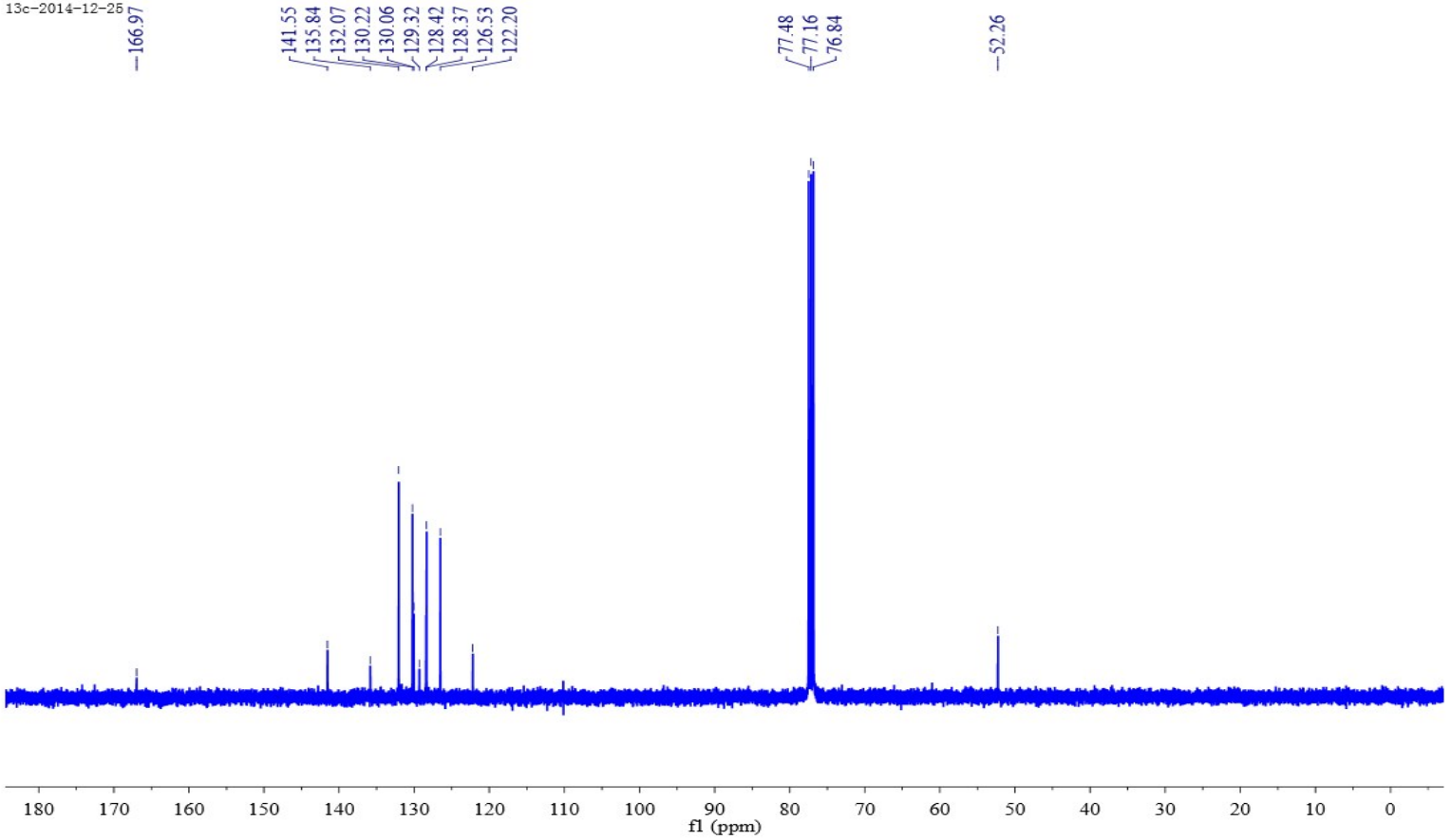

H_3CO_2C
Br

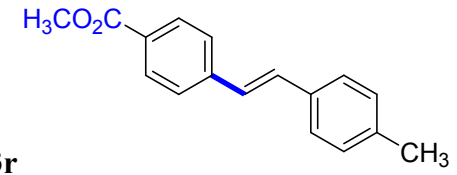
3q


h1-2014-12-25
8.041
8.022
7.573
7.553
7.515
7.495
7.413
7.393
7.264
7.176
7.135
7.089
3.929
2.03
2.04
2.00
2.10
2.06
3.00
0.0 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 -0
f1 (ppm)

