Supporting Information

Enantioselective Pd-Catalyzed Dearomative Reductive Heck and Domino Heck-Suzuki Reactions of 2-CF_3-Indoles

Ren-Xiao Liang,* Jian-Fei Chen, Ying-Ying Huang, Ya-Ping Yu, Han-Yue Zhang, Yu-Feng Song, Gavin Chit Tsui* and Yi-Xia Jia*

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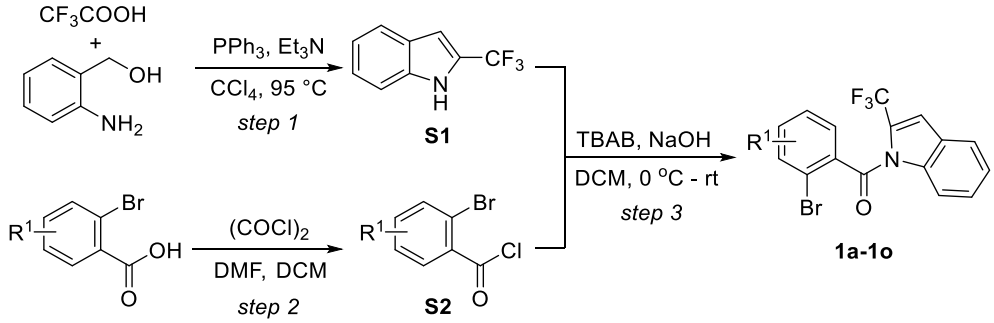
1. General information

Reactions and manipulations involving organometallic or moisture sensitive compounds were carried out under nitrogen atmosphere and glassware was dried by heating gun for 15 min prior to use. ^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra were recorded on Bruker AVANCE III 400 MHz or 600 MHz using $CDCl_3$ as solvent and TMS as internal standard. Anhydrous 1,4-dioxane and toluene were freshly distilled over Na and benzophenone. Anhydrous DCM, Et_3N, and DMF were freshly distilled over CaH_2. Melting points were measured on a Büchi Melting Point B-545 apparatus and uncorrected. Commercial reagents were used as received without further purification unless otherwise noticed. HRMS were recorded on Thermo Scientific LTQ Orbitrap XL. Optical rotations were determined using a Rudolph Autopol IV polarimeter. Chiral HPLC analyses were performed using Agilent 1260 chromatography. Column chromatography was carried out using silica gel (200-300 mesh). Ligands **L1**-**L9** were purchased from commercial sources, and ligands **L10**-**L17** were prepared according to the literature procedures and used directly as received.[1,2]

2. Synthesis of 2-CF_3-indole 1

2.1 For compounds 1a-1o



Step 1:[3]

To a three-neck bottom flask equipped with a condenser was charged with Ph_3P (7.86 g, 30 mmol), CCl_4 (40 mL), and CF_3COOH (10 mmol) at 0 ℃ under a nitrogen atmosphere. After stirring for 15 min, 2-aminobenzyl alcohol (10 mmol) and Et_3N (1.4 mL, 10 mmol) was then added respectively to the reaction mixture via a syringe. The resulting mixture was allowed to reflux for 2 h. When the reaction was completed, the solution was concentrated under reduced pressure. The residue was washed with EtOAc for three times, and the precipitate was removed by filtration. The filtrate was concentrated and purified by column chromatography on silica gel eluting with EtOAc/petroleum ether 1:50 (v/v) to afford compound **S1**.

Step 2:

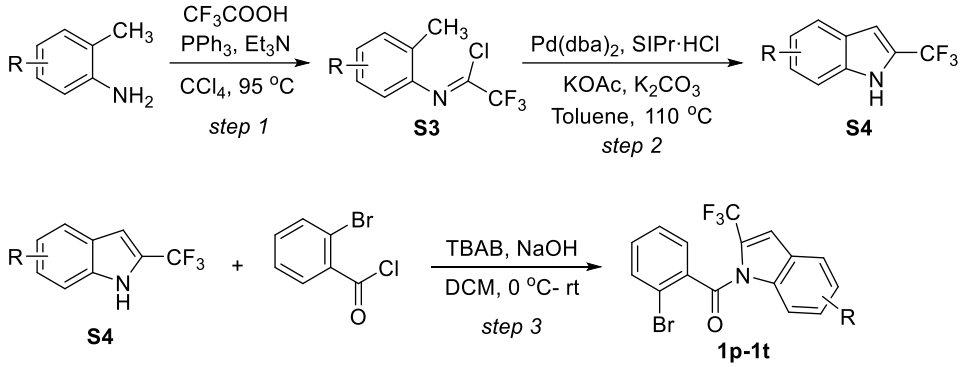
To a 100 mL flask was charged with benzoic acid derivative (977 mg, 8 mmol), anhydrous DCM (20 mL), and catalytic amount of DMF at 0 ℃. The mixture was stirred for 30 minutes. Then, $(COCl)_2$ (0.89 mL, 1.3 equiv) was added dropwise via a syringe. The resulting mixture was allowed to stir at room temperature for 4 h. The solution was concentrated under reduced pressure to afford the crude acid chloride **S2**,

which was used directly for the next step without further purification.

Step 3:

To a suspension of **S1** (1.0 equiv), sodium hydroxide (2.5 equiv), and TBAB (20 mol%) in DCM (0.5 M with respect to **S1**) was added a solution of **S2** (1.5 equiv, 2 M) in DCM dropwise at 0 °C. The reaction mixture was stirred at 0 °C for 30 minutes. After adding additional 0.5 equivalent of **S2** in DCM (2 M) dropwise, the resulting mixture was allowed to stir at room temperature overnight. The solution was extracted with DCM and the combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel eluting with EtOAc/petroleum ether (1:100) to afford compounds **1a-1o**.

2.2 For compounds 1p-1t



Step 1:[4]

To a flask equipped with a condenser was charged with Ph_3P (34.5 g, 132 mmol), Et_3N (7.3 mL, 53 mmol), CCl_4 (21.1 mL, 220 mmol), and CF_3CO_2H (44 mmol) at 0 °C under nitrogen atmosphere. After stirring for 10 min, a solution of *o*-methylaniline (44 mmol) in CCl_4 (21.1 mL, 220 mmol) was added dropwise to the reaction mixture. Upon completion of the addition, the reaction mixture was allowed to reflux for 3 h. The solution was then concentrated under reduced pressure and petroleum ether was then added. The precipitate was removed via filtration and the filtrate was concentrated under reduced pressure. The residue was purified by column chromatography on silica gel eluting with EtOAc/petroleum ether (1:100) to afford compound **S3**.

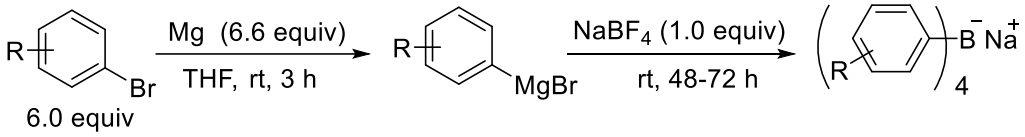
Step 2:[5]

To a flask was charged with $Pd(dba)_2$ (11.6 mg, 0.02 mmol, 1.0 mol%) , SIPr·HCl (8.6 mg, 0.022 mmol, 1.1 mol%), anhydrous KOAc (392 mg, 4.0 mmol, 2.0 equiv) and K_2CO_3 (884 mg, 6.4 mmol, 3.2 equiv) under N_2 atmosphere. Toluene (2 mL) was introduced via a syringe. The resulting mixture was stirred at room temperature for 10 min, then a solution of **S3** (2.0 mmol, 1.0 equiv) in 3 mL toluene were then added. After adding additional 3 mL of toluene, the reaction mixture was allowed to stir at 110 °C (oil bath) for 12 h. When the reaction was completed, the solution was concentrated under reduced pressure. The residue was purified by column chromatography on silica gel eluting with EtOAc/petroleum (1:100) to afford compound **S4**.

Step 3:

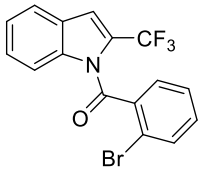
To a suspension of **S4** (1.0 equiv), sodium hydroxide (2.5 equiv), and TBAB (20 mol%) in DCM (0.5 M with respect to **S4**) was added a solution of 2-bromobenzoyl chloride (1.5 equiv, 2 M) in DCM dropwise at 0 °C. The reaction mixture was stirred at 0 ºC for 30 minutes. After adding additional 0.5 equivalent of 2-bromobenzoyl chloride in DCM (2 M) dropwise, the resulting mixture was allowed to stir at room temperature overnight. The solution was extracted with DCM and the combined organic layers were washed with brine, dried over Na_2SO_4, and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel eluting with EtOAc/petroleum ether (1:100) to afford compounds **1p-1t**.

3. Preparation of sodium tetraarylborates

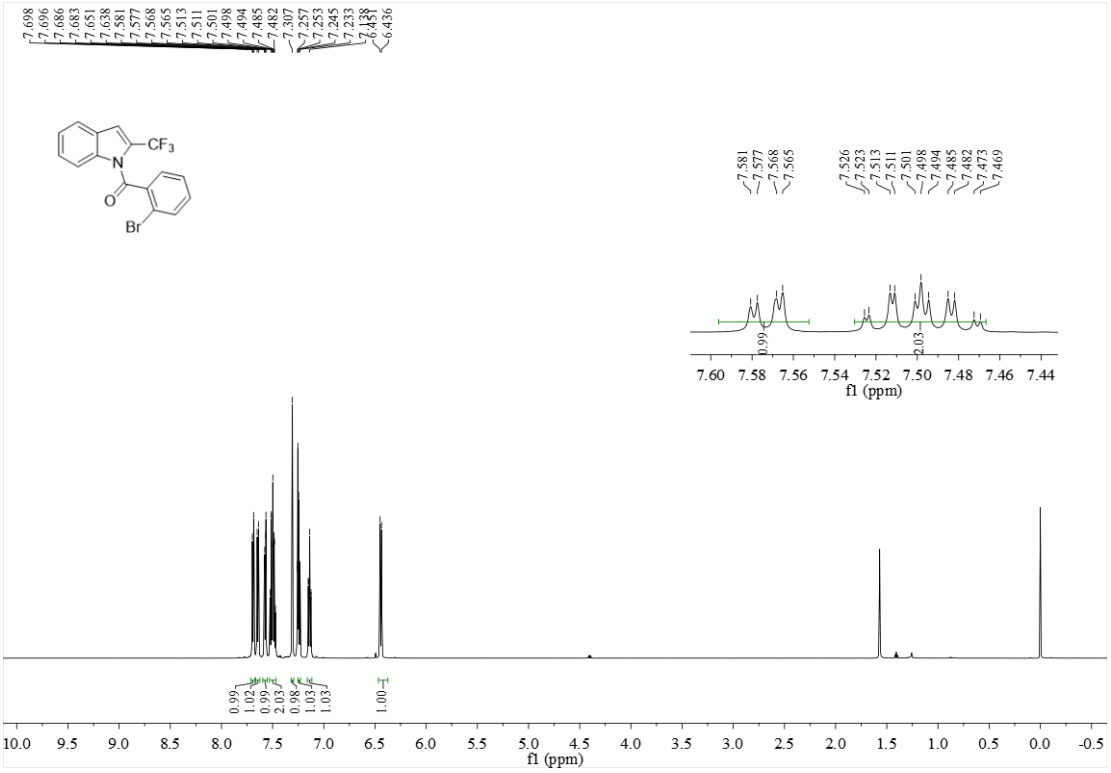


Sodium tetraarylborates were prepared according to the literature.[6] To a suspension of Mg powder (6.6 equiv) in THF (20 mL) was added a grain of iodine, then a solution of aryl bromides (6.0 equiv) in THF (20 mL) was slowly added. The resulting mixture was stirred at room temperature for 3 h, giving a dark gray solution of the aryl Grignard reagent. Upon addition of $NaBF_4$ (1.0 equiv), the heterogeneous reaction mixture was stirred for additional 48-72 h. The reaction mixture was then poured into a solution of Na_2CO_3 in water and stirred for 20 min. After filtering, the filtrate was extracted with ethyl acetate, dried over Na_2SO_4, and concentrated under reduced pressure. The residue was recrystallized from petroleum ether to afford sodium tetraarylborates.

(2-Bromophenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1a):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid, 95% yield (for the last step); m.p. 74-76 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.69 (dd, J = 7.8, 1.3 Hz, 1H), 7.64 (d, J = 7.8 Hz, 1H), 7.57 (dd, J = 7.4, 1.9 Hz, 1H), 7.54-7.43 (m, 2H), 7.31 (s, 1H), 7.29-7.22 (m, 1H), 7.18-7.08 (m, 1H), 6.44 (d, J = 8.6 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 165.5, 137.0, 136.6, 133.9, 133.0, 130.3, 128.1, 127.8, 127.2, 126.8, 123.9, 122.6, 120.7 (q, J = 267.0 Hz), 137.8, 115.1 (q, J = 4.5 Hz), 113.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.4 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_9BrF_3NONa^+$ $(M+Na)^+$ 389.9716, found 389.9717.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0.98
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1.03
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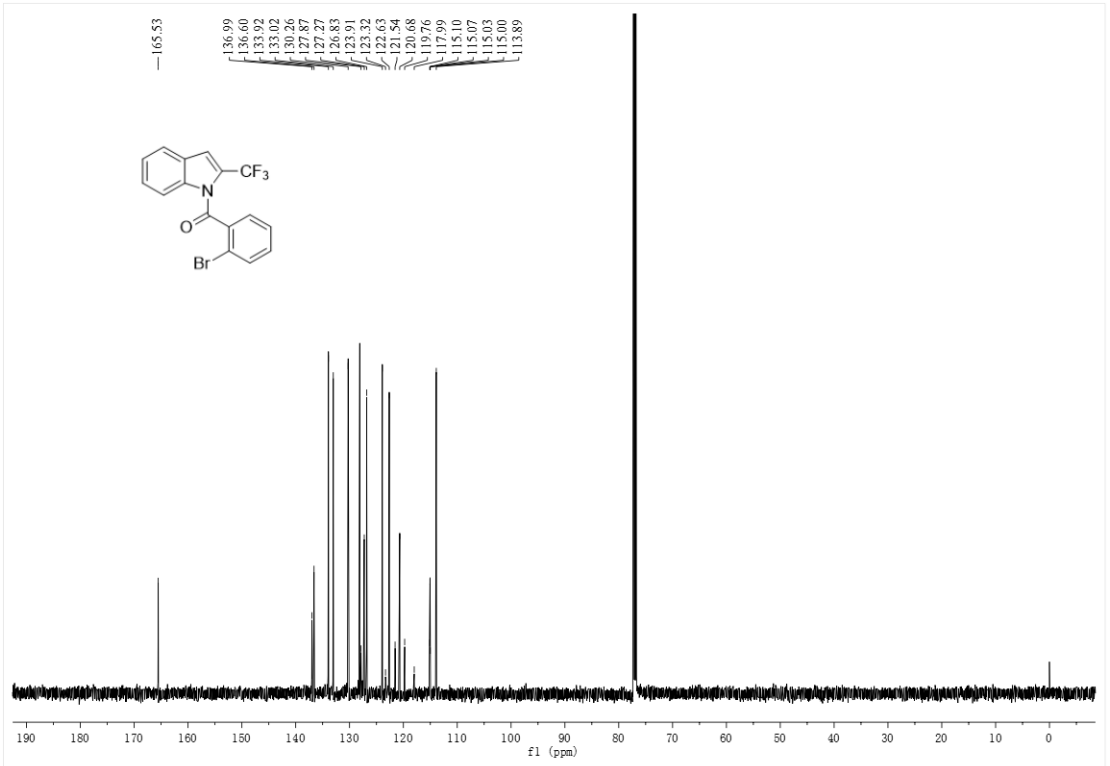
f1 (ppm)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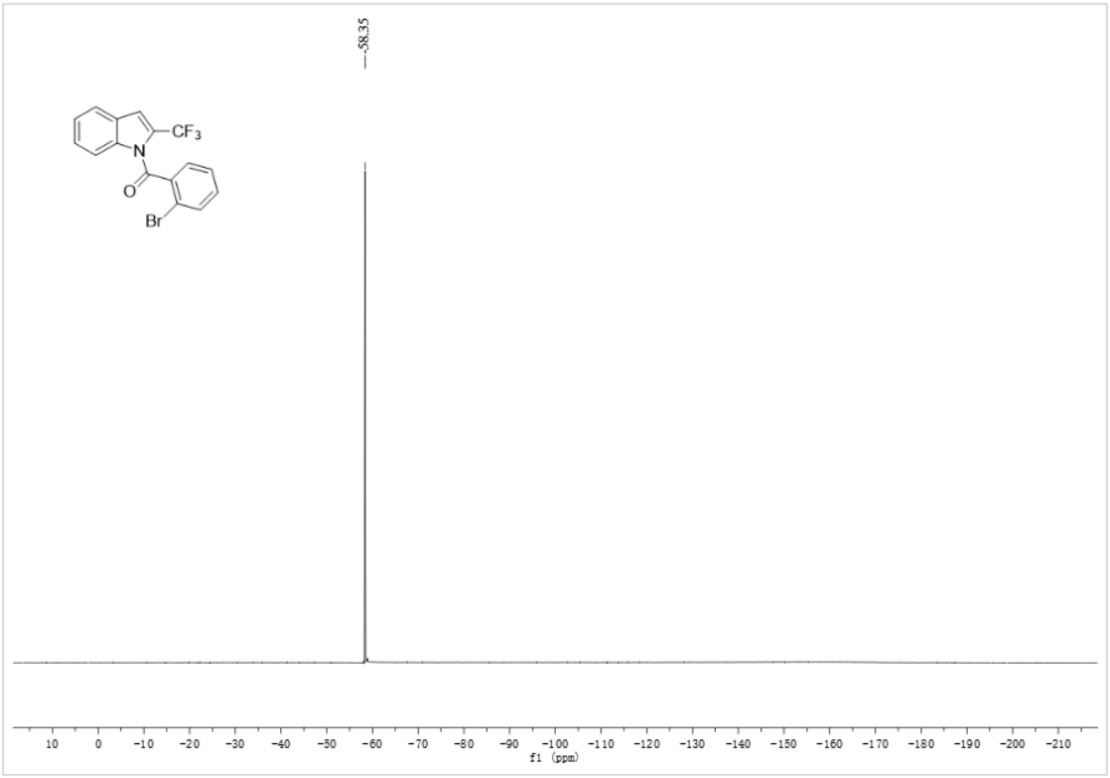
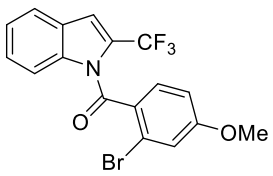
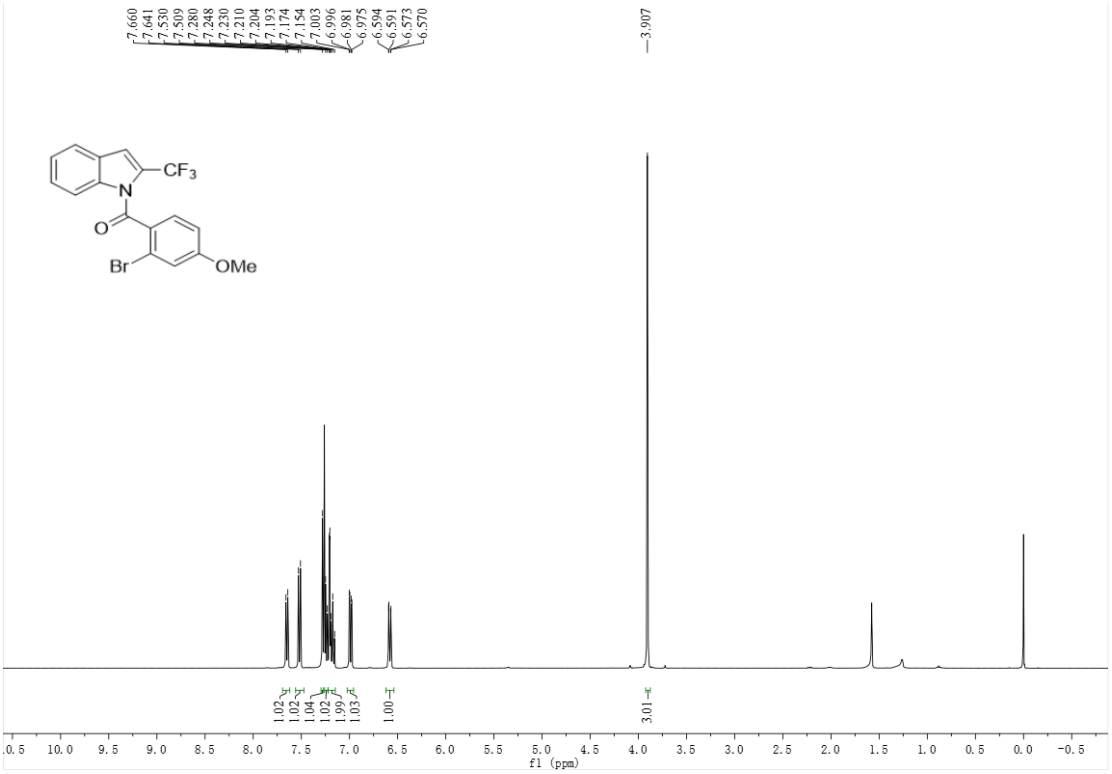


(2-Bromo-4-methoxyphenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1b):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 85% yield (for the last step); m.p. 81-83 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, J = 7.7 Hz, 1H), 7.51 (d, J = 8.6 Hz, 1H), 7.28 (s, 1H), 7.23 (d, J = 7.3 Hz, 1H), 7.24-7.18 (m, 2H), 7.01 (dd, J = 8.6, 2.5 Hz, 1H), 6.58 (dd, J = 8.5, 1.3 Hz, 1H), 3.90 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.6, 162.8, 137.2, 132.3, 128.3, 128.2, 127.8, 127.1, 126.6, 123.6, 122.5 (d, J = 5.0 Hz), 120.7 (q, J = 267.0 Hz), 122.0, 119.4 (d, J = 2.8 Hz), 114.2 (q, J = 5.0 Hz), 113.9 (d, J = 1.6 Hz), 55.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.1 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{11}BrF_3NO_2Na^+$ $(M+Na)^+$ 419.9817, found 419.9815.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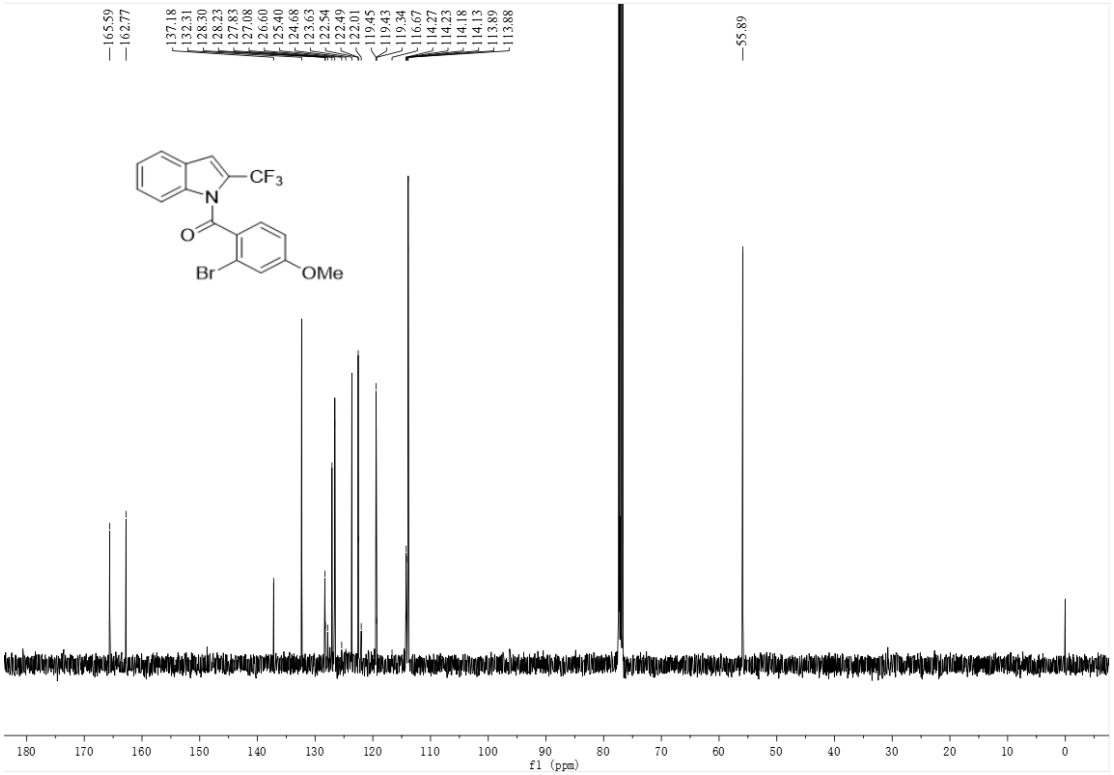
f1 (ppm)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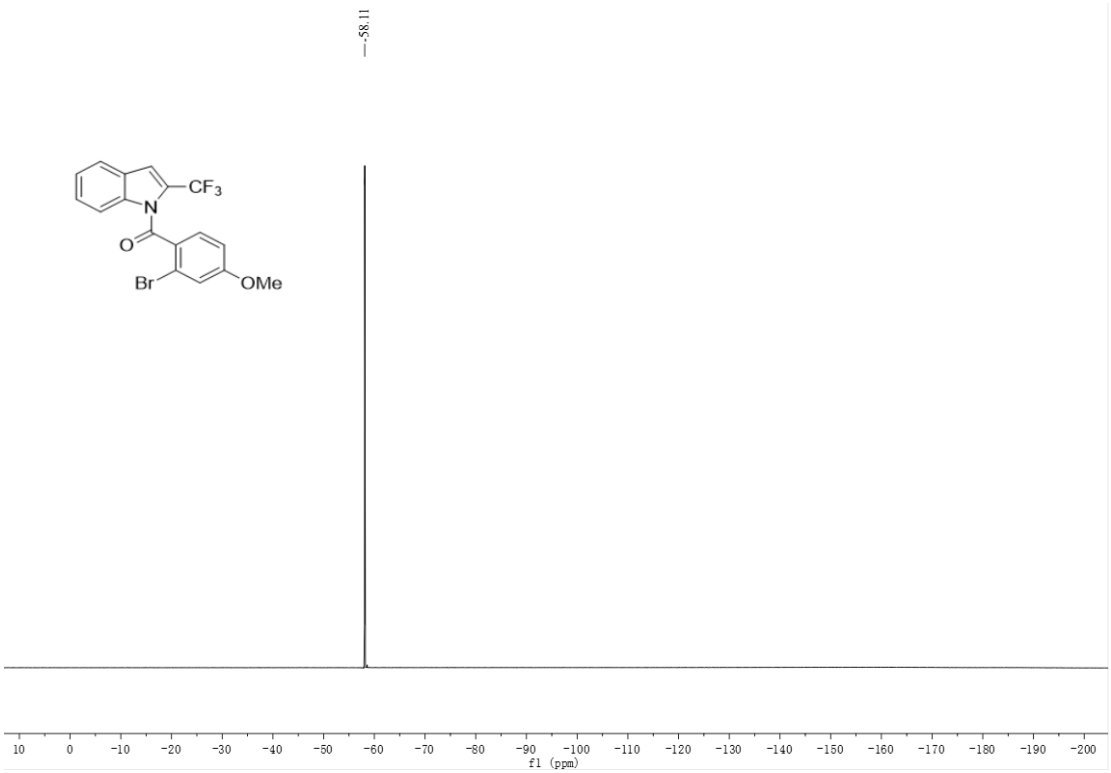
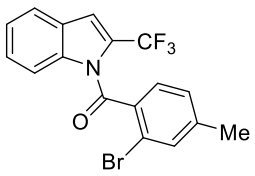
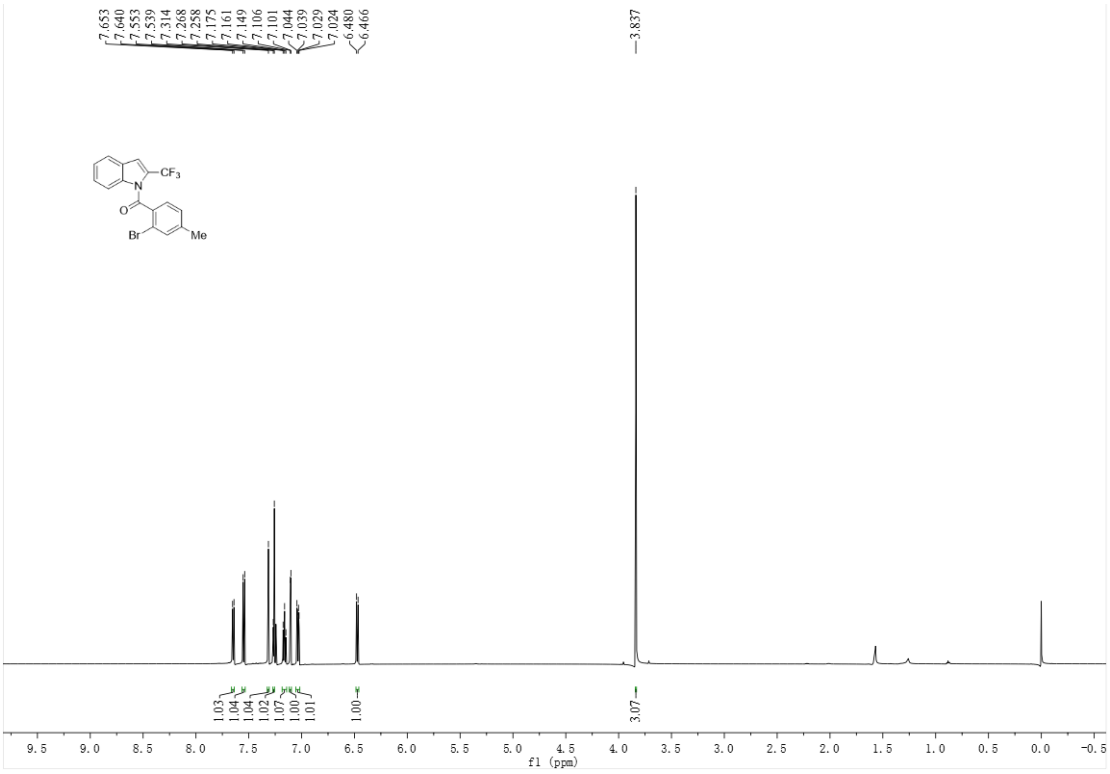
f1 (ppm)



(2-Bromo-4-methylphenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1c):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 88% yield (for the last step); m.p. 87-89 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.64 (d, J = 7.9 Hz, 1H), 7.54 (d, J = 8.9 Hz, 1H), 7.31 (s, 1H), 7.26 (d, J = 5.9 Hz, 1H), 7.19 (t, J = 7.9 Hz, 1H), 7.13 (d, J = 3.0 Hz, 1H), 7.03 (dd, J = 8.9, 3.1 Hz, 1H), 6.47 (d, J = 8.6 Hz, 1H), 3.84 (s, 3H).^{13}C NMR (100 MHz, $CDCl_3$) δ 165.7, 144.2, 137.1, 134.5, 133.6, 130.4, 128.8, 127.6 (q, J = 40.0 Hz), 127.2, 126.7, 123.7, 122.5, 120.71, 120.67 (q, J = 267.0 Hz), 114.6 (q, J = 5.0 Hz), 113.9, 21.3. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.2 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{11}BrF_3NONa^+$ $(M+Na)^+$ 403.9868, found 403.9870.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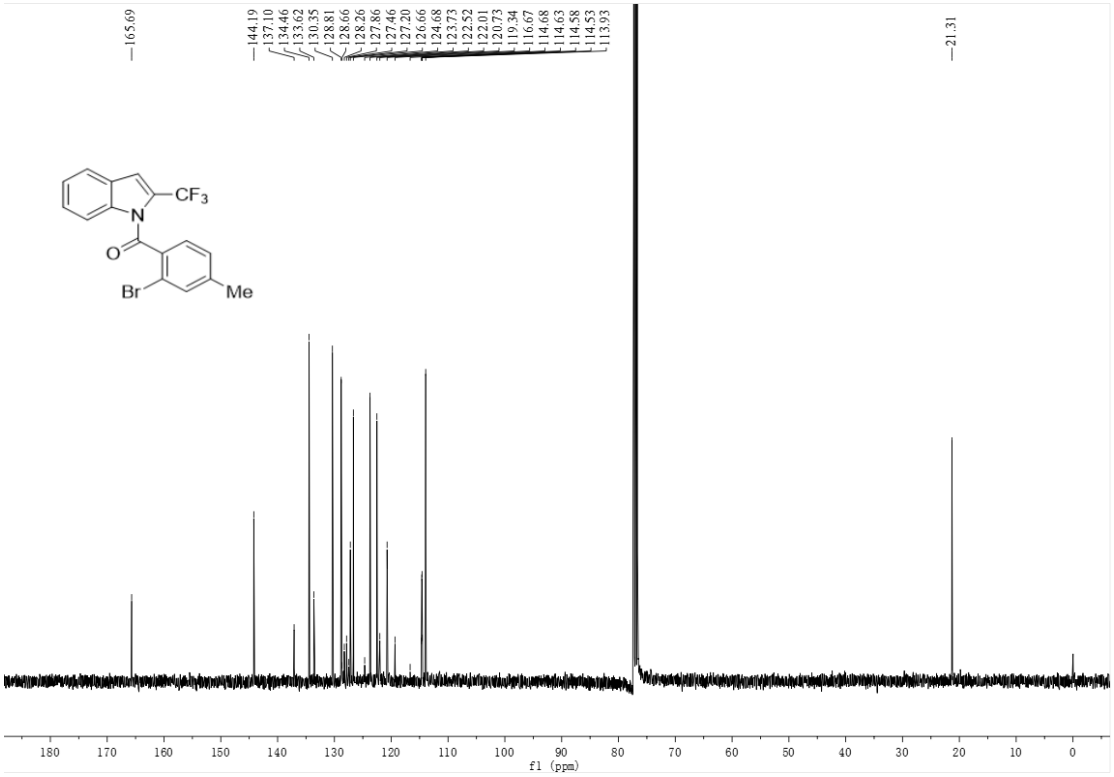
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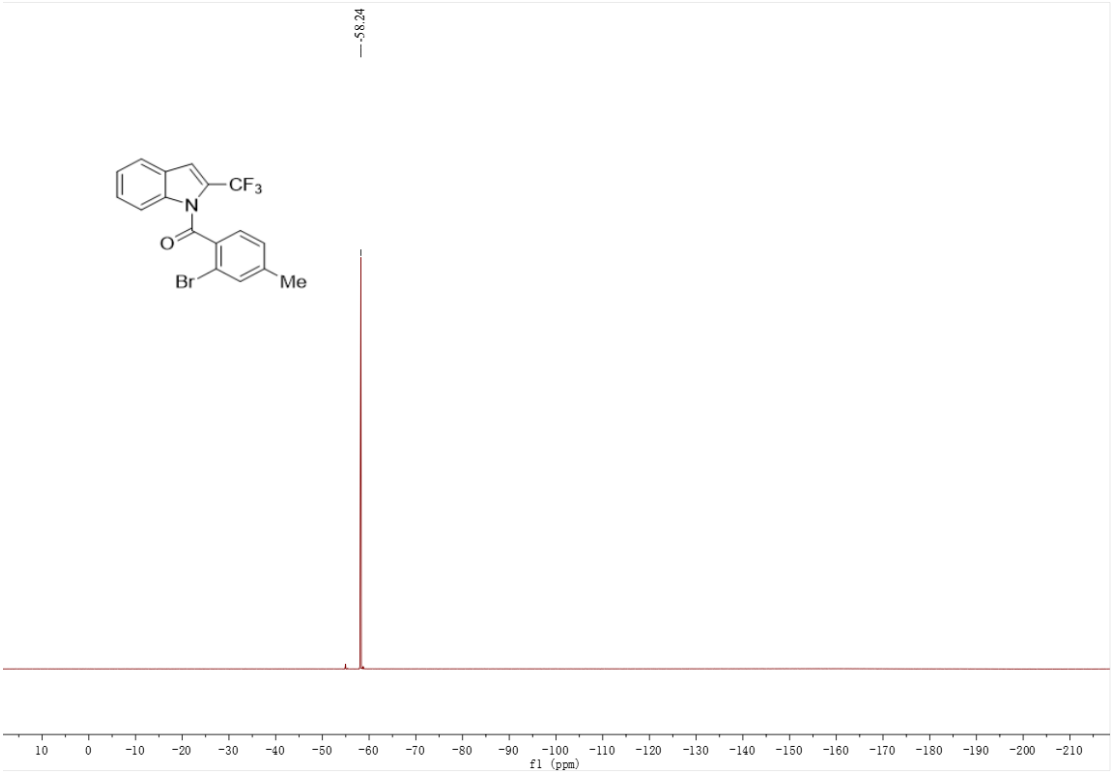
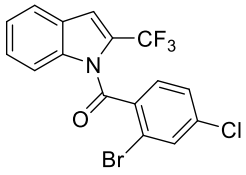
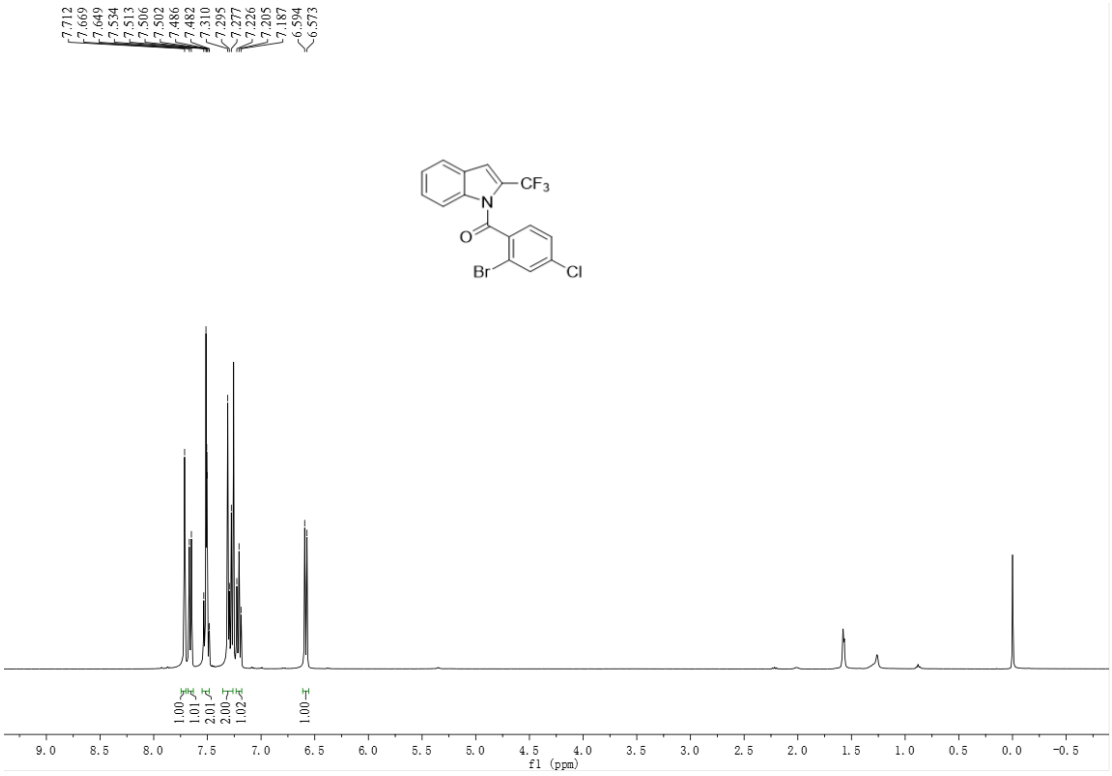


(2-Bromo-4-chlorophenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1d)：



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 77% yield (for the last step); m.p. 94-96 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (s, 1H), 7.66 (d, J = 7.9 Hz, 1H), 7.53-7.48 (m, 2H), 7.30 (t, J = 7.4 Hz, 2H), 7.21 (t, J = 8.4 Hz, 1H), 6.58 (d, J = 8.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.8, 138.7, 136.9, 134.9, 133.8, 131.3, 128.6, 128.3 (q, J = 40.0 Hz),127.2, 127.0, 124.1, 122.8, 121.5, 120.6 (q, J = 267.0 Hz), 115.2 (q, J = 5.0 Hz), 113.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.2 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_8BrClF_3NONa^+$ $(M+Na)^+$ 423.93221, found 423.9325.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Cl
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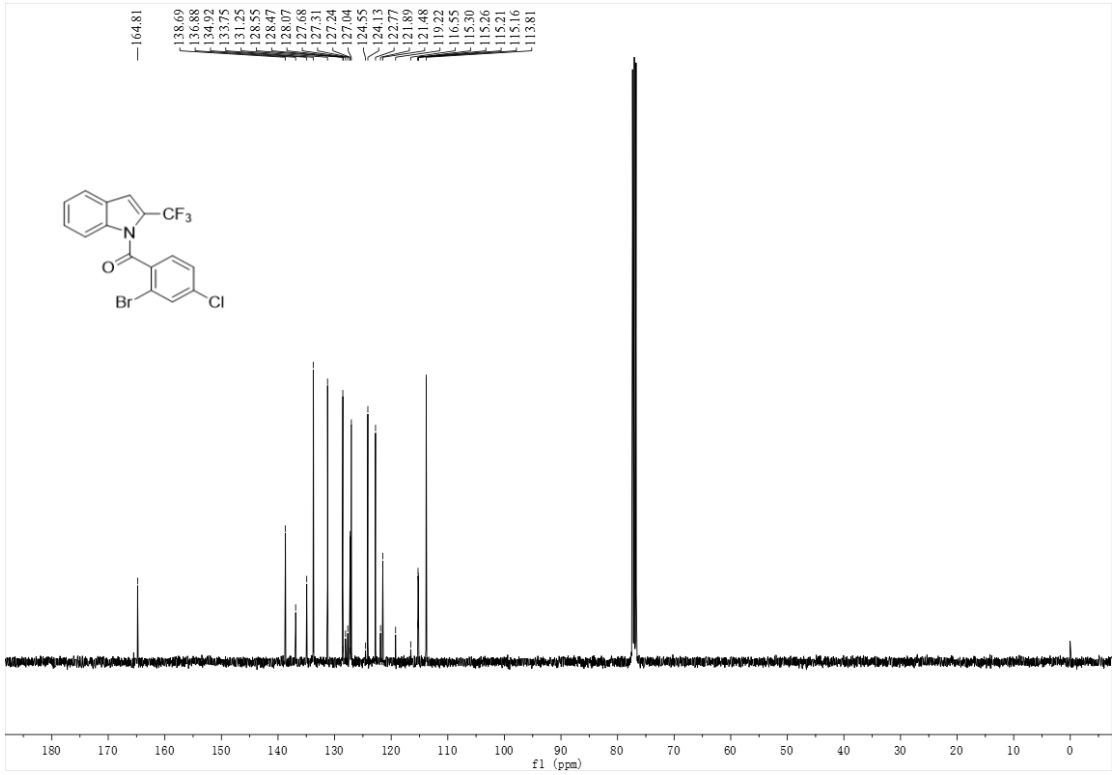
f1 (ppm)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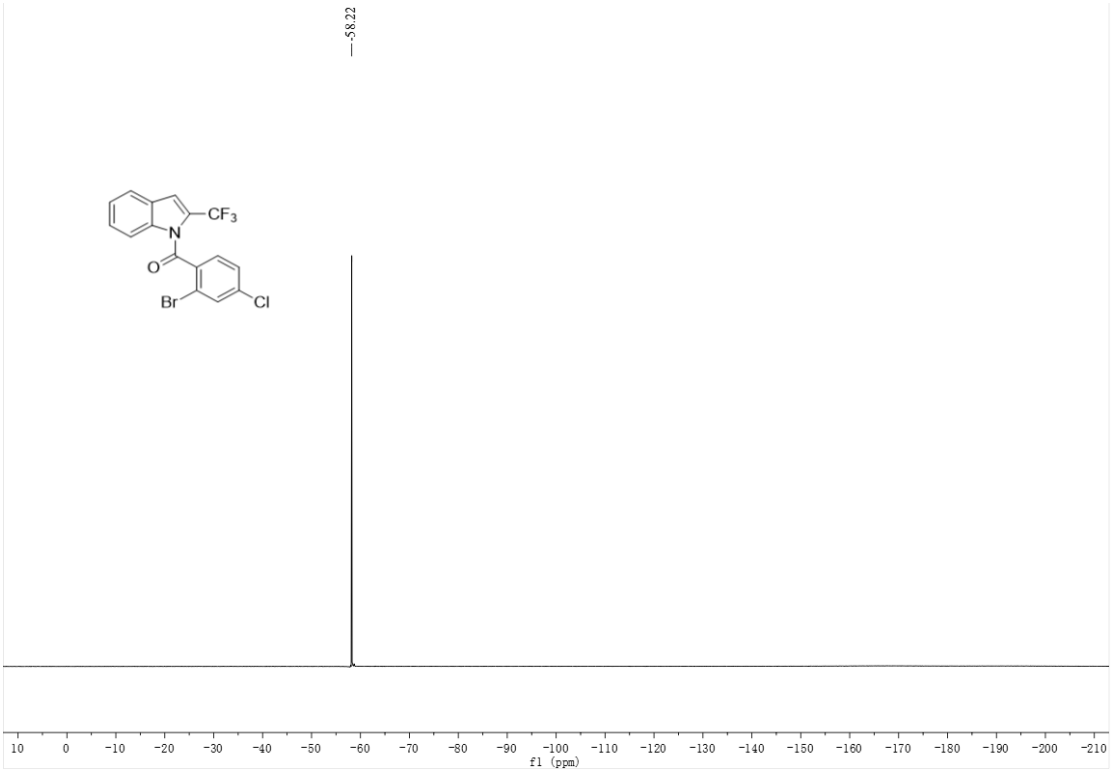
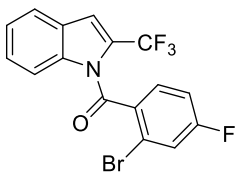
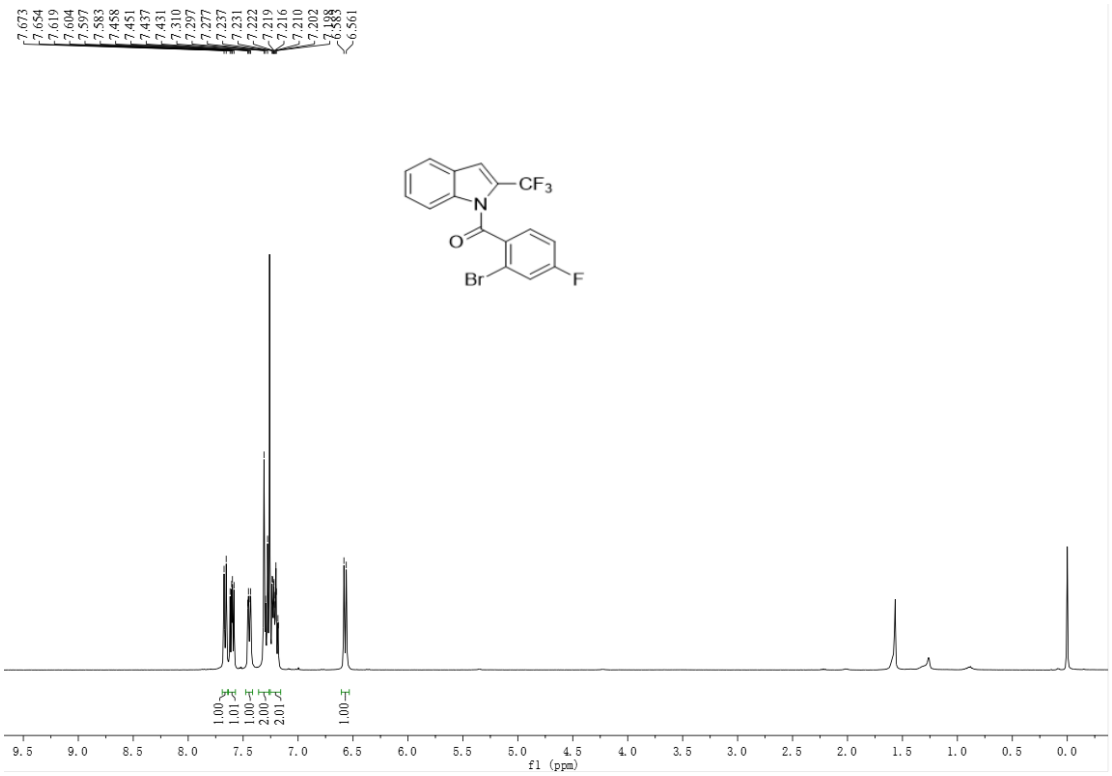


(2-Bromo-4-fluorophenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1e):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 79% yield (for the last step); m.p. 98-100 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, J = 7.8 Hz, 1H), 7.60 (dd, J = 8.6, 5.7 Hz, 1H), 7.44 (dd, J = 8.1, 2.4 Hz, 1H), 7.30 (d, J = 13.1 Hz, 2H), 7.23-7.18 (m, 2H), 6.57 (d, J = 8.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.9, 164.1 (d, J = 257.0 Hz), 137.0, 132.8 (d, J = 4.0 Hz), 132.3 (d, J = 9.0 Hz), 127.2, 127.0, 124.1, 122.8, 122.0 (d, J = 11.0 Hz), 121.7, 121.4, 120.5 (q, J = 267.0 Hz), 115.8 (d, J = 22.0 Hz), 115.6 (q, J = 5.0 Hz), 113.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.2, -104.2 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_8BrF_4NONa^+$ $(M+Na)^+$ 419.9818, found 419.9815.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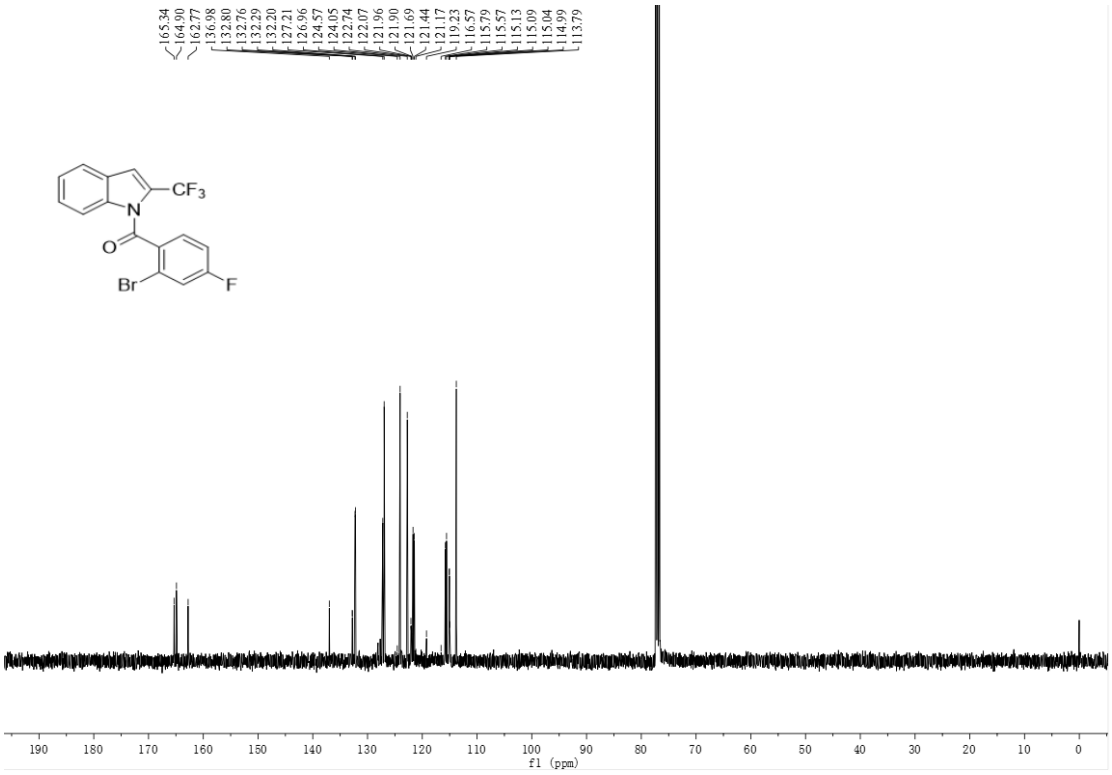
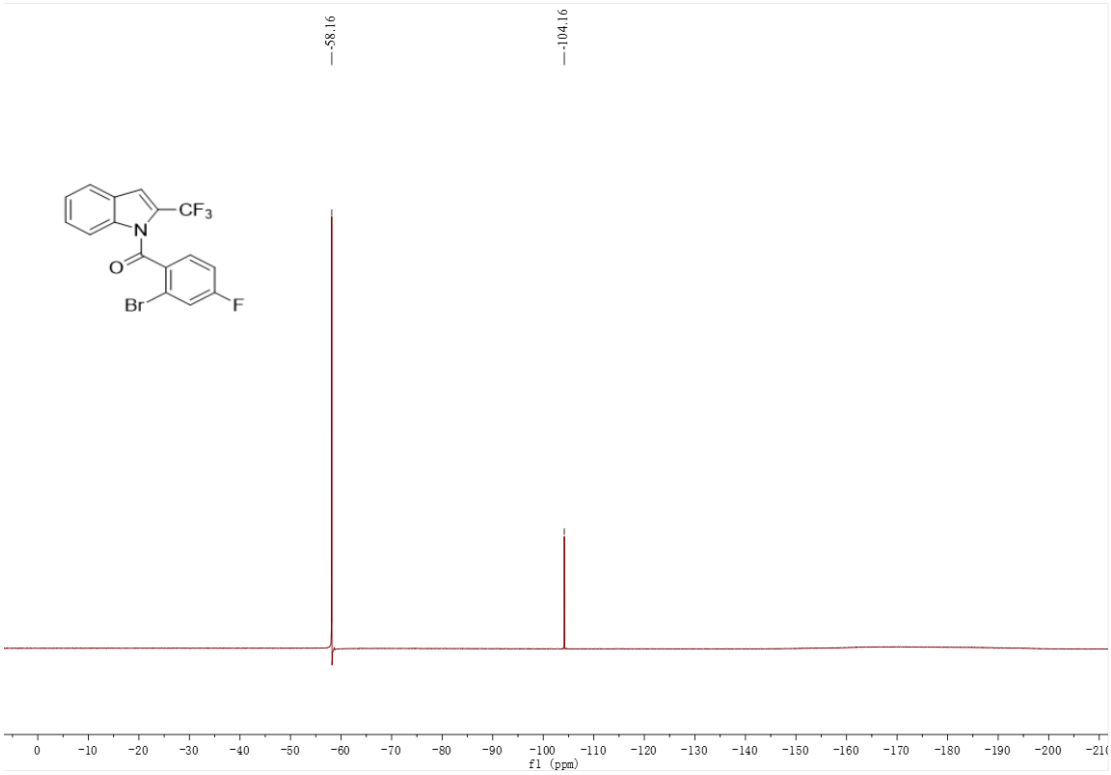
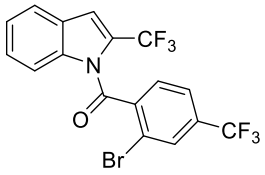
6.565
6.561
CF3
N
O
Br
F
1.00
1.01
1.00
2.00
2.01
1.00
f1 (ppm)

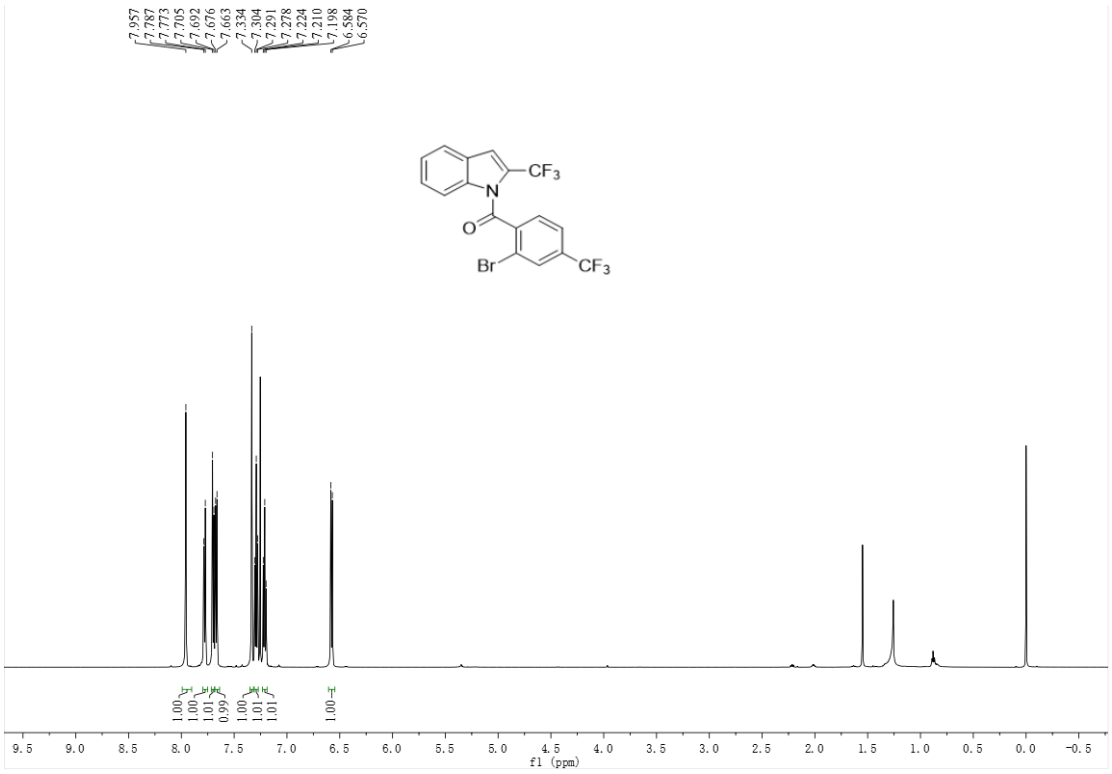

165.34
164.90
162.77
136.98
132.80
132.76
132.29
132.20
127.21
126.96
124.57
124.05
122.74
122.07
121.96
121.90
121.69
121.44
121.17
119.23
116.57
115.79
115.57
115.13
115.09
115.04
114.99
113.79
CF3
N
O
Br
F
f1 (ppm)

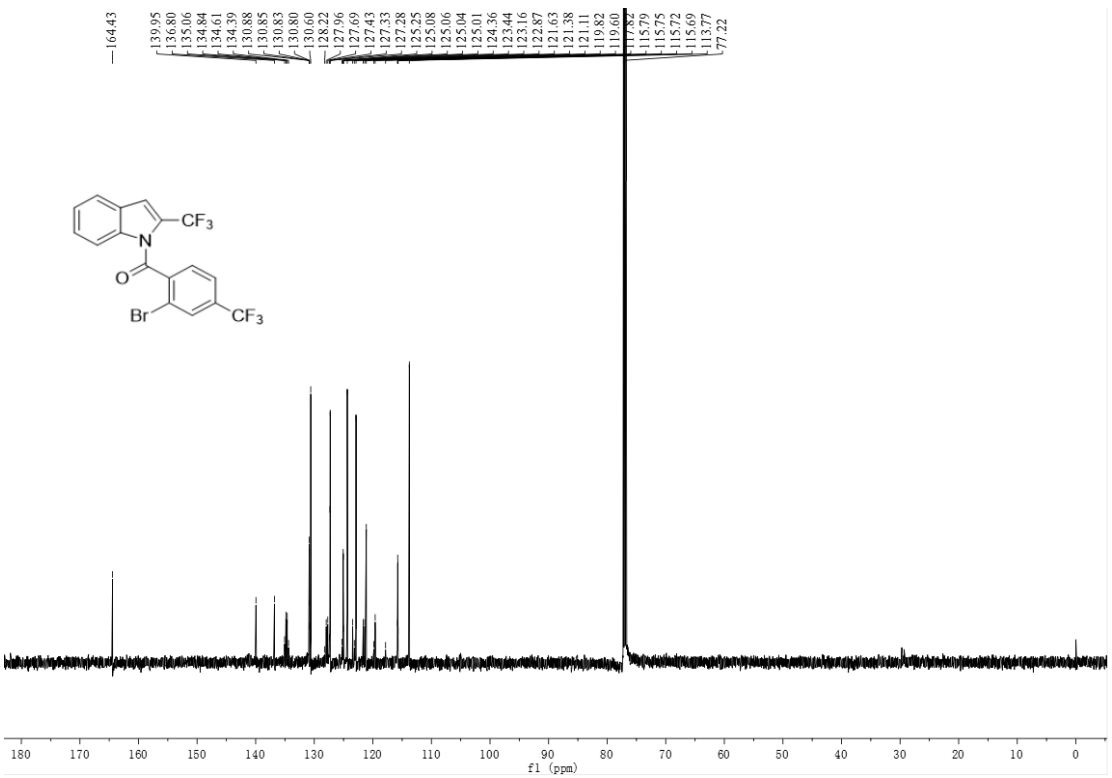


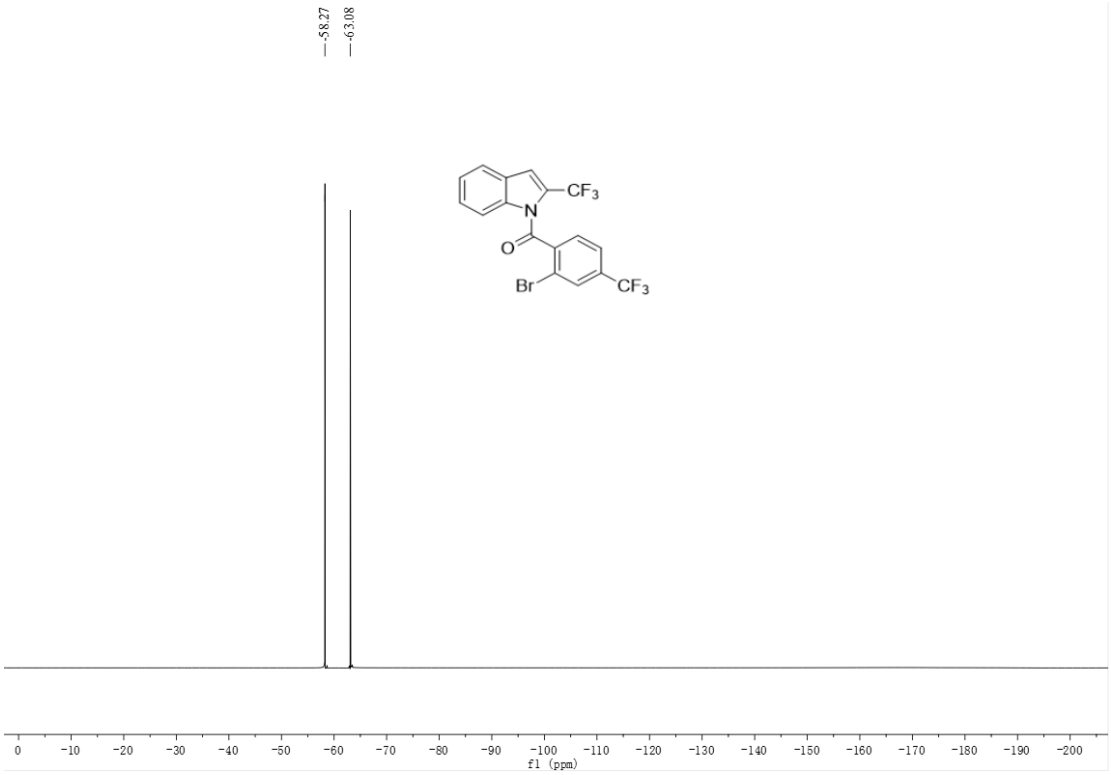
(2-Bromo-4-trifluoromethylphenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1f):



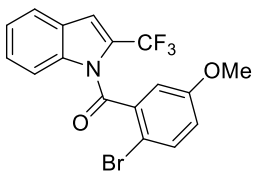
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 62% yield (for the last step); m.p. 95-97 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.96 (s, 1H), 7.78 (d, J = 8.0 Hz, 1H), 7.70 (d, J = 8.0 Hz, 1H), 7.67 (d, J = 7.8 Hz, 1H), 7.34 (s, 1H), 7.29 (t, J = 7.5 Hz, 1H), 7.21 (t, J = 7.9 Hz, 1H), 6.58 (d, J = 8.6 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 164.4, 140.0, 136.9, 134.7 (q, J = 34.5 Hz), 130.8 (q, J = 4.5 Hz), 130.6, 127.8 (q, J = 40.5 Hz), 127.3, 127.2, 125.1 (q, J = 3.0 Hz), 124.4, 122.9, 122.5 (q, J = 272.0 Hz), 121.1, 120.5 (q, J = 267.0 Hz), 115.8 (q, J = 4.5 Hz), 113.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.3, -63.1 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_8BrF_6NONa^+$ $(M+Na)^+$ 457.9586, found 457.9586.


7.957
7.787
7.773
7.705
7.692
7.676
7.663
7.334
7.304
7.291
7.278
7.224
7.210
7.198
6.584
6.570
CF3
N
O
Br
CF3
1.00
1.00
1.01
0.99
1.00
1.01
1.01
1.00
f1 (ppm)

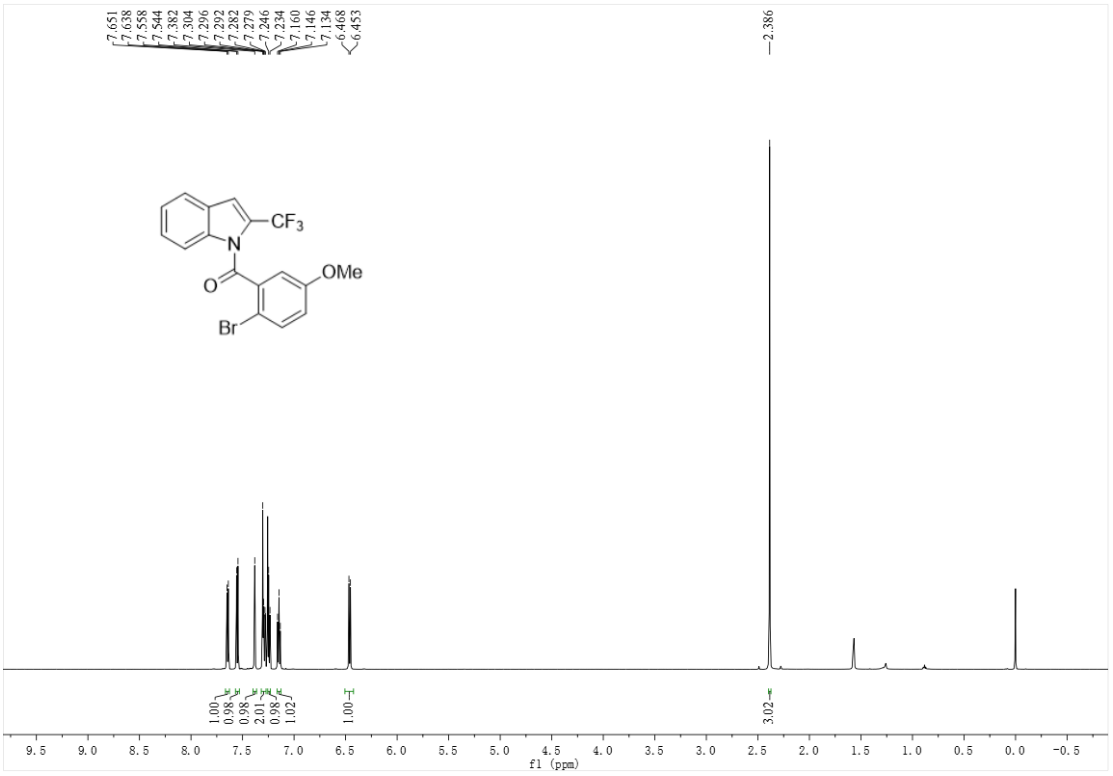

164.43
139.95
136.80
135.06
134.84
134.61
134.39
130.88
130.85
130.83
130.80
130.60
128.22
127.96
127.69
127.43
127.33
127.28
125.25
125.08
125.06
125.04
125.01
124.36
123.44
123.16
122.87
121.63
121.38
121.11
119.82
119.60
115.79
115.75
115.72
115.69
113.77
77.22
CF3
N
O
Br
CF3
f1 (ppm)

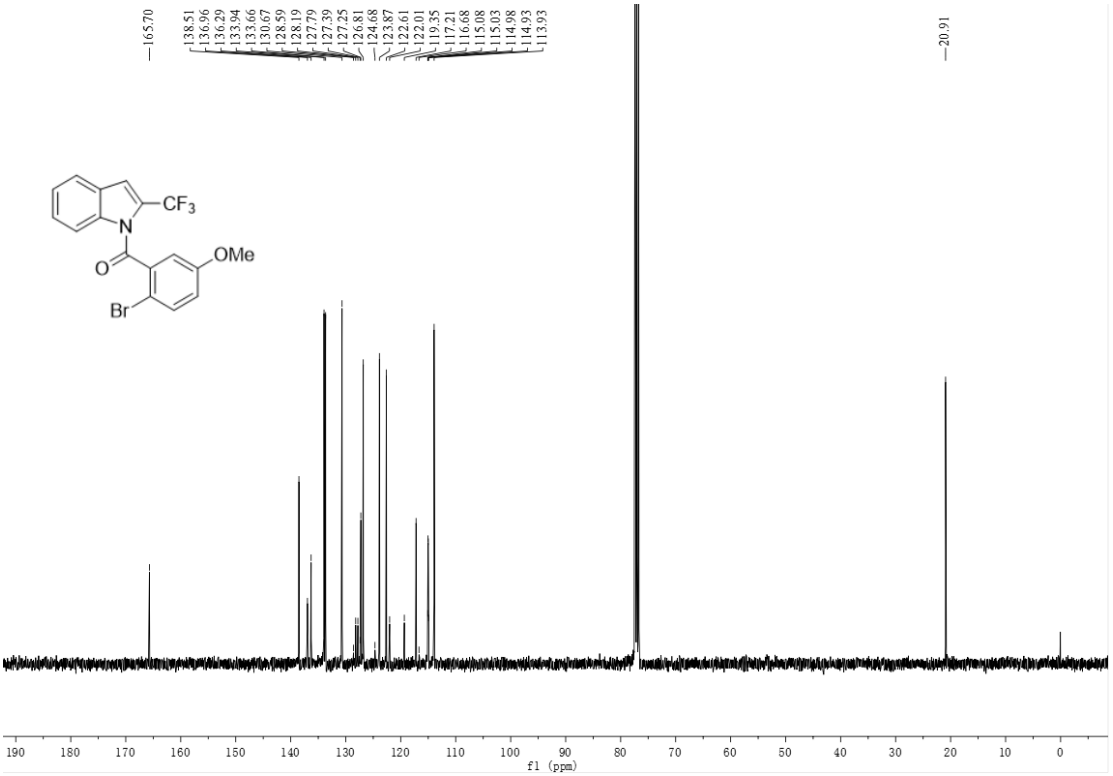


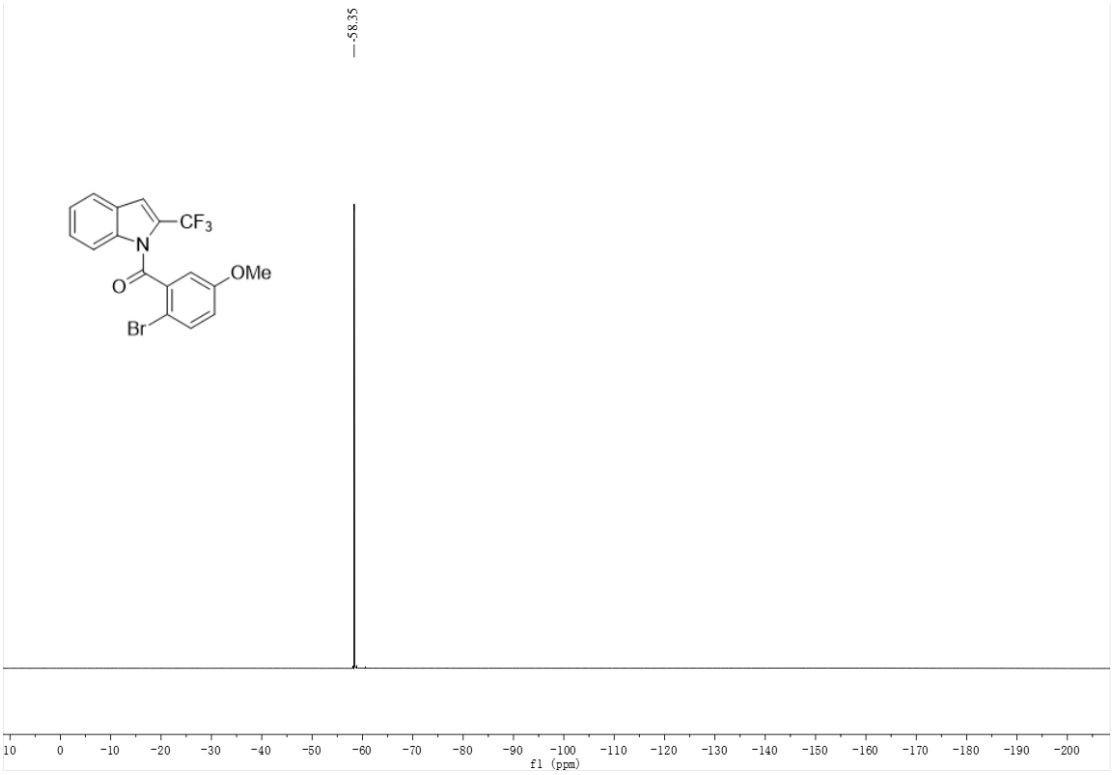
(2-Bromo-5-methoxyphenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1g):



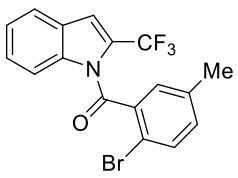
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 81% yield (for the last step); m.p. 106-108 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.64 (d, J = 7.8 Hz, 1H), 7.55 (d, J = 8.2 Hz, 1H), 7.38 (s, 1H), 7.30-7.28 (m, 2H), 7.24 (d, J = 7.2 Hz, 1H), 7.14 (t, J = 7.2 Hz, 1H), 6.46 (d, J = 8.0 Hz, 1H), 2.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.7, 138.5, 137.0, 136.3, 133.8 (d, J = 28.7 Hz), 130.6, 128.0 (q, J = 40.0 Hz), 127.3, 126.8, 123.9, 122.6, 120.7(q, J = 267.0 Hz), 119.4, 117.2, 115.0 (q, J = 5.0 Hz), 113.9, 20.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.4 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{11}BrF_3NO_2Na^+$ $(M+Na)^+$ 419.9818, found 419.9818.


7.651
7.638
7.558
7.544
7.382
7.304
7.296
7.292
7.282
7.279
7.246
7.234
7.160
7.146
7.134
6.468
6.453
2.386
CF3
N
O
OMe
Br
1.00
0.98
0.98
2.01
0.98
1.02
1.00
3.02
f1 (ppm)

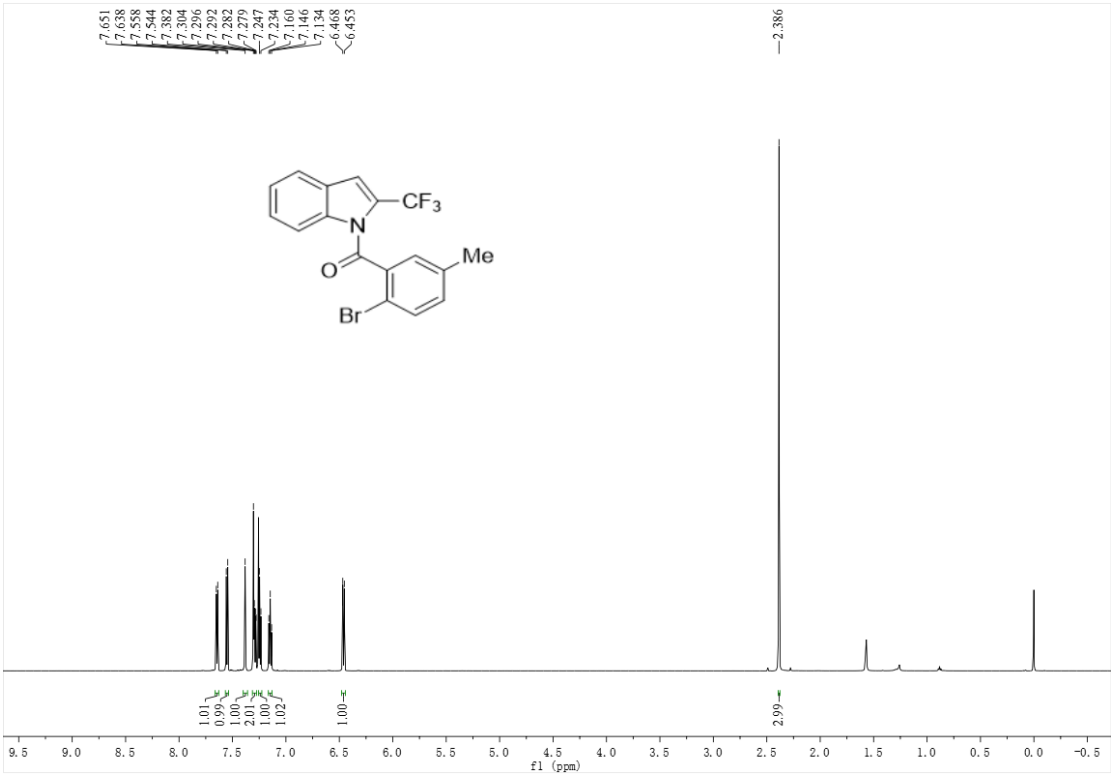

165.70
138.51
136.96
136.29
133.94
133.66
130.67
128.59
128.19
127.79
127.39
127.25
126.81
124.68
123.87
122.61
122.01
119.35
117.21
116.68
115.08
115.03
114.98
114.93
113.93
20.91
CF3
N
O
OMe
Br
f1 (ppm)

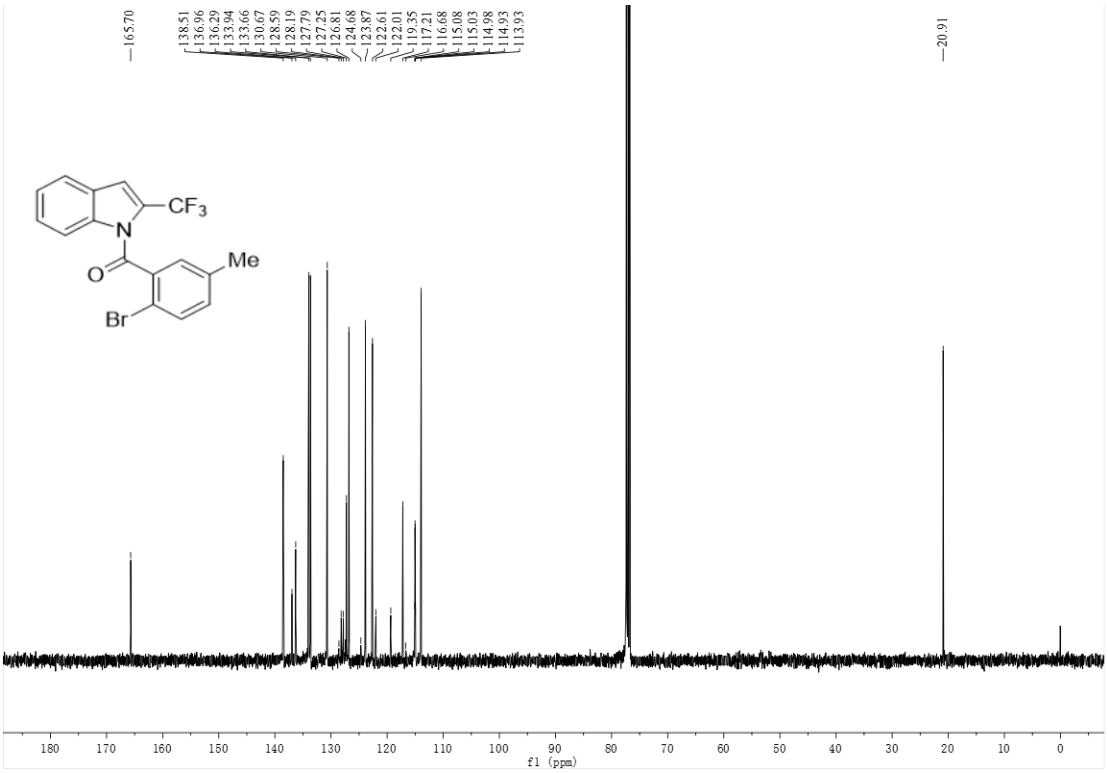


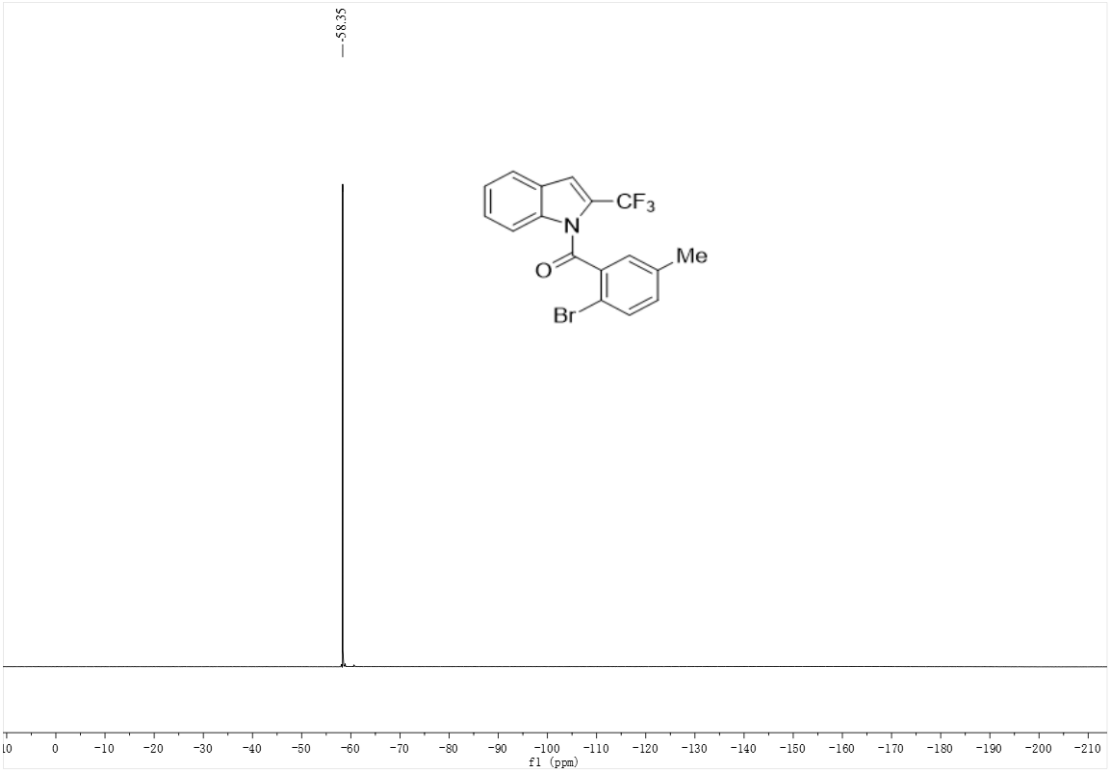
(2-Bromo-5-methylphenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1h):



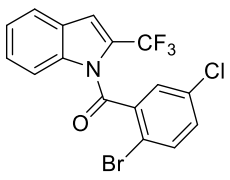
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 90% yield (for the last step); m.p. 89-91 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.64 (d, J = 7.8 Hz, 1H), 7.55 (d, J = 8.2 Hz, 1H), 7.38 (s, 1H), 7.30-7.28 (m, 2H), 7.24 (d, J = 7.6 Hz, 1H), 7.14 (t, J = 7.9 Hz, 1H), 6.46 (d, J = 8.8 Hz, 1H), 2.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.7, 138.5, 137.0, 136.3, 133.9, 133.7, 130.7, 128.0 (q, J = 40.0 Hz), 127.3, 126.8, 123.9, 122.6, 120.7 (q, J = 267.0 Hz), 117.2, 115.0 (q, J = 5.0 Hz), 113.9, 20.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.4 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{11}BrF_3NONa^+$ $(M+Na)^+$ 403.9868, found 403.9870.


