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Supporting Information

Merging Visible-Light Photocatalysis and Copper Catalysis in the decarboxylative difluoroalkylation of *α, β*-unsaturated carboxylic acids with ICF_2CO_2Et

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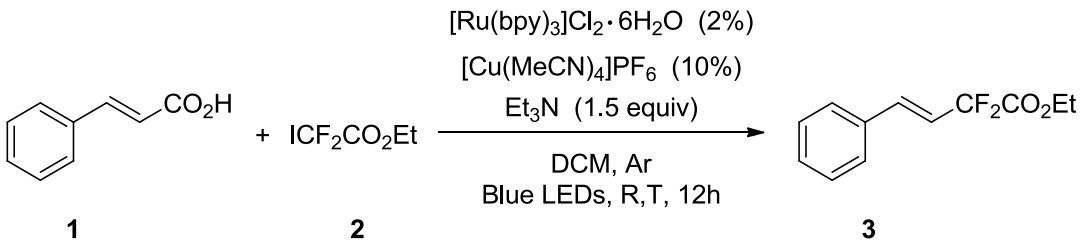
1, General Remarks

Column chromatography was carried out on silica gel. ^{1}H NMR spectra were recorded on 400 MHz in $CDCl_3$ ^{13}C NMR spectra were recorded on 100 MHz in $CDCl_3$. Chemical shifts (ppm) were recorded with tetramethylsilane (TMS) as the internal reference standard. Multiplicities are given as: s (singlet), d (doublet), t (triplet), dd (doublet of doublets), dt (doublet of triplets), q (quartet) or m (multiplet). All new compounds were further characterized by HRMS (high resolution mass spectra). Copies of their ^{1}H NMR and ^{13}C NMR spectra are provided in the Supporting Information. Solvents were dried under standard method. Commercially available reagents were used with further purification.

2, Devices for the photocatalytic reactions

Figure 1.Devices for the photocatalytic reactions

3, General Procedure for the decarboxylative difluoroalkylation of *α, β*-unsaturated carboxylic acids with ICF_2CO_2Et



1 **2** **3**

To a 10 mL of tube were added *α,β*-unsaturated carboxylic acid **1** (0.15 mmol), $[Cu(MeCN)_4]PF_6$ (10 mol %, 0.015 mmol, 5.5 mg) and $[Ru(bpy)_3]Cl_2{\cdot}6H_2O$ (2 mol %, 2.2 mg) under air, The mixture was evacuated and backfilled with Ar (3 times). Ethyl

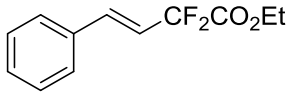
iododifluoroacetate **2** (1.5 equiv, 0.225 mmol, 56.2 mg), Et_3N (1.5 equiv, 0.225 mmol, 22.7 mg), and dichloromethane (1.5 mL) were added successively. The mixture was stirred at room temperature for 12 hours while irradiated by blue LED strip ($\lambda = 450 \pm 15$ nm, 3W electrical power). The reaction was monitored by TLC. The mixture was diluted with EtOAc, and then filtered through a pad of silical gel. The filtrate was concentrated under vacuum and purified by flash column chromatography on silica gel to give product **3**.

4, Prepartion of Starting Materials

All substrates were either purchased and used from commercial suppliers directly.

5，Characterization data of 3a–3af

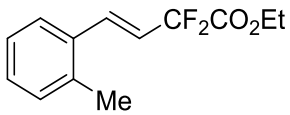
^{1}H NMR and ^{13}C NMR spectra for compounds 3a–3af



Ethyl-2,2-difluoro-4-phenylbut-3-enoate（**3a**，***E/Z*** = 95:5）

The procedure was operated with the general procedure. The product **3a** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (78%, 26.4 mg). This compound is known.[1]

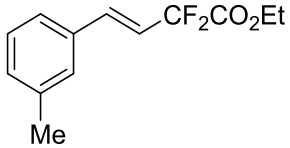
^{1}H NMR (400 MHz, $CDCl_3$): 7.45-7.43 (m, 2H), 7.38 – 7.34 (m, 3H), 7.09 (dt, *J* = 16.1, 2.4 Hz, 1H), 6.31 (dt, *J* = 16.2, 11.4 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.35 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.8 (t, *J* = 34.7 Hz), 136.8 (t, *J* = 9.4 Hz), 134.0, 129.6, 128.8, 127.4, 118.8 (t, *J* = 24.8 Hz), 112.7 (t, *J* = 246.9 Hz), 63.0, 13.9. ^{19}F NMR (476 MHz, $CDCl_3$): -103.1.



Ethyl-2, 2-difluoro-4-(o-tolyl)but-3-enoate (**3b**, ***E/Z*** = 98:2),

The procedure was operated with the general procedure. The product **3b** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (78%, 28.0 mg). This compound is known.[1]

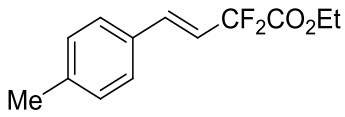
^{1}H NMR (400 MHz, $CDCl_3$): 7.45 (d, *J* = 7.8 Hz, 1H), 7.35 (d, *J* = 16.8 Hz, 1H), 7.26-7.16 (m, 3H), 6.20 (dt, *J* = 16.0, 11.3 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 2.38 (s, 3H), 1.35 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.9, (t, *J* = 34.5 Hz), 136.7, 134.6 (t, *J* = 9.3 Hz), 133.1, 130.6, 129.3, 126.2, 126.0, 120.0 (t, *J* = 24.8 Hz), 112.7 (t, *J* = 246.9 Hz), 63.0, 19.5, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -102.9 (s, 2F).



Ethyl-2, 2-difluoro-4-(m-tolyl)but-3-enoate (**3c**, ***E/Z***= 96:4),

The procedure was operated with the general procedure. The product **3c** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (85%, 30.6 mg). This compound is known.[1]

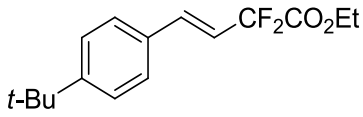
^{1}H NMR (400 MHz, $CDCl_3$) 7.24 (d, *J* = 5.6 Hz, 3H), 7.15 (d, *J* = 5.3 Hz, 1H), 7.02(dt, *J* = 16.2, 2.5 Hz, 1H), 6.28 (dt, *J* =16.1, 11.4 Hz), 4.34 (q, *J* = 7.1 Hz, 2H), 2.35 (s, 3H), 1.35 (t, *J* = 7.1 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$): 163.9 (t, *J* = 35.0 Hz), 138.4, 136.9 (t, *J* = 9.2 Hz), 133.9, 130.4, 128.6, 128.0, 124.6, 118.5 (t, *J* = 25.0 Hz), 112.7 (t, *J* = 246.3 Hz), 63.0, 21.2, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.0.



Ethyl-2, 2-difluoro-4-(p-tolyl)but-3-enoate (**3d**, ***E/Z*** = 99:1),

The procedure was operated with the general procedure. The product **3d** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (90%, 32.4 mg). This compound is known.[1]

^{1}H NMR (400 MHz, $CDCl_3$): 7.32 (d, *J* = 8.0 Hz, 2H), 7.18 (d, *J* = 8.0 Hz, 2H), 7.05 (dt, *J* = 16.2, 2.4 Hz,1H), 6.25 (dt, *J* = 16.1, 11.4 Hz, 1H), 4.34 (q, *J* = 7.1 Hz, 2H), 2.25 (s, 3H), 1.35 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 164.0, (t, *J* = 35.5 Hz), 139.8, 136.7 (t, *J* = 9.5 Hz), 131.3, 129.5, 127.3, 117.7 (t, *J* = 24.9Hz), 112.8 (t, *J* = 246.6 Hz), 63.0, 21.3, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -102.8.

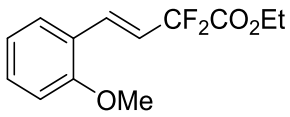


Ethyl-2, 2-difluoro-4-(4-butylphenyl)but-3-enoate (3e, ***E/Z*** = 98:2)

The procedure was operated with the general procedure. The product **3e** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (76%, 32.1 mg). This compound is known.[2]

^{1}H NMR (400 MHz, $CDCl_3$): 7.39 (s, 4H), 7.04 (dt, *J* = 16.1, 2.5 Hz, 1H), 6.27 (dt, *J* = 16.1, 11.4 Hz, 1H), 4.33 (q, *J* = 7.1 Hz, 2H), 1.35 (t, *J* = 7.1 Hz, 3H), 1.32 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.9 (t, *J* = 34.9 Hz), 153.0, 136.5 (t, *J* = 9.4 Hz),

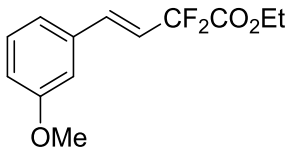
131.3, 127.2, 125.7, 117.9 (t, *J* = 24.9 Hz), 112.8 (t, *J* = 246.8 Hz), 62.9, 34.7, 31.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.0.



Ethyl-2, 2-difluoro-4-(2-methanoxyl)but-3-enoate (3f, ***E/Z*** = 98:2)

The procedure was operated with the general procedure. The product **3f** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless solid (82%, 31.4 mg). This compound is known.[1]

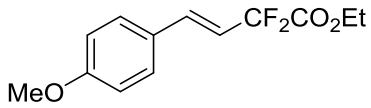
^{1}H NMR (400 MHz, $CDCl_3$): 7.42 (d, *J* = 7.4 Hz, 1H), 7.38-7.29 (m, 2H), 6.96-6.88 (m, 2H), 6.40 (dt, *J* = 16.1, 11.4 Hz, 1H), 4.34 (q, *J* = 7.1 Hz, 2H), 3.86 (s, 3H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 164.1 (t, *J* = 34.9 Hz), 157.7, 132.1 (t, *J* = 9.7 Hz), 130.7, 128.3, 122.9, 120.6, 119.2(t, *J* = 24.6 Hz), 113.0 (t, *J* = 246.6 Hz), 111.0, 62.9, 55.3, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -102.8.



Ethyl-2, 2-difluoro-4-(3-methanoxyl)but-3-enoate (**3g**, ***E/Z*** = 99:1),

The procedure was operated with the general procedure. The product **3g** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (85%, 32.6 mg). This compound is known.[1]

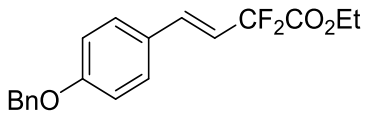
^{1}H NMR (400 MHz, $CDCl_3$): 7.28 (t, *J* = 7.9 Hz, 1H), 7.07-7.02 (m, 2H), 6.96 (s,1H), 6.90 (dd, *J* = 8.1, 2.2 Hz, 1H), 6.29 (dt, *J* = 16.2, 11.4 Hz, 1H), 4.34 (q, *J* = 7.1 Hz, 2H), 3.82 (s, 3H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.8, (t, *J* = 34.2 Hz), 159.9, 136.7 (t, *J* = 9.3 Hz), 135.4, 129.8, 120.0, 119.1 (t, *J* = 25.0 Hz), 115.3, 112.6 (t, *J* = 246.9 Hz), 112.5, 63.1, 55.2, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -102.8.



Ethyl-2, 2-difluoro-4-(4-methanoxyl)but-3-enoate (**3h**, ***E/Z*** = 99:1)

The procedure was operated with the general procedure. The product **3h** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (82%, 31.4 mg). This compound is known.[1]

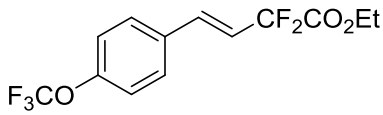
^{1}H NMR (400 MHz, $CDCl_3$): 7.37 (d, *J* = 8.7 Hz, 2H), 7.02 (dt, *J* = 16.1, 2.4 Hz, 1H), 6.89 (d, *J* = 8.7 Hz, 2H), 6.15 (dt, *J* = 16.1, 11.4 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 3.81 (s, 3H), 1.35 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 164.0(t, *J* = 35.0 Hz), 160.7, 136.2 (t, *J* = 9.4 Hz), 128.8, 126.7, 116.3 (t, *J* = 24.8 Hz), 114.1, 112.9 (t, *J* = 246.6 Hz), 62.9, 55.2, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -102.7.



Ethyl-2, 2-difluoro-4-(4- benzyloxy)but-3-enoate (**3i, *E/Z* =** 99:1)

The procedure was operated with the general procedure. The product **3i** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (72%, 35.7 mg). This compound is known.[1]

^{1}H NMR (400 MHz, $CDCl_3$): 7.42-7.30 (m, 7H), 7.02 (dt, *J* = 16.2, 2.4 Hz, 1H), 6.94 (d, *J* = 8.7 Hz, 2H), 6.14 (dt, *J* = 16.1, 11.4 Hz, 1H), 5.07 (s, 2H), 4.34 (q, *J* = 7.1 Hz, 2H), 1.35 (t, *J* = 9.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 164.0 (t, *J* = 35.0 Hz), 159.9, 136.5, 136.2 (t, *J* = 9.4 Hz), 128.9, 128.6, 128.0, 127.4, 127.0, 116.5 (t, *J* = 24.9 Hz), 115.1, 112.8 (t, *J* = 246.7 Hz), 70.0, 62.9, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -102.6.

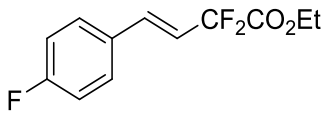


Ethyl-2,2-difluoro-4-(4-(trifluoromethoxy)phenyl)but-3-enoate (**3j**, ***E/Z*** = 85:15)

The procedure was operated with the general procedure. The product 3j was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless solid (90%, 41.8

mg). This compound is known.[1]

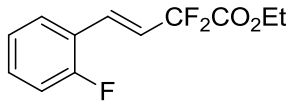
^{1}H NMR (400 MHz, $CDCl_3$): 7.46 (d, *J* = 8.8 Hz, 2H), 7.21 (d, *J* = 8.4 Hz, 2H), 7.05 (dt, *J* = 16.0, 2.4 Hz, 1H), 6.28 (dt, *J* = 16.0, 11.3 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.7 (t, *J* = 34.5 Hz), 149.9, 135.2 (t, *J* = 9.4 Hz), 132.7, 128.8, 121.1, 120.5 (q, *J* = 113.6 Hz), 119.9 (t, *J* = 25.0 Hz), 112.4 (t, *J* = 247.3 Hz), 63.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -57.8 (s, 3F), -103.3 (s, 2F).



Ethyl-2,2-difluoro-4-(4-fluorophenyl)but-3-enoate (**3k**, ***E/Z*** = 97:3)

The procedure was operated with the general procedure. The product **3k** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (86%, 31.4 mg). This compound is known.[1]

^{1}H NMR (400 MHz, $CDCl_3$): 7.43 (dd, *J* = 8.4, 5.2 Hz, 2H), 7.08-7.02 (m, 3H), 6.22 (dt, *J* = 16.1, 11.3 Hz, 1H), 4.34 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.8 (t, *J* = 34.6 Hz), 162.2 (t, *J* = 248.5 Hz), 135.5 (t, *J* = 9.5 Hz), 130.3, 129.2 (d, *J* = 8.2 Hz), 118.5 (td, *J* = 23.8, 2.0 Hz), 115.8 (d, *J* = 21.8 Hz), 112.5 (t, *J* = 246.9 Hz), 63.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.1 (s, 2F), -110.9 (s, F).

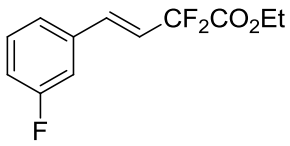


Ethyl-2,2-difluoro-4-(2-fluorophenyl)but-3-enoate (**3l**, ***E/Z*** = 84:16)

The procedure was operated with the general procedure. The product **3l** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (62%, 22.6 mg). This compound is known.[1]

^{1}H NMR (400 MHz, $CDCl_3$): 7.46 (td, *J* = 7.6, 1.5 Hz, 1H), 7.35-7.29 (m, 1H), 7.22 (dt, *J* = 16.4, 2.6 Hz, 1H), 7.16-7.05 (m, 2H), 6.42 (dt, 16.1, 11.3 Hz, 1H), 4.36 (q, *J*

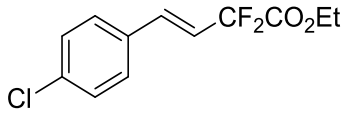
= 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.7 (t, *J* = 34.6 Hz), 162.1 (t, *J* = 251.0 Hz), 131.1 (d, *J* = 8.9 Hz), 129.7 (td, *J* = 9.7, 3.1 Hz), 128.6 (d, *J* = 2.7 Hz), 124.3 (d, *J* = 3.6 Hz), 122.1 (d, *J* = 11.6 Hz), 121.5 (td, *J* = 24.8, 6.6 Hz), 116.1 (d, *J* = 21.8 Hz), 112.5 (t, *J* = 247.2 Hz), 63.1, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -103.6 (s, 2F), -115.7 (s, F).



Ethyl-2,2-difluoro-4-(3-fluorophenyl)but-3-enoate (**3m**, ***E/Z*** = 77:23)

The procedure was operated with the general procedure. The product **3m** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (72%, 26.3 mg). This compound is known.[2]

^{1}H NMR (400 MHz, $CDCl_3$): 7.36-7.28 (m, 1H), 7.21 (d, *J* = 7.6 Hz, 1H), 7.15 (d, *J* = 9.8 Hz, 1H), 7.06-7.02 (m, 2H), 6.31 (dt, 16.1, 11.3 Hz, 1H), 4.36 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.6 (t, *J* = 34.4 Hz), 161.7 (t, *J* = 245.1 Hz), 136.3 (d, *J* = 7.9 Hz), 135.7 (td, *J* = 9.4, 2.4 Hz), 130.4 (d, *J* = 8.1 Hz), 123.4 (d, *J* = 2.0 Hz), 120.2 (t, *J* = 25.0 Hz), 116.5 (d, *J* = 21.2 Hz), 113.9 (d, *J* = 22.0 Hz), 112.4 (t, *J* = 247.2 Hz), 63.1, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -103.4 (s, 2F), -112.6 (s, F).

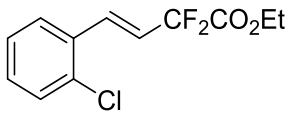


Ethyl-4-(4-chlorophenyl)-2,2-difluorobut-3-enoate (**3n**, ***E/Z*** = 93:7)

The procedure was operated with the general procedure. The product **3n** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (64%, 25.0 mg). This compound is known.[1]

^{1}H NMR (400 MHz, $CDCl_3$): 7.35 (dd, *J* = 16.0, 8.8 Hz, 4H), 7.02 (dt, *J* = 16.1, 2.4 Hz, 1H), 6.28 (dt, *J* = 16.2, 11.3 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.7 (t, *J* = 34.5 Hz), 135.53 (t, *J* = 10.0 Hz),

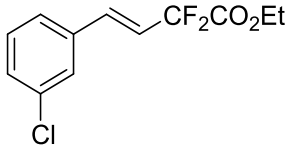
135.49, 132.5, 129.0, 128.6, 119.4 (t, *J* = 25.0 Hz), 112.5 (t, *J* = 247.3 Hz), 63.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.3.



Ethyl-4-(2-chlorophenyl)-2,2-difluorobut-3-enoate (**3o**, ***E/Z*** = 85:15)

The procedure was operated with the general procedure. The product **3o** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (60%, 23.4 mg). This compound is known.[1]

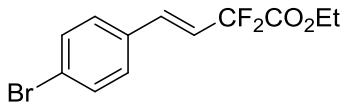
^{1}H NMR (400 MHz, $CDCl_3$): 7.56-7.53 (m, 1H), 7.51 (dt, *J* = 16.2, 2.4 Hz, 1H), 7.40-7.37 (m, 1H), 7.28-7.25 (m, 2H), 6.30 (dt, *J* = 16.4, 11.3 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.37 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.6 (t, *J* = 34.5 Hz), 134.2, 133. 1 (t, *J* = 9.6 Hz), 130.5, 130.0, 127.3, 127.0, 121.5 (t, *J* = 25.0 Hz), 112.4 (t, *J* = 247.2 Hz), 63.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.1.



Ethyl-4-(3-chlorophenyl)-2,2-difluorobut-3-enoate (**3p**, ***E/Z*** = 76:24)

The procedure was operated with the general procedure. The product **3p** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (60%, 23.4 mg). This compound is known.[1]

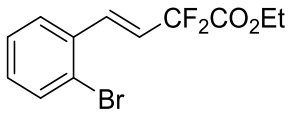
^{1}H NMR (400 MHz, $CDCl_3$): 7.43 (s, 1H), 7.33-7.27 (m, 3H), 7.00 (dt, *J* = 16.0, 2.4 Hz, 1H), 6.30 (dt, *J* = 16.2, 11.3 Hz, 1H), 4.36 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.6 (t, *J* = 34.3 Hz), 135.8, 135.4 (t, *J* = 9.4 Hz), 134.8, 130.0, 129.5, 127.2, 125.5, 120.3 (t, *J* = 24.8 Hz), 112.3 (t, *J* = 247.6 Hz), 63.2, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.5.



Ethyl-4-(4-bromophenyl)-2,2-difluorobut-3-enoate (**3q**, ***E/Z*** = 88:12)

The procedure was operated with the general procedure. The product **3q** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (67%, 30.7 mg). This compound is known.[1]

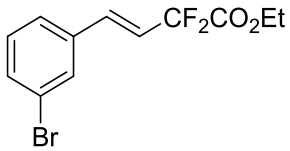
^{1}H NMR (400 MHz, $CDCl_3$): 7.48 (d, *J* = 8.4 Hz, 2H), 7.29 (d, *J* = 8.8 Hz, 2H), 7.02 (dt, *J* = 16.4, 2.4 Hz, 1H), 6.29 (dt, *J* = 16.2, 11.3 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.35 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.6 (t, *J* = 34.5 Hz), 135.5 (t, *J* = 10.0 Hz), 132.9, 131.9, 128.8, 123.7, 119.5 (t, *J* = 25.0 Hz), 112.4 (t, *J* = 247.3 Hz), 63.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.3.



Ethyl-4-(2-bromophenyl)-2,2-difluorobut-3-enoate (**3r**, ***E/Z*** = 82:18)

The procedure was operated with the general procedure. The product 3r was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (60%, 27.4 mg). This compound is known.[2]

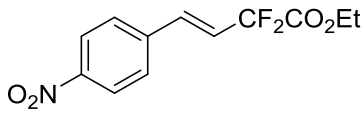
^{1}H NMR (400 MHz, $CDCl_3$): 7.58 (d, *J* = 8.0 Hz, 1H), 7.52 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.47 (dt, *J* = 16.2, 2.4 Hz, 1H), 7.33-7.29 (m, 1H), 7.22-7.18 (m, 1H), 6.28 (dt, *J* = 16.1, 11.0 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.37 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.5 (t, *J* = 34.2 Hz), 135.7 (t, *J* = 9.6 Hz), 133.2, 130.7, 127.7, 127.4, 124.5, 121.6 (t, *J* = 25.0 Hz), 112.3 (t, *J* = 247.1 Hz), 63.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.0.



Ethyl-4-(3-bromophenyl)-2,2-difluorobut-3-enoate (**3s**, ***E/Z*** = 80:20)

The procedure was operated with the general procedure. The product **3s** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (65%, 29.7 mg).

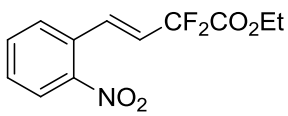
^{1}H NMR (400 MHz, $CDCl_3$): 7.59 (s, 1H), 7.46 (d, *J* = 8.9 Hz, 1H), 7.35 (d, *J* = 8.0 Hz, 1H), 7.27-7.21 (m, 1H), 7.02 (dt, *J* = 16.2, 2.3 Hz, 1H), 6.31 (dt, *J* = 16.2, 11.2 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.6 (t, *J* = 34.4 Hz), 136.1, 135.3 (t, *J* = 9.4 Hz), 132.4, 130.3, 130.1, 126.1, 122.9, 120.4 (t, *J* = 24.9 Hz), 112.3 (t, *J* = 247.4 Hz), 63.2, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.4. HRMS (ESI) (m/z): $[M+NH_4]^+$ calcd. for $C_{12}H_{11}BrF_2O_2$: 322.0249, found: 322.0253.



Ethyl-2,2-difluoro-4-(4-nitrophenyl)but-3-enoate (**3t**, ***E/Z*** = 85:15)

The procedure was operated with the general procedure. The product **3t** was purified with flash silica gel chromatography (PE/EA = 60:1) as a yellow solid (61%, 24.7 mg). This compound is known. [1]

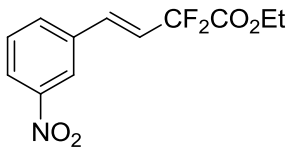
^{1}H NMR (400 MHz, $CDCl_3$): 8.23 (d, *J* = 8.8 Hz, 2H), 7.62 (d, *J* = 8.8 Hz, 2H), 7.14 (dt, *J* = 16.2, 2.4 Hz, 1H), 6.46 (dt, *J* = 16.2, 11.1 Hz, 1H), 4.36 (q, *J* = 7.1 Hz, 2H), 1.38 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.3 (t, *J* = 34.4 Hz), 148.2, 140.2, 134.5 (t, *J* = 9.2 Hz), 128.1, 124.1, 123.2 (t, *J* = 25.1 Hz), 112.0 (t, *J* = 248.0 Hz), 63.4, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.9.



Ethyl-2,2-difluoro-4-(2-nitrophenyl)but-3-enoate (**3u**, ***E/Z*** = 91:9)

The procedure was operated with the general procedure. The product **3u** was purified with flash silica gel chromatography (PE/EA = 60:1) as a yellow solid (56%, 22.7mg). This compound is known.[1]

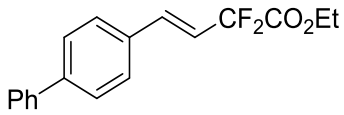
^{1}H NMR (400 MHz, $CDCl_3$): 8.04 (dd, *J* = 8.1, 1.0 Hz, 1H), 7.68-7.51 (m, 4H), 6.26 (dt, *J* = 16.0, 10.8 Hz, 1H), 4.37 (q, *J* = 7.1 Hz, 2H), 1.39 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.3 (t, *J* = 34.0 Hz), 147.9, 133.6, 133.2 (t, *J* = 10.0 Hz), 130.3, 129.9, 129.1, 124.9, 123.9 (t, *J* = 25.5 Hz), 112.0 (t, *J* = 247.5 Hz), 63.3, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -103.2.



Ethyl-2,2-difluoro-4-(3-nitrophenyl)but-3-enoate (**3v**, ***E/Z*** = 58:42)

The procedure was operated with the general procedure. The product **3v** was purified with flash silica gel chromatography (PE/EA = 60:1) as a yellow solid (42%, 17.0 mg).

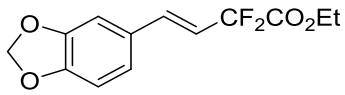
^{1}H NMR (400 MHz, $CDCl_3$): 8.32 (t, *J* = 1.7 Hz, 1H), 8.24-8.17 (m, 2H), 7.77 (d, *J* = 7.7 Hz, 1H), 7.60-7.56 (m, 1H), 7.15 (dt, *J* = 16.2, 2.5 Hz, 1H), 6.48 (dt, *J* = 16.0, 10.8 Hz, 1H), 4.36 (q, *J* = 7.1 Hz, 2H), 1.38 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.3 (t, *J* = 34.1 Hz), 163.1 (t, *J* = 33.3 Hz), 148.6, 136.0 (t, *J* = 7.5 Hz), 135.8, 134.7 (t, *J* = 3.0 Hz), 134.4 (t, *J* = 9.8 Hz), 133.1, 129.9, 129.1, 124.9, 124.1 (t, *J* = 26.2 Hz), 124.0, 123.7 (t, *J* = 3.0 Hz), 123.2, 122.1 (t, *J* = 25.0 Hz), 121.9, 112.1 (t, *J* = 247.8 Hz), 111.9 (t, *J* = 247.2 Hz), 63.3, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -103.7. HRMS (ESI) (m/z): $[M+K]^+$ calcd. for $C_{12}H_{11}F_2NO_4$: 310.0288, found: 310.0290.



Ethyl-2,2-difluoro-4-([1,1'-biphenyl]-4-yl)but-3-enoate (**3w**, ***E/Z*** = 99:1)

The procedure was operated with the general procedure. The product **3w** was purified with flash silica gel chromatography (PE/EA = 60:1) as a white solid (66%, 29.8 mg). This compound is known.[2]

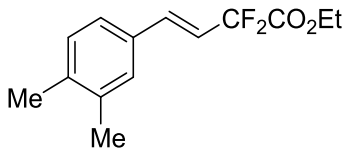
^{1}H NMR (400 MHz, $CDCl_3$): 7.55 (d, *J* = 8.3 Hz, 4H), 7.48 (d, *J* = 8.2 Hz, 2H), 7.41 (t, *J* = 7.3 Hz, 2H), 7.33 (t, *J* = 7.2 Hz, 1H), 7.08 (d, 16.2 Hz, 1H), 6.32 (dt, 16.1, 11.3 Hz, 1H), 4.32 (q, *J* = 7.1 Hz, 2H), 1.33 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.8 (t, *J* = 34.6 Hz), 142.3, 140.0, 136.3 (t, *J* = 9.4 Hz), 132.9, 128.8, 127.8, 127.6, 127.3, 126.9, 118.6 (t, *J* = 25.0 Hz), 112.7 (t, *J* = 246.9 Hz), 63.0, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -102.9.



Ethyl-2,2-difluoro-4-(benzo[d][1,3]dioxol-5-yl)but-3-enoate (**3x**, *E/Z* = 99:1)

The procedure was operated with the general procedure. The product **3x** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (78%, 31.5 mg). This compound is known.[1]

^{1}H NMR (400 MHz, $CDCl_3$): 6.99-6.94 (m, 2H), 6.89 (d, *J* = 8.0 Hz, 1H), 6.77 (d, *J* = 8.0 Hz, 1H), 6.12 (dt, *J* = 16.1, 11.4 Hz, 1H), 5.98 (s, 2H), 4.34 (q, *J* = 7.1 Hz, 2H), 1.35 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.9 (t, *J* = 34.7 Hz), 148.9, 148.2, 136.3 (t, *J* = 9.4 Hz), 128.4, 123.1, 116.7 (t, *J* = 24.8 Hz), 112.8 (t, *J* = 246.9 Hz), 108.3, 106.1, 101.4, 63.0, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -102.6.

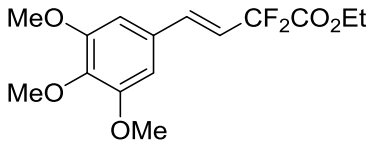


Ethyl-2,2-difluoro-4-(3,4-dimethylphenyl)but-3-enoate (**3y**, ***E/Z*** =99:1)

The procedure was operated with the general procedure. The product **3y** was purified with flash silica gel chromatography (PE/EA = 60:1) as a yellow clear liquid (82 %, 31.2 mg). This compound is known.[2]

^{1}H NMR (400 MHz, $CDCl_3$): 7.21 (s, 1H), 7.16 (d, *J* = 7.8 Hz, 1H), 7.10 (d, *J* = 7.7 Hz, 1H), 7.02 (dt, *J* = 16.1, 2.4 Hz, 1H), 6.23 (dt, *J* = 16.0, 11.4 Hz, 1H), 4.34 (q, *J* = 7.1 Hz, 2H), 2.25 (s, 6H), 1.35 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 164.0 (t, *J* = 35.0 Hz), 138.5, 137.0, 136.8 (t, *J* = 9.3 Hz), 131.7, 130.0, 128.5, 124.9,

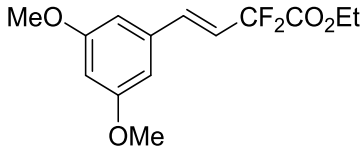
117.5 (t, J = 24.8 Hz), 112.8 (t, J = 247.1 Hz), 62.9, 19.64, 19.60, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -102.8.



Ethyl-2,2-difluoro-4-(3,4,5-trimethoxyphenyl)but-3-enoate (**3z**, ***E/Z*** =98:2)

The procedure was operated with the general procedure. The product **3z** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (75 %, 35.5 mg). This compound is known.[1]

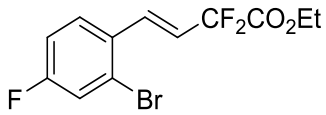
^{1}H NMR (400 MHz, $CDCl_3$): 7.02 (dt, J = 16.1, 2.4 Hz, 1H), 6.67 (s, 2H), 6.22 (dt, J = 16.0, 11.4 Hz, 1H), 4.35 (q, J = 7.1 Hz, 2H), 3.88 (s, 6H), 3.86 (s, 3H) 1.36 (t, J = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.8 (t, J = 34.7 Hz), 153.3, 139.4, 136.7 (t, J = 9.4 Hz), 129.5, 118.0 (t, J = 24.9 Hz), 112.6 (t, J = 247.1 Hz), 104.5, 63.0, 60.7, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -102.9.



Ethyl-2,2-difluoro-4-(3,5-dimethoxyphenyl)but-3-enoate (**3aa**, ***E/Z*** **=** 98:2)

The procedure was operated with the general procedure. The product **3aa** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (55 %, 23.5 mg).