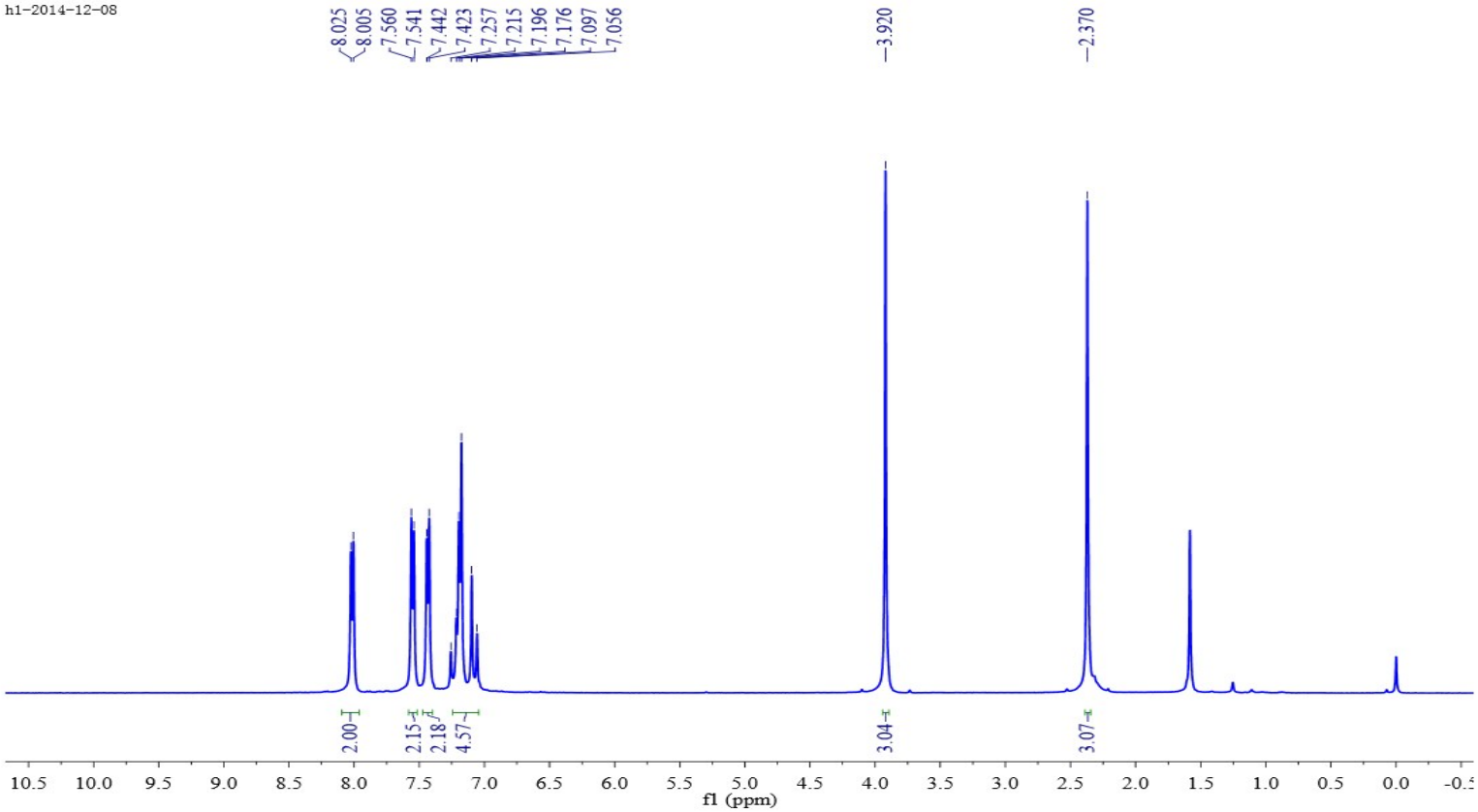

H3CO2C
Br

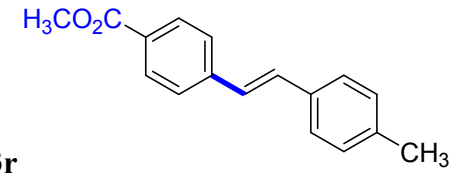
3q


13c-2014-12-25
166.97
141.55
135.84
132.07
130.22
130.06
129.32
128.42
128.37
126.53
122.20
77.48
77.16
76.84
52.26
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