7.651
7.638
7.558
7.544
7.382
7.304
7.296
7.292
7.282
7.279
7.247
7.234
7.160
7.146
7.134
6.468
6.453
2.386
CF3
N
O
Me
Br
1.01
0.99
1.00
2.01
1.00
1.02
1.00
2.99
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 -0.5
f1 (ppm)

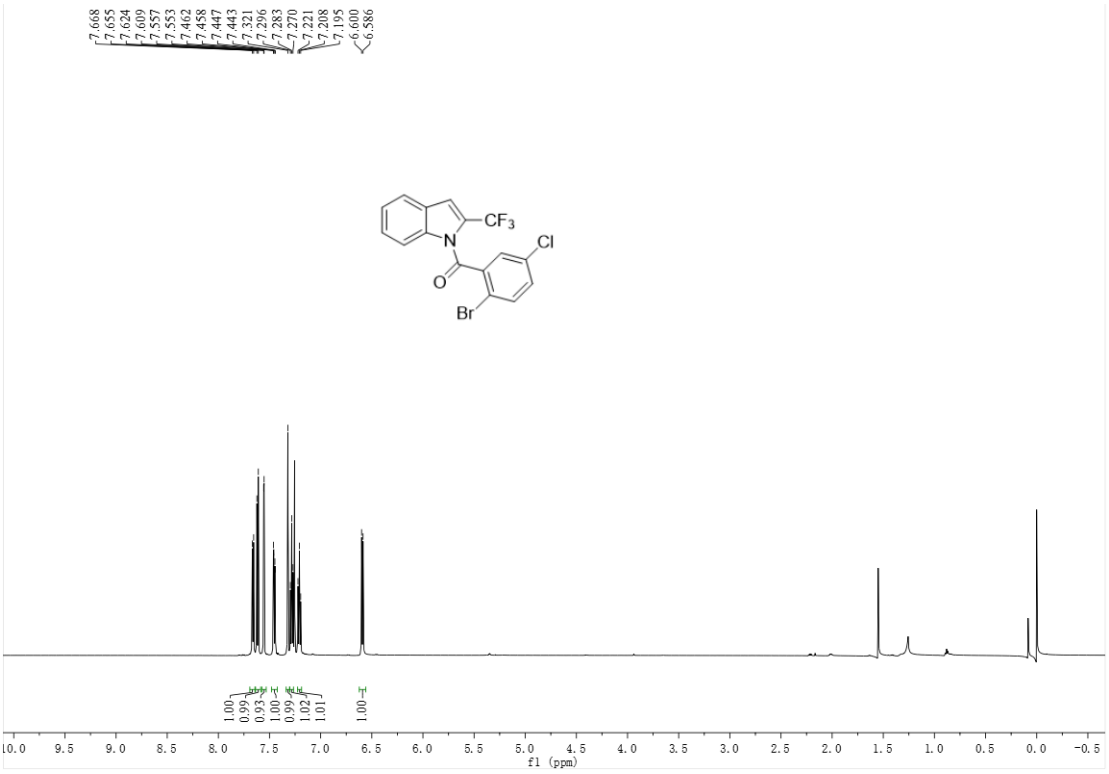

165.70
138.51
136.96
136.29
133.94
133.66
130.67
128.59
128.19
127.79
127.25
126.81
124.68
123.87
122.61
122.01
119.35
117.21
116.68
115.08
115.03
114.98
114.93
113.93
20.91
CF3
N
O
Me
Br
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



(2-Bromo-5-chlorophenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1i)：



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 79% yield (for the last step); m.p. 105-107 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, J = 7.8 Hz, 1H), 7.62 (d, J = 8.6 Hz, 1H), 7.55 (d, J = 2.5 Hz, 1H), 7.45 (dd, J = 8.6, 2.5 Hz, 1H), 7.32 (s, 1H), 7.28 (t, J = 7.5 Hz, 1H), 7.21 (t, J = 7.9 Hz, 1H), 6.59 (d, J = 8.6 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 164.2, 137.9, 136.9, 135.0, 134.4, 133.0, 130.1, 127.9 (q, J = 40.5 Hz), 127.3, 127.1, 124.2, 122.8, 120.5 (q, J = 267.0 Hz) 118.6, 115.5 (q, J = 4.5 Hz), 113.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.3 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_8BrClF_3NONa^+$ $(M+Na)^+$ 423.9322, found 423.9321.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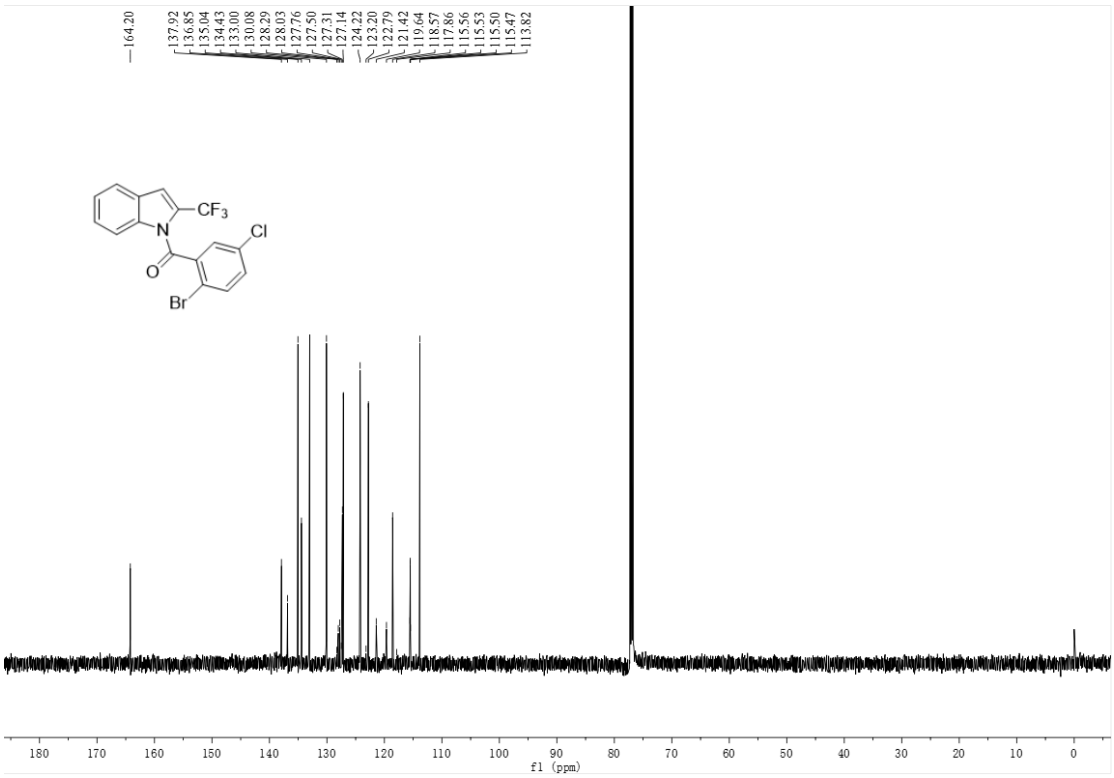
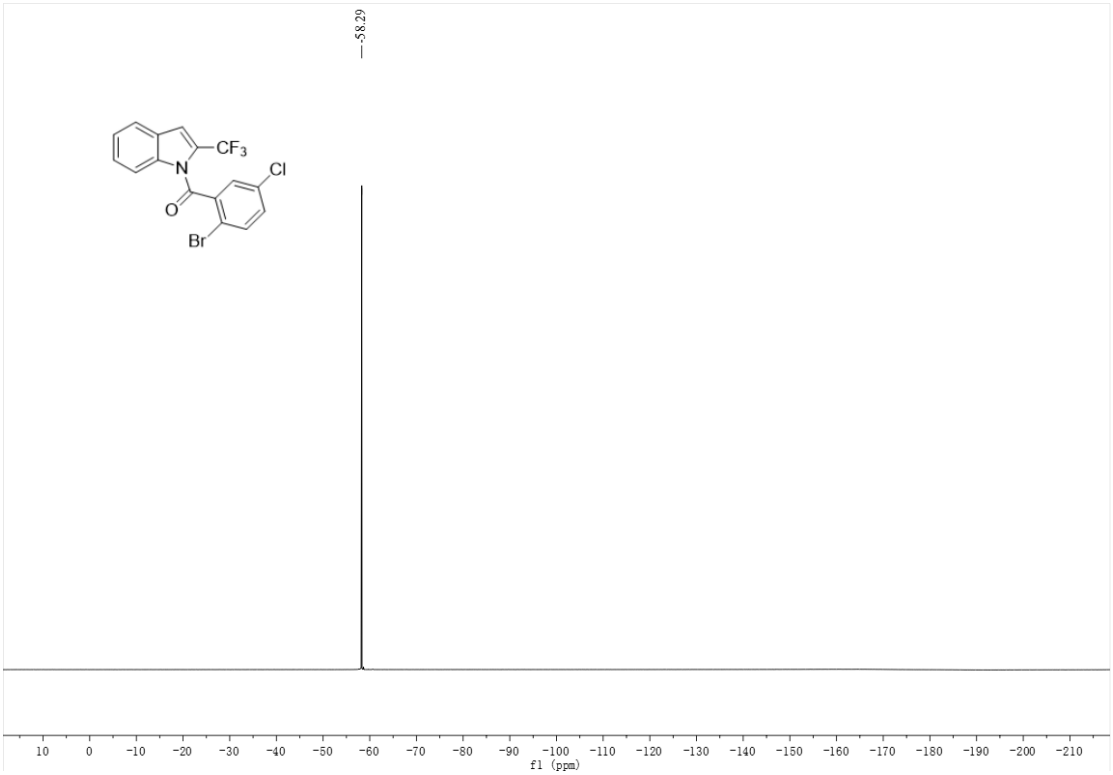
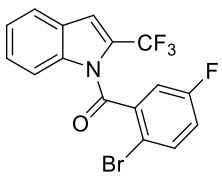
7.655
7.624
7.609
7.557
7.553
7.462
7.458
7.447
7.443
7.321
7.296
7.283
7.270
7.221
7.208
7.195
6.600
6.586
CF3
N
O
Cl
Br
1.00
0.99
0.93
1.00
0.99
1.02
1.01
1.00
f1 (ppm)

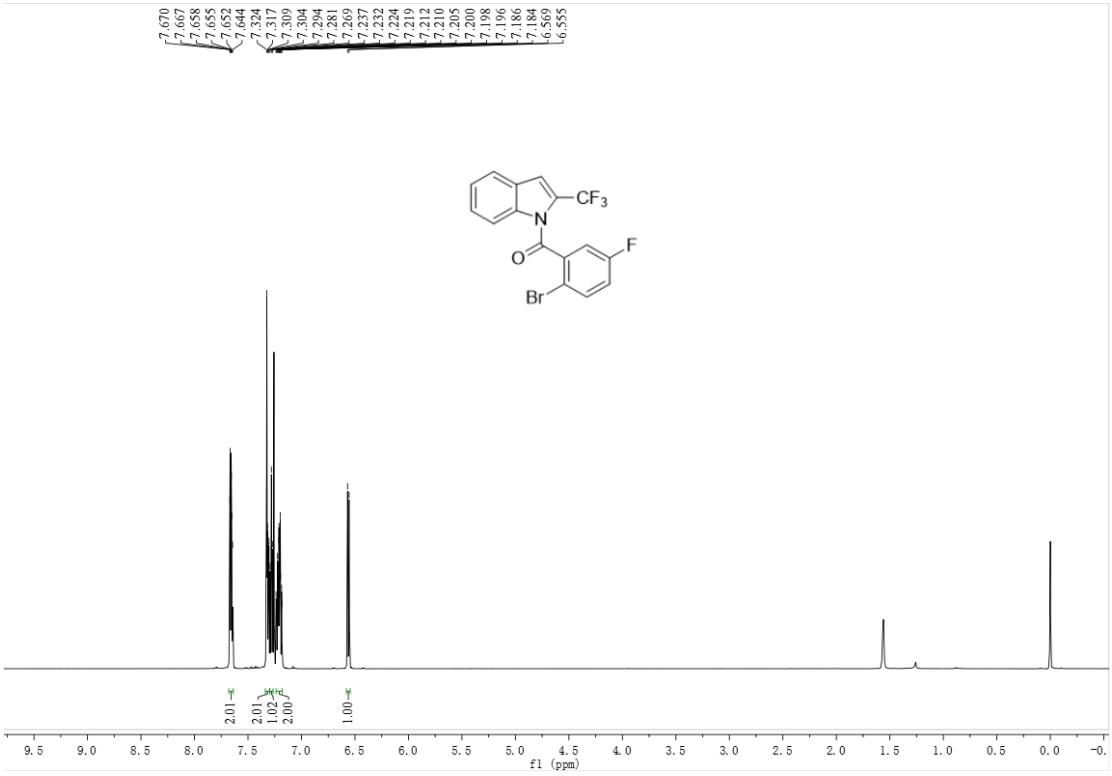

164.20
137.92
136.85
135.04
134.43
133.00
130.08
128.29
128.03
127.76
127.50
127.31
127.14
124.22
123.20
122.79
121.42
119.64
118.57
117.86
115.56
115.53
115.50
115.47
113.82
CF3
N
O
Cl
Br
f1 (ppm)



(2-Bromo-5-fluorophenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1j):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 70% yield (for the last step); m.p. 53-55 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.67-7.64 (m, 2H), 7.32-7.30 (m, 2H), 7.28 (t, J = 7.5 Hz, 1H), 7.23-7.18 (m, 2H), 6.56 (d, J = 8.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.3, 161.9 (d, J = 250.0 Hz), 137.9 (d, J = 7.0 Hz), 136.8, 135.6 (d, J = 8.0 Hz), 127.9 (d, J = 39.0 Hz), 127.3, 127.1, 124.2, 122.8, 120.5 (q, J = 267.0 Hz), 120.4 (d, J = 22.0 Hz), 117.6 (d, J = 24.0 Hz), 115.6 (q, J = 5.0 Hz), 115.0 (d, J = 3.0 Hz), 113.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.4, -111.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_8BrF_4NONa^+$ $(M+Na)^+$ 407.9618, found 407.9621.


7.670
7.667
7.658
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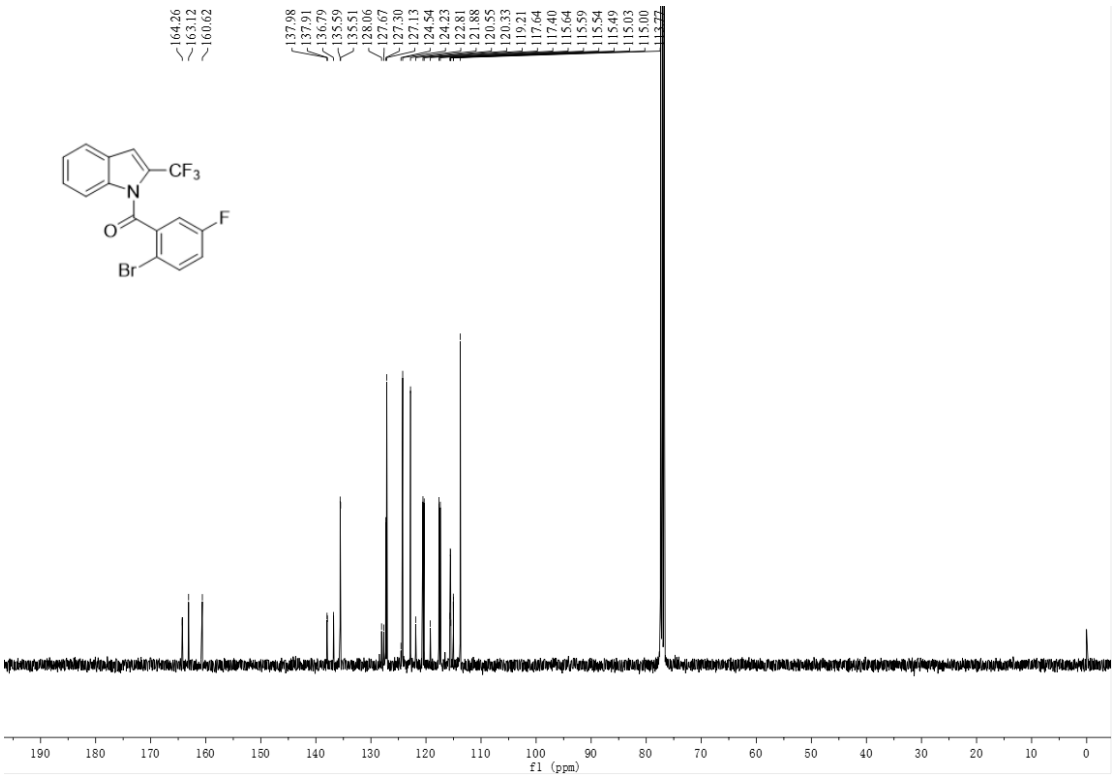
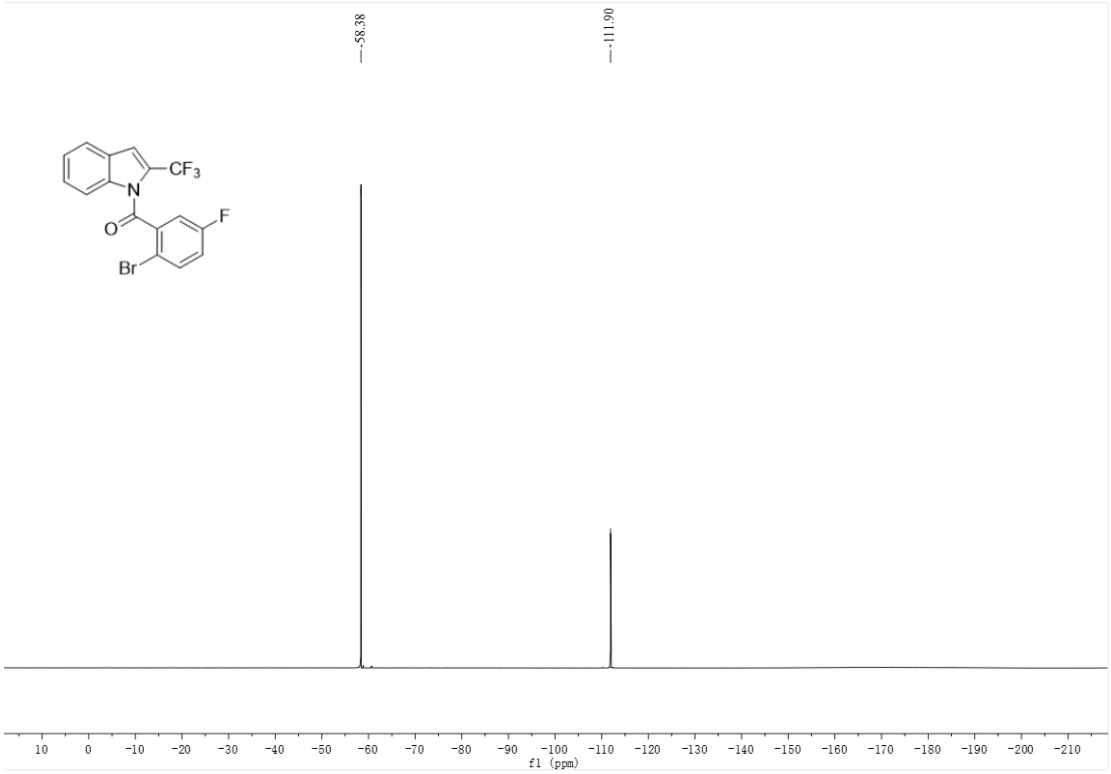
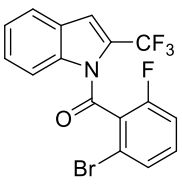
7.644
7.324
7.317
7.309
7.304
7.294
7.281
7.269
7.237
7.232
7.224
7.219
7.212
7.210
7.205
7.200
7.198
7.196
7.186
7.184
6.569
6.555
CF3
N
O
F
Br
2.01
2.01
1.02
2.00
1.00
f1 (ppm)

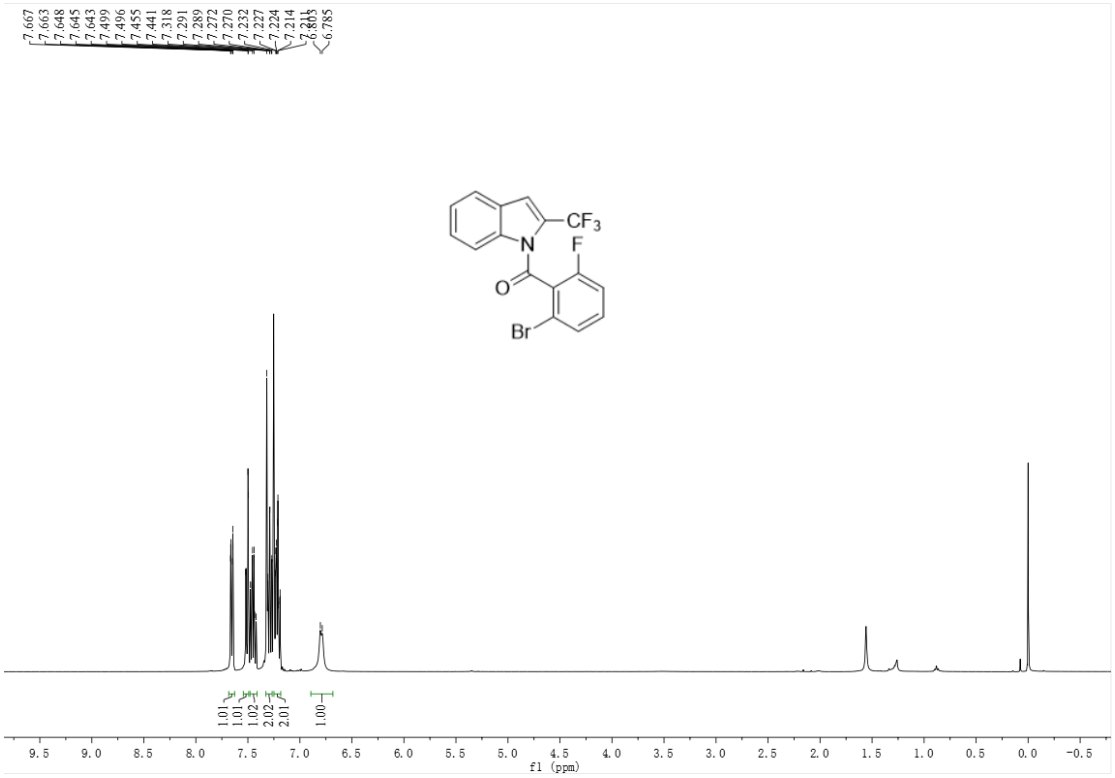

164.26
163.12
160.62
137.98
137.91
136.79
135.59
135.51
128.06
127.67
127.30
127.13
124.54
124.23
122.81
121.88
120.55
120.33
119.21
117.64
117.40
115.64
115.59
115.54
115.49
115.03
115.00
113.22
CF3
N
O
F
Br
f1 (ppm)

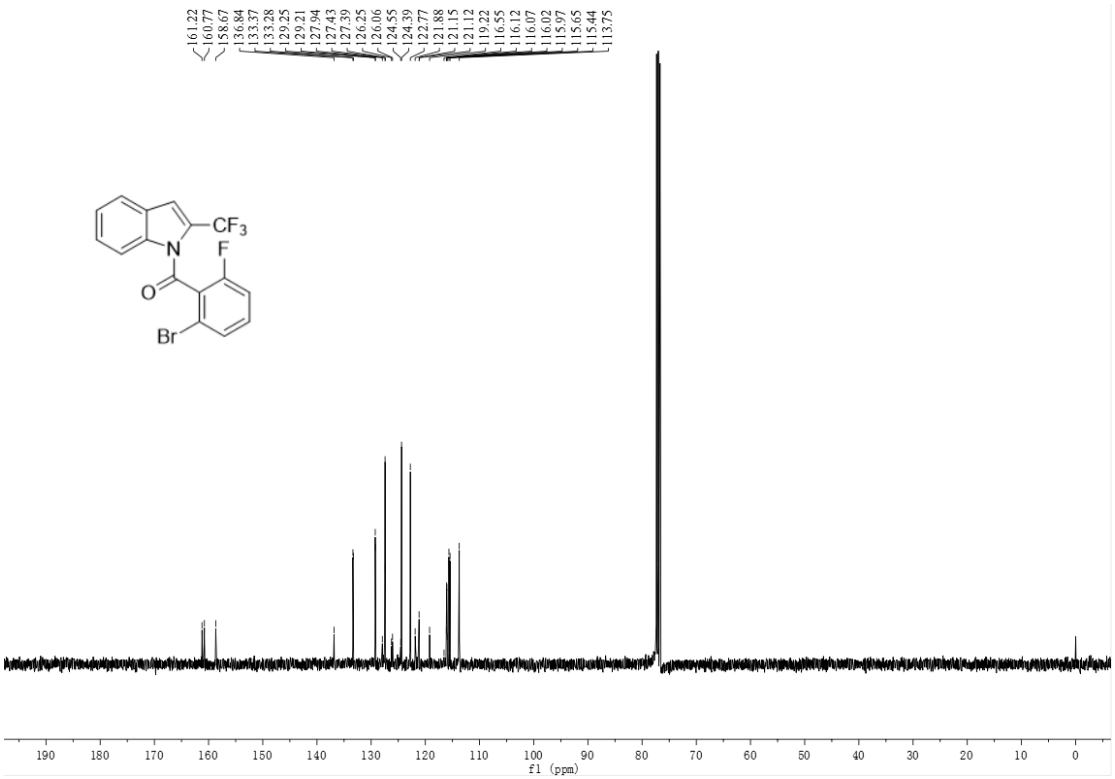


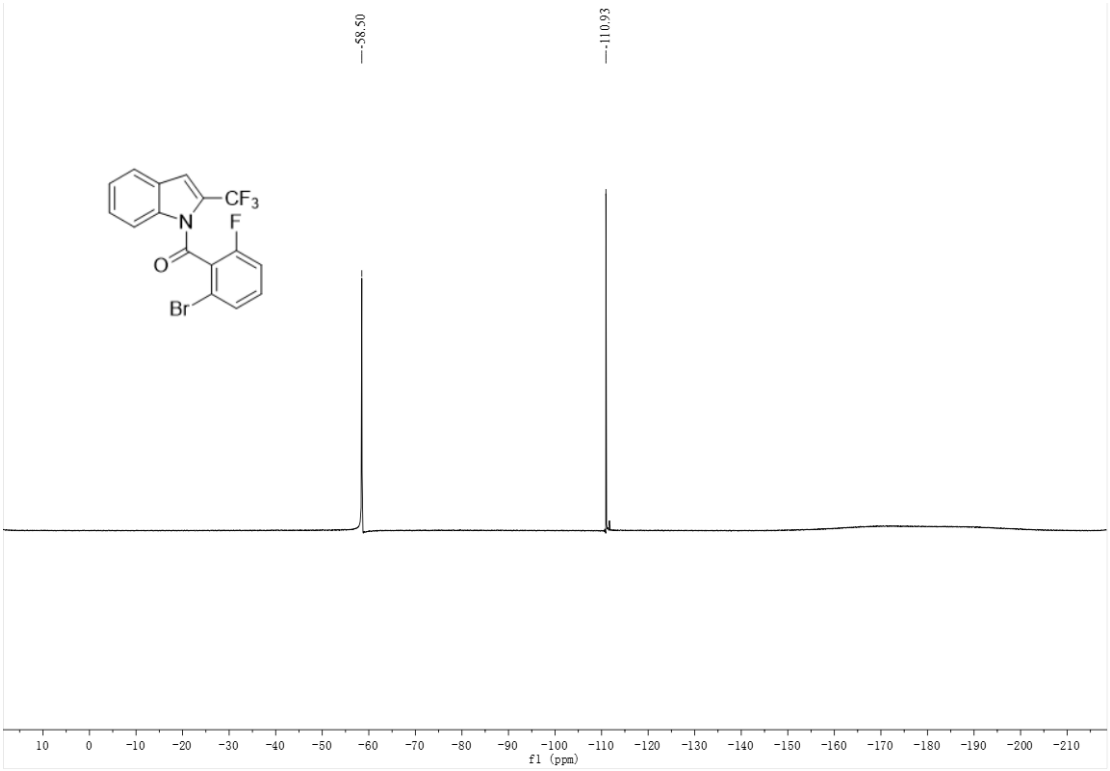
(2-Bromo-6-fluorophenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1k)：



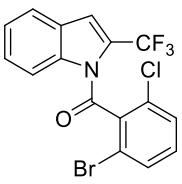
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 64% yield (for the last step); m.p. 94-96 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67-7.65 (m, 1H), 7.51 (dd, J = 8.2, 1.0 Hz, 1H), 7.45 (td, J = 8.1, 5.6 Hz, 1H), 7.32-7.27 (m, 2H), 7.24-7.19 (m, 2H), 6.80 (d, J = 7.3 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.8, 159.9 (d, J = 255.0 Hz), 136.8, 133.4 (d, J = 9.0 Hz), 129.2 (d, J = 4.0 Hz), 127.9, 127.4 (d, J = 4.0 Hz), 126.3, 126.1, 124.4, 122.8, 121.1 (d, J = 3.0 Hz), 120.5 (q, J = 267.0 Hz), 116.5 (q, J = 5.0 Hz), 115.5 (d, J =21.0 Hz), 113.7. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.5, -110.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_8BrF_4NONa^+$ $(M+Na)^+$ 407.9618, found 407.9621.


7.667
7.663
7.648
7.645
7.643
7.499
7.496
7.455
7.441
7.318
7.291
7.289
7.272
7.270
7.232
7.227
7.224
7.214
6.803
6.785
CF3
F
N
O
Br
1.01
1.01
1.02
2.02
2.01
1.00
f1 (ppm)

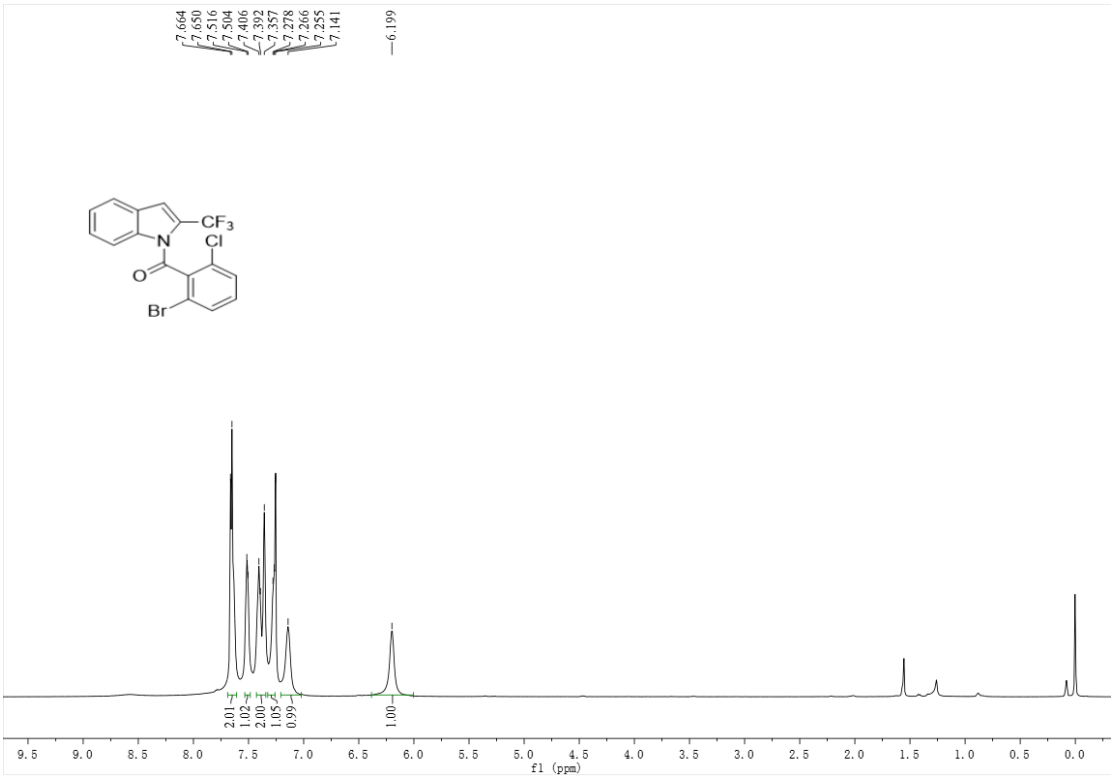

161.22
160.77
158.67
136.84
133.37
133.28
129.25
129.21
127.94
127.43
127.39
126.25
126.06
124.55
124.39
122.77
121.88
121.15
121.12
119.22
116.55
116.12
116.07
116.02
115.97
115.65
115.44
113.75
CF3
F
N
O
Br
f1 (ppm)

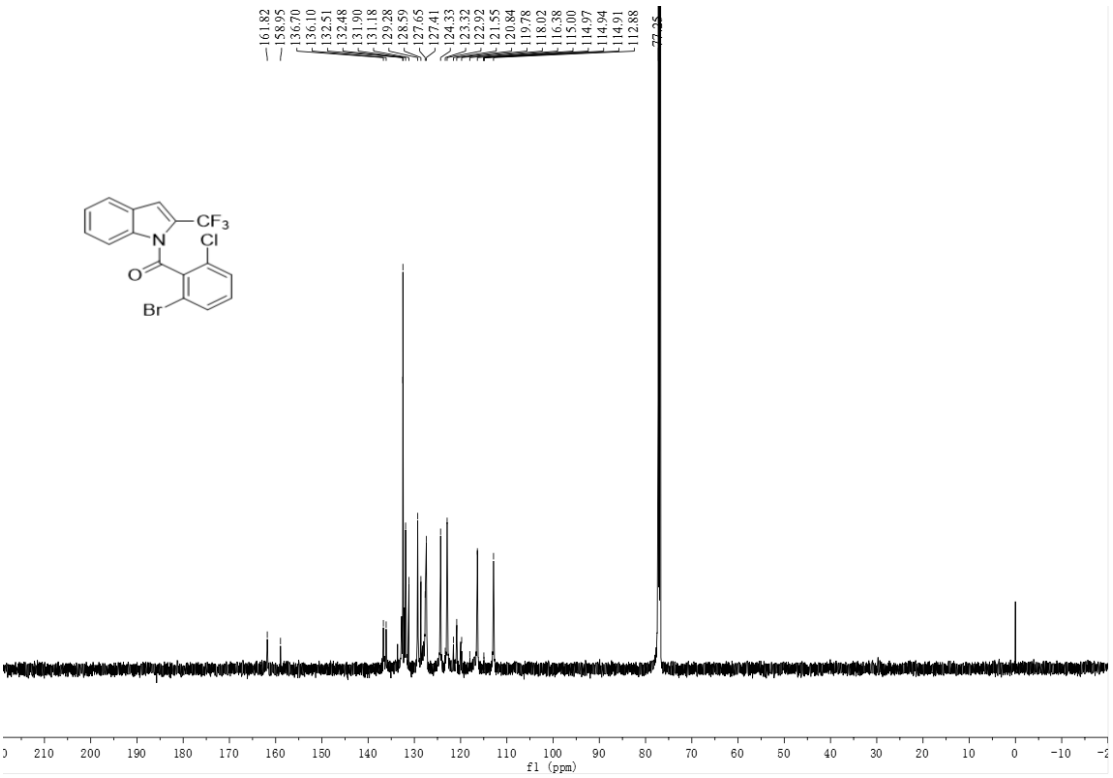


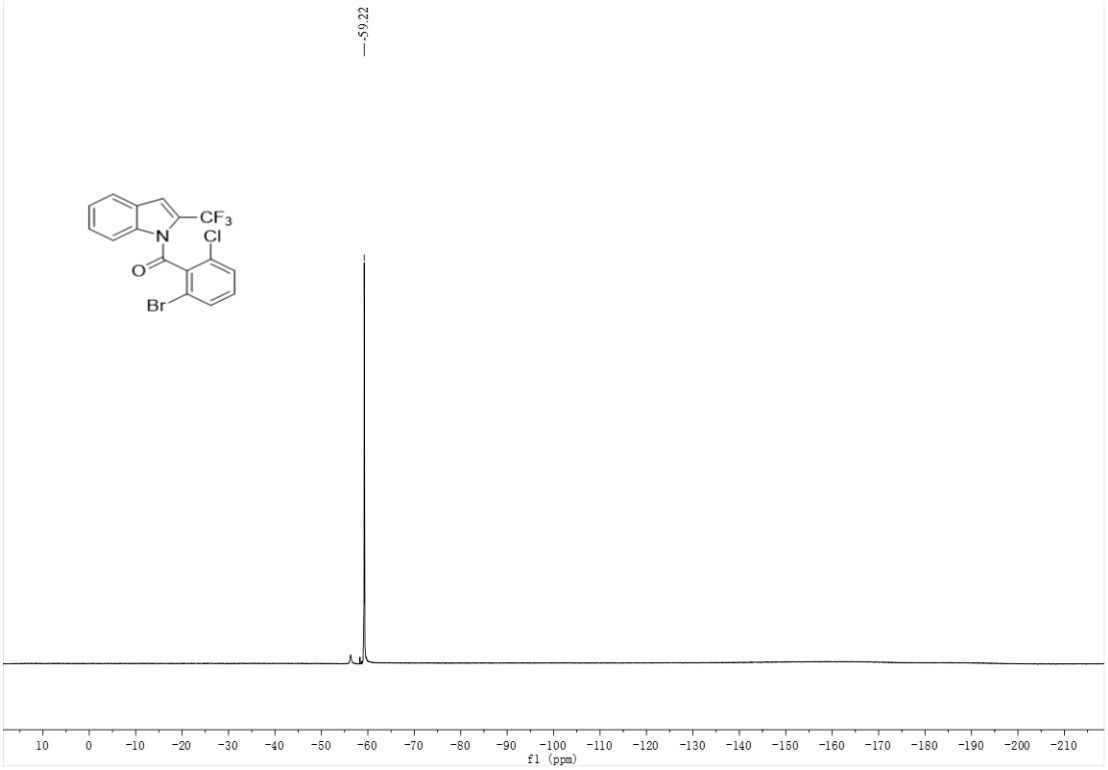
(2-Bromo-6-chlorophenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1l):



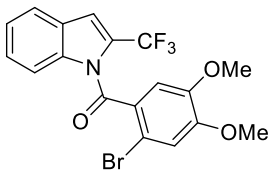
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 66% yield (for the last step); m.p. 77-79 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.66 (d, *J* = 8.2 Hz, 2H), 7.51 (d, *J* = 6.9 Hz, 1H), 7.38 (d, *J* = 29.1 Hz, 2H), 7.27 (d, *J* = 14.0 Hz, 1H), 7.14 (s, 1H), 6.20 (s, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 161.8, 159.0, 136.7, 136.10, 132.5 (d, *J* = 4.5 Hz), 131.9, 131.2, 129.3, 128.6, 127.7 (d, *J* = 4.0 Hz), 124.3, 122.9, 120.7 (q, *J* = 267 Hz), 116.4, 115.0 (q, *J* = 4.5 Hz), 112.9. ^{19}F NMR (377 MHz, $CDCl_3$) *δ* -59.2 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_8BrClF_3NONa^+$ $(M+Na)^+$ 423.9322, found 423.9321.


7.664
7.650
7.516
7.504
7.406
7.392
7.357
7.278
7.266
7.255
7.141
6.199
CF3
Cl
N
O
Br
2.01
1.02
2.00
1.05
0.99
1.00
f1 (ppm)

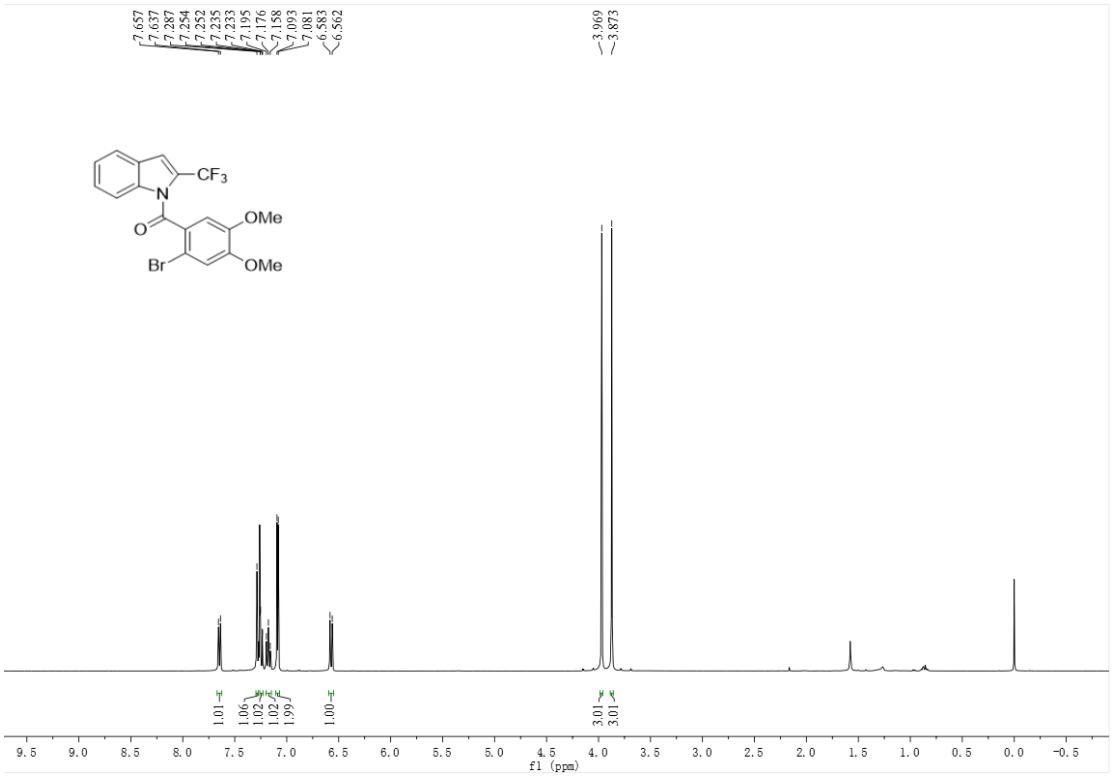

161.82
158.95
136.70
136.10
132.51
132.48
131.90
131.18
129.28
128.59
127.65
127.41
124.33
123.32
122.92
121.55
120.84
119.78
118.02
116.38
115.00
114.97
114.94
114.91
112.88
77.35
CF3
Cl
N
O
Br
f1 (ppm)

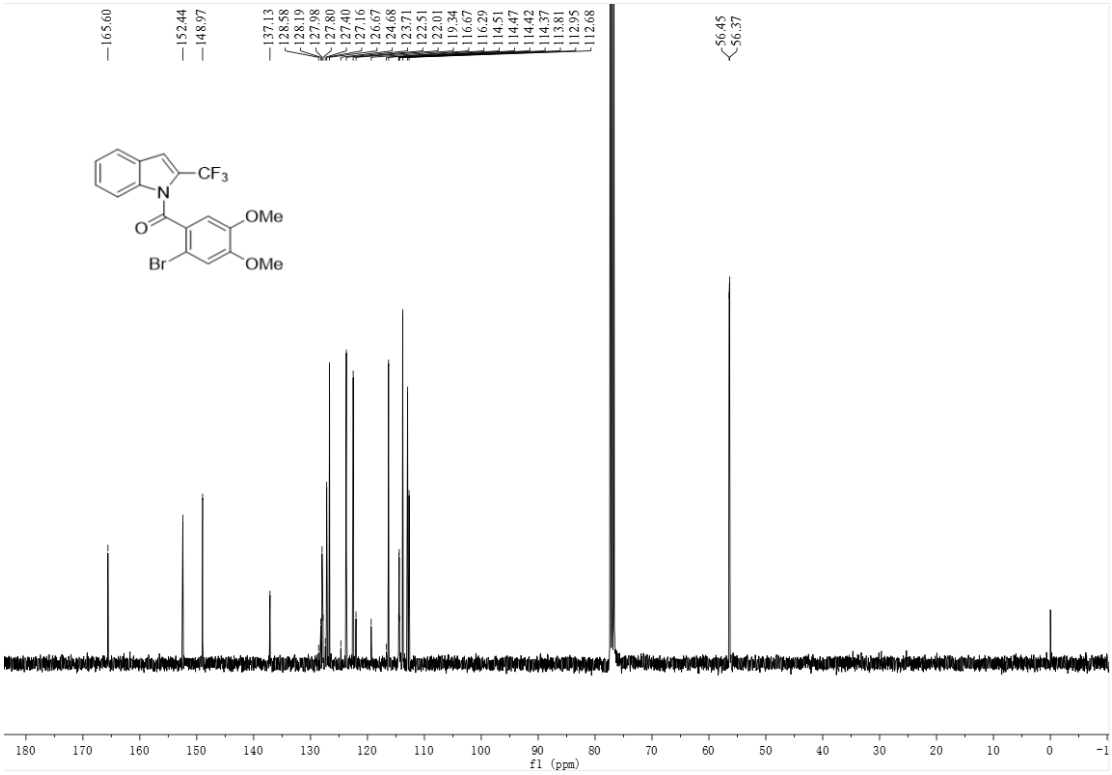


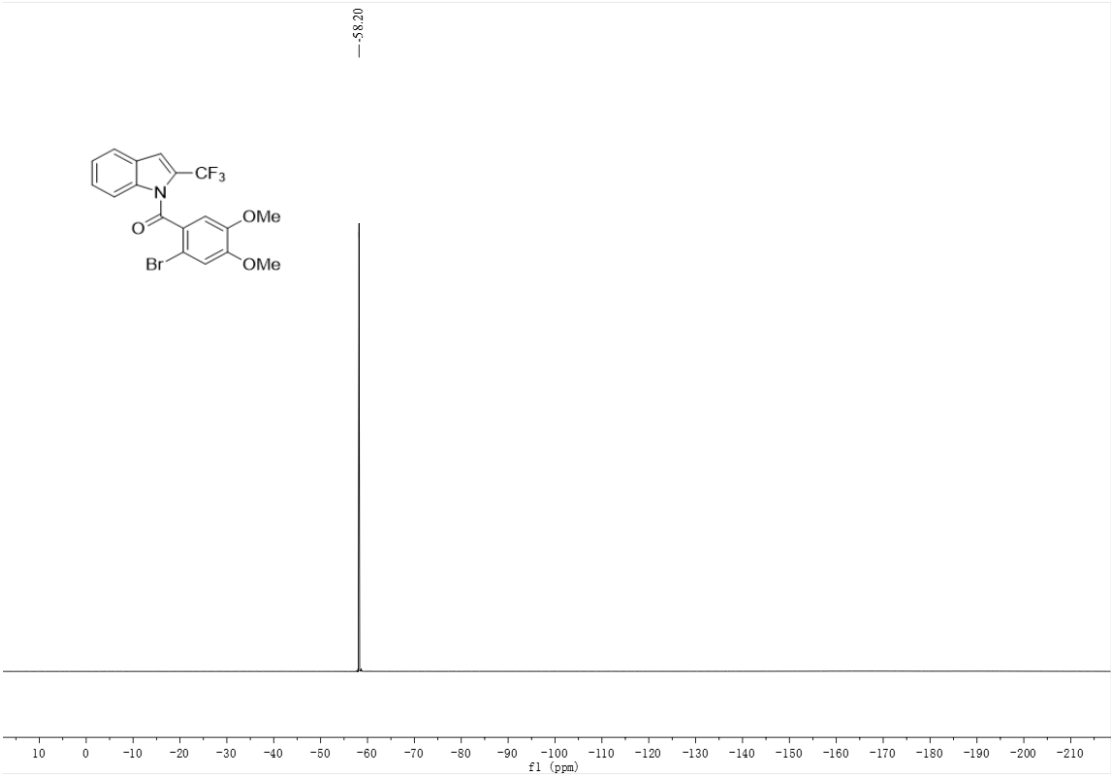
(2-Bromo-4,5-dimethoxyphenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1m):



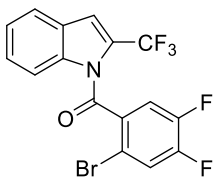
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 75% yield (for the last step); m.p. 115-117 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, J = 7.8 Hz, 1H), 7.29 (s, 1H), 7.24 (dd, J = 7.8, 0.9 Hz, 1H), 7.17 (t, J = 7.4 Hz, 1H), 7.08 (d, J = 4.8 Hz, 2H), 6.57 (d, J = 8.5 Hz, 1H), 3.97 (s, 3H), 3.87 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.6, 152.4, 149.0, 137.1, 128.0 (q, J = 40.0 Hz), 127.98, 127.2, 126.7, 123.7, 122.5, 120.7 (q, J = 267.0 Hz), 116.3, 114.4 (q, J = 5.0 Hz), 113.8, 113.0, 112.7, 56.5, 56.4. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.2 ppm. HRMS *m/z* (ESI+): Calcd for $C_{18}H_{14}BrF_3NO_3^+$ $(M+H)^+$ 428.0104, found 428.0108.


7.657
7.637
7.287
7.254
7.252
7.235
7.233
7.195
7.176
7.158
7.093
7.081
6.583
6.562
3.969
3.873
CF3
N
O
OMe
Br
OMe
1.01
1.06
1.02
1.02
1.99
1.00
3.01
3.01
f1 (ppm)

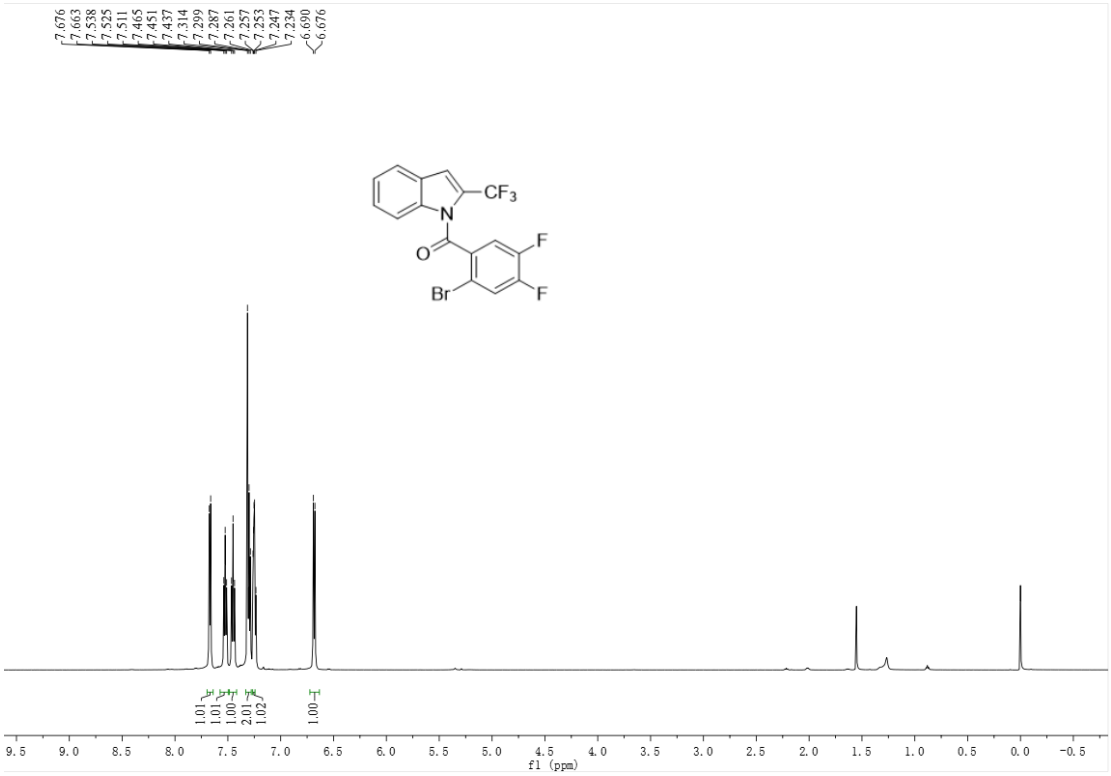

165.60
152.44
148.97
137.13
128.58
128.19
127.98
127.80
127.40
127.16
126.67
124.68
123.71
122.51
122.01
119.34
116.67
116.29
114.51
114.47
114.42
114.37
113.81
112.95
112.68
56.45
56.37
CF3
N
O
OMe
Br
OMe
f1 (ppm)

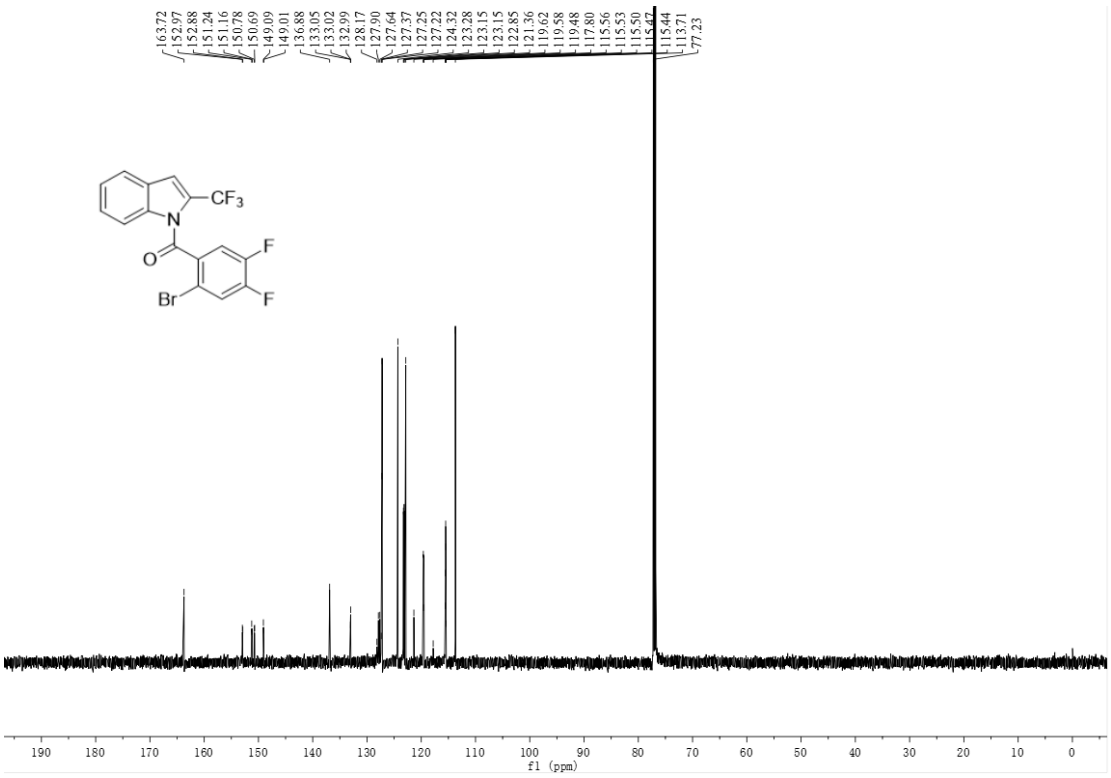


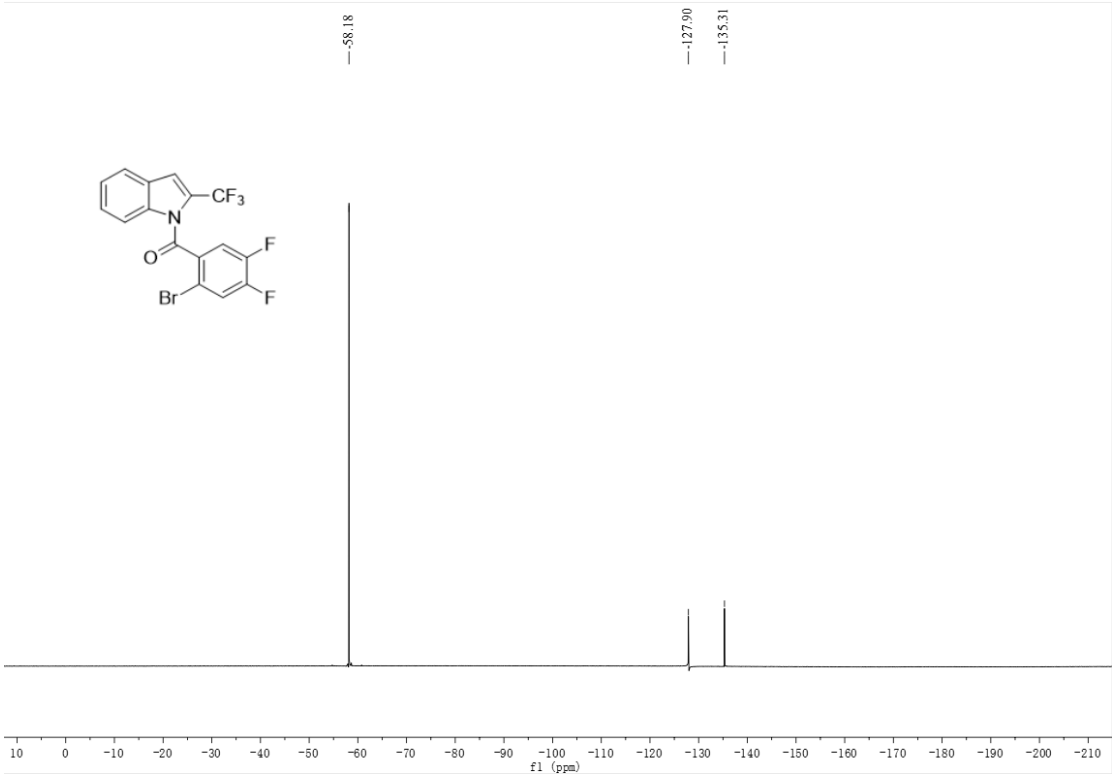
(2-Bromo-4,5-difluorophenyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1n):



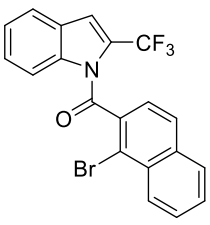
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 59% yield (for the last step); m.p. 98-100 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.67 (d, J = 7.8 Hz, 1H), 7.53 (t, J = 8.0 Hz, 1H), 7.45 (t, J = 8.5 Hz, 1H), 7.30 (t, J = 7.8 Hz, 2H), 7.26-7.23 (m, 1H), 6.68 (d, J = 8.5 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 163.7, 152.1 (dd, J = 259.5, 12.0 Hz), 149.9 (dd, J = 265.5, 12.0 Hz), 136.9, 133.0 (d, J = 4.5 Hz), 127.8 (q, J = 39.0 Hz), 127.3, 127.2, 124.3, 123.3, 123.1, 122.9, 120.5 (q, J = 267.0 Hz), 119.5 (d, J = 21.0 Hz), 115.5 (q, J = 4.5 Hz), 113.7. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.2, -127.9, -135.3 ppm. HRMS *m/z* (ESI+): calcd for $C_{16}H_7BrF_5NONa^+$ $(M+Na)^+$ 425.9523, found 425.9522.


7.676
7.663
7.538
7.525
7.511
7.465
7.451
7.437
7.314
7.299
7.287
7.261
7.257
7.253
7.247
7.234
6.690
6.676
CF3
N
O
F
Br
F
1.01
1.01
1.00
2.01
1.02
1.00
f1 (ppm)

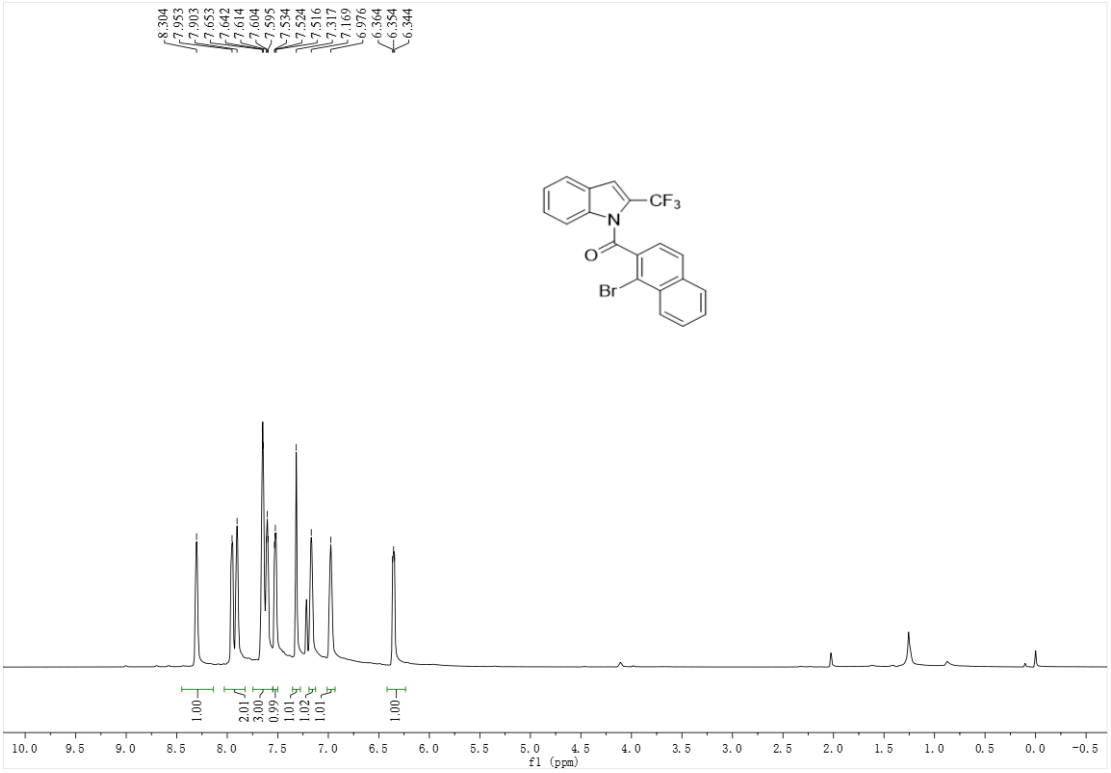

163.72
152.97
152.88
151.24
151.16
150.78
150.69
149.09
149.01
136.88
133.05
133.02
132.99
128.17
127.90
127.64
127.37
127.25
127.22
124.32
123.28
123.15
123.15
122.85
121.36
119.62
119.58
119.48
117.80
115.56
115.53
115.50
115.47
115.44
113.71
77.23
CF3
N
O
F
Br
F
f1 (ppm)

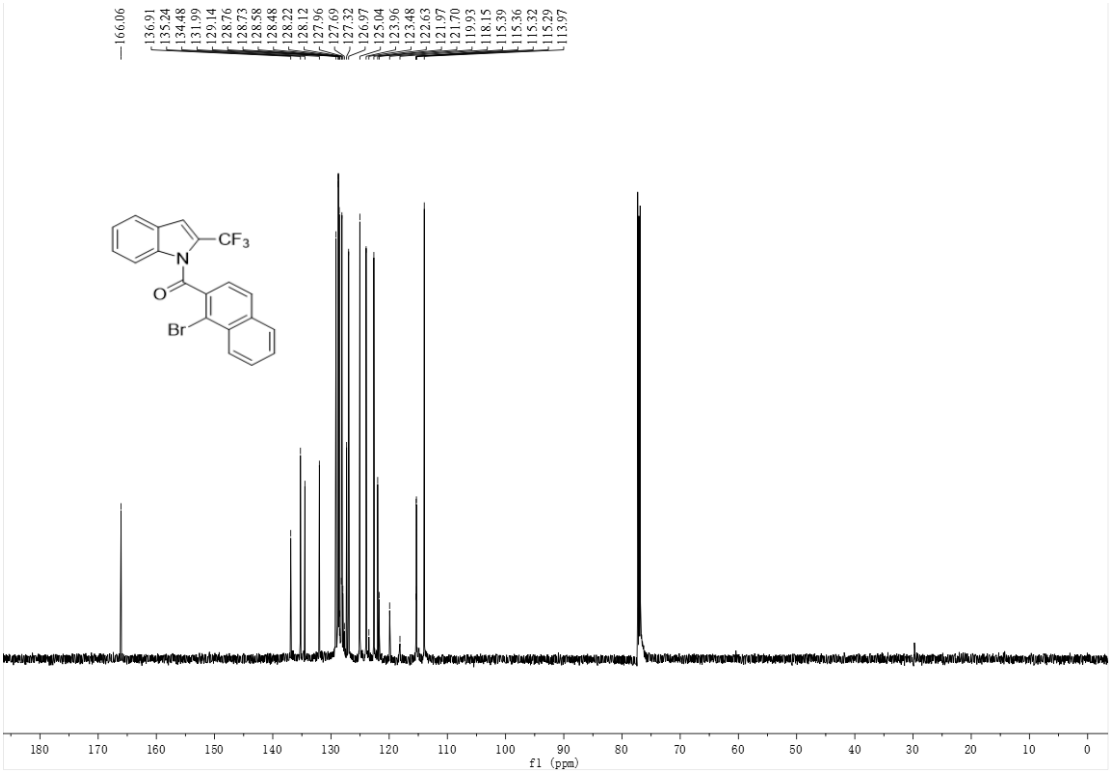


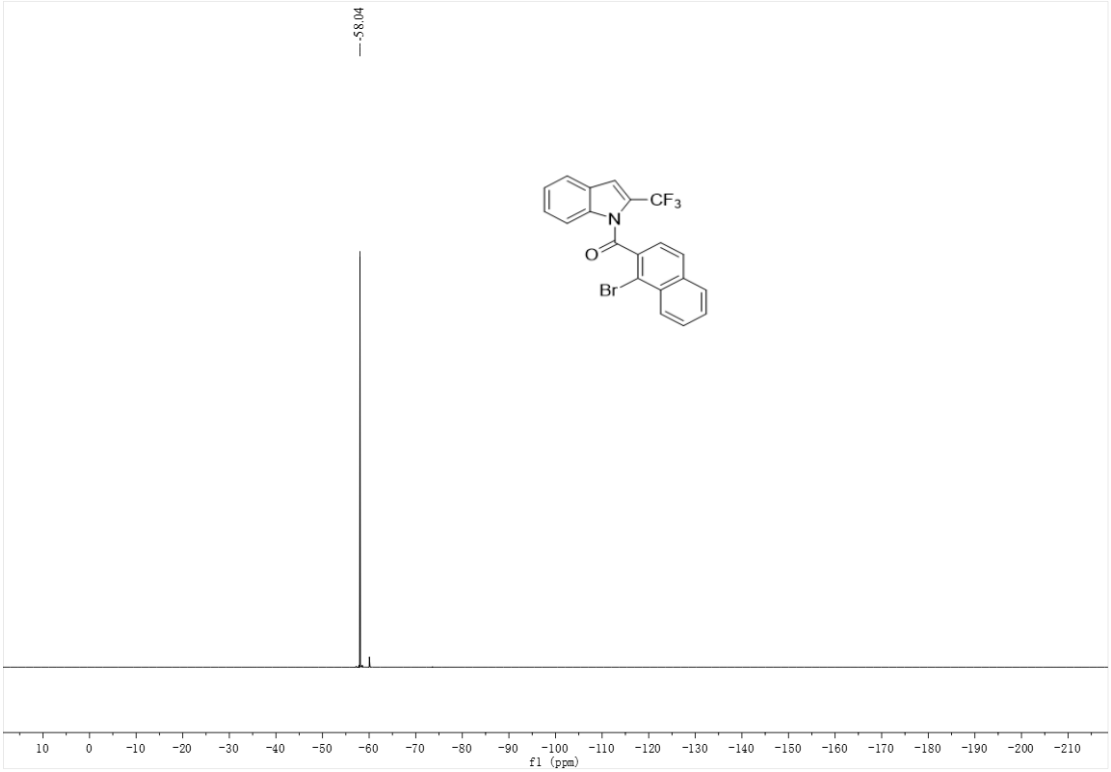
(1-Bromonaphthyl)(2-(trifluoromethyl)-1H-indol-1-yl)methanone (1o):



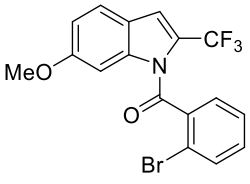
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); reddish brown liquid 49% yield (for the last step). ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.30 (s, 1H), 7.92 (d, J = 29.7 Hz, 2H), 7.65-7.52 (m, 4H), 7.32 (s, 1H), 7.17 (s, 1H), 6.98 (s, 1H), 6.35 (t, J = 6.0 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 166.1, 136.9, 135.2, 134.5, 132.0, 129.1, 128.8, 128.7, 128.6, 128.2 (q, J = 39.0 Hz), 128.1, 127.3, 127.0, 125.0, 124.0, 122.6, 122.0, 120.8 (q, J = 266.0 Hz), 115.4 (q, J = 4.5 Hz), 114.0. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.0 ppm. HRMS *m/z* (ESI+): Calcd for $C_{20}H_{11}BrF_3NONa^+$ $(M+Na)^+$ 439.9868, found 439.9871.


8.304
7.953
7.903
7.653
7.642
7.614
7.604
7.595
7.534
7.524
7.516
7.317
7.169
6.976
6.364
6.354
6.344
CF3
N
O
Br
1.00
2.01
3.00
0.99
1.01
1.02
1.01
1.00
f1 (ppm)

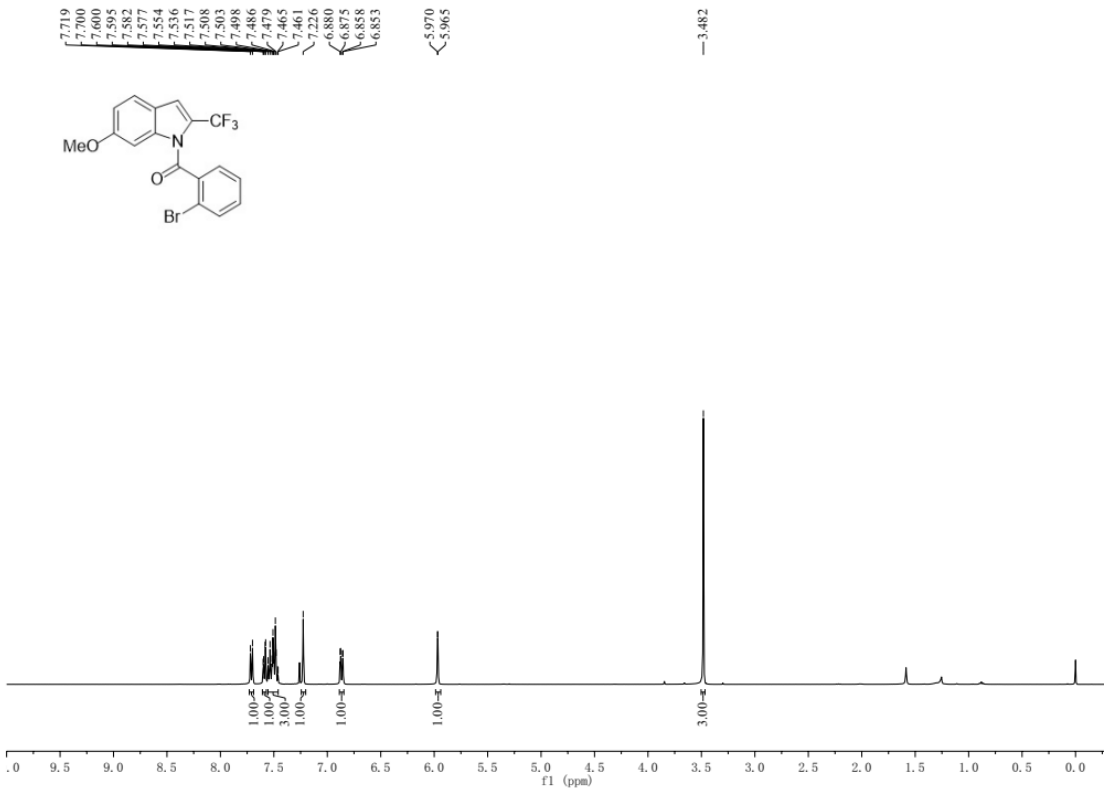

166.06
136.91
135.24
134.48
131.99
129.14
128.76
128.73
128.58
128.48
128.22
128.12
127.96
127.69
127.32
126.97
125.04
123.96
123.48
122.63
121.97
121.70
119.93
118.15
115.39
115.36
115.32
115.29
113.97
CF3
N
O
Br
f1 (ppm)



(2-Bromophenyl)(6-methoxy-2-(trifluoromethyl)-1H-indol-1-yl)methanone (1p):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); reddish brown solid 45% yield (for the last step); m.p. 116-118 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, J = 7.8 Hz, 1H), 7.59 (dd, J = 7.5, 1.9 Hz, 1H), 7.55-7.46 (m, 3H), 7.23 (s, 1H), 6.87 (dd, J = 8.7, 2.2 Hz, 1H), 5.97 (d, J = 2.1 Hz, 1H), 3.48 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 159.3, 138.2, 136.9, 133.8, 132.8, 130.1, 128.1, 126.7, 123.1, 121.0, 120.7 (q, J = 267.7 Hz), 120.69, 115.2 (q, J = 5.0 Hz), 113.6, 98.0, 55.1. ^{19}F NMR (376 MHz, $CDCl_3$) δ -58.0 ppm. Calcd for $C_{17}H_{11}BrF_3NO_2Na^+$ $(M+Na)^+$ 419.9818, found 419.9818.


7.719
7.700
7.600
7.595
7.582
7.577
7.554
7.536
7.517
7.508
7.503
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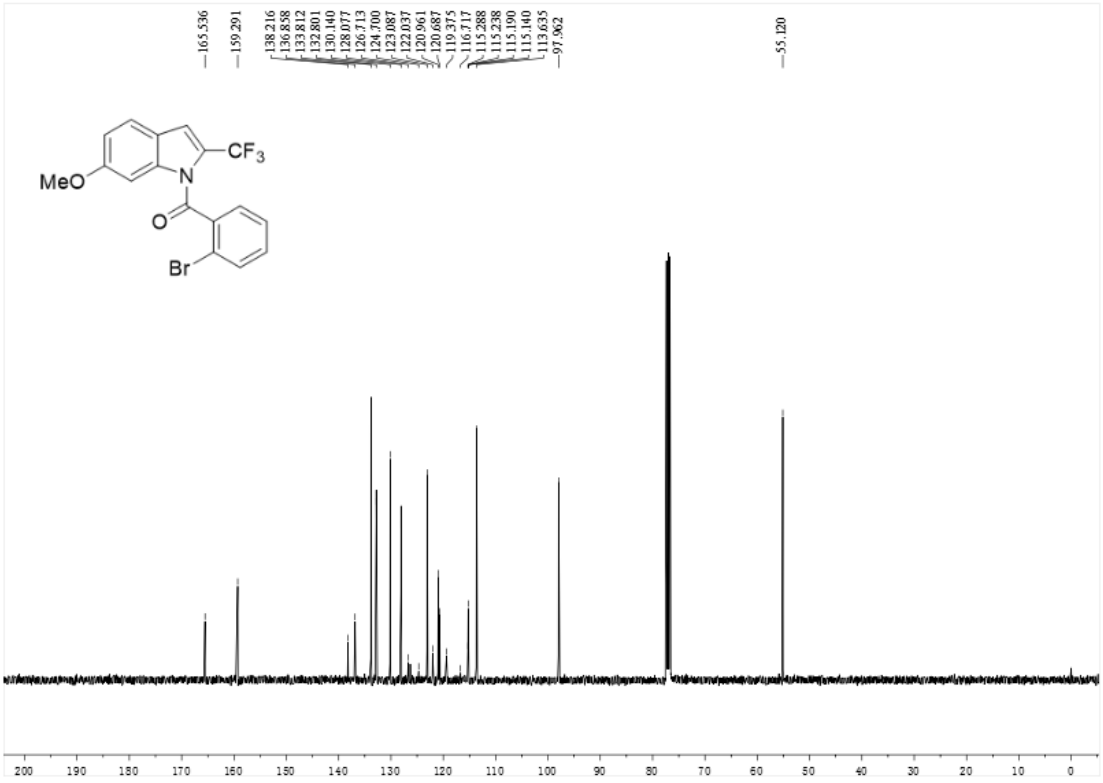
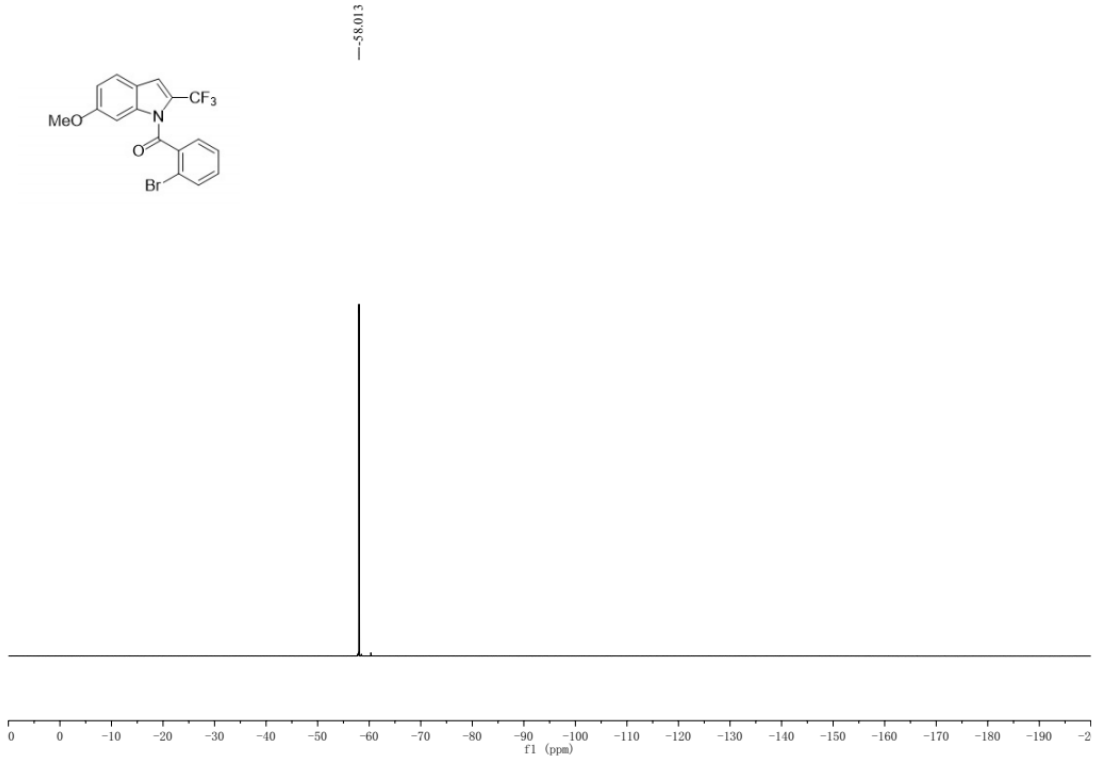
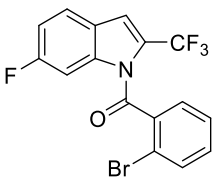
7.486
7.479
7.465
7.461
7.226
6.880
6.875
6.858
6.853
5.970
5.965
3.482
MeO
CF3
N
O
Br
1.00
1.00
3.00
1.00
1.00
1.00
3.00
f1 (ppm)

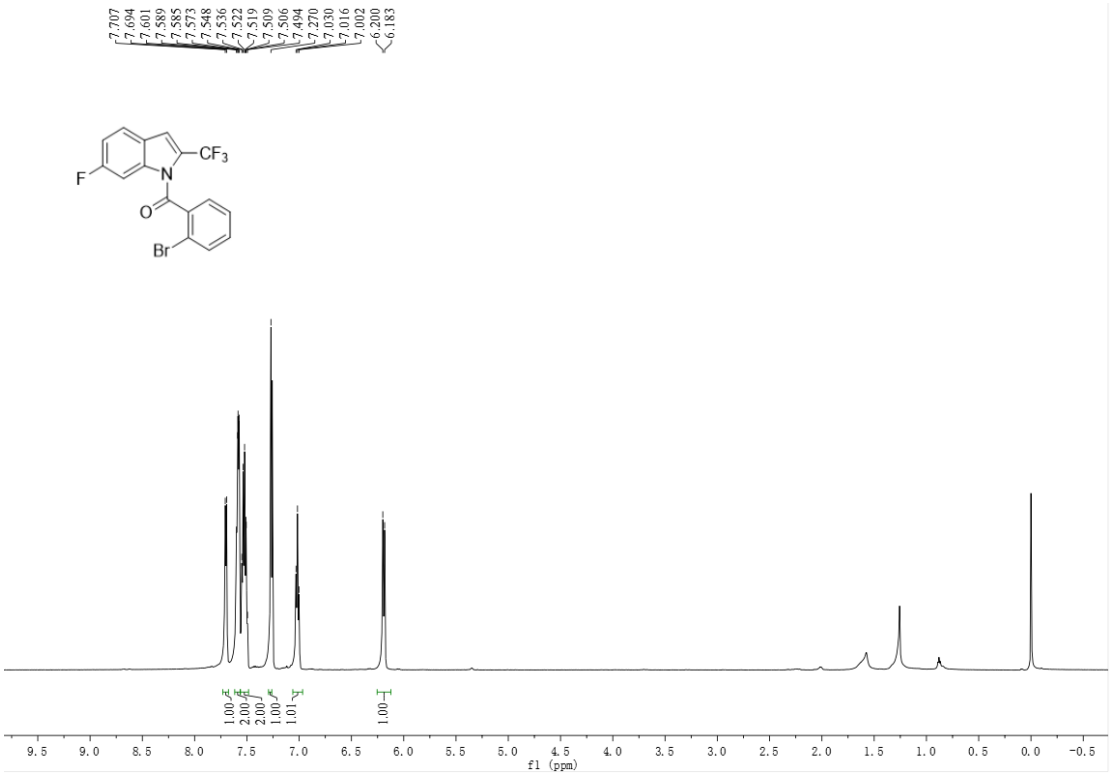

165.536
159.291
138.216
136.858
133.812
132.801
130.140
128.077
126.713
124.700
123.087
122.037
120.961
120.687
119.375
116.717
115.288
115.238
115.190
115.140
113.635
97.962
55.120
MeO
CF3
N
O
Br



(2-Bromophenyl)(6-fluoro-2-(trifluoromethyl)-1H-indol-1-yl)methanone (1q):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); light yellow solid 43% yield (for the last step); m.p. 79-81 ℃. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.70 (d, J = 7.7 Hz, 1H), 7.60-7.57 (m, 2H), 7.55-7.49 (m, 2H), 7.27 (s, 1H), 7.01 (t, J = 8.4 Hz, 1H), 6.19 (d, J = 10.5 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 165.4, 161.9 (d, J = 244.5 Hz), 137.4 (d, J = 12.0 Hz), 136.0, 134.0, 133.3, 130.3, 128.5, (d, J = 4.5 Hz), 128.2, 123.7, 123.6, 120.6, 120.4 (q, J = 267.0 Hz), 114.6 (q, J = 4.5 Hz), 112.9 (d, J = 24.0 Hz), 101.5 (d, J = 30.0 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.2, -112.0 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_8BrF_4NONa^+$ $(M+Na)^+$ 407.9618, found 407.9619.


