Supporting Information

Highly convergent modular access to poly-carbon substituted cyclopropanes *via* Cu(I)-catalyzed multicomponent cyclopropene carboallylation

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1. General information.

Instrumentation and software.

All ^{1}H NMR and ^{13}C NMR pectra were recorded at 25 ºC on a Bruker 600 MHz spectrometer. Chemical shifts (δ) are given in parts per million (ppm) relative to internal standards (TMS, ^{1}H-NMR: δ 0 ppm and ^{13}C-NMR: δ 77.0 ppm for $CDCl_3$). The multiplicity of the NMR signals is assigned as follows: s = singlet, brs = broad singlet, d = doublet, t = triplet, q = quadruplet, m = multiplet, or combinations thereof. NMR yields were determined by addition of a known amount, approximately 20.5 ul, of nitromethane to the crude product and dissolving everything in $CDCl_3$, followed by ^{1}HNMR-analysis. Flash chromatography was performed on silica gel 60 (particle size 300-400 mesh ASTM, purchased from Taizhou, China). Enantioselectivities were determined by Agilent 1260 HPLC system with Darcel Chiralpak columns.

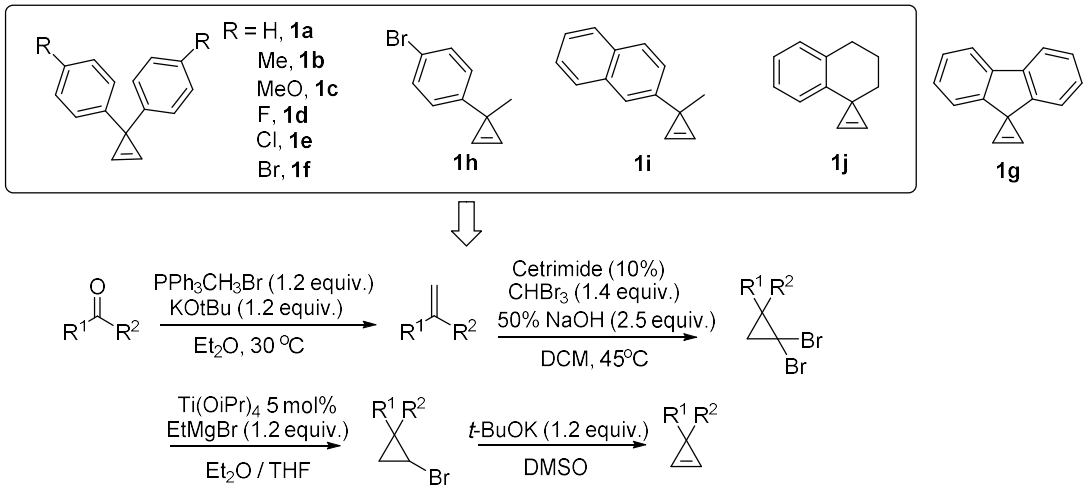
Solvents and reagents.

Unless otherwise noted, all reactions were conducted under a nitrogen atmosphere. Copper salts and other commercial chemicals were used without further purification. Ether was distilled from sodium with benzophenone as indicator. Cyclopropenes **1a-1f**, **1h-1j**, [1a-1b] **1g** [1c] and aryl boronic esters[2] were synthesized according to literature; the structure of existing compounds were verified by comparison with reported ^{1}H NMR data. Allyl bromides were purchased from commercial sources or prepared from the literature [2-(bromomethyl)but-1-ene].[3]

Experimental procedures

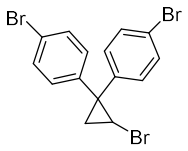
2.1 Preparation of starting materials

Cyclopropenes **1a-1f** and **1h-1j** used in this study (**Scheme S1**) were synthesized according to literature [1a-1b] by a 4-step procedure typically from the corresponding ketones; cyclopropene **1g** was synthesized according to literature by a 3-step procedure from Tosylhydrazone.[1c]



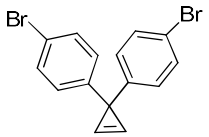
Scheme S1.

Substrates Preparation:



4,4'-(2-bromocyclopropane-1,1-diyl)bis(bromobenzene): $Ti(O^iPr)_4$ (548 μL, 1.9 mmol) was added to a solution of 4,4'-(2,2-dibromocyclopropane-1,1- diyl)bis(bromobenzene) (9.36 g, 18.5 mmol) in and Et_2O (40 mL) at 0 °C. EtMgBr (7.5 mL, 22.2 mmol; 3.0 M solution in Et_2O) was added dropwise to it over 2 h and the mixture was further stirred for 1 h while gradually raising the temperature to room temperature. The reaction was slowly quenched with saturated NH_4Cl aq and 1 M HCl aq was added to it. After extraction with Et_2O, the organic layer was washed with saturated NaCl aq, dried over $MgSO_4$, filtered, and concentrated *in vacuo*. The residue was chromatographed on silica gel with petroleum ether to afford the title compound (6.17 g, 78% yield) as a yellow solid.

M.p. = 73 - 75°C. **^{1}H NMR** (600 MHz, CDCl3) δ 7.50 - 7.46 (m, 2H), 7.40 - 7.36 (m, 2H), 7.25 – 7.21 (m, 2H), 7.08 – 7.05 (m, 2H), 3.64 - 3.60 (m, 1H), 1.87 - 1.82 (m, 1H), 1.80 – 1.76 (m, 1H). **^{13}C NMR** (151 MHz, $CDCl_3$) δ 142.53, 139.18, 132.03, 131.79, 131.54, 129.36, 121.46, 120.85, 35.33, 27.50, 23.99. **HRMS** (ESI-TOF) (*m/z*): Calcd for $C_{15}H_{12}Br_3$ ($[M + H]^+$), 428.8484; found 428.8486.



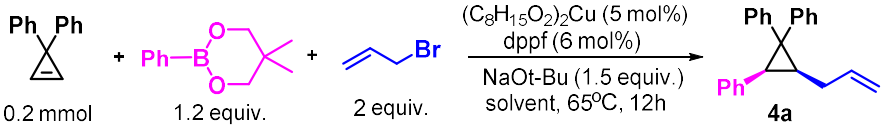
1f

4,4'-(cycloprop-2-ene-1,1-diyl)bis(bromobenzene) (**1f**): KO^tBu (0.67 g, 6.0 mmol) was added portionwise to a solution of 4,4'-(2-bromocyclopropane- 1,1-diyl)bis(bromobenzene) (2.14 g, 5.0 mmol) in DMSO (10 mL), and the mixture was stirred for 18 h. The reaction was quenched with H_2O aq and extracted with Et_2O. The organic layer was washed with saturated NaCl aq, dried over $MgSO_4$, and concentrated *in vacuo*. The residue was chromatographed on silica gel with petroleum ether to afford **1f** (1.50 g, 86% yield) as a yellow solid.

M.p. = 83 - 88°C. **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.47–7.44 (m, 1H), 7.40 (s, 2H), 7.27–7.24 (m, 1H), 7.23 – 7.19 (m, 1H), 7.17 – 7.12 (m, 2H), 7.07–7.00 (m, 1H), 6.90–6.86 (m, 2H). **^{13}C NMR** (151 MHz, $CDCl_3$) δ 146.93, 145.09, 133.10, 131.34, 128.17, 127.83, 126.58, 125.33, 124.96, 113.02, 32.89. **HRMS** (ESI-TOF) (*m/z*): Calcd for $C_{15}H_{10}Br_2$ ($[M+H]^+$), 348.9222; found 348.9225.

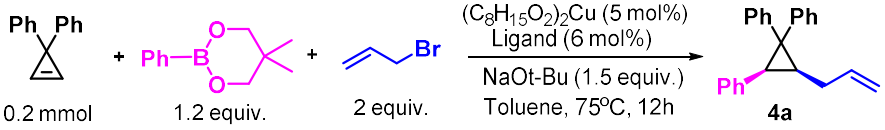
2.2 Reaction optimization

Table S1. Optimization of the cyclopropene carboallylation (I): solvent screening.



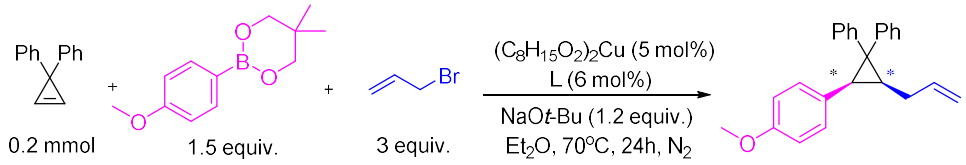
Entry	Solvent	Yield/%
1	THF	trace
2	dioxane	trace
3	Et_2O	40
4	Toluene	40
5	cyclohexane	20

Table S2. Optimization of the cyclopropene carboallylation (II): evaluation of ligands.



Entry	Ligand	Yield/%
1	IMes	trace
2	dcype	trace
3	IPr	25
4	dppf	40
5	PPh_3	20
6	Phen	trace
7	$P(4\text{-}CF_3C_6H_4)_3$	30
8	$P(4\text{-}FC_6H_4)_3$	55
9	$P(4\text{-}ClC_6H_4)_3$	50
10	$P(3,5\text{-di-}CF_3C_6H_3)_3$	16
11	P(*o*-tol)$_3$	trace
12	PCy_3	trace
13	P(*n*-Bu)$_3$	trace
14	P(*t*-Bu)$_3$	trace

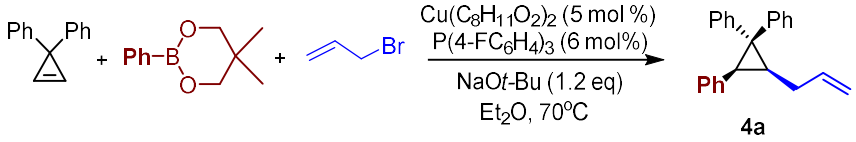
Table S3. Ligand effect on the enantioselective carboallylation.



Entry	Ligand	Yield/%	ee/%
1	(*R*, *R*)-DTBMSegPhos	38	− 69
2	(*R*)-H_8-BINAP	40	− 65
3	(*R*)-MeO-Tol-BIPHEP	28	− 69
4	(*R*)-SegPhos	50	− 60
5	(*R*)-BINAP	25	− 66
6	(*R*, *R*)-Ph-BPE	11	88

2.3 Procedures

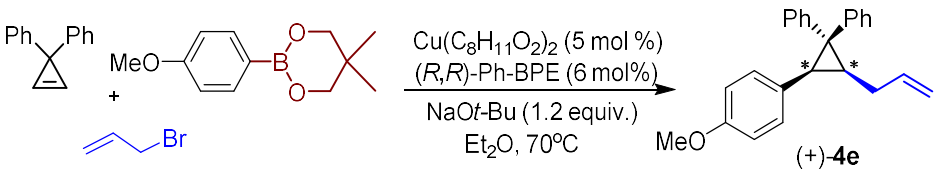
Typical procedure for Cu-catalyzed biscarbonation of cyclopropenes.



4a

In a nitrogen filled glovebox, $Cu(C_8H_{11}O_2)_2$ (0.01 mmol, 5 mol%) and $P(4\text{-}FC_6H_4)_3$ (0.012 mmol, 6 mol%) were dissolved in anhydrous Et_2O (3 mL). The mixture was stirred at room temperature for ca. 2 min before NaO^{t}Bu (0.3 mmol, 1.5 equiv., 23 mg), boronic ester (0.30 mmol, 1.5 equiv.) and allyl bromide (0.6 mmol, 3.0 equiv.) were successively added. Then cyclopropene (0.20 mmol) was added dropwise into the solution. The resulting mixture was stirred at 70 °C for 24 h. After complete conversion, the solvent was removed *in vacuo* and residue was subjected to flash chromatography (eluent: petroleum ether/EtOAc = 200:1) to afford the title compound **4a** (46.2 mg, 75% yield) as a colorless oil.

Catalytic enantioselective three-component arylallylation of cyclopropene:



(+)-**4e**

In a nitrogen filled glovebox, $Cu(C_8H_{11}O_2)_2$ (0.01 mmol, 5 mol%) and (*R*,*R*)-Ph-BPE (0.012 mmol, 6 mol%) were dissolved in anhydrous Et_2O (3 mL) in a screw-cap tube. The mixture was stirred at room temperature for ca. 2 min before NaO^{t}Bu (0.3 mmol, 1.5 equiv., 23 mg), boronic ester (0.30 mmol, 1.5 equiv.) and allyl bromide (0.6 mmol, 3.0 equiv.) were successively added. Then cyclopropene (0.20 mmol) was added dropwise into the solution. The tube was sealed, taken out of the glovebox. The tube was stirred for 24 h in a 70 °C oil bath. After complete conversion, the solvent was removed *in vacuo* and residue was subjected to flash chromatography (eluent: petroleum ether/EtOAc = 200:1) to afford (+)-**4e** (7.5 mg, 11% yield, 94:6 e.r.)

$[\alpha]_D^{20}$ = 19.7 (*c* = 0.5, $CHCl_3$)

