# Supporting Information

# Cu-Catalyzed Enantioselective Decarboxylative Cyanation via the Synergistic Merger of Photocatalysis and Electrochemistry

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## Contents

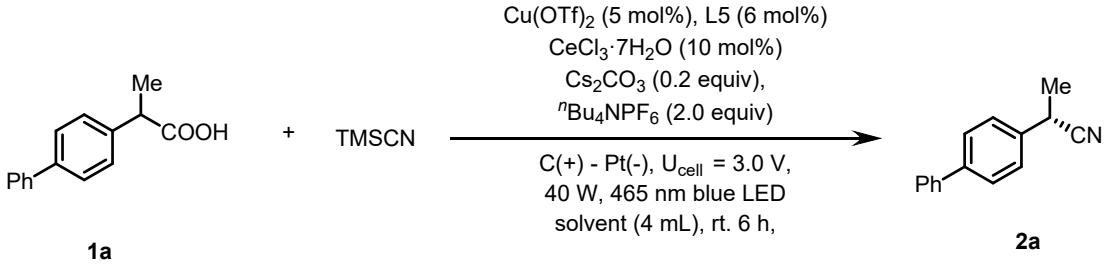
## 1. General Information

All reactions were carried out under an atmosphere of nitrogen in flame-dried sealed tube (vessel size: 10 mL, material: high borosilicate glass, thickness of glassware: 3 mm) with magnetic stirring (speed 1000 rpm). The $[\alpha]^D$ was recorded using PolAAr 3005 High Accuracy Polarimeter. $^1$H NMR spectra, $^{13}$C NMR spectra, and $^{19}$F NMR spectra were recorded on a Bruker 400 MHz spectrometer in $CDCl_3$. All signals are reported in δ units, parts per million (ppm), and were referenced to $CDCl_3$ (δ 7.26 ppm for $^1$H NMR and 77.0 ppm for $^{13}$C NMR) as the internal standard. Data for $^1$H NMR spectra are reported as follows: chemical shift (ppm; s = singlet, d = doublet, t = triplet, dd = doublet of doublets, m = multiplet), coupling constant (Hz), and integration. Data for $^{13}$C NMR are reported in terms of chemical shift (ppm) relative to residual solvent peak ($CDCl_3$: 77.0 ppm). HRMS spectra were recorded on GCQTOF 7200 and Bruker McriOTOF11. Reactions were monitored by thin layer chromatography (TLC) using silica gel plates.

THF was freshly distilled from $CaH_2$; HFIPA (AR grade), DMF (AR grade), $CH_3OH$ (AR grade), DMA (AR grade) and DCE (AR grade) were purchased from Energy Chemical. Flash column chromatography was performed on silica gel 60 (particle size 200-400 mesh ASTM, purchased from Yantai, China) and eluted with petroleum ether/dichloromethane or petroleum ether/ethyl acetate. Reagents were purchased from Aldrich, Bidepharm, Energy Chemical, J&K chemical, and were used as received. Ligands were purchased from Leyan.com. The carboxylic acids were synthesized according to published procedures[1]. Nickel foam was purchased from TAOBAO (https://item.taobao.com/item.htm?spm=a1z09.2.0.0.3b142e8doL22fu&id=613462031143&_u=51bta621701); Carbon felt was purchased from Beijing Jinglong Special Carbon Technology Co., Ltd. Photoreactor was purchased from Wuhangeao.com. The enantionmeric excesses of the products were determined by chiral stationary phase Shimadzu HPLC using a Chiralpak AS-H, AD-H, IC, OD-H, OJ-H, OZ-3, IA.

## 2. Optimization of reaction conditions

### 2.1 Table S1. Screening of solvents for the Reaction[a]

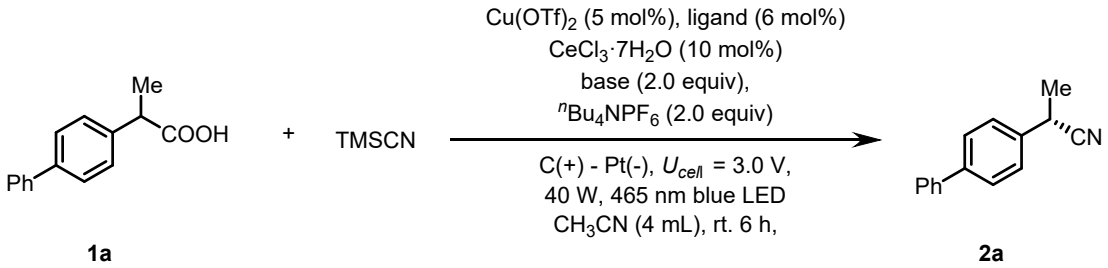



**1a** **2a**

| Entry | Solvent | Yield [%][b] | *ee* [%][c] |
|---|---|---|---|
| 1 | $CH_3CN$ | 13 | 90 |
| 2 | DMF | NR | - |
| 3 | HFIPA | NR | - |
| 5 | MeOH | NR | - |
| 6 | DMA | NR | - |
| 7 | DCE | NR | - |
| 8 | THF | NR | - |

[a] The reaction was performed using 0.2 mmol of **1a** and 0.4 mmol of **2a** for 6 h. [b] Yield was determined by GC using anisole as an internal standard. [c] Determined by HPLC using a chiral stationary phase. NR = no reaction.

### 2.2 Table S2. Screening of bases for the Reaction[a]

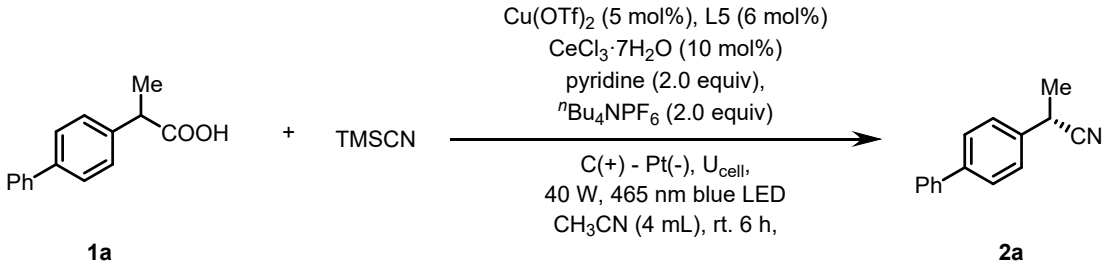



**1a** **2a**

| Entry | Base | Yield [%][b] | *ee* [%][c] |
|---|---|---|---|
| 1 | None | NR | - |
| 2 | DMAP | 3 | 80 |
| 3 | Quinoline | trace | - |
| 4 | 2-isopropyl pyridine | 22 | 92 |
| 5 | Pyridine | 28 | 92 |
| 6 | 2,6-diethylpyridine | 24 | 90 |
| 7 | 2-Picoline | trace | - |
| 8 | 2,6-Lutidine | 7 | 90 |
| 9 | 2,6-dichloropyridine | NR | - |
| 10 | $Cs_2CO_3$（0.2 equiv） | 13 | 89 |

[a] The reaction was performed using 0.2 mmol of **1a** and 0.4 mmol of **2a** for 6 h. [b] Yield was determined by GC using anisole as an internal standard. [c] Determined by HPLC using a chiral stationary phase. NR = no reaction.

## 2.3 Table S3. Screening of the Voltage for the Reaction[a]

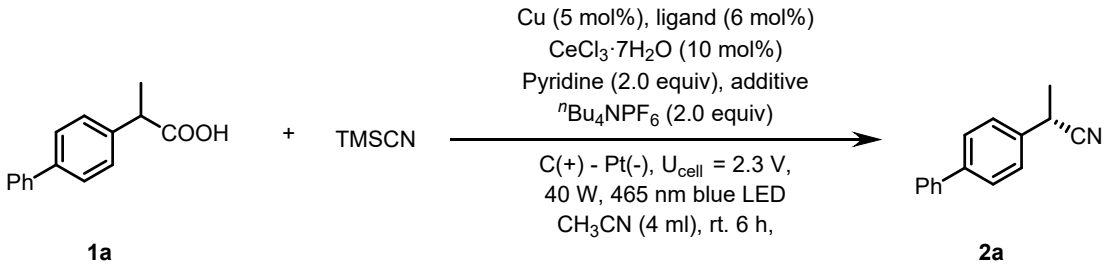



**1a** **2a**

| Entry | $U_{cell}$ | Yield [%][b] | *ee* [%][c] |
|---|---|---|---|
| 1 | 2.1 V | 31 | 88 |
| 2 | 2.2 V | 33 | 87 |
| 3 | 2.3 V | 61 | 86 |
| 4 | 2.4 V | 44 | 90 |
| 5 | 2.5 V | 45 | 90 |
| 6 | 2.6 V | 13 | 92 |
| 7 | 2.7 V | 50 | 89 |
| 8 | 2.8 V | 6 | 87 |
| 9 | 2.9 V | 7 | 90 |
| 10 | 3.0 V | 6 | 90 |

[a] The reaction was performed using 0.2 mmol of **1a** and 0.4 mmol of **2a** for 6 h. [b] Yield was determined by GC using anisole as an internal standard. [c] Determined by HPLC using a chiral stationary phase.

## 2.4 Table S5. Screening of additive for Reaction[a]

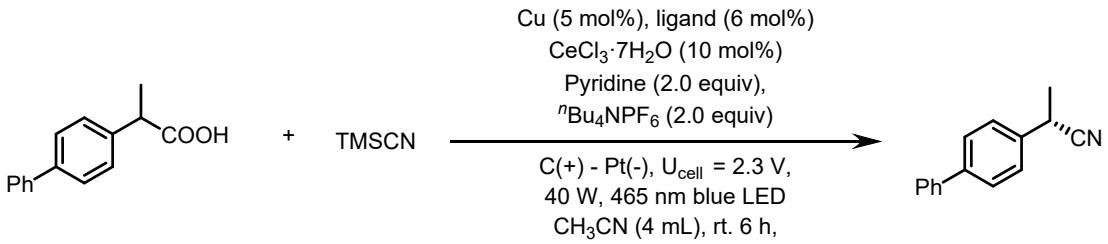



**1a** **2a**

| Entry | additive | Yield [%][b] | *ee* [%][c] |
|---|---|---|---|
| 1 | $H_2O$ (2 eq) | 77 | 93 |
| 2 | $H_2O$ (4 eq) | 35 | 92 |
| 3 | $H_2O$ (6 eq) | 45 | 92 |
| 4 | iPrOH (2 eq) | 32 | 90 |
| 5 | $CH_3COOH$ (2 eq) | 73 | 90 |

[a] The reaction was performed using 0.2 mmol of **1a** and 0.4 mmol of **2a** for 6 h. [b] Yield was determined by GC using anisole as an internal standard. [c] Determined by HPLC using a chiral stationary phase.

## 2.5 Table S4. Screening of Cu precursors for the Reaction[a]



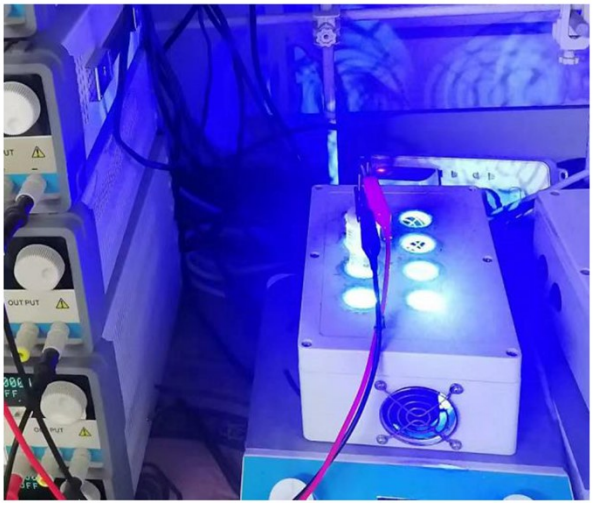

**1a** **2a**

| Entry | Cu | Yield [%][b] | *ee* [%][c] |
|---|---|---|---|
| 1 | CuI | 3 | 80 |
| 2 | CuTc | 6 | 93 |
| 3 | $Cu(CH_3CN)_4BF_6$ | 7 | 93 |
| 4 | $Cu(OAc)_2$ | 11 | 92 |
| 5 | $Cu(OAc)_2 \cdot H_2O$ | 27 | 91 |
| 6 | $Cu(hfacac)_2 \cdot H_2O$ | 76 | 90 |
| 7 | $Cu(hfacac)_2$ | 69 | 90 |
| 8 | Copper bis(2-ethylhexanoate) | 6 | 94 |

[a] The reaction was performed using 0.2 mmol of **1a** and 0.4 mmol of **2a** for 6 h. [b] Yield was determined by GC using anisole as an internal standard. [c] Determined by HPLC using a chiral stationary phase.

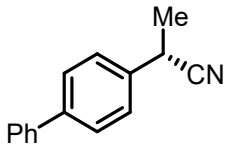
## 3. General procedure

In a nitrogen-filled glove box, an over-dried 10 mL tube charged with a stir bar, to a tube was added $Cu(hfacac)_2 \cdot H_2O$ (5 mol%) and **L5** (6 mol%). $CH_3CN$ (1.0 mL) was added to the tube, and stirred at room temperature for 1 h. $CeCl_3 \cdot 7H_2O$ (7.44 mg, 0.02 mmol), $^nBu_4NPF_6$ (155.0 mg, 0.4 mmol)), phenylpropanoic acids (0.2 mmol), pyridine (32 mg, 0.4 mmol), $H_2O$ (7.2 mg, 0.4 mmol), TMSCN (40.0 mg, 0.4 mmol) were added to the electrochemical cell. Then $CH_3CN$ (3.0 mL) were added to the electrochemical cell. The tube was installed with a Pt foam (1.0 x 0.5 $cm^2$) as the cathode and carbon felt (2.5 x 0.5 $cm^2$) as the anode. The seal-tube was sealed and removed from the glovebox. The reaction mixture was electrolyzed under a constant voltage of 2.3-3.0 V until the complete consumption of the starting materials as detected by TLC (about 6 hours). After the reaction, the reaction was quenched by saturated aqueous $^nBu_4NCl$ solution. Then the aqueous layer was extracted with EtOAc (3 x 3 mL) and the combined organics were washed with sat. brine (4 x 10 mL), dried over anhydrous $MgSO_4$, filtered and concentrated in vacuo. The crude product was purified by column chromatography to furnish the desired product.



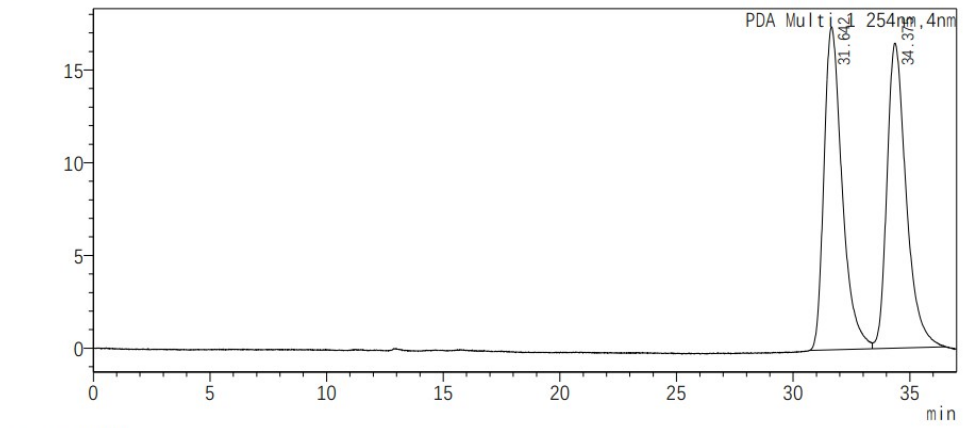
**Characterization data of products:**

**(*S*)-2-([1,1'-Biphenyl]-4-yl)propanenitrile (2a)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2a** as a white solid (31.5 mg, 76% yield) with 90% ee. m.p. 79.2-79.4 °C; $[\alpha]_D^{20}$ = -11.6 (c 0.59, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.60 (dd, *J* = 13.1, 8.2 Hz, 4H), 7.49 – 7.40 (m, 4H), 7.37 (t, *J* = 7.3 Hz, 1H), 3.95 (q, *J* = 7.3 Hz, 1H), 1.69 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.1, 140.3, 136.0, 128.9, 127.8, 127.6, 127.1, 127.1, 121.5, 30.9, 21.4. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{15}H_{13}N$: 207.1048, found 207.1042. HPLC (Daicel Chiralpak AS-H column, hexane/isopropanol = 99/1, flow rate 0.3 mL/min, 254 nm): tR = 31.8 min (minor), tR = 34.3 min (major).

