Supporting Information

Synthesis of α-Quaternary β-Lactams via Copper-Catalyzed Enantioconvergent Radical C(sp^3)–C(sp^2) Cross-Coupling with Organoboronate Esters

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General information

Reactions were carried out under an argon atmosphere using Schlenk techniques. Reagents were purchased at the highest commercial quality and used without further purification, unless otherwise stated. $CuBr \cdot Me_2S$ was purchased from Aladdin. Anhydrous THF and 1,4-dioxane were purchased from J&K Chemical Ltd. Lithium *tert*-butoxide (99%) was purchased from Macklin, which was dry at 90 °C for 3 h under reduced pressure. Analytical thin layer chromatography (TLC) was performed on precoated silica gel 60 GF254 plates. Flash column chromatography was performed using Tsingtao silica gel (60, particle size 0.040–0.063 mm). Visualization on TLC was achieved by use of UV light (254 nm), iodine or basic $KMnO_4$ indicator. NMR spectra were recorded on Bruker DRX-400 spectrometer at 400 MHz for ^1H NMR, 101 MHz for ^{13}C NMR and 376 MHz for ^{19}F NMR, respectively, in $CDCl_3$ with tetramethylsilane (TMS) as internal standard. The chemical shifts were expressed in ppm and coupling constants were given in Hz. Data for ^1H NMR are recorded as follows: chemical shift (ppm), multiplicity (s, singlet; d, doublet; t, triplet; q, quartet; p, pentet, m, multiplet; br, broad), coupling constant (Hz), integration. Data for ^{13}C NMR were reported in terms of chemical shift (δ, ppm). High-resolution mass spectroscopy (HRMS) was obtained on Thermo Scientific Q Exactive using ESI ion source. Enantiomeric excess (ee) was determined using SHIMADZU LC-20AD with SPD-20AV detector or Agilent high-performance liquid chromatography (HPLC) with Hatachi detector (at appropriate wavelength). Column conditions were reported in the experimental section below. X-ray diffraction was measured on a 'Bruker APEX-II CCD' diffractometer with Cu–Kα radiation.

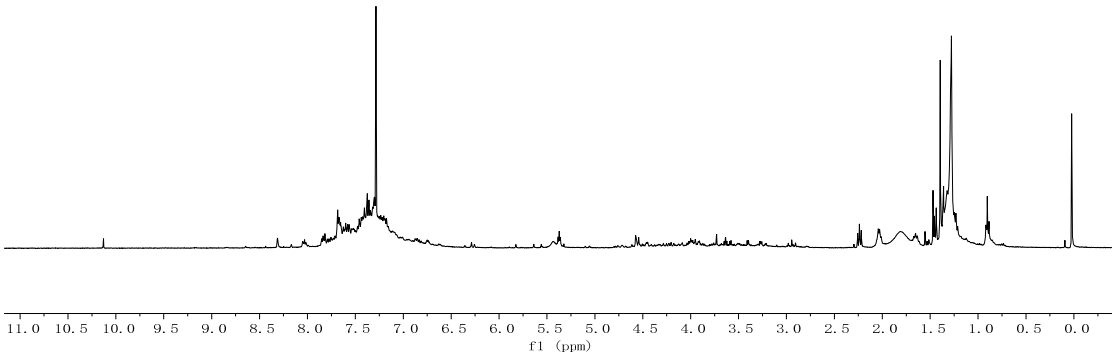
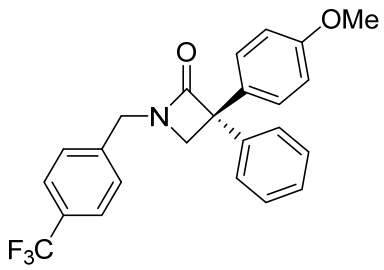


Figure S1. Crude ^{1}H NMR analysis of **E1** under LiO^{t}Bu/DMF conditions: **E1** decomposed in the absence of the catalyst under the LiO^{t}Bu/DMF conditions (**E1** (0.05 mmol), LiO^{t}Bu (3.0 equiv.) and H_2O (1.0 equiv.) in DMF (1.0 mL) at rt for 20 h under argon).



19

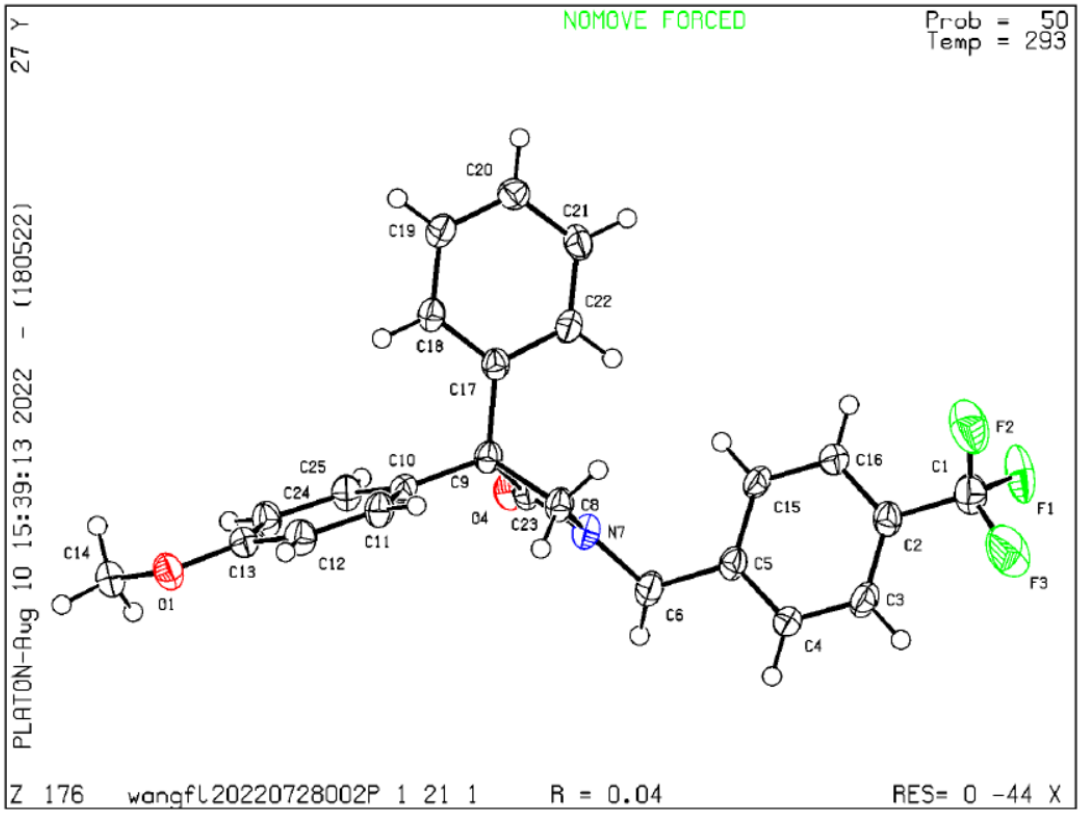
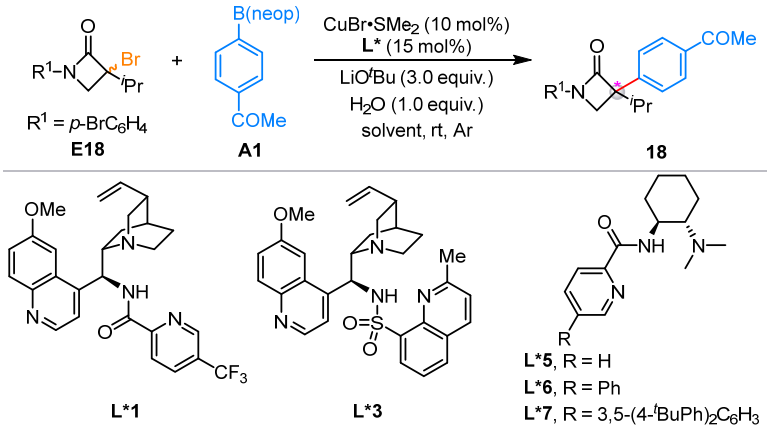


Figure S2. The X-ray structure of 19.

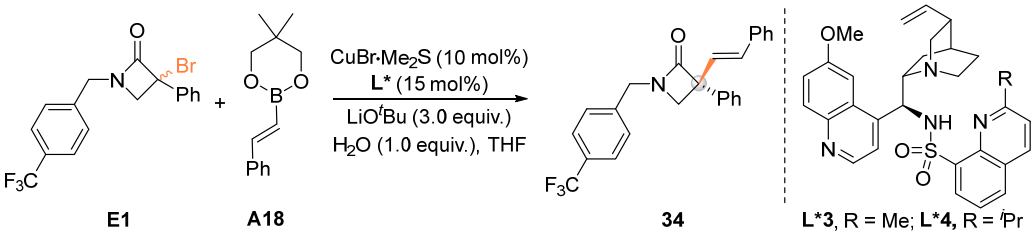
Table S1. Evaluating the reaction of tertiary α-bromo-β-lactam with alkyl chain[a]



Entry	solvent	L*	Yield of **18** [%]	Ee [%]
1	1,4-dioxane/THF	**L*3**	0	-
2	DMF	**L*3**	<5	-
3	DMF	**L*1**	72	–40
4	DMF	**L*5**	85 (80)	56
5	DMF	**L*6**	77	45
6	DMF	**L*7**	50	43

[a] Reaction conditions: **E18** (0.1 mmol), **A1** (0.12 mmol), CuBr·SMe_2 (10 mol%), **L*** (15 mol%), LiO^{t}Bu (3.0 equiv.) and H_2O (1.0 equiv.) in solvent (2.0 mL) at rt for 24 h under argon (Ar). Yields were based on ^{1}H NMR analysis using 1,3,5-trimethoxybenzene as an internal standard. Isolated yield in parenthesis. Ee values were based on HPLC analysis.

Table S2. Effect of ligands in the reaction of alkenylboronate esters[a]



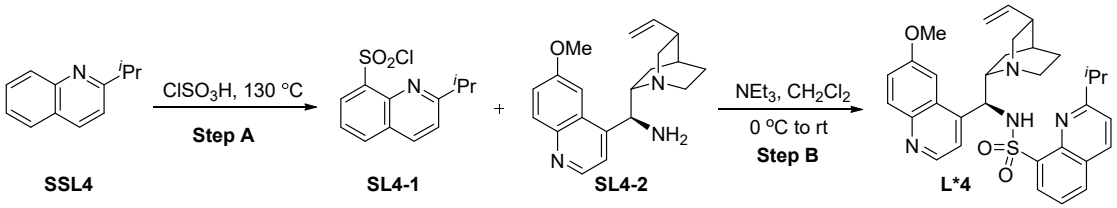
Entry	L*	Temp. (°C)	Conversion of **E1** (%)	Yield of **34** (%)	Ee (%)
1	**L*3**	0	>95	26	81
2	**L*4**	0	>95	30	90
3[b]	**L*4**	–20	>95	51	93
4[c]	**L*4**	–40	>95	75	98

[a] Reaction conditions: **E1** (0.15 mmol), **A18** (0.10 mmol), CuBr·Me_2S (10 mol %), **L*** (15 mol %), LiO^{t}Bu (3.0 equiv.) and H_2O (1.0 equiv.) in THF (2.0 mL) at 0 °C for 45 h under argon. Conversion of **E1** and yield of **34** was based on ^{1}H NMR analysis of the crude product using 1,3,5-trimethoxybenzene as an internal standard. Yield of **34** was based on **A18**. Ee values were based on chiral HPLC analysis. [b] Conducted at –20 °C for 3 d. [c] Conducted at –40 °C for 5 d.

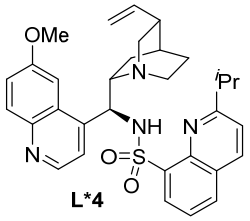
The synthesis of ligands, α-bromo-β-lactams and boron reagents

The synthesis of chiral ligands

Chiral ligand **L*3** was synthesized according to the reported literature.[1]



2-isopropyl-*N*-((*S*)-(6-methoxyquinolin-4-yl)((*1S*,*2S*,*4S*,*5R*)-5-vinylquinuclidin-2-yl)methyl)quinoline-8-sulfonamide (L*4)



Step A: Under an argon atmosphere, **SSL4** (3.59 g, 21 mmol) was added slowly to the chlorosulfonic acid (32 mL) while stirring in an ice bath. the reaction mixture was heated to 130 °C for 6 h. Then the mixture was cooled to room temperature with continuous stirring and poured gradually on crushed ice. The mixture was extracted with CH_2Cl_2 for three times. The combined organic phase was dried over Na_2SO_4, filtered and concentrated under reduced pressure. The residue was purified by flash chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to give **SL4-1** as a white solid (1.98 g, 35% yield).

Step B: Quinine-derived chiral amine **SL4-2** was prepared from quinine according to the previously reported literature procedure.[1] Under an argon atmosphere, chiral amine **SL4-2** (1.05 g, 3.25 mmol) was dissolved in CH_2Cl_2 (20 mL), followed by the addition of triethylamine (1.36 mL, 9.75 mmol) and **SL4-1** (1.05 g, 3.90 mmol) at ice water bath. The reaction mixture was allowed to warm up to room temperature and stirred overnight. After completion, water was poured to above mixture, and the mixture was extracted with CH_2Cl_2. The combined organic phase was dried over Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by flash chromatography on silica gel (gradient eluent: petroleum ether/ethyl acetate 1/1 to ethyl acetate) to provide the product **L*4** as a white solid (1.31 g, 76% yield).

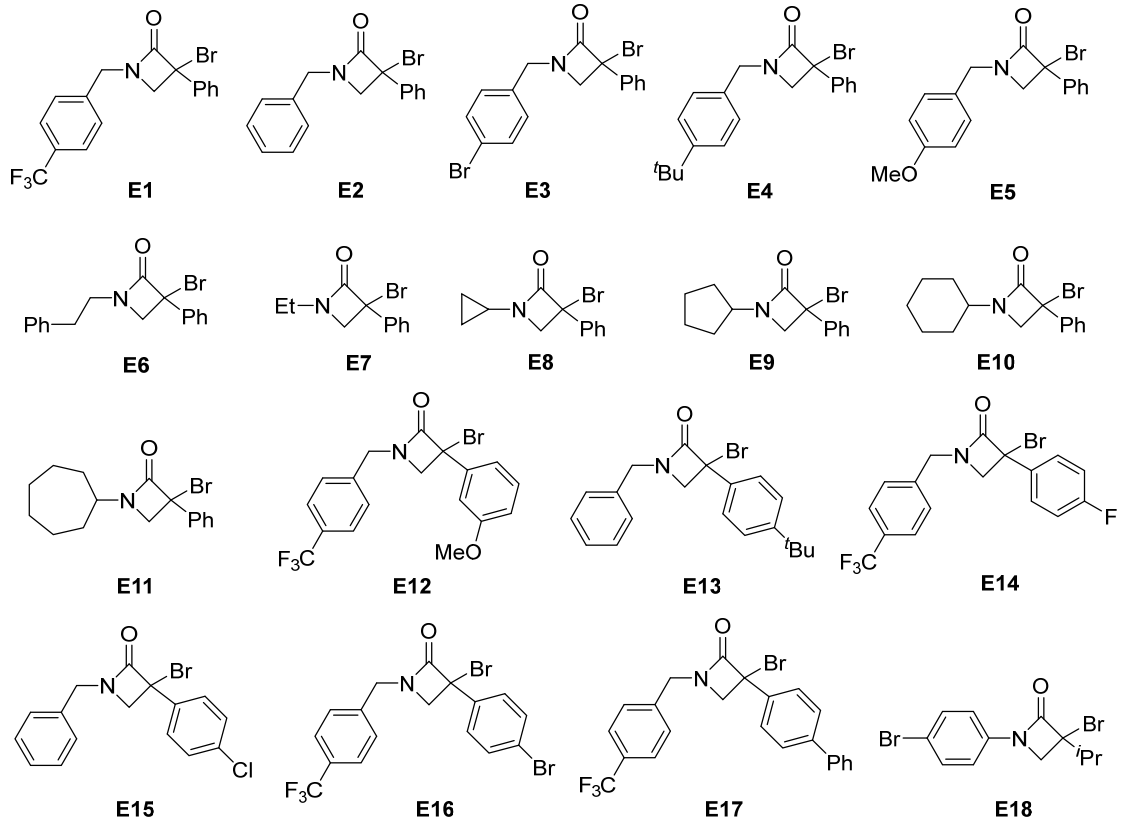
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.67 (d, *J* = 4.5 Hz, 1H), 8.13 (t, *J* = 7.1 Hz, 2H), 8.00 (d, *J* = 9.2 Hz, 1H), 7.94 (d, *J* = 8.2 Hz, 1H), 7.74 – 7.50 (m, 1H), 7.45 (t, *J* = 8.7 Hz, 2H), 7.39 – 7.31 (m, 1H), 7.18 (m, 1H), 5.76 – 5.24 (m, 1H), 4.86 (d, *J* = 17.2 Hz, 2H), 4.76 (d, *J* = 10.6 Hz, 1H), 3.88 (s, 3H), 3.34 (p, *J* = 6.9 Hz, 1H), 3.04 – 2.75 (m, 2H), 2.48 (d, *J* = 14.1 Hz, 1H), 2.15 – 1.87 (m, 1H), 1.84 (d, *J* = 17.5 Hz, 1H), 1.51 (m, 8H), 1.30 – 0.90 (m, 3H), 0.86 – 0.47 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.21, 157.63, 147.46, 144.86, 144.26, 142.62, 141.09, 136.51, 135.32, 132.86, 131.62, 130.24, 127.03, 123.96, 120.98, 119.64, 114.39, 100.94, 60.94, 55.37, 55.29, 53.19, 36.70, 27.50, 27.04, 25.04, 21.99.

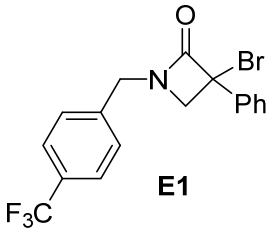
HRMS (ESI) *m/z* calcd. for $C_{32}H_{37}N_4O_3S$ $[M+H]^+$ 557.2581, found 557.2577.

The synthesis of α-bromo-β-lactams

Substrates **E1**–**E18** were prepared according to the previously reported literature procedure.[2]

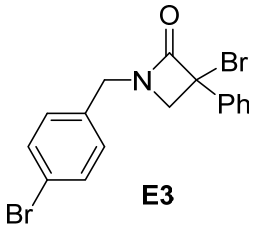


3-bromo-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (E1)



^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.56 (m, 4H), 7.43 – 7.31 (m, 5H), 4.62 (d, J = 15.5 Hz, 1H), 4.43 (d, J = 15.5 Hz, 1H), 3.92 (ABq, J_{AB} = 6.0 Hz, $\Delta\nu_{AB}$ = 13.3 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.40, 138.62, 137.42, 130.60 (q, J = 32.6 Hz), 129.41, 129.12, 128.41, 127.25, 126.17 (q, J = 3.8 Hz), 124.03 (q, J = 272.2 Hz), 60.75, 57.99, 45.85.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.65.
HRMS (ESI) *m/z* calcd. for $C_{17}H_{14}BrF_3NO$ $[M+H]^+$ 384.0205, found 384.0203.

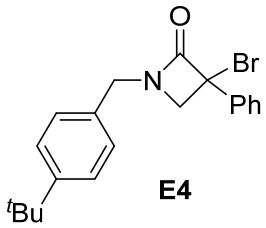
3-bromo-1-(4-bromobenzyl)-3-phenylazetidin-2-one (E3)



E3

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.55 (m, 2H), 7.52 – 7.45 (m, 2H), 7.41 – 7.30 (m, 3H), 7.15 – 7.08 (m, 2H), 4.51 (d, J = 15.2 Hz, 1H), 4.32 (d, J = 15.3 Hz, 1H), 3.87 (ABq, J_{AB} = 6.0 Hz, $\Delta\nu_{AB}$ = 12.4 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.28, 137.49, 133.50, 132.33, 129.88, 129.35, 129.08, 127.24, 122.31, 60.66, 57.76, 45.74.
HRMS (ESI) *m/z* calcd. for $C_{16}H_{14}Br_2NO$ $[M+H]^+$ 393.9437, found 393.9436.

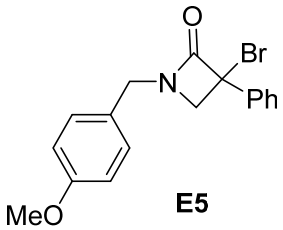
3-bromo-1-(4-(*tert*-butyl)benzyl)-3-phenylazetidin-2-one (E4)



E4

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.57 (m, 2H), 7.42 – 7.30 (m, 5H), 7.17 (d, J = 8.2 Hz, 2H), 4.52 (d, J = 15.1 Hz, 1H), 4.37 (d, J = 15.1 Hz, 1H), 3.89 (ABq, J_{AB} = 6.1 Hz, $\Delta\nu_{AB}$ = 4.0 Hz, 2H), 1.32 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.21, 151.24, 137.80, 131.30, 129.20, 129.01, 127.92, 127.29, 126.03, 60.66, 57.77, 45.97, 34.71, 31.43.
HRMS (ESI) *m/z* calcd. for $C_{20}H_{23}BrNO$ $[M+H]^+$ 372.0958, found 372.0956.

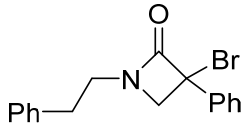
3-bromo-1-(4-methoxybenzyl)-3-phenylazetidin-2-one (E5)



E5

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.52 (m, 2H), 7.42 – 7.29 (m, 3H), 7.20 – 7.08 (m, 2H), 6.92 – 6.82 (m, 2H), 4.48 (d, J = 14.9 Hz, 1H), 4.31 (d, J = 14.9 Hz, 1H), 3.84 (ABq, J = 6.0 Hz, $\Delta\nu_{AB}$ = 9.1 Hz, 2H), 3.79 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.00, 159.42, 137.60, 129.49, 129.10, 128.89, 127.14, 126.20, 114.37, 60.44, 57.37, 55.29, 45.66.
HRMS (ESI) *m/z* calcd. for $C_{17}H_{17}BrNO_2$ $[M+H]^+$ 346.0437, found 346.0435.

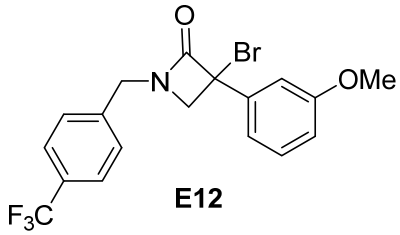
3-bromo-1-phenethyl-3-phenylazetidin-2-one (E6)



E6

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 – 7.47 (m, 2H), 7.38 – 7.28 (m, 3H), 7.25 – 7.18 (m, 3H), 7.18 – 7.13 (m, 2H), 3.78 (ABq, J = 5.8 Hz, $\Delta\nu_{AB}$ = 9.9 Hz, 2H)， 3.55 (t, J = 7.1 Hz, 2H), 2.89 (t, J = 7.1 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 164.91, 137.79, 137.56, 128.98, 128.77, 128.69, 128.60, 127.07, 126.75, 60.18, 58.66, 43.43, 33.92.
HRMS (ESI) *m/z* calcd. for $C_{17}H_{17}BrNO$ $[M+H]^+$ 330.0488, found 330.0487.

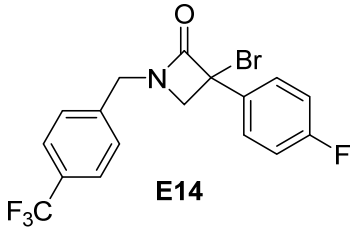
3-bromo-3-(3-methoxyphenyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (E12)



E12

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 (d, J = 8.0 Hz, 2H), 7.36 (d, J = 8.0 Hz, 2H), 7.29 (t, J = 8.2 Hz, 1H), 7.18 – 7.12 (m, 1H), 6.88 (dd, J = 8.3, 2.6 Hz, 1H), 4.61 (d, J = 15.5 Hz, 1H), 4.44 (d, J = 15.5 Hz, 1H), 3.90 (ABq, J = 5.9 Hz, $\Delta\nu_{AB}$ = 16.6 Hz, 2H), 3.82 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ165.19, 159.76, 138.58, 138.46 (d, J = 1.5 Hz), 130.41 (q, J = 32.8 Hz), 130.02, 128.27, 126.02 (q, J = 3.8 Hz), 123.89 (q, J = 272.2 Hz), 119.25, 115.07, 112.57, 60.44, 57.88, 55.36, 45.68.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.61.
HRMS (ESI) *m/z* calcd. for $C_{18}H_{16}BrF_3NO_2$ $[M+H]^+$ 414.0311, found 414.0309.

3-bromo-3-(4-fluorophenyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (E14)

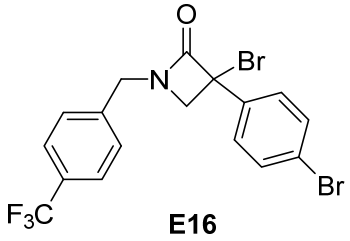


E14

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.51 (m, 4H), 7.36 (d, J = 7.9 Hz, 2H), 7.12 – 7.01 (m, 2H), 4.62 (d, J = 15.5 Hz, 1H), 4.43 (d, J = 15.5 Hz, 1H), 3.89 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.17, 163.05 (d, J = 250.1 Hz), 138.51, 133.47 (d, J = 3.4 Hz), 130.68 (q, J = 32.7 Hz), 129.29 (d, J = 8.5 Hz), 128.42, 126.21 (q, J = 3.8 Hz), 124.02 (q, J = 272.3 Hz), 116.22 (d, J = 21.9 Hz), 59.86, 58.05, 45.88.

^{19}F NMR (376 MHz, $CDCl_3$) δ -62.66, -111.02.
HRMS (ESI) *m/z* calcd. for $C_{17}H_{12}BrF_4NO$ $[M+H]^+$ 402.0111, found 402.0109.

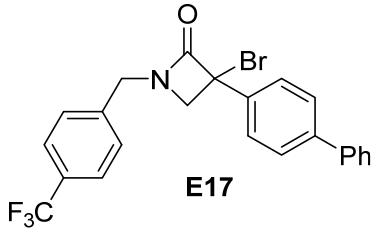
3-bromo-3-(4-bromophenyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (E16)



E16

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 7.9 Hz, 2H), 7.51 (d, *J* = 8.3 Hz, 2H), 7.47 (d, *J* = 8.3 Hz, 2H), 7.36 (d, *J* = 7.9 Hz, 2H), 4.61 (d, *J* = 15.5 Hz, 1H), 4.44 (d, *J* = 15.5 Hz, 1H), 3.89 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 164.80, 138.32, 136.33, 132.22, 130.52 (q, *J* = 32.6 Hz), 128.76, 128.29, 126.09 (q, *J* = 3.8 Hz), 123.88 (q, *J* = 272.2 Hz), 123.60, 59.56, 57.66, 45.77.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.61.
HRMS (ESI) *m/z* calcd. for $C_{17}H_{13}Br_2F_3NO$ $[M+H]^+$ 461.9311, found 461.9308.

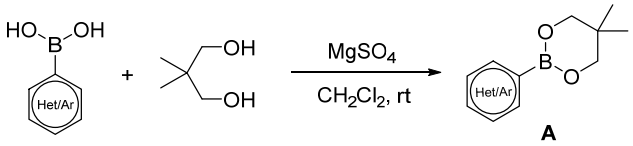
3-([1,1'-biphenyl]-4-yl)-3-bromo-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (E17)



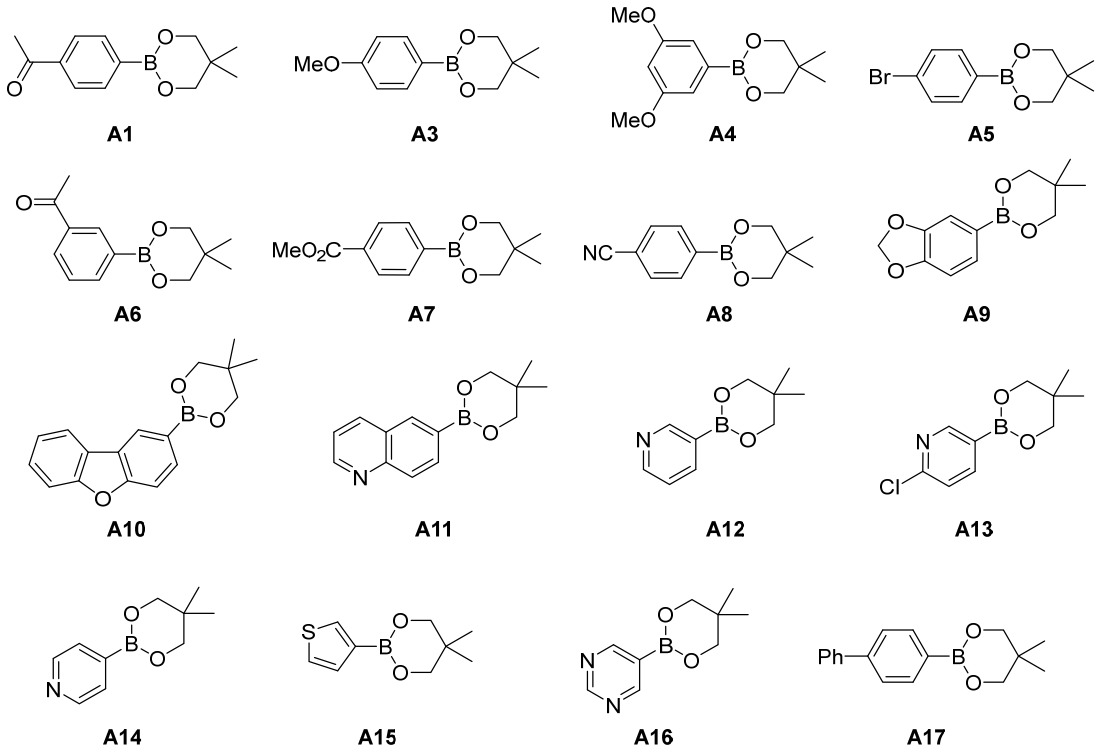
E17

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.55 (m, 8H), 7.46 (t, *J* = 7.5 Hz, 2H), 7.41 – 7.34 (m, 3H), 4.64 (d, *J* = 15.4 Hz, 1H), 4.45 (d, *J* = 15.5 Hz, 1H), 3.96 (ABq, *J* = 6.0 Hz, $\Delta\nu_{AB}$ = 17.8 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 165.35, 142.34, 140.17, 138.63, 136.24, 130.61 (q, *J* = 32.5 Hz), 129.03, 128.43, 127.97, 127.79, 127.71, 127.24, 126.18 (q, *J* = 3.7 Hz), 124.04 (q, *J* = 272.5 Hz), 60.66, 57.98, 45.88.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.61.
HRMS (ESI) *m/z* calcd. for $C_{23}H_{17}BrF_3NO$ $[M+H]^+$ 460.0518, found 460.0516.

General procedure A for the synthesis of (hetero)arylboronates

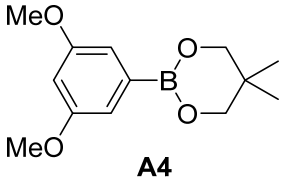


A



The boron reagents (**A1**, **A3–A11**, **A13**, **A15** and **A17**) were synthesized according to the modified reported procedure.[3] To a 50-mL flask equipped with a stir bar was added (hetero)aryl boronic acid (5 mmol, 1.0 equiv.), neopentyl glycol (0.55 g, 1.05 equiv.) and magnesium sulfate (1.20 g). Then dry CH_2Cl_2 (20 mL) was added. The reaction mixture was stirred at room temperature overnight. After completion of the reaction, the reaction mixture was filtered, and concentrated under reduced pressure. The crude product was purified by silica gel chromatography to afford the desired product.
A12, **A14** and **A16** were prepared according to the reported procedure.[4]

2-(3,5-dimethoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane (A4)

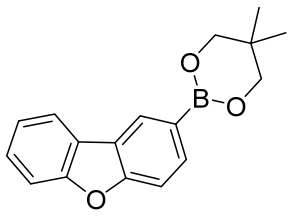


A4

According to the **general procedure A** starting from 3,5-dimethoxyphenylboronic acid (5 mmol), the product was obtained as a white solid (1.15 g, 4.6 mmol, 92% yield).
^{1}H NMR (400 MHz, $CDCl_3$) δ 6.96 (d, *J* = 2.4 Hz, 2H), 6.55 (t, *J* = 2.4 Hz, 1H), 3.81 (s, 6H), 3.77 (s, 4H), 1.03 (s, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 160.50, 110.93, 104.08, 72.48, 55.47, 32.01, 22.04.

HRMS (ESI) *m/z* calcd. for $C_{13}H_{20}BO_4$ $[M+H]^+$ 251.1449, found 251.1447.

2-(dibenzo[*b*,*d*]furan-2-yl)-5,5-dimethyl-1,3,2-dioxaborinane (A10)

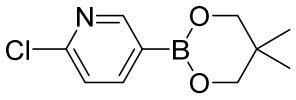


A10

According to the **general procedure A** starting from dibenzo[*b*,*d*]furan-2-ylboronic acid (5 mmol), the product was obtained as a white solid (1.20 g, 4.3 mmol, 86% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.52 – 8.43 (m, 1H), 8.04 – 7.93 (m, 2H), 7.63 – 7.54 (m, 2H), 7.46 (t, *J* = 7.7 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 1H), 3.85 (s, 4H), 1.07 (s, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 158.33, 156.33, 133.16, 127.05, 126.86, 124.45, 123.91, 122.91, 120.81, 111.71, 111.01, 72.50, 32.05, 22.04.
HRMS (ESI) *m/z* calcd. for $C_{17}H_{18}BO_3$ $[M+H]^+$ 281.1344, found 281.1339.

2-chloro-5-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)pyridine (A13)

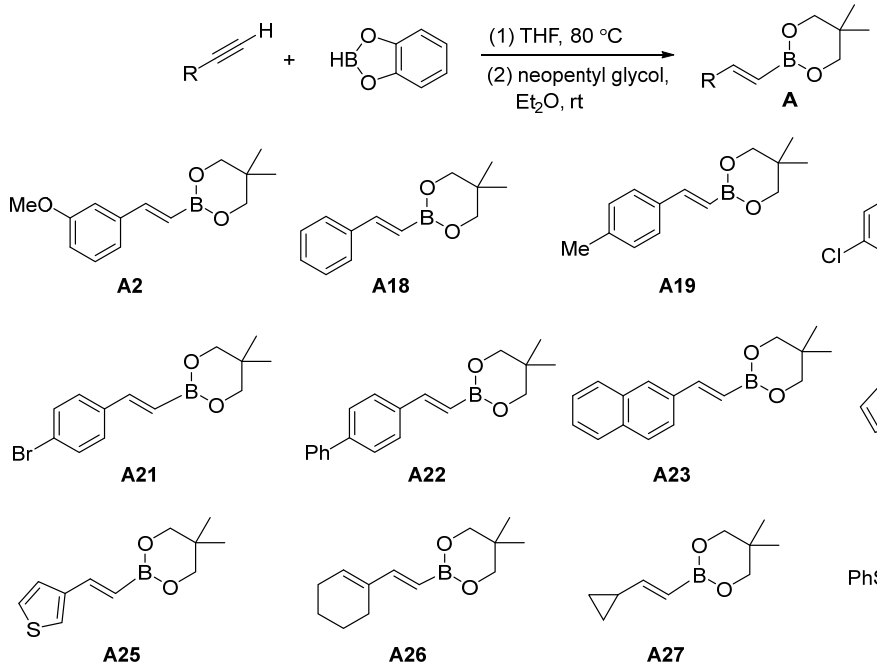


A13

According to the **general procedure A** starting from 2-chloropyridine-5-boronic acid (5 mmol), the product was obtained as a white solid (0.92 g, 4.1 mmol, 82% yield).

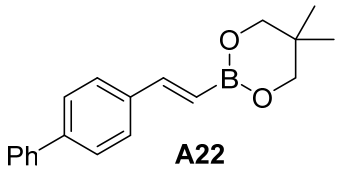
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.69 (s, 1H), 7.97 (d, *J* = 7.9 Hz, 1H), 7.29 (d, *J* = 7.9 Hz, 1H), 3.76 (s, 4H), 1.01 (s, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 155.29, 153.81, 144.21, 123.70, 72.47, 32.08, 21.98.
HRMS (ESI) *m/z* calcd. for $C_{10}H_{14}BClNO_2$ $[M+H]^+$ 226.0801, found 226.0799.

General procedure B for the synthesis of alkenylboronate esters



The boron reagents (**A2**, **A18**, **A19**, **A20**, **A21**, **A24**)[5] and (**A23**, **A26**, **A27**)[6] were synthesized according to the modified reported procedure. In a Schlenk tube were placed alkyne (2 mmol) and catecholborane (1 M in THF, 3 mL, 3 mmol). The resulting mixture was stirred at 75 °C for 16 h and then allowed to cool to room temperature. The reaction was quenched with water (10 mL). The precipitate was isolated by filtration and washed with water. The crude product was placed in a two-neck round flask, and neopentyl glycol (208.3 mg, 2 mmol) and Et_2O (25 mL) were added. The resulting mixture was stirred at room temperature for 12 h, concentrated under reduced pressure, and purified by flash column chromatography on silica gel.

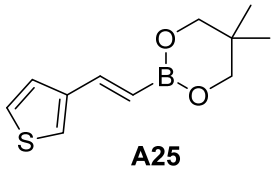
(*E*)-2-(2-([1,1'-biphenyl]-4-yl)vinyl)-5,5-dimethyl-1,3,2-dioxaborinane (A22)



According to the **general procedure B** starting from 4-ethynyl-1,1'-biphenyl (2 mmol), the product was obtained as a white solid (455.2 mg, 1.56 mmol, 78% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.50 (m, 6H), 7.48 – 7.37 (m, 3H), 7.37 – 7.31 (m, 1H), 6.15 (dd, *J* = 18.4, 2.3 Hz, 1H), 3.70 (s, 4H), 1.00 (s, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 146.63, 141.25, 140.68, 136.83, 128.80, 127.74, 127.48, 127.40, 127.24, 126.99, 72.22, 31.88, 21.90.
HRMS (ESI) *m/z* calcd. for $C_{19}H_{22}BO_2$ $[M+H]^+$ 293.1707, found 293.1705.

(*E*)-5,5-dimethyl-2-(2-(thiophen-3-yl)vinyl)-1,3,2-dioxaborinane (A25)

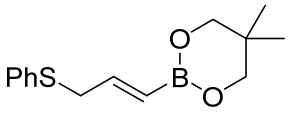


A25

According to the **general procedure B** starting from 3-ethynylthiophene (2 mmol), the product **A25** was obtained as a white solid (310.9 mg, 1.40 mmol, 70% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 – 6.91 (m, 4H), 5.88 (d, *J* = 18.2 Hz, 1H), 3.68 (s, 4H), 0.99 (s, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 141.50, 140.83, 125.98, 125.17, 124.23, 72.19, 31.87, 21.88.
HRMS (ESI) *m/z* calcd. for $C_{11}H_{16}BO_2S$ $[M+H]^+$ 223.0959, found 223.0957.

(*E*)-5,5-dimethyl-2-(3-(phenylthio)prop-1-en-1-yl)-1,3,2-dioxaborinane (A28)



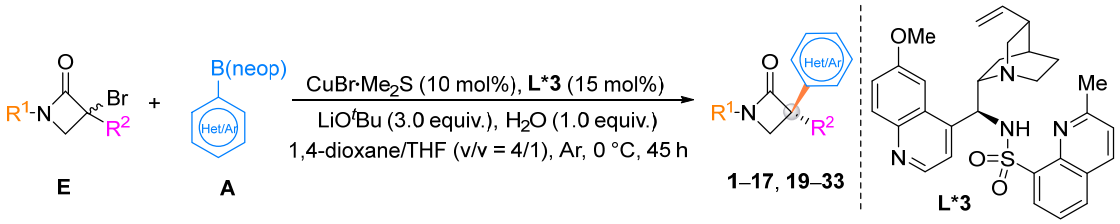
A28

According to the **general procedure B** starting from phenyl(prop-2-yn-1-yl)sulfane (2 mmol), the product was obtained as a colorless oil (314.3 mg, 1.20 mmol, 60% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 – 7.21 (m, 2H), 7.17 (dd, *J* = 8.6, 6.8 Hz, 2H), 7.11 – 7.04 (m, 1H), 6.46 (dt, *J* = 17.5, 6.7 Hz, 1H), 5.62 – 5.29 (m, 1H), 3.53 (d, *J* = 7.1 Hz, 2H), 3.52 (s, 4H), 0.86 (s, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 144.95, 136.22, 129.23, 128.76, 125.93, 72.01, 38.32, 31.72, 21.81.
HRMS (ESI) *m/z* calcd. for $C_{14}H_{20}BO_2S$ $[M+H]^+$ 263.1272, found 263.1270.

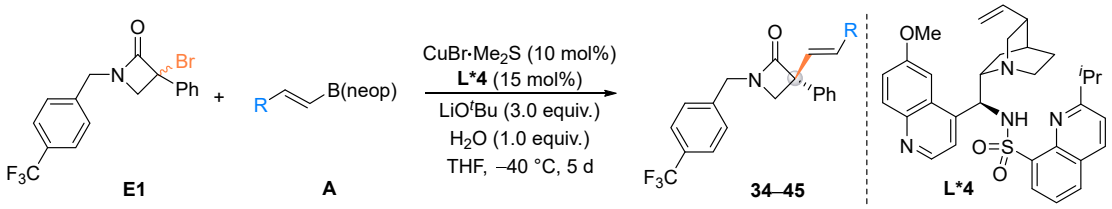
Experimental procedures

General procedure C for enantioconvergent C(sp^3)–C(sp^2) coupling with (hetero)arylboronate esters.



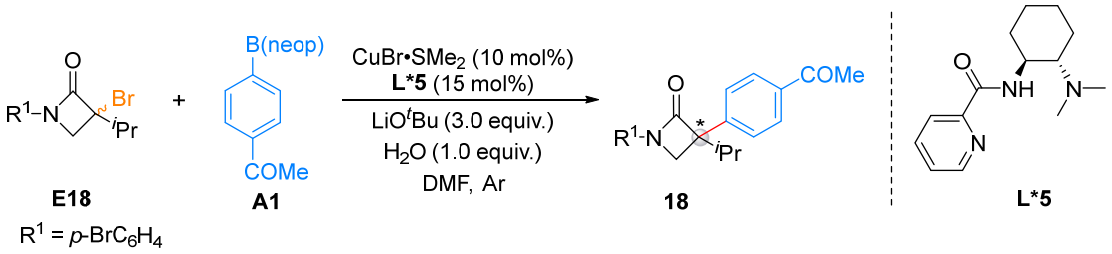
An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with CuBr·Me_2S (2.06 mg, 10 mol%), chiral ligand **L*3** (7.90 mg, 15 mol%), α-bromo-β-lactam **E** (0.12 mmol, 1.2 equiv.), (hetero)arylboronate ester **A** (0.1 mmol, 1.0 equiv.), LiO^{t}Bu (24.0 mg, 0.3 mmol, 3.0 equiv.). The tube was evacuated and backfilled with argon three times. Then 1,4-dioxane/THF (v/v = 4/1, 2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were sequentially added into the mixture under argon. The tube was sealed and the reaction mixture was allowed to stir at 0 °C for 45 h. Upon completion of the reaction (monitored by TLC), the mixture was then filtered through a pad of celite and rinsed with EtOAc. The filtrate was evaporated and the residue was purified by column chromatography on silica gel to afford the desired product.

General procedure D for enantioconvergent C(sp^3)–C(sp^2) coupling with alkenylboronate esters.



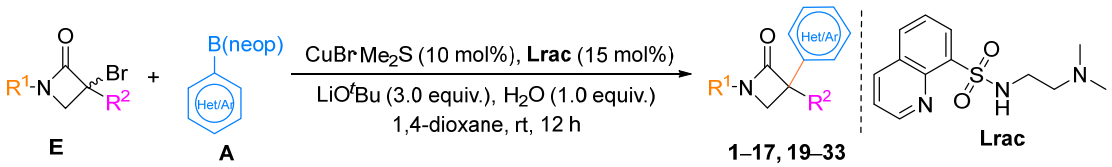
An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with CuBr·Me_2S (2.06 mg, 10 mol%), chiral ligand **L*4** (8.40 mg, 15 mol%), α-bromo-β-lactam **E1** (0.15 mmol, 1.5 equiv.), alkenylboronate ester **A** (0.1 mmol, 1.0 equiv.), LiO^{t}Bu (24.0 mg, 0.3 mmol, 3.0 equiv.). The tube was evacuated and backfilled with argon three times. Then THF (2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were added under argon. The tube was sealed and the reaction mixture was allowed to stir at −40 °C for 5 d. Upon completion of the reaction (monitored by TLC), After the reaction, the mixture was then filtered through a pad of celite and rinsed with EtOAc. The filtrate was evaporated and the residue was purified by column chromatography on silica gel to afford the desired product.

The synthesis of 18.



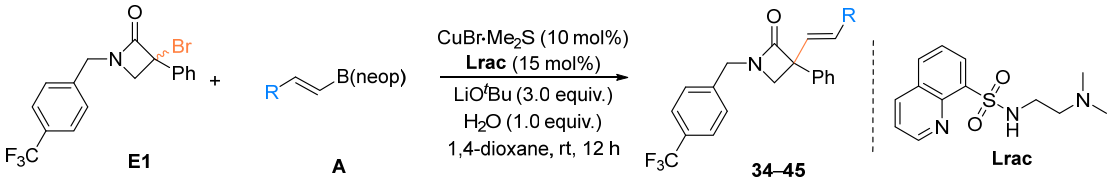
An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with CuBr·Me_2S (2.06 mg, 10 mol%), chiral ligand **L*5** (3.71 mg, 15 mol%), α-bromo-β-lactam **E18** (34.7 mg, 0.1 mmol, 1.0 equiv.), arylboronate ester **A1** (23.2 mg, 0.12 mmol, 1.2 equiv.), LiO^{t}Bu (24.0 mg, 0.3 mmol, 3.0 equiv.). The tube was evacuated and backfilled with argon three times. Then dry DMF (2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were sequentially added into the mixture under argon. The tube was sealed and the reaction mixture was allowed to stir at rt for 24 h. Upon completion of the reaction (monitored by TLC), the mixture was then filtered through a pad of celite and rinsed with EtOAc. The filtrate was evaporated and the residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product **18** as a white solid (30.9 mg, 0.08 mmol, 80% yield).

General procedure E for the synthesis of racemates 1–17 and 19–33.



An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with CuBr·Me_2S (2.06 mg, 10 mol%), ligand **Lrac** (4.19 mg, 15 mol%), α-bromo-β-lactam **E** (0.12 mmol, 1.2 equiv.), (hetero)arylboronate ester **A** (0.1 mmol, 1.0 equiv.), LiO^{t}Bu (24.0 mg, 0.3 mmol, 3.0 equiv.). The tube was evacuated and backfilled with argon three times. Then 1,4-dioxane (2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were sequentially added into the mixture under argon. The tube was sealed and the reaction mixture was allowed to stir at rt for 12 h. Upon completion of the reaction (monitored by TLC), the mixture was then filtered through a pad of celite and rinsed with EtOAc. The filtrate was evaporated and the residue was purified by column chromatography on silica gel to afford the desired product.

General procedure F for the synthesis of racemates 34–45.

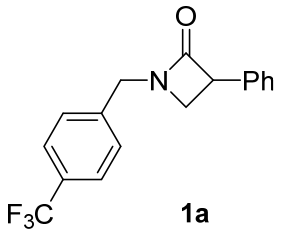


An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with

CuBr·Me_2S (2.06 mg, 10 mol%), ligand **Lrac** (4.19 mg, 15 mol%), α-bromo-β-lactam **E1** (0.15 mmol, 1.5 equiv.), alkenylboronate ester **A** (0.1 mmol, 1.0 equiv.), LiO^tBu (24.0 mg, 0.3 mmol, 3.0 equiv.). The tube was evacuated and backfilled with argon three times. Then 1,4-dioxane (2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were added under argon. The tube was sealed and the reaction mixture was allowed to stir at rt for 12 h. Upon completion of the reaction (monitored by TLC), After the reaction, the mixture was then filtered through a pad of celite and rinsed with EtOAc. The filtrate was evaporated and the residue was purified by column chromatography on silica gel to afford the desired product.

Analytical data

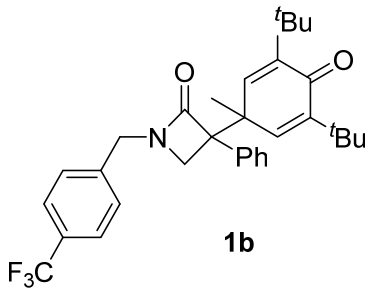
3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (1a)



1a

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 7.9 Hz, 2H), 7.42 (d, *J* = 7.8 Hz, 2H), 7.38 – 7.31 (m, 2H), 7.31 – 7.27 (m, 2H), 4.53 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 23.7 Hz, 2H), 4.43 (dd, *J* = 5.9, 2.5 Hz, 1H), 3.61 (t, *J* = 5.5 Hz, 1H), 3.24 (dd, *J* = 5.4, 2.6 Hz, 1H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 168.61, 139.81, 135.43, 130.31 (d, *J* = 32.7 Hz), 129.04, 128.58, 127.73, 127.34, 126.03 (q, *J* = 3.7 Hz), 124.10 (d, *J* = 272.2 Hz), 54.94, 47.52, 45.85.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.56.
HRMS (ESI) *m/z* calcd. for $C_{17}H_{14}F_3NO$ $[M+H]^+$ 306.1100, found 306.1092.

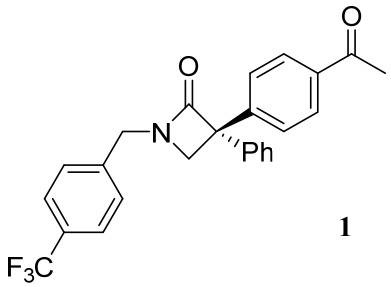
3-(3,5-di-*tert*-butyl-1-methyl-4-oxocyclohexa-2,5-dien-1-yl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (1b)



1b

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 8.0 Hz, 2H), 7.42 – 7.28 (m, 7H), 6.56 (s, 2H), 4.42 (s, 2H), 3.30 (ABq, J_{AB} = 5.6 Hz, $\Delta\nu_{AB}$ = 21.1 Hz, 2H), 1.32 (s, 3H), 1.16 (s, 18H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 185.77, 168.91, 148.86, 147.13, 143.00, 141.99, 139.33, 136.05, 130.41 (q, *J* = 32.6 Hz), 129.19, 128.79, 127.97, 127.71, 126.07 (q, *J* = 3.8 Hz), 124.04 (q, *J* = 272.4 Hz), 67.95, 49.49, 45.73, 42.66, 35.03, 35.00, 29.44, 29.40, 21.62.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.67.
HRMS (ESI) *m/z* calcd. for $C_{32}H_{37}F_3NO_2$ $[M+H]^+$ 524.2771, found 524.2772.

(*S*)-3-(4-acetylphenyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (1)

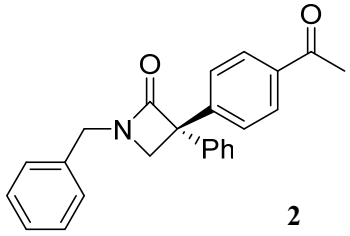


1

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (32.6 mg, 0.077 mmol, 77% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.2 Hz, 2H), 7.59 (d, *J* = 8.0 Hz, 2H), 7.51 (d, *J* = 8.2 Hz, 2H), 7.42 – 7.27 (m, 7H), 4.56 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 12.4 Hz, 2H), 3.83 (ABq, J_{AB} = 5.6 Hz, $\Delta\nu_{AB}$ = 5.7 Hz, 2H), 2.57 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.68, 169.02, 145.30, 139.48, 139.30, 136.23, 130.36 (q, *J* = 32.6 Hz), 129.04, 128.92, 128.47, 127.83, 127.36, 127.01, 126.06 (q, *J* = 3.8 Hz), 124.02 (q, *J* = 272.1 Hz), 66.99, 54.03, 45.80, 26.74.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.59.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 0.8 mL/min. λ = 254 nm, t(major) = 30.7 min, t(minor) = 41.7 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{21}F_3NO_2$ $[M+H]^+$ 424.1519, found 424.1515.

(*S*)-3-(4-acetylphenyl)-1-benzyl-3-phenylazetidin-2-one (2)



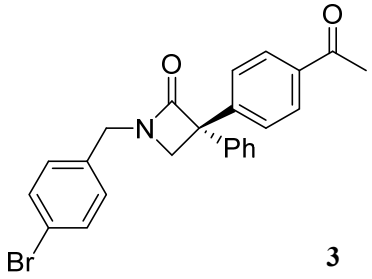
2

According to the **general procedure C** with **E2** (37.9 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (27.0 mg, 0.076 mmol, 76% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 8.2 Hz, 2H), 7.52 (d, *J* = 8.1 Hz, 2H), 7.45 – 7.19 (m, 10H), 4.53 (ABq, J_{AB} = 15.0 Hz, $\Delta\nu_{AB}$ = 25.4 Hz, 2H), 3.88 – 3.70 (m, 2H), 2.59 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.54, 168.72, 145.41, 139.52, 135.98, 134.99, 128.14, 127.89, 127.51, 127.28, 126.96, 66.43, 53.69, 46.12, 26.54.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate

1.0 mL/min. λ = 254 nm, t(major) = 23.6 min, t(minor) = 28.4 min, 99% ee.
HRMS (ESI) *m/z* calcd. for $C_{24}H_{22}NO_2$ $[M+H]^+$ 356.1645, found 356.1643.

(*S*)-3-(4-acetylphenyl)-1-(4-bromobenzyl)-3-phenylazetidin-2-one (3)

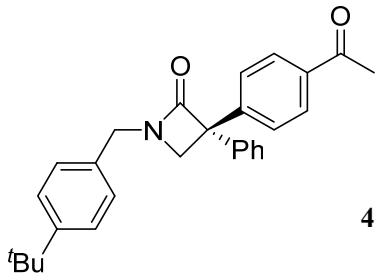


3

According to the **general procedure C** with **E3** (47.4 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (31.3 mg, 0.072 mmol, 72% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 – 7.89 (m, 2H), 7.51 (d, *J* = 8.3 Hz, 2H), 7.49 – 7.45 (m, 2H), 7.42 – 7.26 (m, 5H), 7.13 (d, *J* = 8.3 Hz, 2H), 4.47 (ABq, J_{AB} = 15.1 Hz, $\Delta\nu_{AB}$ = 16.9 Hz, 2H), 3.80 (ABq, J_{AB} = 5.5 Hz, $\Delta\nu_{AB}$ = 6.2 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.64, 168.87, 145.36, 139.52, 136.18, 134.23, 132.19, 129.94, 128.99, 128.87, 127.75, 127.36, 127.03, 122.06, 66.77, 53.84, 45.65, 26.71.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 28.6 min, t(minor) = 34.7 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{24}H_{21}BrNO_2$ $[M+H]^+$ 434.0750, found 434.0749.

(*S*)-3-(4-acetylphenyl)-1-(4-(*tert*-butyl)benzyl)-3-phenylazetidin-2-one (4)



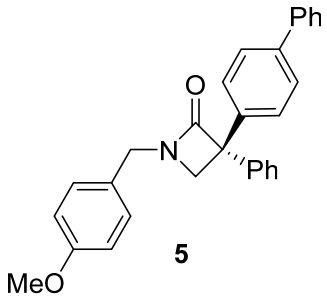
4

According to the **general procedure C** with **E4** (44.7 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 6/1) to yield the product as a colorless oil (33.7 mg, 0.082 mmol, 82% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.2 Hz, 2H), 7.50 (d, *J* = 8.2 Hz, 2H), 7.41 – 7.30 (m, 6H), 7.29 – 7.23 (m, 1H), 7.16 (d, *J* = 8.1 Hz, 2H), 4.47 (ABq, J_{AB} = 15.0 Hz, $\Delta\nu_{AB}$ = 24.3 Hz, 2H), 3.82 – 3.75 (m, 2H), 2.57 (s, 3H), 1.30 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 197.73, 168.84, 151.02, 145.65, 139.75, 136.08, 132.01, 128.92, 128.82, 127.96, 127.63, 127.45, 127.12, 125.92, 66.46, 53.88, 45.85, 34.66, 31.40, 26.73.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 15.9 min, t(minor) = 25.5 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{28}H_{30}NO_2$ $[M+H]^+$ 412.2271, found 412.2267.

(*S*)-3-([1,1'-biphenyl]-4-yl)-1-(4-methoxybenzyl)-3-phenylazetidin-2-one (5)

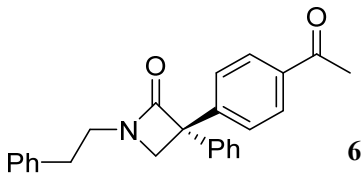


5

According to the **general procedure C** with **E5** (41.4 mg, 0.12 mmol) and 2-([1,1'-biphenyl]-4-yl)-5,5-dimethyl-1,3,2-dioxaborinane **A17** (26.6 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (28.4 mg, 0.068 mmol, 68% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 – 7.49 (m, 4H), 7.48 – 7.39 (m, 6H), 7.37 – 7.31 (m, 3H), 7.30 – 7.22 (m, 1H), 7.23 – 7.12 (m, 2H), 6.95 – 6.79 (m, 2H), 4.45 (s, 2H), 3.79 (s, 3H), 3.76 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 4.9 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.39, 159.27, 140.63, 140.30, 140.16, 139.39, 129.62, 128.80, 128.74, 127.54, 127.40, 127.38, 127.33, 127.29, 127.18, 127.08, 114.29, 66.12, 55.32, 53.98, 45.56.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 80/20, flow rate 0.4 mL/min. λ = 254 nm, t(major) = 21.1 min, t(minor) = 29.0 min, 93% ee.
HRMS (ESI) *m/z* calcd. for $C_{29}H_{26}NO_2$ $[M+H]^+$ 420.1958, found 420.1955.

(*S*)-3-(4-acetylphenyl)-1-phenethyl-3-phenylazetidin-2-one (6)

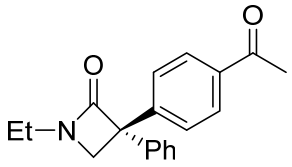


6

According to the **general procedure C** with **E6** (39.6 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (28.1 mg, 0.076 mmol, 76% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.3 Hz, 2H), 7.37 (d, *J* = 8.3 Hz, 2H), 7.33 – 7.19 (m, 8H), 7.18 – 7.13 (m, 2H), 3.69 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 9.1 Hz, 2H), 3.66 – 3.55 (m, 2H), 2.91 (t, *J* = 7.1 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.74, 168.73, 145.51, 139.60, 138.17, 136.03, 128.84, 128.78, 128.75, 128.73, 127.57, 127.46, 127.15, 126.80, 66.36, 54.92, 43.13, 34.18, 26.71.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 26.7 min, t(minor) = 30.3 min, 99% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{24}NO_2$ $[M+H]^+$ 370.1802, found 370.1800.

(*S*)-3-(4-acetylphenyl)-1-ethyl-3-phenylazetidin-2-one (7)

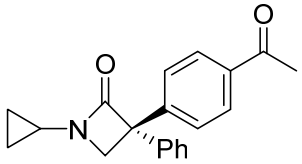


7

According to the **general procedure C** with **E7** (30.5 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 6/1) to yield the product as a colorless oil (27.0 mg, 0.092 mmol, 92% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.3 Hz, 2H), 7.52 (d, *J* = 8.3 Hz, 2H), 7.42 – 7.37 (m, 2H), 7.37 – 7.31 (m, 2H), 7.30 – 7.24 (m, 1H), 3.88 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 4.2 Hz, 2H), 3.38 (q, *J* = 7.3 Hz, 2H), 2.57 (s, 3H), 1.20 (t, *J* = 7.3 Hz, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.75, 168.49, 145.72, 139.82, 136.11, 128.94, 128.83, 127.64, 127.47, 127.12, 65.99, 53.66, 36.70, 26.73, 12.83.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 14.3 min, t(minor) = 17.2 min, 99% ee.
HRMS (ESI) *m/z* calcd. for $C_{19}H_{20}NO_2$ $[M+H]^+$ 294.1489, found 294.1486.

(*S*)-3-(4-acetylphenyl)-1-cyclopropyl-3-phenylazetidin-2-one (8)



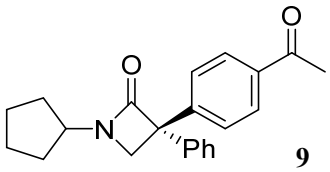
8

According to the **general procedure C** with **E8** (31.9 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 6/1) to yield the product as a colorless oil (24.1 mg, 0.079 mmol, 79% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, J = 8.4 Hz, 2H), 7.49 (d, J = 8.4 Hz, 2H), 7.39 – 7.30 (m, 4H), 7.29 – 7.24 (m, 1H), 3.83 (ABq, J_{AB} = 5.5 Hz, $\Delta\nu_{AB}$ = 4.0 Hz, 2H), 2.69 – 2.61 (m, 1H), 2.57 (s, 3H), 0.87 – 0.81 (m, 2H), 0.80 – 0.73 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 197.72, 169.21, 145.63, 139.74, 136.10, 128.93, 128.82, 127.64, 127.41, 127.08, 65.09, 54.72, 26.72, 24.43, 5.43.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 20.6 min, t(minor) = 22.5 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{20}H_{20}NO_2$ $[M+H]^+$ 306.1489, found 306.1486.

(*S*)-3-(4-acetylphenyl)-1-cyclopentyl-3-phenylazetidin-2-one (9)

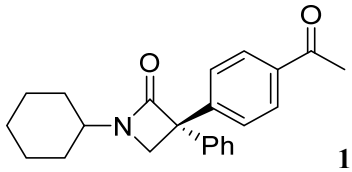


9

According to the **general procedure C** with **E9** (35.3 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (22.0 mg, 0.066 mmol, 66% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 – 7.89 (m, 2H), 7.54 – 7.47 (m, 2H), 7.41 – 7.31 (m, 4H), 7.30 – 7.24 (m, 2H), 4.23 – 4.12 (m, 1H), 3.84 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 4.3 Hz, 2H), 2.57 (s, 3H), 1.96 – 1.83 (m, 2H), 1.76 – 1.57 (m, 6H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.76, 168.31, 145.80, 139.87, 136.08, 128.92, 128.83, 127.59, 127.49, 127.15, 64.72, 53.39, 52.33, 30.31, 30.29, 26.73, 24.15.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 17.6 min, t(minor) = 22.9 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{20}H_{24}NO_2$ $[M+H]^+$ 334.1802, found 334.1799.

(*S*)-3-(4-acetylphenyl)-1-cyclohexyl-3-phenylazetidin-2-one (10)

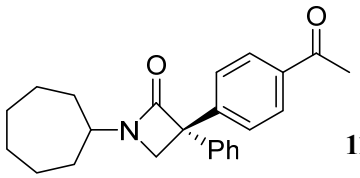


10

According to the **general procedure C** with **E10** (37.0 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 6/1) to yield the product as a colorless oil (21.9 mg, 0.063 mmol, 63% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.3 Hz, 2H), 7.50 (d, *J* = 8.3 Hz, 2H), 7.41 – 7.30 (m, 4H), 7.30 – 7.24 (m, 1H), 3.92 – 3.79 (m, 2H), 3.73 – 3.60 (m, 1H), 2.58 (s, 3H), 1.98 – 1.57 (m, 6H), 1.48 – 1.18 (m, 4H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.76, 168.03, 145.83, 139.90, 136.09, 128.92, 128.82, 127.58, 127.53, 127.18, 64.76, 51.93, 51.30, 30.83, 26.72, 25.38, 24.92.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 90/10, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 33.9 min, t(minor) = 51.2 min, 97% ee.
HRMS (ESI) *m/z* calcd. for $C_{23}H_{26}NO_2$ $[M+H]^+$ 348.1958, found 348.1954.

(*S*)-3-(4-acetylphenyl)-1-cycloheptyl-3-phenylazetidin-2-one (11)

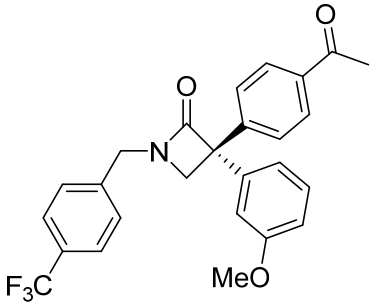


11

According to the **general procedure C** with **E11** (38.7 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 6/1) to yield the product as a colorless oil (19.9 mg, 0.055 mmol, 55% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 – 7.87 (m, 2H), 7.51 (dd, *J* = 8.6, 2.9 Hz, 2H), 7.41 – 7.24 (m, 5H), 3.95 – 3.78 (m, 3H), 2.58 (s, 3H), 2.03 – 1.89 (m, 2H), 1.75 – 1.42 (m, 12H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.75, 167.58, 145.81, 139.88, 136.08, 128.92, 128.82, 127.58, 127.53, 127.18, 64.91, 53.29, 52.06, 32.94, 32.92, 28.04, 26.72, 24.36.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 90/10, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 33.6 min, t(minor) = 45.7 min, 97% ee.
HRMS (ESI) *m/z* calcd. for $C_{24}H_{28}NO_2$ $[M+H]^+$ 362.2115, found 362.2112.

(*R*)-3-(4-acetylphenyl)-3-(3-methoxyphenyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (12)



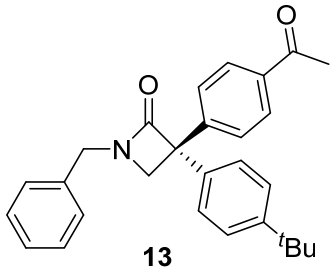
12

According to the **general procedure C** with **E12** (49.7 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent:

petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (35.8 mg, 0.079 mmol, 79% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.3 Hz, 2H), 7.59 (d, *J* = 8.1 Hz, 2H), 7.51 (d, *J* = 8.3 Hz, 2H), 7.35 (d, *J* = 8.0 Hz, 2H), 7.26 (t, *J* = 7.9 Hz, 1H), 6.98 – 6.90 (m, 2H), 6.82 (dd, *J* = 8.2, 2.5 Hz, 1H), 4.55 (s, 2H), 3.84 (ABq, J_{AB} = 5.5 Hz, $\Delta\nu_{AB}$ = 9.3 Hz, 2H), 3.76 (s, 3H), 2.57 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.66, 168.87, 159.95, 145.16, 140.94, 139.31, 136.22, 130.32 (q, *J* = 32.7 Hz), 130.04, 128.89, 128.47, 127.32, 126.04 (q, *J* = 3.7 Hz), 124.01 (q, *J* = 272.1 Hz),119.27, 113.09, 112.93, 66.89, 55.33, 54.07, 45.78, 26.71.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.59.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 27.2 min, t(minor) = 46.1 min, 99% ee.
HRMS (ESI) *m/z* calcd. for $C_{26}H_{23}F_3NO_3$ $[M+H]^+$ 454.1625, found 454.1621.

(*S*)-3-(4-acetylphenyl)-1-benzyl-3-(4-(*tert*-butyl)phenyl)azetidin-2-one (13)

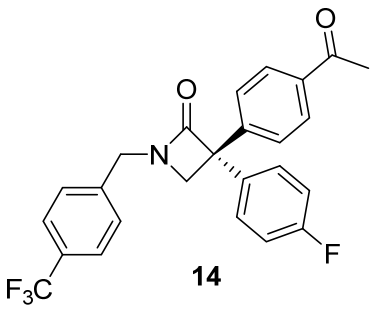


13

According to the **general procedure C** with **E13** (44.6 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 6/1) to yield the product as a white solid (32.9 mg, 0.080 mmol, 80% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.1 Hz, 2H), 7.53 (d, *J* = 8.0 Hz, 2H), 7.41 – 7.23 (m, 9H), 4.52 (ABq, J_{AB} = 15.0 Hz, $\Delta\nu_{AB}$ = 41.9 Hz, 2H), 3.80 (ABq, J_{AB} = 5.5 Hz, $\Delta\nu_{AB}$ = 13.4 Hz, 2H), 2.60 (s, 3H), 1.32 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.66, 169.01, 150.49, 145.69, 136.57, 136.01, 135.17, 128.96, 128.74, 128.29, 127.96, 127.44, 126.65, 125.78, 66.23, 53.89, 46.22, 34.52, 31.30, 26.64.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 15.5 min, t(minor) = 18.1 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{28}H_{30}NO_2$ $[M+H]^+$ 412.2271, found 412.2268.

(*R*)-3-(4-acetylphenyl)-3-(4-fluorophenyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (14)

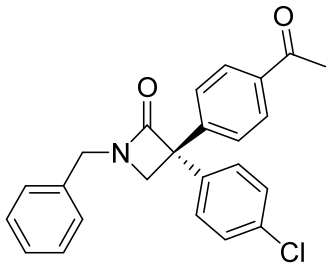


14

According to the **general procedure C** with **E14** (48.3 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (37.1 mg, 0.084 mmol, 84% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.4 Hz, 2H), 7.59 (d, *J* = 8.1 Hz, 2H), 7.47 (d, *J* = 8.4 Hz, 2H), 7.39 – 7.30 (m, 4H), 7.07 – 6.97 (m, 2H), 4.56 (ABq, J_{AB} = 15.8 Hz, $\Delta\nu_{AB}$ = 6.9 Hz, 2H), 3.80 (ABq, J_{AB} = 5.6 Hz, $\Delta\nu_{AB}$ = 10.6 Hz, 2H), 2.57 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.56, 168.81, 162.23 (d, *J* = 247.4 Hz), 145.08, 139.23, 136.39, 135.34 (d, *J* = 3.3 Hz), 130.46 (q, *J* = 32.6 Hz), 128.99, 128.77 (d, *J* = 8.0 Hz), 128.47, 127.27, 126.10 (q, *J* = 3.8 Hz), 124.02 (q, *J* = 272.1 Hz), 115.97 (d, *J* = 21.6 Hz), 66.35, 54.13, 45.85, 26.71.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.62, -114.17.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 20.8 min, t(minor) = 29.5 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{20}F_4NO_2$ $[M+H]^+$ 442.1425, found 442.1423.

(*R*)-3-(4-acetylphenyl)-1-benzyl-3-(4-chlorophenyl)azetidin-2-one (15)



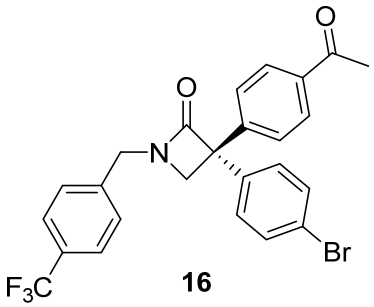
15

According to the **general procedure C** with **E15** (42.1 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (33.1 mg, 0.085 mmol, 85% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.2 Hz, 2H), 7.46 (d, *J* = 8.2 Hz, 2H), 7.37 – 7.25 (m, 7H), 7.22 (d, *J* = 7.4 Hz, 2H), 4.49 (s, 2H), 3.75 (ABq, J_{AB} = 5.7 Hz, $\Delta\nu_{AB}$ = 11.9 Hz, 2H), 2.57 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 197.62, 168.42, 145.02, 138.17, 136.30, 134.99, 133.68, 129.12, 129.09, 128.94, 128.52, 128.28, 128.14, 127.34, 66.00, 53.73, 46.33, 26.72.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 26.7 min, t(minor) = 31.1 min, 99% ee.
HRMS (ESI) *m/z* calcd. for $C_{24}H_{21}ClNO_2$ $[M+H]^+$ 390.1255, found 390.1252.

(*R*)-3-(4-acetylphenyl)-3-(4-bromophenyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (16)

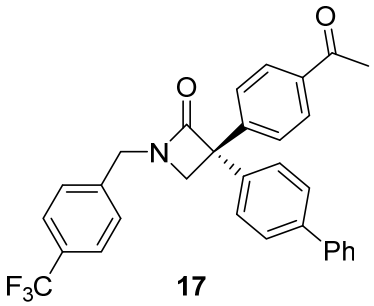


16

According to the **general procedure C** with **E16** (55.6 mg, 0.12 mmol) and 1-(4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 6/1) to yield the product as a colorless oil (38.2 mg, 0.076 mmol, 76% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.3 Hz, 2H), 7.59 (d, *J* = 8.1 Hz, 2H), 7.51 – 7.42 (m, 4H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.29 – 7.23 (m, 2H), 4.55 (s, 2H), 3.79 (ABq, J_{AB} = 5.6 Hz, $\Delta\nu_{AB}$ = 12.0 Hz, 2H), 2.57 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.55, 168.47, 144.70, 139.13, 138.50, 136.42, 132.17, 130.46 (q, *J* = 32.6 Hz), 129.02, 128.75, 128.46, 127.25, 126.11 (q, *J* = 3.8 Hz), 123.99 (q, *J* = 272.2 Hz), 121.97, 66.46, 53.86, 45.86, 26.73.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.60.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 28.1 min, t(minor) = 36.9 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{20}BrF_3NO_2$ $[M+H]^+$ 502.0624, found 502.0623.

(*S*)-3-([1,1'-biphenyl]-4-yl)-3-(4-acetylphenyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (17)



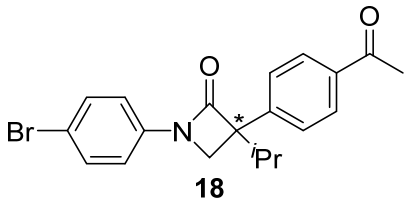
17

According to the **general procedure C** with **E17** (55.2 mg, 0.12 mmol) and 1-(4-(5,5-

dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A1** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a white solid (39.9 mg, 0.080 mmol, 80% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 8.4 Hz, 2H), 7.64 – 7.51 (m, 8H), 7.48 – 7.40 (m, 4H), 7.39 – 7.32 (m, 3H), 4.58 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 12.4 Hz, 2H), 3.86 (ABq, J_{AB} = 5.5 Hz, $\Delta\nu_{AB}$ = 11.6 Hz, 2H), 2.59 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.66, 168.98, 145.25, 140.76, 140.41, 139.30, 138.46, 136.31, 130.40 (q, *J* = 32.6 Hz), 128.98, 128.95, 128.50, 127.73, 127.65, 127.43, 127.39, 127.15, 126.09 (q, *J* = 3.8 Hz), 124.03 (q, *J* = 272.2 Hz), 66.79, 54.06, 45.85, 26.74.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.56.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 39.2 min, t(minor) = 45.6 min, 99% ee.
HRMS (ESI) *m/z* calcd. for $C_{31}H_{25}F_3NO_2$ $[M+H]^+$ 500.1832, found 500.1831.

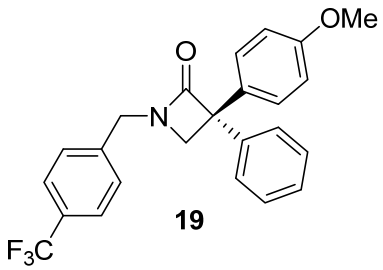
(*S*)-3-(4-acetylphenyl)-1-(4-bromophenyl)-3-isopropylazetidin-2-one (18)



18

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 7.9 Hz, 2H), 7.57 (d, *J* = 8.0 Hz, 2H), 7.48 – 7.40 (m, 2H), 7.31 – 7.22 (m, 2H), 3.86 (ABq, J_{AB} = 5.9 Hz, $\Delta\nu_{AB}$ = 7.7 Hz, 2H), 2.61 (s, 3H), 2.38 – 2.23 (m, 1H), 1.01 (d, *J* = 6.8 Hz, 3H), 0.99 (d, *J* = 6.7 Hz, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 197.71, 167.27, 143.08, 136.95, 136.06, 132.14, 128.17, 127.90, 117.83, 116.56, 66.28, 48.50, 34.57, 26.64, 18.47, 17.73.
HPLC conditions: Chiralcel ODH, *n*-hexane/*i*-PrOH = 90/10, flow rate 0.8 mL/min. λ = 254 nm, t(major) = 13.3 min, t(minor) = 18.9 min, 56% ee.
HRMS (ESI) *m/z* calcd. for $C_{20}H_{21}BrNO_2$ $[M+H]^+$ 386.0750, found 386.0746.

(*S*)-3-(4-methoxyphenyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (19)



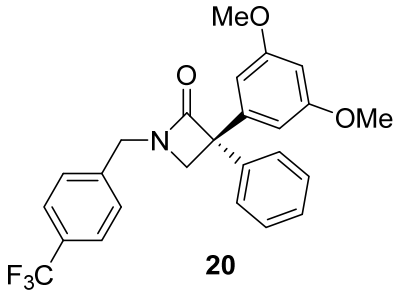
19

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 2-(4-methoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane **A3** (22.0 mg, 0.10 mmol), the

reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 7/1) to yield the product as a white solid (18.9 mg, 0.046 mmol, 46% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 7.9 Hz, 2H), 7.42 – 7.21 (m, 9H), 6.86 (d, *J* = 8.6 Hz, 2H), 4.55 (s, 2H), 3.83 – 3.70 (m, 5H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 170.06, 158.93, 140.50, 139.64, 132.37, 130.29 (q, *J* = 32.5 Hz), 128.85, 128.50, 128.30, 127.45, 127.11, 126.02 (q, *J* = 3.7 Hz), 124.10 (q, *J* = 272.0 Hz), 114.24, 66.49, 55.41, 54.66, 45.72.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.56.
HPLC conditions: Chiralcel IH, *n*-hexane/*i*-PrOH = 90/10, flow rate 0.8 mL/min. λ = 230 nm, t(minor) = 22.7 min, t(major) = 33.4 min, 95% ee.
HRMS (ESI) *m/z* calcd. for $C_{24}H_{21}F_3NO_2$ $[M+H]^+$ 412.1519, found 412.1517.

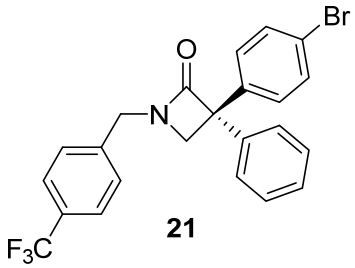
(*S*)-3-(3,5-dimethoxyphenyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (20)



20

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 2-(3,5-dimethoxyphenyl)-5,5-dimethyl-1,3,2-dioxaborinane **A4** (25.0 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 7/1) to yield the product as a white solid (29.1 mg, 0.066 mmol, 66% yield).
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 7.1 Hz, 2H), 7.46 – 7.19 (m, 7H), 6.54 (s, 2H), 6.36 (s, 1H), 4.54 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 22.2 Hz, 2H), 3.85 – 3.62 (m, 8H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.56, 161.04, 142.43, 139.95, 139.58, 130.28 (q, *J* = 32.6 Hz), 128.84, 128.53, 127.57, 127.07, 126.02 (q, *J* = 3.7 Hz), 124.08 (q, *J* = 272.0 Hz), 105.51, 99.21, 67.05, 55.44, 54.54, 45.74.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.58.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 0.8 mL/min. λ = 214 nm, t(minor) = 13.9 min, t(major) = 22.2 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{23}F_3NO_3$ $[M+H]^+$ 442.1625, found 442.1621.

(*S*)-3-(4-bromophenyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (21)

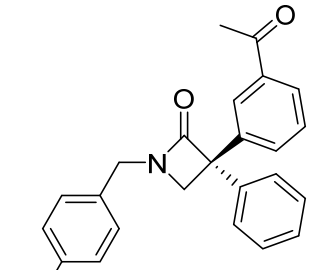


21

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 2-(4-bromophenyl)-5,5-dimethyl-1,3,2-dioxaborinane **A5** (26.9 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (33.1 mg, 0.072 mmol, 72% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 8.1 Hz, 2H), 7.45 (d, *J* = 8.4 Hz, 2H), 7.38 – 7.30 (m, 6H), 7.29 – 7.23 (m, 3H), 4.54 (ABq, J_{AB} = 15.5 Hz, $\Delta\nu_{AB}$ = 9.5 Hz, 2H), 3.77 (ABq, J_{AB} = 5.5 Hz, $\Delta\nu_{AB}$ = 18.4 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.29, 139.68, 139.37, 139.25, 132.01, 130.41 (q, *J* = 32.6 Hz), 129.01, 128.88, 128.49, 127.76, 127.02, 126.08 (q, *J* = 3.7 Hz), 124.06 (q, *J* = 272.1 Hz), 121.65, 66.55, 54.25, 45.81.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.58.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 95/05, flow rate 0.8 mL/min. λ = 214 nm, t(minor) = 30.3 min, t(major) = 32.3 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{23}H_{18}BrF_3NO$ $[M+H]^+$ 460.0518, found 460.0515.

(*S*)-3-(3-acetylphenyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (22)



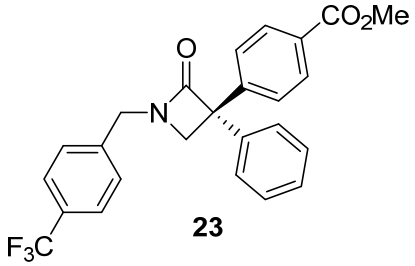
22

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 1-(3-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)phenyl)ethan-1-one **A6** (23.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (30.1 mg, 0.071 mmol, 71% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (t, *J* = 1.8 Hz, 1H), 7.85 (dt, *J* = 7.8, 1.4 Hz, 1H), 7.68 – 7.63 (m, 1H), 7.59 (d, *J* = 8.1 Hz, 2H), 7.44 (t, *J* = 7.8 Hz, 1H), 7.41 – 7.31 (m, 6H), 7.31 – 7.24 (m, 1H), 4.56 (s, 2H), 3.84 (ABq, J_{AB} = 5.5 Hz, $\Delta\nu_{AB}$ = 15.1 Hz, 2H), 2.57 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 197.96, 169.26, 140.89, 139.76, 139.36, 137.63, 132.00, 130.36 (q, *J* = 32.5 Hz), 129.20, 129.04, 128.51, 127.77, 127.65, 127.02, 126.57, 126.07 (q, *J* = 3.7 Hz), 124.04 (q, *J* = 272.2 Hz), 66.77, 54.27, 45.81, 26.77.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.59.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 85/15, flow rate 0.8 mL/min. λ = 230 nm, t(major) = 16.3 min, t(minor) = 17.7 min, 99% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{21}F_3NO_2$ $[M+H]^+$ 424.1519, found 424.1516.

Methyl (S)-4-(2-oxo-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-3-yl)benzoate (23)

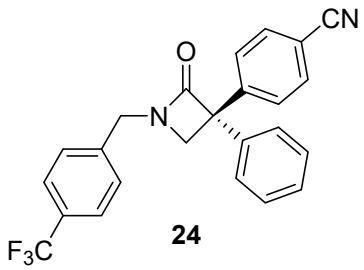


23

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and methyl 4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)benzoate **A7** (24.8 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 7/1) to yield the product as a colorless oil (35.2 mg, 0.080 mmol, 80% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (d, *J* = 8.3 Hz, 2H), 7.59 (d, *J* = 7.9 Hz, 2H), 7.48 (d, *J* = 8.3 Hz, 2H), 7.41 – 7.27 (m, 7H), 4.62 – 4.49 (m, 2H), 3.90 (s, 3H), 3.82 (ABq, J_{AB} = 5.6 Hz, $\Delta\nu_{AB}$ = 7.1 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.08, 166.77, 145.11, 139.52, 139.33, 130.35 (q, *J* = 32.5 Hz), 130.15, 129.36, 129.02, 128.46, 127.79, 127.18, 127.03, 126.05 (q, *J* = 3.8 Hz), 124.03 (q, *J* = 272.2 Hz), 67.01, 54.10, 52.28, 45.78.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.58.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 0.8 mL/min. λ = 214 nm, t(major) = 21.8 min, t(minor) = 30.2 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{21}F_3NO_3$ $[M+H]^+$ 440.1468, found 440.1465.

(*S*)-4-(2-oxo-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-3-yl)benzonitrile (24)



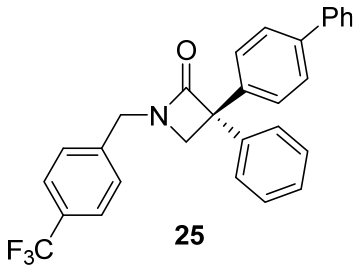
24

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)benzonitrile **A8** (24.8 mg, 0.10 mmol), the reaction

mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 7/1) to yield the product as a white solid (36.2 mg, 0.089 mmol, 89% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (t, *J* = 8.5 Hz, 4H), 7.52 (d, *J* = 8.2 Hz, 2H), 7.40 – 7.27 (m, 7H), 4.56 (s, 2H), 3.81 (ABq, J_{AB} = 5.6 Hz, $\Delta\nu_{AB}$ = 19.3 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 168.56, 145.34, 139.12, 138.96, 132.69, 130.47 (q, *J* = 32.5 Hz), 129.18, 128.49, 128.07, 127.91, 126.98, 126.10 (q, *J* = 3.7 Hz), 123.99 (q, *J* = 272.0 Hz), 118.58, 111.52, 66.83, 53.88, 45.87.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.59.
HPLC conditions: Chiralcel IH, *n*-hexane/*i*-PrOH = 85/15, flow rate 0.8 mL/min. λ = 230 nm, t(major) = 32.8 min, t(minor) = 38.2 min, 99% ee.
HRMS (ESI) *m/z* calcd. for $C_{24}H_{18}F_3NO$ $[M+H]^+$ 407.1366, found 407.1364.

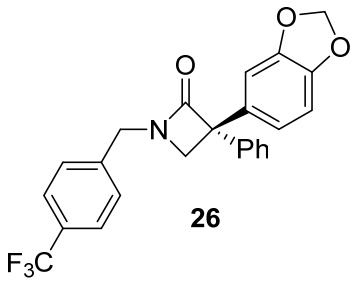
(*S*)-3-([1,1'-biphenyl]-4-yl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (25)



25

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 2-([1,1'-biphenyl]-4-yl)-5,5-dimethyl-1,3,2-dioxaborinane **A17** (26.6 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a white solid (27.9 mg, 0.061 mmol, 61% yield).
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 7.9 Hz, 2H), 7.57 (d, *J* = 7.8 Hz, 4H), 7.50 – 7.41 (m, 6H), 7.40 – 7.32 (m, 5H), 7.32 – 7.27 (m, 1H), 4.58 (s, 2H), 3.89 – 3.78 (m, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.74, 140.60, 140.43, 140.16, 139.54, 139.22, 130.30 (q, *J* = 32.7 Hz), 128.94, 128.92, 128.51, 127.60, 127.58, 127.54, 127.17, 126.04 (q, *J* = 3.8 Hz), 124.09 (q, *J* = 272.2 Hz), 66.85, 54.44, 45.78.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.54.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 0.8 mL/min. λ = 254 nm, t(major) = 15.9 min, t(minor) = 17.8 min, 97% ee.
HRMS (ESI) *m/z* calcd. for $C_{29}H_{23}F_3NO$ $[M+H]^+$ 458.1726, found 458.1723.

(*S*)-3-(benzo[*d*][1,3]dioxol-5-yl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (26)

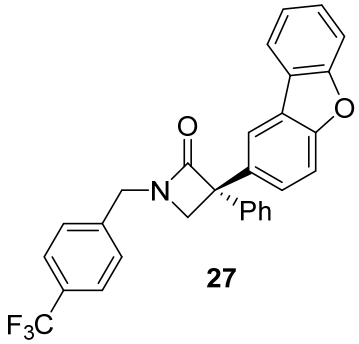


26

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 2-(benzo[*d*][1,3]dioxol-5-yl)-5,5-dimethyl-1,3,2-dioxaborinane **A9** (23.4 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 6/1) to yield the product as a white solid (25.9 mg, 0.061 mmol, 61% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 8.0 Hz, 2H), 7.42 – 7.29 (m, 6H), 7.29 – 7.21 (m, 1H), 6.91 – 6.81 (m, 2H), 6.76 (d, *J* = 8.6 Hz, 1H), 5.93 (s, 2H), 4.54 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 13.2 Hz, 2H), 3.75 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 14.3 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.77, 148.08, 146.98, 140.31, 139.54, 134.11, 130.30 (q, *J* = 32.6 Hz), 128.88, 128.48, 127.55, 127.05, 126.03 (q, *J* = 3.7 Hz), 124.09 (q, *J* = 272.2 Hz), 120.32, 108.42, 107.93, 101.29, 66.72, 54.62, 45.72.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.56.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 90/10, flow rate 0.8 mL/min. λ = 230 nm, t(minor) = 20.5 min, t(major) = 23.3 min, 97% ee.
HRMS (ESI) *m/z* calcd. for $C_{24}H_{19}F_3NO_3$ $[M+H]^+$ 426.1312, found 426.1308.

(*S*)-3-(dibenzo[*b,d*]furan-2-yl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (27)



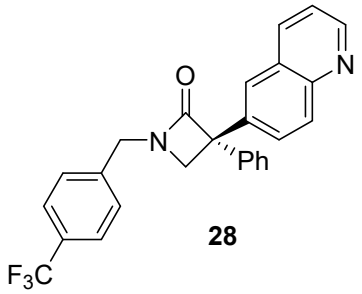
27

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 2-(dibenzo[*b*,*d*]furan-2-yl)-5,5-dimethyl-1,3,2-dioxaborinane **A10** (28.0 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 8/1) to yield the product as a white solid (37.2 mg, 0.079 mmol, 79% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (d, *J* = 1.6 Hz, 1H), 7.92 (d, *J* = 7.7 Hz, 1H), 7.60 (d, *J* = 8.0 Hz, 2H), 7.58 – 7.51 (m, 2H), 7.48 (d, *J* = 1.9 Hz, 1H), 7.47 – 7.42 (m, 3H),

7.41 – 7.33 (m, 5H), 7.33 – 7.26 (m, 1H), 4.60 (ABq, J_{AB} = 15.5 Hz, $\Delta\nu_{AB}$ = 8.8 Hz, 2H), 3.95 – 3.86 (m, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.95, 156.72, 155.42, 140.49, 139.53, 134.91, 130.31 (q, *J* = 32.5 Hz), 128.95, 128.51, 127.59, 127.56, 127.08, 126.42, 126.04 (q, *J* = 3.8 Hz), 124.68, 124.07 (q, *J* = 272.0 Hz), 124.04, 122.95, 120.96, 119.30, 112.00, 111.83, 66.95, 54.86, 45.77.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.53.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(minor) = 13.7 min, t(major) = 15.9 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{29}H_{21}F_3NO_2$ $[M+H]^+$ 472.1519, found 472.1518.

(*S*)-3-phenyl-3-(quinolin-6-yl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (28)

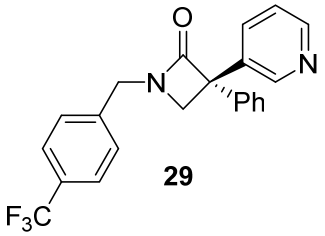


28

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 6-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)quinoline **A11** (24.1 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 3/1) to yield the product as a colorless oil (29.8 mg, 0.069 mmol, 69% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.90 (dd, *J* = 4.3, 1.7 Hz, 1H), 8.16 – 8.11 (m, 1H), 8.08 (d, *J* = 8.8 Hz, 1H), 7.93 (d, *J* = 2.0 Hz, 1H), 7.67 (dd, *J* = 8.8, 2.1 Hz, 1H), 7.59 (d, *J* = 8.0 Hz, 2H), 7.47 – 7.32 (m, 7H), 7.32 – 7.26 (m, 1H), 4.59 (s, 2H), 3.90 (ABq, J_{AB} = 5.5 Hz, $\Delta\nu_{AB}$ = 15.5 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.40, 150.79, 147.54, 139.62, 139.37, 138.44, 136.38, 130.35 (q, *J* = 32.7 Hz), 130.24, 129.02, 128.86, 128.49, 128.21, 127.78, 127.13, 126.05 (q, *J* = 3.6 Hz), 125.65, 124.03 (q, *J* = 272.3 Hz), 121.69, 66.94, 54.18, 45.81.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.57.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 0.8 mL/min. λ = 254 nm, t(major) = 31.3 min, t(minor) = 43.6 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{26}H_{20}F_3N_2O$ $[M+H]^+$ 433.1522, found 433.1520.

(*S*)-3-phenyl-3-(pyridin-3-yl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (29)

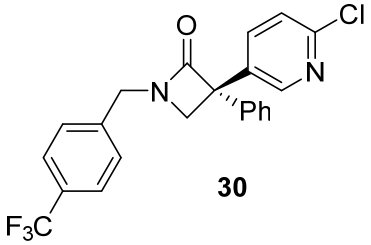


29

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 3-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)pyridine **A12** (19.1 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 3/1) to yield the product as a colorless oil (12.2 mg, 0.032 mmol, 32% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63 (s, 1H), 8.53 (s, 1H), 7.75 (dt, *J* = 8.0, 2.0 Hz, 1H), 7.60 (d, *J* = 8.1 Hz, 2H), 7.42 – 7.32 (m, 6H), 7.32 – 7.23 (m, 2H), 4.56 (s, 2H), 3.83 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 168.76, 148.87, 148.30, 139.22, 139.18, 136.01, 134.96, 130.50 (q, *J* = 32.7 Hz), 129.16, 128.52, 127.97, 127.07, 126.14 (q, *J* = 3.8 Hz), 124.03 (q, *J* = 272.1 Hz), 123.74, 65.11, 53.89, 45.90.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.64.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 214 nm, t(major) = 14.4 min, t(minor) = 25.3 min, 94% ee.
HRMS (ESI) *m/z* calcd. for $C_{22}H_{18}F_3N_2O$ $[M+H]^+$ 383.1366, found 383.1363.

(*S*)-3-(6-chloropyridin-3-yl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (30)



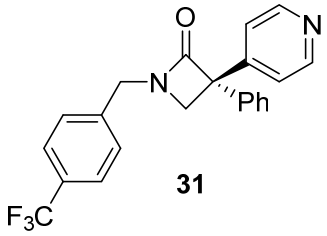
30

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 2-chloro-5-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)pyridine **A13** (22.5 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 3/1) to yield the product as a colorless oil (17.9 mg, 0.043 mmol, 43% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.39 (d, *J* = 2.6 Hz, 1H), 7.71 (dd, *J* = 8.3, 2.5 Hz, 1H), 7.60 (d, *J* = 8.0 Hz, 2H), 7.40 – 7.27 (m, 8H), 4.56 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 14.0 Hz, 2H), 3.81 (ABq, J_{AB} = 5.7 Hz, $\Delta\nu_{AB}$ = 11.5 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 168.29, 150.77, 148.09, 139.07, 138.79, 137.84, 135.00, 130.56 (q, *J* = 32.7 Hz), 129.28, 128.52, 128.16, 126.94, 126.17 (q, *J* = 3.8 Hz), 124.49, 124.01 (d, *J* = 272.1 Hz), 64.47, 53.75, 45.93.

^{19}F NMR (376 MHz, $CDCl_3$) δ -62.63.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 0.8 mL/min. λ = 225 nm, t(major) = 18.8 min, t(minor) = 38.2 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{22}H_{17}ClF_3N_2O$ $[M+H]^+$ 417.0976, found 417.0973.

(*S*)-3-phenyl-3-(pyridin-4-yl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (31)

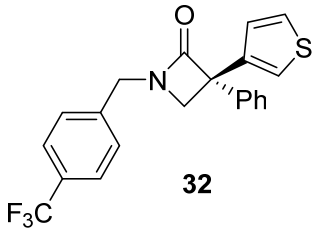


31

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 4-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)pyridine **A14** (19.1 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 2/1) to yield the product as a colorless oil (16.2 mg, 0.042 mmol, 42% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.59 – 8.53 (m, 2H), 7.60 (d, J = 8.0 Hz, 2H), 7.41 – 7.31 (m, 7H), 7.31 – 7.28 (m, 2H), 4.56 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 9.0 Hz, 2H), 3.80 (ABq, J_{AB} = 5.6 Hz, $\Delta\nu_{AB}$ = 9.3 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 168.34, 150.34, 148.85, 139.16, 138.55, 130.53 (q, J = 32.8 Hz), 129.18, 128.51, 128.13, 127.10, 126.14 (q, J = 3.8 Hz), 122.12, 124.02 (q, J = 272.1 Hz), 66.36, 53.61, 45.91.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.64.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 214 nm, t(major) = 16.6 min, t(minor) = 22.3 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{22}H_{18}F_3N_2O$ $[M+H]^+$ 383.1366, found 383.1362.

(*S*)-3-phenyl-3-(thiophen-3-yl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (32)

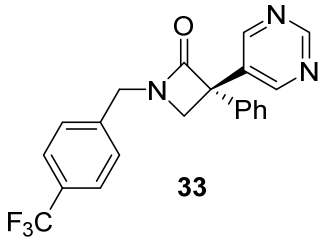


32

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 5,5-dimethyl-2-(thiophen-3-yl)-1,3,2-dioxaborinane **A15** (19.6 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 8/1) to yield the product as a colorless oil (12.0 mg, 0.031 mmol, 31% yield).
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, J = 8.0 Hz, 2H), 7.42 – 7.28 (m, 9H), 7.11 (dd, J = 3.0, 1.4 Hz, 1H), 6.99 (dd, J = 5.0, 1.4 Hz, 1H), 4.55 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 22.2 Hz, 2H), 3.74 (ABq, J_{AB} = 5.3 Hz, $\Delta\nu_{AB}$ = 13.2 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.48, 140.78, 139.58, 130.38 (q, *J* = 32.9 Hz), 128.89, 128.53, 127.69, 127.07, 126.75, 126.52, 126.07 (q, *J* = 3.8 Hz), 124.10 (q, *J* = 272.3 Hz), 122.23, 64.28, 54.74, 45.81.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.60.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 90/10, flow rate 0.8 mL/min. λ = 230 nm, t(major) = 17.9 min, t(minor) = 20.0 min, 92% ee.
HRMS (ESI) *m/z* calcd. for $C_{21}H_{17}F_3NOS$ $[M+H]^+$ 388.0977, found 388.0973.

(*S*)-3-phenyl-3-(pyrimidin-5-yl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (33)

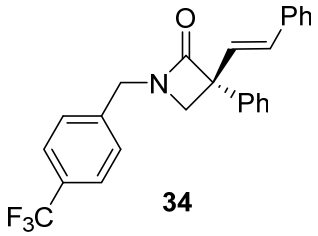


33

According to the **general procedure C** with **E1** (46.1 mg, 0.12 mmol) and 5-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)pyrimidine **A16** (19.2 mg, 0.10 mmol), the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 3/1) to yield the product as a colorless oil (16.9 mg, 0.044 mmol, 44% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.14 (s, 1H), 8.75 (s, 2H), 7.61 (d, *J* = 8.0 Hz, 2H), 7.43 – 7.29 (m, 7H), 4.57 (ABq, J_{AB} = 15.5 Hz, $\Delta\nu_{AB}$ = 9.3 Hz, 2H), 3.83 (ABq, J_{AB} = 5.8 Hz, $\Delta\nu_{AB}$ = 22.3 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 167.64, 157.89, 155.53, 138.90, 137.95, 134.01, 130.65 (q, *J* = 32.5 Hz), 129.46, 128.57, 128.44, 127.04, 126.24 (q, *J* = 3.7 Hz), 123.98 (q, *J* = 272.5 Hz), 63.30, 53.33, 46.04.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.66.
HPLC conditions: Nu-Analytical Solutions INA, *n*-hexane/*i*-PrOH = 85/15, flow rate 1.0 mL/min. λ = 254 nm, t(major) = 16.8 min, t(minor) = 36.4 min, 97% ee.
HRMS (ESI) *m/z* calcd. for $C_{21}H_{17}F_3N_3O$ $[M+H]^+$ 384.1318, found 384.1314.