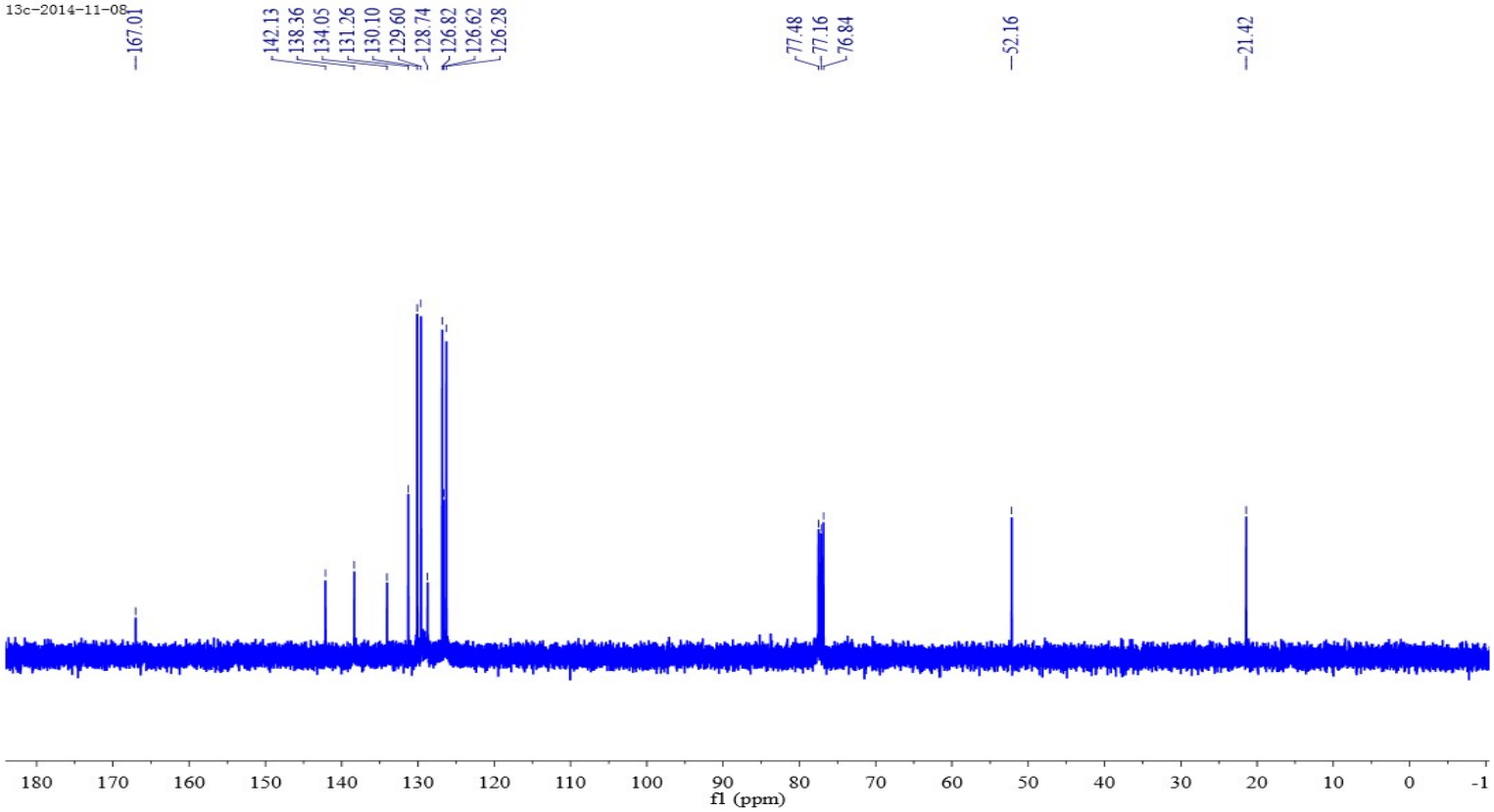

H_3CO_2C
CH_3

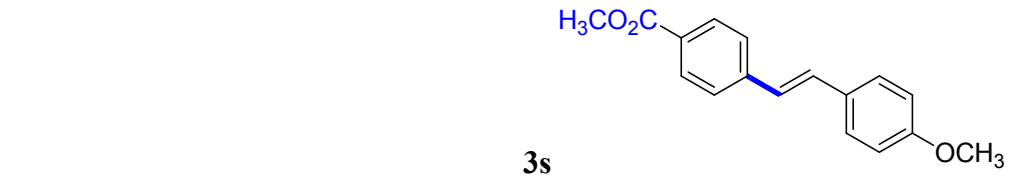
3r


h1-2014-12-08
8.025
8.005
7.560
7.541
7.442
7.423
7.257
7.215
7.196
7.176
7.097
7.056
3.920
2.370
2.00
2.15
2.18
4.57
3.04
3.07
10.5 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)