<Chromatogram>

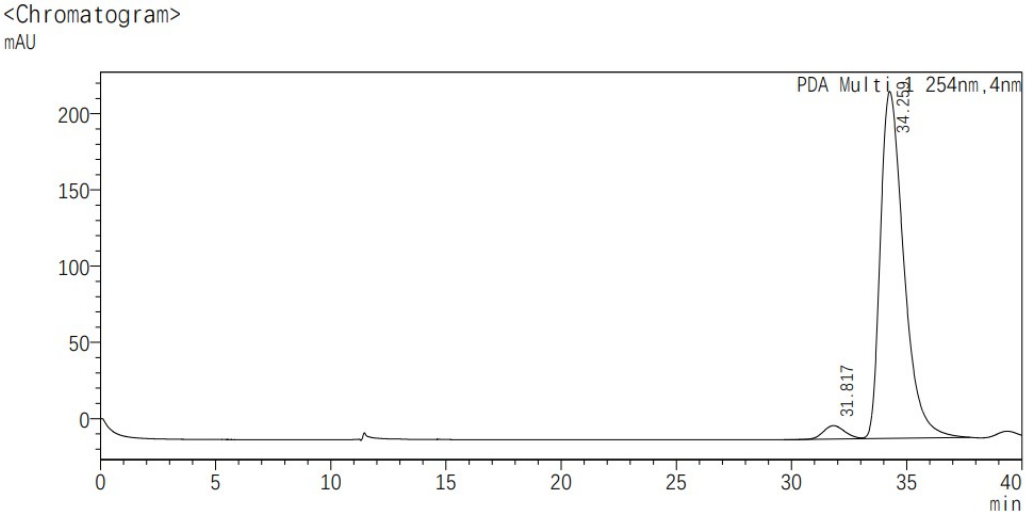



<Peak Table>

PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 31.642 | 17414 | 51.425 | 946432 | 50.030 |
| 2 | 34.375 | 16449 | 48.575 | 945283 | 49.970 |
| Total | | 33863 | 100.000 | 1891716 | 100.000 |

<Chromatogram>

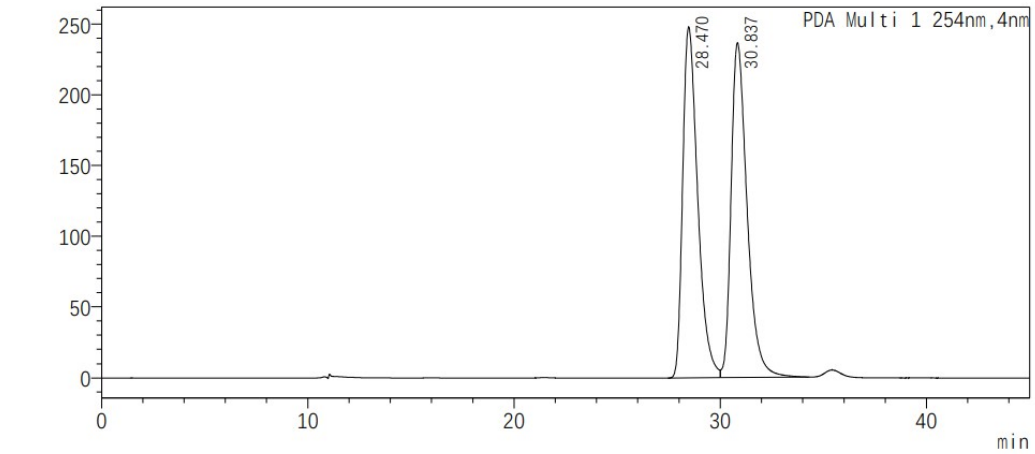



<Peak Table>

PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 31.817 | 8868 | 3.750 | 580310 | 3.478 |
| 2 | 34.259 | 227589 | 96.250 | 16104757 | 96.522 |
| Total | | 236456 | 100.000 | 16685068 | 100.000 |

<Chromatogram>

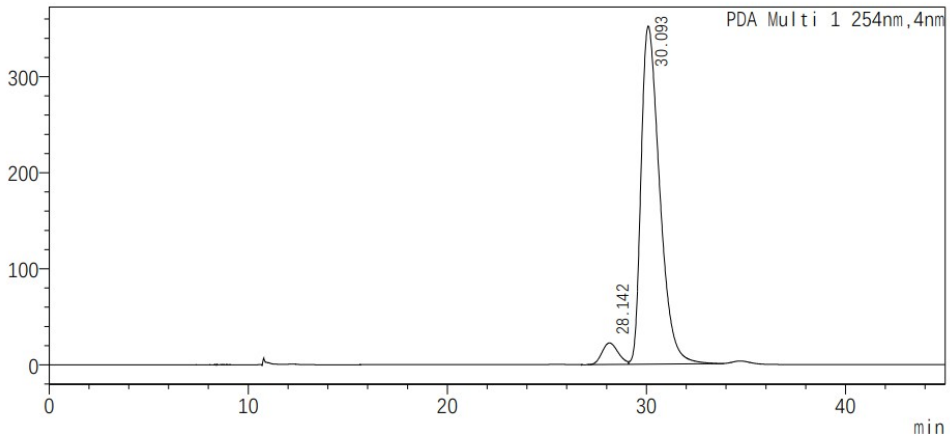



<Peak Table>

PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 28.470 | 248182 | 51.185 | 12524923 | 49.567 |
| 2 | 30.837 | 236693 | 48.815 | 12743796 | 50.433 |
| Total | | 484875 | 100.000 | 25268719 | 100.000 |

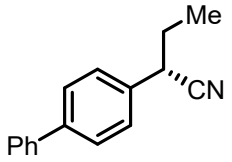
<Chromatogram>
mAU




<Peak Table>
PDA Ch1 254nm

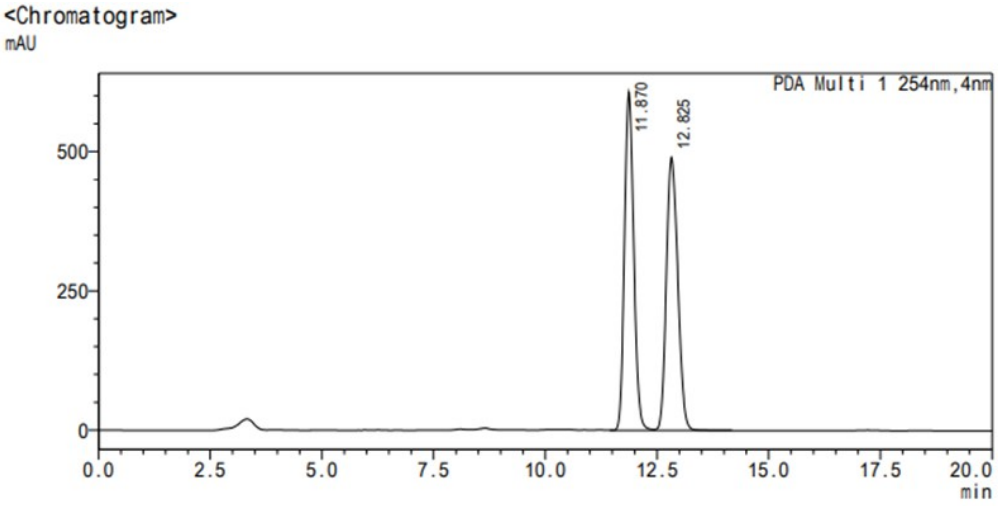
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 28.142 | 22453 | 5.994 | 1262810 | 5.241 |
| 2 | 30.093 | 352118 | 94.006 | 22832790 | 94.759 |
| Total | | 374571 | 100.000 | 24095600 | 100.000 |

**(*S*)-2-([1,1'-Biphenyl]-4-yl)butanenitrile (2b)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2b** as a white solid (31.8 mg, 72% yield) with 90% ee. m.p. 76-77 °C; $[\alpha]_D^{20}$ = -17.2 (c 0.52, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.60 (t, *J* = 8.1 Hz, 4H), 7.47 – 7.35 (m, 5H), 3.79 (t, *J* = 7.2 Hz, 1H), 1.98 (m, 2H) 1.12 (t, *J* = 7.4 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.0, 140.3, 134.7, 128.8, 127.7, 127.7, 127.6, 127.1, 120.7, 38.6, 29.2, 11.5. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{18}H_{15}N$: 221.1204 $C_{16}H_{15}N$: 221.1204, found 221.1197. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 90/10, flow rate 0.5 mL/min, 254 nm): $t_r$ = 17.9 min (major), $t_r$ = 22.2 min (minor).

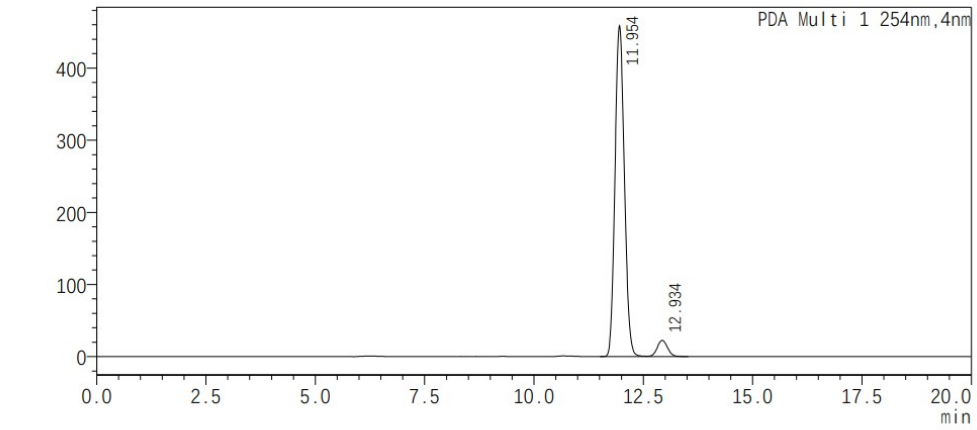
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 11.870 | 606781 | 55.340 | 8771219 | 50.086 |
| 2 | 12.825 | 489681 | 44.660 | 8741246 | 49.914 |
| Total | | 1096461 | 100.000 | 17512465 | 100.000 |

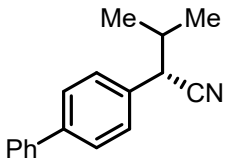
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 11.954 | 458631 | 95.329 | 6850979 | 94.889 |
| 2 | 12.934 | 22474 | 4.671 | 368997 | 5.111 |
| Total | | 481105 | 100.000 | 7219976 | 100.000 |

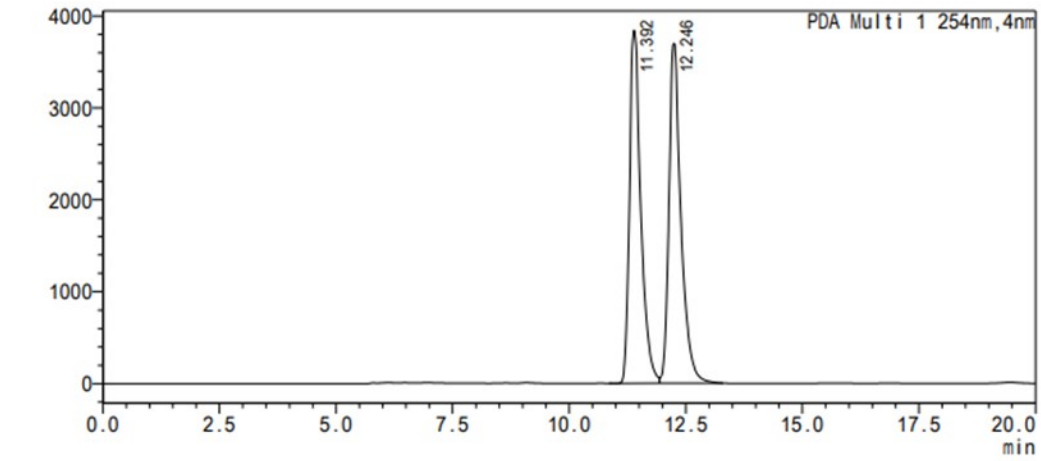
**(*S*)-2-([1,1'-Biphenyl]-4-yl)-3-methylbutanenitrile (2c)**



Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2c** as a white solid (37.4 mg, 80% yield) with 86% ee. m.p. 56-57 °C; $[\alpha]_D^{20}$ = -15.4 (c 0.54, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.62 (s, 1H), 7.61 – 7.57 (m, 3H), 7.46 (t, *J* = 7.5 Hz, 2H), 7.38 (d, *J* = 8.5 Hz, 3H), 3.71 (d, *J* = 6.2 Hz, 1H), 2.18 (m, *J* = 6.7 Hz, 1H), 1.10 (d, *J* = 6.8 Hz, 1H), 1.08 (d, *J* = 6.7 Hz, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 140.9, 140.3, 133.9, 128.8, 128.3, 127.6, 127.5, 127.0, 119.8, 44.8, 33.8, 20.8, 18.8. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{17}H_{17}N$: 235.1361, found 235.1358. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 90/10, flow rate 0.5 mL/min, 254 nm): $t_r$ = 11.1 min (major), $t_r$ = 12.0 min (minor).

.

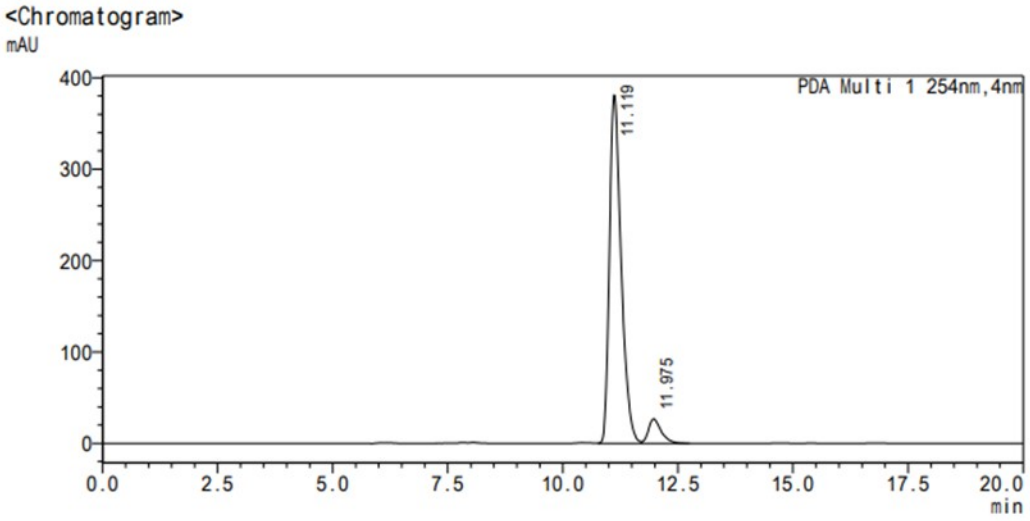
<Chromatogram>




<Peak Table>

PDA Ch1 254nm

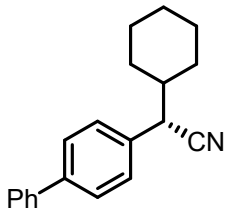
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 11.392 | 3838098 | 50.944 | 64821770 | 49.434 |
| 2 | 12.246 | 3695837 | 49.056 | 66306370 | 50.566 |
| Total | | 7533935 | 100.000 | 131128140 | 100.000 |