7.707
7.694
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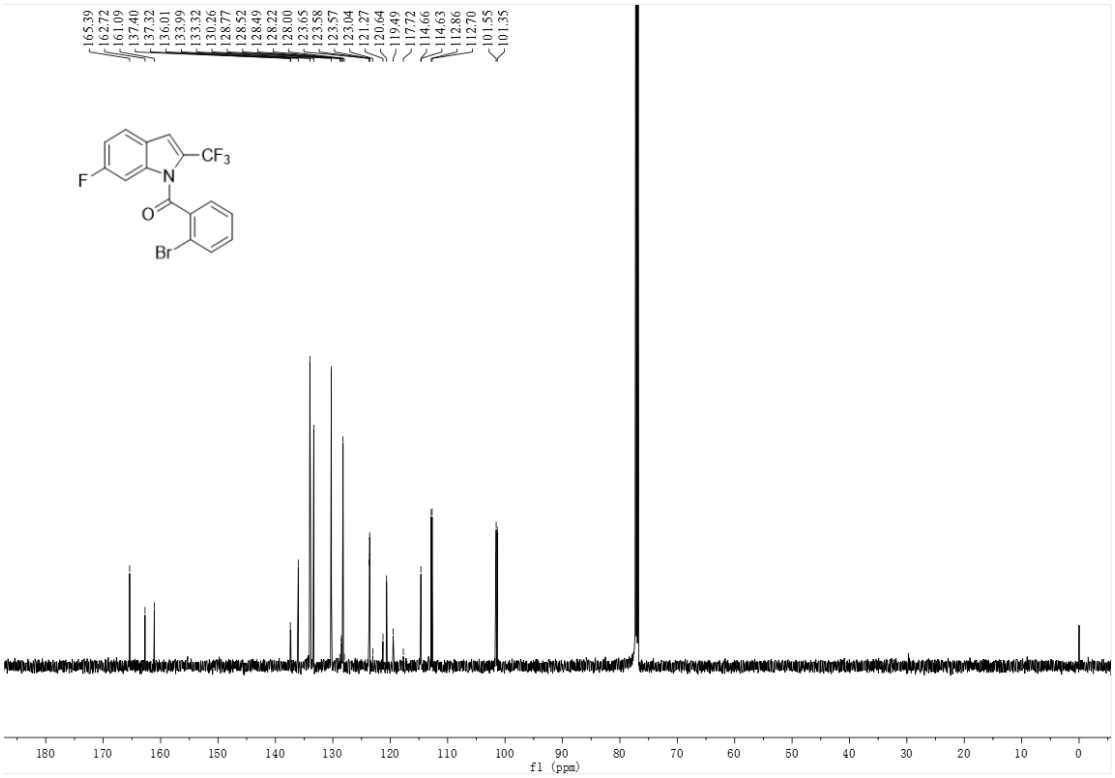
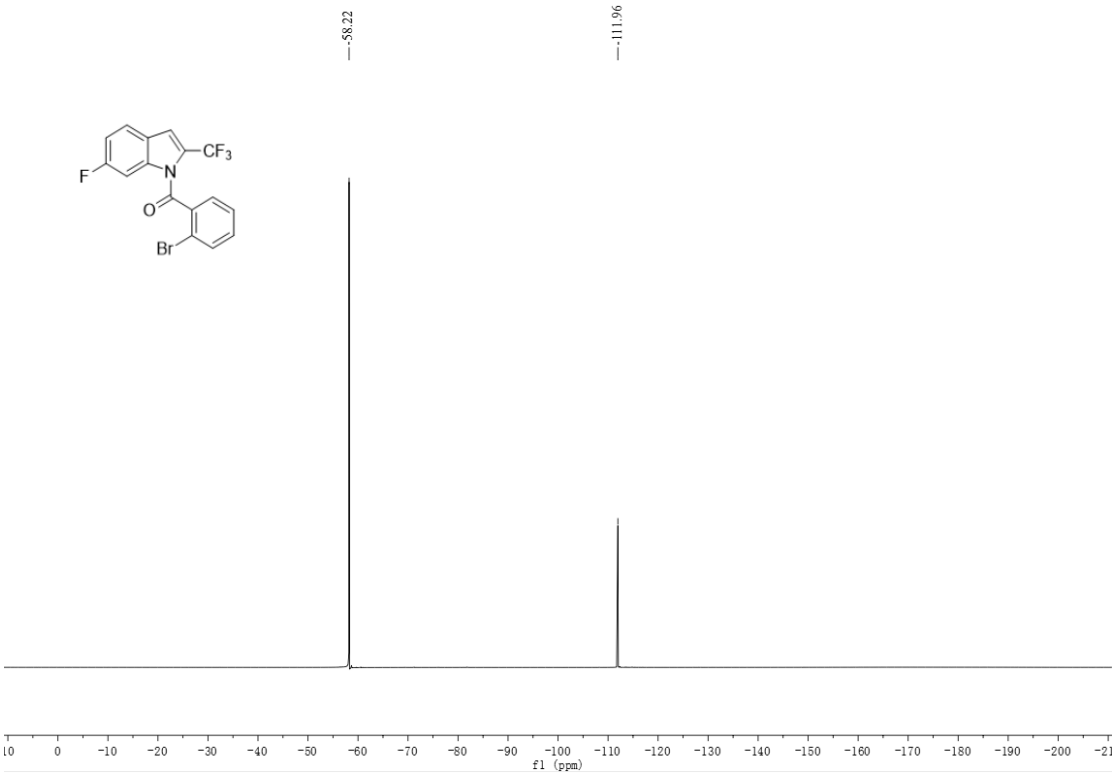
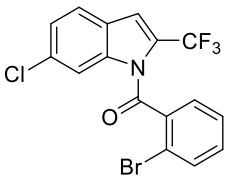
7.589
7.585
7.573
7.548
7.536
7.522
7.519
7.509
7.506
7.494
7.270
7.030
7.016
7.002
6.200
6.183
F
CF3
N
O
Br
1.00
2.00
2.00
1.00
1.01
1.00
f1 (ppm)

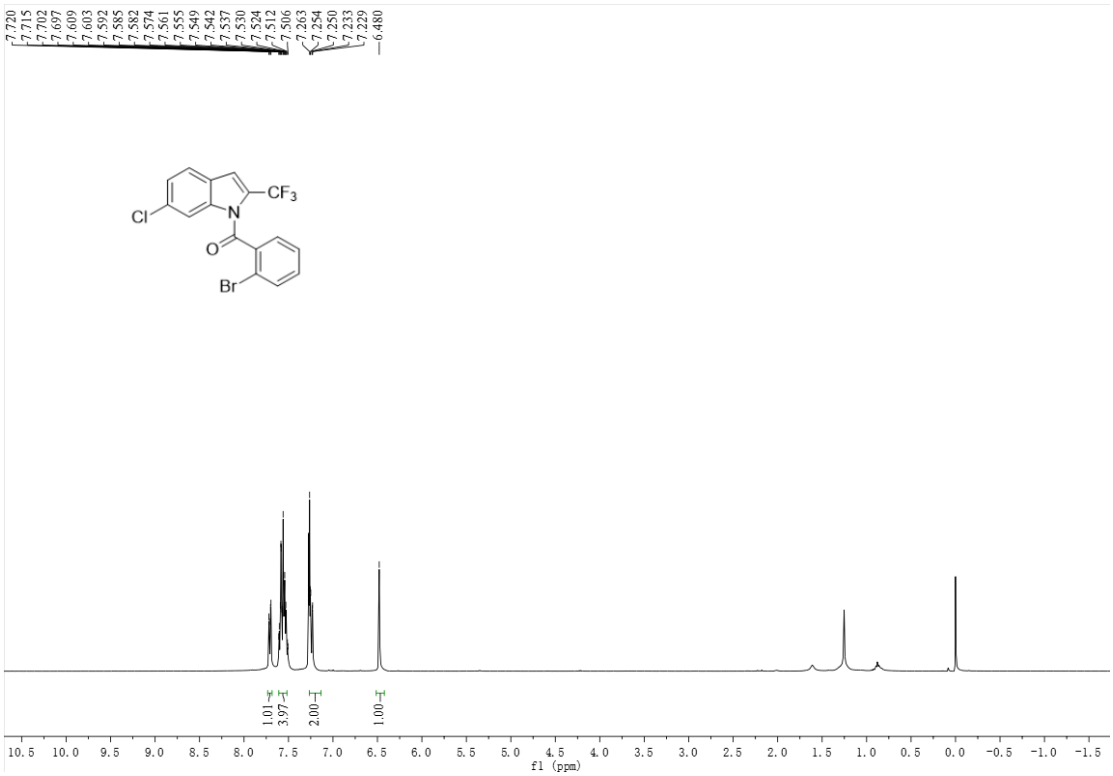

165.39
162.72
161.09
137.40
137.32
136.01
133.99
133.32
130.26
128.77
128.52
128.49
128.22
128.00
123.65
123.58
123.57
123.04
121.27
120.64
119.49
117.72
114.66
114.63
112.86
112.70
101.55
101.35
F
CF3
N
O
Br
f1 (ppm)

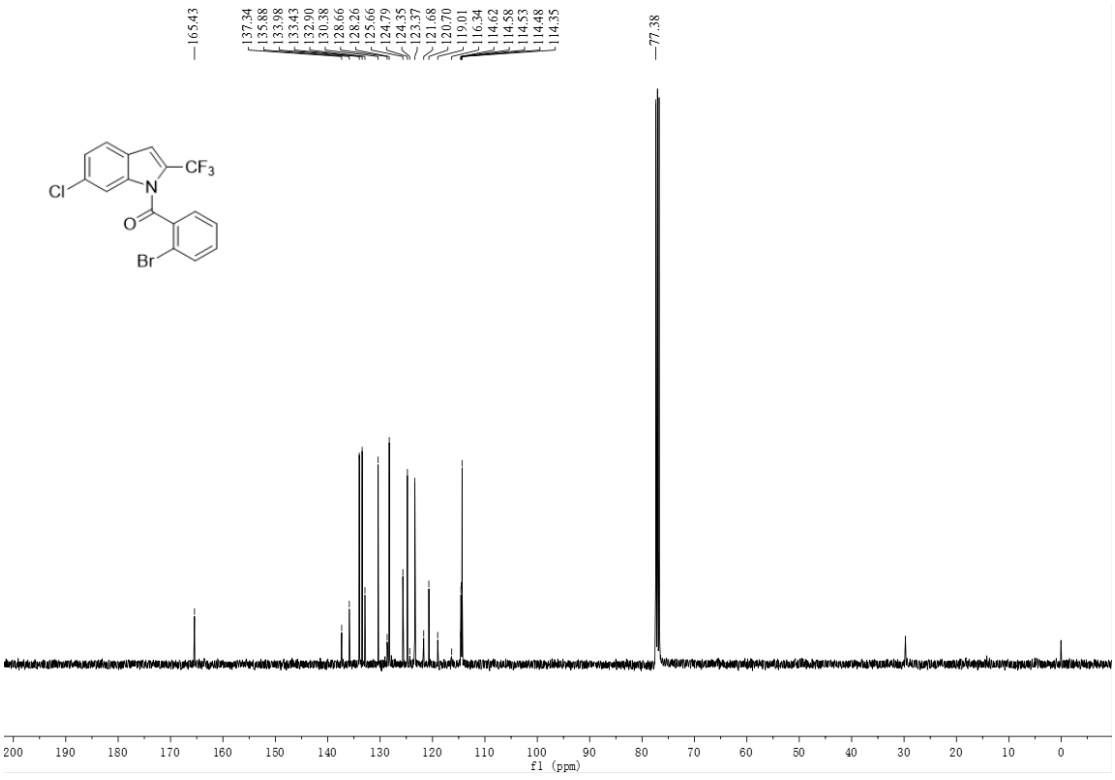


(2-Bromophenyl)(6-chloro-2-(trifluoromethyl)-1H-indol-1-yl)methanone (1r):

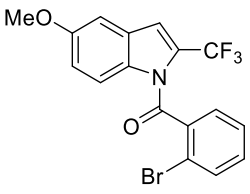


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); white solid 41% yield (for the last step); m.p. 74-76 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (dd, J = 7.1, 1.9 Hz, 1H), 7.61-7.51 (m, 4H), 7.26-7.23 (m, 2H), 6.48 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.4, 137.3, 135.9, 134.0, 133.4, 132.9, 130.4, 128.7, 128.3, 125.7, 124.8, 124.4, 122.9, 120.4 (q, J = 267.0 Hz), 120.7, 114.5 (q, J = 5.0 Hz), 114.4, 77.4. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.3 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_8BrClF_3NONa^+$ $(M+Na)^+$ 423.9322, found 423.9320.

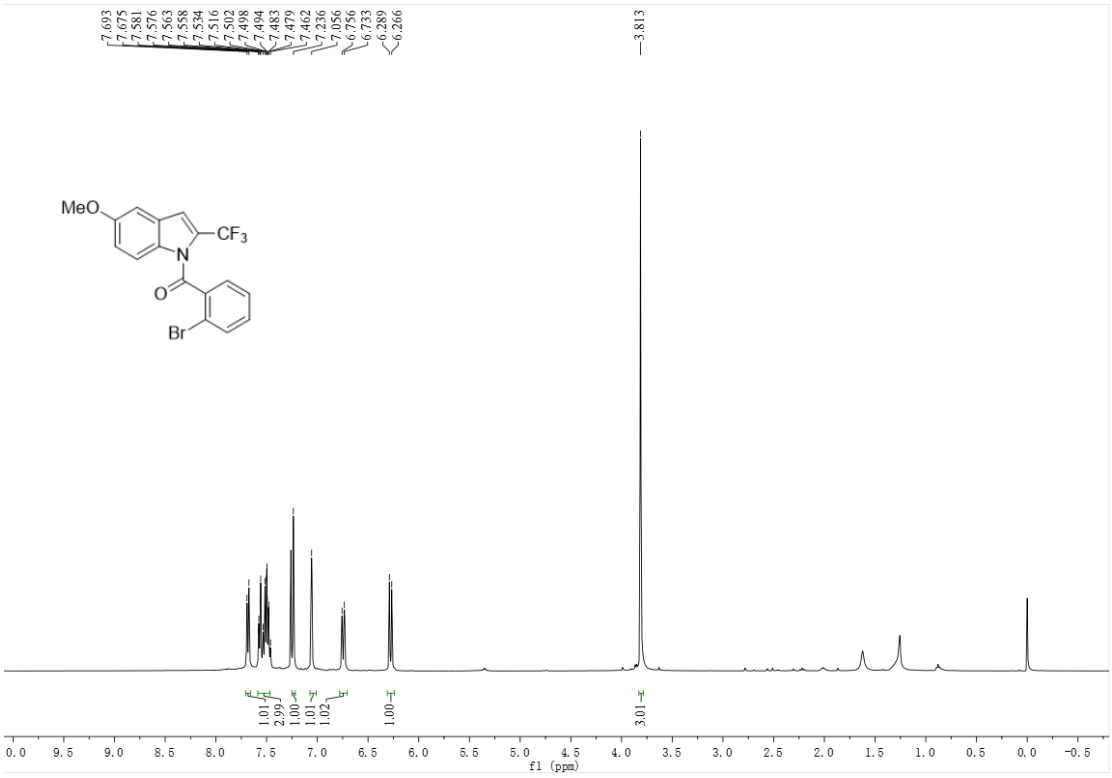

7.720
7.715
7.702
7.697
7.609
7.603
7.592
7.585
7.582
7.574
7.561
7.555
7.549
7.542
7.537
7.530
7.524
7.512
7.506
7.263
7.254
7.250
7.233
7.229
6.480
Cl
N
O
Br
CF3
1.01
3.97
2.00
1.00
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5
f1 (ppm)

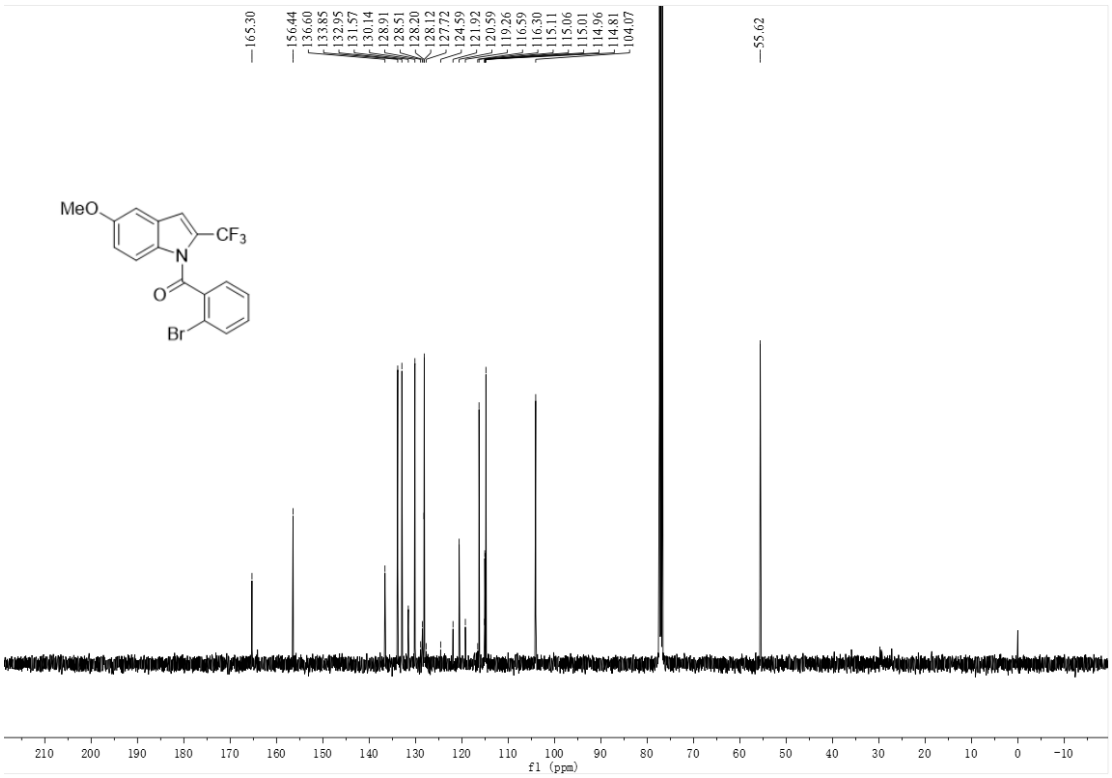

165.43
137.34
135.88
133.98
133.43
132.90
130.38
128.66
128.26
125.66
124.79
124.35
123.37
121.68
120.70
119.01
116.34
114.62
114.58
114.53
114.48
114.35
77.38
Cl
N
O
Br
CF3
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

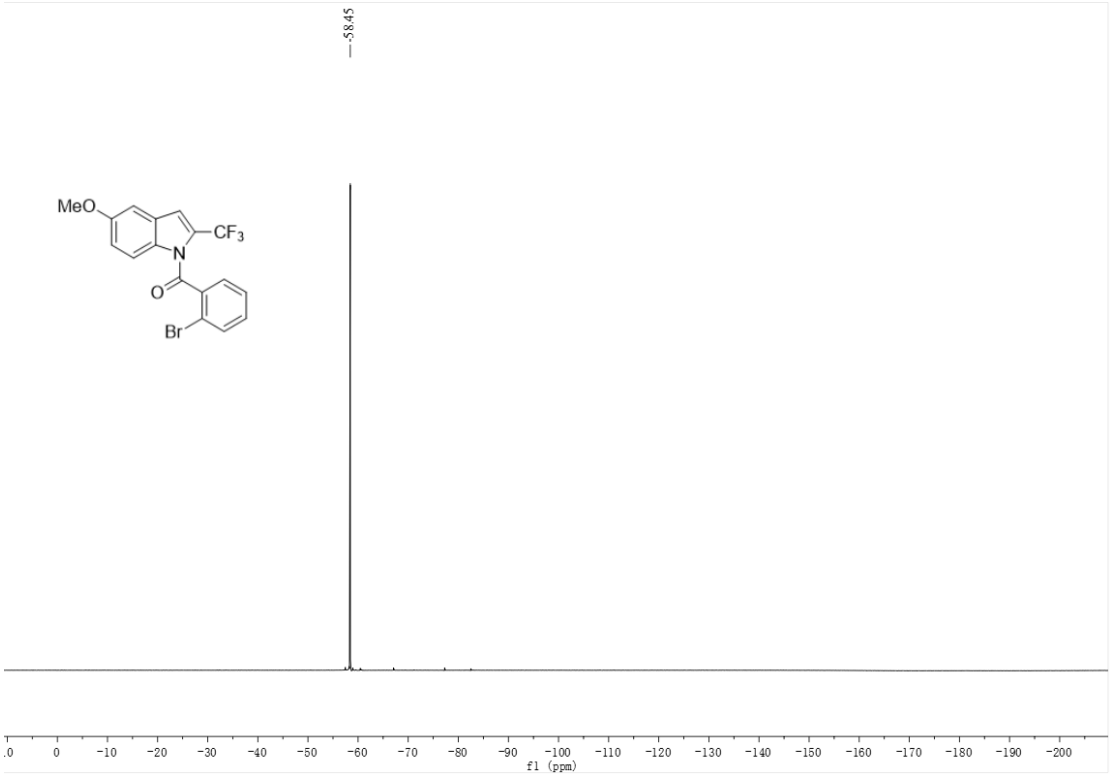
(2-Bromophenyl)(5-methoxy-2-(trifluoromethyl)-1H-indol-1-yl)methanone (1s):



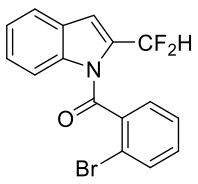
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); reddish brown liquid 44% yield (for the last step). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (d, J = 7.5 Hz, 1H), 7.58-7.46 (m, 3H), 7.23 (s, 1H), 7.05 (s, 1H), 6.74 (d, J = 9.2 Hz, 1H), 6.27 (d, J = 9.2 Hz, 1H), 3.81 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.3, 156.4, 136.6, 133.8, 133.0, 131.6, 130.1, 128.3 (q, J = 40.0 Hz), 128.2, 128.1, 120.6, 120.5 (q, J = 266.0 Hz), 116.3, 115.1 (q, J = 5.0 Hz), 114.8, 104.1, 55.6. ^{19}F NMR (377 MHz, $CDCl_3$) δ -58.5 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{11}BrF_3NO_2Na^+$ $(M+Na)^+$ 419.9818, found 419.9819.


7.693
7.675
7.581
7.576
7.563
7.558
7.534
7.516
7.502
7.498
7.494
7.483
7.479
7.462
7.236
7.056
6.756
6.733
6.289
6.266
3.813
MeO
CF3
N
O
Br
1.01
2.99
1.00
1.01
1.02
1.00
3.01
f1 (ppm)

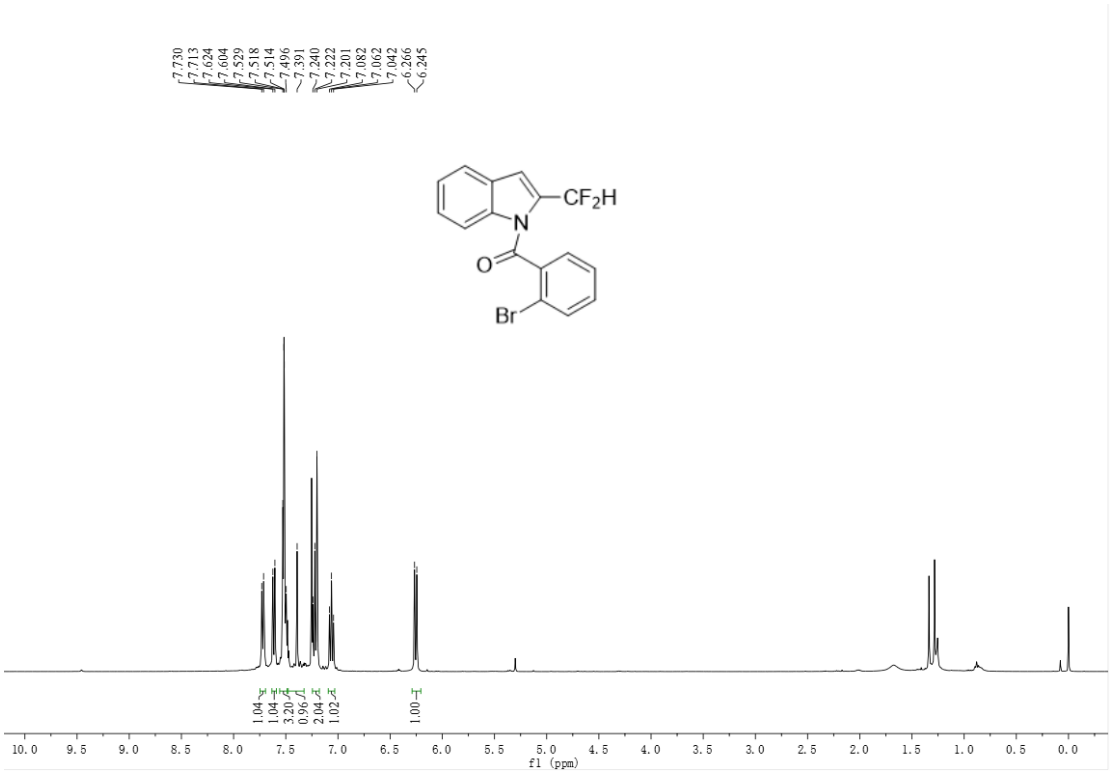

165.30
156.44
136.60
133.85
132.95
131.57
130.14
128.91
128.51
128.20
128.12
127.72
124.59
121.92
120.59
119.26
116.59
116.30
115.11
115.06
115.01
114.96
114.81
104.07
55.62
MeO
CF3
N
O
Br
f1 (ppm)

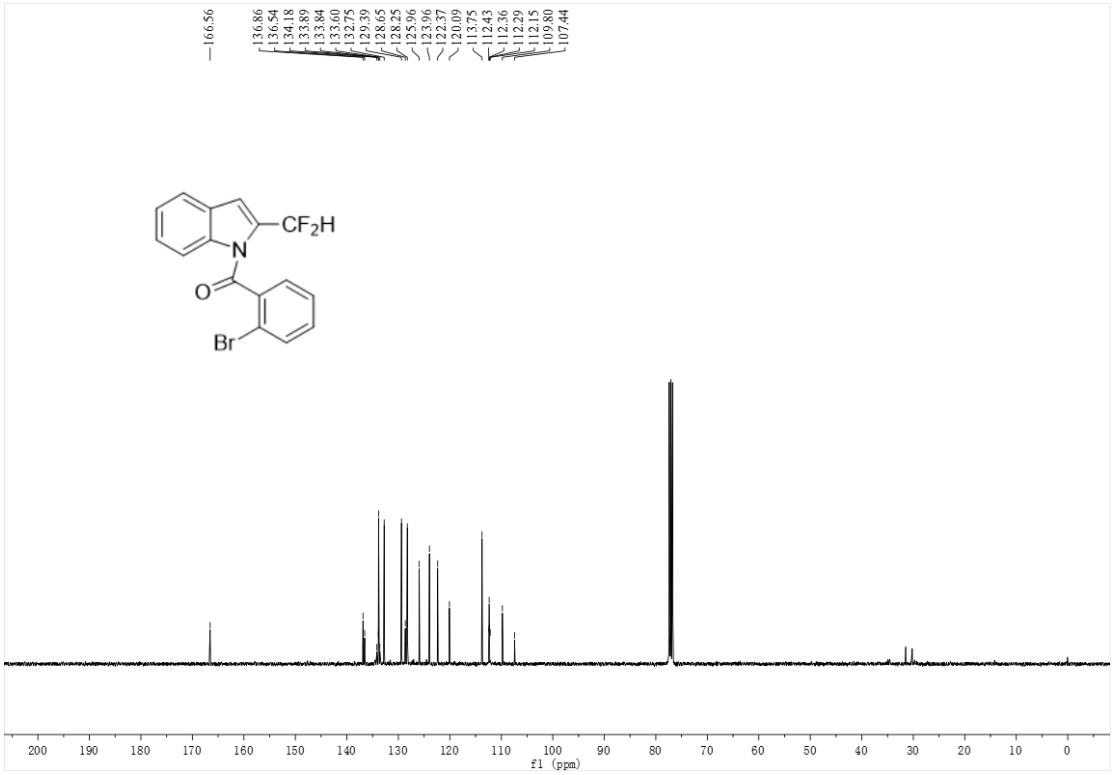


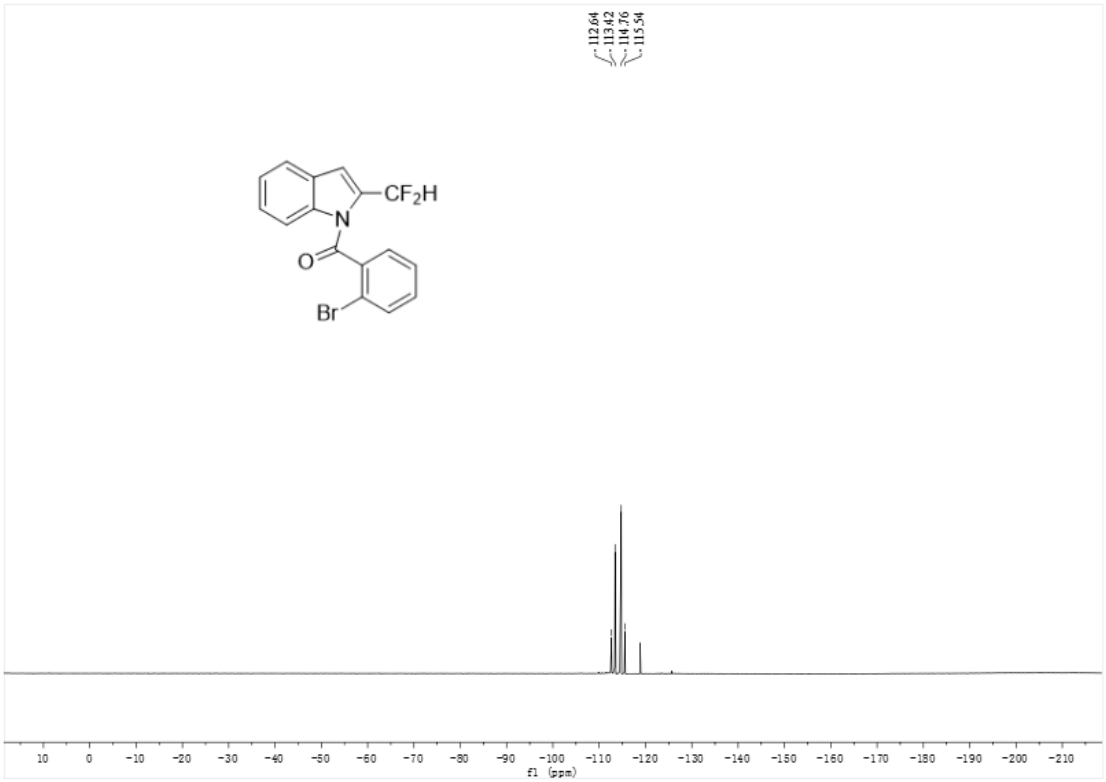
(2-Bromophenyl)(2-(Difluoromethyl)-1H-indol-1-yl)methanone (1t):



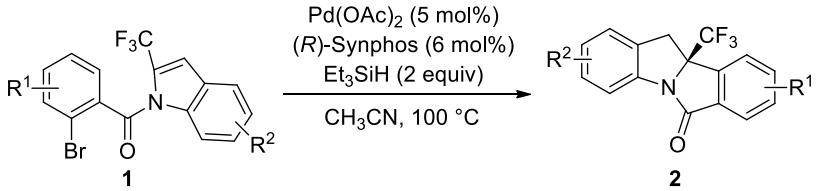
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:100 (v/v); reddish brown liquid 35% yield (for the last step). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, J = 7.0 Hz, 1H), 7.61 (d, J = 7.8 Hz, 1H), 7.53-7.50 (m, 3H), 7.39 (s, 1H), 7.24-7.20 (m, 2H), 7.06 (t, J = 8.1 Hz, 1H), 6.26 (d, J = 8.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.6, 136.9, 136.5, 133. 9 (t, J = 29 Hz), 133.8, 132.8, 129.4, 128.7, 128.3, 126.0, 124.0, 122.4, 120.1, 113.8, 112.4 (t, J = 7 Hz), 109.80 (t, J = 235 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -114.09 (dd, J = 799.2, 293.0 Hz, 2F). HRMS *m/z* (ESI+): Calcd for $C_{16}H_{10}BrF_2NONa^+$ $(M+Na)^+$ 371.9806, found 371.9807.


7.730
7.713
7.624
7.604
7.529
7.518
7.514
7.496
7.391
7.240
7.222
7.201
7.082
7.062
7.042
6.266
6.245
CF2H
N
O
Br
1.04
1.04
3.20
0.96
2.04
1.02
1.00
f1 (ppm)


166.56
136.86
136.54
134.18
133.89
133.84
133.60
132.75
129.39
128.65
128.25
125.96
123.96
122.37
120.09
113.75
112.43
112.36
112.29
112.15
109.80
107.44
CF2H
N
O
Br
f1 (ppm)

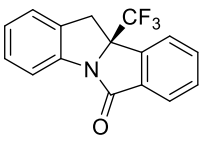


4. Procedure for enantioselective dearomative reductive Heck of 1



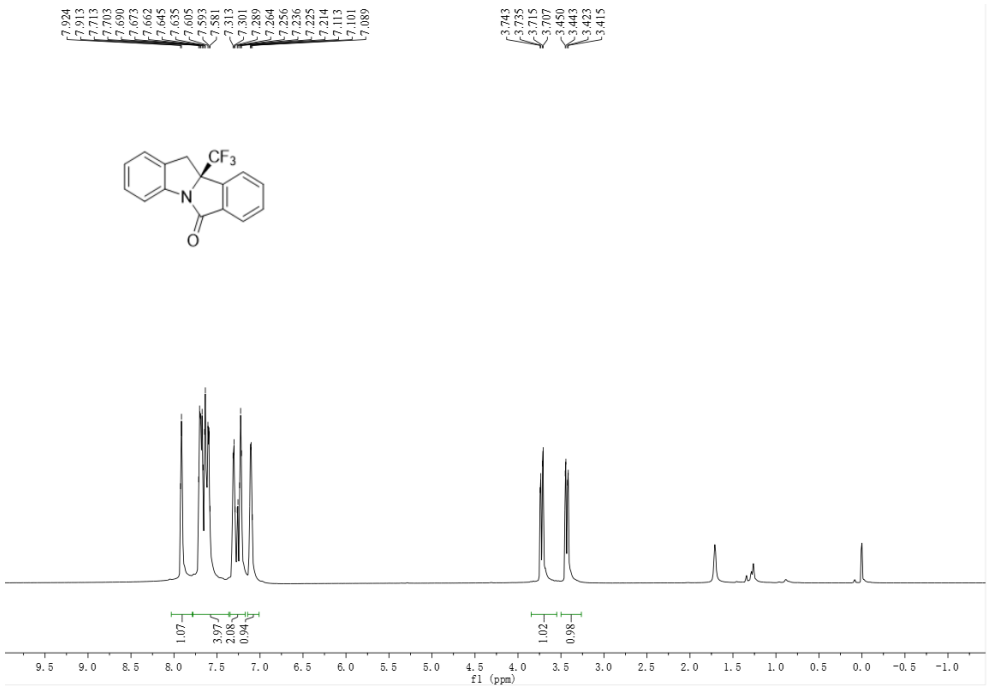
To a dried Schlenk tube were charged with $Pd(OAc)_2$ (2.3 mg, 0.01 mmol) and (*R*)-Synphos (7.6 mg, 0.012 mmol) under N_2 atmosphere, 2.0 mL CH_3CN was then introduced via a syringe and the tube was sealed using Teflon cap. After stirring at 40 °C for 0.5 h, substrate **1** (0.2 mmol) and Et_3SiH (0.4 mmol) were added to the reaction mixture. The resulting mixture was then allowed to stir at 100 °C until the reaction was complete (monitored by TLC). The solution was then concentrated under reduced pressure. The residue was purified by column chromatography on silica gel, eluting with ethyl/petroleum ether 1:50 (v/v) to afford the products **2**.

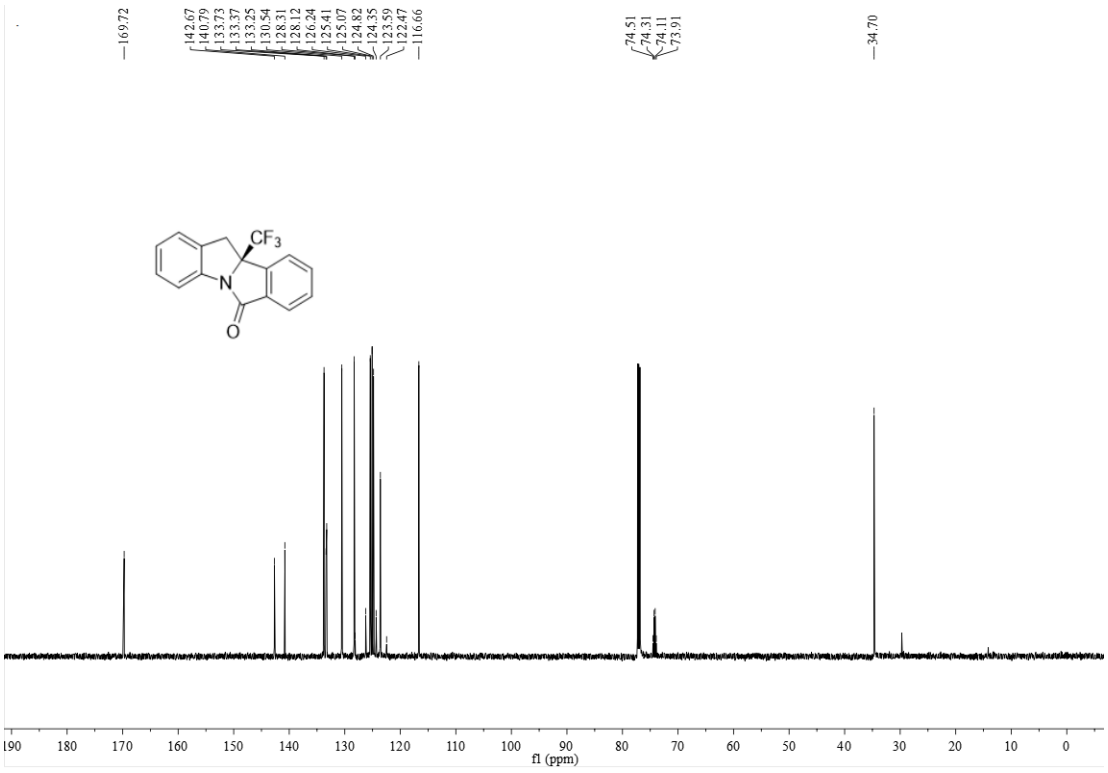
(R)-10b-(Trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2a):

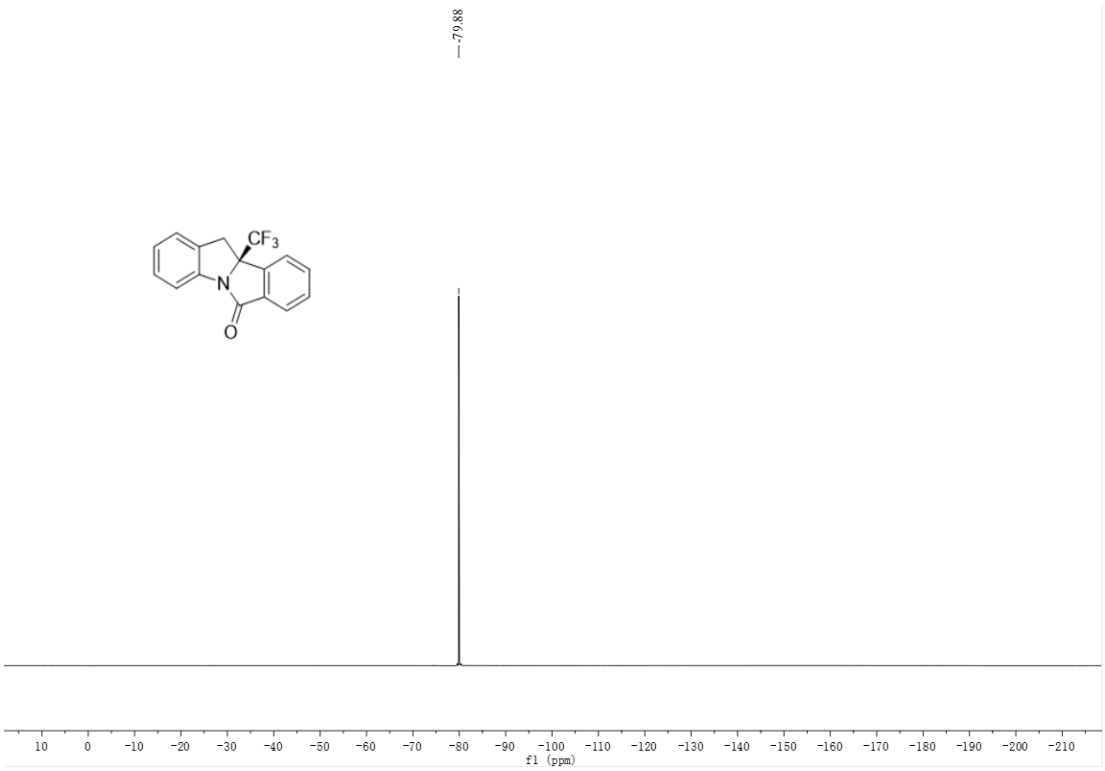


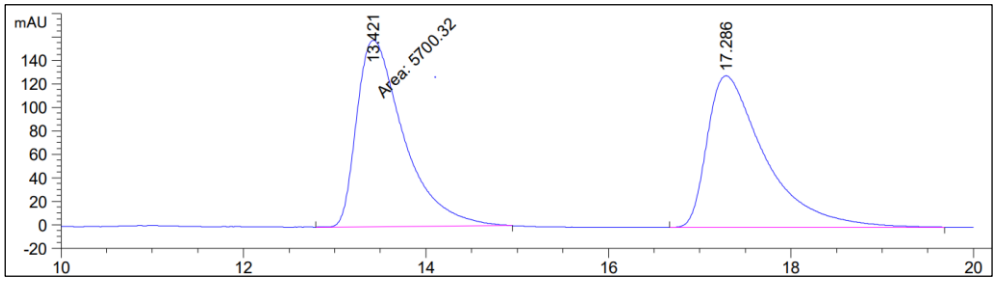
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (68% yield), m.p. 99-101 ℃. $[\alpha]_D^{20}$ = +196.1 (c 0.5, CH_2Cl_2), 99% ee Chiralpak AD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.7 mL/min, 280 nm; t_{major} = 13.4 min, t_{minor} = 17.3 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.92 (d, *J* = 6.6 Hz, 1H), 7.71-7.58 (m, 4H), 7.31-7.21 (m, 2H), 7.10 (t, *J* = 7.1 Hz, 1H), 3.72 (dd, *J* = 16.7, 4.9 Hz, 1H), 3.43 (dd, *J* = 16.4, 4.7 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 169.7, 142.7, 140.8, 133.7, 133.4, 133.2, 130.5, 128.3, 125.3 (q, *J* = 282.0 Hz) 125.4,

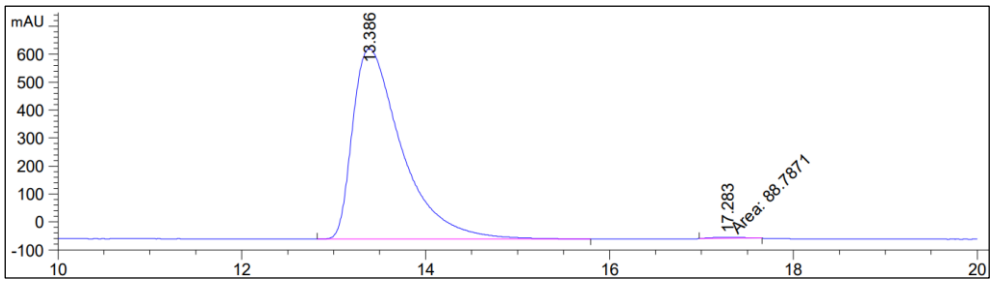
125.1, 124.8, 123.4, 116.7, 74.2 (q, J = 30.0 Hz), 34.7. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_{10}F_3NONa^+$ $(M+Na)^+$ 312.0607, found 312.0606.





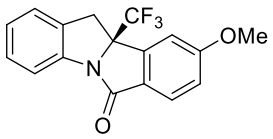




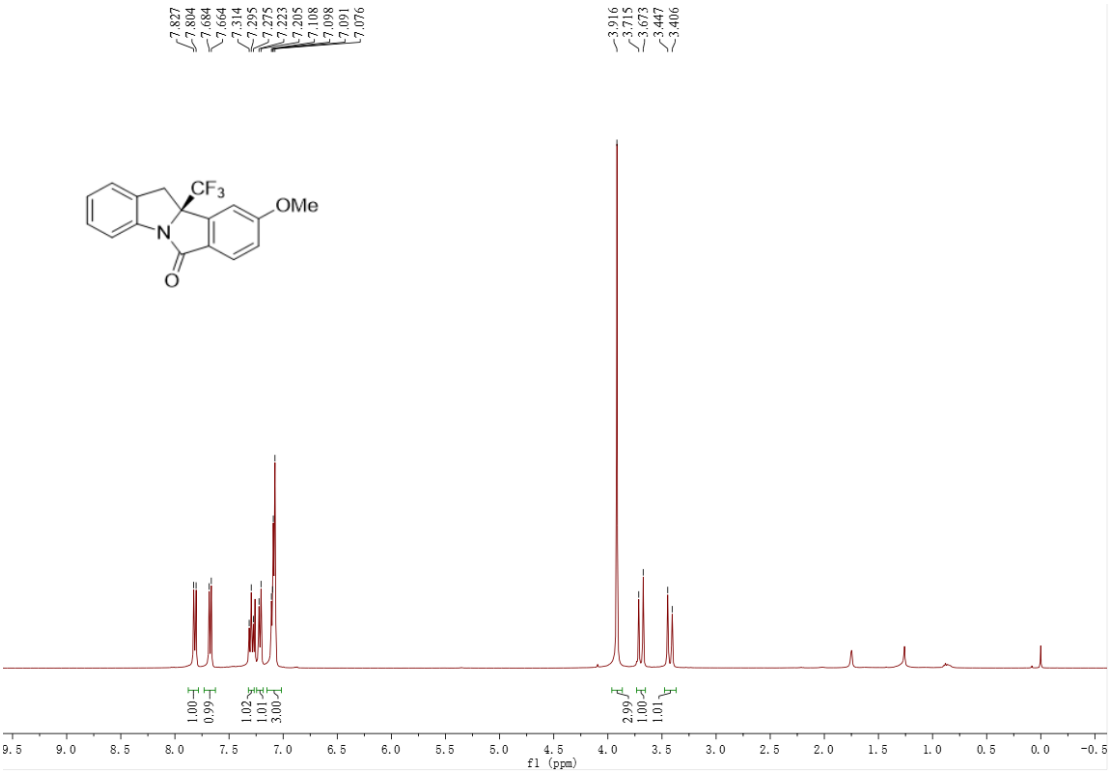


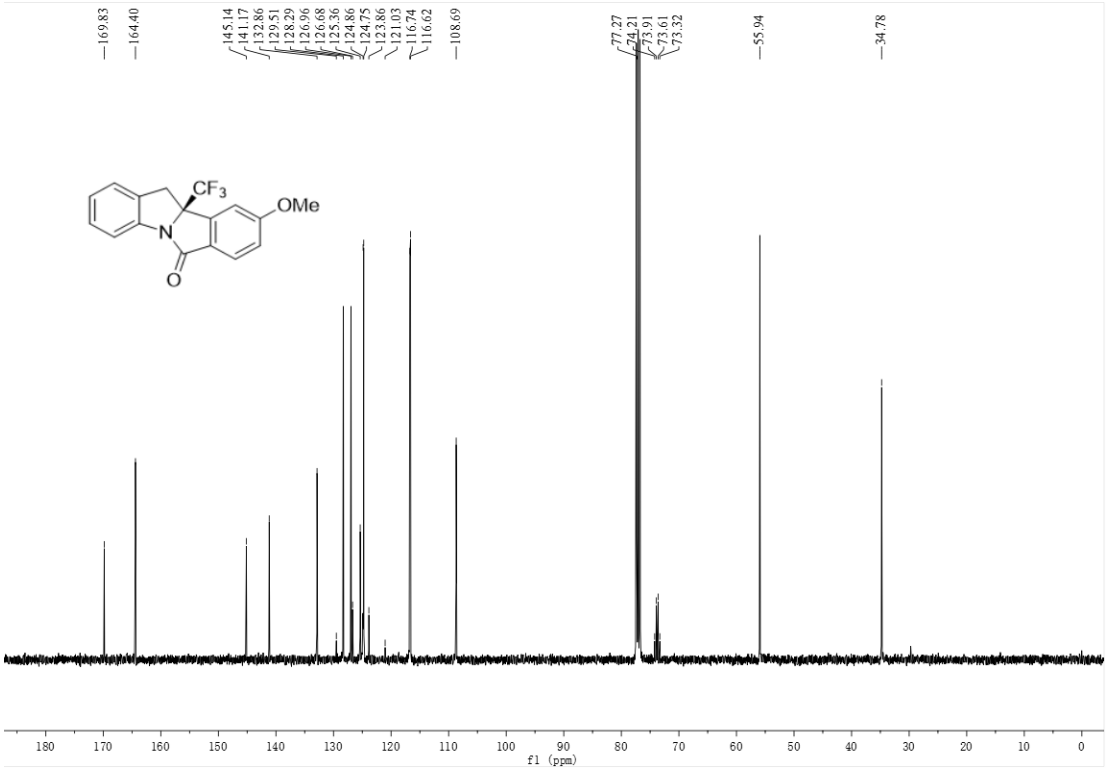
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	13.386	BB	0.5518	2.51969e4	680.76855	99.6489
2	17.283	MM	0.3864	88.78711	3.82941	0.3511

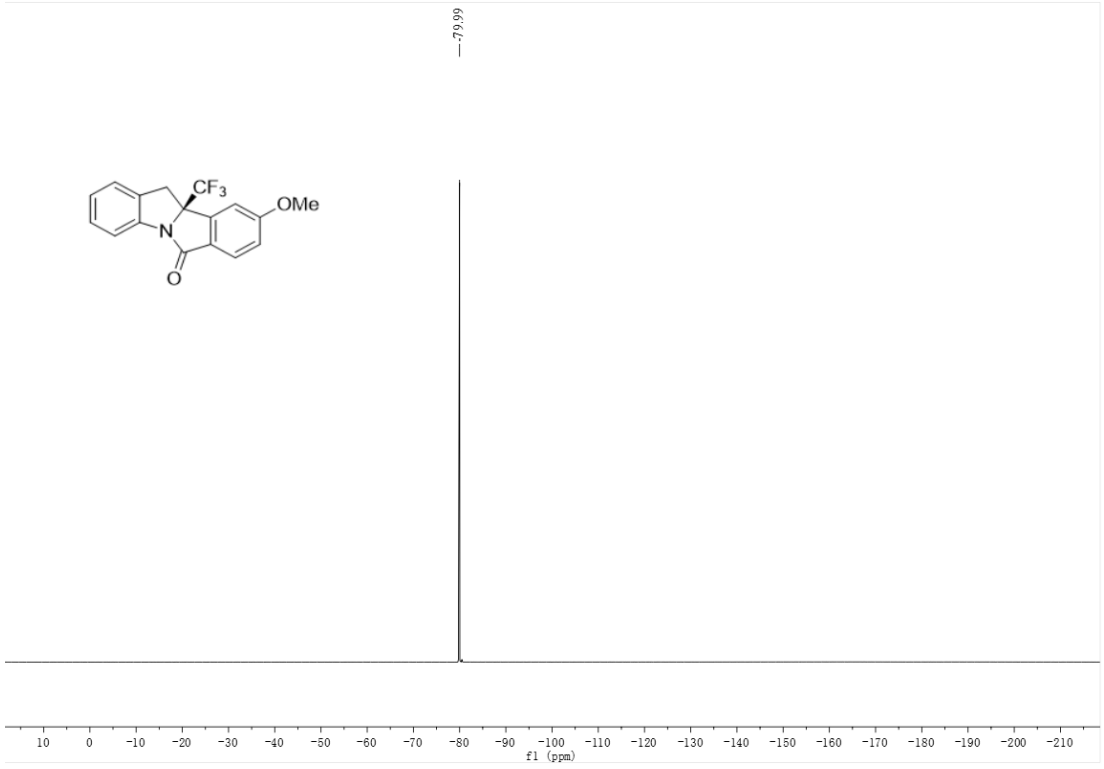
(R)-9-Methoxy-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2b):

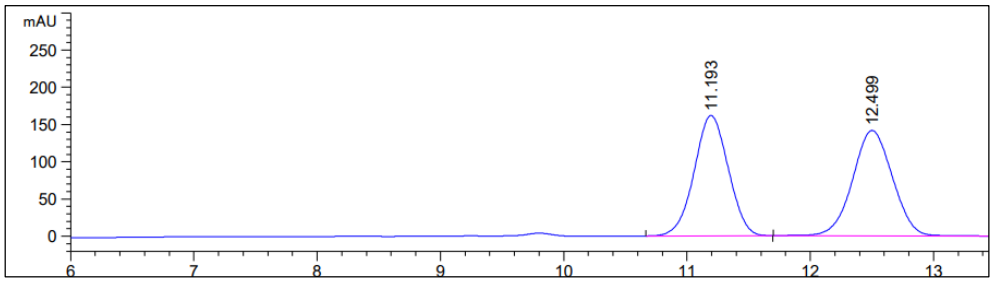


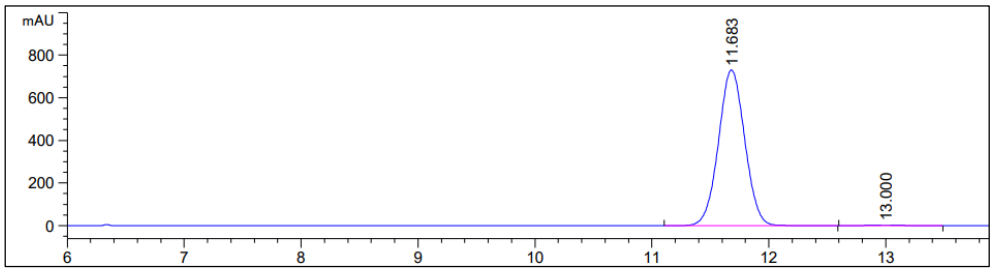
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless oil (58% yield). $[\alpha]_D^{20}$ = +294.4 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.7 mL/min, 280 nm; t_{major} = 11.7 min, t_{minor} = 13.0 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, J = 9.2 Hz, 1H), 7.67 (d, J = 8.0 Hz, 1H), 7.29 (t, J = 7.9 Hz, 1H), 7.21 (d, J = 7.4 Hz, 1H), 7.10-7.07 (m, 3H), 3.92 (s, 3H), 3.69 (d, J = 16.8 Hz, 1H), 3.42 (d, J = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.8, 164.4, 145.1, 141.2, 132.9, 128.3, 127.0, 125.4, 125.3 (q, J = 282.0 Hz), 124.9, 124.8, 123.9, 116.68 (d, J = 12.0 Hz), 108.7, 73.8 (q, J = 30.0 Hz), 55.9, 34.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -80.0 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{12}F_3NONa^+$ $(M+Na)^+$ 342.0712, found 342.0714.




169.83
164.40
145.14
141.17
132.86
129.51
128.29
126.96
126.68
125.36
124.86
124.75
123.86
121.03
116.74
116.62
108.69
77.27
74.21
73.91
73.61
73.32
55.94
34.78
CF3
OMe
N
O
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

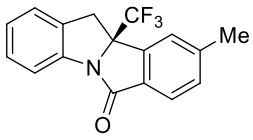

-79.99
CF3
OMe
N
O
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)



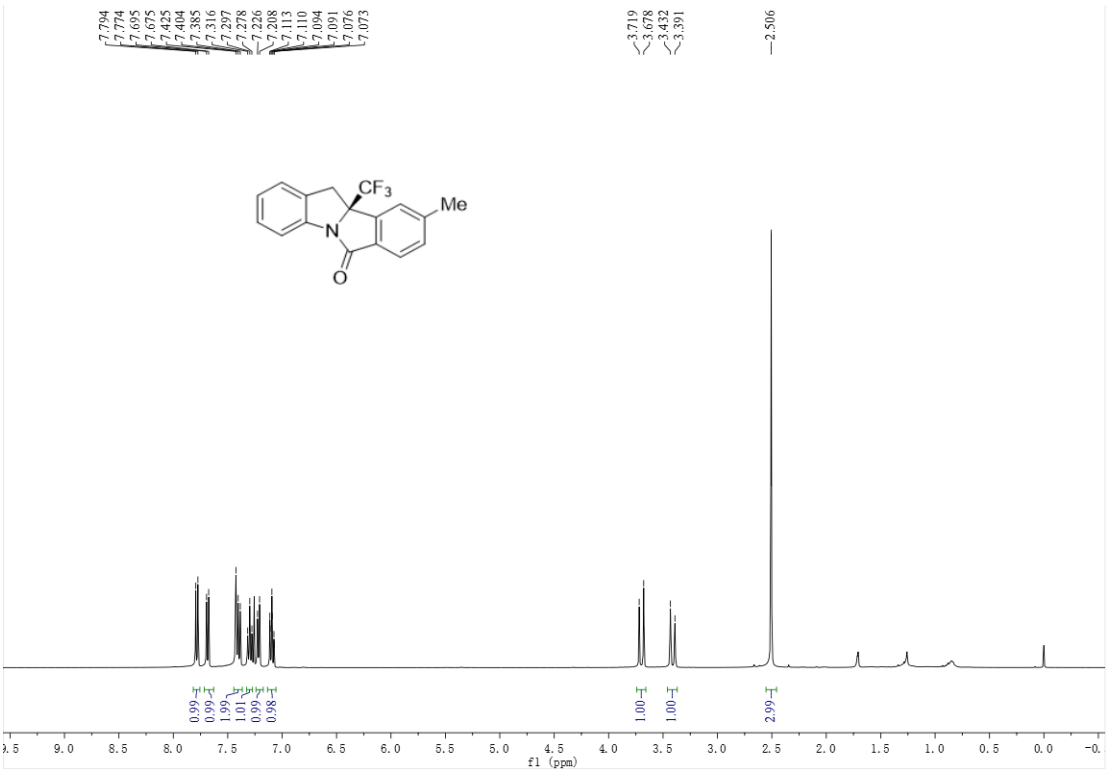


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.683	BB	0.2421	1.14086e4	731.03827	99.4468
2	13.000	BB	0.2656	63.45918	3.70988	0.5532

(R)-9-Methyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2c):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless oil (50% yield). $[\alpha]_D^{20}$ = +264.4 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak AS column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{major} = 8.1 min, t_{minor} = 8.9 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, J = 7.8 Hz, 1H), 7.68 (d, J = 7.8 Hz, 1H), 7.40 (t, J = 8.0 Hz, 2H), 7.30 (t, J = 7.7 Hz, 1H), 7.22 (d, J = 7.5 Hz, 1H), 7.11-7.07 (m, 1H), 3.70 (d, J = 16.5 Hz, 1H), 3.41 (d, J = 16.5 Hz, 1H), 2.51 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.9, 145.0, 143.1, 141.0, 133.2, 131.5, 130.7, 128.3, 125.3 (q, J = 282.0 Hz), 125.2, 125.0, 124.1, 124.8, 116.7, 74.0 (q, J = 30.1 Hz), 34.7, 22.1.^{19}F NMR (377 MHz, $CDCl_3$) δ -79.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{12}F_3NONa^+$ $(M+Na)^+$ 326.0763, found 326.0764.


7.794
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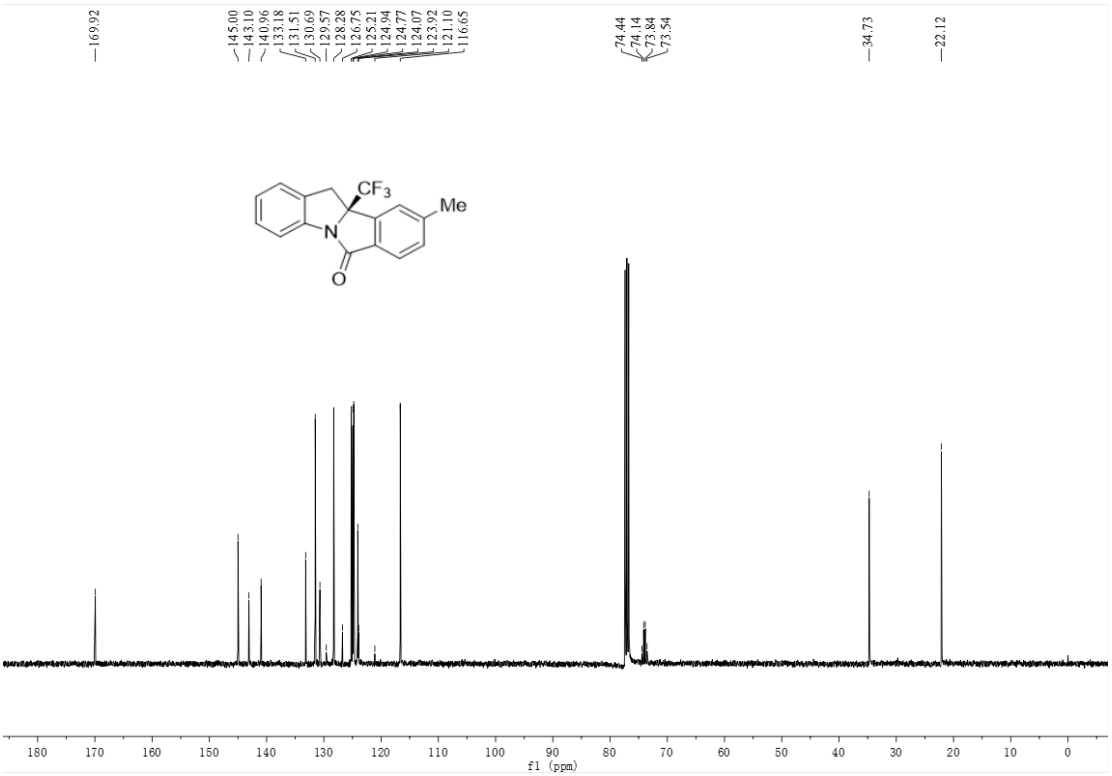
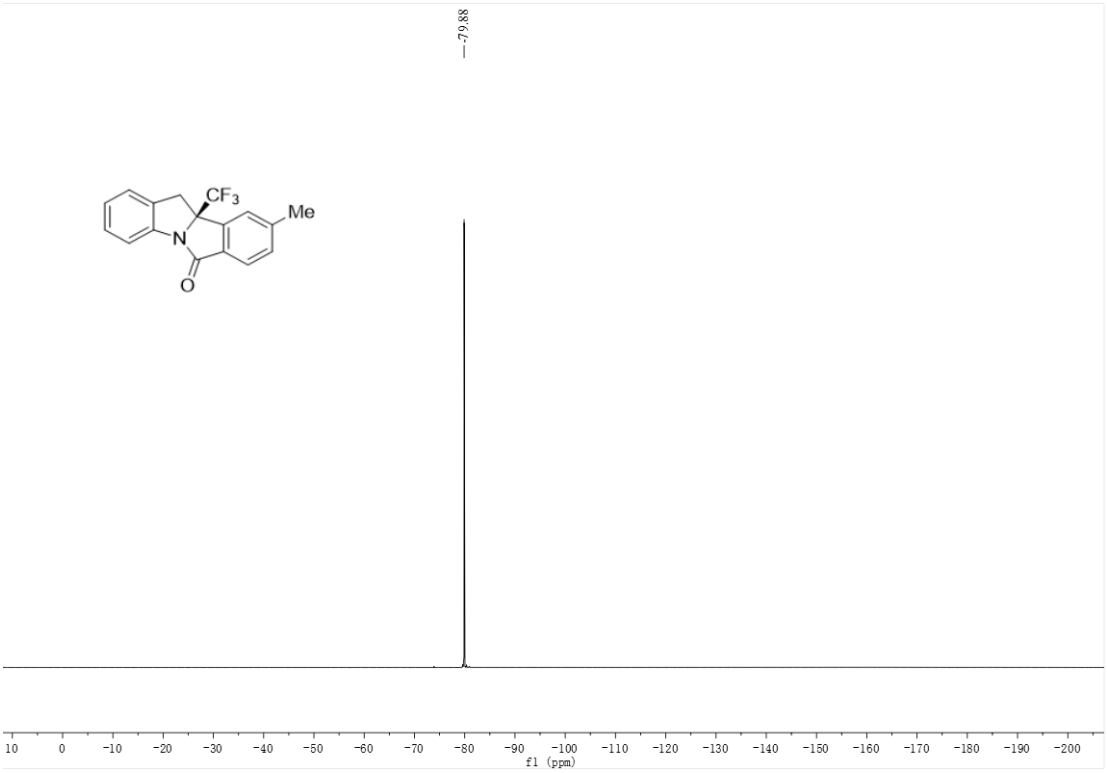
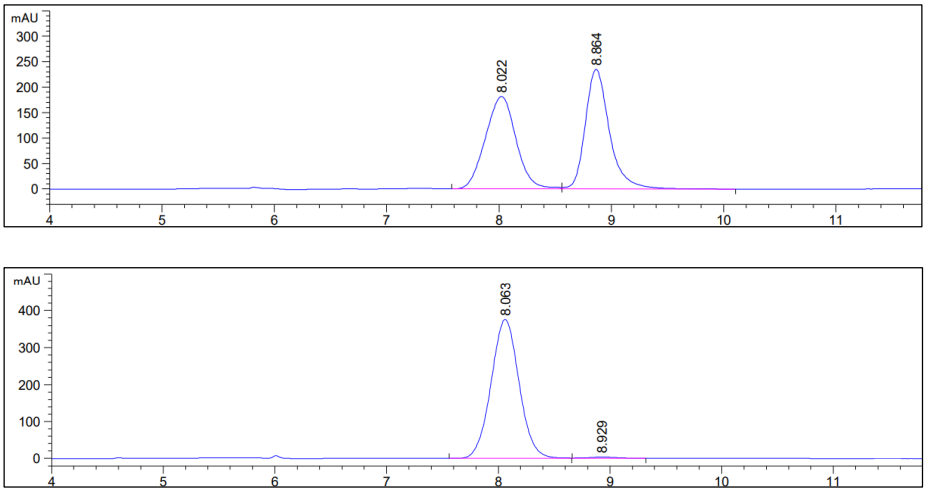
7.425
7.404
7.385
7.316
7.297
7.278
7.226
7.208
7.113
7.110
7.094
7.091
7.076
7.073
3.719
3.678
3.432
3.391
2.506
CF3
Me
N
O
0.99
0.99
1.99
1.01
0.99
0.98
1.00
1.00
2.99
f1 (ppm)

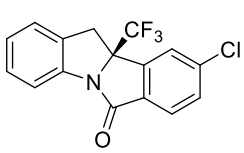

169.92
145.00
143.10
140.96
133.18
131.51
130.69
129.57
128.28
126.75
125.21
124.94
124.77
124.07
123.92
121.10
116.65
74.44
74.14
73.84
73.54
34.73
22.12
CF3
Me
N
O
f1 (ppm)



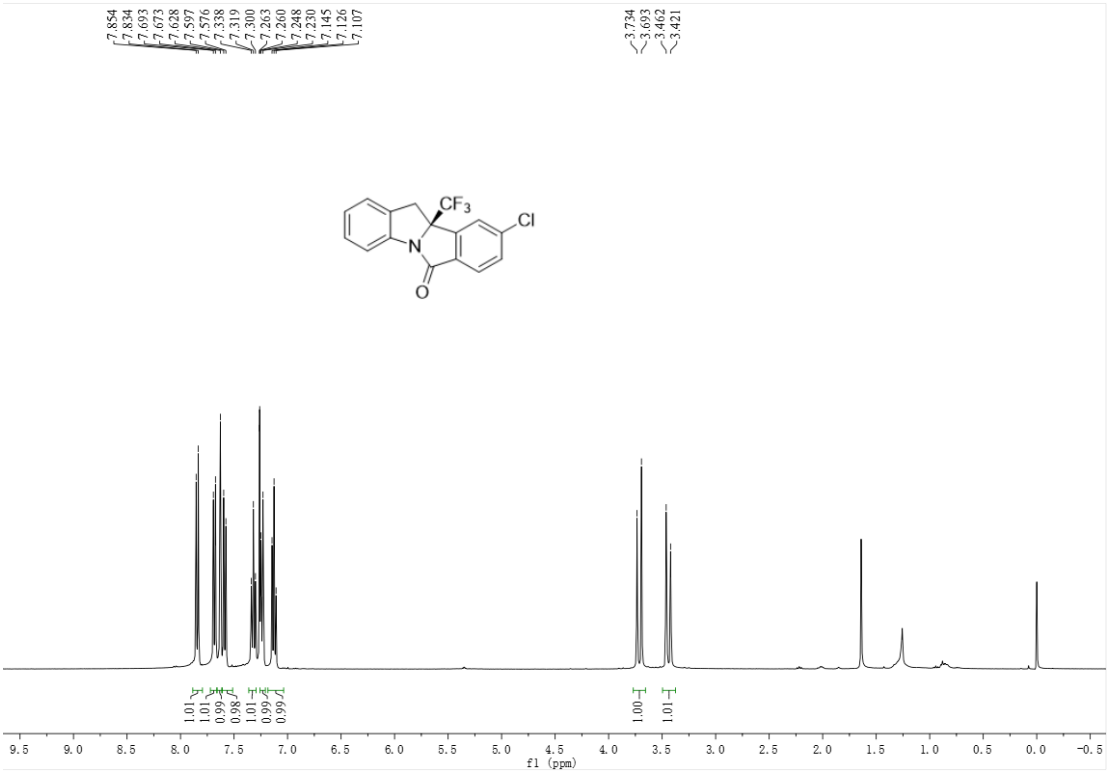


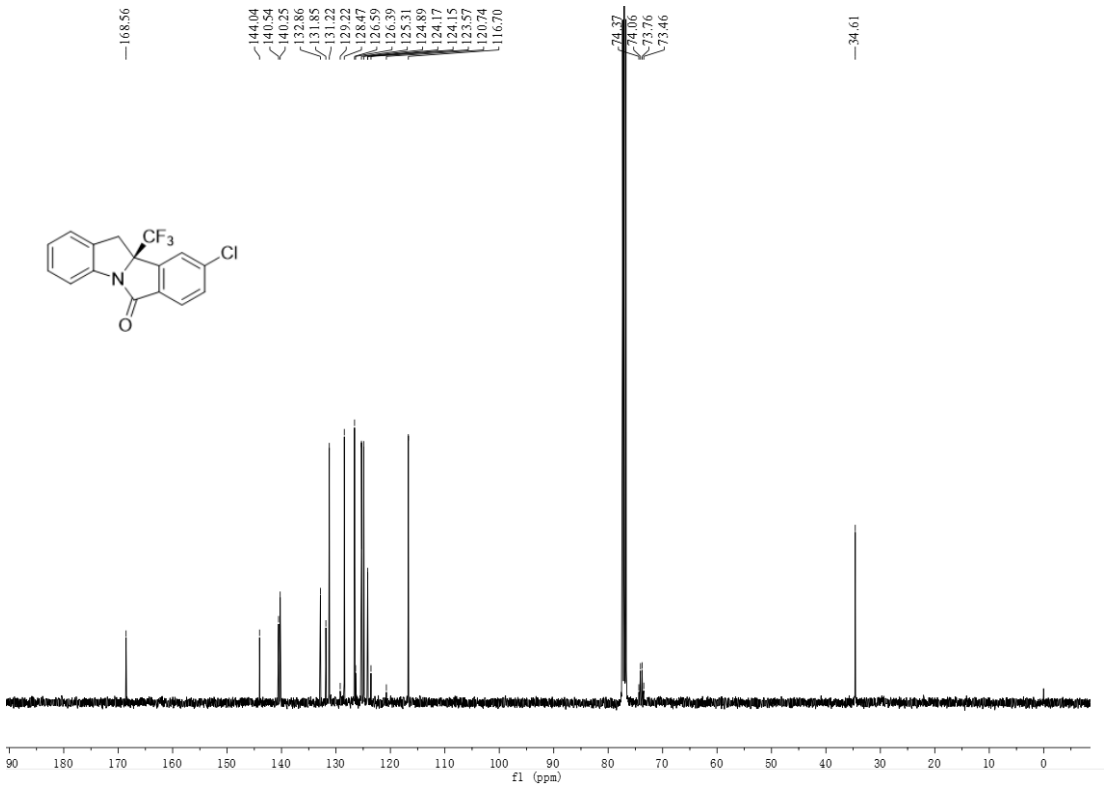
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.063	BB	0.2695	6533.57520	374.56882	99.2528
2	8.929	BB	0.2463	49.18355	3.07998	0.7472

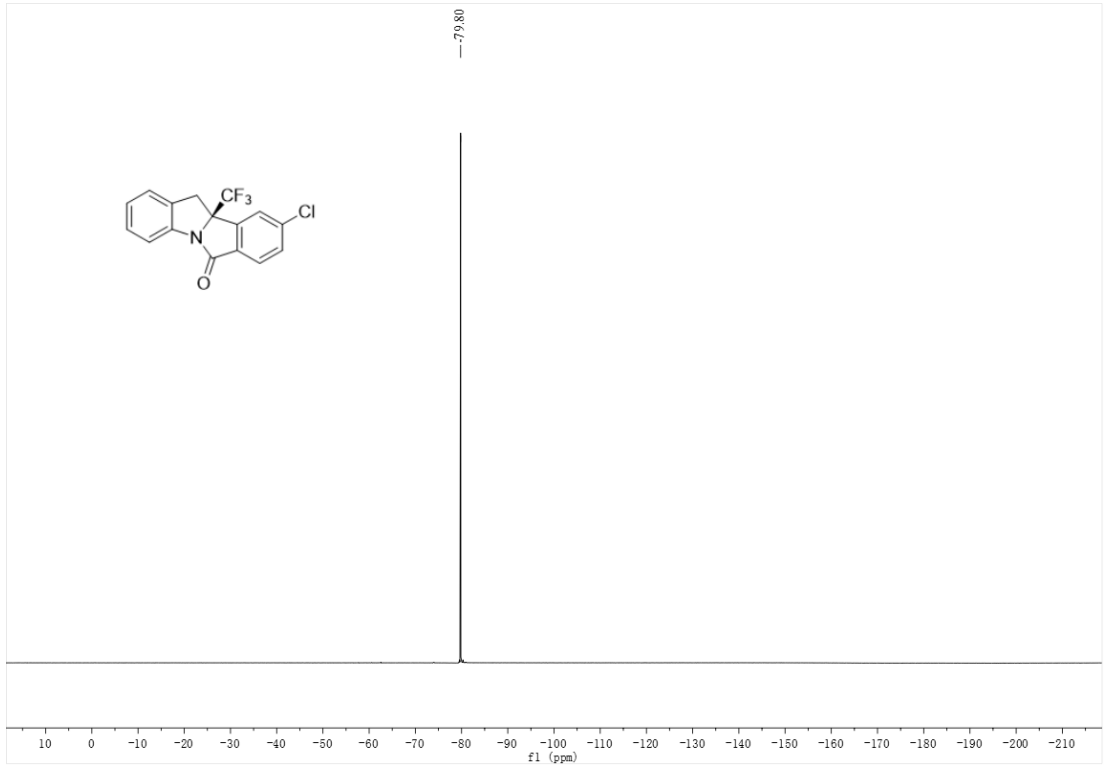
(R)-9-chloro-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2d):

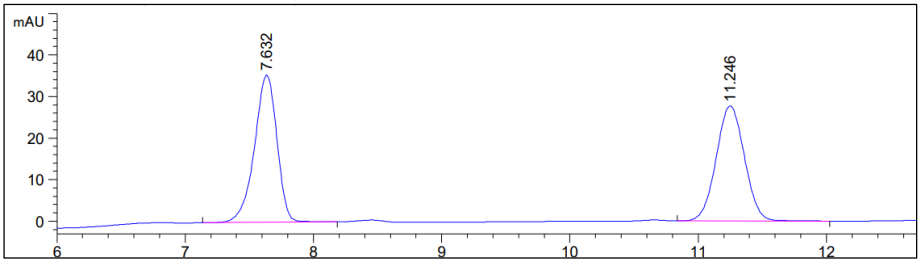


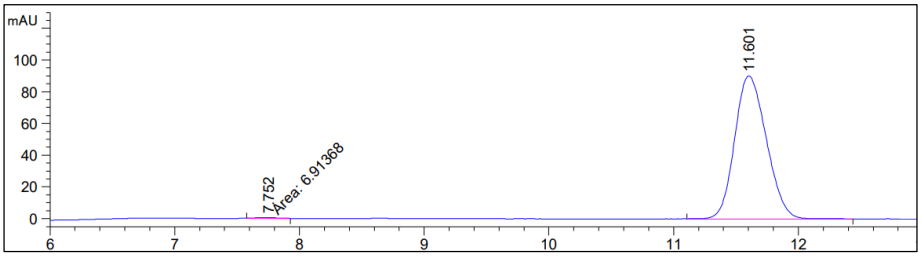
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (41% yield), m.p. 103-105 ℃. $[\alpha]_D^{20}$ = +177.3 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak C4 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.7 mL/min, 280 nm; t_{minor} = 7.8 min, t_{major} = 11.6 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (d, J = 8.1 Hz, 1H), 7.68 (d, J = 7.9 Hz, 1H), 7.63 (s, 1H), 7.59 (d, J = 8.2 Hz, 1H), 7.32 (t, J = 7.7 Hz, 1H), 7.26-7.23 (m, 1H), 7.13 (t, J = 7.8 Hz, 1H), 3.71 (d, J = 16.5 Hz, 1H), 3.44 (d, J = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.7, 144.0, 140.5, 140.3, 132.9, 131.9, 131.2, 128.5, 126.6, 125.3, 125.0 (q, J = 282.0 Hz), 124.9, 124.2, 116.7, 73.9 (q, J = 30.0 Hz), 34.6. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.8 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_9ClF_3NONa^+$ $(M+Na)^+$ 346.0217, found 346.0216.