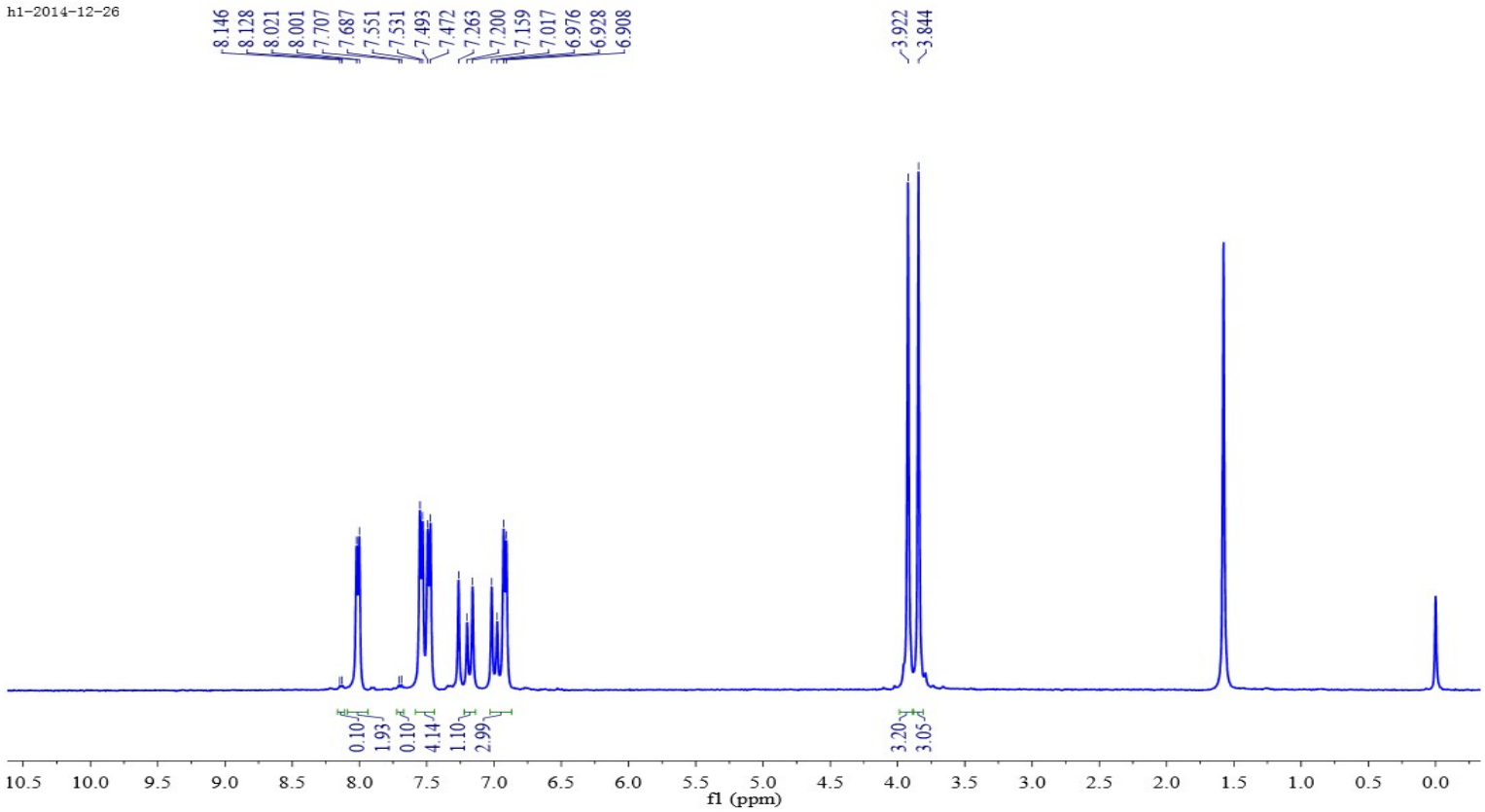

H3CO2C
CH3

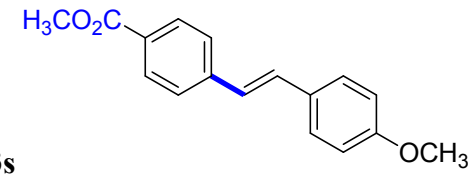
3r


13c-2014-11-08
167.01
142.13
138.36
134.05
131.26
130.10
129.60
128.74
126.82
126.62
126.28
77.48
77.16
76.84
52.16
21.42
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-1
f1 (ppm)

