Supporting information

Generation of the CF_3 Radical from Trifluoromethyl Sulfonium Salt and Its Trifluoromethylation of Styrenes

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Experimental Details

1. General

Unless otherwise stated, NMR spectra were recorded in $CDCl_3$ at 300 MHz (^{1}H NMR), 282 MHz (^{19}F NMR) and 100 MHz (^{13}C NMR). All chemical shifts are reported in ppm relative to TMS or $CFCl_3$ (positive for downfield shifts) as external standards. MS experiments were performed on an Agilent 5973N instrument for EI-MS and a Waters Micromass GCT Premier instrument for HRMS. DMF (≥99.5%) and $Na_2S_2O_4$ (≥90.0%) or $HOCH_2SO_2Na\cdot 2H_2O$ (≥99.0%) were used without any purification. *S*-(trifluoromethyl)diphenylsulfonium triflate $[Ph_2SCF_3]^+[OTf]^-$ was synthesized according to the literature procedure.[1] Styrenes (**1b-k**) were all prepared according to the literature.[2] Other reagents used below were all purchased from commercial sources.

2. Synthesis of *S*-(trifluoromethyl)diphenylsulfonium Salt $[Ph_2SCF_3]^+[OTf]^-$ [1]

Under a nitrogen atmosphere, benzene (20 mL, 0.220 mol) and trifluoromethanesulfonic anhydride (17 mL, 0.100 mol) were added into a suspension of sodium trifluoromethylsulfinate (6.98 g, 44.7 mmol) in dichloromethane (5 mL), which was well cooled by an ice-bath. After vigorously stirring at 0 ^{o}C for 1.5 h, the reaction mixture was warmed to room temperature and allowed to react for 34 hours. Then the reaction mixture was diluted with CH_2Cl_2 (150 mL), washed successively with saturated aqueous $NaHCO_3$ and saturated brine and dried over Na_2SO_4. After concentration under reduced pressure, the residue was purified by column chromatography on silica gel using dichloromethane / acetonitrile (4:1) as the eluent. 4.53 g of **$[Ph_2SCF_3]^+[OTf]^-$** (11.2 mmol, 25%) was obtained as a light yellow solid. ^{1}H NMR (CD_3COCD_3): δ 8.43 (d, *J* = 8.1 Hz, 4H), 8.13 (t, *J* =7.5 Hz, 2H), 8.00 (t, *J* = 8.1 Hz, 4H). ^{19}F NMR: δ -51.0 (s, 3F), -78.5 (s, 3F).

3. General Procedure for the Synthesis of Styrenes 1b-i, 1k [2a]

4-Nitrobenzaldehyde (0.151g, 1.0 mmol) was dissolved in dry THF (10 mL). Methyltriphenylphosphonium iodide (0.448 g, 1.1 mmol) and DBU (0.20 mL, 1.3 mmol) were added. The reaction mixture was then stirred at room temperature overnight. After diluted by ethyl ether (30 mL), the reaction mixture was washed with water (3×20 mL), dried over anhydrous sodium sulfate and evaporated under reduced pressure. The crude product was purified by column chromatography (eluent: petroleum ether/ethyl acetate = 12:1), providing 1-nitro-4-vinylbenzene **1c** (0.072 g, 0.48 mmol, 48% yield) as yellow liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.19 (d, *J* = 8.8 Hz, 2H), 7.54 (d, *J* = 8.8 Hz, 2H), 6.79 (dd, *J* = 17.6 Hz, *J* = 10.9 Hz, 1H), 5.93 (d, *J* = 17.6 Hz, 1H), 5.50 (d, *J* = 10.9 Hz, 1H).

1-nitro-3-vinylbenzene (**1b**): 45% yield, yellow liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.26 (s, 1H), 8.11 (d, *J* = 8.1 Hz, 1H), 7.71 (d, *J* = 7.8 Hz, 1H), 7.50 (t, *J* = 7.9 Hz, 1H), 6.78 (dd, *J* = 17.6 Hz, *J* = 10.9 Hz, 1H), 5.90 (d, *J* = 17.6 Hz, 1H), 5.45 (d, *J* = 10.9 Hz, 1H).

3-vinylbiphenyl (**1d**): 23% yield, colorless liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.61-7.59 (m, 3H), 7.50-7.33 (m, 6H), 6.79 (dd, *J* = 17.5 Hz, *J* = 10.8 Hz, 1H), 5.82 (d, *J* = 17.5 Hz, 1H), 5.30 (d, *J* = 10.8 Hz, 1H).

4-vinylbiphenyl (**1e**): The reaction mixture was refluxed overnight. 27% yield, white solid. ^{1}H

NMR (300 MHz, $CDCl_3$): δ 7.58 (m, 4H), 7.49-7.40 (m, 4H), 7.33 (t, *J* = 7.4 Hz, 1H), 6.75 (dd, *J* = 17.7 Hz, *J* = 10.9 Hz, 1H), 5.78 (d, *J* = 17.7 Hz, 1H), 5.26 (d, *J* = 10.9 Hz, 1H).

1-chloro-2-vinylbenzene (**1f**): The reaction mixture was refluxed overnight. 47% yield, colorless liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.56 (dd, *J* = 7.3 Hz, *J* = 2.0 Hz, 1H), 7.35 (d, *J* = 7.6 Hz, *J* = 1.7 Hz, 1H), 7.11 (dd, *J* = 17.5 Hz, *J* = 11.1 Hz, 1H), 5.74 (d, *J* = 17.5 Hz, 1H), 5.38 (d, *J* = 11.1 Hz, 1H).

1-chloro-4-vinylbenzene (**1g**): 30% yield, colorless liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.34 (d, *J* = 8.5 Hz, 2H), 7.29 (d, *J* = 8.5 Hz, 2H), 6.67 (dd, *J* = 17.5 Hz, *J* = 10.9 Hz, 1H), 5.72 (d, *J* = 17.5 Hz, 1H), 5.27 (d, *J* = 10.9 Hz, 1H).

1-bromo-4-vinylbenzene (**1h**): The reaction mixture was refluxed overnight. 43% yield, colorless liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.44 (d, *J* = 8.1 Hz, 2H), 7.27 (d, *J* = 8.1 Hz, 2H), 6.65 (dd, *J* = 17.6 Hz, *J* = 10.8 Hz, 1H), 5.74 (d, *J* = 17.6 Hz, 1H), 5.28 (d, *J* = 10.8 Hz, 1H).

1-methyl-4-vinylbenzene (**1i**): The reaction mixture was refluxed overnight. 80% yield, colorless liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.31 (d, *J* = 8.1 Hz, 2H), 7.13 (d, *J* = 8.1 Hz, 2H), 6.69 (dd, *J* = 17.6 Hz, *J* = 10.9 Hz, 1H), 5.69 (d, *J* = 17.6 Hz, 1H), 5.18 (d, *J* = 10.9 Hz, 1H).

1-vinylnaphthalene (**1k**): The reaction mixture was refluxed overnight. 74% yield, colorless liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.12 (dm, *J* = 8.3 Hz, 1H), 7.85 (dm, *J* = 8.3 Hz, 1H), 7.79 (d, *J* = 8.1 Hz, 1H), 7.62 (d, *J* = 7.1 Hz, 1H), 7.54-7.43 (m, 4H), 5.79 (dd, *J* = 17.3 Hz, *J* = 1.5 Hz, 1H), 5.48 (dd, *J* = 10.9 Hz, *J* = 1.4 Hz, 1H).

4. Procedure for the Synthesis of Styrene 1j [2b]

Methyltriphenylphosphonium iodide (0.868 g, 2.14 mmol) was dissolved in dry DMF (5 mL) at 0 °C. Sodium hydride (0.334 g, 57.6%, 8.01 mmol) and 4-methoxybenzaldehyde (0.28 mL, 2.26 mmol) were then added. After keeping at 0 °C for 2 h, the reaction mixture was allowed to stir at room temperature for 8 h. EtOH (5 mL) was added and the reaction mixture was diluted with ethyl ether (30 mL). The organic layer was then washed with water (5×20 mL), dried over anhydrous sodium sulfate and evaporated under reduced pressure. The crude product was purified by column chromatography (eluent: petroleum ether), yielding 4-methoxystyrene **1j** (0.030 g, 0.224 mmol, 10% yield) in the form of colorless liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.35 (d, *J* = 8.5 Hz, 2H), 6.86 (d, *J* = 8.5 Hz, 2H), 6.66 (dd, *J* = 17.5 Hz, *J* = 10.9 Hz, 1H), 5,61 (d, *J* = 17.5 Hz, 1H), 5,12 (d, *J* = 10.9 Hz, 1H), 3.81 (s, 3H).

5. General Procedure for the Oxidative-trifluoromethylation of Styrenes 1a-l

General procedure for the oxidative-trifluoromethylation of styrenes: The styrene **1e** (27 mg, 0.15 mmol) and $[Ph_2SCF_3]^+[OTf]^-$ (120 mg, 0.30 mmol) were dissolved in DMF (4 mL) in a round-bottom flask (25ml), cooling to 0 °C. Then $HOCH_2SO_2Na\cdot 2H_2O$ (140 mg, 0.90 mmol) was added, and the reaction mixture was stirred at 0 °C for 6 h. After dilution with

diethyl ether, the mixture was washed with H_2O, dried over Na_2SO_4 and concentrated under reduced pressure. The crude residue was purified by column chromatography on silica gel [eluent: petroleum ether/ethyl acetate (15:1)] to give 13 mg of pure **2e** (0.049 mmol, 33%): white solid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.02 (d, *J* = 8.5 Hz, 2H), 7.73 (d, *J* = 8.5 Hz, 2H), 7.64 (d, *J* = 7.1 Hz, 2H), 7.52-7.42 (m, 3H), 3.83 (q, *J* = 10.0 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -62.4 (t, *J* = 10.0 Hz, 3F).

3,3,3-trifluoro-1-phenylpropan-1-one (**2a**): white solid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.95 (d, *J* = 7.3 Hz, 2H), 7.65 (t, *J* = 7.3 Hz, 1H), 7.52 (t, *J* = 7.1 Hz, 2H), 3.81 (q, *J* = 9.7 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -62.4 (t, *J* = 9.7 Hz, 3F).

3,3,3-trifluoro-1-(3-nitrophenyl)propan-1-one (**2b**): white solid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.76 (s, 1H), 8.51 (d, *J* = 7.9 Hz, 1H), 8.30 (t, *J* = 7.9 Hz, 1H), 7.77 (t, *J* = 7.9 Hz, 1H), 3.88 (q, *J* = 9.9 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -62.4 (t, *J* = 9.9 Hz, 3F).

3,3,3-trifluoro-1-(4-nitrophenyl)propan-1-one (**2c**): white solid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.37 (d, *J* = 8.8 Hz, 2H), 8.11 (t, *J* = 8.8 Hz, 2H), 3.86 (q, *J* = 9.7 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -62.4 (t, *J* = 9.7 Hz, 3F).

1-(biphenyl-3-yl)-3,3,3-trifluoropropan-1-one (**2d**): yellow liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.15 (s, 1H), 7.90 (d, *J* = 7.8 Hz, 1H), 7.86 (d, *J* = 7.9 Hz, 1H), 7.62-7.56 (m, 3H), 7.51-7.38 (m, 3H), 3.85 (q, *J* = 10.0 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -61.7 (t, *J* = 10.0 Hz, 3F). ^{13}C NMR (100 MHz, $CDCl_3$): 189.7, 142.3, 139.8, 136.4, 132.8, 129.4, 129.1, 128.1, 127.2, 127.1, 127.1, 124.0 (*J* = 276.5 Hz), 42.3 (*J* = 27.9 Hz). EI-MS (m/z, %): 264 (39.2), 182 (18.9), 181 (88.9), 155 (10.3), 153 (64.7), 152 (100), 151 (25.3), 76 (16.8). IR (KBr): 3064, 3034, 2933, 2855, 1701, 1599, 1586, 1501,1480, 1454, 1423, 1371, 1337, 1278, 1217, 1104, 1055, 1032, 999, 936, 909, 854, 801, 757, 698, 616, 550, 532, 504 cm^{-1}. HRMS for $C_{15}H_{11}F_3O$: 264.0762; Found: 264.0763.

1-(2-chlorophenyl)-3,3,3-trifluoropropan-1-one (**2f**): yellow liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.55 (d, *J* = 7.2 Hz, 1H), 7.47-7.44 (m, 2H), 7.40-7.35 (m, 1H), 3.86 (q, *J* = 10.0 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -62.0 (t, *J* = 10.0 Hz, 3F).

1-(4-chlorophenyl)-3,3,3-trifluoropropan-1-one (**2g**): white solid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.88 (d, *J* = 8.7 Hz, 2H), 7.50 (d, *J* = 8.7 Hz, 2H), 3.77 (q, *J* = 10.3 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -61.9 (t, *J* = 10.3 Hz, 3F).

1-(4-bromophenyl)-3,3,3-trifluoropropan-1-one (**2h**): white solid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.80 (d, *J* = 8.5 Hz, 2H), 7.66 (d, *J* = 8.5 Hz, 2H), 3.77 (q, *J* = 10.0 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -62.4 (t, *J* = 10.0 Hz, 3F).

3,3,3-trifluoro-1-*p*-tolylpropan-1-one (**2i**): white solid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.83 (d, *J* = 8.3 Hz, 2H), 7.30 (d, *J* = 8.3 Hz, 2H), 3.76 (q, *J* = 10.0 Hz, 2H), 2.44 (s, 3H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -62.0 (t, *J* = 10.0 Hz, 3F).

3,3,3-trifluoro-1-(4-methoxyphenyl)propan-1-one (**2j**): yellow liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.92 (d, *J* = 8.8 Hz, 2H), 6.97 (d, *J* = 8.8 Hz, 2H), 3.90 (s, 3H), 3.74 (q, *J* = 10.0 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -62.4 (t, *J* = 10.0 Hz, 3F).

