Supplementary Information for

N-Heterocyclic carbene catalyzed SuFEx reactions of fluoroalkylated secondary benzylic alcohols

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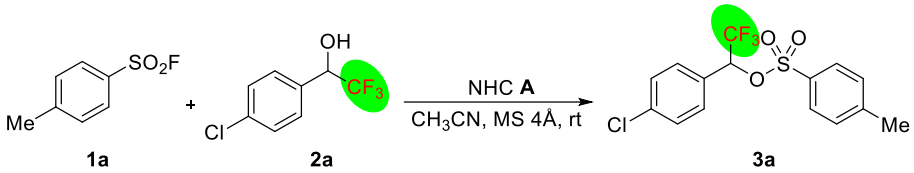
Contents

1. General experimental methods

Unless otherwise indicated, all reactions were conducted under a nitrogen atmosphere in oven-dried glassware. ^{1}H NMR (400 MHz), ^{13}C NMR (100 MHz) spectra were recorded in $CDCl_3$ on a Bruker Avance III 400 MHz spectrometer with TMS as internal standard at room temperature, the chemical shifts (δ) were expressed in ppm and J values were given in Hz. High resolution mass spectra (HRMS) were obtained on a Thermo Scientific Q Exactive mass spectrometry equipped with an ESI or EI source. All commercially available chemicals were purchased from Adamas, Alfa-Aesar and Bide Pharmatech and used as received without further purification unless otherwise stated. Sulfonyl fluorides were prepared according to literature procedures [1]. Trifluoromethyl [2], difluoromethyl [3], bromodifluoromethyl [4] and iododifluoromethyl [5], as well as pentafluoroethyl [6] substituted secondary benzylic alcohols were prepared according to the literature. Anhydrous THF, toluene, 1,4-dioxane, DCM, DCE and CH_3CN were distilled from sodium/benzophenone or calcium hydride prior to use. 4Å Molecular sieves were calcined in a muffle furnace under air at 350°C for 5h prior to use. Column chromatography was performed on silica gel (200-300 mesh). Petroleum ether (PE), where used, has a boiling point range of 60–90°C.

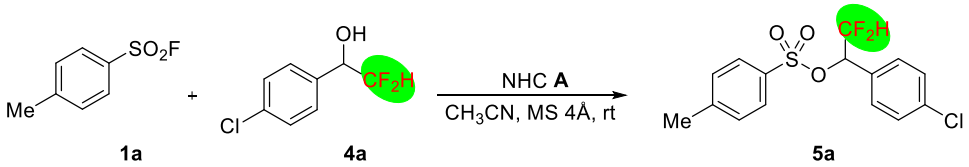
2. Typical procedure for synthesis of product 3a



1a **2a** **3a**

To a suspension of sulfonyl fluoride **1a** (0.25 mmol), secondary benzylic alcohols **2a** (0.20 mmol) and MS 4Å (200 mg) in anhydrous CH_3CN (1.0 mL) was added NHC **A** (10 mol%). The mixture was stirred at ambient temperature until full consumption of the starting alcohol **2a** indicated by TLC. The reaction mixture was then diluted with ethyl acetate, filtered through a short pad of silica gel and concentrated. The crude product was purified by flash column chromatography on silica gel to afford the desired product **3a**.

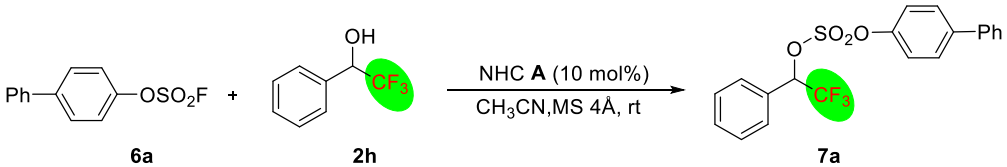
Typical procedure for synthesis of product 5a



1a **4a** **5a**

To a suspension of sulfonyl fluoride **1a** (0.25 mmol), secondary benzylic alcohols **4a** (0.20 mmol) and MS 4Å (200 mg) in anhydrous CH_3CN (1.0 mL) was added NHC **A** (10 mol%). The mixture was stirred at ambient temperature until full consumption of the starting alcohol **4a** indicated by TLC. The reaction mixture was then diluted with ethyl acetate, filtered through a short pad of silica gel and concentrated. The crude product was purified by flash column chromatography on silica gel to afford the desired product **5a**.

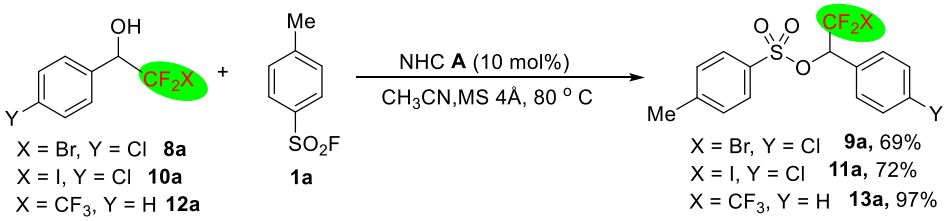
Typical procedure for synthesis of product 7a



6a **2h** **7a**

To a suspension of fluorosulfates **6a** (0.25 mmol), secondary benzylic alcohols **2h** (0.20 mmol) and MS 4Å (200 mg) in anhydrous CH_3CN (1.0 mL) was added NHC **A** (10 mol%). The mixture was stirred at ambient temperature until full consumption of the starting alcohol **2h** indicated by TLC. The reaction mixture was then diluted with ethyl acetate, filtered through a short pad of silica gel and concentrated. The crude product was purified by flash column chromatography on silica gel to afford the desired product **7a**. Increasing the catalyst loading to 20 mol %, difluoromethyl benzyl alcohols can also undergo this SuFEx to give the corresponding sulfates in good yields.

procedure for SuFEX reaction of bromodifluoromethyl, iododifluoromethyl and pentafluoroethyl



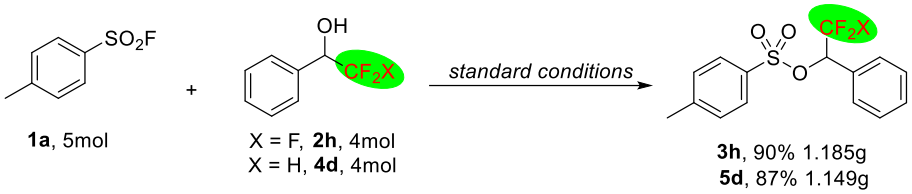
X = Br, Y = Cl **8a**
X = I, Y = Cl **10a**
X = CF_3, Y = H **12a**

1a

X = Br, Y = Cl **9a,** 69%
X = I, Y = Cl **11a,** 72%
X = CF_3, Y = H **13a,** 97%

To a suspension of sulfonyl fluoride **1a** (0.25 mmol), secondary benzylic alcohols **12a** (0.20 mmol) and MS 4Å (200 mg) in anhydrous CH_3CN (1.0 mL) was added NHC **A** 10 mol%). The mixture was stirred at ambient temperature until full consumption of the starting alcohol **12a** indicated by TLC. The reaction mixture was then diluted with ethyl acetate, filtered through a short pad of silica gel and concentrated. The crude product was purified by flash column chromatography on silica gel to afford the desired product **13a**. at a temperature of 80 degrees, bromodifluoromethyl and iododidifluoromethyl substituted secondary benzylic alcohols can also produce the desired product **9a** and **11a**.

3. Gram-scale synthesis of products:



1a, 5mol

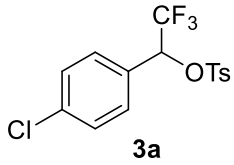
X = F, **2h**, 4mol
X = H, **4d**, 4mol

3h, 90% 1.185g
5d, 87% 1.149g

To a suspension of sulfonyl fluoride **1a** (5 mmol), secondary benzylic alcohols **2h** or **4d** (4 mmol) and MS 4Å (4 g) in anhydrous CH_3CN (20.0 mL) was added NHC **A** (10 mol%). The mixture was stirred at ambient temperature until full consumption of the starting alcohol **2h** or **4d** indicated by TLC. The reaction mixture was then diluted with ethyl acetate, filtered through a short pad of silica gel and concentrated. The crude product was purified by flash column chromatography on silica gel to afford the desired product **3h and 5d** (1.185g, 90% yield and 1.149g, 87% yield).

4. Characterization data of products

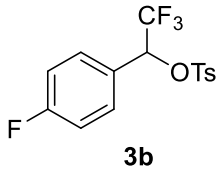
*1-(4-chlorophenyl)-2,2,2-trifluoroethyl 4-methylbenzenesulfonate(**3a**)*



3a

White solid (72.2 mg, 99% yield); mp: 79-81℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.4 Hz, 2H), 7.26 (s, 4H), 7.22 (d, *J* = 8.4 Hz, 2H), 5.67 (q, *J* = 6.0 Hz, 1H), 2.38 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 136.6, 132.9, 129.9, 129.5, 129.0, 128.3, 128.0, 122.1 (q, *J* = 279.6 Hz), 77.3 (q, *J* = 34.4 Hz), 21.6; ^{19}F NMR (75 MHz, $CDCl_3$) δ -74.22 (d, *J* = 6.2 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{13}ClF_3O_3S^+$ $[M+H]^+$ 365.0221, Found, 365.0223.

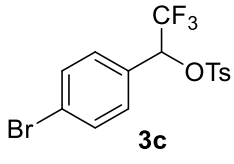
*2,2,2-trifluoro-1-(4-fluorophenyl)ethyl 4-methylbenzenesulfonate(**3b**)* [7]



3b

White solid (67.5 mg, 97% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.4 Hz, 2H), 7.32 (dd, *J* = 8.4, 5.2 Hz, 2H), 7.23 (d, *J* = 8.4 Hz, 2H), 7.00 (t, *J* = 8.4 Hz, 2H), 5.66 (q, *J* = 6.4 Hz, 1H), 2.40 (s,3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.7 (d, *J* = 250.5 Hz), 145.6, 132.9, 130.2 (d, *J* = 8.8 Hz), 129.8, 127.9, 125.7 (d, *J* = 2.7 Hz), 122.1 (q, *J* = 279.4 Hz), 115.8 (d, *J* = 22.0 Hz), 77.4 (q, *J* = 34.0 Hz), 21.6.

*1-(4-bromophenyl)-2,2,2-trifluoroethyl 4-methylbenzenesulfonate(**3c**)*

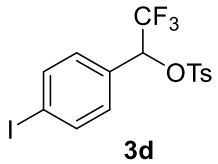


3c

White solid (81.0 mg, 99% yield); mp: 96-98℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.4 Hz, 2H), 7.44 (d, *J* = 8.4 Hz, 2H), 7.22 (dd, *J* = 16.0, 8.0 Hz, 4H), 5.63 (q, *J* = 6.0 Hz, 1H), 2.41 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 132.9, 132.0, 129.9,

129.8, 128.9, 128.0, 124.9, 122.0 (q, J = 279.6 Hz), 77.4 (q, J = 34.4 Hz), 21.8; ^{19}F NMR (75 MHz, $CDCl_3$) δ -74.09 (d, J = 7.3 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{13}BrF_3O_3S^+$ $[M+H]^+$ 408.9715, Found, 408.9711.

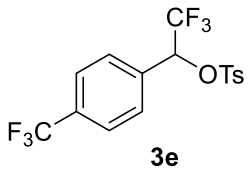
*2,2,2-trifluoro-1-(4-iodophenyl)ethyl 4-methylbenzenesulfonate(**3d**)*



3d

White solid (87.5 mg, 96% yield); mp: 121-123℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 – 7.57 (m, 4H), 7.23 (d, J = 8.0 Hz, 2H), 7.05 (d, J = 8.0 Hz, 2H), 5.61 (q, J = 6.0 Hz, 1H), 2.41 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 138.0, 132.9, 129.9, 129.9, 129.5, 128.0, 122.1 (q, J = 281.3 Hz), 77.6 (q, J = 34.6 Hz), 96.8, 21.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -74.07 (d, J = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{13}IF_3O_3S^+$ $[M+H]^+$ 456.9577, Found, 456.9574.

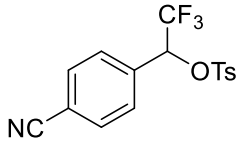
*2,2,2-trifluoro-1-(4-(trifluoromethyl)phenyl)ethyl 4-methylbenzenesulfonate(**3e**)* [8]



3e

White solid (74.8 mg, 94% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, J = 8.4 Hz, 2H), 7.57 (d, J = 8.4 Hz, 2H), 7.46 (d, J = 8.0 Hz, 2H), 7.22 (d, J = 8.0 Hz, 2H), 5.72 (q, J = 6.0 Hz, 1H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 133.6, 132.7, 132.5, 132.2, 129.8, 128.6, 128.0, 125.6, 122.8 (q, J = 116.0 Hz), 21.58.

*1-(4-cyanophenyl)-2,2,2-trifluoroethyl 4-methylbenzenesulfonate(**3f**)*

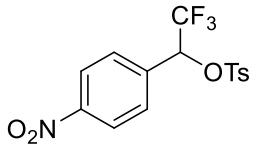


3f

White solid (62.5 mg, 88% yield); mp: 114-116℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59

(dd, *J* = 22.0, 8.4 Hz, 4H), 7.42 (d, *J* = 8.0 Hz, 2H), 7.20 (d, *J* = 8.0 Hz, 2H), 5.65 (q, *J* = 6.0 Hz, 1H), 2.35 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 146.2, 134.9, 132.6, 132.5, 130.1, 128.9, 128.1, 121.9 (q, *J* = 280.0 Hz), 117.9, 114.4, 76.8 (q, *J* = 34.4 Hz), 21.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.83 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{13}F_3NO_3S^+$ $[M+H]^+$ 356.0563, Found, 356.0568.

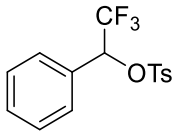
*2,2,2-trifluoro-1-(4-nitrophenyl)ethyl 4-methylbenzenesulfonate(**3g**)*



3g

White solid (55.5 mg, 74% yield); mp: 130-132°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 – 8.06 (m, 2H), 7.79 – 7.65 (m, 2H), 7.58 (d, *J* = 8.4 Hz, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 5.79 (q, *J* = 6.0 Hz, 1H), 2.42 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 149.1, 146.3, 136.6, 132.5, 130.1, 129.2, 128.1, 123.9, 121.9 (q, *J* = 280.0 Hz), 76.6 (q, *J* = 34.5 Hz), 21.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.79 (d, *J* = 6.2 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{13}F_3NO_3S^+$ $[M+H]^+$376.0461, Found, 376.0465.

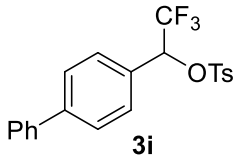
*2,2,2-trifluoro-1-phenylethyl 4-methylbenzenesulfonate(**3h**)* [9]



3h

White solid (65.3 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 8.4 Hz, 2H), 7.40-7.24 (m, 5H), 7.20 (d, *J* = 8.0 Hz, 2H), 5.67 (q, *J* = 6.4 Hz, 1H), 2.38 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.5, 133.1, 130.3, 129.8, 128.8, 128.2, 128.1, 122.4 (q, *J* = 279.5 Hz), 78.2 (q, *J* = 34.1 Hz), 21.7.

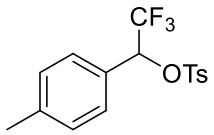
*1-([1,1'-biphenyl]-4-yl)-2,2,2-trifluoroethyl 4-methylbenzenesulfonate(**3i**)* [8]



3i

White solid (74.7 mg, 92% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, *J* = 8.4 Hz, 2H), 7.51 (dd, *J* = 10.0, 7.6 Hz, 4H), 7.44 (t, *J* = 7.2 Hz, 2H), 7.38 (d, *J* = 8.4 Hz, 3H), 7.20 (d, *J* = 8.0 Hz, 2H), 5.72 (q, *J* = 6.4 Hz, 1H), 2.35 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.5, 143.3, 140.1, 133.2, 129.8, 129.0, 128.7, 128.6, 128.1, 128.1, 127.4, 127.2, 122.4 (q, *J* = 281.2 Hz), 77.2, 78.1 (q, *J* = 34.5 Hz), 21.7.

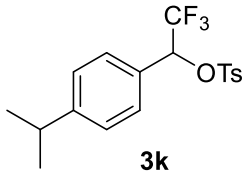
*2,2,2-trifluoro-1-(p-tolyl)ethyl 4-methylbenzenesulfonate(**3j**)* [7]



3j

White solid (68.1 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 8.4 Hz, 2H), 7.21 (d, *J* = 8.0 Hz, 4H), 7.10 (d, *J* = 8.0 Hz, 2H), 5.63 (q, *J* = 6.4 Hz, 1H), 2.39 (s, 3H), 2.32 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.4, 140.6, 133.2, 129.8, 129.4, 128.2, 128.0, 126.9, 122.4 (q, *J* = 279.4 Hz), 78.2 (q, *J* = 34.1 Hz), 21.6, 21.4.

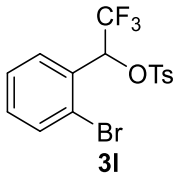
*2,2,2-trifluoro-1-(4-isopropylphenyl)ethyl 4-methylbenzenesulfonate(**3k**)* [7]



3k

White solid (70.0 mg, 94% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.4 Hz, 2H), 7.23 – 7.07 (m, 6H), 5.64 (q, *J* = 6.4 Hz, 1H), 7.79 – 7.65 (m, 1H), 2.36 (s, 3H), 1.21 (s, 3H), 1.20 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.4, 145.2, 133.3, 129.7, 128.3, 128.0, 127.0, 126.8, 122.4 (q, *J* = 279.4 Hz), 78.4 (q, *J* = 34.0 Hz), 34.0, 23.9, 23.9, 21.7.

*1-(2-bromophenyl)-2,2,2-trifluoroethyl 4-methylbenzenesulfonate(**3l**)*

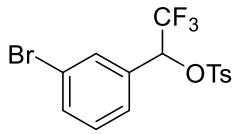


3l

White solid (77.7 mg, 95% yield); mp: 72-74°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64

(d, *J* = 8.4 Hz, 2H), 7.48 (d, *J* = 8.0 Hz, 1H), 7.37 (s, 1H), 7.27 (d, *J* = 8.0 Hz, 1H), 7.25-7.14 (m, 3H), 5.61 (q, *J* = 6.4 Hz, 1H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.9, 133.5, 132.8, 131.7, 131.1, 130.3, 129.9, 128.0, 126.9, 122.7, 122.1 (q, *J* = 279.6 Hz), 77.2 (q, *J* = 23.6 Hz), 21.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.89 (d, *J* = 6.2 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{13}BrF_3O_3S^+$ [M+H] $^+$408.9715, Found, 408.9711.

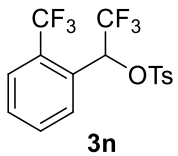
*1-(3-bromophenyl)-2,2,2-trifluoroethyl 4-methylbenzenesulfonate(**3m**)* [8]



3m

White solid (79.3 mg, 97% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 (d, *J* = 8.4 Hz, 2H), 7.50 (d, *J* = 8.0 Hz, 1H), 7.44 (d, *J* = 8.0 Hz, 1H), 7.23 (dd, *J* = 19.4, 8.0 Hz, 4H), 6.24 (q, *J* = 6.0 Hz, 1H), 2.37 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.7, 132.9, 132.5, 131.6, 123.0, 129.9, 129.8, 128.1, 127.9, 124.1, 122.3 (q, *J* = 280.1 Hz), 76.4 (q, *J* = 34.5 Hz), 21.7.

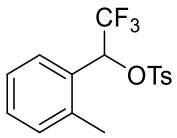
*2,2,2-trifluoro-1-(2-(trifluoromethyl)phenyl)ethyl 4-methylbenzenesulfonate(**3n**)*



3n

White solid (73.2 mg, 92% yield); mp: 68-70℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (q, *J* = 8.4, 8.0 Hz, 4H), 7.56 – 7.47 (m, 2H), 7.23 (d, *J* = 8.0 Hz, 2H), 6.11 (q, *J* = 5.6 Hz, 1H), 2.39 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 132.6, 132.4, 130.5, 130.2, 129.9, 129.1 (q, *J* = 31.0 Hz), 128.6, 128.2, 126.3 (q, *J* = 5.6 Hz), 123.6 (q, *J* = 272.3 Hz) 122.0 (q, *J* = 280.4 Hz) 73.3 (q, *J* = 31.8 Hz) 21.7. ^{19}F NMR (75 MHz, $CDCl_3$) δ -55.41 (d, *J* = 4.6 Hz), -73.49 – -73.73 (m). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{13}F_6O_3S^+$ [M+H] $^+$399.0484, Found, 399.0488.

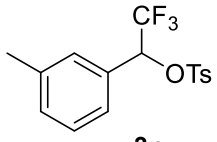
*2,2,2-trifluoro-1-(o-tolyl)ethyl 4-methylbenzenesulfonate(**3o**)* [8]



3o

White solid (66.1 mg, 96% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.4 Hz, 2H), 7.33 (d, *J* = 8.0 Hz, 1H), 7.26 – 7.20 (m, 1H), 7.18 (d, *J* = 8.0 Hz, 2H), 7.13 – 7.06 (m, 2H), 5.99 (q, *J* = 6.4 Hz, 1H), 2.37 (s, 3H), 2.36 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.4, 136.8, 133.1, 130.6, 130.1, 129.8, 128.3, 127.9, 126.5, 122.7 (q, *J* = 279.6 Hz), 74.5 (q, *J* = 34.3 Hz), 21.7, 19.3.

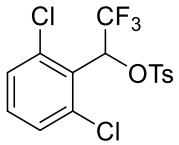
*2,2,2-trifluoro-1-(m-tolyl)ethyl 4-methylbenzenesulfonate(**3p**)* [8]



3p

White solid (67.4 mg, 98% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 8.4 Hz, 2H), 7.23 – 7.09 (m, 5H), 7.07 (s, 1H), 5.62 (q, *J* = 6.4 Hz, 1H), 2.38 (s, 3H), 2.27 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.4, 138.5, 133.2, 131.1, 129.7, 129.6, 128.8, 128.6, 128.1, 125.4, 122.4 (q, *J* = 279.4 Hz), 78.4 (q, *J* = 34.0 Hz), 21.7, 21.3.

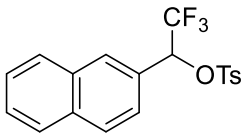
*1-(2,6-dichlorophenyl)-2,2,2-trifluoroethyl 4-methylbenzenesulfonate(**3q**)*



3q

White solid (71.8 mg, 90% yield); mp: 81-83℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 – 7.67 (m, 2H), 7.28 (dd, *J* = 6.8, 2.8 Hz, 1H), 7.21 – 7.15 (m, 4H), 6.55 (q, *J* = 7.2 Hz, 1H), 2.36 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 136.9, 136.1, 132.2, 131.6, 131.0, 129.8, 128.4, 128.1, 125.4, 122.5 (q, *J* = 281.2 Hz), 74.3 (q, *J* = 36.7 Hz), 21.7. ^{19}F NMR (75 MHz, $CDCl_3$) δ -70.36 (d, *J* = 7.3 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{12}Cl_2F_3O_3S^+$ [M+H] $^{+}$398.9831, Found, 398.9833.

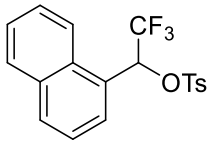
*2,2,2-trifluoro-1-(naphthalen-2-yl)ethyl 4-methylbenzenesulfonate(**3r**)* [8]



3r

White solid (75.2 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 – 7.70 (m, 4H), 7.61 (d, *J* = 8.4 Hz, 2H), 7.54 – 7.47 (m, 2H), 7.39 (d, *J* = 8.4 Hz, 1H), 7.05 (d, *J* = 8.0 Hz, 2H), 5.83 (q, *J* = 6.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.5, 134.0, 133.1, 132.6, 129.7, 128.9, 128.8, 128.4, 128.0, 127.8, 127.5, 126.9, 126.9, 124.4, 122.5 (q, *J* = 279.7 Hz), 34.2 (q, *J* = 78.6 Hz), 21.5.

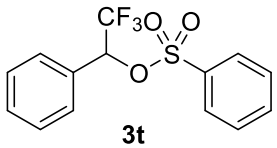
*2,2,2-trifluoro-1-(naphthalen-1-yl)ethyl 4-methylbenzenesulfonate(**3s**)* [10]



3s

White solid (74.5 mg, 98% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.4 Hz, 1H), 7.83 (d, *J* = 8.0 Hz, 2H), 7.60 – 7.48 (m, 5H), 7.35 (t, *J* = 8.0 Hz, 1H), 6.97 (d, *J* = 8.0 Hz, 2H), 6.50 (q, *J* = 6.0 Hz, 1H), 2.25 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.3, 133.5, 132.8, 130.9, 130.8, 129.5, 128.9, 127.9, 127.8, 127.4, 126.2, 125.6, 124.9, 122.7 (q, *J* = 280.0 Hz), 122.5, 21.6.

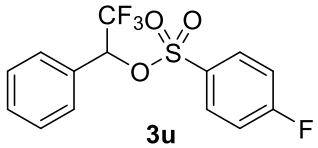
*2,2,2-trifluoro-1-phenylethyl benzenesulfonate(**3t**)* [9]



3t

White solid (61.9 mg, 98% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (dd, *J* = 8.4, 1.2 Hz, 2H), 7.50 – 7.46 (m, 1H), 7.33 (t, *J* = 8.0 Hz, 2H), 7.30 – 7.17 (m, 5H), 5.62 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 136.2, 134.3, 130.5, 129.6, 129.2, 128.8, 128.2, 128.0, 122.3 (q, *J* = 281.1 Hz), 78.5 (q, *J* = 34.4 Hz).

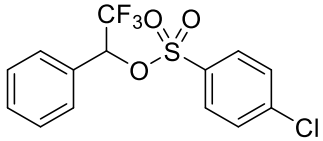
*2,2,2-trifluoro-1-phenylethyl 4-fluorobenzenesulfonate(**3u**)* [9]



3u

White solid (65.4 mg, 98% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.65 (m, 2H), 7.30 (dd, *J* = 8.8, 4.8 Hz, 1H), 7.23 (d, *J* = 4.8 Hz, 4H), 7.03 – 6.96 (m, 2H), 5.62 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 166.01 (d, *J* = 257.6 Hz), 132.30 (d, *J* = 3.3 Hz), 130.91 (d, *J* = 9.9 Hz), 130.62, 129.44, 128.88, 128.26, 122.28 (q, *J* = 279.4 Hz), 116.61 (d, *J* = 22.8 Hz), 78.64 (q, *J* = 34.5 Hz).

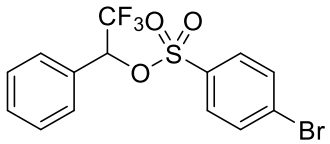
*2,2,2-trifluoro-1-phenylethyl 4-chlorobenzenesulfonate(**3v**)* [9]



3v

White solid (68.0 mg, 97% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 8.8 Hz, 2H), 7.33 – 7.26 (m, 3H), 7.23 (d, *J* = 4.4 Hz, 4H), 5.62 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 141.1, 134.7, 130.6, 129.6, 129.4, 128.9, 128.3, 122.3 (q, *J* = 281.1 Hz), 78.7 (q, *J* = 34.6 Hz).

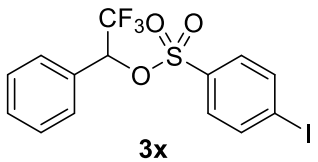
*2,2,2-trifluoro-1-phenylethyl 4-bromobenzenesulfonate(**3w**)* [9]



3w

White solid (76.6 mg, 97% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.92 – 6.82 (m, 4H), 6.72 – 6.66 (m, 1H), 6.61 (d, *J* = 4.8 Hz, 4H), 5.00 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 135.3, 132.6, 130.7, 129.7, 129.4, 129.4, 128.9, 128.3, 122.3 (q, *J* = 281.1 Hz), 78.8 (q, *J* = 34.6 Hz).

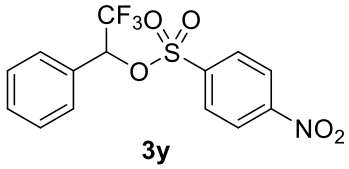
*2,2,2-trifluoro-1-phenylethyl 4-iodobenzenesulfonate(**3x**)* [9]



3x

White solid (87.5 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 – 7.70 (m, 2H), 7.46 – 7.35 (m, 3H), 7.30 (d, *J* = 5.2 Hz, 4H), 5.69 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 138.5, 135.9, 130.6, 129.3, 129.1, 128.9, 128.3, 122.2 (q, *J* = 281.1 Hz), 102.2, 78.7 (q, *J* = 34.5 Hz).

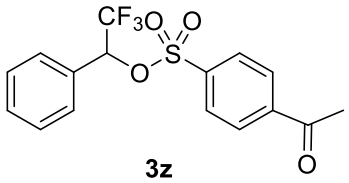
*2,2,2-trifluoro-1-phenylethyl 4-nitrobenzenesulfonate(**3y**)*



3y

White solid (56.3 mg, 78% yield); mp: 95-98℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.8 Hz, 2H), 7.92 (d, *J* = 8.8 Hz, 2H), 7.42 – 7.36 (m, 1H), 7.31 (d, *J* = 4.0 Hz, 4H), 5.77 (q, *J* = 6.0 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 150.9, 141.9, 131.0, 129.3, 129.0, 128.9, 128.4, 124.4, 122.1 (q, *J* = 281.2 Hz), 79.4 (q, *J* = 34.8 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.92 (d, *J* = 7.3 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{11}F_3NO_5S^+$ $[M+H]^+$362.0305, Found, 362.0308.

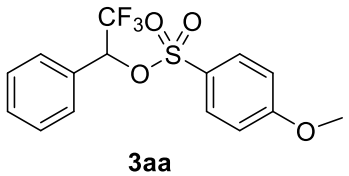
*2,2,2-trifluoro-1-phenylethyl 4-acetylbenzenesulfonate(**3z**)* [9]



3z

White solid (70.9 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 – 7.92 (m, 2H), 7.89 – 7.81 (m, 2H), 7.41 – 7.34 (m, 1H), 7.34 – 7.25 (m, 4H), 5.74 (q, *J* = 6.4 Hz, 1H), 2.62 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 196.5, 141.1, 140.0, 130.7, 129.3, 128.9, 128.3, 128.2, 122.2 (q, *J* = 281.1 Hz), 78.9 (q, *J* = 34.6 Hz), 27.0.

*2,2,2-trifluoro-1-phenylethyl 4-methoxybenzenesulfonate(**3aa**)* [9]

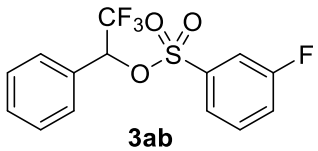


3aa

White solid (65.7 mg, 95% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.59 (m, 2H),

7.33 – 7.27 (m, 1H), 7.24 (d, *J* = 6.0 Hz, 4H), 6.82 – 6.76 (m, 2H), 5.58 (q, *J* = 6.4 Hz, 1H), 3.77 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 164.2, 130.4, 130.3, 129.9, 128.8, 128.2, 127.5, 122.4 (q, *J* = 281.2 Hz), 78.1 (q, *J* = 34.2 Hz), 114.4, 55.9.

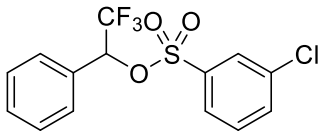
*2,2,2-trifluoro-1-phenylethyl 3-fluorobenzenesulfonate(**3ab**)*



3ab

White solid (66.1 mg, 99% yield); mp: 82-85°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.39 (m, 2H), 7.39 – 7.24 (m, 3H), 7.24 – 7.14 (m, 4H), 5.63 (qd, *J* = 6.4, 1.6 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 162.2 (d, *J* = 251.1 Hz), 138.1 (d, *J* = 7.2 Hz), 136.7 (d, *J* = 246.9 Hz), 131.7 (d, *J* = 7.9 Hz), 130.7, 129.2, 128.9, 128.3, 125.0 (q, *J* = 279.4 Hz), 123.8 (d, *J* = 3.5 Hz), 121.6 (d, *J* = 21.1 Hz), 79.0 (qd, *J* = 34.6, 8.0 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -74.05 (d, *J* = 6.1 Hz), -105.21 – -105.48 (m). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{11}F_4O_3S^+$ [M+H] $^+$335.0360, Found, 335.0365.

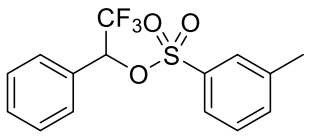
*2,2,2-trifluoro-1-phenylethyl 3-chlorobenzenesulfonate(**3ac**)*



3ac

White solid (69.4 mg, 99% yield); mp: 92-95°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 – 7.52 (m, 2H), 7.42 (d, *J* = 8.0 Hz, 1H), 7.32 – 7.24 (m, 2H), 7.22 (d, *J* = 4.4 Hz, 4H), 5.63 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 137.9, 135.4, 134.3, 130.8, 130.5, 129.1, 128.9, 128.3, 128.1, 126.0. 122.2 (q, *J* = 279.4 Hz), δ 79.0 (q, *J* = 34.7 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.89 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{11}ClF_3O_3S^+$ [M+H] $^+$351.0064, Found, 351.0066.

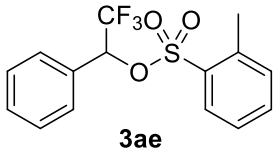
*2,2,2-trifluoro-1-phenylethyl 3-methylbenzenesulfonate(**3ad**)* [9]



3ad

White solid (65.3 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 (d, *J* = 8.0 Hz, 1H), 7.42 (s, 1H), 7.30 – 7.17 (m, 7H), 5.60 (q, *J* = 6.4 Hz, 1H), 2.22 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 139.6, 136.0, 135.0, 130.4, 129.7, 129.1, 128.7, 128.3, 128.2, 125.1, 122.4 (q, *J* = 281.0 Hz), 78.4 (q, *J* = 34.4 Hz), 21.2.

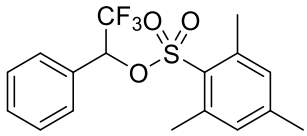
*2,2,2-trifluoro-1-phenylethyl 2-methylbenzenesulfonate(**3ae**)* [9]



3ae

White solid (64.0 mg, 97% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.38 – 7.34 (m, 1H), 7.30 – 7.21 (m, 4H), 7.21 – 7.13 (m, 3H), 5.51 (q, *J* = 6.4 Hz, 1H), 2.52 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 138.8, 134.7, 134.3, 132.7, 130.5, 129.8, 129.6, 128.8, 128.2, 126.2, 122.4 (q, *J* = 281.2 Hz), 78.3 (q, *J* = 34.3 Hz), 20.3.

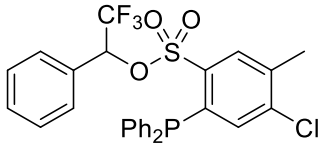
*2,2,2-trifluoro-1-phenylethyl 2,4,6-trimethylbenzenesulfonate(**3af**)*



3af

White solid (68.0 mg, 95% yield); mp: 117-119℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.24 (m, 5H), 6.87 (s, 2H), 5.59 (q, *J* = 6.4 Hz, 1H), 2.55 (s, 6H), 2.26 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 144.0, 140.0, 131.8, 131.2, 130.4, 129.9, 128.7, 128.2, 122.5 (q, *J* = 281.4 Hz), 77.8 (q, *J* = 34.1 Hz), 22.7, 21.1. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.74 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{17}H_{18}F_3O_3S^+$ $[M+H]^+$359.0923, Found, 359.0928.

*2,2,2-trifluoro-1-phenylethyl 4-chloro-2-(diphenylphosphaneyl)-5-methyl benzenesulfonate(**3ag**)*

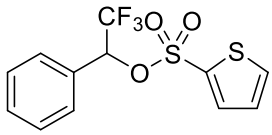


3ag

White solid (103.1 mg, 94% yield); mp: 121-123℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ

7.86 (d, *J* = 3.6 Hz, 1H), 7.43 – 7.35 (m, 6H), 7.34 – 7.26 (m, 5H), 7.24-7.19 (m, 2H), 7.09 – 7.02 (m, 2H), 6.97 (d, *J* = 2.2 Hz, 1H), 6.01 (q, *J* = 6.0 Hz, 1H), 2.34 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.8 (d, *J* = 2.6 Hz), 139.1 (d, *J* = 25.1 Hz),139.2, 138.9, 138.2, 138.0, 137.9, 136.6, 135.7 (d, *J* = 2.2 Hz), 135.6 (d, *J* = 2.3 Hz), 133.8 (d, *J* = 6.2 Hz), 133.6, 132.9 (d, *J* = 3.4 Hz), 130.3, 129.4, 129.3, 128.9, 128.9, 128.8, 128.8, 128.7, 128.5, 122.5 (q, *J* = 281.5 Hz), 79.1 (qd, *J* = 34.3, 5.9 Hz), 19.9. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.45 (d, *J* = 7.6 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{27}H_{22}ClF_3O_3PS^+$ [M+H] $^+$549.0662, Found, 549.0668.

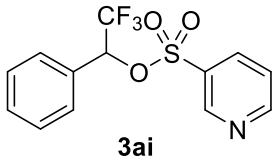
*2,2,2-trifluoro-1-phenylethyl thiophene-2-sulfonate(**3ah**)*



3ah

White solid (63.8 mg, 99% yield); mp: 78-80℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.49 (m, 2H), 7.41 – 7.27 (m, 5H), 6.96 (dd, *J* = 5.2, 4.0 Hz, 1H), 5.70 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 135.6, 135.1, 134.7, 130.6, 129.4, 128.8, 128.2, 127.6, 122.2 (q, *J* = 281.2 Hz), 79.1 (q, *J* = 34.5 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -74.06 (d, *J* = 7.3 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{12}H_{10}F_3O_3S_2^+$ [M+H] $^+$323.0018, Found, 323.0011.

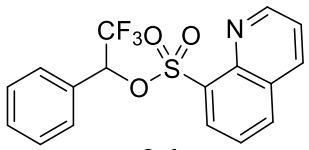
*2,2,2-trifluoro-1-phenylethyl pyridine-3-sulfonate(**3ai**)*



3ai

White solid (62.8 mg, 99% yield); mp: 79-81℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.94 (d, *J* = 2.4 Hz, 1H), 8.76 (dd, *J* = 4.8, 1.6 Hz, 1H), 8.00 – 7.97 (m, 1H), 7.42 – 7.27 (m, 6H), 5.77 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 154.6, 148.6, 135.4, 133.3, 130.9, 129.0, 128.9, 128.3, 122.2 (q, *J* = 281.2 Hz), 123.7, 79.1 (q, *J* = 34.7 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -74.03 (d, *J* = 6.6 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{13}H_{11}F_3NO_3S^+$ [M+H] $^+$318.0406, Found, 318.0401.

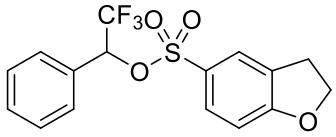
*2,2,2-trifluoro-1-phenylethyl quinoline-8-sulfonate(**3aj**)*



3aj

White solid (71.2 mg, 97% yield); mp: 92-94℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.94 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.46 (dd, *J* = 7.2, 1.6 Hz, 1H), 8.16 (dd, *J* = 8.4, 1.6 Hz, 1H), 8.04 (dd, *J* = 8.2, 1.6 Hz, 1H), 7.58 (t, *J* = 7.6 Hz, 1H), 7.47 (dd, *J* = 8.4, 4.4 Hz, 1H), 7.36 (d, *J* = 7.2 Hz, 2H), 7.28 – 7.14 (m, 3H), 6.42 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 151.8, 143.6, 136.4, 135.2, 134.4, 133.2, 130.6, 129.9, 128.9, 128.3, 128.1, 125.4 (q, *J* = 279.7 Hz), 125.3, 122.5, 79.8 (q, *J* = 33.9 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -74.07 (d, *J* = 6.2 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{17}H_{13}F_3NO_3S^+$ [M+H]$^+$368.0563, Found, 368.0566.

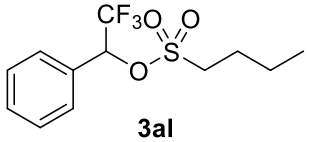
*2,2,2-trifluoro-1-phenylethyl 2,3-dihydrobenzofuran-5-sulfonate(**3ak**)* [9]



3ak

White solid (70.2 mg, 98% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.49 (s, 1H), 7.39 – 7.25 (m, 5H), 6.72 (d, *J* = 8.4 Hz, 1H), 5.63 (q, *J* = 6.4 Hz, 1H), 4.63 (t, *J* = 8.8 Hz, 2H), 3.13 (t, *J* = 8.8 Hz, 2H).^{13}C NMR (100 MHz, $CDCl_3$) δ 165.2, 130.3, 130.0, 129.9, 128.7, 128.6, 128.3, 127.1, 125.4, 122.4 (q, *J* = 281.1 Hz), 109.6, 72.6, 78.0 (q, *J* = 34.3 Hz), 28.3.

*2,2,2-trifluoro-1-phenylethyl butane-1-sulfonate(**3al**)*

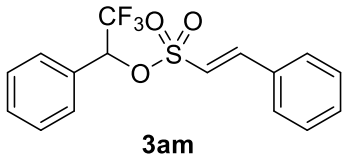


3al

White solid (54.5 mg, 92% yield); mp: 58-60℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 – 7.30 (m, 5H), 5.69 (q, *J* = 6.4 Hz, 1H), 3.03 – 2.84 (m, 2H), 1.71 – 1.63 (m, 7.2 Hz, 2H), 1.32 – 1.19 (m, 2H), 0.76 (t, *J* = 7.2 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 130.8,

130.1, 129.1, 128.2, 122.5 (q, J = 281.1 Hz), 77.7 (q, J = 34.4 Hz),52.1, 25.2, 21.2, 13.3. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.96 (d, *J* = 7.4 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{12}H_{16}F_3O_3S^+$ [M+H] $^+$297.0767, Found, 297.0764.

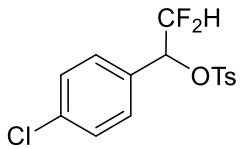
*2,2,2-trifluoro-1-phenylethyl (E)-2-phenylethene-1-sulfonate(**3am**)*



3am

White solid (67.0 mg, 98% yield); mp: 115-117°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 – 7.46 (m, 3H), 7.46 – 7.42 (m, 1H), 7.42 – 7.35 (m, 5H), 7.32 (dd, *J* = 8.4, 1.2 Hz, 2H), 6.51 (d, *J* = 15.6 Hz, 1H), 5.70 (q, *J* = 6.4 Hz, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.6, 131.9, 131.7, 130.7, 130.0, 129.3, 129.1, 128.7, 128.4, 121.5, 122.5 (q, *J* = 281.0 Hz), 78.4 (q, *J* = 34.3 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.75 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{14}F_3O_3S^+$ [M+H] $^+$343.0610, Found, 343.0618.

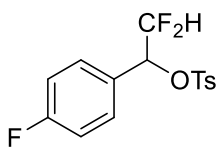
*1-(4-chlorophenyl)-2,2-difluoroethyl 4-methylbenzenesulfonate(**5a**)*



5a

White solid (67.2 mg, 97% yield); mp: 64-66°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.60 (m, 2H), 7.30 – 7.16 (m, 6H), 6.04 – 5.75 (m, 1H), 5.49 – 5.43 (m, 1H), 2.40 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.6, 136.0, 133.2, 129.9, 129.5, 129.0, 128.0, 112.80 (t, *J* = 247.5 Hz), 79.00 (t, *J* = 27.2 Hz), 21.7. ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.15 – -125.42 (m). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{14}ClF_2O_3S^+$ [M+H] $^+$347.0315, Found, 347.0318.

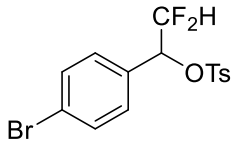
*2,2-difluoro-1-(4-fluorophenyl)ethyl 4-methylbenzenesulfonate(**5b**)* [11]



5b

White solid (65.3 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.4 Hz, 2H), 7.30 – 7.18 (m, 4H), 7.05 – 6.93 (m, 2H), 6.04 – 5.75 (m, 1H), 5.50 – 5.44 (m, 1H), 2.40 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 163.6 (d, *J* = 249.6 Hz), 145.5, 133.3, 130.1 (d, *J* = 8.8 Hz), 129.9, 128.0, 126.9, 115.8 (d, *J* = 22.0 Hz), 112.9 (t, *J* = 247.2 Hz), 79.1 (t, *J* = 27.2 Hz), 21.7.

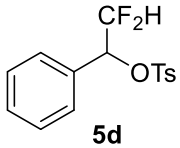
*1-(4-bromophenyl)-2,2-difluoroethyl 4-methylbenzenesulfonate(**5c**)*



5c

Yellow oil (77.4 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.59 (m, 2H), 7.46 – 7.37 (m, 2H), 7.23 (d, *J* = 8.0 Hz, 2H), 7.17 – 7.07 (m, 2H), 6.03 – 5.75 (m, 1H), 5.47 – 5.41 (m, 1H), 2.41 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.6, 133.2, 131.9, 129.9, 129.7, 128.0, 124.3, 112.7 (t, *J* = 247.6 Hz), 79.1 (t, *J* = 27.2 Hz), 21.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -123.83 – -125.10 (m). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{14}BrF_2O_3S^+$ $[M+H]^+$390.9810, Found, 390.9815.

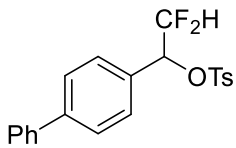
*2,2-difluoro-1-phenylethyl 4-methylbenzenesulfonate(**5d**)* [11]



5d

White solid (61.8 mg, 99% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 8.4 Hz, 2H), 7.35 – 7.22 (m, 5H), 7.19 (d, *J* = 8.0 Hz, 2H), 6.04 – 5.76 (m, 1H), 5.51 – 5.45 (m, 1H), 2.37 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.3, 133.4, 130.9 (dd, *J* = 2.6, 1.5 Hz), 129.8, 129.8, 128.7, 128.0, 128.0, 113.1 (dd, *J* = 248.1, 246.7 Hz), 79.9 (t, *J* = 26.9 Hz), 21.7.

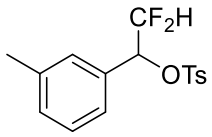
*1-([1,1'-biphenyl]-4-yl)-2,2-difluoroethyl 4-methylbenzenesulfonate(**5e**)* [8]



5e

White solid (68.3 mg, 88% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.55 (m, 2H), 7.48 – 7.40 (m, 4H), 7.40 – 7.33 (m, 2H), 7.33 – 7.21 (m, 3H), 7.16 – 7.09 (m, 2H), 6.02 – 5.73 (m, 1H), 5.49 – 5.43 (m, 1H), 2.29 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.3, 142.9, 140.3, 133.5, 129.8, 129.0, 128.6, 128.1, 128.0, 127.4, 127.2, 114.3 (t, *J* = 245.7 Hz), 79.8 (t, *J* = 27.0 Hz), 21.8.

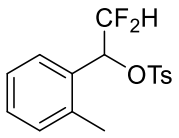
*2,2-difluoro-1-(m-tolyl)ethyl 4-methylbenzenesulfonate(**5f**)*



5f

Yellow oil (63.9 mg, 98% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 8.4 Hz, 2H), 7.23 – 7.10 (m, 4H), 7.05 (d, *J* = 7.6 Hz, 1H), 7.01 (s, 1H), 6.03 – 5.75 (m, 1H), 5.47 – 5.40 (m, 1H), 2.38 (s, 3H), 2.26 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.2, 138.5, 133.5, 130.6, 130.8 (q, *J* = 1.6 Hz), 129.7, 128.6, 128.6, 128.0, 125.2, 113.1 (dd, *J* = 248.2, 246.5 Hz), 80.1 (dd, *J* = 27.6, 26.2 Hz), 21.7, 21.3. ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.01 – -125.05 (m). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{17}F_2O_3S^+$ $[M+H]^+$327.0861, Found, 327.0865.

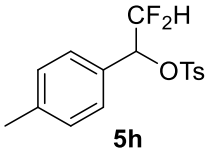
*2,2-difluoro-1-(o-tolyl)ethyl 4-methylbenzenesulfonate(**5g**)*



5g

Yellow oil (62.6 mg, 96% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.56 (m, 2H), 7.27 – 7.22 (m, 1H), 7.22 – 7.14 (m, 3H), 7.09 (d, *J* = 7.6 Hz, 2H), 6.08 – 5.81 (m, 1H), 5.81 – 5.73 (m, 1H), 2.36 (s, 3H), 2.32 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.2, 136.7, 133.4, 130.6, 129.7, 129.6, 129.5, 128.2, 127.9, 126.4, 113.6 (dd, *J* = 248.7, 245.7 Hz), 76.5 (dd, *J* = 28.8, 26.7 Hz), 21.7, 19.4. ^{19}F NMR (75 MHz, $CDCl_3$) δ -122.97 – -124.01 (m). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{17}F_2O_3S^+$ $[M+H]^+$327.0861, Found, 327.0863.

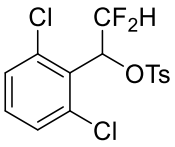
*2,2-difluoro-1-(p-tolyl)ethyl 4-methylbenzenesulfonate(**5h**)* [11]



5h

White solid (64.6 mg, 99% yield); mp: 68-70℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 – 7.60 (m, 2H), 7.20 (d, *J* = 7.9 Hz, 2H), 7.17 – 7.05 (m, 4H), 6.03 – 5.74 (m, 1H), 5.47 – 5.41 (m, 1H), 2.38 (s, 3H), 2.31 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.2, 140.0, 133.5, 129.8, 129.4, 128.0, 127.9, 113.1 (dd, *J* = 247.9, 246.4 Hz), 80.1 (t, *J* = 26.4 Hz), 21.7, 21.3.

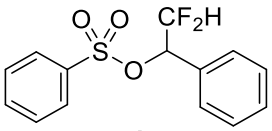
*1-(2,6-dichlorophenyl)-2,2-difluoroethyl 4-methylbenzenesulfonate(**5i**)*



5i

White solid (68.6 mg, 90% yield); mp: 123-125℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.66 (m, 2H), 7.30 – 7.11 (m, 5H), 6.59 – 6.22 (m, 2H), 2.36 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.41, 136.2 (d, *J* = 213.5 Hz), 132.7, 131.5, 129.7, 129.4 (d, *J* = 136.9 Hz), 127.5 (d, *J* = 6.8 Hz), 128.0, 111.8 (dd, *J* = 251.4, 241.2 Hz), 76.5 (dd, *J* = 35.9, 29.1 Hz), 21.7. ^{19}F NMR (75 MHz, $CDCl_3$) δ -121.04 – -122.32 (m). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{13}ClF_2O_3S^+$ [M+H] $^+$380.9925, Found, 380.9929.

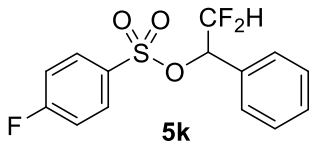
*2,2-difluoro-1-phenylethyl benzenesulfonate(**5j**)*



5j

White solid (58.4 mg, 98% yield); mp: 84-86℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 – 7.70 (m, 2H), 7.57 – 7.50 (m, 1H), 7.44 – 7.36 (m, 2H), 7.35 – 7.22 (m, 5H), 6.06 – 5.77 (m, 1H), 5.55 – 5.48 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 136.4, 134.1,130.8, 130.0, 129.2, 128.8, 128.0, 127.9, 113.0 (dd, *J* = 248.1, 246.7 Hz), 80.3 (t, *J* = 26.6 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.09 – -124.97 (m). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{13}F_2O_3S^+$ [M+H] $^+$299.0548, Found, 299.0544.

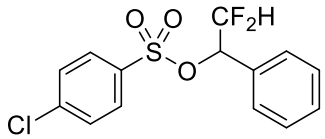
*2,2-difluoro-1-phenylethyl 4-fluorobenzenesulfonate(**5k**)*



5k

White solid (60.7 mg, 96% yield); mp: 50-52℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 – 7.65 (m, 2H), 7.39 – 7.20 (m, 5H), 7.12 – 7.00 (m, 2H), 6.06 – 5.78 (m, 1H), 5.55 – 5.49 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.9 (d, *J* = 257.3 Hz), 132.6 (d, *J* = 3.3 Hz), 130.9 (d, *J* = 9.7 Hz), 130.7, 130.1, 128.9, 128.1. 116.5 (d, *J* = 22.8 Hz), 113.0 (dd, *J* = 248.4, 246.6 Hz), 80.4 (dd, *J* = 27.7, 26.2 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -100.35 – -100.77 (m), -124.22 – -125.76 (m). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{17}F_2O_3S^+$ [M+H] $^{+}$317.0454, Found, 317.0458.

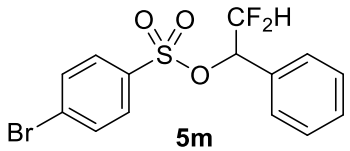
*2,2-difluoro-1-phenylethyl 4-chlorobenzenesulfonate(**5l**)*



5l

Yellow oil (63.2 mg, 95% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 – 7.61 (m, 2H), 7.41 – 7.33 (m, 3H), 7.33 – 7.27 (m, 2H), 7.24 (d, *J* = 8.0 Hz, 2H), 6.06 – 5.78 (m, 1H), 5.55 – 5.49 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 140.8, 135.0, 130.6, 130.1, 129.5, 129.4, 128.9, 128.1, 113.0 (dd, *J* = 248.4, 246.7 Hz), 80.5 (dd, *J* = 27.7, 26.2 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.08 – -125.36 (m). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{12}ClF_2O_3S^+$ [M+H] $^{+}$333.0158, Found, 33.0155.

*2,2-difluoro-1-phenylethyl 4-bromobenzenesulfonate(**5m**)*

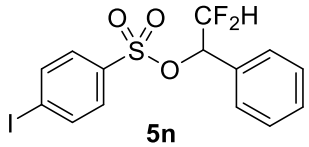


5m

White solid (72.4 mg, 96% yield); mp: 81 – 83℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.47 (m, 4H), 7.39 – 7.18 (m, 5H), 6.06 – 5.78 (m, 1H), 5.55 – 5.49 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 135.5, 132.5, 130.6, 130.1, 129.4, 129.3, 128.9, 128.1, 113.0 (dd, *J* = 248.4, 246.7 Hz), 80.5 (dd, *J* = 27.6, 26.2 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.12 – -125.39 (m). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{12}BrF_2O_3S^+$ [M+H] $^{+}$376.9653, Found,

376.9655.

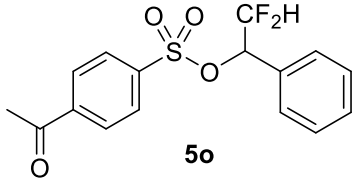
*2,2-difluoro-1-phenylethyl 4-iodobenzenesulfonate(**5n**)*



5n

White solid (82.2 mg, 97% yield); mp: 92-94℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.69 (m, 2H), 7.46 – 7.39 (m, 2H), 7.39 – 7.32 (m, 1H), 7.32 – 7.20 (m, 4H), 6.06 – 5.78 (m, 1H), 5.54-5.48 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 138.4, 136.2, 130.6, 130.1, 129.1, 128.9, 128.1, 112.9 (dd, *J* = 248.4, 246.7 Hz), 101.9, 80.5 (dd, *J* = 27.6, 26.1 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.07 – -125.35 (m). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{12}F_2IO_3S^+$ $[M+H]^+$424.9514, Found, 424.9511.

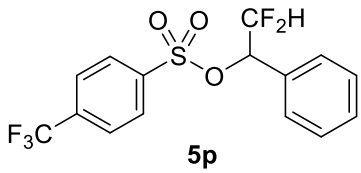
*2,2-difluoro-1-phenylethyl 4-acetylbenzenesulfonate(**5o**)*



5o

White solid (63.9 mg, 94% yield); mp: 87-89℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 – 7.90 (m, 2H), 7.87 – 7.75 (m, 2H), 7.37 – 7.21 (m, 5H), 6.07 – 5.79 (m, 1H), 5.59 – 5.53 (m, 1H), 2.61 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 196.6, 140.9, 140.2, 130.5, 130.2, 128.9, 128.8, 128.3, 128.1, 112.9 (dd, *J* = 248.5, 246.7 Hz), 80.7 (dd, *J* = 27.8, 26.0 Hz), 27.0. ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.02 – -125.05 (m). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{15}F_2O_4S^+$ $[M+H]^+$341.0654, Found, 341.0655.

*2,2-difluoro-1-phenylethyl 4-(trifluoromethyl)benzenesulfonate(**5p**)*

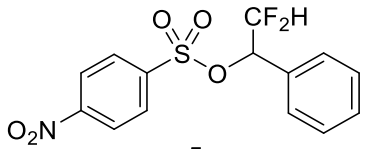


5p

White solid (67.3 mg, 92% yield); mp: 59-61℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (dd, *J* = 85.2, 8.0 Hz, 4H), 7.36 – 7.30 (m, 1H), 7.29 – 7.19 (m, 4H), 6.08 – 5.80 (m, 1H), 5.59 – 5.53 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 140.2, 130.3, 128.9, 128.5,

128.2, 135.6 (q, J = 33.2 Hz), 126.2 (q, J = 3.7 Hz), 123.1 (q, J = 273.1 Hz), 112.9 (dd, J = 248.5, 246.7 Hz), 81.0 (dd, J = 27.8, 26.1 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.28 – -125.58 (m). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{12}F_5O_3S^+$ [M+H] $^+$367.0422, Found, 367.0423.

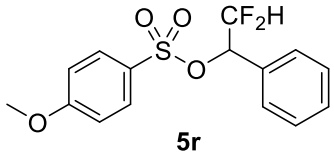
*2,2-difluoro-1-phenylethyl 4-nitrobenzenesulfonate(**5q**)*



5q

White solid (51.4 mg, 75% yield); mp: 98-100℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 – 8.16 (m, 2H), 7.95 – 7.87 (m, 2H), 7.39 – 7.22 (m, 5H), 6.09-5.81 (m, 1H), 5.64 – 5.57 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 150.7, 142.2, 130.5, 130.2, 129.3, 129.0, 128.2, 124.2, 112.8 (dd, J = 248.7, 246.8 Hz), 81.3 (dd, J = 27.8, 25.9 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.22 – -125.25 (m). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{12}F_2NO_5S^+$ [M+H] $^+$344.0399, Found, 344.0394.

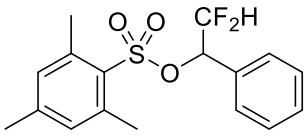
*2,2-difluoro-1-phenylethyl 4-methoxybenzenesulfonate(**5r**)*



5r

White solid (59.7 mg, 91% yield); mp: 85-87℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 – 7.63 (m, 2H), 7.38 – 7.19 (m, 5H), 6.91 – 6.81 (m, 2H), 6.05 – 5.76 (m, 1H), 5.49 – 5.43 (m, 1H), 3.82 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 164.0, 131.0, 130.3, 129.8, 128.7, 128.0, 127.7, 114.4, 114.4 (t, J = 245.7 Hz), 79.8 (t, J = 26.9 Hz), 55.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.14 – -125.42 (m). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{15}F_2O_4S^+$ [M+H] $^+$329.0654, Found, 329.0658.

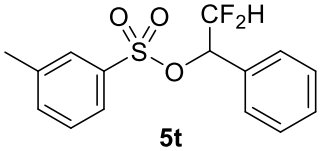
*2,2-difluoro-1-phenylethyl 2,4,6-trimethylbenzenesulfonate(**5s**)*



5s

White solid (59.2 mg, 87% yield); mp: 79-81℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.19 (m, 5H), 6.86 (s, 2H), 6.09 – 5.81 (m, 1H), 5.43 – 5.36 (m, 1H), 2.54 (s, 6H), 2.25 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 143.8, 139.9, 131.8, 131.2, 130.9, 129.9, 128.6, 128.1, 113.2 (t, *J* = 247.3 Hz), 79.3 (t, *J* = 26.6 Hz), 22.7, 21.1. ^{19}F NMR (75 MHz, $CDCl_3$) δ -123.99 – -125.02 (m). HRMS (ESI) *m/z*: Calcd. for $C_{17}H_{19}F_2O_3S^+$ [M+H] $^+$341.1017, Found, 341.1019.

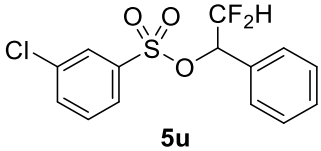
*2,2-difluoro-1-phenylethyl 3-methylbenzenesulfonate(**5t**)*



5t

White solid (61.8 mg, 99% yield); mp: 53-55℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 (d, *J* = 7.6 Hz, 1H), 7.50 (s, 1H), 7.36 – 7.18 (m, 7H), 6.06 – 5.78 (m, 1H), 5.53 – 5.47 (m, 1H), 2.29 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 139.5, 136.2, 134.8, 130.8, 129.9, 129.0, 128.6, 128.3, 128.1, 125.1, 114.3. (t, *J* = 245.7 Hz), 80.1 (t, *J* = 26.9 Hz), 21.2. ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.01 – -125.29 (m). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{14}F_2O_3S^+$ [M+H] $^+$312.0626, Found, 312.0625.

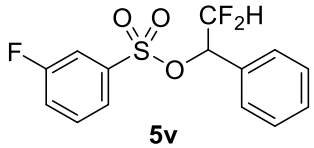
*2,2-difluoro-1-phenylethyl 3-chlorobenzenesulfonate(**5u**)*



5u

Yellow oil (62.5 mg, 94% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.58 (m, 2H), 7.52 – 7.44 (m, 1H), 7.37 – 7.20 (m, 6H), 6.08 – 5.79 (m, 1H), 5.57 – 5.50 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 138.2, 135.3, 134.1, 130.4, 130.3, 130.2, 128.8, 128.1, 128.0, 126.0, 112.9 (dd, *J* = 248.4, 246.7 Hz), 80.8 (dd, *J* = 27.8, 26.2 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.16 – -125.44 (m). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{12}ClF_2O_3S^+$ [M+H] $^+$333.0158, Found, 333.0155.

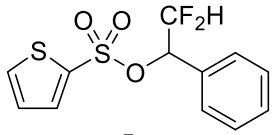
*2,2-difluoro-1-phenylethyl 3-fluorobenzenesulfonate(**5v**)*



5v

Yellow oil (63.2 mg, 95% yield);^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.59 (m, 1H), 7.58 – 7.45 (m, 1H), 7.44 – 7.19 (m, 7H), 6.08 – 5.79 (m, 1H), 5.59 – 5.51 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 162.1 (d, *J* = 252.4 Hz), 138.3 (d, *J* = 7.3 Hz), 136.6 (d, *J* = 287.9 Hz), 134.0, 130.1, 130.9 (d, *J* = 7.8 Hz), 128.7, 125.9, 123.7 (d, *J* = 3.4 Hz), 121.2 (d, *J* = 21.1 Hz), 112.8 (t, *J* = 246.4 Hz), 80.7 (ddd, *J* = 27.7, 26.2, 7.8 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -110.57 – -111.13 (m), -125.31 – -126.18 (m). HRMS (ESI) *m/z*: Calcd. for $C_{14}H_{12}F_3O_3S^+$ [M+H] $^+$317.0454, Found, 317.0455.

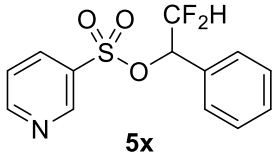
*2,2-difluoro-1-phenylethyl thiophene-2-sulfonate(**5w**)*



5w

White solid (55.9 mg, 92% yield); mp: 73-75°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.48 (m, 2H), 7.38 – 7.26 (m, 5H), 6.96 (dd, *J* = 5.0, 3.9 Hz, 1H), 6.07 – 5.79 (m, 1H), 5.56 – 5.50 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 136.0, 134.9, 134.4, 130.6, 130.1, 128.8, 128.0, 127.5, 113.0 (dd, *J* = 248.4, 246.8 Hz), 81.0 (t, *J* = 26.66, 246.8 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.06 – -125.34 (m). HRMS (ESI) *m/z*: Calcd. for $C_{12}H_{11}F_2O_3S_2^+$ [M+H] $^+$305.0112, Found, 305.0110.

*2,2-difluoro-1-phenylethyl pyridine-3-sulfonate(**5x**)*

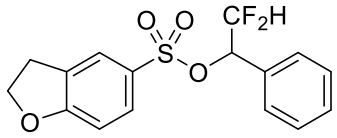


5x

White solid (55.6 mg, 93% yield); mp: 85-87°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.87 (dd, *J* = 2.4, 0.8 Hz, 1H), 8.68 (dd, *J* = 4.8, 1.6 Hz, 1H), 7.92-7.89 (m, 1H), 7.31 – 7.26 (m, 1H), 7.26 – 7.21 (m, 3H), 7.21 – 7.18 (m, 2H), 6.02-5.73 (m, 1H), 5.54 – 5.48 (m,

1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 154.4, 148.6, 135.4, 133.6, 130.4, 130.3, 129.0, 128.2, 123.6, 112.9 (dd, *J* = 248.6, 246.7 Hz), 81.0 (dd, *J* = 27.8, 26.1 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.25 – -125.28 (m). HRMS (ESI) *m/z*: Calcd. for $C_{12}H_{11}F_2NO_3S^+$ [M+H] $^+$299.0422, Found, 299.0425.

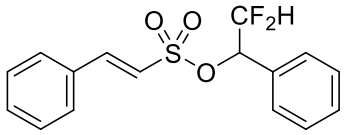
*2,2-difluoro-1-phenylethyl 2,3-dihydrobenzofuran-5-sulfonate(**5y**)*



5y

White solid (64.6 mg, 95% yield); mp: 108-110℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.49 (s, 1H), 7.36 – 7.20 (m, 5H), 6.71 (d, *J* = 8.4 Hz, 1H), 5.06 – 5.77 (m, 1H), 5.48 – 5.42 (m, 1H), 4.62 (t, *J* = 8.8 Hz, 2H), 3.12 (t, *J* = 8.8 Hz, 2H).^{13}C NMR (100 MHz, $CDCl_3$) δ 165.0, 131.1, 129.9, 129.8, 128.6, 128.1, 127.4, 125.3, 114.4 (t, *J* = 245.63 Hz), 109.6, 79.7 (t, *J* = 26.9 Hz), 72.6, 28.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.02 – -125.30 (m). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{14}F_2O_4S^+$ [M+H] $^+$340.0575, Found,340.0577.

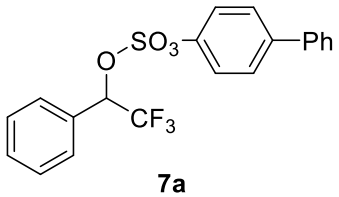
*2,2-difluoro-1-phenylethyl (E)-2-phenylethene-1-sulfonate(**5z**)*



5z

White solid (62.9 mg, 97% yield); mp: 93-95℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (d, *J* = 15.6 Hz, 1H), 7.46 – 7.34 (m, 8H), 7.34 – 7.28 (m, 2H), 6.50 (d, *J* = 15.2 Hz, 1H), 5.13 – 5.85 (m, 1H), 5.56 – 5.50 (m, 1H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.2, 131.8, 131.7, 131.3, 130.2, 129.2, 129.0, 128.6, 128.2, 121.8, 113.2 (dd, *J* = 248.0, 246.5 Hz), 80.2 (dd, *J* = 27.5, 26.1 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -123.95 – -125.50 (m). HRMS (ESI) *m/z*: Calcd. for $C_{16}H_{15}F_2O_3S^+$ [M+H] $^+$325.0704, Found, 325.0705.

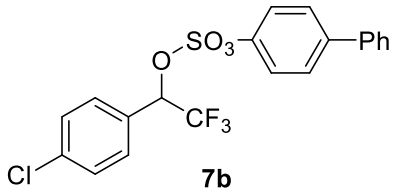
*1-([1,1'-biphenyl]-4-yl)-1-((2,2,2-trifluoro-1-phenylethoxy)thio)-1l3,3l1-trioxidane(**7a**)*



7a

White solid (71.0 mg, 87% yield); mp: 84-86℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 – 7.24 (m, 12H), 7.08 – 6.93 (m, 2H), 5.74 (q, *J* = 6.0 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.4, 141.0, 139.7, 131.2, 129.1, 129.1, 128.9, 128.6, 128.6, 128.0, 127.2, 122.1 (q, *J* = 281.3 Hz), 121.3, 81.6 (q, *J* = 34.8 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.63 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{20}H_{16}F_3O_4S^+$ [M+H] $^{+}$409.0716, Found, 409.0711.