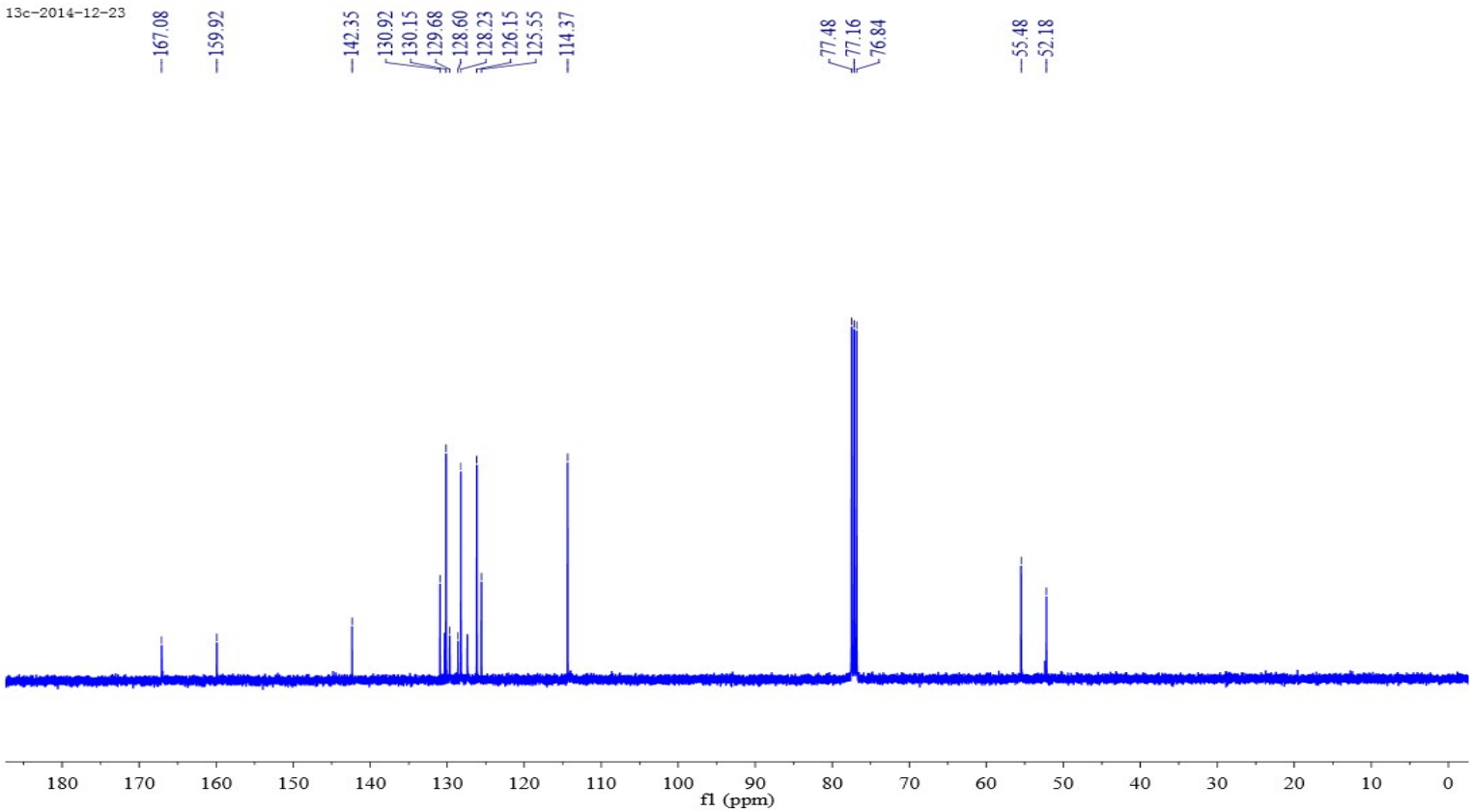

H_3CO_2C
OCH_3

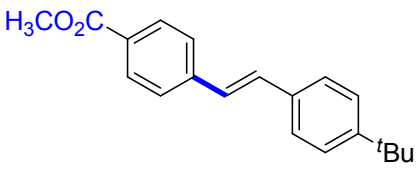
3s


h1-2014-12-26
8.146
8.128
8.021
8.001
7.707
7.687
7.551
7.531
7.493
7.472
7.263
7.200
7.159
7.017
6.976
6.928
6.908
3.922
3.844
0.10
1.93
0.10
4.14
1.10
2.99
3.20
3.05
10.5 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)