3,3,3-trifluoro-1-(naphthalen-1-yl)propan-1-one (**2k**): yellow liquid. ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.71 (d, *J* = 8.7 Hz, 1H), 8.07 (d, *J* = 8.1 Hz, 1H), 7.89 (t, *J* = 7.8 Hz, 2H), 7.67-7.51 (m, 3H), 3.91 (q, *J* = 10.0 Hz, 2H). ^{19}F NMR (282 MHz, $CDCl_3$): δ -61.8 (t, *J* = 10.0 Hz, 3F). ^{13}C NMR (100 MHz, $CDCl_3$): 192.9, 134.2, 134.1, 134.0, 130.2, 128.8, 128.6, 127.0, 125.6, 124.9, 124.2, 124.0 (*J* = 276.6 Hz), 45.0 (*J* = 27.8 Hz). EI-MS (m/z, %): 238 (29.4), 156 (15.7), 155 (100), 128 (15.3), 127 (97.3), 126 (21.1), 77 (11.6), 63 (9.69). IR (KBr): 3053, 2930, 2855, 1690, 1595, 1574, 1508, 1464, 1418, 1397, 1361, 1266, 1235, 1215, 1186, 1139, 1104, 1081, 951, 924, 855, 803, 792, 776, 668, 649, 619, 560, 511, 487 cm^{-1}. HRMS for $C_{13}H_9F_3O$: 238.0605; Found: 238.0607.

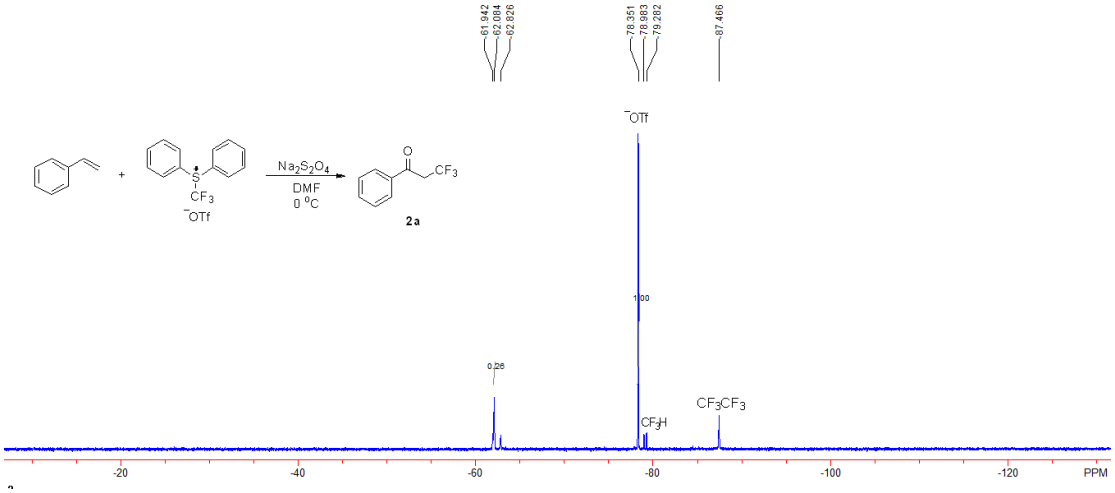
References

(1) (a) E. Magnier, J. C. Blazejewski, M. Tordeux and C. Wakselman, *Angew. Chem. Int. Ed.* 2006, **45**, 1279. (b) Y. Mace, B. Raymondeau, C. Pradet, J. -C. Blazejewski and E. Magnier, *Eur. J. Org. Chem.* 2009, 1390. (c) C. -P. Zhang, H. -P. Cao, Z. -L. Wang, C. -T. Zhang, Q. -Y. Chen and J. -C. Xiao, *Synlett.* 2010, **7**, 1089.

(2) (a) D. Simoni, M. Rossi, R. Rondanin, A. Mazzali, R. Baruchello, C. Malagutti, M. Roberti and F. P. Invidiata, *Org. Lett.* 2000, **2**, 3765. (b) K. Ahmad, N. F. Thomas, M. R. Mukhtar, I. Noorbatcha, J. -F. F. Weber, M. A. Nafiah, S. S. Velu, K. Takeya, H. Morita, C. -G. Lim, A. H. A. Hadi and K. Awang, *Tetrahedron* 2009, **65**, 1504.

The ^{19}F NMR Analysis of Reaction Mixture

Table 1, entry 2



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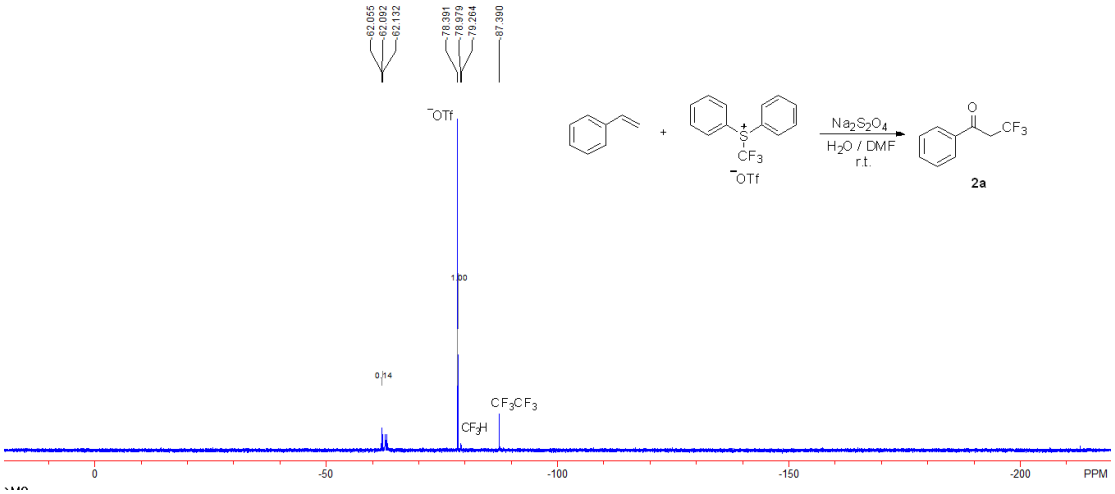

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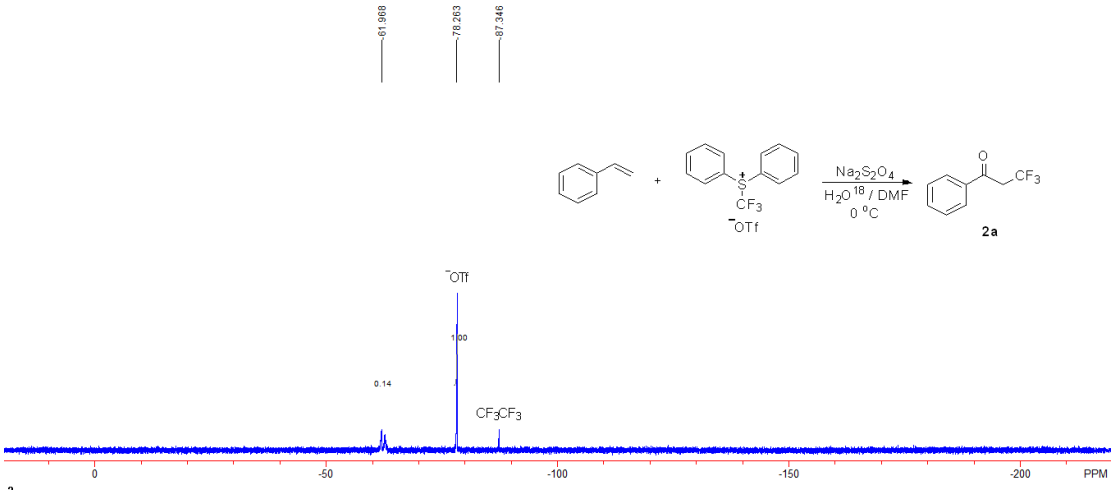

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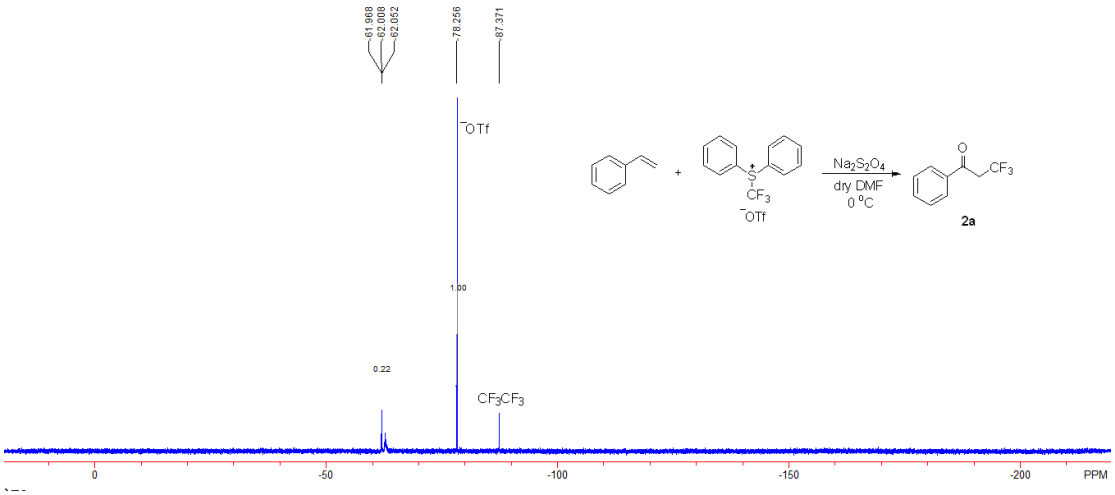

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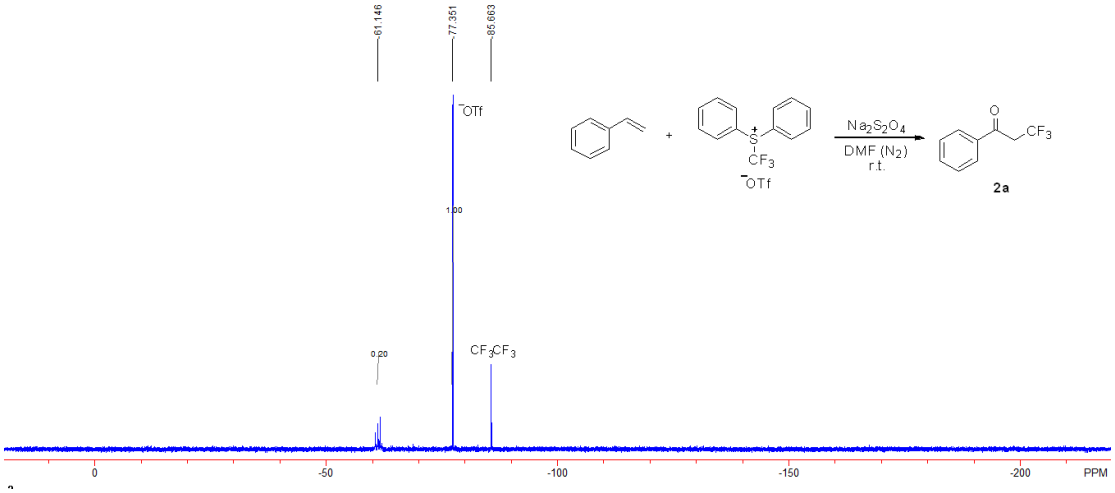

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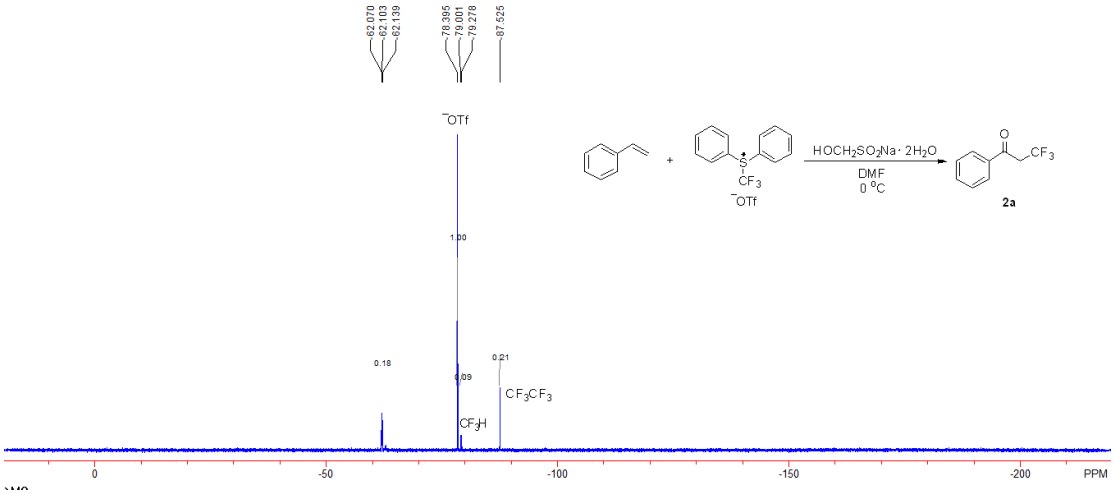

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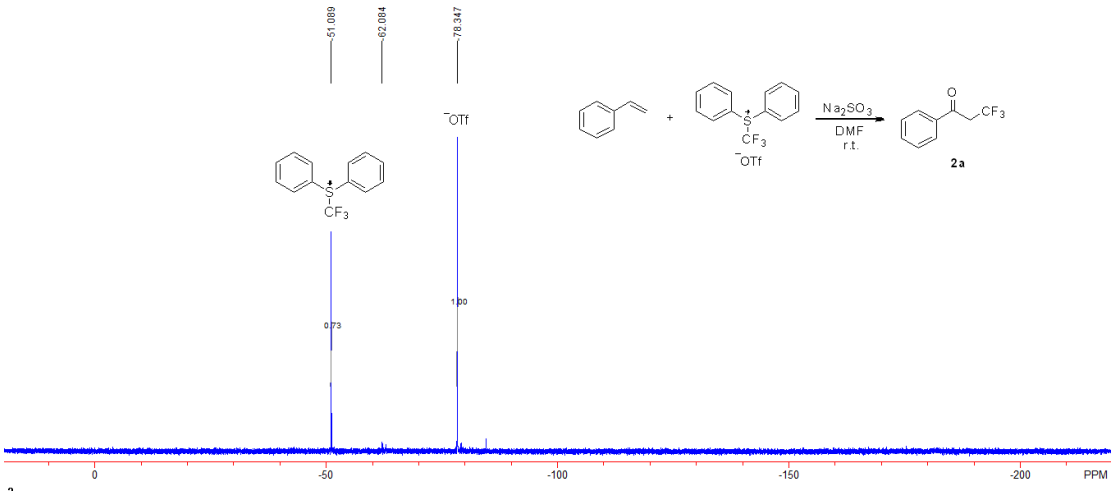