2.4. Crystal structure of compound (±)-4e (CCDC# 1935679).

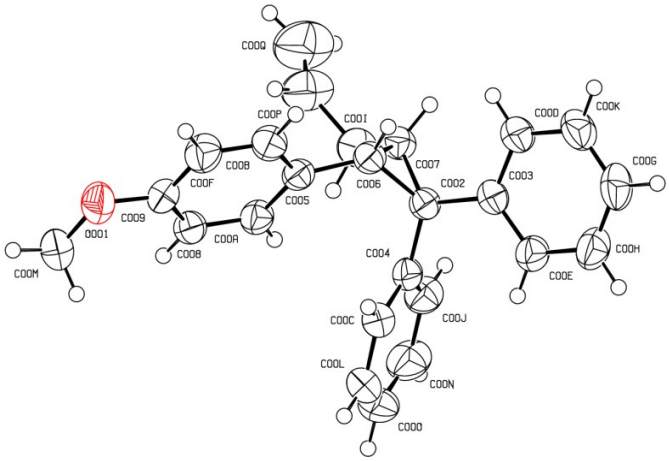


Figure S1. ORTEP representation of compound (±)**-4e**.

```
Bond precision:  C-C = 0.0034 A          Wavelength=1.54178

Cell:            a=10.220(2)     b=9.550(2)           c=20.071(5)
                 alpha=90        beta=93.737(13)      gamma=90
Temperature:     273 K

                Calculated                Reported
Volume          1954.8(7)                 1954.8(8)
Space group     P 21/c                    P 1 21/c 1
Hall group      -P 2ybc                   -P 2ybc
Moiety formula  C25 H24 O                 C25 H24 O
Sum formula     C25 H24 O                 C25 H24 O
Mr              340.44                    338.42
Dx,g cm-3       1.157                     1.150
Z               4                         4
Mu (mm-1)       0.525                     0.525
F000            728.0                     720.0
F000'           729.92
h,k,lmax        12,11,24                  12,11,24
Nref            3685                      3594
Tmin,Tmax
Tmin'

Correction method= Not given

Data completeness= 0.975          Theta(max)= 69.671

R(reflections)= 0.0624( 2969)     wR2(reflections)= 0.1530( 3594)

S = 1.081                 Npar= 236
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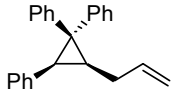
Figure S2. Crystal structure parameters.

3. Compound Characterization



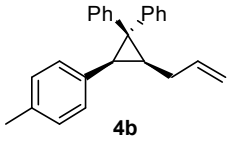
4a

((2S*,3S*)-3-Allylcyclopropane-1,1,2-triyl)tribenzene (4a): following the general procedure, the reaction of 5,5-dimethyl-2-phenyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 57.0 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4a** (46.2 mg, 75% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.28–7.24 (m, 2H), 7.19–7.13 (m, 4H), 7.13–7.09 (m, 3H), 7.08–7.03 (m, 4H), 6.77–6.72 (m, 2H), 5.79–5.71 (m, 1H), 5.06–4.99 (m, 1H), 4.93–4.89 (m, 1H), 2.74 (d, *J* = 10.2 Hz, 1H), 2.59–2.51 (m, 1H), 2.26–2.18 (m, 1H), 2.04–1.97 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.07, 138.16, 137.77, 137.56, 132.01, 129.75, 128.42, 128.23, 127.57, 127.45, 126.55, 125.85, 125.37, 115.22, 40.82, 35.27, 31.79, 30.08.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{22}$ ($[M+H]^+$), 311.1794; found 311.1782.



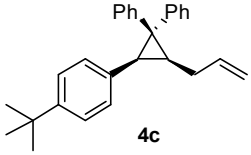
4b

((2S*,3S*)-2-Allyl-3-(p-tolyl)cyclopropane-1,1-diyl)dibenzene (4b): following the general procedure, the reaction of 5,5-dimethyl-2-(p-tolyl)- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 61.2 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 0.0720 g) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4b** (46.6 mg, 72% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.33–7.31 (m, 2H), 7.26–7.21 (m, 4H), 7.21–7.16 (m, 3H), 7.14–7.09 (m, 1H), 6.97–6.92 (m, 2H), 6.72–6.68 (m, 2H), 5.87–5.79 (m, 1H), 5.14–5.07 (m, 1H), 5.01–4.96 (m, 1H), 2.78 (d, *J* = 10.2 Hz, 1H), 2.63–2.56 (m, 1H), 2.31–2.24 (m, 4H), 2.08–2.01 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.18, 137.90, 137.69, 134.92, 134.83, 132.06, 129.63, 128.39, 128.22, 128.19, 127.55, 126.50, 125.78, 115.15, 40.52, 35.04, 31.66, 30.12, 20.91.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{24}$ ($[M + H]^+$), 325.1950; found 325.1955.



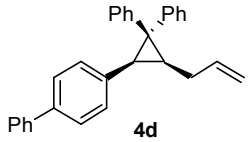
4c

((2S*,3S*)-2-Allyl-3-(4-(*tert*-butyl)phenyl)cyclopropane-1,1-diyl)dibenzene (4c): following the general procedure, the reaction of 2-(4-(tert-butyl)phenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 73.8 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4c** (38.1 mg, 52% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.27–7.24 (m, 2H), 7.18–7.10 (m, 7H), 7.09–7.05 (m, 2H), 7.05–7.01 (m, 1H), 5.81–5.73 (m, 1H), 5.05–5.00 (m, 1H), 4.94–4.89 (m, 1H), 2.71 (d, *J* = 9.6 Hz, 1H), 2.53–2.46 (m, 1H), 2.22–2.16 (m, 1H), 1.99–1.93 (m, 1H), 1.20 (s, 9H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.25, 148.12, 138.00, 137.83, 134.89, 132.06, 129.40, 128.39, 128.16, 127.64, 126.45, 125.77, 124.34, 115.12, 77.21, 77.00, 76.79, 40.62, 34.83, 34.25, 31.56, 31.34, 30.24.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{28}H_{30}$ ([M+H]$^+$), 367.2420; found 367.2418.



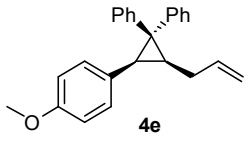
4d

4-((1S*,3S*)-3-Allyl-2,2-diphenylcyclopropyl)-1,1'-biphenyl (4d): following the general procedure, the reaction of 2-([1,1'-biphenyl]-4-yl)-5,5-dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 79.8 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4d** (67.5 mg, 87% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.59–7.55 (m, 2H), 7.43–7.37 (m, 4H), 7.37–7.33 (m, 2H), 7.32–7.28 (m, 1H), 7.26–7.23 (m, 4H), 7.23–7.20 (m, 3H), 7.16–7.12 (m, 1H), 6.90–6.86 (m, 2H), 5.90–5.82 (m, 1H), 5.16–5.10 (m, 1H), 5.03–4.99 (m, 1H), 2.855 (d, *J* = 10.2 Hz, 1H), 2.69–2.61 (m, 1H), 2.37–2.29 (m, 1H), 2.15–2.08 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.02, 140.76, 138.01, 137.74, 137.56, 137.40, 132.07, 130.15, 128.69, 128.45, 128.30, 127.56, 126.99, 126.80, 126.63, 126.02, 125.89, 115.31, 41.05, 35.10, 32.03, 30.14.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{30}H_{26}$ ([M+H]$^+$), 387.2107; found 387.2102.



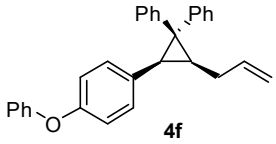
4e

((2S*,3S*)-2-Allyl-3-(4-methoxyphenyl)cyclopropane-1,1-diyl)dibenzene (4e): following the general procedure, the reaction of 2-(4-methoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4e** (61.5 mg, 91% yield) as a yellow solid. M.p. = 87 - 89°C.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.25–7.21 (m, 2H), 7.18–7.13 (m, 4H), 7.13–7.08 (m, 3H), 7.06–7.02 (m, 1H), 6.68–6.64 (m, 2H), 5.63–5.59 (m, 2H), 5.80–5.71 (m, 1H), 5.06–4.99 (m, 1H), 4.93–4.89 (m, 1H), 3.64 (s, 3H), 2.69 (d, *J* = 9.6 Hz, 1H), 2.55– 2.48 (m, 1H), 2.22–2.15 (m, 1H), 1.99–1.92 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.46, 149.15, 137.88, 137.65, 132.10, 130.63, 129.98, 128.38, 128.20, 127.50, 126.49, 125.75, 115.17, 112.96, 55.09, 40.14, 34.67, 31.43, 30.12.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{24}O$ ([M + H]$^+$), 341.1899; found 341.1892.



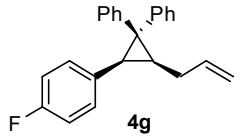
4f

((2S*,3S*)-2-Allyl-3-(4-phenoxyphenyl)cyclopropane-1,1-diyl)dibenzene (4f): following the general procedure, the reaction of 5,5-dimethyl-2-(4-phenoxyphenyl)-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 84.6 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4f** (72.7 mg, 90% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.34–7.28 (m, 4H), 7.27–7.21 (m, 4H), 7.21–7.16 (m, 3H), 7.15–7.10 (m, 1H), 7.09–7.04 (m, 1H), 7.00–6.96 (m, 2H), 6.82–6.76 (m, 4H), 5.90–5.80 (m, 1H), 5.14–5.07 (m, 1H), 5.04–4.98 (m, 1H), 2.81 (d, *J* = 9.6 Hz, 1H), 2.67–2.59 (m, 1H), 2.34 –2.27 (m, 1H), 2.12–2.05 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.38, 154.98, 149.01, 137.74, 137.53, 133.00, 132.03, 130.87, 129.63, 128.43, 128.25, 127.54, 126.59, 125.85, 123.00, 118.68, 118.00, 115.28, 40.50, 34.68, 31.59, 30.12.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{30}H_{26}O$ ($[M + H]^+$), 403.2056; found 403.2048.



4g

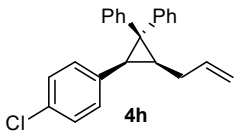
((2S*,3S*)-2-Allyl-3-(4-fluorophenyl)cyclopropane-1,1-diyl)dibenzene (4g): following the general procedure, the reaction of 2-(4-fluorophenyl)-5,5-dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 62.4 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4g** (46.3 mg, 71% yield) as a yellow solid. M.p. = 79 - 81°C.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.34–7.29 (m, 2H), 7.27–7.18 (m, 5H), 7.18–7.10 (m, 3H), 6.85–6.80 (m, 2H), 6.79–6.74 (m, 2H), 5.86–5.77 (m, 1H), 5.12–5.06 (m, 1H), 2.80 (d, *J* = 10.2 Hz, 1H), 2.65–2.58 (m, 1H), 2.28–2.21 (m, 1H), 2.09–2.03 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 161.05 (d, *J* = 242.7 Hz), 148.85, 137.55, 137.30, 133.75 (d, *J* = 3.2 Hz), 131.99, 130.95 (d, *J* = 7.5 Hz), 128.45, 128.32, 127.49, 126.67, 125.91, 115.35, 114.31 (d, *J* = 20.9 Hz), 40.53, 34.51, 31.57, 29.97.

^{19}F NMR (470 MHz, $CDCl_3$) δ – 117.99 (tt, *J* = 8.9, 5.2 Hz).

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{21}F$ ($[M + H]^+$), 329.1700; found 329.1708.



4h

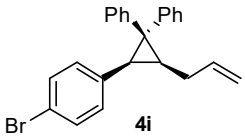
((2S*,3S*)-2-Allyl-3-(4-chlorophenyl)cyclopropane-1,1-diyl)dibenzene (4h): following the general procedure, the reaction of 2-(4-chlorophenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 67.3 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0

equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4h** (59.5 mg, 87% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.32–7.30 (m, 2H), 7.27–7.18 (m, 5H), 7.18–7.14 (m, 2H), 7.14–7.11 (m, 1H), 7.01–7.08 (m, 2H), 6.75–6.69 (m, 2H), 5.85–5.75 (m, 1H), 5.12–5.06 (m, 1H), 5.02–4.98 (m, 1H), 2.78 (d, *J* = 9.6 Hz, 1H), 2.66–2.58 (m, 1H), 2.27–2.22 (m, 1H), 2.12 –2.05 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.70, 137.36, 137.18, 136.75, 131.93, 131.25, 130.90, 128.47, 128.39, 127.57, 127.45, 126.76, 125.98, 115.44, 34.67, 31.90, 30.32, 29.90.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{21}Cl$ ($[M+H]^+$), 345.1404; found 345.1406.



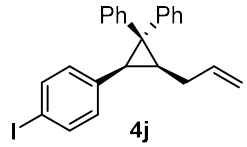
4i

((2S*,3S*)-2-Allyl-3-(4-bromophenyl)cyclopropane-1,1-diyl)dibenzene (4i): following the general procedure, the reaction of 2-(4-bromophenyl)- 5,5- dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 80.7 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4i** (63.5 mg, 82% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.32–7.28 (m, 2H), 7.27–7.18 (m, 7H), 7.18–7.10 (m, 3H), 6.68–6.64 (m, 2H), 5.85–5.75 (m, 1H), 5.12–5.06 (m, 1H), 5.02–4.97 (m, 1H), 2.76 (d, *J* = 9.6 Hz, 1H), 2.66–2.57 (m, 1H), 2.26–1.90 (m, 1H), 2.12–2.05 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.66, 137.30, 137.15, 131.92, 131.29, 130.50, 128.47, 128.40, 127.45, 126.77, 125.99, 119.34, 115.45, 41.02, 34.73, 31.92, 29.87.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{21}Br$($[M + H]^+$), 389.0899; found 389.0901.



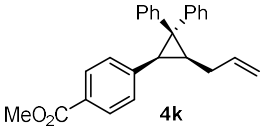
4j

((2S*,3S*)-2-Allyl-3-(4-iodophenyl)cyclopropane-1,1-diyl)dibenzene (4j): following the general procedure, the reaction of 2-(4-iodophenyl)-5,5- dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 91.1 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4j** (65.7 mg, 75% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.46 – 7.41 (m, 2H), 7.32 – 7.28 (m, 2H), 7.27 – 7.18 (m, 5H), 7.18 – 7.10 (m, 3H), 6.52 – 6.51 (m, 2H), 5.84 – 5.76 (m, 1H), 5.12 – 5.06 (m, 1H), 5.02 – 4.97 (m, 1H), 2.74 (d, *J* = 9.6 Hz, 1H), 2.65 – 2.57 (m, 1H), 2.26 – 2.18 (m, 1H), 2.12 – 2.05 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.66, 138.03, 137.28, 137.16, 136.45, 131.90, 131.66, 128.48, 128.42, 127.45, 126.78, 126.00, 125.51, 115.46, 34.84, 32.00, 30.32, 29.86.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{21}I$ ($[M + H]^+$), 437.0760; found 437.0762.