<Peak Table>
PDA Ch1 254nm

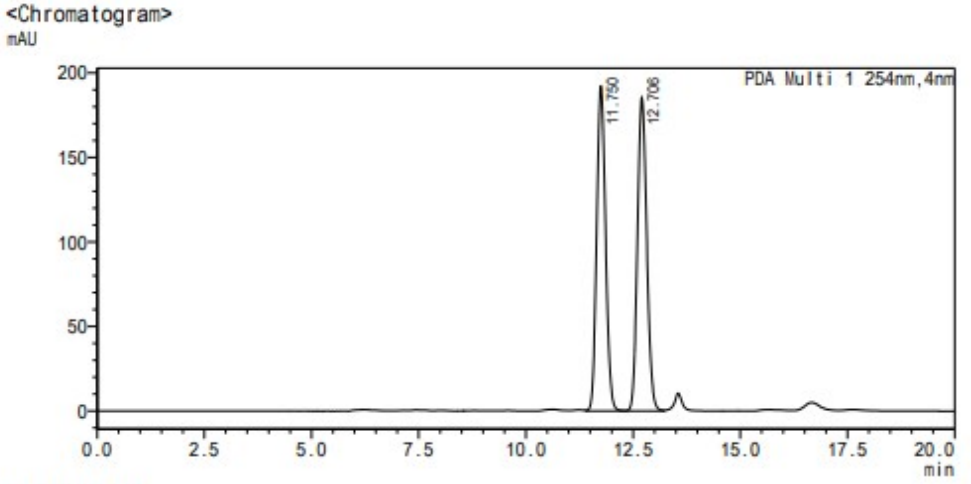
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 11.119 | 380872 | 93.434 | 6756406 | 92.887 |
| 2 | 11.975 | 26768 | 6.566 | 517395 | 7.113 |
| Total | | 407640 | 100.000 | 7273802 | 100.000 |

**(*S*)-2-([1,1'-Biphenyl]-4-yl)-2-cyclohexylacetonitrile (2d)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2d** as a white solid (19.3 mg, 35% yield) with 94% ee. m.p. 146.8-146.9 °C; $[\alpha]_D^{20}$ = -4.7 (c 0.46, $CHCl_3$); $^1$**H NMR** (400 MHz, $CDCl_3$) δ 7.64 – 7.55 (m, 4H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.40 – 7.31 (m, 3H), 3.68 (d, *J* = 6.6 Hz, 1H), 1.89 (m, 1H), 1.83 – 1.65 (m, 6H), 1.21 (m, 4H). $^{13}$**C NMR** (101 MHz, $CDCl_3$) δ 140.9, 133.7, 128.8, 128.8, 128.4, 127.5, 127.5, 127.1, 120.1, 44.0, 42.8, 31.3, 29.6, 26.0, 25.8, 25.8. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{20}H_{21}N$: 275.1674, found 275.1672. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 90/10, flow rate 0.5 mL/min, 254 nm): $t_r$ = 11.6 min (major), $t_r$ = 12.7 min (minor).

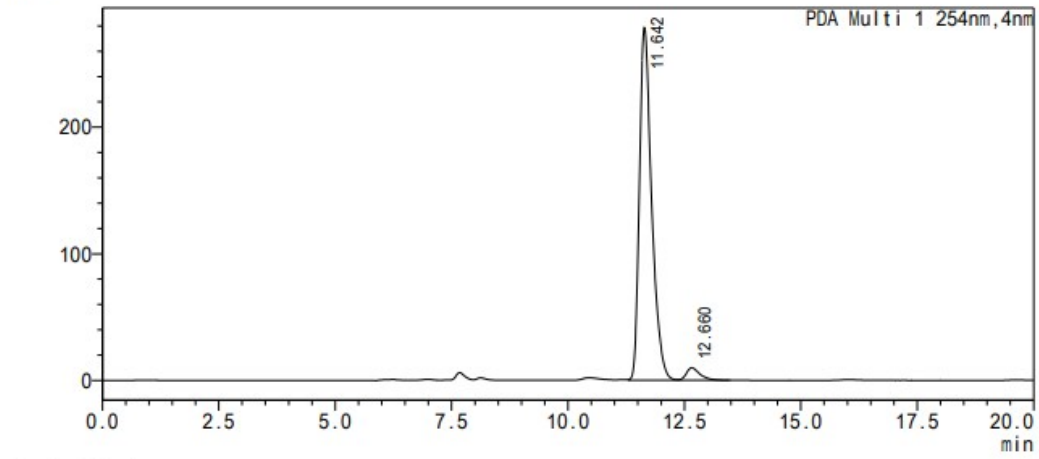
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 11.750 | 192095 | 50.898 | 2774981 | 49.664 |
| 2 | 12.706 | 185318 | 49.102 | 2812584 | 50.336 |
| Total | | 377413 | 100.000 | 5587565 | 100.000 |

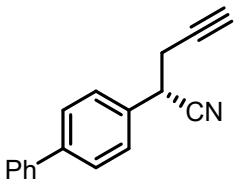
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

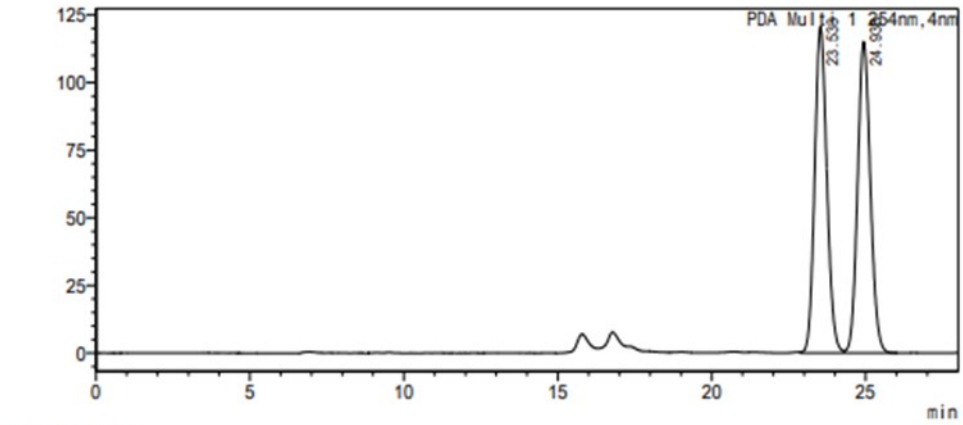
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 11.642 | 278578 | 96.566 | 5086497 | 96.183 |
| 2 | 12.660 | 9906 | 3.434 | 201875 | 3.817 |
| Total | | 288483 | 100.000 | 5288372 | 100.000 |

**(*S*)-2-([1,1'-Biphenyl]-4-yl)pent-4-ynenitrile (2e)**



Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2e** as a white solid (24.5 mg, 53% yield) with 90% ee. m.p. 65-66 °C; $[\alpha]_D^{20}$ = -15.7 (c 0.52, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.66 – 7.60 (m, 4H), 7.48 (m, 4H), 7.42 – 7.38 (m, 1H), 4.09 (t, *J* = 7.0 Hz, 1H), 2.93 – 2.80 (m, 2H), 2.22 (t, *J* = 2.6 Hz, 1H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.7, 140.1, 133.1, 128.9, 127.8, 127.8, 127.7, 127.1, 119.4, 78.5, 72.5, 36.6, 25.9. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{17}H_{13}N$: 231.1048, found 231.1044. HPLC (Daicel Chiralpak IG column, hexane/isopropanol = 90/10, flow rate 0.5 mL/min, 254 nm): $t_r$ = 22.6 min (major), tR = 24.0 min (minor).

<Chromatogram>

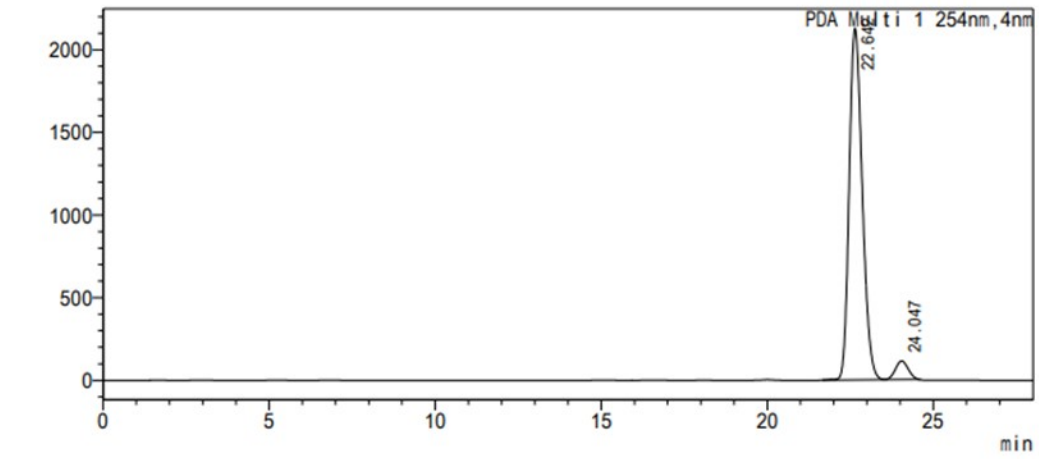



<Peak Table>

PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 23.533 | 120532 | 51.187 | 3321044 | 49.984 |
| 2 | 24.938 | 114943 | 48.813 | 3323117 | 50.016 |
| Total | | 235475 | 100.000 | 6644160 | 100.000 |

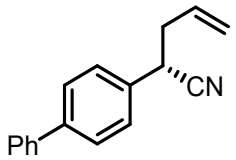
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

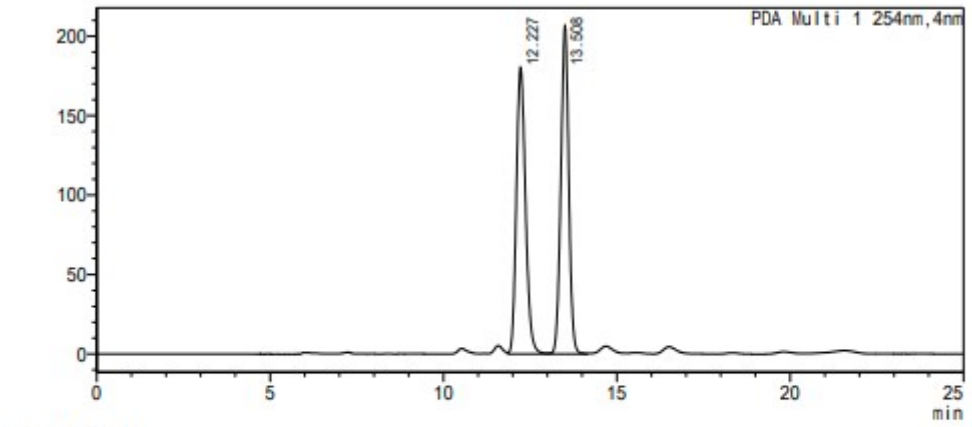
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 22.642 | 2126298 | 94.981 | 58160528 | 95.078 |
| 2 | 24.047 | 112353 | 5.019 | 3010885 | 4.922 |
| Total | | 2238651 | 100.000 | 61171412 | 100.000 |

**(*S*)-2-([1,1'-Biphenyl]-4-yl)pent-4-enenitrile (2f)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2f** as a white solid (19.1 mg, 41% yield) with 90% ee. m.p. 92.1-92.7 °C; $[\alpha]_D^{20}$ = -18.8 (c 0.5, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.60 (t, *J* = 9.1 Hz, 4H), 7.42 (m, 5H), 5.84 (td, *J* = 17.3, 7.0 Hz, 1H), 5.24-5.20 (m, 3H), 3.90 (t, *J* = 7.2 Hz, 1H), 2.69 (m, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.2, 140.2, 134.1, 132.6, 128.9, 127.7, 127.7 127.6, 127.1, 120.2, 119.5, 39.8, 37.2. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{17}H_{15}N$: 233.1204, found 233.1201. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 90/10, flow rate 0.5 mL/min, 254 nm): $t_r$ = 12.1 min (major), $t_r$ = 13.4 min (minor).

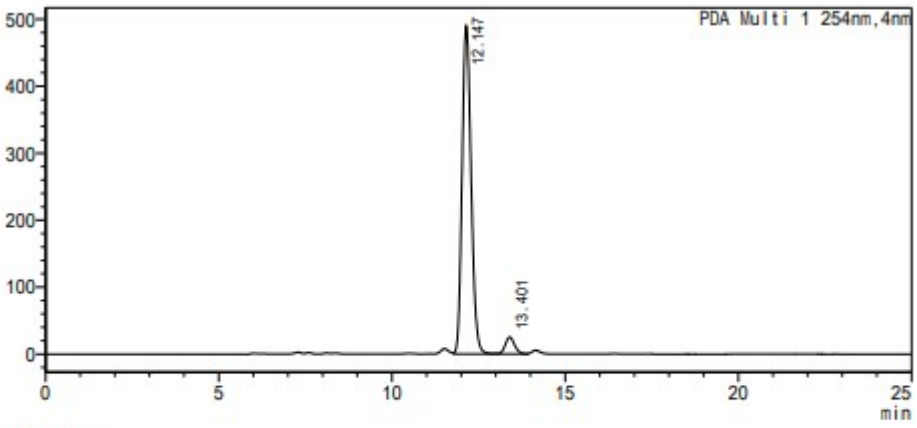
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 12.227 | 180278 | 46.644 | 3318679 | 50.370 |
| 2 | 13.508 | 206222 | 53.356 | 3269897 | 49.630 |
| Total | | 386500 | 100.000 | 6588576 | 100.000 |

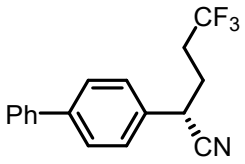
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 12.147 | 489542 | 95.099 | 8894080 | 94.889 |
| 2 | 13.401 | 25227 | 4.901 | 479059 | 5.111 |
| Total | | 514769 | 100.000 | 9373139 | 100.000 |

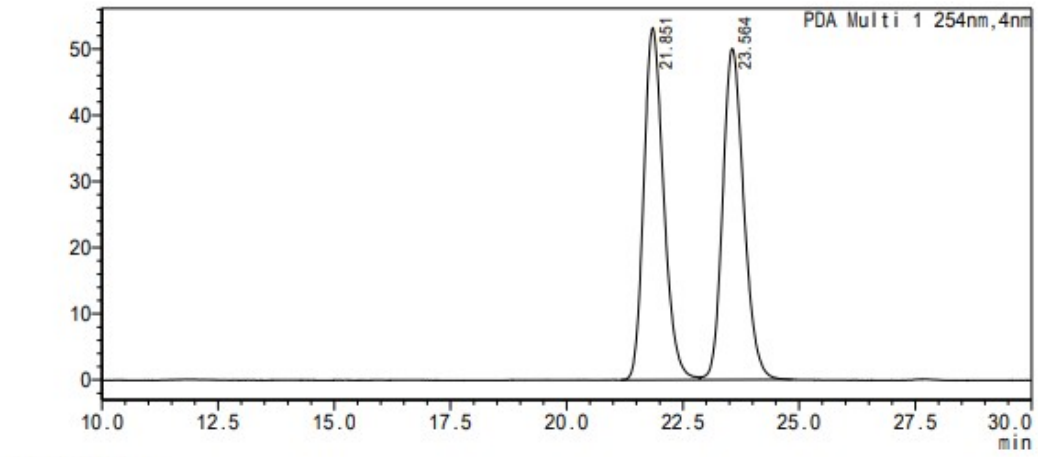
**(*S*)-2-([1,1'-Biphenyl]-4-yl)-5,5,5-trifluoropentanenitrile (2g)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2g** as a white solid

(40.5 mg, 70% yield) with 93% ee. m.p. 110.1-110.3 °C; $[\alpha]_D^{20}$ = -14.5 (c 0.54, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.68 – 7.56 (m, 4H), 7.51 – 7.32 (m, 5H), 3.96 (t, *J* = 7.2 Hz, 1H), 2.40 – 2.16 (m, 4H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.8, 140.0, 133.0, 128.9, 128.1, 127.8, 127.6, 127.1, 126.4 (q, $^1J_{C\text{-}F}$ = 276.3 Hz), 119.5, 35.9, 31.2 (q, $^2J_{C\text{-}F}$ = 29.4 Hz), 28.2 (q, $^3J_{C\text{-}F}$ = 2.9 Hz). **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -66.01. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{17}H_{14}F_3N$: 289.1078, found 289.1072. HPLC (Daicel Chiralpak IC column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 254 nm): $t_r$ = 21.9 min (minor), $t_r$ = 23.6 min (major).