168.56
144.04
140.54
140.25
132.86
131.85
131.22
129.22
128.47
126.59
126.39
125.31
124.89
124.17
124.15
123.57
120.74
116.70
74.37
74.06
73.76
73.46
34.61
CF3
Cl
N
O
f1 (ppm)

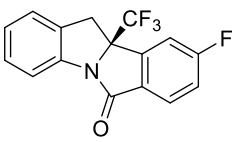

79.80
CF3
Cl
N
O
f1 (ppm)



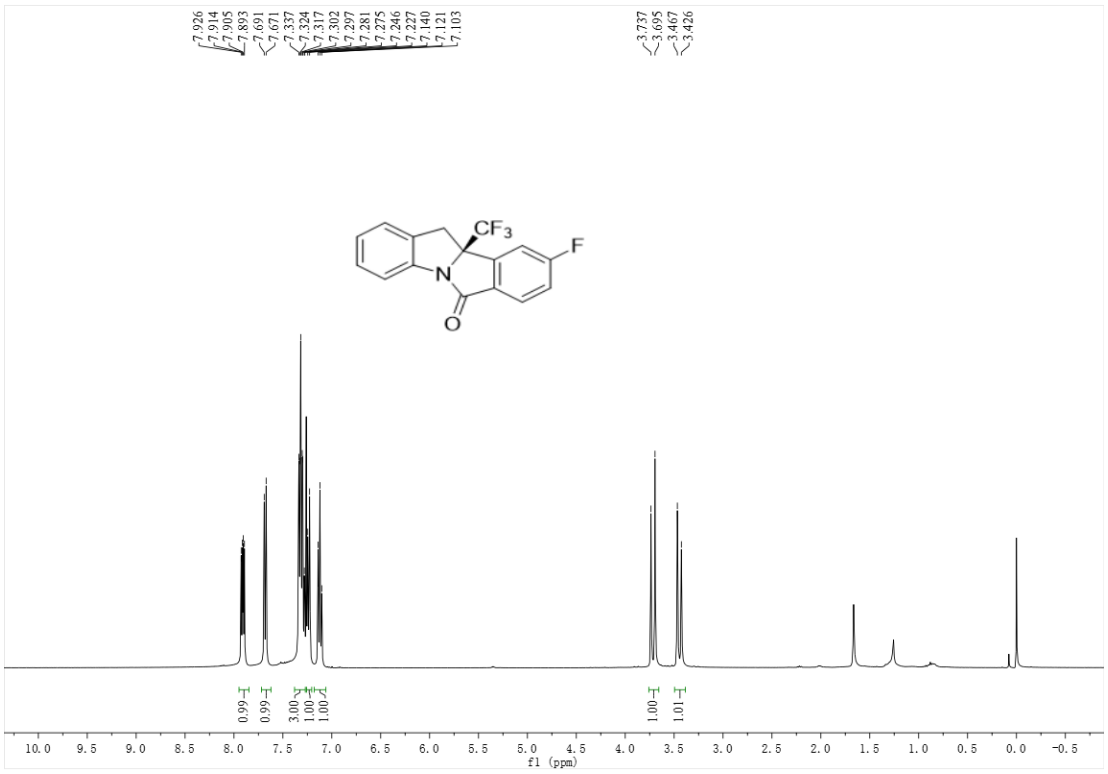


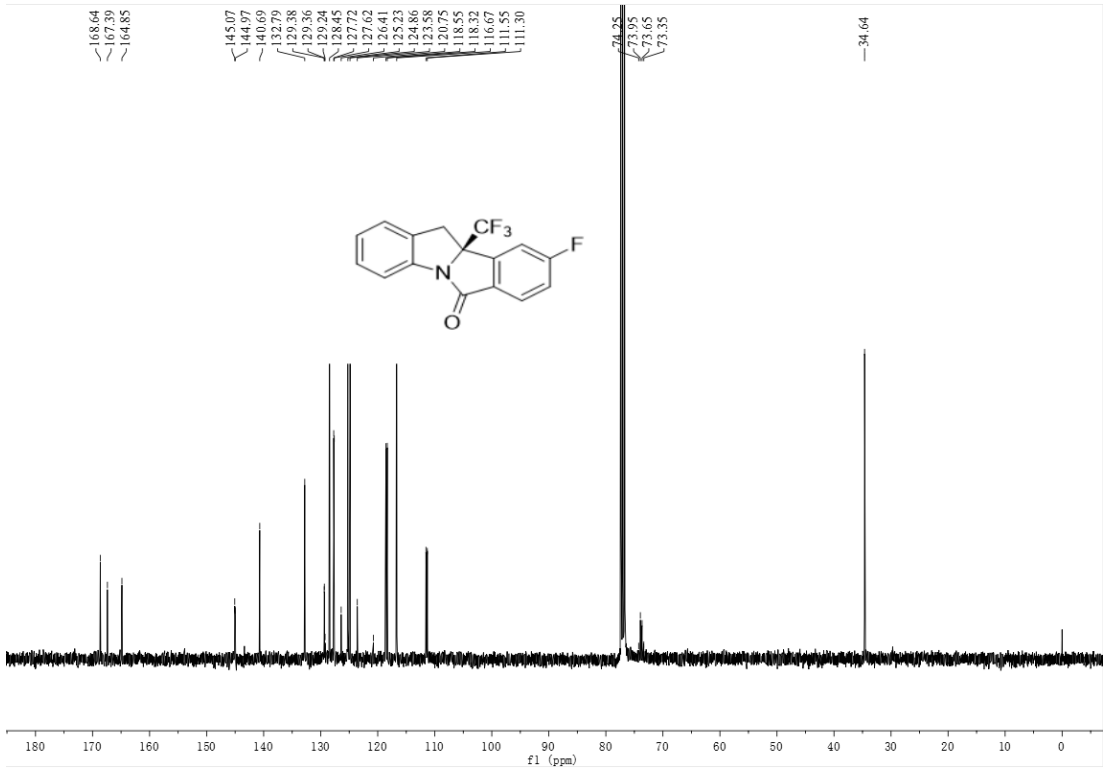
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.752	MM	0.2034	6.91368	5.66398e-1	0.4328
2	11.601	BB	0.2780	1590.40479	90.08007	99.5672

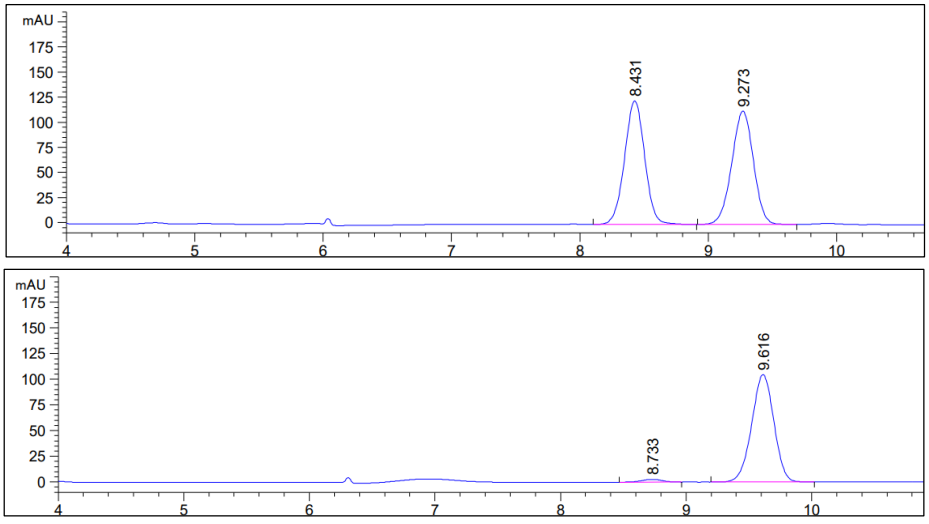
(R)-9-fluoro-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2e):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (48% yield), m.p. 118-120 ℃. $[\alpha]_D^{20}$ = +137.4 (c 0.5, CH_2Cl_2), 95% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.7 mL/min, 280 nm; t_{minor} = 8.7 min, t_{major} = 9.6 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (dd, J = 8.4, 5.0 Hz, 1H), 7.68 (d, J = 7.8 Hz, 1H), 7.33-7.27 (m, 3H), 7.23 (d, J = 7.5 Hz, 1H), 7.12 (t, J = 7.5 Hz, 1H), 3.71 (d, J = 16.5 Hz, 1H), 3.44 (d, J = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.6, 166.1 (d, J = 254.0 Hz), 145.1, 145.0, 140.7, 132.8, 129.4 (d, J = 10.0 Hz), 128.5, 127.7 (d, J = 40.0 Hz), 125.3 (d, J = 37.0 Hz), 125.0 (q, J = 283.0 Hz), 118.6 (d, J = 23.0 Hz), 116.7, 111.5 (d, J = 25.0 Hz), 74.8 (q, J = 30.0 Hz), 34.6. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.9, -102.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_9F_4NONa^+$ $(M+Na)^+$ 330.0513, found 330.0513.

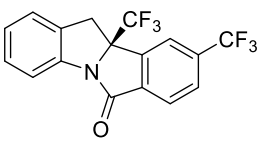

7.926
7.914
7.905
7.893
7.691
7.671
7.337
7.324
7.317
7.302
7.297
7.281
7.275
7.246
7.227
7.140
7.121
7.103
3.737
3.695
3.467
3.426
CF3
F
N
O
0.99
0.99
3.00
1.00
1.00
1.00
1.01
f1 (ppm)


168.64
167.39
164.85
145.07
144.97
140.69
132.79
129.38
129.36
129.24
128.45
127.72
127.62
126.41
125.23
124.86
123.58
120.75
118.55
118.32
116.67
111.55
111.30
74.25
73.95
73.65
73.35
34.64
CF3
F
N
O
f1 (ppm)



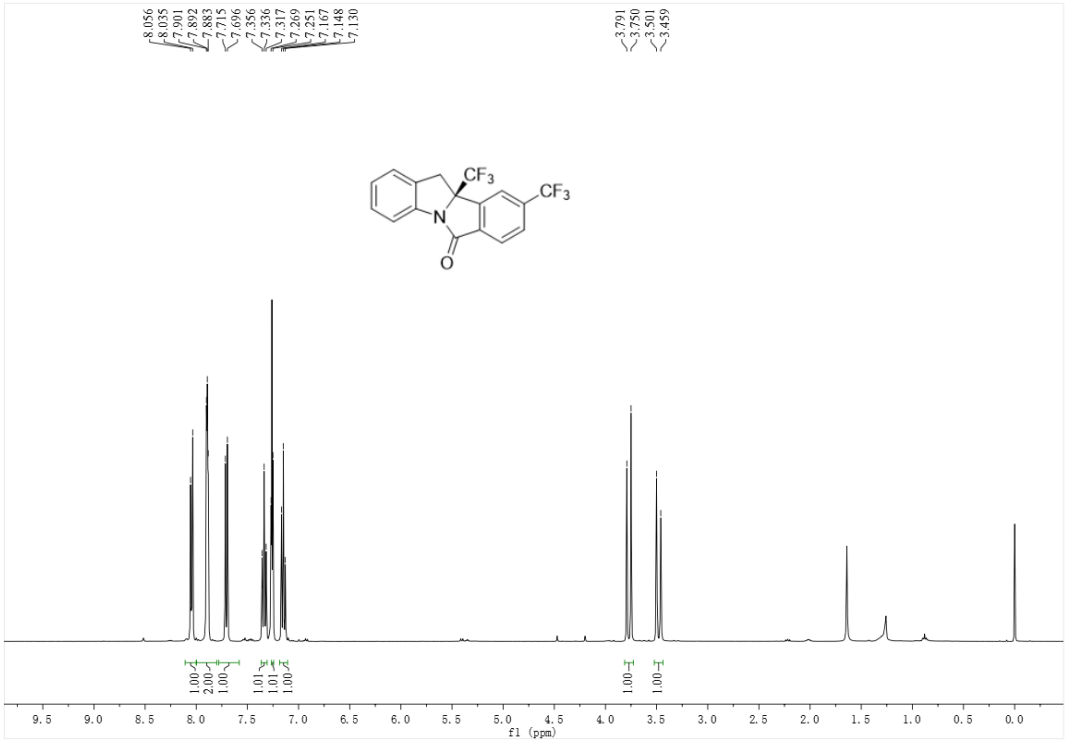
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.733	BB	0.1692	30.54169	2.71653	2.3168
2	9.616	BB	0.1917	1287.71155	104.58039	97.6832

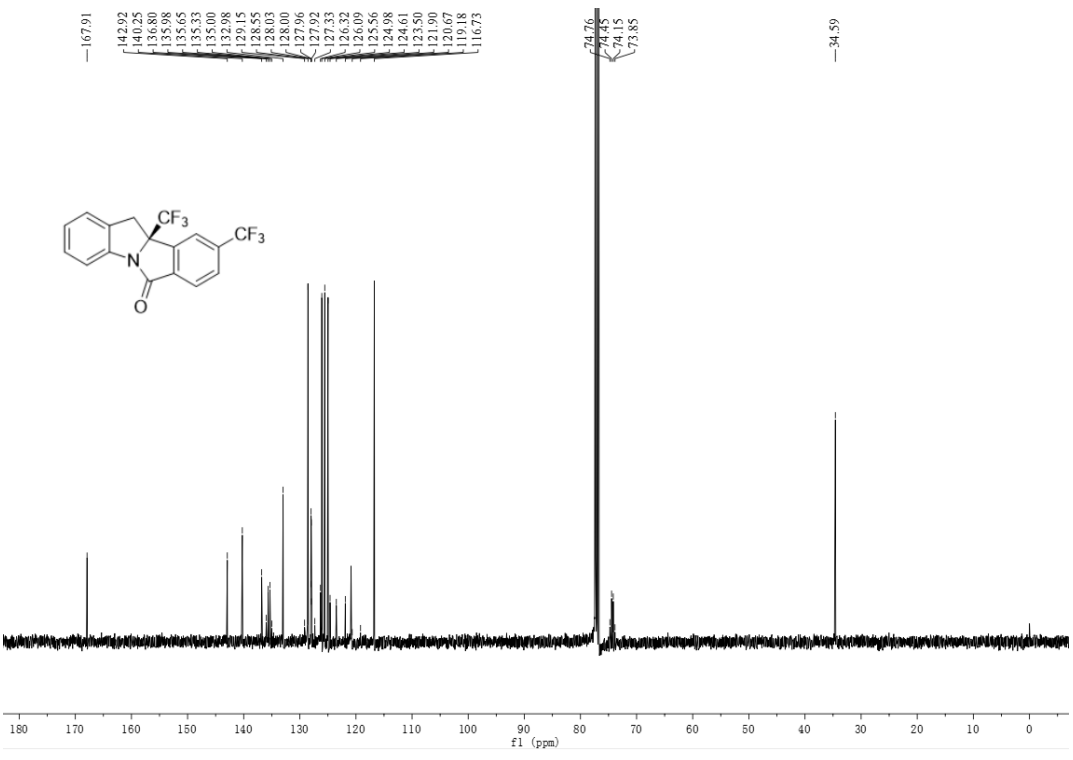
(R)-9-Trifluoromethyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2f):

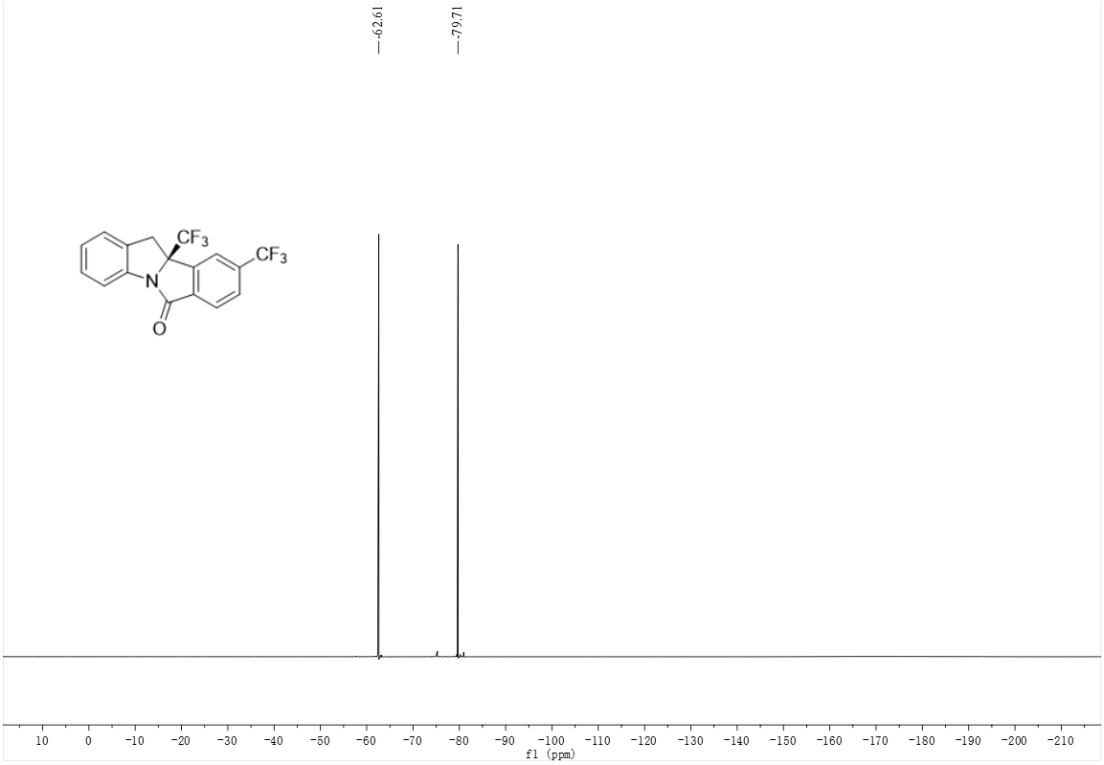


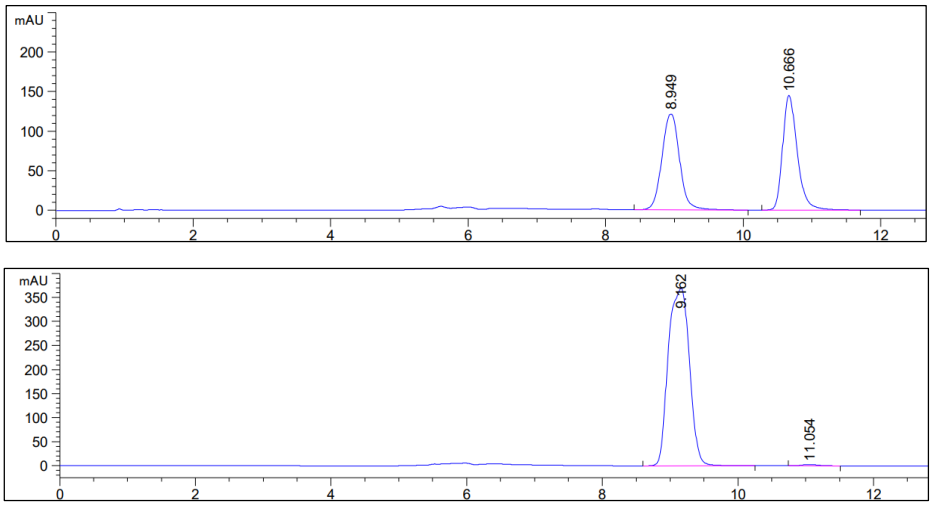
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (51% yield), m.p. 111-113 ℃. $[\alpha]_D^{20}$ = +164.5 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak OJ-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{major} = 9.2 min, t_{minor} = 11.1 min]. ^{1}H NMR (400 MHz,

$CDCl_3$) δ 8.04 (d, J = 8.3 Hz, 1H), 7.90-7.88 (m, 2H), 7.70 (d, J = 7.8 Hz, 1H), 7.33 (t, J = 7.7 Hz, 1H), 7.26 (d, J = 7.3 Hz, 1H), 7.14 (t, J = 7.4 Hz, 1H), 3.77 (d, J = 16.5 Hz, 1H), 3.48 (d, J = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.9, 142.9, 140.2, 136.8, 135.5 (q, J = 33.0 Hz), 133.0, 129.2, 128.6, 128.0 (q, J = 4.0 Hz), 126.1, 125.6, 125.0, 124.9 (q, J = 282.0 Hz), 123.3 (q, J = 271.0 Hz), 116.7, 74.5 (q, J = 30.0 Hz), 34.6. ^{19}F NMR (377 MHz, $CDCl_3$) δ -62.6, -79.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_9F_6NONa^+$ $(M+Na)^+$ 380.0481, found 380.0481.



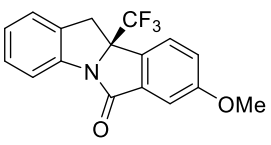






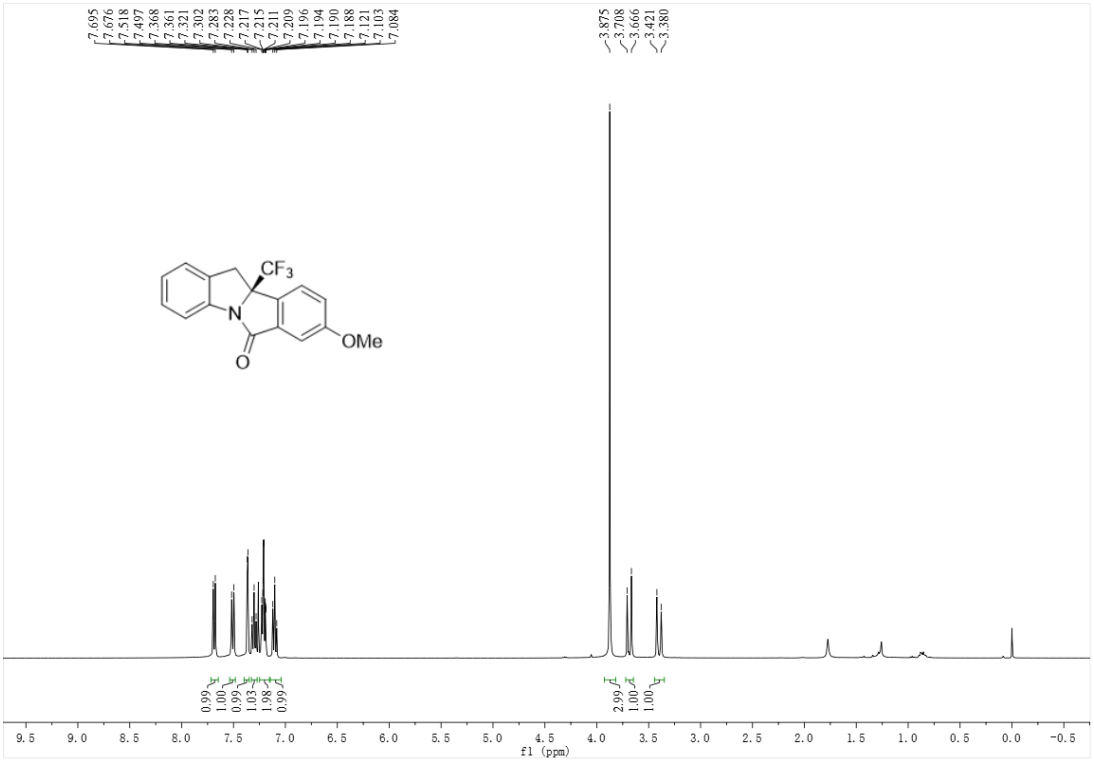
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.162	BB	0.3039	7975.59277	369.42911	99.4798
2	11.054	BB	0.2427	41.70782	2.63448	0.5202

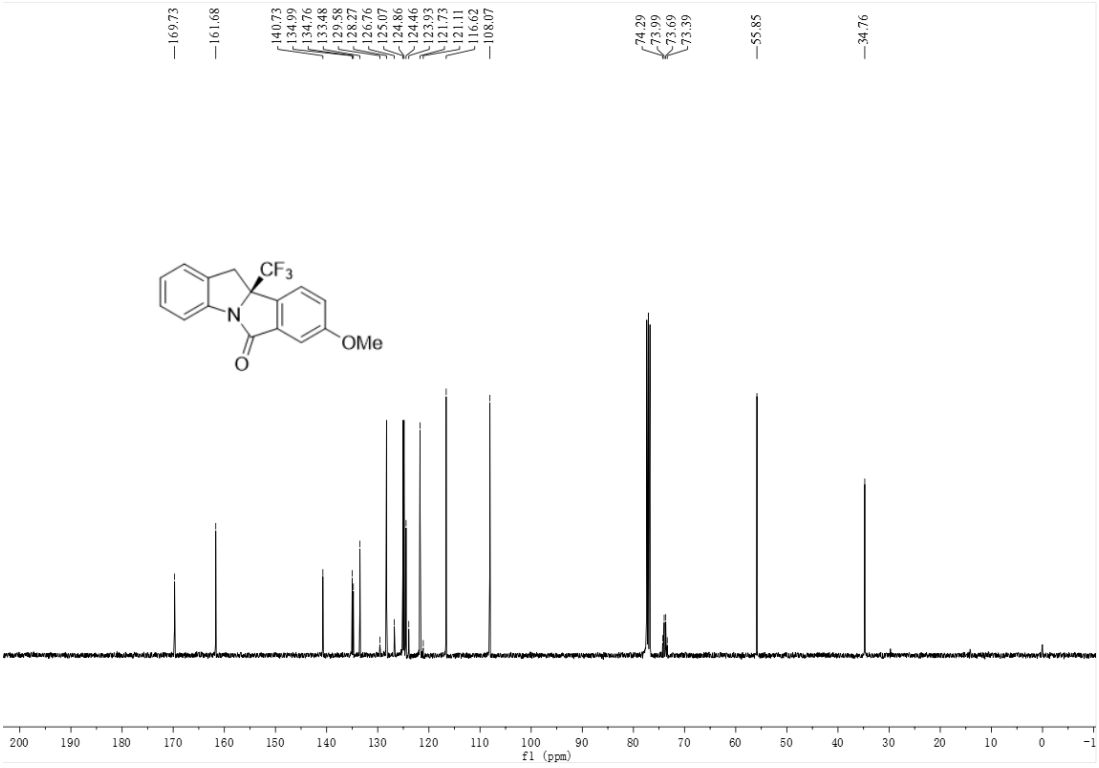
(R)-8-methyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2g):

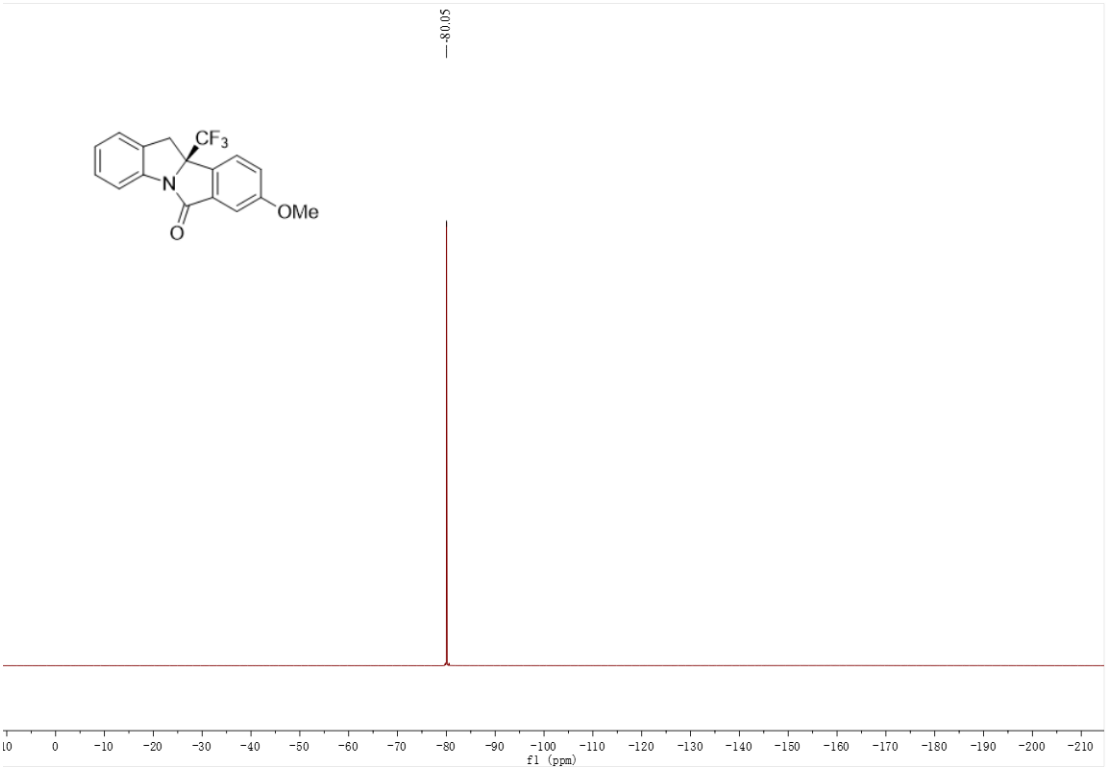


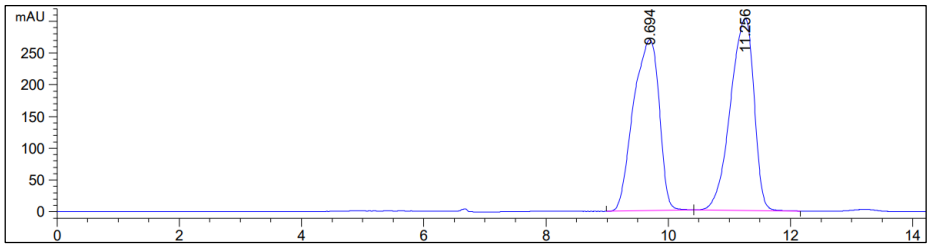
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless oil (68% yield). $[\alpha]_D^{20}$ = +119.2 (c 0.5, CH_2Cl_2), 91% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.7 mL/min, 280 nm; t_{minor} = 9.2 min, t_{major} = 10.9 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68

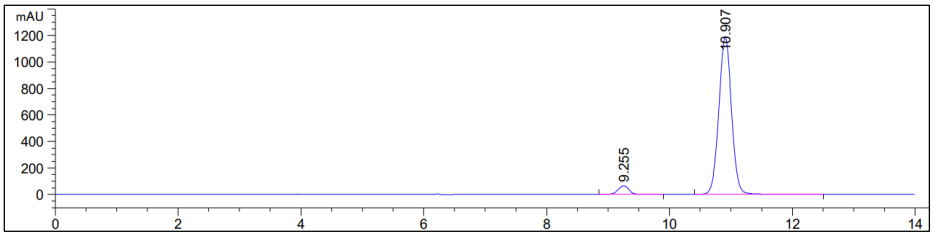
(d, *J* = 8.0 Hz, 1H), 7.50 (d, *J* = 8.4 Hz, 1H), 7.36 (d, *J* = 2.8 Hz, 1H), 7.30 (t, *J* = 7.7 Hz, 1H), 7.22-7.18 (m, 2H), 7.10 (t, *J* = 7.2 Hz, 1H), 3.88 (s, 3H), 3.68 (d, *J* = 16.5 Hz, 1H), 3.40 (d, *J* = 16.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.7, 161.7, 140.7, 135.0, 134.8, 133.5, 128.3, 125.3 (q, *J* = 282.0 Hz), 125.1, 124.9, 124.5, 121.7, 116.6, 108.1, 73.8 (q, *J* = 30.0 Hz), 55.9, 34.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -80.1 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{12}F_3NONa^+$ $(M+Na)^+$ 342.0712, found 342.0714.





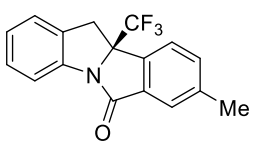






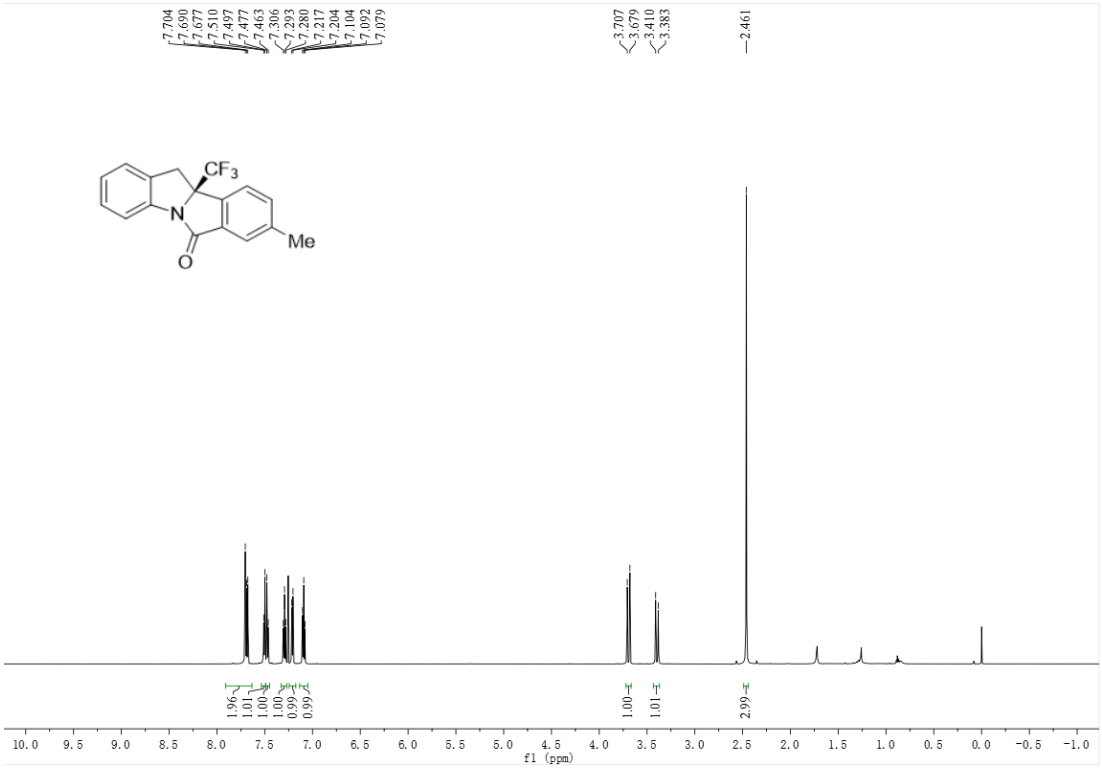
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.255	BB	0.1849	773.66467	64.98856	4.3535
2	10.907	BB	0.2209	1.69975e4	1188.04724	95.6465

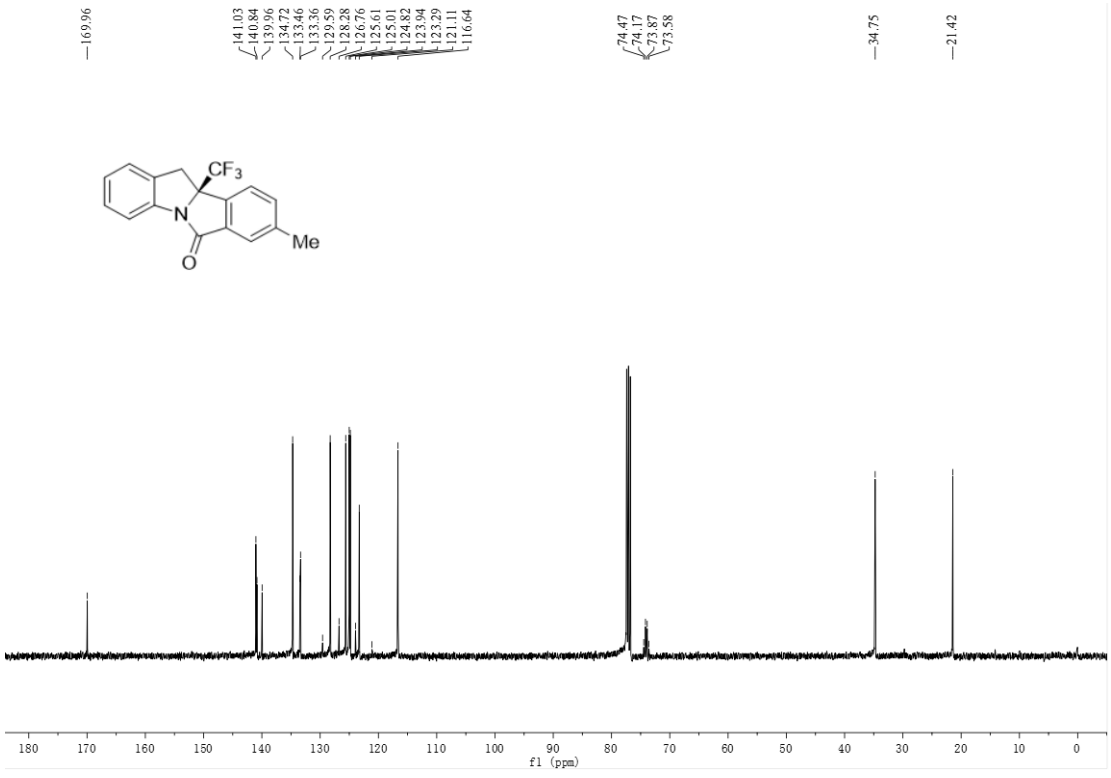
(R)-8-methyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2h):

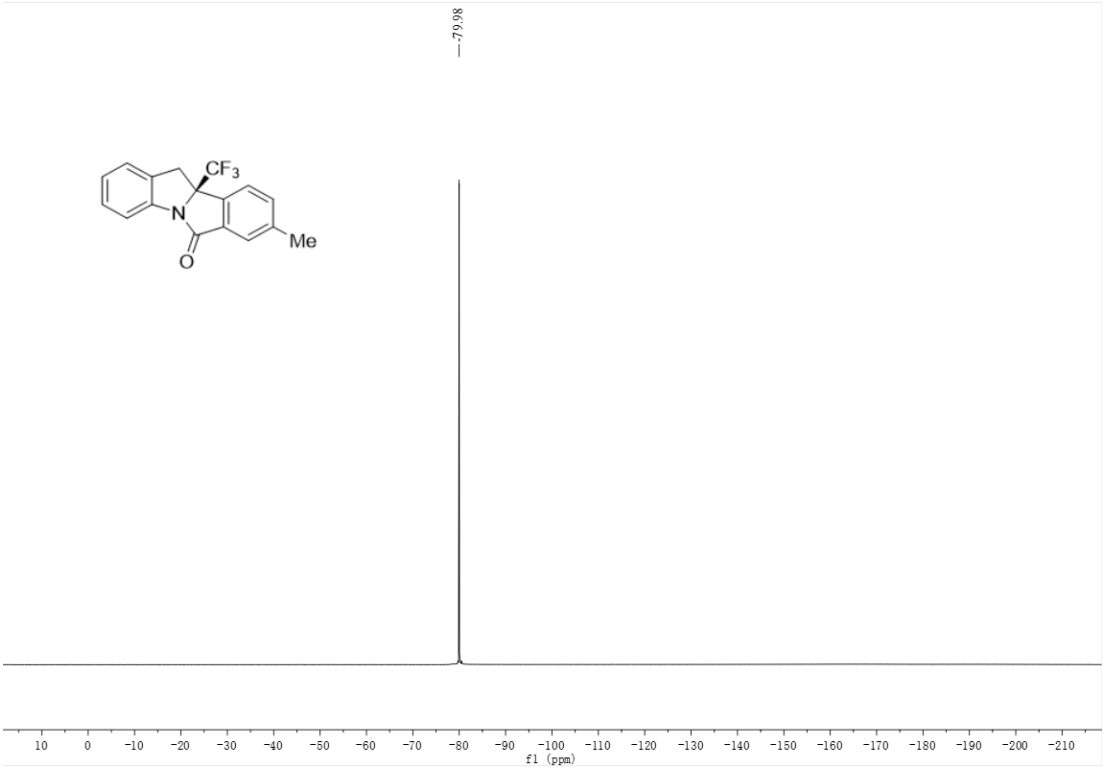


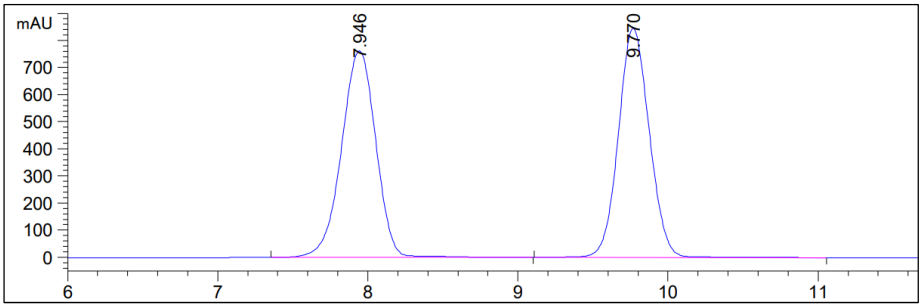
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless oil (71% yield). $[\alpha]_D^{20}$ = +179.0 (c 0.5, CH_2Cl_2), 98% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.7 mL/min, 280 nm; t_{minor} = 8.2 min, t_{major} = 10.0 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.69 (t, J = 7.8 Hz, 2H), 7.50 (d, J = 7.8 Hz , 1H), 7.47 (d, J = 7.8 Hz , 1H), 7.29 (t, J = 7.8

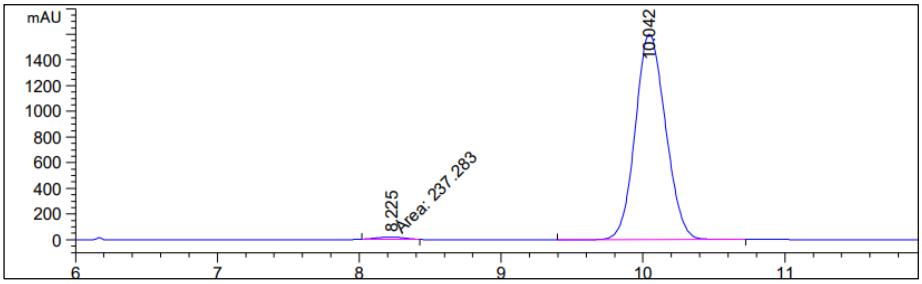
Hz, 1H), 7.21 (d, *J* = 7.8 Hz, 1H), 7.09 (t, *J* = 7.5 Hz, 1H), 3.69 (d, *J* = 16.4 Hz, 1H), 3.40 (d, *J* = 16.4 Hz, 1H), 2.46 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.0, 141.0, 140.8, 140.0, 134.7, 133.5, 133.4, 128.3, 125.6, 125.3 (q, *J* = 282.0 Hz), 125.0, 124.8, 123.3, 116.6, 74.0 (q, *J* = 30.0 Hz), 34.8, 21.4. ^{19}F NMR (377 MHz, $CDCl_3$) δ -80.0 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{12}F_3NONa^+$ $(M+Na)^+$ 326.0763, found 326.0764.





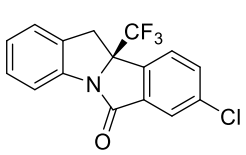




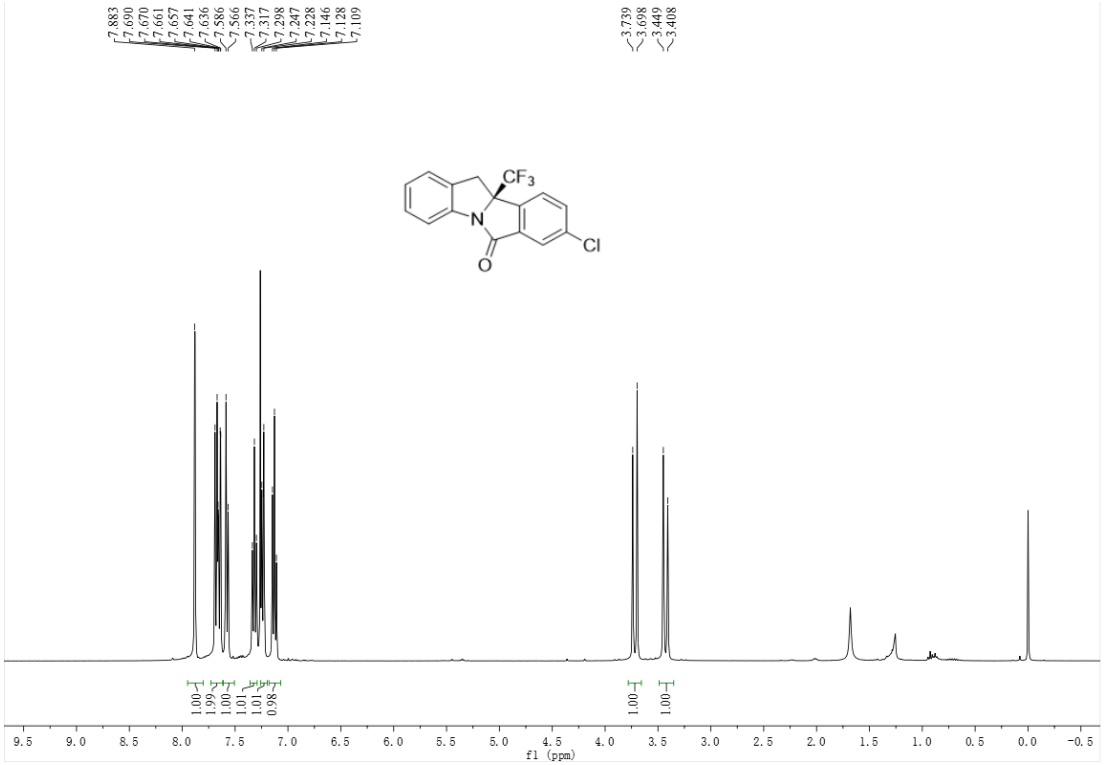


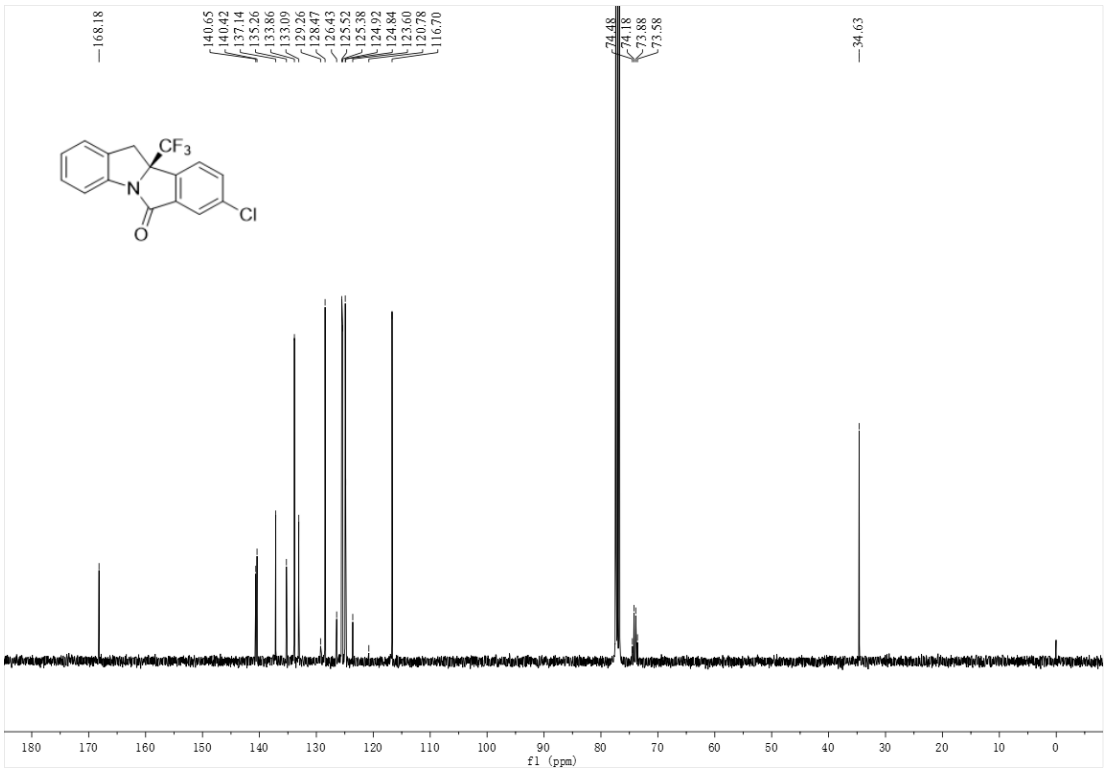
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.225	MM	0.2203	237.28329	17.95410	0.9909
2	10.042	BB	0.2288	2.37095e4	1601.03760	99.0091

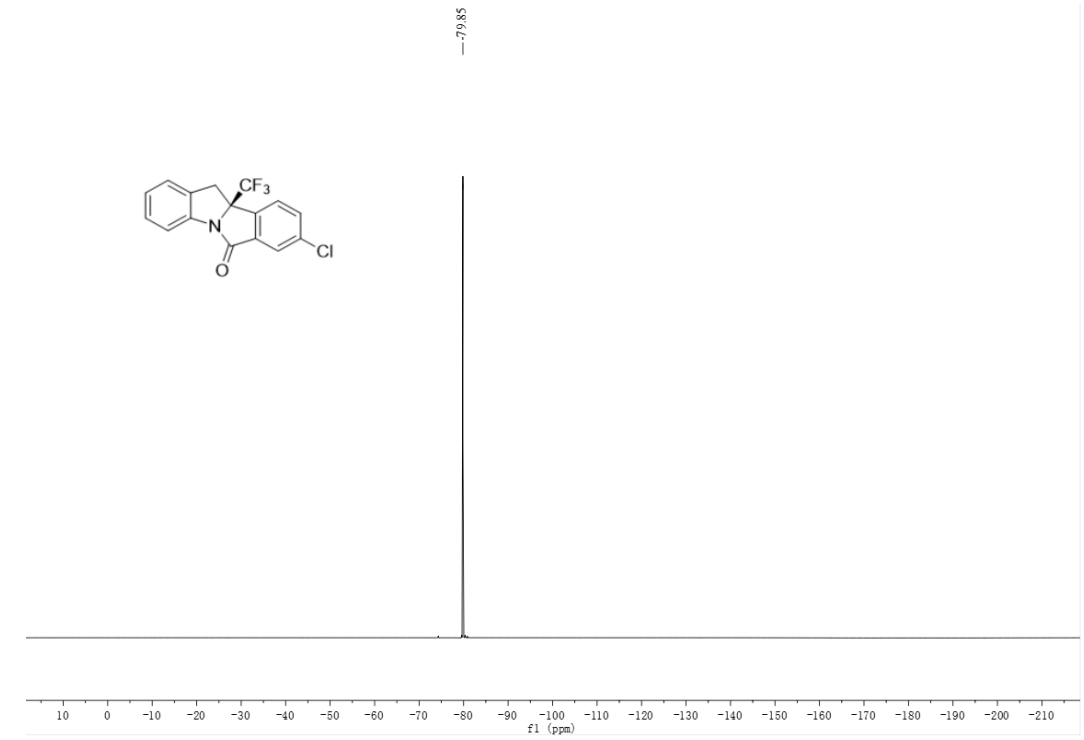
(R)-8-chloro-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2i):

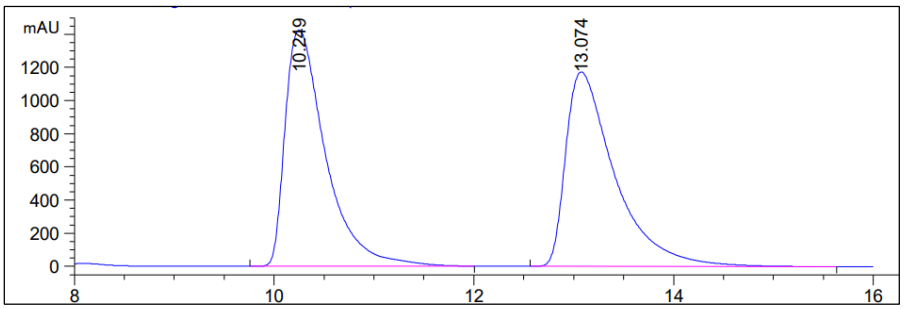


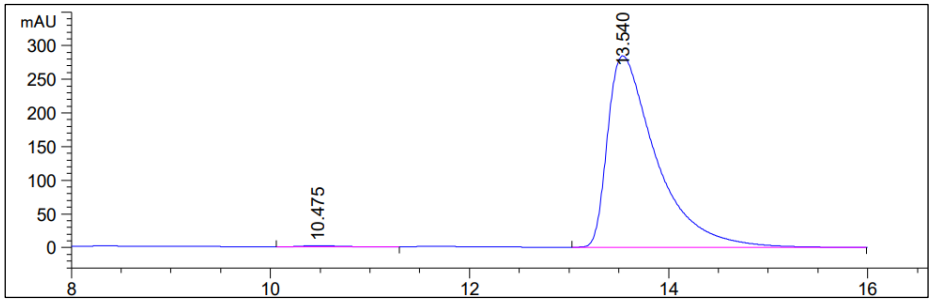
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (65% yield), m.p. 102-104 ℃. $[\alpha]_D^{20}$ = +82.4 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak AD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{minor} = 10.5 min, t_{major} = 13.5 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 (s, 1H), 7.69-7.63 (m, 2H), 7.57 (d, J = 8.2 Hz, 1H), 7.31 (t, J = 7.7 Hz, 1H), 7.23 (d, J = 7.5 Hz, 1H), 7.12 (d, J = 7.5 Hz, 1H), 3.71 (d, J = 16.5 Hz, 1H), 3.43 (d, J = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.2, 140.7, 140.4, 137.1, 135.3, 133.9, 133.1, 128.5, 125.5, 125.4, 125.0 (q, J = 282.0 Hz), 124.9, 124.8, 116.7, 74.0 (q, J = 30.0 Hz), 34.6. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.9 ppm. HRMS m/z (ESI+): Calcd for $C_{16}H_9ClF_3NONa^+$ $(M+Na)^+$ 346.0217, found 346.0216.




168.18
140.65
140.42
137.14
135.26
133.86
133.09
129.26
128.47
126.43
125.52
125.38
124.92
124.84
123.60
120.78
116.70
74.48
74.18
73.88
73.58
34.63
CF3
N
O
Cl
f1 (ppm)

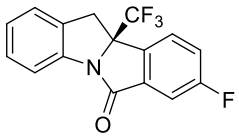

-79.85
CF3
N
O
Cl
f1 (ppm)


mAU
10.249
13.074

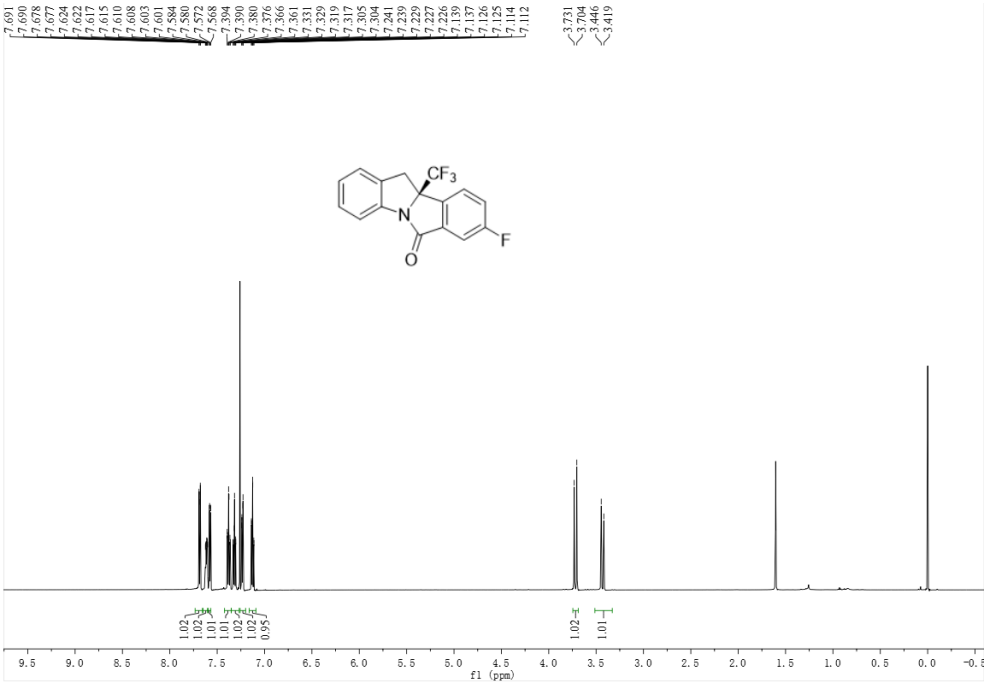


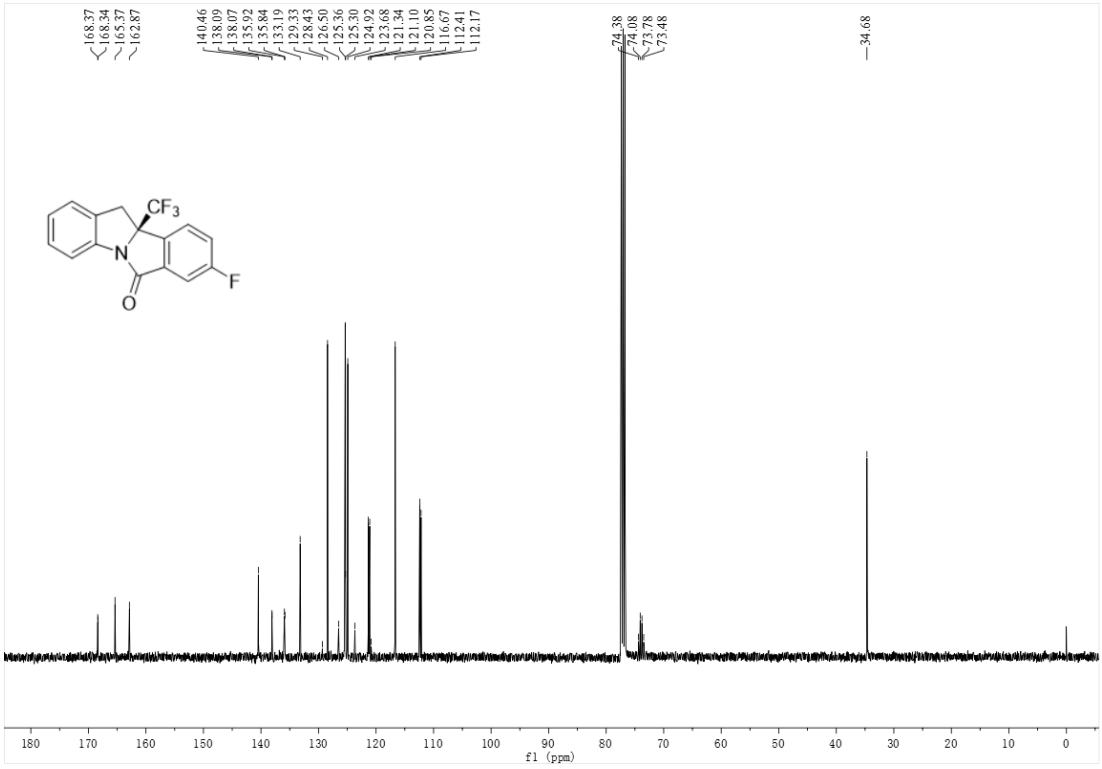
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.475	BB	0.3106	46.70729	1.82469	0.4826
2	13.540	BBA	0.5036	9631.70410	284.08432	99.5174

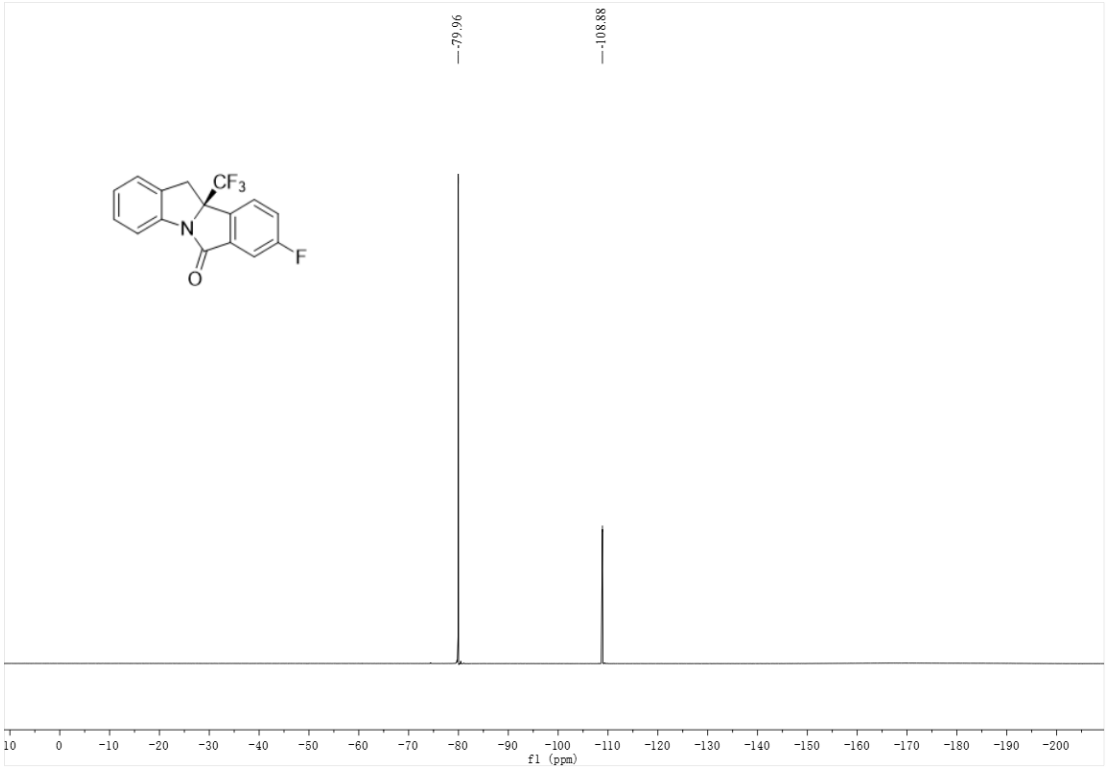
(R)-8-Fluoro-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2j):

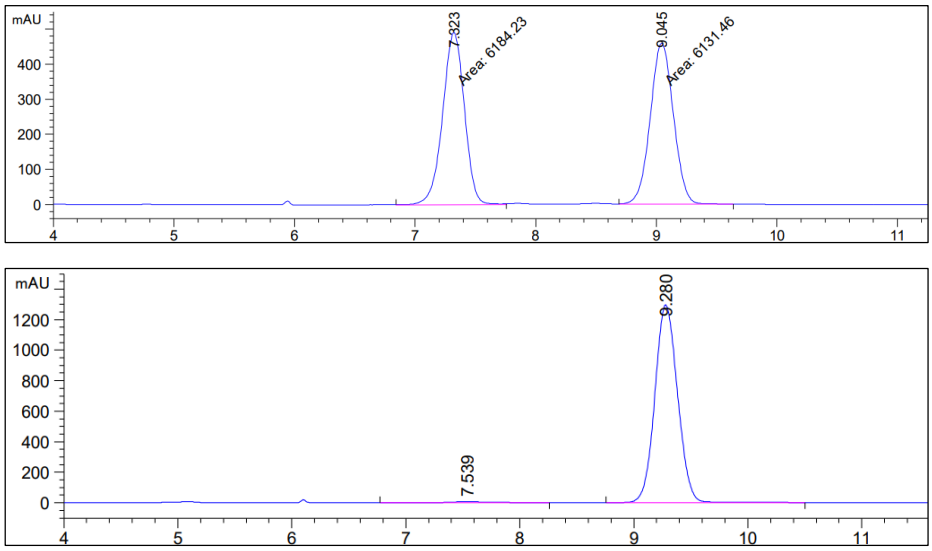


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless oil (67% yield). $[\alpha]_D^{20}$ = +92.0 (c 0.5, CH_2Cl_2), 98% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.7 mL/min, 280 nm; t_{minor} = 7.5 min, t_{major} = 9.3 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.68 (dd, J = 7.9, 1.0 Hz, 1H), 7.62-7.60 (m, 1H), 7.58 (dd, J = 7.2, 2.5 Hz, 1H), 7.38 (td, J = 8.5, 2.5 Hz, 1H), 7.33-7.30 (m, 1H), 7.13 (td, J = 7.5, 1.1 Hz, 1H), 3.72 (d, J = 16.4 Hz, 1H), 3.43 (d, J = 16.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.4 (d, J = 3.0 Hz), 161.1 (d, J = 250.0 Hz), 140.5, 138.1 (d, J = 2.0 Hz), 135.9 (d, J = 8.0 Hz), 133.2, 128.4, 125.4, 125.3, 125.1 (q, J = 282.0 Hz), 124.9, 121.2 (d, J = 24.0 Hz), 116.7, 112.4 (d, J = 24.0 Hz), 74.4 (q, J = 30.0 Hz), 34.7. ^{19}F NMR (377 MHz, $CDCl_3$) δ -80.0, -108.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_9F_4NONa^+$ $(M+Na)^+$ 330.0513, found 330.0513.



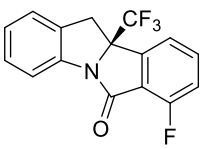

168.37
168.34
165.37
162.87
140.46
138.09
138.07
135.92
135.84
133.19
129.33
128.43
126.50
125.36
125.30
124.92
123.68
121.34
121.10
120.85
116.67
112.41
112.17
74.38
74.08
73.78
73.48
34.68
CF3
N
O
F
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-79.96
-108.88
CF3
N
O
F
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
f1 (ppm)

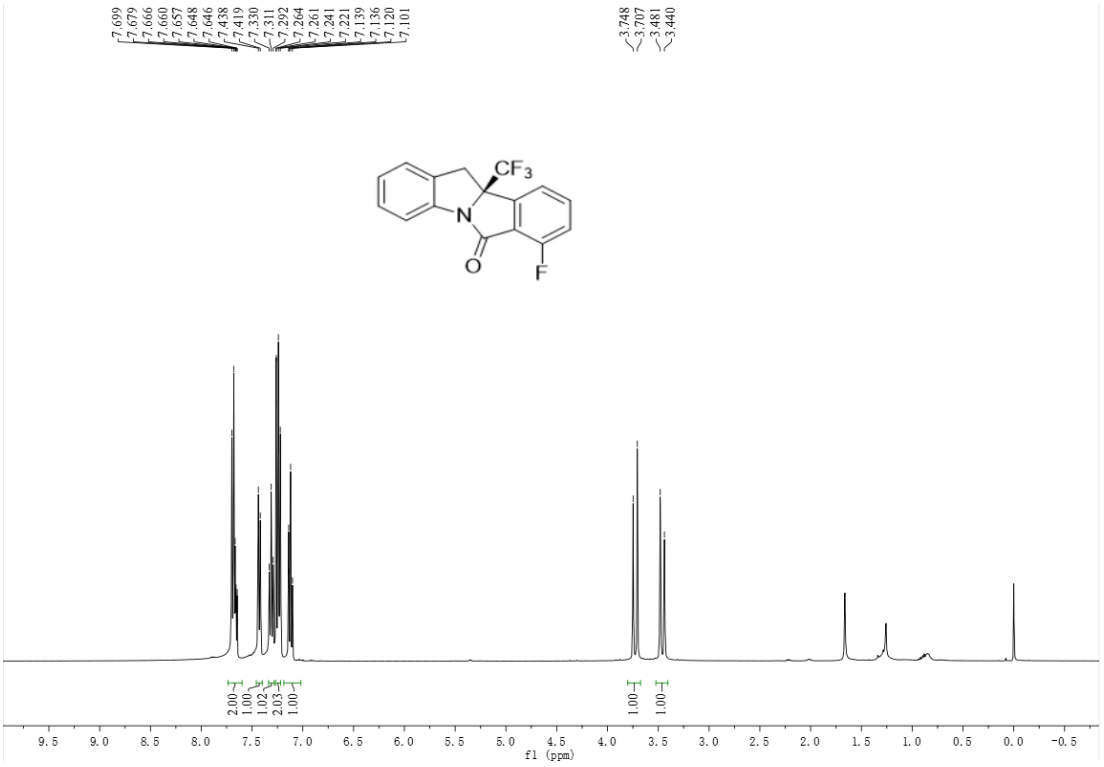


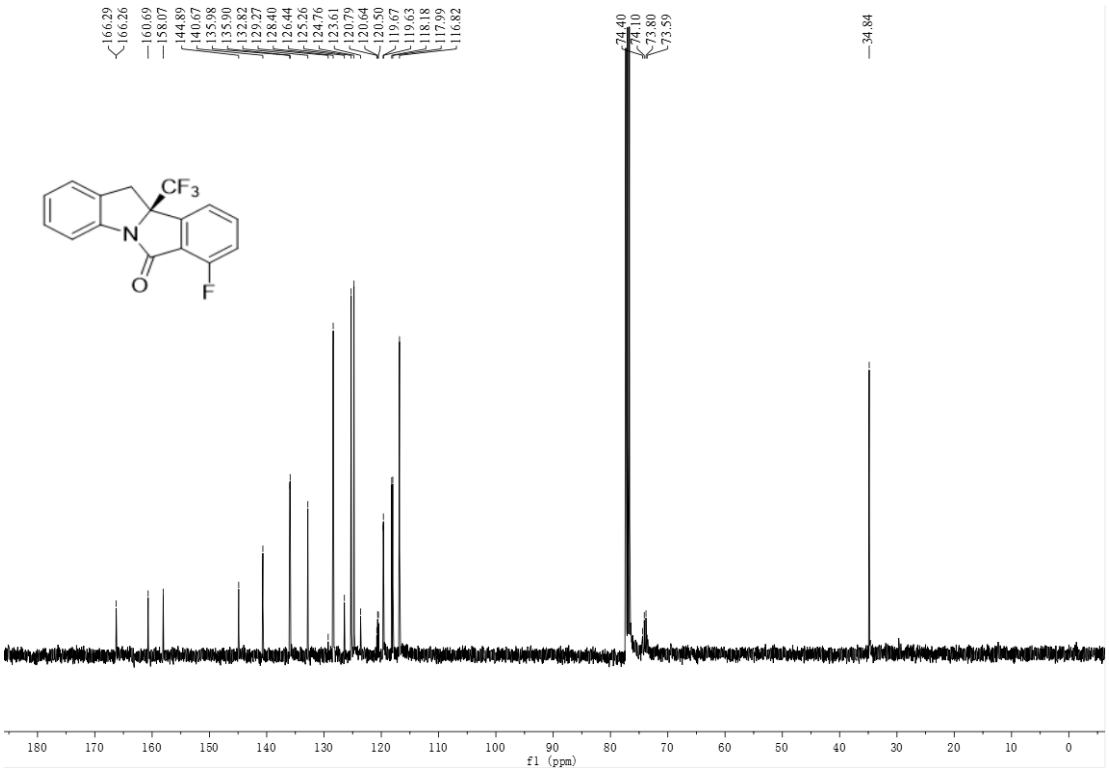
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.539	BB	0.2811	162.63853	8.21159	0.8985
2	9.280	BB	0.2156	1.79388e4	1295.12329	99.1015

(R)-7-Fluoro-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2k):



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (57% yield), m.p. 105-107 ℃. $[\alpha]_D^{20}$ = +117.5 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.7 mL/min, 280 nm; t_{minor} = 10.3 min, t_{major} = 11.8 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69-7.64 (m, 2H), 7.42 (d, J = 7.6 Hz, 1H), 7.31 (t, J = 7.7 Hz, 1H), 7.24 (t, J = 8.0 Hz, 2H), 7.11 (t, J = 7.6 Hz, 1H), 3.73 (d, J = 16.5 Hz, 1H), 3.46 (d, J = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.3 (d, J = 3.0 Hz), 159.4 (d, J = 262.0 Hz), 144.9, 140.7, 135.9 (d, J = 8.0 Hz), 132.8, 128.4, 125.0 (q, J = 282.0 Hz), 125.3, 124.8, 120.6 (d, J = 14.0 Hz), 119.7 (d, J = 4.0 Hz), 118.1 (d, J = 19.0 Hz), 116.8, 74.0 (q, J = 30.0 Hz), 34.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -80.0, -114.2 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_9F_4NONa^+$ $(M+Na)^+$ 330.0513, found 330.0513.


7.699
7.679
7.666
7.660
7.657
7.648
7.646
7.438
7.419
7.330
7.311
7.292
7.264
7.261
7.241
7.221
7.139
7.136
7.120
7.101
3.748
3.707
3.481
3.440
CF3
N
O
F
2.00
1.00
1.02
2.03
1.00
1.00
1.00
f1 (ppm)


166.29
166.26
160.69
158.07
144.89
140.67
135.98
135.90
132.82
129.27
128.40
126.44
125.26
124.76
123.61
120.79
120.64
120.50
119.67
119.63
118.18
117.99
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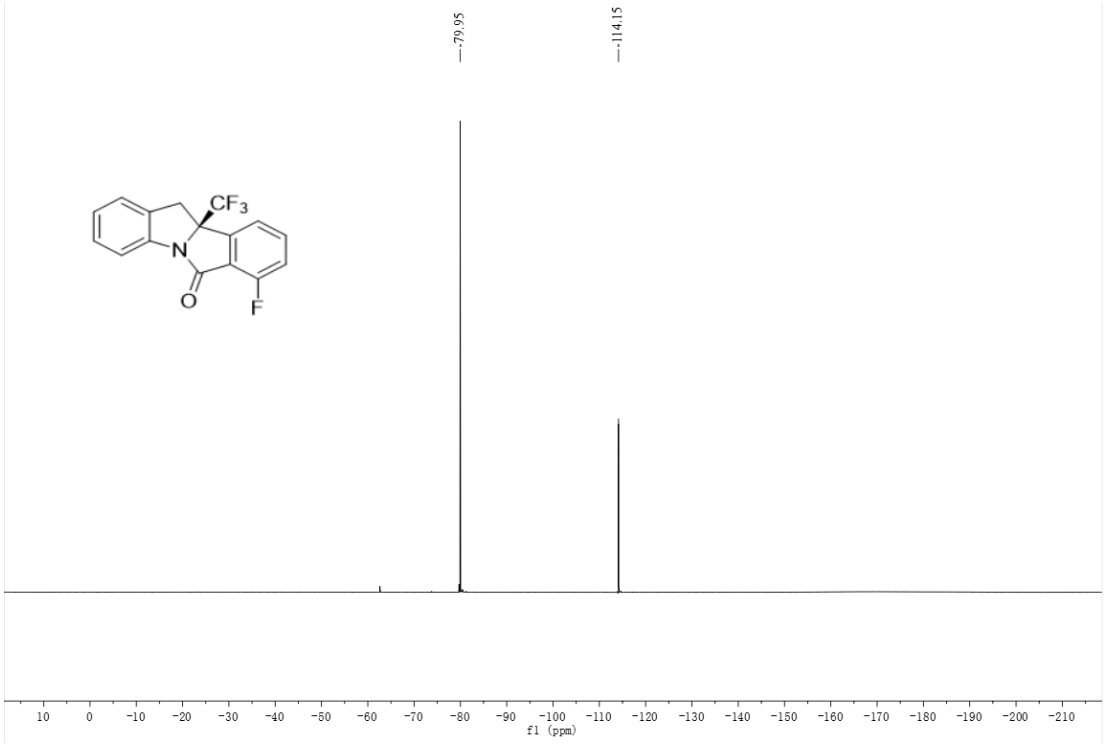
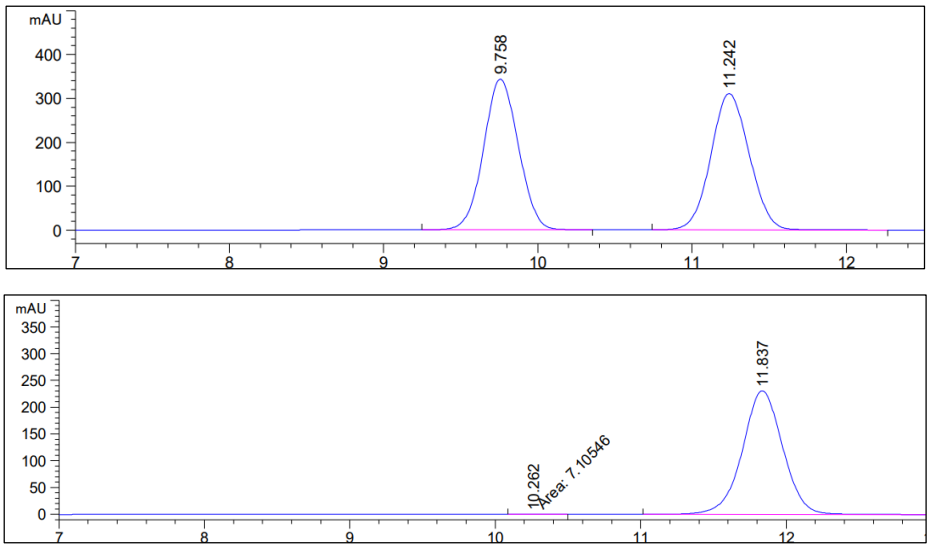
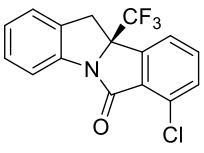
74.40
74.10
73.80
73.59
34.84
CF3
N
O
F
f1 (ppm)





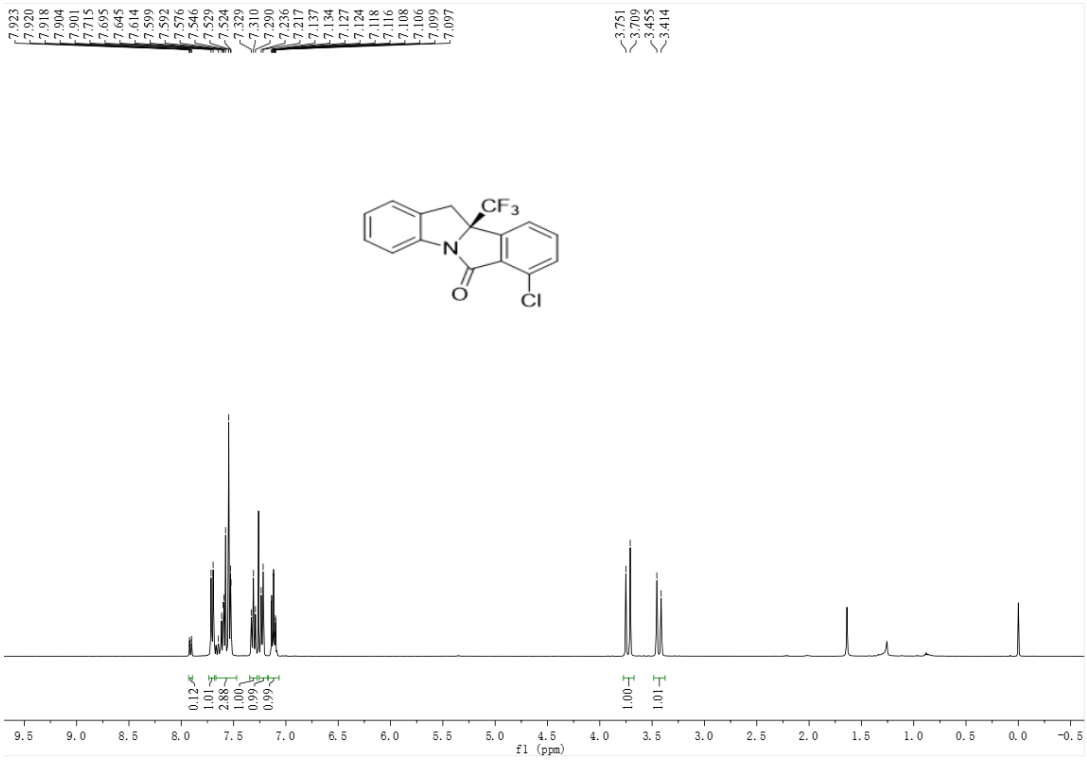
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.262	MM	0.2587	7.10546	4.57784e-1	0.1588
2	11.837	BB	0.2956	4467.56201	231.03877	99.8412

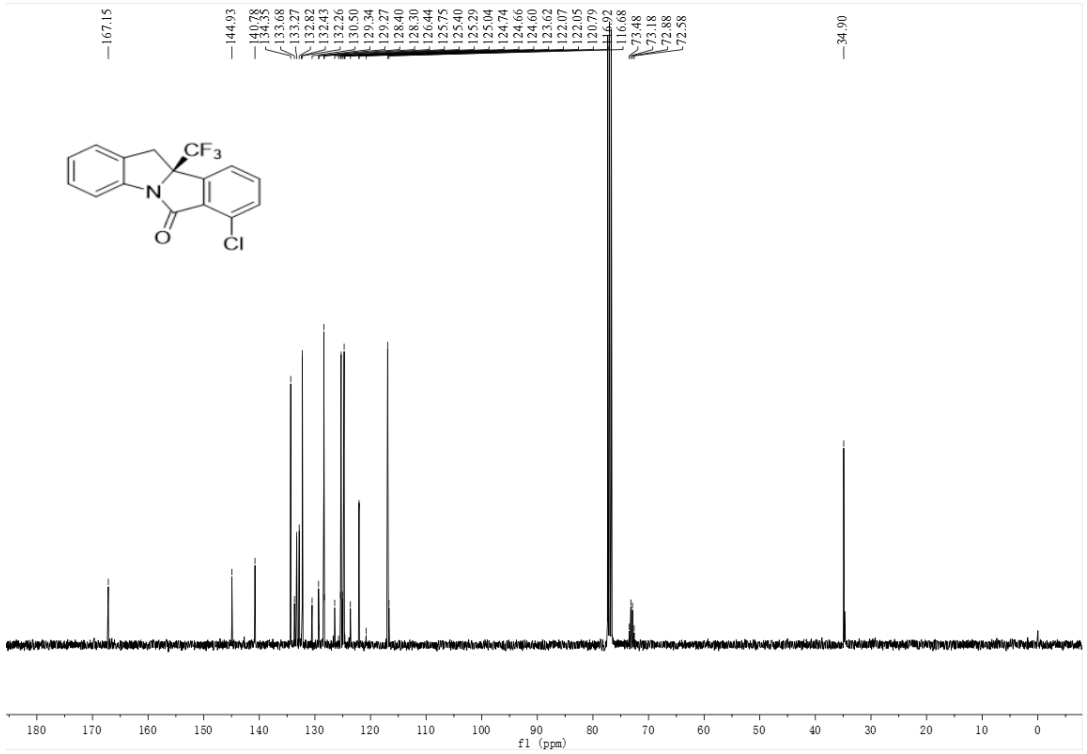
(R)-7-chloro-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2l):

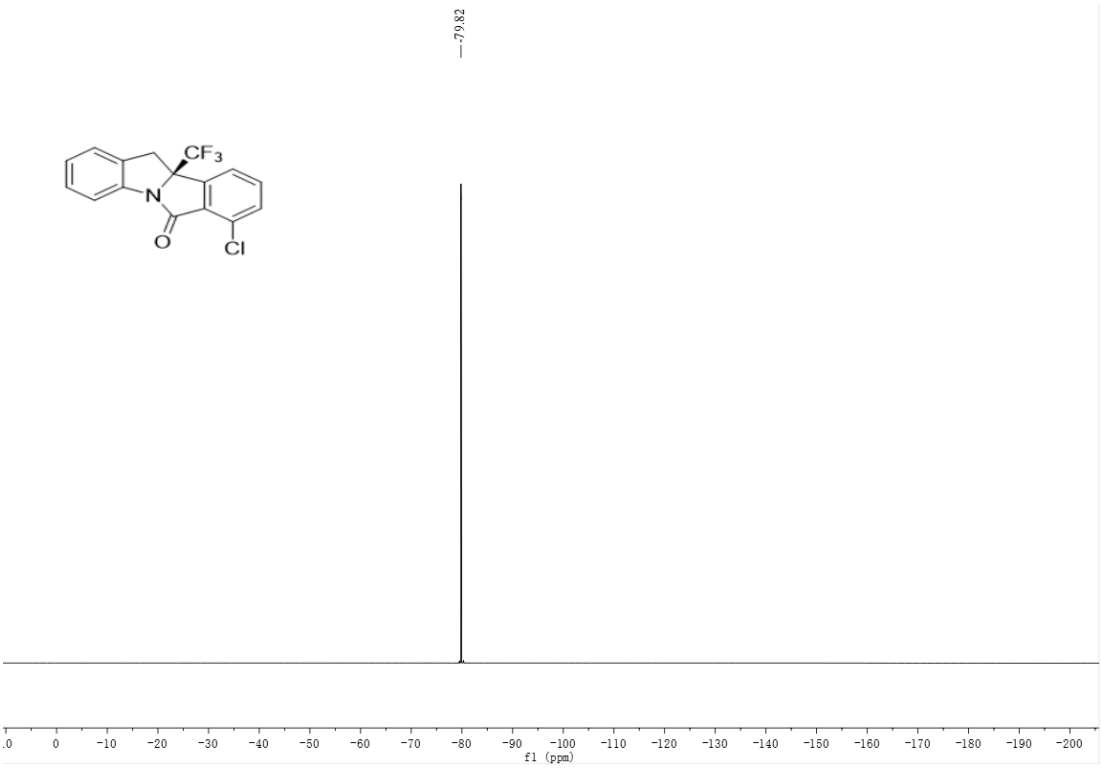


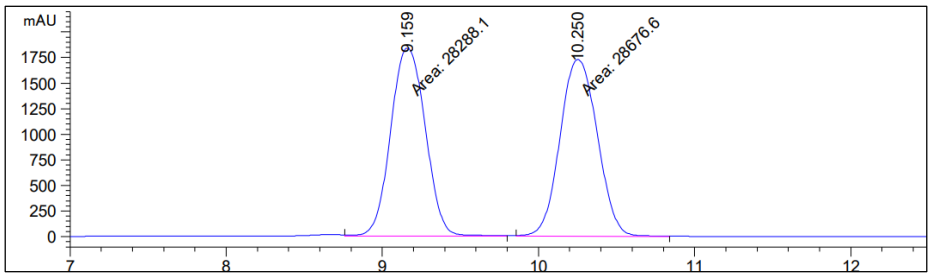
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless oil (61% yield), m.p. 138-140 ℃. $[\alpha]_D^{20}$ = +165.5 (c 0.5, CH_2Cl_2), 90% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.7 mL/min, 210 nm; t_{minor} = 9.6 min, t_{major} = 10.7 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ

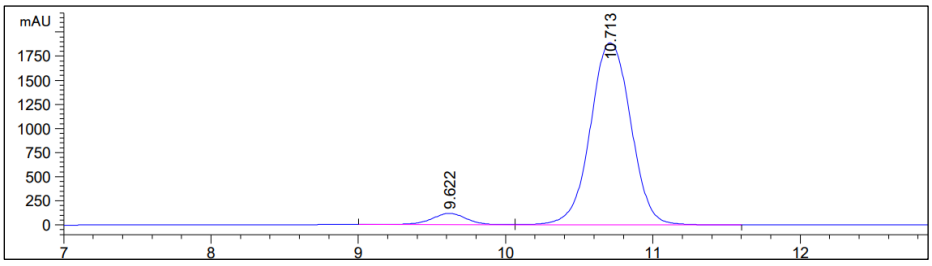
7.70 (d, *J* = 7.9 Hz, 1H), 7.64-7.52 (m, 3H), 7.30 (t, *J* = 7.7 Hz, 1H), 7.22 (d, *J* = 7.5 Hz, 1H), 7.11 (td, *J* = 7.5, 1.1 Hz, 1H), 3.73 (d, *J* = 16.5 Hz, 1H), 3.43 (d, *J* = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.2, 144.9, 140.8, 134.4, 133.1 (q, *J* = 41.0 Hz), 132.3, 130.5, 129.3, 128.4 (d, *J* = 7.0 Hz), 125.3 (d, *J* = 36.0 Hz), 125.0 (q, *J* = 282.0 Hz), 124.7, 122.1 (d, *J* = 2.0 Hz), 116.8 (d, *J* = 24.0 Hz), 73.1 (q, *J* = 30.0 Hz), 34.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.8 ppm. HRMS m/z (ESI+): Calcd for $C_{16}H_9ClF_3NONa^+$ $(M+Na)^+$ 346.0217, found 346.0218.