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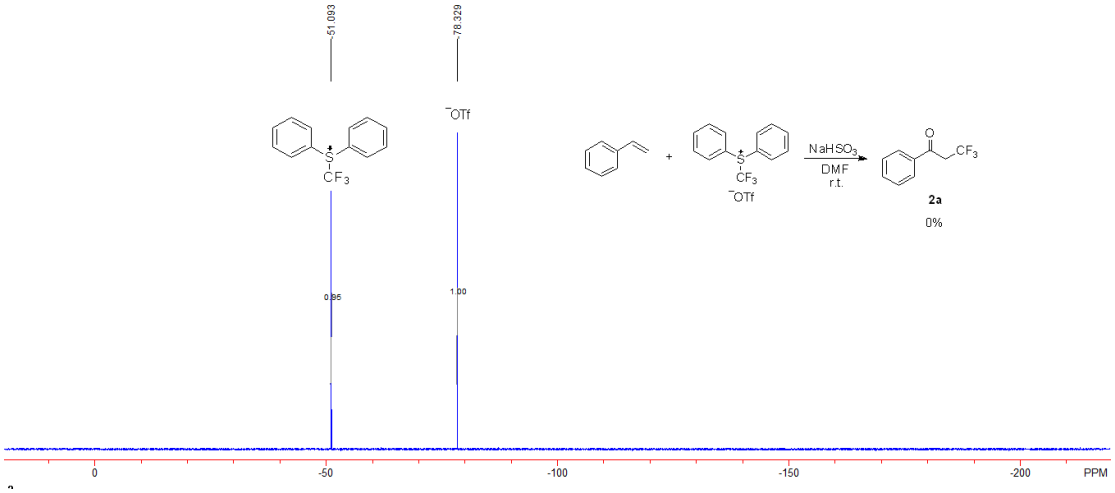

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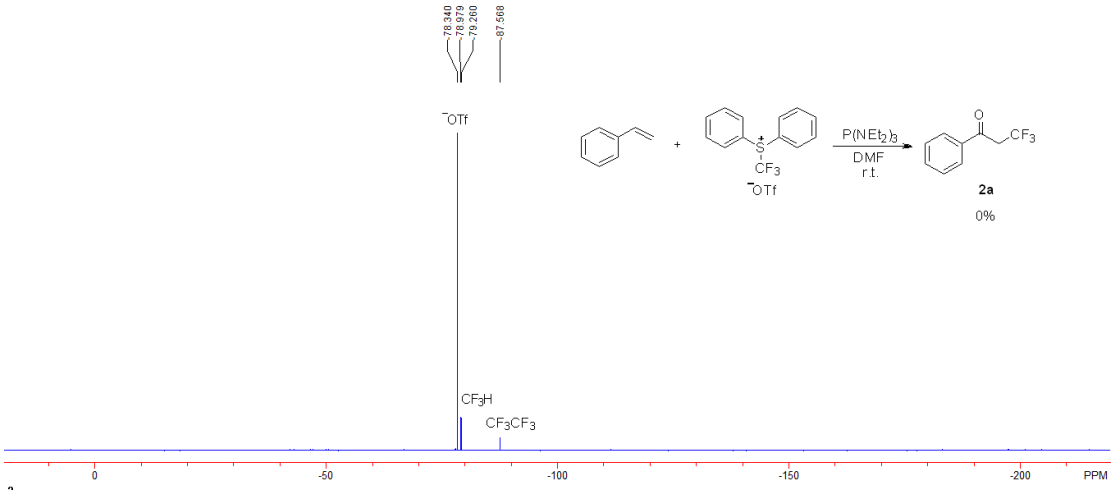

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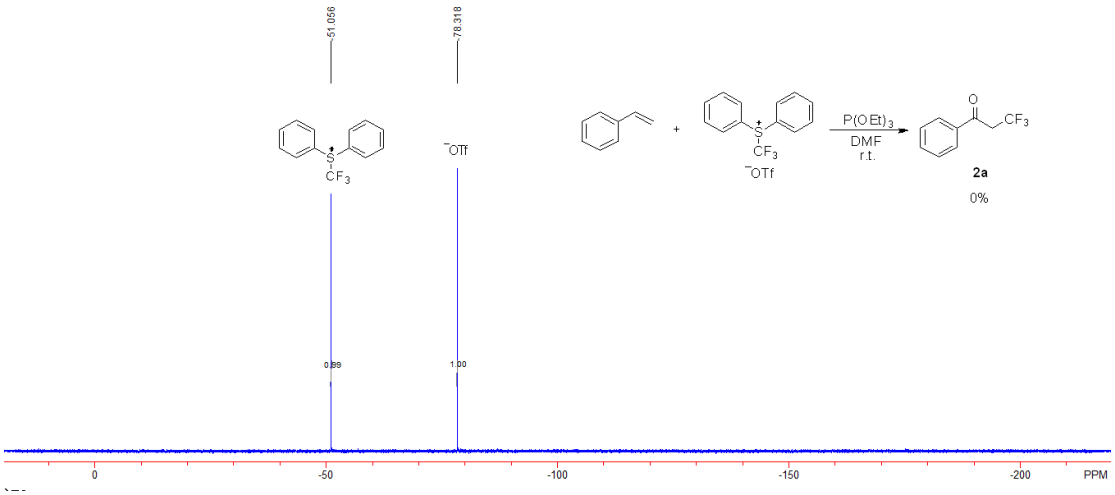

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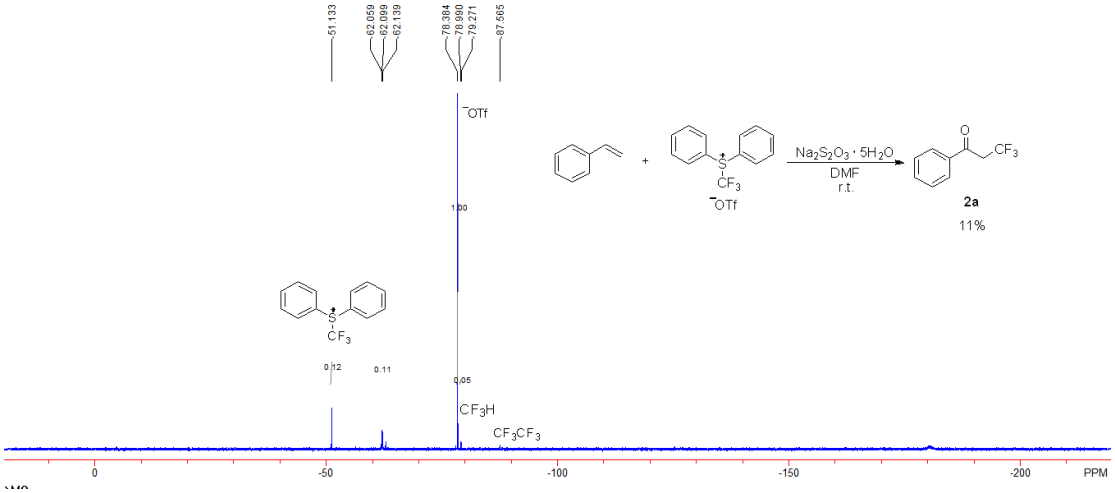

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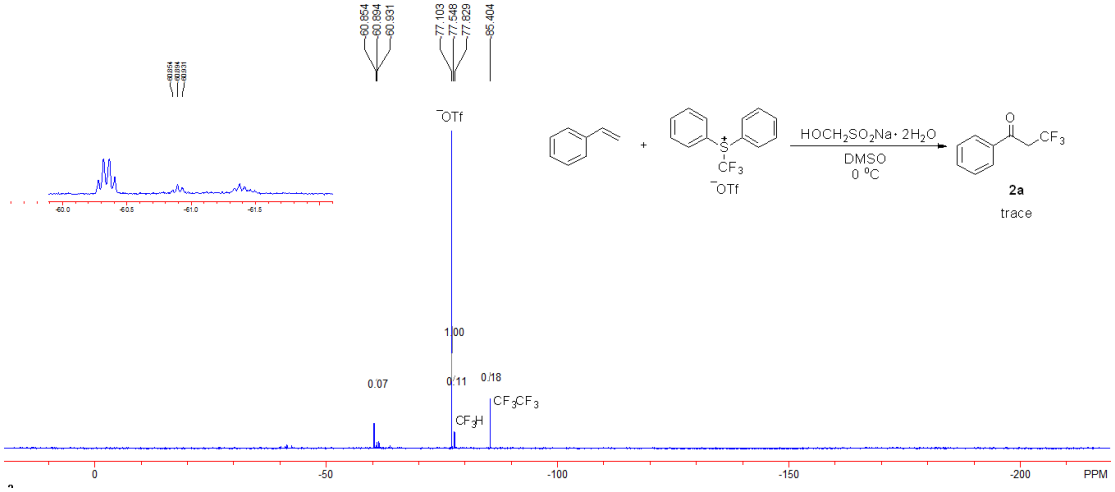

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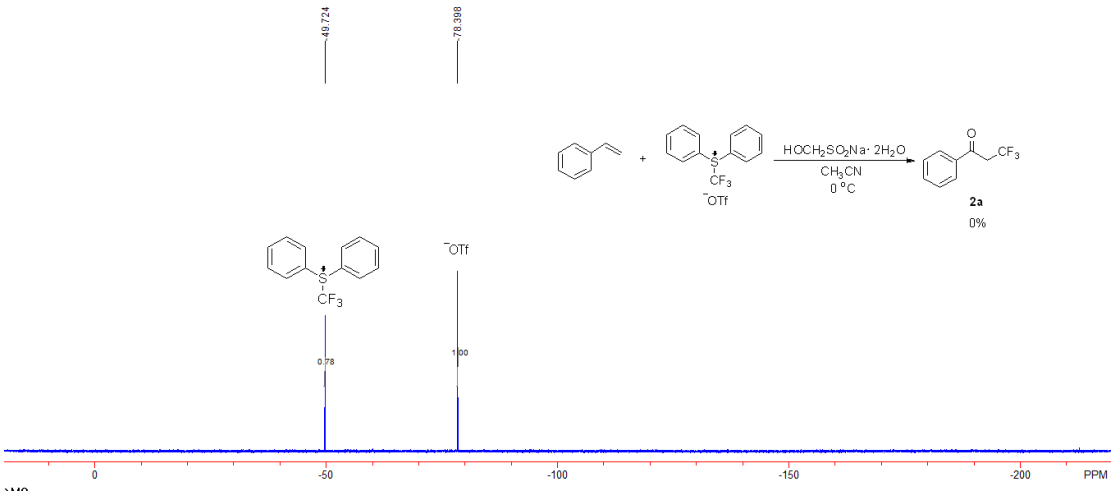

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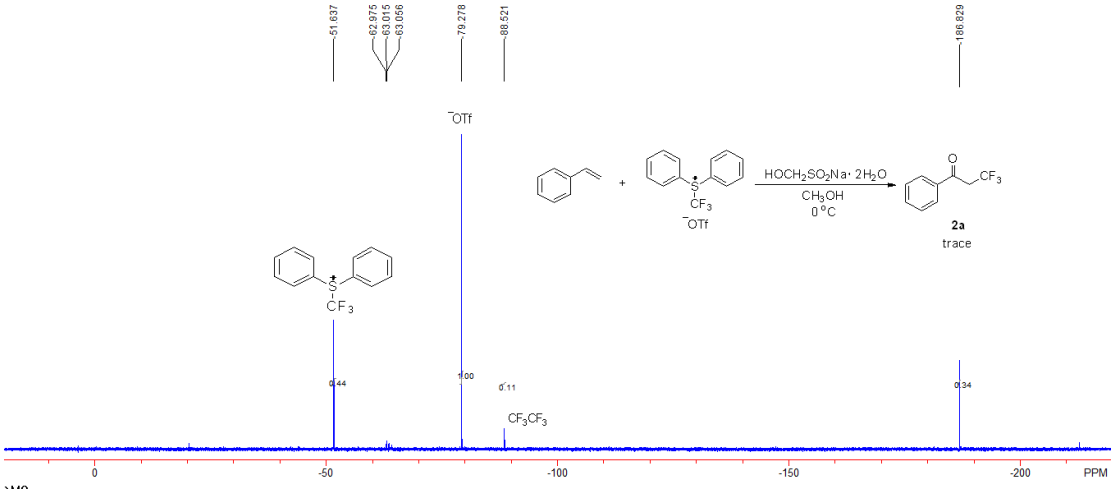