<Chromatogram>

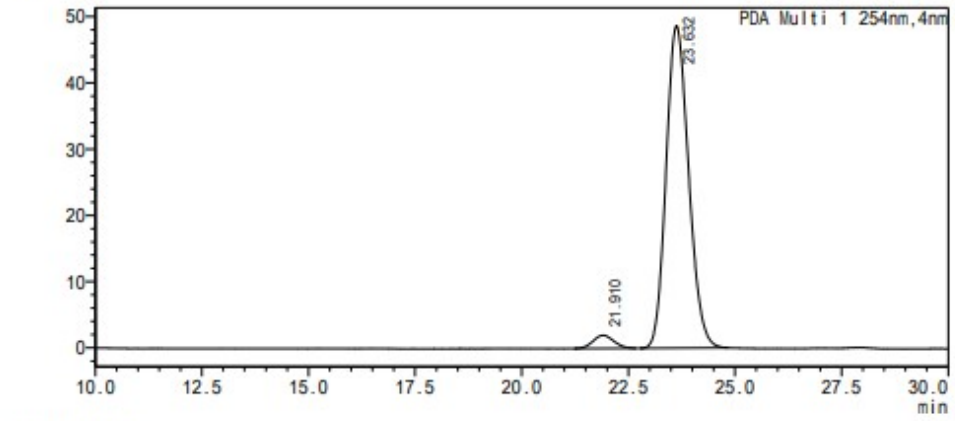



<Peak Table>

PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 21.851 | 53166 | 51.516 | 1580221 | 49.983 |
| 2 | 23.564 | 50037 | 48.484 | 1581309 | 50.017 |
| Total | | 103203 | 100.000 | 3161530 | 100.000 |

<Chromatogram>

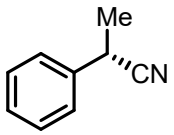



<Peak Table>

PDA Ch1 254nm

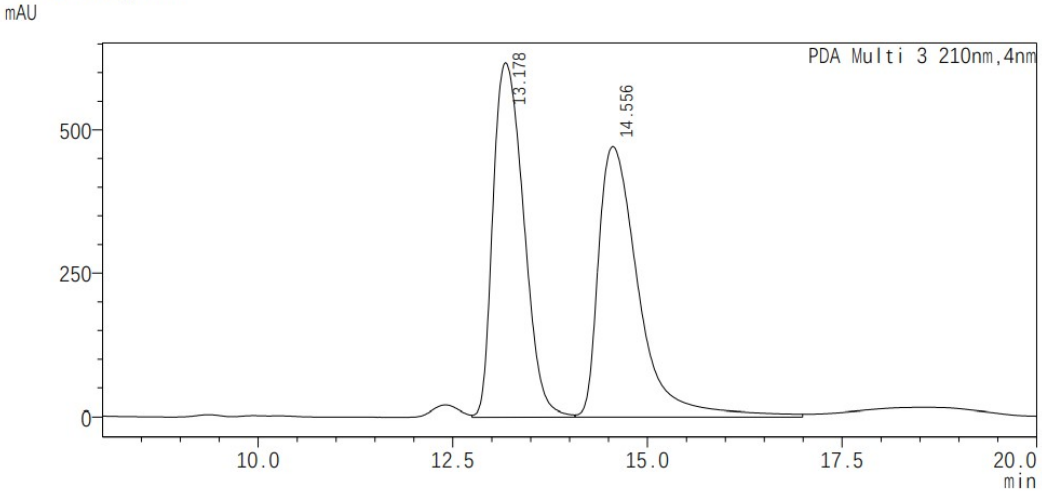
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 21.910 | 1982 | 3.915 | 67041 | 3.613 |
| 2 | 23.632 | 48652 | 96.085 | 1788578 | 96.387 |
| Total | | 50634 | 100.000 | 1855619 | 100.000 |

**(*S*)-2-Phenylpropanenitrile (2h)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2h** as a yellow liquid (23.3 mg, 89% yield) with 85% ee; $[\alpha]_D^{20}$ = -3.5 (c 0.47, $CHCl_3$); $^1$**H NMR** (400 MHz, $CDCl_3$) δ 7.43 – 7.30 (m, 5H), 3.90 (q, *J* = 7.2 Hz, 1H), 1.61 (d, *J* = 7.2 Hz, 3H). $^{13}$**C NMR** (101 MHz, $CDCl_3$) δ 137.0, 129.0, 127.9, 126.6, 121.5, 31.1, 21.3. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_9H_9N$: 131.0735, found 131.0730. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 210 nm): $t_r$ = 13.1 min (major), $t_r$ = 14.6 min (minor).

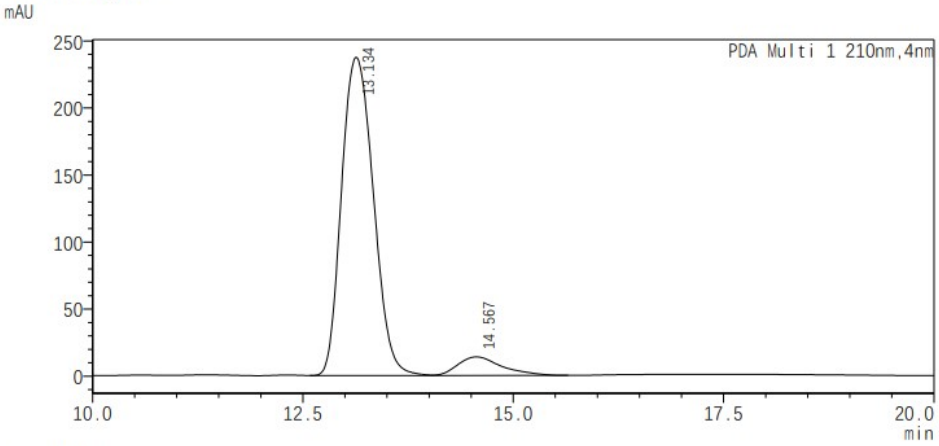
<Chromatogram>




<Peak Table>
PDA Ch3 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 13.178 | 617520 | 56.718 | 16904546 | 49.985 |
| 2 | 14.556 | 471226 | 43.282 | 16914771 | 50.015 |
| Total | | 1088746 | 100.000 | 33819317 | 100.000 |

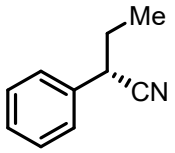
<Chromatogram>



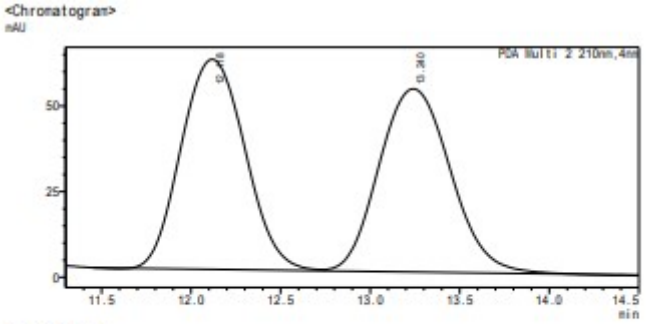

<Peak Table>
PDA Ch1 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 13.134 | 237263 | 94.482 | 6259743 | 92.550 |
| 2 | 14.567 | 13856 | 5.518 | 503909 | 7.450 |
| Total | | 251119 | 100.000 | 6763651 | 100.000 |

**(*S*)-2-Phenylbutanenitrile (2i)**

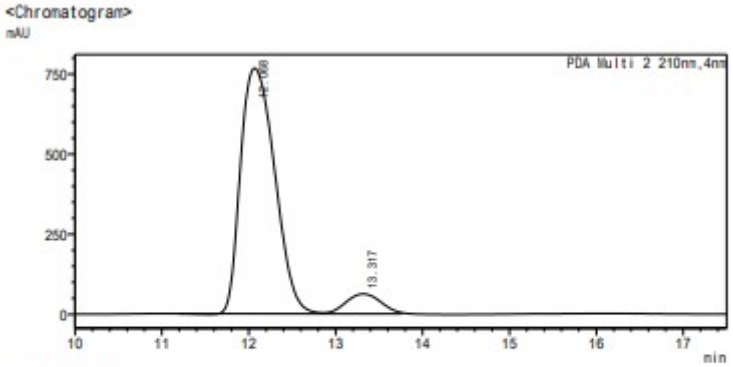


Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2i** as a yellow liquid (19.4 mg, 67% yield) with 85% ee; $[\alpha]_D^{20}$ = -28.7 (c 0.49, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.43 – 7.35 (m, 2H), 7.35 – 7.29 (m, 3H), 3.74 (t, *J* = 7.2 Hz, 1H), 1.99 – 1.90 (m, 2H), 1.08 (t, *J* = 7.4 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 135.7, 129.0, 128.0, 127.3, 120.7, 38.9, 29.2, 11.4. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{10}H_{11}N$: 145.0891, found 145.0885. HPLC (Daicel Chiralpak AS-H column, exane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 210 nm): $t_r$ = 12.1 min (major), $t_r$ = 13.3 min (minor).




<Peak Table>
PDA Ch2 210nm

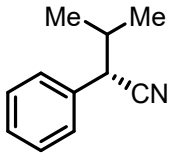
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 12.118 | 61365 | 53.419 | 1522990 | 50.710 |
| 2 | 13.240 | 53510 | 46.581 | 1480358 | 49.290 |
| Total | | 114874 | 100.000 | 3003348 | 100.000 |




<Peak Table>
PDA Ch2 210nm

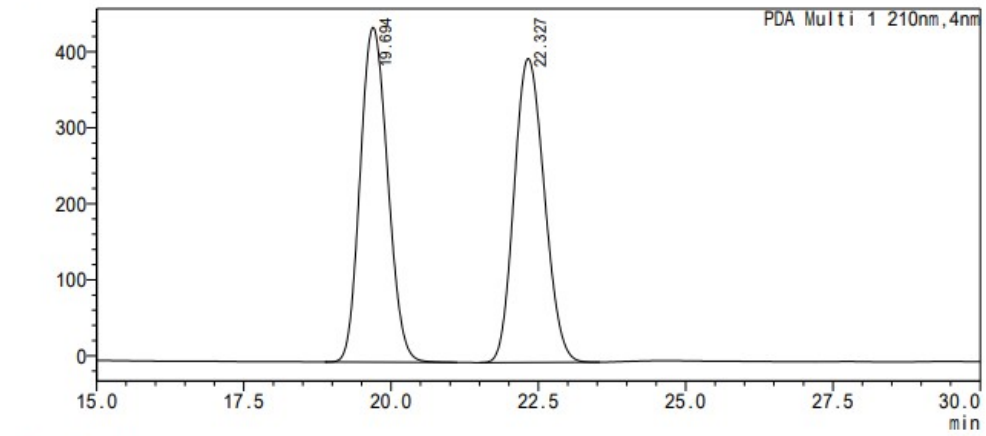
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 12.068 | 766705 | 92.514 | 20980989 | 92.348 |
| 2 | 13.317 | 62040 | 7.486 | 1738450 | 7.652 |
| Total | | 828745 | 100.000 | 22719439 | 100.000 |

**(*S*)-3-Methyl-2-phenylbutanenitrile (2j)**



Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2j** as a yellow liquid (16.2 mg, 51% yield) with 85% ee; $[\alpha]_D^{20}$ = -8.9 (c 0.45, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.40 – 7.26 (m, 5H), 3.66 (t, *J* = 6.3 Hz, 1H), 2.13 (m, 2H), 1.05 (t, *J* = 7.9 Hz, 6H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 134.9, 128.8, 127.9, 119.8, 45.1, 33.8, 20.8, 18.8. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{11}H_{13}N$: 159.1048, found 159.1044. HPLC (Daicel Chiralpak IC column, exane/isopropanol = 99/1, flow rate 0.5 mL/min, 210 nm): $t_r$ = 20.3 min (minor), $t_r$ = 23.2 min (major).

<Chromatogram>

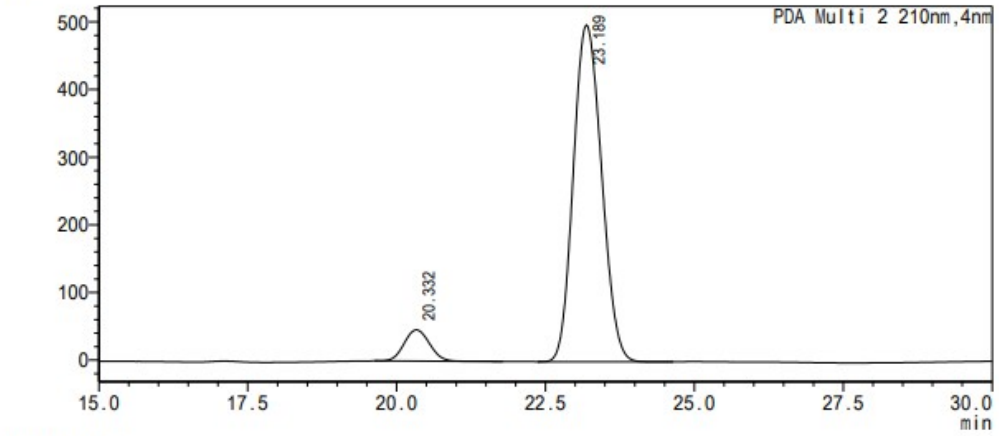



<Peak Table>

PDA Ch1 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 19.694 | 440228 | 52.405 | 14295978 | 50.020 |
| 2 | 22.327 | 399815 | 47.595 | 14284491 | 49.980 |
| Total | | 840042 | 100.000 | 28580469 | 100.000 |

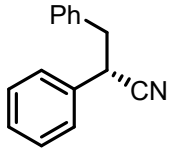
<Chromatogram>




<Peak Table>
PDA Ch2 210nm

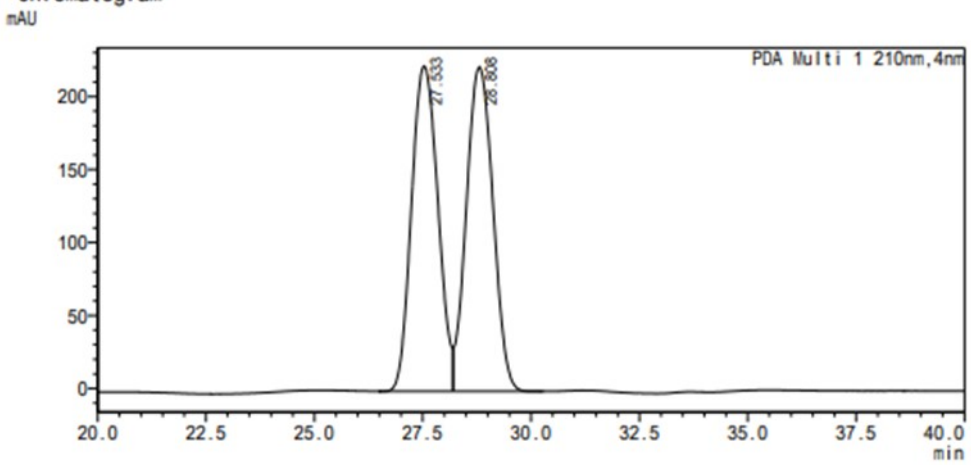
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 20.332 | 46165 | 8.492 | 1366632 | 7.691 |
| 2 | 23.189 | 497454 | 91.508 | 16403661 | 92.309 |
| Total | | 543619 | 100.000 | 17770293 | 100.000 |

**(*S*)-2,3-Diphenylpropanenitrile (2k)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2k** as a white solid (22.0 mg, 53% yield) with 84% ee. m.p. 57-58 °C; $[\alpha]_D^{20}$ = -4.4 (c 0.53, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.41 – 7.23 (m, 8H), 7.15 (d, *J* = 8.1 Hz, 2H), 4.01 (t, *J* = 7.4 Hz, 1H), 3.17 (m, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 136.3, 135.2, 129.19, 129.0, 128.6, 128.2, 127.5, 127.4, 120.3, 42.2, 39.8. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{15}H_{13}N$: 207.1048, found 207.1045. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 210 nm): $t_r$ = 27.5 min (major), $t_r$ = 28.6 min (minor).