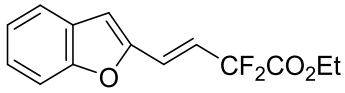
^{1}H NMR (400 MHz, $CDCl_3$): 7.01 (dt, J = 16.1, 2.4 Hz, 1H), 6.58 (d, J = 2.0 Hz, 2H), 6.46 (t, J = 2.0 Hz, 1H), 6.26 (dt, J = 16.1, 11.4 Hz, 1H), 4.34 (q, J = 7.1 Hz, 2H), 3.80 (s, 6H), 1.36 (t, J = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.8 (t, J = 34.5 Hz), 161.0, 136.8 (t, J = 9.3 Hz), 135.9, 119.3 (t, J = 24.8 Hz), 112.6 (t, J = 247.1 Hz), 105.4, 101.7, 63.1, 55.3, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.2. HRMS (ESI) (m/z): $[M+K]^+$ calcd. for $C_{14}H_{16}F_2O_4$: 325.0648, found: 325.0653.



Ethyl-2,2-difluoro-4-(2-bromo-4-fluorophenyl)but-3-enoate (**3ab**, ***E/Z*** = 80:20)

The procedure was operated with the general procedure. The product **3ab** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (62 %, 30.0 mg). This compound is known.[1]

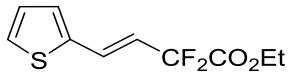
^{1}H NMR (400 MHz, $CDCl_3$): 7.53 (dd, *J* = 8.7, 5.8 Hz, 1H), 7.37 (dt, *J* = 16.0, 2.5 Hz, 1H), 7.33 (dd, *J* = 8.2, 2.6 Hz, 1H), 7.05 (td, *J* = 8.3, 2.5 Hz, 1H), 6.21 (dt, *J* = 16.1, 11.4 Hz, 1H), 4.36 (q, *J* = 7.1 Hz, 2H), 1.37 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.5 (t, *J* = 34.5 Hz), 161.4 (d, *J* = 242.3 Hz), 134.5 (t, *J* = 9.6 Hz), 130.5 (d, *J* = 3.8 Hz), 128.5 (d, *J* = 8.7 Hz), 124.6 (d, *J* = 9.5 Hz), 124.6 (d, *J* = 9.5 Hz), 121.5 (t, *J* = 25.4 Hz), 120.5 (d, *J* = 24.4 Hz), 115.0 (t, *J* = 21.5 Hz), 112.2 (t, *J* = 248.3 Hz), 63.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.0 (s, 2F), -109.0 (s. 1F).



Ethyl-2,2-difluoro-4-(benzofuran-2-yl) but-3-enoate (**3ac**, ***E/Z*** = 99:1)

The procedure was operated with the general procedure. The product **3ac** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (58%, 23.1 mg).

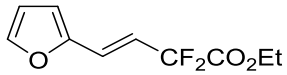
^{1}H NMR (400 MHz, $CDCl_3$): 7.55 (d, *J* = 7.7 Hz, 1H), 7.46 (d, *J* = 8.2 Hz, 1H), 7.35-7.31 (m, 1H), 7.22 (t, *J* = 8.2 Hz, 1H), 6.98 (dt, *J* = 15.8, 2.4 Hz, 1H), 6.81 (s, 1H), 6.51 (dt, *J* = 15.7, 12.0 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.37 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.6 (t, *J* = 34.6 Hz), 155.2, 151.6, 128.2, 126.0, 124.5 (t, *J* = 9.8 Hz), 123.2, 121.6, 119.8 (t, *J* = 25.0 Hz), 112.4 (t, *J* = 256.2 Hz), 111.2, 109.3, 63.2, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -103.7. HRMS (ESI) (m/z): $[M+K]^+$ calcd. for $C_{14}H_{12}F_2O_3$: 305.0386, found: 305.0390.



Ethyl-2,2-difluoro-4-(thiophen-2-yl)but-3-enoate (**3ad**, ***E/Z*** = 99:1)

The procedure was operated with the general procedure. The product **3ad** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (70%, 24.3 mg). This compound is known.[1]

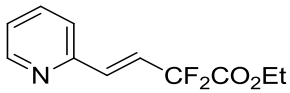
^{1}H NMR (400 MHz, $CDCl_3$): 7.31 (d, *J* = 4.9 Hz, 1H), 7.20-7.14 (m, 2H), 7.01 (dd, *J* = 4.8, 3.6 Hz, 1H), 6.12 (dt, *J* = 15.8, 11.5 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.7 (t, *J* = 34.7 Hz), 138.8, 129.7 (t, *J* = 10.0 Hz), 129.3, 127.7, 127.2, 117.5 (t, *J* = 25.1 Hz), 112.4 (t, *J* = 247.1 Hz), 63.1, 13.9. ^{19}F NMR (376 MHz, $CDCl_3$): -102.8.



Ethyl-2,2-difluoro-4-(furan-2-yl)but-3-enoate (**3ae**, ***E/Z*** = 99:1)

The procedure was operated with the general procedure. The product **3ae** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (52%, 16.5 mg). This compound is known.[1]

^{1}H NMR (400 MHz, $CDCl_3$): 7.43 (s, 1H), 6.87 (dt, *J* = 15.9, 2.5 Hz, 1H), 6.48 (d, *J* = 3.2 Hz, 1H), 6.42 (dd, *J* = 3.3, 1.8 Hz, 1H), 6.22 (dt, *J* = 15.8, 12.0 Hz, 1H), 4.32 (q, *J* = 7.1 Hz, 2H), 1.35 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.7 (t, *J* = 34.6 Hz), 150.1, 143.9, 124.1 (t, *J* = 10.1 Hz), 116.6 (t, J = 25.0 Hz), 112.7, 112.6 (t, *J* = 246.9 Hz), 111.8, 63.0, 13.8. ^{19}F NMR (376 MHz, $CDCl_3$): -103.4.



Ethyl -2,2-difluoro-4-(pyridin-2-yl)but-3-enoate (**3af**, ***E/Z*** = 95:5)

The procedure was operated with the general procedure. The product **3af** was purified with flash silica gel chromatography (PE/EA = 60:1) as a colorless clear liquid (15%, 5.1 mg). This compound is known.[2]

^{1}H NMR (400 MHz, $CDCl_3$): 8.62 (d, *J* = 4.2 Hz, 1H), 7.70 (td, *J* = 7.6, 1.7 Hz, 1H),

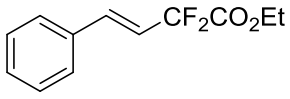
7.32 (d, *J* = 7.7 Hz, 1H), 7.26-7.23 (m, 1H), 7.14 (dt, *J* = 15.8, 2.3 Hz, 1H), 6.22 (dt, *J* = 15.8, 11.8 Hz, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): 163.5 (t, *J* = 34.3 Hz), 152.2, 149.8, 136.7, 135.8 (t, *J* = 9.2 Hz), 123.8, 123.5, 122.9 (*J* = 24.8 Hz), 112.6 (t, *J* = 246.8 Hz), 63.0, 13.7. ^{19}F NMR (376 MHz, $CDCl_3$): -103.8.

References:

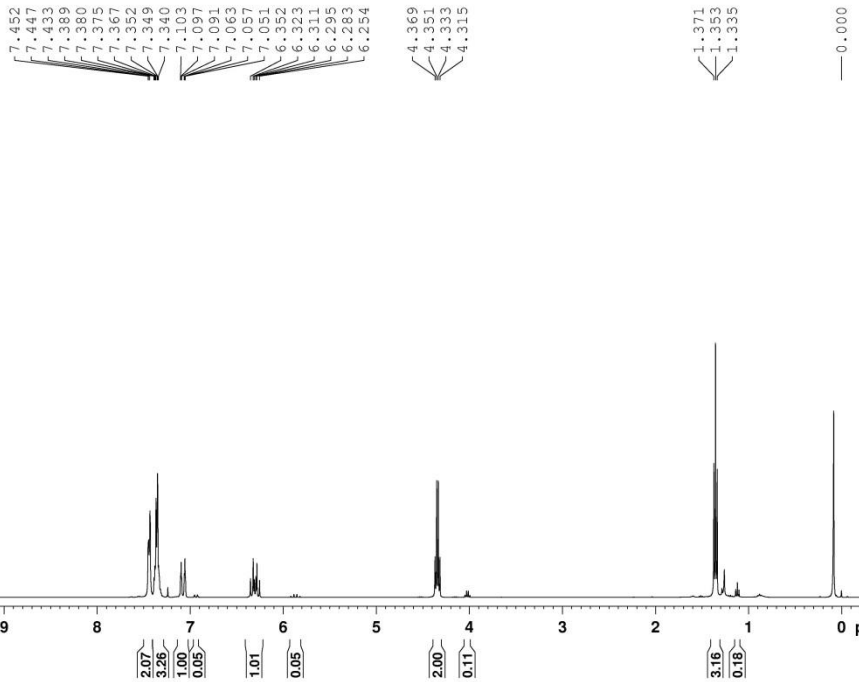
1) Li, G.; Wang, T.; Fei, F.; Su, Y. M.; Li, Y.; Lan, Q.; Wang, X. S. *Angew. Chem., Int. Ed.* **2016**, *55*, 3491-3495.

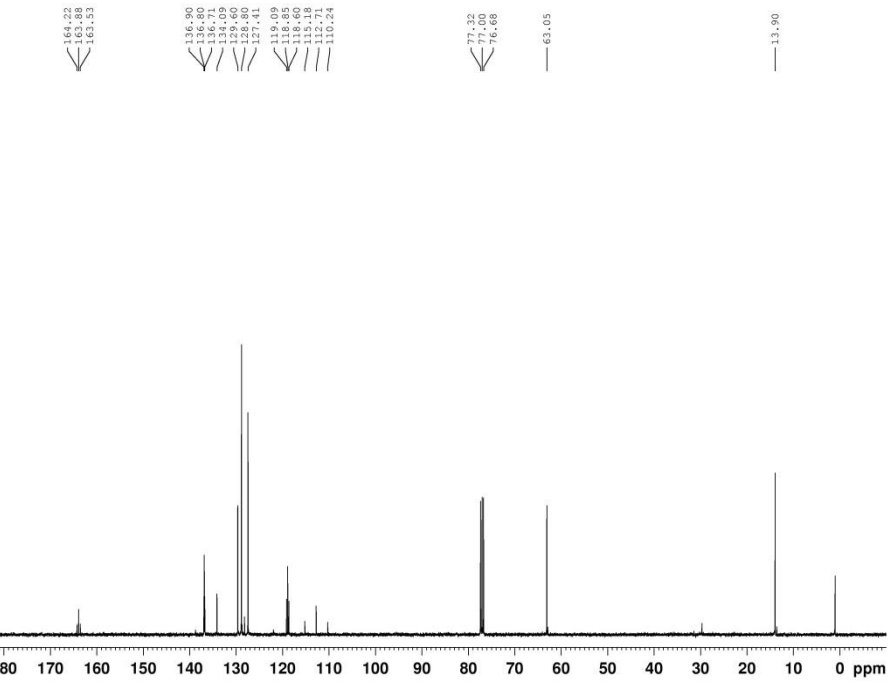
2) Ke, M.; Feng, Q.; Yang, K.; Song, Q. *Org. Chem. Front.* **2016,** *3*, 150-155.

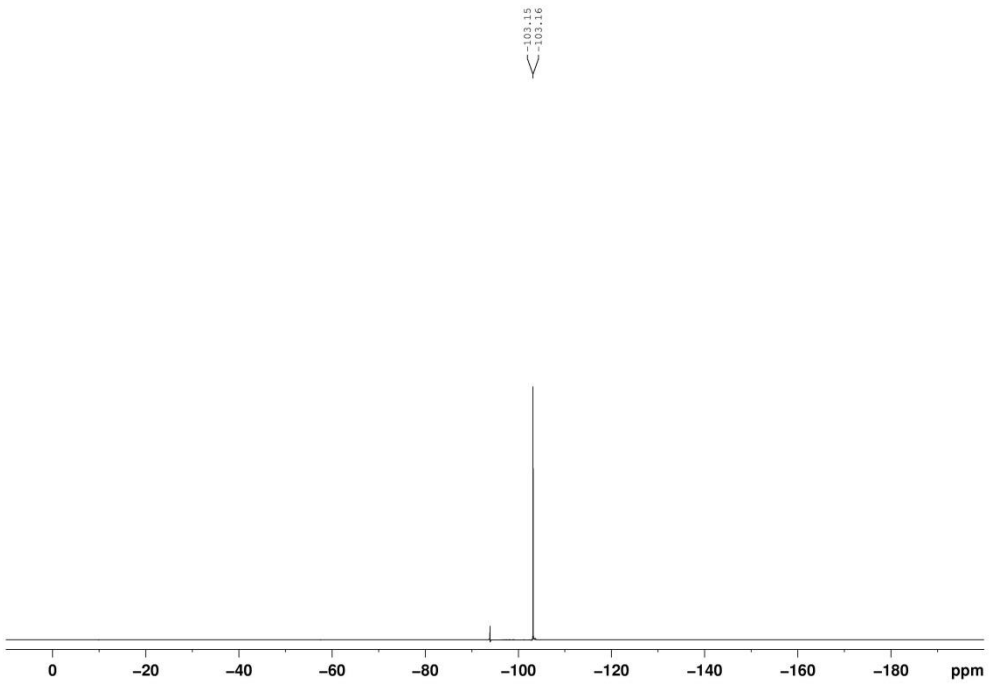
^{1}H NMR and ^{13}C NMR Spectra of the Products



3a



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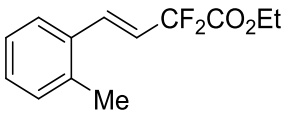
-120
-140
-160
-180
ppm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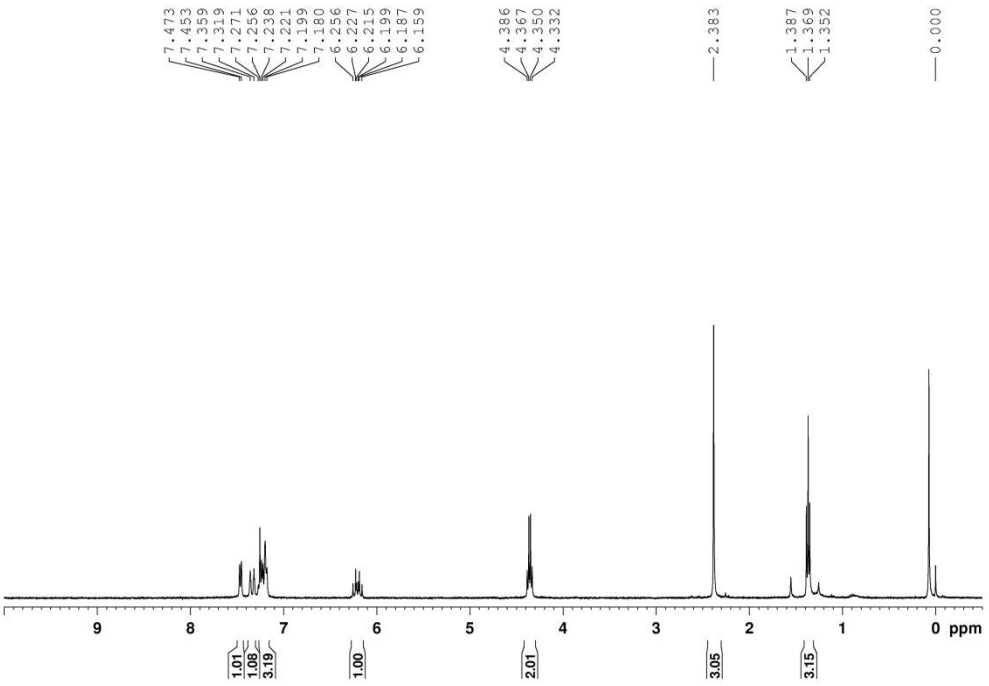
Me

3b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7.221
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6.215
6.199
6.187
6.159
4.386
4.367
4.350
4.332
2.383
1.387
1.369
1.352
0.000
9
8
7
6
5
4
3
2
1
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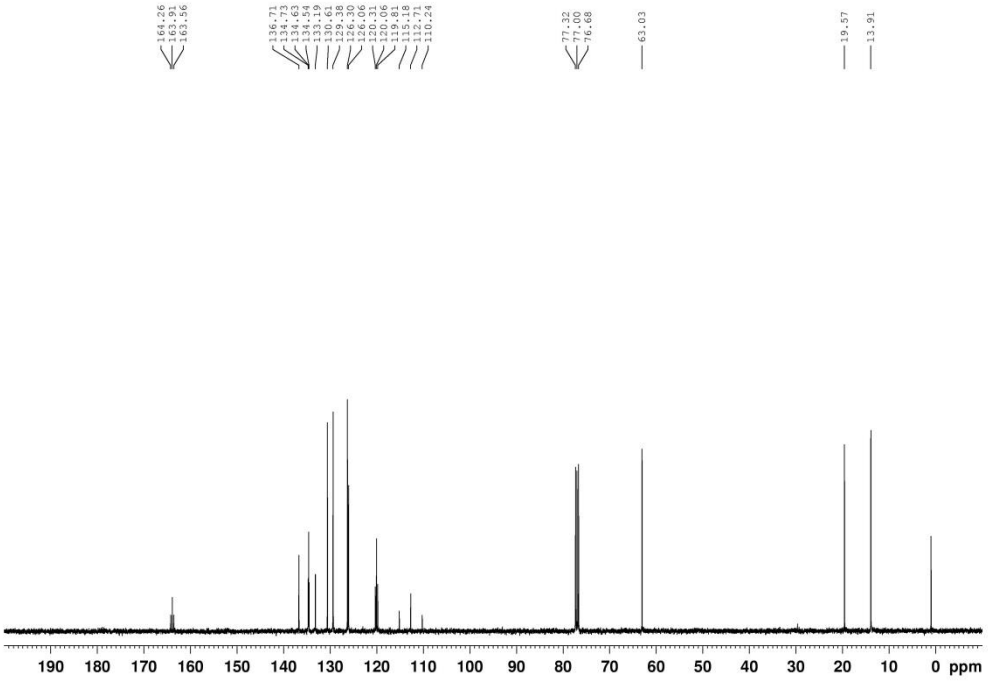
3.19
1.00
2.01
3.05
3.15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163.91
163.56
136.71
134.73
134.63
134.54
132.19
130.61
129.38
126.30
126.06
120.31
120.06
119.81
115.18
112.71
110.24
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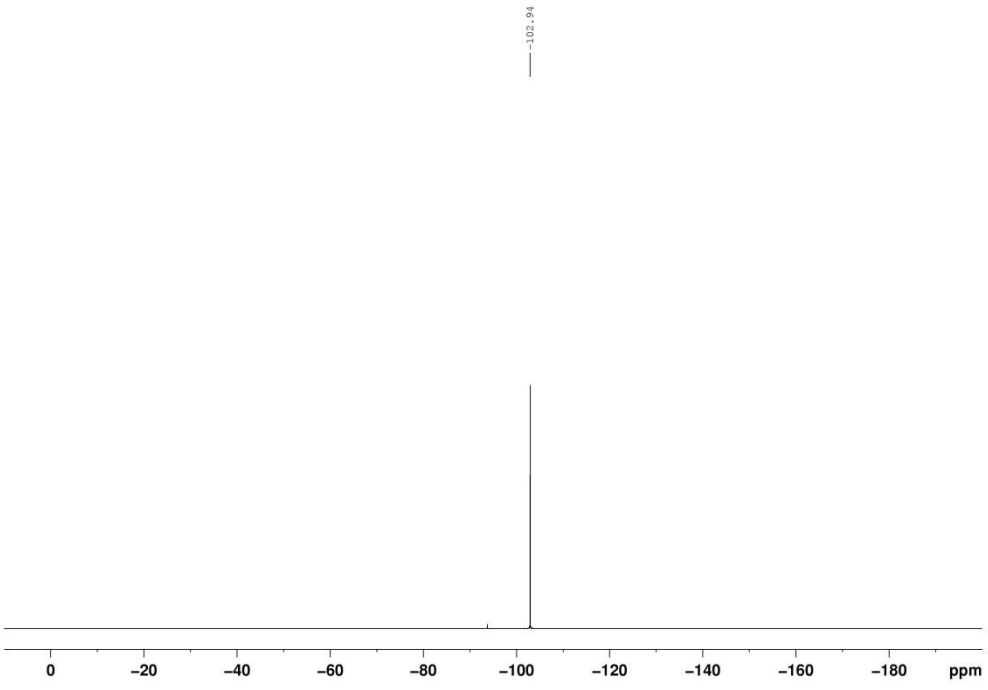
77.00
76.68
63.03
19.57
13.91
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm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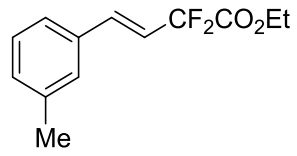
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm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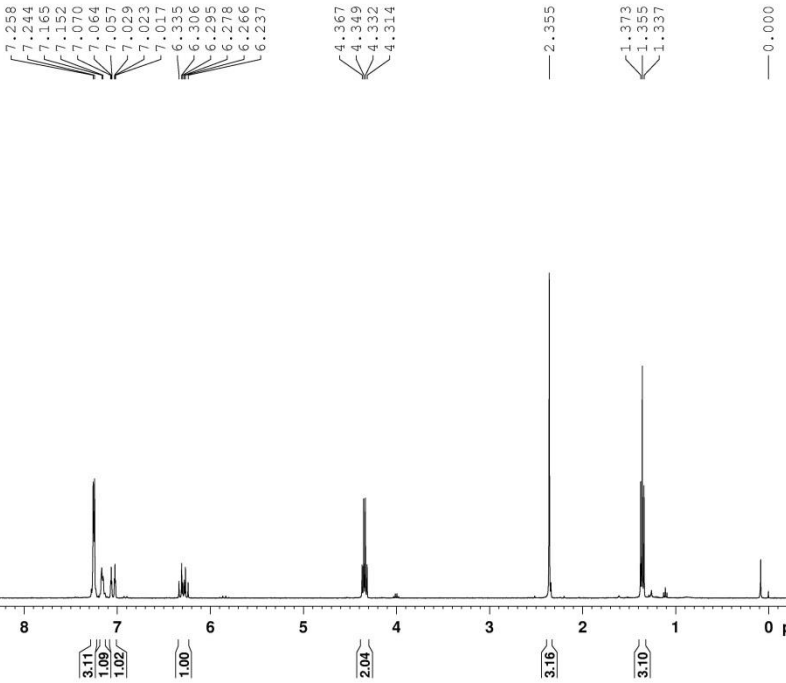
Me

3c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6.278
6.266
6.237
4.367
4.349
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4.314
2.355
1.373
1.355
1.337
0.000
9
8
7
6
5
4
3
2
1
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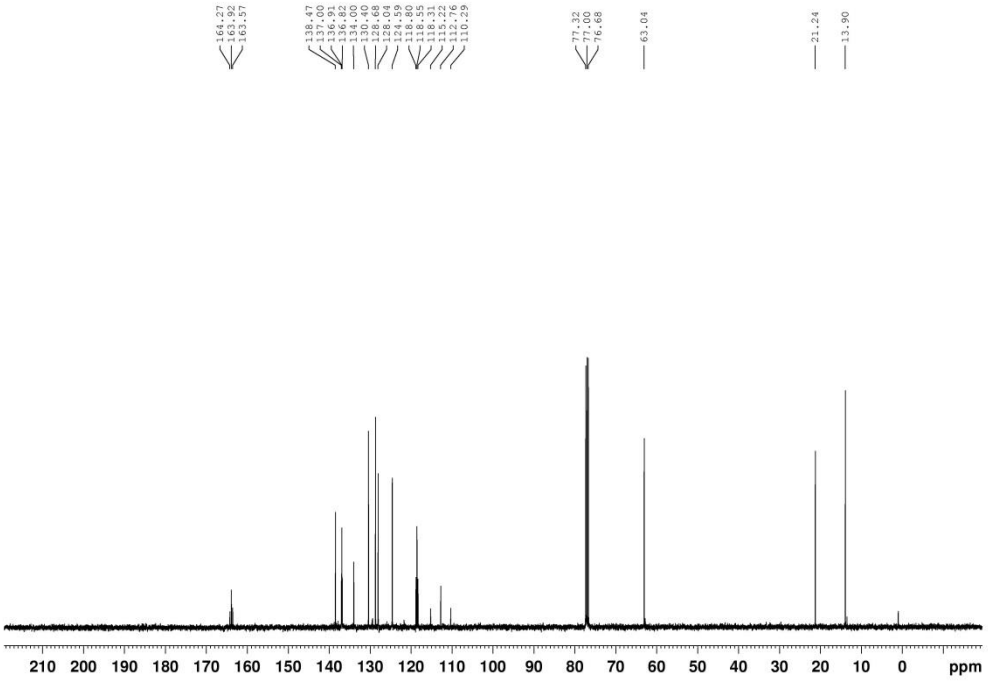
3.16
3.10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134.00
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128.68
128.04
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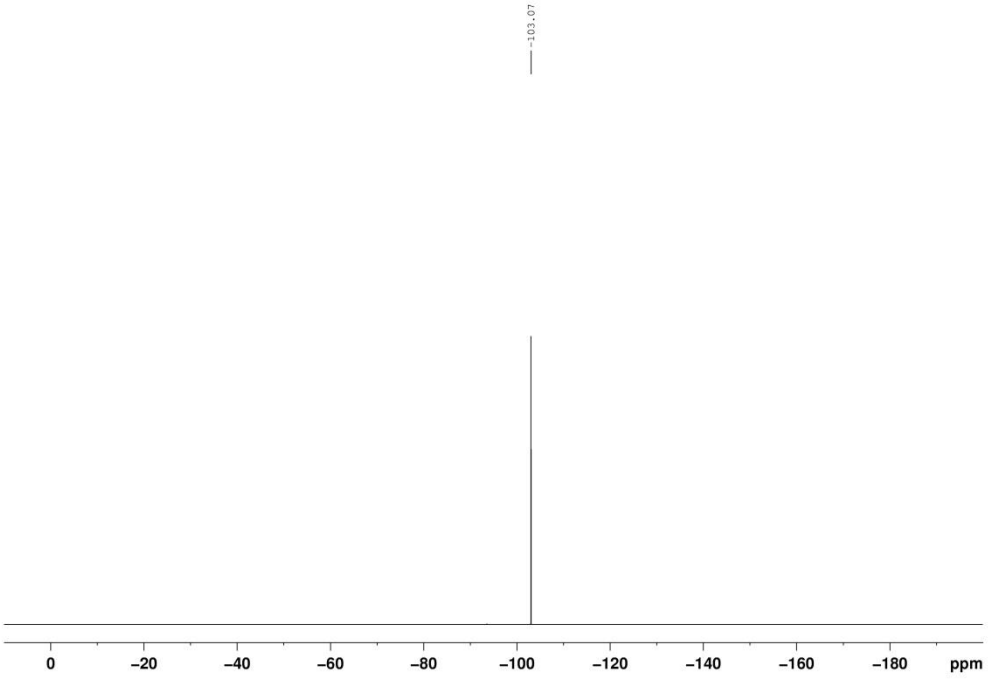
118.80
118.55
118.31
115.22
112.76
110.29
77.32
77.00
76.68
63.04
21.24
13.90
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm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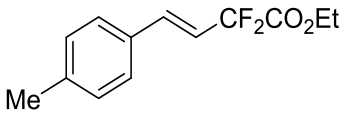
-180
ppm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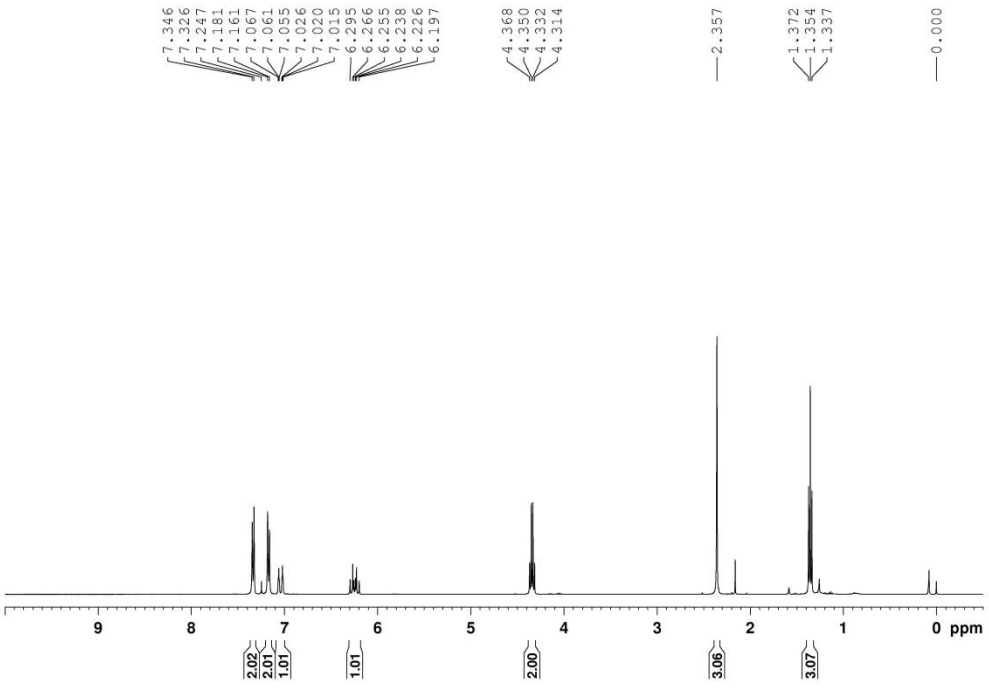
Me

3d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6.255
6.238
6.226
6.197
4.368
4.350
4.332
4.314
2.357
1.372
1.354
1.337
0.000
9
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6
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3
2
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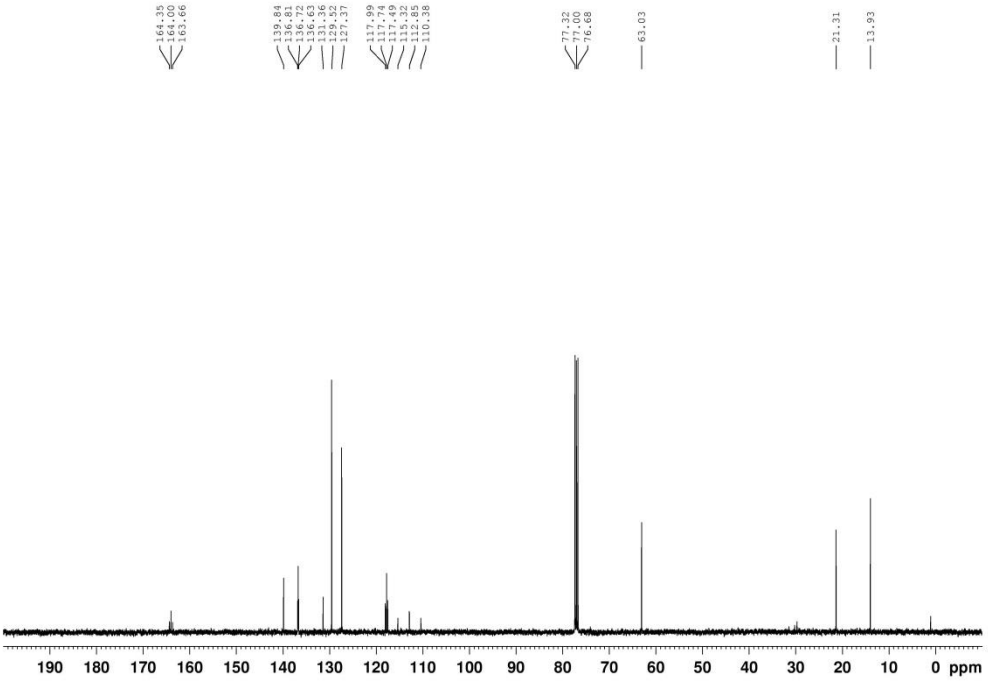
3.07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131.36
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127.37
117.99
117.74
117.49
115.32
115.05
110.38
77.32
77.00
76.68
63.03
21.31
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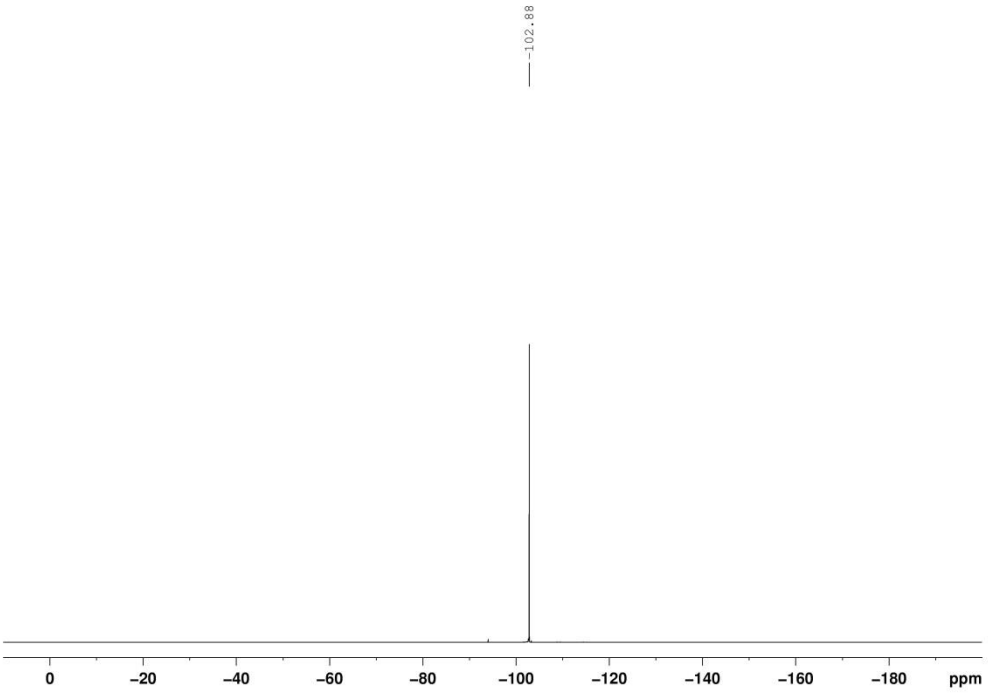
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm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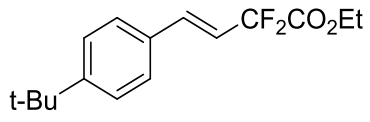
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm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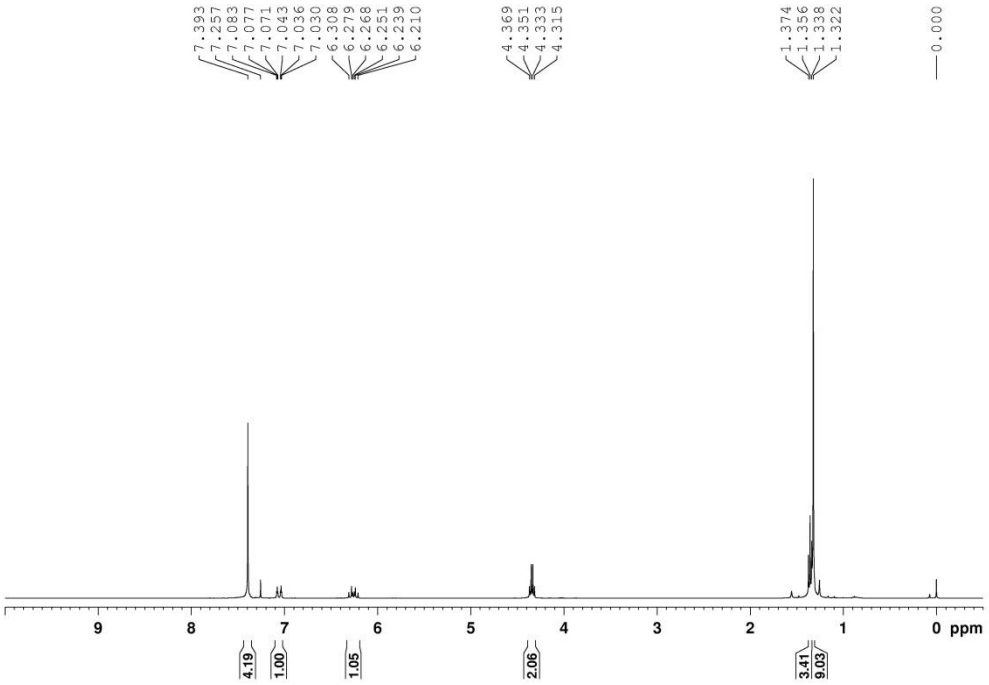
t-Bu