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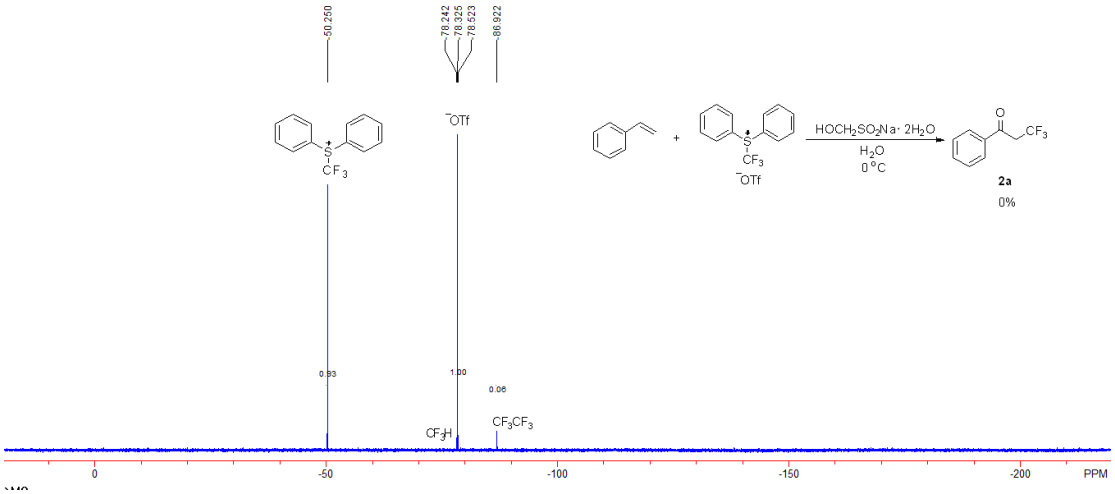

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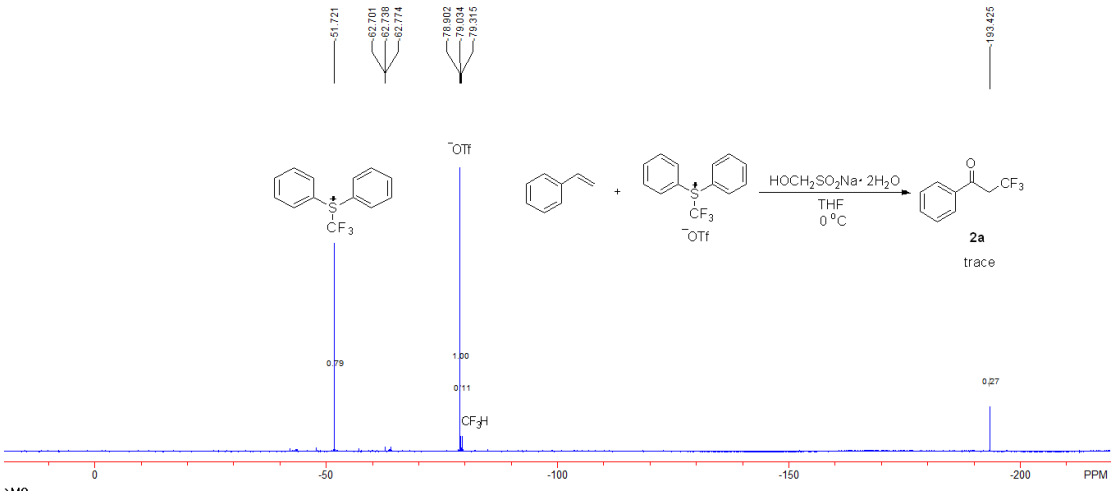

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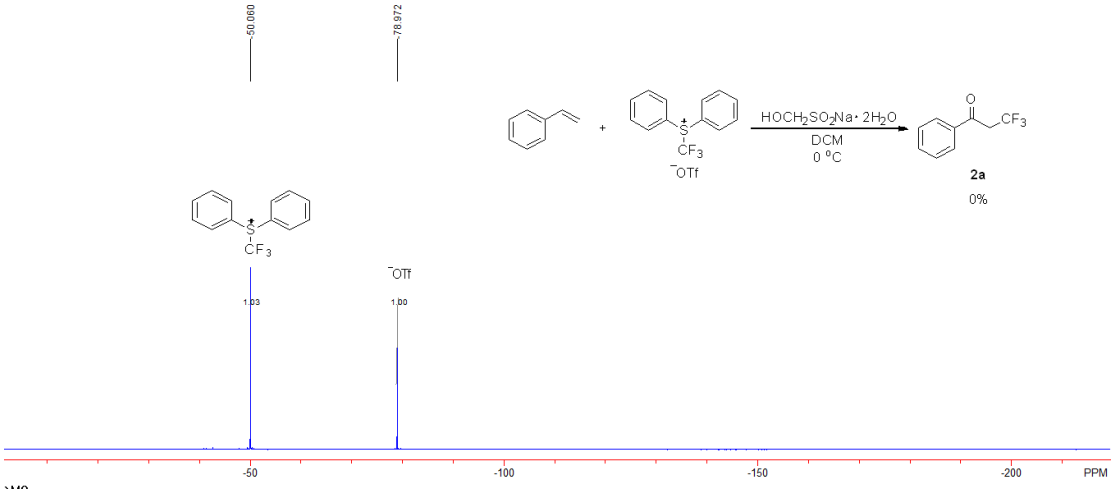

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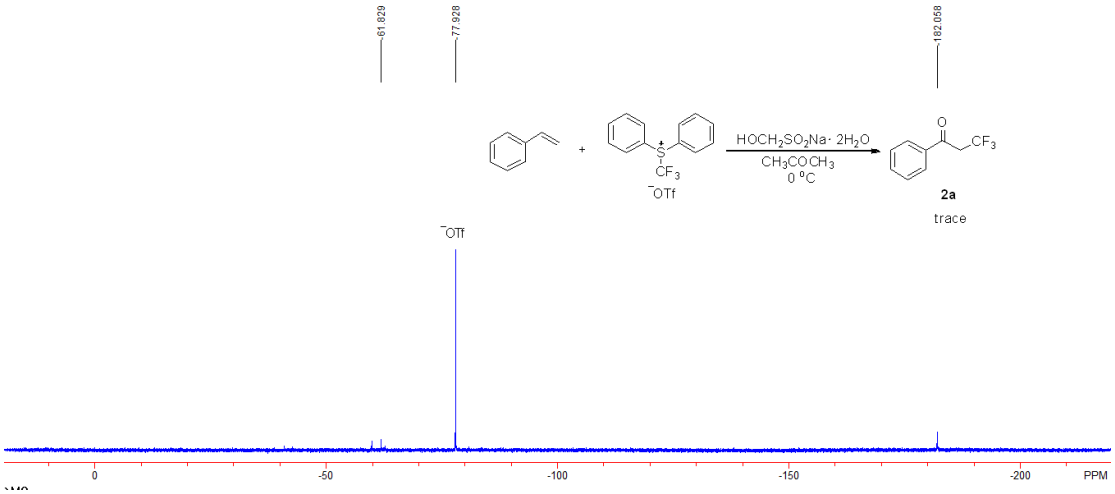
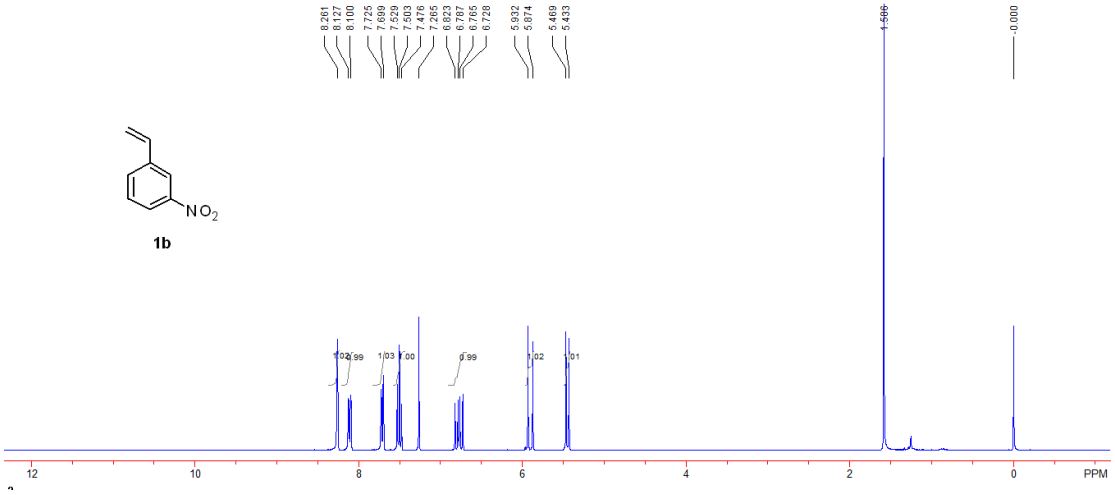
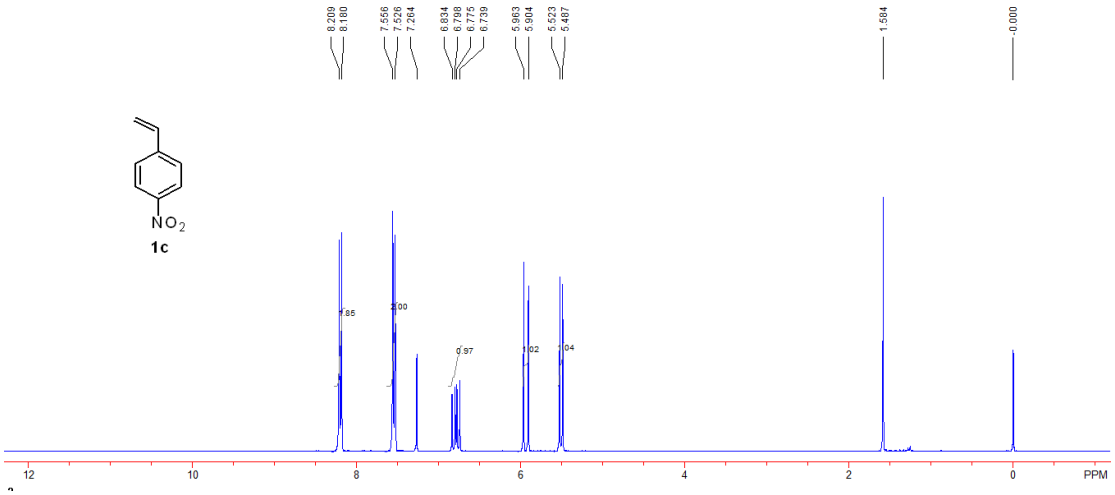
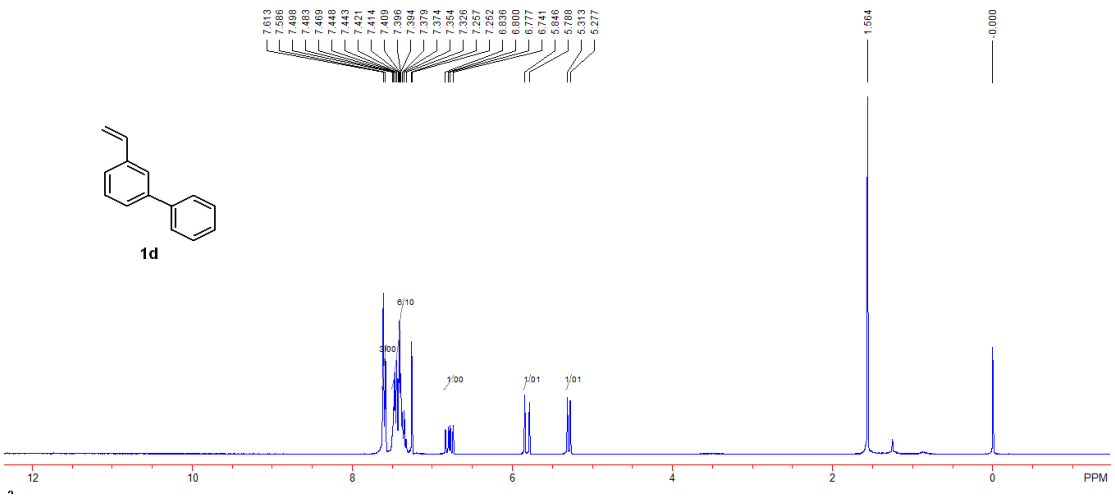
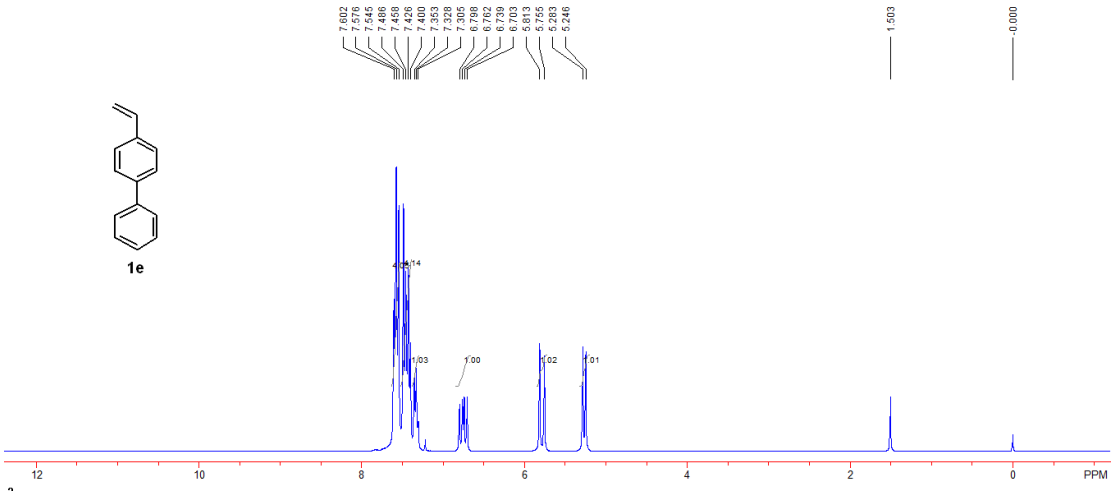