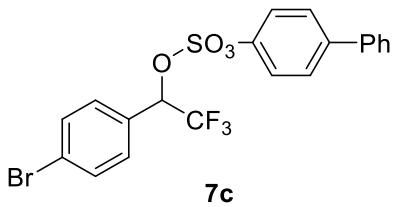
*1-([1,1'-biphenyl]-4-yl)-1-((1-(4-chlorophenyl)-2,2,2-trifluoroethoxy)thio)-1l3,3l1-trioxidane(**7b**)*



7b

White solid (75.2 mg, 85% yield); mp: 109-111℃;^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 – 7.49 (m, 4H), 7.47 – 7.42 (m, 2H), 7.38 (s, 5H), 7.19 – 7.11 (m, 2H), 5.79 (q, *J* = 6.0 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.4, 141.1, 139.6, 137.5, 129.8, 129.5, 129.1, 128.6, 128.1, 127.4, 127.3, 121.9 (q, *J* = 281.2 Hz), 121.2, 80.8 (q, *J* = 35.1 Hz) ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.83 (d, *J* = 6.0 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{20}H_{15}ClF_3O_4S^+$ [M+H] $^{+}$443.0326, Found, 443.0322.

*1-([1,1'-biphenyl]-4-yl)-1-((1-(4-bromophenyl)-2,2,2-trifluoroethoxy)thio)-1l3,3l1-trioxidane(**7c**)*

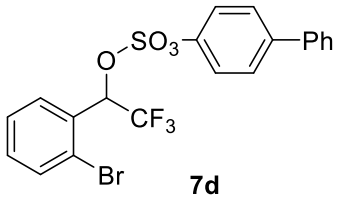


7c

White solid (79.9 mg, 82% yield); mp: 107-109℃;^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55

– 7.27 (m, 11H), 7.18 – 7.10 (m, 2H), 5.77 (q, *J* = 6.0 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.4, 141.1, 139.5, 132.4, 130.0, 129.1, 128.9, 128.6, 128.1, 127.3, 125.8, 123.2, 121.8 (q, *J* = 281.4 Hz), 80.8 (q, *J* = 35.1 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.73 (d, *J* = 6.0 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{20}H_{15}BrF_3O_4S^+$ [M+H] $^+$486.9821, Found, 486.9822.

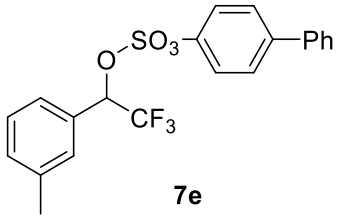
*1-([1,1'-biphenyl]-4-yl)-1-((1-(2-bromophenyl)-2,2,2-trifluoroethoxy)thio)-1l3,3l1-trioxidane(**7d**)*



7d

White solid (75.0 mg, 77% yield); mp: 107-109°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 – 7.55 (m, 2H), 7.52 – 7.41 (m, 6H), 7.40 – 7.33 (m, 2H), 7.33 – 7.27 (m, 1H), 7.19 – 7.11 (m, 2H), 6.51 (q, *J* = 5.6 Hz, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 149.3, 141.0, 139.6, 133.4, 132.4, 129.9, 129.1, 128.7, 128.2, 128.0, 127.2, 124.4, 122.1 (q, *J* = 280.2 Hz), 121.5, 121.2, 79.6 (q, *J* = 35.3 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.63 (d, *J* = 6.0 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{20}H_{15}BrF_3O_4S^+$ [M+H] $^+$486.9821, Found, 486.9825.

*1-([1,1'-biphenyl]-4-yl)-1-((2,2,2-trifluoro-1-(m-tolyl)ethoxy)thio)-1l3,3l1-trioxidane(**7e**)*

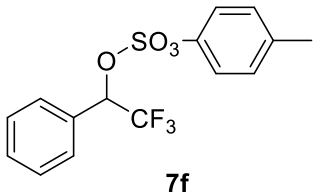


7e

Colorless liquid (62.9 mg, 97% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 – 7.40 (m, 6H), 7.40 – 7.23 (m, 5H), 7.12 – 7.05 (m, 2H), 5.79 (q, *J* = 6.2 Hz, 1H), 2.34 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.5, 140.9, 139.7, 139.1, 131.9, 129.1, 129.1, 129.0, 128.8, 128.5, 128.0, 127.2, 125.7, 122.1 (q, *J* = 281.4 Hz), 121.3, 81.7 (q, *J* = 34.8 Hz), 21.4. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.59 (d, *J* = 6.0 Hz). HRMS (ESI) *m/z*: Calcd. for

$C_{21}H_{18}F_3O_4S^+$ [M+H] $^+$423.0872, Found, 423.0877.

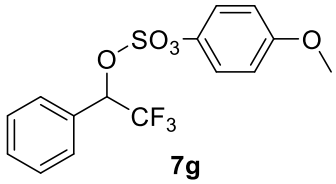
*1-([1,1'-biphenyl]-4-yl)-1-((2,2,2-trifluoro-1-phenylethoxy)thio)-1l3,3l1-trioxidane(**7f**)*



7f

White solid (56.7 mg, 82% yield); mp: 94-96°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 – 7.38 (m, 5H), 7.07 (d, *J* = 8.4 Hz, 2H), 6.95 – 6.87 (m, 2H), 5.78 (q, *J* = 6.0 Hz, 1H), 2.31 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 148.1, 137.7, 131.1, 130.4, 129.1, 129.0, 128.5, 124.9 (q, *J* = 279.5 Hz), 81.4 (q, *J* = 34.8 Hz), 120.8, 20.9. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.71 (d, *J* = 6.0 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{14}F_3O_4S^+$ [M+H] $^+$347.0559, Found, 347.0555.

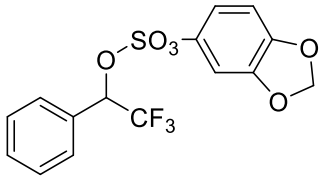
*1-(4-methoxyphenyl)-1-((2,2,2-trifluoro-1-phenylethoxy)thio)-1l3,3l1-trioxidane(**7g**)*



7g

White solid (57.9 mg, 80% yield); mp: 70-72°C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 – 7.39 (m, 5H), 6.99 – 6.91 (m, 2H), 6.80 – 6.71 (m, 2H), 5.78 (q, *J* = 6.0 Hz, 1H), 3.76 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.6, 143.5, 131.0, 129.0, 128.9, 128.4, 125.1 (q, *J* = 218.3 Hz), 122.1, 114.7, 81.3 (q, *J* = 34.7 Hz), 55.6. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.71 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{14}F_3O_5S^+$ [M+H] $^+$363.0509, Found, 363.0508.

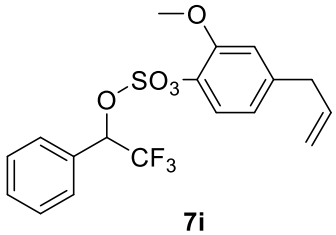
*5-(((2,2,2-trifluoro-1-phenylethoxy)thio)-1l3,3l1-trioxidaneyl)benzo[d][1,3]dioxole(**7h**)*



7h

White solid (60.9 mg, 81% yield); mp: 91-94℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 – 7.40 (m, 5H), 6.64 (dd, *J* = 8.0, 0.8 Hz, 1H), 6.57 – 6.31 (m, 2H), 5.97 (q, *J* = 1.6 Hz, 2H), 5.78 (q, *J* = 6.0 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 148.3, 147.0, 144.1, 131.2, 129.1, 128.9, 128.6, 122.1 (q, *J* = 281.3 Hz), 114.2, 108.0, 103.3, 102.3, 81.6 (q, *J* = 34.8 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.67 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{12}F_3O_6S^+$ [M+H] $^+$377.0301, Found, 377.0303.

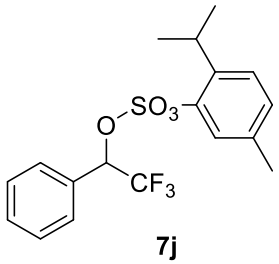
*1-(4-allyl-2-methoxyphenyl)-1-((2,2,2-trifluoro-1-phenylethoxy)thio)-1l3,3l1-trioxidane(**7i**)*



7i

Yellow liquid (63.5 mg, 79% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 – 7.37 (m, 5H), 7.01 (d, *J* = 8.4 Hz, 1H), 6.79 – 6.63 (m, 2H), 6.00 – 5.82 (m, 2H), 5.15 – 5.02 (m, 2H), 3.78 (s, 3H), 3.34 (d, *J* = 6.8 Hz, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.2, 141.2, 137.4, 136.6, 130.9, 129.3, 129.0, 128.4, 122.2 (q, *J* = 281.3 Hz), 122.1, 120.7, 116.7, 113.3, 81.1 (q, *J* = 34.7 Hz). 55.9, 40.1. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.81 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{18}H_{18}F_3O_5S^+$ [M+H] $^+$403.0822, Found, 403.0825.

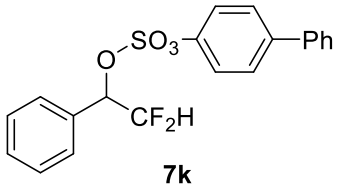
*1-(2-isopropyl-5-methylphenyl)-1-((2,2,2-trifluoro-1-phenylethoxy)thio)-1l3,3l1-trioxidane(**7j**)*



7j

Colorless liquid (59.8 mg, 77% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 – 7.37 (m, 5H), 7.16 (d, *J* = 8.0 Hz, 1H), 7.04 (d, *J* = 8.0 Hz, 1H), 6.90 (s, 1H), 5.84 (q, *J* = 6.0 Hz, 1H), 3.16 – 3.05 (m, 1H), 2.23 (s, 3H), 1.13 (dd, *J* = 9.6, 6.8 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.8, 137.7, 137.3, 131.1, 129.1, 129.1, 128.8, 128.5, 127.2, 122.2 (q, *J* = 281.3 Hz), 121.0, 81.4 (q, *J* = 34.8 Hz), 26.7, 23.2, 23.1, 20.9. ^{19}F NMR (75 MHz, $CDCl_3$) δ -73.69 (d, *J* = 6.1 Hz). HRMS (ESI) *m/z*: Calcd. for $C_{18}H_{20}F_3O_4S^+$ [M+H] $^{+}$389.1029, Found, 389.1025.

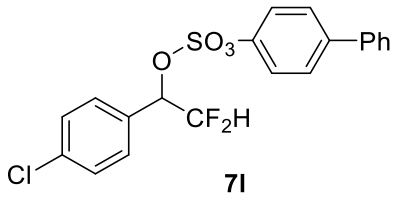
*1-([1,1'-biphenyl]-4-yl)-1-((2,2-difluoro-1-phenylethoxy)thio)-1l3,3l1-trioxidane(**7k**)*



7k

Colorless liquid (56.2 mg, 72% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 – 7.34 (m, 12H), 7.16 – 7.05 (m, 2H), 6.20 – 5.91 (m, 1H), 5.72 – 5.66 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.5, 140.9, 139.8,130.0, 130.7, 129.2, 129.1, 128.6, 128.4, 128.0, 127.3, 121.4, 113.9 (t, *J* = 245.4 Hz), 83.6 (t, *J* = 26.8 Hz). ^{9}F NMR (75 MHz, $CDCl_3$) δ -124.38 – -125.66 (m). HRMS (ESI) *m/z*: Calcd. for $C_{20}H_{17}F_2O_4S^+$ [M+H] $^{+}$391.0810, Found, 391.0811.

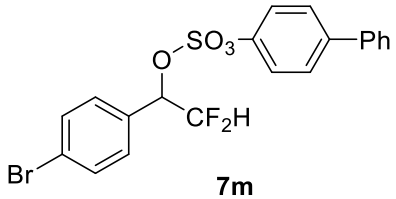
*1-([1,1'-biphenyl]-4-yl)-1-((1-(4-chlorophenyl)-2,2-difluoroethoxy)thio)-1l3,3l1-trioxidane(**7l**)*



7l

Colorless liquid (59.4 mg, 70% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 – 7.51 (m, 3H), 7.48 – 7.32 (m, 8H), 7.20 – 7.12 (m, 2H), 6.18 – 5.89 (m, 1H), 5.68 – 62 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.3, 140.9, 139.5, 136.8, 129.6, 129.3, 129.0, 128.5, 127.9, 127.2, 127.2, 121.2, 112.2, 82.4 (t, *J* = 27.2 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.09 – -125.64 (m). HRMS (ESI) *m/z*: Calcd. for $C_{20}H_{16}ClF_2O_4S^+$ [M+H] $^+$425.0420, Found, 425.0422.

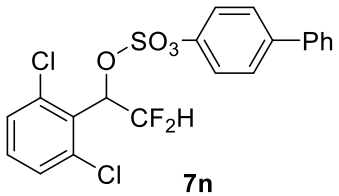
*1-([1,1'-biphenyl]-4-yl)-1-((1-(4-bromophenyl)-2,2-difluoroethoxy)thio)-1l3,3l1-trioxidane(7**m**)*



7m

Colorless liquid (63.8 mg, 68% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 – 7.50 (m, 5H), 7.48 – 7.43 (m, 2H), 7.41 – 7.37 (m, 1H), 7.32 – 7.24 (m, 3H), 7.20 – 7.10 (m, 2H), 6.18 – 5.89 (m, 1H), 5.67 – 5.60 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.4, 141.1, 139.6, 132.4, 129.9, 129.1, 128.7, 128.0, 127.3, 125.2, 121.3, 112.3 (t, *J* = 245.8 Hz), 82.5 (t, *J* = 26.9 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.11 – -125.66 (m). HRMS (ESI) *m/z*: Calcd. for $C_{20}H_{16}BrF_2O_4S^+$ [M+H] $^+$468.9915, Found, 468.9911.

*1-([1,1'-biphenyl]-4-yl)-1-((1-(2,6-dichlorophenyl)-2,2-difluoroethoxy)thio)-1l3,3l1-trioxidane(7**n**)*

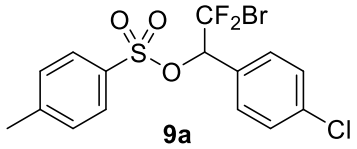


7n

Colorless liquid (56.9 mg, 62% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 – 7.41 (m, 6H), 7.40 – 7.29 (m, 3H), 7.28 – 7.19 (m, 3H), 6.77 – 6.45 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.4, 140.8, 139.7, 132.2, 130.3, 129.1, 128.6, 128.0, 127.2, 127.0, 126.9, 121.2, 111.6 (dd, *J* = 251.4, 241.7 Hz), 79.7 (dd, *J* = 36.9, 29.5 Hz). ^{19}F NMR (75 MHz, $CDCl_3$) δ -124.17 – -125.75 (m). HRMS (ESI) *m/z*: Calcd. for

$C_{20}H_{15}Cl_2F_2O_4S^+$ [M+H] $^+$459.0031, Found, 459.0033.

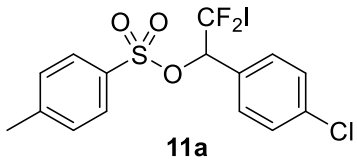
*2-bromo-1-(4-chlorophenyl)-2,2-difluoroethyl 4-methylbenzenesulfonate (**9a**)*



9a

White solid (58.7 mg, 69% yield); mp: 66-68℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 8.4 Hz, 2H), 7.22 (t, *J* = 5.2 Hz, 3H), 7.19 – 7.11 (m, 3H), 5.57 (q, *J* = 6.0 Hz, 1H), 2.35 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 136.7, 133.0, 130.0, 129.6, 129.1, 128.8, 128.8, 128.4, 128.1, 122.2 (t, *J* = 279.6 Hz), 21.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -121.65 – -122.93 (m). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{13}BrClF_2O_3S^+$ [M+H] $^+$424.9420, Found, 424.9422.

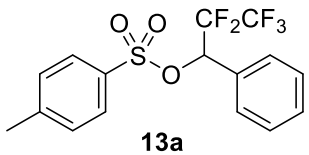
*1-(4-chlorophenyl)-2,2-difluoro-2-iodoethyl 4-methylbenzenesulfonate(**11a**)*



11a

White solid (68.0 mg, 72% yield); mp: 64-66℃; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.62 (m, 2H), 7.30 – 7.27 (m, 3H), 7.27 – 7.22 (m, 3H), 5.64 (q, *J* = 6.0 Hz, 1H), 2.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 136.7, 133.0, 130.0, 129.6, 129.1, 129.8, 128.8, 128.1, 122.2 (t, *J* = 279.6 Hz), 21.8. ^{19}F NMR (75 MHz, $CDCl_3$) δ -121.36 – -122.64 (m). HRMS (ESI) *m/z*: Calcd. for $C_{15}H_{13}BrClF_2IO_3S^+$ [M+H] $^+$472.9281, Found, 472.9283.

*2,2,3,3,3-pentafluoro-1-phenylpropyl 4-methylbenzenesulfonate(**13a**)* [12]

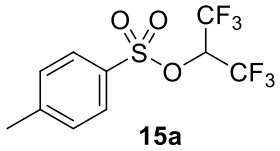


13a

White solid (73.7 mg, 97% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.51 (m, 2H),

7.38 – 7.23 (m, 5H), 7.19 – 7.11 (m, 2H), 5.79 (dd, *J* = 15.2, 7.6 Hz, 1H), 2.36 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 145.5, 133.1, 130.4, 129.7, 129.2, 128.7, 128.6, 128.1, 118.6 (dt, *J* = 285.2, 34.5 Hz), 111.7 (ddd, *J* = 263.7, 256.1, 36.9 Hz). 21.7.

*1,1,1,3,3,3-hexafluoropropan-2-yl 4-methylbenzenesulfonate(**15a**)* [13]



15a

White solid (45.7 mg, 71% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, *J* = 8.5 Hz, 2H), 7.32 (d, *J* = 8.1 Hz, 2H), 5.19 (m, 1H), 2.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.7, 132.1, 130.3, 128.3, 115.8 – 124.26 (m), 71.31 – 72.72 (m), 21.93. ^{19}F NMR (75 MHz, $CDCl_3$) δ -71.20 (d, *J* = 5.9 Hz).

5. References：

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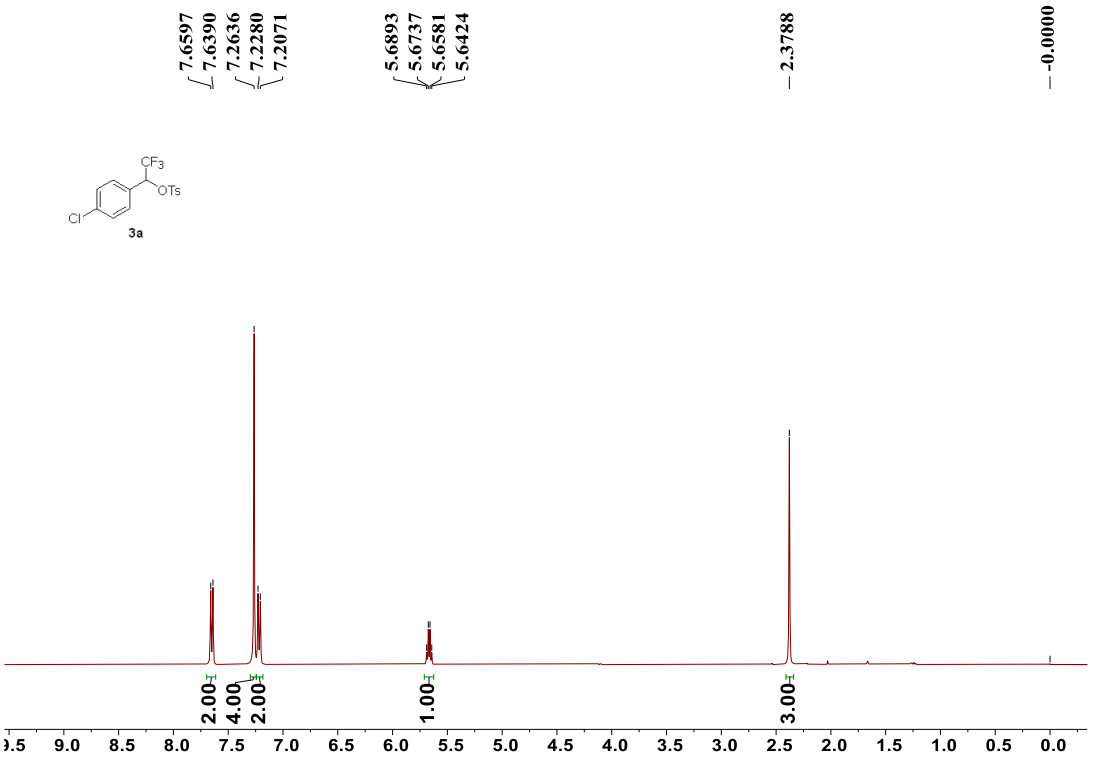
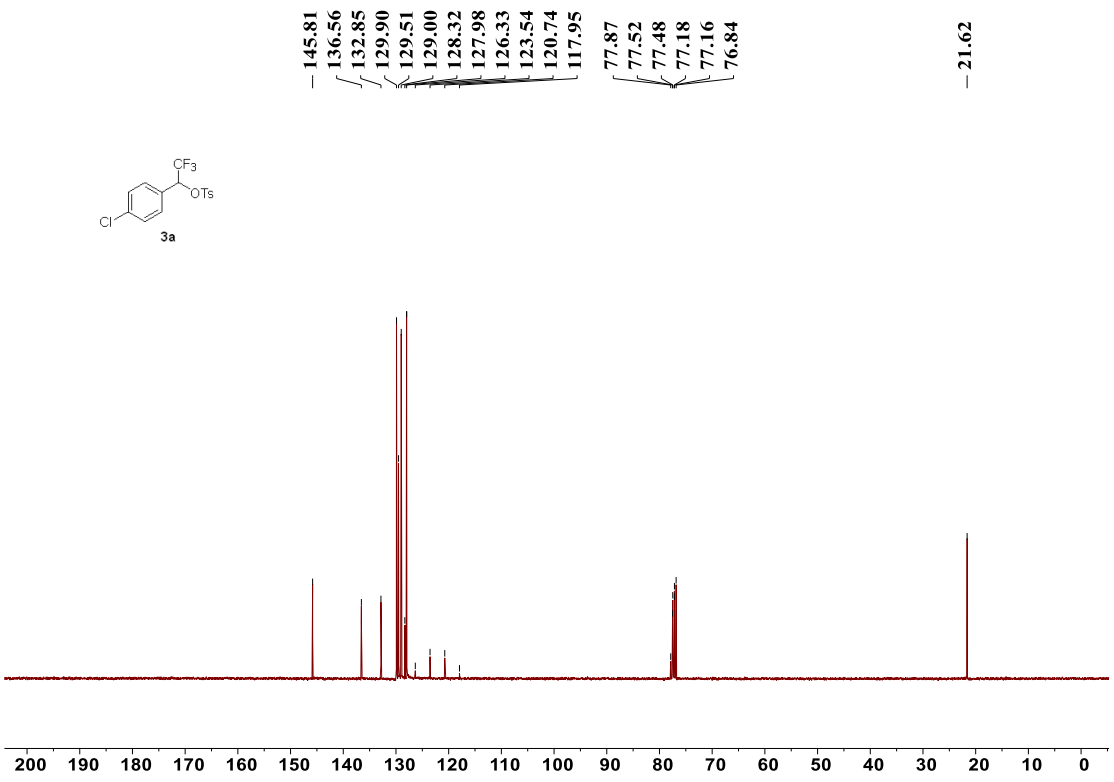
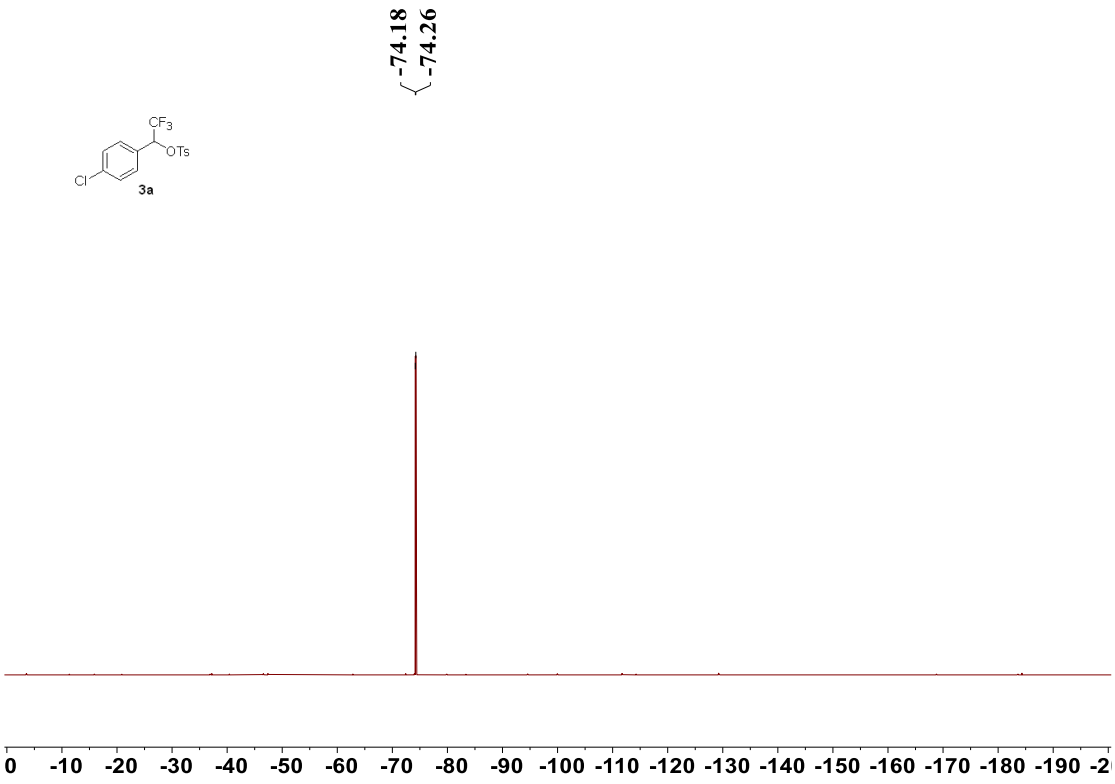
6. Copies of NMR spectra