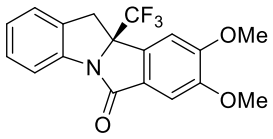






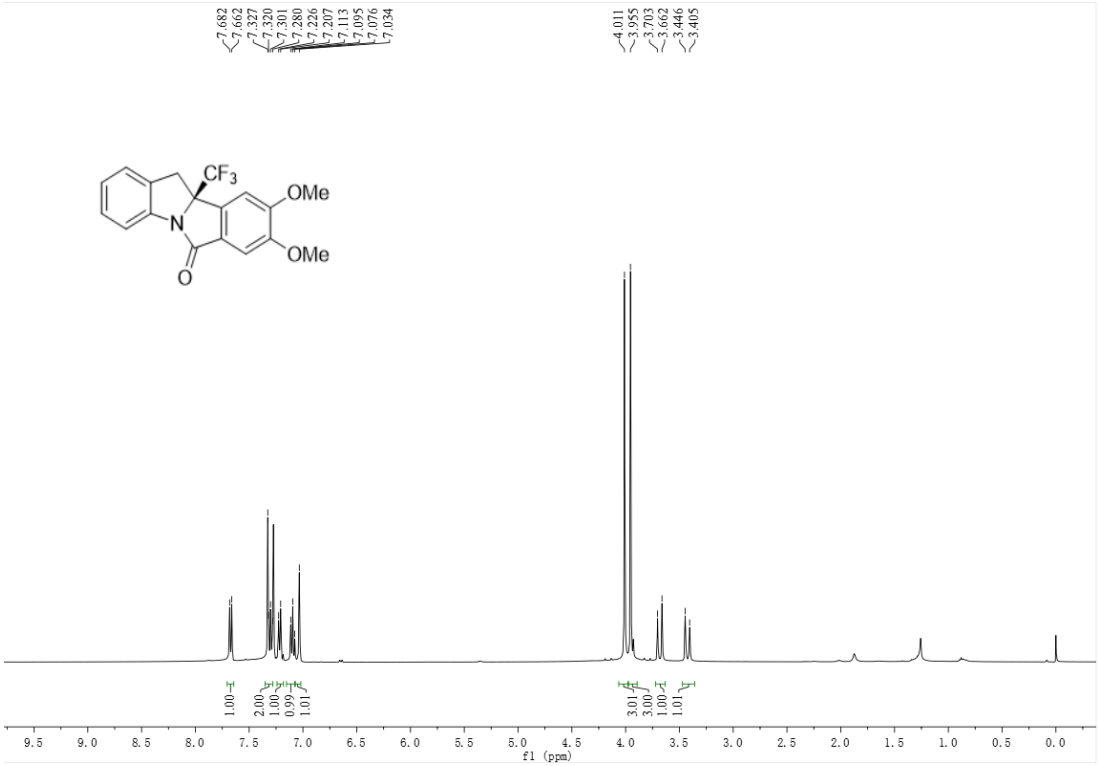
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.622	BV	0.2519	1948.92200	117.27740	5.1361
2	10.713	VB	0.2982	3.59965e4	1889.95056	94.8639

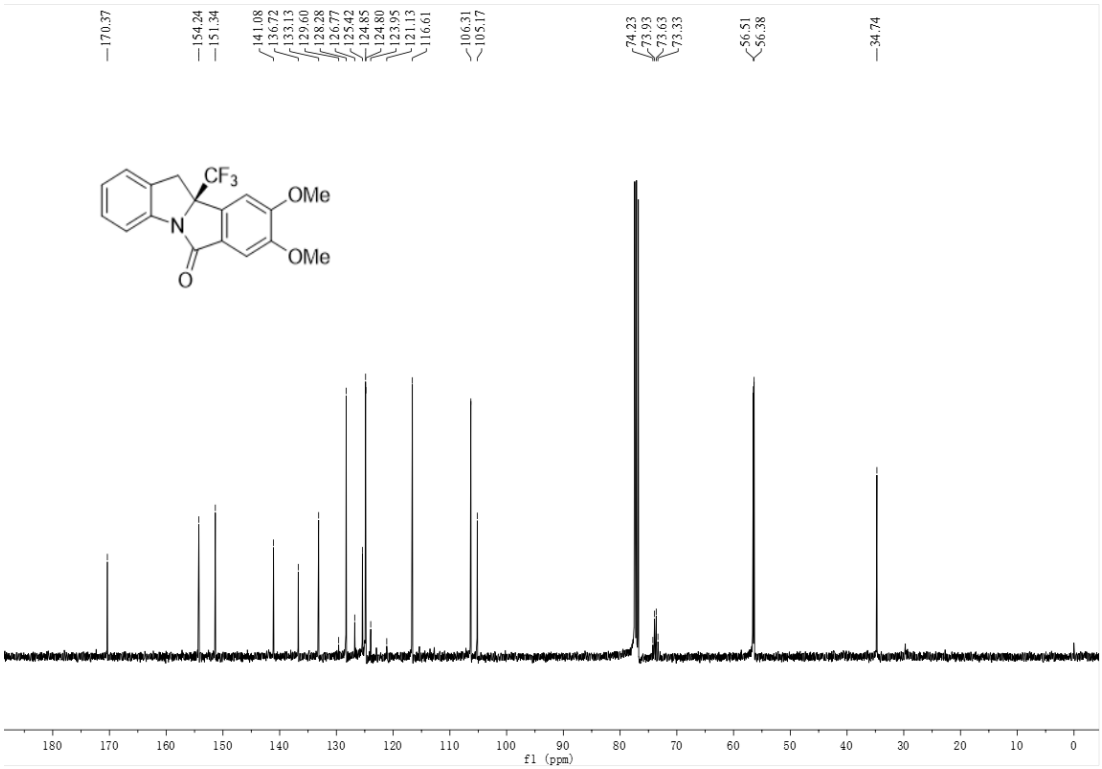
(R)-8,9-Dimethoxy-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2m):

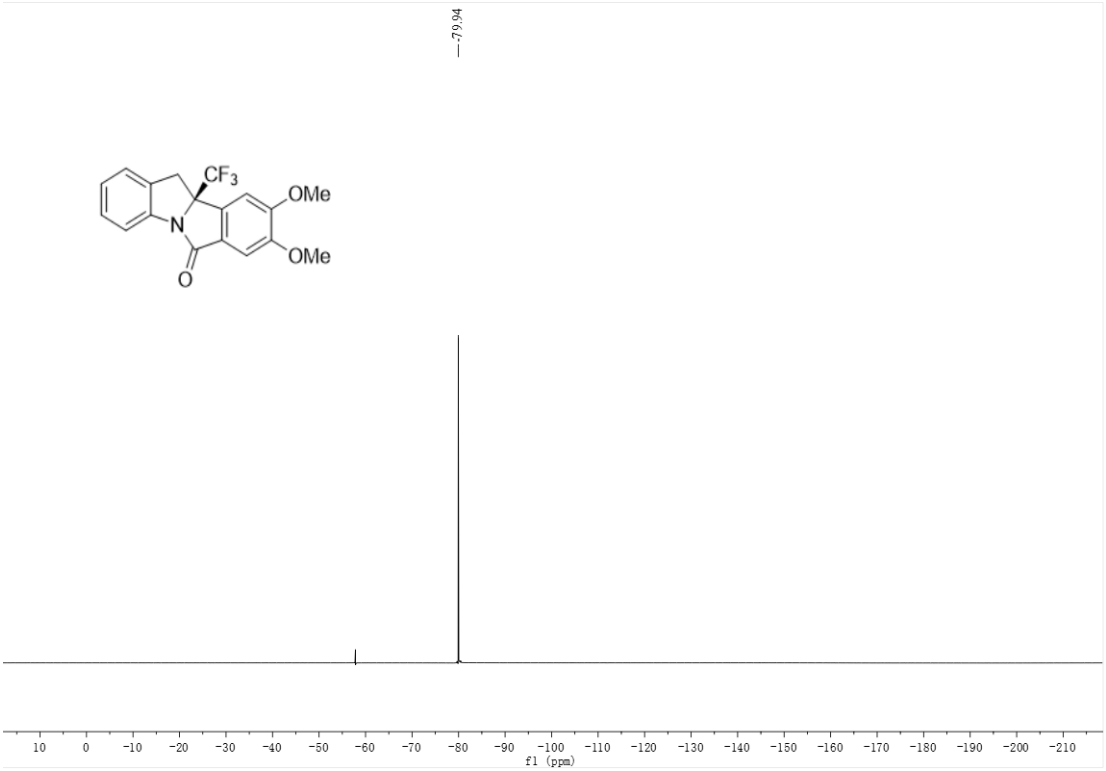


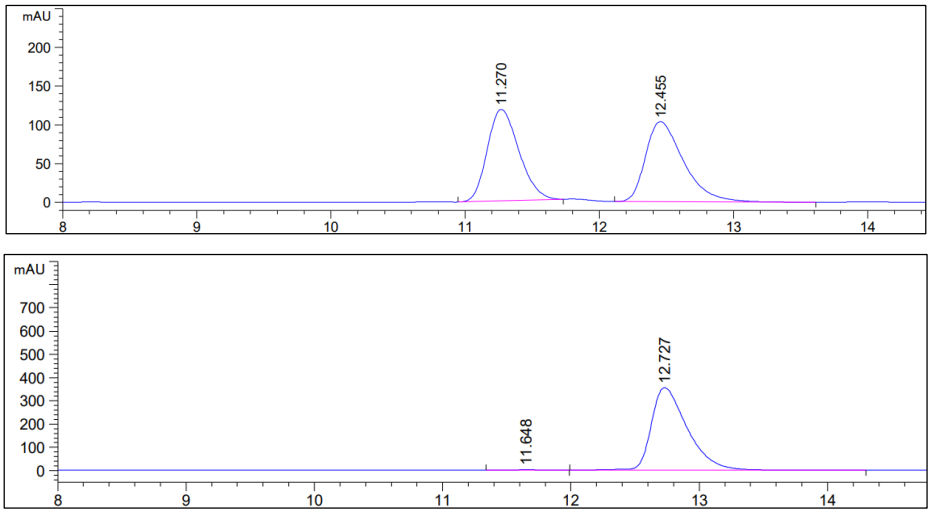
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless oil (72% yield). $[\alpha]_D^{20}$ = +196.0 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak AD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 85/15, 0.6

mL/min, 254 nm; t_{minor} = 11.6 min, t_{major} = 12.7 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 (d, J = 7.8 Hz, 1H), 7.33-7.28 (m, 2H), 7.22 (d, J = 7.8 Hz, 1H), 7.10 (t, J = 7.5 Hz, 1H), 7.03 (s, 1H), 4.01 (s, 3H), 3.96 (s, 3H), 3.68 (d, J = 16.5 Hz, 1H), 3.43 (d, J = 16.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.4, 154.2, 151.3, 141.1, 136.7, 133.1, 128.3, 125.3 (q, J = 282.0 Hz), 125.4, 124.9, 124.8, 116.6, 106.3, 105.2, 73.8 (q, J = 30.0 Hz), 56.5, 56.4, 34.7.^{19}F NMR (377 MHz, $CDCl_3$) δ -79.9 ppm. HRMS m/z (ESI+): Calcd for $C_{18}H_{14}F_3NO_3Na^+$ $(M+Na)^+$ 372.0818, found 372.0817.



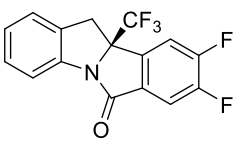






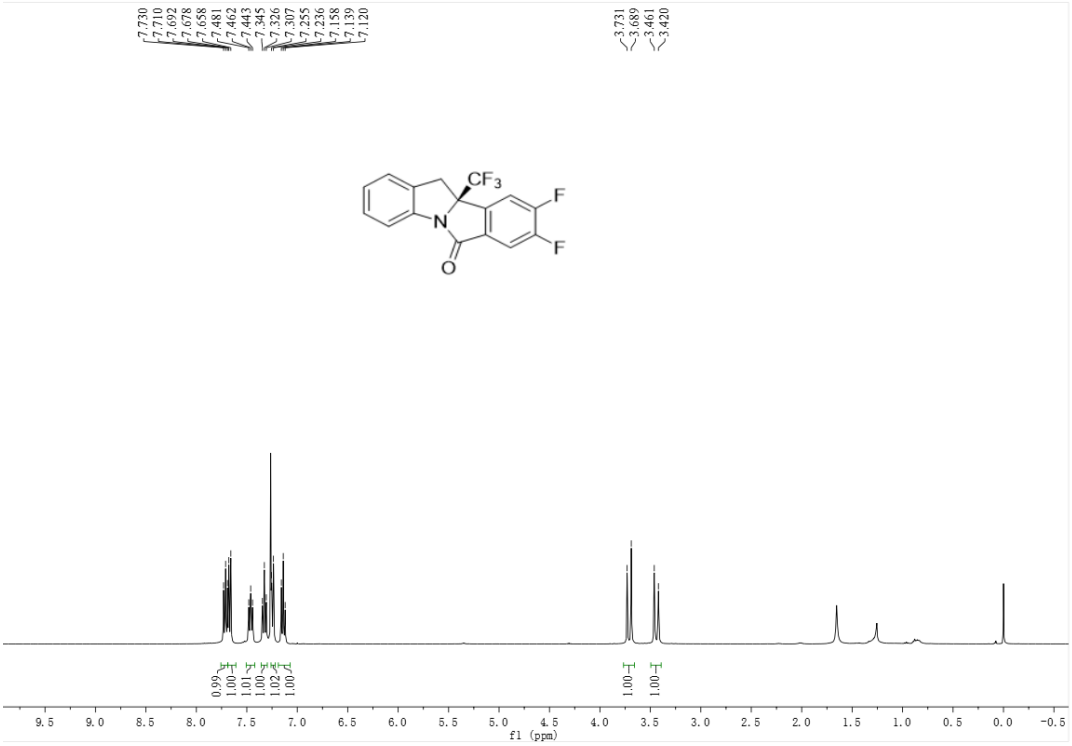
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.648	BB	0.2346	47.75061	3.19108	0.4148
2	12.727	BB	0.2956	1.14646e4	587.54749	99.5852

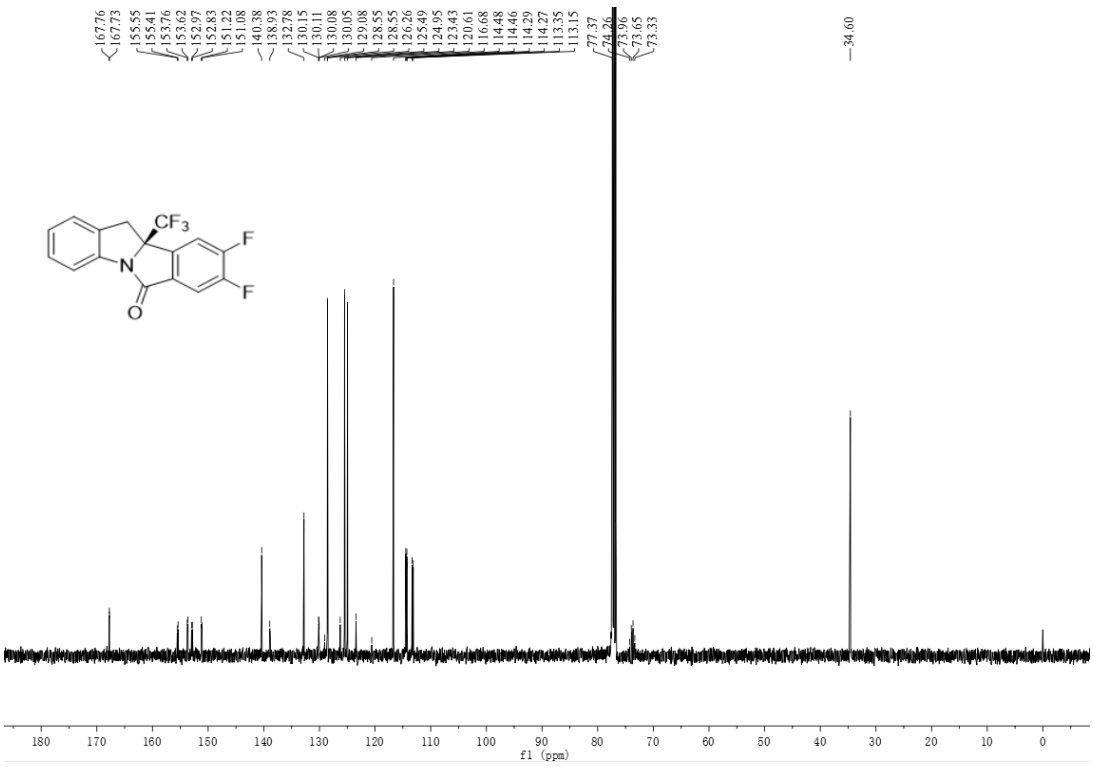
(R)-8,9-Difluoro-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2n):

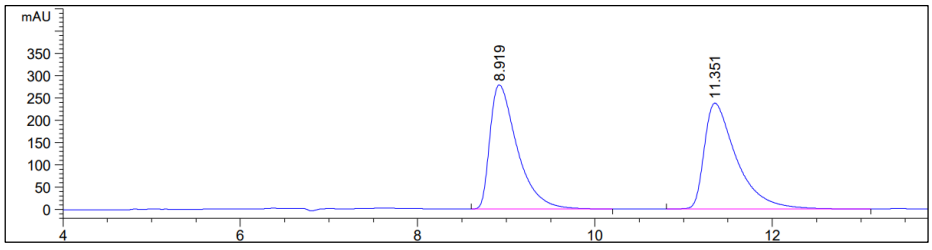


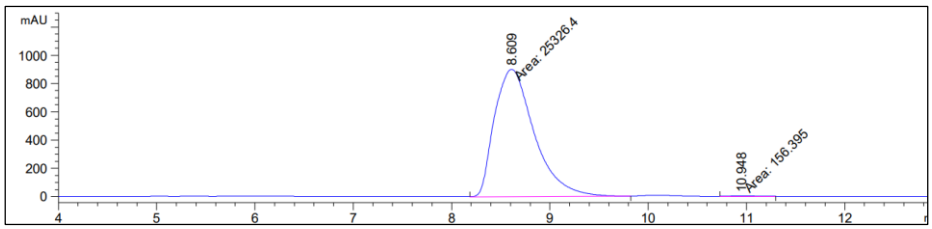
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (50% yield), m.p. 135-137 ℃. $[\alpha]_D^{20}$ = +107.4 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak AD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{major} = 8.6 min, t_{minor} = 10.9 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (t, J = 7.9 Hz, 1H), 7.67 (d, J = 7.9 Hz, 1H), 7.47 (t, J = 7.9 Hz, 1H),

7.33 (t, *J* = 7.7 Hz, 1H), 7.25 (d, *J* = 7.6 Hz, 2H), 7.14 (t, *J* = 7.5 Hz, 1H), 3.71 (d, *J* = 16.5 Hz, 1H), 3.44 (d, *J* = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.8 (d, *J* = 3.0 Hz), 154.6 (dd, *J* = 179.0, 14.0 Hz), 152.0 (dd, *J* = 175.0, 14.0 Hz), 140.4, 138.9 (d, *J* = 8.0 Hz), 132.8, 130.1 (dd, *J* = 7.0, 6.0 Hz), 128.6, 125.5, 125.0, 120.6 (q, *J* = 283.0 Hz), 116.7, 114.4 (dd, *J* = 19.3, 1.9 Hz) 113.2 (d, *J* = 20.0 Hz), 74.0 (q, *J* = 30.0 Hz), 34.6. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.9, -125.7, -131.6 ppm. HRMS m/z (ESI+): Calcd for C16H9F5NO+ (M+H)+ 326.0599, found 326.0600.



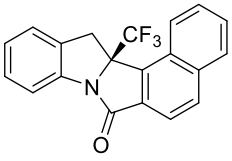






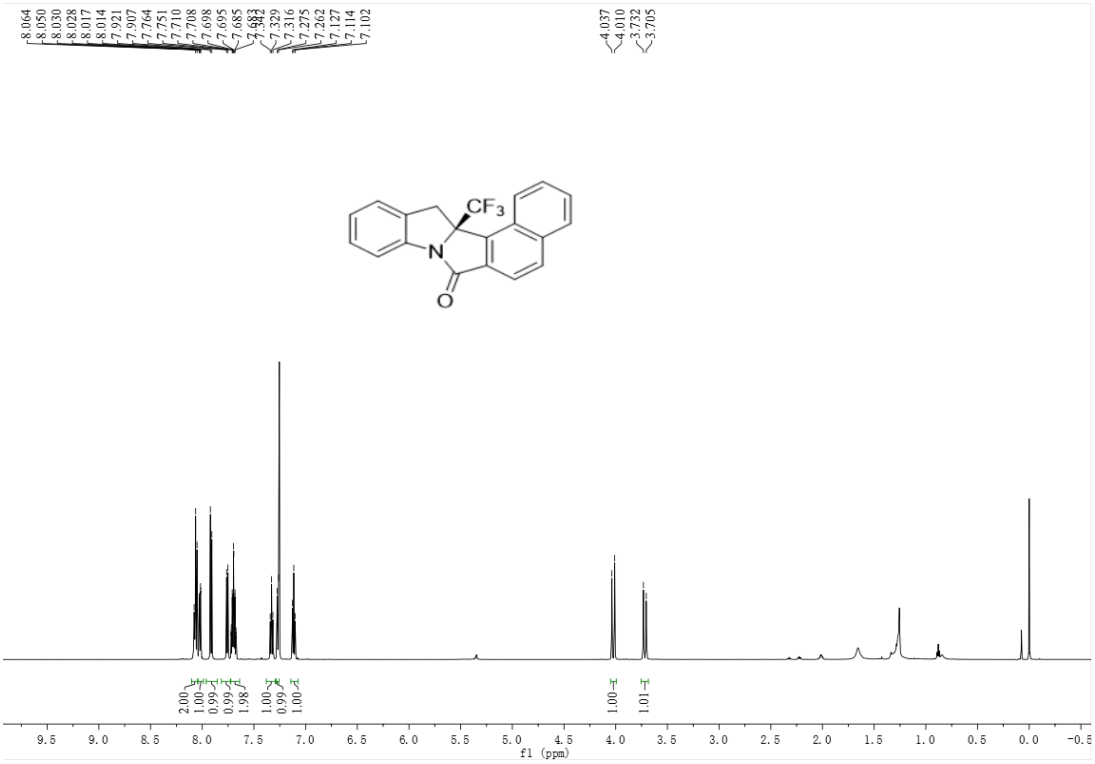
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	8.609	MM	0.4716	2.55272e4	902.10590	99.7862
2	10.948	MM	0.2672	54.70612	3.41213	0.2138

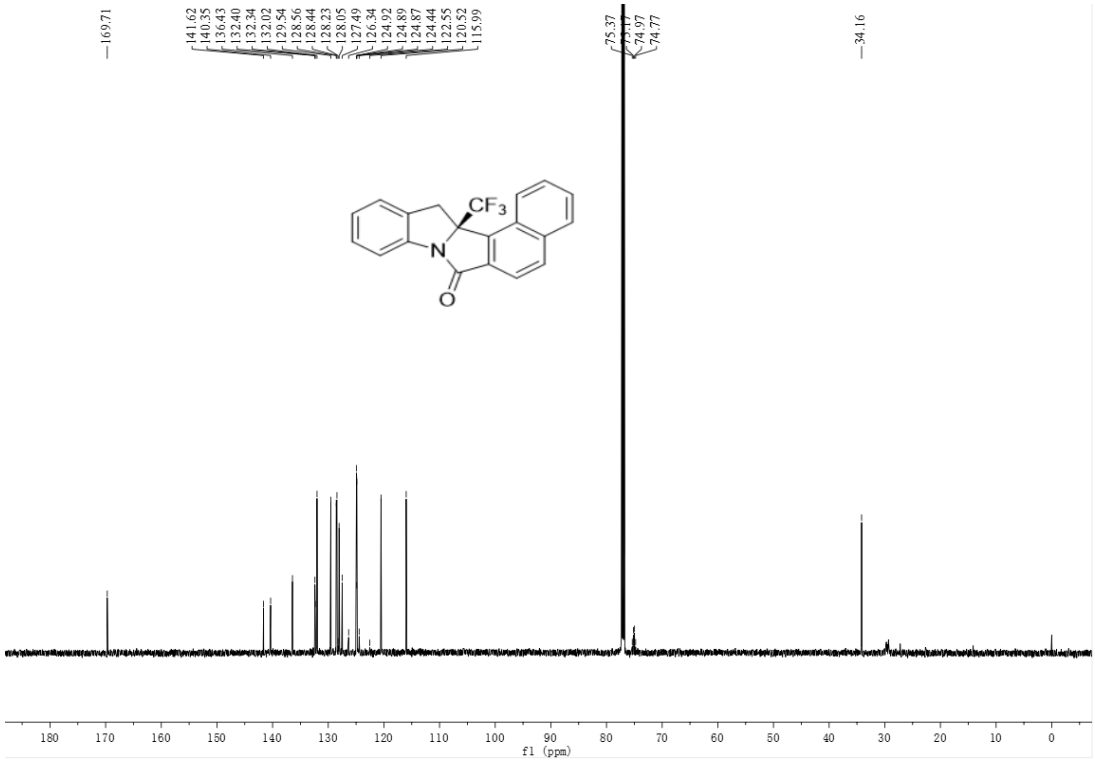
(R)-13a-(Trifluoromethyl)-13,13a-dihydro-7H-benzo[6,7]isoindolo[2,1-a]indol-7-one (2o):

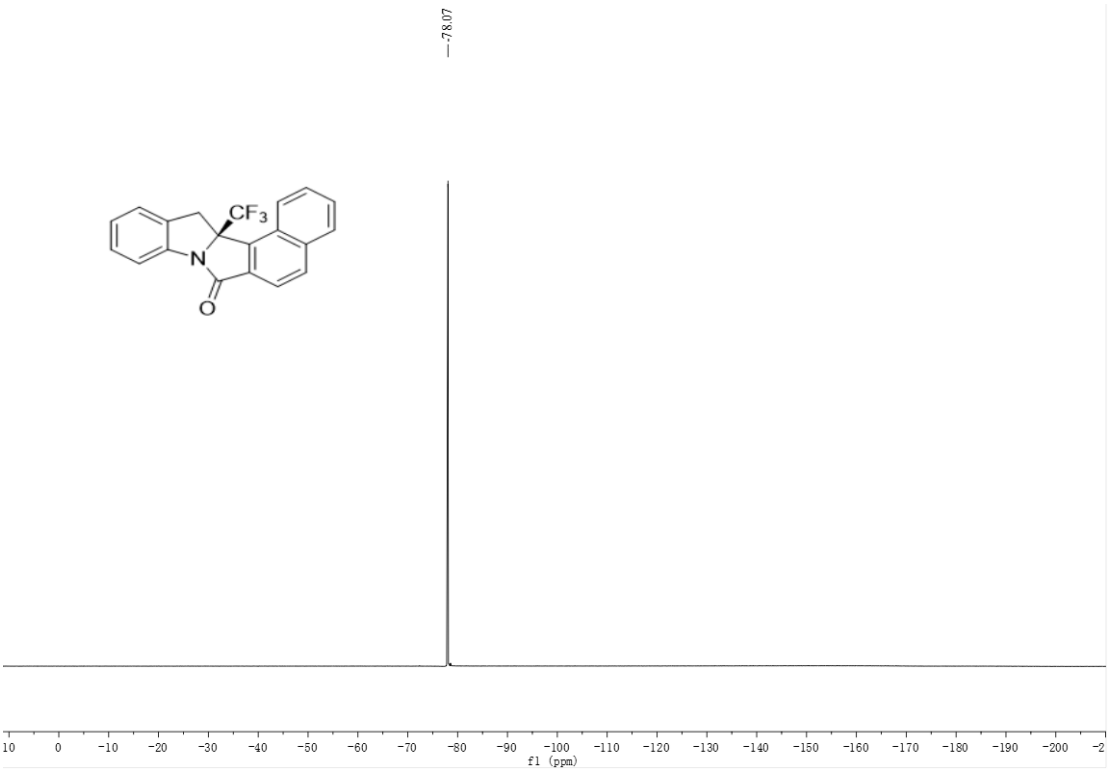


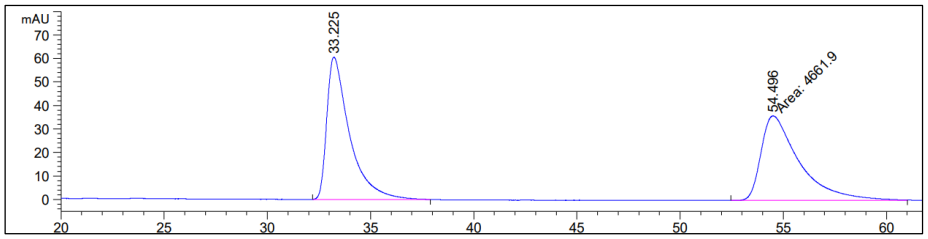
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless liquid (23% yield), $[\alpha]_D^{20}$ = +149.0 (c 0.5, CH_2Cl_2), 89% ee [Daicel Chiralpak AD-H column (25 cm ×0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{major} = 32.8 min, t_{minor} = 54.3 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.06 (t, J = 8.6 Hz, 2H), 8.02 (dd, J = 8.0, 1.5 Hz, 1H), 7.91 (d, J = 8.3 Hz,

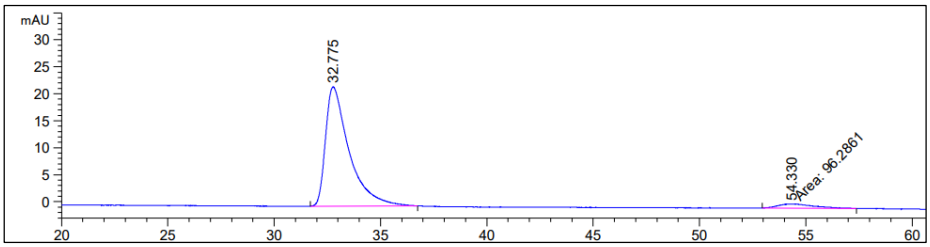
1H), 7.76 (d, *J* = 7.9 Hz, 1H), 7.72-7.67 (m, 2H), 7.33 (t, *J* = 7.7 Hz, 1H), 7.27 (d, *J* = 7.5 Hz, 1H), 7.11 (t, *J* = 7.5 Hz, 1H), 4.02 (d, *J* = 16.3 Hz, 1H), 3.72 (d, *J* = 16.3 Hz, 1H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 169.7, 141.6, 140.4, 136.4, 132.4, 132.3, 132.0, 129.5, 128.6, 128.4, 128.1, 127.5, 125.4 (q, *J* = 282.0 Hz), 124.92, 124.89, 124.87, 120.5, 116.0, 75.1 (q, *J* = 30.0 Hz), 34.2. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.1 ppm. HRMS *m/z* (ESI+): Calcd for $C_{20}H_{12}F_3NONa^+$ $(M+Na)^+$ 362.0763, found 362.0760.





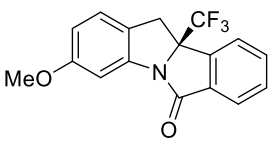






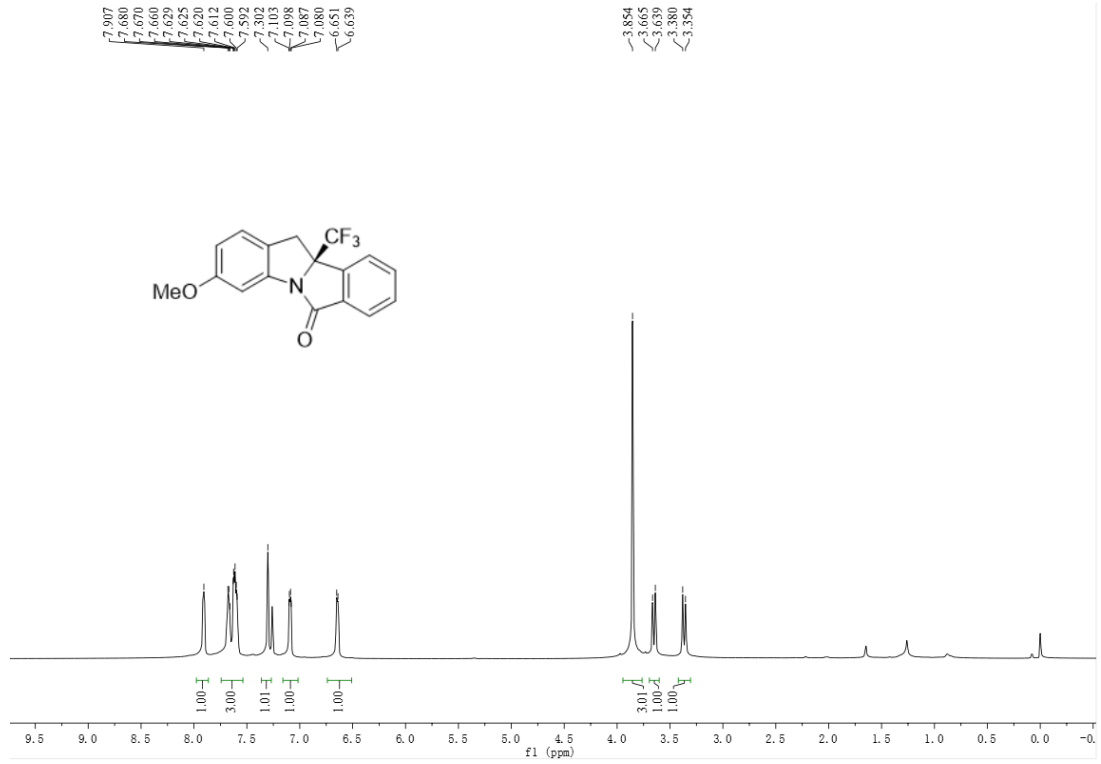
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	32.775	BB	1.0263	1704.50061	22.08725	94.6531
2	54.330	MM	2.0453	96.28606	7.84603e-1	5.3469

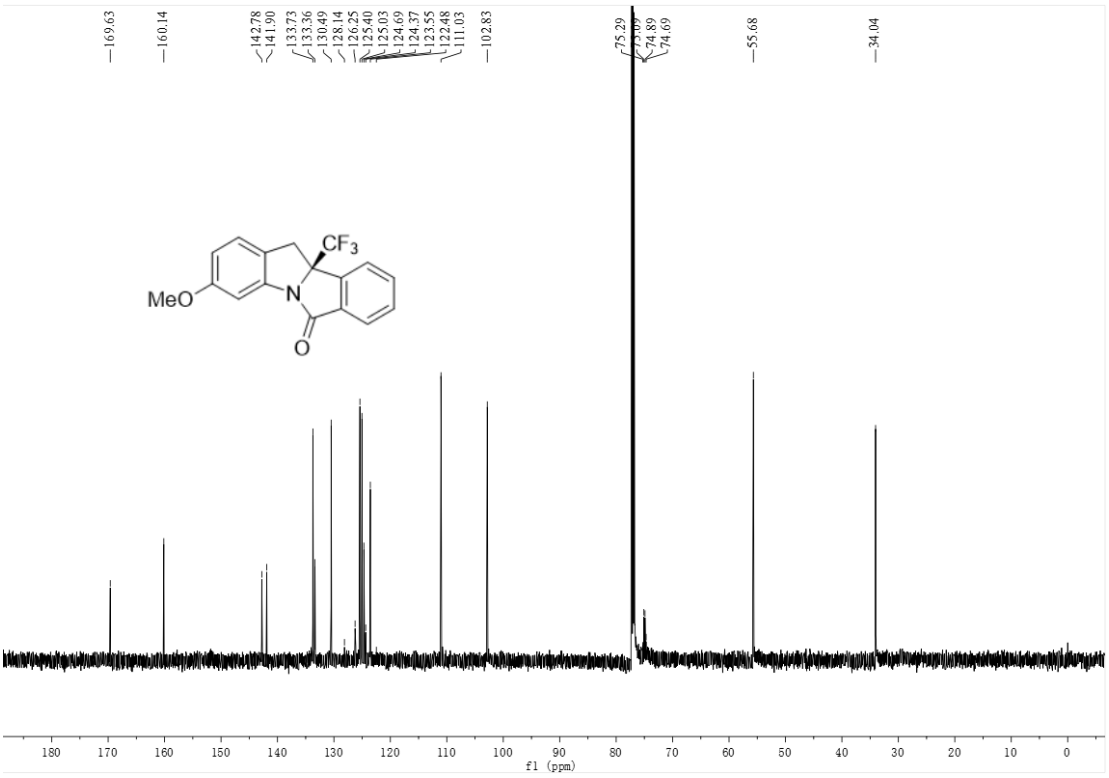
(R)-3-Methoxy-10b-(difluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2p):

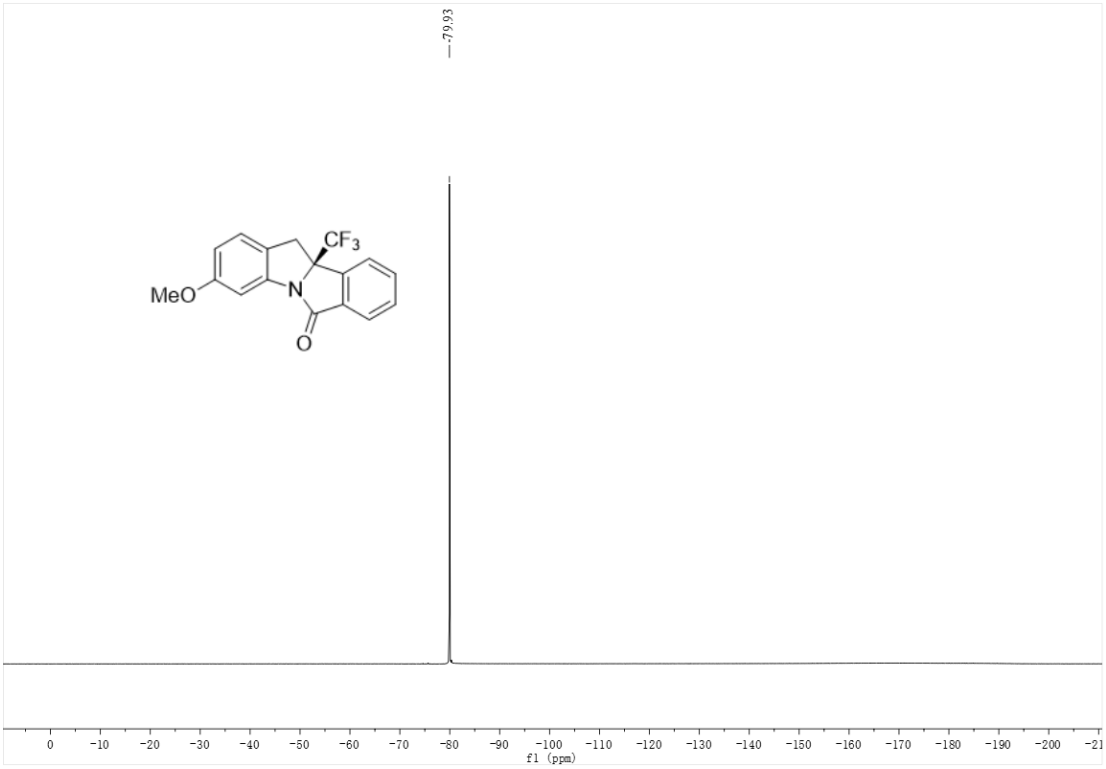


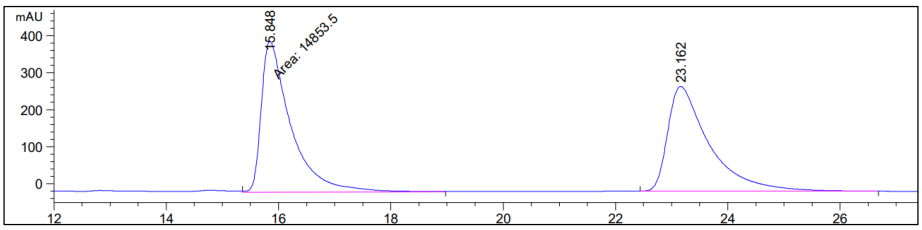
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (62% yield), m.p. 140-142 ℃. $[\alpha]_D^{20}$ = +300.0 (c 0.5, CH_2Cl_2), 98% ee [Daicel Chiralpak AD-H column (25 cm ×0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 210 nm; t_{minor} = 15.9 min, t_{major} = 23.2 min]. ^{1}H NMR (600 MHz,

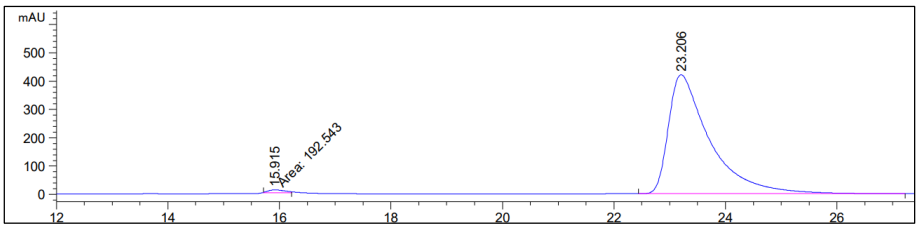
$CDCl_3$) δ 7.91 (s, 1H), 7.63-7.60 (m, 3H), 7.30 (s, 1H), 7.11 (q, J = 4.1, 3.4 Hz, 1H), 6.65 (d, J = 7.2, 1H), 3.85 (s, 3H), 3.65 (d, J = 15.8 Hz, 1H), 3.37 (d, J = 15.8 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 169.6, 160.1, 142.8, 141.9, 133.7, 133.4, 130.5, 125.4, 125.3 (q, J = 282.0 Hz), 125.0, 124.7, 123.6, 111.0, 102.8, 75.0 (q, J = 30.0 Hz), 55.7, 34.0. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{12}F_3NONa^+$ $(M+Na)^+$ 342.0712, found 342.0711.





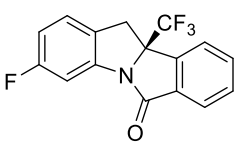






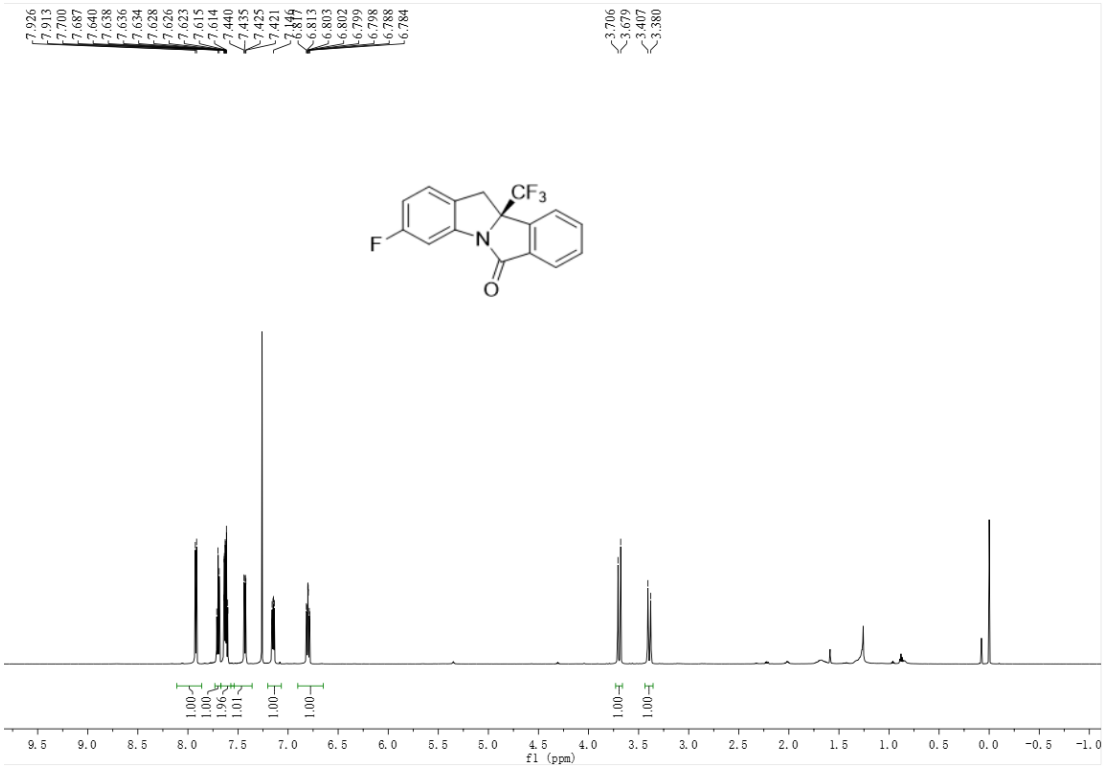
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.923	MM	0.3551	44.71601	2.09854	1.0629
2	23.206	BB	0.7292	4162.41504	82.14651	98.9371

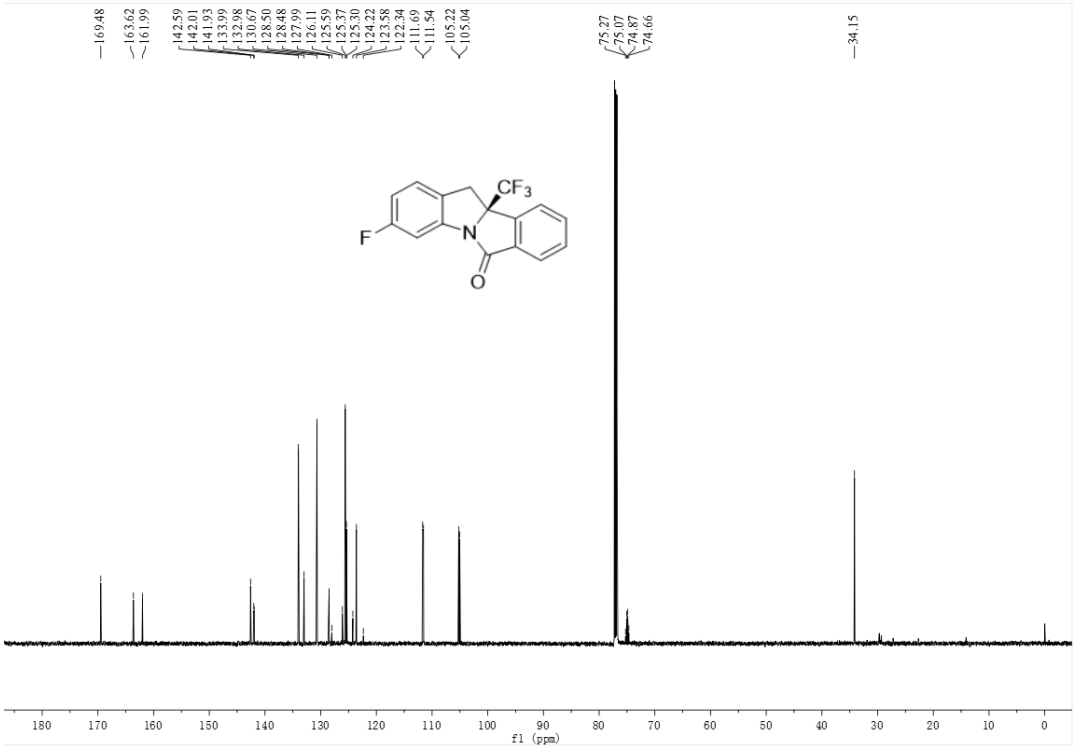
(R)-3-fluoro-10b-(difluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2q):

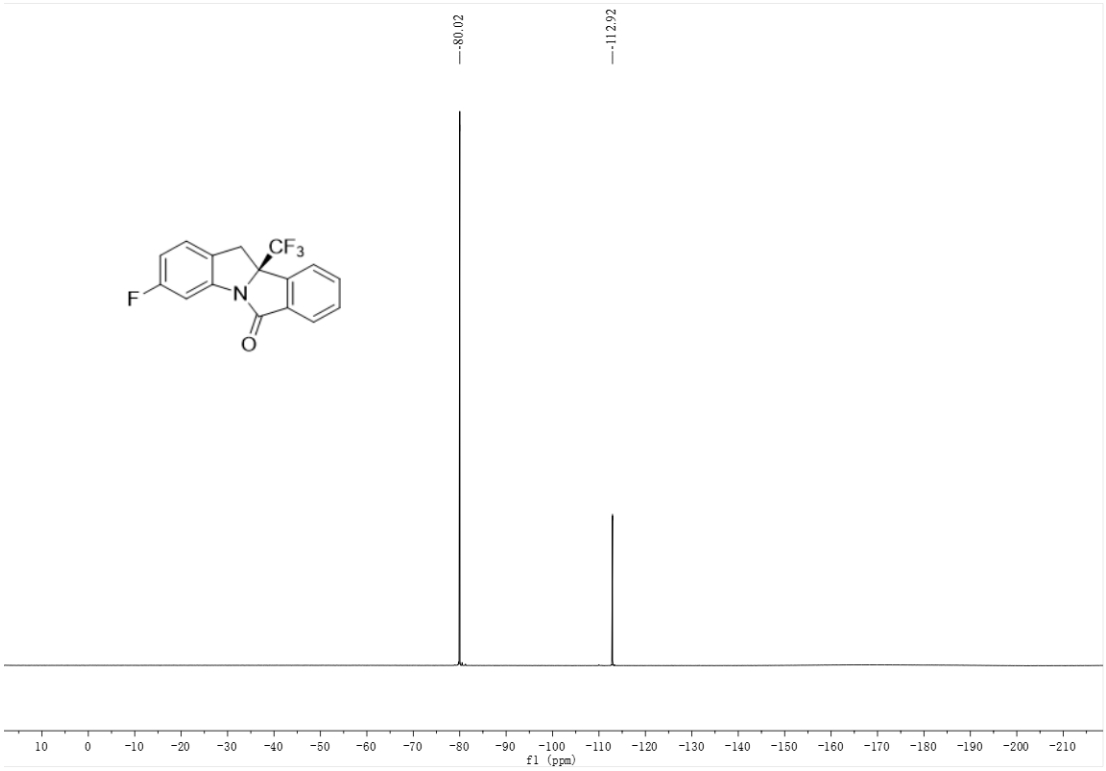


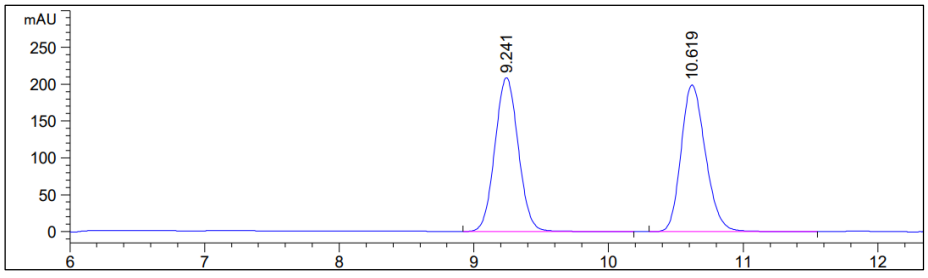
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (47% yield), m.p. 83-85 ℃. $[\alpha]_D^{20}$ = +175.9 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak OJ column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{major} = 9.5 min, t_{minor} = 10.9 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.92 (d, J = 7.6 Hz, 1H), 7.70 (t, J = 7.5 Hz, 1H), 7.64-7.61 (m, 2H), 7.43 (dd,

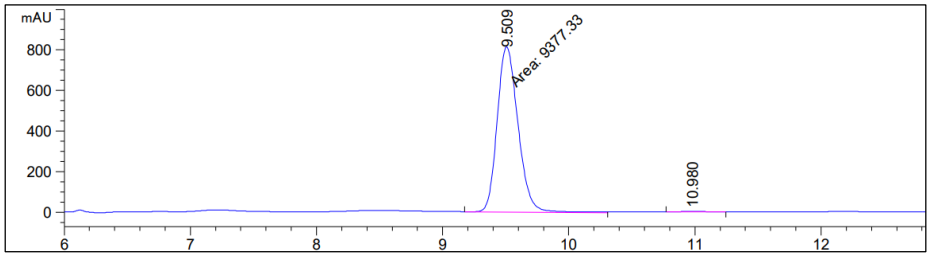
J = 8.7, 2.5 Hz, 1H), 7.17-7.14 (m, 1H), 6.82-6.78 (m, 1H), 3.69 (d, *J* = 16.3 Hz, 1H), 3.39 (d, *J* = 16.3 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 169.5, 162.8 (d, *J* = 244.5 Hz), 142.6, 142.0 (d, *J* = 12.0 Hz), 134.0, 133.0, 130.7, 128.5 (d, *J* = 3.0 Hz), 125.6, 125.3 (d, *J* = 10.5 Hz), 125.2 (q, *J* = 282.0 Hz), 123.6, 111.6 (d, *J* = 7.5 Hz), 105.1(d, *J* = 27.0 Hz), 75.0 (d, *J* = 30.0 Hz), 34.1. ^{19}F NMR (377 MHz, $CDCl_3$) δ -80.0, -112.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_9F_4NONa^+$ $(M+Na)^+$ 330.0513, found 330.0514.





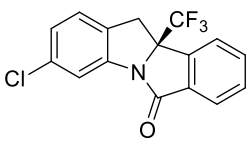






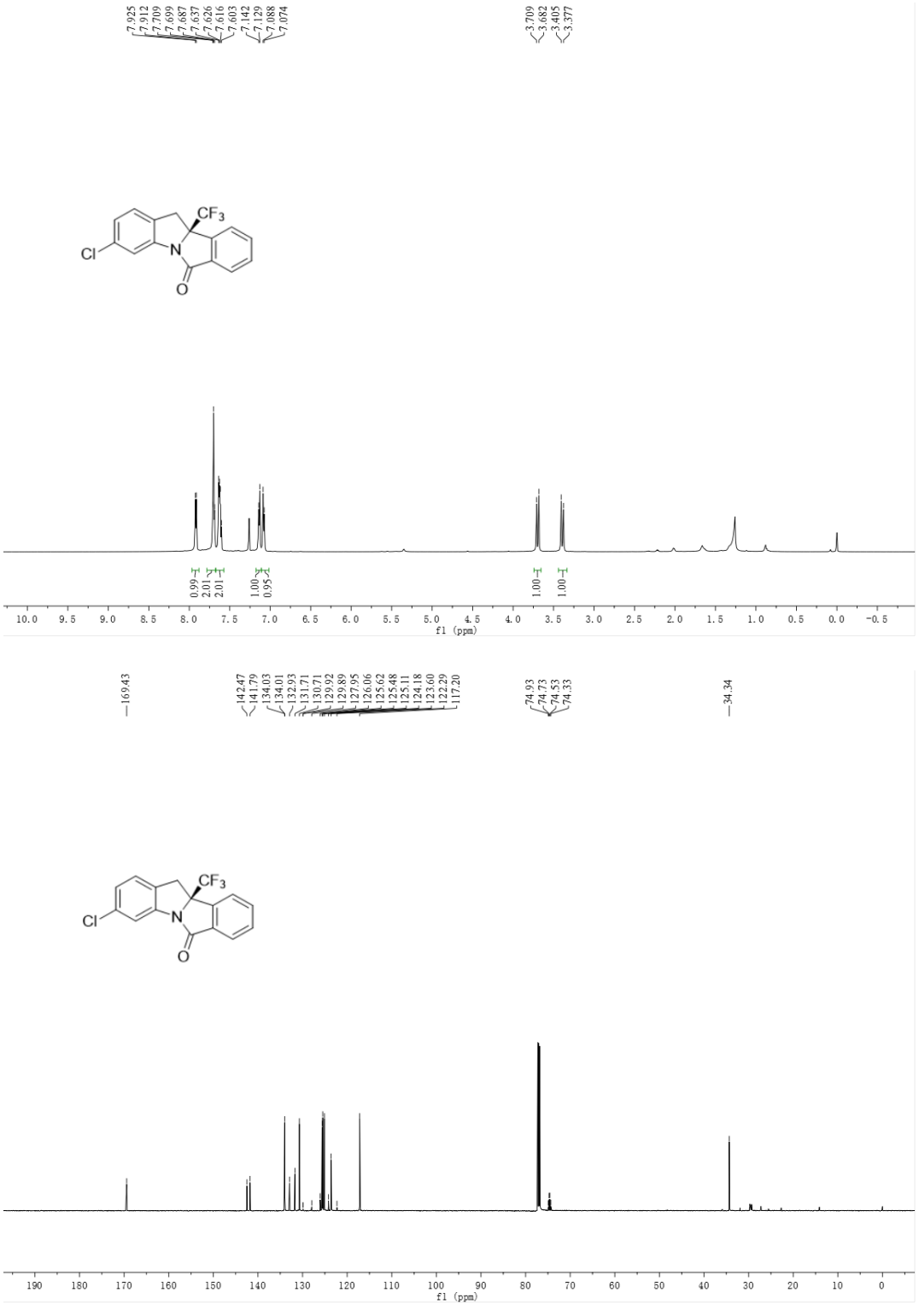
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.509	MM	0.1917	9377.62402	815.35437	99.6795
2	10.980	BB	0.1859	30.15655	2.51559	0.3205

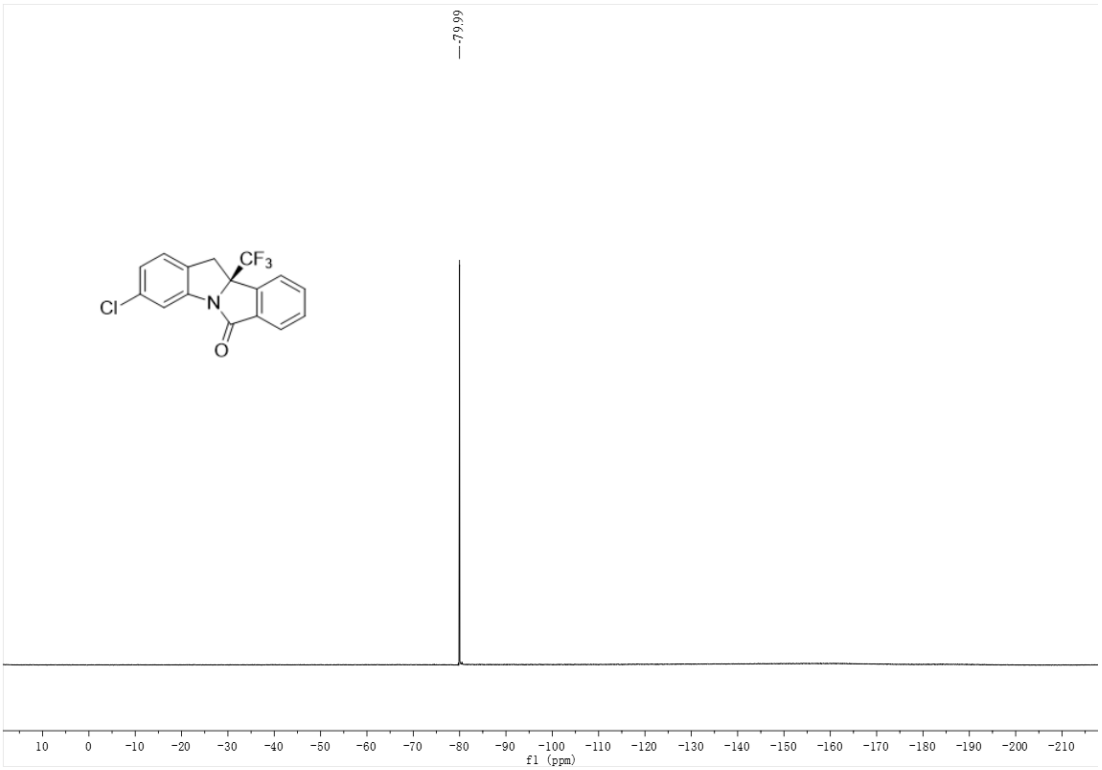
(R)-3-chloro-10b-(difluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2r):

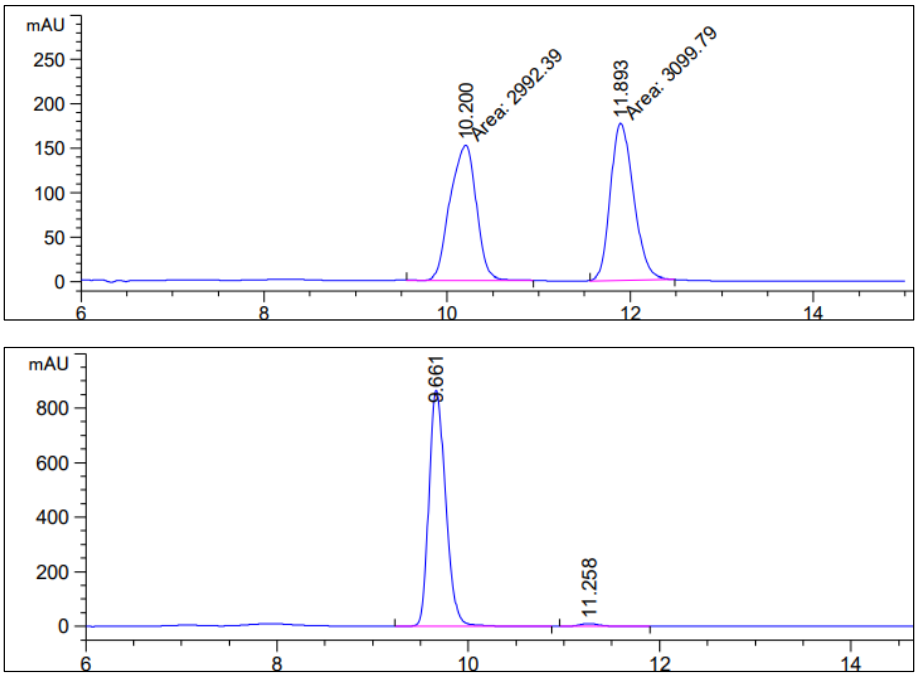


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (57% yield), m.p. 175-177 ℃. $[\alpha]_D^{20}$ = +154.3 (c 0.5, CH_2Cl_2), 97% ee [Daicel Chiralpak OJ column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{major} = 9.6 min, t_{minor} = 11.2 min]. ^{1}H NMR (600 MHz,

$CDCl_3$) δ 7.92 (d, J = 7.5 Hz, 1H), 7.72 (d, J = 7.7 Hz, 2H), 7.61 (dd, J = 13.0, 7.0 Hz, 2H), 7.14 (d, J = 7.9 Hz, 1H), 7.08 (d, J = 8.0 Hz, 1H), 3.70 (d, J = 16.6 Hz, 1H), 3.39 (d, J = 16.6 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 169.4, 142.5, 141.8, 134.0 (d, J = 30.0 Hz), 132.9, 131.7, 130.7, 129.9 (d, J = 4.5 Hz), 125.6, 125.5, 125.11, 125.09 (q, J = 282.0 Hz), 123.6, 117.2, 74.6 (q, J = 30.0 Hz), 34.34. ^{19}F NMR (377 MHz, $CDCl_3$) δ -80.0 ppm. HRMS m/z (ESI+): Calcd for $C_{16}H_9ClF_3NONa^+$ $(M+Na)^+$ 346.0217, found 346.0219.

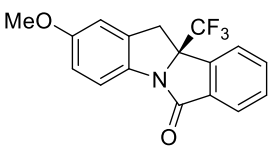




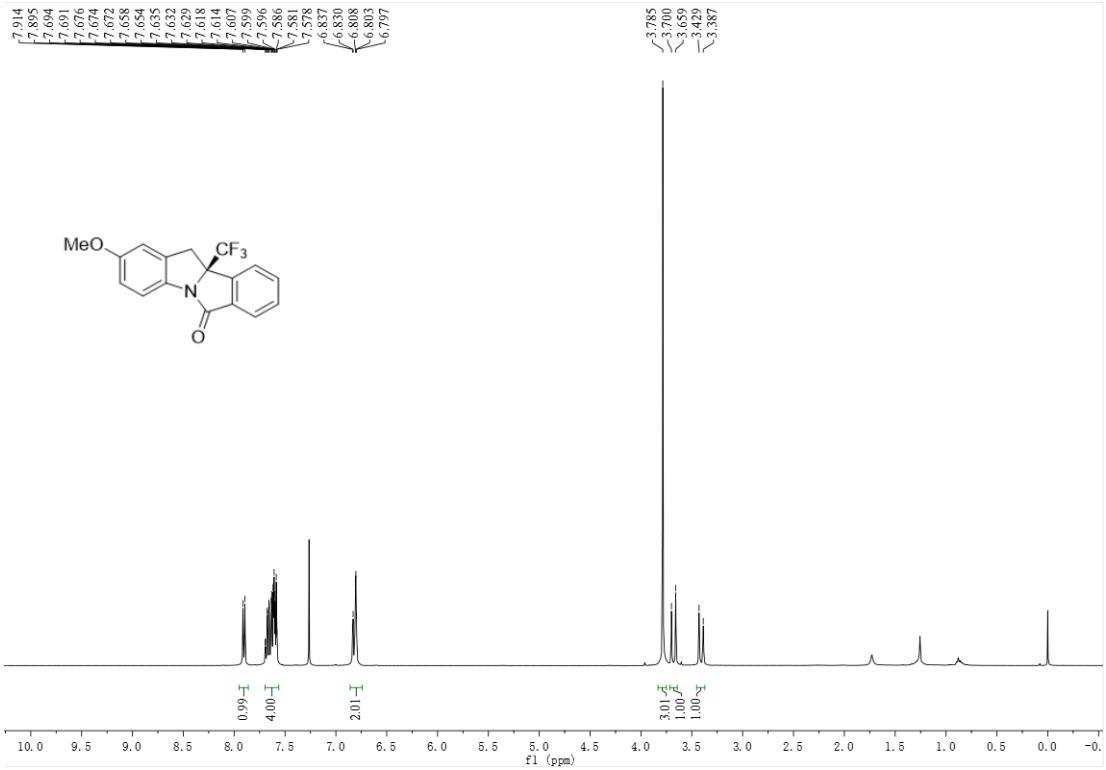


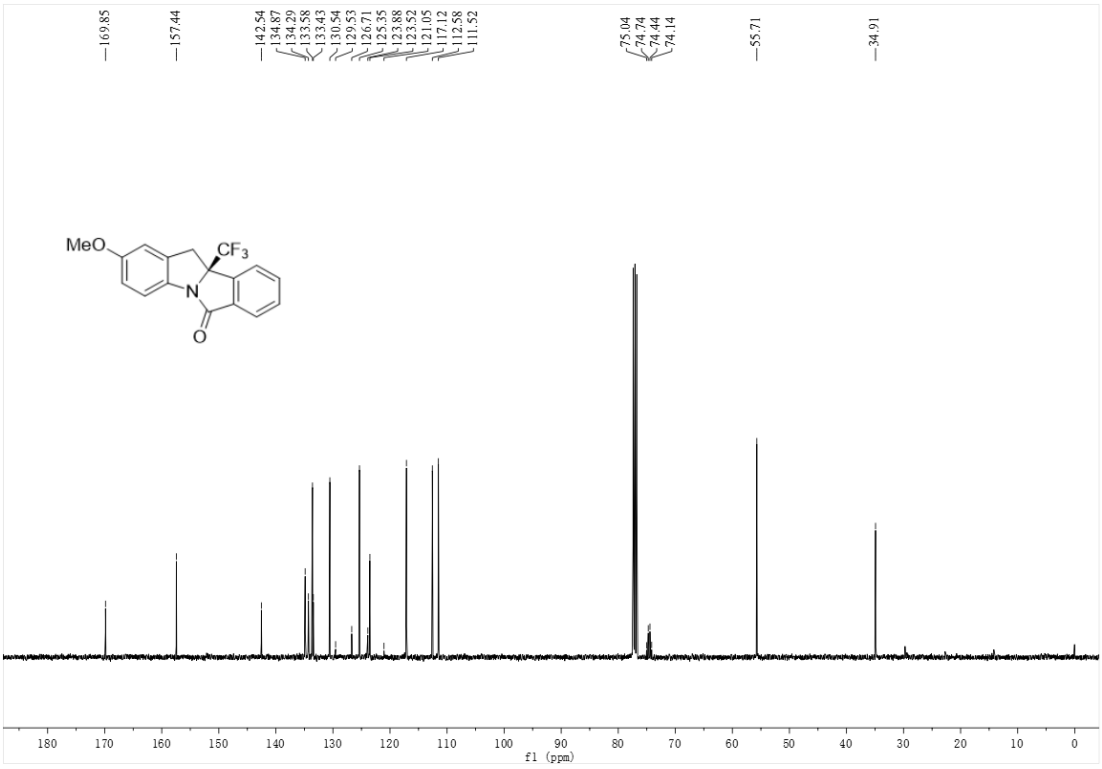
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.661	BB	0.1875	1.05030e4	865.95343	98.6964
2	11.258	BB	0.2175	138.72108	9.89683	1.3036

(R)-2-Methoxy-10b-(difluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2s):

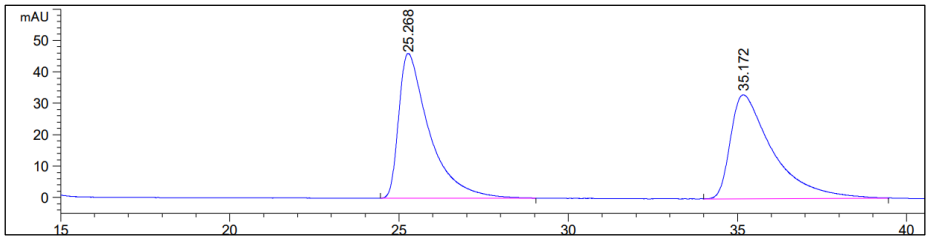


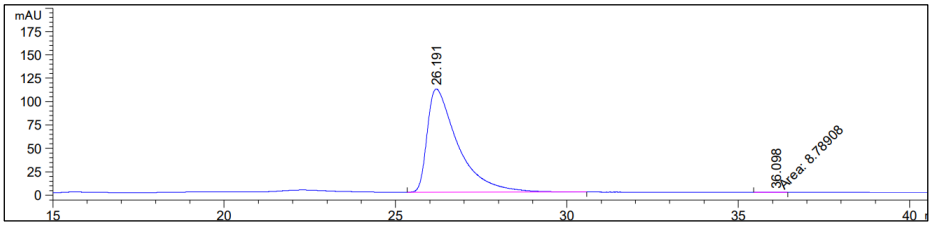
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless oil (53% yield). $[\alpha]_D^{20}$ = +94.4 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak AD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{major} = 26.2 min, t_{minor} = 36.1 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, J = 7.5 Hz, 1H), 7.70-7.58 (m, 4H), 6.84-6.80 (m, 2H), 3.79 (s, 3H), 3.68 (d, J = 16.5 Hz, 1H), 3.41 (d, J = 16.5 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$)) δ 169.9, 157.4, 142.5, 134.9, 134.3, 133.6, 133.4, 130.5, 125.4, 125.3 (q, J = 283.0 Hz), 123.5, 117.1, 112.6, 111.5, 74.5 (q, J = 30.0 Hz), 55.7, 34.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.8 ppm. HRMS *m/z* (ESI+): Calcd for $C_{17}H_{12}F_3NONa^+$ $(M+Na)^+$ 342.0712, found 362.0713.




169.85
157.44
142.54
134.87
134.29
133.58
133.43
130.54
129.53
126.71
125.35
123.88
123.52
121.05
117.12
112.58
111.52
75.04
74.74
74.44
74.14
55.71
34.91
MeO
CF3
N
O
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

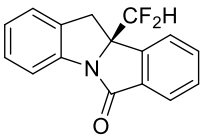

-79.77
MeO
CF3
N
O
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)



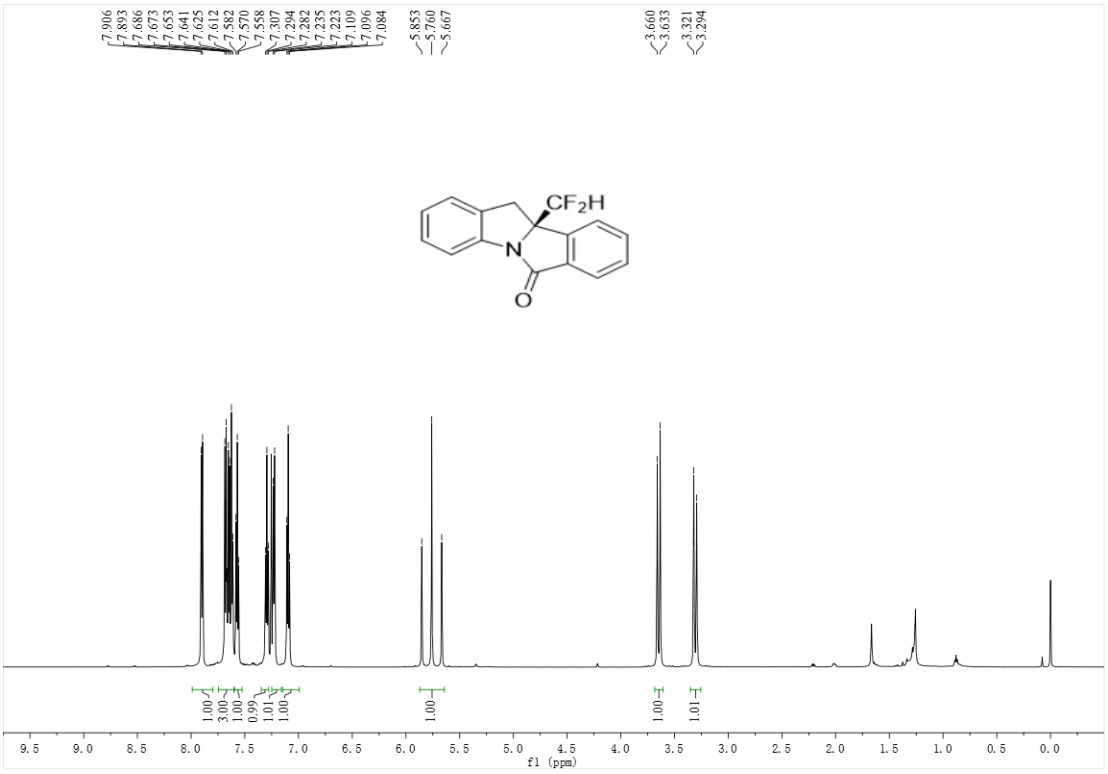


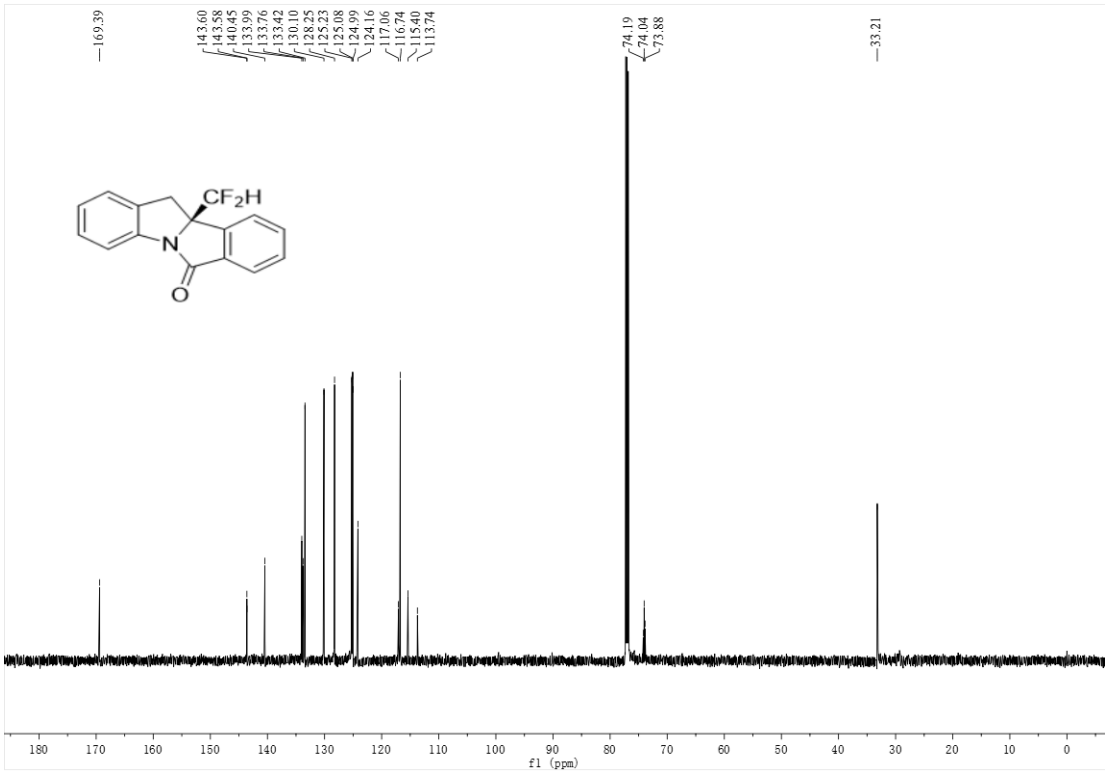
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.191	BB	0.9087	6874.49170	110.36417	99.9251
2	36.098	MM	0.6438	5.15245	1.33389e-1	0.0749

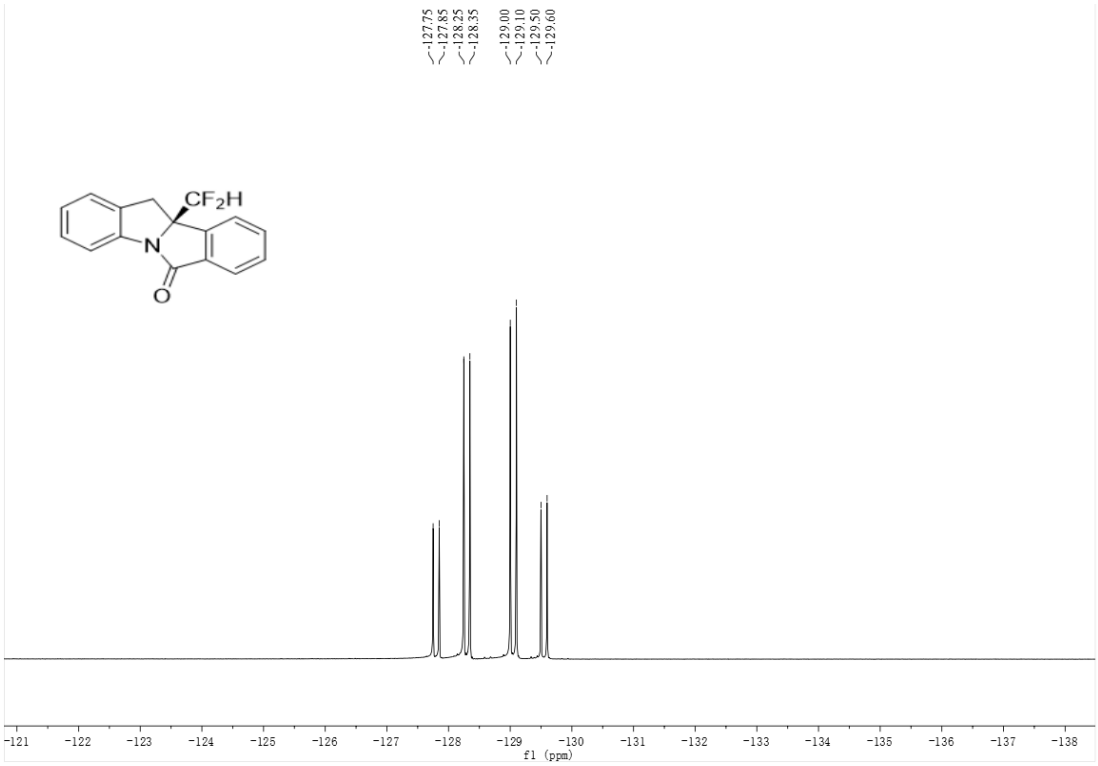
(R)-10b-(Difluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (2t):

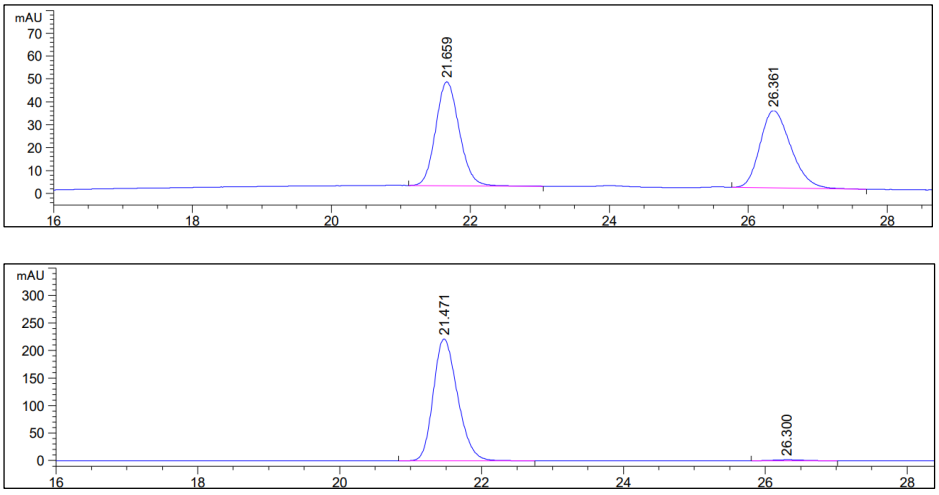


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); colorless liquid (51% yield). $[\alpha]_D^{20}$ = +206.5 (c 0.5, CH_2Cl_2), 98% ee [Daicel Chiralpak OJ-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{major} = 21.5 min, t_{minor} = 26.3 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.90 (d, J = 7.5 Hz, 1H), 7.69-7.61 (m, 3H), 7.57 (t, J = 7.4 Hz, 1H), 7.29 (t, J = 7.7 Hz, 1H), 7.23 (d, J = 7.4 Hz, 1H), 7.10 (t, J = 7.5 Hz, 1H), 5.76 (t, J = 55.8 Hz, 1H), 3.65 (d, J = 16.2 Hz, 1H), 3.31 (d, J = 16.2 Hz, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 169.4, 143.6 (d, J = 3.0 Hz), 140.4, 133.9 (d, J = 34.5.0 Hz), 133.4, 130.1, 128.3, 125.2, 125.1 (d, J = 13.5.0 Hz), 124.2, 117.1, 116.7, 115.4, 113.7, 74.1 (t, J = 24.0 Hz), 33.2. ^{19}F NMR (565 MHz, $CDCl_3$) δ -128.67 (ddd, J = 706.6, 281.1, 55.6 Hz, 2F). HRMS *m/z* (ESI+): Calcd for $C_{16}H_{11}F_2NONa^+$ $(M+Na)^+$ 294.0701, found 294.0700.