***(R,E)*-3-phenyl-3-styryl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (34)**

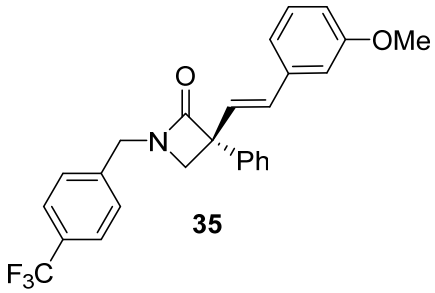


34

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-5,5-dimethyl-2-styryl-1,3,2-dioxaborinane **A18** (21.6 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (28.8 mg, 0.071 mmol, 71% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.1 Hz, 2H), 7.49 – 7.43 (m, 2H), 7.41 – 7.26 (m, 9H), 7.25 – 7.21 (m, 1H), 6.51 (s, 2H), 4.54 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 28.9 Hz, 2H), 3.61 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.28, 136.33, 131.77, 130.16 (q, *J* = 32.5 Hz), 128.82, 128.61, 128.59, 128.35, 127.93, 127.60, 127.06, 126.50, 125.92 (q, *J* = 3.8 Hz), 123.98 (q, *J* = 272.1 Hz), 65.47, 53.52, 45.57.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.55.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(major) = 24.3 min, t(minor) = 30.6 min, 98% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{21}F_3NO$ $[M+H]^+$ 408.1570, found 408.1567.

(*R,E*)-3-(3-methoxystyryl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (35)

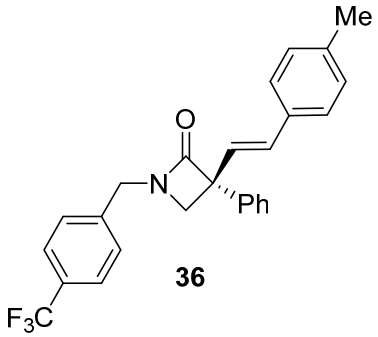


35

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-2-(3-methoxystyryl)-5,5-dimethyl-1,3,2-dioxaborinane **A2** (24.6 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (30.5 mg, 0.070 mmol, 70% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 8.0 Hz, 2H), 7.46 (d, *J* = 7.5 Hz, 2H), 7.42 – 7.34 (m, 4H), 7.34 – 7.26 (m, 1H), 7.25 – 7.13 (m, 1H), 6.93 (d, *J* = 7.7 Hz, 1H), 6.87 (t, *J* = 2.0 Hz, 1H), 6.78 (dd, *J* = 8.2, 2.5 Hz, 1H), 6.50 (s, 2H), 4.53 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 23.8 Hz, 2H), 3.77 (s, 3H), 3.60 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.22, 159.80, 139.45, 138.46, 137.76, 131.64, 130.13 (q, *J* = 32.6 Hz), 129.55, 128.91, 128.81, 128.32, 127.92, 127.63, 127.59, 125.89 (q, *J* = 3.8 Hz), 123.97 (q, *J* = 272.1 Hz), 119.11, 113.74, 111.66, 65.42, 55.19, 53.47, 45.54.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.55.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 1.0 mL/min. λ = 254 nm, t(minor) = 24.5 min, t(major) = 46.4 min, 94% ee.
HRMS (ESI) *m/z* calcd. for $C_{26}H_{23}F_3NO$ $[M+H]^+$ 438.1675, found 438.1673.

(*R,E*)-3-(4-methylstyryl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (36)



36

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-5,5-dimethyl-2-(4-methylstyryl)-1,3,2-dioxaborinane **A19** (23.0 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (30.2 mg, 0.072 mmol, 72% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.0 Hz, 2H), 7.45 (d, *J* = 7.3 Hz, 2H), 7.41 – 7.35 (m, 4H), 7.31 (d, *J* = 7.3 Hz, 1H), 7.27 – 7.19 (m, 2H), 7.10 (d, *J* = 7.9 Hz, 2H), 6.47 (ABq, J_{AB} = 16.0 Hz, $\Delta\nu_{AB}$ = 9.8 Hz, 2H), 4.54 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 30.5 Hz, 2H), 3.60 (s, 2H), 2.32 (s, 3H).

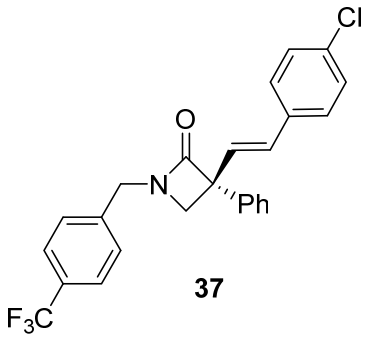
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.44, 139.52, 138.64, 137.83, 133.57, 131.64, 130.18 (q, *J* = 32.4 Hz), 129.30, 128.81, 128.36, 127.56, 127.08, 126.42, 125.93 (q, *J* = 3.8 Hz), 124.00 (q, *J* = 272.1 Hz), 65.50, 53.59, 45.58, 21.21.

^{19}F NMR (376 MHz, $CDCl_3$) δ -62.55.

HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.5 mL/min. λ = 254 nm, t(major) = 27.3 min, t(minor) = 28.5 min, 98% ee.

HRMS (ESI) *m/z* calcd. for $C_{26}H_{23}F_3NO$ $[M+H]^+$ 422.1726, found 422.1723.

(*R,E*)-3-(4-chlorostyryl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (37)



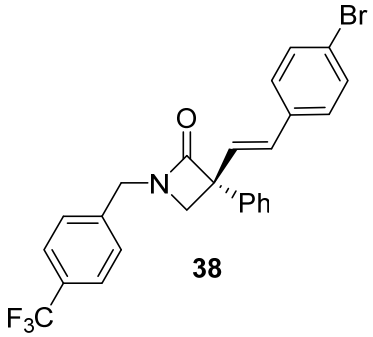
37

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-2-(4-chlorostyryl)-5,5-dimethyl-1,3,2-dioxaborinane **A20** (25.0 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/dichloromethane 2/1) to yield the product as a colorless oil (30.0 mg, 0.068 mmol, 68% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.1 Hz, 2H), 7.45 (dd, *J* = 8.2, 1.5 Hz, 2H), 7.41 – 7.35 (m, 4H), 7.34 – 7.29 (m, 1H), 7.25 (s, 4H), 6.46 (ABq, J_{AB} = 15.7 Hz,

$\Delta\nu_{AB}$ = 14.0 Hz, 2H), 4.54 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 18.2 Hz, 2H), 3.60 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 8.0 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.07, 139.40, 138.27, 134.84, 133.56, 130.66, 130.22 (q, *J* = 32.6 Hz), 129.36, 128.88, 128.75, 128.37, 127.73, 127.70, 127.07, 125.94 (q, *J* = 3.7 Hz), 123.97 (q, *J* = 272.1 Hz), 65.42, 53.49, 45.62.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.56.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(minor) = 36.6 min, t(major) = 37.9 min, 90% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{20}ClF_3NO$ $[M+H]^+$ 442.1180, found 442.1179.

(*R,E*)-3-(4-bromostyryl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (38)

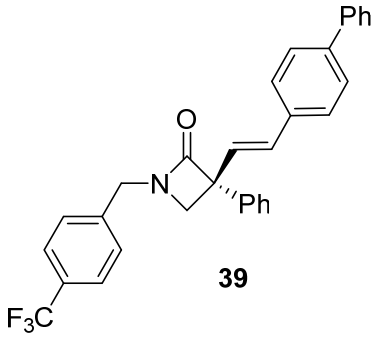


38

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-2-(4-bromostyryl)-5,5-dimethyl-1,3,2-dioxaborinane **A21** (29.5 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/dichloromethane 2/1) to yield the product as a colorless oil (35.0 mg, 0.072 mmol, 72% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.0 Hz, 2H), 7.48 – 7.42 (m, 2H), 7.42 – 7.34 (m, 6H), 7.34 – 7.27 (m, 1H), 7.19 (d, *J* = 8.5 Hz, 2H), 6.46 (ABq, J_{AB} = 16.0 Hz, $\Delta\nu_{AB}$ = 26.5 Hz, 2H), 4.53 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 17.4 Hz, 2H), 3.60 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 7.5 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.01, 139.39, 139.37, 138.21, 135.27, 131.67, 130.70, 130.18 (q, *J* = 32.6 Hz), 129.48, 128.86, 128.35, 128.03, 127.69, 127.06, 125.92 (q, *J* = 3.7 Hz), 123.95 (q, *J* = 272.1 Hz), 121.70, 65.41, 53.44, 45.60.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.51.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(minor) = 26.0 min, t(major) = 27.9 min, 94% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{20}BrF_3NO$ $[M+H]^+$ 486.0675, found 486.0673.

(*R,E*)-3-(2-([1,1'-biphenyl]-4-yl)vinyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (39)

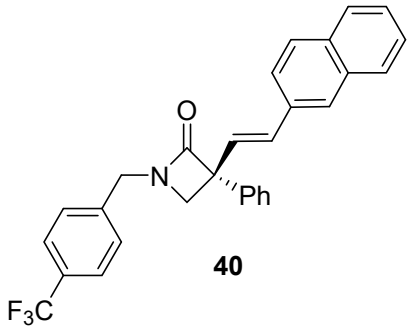


39

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-2-(2-([1,1'-biphenyl]-4-yl)vinyl)-5,5-dimethyl-1,3,2-dioxaborinane **A22** (29.2 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/dichloromethane 2/1) to yield the product as a colorless oil (30.8 mg, 0.064 mmol, 64% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.42 (m, 6H), 7.42 – 7.36 (m, 2H), 7.38 – 7.27 (m, 8H), 7.27 – 7.20 (m, 2H), 6.47 (s, 2H), 4.45 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 29.5 Hz, 2H), 3.53 (s, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.26, 140.66, 140.54, 139.48, 138.50, 135.37, 131.32, 130.18 (q, *J* = 32.6 Hz), 128.85, 128.81, 128.71, 128.36, 127.63, 127.41, 127.26, 127.09, 126.96, 126.93, 125.94 (q, *J* = 3.7 Hz), 123.99 (q, *J* = 272.0 Hz), 65.54, 53.54, 45.59.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.49.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(major) = 40.9 min, t(minor) = 61.0 min, 94% ee.
HRMS (ESI) *m/z* calcd. for $C_{31}H_{25}F_3NO$ $[M+H]^+$ 484.1883, found 484.1881.

(*R,E*)-3-(2-(naphthalen-2-yl)vinyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (40)



40

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-5,5-dimethyl-2-(2-(naphthalen-2-yl)vinyl)-1,3,2-dioxaborinane **A23** (26.6 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/dichloromethane 2/1) to yield the product as a colorless oil (27.8 mg, 0.061 mmol, 61% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (dd, *J* = 9.0, 6.7 Hz, 3H), 7.68 (d, *J* = 1.7 Hz, 1H), 7.61 (d, *J* = 8.0 Hz, 2H), 7.55 (dd, *J* = 8.6, 1.8 Hz, 1H), 7.53 – 7.47 (m, 2H), 7.47 – 7.36

(m, 6H), 7.35 – 7.29 (m, 1H), 6.65 (ABq, J_{AB} = 16.0 Hz, $\Delta\nu_{AB}$ = 10.7 Hz, 2H), 4.55 (ABq, J_{AB} = 15.5 Hz, $\Delta\nu_{AB}$ = 22.1 Hz, 2H), 3.64 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 3.9 Hz, 2H).

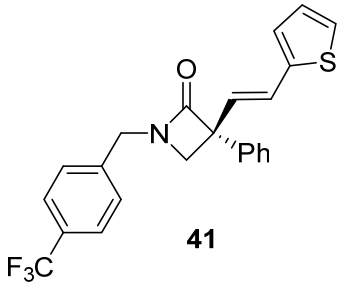
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.32, 139.48, 138.52, 133.78, 133.52, 133.10, 131.96, 130.21 (q, *J* = 32.4 Hz), 129.00, 128.88, 128.39, 128.26, 128.03, 127.68, 127.15, 126.80, 126.37, 126.07, 125.96 (q, *J* = 3.7 Hz), 123.99 (q, *J* = 272.1 Hz), 123.39, 65.61, 53.59, 45.63.

^{19}F NMR (376 MHz, $CDCl_3$) δ -62.54.

HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.5 mL/min. λ = 280 nm, t(minor) = 44.3 min, t(major) = 49.6 min, 96% ee.

HRMS (ESI) *m/z* calcd. for $C_{29}H_{23}F_3NO$ $[M+H]^+$ 458.1726, found 458.1723.

(*R,E*)-3-phenyl-3-(2-(thiophen-2-yl)vinyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (41)



41

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-5,5-dimethyl-2-(2-(thiophen-2-yl)vinyl)-1,3,2-dioxaborinane **A24** (22.2 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (23.0 mg, 0.056 mmol, 56% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.0 Hz, 2H), 7.50 – 7.42 (m, 2H), 7.42 – 7.28 (m, 6H), 7.14 (dd, *J* = 4.9, 1.3 Hz, 1H), 6.97 – 6.89 (m, 2H), 6.61 (d, *J* = 15.7 Hz, 1H), 6.34 (d, *J* = 15.8 Hz, 1H), 4.53 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 11.6 Hz, 2H), 3.58 (ABq, J_{AB} = 5.4 Hz, $\Delta\nu_{AB}$ = 12.0 Hz, 2H).

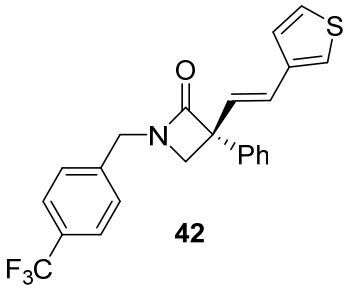
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.05, 141.40, 139.43, 138.26, 130.22 (q, *J* = 32.5 Hz), 129.16 (d, *J* = 29.3 Hz), 128.86, 128.37, 128.31, 128.11, 127.68, 127.45, 127.12, 126.45, 125.95 (q, *J* = 3.7 Hz), 125.32, 124.62, 123.99 (q, *J* = 272.1 Hz), 65.35, 53.63, 53.46, 45.63.

^{19}F NMR (376 MHz, $CDCl_3$) δ -62.56.

HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(major) = 23.7 min, t(minor) = 40.3 min, 95% ee.

HRMS (ESI) *m/z* calcd. for $C_{23}H_{19}F_3NOS$ $[M+H]^+$ 414.1134, found 414.1130.

(*R,E*)-3-phenyl-3-(2-(thiophen-3-yl)vinyl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (42)

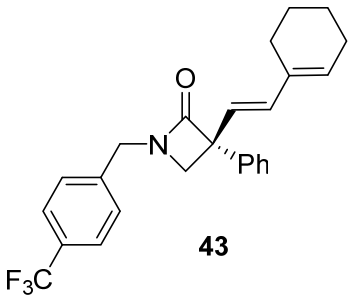


42

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-5,5-dimethyl-2-(2-(thiophen-3-yl)vinyl)-1,3,2-dioxaborinane **A25** (22.2 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (19.2 mg, 0.047 mmol, 47% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.0 Hz, 2H), 7.45 (d, *J* = 7.2 Hz, 2H), 7.38 (t, *J* = 7.9 Hz, 4H), 7.34 – 7.28 (m, 1H), 7.28 – 7.22 (m, 1H), 7.18 (d, *J* = 5.1 Hz, 1H), 7.12 (d, *J* = 2.9 Hz, 1H), 6.51 (d, *J* = 15.9 Hz, 1H), 4.54 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 21.3 Hz, 2H), 3.59 (ABq, J_{AB} = 5.3 Hz, $\Delta\nu_{AB}$ = 7.8 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.30, 139.47, 138.97, 138.50, 130.21 (q, *J* = 32.4 Hz), 128.84, 128.49, 128.37, 127.61, 127.10, 126.10, 125.95 (q, *J* = 3.8 Hz), 124.80, 123.99 (q, *J* = 272.1 Hz), 122.86, 65.43, 53.56, 45.61.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.55.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(major) = 27.8 min, t(minor) = 45.5 min, 95% ee.
HRMS (ESI) *m/z* calcd. for $C_{23}H_{19}F_3NOS$ $[M+H]^+$ 414.1134, found 414.1130.

(*R,E*)-3-(2-(cyclohex-1-en-1-yl)vinyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (43)



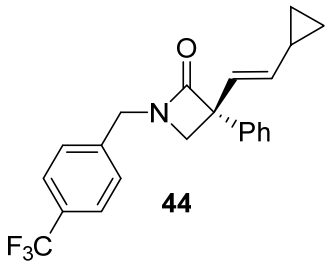
43

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-2-(2-(cyclohex-1-en-1-yl)vinyl)-5,5-dimethyl-1,3,2-dioxaborinane **A26** (22.0 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (18.8 mg, 0.046 mmol, 46% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 7.9 Hz, 2H), 7.53 – 7.29 (m, 5H), 7.31 – 7.02 (m, 1H), 6.11 (d, *J* = 15.8 Hz, 1H), 5.82 (d, *J* = 15.9 Hz, 1H), 5.71 (d, *J* = 3.7 Hz, 1H), 4.51 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 8.5 Hz, 2H), 3.53 (ABq, J_{AB} = 5.3 Hz, $\Delta\nu_{AB}$ =

5.3 Hz, 2H), 2.19 – 2.00 (m, 4H), 1.93 – 1.34 (m, 4H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.83, 139.59, 139.09, 135.42, 134.82, 131.00, 130.11 (q, *J* = 32.6 Hz), 128.70, 128.35, 127.37, 127.03, 125.88 (q, *J* = 3.8 Hz), 124.36, 124.01 (q, *J* = 272.1 Hz), 65.37, 53.83, 45.53, 25.90, 24.43, 22.42, 22.36.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.55.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(minor) = 13.4 min, t(major) = 15.0 min, 90% ee.
HRMS (ESI) *m/z* calcd. for $C_{25}H_{25}F_3NO$ $[M+H]^+$ 412.1883, found 412.1880.

(*R,E*)-3-(2-cyclopropylvinyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (44)

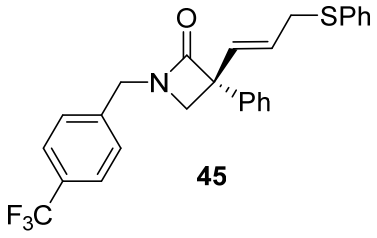


44

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-2-(2-cyclopropylvinyl)-5,5-dimethyl-1,3,2-dioxaborinane **A27** (18.0 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (15.0 mg, 0.040 mmol, 40% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 7.9 Hz, 2H), 7.43 – 7.31 (m, 6H), 7.31 – 7.25 (m, 1H), 5.85 (d, *J* = 15.4 Hz, 1H), 5.07 (dd, *J* = 15.4, 9.0 Hz, 1H), 4.50 (ABq, J_{AB} = 15.4 Hz, $\Delta\nu_{AB}$ = 41.0 Hz, 2H), 3.48 (ABq, J_{AB} = 5.2 Hz, $\Delta\nu_{AB}$ = 21.0 Hz, 2H), 1.45 – 1.34 (m, 1H), 0.77 – 0.63 (m, 2H), 0.42 – 0.27 (m, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.84, 139.65, 138.93, 136.99, 130.09 (q, *J* = 32.6 Hz), 128.64, 128.30, 127.30, 126.95, 126.62, 125.84 (q, *J* = 3.7 Hz), 124.00 (q, *J* = 272.1 Hz), 65.12, 53.73, 45.42, 13.94, 6.86, 6.84.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.54.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(minor) = 22.4 min, t(major) = 26.9 min, 92% ee.
HRMS (ESI) *m/z* calcd. for $C_{22}H_{21}F_3NO$ $[M+H]^+$ 372.1570, found 372.1566.

(*R,E*)-3-phenyl-3-(3-(phenylthio)prop-1-en-1-yl)-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (45)

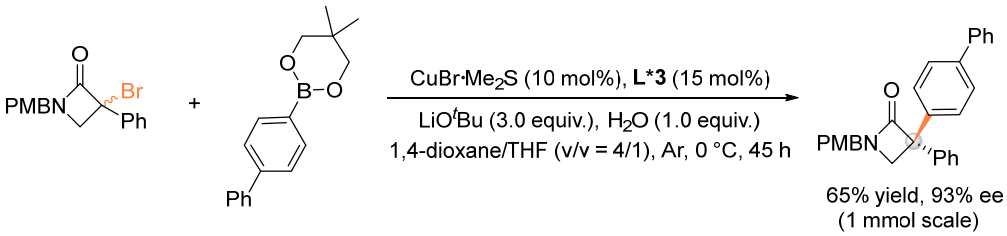


45

According to the **general procedure D** with **E1** (57.4 mg, 0.15 mmol) and (*E*)-5,5-dimethyl-2-(3-(phenylthio)prop-1-en-1-yl)-1,3,2-dioxaborinane **A28** (26.2 mg, 0.10 mmol) at −40 °C for 5 d, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to yield the product as a colorless oil (21.7 mg, 0.048 mmol, 48% yield).

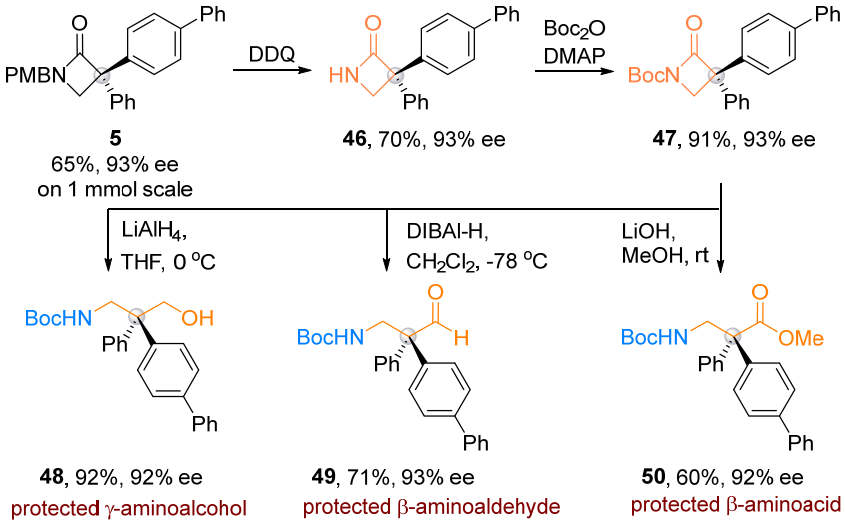
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 8.0 Hz, 2H), 7.40 – 7.10 (m, 12H), 5.87 – 5.72 (m, 1H), 5.67 (dt, *J* = 15.4, 6.8 Hz, 1H), 4.54 (d, *J* = 15.4 Hz, 1H), 4.38 (d, *J* = 15.4 Hz, 1H), 3.51 (dt, *J* = 6.9, 1.3 Hz, 2H), 3.42 (d, *J* = 5.3 Hz, 1H), 3.29 (d, *J* = 5.3 Hz, 1H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.06, 139.47, 138.22, 135.15, 132.29, 130.97, 130.14 (q, *J* = 32.6 Hz), 128.80, 128.71, 128.28, 127.92, 127.48, 126.85, 126.66, 125.89 (q, *J* = 3.8 Hz), 123.99 (q, *J* = 272.2 Hz), 64.93, 53.25, 45.45, 36.53.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.54.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(minor) = 30.4 min, t(major) = 32.0 min, 96% ee.
HRMS (ESI) *m/z* calcd. for $C_{26}H_{23}F_3NOS$ $[M+H]^+$ 454.1447, found 454.1444.

One-mmol scale reaction

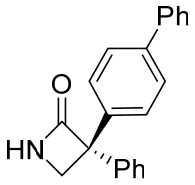


Large Scale: according to the **general procedure C** with **E5** (345 mg, 1.0 mmol) and 2-([1,1'-biphenyl]-4-yl)-5,5-dimethyl-1,3,2-dioxaborinane (266 mg, 1.0 mmol) at 0 °C for 45 h, the reaction mixture was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 5/1) to yield the product as a colorless oil (272 mg, 0.65 mmol, 65% yield).

Derivatizations of *α*-quaternary β-lactams



(*S*)-3-([1,1'-biphenyl]-4-yl)-3-phenylazetidin-2-one (46)



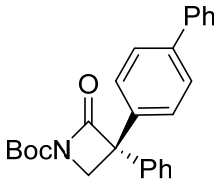
46

To a stirred solution of **5** (154.5 mg, 0.369 mmol, 1.0 equiv.) in a mixture solvent of CH_2Cl_2 (6 mL) and H_2O (0.6 mL) was added 2,3-dichloro-5,6-dicyano-*para*-benzoquinone (DDQ, 251 mg, 1.11 mmol, 3.0 equiv.) at room temperature. The reaction mixture was stirred at that temperature for 24 h. Upon completion (monitored by TLC), the reaction mixture was diluted with CH_2Cl_2, quenched with saturated $NaHCO_3$ solution, and extracted with CH_2Cl_2 three times (3 × 10 mL). The combined organic layer was washed with saturated $NaHCO_3$ solution, dried with Na_2SO_4, filtered and concentrated in vacuo. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 4/1) to give product **46** as a colorless oil (77.3

mg, 70% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 – 7.53 (m, 4H), 7.52 – 7.40 (m, 6H), 7.39 – 7.32 (m, 3H), 7.32 – 7.23 (m, 1H), 6.04 (s, 1H), 3.98 (ABq, J_{AB} = 5.3 Hz, $\Delta\nu_{AB}$ = 4.4 Hz, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 170.54, 140.60, 140.31, 140.07, 139.17, 128.87, 128.82, 128.79, 128.71, 127.47, 127.45, 127.41, 127.10, 68.05, 51.27.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 80/20, flow rate 0.5 mL/min. λ = 254 nm, t(major) = 17.5 min, t(minor) = 19.8 min, 93% ee.
HRMS (ESI) *m/z* calcd. for $C_{21}H_{18}NO$ $[M+H]^+$ 300.1383, found 300.1381.

***tert*-butyl (*S*)-3-([1,1'-biphenyl]-4-yl)-2-oxo-3-phenylazetidine-1-carboxylate (47)**

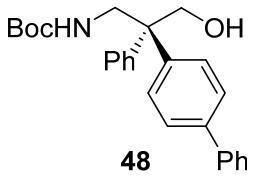


47

To a solution of **46** (29.9 mg, 0.1 mmol, 1.0 equiv.) and 4-dimethylaminopyridine (DMAP, 24.4 mg, 0.20 mmol, 2.0 equiv.) in anhydrous CH_2Cl_2 (2.0 mL) was added Boc_2O (115 μL, 0.50 mmol, 5.0 equiv.) under argon atmosphere. The resulting mixture was stirred at room temperature for 1 h. Upon completion (monitored by TLC), the reaction mixture was quenched by HCl (0.5 M, 5.0 mL). The mixture was extracted with CH_2Cl_2 three times (3 × 10 mL). The combined organic layer was washed with water and brine, dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to give product **47** as a colorless oil (36.4 mg, 91% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (t, J = 8.4 Hz, 4H), 7.51 – 7.40 (m, 6H), 7.40 – 7.33 (m, 3H), 7.33 – 7.26 (m, 1H), 4.25 (ABq, J_{AB} = 6.6 Hz, $\Delta\nu_{AB}$ = 4.8 Hz, 2H), 1.54 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 166.66, 148.19, 140.70, 140.42, 139.27, 138.29, 128.96, 128.85, 127.79, 127.61, 127.53, 127.32, 127.11, 126.99, 126.92, 83.81, 65.23, 52.90, 28.06.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 90/10, flow rate 0.5 mL/min. λ = 254 nm, t(minor) = 12.9 min, t(major) = 14.7 min, 93% ee.
HRMS (ESI) *m/z* calcd. for $C_{26}H_{26}NO_3$ $[M+Na]^+$ 422.1727, found 422.1721.

***tert*-butyl (*S*)-(2-([1,1'-biphenyl]-4-yl)-3-hydroxy-2-phenylpropyl)carbamate (48)**

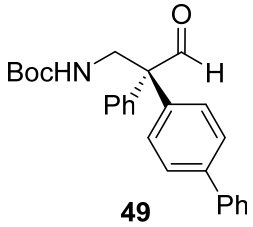


48

To a solution of **47** (20.0 mg, 0.05 mmol, 1.0 equiv.) in anhydrous THF (1.0 mL) was added $LiAlH_4$ (5.7 mg, 0.15 mmol, 3.0 equiv.) at 0 °C under argon atmosphere. The reaction mixture was stirred at that temperature for 4 h. Upon completion (monitored by TLC), the reaction mixture was quenched by saturated NH_4Cl (2.0 mL), filtered through a short pad of celite and rinsed with EtOAc. The filtrate was extracted with EtOAc three times (3 × 10 mL). The combined organic layer was washed with water and brine, dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 3/1) to give **48** as a colorless oil (18.5 mg, 92% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.47 (m, 4H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.33 (t, *J* = 7.4 Hz, 3H), 7.28 – 7.18 (m, 5H), 4.59 (t, *J* = 6.6 Hz, 1H), 4.21 (s, 2H), 4.11 – 3.95 (m, 2H), 3.58 (s, 1H), 1.43 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 157.48, 144.13, 143.31, 140.60, 139.42, 128.81, 128.57, 128.32, 127.91, 127.33, 127.13, 127.03, 126.75, 80.29, 66.36, 52.23, 45.50, 28.35.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 80/20, flow rate 0.5 mL/min. λ = 254 nm, t(minor) = 14.8 min, t(major) = 20.0 min, 92% ee.
HRMS (ESI) *m/z* calcd. for $C_{26}H_{30}NO_3$ $[M+H]^+$ 404.2220, found 404.2215.

***tert*-butyl (*S*)-(2-([1,1'-biphenyl]-4-yl)-3-oxo-2-phenylpropyl)carbamate (49)**



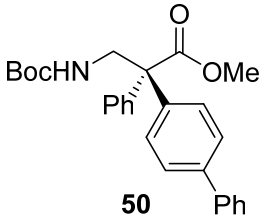
49

To a solution of **47** (20.0 mg, 0.05 mmol, 1.0 equiv.) in anhydrous CH_2Cl_2 (1.0 mL) was added DIBALH (0.1 mL, 0.10 mmol, 1 M in hexane, 2.0 equiv.) at −78 °C under argon atmosphere. The reaction mixture was stirred at that temperature for 2 h. Upon completion (monitored by TLC), the reaction mixture was quenched by saturated NH_4Cl (2.0 mL) at −78 °C, filtered through a short pad of celite and rinsed with EtOAc. The filtrate was extracted with EtOAc (3 × 10 mL). The combined organic layer was washed with water and brine, dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to give **49** as a colorless oil (14.2 mg, 71% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.91 (s, 1H), 7.72 – 7.52 (m, 4H), 7.52 – 7.31 (m, 6H), 7.32 – 7.03 (m, 4H), 4.80 (s, 1H), 4.11 (d, *J* = 6.5 Hz, 2H), 1.29 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 199.23, 155.51, 140.68, 140.32, 138.26, 137.16, 129.36, 129.05, 128.93, 128.89, 127.89, 127.62, 127.11, 64.14, 53.47, 43.96, 28.28.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(minor) = 13.3 min, t(major) = 16.3 min, 93% ee.
HRMS (ESI) *m/z* calcd. for $C_{26}H_{28}NO_3$ $[M+H]^+$ 402.2064, found 402.2060.

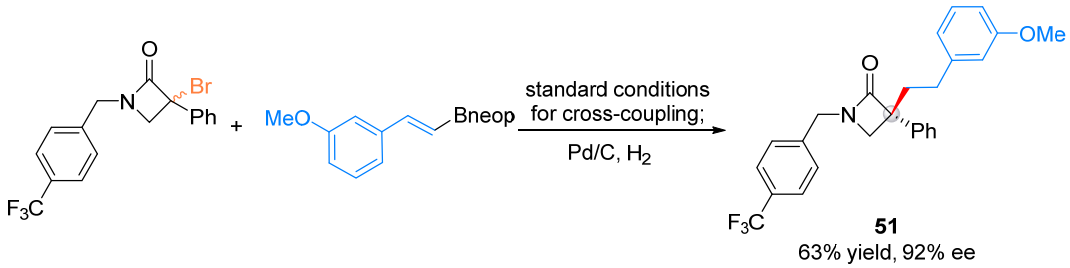
Methyl (*S*)-2-([1,1'-biphenyl]-4-yl)-3-((tert-butoxycarbonyl)amino)-2-phenylpropanoate (50)



50

To a solution of **47** (20.0 mg, 0.05 mmol, 1.0 equiv.) in anhydrous MeOH (1.0 mL) was added LiOH (6.0 mg, 0.25 mmol, 5.0 equiv.) at room temperature under argon atmosphere. The resulting mixture was stirred at that temperature for 2 h. Upon completion (monitored by TLC), the reaction mixture was quenched by saturated, filtered through a short pad of celite, and rinsed with EtOAc. The filtrate was extracted with EtOAc three times (3 × 10 mL). The combined organic layer was washed with water and brine, dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to give **50** as a white solid (12.9 mg, 60% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.41 (m, 4H), 7.36 (t, *J* = 7.6 Hz, 2H), 7.32 – 7.10 (m, 8H), 4.93 (s, 1H), 4.07 (d, *J* = 6.4 Hz, 2H), 3.71 (s, 3H), 1.21 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 174.70, 155.50, 140.54, 140.52, 140.14, 139.50, 129.27, 128.81, 128.77, 128.27, 127.42, 127.08, 126.84, 61.15, 52.76, 46.98, 29.74, 28.29.
HPLC conditions: Nu-Analytical Solutions ND, *n*-hexane/*i*-PrOH = 95/5, flow rate 0.7 mL/min. λ = 254 nm, t(minor) = 19.4 min, t(major) = 22.1 min, 92% ee.
HRMS (ESI) *m/z* calcd. for $C_{27}H_{30}NO_4$ $[M+H]^+$ 432.2169, found 432.2167.

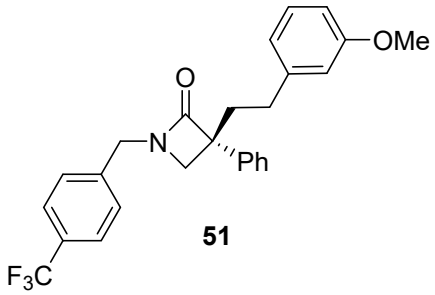


51
63% yield, 92% ee

The procedure followed the **general procedure D**, except the following changes: After completion of the reaction, the reaction mixture was filtered by a short pad of silica gel (eluent: EtOAc) and concentrated under reduced pressure. Then crude product was dissolved in MeOH (3 mL), followed by the addition of 4 mg Pd/C as solid (5 wt.%, wetted with ca. 55% water). Then a hydrogen-filled balloon was attached. The reaction

was stirred at 50 °C for 8 h. The resulting mixture was filtered and concentrated, and the residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to give **51** as a colorless oil (27.2 mg, 63% yield).

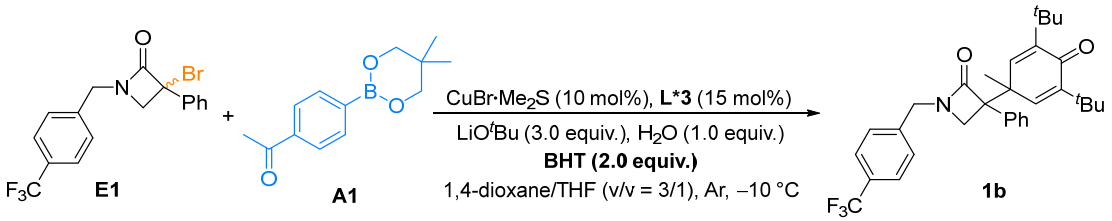
(*R*)-3-(3-methoxyphenethyl)-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-2-one (51)



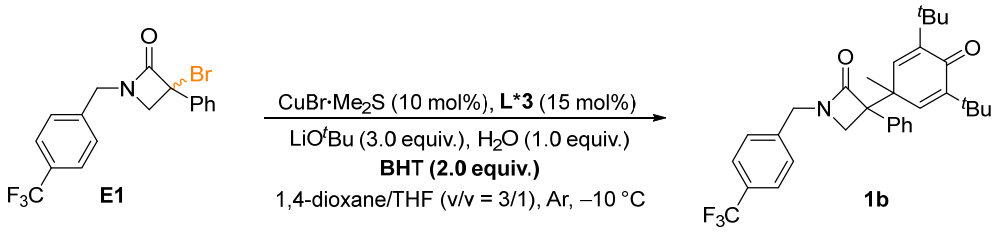
51

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 8.1 Hz, 2H), 7.51 – 7.42 (m, 2H), 7.42 – 7.27 (m, 5H), 7.15 (t, *J* = 7.9 Hz, 1H), 6.74 – 6.66 (m, 2H), 6.64 (t, *J* = 2.1 Hz, 1H), 4.47 (ABq, J_{AB} = 15.3 Hz, $\Delta\nu_{AB}$ = 37.8 Hz, 2H), 3.75 (s, 3H), 3.45 (d, *J* = 5.4 Hz, 1H), 3.32 (d, *J* = 5.4 Hz, 1H), 2.77 – 2.66 (m, 1H), 2.53 – 2.41 (m, 1H), 2.35 – 2.19 (m, 2H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 170.89, 159.71, 142.96, 139.67, 139.37, 130.15 (q, *J* = 32.5 Hz), 129.43, 128.70, 128.41, 127.90 (d, *J* = 4.8 Hz), 127.35, 126.69, 125.88 (q, *J* = 3.7 Hz), 124.00 (q, *J* = 272.2 Hz), 120.60, 114.01, 111.40, 63.08, 55.16, 51.92, 45.43, 39.33, 31.37.
^{19}F NMR (376 MHz, $CDCl_3$) δ -62.56.
HPLC conditions: Nu-Analytical Solutions INB, *n*-hexane/*i*-PrOH = 90/10, flow rate 1.0 mL/min. λ = 254 nm, t(minor) = 15.7 min, t(major) = 26.6 min, 92% ee.
HRMS (ESI) *m/z* calcd. for $C_{34}H_{28}N_2O_2P$ $[M+H]^+$ 440.1832, found 440.1829.

Radical trap experiments

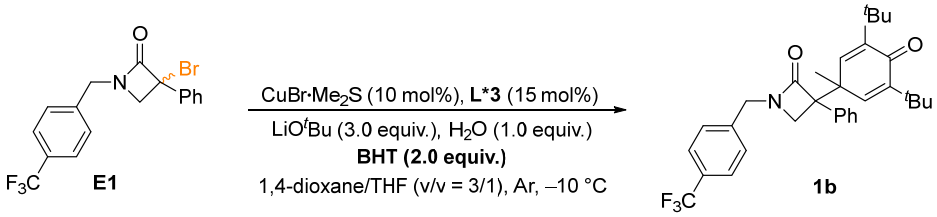


An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with CuBr·Me_2S (2.06 mg, 10 mol%), chiral ligand **L*3** (7.90 mg, 15 mol%), α-bromo-β-lactam **E1** (46.1 mg, 0.12 mmol, 1.2 equiv.), **A1** (23.2 mg, 0.1 mmol, 1.0 equiv.), LiO^{t}Bu (24.0 mg, 0.3 mmol, 3.0 equiv.) and BHT (44.1 mg, 0.2 mmol, 2.0 equiv.). The tube was evacuated and backfilled with argon three times. Then 1,4-dioxane/THF (v/v = 3/1, 2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were sequentially added into the mixture under argon. The tube was sealed and the reaction mixture was allowed to stir at –10 °C for 45 h. Upon completion, the mixture was filtered through a pad of silica gel and rinsed with EtOAc. The filtrate was evaporated and the residue was purified by column chromatography on silica gel (gradient eluent: petroleum ether/ethyl acetate 10/1–5/1) to give **1b** as colorless oil (42.0 mg, 67% yield based on **E1**) and the coupling product **1** as a colorless oil (6.6 mg, 13% yield based on **E1**).



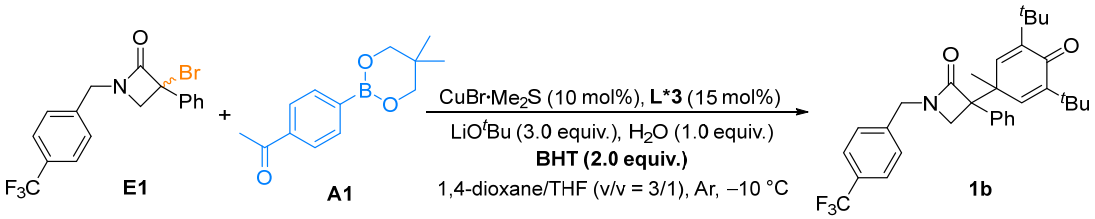
An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with CuBr·Me_2S (2.06 mg, 10 mol%), chiral ligand **L*3** (7.90 mg, 15 mol%), α-bromo-β-lactam **E1** (46.1 mg, 0.12 mmol, 1.2 equiv.), LiO^{t}Bu (24.0 mg, 0.3 mmol, 3.0 equiv.) and BHT (44.1 mg, 0.2 mmol, 2.0 equiv.). The tube was evacuated and backfilled with argon three times. Then 1,4-dioxane/THF (v/v = 3/1, 2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were sequentially added into the mixture under argon. The tube was sealed and the reaction mixture was allowed to stir at –10 °C for 45 h. Upon completion, the mixture was filtered through a pad of silica gel and rinsed with EtOAc. The filtrate was evaporated and the residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate 10/1) to give **1b** as colorless oil (46.5 mg, 74% yield based on **E1**).

Kinetic experiments



Reaction time	Yield of **1b**
15 min	3%
30 min	6%
45 min	12%
60 min	18%
75 min	21%

An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with CuBr·Me_2S (2.06 mg, 10 mol%), chiral ligand **L*3** (7.90 mg, 15 mol%), α-bromo-β-lactam **E1** (46.1 mg, 0.12 mmol, 1.2 equiv.), LiO^{t}Bu (24.0 mg, 0.3 mmol, 3.0 equiv.) and BHT (44.1 mg, 0.2 mmol, 2.0 equiv.). The tube was evacuated and backfilled with argon three times. Then 1,4-dioxane/THF (v/v = 3/1, 2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were sequentially added into the mixture under argon. The tube was sealed and the reaction mixture was allowed to stir at –10 °C for the indicated time. Upon completion, the mixture was then filtered through a pad of silica gel eluting with EtOAc. The filtrate was evaporated and the yield of **1b** (based on **E1)** was determined by ^{1}H NMR spectra with 1,3,5-trimethoxybenzene as an internal standard.



Reaction time	Yield of **1b**
15 min	4%
30 min	6%
45 min	13%
60 min	17%
75 min	20%

An oven-dried Schlenk tube equipped with a magnetic stirring bar was charged with CuBr·Me_2S (2.06 mg, 10 mol%), chiral ligand **L*3** (7.90 mg, 15 mol%), α-bromo-β-lactams **E1** (46.1 mg, 0.12 mmol, 1.2 equiv.), **A1** (23.2 mg, 0.1 mmol, 1.0 equiv.), LiO^{t}Bu (24.0 mg, 0.3 mmol, 3.0 equiv.) and BHT (44.1 mg, 0.2 mmol, 2.0 equiv.). The tube was evacuated and backfilled with argon three times. Then 1,4-dioxane/THF (v/v

= 3/1, 2.0 mL) and H_2O (1.8 mg, 1.0 equiv.) were sequentially added into the mixture under argon. The tube was sealed and the reaction mixture was allowed to stir at −10 °C for the indicated time. Upon completion, the mixture was then filtered through a pad of silica gel and rinsed with EtOAc. The filtrate was evaporated and the yield of **1b** (based on **E1)** was determined by ^{1}H NMR spectra with 1,3,5-trimethoxybenzene as an internal standard.

References

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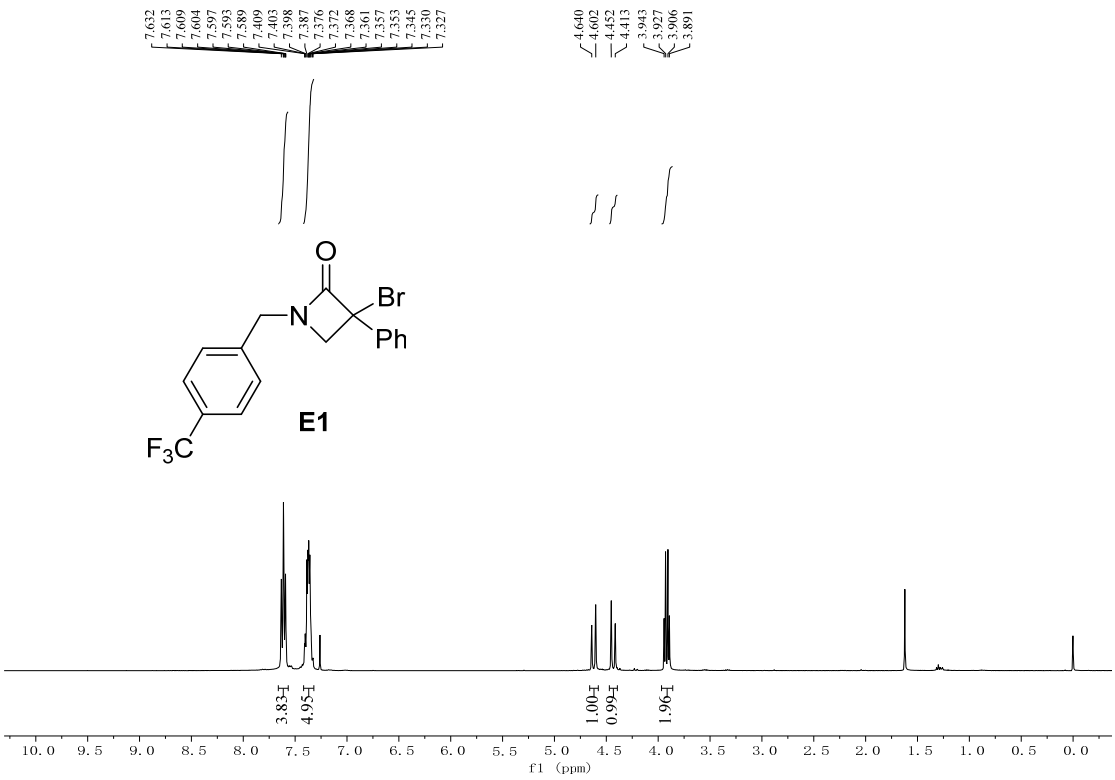
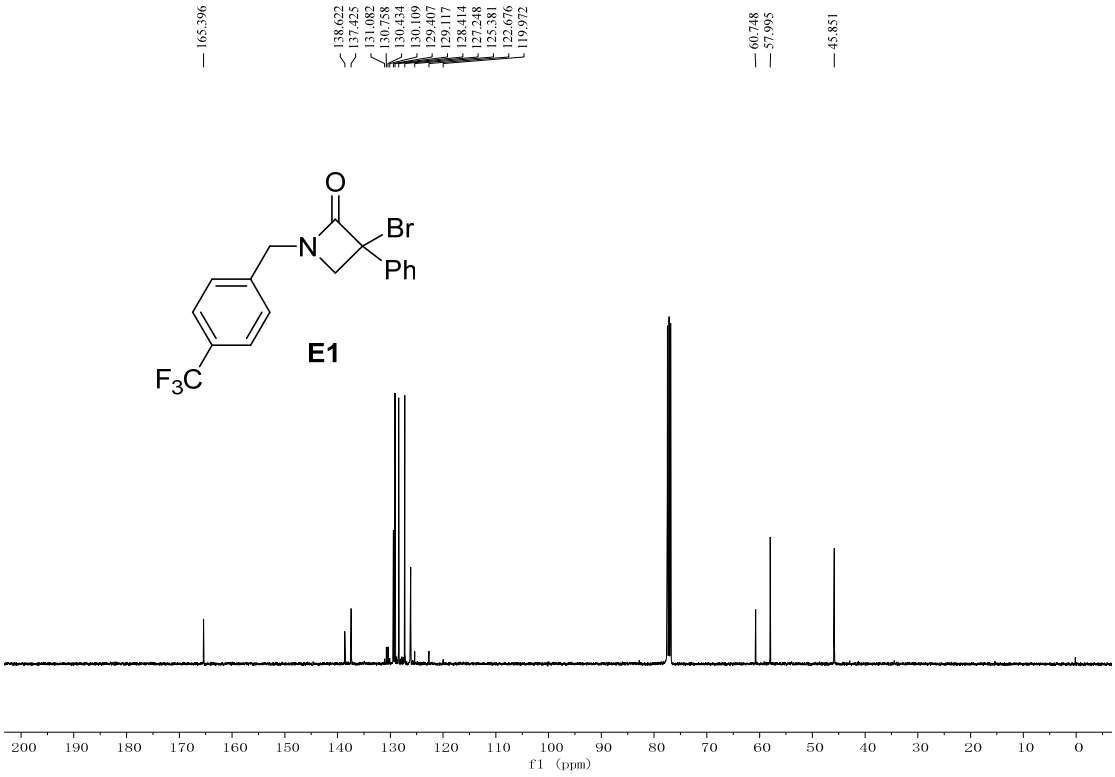
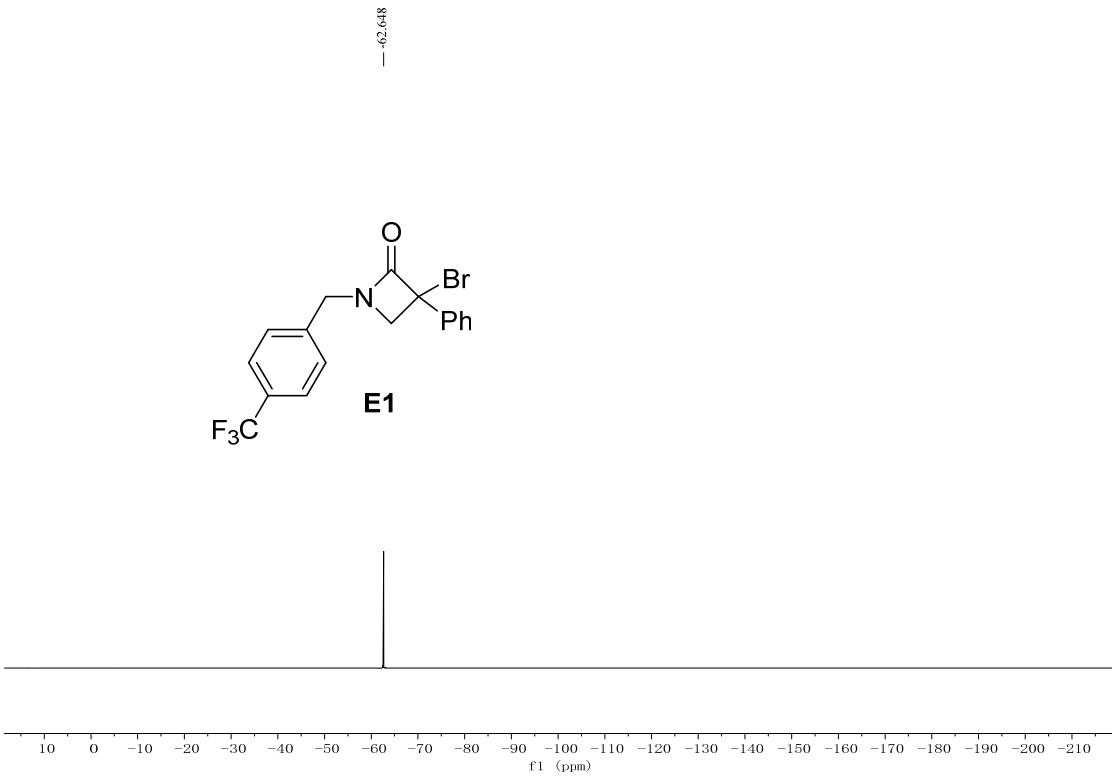
NMR spectra

E1



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Br
N
Ph
E1
F3C
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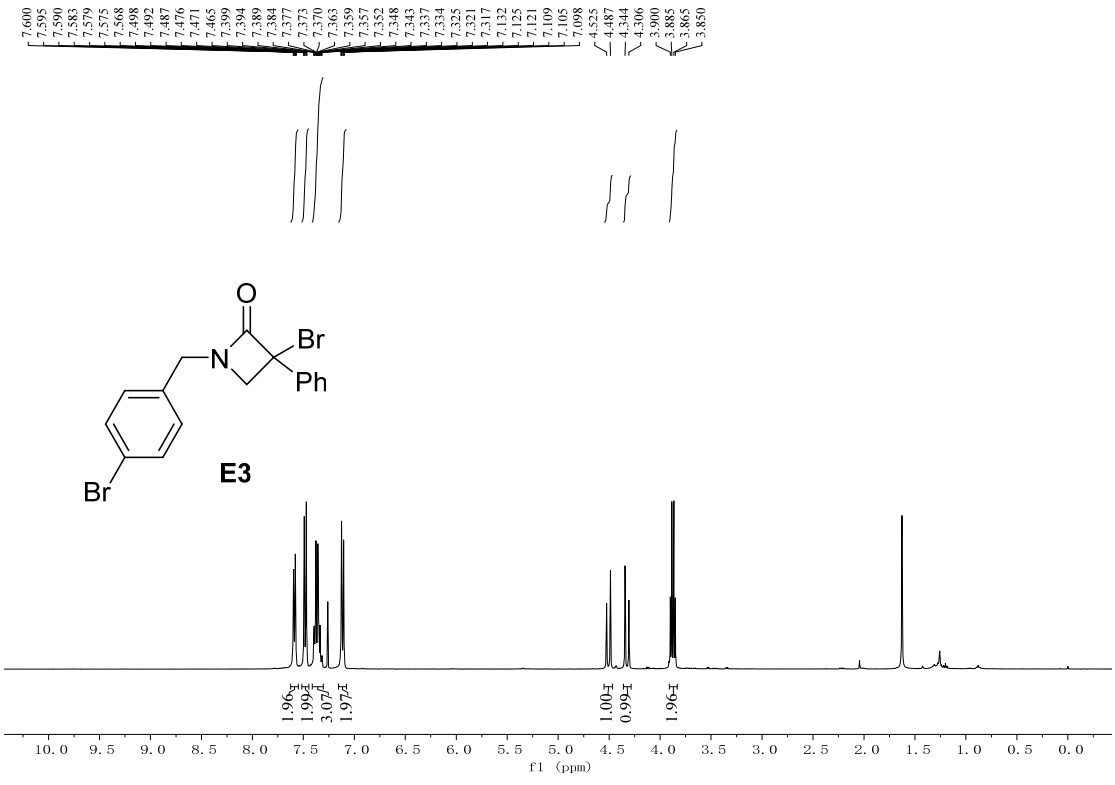
f1 (ppm)

E3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1.96
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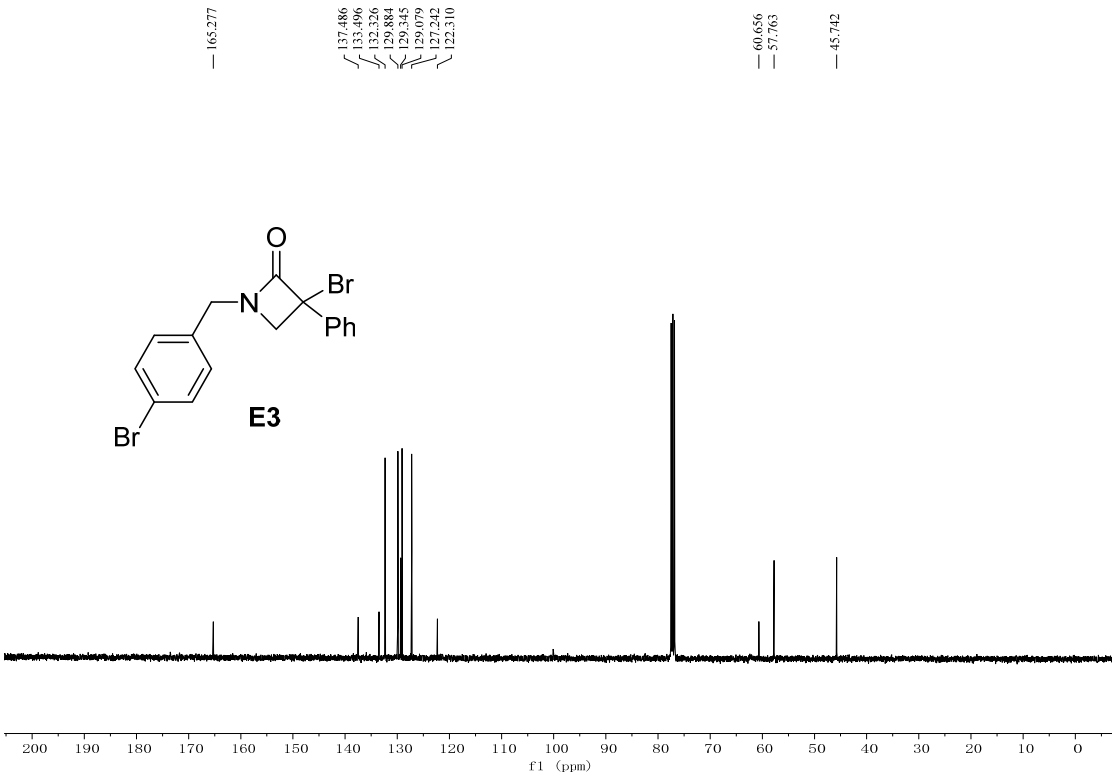
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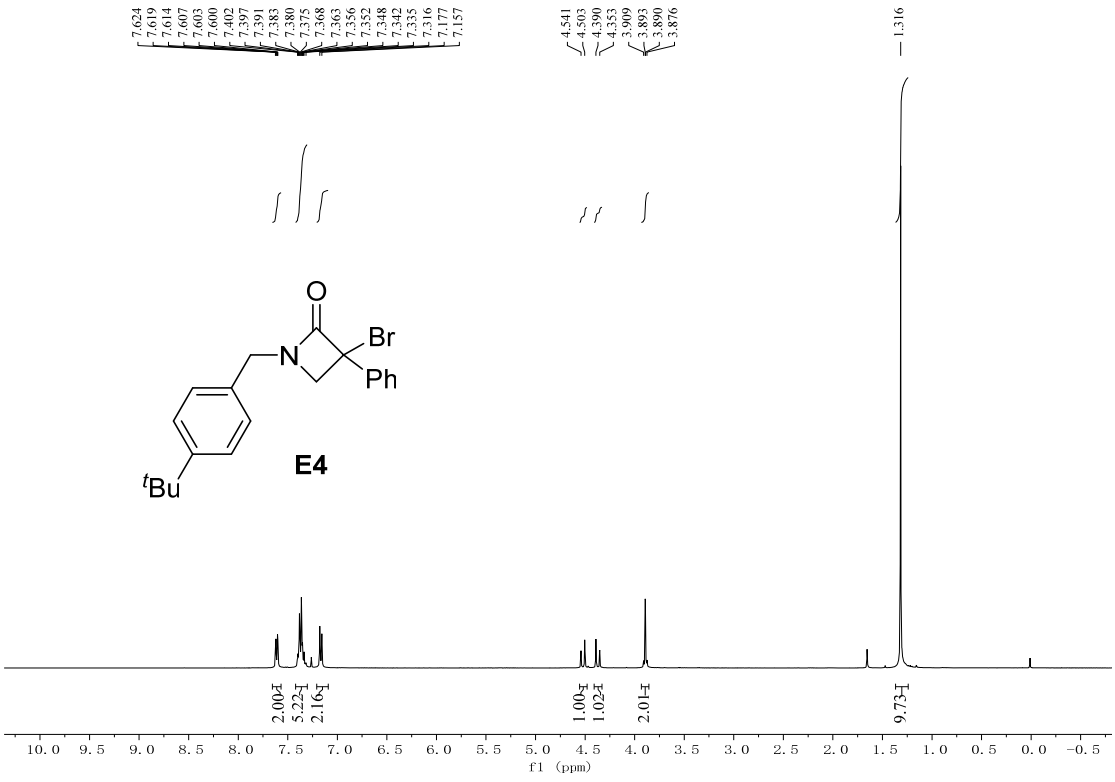
E4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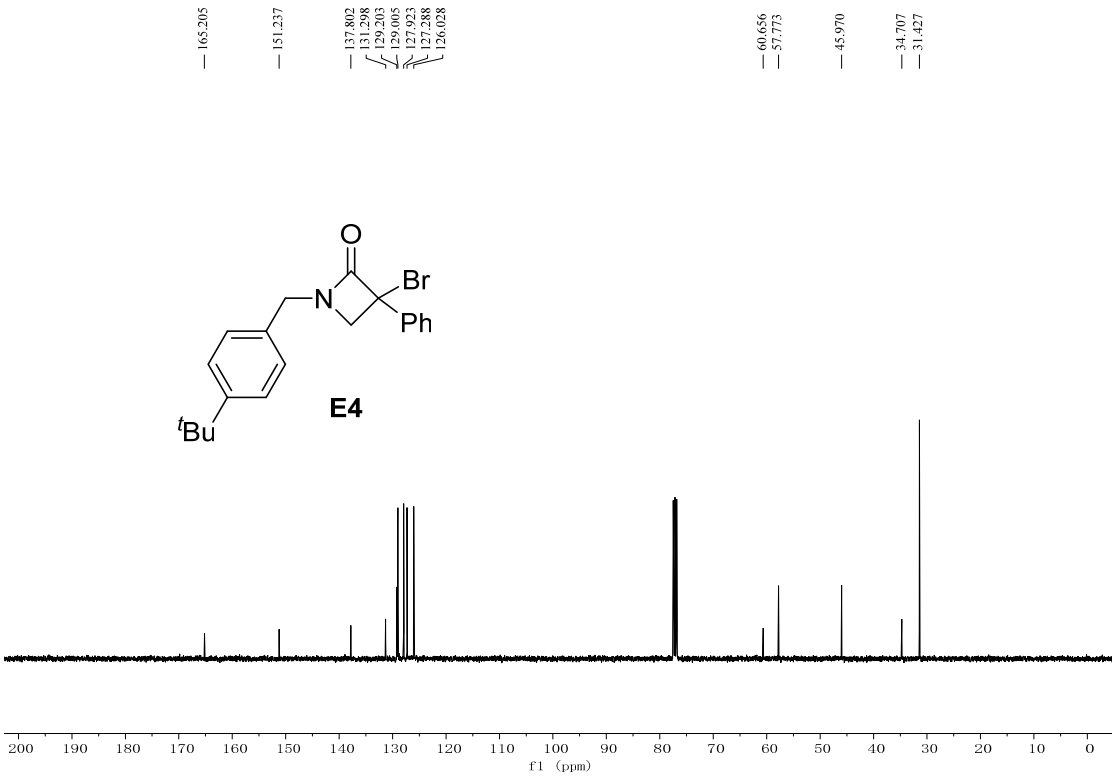
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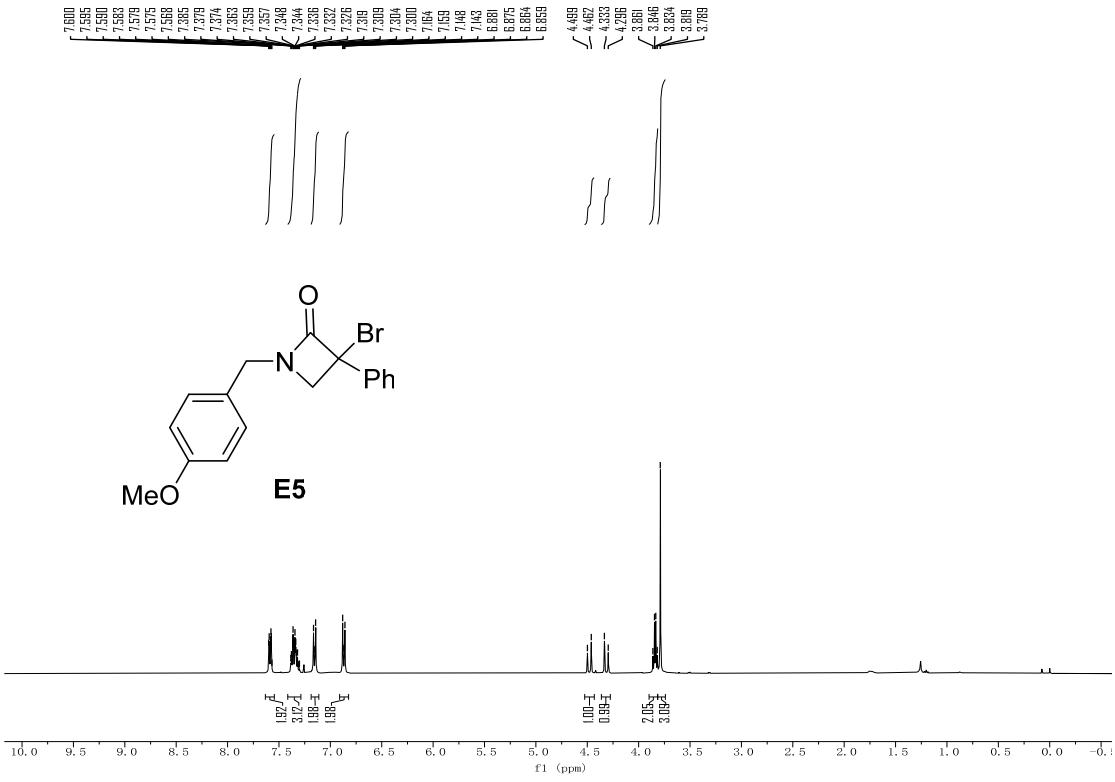
f1 (ppm)

E5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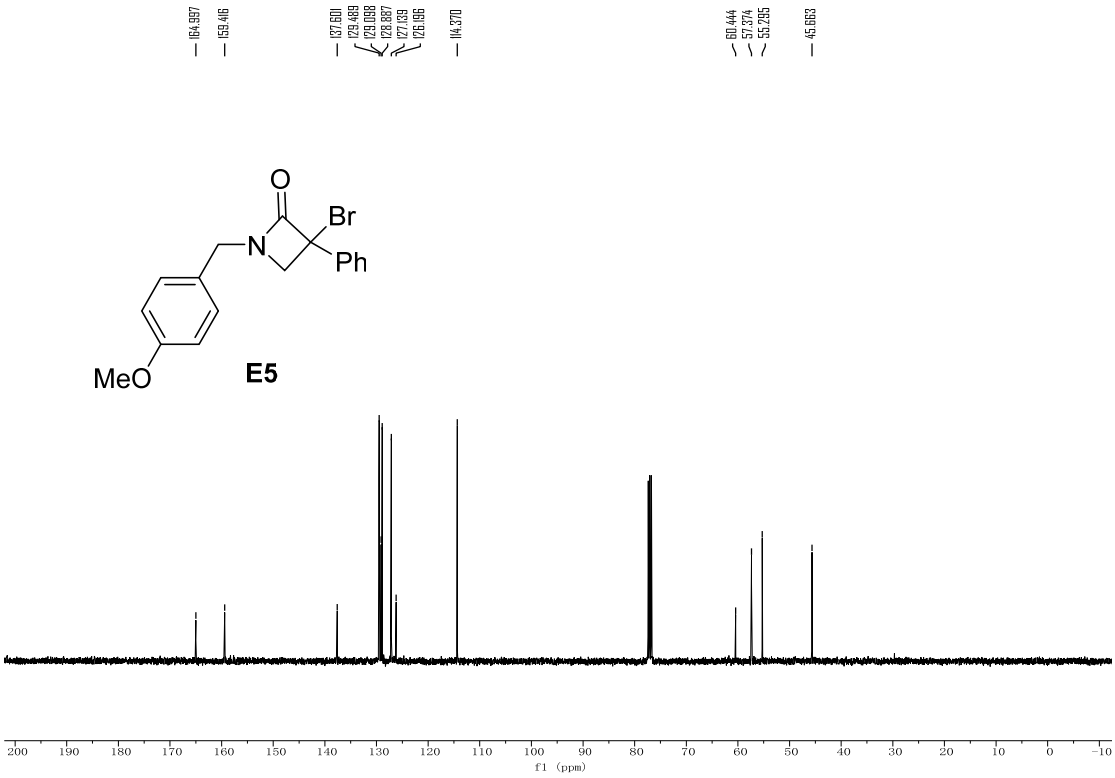
f1 (ppm)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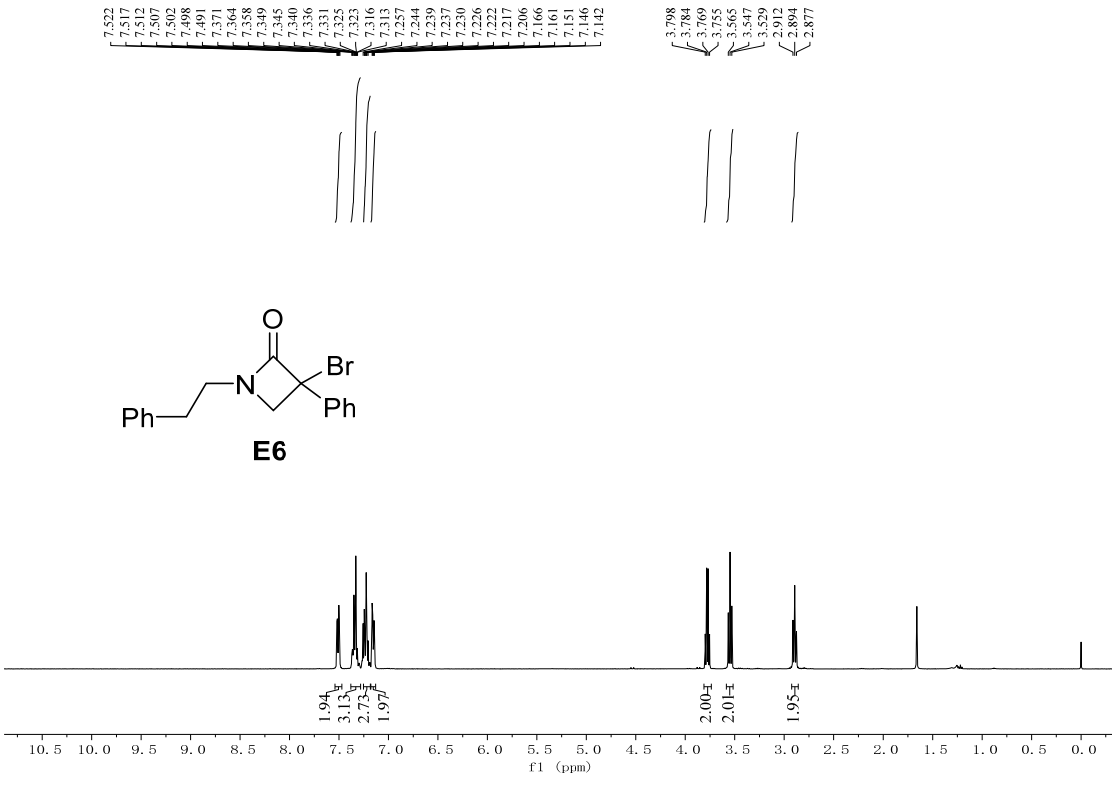
f1 (ppm)

E6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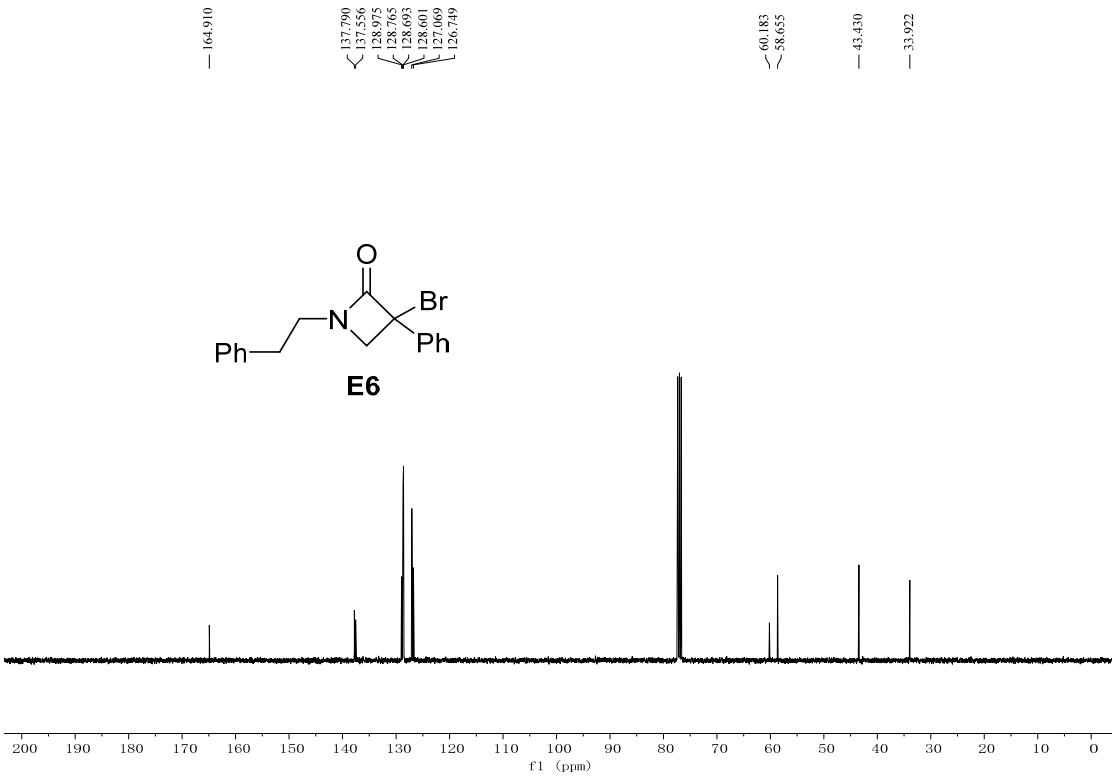
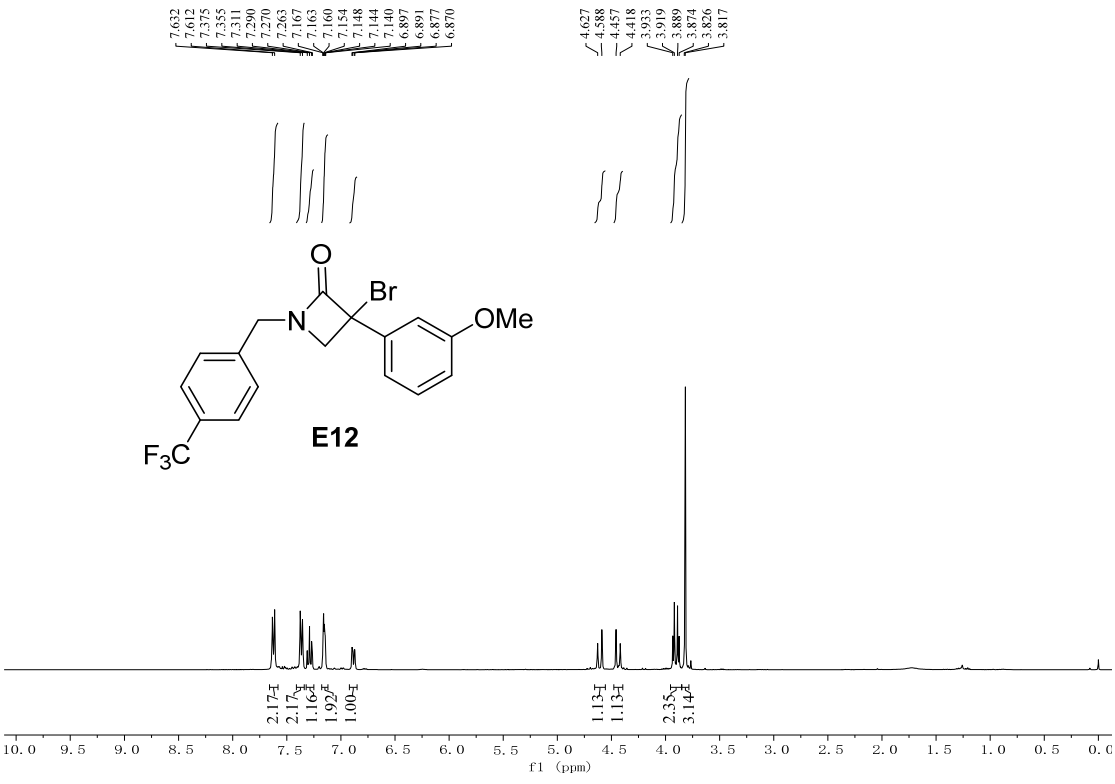
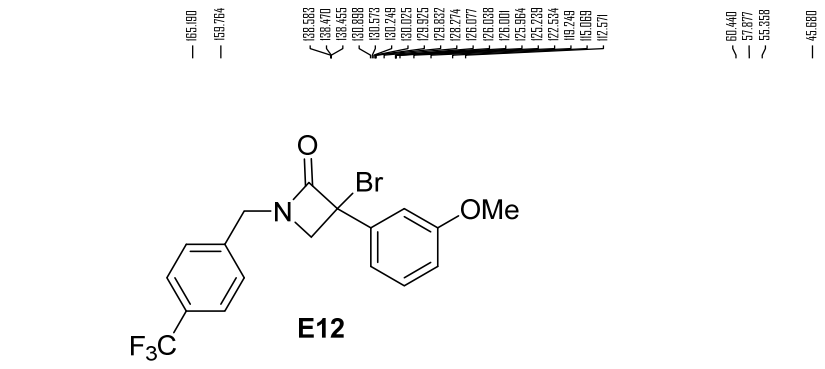
7.226
7.222
7.217
7.206
7.166
7.161
7.151
7.146
7.142
3.798
3.784
3.769
3.755
3.565
3.547
3.529
2.912
2.894
2.877
O
Br
N
Ph
Ph
E6
1.94
3.13
2.73
1.97
2.00
2.01
1.95
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


164.910
137.790
137.556
128.975
128.765
128.693
128.601
127.069
126.749
60.183
58.655
43.430
33.922
O
Br
N
Ph
Ph
E6
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

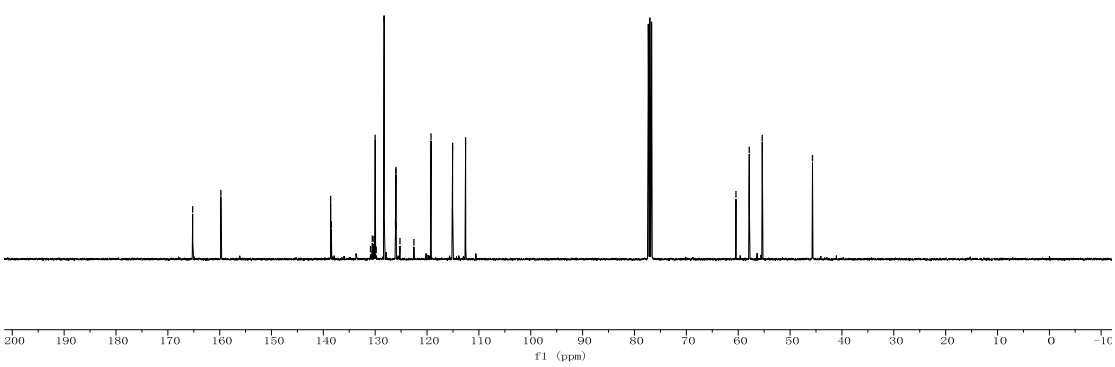
E12

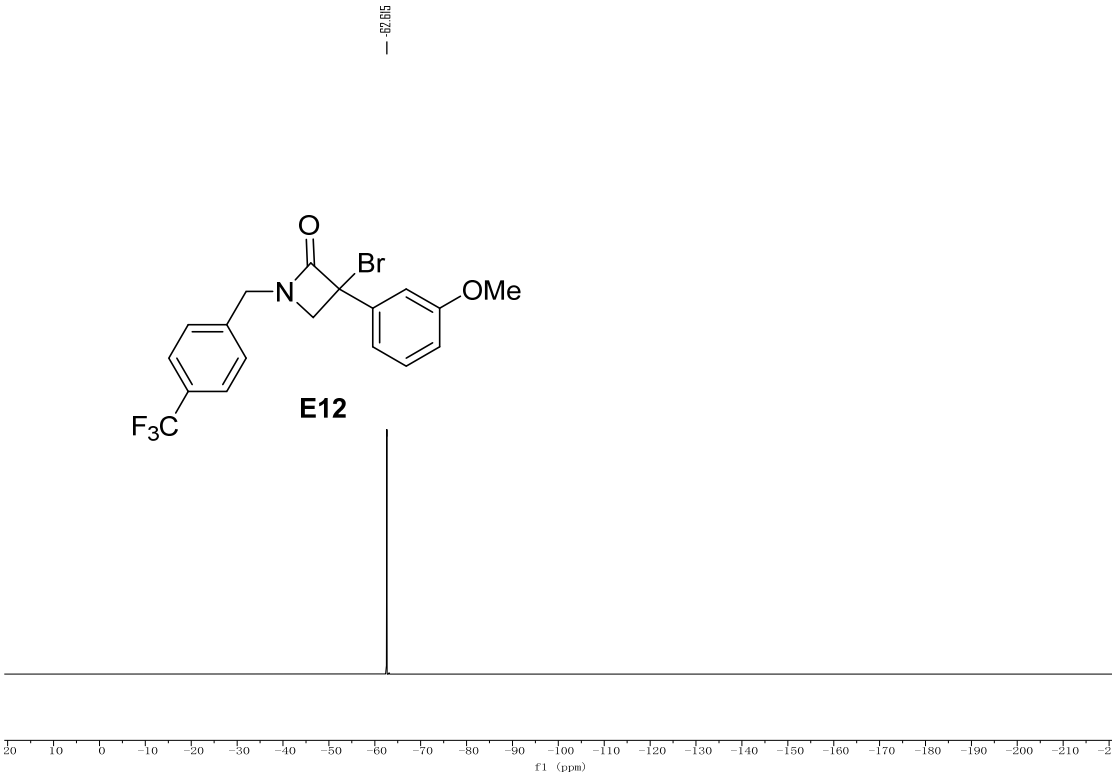

7.632
7.612
7.375
7.355
7.311
7.290
7.270
7.263
7.167
7.163
7.160
7.154
7.148
7.144
7.140
6.897
6.891
6.877
6.870
4.627
4.588
4.457
4.418
3.933
3.919
3.889
3.874
3.826
3.817
O
Br
N
OMe
F3C
E12
2.17
2.17
1.16
1.92
1.00
1.13
1.13
2.35
3.14
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


165.190
159.784
138.583
138.470
138.455
130.888
130.573
130.249
130.025
129.925
129.832
128.274
126.077
126.038
126.001
125.964
125.239
122.534
119.249
115.069
112.571
60.440
57.877
55.358
45.680

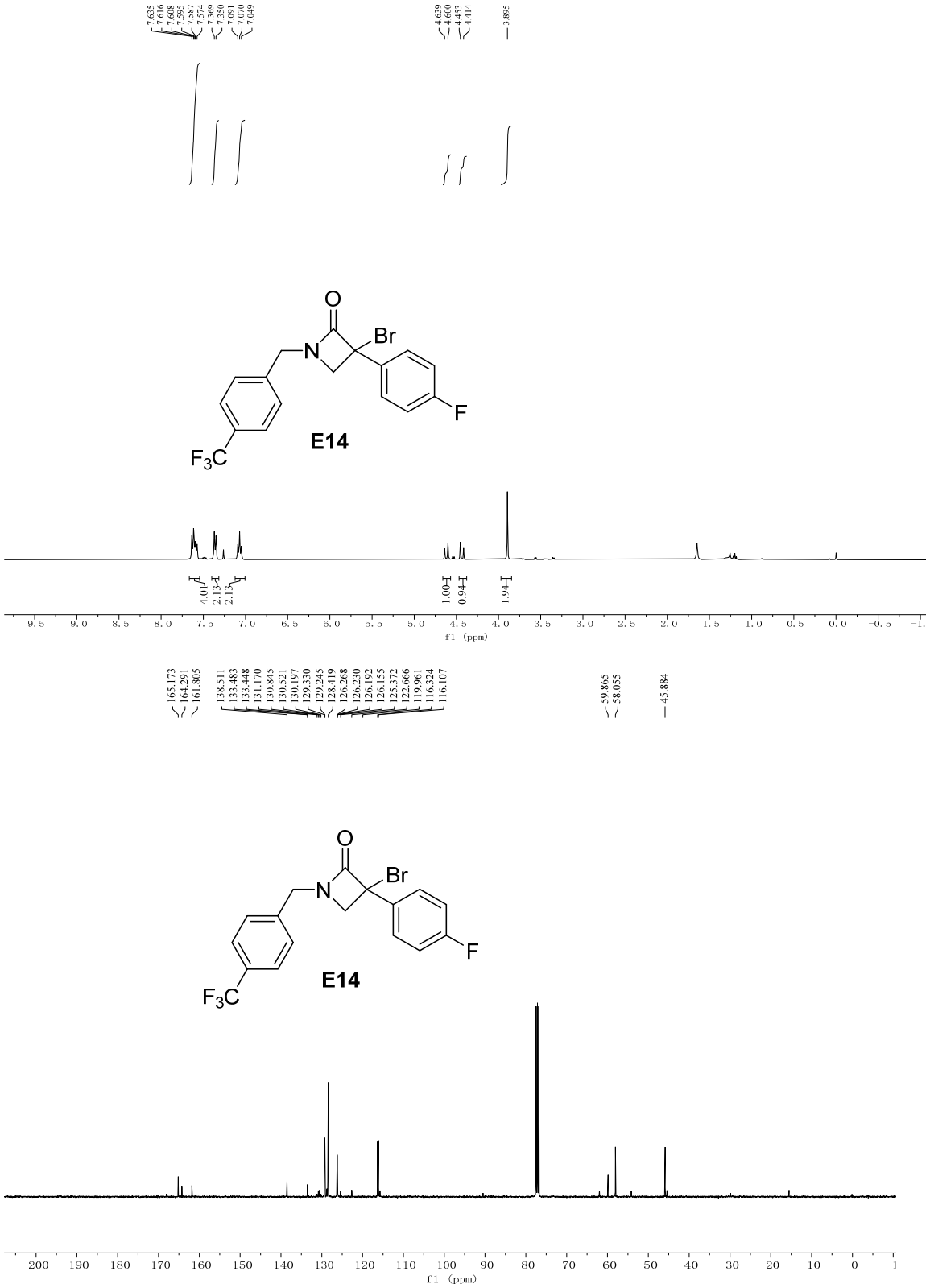
O
Br
N
OMe
F3C

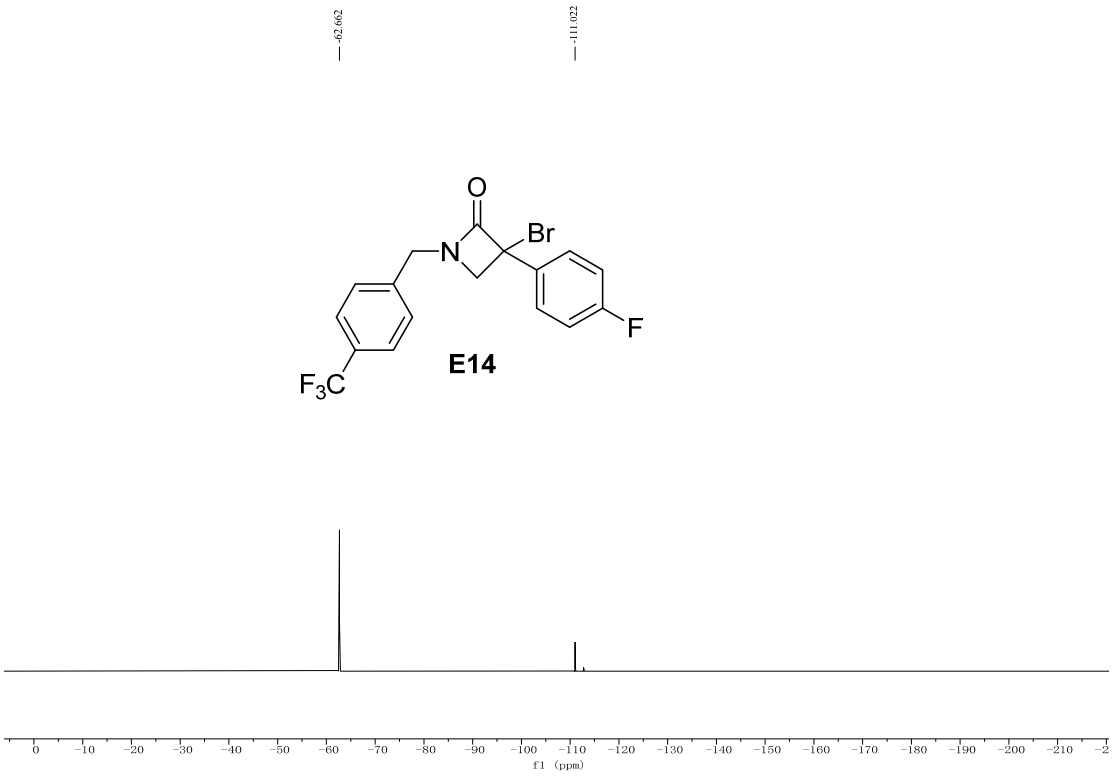
E12


200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

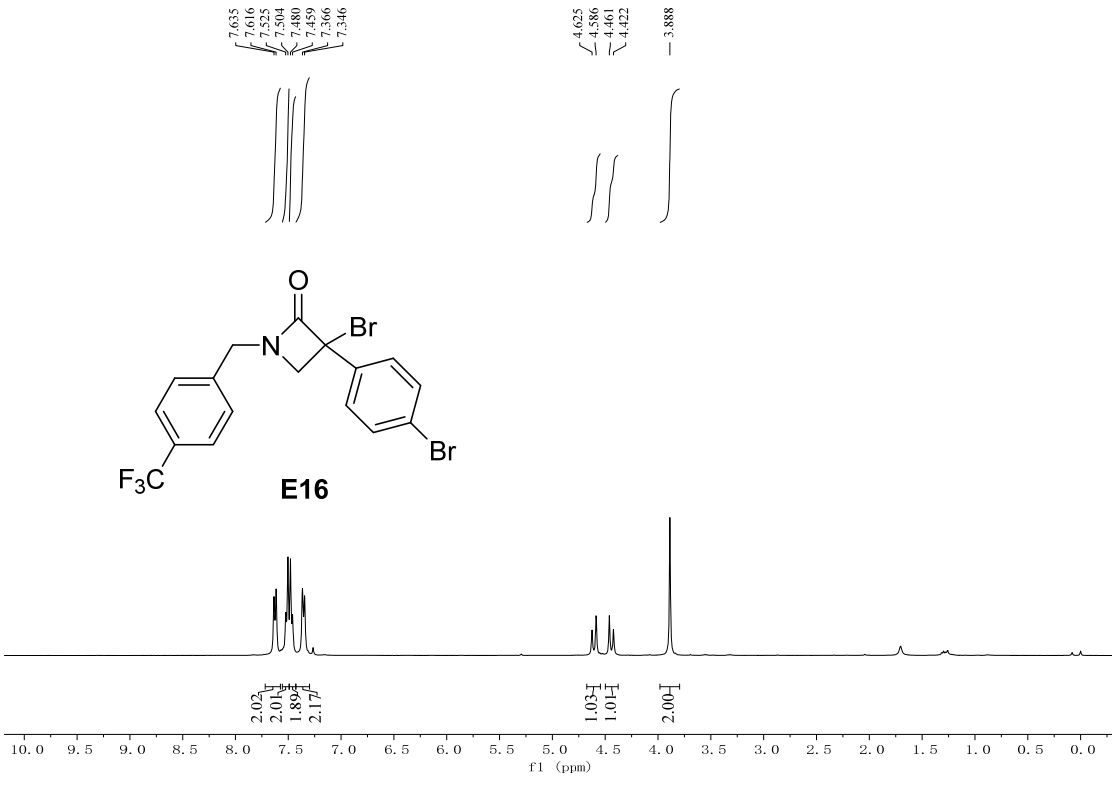

-62.615
O
Br
N
OMe
F3C
E12
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

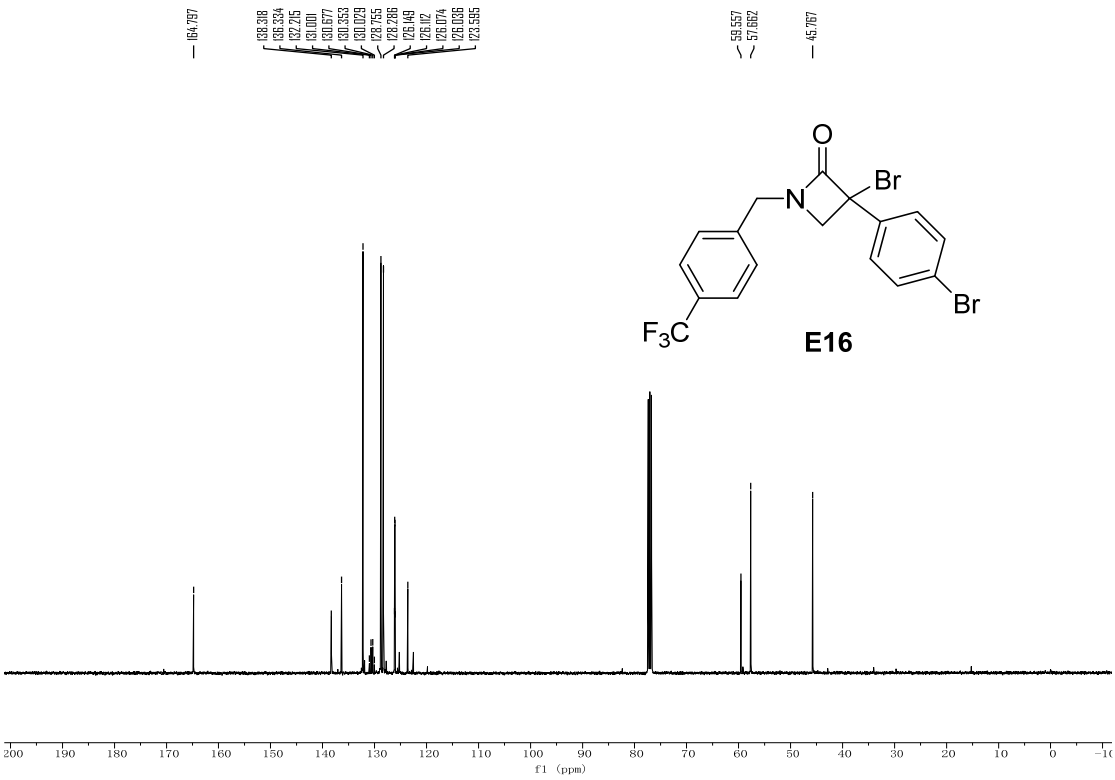
E14

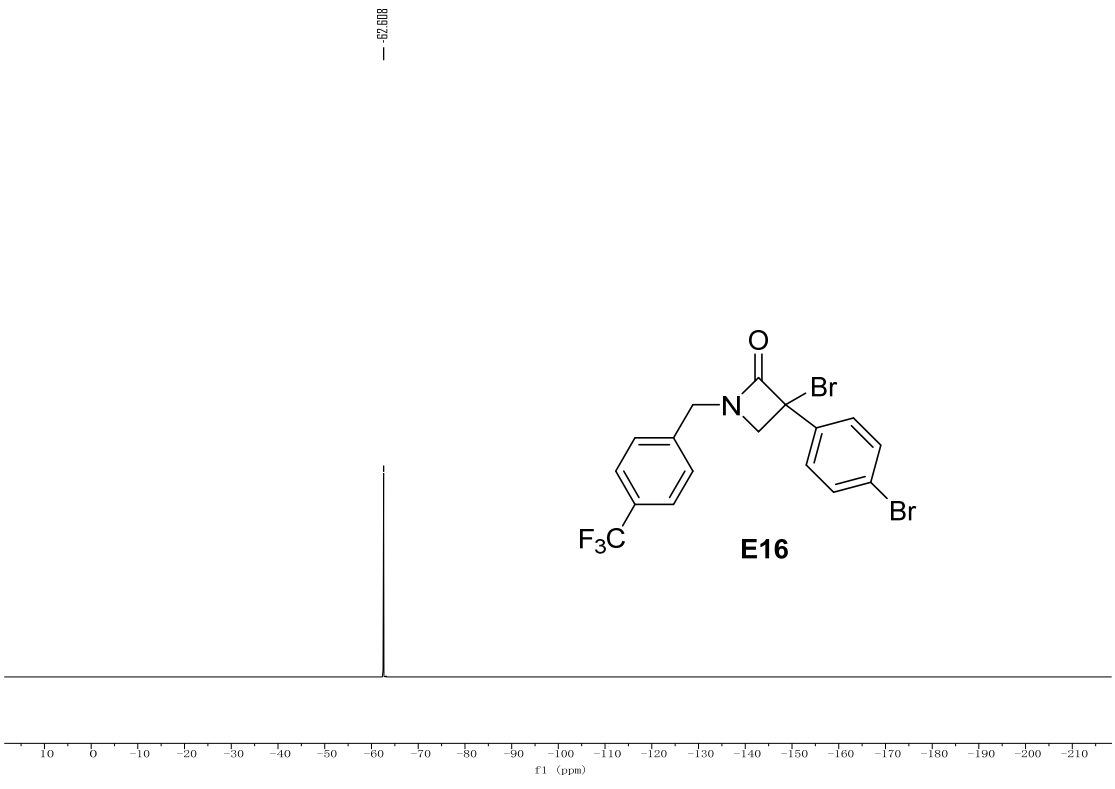

7.635
7.616
7.608
7.595
7.587
7.574
7.369
7.350
7.091
7.070
7.049
4.639
4.600
4.453
4.414
3.895
O
Br
N
F
F3C
E14
4.01
2.13
2.13
1.00
0.94
1.94
f1 (ppm)
165.173
164.291
161.805
138.511
133.483
133.448
131.170
130.845
130.521
130.197
129.330
129.245
128.419
126.268
126.230
126.192
126.155
125.372
122.666
119.961
116.324
116.107
59.865
58.055
45.884
O
Br
N
F
F3C
E14
f1 (ppm)


-62.662
-111.022
O
Br
N
F
F3C
E14
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
−210
f1 (ppm)