-74.18
-74.26
CF3
OTs
Cl
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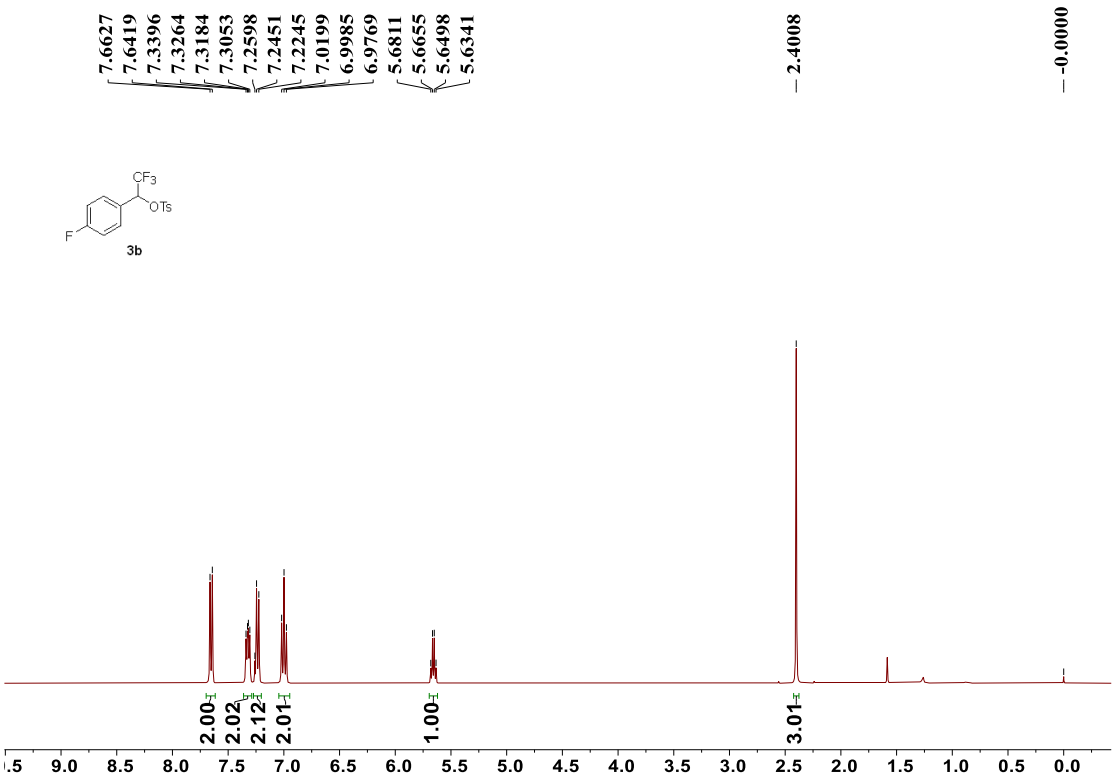
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1.00
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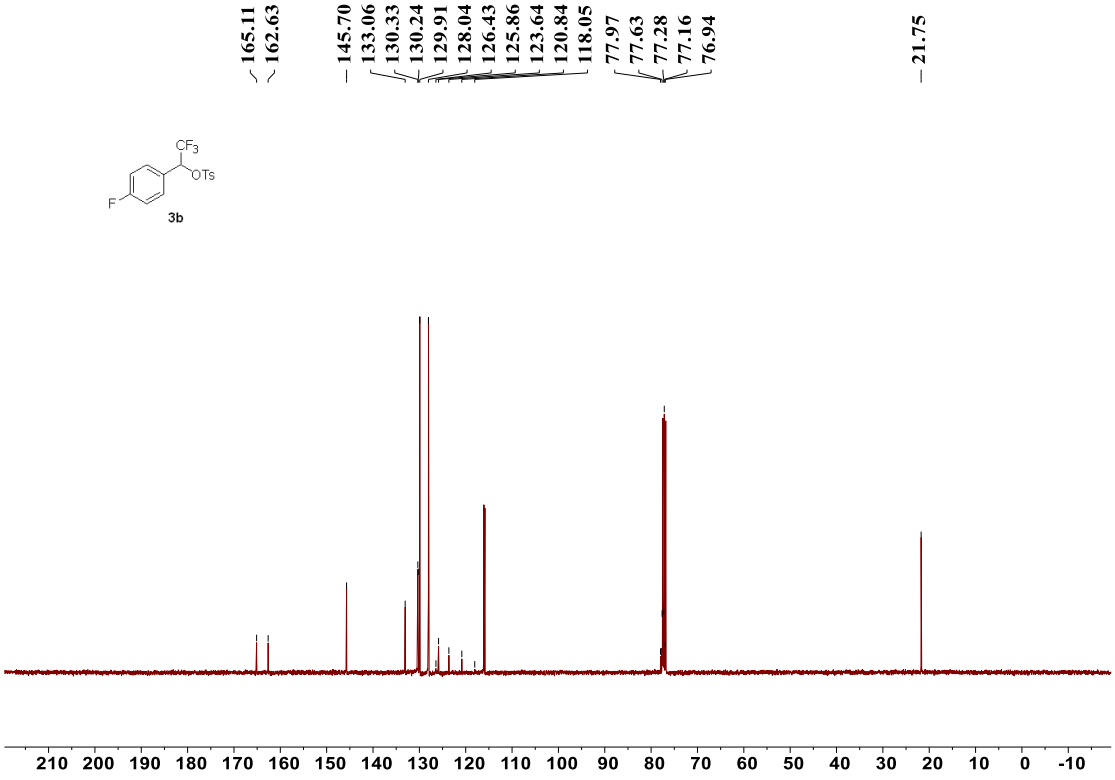
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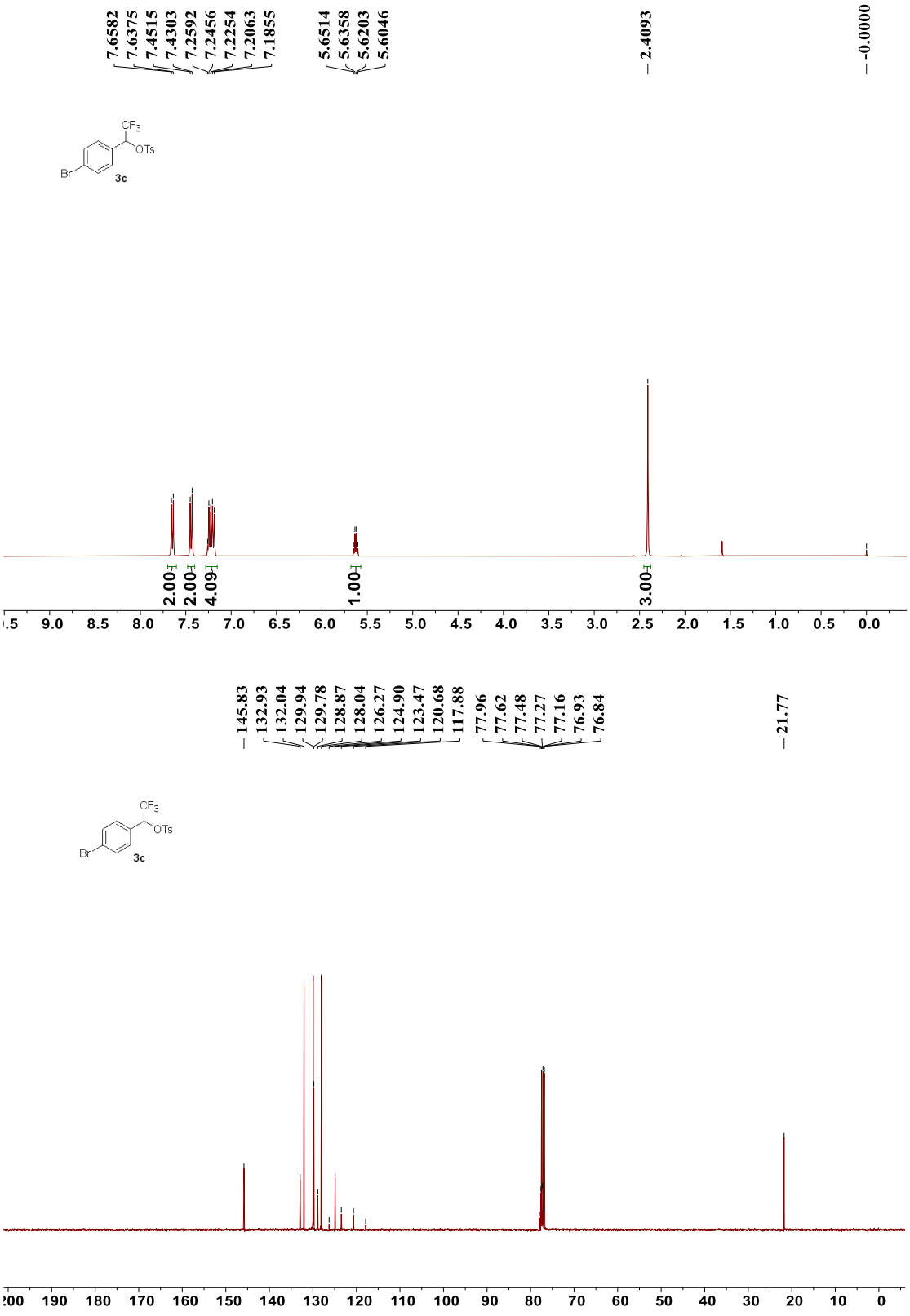
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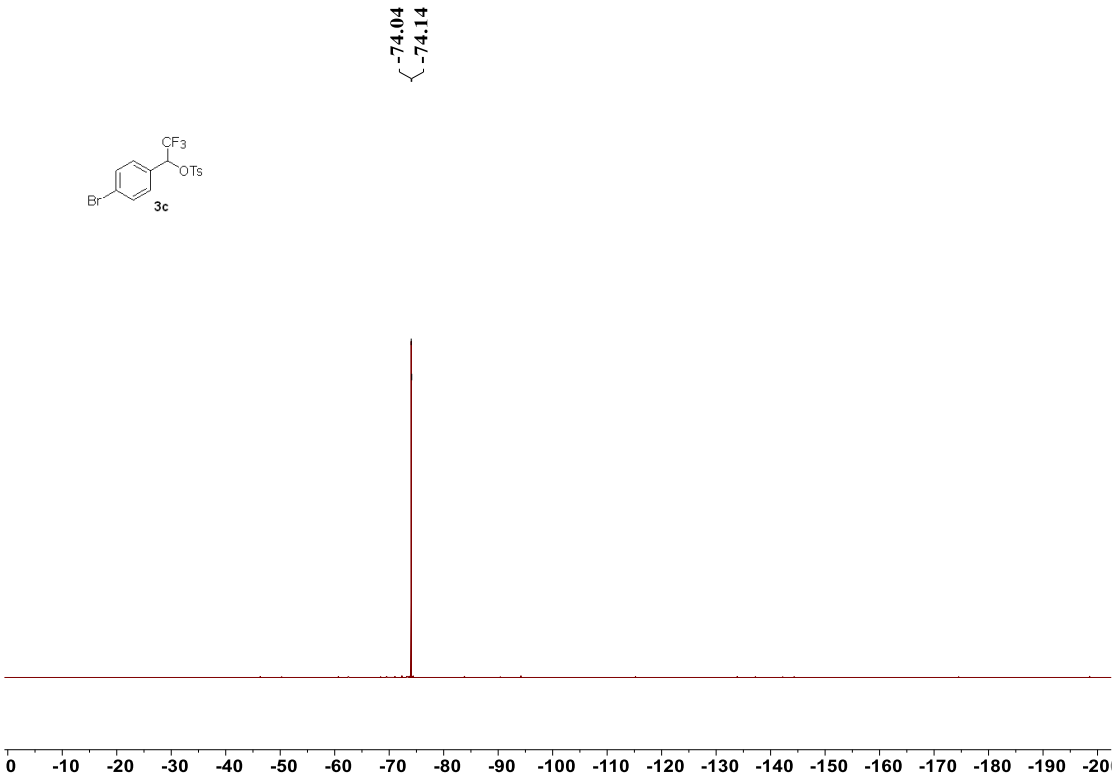
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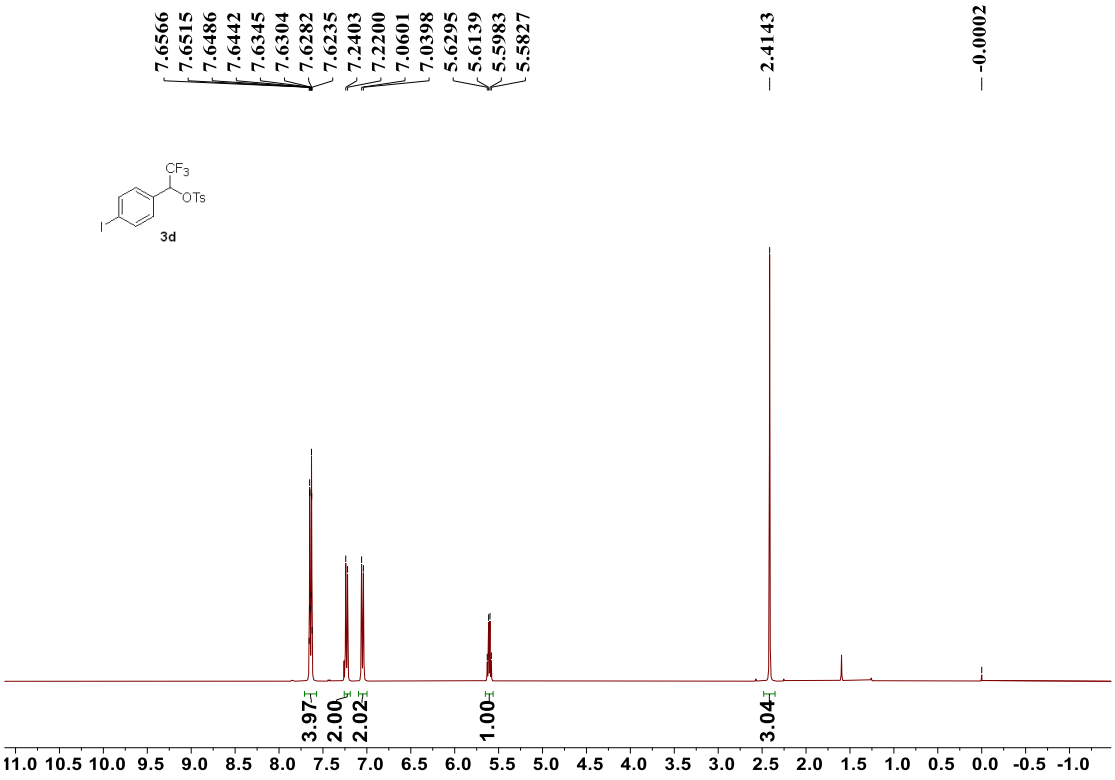
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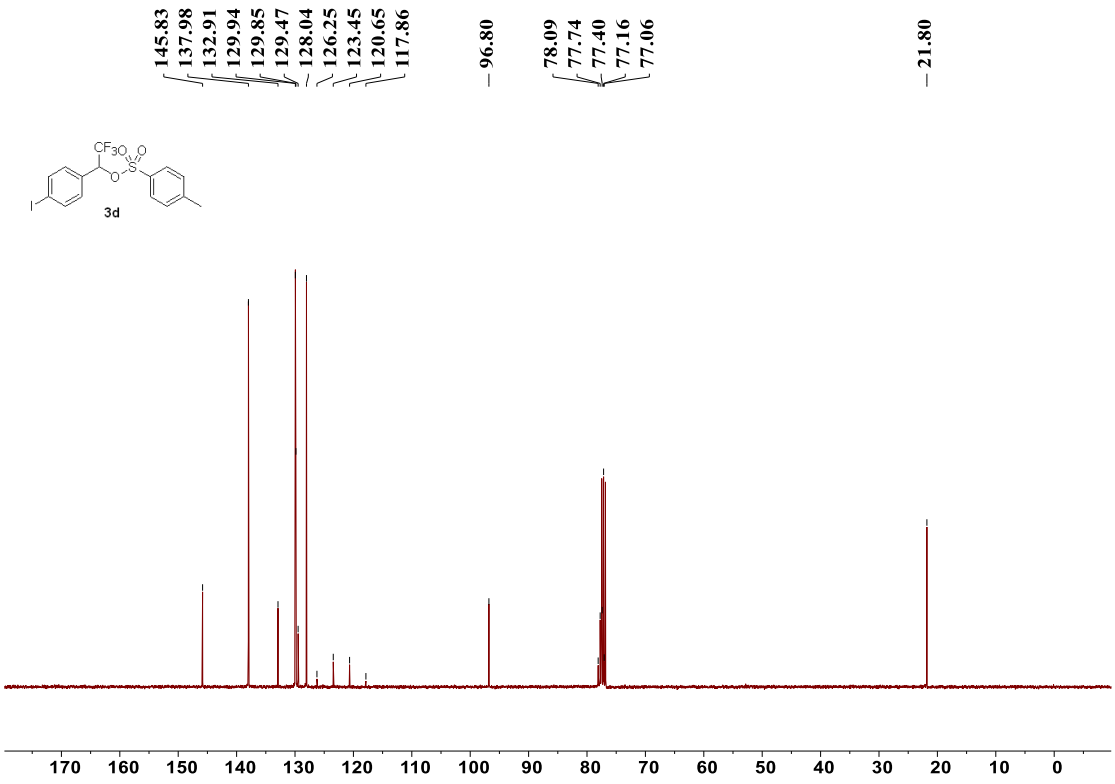
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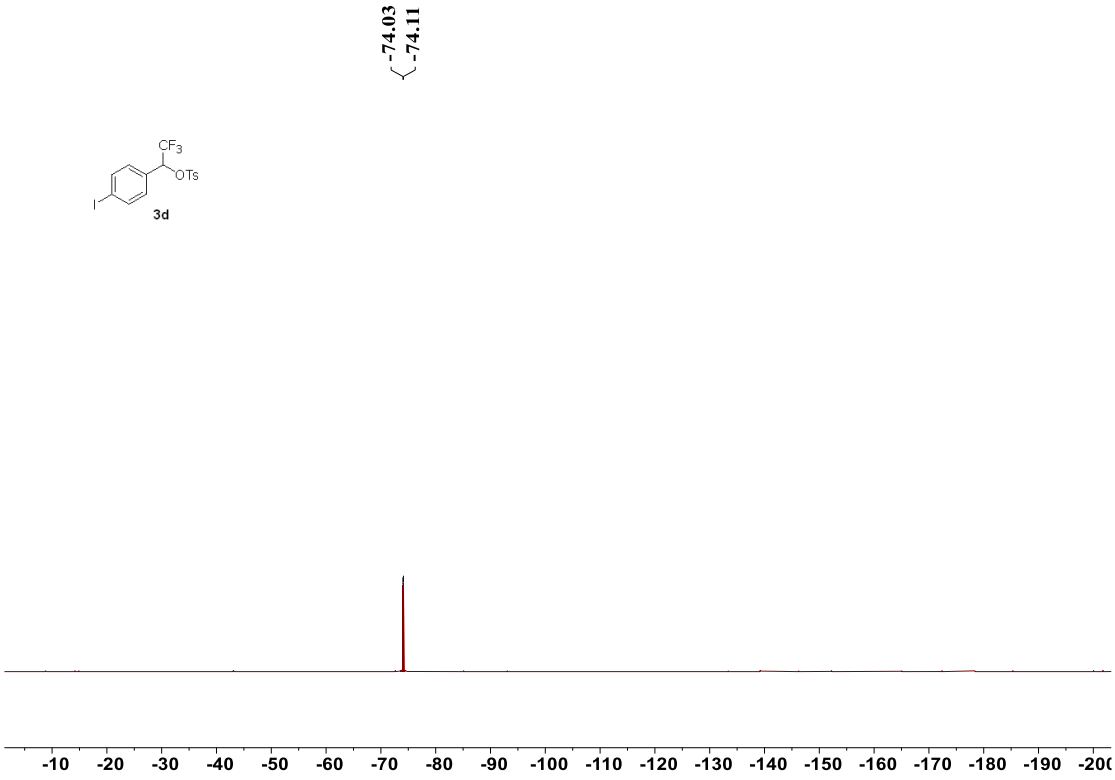
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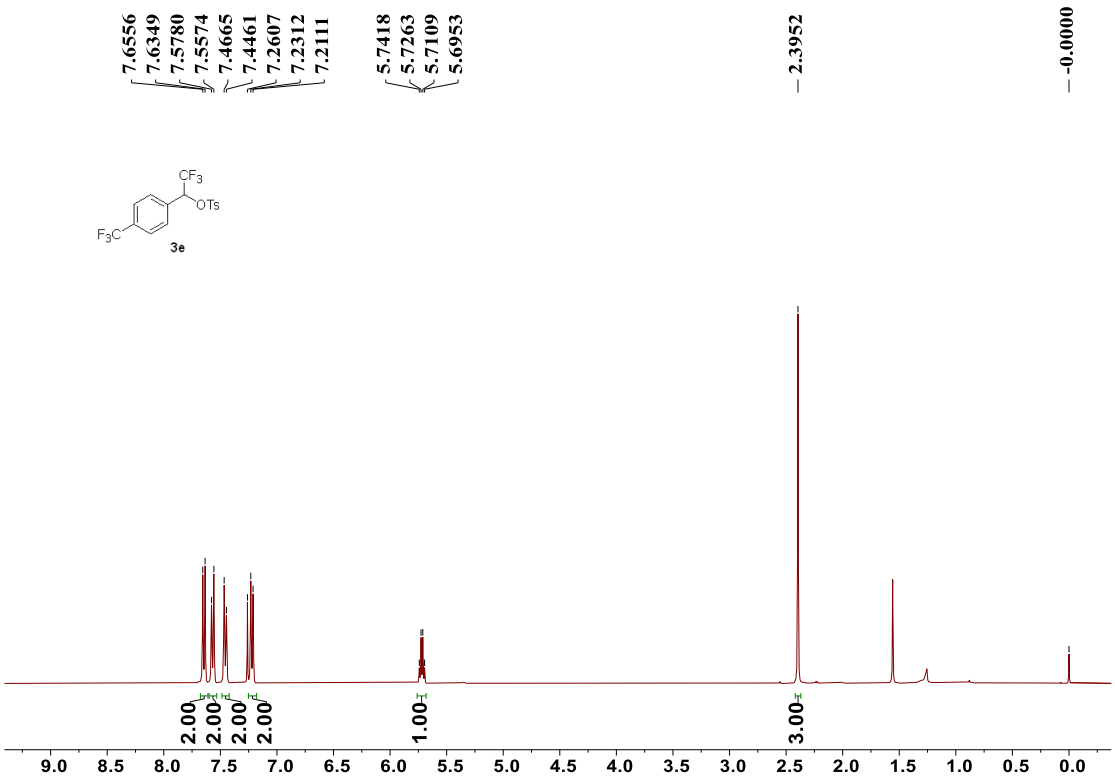
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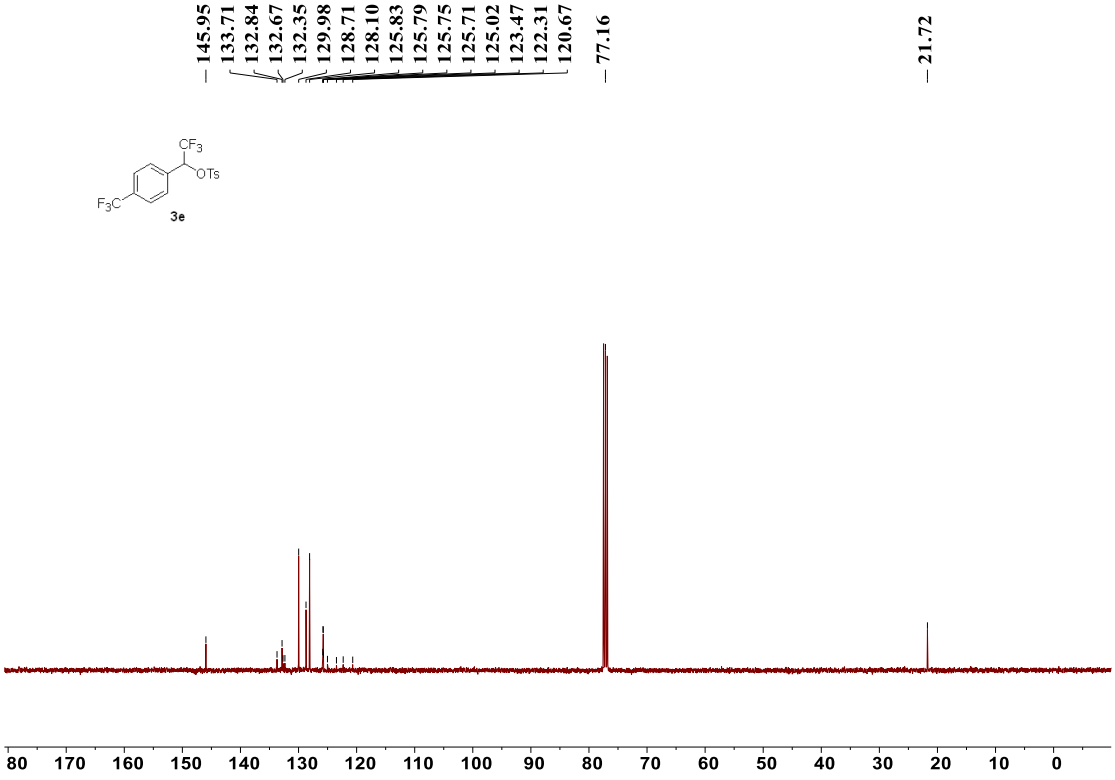
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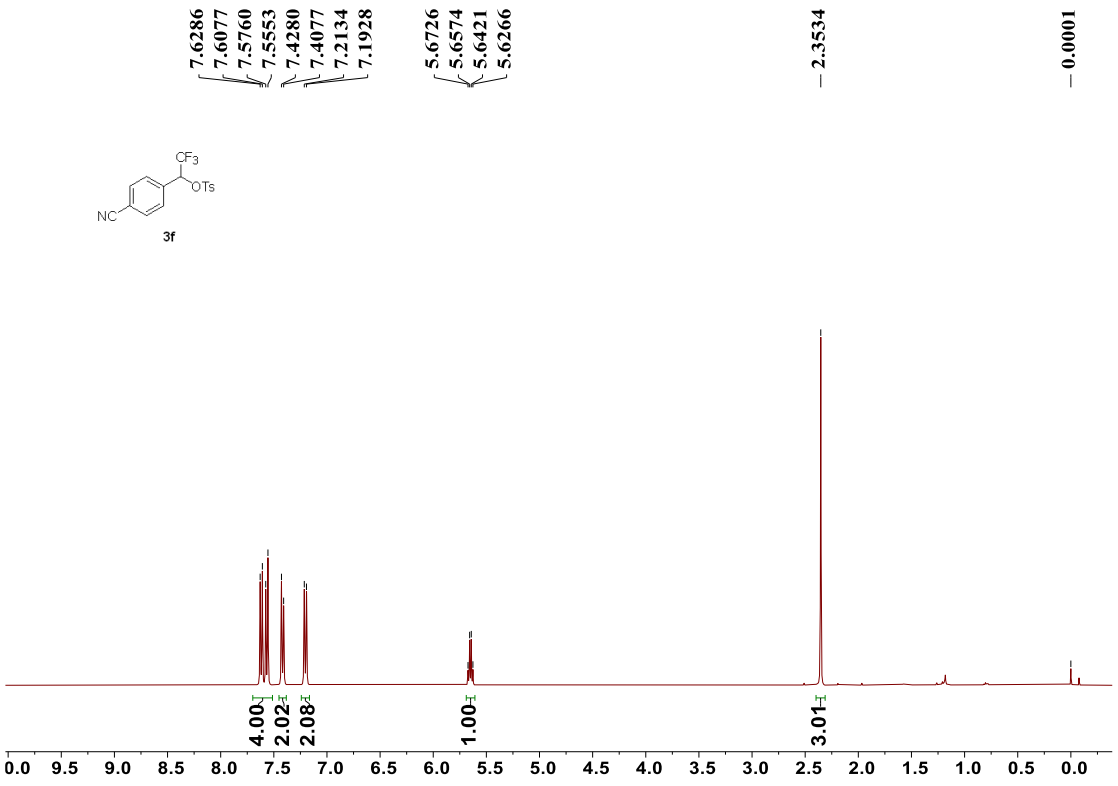
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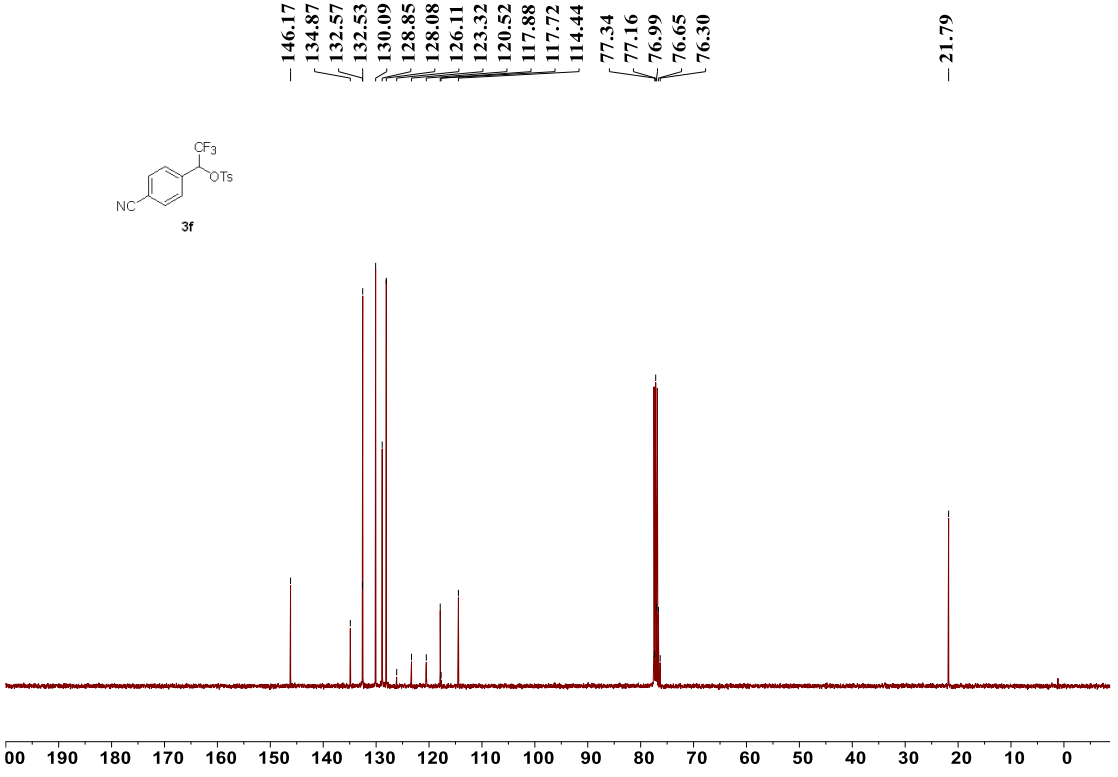
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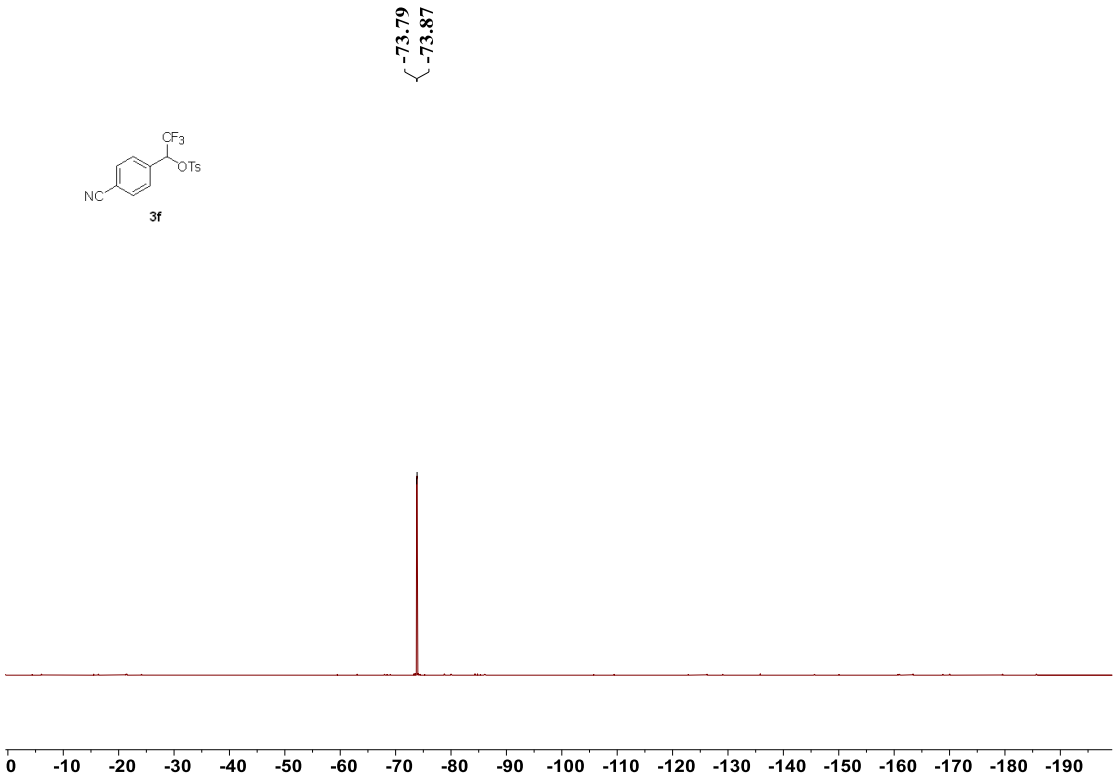
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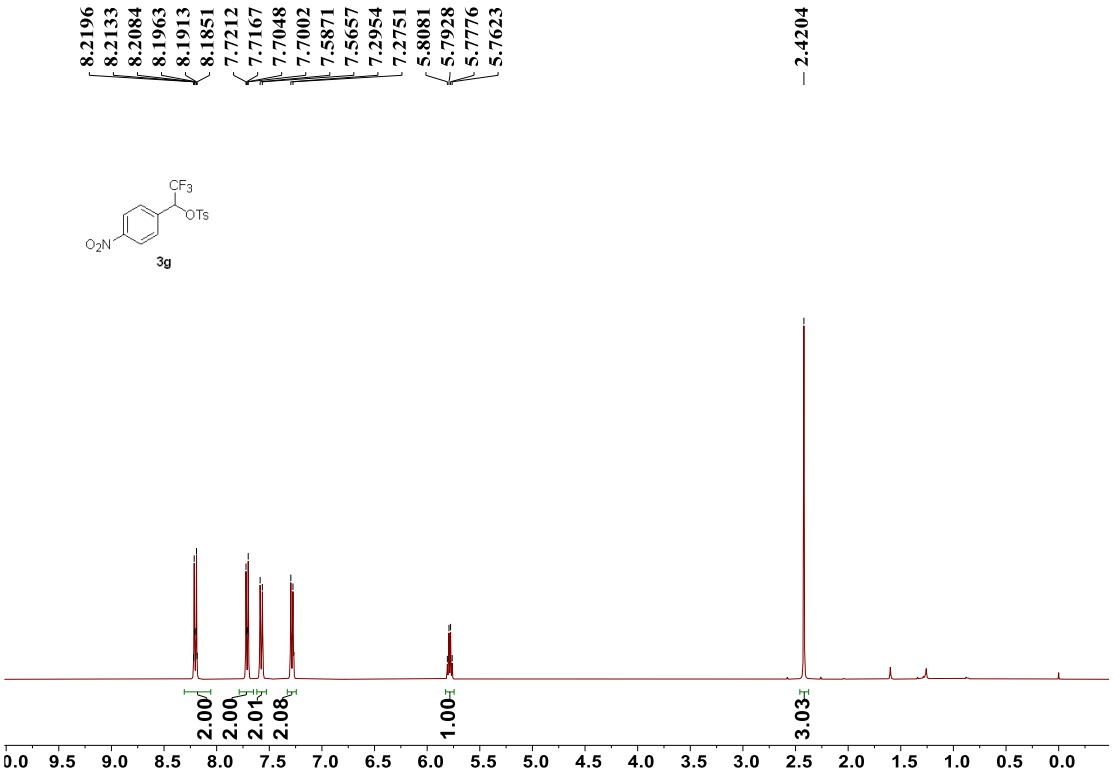
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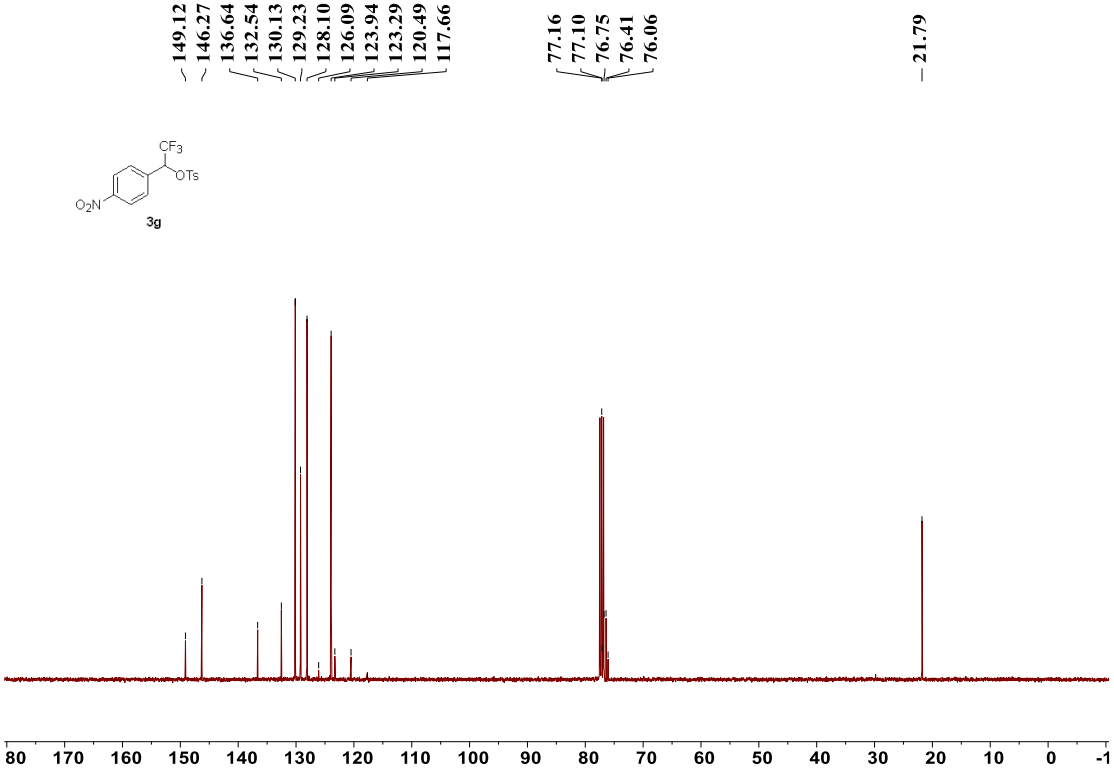
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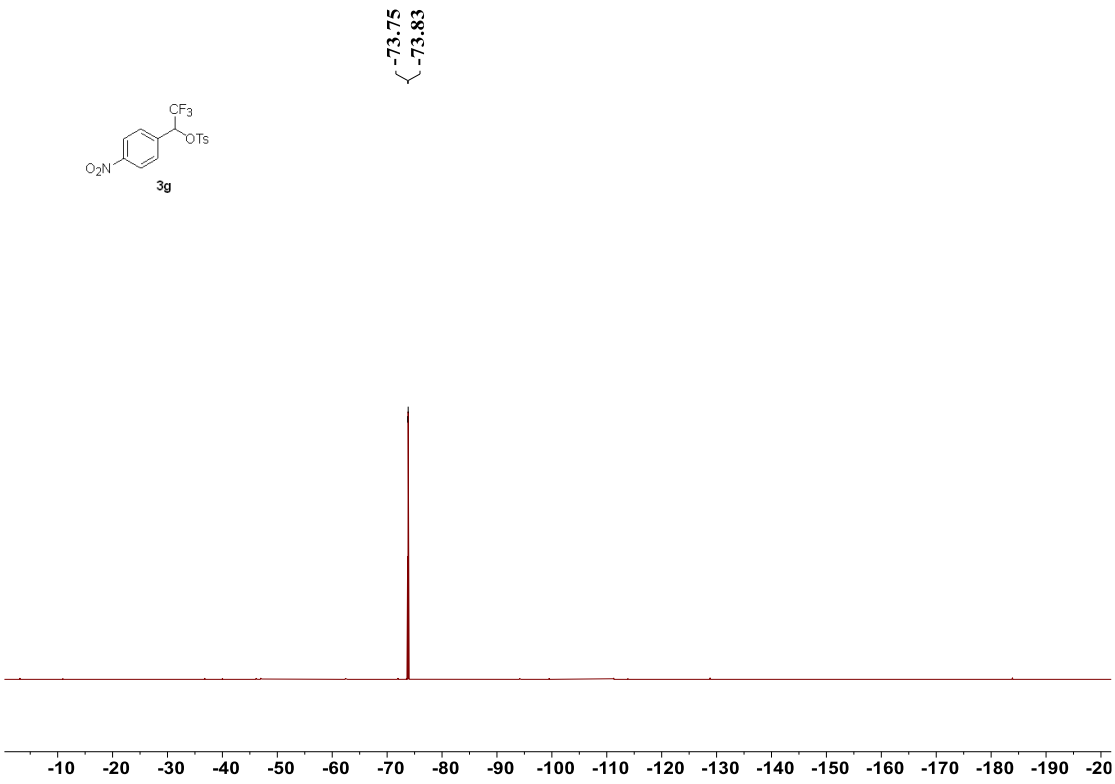
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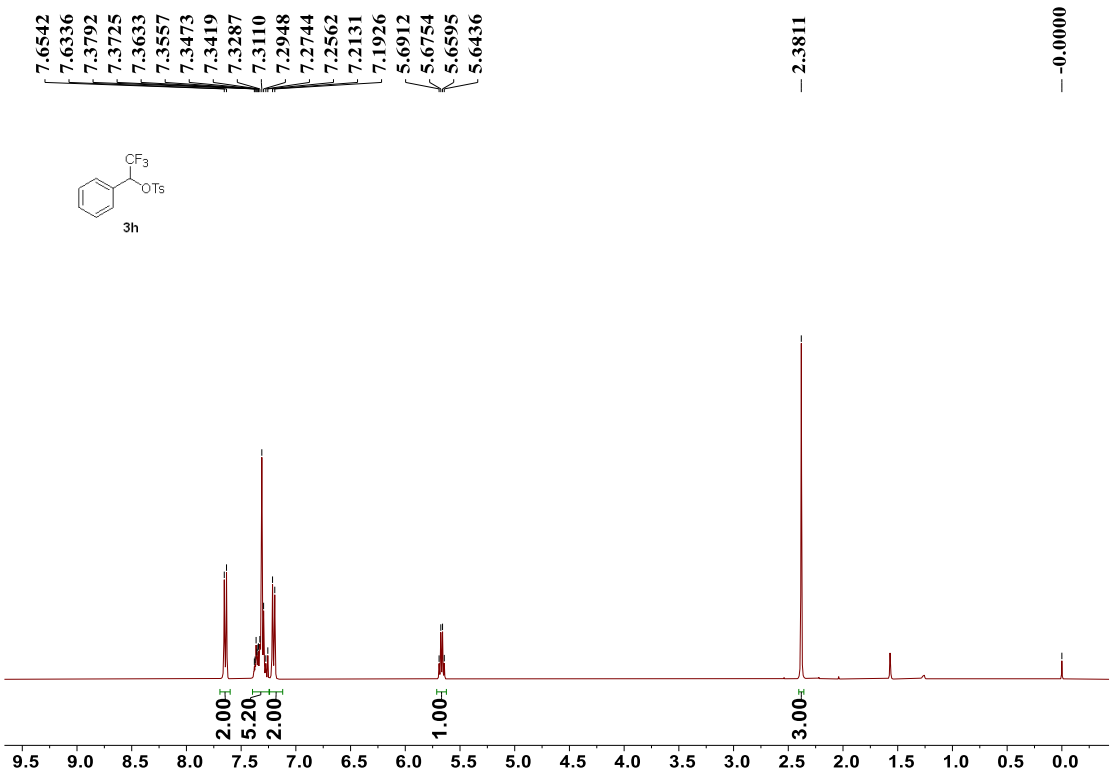
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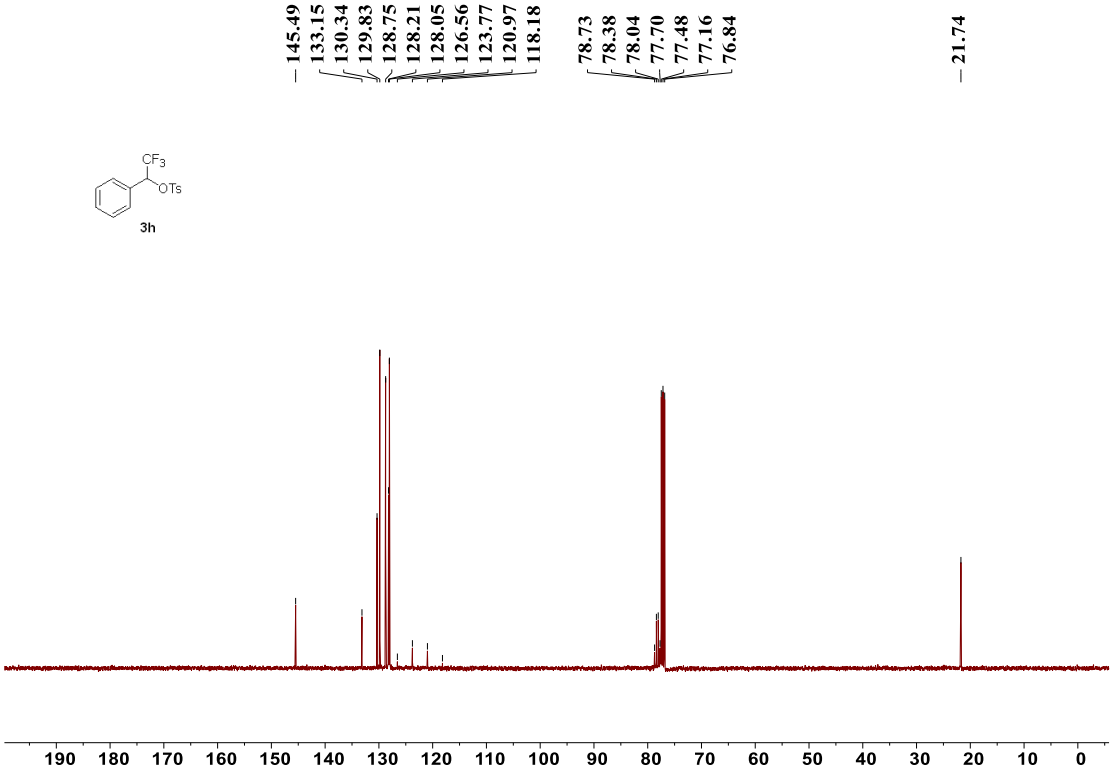
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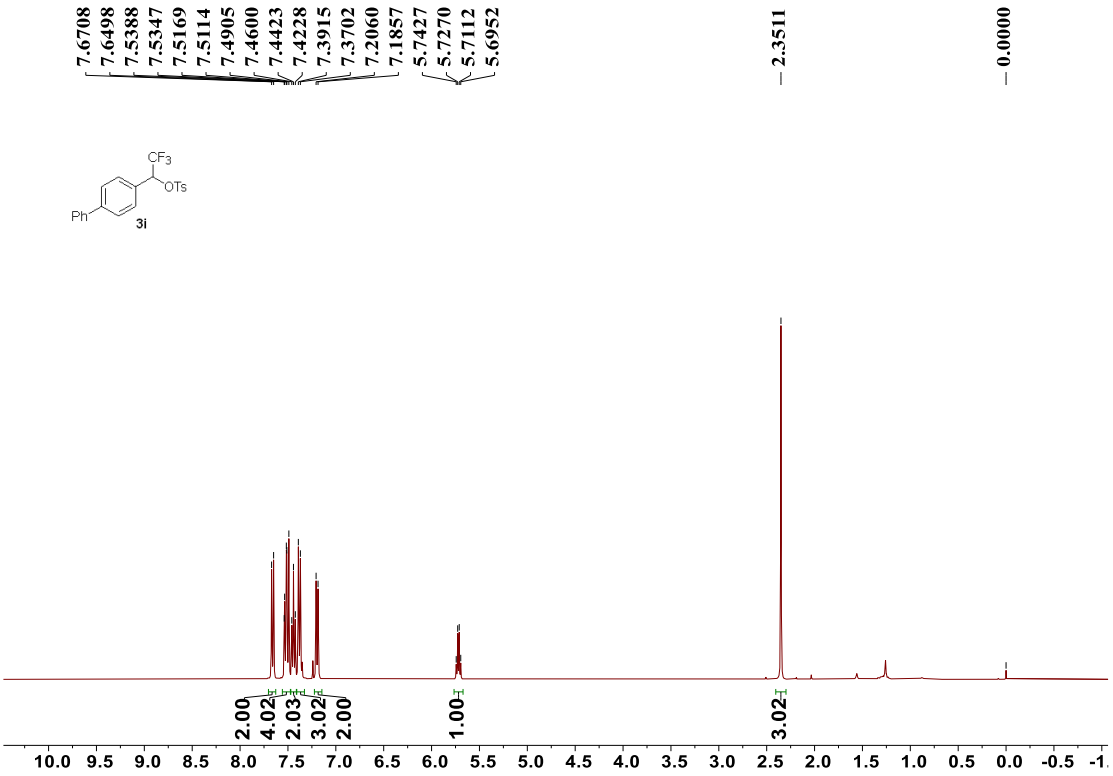
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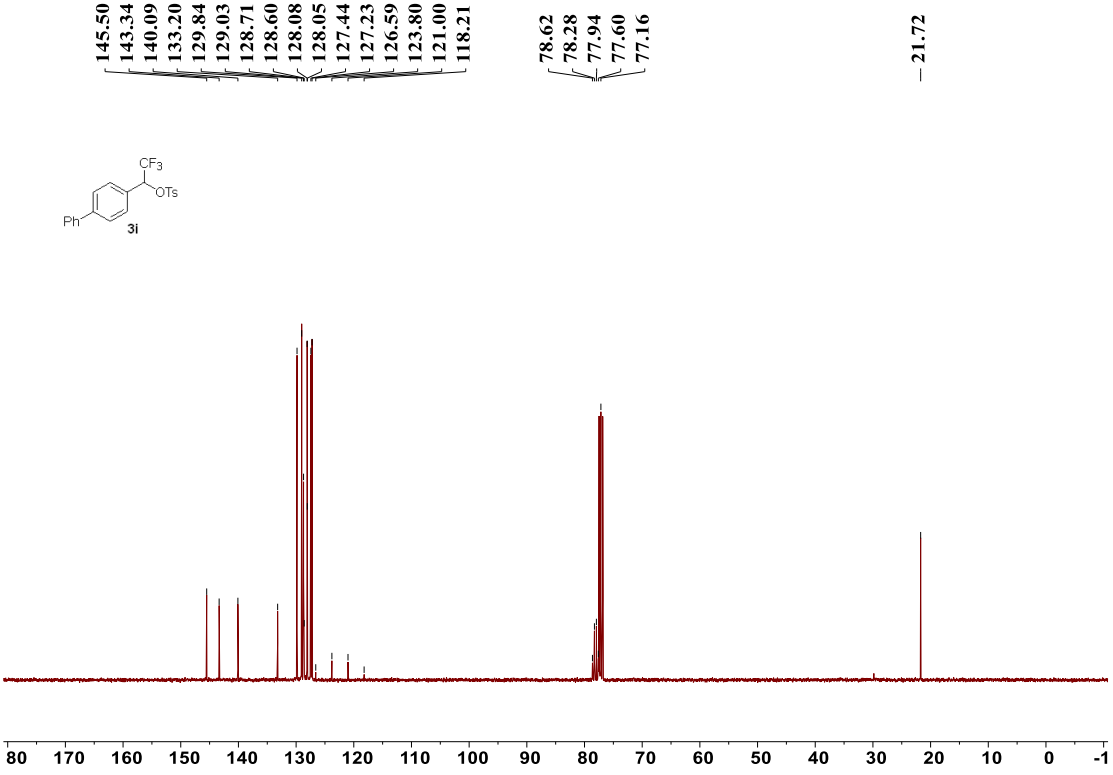
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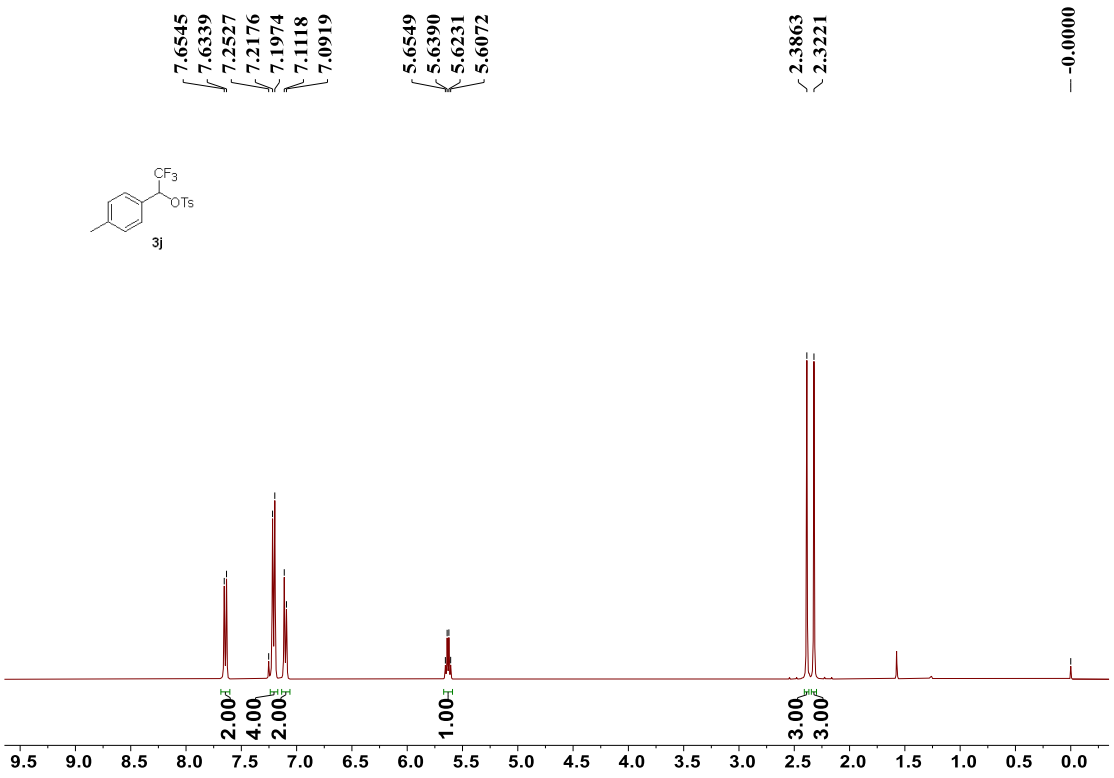
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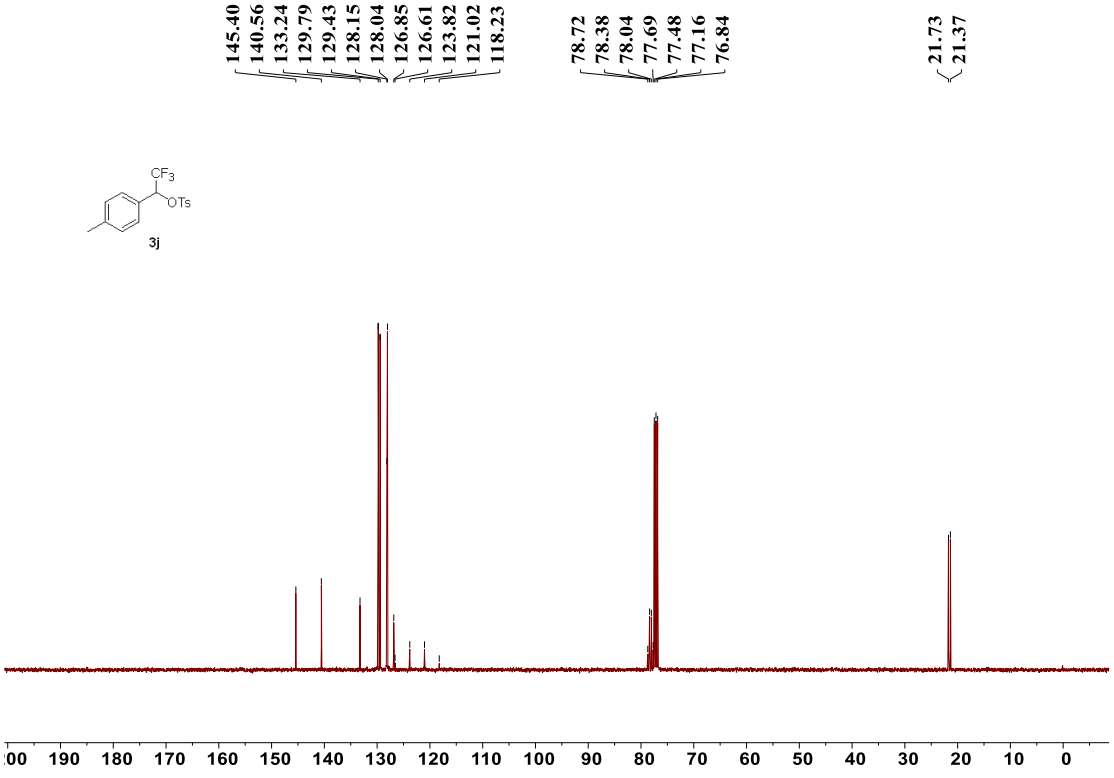
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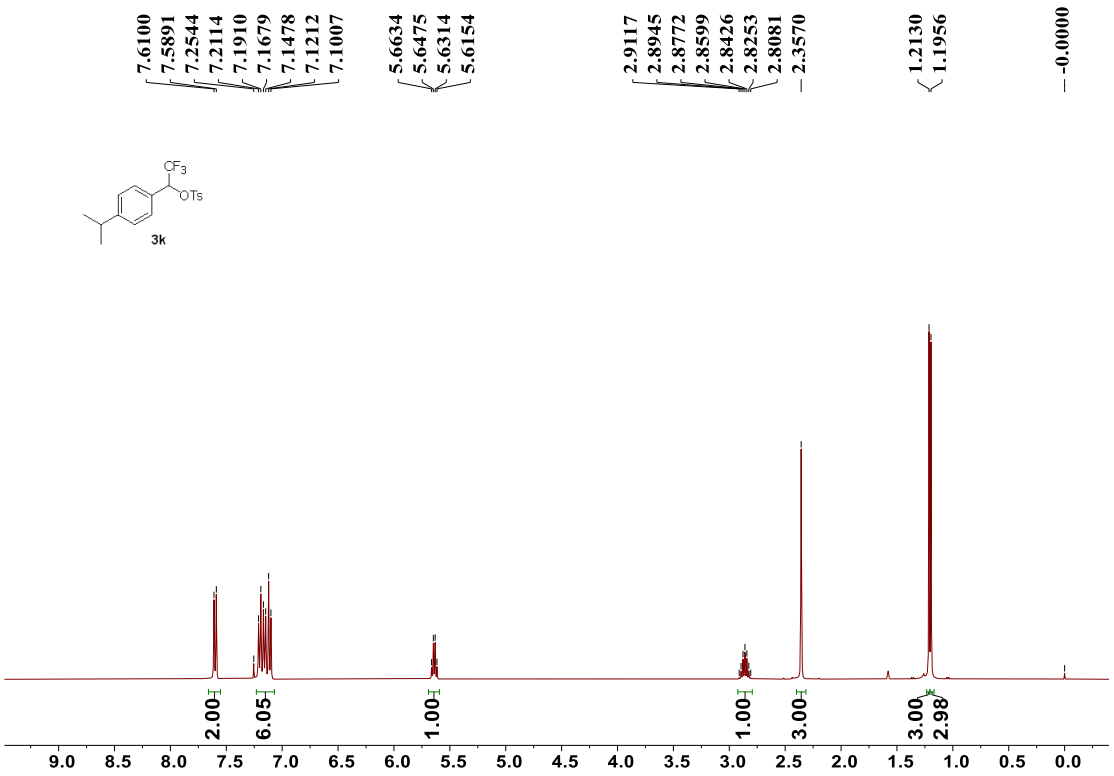
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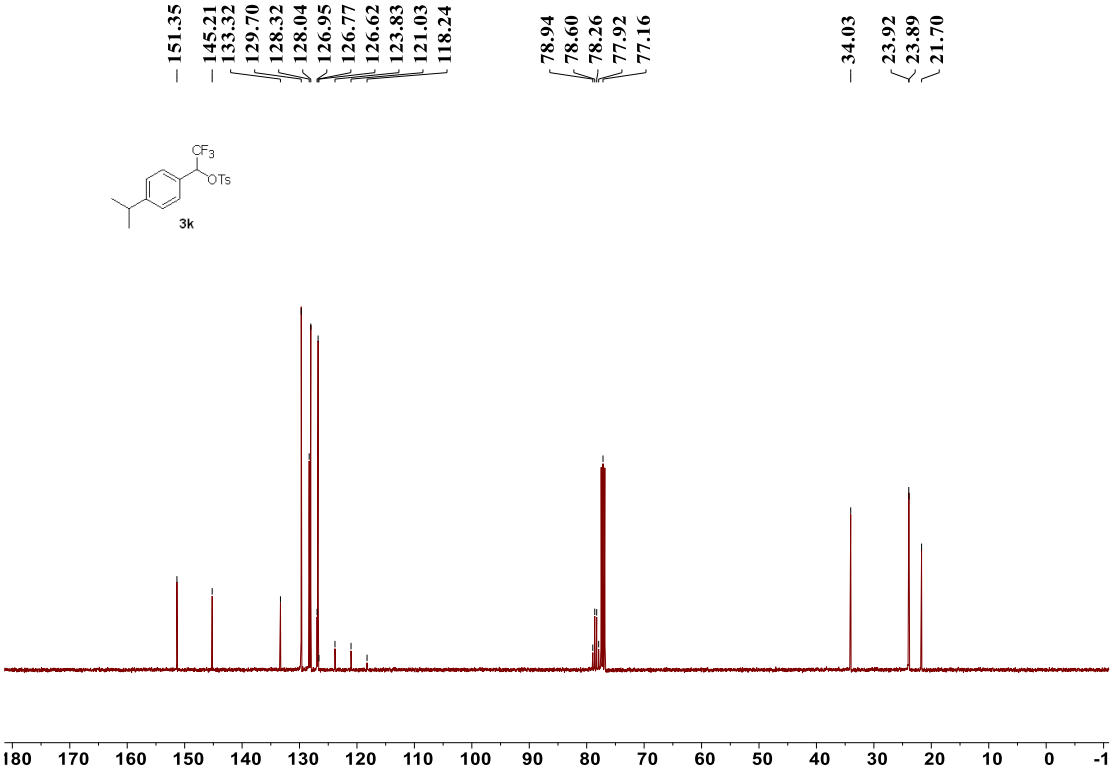
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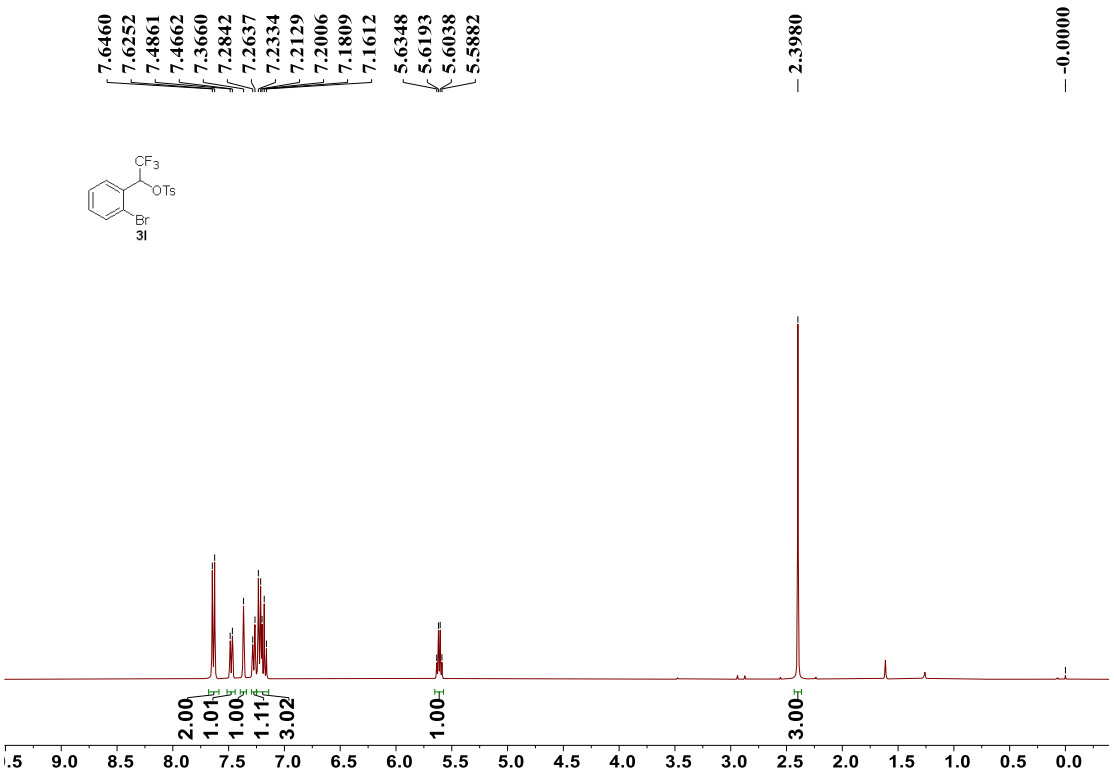
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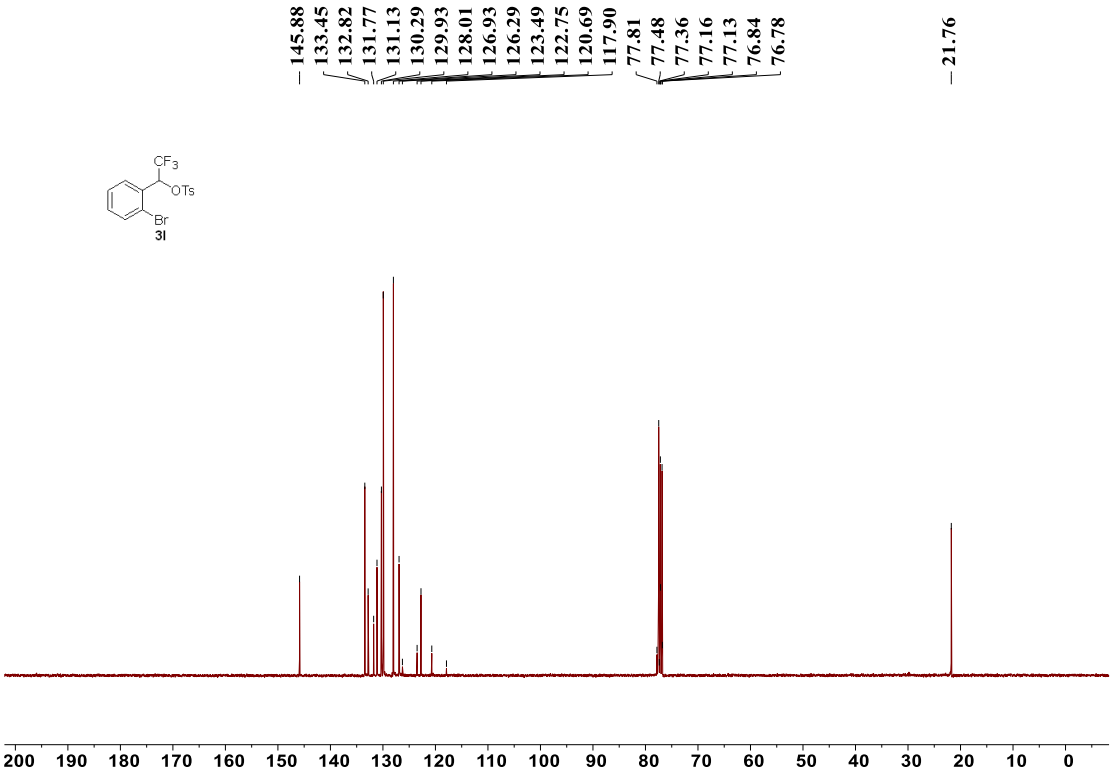
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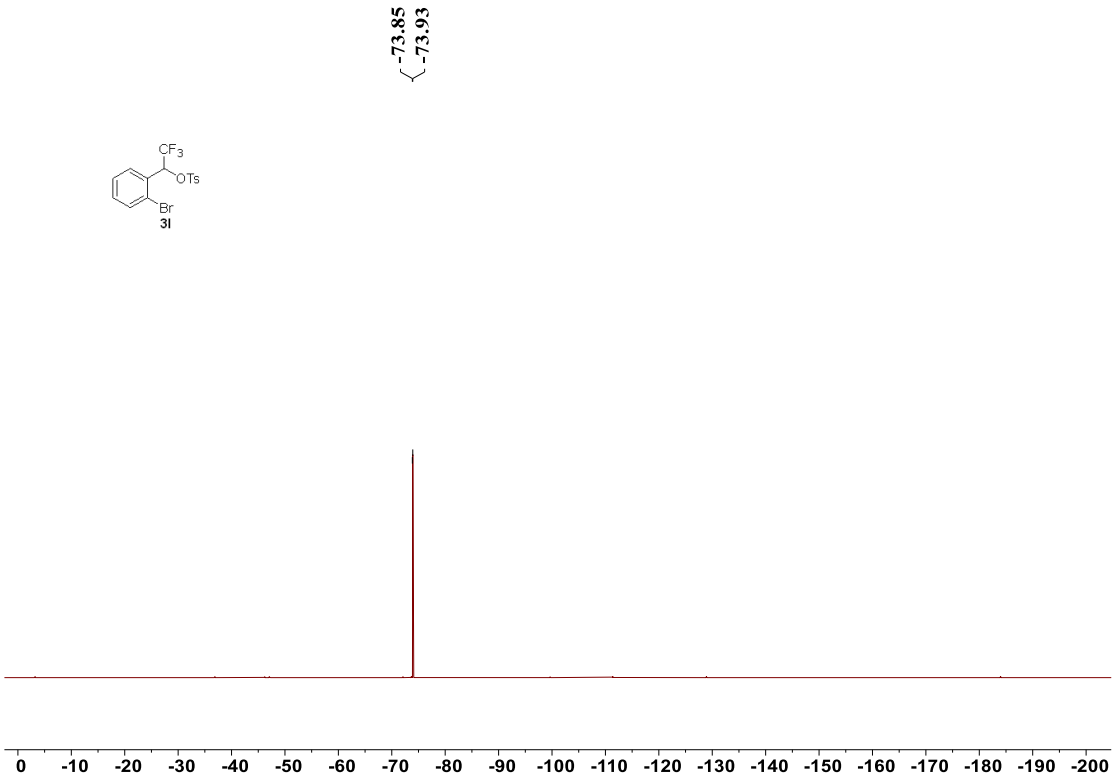
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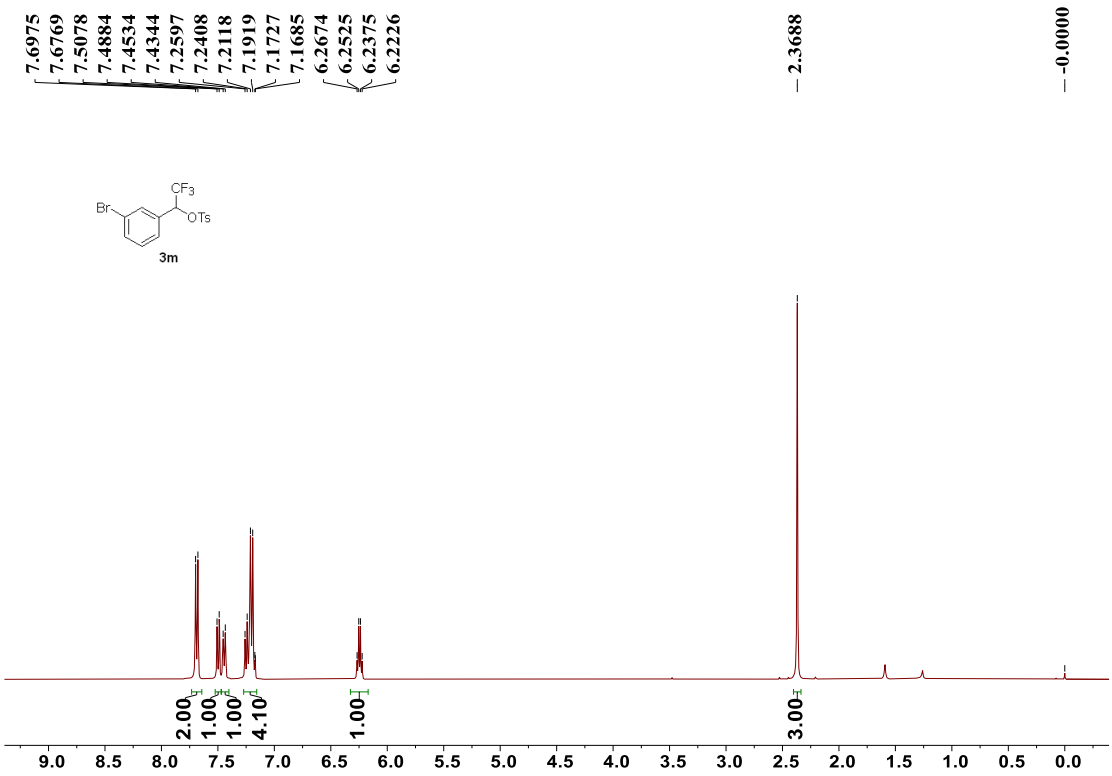
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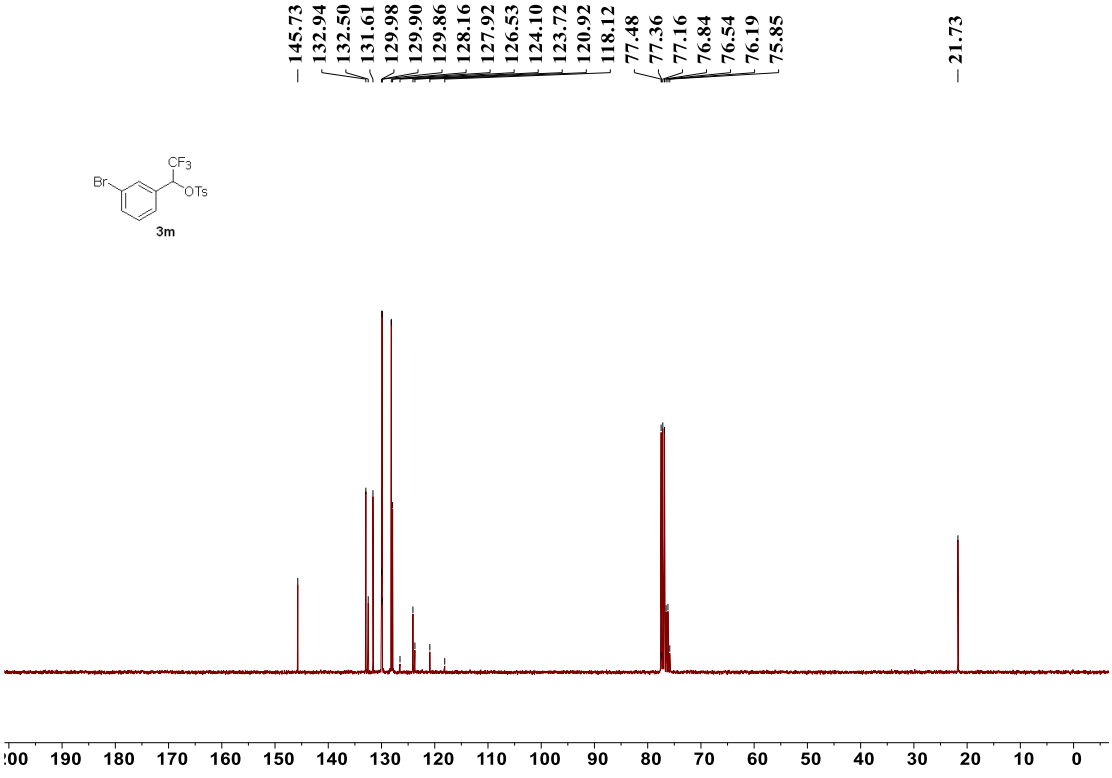
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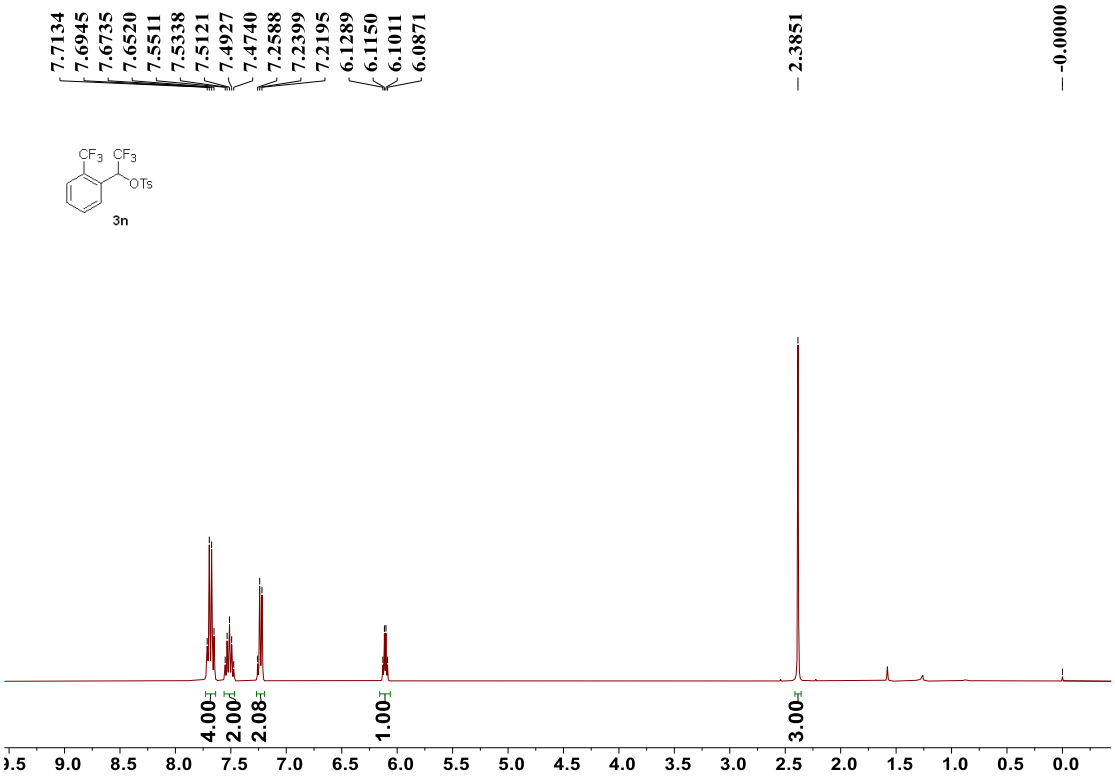
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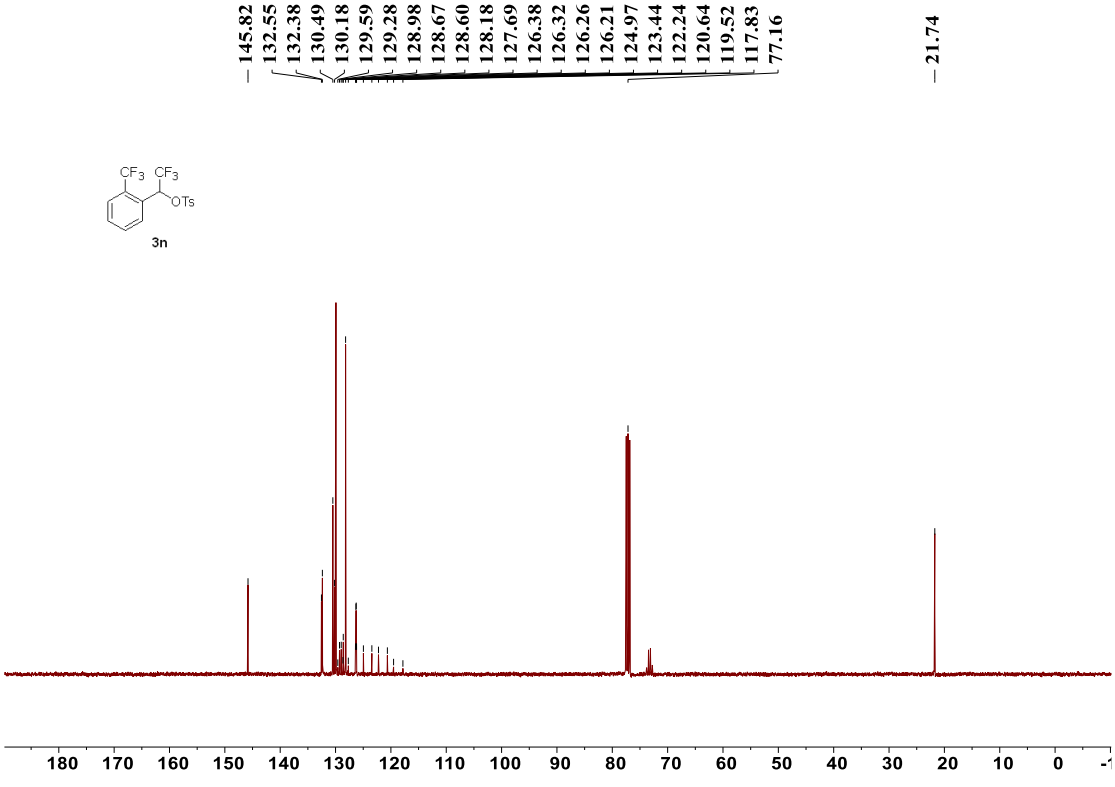
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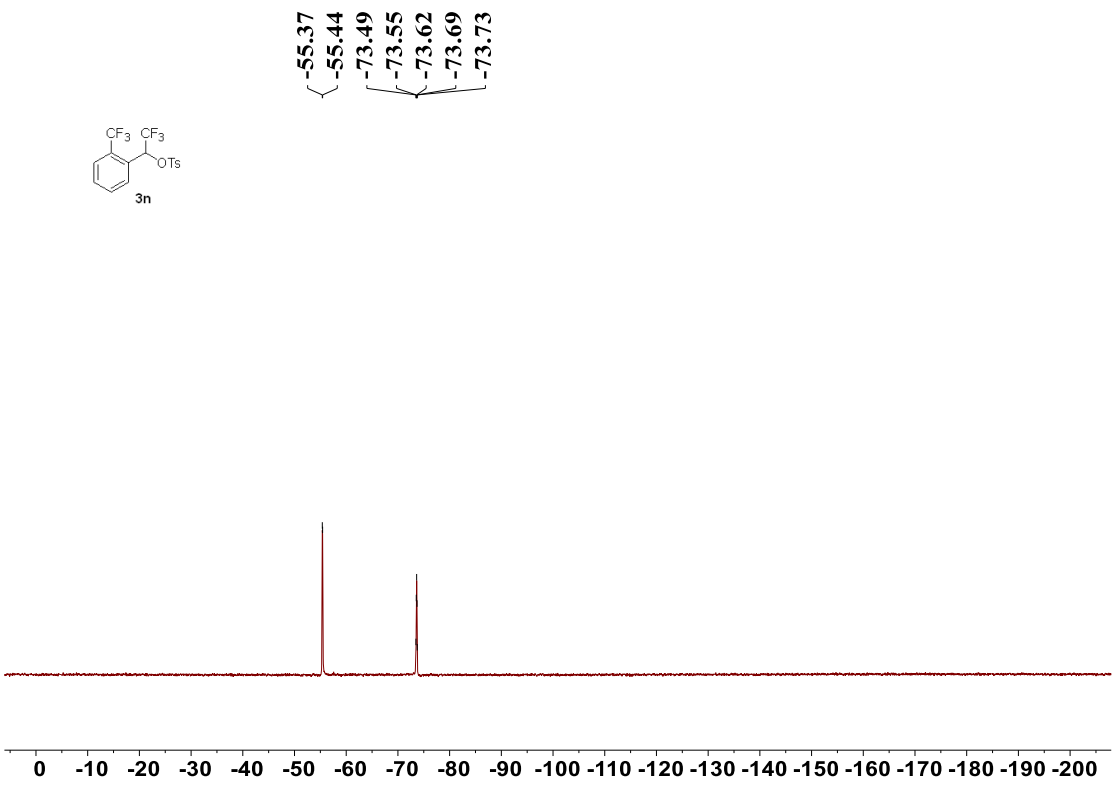
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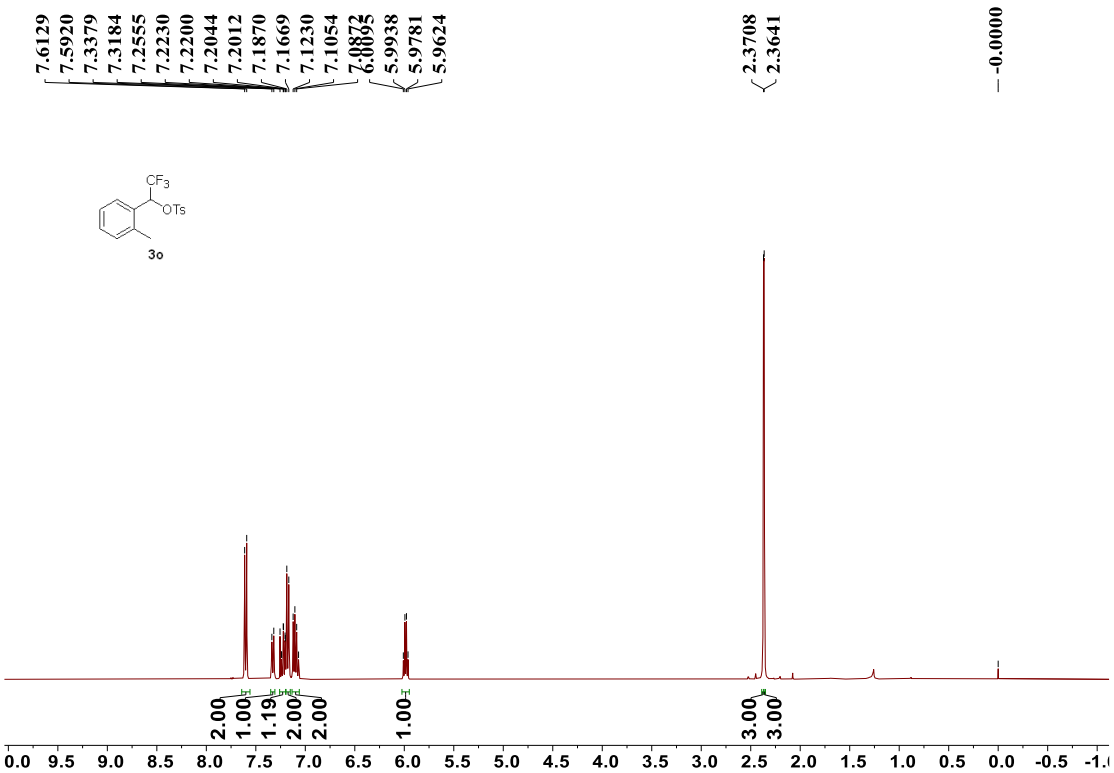
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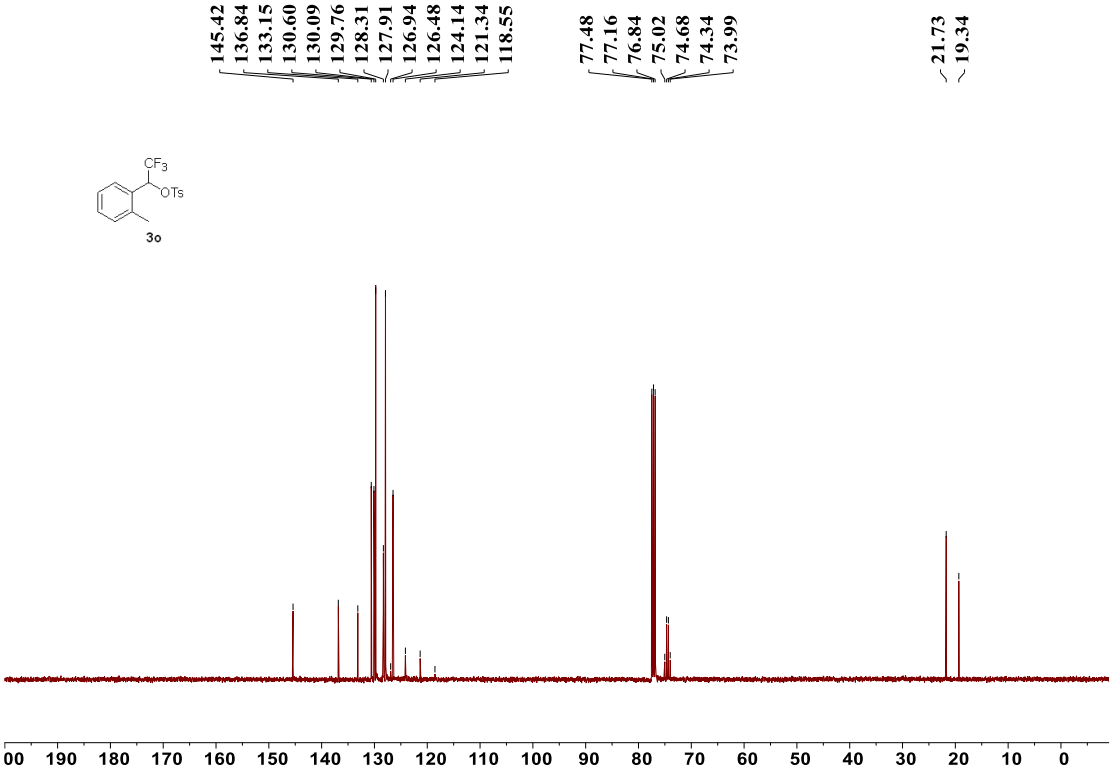