7.906
7.893
7.686
7.673
7.653
7.641
7.625
7.612
7.582
7.570
7.558
7.307
7.294
7.282
7.235
7.223
7.109
7.096
7.084
5.853
5.760
5.667
3.660
3.633
3.321
3.294
CF2H
N
O
1.00
3.00
1.00
0.99
1.01
1.00
1.00
1.00
1.01
f1 (ppm)

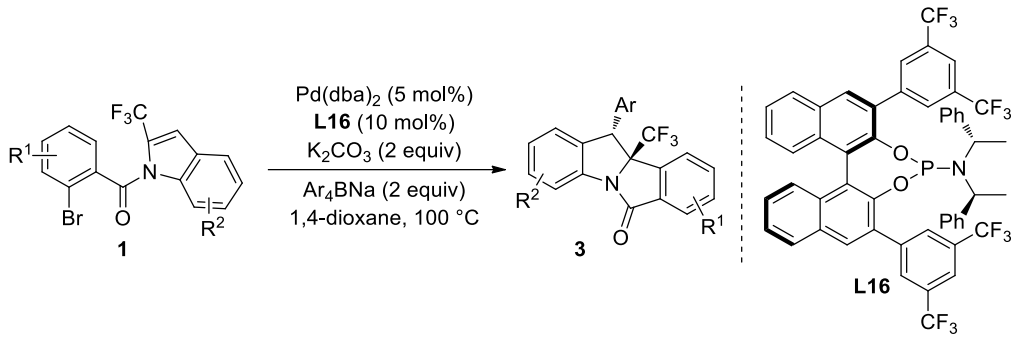

169.39
143.60
143.58
140.45
133.99
133.76
133.42
130.10
128.25
125.23
125.08
124.99
124.16
117.06
116.74
115.40
113.74
74.19
74.04
73.88
33.21
CF2H
N
O
f1 (ppm)





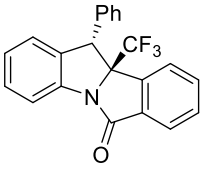
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	21.471	BB	0.3677	5267.42529	221.33359	98.9457
2	26.300	BB	0.3607	56.12598	1.87807	1.0543

5. Procedure for enantioselective Heck-Suzuki reaction of 1 with Ar_4BNa

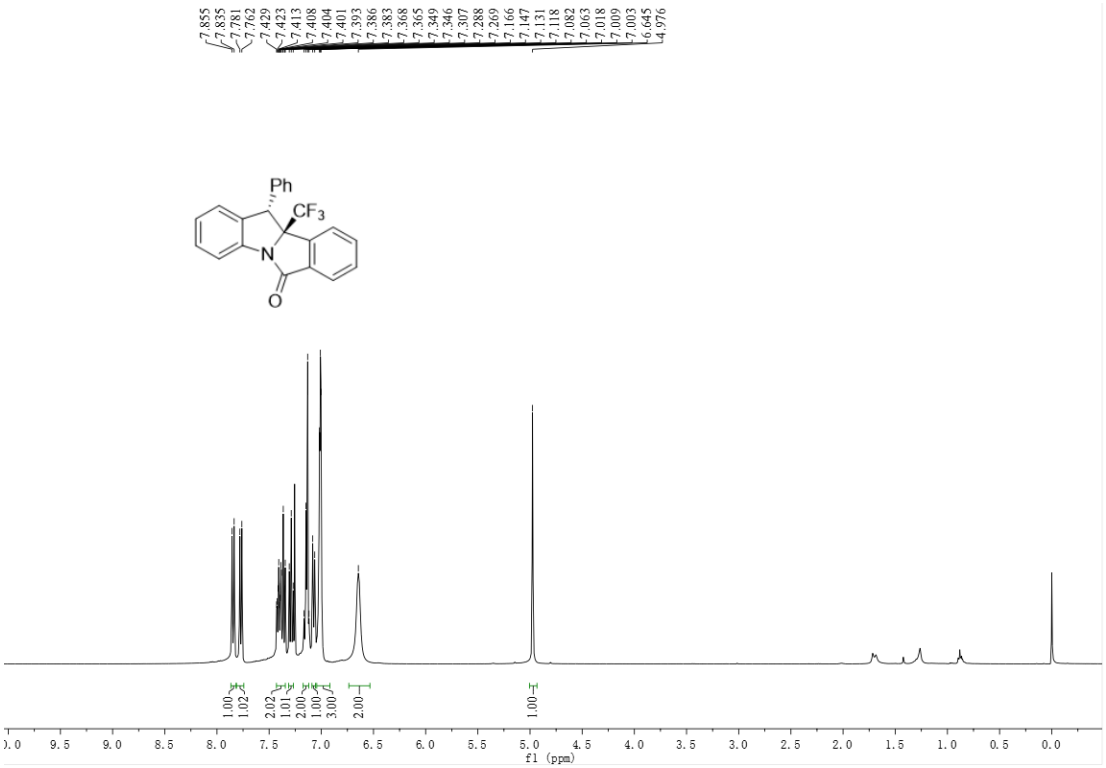


To a dried Schlenk tube were charged with $Pd(dba)_2$ (5 mol%, 5.8 mg), chiral ligand **L16** (10 mol%, 19.2 mg), substrate **1** (0.2 mmol), K_2CO_3 (0.4 mmol, 55.2 mg), and Ar_4BNa (0.4 mmol) under N_2 atmosphere. 1,4-Dioxane (2.0 mL) was then introduced via a syringe and the tube was sealed using Teflon cap. The resulting mixture was stirred at 100 ^oC until the reaction was completed (monitored by TLC). The solution was then concentrated under reduced pressure and the residue was purified by flash chromatography on silica gel, eluting with ethyl acetate/petroleum ether (v/v = 1/80) to afford product **3**.

(10bR,11S)-11-Phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3a)：



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (85% yield), m.p. 169-171 ℃. $[\alpha]_D^{20}$ = +63.0 (c 0.5, CH_2Cl_2), 95% ee [Daicel Chiralpak AD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{minor} = 7.5 min, t_{major} = 16.2 min]. ^1H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, J = 7.9 Hz, 1H), 7.77 (d, J = 7.8 Hz, 1H), 7.43-7.35 (m, 2H), 7.29 (t, J = 7.8 Hz, 1H), 7.14 (q, J = 6.4, 5.3 Hz, 2H), 7.07 (d, J = 7.6 Hz, 1H), 7.02-7.00 (m, 3H), 6.65 (s, 2H), 4.98 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.1, 140.5, 140.1, 139.0, 137.0, 133.3, 132.8, 130.0, 128.9, 128.6, 128.4, 127.6, 125.8, 125.6, 125.4 (q, J = 282.0 Hz), 124.9, 124.7, 116.5, 78.5 (q, J = 30.0 Hz), 51.0. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{22}H_{14}F_3NONa^+$ $(M+Na)^+$ 388.0919, found 388.0915.


7.855
7.835
7.781
7.762
7.429
7.423
7.413
7.408
7.404
7.401
7.393
7.386
7.383
7.368
7.365
7.349
7.346
7.307
7.288
7.269
7.166
7.147
7.131
7.118
7.082
7.063
7.018
7.009
7.003
6.645
4.976
Ph
CF3
N
O
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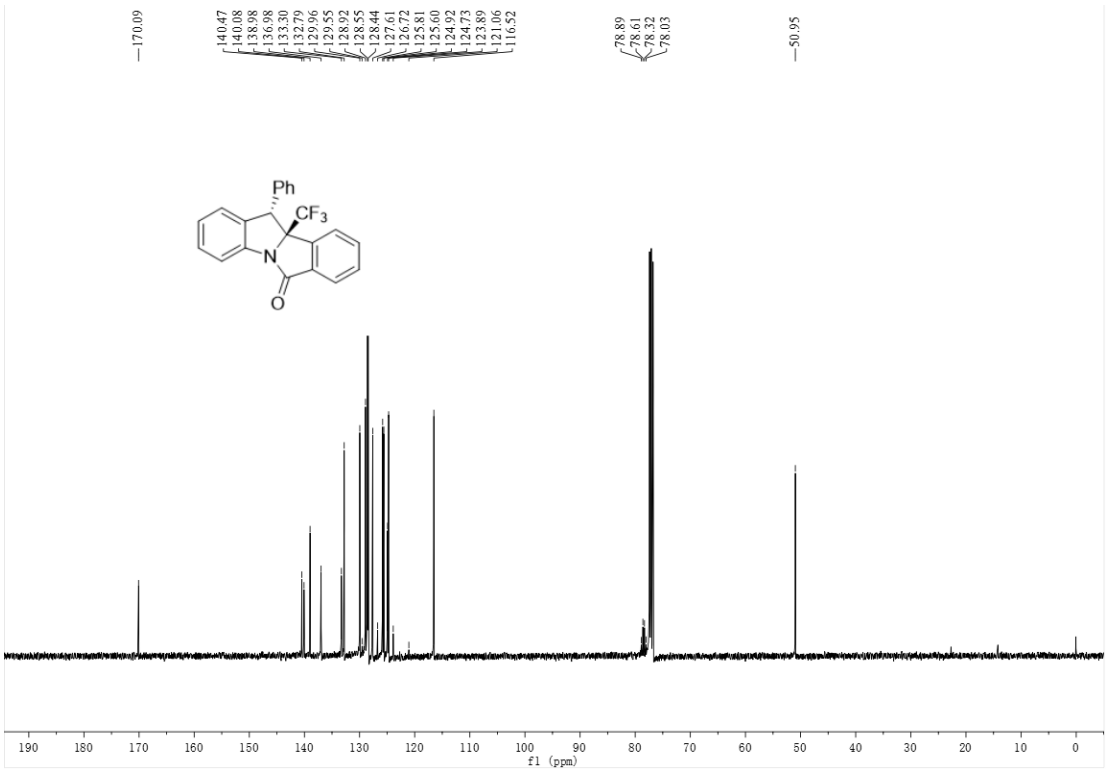
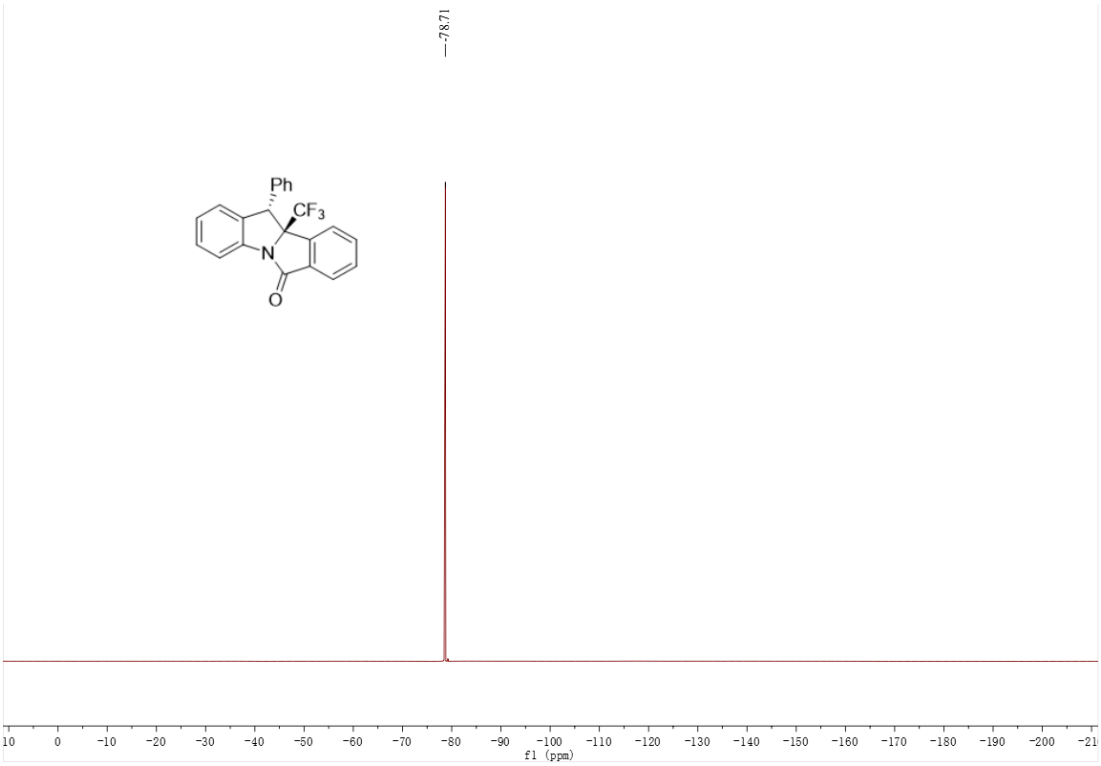
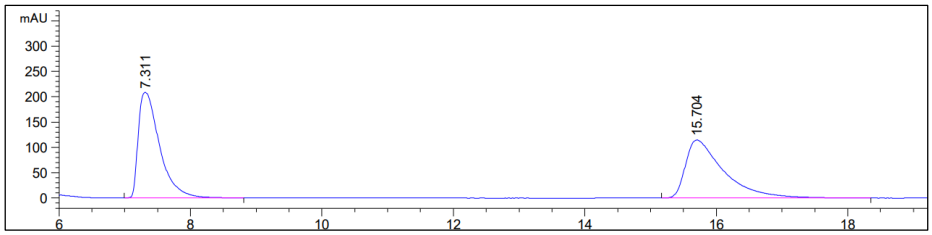
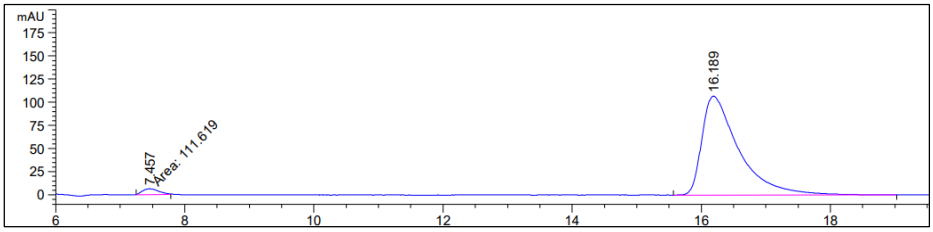
2.02
1.01
2.00
1.00
3.00
2.00
1.00
f1 (ppm)


170.09
140.47
140.08
138.98
136.98
133.30
132.79
129.96
129.55
128.92
128.55
128.44
127.61
126.72
125.81
125.60
124.92
124.73
123.89
121.06
116.52
78.89
78.61
78.32
78.03
50.95
Ph
CF3
N
O
f1 (ppm)

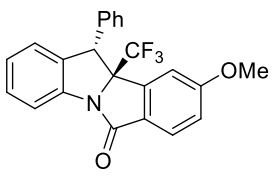






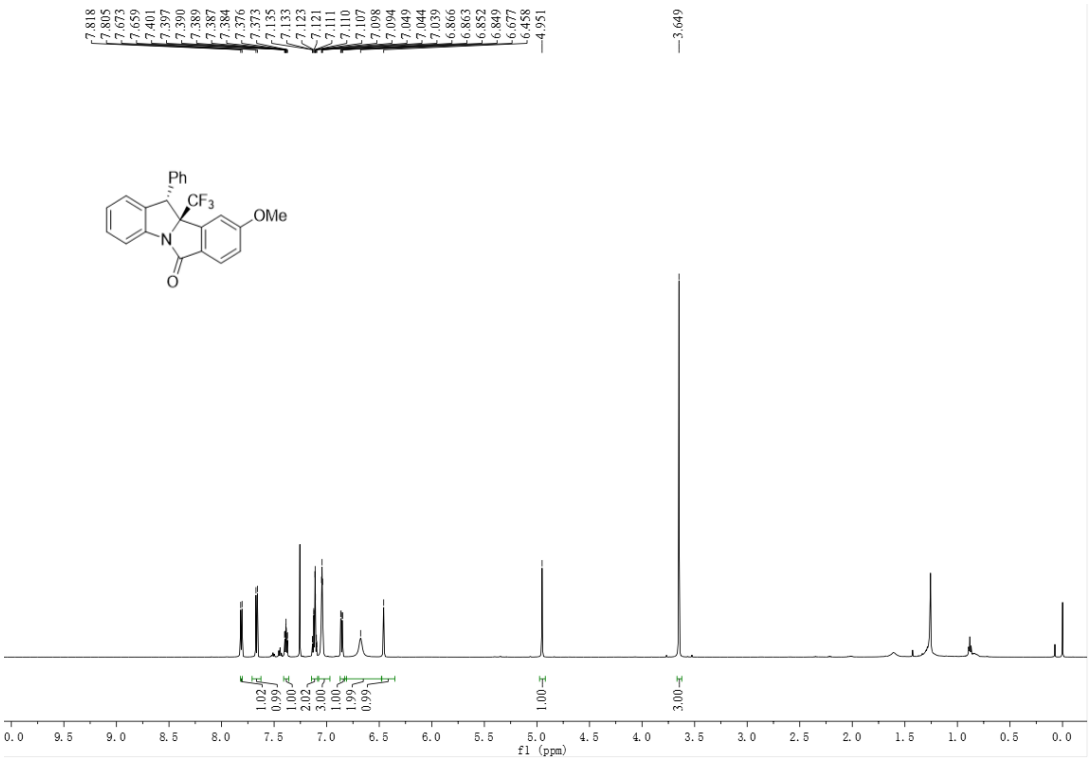
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.462	BB	0.3172	167.40544	8.03098	2.3374
2	16.171	BB	0.5812	6994.52881	176.15477	97.6626

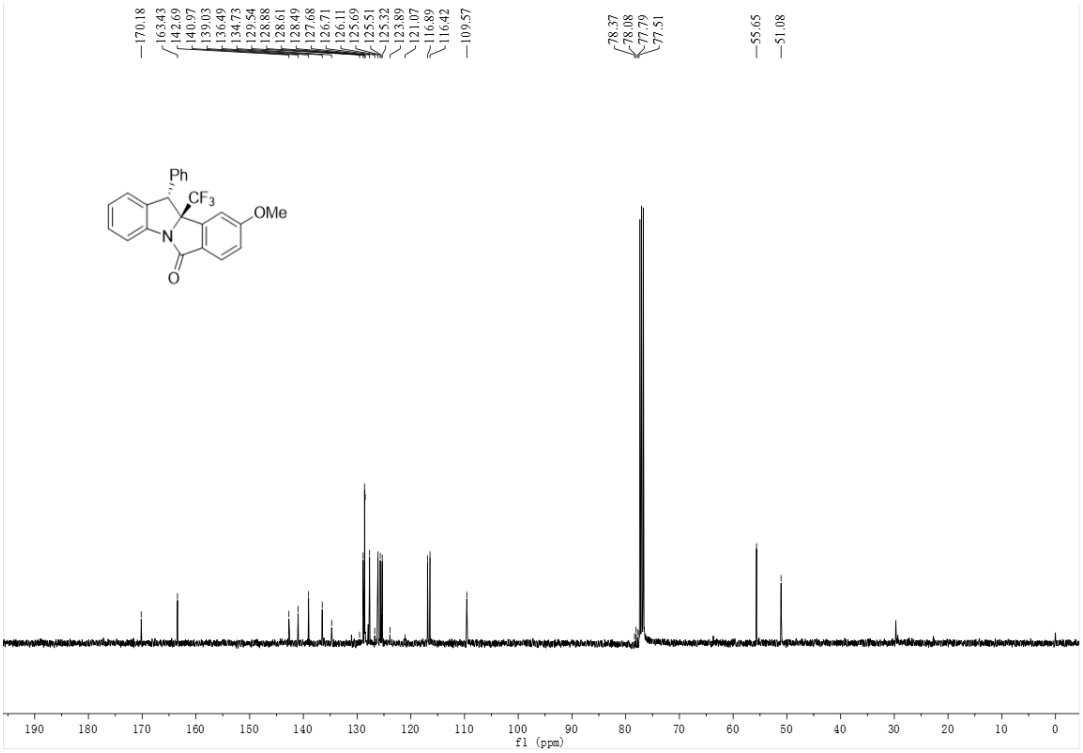
(10bR,11S)-9-Methoxy-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3b)：

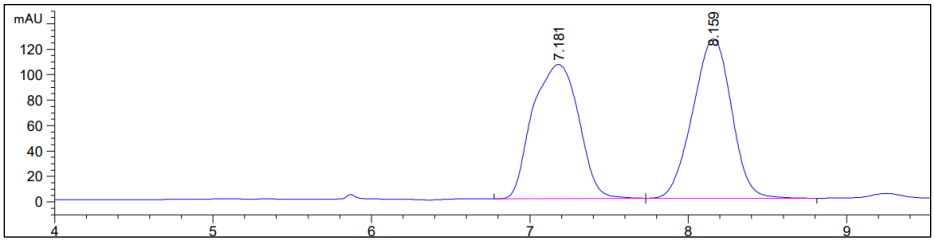


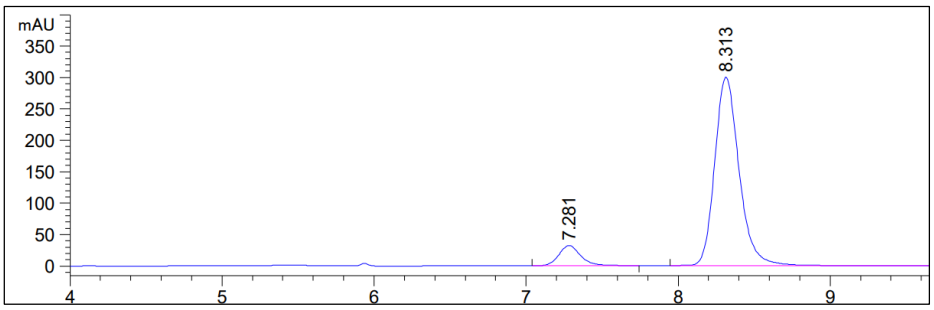
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (68% yield), m.p. 124-126 ℃. $[\alpha]_D^{20}$ = +44.5 (c 0.5, CH_2Cl_2), 83% ee [Daicel Chiralpak OD-H column (25 cm ×0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{minor} = 7.3 min, t_{major} = 8.3 min].

^{1}H NMR (600 MHz, $CDCl_3$) δ 7.81 (d, J = 7.9 Hz, 1H), 7.66 (d, J = 8.5 Hz, 1H), 7.39 (ddd, J = 8.2, 6.9, 2.0 Hz, 1H), 7.13-7.09 (m, 2H), 7.04 (t, J = 2.9 Hz, 3H), 6.86 (dd, J = 8.5, 2.3 Hz, 1H), 6.68 (s, 2H), 6.46 (s, 1H), 4.95 (s, 1H), 3.65 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.2, 163.4, 142.7, 141.0, 139.0, 136.5, 134.7, 128.9, 128.6, 128.5, 127.7, 126.1, 125.7, 125.5, 125.4 (q, J = 282.0 Hz), 125.3, 116.9, 116.4, 109.6, 77.9 (q, J = 30.0 Hz), 55.6, 51.1. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS m/z (ESI+): Calcd for $C_{23}H_{16}F_3NO_2Na^+$ $(M+Na)^+$ 418.1025, found 418.1025.



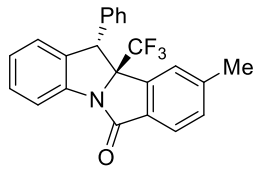




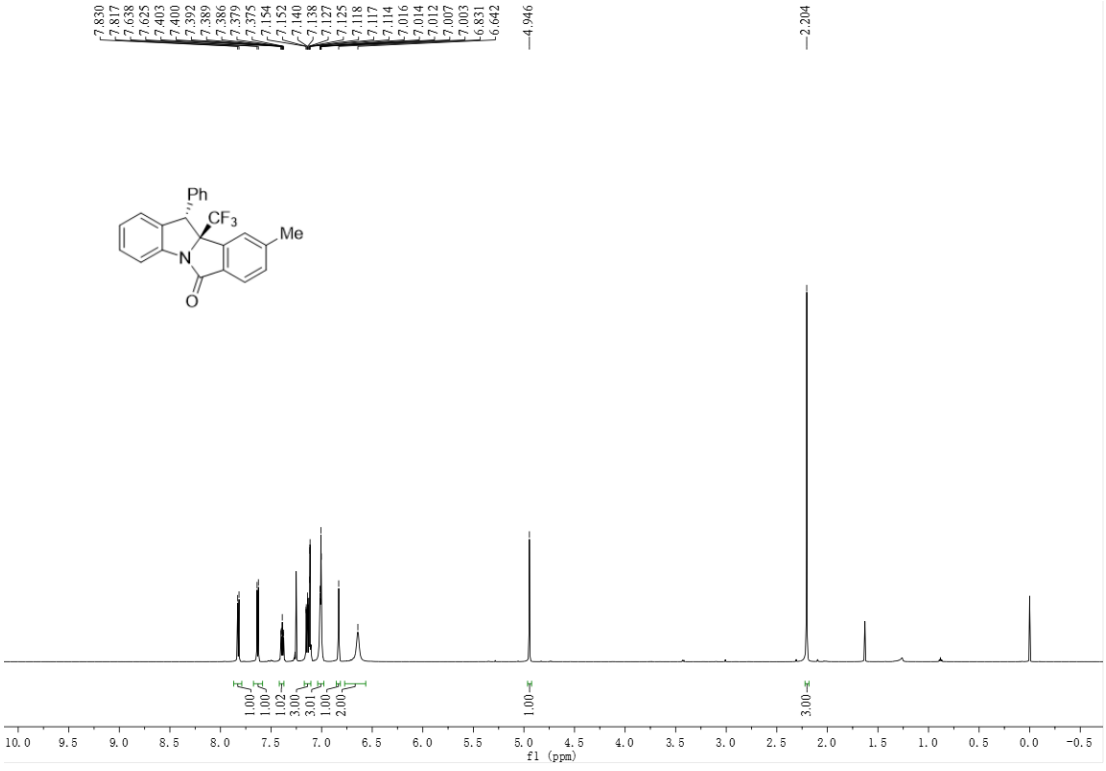


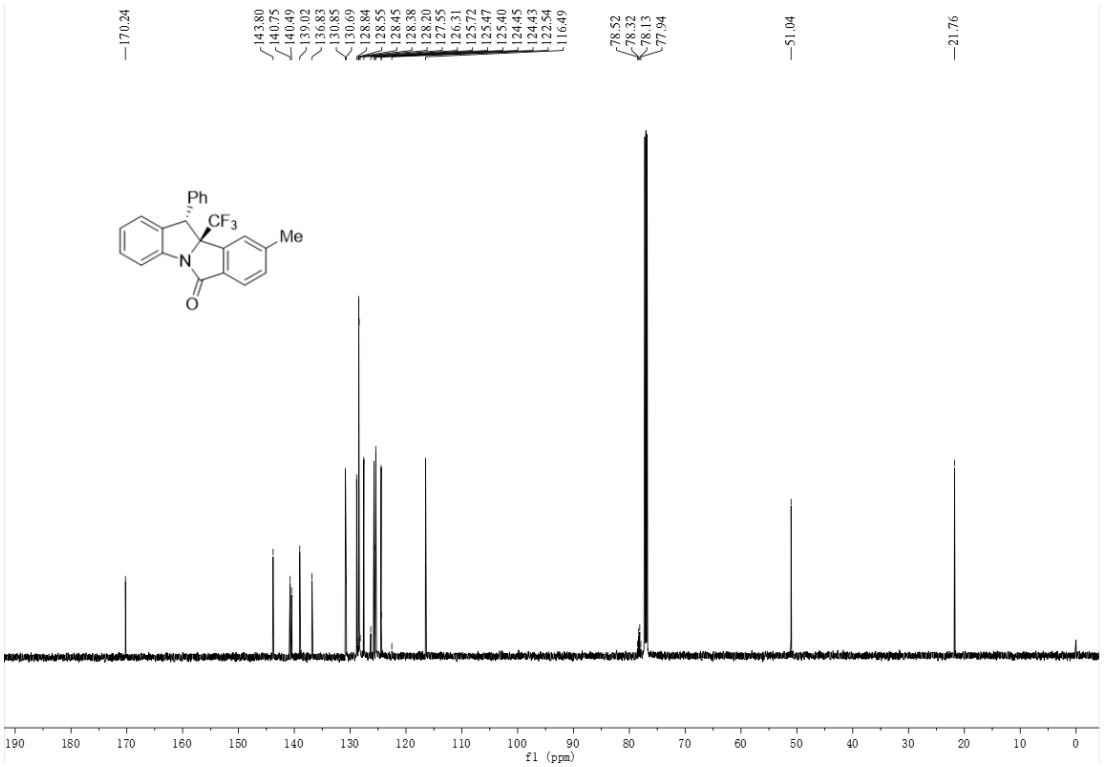
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.281	BB	0.1528	321.30090	32.08439	8.7909
2	8.313	BB	0.1716	3333.60815	300.20120	91.2091

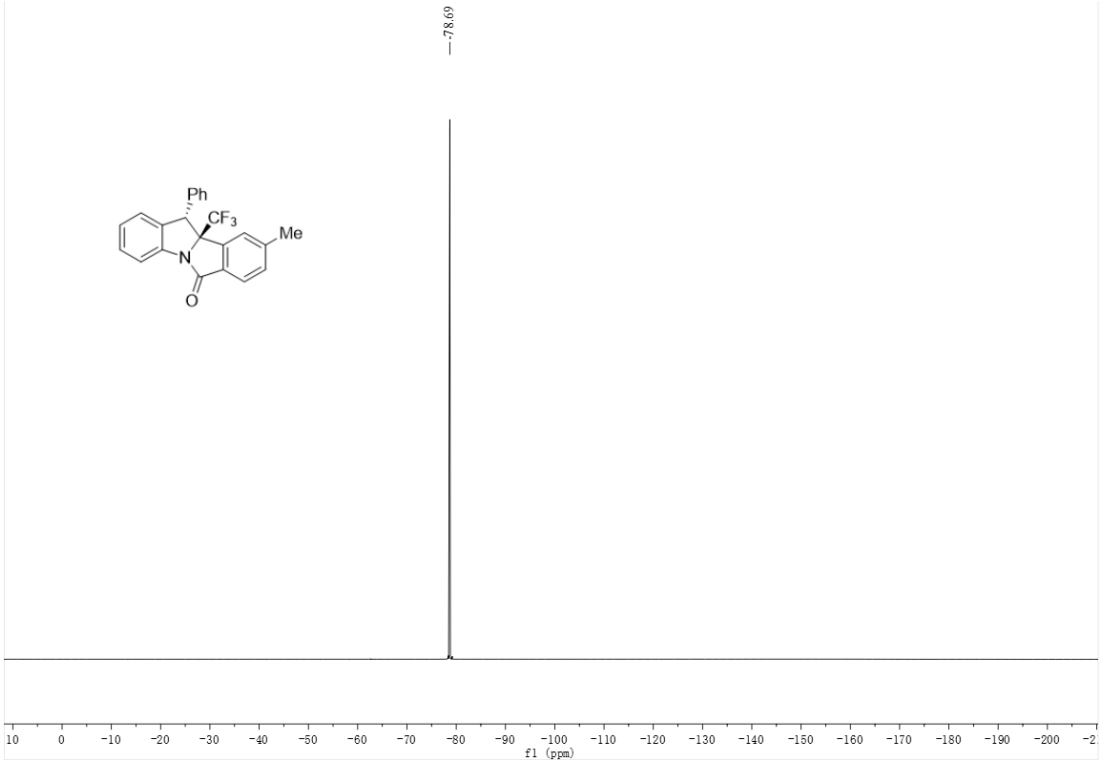
(10bR,11S)-9-Methyl-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3c)：

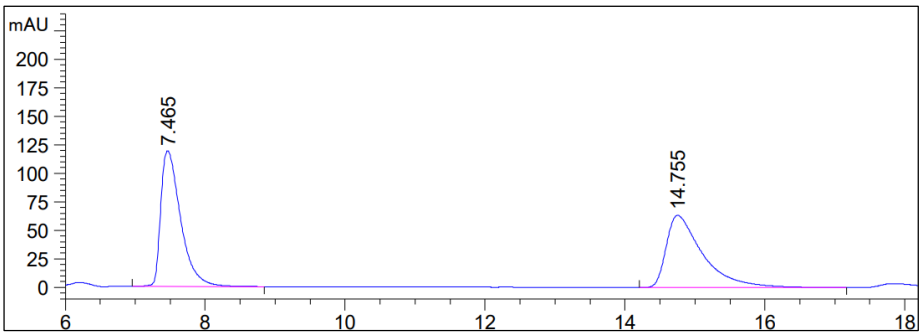


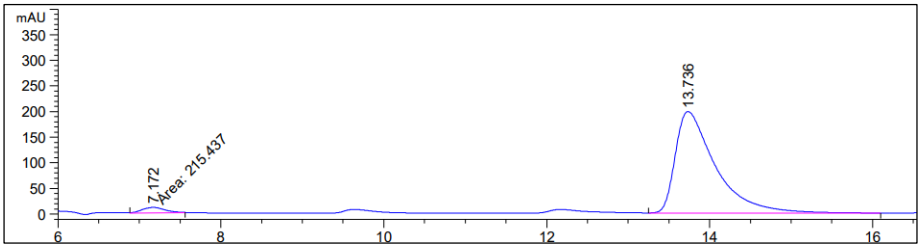
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); colorless liquid (74% yield). $[\alpha]_D^{20}$ = +22.2 (c 0.5, CH_2Cl_2), 94% ee [Daicel Chiralpak AD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 254 nm; t_{minor} = 7.2 min, t_{major} = 13.7 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.83 (d, J = 7.9 Hz, 1H), 7.64 (d, J = 7.8 Hz, 1H), 7.41-7.38 (m, 1H), 7.16-7.12 (m, 3H), 7.01 (t, J = 2.5 Hz, 2H), 6.83 (s, 1H), 6.64 (s, 2H), 4.95 (s, 1H), 2.20 (s, 3H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 170.2, 143.8, 140.8, 140.5, 139.0, 136.8, 130.8, 130.7, 128.8, 128.6, 128.5, 128.4, 125.7, 125.5, 125.4, 125.37 (q, J = 282.0 Hz), 124.5, 116.5, 78.2 (q, J = 30.0 Hz), 51.0, 21.8. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{23}H_{16}F_3NONa^+$ $(M+Na)^+$ 402.1076, found 402.1077.




170.24
143.80
140.75
140.49
139.02
136.83
130.85
130.69
128.84
128.55
128.45
128.38
128.20
127.55
126.31
125.72
125.47
125.40
124.45
124.43
122.54
116.49
78.52
78.32
78.13
77.94
51.04
21.76
Ph
CF3
Me
N
O
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

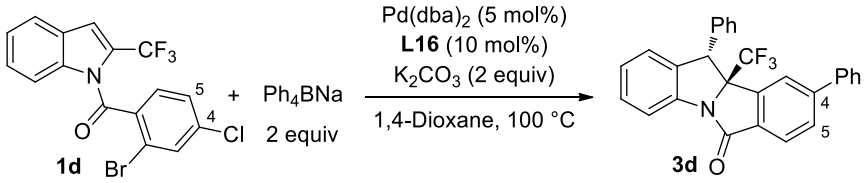

-78.69
Ph
CF3
Me
N
O
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)

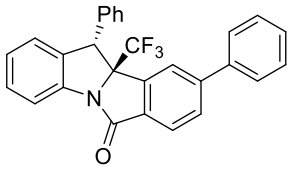




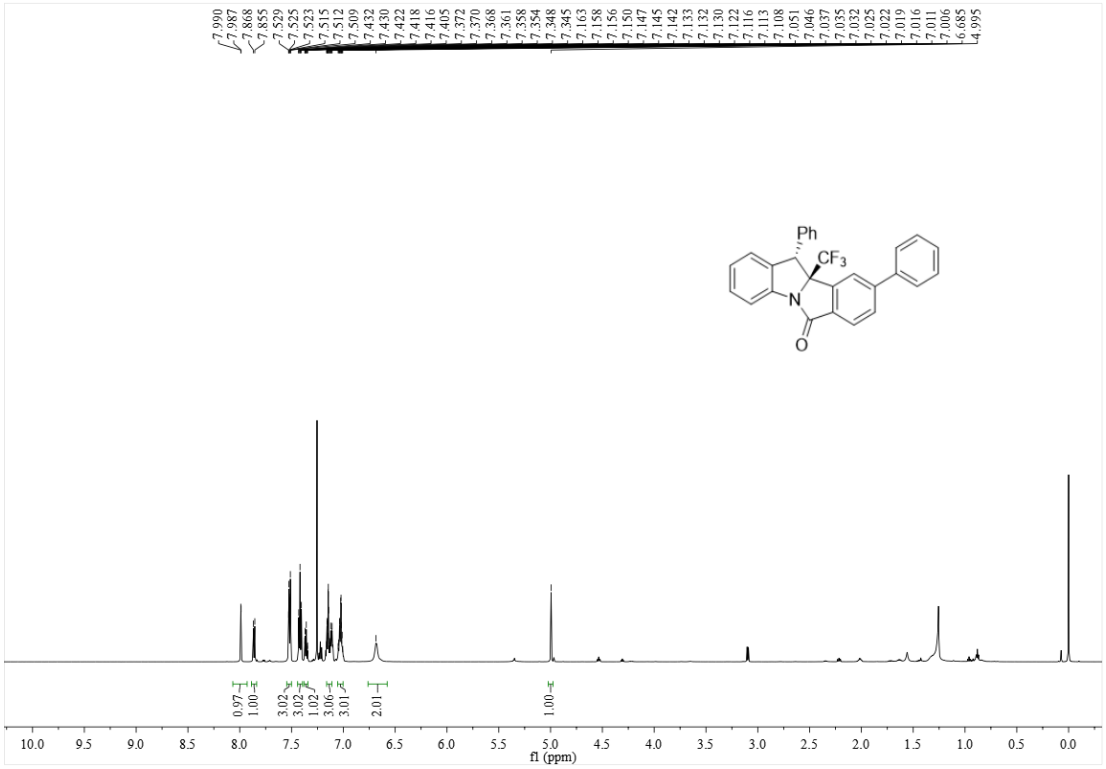
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.172	MM	0.3300	215.43733	10.88221	3.0945
2	13.736	BB	0.5034	6746.43994	198.05679	96.9055

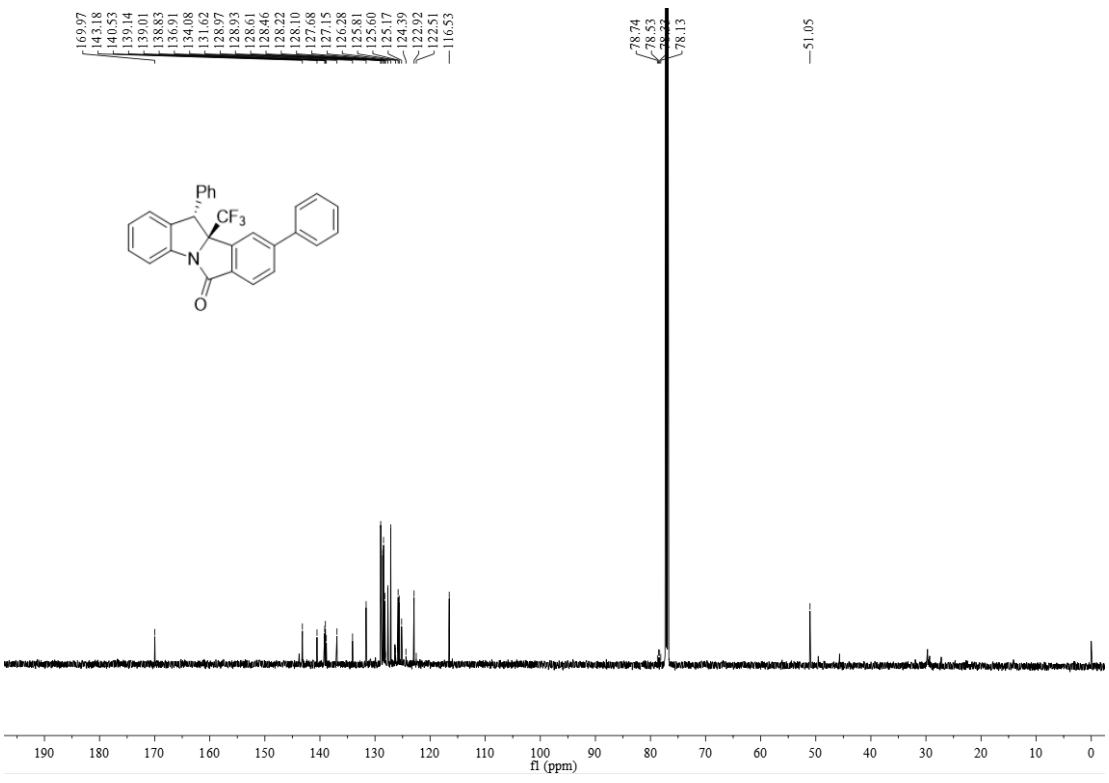
(10bR,11S)-9-Phenyl-11-Phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3d)：

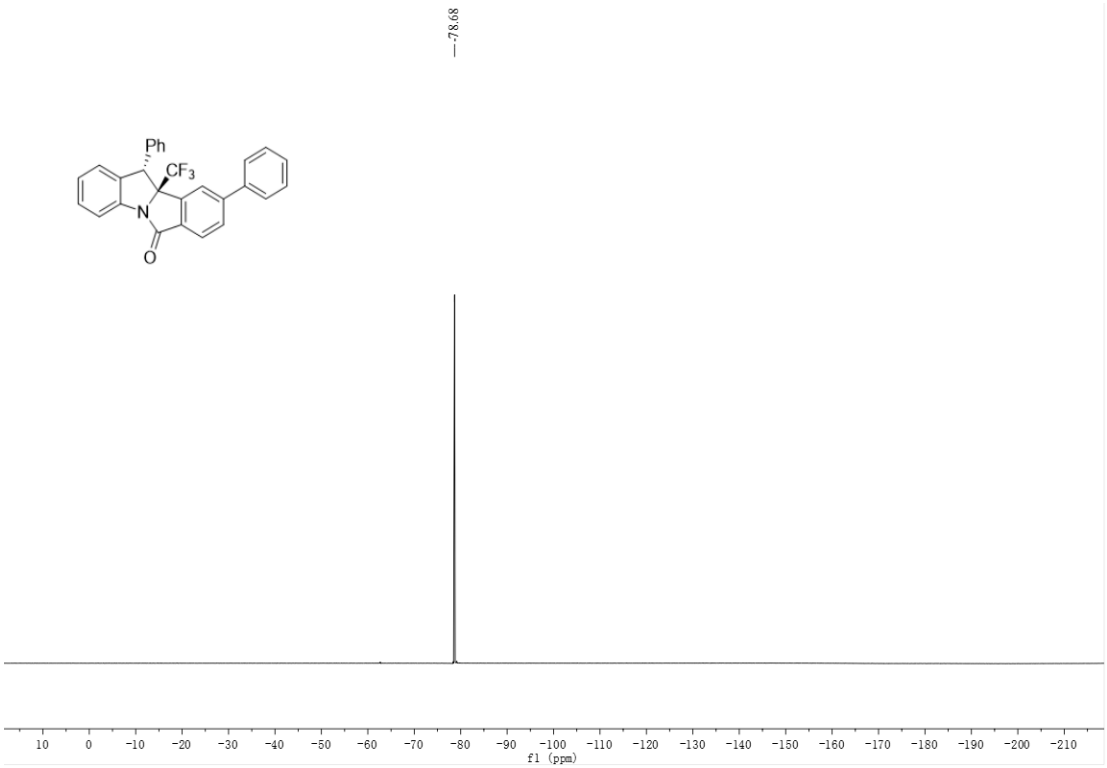


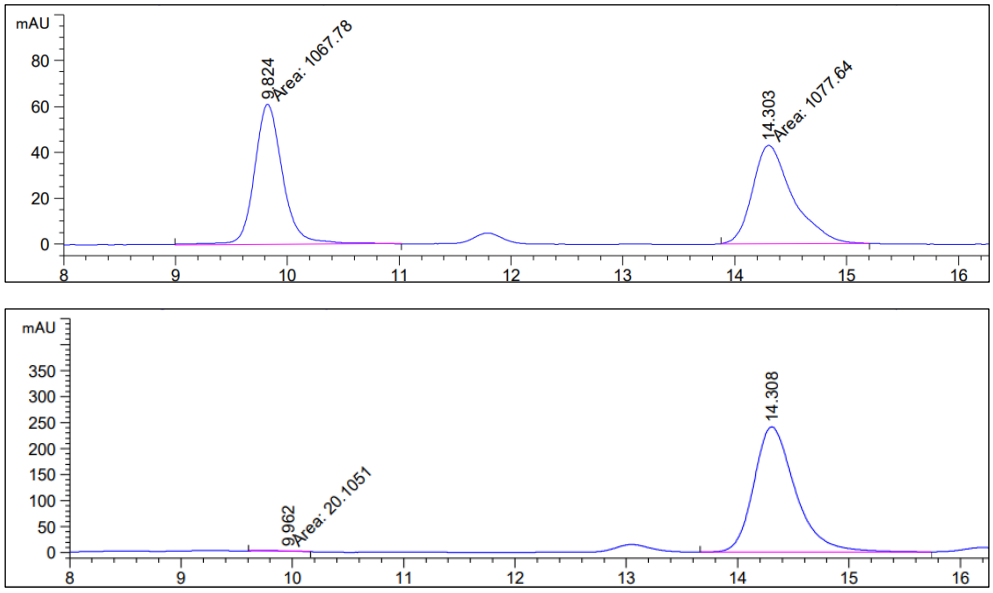


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (80% yield). $[\alpha]_D^{20}$ = -36.8 (c 0.5, CH_2Cl_2), 99% ee [Daicel Chiralpak A2 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 210 nm; t_{minor} = 9.8 min, t_{major} = 14.3 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.99 (d, J = 1.7 Hz, 1H), 7.86 (d, J = 7.9 Hz, 1H), 7.52 (dt, J = 8.1, 1.6 Hz, 3H), 7.43-7.41 (m, 3H), 7.37-7.35 (m, 1H), 7.16-7.11 (m, 3H), 7.05-7.01 (m, 3H), 6.68 (s, 2H), 5.00 (s, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) ^{13}C NMR (150 MHz, $CDCl_3$) δ 167.0, 143.0, 140.5, 139.1, 139.0, 138.8, 136.9, 134.1, 131.6, 129.0, 128.9, 128.6, 128.5, 128.2, 127.7, 127.2, 125.8, 125.6, 125.3 (q, J = 282 Hz), 125.2, 122.9, 116.53, 78.4 (q, J = 30 Hz), 51.05. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{28}H_{18}F_3NONa^+$ $(M+Na)^+$ 464.1233, found 464.1233.


7.990
7.987
7.868
7.855
7.529
7.525
7.523
7.515
7.512
7.509
7.432
7.430
7.422
7.418
7.416
7.405
7.372
7.370
7.368
7.361
7.358
7.354
7.348
7.345
7.163
7.158
7.156
7.150
7.147
7.145
7.142
7.133
7.132
7.130
7.122
7.116
7.113
7.108
7.051
7.046
7.037
7.035
7.032
7.025
7.022
7.019
7.016
7.011
7.006
6.685
4.995
Ph
CF3
N
O
0.97
1.00
3.02
3.02
1.02
3.06
3.01
2.01
1.00
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)

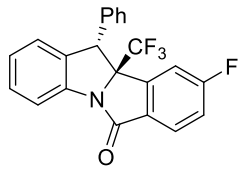

169.97
143.18
140.55
139.14
139.01
138.83
136.91
134.08
131.62
128.97
128.93
128.61
128.46
128.22
128.10
127.68
127.15
126.28
125.81
125.60
125.17
124.39
122.92
122.51
116.53
78.74
78.53
78.32
78.13
51.05
Ph
CF3
N
O
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



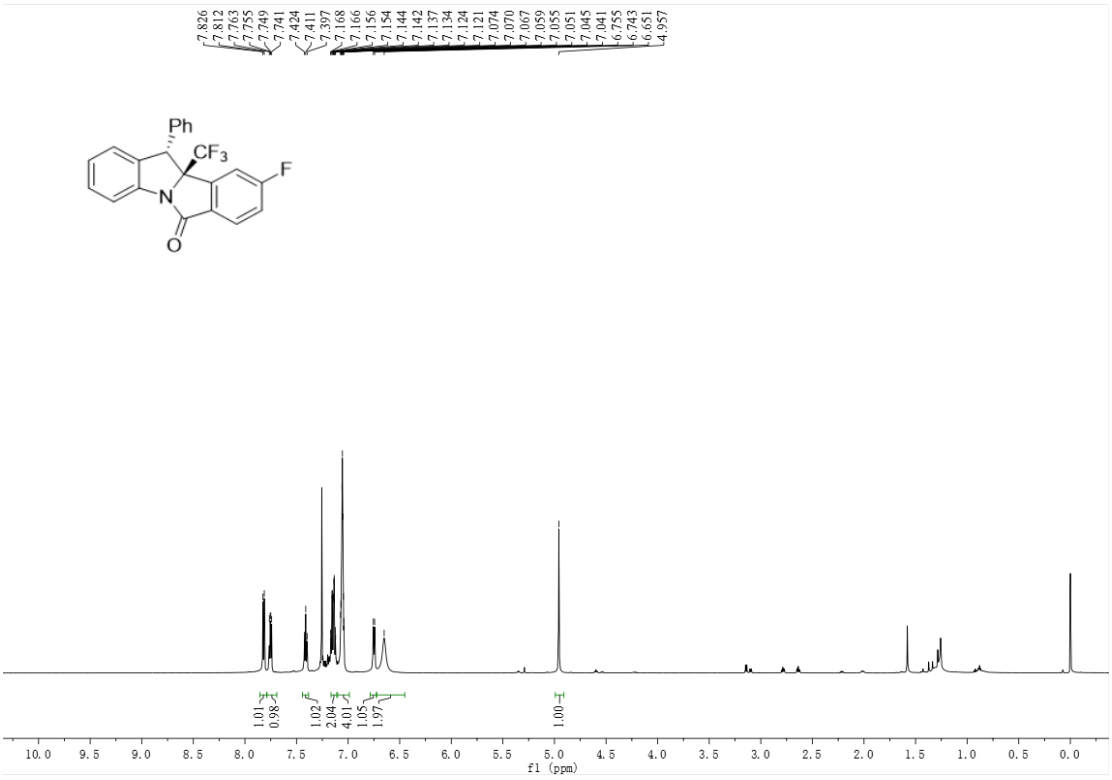


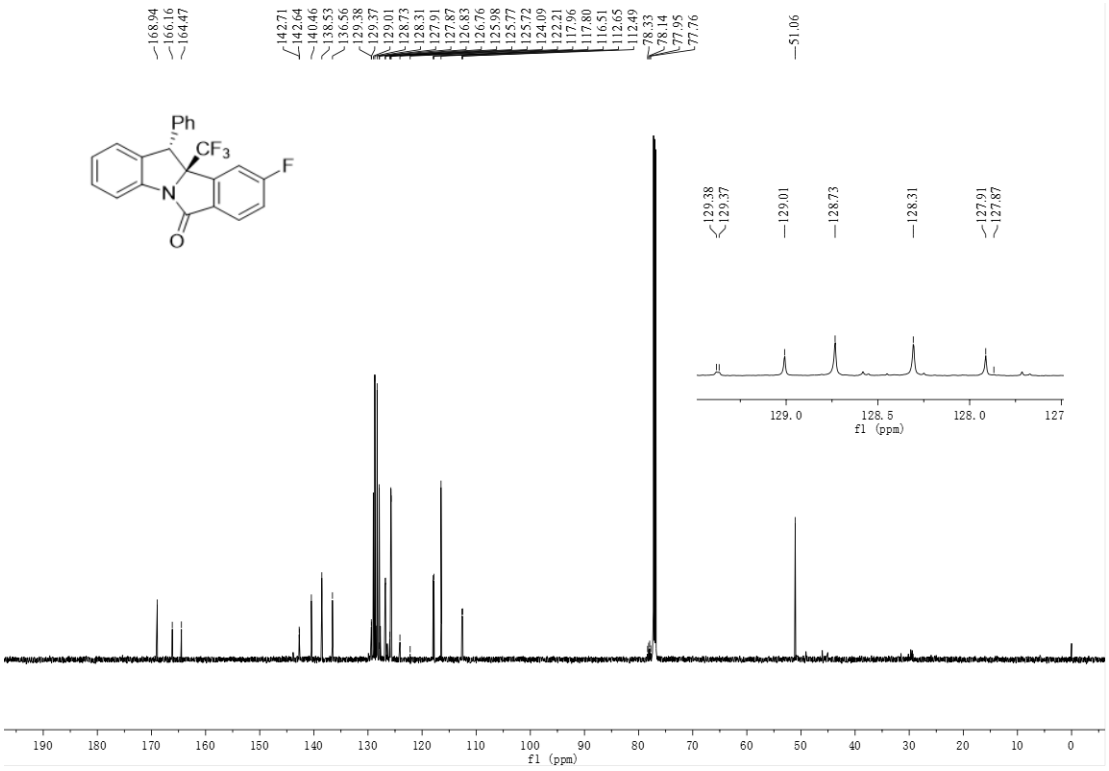
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.962	MM	0.3776	20.10506	8.87328e-1	0.3216
2	14.308	BB	0.3944	6232.12842	240.39958	99.6784
Totals :				6252.23348	241.28691	

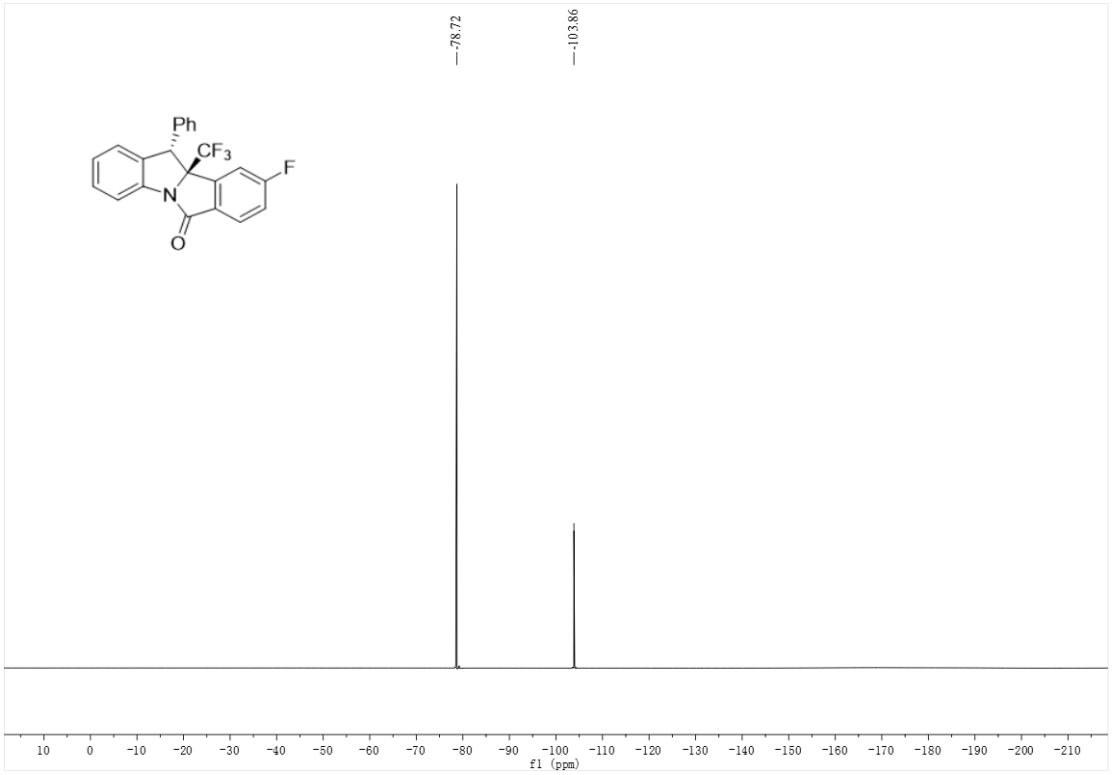
(10bR,11S)-9-Fluoro-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3e)：

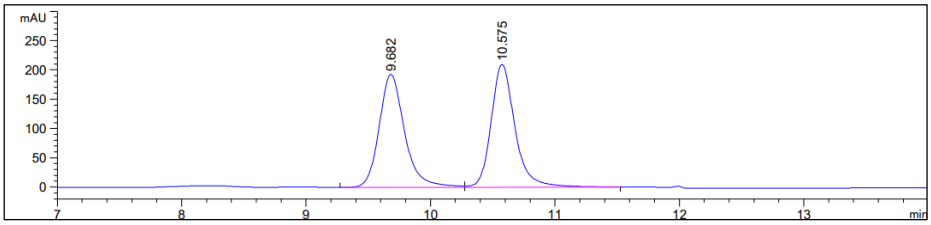


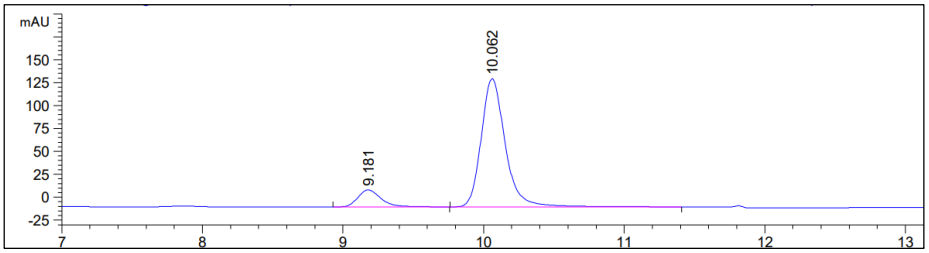
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (56% yield), m.p. 150-152 ℃. $[\alpha]_D^{20}$ = +67.8 (c 0.5, CH_2Cl_2), 77% ee [Daicel Chiralpak C2 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 95/05, 0.5 mL/min, 280 nm; t_{minor} = 9.2 min, t_{major} = 10.1 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.82 (d, J = 7.9 Hz, 1H), 7.76 (dd, J = 8.4, 4.9 Hz, 1H), 7.41 (t, J = 8.2 Hz, 1H), 7.20-7.10 (m, 2H), 7.06 (m, 4H), 6.75 (d, J = 7.7 Hz, 2H), 6.65 (s, 2H), 4.96 (s, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 168.9, 165.3 (d, J = 253.5 Hz), 142.7 (d, J = 10.5 Hz), 140.5, 138.5, 136.6, 129.4 (d, J = 1.5 Hz), 129.0, 128.7, 128.3, 127.9, 126.8 (d, J = 10.5 Hz), 125.8 (d, J = 7.5 Hz), 125.0 (q, J = 282 Hz), 117.9, 117.80, 116.5, 112.7, 112.5, 78.1 (q, J = 30.0 Hz), 51.06. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7, -103.9 ppm. HRMS m/z (ESI+): Calcd for $C_{22}H_{13}F_4NONa^+$ $(M+Na)^+$ 406.0826, found 406.0826.




168.94
166.16
164.47
142.71
142.64
140.46
138.53
136.56
129.38
129.37
129.01
128.73
128.31
127.91
127.87
126.83
126.76
125.98
125.77
125.72
124.09
122.21
117.96
117.80
116.51
112.65
112.49
78.33
78.14
77.95
77.76
51.06
Ph
CF3
F
N
O
129.38
129.37
129.01
128.73
128.31
127.91
127.87
129.0
128.5
128.0
127
f1 (ppm)
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

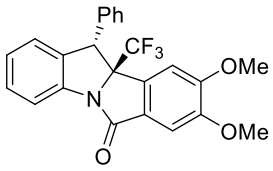

-78.72
-103.86
Ph
CF3
F
N
O
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)



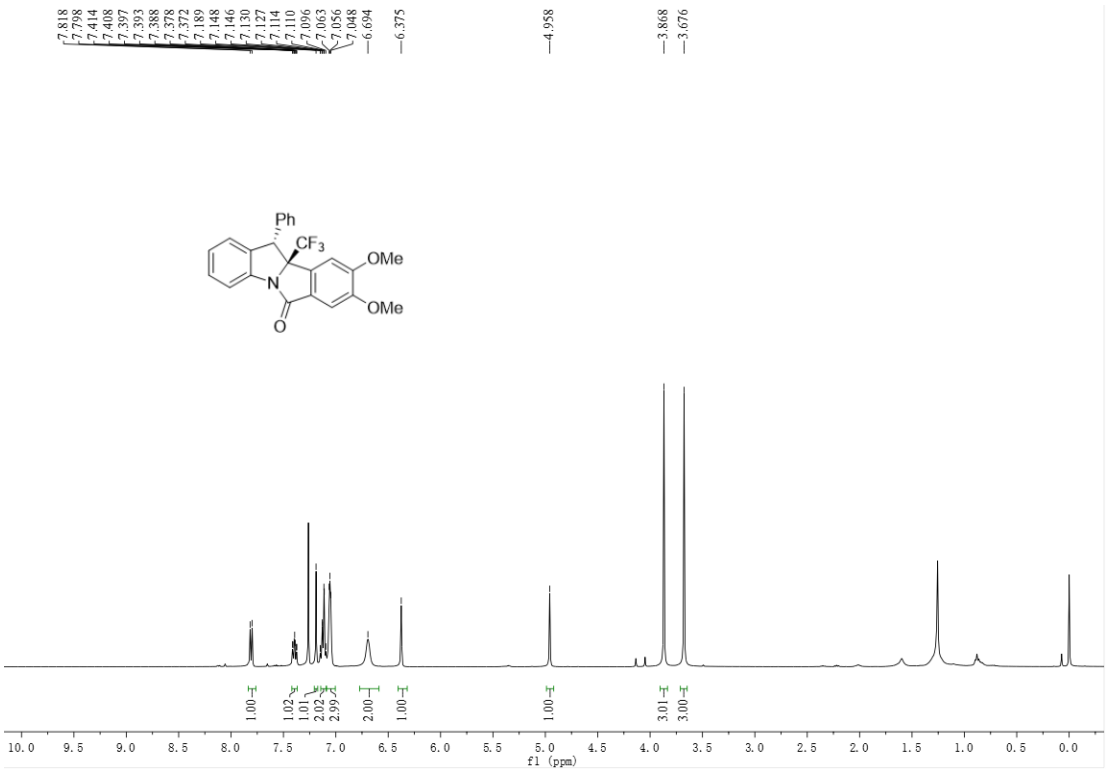


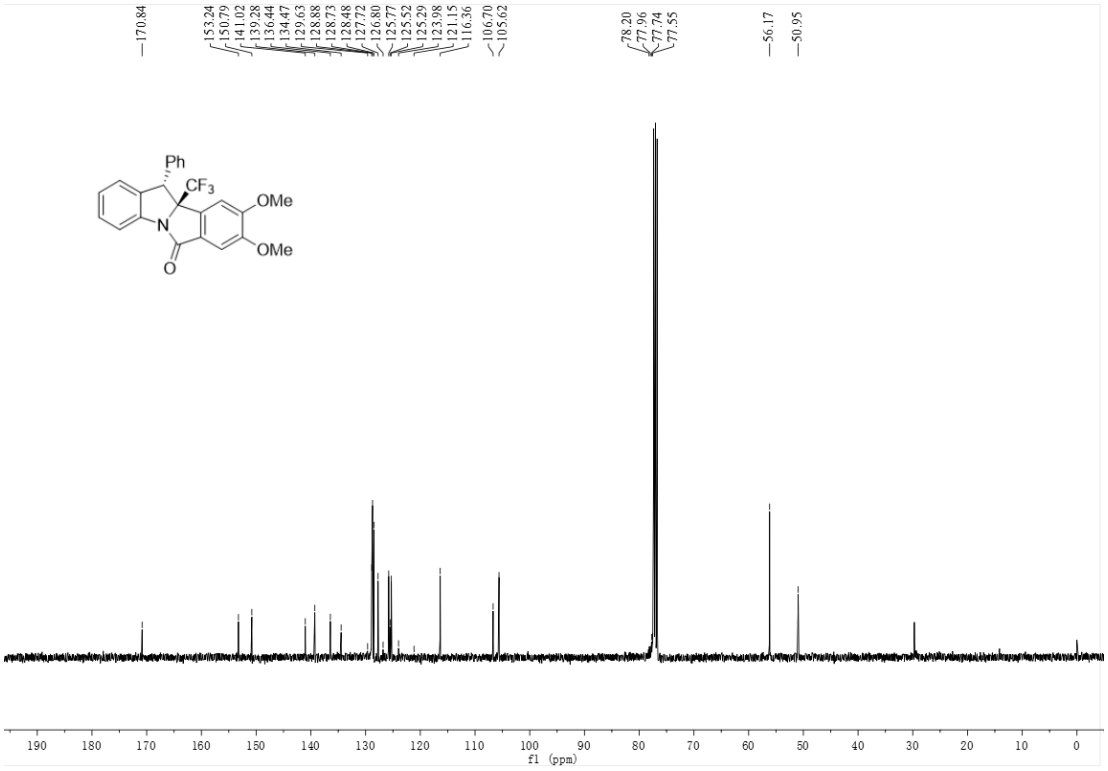
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.181	BB	0.1759	214.13696	18.65736	11.4118
2	10.062	BB	0.1809	1662.31836	139.63023	88.5882

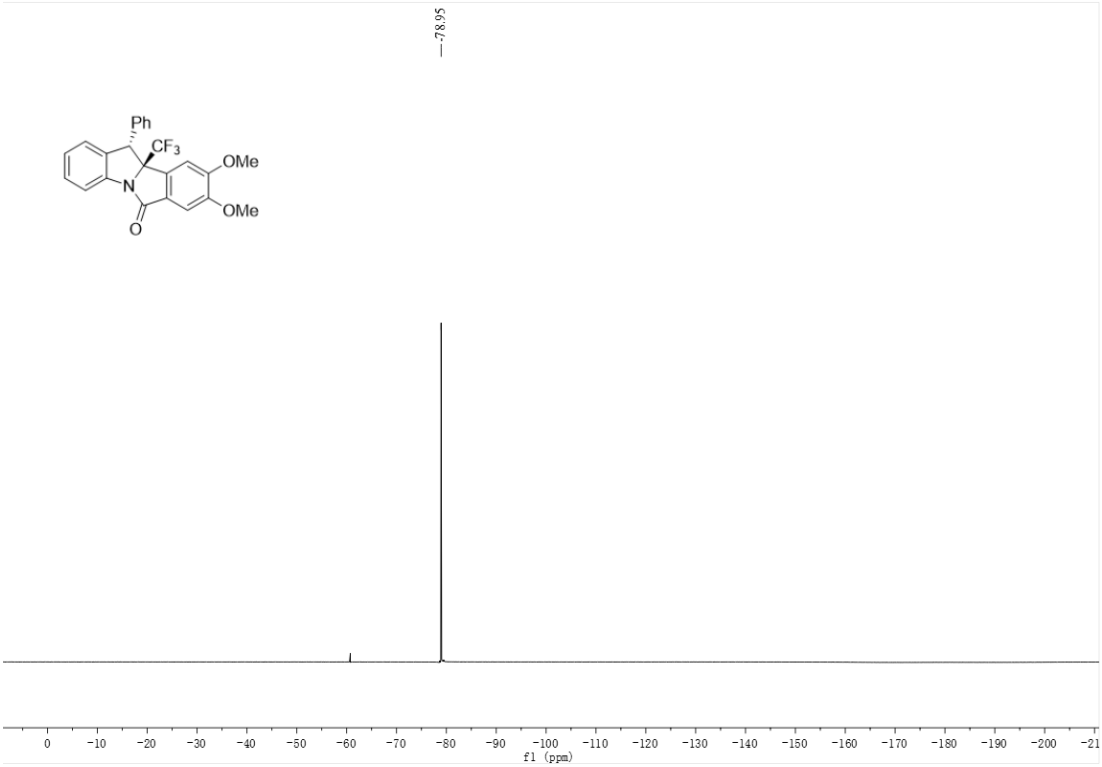
(10bR,11S)-8,9-Dimethoxy-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one(3f)：

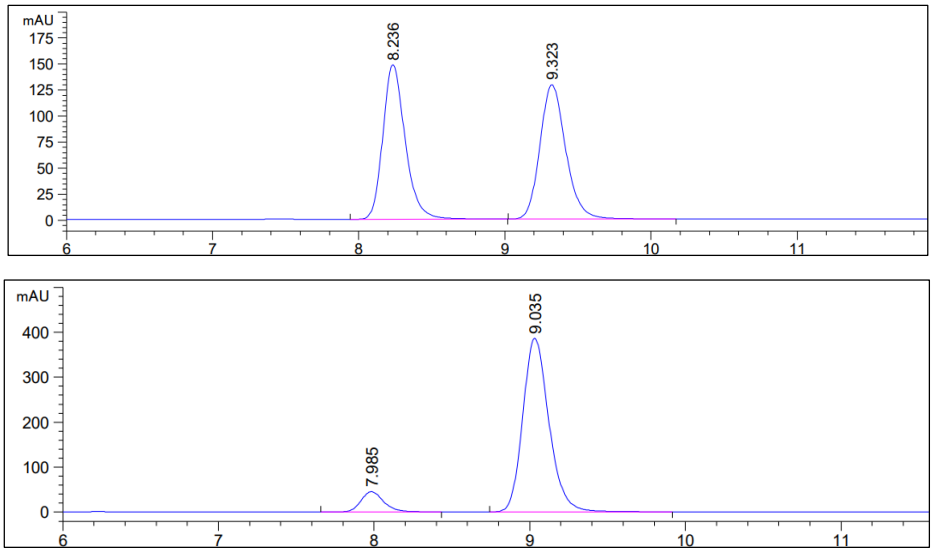


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (51% yield), m.p. 150-152 ℃. $[\alpha]_D^{20}$ = +93.0 (c 0.5, CH_2Cl_2), 82% ee [Daicel Chiralpak OD-H column (25 cm ×0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{minor} = 8.0 min, t_{major} = 9.0 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, J = 7.9 Hz, 1H), 7.40 (ddd, J = 8.3, 6.5, 2.2 Hz, 1H), 7.19 (s, 1H), 7.15-7.10 (m, 2H), 7.07-7.05 (m, 3H), 6.70 (s, 2H), 6.38 (s, 1H), 4.96 (s, 1H), 3.87 (s, 3H), 3.68 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.8, 153.2, 150.8, 141.0, 139.3, 136.4, 134.5, 128.9, 128.7, 128.5, 127.7, 125.8, 125.5, 125.4 (q, J = 282.0 Hz), 125.3, 116.4, 106.7, 105.6, 78.9 (q, J = 30.0 Hz), 56.2, 50.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.0 ppm. HRMS *m/z* (ESI+): Calcd for $C_{24}H_{18}F_3NO_3Na^+$ $(M+Na)^+$ 448.1131, found 448.1130.


7.818
7.798
7.414
7.408
7.397
7.393
7.388
7.378
7.372
7.189
7.148
7.146
7.130
7.127
7.114
7.110
7.096
7.063
7.056
7.048
6.694
6.375
4.958
3.868
3.676
Ph
CF3
OMe
OMe
N
O
1.00
1.02
1.01
2.02
2.99
2.00
1.00
1.00
3.01
3.00
f1 (ppm)

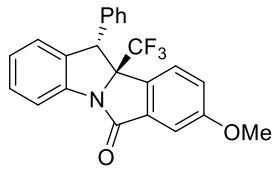

170.84
153.24
150.79
141.02
139.28
136.44
134.47
129.63
128.88
128.73
128.48
127.72
126.80
125.77
125.52
125.29
123.98
121.15
116.36
106.70
105.62
78.20
77.96
77.74
77.55
56.17
50.95
Ph
CF3
OMe
OMe
N
O
f1 (ppm)



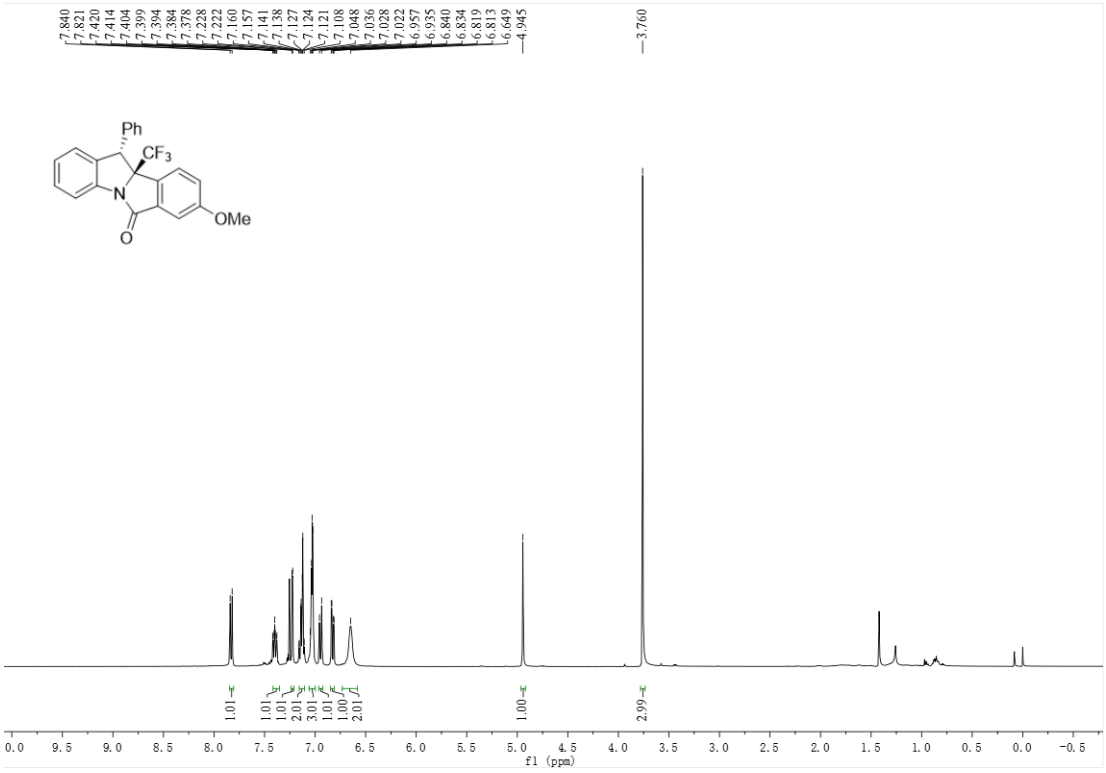


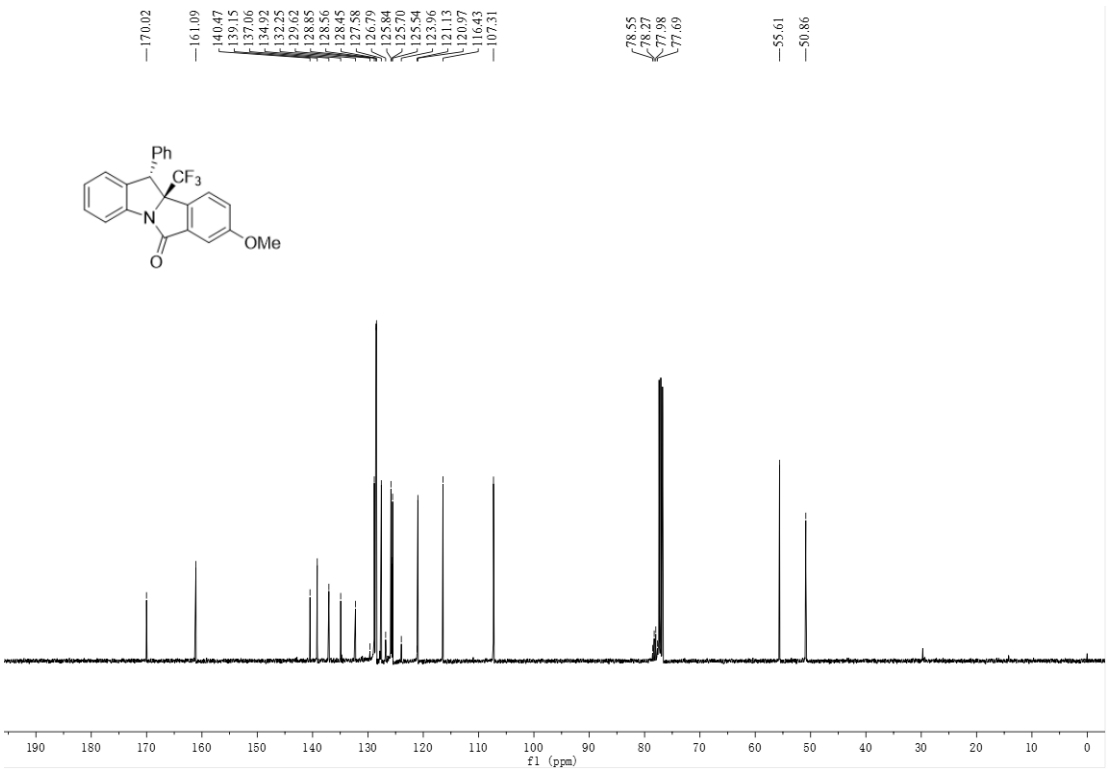
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.985	BB	0.1542	455.26437	44.95000	9.1564
2	9.035	BB	0.1805	4516.83936	386.17456	90.8436

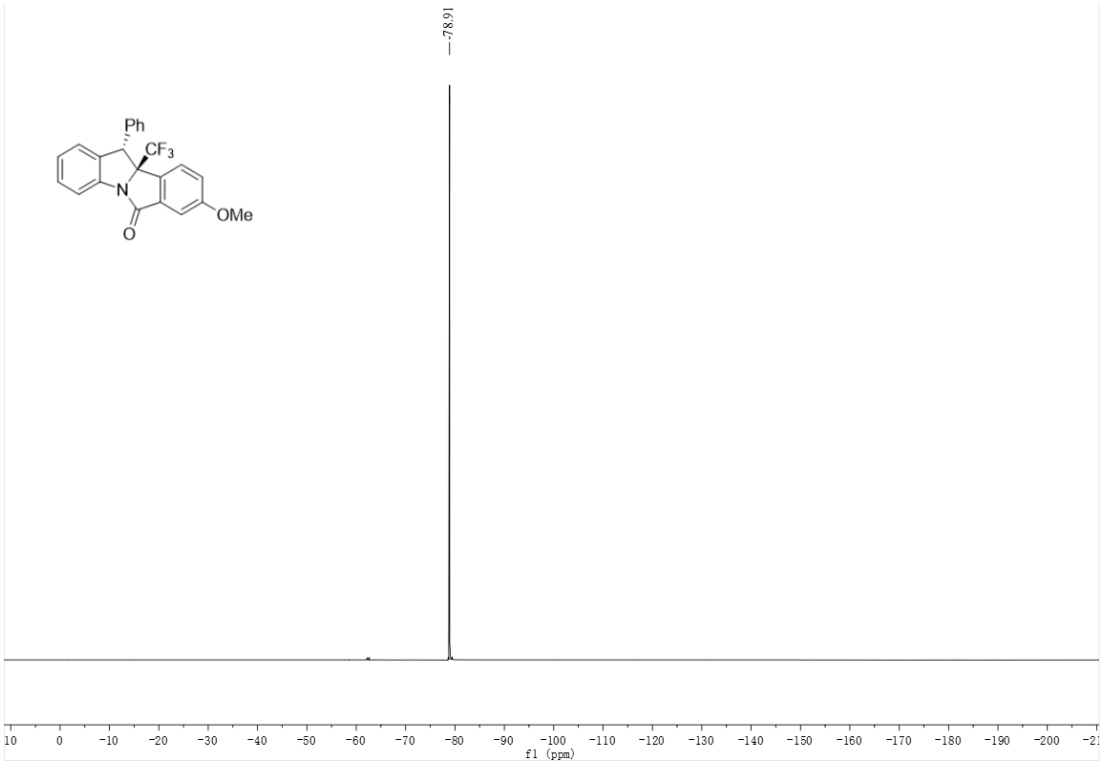
(10bR,11S)-8-Methoxy-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3g)：



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); colorless liquid (76% yield). $[\alpha]_D^{20}$ = +62.7 (c 0.5, CH_2Cl_2), 92% ee [Daicel Chiralpak A2 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{minor} = 12.3 min, t_{major} = 14.7 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (d, J = 7.9 Hz, 1H), 7.40 (ddd, J = 8.3, 6.4, 2.3 Hz, 1H), 7.23 (d, J = 2.4 Hz, 1H), 7.16-7.11 (m, 2H), 7.05-7.02 (m, 3H), 6.95 (d, J = 8.5 Hz, 1H), 6.83 (dd, J = 8.5, 2.5 Hz, 1H), 6.65 (s, 2H), 4.95 (s, 1H), 3.76 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.0, 161.1, 140.5, 139.2, 137.1, 134.9, 132.3, 128.9, 128.6, 128.4, 127.6, 125.8, 125.7, 125.5, 125.4 (q, J = 282.0 Hz), 121.0, 116.4, 107.3, 78.2 (q, J = 30.0 Hz), 55.6, 50.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{23}H_{16}F_3NO_2Na^+$ $(M+Na)^+$ 418.1025, found 418.1025.