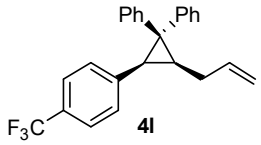
4k

Methyl 4-((1S*,3S*)-3-allyl-2,2-diphenylcyclopropyl)benzoate (4k): following the general procedure, the reaction of methyl 4-(5,5-dimethyl-1,3,2- dioxaborinan-2-yl)benzoate (0.30 mmol, 1.5 equiv., 74.4 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4k** (27.4 mg, 37% yield) as a white solid. M.p. = 84 - 88°C.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.81–7.78 (m, 2H), 7.34–7.31 (m, 2H), 7.27–7.20 (m, 5H), 7.18–7.12 (m, 3H), 6.88–6.85 (m, 2H), 5.83–5.75 (m, 1H), 5.11–5.06 (m, 1H), 5.00–4.98 (m, 1H), 3.87 (s, 3H), 2.86 (d, *J* = 9.6 Hz, 1H), 2.71–2.64 (m, 1H), 2.32– 2.25 (m, 1H), 2.20–2.13 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 167.16, 148.55, 144.19, 137.22, 137.04, 131.84, 129.59, 128.64, 128.51, 128.44, 127.46, 127.15, 126.84, 126.07, 115.51, 51.91, 41.98, 35.38, 32.67, 29.92.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{26}H_{24}O_2$ ([M + H]$^+$), 369.1849; found 369.1856.



4l

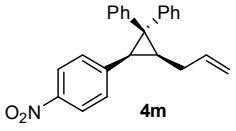
((2S*,3S*)-2-Allyl-3-(4-(trifluoromethyl)phenyl)cyclopropane-1,1-diyl)dibenzene (4l): following the general procedure, the reaction of 5,5-dimethyl-2-(4-(trifluoromethyl)phenyl)-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 77.4 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 0.0384 g) afforded **4l** (29.4 mg, 39% yield) as a white solid. M.p. = 236 - 240°C.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.39 – 7.36 (m, 2H), 7.34 – 7.31 (m, 2H), 7.28 – 7.20 (m, 5H), 7.19 – 7.12 (m, 3H), 6.91 – 6.87 (m, 2H), 5.83 – 5.75 (m, 1H), 5.12 – 5.06 (m, 1H), 5.02 – 4.97 (m, 1H), 2.86 (d, *J* = 9.6 Hz, 1H), 2.70 – 2.63 (m, 1H), 2.29 – 2.21 (m, 1H), 2.18 – 2.12 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.49, 142.68, 137.15, 136.97, 131.84, 129.80, 128.54, 128.50, 127.52 (q, *J* = 32.5 Hz), 127.48, 126.91, 126.12, 124.38 (q, $^1J_{C\text{-}F}$ = 271.8 Hz), 124.25 (q, $^1J_{C\text{-}F}$ = 4.5 Hz), 115.57, 41.75, 34.98, 32.40, 29.84.

^{19}F NMR (470 MHz, $CDCl_3$) δ – 62.22 (s).

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{21}F_3Na$ ([M + Na]$^+$), 401.1481; found 401.1488.



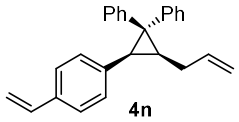
4m

((2S*,3S*)-2-Allyl-3-(4-nitrophenyl)cyclopropane-1,1-diyl)dibenzene (4m): following the general procedure, the reaction of 5,5-dimethyl-2- (4-nitrophenyl)- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 70.5 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenylcyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4m** (30.8 mg, 43% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.93 – 7.89 (m, 2H), 7.27 – 7.24 (m, 2H), 7.22 – 7.17 (m, 5H), 7.12 – 7.07 (m, 3H), 6.87 – 6.83 (m, 2H), 5.76 – 5.66 (m, 1H), 5.04 – 4.98 (m, 1H), 4.95 – 4.90 (m, 1H), 2.87 – 2.82 (m, 1H), 2.69 – 2.60 (m, 1H), 2.23 – 2.14 (m, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.03, 146.95, 145.71, 136.71, 136.52, 131.69, 130.07, 128.68, 128.62, 127.39, 127.17, 126.33, 122.57, 115.82, 42.86, 35.25, 33.25, 29.72.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{21}NO_2$ ([M + H]$^+$), 356.1645; found 356.1641.



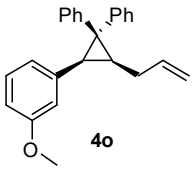
4n

((2S*,3S*)-2-Allyl-3-(4-vinylphenyl)cyclopropane-1,1-diyl)dibenzene (4n): following the general procedure, the reaction of 5,5-dimethyl-2-(4-vinylphenyl)-1,3,2- dioxaborinane (0.30 mmol, 1.5 equiv., 64.8 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4n** (45.4 mg, 68% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.26–7.23 (m, 2H), 7.20–7.15 (m, 5H), 7.13–7.10 (m, 4H), 7.07–7.03 (m, 1H), 6.71–6.68 (m, 2H), 6.61–6.54 (m, 1H), 5.79–5.71 (m, 1H), 5.63–5.58 (m, 1H), 5.12–5.08 (m, 1H), 5.06–5.00 (m, 1H), 4.94–4.90 (m, 1H), 2.73 (d, *J* = 9.6 Hz, 1H), 2.59 –2.52 (m, 1H), 2.24–2. 17 (m, 1H), 2.05–1.98 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.96, 137.99, 137.66, 137.49, 136.54, 134.65, 132.01, 129.85, 128.43, 128.28, 127.50, 126.62, 125.87, 125.31, 115.28, 112.91, 41.04, 35.24, 32.07, 30.08.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{26}H_{24}$ ([M + H]$^+$), 337.1950; found 337.1952.



4o

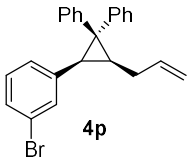
((2S*,3S*)-2-Allyl-3-(3-methoxyphenyl)cyclopropane-1,1-diyl)dibenzene (4o): following the general procedure, the reaction of 2-(3-methoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4o** (40.9 mg, 60% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.28–7.24 (m, 2H), 7.19–7.09 (m, 7H), 7.07–7.03 (m, 1H), 7.01–6.96 (m, 1H), 6.30–6.59 (m, 1H), 6.45–6.41 (m, 1H), 6.23–6.20 (m, 1H), 5.81–5.72 (m, 1H), 5.07–5.01 (m, 1H), 4.95–4.90 (m, 1H), 3.49 (s, 3H), 2.72 (d, *J* = 10.2 Hz, 1H), 2.59–2.52

(m, 1H), 2.26–2.19 (m, 1H), 2.02–1.96 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 158.72, 149.02, 139.75, 137.83, 137.55, 131.99, 128.43, 128.30, 128.25, 127.59, 126.57, 125.88, 122.54, 115.25, 115.02, 111.33, 54.84, 40.94, 35.11, 31.90, 30.18.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{24}O$ ([M + H]$^+$), 341.1899; found 341.1893.



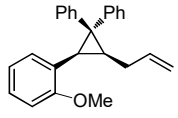
4p

((2S*,3S*)-2-Allyl-3-(3-bromophenyl)cyclopropane-1,1-diyl)dibenzene (4p): following the general procedure, the reaction of 2-(3-bromophenyl)-5,5-dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 80.4 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4p** (38.9 mg, 50% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.34–7.30 (m, 2H), 7.27–7.19 (m, 6H), 7.18–7.11 (m, 3H), 7.07–7.05 (m, 1H), 6.92 (t, *J* = 7.8 Hz, 1H), 6.63–6.60 (m, 1H), 5.86–5.78 (m, 1H), 5.13–5.07 (m, 1H), 5.03–4.99 (m, 1H), 2.75 (d, *J* = 9.6 Hz, 1H), 2.66–2.59 (m, 1H), 2.28–2.21 (m, 1H), 2.12–2.07 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.58, 140.75, 137.23, 137.15, 132.85, 131.85, 128.81, 128.50, 128.42, 128.37, 127.96, 127.50, 126.82, 126.04, 121.60, 115.50, 41.28, 34.74, 32.05, 29.89.

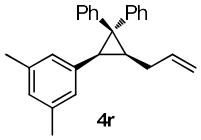
HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{21}Br$ ([M + H]$^+$), 389.0899; found 389.0902.



4q

((2S*,3S*)-2-Allyl-3-(2-methoxyphenyl)cyclopropane-1,1-diyl)dibenzene (4q): following the general procedure, the reaction of 2-(2-methoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4q** (10.9 mg, 16% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.48 (d, *J* = 7.8 z, 2H), 7.29–7.26 (m, 2H), 7.17–7.08 (m, 7H), 6.91 (d, *J* = 7.8 Hz, 1H), 6.66 (t, *J* = 7.8 Hz, 1H), 6.60 (d, *J* = 7.2 Hz, 1H), 5.99–5.91 (m, 1H), 5.19–5.04 (m, 2H), 3.91 (s, 3H), 3.15 (d, *J* = 9.6 Hz, 1H), 2.64–2.54 (m, 1H), 2.43–2.35 (m, 1H), 2.13–2.06 (m, 1H). **^{13}C NMR** (150 MHz, $CDCl_3$) δ 159.15, 149.51, 139.27, 138.01, 131.32, 128.81, 128.28, 127.93, 127.06, 126.56, 126.06, 125.74, 119.63, 115.22, 110.04, 77.21, 77.00, 76.79, 55.53, 39.66, 30.82, 30.27, 27.59. **HRMS** (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{25}O$ ([M + H]$^+$), 341.1900; found 341.1904.



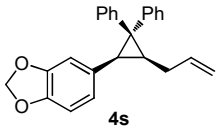
4r

((2S*,3S*)-2-Allyl-3-(3,5-dimethylphenyl)cyclopropane-1,1-diyl)dibenzene (4r): following the general procedure, the reaction of 2-(3,5-dimethylphenyl)-5,5- dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 65.0 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 83.4 mg) afforded **4r** (39.2 mg, 58% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.27–7.24 (m, 2H), 7.18–7.13 (m, 4H), 7.13–7.09 (m, 3H), 7.06–7.03 (m, 1H), 6.70 (s, 1H), 6.34 (s, 2H), 5.82–5.74 (m, 1H), 5.07–5.01 (m, 1H), 4.95–4.91 (m, 1H), 2.66 (d, *J* = 9.6 Hz, 1H), 2.54–2.47 (m, 1H), 2.25–2. 17 (m, 1H), 2.08 (s, 6H), 2.00–1.93 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.24, 137.99, 137.97, 137.88, 136.71, 132.10, 128.44, 128.09, 127.85, 127.66, 127.07, 126.50, 125.83, 115.19, 40.72, 35.24, 31.82, 30.24, 21.40.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{26}H_{26}$ ([M + H]$^+$), 339.2107; found 339.2105.



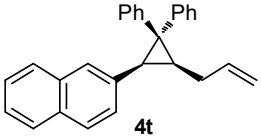
4s

5-((1S*,3S*)-3-Allyl-2,2-diphenylcyclopropyl)benzo[d][1,3]dioxole (4s): following the general procedure, the reaction of 2-(benzo[d][1,3] dioxol-5-yl)- 5,5-dimethyl-1,3,2-dioxa-borinane (0.30 mmol, 1.5 equiv., 70.2 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenylcyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4s** (28.4 mg, 40% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.25–7.22 (m, 2H), 7.19–7.14 (m, 4H), 7.14–7.09 (m, 3H), 7.07–7.03 (m, 1H), 6.56 (d, *J* = 7.8 Hz, 1H), 6.37–6.34 (m, 1H), 6.16–6.14 (m, 1H), 5.82–5.79 (m, 2H), 5.79–5.73 (m, 1H), 5.07–5.02 (m, 1H), 4.96–4.92 (m, 1H), 2.68 (d, *J* = 9.6 Hz, 1H), 2.55–2.48 (m, 1H), 2.23–2. 15 (m, 1H), 1.98–1.91 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.06, 146.85, 145.34, 137.75, 137.55, 131.96, 131.82, 128.41, 128.25, 127.54, 126.61, 125.83, 123.07, 115.25, 109.94, 107.55, 100.71, 40.34, 35.07, 31.43, 30.11.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{22}O_2$ ([M + H]$^+$), 355.1692; found 355.1699.



4t

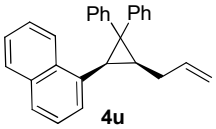
2-((1S*,3S*)-3-Allyl-2,2-diphenylcyclopropyl)naphthalene (4t): following the general procedure, the reaction of 5,5-dimethyl-2-(naphthalen-2-yl)- 1,3,2- dioxaborinane (0.30

mmol, 1.5 equiv., 72.0 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4t** (49.4 mg, 69% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.69–7.64 (m, 1H), 7.54–7.50 (m, 1H), 7.50–7.46 (m, 1H), 7.32–7.27 (m, 4H), 7.21–7.16 (m, 3H), 7.15–7.11 (m, 5H), 7.08–7.04 (m, 1H), 6.92–6.88 (m, 1H), 5.79–5.70 (m, 1H), 5.06–5.00 (m, 1H), 4.91–4.87 (m, 1H), 2.90 (d, *J* = 9.6 Hz, 1H), 2.67 –2.59 (m, 1H), 2.34–2.27 (m, 1H), 2.12–2.05 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.99, 137.77, 137.51, 135.86, 132.99, 132.06, 131.56, 128.60, 128.46, 128.28, 128.12, 127.58, 127.57, 127.35, 126.63, 125.91, 125.71, 125.13, 115.31, 41.08, 35.52, 32.22, 30.22.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{28}H_{24}$ ([M + H]$^+$), 361.1950; found 361.1948.



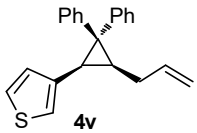
4u

1-((1S*,3S*)-3-Allyl-2,2-diphenylcyclopropyl)naphthalene (4u): following the general procedure, the reaction of 5,5-dimethyl-2- (naphthalen-1-yl)- 1,3,2- dioxaborinane (0.30 mmol, 1.5 equiv., 72.0 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv.,, 38.4 mg) afforded **4u** (12.3 mg, 17% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 8.22–8.18 (m, 1H), 7.89–7.85 (m, 1H), 7.71–7.67(m, 1H),7.52 –7.47 (m, 2H), 7.37–7.30 (m, 4H), 7.24–7.18 (m, 2H), 7.14–7.10 (m, 1H), 7.09–7.01 (m, 3H), 6.96–6.92 (m ,2H), 6.07–5.98 (m, 1H), 5.25–5.20 (m, 1H), 5.12– 5.08 (m, 1H), 3.23–3.19 (m, 1H), 2.59–2.52 (m, 1H), 2.51–2.43 (m, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.62, 138.84, 137.97, 134.61, 134.42, 133.62, 131.64, 128.82, 128.51, 127.85, 127.31, 126.66, 126.20, 126.14, 125.81, 125.49, 125.08, 124.69, 115.60, 39.30, 33.36, 31.60, 30.19.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{28}H_{24}$ ([M + H]$^+$), 361.1950; found 361.1958.