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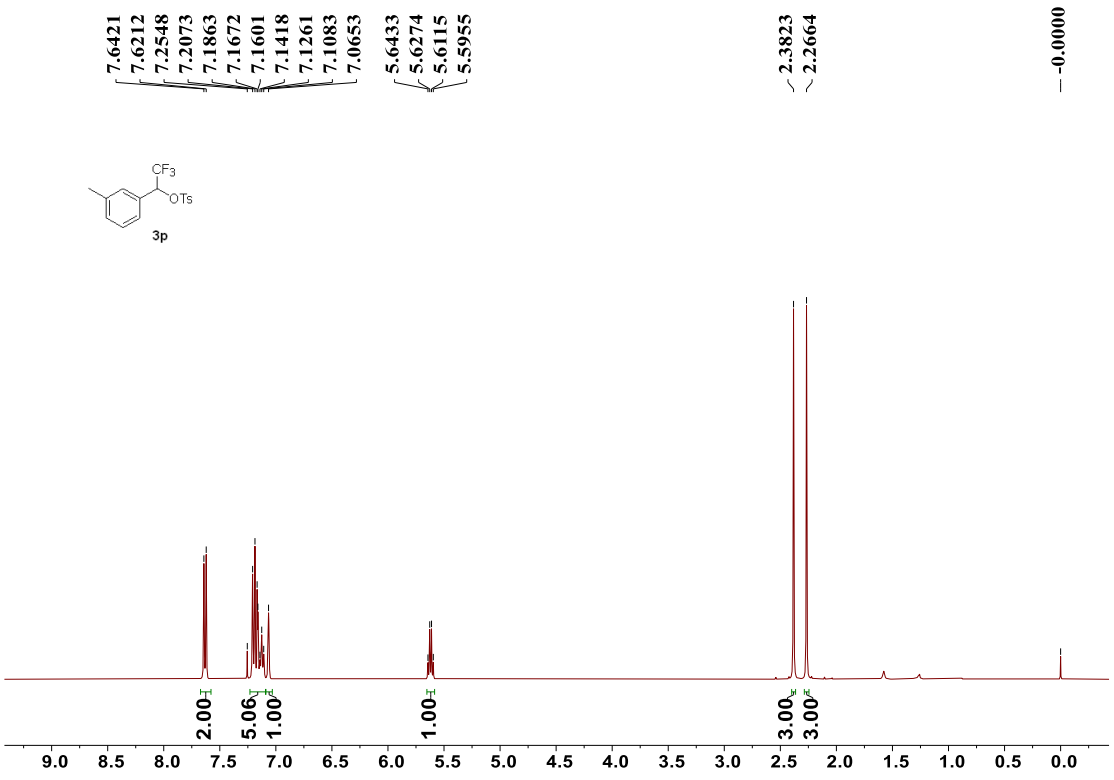
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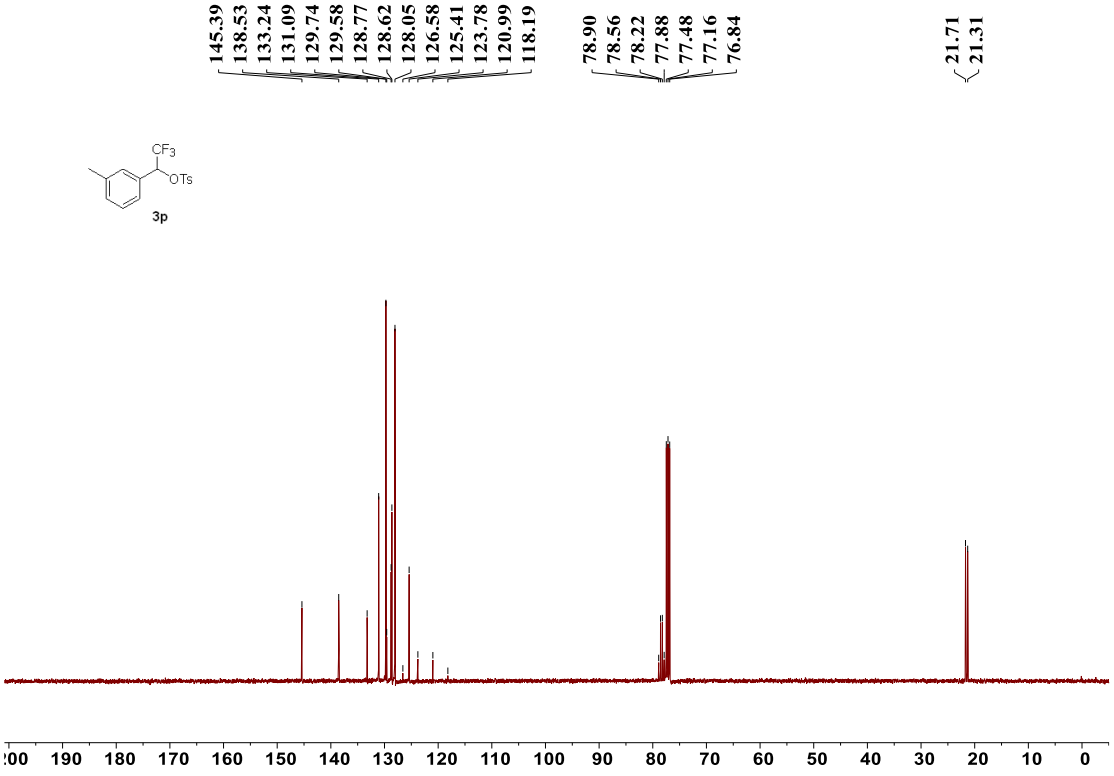
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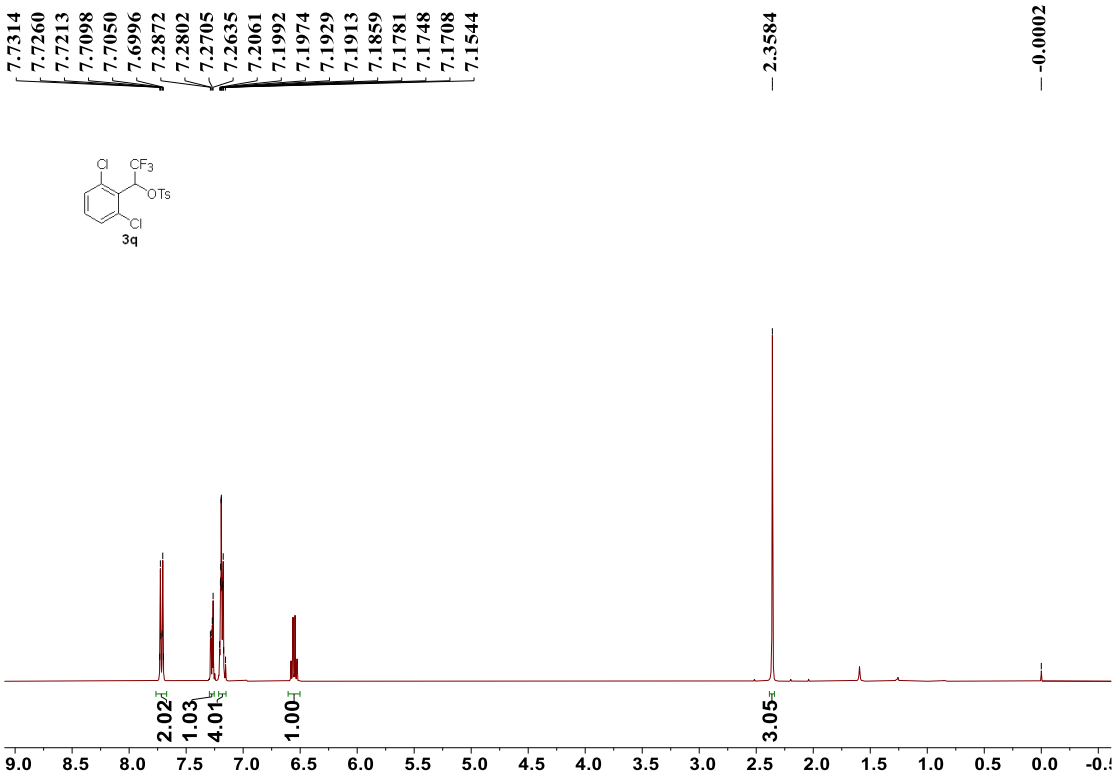
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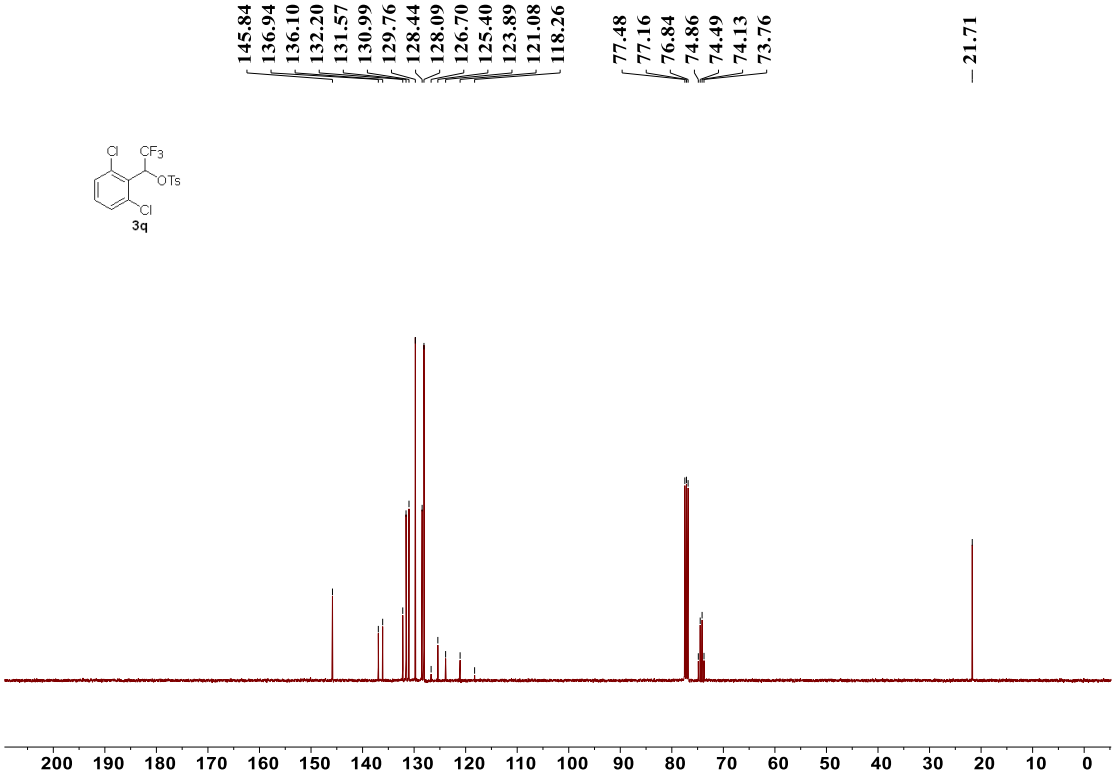
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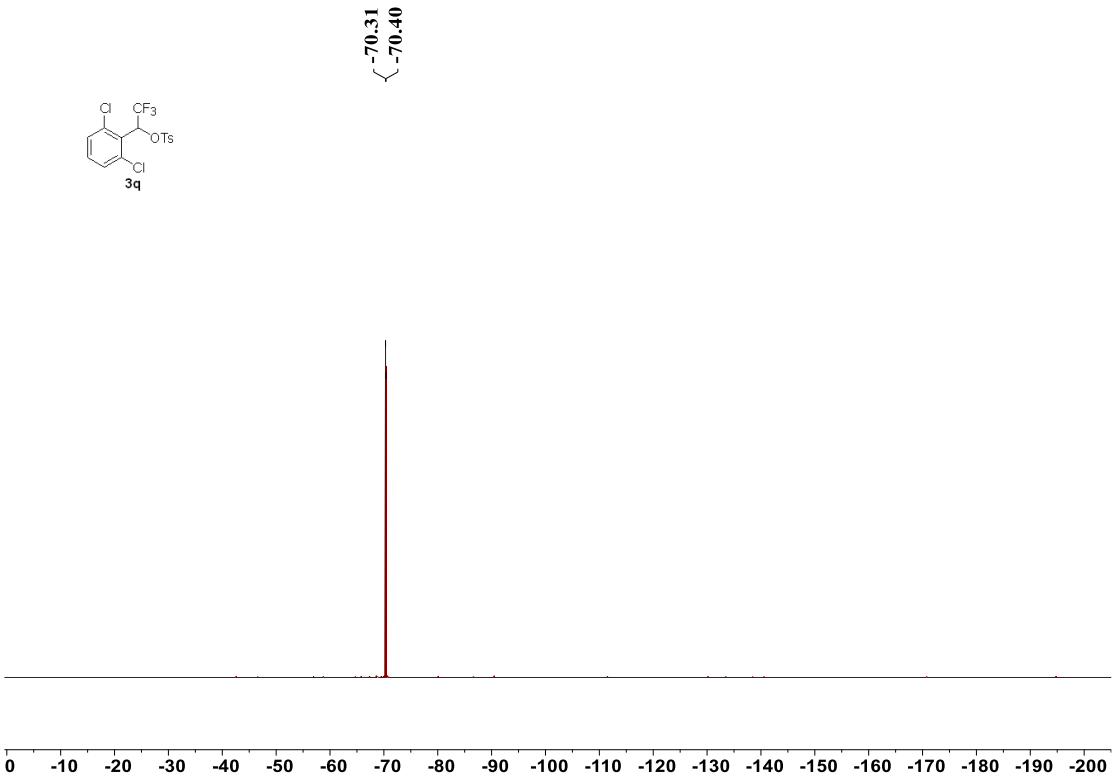
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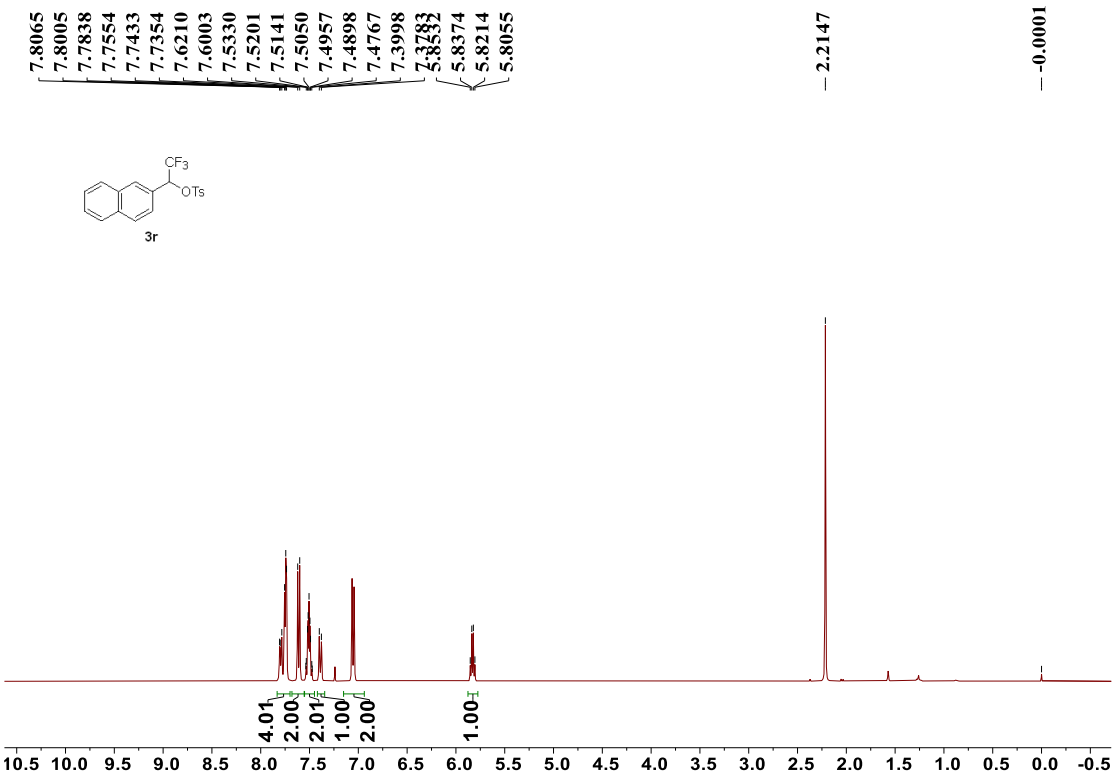
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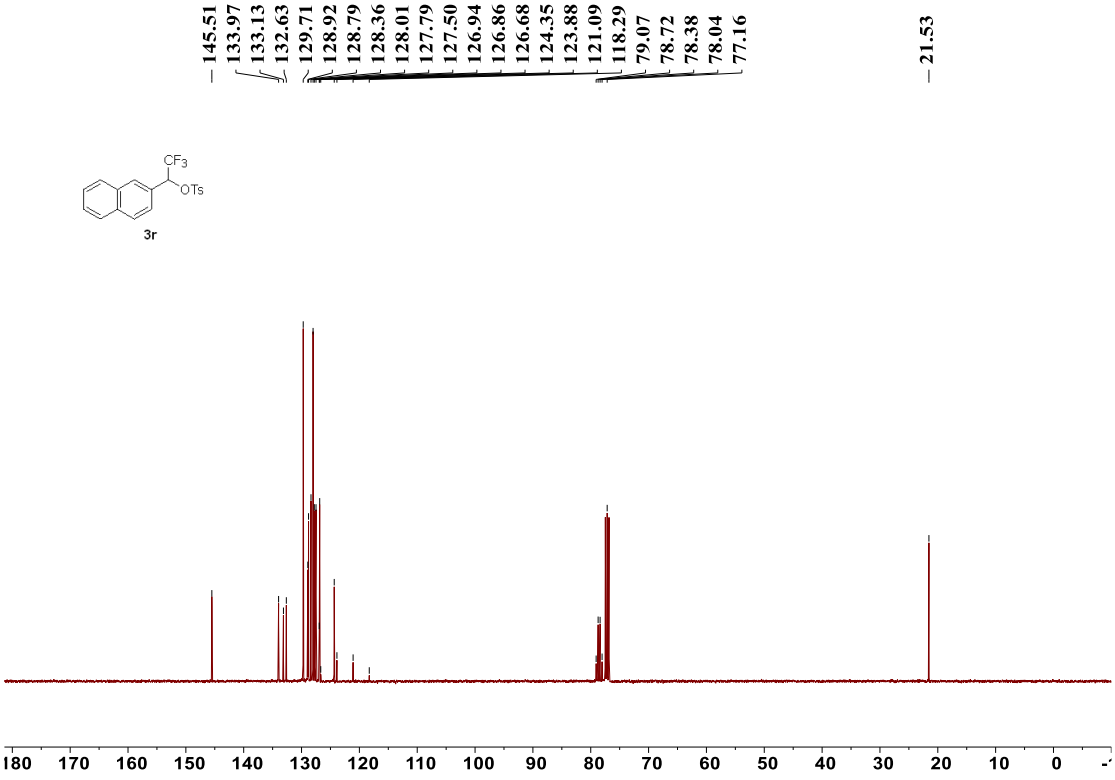
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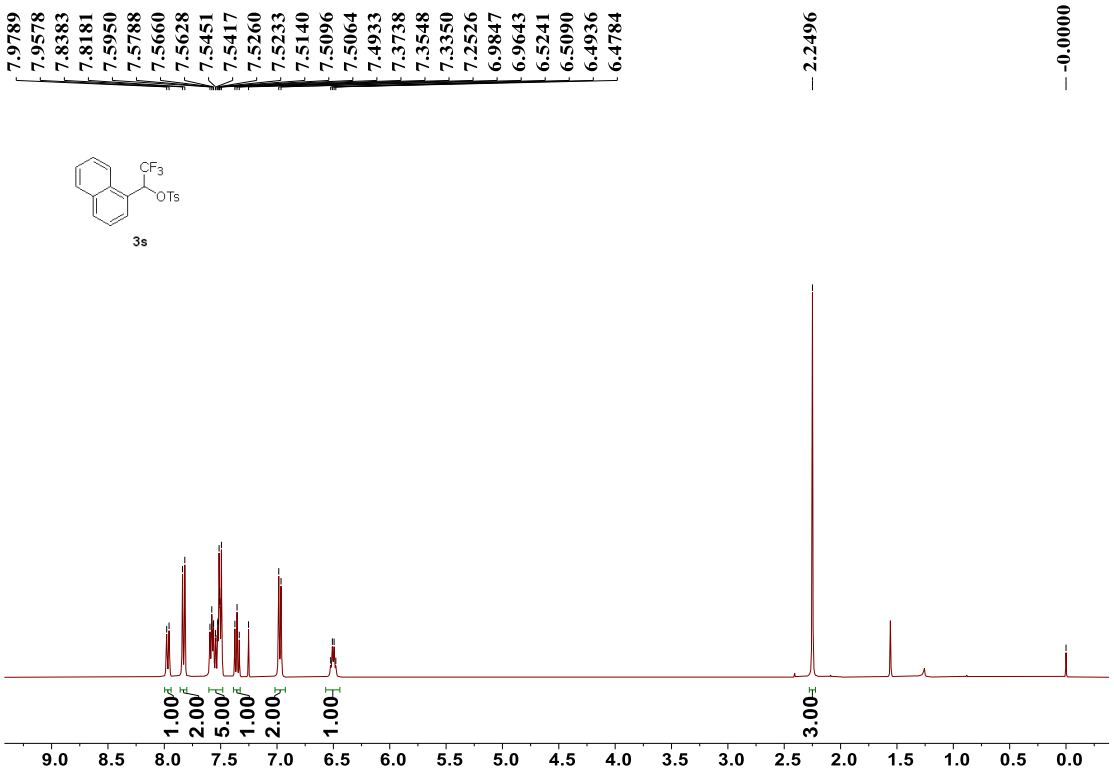
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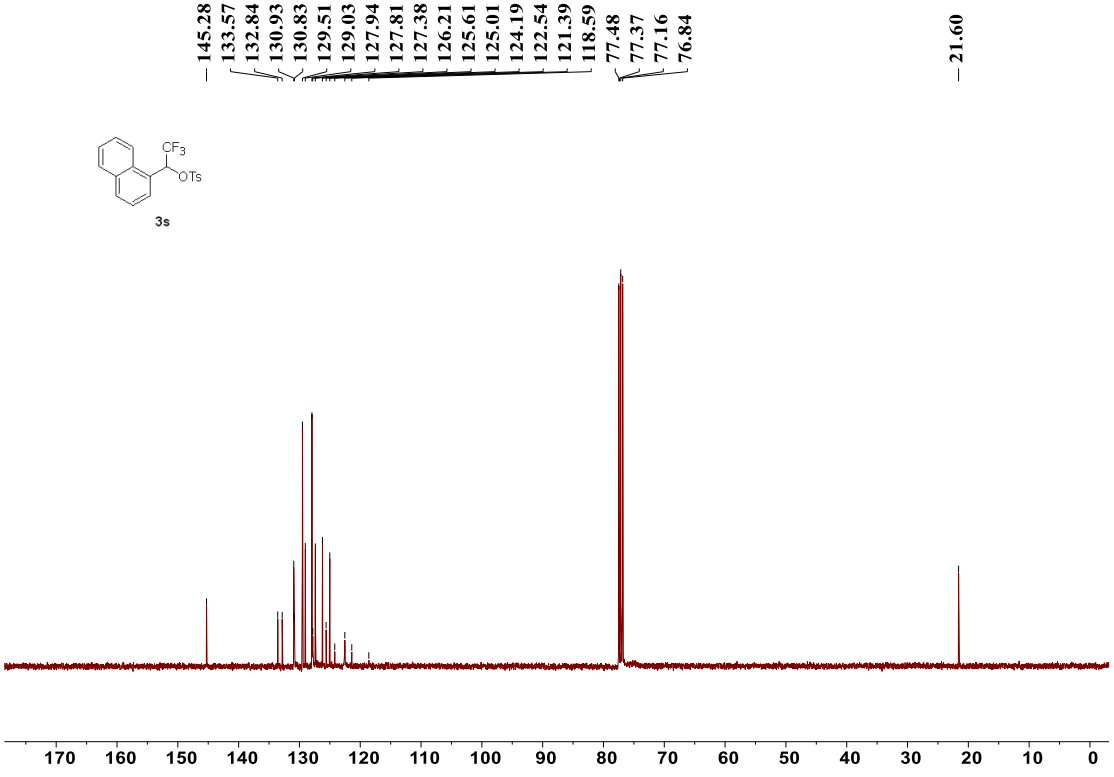
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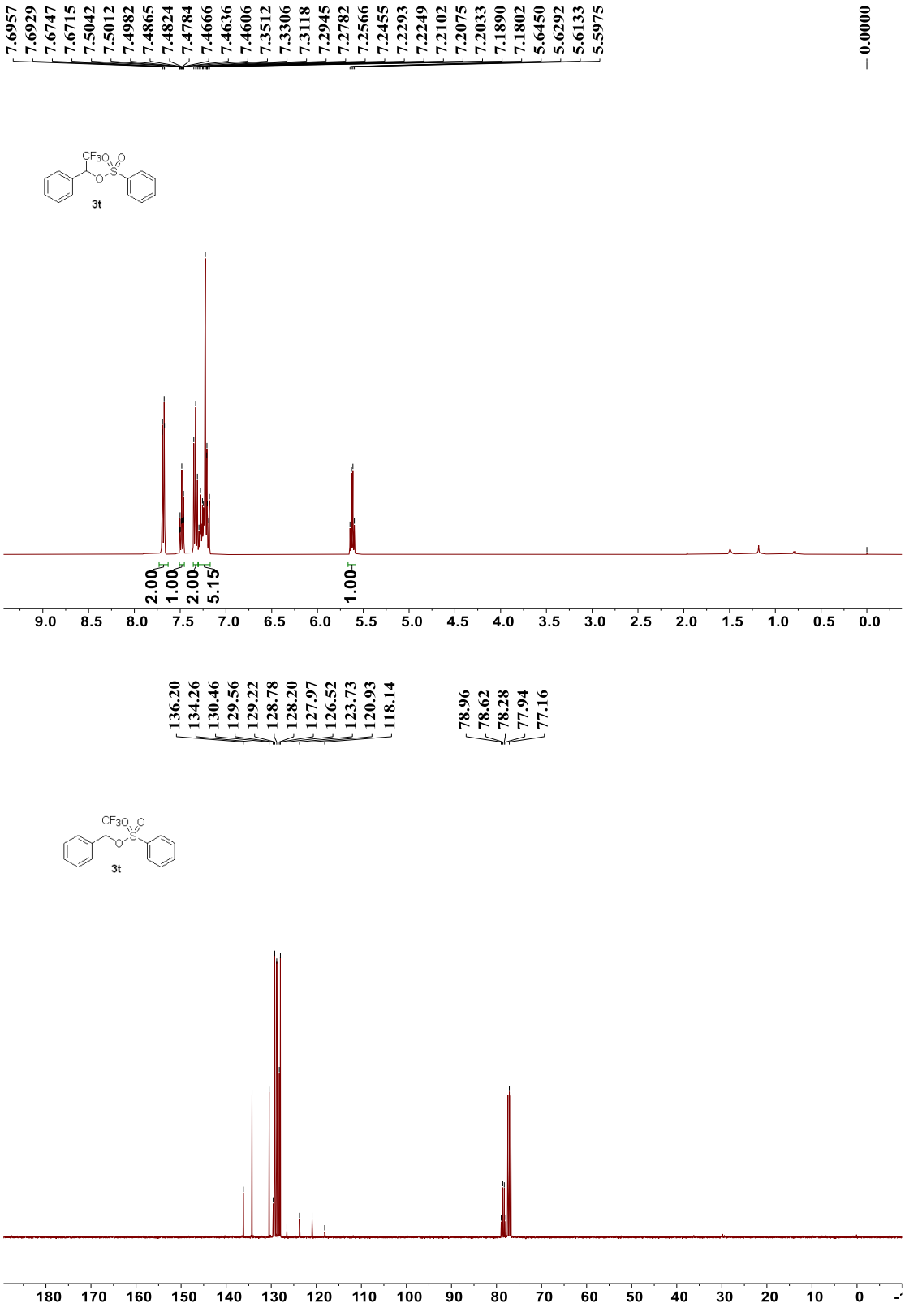
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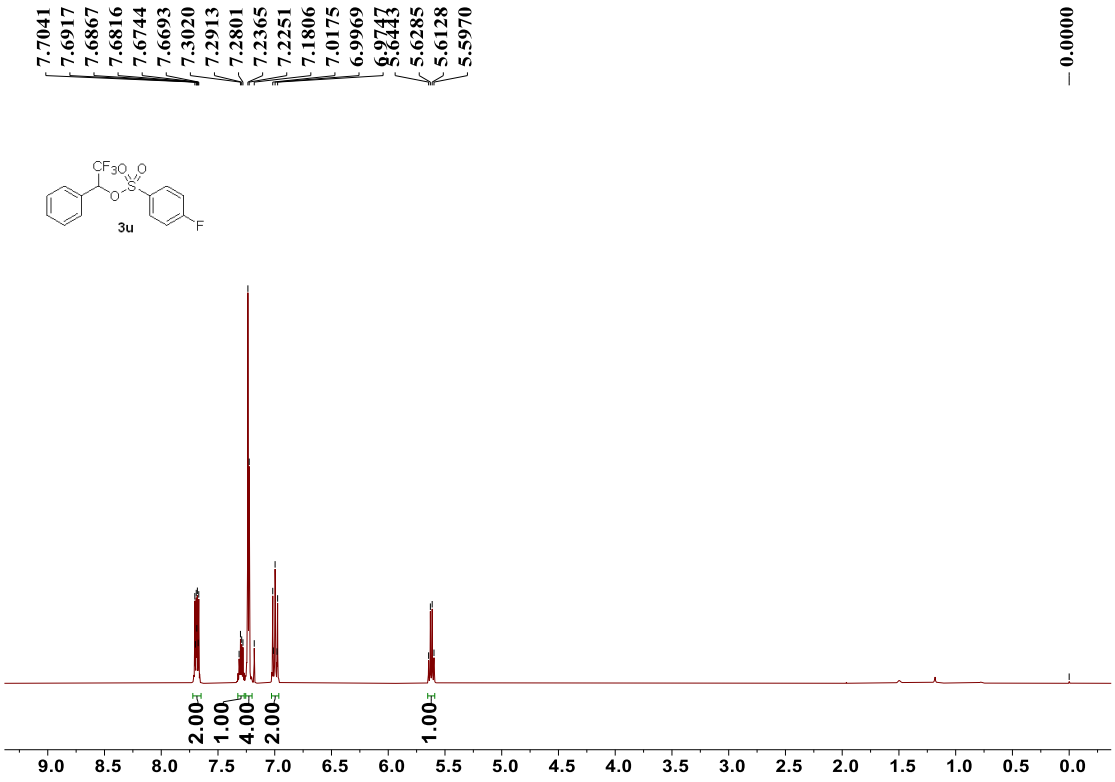
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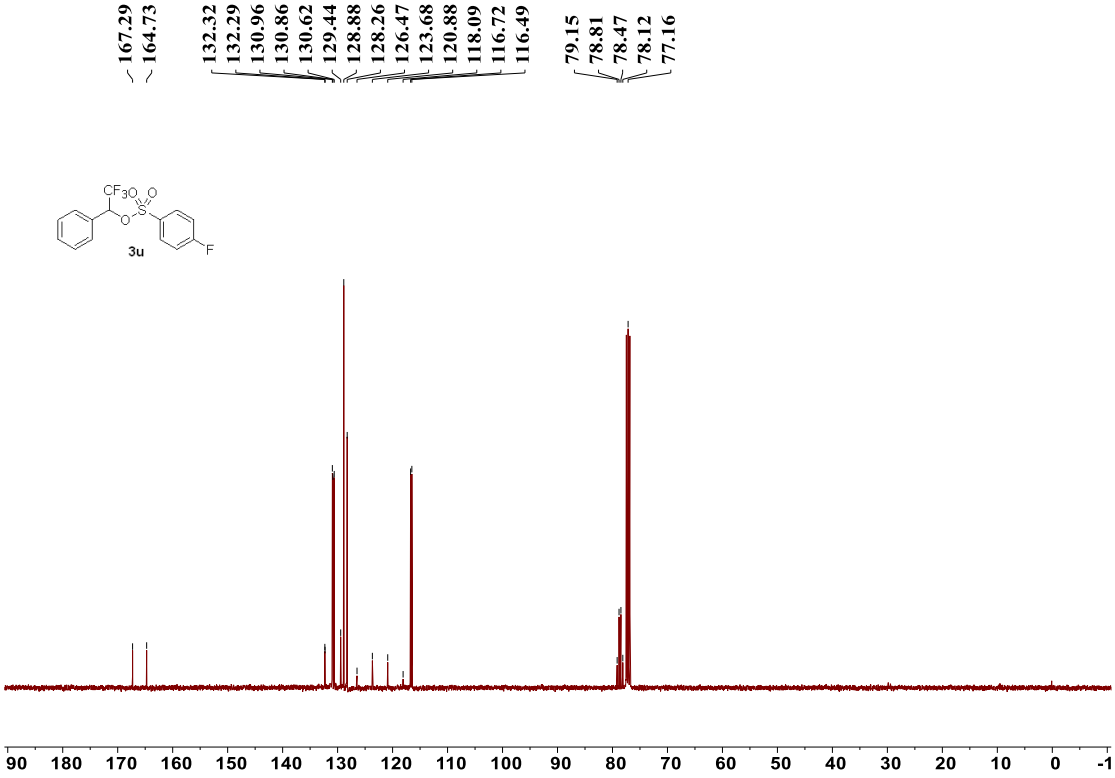
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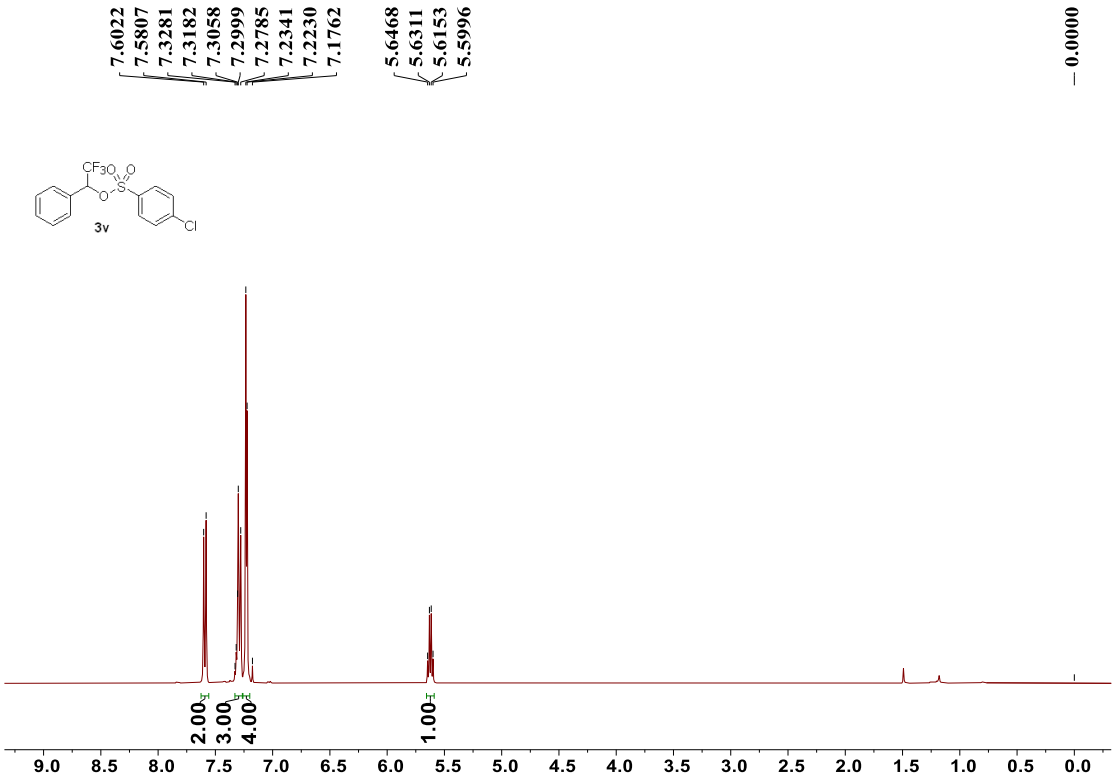
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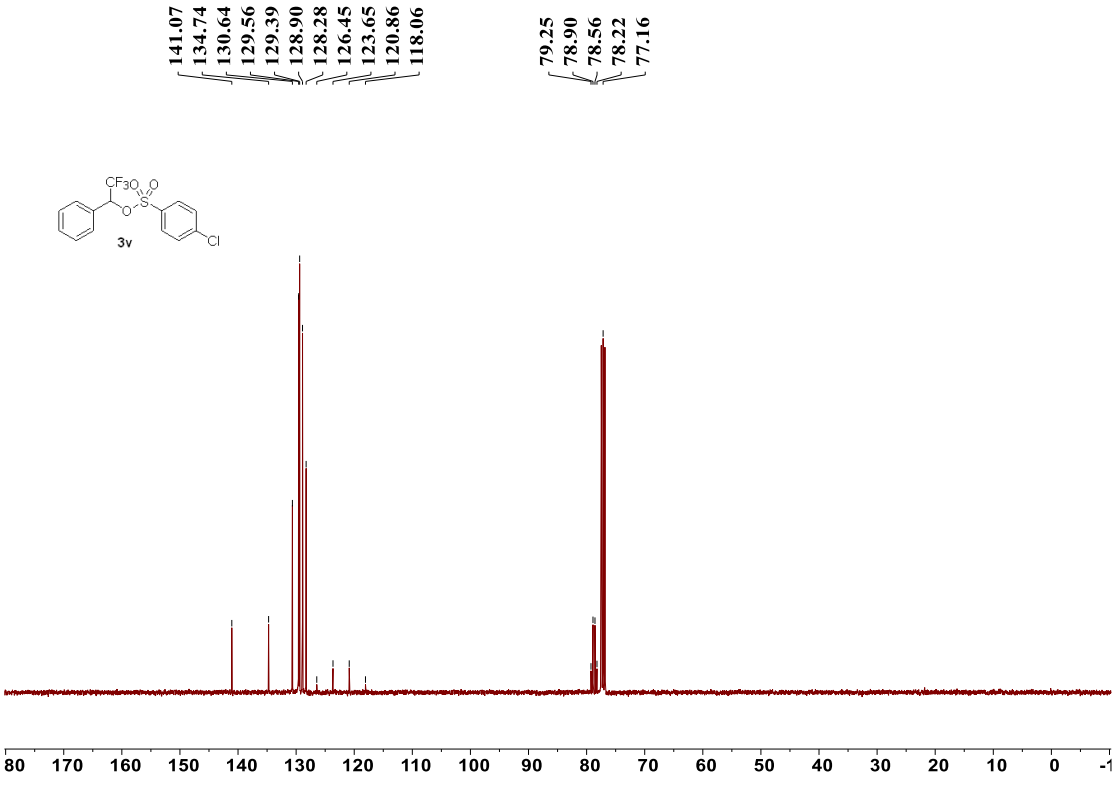
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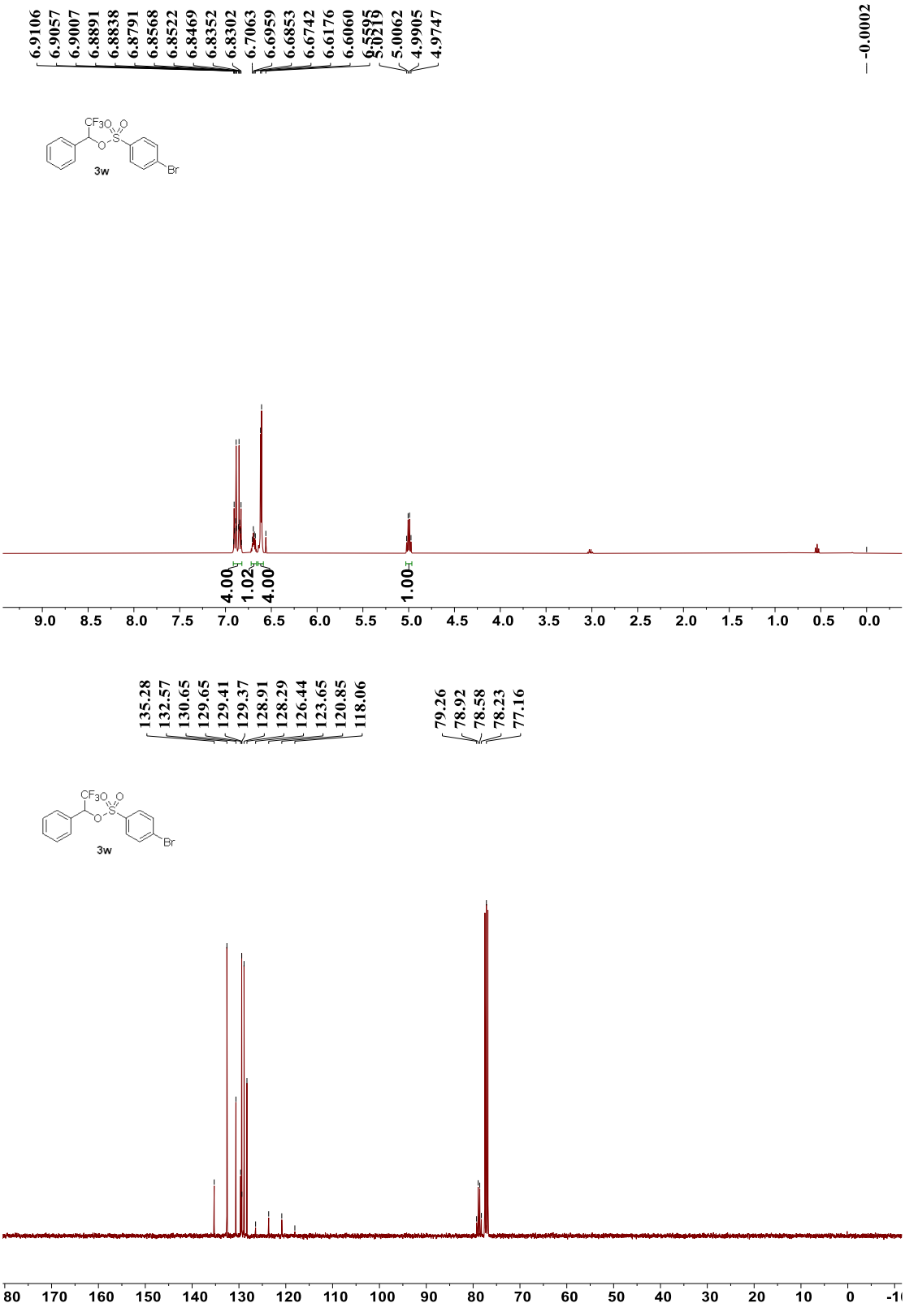
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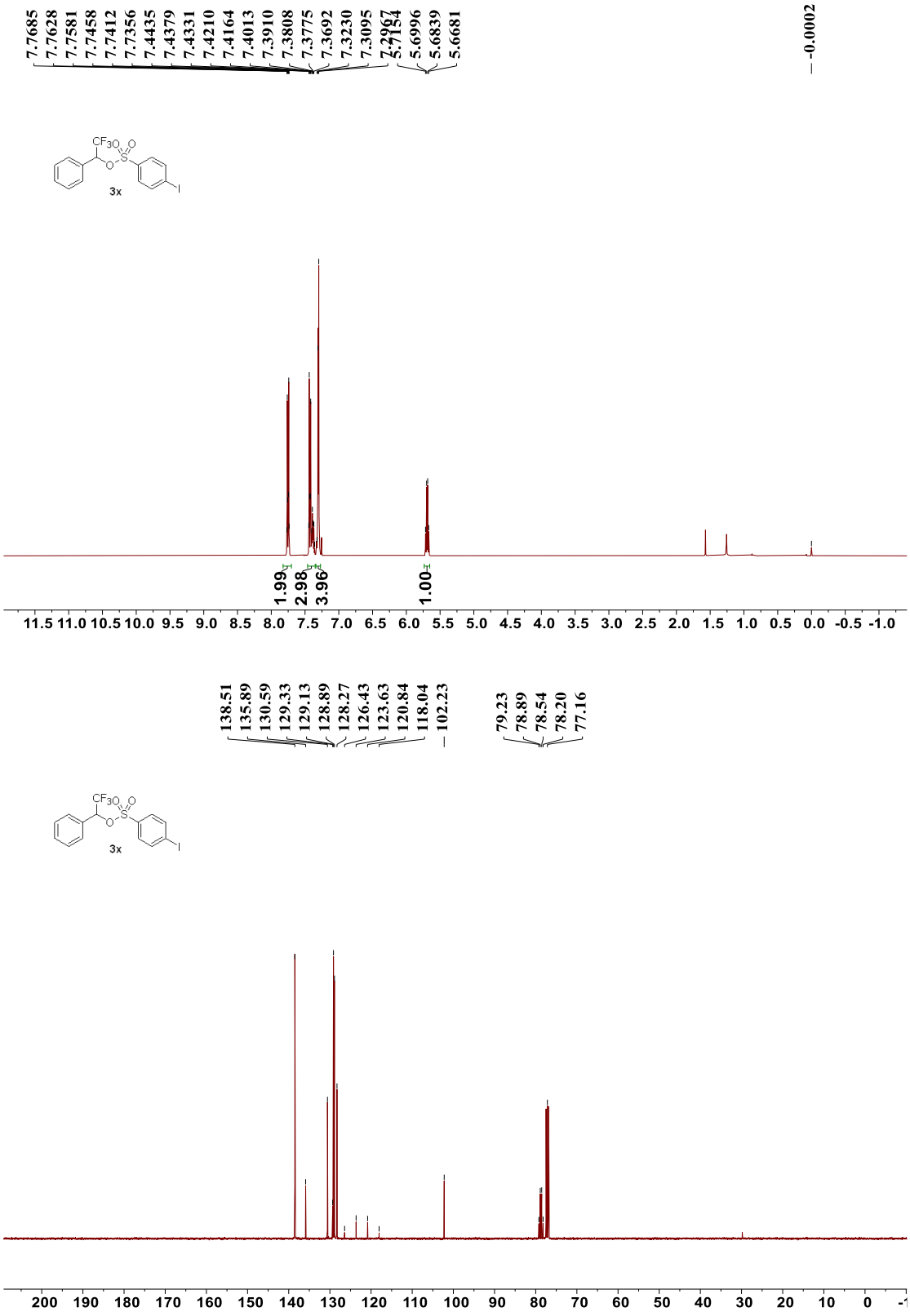
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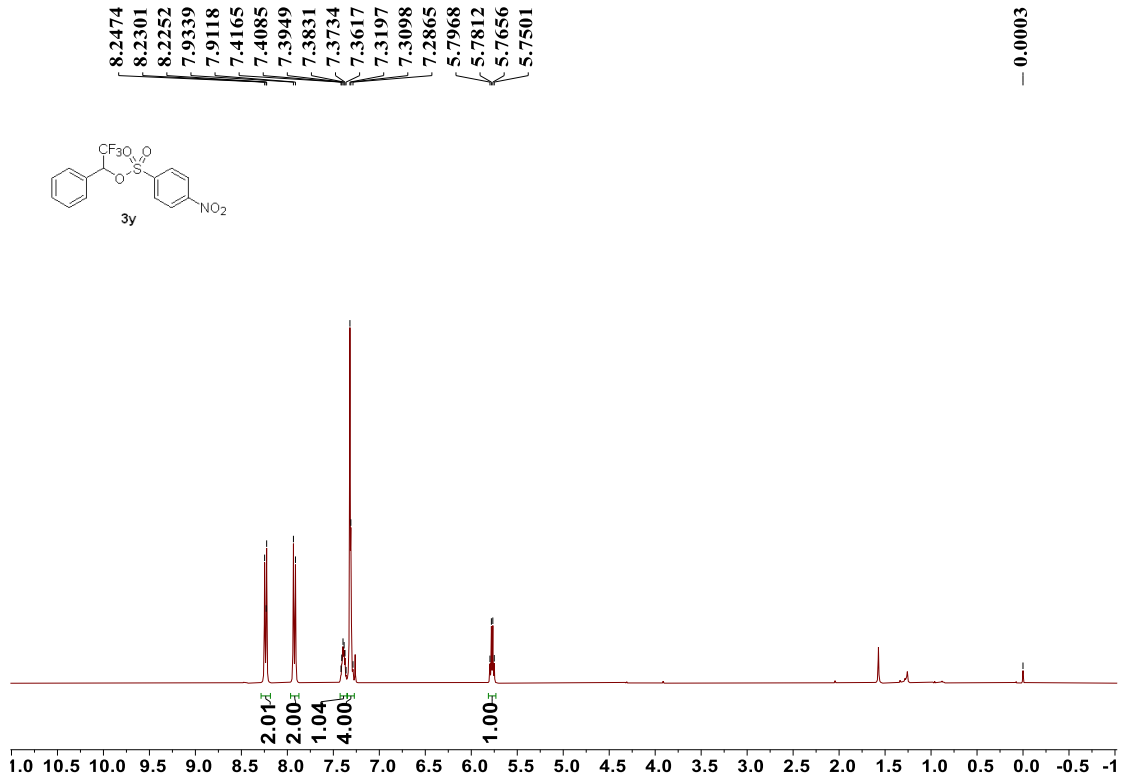
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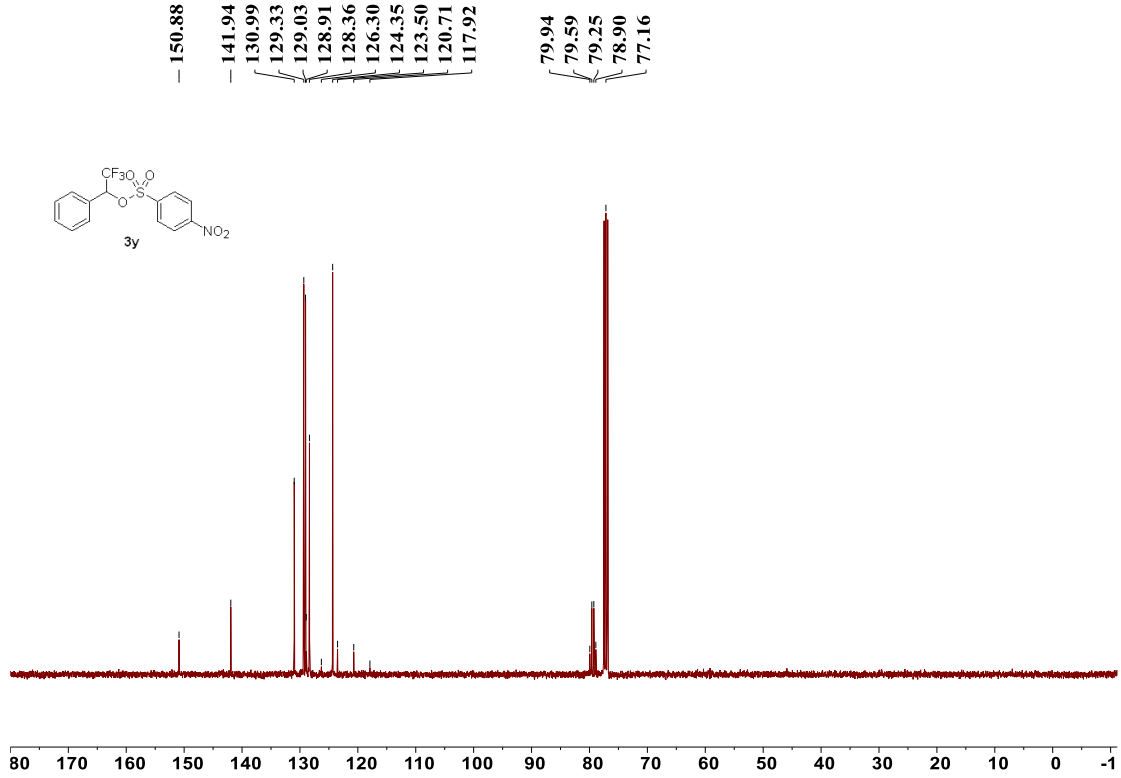
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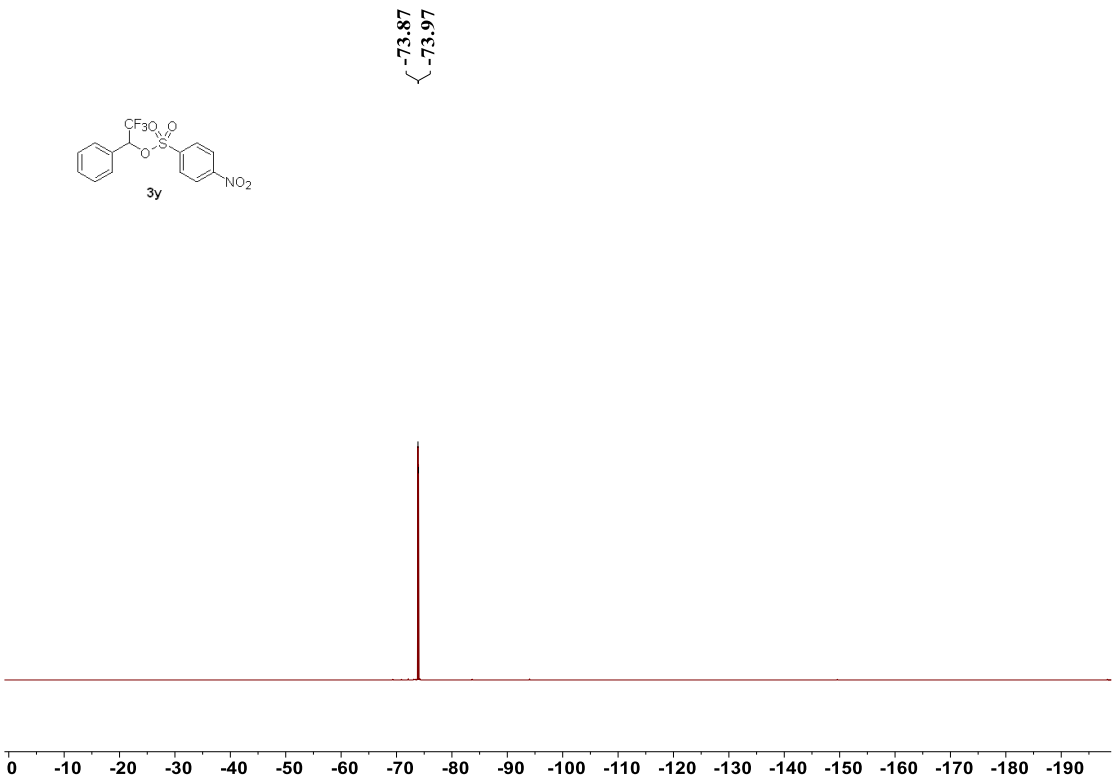
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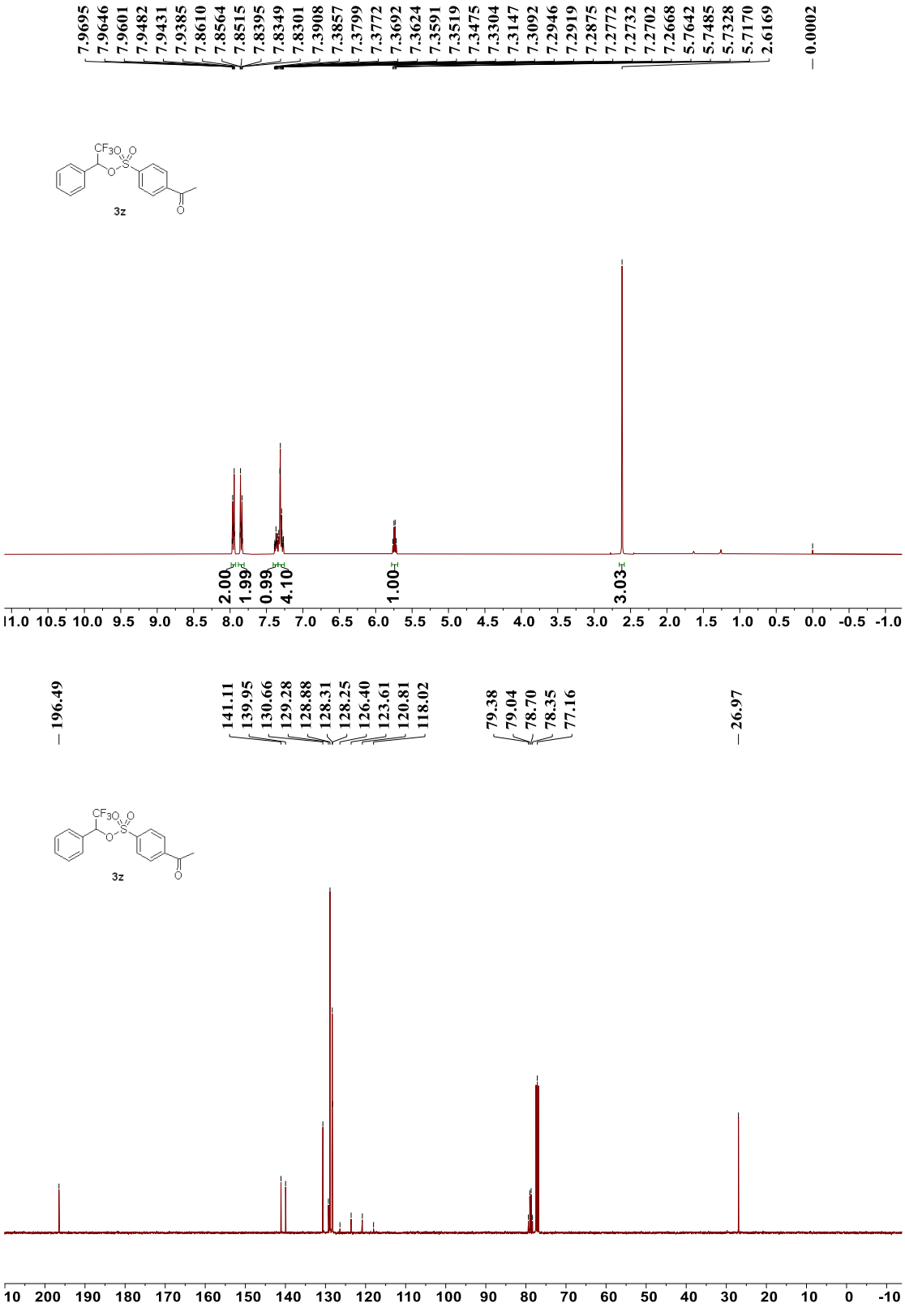
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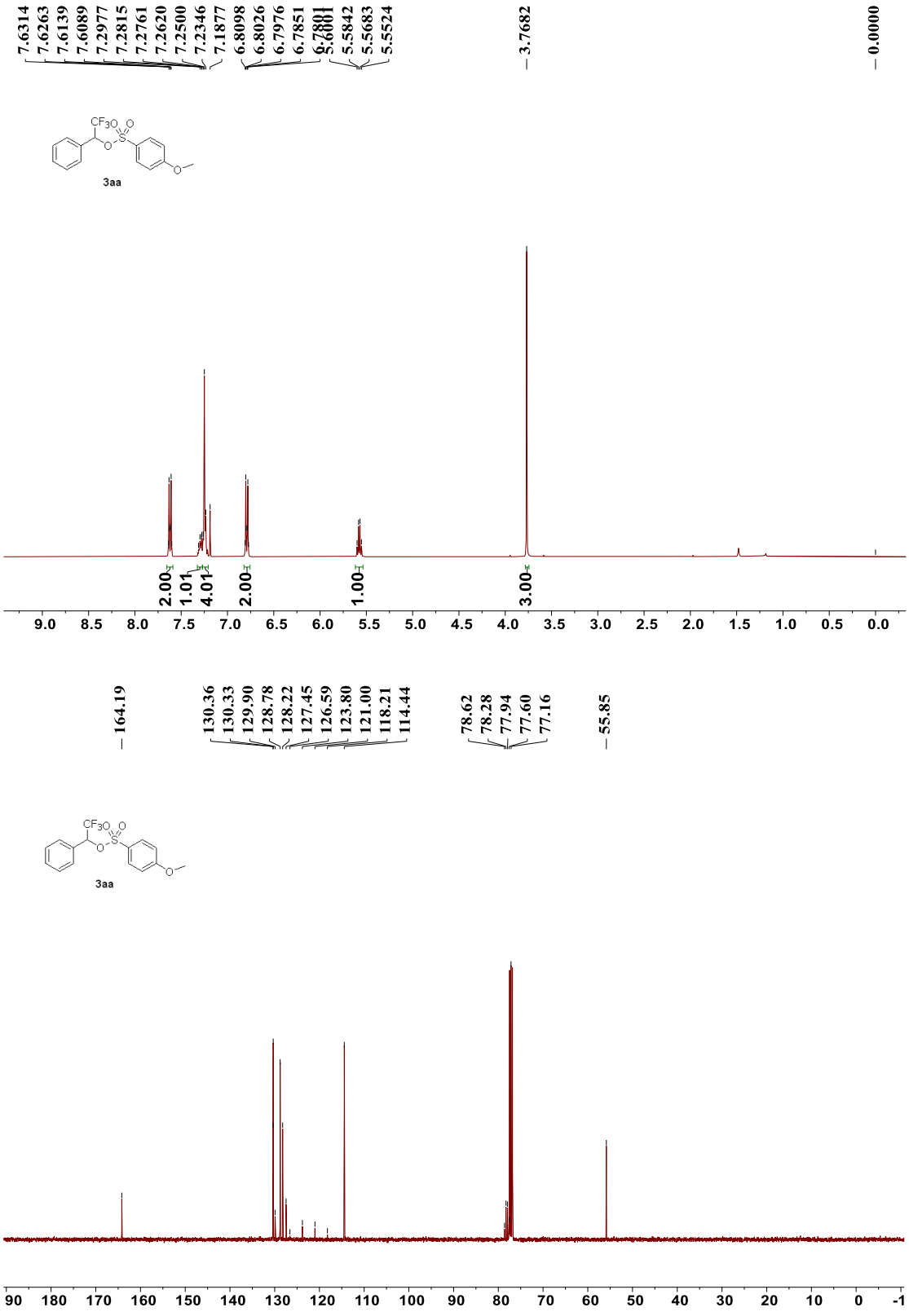
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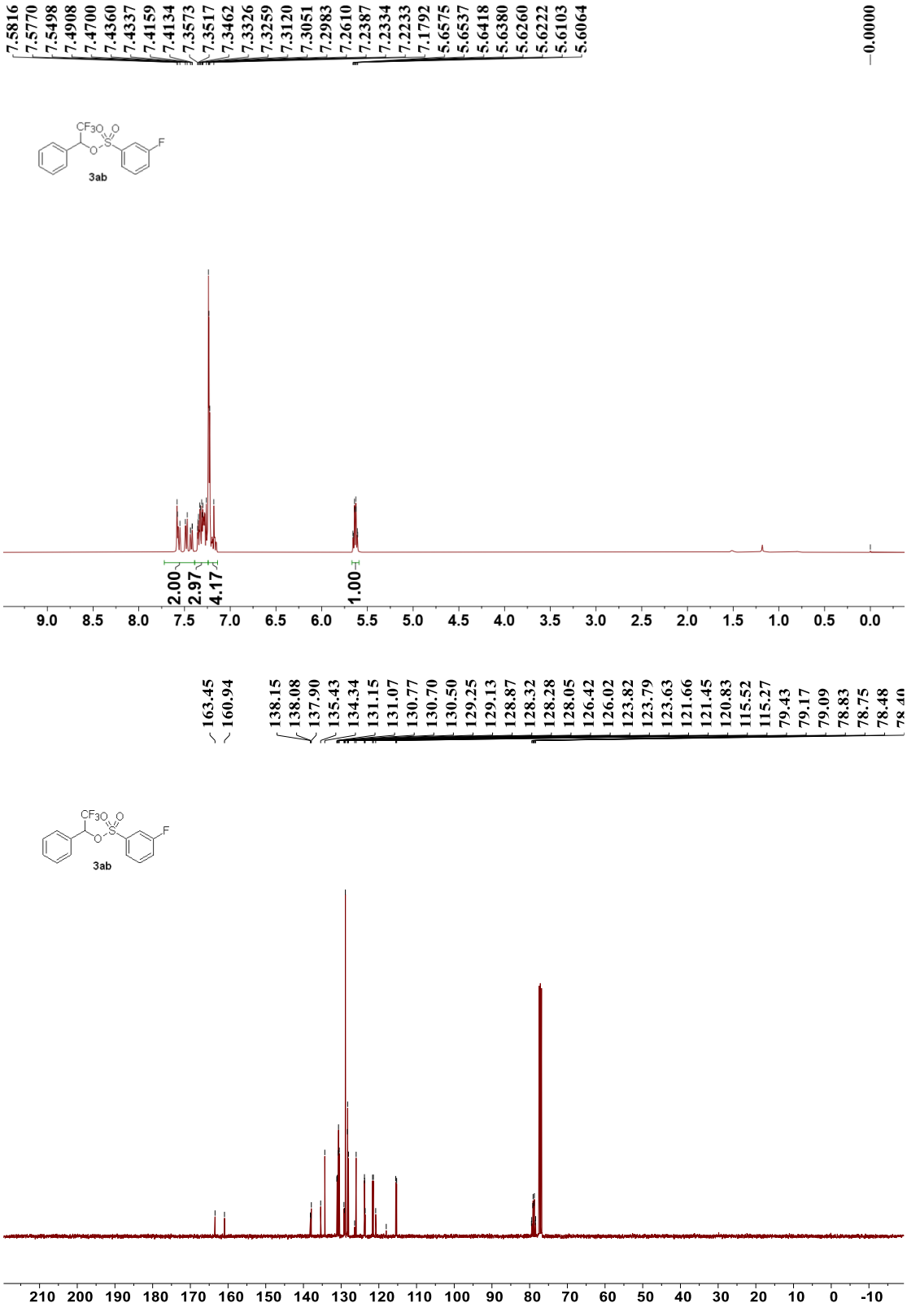
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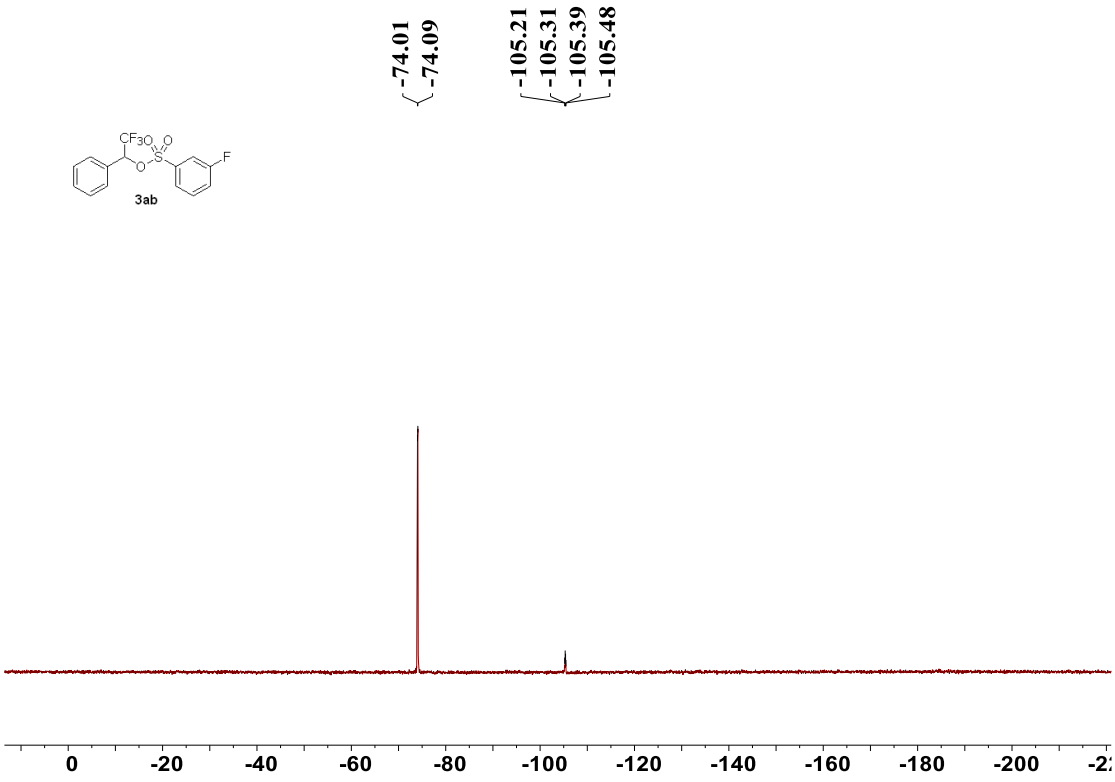
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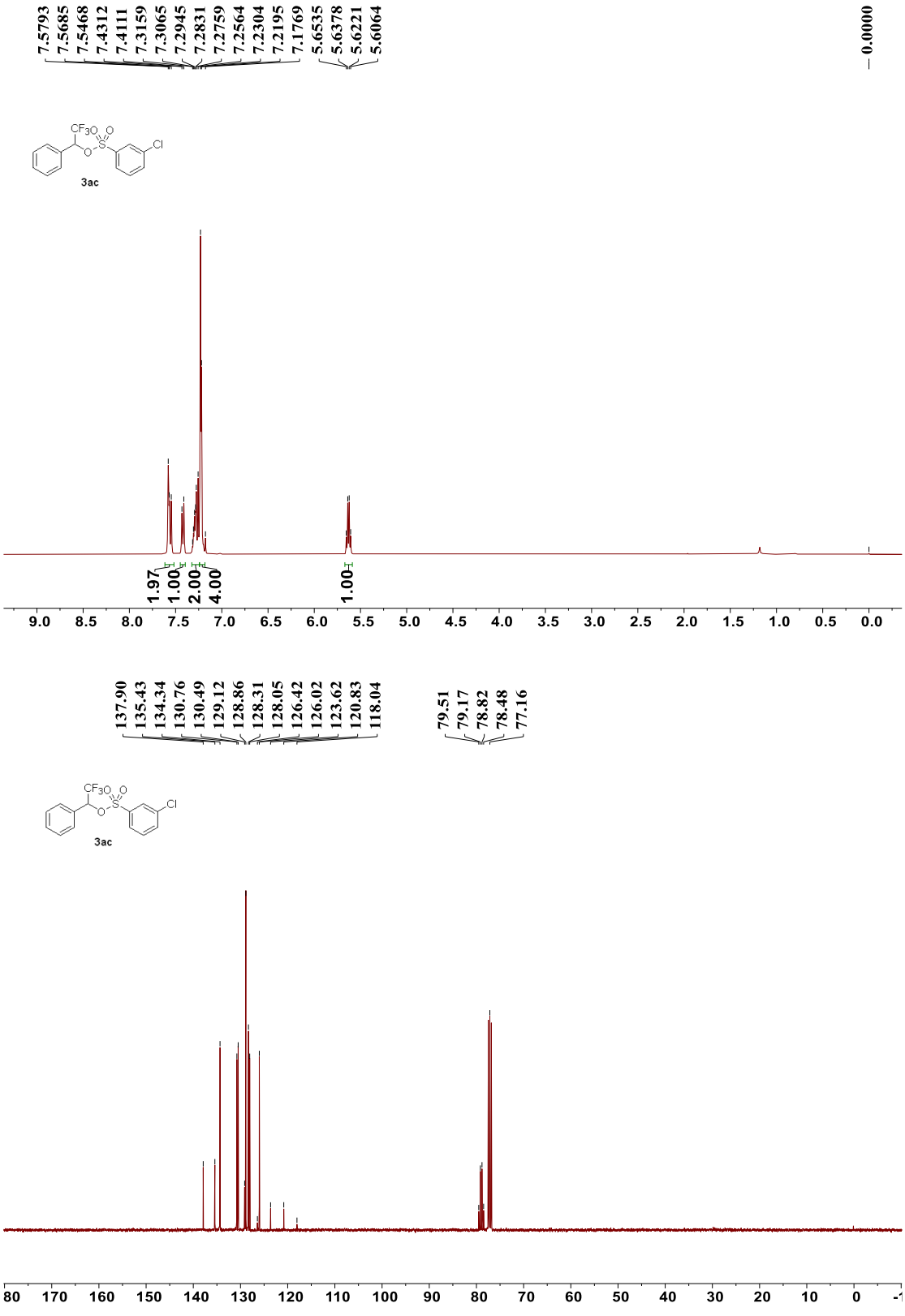
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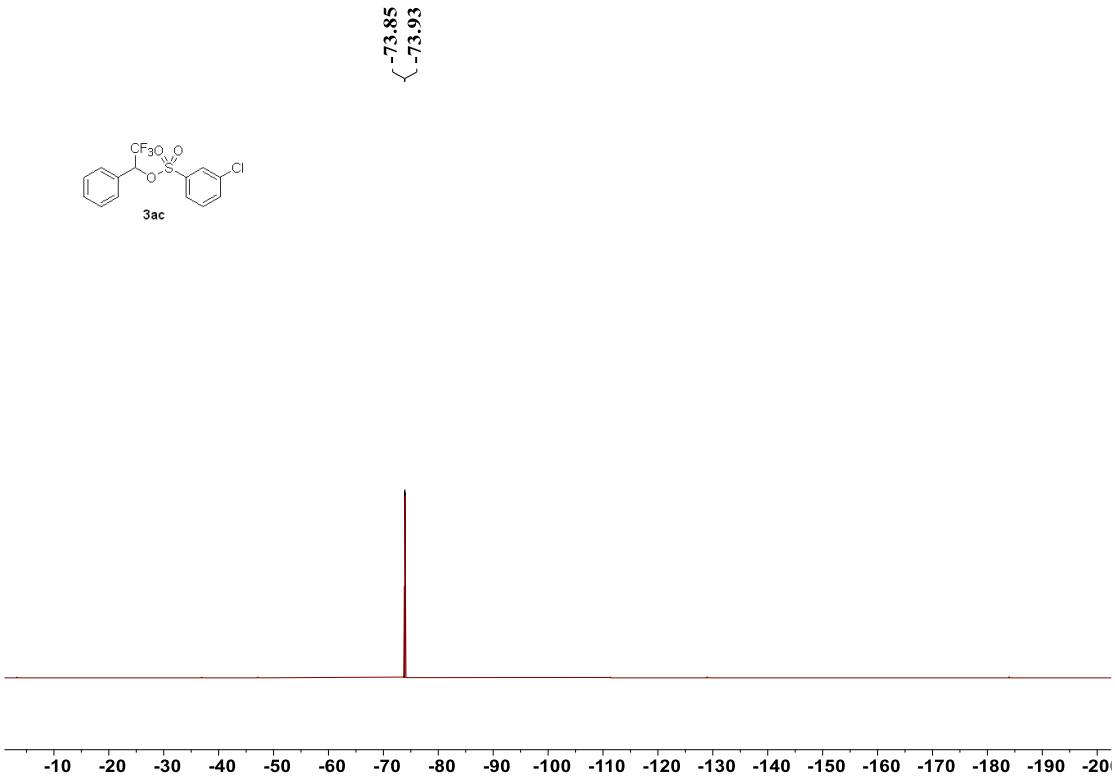
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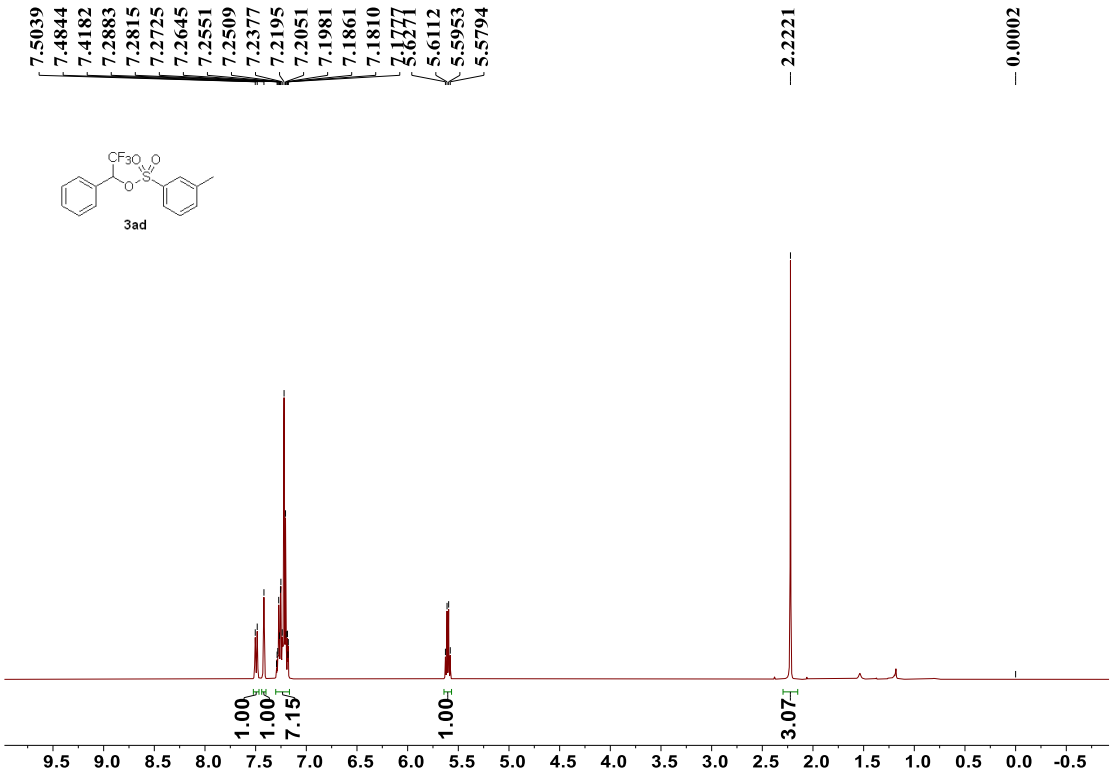
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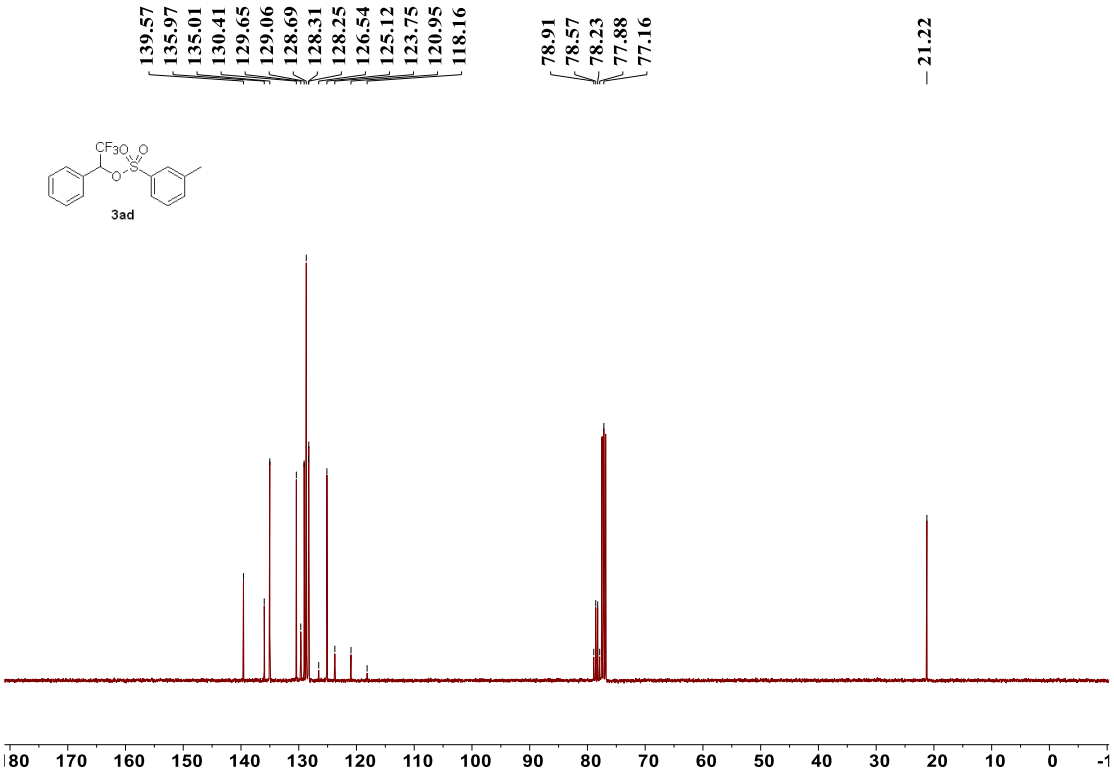
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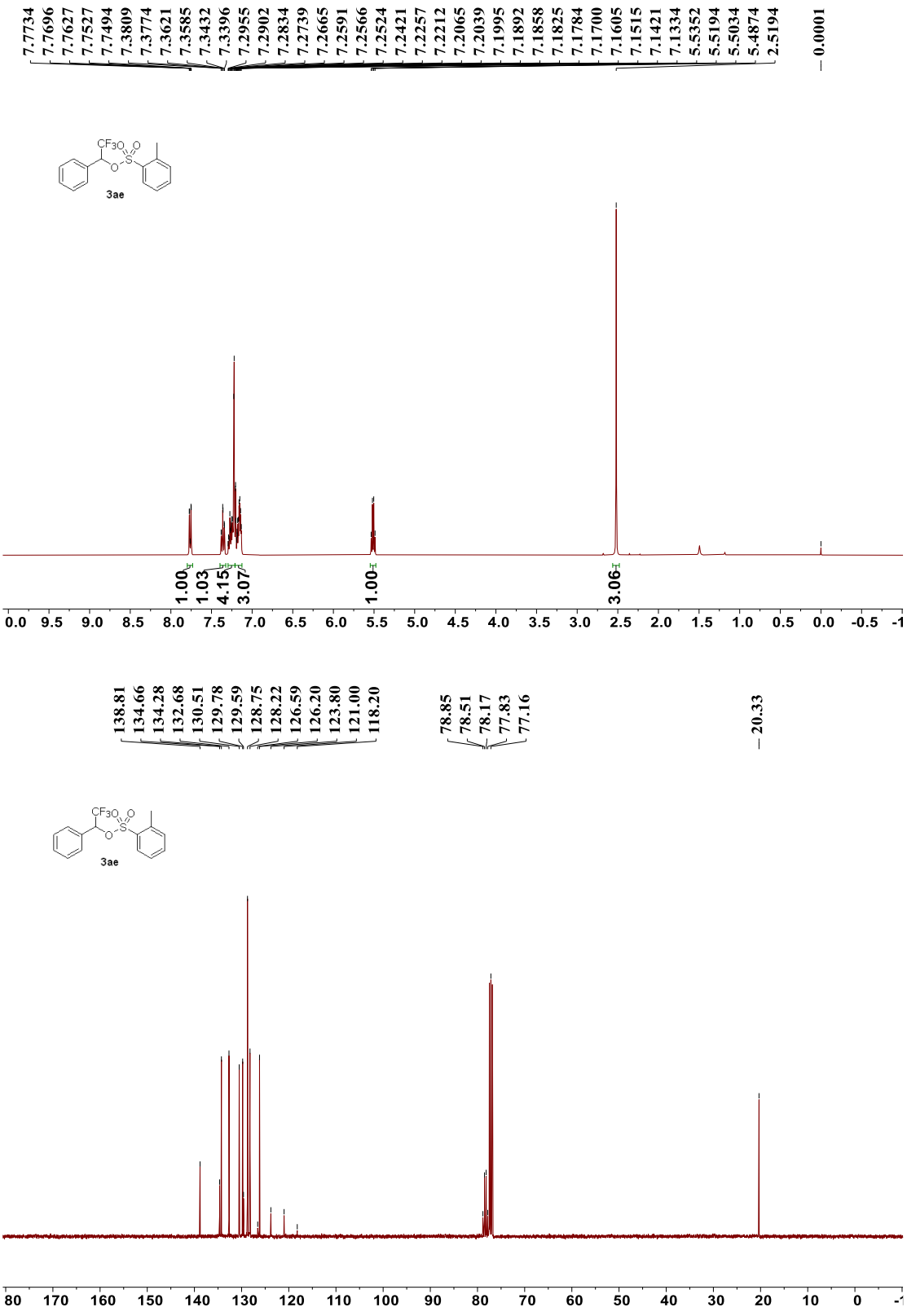
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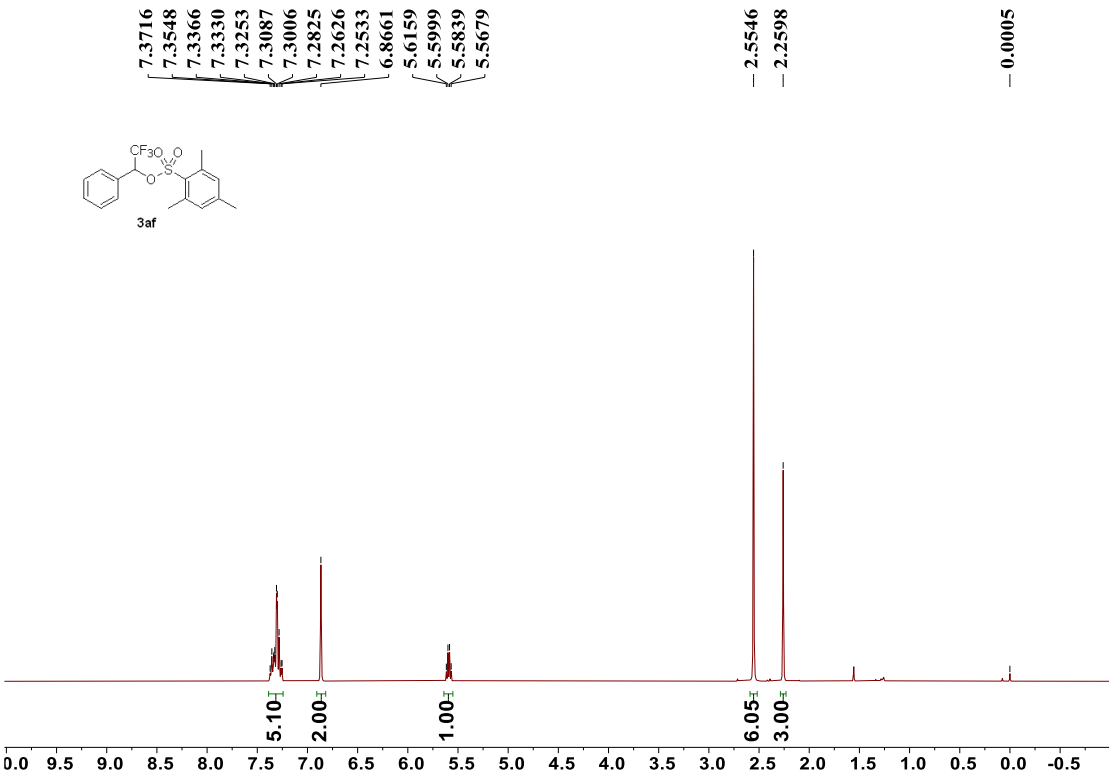
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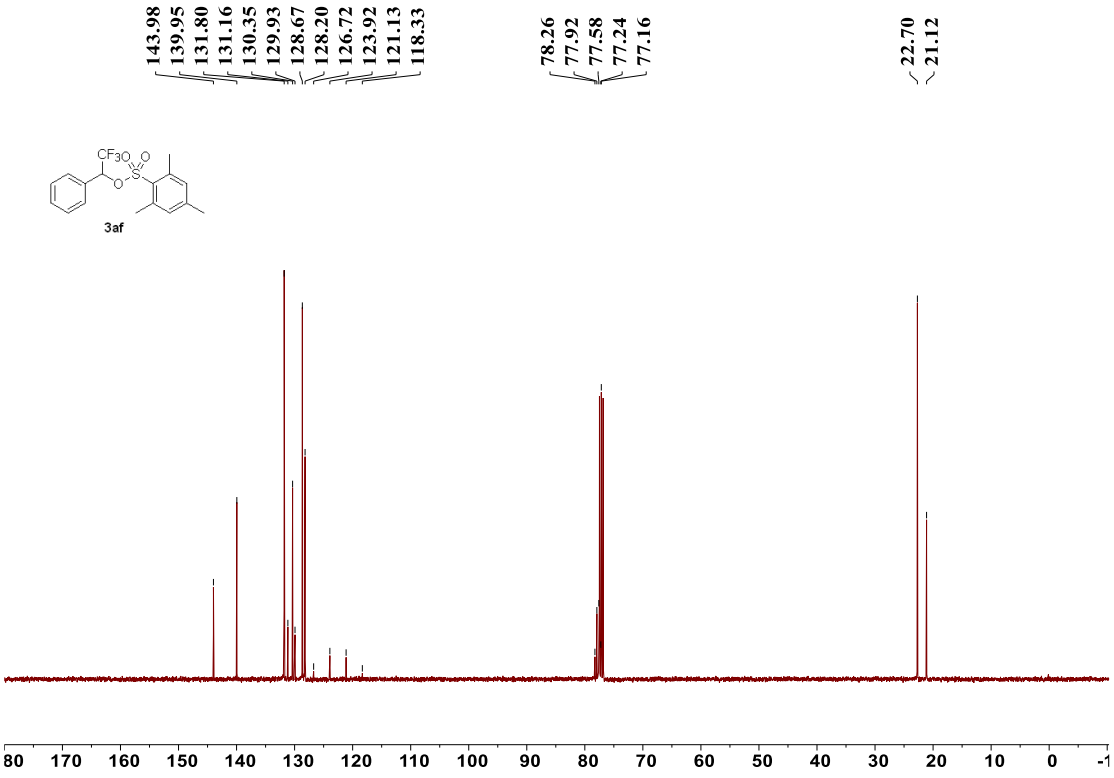
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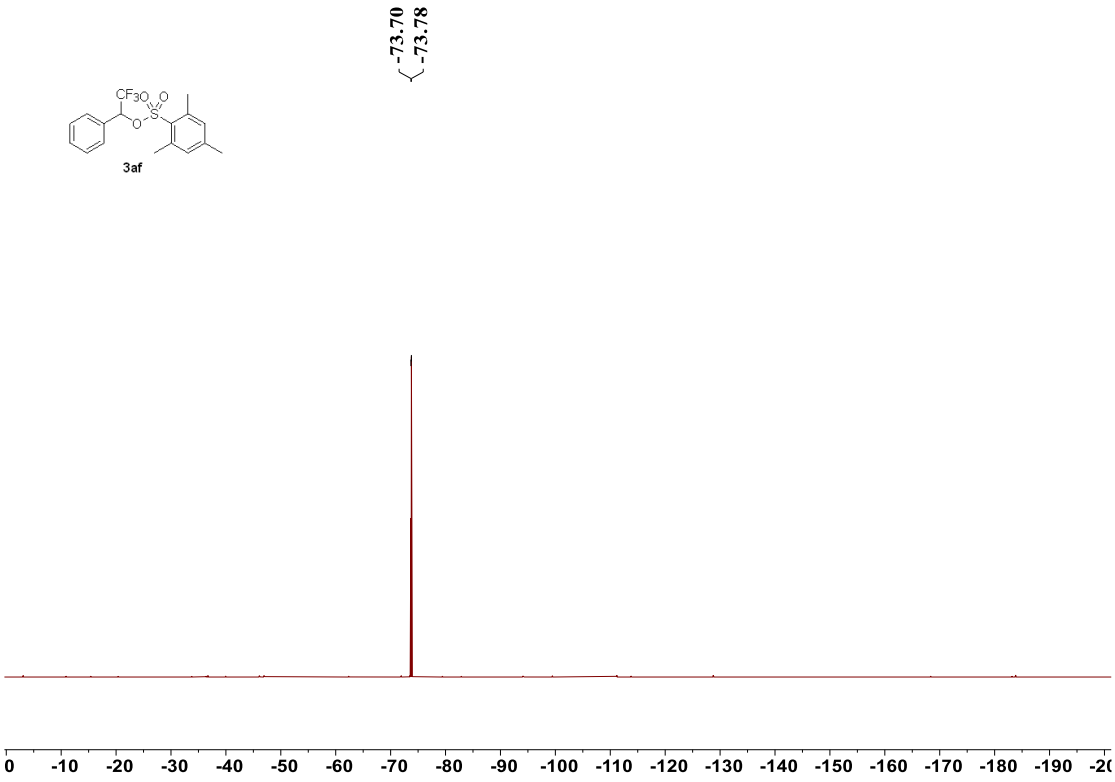
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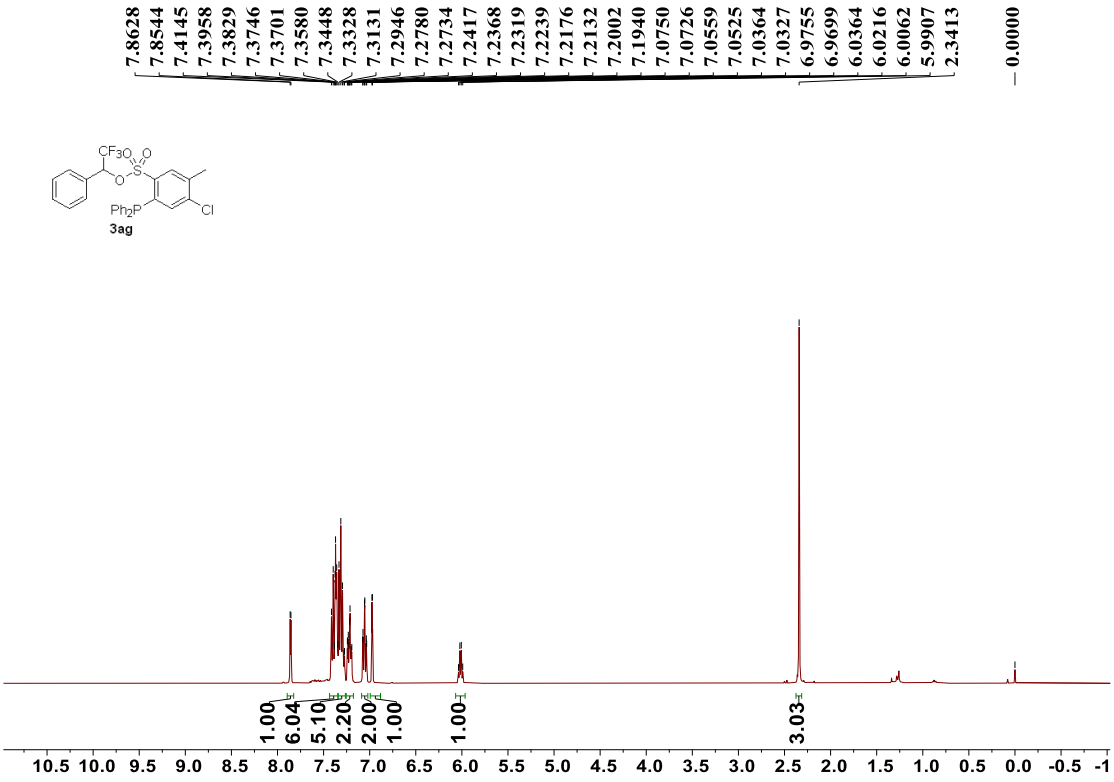
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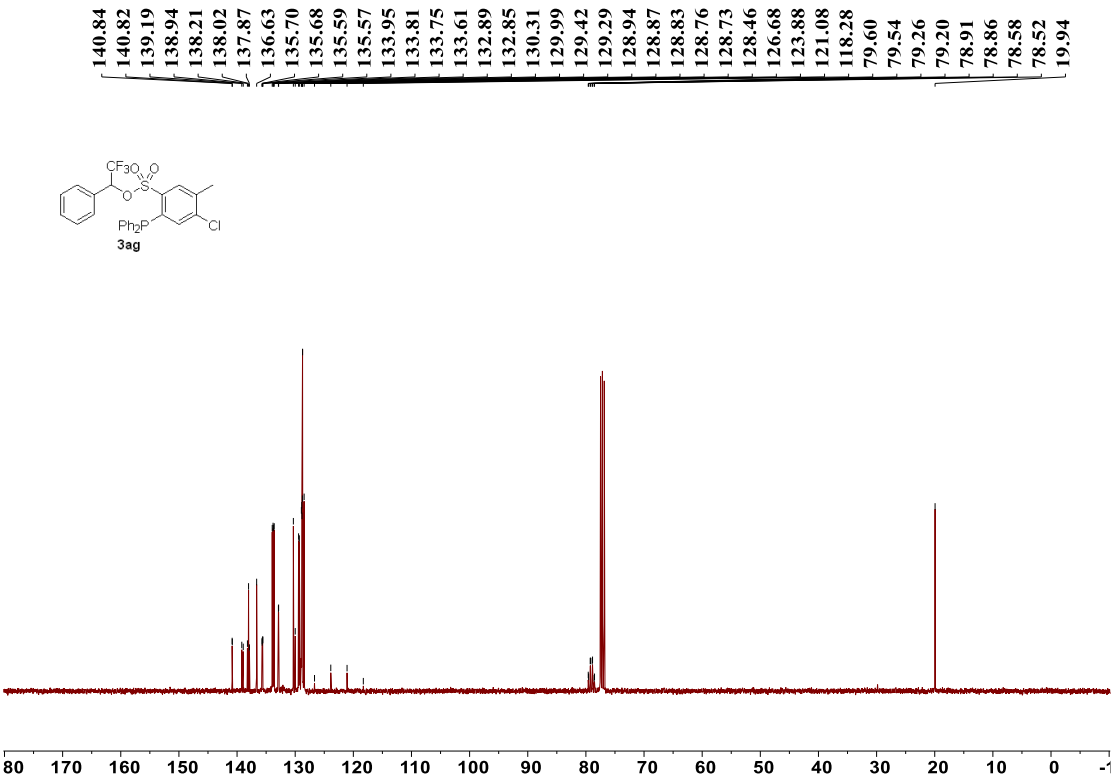
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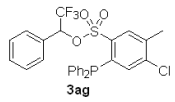