170.02
161.09
140.47
139.15
137.06
134.92
132.25
129.62
128.85
128.56
128.45
127.58
126.79
125.84
125.70
125.54
123.96
121.13
120.97
116.43
107.31
78.55
78.27
77.98
77.69
55.61
50.86
Ph
CF3
N
O
OMe
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-78.91
Ph
CF3
N
O
OMe
10
0
-10
-20
-30
-40
-50
-60
-70
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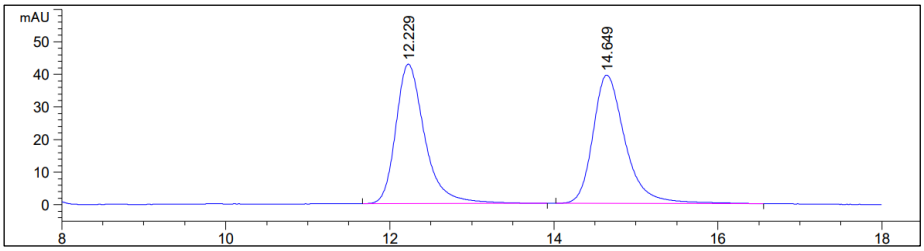
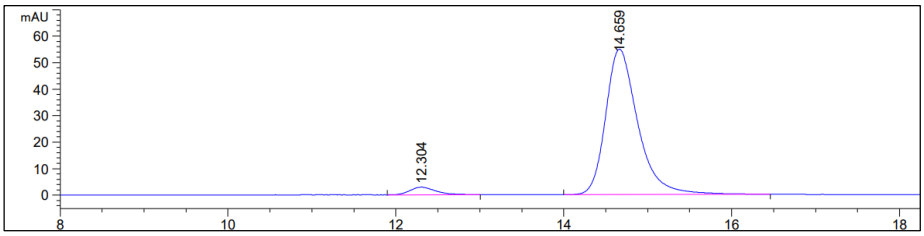
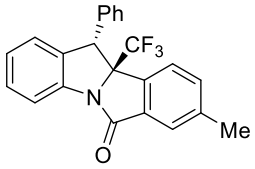
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
f1 (ppm)



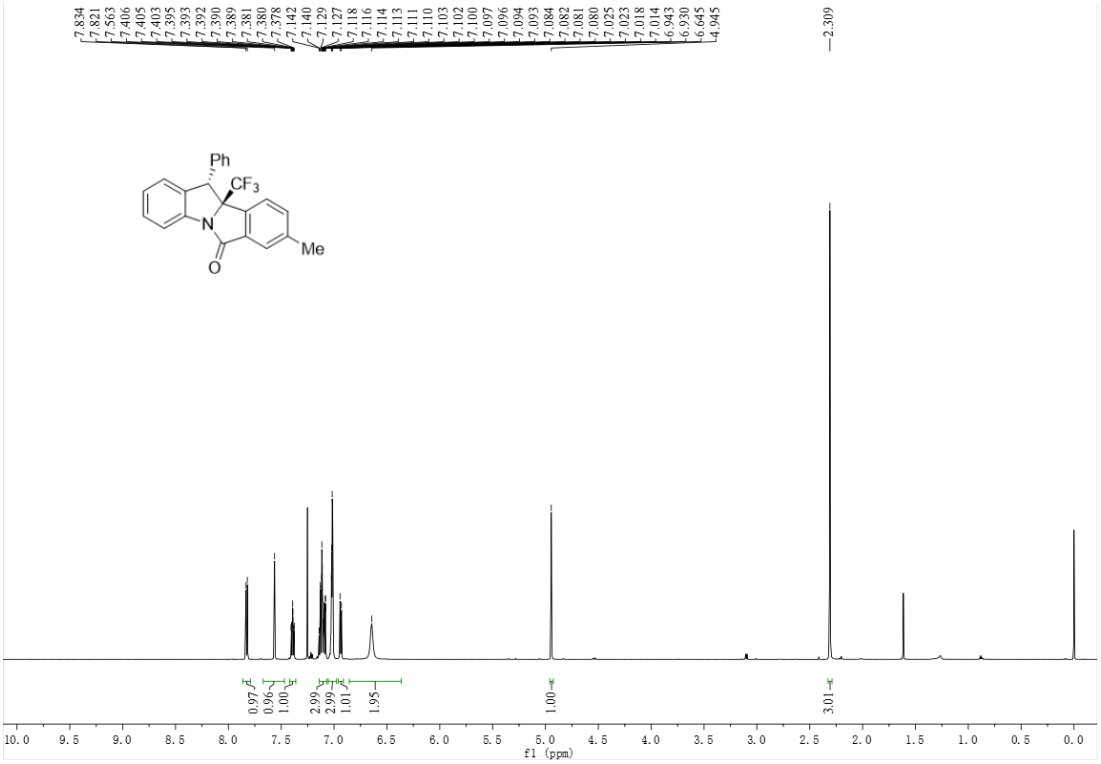


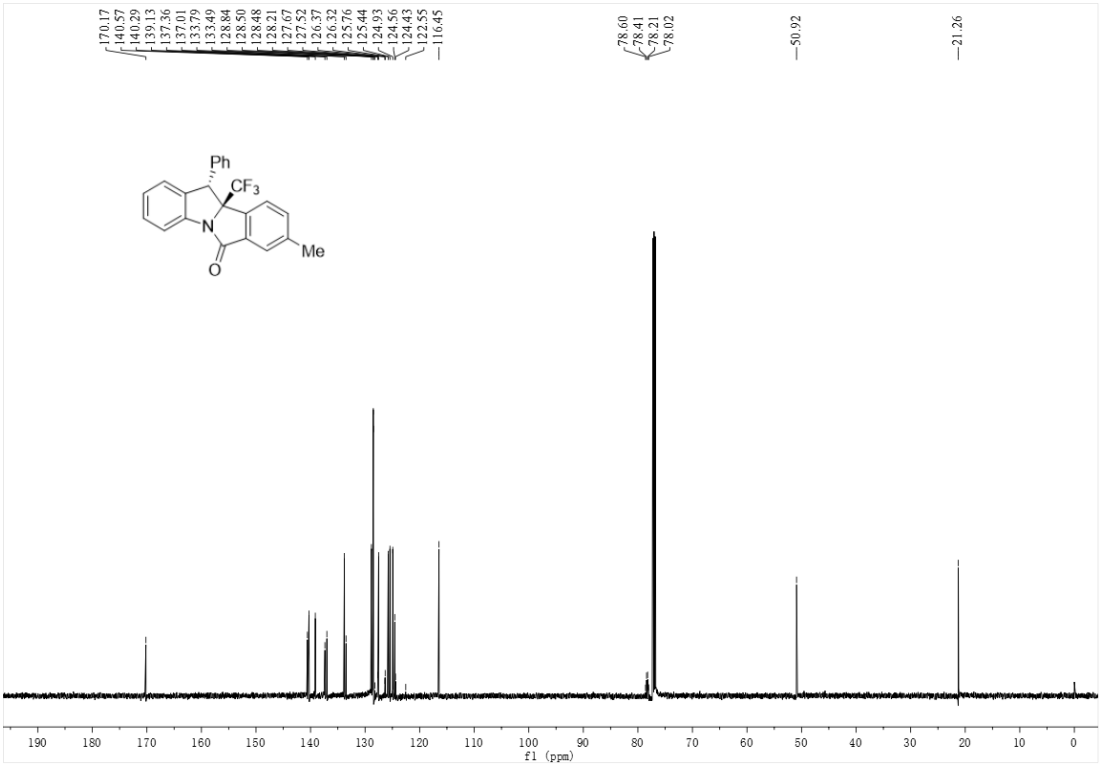
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	12.304	BB	0.3117	61.71142	2.88298	4.0360
2	14.659	BB	0.4020	1467.31445	54.87431	95.9640

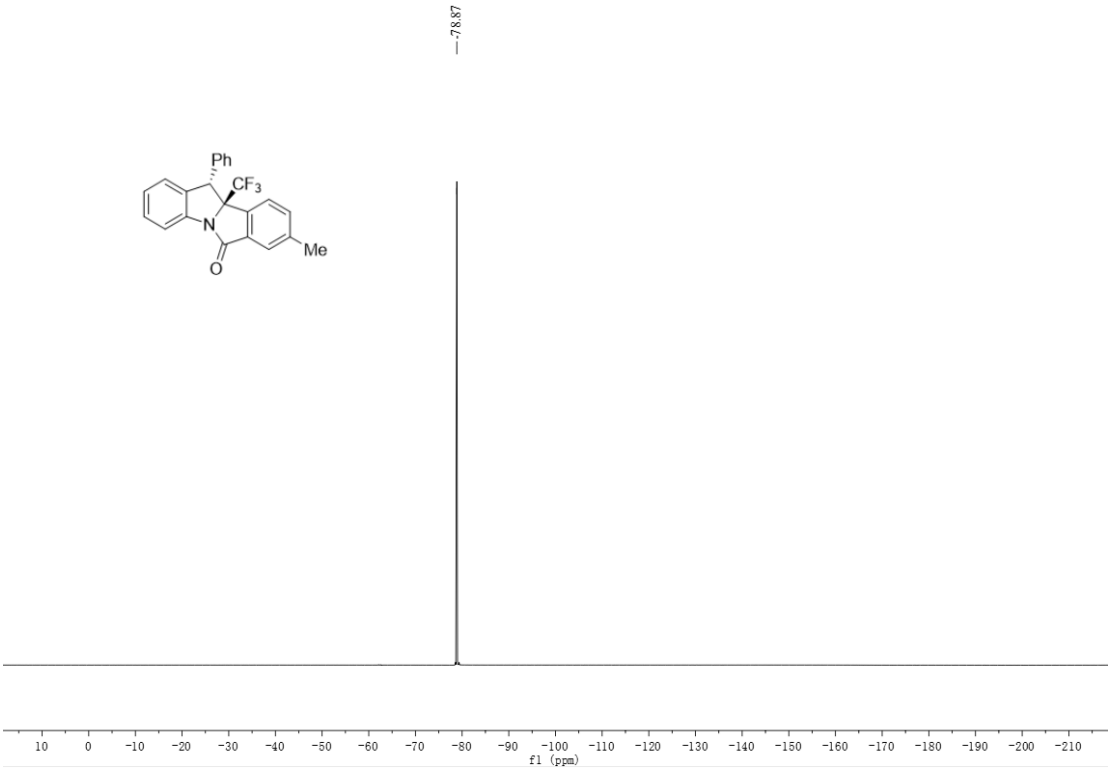
***(10bR,11S)-8-Methyl-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3h)*:**

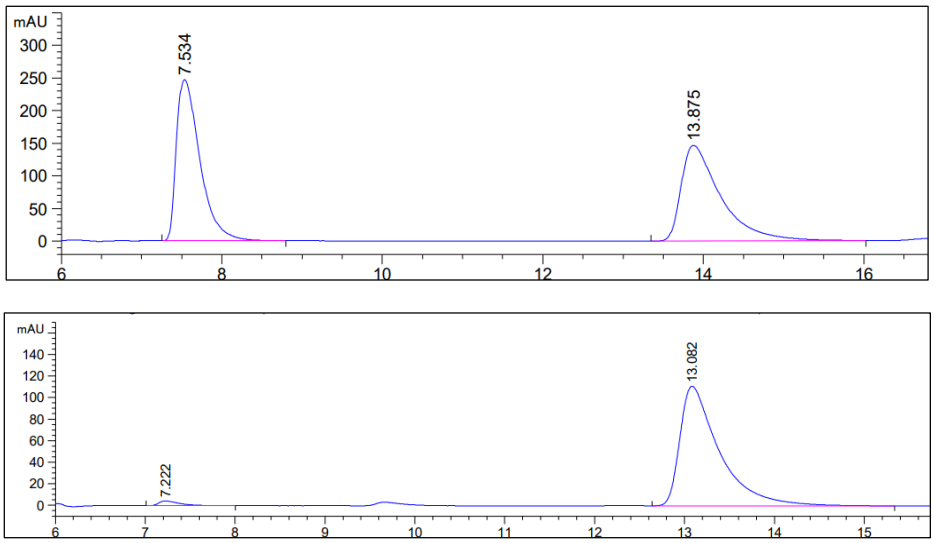


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (83% yield), m.p. 142-144 ℃. $[\alpha]_D^{20}$ = +48.8 (c 0.5, CH_2Cl_2), 96% ee [Daicel Chiralpak OD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{minor} = 7.2 min, t_{major} = 13.1 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.83 (d, J = 7.9 Hz, 1H), 7.56 (s, 1H), 7.41-7.38 (m, 1H), 7.14-7.08 (m, 3H), 7.03 (dd, J = 5.0, 2.0 Hz, 3H), 6.94 (d, J = 7.9 Hz, 1H), 6.65 (s, 2H), 4.95 (s, 1H), 2.31 (s, 3H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 170.2, 140.6, 140.3, 139.1, 137.4, 137.0, 133.8, 133.5, 128.8, 128.5, 127.7, 127.5, 125.8, 125.44, 125.38 (q, J = 282.0 Hz), 124.9, 124.6, 116.5, 78.3 (q, J = 30.0 Hz), 50.9, 21.3. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{23}H_{16}F_3NONa^+$ $(M+Na)^+$ 402.1076, found 402.1075.


7.834
7.821
7.563
7.406
7.405
7.403
7.395
7.393
7.392
7.390
7.389
7.381
7.380
7.378
7.142
7.140
7.129
7.127
7.118
7.116
7.114
7.113
7.111
7.110
7.103
7.102
7.100
7.097
7.096
7.094
7.093
7.084
7.082
7.081
7.080
7.025
7.023
7.018
7.014
6.943
6.930
6.645
4.945
2.309
Ph
CF3
N
O
Me
0.97
0.96
1.00
2.99
2.99
1.01
1.95
1.00
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
f1 (ppm)

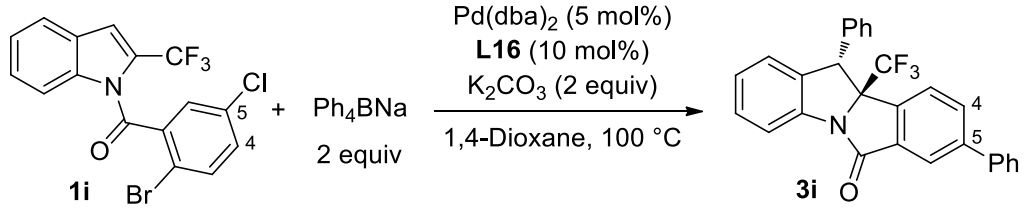

170.17
140.57
140.29
139.13
137.36
137.01
133.79
133.49
128.84
128.50
128.48
128.21
127.67
127.52
126.37
126.32
125.76
125.44
124.93
124.56
124.43
122.55
116.45
78.60
78.41
78.21
78.02
50.92
21.26
Ph
CF3
N
O
Me
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

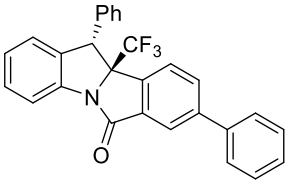




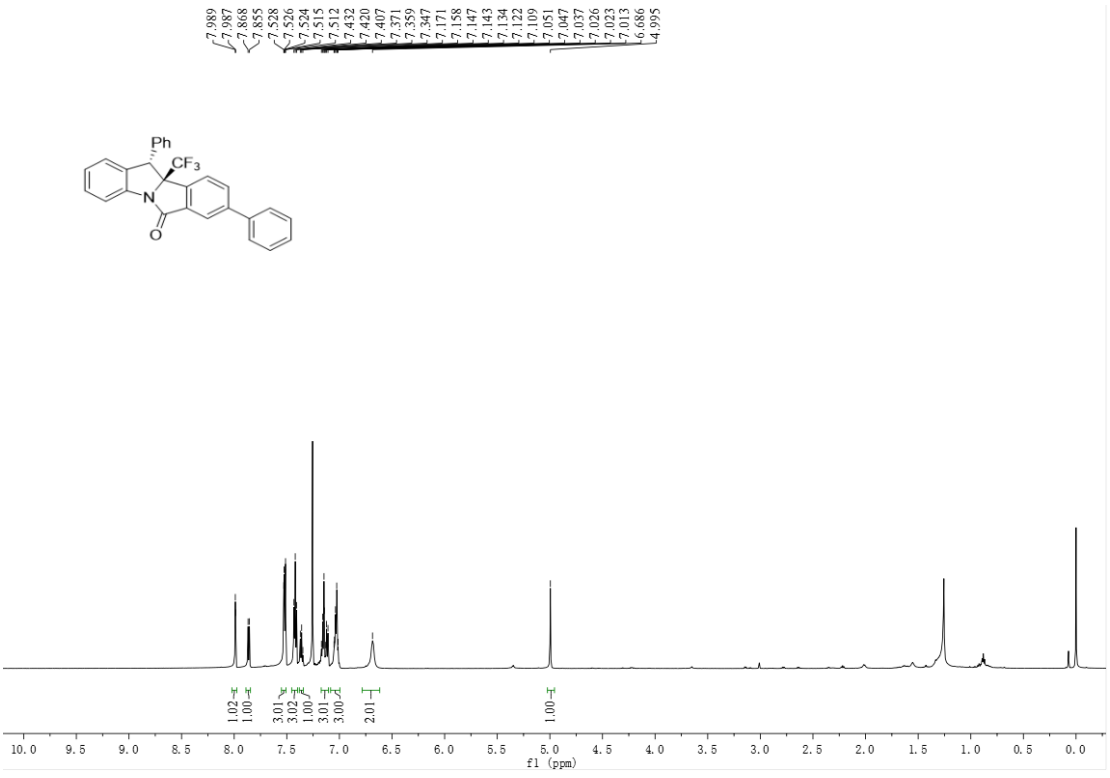
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.222	BB	0.2382	72.41095	4.44114	2.0983
2	13.082	BB	0.4391	3378.59888	110.99972	97.9017

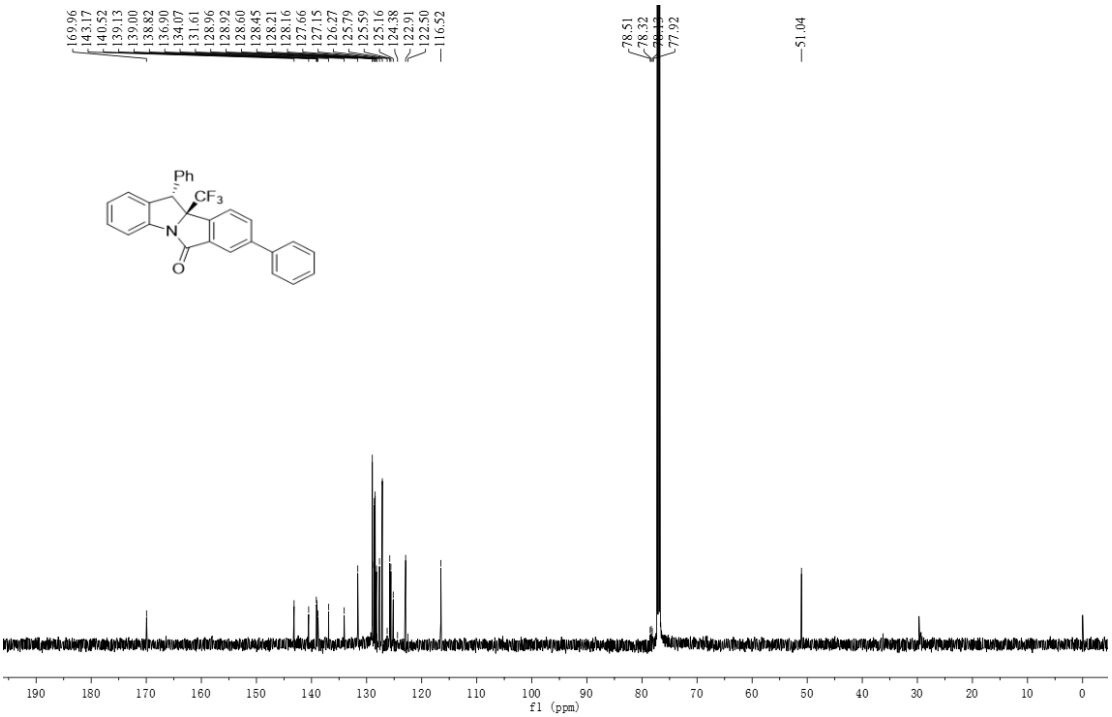
(10bR,11S)-8-Phenyl-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3i)：

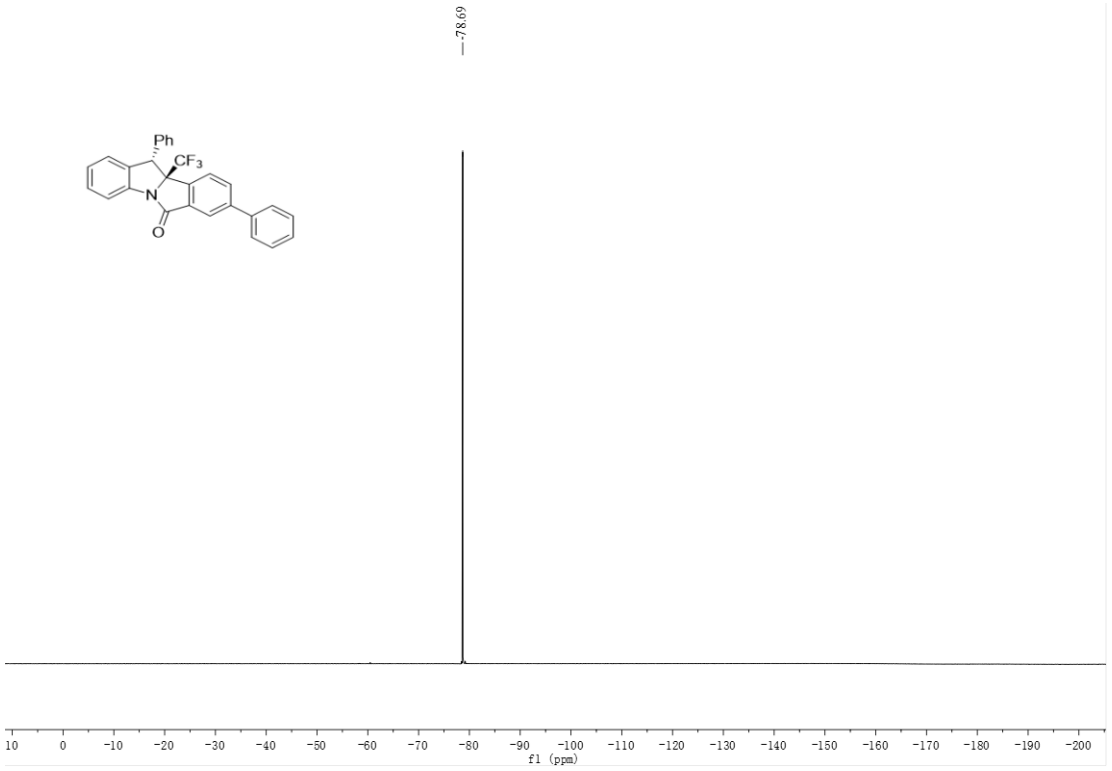




Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (72% yield). $[\alpha]_D^{20}$ = -89.6 (c 0.5, CH_2Cl_2), 90% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 254 nm; t_{minor} = 7.9 min, t_{major} = 10.8 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.99 (d, J = 1.2 Hz, 1H), 7.86 (d, J = 7.9 Hz, 1H), 7.52 (dd, J = 8.1, 1.7 Hz, 3H), 7.42 (t, J = 7.5 Hz, 3H), 7.36 (t, J = 7.2 Hz, 1H), 7.17-7.11 (m, 3H), 7.05-7.01 (m, 3H), 6.69 (s, 2H), 5.00 (s, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 170.0, 143.2, 140.5, 139.1, 139.0, 138.8, 136.9, 134.1, 131.6, 129.0, 128.9, 128.6, 128.4, 128.2, 127.7, 127.1, 125.8, 125.6, 125.2, 125.4 (q, J = 282.0 Hz), 122.9, 116.5, 78.2 (q, J = 30.0 Hz), 51.0. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{28}H_{18}F_3NONa^+$ $(M+Na)^+$ 464.1233, found 464.1233.




169.96
143.17
140.52
139.13
139.00
138.82
136.90
134.07
131.61
128.96
128.92
128.60
128.45
128.21
128.16
127.66
127.15
126.27
125.79
125.59
125.16
124.38
122.91
122.50
116.52
78.51
78.32
77.92
51.04
Ph
CF3
N
O
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-78.69
Ph
CF3
N
O
10
0
-10
-20
-30
-40
-50
-60
-70
-80
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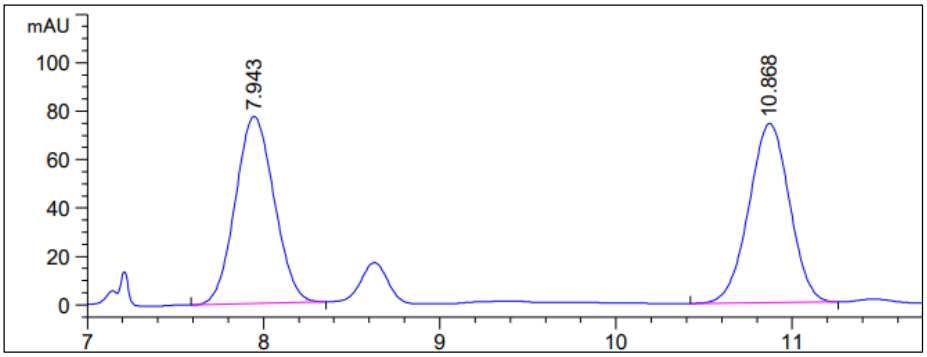
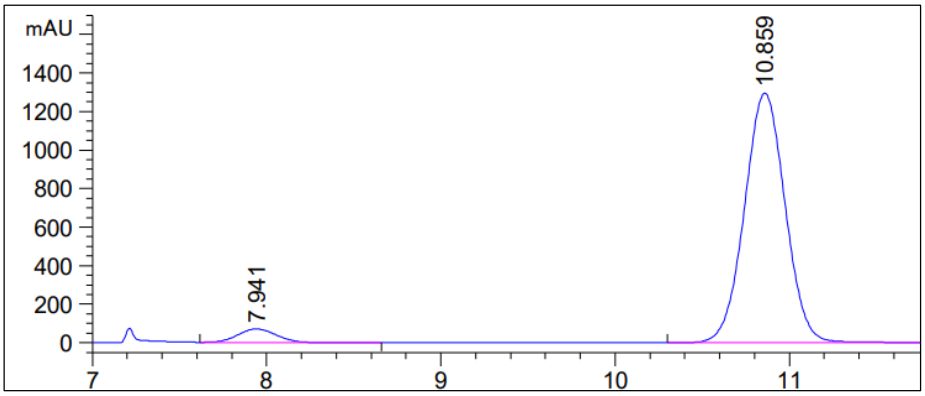
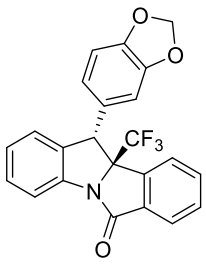
-120
-130
-140
-150
-160
-170
-180
-190
-200
f1 (ppm)



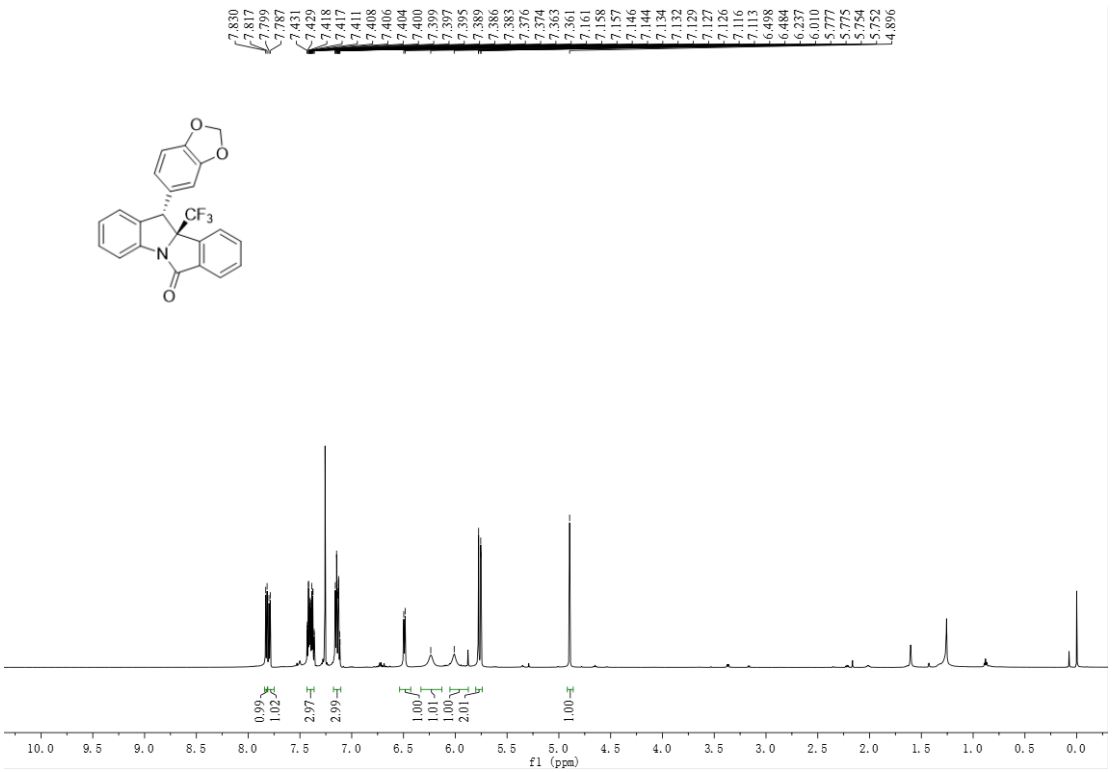


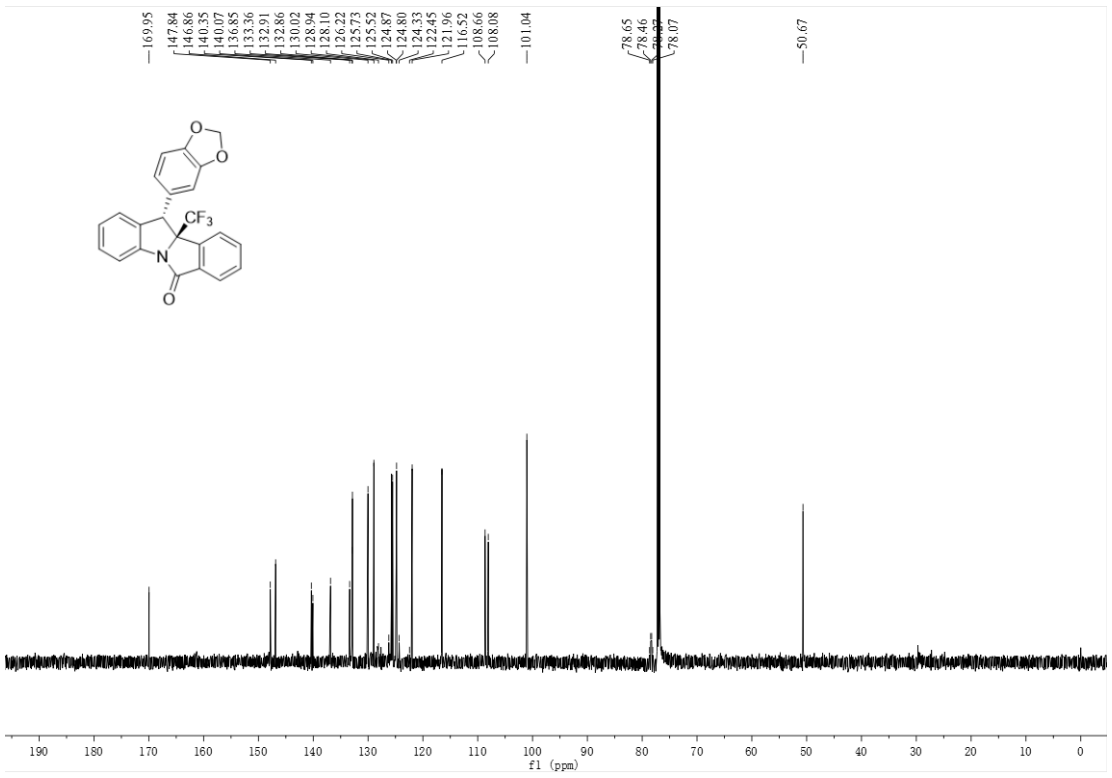
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.941	VB	0.2428	1116.70337	71.28969	5.0472
2	10.859	BB	0.2512	2.10084e4	1295.15869	94.9528

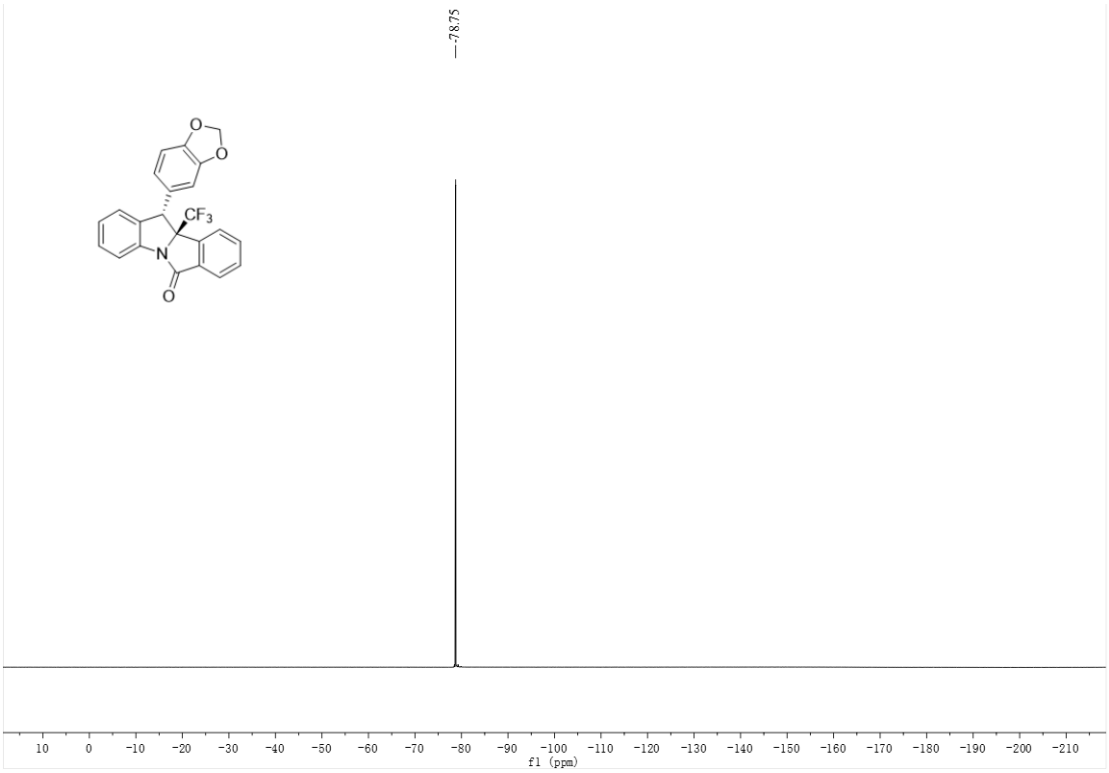
(10bR,11S)-11-(Benzo[d] [1,3]dioxa-5-yl)-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]Indole-6-one (3j):

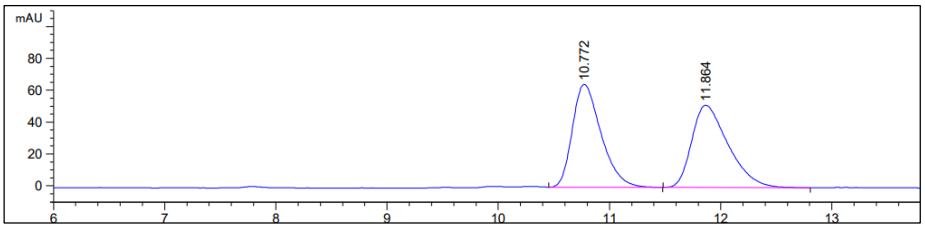


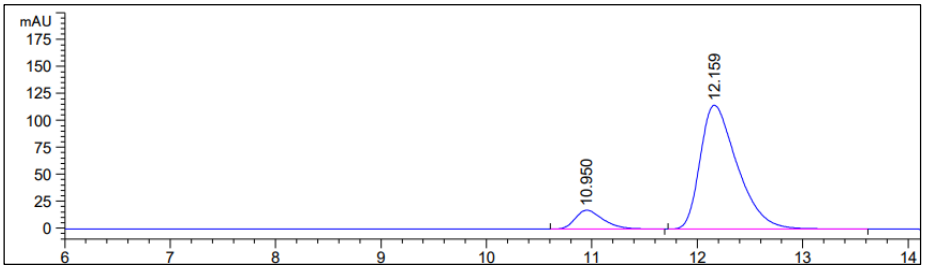
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (57% yield). $[\alpha]_D^{20}$ = +21.9 (c 0.5, CH_2Cl_2), 80% ee [Daicel Chiralpak AS column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{minor} = 10.9 min, t_{major} = 12.2 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.82 (d, J = 7.9 Hz, 1H), 7.79 (d, J = 7.2 Hz, 1H), 7.43-7.36 (m, 3H), 7.16-7.11 (m, 3H), 6.49 (d, J = 8.4 Hz, 1H), 6.23 (s, 1H), 6.01 (s, 1H), 5.76 (dd, J = 13.7, 1.5 Hz, 2H), 4.90 (s, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 170.0, 147.8, 146.9, 140.3, 140.1, 136.9, 133.4, 132.9, 132.9, 130.0, 128.9, 125.7, 125.5, 125.4 (q, J = 282.0 Hz), 124.9, 124.8, 122.0, 116.5, 108.7, 108.1, 101.0, 78.4 (q, J = 30.0 Hz), 50.7. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.8 ppm. HRMS *m/z* (ESI+): calcd for $C_{23}H_{14}F_3NO_3Na^+$ $(M+Na)^+$ 432.0818, found 432.0818.


7.830
7.817
7.799
7.787
7.431
7.429
7.418
7.417
7.411
7.408
7.406
7.404
7.400
7.399
7.397
7.395
7.389
7.386
7.383
7.376
7.374
7.363
7.361
7.161
7.158
7.157
7.146
7.144
7.134
7.132
7.129
7.127
7.126
7.116
7.113
6.498
6.484
6.237
6.010
5.777
5.775
5.754
5.752
4.896
O
O
CF3
N
O
0.99
1.02
2.97
2.99
1.00
1.01
1.00
2.01
1.00
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)


169.95
147.84
146.86
140.35
140.07
136.85
133.36
132.91
132.86
130.02
128.94
128.10
126.22
125.73
125.52
124.87
124.80
124.33
122.45
121.96
116.52
108.66
108.08
101.04
78.65
78.46
78.27
78.07
50.67
O
O
CF3
N
O
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

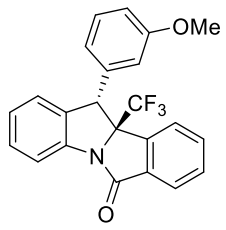




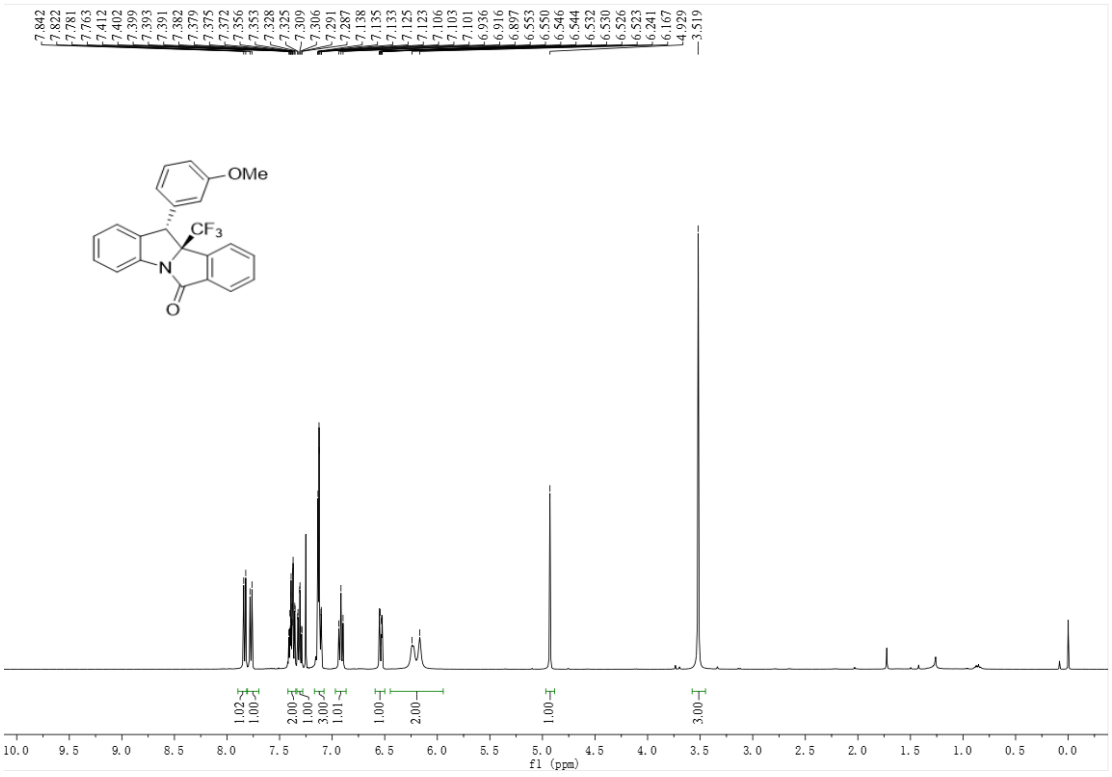


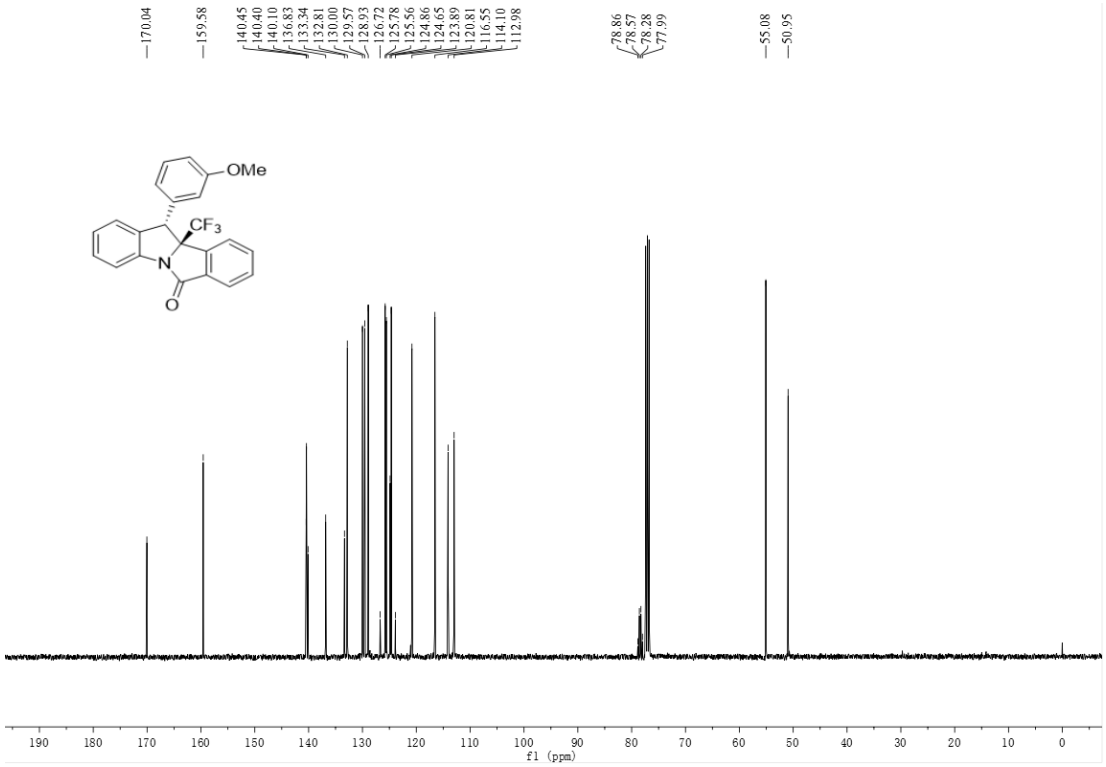
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.950	BB	0.2862	323.06879	17.43327	10.2962
2	12.159	BB	0.3674	2814.68701	115.04078	89.7038

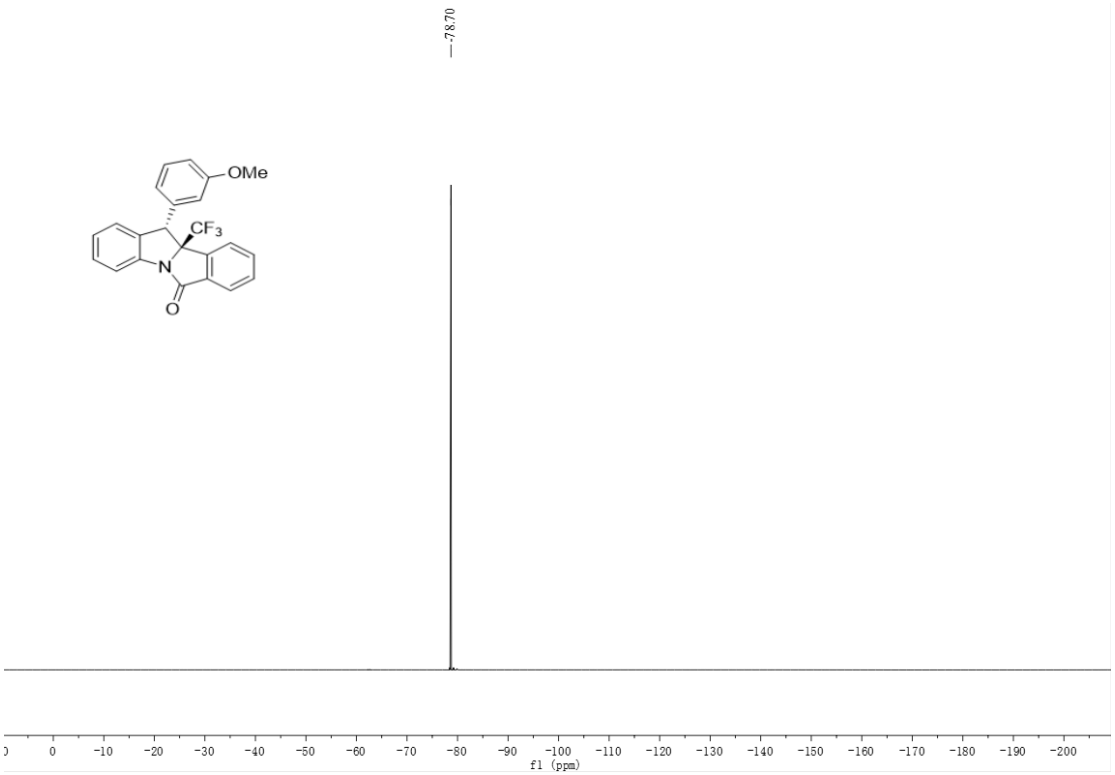
(10bR,11S)-11-(3-Methoxyphenyl)-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3k)：

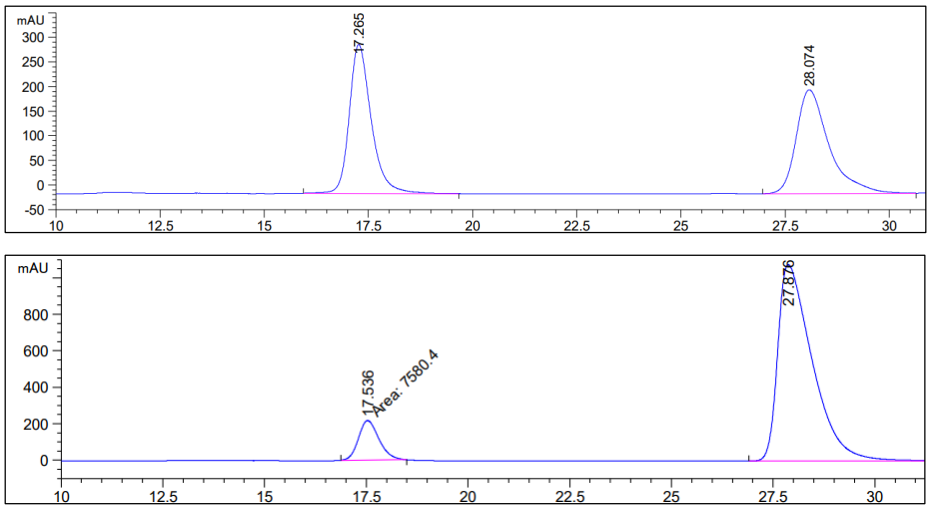


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); colorless liquid (90% yield). $[\alpha]_D^{20}$ = +62.2 (c 0.5, CH_2Cl_2), 79% ee [Daicel Chiralpak A2 column (25 cm ×0.46 cm ID), ^{n}hexane/^{i}PrOH = 95/05, 0.6 mL/min, 210 nm; t_{minor} = 17.5 min, t_{major} = 27.9 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (d, J = 7.9 Hz, 1H), 7.68 (d, J = 7.8 Hz, 1H), 7.42-7.36 (m, 2H), 7.31 (td, J = 7.5, 1.3 Hz, 1H), 7.14-7.11 (m, 3H), 6.92 (t, J = 7.9 Hz, 1H), 6.54 (ddd, J = 8.3, 2.6, 0.9 Hz, 1H), 6.21 (d, J = 29.7 Hz, 2H), 4.93 (s, 1H), 3.52 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.0, 159.6, 140.5, 140.4, 140.1, 136.8, 133.3, 132.8, 130.0, 129.6, 128.9, 125.8, 125.6, 125.4 (q, J = 282.0 Hz), 124.9, 124.6, 120.8, 116.5, 114.1, 113.0, 78.5 (q, J = 30.0 Hz), 55.1, 50.9. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{23}H_{16}F_3NO_2Na^+$ $(M+Na)^+$ 418.1025, found 418.1025.



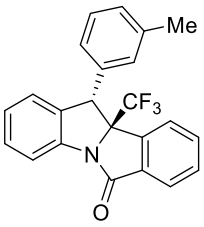

170.04
159.58
140.45
140.40
140.10
136.83
133.34
132.81
130.00
129.57
128.93
126.72
125.78
125.56
124.86
124.65
123.89
120.81
116.55
114.10
112.98
78.86
78.57
78.28
77.99
55.08
50.95
OMe
CF3
N
O
f1 (ppm)


-78.70
OMe
CF3
N
O
f1 (ppm)

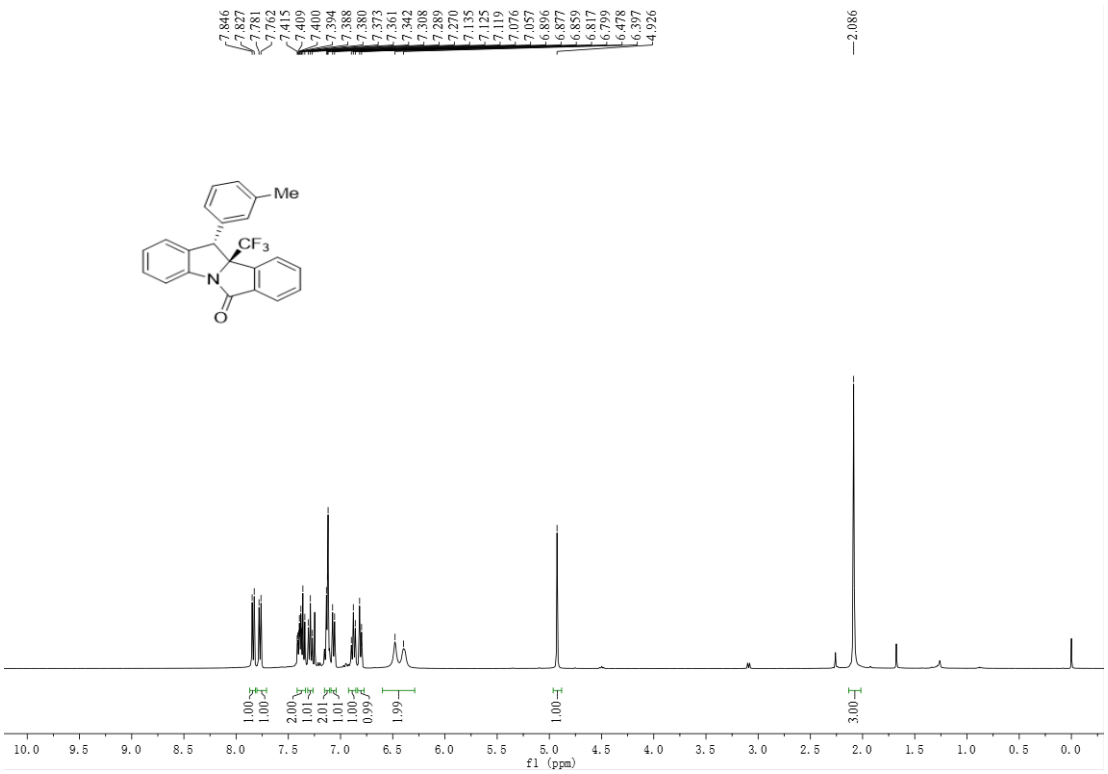


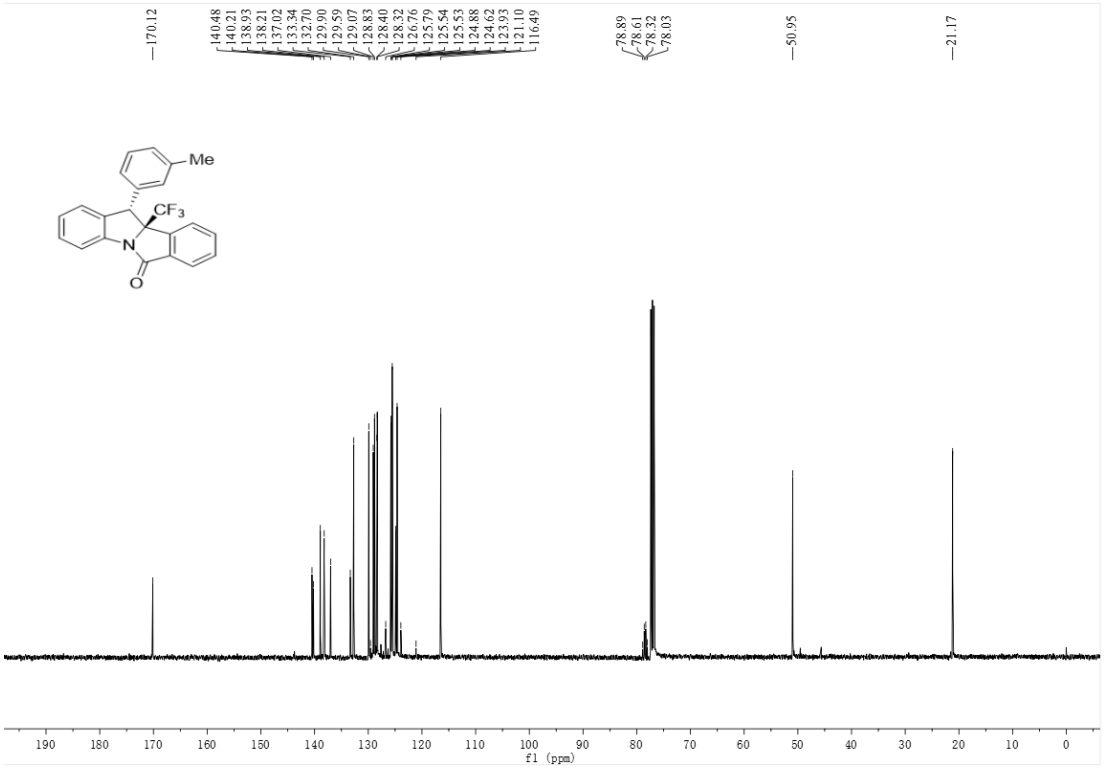
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	17.536	MM	0.5825	7580.40430	216.87651	10.6503
2	27.876	BB	0.8585	6.35949e4	1077.64136	89.3497

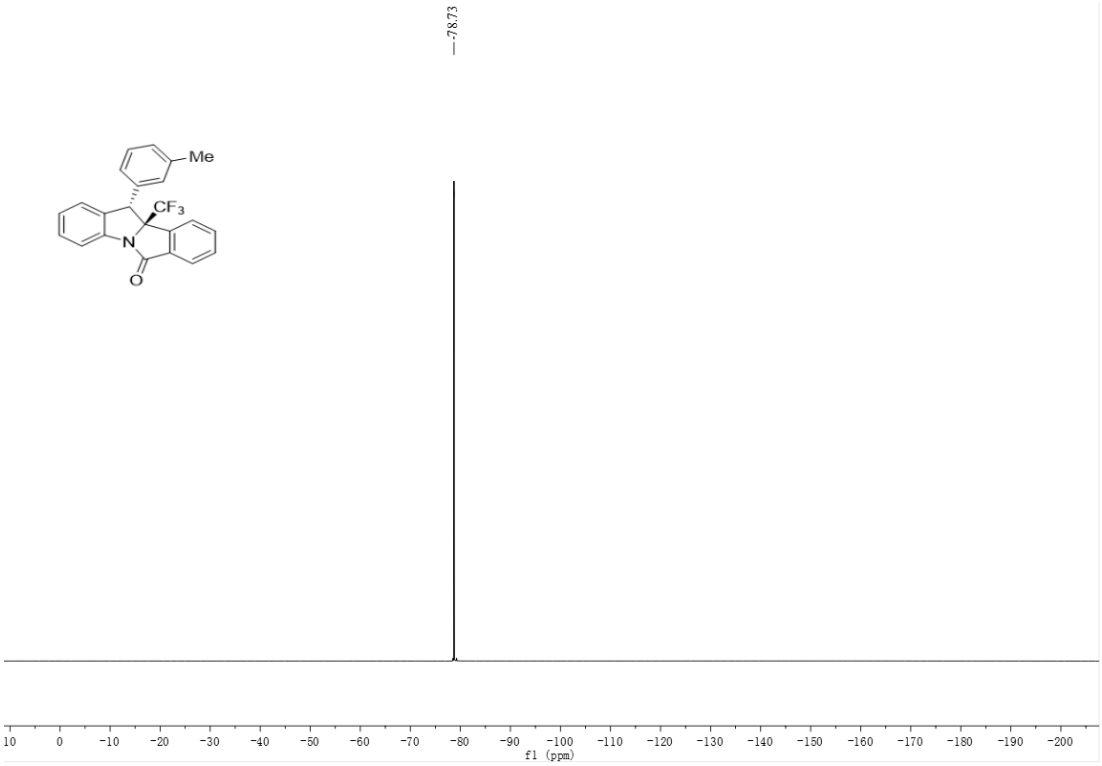
***(10bR,11S)-11-(3-Methylphenyl)-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3l)*:**

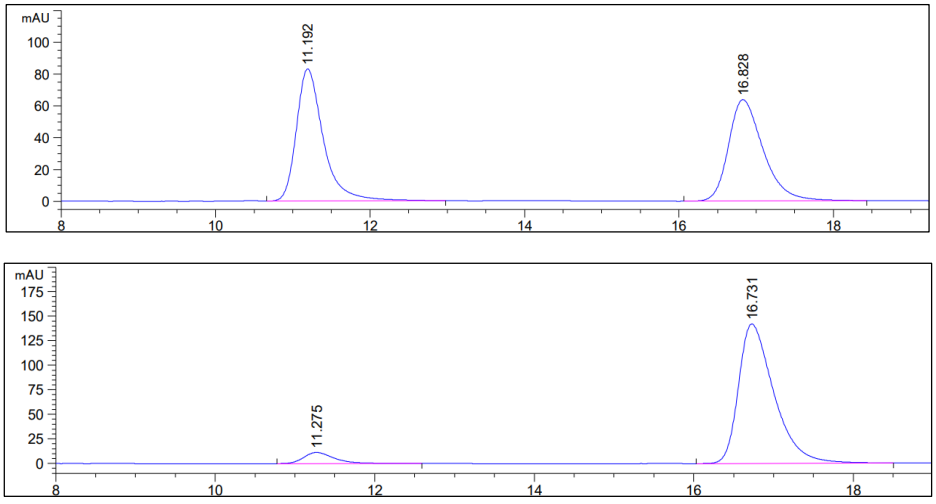


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (86% yield), m.p. 188-190 ℃. $[\alpha]_D^{20}$ = +79.9 (c 0.5, CH_2Cl_2), 87% ee [Daicel Chiralpak A2 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{minor} = 11.3 min, t_{major} = 16.7 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (d, J = 7.9 Hz, 1H), 7.68 (d, J = 7.8 Hz, 1H), 7.42-7.35 (m, 2H), 7.30 (t, J = 7.8 Hz, 1H), 7.14 (d, J = 6.3 Hz, 2H), 7.07 (d, J = 7.6 Hz, 1H), 6.68 (t, J = 7.5 Hz, 1H), 6.82 (d, J = 7.5 Hz, 1H), 6.44 (d, J = 32.4 Hz, 2H), 4.93 (s, 1H), 2.09 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.1, 140.5, 140.2, 138.9, 138.2, 137.0, 133.3, 132.7, 129.9, 129.1, 128.8, 128.4, 128.3, 125.8, 125.5, 125.4 (q, J = 282.0 Hz), 124.9, 124.6, 116.5, 78.5 (q, J = 30.0 Hz), 51.0, 21.2. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{23}H_{16}F_3NONa^+$ $(M+Na)^+$ 402.1076, found 402.1076.


7.846
7.827
7.781
7.762
7.415
7.409
7.400
7.394
7.388
7.380
7.373
7.361
7.342
7.308
7.289
7.270
7.135
7.125
7.119
7.076
7.057
6.896
6.877
6.859
6.817
6.799
6.478
6.397
4.926
2.086
Me
CF3
N
O
1.00
1.00
2.00
1.01
2.01
1.01
1.00
0.99
1.99
1.00
3.00
f1 (ppm)

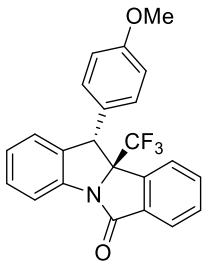

170.12
140.48
140.21
138.93
138.21
137.02
133.34
132.70
129.90
129.59
129.07
128.83
128.40
128.32
126.76
125.79
125.54
125.53
124.88
124.62
123.93
121.10
116.49
78.89
78.61
78.32
78.03
50.95
21.17
Me
CF3
N
O
f1 (ppm)



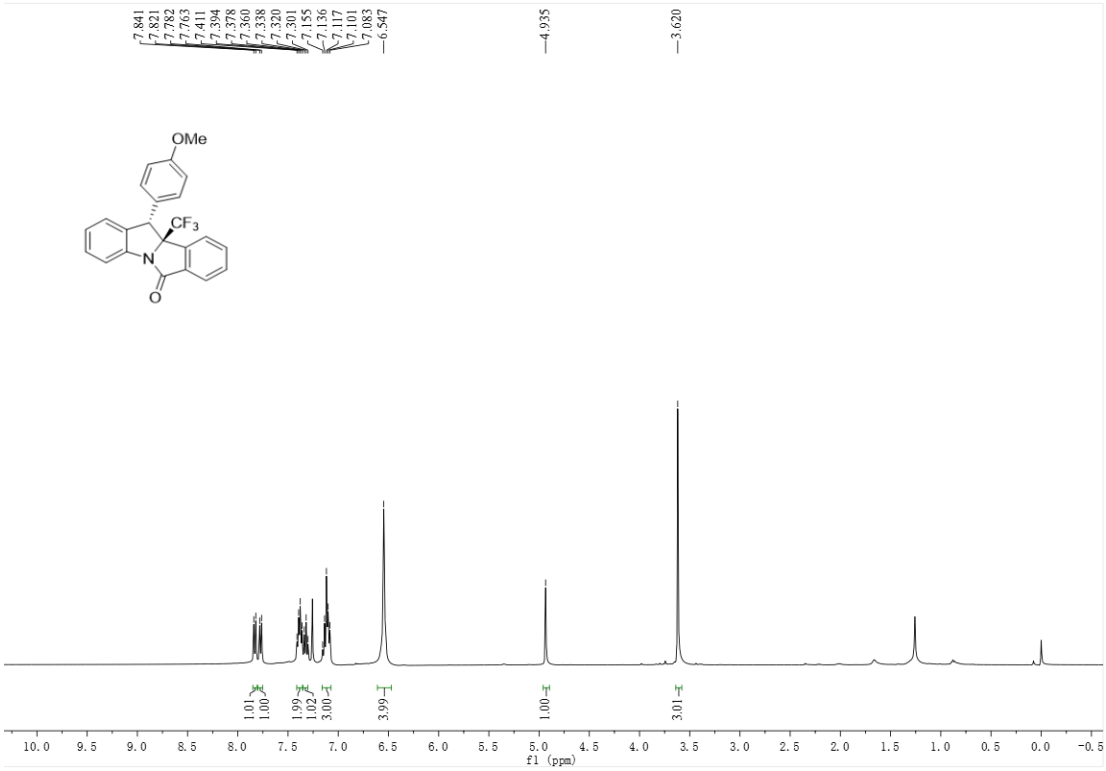


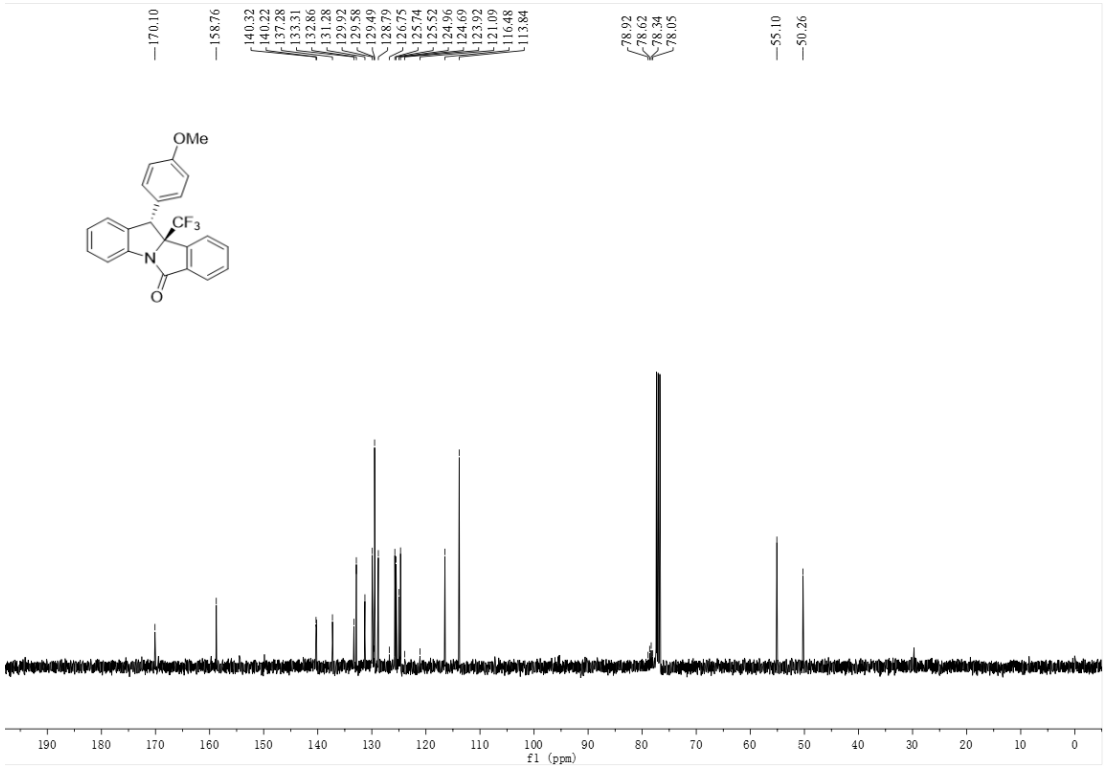
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	11.275	BB	0.4046	306.05478	11.35109	6.5259
2	16.731	BB	0.4681	4383.76611	142.04189	93.4741

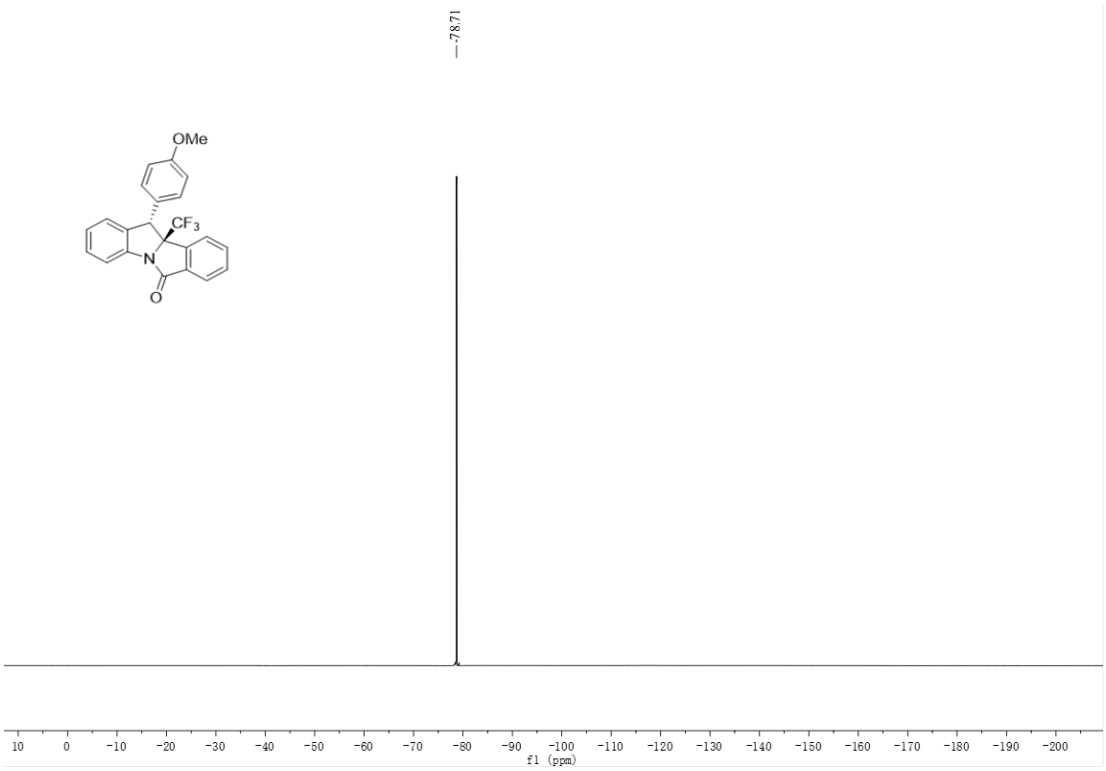
(10bR,11S)-11-(4-Methoxyphenyl)-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3m)：

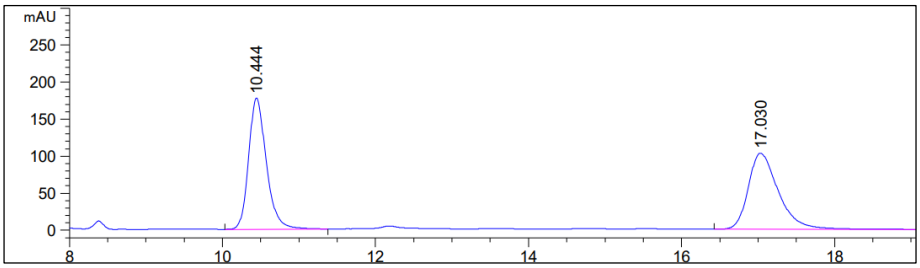


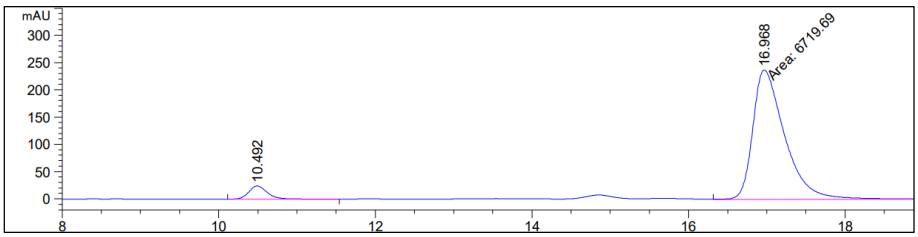
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); colorless liquid (82% yield). $[\alpha]_D^{20}$ = +119.1 (c 0.5, CH_2Cl_2), 89% ee [Daicel Chiralpak A2 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 80/20, 0.6 mL/min, 280 nm; t_{minor} = 10.5 min, t_{major} = 17.0 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (d, J = 7.9 Hz, 1H), 7.77 (d, J = 7.8 Hz, 1H), 7.38 (q, J = 6.9 Hz, 2H), 7.32 (t, J = 7.8 Hz, 1H), 7.15-7.08 (m, 3H), 6.55 (s, 4H), 4.94 (s, 1H), 3.62 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.1, 158.8, 140.3, 140.2, 137.3, 133.3, 132.9, 131.3, 129.9, 129.5, 128.8, 125.7, 125.5, 125.4 (q, J = 282.0 Hz), 125.0, 124.7, 116.5, 113.8, 78.5 (q, J = 30.0 Hz), 55.1, 50.3. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{23}H_{16}F_3NO_2Na^+$ $(M+Na)^+$ 418.1025, found 418.1023.




170.10
158.76
140.32
140.22
137.28
133.31
132.86
131.28
129.92
129.58
129.49
128.79
126.75
125.74
125.52
124.96
124.69
123.92
121.09
116.48
113.84
78.92
78.62
78.34
78.05
55.10
50.26
OMe
CF3
N
O
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

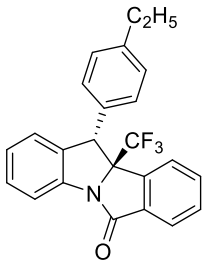

-78.71
OMe
CF3
N
O
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200
f1 (ppm)



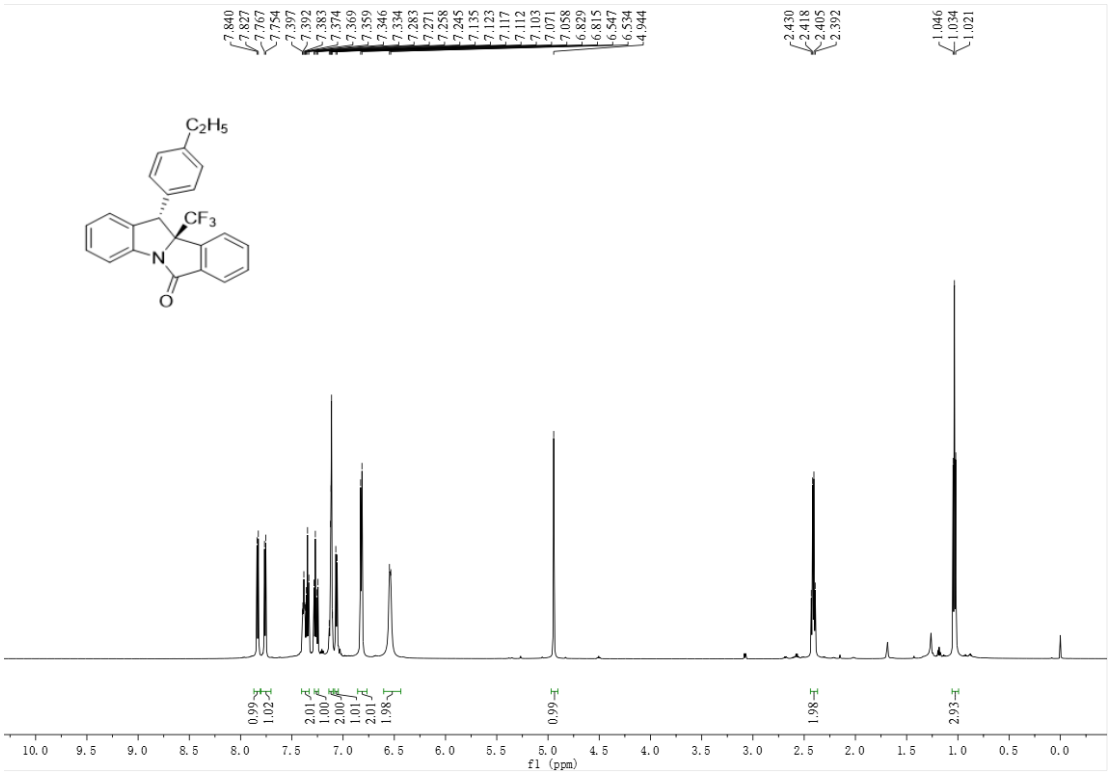


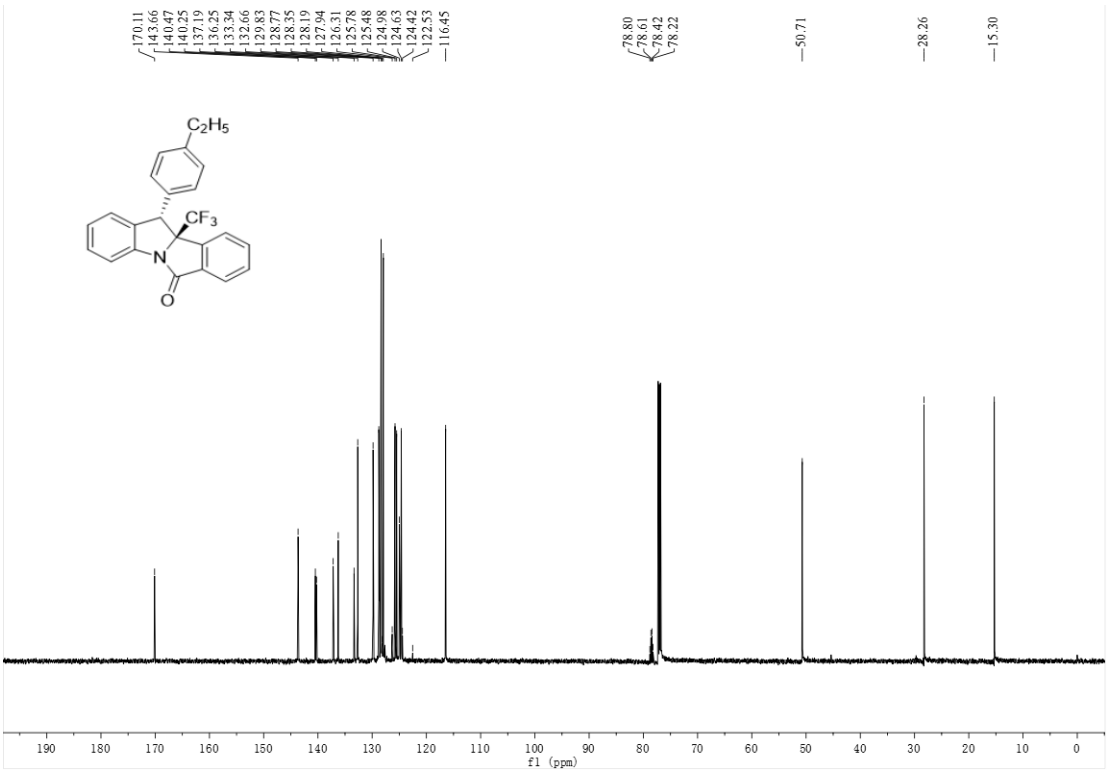
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.492	BB	0.2501	396.75803	24.09507	5.5752
2	16.968	MM	0.4720	6719.68506	237.28894	94.4248

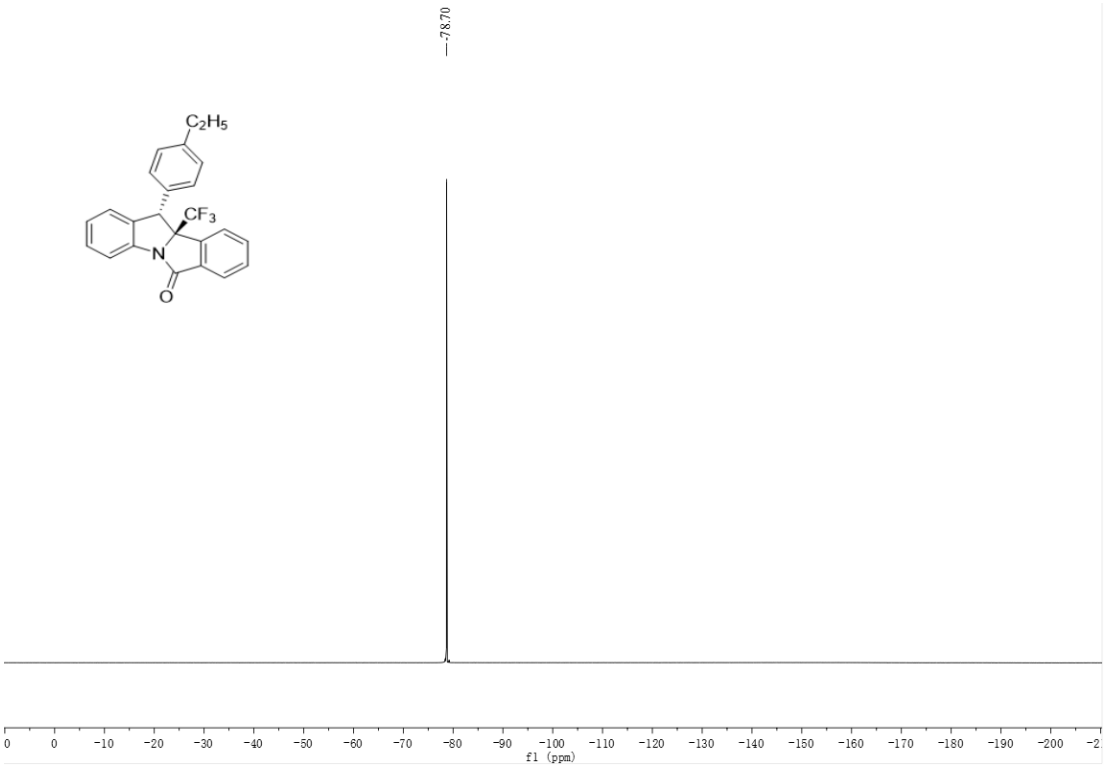
(10bR,11S)-11-(4-Ethylphenyl)-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3n)：

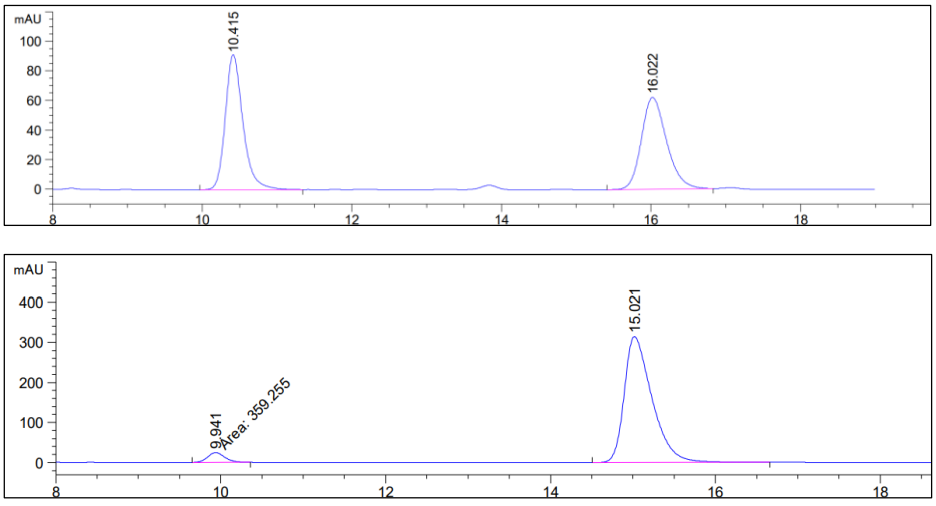


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (79% yield). $[\alpha]_D^{20}$ = +27.8 (c 0.5, CH_2Cl_2), 91% ee [Daicel Chiralpak A2 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{minor} = 9.9 min, t_{major} = 15.0 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.83 (d, J = 7.9 Hz, 1H), 7.76 (d, J = 7.8 Hz, 1H), 7.36 (dt, J = 20.9, 6.6 Hz, 2H), 7.26 (dd, J = 15.3, 7.8 Hz, 1H), 7.14-7.10 (m, 2H), 7.06 (d, J = 7.8 Hz, 1H), 6.82 (d, J = 8.4 Hz, 2H), 6.54 (d, J = 7.7 Hz, 2H), 4.94 (s, 1H), 2.41 (q, J = 7.6 Hz, 2H), 1.03 (t, J = 7.6 Hz, 3H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 170.1, 143.7, 140.5, 140.3, 137.2, 136.3, 133.3, 132.7, 129.8, 128.8, 128.3, 127.9, 125.8, 125.5, 125.4 (q, J = 282.0 Hz), 125.0, 124.6, 116.5, 78.5 (q, J = 30.0 Hz), 50.7, 28.3, 15.3. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{24}H_{18}F_3NONa^+$ $(M+Na)^+$ 416.1233, found 416.1232.