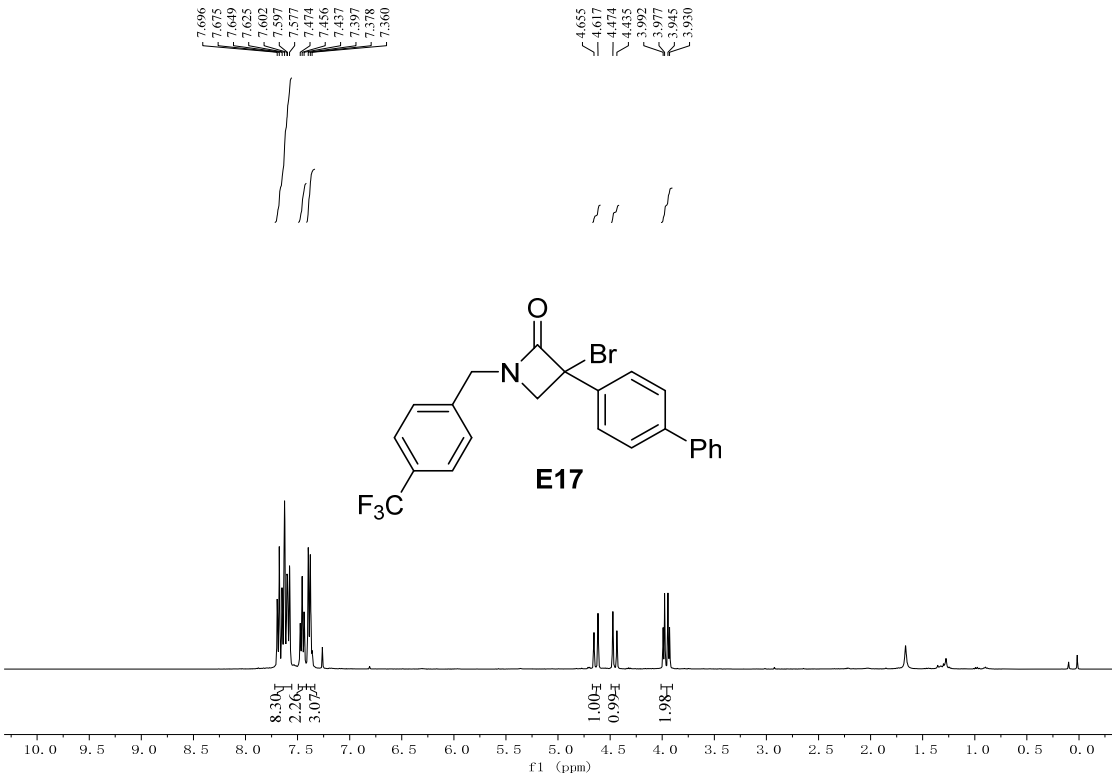
E16

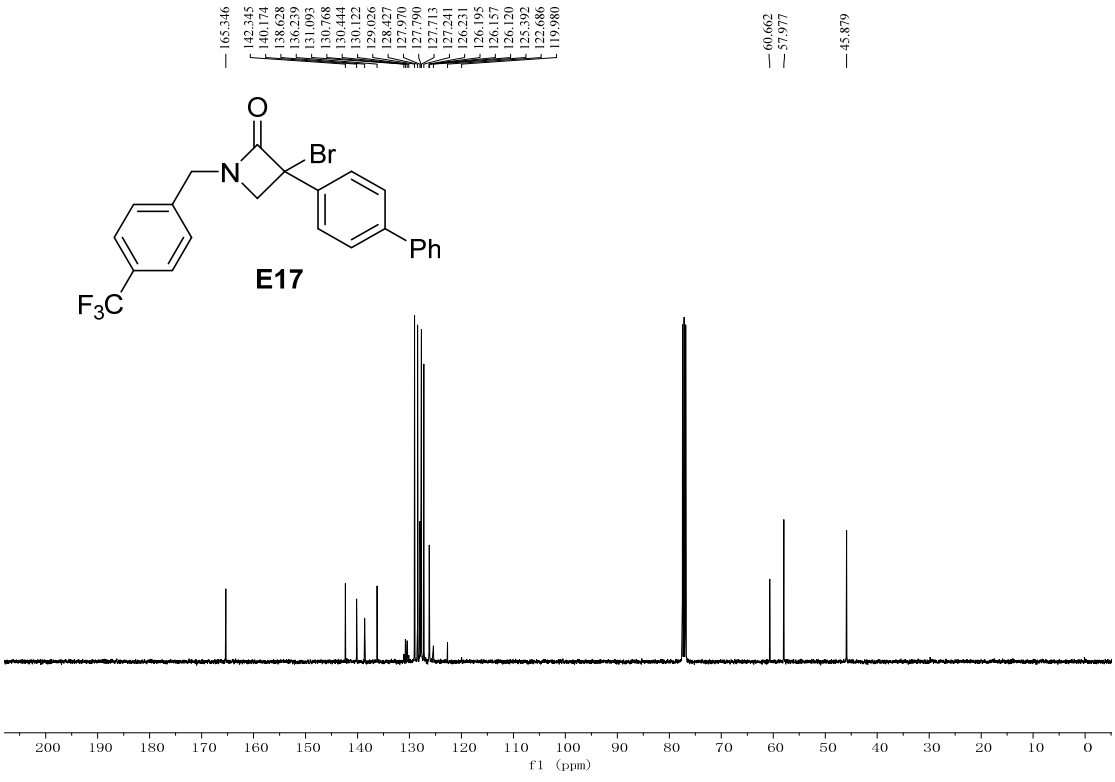

7.635
7.616
7.525
7.504
7.480
7.459
7.366
7.346
4.625
4.586
4.461
4.422
3.888
O
Br
N
Br
F3C
E16
2.02
2.01
1.89
2.17
1.03
1.01
2.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

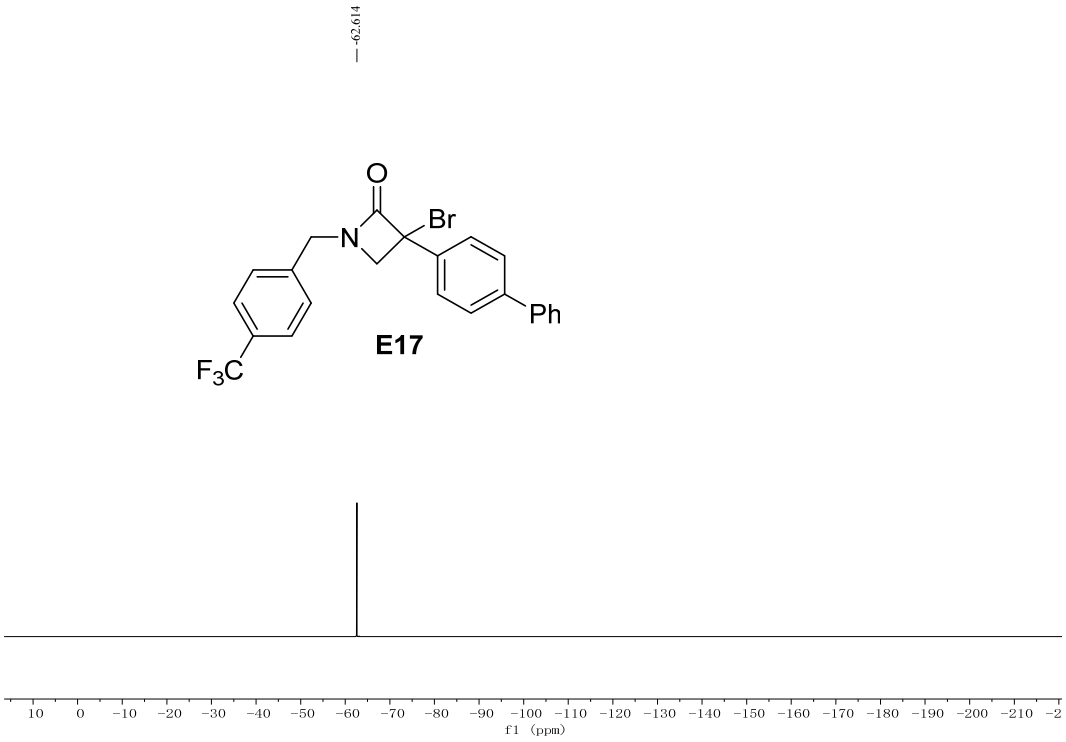

164.797
138.318
136.334
132.215
131.001
130.677
130.353
130.029
129.755
129.286
128.143
126.112
126.074
126.036
123.595
59.557
57.662
45.767
O
Br
N
Br
F3C
E16
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.688
O
Br
N
Br
F3C
E16
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

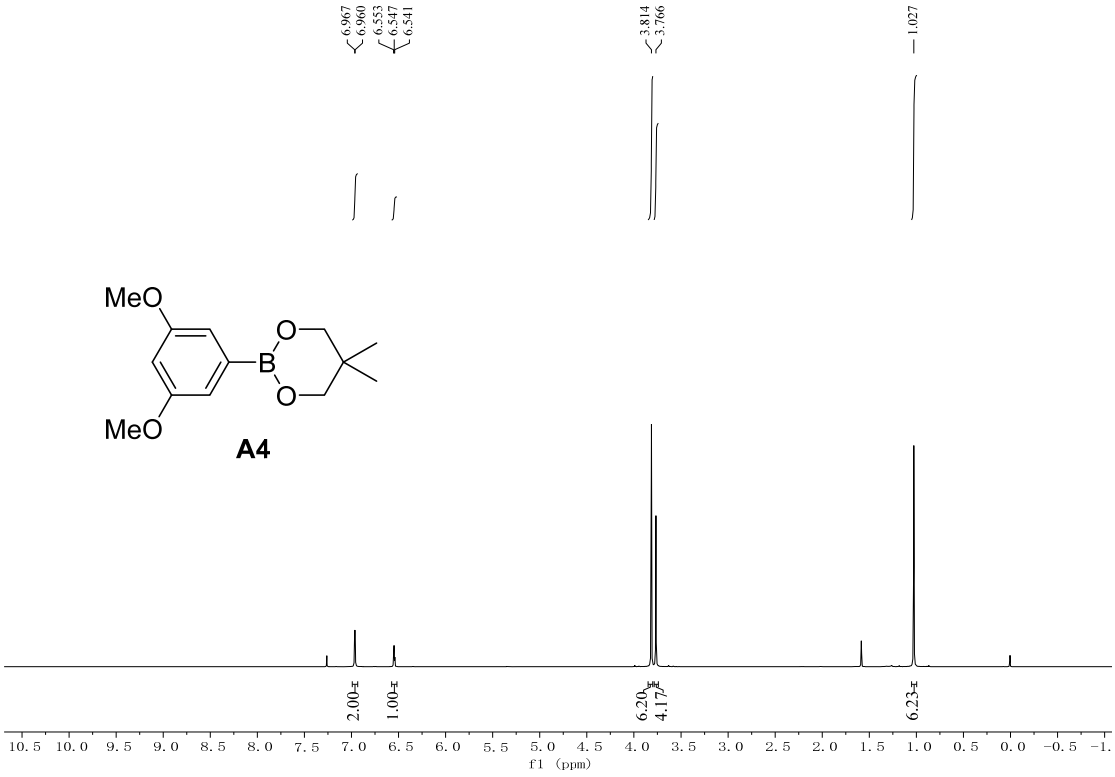
E17

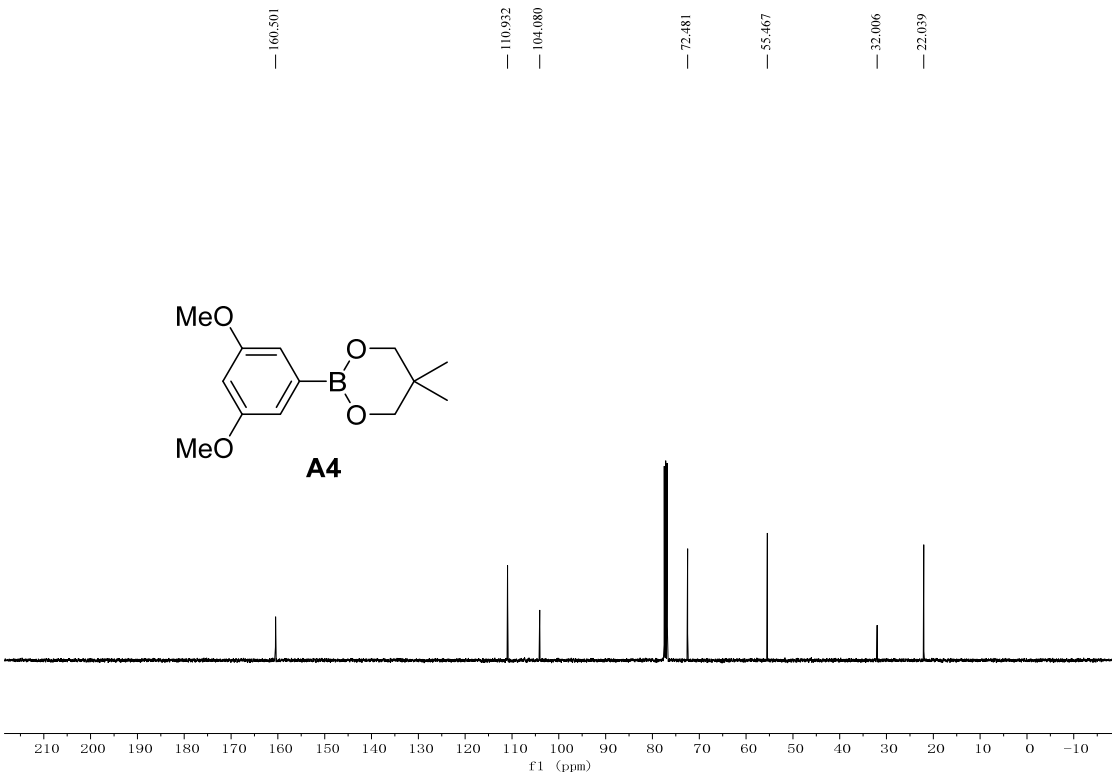

7.696
7.675
7.649
7.625
7.602
7.597
7.577
7.474
7.456
7.437
7.397
7.378
7.360
4.655
4.617
4.474
4.435
3.992
3.977
3.945
3.930
O
N
Br
Ph
F3C
E17
8.30
2.26
3.07
1.00
0.99
1.98
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


165.346
142.345
140.174
138.628
136.239
131.093
130.768
130.444
130.122
129.026
128.427
127.970
127.790
127.713
127.241
126.231
126.195
126.157
126.120
125.392
122.686
119.980
60.662
57.977
45.879
O
N
Br
Ph
F3C
E17
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

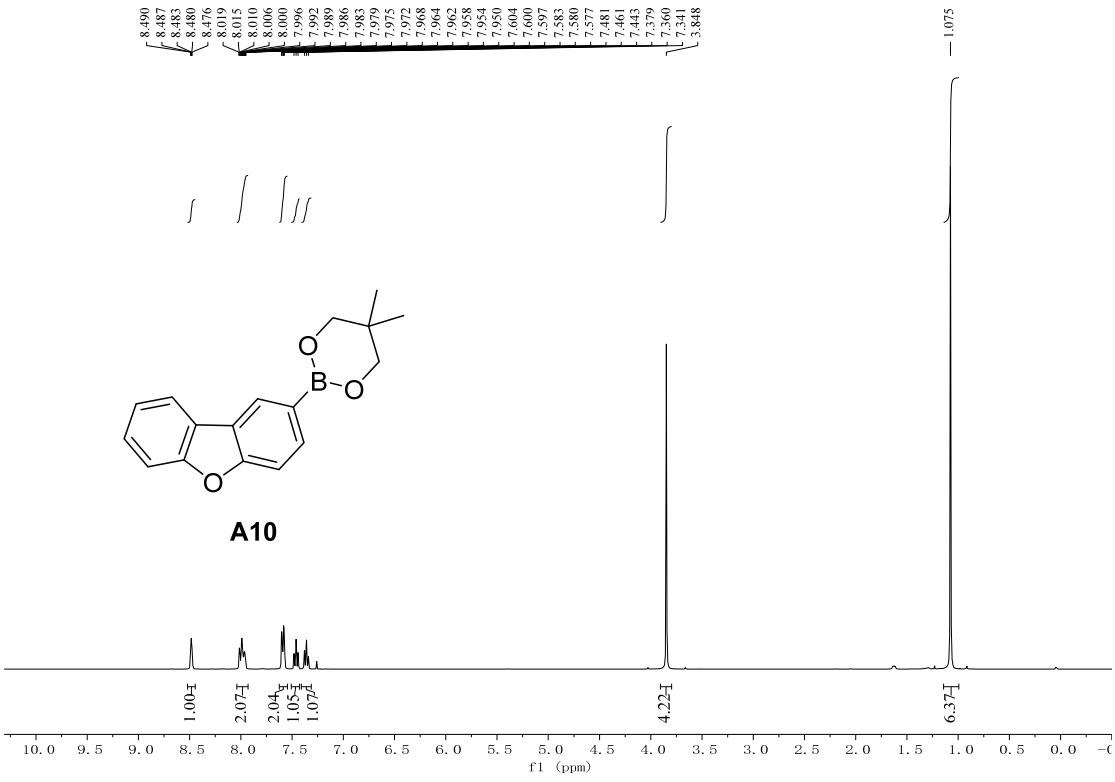

-62.614
O
Br
N
Ph
F3C
E17
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

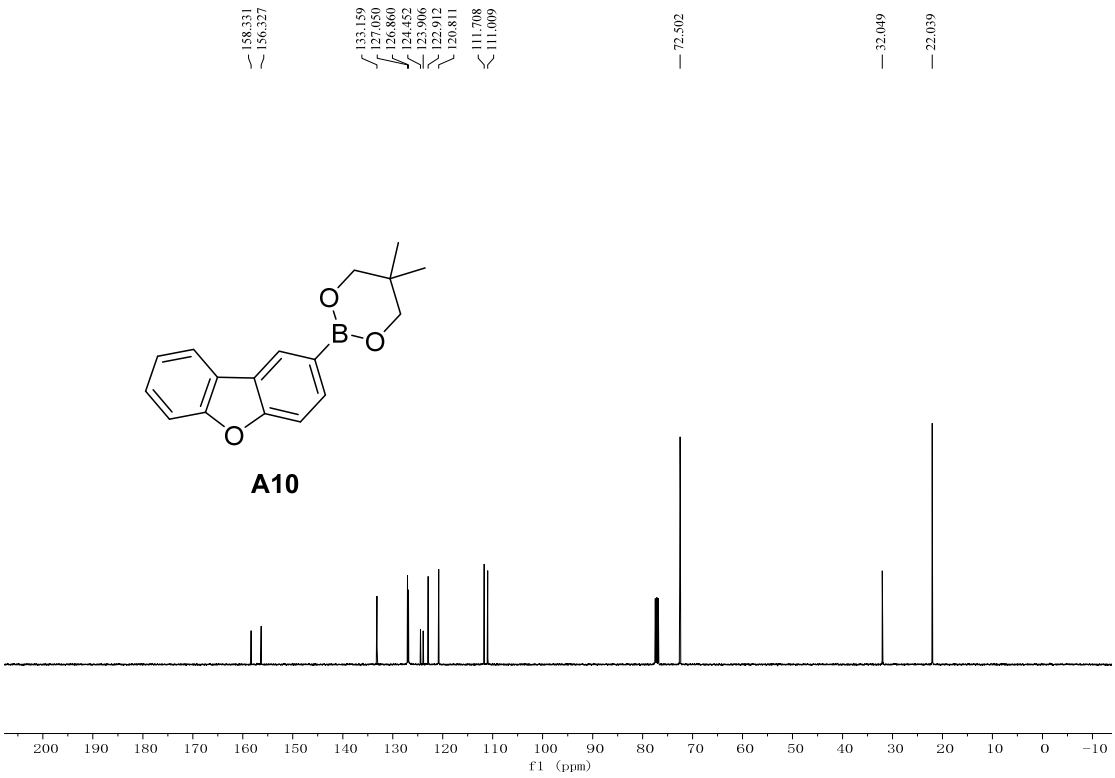
A4


6.967
6.960
6.553
6.547
6.541
3.814
3.766
1.027
MeO
MeO
O
B
O
A4
2.00
1.00
6.20
4.17
6.23
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

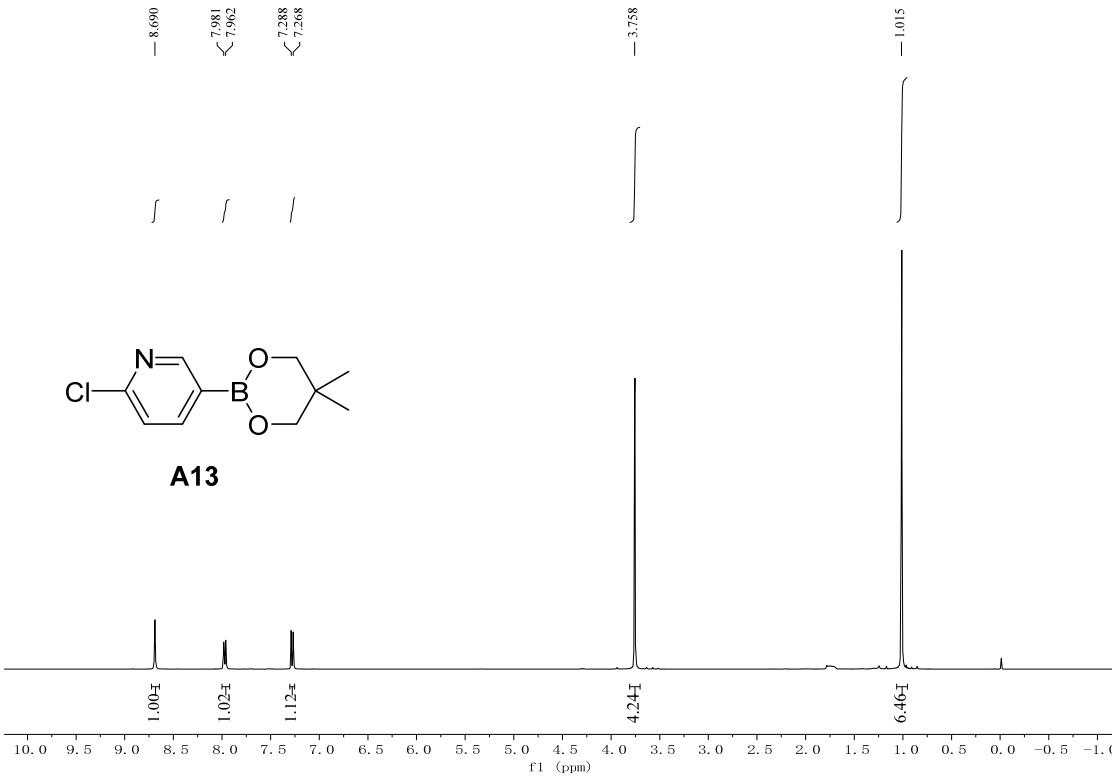

160.501
110.932
104.080
72.481
55.467
32.006
22.039
MeO
MeO
O
B
O
A4
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

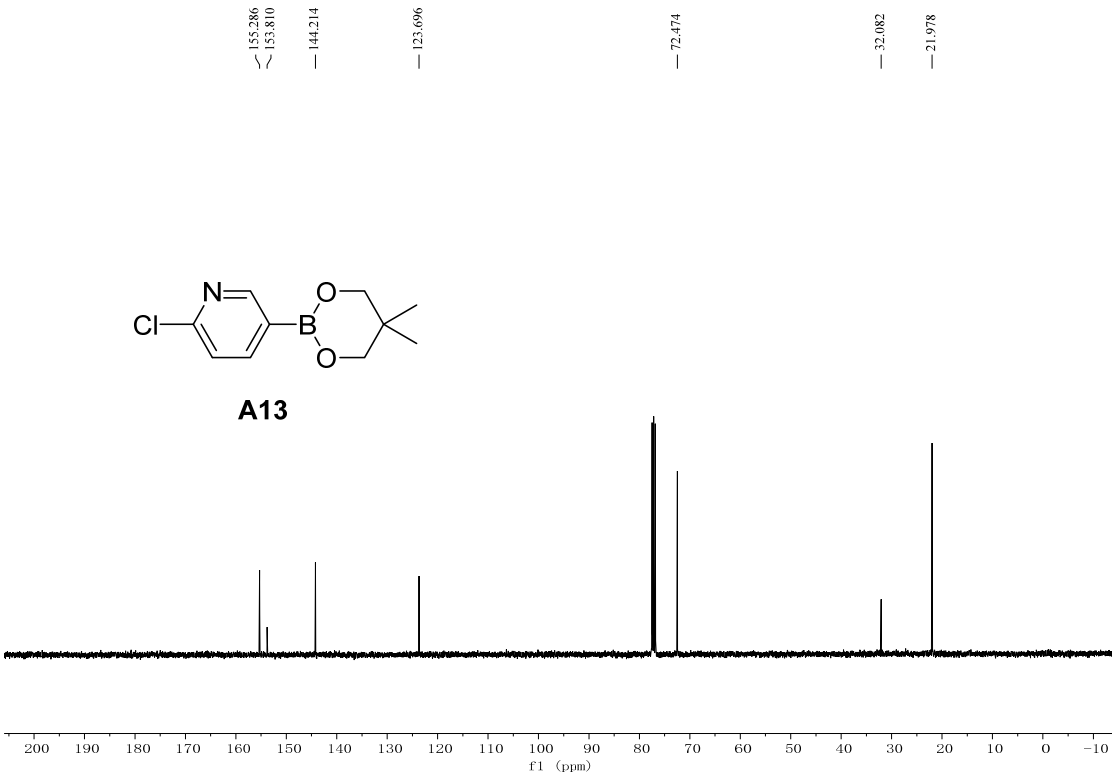
A10


8.490
8.487
8.483
8.480
8.476
8.019
8.015
8.010
8.006
8.000
7.996
7.992
7.989
7.986
7.983
7.979
7.975
7.972
7.968
7.964
7.962
7.958
7.954
7.950
7.604
7.600
7.597
7.583
7.580
7.577
7.481
7.461
7.443
7.379
7.360
7.341
3.848
1.075
O
B
O
O
A10
1.00
2.07
2.04
1.05
1.07
4.22
6.37
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

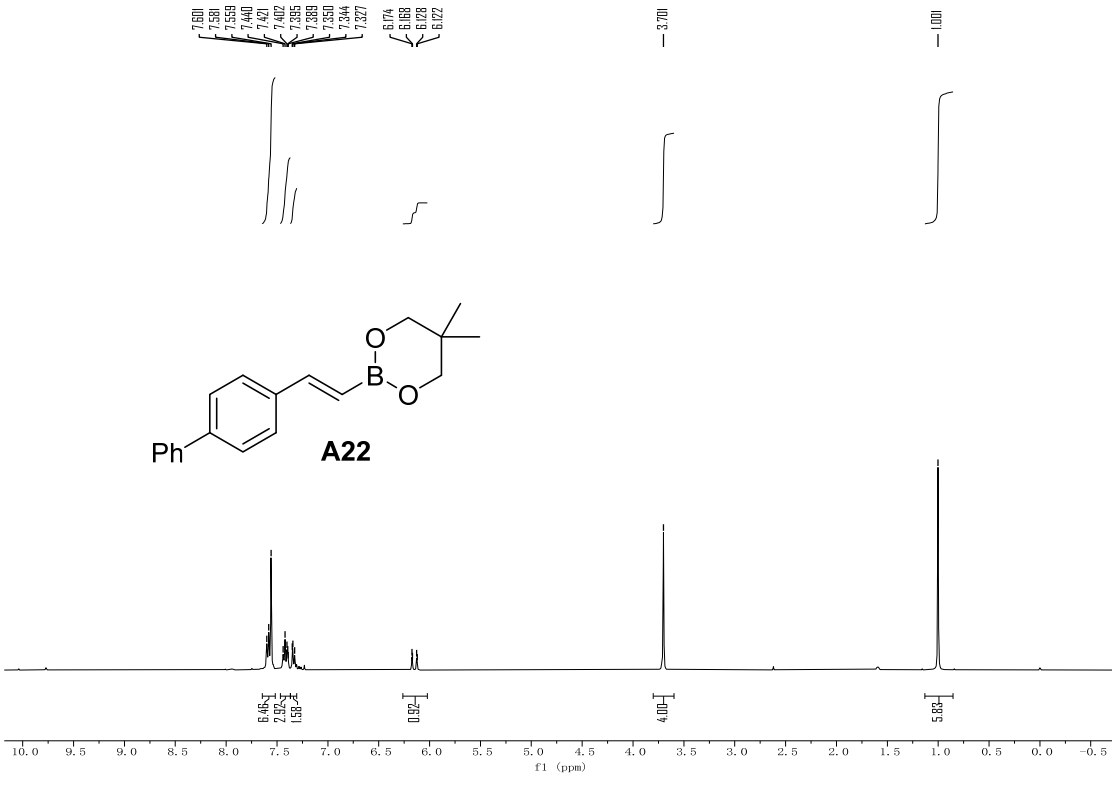

158.331
156.327
133.159
127.050
126.860
124.452
123.906
122.912
120.811
111.708
111.009
72.502
32.049
22.039
A10
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

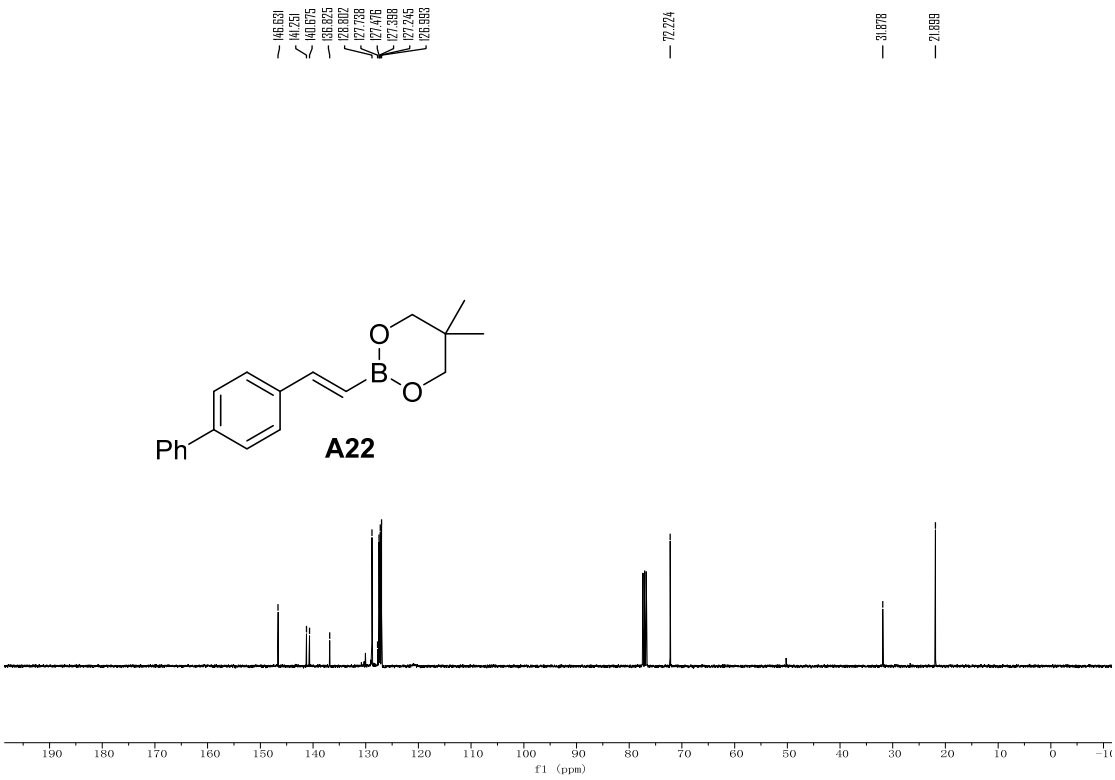
A13


8.690
7.981
7.962
7.288
7.268
3.758
1.015
A13
1.00
1.02
1.12
4.24
6.46
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5
f1 (ppm)

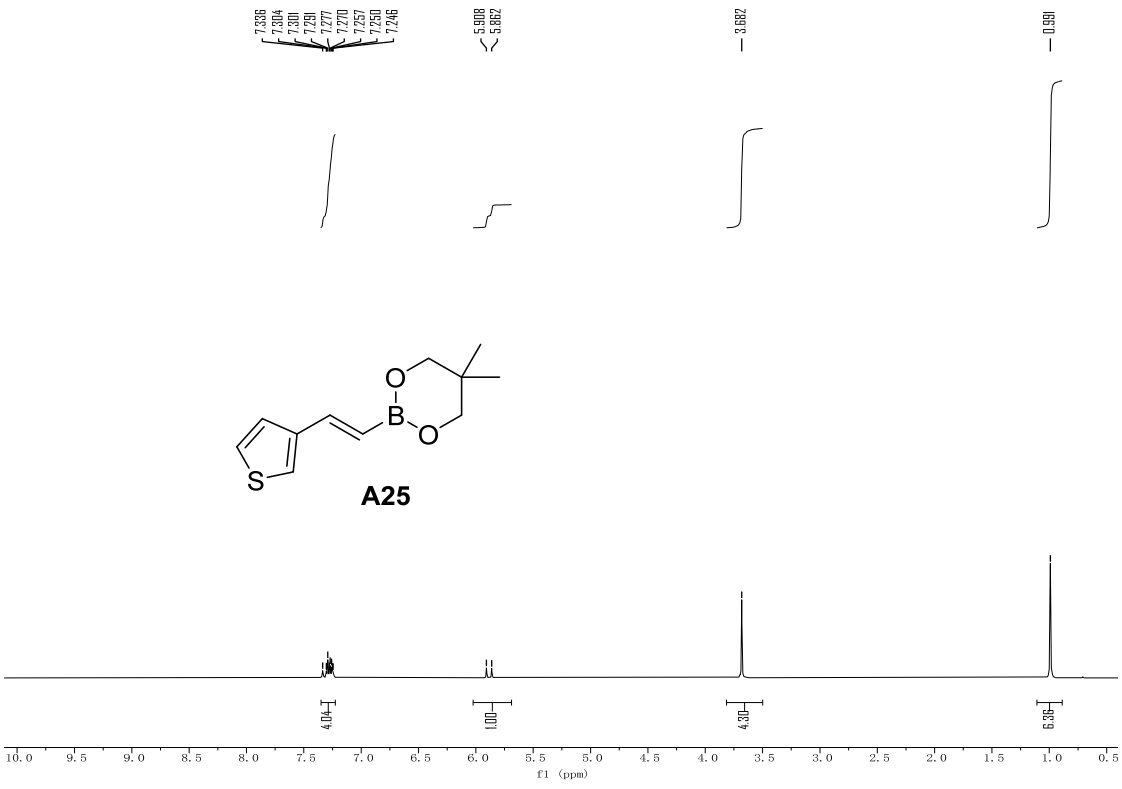

155.286
153.810
144.214
123.696
72.474
32.082
21.978
N
Cl
B
O
O
A13
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

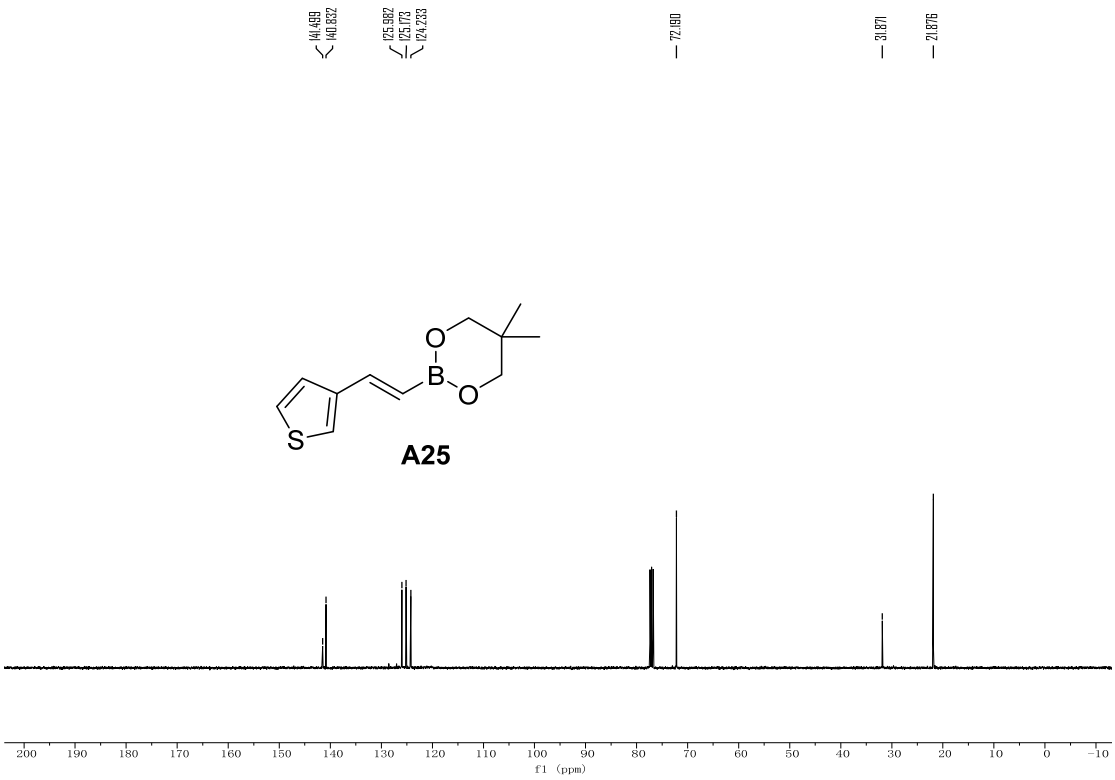
A22


7.601
7.581
7.559
7.440
7.421
7.402
7.385
7.369
7.350
7.344
7.327
6.174
6.158
6.128
6.122
3.701
1.000
O
B
O
Ph
A22
6.46
2.86
1.58
0.92
4.00
5.83
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5
f1 (ppm)

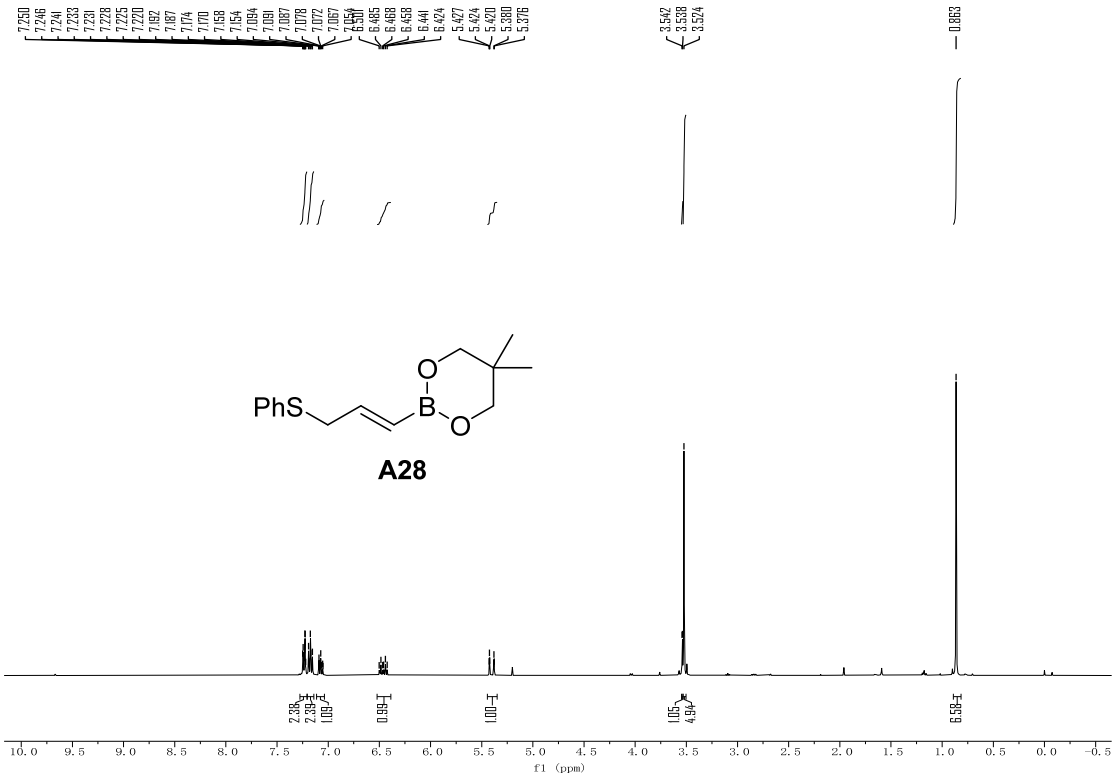

146.631
141.751
140.675
136.825
128.802
127.738
127.476
127.398
127.245
126.993
72.224
31.878
21.899
O
B
O
Ph
A22
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

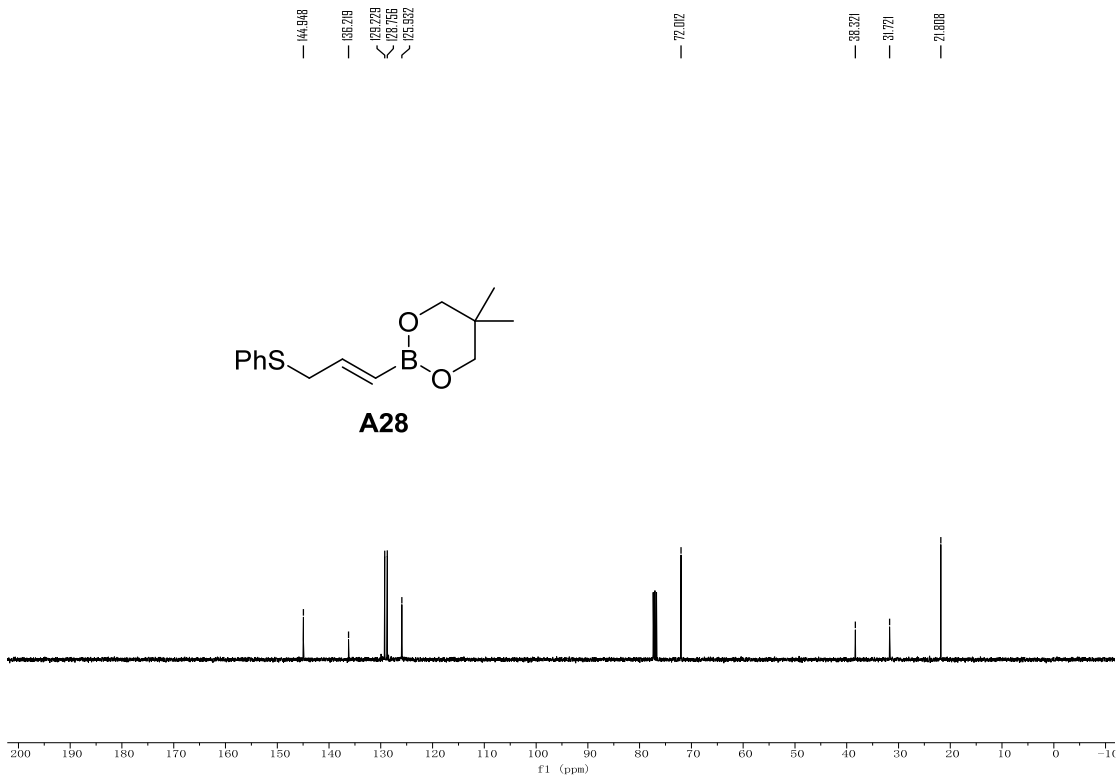
A25


7.336
7.304
7.301
7.291
7.277
7.270
7.257
7.250
7.246
5.910
5.862
3.682
0.991
O
B
O
S
A25
4.04
1.00
4.30
6.35
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

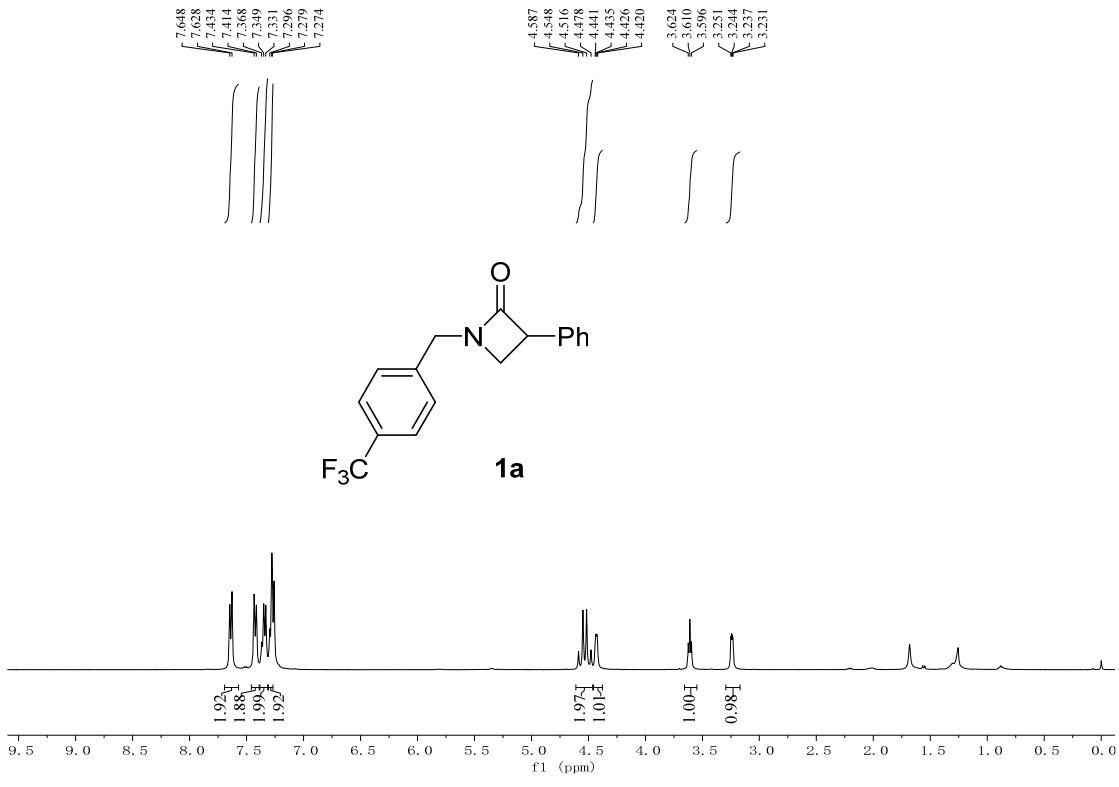

141.489
140.832
125.982
125.173
124.233
72.190
31.871
21.876
A25
f1 (ppm)

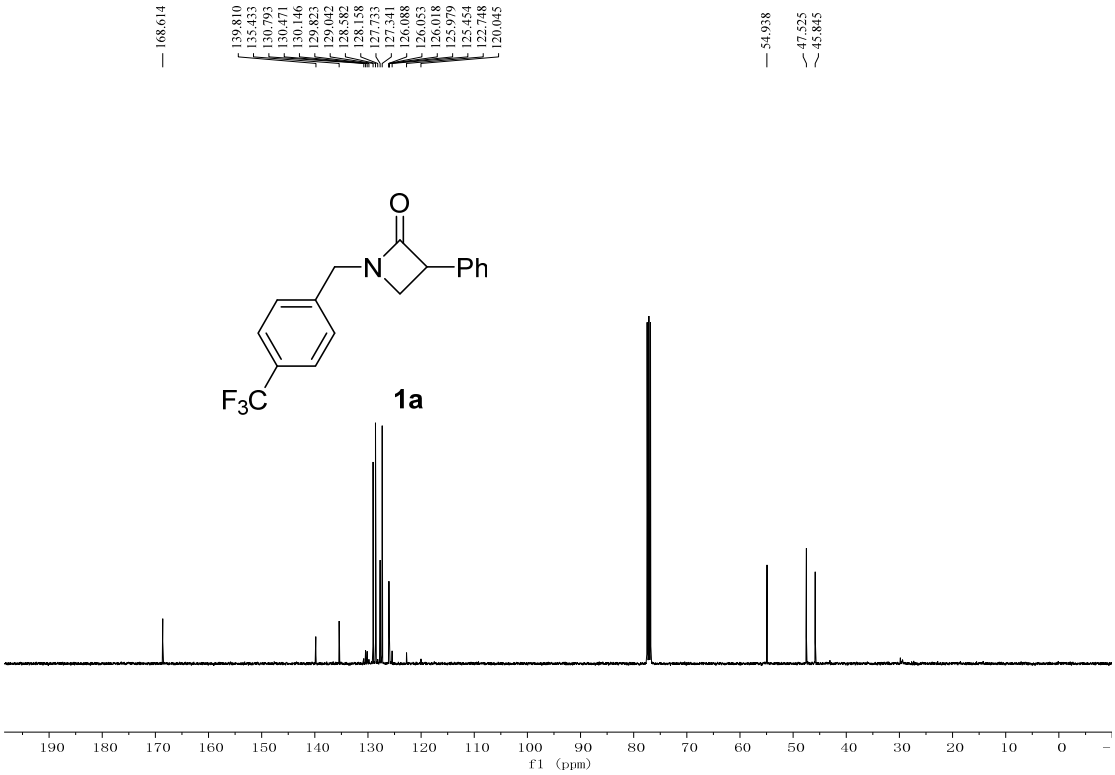
A28

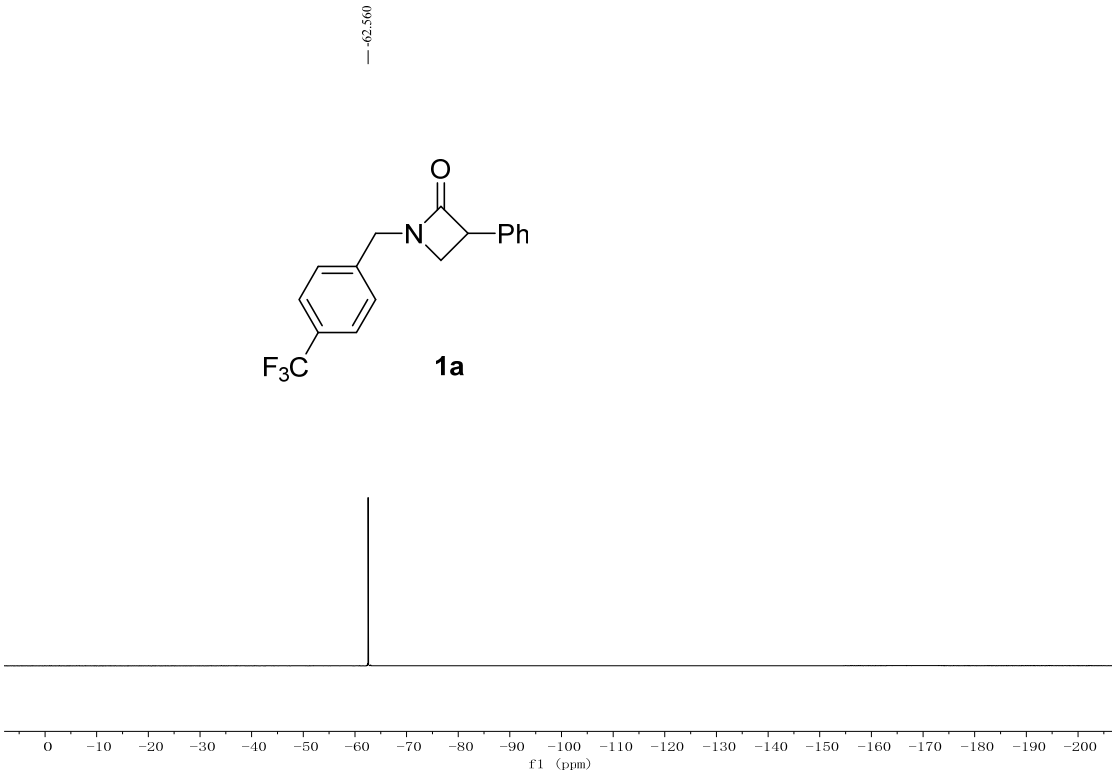

7.250
7.246
7.241
7.233
7.231
7.228
7.225
7.220
7.192
7.187
7.174
7.170
7.158
7.154
7.094
7.091
7.087
7.078
7.072
7.067
7.054
6.501
6.495
6.468
6.458
6.441
6.424
5.427
5.424
5.420
5.380
5.376
3.542
3.538
3.524
0.863
PhS
A28
2.38
2.39
1.09
0.89
1.00
1.05
4.94
6.58
f1 (ppm)


144.948
136.219
129.229
128.756
125.832
72.012
38.321
31.721
21.808
PhS
O
B
O
A28
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

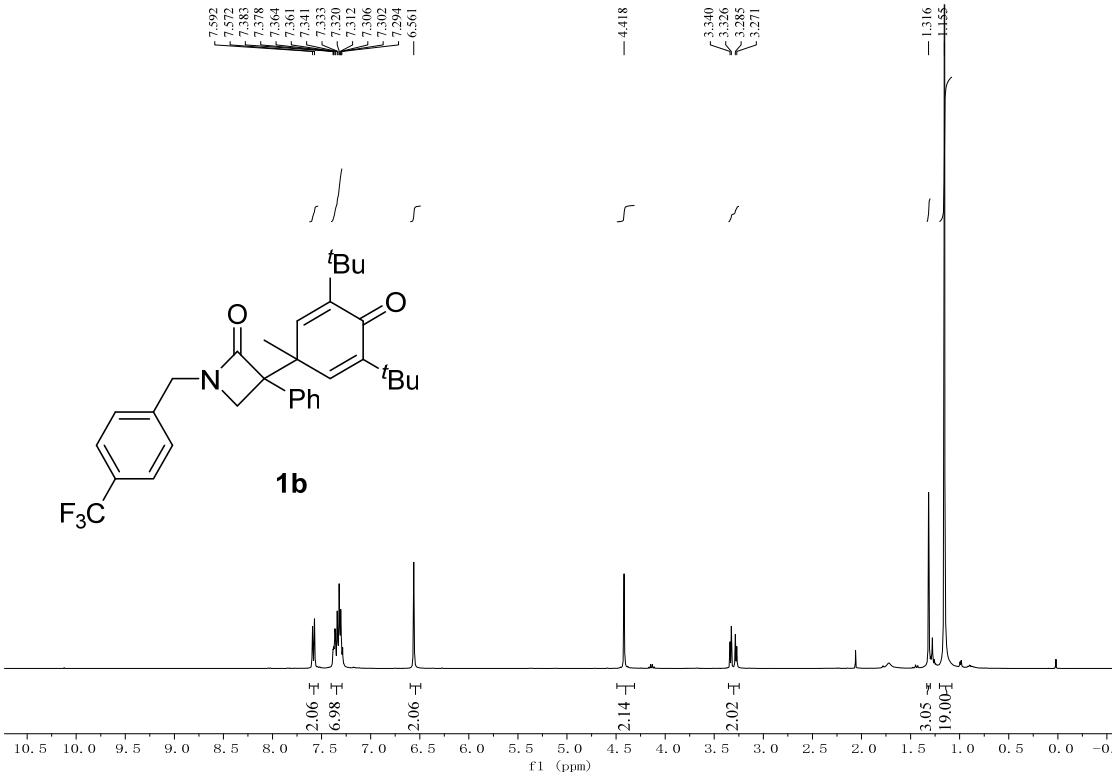
1a

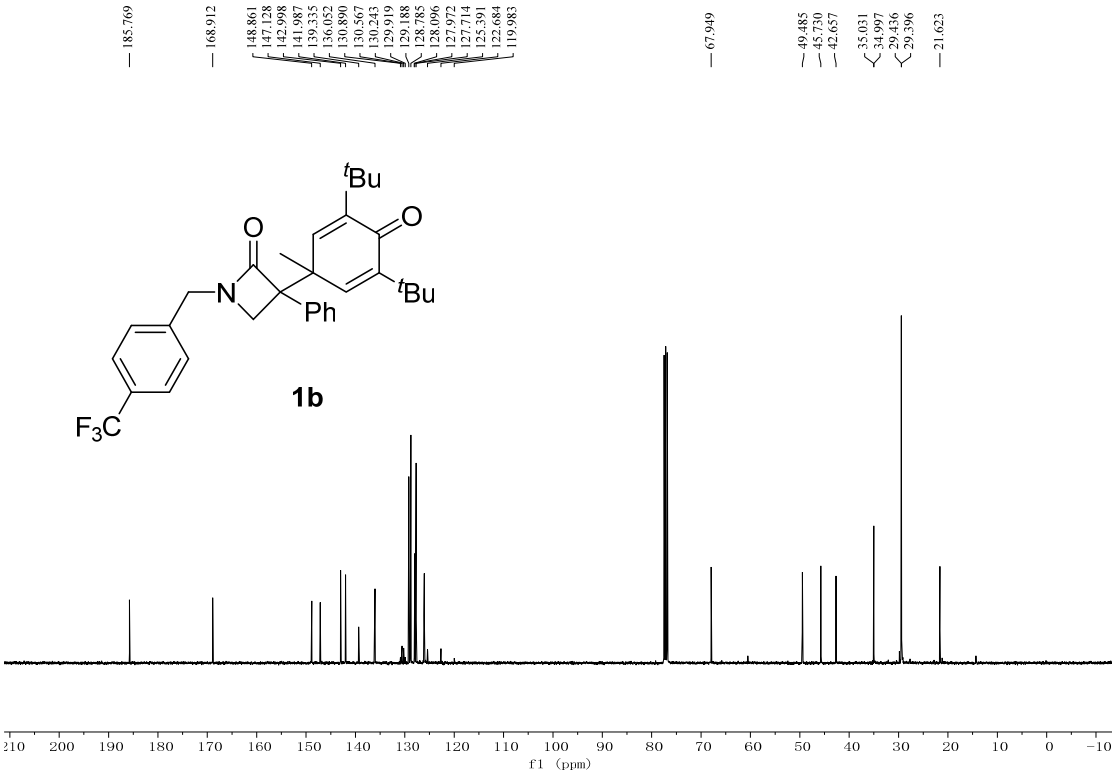

7.648
7.628
7.434
7.414
7.368
7.349
7.331
7.296
7.279
7.274
4.587
4.548
4.516
4.478
4.441
4.435
4.426
4.420
3.624
3.610
3.596
3.251
3.244
3.237
3.231
O
N
Ph
F3C
1a
1.92
1.88
1.99
1.92
1.97
1.01
1.00
0.98
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

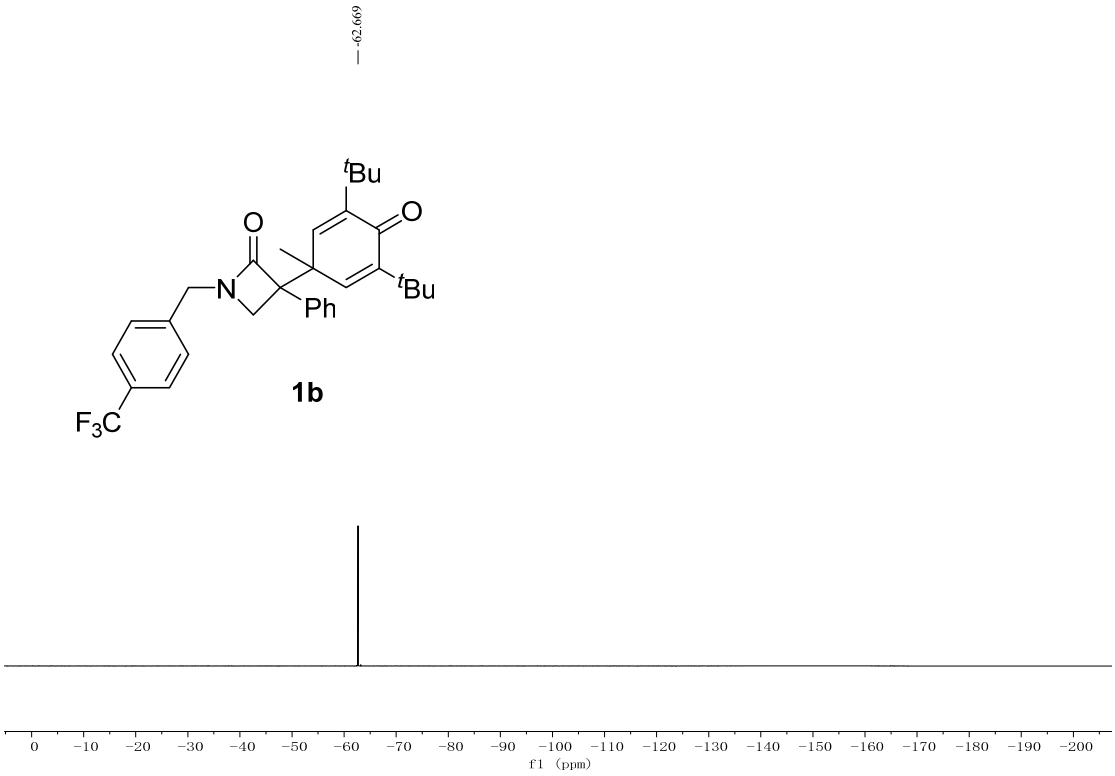

168.614
139.810
135.433
130.793
130.471
130.146
129.823
129.042
128.582
128.158
127.733
127.341
126.088
126.053
126.018
125.979
125.454
122.748
120.045
54.938
47.525
45.845
O
N
Ph
F3C
1a
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.560
O
N
Ph
F3C
1a
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200
f1 (ppm)

1b


7.592
7.572
7.383
7.378
7.364
7.361
7.341
7.333
7.320
7.312
7.306
7.302
7.294
6.561
4.418
3.340
3.326
3.285
3.271
1.316
1.155
tBu
O
O
N
Ph
tBu
F3C
1b
2.06
6.98
2.06
2.14
2.02
3.05
19.00
f1 (ppm)


185.769
168.912
148.861
147.128
142.998
141.987
139.335
136.052
130.890
130.567
130.243
129.919
129.188
128.785
128.096
127.972
127.714
125.391
122.684
119.983
67.949
49.485
45.730
42.657
35.031
34.997
29.436
29.396
21.623
tBu
O
O
N
Ph
tBu
F3C
1b
f1 (ppm)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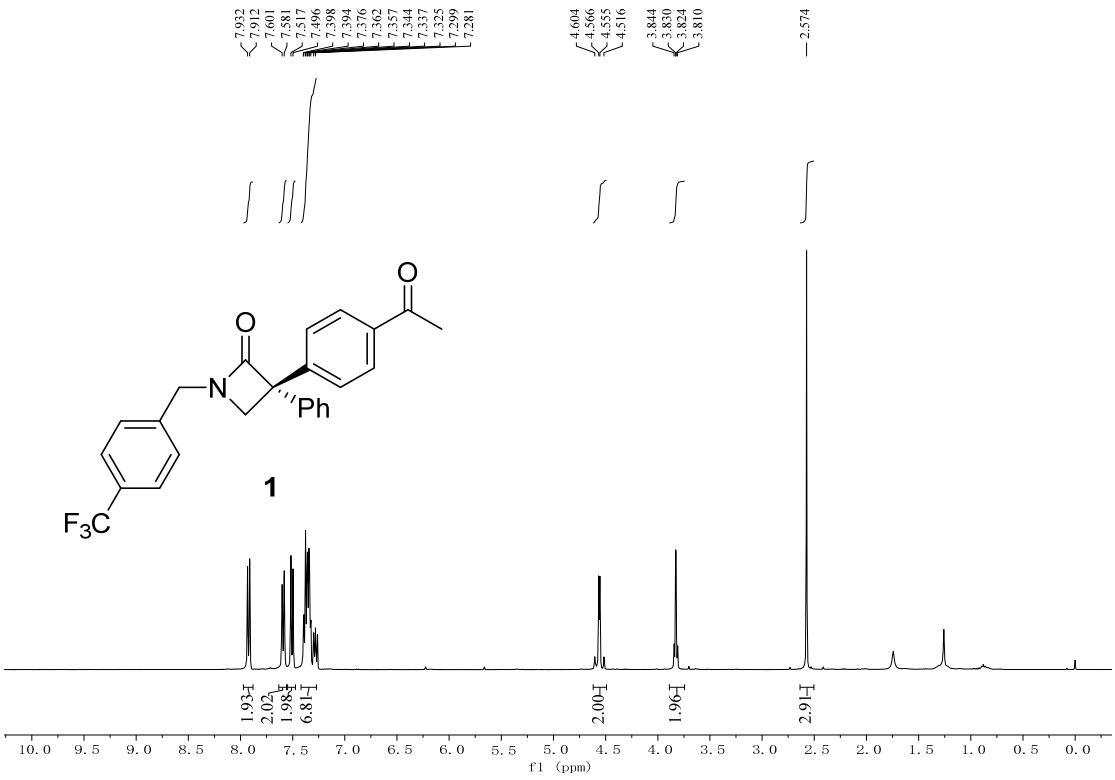
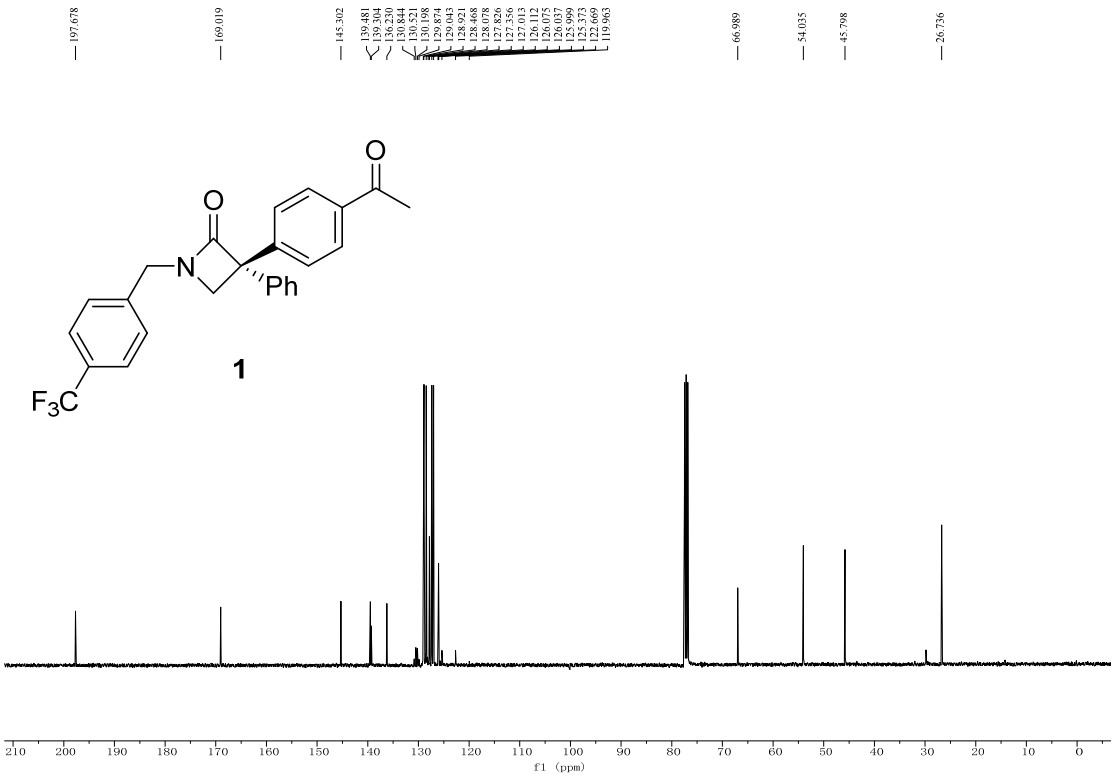
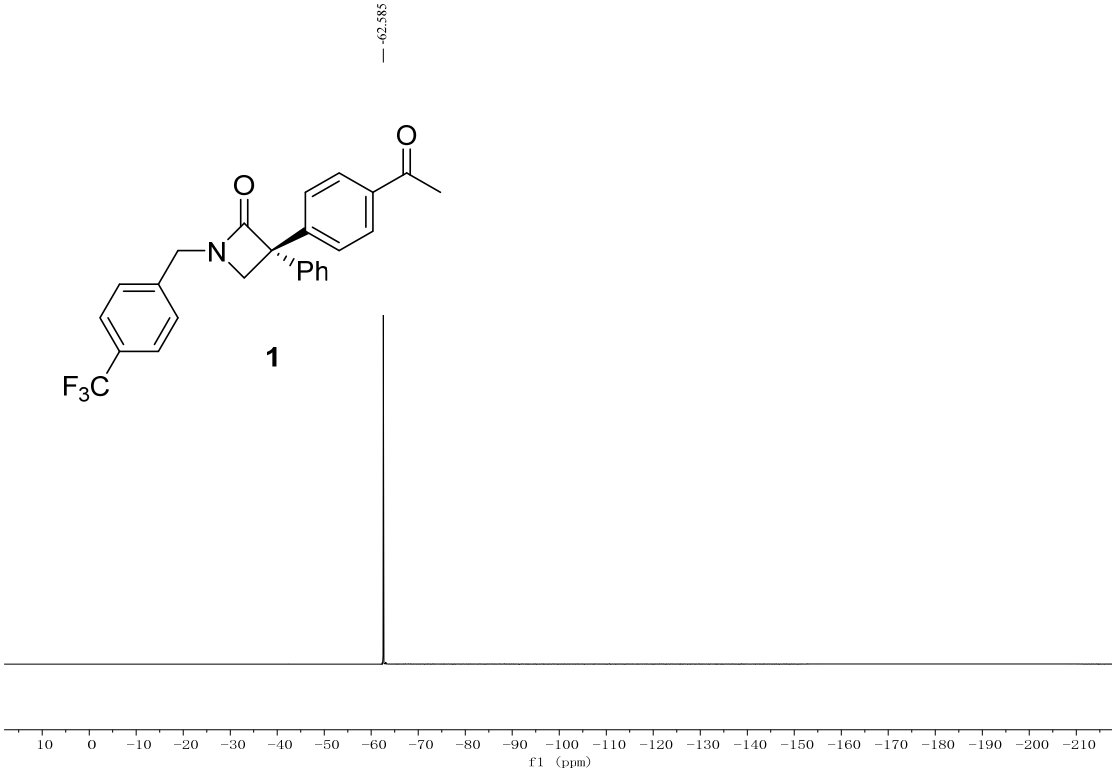
tBu
O
O
N
Ph
tBu
F3C
1b
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

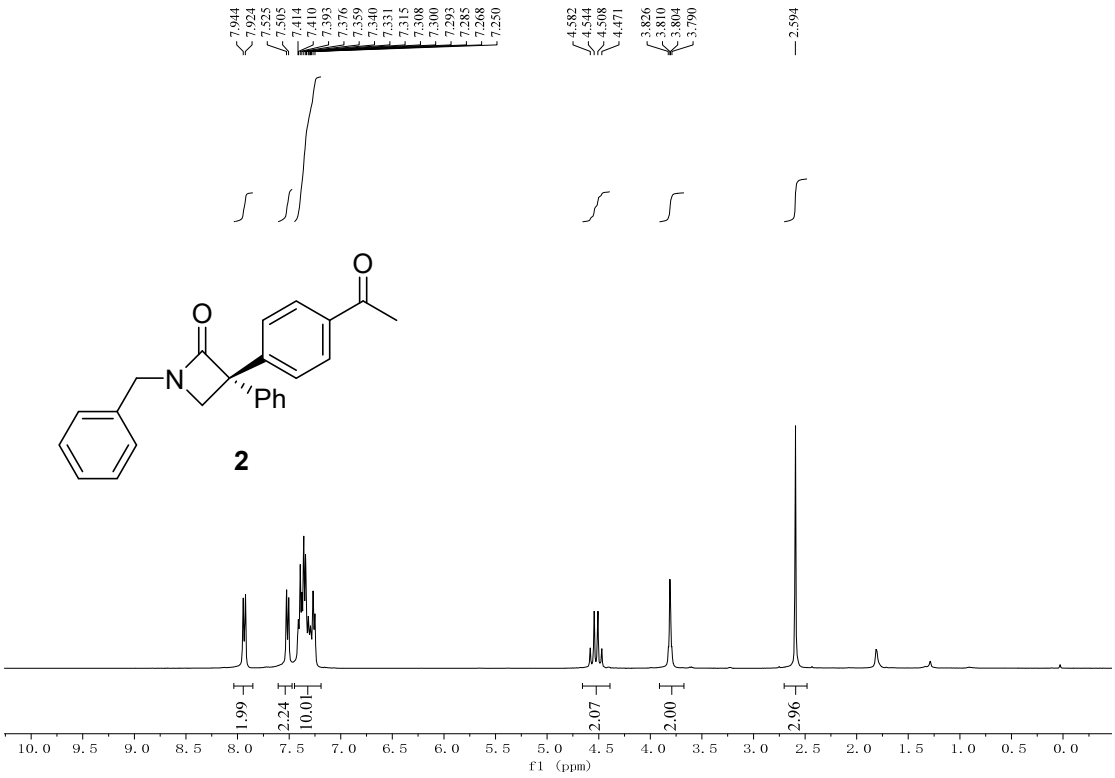
1

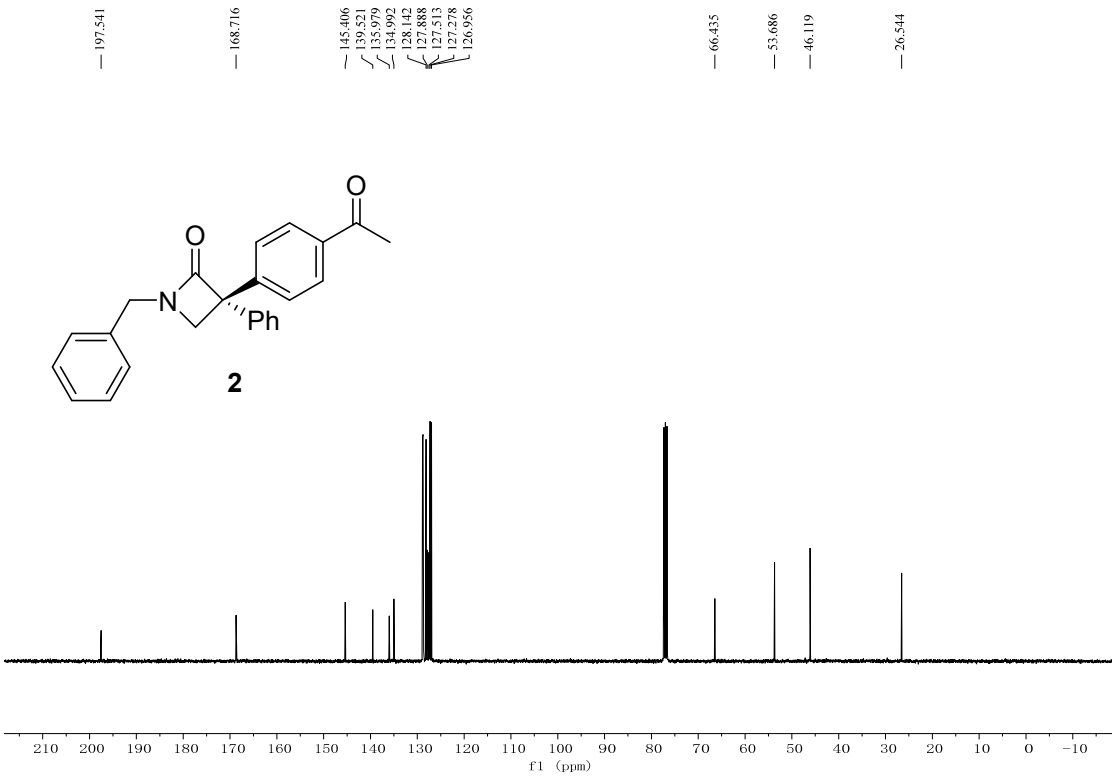

7.932
7.912
7.601
7.581
7.517
7.496
7.398
7.394
7.376
7.362
7.357
7.344
7.337
7.325
7.299
7.281
4.604
4.566
4.555
4.516
3.844
3.830
3.824
3.810
2.574
O
O
N
Ph
1
F3C
1.93H
2.02H
1.98H
6.81H
2.00H
1.96H
2.91H
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


197.678
169.019
145.302
139.481
139.304
136.230
130.844
130.521
130.198
129.874
129.643
128.921
128.468
128.078
127.826
127.356
127.013
126.112
126.075
126.037
125.999
125.373
122.669
119.963
66.989
54.035
45.798
26.736
O
O
N
Ph
F3C
1
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

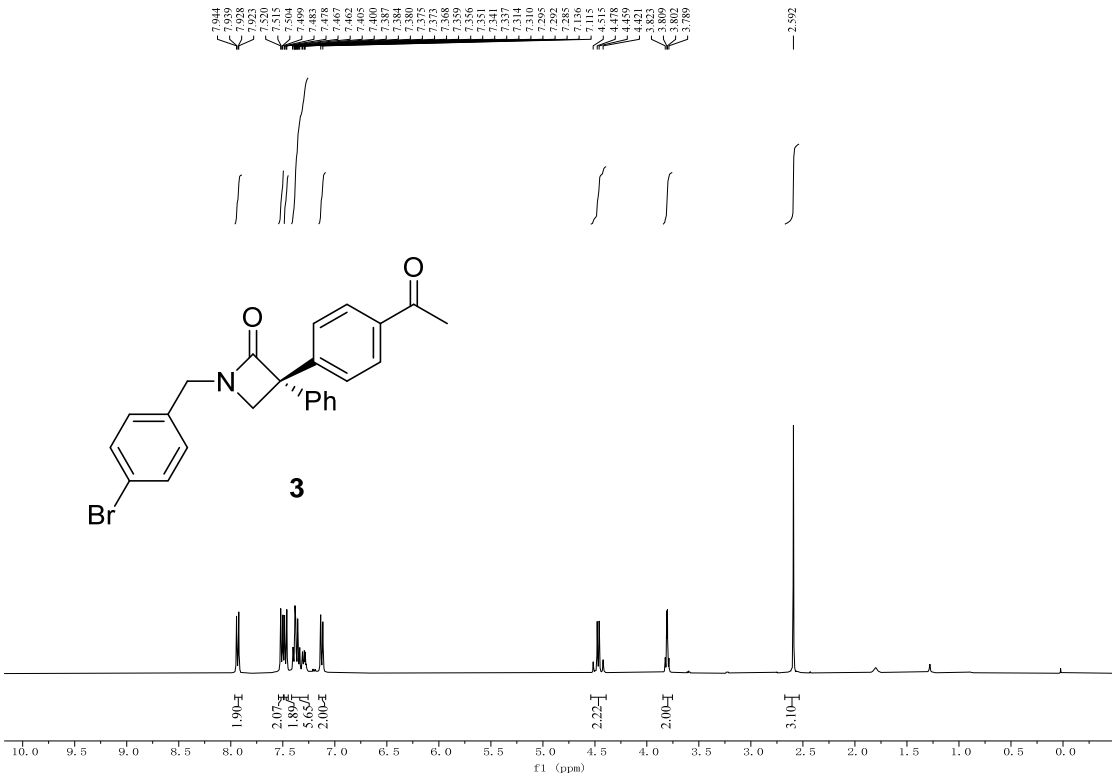

-62.585
O
O
N
Ph
F3C
1
10 0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −210
f1 (ppm)

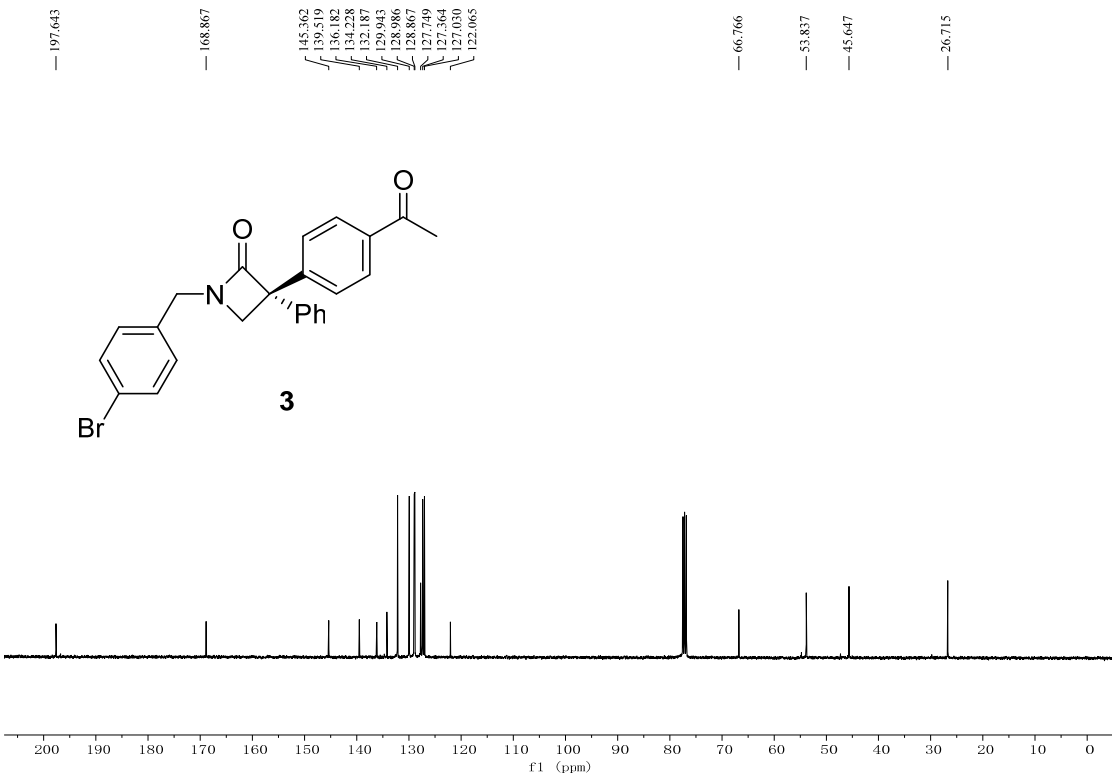
2


7.944
7.924
7.525
7.505
7.414
7.410
7.393
7.376
7.359
7.340
7.331
7.315
7.308
7.300
7.293
7.285
7.268
7.250
4.582
4.544
4.508
4.471
3.826
3.810
3.804
3.790
2.594
O
O
N
Ph
2
1.99
2.24
10.01
2.07
2.00
2.96
f1 (ppm)

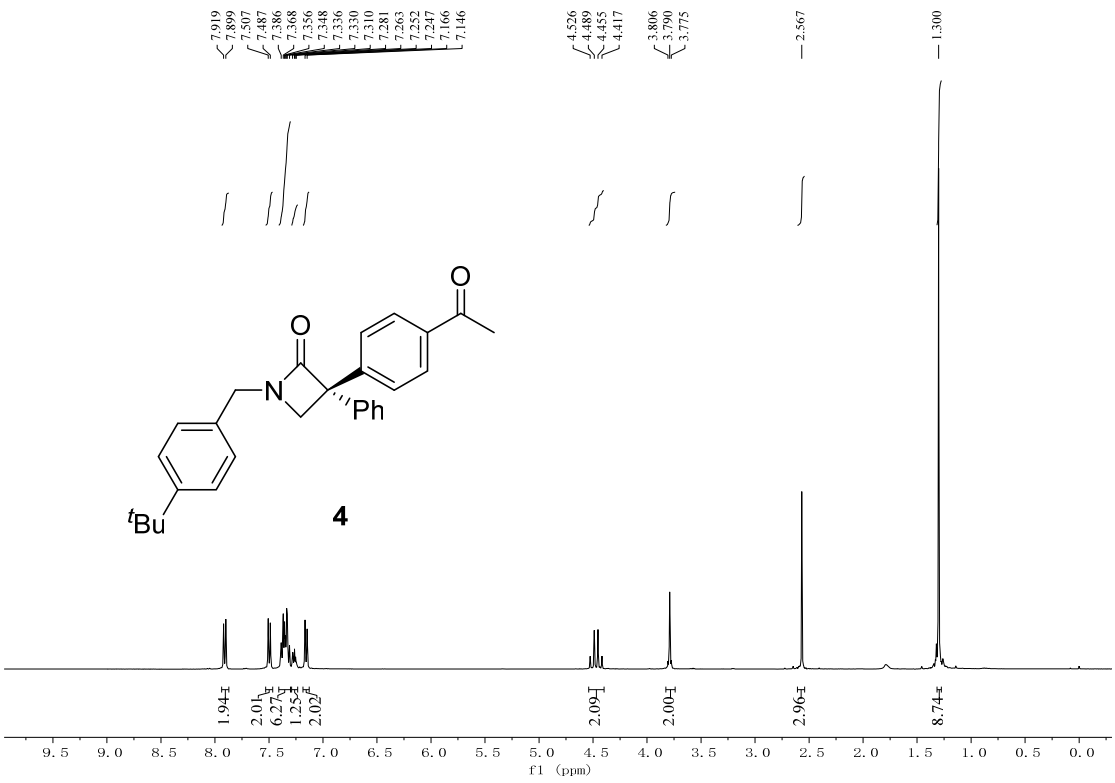

197.541
168.716
145.406
139.521
135.979
134.992
128.142
127.888
127.513
127.278
126.956
66.435
53.686
46.119
26.544
O
O
N
Ph
2
f1 (ppm)

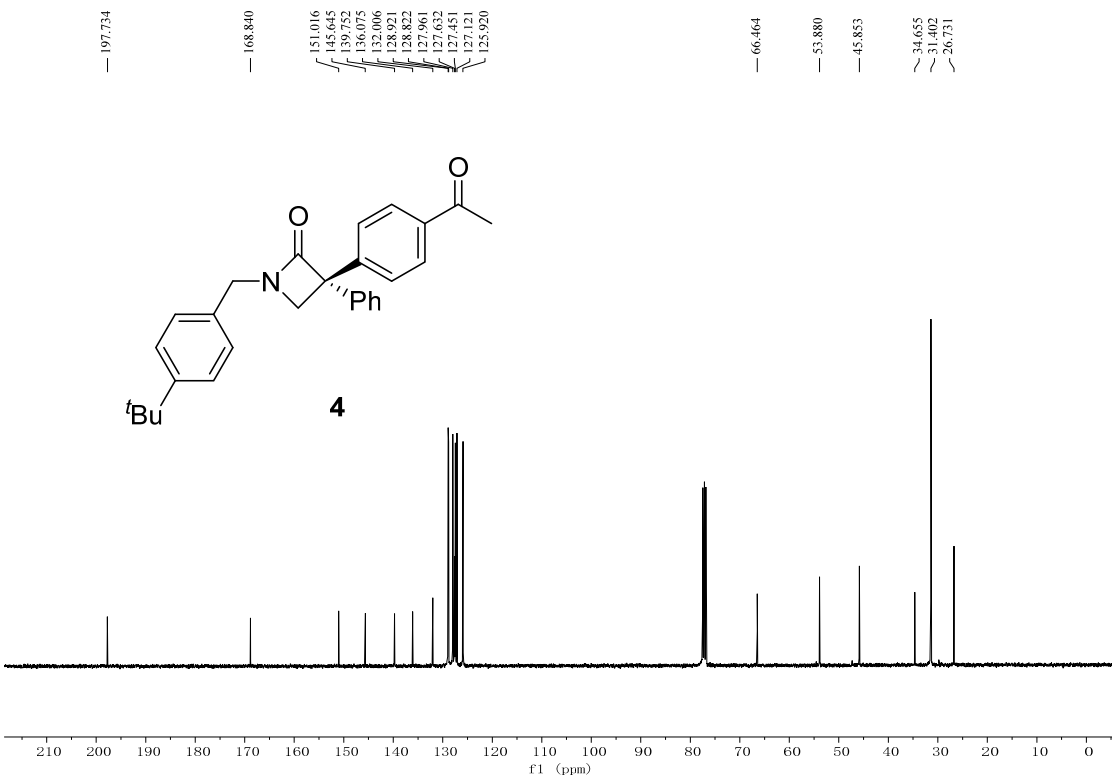
3


7.944
7.939
7.938
7.925
7.520
7.515
7.504
7.499
7.483
7.478
7.466
7.462
7.405
7.400
7.387
7.384
7.380
7.375
7.373
7.368
7.359
7.356
7.351
7.341
7.337
7.314
7.310
7.295
7.292
7.285
7.136
7.115
4.515
4.478
4.459
4.421
3.823
3.809
3.802
3.789
2.592
O
O
N
Ph
Br
3
1.90
2.07
1.89
5.65
2.00
2.22
2.00
3.10
f1 (ppm)


197.643
168.867
145.362
139.519
136.182
134.228
132.187
129.943
128.986
128.867
127.749
127.364
127.030
122.065
66.766
53.837
45.647
26.715
O
O
N
Ph
Br
3
f1 (ppm)

4


7.919
7.899
7.507
7.487
7.386
7.368
7.356
7.348
7.336
7.330
7.310
7.281
7.263
7.252
7.247
7.166
7.146
4.526
4.489
4.455
4.417
3.806
3.790
3.775
2.567
1.300
O
O
N
Ph
tBu
4
1.94
2.01
6.27
1.25
2.02
2.09
2.00
2.96
8.74
f1 (ppm)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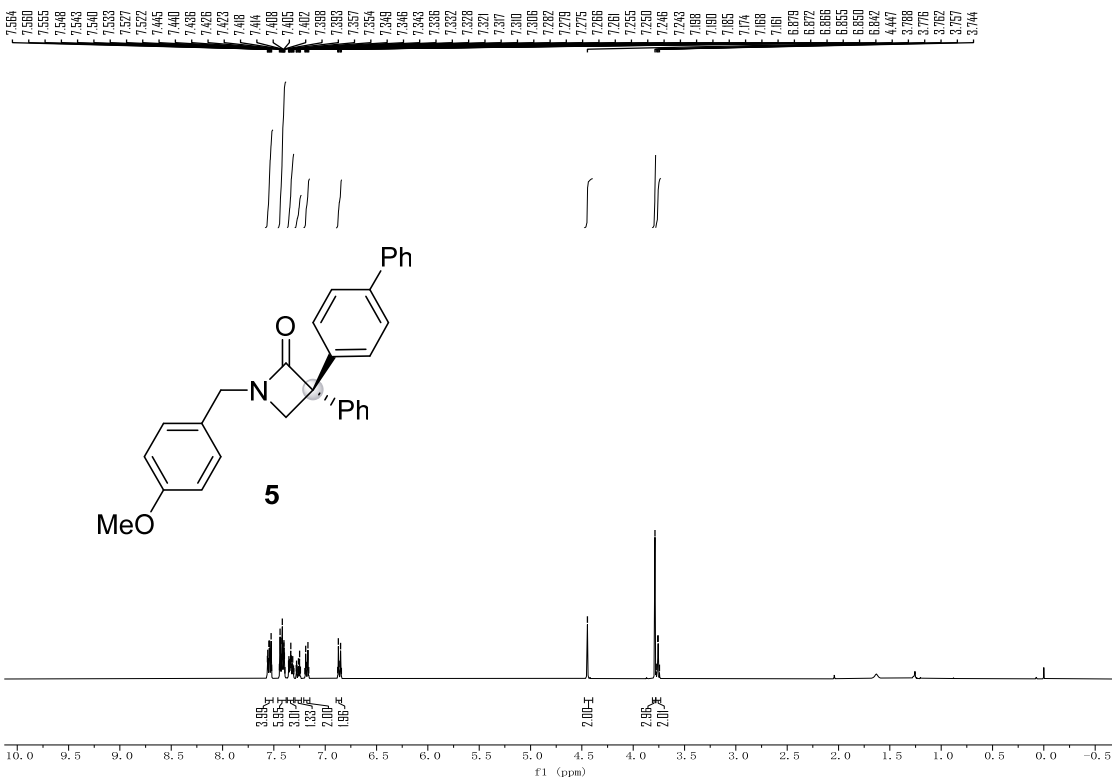
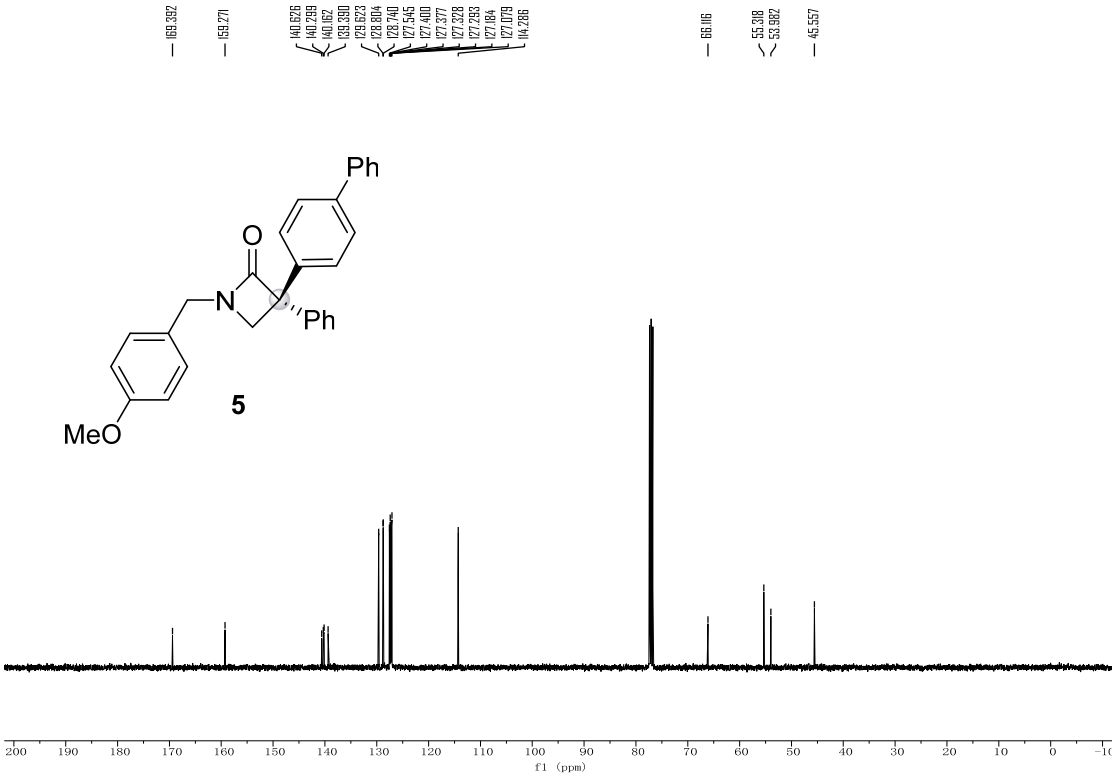
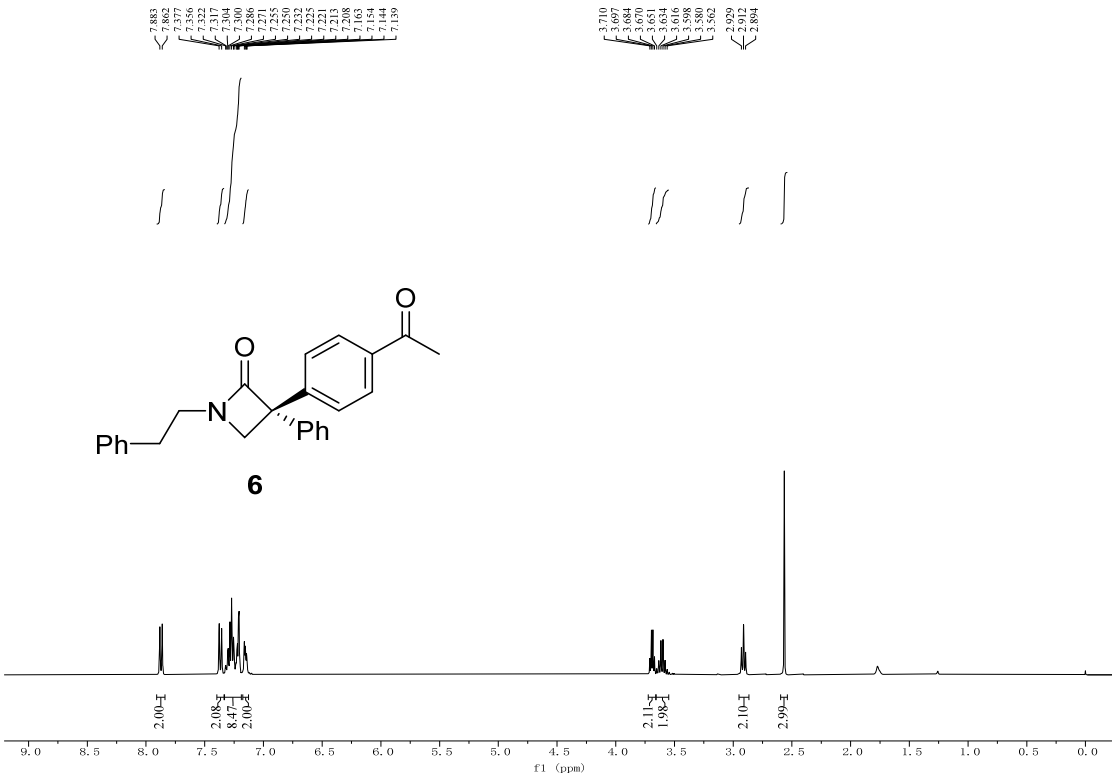
151.016
145.645
139.752
136.075
132.006
128.921
128.822
127.961
127.632
127.451
127.121
125.920
66.464
53.880
45.853
34.655
31.402
26.731
O
O
N
Ph
tBu
4
f1 (ppm)

5


7.564
7.560
7.555
7.548
7.543
7.540
7.533
7.527
7.522
7.445
7.440
7.436
7.426
7.423
7.418
7.414
7.408
7.405
7.402
7.398
7.393
7.357
7.354
7.348
7.346
7.343
7.336
7.332
7.328
7.321
7.317
7.310
7.306
7.282
7.279
7.275
7.266
7.261
7.255
7.250
7.246
7.243
7.198
7.190
7.185
7.174
7.168
7.161
6.879
6.872
6.866
6.855
6.850
6.842
4.447
3.788
3.776
3.762
3.757
3.744
Ph
O
N
Ph
MeO
5
3.194
5.955
3.014
1.334
2.109
1.936
2.103
2.195
2.000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5
f1 (ppm)


169.392
159.271
140.626
140.289
140.062
131.380
129.623
128.804
128.740
127.545
127.400
127.377
127.328
127.283
127.184
127.079
114.286
66.116
55.398
53.982
45.557
Ph
O
N
Ph
MeO
5
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