4v

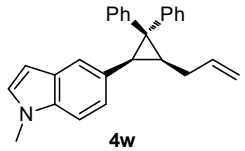
3-((1R*,3S*)-3-Allyl-2,2-diphenylcyclopropyl)thiophene (4v): following the general procedure, the reaction of 5,5-dimethyl-2-(thiophen-3-yl)-1,3,2- dioxaborinane (0.30 mmol, 1.5 equiv., 58.8 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4v** (11.2 mg, 18% yield) as a white solid. M.p. 54-56 ºC.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.23 – 7.20 (m, 2H), 7.19 – 7.16 (m, 4H), 7.15 – 7.13 (m, 3H), 7.07 – 7.03 (m, 2H), 6.55 (dd, *J* = 4.8, 1.2 Hz, 1H), 6.34 (dd, *J* = 3.0, 1.2 Hz, 1H), 5.74 (dddd, *J* = 17.1, 10.3, 6.7, 5.4 Hz, 1H), 5.01 (dq, *J* = 17.2, 1.7 Hz, 1H), 4.94 – 4.90 (m, 1H), 2.90 (d,

J = 9.6 Hz, 1H), 2.51 (dtt, *J* = 16.1, 6.8, 1.4 Hz, 1H), 2.13 (dddt, *J* = 15.2, 7.3, 5.4, 1.7 Hz, 1H), 1.96 – 1.91 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.62, 138.00, 137.97, 137.44, 132.08, 129.97, 128.40, 128.21, 127.37, 126.65, 125.84, 123.50, 120.92, 115.20, 40.22, 31.30, 31.15, 30.74.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{22}H_{20}S$ ([M + H]$^+$), 317.1358; found 317.1350.



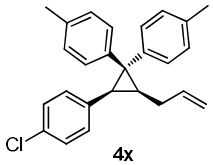
4w

5-((1S*, 3S*)-3-Allyl-2,2-diphenylcyclopropyl)-1-methyl-1*H*-indole (4w): following the general procedure, the reaction of 5-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)-1- methyl-*1H*-indole (0.30 mmol, 1.5 equiv., 72.9 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4w** (43.2 mg, 60% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.29–7.25(m, 2H), 7.17–7.13 (m, 2H), 7.12–7.06 (m, 5H), 7.05–6.98 (m, 3H), 6.86–6.84 (m, 1H), 6.68–6.64 (m, 1H), 6.22–6.19 (m, 1H), 5.81–5.72 (m, 1H), 5.05–5.01 (m, 1H), 4.91–4.85 (m,1H), 3.59 (s, 3H), 2.85 (d, *J* = 10.2 Hz, 1H), 2.59–2.51 (m, 1H), 2.34–2.26 (m, 1H), 2.03–1.95 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 149.55, 138.31, 138.01, 135.07, 132.16, 128.66, 128.45, 128.34, 128.04, 127.65, 126.27, 125.63, 124.12, 121.63, 115.00, 108.13, 100.61, 40.00, 35.69, 32.71, 31.47, 30.35.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{27}H_{25}N$ ([M + H]$^+$), 364.2059; found 364.2052.



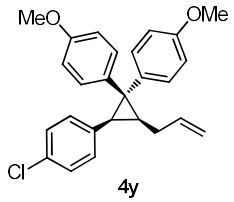
4x

4,4'-((2S*,3S*)-2-Allyl-3-(4-chlorophenyl)cyclopropane-1,1-diyl)bis(methylbenzene) (4x): following the general procedure, the reaction of 2-(4-chlorophenyl)- 5,5-dimethyl-1,3,2-dioxaborinane (0.20 mmol, 1.0 equiv., 44.8 mg), 3-bromoprop- 1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 4,4'-(cycloprop- 2-ene-1, 1-diyl) bis (methylbenzene) (0.30 mmol, 1.5 equiv., 66.0 mg) afforded **4x** (37.6 mg, 50% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.20–7.16 (m, 2H), 7.11–7.08 (m, 2H), 7.06–7.01 (m, 6H), 6.76–6.72 (m, 2H), 5.8–5.75 (m, 1H), 5.11–5.05 (m, 1H), 5.00–4.95 (m, 1H), 2.71 (d, *J* = 9.6 Hz, 1H), 2.64–2.56 (m, 1H), 2.31–2.25 (m, 6H), 2.25–2.18 (m, 1H), 2.07–2.01 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 146.11, 137.33, 136.99, 136.21, 135.47, 134.42, 131.67, 131.09, 130.90, 129.12, 127.50, 127.24, 115.30, 40.28, 34.64, 31.80, 29.90, 21.11, 20.88.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{26}H_{26}Cl$ ([M + H]$^+$), 373.1718; found 373.1719.



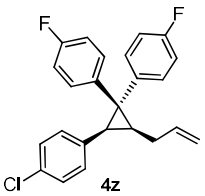
4y

4,4'-((2S*,3S*)-2-Allyl-3-(4-chlorophenyl)cyclopropane-1,1-diyl)bis(methoxybenzene) (4y): following the general procedure, the reaction of 2-(4-chlorophenyl)-5,5- dimethyl-1,3,2-dioxaborinane (0.20 mmol, 1.0 equiv., 44.8 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 4,4'-(cycloprop-2-ene-1,1-diyl) bis (methoxybenzene) (0.30 mmol, 1.5 equiv., 75.6 mg) afforded **4y** (46.5 mg, 58% yield) as a yellow solid. M.p. 38-40 °C.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.22–7.18 (m, 2H), 7.12–7.08 (m, 2H), 7.06–7.03 (m, 2H), 6.80–6.76 (m, 4H), 6.75–6.72 (m, 2H), 5.84–5.76 (m, 1H), 5.11–5.06 (m, 1H), 5.01–4.97 (m, 1H), 3.77 (s, 3H), 3.74 (s, 3H), 2.69 (d, *J* = 9.6 Hz, 1H), 2.61–2.54 (m, 1H), 2.25–2.18 (m, 1H), 2.04–1.99 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 146.13, 137.34, 137.01, 136.22, 135.48, 134.45, 131.69, 131.11, 130.91, 129.13, 127.51, 127.25, 115.31, 40.29, 34.66, 31.82, 29.91, 21.11, 20.88.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{26}H_{26}ClO_2$ ($[M + H]^+$), 405.1616; found 405.1625.



4z

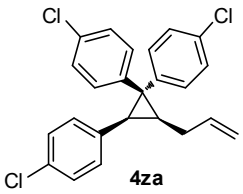
4,4'-((2S*,3S*)-2-Allyl-3-(4-chlorophenyl)cyclopropane-1,1-diyl)bis(fluorobenzene) (4z): following the general procedure, the reaction of 2-(4-chlorophenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 67.3 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 4,4'- (cycloprop-2-ene-1,1-diyl)bis(fluorobenzene) (0.20 mmol, 1.0 equiv., 45.6 mg) afforded **4z** (57 mg, 75% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.26 – 7.22 (m, 2H), 7.14 – 7.07 (m, 4H), 6.97 – 6.90 (m, 4H), 6.75 – 6.70 (m, 2H), 5.85 – 5.76 (m, 1H), 5.13 – 5.07 (m, 1H), 5.05 – 4.99 (m,1H), 2.72 (d, *J* = 9.6 Hz, 1H), 2.61 – 2.52 (m, 1H), 2.28 – 2.20 (m, 1H), 2.07 – 2.01 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 161.69 (d, *J* = 245.0 Hz), 161.11 (d, *J* = 243.6 Hz), 144.30 (d, *J* = 3.0 Hz), 136.91, 136.24, 133.30 (d, *J* = 7.8 Hz), 133.14 (d, *J* = 3.5 Hz), 131.55, 130.80, 128.94 (d, *J* = 8.0 Hz), 127.76, 115.56 (d, *J* = 29.3 Hz), 115.47 (d, *J* = 28.2 Hz), 115.24, 39.51, 34.67, 31.89, 29.78.

^{19}F NMR (470 MHz, $CDCl_3$) δ – 115.07 (tt, *J* = 8.5, 5.6 Hz, 1F), – 116.66 (tt, *J* = 8.5, 5.2 Hz, 1F).

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{19}ClF_2$ ($[M + H]^+$), 381.1216; found 381.1208.



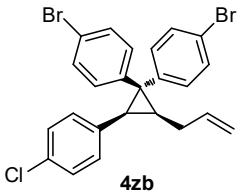
4za

4,4',4''-((2S*,3S*)-3-Allylcyclopropane-1,1,2-triyl)tris(chlorobenzene) (4za): following the general procedure, the reaction of 2-(4-chlorophenyl)-5,5-dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 67.3 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 4,4'-(cycloprop-2-ene-1,1-diyl)bis(chlorobenzene) (0.20 mmol, 1.0 equiv., 52.0 mg) afforded **4za** (55.4 mg, 67% yield) as a yellow solid. M.p. 98-100 ºC.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.25–7.18 (m, 6H), 7.15–7.11 (m, 2H), 7.07–7.03 (m, 2H), 6.75–6.72 (m, 2H), 5.84–5.76 (m, 1H), 5.12–5.07 (m, 1H), 5.04–5.00 (m, 1H), 2.72 (d, *J* = 10.2 Hz, 1H), 2.59–2.52 (m, 1H), 2.27–2.21 (m, 1H), 2.08–2.03 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 146.60, 136.75, 135.92, 135.57, 133.12, 133.01, 131.98, 131.69, 130.80, 128.81, 128.76, 128.69, 127.84, 115.81, 39.62, 34.77, 31.82, 29.74.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{19}Cl_3$ ([M + H]$^+$), 413.0625; found 413.0620.



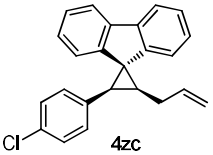
4zb

4,4'-((2S*,3S*)-2-Allyl-3-(4-chlorophenyl)cyclopropane-1,1-diyl)bis(bromobenzene)(4zb): following the general procedure, the reaction of 2-(4-chlorophenyl) - 5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 67.3 mg), 3-bromoprop- 1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 4,4'-(cycloprop-2-ene-1,1-diyl) bis(bromobenzene) (0.20 mmol, 1.0 equiv., 69.5 mg) afforded **4zb** (79 mg, 79% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.40–7.34 (m, 4H), 7.15–7.11 (m, 4H), 7.01–6.96 (m, 2H), 6.76–6.72 (m, 2H), 5.84–5.75 (m, 1H), 5.12–5.06 (m, 1H), 5.05–5.00 (m, 1H), 2.72 (d, *J* = 9.6 Hz, 1H), 2.58–2.51 (m, 1H), 2.28–2.20 (m, 1H), 2.08–2.02 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 147.02, 136.70, 136.00, 135.85, 133.48, 131.77, 131.71, 131.64, 130.79, 129.14, 127.85, 121.23, 120.04, 115.83, 39.74, 34.73, 31.74, 29.72.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{19}Br_2Cl$ ([M + H]$^+$), 500.9614; found 500.9606.



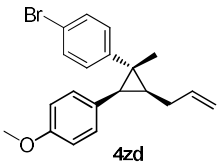
4zc

(2S*,3S*)-2-Allyl-3-(4-chlorophenyl)spiro[cyclopropane-1,9'-fluorene] (4zc): following the general procedure, the reaction of 2-(4-chlorophenyl)-5,5-dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 67.3 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and spiro[cyclopropane-1,9'-fluoren]-2-ene (0.20 mmol, 1.0 equiv., 38.0 mg) afforded **4zc** (44.7 mg, 65% yield) as a white solid. M.p. 45-47ºC.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.89–7.83 (m, 2H), 7.41–7.30 (m, 3H), 7.26–7.21 (m, 2H), 7.16–7.12 (m, 1H), 7.05–6.97 (m, 3H), 6.25 (d, *J* = 7.8 Hz, 1H), 5.70–5.61 (m, 1H), 4.94–4.89 (m, 1H), 4.89–4.85 (m, 1H), 3.42 (d, *J* = 8.4 Hz, 1H), 2.70–2.62 (m, 1H), 2.38–2.31 (m, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 148.82, 141.44, 141.41, 139.12, 136.57, 132.82, 132.77, 132.73, 128.35, 127.01, 126.07, 125.90, 125.53, 125.09, 119.93, 119.63, 118.37, 115.52, 37.74, 35.87, 33.60, 29.51.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{24}H_{19}Cl$ ($[M + H]^+$), 343.1248; found 343.1256.



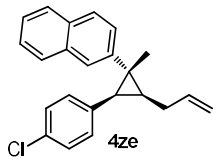
4zd

1-((1S*,2R*,3S*)-3-allyl-2-(4-bromophenyl)-2-methylcyclopropyl)-4-methoxybenzene (4zd): following the general procedure, the reaction of 2-(4-methoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.6 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 1-bromo-4-(1-methyl- cycloprop-2-en-1-yl)benzene (0.20 mmol, 1.0 equiv., 41.5 mg) afforded **4zd** (28.5 mg, 40% yield, 84:16 d.r.) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.46-7.41 (m, 2H), 7.40-7.37 (0.48H, ArH of the minor isomer), 7.28-7.23 (m, 2H), 7.22-7.17 (m, 2H), 7.01-6.97 (m, 0.44H, ArH of the minor isomer), 6.91-6.84 (m, 2H), 6.68-6.63 (m, 0.38H), 6.62-6.58 (m, 0.36H, ArH of the minor isomer), 6.00 (ddt, *J* = 17.4, 10.8, 6.0 Hz, 1H), 5.71 (ddt, *J* = 17.4, 10.8, 6.0 Hz, 0.19H, C=CH of the minor isomer), 5.18-5.10 (m, 1H), 5.10-5.05 (m, 1H), 5.04-4.99 (m, 0.23H, C=CH of the minor isomer), 4.96-4.91 (m, 0.19H, C=CH of the minor isomer), 3.80 (s, 3H), 3.93 (s, 0.54H, OMe of the minor isomer), 2.45-2.36 (m, 2H), 2.36-2.30 (m, 0.21H), 2.20 (d, *J* = 9.6 Hz, 0.20H), 2.08-1.96 (m, 1.22H), 1.51-1.46 (m, 1H), 1.46 (s, 0.6H, Me of the minor isomer), 1.19 (s, 3H);

^{13}C NMR (151 MHz, $CDCl_3$) δ (peaks of isomers were recorded together and not assigned to each isomer) 158.09, 157.23, 148.42, 139.23, 137.99, 137.82, 132.84, 131.81, 131.40, 131.39, 130.26, 130.20, 129.22, 128.82, 120.18, 119.36, 115.10, 114.79, 113.73, 112.92, 55.21, 55.08, 33.37, 33.13, 30.93, 30.71, 30.59, 30.22, 29.78, 27.91, 27.68, 17.47.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{20}H_{21}BrO$ ($[M + H]^+$), 357.0849; found 357.0856.



4ze

78:22 d.r.

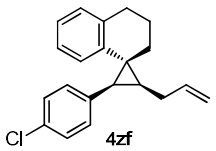