3e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4.333
4.315
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1.356
1.338
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5
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3
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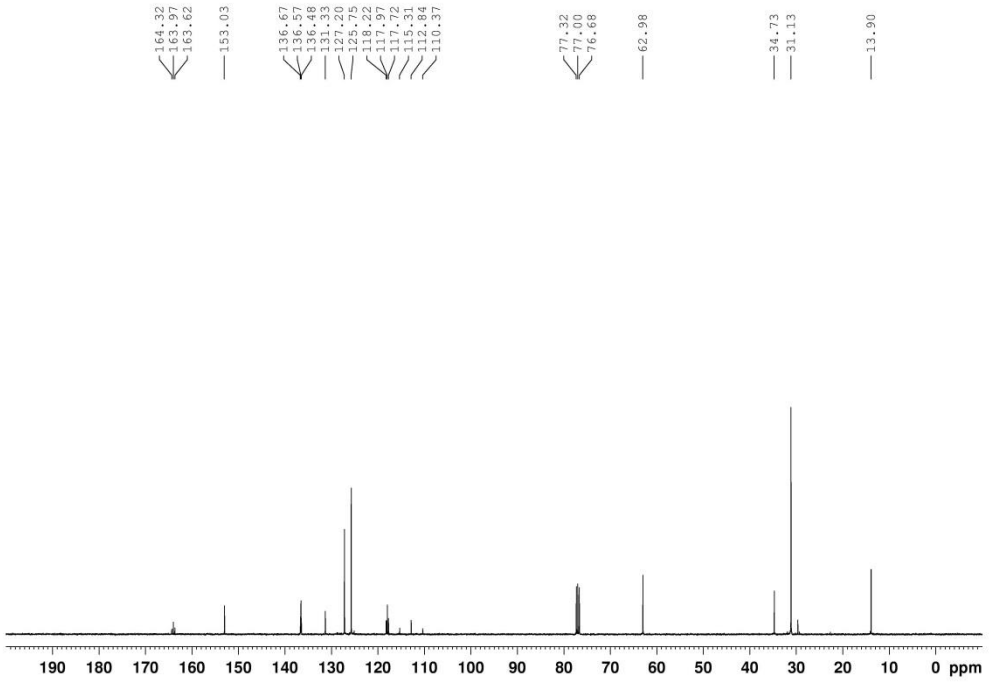
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115.31
112.84
110.37
77.32
77.00
76.68
62.98
34.73
31.13
13.90
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150
140
130
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80
70
60
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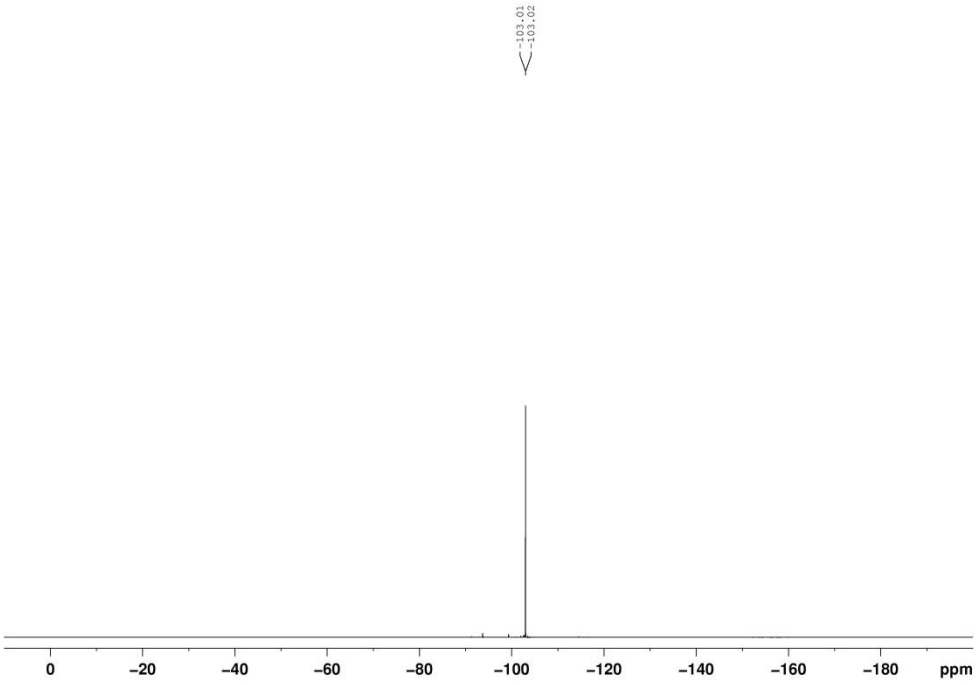
40
30
20
10
0 ppm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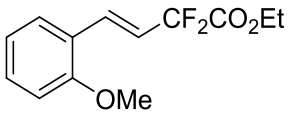
-120
-140
-160
-180
ppm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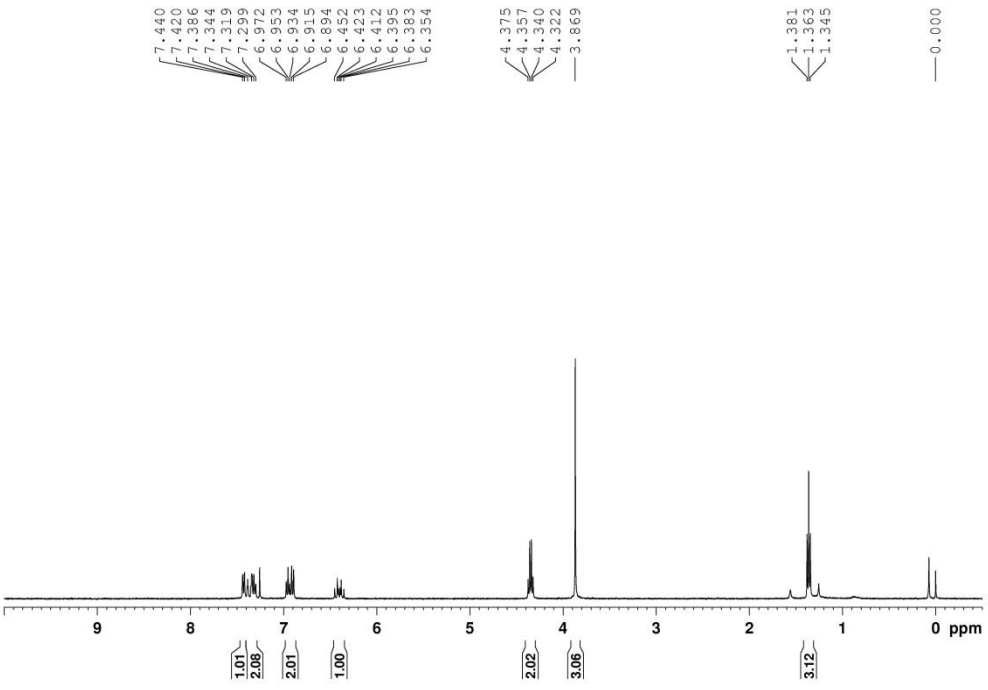
OMe

3f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6.412
6.395
6.383
6.354
4.375
4.357
4.340
4.322
3.869
1.381
1.363
1.345
0.000
9
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7
6
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3
2
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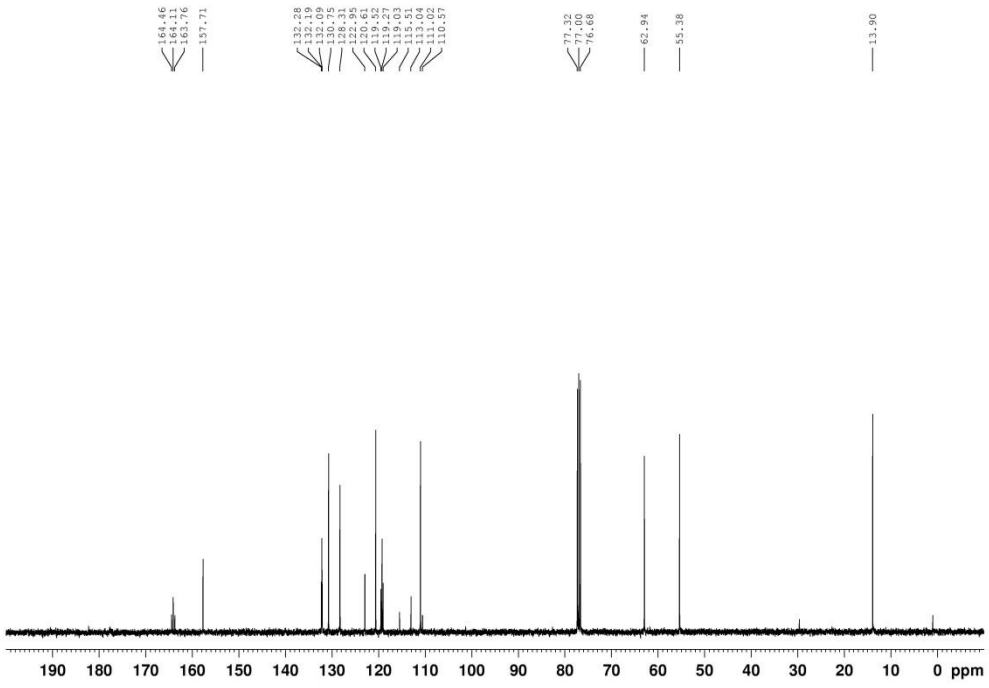
3.12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119.27
119.03
115.51
113.04
111.02
110.57
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77.00
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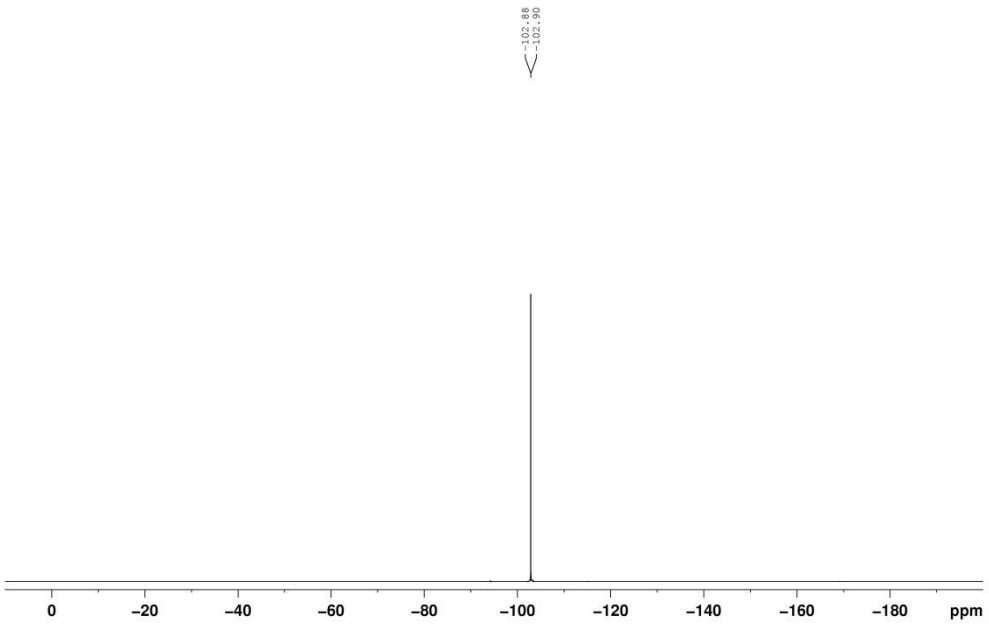
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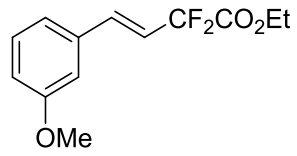
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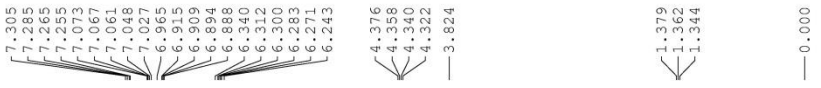
OMe

3g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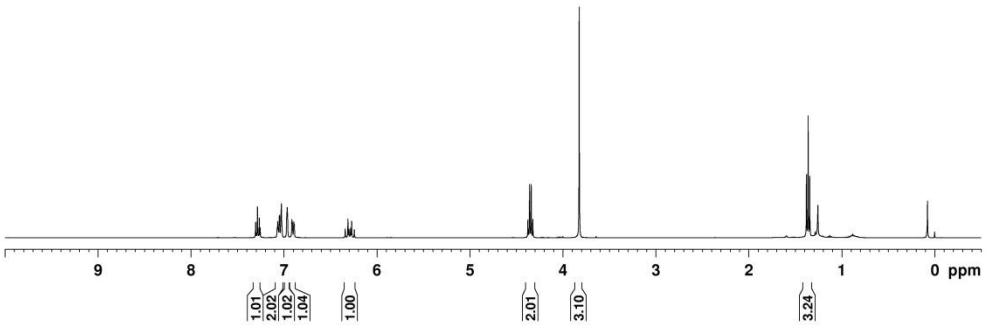
9
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7
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5
4
3
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2.02
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1.04
1.00
2.01
3.10
3.24


164.22
163.87
163.53
159.90
136.85
136.75
136.66
135.47
129.83
120.03
119.38
119.13
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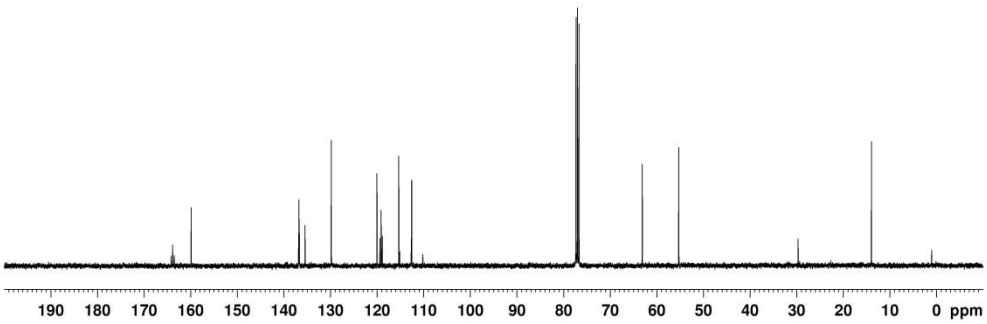
63.10
55.27
13.92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30
20
10
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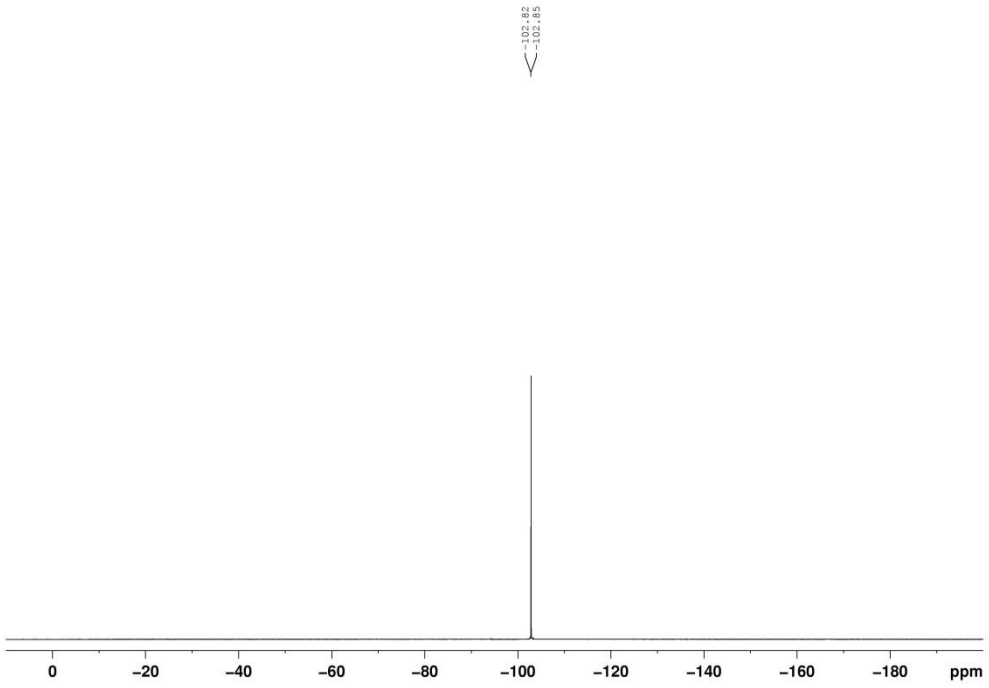
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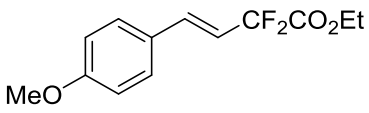
ppm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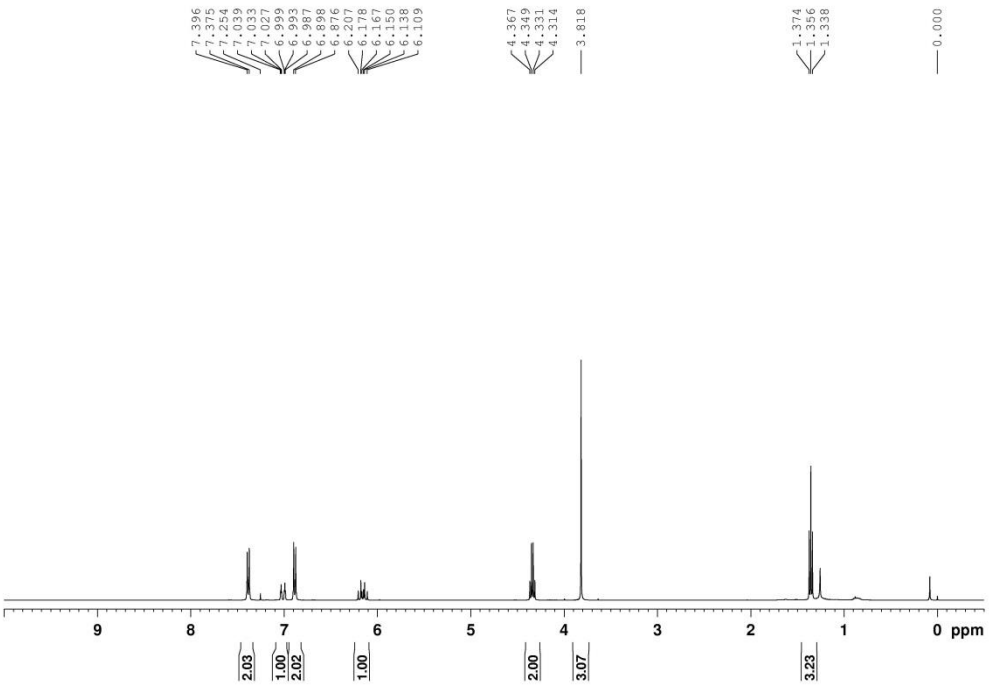
MeO

3h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6.167
6.150
6.138
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4.367
4.349
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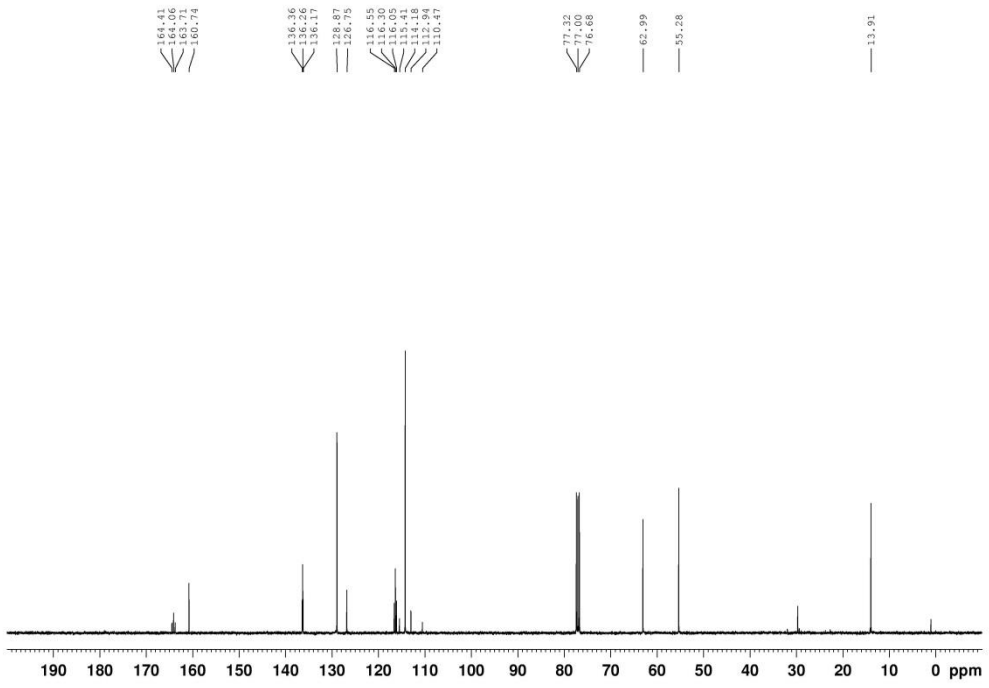
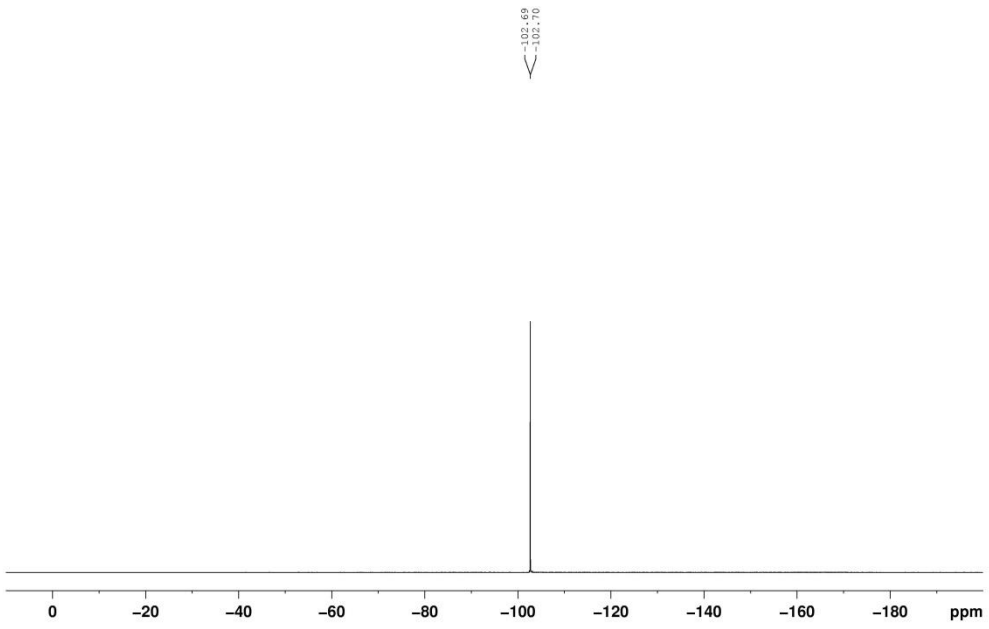
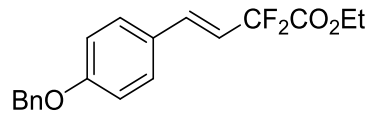
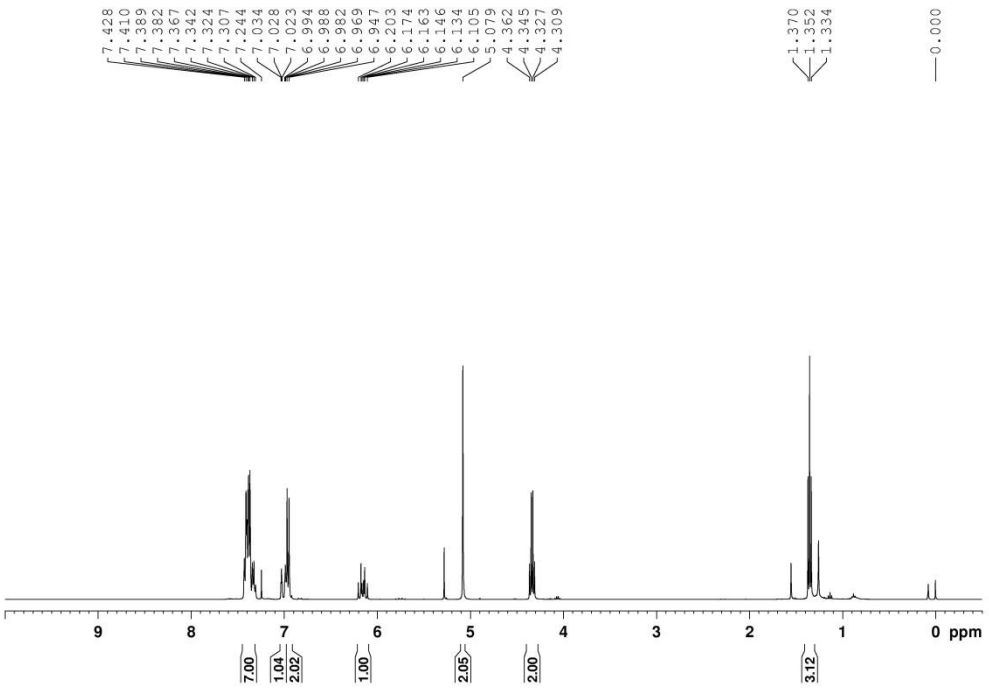
3.818
1.374
1.356
1.338
0.000
9
8
7
6
5
4
3
2
1
0 ppm
2.03
1.00
2.02
1.00
2.00
3.07
3.23

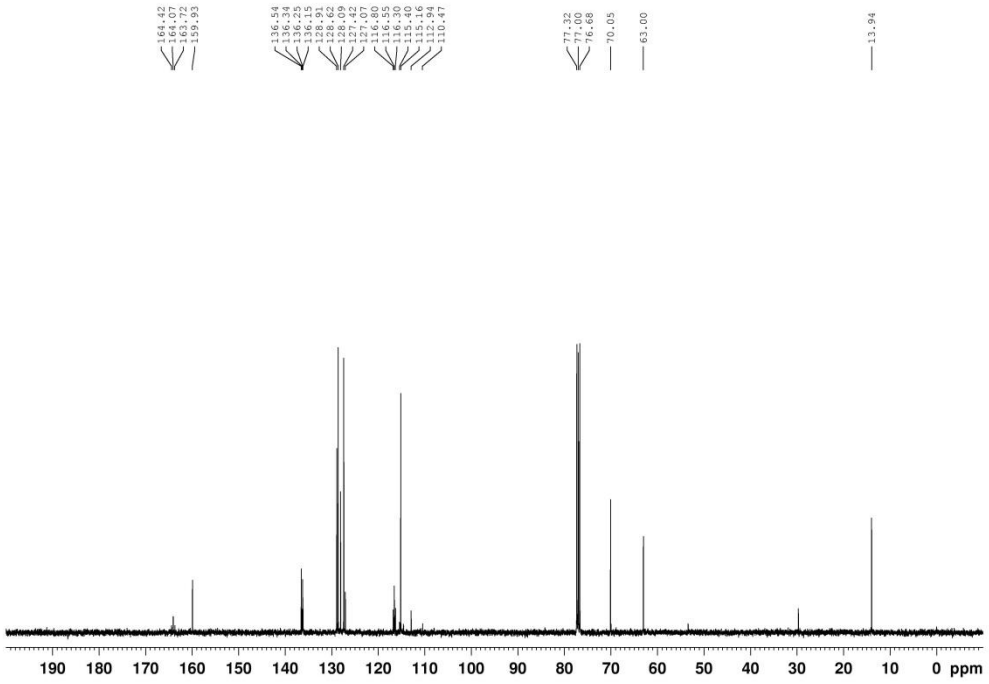

164.41
164.06
163.71
160.74
136.36
136.26
136.17
128.87
126.75
116.55
116.30
116.05
115.41
114.18
112.94
110.47
77.32
77.00
76.68
62.99
55.28
13.91
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