6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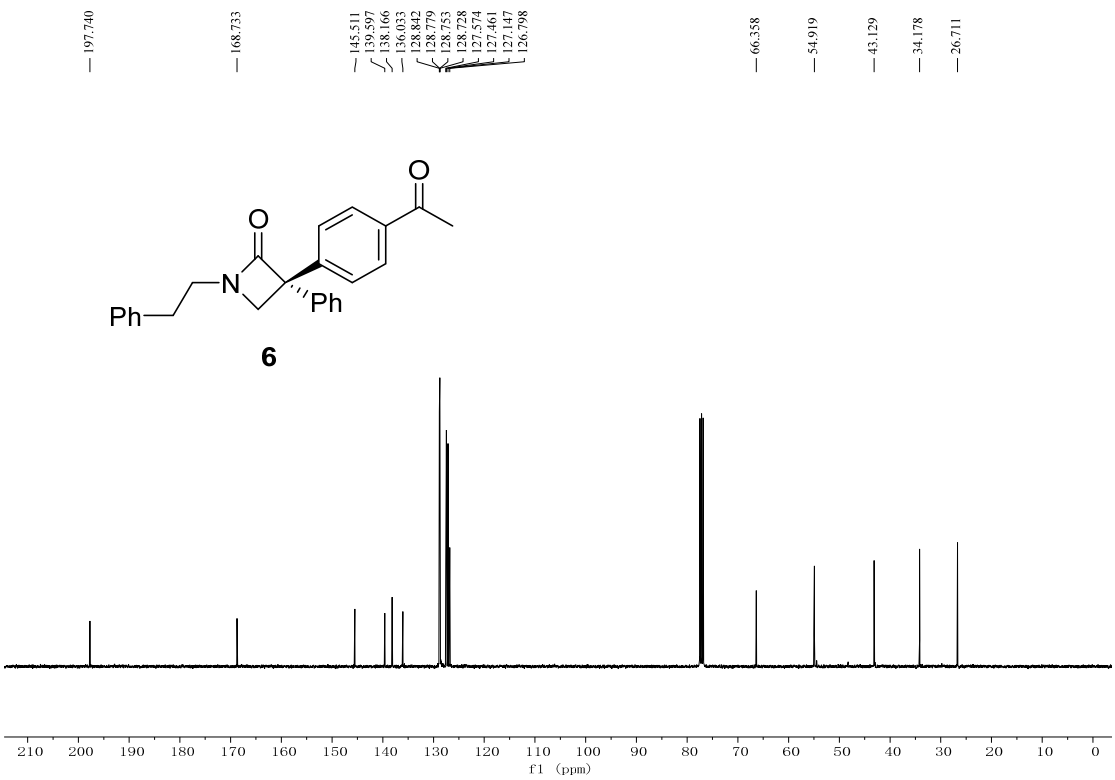
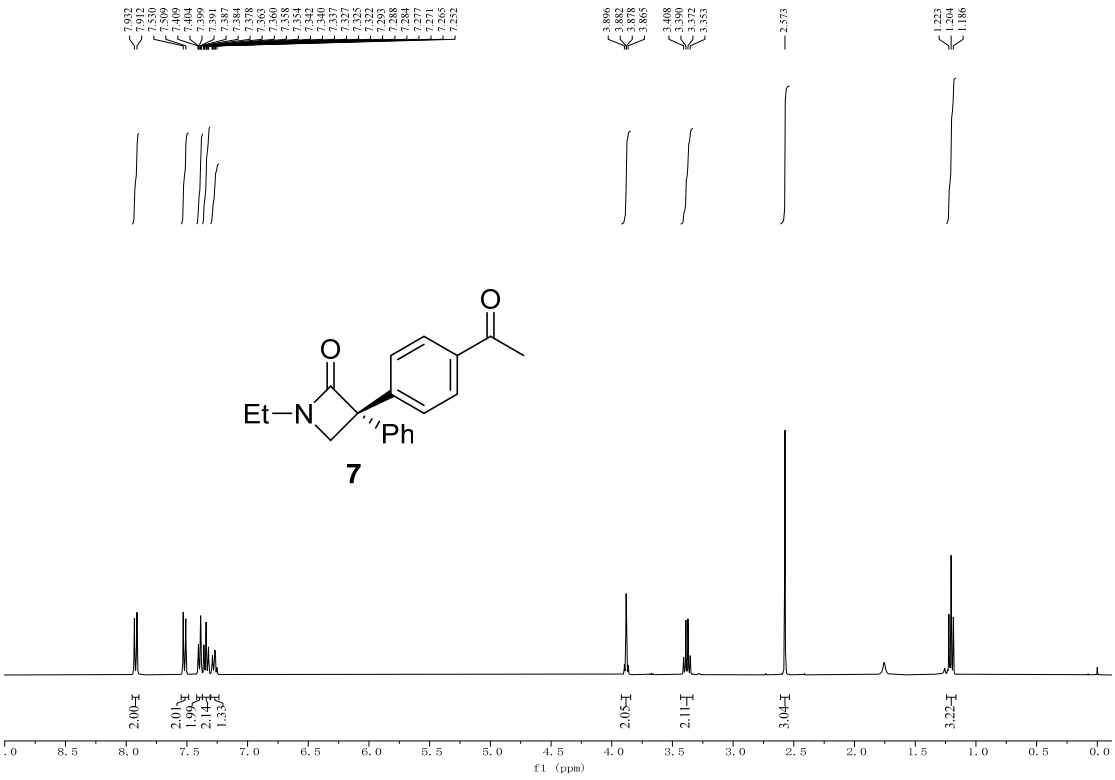
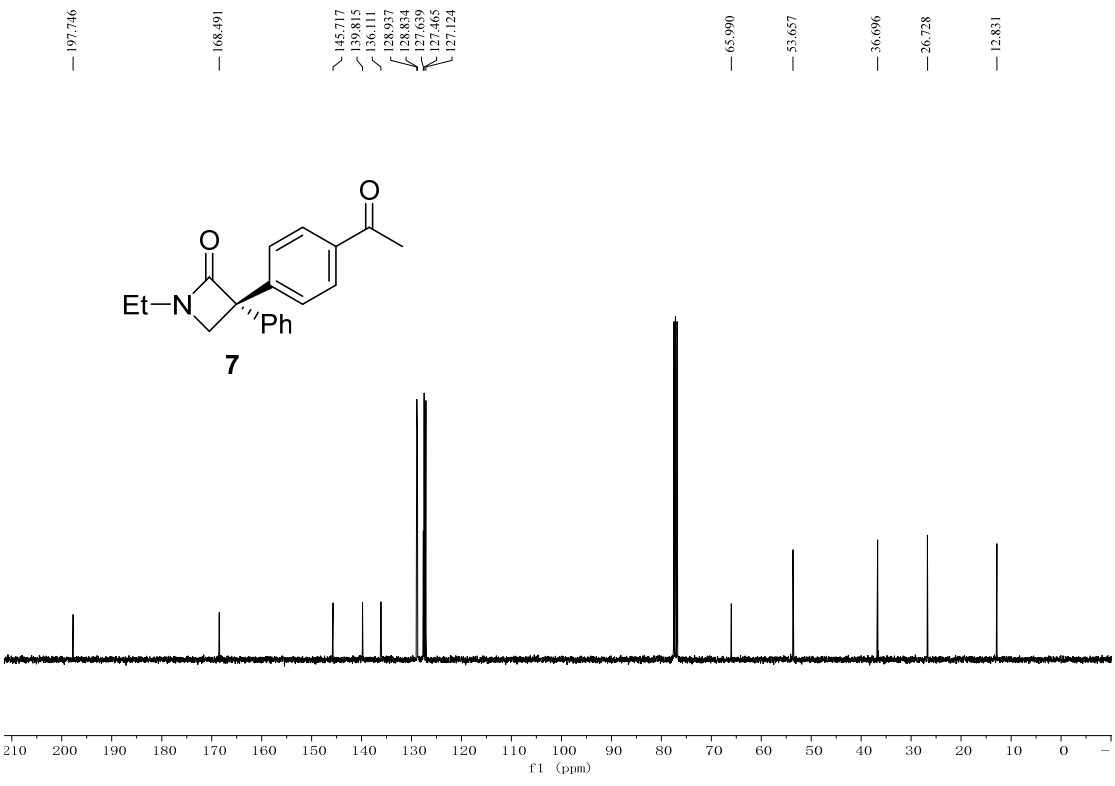
7.862
7.377
7.356
7.322
7.317
7.304
7.300
7.286
7.271
7.255
7.250
7.232
7.225
7.221
7.213
7.208
7.163
7.154
7.144
7.139
3.710
3.697
3.684
3.670
3.651
3.634
3.616
3.598
3.580
3.562
2.929
2.912
2.894
O
O
N
Ph
Ph
6
2.00
2.08
8.47
2.00
2.11
1.98
2.10
2.99
f1 (ppm)


197.740
168.733
145.511
139.597
138.166
136.033
128.842
128.779
128.753
128.728
127.574
127.461
127.147
126.798
66.358
54.919
43.129
34.178
26.711
O
O
N
Ph
Ph
6
f1 (ppm)

7


7.932
7.912
7.530
7.509
7.409
7.404
7.399
7.391
7.387
7.384
7.378
7.363
7.360
7.358
7.354
7.343
7.340
7.337
7.327
7.325
7.322
7.293
7.288
7.284
7.277
7.271
7.265
7.252
3.896
3.882
3.878
3.865
3.408
3.390
3.372
3.353
2.573
1.223
1.204
1.186
O
O
Et—N
Ph
7
2.00
2.01
1.99
2.14
1.33
2.05
2.11
3.04
3.22
f1 (ppm)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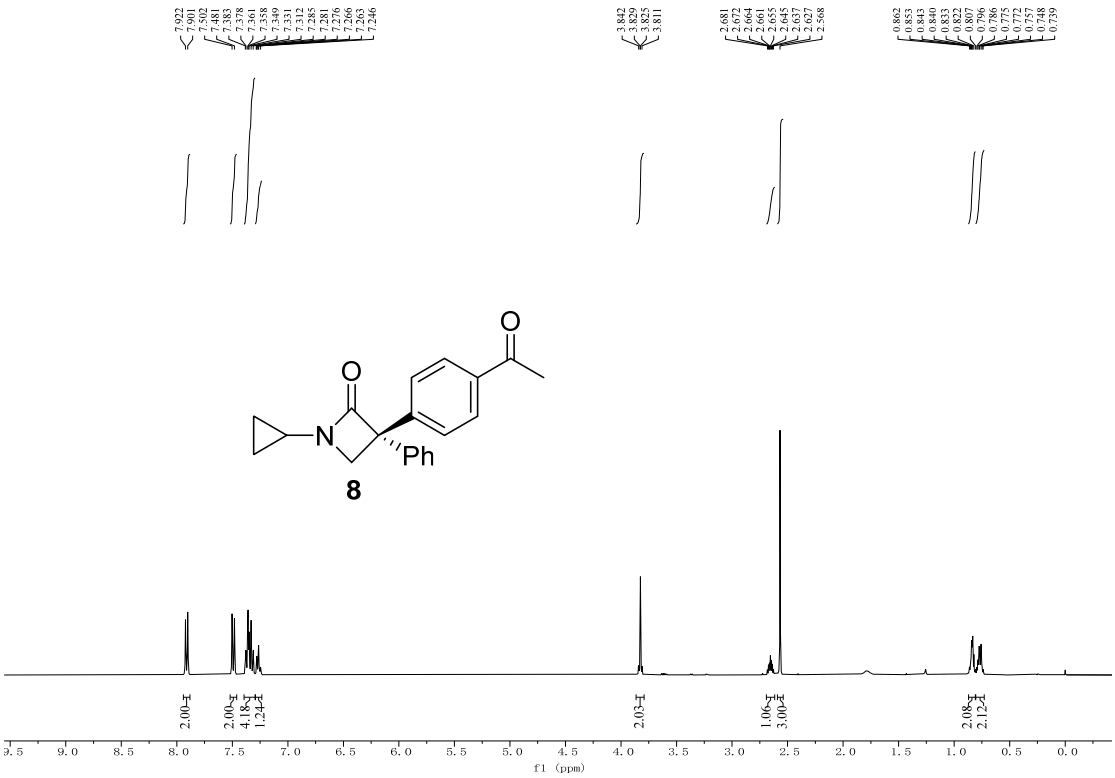
145.717
139.815
136.111
128.937
128.834
127.639
127.465
127.124
65.990
53.657
36.696
26.728
12.831
O
O
Et—N
Ph
7
f1 (ppm)

8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7.901
7.502
7.481
7.383
7.378
7.361
7.358
7.349
7.331
7.312
7.285
7.201
7.276
7.266
7.263
7.246
3.842
3.829
3.825
3.811
2.681
2.672
2.664
2.661
2.655
2.645
2.637
2.627
2.568
0.862
0.853
0.843
0.840
0.833
0.822
0.807
0.796
0.786
0.775
0.772
0.757
0.748
0.739
O
O
N
Ph
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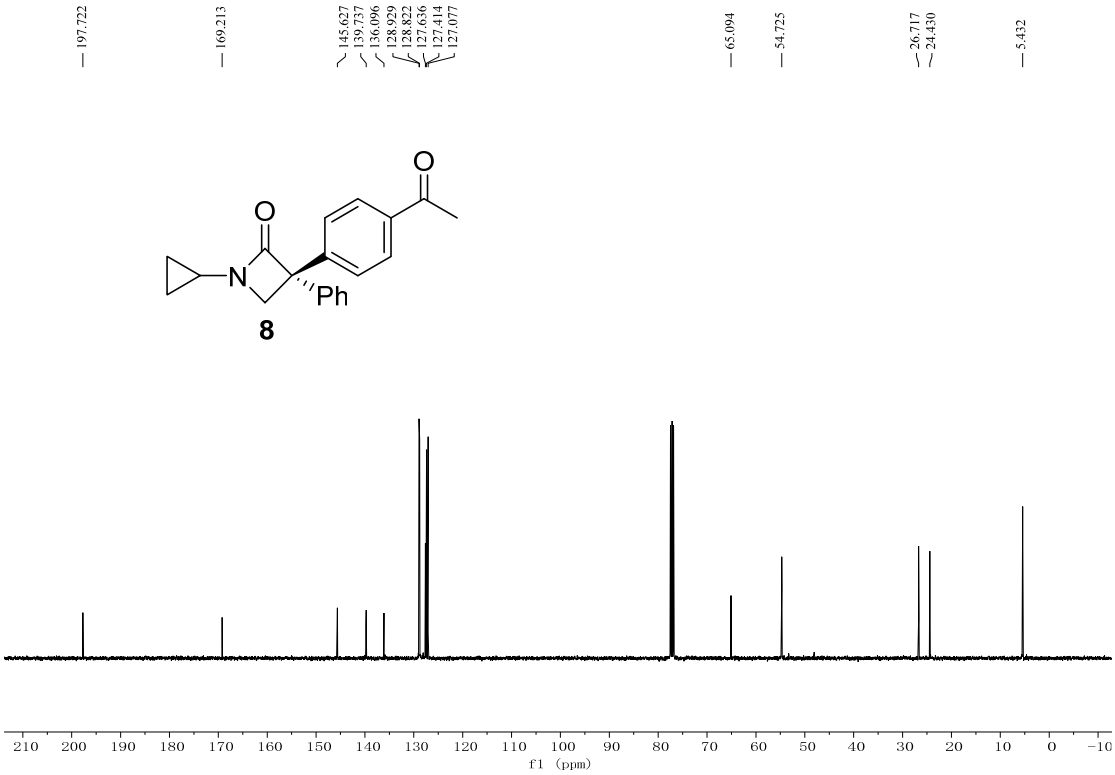
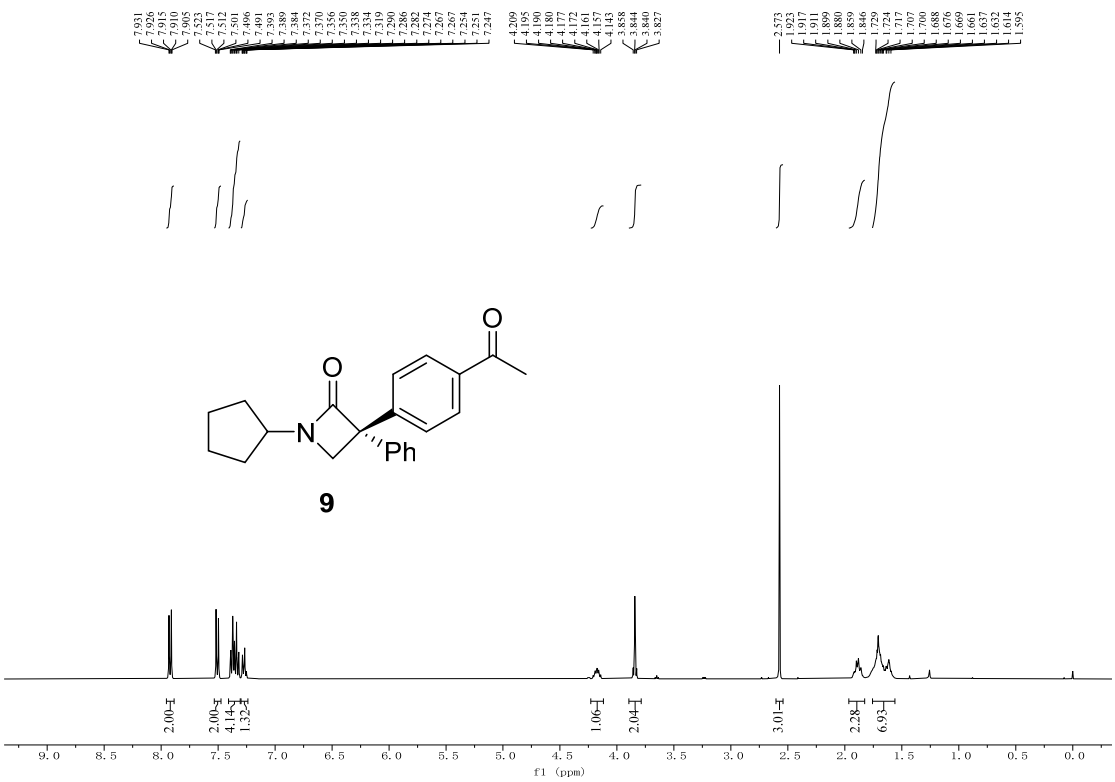
2.00
2.00
4.18
1.24
2.03
1.06
3.00
2.08
2.12
f1 (ppm)


197.722
169.213
145.627
139.737
136.096
128.929
128.822
127.636
127.414
127.077
65.094
54.725
26.717
24.430
5.432
O
O
N
Ph
8
f1 (ppm)

9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7.915
7.910
7.905
7.523
7.517
7.512
7.501
7.496
7.491
7.393
7.389
7.384
7.372
7.370
7.356
7.350
7.338
7.334
7.319
7.290
7.286
7.282
7.274
7.267
7.254
7.251
7.247
4.209
4.195
4.190
4.180
4.177
4.172
4.161
4.157
4.143
3.858
3.844
3.840
3.827
2.573
1.923
1.917
1.911
1.890
1.880
1.859
1.846
1.729
1.724
1.717
1.707
1.700
1.688
1.676
1.669
1.661
1.637
1.632
1.614
1.595
O
O
N
Ph
9
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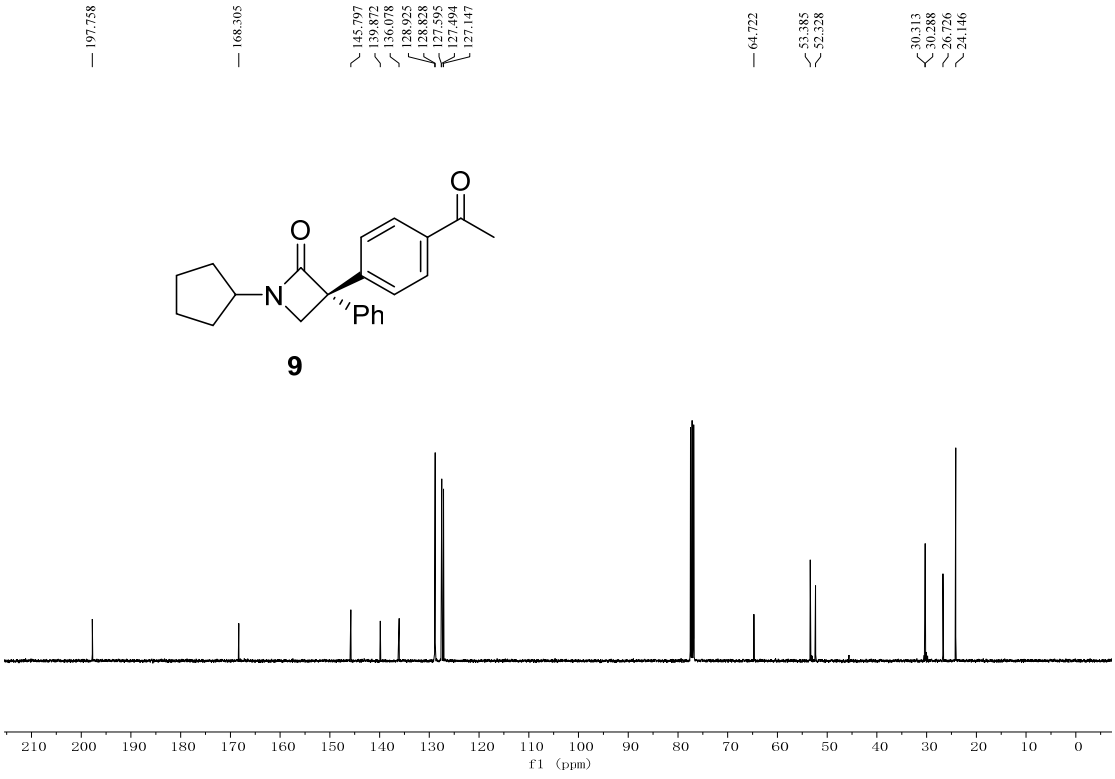
2.00
4.14
1.32
1.06
2.04
3.01
2.28
6.93
f1 (ppm)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139.872
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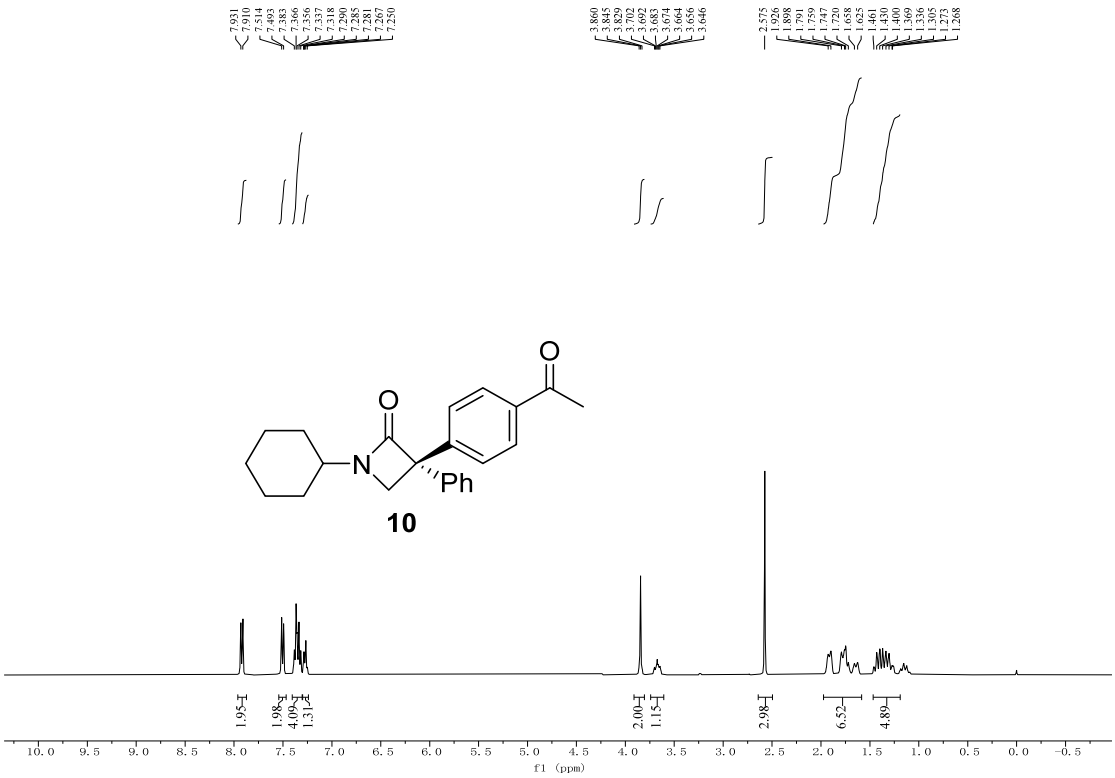
128.925
128.828
127.595
127.494
127.147
64.722
53.385
52.328
30.313
30.288
26.726
24.146
O
O
N
Ph
9
f1 (ppm)

10


7.931
7.910
7.514
7.493
7.383
7.366
7.356
7.337
7.318
7.290
7.285
7.281
7.267
7.250
3.860
3.845
3.829
3.707
3.692
3.683
3.674
3.664
3.656
3.646
2.575
1.926
1.898
1.791
1.759
1.747
1.720
1.658
1.625
1.461
1.430
1.400
1.369
1.336
1.305
1.273
1.268
O
O
N
Ph
10
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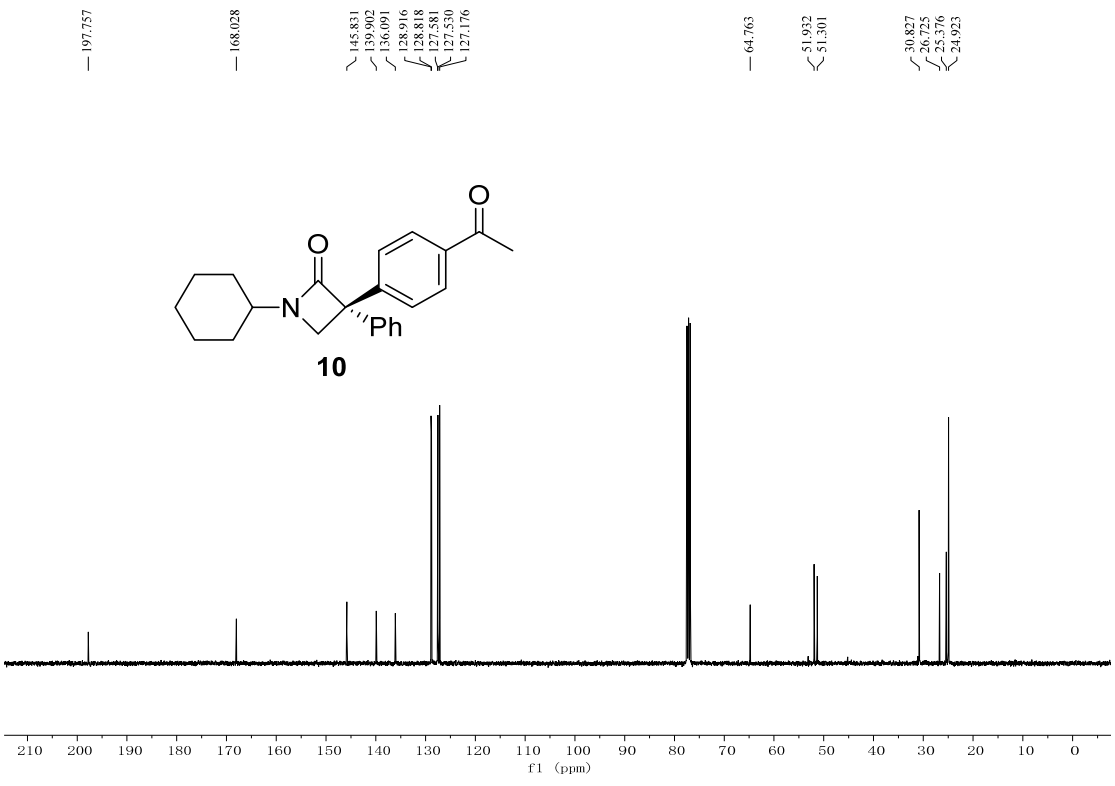
1.98
4.09
1.31
2.00
1.15
2.98
6.52
4.89
f1 (ppm)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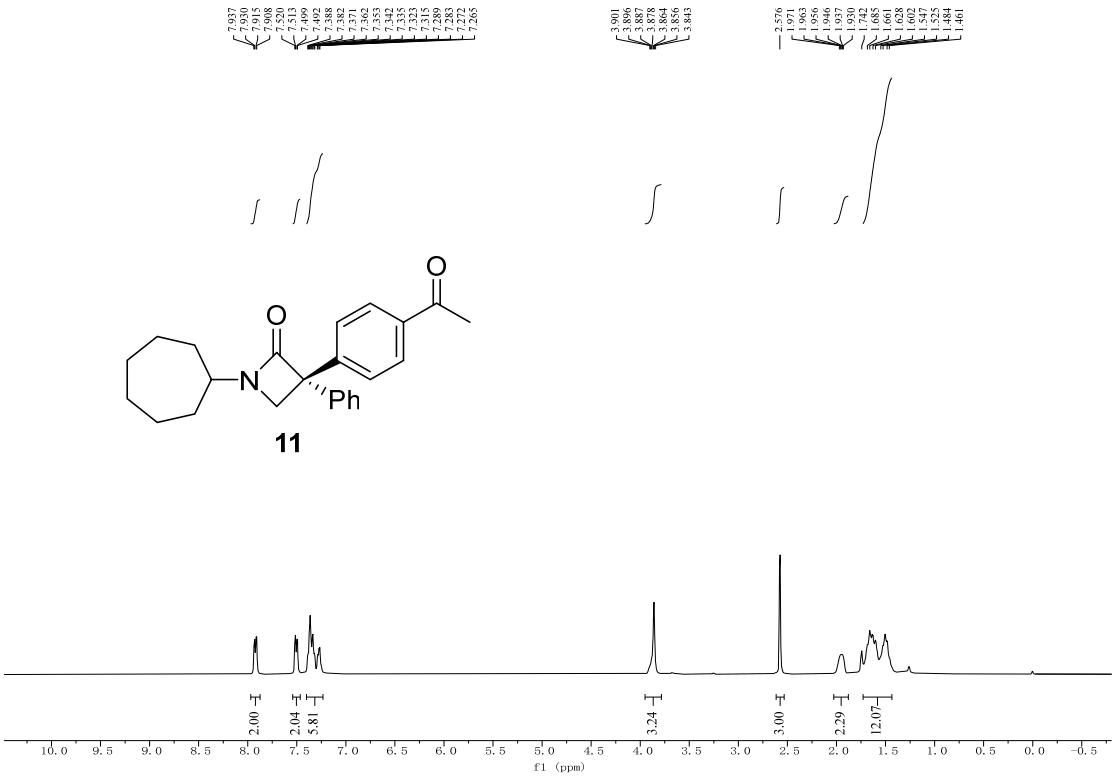
145.831
139.902
136.091
128.916
128.818
127.581
127.530
127.176
64.763
51.932
51.301
30.827
26.725
25.376
24.923
O
O
N
Ph
10
f1 (ppm)

11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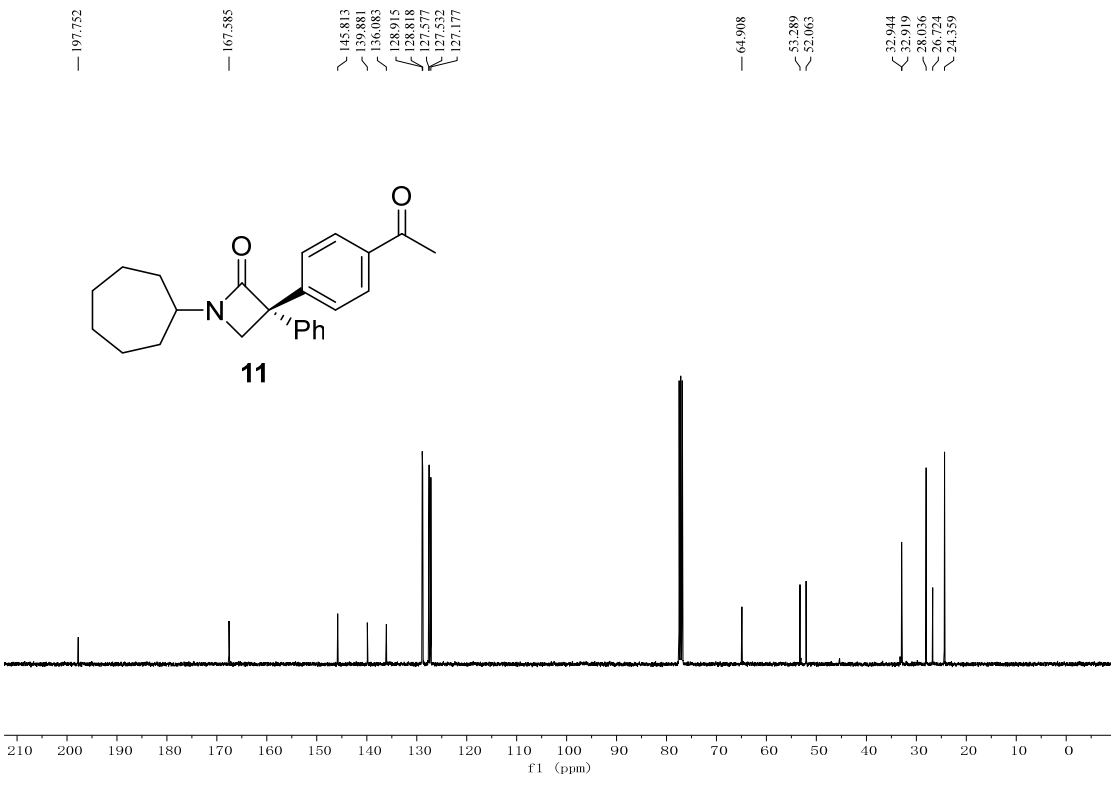
7.915
7.908
7.520
7.513
7.499
7.492
7.388
7.382
7.371
7.360
7.353
7.342
7.335
7.323
7.315
7.289
7.283
7.272
7.265
3.901
3.896
3.887
3.878
3.864
3.856
3.845
2.576
1.971
1.963
1.956
1.946
1.937
1.930
1.742
1.685
1.661
1.628
1.602
1.547
1.525
1.484
1.461
O
O
N
Ph
11
2.00
2.04
5.81
3.24
3.00
2.29
12.07
f1 (ppm)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145.813
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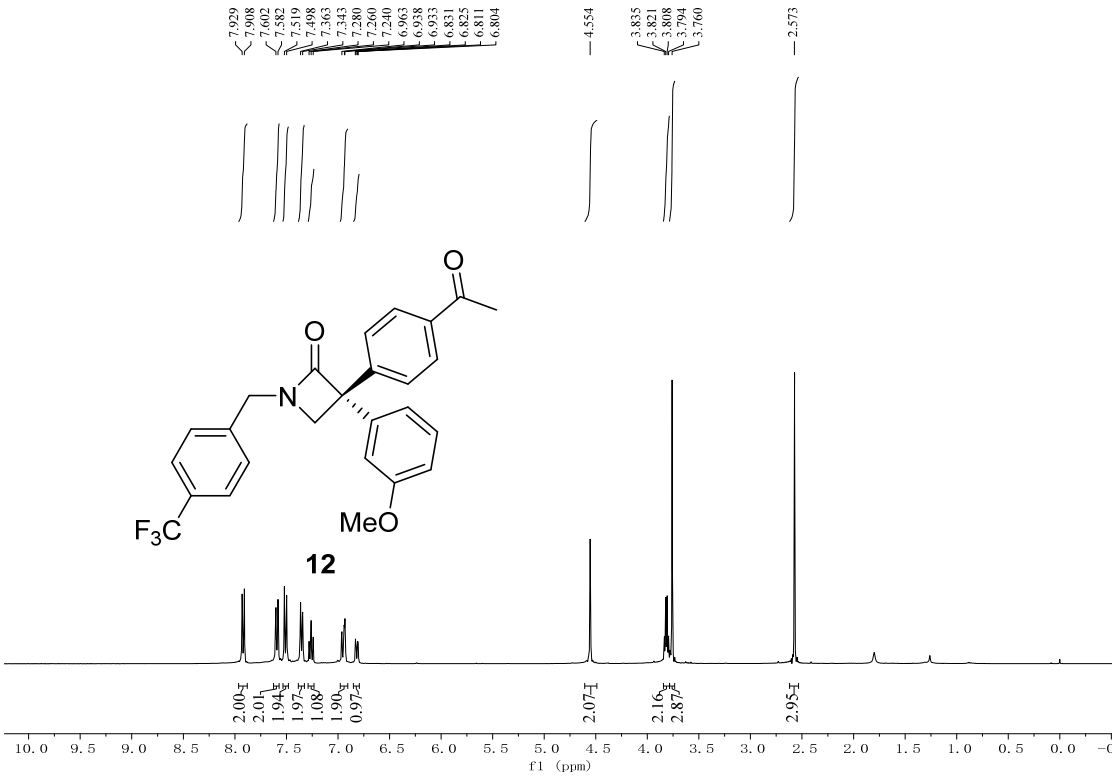
136.083
128.915
128.818
127.577
127.532
127.177
64.908
53.289
52.063
32.944
32.919
28.036
26.724
24.359
O
O
N
Ph
11
f1 (ppm)

12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7.602
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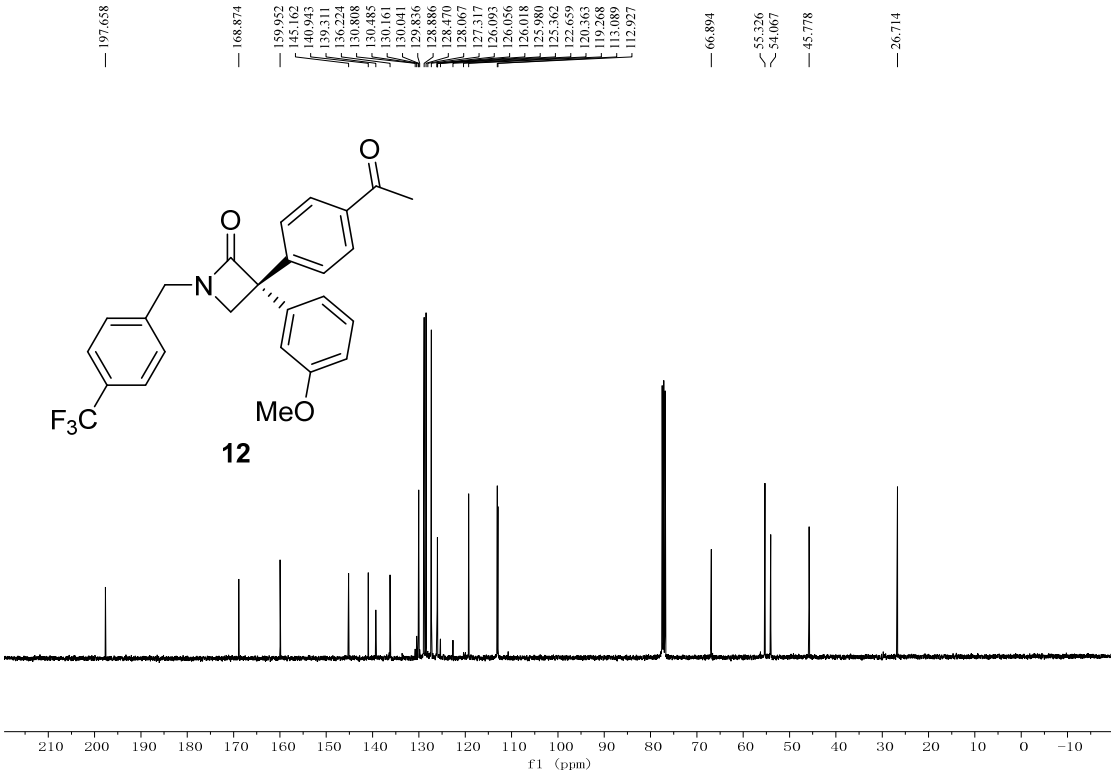
7.519
7.498
7.363
7.343
7.280
7.260
7.240
6.963
6.938
6.933
6.831
6.825
6.811
6.804
4.554
3.835
3.821
3.808
3.794
3.760
2.573
O
O
N
F3C
MeO
12
2.00
2.01
1.94
1.97
1.08
1.90
0.97
2.07
2.16
2.87
2.95
f1 (ppm)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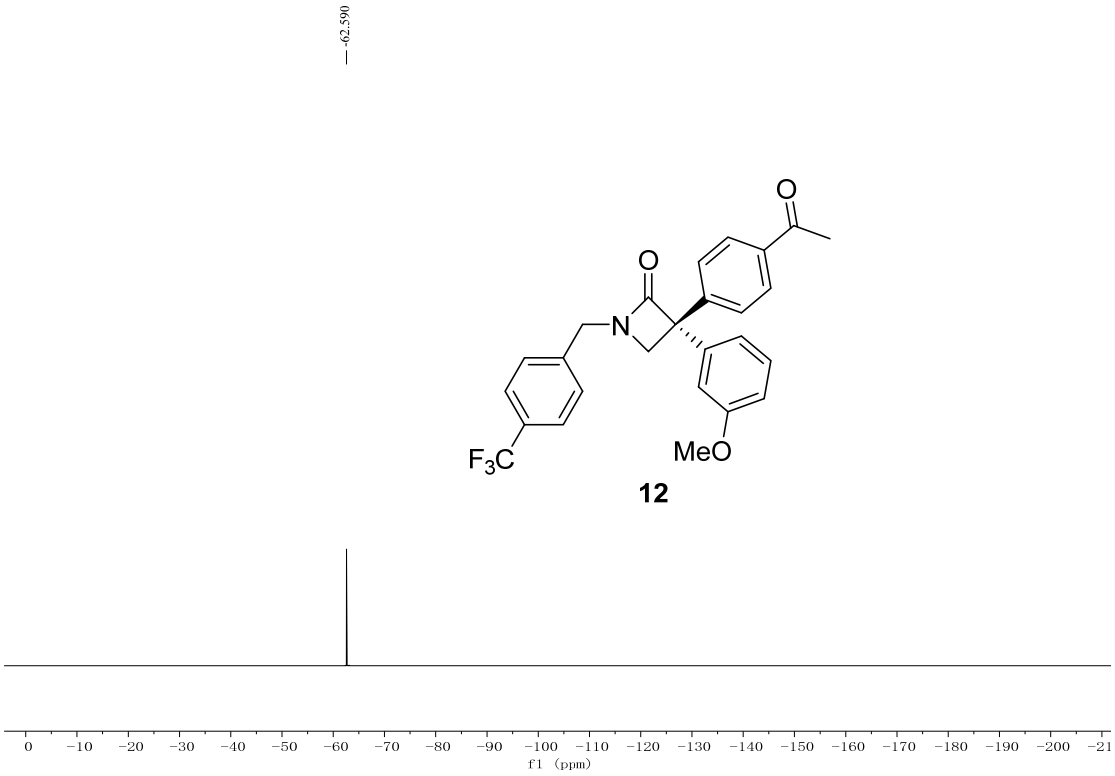
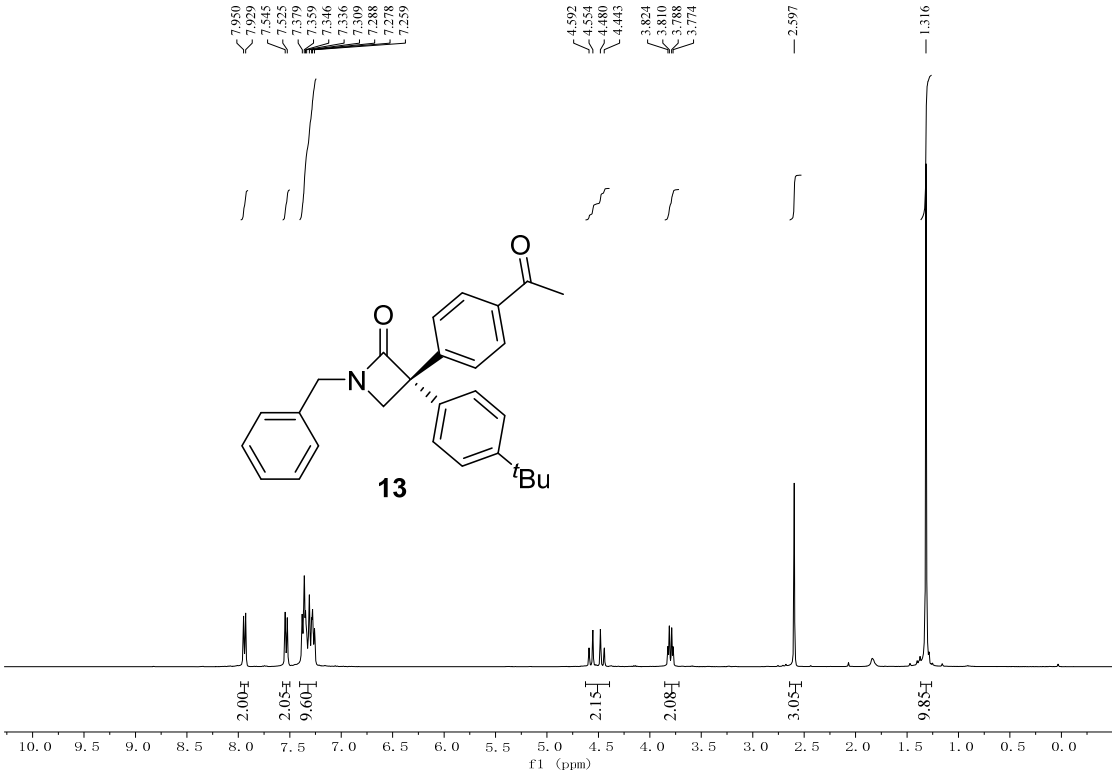
139.311
136.224
130.808
130.485
130.161
130.041
129.836
128.886
128.470
128.067
127.317
126.093
126.056
126.018
125.980
125.362
122.659
120.363
119.268
113.089
112.927
66.894
55.326
54.067
45.778
26.714
O
O
N
F3C
MeO
12
f1 (ppm)


-62.590
O
O
N
F3C
MeO
12
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −21
f1 (ppm)

13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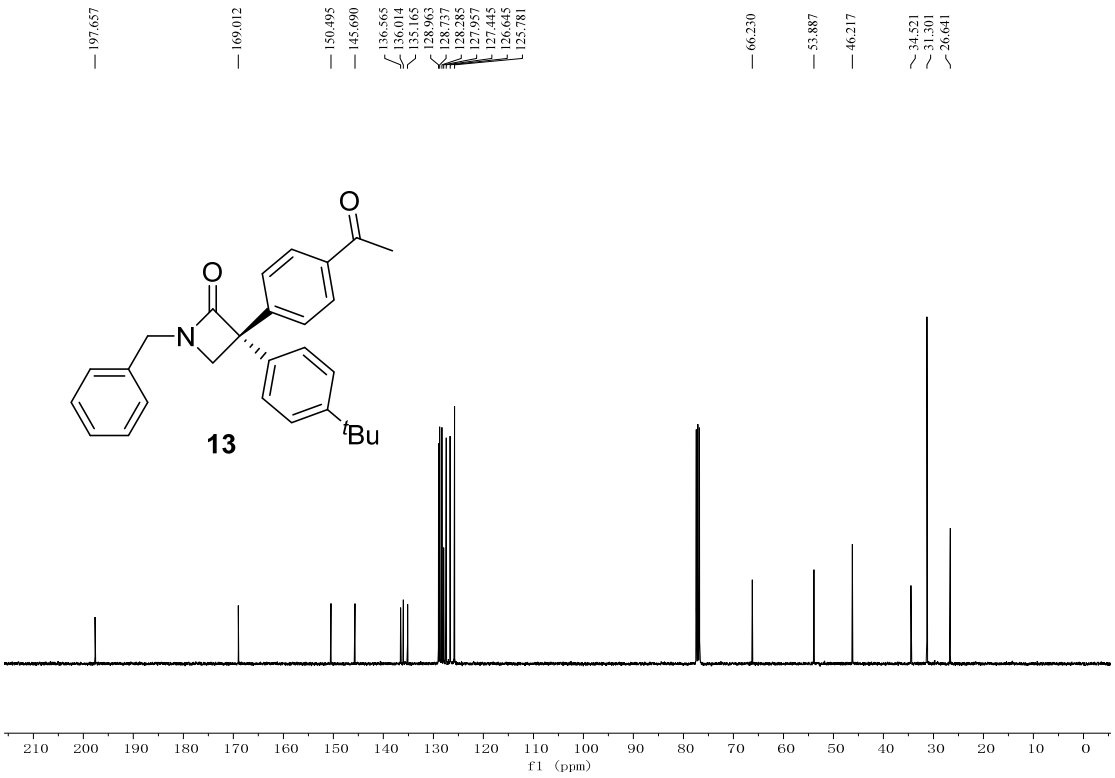
7.545
7.525
7.379
7.359
7.346
7.336
7.309
7.288
7.278
7.259
4.592
4.554
4.480
4.443
3.824
3.810
3.788
3.774
2.597
1.316
O
O
N
tBu
13
2.00
2.05
9.60
2.15
2.08
3.05
9.85
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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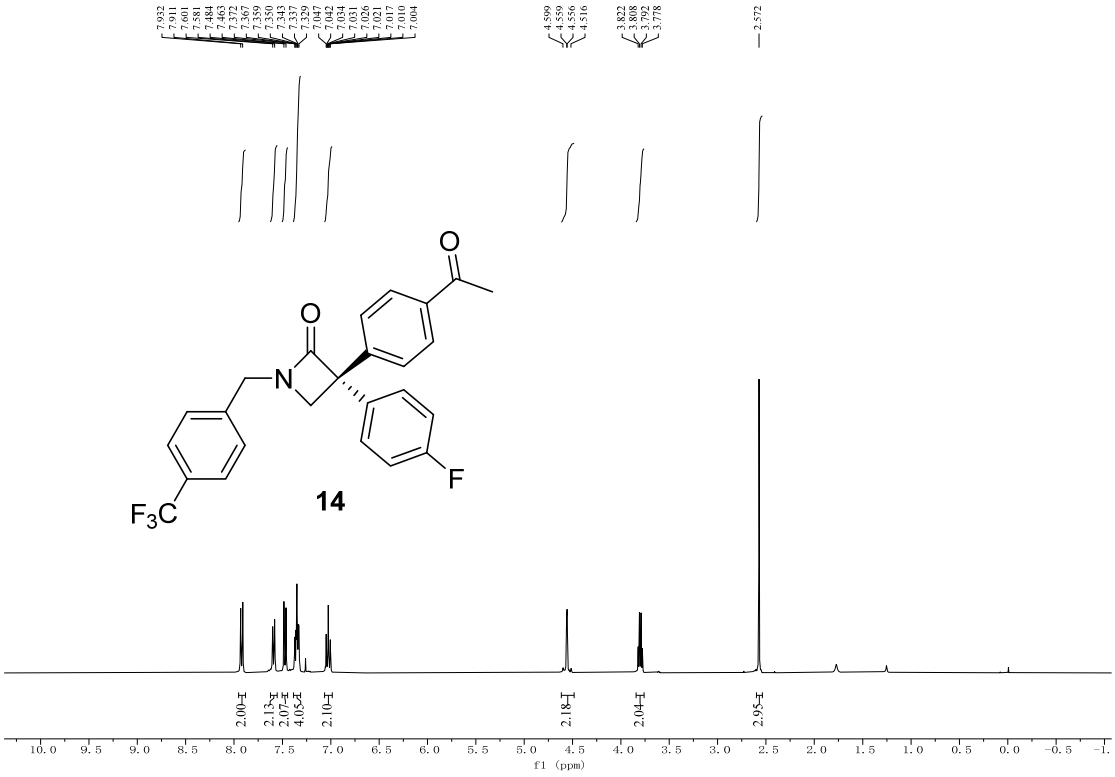
169.012
150.495
145.690
136.565
136.014
135.165
128.963
128.737
128.285
127.957
127.445
126.645
125.781
66.230
53.887
46.217
34.521
31.301
26.641
O
O
N
tBu
13
f1 (ppm)

14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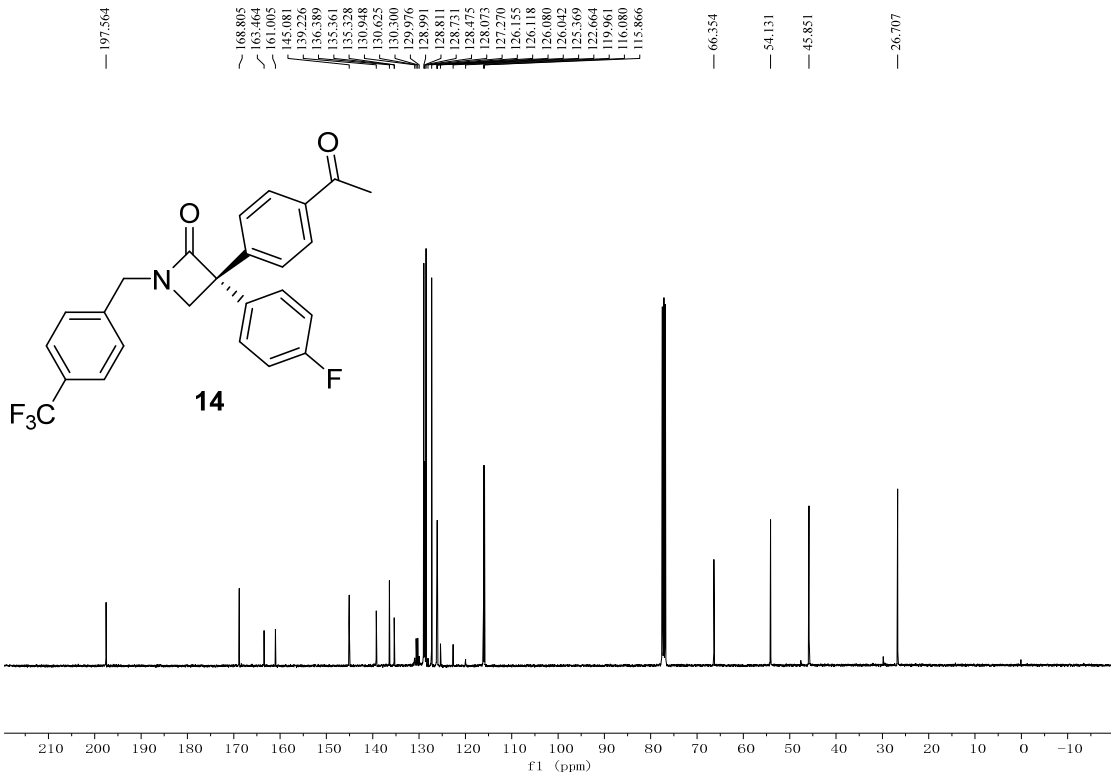
7.911
7.901
7.881
7.484
7.463
7.372
7.367
7.359
7.350
7.343
7.337
7.329
7.047
7.042
7.034
7.031
7.006
7.021
7.017
7.010
7.004
4.589
4.559
4.556
4.516
3.822
3.808
3.792
3.778
2.572
O
O
N
F
F3C
14
2.00
2.13
2.07
4.05
2.10
2.18
2.04
2.95
f1 (ppm)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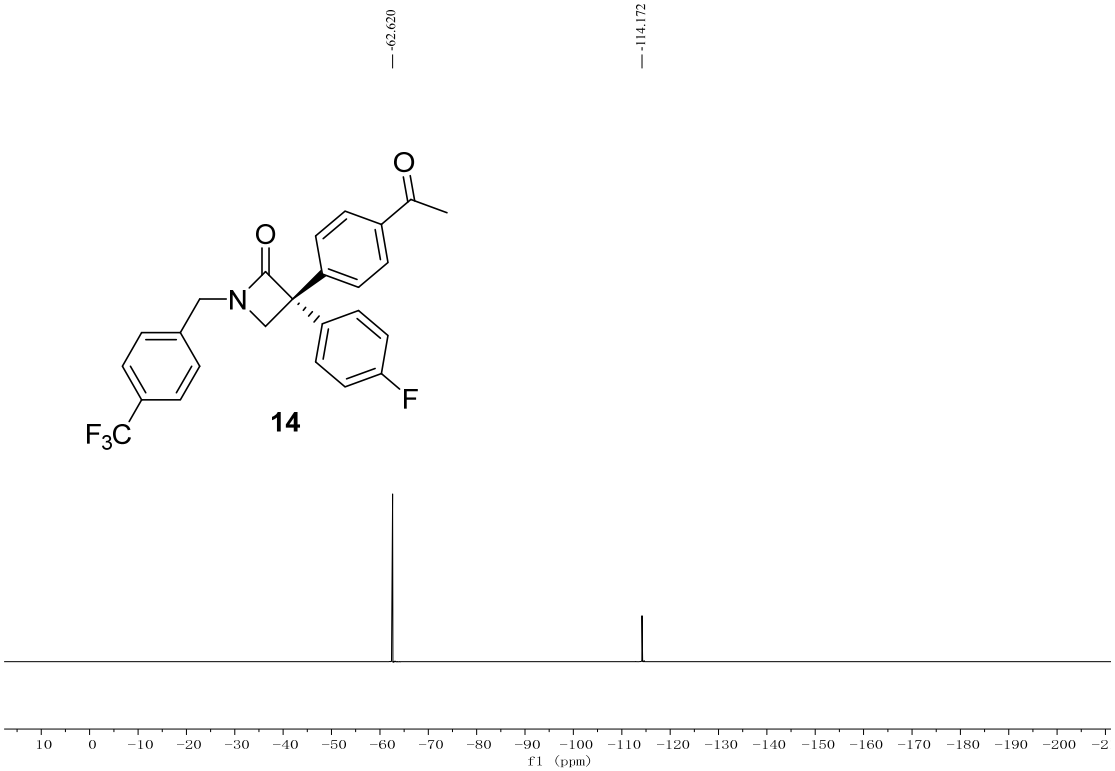
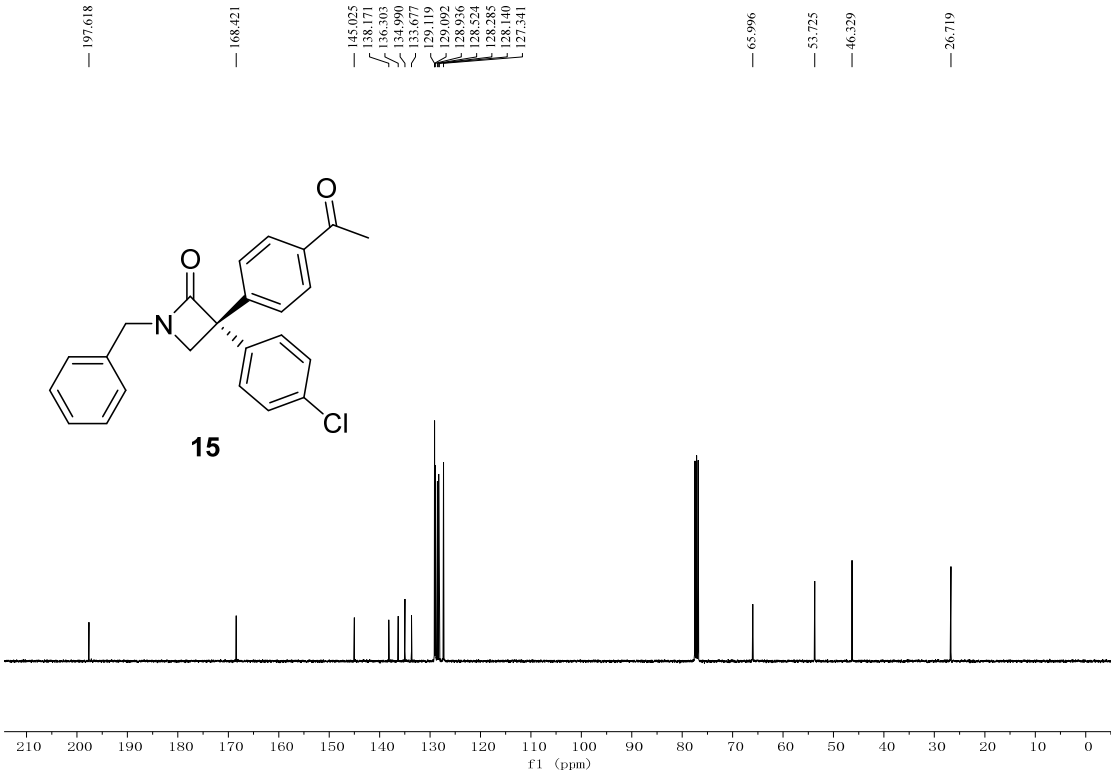
168.805
163.464
161.005
145.081
139.226
136.389
135.361
135.328
130.948
130.625
130.300
129.976
128.991
128.811
128.731
128.475
128.073
127.270
126.155
126.118
126.080
126.042
125.369
122.664
119.961
116.080
115.866
66.354
54.131
45.851
26.707
O
O
N
F
F3C
14
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)


-62.620
-114.172
O
O
N
F
F3C
14
10 0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −2
f1 (ppm)

15


7.921
7.900
7.467
7.446
7.342
7.338
7.324
7.320
7.313
7.306
7.303
7.231
7.213
4.495
3.776
3.762
3.743
3.729
2.571
O
O
N
Cl
15
2.00
2.05
7.17
1.94
2.02
2.01
2.97
f1 (ppm)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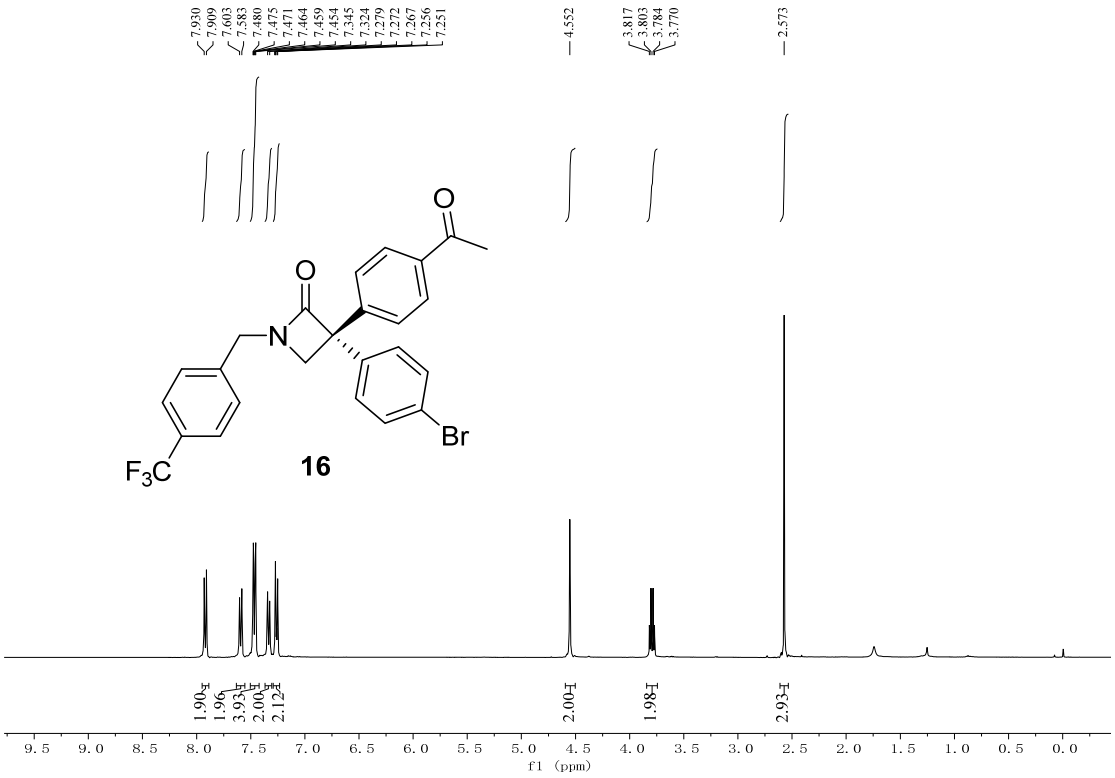
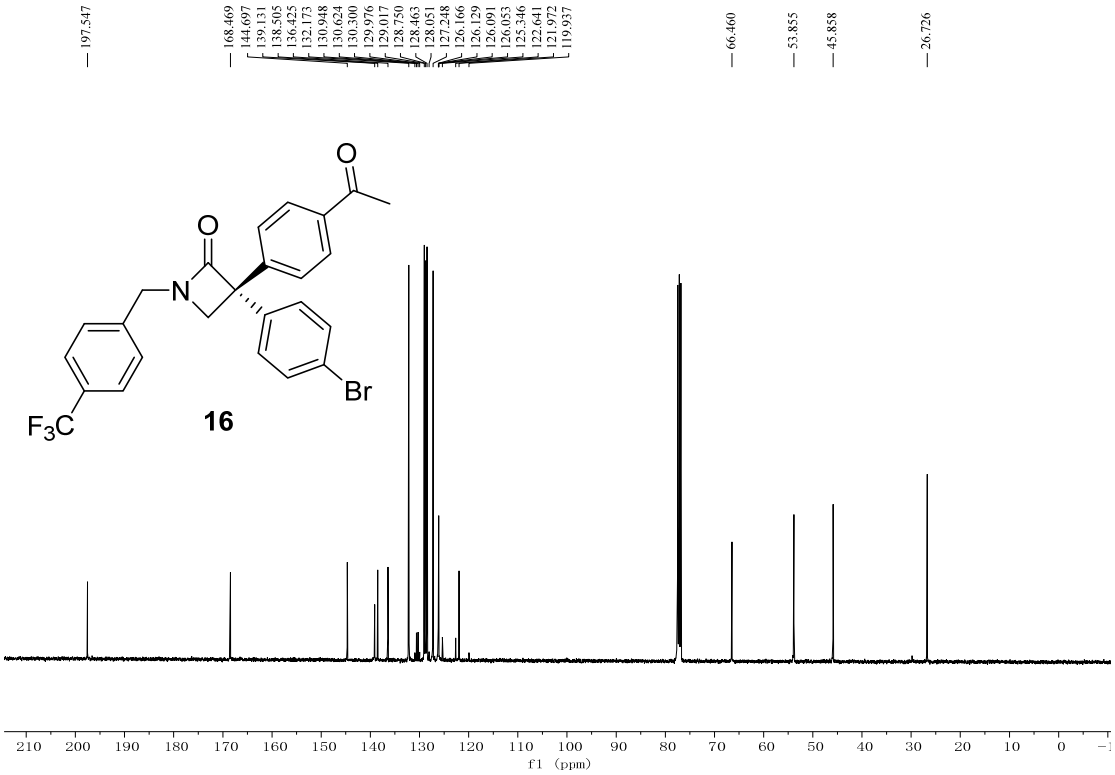
134.990
133.677
129.119
129.092
128.936
128.524
128.285
128.140
127.341
65.996
53.725
46.329
26.719
O
O
N
Cl
15
f1 (ppm)

16


7.930
7.909
7.603
7.583
7.480
7.475
7.471
7.464
7.459
7.454
7.345
7.324
7.279
7.272
7.267
7.256
7.251
4.552
3.817
3.803
3.784
3.770
2.573
O
O
N
Br
F3C
16
1.90
1.96
3.93
2.00
2.12
2.00
1.98
2.93
f1 (ppm)


197.547
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144.697
139.131
138.505
136.425
132.173
130.948
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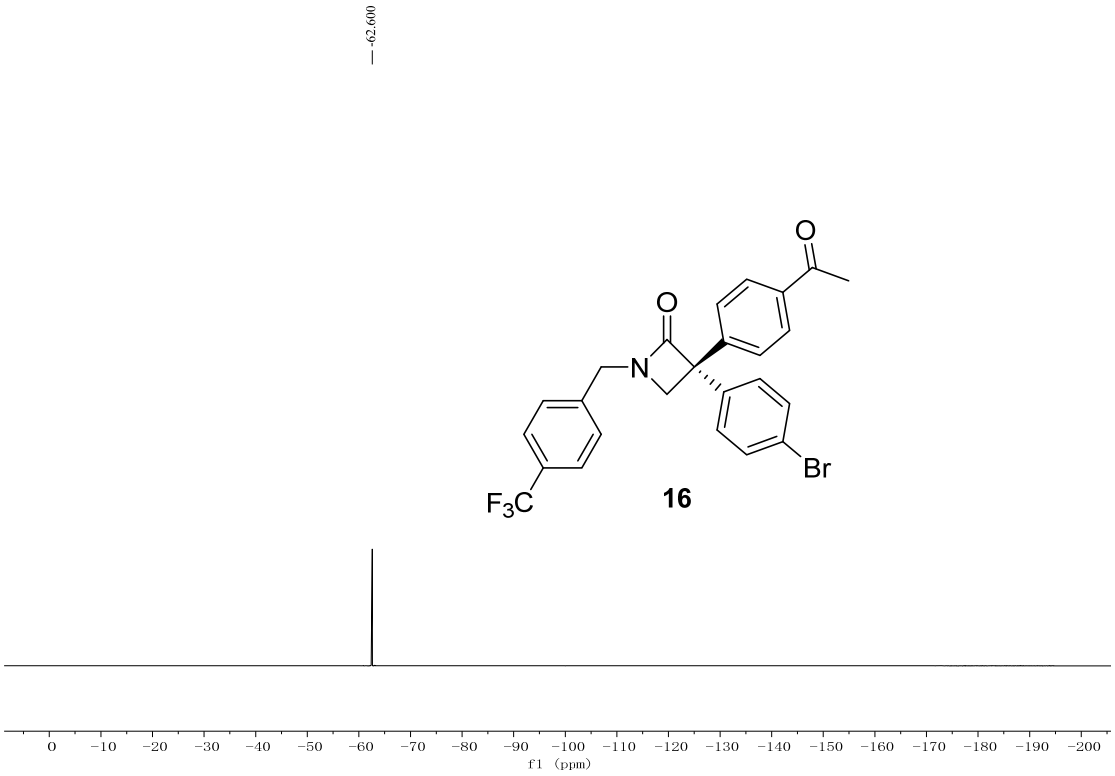
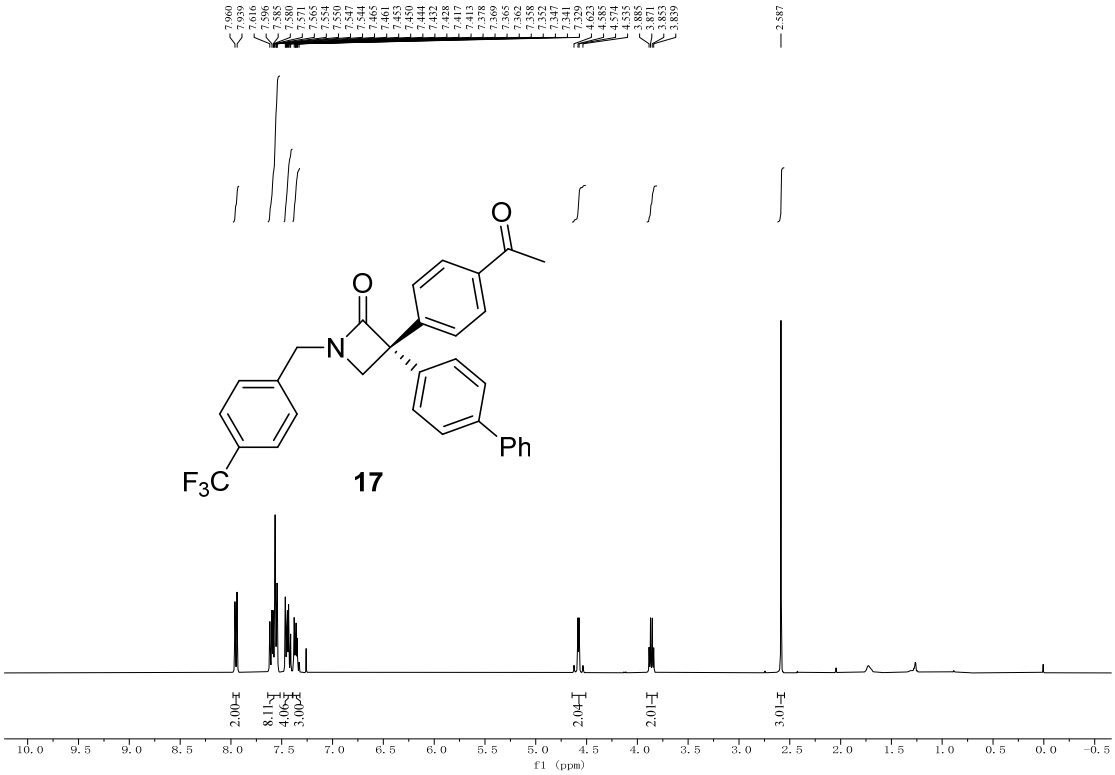
130.300
129.976
129.017
128.750
128.463
128.051
127.248
126.166
126.129
126.091
126.053
125.346
122.641
121.972
119.937
66.460
53.855
45.858
26.726
O
O
N
Br
F3C
16
f1 (ppm)


-62.600
O
O
N
Br
F3C
16
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200
f1 (ppm)

17


7.960
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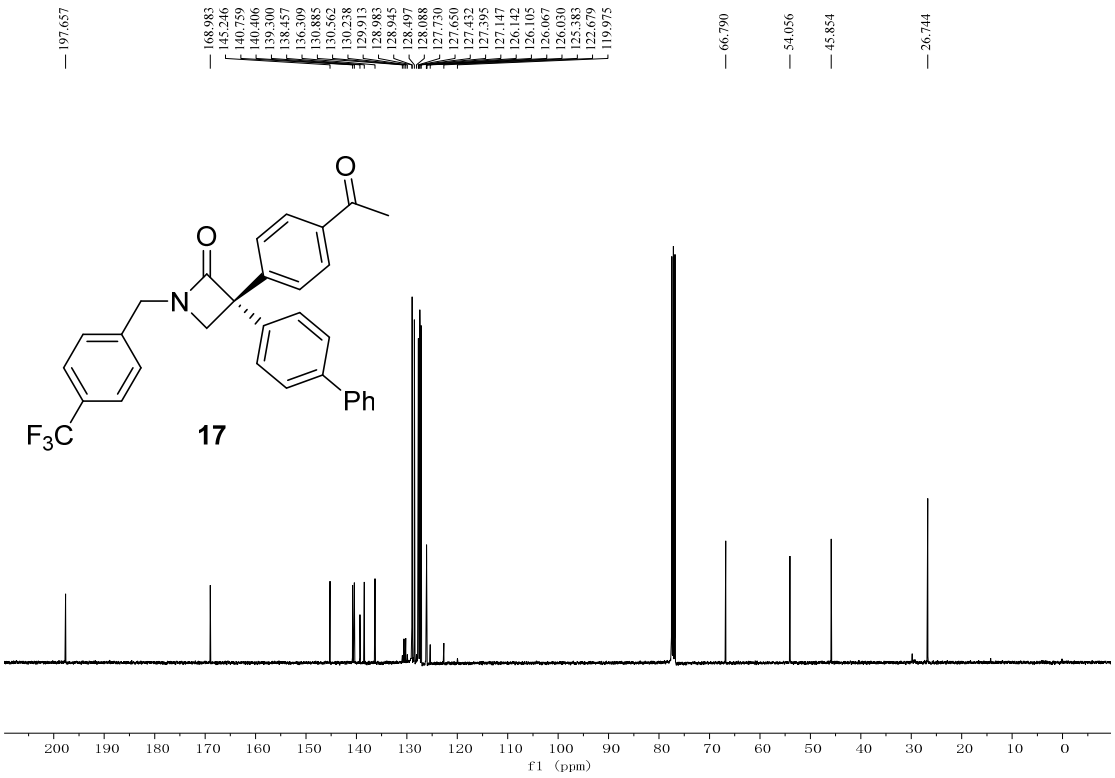
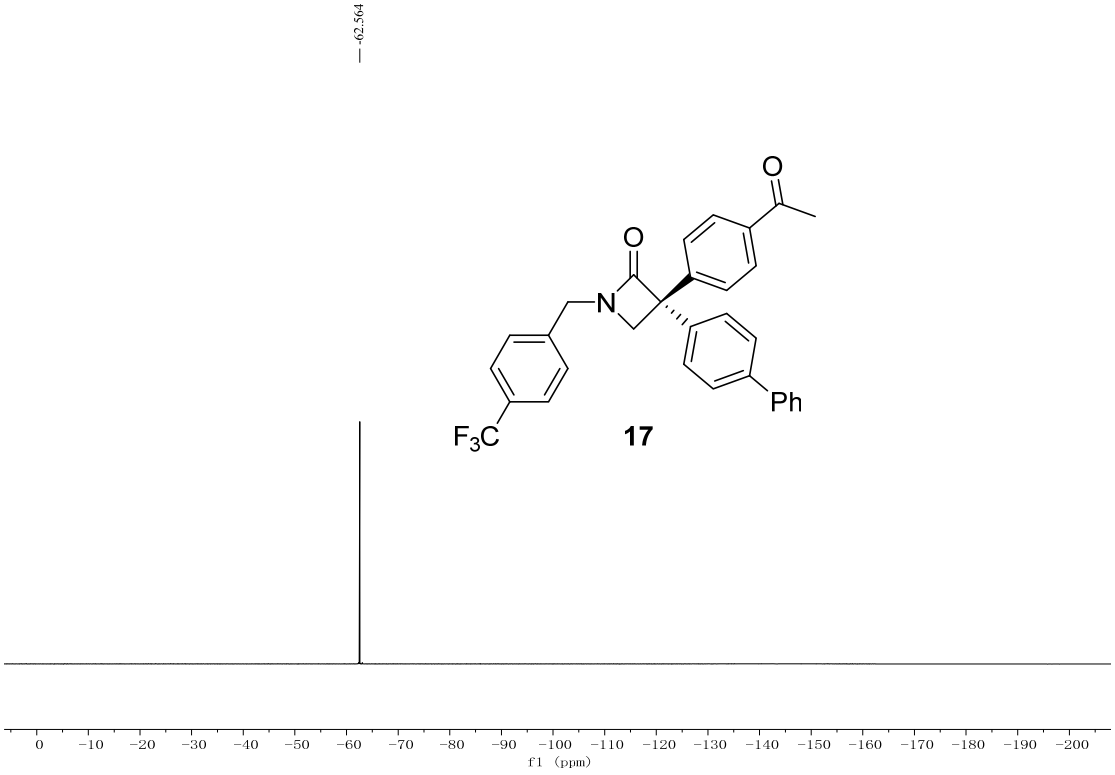
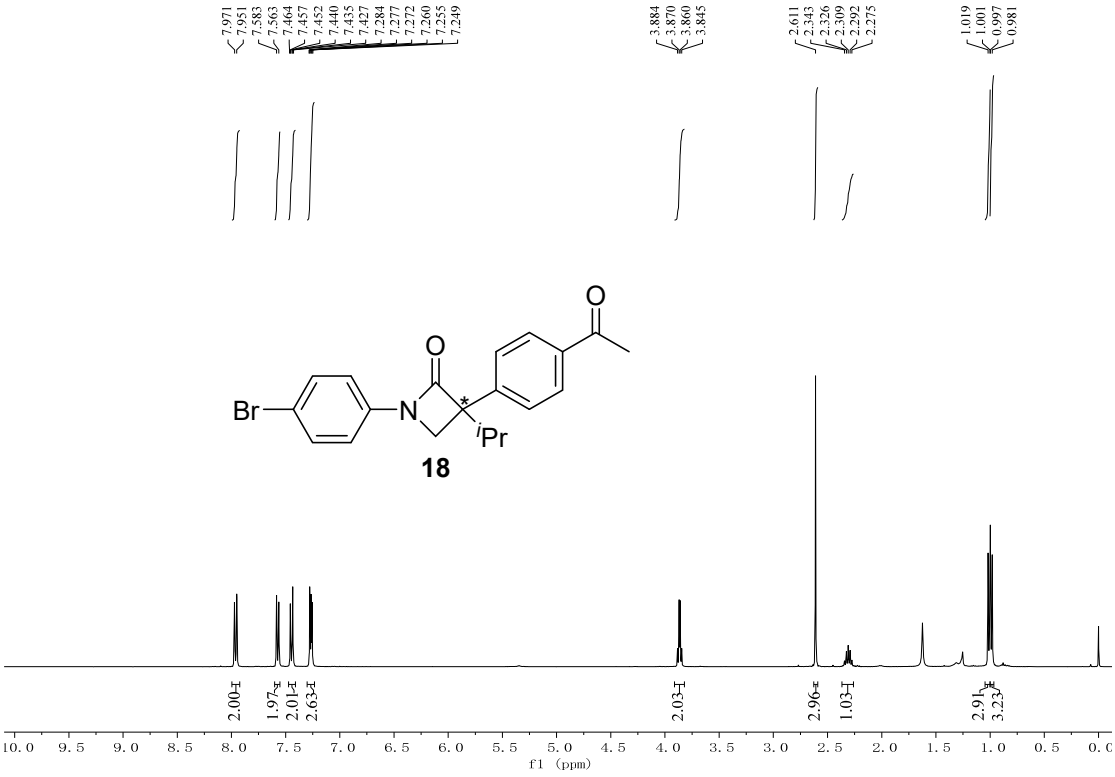
7.606
7.596
7.585
7.580
7.571
7.565
7.554
7.550
7.547
7.544
7.465
7.461
7.453
7.450
7.444
7.432
7.428
7.417
7.413
7.378
7.369
7.365
7.362
7.358
7.352
7.347
7.341
7.329
4.623
4.585
4.574
4.535
3.885
3.871
3.853
3.839
2.587
O
O
N
Ph
F3C
17
2.00
8.11
4.06
3.00
2.04
2.01
3.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


197.657
168.983
145.246
140.759
140.406
139.300
138.457
136.309
130.885
130.562
130.238
129.913
128.983
128.945
128.497
128.088
127.730
127.650
127.432
127.395
127.147
126.142
126.105
126.067
126.030
125.383
122.679
119.975
66.790
54.056
45.854
26.744
O
O
N
Ph
F3C
17
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.564
O
O
N
Ph
F3C
17
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200
f1 (ppm)

18


7.971
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7.583
7.563
7.464
7.457
7.452
7.440
7.435
7.427
7.284
7.277
7.272
7.260
7.255
7.249
3.884
3.870
3.860
3.845
2.611
2.343
2.326
2.309
2.292
2.275
1.019
1.001
0.997
0.981
O
O
Br
N
*
iPr
18
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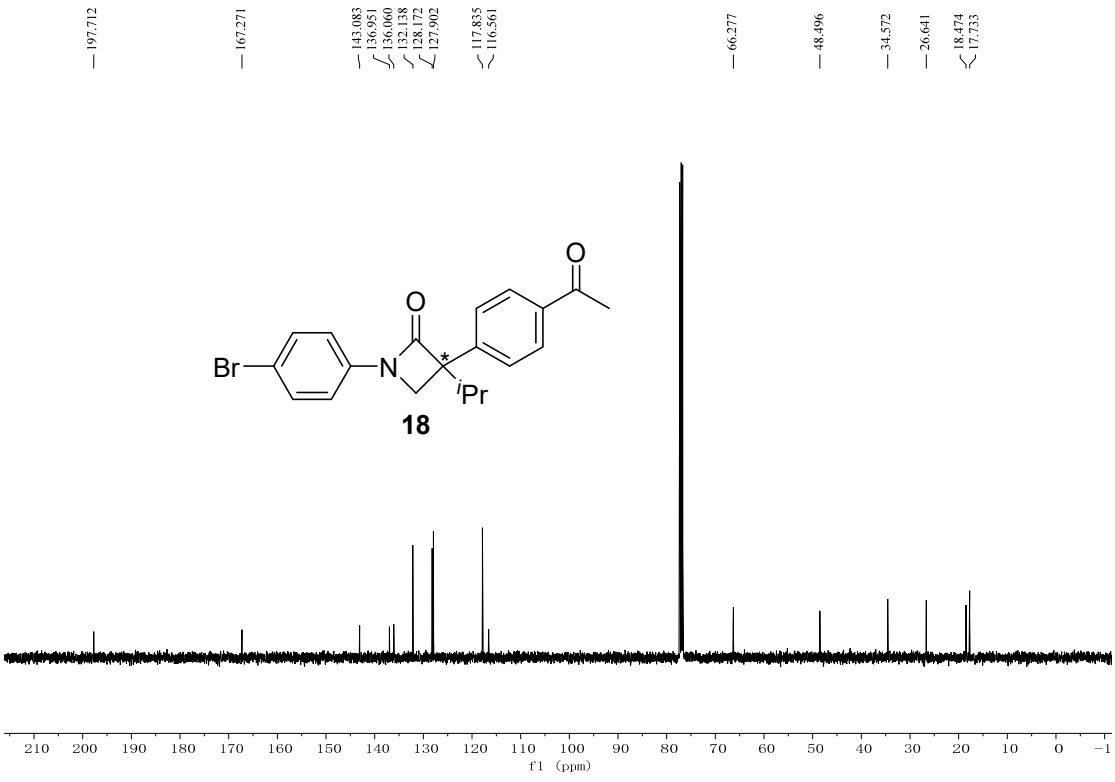
1.97
2.01
2.63
2.03
2.96
1.03
2.91
3.23
f1 (ppm)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143.083
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136.060
132.138
128.172
127.902
117.835
116.561
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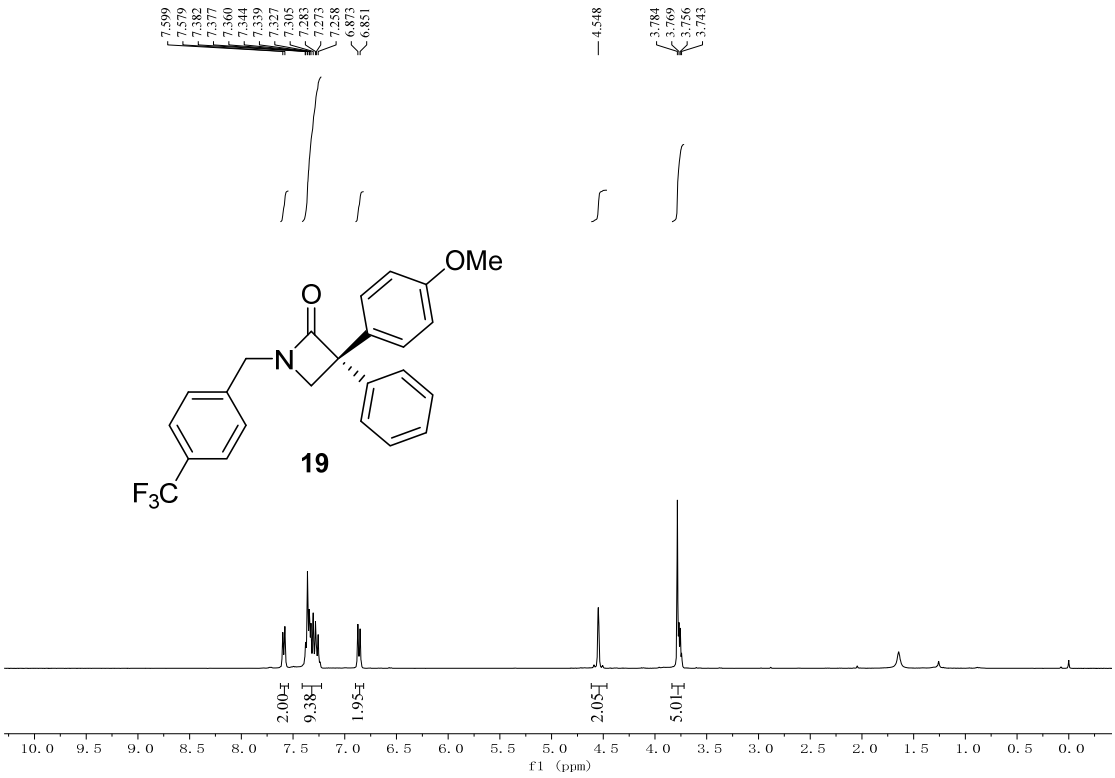
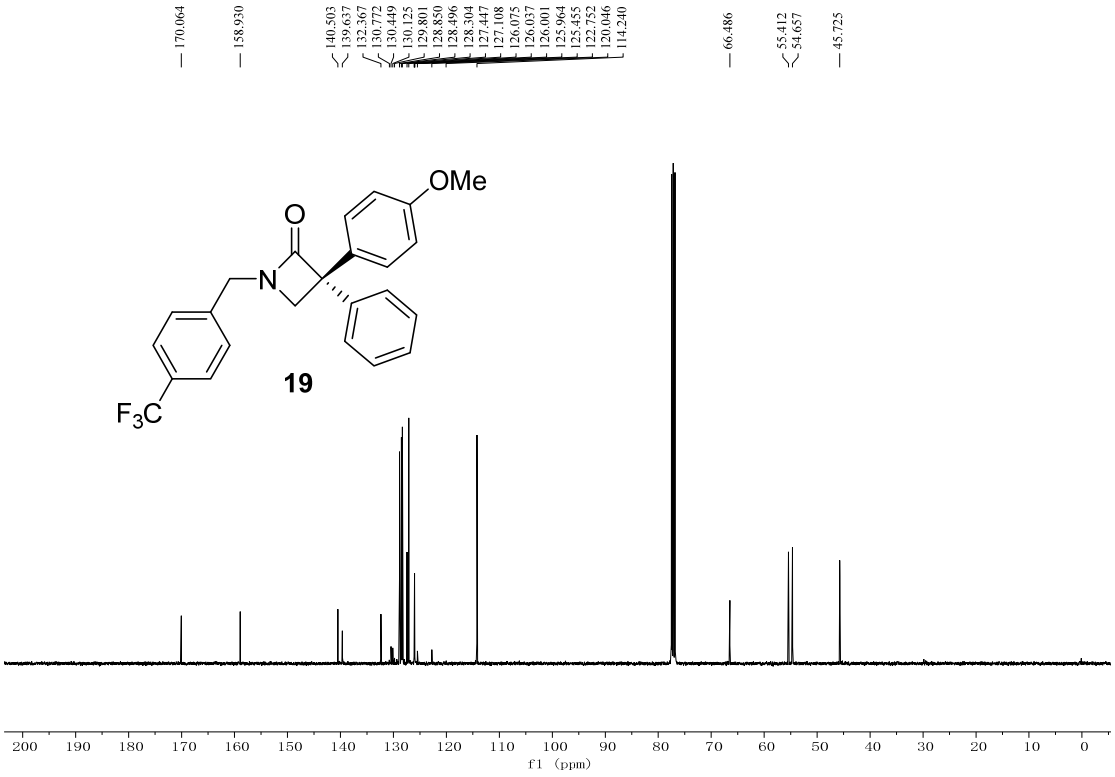
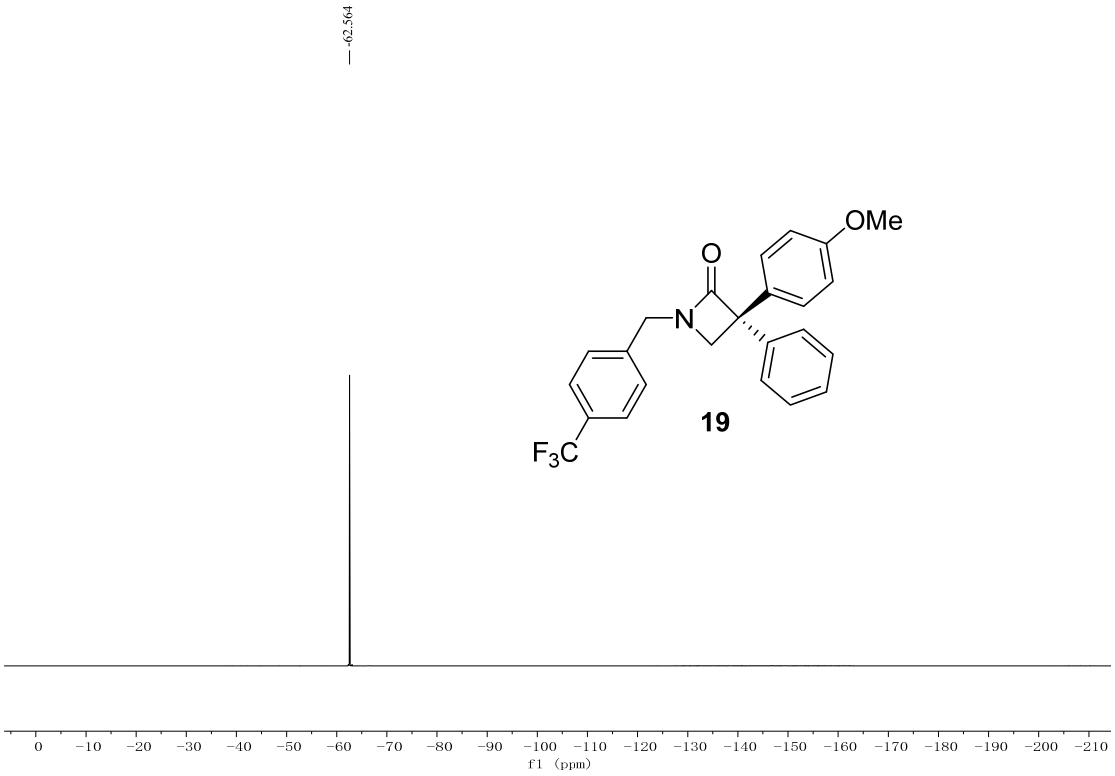
48.496
34.572
26.641
18.474
17.733
O
O
Br
N
*
iPr
18
f1 (ppm)

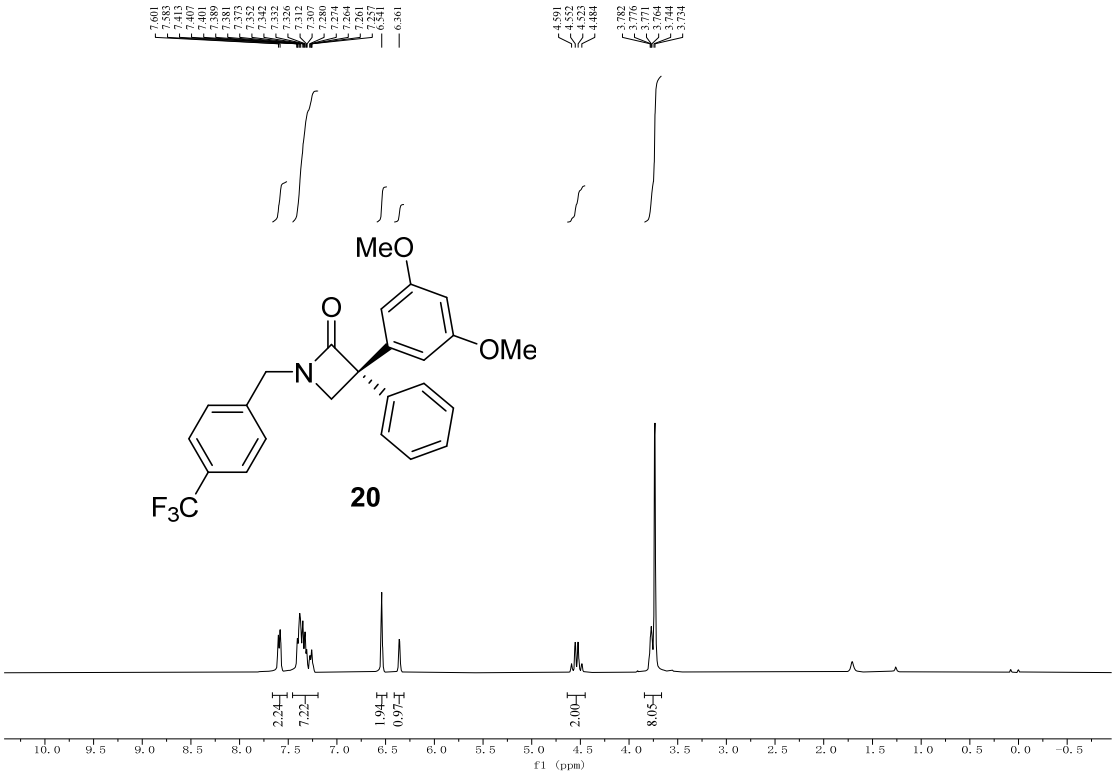
19


7.599
7.579
7.382
7.377
7.360
7.344
7.339
7.327
7.305
7.283
7.273
7.258
6.873
6.851
4.548
3.784
3.769
3.756
3.743
OMe
O
N
19
F3C
2.00
9.38
1.95
2.05
5.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


170.064
158.930
140.503
139.637
132.367
130.772
130.449
130.125
129.801
128.850
128.496
128.304
127.447
127.108
126.075
126.037
126.001
125.964
125.455
122.752
120.046
114.240
66.486
55.412
54.657
45.725
OMe
O
N
19
F3C
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.564
OMe
O
N
F3C
19
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −210
f1 (ppm)