2-((1R*,2S*,3S*)-2-allyl-3-(4-chlorophenyl)-1-methylcyclopropyl)naphthalene (4ze): following the general procedure, the reaction of 2-(4-chlorophenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.6 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 2-(1-methylcycloprop-2-en-1-yl)naphthalene (0.20 mmol, 1.0 equiv.,

36.0 mg) afforded **4ze** (15.7 mg, 24% yield, 78:22 d.r.) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ (overlapped peaks of isomers were assigned together) 7.86-7.77 (m, 4.3H), 7.77-7.71 (m, 0.6H), 7.63 (s, 0.3H), 7.55-7.50 (m, 1H), 7.50-7.41 (m, 2.6H), 7.36-7.27 (m, 4H), 7.22-7.17 (m, 0.3H), 7.02-6.97 (m, 0.6H), 6.64-6.58 (m, 0.6H), 6.06 (ddt, *J* = 17.4, 10.8, 6.0 Hz, 1H), 5.72 (ddt, *J* = 17.4, 10.8, 6.0 Hz, 0.3H), 5.24-5.17 (m, 1H), 5.16-5.09 (m, 1H), 5.07-5.01 (m, 0.3H), 4.99-4.93 (m, 0.3H), 2.54 (d, *J* = 9.6 Hz, 1H), 2.51 (t, *J* = 6.0 Hz, 0.3H), 2.47-2.37 (m, 1H), 2.32-2.24 (m, 0.3H), 2.13-2.01 (m, 1.3H); 1.67 (dt, *J* = 9.0, 6.0 Hz, 1H), 1.60-1.56 (m, 0.3H), 1.56 (s, 1H, methyl of the minor isomer), 1.30 (s, 3H, methyl of the major isomer);

^{13}C NMR (151 MHz, $CDCl_3$) δ (peaks correspond to both isomers and are not assigned to each isomer) 146.29, 137.87, 137.62, 137.36, 137.23, 135.80, 133.55, 133.52, 132.31, 132.13, 132.10, 131.96, 130.72, 130.50, 129.53, 129.16, 128.46, 128.14, 127.95, 127.71, 127.64, 127.58, 127.55, 127.40, 126.26, 126.07, 125.82, 125.66, 125.45, 125.40, 115.30, 114.98, 33.63, 33.31, 32.55, 31.60, 30.57, 30.28, 29.73, 28.54, 27.61, 17.68.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{23}H_{21}Cl$ ($[M + H]^+$), 333.1405; found 333.1412.



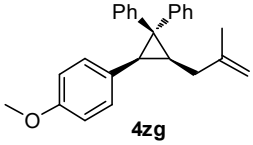
4zf

(1R,2S*,3S*)-2-Allyl-3-(4-chlorophenyl)-3',4'-dihydro-2'H-spiro[cyclopropane-1,1'-naphthalene] (4zf): following the general procedure, the reaction of 2-(4-chlorophenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 67.3 mg), 3-bromoprop-1-ene (0.60 mmol, 3.0 equiv., 72.0 mg) and 3',4'-dihydro-*2'H*-spiro [cyclopropane-1,1'-naphthalen]-2-ene (0.20 mmol, 1.0 equiv., 31.2 mg) afforded **4zf** (27 mg, 44% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.28–7.25 (m, 2H), 7.23–7.19 (m, 2H), 7.19–7.14 (m, 1H), 7.11–7.06 (m, 2H), 6.85 (d, *J* = 7.8 Hz, 1H), 6.03–5.94 (m, 1H), 5.14–5.08 (m, 1H), 5.07–5.03 (m, 1H), 2.93–2.80 (m, 2H), 2.57 (d, *J* = 9.6 Hz, 1H), 2.40–2.33 (m, 1H), 2.21–2.14 (m, 1H), 1.87–1.81(m, 2H), 1.68–1.62 (m, 1H), 1.55–1.52 (m, 2H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 142.42, 137.79, 137.45, 135.55, 132.06, 132.01, 128.82, 128.39, 126.37, 124.75, 121.83, 115.24, 35.35, 32.16, 30.82, 29.77, 25.37, 25.11, 22.16.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{21}H_{21}Cl$ ($[M + H]^+$), 309.1404; found 309.1409.



4zg

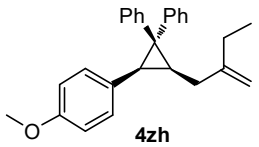
((2S*,3S*)-2-(4-Methoxyphenyl)-3-(2-methylallyl)cyclopropane-1,1-diyl)dibenzene (4zg): following the general procedure, the reaction of 2-(4-methoxyphenyl)- 5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 3-bromo- 2-methylprop-1-ene (0.60 mmol, 3.0 equiv., 81.0 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg)

afforded **4zg** (47.5 mg, 67% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.27–7.23 (m, 2H), 7.18–7.09 (m, 7H), 7.06–7.01 (m, 1H), 6.67–6.59 (m, 4H), 4.80 (s, 1H), 4.71 (s, 1H), 3.66 (s, 3H), 2.73 (d, *J* = 9.6 Hz, 1H), 2.49–2.40 (m, 1H), 2.12–2.01 (m, 2H), 1.61 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.43, 149.29, 145.27, 138.03, 132.05, 130.73, 130.11, 128.39, 128.18, 127.45, 126.44, 125.72, 112.89, 110.33, 55.08, 39.68, 34.79, 33.39, 30.63, 23.48.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{26}H_{26}NaO$ ($[M + Na]^+$),377.1863; found 377.1876.



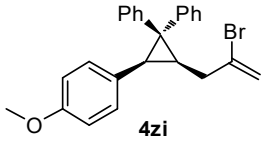
4zh

((2S*,3S*)-2-(4-Methoxyphenyl)-3-(2-methylenebutyl)cyclopropane-1,1-diyl)dibenzene (4zh): following the general procedure, the reaction of 2-(4-methoxyphenyl)- 5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 2-(bromomethyl) but-1-ene (0.60 mmol, 3.0 equiv., 88.8 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4zh** (51.4 mg, 70% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.27–7.23 (m, 2H), 7.1–7.13 (m, 4H), 7.13–7.09 (m, 3H), 7.07 –7.03 (m, 1H), 6.67–6.63 (m, 2H), 6.63–6.59 (m, 2H), 4.85 (s, 1H), 4.73 (s, 1H), 3.67 (s, 3H), 2.74 (d, *J* = 9.6 Hz, 1H), 2.48–2.41 (m, 1H), 2.13–2.04 (m, 2H), 1.97–1.86 (m, 2H), 0.92–0.87 (t, *J* = 7.8 Hz, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.41, 151.87, 149.30, 138.02, 132.07, 130.73, 130.13, 128.38, 128.16, 127.43, 126.44, 125.70, 112.87, 108.22, 55.09, 39.68, 34.84, 31.88, 30.61, 29.84, 12.51.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{27}H_{28}NaO$ ($[M + Na]^+$), 391.2032; found 391.2033.



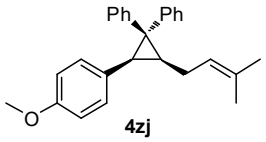
4zi

((2S*,3S*)-2-(2-Bromoallyl)-3-(4-methoxyphenyl)cyclopropane-1,1-diyl)dibenzene (4zi): following the general procedure, the reaction of 2-(4-methoxyphenyl)- 5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 2,3- dibromoprop-1-ene (0.60 mmol, 3.0 equiv., 118.7 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 84.0 mg) afforded **4zi** (56.0 mg, 67% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.30–7.26 (m, 2H), 7.20–7.15 (m, 4H), 7.15–7.10 (m, 3H), 7.08–7.04 (m, 1H), 6.62 (s, 4H), 5.45 (s, 1H), 5.31 (s, 1H), 3.67 (s, 3H), 2.95– 2.89 (m, 1H), 2.76 (d, *J* = 9.6 Hz, 1H), 2.57–2.51 (m, 1H), 2.21–2.15 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.62, 148.68, 137.51, 132.92, 131.82, 130.63, 129.17, 128.49, 128.37, 127.56, 126.70, 126.00, 117.02, 113.04, 55.11, 39.93, 37.77, 34.35, 30.35.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{23}BrO$ ($[M + H]^+$), 419.1005; found 419.1012.



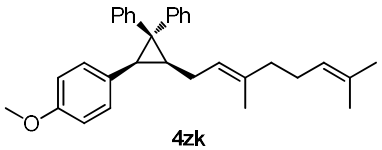
4zj

((2S*,3S*)-2-(4-methoxyphenyl)-3-(3-methylbut-2-en-1-yl)cyclopropane-1,1-diyl)dibenzene (4zj): following the general procedure, the reaction of 2-(4-methoxyphenyl)- 5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg, 1-bromo-3- methylbut-2-ene (0.60 mmol, 3.0 equiv., 89.4 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4zj** (44.2 mg, 60% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.22–7.19 (m, 2H), 7.17–7.12 (m, 4H), 7.12–7.06 (m, 3H), 7.05–7.00 (m, 1H), 6.70–6.65 (m, 2H), 6.64–6.60 (m, 2H), 5.15–5.10 (m, 1H), 3.67 (s, 3H), 2.64 (d, *J* = 9.6 Hz, 1H), 2.47–2.40 (m, 1H), 2.11–2.03 (m, 1H), 1.91– 1.85 (m, 1H), 1.61 (s, 3H), 1.49 (s, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.40, 149.40, 138.00, 132.25, 131.97, 130.68, 130.29, 128.32, 128.16, 127.50, 126.37, 125.64, 123.59, 112.96, 55.10, 40.24, 34.92, 33.07, 25.79, 24.77, 18.05.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{27}H_{28}O$ ([M + H]$^+$), 369.2212; found 369.2220.



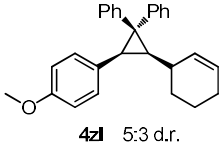
4zk

((2S*,3S*)-2-((*E*)-3,7-Dimethylocta-2,6-dien-1-yl)-3-(4-methoxyphenyl)cyclopropane-1,1-diyl)dibenzene (4zk): following the general procedure, the reaction of 2-(4-methoxyphenyl)-5,5-dimethyl- 1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), (*E*)-1-bromo-3,7-dimethylocta- 2,6- diene (0.60 mmol, 1.5 equiv., 64.8 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4zk** (35.8 mg, 41% yield) as a white solid. M.p.116-119ºC.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.32–7.29 (m, 2H), 7.25–7.20 (m, 4H), 7.19–7.15 (m, 3H), 7.13–7.09 (m, 1H), 6.78–6.74 (m, 2H), 6.71–6.68 (m, 2H), 5.26–5.22 (m, 1H), 5.12–5.07 (m, 1H), 3.75 (s, 3H), 2.72 (d, *J* = 10.2 Hz, 1H), 2.53–2.46 (m, 1H), 2.20–2. 13 (m, 1H), 2.12–2.04 (m, 2H), 2.04–1.92 (m, 3H), 1.68–1.66 (m, 3H), 1.61–1.59 (m, 3H),1.57–1.54 (m, 3H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.39, 149.45, 138.08, 135.55, 132.20, 131.34, 130.68, 130.30, 128.33, 128.16, 127.60, 126.34, 125.65, 124.26, 123.68, 112.95, 55.10, 40.34, 39.67, 34.78, 32.99, 26.59, 25.70, 24.67, 17.71, 16.34.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{32}H_{36}O$ ([M + H]$^+$), 437.2838; found 437.2846.



4zl 5:3 d.r.

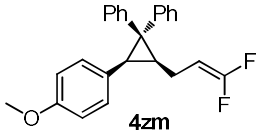
((2S*,3S*)-2-((S)-Cyclohex-2-en-1-yl)-3-(4-methoxyphenyl)cyclopropane-1,1-diyl)dibenz

ene (4zl): following the general procedure, the reaction of 2-(4-methoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 1-(bromomethyl)cyclohex-1-ene (0.60 mmol, 3.0 equiv., 96.6 mg) and 3,3-diphenyl cyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4zl** (47.7 mg, 63% yield, 5:3 d.r.) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ (most peaks of the two diastereomers overlap and have been integrated and assigned together) 7.31-7.21 (m, 3.51H), 7.18-7.06 (m, 11.7H), 7.06-7.00 (m, 1.72H), 6.69-6.64 (m, 1.25H), 6.63-6.57 (m, 5.20H), 6.19-6.14 (m, 1H, H_a (vinyl) of the major isomer), 5.82-5.76 (m, 1H, H_b (vinyl) of the major isomer), 5.50-5.44 (m, m, 1H, H_b (vinyl) of the minor isomer), 5.07-5.02 (m, 1H, H_a (vinyl) of the major isomer), 3.67 (s, 5H), 2.65 (d, J = 10.2 Hz, 0.60H), 2.63 (d, J = 9.6 Hz, 1H), 2.43-2.35 (m, 0.6H), 2.35-2.27 (m, 1H), 2.27-2.21 (m, 0.6H), 2.04-1.83 (m, 3.6H), 1.83-1.72 (m, 2H), 1.72-1.65 (m, 1H), 1.64-1.55 (m, 0.8H), 1.55-1.47 (m, 1.2H), 1.31-1.21 (m, 2.3H), 1.11-1.00 (m, 1H), 0.84-0.76 (m, 0.50H);

^{13}C NMR (151 MHz, $CDCl_3$) δ (peaks of each diastereomer were not assigned) δ 157.42, 157.37, 149.48, 149.47, 138.36, 138.23, 132.03, 131.89, 131.71, 130.62, 130.60, 130.52, 130.35, 130.23, 128.36, 128.25, 128.22, 128.20, 127.81, 127.72, 127.57, 126.40, 126.38, 125.71, 125.69, 112.98, 112.91, 55.07, 41.28, 41.13, 39.01, 38.90, 34.46, 34.18, 31.50, 30.95, 30.72, 28.10, 25.26, 25.07, 21.33, 21.11.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{29}H_{30}O$ ($[M + H]^+$),395.2369; found 395.2377.



4zm

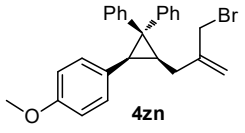
((2S*,3S*)-2-(3,3-Difluoroallyl)-3-(4-methoxyphenyl)cyclopropane-1,1-diyl)dibenzene (4zm): following the general procedure, the reaction of 2-(4-methoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 3-bromo-3,3-difluoroprop-1-ene (0.60 mmol, 3.0 equiv., 93.5 mg) and 3,3-diphenylcyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4zm** (34.6mg, 46% yield) as a colorless oil.

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.23–7.20 (m, 2H), 7.19–7.11 (m, 5H), 7.09–88.67 7.03 (m, 3H), 6.66–6.61 (m, 4H), 3.98–3.89 (m, 1H), 3.67 (s, 3H), 2.67 (d, J = 9.6 Hz, 1H), 2.59–2.52 (m, 1H), 2.09–2.01 (m, 1H), 1.93–1.87 (m, 1H).

^{13}C NMR (151 MHz, $CDCl_3$) δ 157.60, 156.06 (t, $^1J_{C\text{-}F}$ = 286.9 Hz), 148.76, 137.46, 131.92, 130.53, 129.35, 128.44, 128.35, 127.46, 126.67, 125.91, 113.13, 77.26 (t, $^2J_{C\text{-}F}$ = 21.1 Hz), 55.12, 40.43, 34.45, 31.81 (t, $^4J_{C\text{-}F}$ = 2.3 Hz), 19.43 (d, $^3J_{C\text{-}F}$ = 4.5 Hz).

^{19}F NMR (470 MHz, $CDCl_3$) δ – 88.67 (d, $^2J_{F\text{-}F}$ = 47.0 Hz, 1F); – 90.35 (dd, $^2J_{F\text{-}F}$ = 47.0 Hz, $^3J_{F\text{-}H\ (trans)}$ = 25.6 Hz, 1F).