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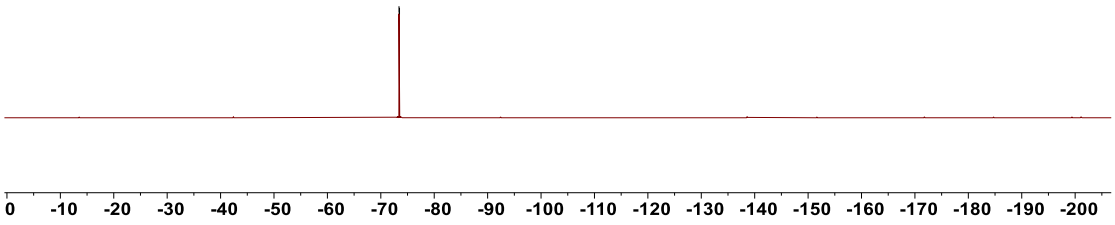

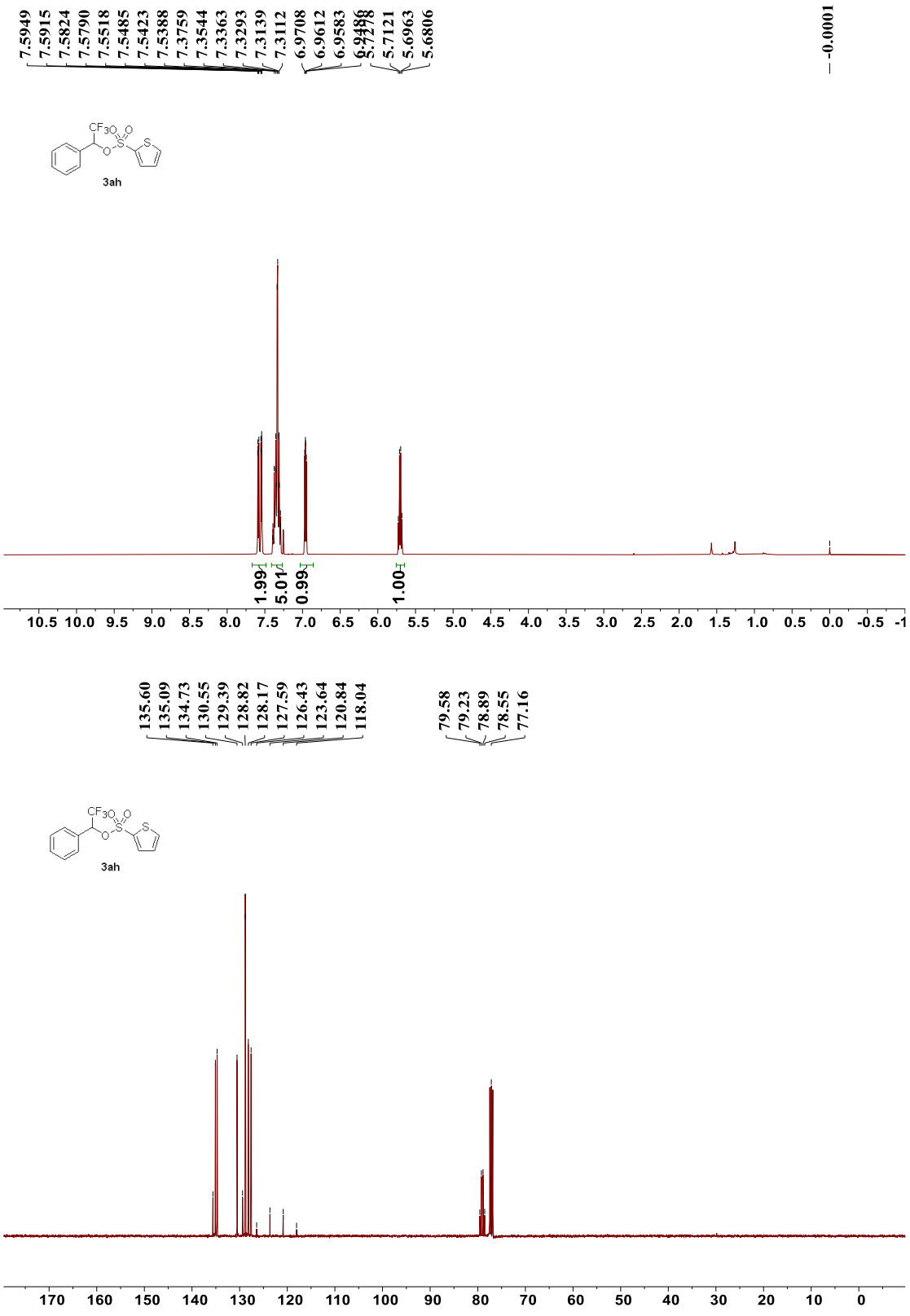
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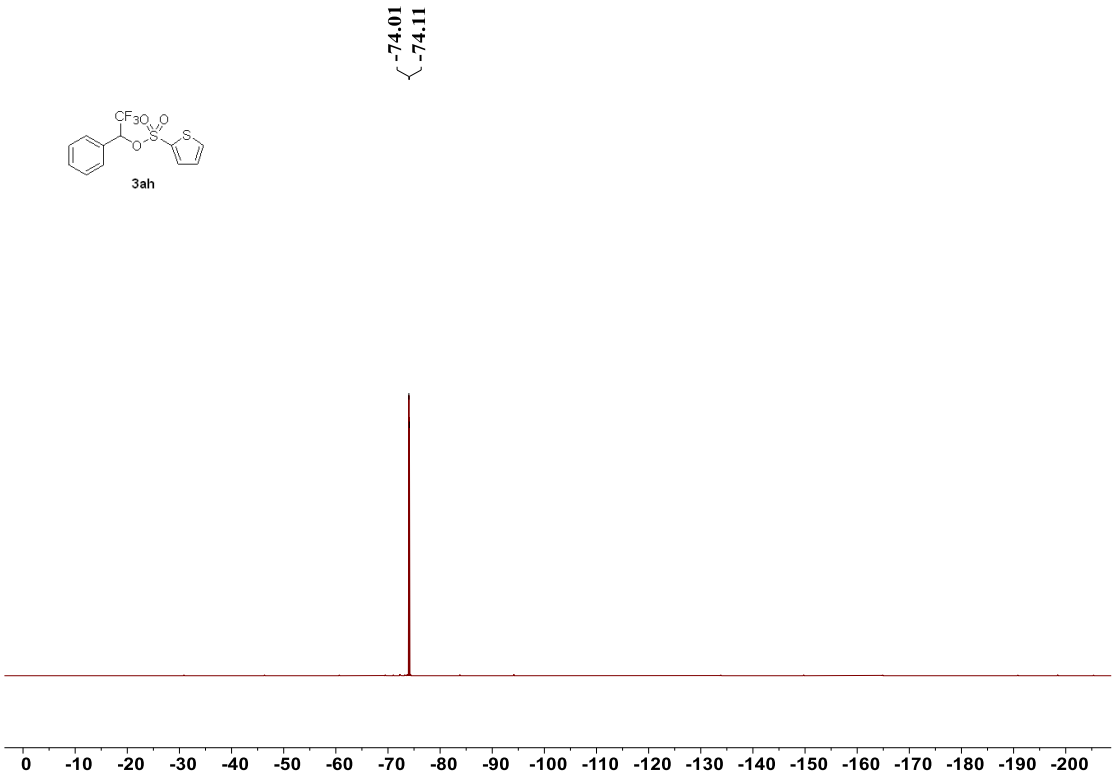
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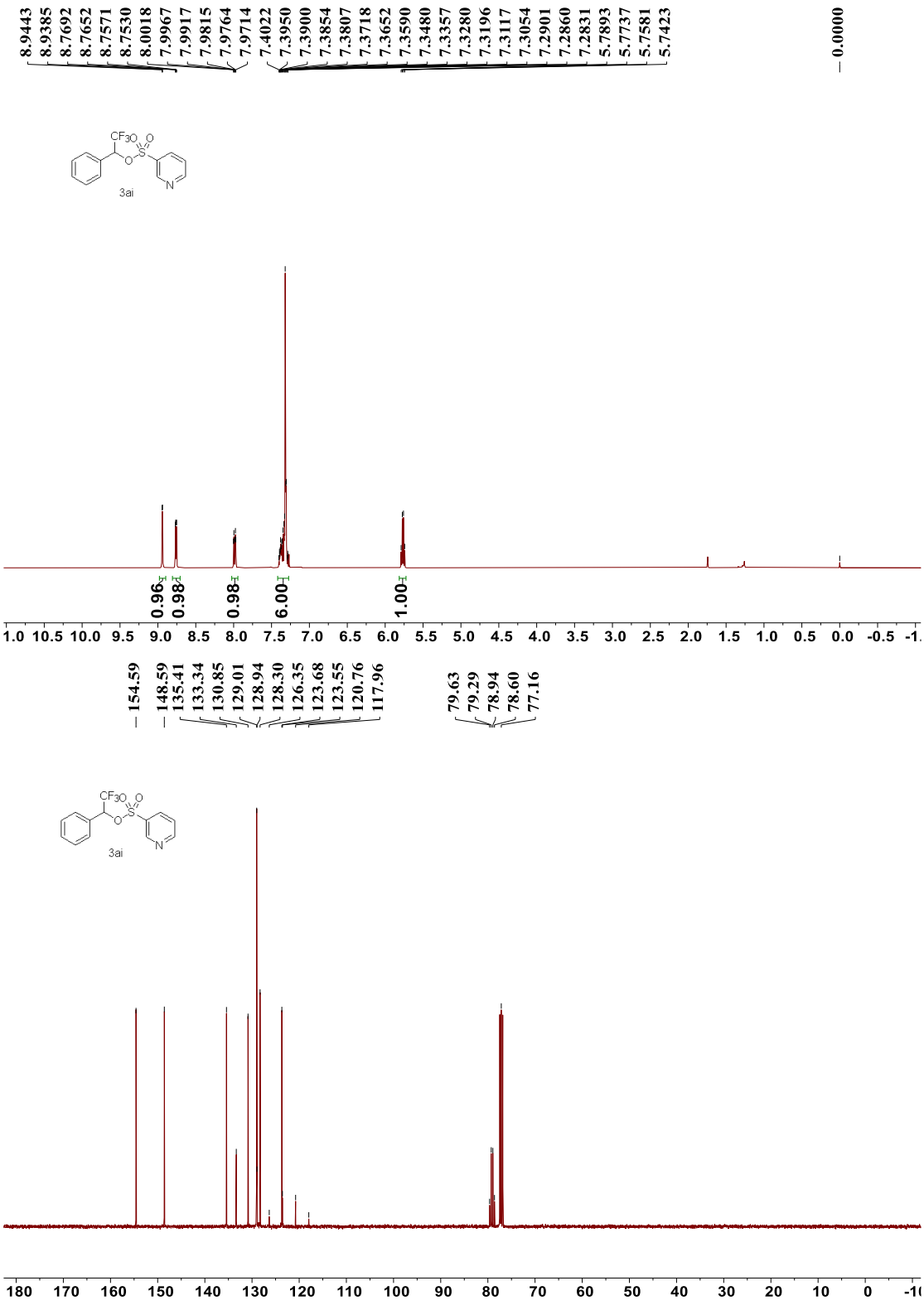
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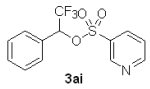

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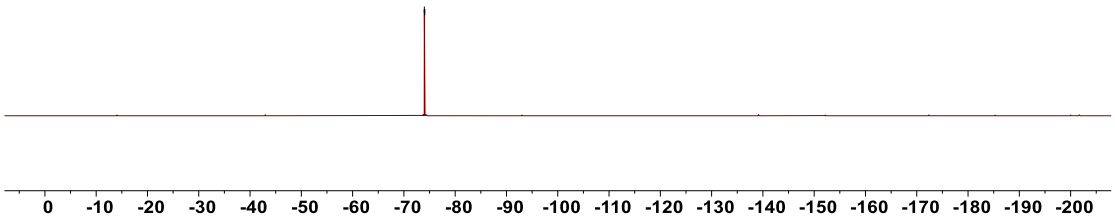

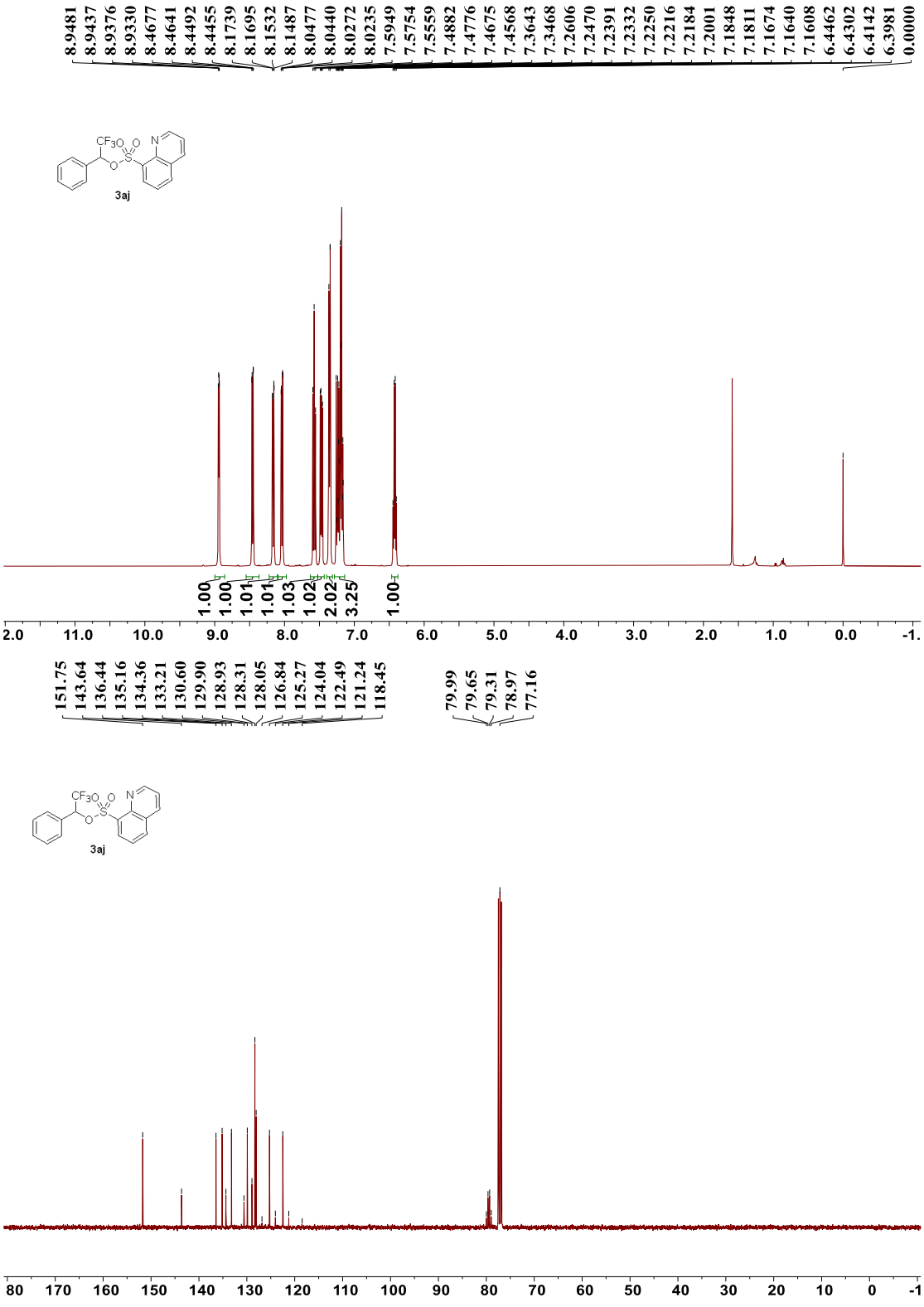
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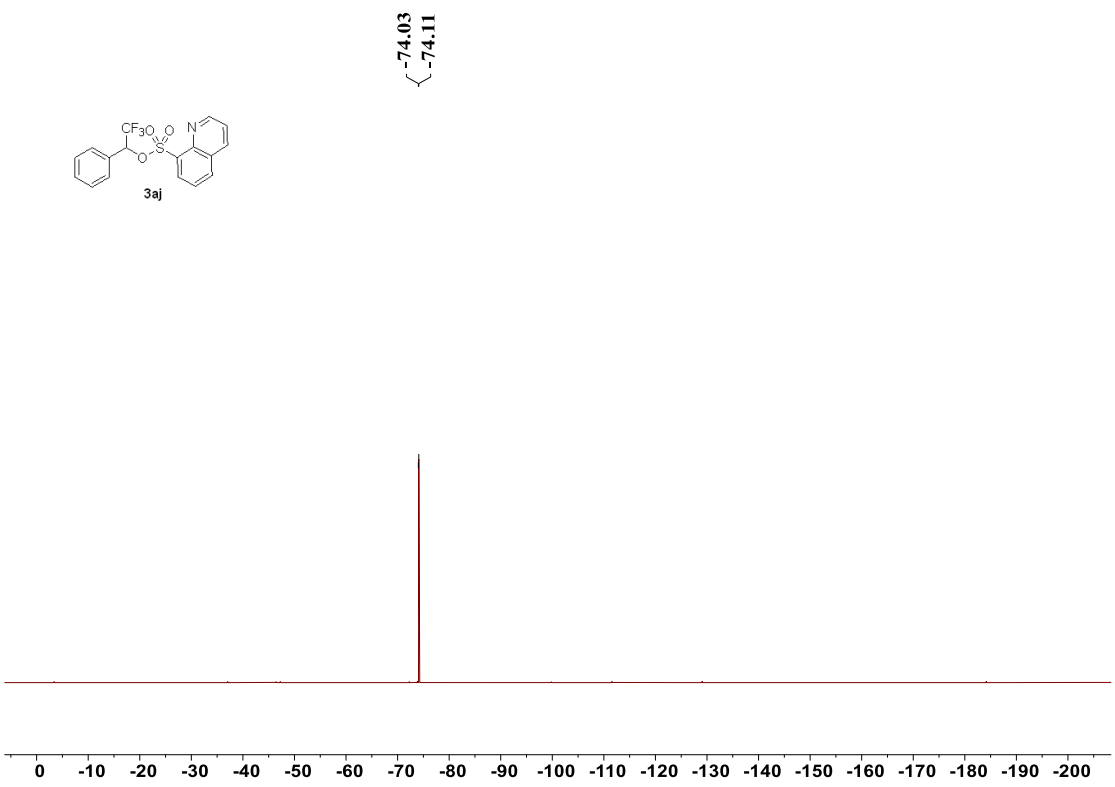
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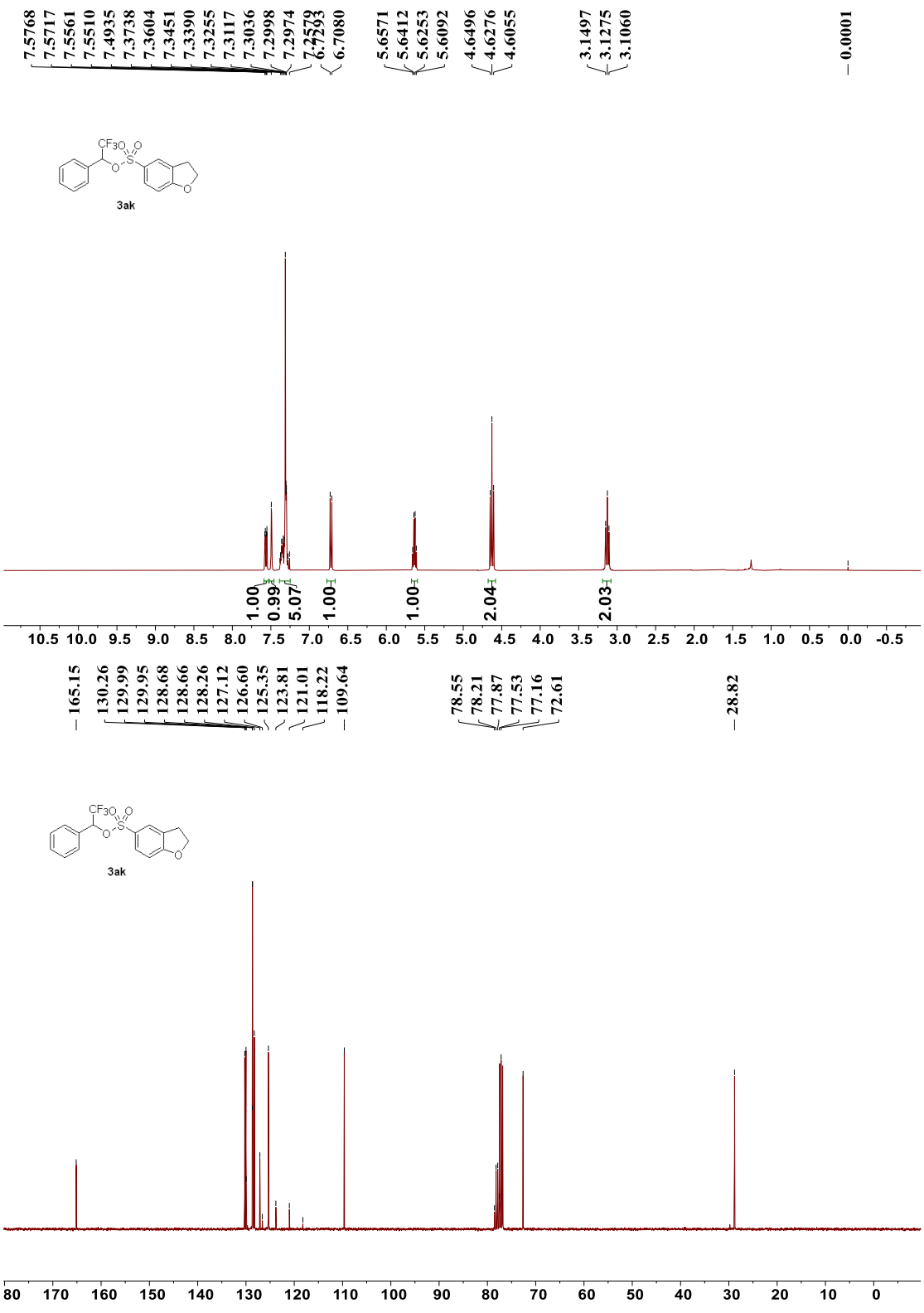
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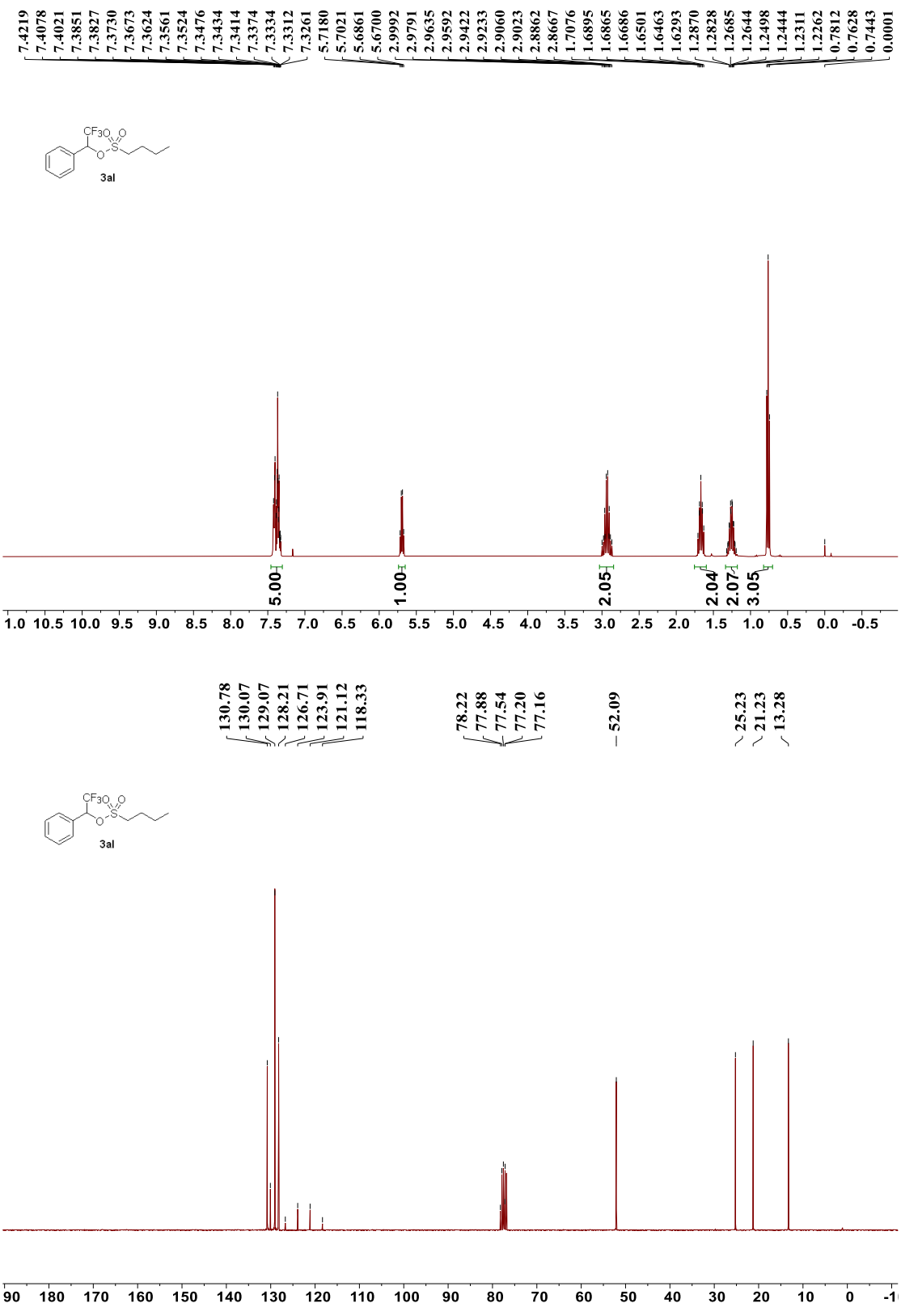
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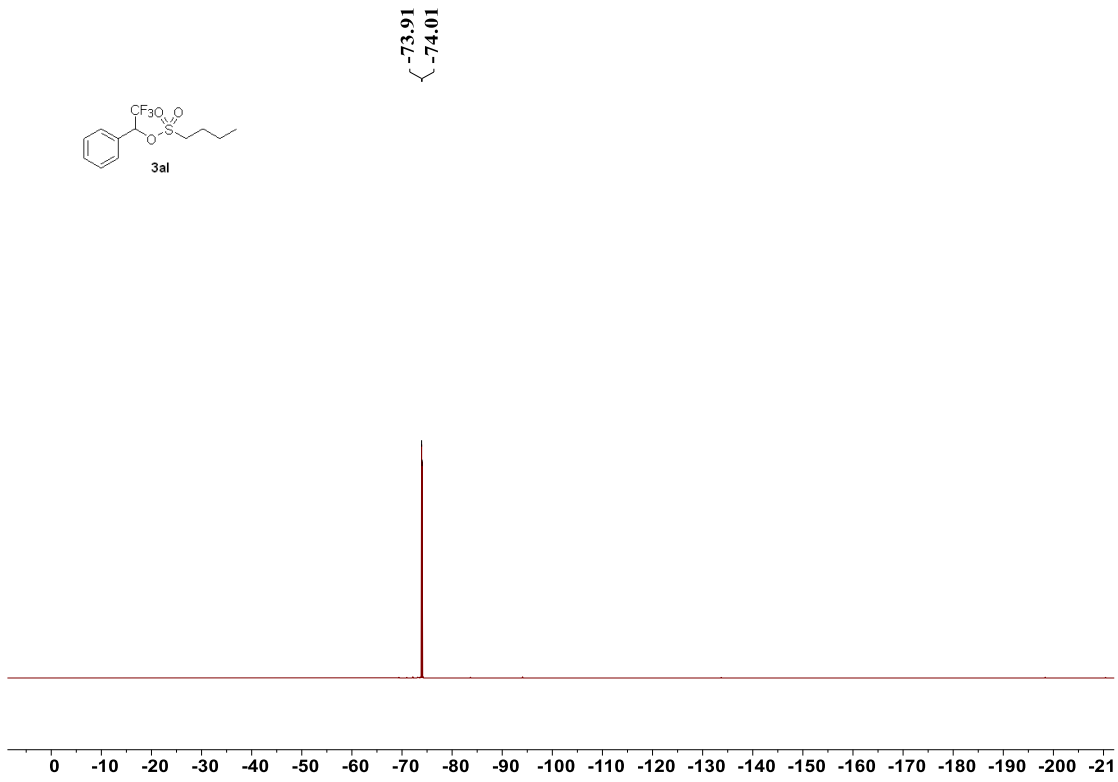
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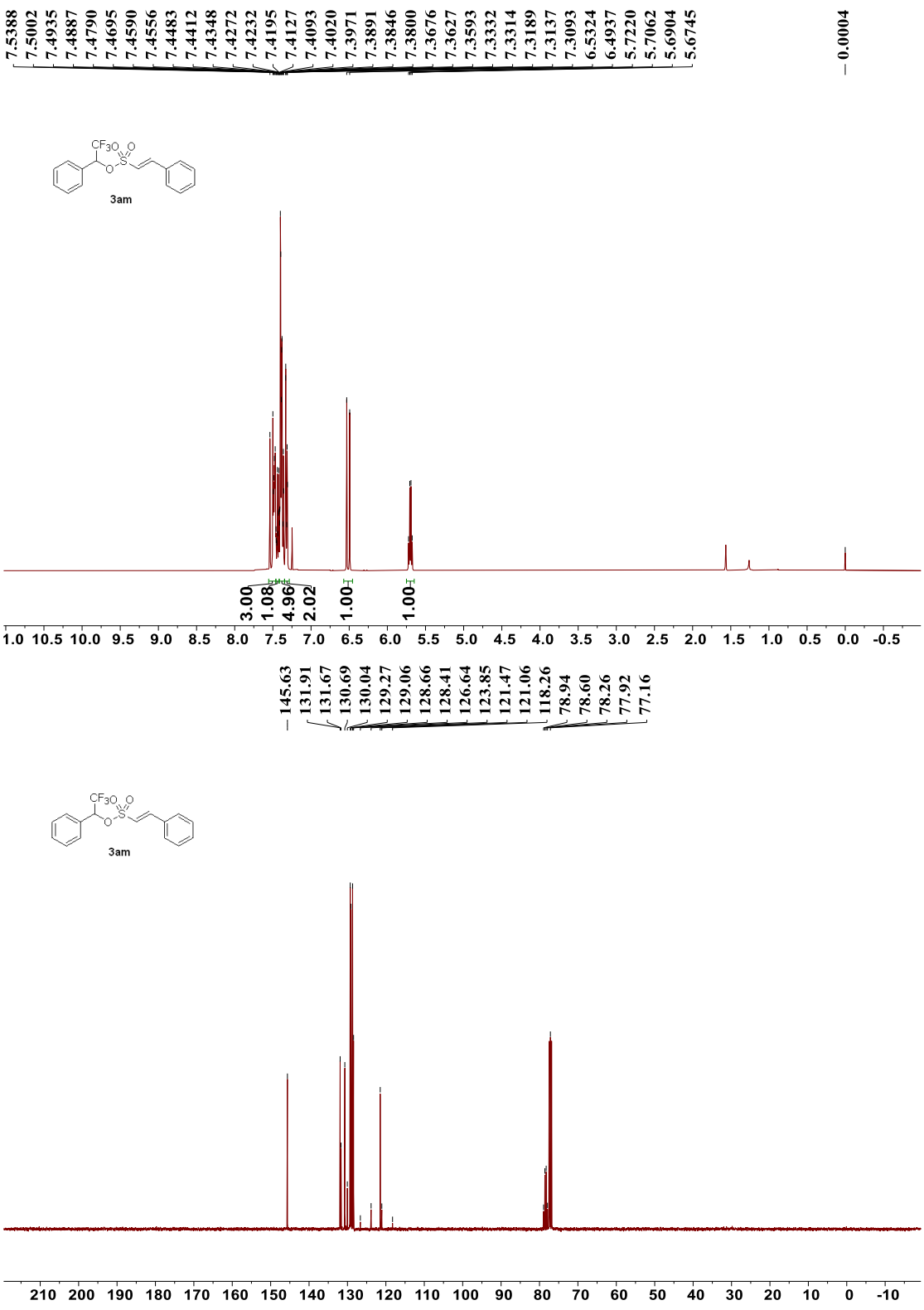
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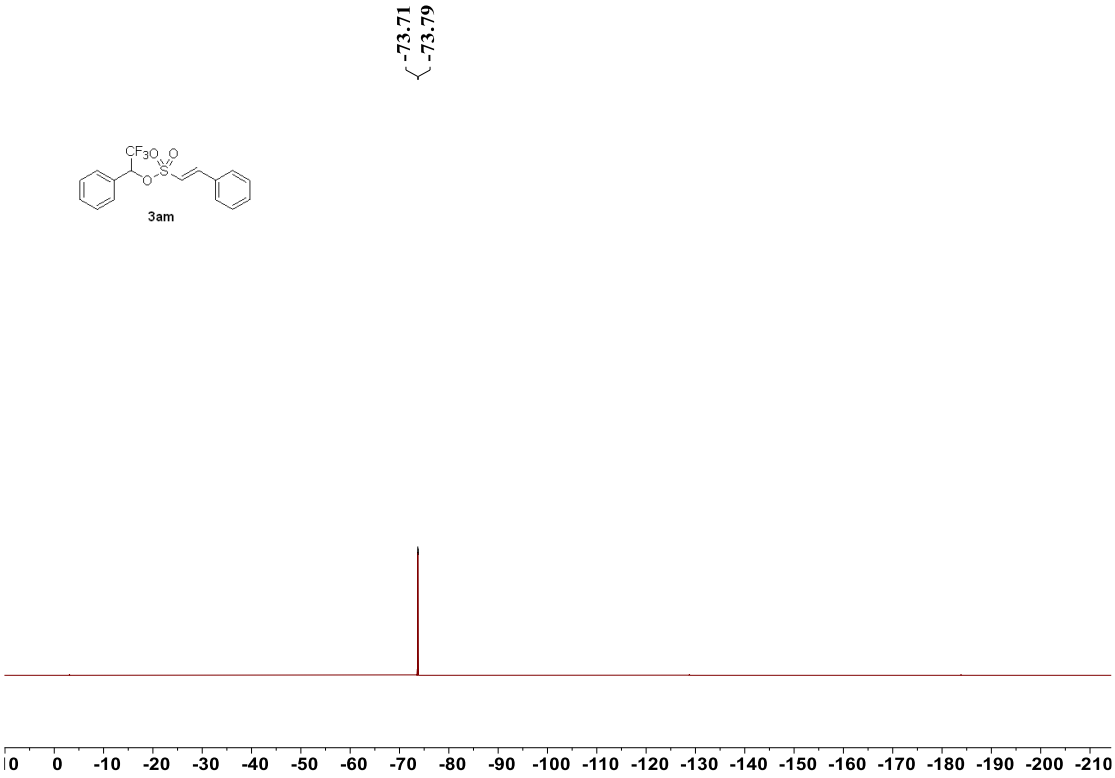
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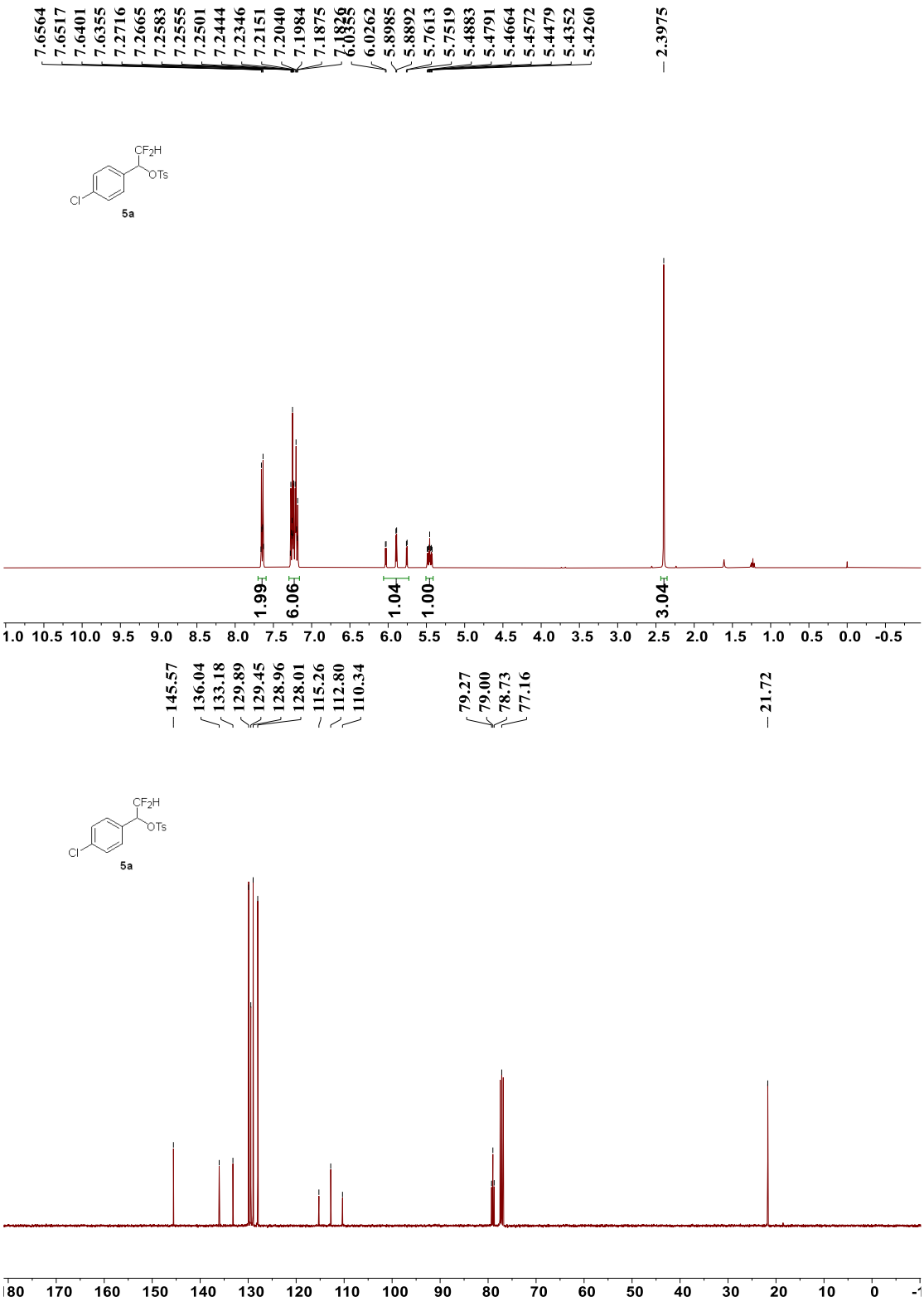
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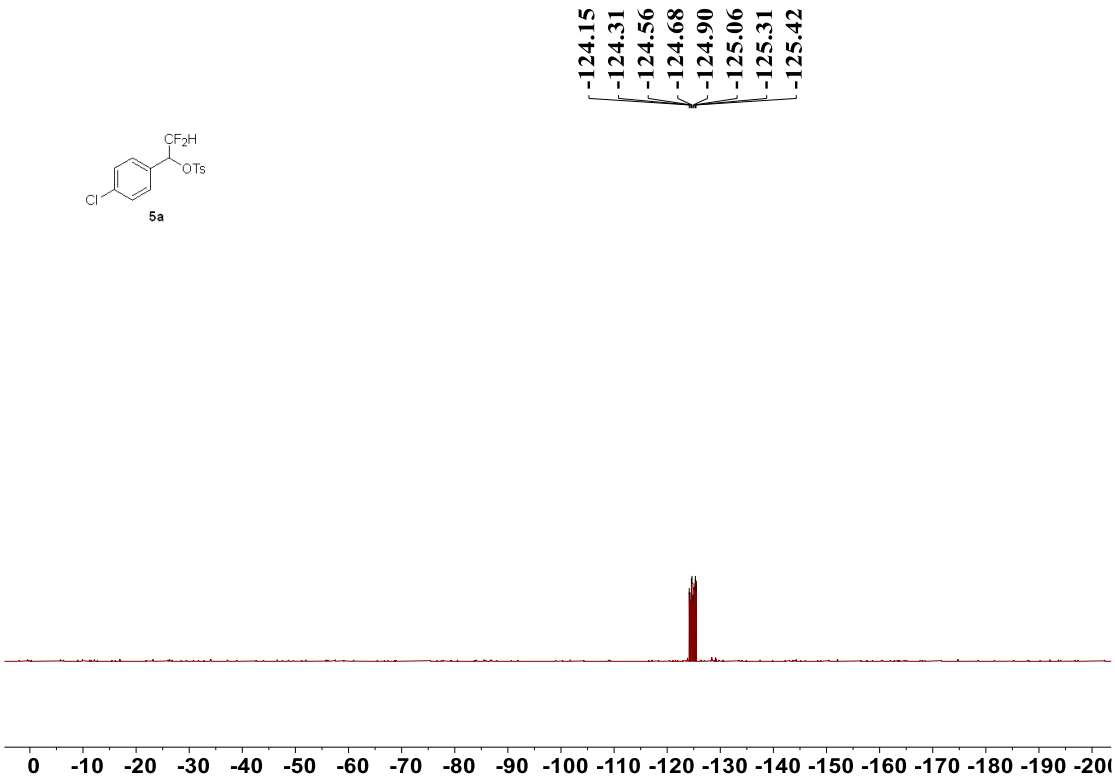
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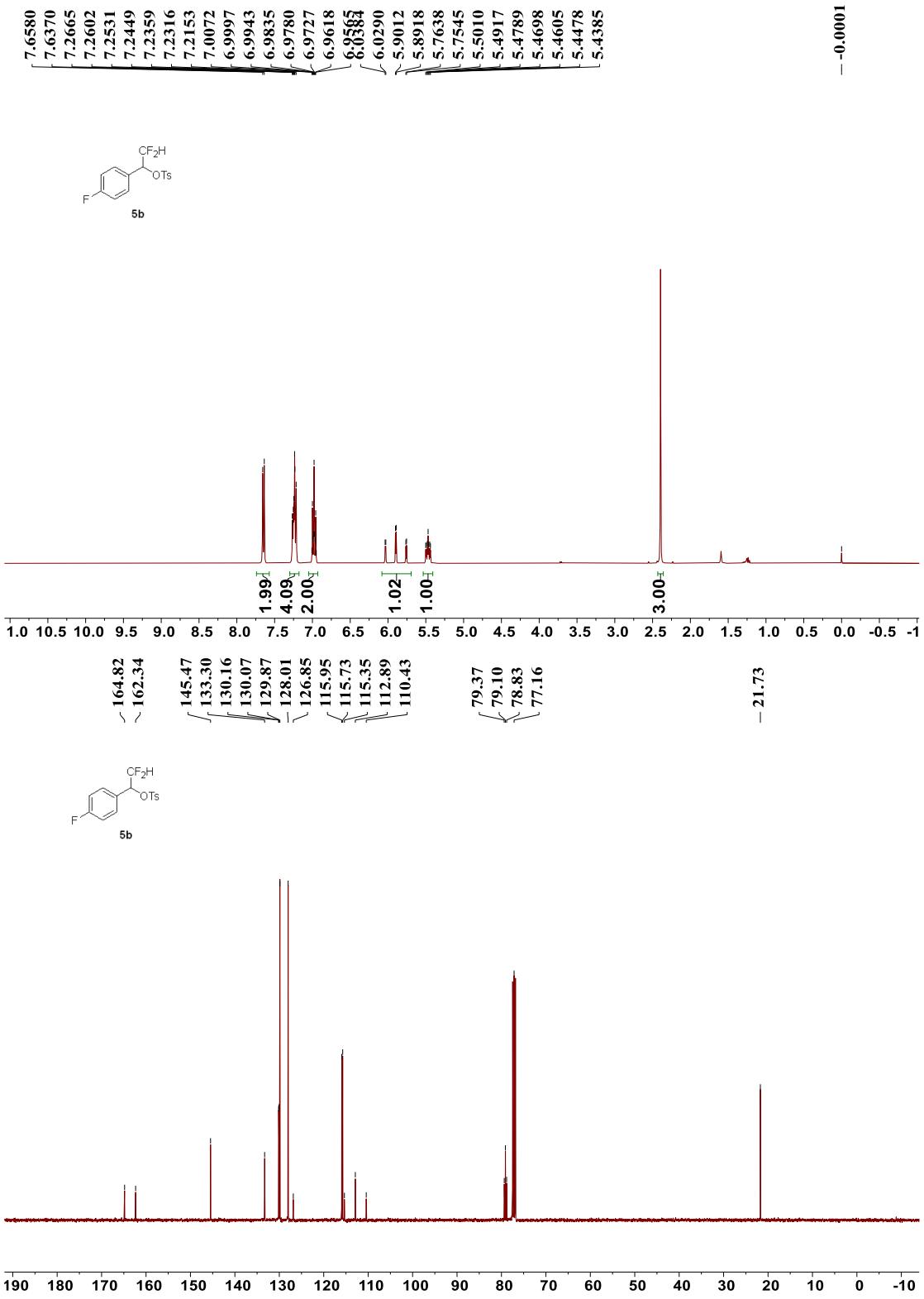
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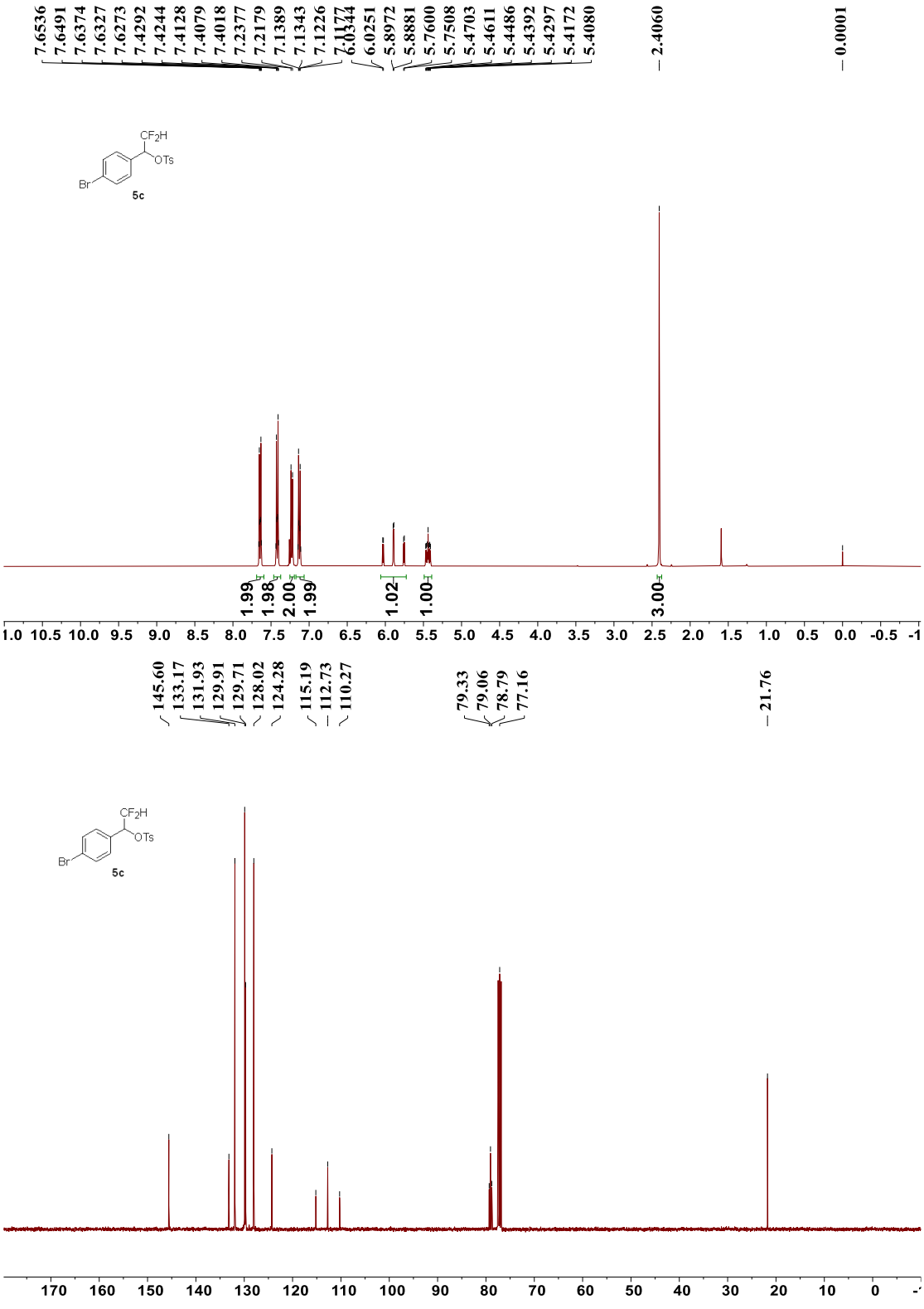
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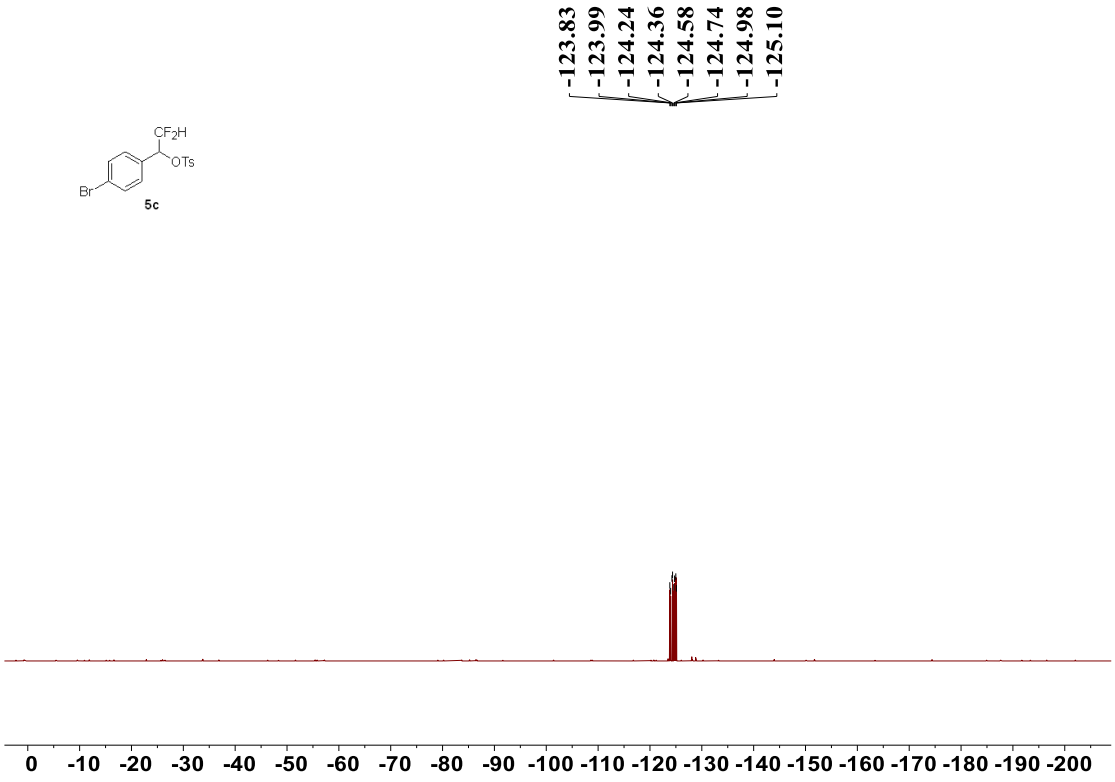
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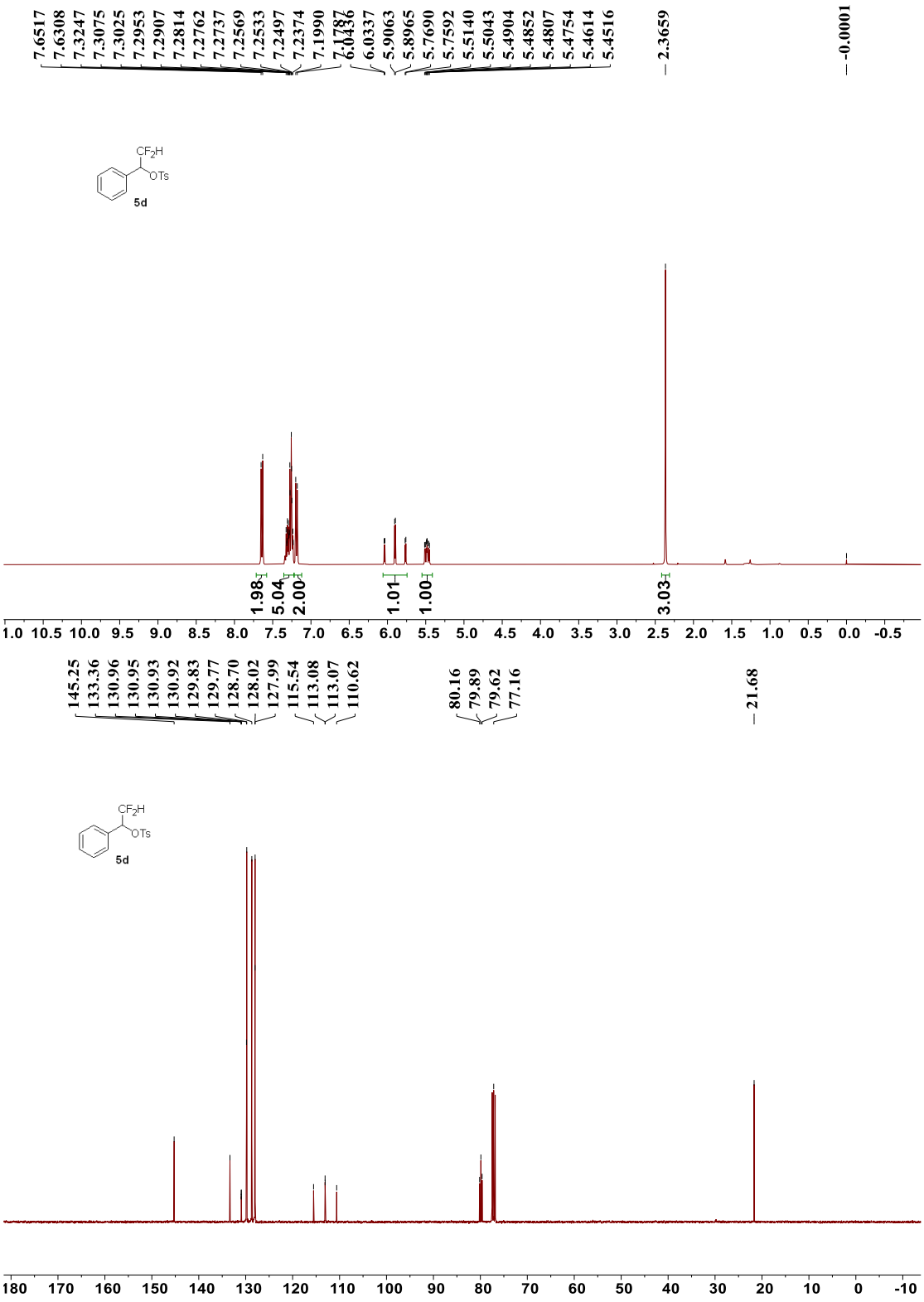
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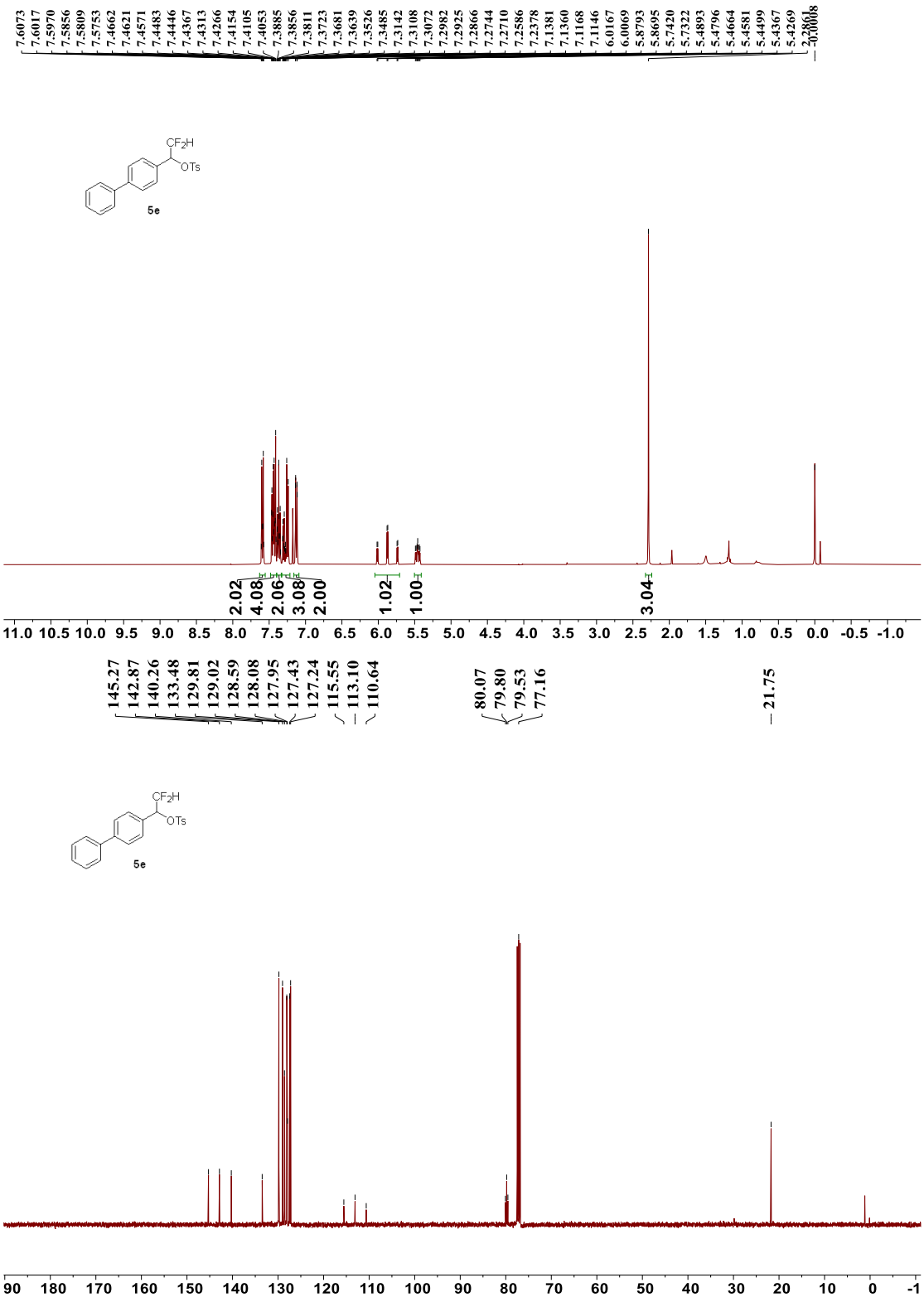
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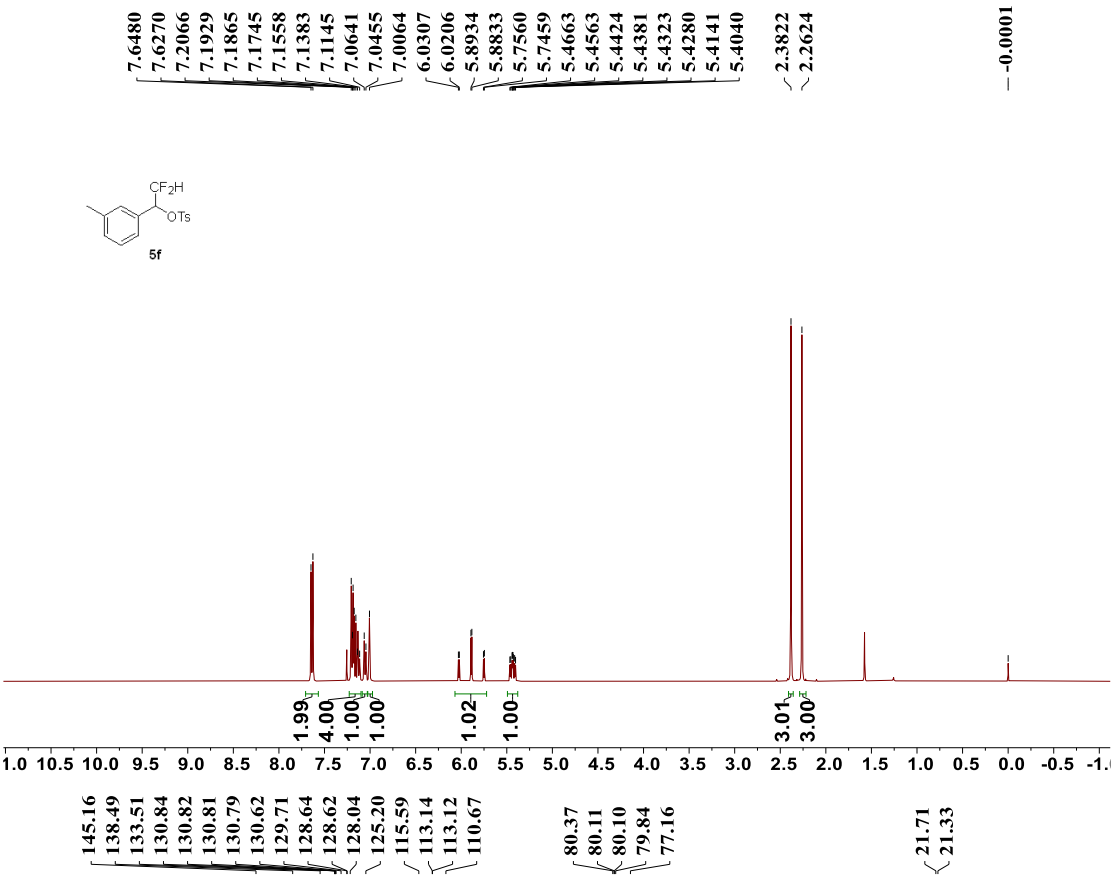
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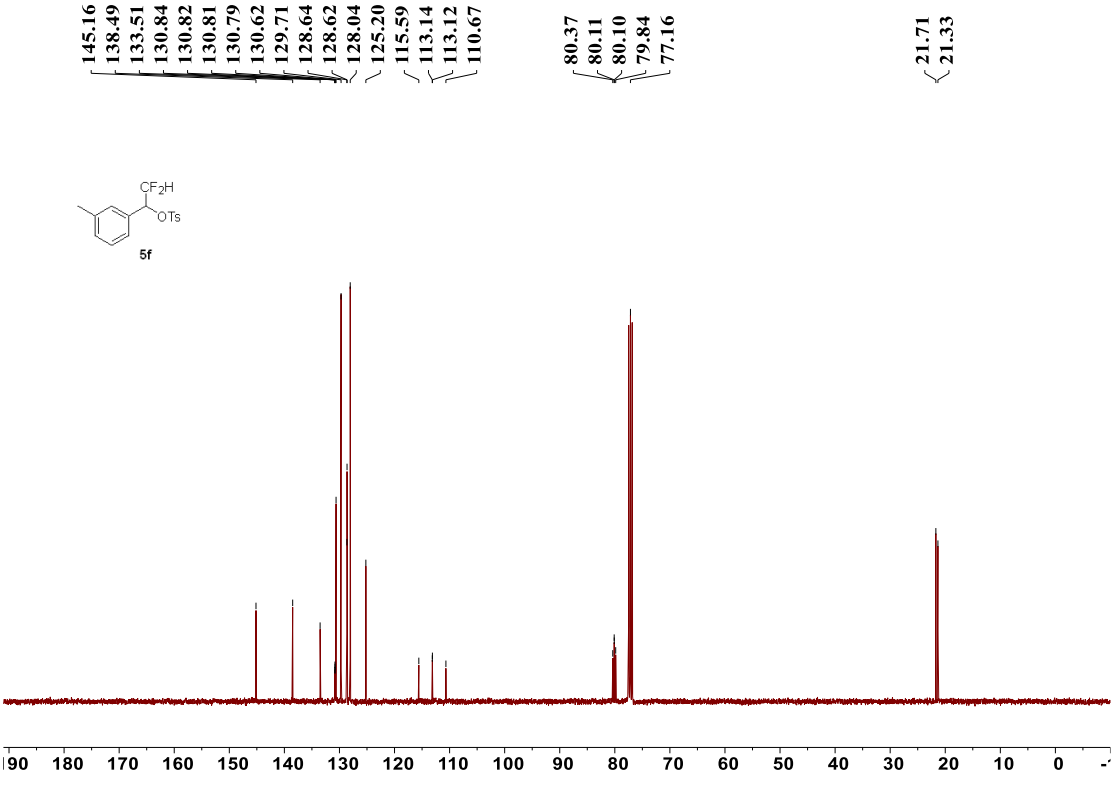
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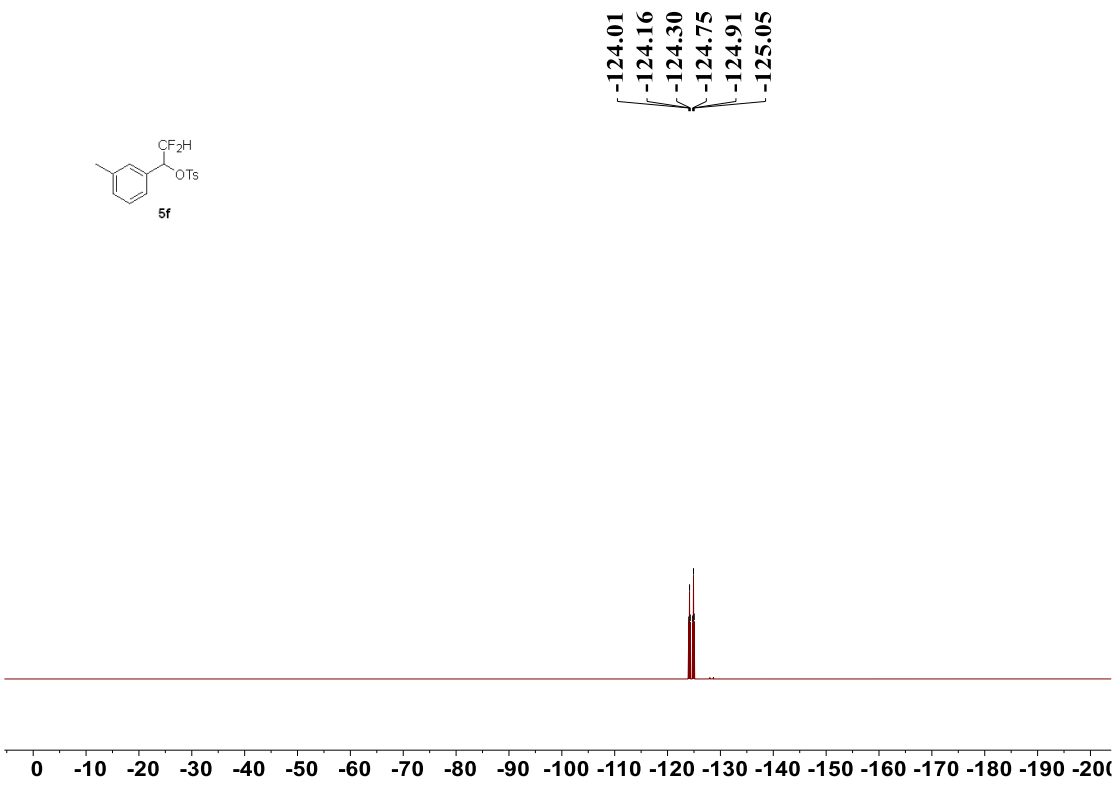
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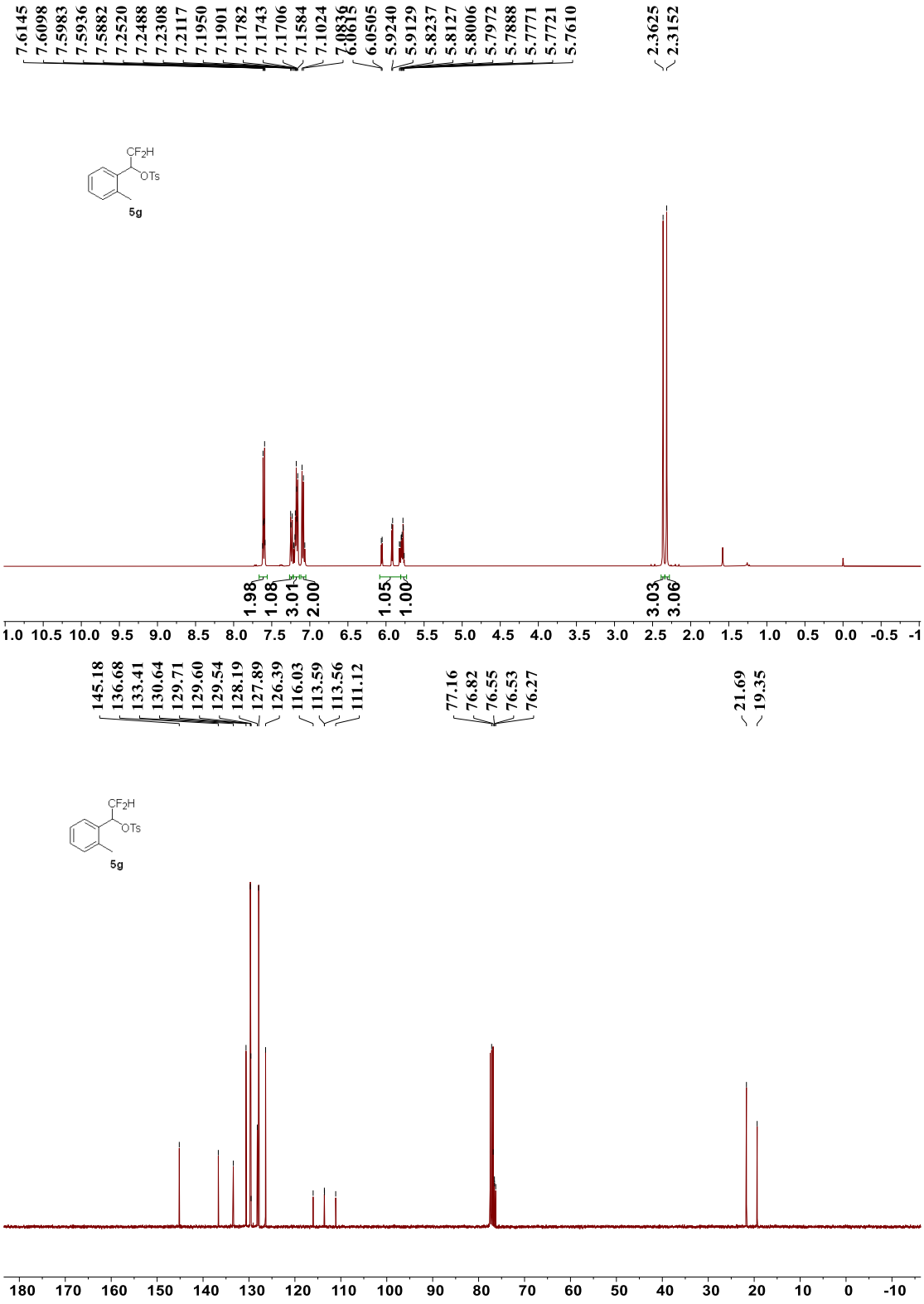
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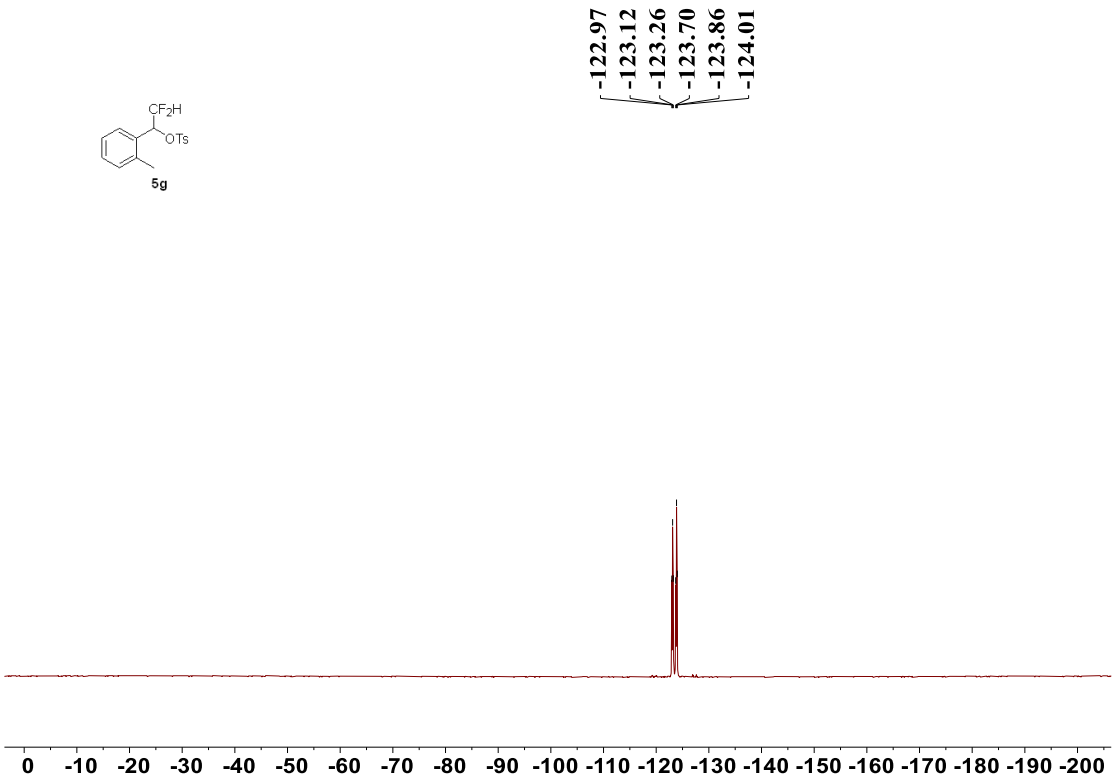
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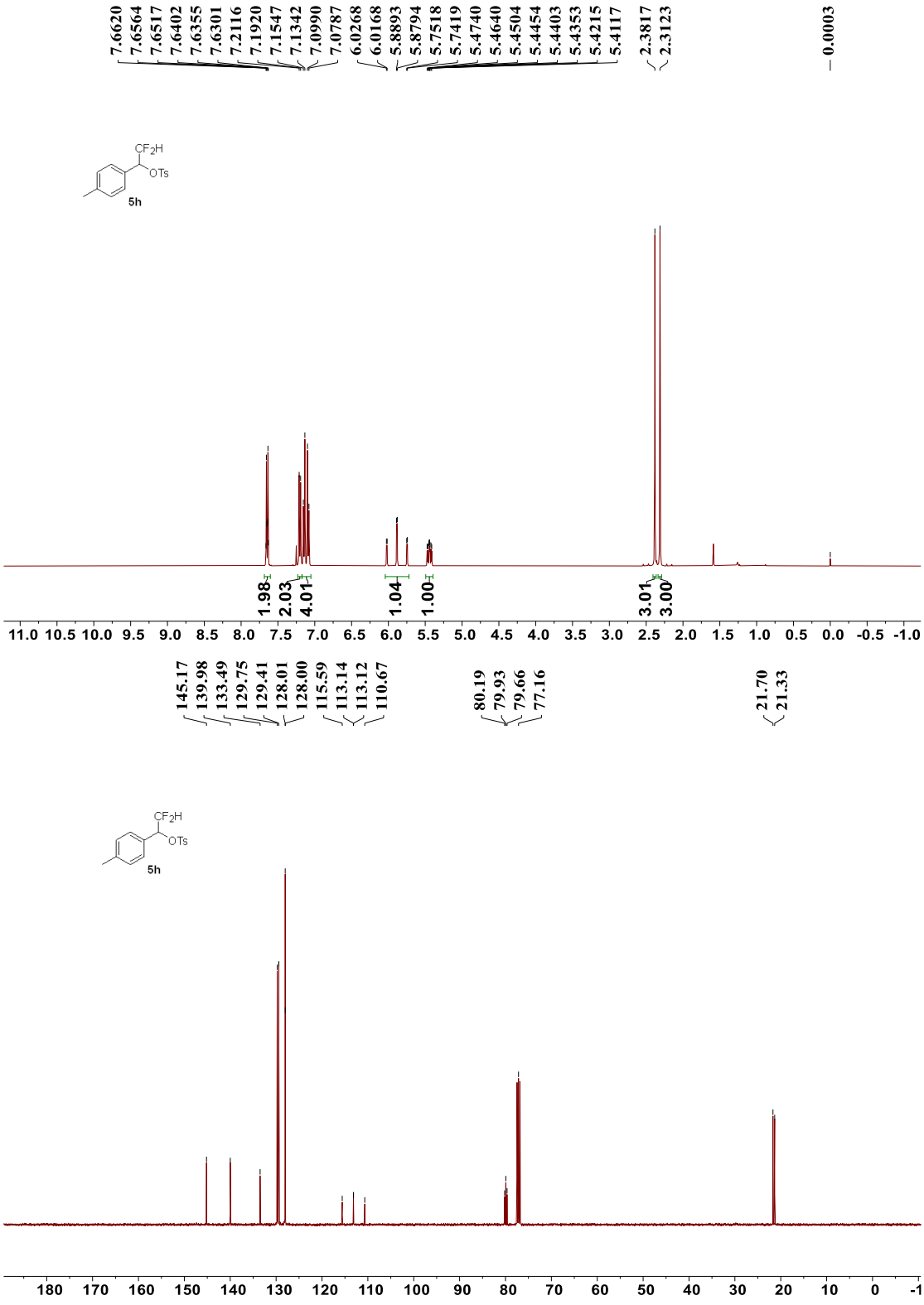
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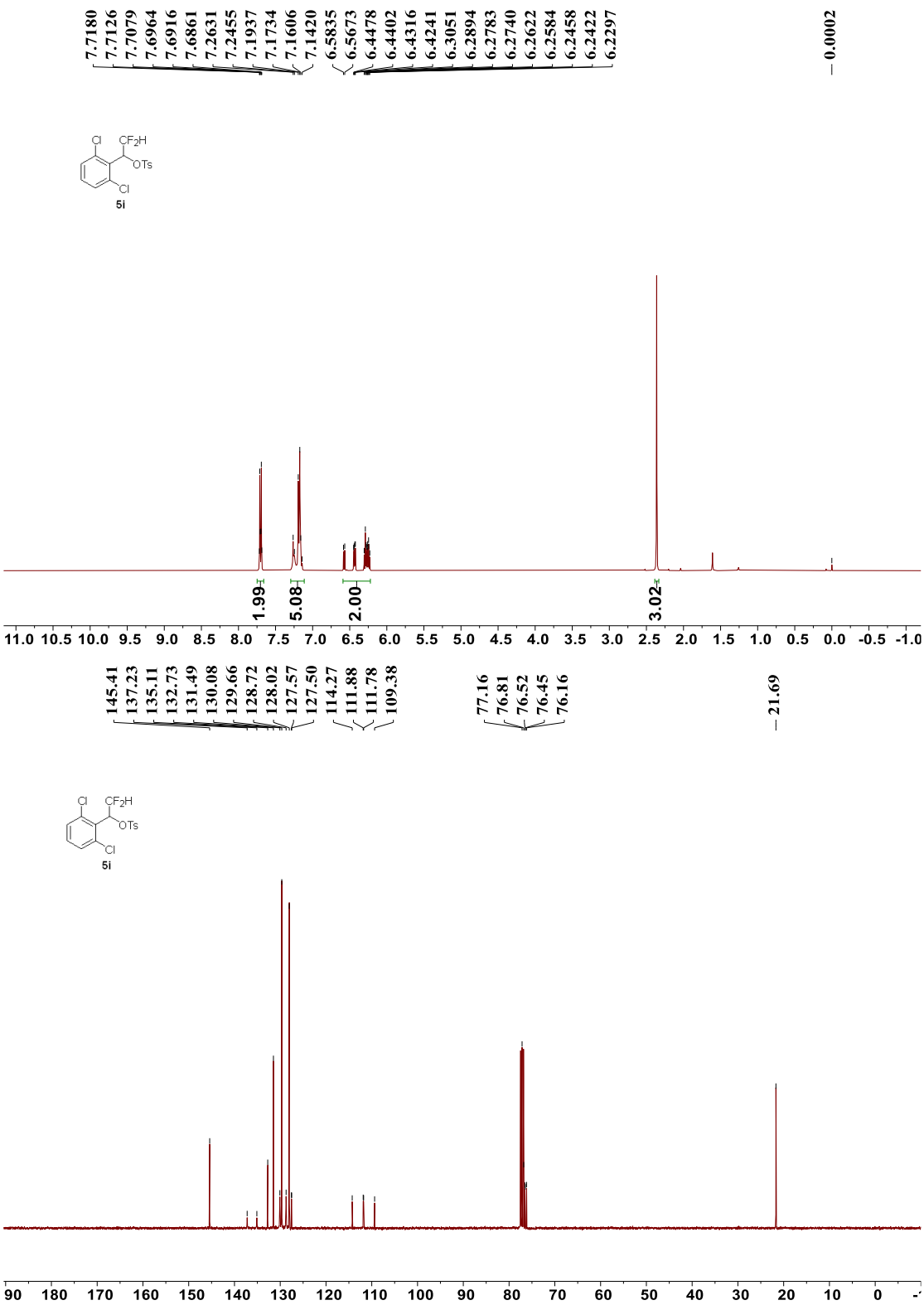
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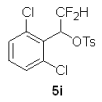