<Chromatogram>

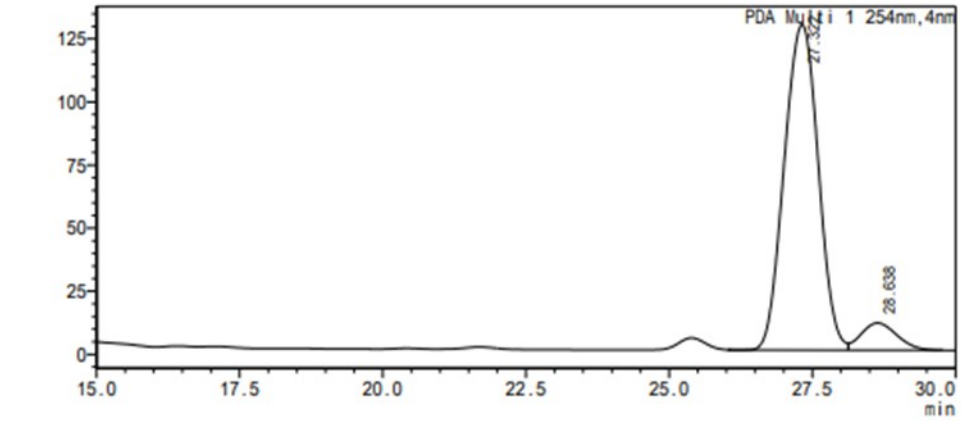



<Peak Table>

PDA Ch1 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 27.533 | 222713 | 50.053 | 9439585 | 49.821 |
| 2 | 28.808 | 222238 | 49.947 | 9507514 | 50.179 |
| Total | | 444951 | 100.000 | 18947099 | 100.000 |

<Chromatogram>

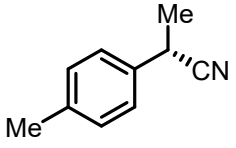



<Peak Table>

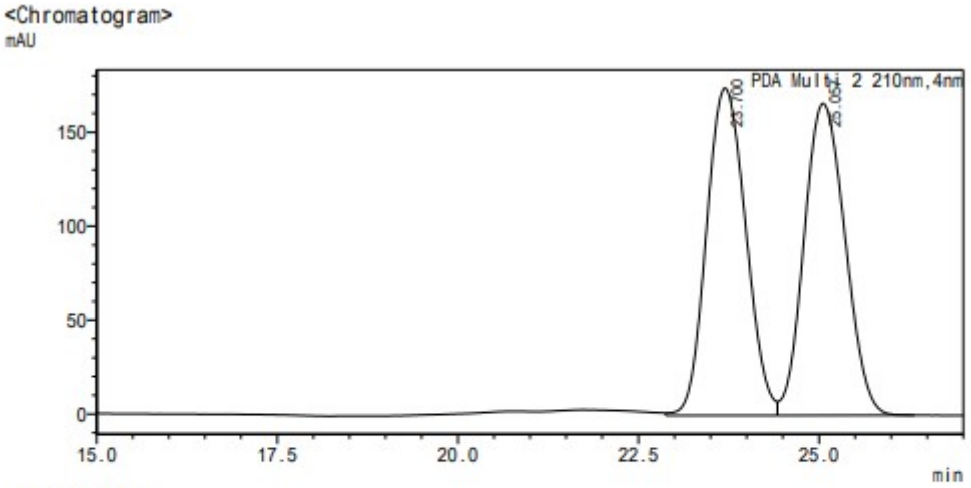
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 27.322 | 128961 | 92.314 | 5321932 | 91.931 |
| 2 | 28.638 | 10738 | 7.686 | 467098 | 8.069 |
| Total | | 139698 | 100.000 | 5789030 | 100.000 |

**(*S*)-2-(*p*-Tolyl)propanenitrile (2l)**



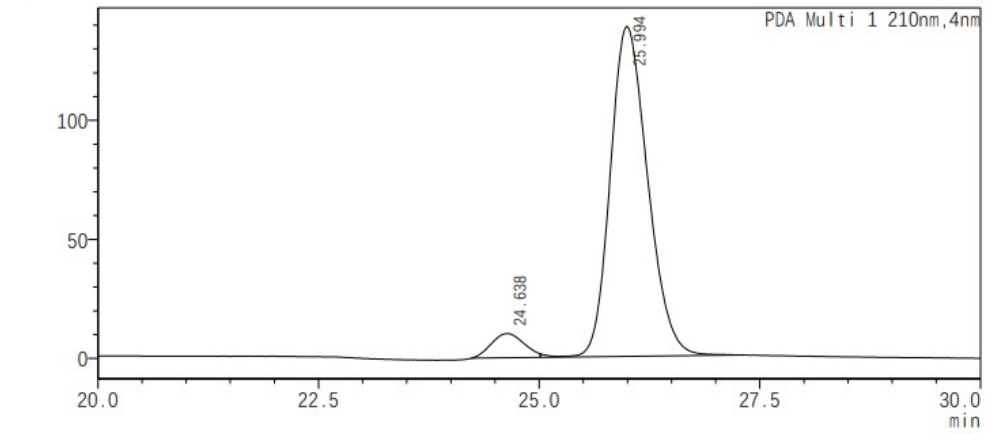
Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2l** as a yellow liquid (17.4 mg, 60% yield) with 88% ee; $[\alpha]_D^{20}$ = -18.5 (c 0.25, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.26 – 7.18 (m, 2H), 7.19 (d, *J* = 8.0 Hz, 2H), 3.86 (q, *J* = 7.3 Hz, 1H), 2.35 (s, 3H), 1.62 (d, *J* = 7.2 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 137.8, 134.1, 129.7, 126.5, 121.7, 30.8, 21.5, 21.0. HRMS (EI): m/z: $[M]^+$ Calcd for $C_{10}H_{11}N$: 145.0891, found 145.0886. HPLC (Daicel Chiralpak IE column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 210 nm): $t_r$ = 24.6 min (minor), $t_r$= 26.0 min (major).




<Peak Table>
PDA Ch2 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 23.700 | 174205 | 51.210 | 6595560 | 50.173 |
| 2 | 25.057 | 165975 | 48.790 | 6550034 | 49.827 |
| Total | | 340180 | 100.000 | 13145594 | 100.000 |

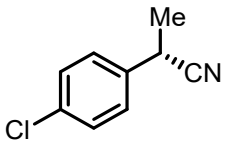
<Chromatogram>




<Peak Table>
PDA Ch1 210nm

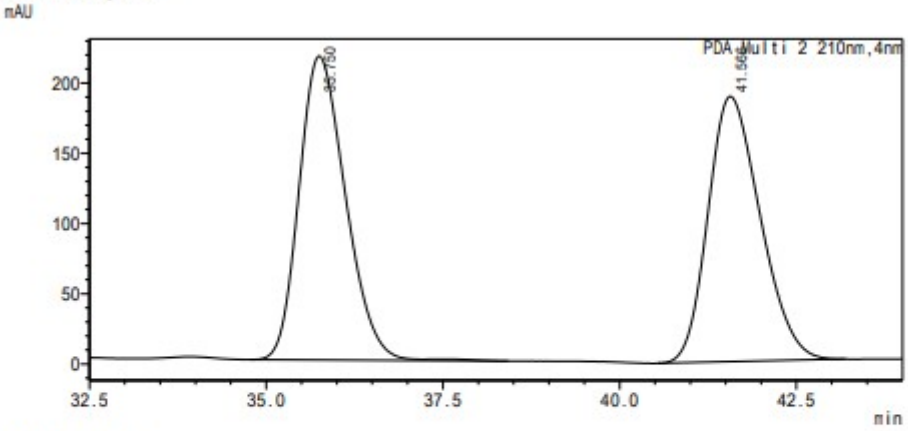
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 24.638 | 10160 | 6.832 | 261169 | 5.998 |
| 2 | 25.994 | 138563 | 93.168 | 4093210 | 94.002 |
| Total | | 148724 | 100.000 | 4354379 | 100.000 |

**(*S*)-2-(4-Chlorophenyl)propanenitrile (2m)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2m** as a yellow liquid (23.1 mg, 70% yield) with 88% ee; $[\alpha]_D^{20}$ = -19.5 (c 0.59, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.39 – 7.33 (m, 2H), 7.31 – 7.27 (m, 2H), 3.88 (q, *J* = 7.3 Hz, 1H), 1.63 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 135.5, 134.0, 129.3, 128.1, 121.1, 30.7, 21.3. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_9H_8ClN$: 165.0345, found 165.0340. HPLC (Daicel Chiralpak OJ-H column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 210 nm): $t_r$ = 34.5 min (minor), $t_r$ = 39.7 min (major).

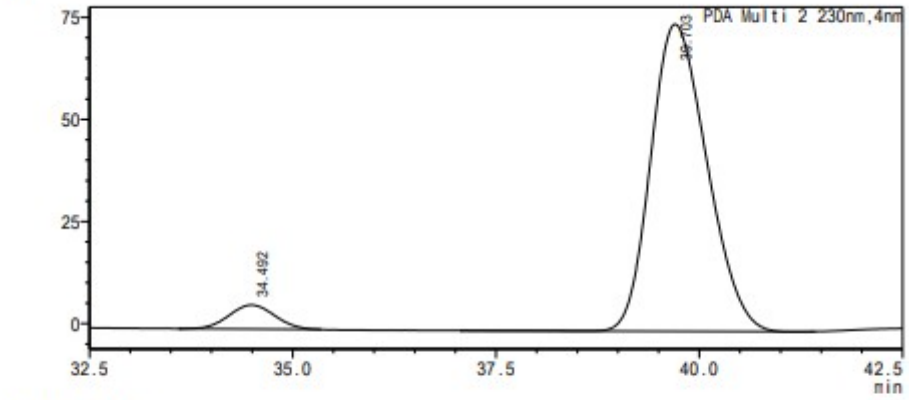
<Chromatogram>




<Peak Table>
PDA Ch2 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 35.750 | 216261 | 53.396 | 9906803 | 50.501 |
| 2 | 41.566 | 188755 | 46.604 | 9710397 | 49.499 |
| Total | | 405016 | 100.000 | 19617200 | 100.000 |

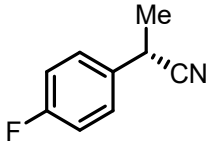
<Chromatogram>




<Peak Table>
PDA Ch2 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 34.492 | 5884 | 7.258 | 229950 | 5.998 |
| 2 | 39.703 | 75189 | 92.742 | 3603722 | 94.002 |
| Total | | 81073 | 100.000 | 3833672 | 100.000 |

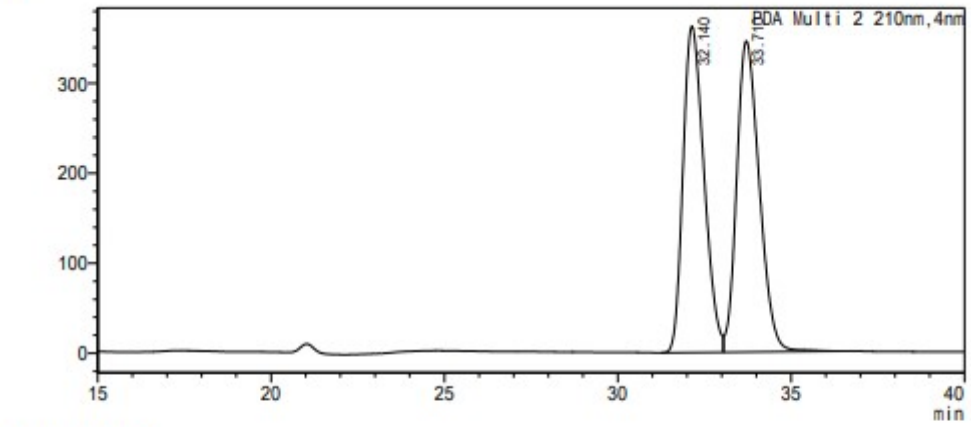
**(*S*)-2-(4-Fluorophenyl)propanenitrile (2n)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2n** as a yellow liquid (12.0 mg, 40% yield) with 81% ee; $[\alpha]_D^{20}$ = -12.5 (c 0.25, $CHCl_3$); **$^1$H NMR** (400 MHz,

$CDCl_3$) δ 7.38 – 7.28 (m, 2H), 7.13 – 7.00 (m, 2H), 3.89 (q, $J$ = 7.3 Hz, 1H), 1.63 (d, $J$ = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 162.4 (d, $^{1}J_{C\text{-}F}$ = 247.3 Hz), 132.8 (d, $^{4}J_{C\text{-}F}$ = 3.6 Hz), 128.4 (d, $^{3}J_{C\text{-}F}$ = 8.0 Hz), 121.4, 116.1 (d, $^{2}J_{C\text{-}F}$ = 22.5 Hz), 30.6, 21.5; **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -113.88. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_9H_8FN$: 149.0641, found 149.0634. HPLC (Daicel Chiralpak OJ-H column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 210 nm): $t_r$ = 32.0 min (minor), $t_r$ = 33.3 min (major).

<Chromatogram>

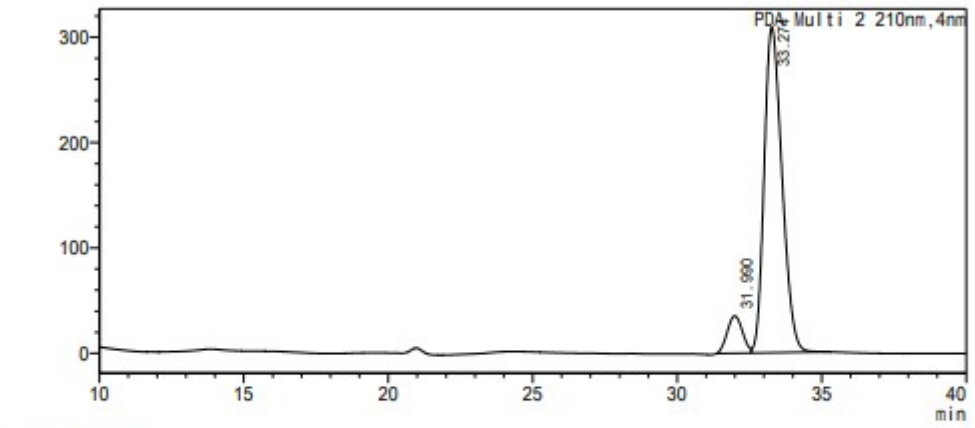



<Peak Table>

PDA Ch2 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 32.140 | 362610 | 51.202 | 15257503 | 49.307 |
| 2 | 33.710 | 345592 | 48.798 | 15686181 | 50.693 |
| Total | | 708202 | 100.000 | 30943684 | 100.000 |

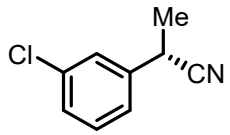
<Chromatogram>




<Peak Table>
PDA Ch2 210nm

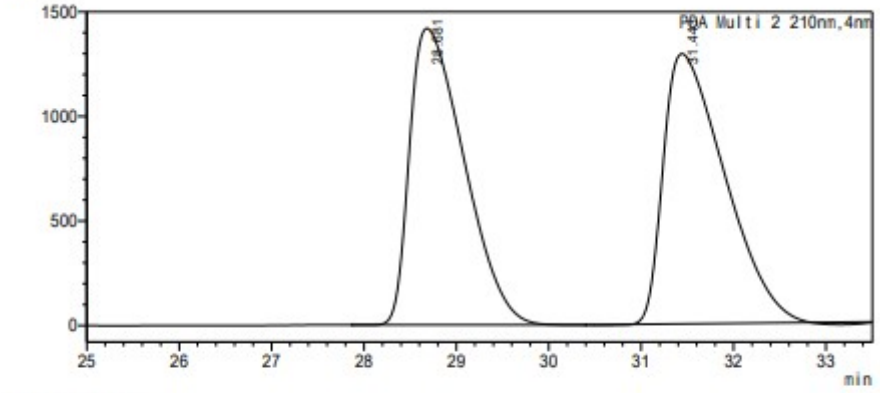
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 31.990 | 35482 | 10.301 | 1304718 | 8.948 |
| 2 | 33.274 | 308962 | 89.699 | 13276091 | 91.052 |
| Total | | 344443 | 100.000 | 14580809 | 100.000 |

**(*S*)-2-(3-Chlorophenyl)propanenitrile (2o)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2o** as a yellow liquid (13.2 mg, 40% yield) with 90% ee; $[\alpha]_D^{20}$ = -19.3 (c 0.50, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.35 (t, *J* = 2.1 Hz, 1H), 7.34 – 7.27 (m, 2H), 7.27 – 7.24 (m, 1H), 3.88 (q, *J* = 7.3 Hz, 1H), 1.65 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 138.9, 135.0, 130.4, 128.4, 127.0, 124.9, 120.9, 30.9, 21.2. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_9H_8ClN$: 165.0345, found 165.0343. HPLC (Daicel Chiralpak OJ-H column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 210 nm): $t_r$ = 27.8 min (major), $t_r$ = 30.5 min (minor).