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{22}F_2O$ ($[M + H]^+$),377.1711; found 377.1719.



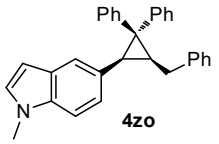
4zn

((2S*,3S*)-2-(3,3-Difluoroallyl)-3-(4-methoxyphenyl)cyclopropane-1,1-diyl)dibenzene (4zn): following the general procedure, the reaction of 2-(4-methoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane (0.30 mmol, 1.5 equiv., 66.0 mg), 3-bromo-2-(bromomethyl)prop-1-ene (0.60 mmol, 3.0 equiv., 127.1mg) and 3,3-diphenylcyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4zn** (32.0mg, 37%yield) as a pair of atropoisomeric isomers (ratio: 3:2).

^{1}H NMR (600 MHz, C_6D_6) δ (overlapped peaks of the isomers are assigned together) 7.31-7.22 (m, 4H), 7.16 (s, 4H), 7.14-7.07 (m, 4H), 7.04-6.97 (m, 2H), 6.76-6.70 (m, 2H), 6.65-6.59 (m, 2H), 4.98 (s, 0.4H), 4.96 (s, 0.6H), 4.89 (s, 0.4H), 4.87 (s, 0.6H), 3.64 (d, *J* = 11.4 Hz, 0.4H), 3.55 (d, *J* = 10.2 Hz, 0.6H), 3.53 (d, *J* = 11.4 Hz, 0.4H), 3.44 (d, *J* = 10.2 Hz, 0.6H), 3.24 (s, 3H), 2.91 (dd, *J* = 17.4, 6.0 Hz, 0.6H), 2.85 (dd, *J* = 16.2, 6.0 Hz, 0.4H), 2.74 (d, *J* = 9.6 Hz, 1H), 2.40-2.28 (m, 1H), 2.07-2.00 (m, 1H);

^{13}C NMR (151 MHz, $CDCl_3$): (peaks of two isomers were not assigned and recorded together) 157.56, 148.98, 144.72, 144.45, 137.70, 137.68, 131.94, 130.64, 129.63, 128.45, 128.31, 127.39, 127.38, 126.63, 125.86, 115.74, 115.11, 113.01, 113.00, 55.11, 48.89, 39.75, 39.73, 37.33, 34.64, 34.62, 30.24, 30.18, 29.57, 29.21.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{22}F_2O$ ([M + H]$^+$), 433.1162; found 433.1170.



4zo

5-((1S*,3S*)-3-benzyl-2,2-diphenylcyclopropyl)-1-methyl-1*H*-indole (4zo): following the general procedure, the reaction of 5-(5,5-dimethyl- 1,3,2-dioxaborinan-2-yl)-1-methyl-1H-indole (0.30 mmol, 1.5 equiv.,72.9 mg), benzyl bromide (0.60 mmol, 3.0 equiv., 51.0 mg) and 3,3-diphenylcyclopropene (0.20 mmol, 1.0 equiv., 38.4 mg) afforded **4zo** (19.8 mg, 24% yield) as a colorless oil.

^{1}H NMR (600 MHz, C_6D_6) δ 7.38-7.30 (m, 2H), 7.30-7.17 (m, 9H), 7.17-7.07 (m, 6H), 7.02-6.94 (m, 1H), 6.85-6.77 (m, 1H), 6.31 (d, *J* = 3.0 Hz, 1H), 3.74 (s, 3H), 3.23 (dd, *J* = 15.6, 6.6 Hz, 1H), 3.08-2.96 (m, 2H), 2.38-2.30 (m, 1H);

^{13}C NMR (151 MHz, $CDCl_3$): δ 149.50, 141.88, 138.34, 135.19, 132.28, 128.70, 128.48, 128.43, 128.36, 128.26, 128.10, 128.08, 127.60, 126.33, 125.70, 125.64, 124.43, 121.99, 108.22, 100.71, 39.89, 36.25, 33.43, 32.79, 31.60.

HRMS (ESI-TOF) (*m/z*): Calcd for $C_{25}H_{22}F_2O$ ([M + H]$^+$),414.2216; found 414.2223.

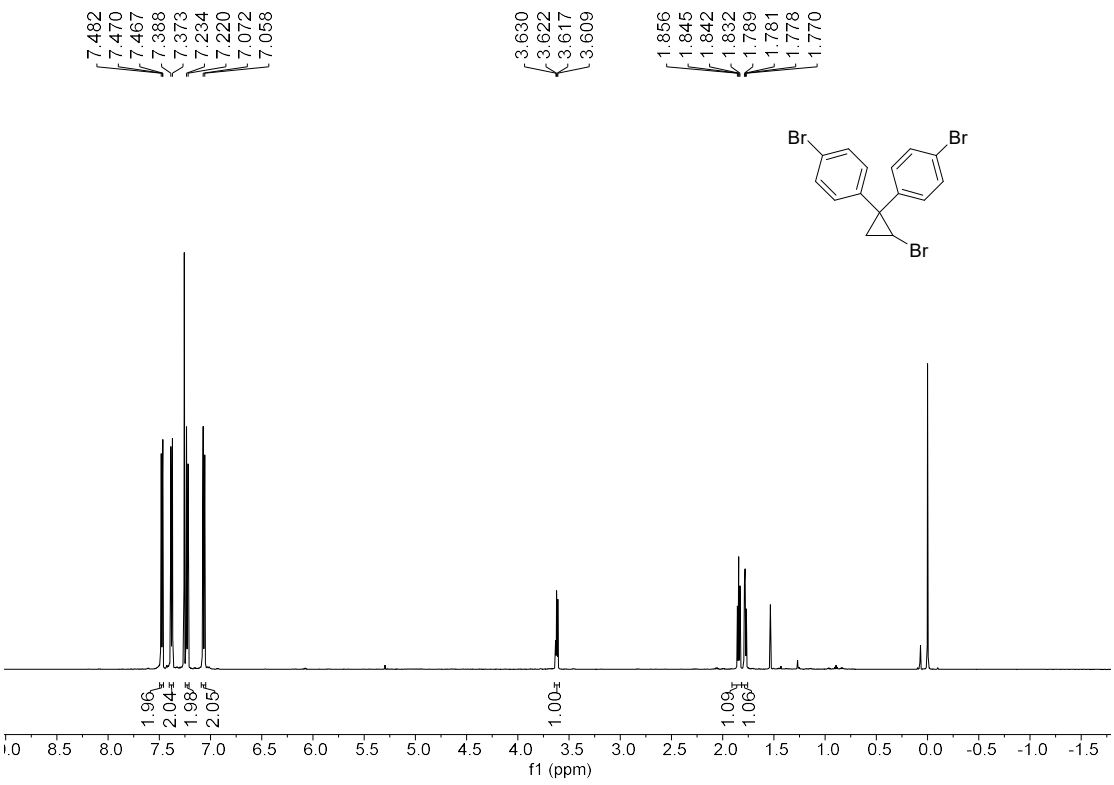
References

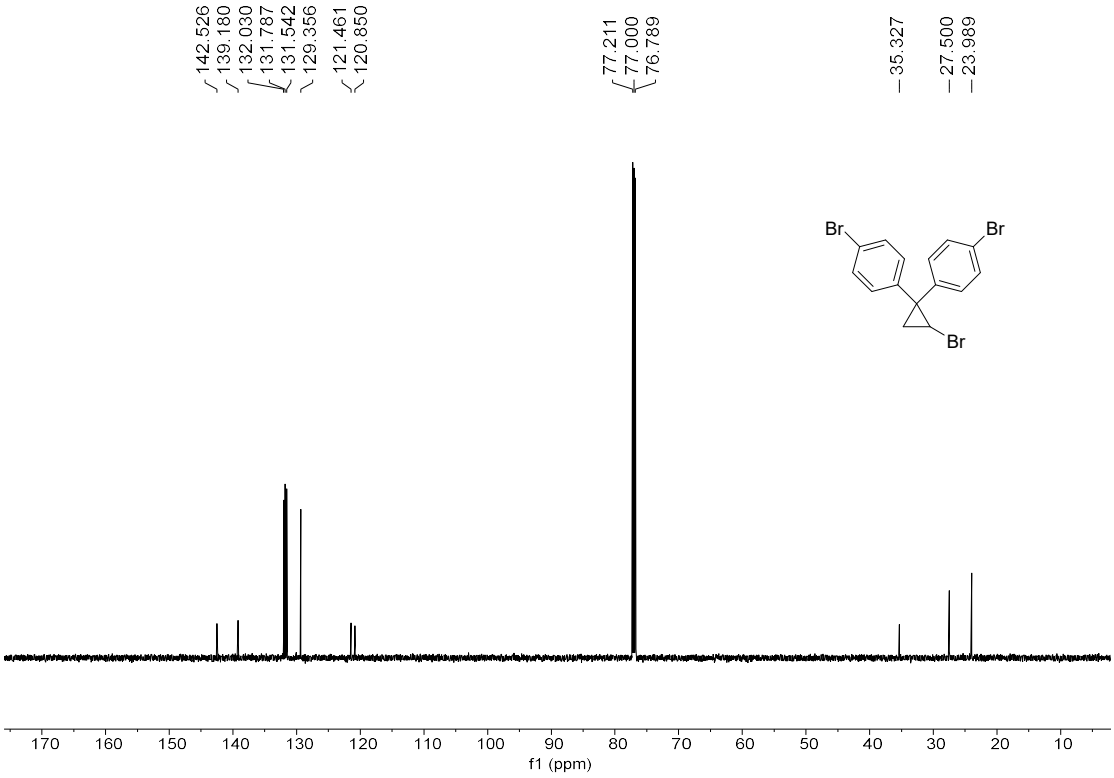
[1] (a) Sherrill, W. M.; Kim, R.; Rubin, M. *Tetrahedron* **2008**, *64*, 8610 – 8617. (b) Phan, D. H. T.; Kou, K. G. M., Dong, V. M. *J. Am. Chem. Soc* **2010,** *132*, 16354–16355. (c) Krämer, K.; Leong, P.; Lautens, M. *Org. Lett.* **2011**, *13*, 819-821. (c). Zhang, H.; Wang, B.; Yi; H.; Wang; J. *Org. Lett.* **2015**, *17*, 3322 – 3325.

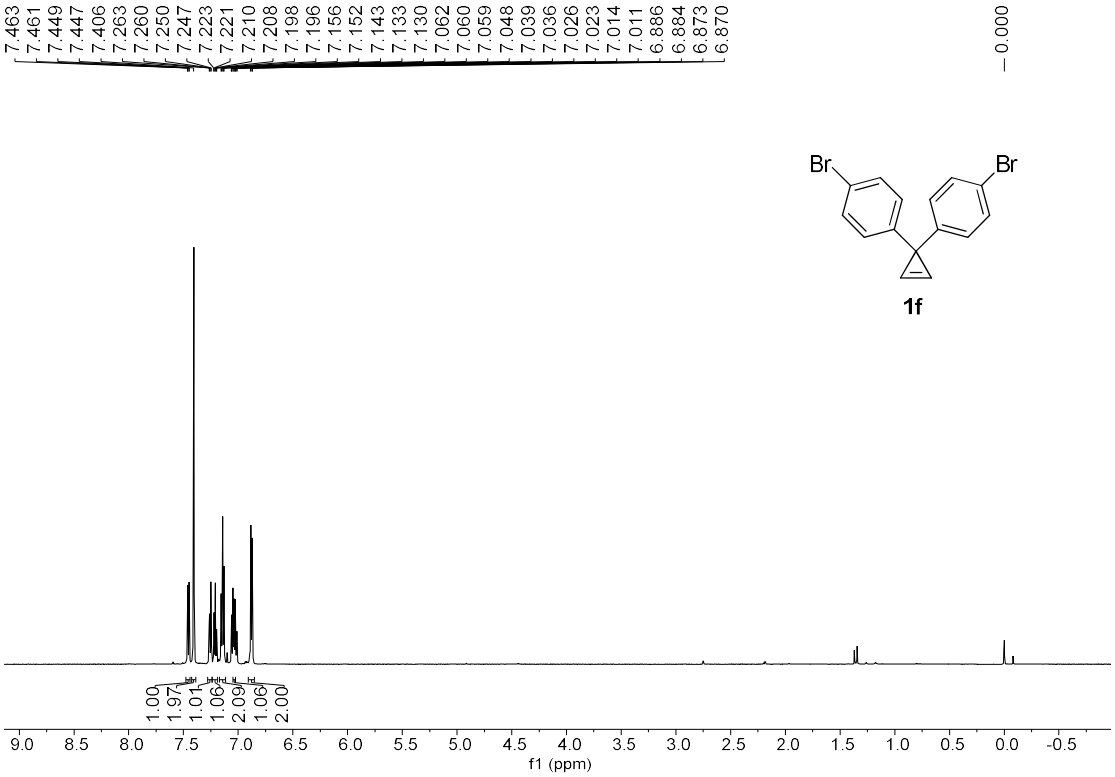
[2] Liu, X. Y.; Yang, C. T.; Zhang, Z. Q.; Lu, X.; Luo, X.; Xiao, B.; Fu, Y. *Chem. Commun.* **2015**, *51*, 2388 – 2391.

[3] Zhao, H.; Chen, X. W.; Jiang, H. F.; Zhang, M. *Org. Chem. Front*. **2018**, 5, 539–543.

4. NMR spectra and HPLC chromatographs of new compounds



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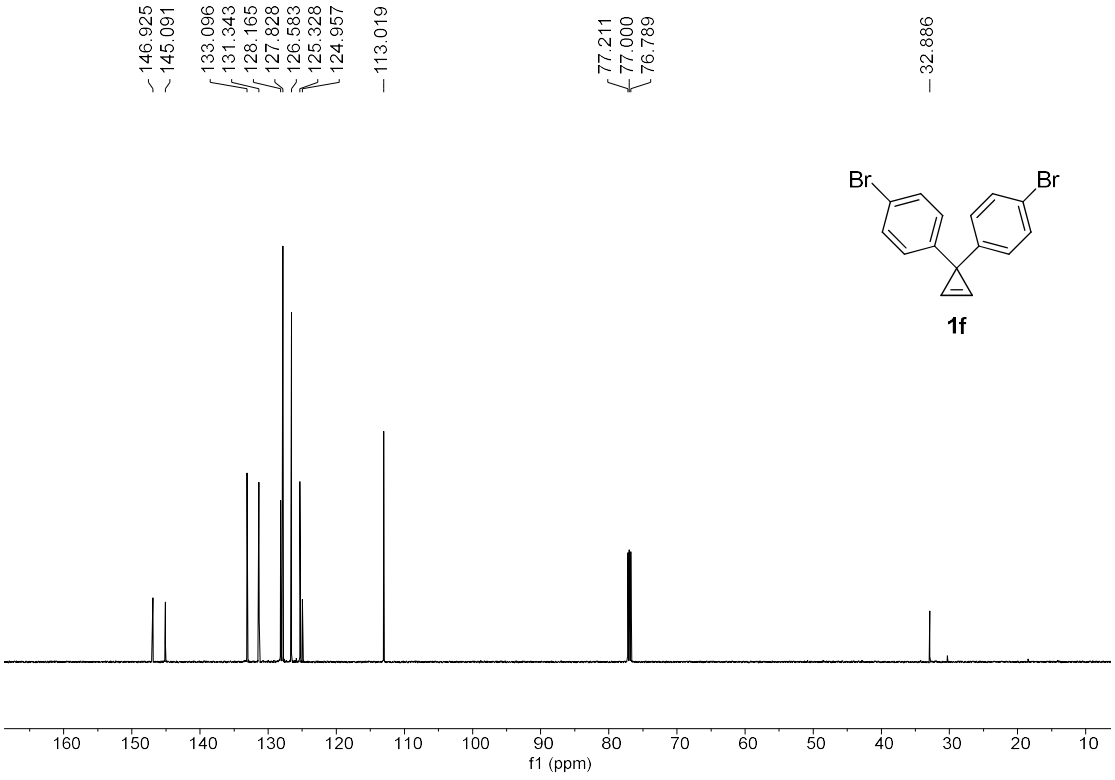
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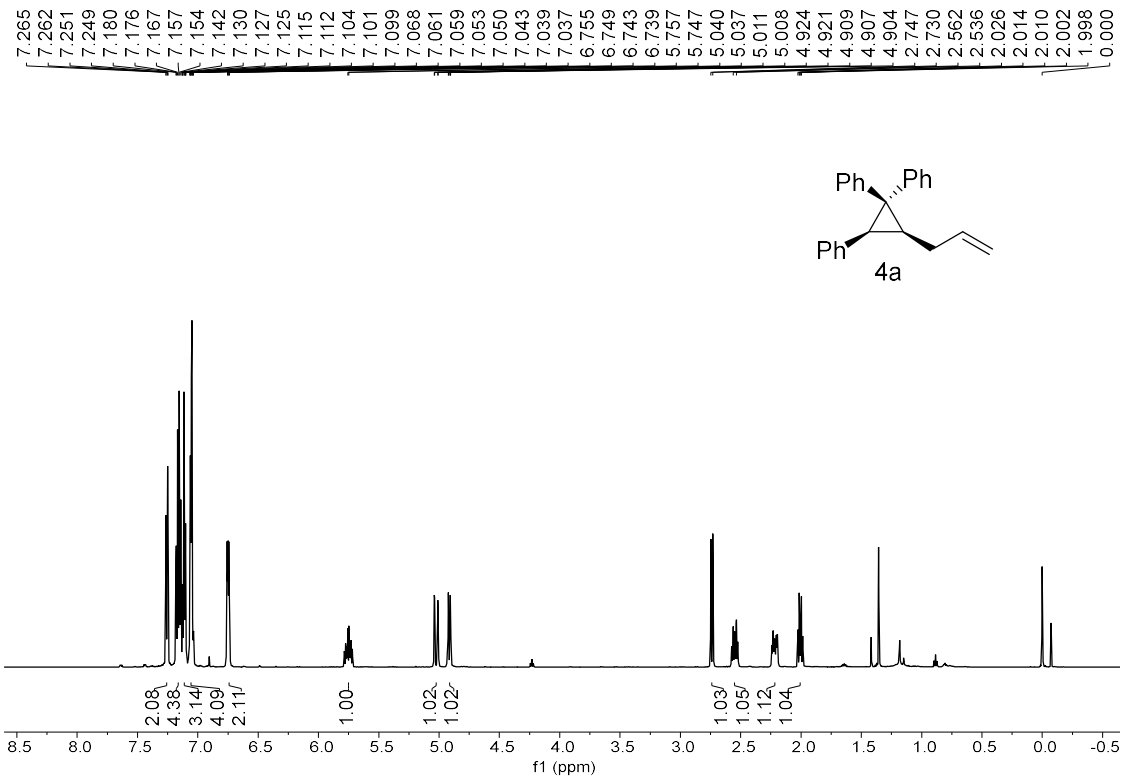
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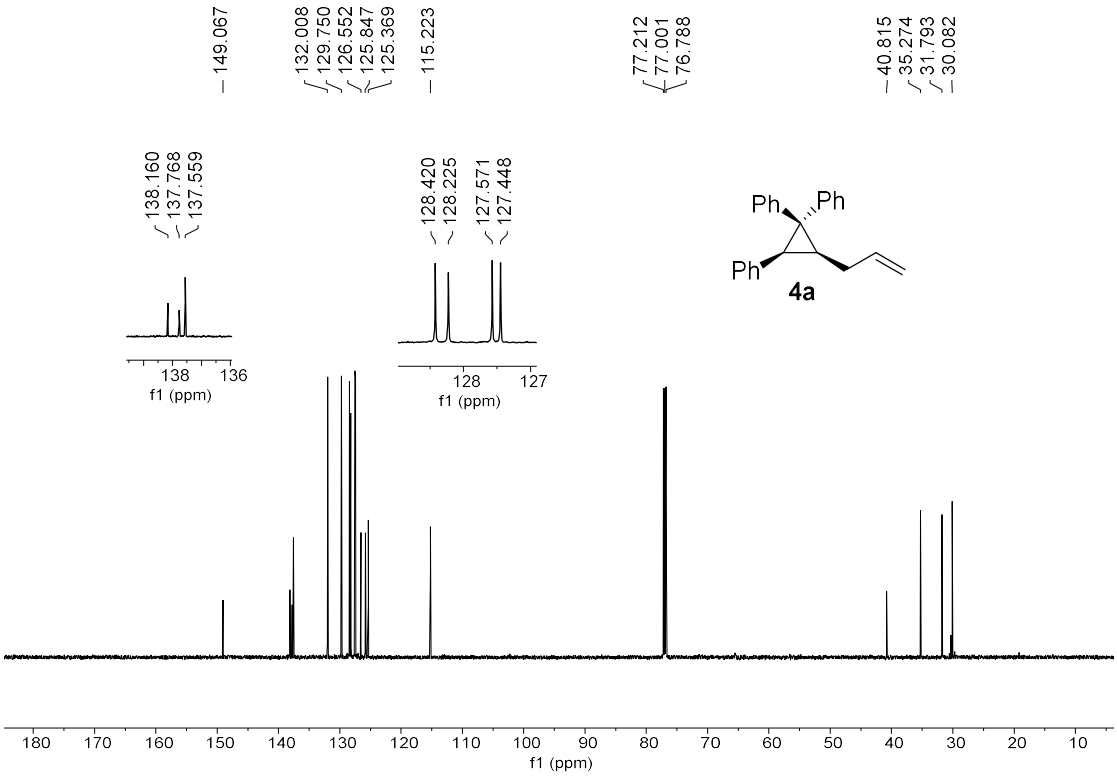
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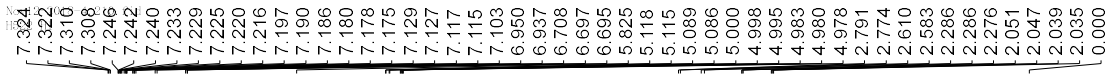
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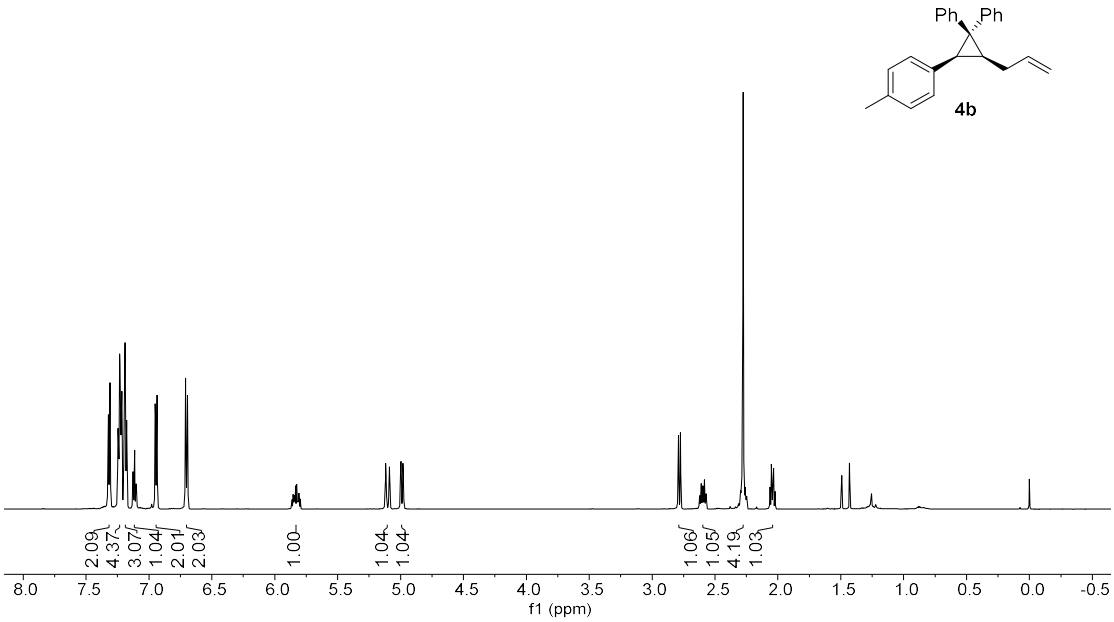
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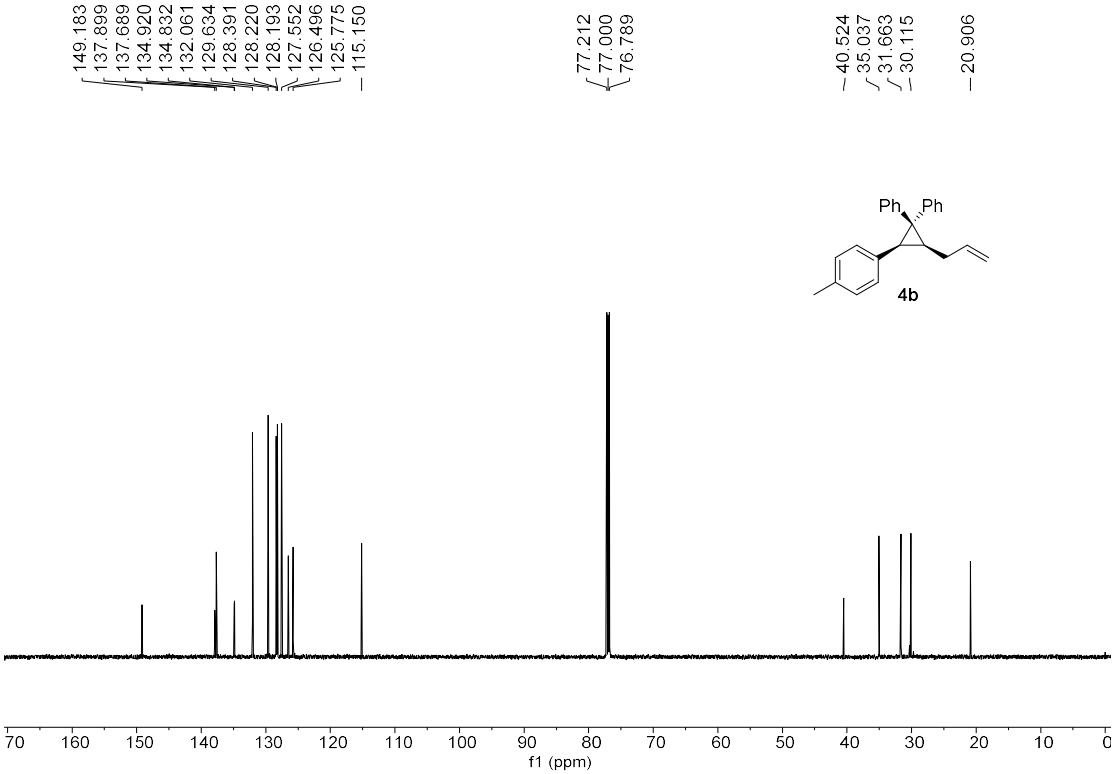
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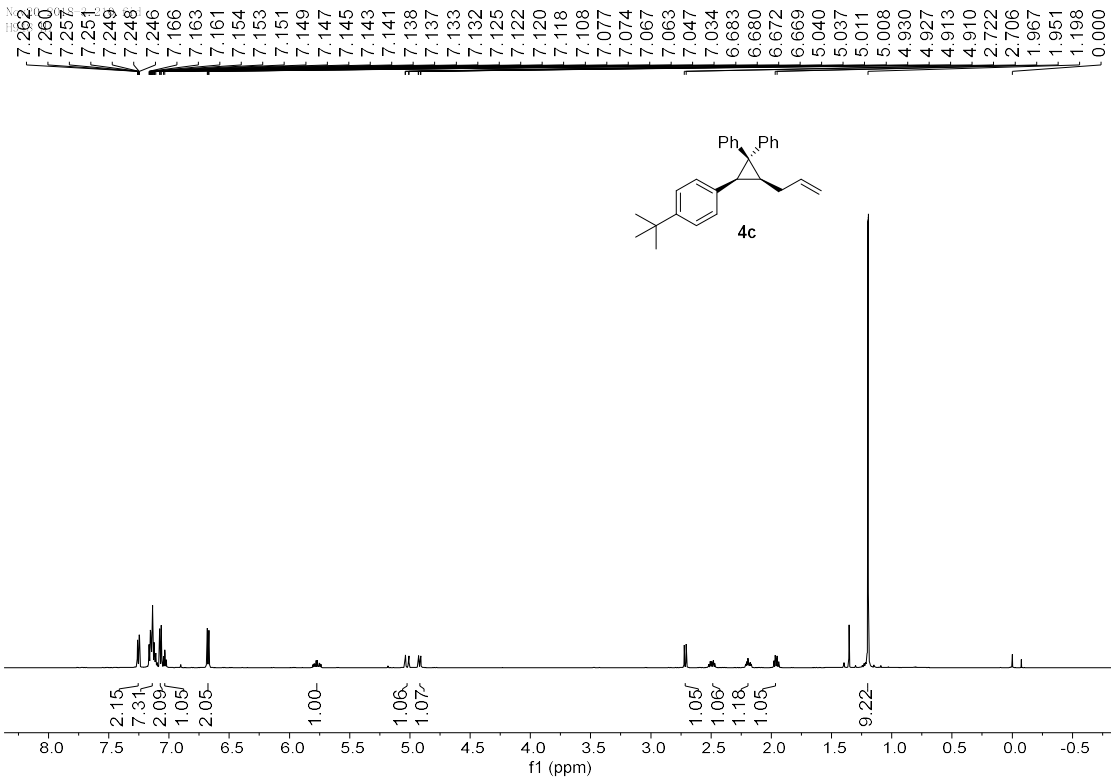
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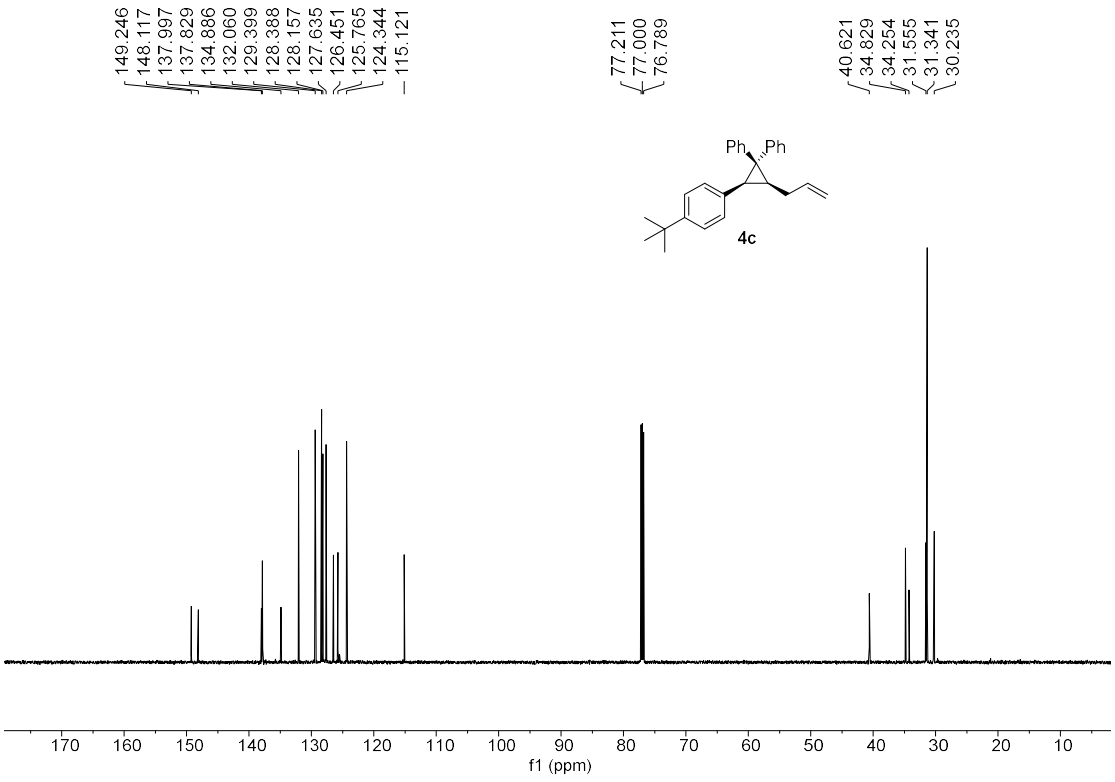
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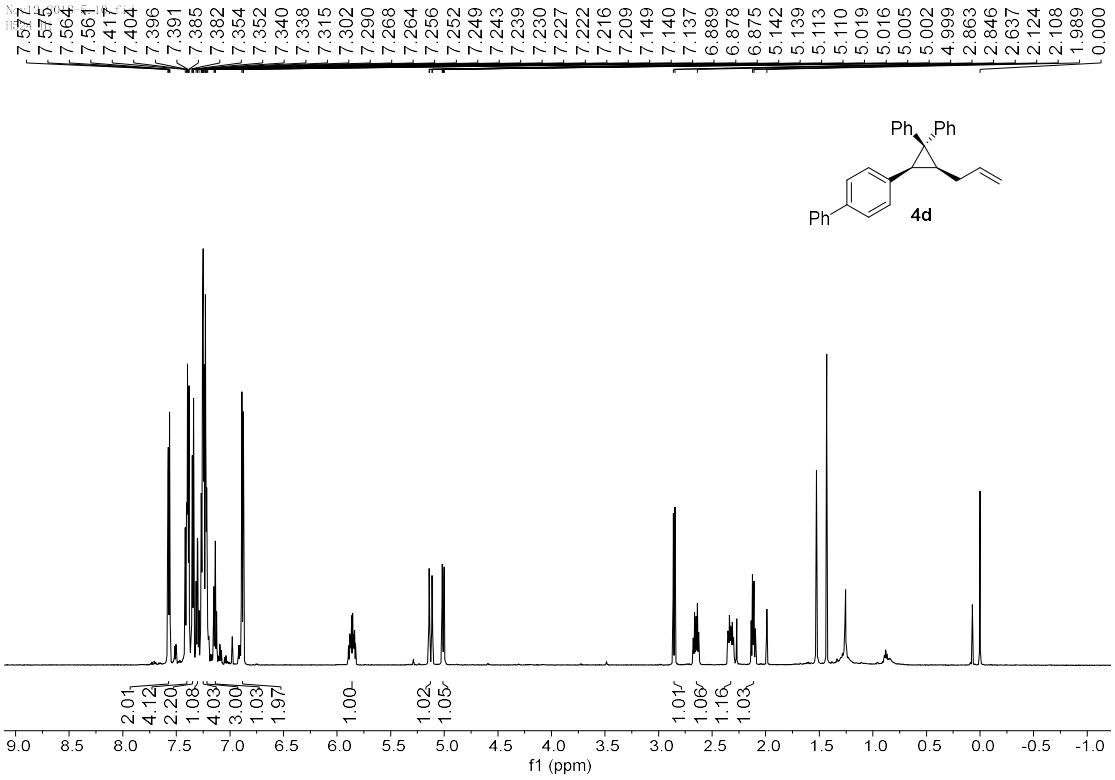
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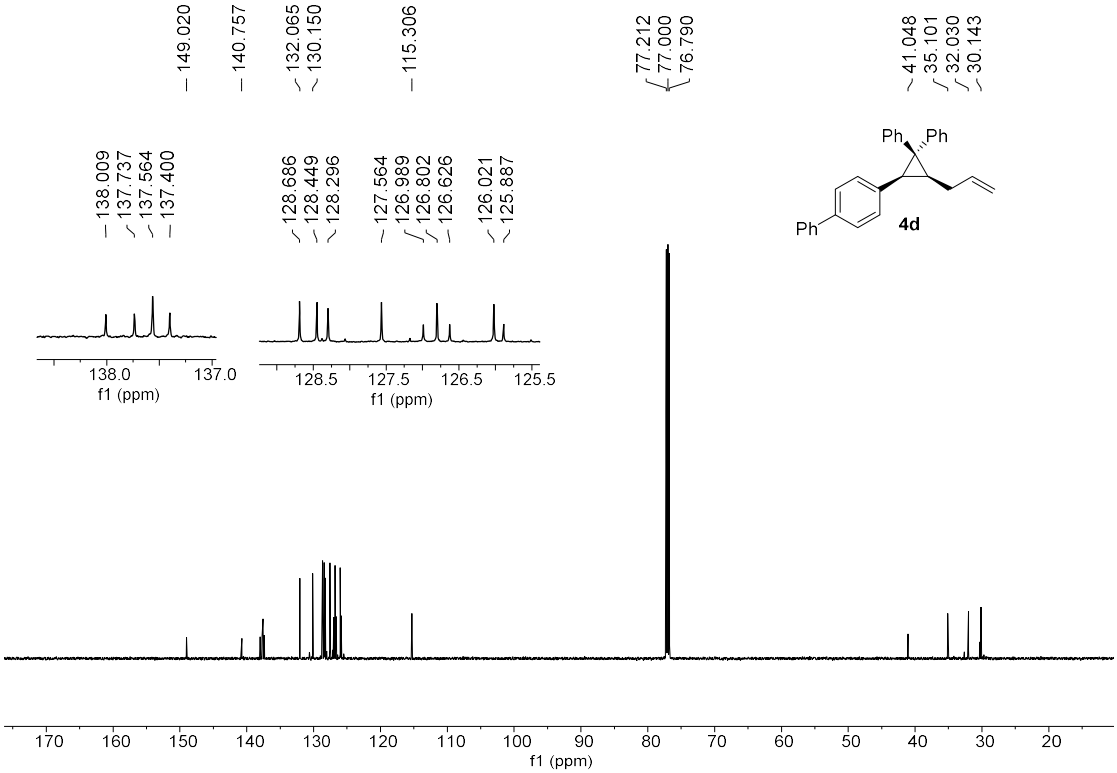
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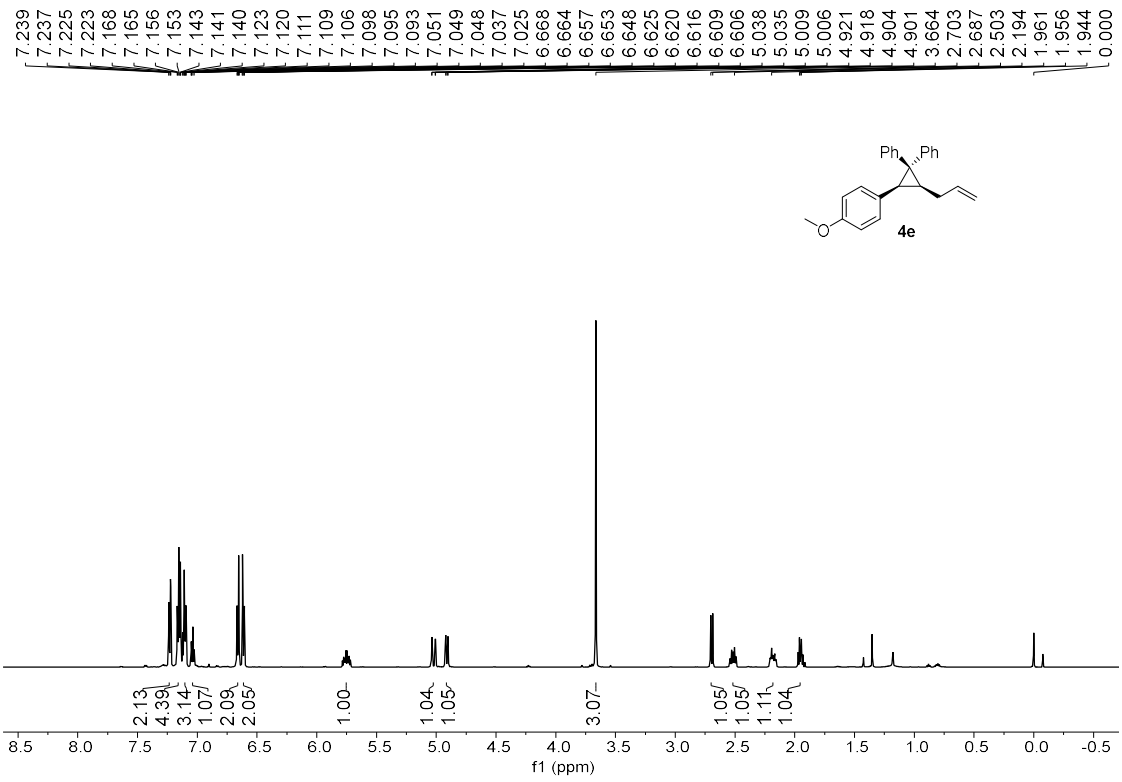
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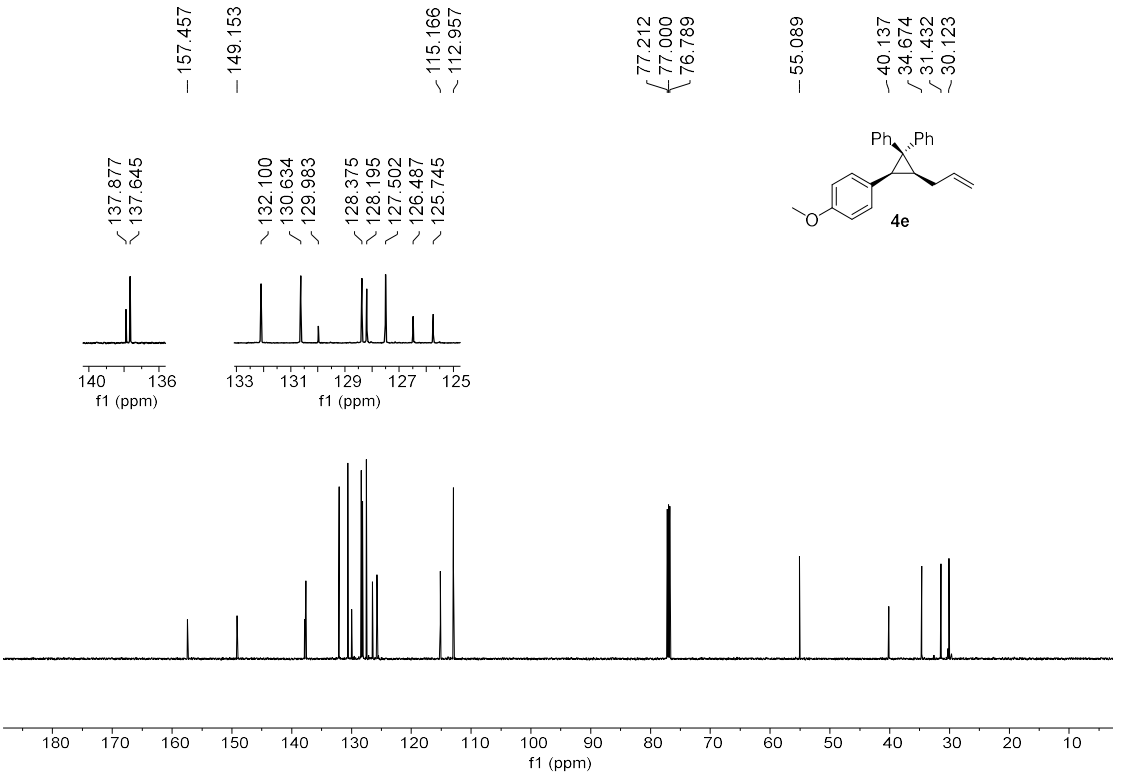
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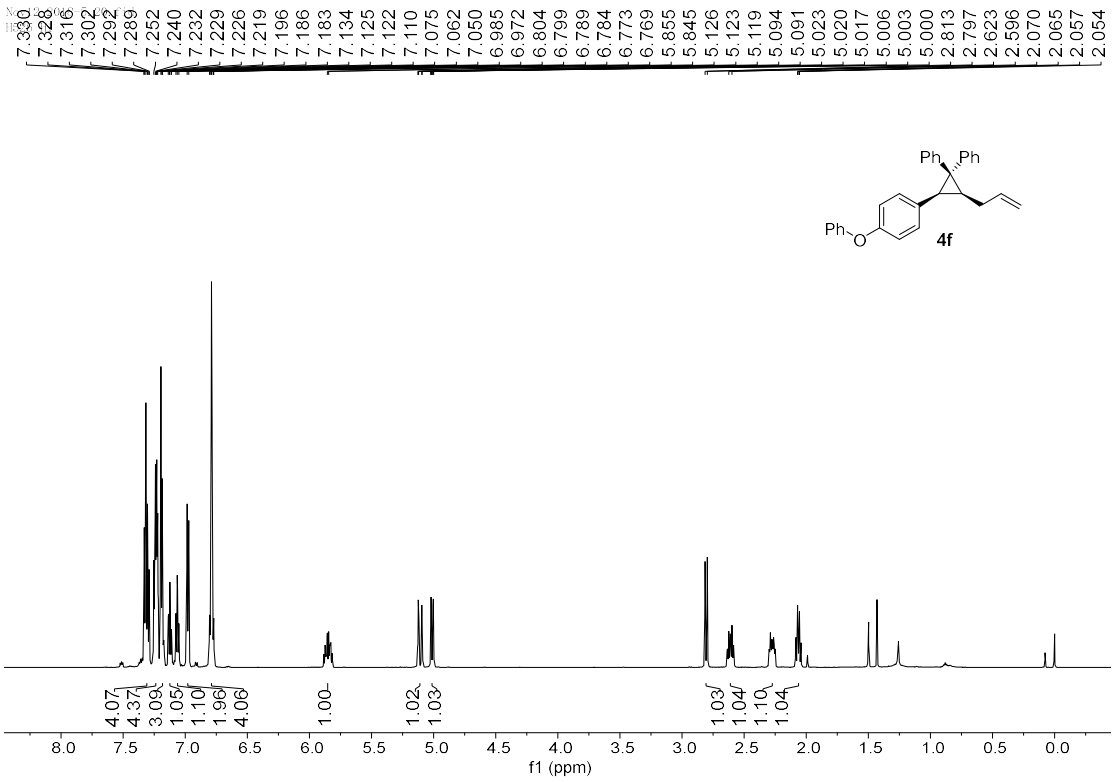
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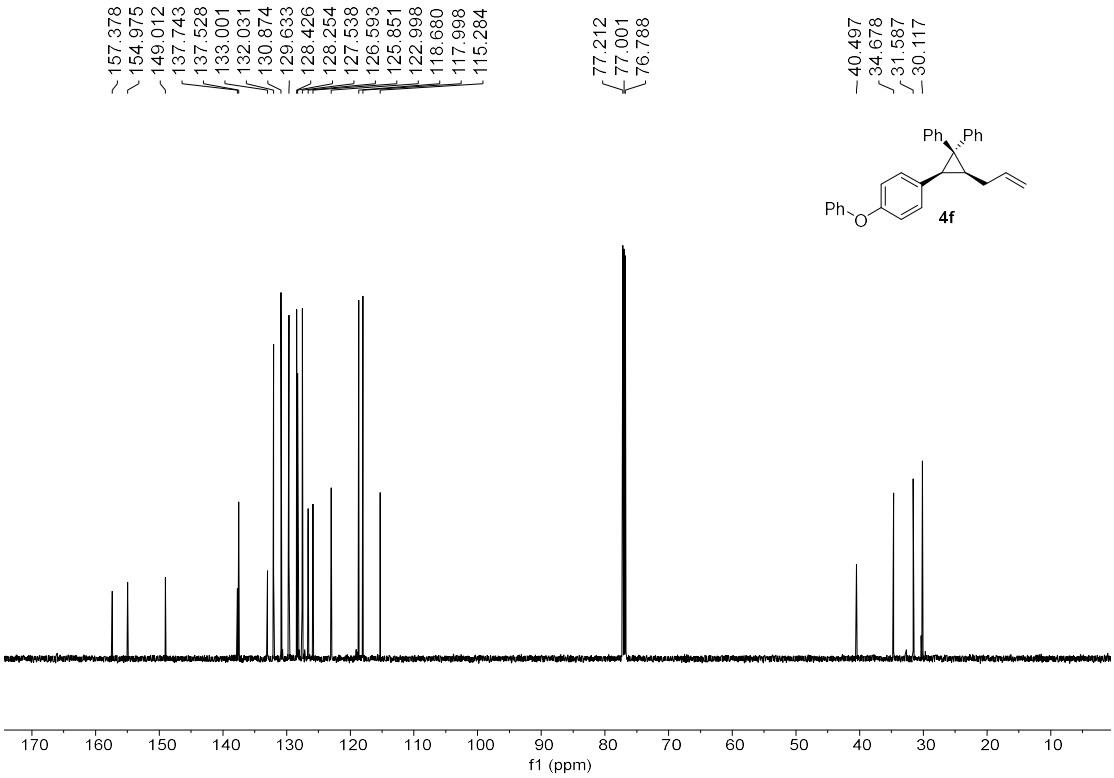
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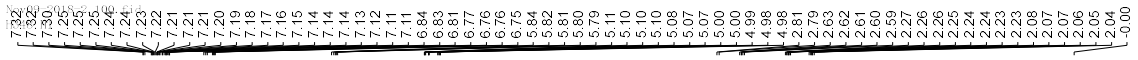

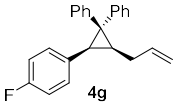
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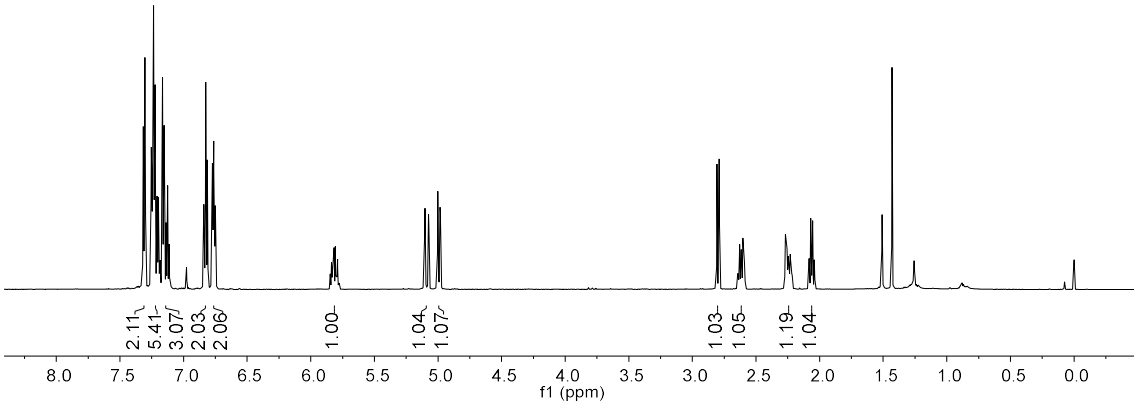
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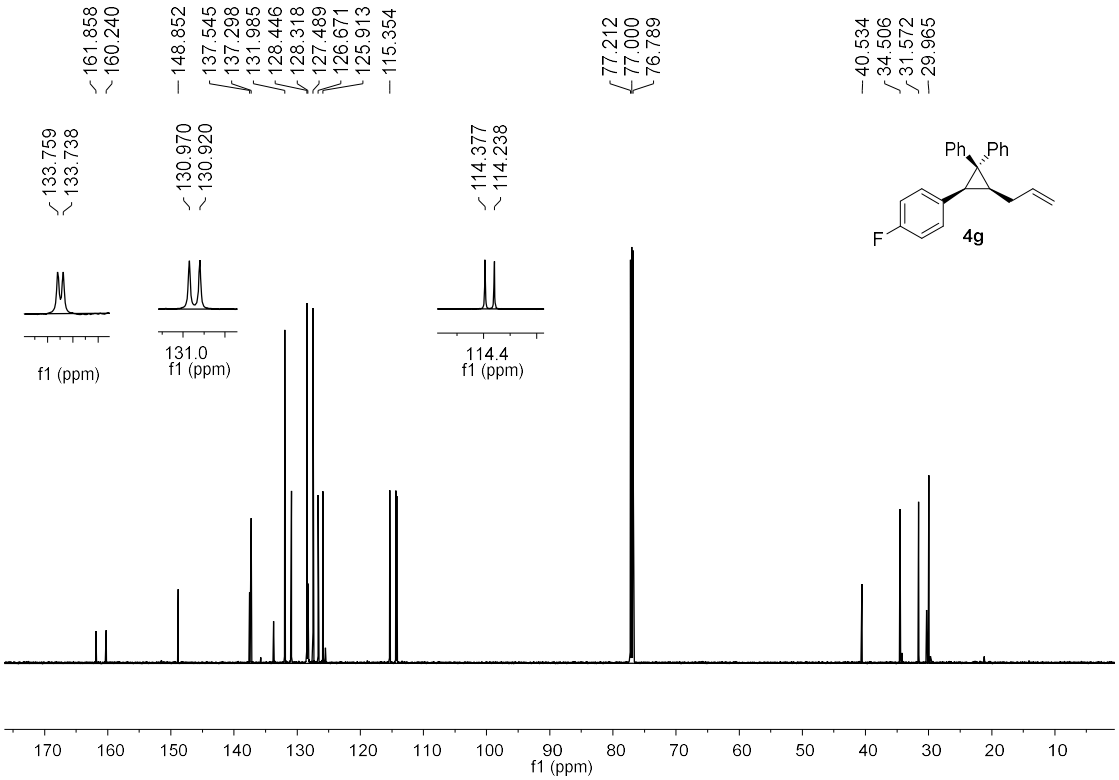
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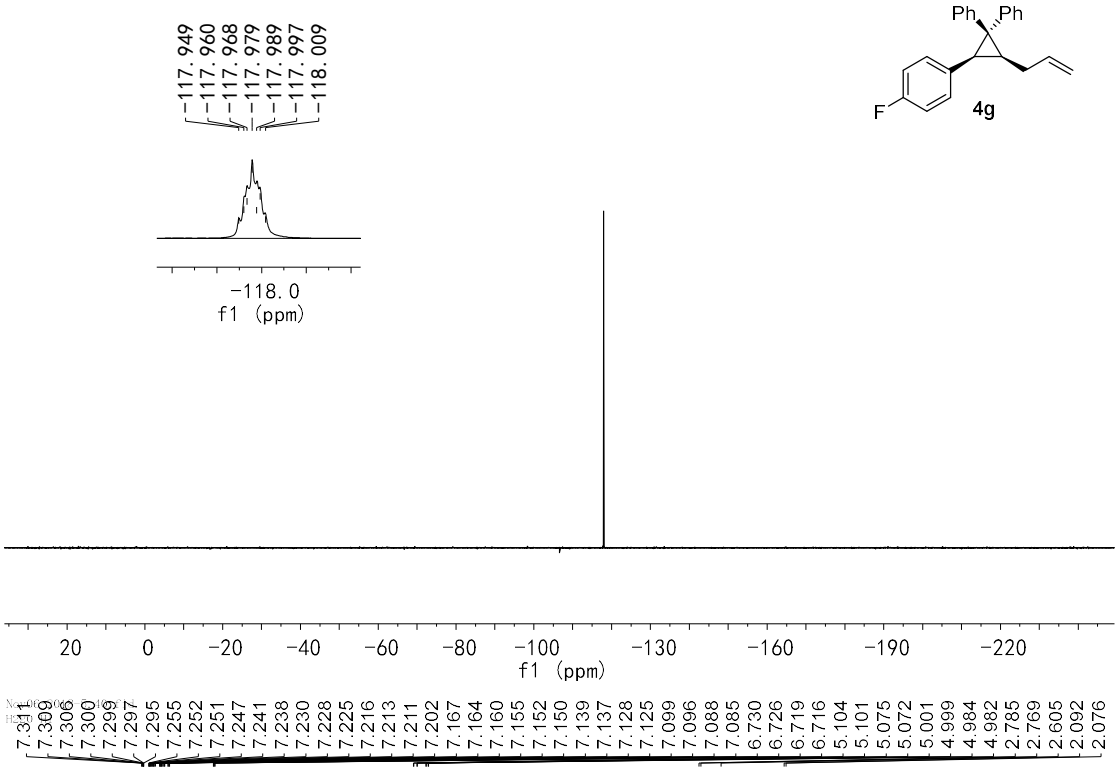
F
4g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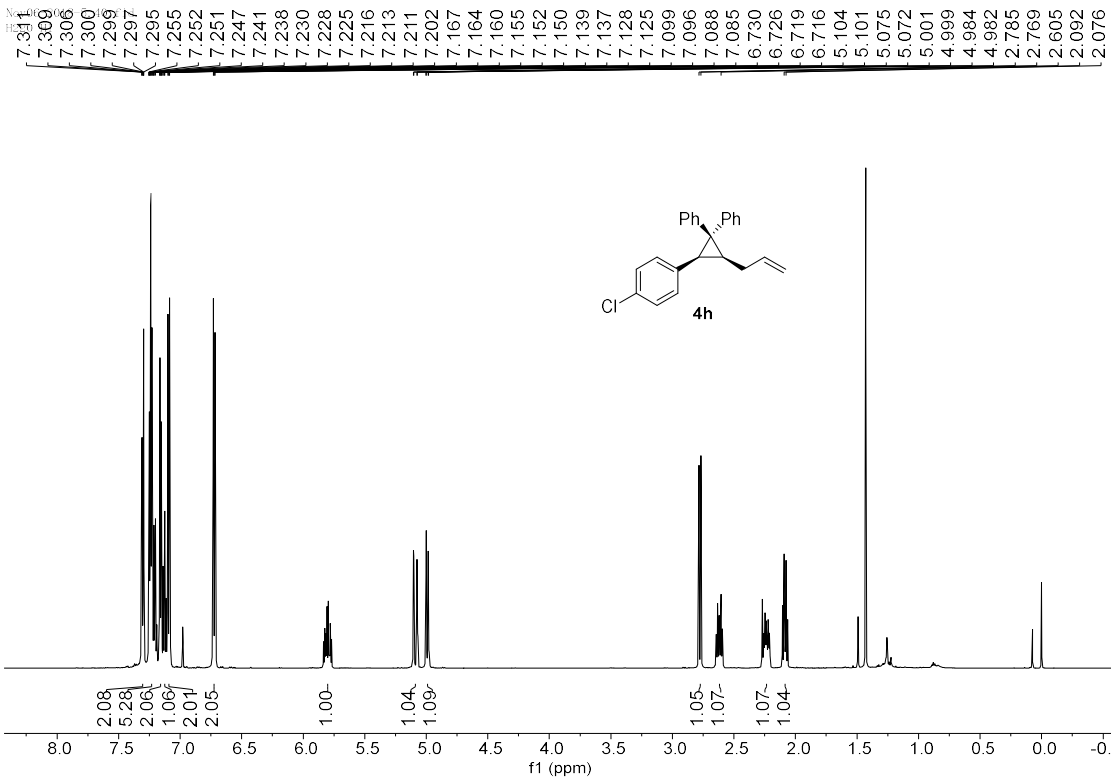
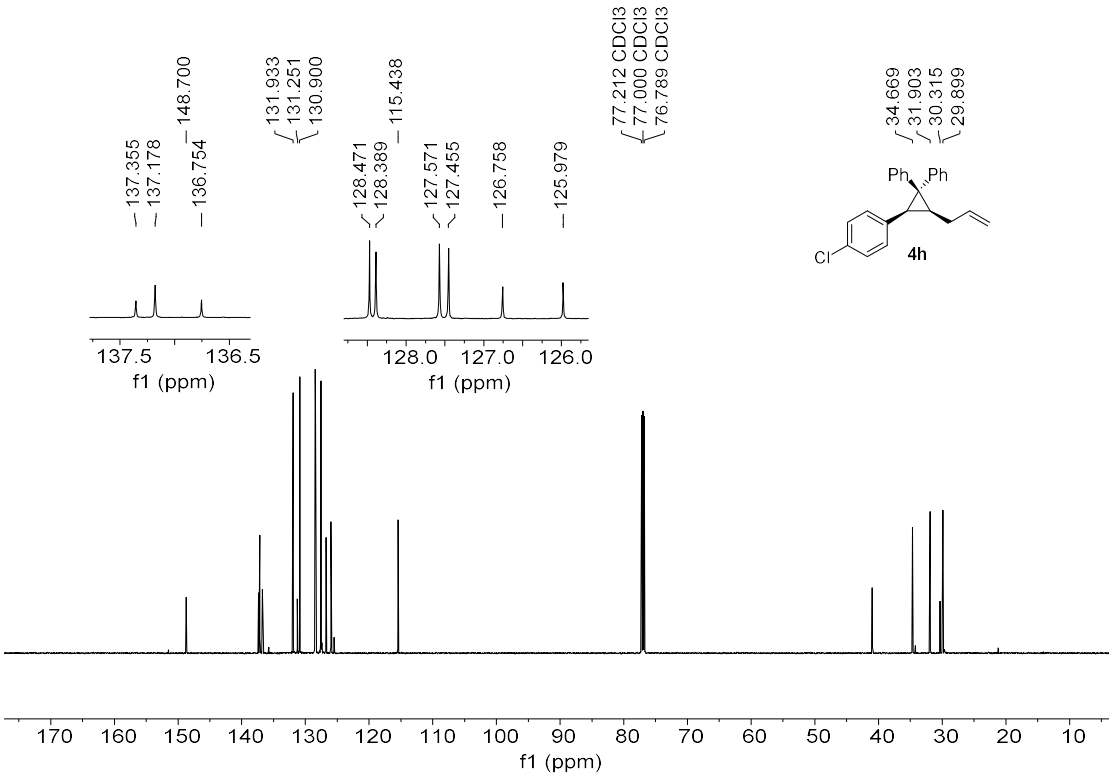
−117.960
−117.968
−117.979
−117.989
−117.997
−118.009
−118.0
f1 (ppm)
Ph
Ph
F
4g
20
0
−20
−40
−60
−80
−100
−130
−160
−190
−220
f1 (ppm)


Ph
Ph
Cl
4h
2.08
5.28
2.06
1.06
2.01
2.05
1.00
1.04
1.09
1.05
1.07
1.07
1.04
f1 (ppm)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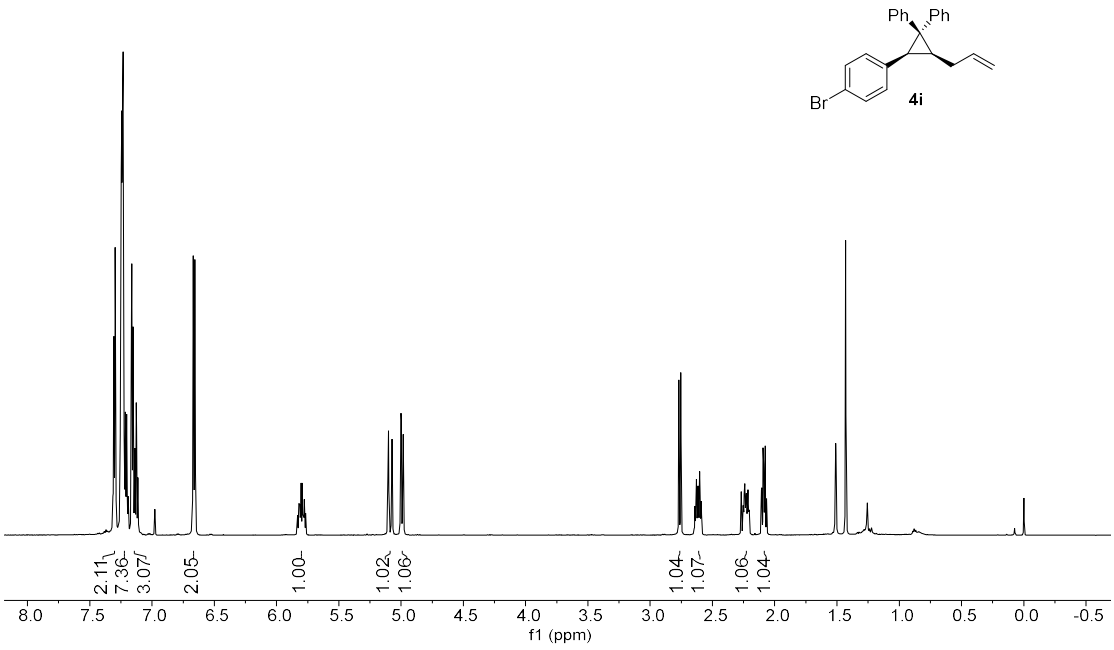
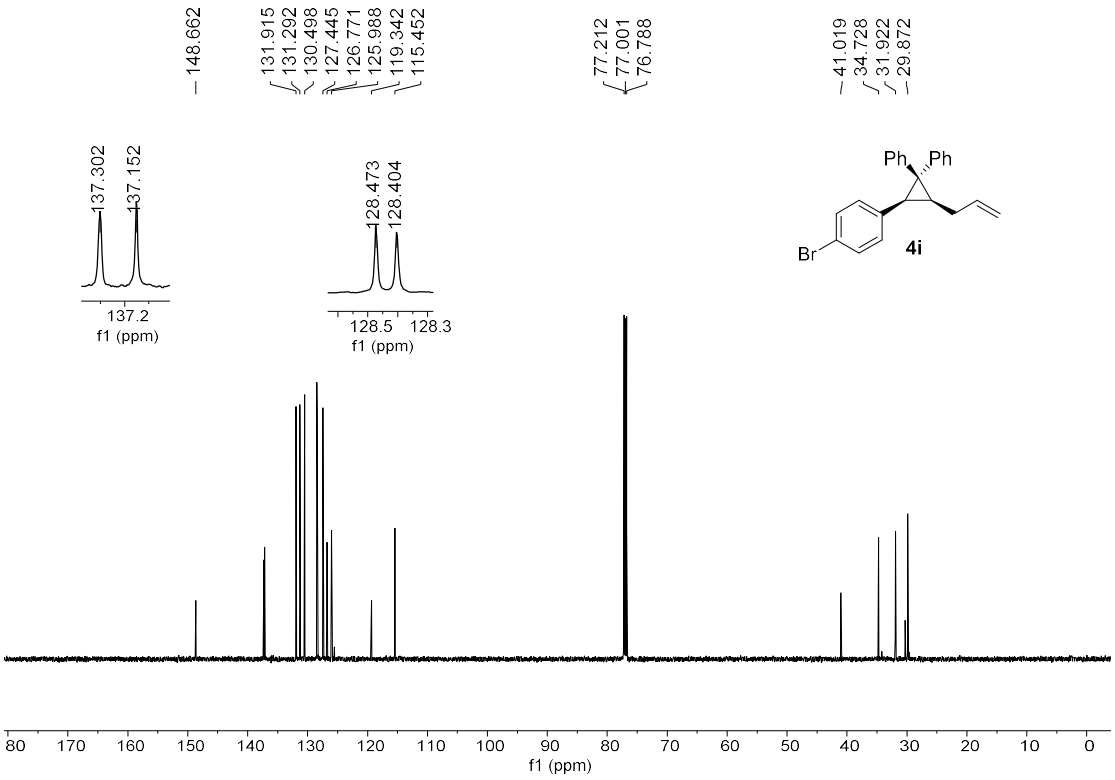
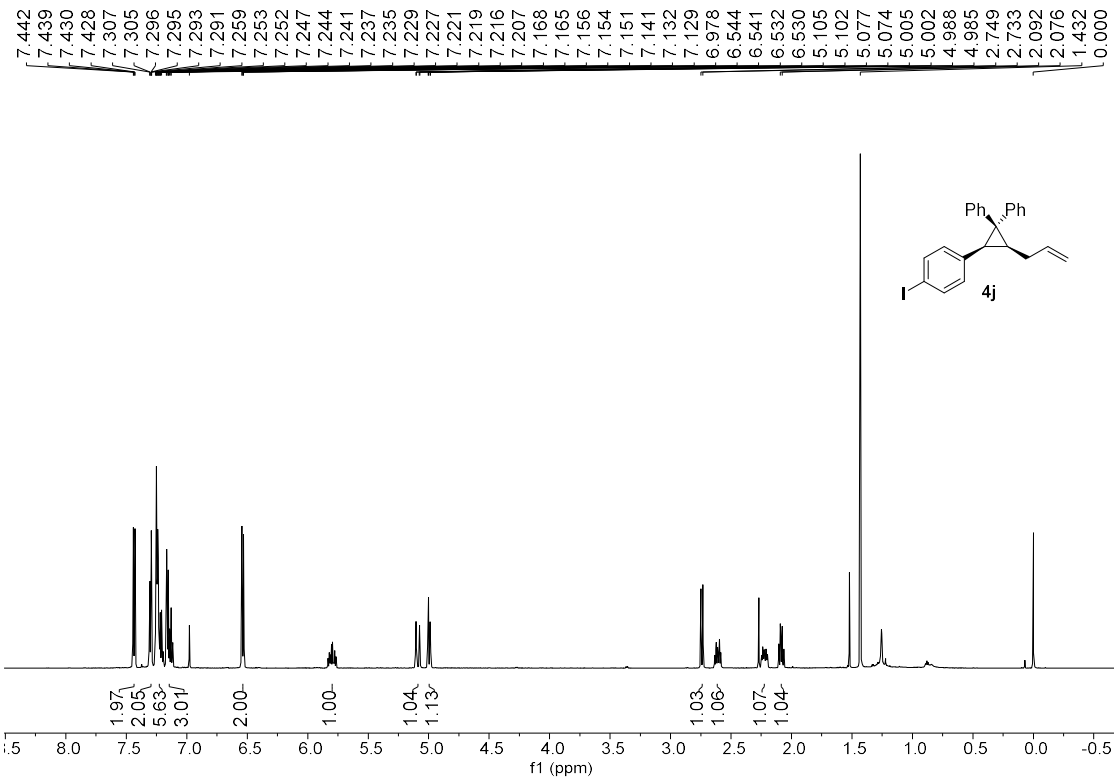
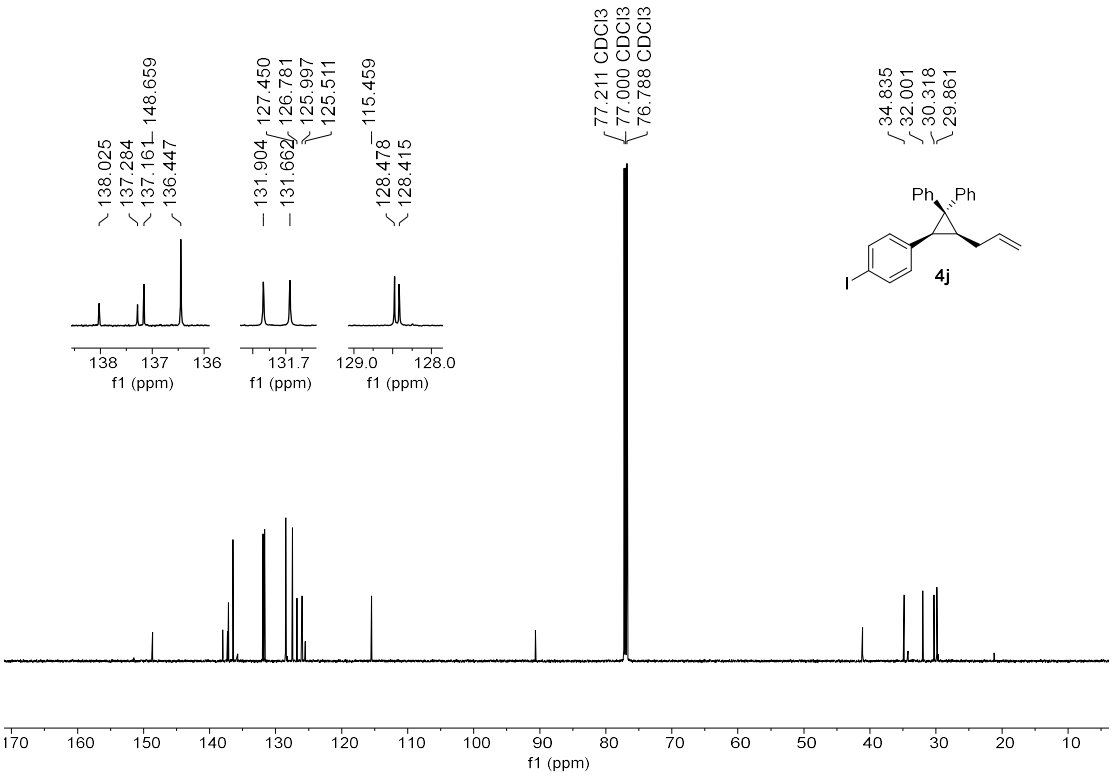
148.700
136.754
131.933
131.251
130.900
128.471
128.389
115.438
127.571
127.455
126.758
125.979
77.212 CDCl3
77.000 CDCl3
76.789 CDCl3
34.669
31.903
30.315
29.899
Ph
Ph
Cl
4h
137.5
136.5
f1 (ppm)
128.0
127.0
126.0
f1 (ppm)
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

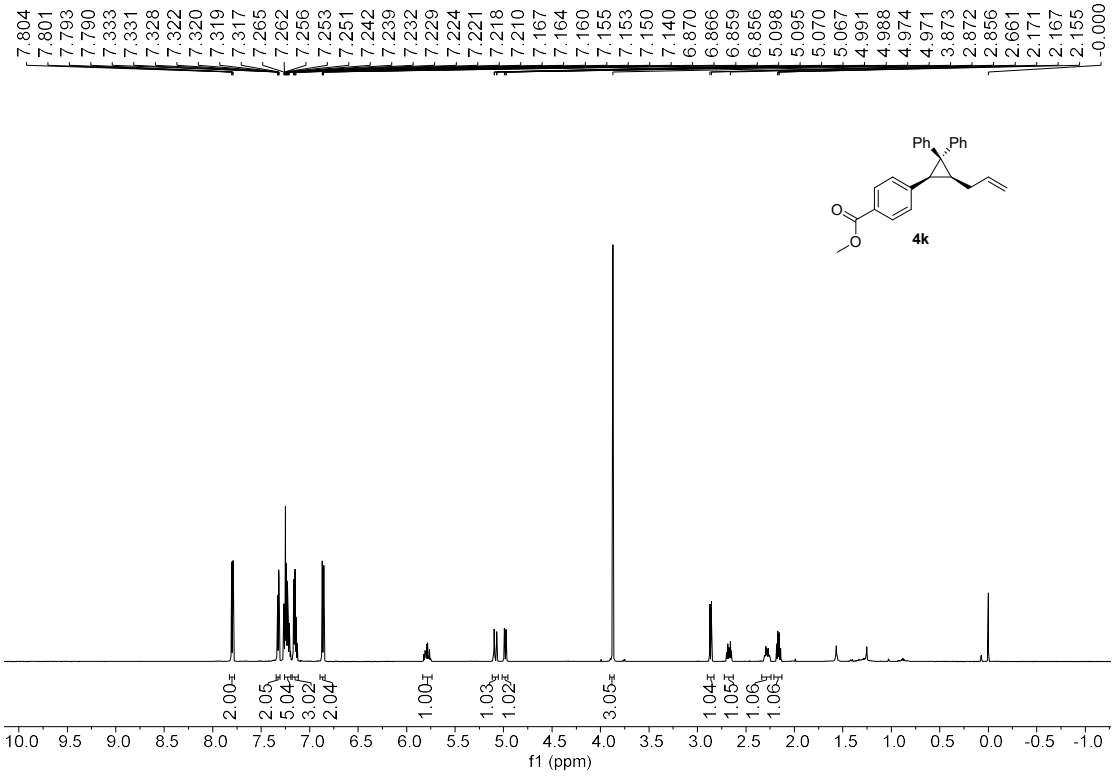

7.310
7.307
7.304
7.295
7.293
7.290
7.257
7.254
7.251
7.247
7.243
7.240
7.238
7.236
7.232
7.230
7.225
7.217
7.215
7.212
7.203
7.166
7.163
7.160
7.152
7.150
7.138
7.126
7.123
6.670
6.666
6.656
6.652
5.104
5.101
5.075
5.072
5.002
5.000
4.997
4.985
4.982
2.769
2.753
2.602
2.093
2.089
2.077
1.510
1.430
1.427

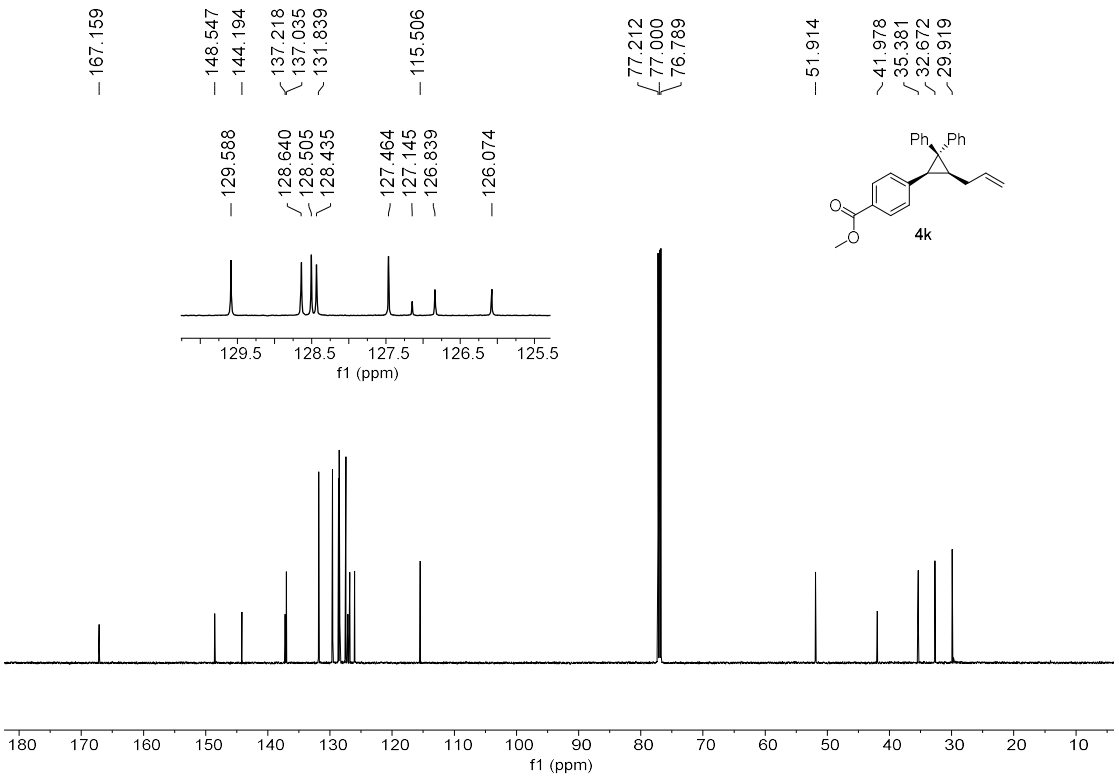

Ph
Ph
Br
4i
2.11
7.36
3.07
2.05
1.00
1.02
1.06
1.04
1.07
1.06
1.04
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

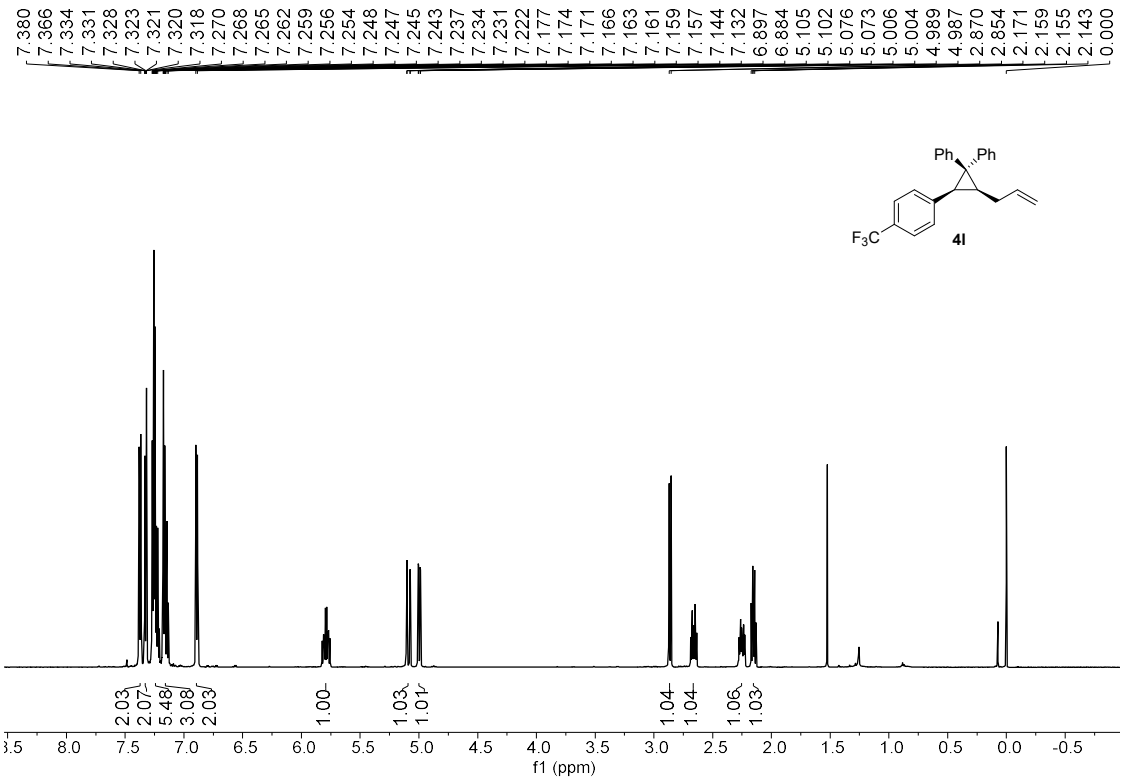

148.662
131.915
131.292
130.498
127.445
126.771
125.988
119.342
115.452
77.212
77.001
76.788
41.019
34.728
31.922
29.872
137.302
137.152
137.2
f1 (ppm)
128.473
128.404
128.5
128.3
f1 (ppm)
Ph
Ph
Br
4i
80
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.442
7.439
7.430
7.428
7.307
7.305
7.296
7.295
7.293
7.291
7.259
7.253
7.252
7.247
7.244
7.241
7.237
7.235
7.229
7.227
7.221
7.219
7.216
7.207
7.168
7.165
7.156
7.154
7.151
7.141
7.132
7.129
6.978
6.544
6.541
6.532
6.530
5.105
5.102
5.077
5.074
5.005
5.002
4.988
4.985
2.749
2.733
2.092
2.076
1.432
0.000
Ph
Ph
I
4j
1.97
2.05
5.63
3.01
2.00
1.00
1.04
1.13
1.03
1.06
1.07
1.04
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


138.025
137.284
137.161
148.659
136.447
131.904
127.450
131.662
126.781
125.997
125.511
115.459
128.478
128.415
77.211 CDCl3
77.000 CDCl3
76.788 CDCl3
34.835
32.001
30.318
29.861
Ph
Ph
I
4j
f1 (ppm)


7.804
7.801
7.793
7.790
7.333
7.331
7.328
7.322
7.320
7.319
7.317
7.265
7.262
7.256
7.253
7.251
7.242
7.239
7.232
7.229
7.224
7.221
7.218
7.210
7.167
7.164
7.160
7.155
7.153
7.150
7.140
6.870
6.866
6.859
6.856
5.098
5.095
5.070
5.067
4.991
4.988
4.974
4.971
3.873
2.872
2.856
2.661
2.171
2.167
2.155
-0.000
Ph
Ph
O
O
4k
2.00
2.05
5.04
3.02
2.04
1.00
1.03
1.02
3.05
1.04
1.05
1.06
1.06
f1 (ppm)


167.159
148.547
144.194
137.218
137.035
131.839
115.506
77.212
77.000
76.789
51.914
41.978
35.381
32.672
29.919
129.588
128.640
128.505
128.435
127.464
127.145
126.839
126.074
Ph
Ph
O
O
4k
129.5
128.5
127.5
126.5
125.5
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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7.366
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7.331
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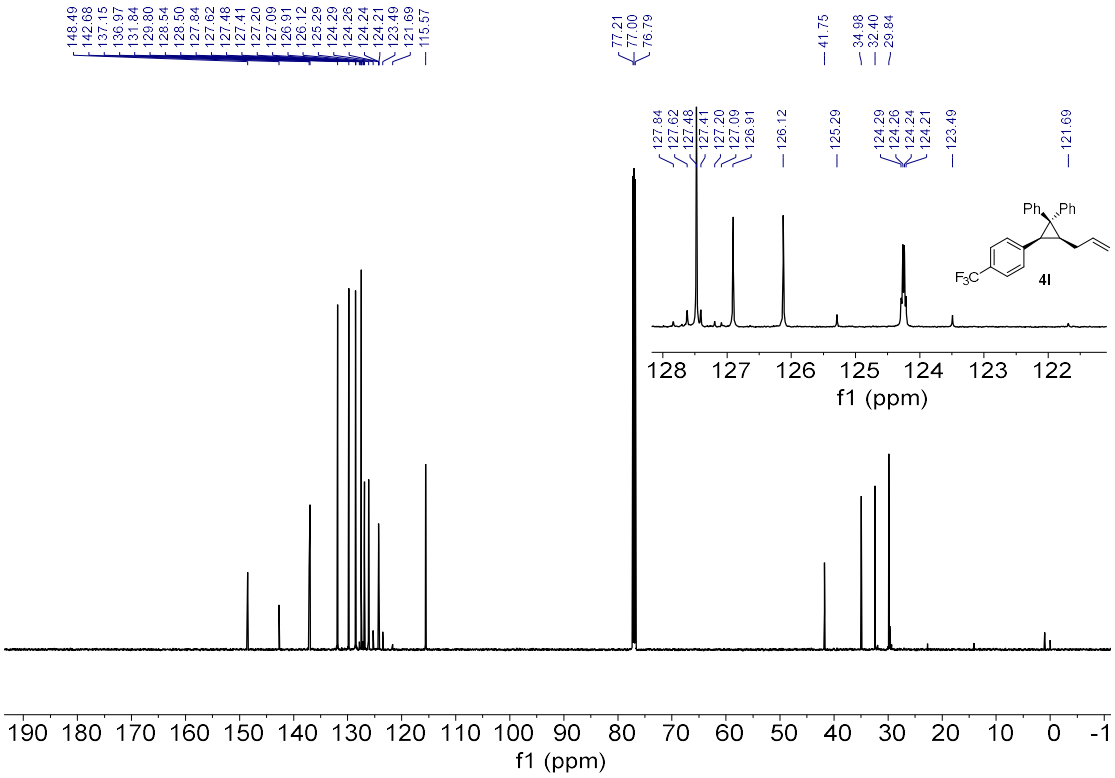
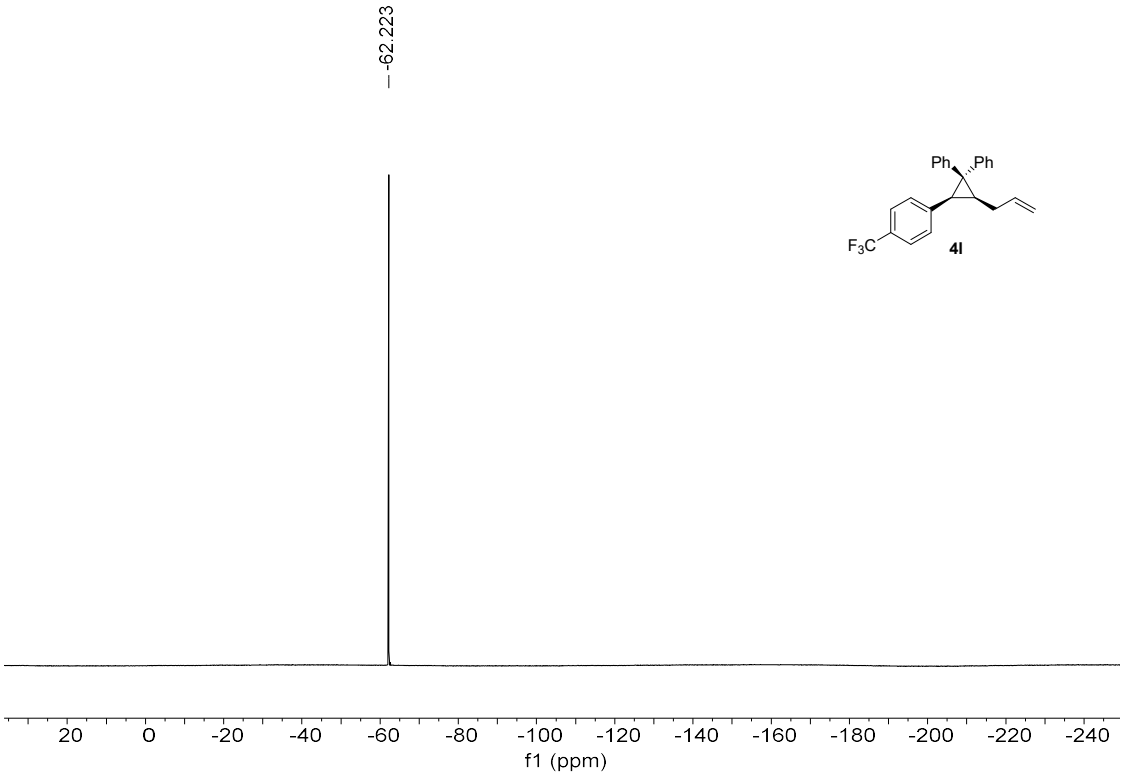
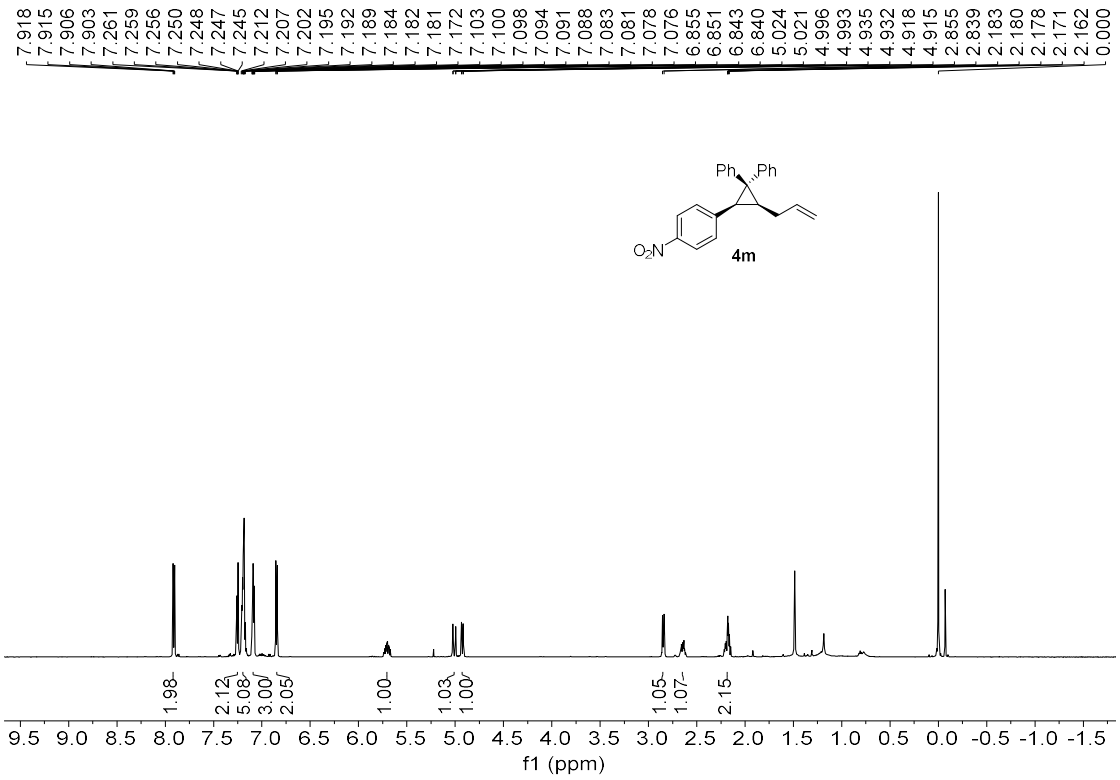
7.323
7.321
7.320
7.318
7.270
7.268
7.265
7.262
7.259
7.256
7.254
7.248
7.247
7.245
7.243
7.237
7.234
7.231
7.222
7.177
7.174
7.171
7.166
7.163
7.161
7.159
7.157
7.144
7.132
6.897
6.884
5.105
5.102
5.076
5.073
5.006
5.004
4.989
4.987
2.870
2.854
2.171
2.159
2.155
2.143
0.000
Ph
Ph
F3C
4l
2.03
2.07
5.48
3.08
2.03
1.00
1.03
1.01
1.04
1.04
1.06
1.03
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


148.49
142.68
137.15
136.97
131.84
129.80
128.54
128.50
127.84
127.62
127.48
127.41
127.20
127.09
126.91
126.12
125.29
124.29
124.26
124.24
124.21
123.49
121.69
115.57
77.21
77.00
76.79
41.75
34.98
32.40
29.84
Ph
Ph
F3C
4l
f1 (ppm)
f1 (ppm)


-62.223
Ph
Ph
F3C
4l
f1 (ppm)


7.918
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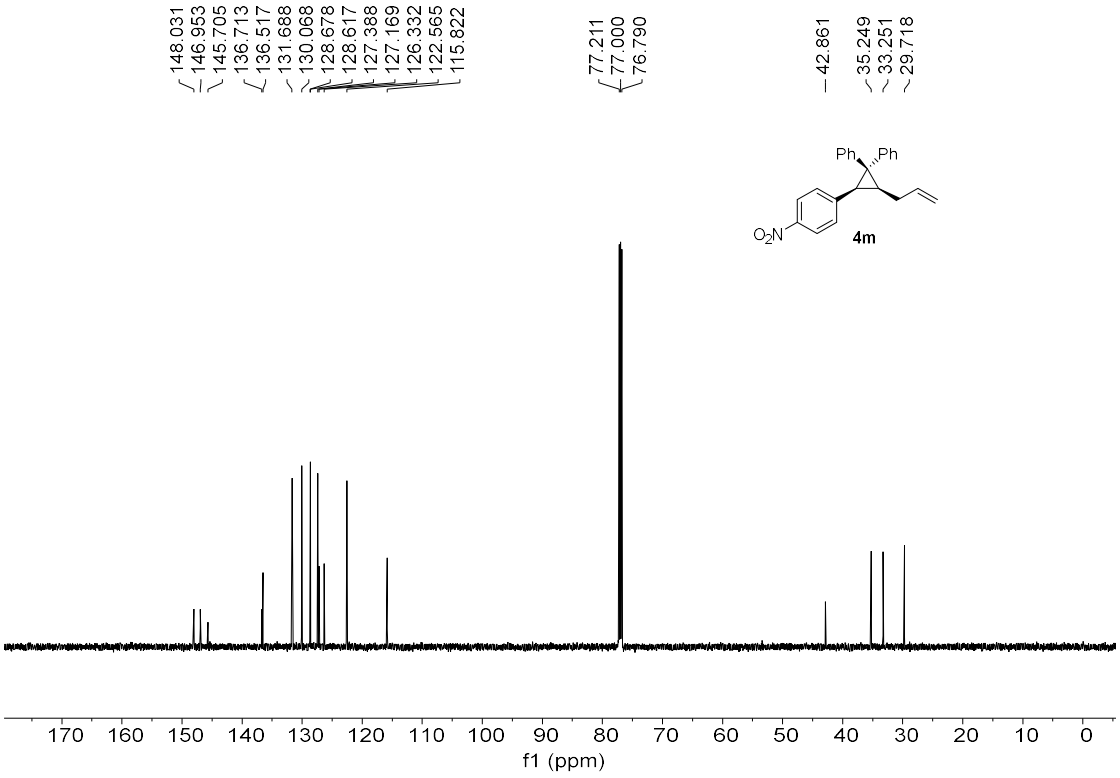
7.906
7.903
7.261
7.259
7.256
7.250
7.248
7.247
7.245
7.212
7.207
7.202
7.195
7.192
7.189
7.184
7.182
7.181
7.172
7.103
7.100
7.098
7.094
7.091
7.088
7.083
7.081
7.078
7.076
6.855
6.851
6.843
6.840
5.024
5.021
4.996
4.993
4.935
4.932
4.918
4.915
2.855
2.839
2.183
2.180
2.178
2.171
2.162
0.000
Ph
Ph
O2N
4m
1.98
2.12
5.08
3.00
2.05
1.00
1.03
1.00
1.05
1.07
2.15
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 -1.5
f1 (ppm)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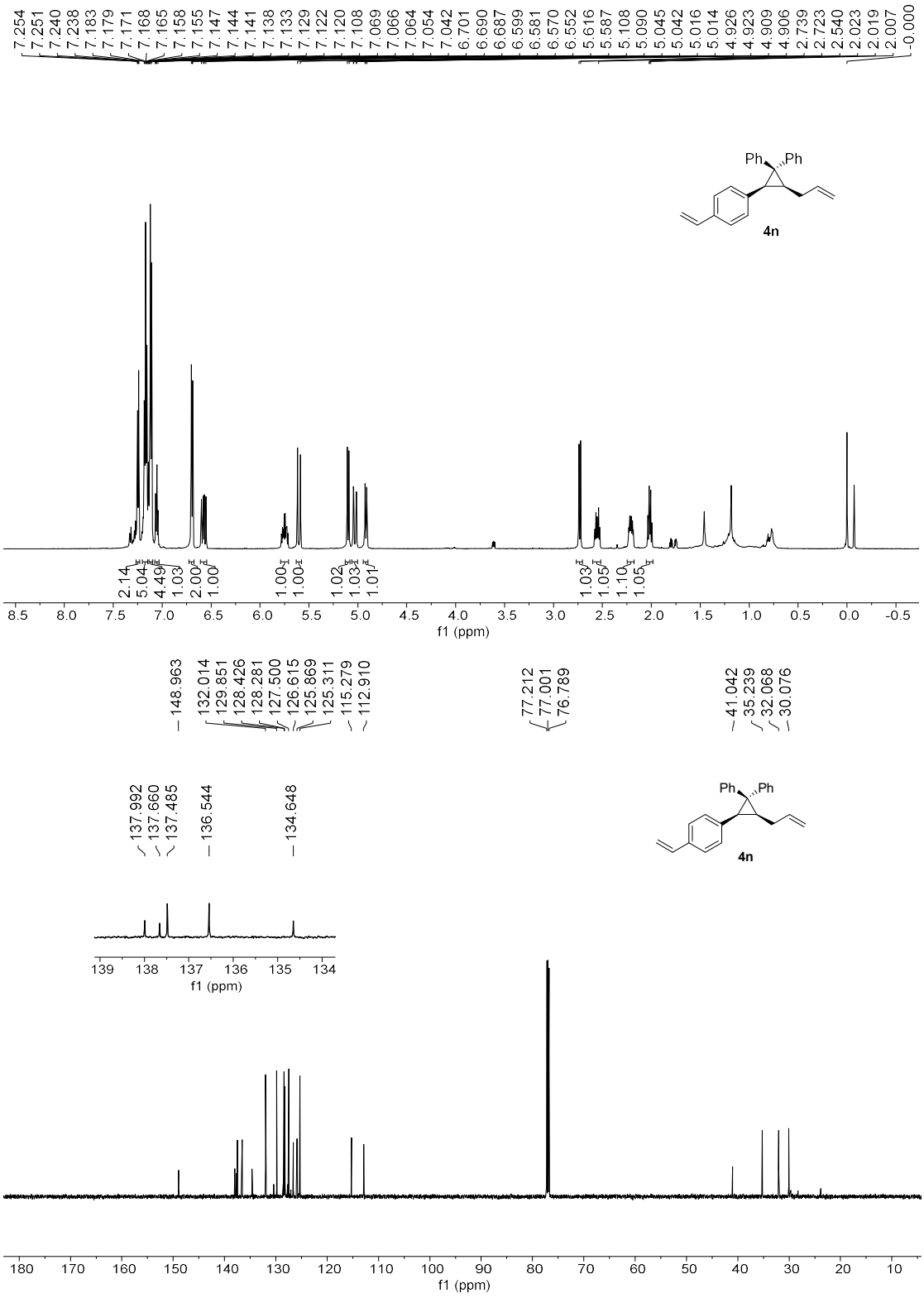
127.388
127.169
126.332
122.565
115.822
77.211
77.000
76.790
42.861
35.249
33.251
29.718
Ph
Ph
O2N
4m
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.254
7.251
7.240
7.238
7.183
7.179
7.171
7.168
7.165
7.158
7.155
7.147
7.144
7.141
7.138
7.133
7.129
7.122
7.120
7.108
7.069
7.066
7.064
7.054
7.042
6.701
6.690
6.687
6.599
6.581
6.570
6.552
5.616
5.587
5.108
5.090
5.045
5.042
5.016
5.014
4.926
4.923
4.909
4.906
2.739
2.723
2.540
2.023
2.019
2.007
-0.000
Ph
Ph
4n
2.14
5.04
4.49
1.03
2.00
1.00
1.00
1.00
1.02
1.03
1.01
1.03
1.05
1.10
1.05
f1 (ppm)
148.963
132.014
129.851
128.426
128.281
127.500
126.615
125.869
125.311
115.279
112.910
77.212
77.001
76.789
41.042
35.239
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137.660
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136.544
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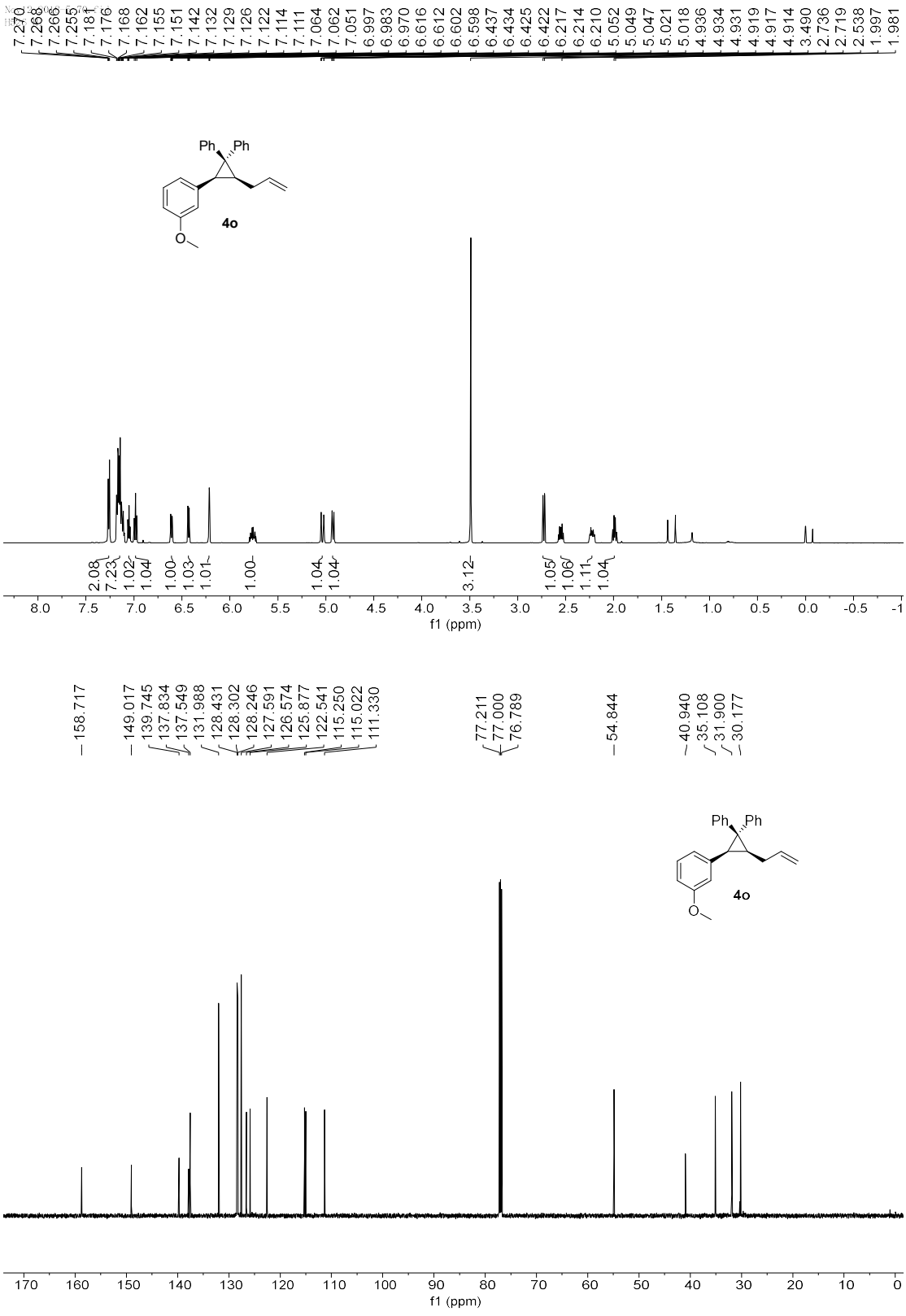
Ph
Ph
4n
f1 (ppm)
f1 (ppm)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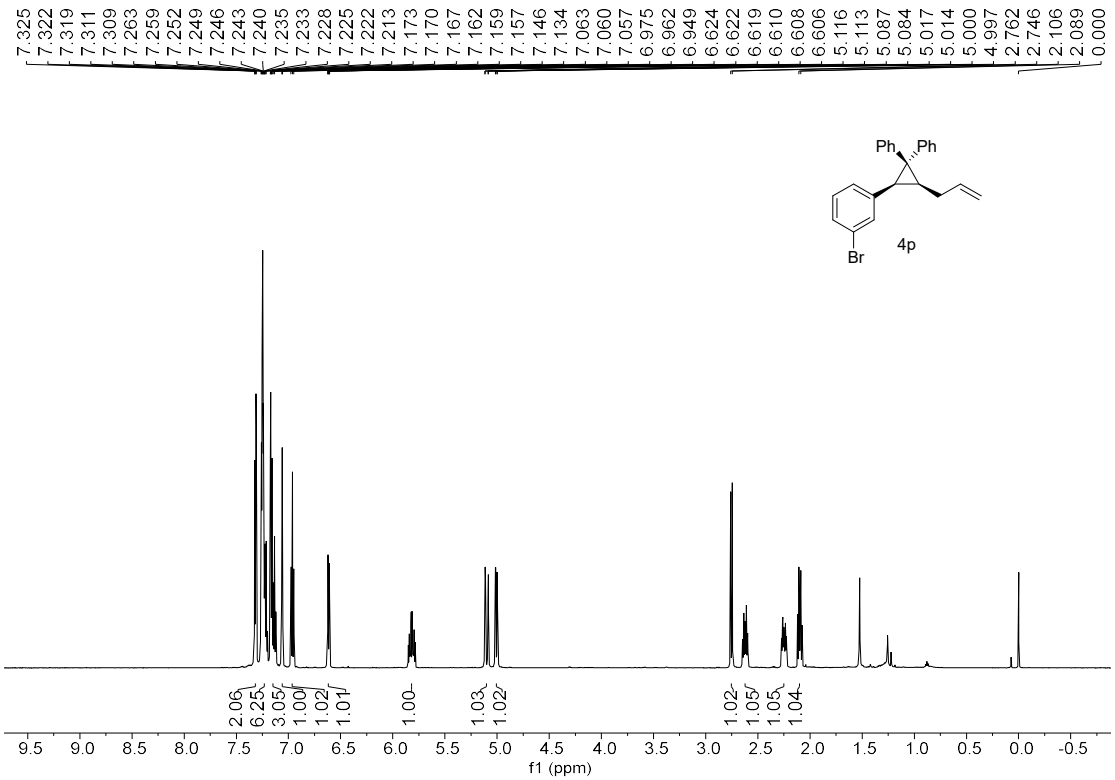
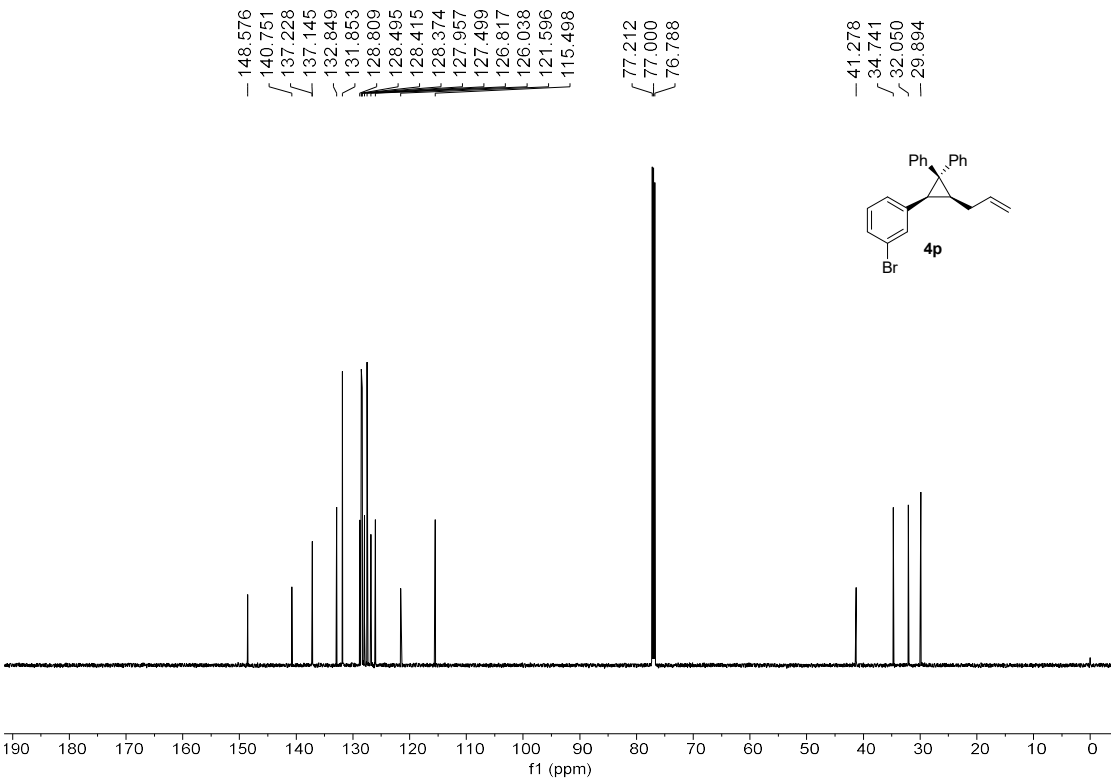
7.268
7.266
7.255
7.181
7.176
7.168
7.162
7.155
7.151
7.142
7.132
7.129
7.126
7.122
7.114
7.111
7.064
7.062
7.051
6.997
6.983
6.970
6.616
6.612