20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7.401
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7.353
7.352
7.342
7.332
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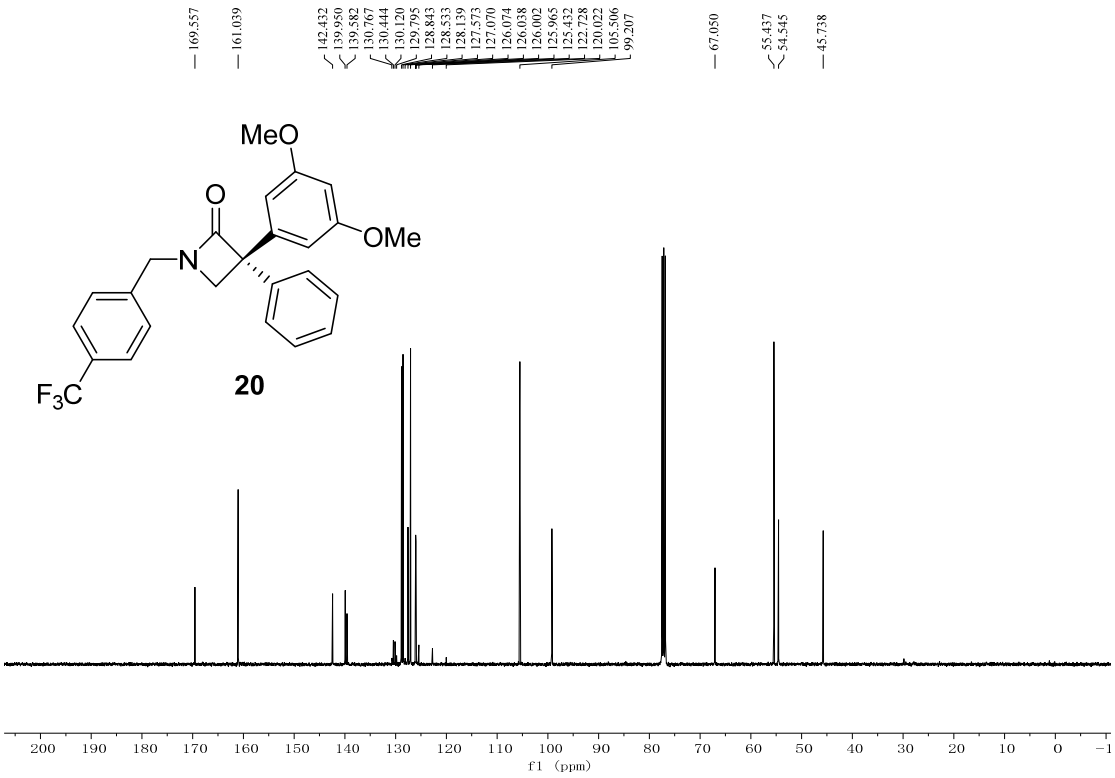
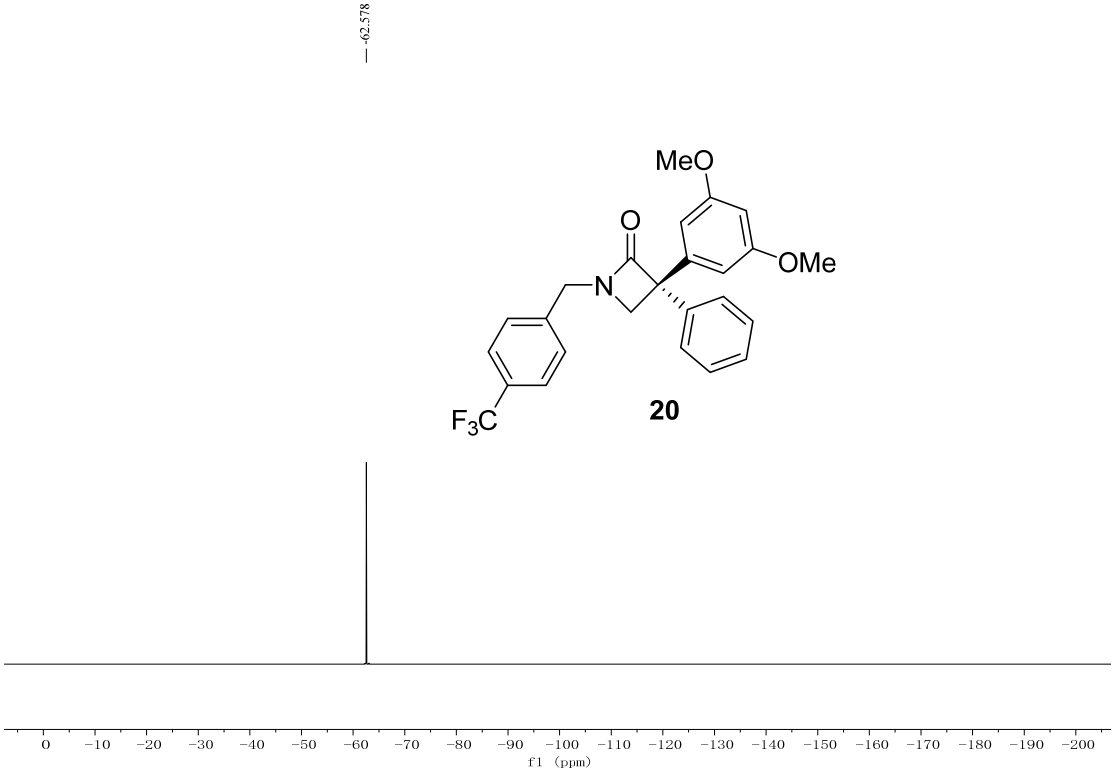
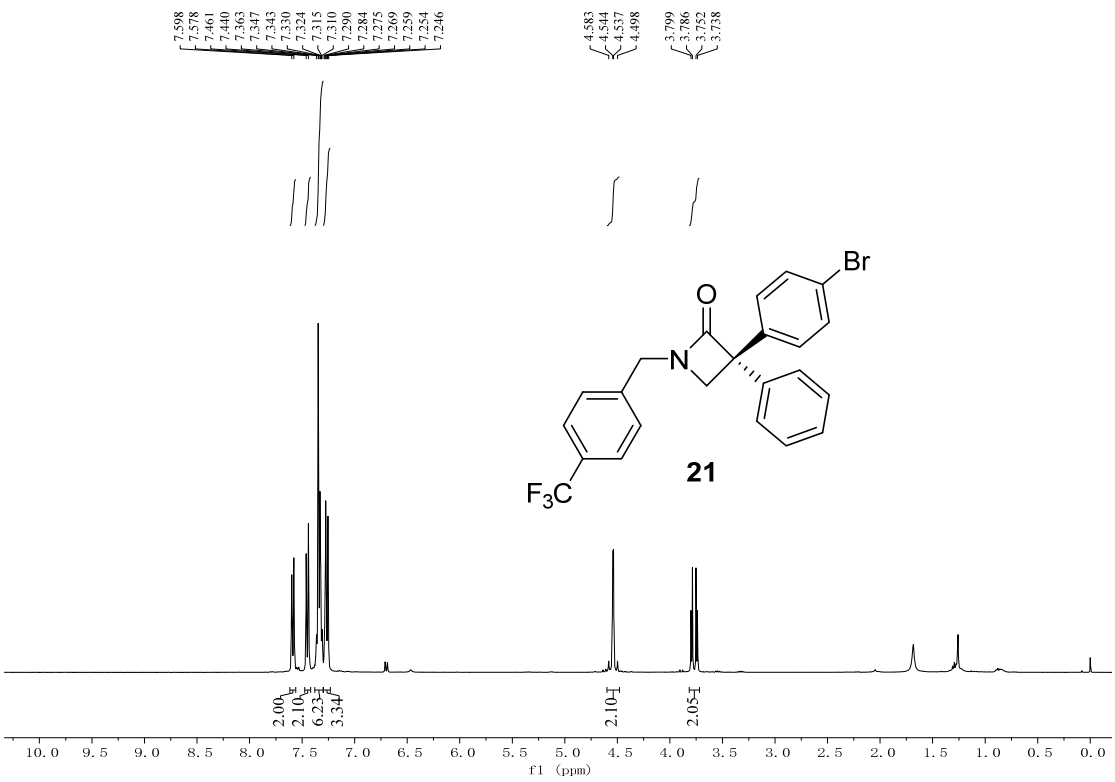
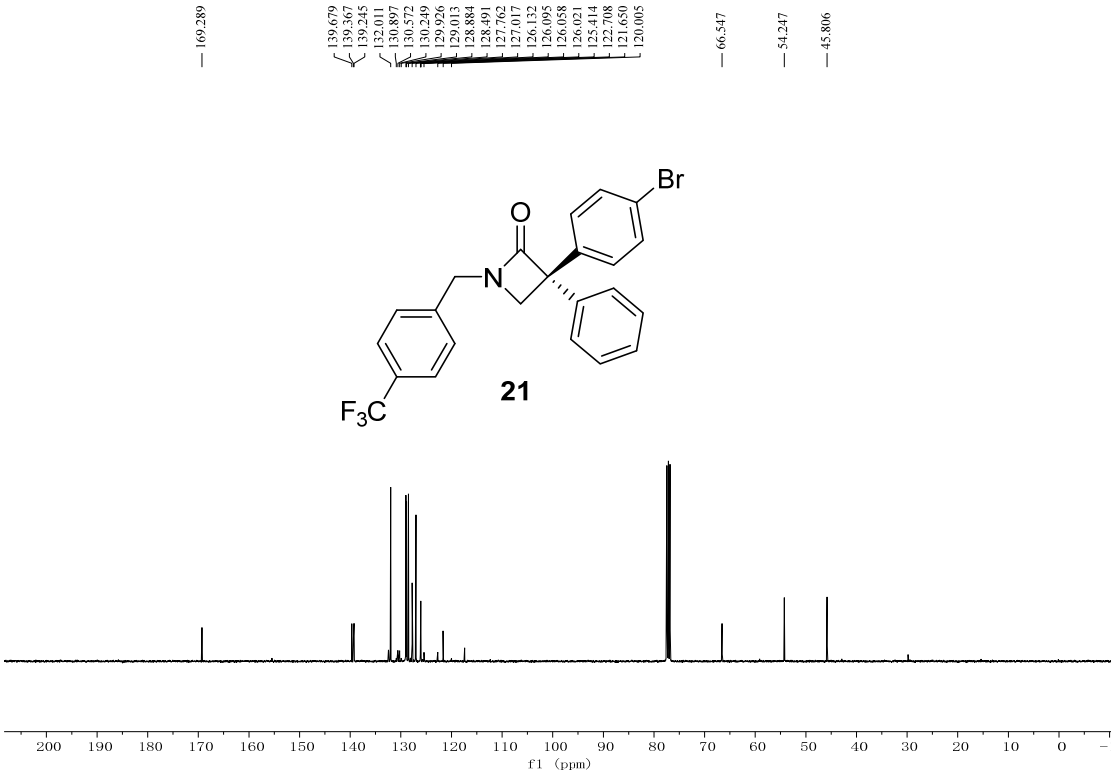
7.312
7.307
7.280
7.274
7.264
7.261
7.257
6.541
6.361
4.591
4.552
4.523
4.484
3.782
3.776
3.771
3.764
3.744
3.734
MeO
O
N
OMe
F3C
20
2.24
7.22
1.94
0.97
2.00
8.05
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

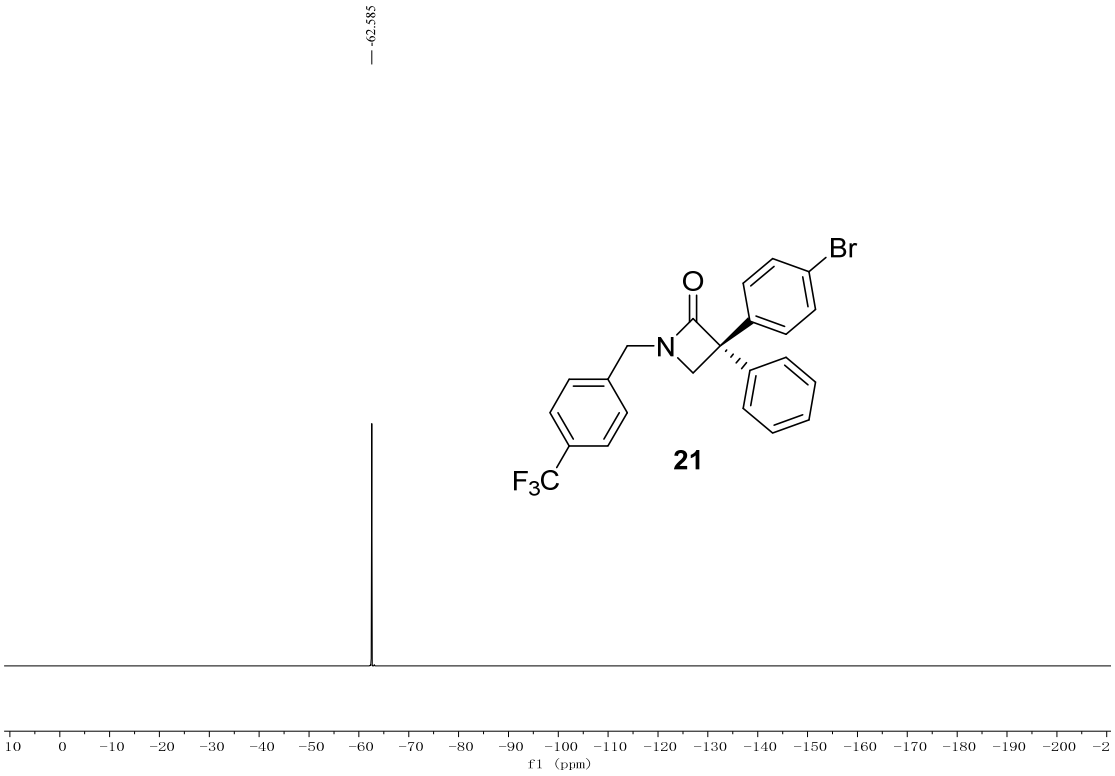

169.557
161.039
142.432
139.950
139.582
130.767
130.444
130.120
129.795
128.843
128.533
128.139
127.573
127.070
126.074
126.038
126.002
125.965
125.432
122.728
120.022
105.506
99.207
67.050
55.437
54.545
45.738
MeO
O
OMe
N
F3C
20
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −1
f1 (ppm)


-62.578
MeO
O
OMe
N
F3C
20
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200
f1 (ppm)

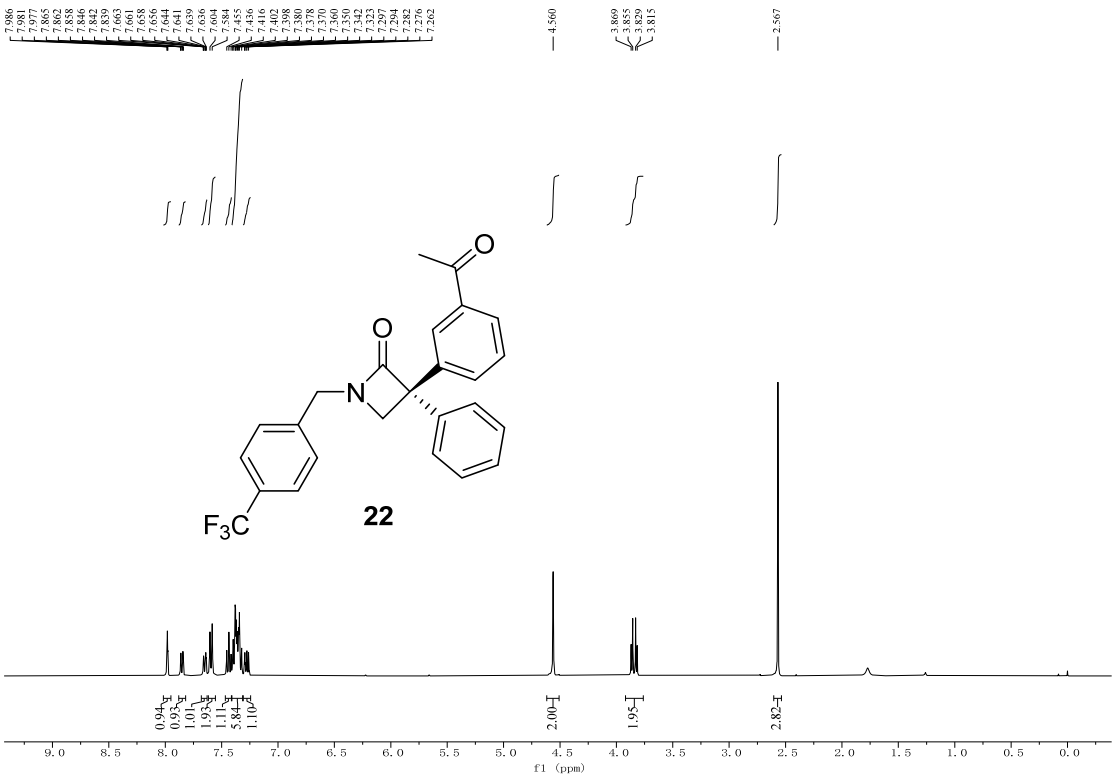
21

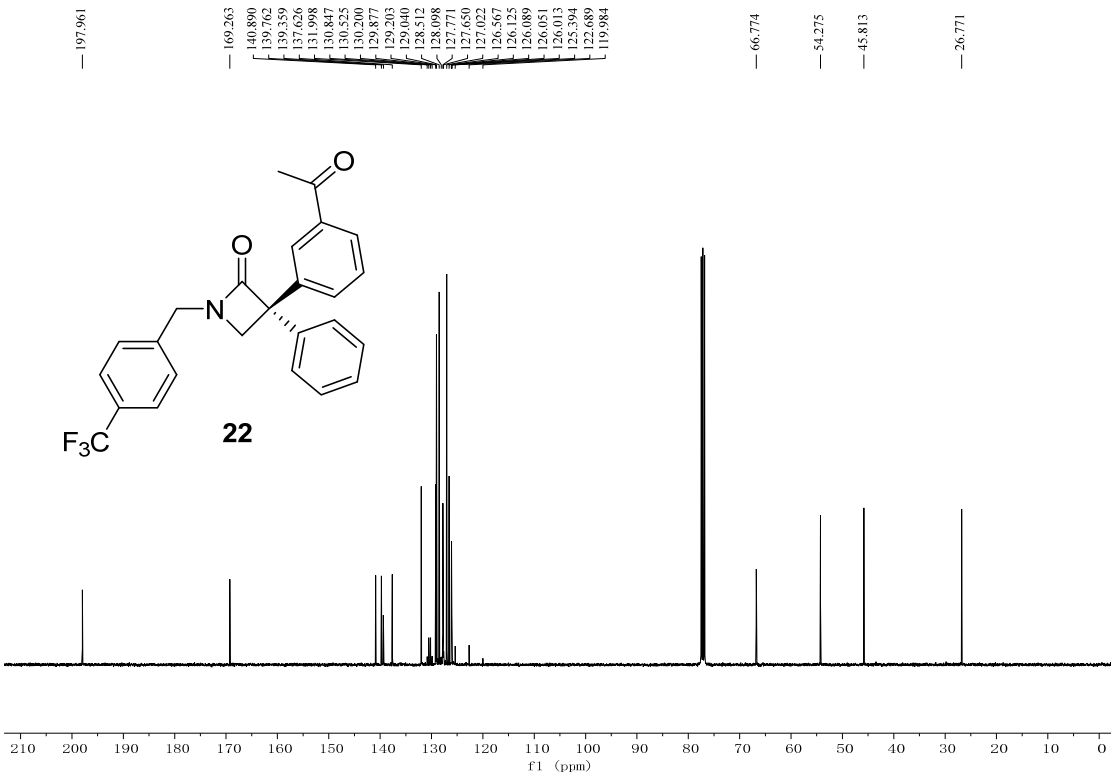

7.598
7.578
7.461
7.440
7.363
7.347
7.343
7.330
7.324
7.315
7.310
7.290
7.284
7.275
7.269
7.259
7.254
7.246
4.583
4.544
4.537
4.498
3.799
3.786
3.752
3.738
Br
O
N
F3C
21
2.00
2.10
6.23
3.34
2.10
2.05
f1 (ppm)

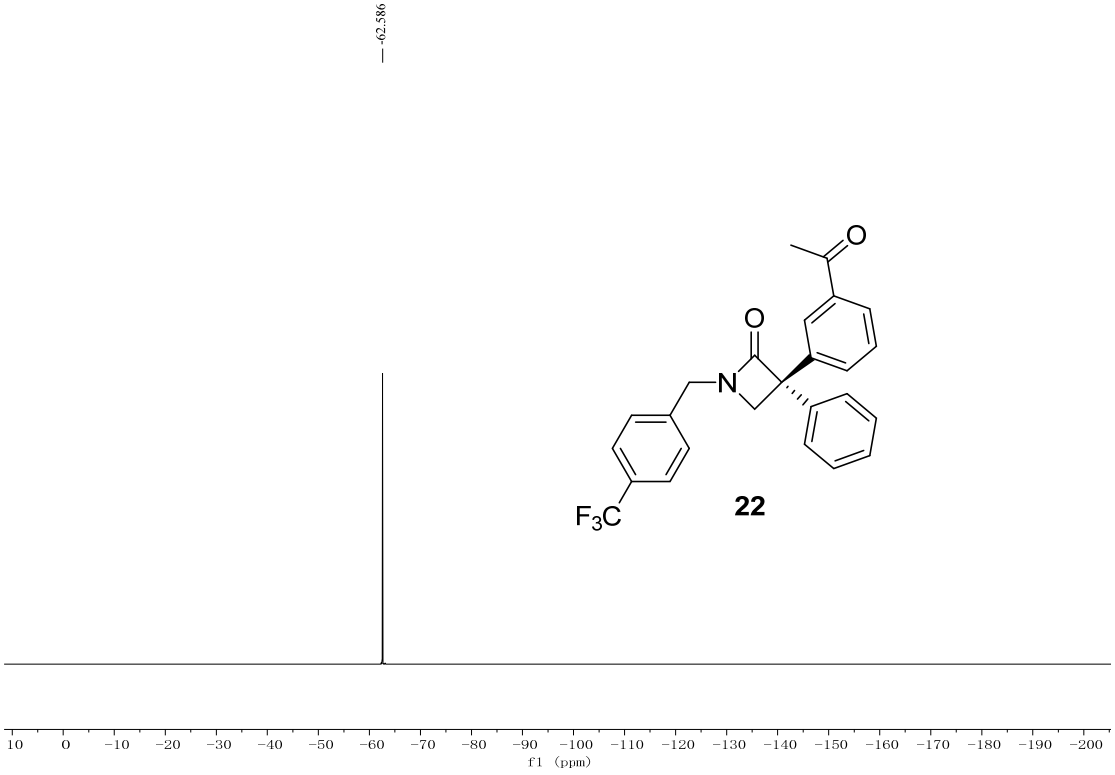

169.289
139.679
139.367
139.245
132.011
130.897
130.572
130.249
129.926
129.013
128.884
128.491
127.762
127.017
126.132
126.095
126.058
126.021
125.414
122.708
121.650
120.005
66.547
54.247
45.806
Br
O
N
F3C
21
f1 (ppm)


-62.585
Br
O
N
F3C
21
10 0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −2
f1 (ppm)

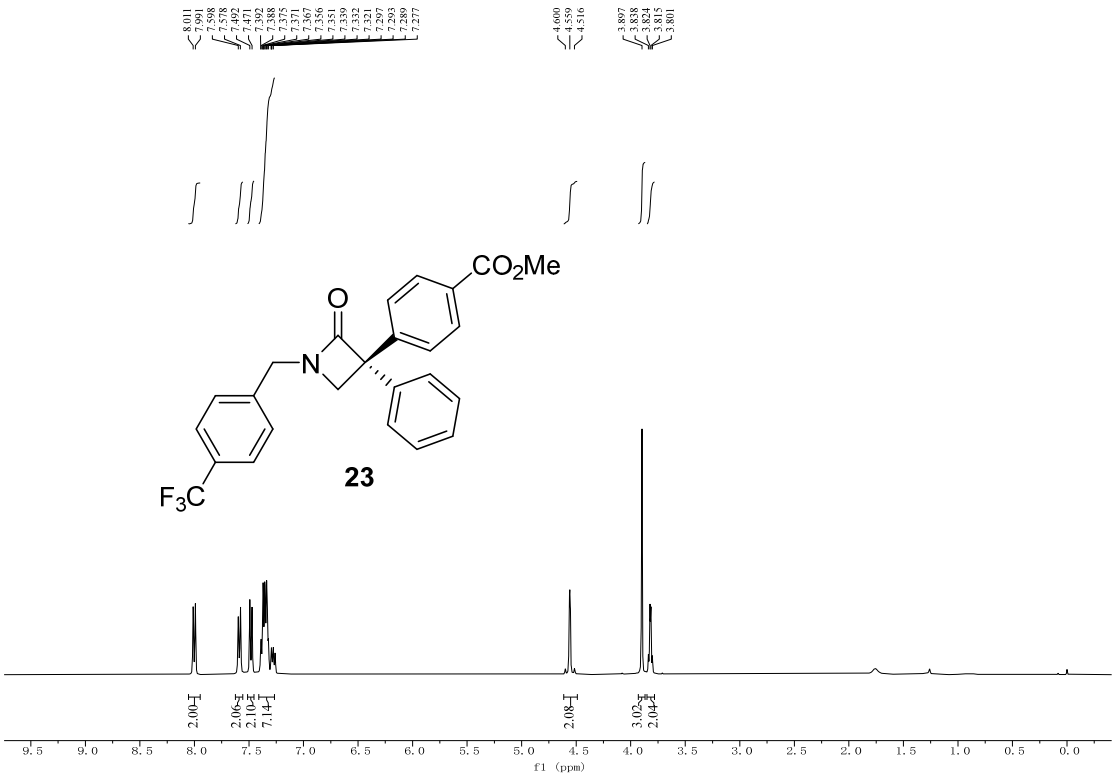
22

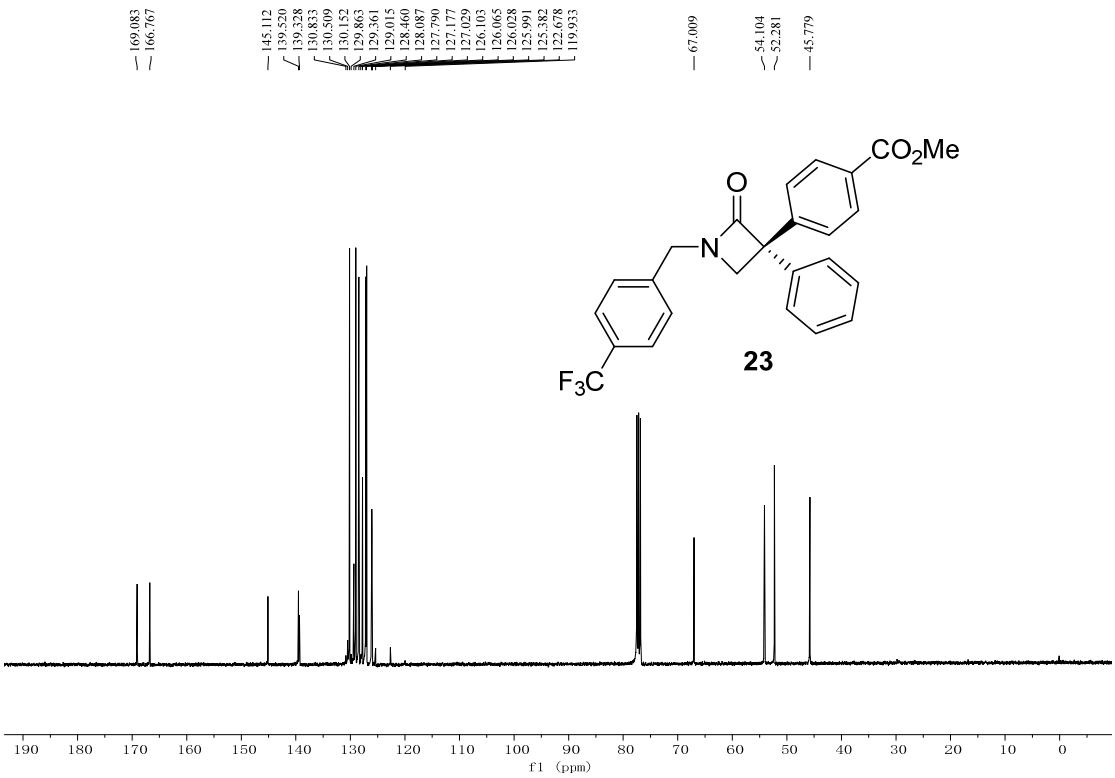

7.986
7.981
7.977
7.865
7.862
7.858
7.846
7.842
7.839
7.663
7.661
7.658
7.656
7.644
7.641
7.639
7.636
7.604
7.584
7.455
7.436
7.416
7.402
7.398
7.380
7.378
7.370
7.360
7.350
7.342
7.323
7.297
7.284
7.282
7.276
7.262
4.560
3.869
3.855
3.829
3.815
2.567
O
O
N
F3C
22
0.94
0.93
1.01
1.93
1.11
5.84
1.10
2.00
1.95
2.82
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)

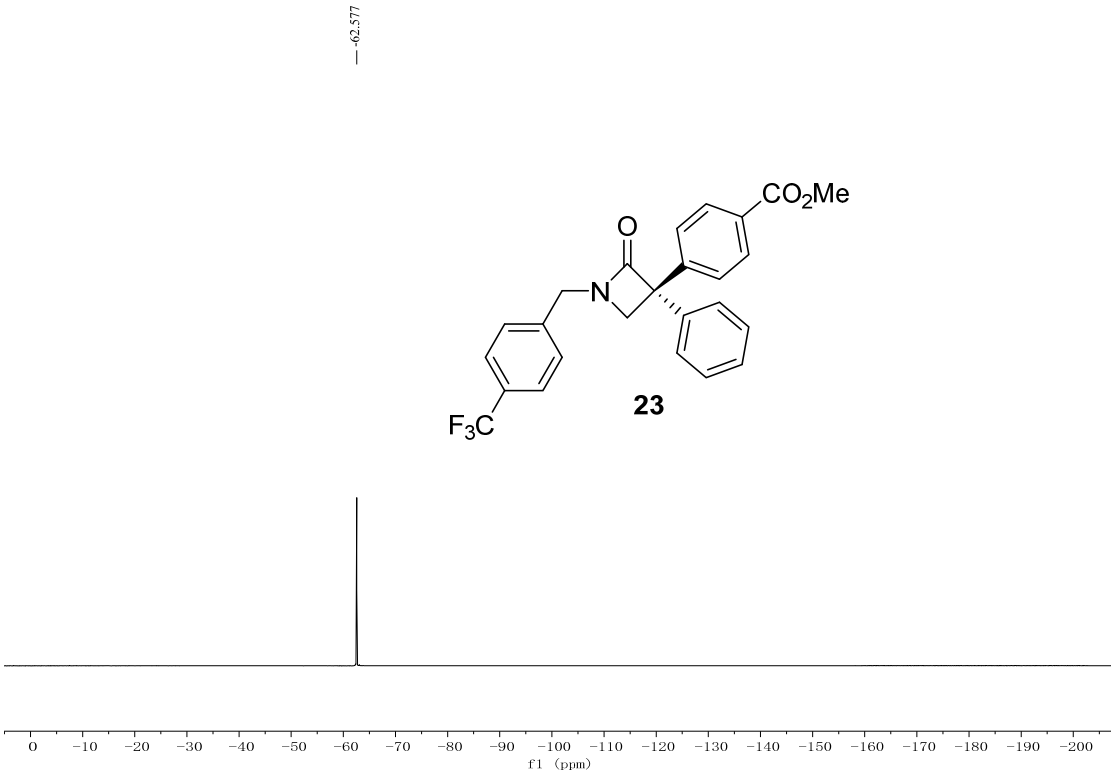

197.961
169.263
140.890
139.762
139.359
137.626
131.998
130.847
130.525
130.200
129.877
129.203
129.040
128.512
128.098
127.771
127.650
127.022
126.567
126.125
126.089
126.051
126.013
125.394
122.689
119.984
66.774
54.275
45.813
26.771
O
O
N
F3C
22
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.586
O
O
N
F3C
22
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

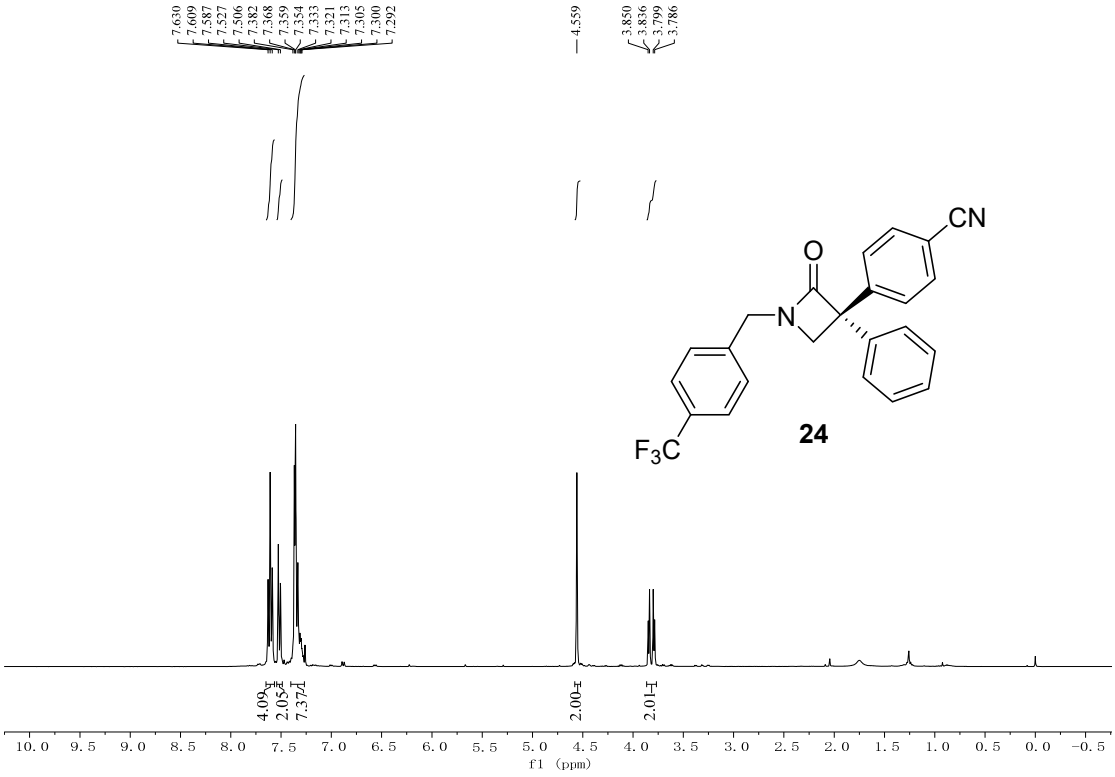
23

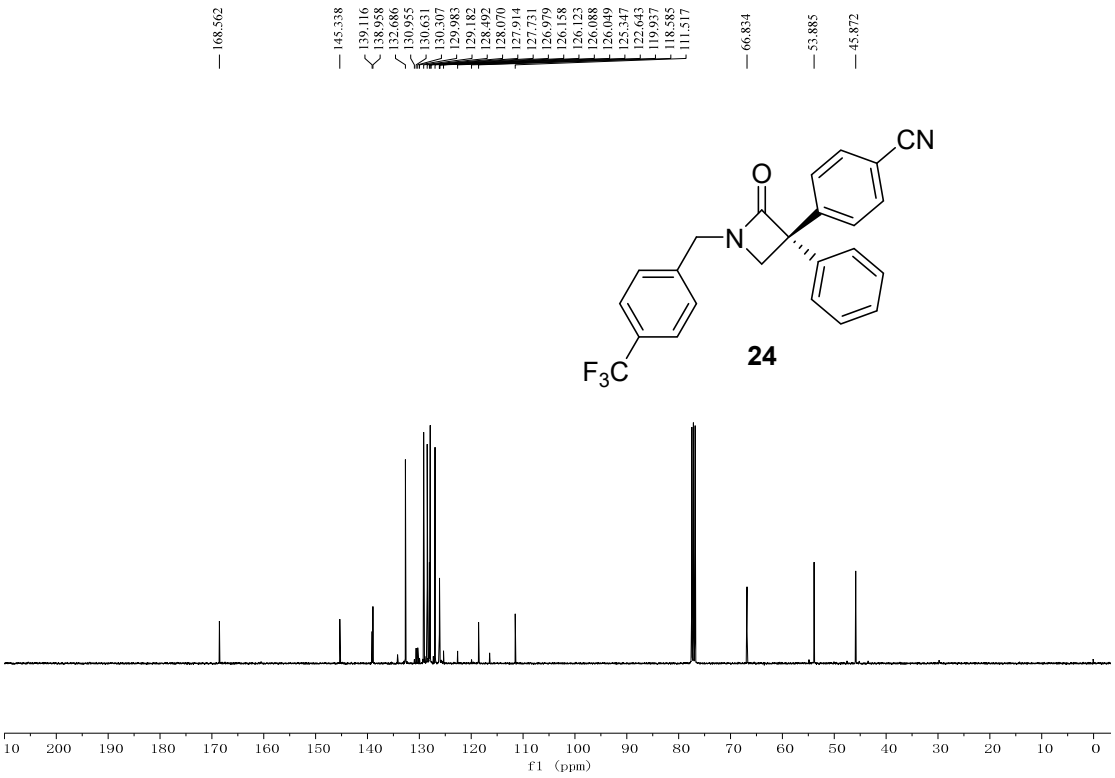

8.011
7.991
7.988
7.578
7.492
7.471
7.392
7.388
7.375
7.371
7.367
7.356
7.351
7.339
7.332
7.321
7.307
7.293
7.289
7.277
4.600
4.559
4.516
3.897
3.838
3.824
3.815
3.801
CO2Me
O
N
F3C
23
2.00
2.06
2.10
7.14
2.08
3.02
2.04
f1 (ppm)

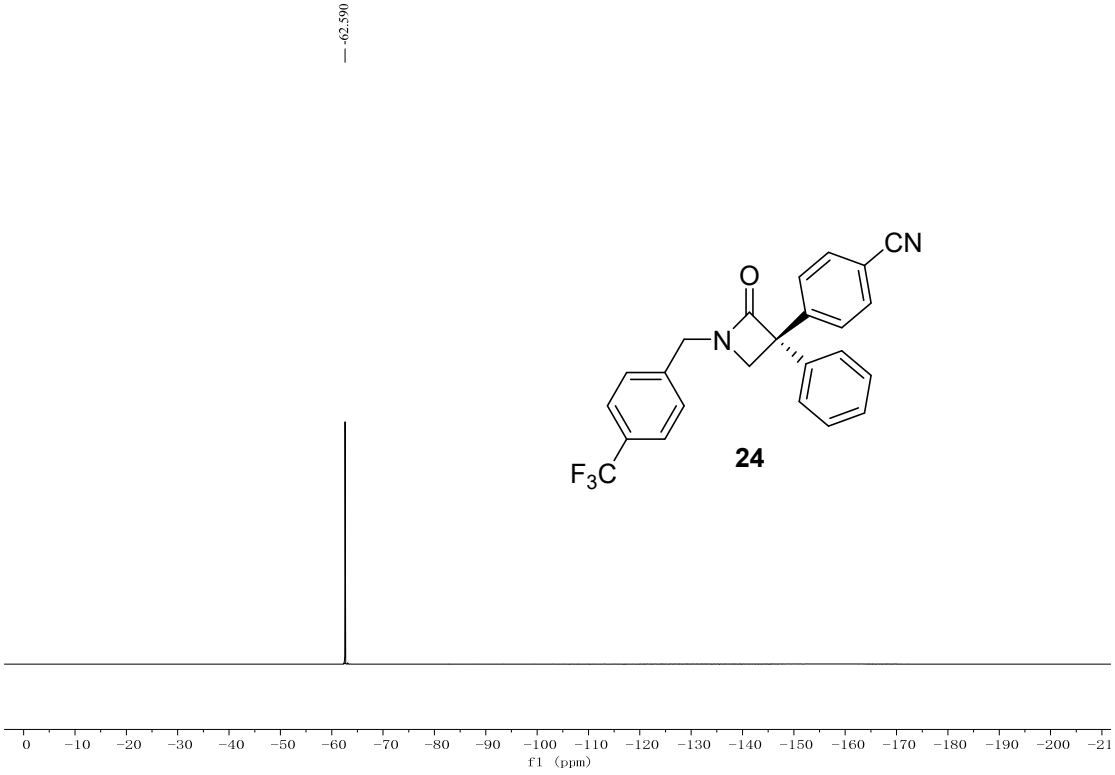

169.083
166.767
145.112
139.520
139.328
130.833
130.509
130.152
129.863
129.361
129.015
128.460
128.087
127.790
127.177
127.029
126.103
126.065
126.028
125.991
125.382
122.678
119.933
67.009
54.104
52.281
45.779
CO2Me
O
N
F3C
23
f1 (ppm)


-62.577
CO2Me
O
N
F3C
23
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

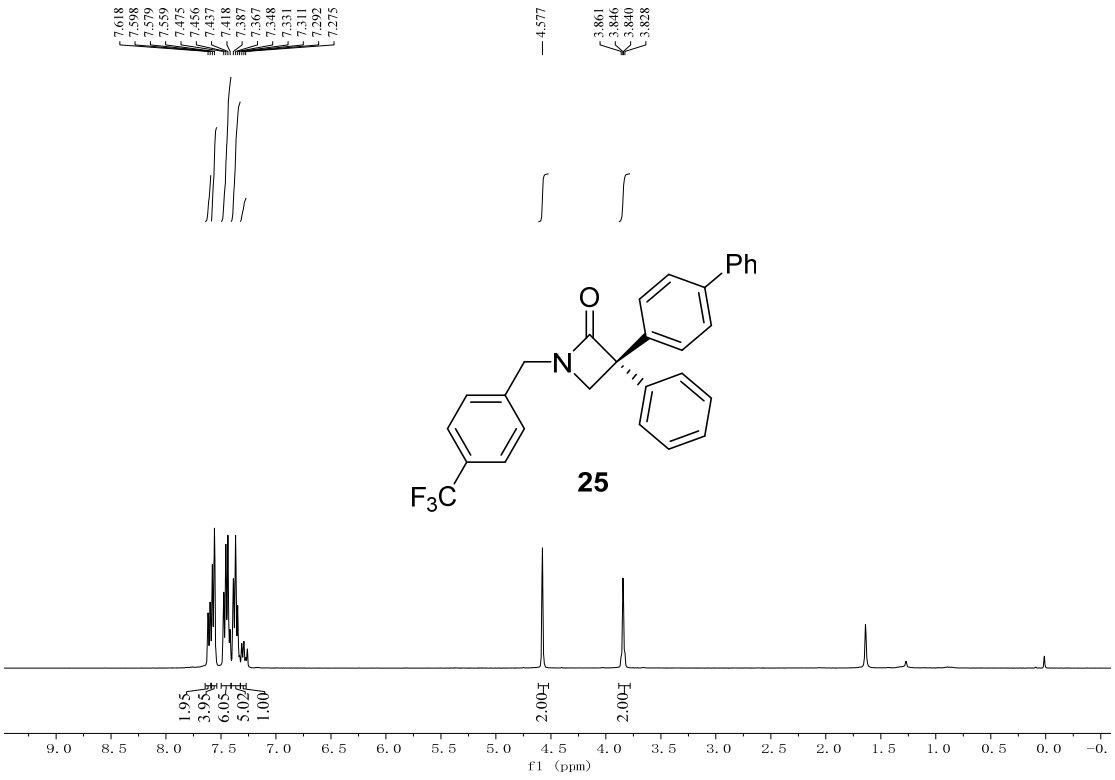
24

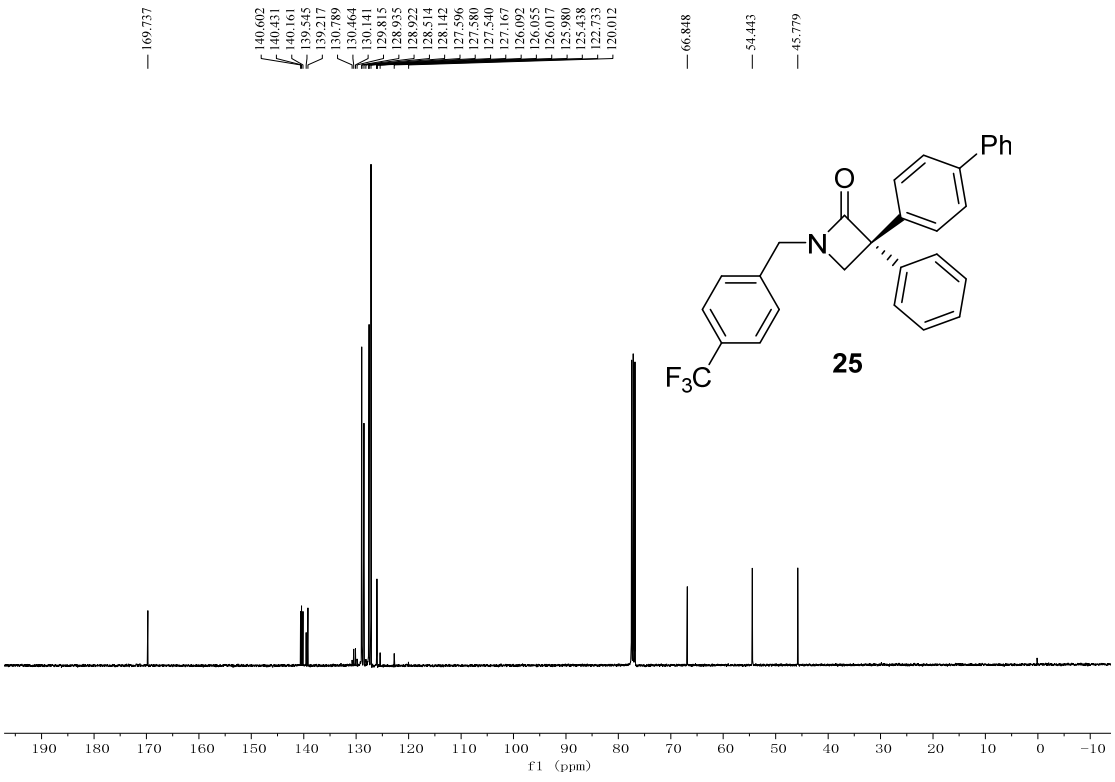

7.630
7.609
7.587
7.527
7.506
7.382
7.368
7.359
7.354
7.333
7.321
7.313
7.305
7.300
7.292
4.559
3.850
3.836
3.799
3.786
CN
O
N
F3C
24
4.09
2.05
7.37
2.00
2.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

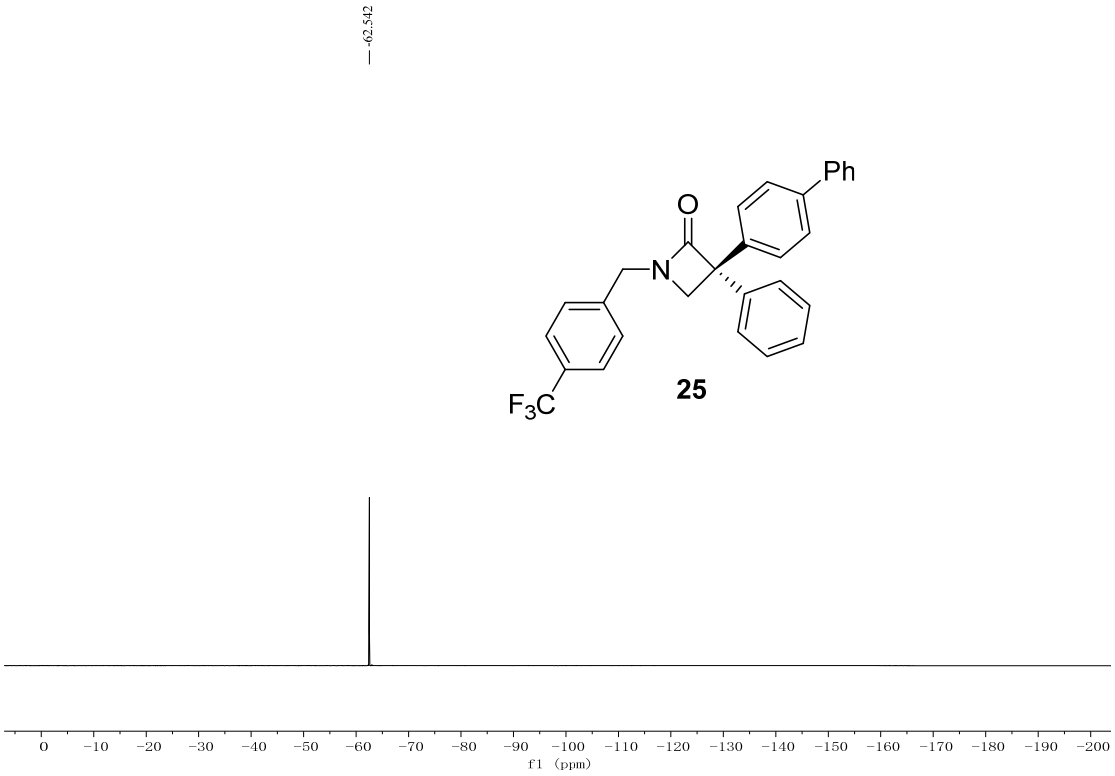

168.562
145.338
139.116
138.958
132.686
130.955
130.631
130.307
129.983
129.182
128.492
128.070
127.914
127.731
126.979
126.158
126.123
126.088
126.049
125.347
122.643
119.937
118.585
111.517
66.834
53.885
45.872
CN
O
N
F3C
24
10 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.590
CN
O
N
F3C
24
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −21
f1 (ppm)

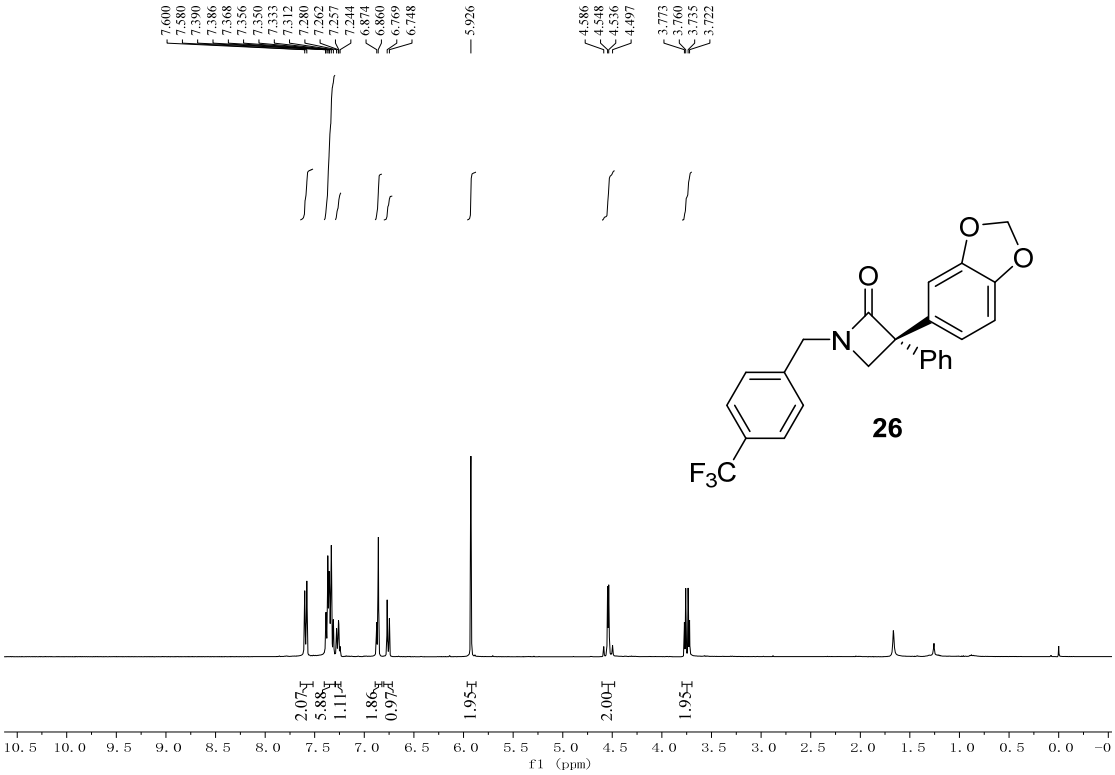
25

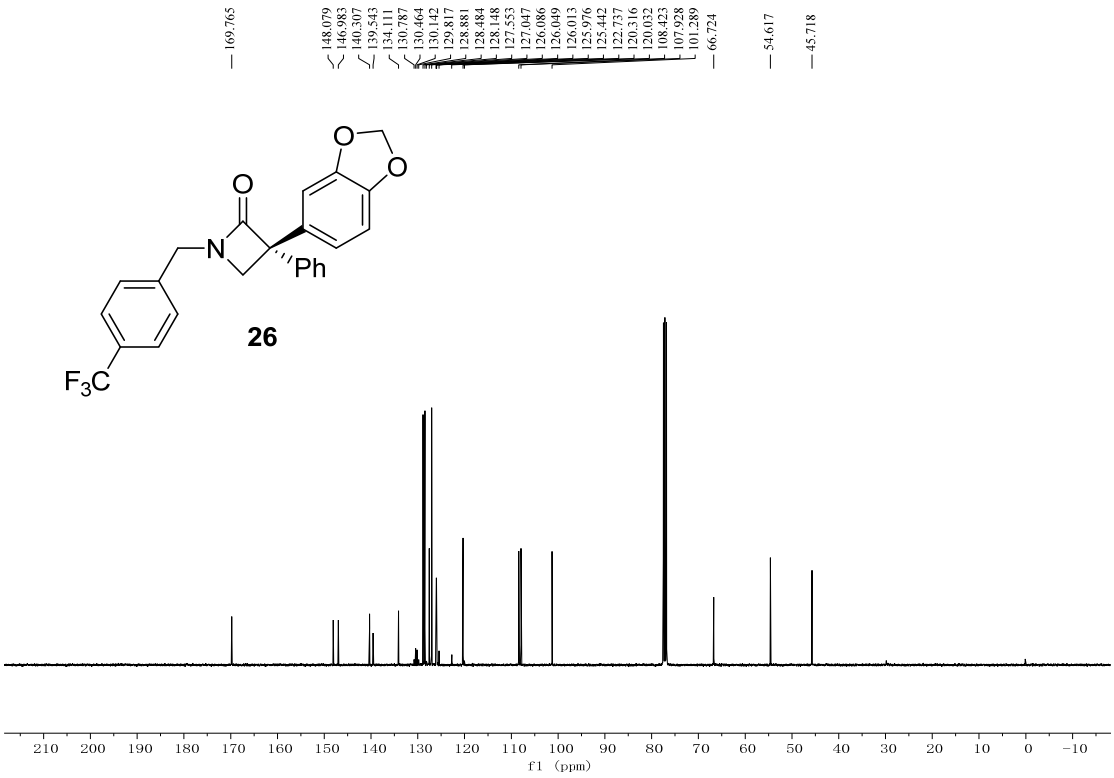

7.618
7.598
7.579
7.559
7.475
7.456
7.437
7.418
7.387
7.367
7.348
7.331
7.311
7.292
7.275
4.577
3.861
3.846
3.840
3.828
Ph
O
N
F3C
25
1.95
3.95
6.05
5.02
1.00
2.00
2.00
f1 (ppm)

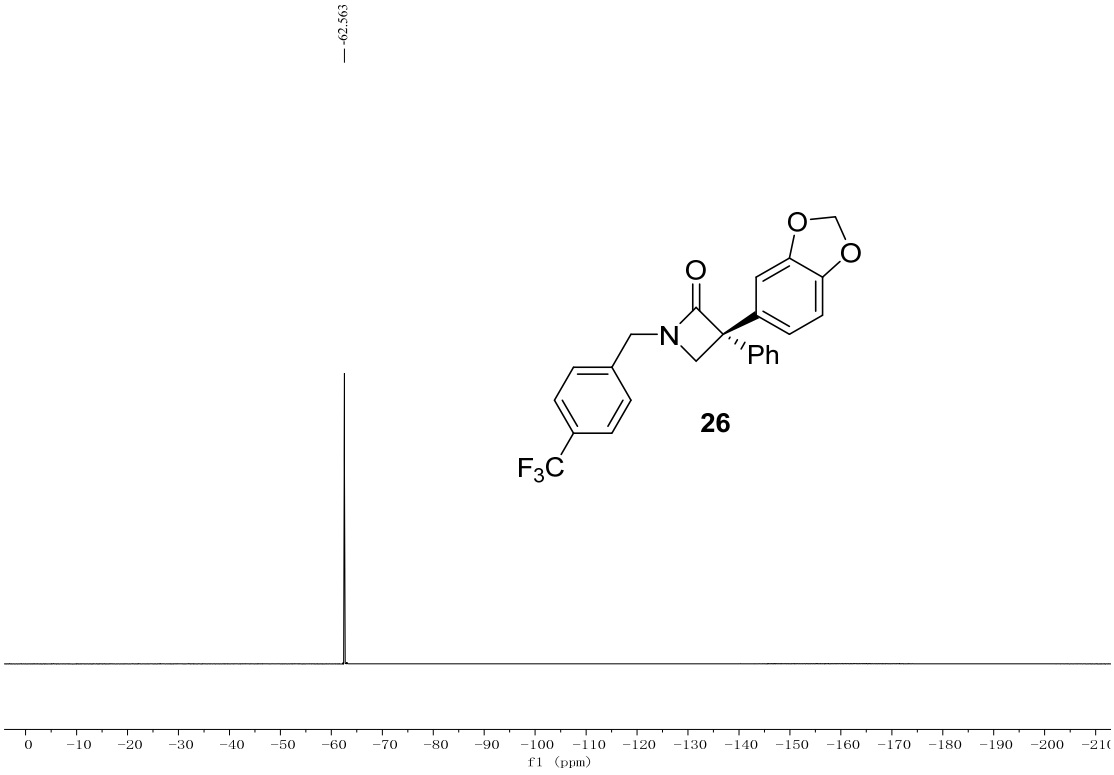

169.737
140.602
140.431
140.161
139.545
139.217
130.789
130.464
130.141
129.815
128.935
128.922
128.514
128.142
127.596
127.580
127.540
127.167
126.092
126.055
126.017
125.980
125.438
122.733
120.012
66.848
54.443
45.779
Ph
O
N
F3C
25
f1 (ppm)


-62.542
Ph
O
N
F3C
25
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
f1 (ppm)

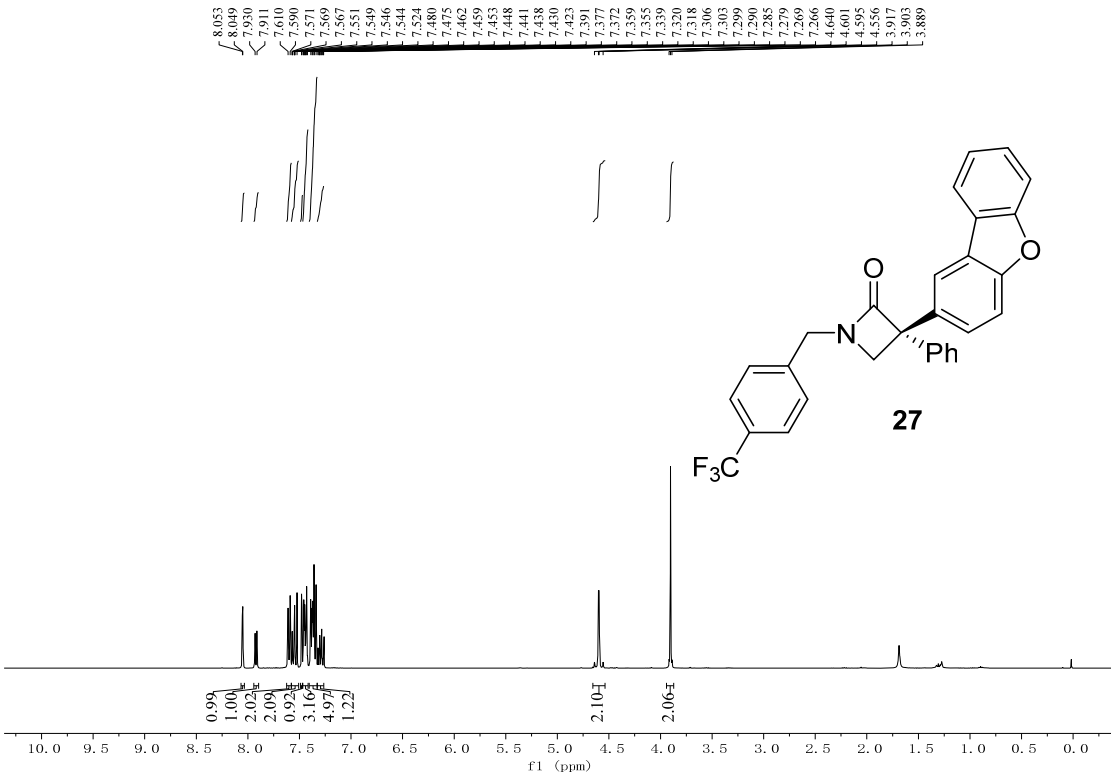
26

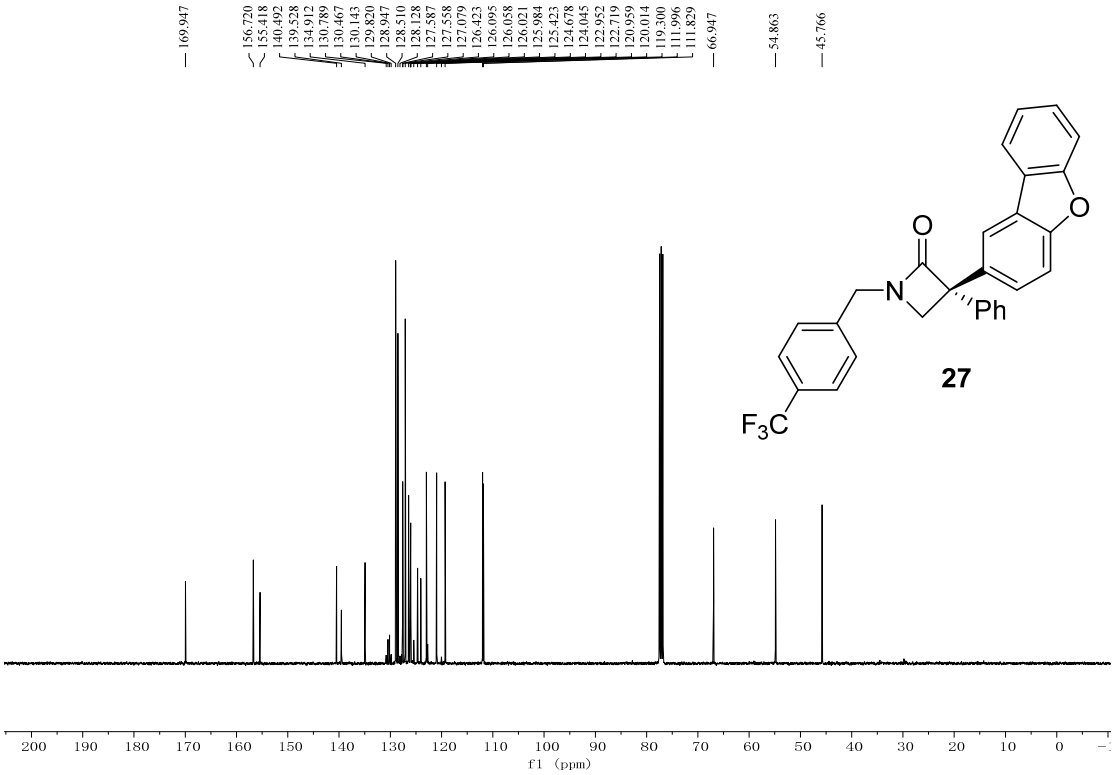

7.600
7.580
7.390
7.386
7.368
7.366
7.356
7.350
7.333
7.312
7.280
7.262
7.257
7.244
6.874
6.860
6.769
6.748
5.926
4.586
4.548
4.536
4.497
3.773
3.760
3.735
3.722
O
O
O
N
Ph
F3C
26
2.07
5.88
1.11
1.86
0.97
1.95
2.00
1.95
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

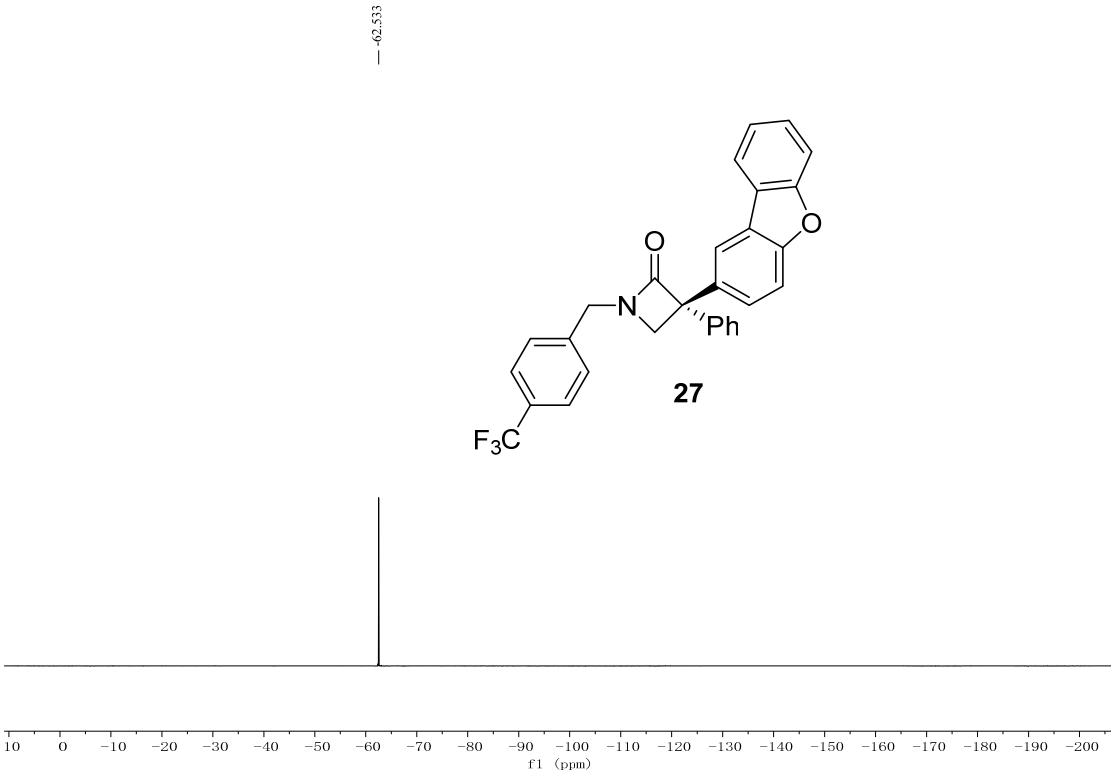

169.765
148.079
146.983
140.307
139.543
134.111
130.787
130.464
130.142
129.817
128.881
128.484
128.148
127.553
127.047
126.086
126.049
126.013
125.976
125.442
122.737
120.316
120.032
108.423
107.928
101.289
66.724
54.617
45.718
O
O
O
N
Ph
F3C
26
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)


−62.563
O
O
O
N
Ph
F3C
26
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200
f1 (ppm)

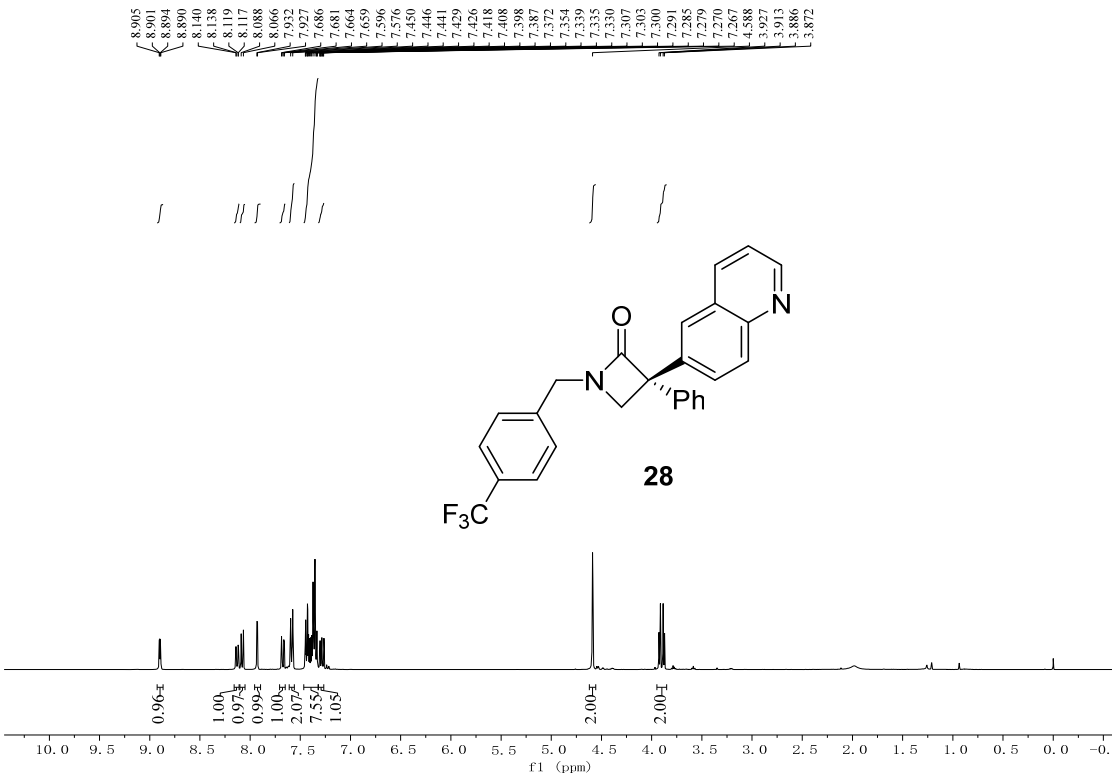
27

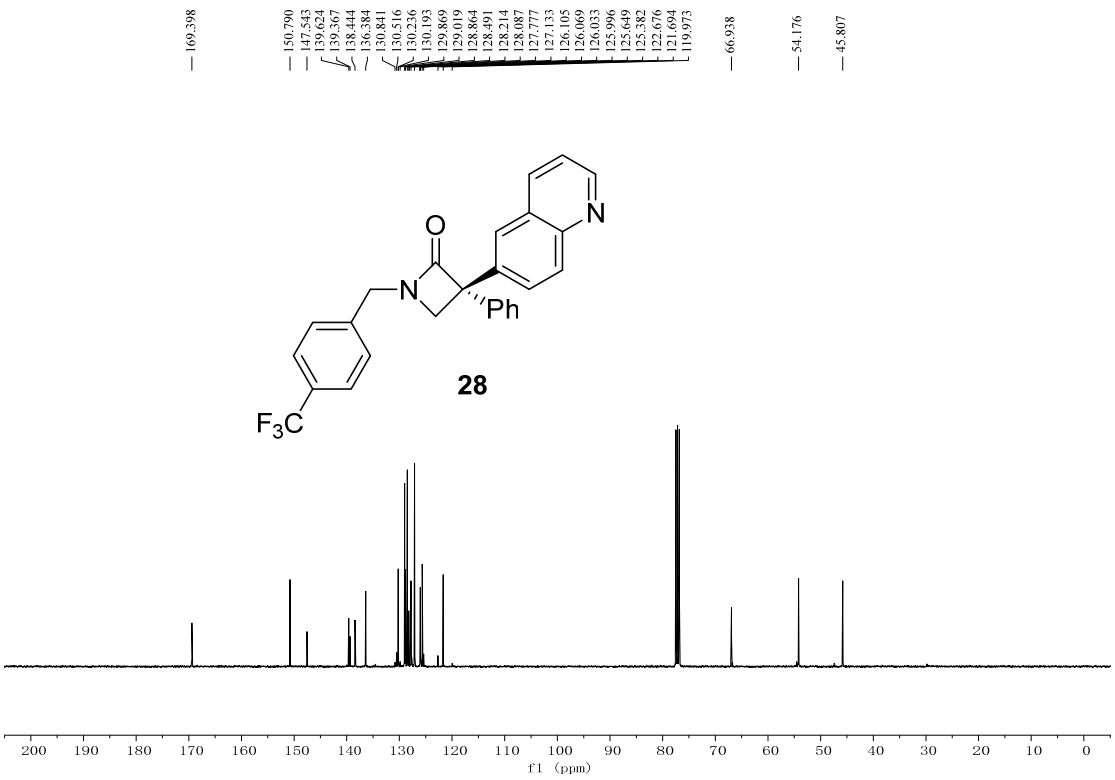

8.053
8.049
7.930
7.911
7.610
7.590
7.571
7.569
7.567
7.551
7.549
7.546
7.544
7.524
7.480
7.475
7.462
7.459
7.453
7.448
7.441
7.438
7.430
7.423
7.391
7.377
7.372
7.359
7.355
7.339
7.320
7.318
7.306
7.303
7.299
7.290
7.285
7.279
7.269
7.266
4.640
4.601
4.595
4.556
3.917
3.903
3.889
O
O
N
Ph
F3C
27
0.99
1.00
2.02
2.09
0.92
3.16
4.97
1.22
2.10
2.06
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

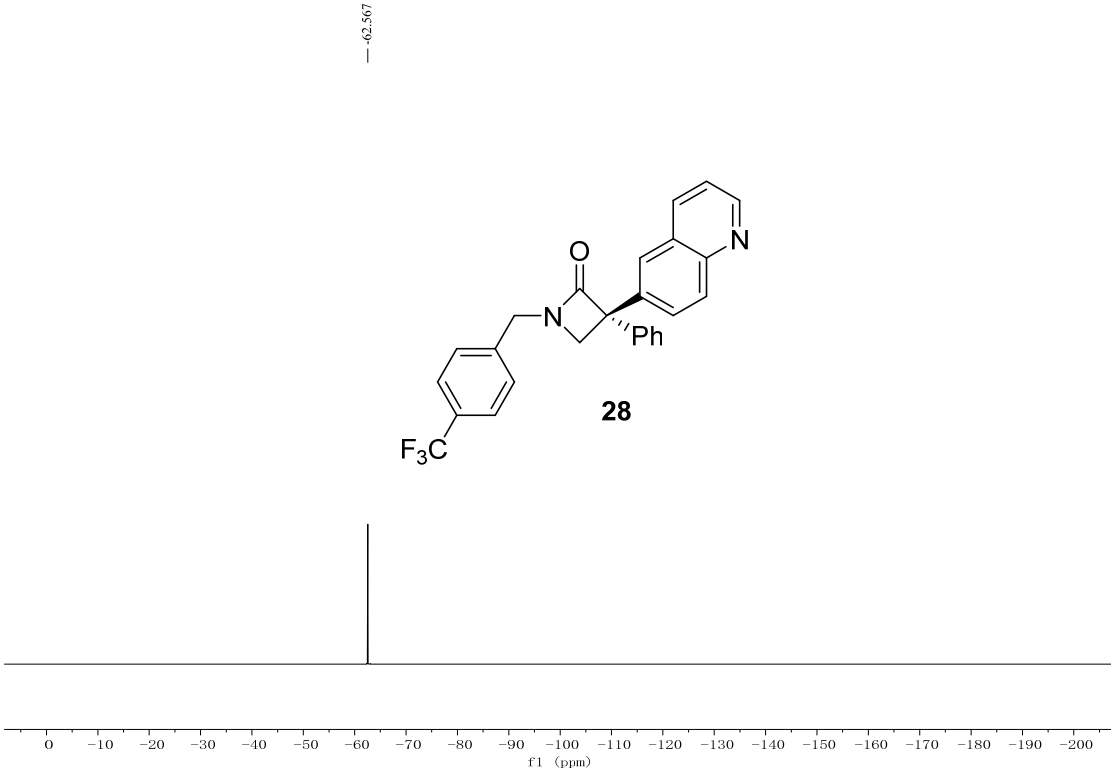

169.947
156.720
155.418
140.492
139.528
134.912
130.789
130.467
130.143
129.820
128.947
128.510
128.128
127.587
127.558
127.079
126.423
126.095
126.058
126.021
125.984
125.423
124.678
124.045
122.952
122.719
120.959
120.014
119.300
111.996
111.829
66.947
54.863
45.766
O
O
N
Ph
F3C
27
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.533
O
O
N
Ph
27
F3C
10 0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200
f1 (ppm)

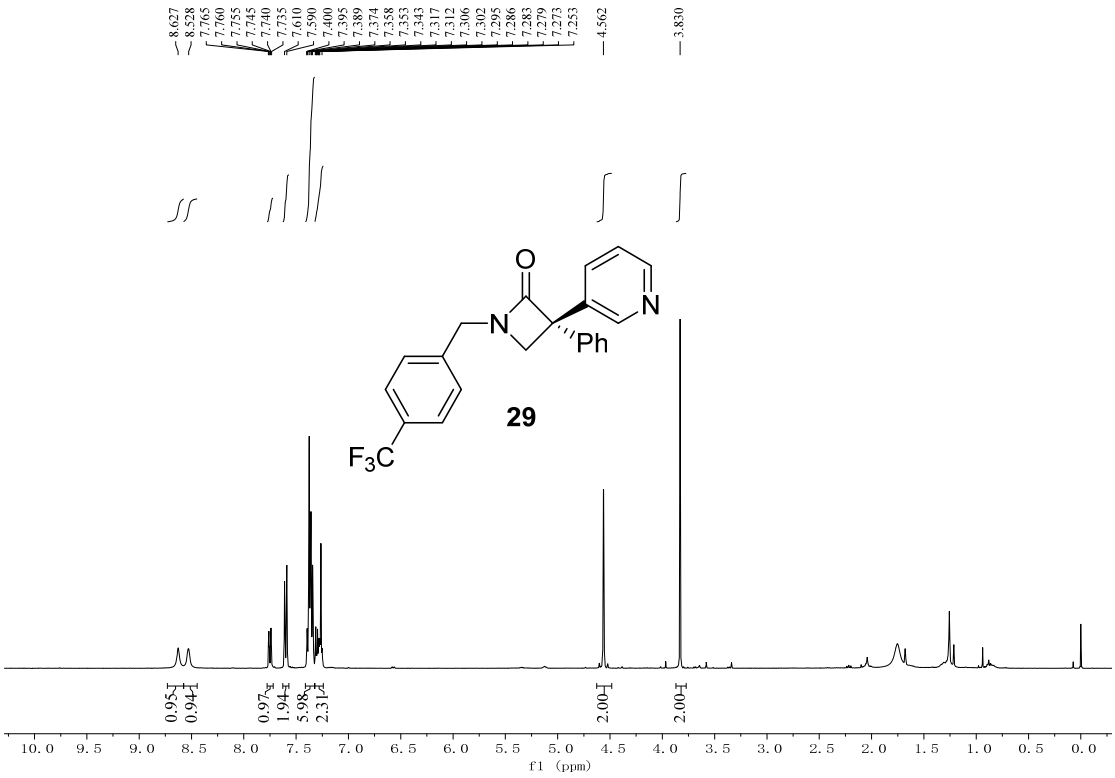
28

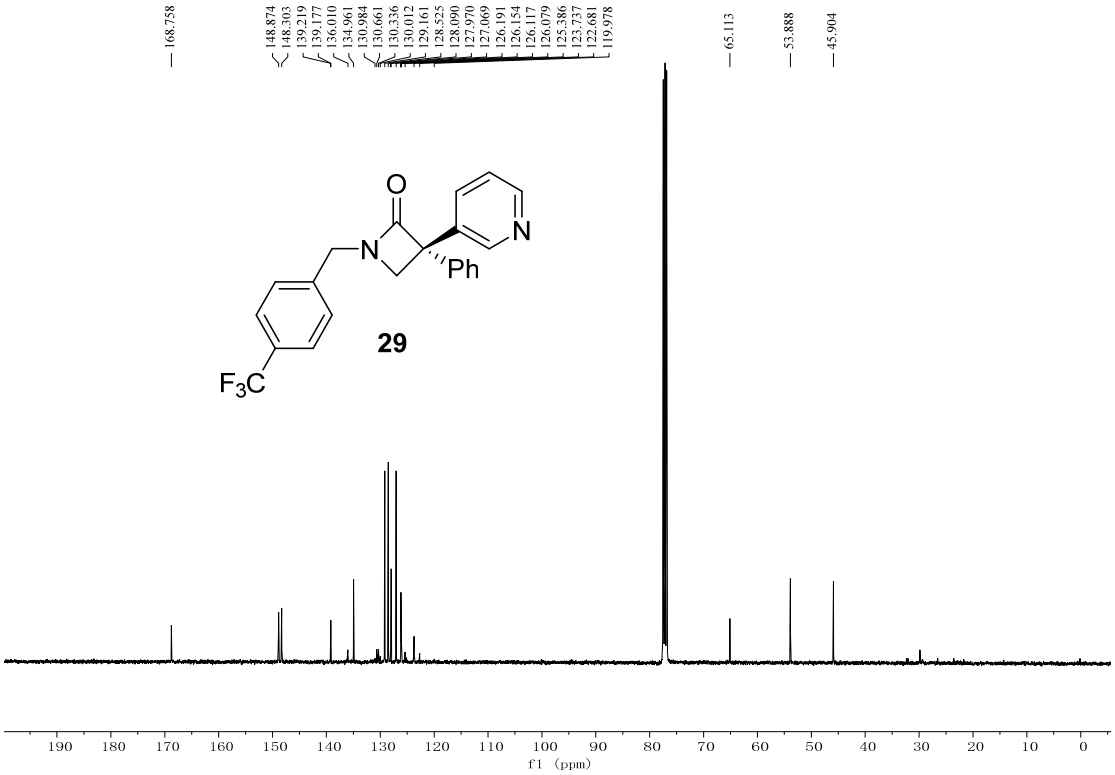

8.905
8.901
8.894
8.890
8.140
8.138
8.119
8.117
8.088
8.066
7.932
7.927
7.686
7.681
7.664
7.659
7.596
7.576
7.450
7.446
7.441
7.429
7.426
7.418
7.408
7.398
7.387
7.372
7.354
7.339
7.335
7.330
7.307
7.303
7.300
7.291
7.285
7.279
7.270
7.267
4.588
3.927
3.913
3.886
3.872
O
N
N
Ph
28
F3C
0.96
1.00
0.97
0.99
1.00
2.07
7.55
1.05
2.00
2.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.
f1 (ppm)

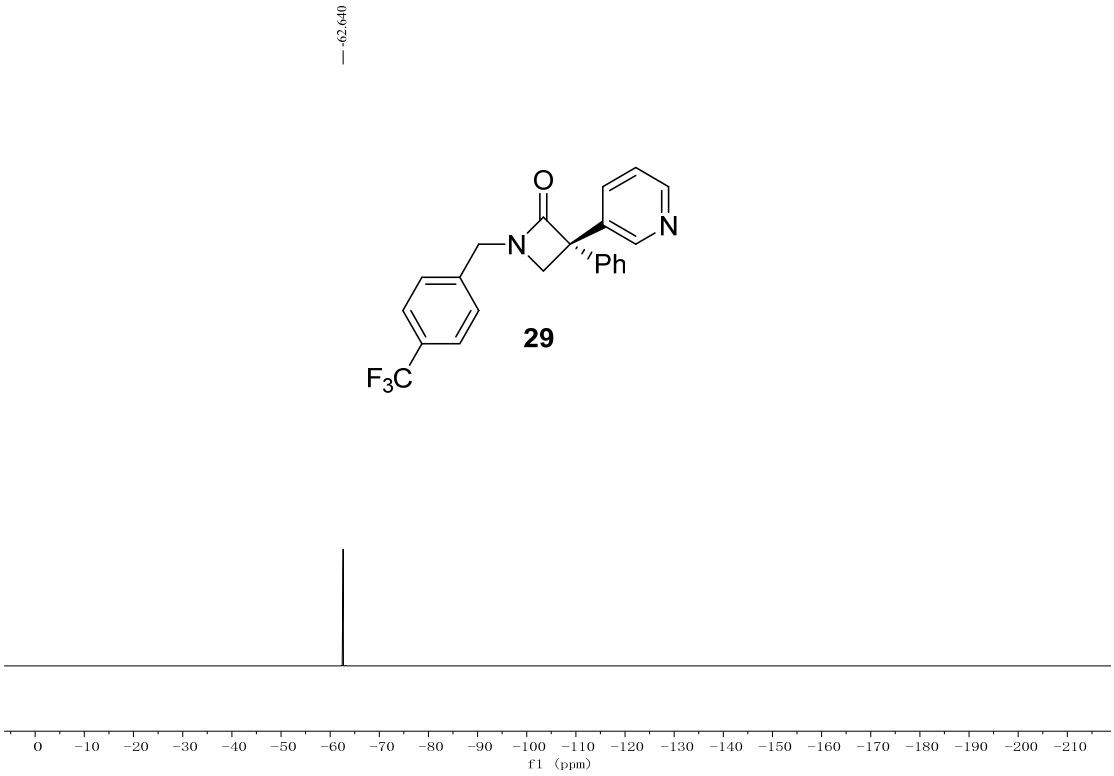

169.398
150.790
147.543
139.624
139.367
138.444
136.384
130.841
130.516
130.236
130.193
129.869
129.019
128.864
128.491
128.214
128.087
127.777
127.133
126.105
126.069
126.033
125.996
125.649
125.382
122.676
121.694
119.973
66.938
54.176
45.807
O
N
N
Ph
F3C
28
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.567
O
N
N
Ph
F3C
28
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200
f1 (ppm)

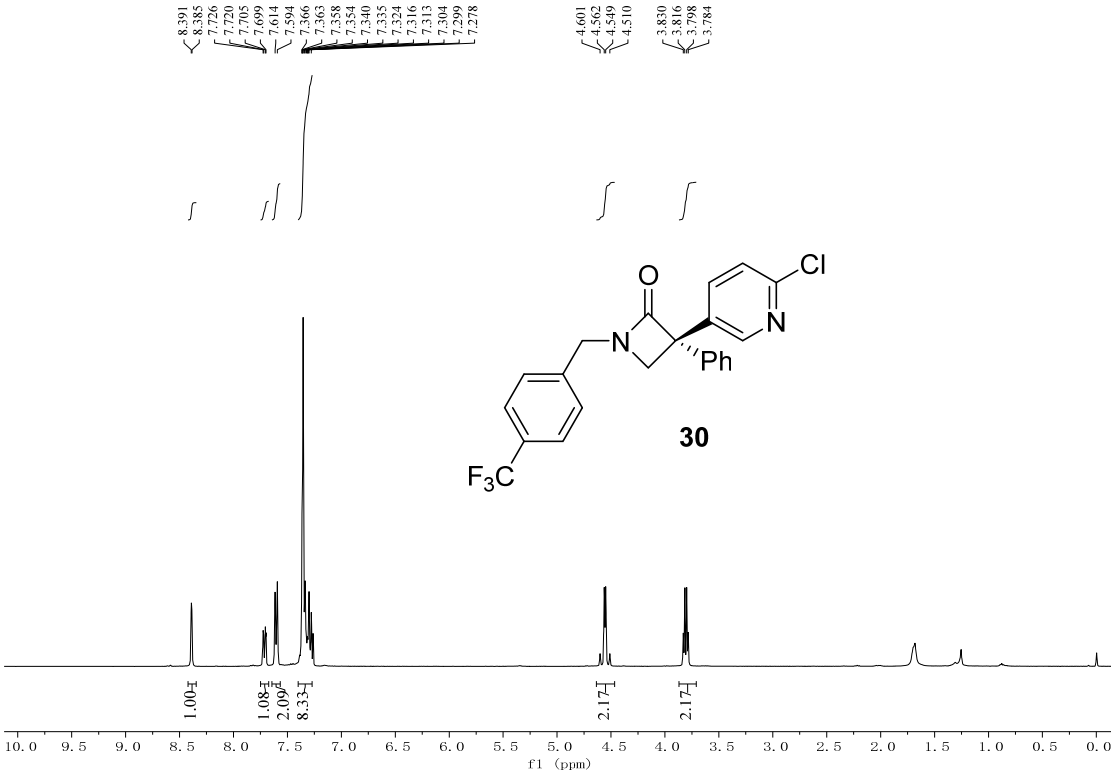
29

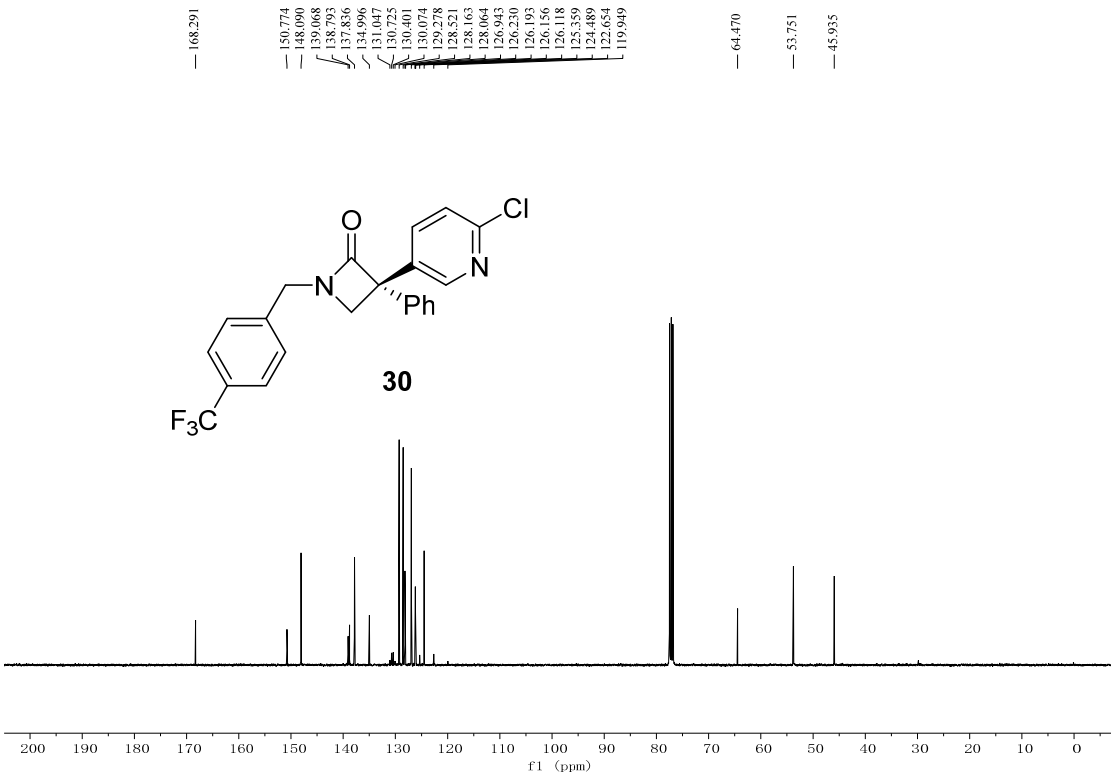

8.627
8.528
7.765
7.760
7.755
7.745
7.740
7.735
7.610
7.590
7.400
7.395
7.389
7.374
7.358
7.353
7.343
7.317
7.312
7.306
7.302
7.295
7.286
7.283
7.279
7.273
7.253
4.562
3.830
O
N
N
Ph
29
F3C
0.95
0.94
0.97
1.94
5.98
2.31
2.00
2.00
f1 (ppm)

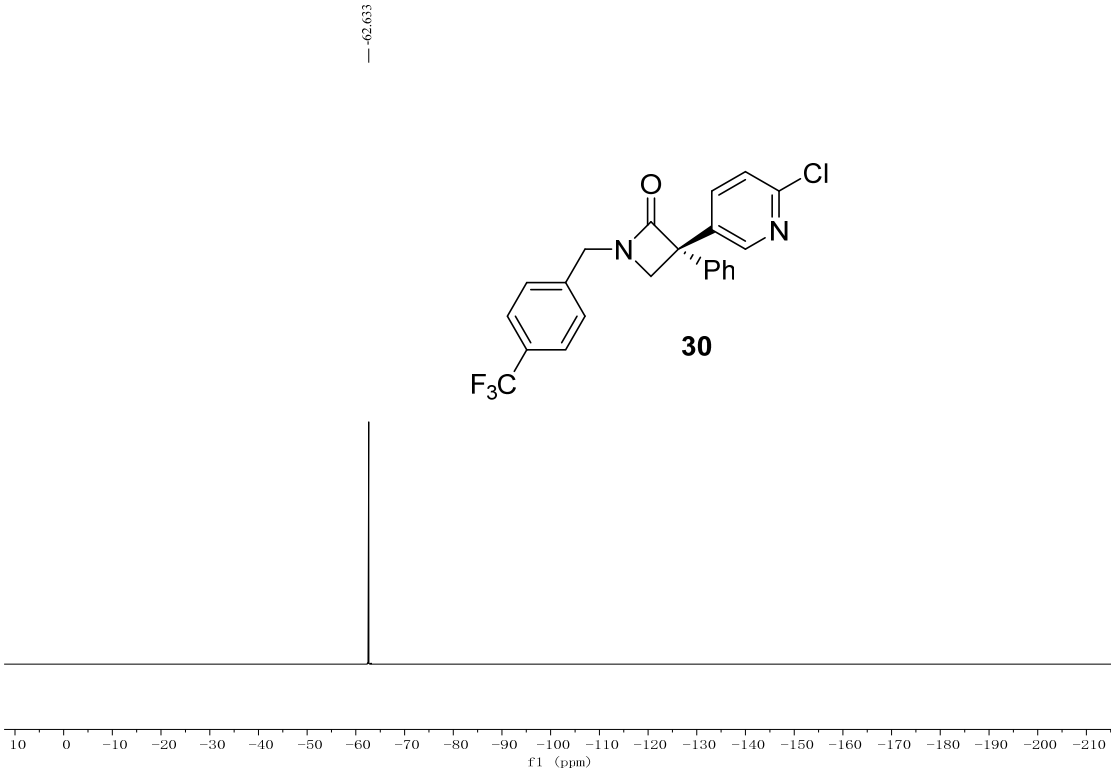

168.758
148.874
148.303
139.219
139.177
136.010
134.961
130.984
130.661
130.336
130.012
129.161
128.525
128.090
127.970
127.069
126.191
126.154
126.117
126.079
125.386
123.737
122.681
119.978
65.113
53.888
45.904
O
N
N
Ph
29
F3C
f1 (ppm)


-62.640
O
N
N
Ph
29
F3C
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

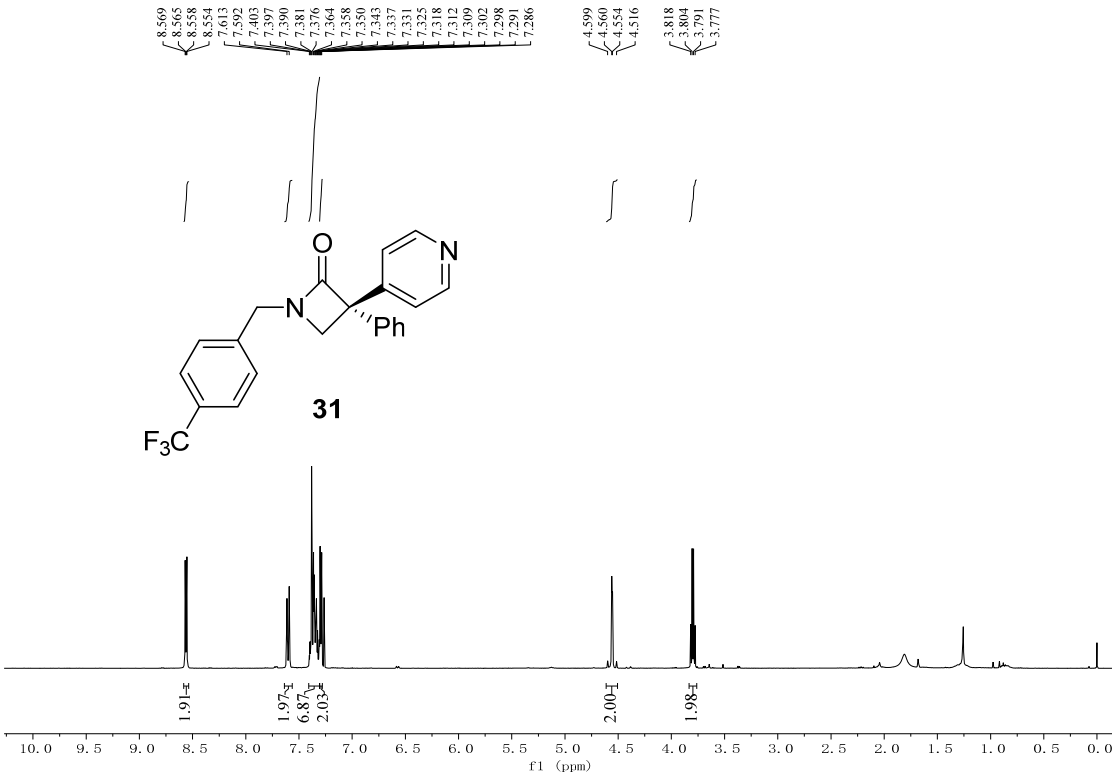
30

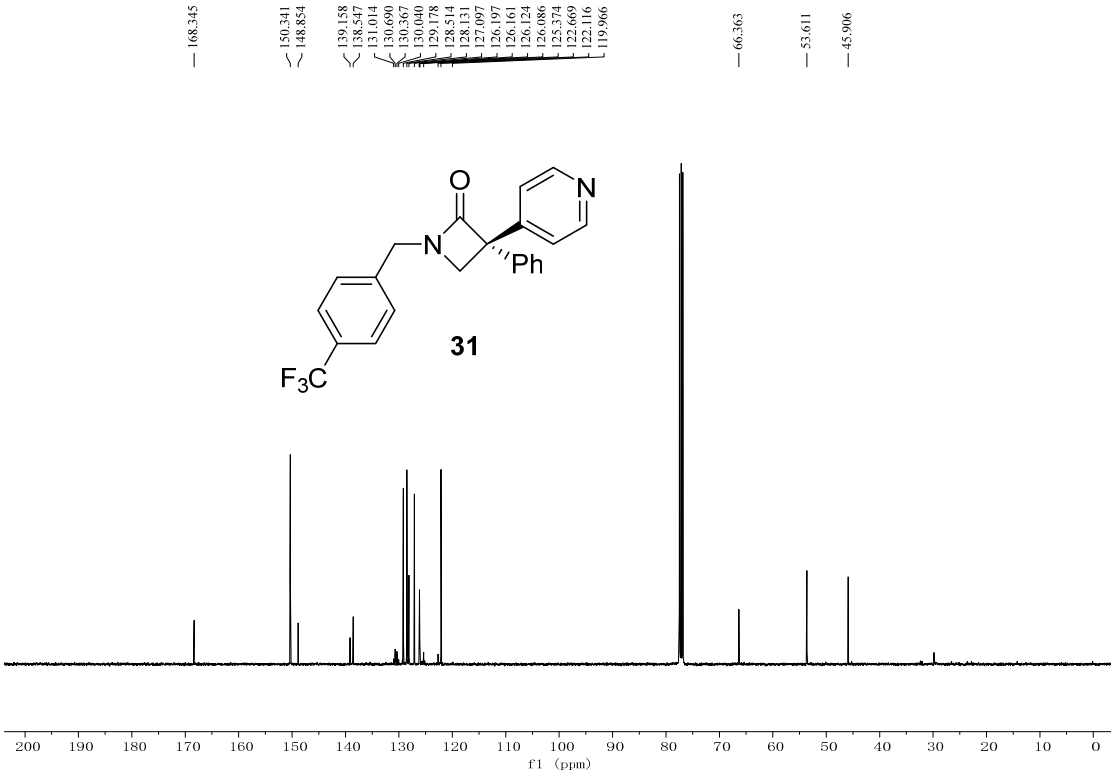

8.391
8.385
7.726
7.720
7.705
7.699
7.614
7.594
7.366
7.363
7.358
7.354
7.340
7.335
7.324
7.316
7.313
7.304
7.299
7.278
4.601
4.562
4.549
4.510
3.830
3.816
3.798
3.784
O
Cl
N
N
Ph
30
F3C
1.00
1.08
2.09
8.33
2.17
2.17
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

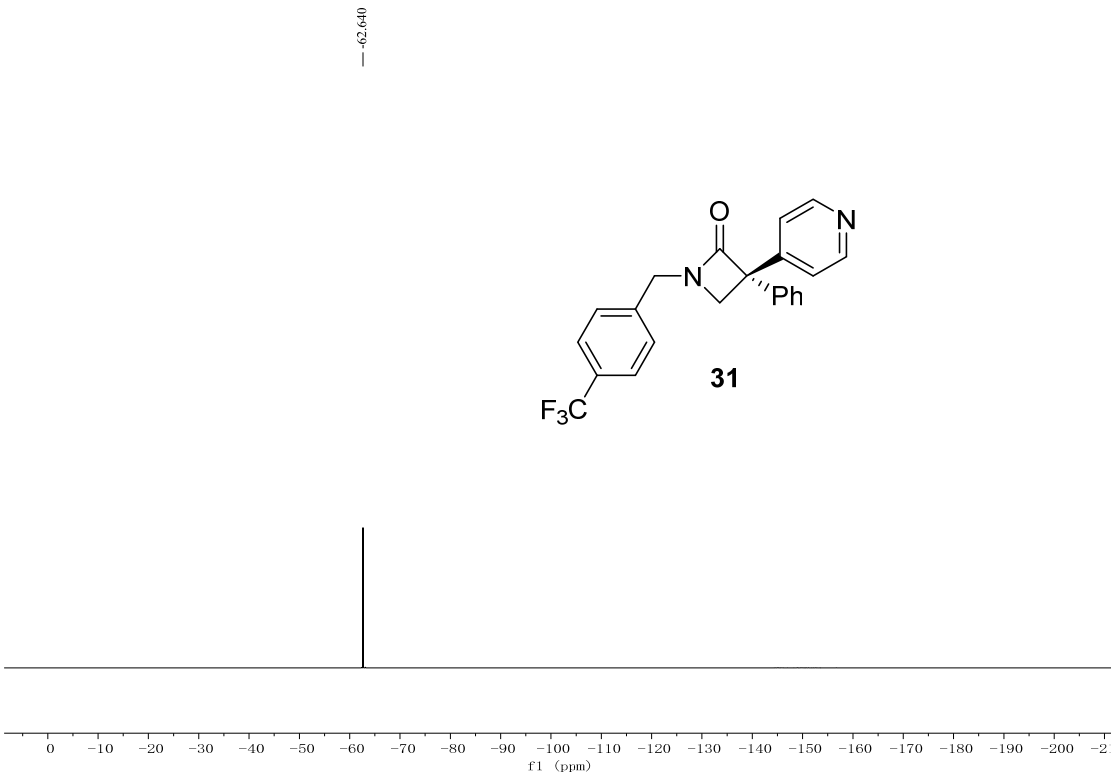

168.291
150.774
148.090
139.068
138.793
137.836
134.996
131.047
130.725
130.401
130.074
129.278
128.521
128.163
128.064
126.943
126.230
126.193
126.156
126.118
125.359
124.489
122.654
119.949
64.470
53.751
45.935
O
Cl
N
N
Ph
F3C
30
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.633
O
Cl
N
N
Ph
F3C
30
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