Copies of NMR Spectra for 1b-k





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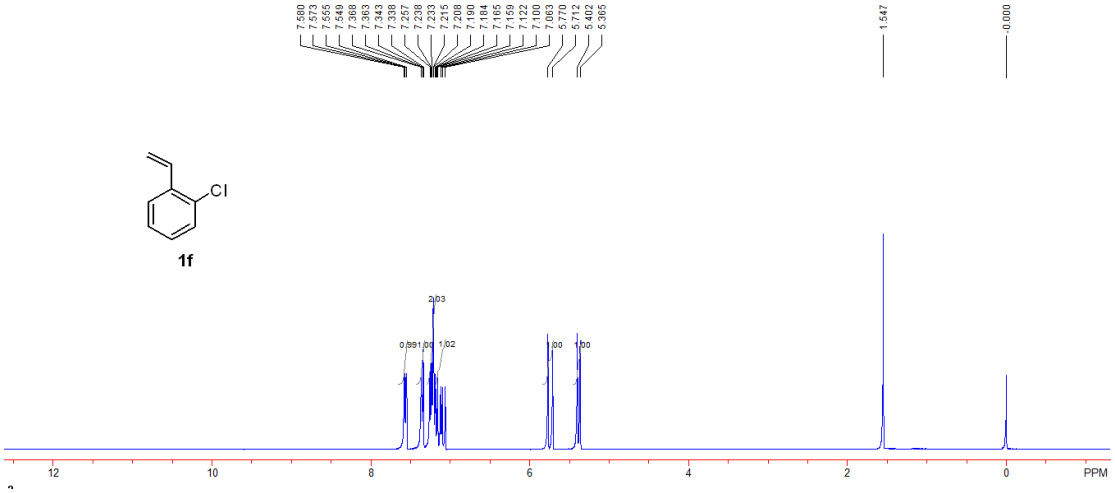
7.545
7.466
7.438
7.426
7.400
7.353
7.328
7.305
6.798
6.762
6.739
6.703
5.813
5.755
5.283
5.246
1.503
0.000
4.14
1.03
1.00
1.02
1.01
12
10
8
6
4
2
0
PPM

1e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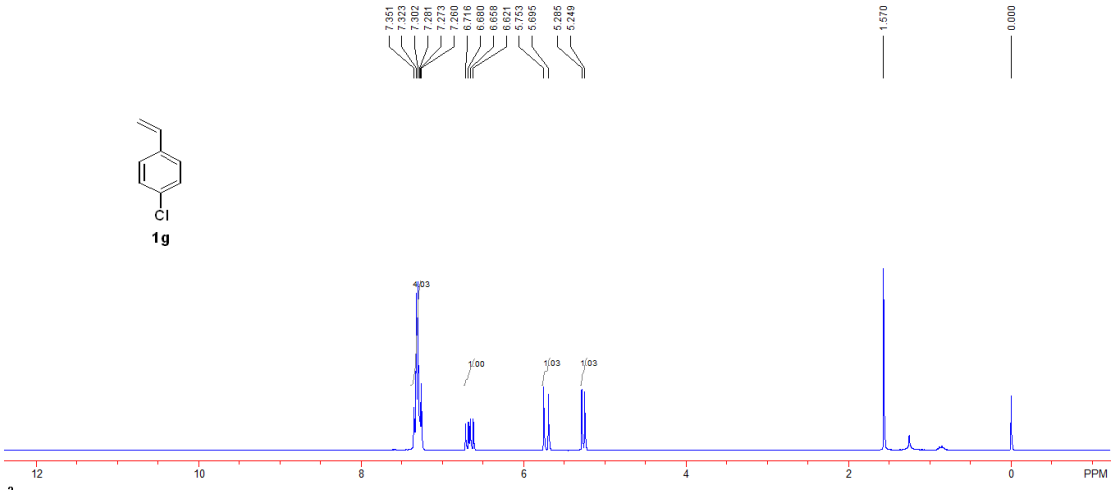
7.573
7.555
7.549
7.388
7.363
7.343
7.338
7.257
7.238
7.233
7.215
7.208
7.190
7.184
7.165
7.159
7.122
7.100
7.063
5.770
5.732
5.402
5.365
1.547
0.000
2.03
0.991.00
1.02
1.00
1.00
12
10
8
6
4
2
0
PPM

1f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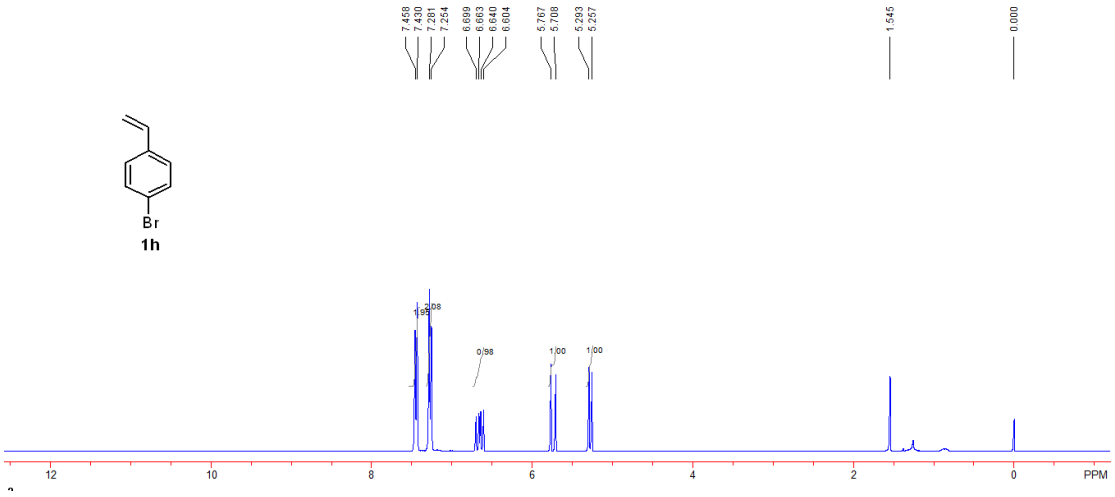
7.323
7.302
7.281
7.273
7.260
6.716
6.680
6.658
6.621
5.753
5.695
5.285
5.249
1.570
0.000
4.03
1.00
1.03
1.03
12
10
8
6
4
2
0
PPM

1g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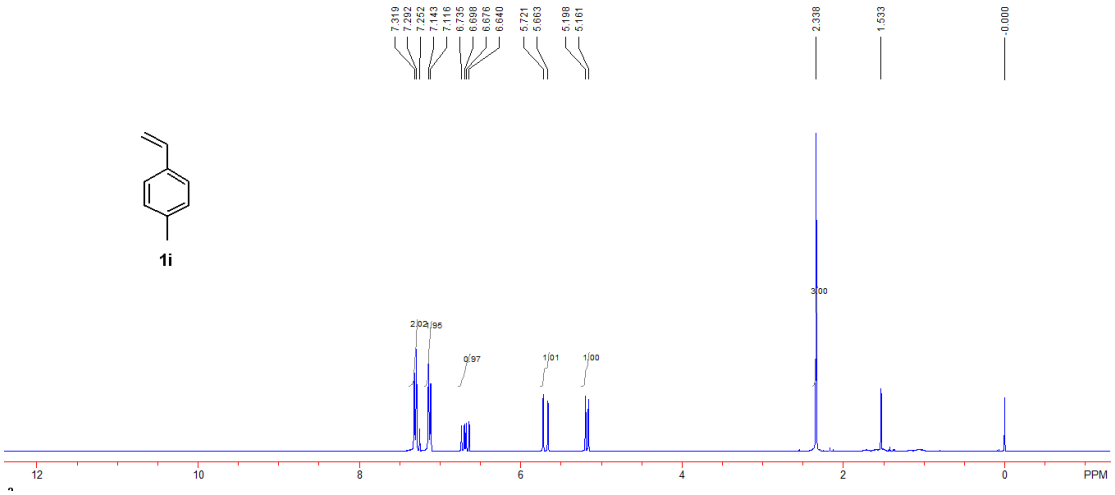
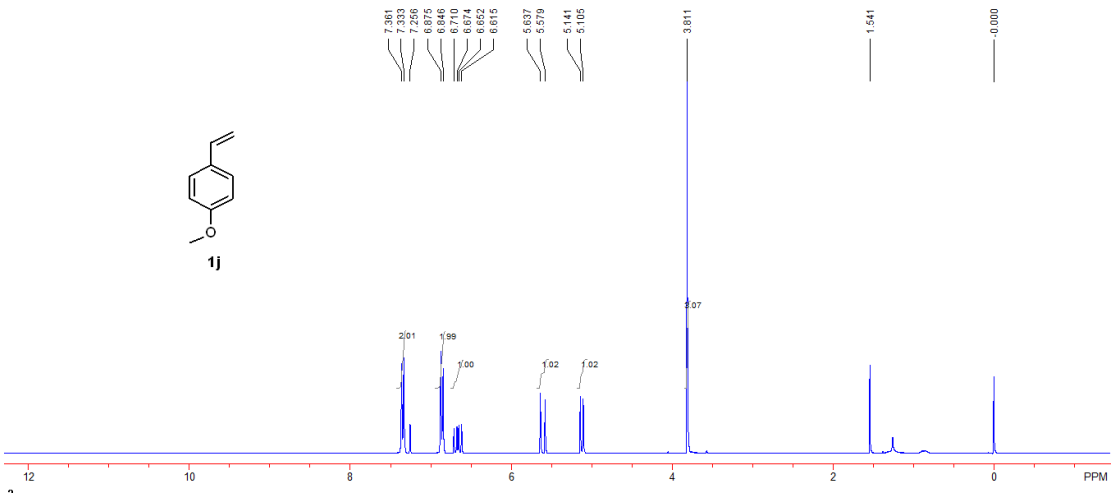
7.430
7.281
7.254
6.689
6.663
6.640
6.604
5.767
5.708
5.293
5.257
1.545
0.000
Br
1h
2.08
1.95
0.98
1.00
1.00
12
10
8
6
4
2
0
PPM


7.319
7.292
7.252
7.143
7.116
6.735
6.698
6.676
6.640
5.721
5.663
5.198
5.161
2.338
1.533
0.000
1i
3.00
2.02
1.95
0.97
1.01
1.00
12
10
8
6
4
2
0
PPM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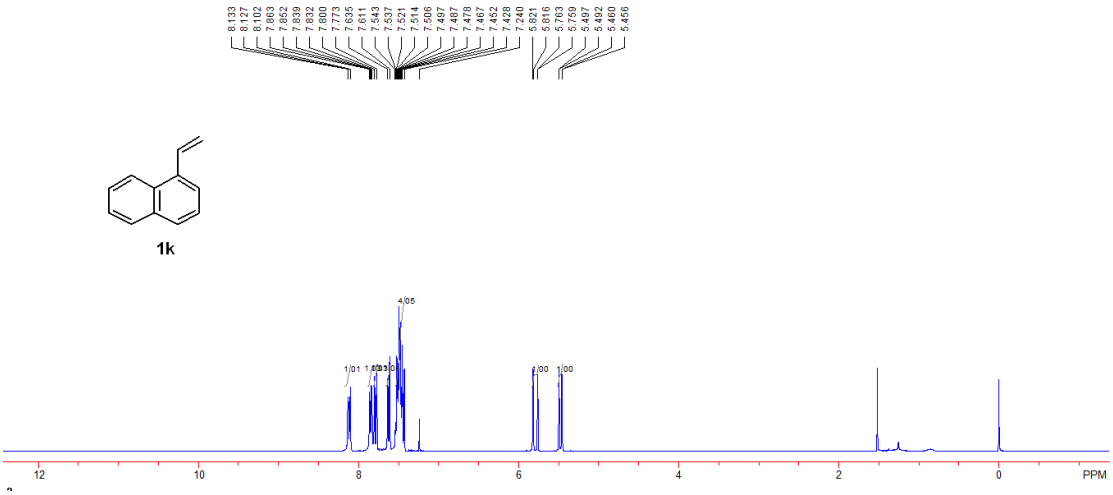
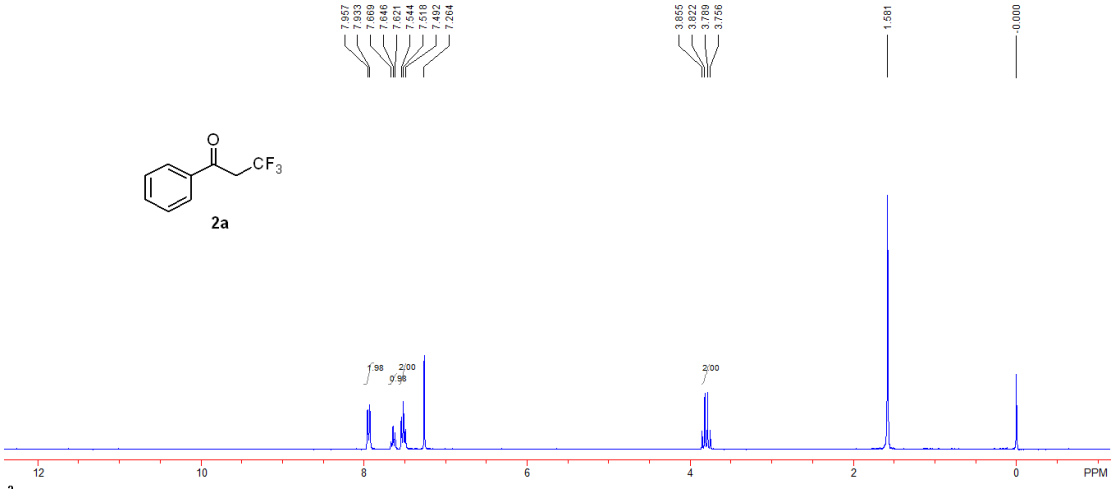
7.333
7.256
6.875
6.846
6.710
6.674
6.652
6.615
5.637
5.579
5.141
5.105
3.811
1.541
0.000
O
1j
3.07
2.01
1.99
1.00
1.02
1.02
12
10
8
6
4
2
0
PPM


8.133
8.127
8.102
7.863
7.852
7.839
7.832
7.800
7.773
7.635
7.611
7.543
7.537
7.521
7.514
7.506
7.497
7.487
7.478
7.467
7.452
7.428
7.240
6.871
5.815
5.763
5.759
5.497
5.492
5.460
5.456
1k
4.05
1.01
1.00
1.00
12
10
8
6
4
2
0
PPM