6.602
6.598
6.437
6.434
6.425
6.422
6.217
6.214
6.210
5.052
5.049
5.047
5.021
5.018
4.936
4.934
4.931
4.919
4.917
4.914
3.490
2.736
2.719
2.538
1.997
1.981
Ph
Ph
4o
O
2.08
7.23
1.02
1.04
1.00
1.03
1.01
1.00
1.04
1.04
3.12
1.05
1.06
1.11
1.04
f1 (ppm)
158.717
149.017
139.745
137.834
137.549
131.988
128.431
128.302
128.246
127.591
126.574
125.877
122.541
115.250
115.022
111.330
77.211
77.000
76.789
54.844
40.940
35.108
31.900
30.177
Ph
Ph
4o
O
f1 (ppm)


7.325
7.322
7.319
7.311
7.309
7.263
7.259
7.252
7.249
7.246
7.243
7.240
7.235
7.233
7.228
7.225
7.222
7.213
7.173
7.170
7.167
7.162
7.159
7.157
7.146
7.134
7.063
7.060
7.057
6.975
6.962
6.949
6.624
6.622
6.619
6.610
6.608
6.606
5.116
5.113
5.087
5.084
5.017
5.014
5.000
4.997
2.762
2.746
2.106
2.089
0.000
Ph
Ph
Br
4p
2.06
6.25
3.05
1.00
1.02
1.01
1.00
1.03
1.02
1.02
1.05
1.05
1.04
f1 (ppm)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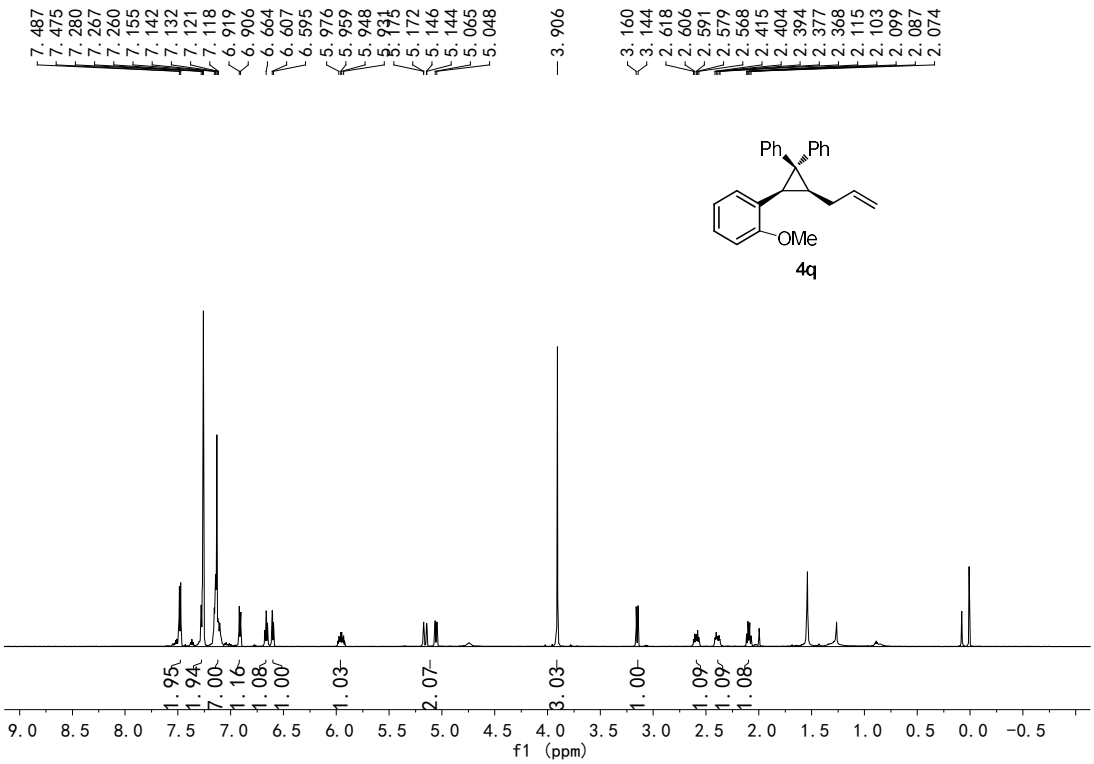
137.228
137.145
132.849
131.853
128.809
128.495
128.415
128.374
127.957
127.499
126.817
126.038
121.596
115.498
77.212
77.000
76.788
41.278
34.741
32.050
29.894
Ph
Ph
Br
4p
f1 (ppm)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7.267
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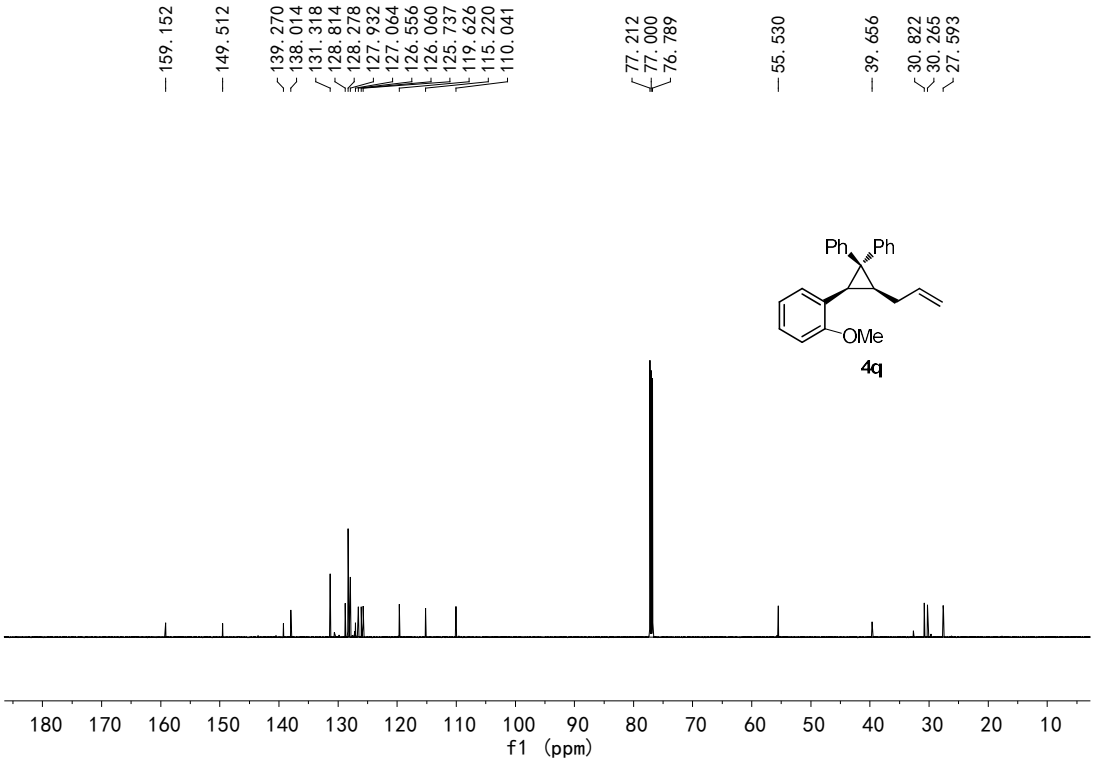
7.155
7.142
7.132
7.121
7.118
6.919
6.906
6.664
6.607
6.595
5.976
5.959
5.948
5.931
5.175
5.172
5.146
5.144
5.065
5.048
3.906
3.160
3.144
2.618
2.606
2.591
2.579
2.568
2.415
2.404
2.394
2.377
2.368
2.115
2.103
2.099
2.087
2.074
Ph
Ph
OMe
4q
1.95
1.94
7.00
1.16
1.08
1.00
1.03
2.07
3.03
1.00
1.09
1.09
1.08
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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138.014
131.318
128.814
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127.932
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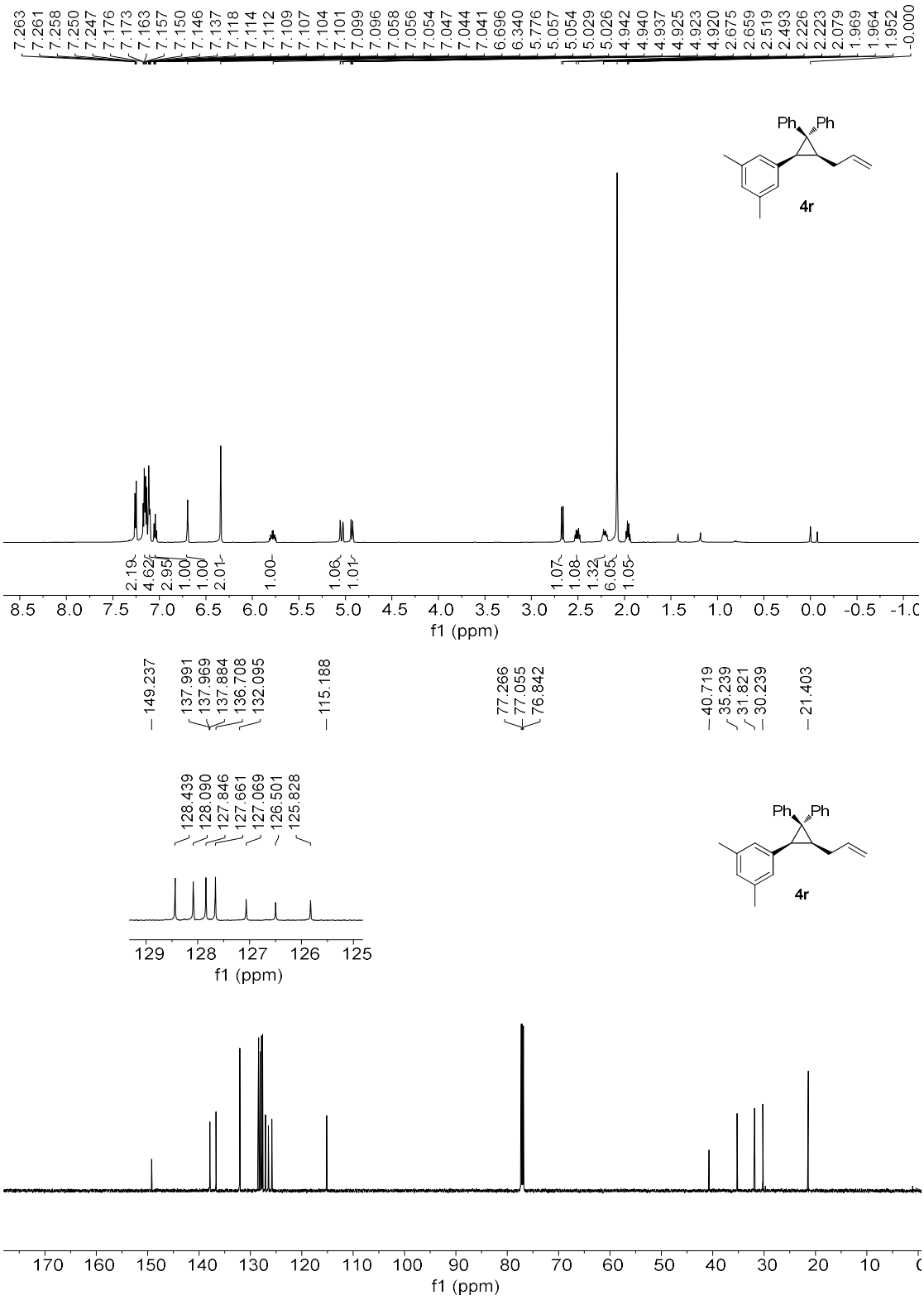
126.060
125.737
119.626
115.220
110.041
77.212
77.000
76.789
55.530
39.656
30.822
30.265
27.593
Ph
Ph
OMe
4q
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


7.263
7.261
7.258
7.250
7.247
7.176
7.173
7.163
7.157
7.150
7.146
7.137
7.118
7.114
7.112
7.109
7.107
7.104
7.101
7.099
7.096
7.058
7.056
7.054
7.047
7.044
7.041
6.696
6.340
5.776
5.057
5.054
5.029
5.026
4.942
4.940
4.937
4.925
4.923
4.920
2.675
2.659
2.519
2.493
2.226
2.223
2.079
1.969
1.964
1.952
0.000
Ph
Ph
4r
2.19
4.62
2.95
1.00
1.00
2.01
1.00
1.06
1.01
1.07
1.08
1.32
6.05
1.05
f1 (ppm)
149.237
137.991
137.969
137.884
136.708
132.095
115.188
77.266
77.055
76.842
40.719
35.239
31.821
30.239
21.403
128.439
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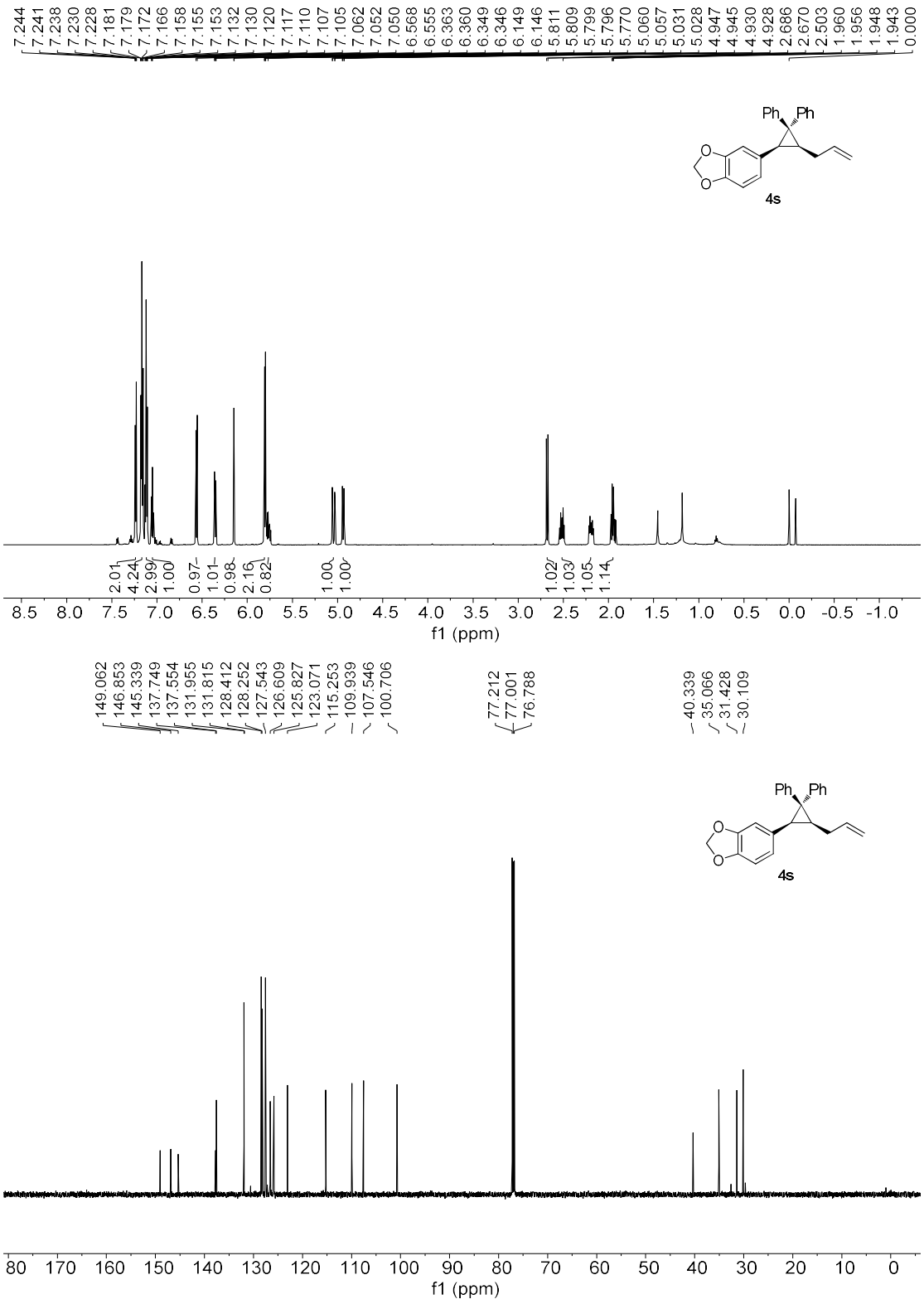
127.846
127.661
127.069
126.501
125.828
Ph
Ph
4r
f1 (ppm)
f1 (ppm)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7.238
7.230
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7.172
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7.158
7.155
7.153
7.132
7.130
7.120
7.117
7.110
7.107
7.105
7.062
7.052
7.050
6.568
6.555
6.363
6.360
6.349
6.346
6.149
6.146
5.811
5.809
5.799
5.796
5.770
5.060
5.057
5.031
5.028
4.947
4.945
4.930
4.928
2.686
2.670
2.503
1.960
1.956
1.948
1.943
0.000
Ph
Ph
O
O
4s
2.01
4.24
2.99
1.00
0.97
1.01
0.98
2.16
0.82
1.00
1.00
1.02
1.03
1.05
1.14
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
f1 (ppm)
149.062
146.853
145.339
137.749
137.554
131.955
131.815
128.412
128.252
127.543
126.609
125.827
123.071
115.253
109.939
107.546
100.706
77.212
77.001
76.788
40.339
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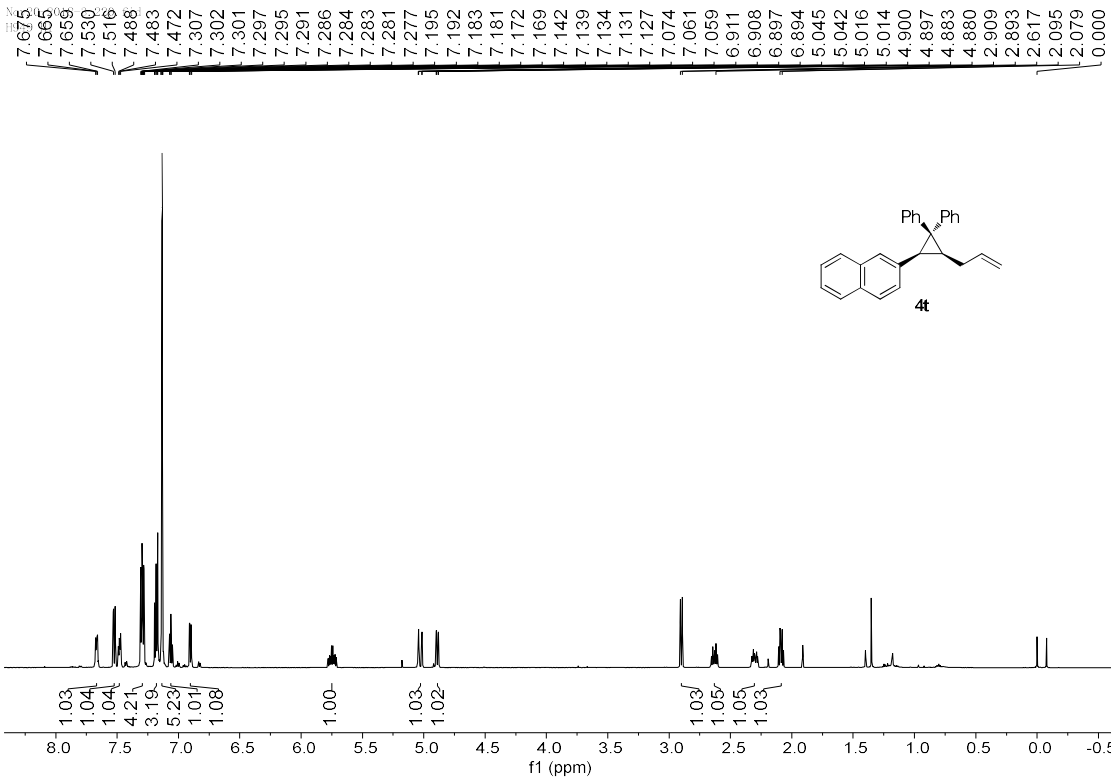
31.428
30.109
Ph
Ph
O
O
4s
80 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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7.665
7.659
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7.472
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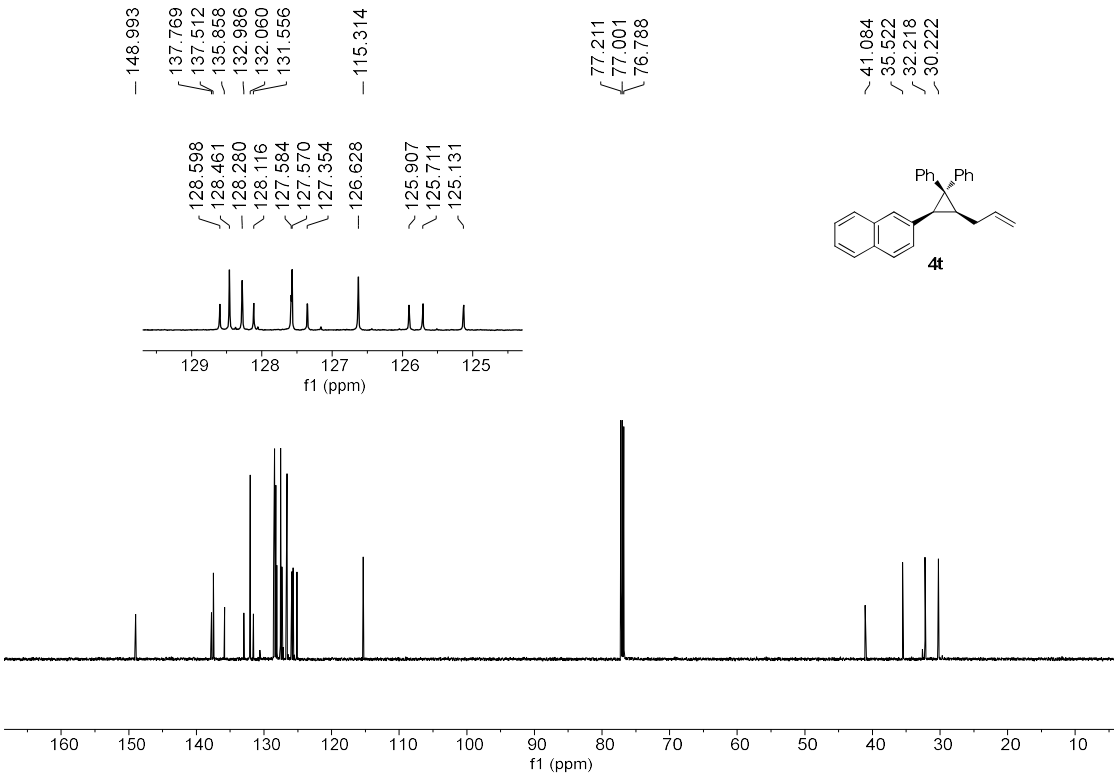
7.302
7.301
7.297
7.295
7.291
7.286
7.284
7.283
7.281
7.277
7.195
7.192
7.183
7.181
7.172
7.169
7.142
7.139
7.134
7.131
7.127
7.074
7.061
7.059
6.911
6.908
6.897
6.894
5.045
5.042
5.016
5.014
4.900
4.897
4.883
4.880
2.909
2.893
2.617
2.095
2.079
0.000
Ph
Ph
4t
1.03
1.04
1.04
4.21
3.19
5.23
1.01
1.08
1.00
1.03
1.02
1.03
1.05
1.05
1.03
f1 (ppm)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137.512
135.858
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131.556
115.314
77.211
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76.788
41.084
35.522
32.218
30.222
128.598
128.461
128.280
128.116
127.584
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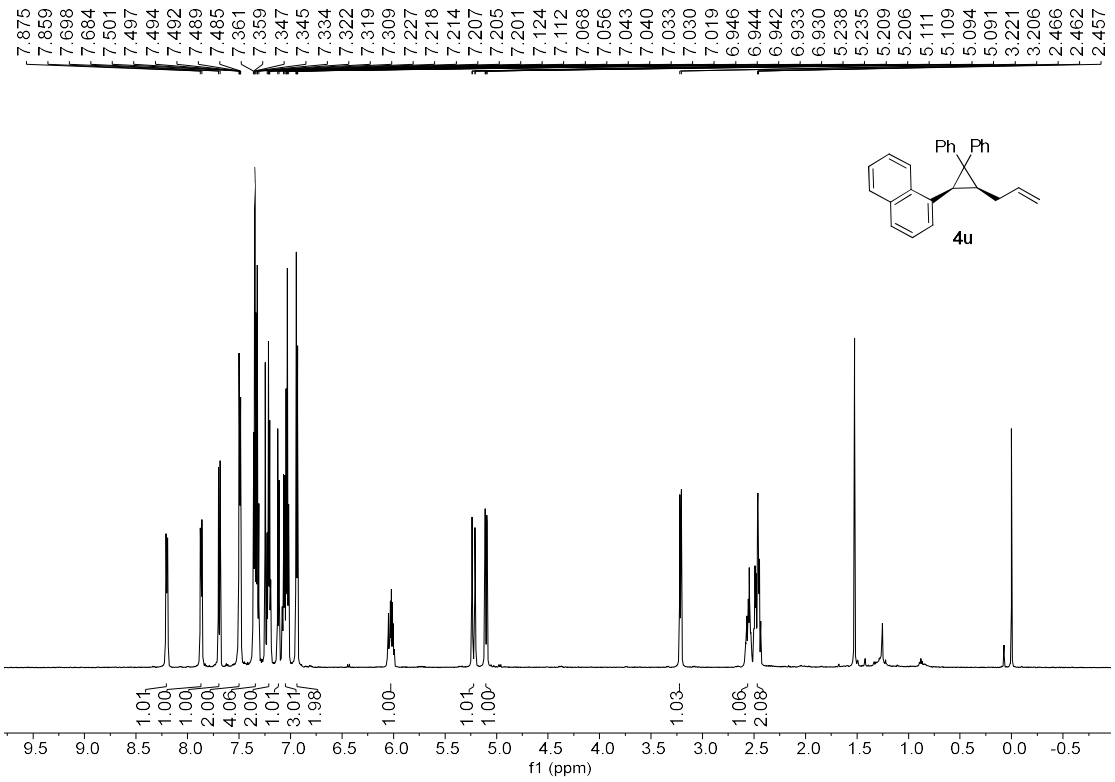
127.354
126.628
125.907
125.711
125.131
Ph
Ph
4t
f1 (ppm)
f1 (ppm)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7.494
7.492
7.489
7.485
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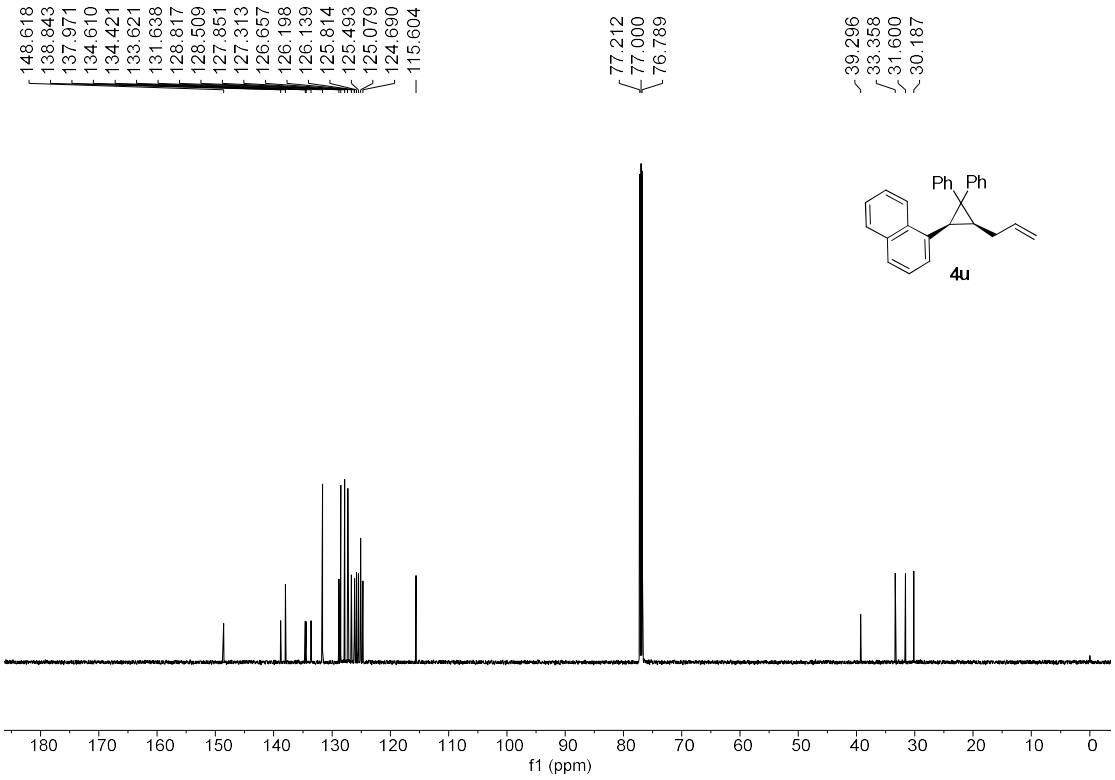
7.359
7.347
7.345
7.334
7.322
7.319
7.309
7.227
7.218
7.214
7.207
7.205
7.201
7.124
7.112
7.068
7.056
7.043
7.040
7.033
7.030
7.019
6.946
6.944
6.942
6.933
6.930
5.238
5.235
5.209
5.206
5.111
5.109
5.094
5.091
3.221
3.206
2.466
2.462
2.457
Ph Ph
4u
1.01
1.00
1.00
2.00
4.06
2.00
1.01
3.01
1.98
1.00
1.01
1.00
1.03
1.06
2.08
f1 (ppm)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133.621
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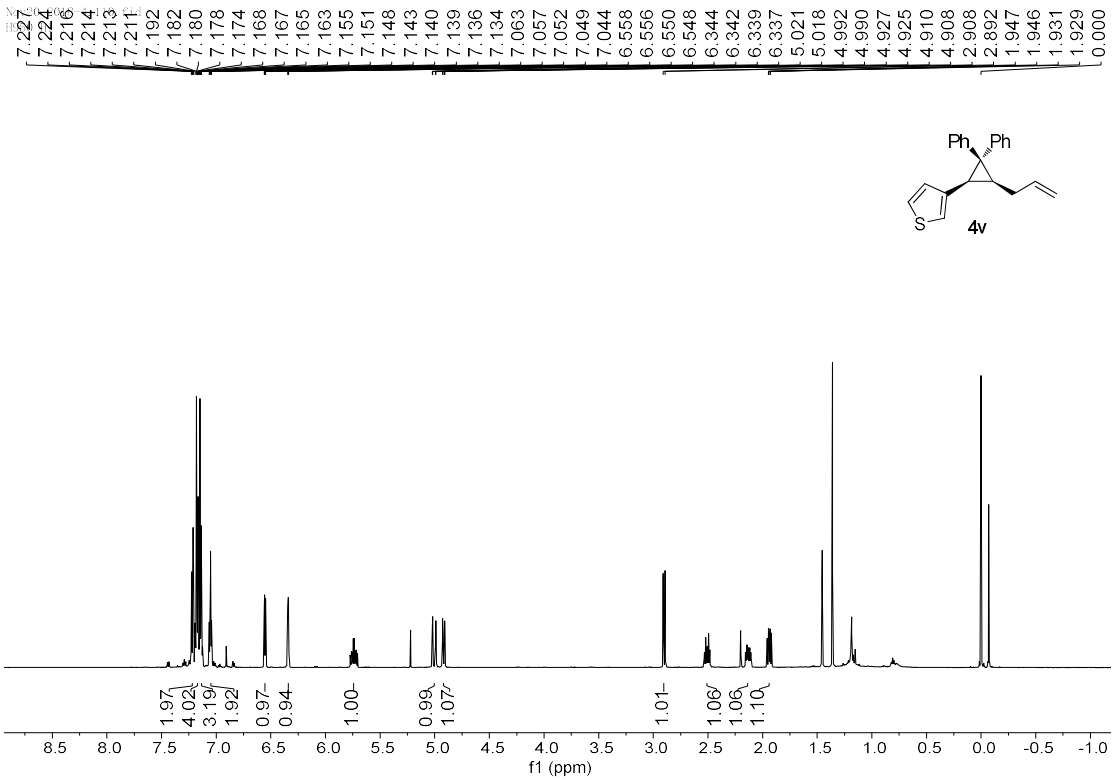
128.509
127.851
127.313
126.657
126.198
126.139
125.814
125.493
125.079
124.690
115.604
77.212
77.000
76.789
39.296
33.358
31.600
30.187
Ph Ph
4u
f1 (ppm)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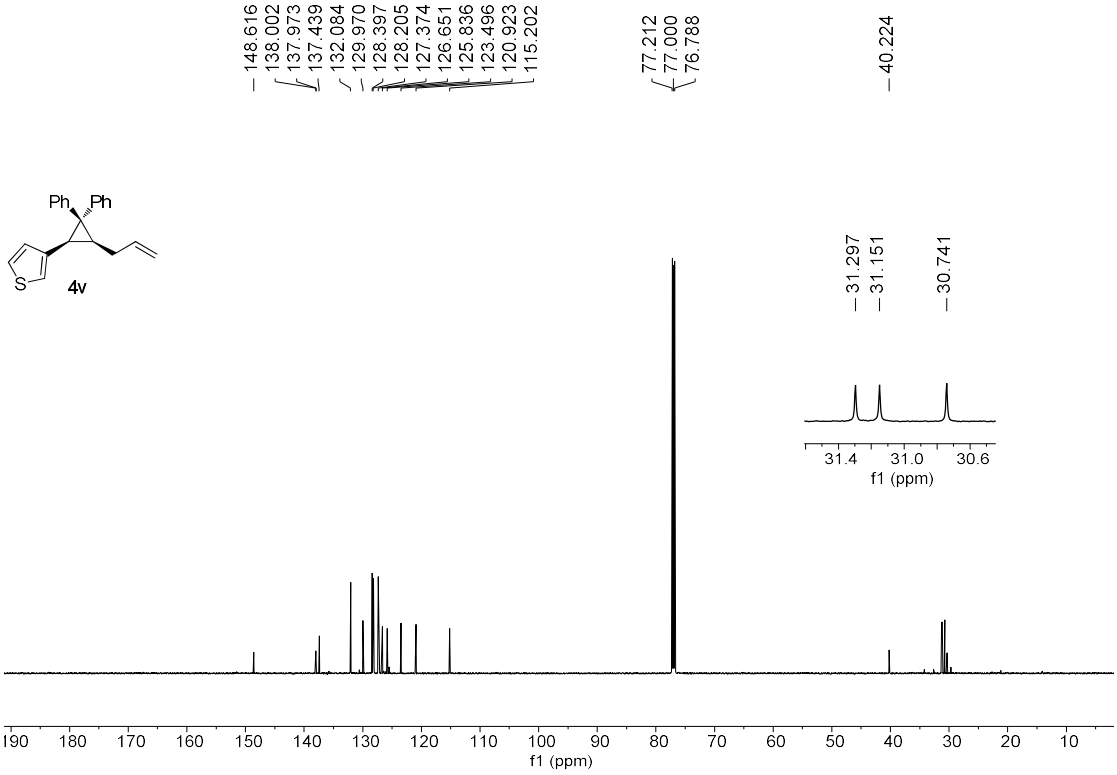
7.224
7.216
7.214
7.213
7.211
7.192
7.182
7.180
7.178
7.174
7.168
7.167
7.165
7.163
7.155
7.151
7.148
7.143
7.140
7.139
7.136
7.134
7.063
7.057
7.052
7.049
7.044
6.558
6.556
6.550
6.548
6.344
6.342
6.339
6.337
5.021
5.018
4.992
4.990
4.927
4.925
4.910
4.908
2.908
2.892
1.947
1.946
1.931
1.929
0.000
Ph
Ph
S
4v
1.97
4.02
3.19
1.92
0.97
0.94
1.00
0.99
1.07
1.01
1.06
1.06
1.10
f1 (ppm)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137.973
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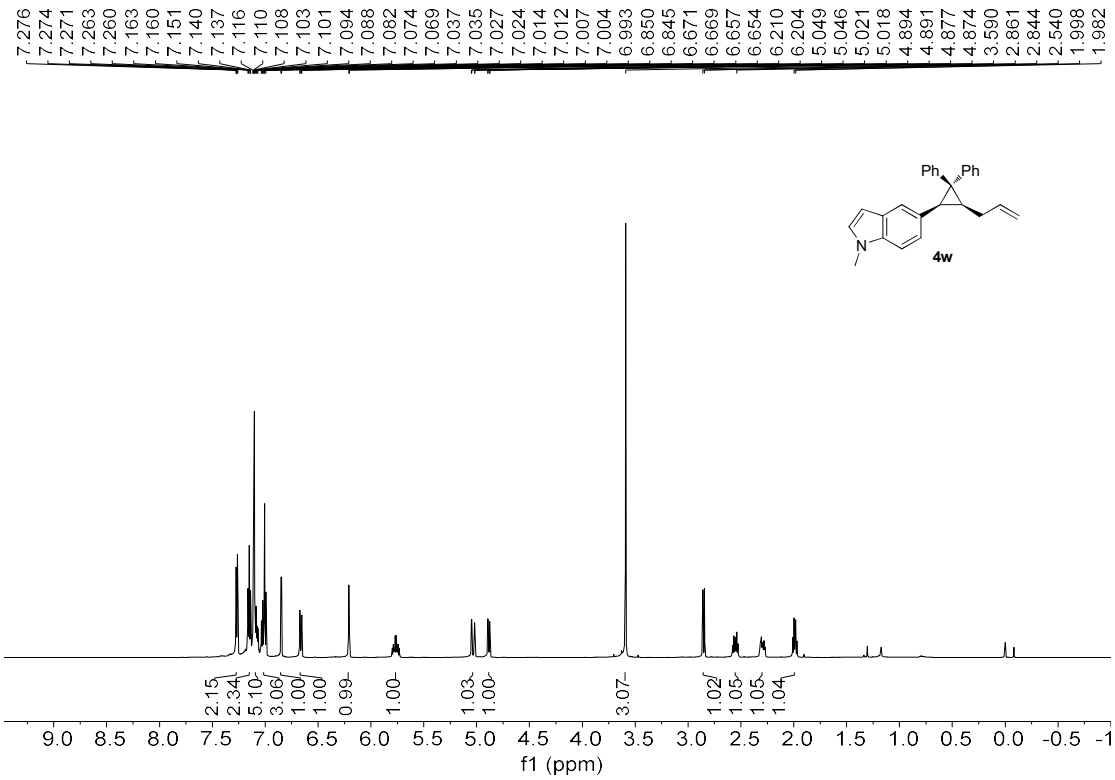
128.397
128.205
127.374
126.651
125.836
123.496
120.923
115.202
77.212
77.000
76.788
40.224
Ph
Ph
S
4v
31.297
31.151
30.741
31.4
31.0
30.6
f1 (ppm)
f1 (ppm)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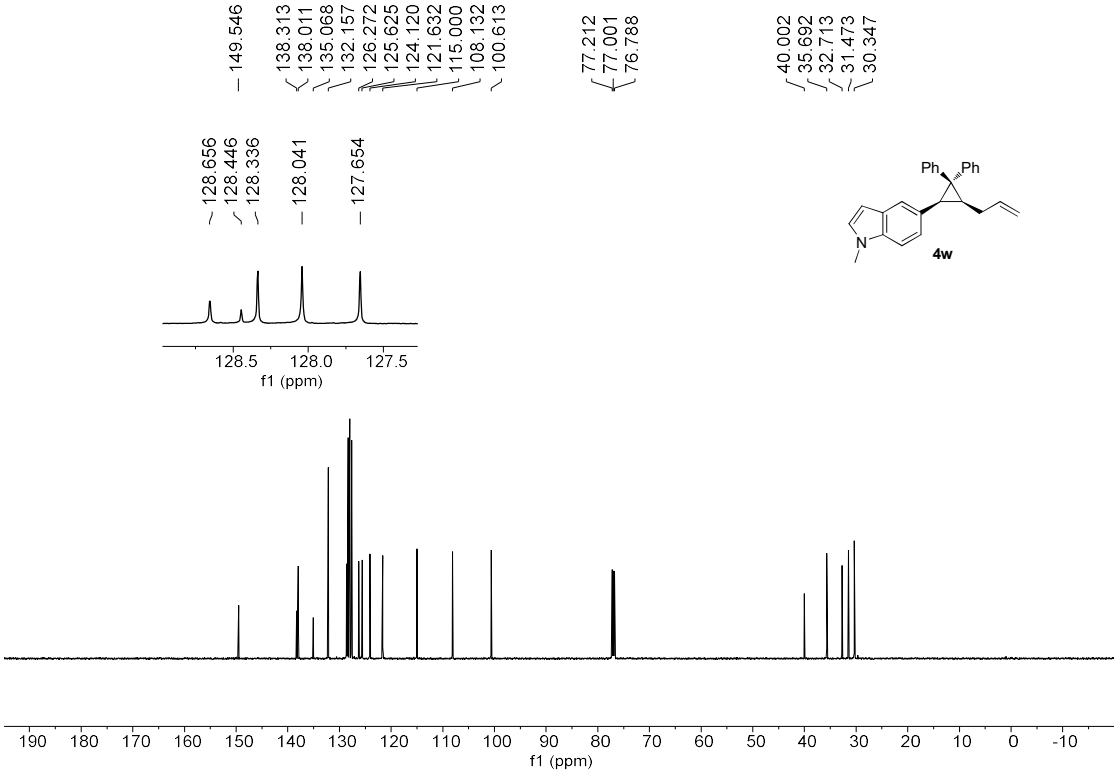
7.274
7.271
7.263
7.260
7.163
7.160
7.151
7.140
7.137
7.116
7.110
7.108
7.103
7.101
7.094
7.088
7.082
7.074
7.069
7.037
7.035
7.027
7.024
7.014
7.012
7.007
7.004
6.993
6.850
6.845
6.671
6.669
6.657
6.654
6.210
6.204
5.049
5.046
5.021
5.018
4.894
4.891
4.877
4.874
3.590
2.861
2.844
2.540
1.998
1.982
Ph
Ph
N
4w
2.15
2.34
5.10
3.06
1.00
1.00
0.99
1.00
1.03
1.00
3.07
1.02
1.05
1.05
1.04
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
f1 (ppm)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138.011
135.068
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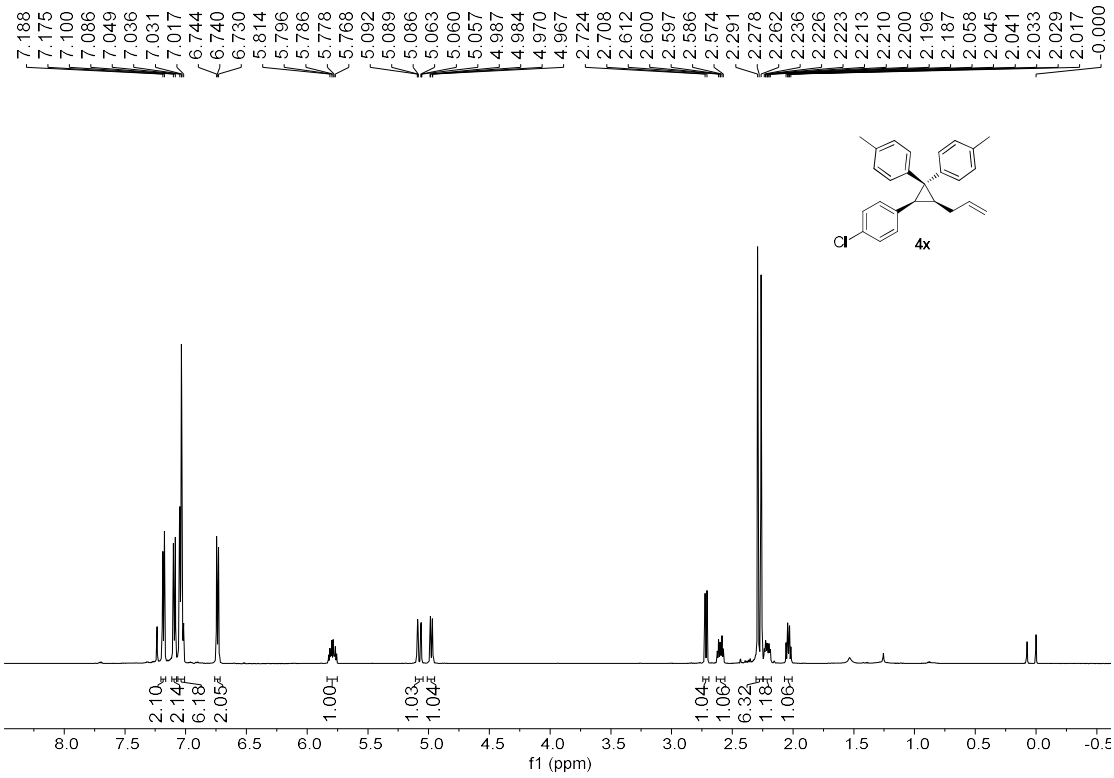
124.120
121.632
115.000
108.132
100.613
77.212
77.001
76.788
40.002
35.692
32.713
31.473
30.347
128.656
128.446
128.336
128.041
127.654
128.5
128.0
127.5
f1 (ppm)
Ph
Ph
N
4w
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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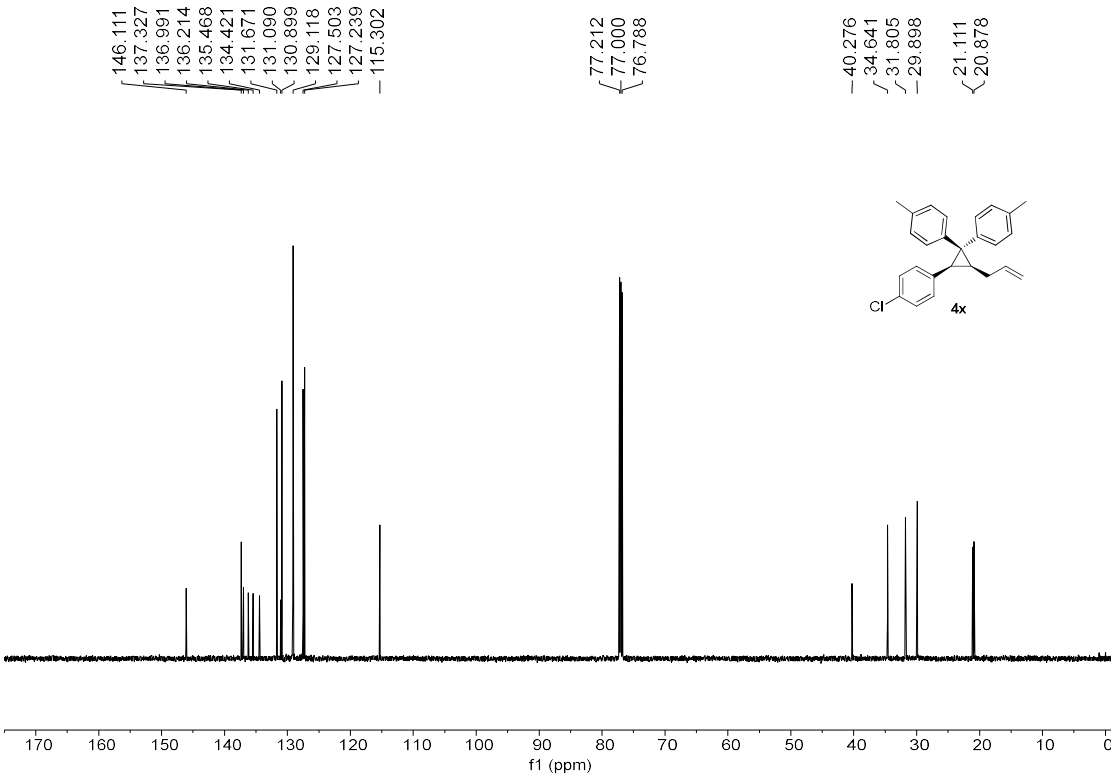
7.100
7.086
7.049
7.036
7.031
7.017
6.744
6.740
6.730
5.814
5.796
5.786
5.778
5.768
5.092
5.089
5.086
5.063
5.060
5.057
4.987
4.984
4.970
4.967
2.724
2.708
2.612
2.600
2.597
2.586
2.574
2.291
2.278
2.262
2.236
2.226
2.223
2.213
2.210
2.200
2.196
2.187
2.058
2.045
2.041
2.033
2.029
2.017
-0.000
Cl
4x
2.10
2.14
6.18
2.05
1.00
1.03
1.04
1.04
1.06
6.32
1.18
1.06
f1 (ppm)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131.090
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127.503
127.239
115.302
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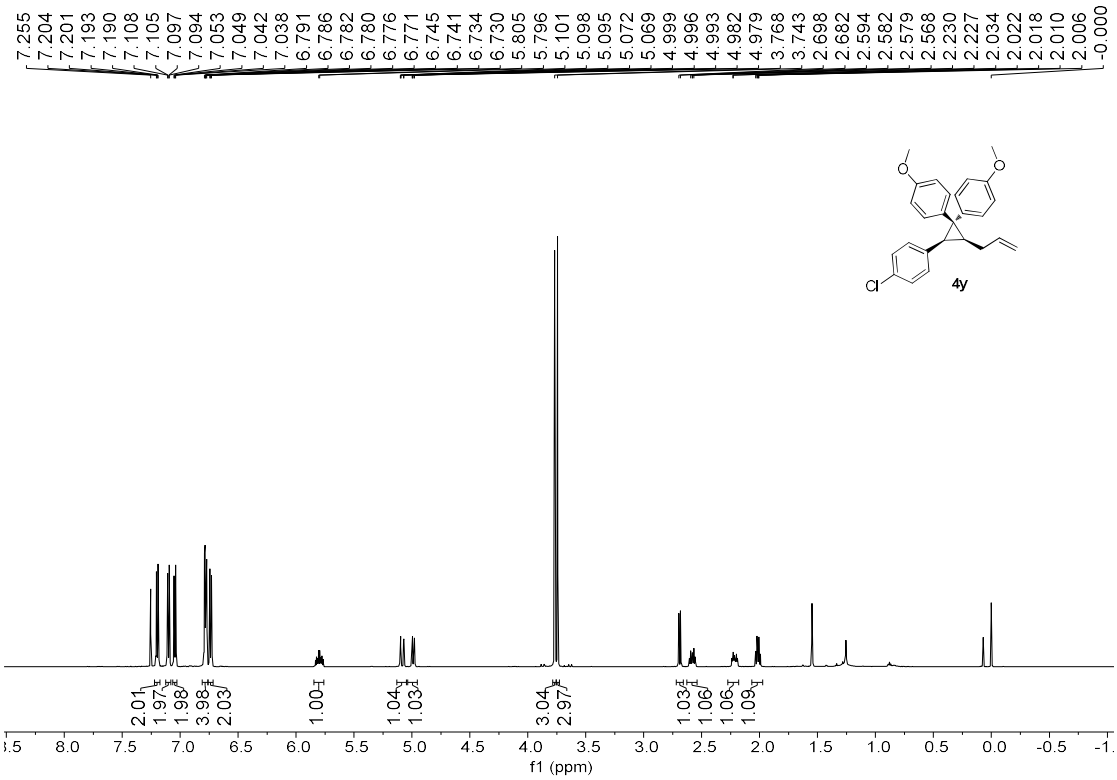
77.000
76.788
40.276
34.641
31.805
29.898
21.111
20.878
Cl
4x
f1 (ppm)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7.201
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7.190
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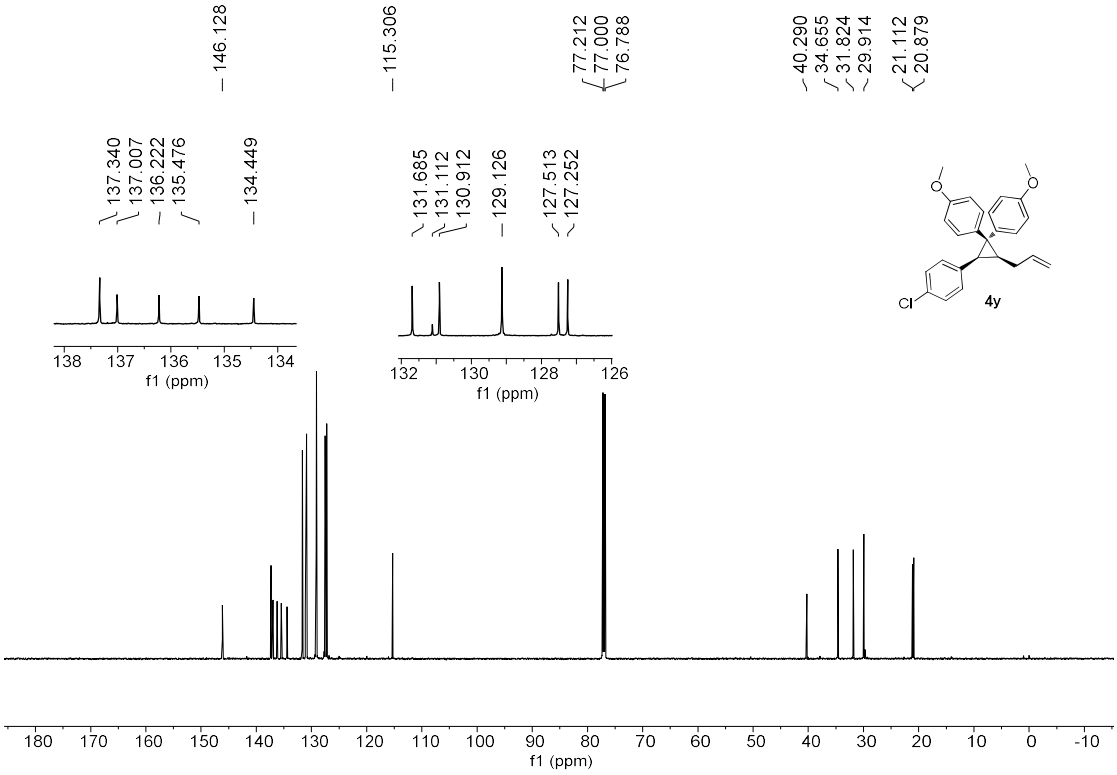
7.097
7.094
7.053
7.049
7.042
7.038
6.791
6.786
6.782
6.780
6.776
6.771
6.745
6.741
6.734
6.730
5.805
5.796
5.101
5.098
5.095
5.072
5.069
4.999
4.996
4.993
4.982
4.979
3.768
3.743
2.698
2.682
2.594
2.582
2.579
2.568
2.230
2.227
2.034
2.022
2.018
2.010
2.006
-0.000
Cl
4y
2.01
1.97
1.98
3.98
2.03
1.00
1.04
1.03
3.04
2.97
1.03
1.06
1.06
1.09
f1 (ppm)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137.340
137.007
136.222
135.476
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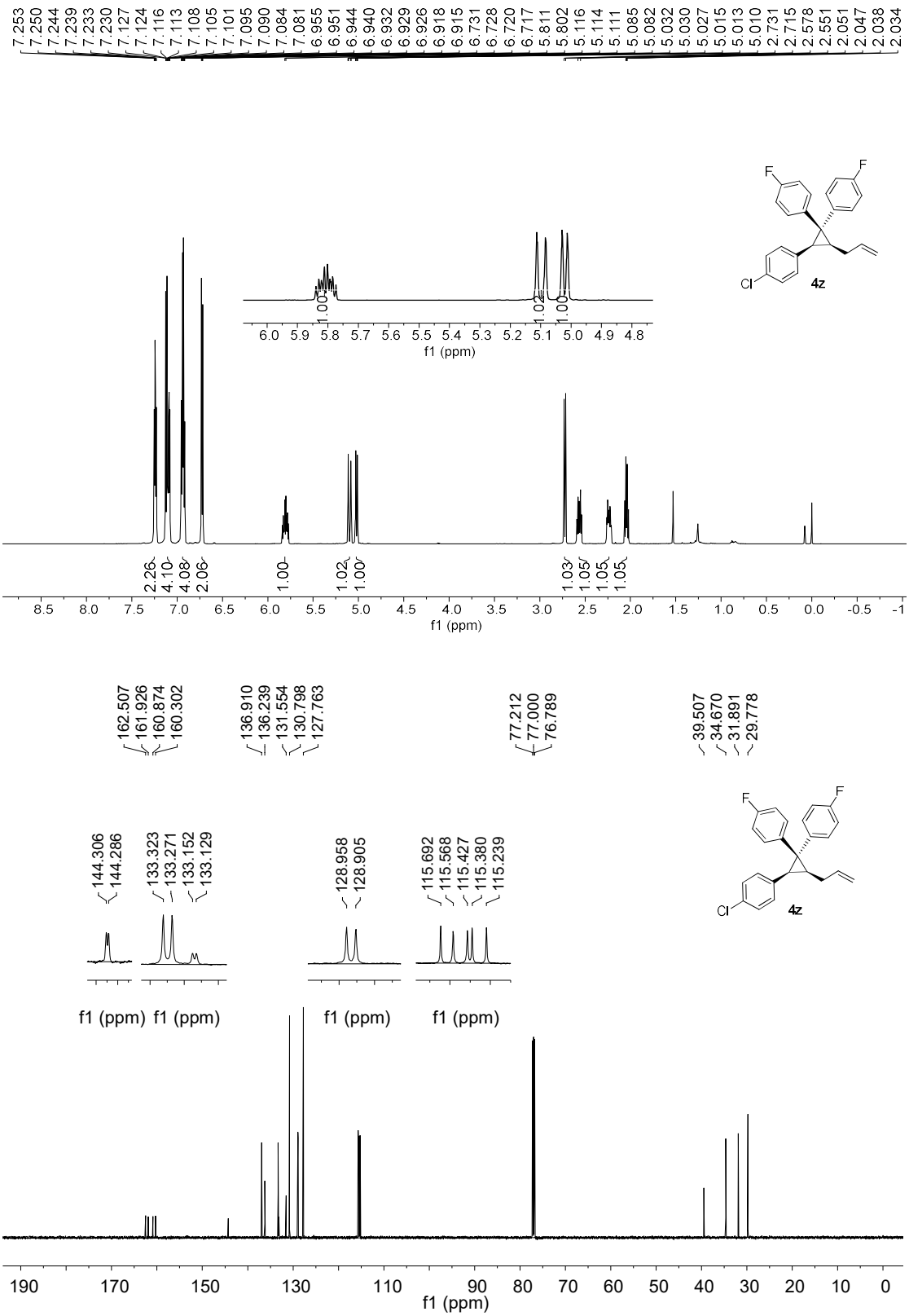
130.912
129.126
127.513
127.252
Cl
4y
f1 (ppm)
f1 (ppm)
f1 (ppm)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7.124
7.116
7.113
7.108
7.105
7.101
7.095
7.090
7.084
7.081
6.955
6.951
6.944
6.940
6.932
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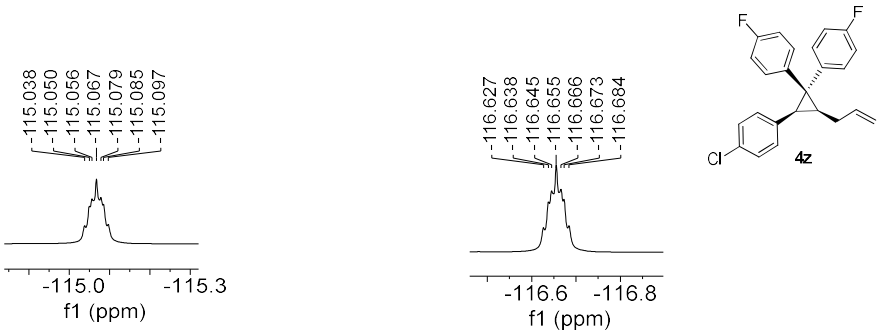
6.918
6.915
6.731
6.728
6.720
6.717
5.811
5.802
5.116
5.114
5.111
5.085
5.082
5.032
5.030
5.027
5.015
5.013
5.010
2.731
2.715
2.578
2.551
2.051
2.047
2.038
2.034
F
F
Cl
4z
1.00
1.02
1.00
6.0 5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8
f1 (ppm)
2.26
4.10
4.08
2.06
1.00
1.02
1.00
1.03
1.05
1.05
1.05
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
f1 (ppm)
162.507
161.926
160.874
160.302
136.910
136.239
131.554
130.798
127.763
77.212
77.000
76.789
39.507
34.670
31.891
29.778
144.306
144.286
133.323
133.271
133.152
133.129
128.958
128.905
115.692
115.568
115.427
115.380
115.239
f1 (ppm)
f1 (ppm)
f1 (ppm)
f1 (ppm)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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-115.056
-115.067
-115.079
-115.085
-115.097
-115.0
-115.3
f1 (ppm)
-116.627
-116.638
-116.645
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-116.673
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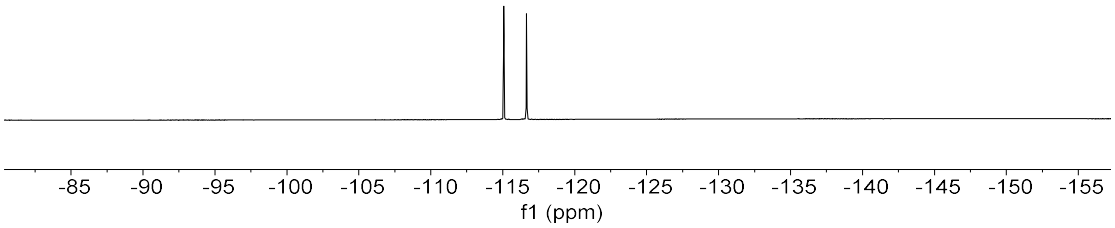
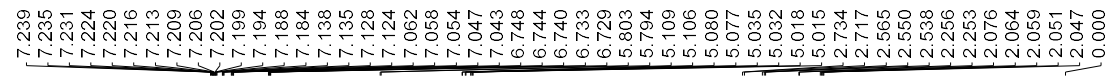
-116.6
-116.8
f1 (ppm)
F
F
Cl
4z


-85 -90 -95 -100 -105 -110 -115 -120 -125 -130 -135 -140 -145 -150 -155
f1 (ppm)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7.224
7.220
7.216
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7.209
7.206
7.202
7.199
7.194
7.188
7.184
7.138
7.135
7.128
7.124
7.062
7.058
7.054
7.047
7.043
6.748
6.744
6.740
6.733
6.729
5.803
5.794
5.109
5.106
5.080
5.077
5.035
5.032
5.018
5.015
2.734
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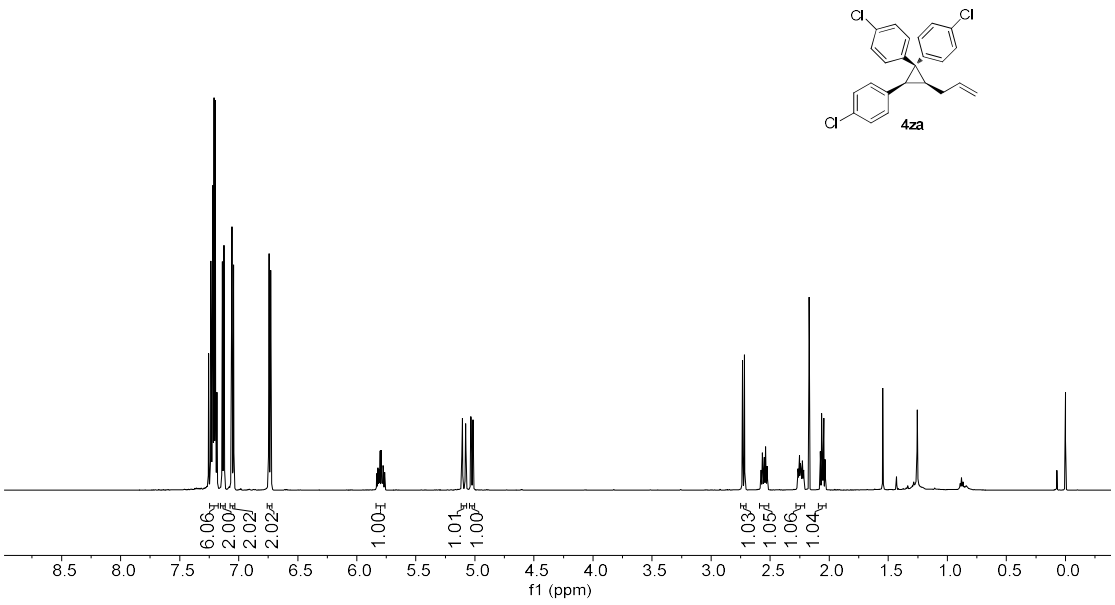
0.000


Cl
Cl
Cl
4za
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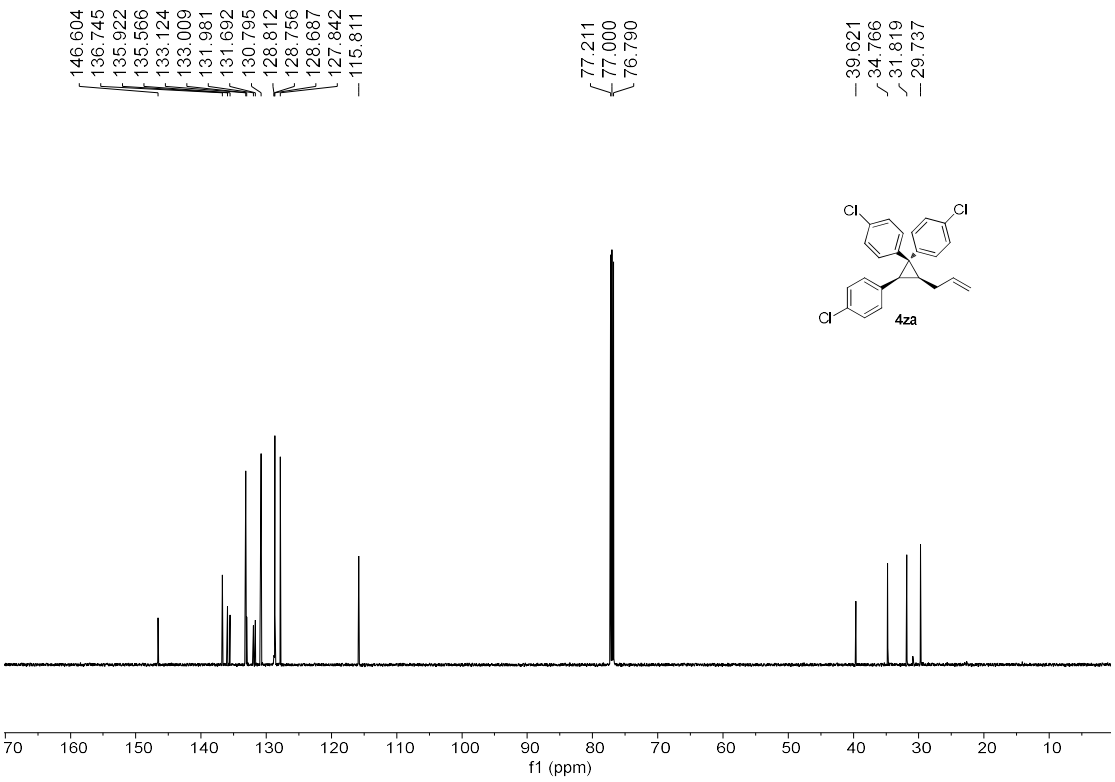
2.00
2.02
2.02
1.00
1.01
1.00
1.03
1.05
1.06
1.04
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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135.922