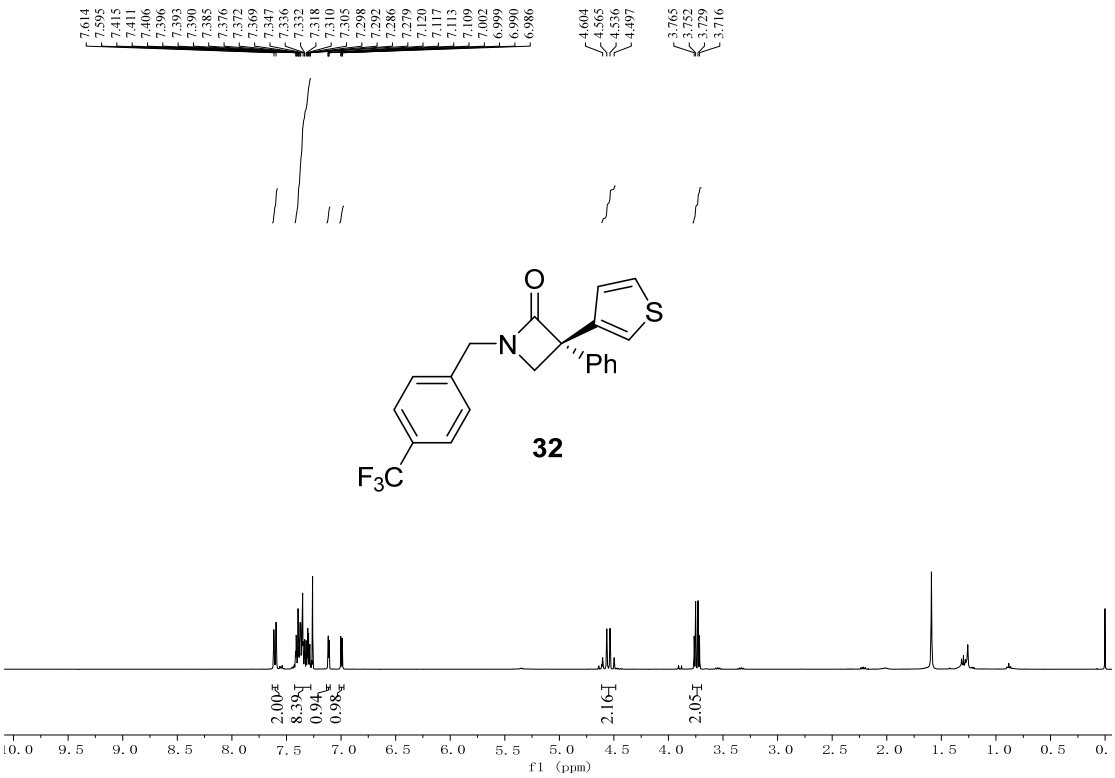
31

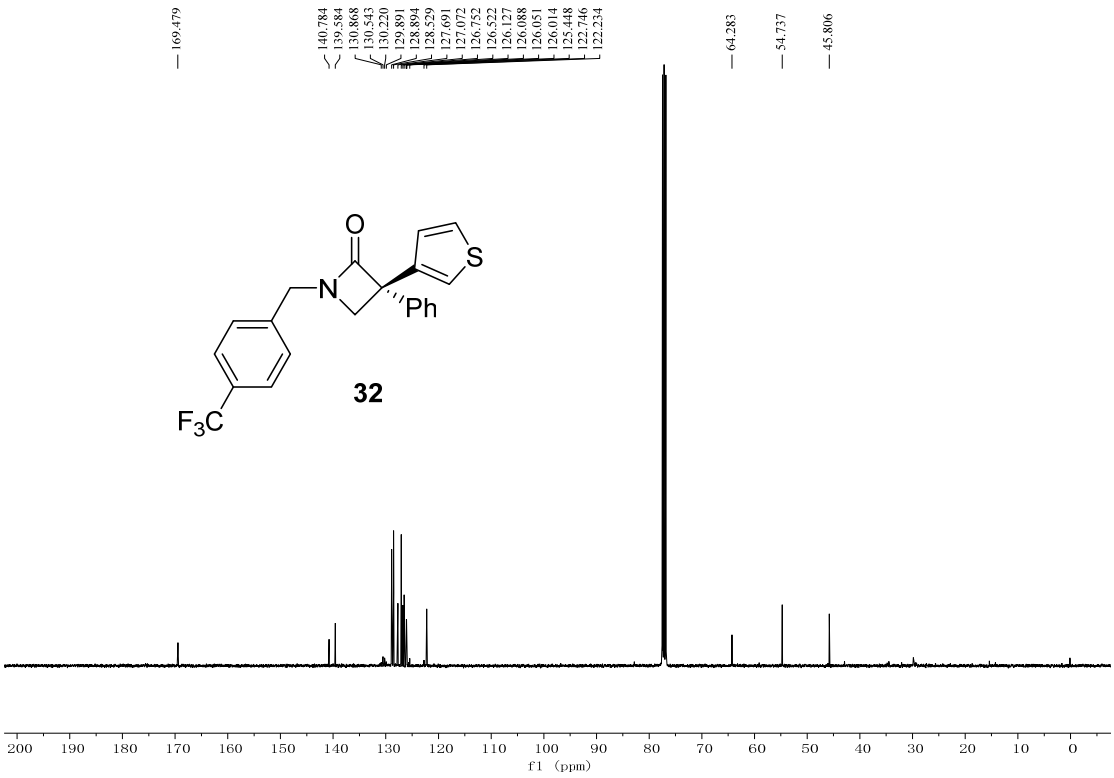

8.569
8.565
8.558
8.554
7.613
7.592
7.403
7.397
7.390
7.381
7.376
7.364
7.358
7.350
7.343
7.337
7.331
7.325
7.318
7.312
7.309
7.302
7.298
7.291
7.286
4.599
4.560
4.554
4.516
3.818
3.804
3.791
3.777
O
N
N
Ph
F3C
31
1.91
1.97
6.87
2.03
2.00
1.98
f1 (ppm)

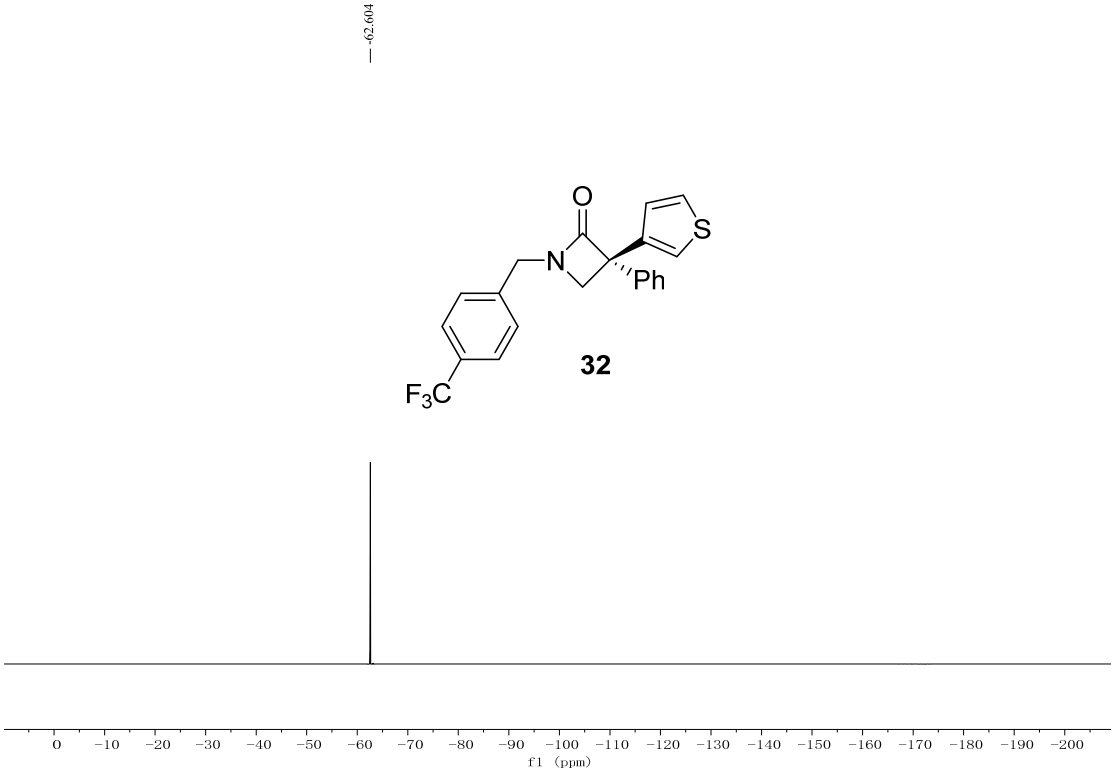

168.345
150.341
148.854
139.158
138.547
131.014
130.690
130.367
130.040
129.178
128.514
128.131
127.097
126.197
126.161
126.124
126.086
125.374
122.669
122.116
119.966
66.363
53.611
45.906
O
N
N
Ph
F3C
31
f1 (ppm)


-62.640
O
N
N
Ph
F3C
31
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
f1 (ppm)

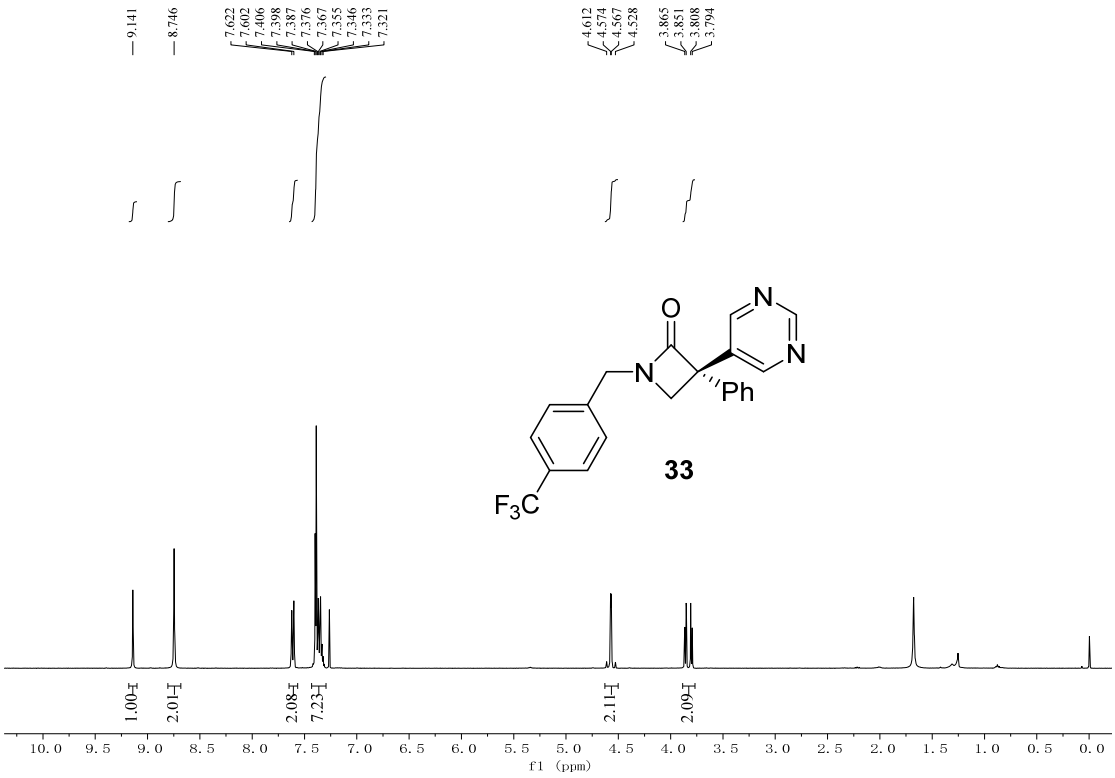
32

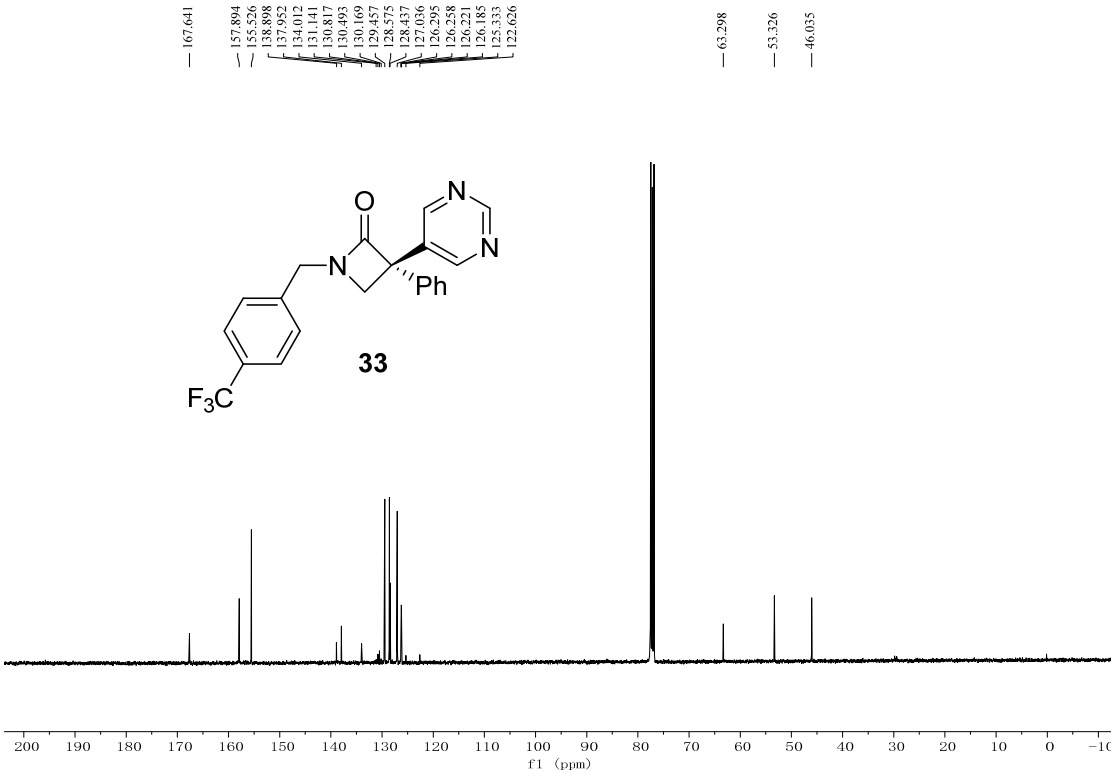

7.614
7.595
7.415
7.411
7.406
7.396
7.393
7.390
7.385
7.376
7.372
7.369
7.347
7.336
7.332
7.318
7.310
7.305
7.298
7.292
7.286
7.279
7.120
7.117
7.113
7.109
7.002
6.999
6.990
6.986
4.604
4.565
4.536
4.497
3.765
3.752
3.729
3.716
O
S
N
Ph
F3C
32
2.00
8.39
0.94
0.98
2.16
2.05
f1 (ppm)

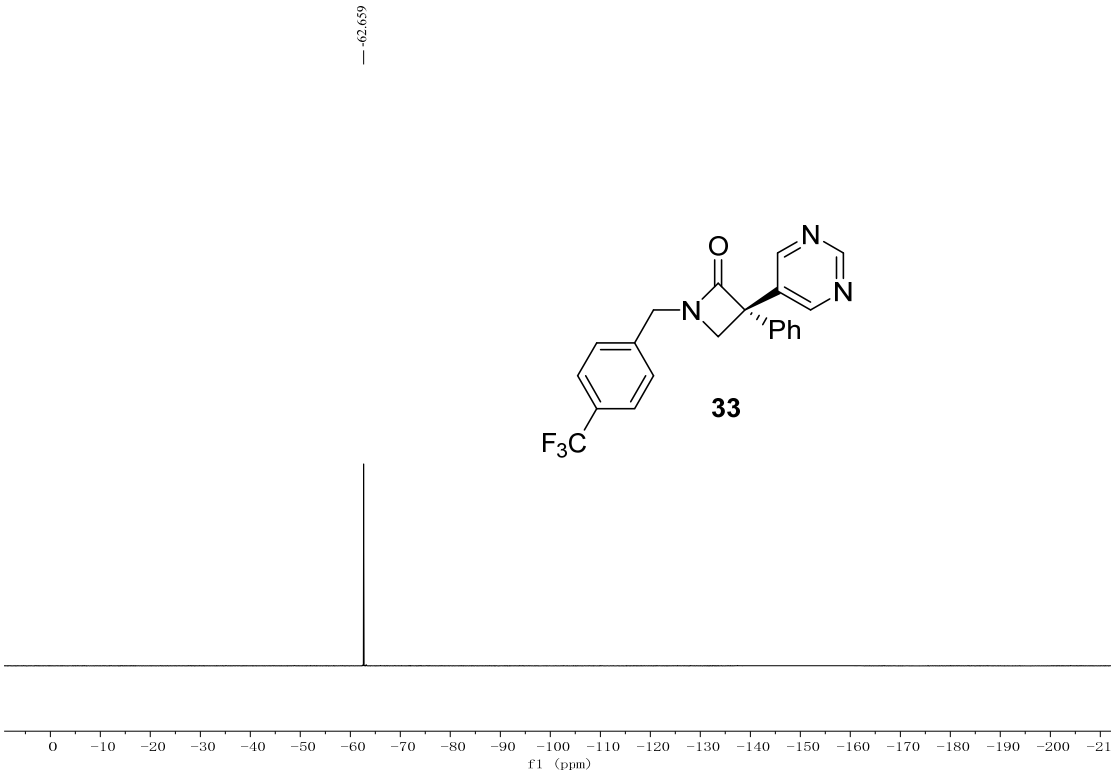

169.479
140.784
139.584
130.868
130.543
130.220
129.891
128.894
128.529
127.691
127.072
126.752
126.522
126.127
126.088
126.051
126.014
125.448
122.746
122.234
64.283
54.737
45.806
O
S
N
Ph
F3C
32
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-62.604
O
S
N
Ph
F3C
32
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200
f1 (ppm)

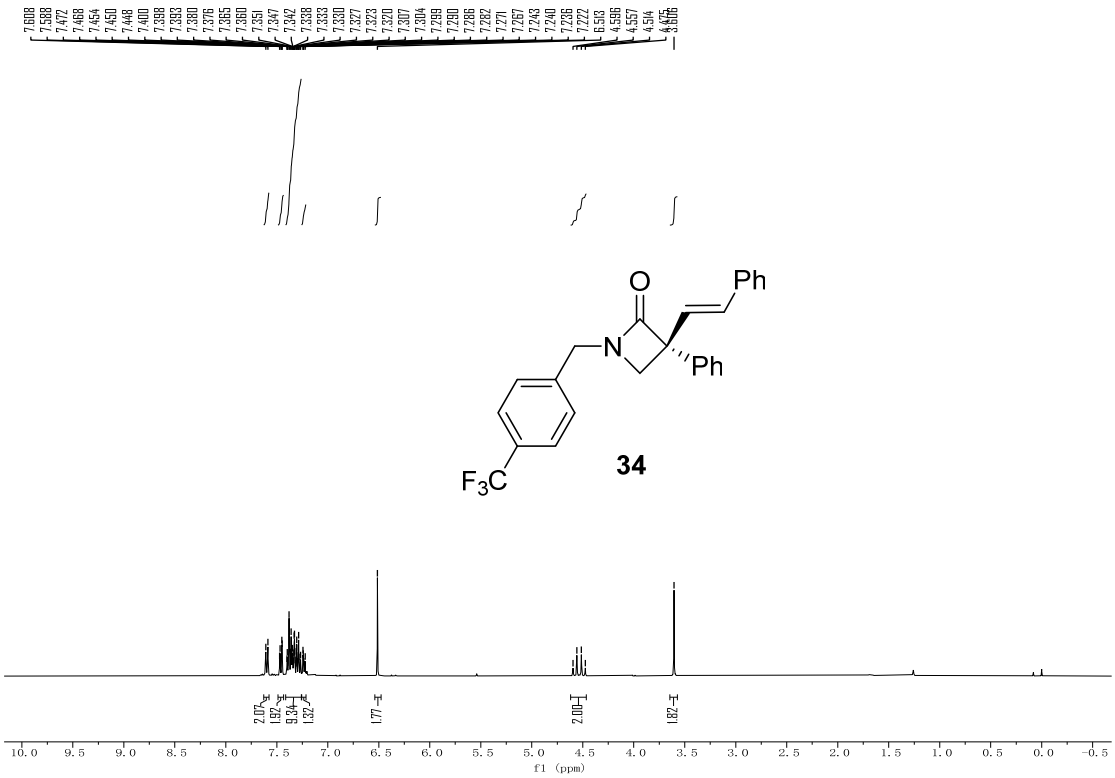
33

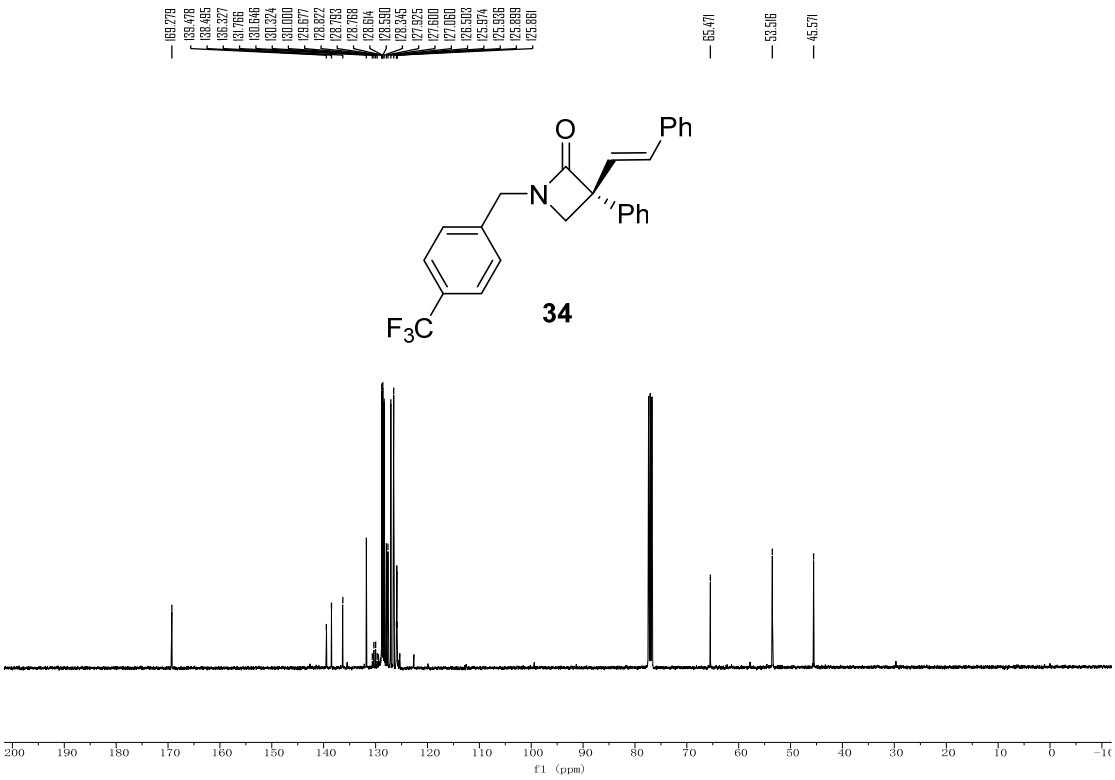

9.141
8.746
7.622
7.602
7.406
7.398
7.387
7.376
7.367
7.355
7.346
7.333
7.321
4.612
4.574
4.567
4.528
3.865
3.851
3.808
3.794
O
N
N
N
Ph
F3C
33
1.00
2.01
2.08
7.23
2.11
2.09
f1 (ppm)

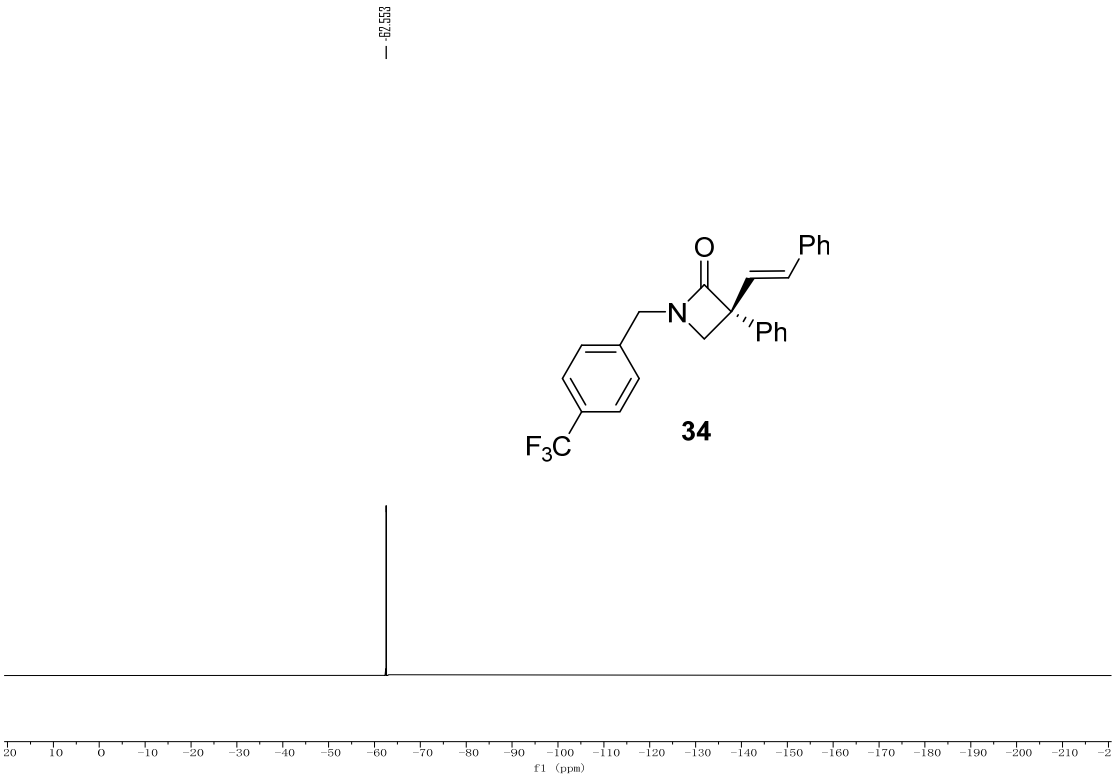

167.641
157.894
155.526
138.898
137.952
134.012
131.141
130.817
130.493
130.169
129.457
128.575
128.437
127.036
126.295
126.258
126.221
126.185
125.333
122.626
63.298
53.326
46.035
O
N
N
N
Ph
F3C
33
f1 (ppm)


-62.659
O
N
N
N
Ph
F3C
33
0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −21
f1 (ppm)

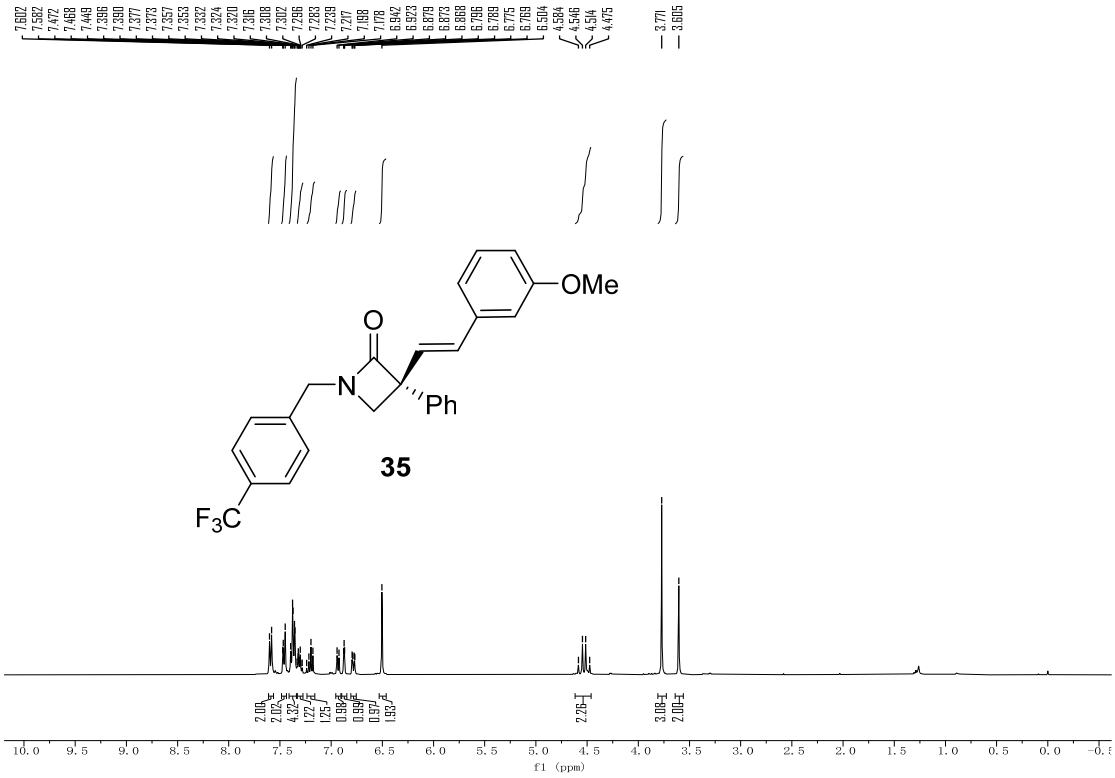
34

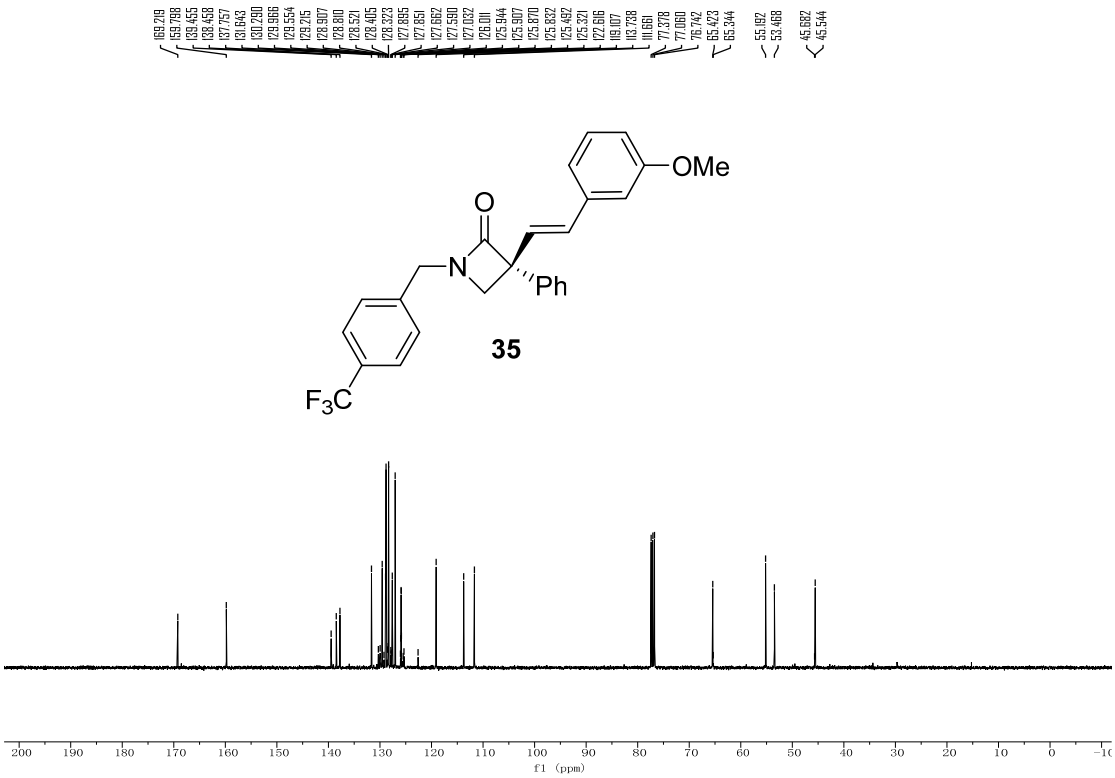

O
Ph
N
Ph
F3C
34
2.07
1.92
9.34
1.22
1.77
2.00
1.82
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5
f1 (ppm)

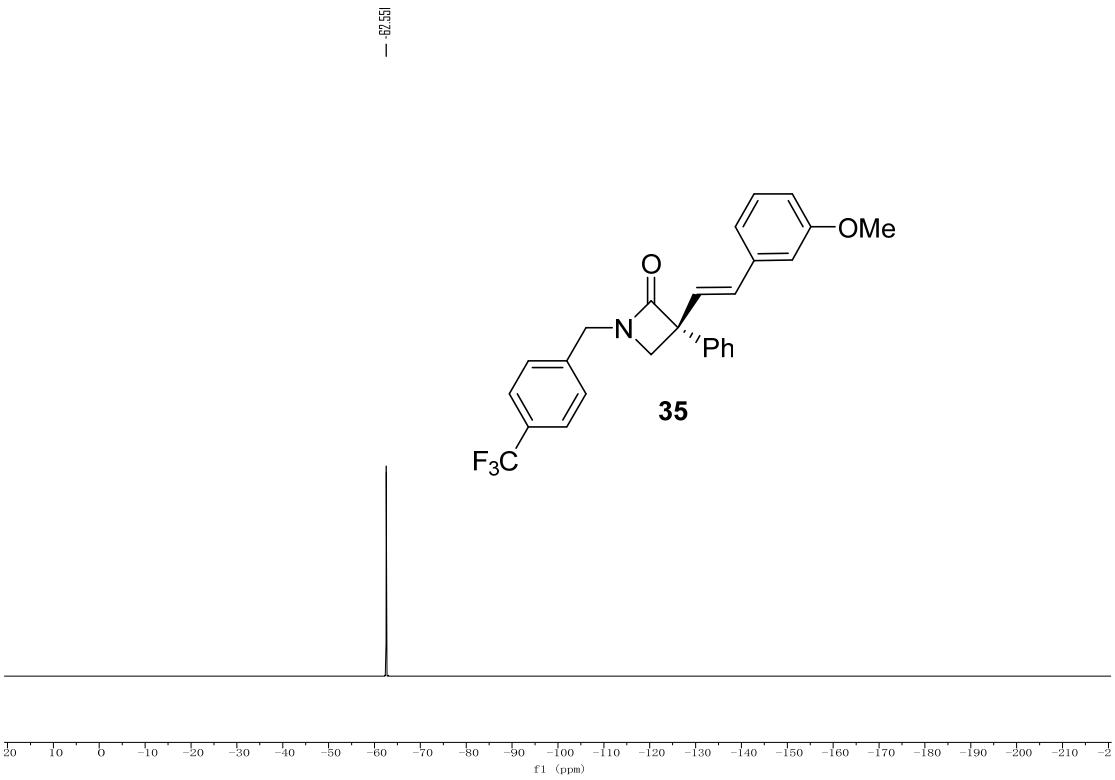

160.279
139.478
138.485
136.327
131.766
130.646
130.324
130.000
129.677
128.822
128.783
128.768
128.614
128.580
128.345
127.925
127.600
127.060
126.503
125.974
125.936
125.899
125.861
65.471
53.516
45.571
O
Ph
N
Ph
F3C
34
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-62.553
O
Ph
N
Ph
F3C
34
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

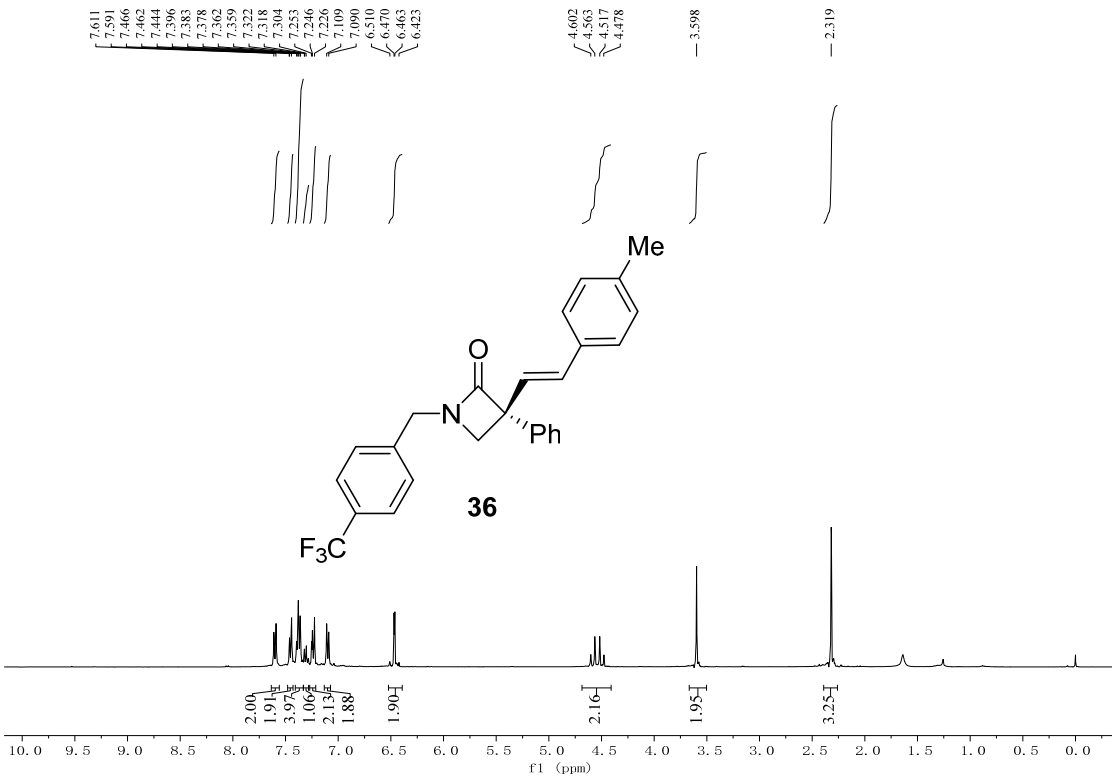
35

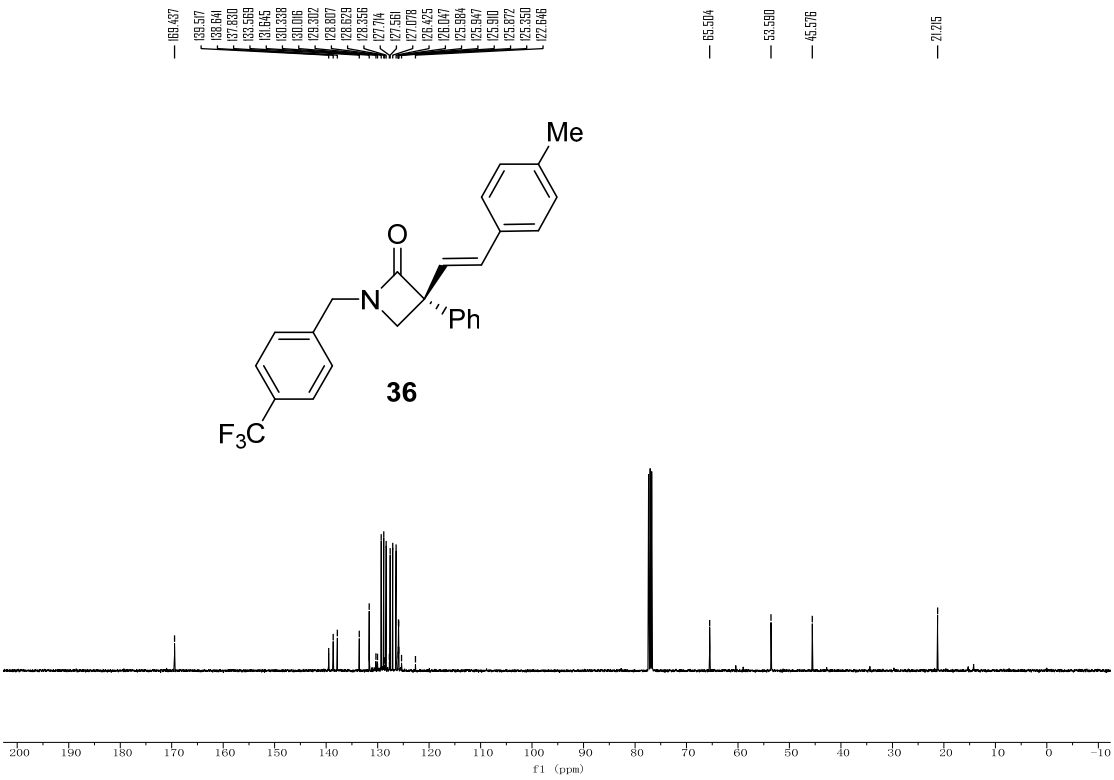

7.602
7.582
7.472
7.468
7.449
7.336
7.330
7.377
7.373
7.357
7.353
7.322
7.324
7.320
7.316
7.308
7.302
7.236
7.263
7.239
7.217
7.198
7.178
6.942
6.923
6.879
6.873
6.868
6.796
6.769
6.775
6.763
6.504
4.584
4.546
4.514
4.475
3.771
3.605
OMe
O
N
Ph
35
F3C
2.108
2.112
4.322
1.227
1.25
0.599
0.597
1.933
2.276
3.108
2.104
f1 (ppm)

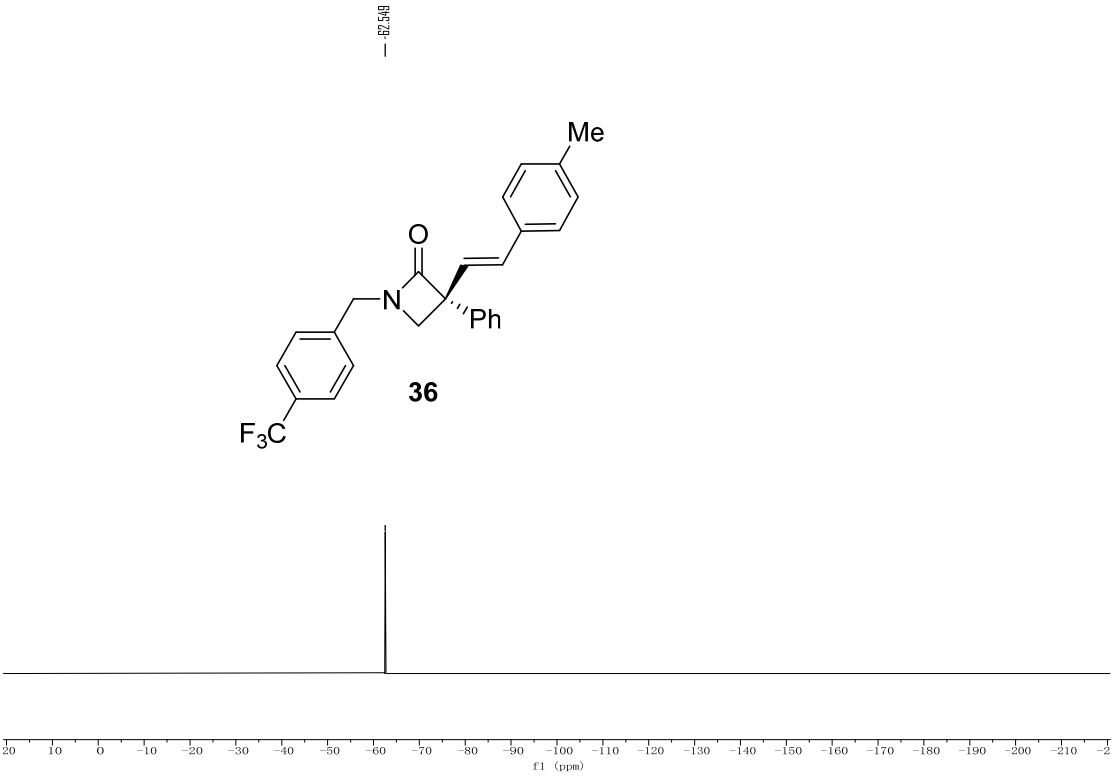

169.279
159.788
139.455
138.458
137.757
131.643
130.298
129.966
129.554
129.215
128.907
128.810
128.521
128.405
128.323
127.895
127.851
127.662
127.580
127.032
126.011
125.944
125.907
125.870
125.832
125.482
125.321
122.616
119.107
113.738
111.661
77.378
77.060
76.742
65.423
65.344
55.162
53.468
45.582
45.544
OMe
O
N
Ph
35
F3C
f1 (ppm)


-62.551
OMe
O
N
Ph
35
F3C
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

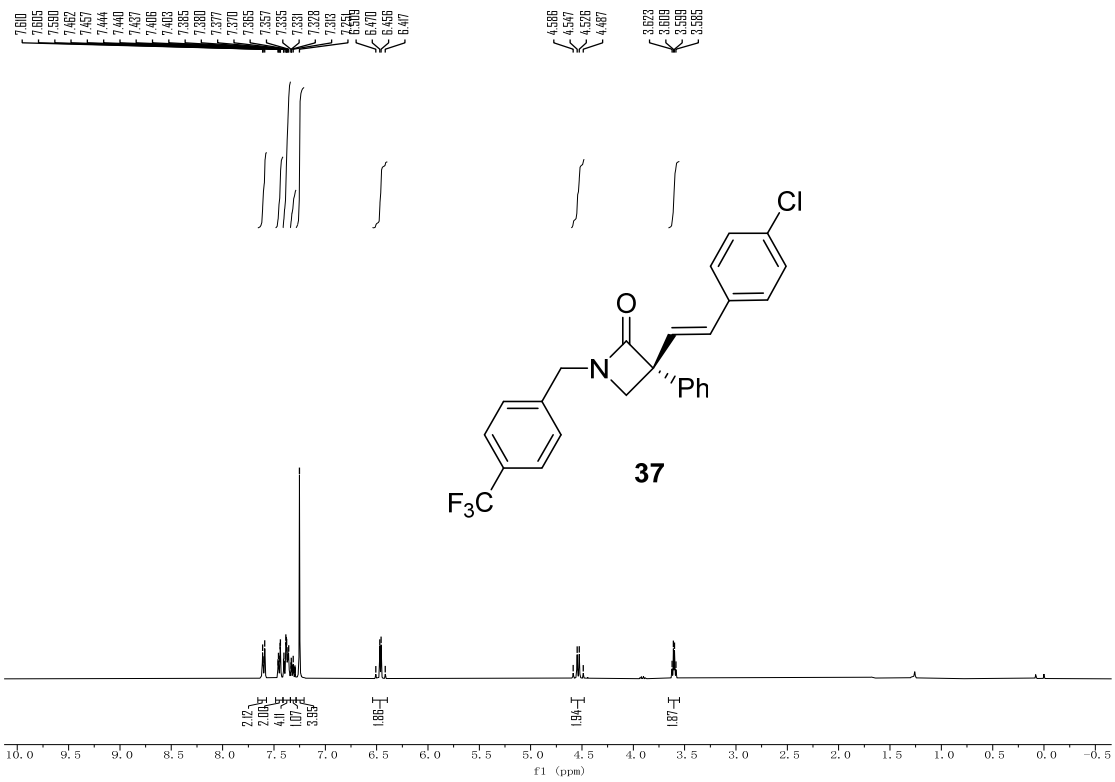
36

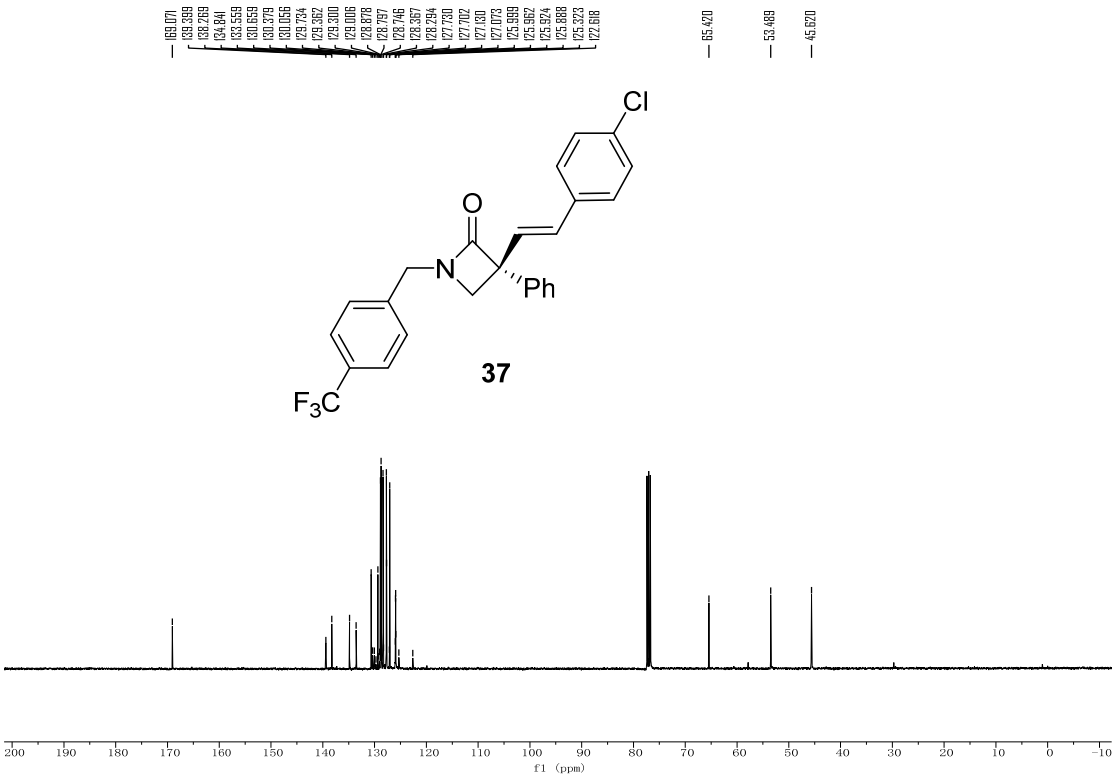

7.611
7.591
7.466
7.462
7.444
7.396
7.383
7.378
7.362
7.359
7.322
7.318
7.304
7.253
7.246
7.226
7.109
7.090
6.510
6.470
6.463
6.423
4.602
4.563
4.517
4.478
3.598
2.319
Me
O
N
Ph
36
F3C
2.00
1.91
3.97
1.06
2.13
1.88
1.90
2.16
1.95
3.25
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

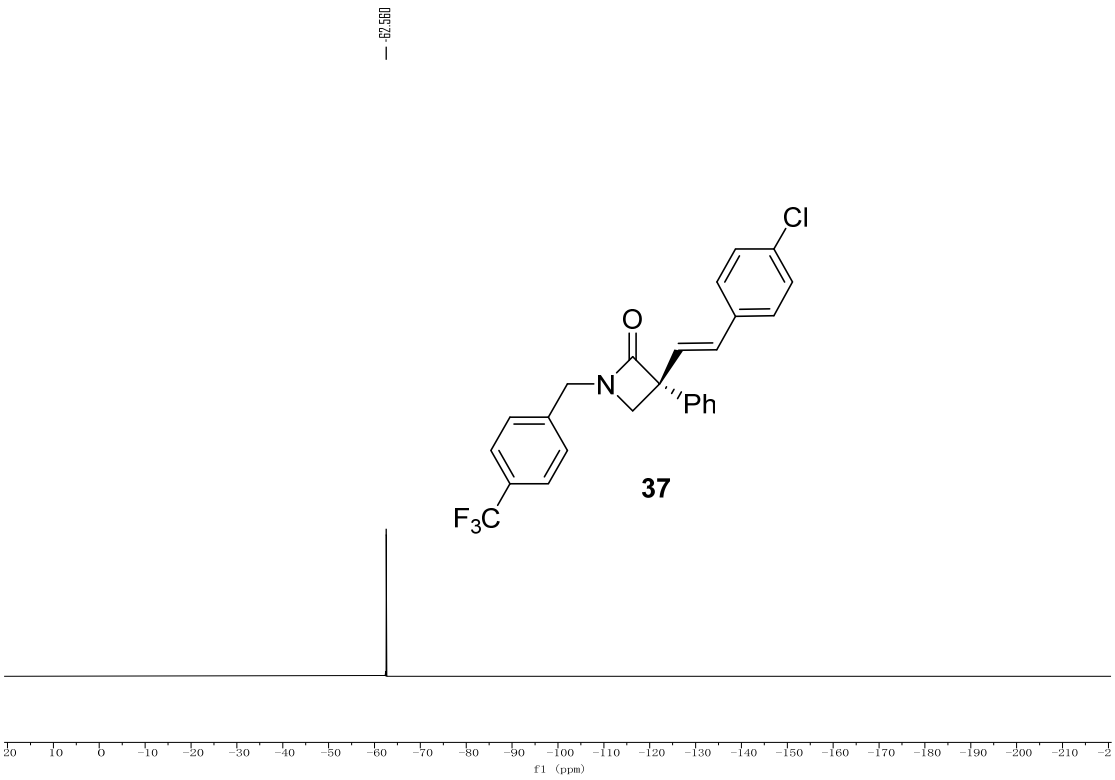

169.437
139.517
138.641
137.8330
133.5169
131.645
130.2338
130.016
129.3012
128.8817
128.6529
128.3556
127.774
127.5581
127.1078
126.4225
126.1047
125.9894
125.947
125.910
125.8772
125.3350
122.6946
65.504
53.590
45.576
21.205
Me
O
N
Ph
36
F3C
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-62.549
Me
O
N
Ph
36
F3C
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

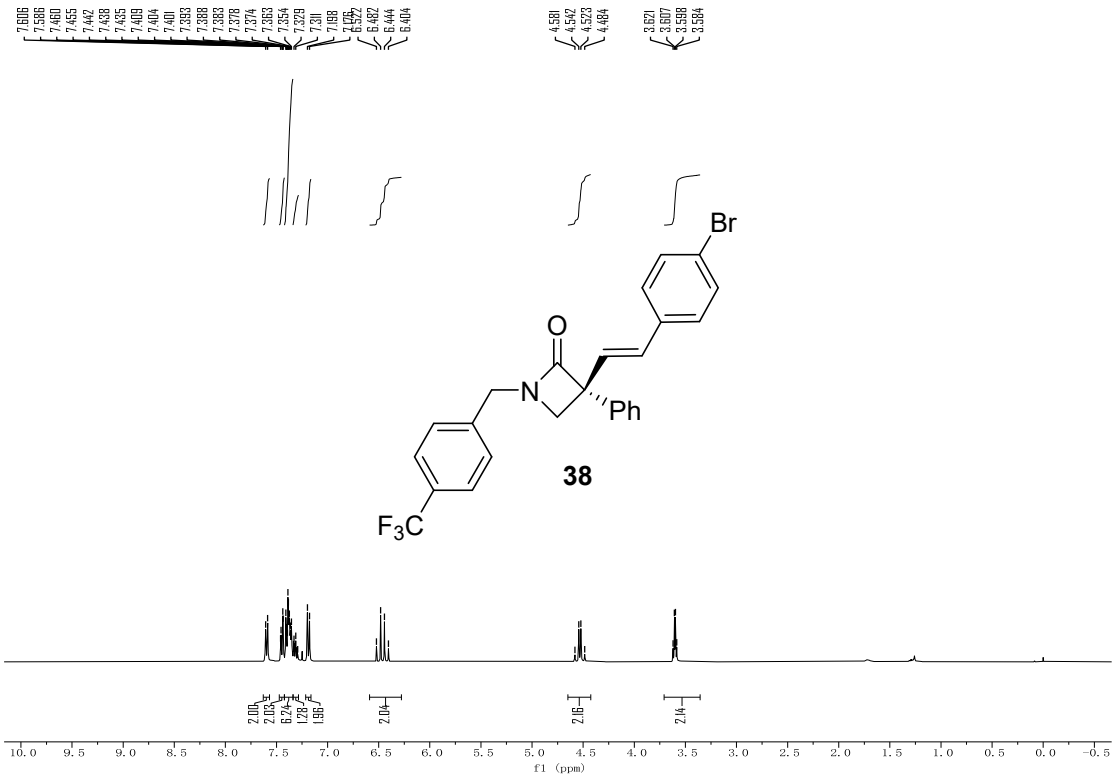
37

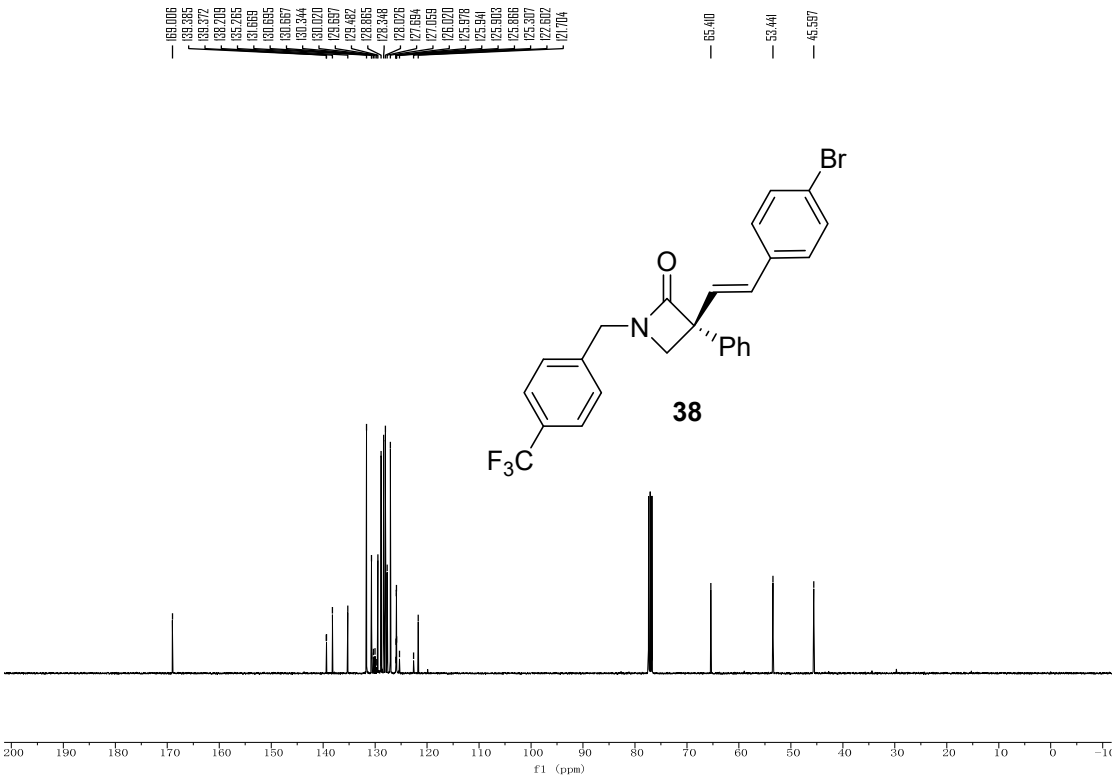

7.610
7.605
7.590
7.462
7.457
7.444
7.440
7.437
7.406
7.403
7.385
7.380
7.377
7.370
7.365
7.357
7.335
7.331
7.328
7.313
7.251
6.509
6.470
6.456
6.417
4.586
4.547
4.526
4.487
3.623
3.609
3.599
3.585
Cl
O
N
Ph
F3C
37
2.12
2.10
4.11
1.07
3.95
1.86
1.94
1.87
f1 (ppm)

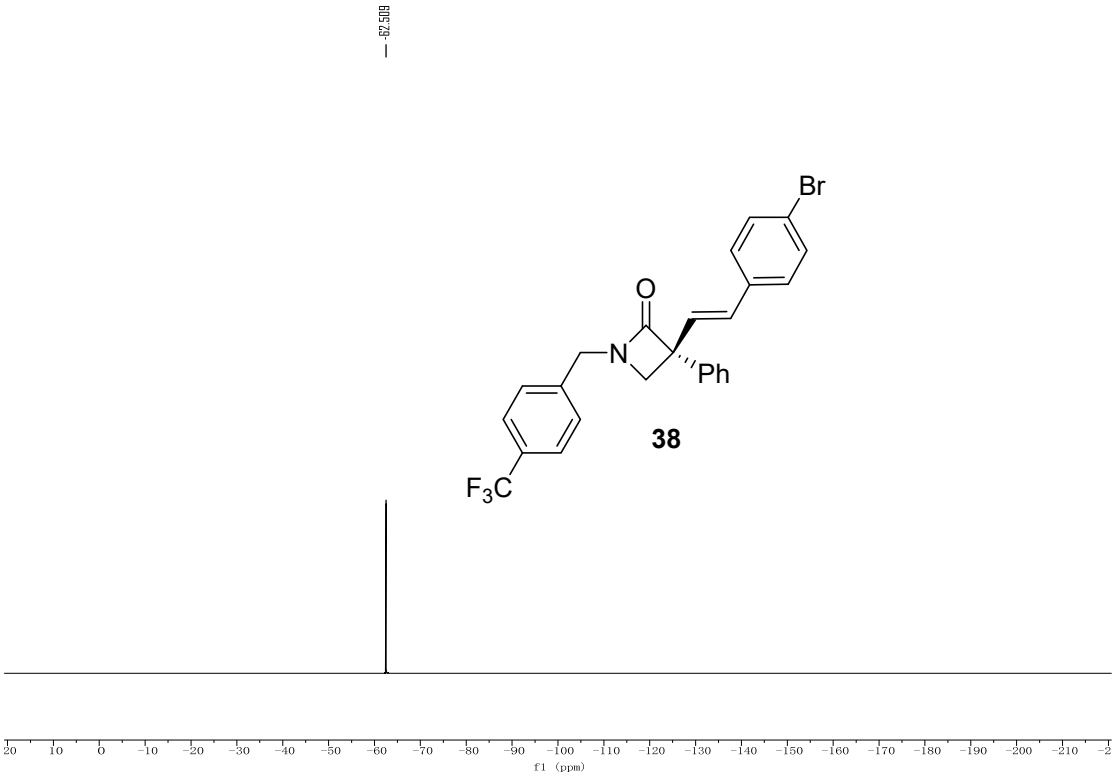

169.1071
163.3399
138.2769
134.8441
133.5559
130.6553
130.3779
130.1056
129.7734
129.3362
129.3100
129.1006
128.8778
128.7197
128.7461
128.3367
128.2794
127.7930
127.7702
127.1530
127.0173
125.9969
125.9962
125.9374
125.8888
125.3323
122.6918
65.4270
53.4693
45.8270
Cl
O
N
Ph
F3C
37
f1 (ppm)


— -62.560
Cl
O
N
Ph
F3C
37
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

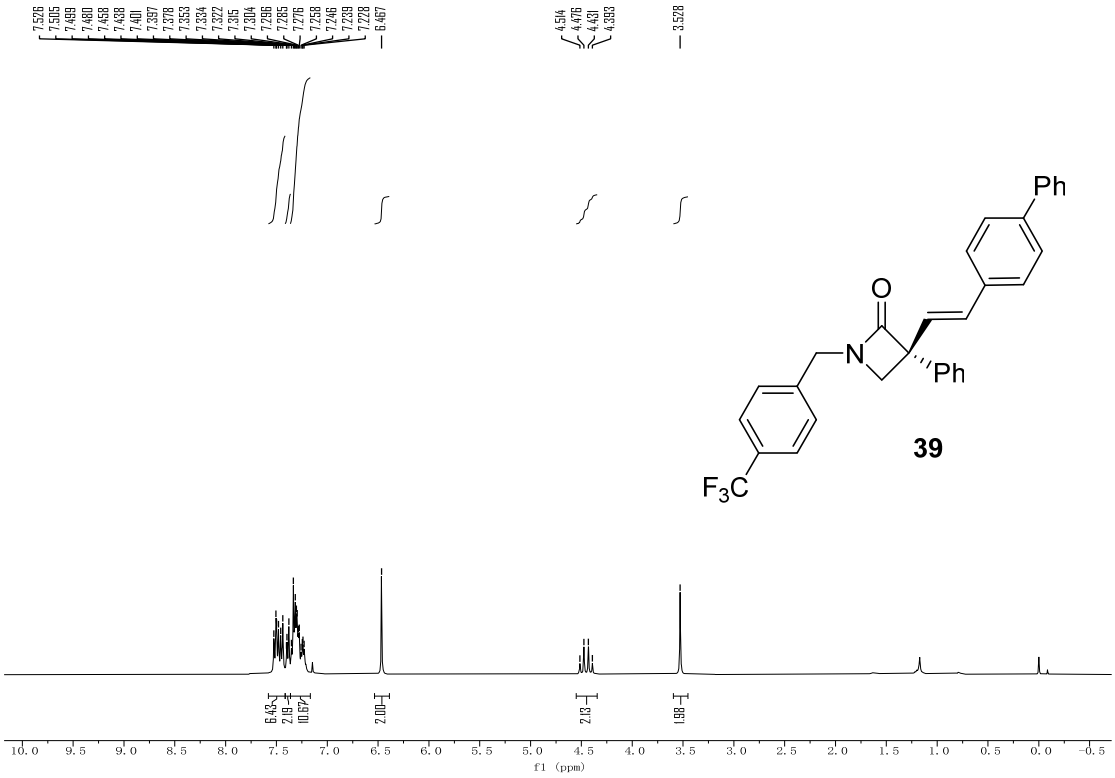
38

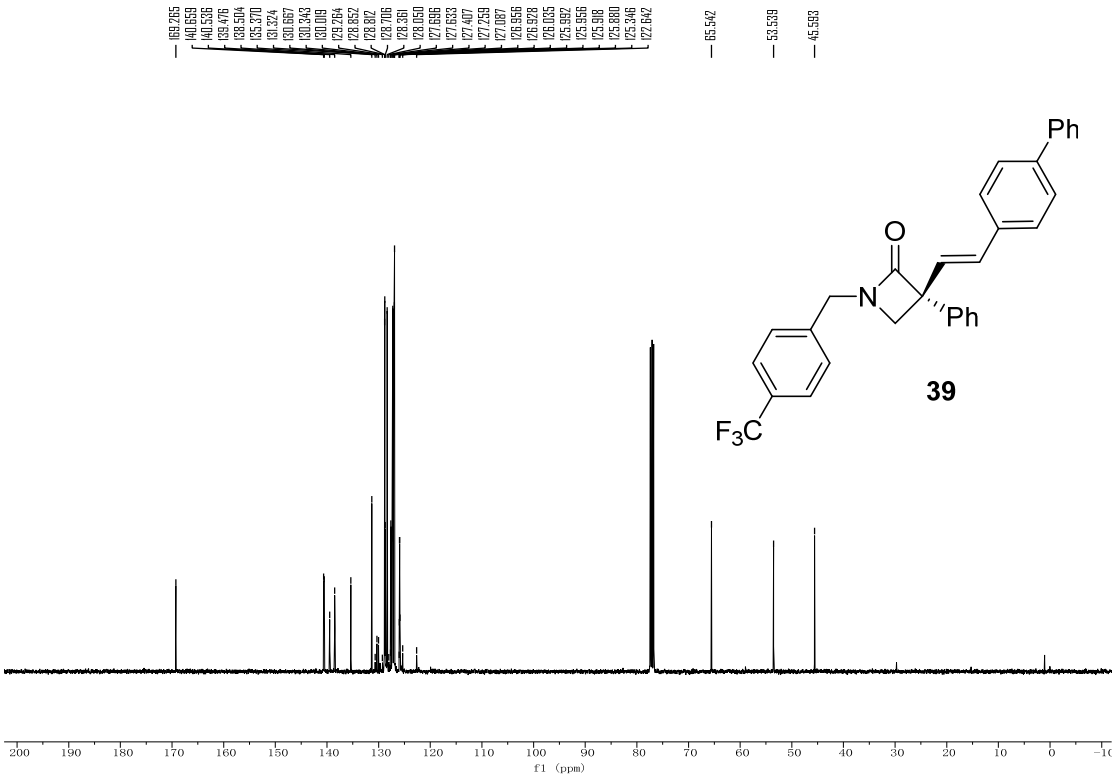

7.606
7.586
7.460
7.455
7.442
7.438
7.435
7.409
7.404
7.401
7.393
7.388
7.383
7.378
7.374
7.363
7.354
7.229
7.211
7.198
7.076
6.522
6.482
6.444
6.404
4.581
4.542
4.523
4.484
3.621
3.607
3.598
3.584
Br
O
N
Ph
38
F3C
2.00
2.05
6.24
1.28
1.96
2.04
2.16
2.14
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

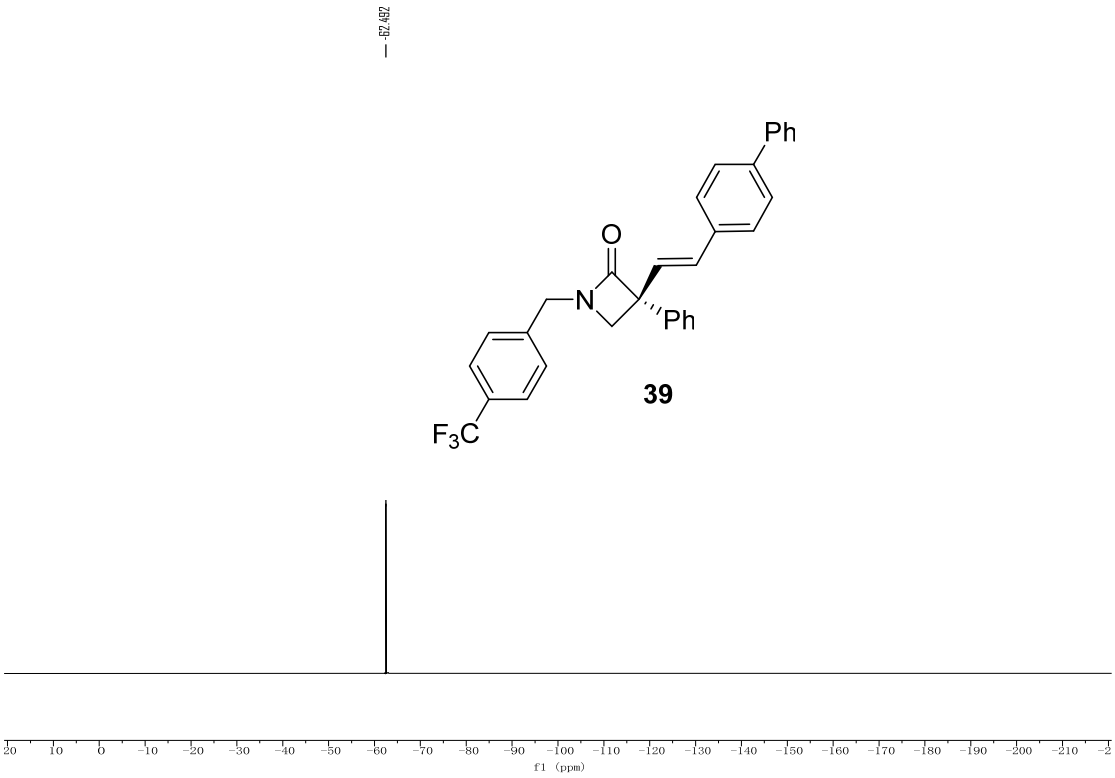

169.006
133.385
133.372
128.210
125.765
131.663
130.695
130.667
130.344
130.020
129.697
129.482
128.865
128.348
128.026
127.694
127.059
126.020
125.978
125.941
125.903
125.886
125.307
122.602
121.704
65.410
53.441
45.597
Br
O
N
Ph
38
F3C
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-62.569
Br
O
N
Ph
38
F3C
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

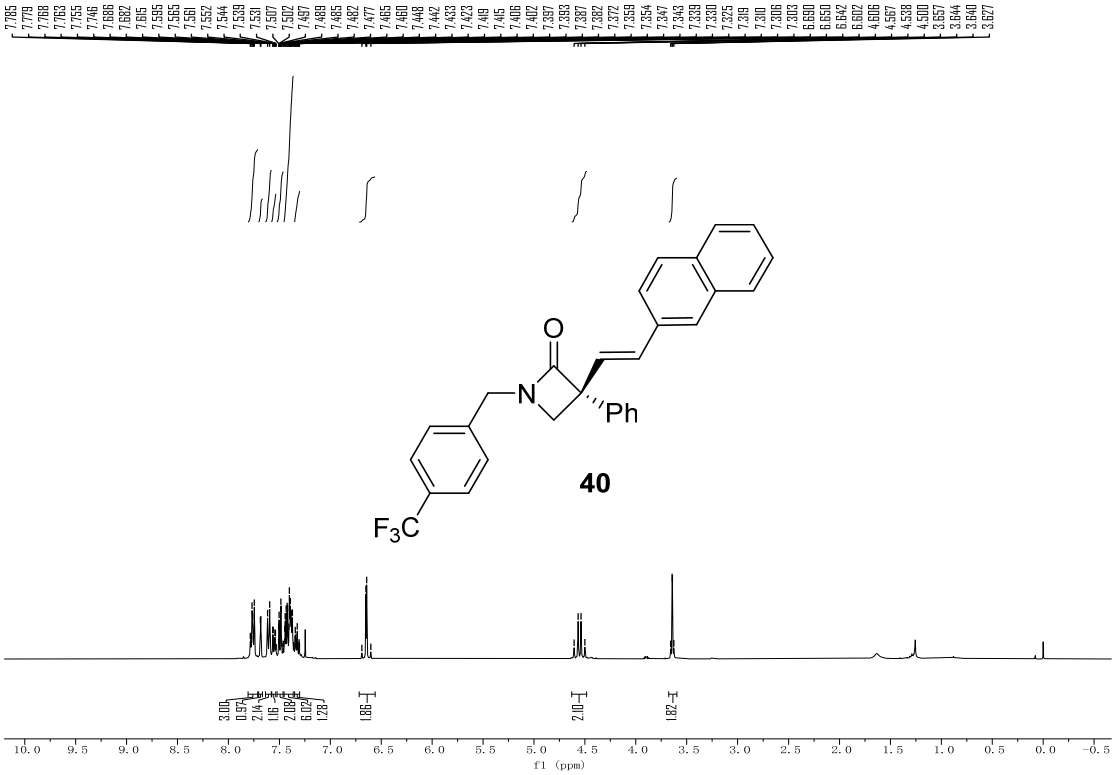
39

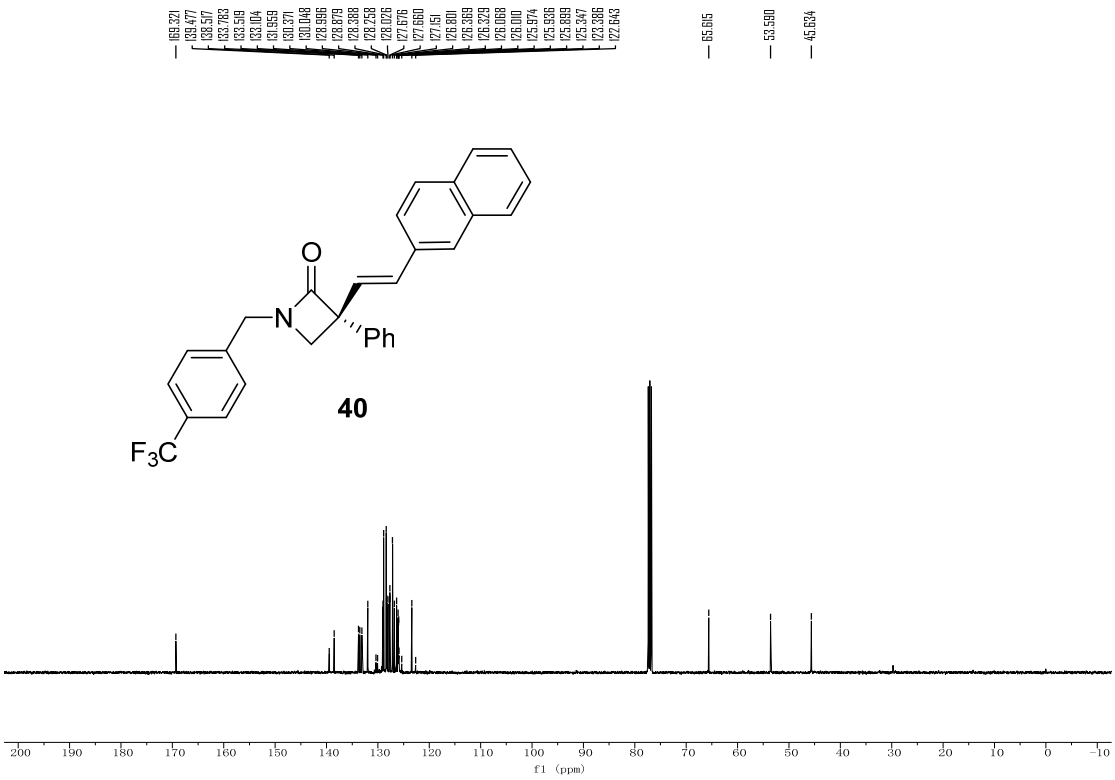

7.526
7.505
7.499
7.480
7.458
7.438
7.401
7.397
7.378
7.353
7.334
7.322
7.315
7.304
7.296
7.285
7.276
7.258
7.246
7.239
7.228
6.467
4.514
4.476
4.431
4.393
3.528
Ph
O
N
Ph
F3C
39
6.43
2.19
10.67
2.00
2.13
1.98
f1 (ppm)

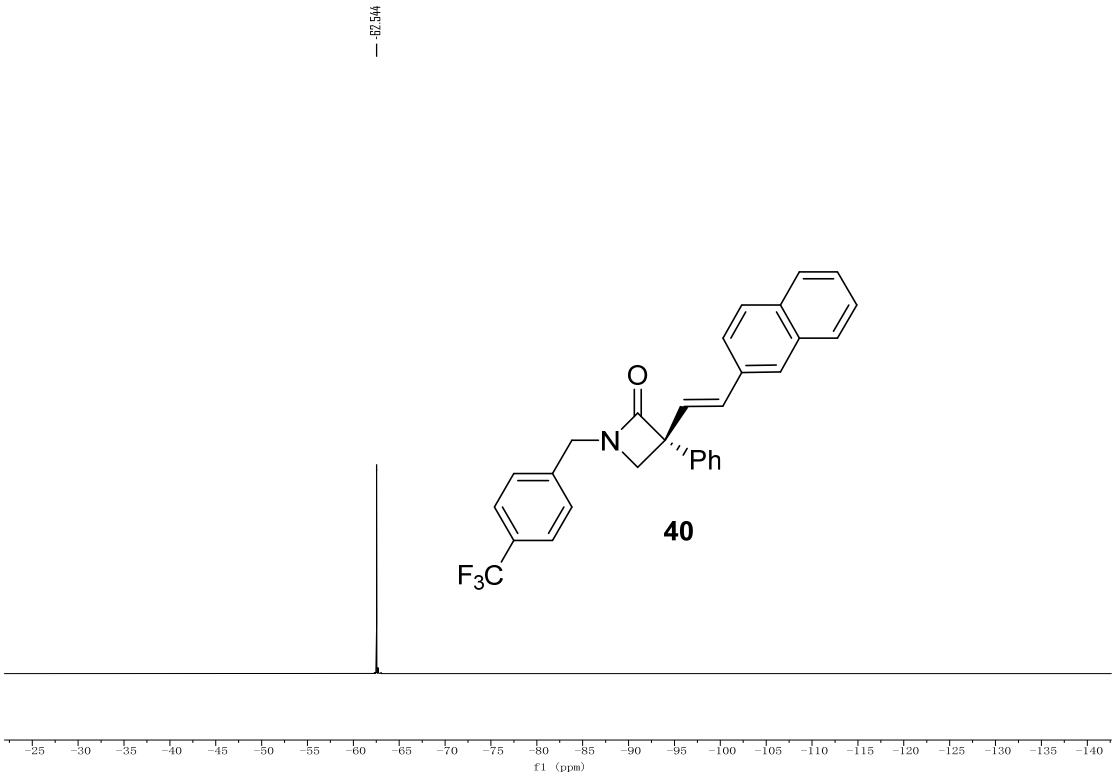

169.265
140.655
140.538
139.476
138.504
135.370
131.424
130.667
130.343
130.019
129.264
128.852
128.812
128.706
128.381
128.050
127.686
127.653
127.407
127.259
127.087
126.956
126.928
126.063
125.962
125.956
125.918
125.880
125.346
122.642
65.542
53.539
45.583
Ph
O
N
Ph
F3C
39
f1 (ppm)


-62.462
Ph
O
N
Ph
F3C
39
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

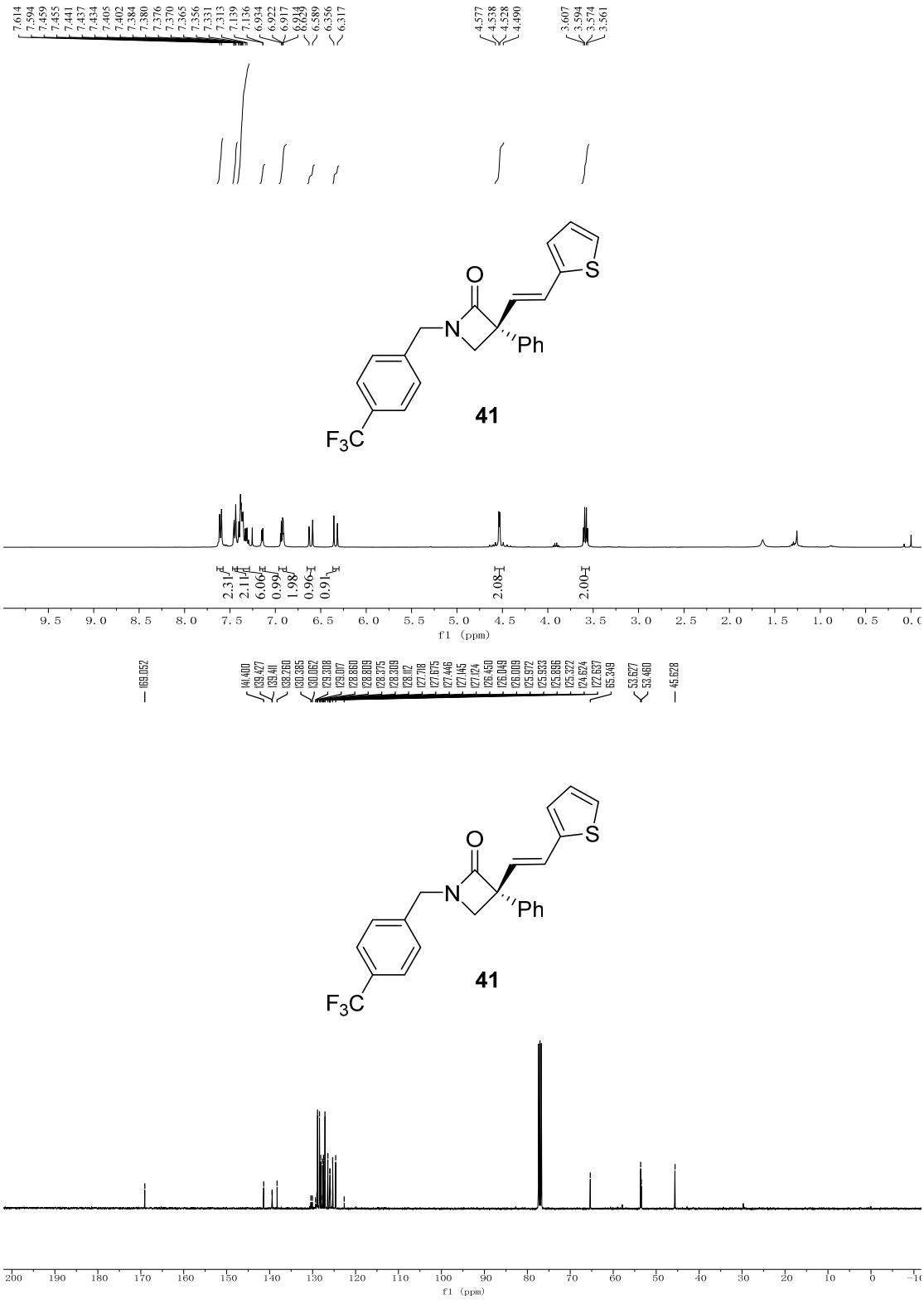
40


7.785
7.779
7.768
7.763
7.755
7.746
7.686
7.682
7.615
7.595
7.565
7.561
7.552
7.544
7.539
7.531
7.507
7.502
7.497
7.489
7.485
7.482
7.477
7.465
7.460
7.448
7.442
7.433
7.423
7.413
7.405
7.402
7.397
7.383
7.387
7.382
7.372
7.359
7.354
7.347
7.343
7.339
7.330
7.325
7.318
7.310
7.306
7.303
6.690
6.650
6.642
6.602
4.606
4.597
4.538
4.500
3.657
3.644
3.640
3.627
O
N
Ph
F3C
40
3.00
0.97
2.44
1.16
2.09
6.02
1.28
1.86
2.00
1.82
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

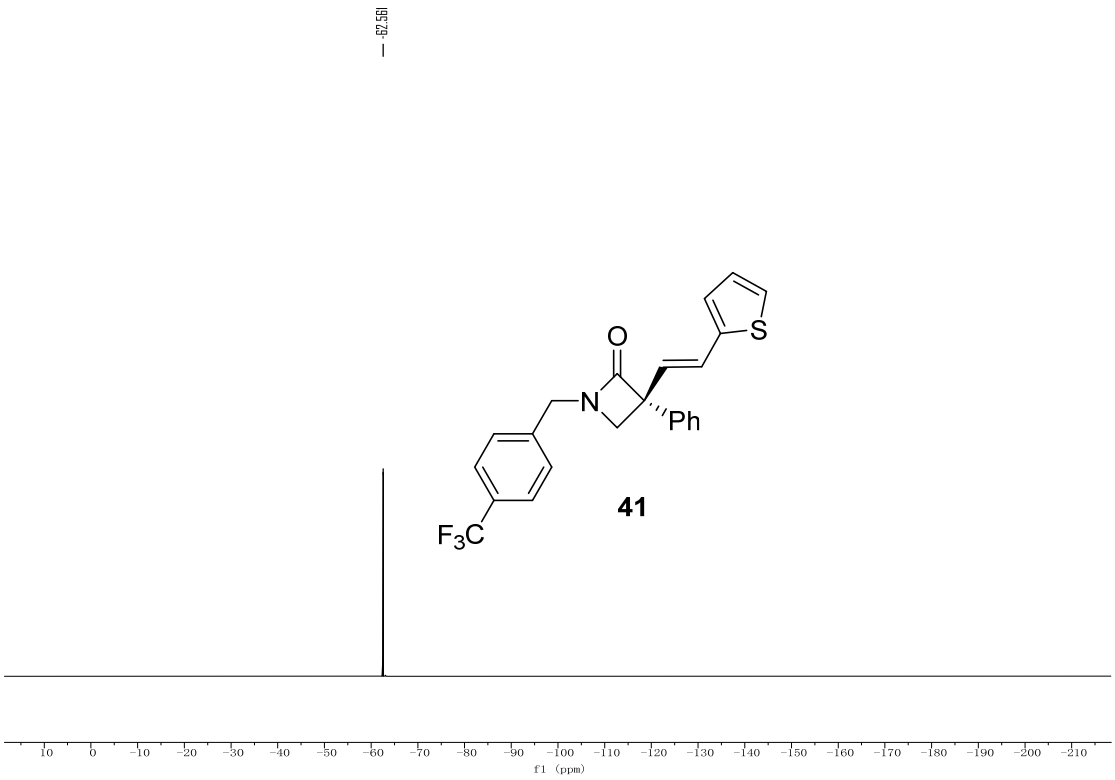

169.321
139.477
138.517
133.783
132.549
133.104
131.959
130.371
130.048
128.996
128.879
128.368
128.238
128.026
127.676
127.660
127.151
126.801
126.389
126.229
126.068
126.010
125.974
125.936
125.899
125.347
123.386
122.643
65.615
53.590
45.634
O
N
Ph
F3C
40
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-62.544
O
N
Ph
F3C
40
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
-90
-95
-100
-105
-110
-115
-120
-125
-130
-135
-140
f1 (ppm)

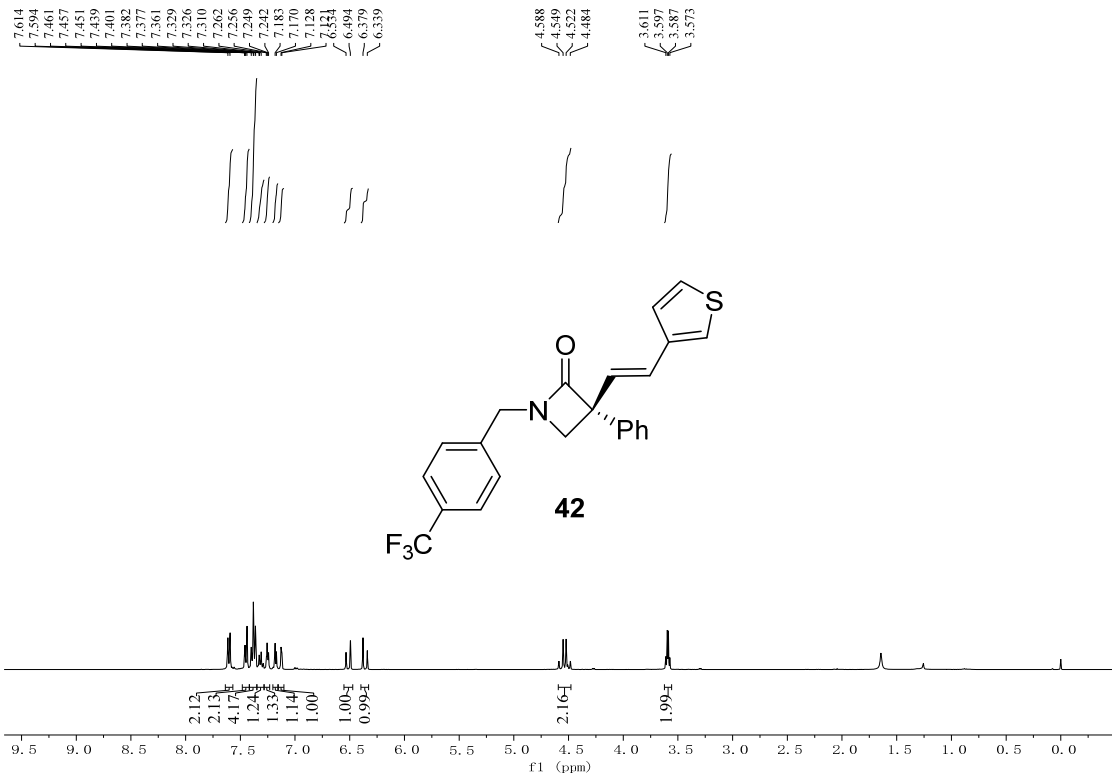
41

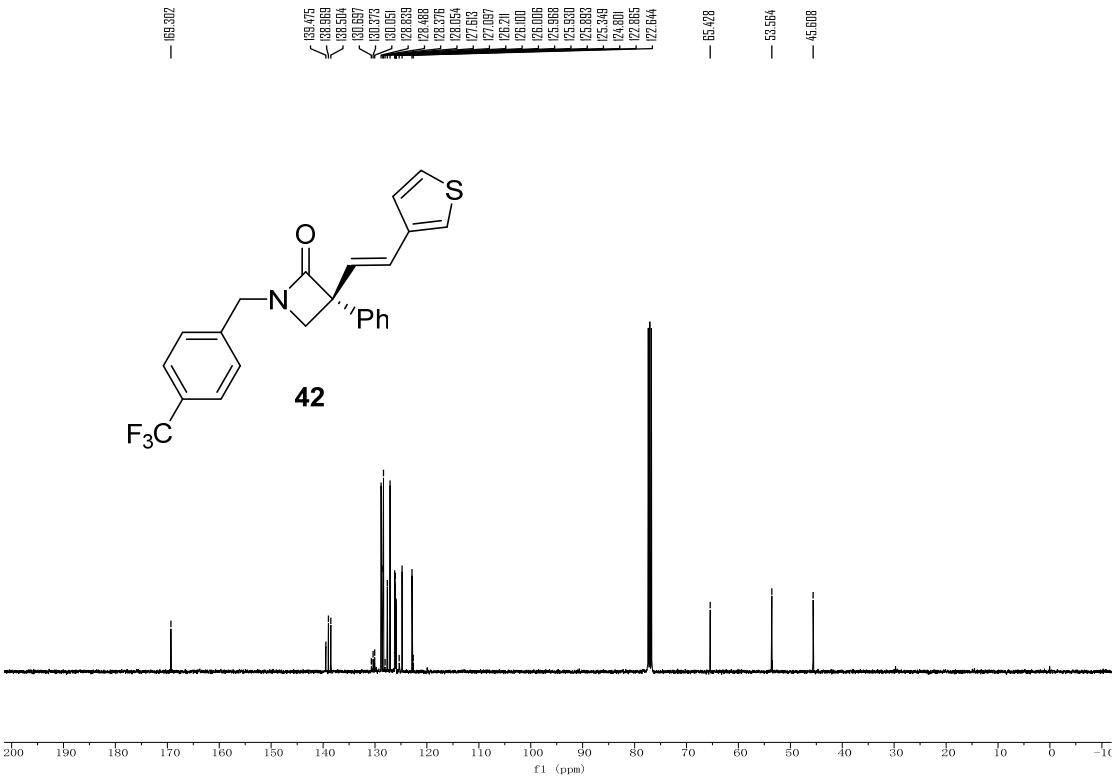

7.614
7.594
7.459
7.455
7.441
7.437
7.434
7.405
7.402
7.384
7.380
7.376
7.370
7.365
7.356
7.331
7.313
7.139
7.136
6.934
6.922
6.917
6.914
6.589
6.356
6.317
4.577
4.538
4.528
4.490
3.607
3.594
3.574
3.561
O
S
N
Ph
F3C
41
2.31
2.11
6.06
0.99
1.98
0.96
0.91
2.08
2.00
f1 (ppm)

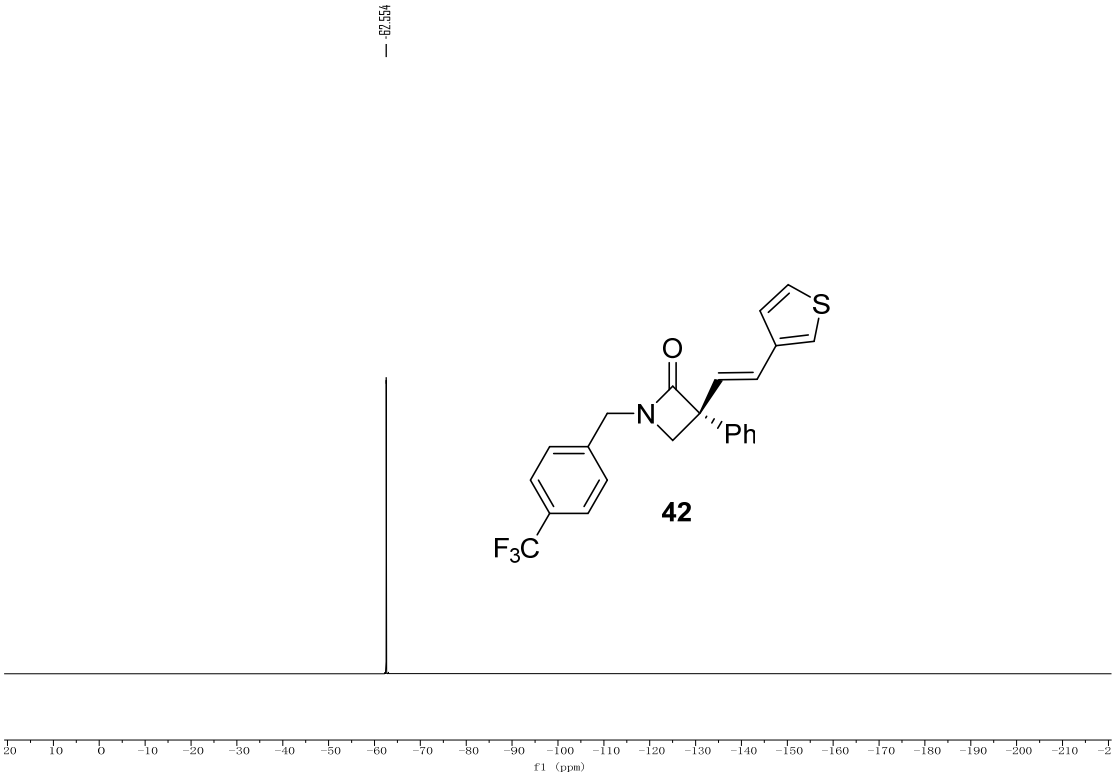
169.052
144.400
139.427
139.411
138.260
130.385
130.062
129.308
129.107
128.860
128.808
128.375
128.309
128.112
127.778
127.675
127.446
127.145
127.124
126.450
126.049
126.009
125.972
125.933
125.886
125.222
124.624
122.637
65.349
53.827
53.460
45.828
O
S
N
Ph
F3C
41
f1 (ppm)


-62.561
O
S
N
Ph
F3C
41
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

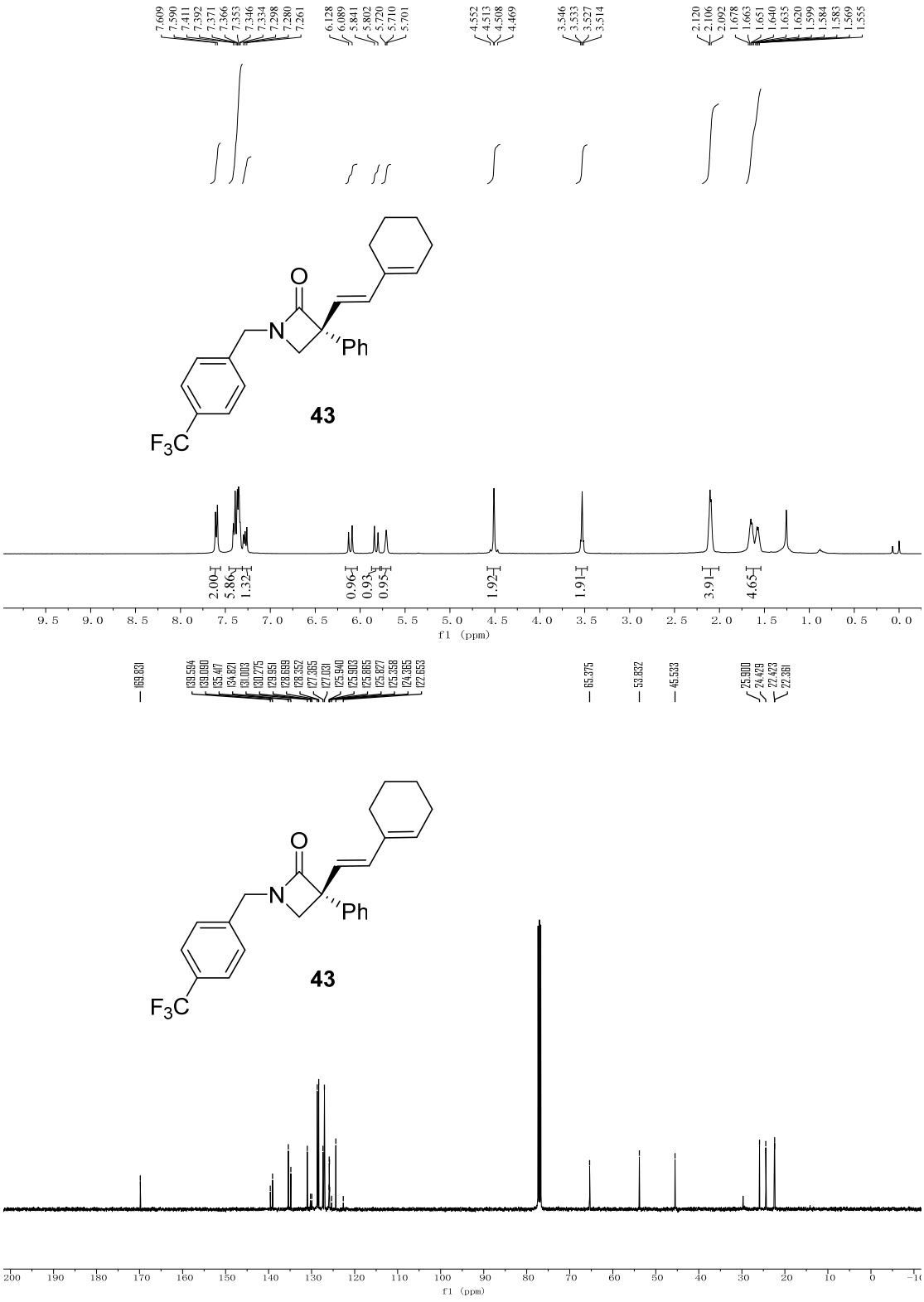
42

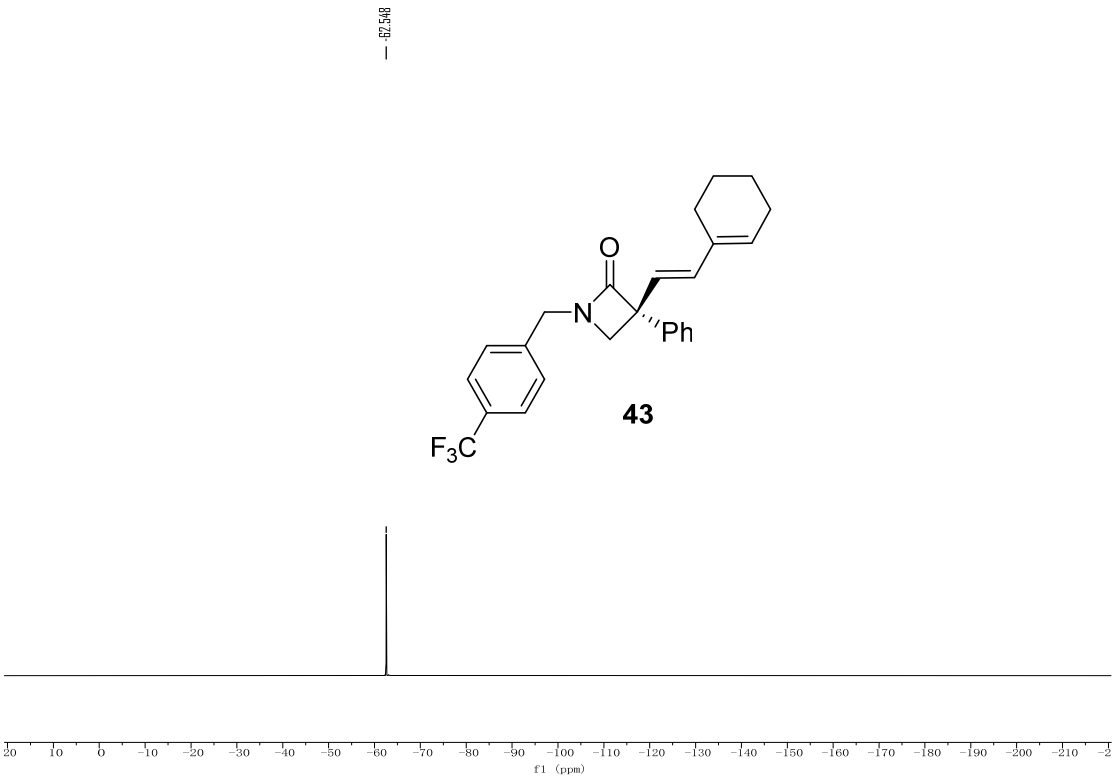

7.614
7.594
7.461
7.457
7.451
7.439
7.401
7.382
7.377
7.361
7.329
7.326
7.310
7.262
7.256
7.249
7.242
7.183
7.170
7.128
6.534
6.494
6.379
6.339
4.588
4.549
4.522
4.484
3.611
3.597
3.587
3.573
O
S
N
Ph
F3C
42
2.12
2.13
4.17
1.24
1.33
1.14
1.00
1.00
0.99
2.16
1.99
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