Copies of NMR Spectra for 2a-k



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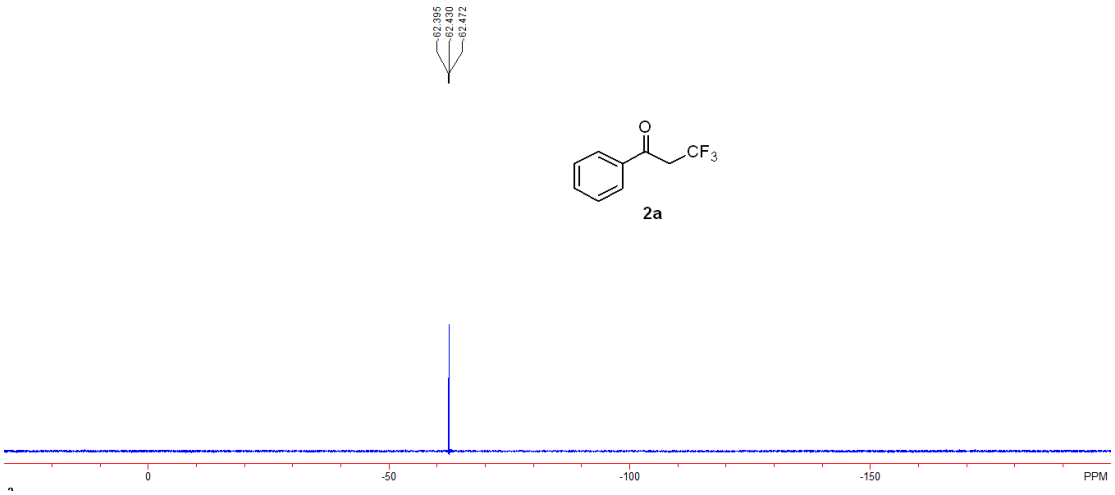
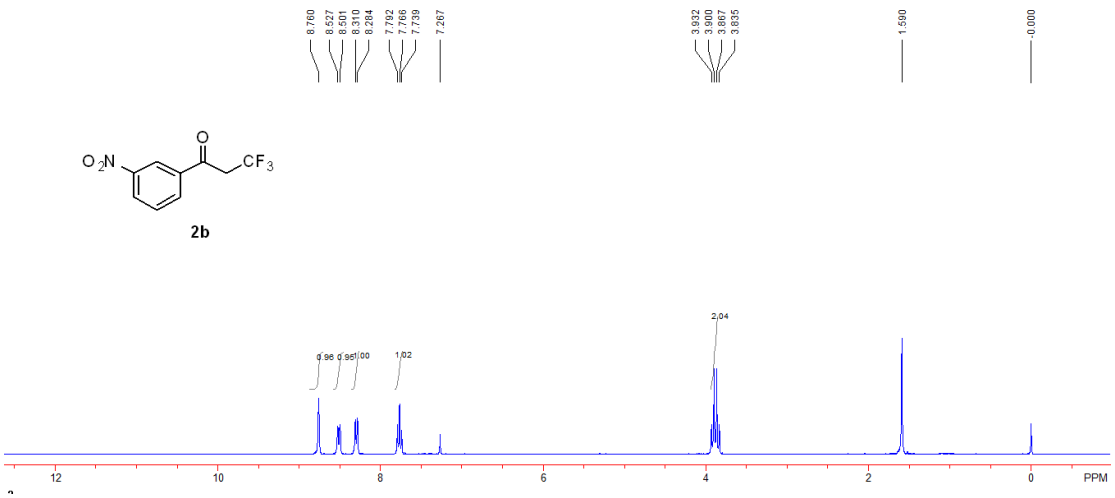
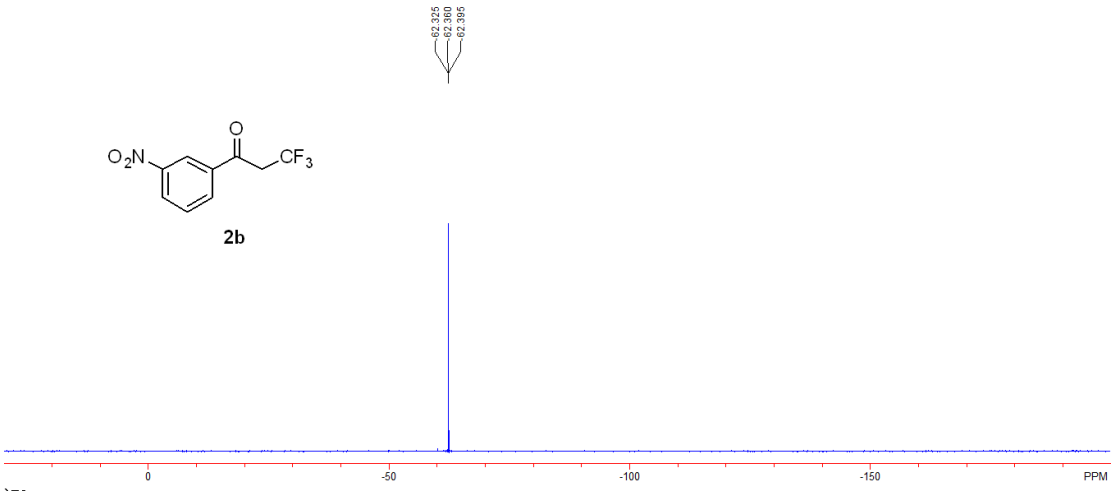


2a



2b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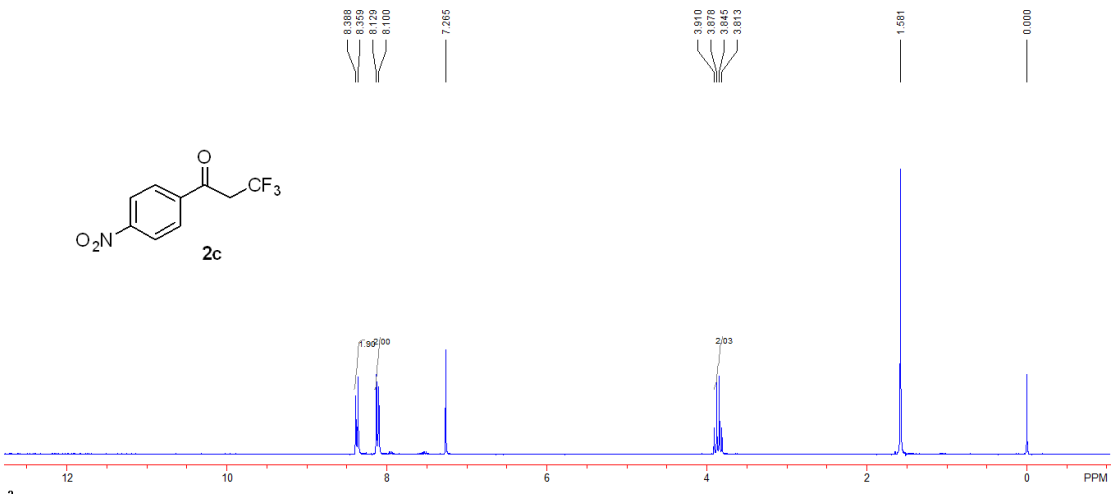
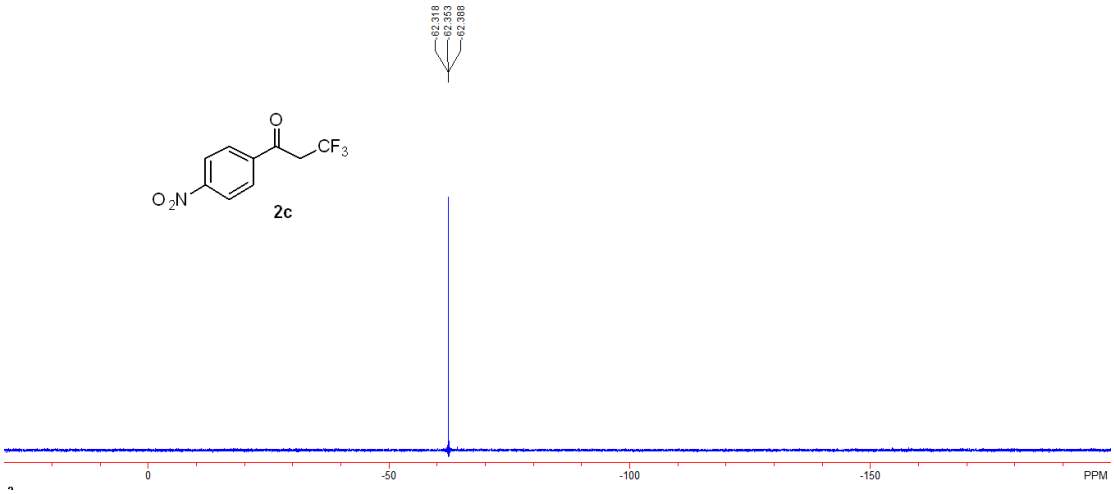
62.360
62.395
O
O_2N
CF_3
0
-50
-100
-150
PPM

2b


8.388
8.359
8.129
8.100
7.265
3.910
3.879
3.845
3.813
1.581
0.000
O
CF_3
O_2N
1.99
2.00
2.03
12
10
8
6
4
2
0
PPM

2c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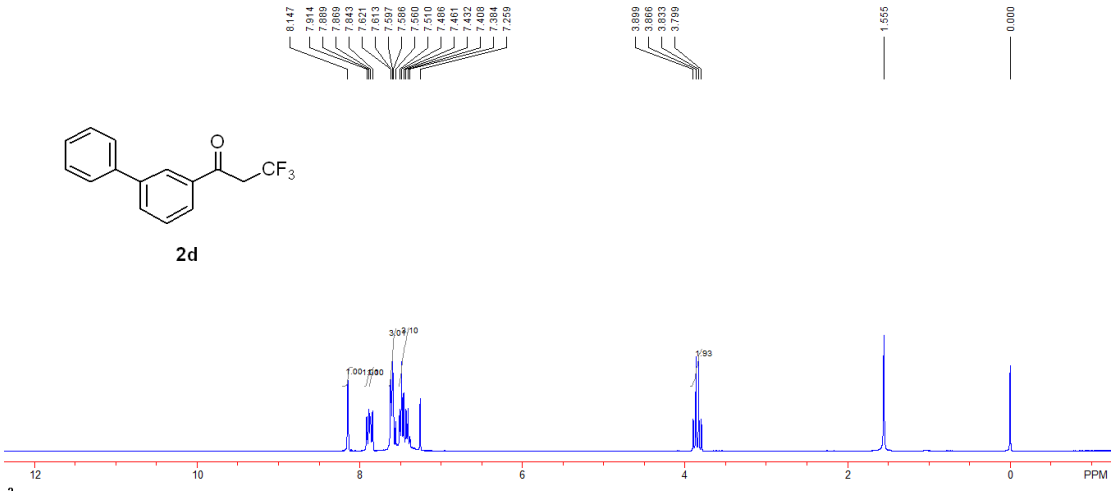
62.353
62.388
O
CF_3
O_2N
0
-50
-100
-150
PPM