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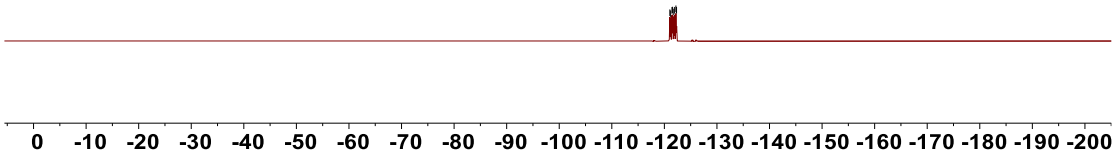

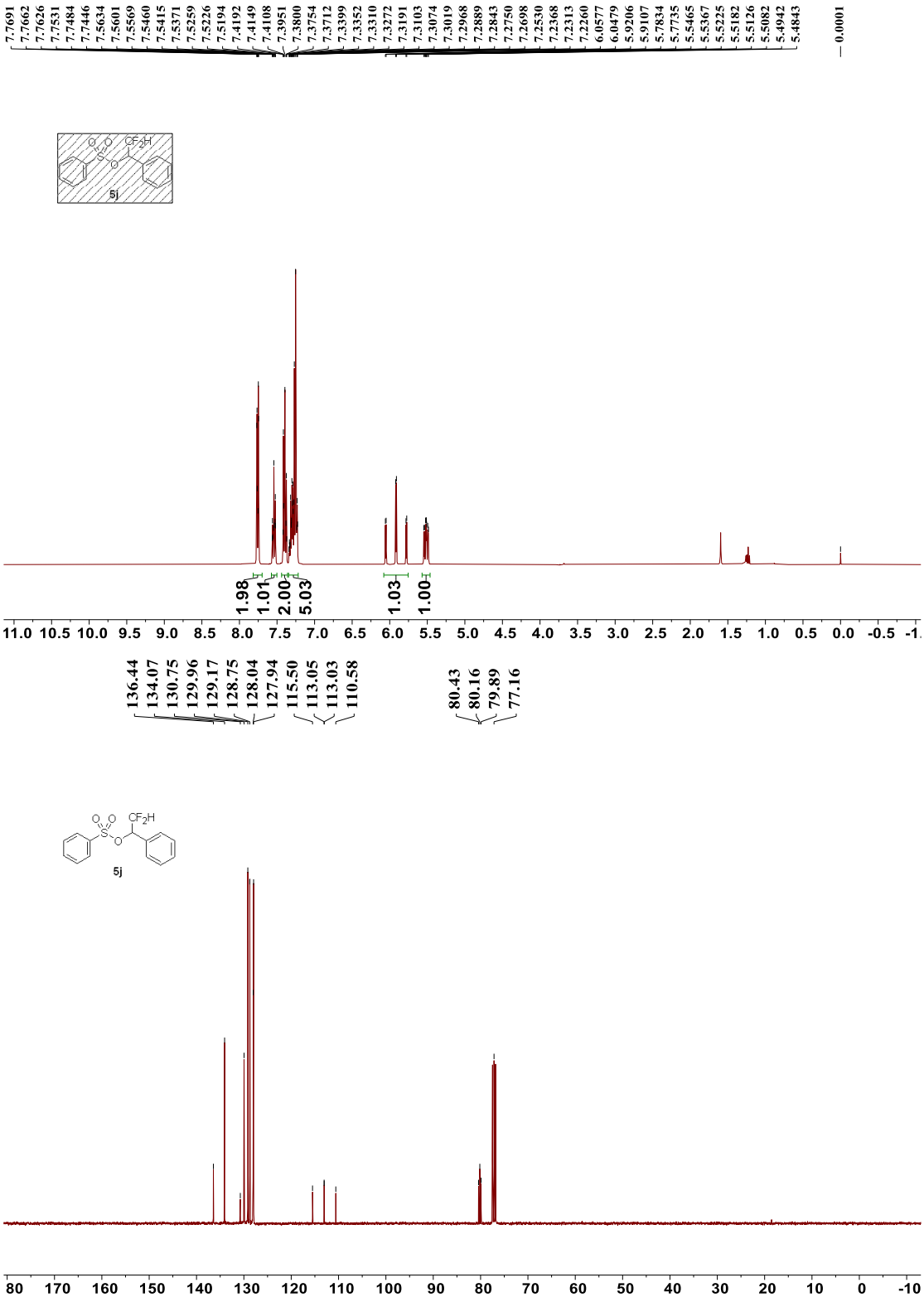
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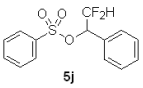

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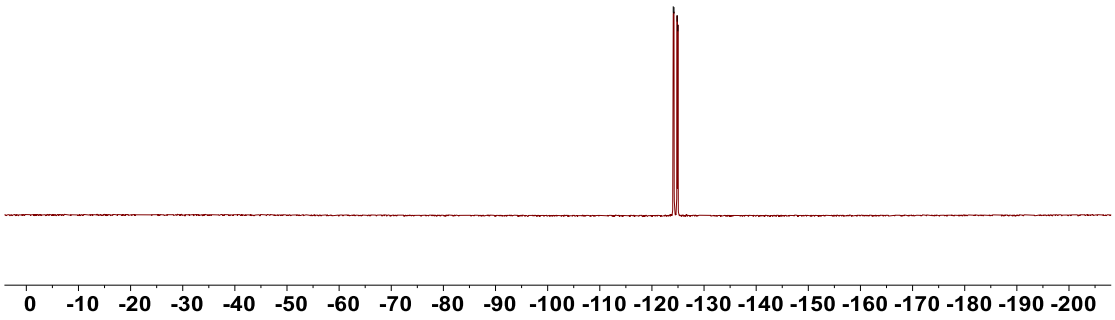


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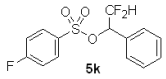
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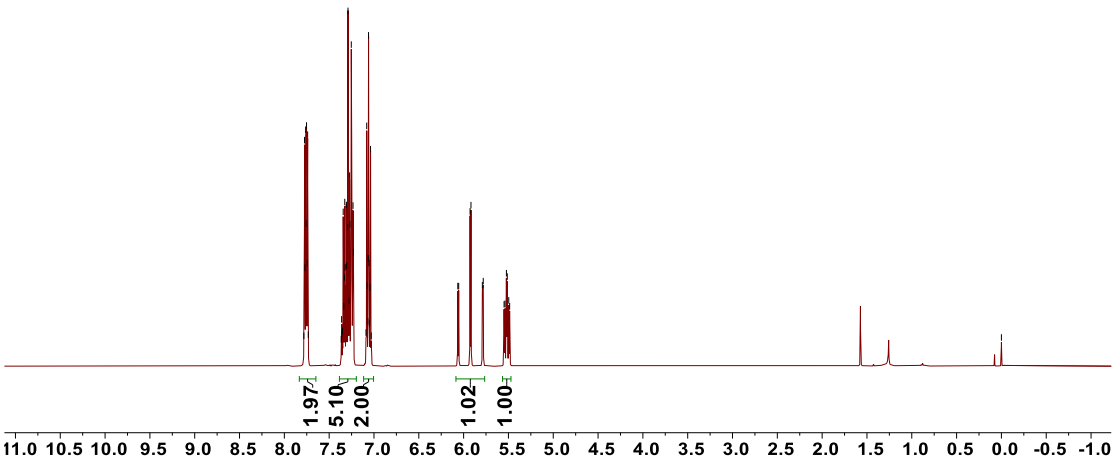
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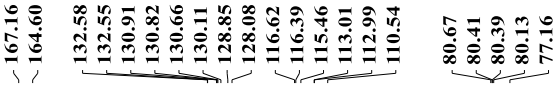
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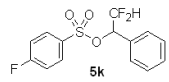
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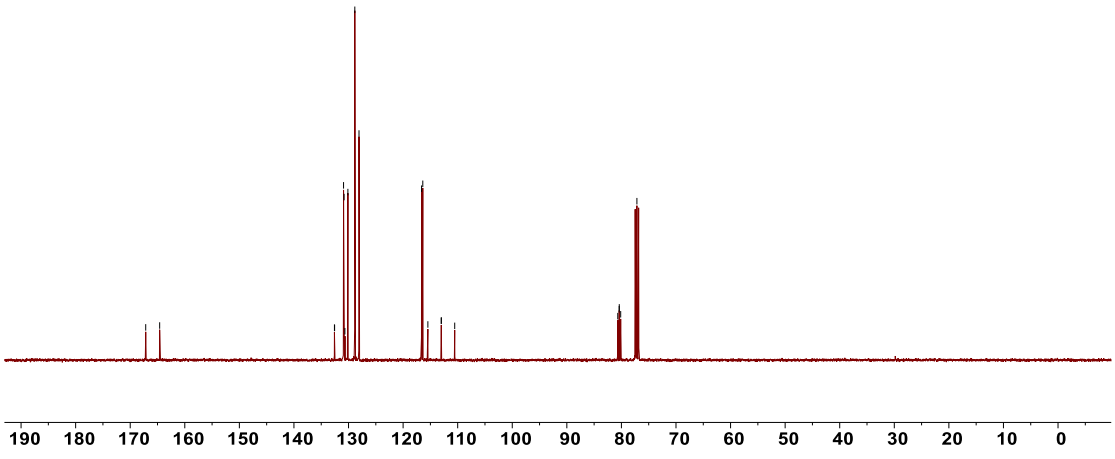
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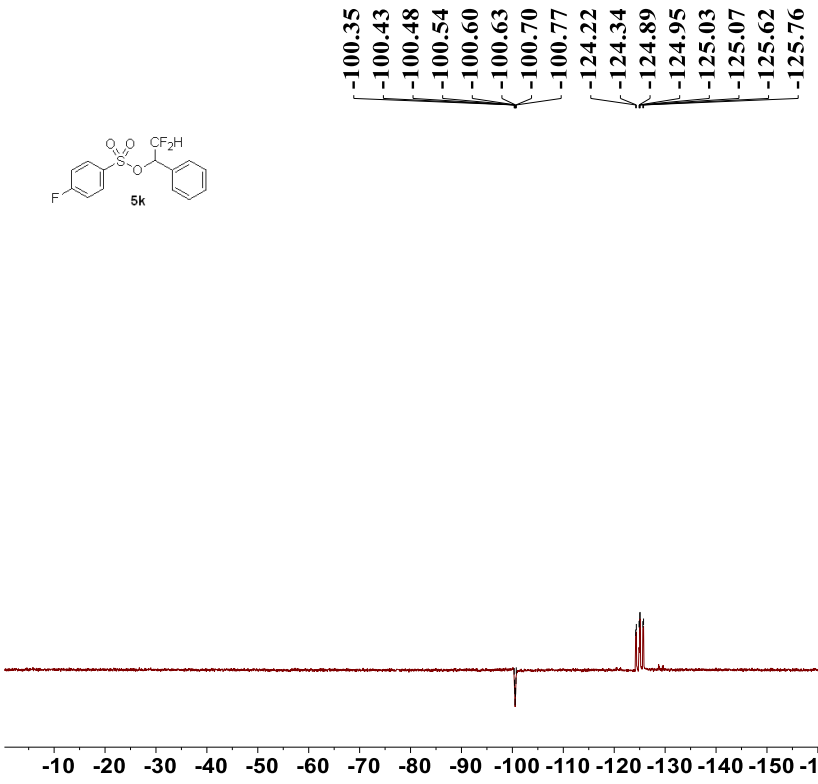
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-125.03
-125.07
-125.62
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O
O
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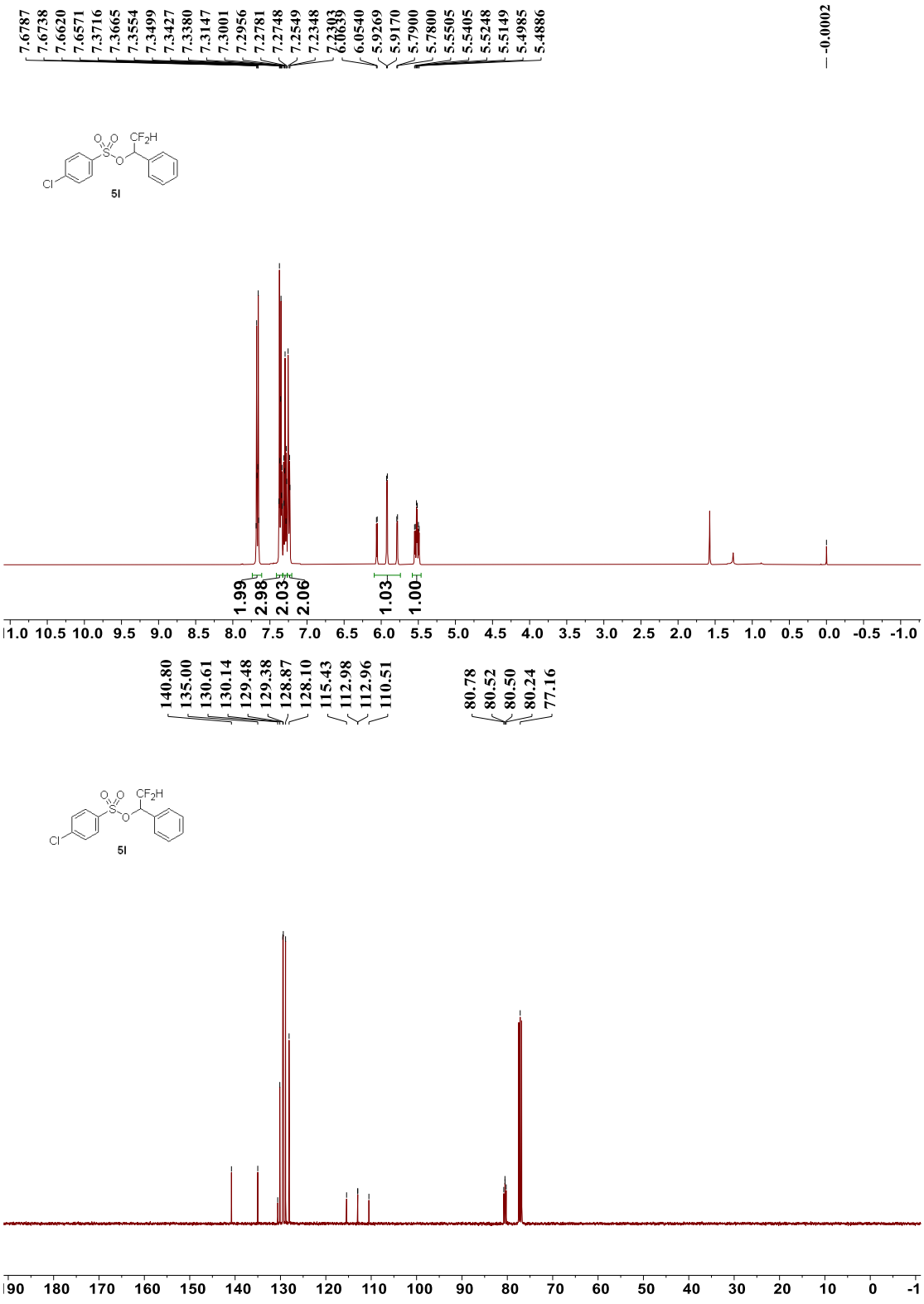
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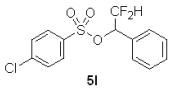

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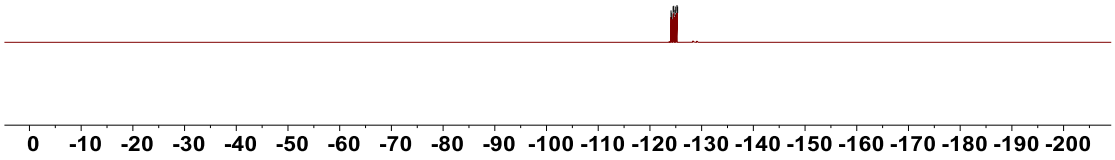

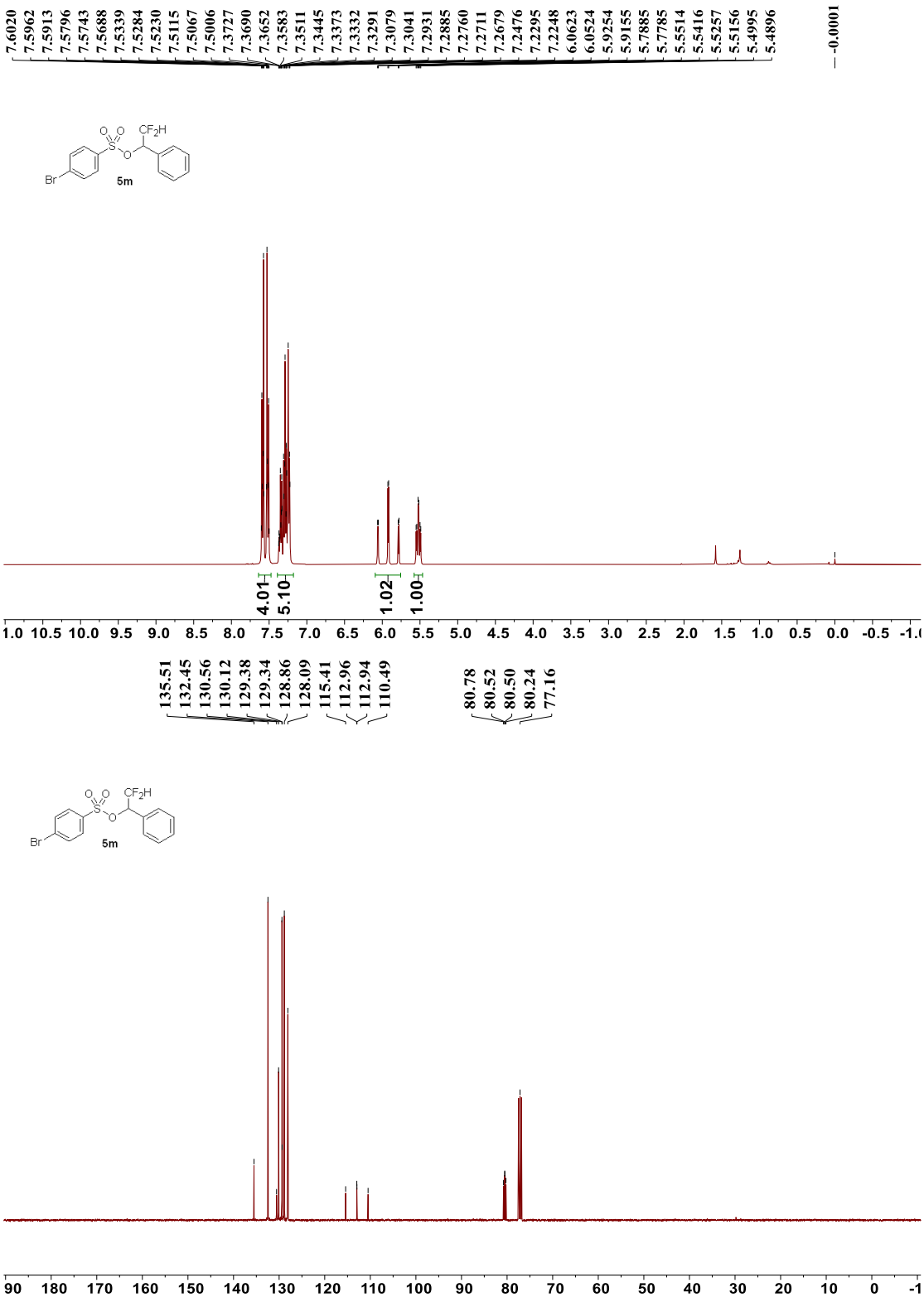
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5.10
1.02
1.00
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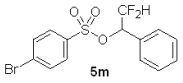

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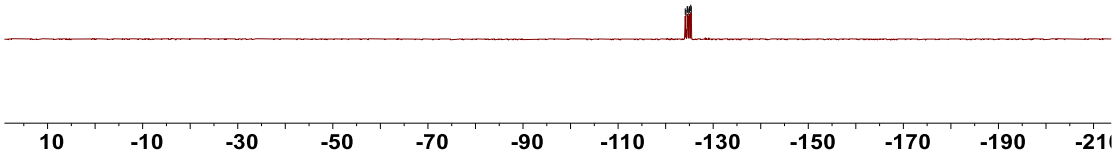

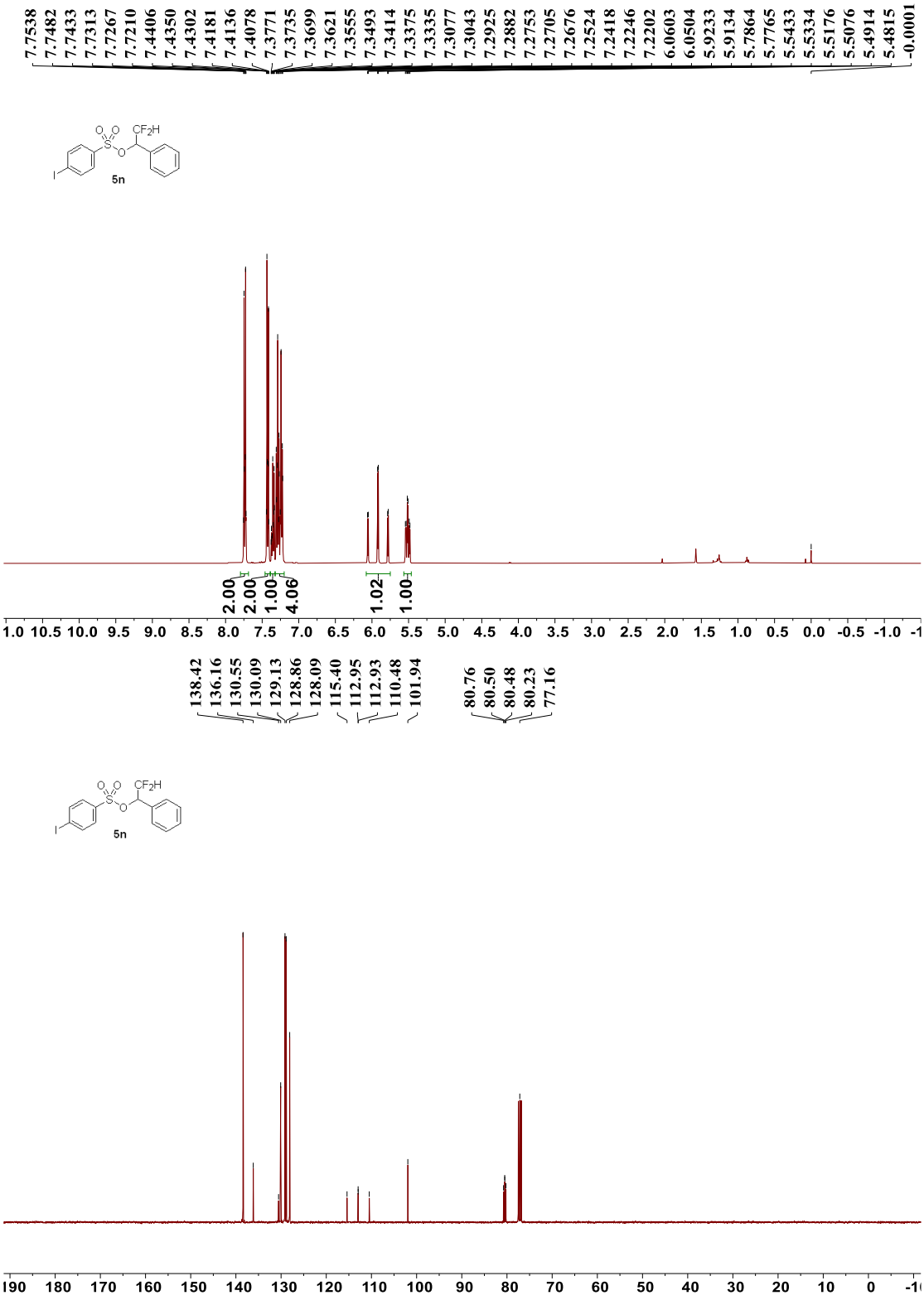
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1.00
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1.00
1.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1
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129.13
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CF2H
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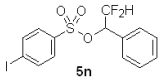

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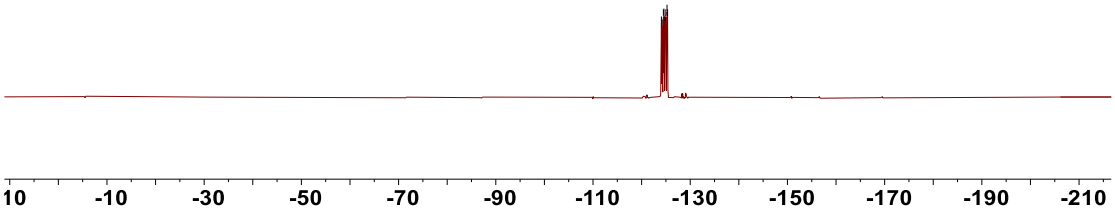

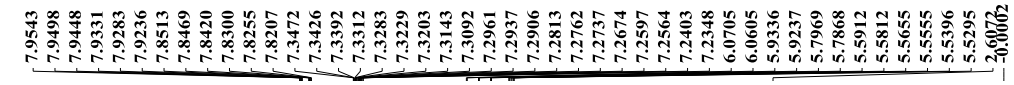
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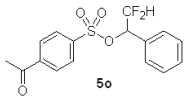
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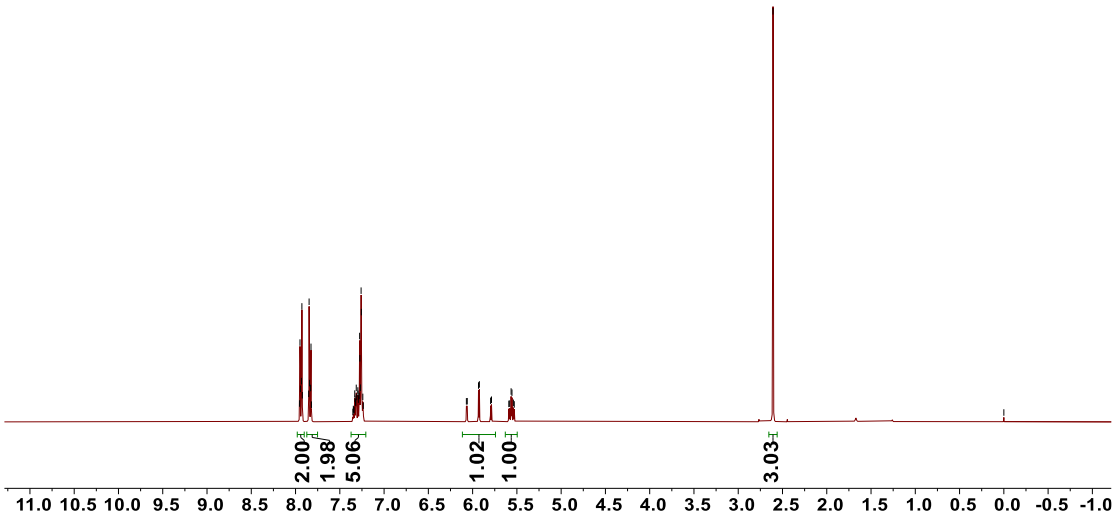
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1.00
3.03
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0


196.57
140.93
140.22
130.52
130.15
128.85
128.80
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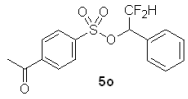
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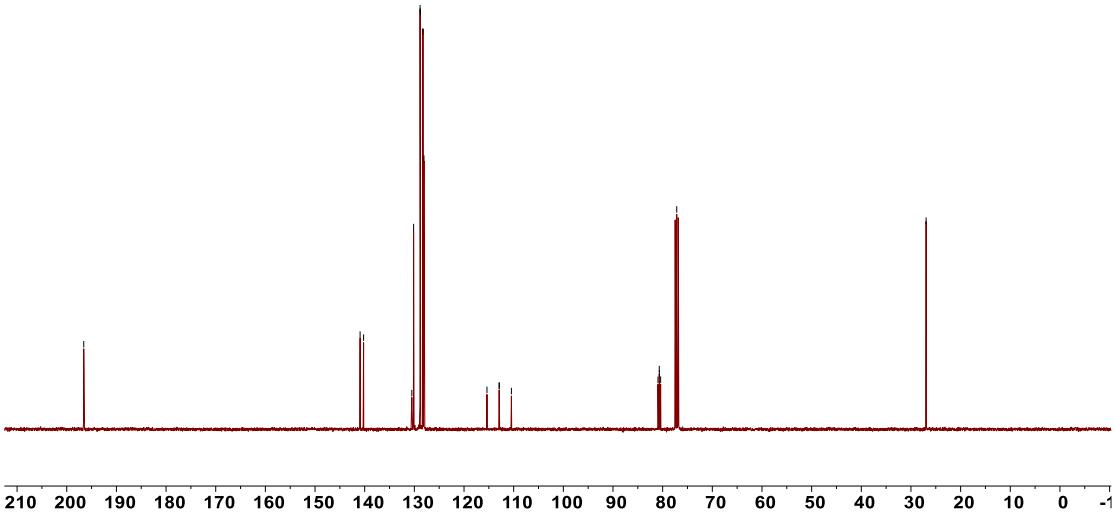
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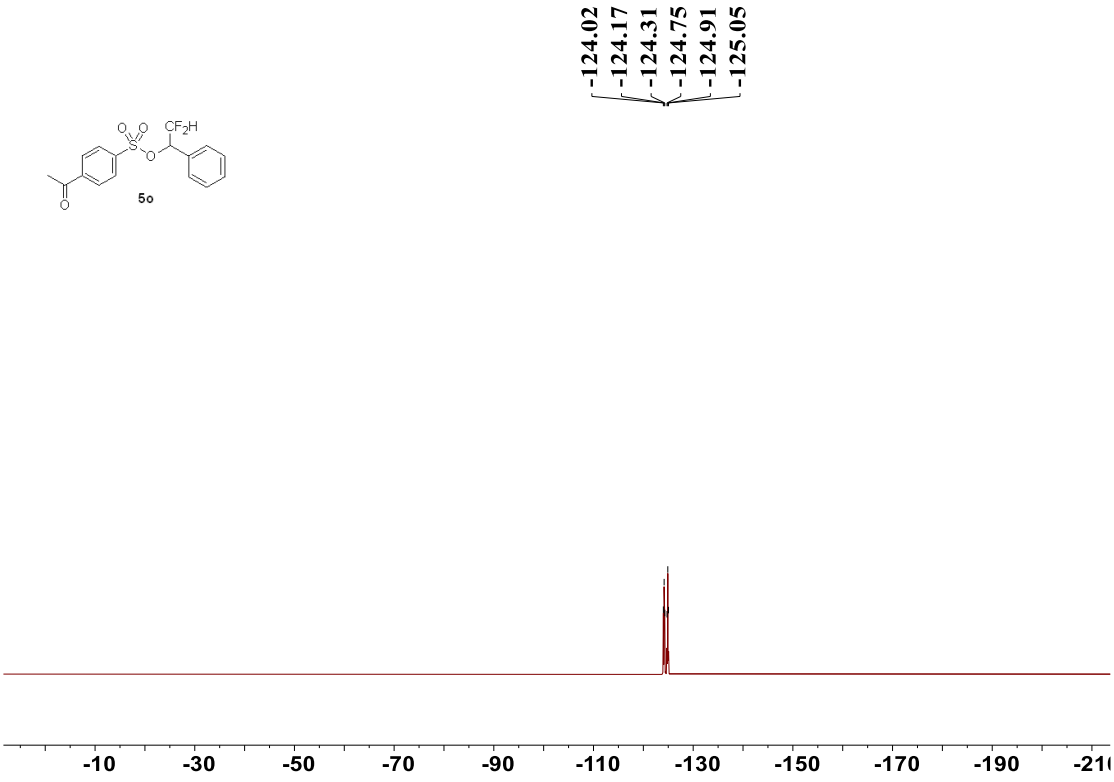
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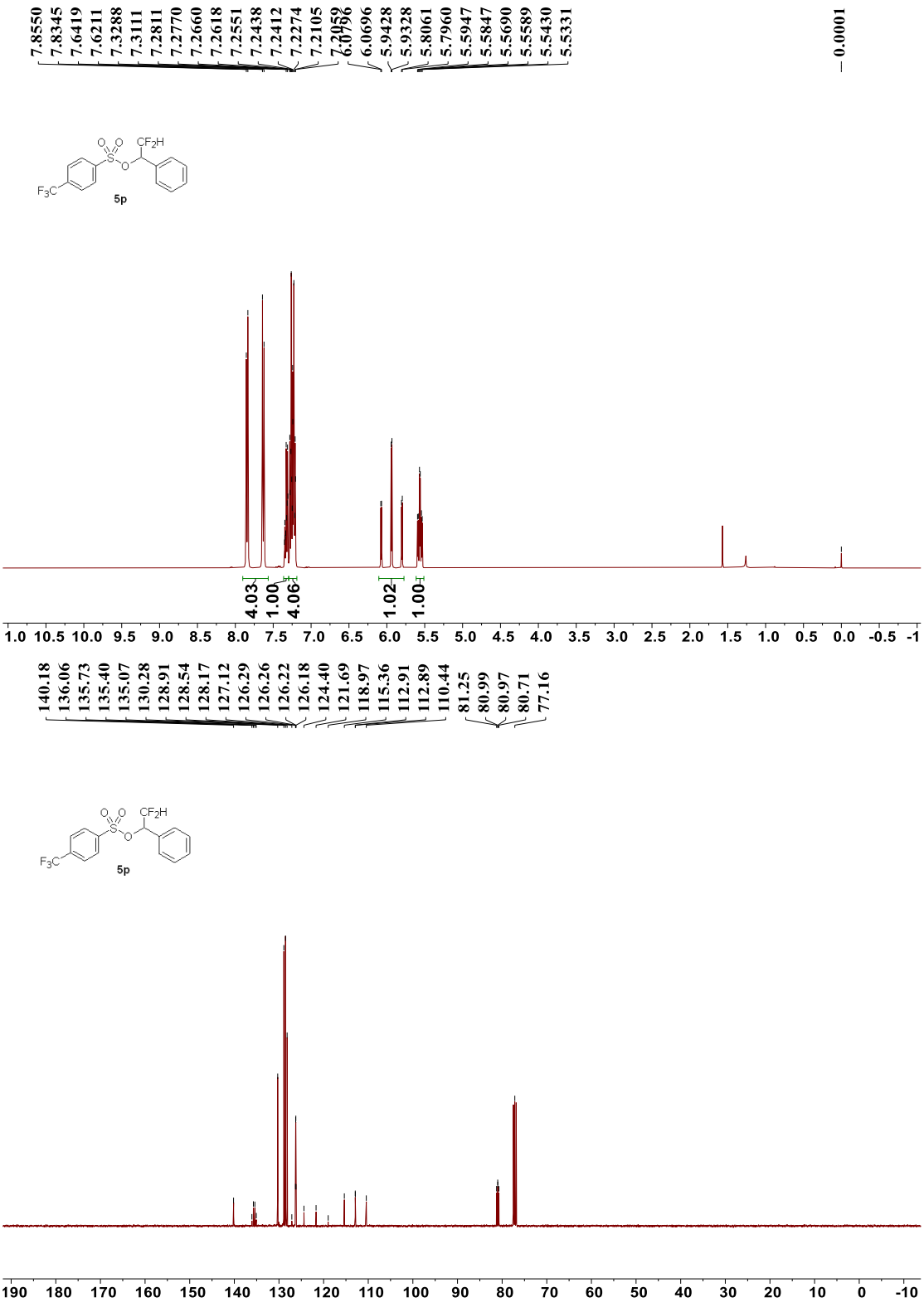
-170
-190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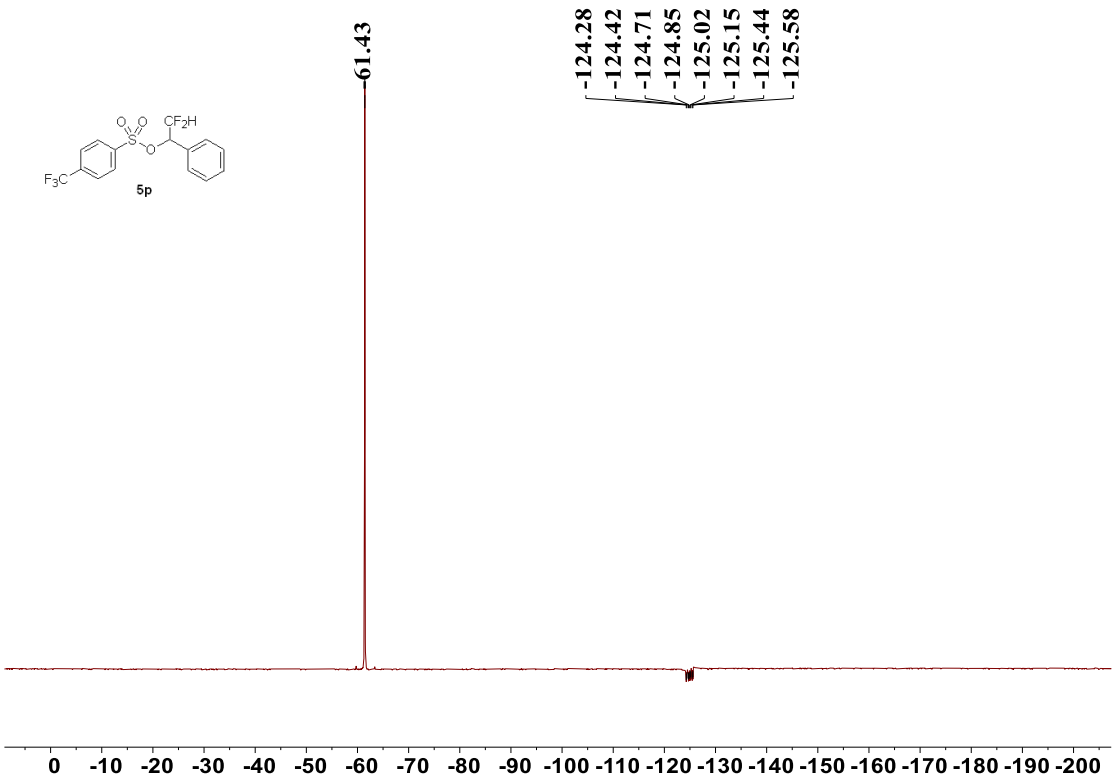
5p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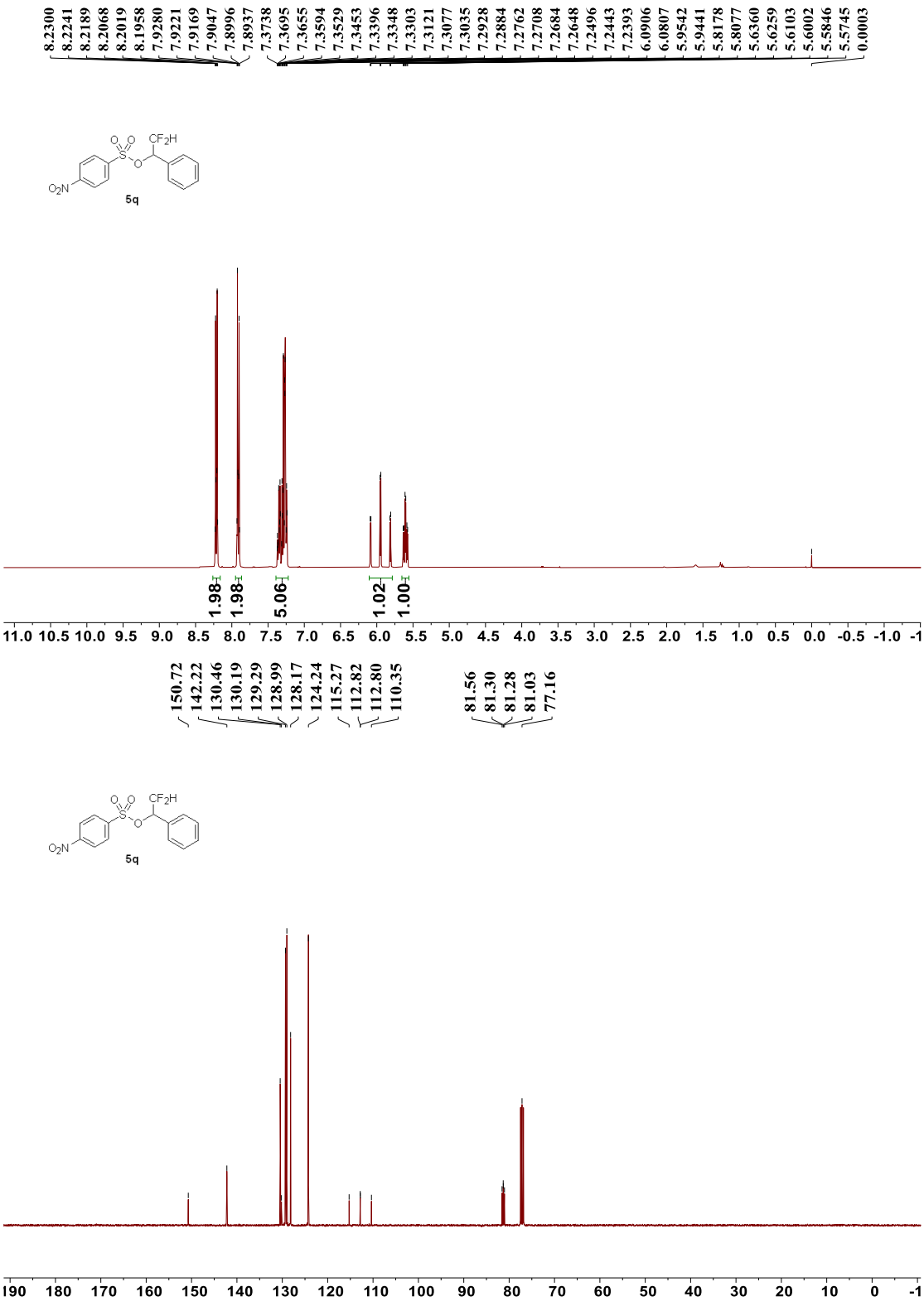
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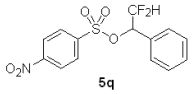

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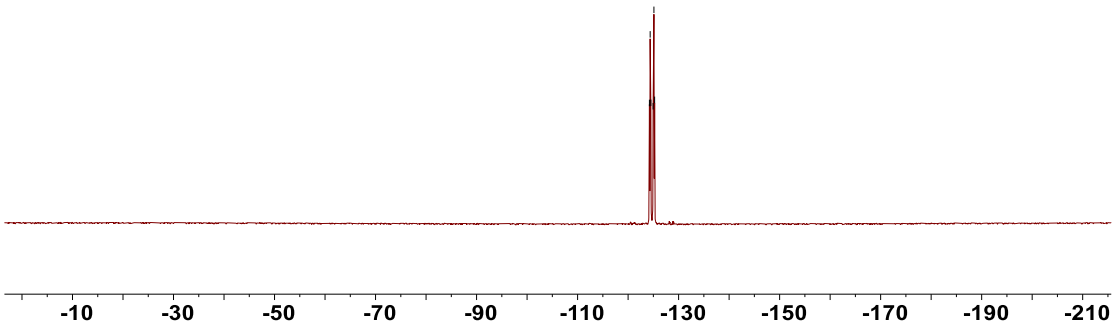

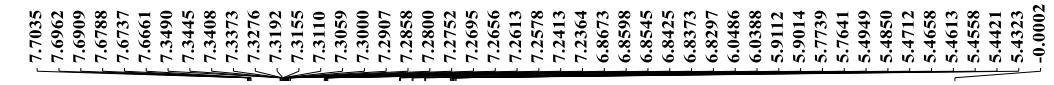
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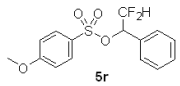
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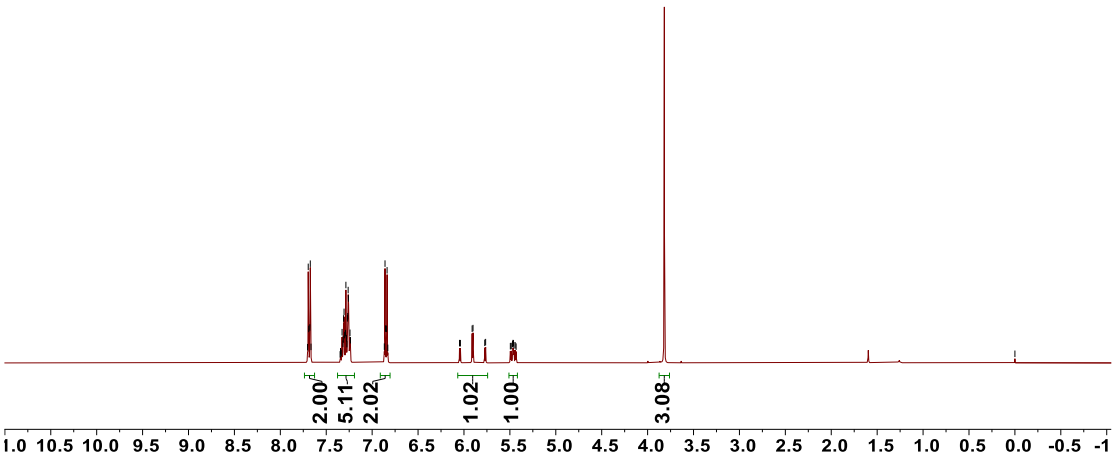
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2.02
1.02
1.00
3.08
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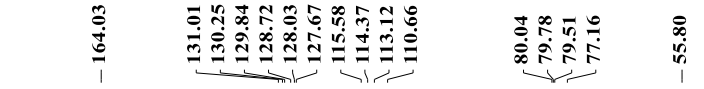
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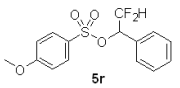
55.80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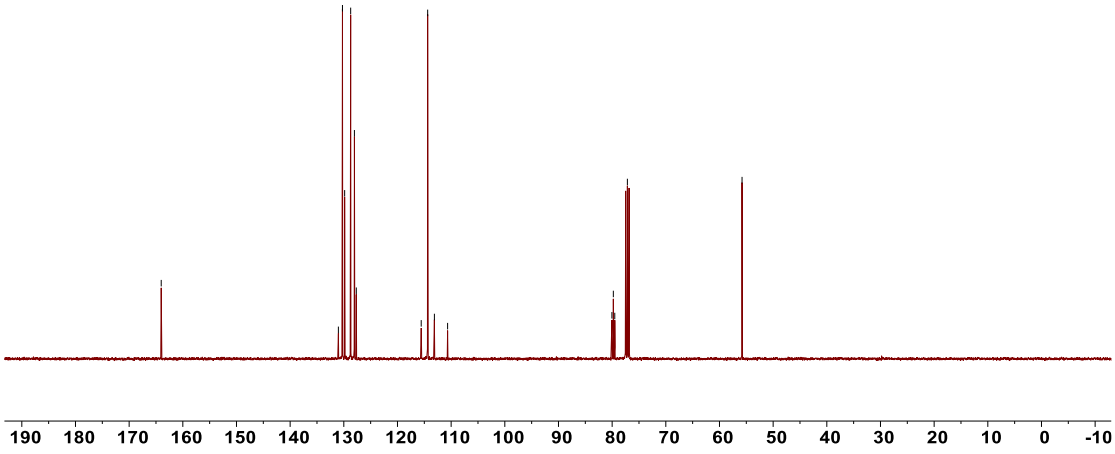
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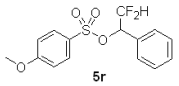