169.302
139.475
138.969
138.504
130.697
130.373
130.051
128.839
128.468
128.376
128.054
127.613
127.097
126.211
126.100
126.006
125.968
125.930
125.893
125.349
124.801
122.865
122.644
65.428
53.564
45.608
S
O
N
Ph
42
F3C
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

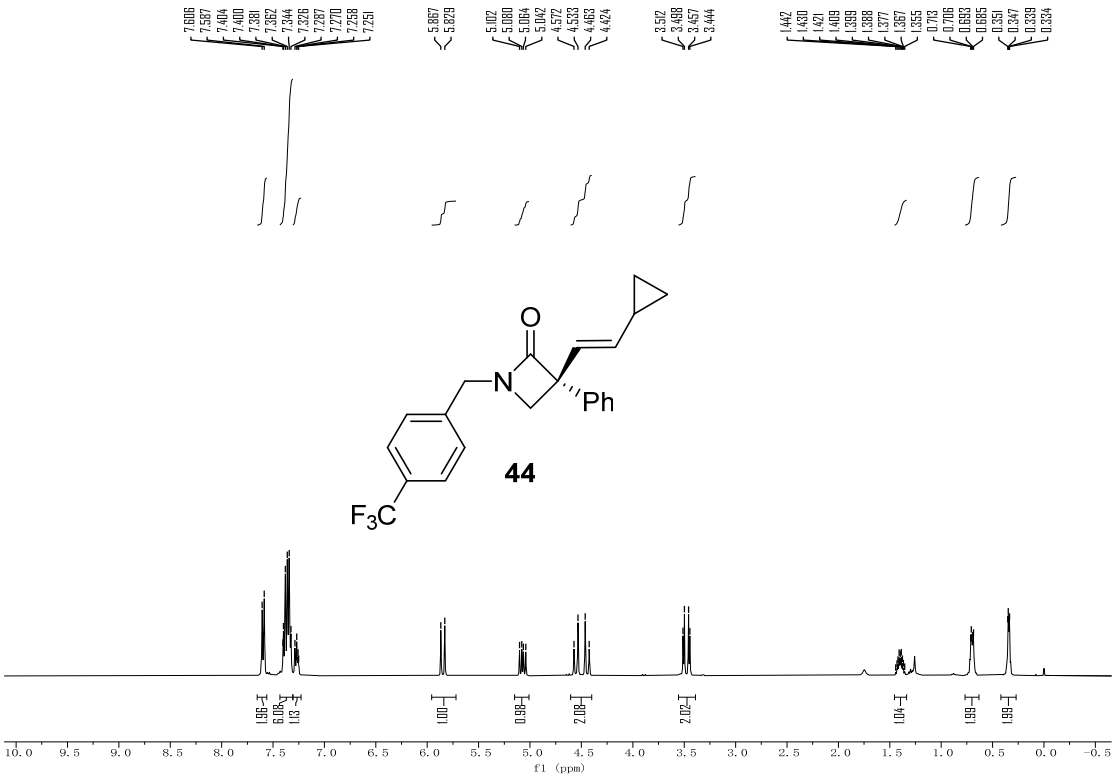

-62.554
S
O
N
Ph
42
F3C
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

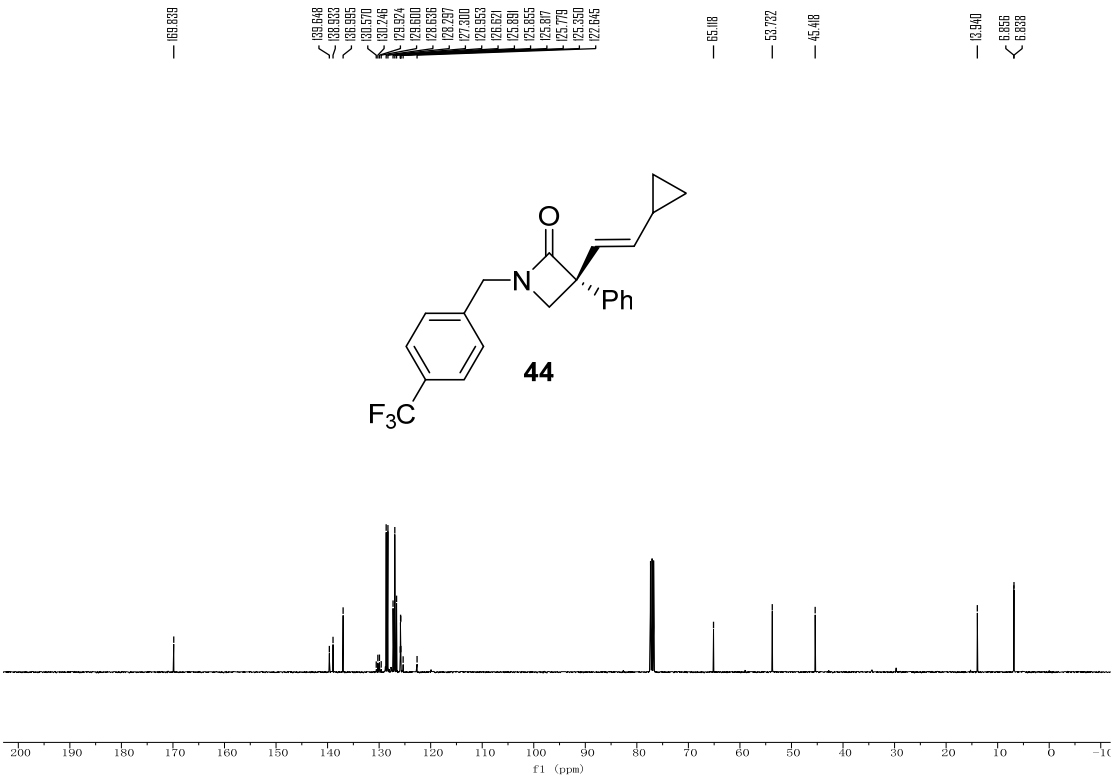
43

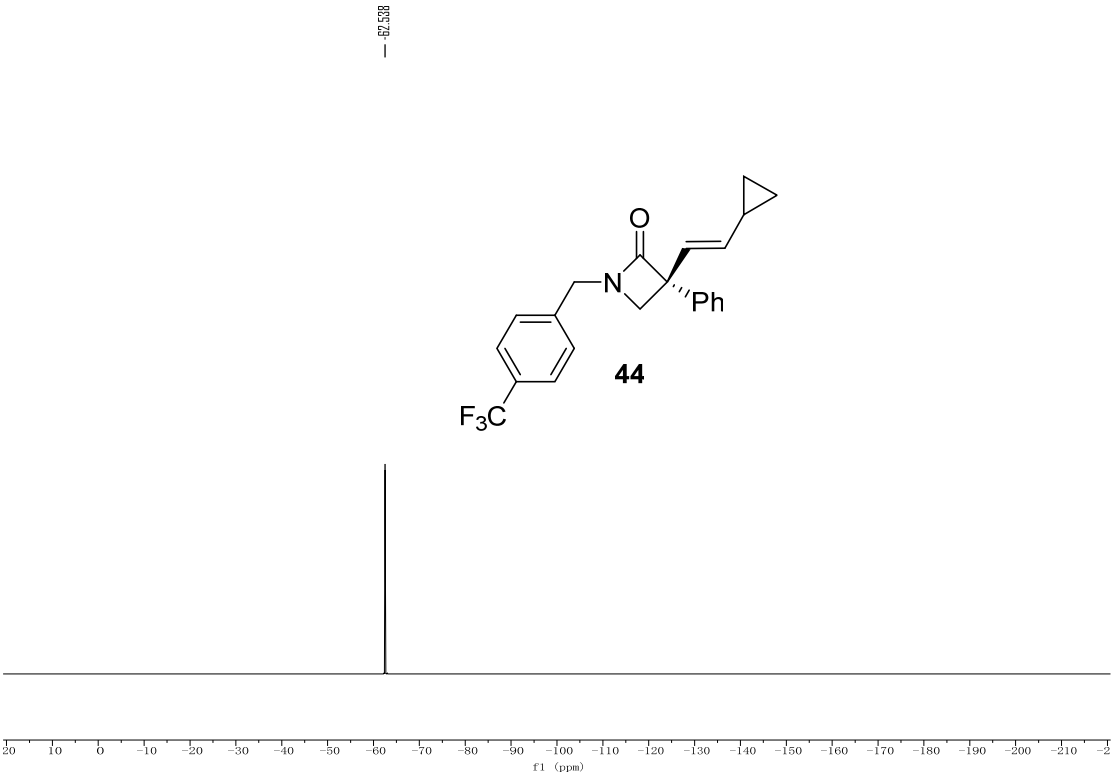

7.609
7.590
7.411
7.392
7.371
7.366
7.353
7.346
7.334
7.298
7.280
7.261
6.128
6.089
5.841
5.802
5.720
5.710
5.701
4.552
4.513
4.508
4.469
3.546
3.533
3.527
3.514
2.120
2.106
2.092
1.678
1.663
1.651
1.640
1.635
1.620
1.599
1.584
1.583
1.569
1.555
O
N
Ph
F3C
43
2.00
5.86
1.32
0.96
0.93
0.95
1.92
1.91
3.91
4.65
f1 (ppm)
169.831
139.594
139.090
135.447
134.821
131.002
130.775
129.951
128.699
128.352
127.985
127.631
125.940
125.903
125.885
125.827
125.358
124.385
122.653
65.375
53.832
45.533
25.980
24.429
22.423
22.361
O
N
Ph
F3C
43
f1 (ppm)


-62.548
O
N
Ph
F3C
43
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

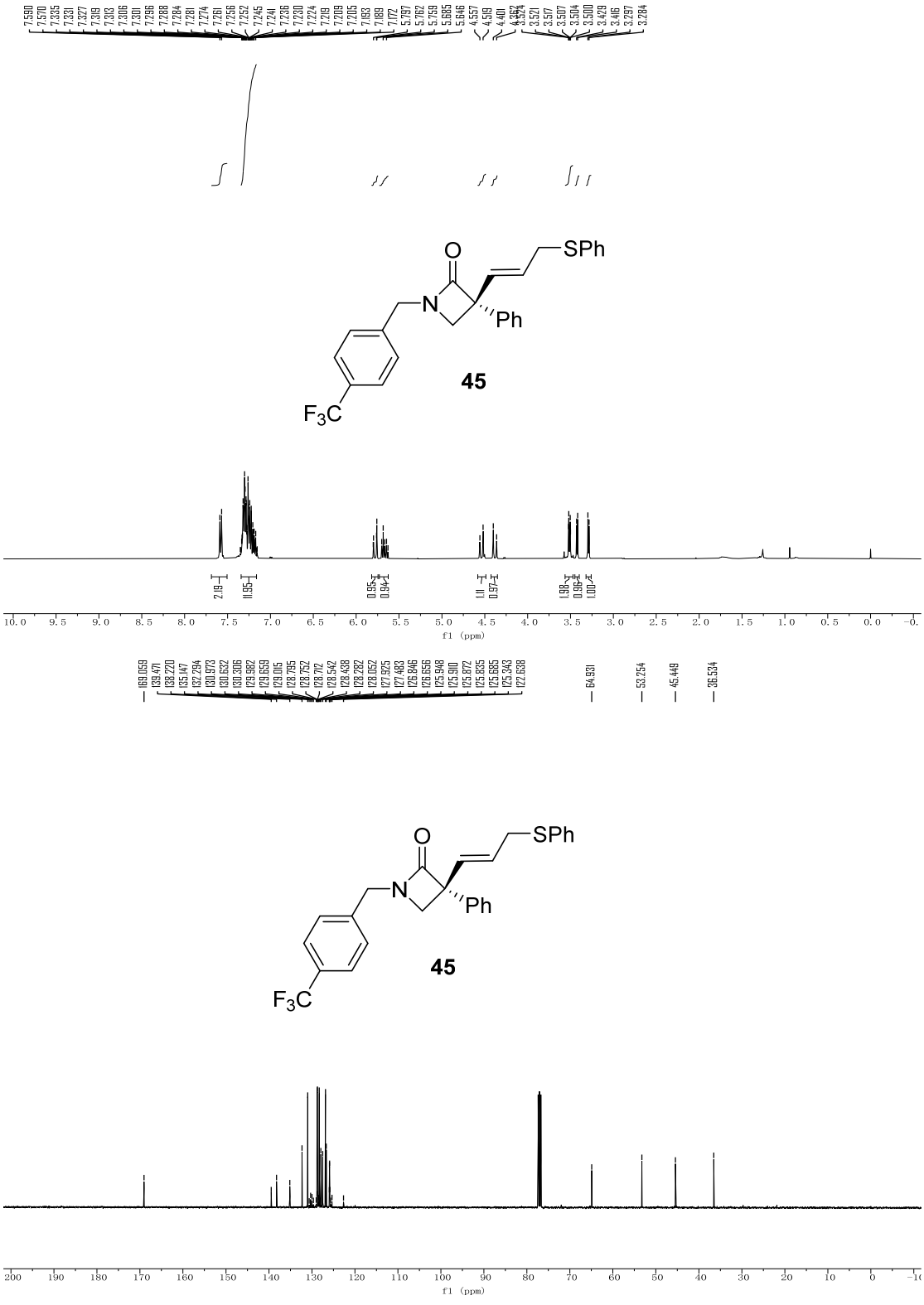
44

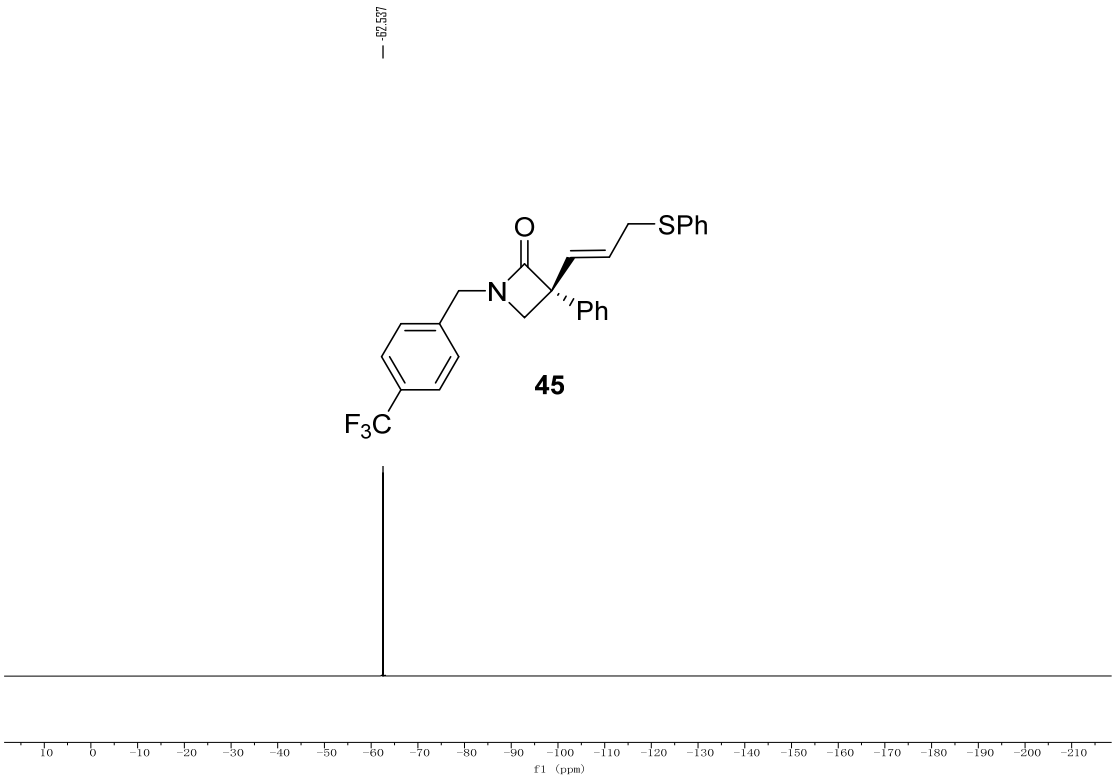

7.6006
7.5587
7.4044
7.4010
7.3781
7.3562
7.3444
7.3226
7.2787
7.2770
7.2538
7.2251
5.8867
5.8629
5.1102
5.1080
5.1064
5.1042
4.5572
4.5533
4.4483
4.4424
3.5312
3.4838
3.4657
3.4444
1.4442
1.4430
1.4421
1.4409
1.3998
1.3988
1.3777
1.3567
1.3555
0.7113
0.7096
0.6893
0.6865
0.3551
0.3347
0.3339
0.3334
O
N
Ph
F3C
44
1.96
6.08
3.13
1.00
0.99
2.08
2.02
1.04
1.93
1.99
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


169.839
139.648
138.833
136.995
130.570
130.246
129.924
129.600
128.636
128.297
127.300
126.953
126.621
125.891
125.855
125.817
125.779
125.550
122.645
65.118
52.732
45.448
13.940
6.856
6.638
O
N
Ph
44
F3C
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

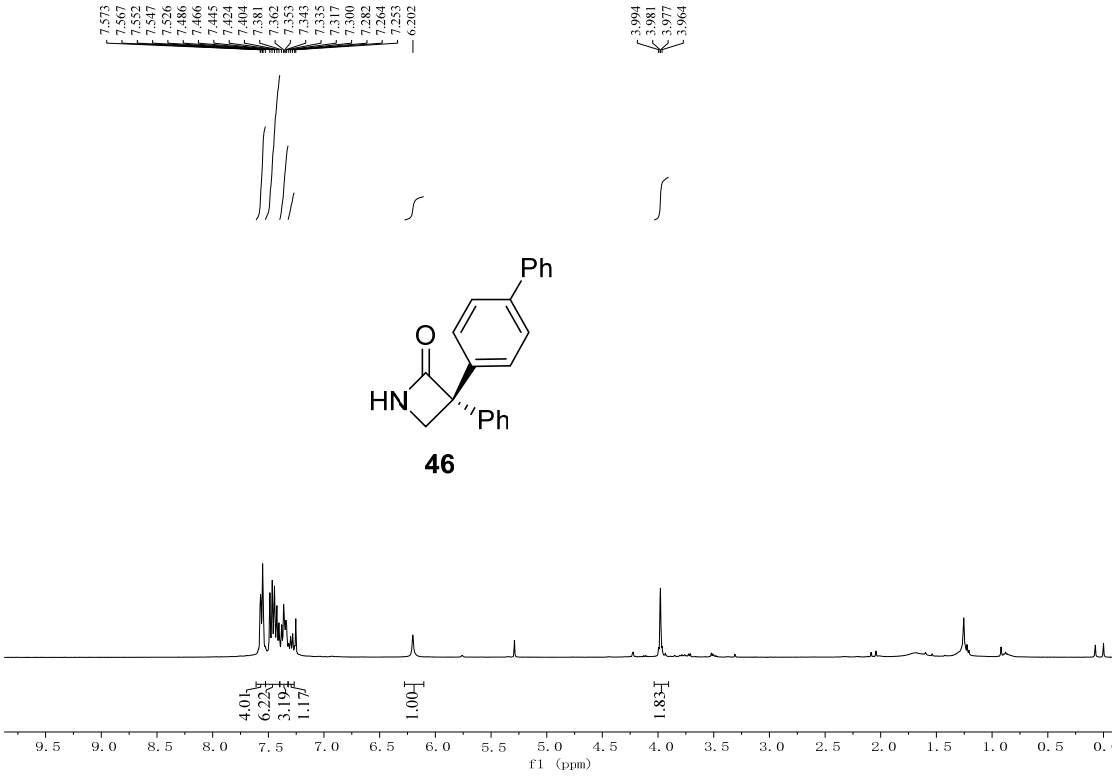

-62.588
O
N
Ph
44
F3C
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -2
f1 (ppm)

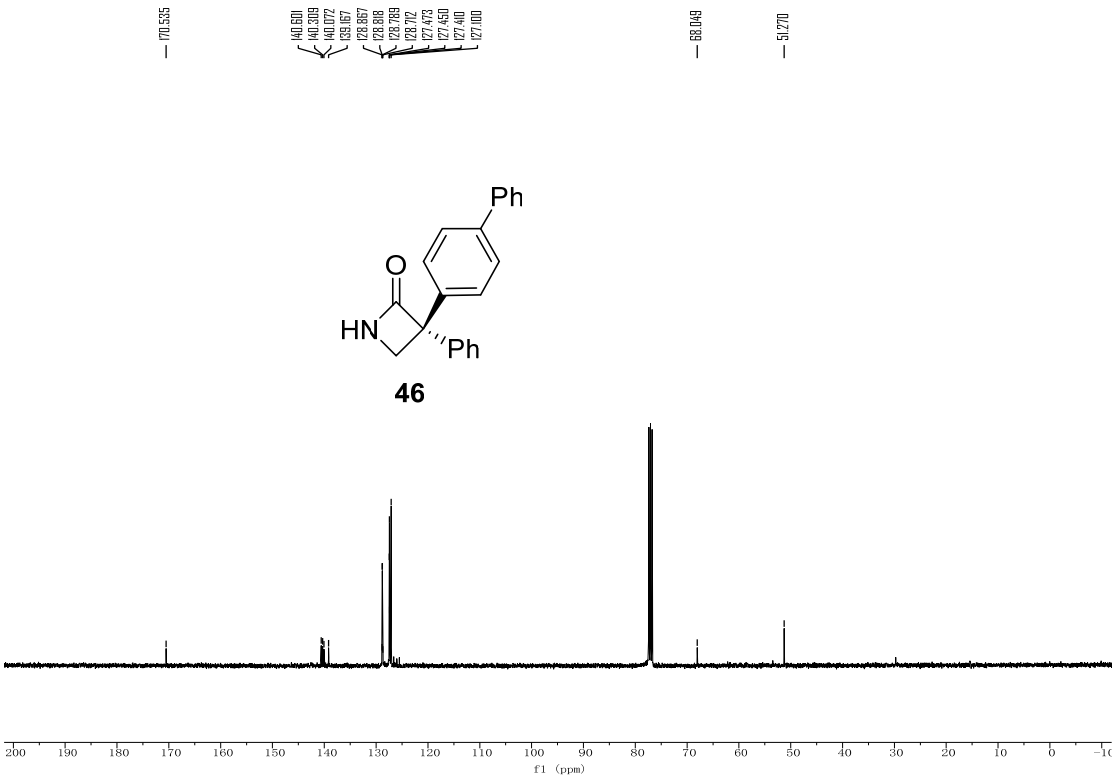
45



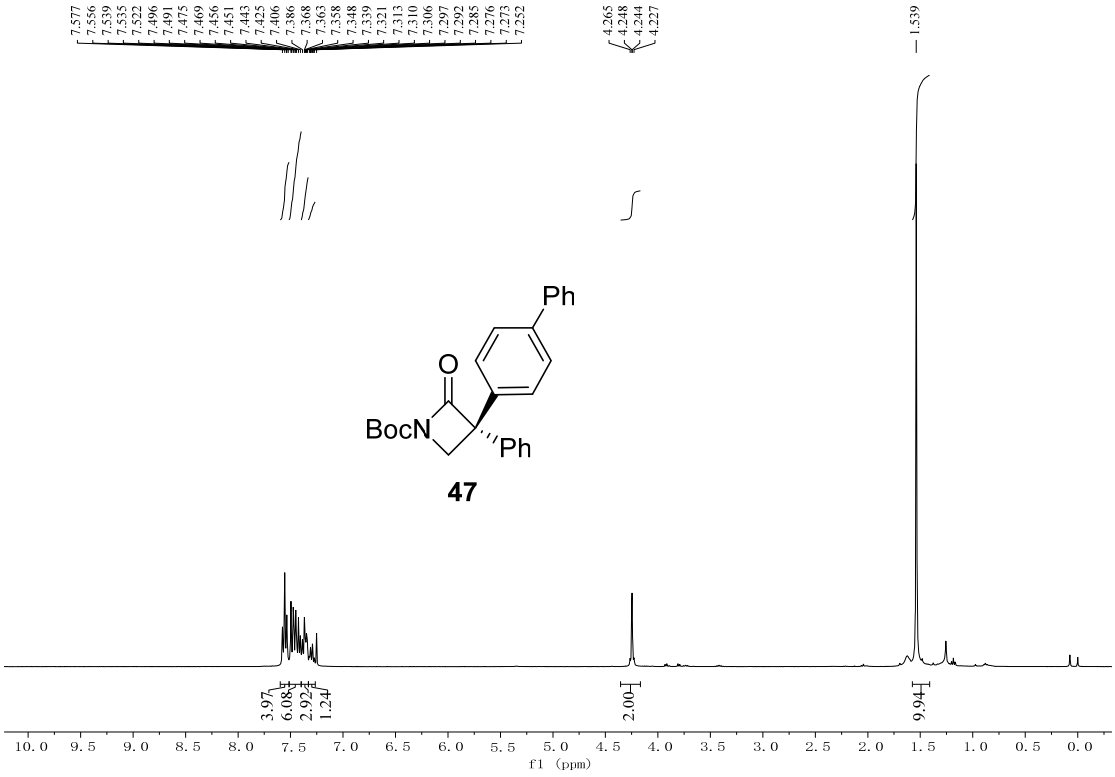

-62.537
O
SPh
N
Ph
F3C
45
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

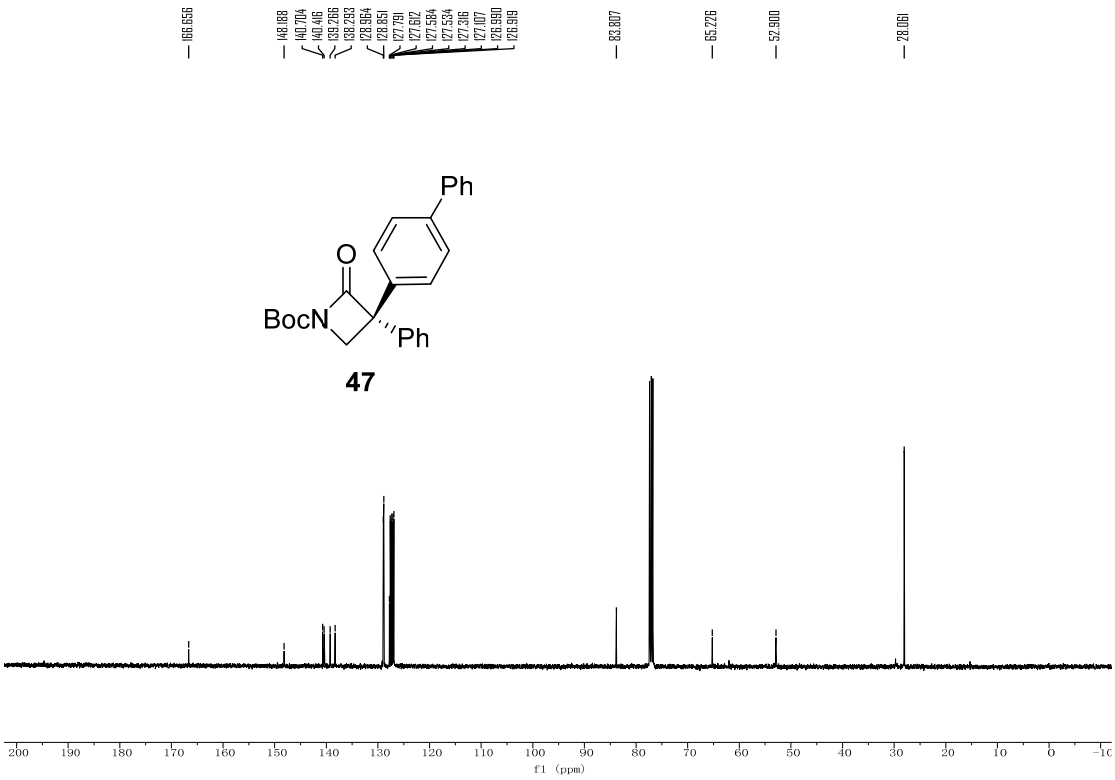
46


7.573
7.567
7.552
7.547
7.526
7.486
7.466
7.445
7.424
7.404
7.381
7.362
7.353
7.343
7.335
7.317
7.300
7.282
7.264
7.253
6.202
3.994
3.981
3.977
3.964
Ph
O
HN
Ph
46
4.01
6.22
3.19
1.17
1.00
1.83
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
f1 (ppm)

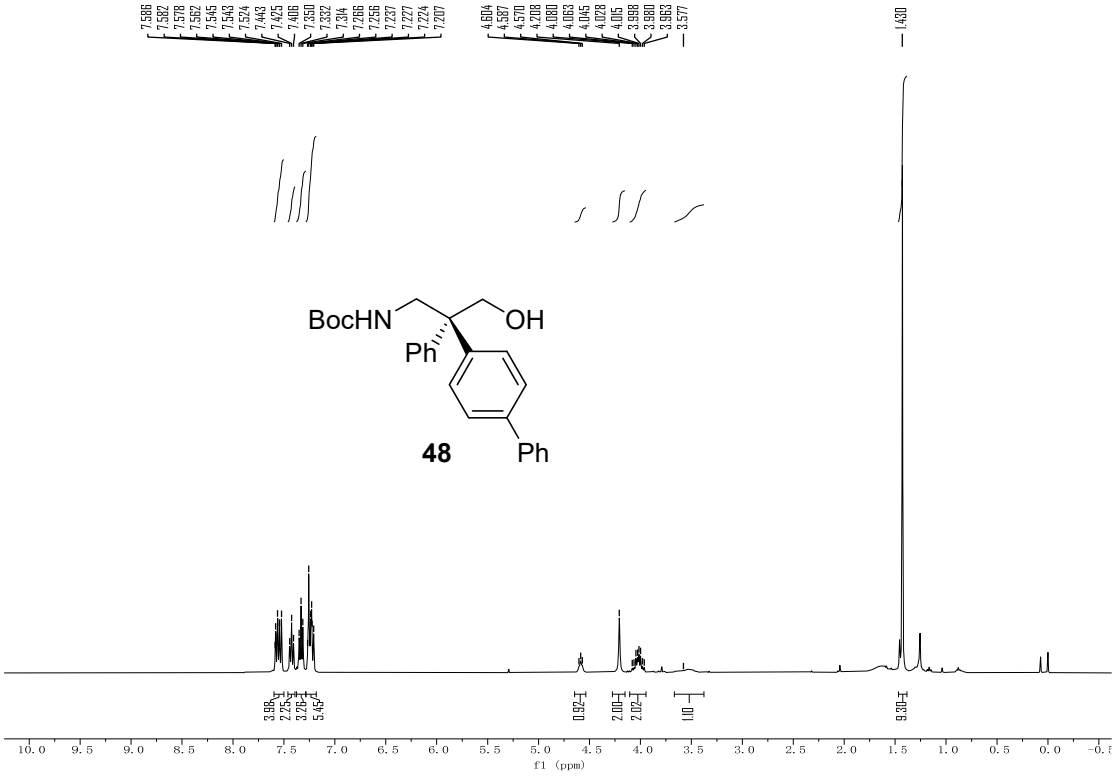

170.5335
140.8011
140.3089
140.0772
139.1677
128.8867
128.8618
128.7783
128.7712
127.4773
127.4450
127.4410
127.1000
68.1048
51.2770
Ph
O
HN
Ph
46
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

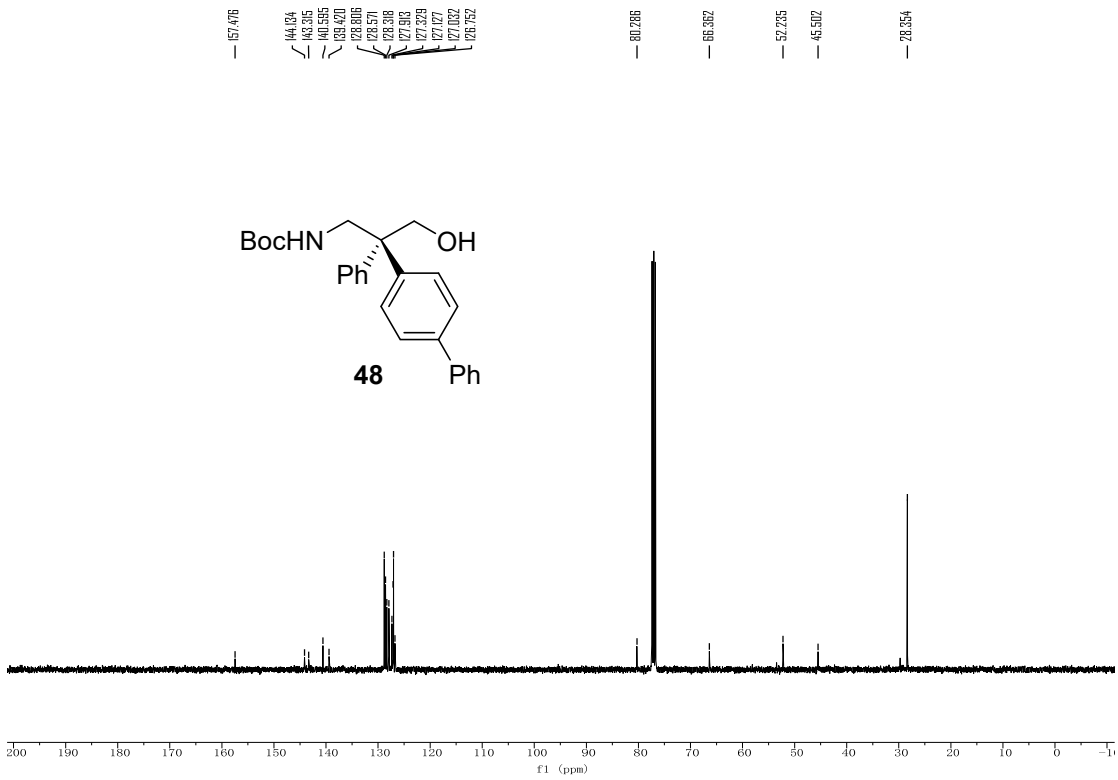
47


7.577
7.556
7.539
7.535
7.522
7.496
7.491
7.475
7.469
7.456
7.451
7.443
7.425
7.406
7.386
7.368
7.363
7.358
7.348
7.339
7.321
7.313
7.310
7.306
7.297
7.292
7.285
7.276
7.273
7.252
4.265
4.248
4.244
4.227
1.539
Ph
O
BocN
Ph
47
3.97
6.08
2.92
1.24
2.00
9.94
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


166.656
148.188
140.704
140.416
139.266
138.293
129.864
128.851
127.791
127.612
127.584
127.534
127.316
127.107
126.930
126.919
83.807
65.226
52.900
28.061
Ph
O
BocN
Ph
47
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

48


7.586
7.582
7.578
7.562
7.545
7.543
7.524
7.443
7.425
7.408
7.350
7.322
7.304
7.266
7.256
7.237
7.227
7.224
7.207
4.604
4.587
4.570
4.208
4.080
4.063
4.045
4.028
4.015
3.998
3.980
3.963
3.577
1.430
BocHN
OH
Ph
48
Ph
3.95
2.25
3.26
5.45
0.92
2.00
2.02
1.00
9.30
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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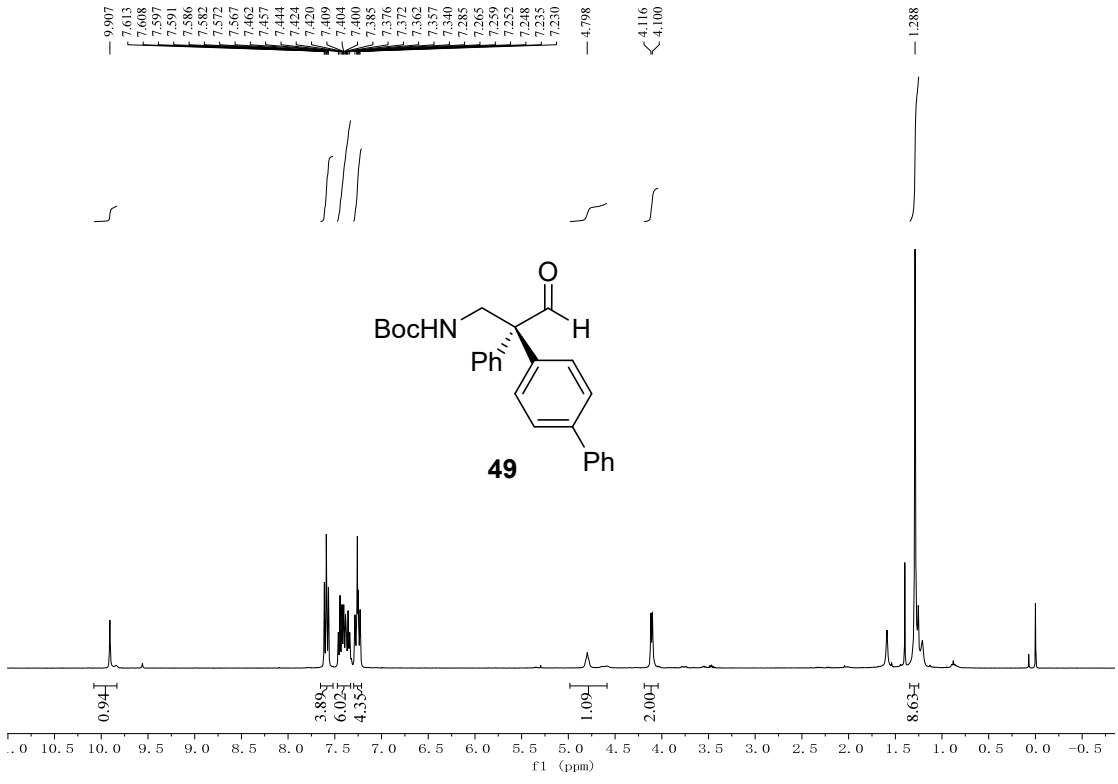
144.034
143.315
140.595
139.420
128.808
128.571
128.318
127.913
127.329
127.127
127.032
126.752
80.286
66.362
52.235
45.502
28.354
BocHN
OH
Ph
48
Ph
f1 (ppm)

49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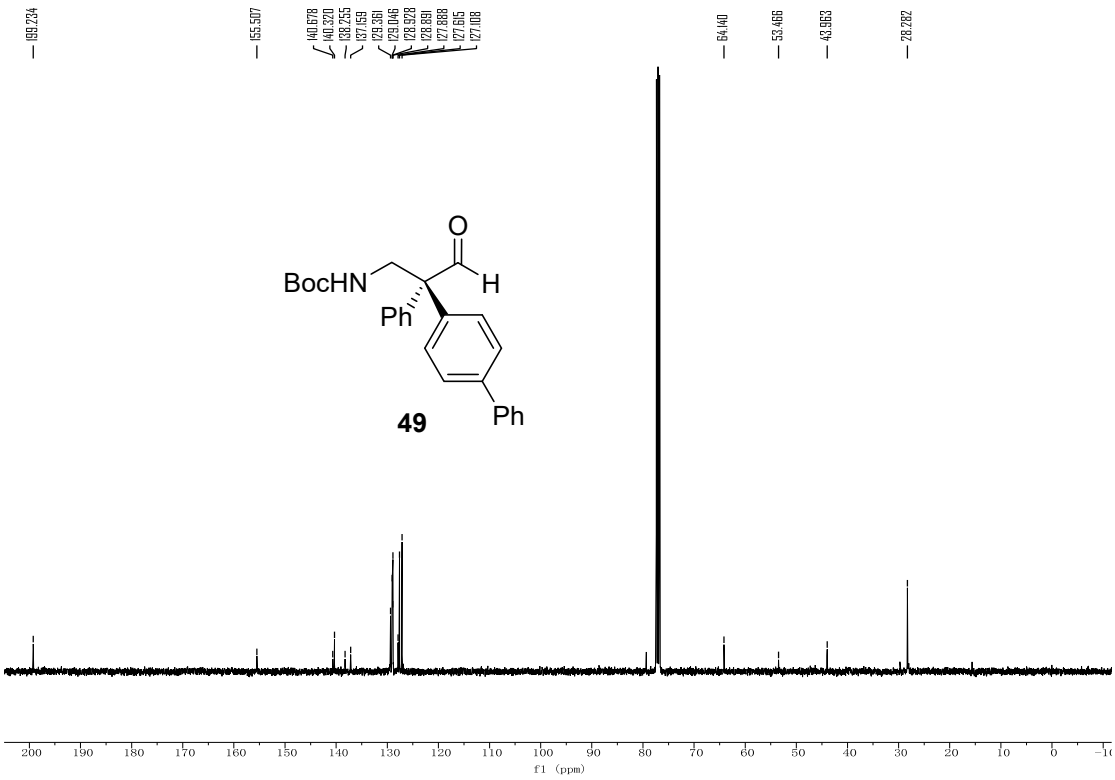
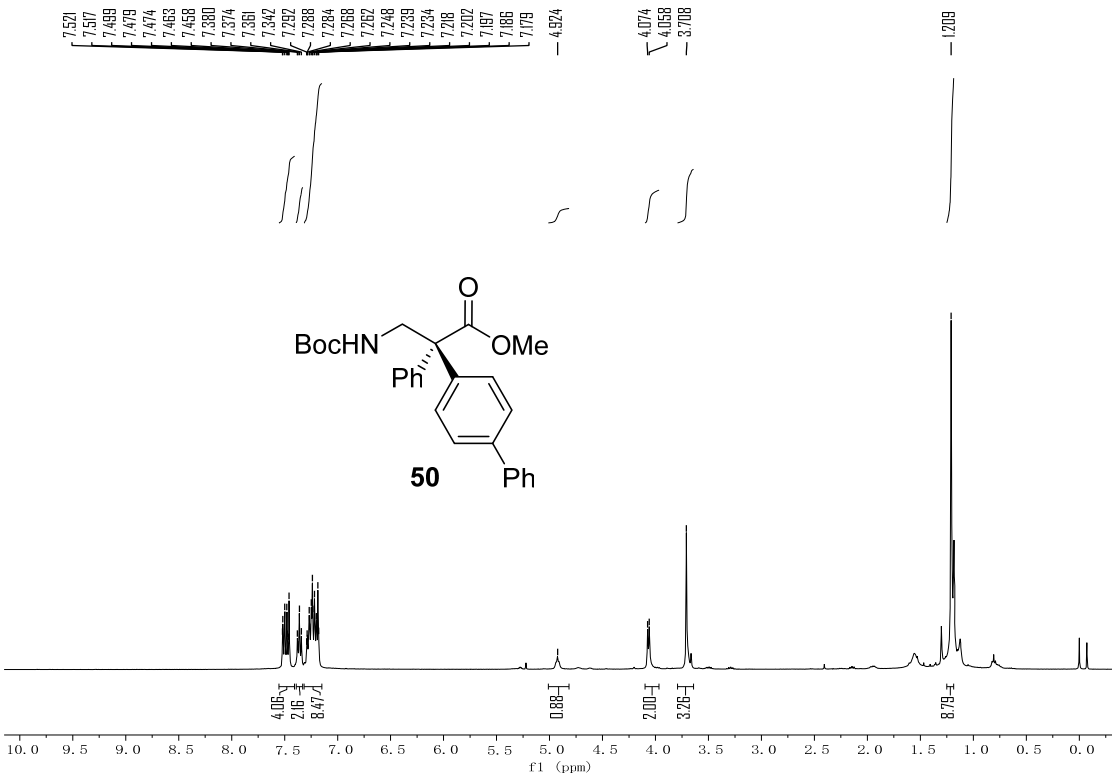
7.613
7.608
7.597
7.591
7.586
7.582
7.572
7.567
7.462
7.457
7.444
7.424
7.420
7.409
7.404
7.400
7.385
7.376
7.372
7.362
7.357
7.340
7.285
7.265
7.259
7.252
7.248
7.235
7.230
4.798
4.116
4.100
1.288
O
H
BocHN
Ph
49
Ph
0.94
3.89
6.02
4.35
1.09
2.00
8.63
f1 (ppm)


199.234
155.507
140.678
140.320
138.255
137.159
129.361
129.046
128.923
128.891
127.888
127.615
127.108
64.140
53.466
43.963
28.282
O
BocHN
H
Ph
Ph
49
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

50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7.463
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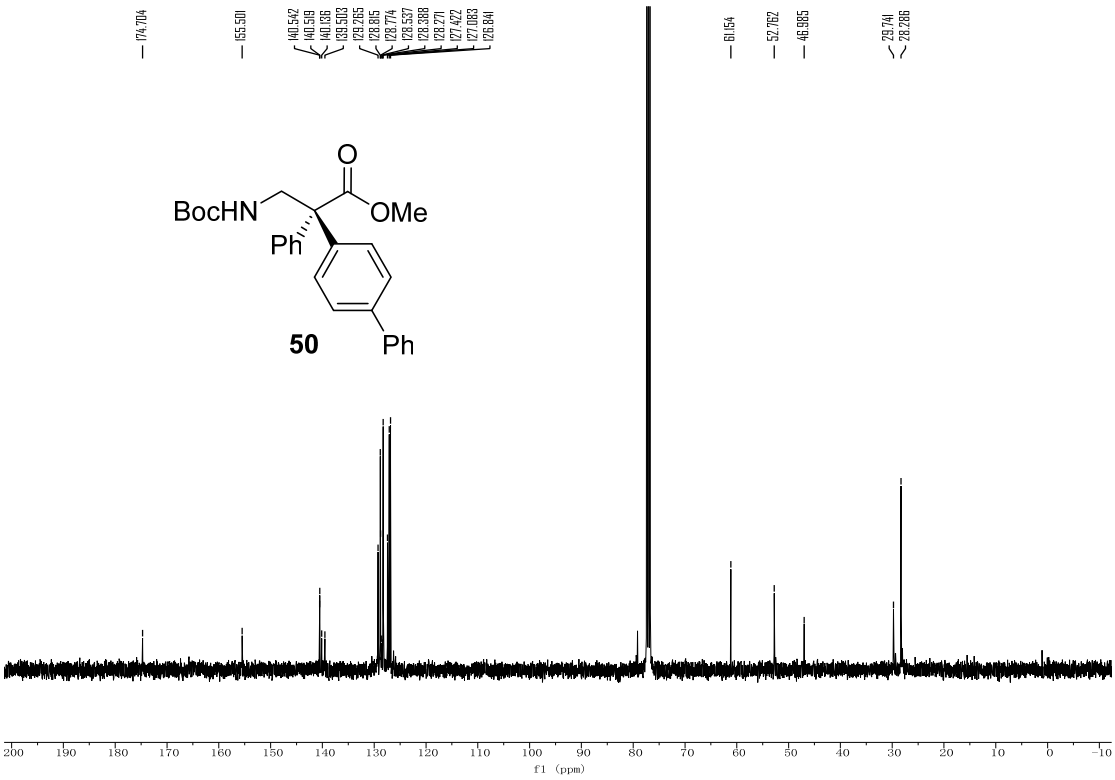
7.380
7.374
7.361
7.342
7.292
7.288
7.284
7.268
7.262
7.248
7.239
7.234
7.218
7.202
7.197
7.186
7.179
4.924
4.074
4.058
3.708
1.209
O
BocHN
OMe
Ph
Ph
50
4.06
2.16
8.47
0.88
2.00
3.26
8.79
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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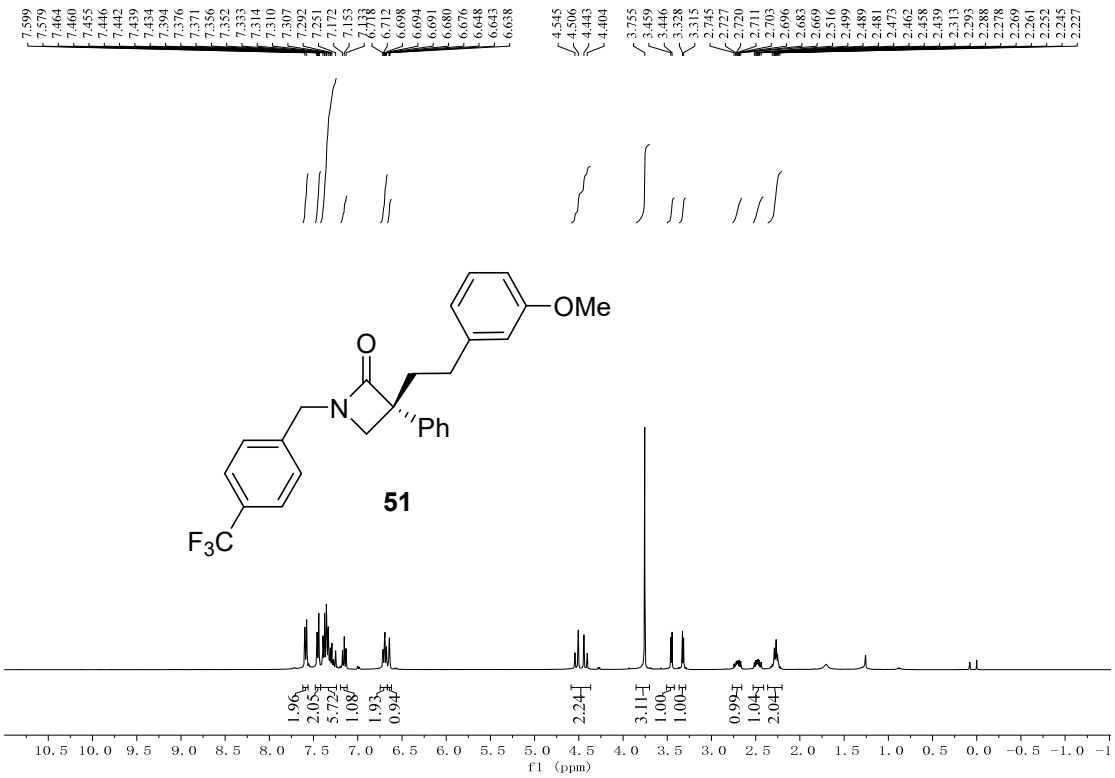
155.501
140.542
140.549
140.135
133.503
129.265
128.815
128.774
128.527
128.368
128.271
127.422
127.083
126.841
61.154
52.762
46.985
29.741
28.286
BocHN
OMe
Ph
50
Ph
f1 (ppm)

51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7.464
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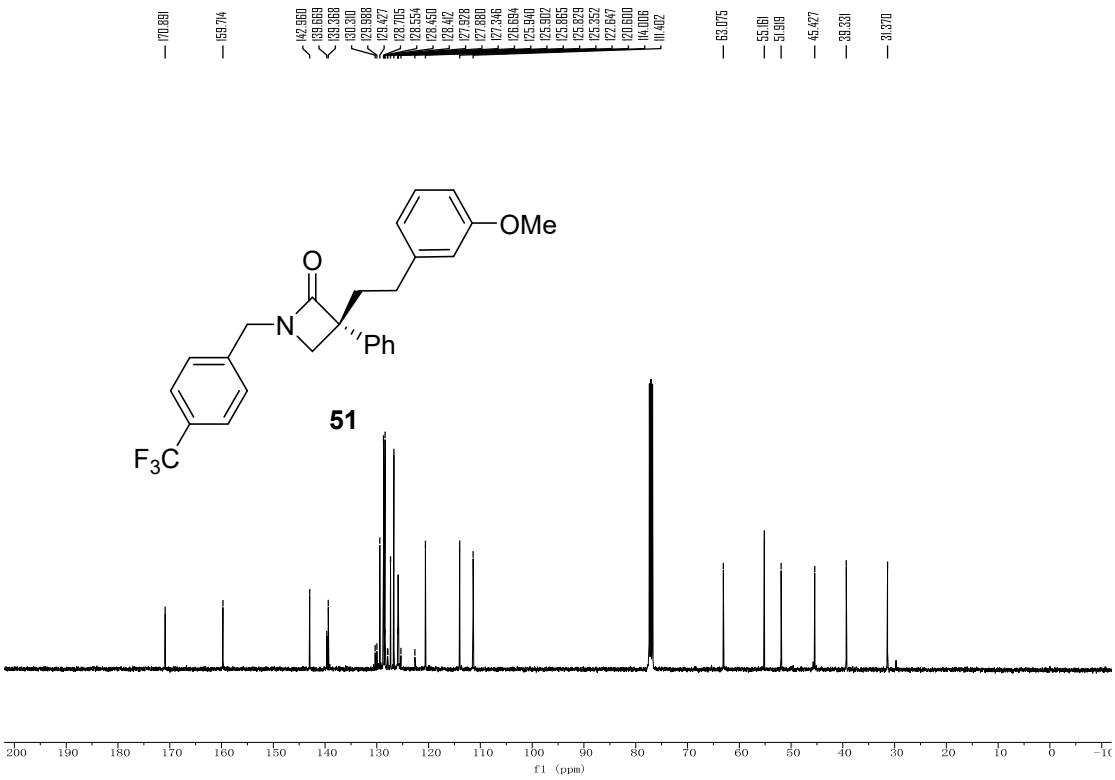
7.455
7.446
7.442
7.439
7.434
7.394
7.376
7.371
7.356
7.352
7.333
7.314
7.310
7.307
7.292
7.251
7.172
7.153
7.133
6.718
6.712
6.698
6.694
6.691
6.680
6.676
6.648
6.643
6.638
4.545
4.506
4.443
4.404
3.755
3.459
3.446
3.328
3.315
2.745
2.727
2.720
2.711
2.703
2.696
2.683
2.669
2.516
2.499
2.489
2.481
2.473
2.462
2.458
2.439
2.313
2.293
2.288
2.278
2.269
2.261
2.252
2.245
2.227
OMe
O
N
Ph
51
F3C
1.96
2.05
5.72
1.08
1.93
0.94
2.24
3.11
1.00
1.00
0.99
1.04
2.04
f1 (ppm)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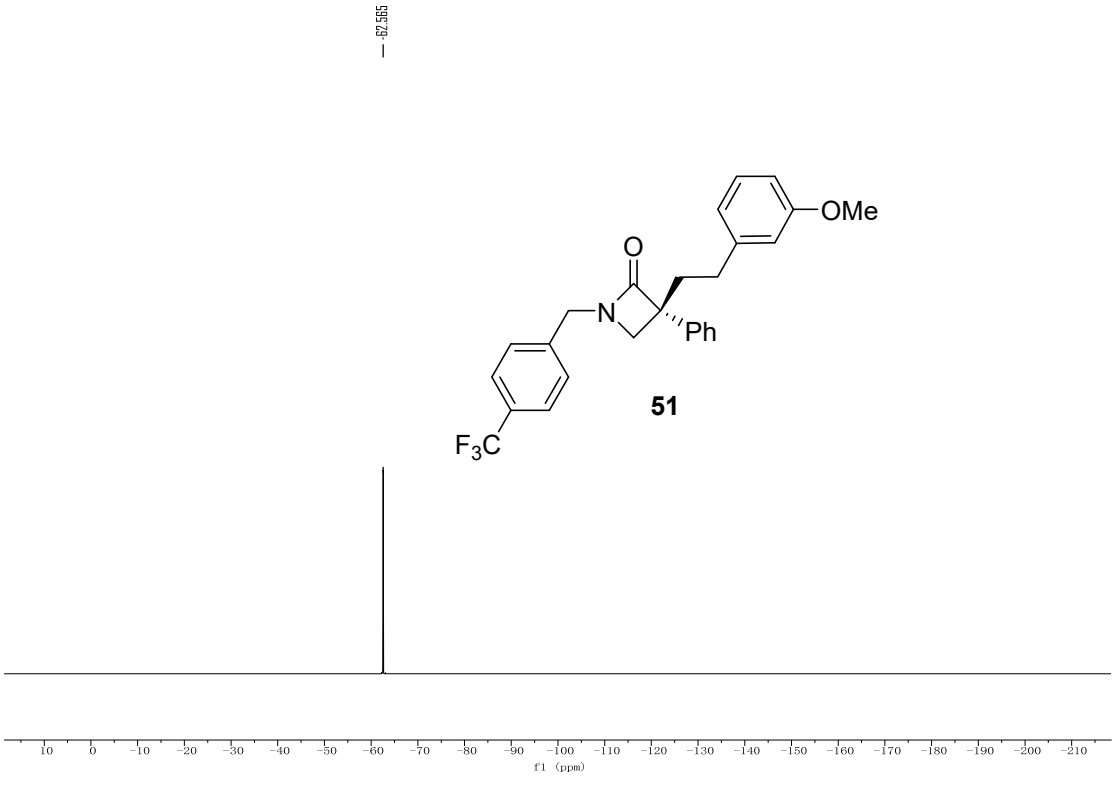
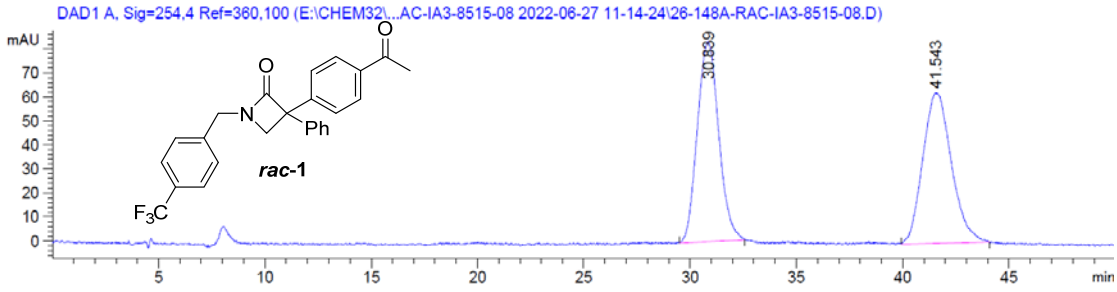
159.714
142.980
139.669
139.368
130.310
129.868
129.427
128.705
128.554
128.450
128.402
127.923
127.880
127.346
126.694
125.940
125.902
125.865
125.829
125.352
122.647
120.600
114.006
111.402
63.075
55.161
51.998
45.427
39.331
31.970
OMe
O
N
Ph
51
F3C
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-62.565
OMe
O
N
Ph
51
F3C
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
−210
f1 (ppm)

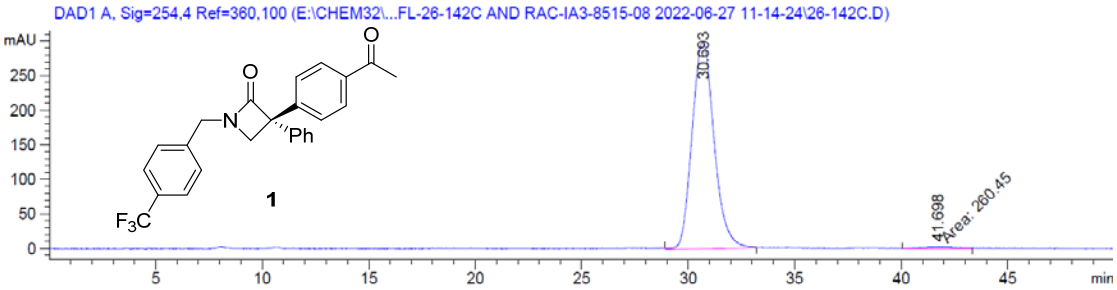
HPLC spectra

1



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

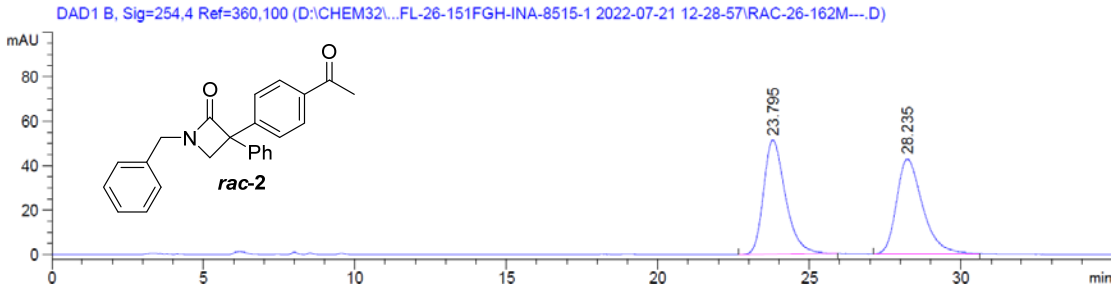
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.839	VV R	0.8327	5824.47852	83.40447	49.8277
2	41.543	MM R	1.5552	5864.76709	62.85151	50.1723
Totals :				1.16892e4	146.25598	



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

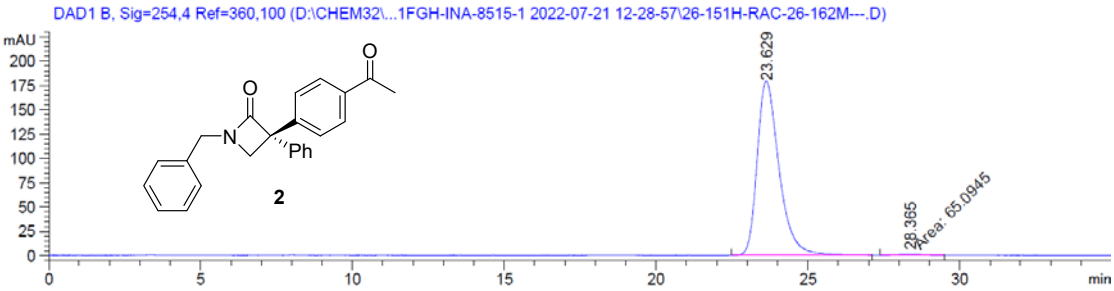
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.693	MM R	1.1943	2.14763e4	299.70462	98.8018
2	41.698	MM	1.5764	260.45026	2.75362	1.1982
Totals :				2.17367e4	302.45824	

2



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

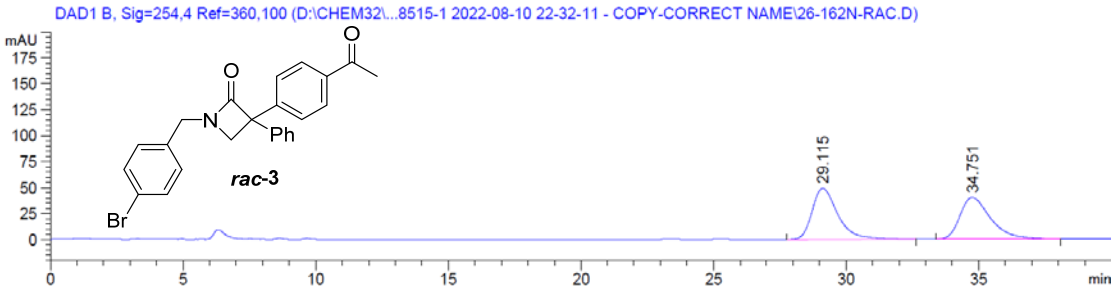
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.795	BB	0.7522	2583.58276	51.24211	50.5549
2	28.235	BB	0.8380	2526.87061	42.47932	49.4451
Totals :				5110.45337	93.72142	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

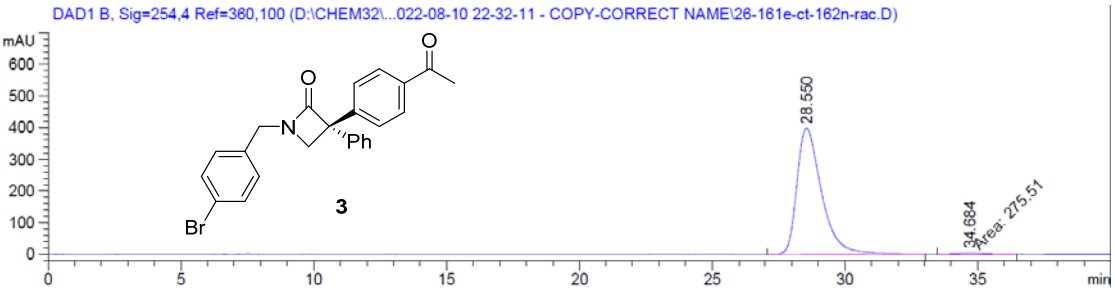
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.629	BB	0.7601	9001.26563	179.18869	99.2820
2	28.365	MM	0.9288	65.09454	1.16811	0.7180
Totals :				9066.36017	180.35680	

3



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

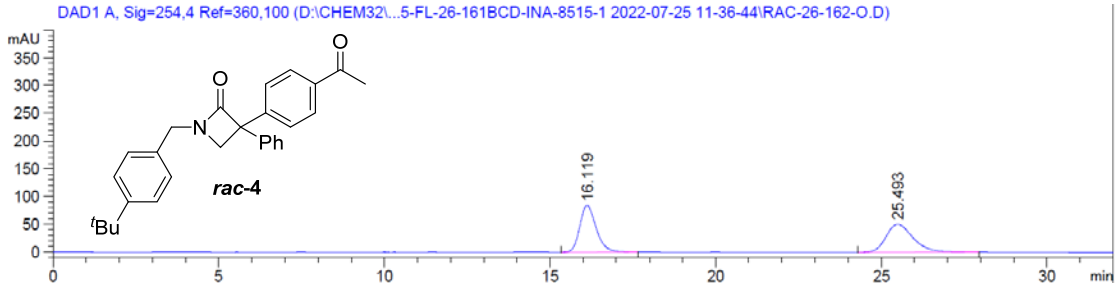
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	29.115	BB	0.9599	3335.54395	49.38788	50.7647
2	34.751	BB	0.9817	3235.05273	40.24904	49.2353
Totals :				6570.59668	89.63692	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

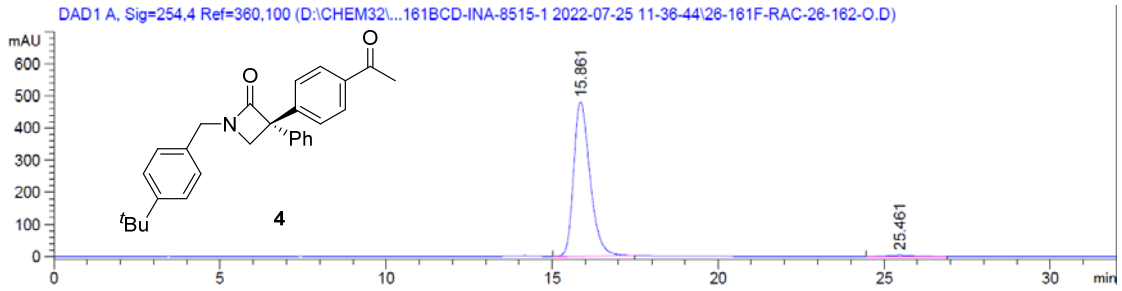
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	28.550	BB	0.9629	2.55803e4	397.45813	98.9344
2	34.684	MM	1.2898	275.51050	3.56008	1.0656
Totals :				2.58558e4	401.01821	

4



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

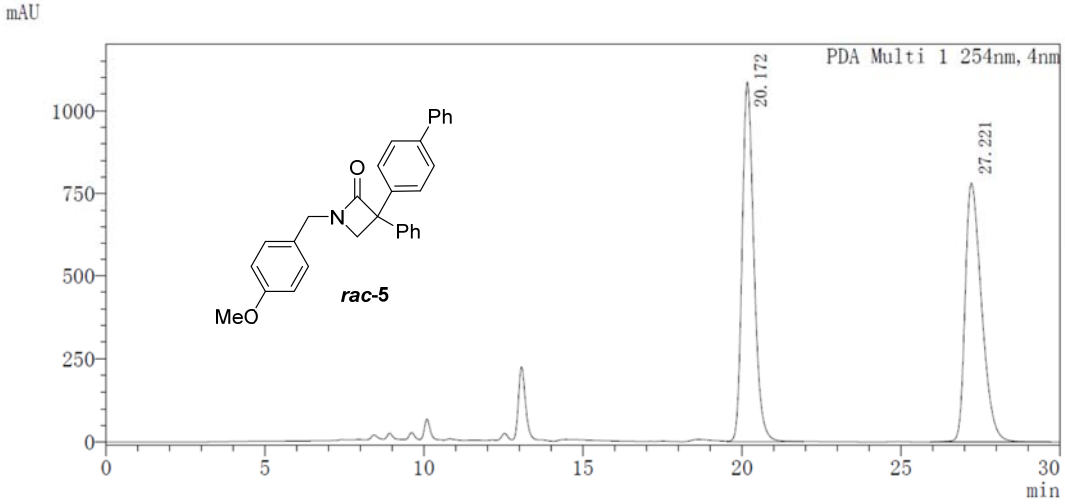
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.119	BB	0.5253	2908.24805	84.55694	50.0836
2	25.493	BB	0.8393	2898.54224	50.67732	49.9164
Totals :				5806.79028	135.23426	



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.861	BB	0.5223	1.64123e4	480.75385	98.8352
2	25.461	BB	0.6674	193.41756	3.41160	1.1648
Totals :				1.66058e4	484.16544	

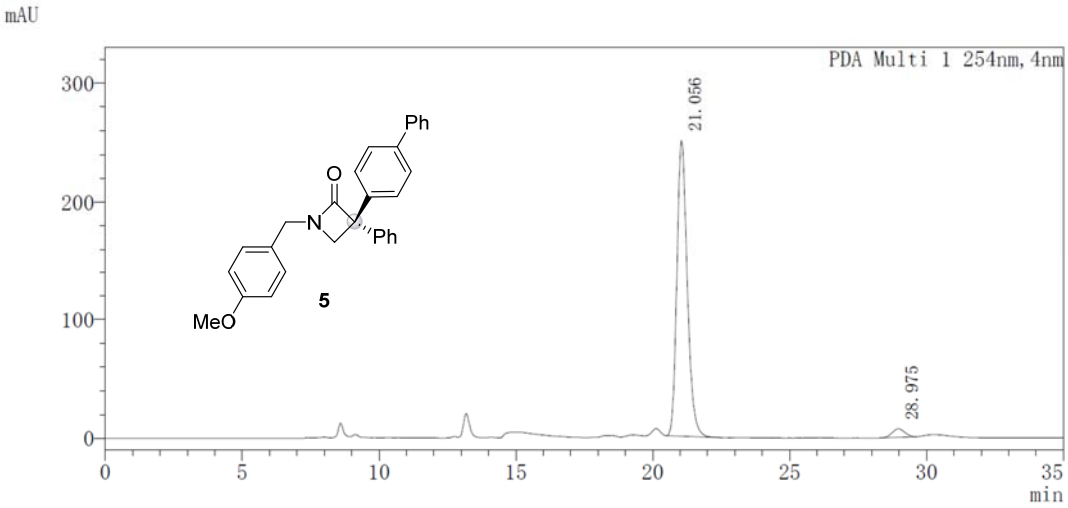
5



Peak Table

PDA Ch1 254nm

Peak#	Ret. Time	Area	Area%
1	20.172	27886958	49.815
2	27.221	28093941	50.185

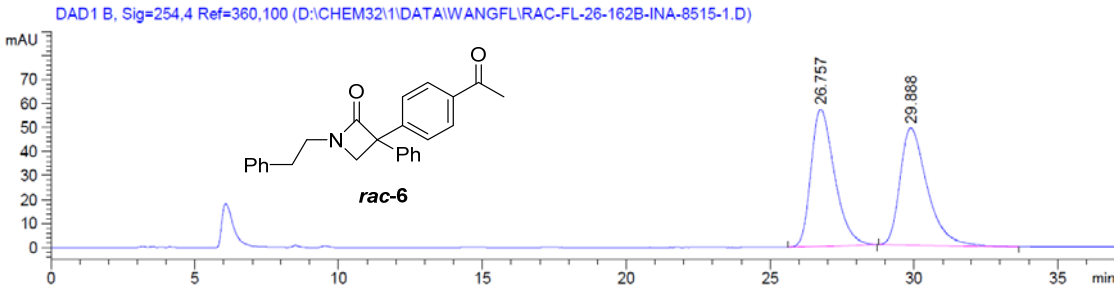


Peak Table

PDA Ch1 254nm

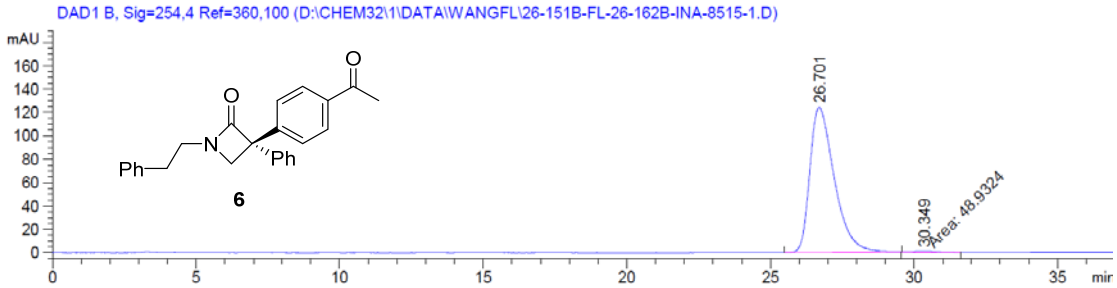
Peak#	Ret. Time	Area	Area%
1	21.056	6592824	96.658
2	28.975	227969	3.342

6



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

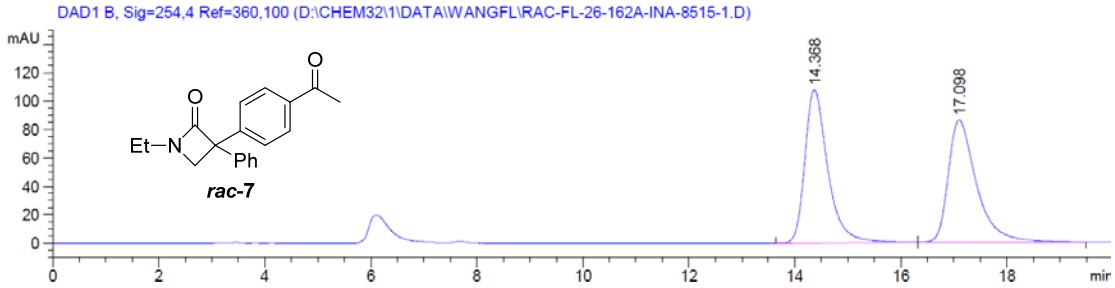
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.757	BB	0.8321	3260.00635	57.09736	50.2564
2	29.888	BB	0.9445	3226.73975	48.85796	49.7436
Totals :				6486.74609	105.95532	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

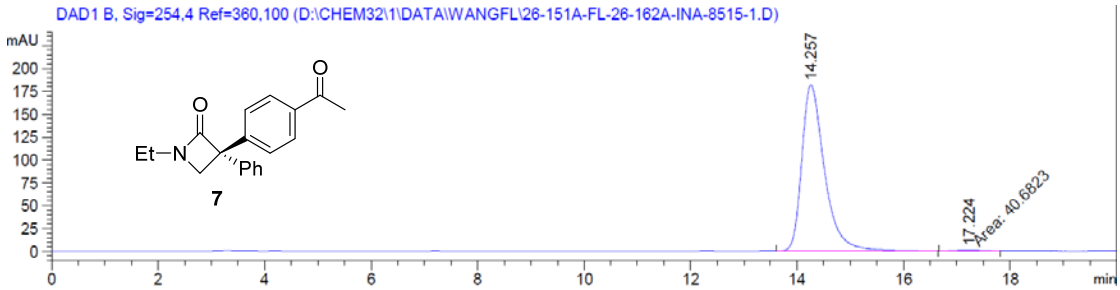
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.701	BB	0.8950	7339.66211	123.91991	99.3377
2	30.349	MM	0.9794	48.93238	8.32660e-1	0.6623
Totals :				7388.59449	124.75257	

7



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

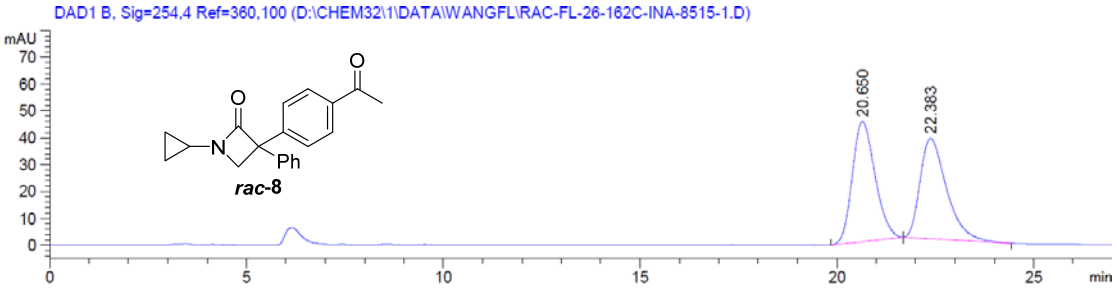
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.368	BB	0.4509	3221.16846	107.71793	50.2814
2	17.098	BB	0.5602	3185.11646	85.98223	49.7186
Totals :				6406.28491	193.70016	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

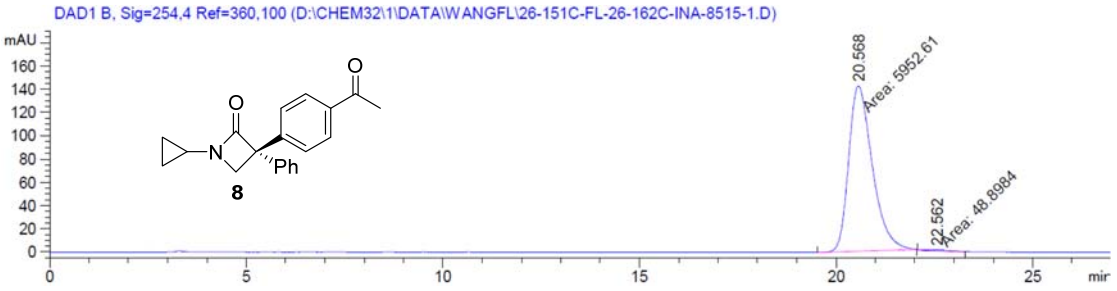
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.257	BB	0.4478	5384.79639	181.67242	99.2502
2	17.224	MM	0.5602	40.68226	1.21034	0.7498
Totals :				5425.47865	182.88277	

8



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

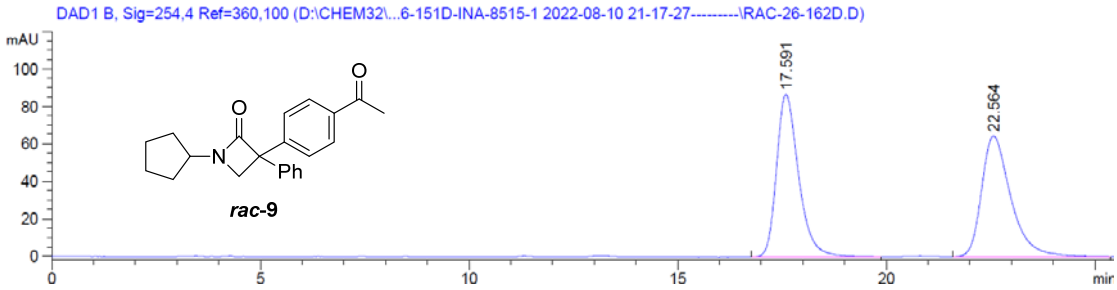
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.650	BB	0.6161	1796.52063	44.77447	50.5559
2	22.383	BB	0.6887	1757.01318	37.49710	49.4441
Totals :				3553.53381	82.27156	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

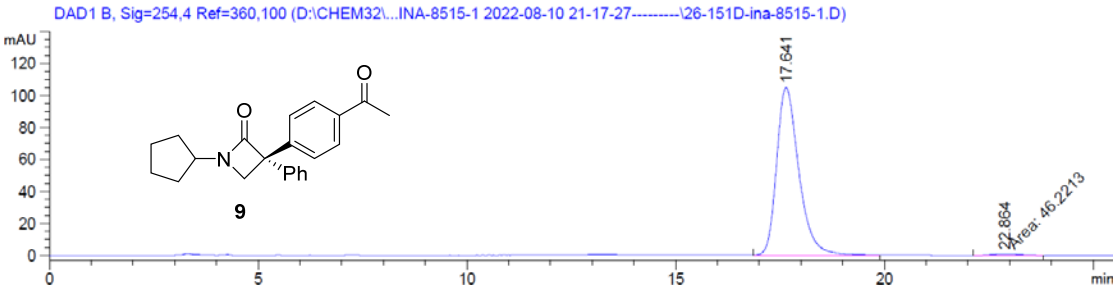
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.568	MM	0.6982	5952.60938	142.09669	99.1852
2	22.562	MM	0.8728	48.89840	9.33705e-1	0.8148
Totals :				6001.50777	143.03040	

9



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

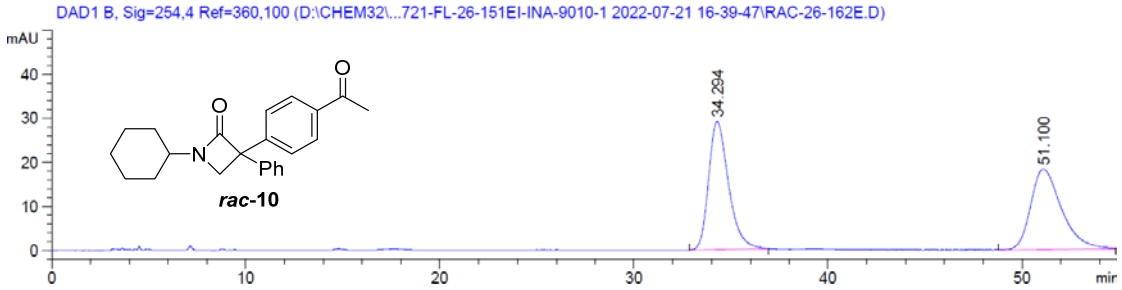
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.591	BB	0.5546	3188.25757	86.78456	50.4456
2	22.564	BB	0.7177	3131.93481	64.36694	49.5544
Totals :				6320.19238	151.15150	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

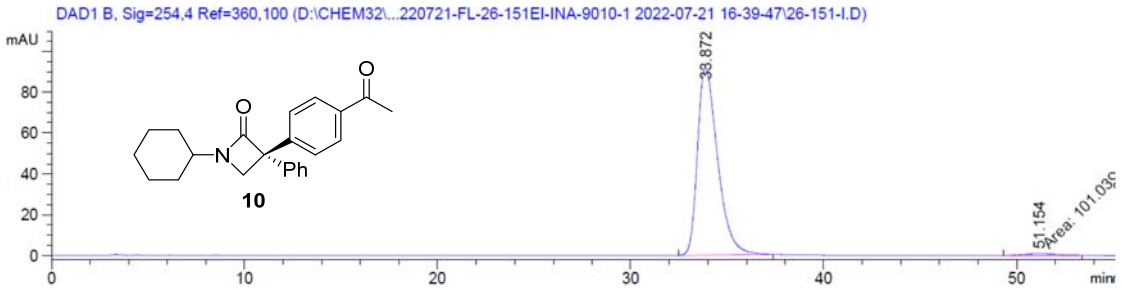
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.641	BB	0.5547	3865.55786	104.69955	98.8184
2	22.864	MM	0.7420	46.22134	1.03820	1.1816
Totals :				3911.77920	105.73775	

10



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

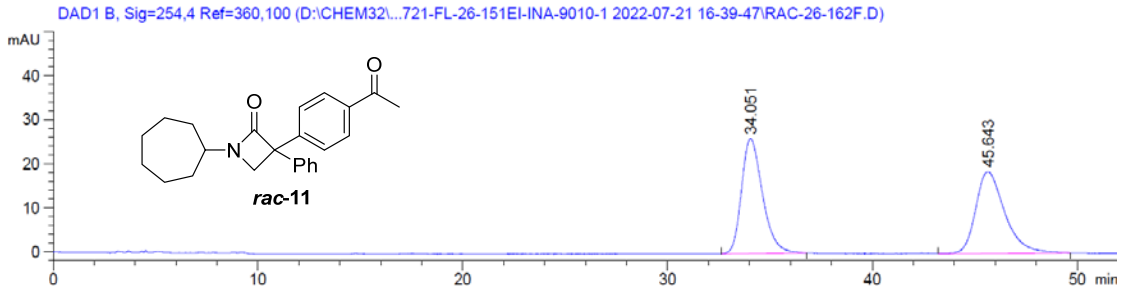
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	34.294	BB	0.9794	2067.60864	29.01498	50.7125
2	51.100	MM R	1.8390	2009.50952	18.21189	49.2875
Totals :				4077.11816	47.22686	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

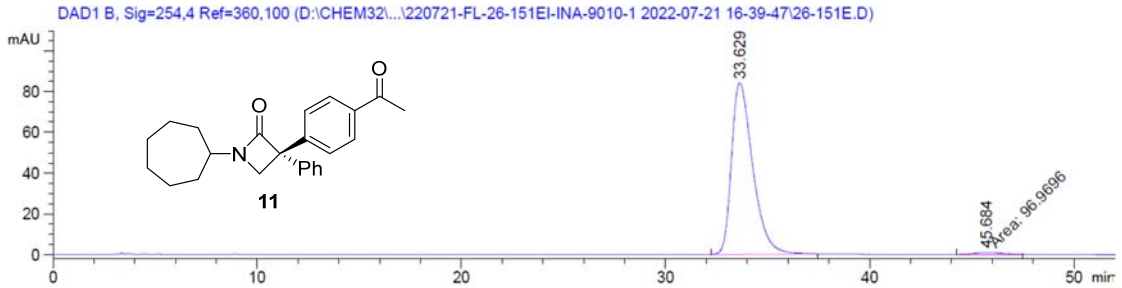
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	33.872	BB	1.0700	6663.96826	91.89967	98.5065
2	51.154	MM	1.8354	101.03861	9.17474e-1	1.4935
Totals :				6765.00687	92.81714	

11



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	34.051	BB	0.9591	1858.44470	26.02610	50.4398
2	45.643	MM R	1.6438	1826.03821	18.51455	49.5602
Totals :				3684.48291	44.54065	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	33.629	BB	1.0570	6089.19482	84.27390	98.4325
2	45.684	MM	1.5848	96.96959	1.01980	1.5675
Totals :				6186.16441	85.29371	

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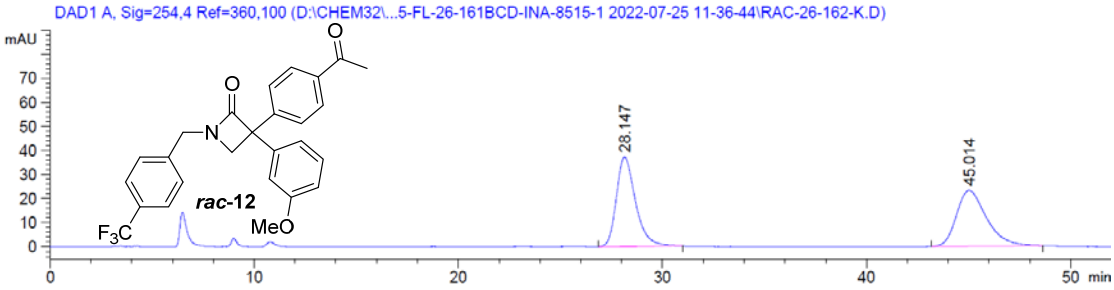
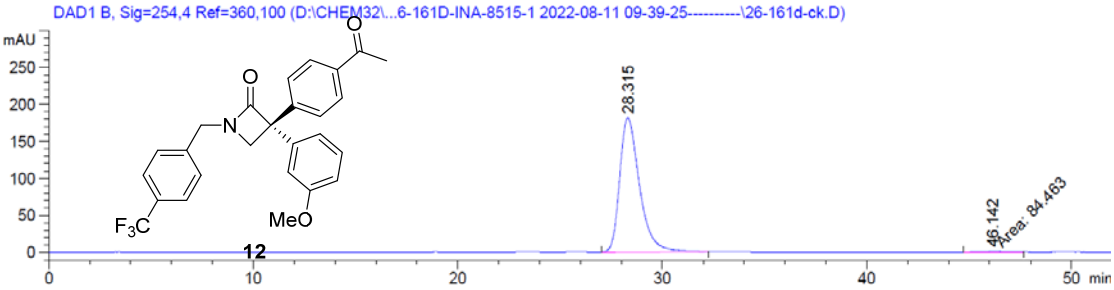


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

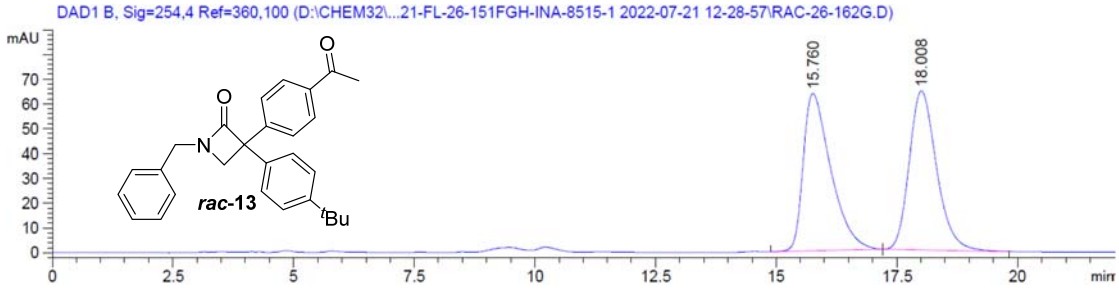
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	28.147	BB	0.9211	2414.27808	37.20126	50.5568
2	45.014	BB	1.1953	2361.10303	23.16147	49.4432
Totals :				4775.38110	60.36273	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

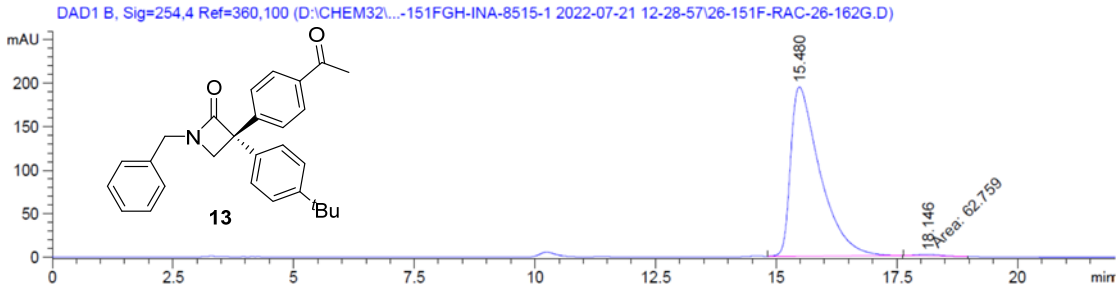
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	28.315	BB	0.9898	1.21344e4	181.53654	99.3087
2	46.142	MM	1.6397	84.46295	8.58495e-1	0.6913
Totals :				1.22189e4	182.39504	

13



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.760	BB	0.5965	2536.95166	63.44510	50.0725
2	18.008	BB	0.5980	2529.60498	64.15504	49.9275
Totals :				5066.55664	127.60014	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.480	BB	0.6179	8235.60840	194.53886	99.2437
2	18.146	MM	0.5748	62.75905	1.81964	0.7563
Totals :				8298.36745	196.35851	

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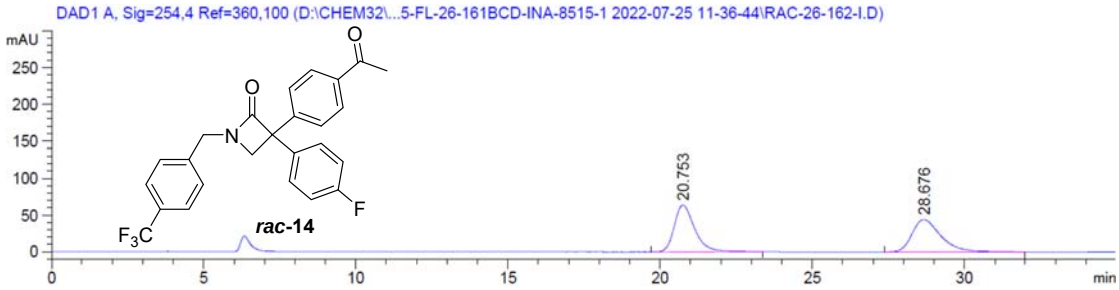
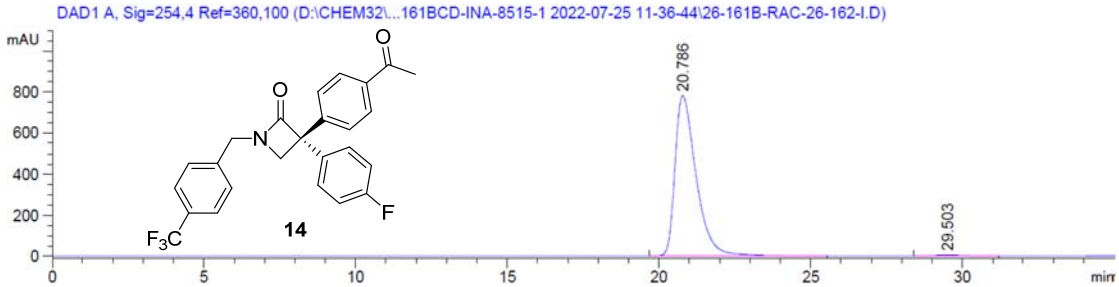


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.753	BB	0.7036	2992.34839	63.74682	50.4794
2	28.676	BB	0.9405	2935.51123	44.10530	49.5206
Totals :				5927.85962	107.85213	



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.786	BB	0.7307	3.80798e4	781.13391	99.0372
2	29.503	BB	0.7740	370.18701	5.62324	0.9628
Totals :				3.84500e4	786.75715	

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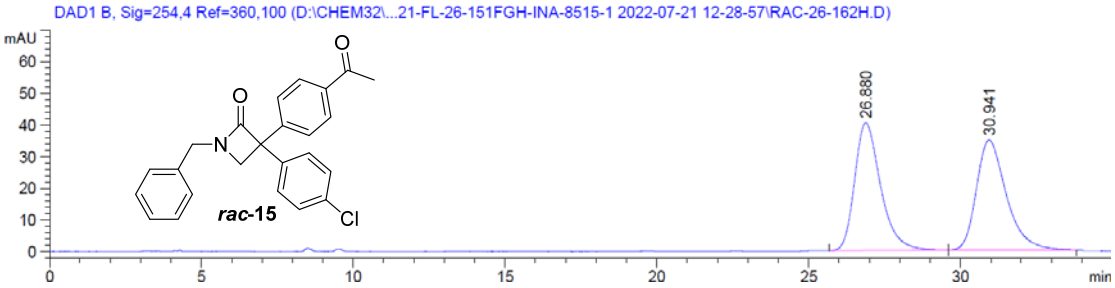
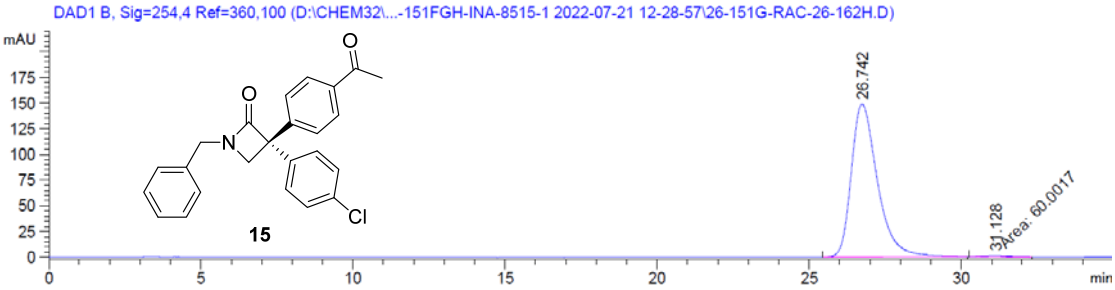


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.880	BB	0.8664	2402.12793	40.35713	50.1073
2	30.941	BB	0.9607	2391.84058	34.76551	49.8927
Totals :				4793.96851	75.12265	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.742	BB	0.8926	8853.08496	148.70734	99.3268
2	31.128	MM	1.0817	60.00172	9.24464e-1	0.6732
Totals :				8913.08669	149.63180	