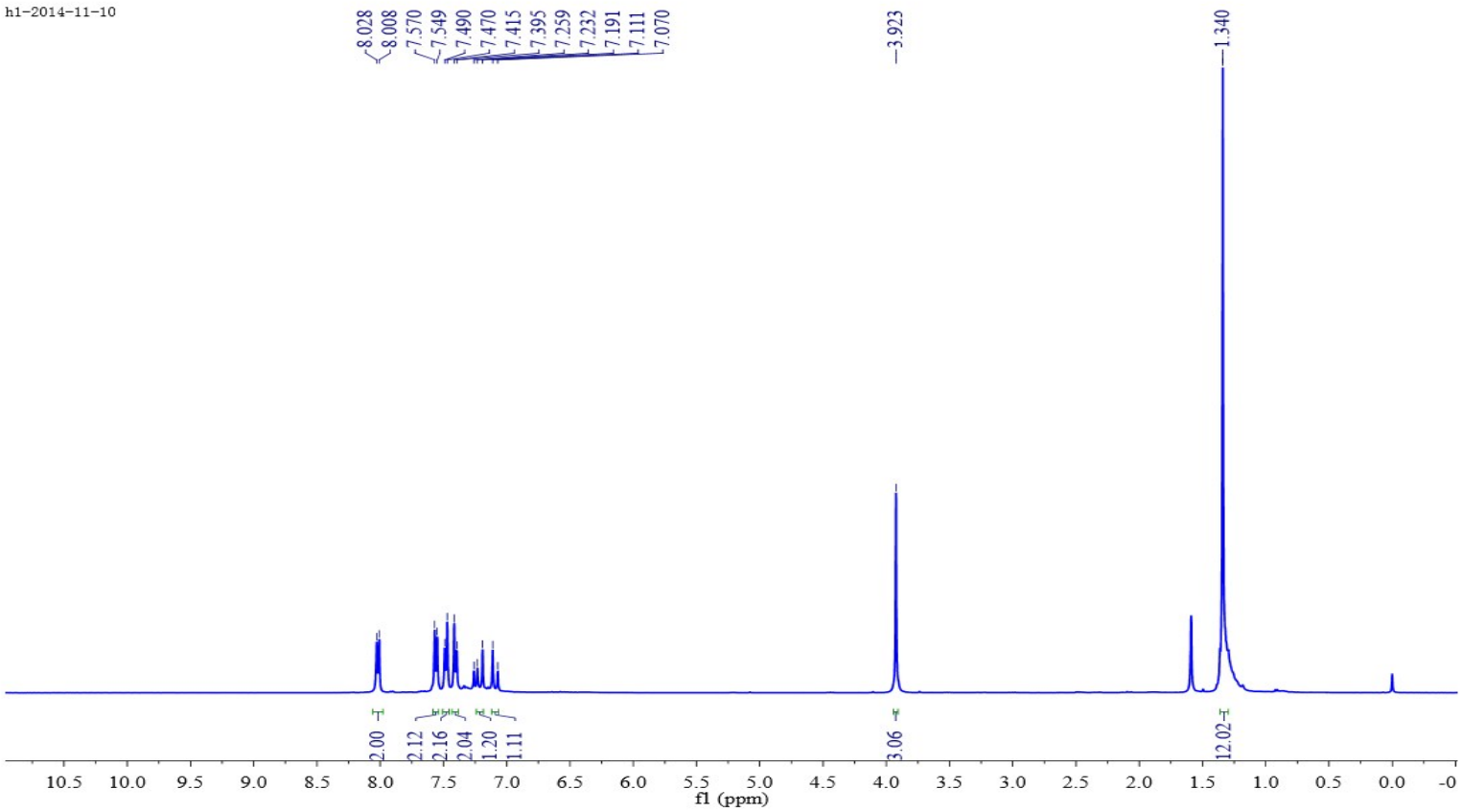

H3CO2C
OCH3

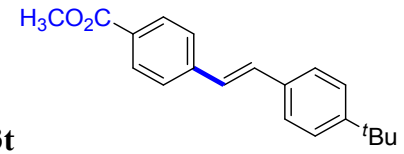
3s


13c-2014-12-23
167.08
159.92
142.35
130.92
130.15
129.68
128.60
128.23
126.15
125.55
114.37
77.48
77.16
76.84
55.48
52.18
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