7.840
7.827
7.767
7.754
7.397
7.392
7.383
7.374
7.369
7.359
7.346
7.334
7.283
7.271
7.258
7.245
7.135
7.123
7.117
7.112
7.103
7.071
7.058
6.829
6.815
6.547
6.534
4.944
2.430
2.418
2.405
2.392
1.046
1.034
1.021
C2H5
CF3
N
O
0.99
1.02
2.01
1.00
2.00
1.01
2.01
1.98
0.99
1.98
2.93
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)

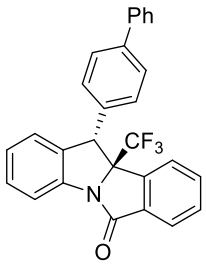

170.11
143.66
140.47
140.25
137.19
136.25
133.34
132.66
129.83
128.77
128.35
128.19
127.94
126.31
125.78
125.48
124.98
124.63
124.42
122.53
116.45
78.80
78.61
78.42
78.22
50.71
28.26
15.30
C2H5
CF3
N
O
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



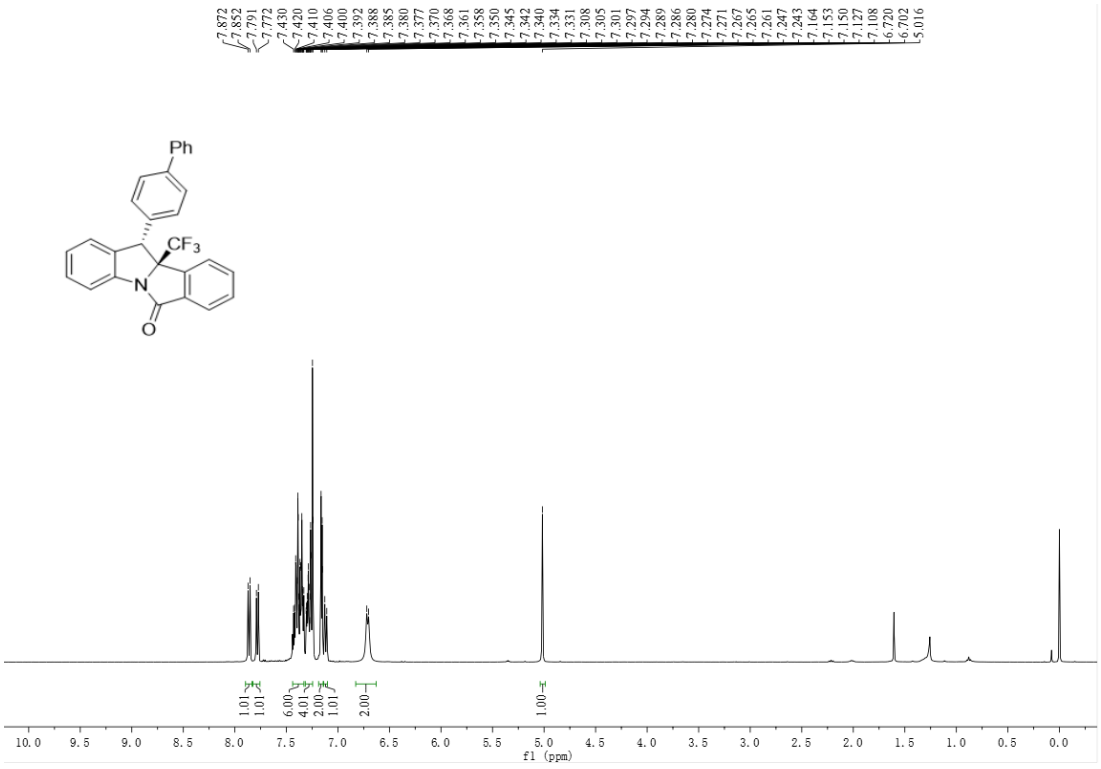


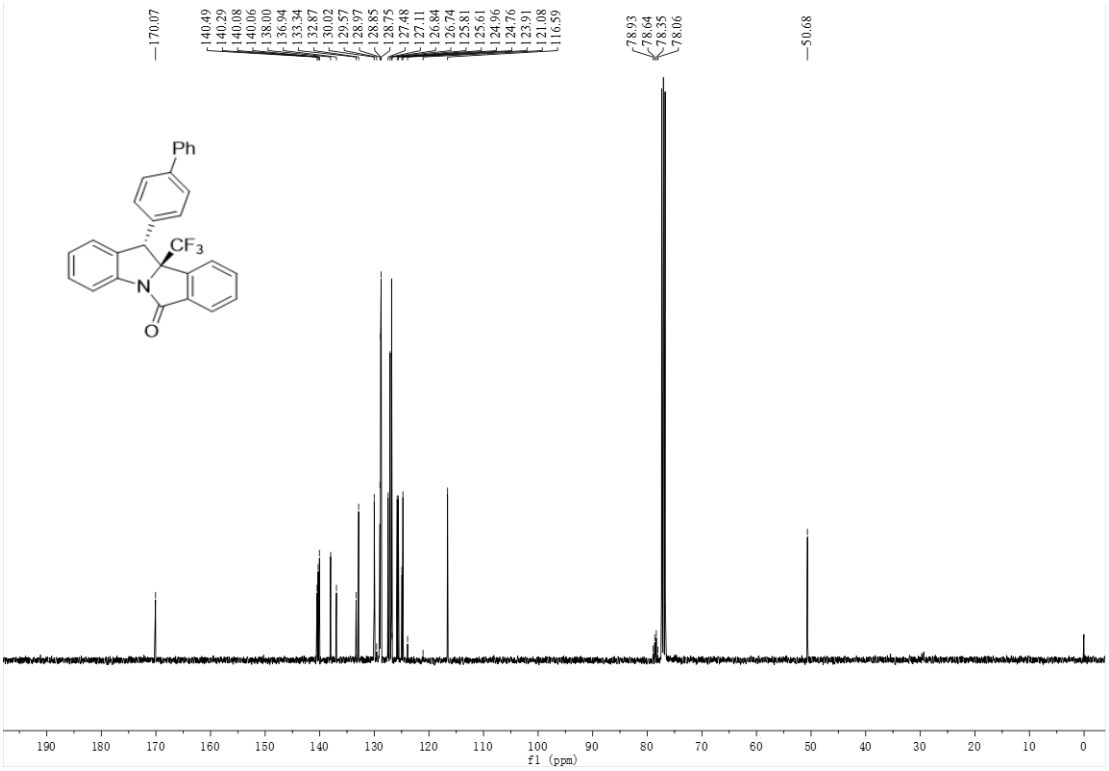
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.941	MM	0.2430	359.25497	24.63819	4.6568
2	15.021	BB	0.3509	7355.41992	314.46463	95.3432

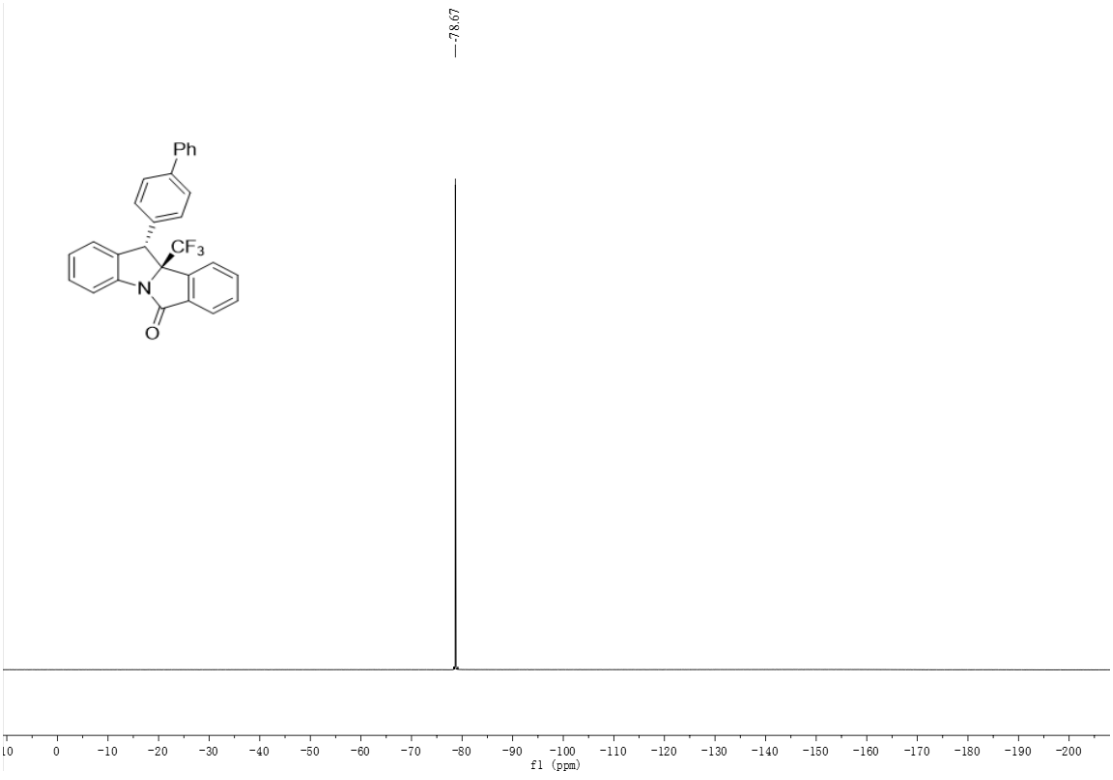
(10bR,11S)-11-([[1,1'-Biphenyl]-4-yl])-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indole Dol-6-one (3o)：



Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); colorless liquid (51% yield). $[\alpha]_D^{20}$ = +20.8 (c 0.5, CH_2Cl_2), 93% ee [Daicel Chiralpak A2 column (25 cm ×0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 254 nm; t_{minor} = 15.7 min, t_{major} = 31.5 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, J = 7.9 Hz, 1H), 7.78 (d, J = 7.8 Hz, 1H), 7.43-7.33 (m, 6H), 7.35-7.23 (m, 4H), 7.16 (d, J = 4.2 Hz, 2H), 7.12 (d, J = 7.8 Hz, 1H), 6.71 (d, J = 7.2 Hz, 2H), 5.02 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.1, 140.5, 140.3, 140.08, 140.06, 138.0, 136.9, 133.3, 132.9, 130.0, 129.0, 128.9, 128.8, 127.5, 127.1, 126.8, 125.8, 125.6, 125.4 (q, J = 282.0 Hz), 125.0, 124.8, 116.6, 78.5 (q, J = 30.0 Hz), 50.7. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7 ppm. HRMS *m/z* (ESI+): Calcd for $C_{28}H_{18}F_3NONa^+$ $(M+Na)^+$ 464.1233, found 464.1234.




170.07
140.49
140.29
140.08
140.06
138.00
136.94
133.34
132.87
130.02
129.57
128.97
128.85
128.75
127.48
127.11
126.84
126.74
125.81
125.61
124.96
124.76
123.91
121.08
116.59
78.93
78.64
78.35
78.06
50.68
Ph
CF3
N
O
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-78.67
Ph
CF3
N
O
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
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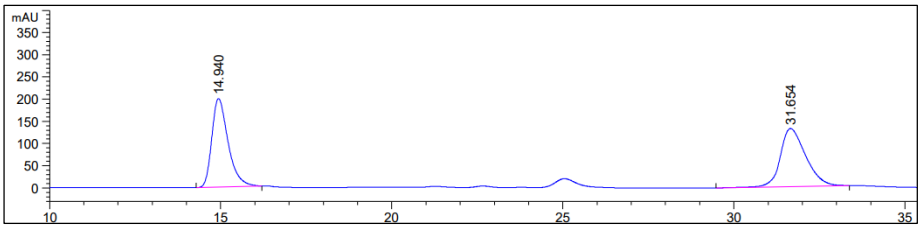
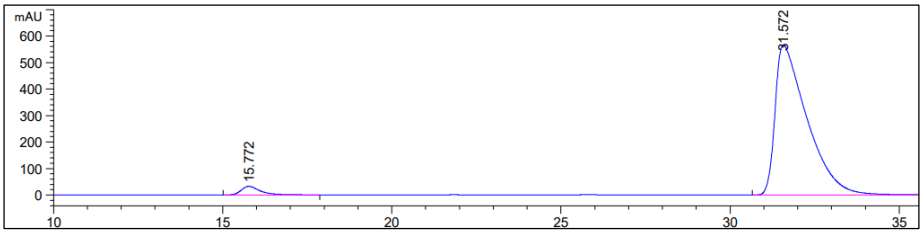
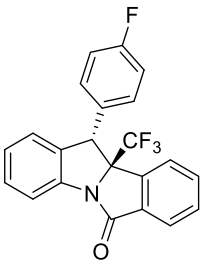
-120
-130
-140
-150
-160
-170
-180
-190
-200
f1 (ppm)



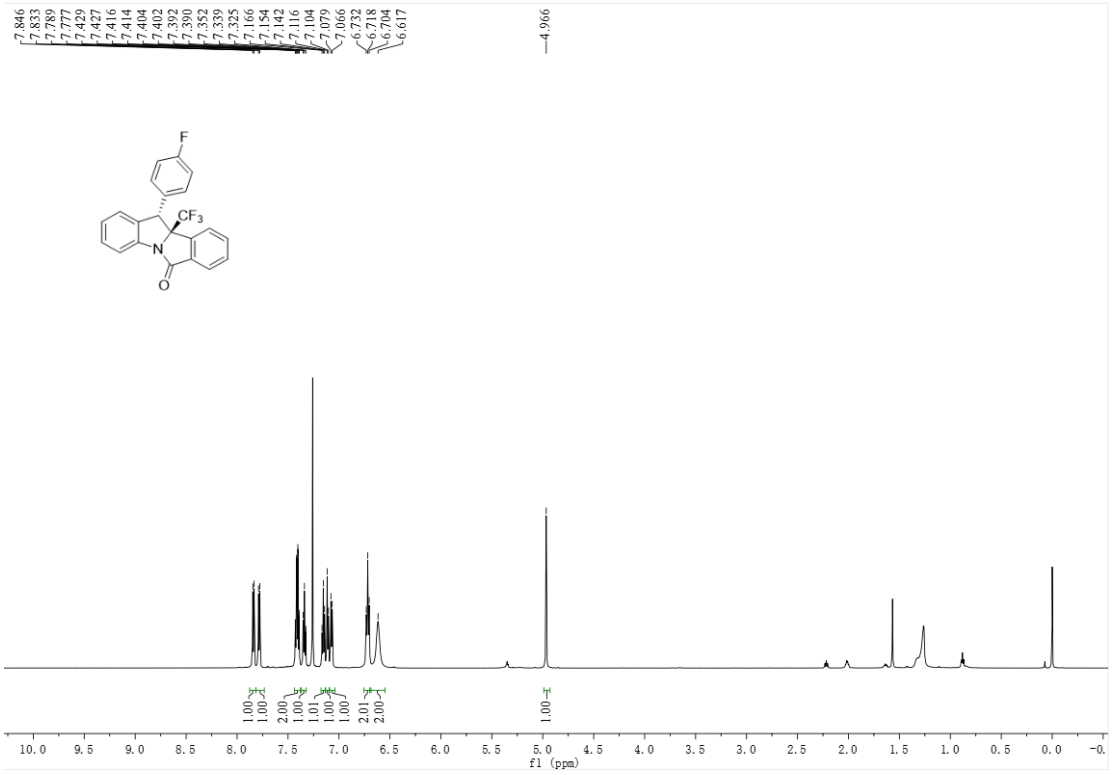


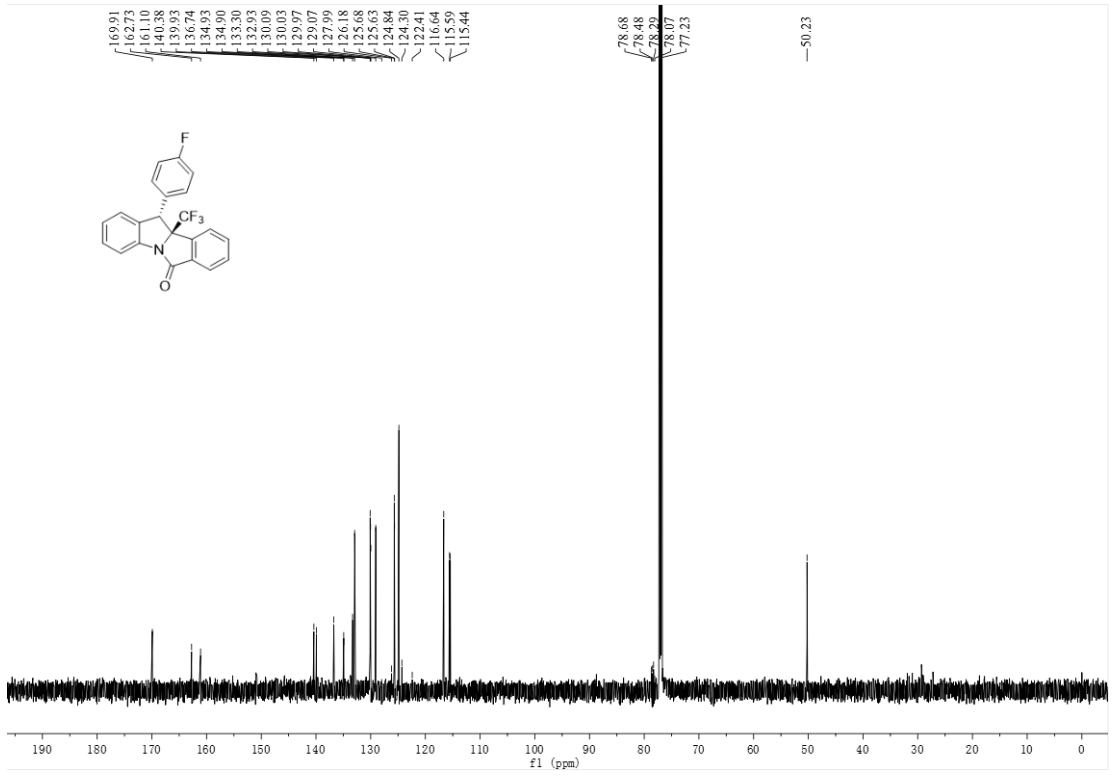
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.772	BB	0.5882	1300.75732	32.54968	3.3880
2	31.572	BB	0.9459	3.70928e4	565.01642	96.6120

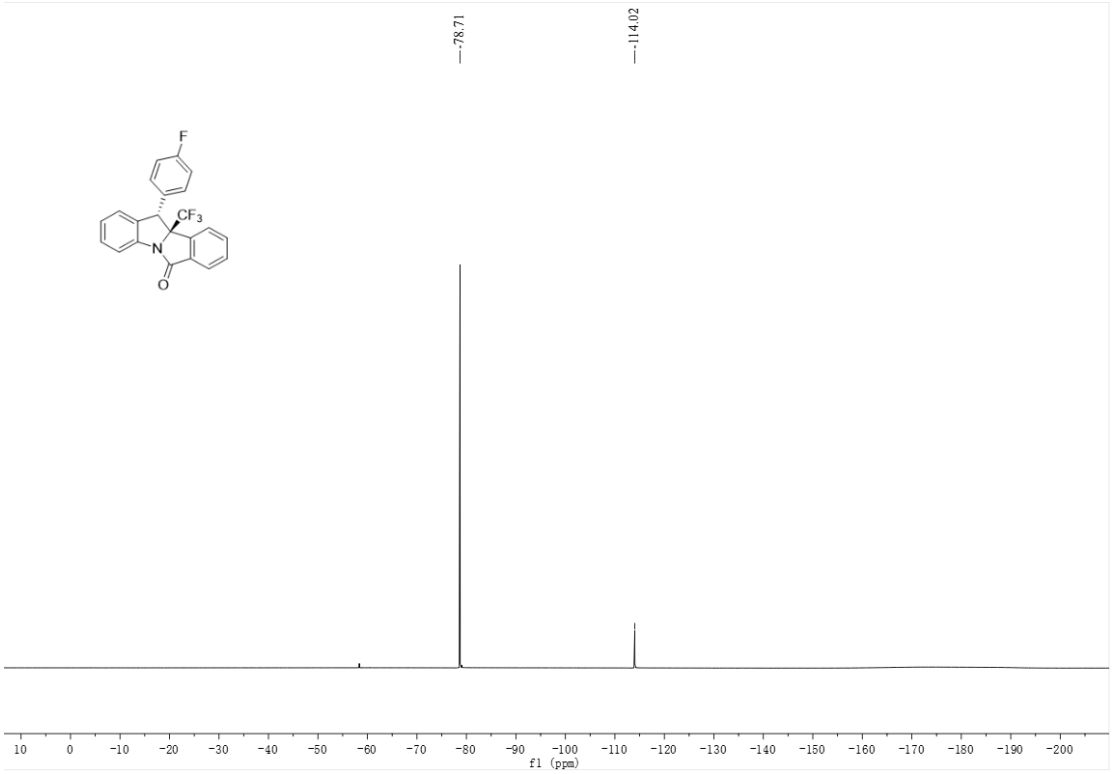
(10bR,11S)-11-(4-fluorophenyl)-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3p):

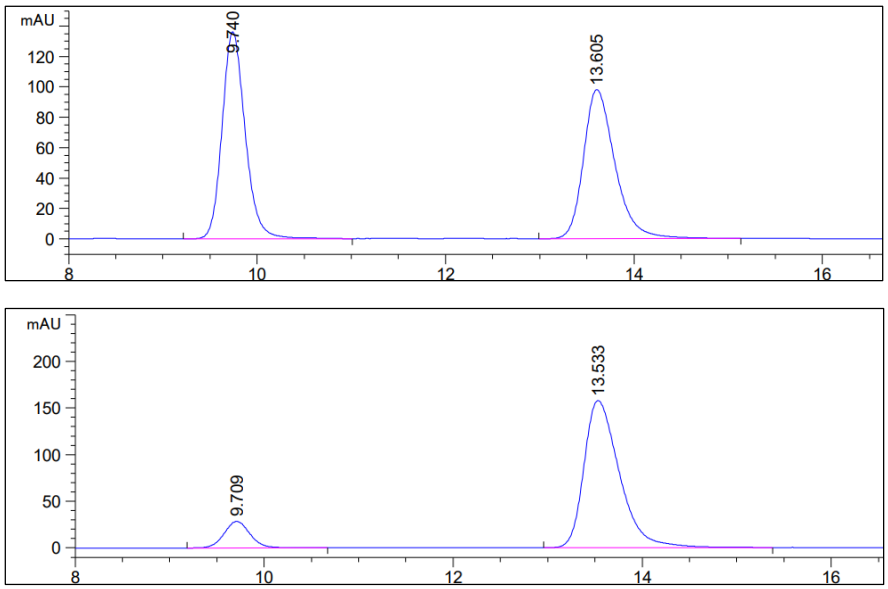


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (45% yield), m.p. 216-218 ℃. $[\alpha]_D^{20}$ = +58.8 (c 0.5, CH_2Cl_2), 77% ee [Daicel Chiralpak A2 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{minor} = 9.7 min, t_{major} = 13.5 min]. ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.84 (d, J = 7.9 Hz, 1H), 7.78 (d, J = 7.2 Hz, 1H), 7.41 (dd, J = 7.5, 1.2 Hz, 2H), 7.34 (t, J = 8.0 Hz, 1H), 7.15 (t, J = 7.4 Hz, 1H), 7.11 (d, J = 7.4 Hz, 1H), 7.07 (d, J = 7.7 Hz, 1H), 6.72 (t, J = 8.5 Hz, 2H), 6.62 (s, 2H), 4.97 (s, 1H). ^{13}C NMR (150 MHz, $CDCl_3$) δ 169.9, 161.9 (d, J = 244.5 Hz), 140.4, 139.9, 136.7, 134.9 (d, J = 4.5 Hz), 133.3, 132.9, 130.1 (d, J = 9.0 Hz), 130.0, 129.1, 125.7 (d, J = 7.5 Hz), 125.3 (q, J = 282.0 Hz), 124.8, 116.6, 115.6, 115.4, 78.4 (q, J = 30.0 Hz), 50.2. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.7, -114.0 ppm. HRMS *m/z* (ESI+): Calcd for $C_{22}H_{13}F_4NONa^+$ $(M+Na)^+$ 406.0826, found 406.0824.


7.846
7.833
7.789
7.777
7.429
7.427
7.416
7.414
7.404
7.402
7.392
7.390
7.352
7.339
7.325
7.166
7.154
7.142
7.116
7.104
7.079
7.066
6.732
6.718
6.704
6.617
4.966
F
CF3
N
O
1.00
1.00
2.00
1.00
1.01
1.00
1.00
2.01
2.00
1.00
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)

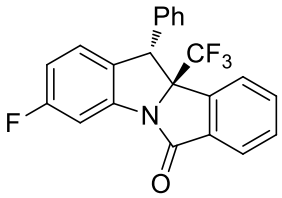

169.91
162.73
161.10
140.38
139.93
136.74
134.93
134.90
133.30
132.93
130.09
130.03
129.97
129.07
127.99
126.18
125.68
125.63
124.84
124.30
122.41
116.64
115.59
115.44
78.68
78.48
78.29
78.07
77.23
50.23
F
CF3
N
O
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



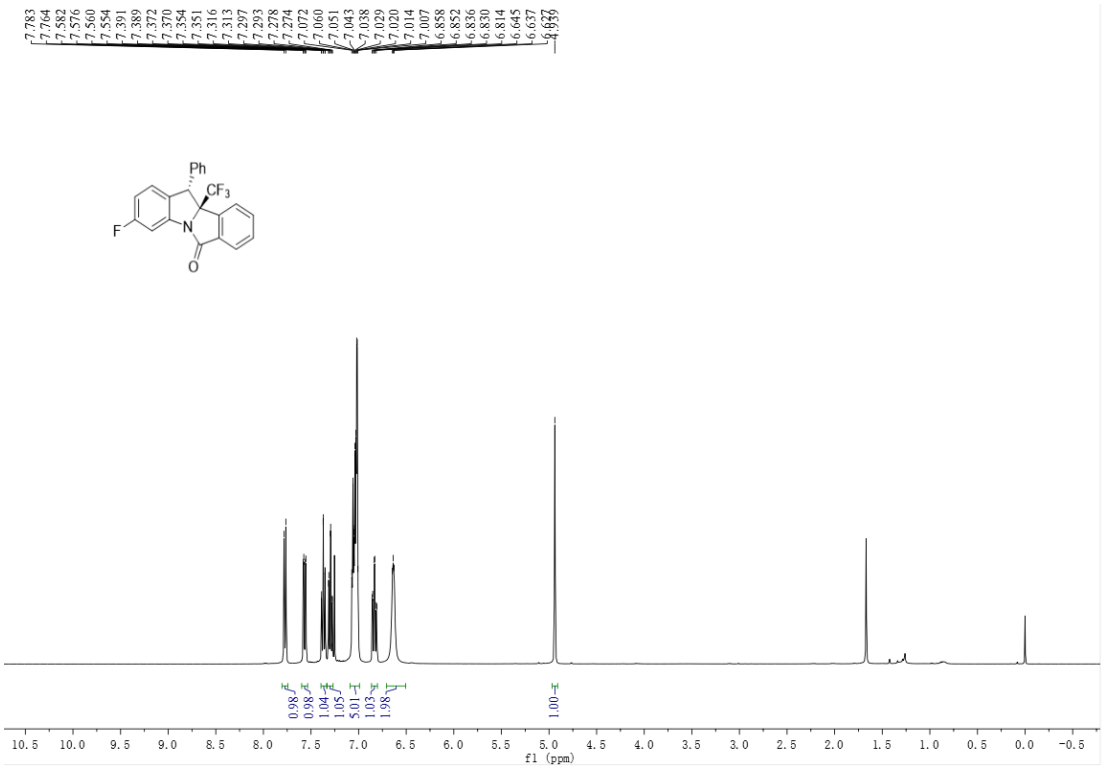


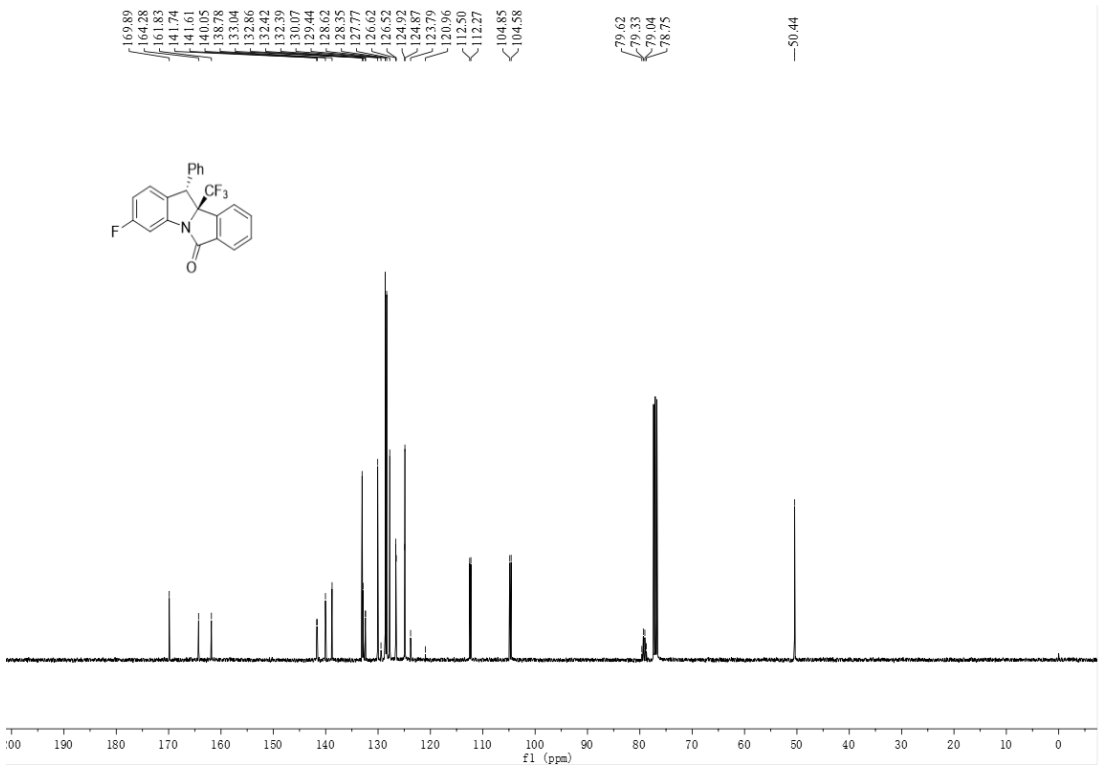
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.709	BB	0.2956	544.62036	28.41247	11.7068
2	13.533	BB	0.3974	4107.53760	157.93803	88.2932

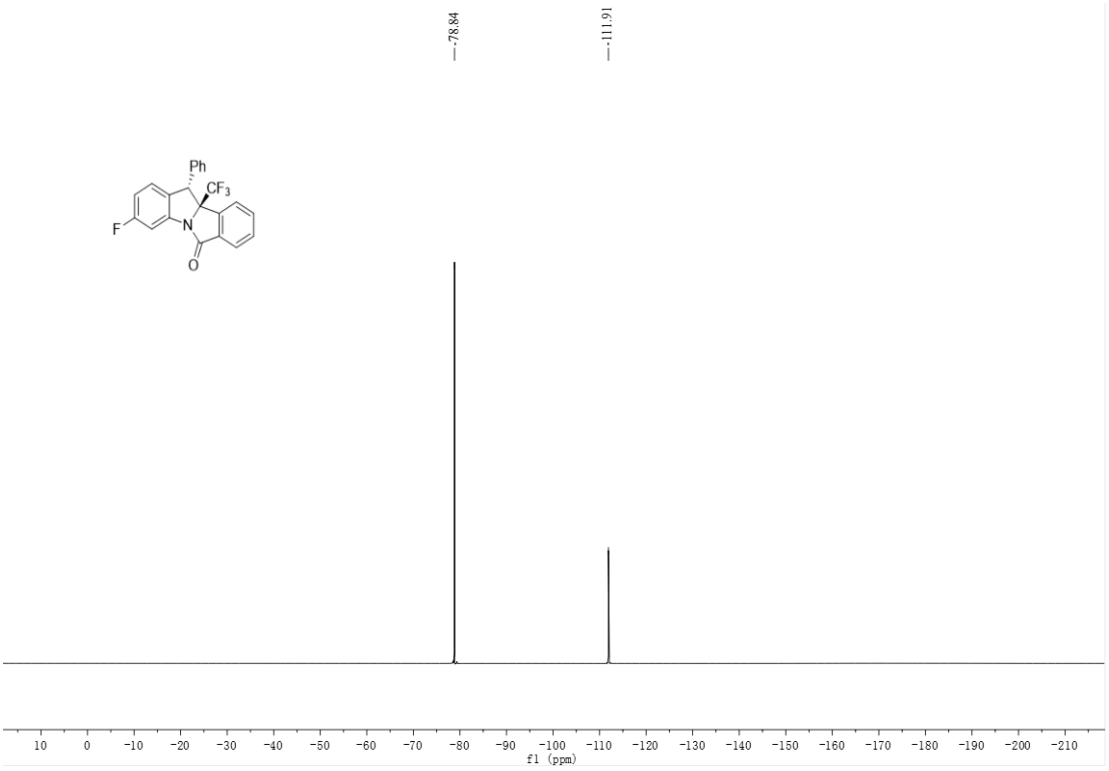
(10bR,11S)-3-fluoro-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3q):

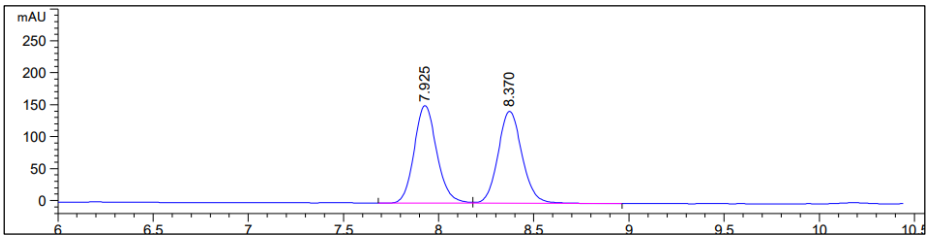


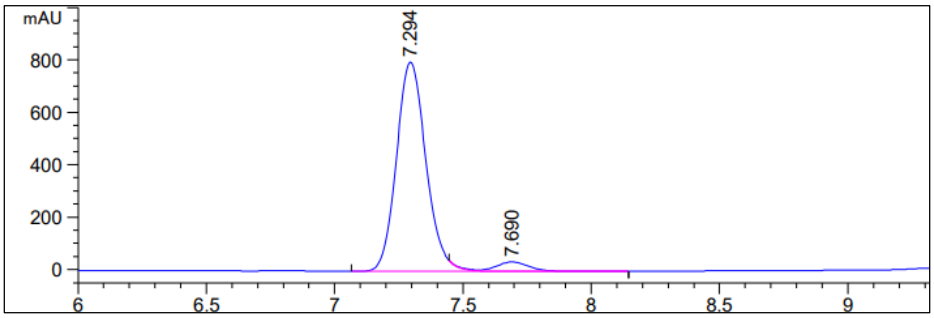
Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (58% yield), m.p. 155-157 ℃. $[\alpha]_D^{20}$ = +89.1 (c 0.5, CH_2Cl_2), 90% ee [Daicel Chiralpak OD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 230 nm; t_{major} = 7.3 min, t_{minor} = 7.7 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (d, J = 7.5 Hz, 1H), 7.57 (dd, J = 8.8, 2.5 Hz, 1H), 7.37 (td, J = 7.5, 1.0 Hz, 1H), 7.30 (td, J = 7.6, 1.3 Hz, 1H), 7.13-6.96 (m, 5H), 6.83 (td, J = 8.7, 2.5 Hz, 1H), 6.67-6.55 (m, 2H), 4.94 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.9, 163.1 (d, J = 245.0 Hz), 141.7 (d, J = 13.0 Hz), 140.1, 138.8, 133.0, 132.9, 132.4 (d, J = 3.0 Hz), 130.1, 128.6, 128.4, 127.8, 126.6 (d, J = 7.0 Hz), 124.9, 124.8, 125.2 (q, J = 282.0 Hz), 112.4 (d, J = 23.0 Hz), 104.7 (d, J = 27.0 Hz), 79.2 (q, J = 30.0 Hz), 50.44. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.8, -111.9 ppm. HRMS m/z (ESI+): Calcd for $C_{22}H_{14}F_4NO^+$ $(M+H)^+$ 384.1006, found 384.1011.




169.89
164.28
161.83
141.74
141.61
140.05
138.78
133.04
132.86
132.42
132.39
130.07
129.44
128.62
128.35
127.77
126.62
126.52
124.92
124.87
123.79
120.96
112.50
112.27
104.85
104.58
79.62
79.33
79.04
78.75
50.44
Ph
CF3
F
N
O
f1 (ppm)

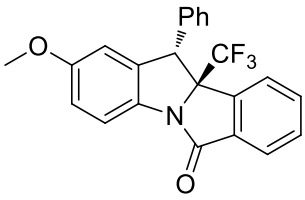

-78.84
-111.91
Ph
CF3
F
N
O
f1 (ppm)



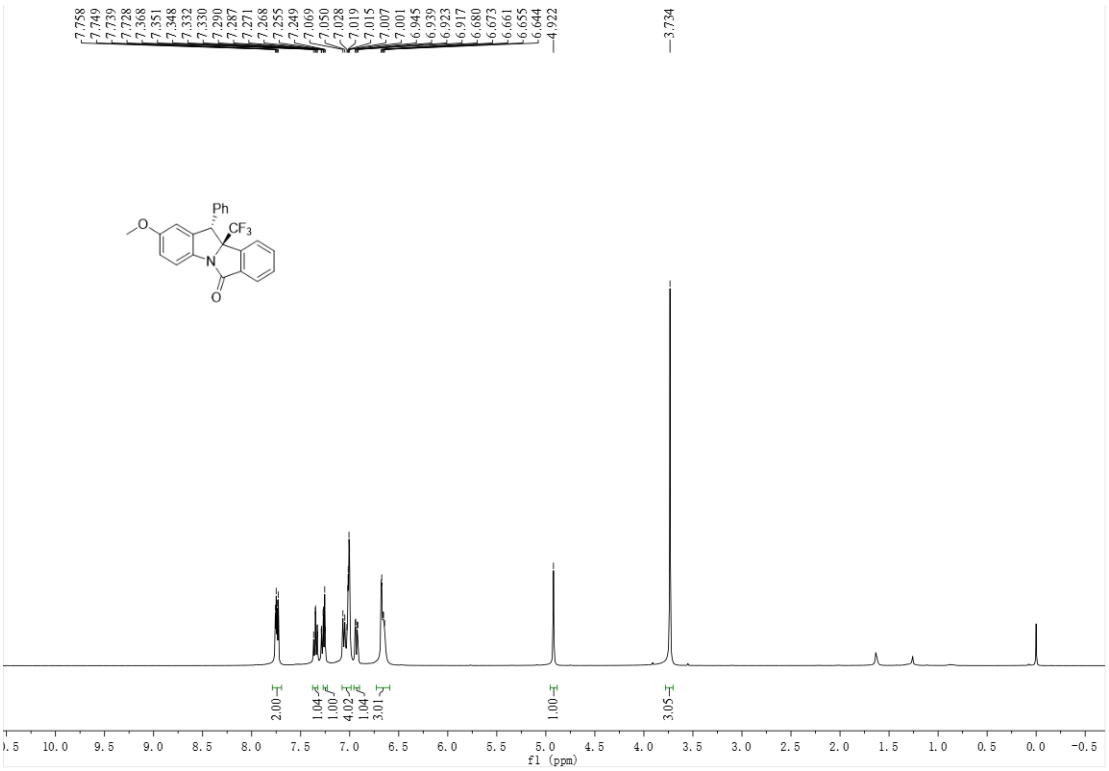


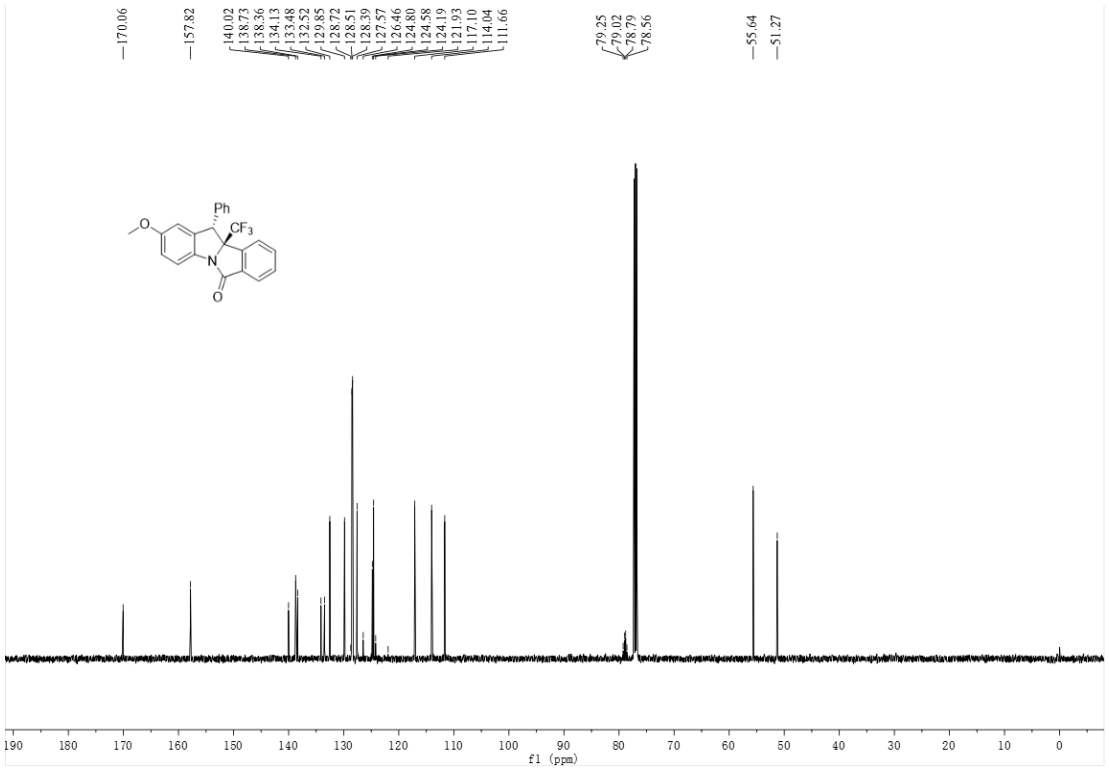
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.294	BV R	0.1232	6377.10938	798.21820	95.0878
2	7.690	VB E	0.1382	329.43869	36.19021	4.9122

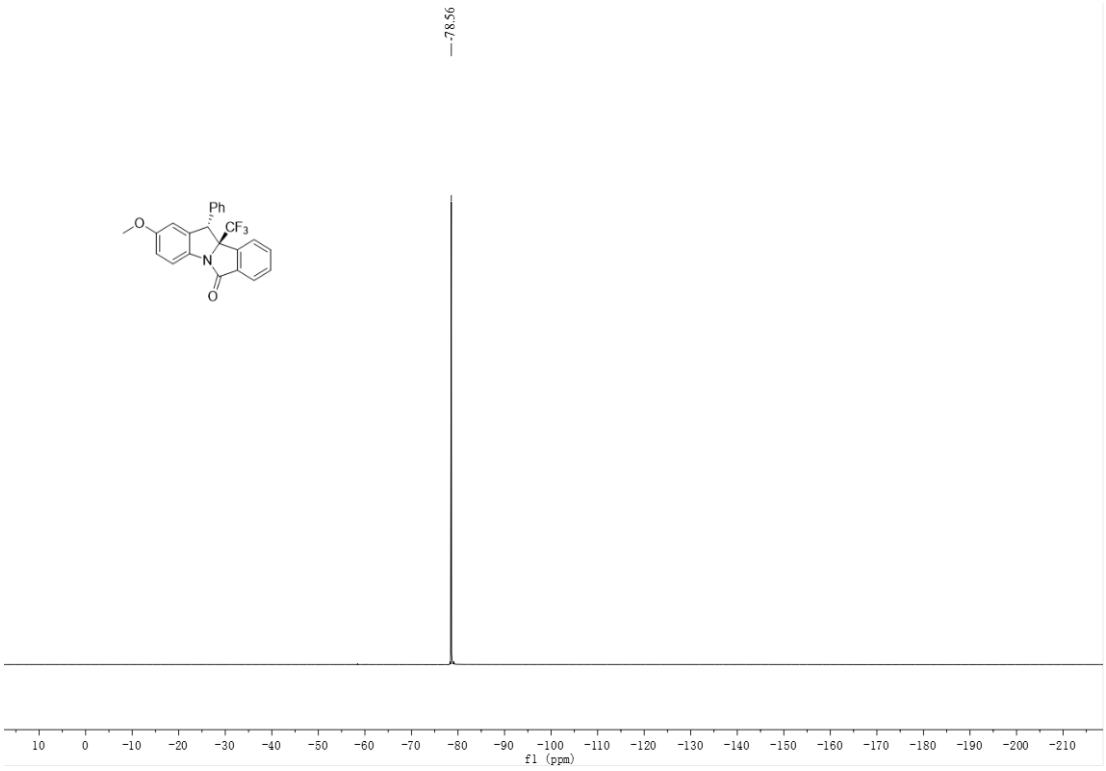
(10bR,11S)-2-methoxy-11-phenyl-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (3r):

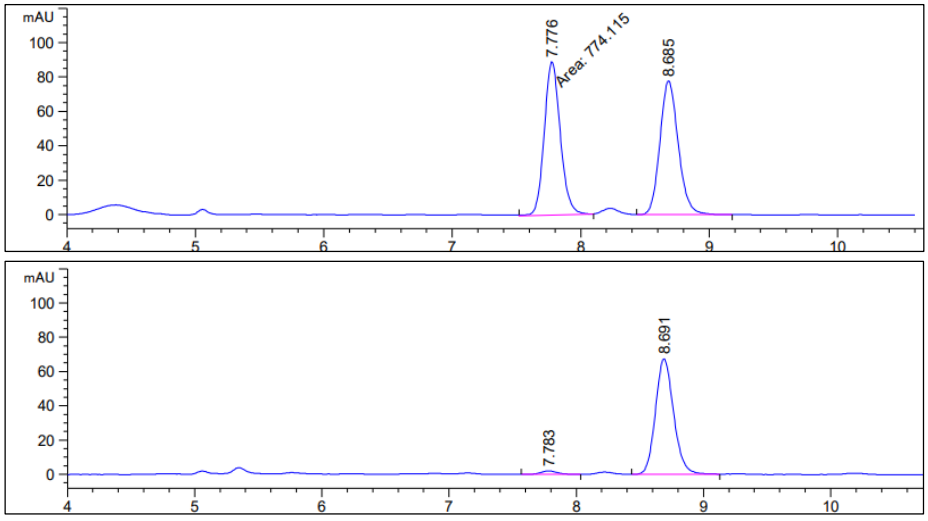


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:80 (v/v); white solid (68% yield), m.p. 108-110 ℃. $[\alpha]_D^{20}$ = +53.4 (c 0.5, CH_2Cl_2), 95% ee [Daicel Chiralpak OD-H column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 85/15, 0.6 mL/min, 280 nm; t_{minor} = 7.8 min, t_{major} = 8.7 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (dd, J = 8.1, 4.0 Hz, 2H), 7.39-7.32 (m, 1H), 7.31-7.22 (m, 1H), 7.13-6.97 (m, 4H), 6.93 (dd, J = 8.6, 2.6 Hz, 1H), 6.66 (dd, J = 9.6, 4.7 Hz, 3H), 4.92 (s, 1H), 3.73 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.1, 157.8, 140.0, 138.7, 138.4, 134.1, 133.5, 132.5, 129.9, 128.5, 128.4, 127.6, 125.3 (q, J = 282.0 Hz), 124.8, 124.6, 117.1, 114.0, 111.7, 78.7 (q, J = 282.0 Hz), 55.6, 51.3. ^{19}F NMR (377 MHz, $CDCl_3$) δ -78.8, -111.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{23}H_{17}F_3NO_2^+$ $(M+H)^+$ 396.1206, found 396.1210.


7.758
7.749
7.739
7.728
7.368
7.351
7.348
7.332
7.330
7.290
7.287
7.271
7.268
7.255
7.249
7.069
7.050
7.028
7.019
7.015
7.007
7.001
6.945
6.939
6.923
6.917
6.680
6.673
6.661
6.655
6.644
4.922
3.734
Ph
CF3
O
N
O
2.00
1.04
1.00
4.02
1.04
3.01
1.00
3.05
f1 (ppm)


170.06
157.82
140.02
138.73
138.36
134.13
133.48
132.52
129.85
128.72
128.51
128.39
127.57
126.46
124.80
124.58
124.19
121.93
117.10
114.04
111.66
79.25
79.02
78.79
78.56
55.64
51.27
Ph
CF3
O
N
O
f1 (ppm)

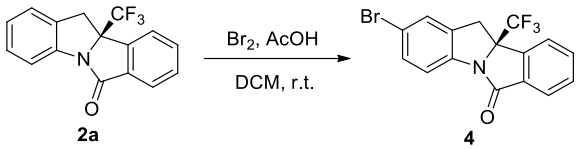




Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	7.783	BB	0.1362	18.48601	2.07053	2.6851
2	8.691	BB	0.1539	669.97699	67.43826	97.3149

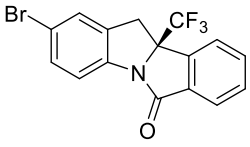
6 Synthetic transformations

6.1 Bromination of 2a

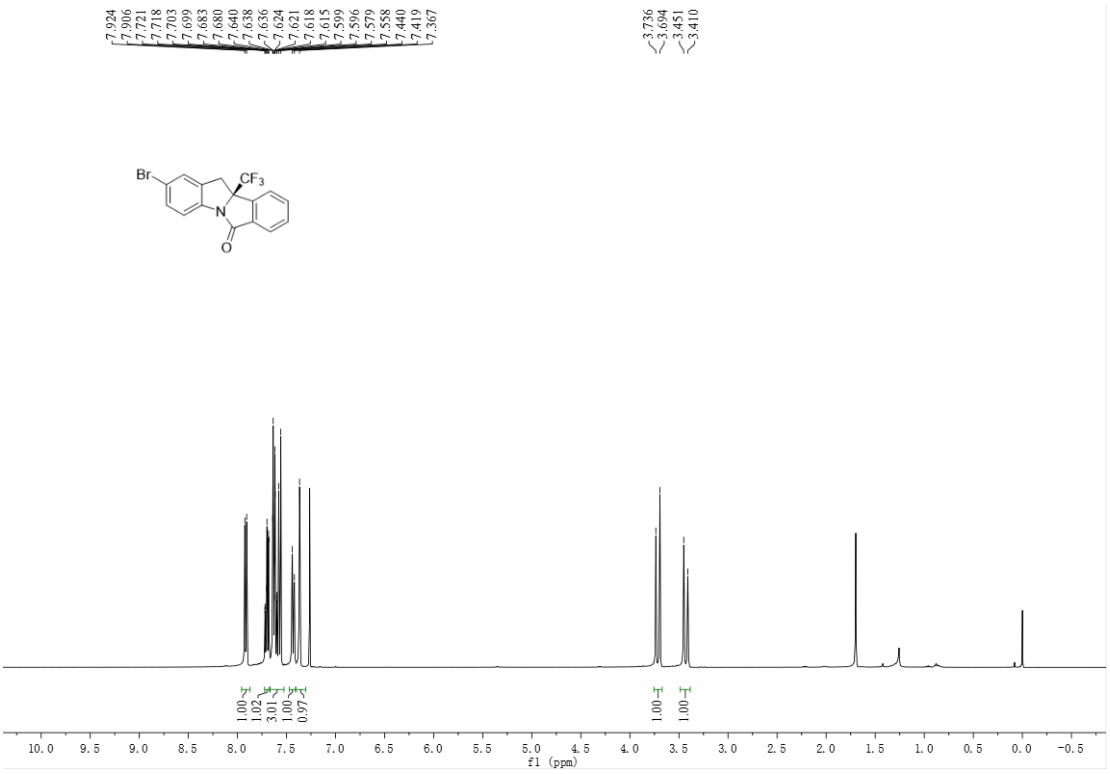


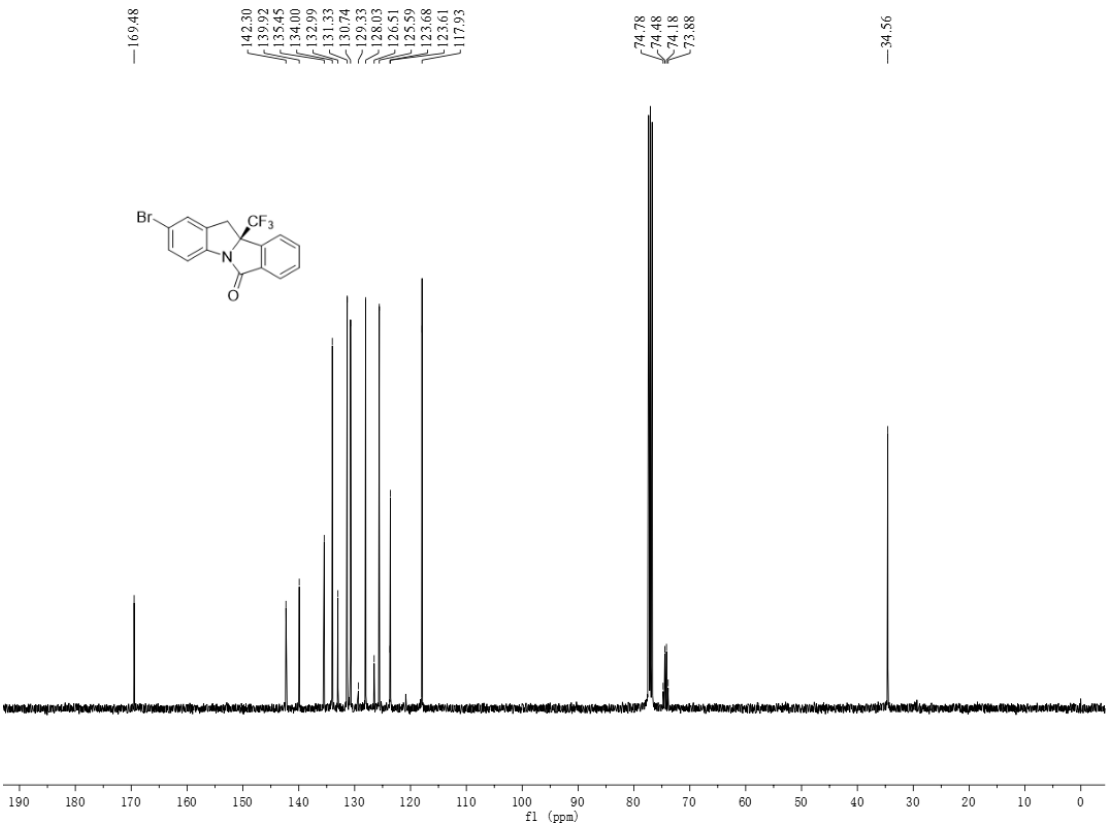
A reported procedure in the literature was followed for the synthesis of **4**[7]. To a suspension of **2a** (0.2 mmol, 99% ee) in AcOH (2 mL) was added Br_2 (160 mg, 2 mmol) at room temperature, and the mixture was stirred for 0.5 h. CH_2Cl_2 (4 mL) was then introduced via a syringe. The resulting mixture was allowed to stir at room temperature overnight. The reaction was then quenched with saturated $Na_2S_2O_3$ and extracted with CH_2Cl_2. The combined organic layers were washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The residue was purified by flash chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v), to afford **4** (80% yield, 98% ee).

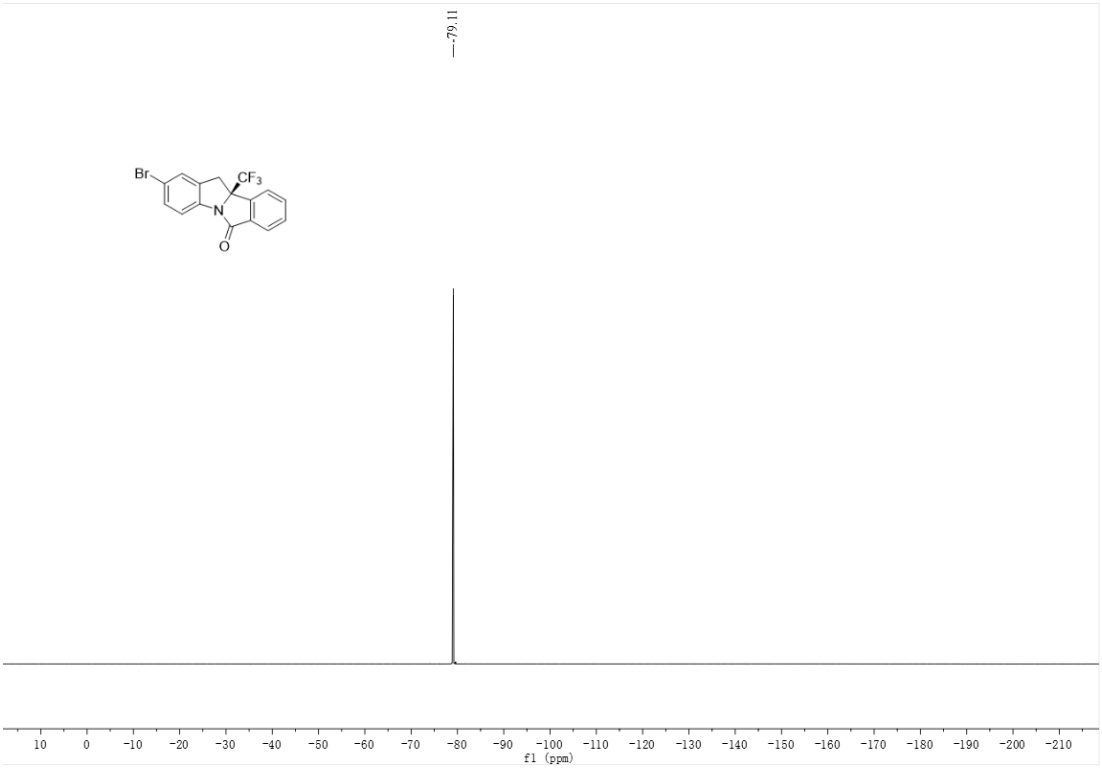
(R)-2-bromo-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indol-6-one (4):

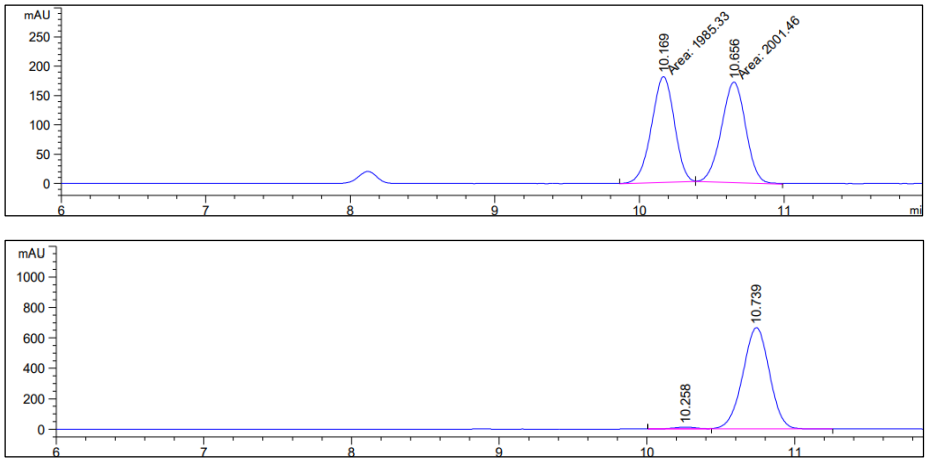


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (80% yield), m.p. 106-108 ℃. $[\alpha]_D^{20}$ = +171.2 (c 0.5, CH_2Cl_2), 98% ee [Daicel Chiralpak C1 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 280 nm; t_{minor} = 10.3 min, t_{major} = 10.7 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, J = 7.5 Hz, 1H), 7.76-7.67 (m, 1H), 7.65-7.53 (m, 3H), 7.43 (d, J = 8.3 Hz, 1H), 7.37 (s, 1H), 3.71 (d, J = 16.7 Hz, 1H), 3.43 (d, J = 16.7 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.5, 142.3, 139.9, 135.5, 134.0, 133.0, 131.3, 130.7, 128.0, 125.6, 125.1 (q, J = 282.0 Hz), 123.68, 123.61, 117.9, 78.4 (q, J = 30.0 Hz), 34.56. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.1 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_{10}BrF_3NO^+$ $(M+H)^+$ 369.9862, found 369.9865.


7.924
7.906
7.721
7.718
7.703
7.699
7.683
7.680
7.640
7.638
7.636
7.624
7.621
7.618
7.615
7.599
7.596
7.579
7.558
7.440
7.419
7.367
3.736
3.694
3.451
3.410
Br
CF3
N
O
1.00
1.02
3.01
1.00
0.97
1.00
1.00
f1 (ppm)

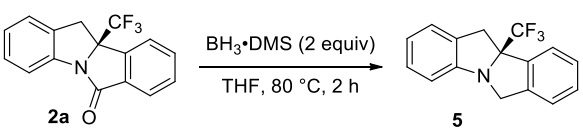

169.48
142.30
139.92
135.45
134.00
132.99
131.33
130.74
129.33
128.03
126.51
125.59
123.68
123.61
117.93
74.78
74.48
74.18
73.88
34.56
Br
CF3
N
O
f1 (ppm)





Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	10.259	MM	0.1464	107.96466	12.29424	0.9816
2	10.739	MM	0.2089	1.08909e4	868.80859	99.0184

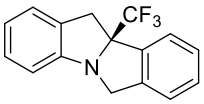
6.2 Reduction of 2a



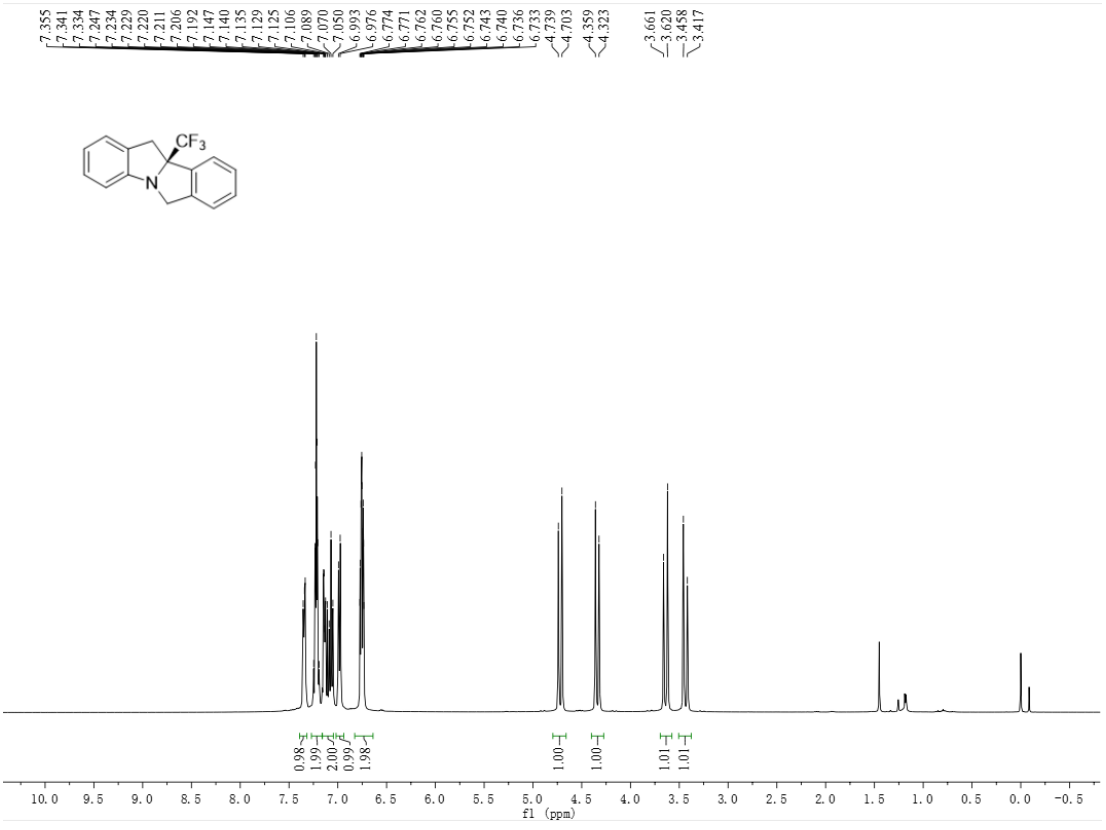
A reported procedure in the literature was followed for the synthesis of **5**.[8] To a solution of **2a** (0.2 mmol, 1 equiv) in THF (2 mL) was added BH_3·DMS (45.5 µL, 0.4

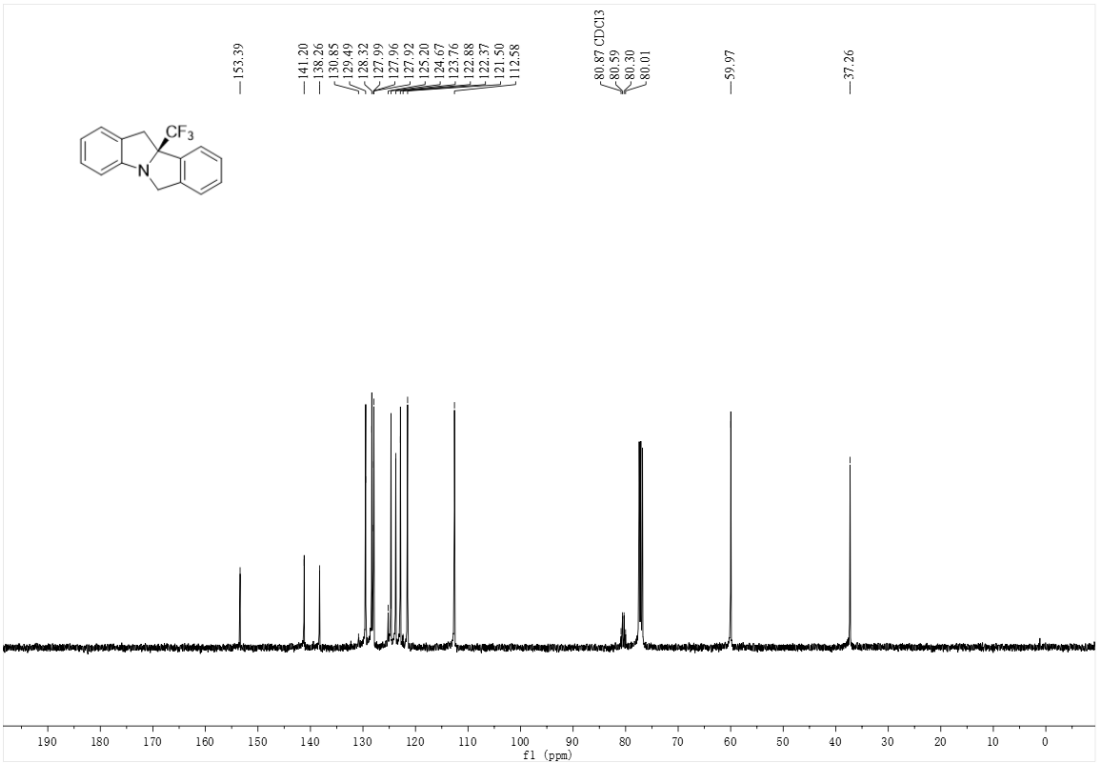
mol, 2 equiv) dropwise. The resulting mixture was refluxed for 1 hour until the starting material was all comsumed. The mixture was cooled to 0 °C and MeOH (1 mL) was added. After the evolution of gas ceased, the solution was concentrated under reduced pressure, the residue was purified by flash chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v), to afford **5** (94% yield, 98% ee).

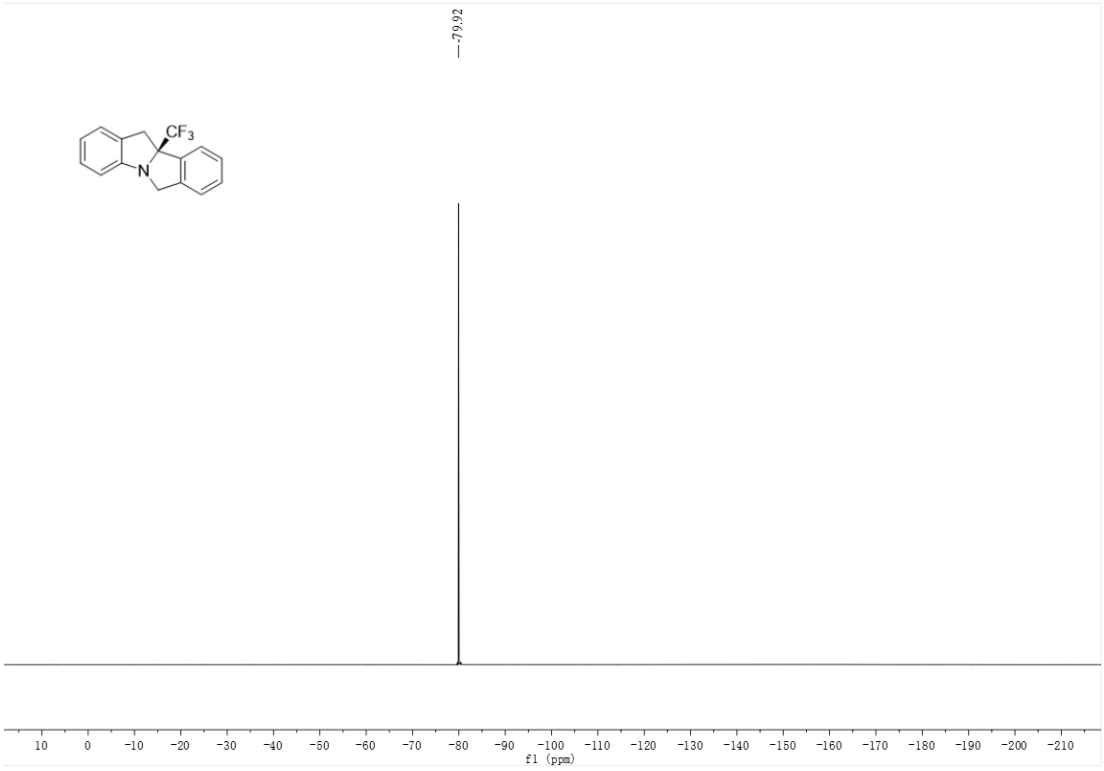
(R)-10b-(trifluoromethyl)-10b,11-dihydro-6H-isoindolo[2,1-a]indole (5):

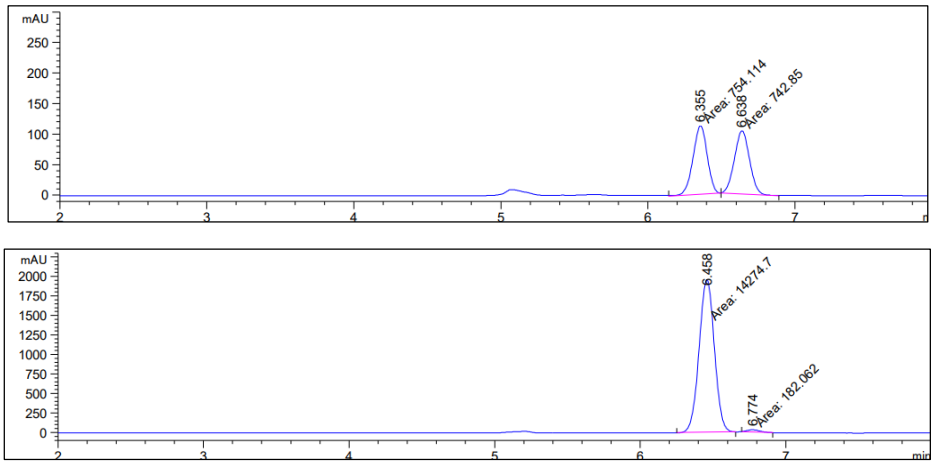


Purified by chromatography on silica gel, eluting with ethyl acetate/petroleum ether 1:50 (v/v); white solid (94% yield), m.p. 77-79 ℃. $[\alpha]_D^{20}$ = +212.0 (c 0.5, CH_2Cl_2), 98% ee [Daicel Chiralpak A2 column (25 cm × 0.46 cm ID), ^{n}hexane/^{i}PrOH = 90/10, 0.6 mL/min, 230 nm; t_{major} = 6.4 min, t_{minor} = 6.7 min]. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36-7.31 (m, 1H), 7.25-7.18 (m, 2H), 7.16-7.10 (m, 1H), 7.07 (t, J = 7.6 Hz, 1H), 6.98 (d, J = 6.8 Hz, 1H), 6.79-6.68 (m, 2H), 4.72 (d, J = 14.7 Hz, 1H), 4.34 (d, J = 14.6 Hz, 1H), 3.64 (d, J = 16.4 Hz, 1H), 3.44 (d, J = 16.4 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.4, 141.0, 138.3, 129.5, 128.3, 128.0, 127.9, 126.6 (q, J = 282.0 Hz), 124.7, 123.8, 122.9, 121.5, 112.6, 80.4 (q, J = 30.0 Hz), 59.97, 37.26. ^{19}F NMR (377 MHz, $CDCl_3$) δ -79.9 ppm. HRMS *m/z* (ESI+): Calcd for $C_{16}H_{13}F_3N^+$ $(M+H)^+$ 276.0990, found 276.0993.




153.39
141.20
138.26
130.85
129.49
128.32
127.99
127.96
127.92
125.20
124.67
123.76
122.88
122.37
121.50
112.58
80.87 CDCl3
80.59
80.30
80.01
59.97
37.26
CF3
N
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

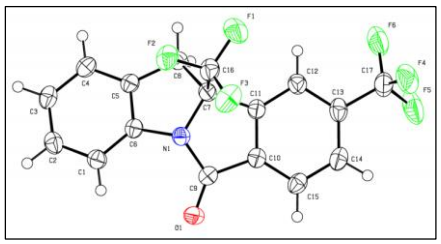

-79.92
CF3
N
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.458	MM	0.1212	1.42747e4	1963.04309	98.7406
2	6.774	MM	0.1020	182.06216	29.75239	1.2594

7 Crystal report of compounds 2f and 3a

7.1 Crystal report of compound 2f (grown in a mixed solvent of DCM and n-hexane)



checkCIF/PLATON report

Structure factors have been supplied for datablock(s) cu_210317_cjf_1_4_cf3_0m

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: cu_210317_cjf_1_4_cf3_0m

Bond precision: C-C = 0.0032 A Wavelength=1.54178

Cell: a=10.5776(5) b=6.1725(3) c=12.0797(6)
alpha=90 beta=107.532(2) gamma=90
Temperature: 170 K

	Calculated	Reported
Volume	752.05(6)	752.05(6)
Space group	P 21	P 1 21 1
Hall group	P 2yb	P 2yb
Moiety formula	C17 H9 F6 N O	C17 H9 F6 N O
Sum formula	C17 H9 F6 N O	C17 H9 F6 N O
Mr	357.25	357.25
Dx,g cm-3	1.578	1.578
Z	2	2
Mu (mm-1)	1.329	1.329
F000	360.0	360.0
F000'	361.60	
h,k,lmax	12,7,14	12,7,14
Nref	2748[1513]	2740
Tmin,Tmax	0.625,0.671	0.589,0.753
Tmin'	0.567	

Correction method= # Reported T Limits: Tmin=0.589 Tmax=0.753
AbsCorr = MULTI-SCAN

Data completeness= 1.81/1.00 Theta(max)= 68.124

R(reflections)= 0.0317(2694) wR2(reflections)= 0.0790(2740)

S = 1.075 Npar= 226

The following ALERTS were generated. Each ALERT has the format
test-name_ALERT_alert-type_alert-level.
Click on the hyperlinks for more details of the test.

Alert level G

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PLAT242_ALERT_2_G Low    'MainMol' Ueq as Compared to Neighbors of        C16 Check
PLAT242_ALERT_2_G Low    'MainMol' Ueq as Compared to Neighbors of        C17 Check
PLAT432_ALERT_2_G Short Inter X...Y Contact  O1       ..C9              2.94 Ang.
                                          1-x,-1/2+y,1-z  =      2_646 Check
PLAT791_ALERT_4_G Model has Chirality at C7          (Sohnke SpGr)         R Verify
PLAT909_ALERT_3_G Percentage of I>2sig(I) Data at Theta(Max) Still        97% Note
PLAT912_ALERT_4_G Missing # of FCF Reflections Above STh/L=  0.600          2 Note
PLAT978_ALERT_2_G Number C-C Bonds with Positive Residual Density.          2 Info
```

```
  0 ALERT level A = Most likely a serious problem - resolve or explain
  0 ALERT level B = A potentially serious problem, consider carefully
  1 ALERT level C = Check. Ensure it is not caused by an omission or oversight
  7 ALERT level G = General information/check it is not something unexpected

  0 ALERT type 1 CIF construction/syntax error, inconsistent or missing data
  4 ALERT type 2 Indicator that the structure model may be wrong or deficient
  2 ALERT type 3 Indicator that the structure quality may be low
  2 ALERT type 4 Improvement, methodology, query or suggestion
  0 ALERT type 5 Informative message, check
```

It is advisable to attempt to resolve as many as possible of the alerts in all categories. Often the minor alerts point to easily fixed oversights, errors and omissions in your CIF or refinement strategy, so attention to these fine details can be worthwhile. In order to resolve some of the more serious problems it may be necessary to carry out additional measurements or structure refinements. However, the purpose of your study may justify the reported deviations and the more serious of these should normally be commented upon in the discussion or experimental section of a paper or in the "special_details" fields of the CIF. checkCIF was carefully designed to identify outliers and unusual parameters, but every test has its limitations and alerts that are not important in a particular case may appear. Conversely, the absence of alerts does not guarantee there are no aspects of the results needing attention. It is up to the individual to critically assess their own results and, if necessary, seek expert advice.

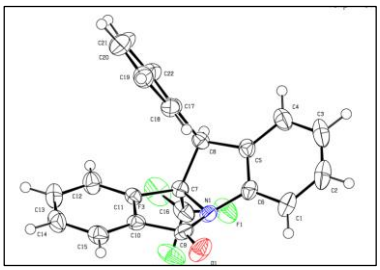
Publication of your CIF in IUCr journals

A basic structural check has been run on your CIF. These basic checks will be run on all CIFs submitted for publication in IUCr journals (*Acta Crystallographica*, *Journal of Applied Crystallography*, *Journal of Synchrotron Radiation*); however, if you intend to submit to *Acta Crystallographica Section C* or *E* or *IUCrData*, you should make sure that full publication checks are run on the final version of your CIF prior to submission.

Publication of your CIF in other journals

Please refer to the *Notes for Authors* of the relevant journal for any special instructions relating to CIF submission.

7.2 Crystal report of compound 3a (grown in a mixed solvent of DCM and n-hexane)



checkCIF/PLATON report

Structure factors have been supplied for datablock(s) cu_210316_cjf_2_bd_0m

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: cu_210316_cjf_2_bd_0m

Bond precision: C-C = 0.0026 A Wavelength=1.54178

Cell: a=9.7165(13) b=11.402(2) c=15.962(2)
alpha=90 beta=90 gamma=90
Temperature: 170 K

	Calculated	Reported
Volume	1768.4(4)	1768.5(5)
Space group	P 21 21 21	P 21 21 21
Hall group	P 2ac 2ab	P 2ac 2ab
Moiety formula	C22 H14 F3 N O	C22 H14 F3 N O
Sum formula	C22 H14 F3 N O	C22 H14 F3 N O
Mr	365.34	365.34
Dx,g cm-3	1.372	1.372
Z	4	4
Mu (mm-1)	0.895	0.895
F000	752.0	752.0
F000'	754.68	
h,k,lmax	11,13,19	11,13,19
Nref	3237[1863]	3236
Tmin,Tmax	0.777,0.814	0.664,0.753
Tmin'	0.696	

Correction method= # Reported T Limits: Tmin=0.664 Tmax=0.753
AbsCorr = MULTI-SCAN

Data completeness= 1.74/1.00 Theta(max)= 68.256

R(reflections)= 0.0290(3217) wR2(reflections)= 0.0729(3236)

S = 1.072 Npar= 244

The following ALERTS were generated. Each ALERT has the format
test-name_ALERT_alert-type_alert-level.
Click on the hyperlinks for more details of the test.

Alert level C

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PLAT230_ALERT_2_C Hirshfeld Test Diff for    C20      --C21      .        6.2 s.u.
```

Alert level G

```
PLAT242_ALERT_2_G Low    'MainMol' Ueq as Compared to Neighbors of        C16 Check
PLAT791_ALERT_4_G Model has Chirality at C7          (Sohnke SpGr)          R Verify
PLAT791_ALERT_4_G Model has Chirality at C8          (Sohnke SpGr)          S Verify
PLAT978_ALERT_2_G Number C-C Bonds with Positive Residual Density.          0 Info
```

```
   0 ALERT level A = Most likely a serious problem - resolve or explain
   0 ALERT level B = A potentially serious problem, consider carefully
   1 ALERT level C = Check. Ensure it is not caused by an omission or oversight
   4 ALERT level G = General information/check it is not something unexpected

   0 ALERT type 1 CIF construction/syntax error, inconsistent or missing data
   3 ALERT type 2 Indicator that the structure model may be wrong or deficient
   0 ALERT type 3 Indicator that the structure quality may be low
   2 ALERT type 4 Improvement, methodology, query or suggestion
   0 ALERT type 5 Informative message, check
```

It is advisable to attempt to resolve as many as possible of the alerts in all categories. Often the minor alerts point to easily fixed oversights, errors and omissions in your CIF or refinement strategy, so attention to these fine details can be worthwhile. In order to resolve some of the more serious problems it may be necessary to carry out additional measurements or structure refinements. However, the purpose of your study may justify the reported deviations and the more serious of these should normally be commented upon in the discussion or experimental section of a paper or in the "special_details" fields of the CIF. checkCIF was carefully designed to identify outliers and unusual parameters, but every test has its limitations and alerts that are not important in a particular case may appear. Conversely, the absence of alerts does not guarantee there are no aspects of the results needing attention. It is up to the individual to critically assess their own results and, if necessary, seek expert advice.

Publication of your CIF in IUCr journals

A basic structural check has been run on your CIF. These basic checks will be run on all CIFs submitted for publication in IUCr journals (*Acta Crystallographica*, *Journal of Applied Crystallography*, *Journal of Synchrotron Radiation*); however, if you intend to submit to *Acta Crystallographica Section C* or *E* or *IUCrData*, you should make sure that full publication checks are run on the final version of your CIF prior to submission.

Publication of your CIF in other journals

Please refer to the *Notes for Authors* of the relevant journal for any special instructions relating to CIF submission.

PLATON version of 05/12/2020; check.def file version of 05/12/2020

7. References

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[2] F. Verdugo, L. Villarino, J. Durán, M. Gulás, J. L. Mascareñas, F. López, *ACS Catal.*, 2018, **8**, 6100.

[3] T.-F. Zhang, Q.-W. Ma, W.-G. Ni, Z.-X. Wang, *Synthesis,* 2014, **46**, 3309.

[4] Z.-X. Wang, F.-L. Ge, W. Wen, H.-Z. Jiang, H. Jian, *J. Org. Chem.,* 2007, **128**, 1143.

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[7] C. Shen, R.-R. Liu, Y.-X. Jia, *J. Am. Chem. Soc.*, 2015, **137**, 4936.

[8] D. A. Petrone, M. Kondo, M. Lautens, *Chem. Eur. J.*, 2016, **22**, 5684.