<Chromatogram>

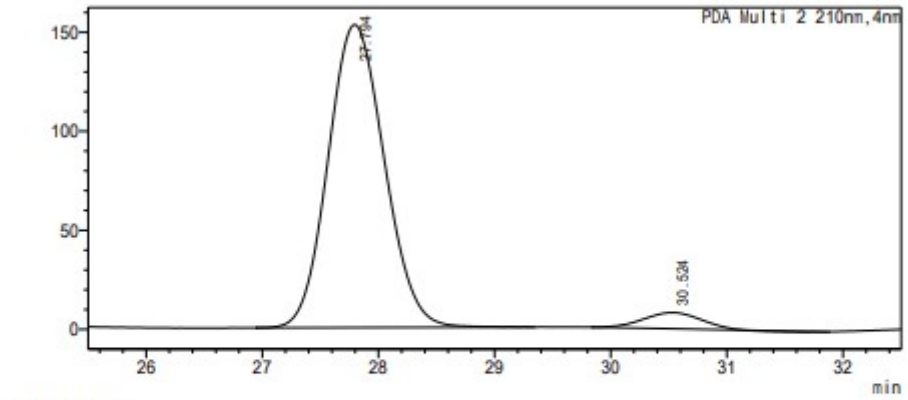



<Peak Table>

PDA Ch2 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 28.681 | 1418097 | 52.322 | 58124104 | 49.452 |
| 2 | 31.443 | 1292223 | 47.678 | 59412571 | 50.548 |
| Total | | 2710320 | 100.000 | 117536675 | 100.000 |

<Chromatogram>

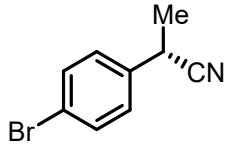



<Peak Table>

PDA Ch2 210nm

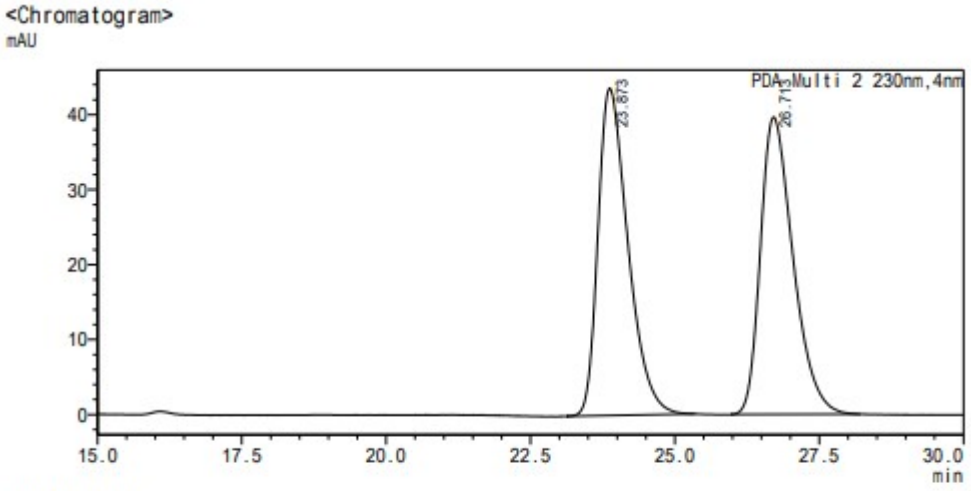
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 27.794 | 152894 | 94.947 | 5156324 | 94.999 |
| 2 | 30.524 | 8136 | 5.053 | 271436 | 5.001 |
| Total | | 161030 | 100.000 | 5427760 | 100.000 |

**(*S*)-2-(4-Bromophenyl)propanenitrile (2p)**



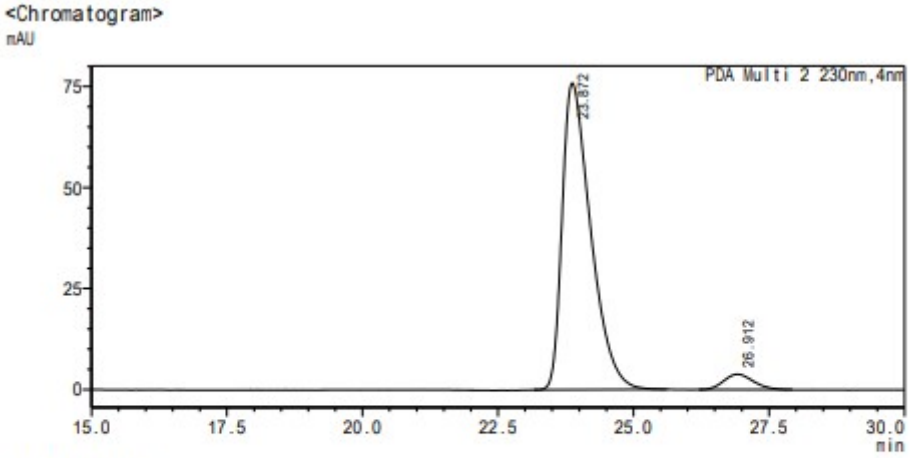

Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2p** as a yellow liquid (21.3 mg, 51% yield) with 90% ee; $[\alpha]_D^{20}$ = -12.6 (c 0.48, $CHCl_3$); $^1$**H NMR** (400 MHz,

$CDCl_3$) δ 7.56 – 7.48 (m, 2H), 7.26 – 7.18 (m, 2H), 3.87 (q, *J* = 7.2 Hz, 1H), 1.63 (d, *J* = 7.3 Hz, 3H). $^{13}$**C NMR** (101 MHz, $CDCl_3$) δ 136.0, 132.3, 128.4, 122.1, 121.0, 30.8, 21.3. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_9H_8BrN$: 208.9840, found 208.9833. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 230nm): $t_r$ = 23.9 min (major), $t_r$ = 26.9 min (minor).




<Peak Table>
PDA Ch2 230nm

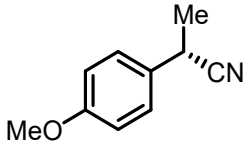
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 23.873 | 43641 | 52.387 | 1578819 | 50.296 |
| 2 | 26.713 | 39664 | 47.613 | 1560209 | 49.704 |
| Total | | 83306 | 100.000 | 3139028 | 100.000 |



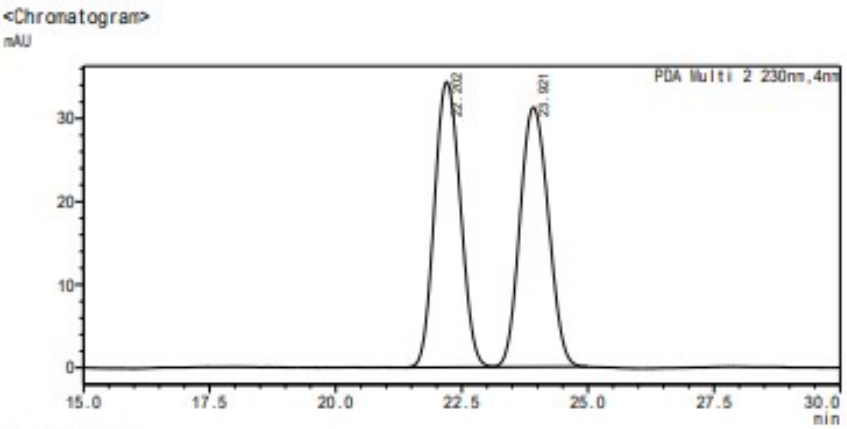

<Peak Table>
PDA Ch2 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 23.872 | 75884 | 95.222 | 2782263 | 95.018 |
| 2 | 26.912 | 3808 | 4.778 | 145886 | 4.982 |
| Total | | 79692 | 100.000 | 2928149 | 100.000 |

**(*S*)-2-(4-Methoxyphenyl)propanenitrile (2q)**



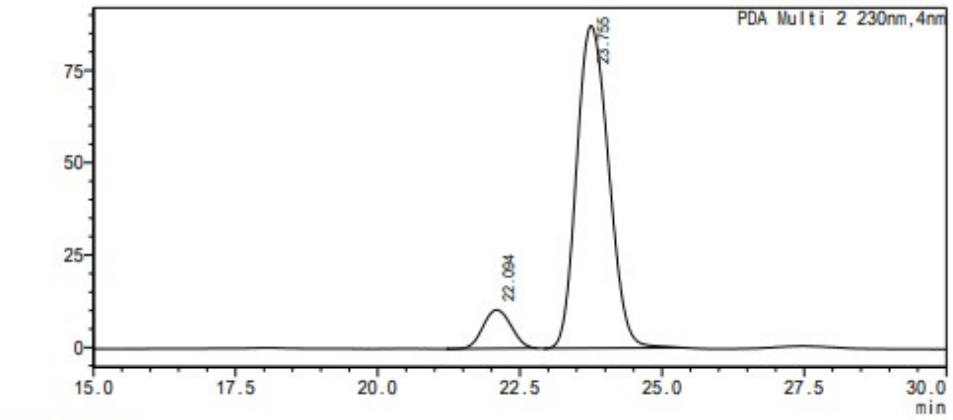

Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2q** as a yellow liquid (19.0 mg, 58% yield) with 81% ee; $[\alpha]_D^{20}$ = -9.2 (c 0.50, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.30 – 7.27 (m, 2H), 7.00 – 6.87 (m, 2H), 3.88 (q, *J* = 7.3 Hz, 1H), 3.83 (s, 3H), 1.64 (d, *J* = 7.2 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 159.3, 129.1, 127.8, 121.8, 114.5, 55.3, 30.5, 21.5. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{10}H_{11}NO$: 161.0841, found 161.0834. HPLC (Daicel Chiralpak OZ-3 column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 230 nm): $t_r$ = 22.1 min (minor), $t_r$ = 23.8 min (major).




<Peak Table>
PDA Ch2 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 22.202 | 34324 | 52.353 | 1226186 | 50.020 |
| 2 | 23.921 | 31239 | 47.647 | 1225223 | 49.980 |
| Total | | 65562 | 100.000 | 2451409 | 100.000 |

<Chromatogram>

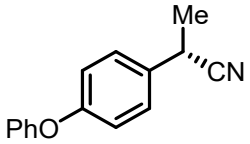



<Peak Table>

PDA Ch2 230nm

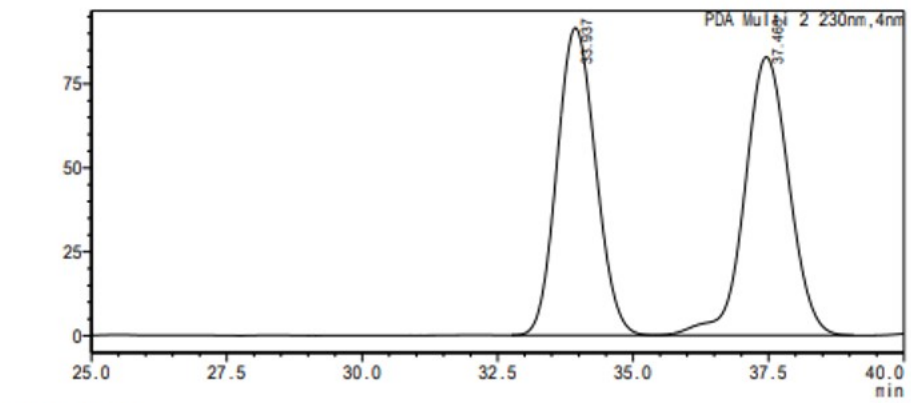
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 22.094 | 10422 | 10.669 | 358387 | 9.494 |
| 2 | 23.755 | 87269 | 89.331 | 3416608 | 90.506 |
| Total | | 97691 | 100.000 | 3774995 | 100.000 |

**(*S*)-2-(4-Phenoxyphenyl)propanenitrile (2r)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2r** as a yellow liquid (25.9 mg, 58% yield) with 88% ee; $[\alpha]_D^{20}$ = -5.9 (c 0.50, $CHCl_3$); $^1$**H NMR** (400 MHz, $CDCl_3$) δ 7.35 (q, *J* = 8.5 Hz, 3H), 7.18 – 7.07 (m, 2H), 7.02 (d, *J* = 8.6 Hz, 3H), 6.94 (d, *J* = 6.9 Hz, 1H), 3.86 (q, *J* = 7.3 Hz, 1H), 1.64 (d, *J* = 7.2 Hz, 3H). $^{13}$**C NMR** (101 MHz, $CDCl_3$) δ 158.0, 156.6, 138.9, 130.5, 129.9, 123.8, 121.3, 119.2, 118.0, 117.1, 31.1, 21.3. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{15}H_{13}NO$: 223.0997, found 223.0994. HPLC (Daicel Chiralpak IC column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 230 nm): $t_r$ = 33.9 min (minor), $t_r$ = 37.2 min (major).

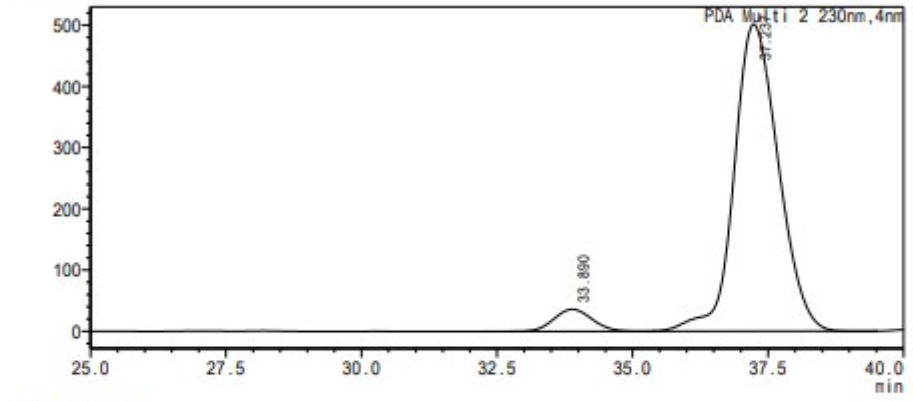
<Chromatogram>




<Peak Table>
PDA Ch2 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 33.937 | 91498 | 52.480 | 4545694 | 49.064 |
| 2 | 37.463 | 82849 | 47.520 | 4719115 | 50.936 |
| Total | | 174347 | 100.000 | 9264810 | 100.000 |

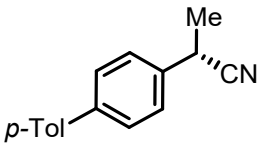
<Chromatogram>




<Peak Table>
PDA Ch2 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 33.890 | 36016 | 6.698 | 1758747 | 5.808 |
| 2 | 37.237 | 501702 | 93.302 | 28525122 | 94.192 |
| Total | | 537718 | 100.000 | 30283868 | 100.000 |

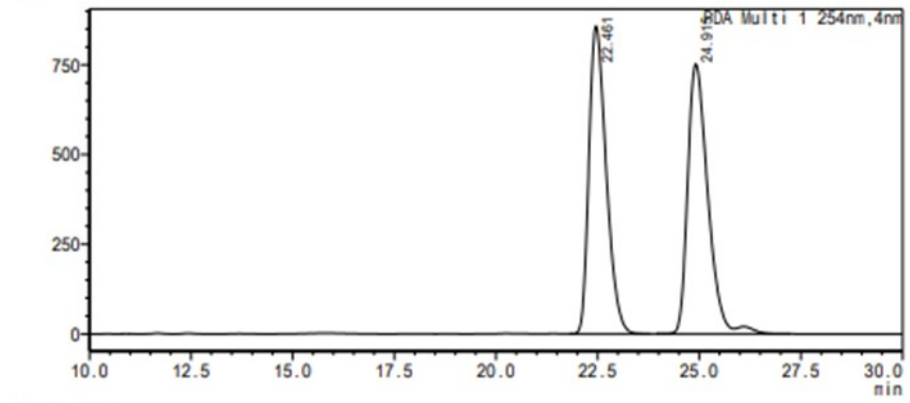
**(*S*)-2-(4'-Methyl-[1,1'-biphenyl]-4-yl)propanenitrile (2s)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2s** as a white solid (32.3mg, 73% yield) with 90% ee. m.p. 109-110 °C; $[\alpha]_D^{20}$ = -13.0 (c 0.50, $CHCl_3$); **$^1$H**

**NMR** (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 8.3 Hz, 2H), 7.47 (d, *J* = 8.2 Hz, 2H), 7.40 (d, *J* = 8.2 Hz, 2H), 7.25 (d, *J* = 6.8 Hz, 2H), 3.93 (q, *J* = 7.2 Hz, 1H), 2.39 (s, 3H), 1.67 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 133.3, 133.0, 132.8, 129.0, 127.8, 127.7, 126.7 126.4, 126.4, 124.8, 120.7, 39.0, 29.0, 11.5. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{16}H_{15}N$: 221.1204, found 221.1198. HPLC (Daicel Chiralpak IC column, hexane/isopropanol = 99/1, flow rate 1.0 mL/min, 254 nm): $t_r$ = 21.8 min (minor), $t_r$ = 24.0 min (major).