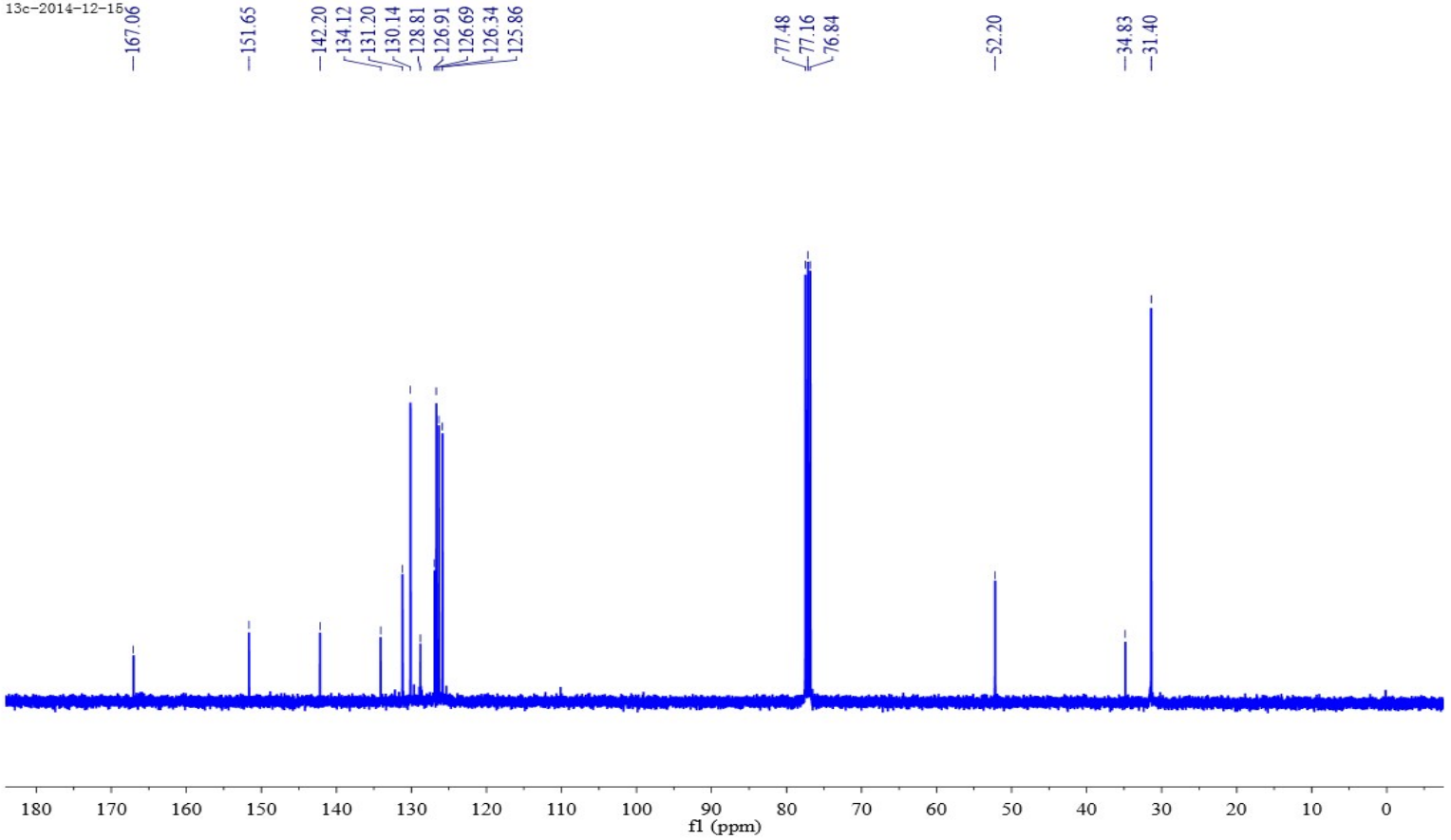

H_3CO_2C
^{t}Bu

3t


h1-2014-11-10
8.028
8.008
7.570
7.549
7.490
7.470
7.415
7.395
7.259
7.232
7.191
7.111
7.070
3.923
1.340
2.00
2.12
2.16
2.04
1.20
1.11
3.06
12.02
f1 (ppm)


H3CO2C
tBu

3t


13c-2014-12-15
167.06
151.65
142.20
134.12
131.20
130.14
128.81
126.91
126.69
126.34
125.86
77.48
77.16
76.84
52.20
34.83
31.40
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)