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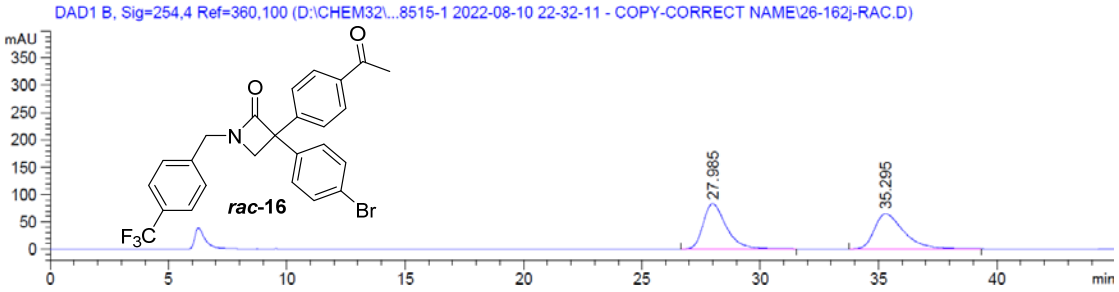
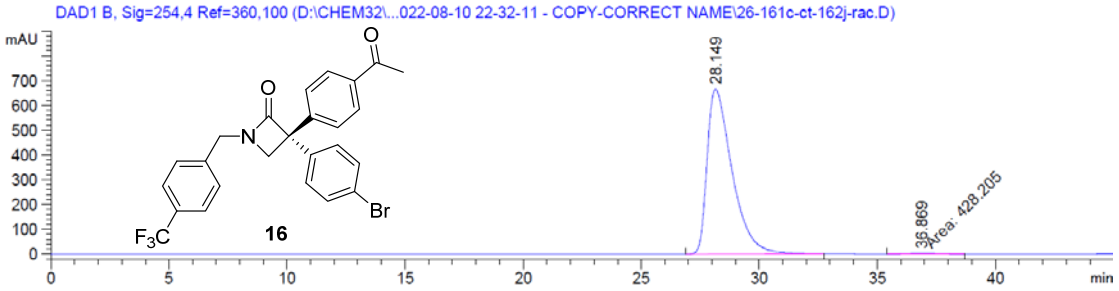


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

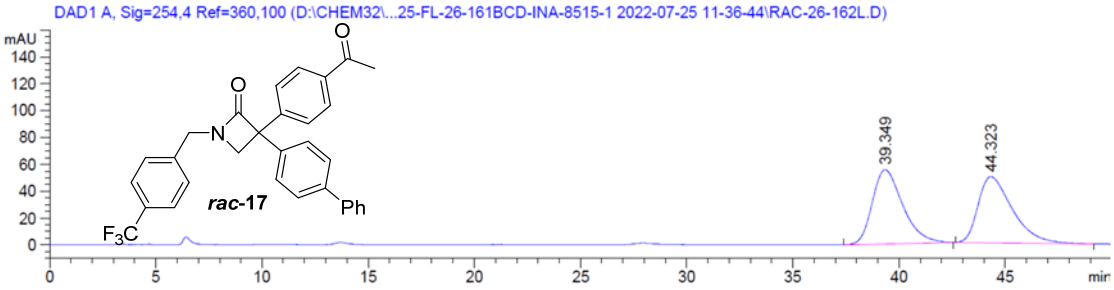
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	27.985	BB	0.9754	5615.32861	83.20028	50.3084
2	35.295	BB	1.2171	5546.47412	64.38098	49.6916
Totals :				1.11618e4	147.58126	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

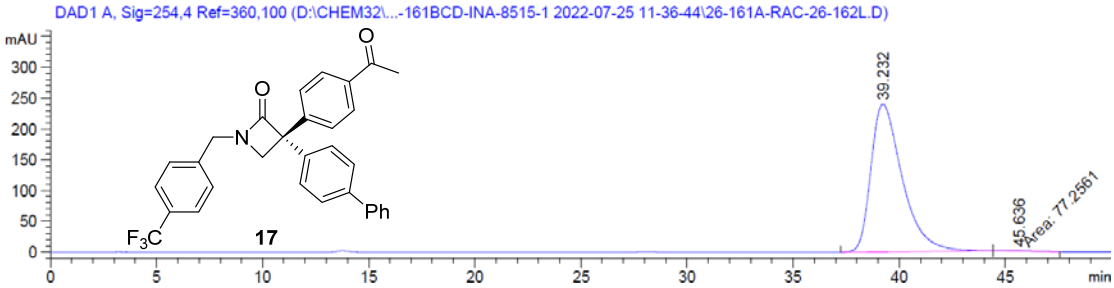
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	28.149	BB	1.1013	4.88940e4	665.36096	99.1318
2	36.869	MM	1.5852	428.20523	4.50225	0.8682
Totals :				4.93222e4	669.86321	

17



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	39.349	BB	1.3347	5522.70313	55.50960	49.9418
2	44.323	BB	1.3200	5535.57422	49.45081	50.0582
Totals :				1.10583e4	104.96040	



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	39.232	BB	1.5050	2.45758e4	239.52751	99.6866
2	45.636	MM	1.5159	77.25607	8.49409e-1	0.3134
Totals :				2.46530e4	240.37692	

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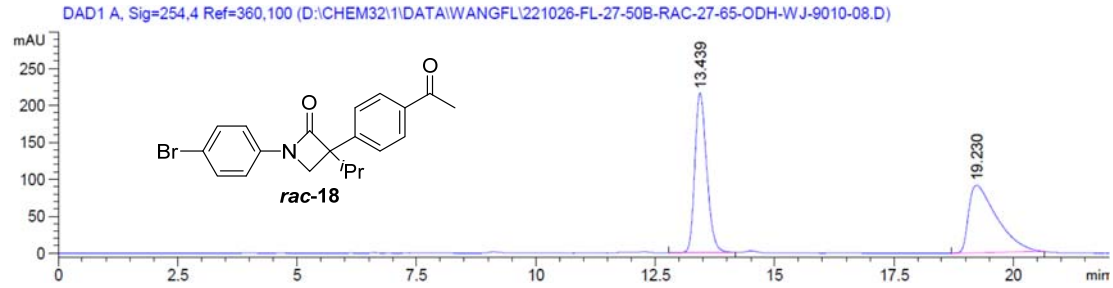
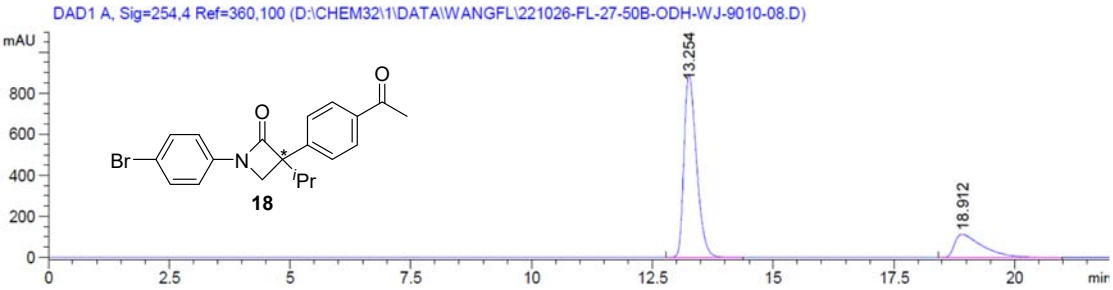


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.439	MM R	0.2907	3776.43628	216.53685	50.0192
2	19.230	MM R	0.6857	3773.53906	91.71773	49.9808
Totals :				7549.97534	308.25458	



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.254	BB	0.2781	1.60378e4	890.75775	78.2390
2	18.912	BB	0.5785	4460.67578	112.04576	21.7610
Totals :				2.04985e4	1002.80351	

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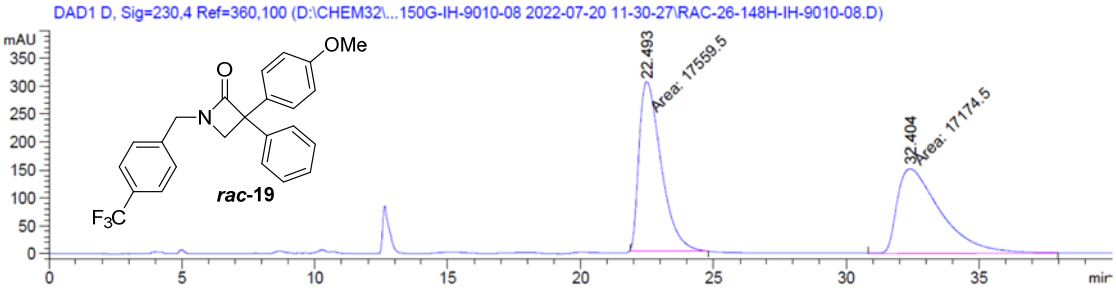
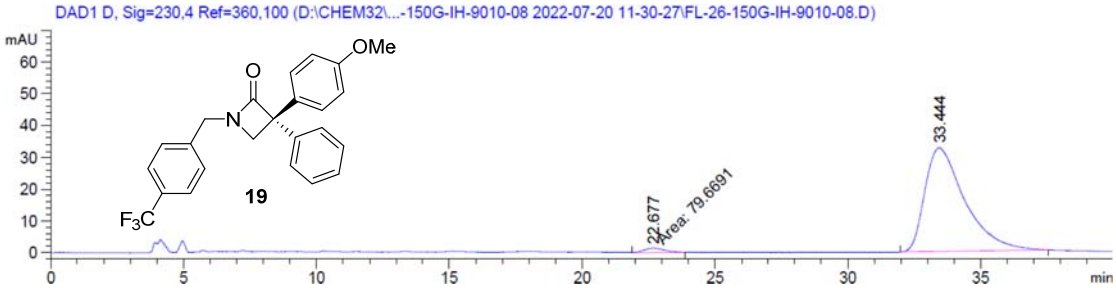


Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	22.493	MM	0.9629	1.75595e4	303.93359	50.5541
2	32.404	MM	1.8854	1.71745e4	151.82225	49.4459
Totals :				3.47340e4	455.75584	



Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	22.677	MM	0.9224	79.66912	1.43958	2.2680
2	33.444	BB	1.2372	3433.14941	32.69023	97.7320
Totals :				3512.81853	34.12981	

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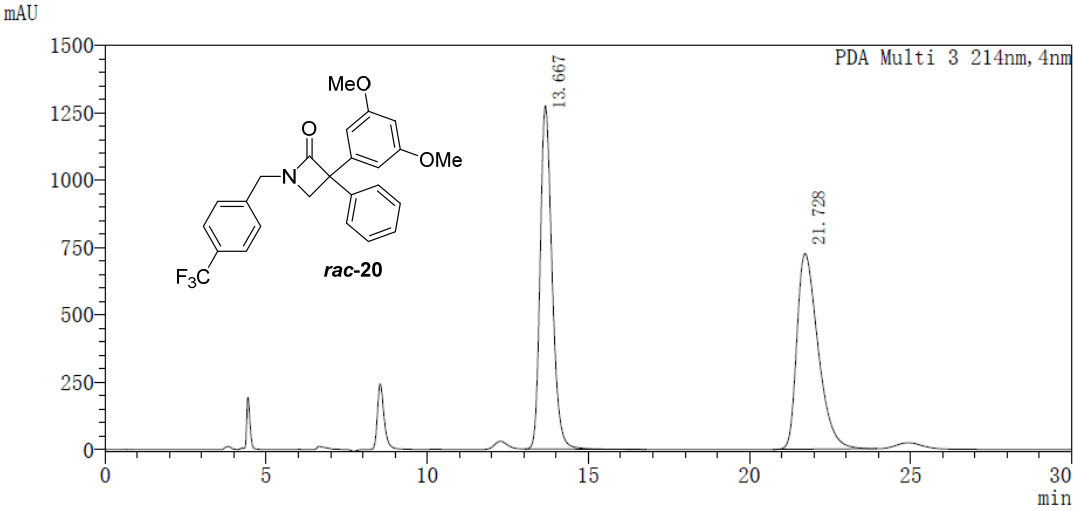
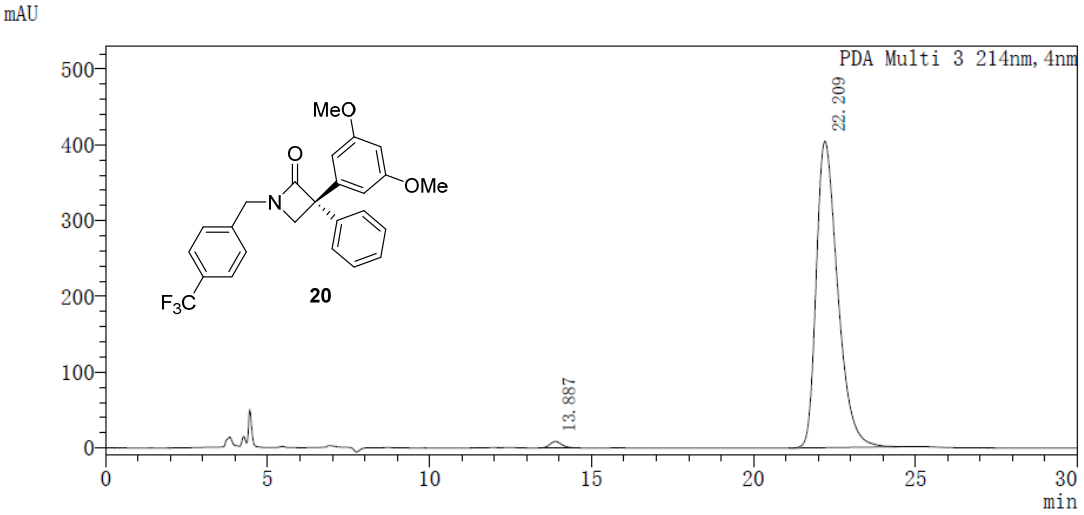


Peak Table

PDA Ch3 214nm

Peak#	Ret. Time	Area	Area%
1	13.667	32720852	49.639
2	21.728	33196165	50.361

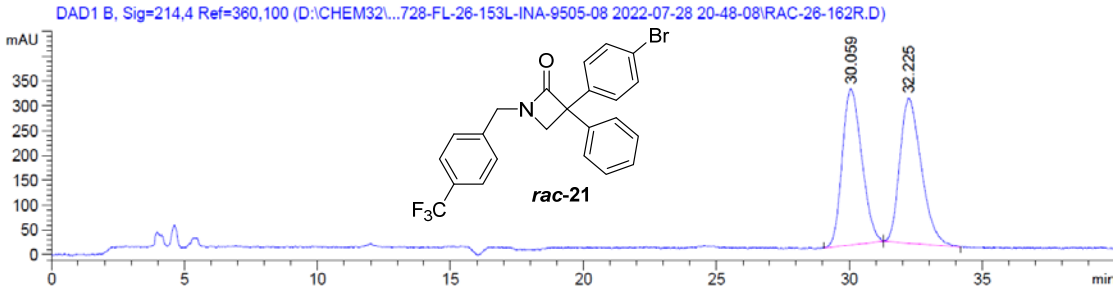


Peak Table

PDA Ch3 214nm

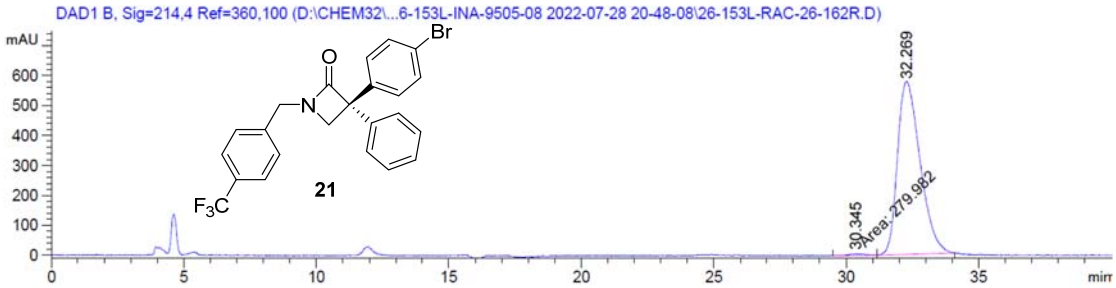
Peak#	Ret. Time	Area	Area%
1	13.887	221046	1.173
2	22.209	18629440	98.827

21



Signal 2: DAD1 B, Sig=214,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.059	VB R	0.6162	1.60771e4	314.61142	49.3848
2	32.225	VV R	0.6708	1.64776e4	292.29239	50.6152
Totals :				3.25546e4	606.90381	



Signal 2: DAD1 B, Sig=214,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.345	MM	0.7036	279.98206	6.63173	0.8081
2	32.269	VV R	0.7084	3.43685e4	579.07996	99.1919
Totals :				3.46484e4	585.71169	

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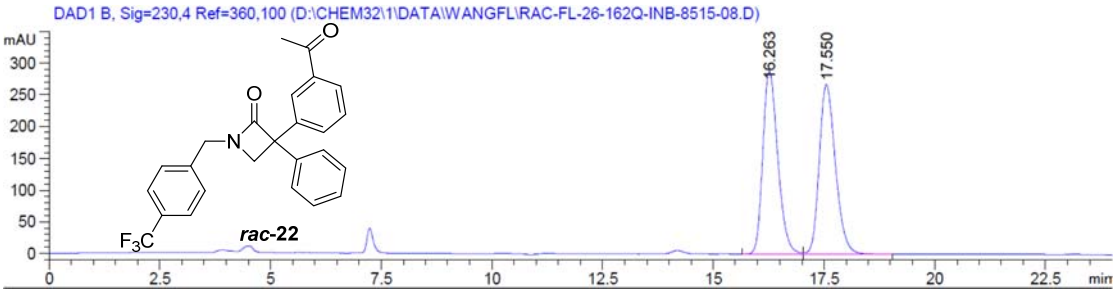
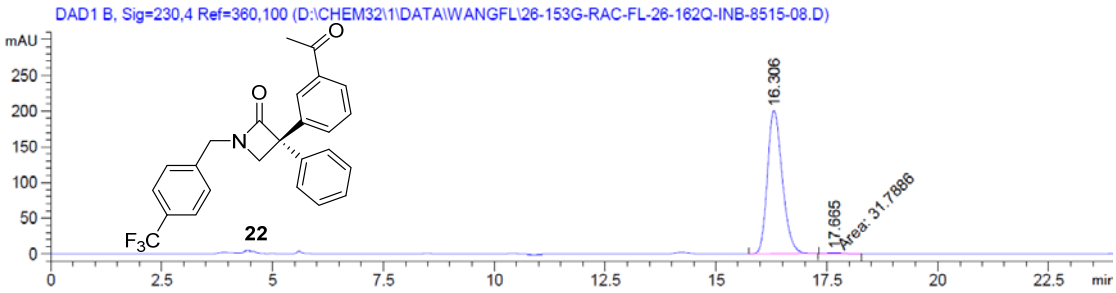


methyl (*S*)-4-(2-oxo-3-phenyl-1-(4-(trifluoromethyl)benzyl)azetidin-3-yl)benzoate

Signal 2: DAD1 B, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.263	BV	0.3605	6783.08887	288.25833	49.8735
2	17.550	VB	0.3959	6817.49170	266.99896	50.1265
Totals :				1.36006e4	555.25729	



Signal 2: DAD1 B, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.306	BB	0.3590	4699.31592	200.86104	99.3281
2	17.665	MM	0.3873	31.78858	1.36809	0.6719
Totals :				4731.10450	202.22913	

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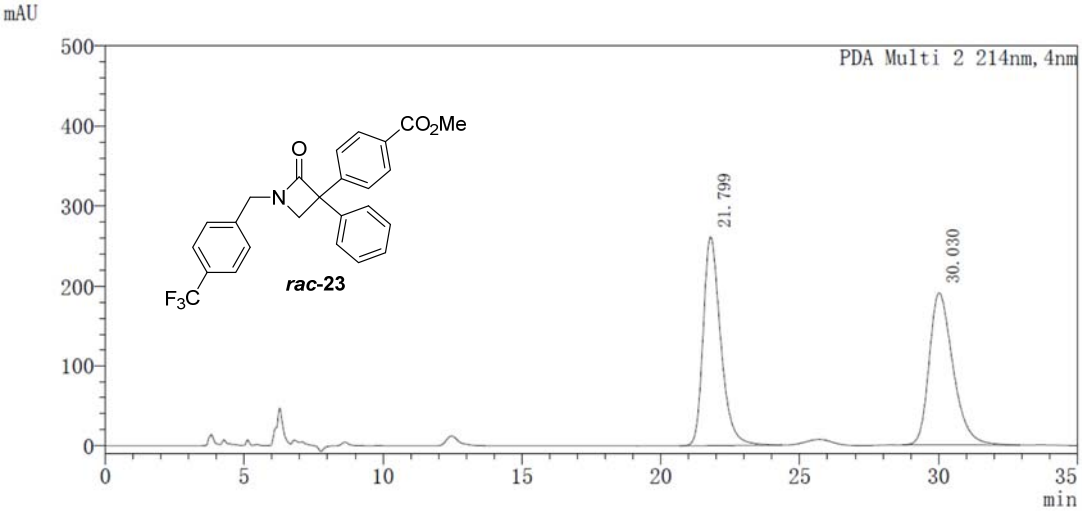
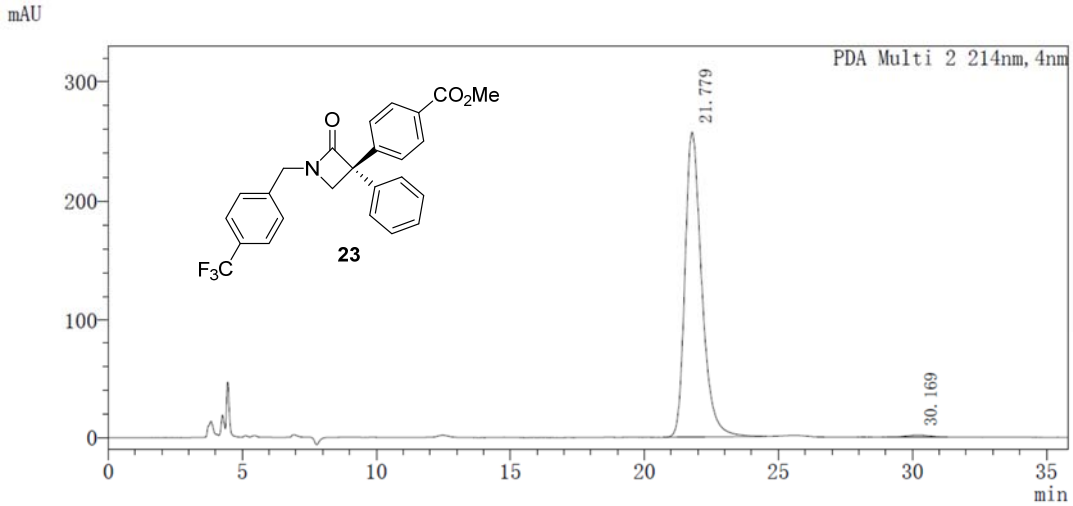


Peak Table

PDA Ch2 214nm

Peak#	Ret. Time	Area	Area%
1	21.799	11476243	50.216
2	30.030	11377531	49.784

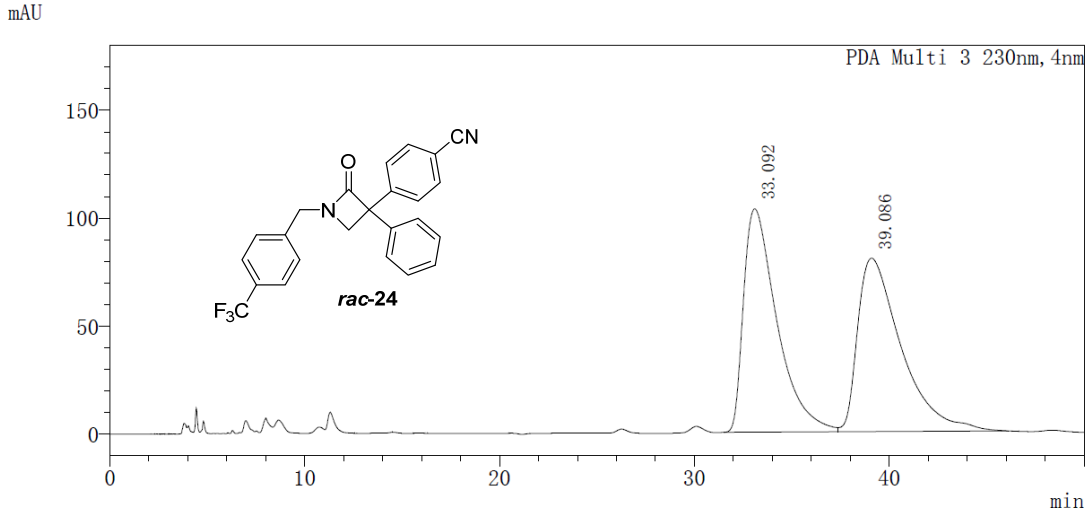


Peak Table

PDA Ch2 214nm

Peak#	Ret. Time	Area	Area%
1	21.779	11207166	99.177
2	30.169	93007	0.823

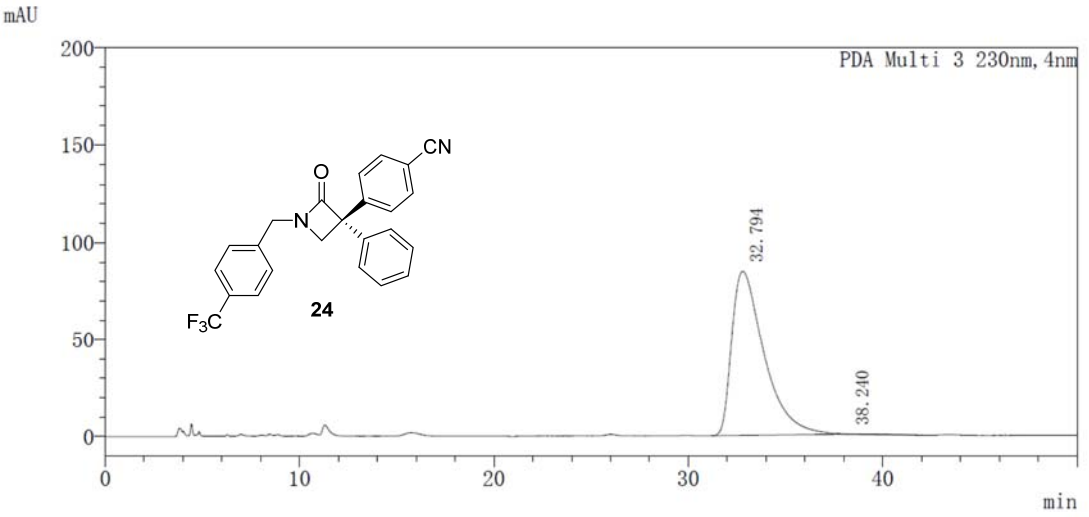
24



Peak Table

PDA Ch3 230nm

Peak#	Ret. Time	Area	Area%
1	33.092	12327428	49.709
2	39.086	12471958	50.291

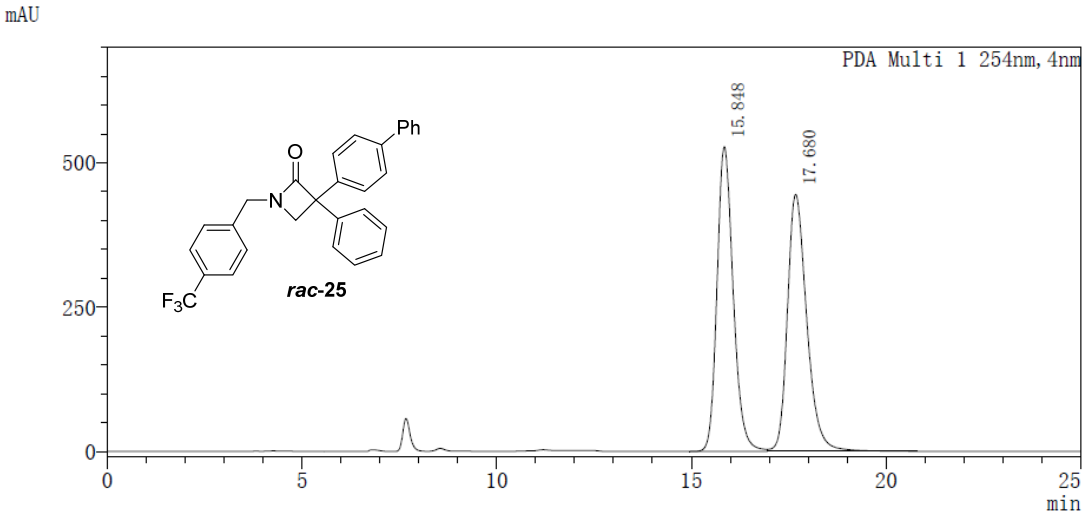


Peak Table

PDA Ch3 230nm

Peak#	Ret. Time	Area	Area%
1	32.794	9805200	99.902
2	38.240	9627	0.098

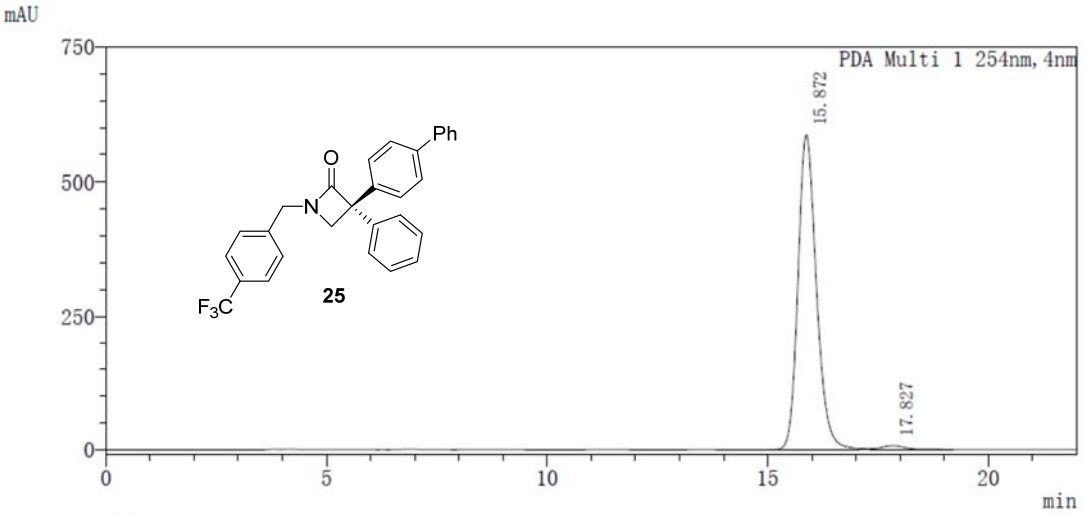
25



Peak Table

PDA Ch1 254nm

Peak#	Ret. Time	Area	Area%
1	15.848	15269777	49.800
2	17.680	15392732	50.200

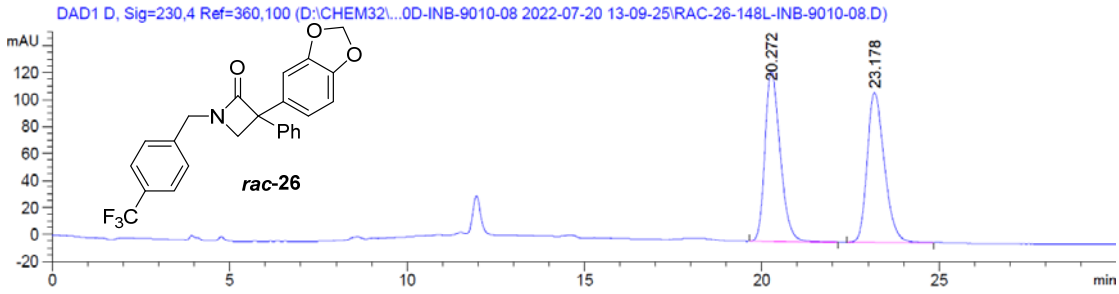


Peak Table

PDA Ch1 254nm

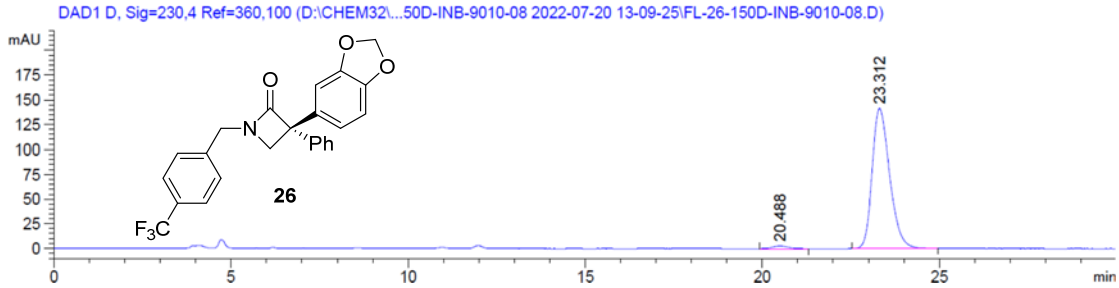
Peak#	Ret. Time	Area	Area%
1	15.872	17087001	98.355
2	17.827	285833	1.645

26



Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.272	BB	0.4576	3761.28345	126.25066	50.0509
2	23.178	BB	0.5184	3753.62939	111.02550	49.9491
Totals :				7514.91284	237.27615	



Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	20.488	BB	0.3688	84.57470	2.71949	1.7094
2	23.312	BB	0.5310	4863.09961	141.50256	98.2906
Totals :				4947.67431	144.22206	

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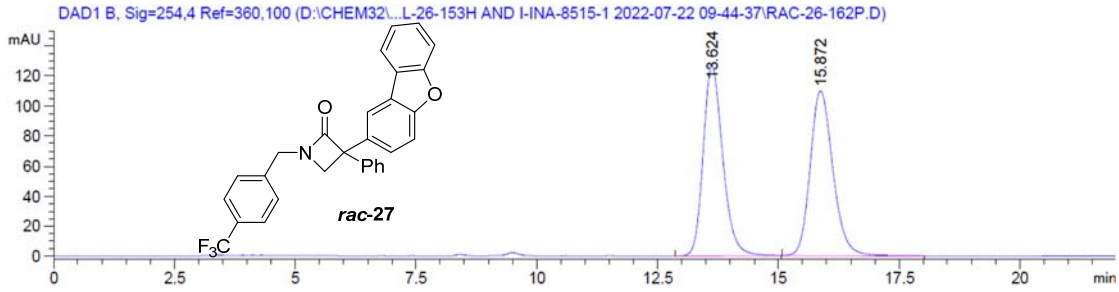
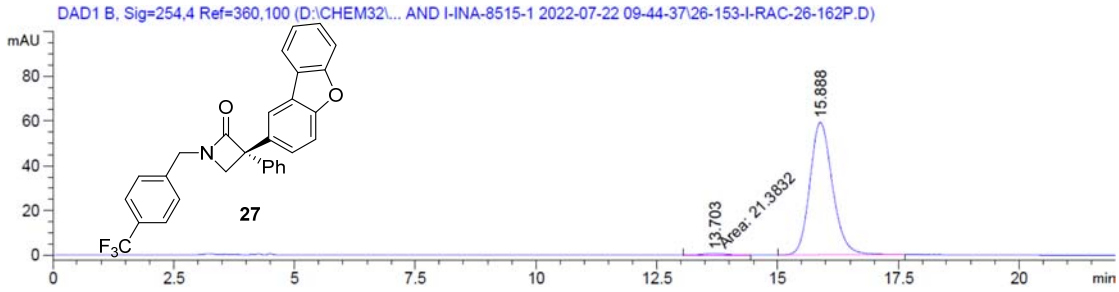


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.624	BB	0.4335	3585.18311	126.94472	49.9618
2	15.872	BB	0.5060	3590.66284	109.66668	50.0382
Totals :				7175.84595	236.61140	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.703	MM	0.4654	21.38318	7.65778e-1	1.0918
2	15.888	BB	0.5002	1937.14575	59.12378	98.9082
Totals :				1958.52893	59.88956	

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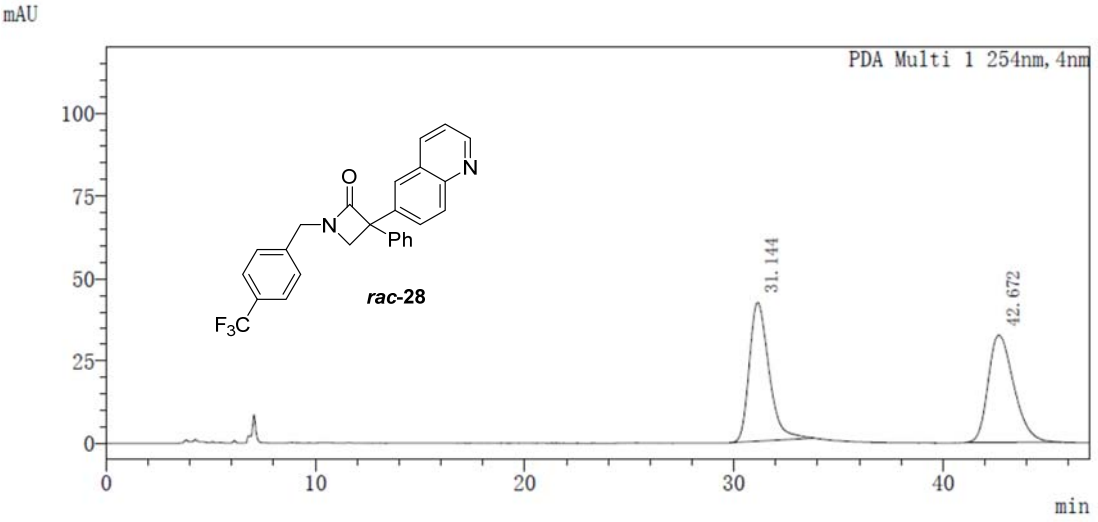
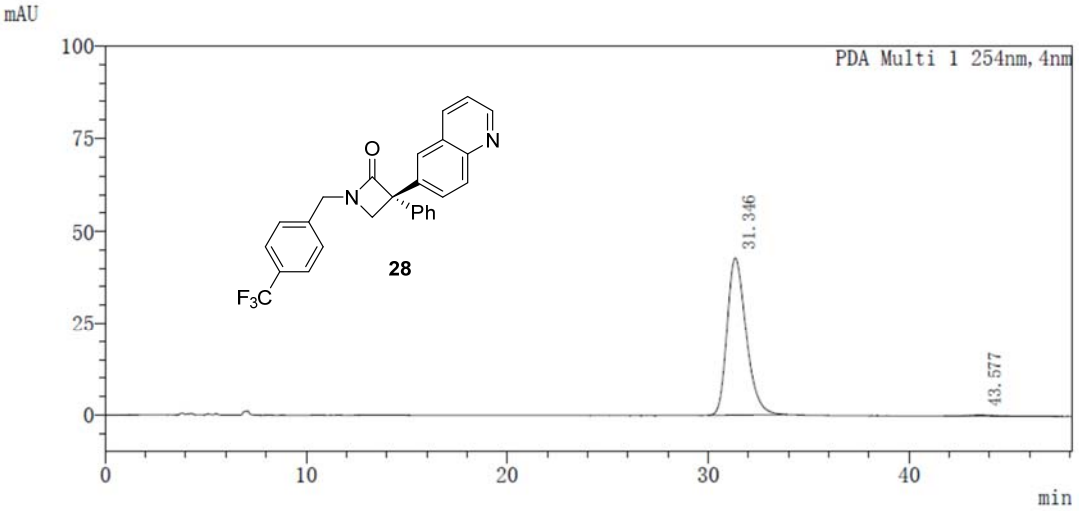


Peak Table

PDA Ch1 254nm

Peak#	Ret. Time	Area	Area%
1	31.144	2759963	49.787
2	42.672	2783547	50.213

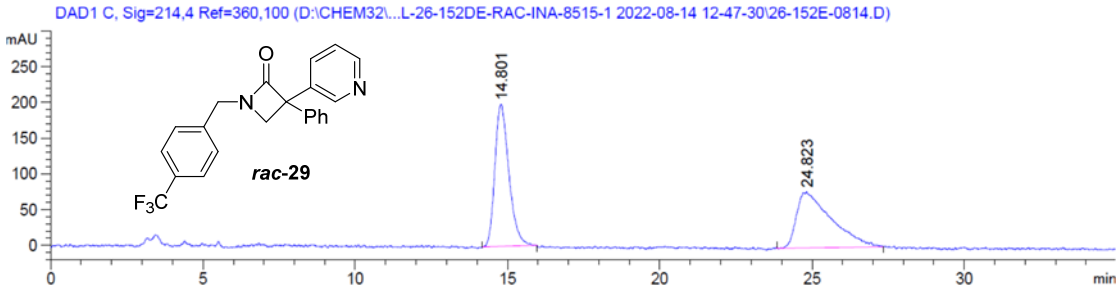


Peak Table

PDA Ch1 254nm

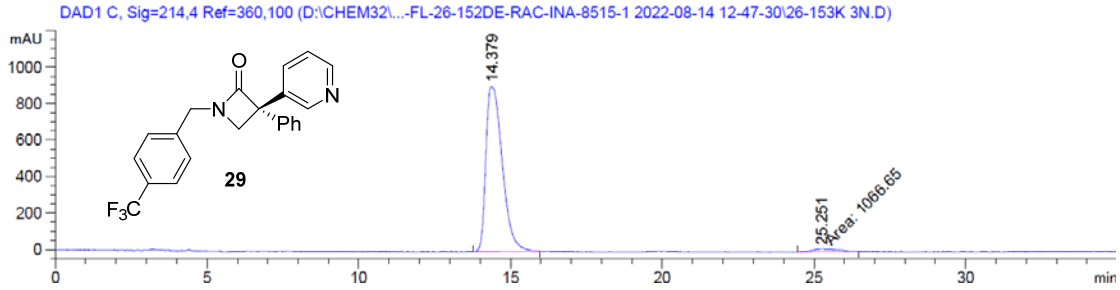
Peak#	Ret. Time	Area	Area%
1	31.346	2825799	99.240
2	43.577	21635	0.760

29



Signal 3: DAD1 C, Sig=214,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.801	MM R	0.5331	6339.51318	198.21106	50.7741
2	24.823	MM R	1.3100	6146.19775	78.19623	49.2259
Totals :				1.24857e4	276.40729	



Signal 3: DAD1 C, Sig=214,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.379	VV R	0.4496	3.38161e4	905.03296	96.9422
2	25.251	MM	0.9768	1066.65369	18.20057	3.0578
Totals :				3.48827e4	923.23353	

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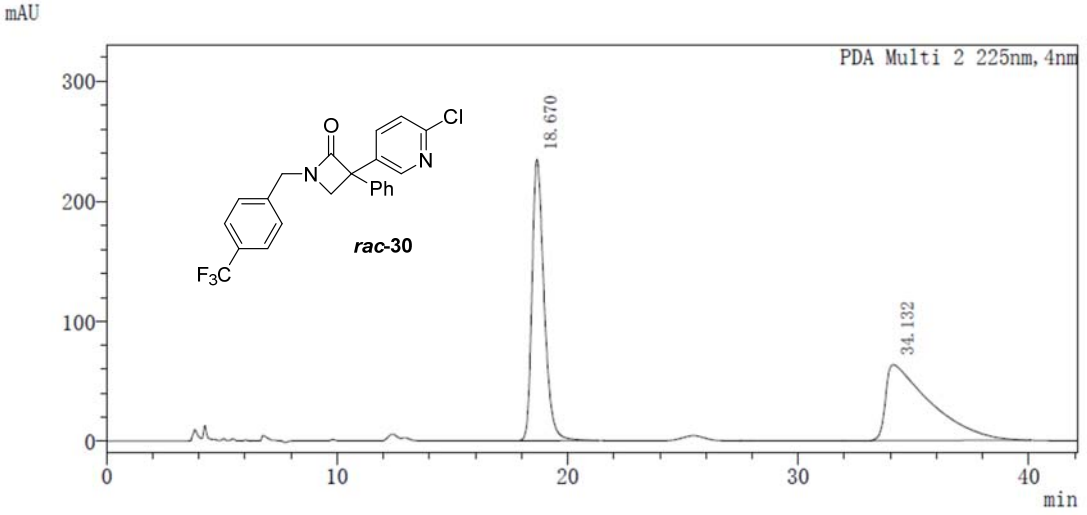
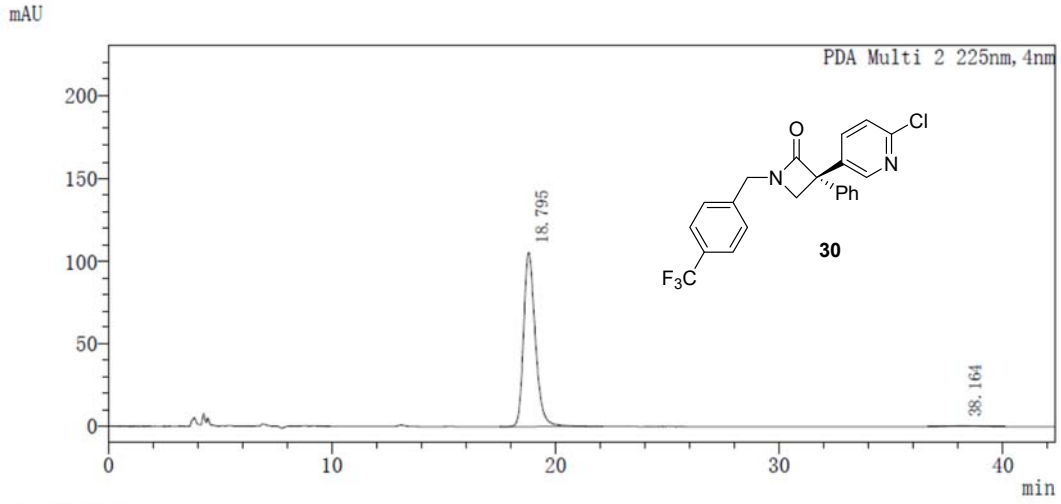


Peak Table

PDA Ch2 225nm

Peak#	Ret. Time	Area	Area%
1	18.670	8548344	50.165
2	34.132	8492210	49.835

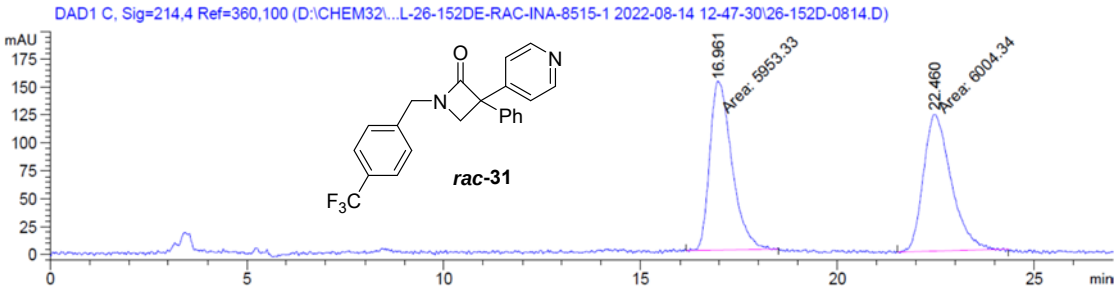


Peak Table

PDA Ch2 225nm

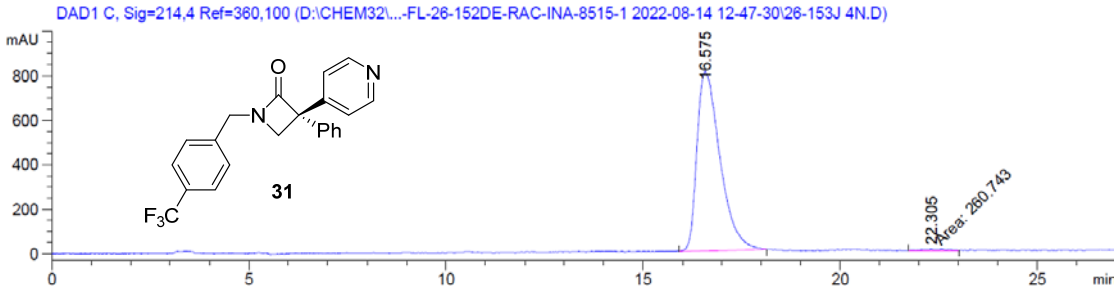
Peak#	Ret. Time	Area	Area%
1	18.795	3858629	99.082
2	38.164	35743	0.918

31



Signal 3: DAD1 C, Sig=214,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.961	MM	0.6552	5953.33105	151.43237	49.7867
2	22.460	MM	0.8185	6004.33740	122.25704	50.2133
Totals :				1.19577e4	273.68941	



Signal 3: DAD1 C, Sig=214,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.575	BV R	0.4835	3.27101e4	809.27460	99.2092
2	22.305	MM	0.6294	260.74268	6.90459	0.7908
Totals :				3.29708e4	816.17918	

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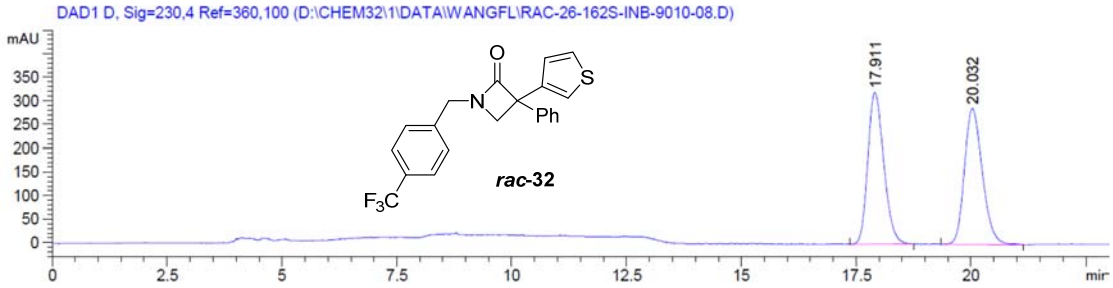
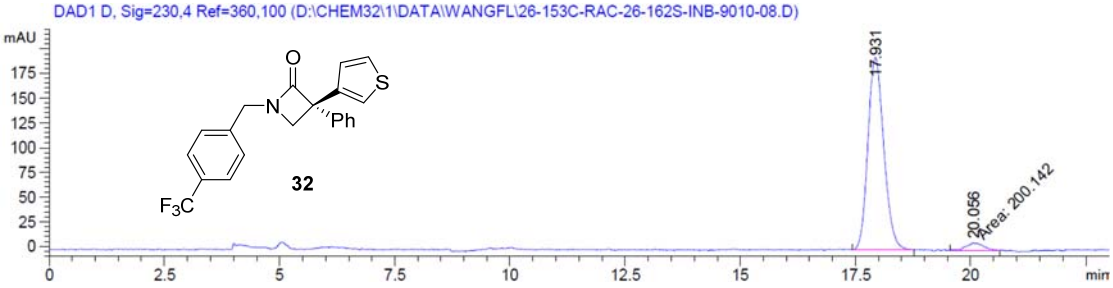


Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.911	VV R	0.3547	7780.53662	321.08081	49.8330
2	20.032	VV R	0.4186	7832.68506	288.32114	50.1670
Totals :				1.56132e4	609.40195	



Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.931	BV R	0.3680	4678.41406	194.91843	95.8975
2	20.056	MM	0.4365	200.14212	7.64223	4.1025
Totals :				4878.55618	202.56065	

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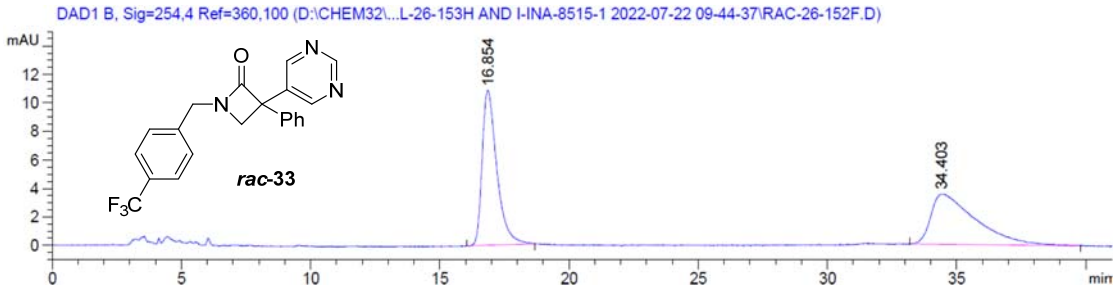
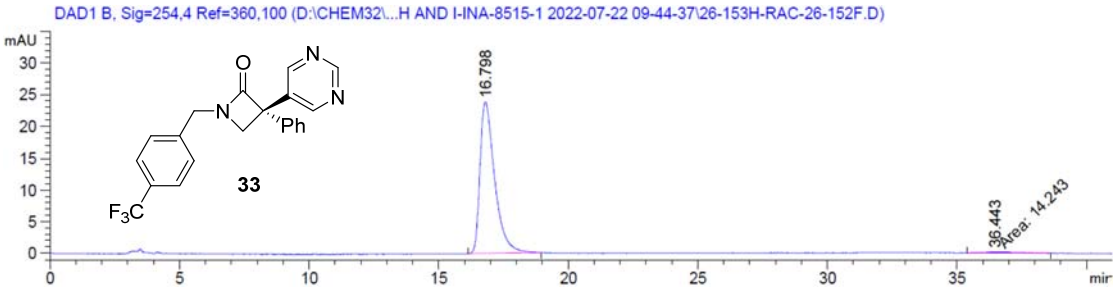


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.854	MM R	0.6592	429.04758	10.84750	50.2920
2	34.403	MM R	1.9928	424.06506	3.54662	49.7080
Totals :				853.11264	14.39412	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.798	BB	0.5820	938.88367	23.91457	98.5057
2	36.443	MM	1.5001	14.24299	1.58243e-1	1.4943
Totals :				953.12665	24.07282	

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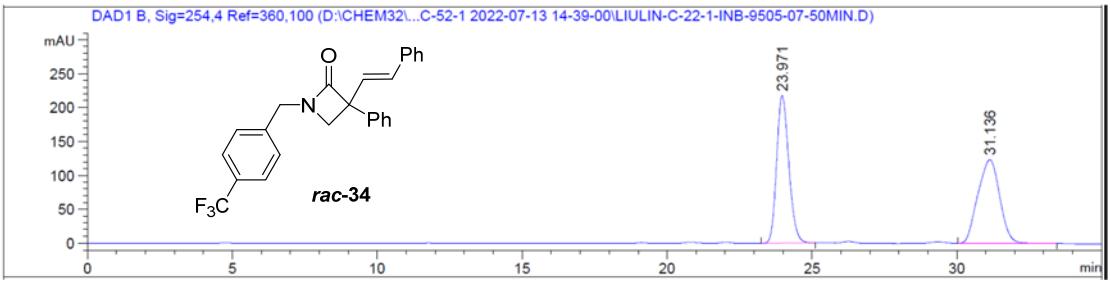
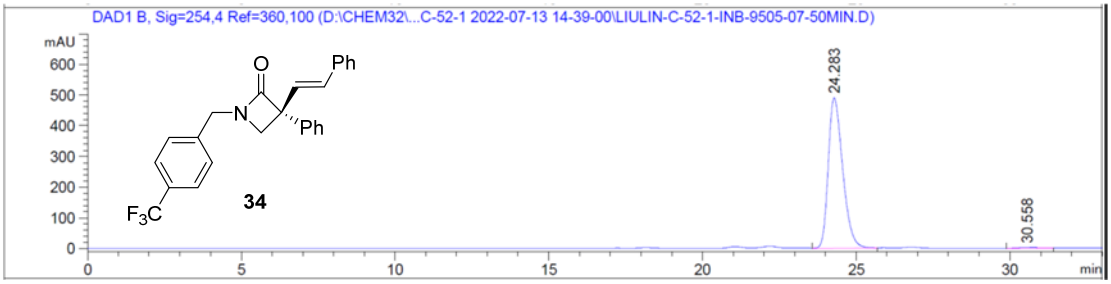


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.971	BB	0.4541	6379.45605	217.54422	49.7476
2	31.136	BB	0.7674	6444.19189	123.37260	50.2524
Totals :				1.28236e4	340.91682	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.283	BB	0.5028	1.59656e4	489.14960	99.2687
2	30.558	BB	0.4576	117.61275	3.09334	0.7313
Totals :				1.60832e4	492.24294	

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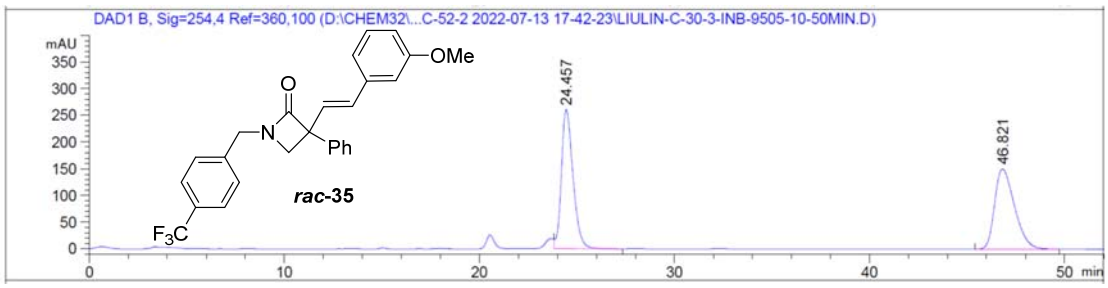
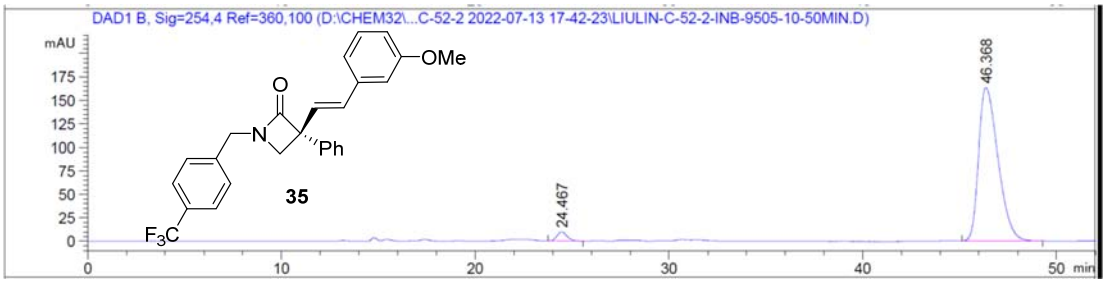


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.457	VB	0.6361	1.08603e4	260.65082	50.4388
2	46.821	BB	1.0525	1.06713e4	150.99754	49.5612
Totals :				2.15316e4	411.64836	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.467	BB	0.5134	350.63693	9.75339	2.9943
2	46.368	BB	1.0558	1.13597e4	163.25108	97.0057
Totals :				1.17103e4	173.00447	

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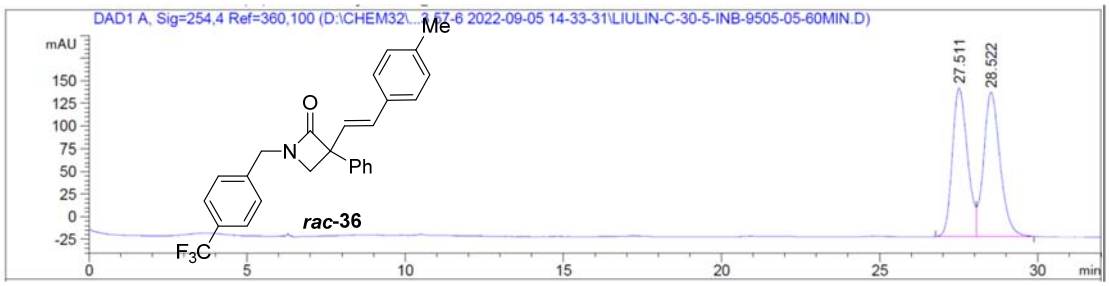
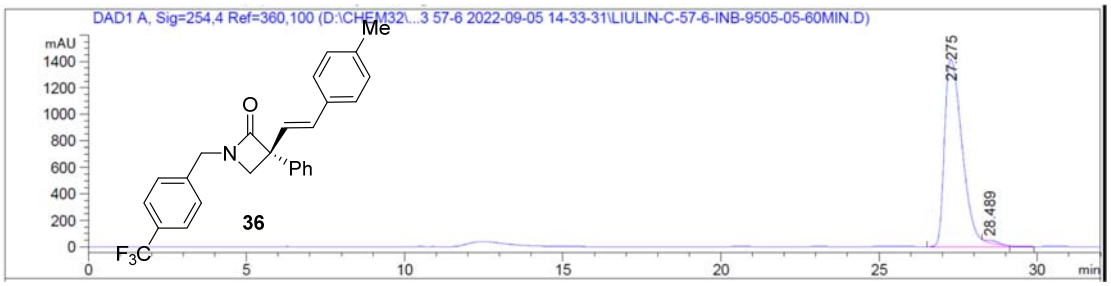


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	27.511	BV	0.5143	5460.81641	164.06172	48.6187
2	28.522	VB	0.5348	5771.11035	159.25868	51.3813
Totals :				1.12319e4	323.32040	



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	27.275	BV R	0.6092	5.57043e4	1415.20935	98.9651
2	28.489	VB E	0.3943	582.51251	17.96526	1.0349
Totals :				5.62868e4	1433.17461	

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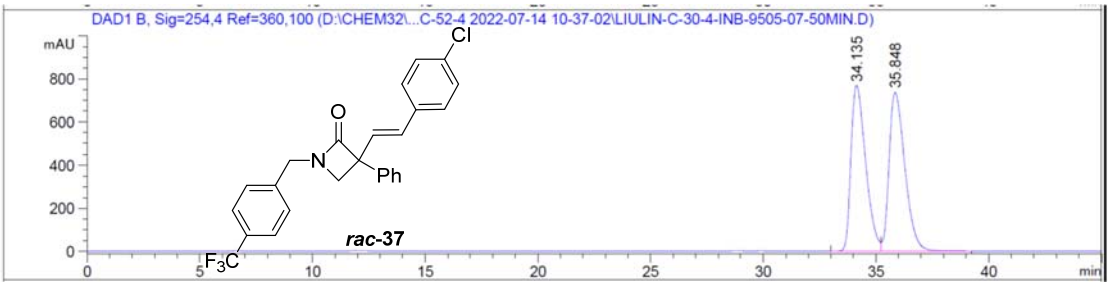
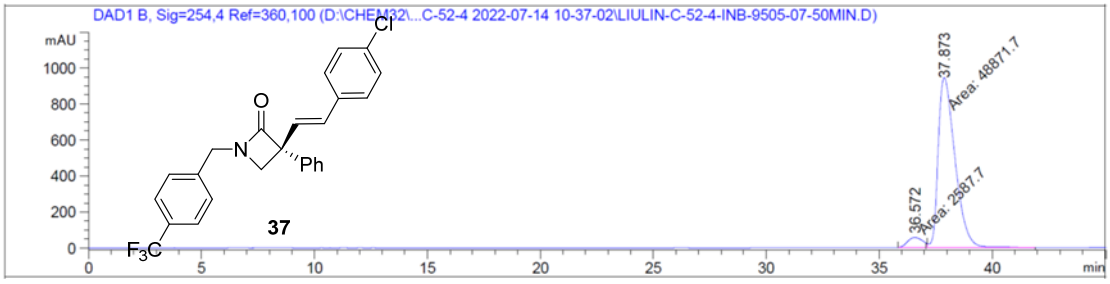


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	34.135	BV	0.7007	3.48702e4	769.42883	49.2672
2	35.848	VB	0.7411	3.59074e4	736.13171	50.7328



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	36.572	MM	0.7658	2587.69727	56.32151	5.0286
2	37.873	MM	0.8618	4.88717e4	945.16632	94.9714
Totals :				5.14594e4	1001.48783	

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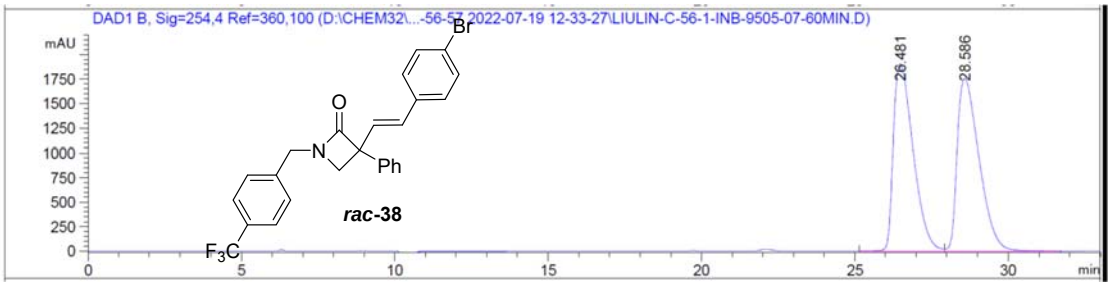
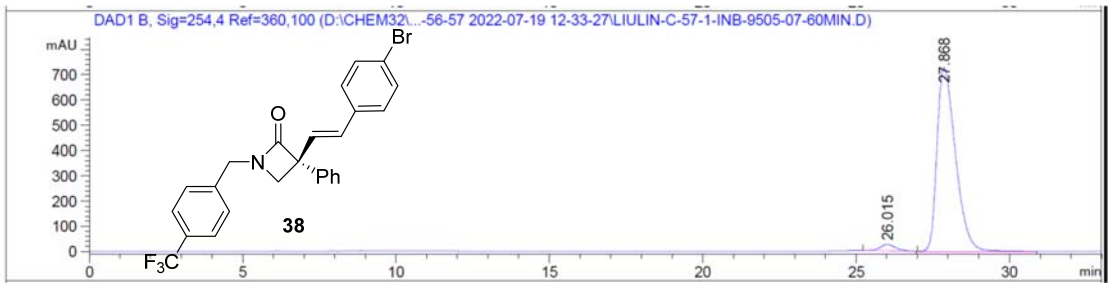


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.481	BV	0.6935	8.55050e4	1905.64050	49.6414
2	28.586	VB	0.7630	8.67403e4	1753.86169	50.3586
Totals :				1.72245e5	3659.50220	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.015	BB	0.5383	905.49200	25.25428	2.8918
2	27.868	BB	0.6442	3.04072e4	726.60645	97.1082
Totals :				3.13127e4	751.86073	

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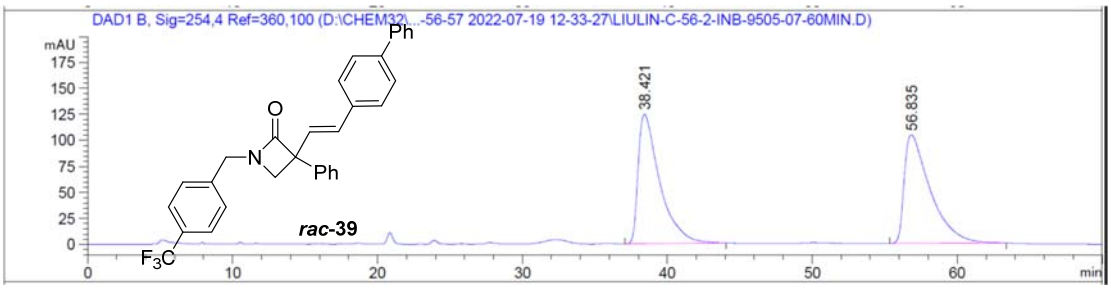
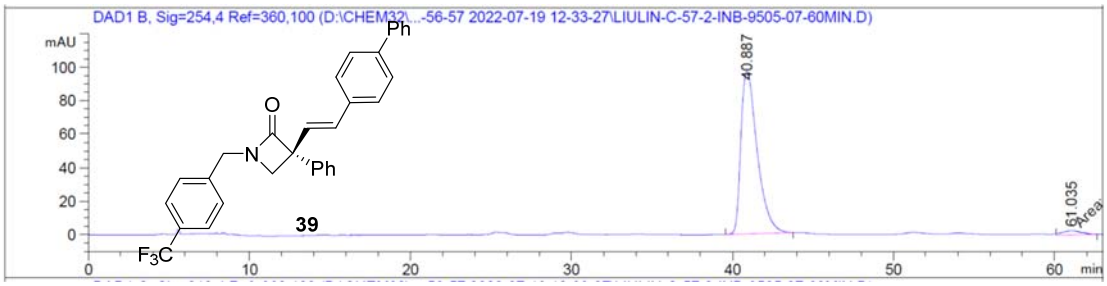


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	38.421	BB	1.4432	1.29516e4	124.54884	49.6708
2	56.835	BB	1.6907	1.31233e4	104.38615	50.3292
Totals :				2.60749e4	228.93499	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	40.887	BB	1.0612	6844.25879	97.00379	97.0259
2	61.035	MM	1.3868	209.79242	2.52130	2.9741
Totals :				7054.05121	99.52509	

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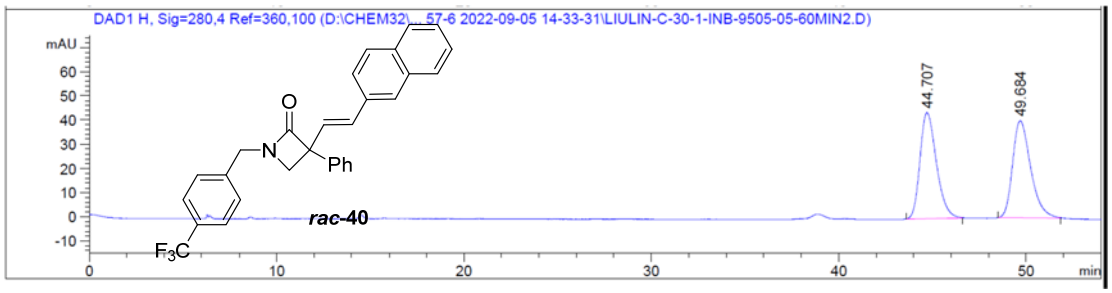
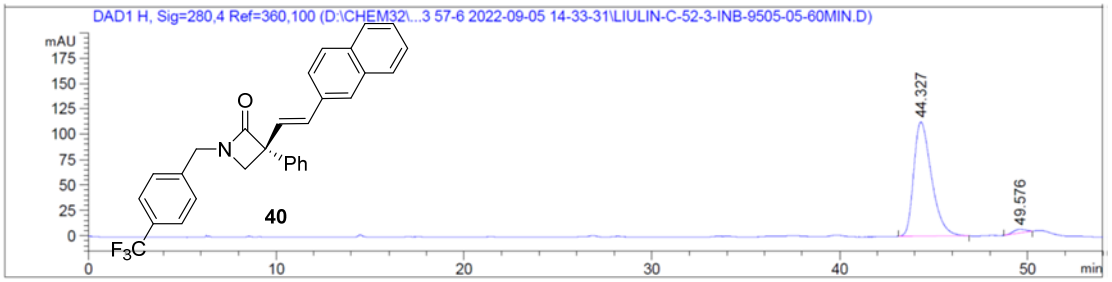


Signal 8: DAD1 H, Sig=280,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	44.707	BB	0.7247	2658.06616	43.75533	49.7237
2	49.684	BB	0.8184	2687.60474	40.07709	50.2763
Totals :				5345.67090	83.83242	



Signal 8: DAD1 H, Sig=280,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	44.327	BB	0.9608	7425.79053	112.38922	97.8736
2	49.576	BB	0.5249	161.33397	3.66988	2.1264
Totals :				7587.12450	116.05910	

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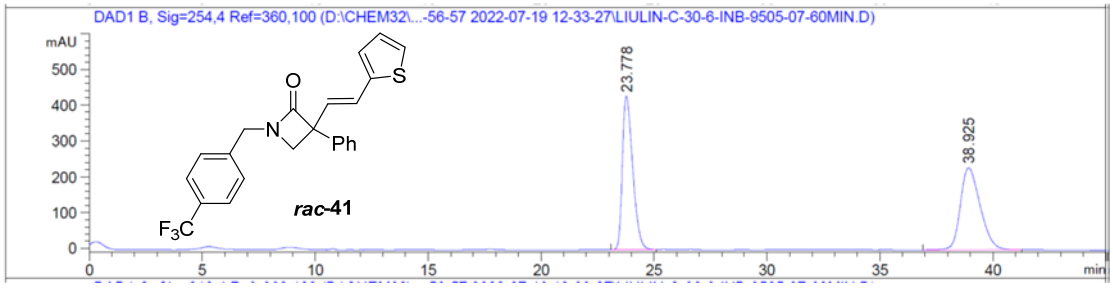
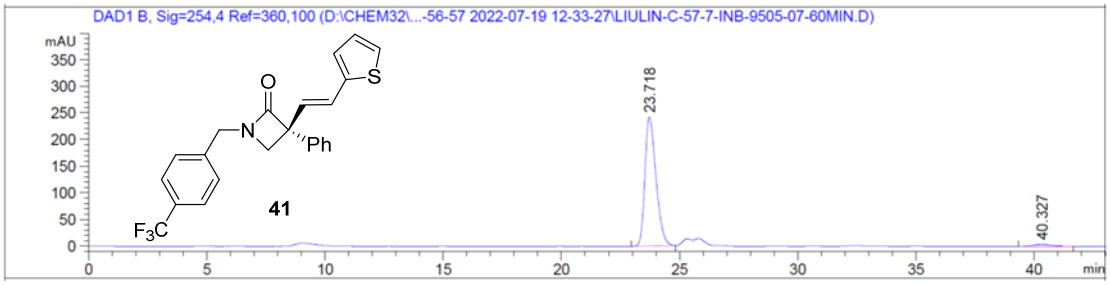


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.778	BB	0.4961	1.37298e4	428.20868	49.5087
2	38.925	BB	0.9297	1.40023e4	230.18011	50.4913
Totals :				2.77321e4	658.38879	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	23.718	BB	0.5071	7898.31250	241.82326	97.4181
2	40.327	BB	0.6459	209.33113	3.85280	2.5819
Totals :				8107.64363	245.67606	

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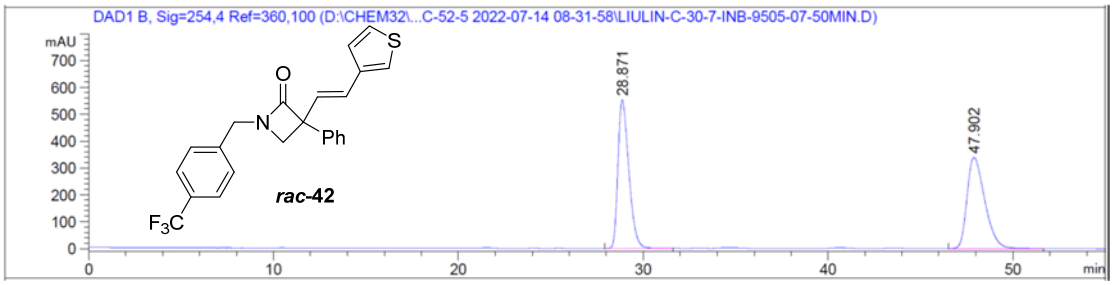
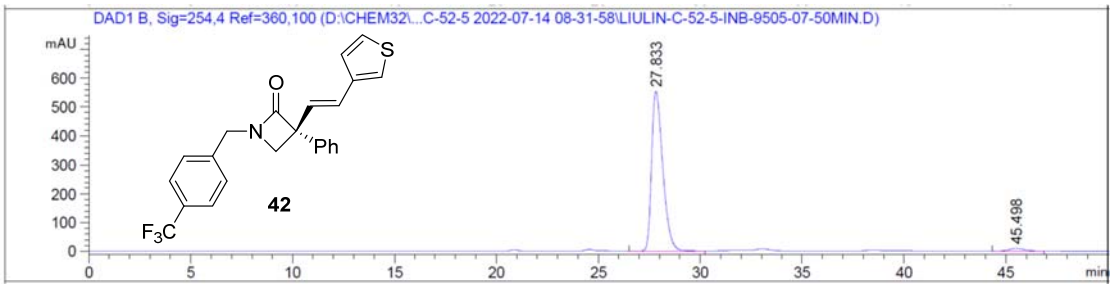


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

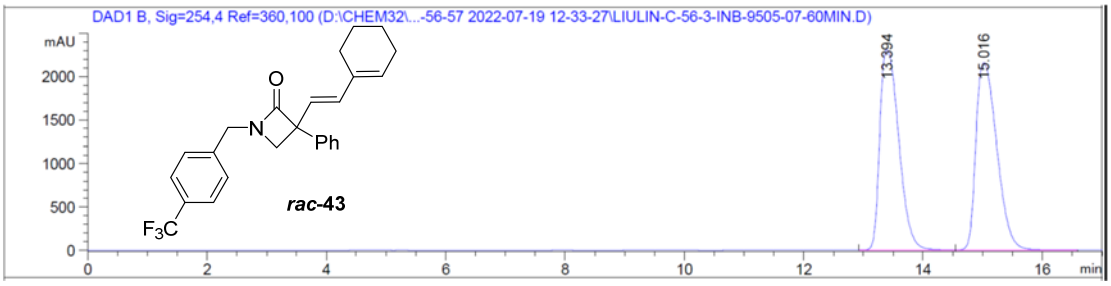
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	28.871	BB	0.6319	2.27318e4	552.64990	50.0859
2	47.902	BB	1.0245	2.26538e4	339.49582	49.9141
Totals :				4.53856e4	892.14572	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

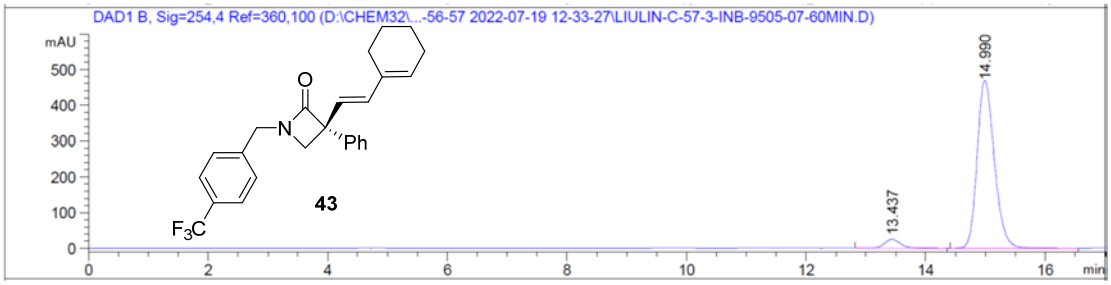
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	27.833	BB	0.5897	2.12690e4	554.20416	97.3701
2	45.498	BB	0.6722	574.46356	10.18212	2.6299
Totals :				2.18435e4	564.38628	

43



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.394	BB	0.3502	5.10920e4	2308.82935	49.3289
2	15.016	BB	0.3838	5.24821e4	2157.73169	50.6711
Totals :				1.03574e5	4466.56104	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.437	BB	0.2887	473.63528	24.81087	4.8110
2	14.990	BB	0.3092	9371.19824	468.80698	95.1890
Totals :				9844.83353	493.61785	

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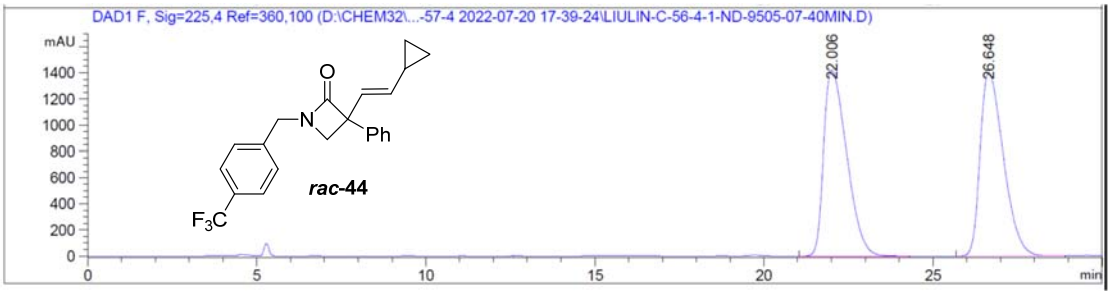
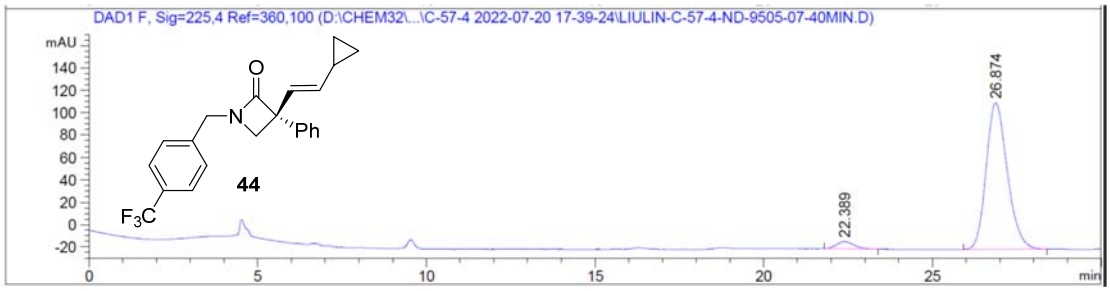


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
7	22.008	BB	0.7006	3.94248e4	847.66626	49.5909
8	26.650	BB	0.7199	3.93433e4	834.71027	49.4884
Totals :				7.95001e4	1741.40368	



Signal 6: DAD1 F, Sig=225,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	22.389	BB	0.4300	237.10852	6.52483	3.9937
2	26.874	BB	0.6425	5700.02686	130.76941	96.0063
Totals :				5937.13538	137.29423	

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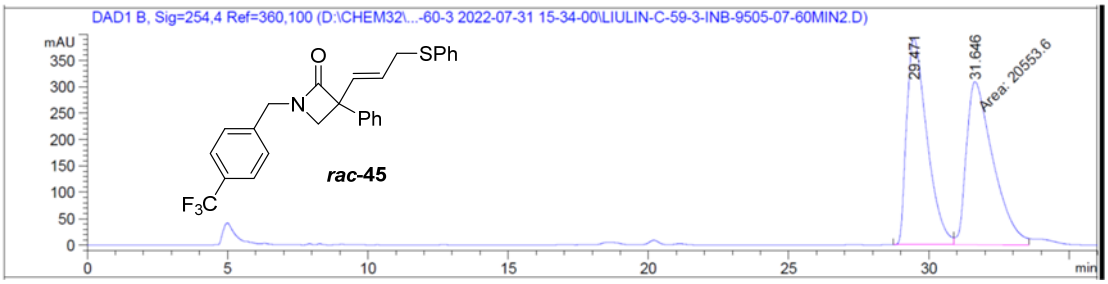
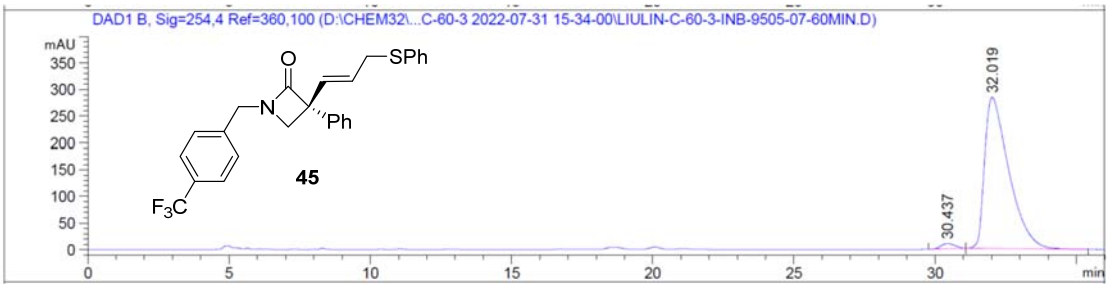


Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	29.471	BV	0.7753	1.96977e4	391.28668	48.9368
2	31.646	MF	1.1068	2.05536e4	309.49512	51.0632
Totals :				4.02513e4	700.78180	



Signal 2: DAD1 B, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.437	BB	0.5130	342.84610	9.87607	1.9820
2	32.019	BB	0.8869	1.69550e4	283.01810	98.0180
Totals :				1.72978e4	292.89416	

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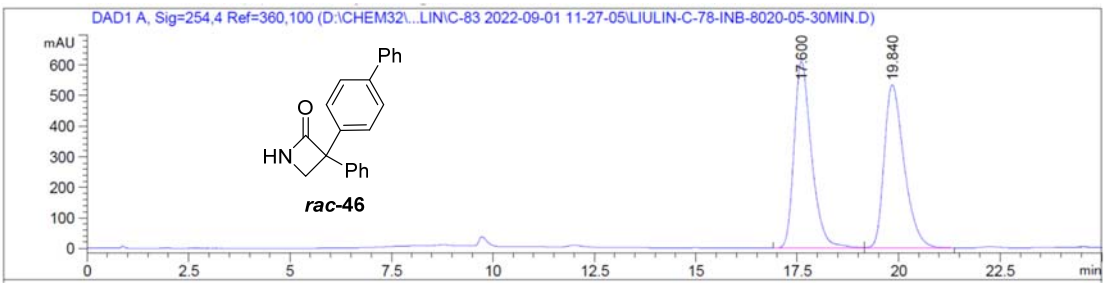

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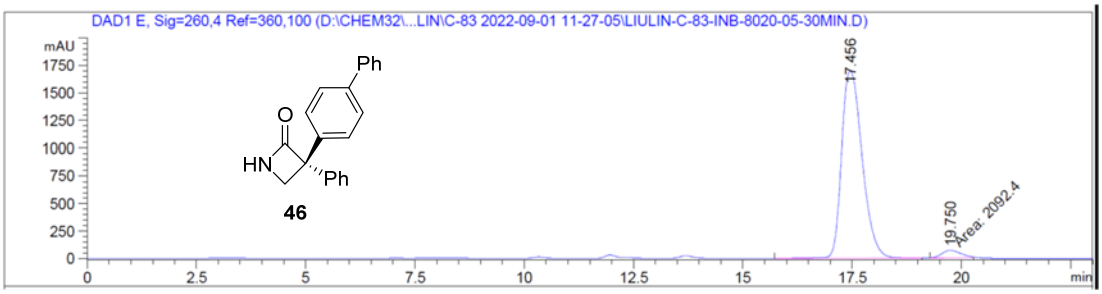
Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.600	BV	0.4497	1.83537e4	612.23517	50.0941
2	19.840	VB	0.5253	1.82847e4	534.26135	49.9059
Totals :				3.66384e4	1146.49652	



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Signal 5: DAD1 E, Sig=260,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.456	BB	0.5063	5.56042e4	1697.05603	96.3734
2	19.750	MM	0.5067	2092.40430	68.82820	3.6266
Totals :				5.76966e4	1765.88423	

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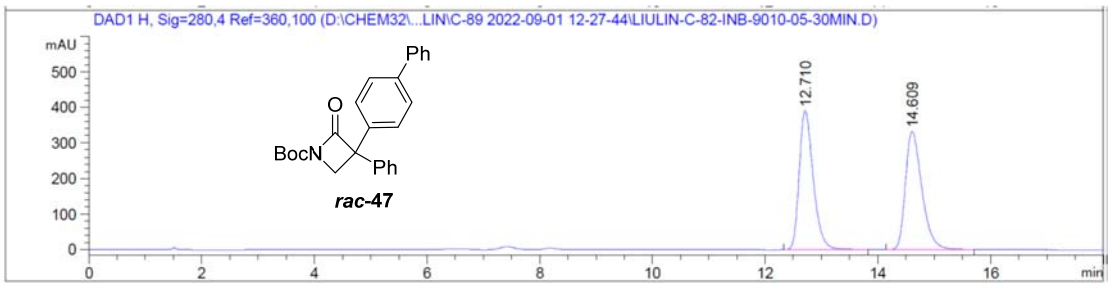
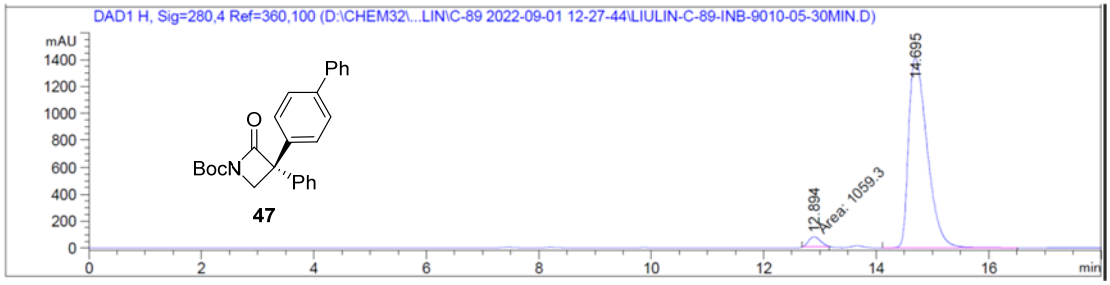


Signal 8: DAD1 H, Sig=280,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.710	BB	0.2664	6776.86035	390.68729	50.0474
2	14.609	BB	0.3124	6764.03711	330.99664	49.9526



Signal 8: DAD1 H, Sig=280,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.894	MM	0.2405	1059.30017	73.39728	3.1591
2	14.695	BB	0.3607	3.24719e4	1409.70300	96.8409
Totals :				3.35312e4	1483.10028	

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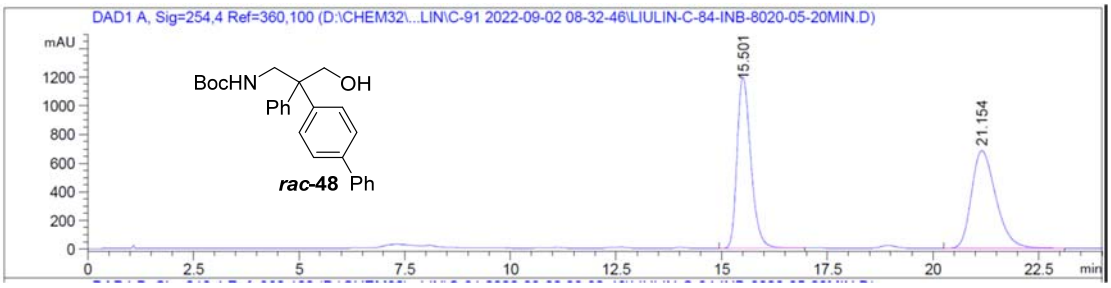
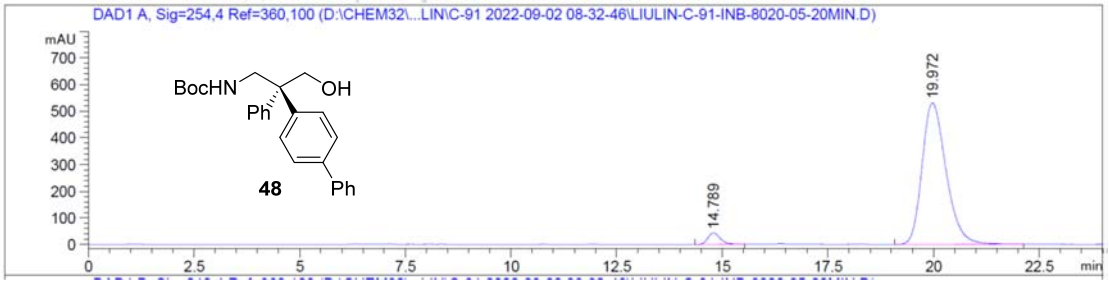


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.501	BB	0.3516	2.69694e4	1193.44373	49.5821
2	21.154	BB	0.6223	2.74241e4	683.18335	50.4179
Totals :				5.43935e4	1876.62708	



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	14.789	BB	0.3100	890.34546	43.64949	4.0727
2	19.972	BB	0.6135	2.09709e4	530.08606	95.9273
Totals :				2.18612e4	573.73555	

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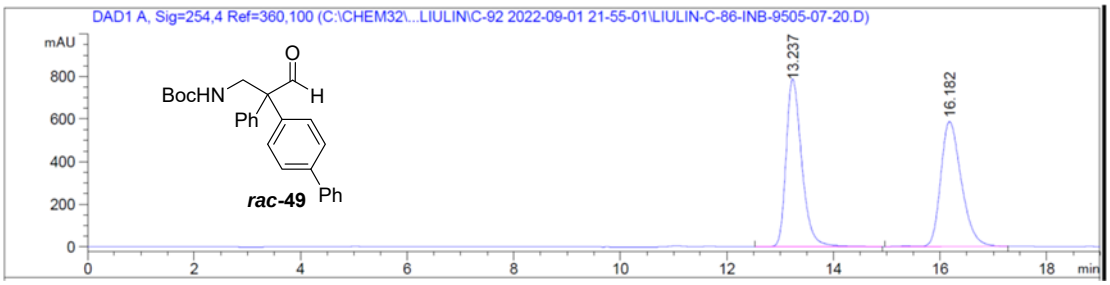
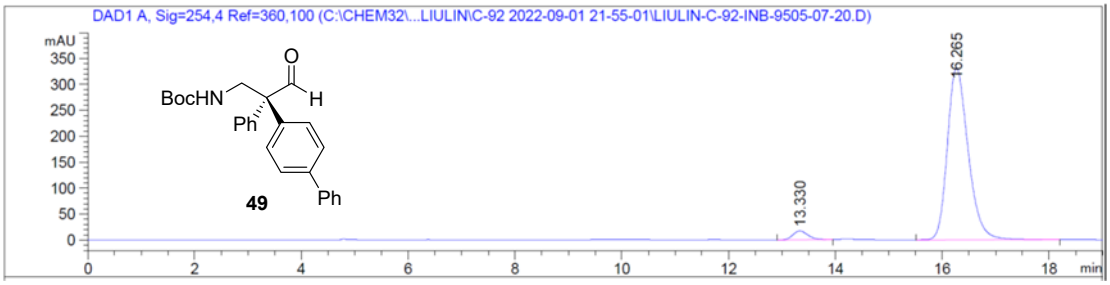


Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.237	BB	0.3141	1.60573e4	786.85956	50.4349
2	16.182	VB R	0.4157	1.57804e4	584.95282	49.5651
Totals :				3.18377e4	1371.81238	



Signal 1: DAD1 A, Sig=254,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.330	BB	0.3019	337.81970	17.14351	3.6321
2	16.265	BB	0.4155	8963.14746	331.46527	96.3679
Totals :				9300.96716	348.60878	

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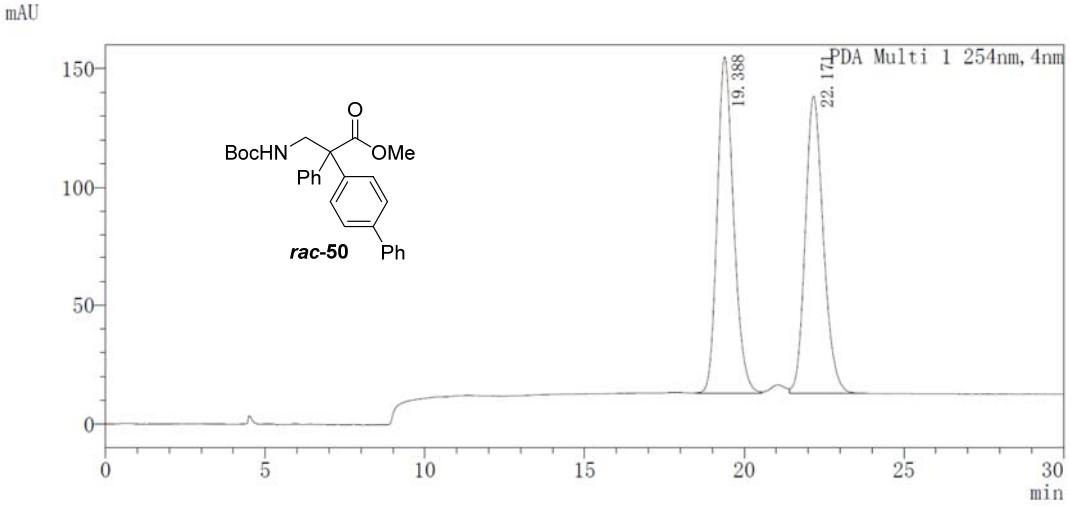
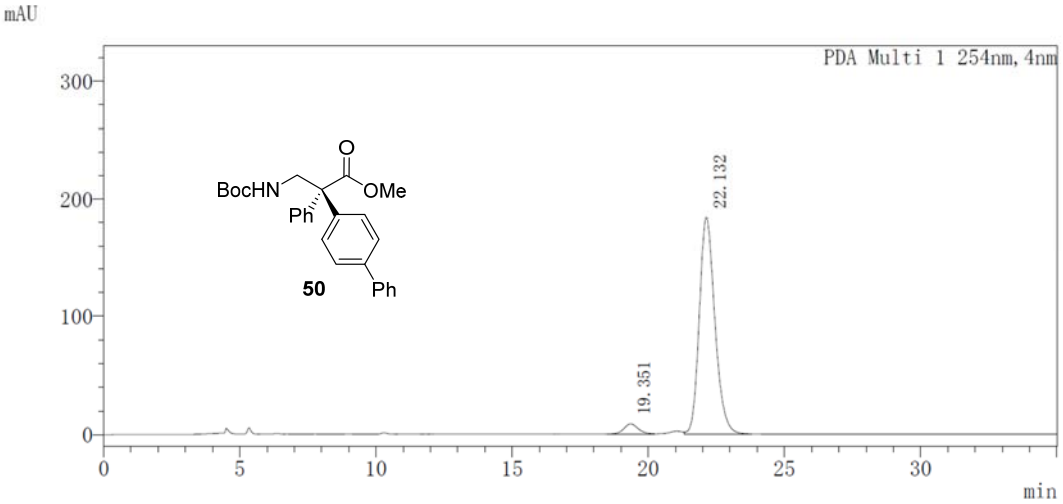


Peak Table

PDA Ch1 254nm

Peak#	Ret. Time	Area	Area%
1	19.388	5089493	50.730
2	22.171	4943011	49.270



Peak Table

PDA Ch1 254nm

Peak#	Ret. Time	Area	Area%
1	19.351	316264	4.161
2	22.132	7285119	95.839

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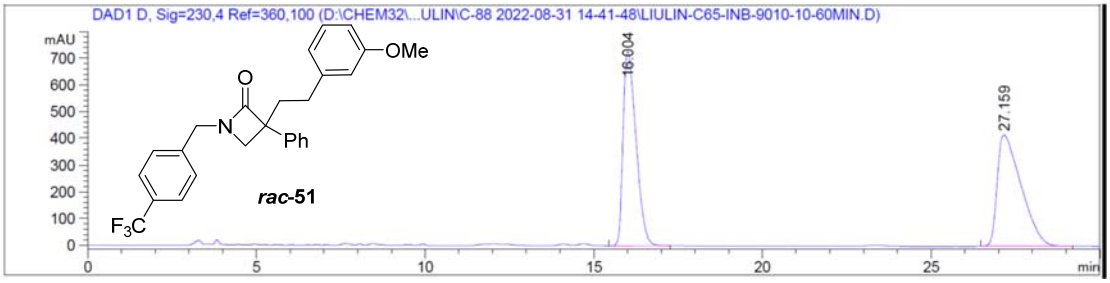
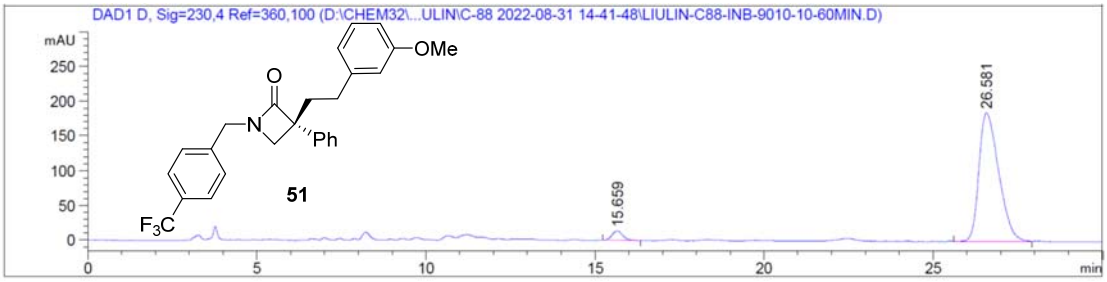


Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.004	BB	0.4168	1.93772e4	727.38300	48.5816
2	27.159	BB	0.7015	2.05087e4	415.77646	51.4184
Totals :				3.98859e4	1143.15945	



Signal 4: DAD1 D, Sig=230,4 Ref=360,100

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.659	BB	0.3329	296.55893	13.36415	3.7787
2	26.581	VB R	0.6334	7551.70801	185.31050	96.2213
Totals :				7848.26694	198.67465	