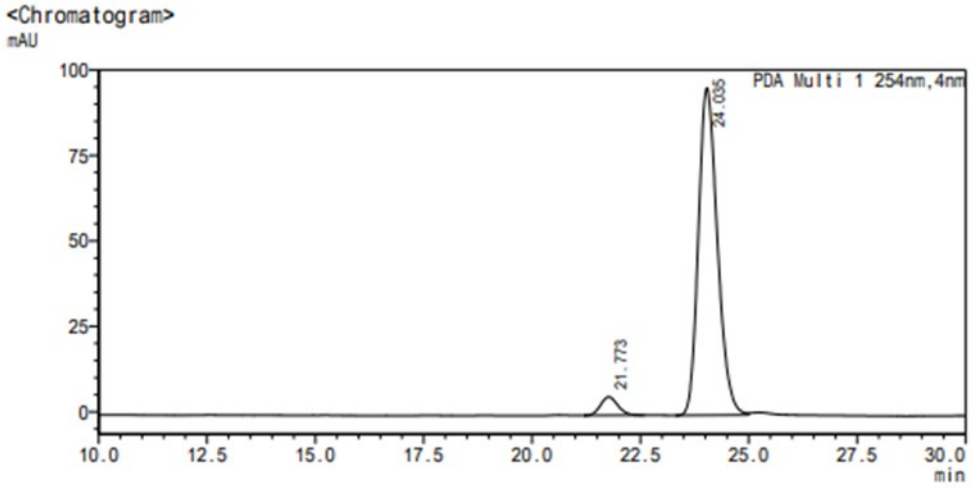
<Chromatogram>




<Peak Table>

PDA Ch1 254nm

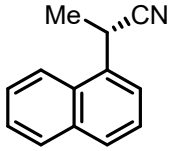
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 22.461 | 857143 | 53.274 | 25353567 | 49.321 |
| 2 | 24.915 | 751792 | 46.726 | 26051871 | 50.679 |
| Total | | 1608935 | 100.000 | 51405437 | 100.000 |




<Peak Table>
PDA Ch1 254nm

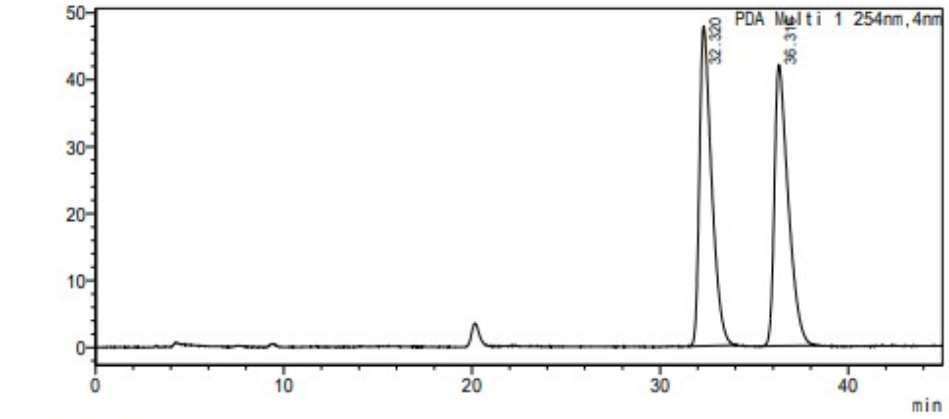
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 21.773 | 5386 | 5.329 | 149543 | 4.873 |
| 2 | 24.035 | 95679 | 94.671 | 2919371 | 95.127 |
| Total | | 101065 | 100.000 | 3068914 | 100.000 |

**(*S*)-2-(Naphthalen-1-yl)propanenitrile (2t)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2t** as a white solid (23.1 mg, 64% yield) with 94% ee. m.p. 87-88 °C; $[\alpha]_D^{20}$ = -43.0 (c 0.50, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.98 – 7.89 (m, 2H), 7.87 – 7.80 (m, 1H), 7.70 (dd, *J* = 7.2, 1.4 Hz, 1H), 7.63 – 7.42 (m, 3H), 4.63 (q, *J* = 7.2 Hz, 1H), 1.79 (d, *J* = 7.2 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 134.0, 132.7, 129.8, 129.3, 128.9, 126.9, 126.1, 125.6, 124.7, 122.1, 121.8, 28.2, 20.6. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{13}H_{11}N$: 181.0891, found 181.0884. HPLC (Daicel Chiralpak OJ-H column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 254 nm): $t_r$ = 31.3 min (major), tR = 36.2 min (minor).

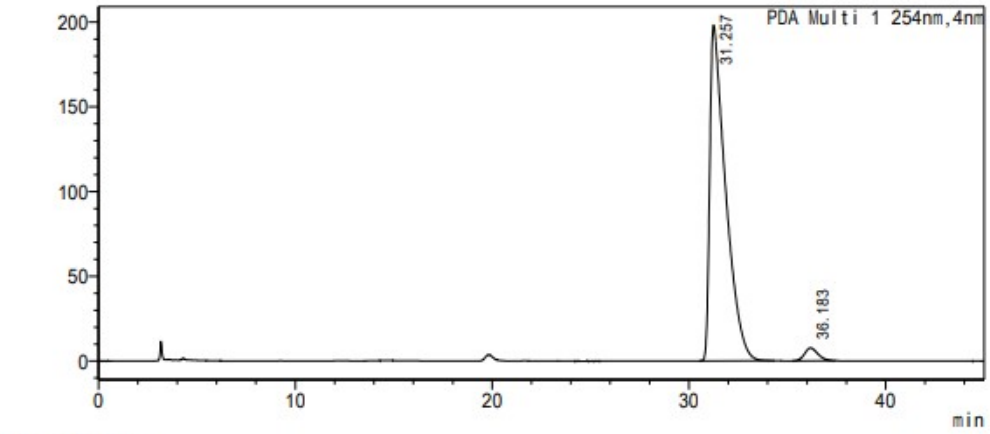
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 32.320 | 47755 | 53.190 | 2151675 | 49.980 |
| 2 | 36.316 | 42027 | 46.810 | 2153424 | 50.020 |
| Total | | 89782 | 100.000 | 4305100 | 100.000 |

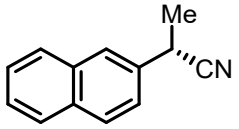
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 31.257 | 198022 | 96.322 | 11076602 | 96.907 |
| 2 | 36.183 | 7561 | 3.678 | 353479 | 3.093 |
| Total | | 205583 | 100.000 | 11430081 | 100.000 |

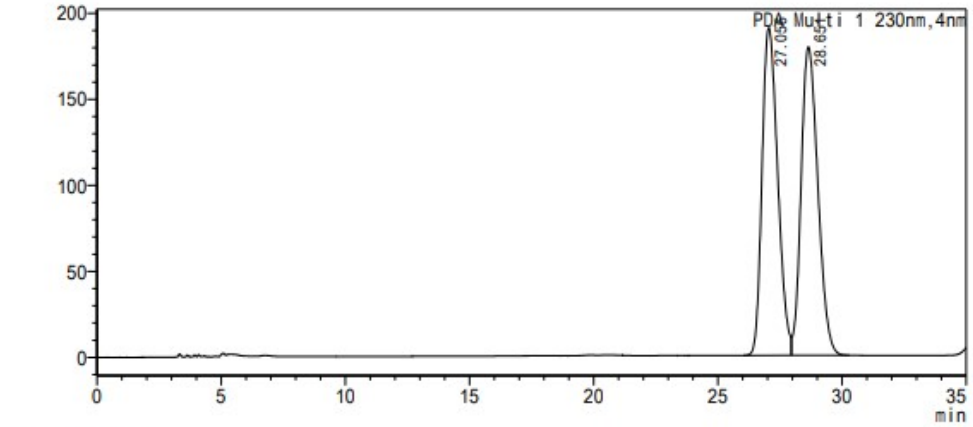
**(*S*)-2-(Naphthalen-2-yl)propanenitrile (2u)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2u** as a white solid

(29.0mg, 80% yield) with 92% ee. m.p. 86-87 °C; $[\alpha]_D^{20}$ = -24.0 (c 0.50, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.92 – 7.82 (m, 4H), 7.56 – 7.48 (m, 2H), 7.43 (dd, *J* = 8.4, 2.0 Hz, 1H), 4.07 (q, *J* = 7.2 Hz, 1H), 1.73 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 134.3, 133.3, 132.8, 129.1, 127.8, 127.7, 126.7, 126.5, 125.6, 124.4, 121.5, 31.4, 21.4. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{13}H_{11}N$: 181.0891, found 181.0884. HPLC (Daicel Chiralpak IC column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 230 nm): $t_r$ = 27.2 min (minor), $t_r$ = 28.7 min (major).

<Chromatogram>

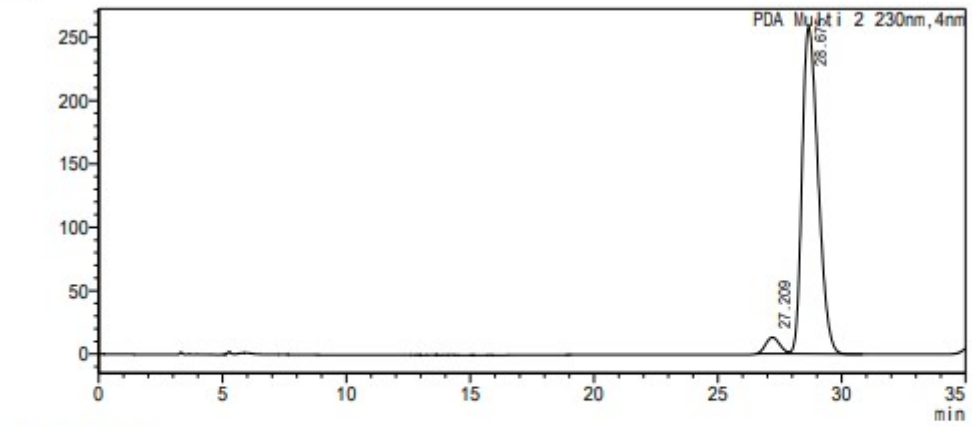



<Peak Table>

PDA Ch1 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 27.056 | 190543 | 51.529 | 8336715 | 49.751 |
| 2 | 28.651 | 179234 | 48.471 | 8420031 | 50.249 |
| Total | | 369777 | 100.000 | 16756746 | 100.000 |

<Chromatogram>

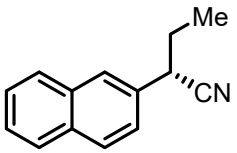



<Peak Table>

PDA Ch2 230nm

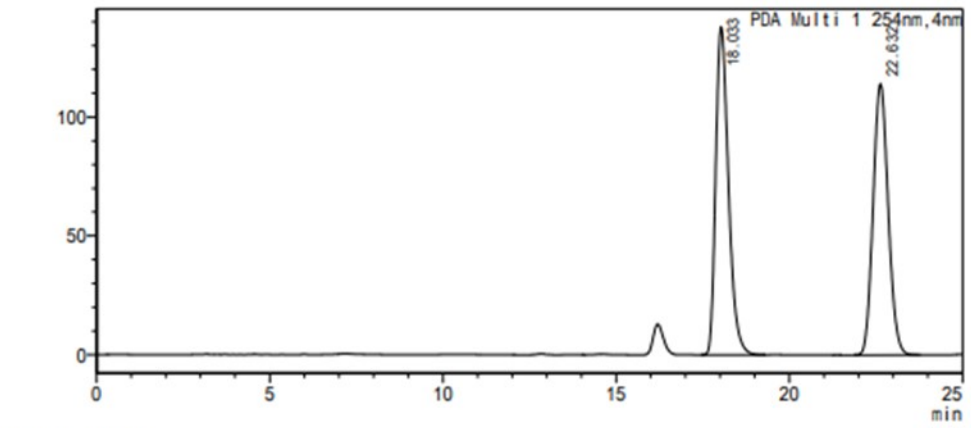
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 27.209 | 12918 | 4.772 | 512070 | 4.223 |
| 2 | 28.675 | 257775 | 95.228 | 11613371 | 95.777 |
| Total | | 270693 | 100.000 | 12125441 | 100.000 |

**(*S*)-2-(Naphthalen-2-yl)butanenitrile (2v)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2v** as a white solid (23.8 mg 61% yield) with 90% ee. m.p. 58-59 °C; $[\alpha]_D^{20}$ = -29.8 (c 0.52, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.88 – 7.82 (m, 4H), 7.55 – 7.49 (m, 2H), 7.40 (dd, J = 8.5, 1.9 Hz, 1H), 3.91 (t, *J* = 7.1 Hz, 1H), 2.04 (m, 2H), 1.11 (t, *J* = 7.4 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 133.3, 133.0, 132.8, 129.0, 127.9, 127.7, 126.7, 126.5, 126.4, 124.8, 39.1, 29.1, 11.5. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{14}H_{13}N$: 195.1048, found 195.1042. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 254 nm): $t_r$ = 17.9 min (major), $t_r$ = 22.2 min (minor).