5r

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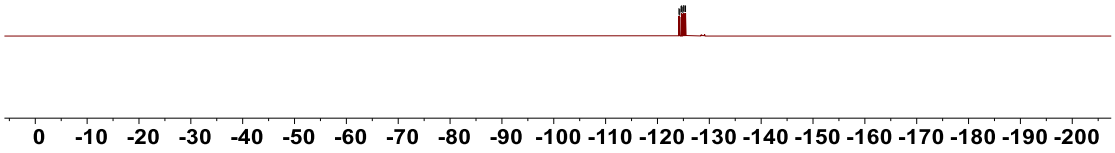

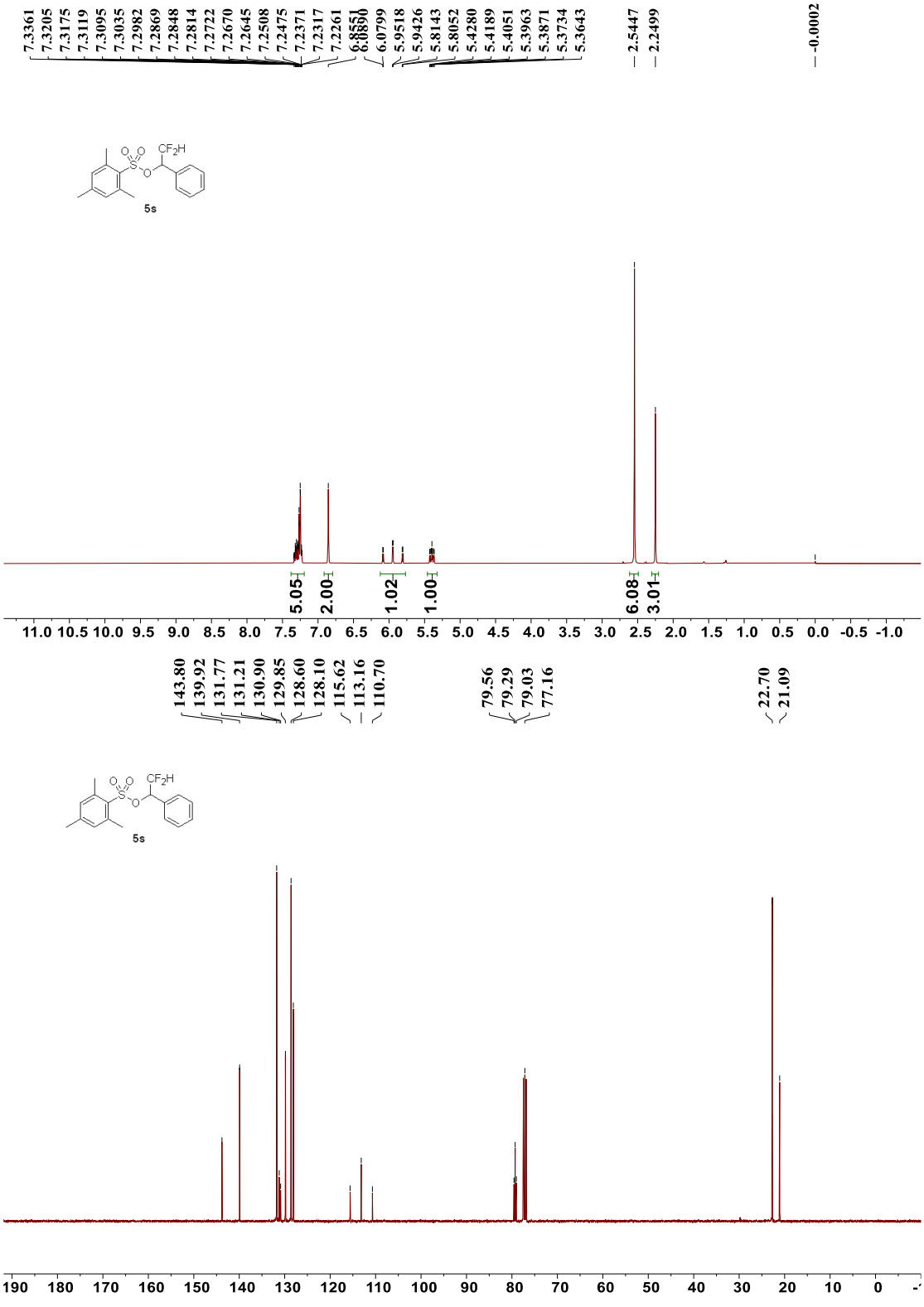
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1.02
1.00
6.08
3.01
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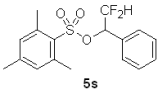

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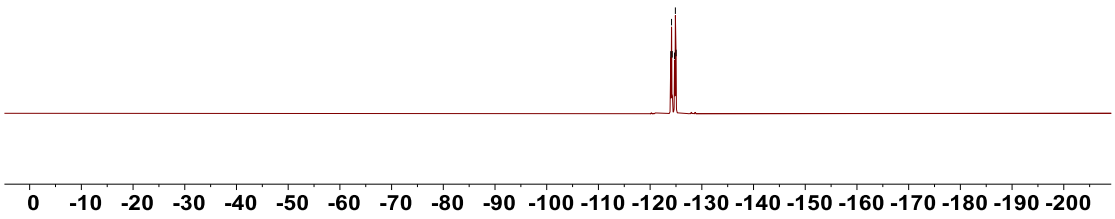

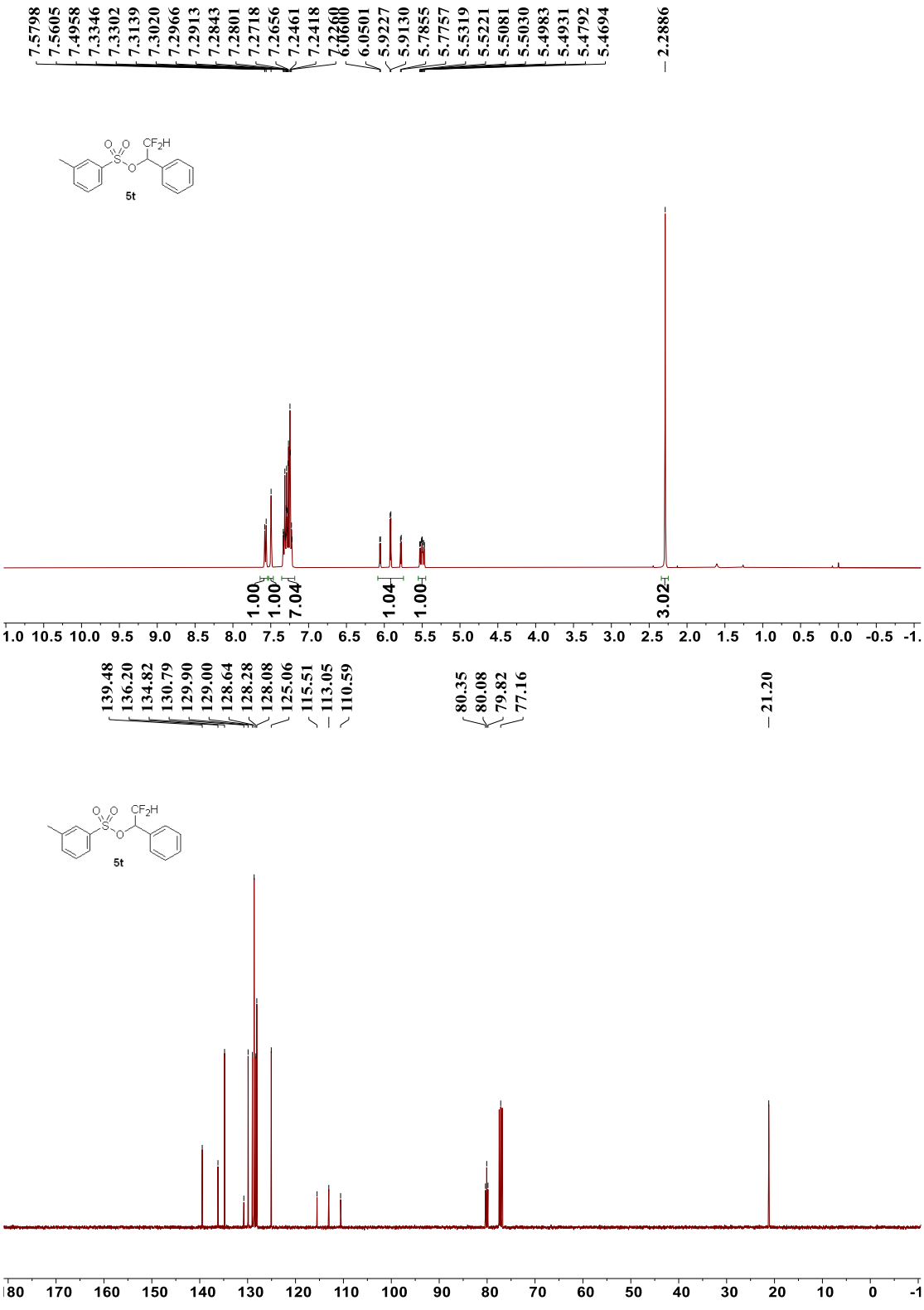
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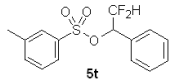

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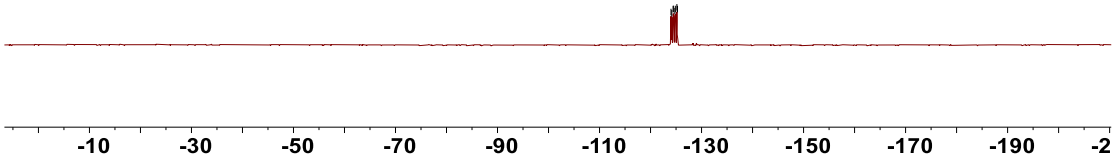

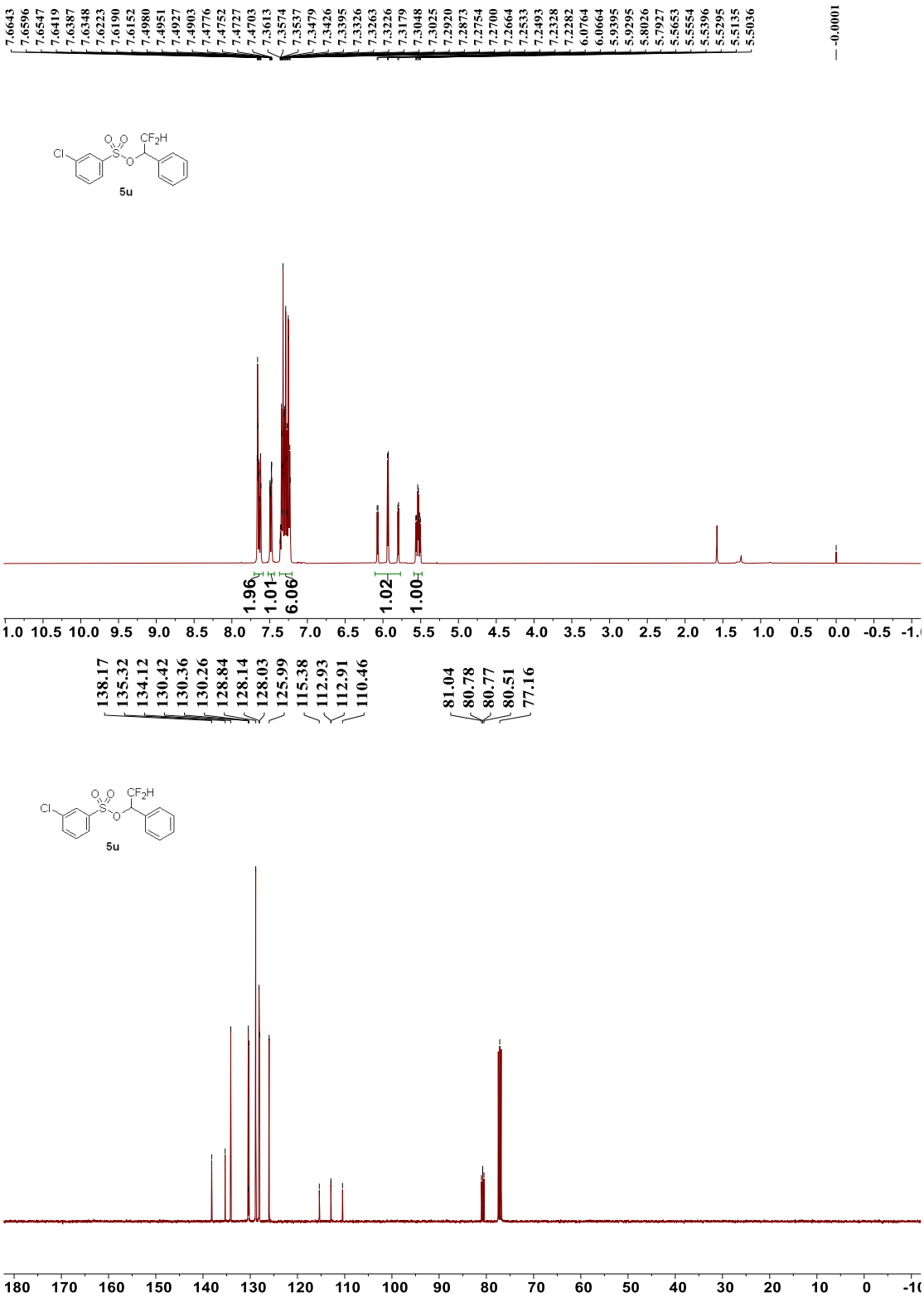
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Cl
O
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CF2H
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1.96
1.01
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1.00
1.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
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135.32
134.12
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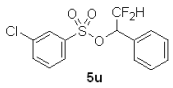

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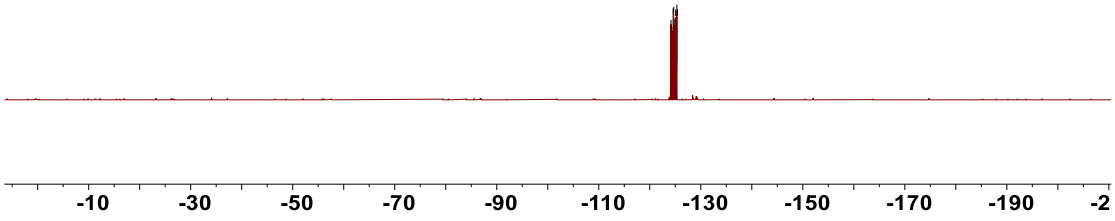

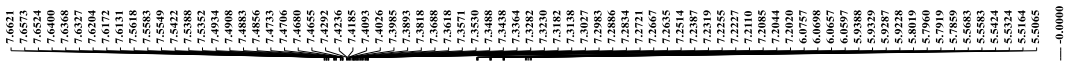

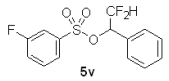

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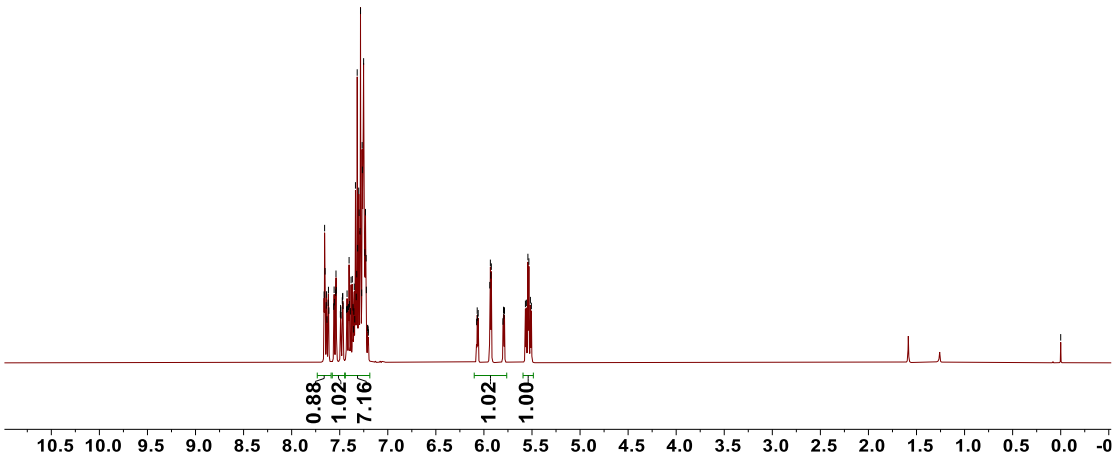

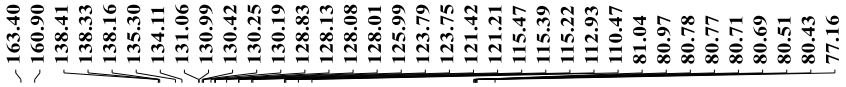

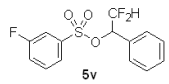

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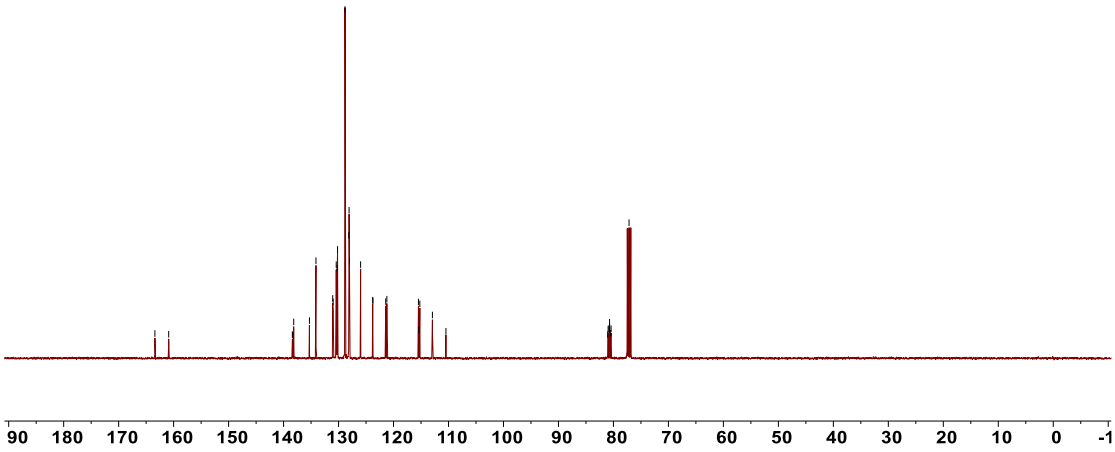

F
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S
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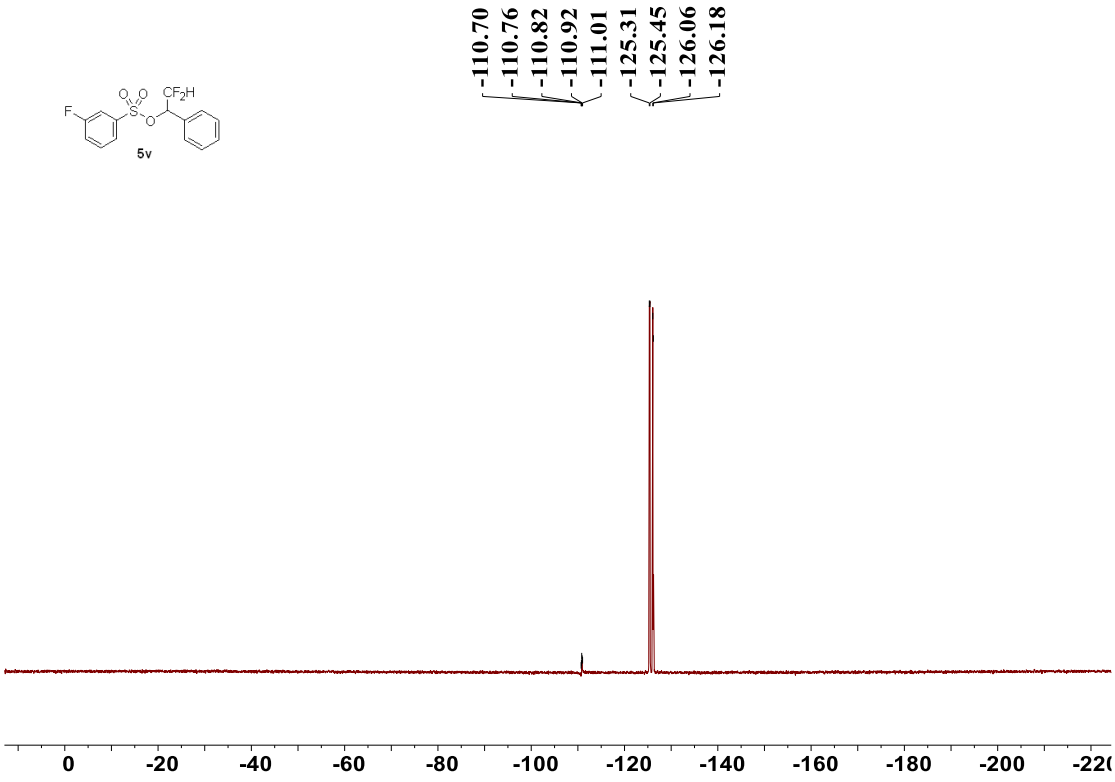
CF2H

5v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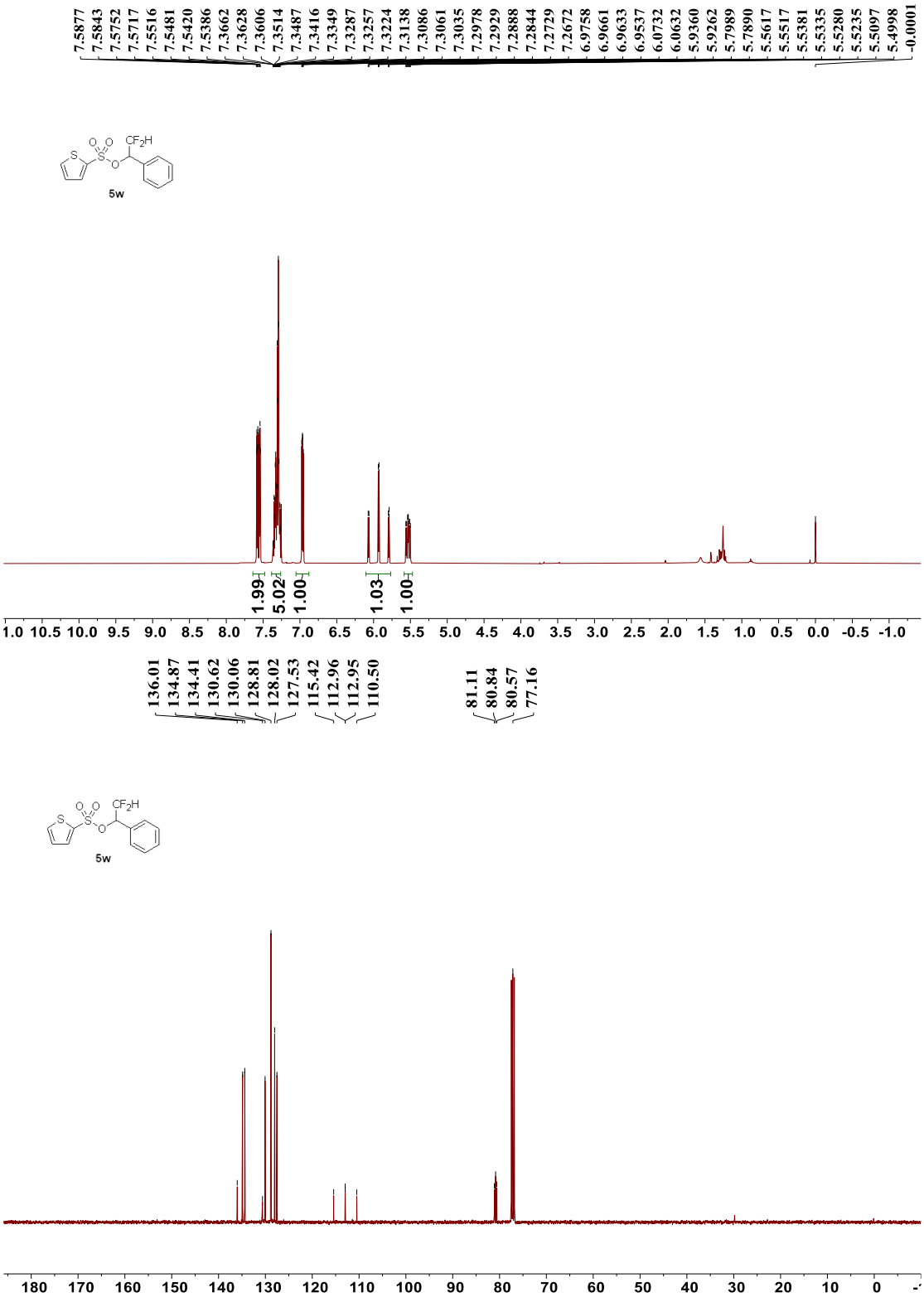
-200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CF2H
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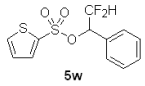

5w

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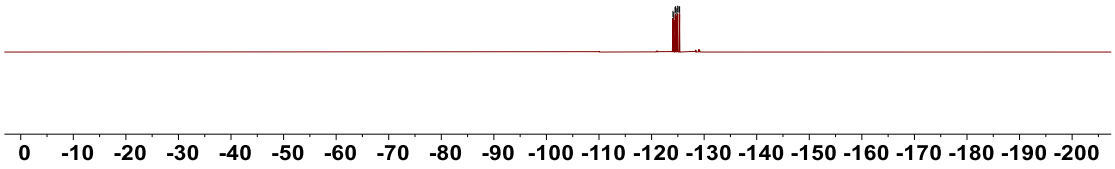

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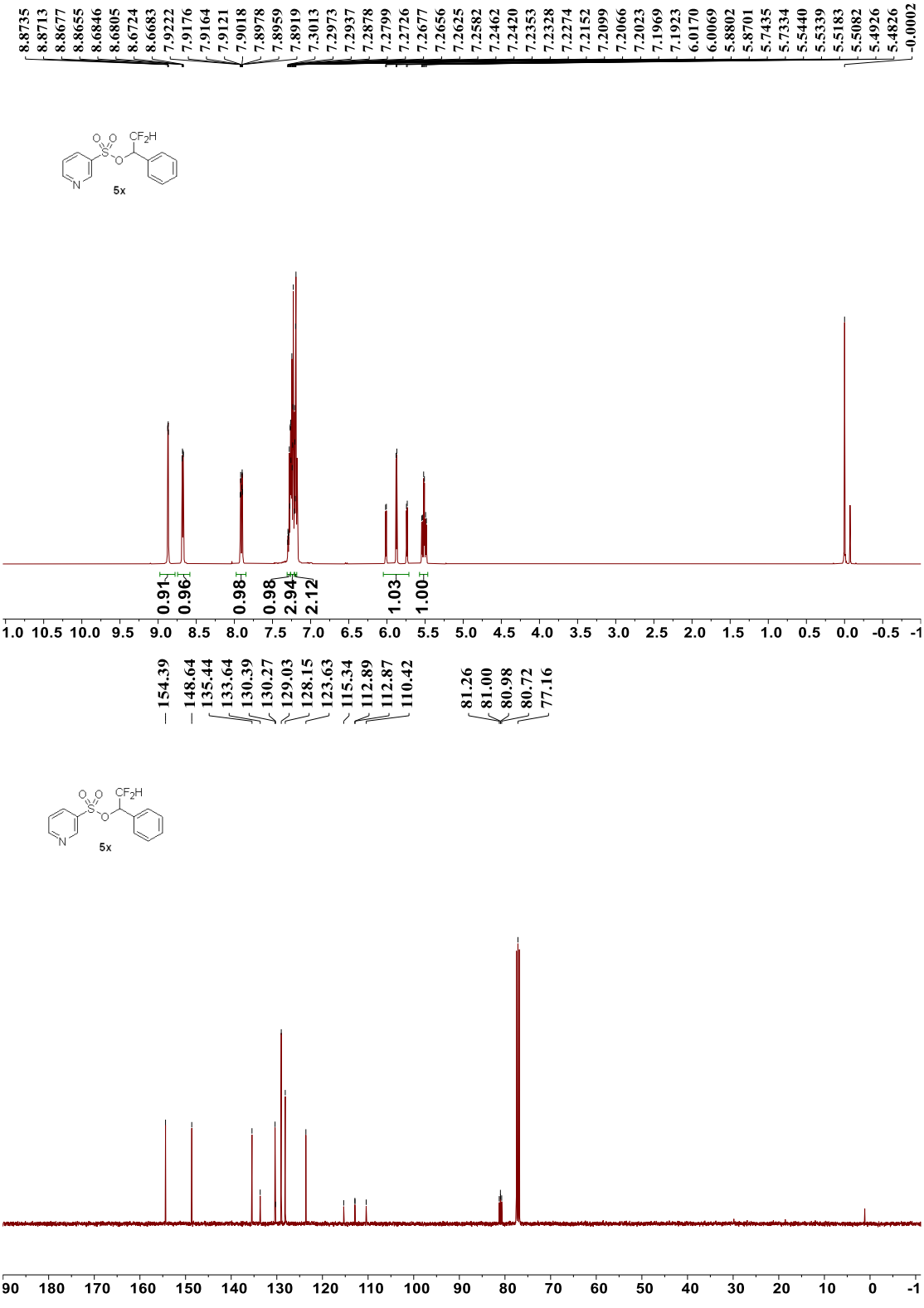
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7.2066
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0.98
0.98
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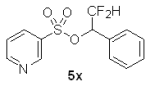

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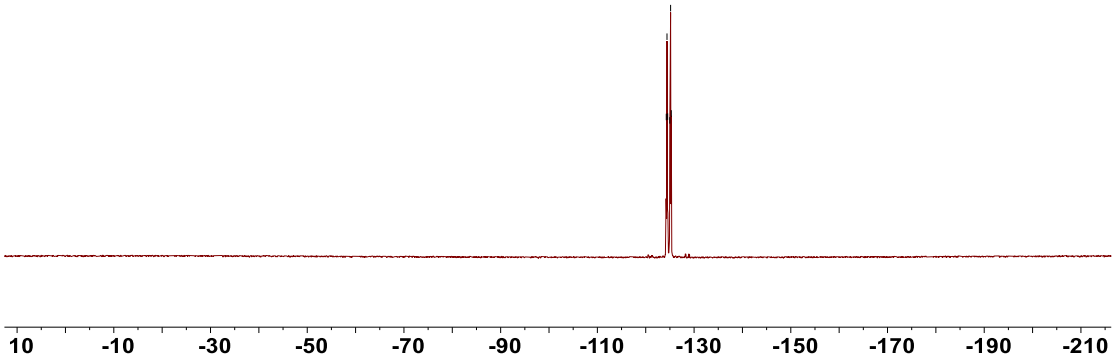

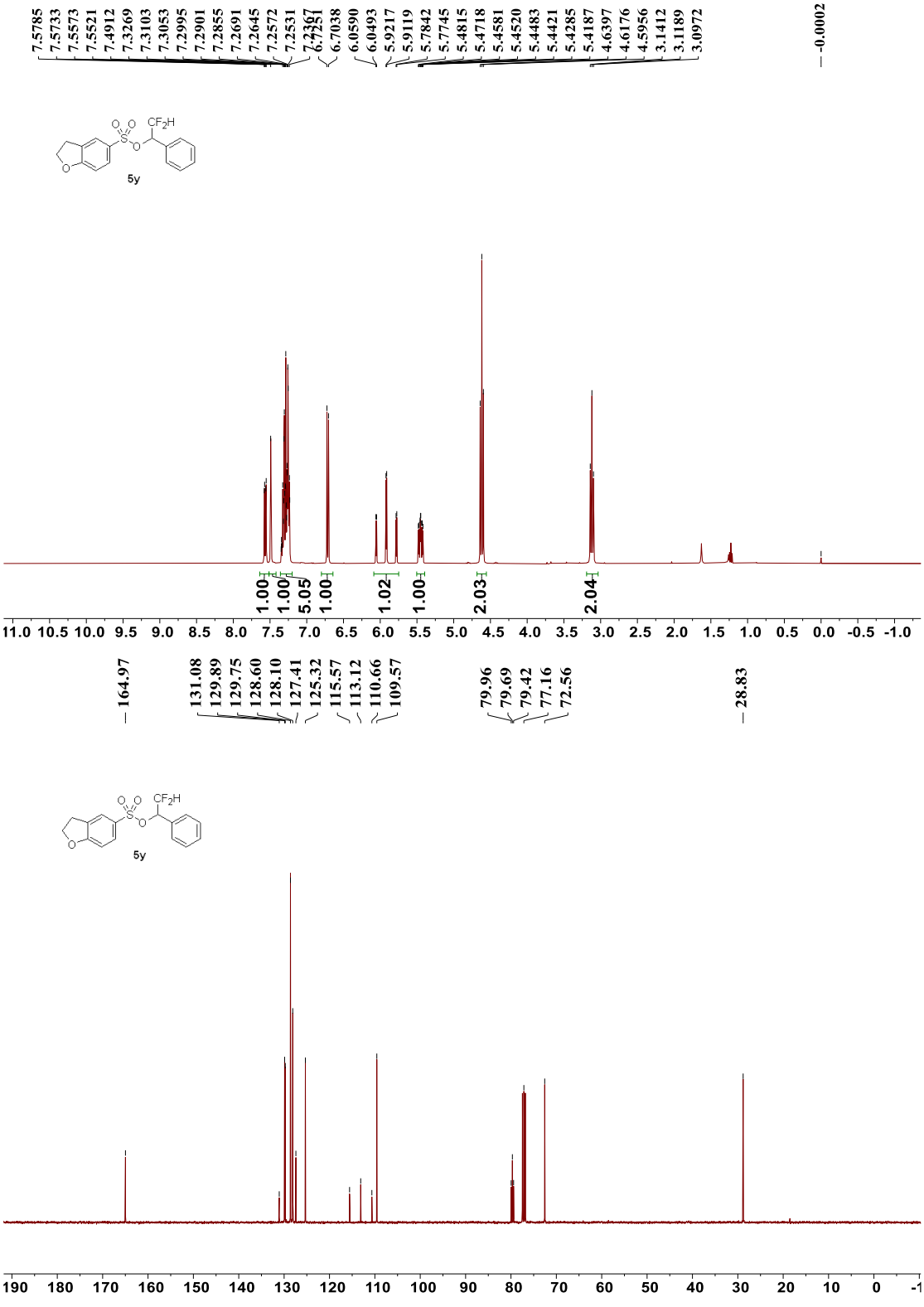
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2.03
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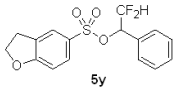

5y

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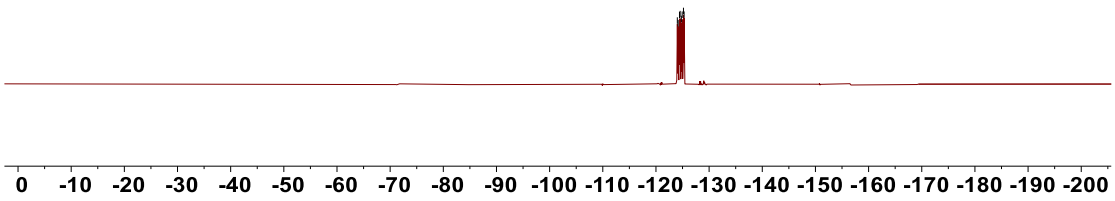

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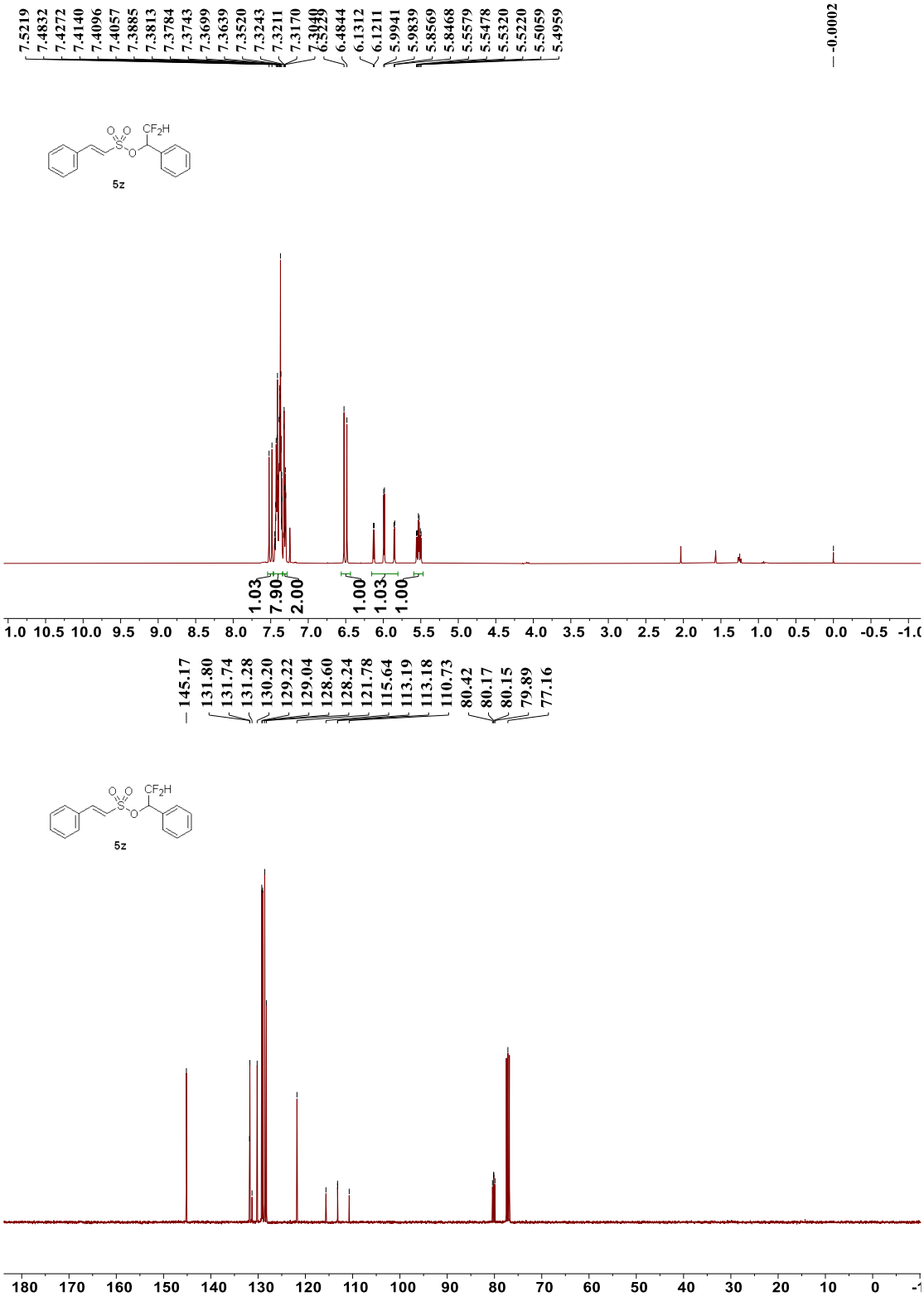
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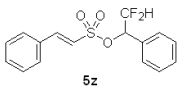

5z

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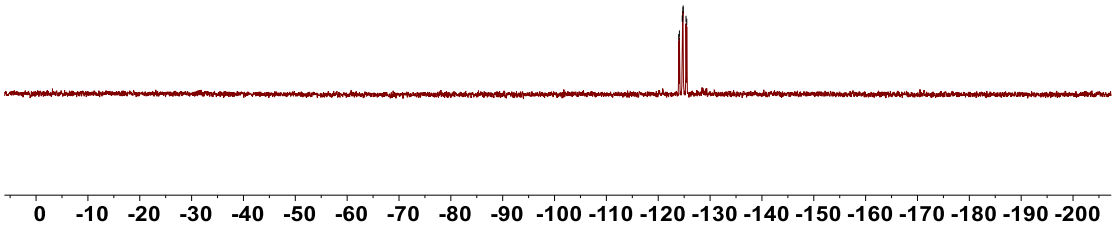