2c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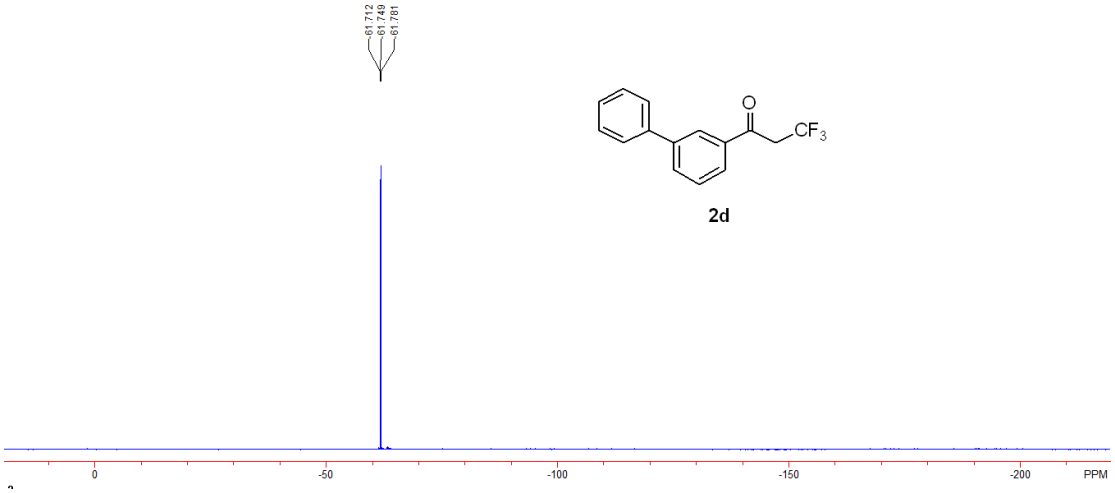
7.889
7.869
7.843
7.621
7.613
7.597
7.586
7.560
7.510
7.486
7.461
7.432
7.408
7.384
7.259
3.899
3.866
3.833
3.799
1.555
0.000
O
CF3
2d
3.09
3.10
1.00
1.00
1.93
12
10
8
6
4
2
0
PPM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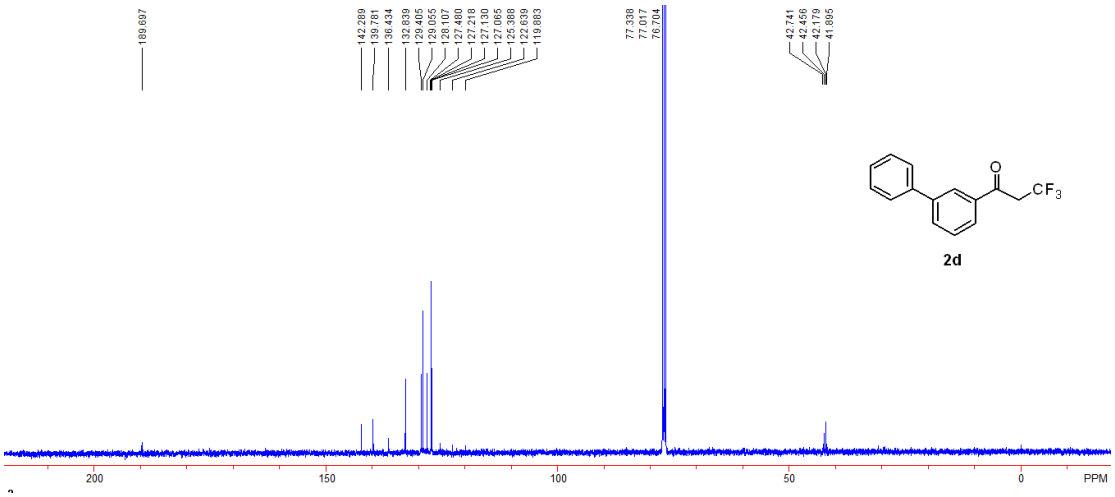
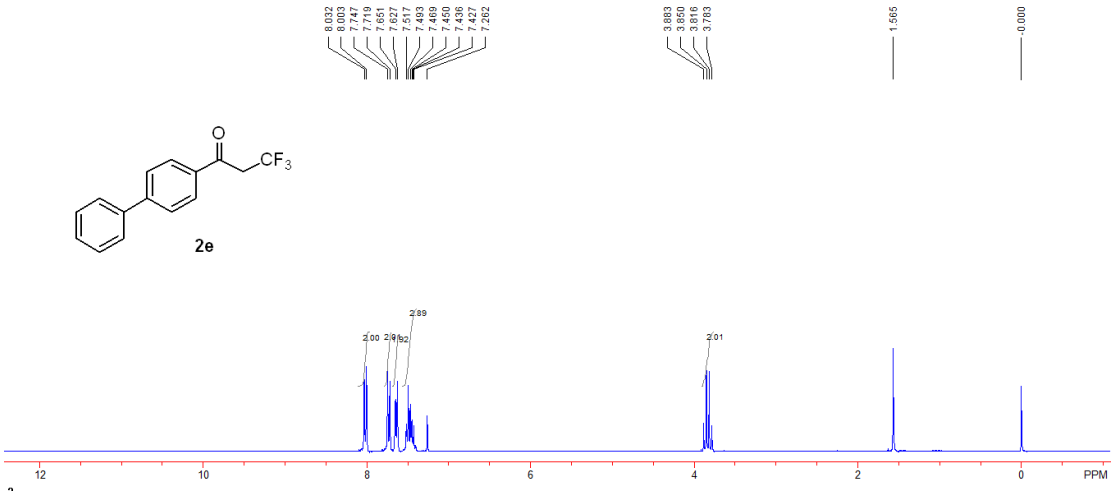
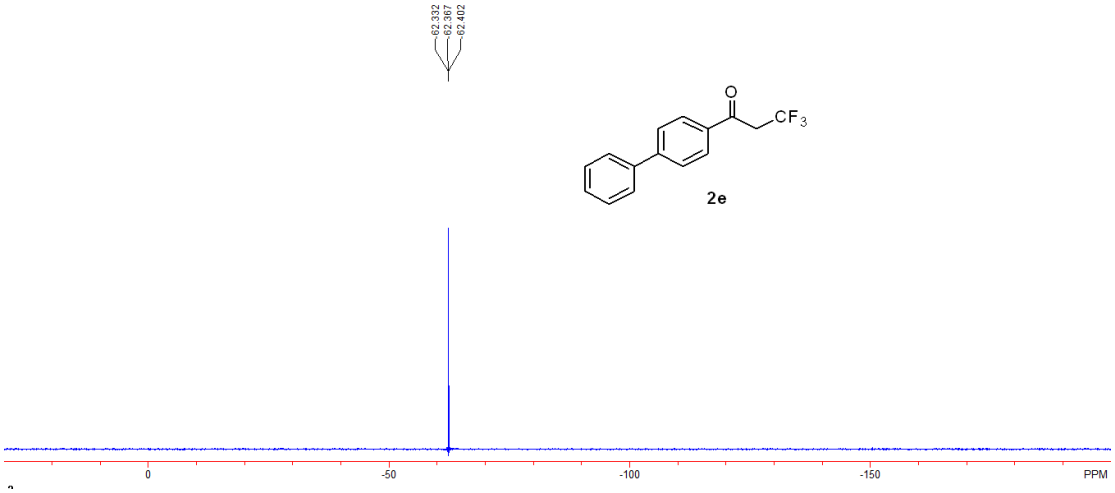
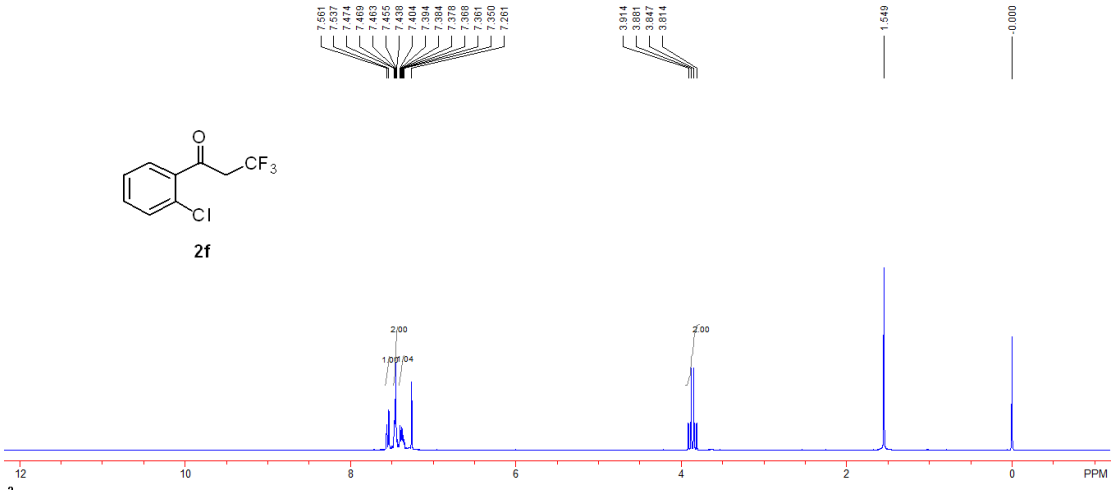
61.749
61.781
O
CF3
2d
0
-50
-100
-150
-200
PPM


189.697
142.289
139.781
136.434
132.839
129.405
129.055
128.107
127.480
127.218
127.130
127.065
125.388
122.639
119.883
77.338
77.017
76.704
42.741
42.456
42.179
41.895
O
CF3
2d
200
150
100
50
0
PPM


8.032
8.003
7.747
7.719
7.651
7.627
7.517
7.493
7.469
7.450
7.436
7.427
7.262
3.883
3.850
3.816
3.783
1.565
0.000
CF3
O
2e
2.89
2.00
2.01
2.01
12
10
8
6
4
2
0
PPM