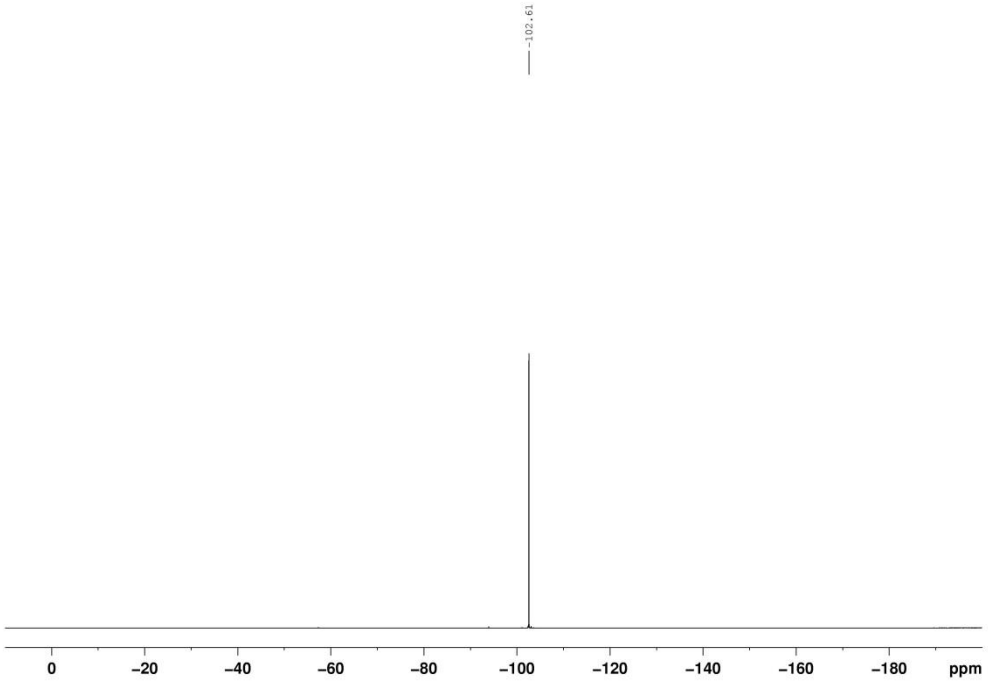

-102.69
-102.70
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm

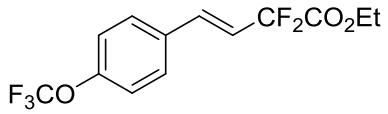

CF2CO2Et
BnO

3i

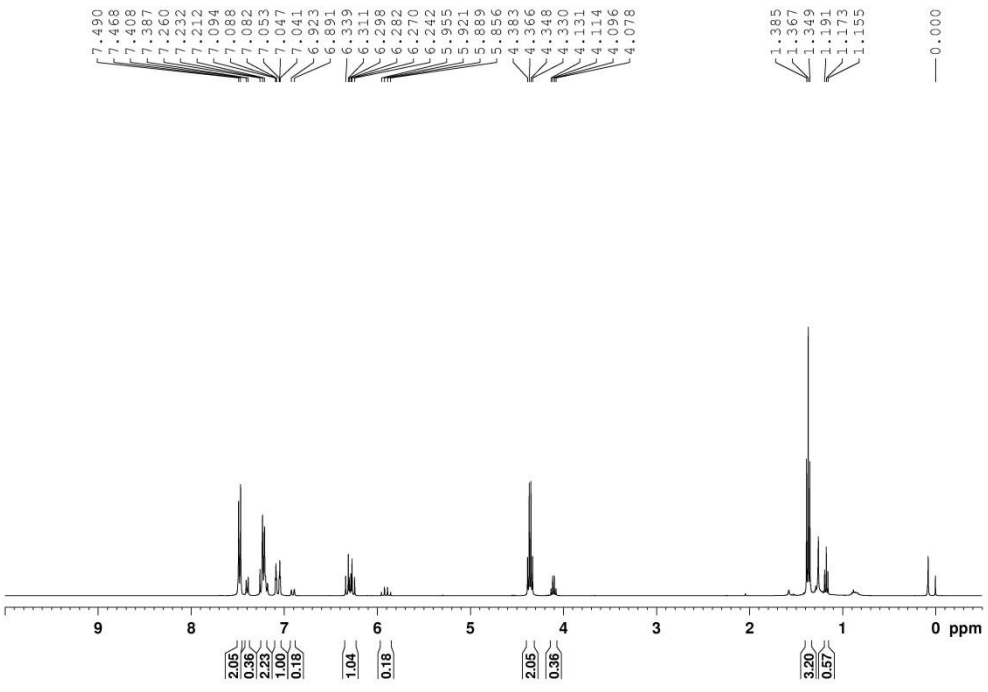

7.428
7.410
7.389
7.382
7.367
7.342
7.324
7.307
7.244
7.034
7.028
7.023
6.994
6.988
6.982
6.969
6.947
6.203
6.174
6.163
6.146
6.134
6.105
5.079
4.362
4.345
4.327
4.309
1.370
1.352
1.334
0.000
9
8
7
6
5
4
3
2
1
0 ppm
7.00
1.04
2.02
1.00
2.05
2.00
3.12

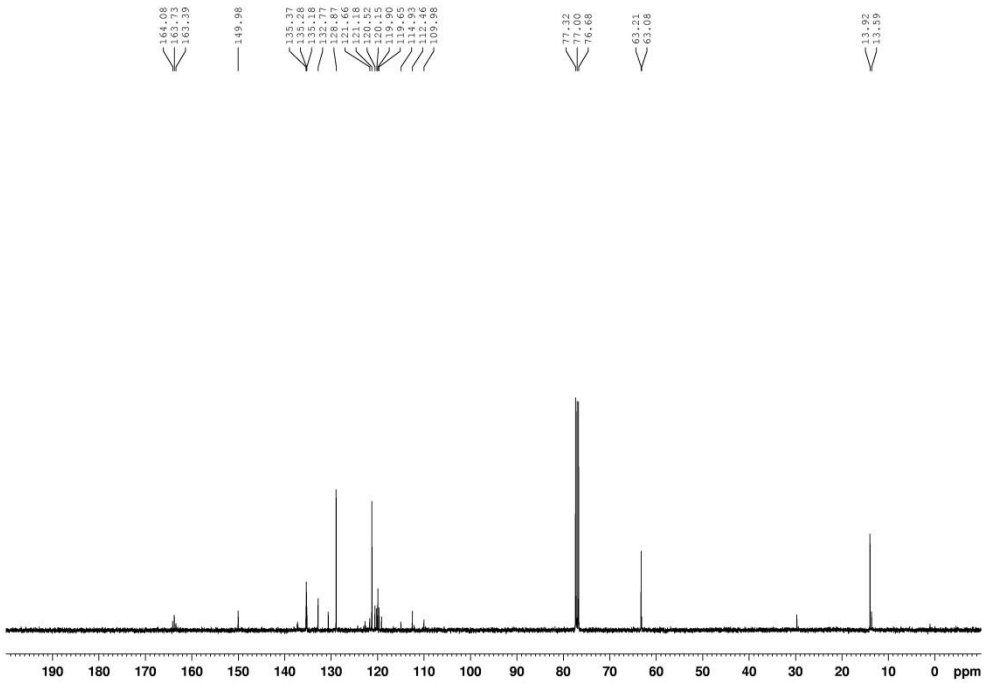

164.42
164.07
163.72
159.93
136.54
136.34
136.25
136.15
128.91
128.62
128.09
127.42
127.07
116.80
116.55
116.30
115.40
115.16
112.94
110.47
77.32
77.00
76.68
70.05
63.00
13.94
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm

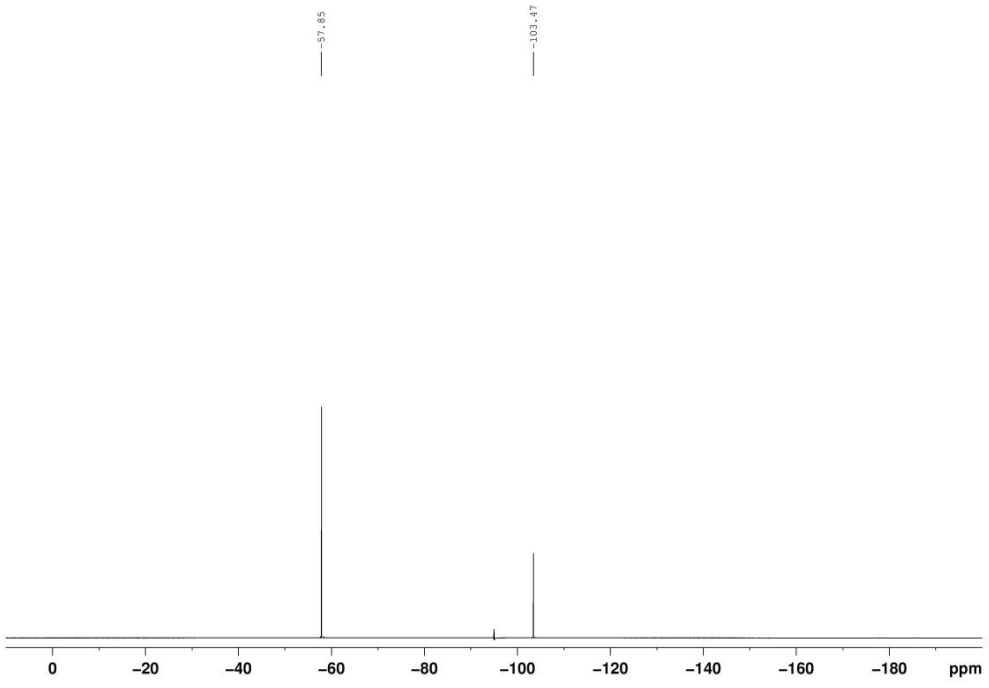

-102.61
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

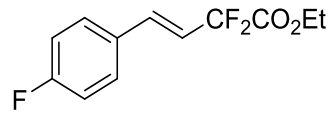

CF2CO2Et
F3CO

3j

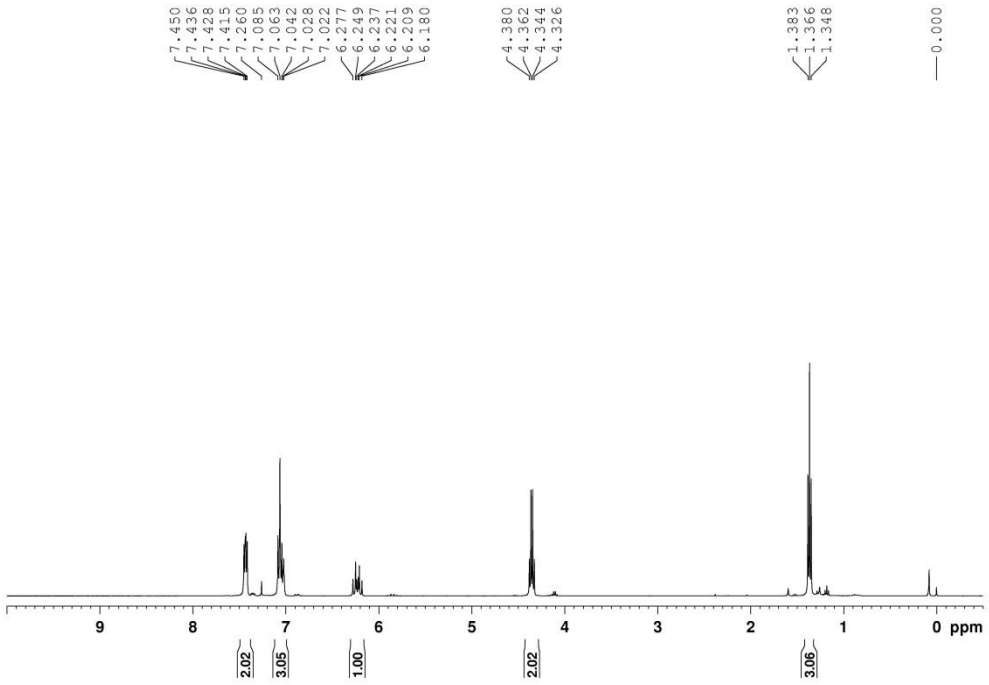

7.490
7.468
7.408
7.387
7.260
7.232
7.212
7.094
7.088
7.082
7.053
7.047
7.041
6.923
6.891
6.339
6.311
6.298
6.282
6.270
6.242
5.955
5.921
5.889
5.856
4.383
4.366
4.348
4.330
4.131
4.114
4.096
4.078
1.385
1.367
1.349
1.191
1.173
1.155
0.000
9
8
7
6
5
4
3
2
1
0 ppm
2.05
0.36
2.23
1.00
0.18
1.04
0.18
2.05
0.36
3.20
0.57


164.08
160.73
163.39
149.98
135.37
135.28
135.18
132.77
128.87
121.66
121.18
120.52
120.15
119.90
119.65
114.93
112.46
109.98
77.32
77.00
76.68
63.21
63.08
13.92
13.59
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-57.85
-103.47
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


CF2CO2Et
F

3k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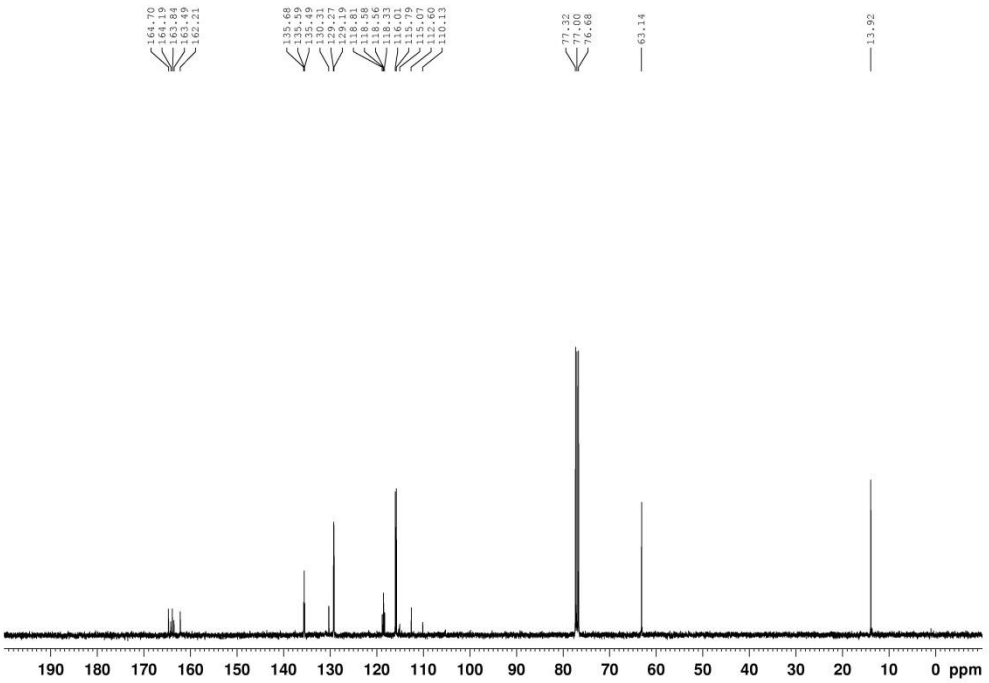
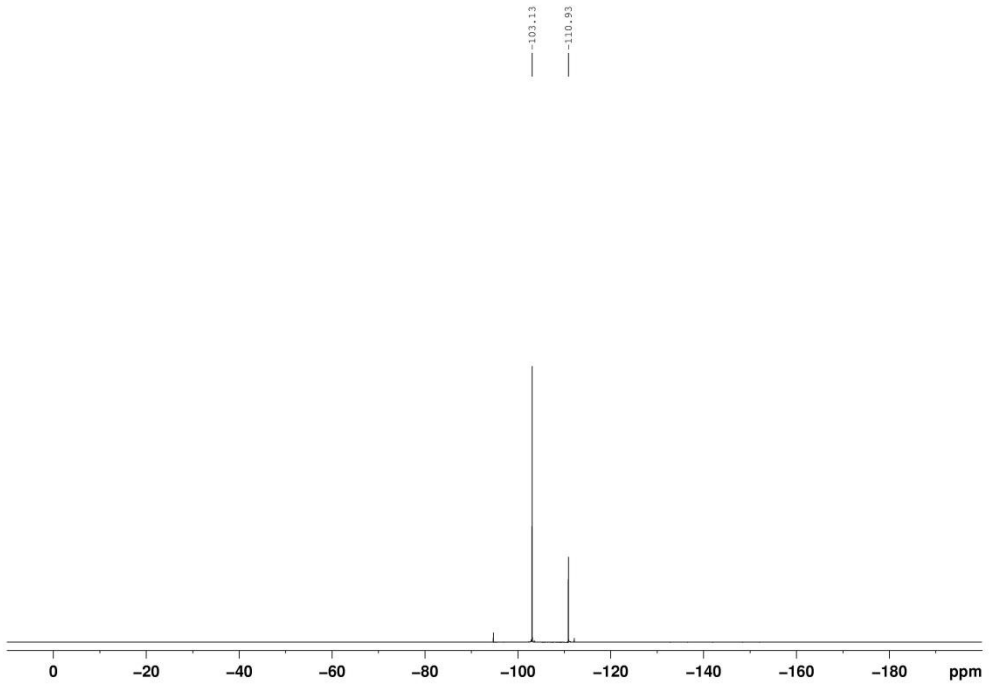
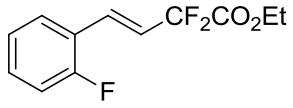
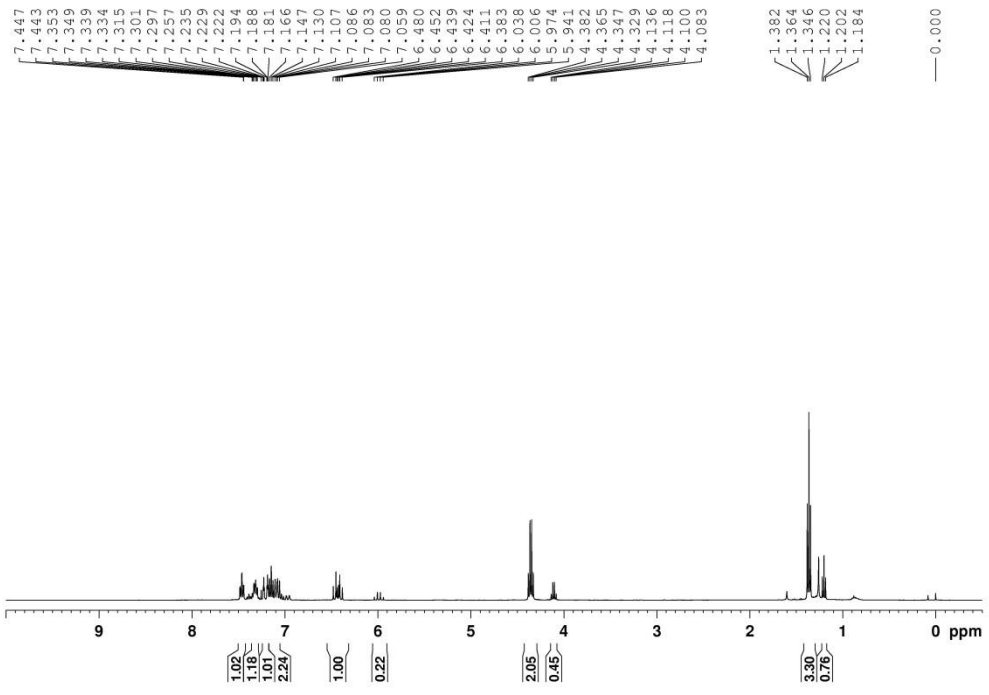
7.436
7.428
7.415
7.260
7.085
7.063
7.042
7.028
7.022
6.277
6.249
6.237
6.221
6.209
6.180
4.380
4.362
4.344
4.326
1.383
1.366
1.348
0.000
9
8
7
6
5
4
3
2
1
0 ppm
2.02
3.05
1.00
2.02
3.06

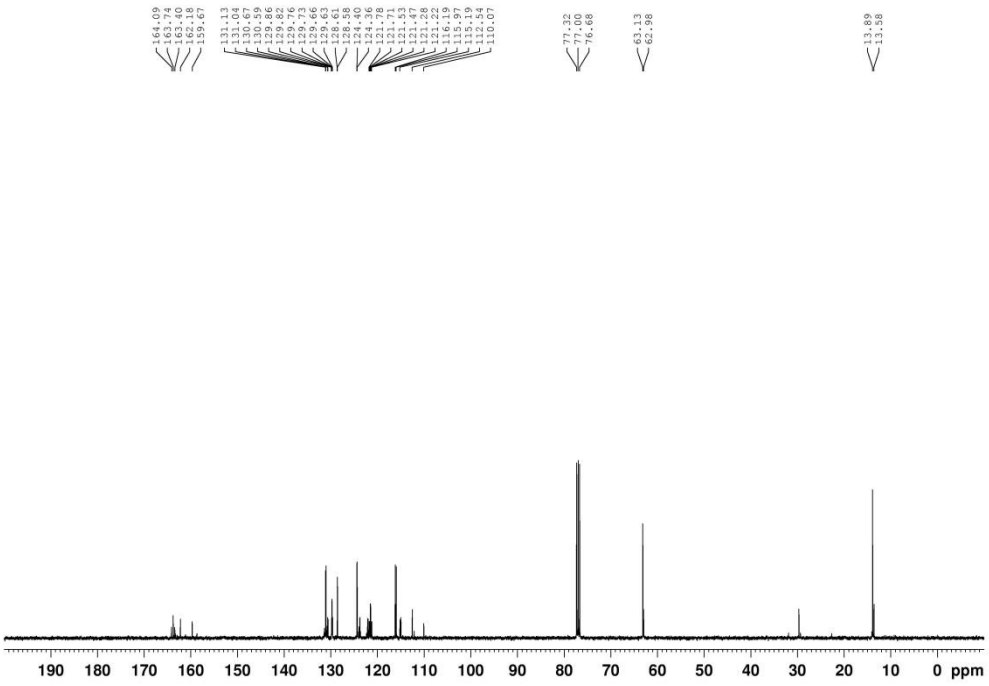

164.70
164.19
163.84
163.49
162.21
135.68
135.59
135.49
130.31
129.77
129.49
118.81
118.58
118.56
118.33
116.01
115.79
115.07
112.60
110.13
77.32
77.00
76.68
63.14
13.92
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm

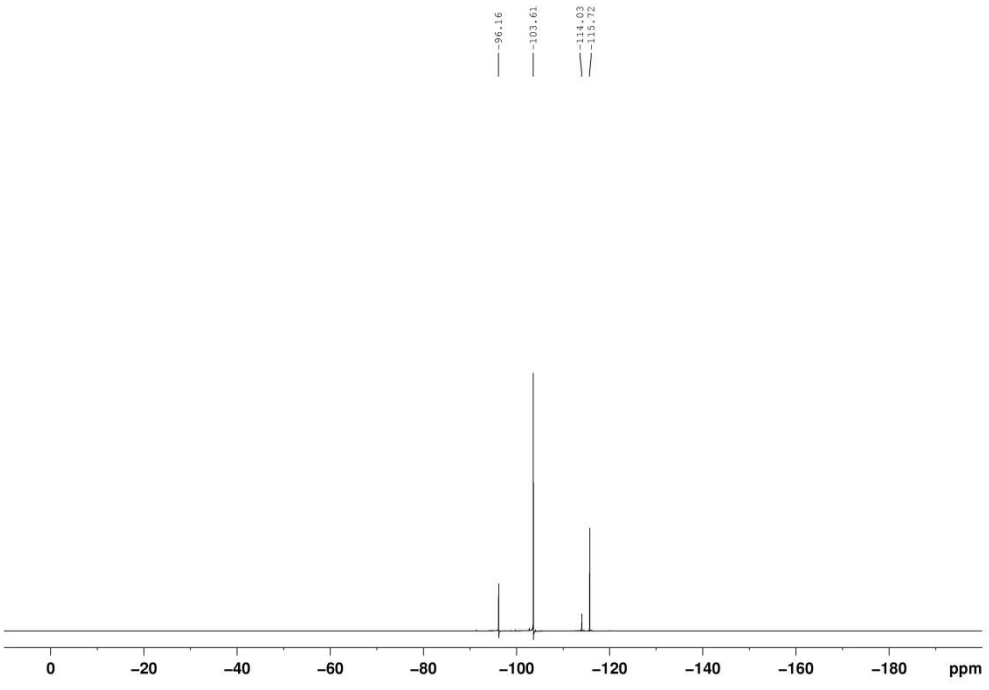

-103.13
-110.93
0
−20
−40
−60
−80
−100
−120
−140
−160
−180
ppm

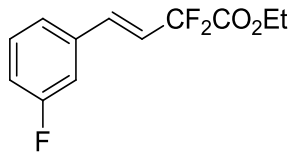

CF2CO2Et
F

3l

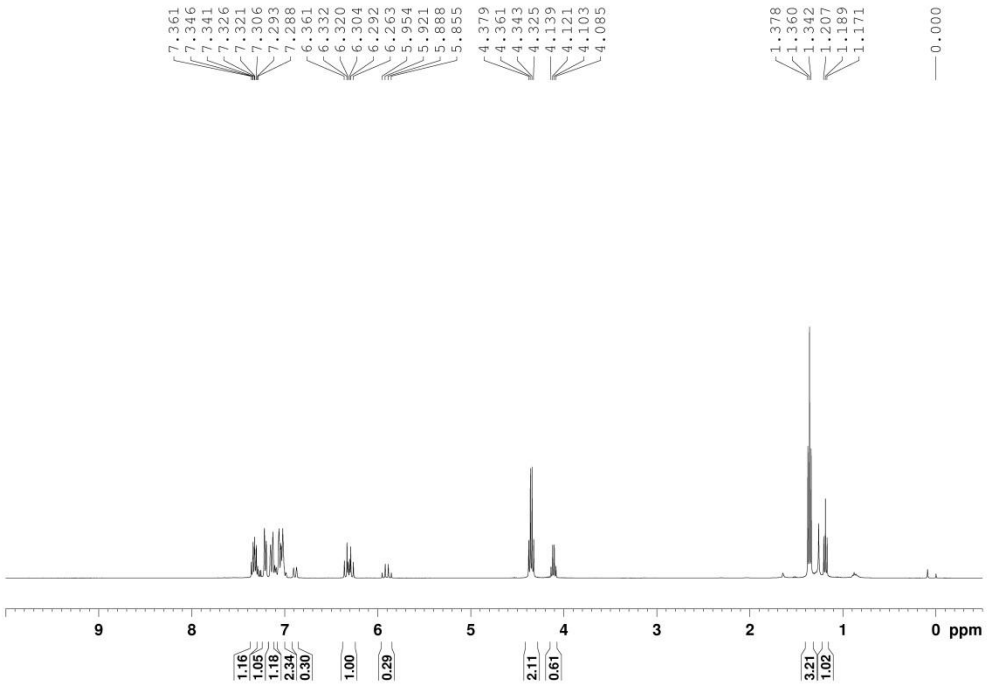

7.447
7.443
7.353
7.349
7.339
7.334
7.315
7.301
7.297
7.257
7.235
7.229
7.222
7.194
7.188
7.181
7.166
7.147
7.130
7.107
7.086
7.083
7.080
7.059
6.480
6.452
6.439
6.424
6.411
6.383
6.038
6.006
5.974
5.941
4.382
4.365
4.347
4.329
4.136
4.118
4.100
4.083
1.382
1.364
1.346
1.220
1.202
1.184
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.02
1.18
1.01
2.24
1.00
0.22
2.05
0.45
3.30
0.76

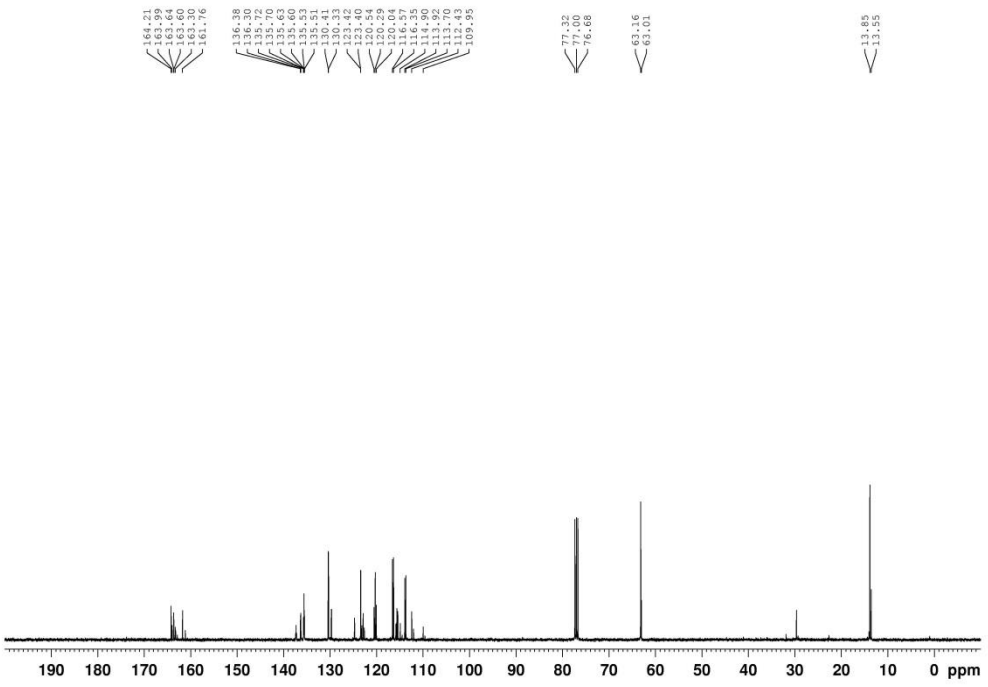

164.09
163.74
163.40
162.18
159.67
131.13
131.04
130.67
130.59
129.86
129.82
129.76
129.73
129.66
129.63
128.61
128.58
124.40
124.36
121.78
121.71
121.63
121.47
121.28
121.22
116.19
115.97
115.79
112.54
110.07
77.32
77.00
76.68
63.13
62.98
13.89
13.58
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

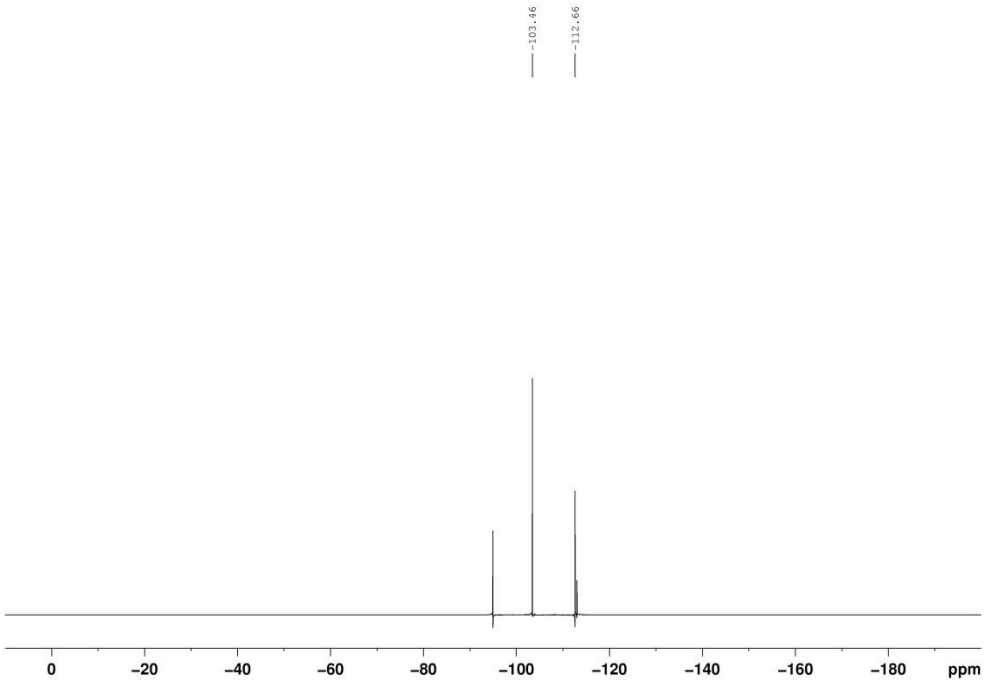

-96.16
-103.61
-114.03
-115.72
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


CF2CO2Et
F

3m


7.361
7.346
7.341
7.326
7.321
7.306
7.293
7.288
6.361
6.332
6.320
6.304
6.292
6.263
5.954
5.921
5.888
5.855
4.379
4.361
4.343
4.325
4.139
4.121
4.103
4.085
1.378
1.360
1.342
1.207
1.189
1.171
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.16
1.05
1.18
2.34
0.30
1.00
0.29
2.11
0.61
3.21
1.02


164.21
163.99
163.64
163.60
163.30
161.76
136.38
136.30
135.72
135.70
135.63
135.60
135.53
135.51
130.41
130.33
123.42
123.40
120.04
120.29
120.04
116.57
116.35
114.30
113.92
113.70
112.43
109.95
77.32
77.00
76.68
63.16
63.01
13.85
13.55
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm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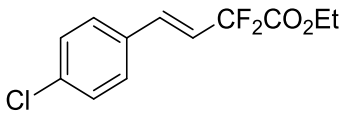
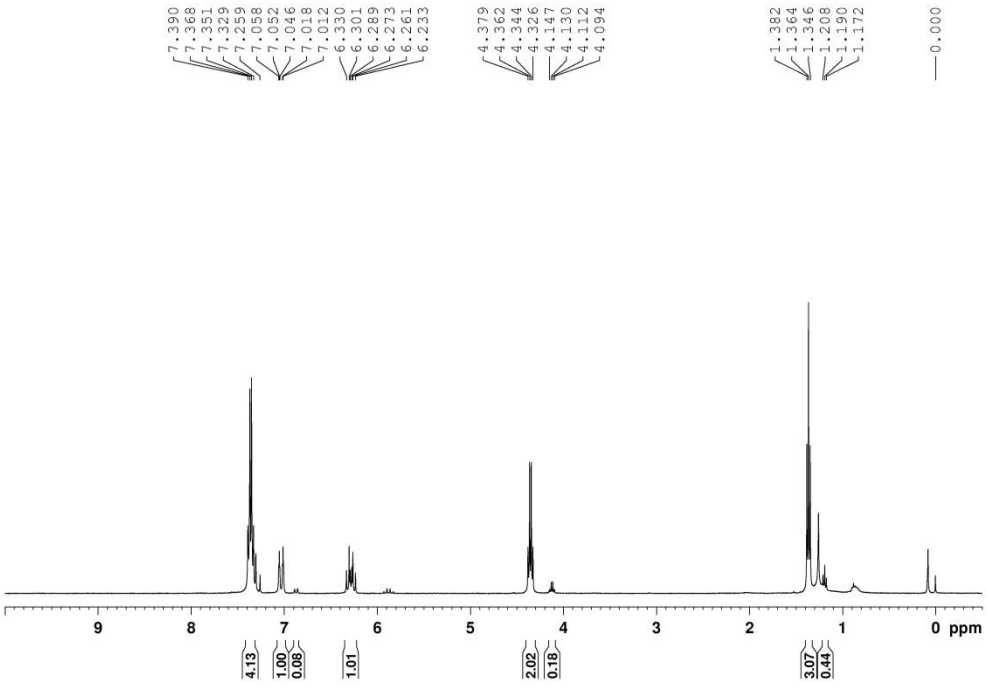
-112.66
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm


CF2CO2Et
Cl

3n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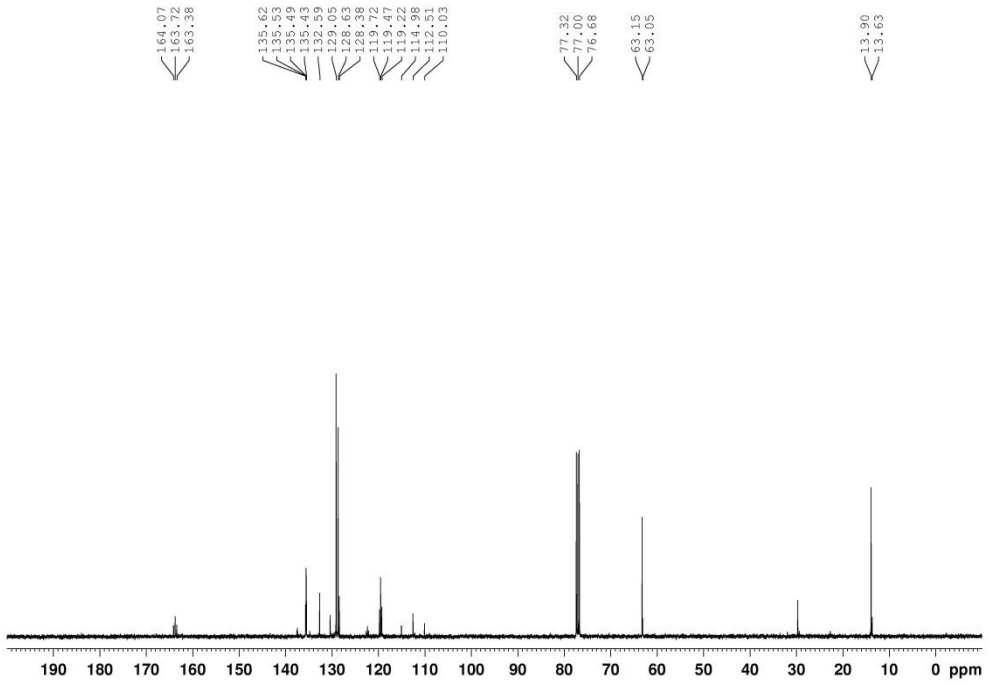
7.368
7.351
7.329
7.259
7.058
7.052
7.046
7.018
7.012
6.330
6.301
6.289
6.273
6.261
6.233
4.379
4.362
4.344
4.326
4.147
4.130
4.112
4.094
1.382
1.364
1.346
1.208
1.190
1.172
0.000
9
8
7
6
5
4
3
2
1
0 ppm
4.13
1.00
0.08
1.01
2.02
0.18
3.07
0.44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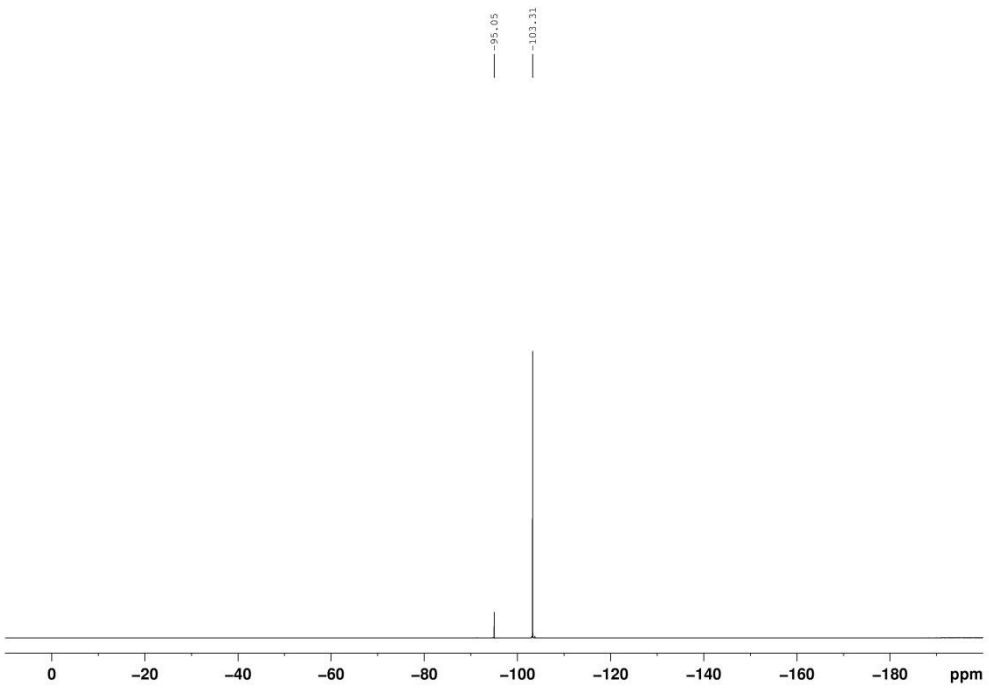
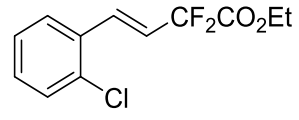
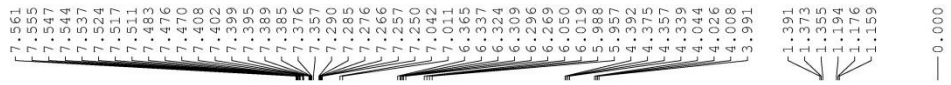
163.72
163.38
135.62
135.53
135.49
135.43
132.59
129.05
128.63
128.38
119.72
119.47
119.22
114.98
112.51
110.03
77.32
77.00
76.68
63.15
63.05
13.90
13.63
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-95.05
-103.31
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


CF2CO2Et
Cl

3o


7.561
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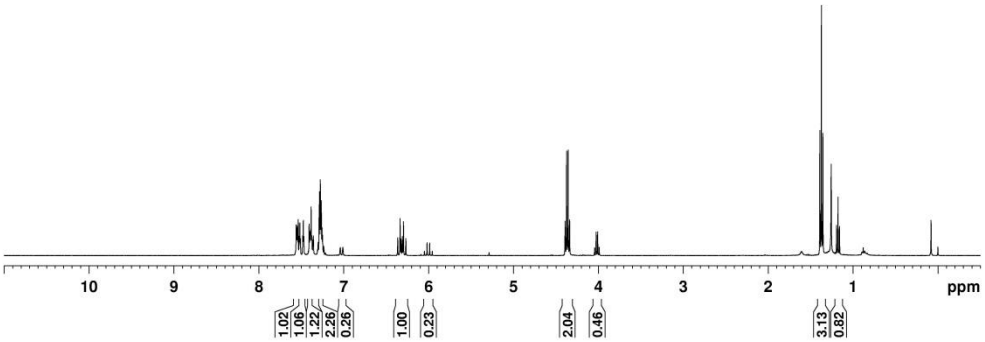
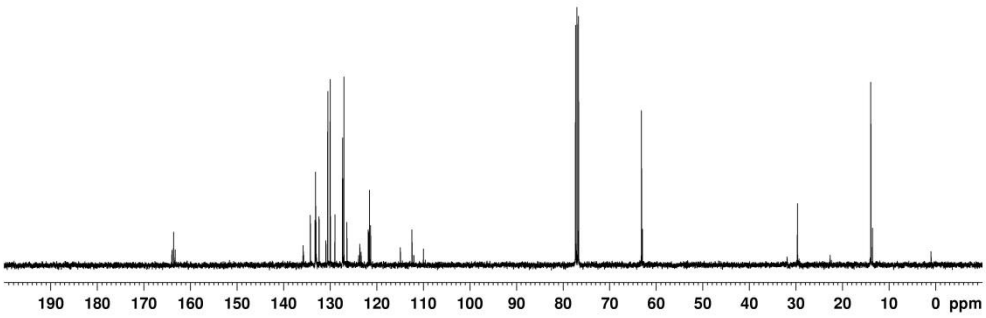
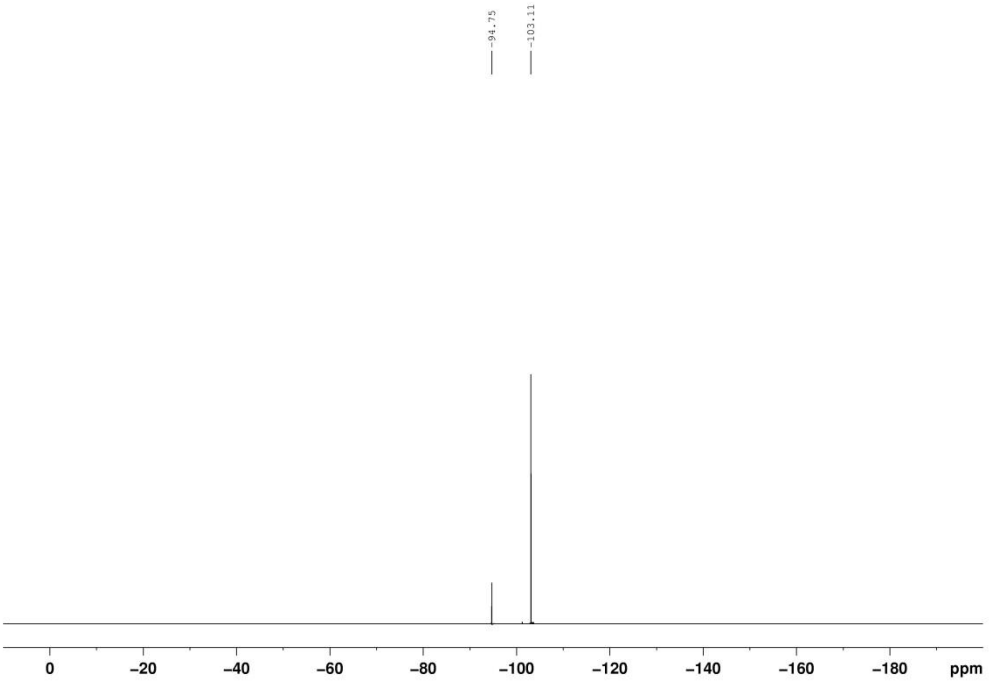
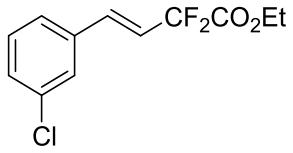
7.547
7.544
7.537
7.524
7.517
7.511
7.483
7.476
7.470
7.408
7.402
7.399
7.395
7.389
7.385
7.376
7.357
7.290
7.285
7.276
7.266
7.257
7.250
7.042
7.011
6.365
6.337
6.324
6.309
6.296
6.269
6.050
6.019
5.988
5.957
4.392
4.375
4.357
4.339
4.044
4.026
4.008
3.991
1.391
1.373
1.355
1.194
1.176
1.159
0.000


10
9
8
7
6
5
4
3
2
1
ppm
1.02
1.06
1.22
2.26
0.26
1.00
0.23
2.04
0.46
3.13
0.82

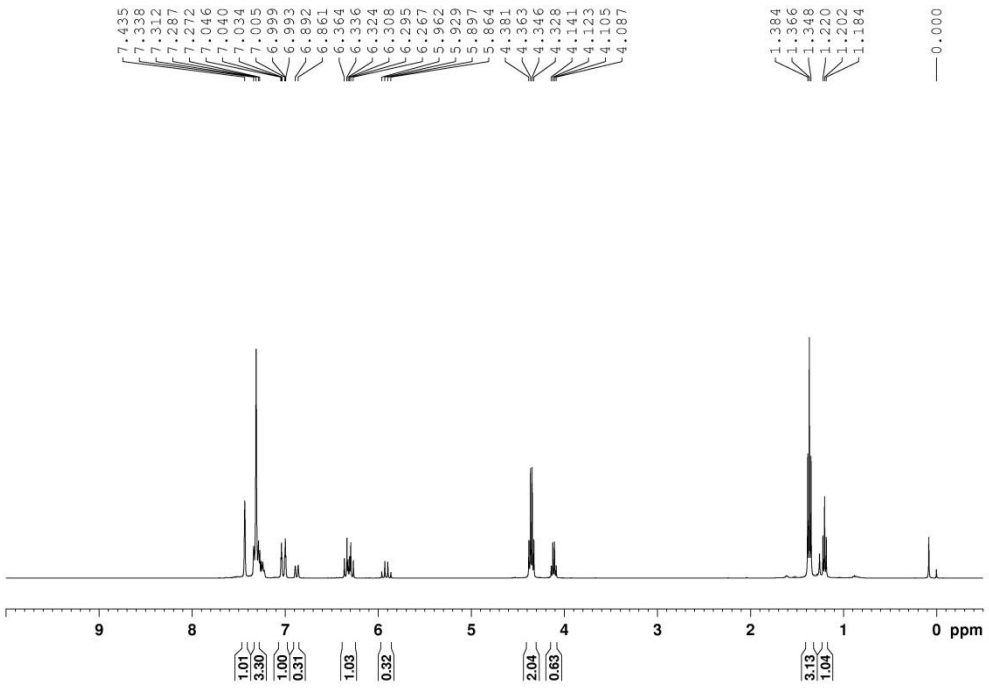

163.99
163.64
163.30
134.27
133.25
133.16
133.06
132.40
130.53
130.02
128.97
127.35
127.06
126.43
121.83
121.57
121.32
114.93
114.46
109.99
77.32
77.00
76.68
63.17
62.97
13.91
13.55


190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm


-94.75
-103.11
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm


CF2CO2Et
Cl

3p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7.338
7.312
7.287
7.272
7.046
7.040
7.034
7.005
6.999
6.993
6.892
6.861
6.364
6.336
6.324
6.308
6.295
6.267
5.962
5.929
5.897
5.864
4.381
4.363
4.346
4.328
4.141
4.123
4.105
4.087
1.384
1.366
1.348
1.220
1.202
1.184
0.000
9
8
7
6
5
4
3
2
1
0 ppm
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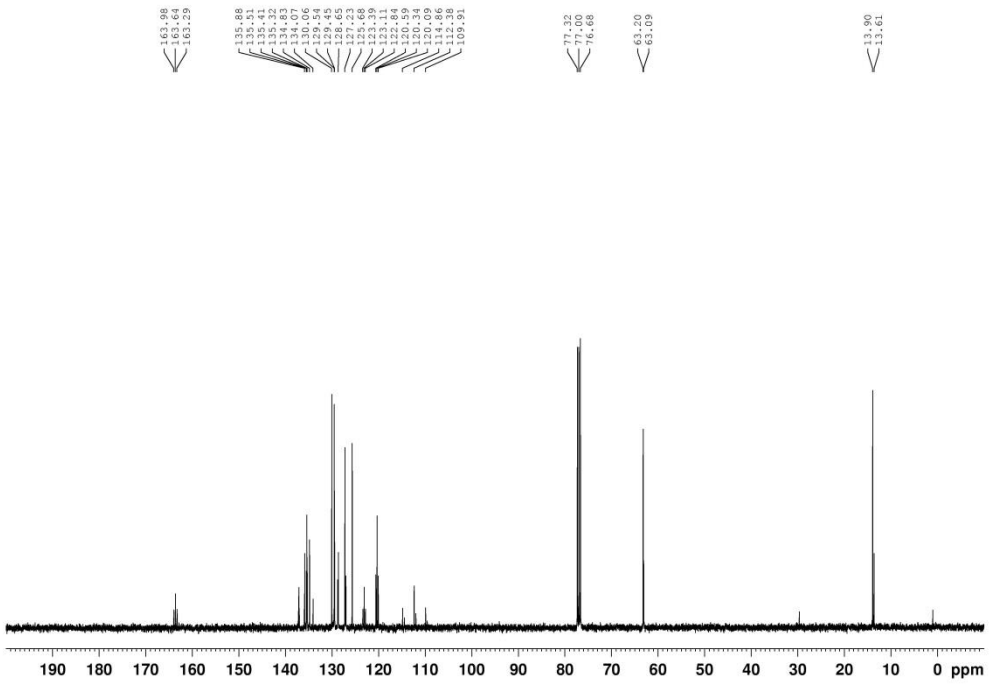
3.30
1.00
0.31
1.03
0.32
2.04
0.63
3.13
1.04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163.64
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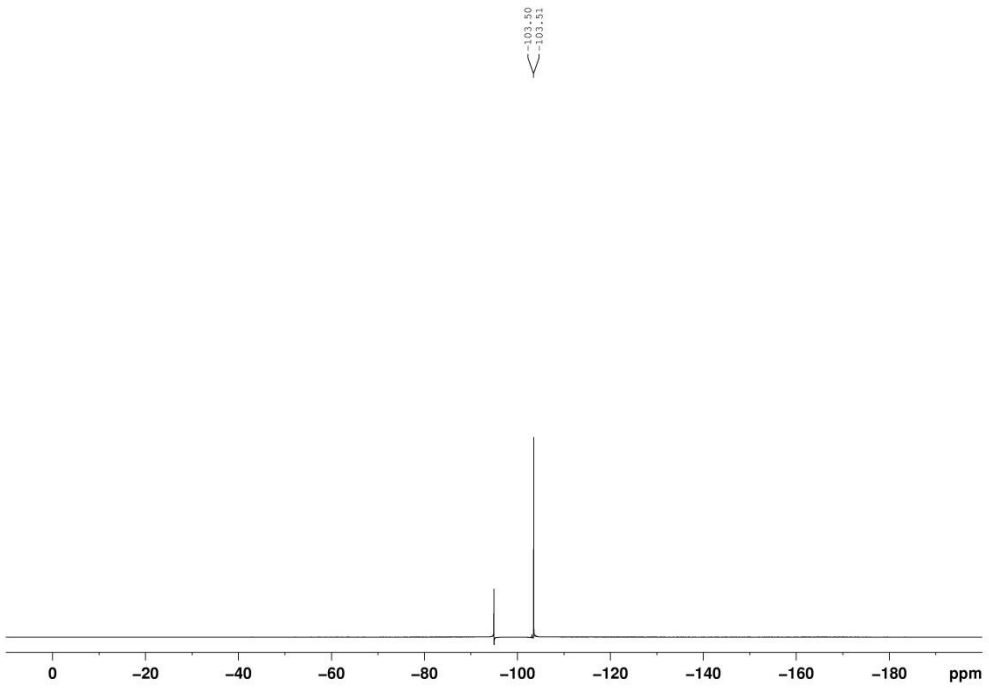
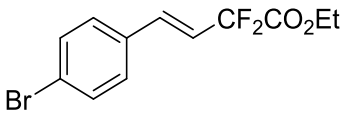
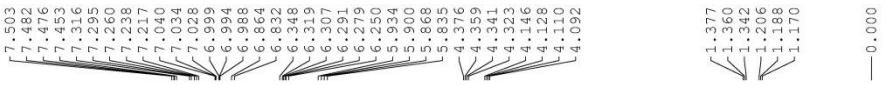
135.88
135.51
135.41
135.32
134.83
134.07
130.06
129.54
129.45
128.65
127.23
125.68
123.19
123.11
122.84
120.59
120.34
120.09
114.86
112.38
109.91
77.32
77.00
76.68
63.20
63.09
13.90
13.61
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-103.50
-103.51
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


CF2CO2Et
Br

3q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7.482
7.476
7.453
7.316
7.295
7.260
7.238
7.217
7.040
7.034
7.028
6.999
6.994
6.988
6.864
6.832
6.348
6.319
6.307
6.291
6.279
6.250
5.934
5.900
5.868
5.835
4.376
4.359
4.341
4.323
4.146
4.128
4.110
4.092
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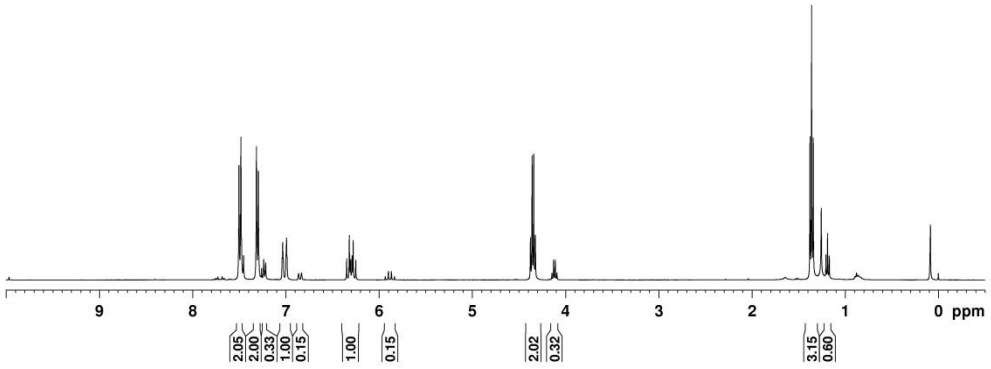
1.360
1.342
1.206
1.188
1.170
0.000


9
8
7
6
5
4
3
2
1
0 ppm
2.05
2.00
0.33
1.00
0.15
1.00
0.15
2.02
0.32
3.15
0.60


164.01
163.66
163.32
135.67
135.58
135.48
132.97
131.99
131.32
128.86
123.73
119.76
119.52
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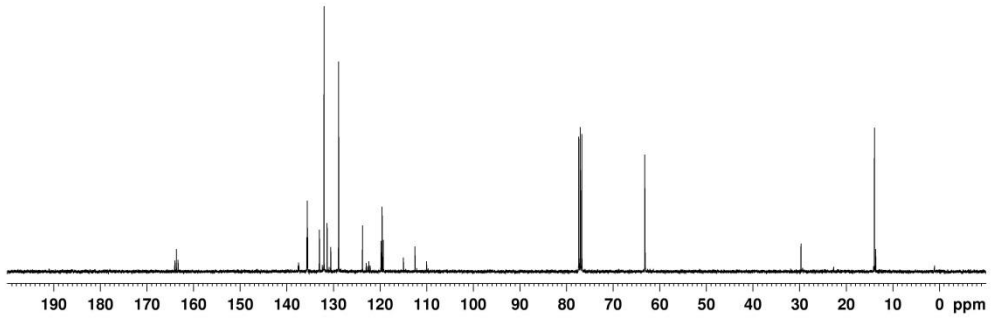
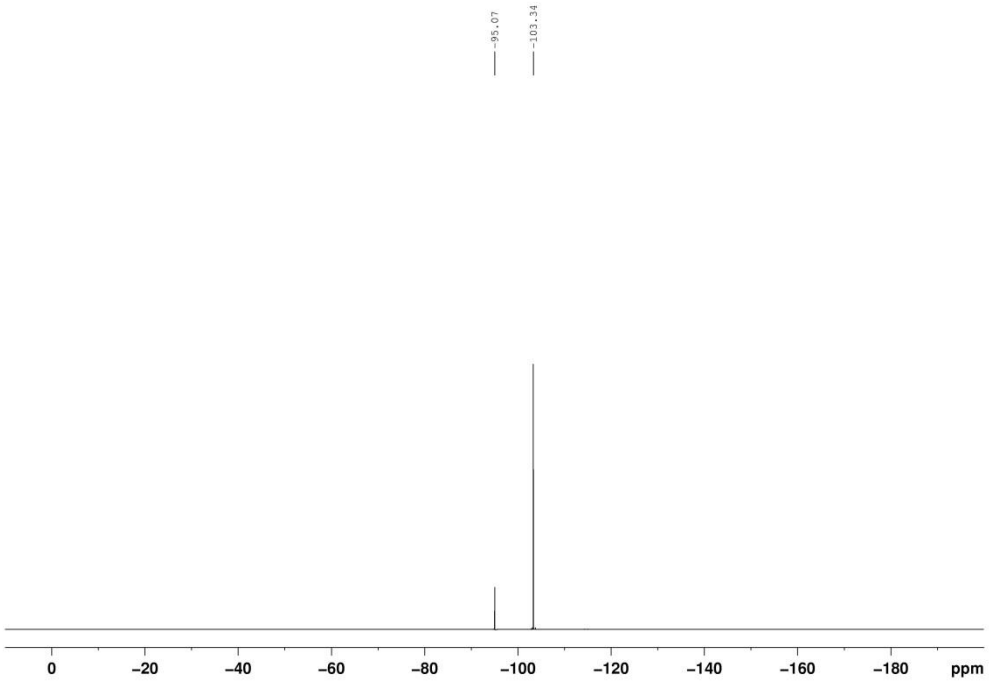
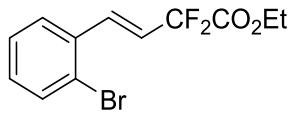
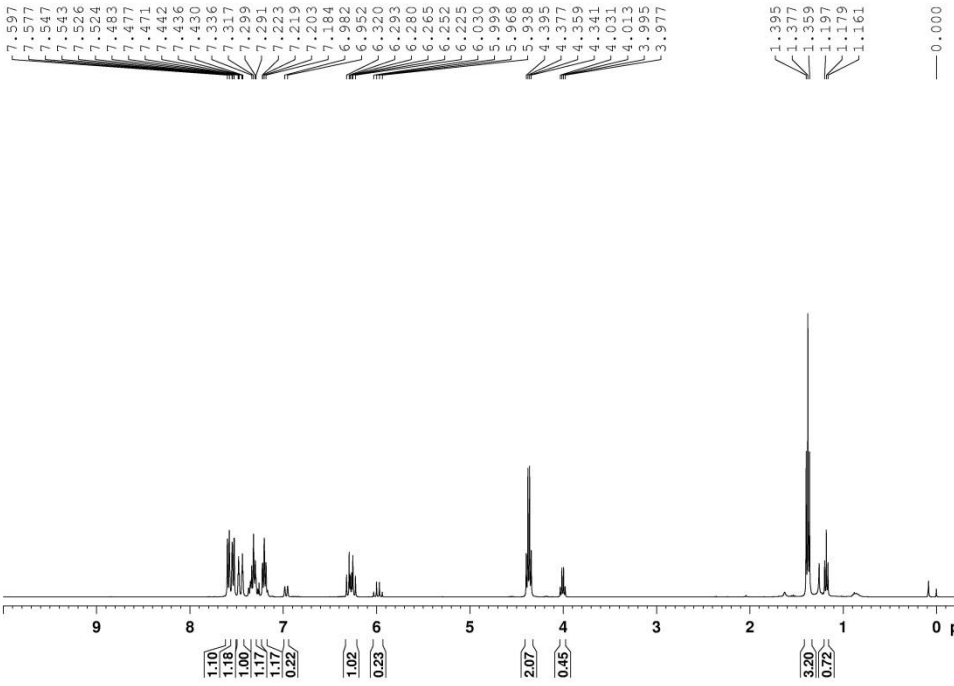
114.95
112.48
110.00
77.32
77.00
76.68
63.16
63.06
13.89
13.62

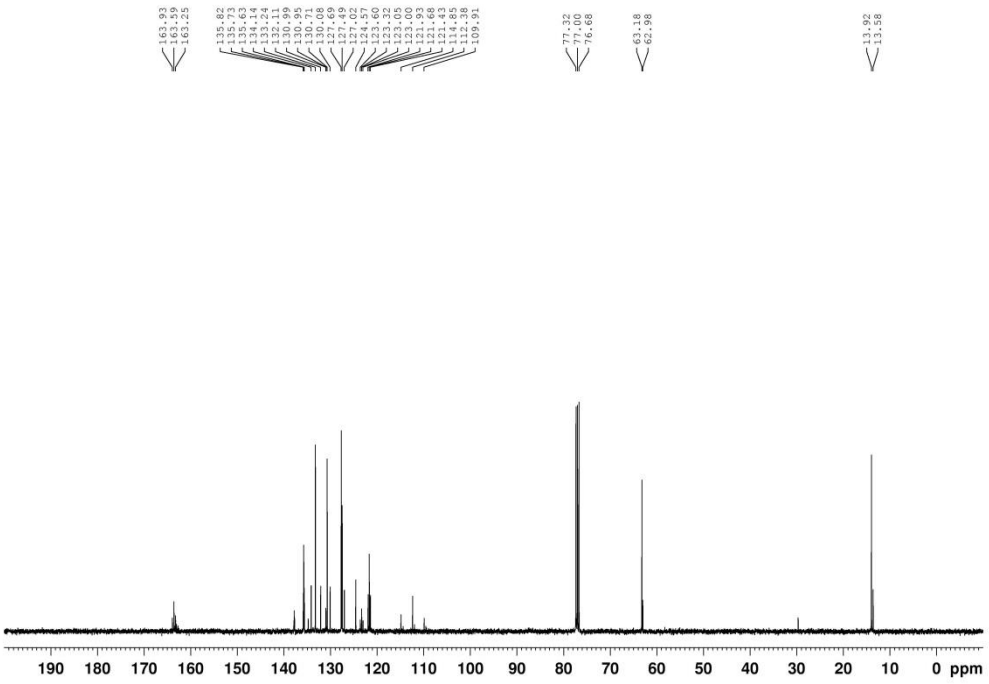

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm

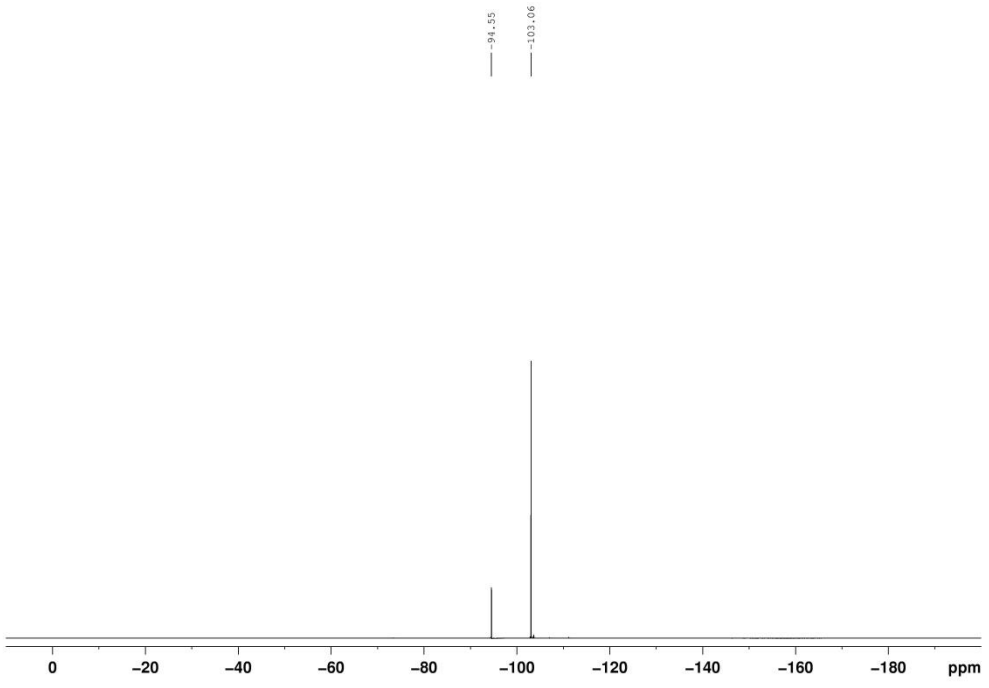

-95.07
-103.34
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

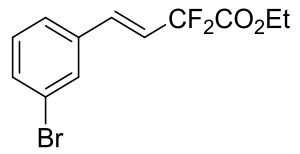

CF2CO2Et
Br

3r

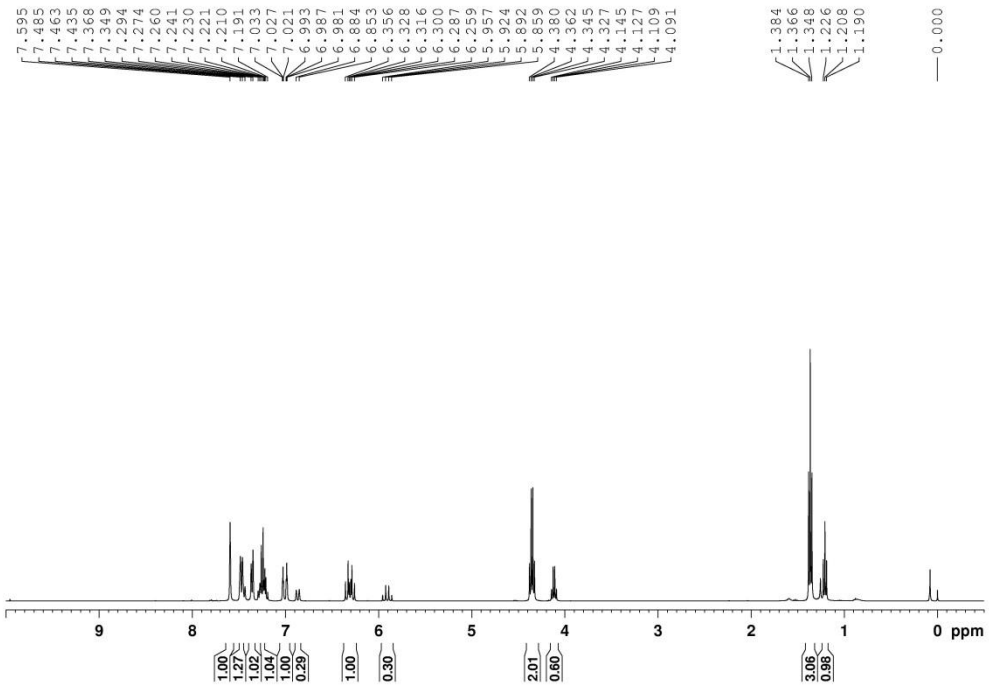

7.597
7.577
7.547
7.543
7.526
7.524
7.483
7.477
7.471
7.442
7.436
7.430
7.336
7.317
7.299
7.291
7.223
7.219
7.203
7.184
6.982
6.952
6.320
6.293
6.280
6.265
6.252
6.225
6.030
5.999
5.968
5.938
4.395
4.377
4.359
4.341
4.031
4.013
3.995
3.977
1.395
1.377
1.359
1.197
1.179
1.161
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.10
1.18
1.00
1.17
1.17
0.22
1.02
0.23
2.07
0.45
3.20
0.72