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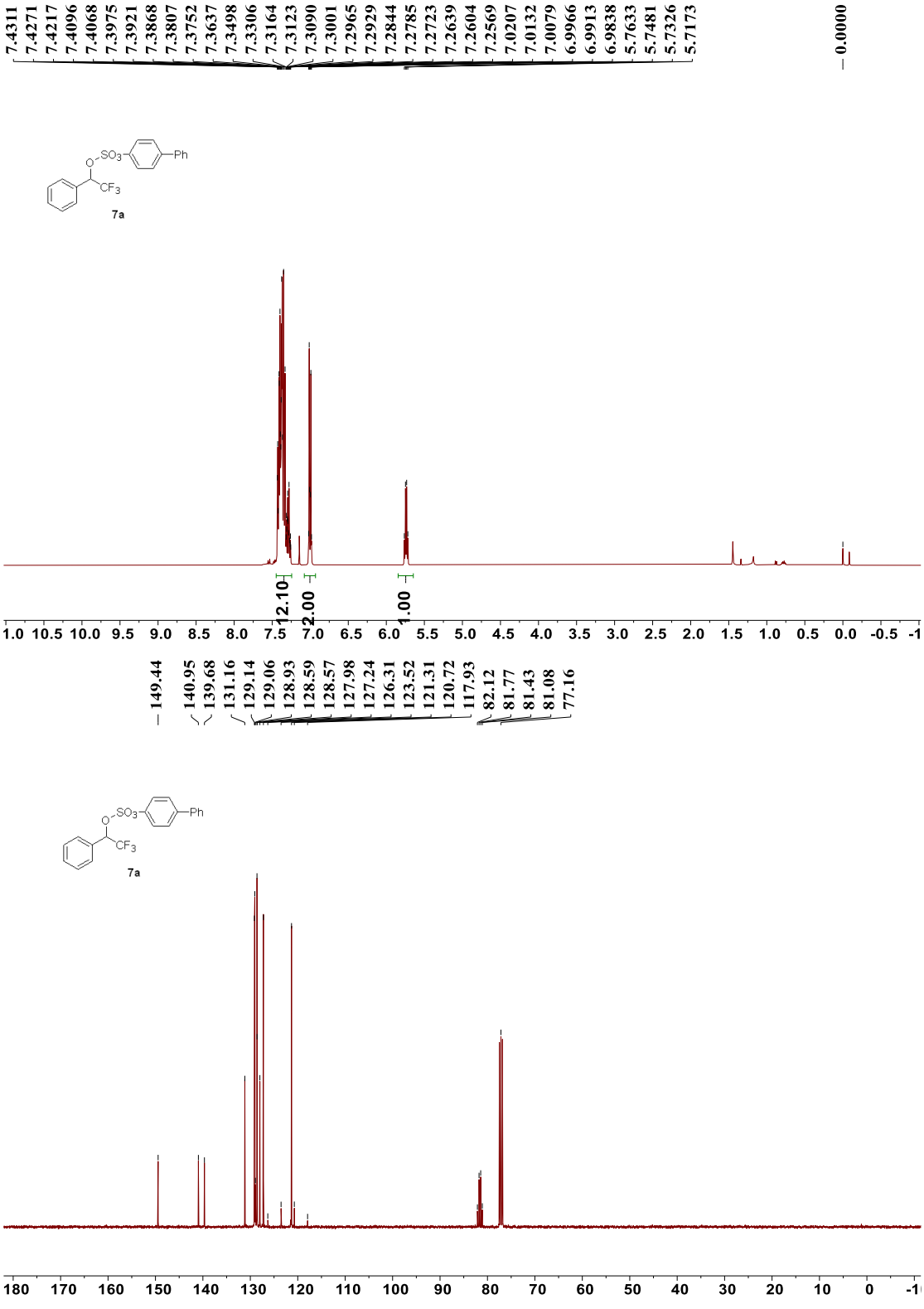
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CF3
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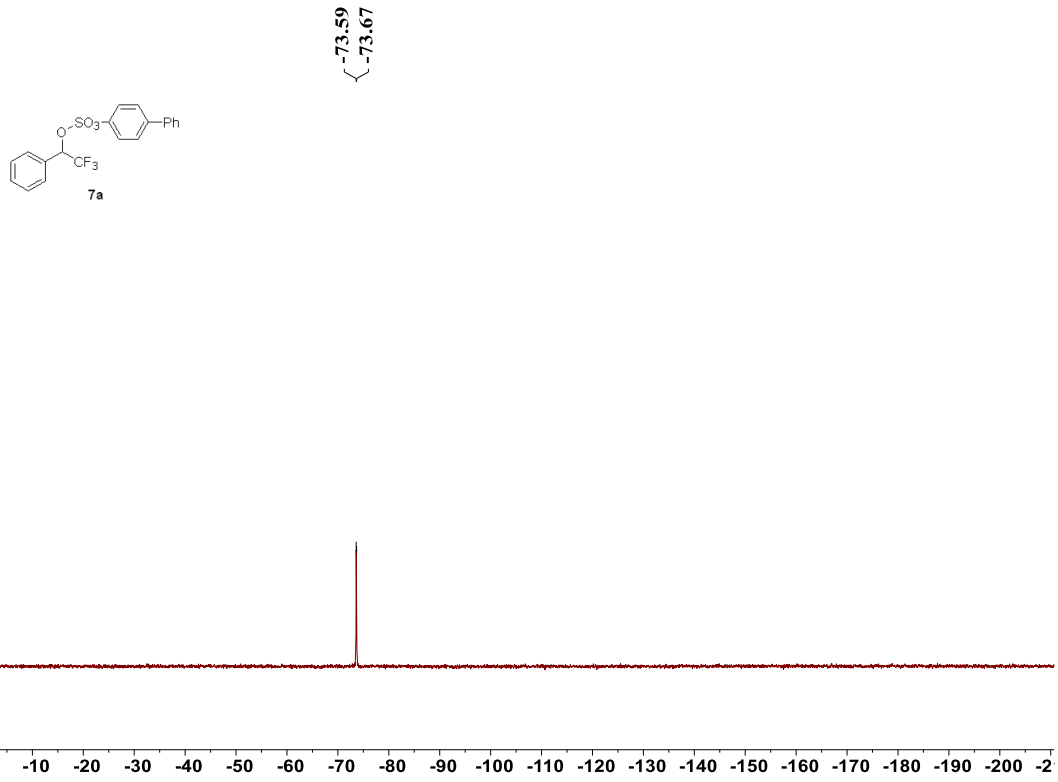
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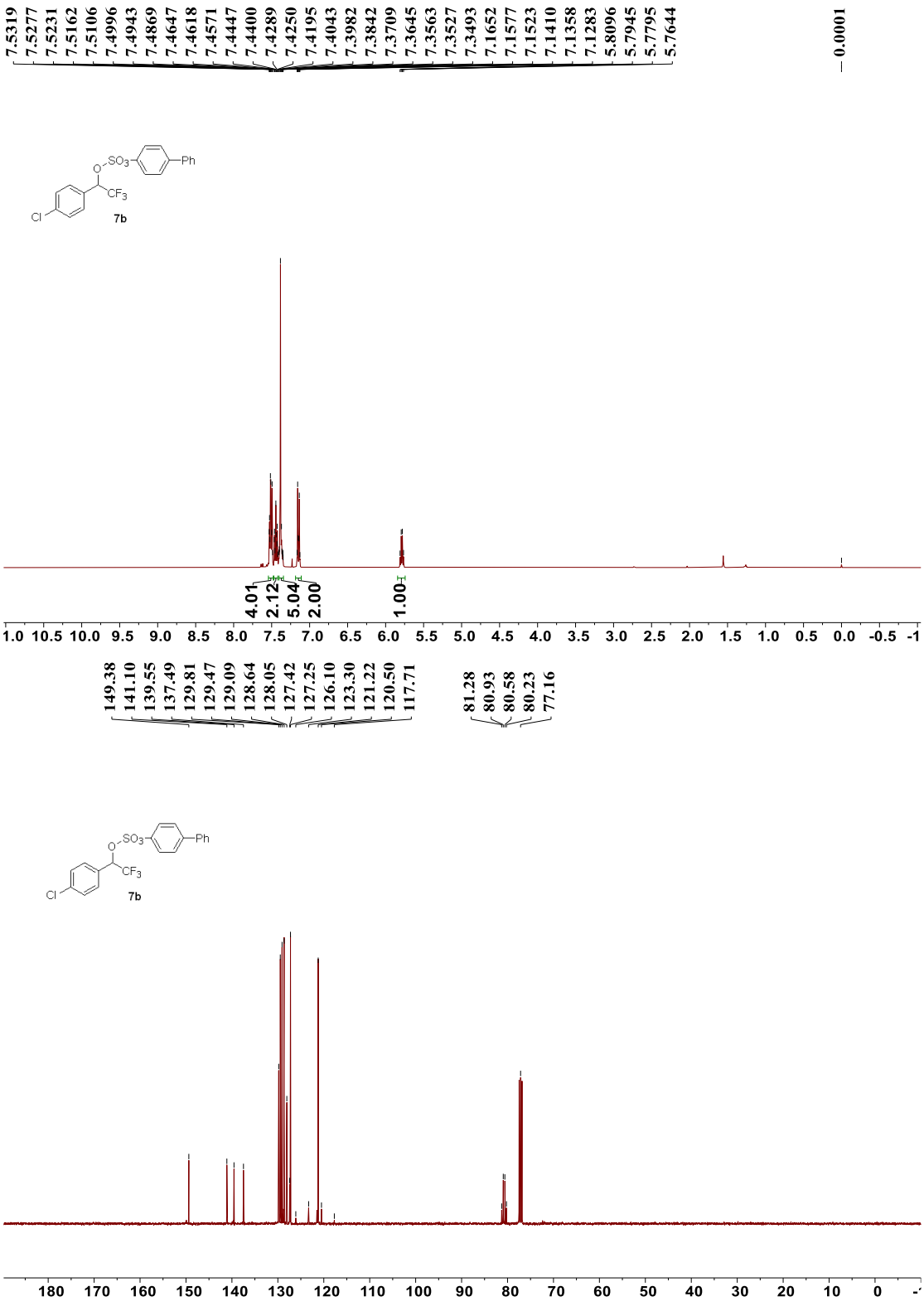
-200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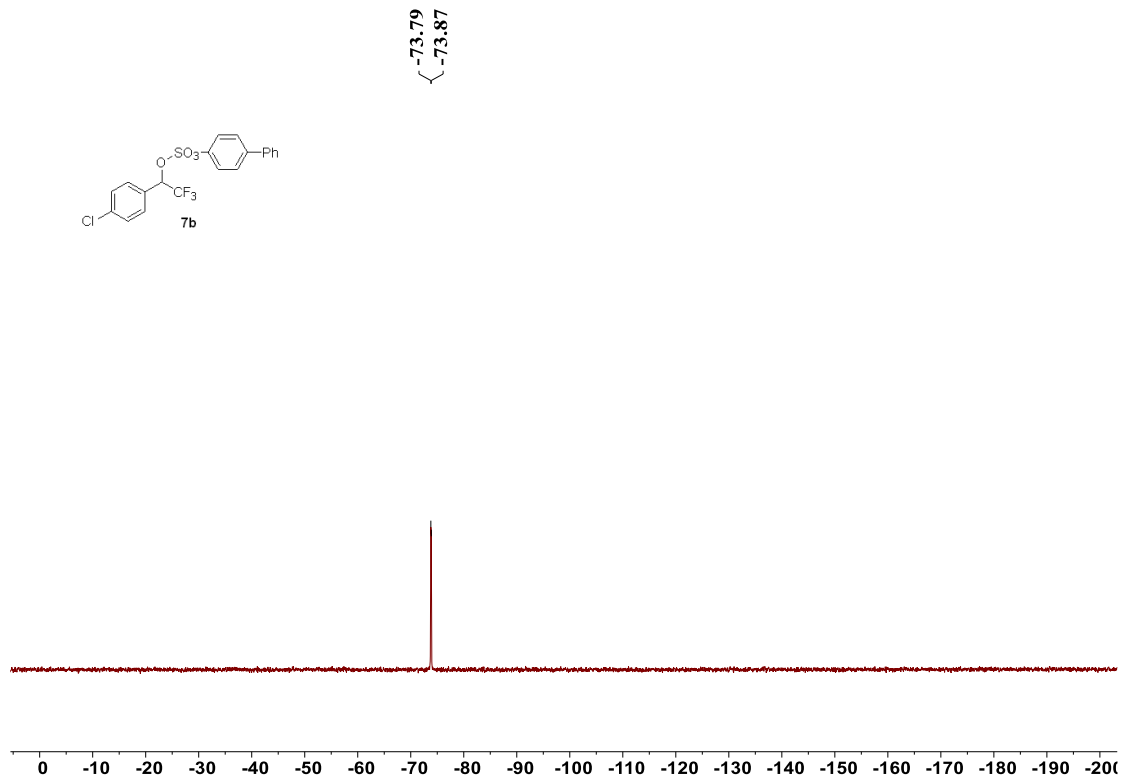
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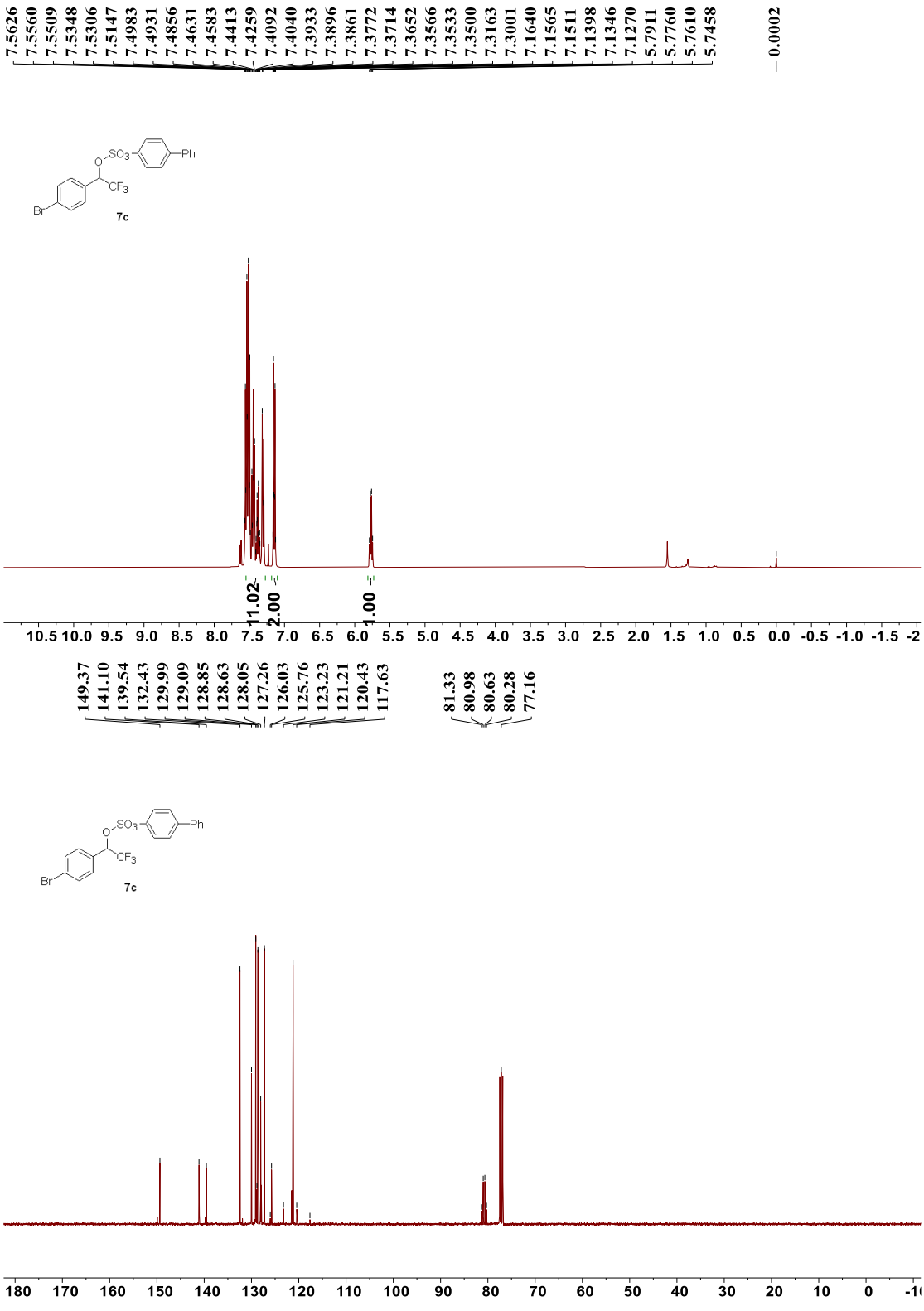
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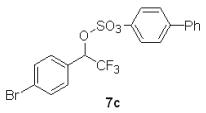
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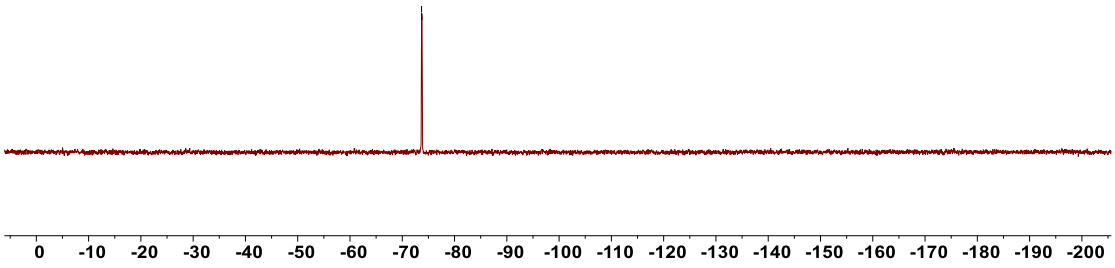
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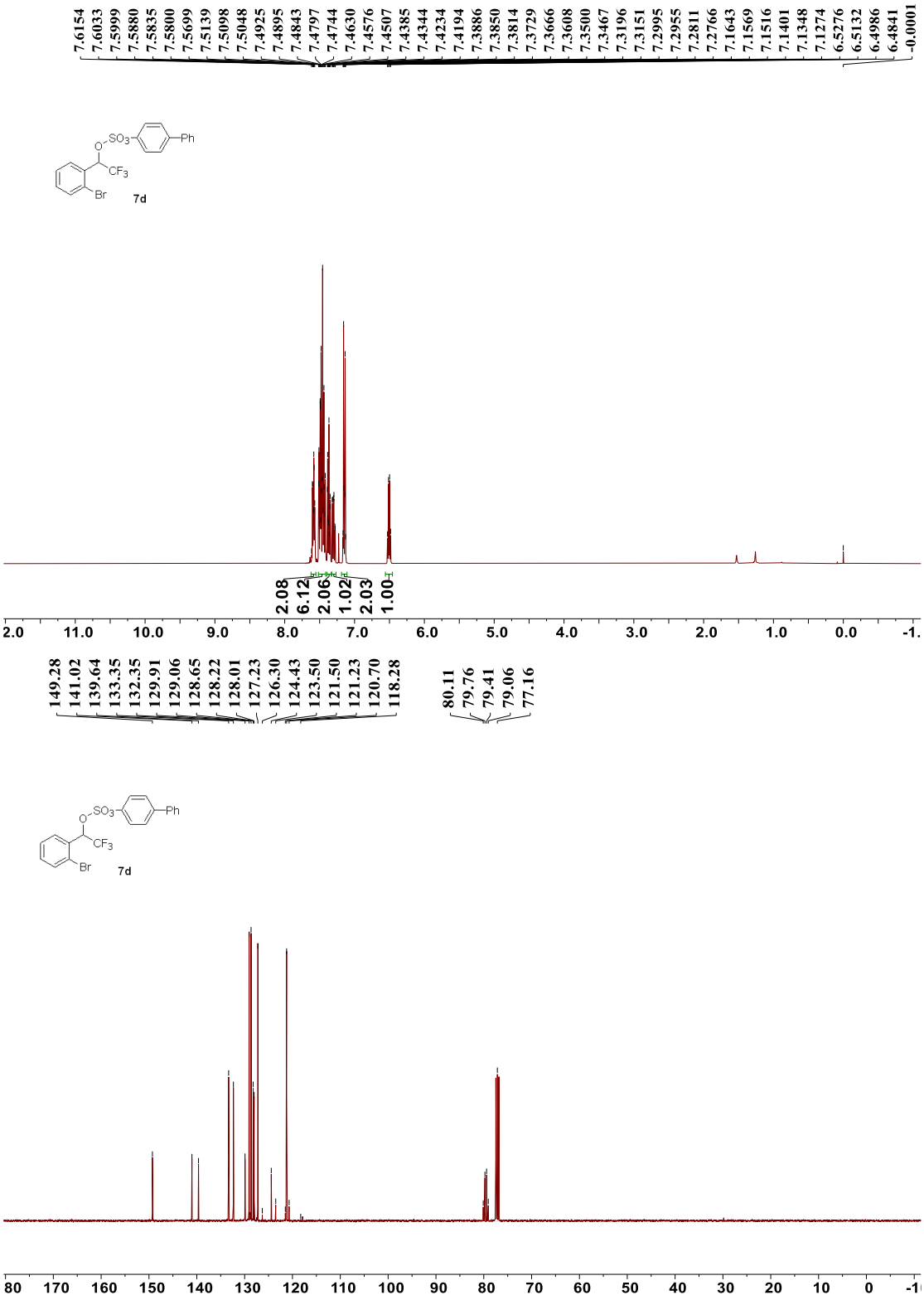
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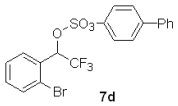
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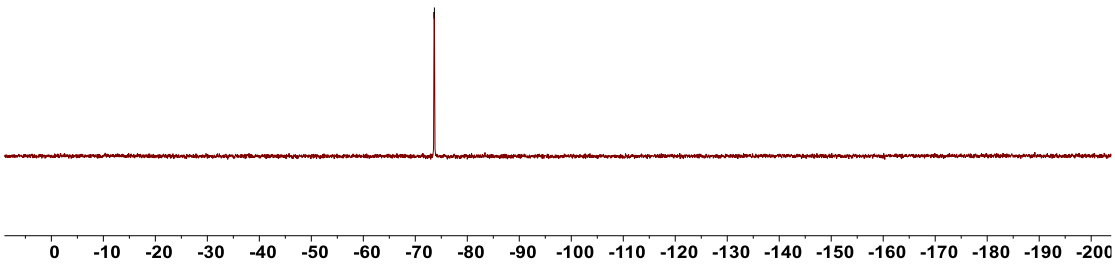
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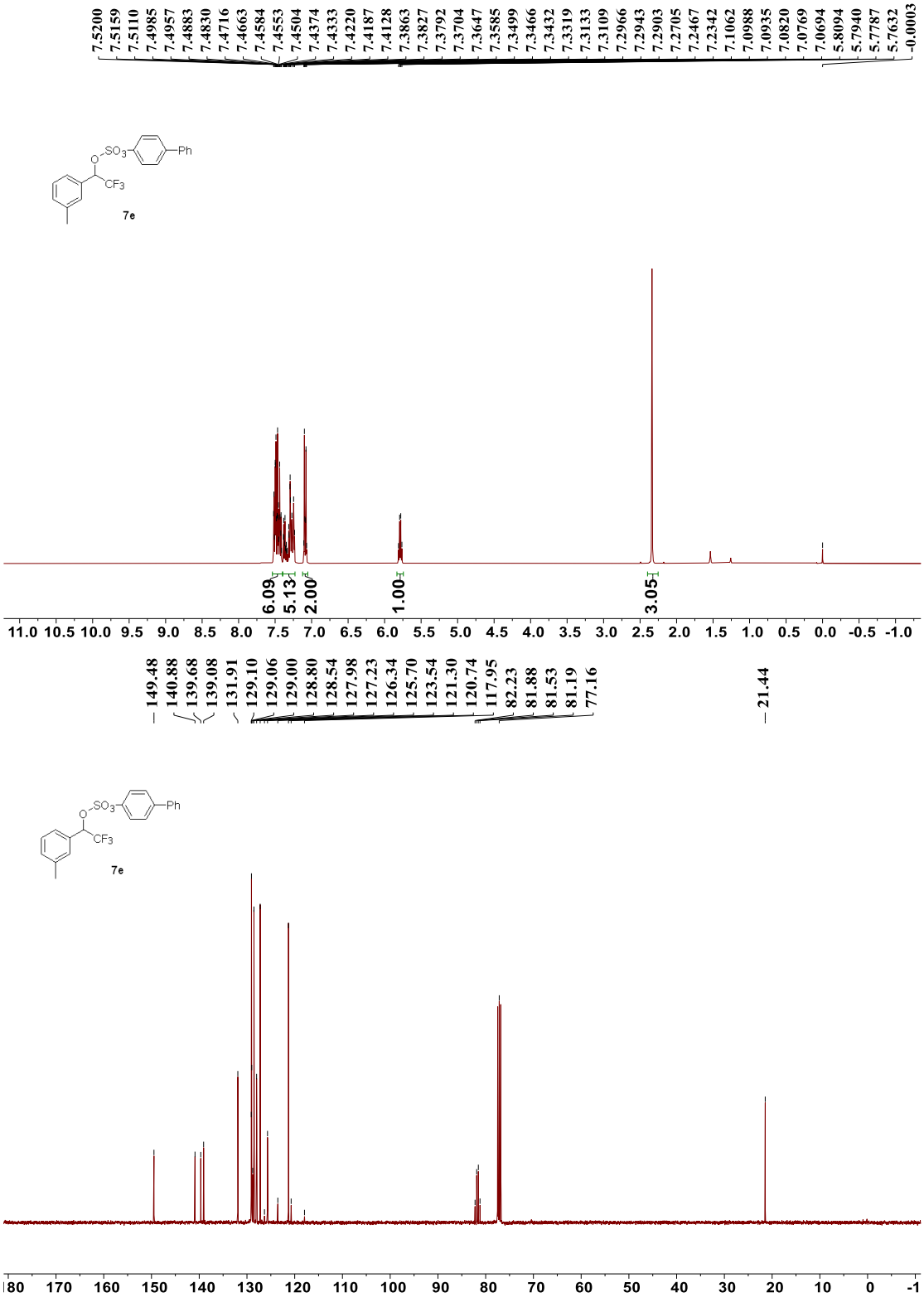
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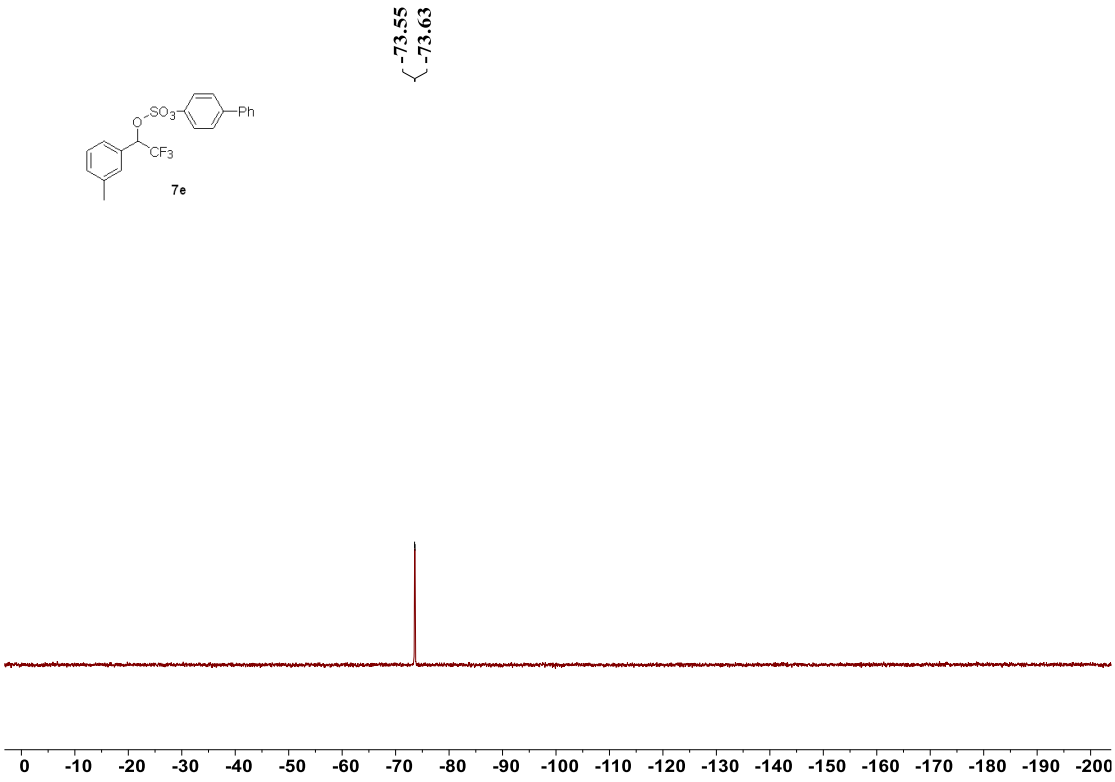
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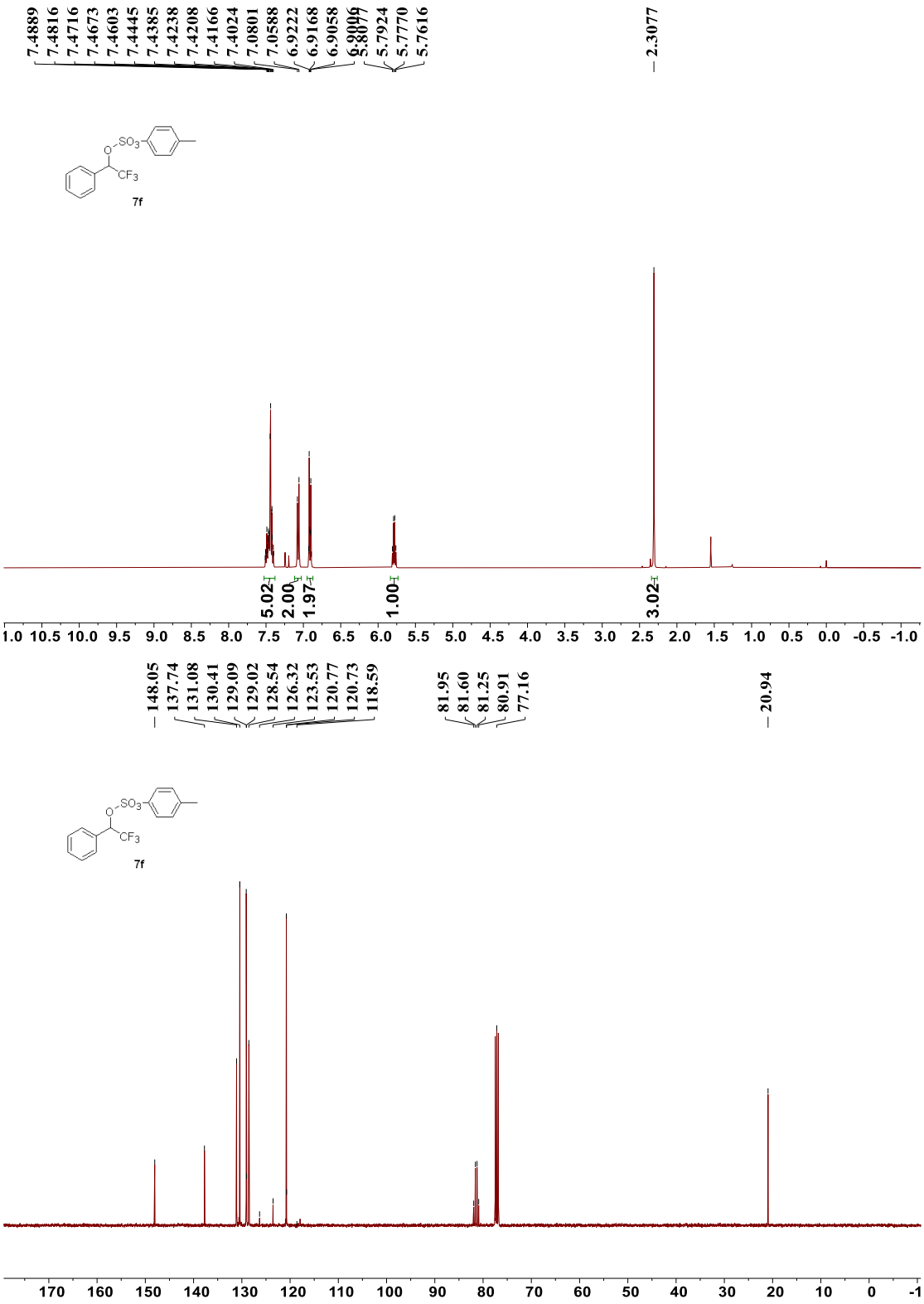
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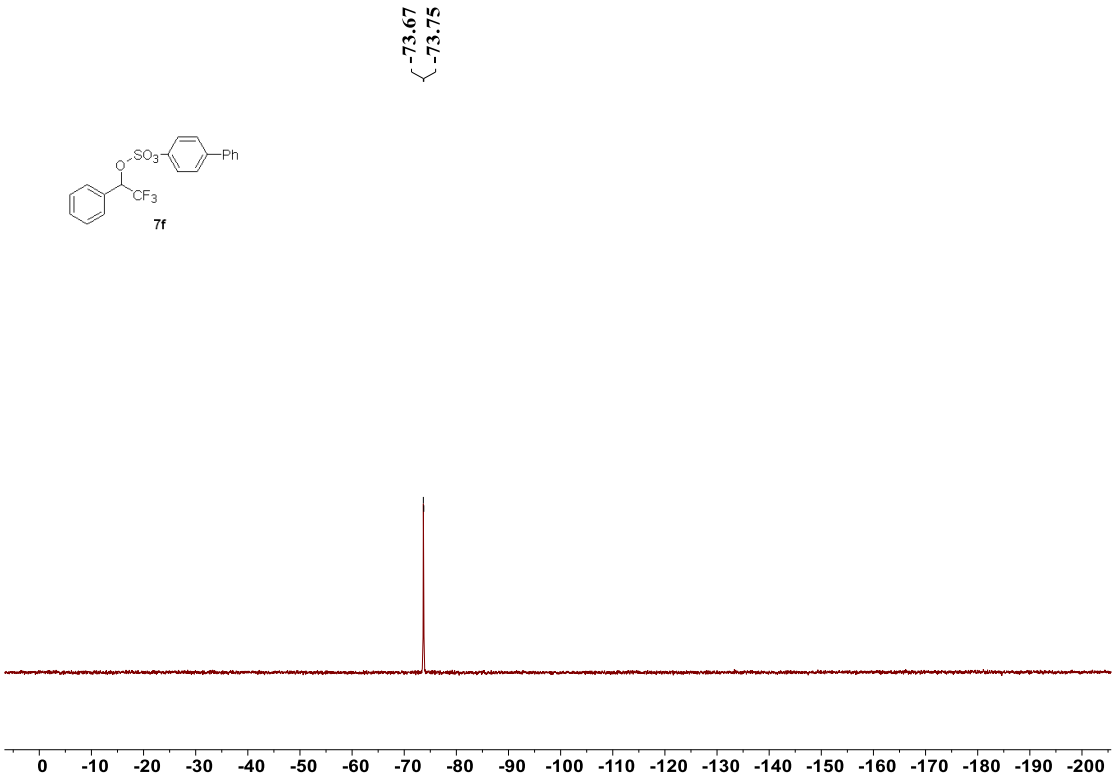
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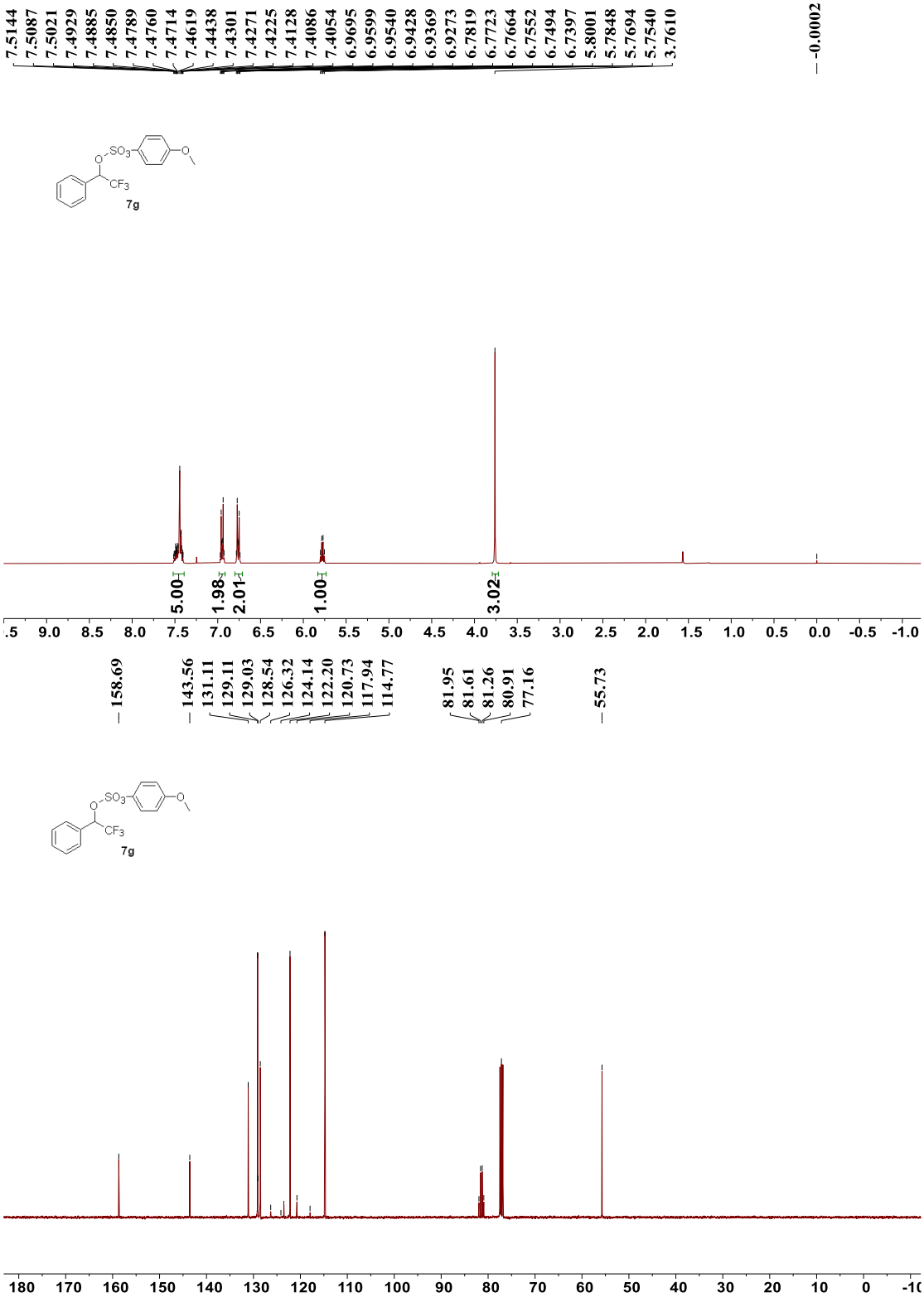
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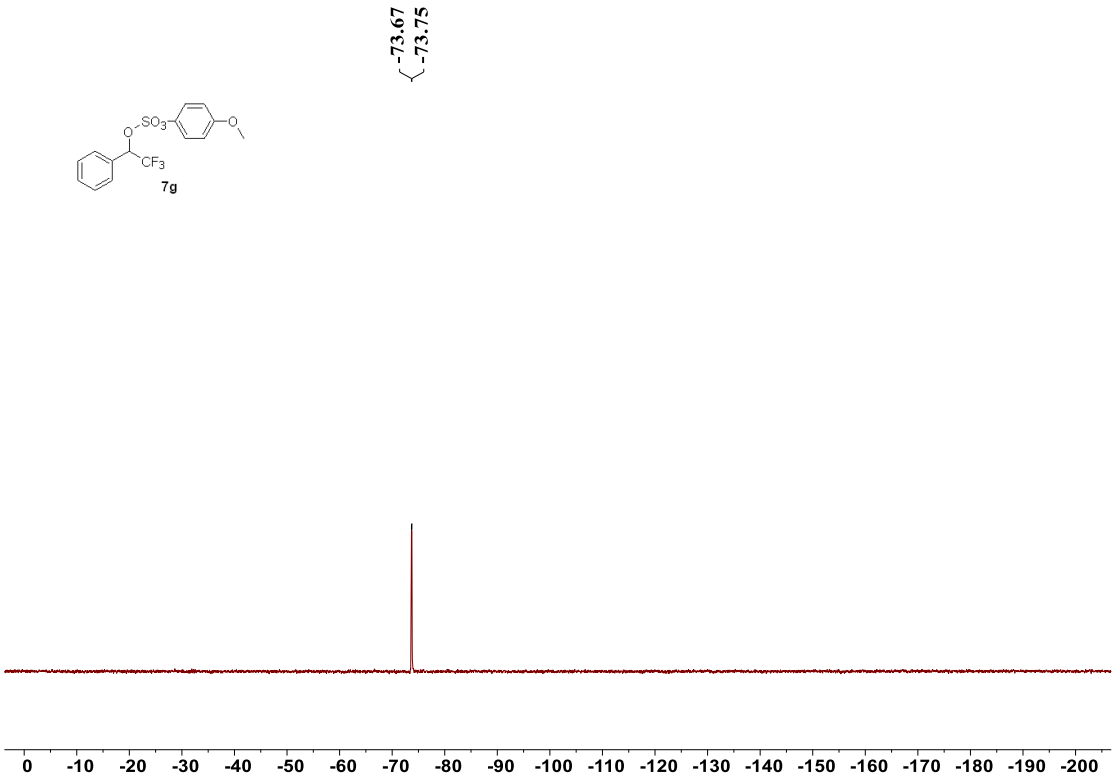
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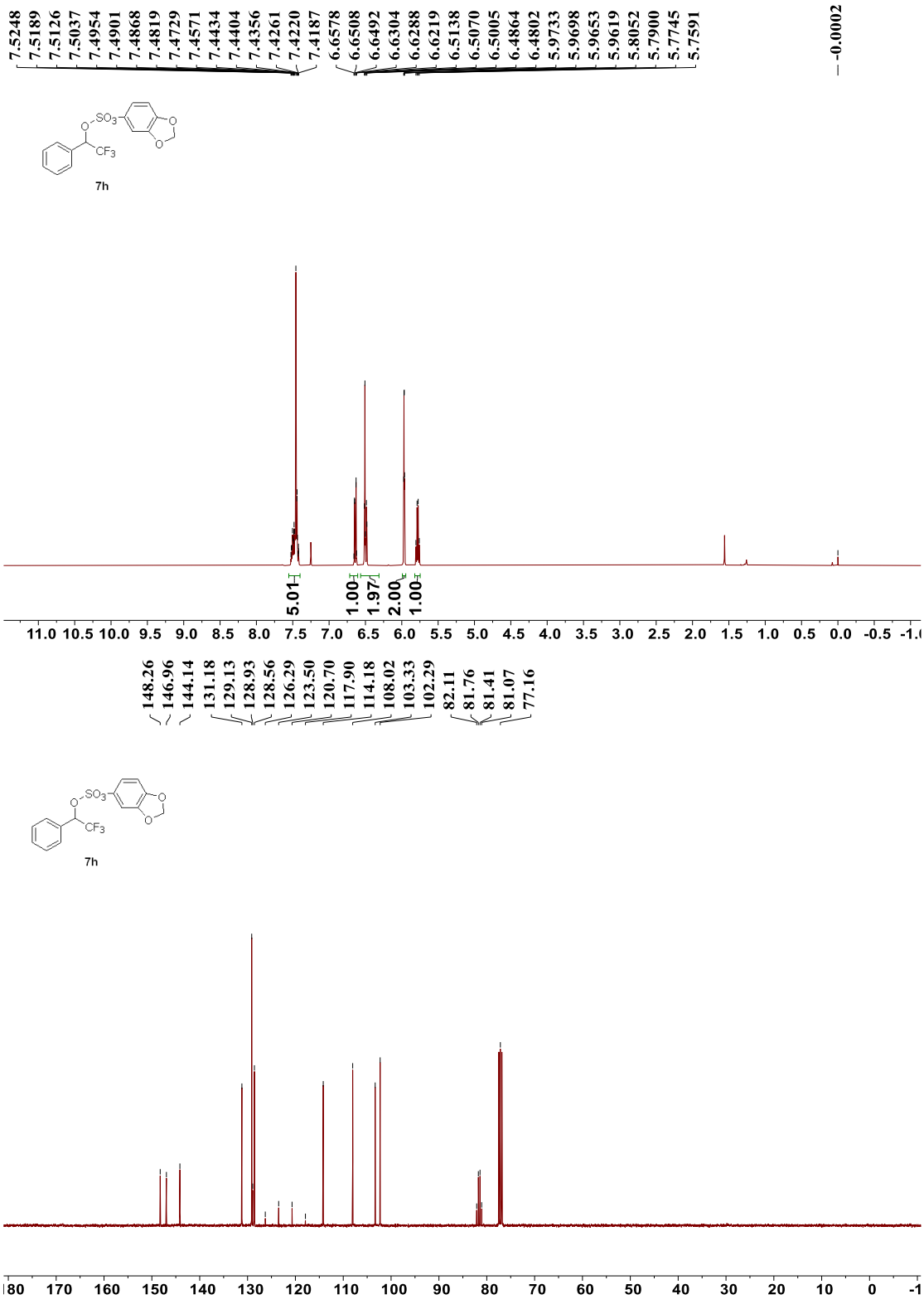
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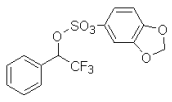
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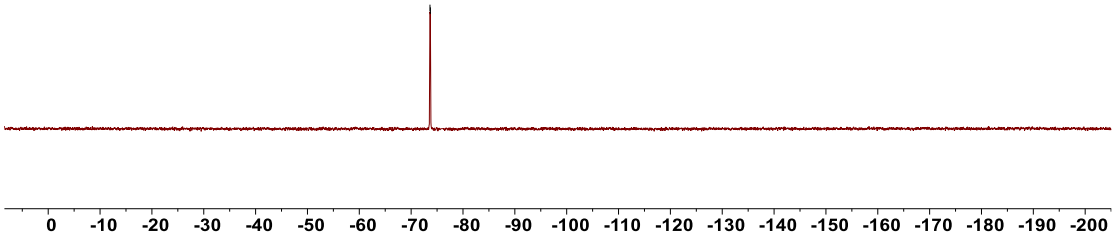
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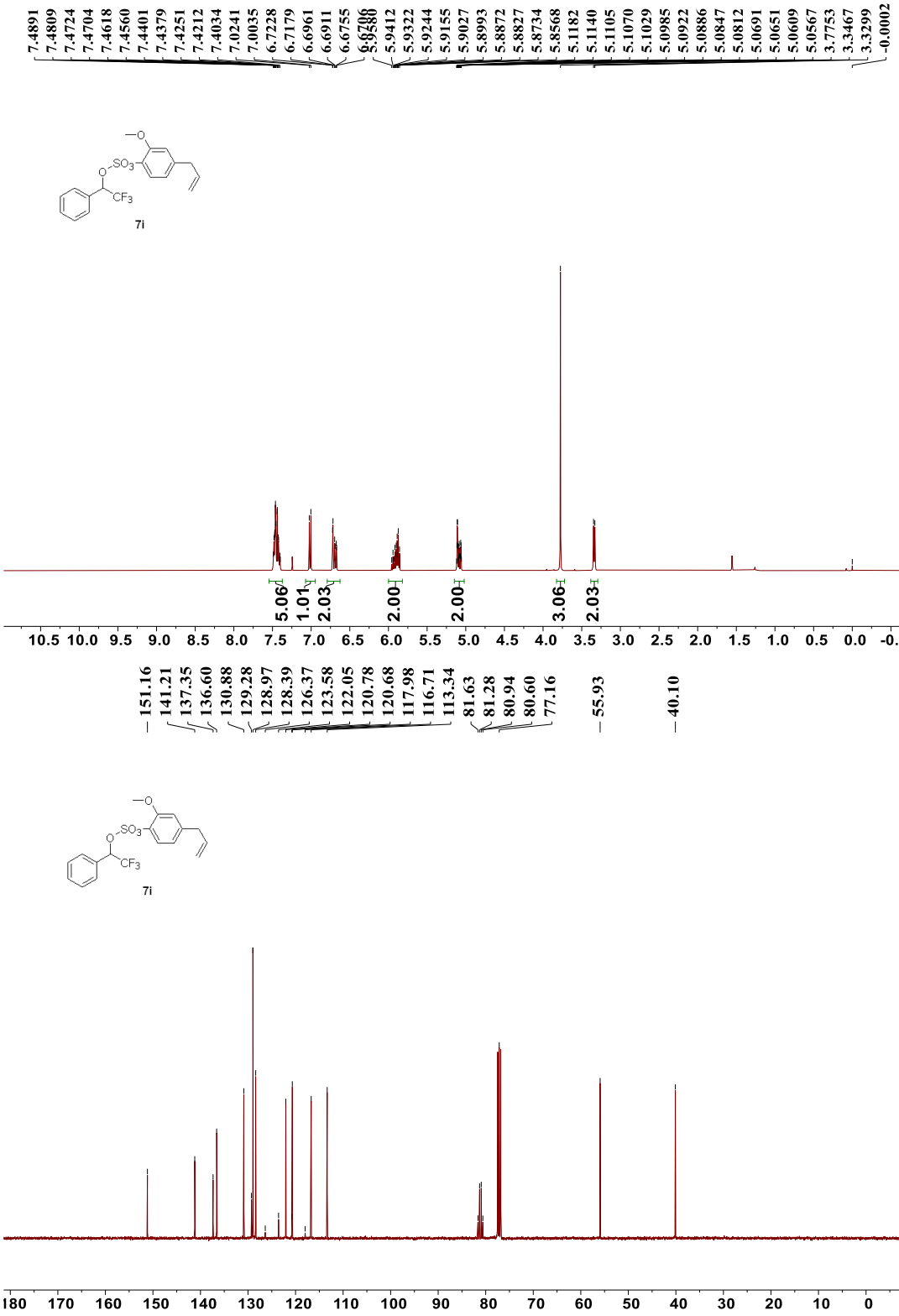
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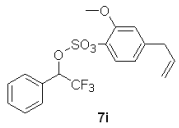
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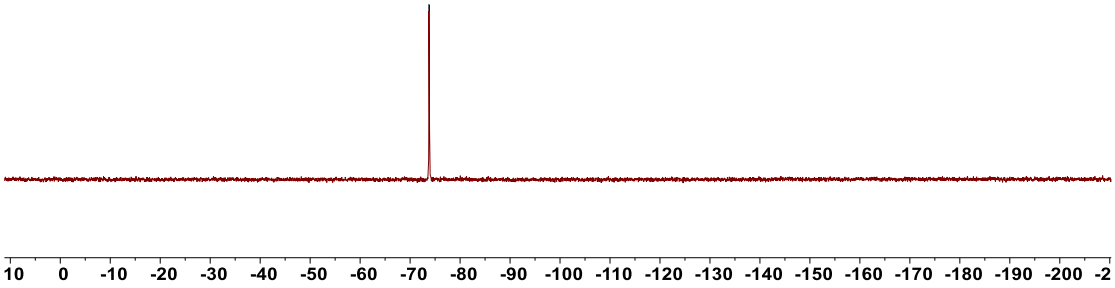
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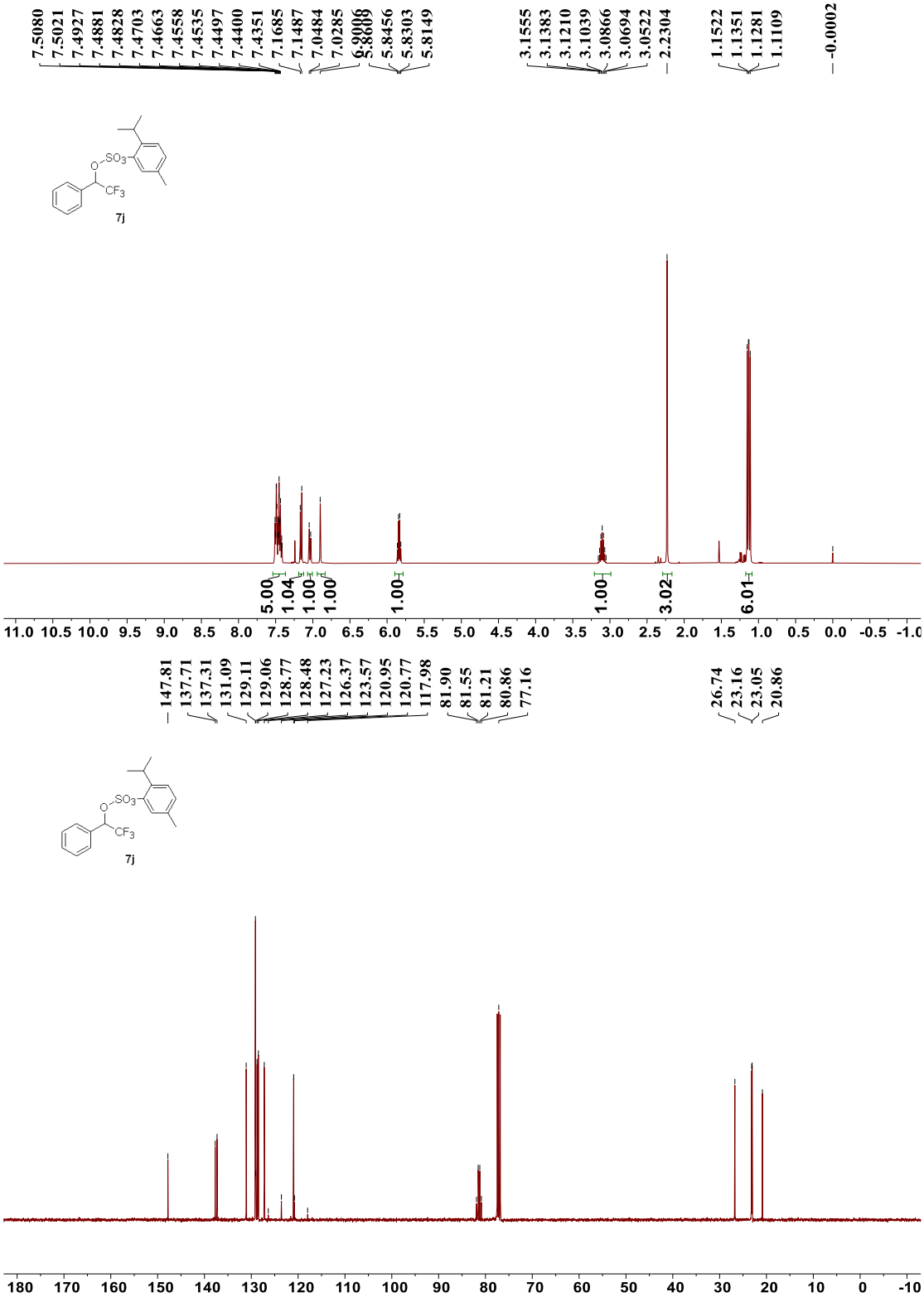
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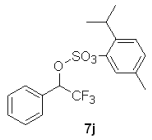
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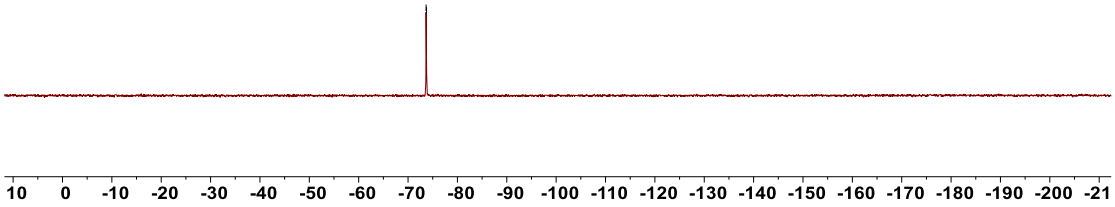
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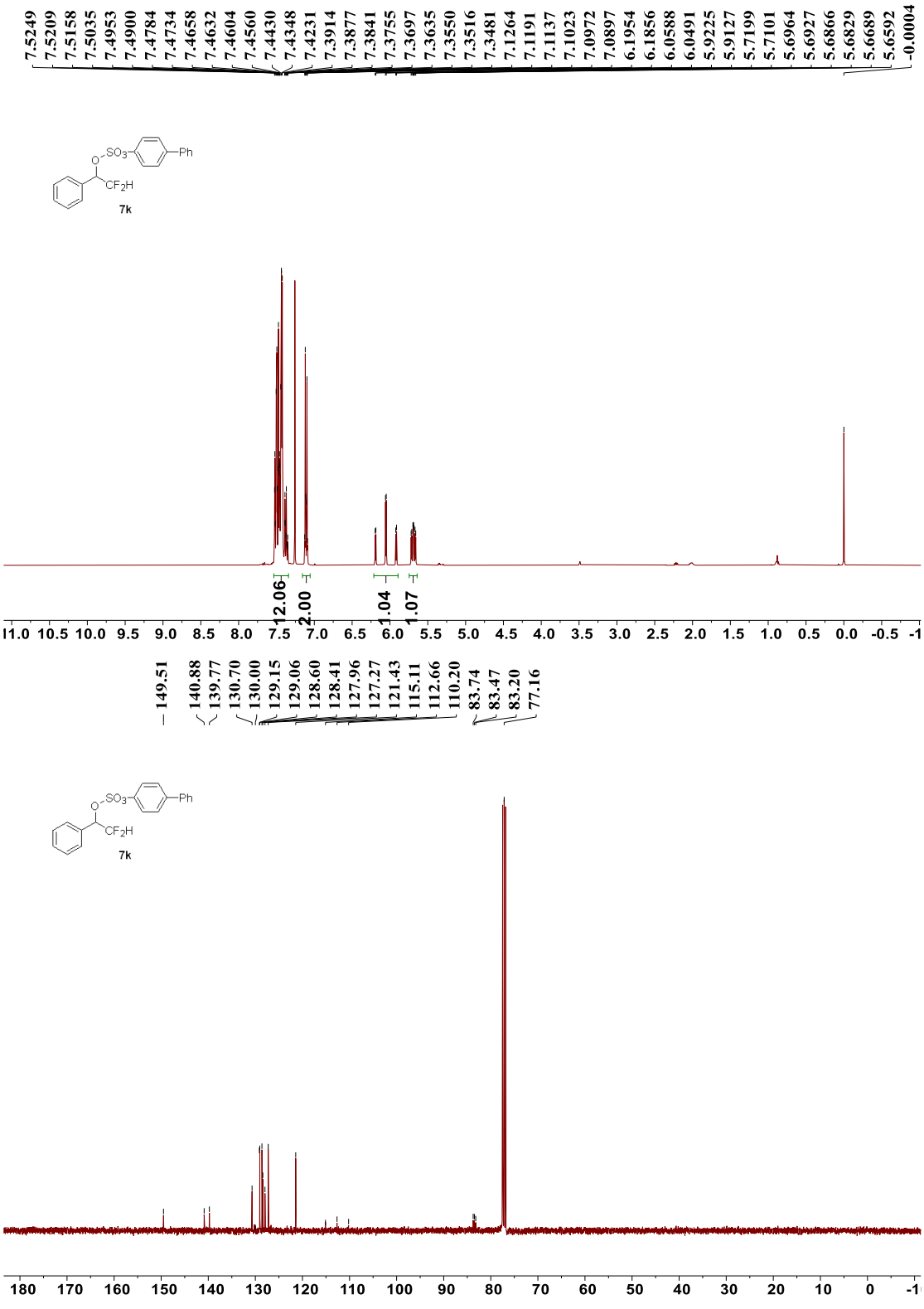
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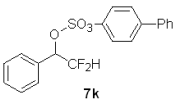

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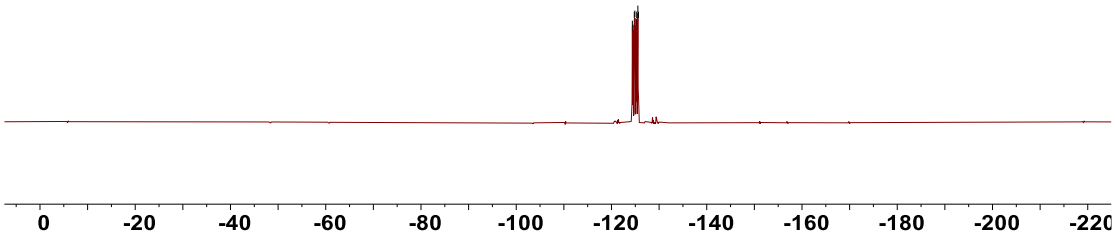

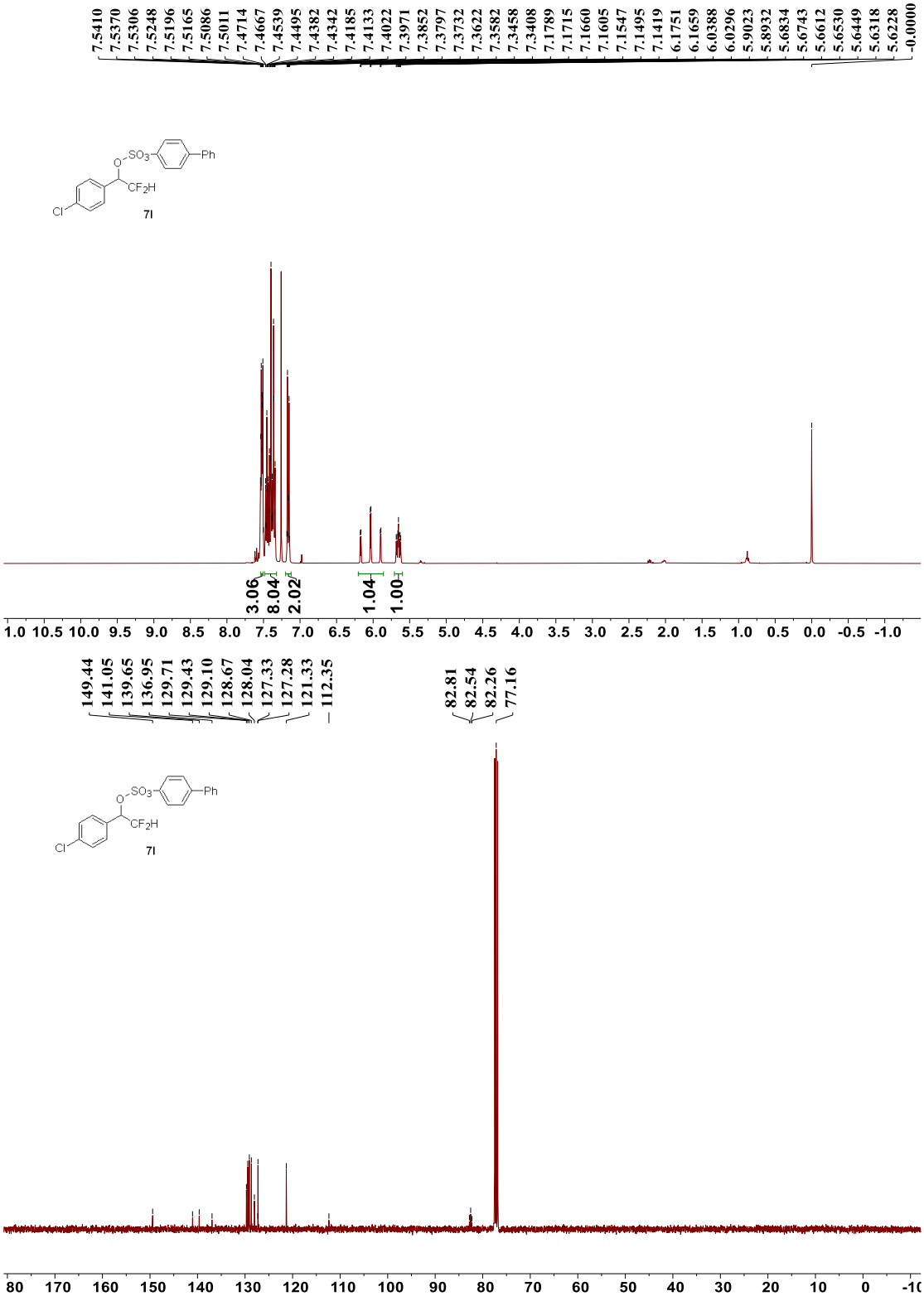
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SO3
Ph
O
CF2H
Cl
7l
3.06
8.04
2.02
1.04
1.00
1.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
149.44
141.05
139.65
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127.28
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112.35
82.81
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SO3
Ph
O
CF2H
Cl
7l
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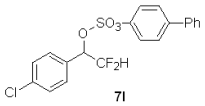

7l

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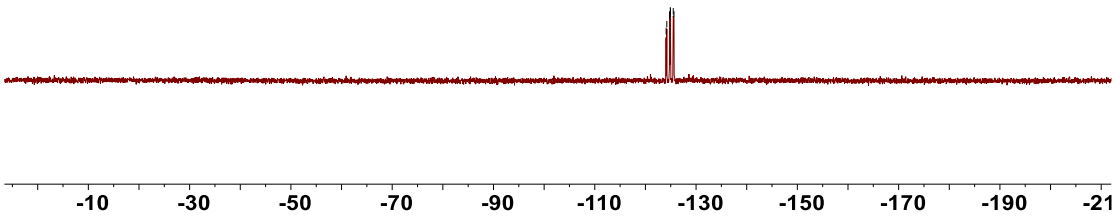

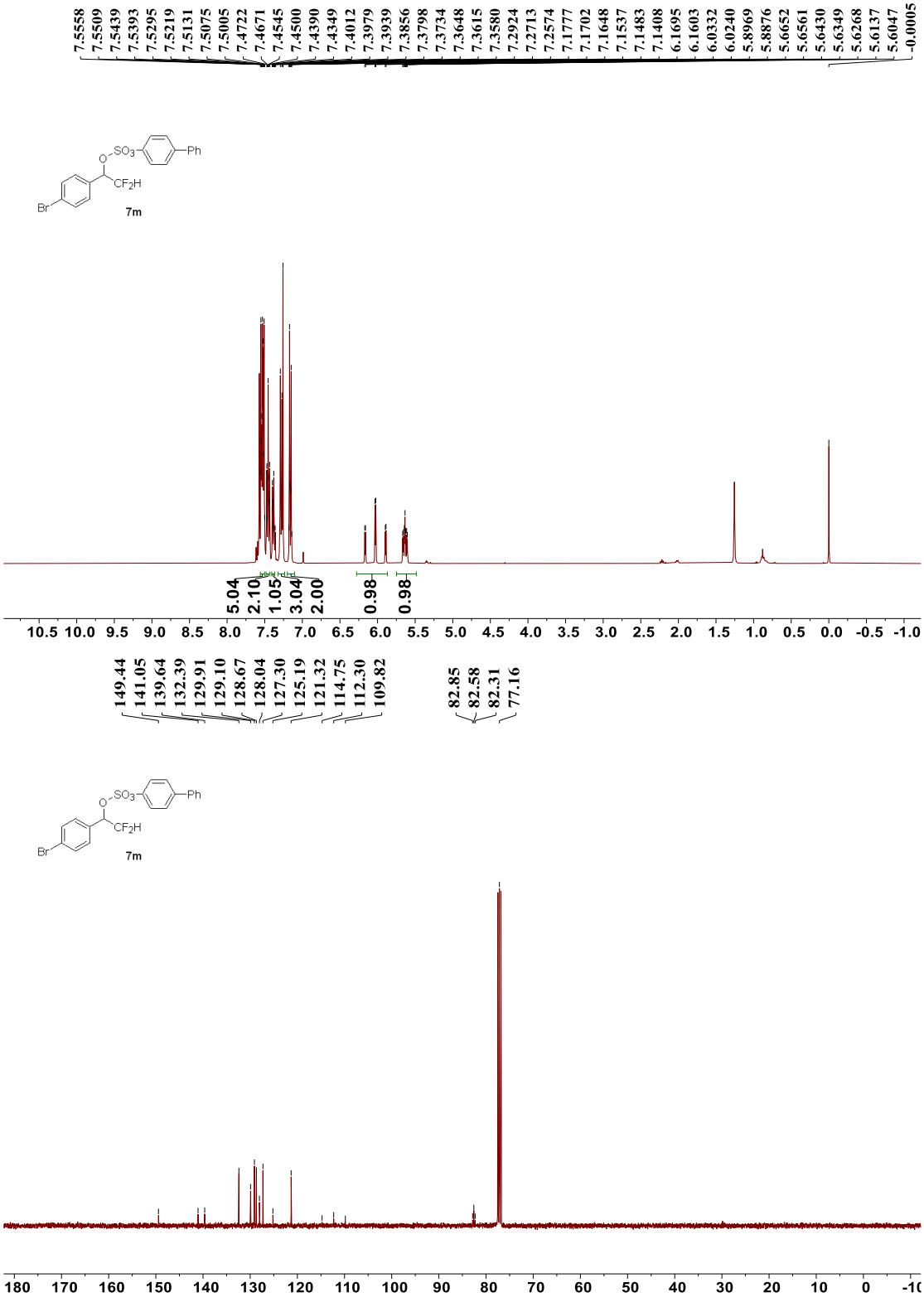
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7.4500
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7.4012
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7.3856
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7.3734
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7.3615
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7.2713
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7.1777
7.1702
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SO3
Ph
O
CF2H
Br
7m
5.04
2.10
1.05
3.04
2.00
0.98
0.98
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
149.44
141.05
139.64
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129.91
129.10
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127.30
125.19
121.32
114.75
112.30
109.82
82.85
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77.16
SO3
Ph
O
CF2H
Br
7m
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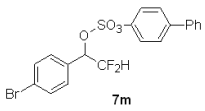

7m

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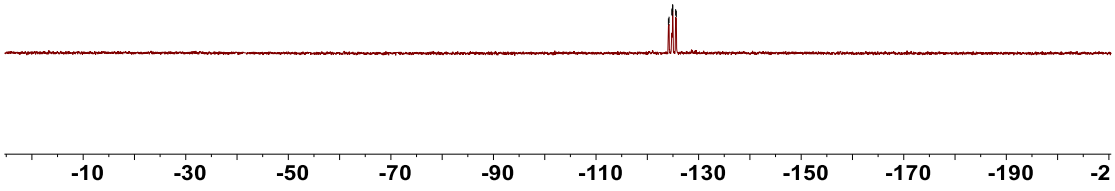
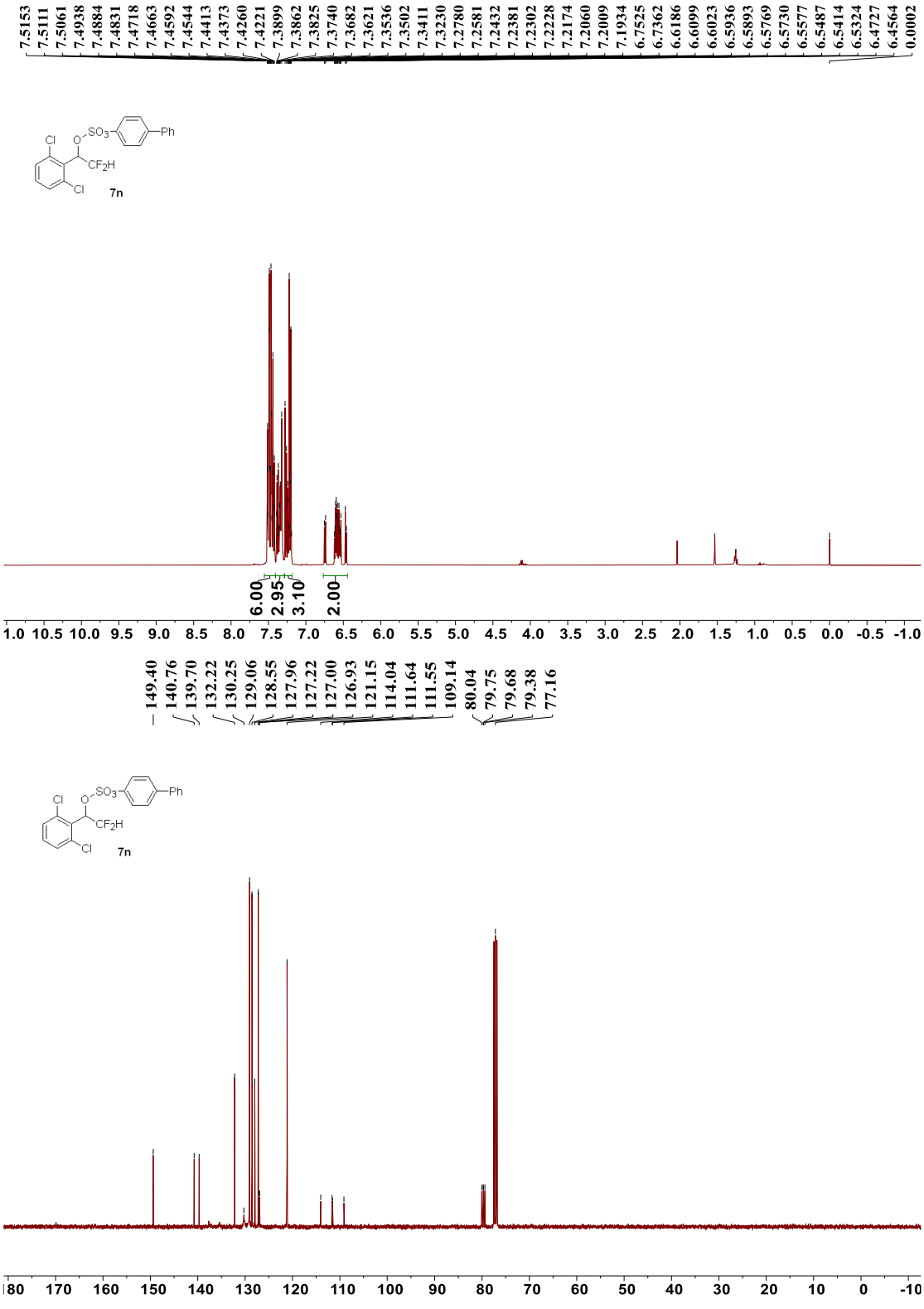
-125.66

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7.3862
7.3825
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7.3682
7.3621
7.3536
7.3502
7.3411
7.3230
7.2780
7.2581
7.2432
7.2381
7.2302
7.2228
7.2174
7.2060
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7.1934
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6.7362
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6.6023
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Cl
O
SO3
Ph
CF2H
Cl
7n
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2.95
3.10
2.00
1.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
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127.22
127.00
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111.64
111.55
109.14
80.04
79.75
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Cl
O
SO3
Ph
CF2H
Cl
7n
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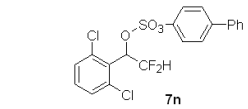

7n

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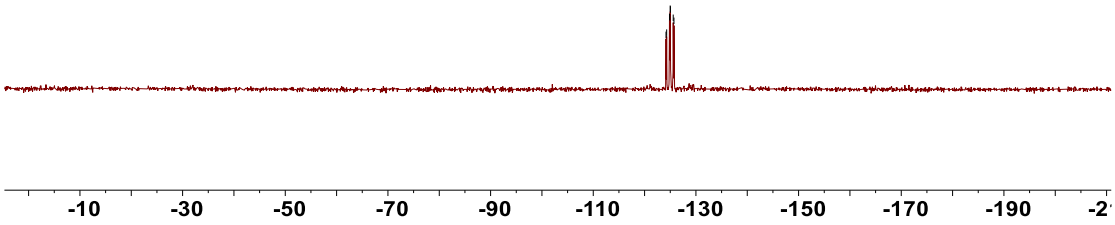

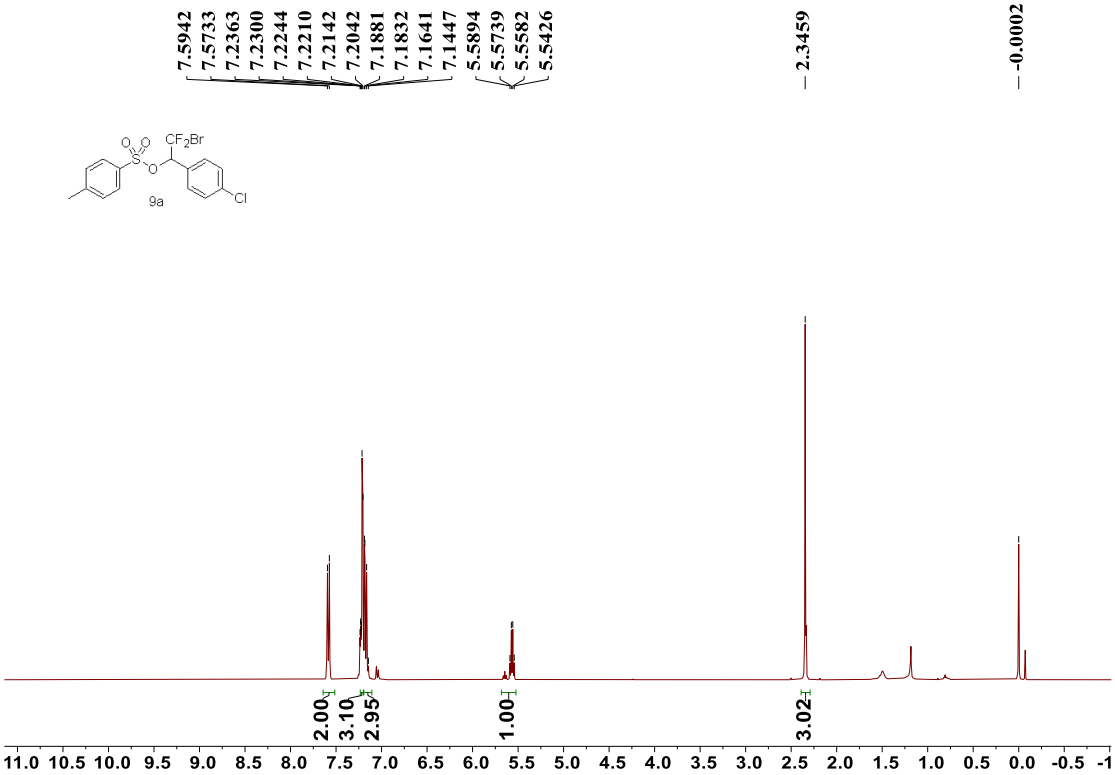
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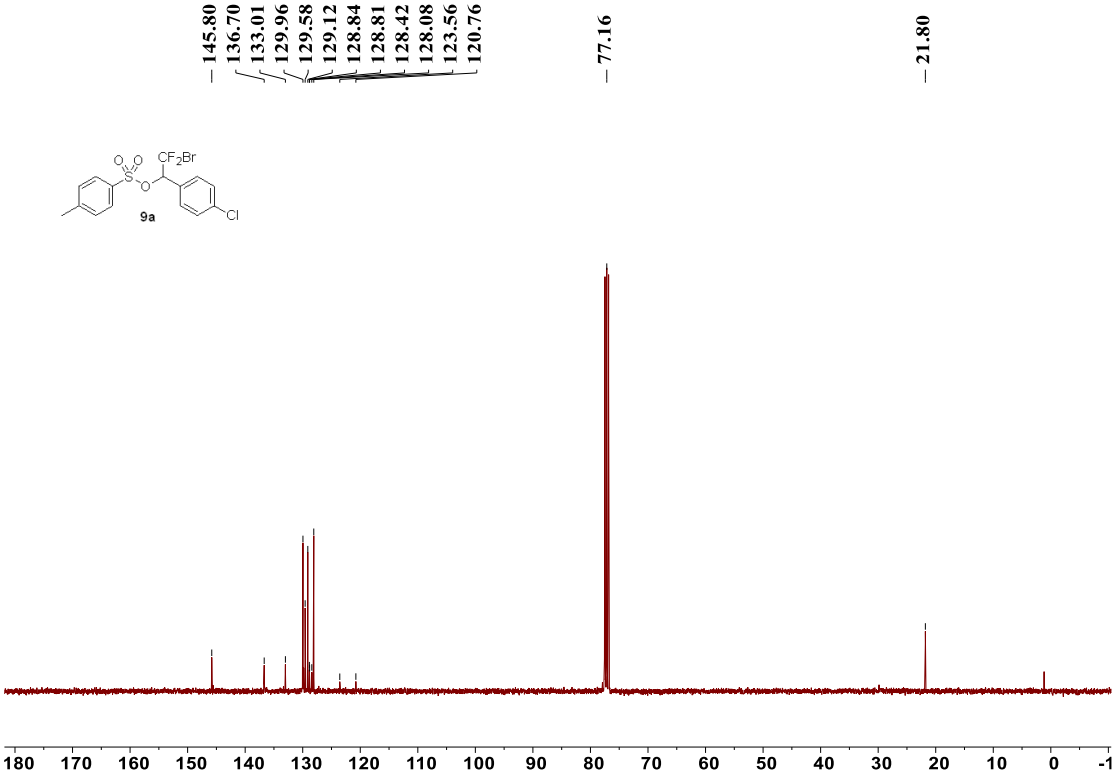
2.3459
-0.0002
CF2Br
Cl
9a
2.00
3.10
2.95
1.00
3.02
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1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CF2Br
Cl
9a
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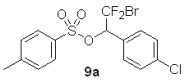

9a

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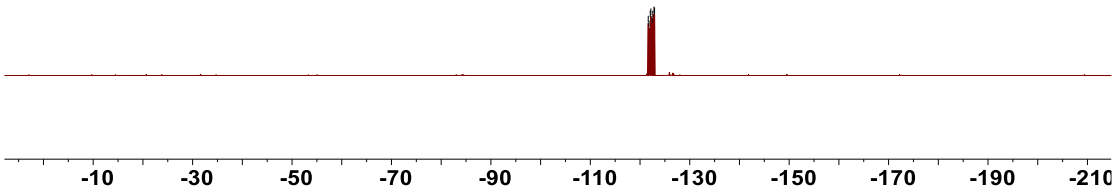

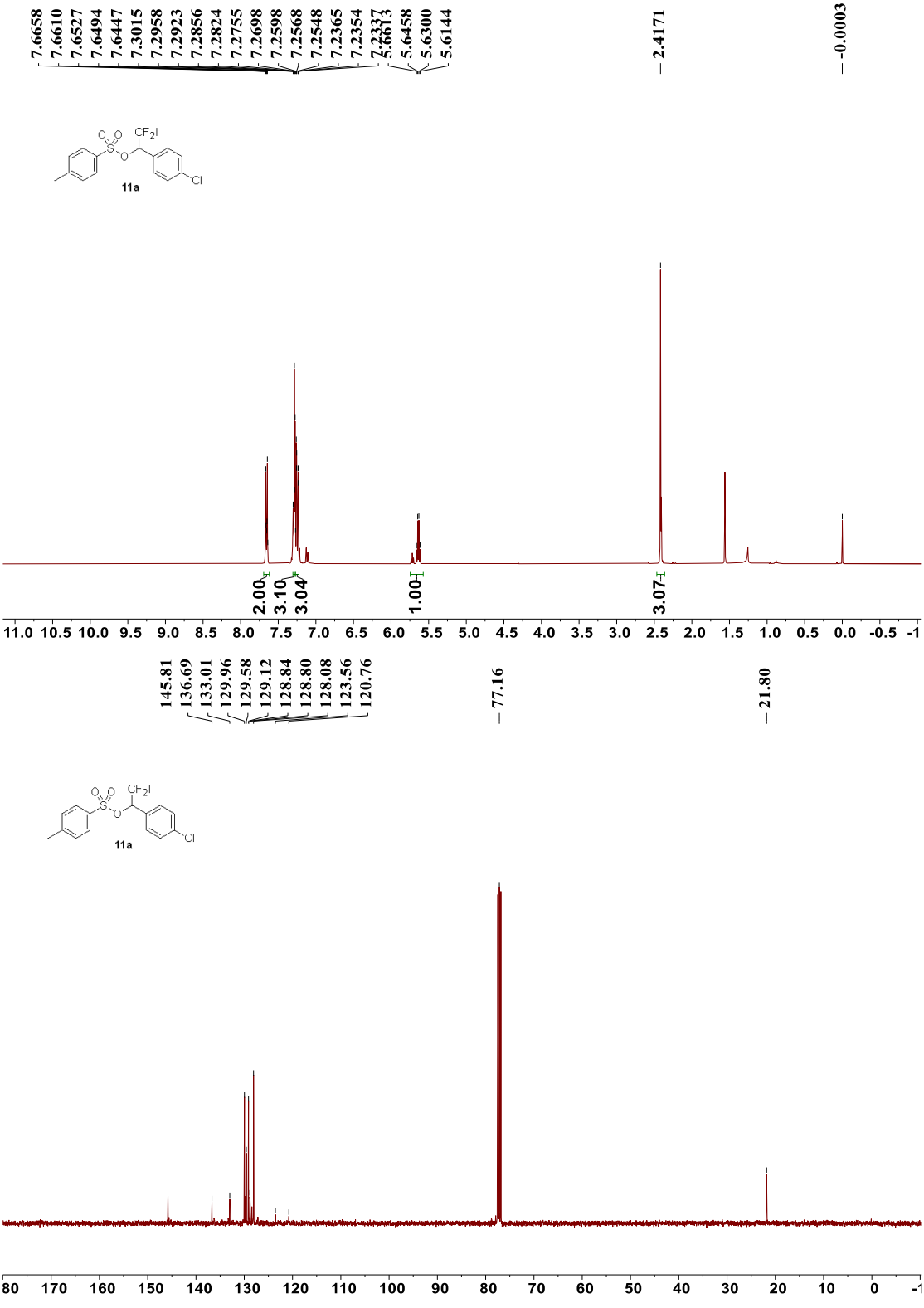
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CF2I
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S
O
O
Cl
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3.04
1.00
3.07
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
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136.69
133.01
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129.58
129.12
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128.80
128.08
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O
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Cl
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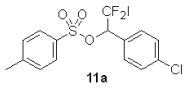

11a

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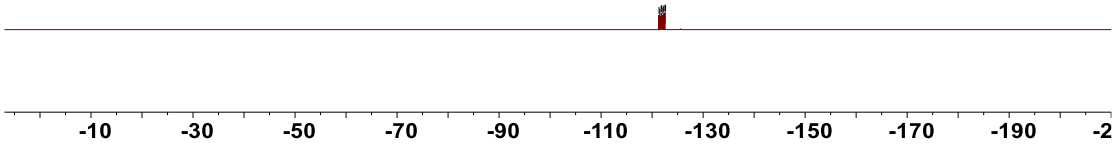

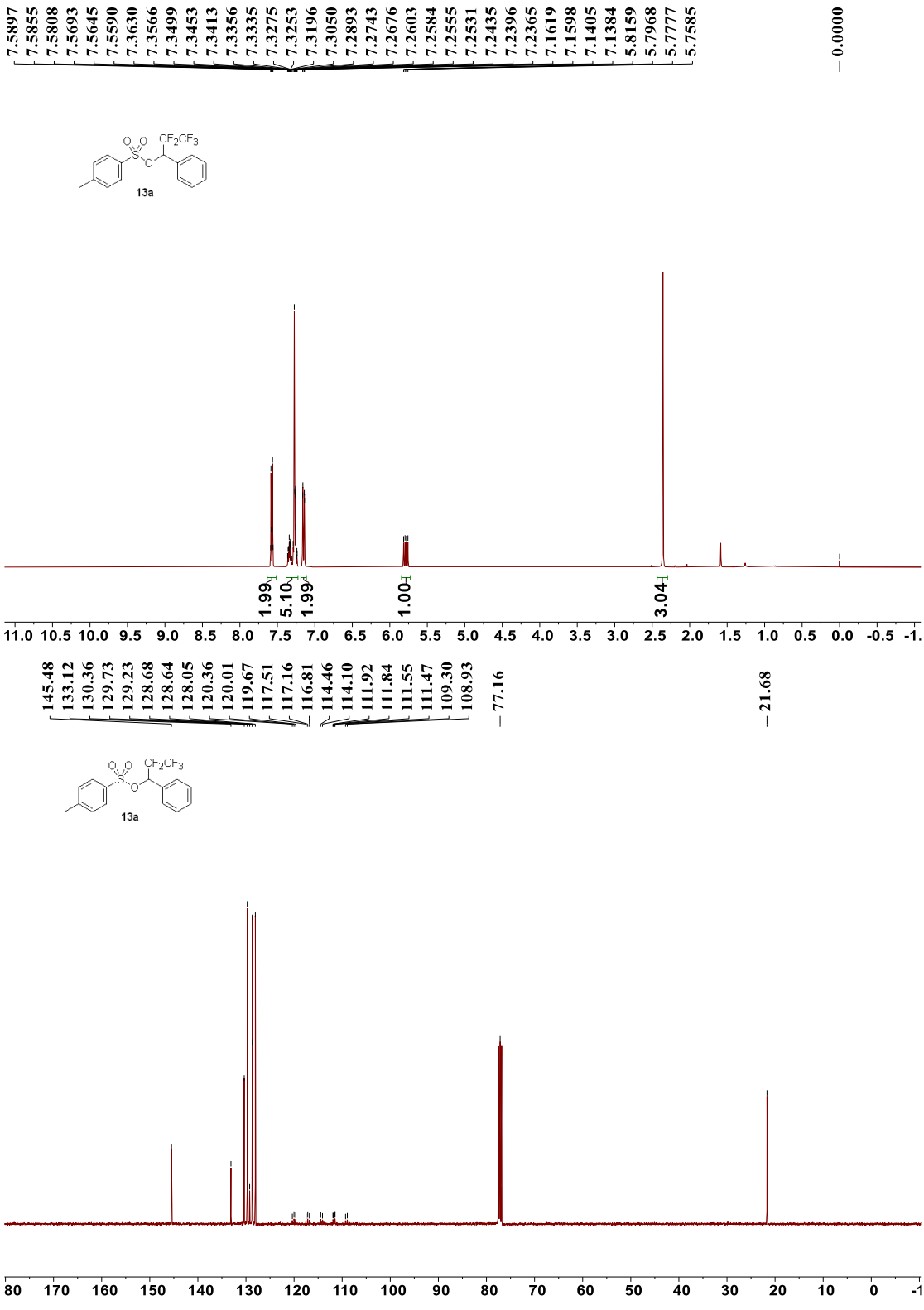
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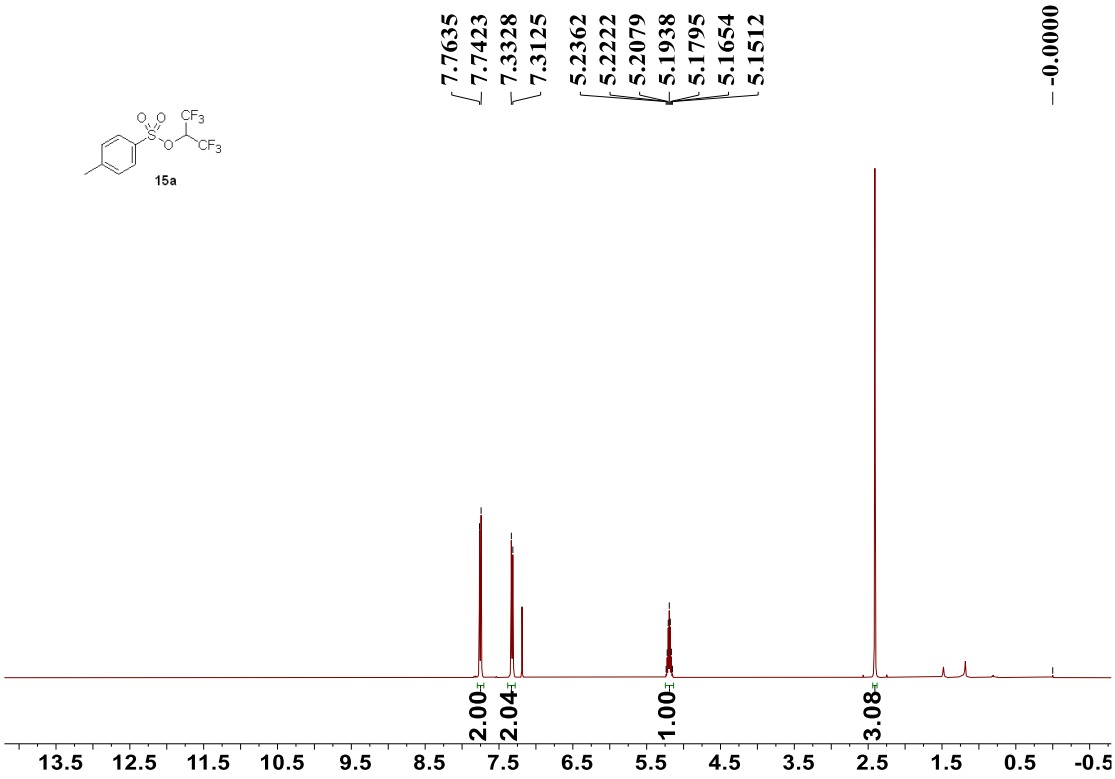
CF2CF3
13a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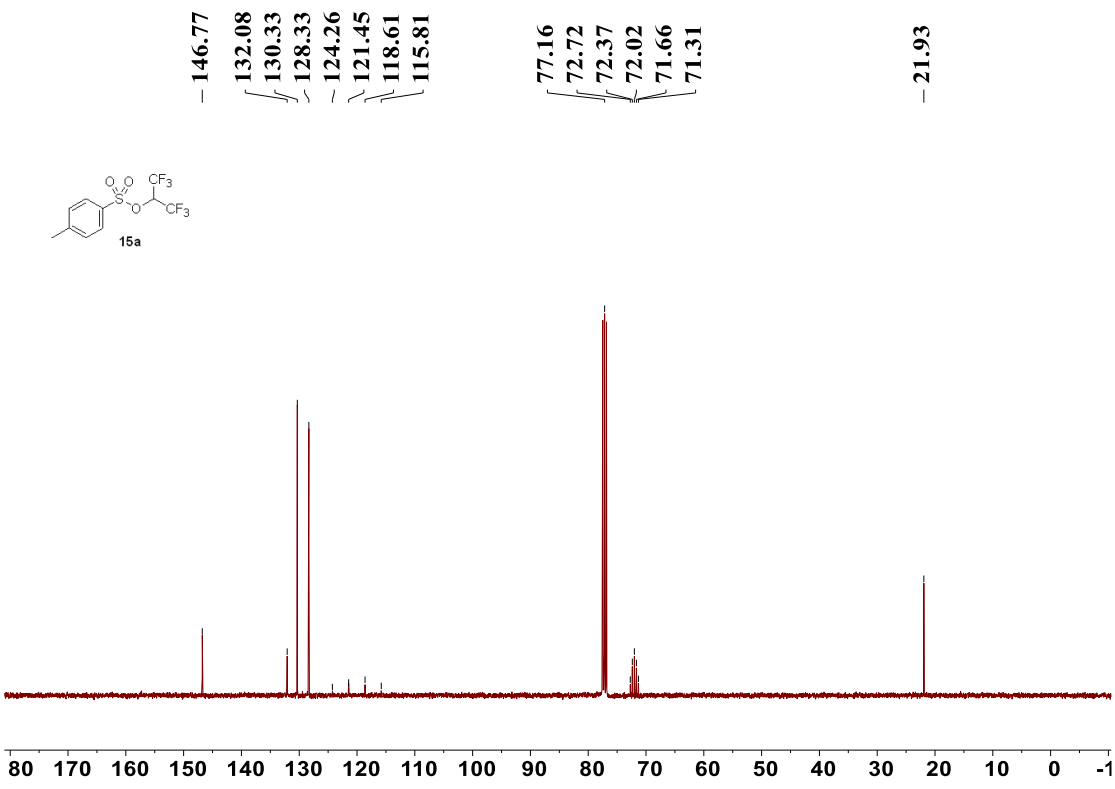
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71.31
21.93
15a
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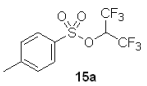

15a

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