62.332
62.367
62.402
CF3
O
2e
0
-50
-100
-150
PPM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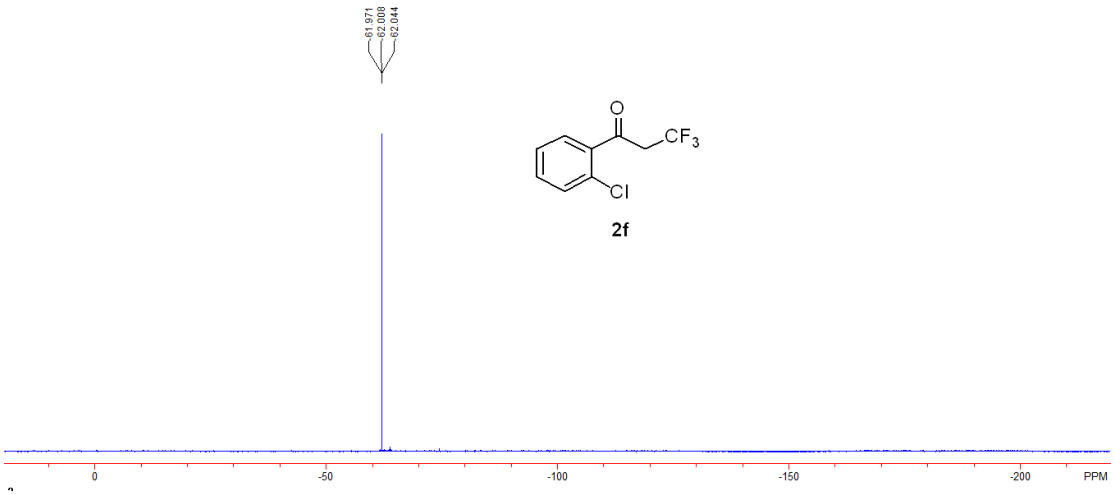
7.474
7.469
7.463
7.455
7.438
7.404
7.394
7.384
7.378
7.368
7.361
7.350
7.261
3.914
3.881
3.847
3.814
1.549
0.000
CF3
O
Cl
2f
2.00
1.00
1.04
2.00
12
10
8
6
4
2
0
PPM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CF3
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-100
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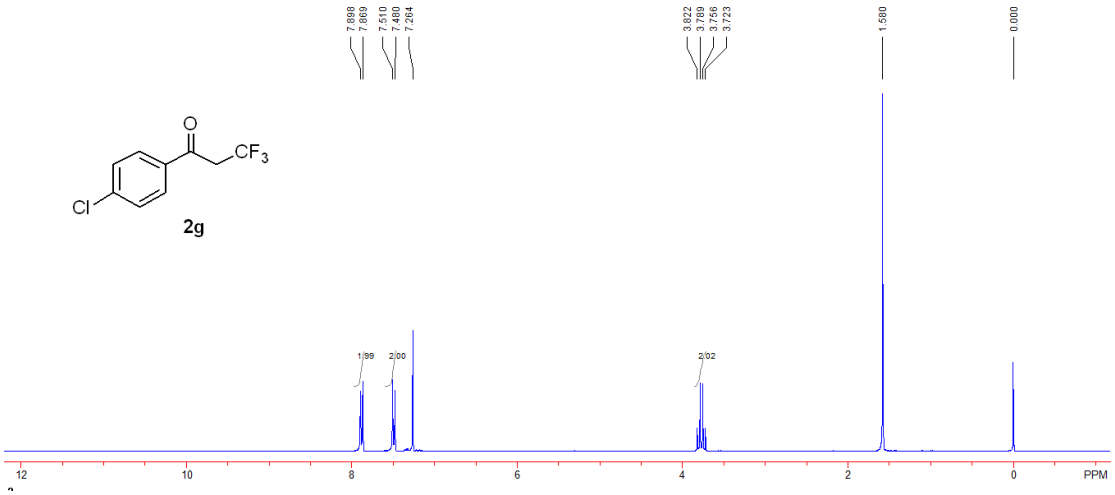
-200
PPM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7.869
7.510
7.480
7.264
3.822
3.789
3.756
3.723
1.580
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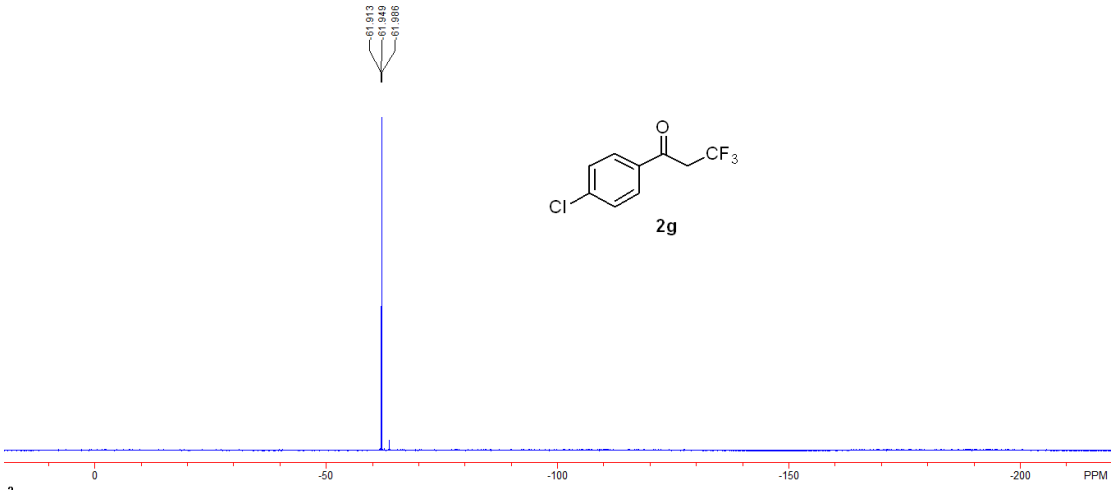
CF3
Cl
2g
1.99
2.00
2.02
12
10
8
6
4
2
0
PPM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-61.986
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CF3
Cl
2g
0
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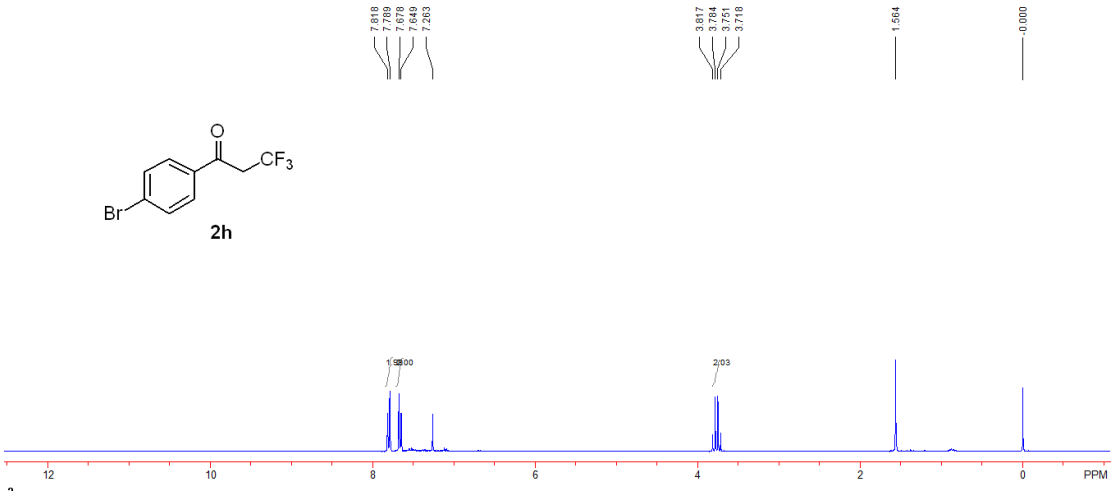
-100
-150
-200
PPM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7.789
7.678
7.649
7.263
3.817
3.784
3.751
3.718
1.564
0.000
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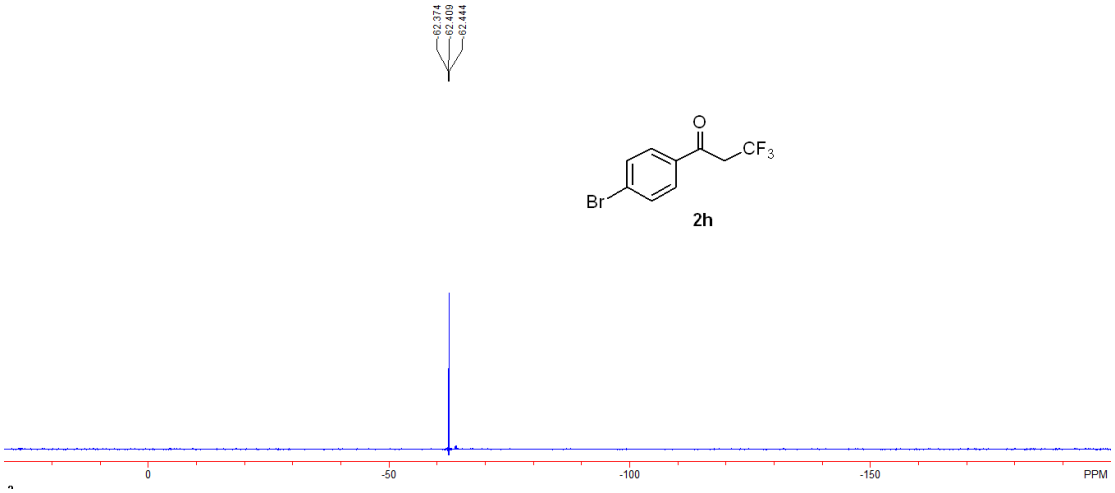
CF3
Br
2h
2.03
12
10
8
6
4
2
0
PPM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62.444
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CF3
Br
2h
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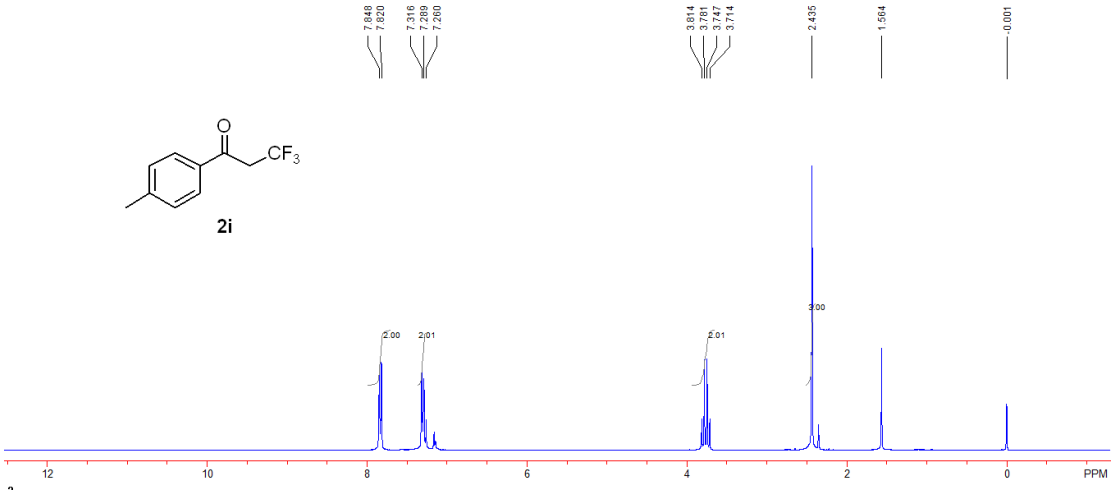
-100
-150
PPM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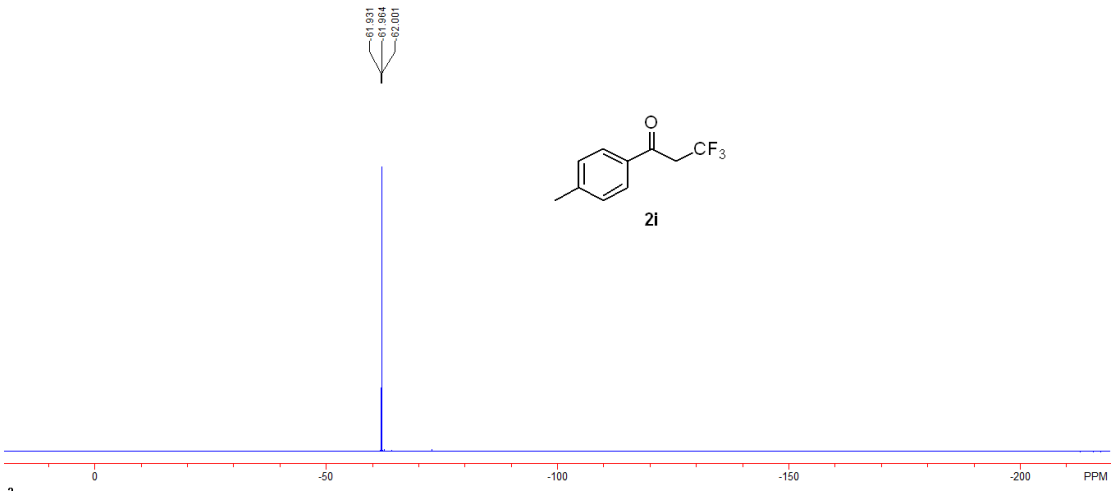
7.820
7.316
7.289
7.260
3.814
3.781
3.747
3.714
2.435
1.564
0.001
O
CF3
2i
3.00
2.00
2.01
2.01
12
10
8
6
4
2
0
PPM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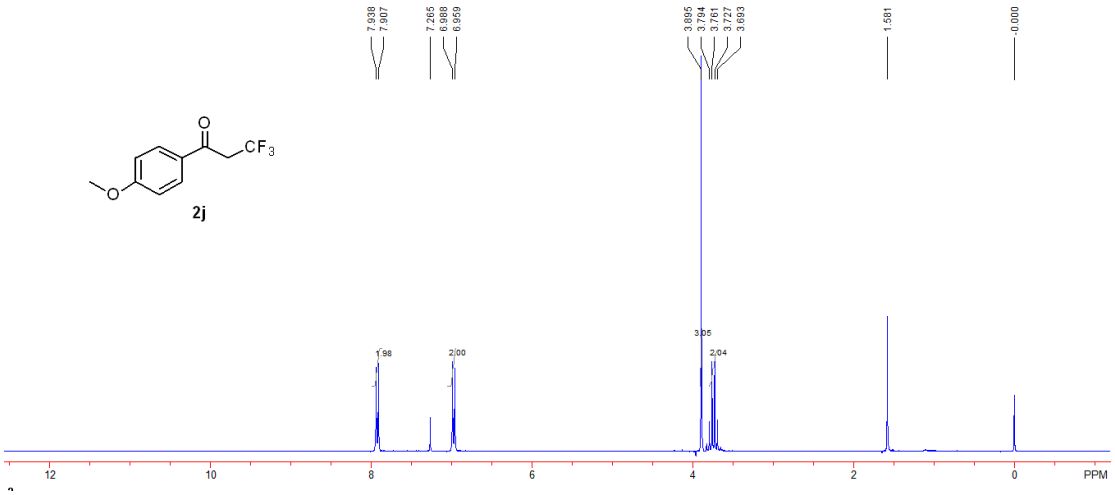
-200
PPM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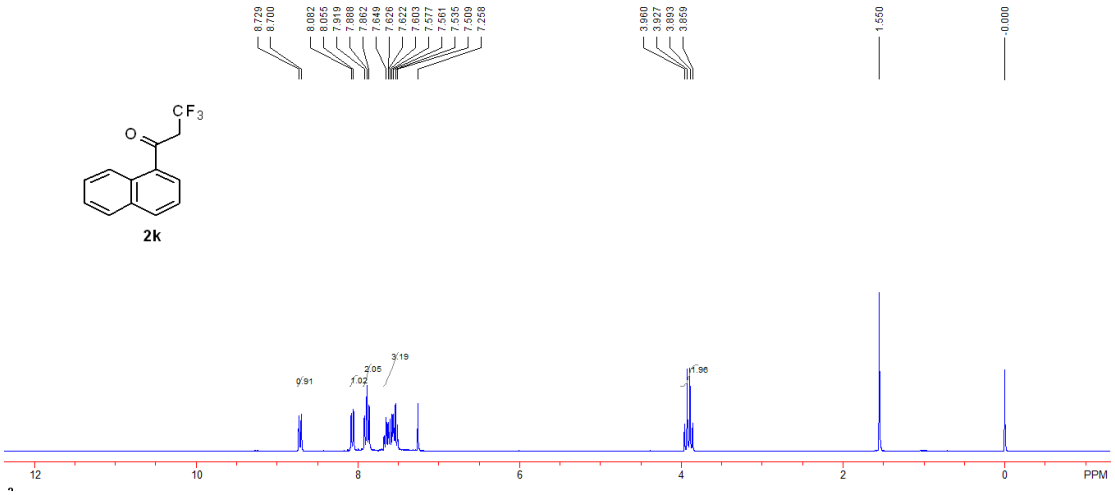
7.265
6.988
6.959
3.805
3.794
3.761
3.727
3.693
1.581
0.000
O
CF3
O
2j
1.98
2.00
3.05
2.04
12
10
8
6
4
2
0
PPM


-62.325
-62.360
-62.395
O
CF3
O
2j
0
-50
-100
-150
PPM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8.082
8.055
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7.649
7.626
7.622
7.603
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7.561
7.535
7.509
7.258
3.960
3.927
3.893
3.859
1.550
0.000
CF3
O
2k
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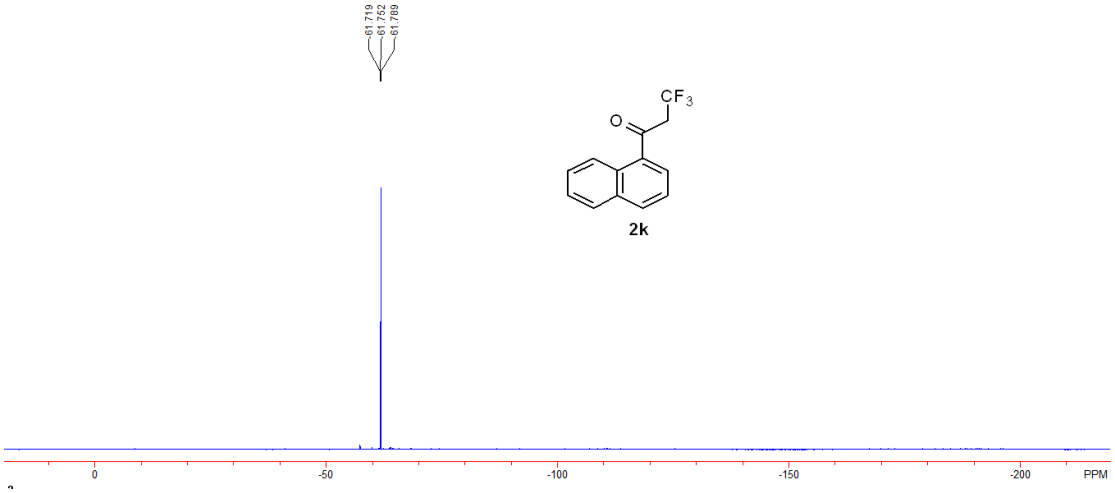
1.02
2.05
3.19
1.96
12
10
8
6
4
2
0
PPM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61.789
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O
2k
0
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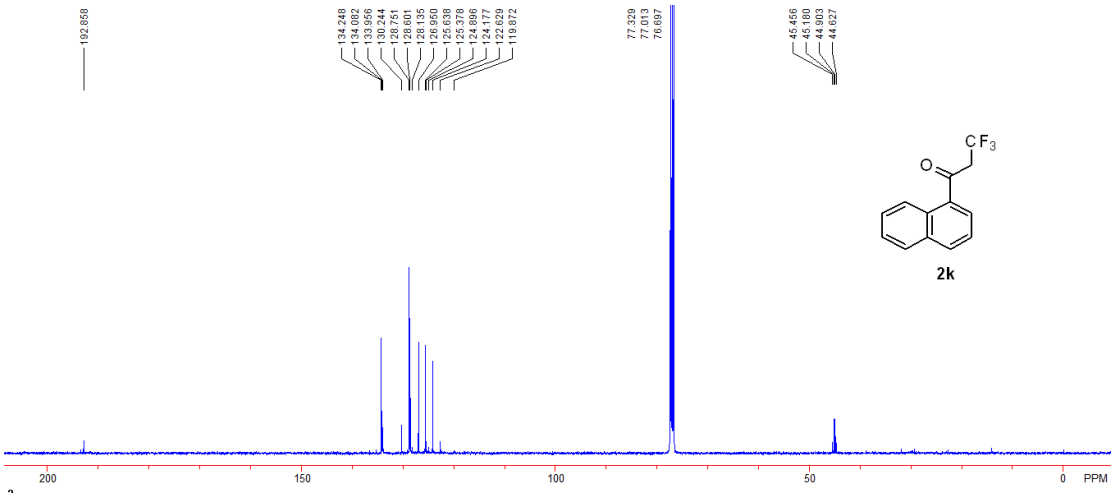
-100
-150
-200
PPM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134.082
133.956
130.244
128.751
128.651
128.135
126.950
125.638
125.378
124.896
124.177
122.629
119.872
77.329
77.013
76.697
45.456
45.180
44.903
44.627
CF3
O
2k
200
150
100
50
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PPM