163.93
163.59
163.25
135.82
135.73
135.63
134.14
133.24
132.11
131.09
130.95
130.71
130.08
127.69
127.49
127.02
124.57
123.60
123.32
123.05
123.00
121.93
121.68
121.43
114.85
112.38
109.91
77.32
77.00
76.68
63.18
62.98
13.92
13.58
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-94.55
-103.06
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


CF2CO2Et
Br

3s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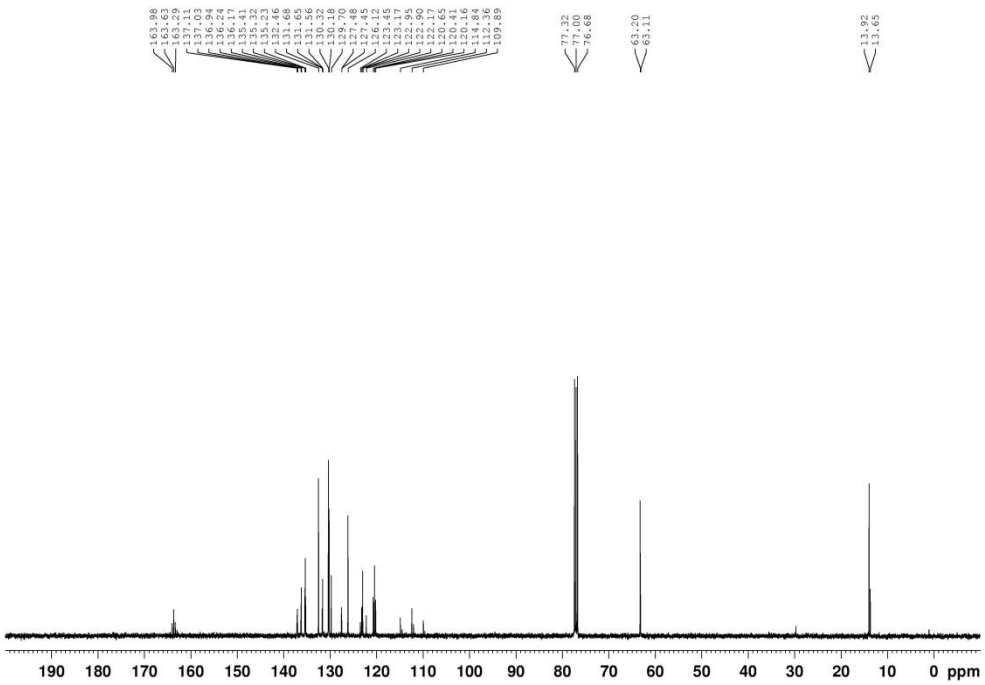
7.485
7.463
7.435
7.368
7.349
7.294
7.274
7.260
7.241
7.230
7.221
7.210
7.191
7.033
7.027
7.021
6.993
6.987
6.981
6.884
6.853
6.356
6.328
6.316
6.300
6.287
6.259
5.957
5.924
5.892
5.859
4.380
4.362
4.345
4.327
4.145
4.127
4.109
4.091
1.384
1.366
1.348
1.226
1.208
1.190
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.00
1.27
1.02
1.04
1.00
0.29
1.00
0.30
2.01
0.60
3.06
0.98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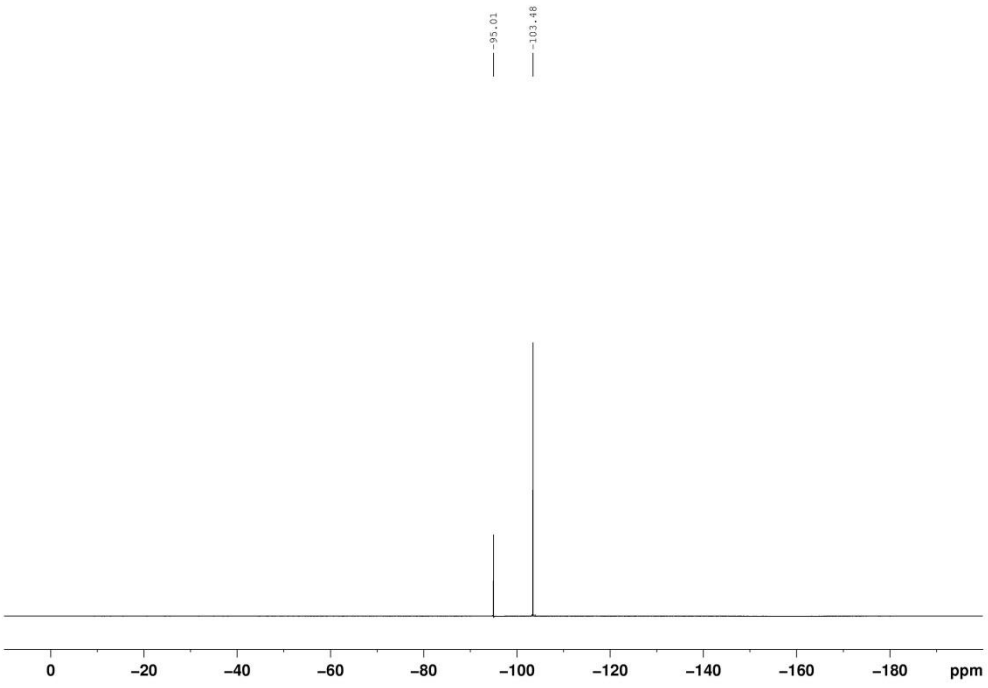
163.63
163.29
137.11
137.03
136.94
136.24
135.77
135.41
135.32
135.23
132.46
131.68
131.65
131.56
130.32
130.18
129.70
127.48
127.45
126.12
123.45
123.17
122.95
122.90
122.17
120.65
120.41
120.16
114.84
112.36
109.89
77.32
77.00
76.68
63.20
63.11
13.92
13.65
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm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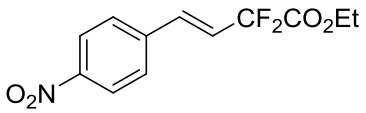
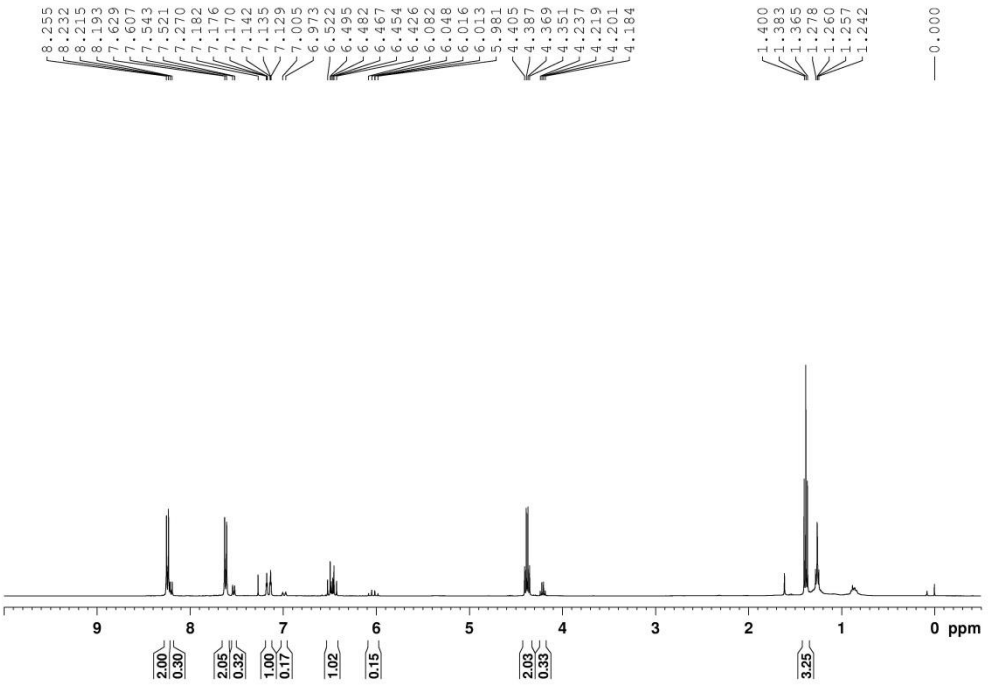
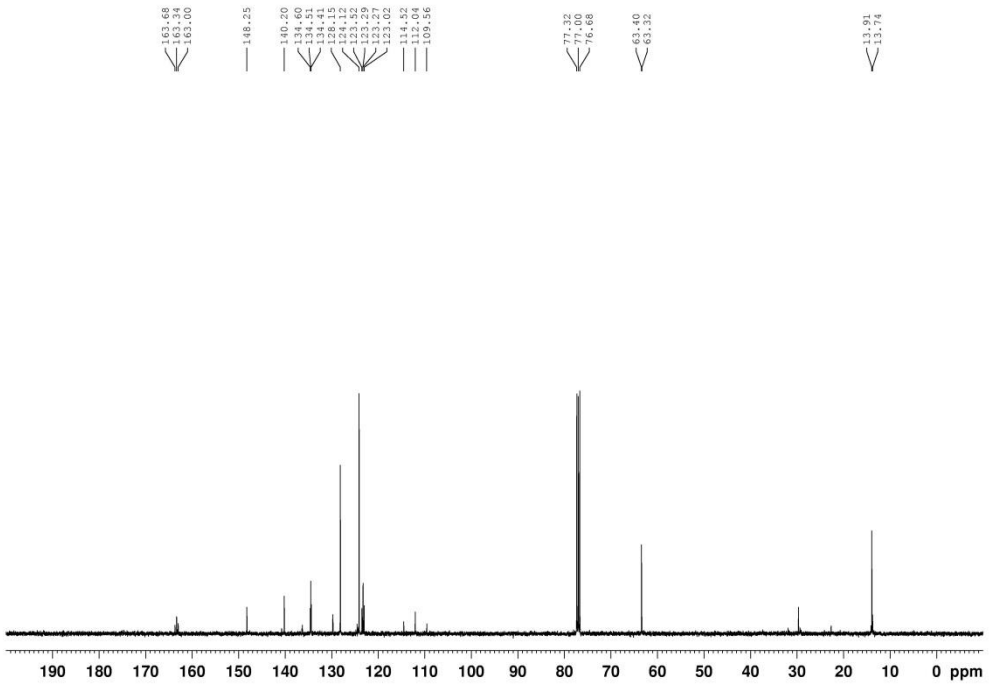
-103.48
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm


CF2CO2Et
O2N

3t


8.255
8.232
8.215
8.193
7.629
7.607
7.543
7.521
7.270
7.182
7.176
7.170
7.142
7.135
7.129
7.005
6.973
6.522
6.495
6.482
6.467
6.454
6.426
6.082
6.048
6.016
6.013
5.981
4.405
4.387
4.369
4.351
4.237
4.219
4.201
4.184
1.400
1.383
1.365
1.278
1.260
1.257
1.242
0.000
9
8
7
6
5
4
3
2
1
0 ppm
2.00
0.30
2.05
0.32
1.00
0.17
1.02
0.15
2.03
0.33
3.25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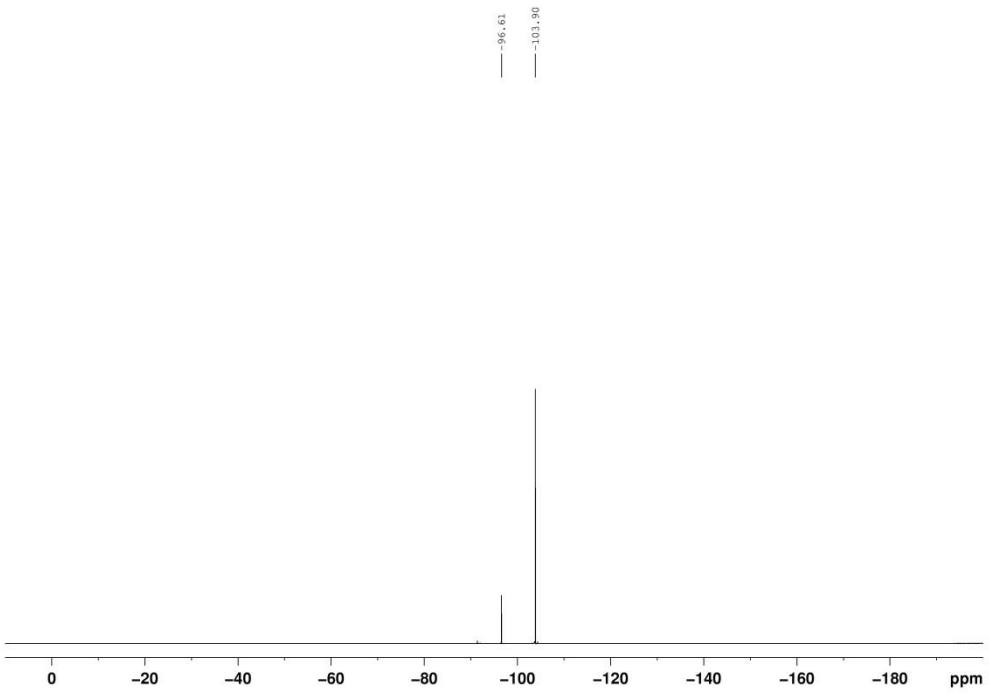
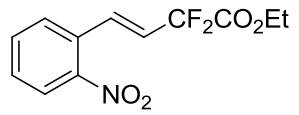
163.34
163.00
148.25
140.20
134.60
134.51
134.41
128.15
124.12
123.52
123.29
123.27
123.02
114.52
112.04
109.56
77.32
77.00
76.68
63.40
63.32
13.91
13.74
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-96.61
-103.90
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm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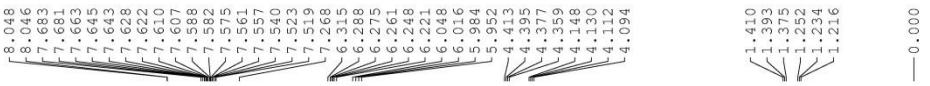
NO2

3u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8.046
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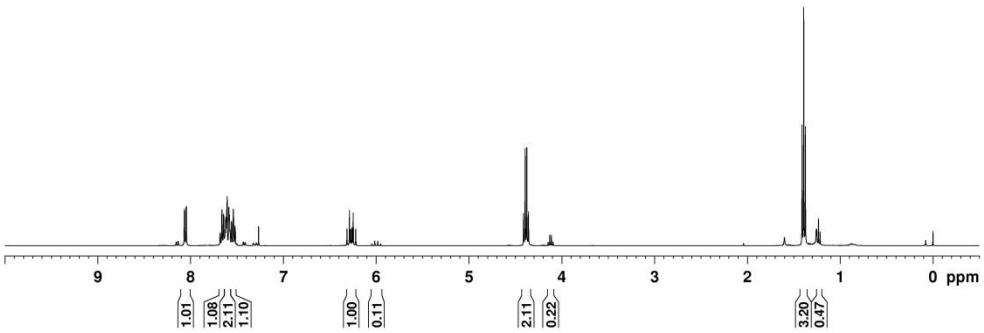
7.681
7.663
7.645
7.643
7.628
7.622
7.610
7.607
7.588
7.582
7.575
7.561
7.557
7.540
7.523
7.519
7.268
6.315
6.288
6.275
6.261
6.248
6.221
6.048
6.016
5.984
5.952
4.413
4.395
4.377
4.359
4.148
4.130
4.112
4.094
1.410
1.393
1.375
1.252
1.234
1.216
0.000


9
8
7
6
5
4
3
2
1
0 ppm
1.01
1.08
2.11
1.10
1.00
0.11
2.11
0.22
3.20
0.47


163.69
163.35
163.01
147.95
133.60
133.34
133.24
133.14
130.36
129.98
129.17
124.91
124.19
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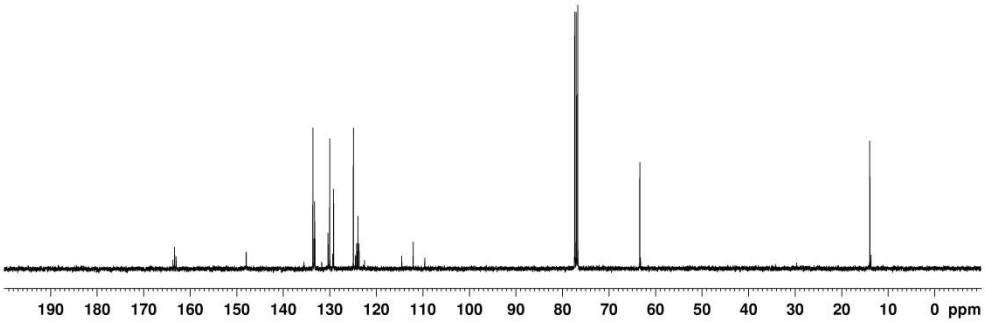
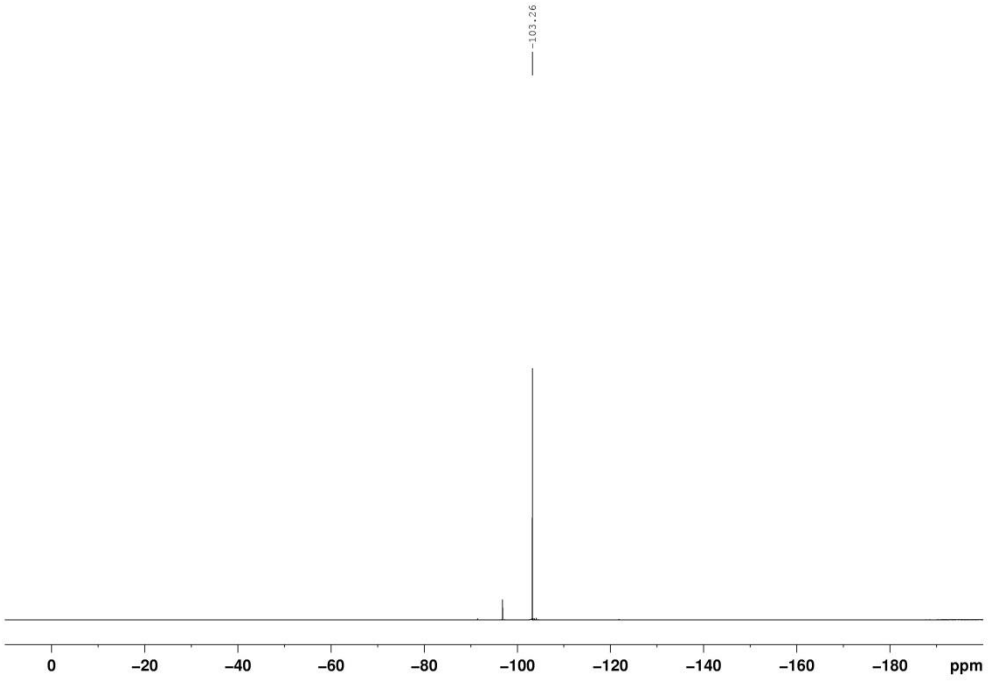
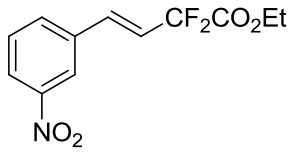
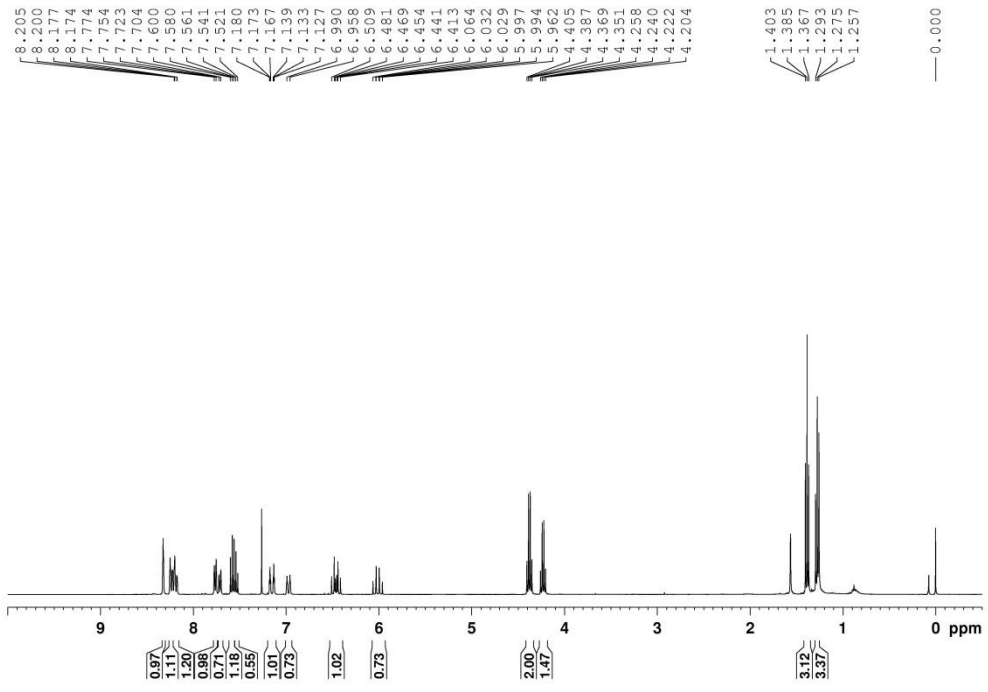
109.57
77.32
77.00
76.68
63.34
13.89

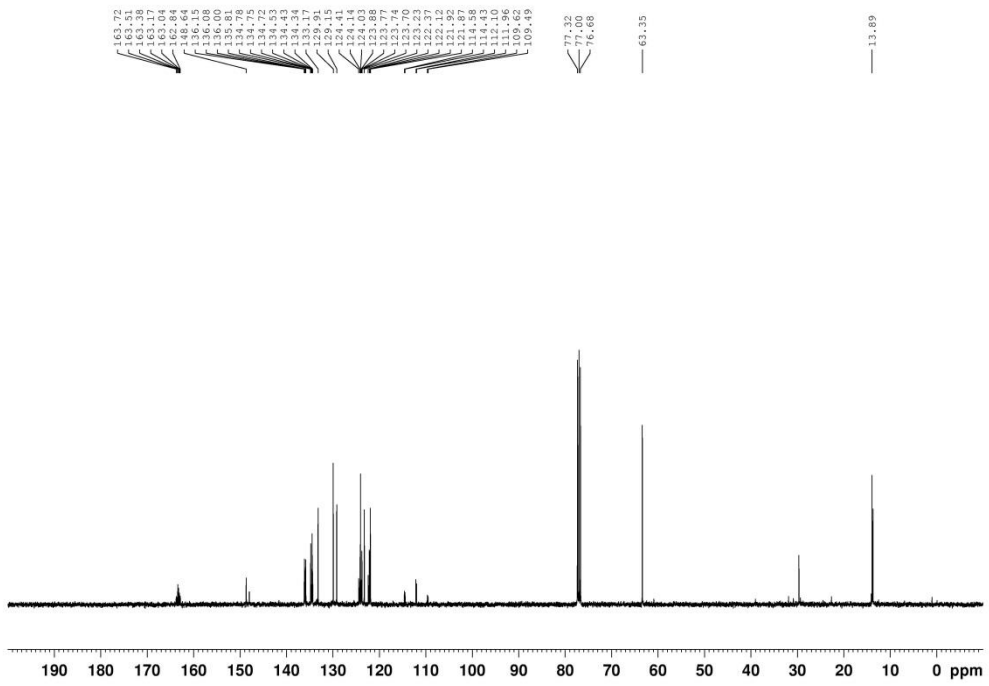

190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm

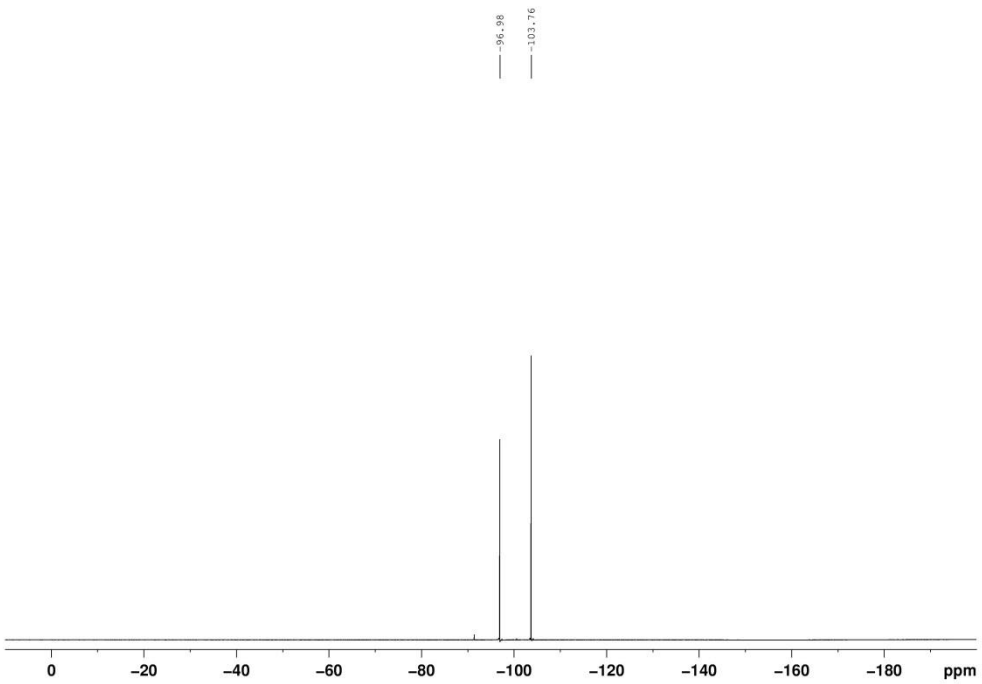

-103.26
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

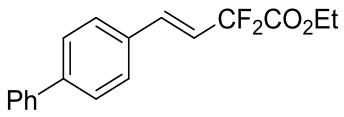

CF2CO2Et
NO2

3v

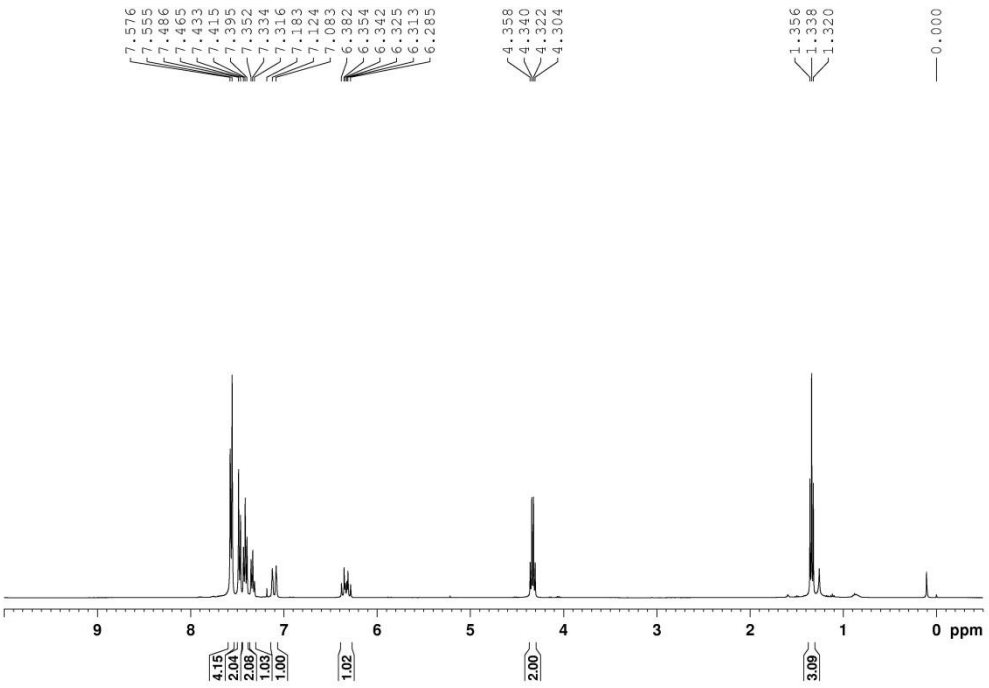

8.205
8.200
8.177
8.174
7.774
7.754
7.723
7.704
7.600
7.580
7.561
7.541
7.521
7.180
7.173
7.167
7.139
7.133
7.127
6.990
6.958
6.509
6.481
6.469
6.454
6.441
6.413
6.064
6.032
6.029
5.997
5.994
5.962
4.405
4.387
4.369
4.351
4.258
4.240
4.222
4.204
1.403
1.385
1.367
1.293
1.275
1.257
0.000
9
8
7
6
5
4
3
2
1
0 ppm
0.97
1.11
1.20
0.98
0.71
1.18
0.55
1.01
0.73
1.02
0.73
2.00
1.47
3.12
3.37


163.72
163.51
163.38
163.17
163.04
162.84
148.64
136.15
136.08
136.00
135.81
134.78
134.75
134.72
134.53
134.43
134.34
133.17
129.91
129.15
124.41
124.14
124.03
123.88
123.77
123.74
123.70
123.23
123.17
122.12
121.92
121.87
114.58
114.43
112.10
111.96
109.62
109.49
77.32
77.00
76.68
63.35
13.89
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-96.98
-103.76
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