135.566
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133.009
131.981
131.692
130.795
128.812
128.756
128.687
127.842
115.811
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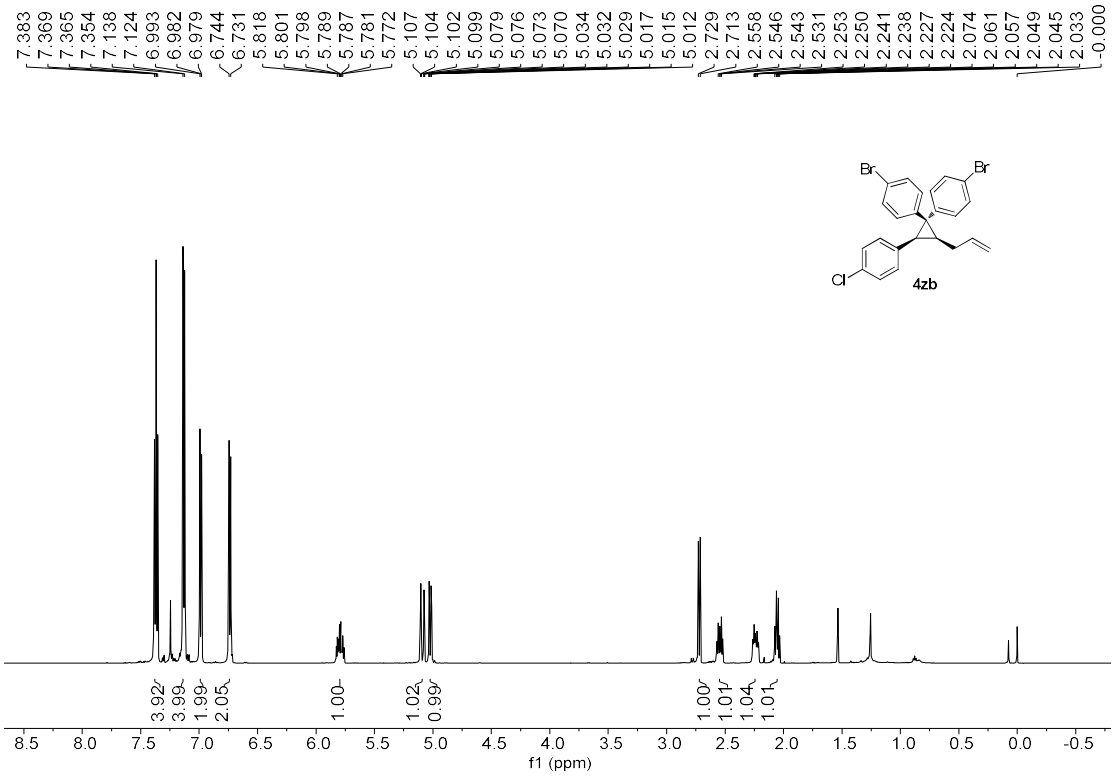
77.000
76.790
39.621
34.766
31.819
29.737
Cl
Cl
Cl
4za
f1 (ppm)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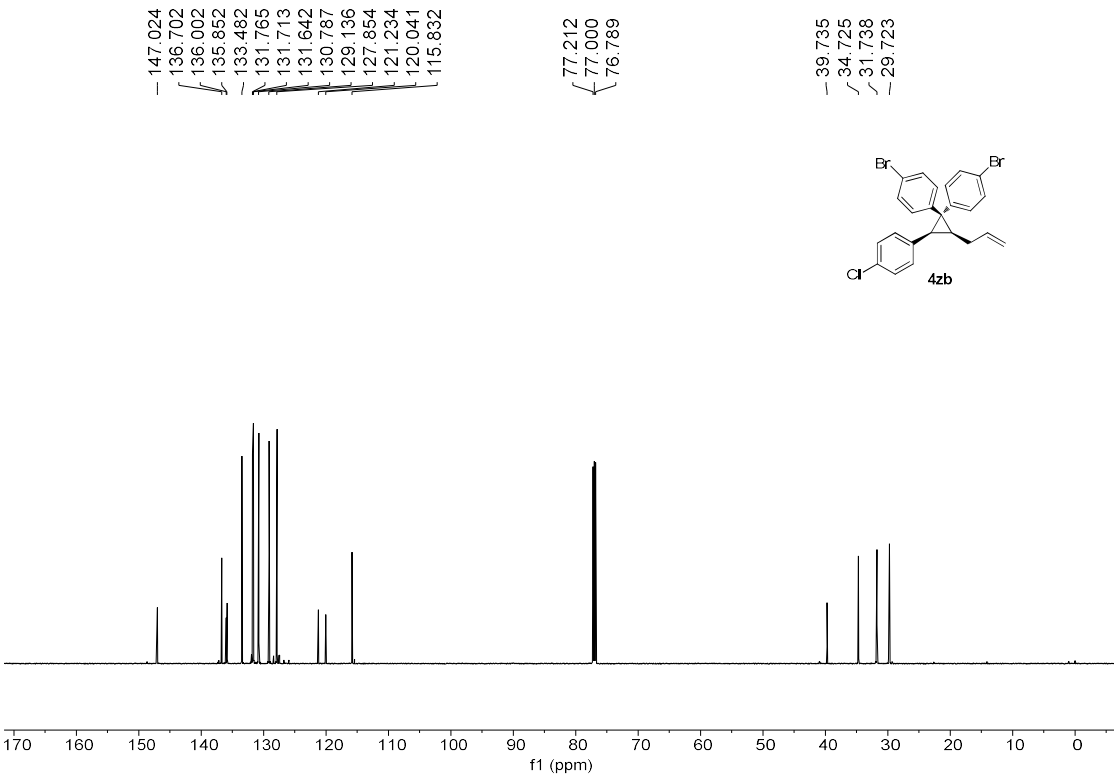
5.798
5.789
5.787
5.781
5.772
5.107
5.104
5.102
5.099
5.079
5.076
5.073
5.070
5.034
5.032
5.029
5.017
5.015
5.012
2.729
2.713
2.558
2.546
2.543
2.531
2.253
2.250
2.241
2.238
2.227
2.224
2.074
2.061
2.057
2.049
2.045
2.033
-0.000
Br
Br
Cl
4zb
3.92
3.99
1.99
2.05
1.00
1.02
0.99
1.00
1.01
1.04
1.01
f1 (ppm)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131.642
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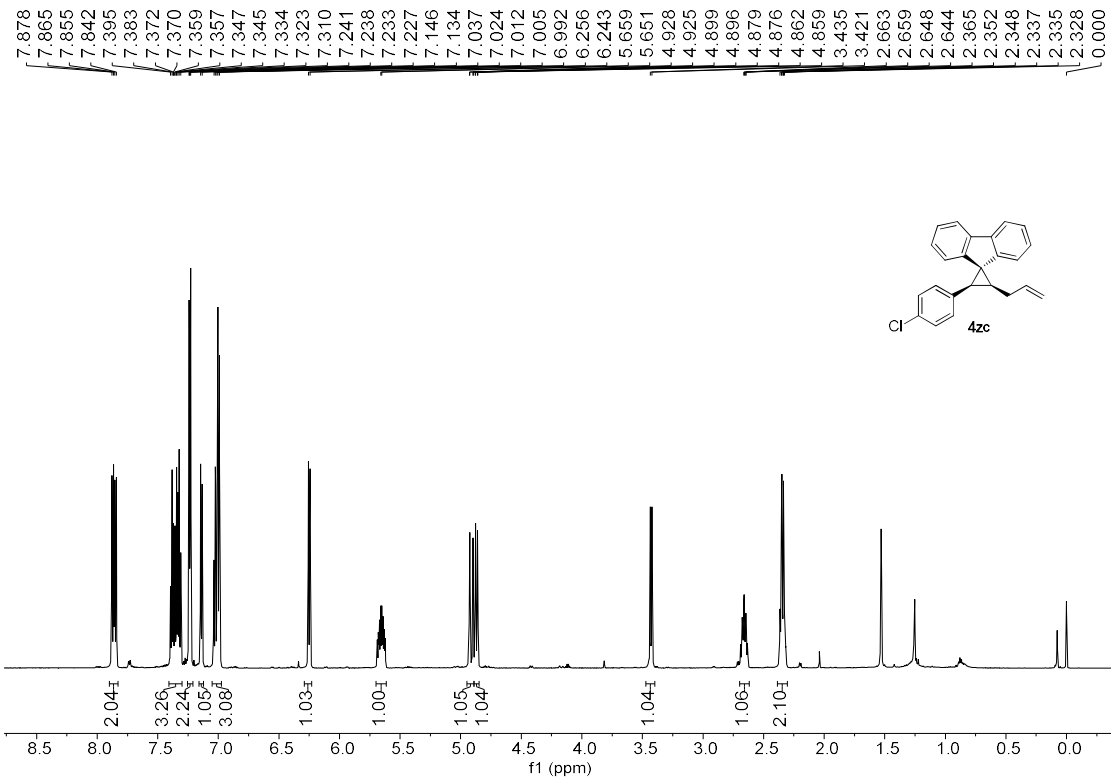
129.136
127.854
121.234
120.041
115.832
77.212
77.000
76.789
39.735
34.725
31.738
29.723
Br
Br
Cl
4zb
f1 (ppm)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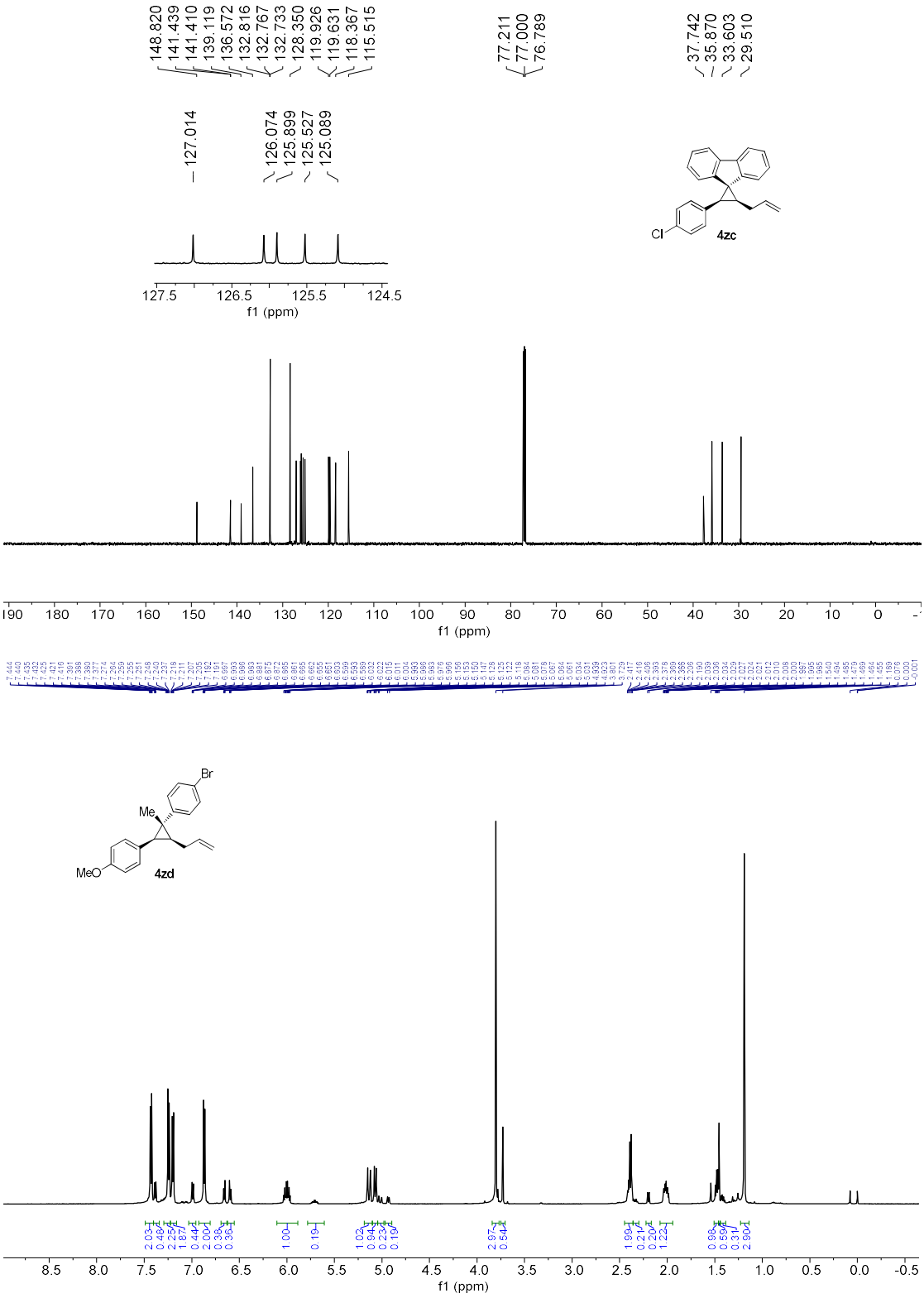
7.345
7.334
7.323
7.310
7.241
7.238
7.233
7.227
7.146
7.134
7.037
7.024
7.012
7.005
6.992
6.256
6.243
5.659
5.651
4.928
4.925
4.899
4.896
4.879
4.876
4.862
4.859
3.435
3.421
2.663
2.659
2.648
2.644
2.365
2.352
2.348
2.337
2.335
2.328
0.000
Cl
4zc
2.04
3.26
2.24
1.05
3.08
1.03
1.00
1.05
1.04
1.04
1.06
2.10
f1 (ppm)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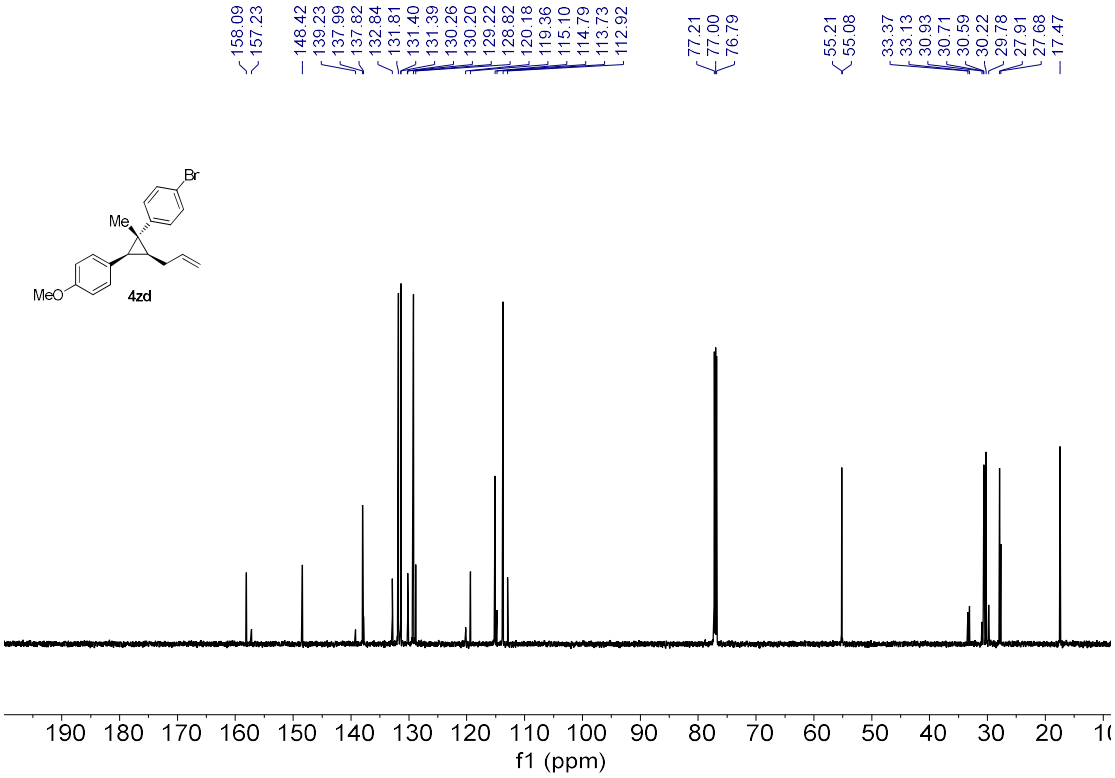
141.439
141.410
139.119
136.572
132.816
132.767
132.733
128.350
119.926
119.631
118.367
115.515
77.211
77.000
76.789
37.742
35.870
33.603
29.510
127.014
126.074
125.899
125.527
125.089
127.5
126.5
125.5
124.5
f1 (ppm)
Cl
4zc
f1 (ppm)
Br
Me
MeO
4zd
f1 (ppm)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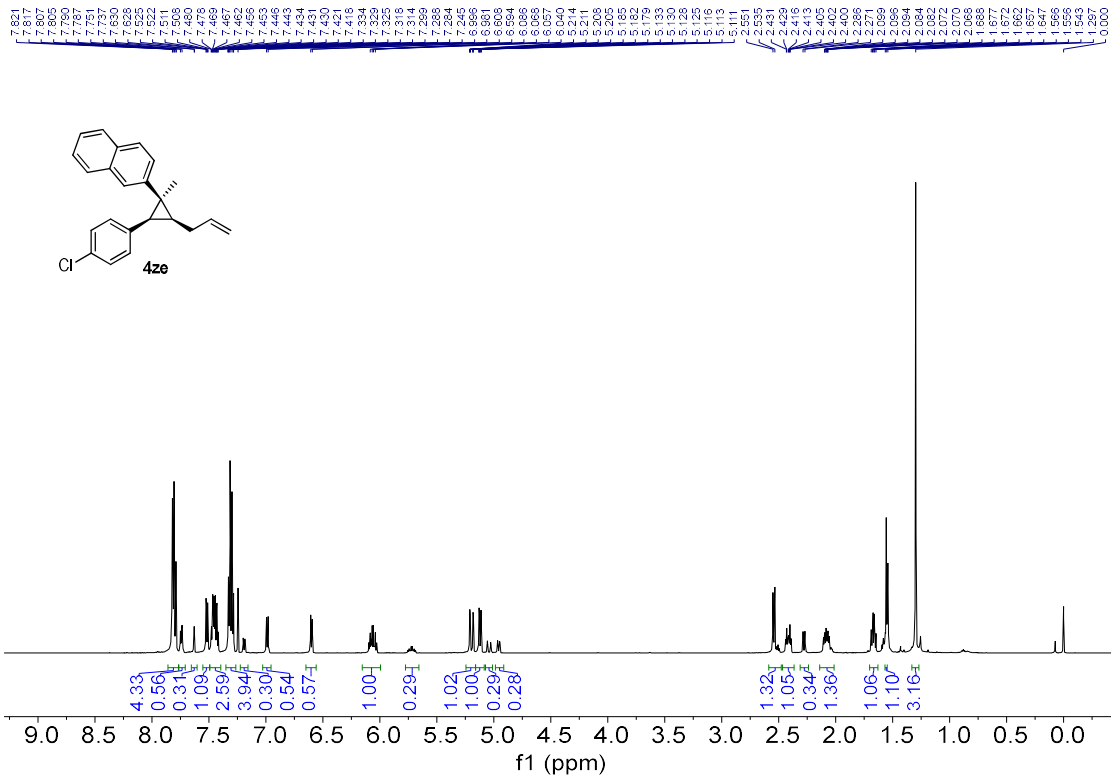
157.23
148.42
139.23
137.99
137.82
132.84
131.81
131.40
131.39
130.26
130.20
129.22
128.82
120.18
119.36
115.10
114.79
113.73
112.92
77.21
77.00
76.79
55.21
55.08
33.37
33.13
30.93
30.71
30.59
30.22
29.78
27.91
27.68
17.47
Br
Me
MeO
4zd
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 1
f1 (ppm)


Cl
4ze
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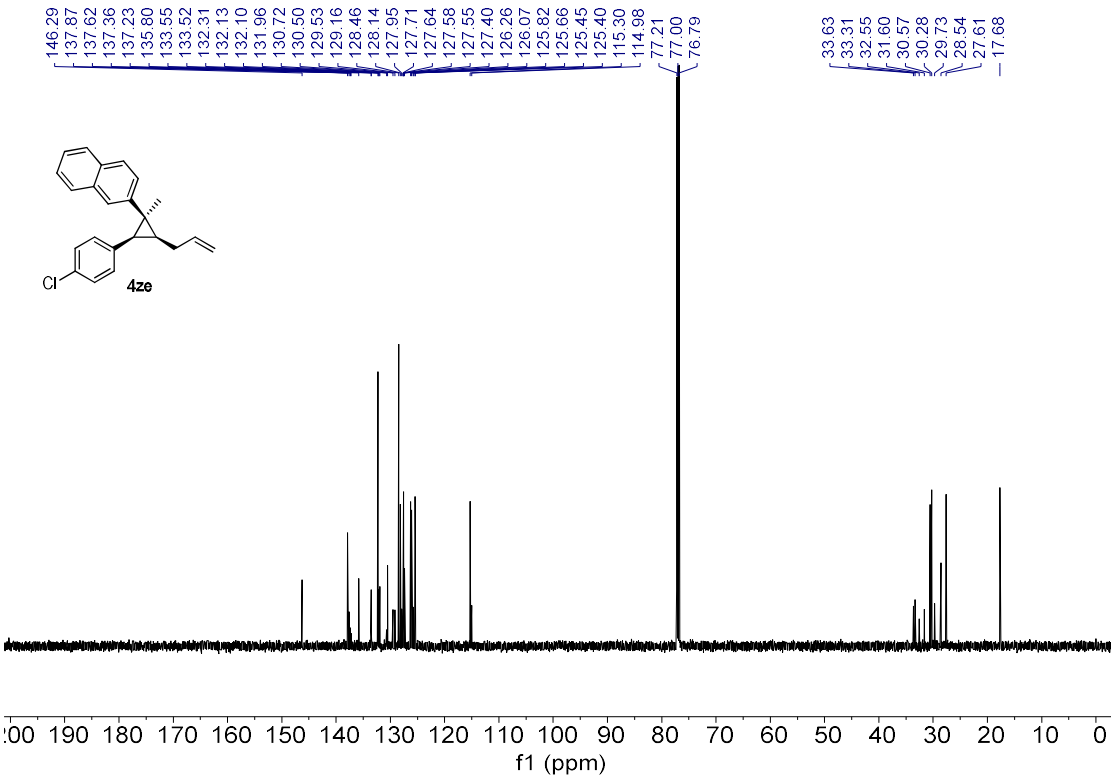
0.56
0.31
1.09
2.59
3.94
0.30
0.54
0.57
1.00
0.29
1.02
1.00
0.29
0.28
1.32
1.05
0.34
1.36
1.06
1.10
3.16
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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137.87
137.62
137.36
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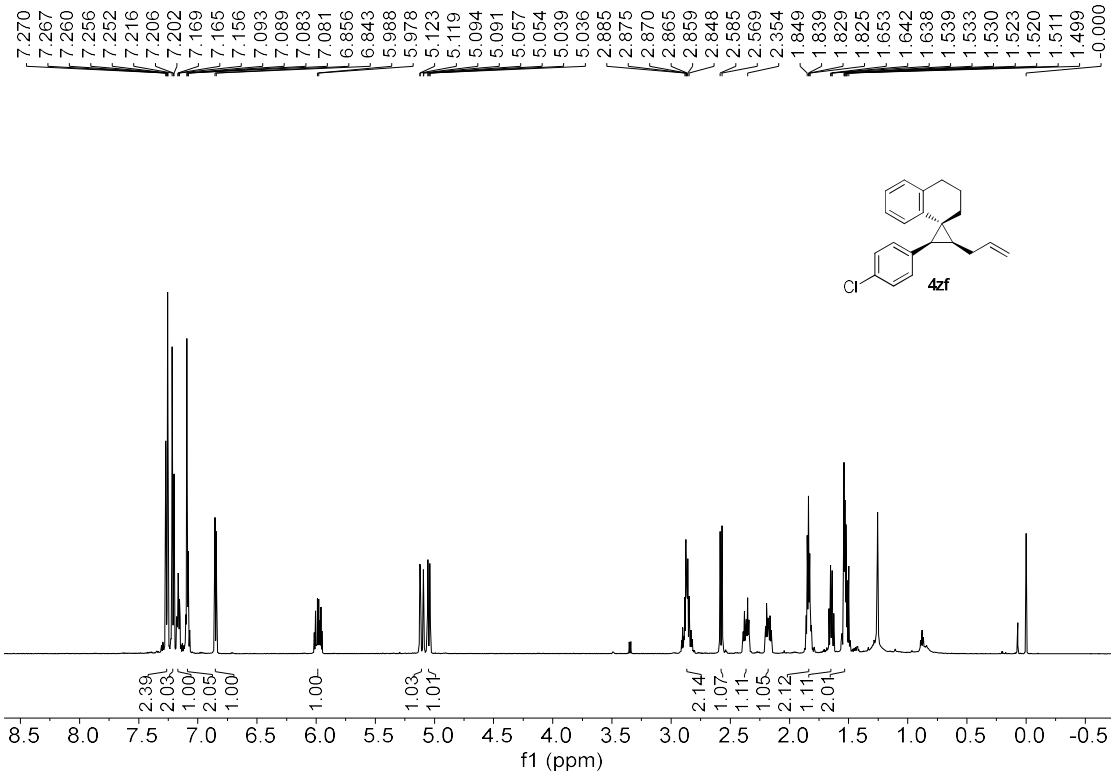
133.55
133.52
132.31
132.13
132.10
131.96
130.72
130.50
129.53
129.16
128.46
128.14
127.95
127.71
127.64
127.58
127.55
127.40
126.26
126.07
125.82
125.66
125.45
125.40
115.30
114.98
77.21
77.00
76.79
33.63
33.31
32.55
31.60
30.57
30.28
29.73
28.54
27.61
17.68
Cl
4ze
f1 (ppm)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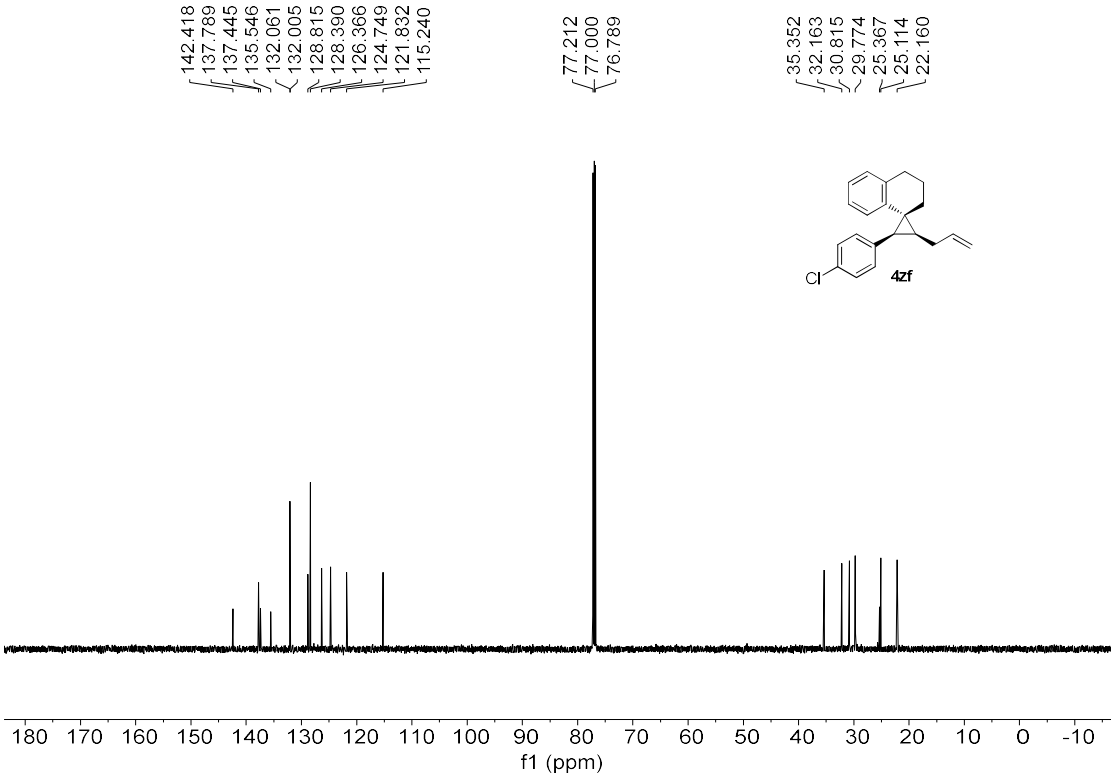
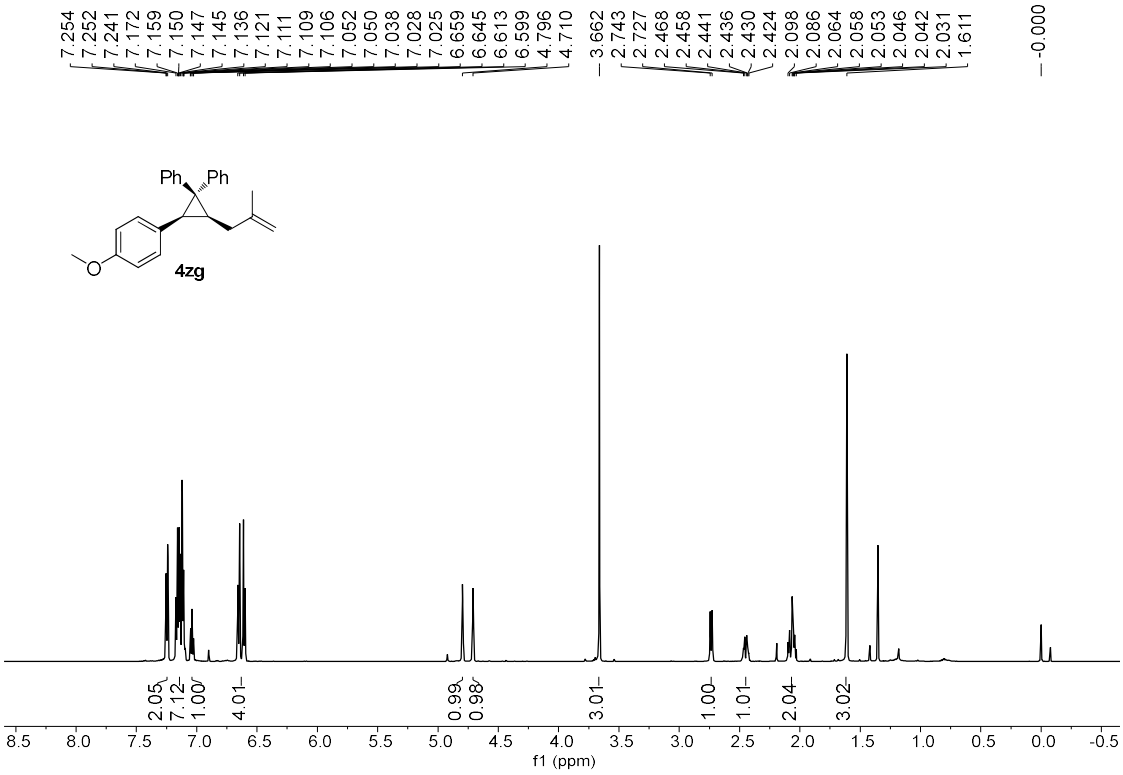
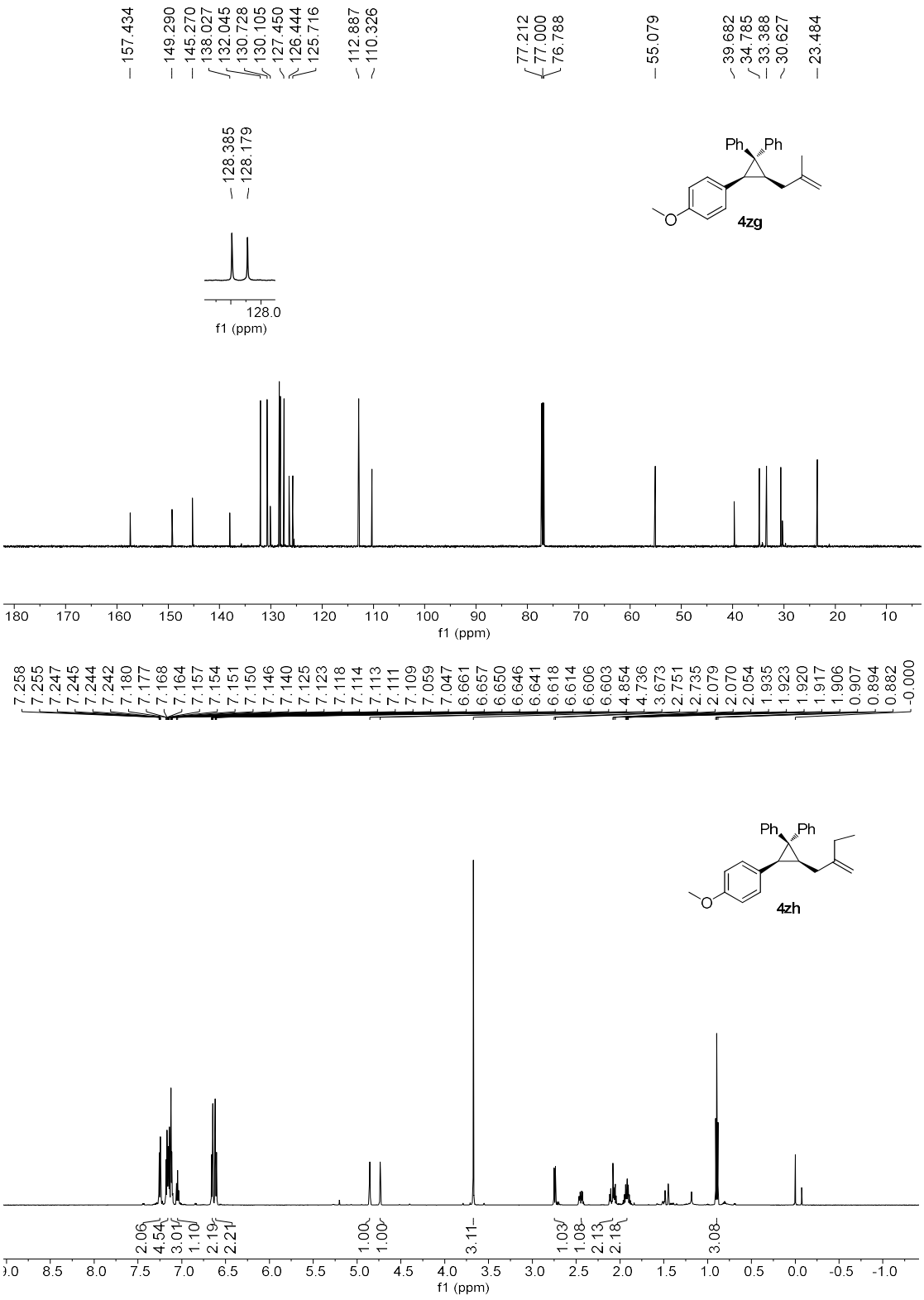
7.267
7.260
7.256
7.252
7.216
7.206
7.202
7.169
7.165
7.156
7.093
7.089
7.083
7.081
6.856
6.843
5.988
5.978
5.123
5.119
5.094
5.091
5.057
5.054
5.039
5.036
2.885
2.875
2.870
2.865
2.859
2.848
2.585
2.569
2.354
1.849
1.839
1.829
1.825
1.653
1.642
1.638
1.539
1.533
1.530
1.523
1.520
1.511
1.499
-0.000
Cl
4zf
2.39
2.03
1.00
2.05
1.00
1.00
1.03
1.01
2.14
1.07
1.11
1.05
2.12
1.11
2.01
f1 (ppm)


142.418
137.789
137.445
135.546
132.061
132.005
128.815
128.390
126.366
124.749
121.832
115.240
77.212
77.000
76.789
35.352
32.163
30.815
29.774
25.367
25.114
22.160
Cl
4zf
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.254
7.252
7.241
7.172
7.159
7.150
7.147
7.145
7.136
7.121
7.111
7.109
7.106
7.052
7.050
7.038
7.028
7.025
6.659
6.645
6.613
6.599
4.796
4.710
3.662
2.743
2.727
2.468
2.458
2.441
2.436
2.430
2.424
2.098
2.086
2.064
2.058
2.053
2.046
2.042
2.031
1.611
-0.000
Ph
Ph
O
4zg
2.05
7.12
1.00
4.01
0.99
0.98
3.01
1.00
1.01
2.04
3.02
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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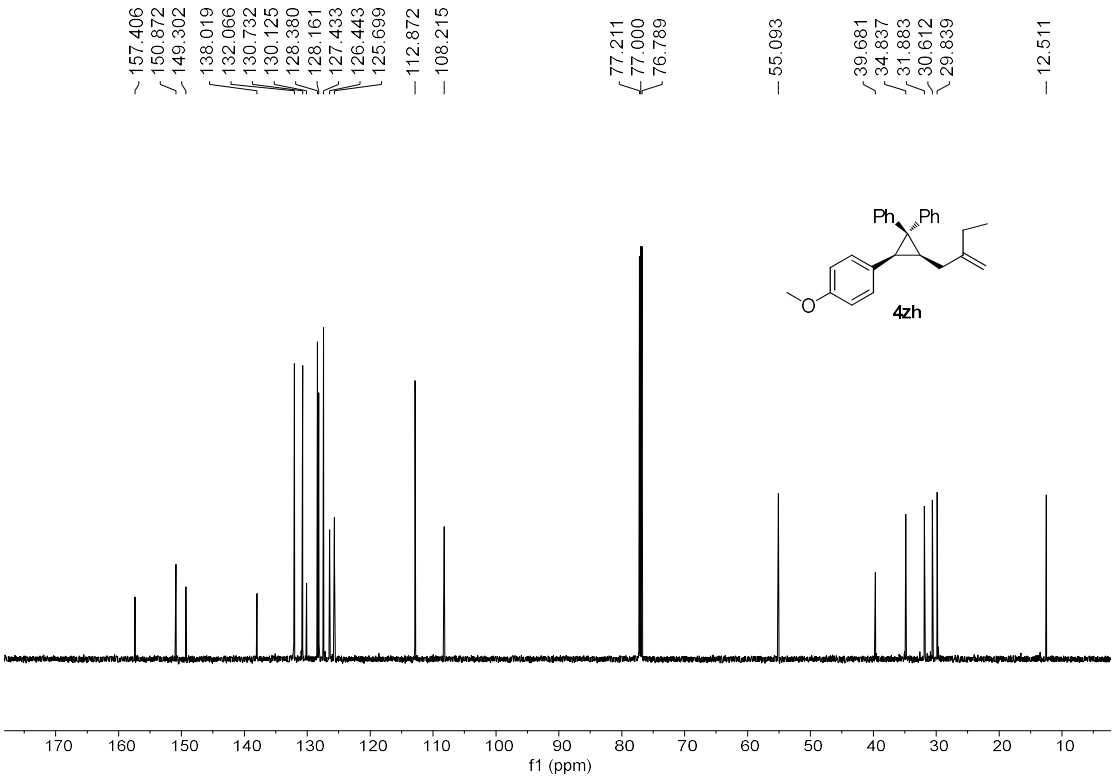
130.728
130.105
127.450
126.444
125.716
112.887
110.326
77.212
77.000
76.788
55.079
39.682
34.785
33.388
30.627
23.484
128.385
128.179
128.0
f1 (ppm)
Ph
Ph
O
4zg
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)
7.258
7.255
7.247
7.245
7.244
7.242
7.180
7.177
7.168
7.164
7.157
7.154
7.151
7.150
7.146
7.140
7.125
7.123
7.118
7.114
7.113
7.111
7.109
7.059
7.047
6.661
6.657
6.650
6.646
6.641
6.618
6.614
6.606
6.603
4.854
4.736
3.673
2.751
2.735
2.079
2.070
2.054
1.935
1.923
1.920
1.917
1.906
0.907
0.894
0.882
-0.000
Ph
Ph
O
4zh
2.06
4.54
3.01
1.10
2.19
2.21
1.00
1.00
3.11
1.03
1.08
2.13
2.18
3.08
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
f1 (ppm)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149.302
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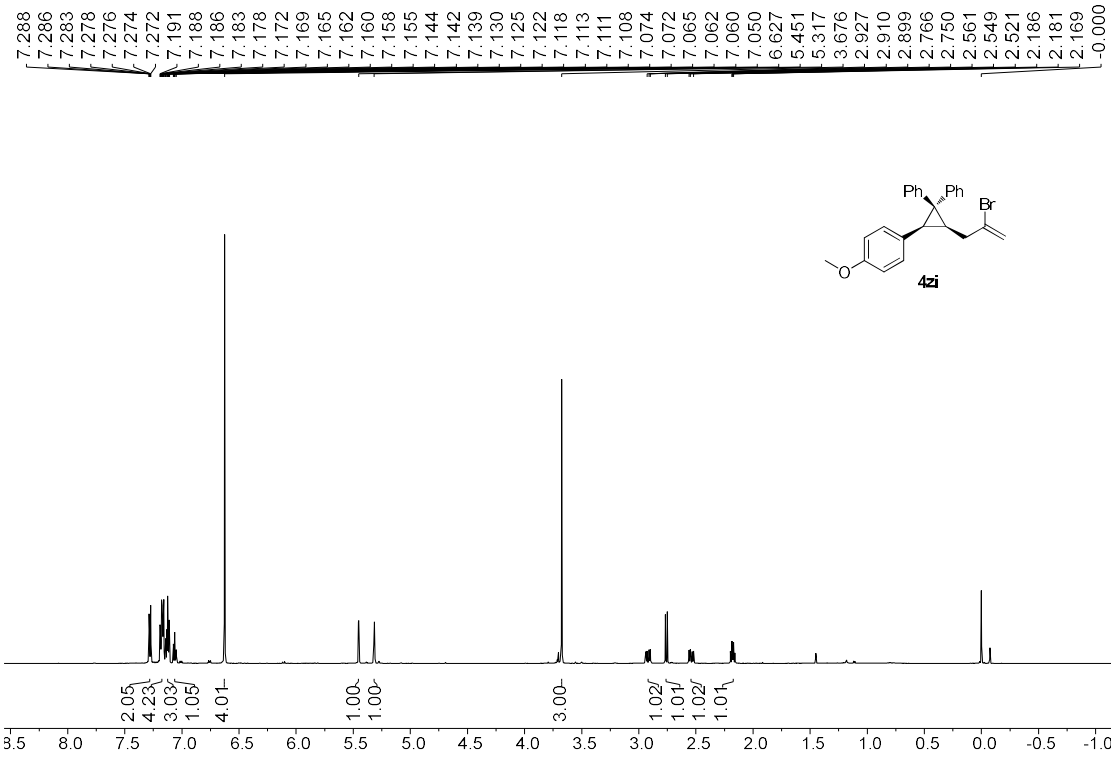
130.732
130.125
128.380
128.161
127.433
126.443
125.699
112.872
108.215
77.211
77.000
76.789
55.093
39.681
34.837
31.883
30.612
29.839
12.511
Ph
Ph
O
4zh
f1 (ppm)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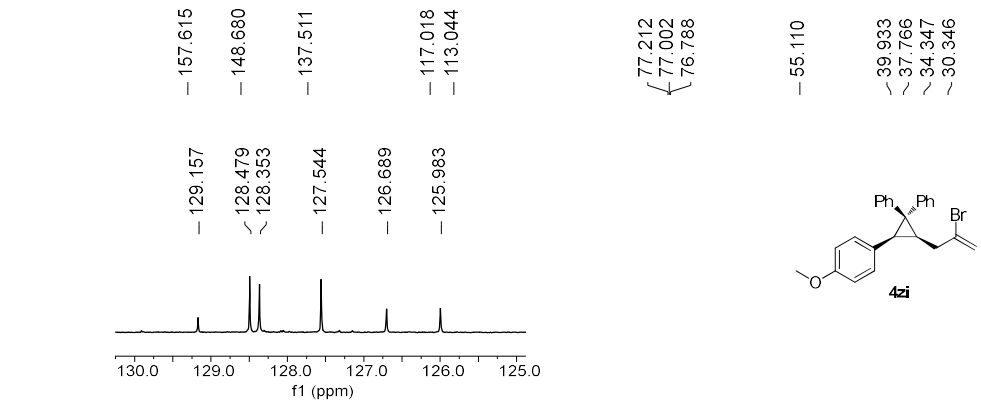
7.276
7.274
7.272
7.191
7.188
7.186
7.183
7.178
7.172
7.169
7.165
7.162
7.160
7.158
7.155
7.144
7.142
7.139
7.130
7.125
7.122
7.118
7.113
7.111
7.108
7.074
7.072
7.065
7.062
7.060
7.050
6.627
5.451
5.317
3.676
2.927
2.910
2.899
2.766
2.750
2.561
2.549
2.521
2.186
2.181
2.169
-0.000
Ph
Ph
Br
O
4zi
2.05
4.23
3.03
1.05
4.01
1.00
1.00
3.00
1.02
1.01
1.02
1.01
f1 (ppm)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76.788
55.110
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37.766
34.347
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128.479
128.353
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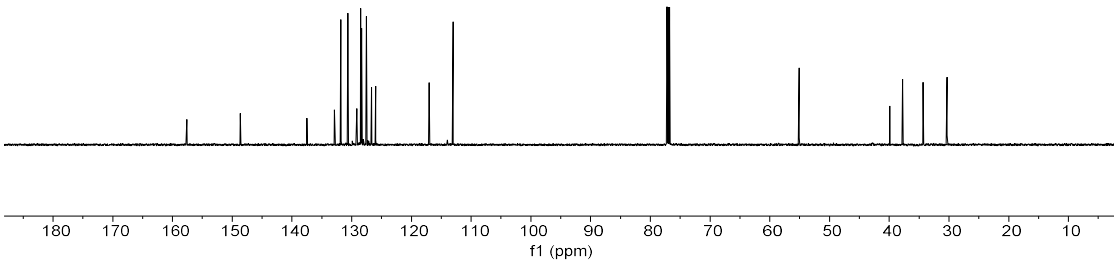
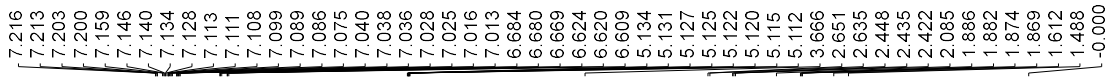
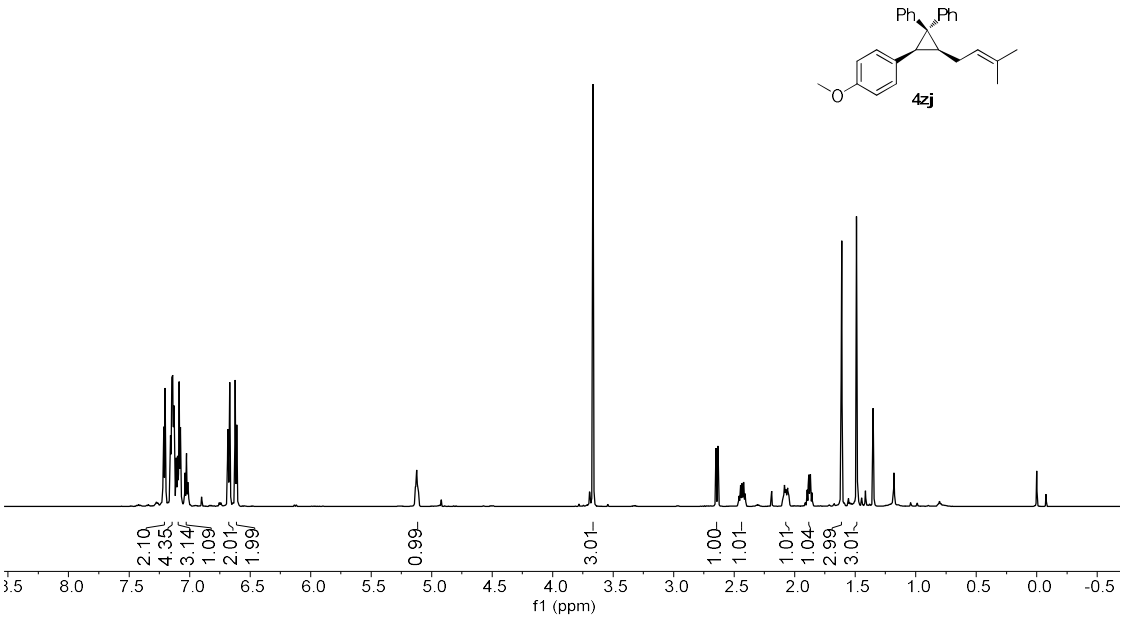
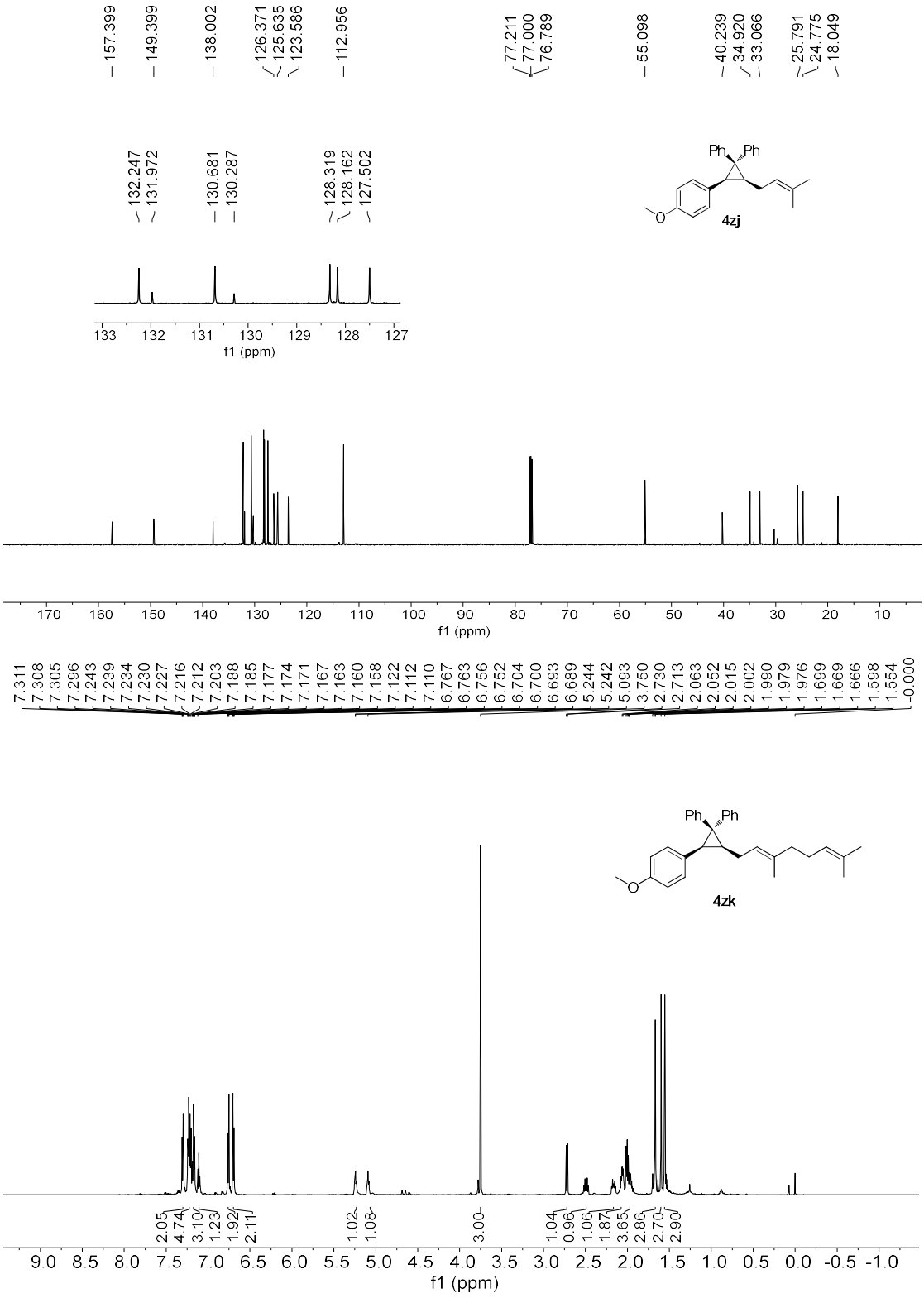
125.983
Ph
Ph
Br
O
4zi
f1 (ppm)


f1 (ppm)




Ph
Ph
O
4zj
2.10
4.35
3.14
1.09
2.01
1.99
0.99
3.01
1.00
1.01
1.01
1.04
2.99
3.01
f1 (ppm)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77.000
76.789
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40.239
34.920
33.066
25.791
24.775
18.049
132.247
131.972
130.681
130.287
128.319
128.162
127.502
Ph
Ph
O
4zj
f1 (ppm)
7.311
7.308
7.305
7.296
7.243
7.239
7.234
7.230
7.227
7.216
7.212
7.203
7.188
7.185
7.177
7.174
7.171
7.167
7.163
7.160
7.158
7.122
7.112
7.110
6.767
6.763
6.756
6.752
6.704
6.700
6.693
6.689
5.244
5.242
5.093
3.750
2.730
2.713
2.063
2.052
2.015
2.002
1.990
1.979
1.976
1.699
1.669
1.666
1.598
1.554
-0.000
Ph
Ph
O
4zk
2.05
4.74
3.10
1.23
1.92
2.11
1.02
1.08
3.00
1.04
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1.06
1.87
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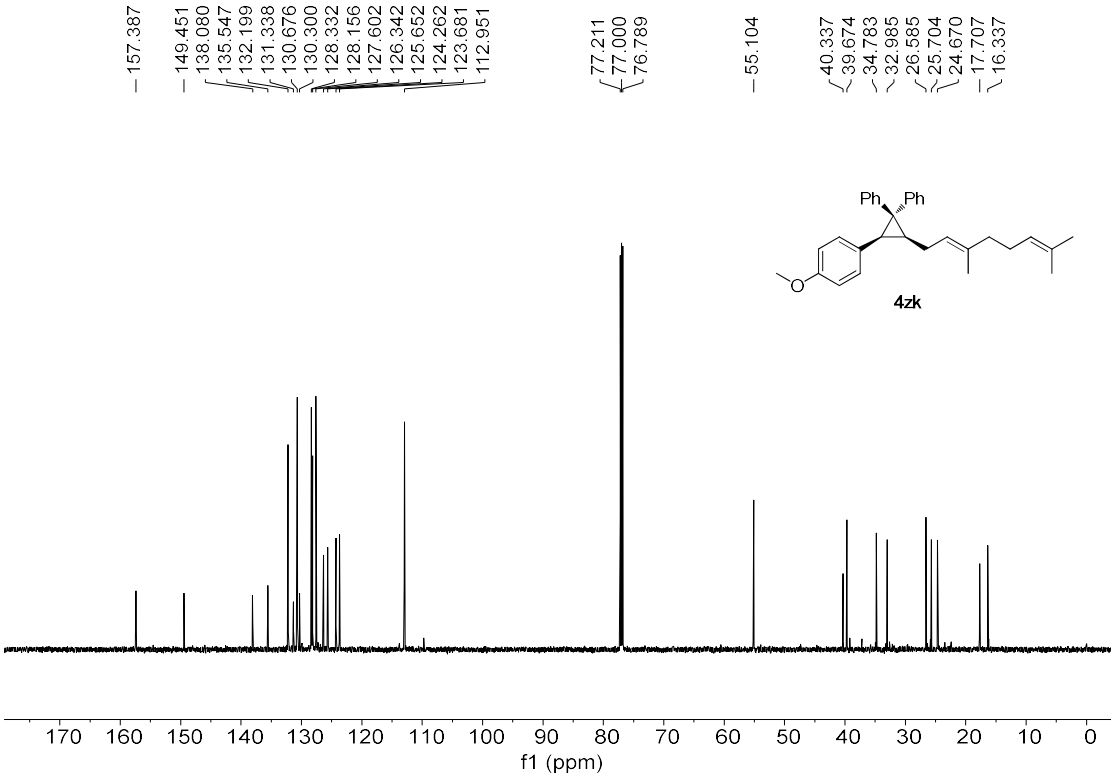
2.86
2.70
2.90
f1 (ppm)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128.156
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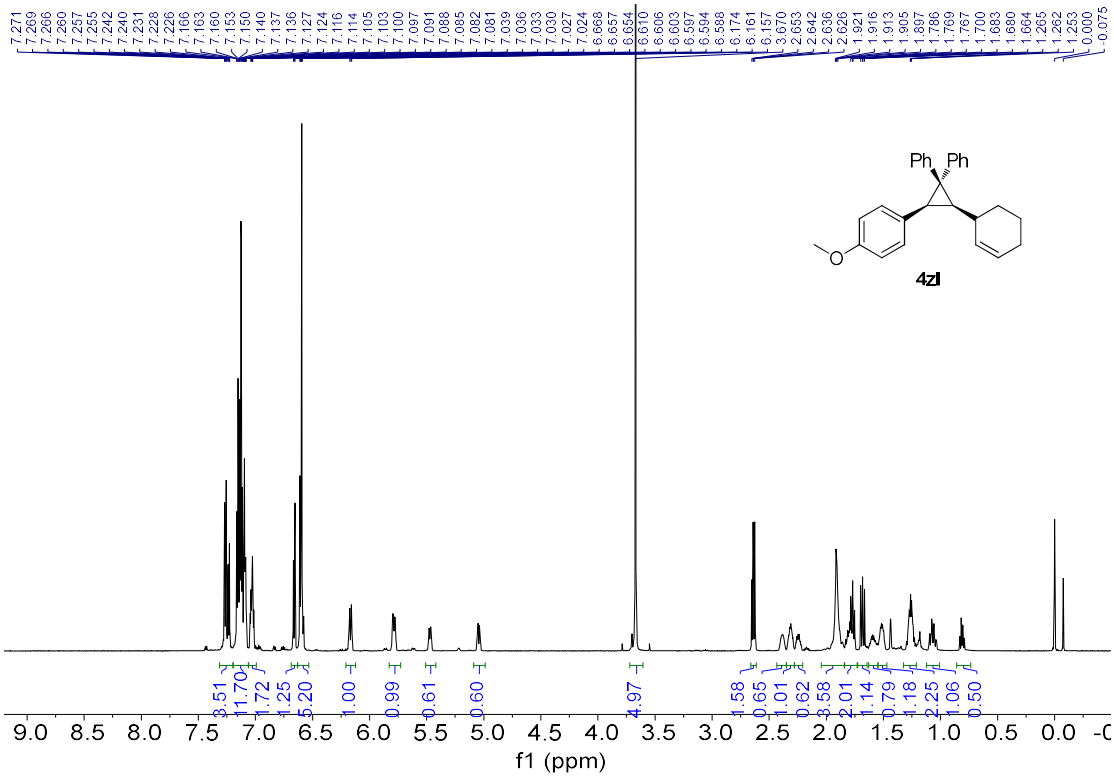
126.342
125.652
124.262
123.681
112.951
77.211
77.000
76.789
55.104
40.337
39.674
34.783
32.985
26.585
25.704
24.670
17.707
16.337
Ph
Ph
O
4zk
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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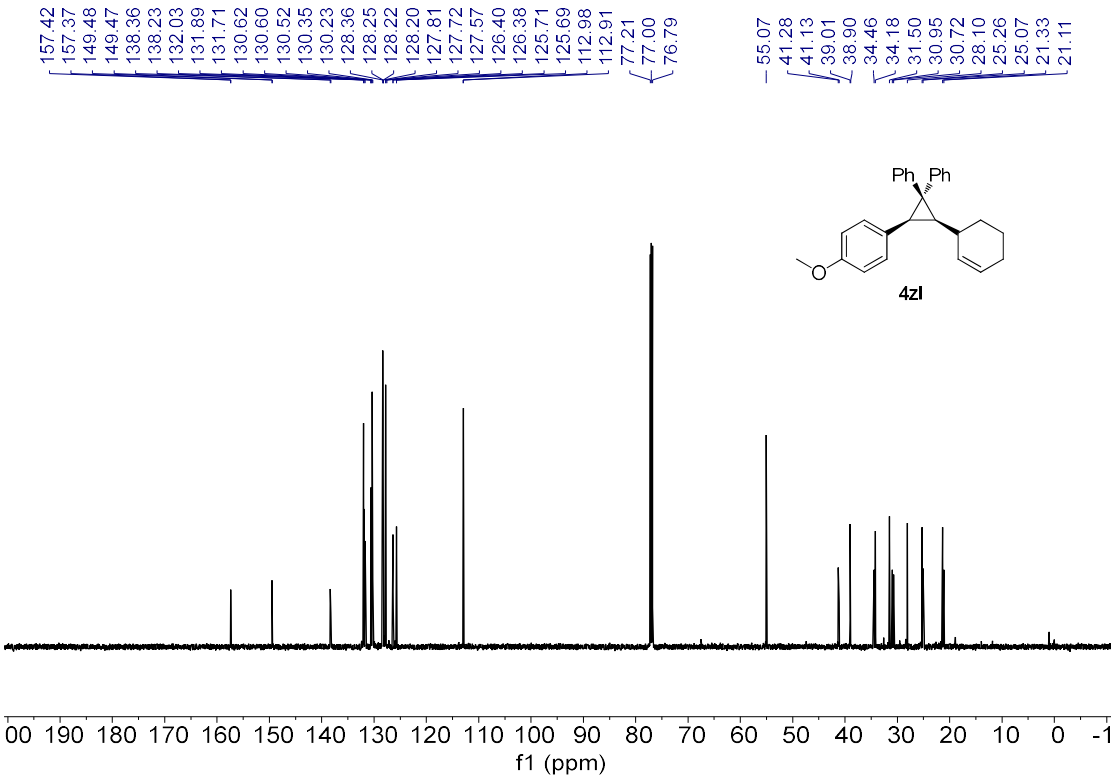
7.255
7.242
7.240
7.231
7.228
7.226
7.166
7.163
7.160
7.153
7.150
7.140
7.137
7.136
7.127
7.124
7.116
7.114
7.105
7.103
7.100
7.097
7.091
7.088
7.085
7.082
7.081
7.039
7.036
7.033
7.030
7.027
7.024
6.668
6.657
6.654
6.610
6.606
6.603
6.597
6.594
6.588
6.174
6.161
6.157
3.670
2.653
2.642
2.636
2.026
1.921
1.916
1.913
1.905
1.897
1.786
1.769
1.767
1.700
1.683
1.680
1.664
1.265
1.262
1.253
0.000
-0.075
Ph
Ph
O
4zl
3.51
11.70
1.72
1.25
5.20
1.00
0.99
0.61
0.60
4.97
1.58
0.65
1.01
0.62
3.58
2.01
1.14
0.79
1.18
2.25
1.06
0.50
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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130.35
130.23
128.36
128.25
128.22
128.20
127.81
127.72
127.57
126.40
126.38
125.71
125.69
112.98
112.91
77.21
77.00
76.79
55.07
41.28
41.13
39.01
38.90
34.46
34.18
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28.10
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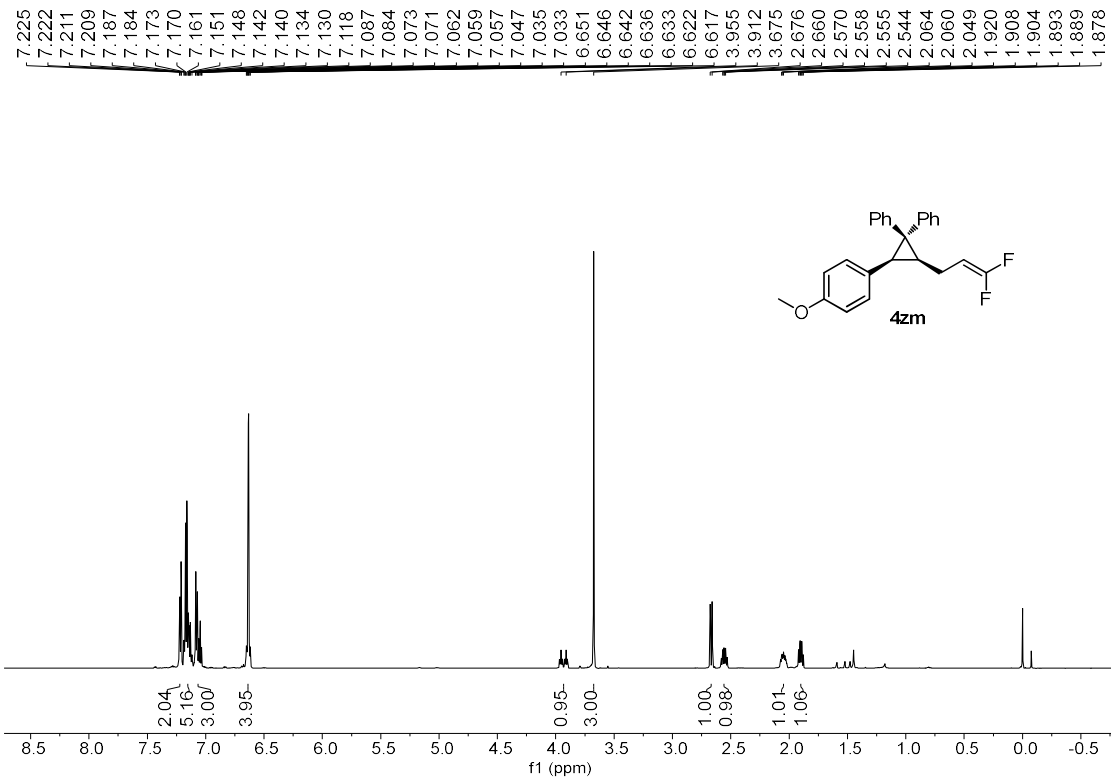
25.07
21.33
21.11
Ph
Ph
O
4zl
f1 (ppm)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7.140
7.134
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7.118
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7.084
7.073
7.071
7.062
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7.057
7.047
7.035
7.033
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6.642
6.636
6.633
6.622
6.617
3.955
3.912
3.675
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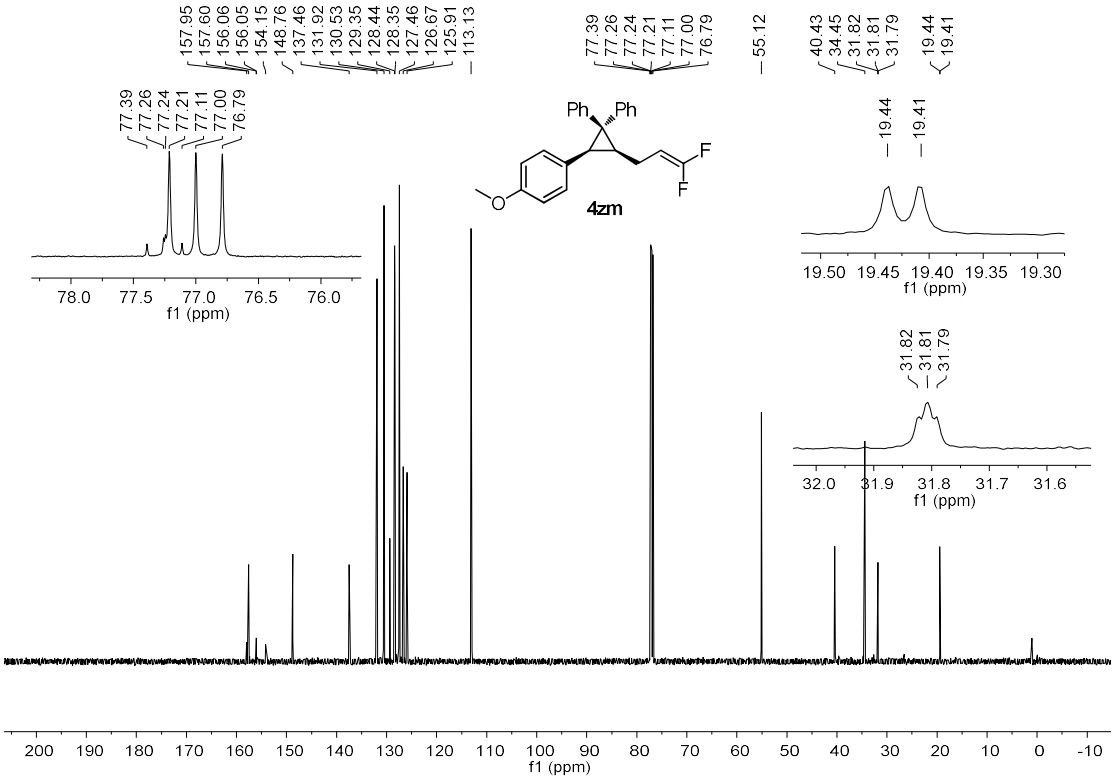
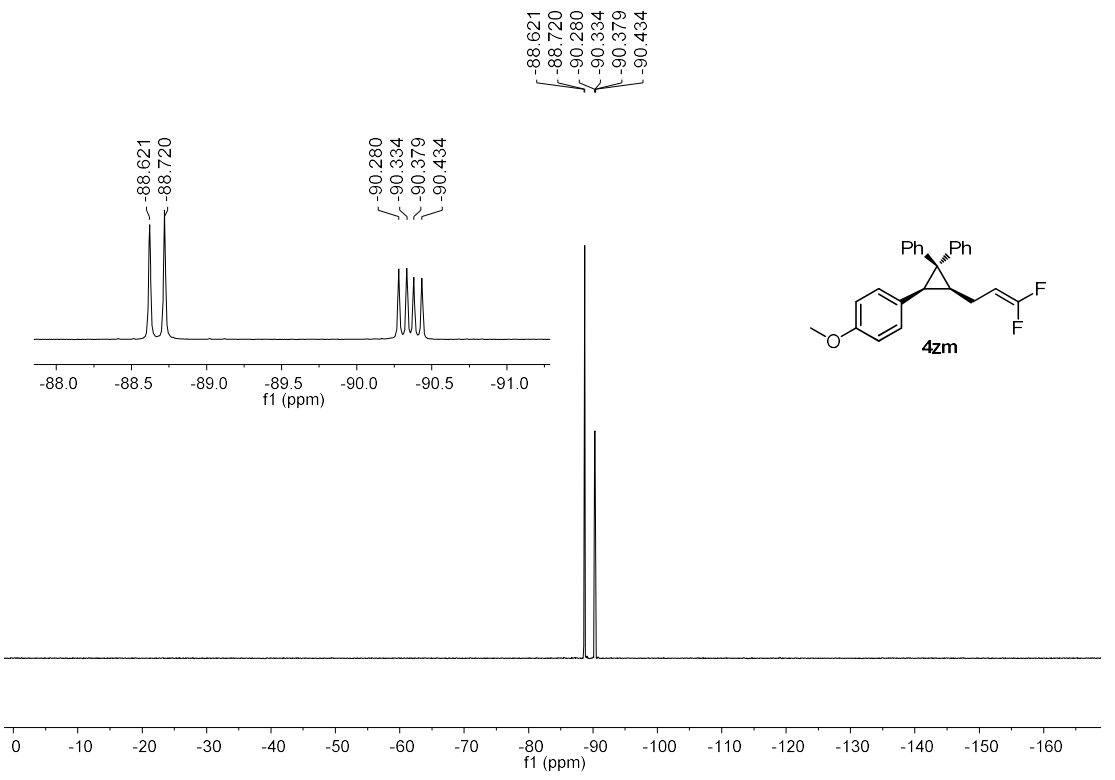
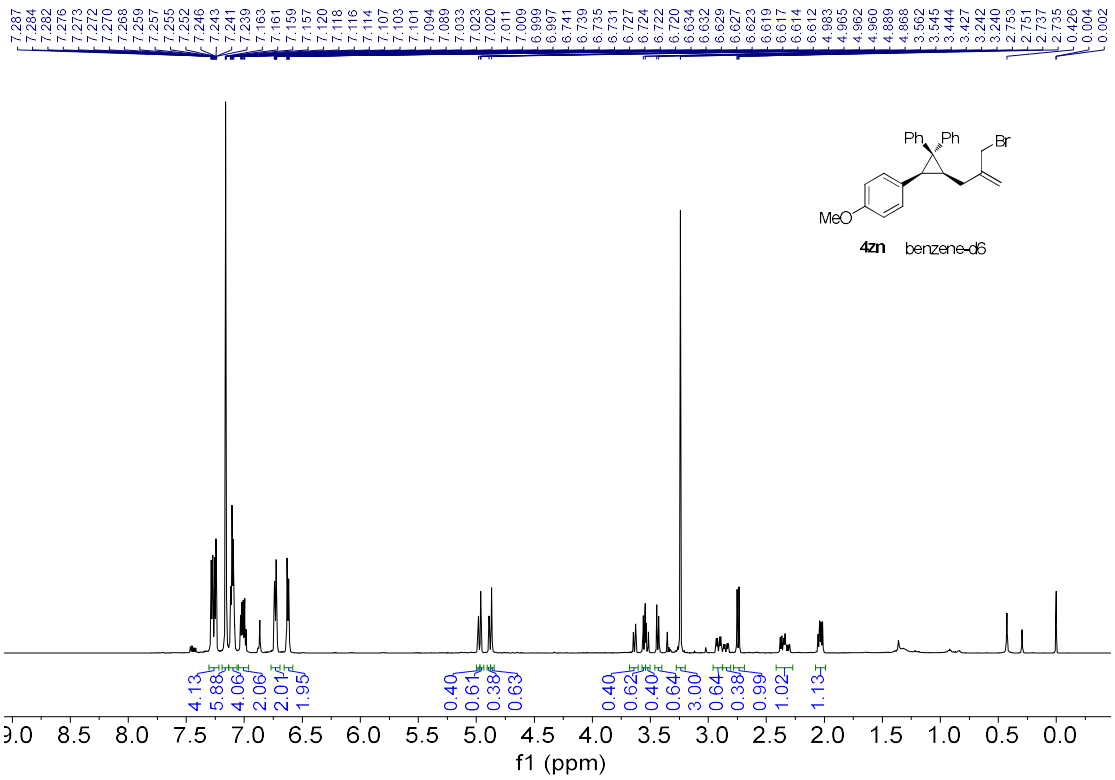
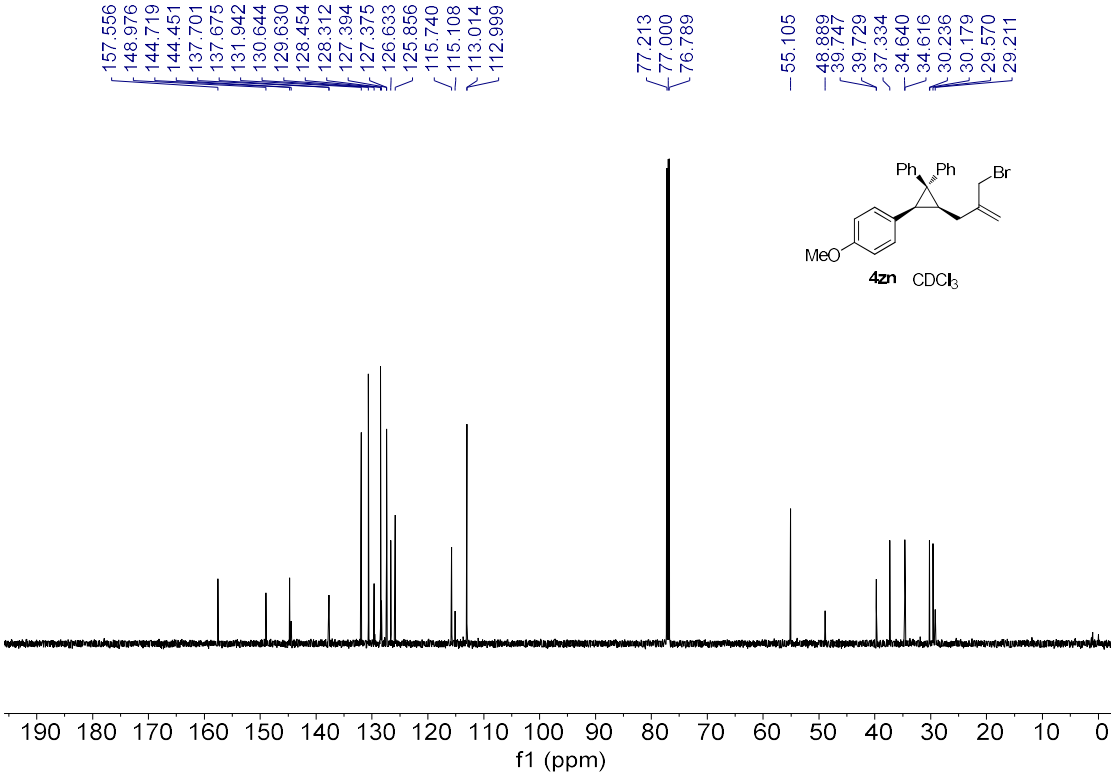
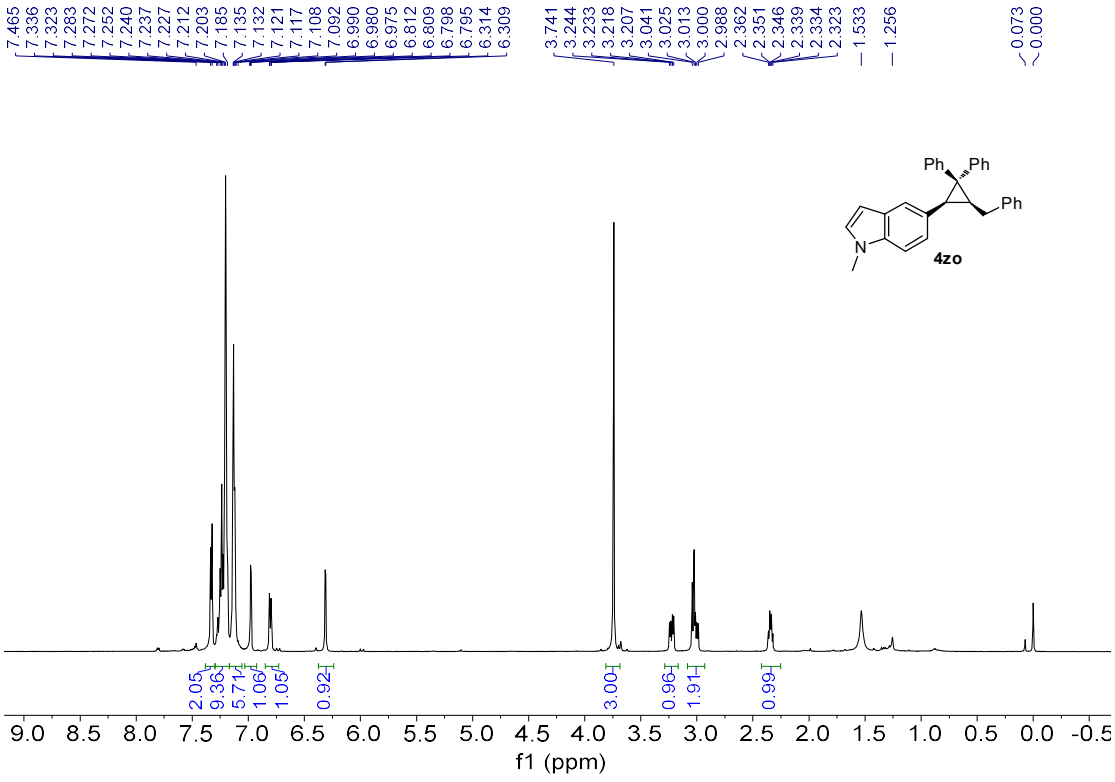
2.558
2.555
2.544
2.064
2.060
2.049
1.920
1.908
1.904
1.893
1.889
1.878
Ph
Ph
F
F
O
4zm
2.04
5.16
3.00
3.95
0.95
3.00
1.00
0.98
1.01
1.06
f1 (ppm)

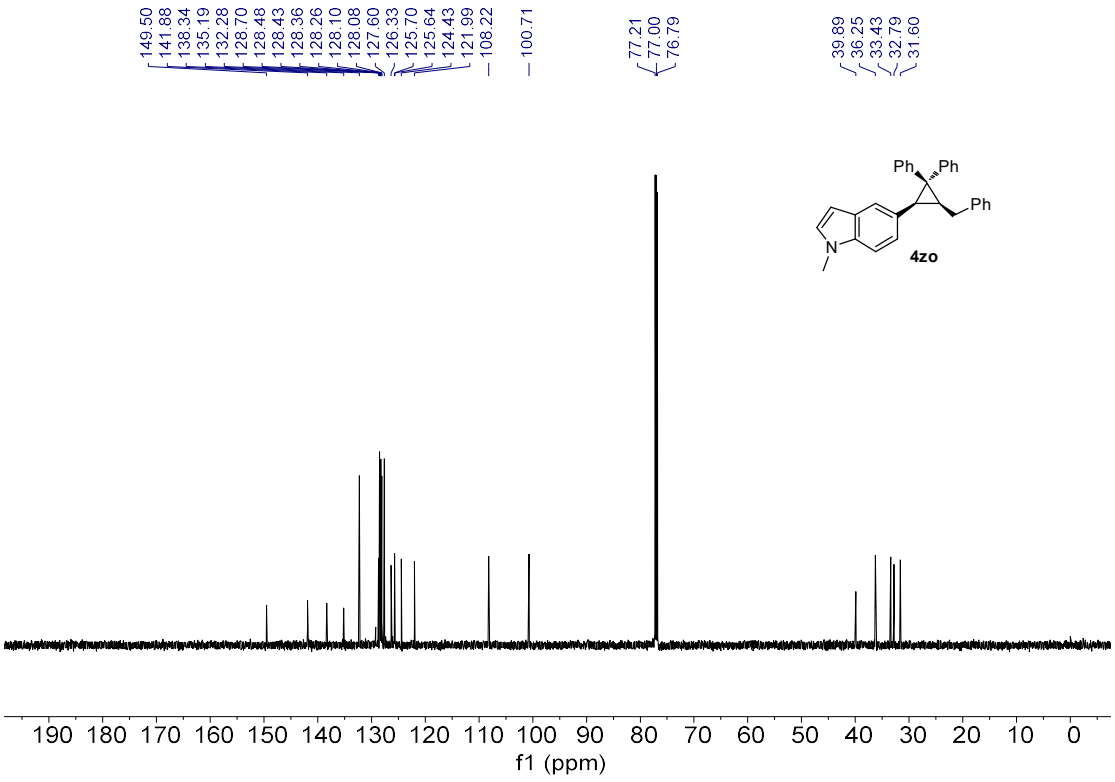

157.95
157.60
156.06
156.05
154.15
148.76
137.46
131.92
130.53
129.35
128.44
128.35
127.46
126.67
125.91
113.13
77.39
77.26
77.24
77.21
77.11
77.00
76.79
55.12
40.43
34.45
31.82
31.81
31.79
19.44
19.41
Ph
Ph
F
F
O
4zm
f1 (ppm)


-88.621
-88.720
-90.280
-90.334
-90.379
-90.434
Ph
Ph
F
F
O
4zm
f1 (ppm)


Ph
Ph
Br
MeO
4zn benzene-d6
f1 (ppm)

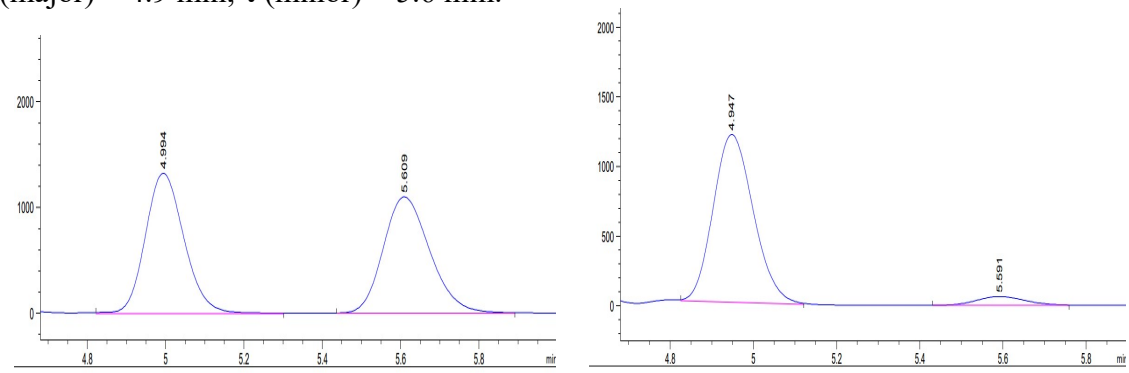

Ph
Ph
Br
MeO
4zn CDCl3
f1 (ppm)


7.465
7.336
7.323
7.283
7.272
7.252
7.240
7.237
7.227
7.212
7.203
7.185
7.135
7.132
7.121
7.117
7.108
7.092
6.990
6.980
6.975
6.812
6.809
6.798
6.795
6.314
6.309
3.741
3.244
3.233
3.218
3.207
3.041
3.025
3.013
3.000
2.988
2.362
2.351
2.346
2.339
2.334
2.323
1.533
1.256
0.073
0.000
Ph
Ph
Ph
N
4zo
2.05
9.36
5.71
1.06
1.05
0.92
3.00
0.96
1.91
0.99
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


149.50
141.88
138.34
135.19
132.28
128.70
128.48
128.43
128.36
128.26
128.10
128.08
127.60
126.33
125.70
125.64
124.43
121.99
108.22
100.71
77.21
77.00
76.79
39.89
36.25
33.43
32.79
31.60
Ph
Ph
Ph
N
4zo
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

HPLC traces of (+)-**4e**.

HPLC conditions: chiralpak OD-H column, hexanes/i-PrOH = 99/1, 1 mL/min, τ (major) = 4.9 min; τ (minor) = 5.6 min.



Racemic:

Peak	PetTime	Type	Width(min)	Area(mAu*S)	Hight(mAu)	Area%
1	4.994	MM R	0.1148	9141.33008	1327.40552	50.1945
2	5.609	MM R	0.1376	9070.47559	1098.53735	49.8055

Chiral:

Peak	PetTime	Type	Width(min)	Area(mAu*S)	Hight(mAu)	Area%
1	4.947	MM R	0.1095	8078.30518	1204.73352	94.0192
2	5.591	MM R	0.1261	513.88239	63.11434	5.9808