CF2CO2Et
Ph

3w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7.555
7.486
7.465
7.433
7.415
7.395
7.352
7.334
7.316
7.183
7.124
7.083
6.382
6.354
6.342
6.325
6.313
6.285
4.358
4.340
4.322
4.304
1.356
1.338
1.320
0.000
9
8
7
6
5
4
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2
1
0 ppm
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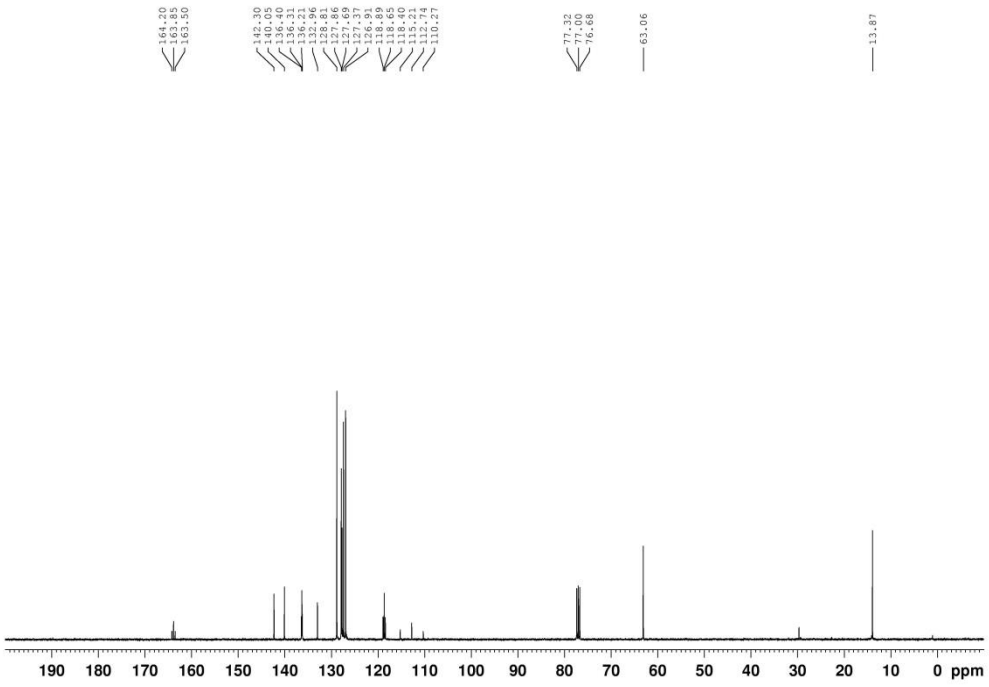
2.04
2.08
1.03
1.00
1.02
2.00
3.09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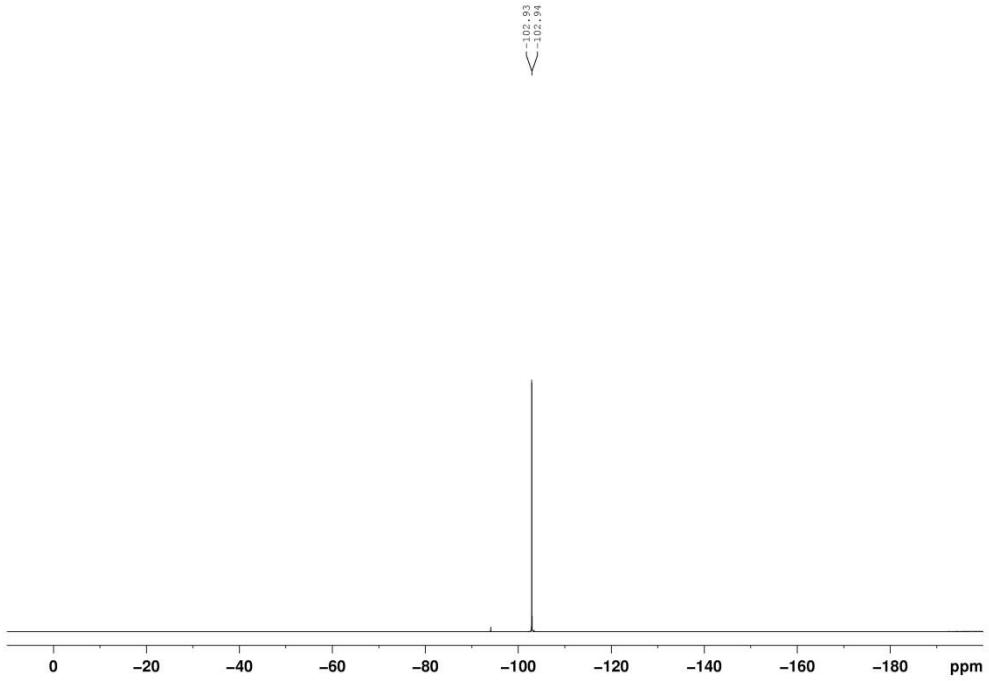
163.85
163.50
142.30
140.05
136.40
136.31
136.21
132.96
128.81
127.86
127.69
127.33
126.91
118.89
118.65
118.40
115.21
112.74
110.27
77.32
77.00
76.68
63.06
13.87
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm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-102.94
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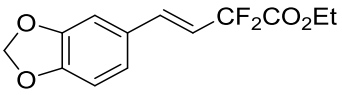
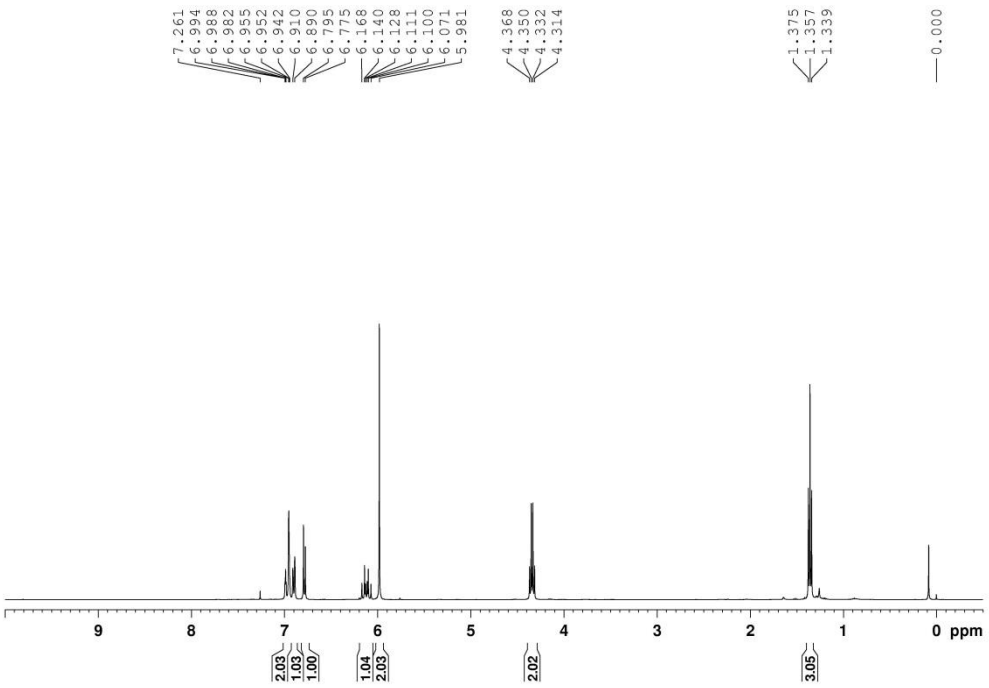
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm


O
O
CF2CO2Et

3x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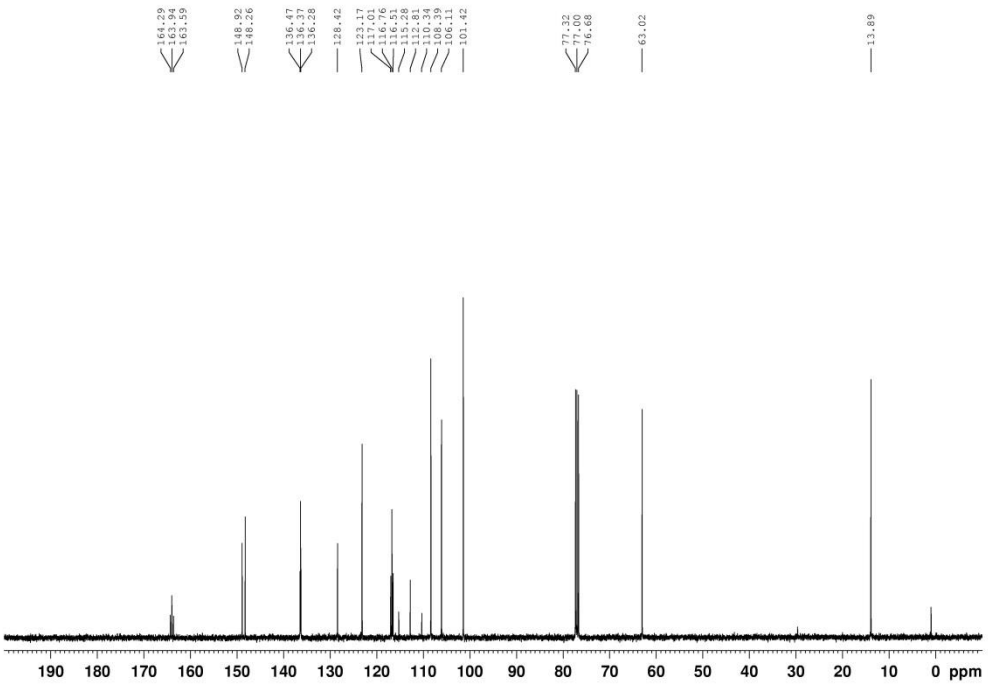
6.988
6.982
6.955
6.952
6.942
6.910
6.890
6.795
6.775
6.168
6.140
6.128
6.111
6.100
6.071
5.981
4.368
4.350
4.332
4.314
1.375
1.357
1.339
0.000
9
8
7
6
5
4
3
2
1
0 ppm
2.03
1.03
1.00
1.04
2.03
2.02
3.05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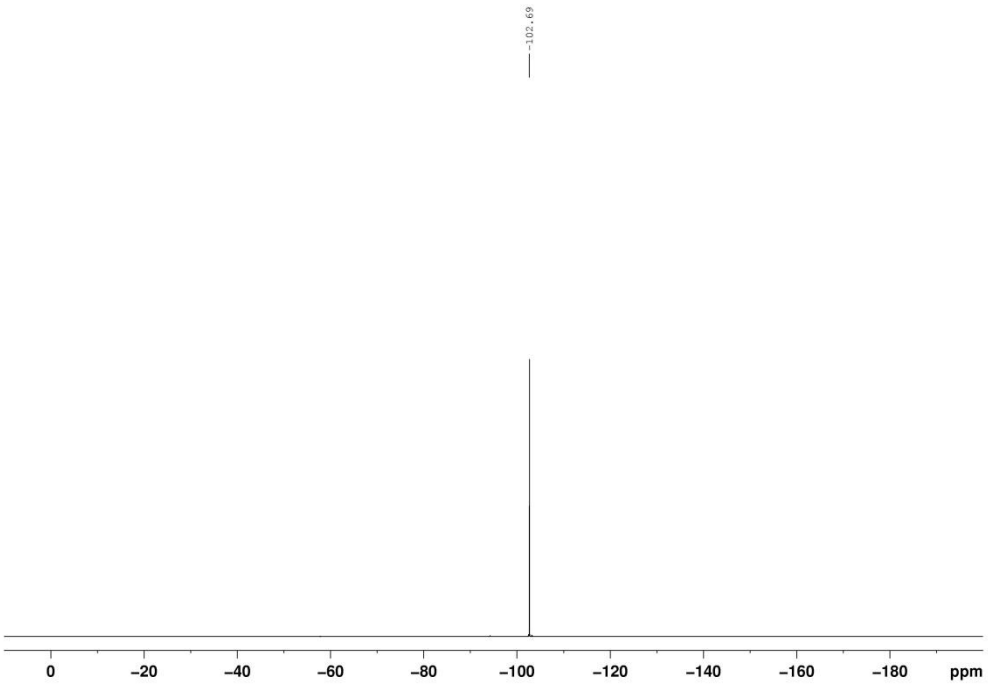
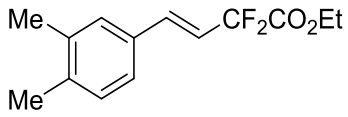
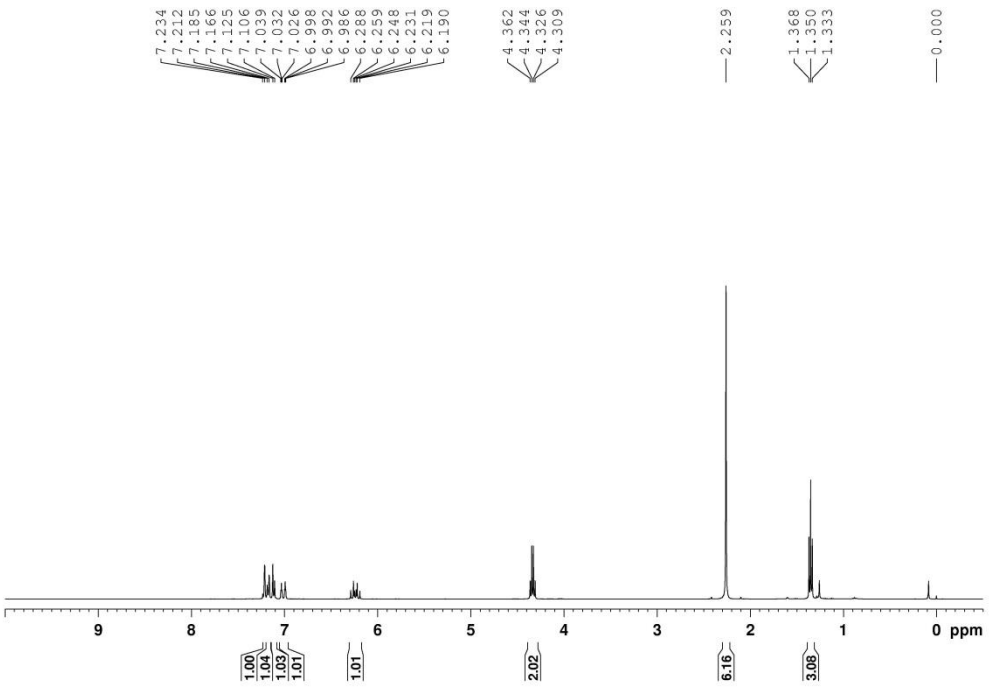
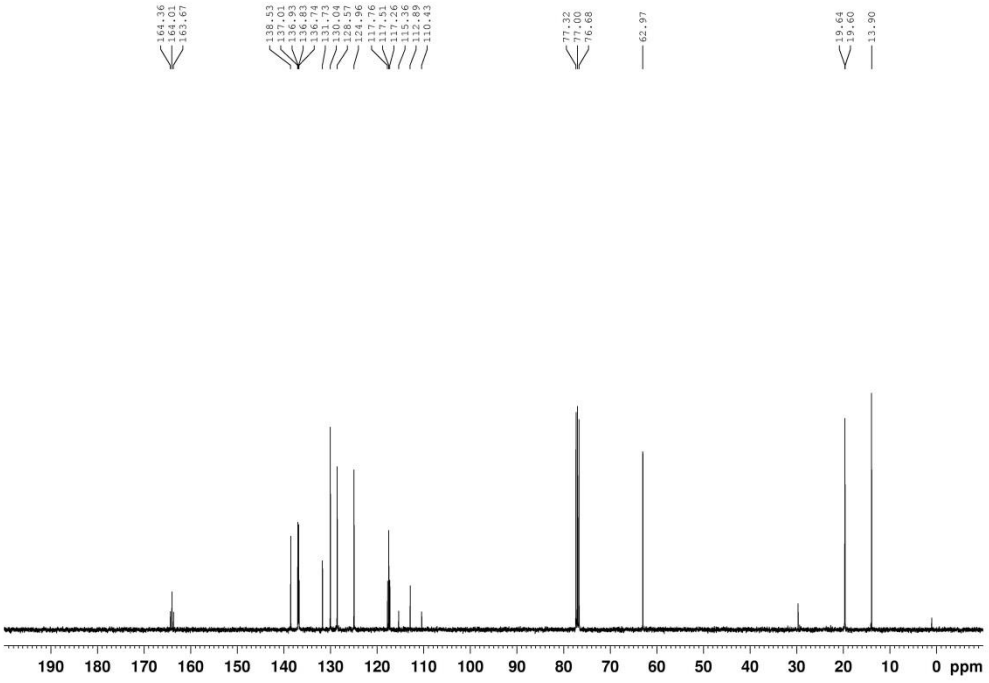
163.94
163.59
148.92
148.26
136.47
136.37
136.28
128.42
123.17
117.01
116.76
116.51
115.28
112.81
110.34
108.39
106.11
101.42
77.32
77.00
76.68
63.02
13.89
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-102.69
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


Me
Me
CF2CO2Et

3y


7.234
7.212
7.185
7.166
7.125
7.106
7.039
7.032
7.026
6.998
6.992
6.986
6.288
6.259
6.248
6.231
6.219
6.190
4.362
4.344
4.326
4.309
2.259
1.368
1.350
1.333
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.00
1.04
1.03
1.01
1.01
2.02
6.16
3.08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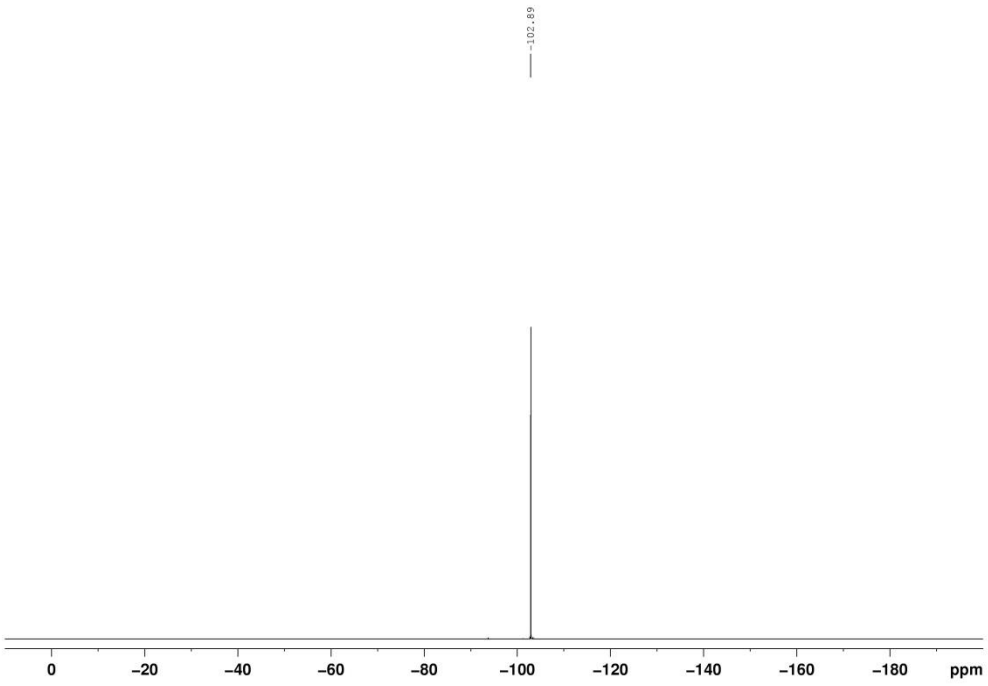
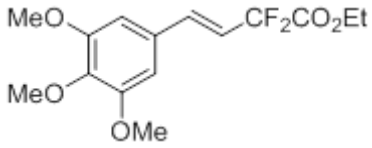
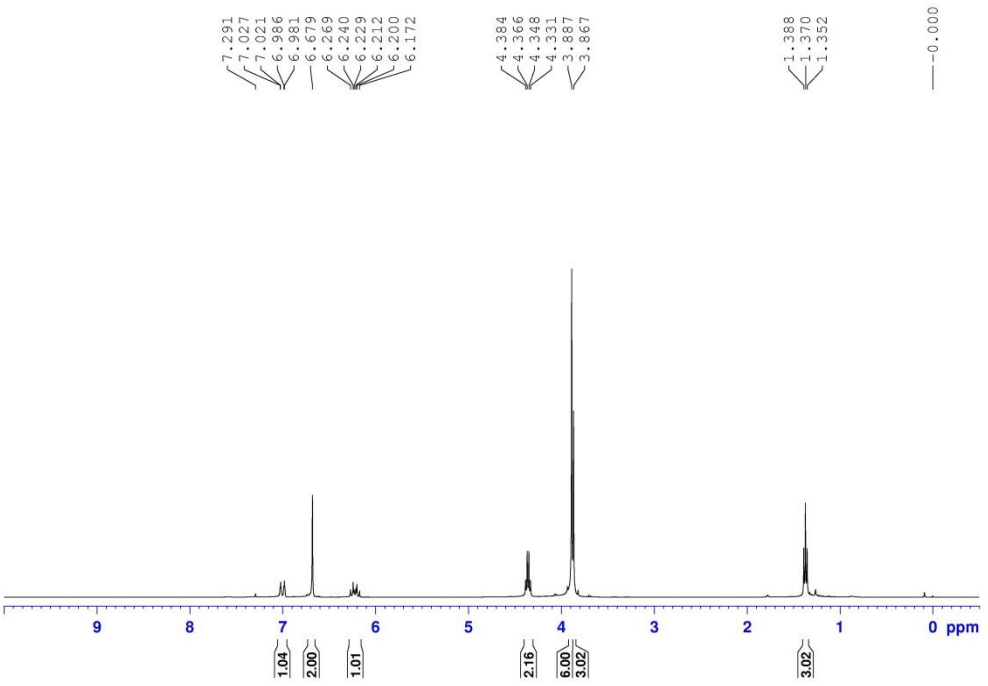
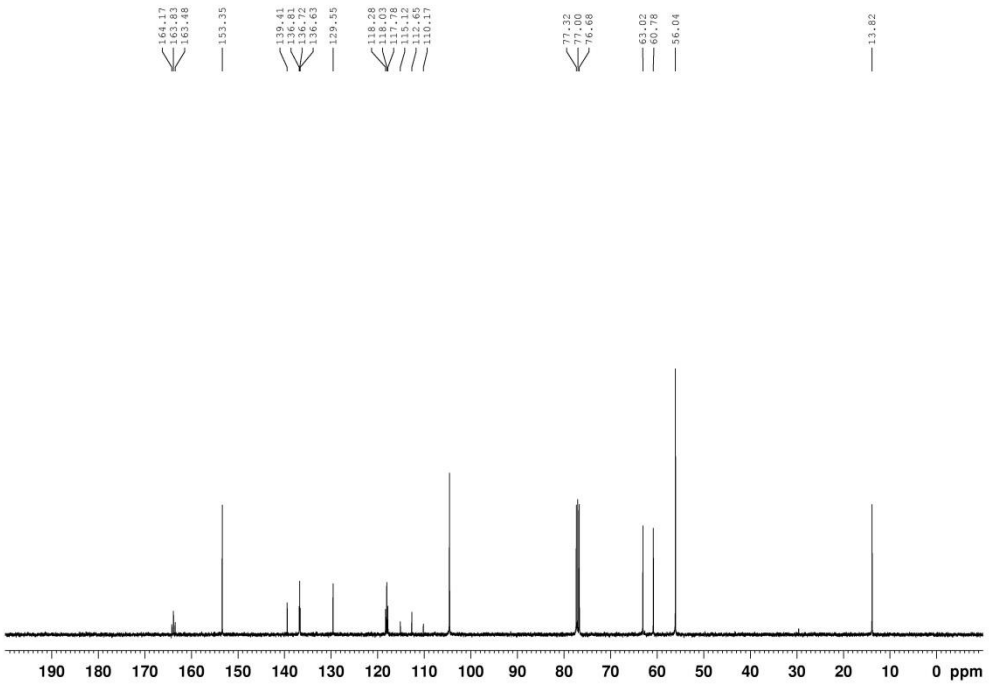
164.01
163.67
138.53
137.01
136.93
136.63
136.14
131.73
130.04
128.57
124.96
117.76
117.51
117.26
115.36
112.89
110.43
77.32
77.00
76.68
62.97
19.64
19.60
13.90
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm

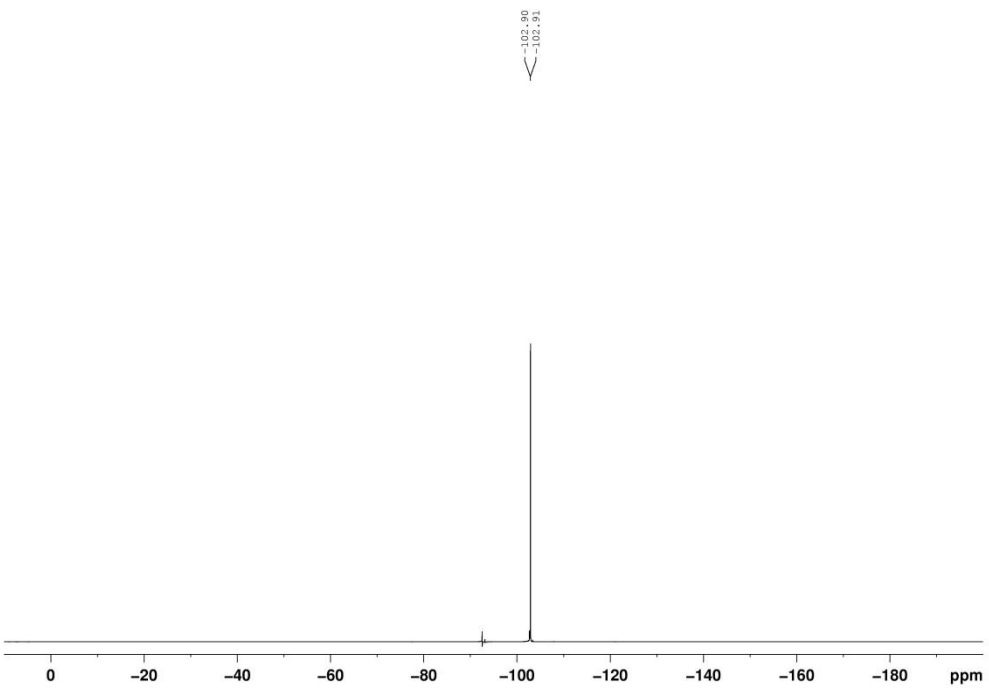

-102.89
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

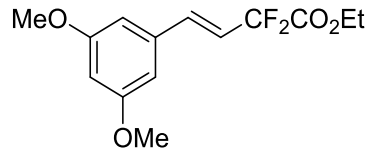

MeO
MeO
OMe
CF2CO2Et

3z

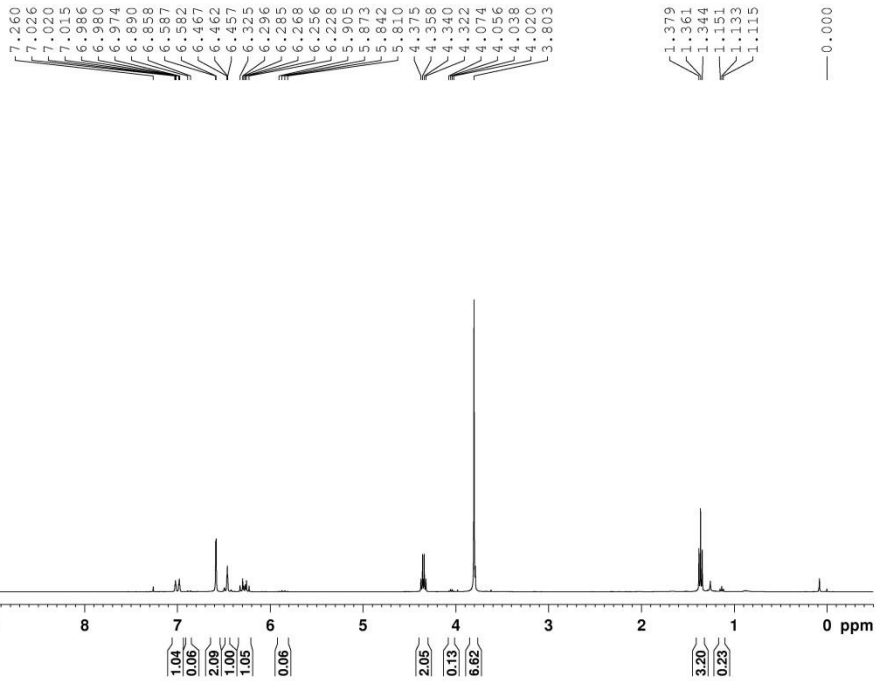

7.291
7.027
7.021
6.986
6.981
6.679
6.269
6.240
6.229
6.212
6.200
6.172
4.384
4.366
4.348
4.331
3.887
3.867
1.388
1.370
1.352
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.04
2.00
1.01
2.16
6.00
3.02
3.02


164.17
163.83
163.48
153.35
139.41
136.81
136.72
136.63
129.55
118.28
118.03
117.78
115.12
112.65
110.17
77.32
77.00
76.68
63.02
60.78
56.04
13.82
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-102.90
-102.91
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


MeO
CF2CO2Et
OMe

3aa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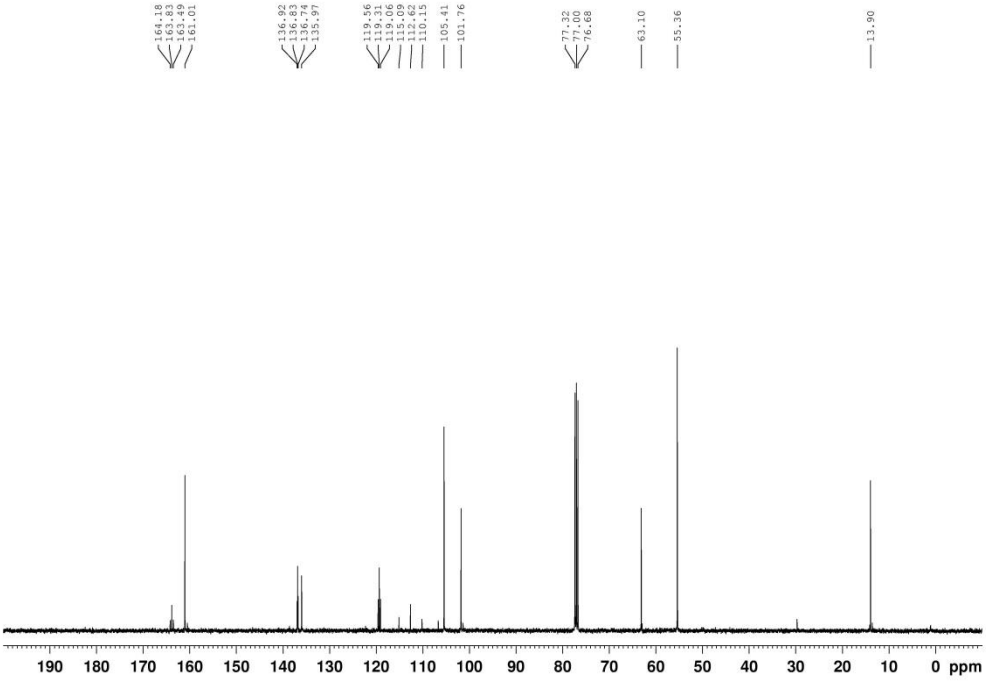
7.026
7.020
7.015
6.986
6.980
6.974
6.890
6.858
6.587
6.582
6.467
6.462
6.457
6.325
6.296
6.285
6.268
6.256
6.228
5.905
5.873
5.842
5.810
4.375
4.358
4.340
4.322
4.074
4.056
4.038
4.020
3.803
1.379
1.361
1.344
1.151
1.133
1.115
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.04
0.06
2.09
1.00
1.05
0.06
2.05
0.13
6.62
3.20
0.23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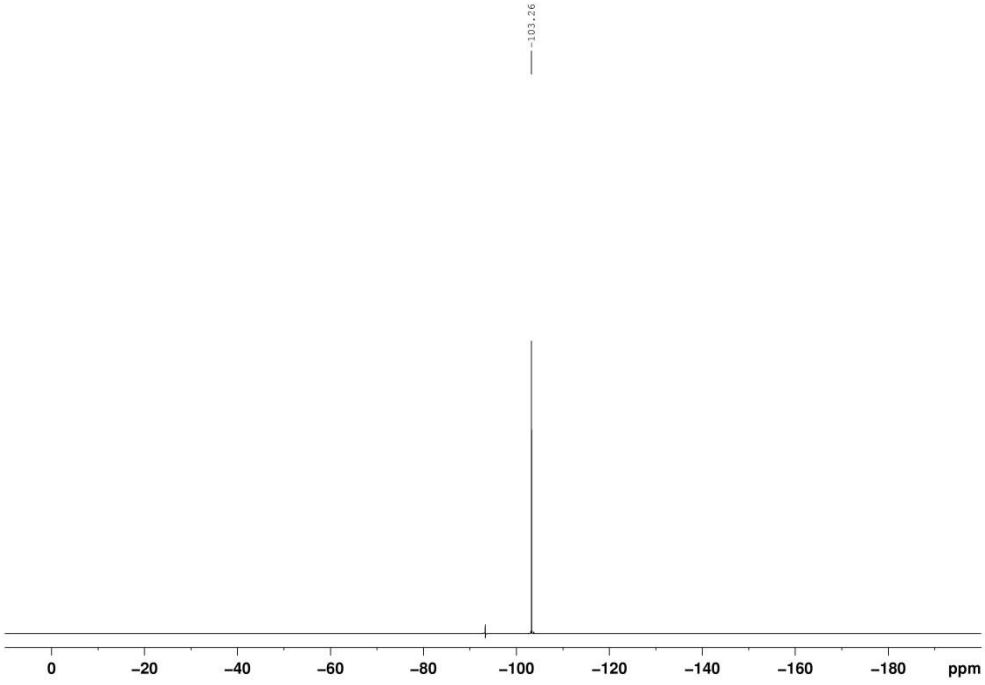
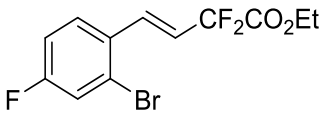
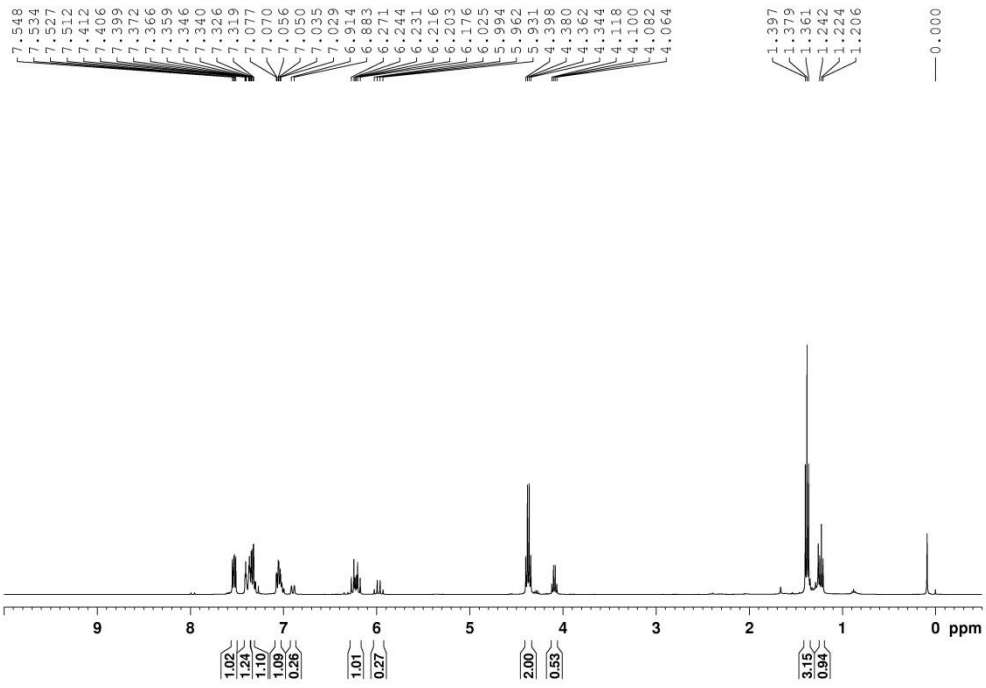
163.83
163.49
161.01
136.92
136.83
136.74
135.97
119.56
119.31
119.06
115.09
115.02
110.15
105.41
101.76
77.32
77.00
76.68
63.10
55.36
13.90
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm


-103.26
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm


CF2CO2Et
F
Br

3ab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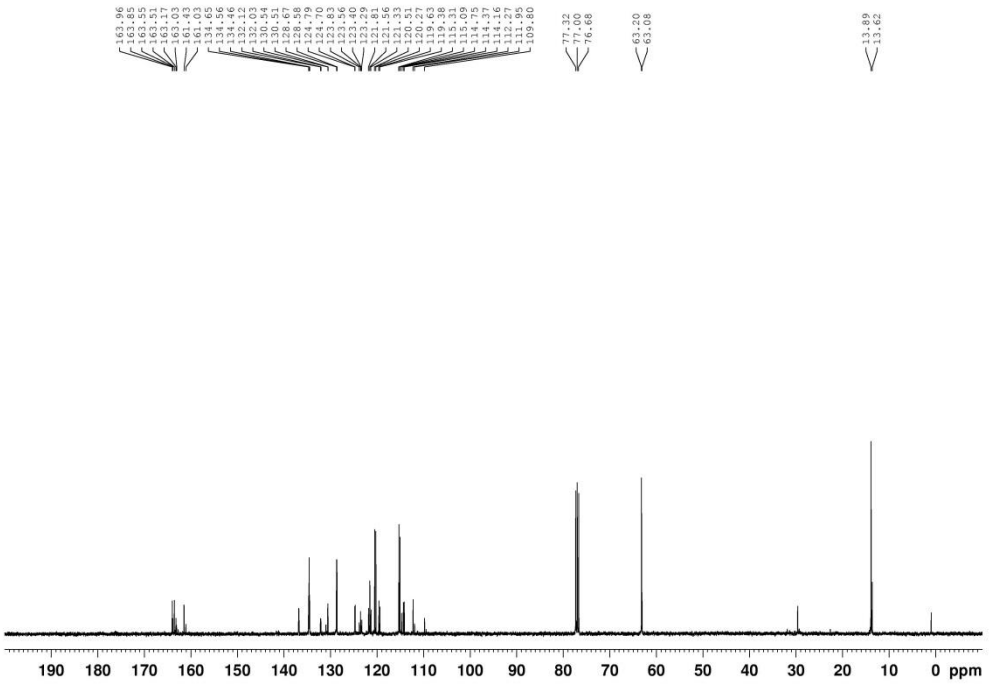
7.527
7.512
7.412
7.406
7.399
7.372
7.366
7.359
7.346
7.340
7.326
7.319
7.077
7.070
7.056
7.050
7.035
7.029
6.914
6.883
6.271
6.244
6.231
6.216
6.203
6.176
6.025
5.994
5.962
5.931
4.398
4.380
4.362
4.344
4.118
4.100
4.082
4.064
1.397
1.379
1.361
1.242
1.224
1.206
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.02
1.24
1.10
1.09
0.26
1.01
0.27
2.00
0.53
3.15
0.94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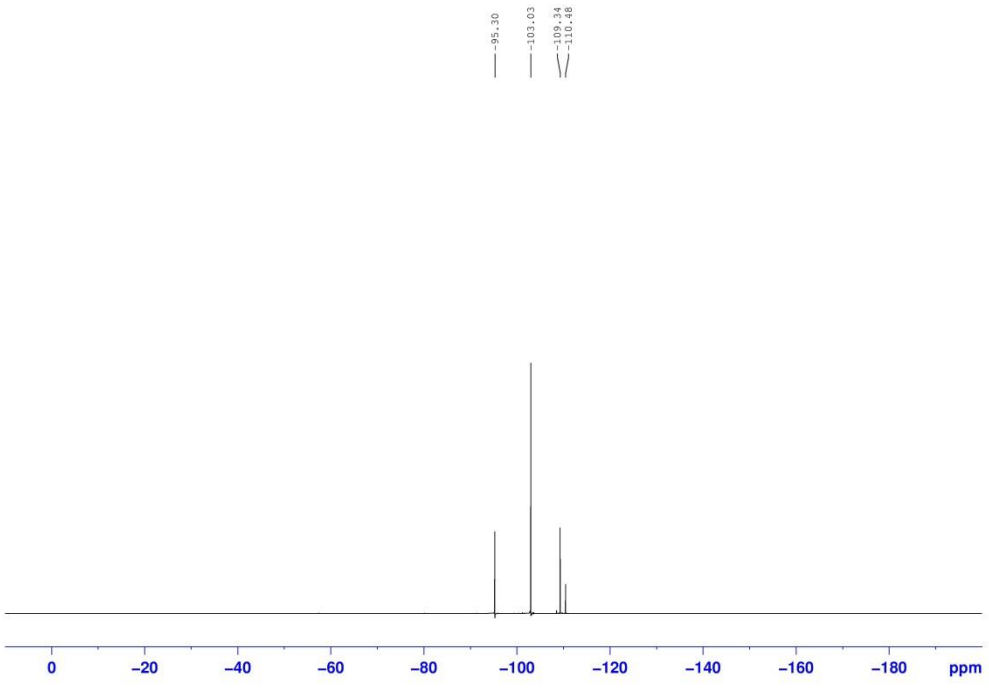
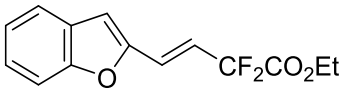
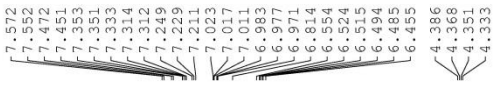
163.55
163.51
163.17
163.03
161.43
161.03
134.65
134.56
134.46
132.12
132.03
130.54
130.51
130.47
128.58
124.79
124.70
123.83
123.56
123.40
123.29
121.81
121.56
121.33
120.51
120.27
119.63
119.38
115.31
115.09
114.75
114.37
114.16
112.27
111.95
109.80
77.32
77.00
76.68
63.20
63.08
13.89
13.62
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-95.30
-103.03
-109.34
-110.48
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


O
CF2CO2Et

3ac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7.552
7.472
7.451
7.353
7.351
7.333
7.314
7.312
7.249
7.229
7.211
7.023
7.017
7.011
6.983
6.977
6.971
6.814
6.554
6.524
6.515
6.494
6.485
6.455
4.386
4.368
4.351
4.333
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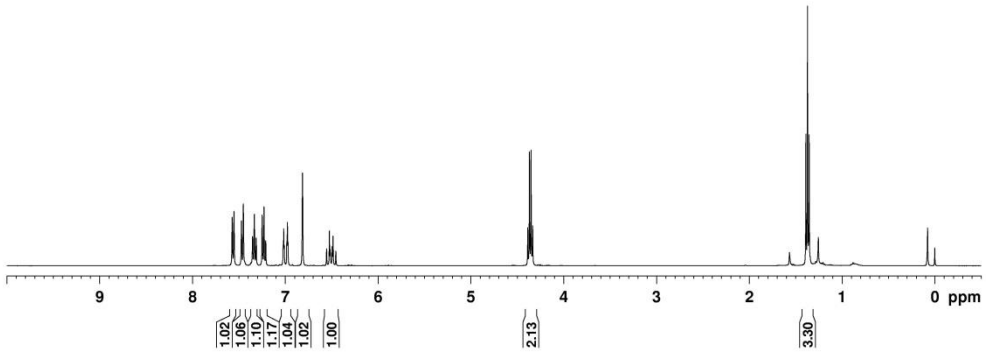
1.371
1.353
0.000


9
8
7
6
5
4
3
2
1
0 ppm
1.02
1.06
1.10
1.17
1.04
1.02
1.00
2.13
3.30


163.96
163.61
163.27
155.26
151.63
128.29
126.01
124.67
124.57
124.47
123.85
121.61
120.07
119.82
119.57
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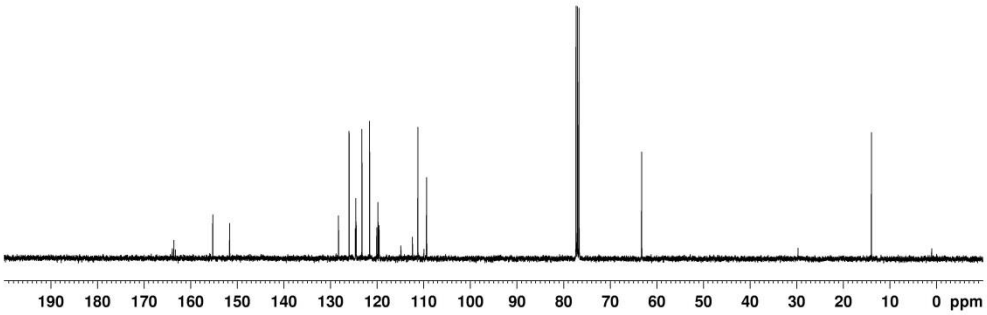
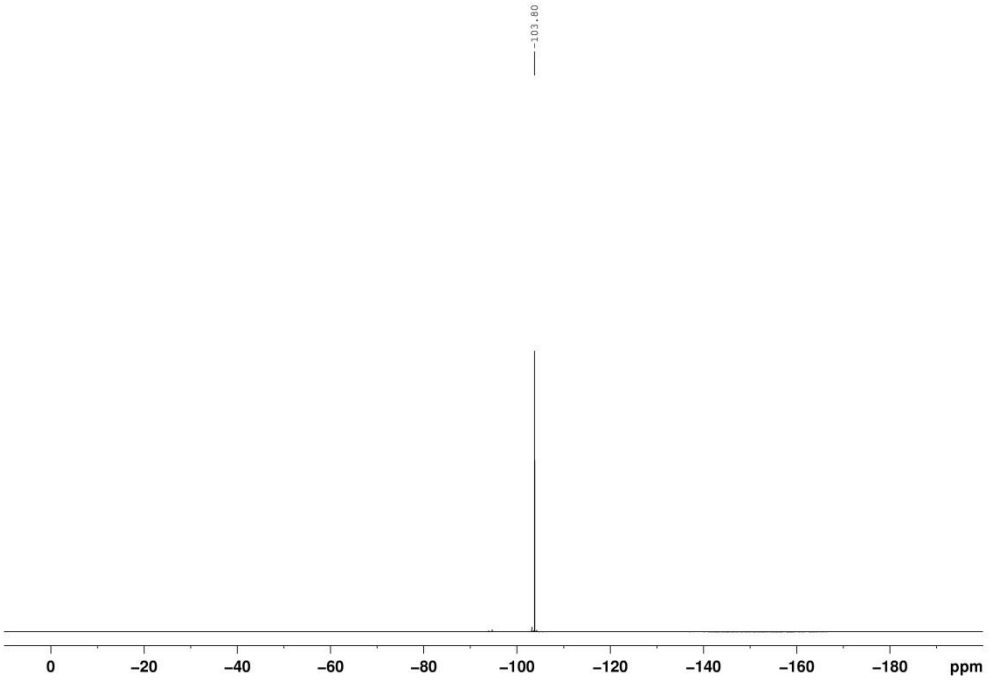
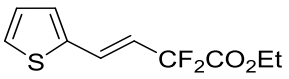
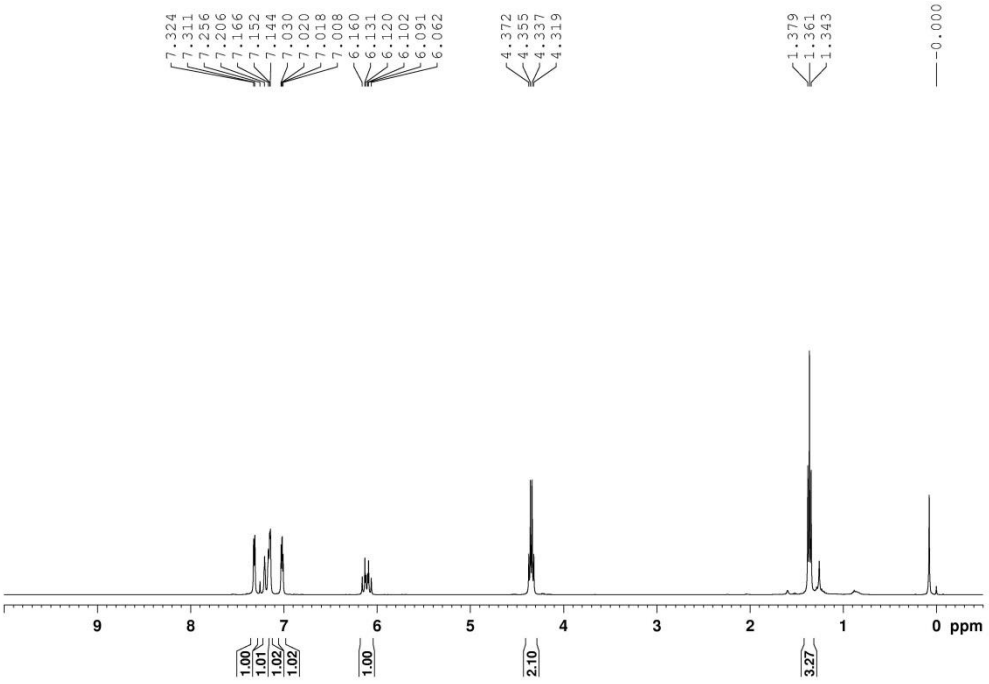
109.38
77.32
77.00
76.68
63.23
13.93


190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm


-103.80
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm


S
CF2CO2Et

3ad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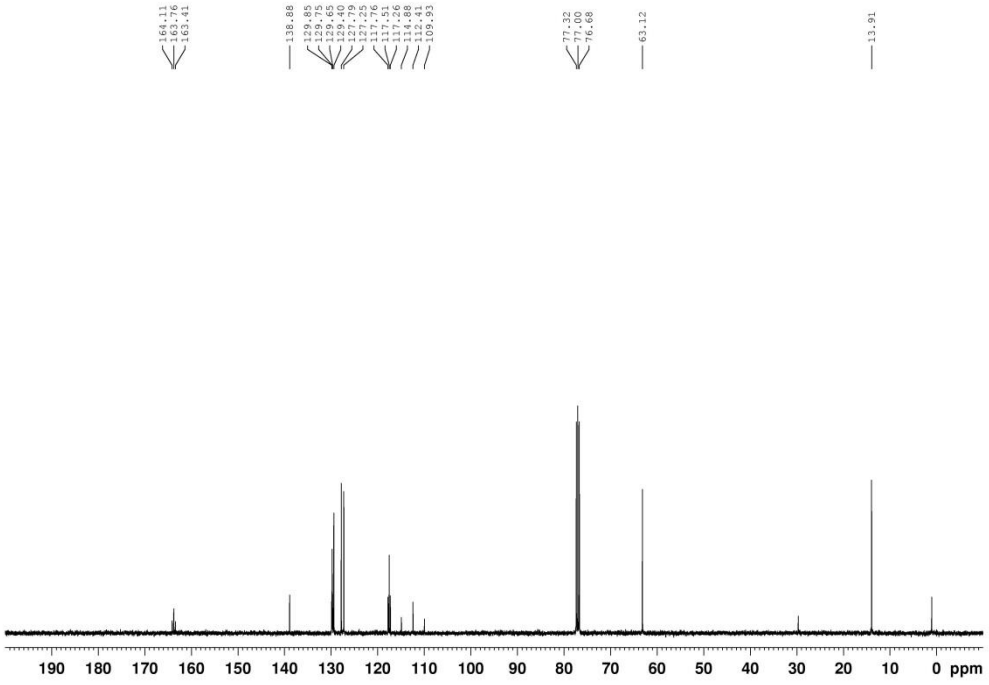
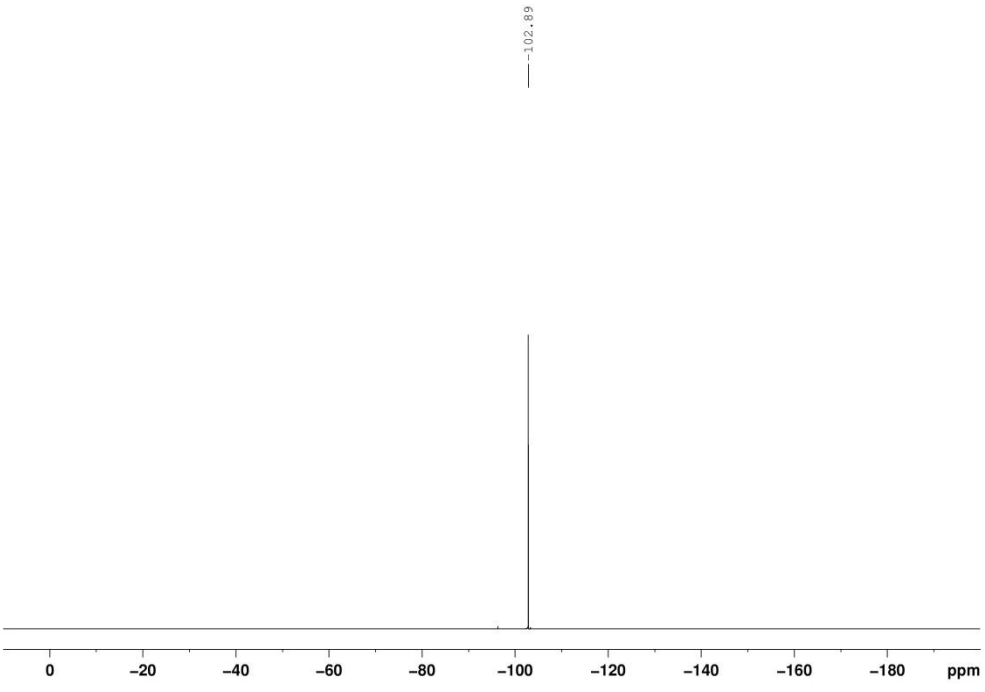
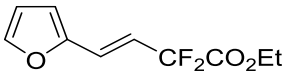
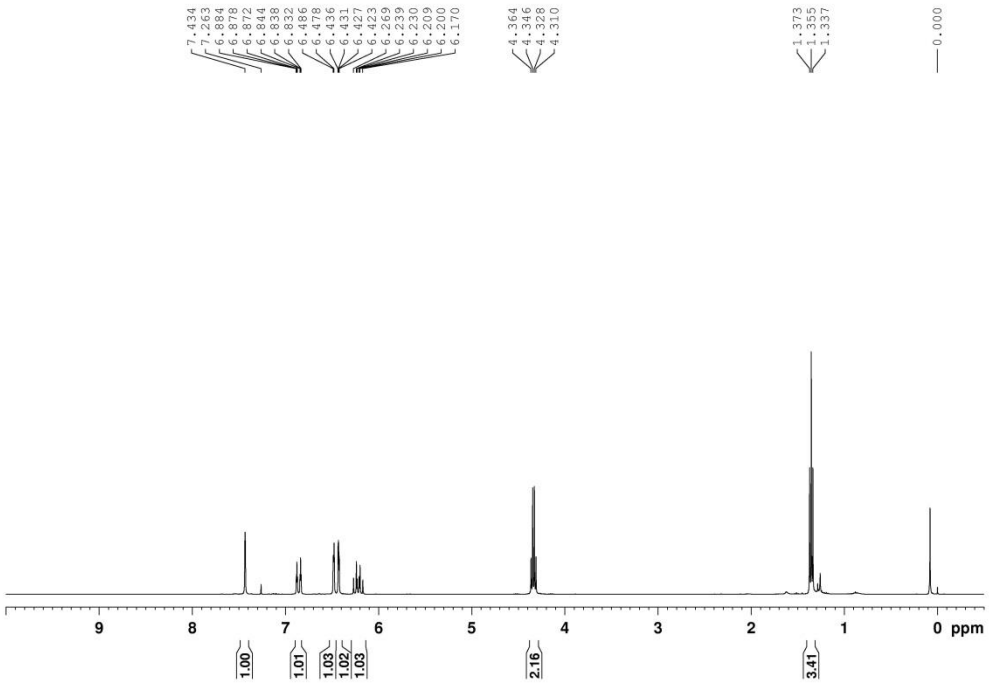
7.311
7.256
7.206
7.166
7.152
7.144
7.030
7.020
7.018
7.008
6.160
6.131
6.120
6.102
6.091
6.062
4.372
4.355
4.337
4.319
1.379
1.361
1.343
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.00
1.01
1.02
1.02
1.00
2.10
3.27


164.11
163.76
163.41
138.88
129.85
129.75
129.65
129.40
127.79
127.25
117.76
117.51
117.26
114.88
112.41
109.93
77.32
77.00
76.68
63.12
13.91
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-102.89
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm


O
CF2CO2Et

3ae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6.884
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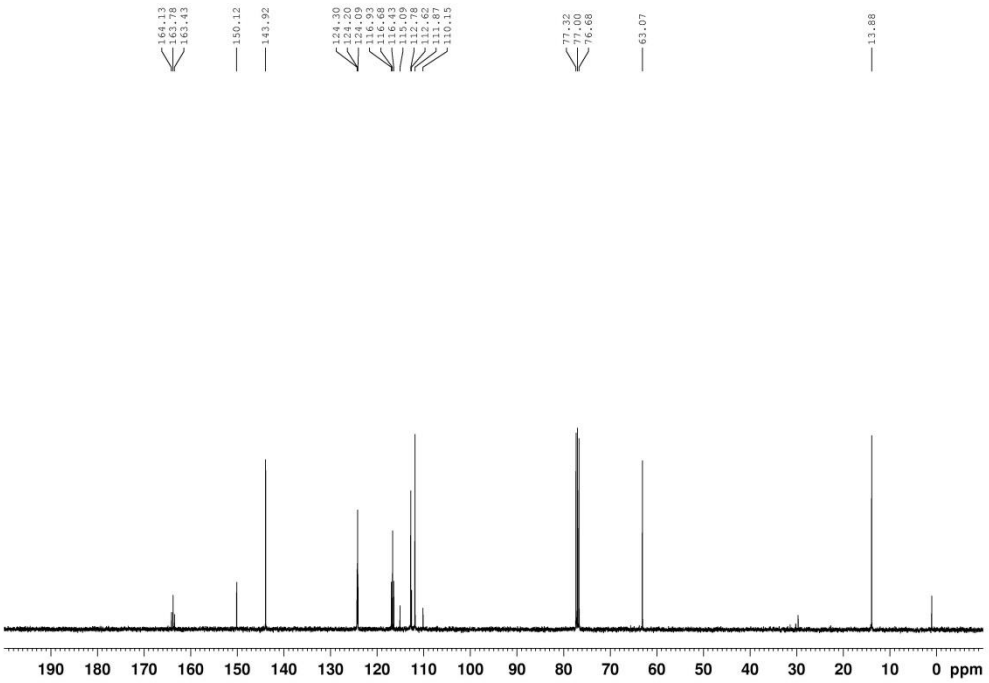
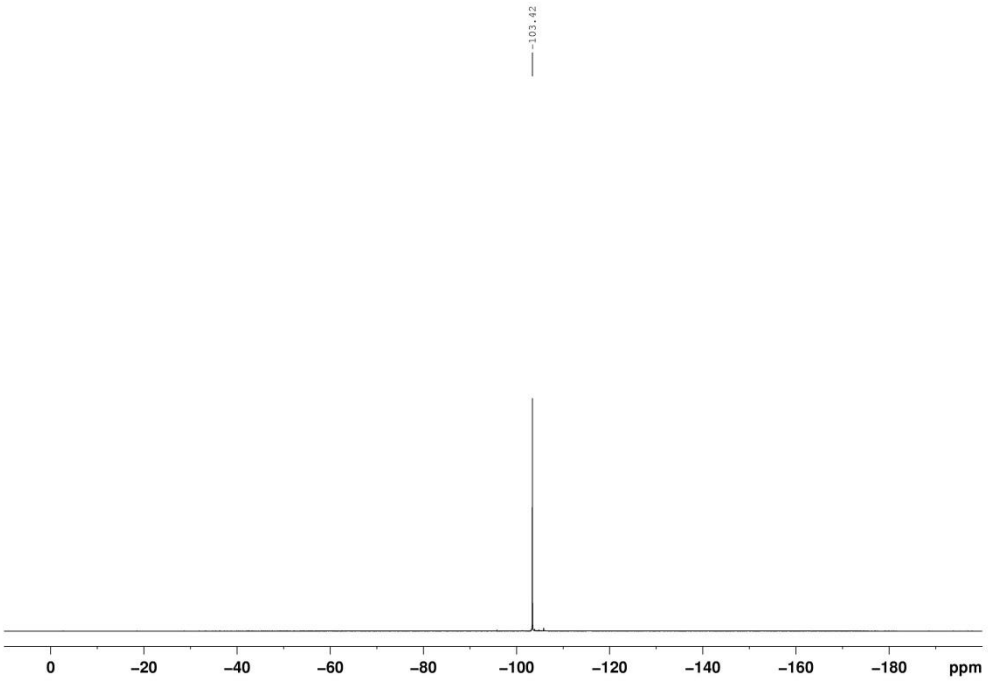
6.838
6.832
6.486
6.478
6.436
6.431
6.427
6.423
6.269
6.239
6.230
6.209
6.200
6.170
4.364
4.346
4.328
4.310
1.373
1.355
1.337
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.00
1.01
1.03
1.02
1.03
2.16
3.41


164.13
163.78
163.43
150.12
143.92
124.30
124.20
124.09
116.93
116.68
116.43
115.09
112.78
112.62
111.87
110.15
77.32
77.00
76.68
63.07
13.88
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm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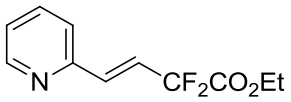
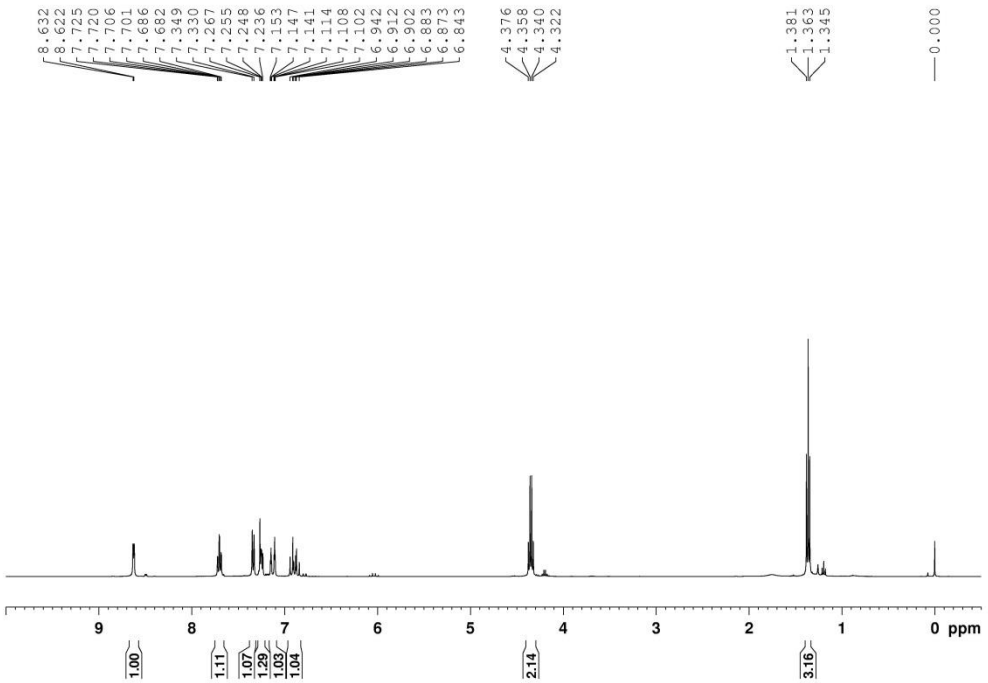
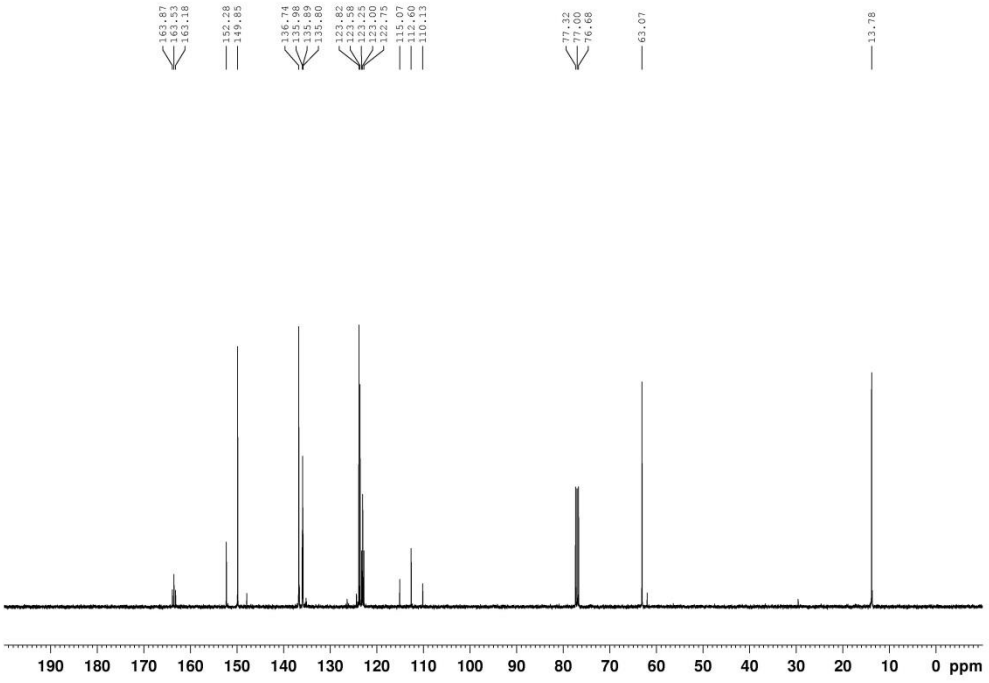
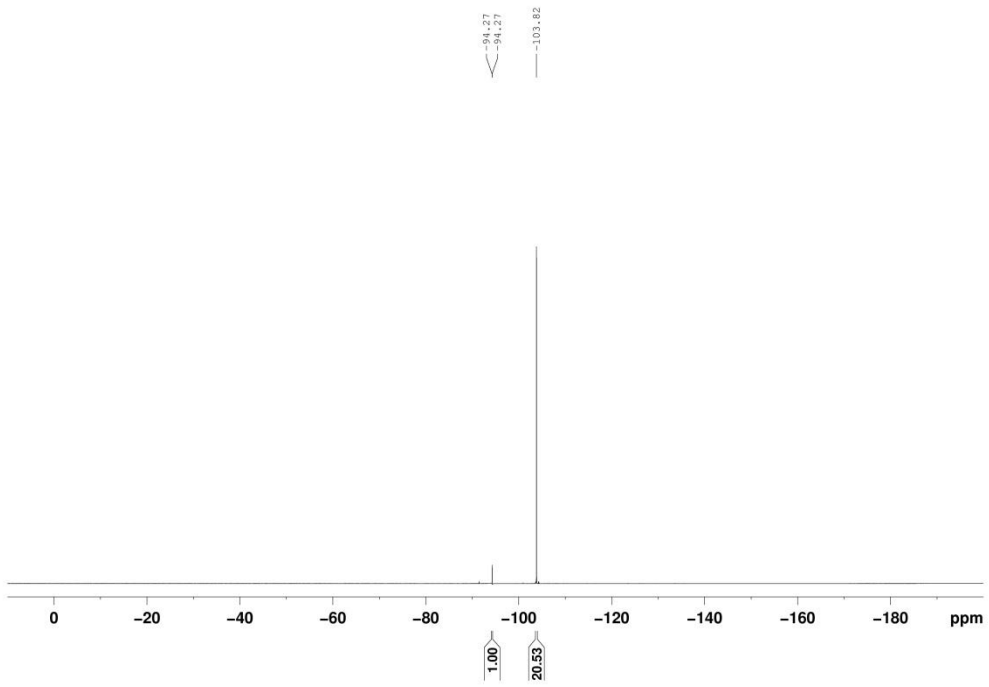
-40
-60
-80
-100
-120
-140
-160
-180
ppm


N
CF2CO2Et

3af


8.632
8.622
7.725
7.720
7.706
7.701
7.686
7.682
7.349
7.330
7.267
7.255
7.248
7.236
7.153
7.147
7.141
7.114
7.108
7.102
6.942
6.912
6.902
6.883
6.873
6.843
4.376
4.358
4.340
4.322
1.381
1.363
1.345
0.000
9
8
7
6
5
4
3
2
1
0 ppm
1.00
1.11
1.07
1.29
1.03
1.04
2.14
3.16


163.87
163.53
163.18
152.28
149.85
136.74
135.98
135.89
135.80
123.82
123.58
123.25
123.00
122.75
115.07
112.60
110.13
77.32
77.00
76.68
63.07
13.78
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


-94.27
-94.27
-103.82
0 -20 -40 -60 -80 -100 -120 -140 -160 -180 ppm
1.00
20.53