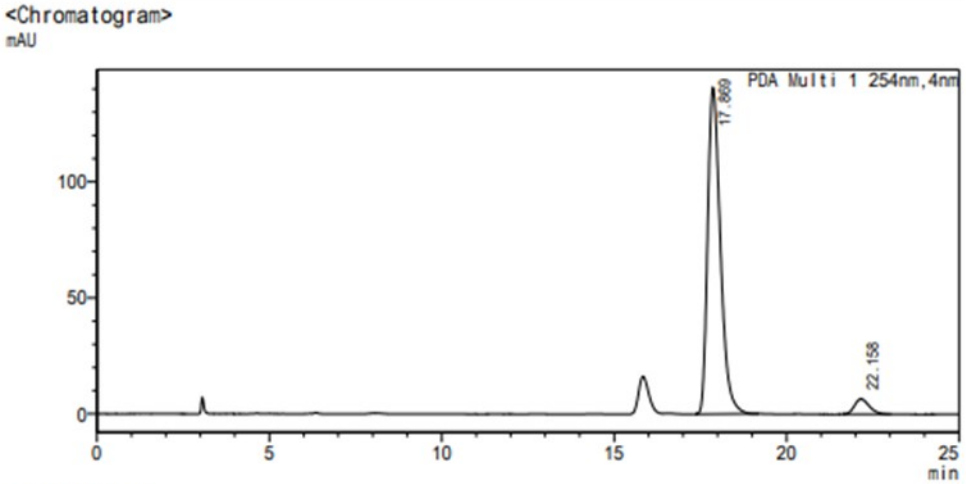
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 18.033 | 137891 | 54.725 | 3533826 | 50.589 |
| 2 | 22.632 | 114080 | 45.275 | 3451576 | 49.411 |
| Total | | 251971 | 100.000 | 6985401 | 100.000 |

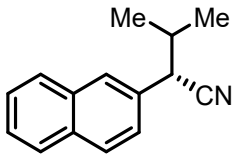
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 17.869 | 140570 | 95.524 | 3616990 | 94.865 |
| 2 | 22.158 | 6586 | 4.476 | 195782 | 5.135 |
| Total | | 147156 | 100.000 | 3812772 | 100.000 |

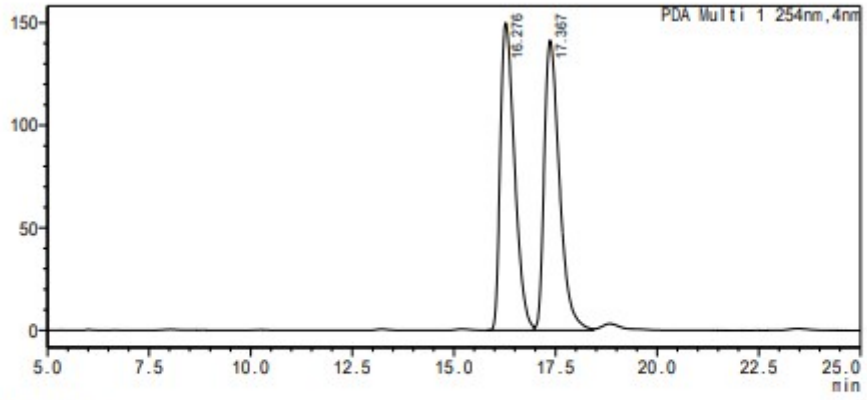
**(*S*)-3-Methyl-2-(naphthalen-2-yl)butanenitrile (2w)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2w** as a yellow

liquid (22.2 mg, 53% yield) with 86% ee; $[\alpha]_D^{20}$ = -27.3 (c 0.82, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.89 – 7.83 (m, 3H), 7.81 (d, *J* = 1.7 Hz, 1H), 7.57 – 7.46 (m, 2H), 7.38 (dd, *J* = 8.5, 1.9 Hz, 1H), 3.84 (d, *J* = 6.2 Hz, 1H), 2.24 (m, 2H), 1.11 (d, *J* = 6.7 Hz, 3H), 1.07 (d, *J* = 6.7 Hz, 3H).**$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 133.1, 132.8, 132.3, 128.7, 127.9, 127.7, 127.0, 126.6, 126.4, 125.3, 119.8, 45.3, 33.7, 20.9, 18.8. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{15}H_{15}N$: 209.1204, found 209.1199. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 254 nm): $t_r$ = 16.2 min (major), $t_r$ = 17.4 min (minor).

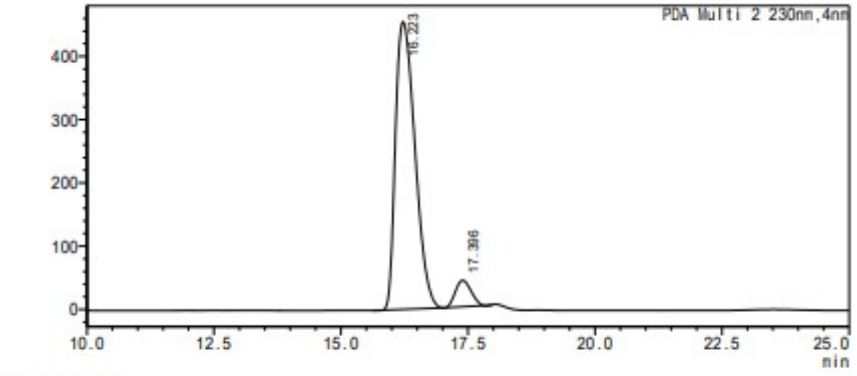
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 16.276 | 149804 | 51.455 | 3656269 | 49.719 |
| 2 | 17.367 | 141329 | 48.545 | 3697554 | 50.281 |
| Total | | 291133 | 100.000 | 7353823 | 100.000 |

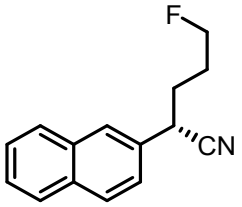
<Chromatogram>




<Peak Table>
PDA Ch2 230nm

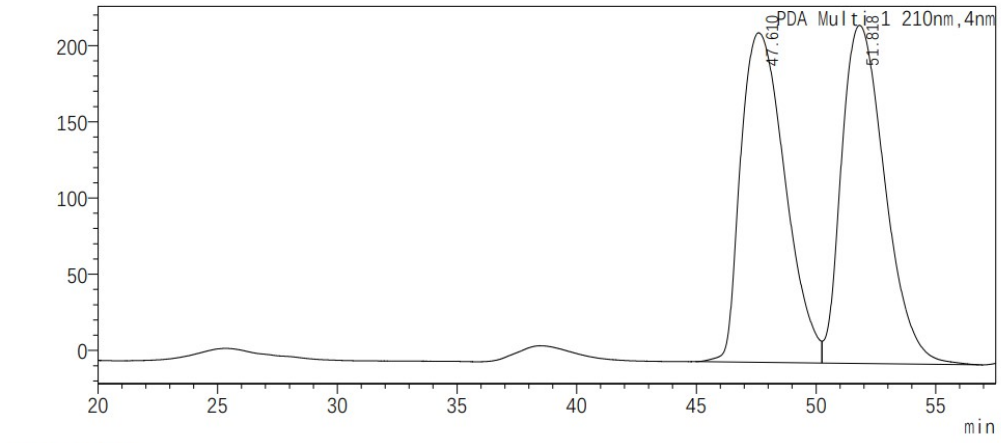
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 16.223 | 454487 | 91.603 | 12159286 | 93.185 |
| 2 | 17.396 | 41661 | 8.397 | 889268 | 6.815 |
| Total | | 496147 | 100.000 | 13048554 | 100.000 |

**(*S*)-5-Fluoro-2-(naphthalen-2-yl)pentanenitrile (2x)**



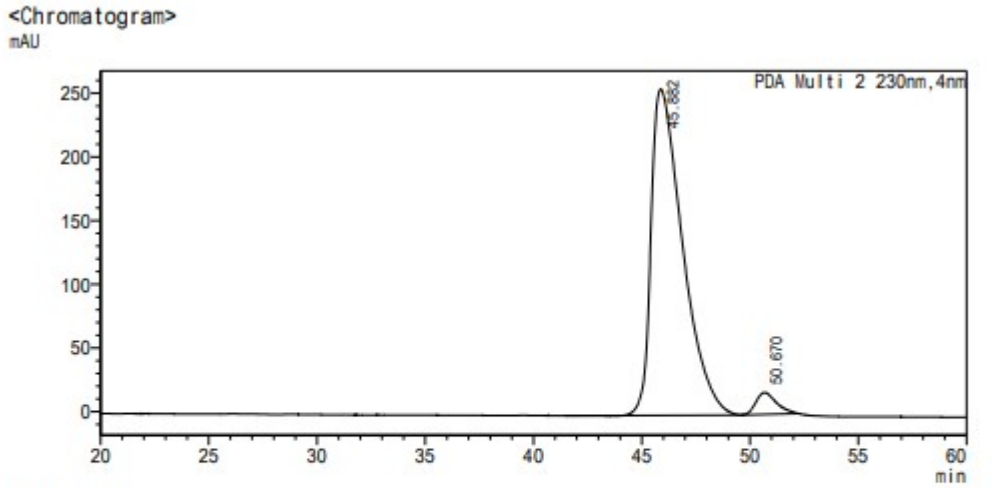

Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2x** as a yellow liquid (24.5 mg, 54% yield) with 92% ee; $[\alpha]_D^{20}$ = -32.5 (c 0.50, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.92 – 7.82 (m, 4H), 7.57 – 7.49 (m, 2H), 7.42 (dd, *J* = 8.5, 2.0 Hz, 1H), 4.56 (q, *J* = 5.9 Hz, 1H), 4.44 (q, *J* = 6.0 Hz, 1H), 4.04 (t, *J* = 7.3 Hz, 1H), 2.20 – 2.12 (m, 2H), 1.98 – 1.85 (m, 2H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 133.3, 132.8, 132.6, 129.2, 127.8, 127.7, 126.8, 126.58, 126.4, 124.6, 120.4, 83.0 (d, $^1J_{C\text{-}F}$ = 166.4 Hz), 37.1, 31.8 (d, $^3J_{C\text{-}F}$ = 4.4 Hz), 27.8 (d, $^2J_{C\text{-}F}$ = 20.3 Hz). **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{15}H_{14}FN$: 227.1110, found 227.1106. HPLC (Daicel Chiralpak AD-H column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 210 nm): $t_r$ = 45.9 min (major), tR = 50.7 min (minor).

<Chromatogram>




<Peak Table>
PDA Ch1 210nm

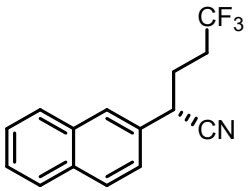
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 47.610 | 216170 | 49.357 | 27792674 | 49.807 |
| 2 | 51.818 | 221802 | 50.643 | 28007972 | 50.193 |
| Total | | 437972 | 100.000 | 55800646 | 100.000 |




<Peak Table>
PDA Ch2 230nm

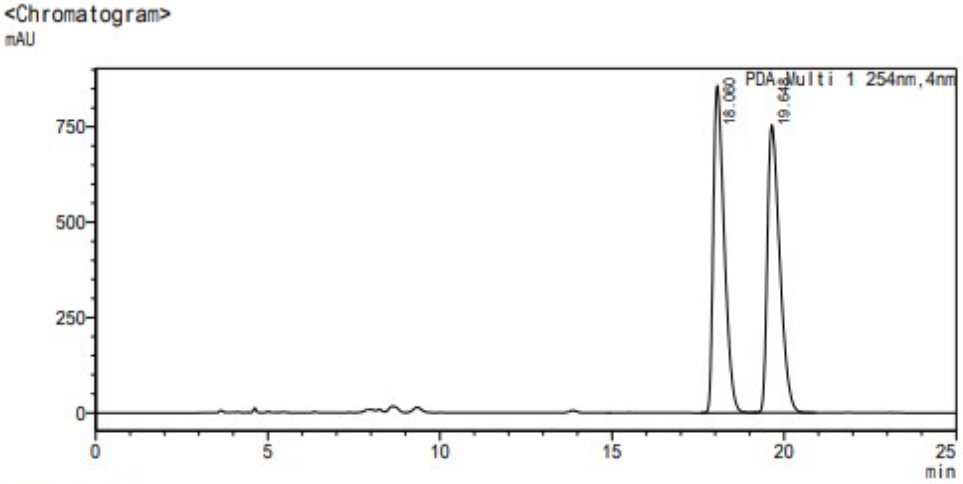
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 45.882 | 256080 | 93.732 | 25954898 | 95.811 |
| 2 | 50.670 | 17126 | 6.268 | 1134763 | 4.189 |
| Total | | 273206 | 100.000 | 27089661 | 100.000 |

**(*S*)-5,5,5-Trifluoro-2-(naphthalen-2-yl)pentanenitrile (2y)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2y** as a white solid (31.6 mg, 60% yield) with 93% ee. m.p. 55-56 °C; $[\alpha]_D^{20}$ = -21.6 (c 0.50, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.95 – 7.80 (m, 4H), 7.60 – 7.50 (m, 2H), 7.40 (dd, $J$ = 8.5, 1.9 Hz, 1H), 4.13 – 4.04 (m, 1H), 2.37 – 2.20 (m, 4H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 133.3, 133.0, 131.3, 129.6, 127.9, 127.8, 127.0, 126.9, 126.5, 126.4 (q, $^1J_{C\text{-}F}$ = 276.3 Hz), 124.2, 119.5, 53.4, 36.3, 31.1 (q, $^2J_{C\text{-}F}$ = 29.8 Hz), 28.1(q, $^3J_{C\text{-}F}$ = 3.3 Hz). **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -65.70. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{15}H_{12}F_3N$: 263.0922, found 263.0917. HPLC (Daicel Chiralpak OZ-3 column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 254 nm): $t_r$ = 18.2 min (major), $t_r$ = 20.0 min (minor).

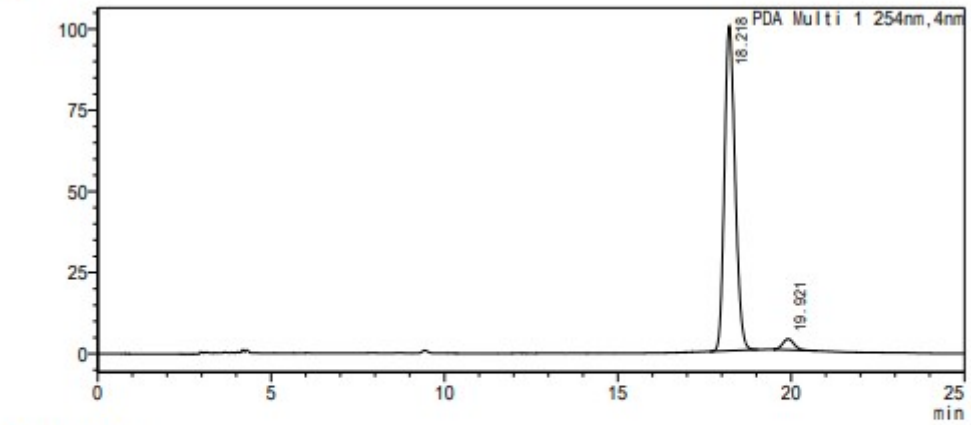
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 18.060 | 855441 | 53.129 | 18894507 | 49.965 |
| 2 | 19.648 | 754678 | 46.871 | 18920696 | 50.035 |
| Total | | 1610118 | 100.000 | 37815203 | 100.000 |

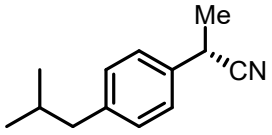
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

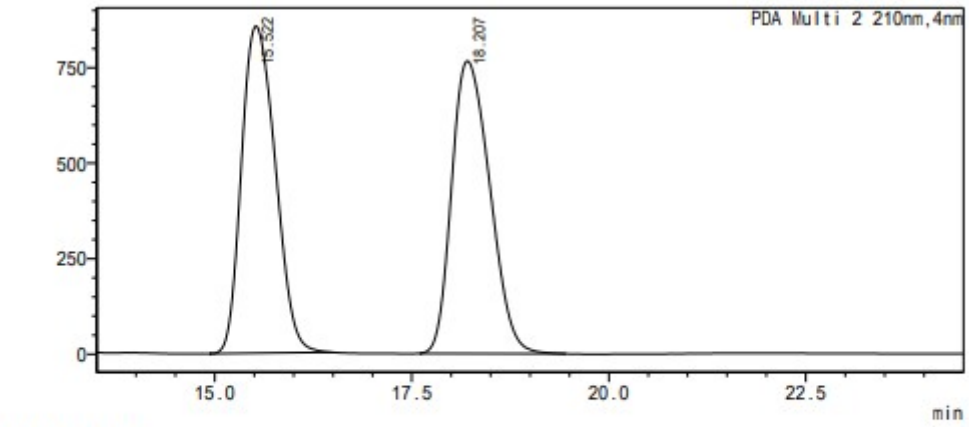
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 18.218 | 99956 | 96.731 | 2136214 | 96.449 |
| 2 | 19.921 | 3378 | 3.269 | 78651 | 3.551 |
| Total | | 103334 | 100.000 | 2214865 | 100.000 |

**(*S*)-2-(4-sobutylphenyl)propanenitrile (2z)**



Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatography （hexanes: EA = 20:1-10:1) afforded the product **2z** as a yellow liquid (24.3 mg, 86% yield) with 86% ee; $[\alpha]_D^{20}$ = -13.6 (c 0.52, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.28 – 7.23 (m, 2H), 7.18 – 7.13 (m, 2H), 3.87 (q, *J* = 7.3 Hz, 1H), 2.47 (d, *J* = 7.2 Hz, 2H), 1.92 – 1.81 (m, 1H), 1.63 (d, *J* = 7.3 Hz, 3H), 0.91 (s, 3H), 0.89 (s, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.6, 134.3, 129.8, 126.4, 121.8, 44.9, 30.9, 30.1, 22.3, 21.4. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{13}H_{17}N$: 187.1361, found 187.1357. HPLC (Daicel Chiralpak OJ-H column, hexane/isopropanol = 99.5/0.5, flow rate 1.0 mL/min, 210 nm): $t_r$ = 15.1 min (minor), tR = 17.7 min (major).

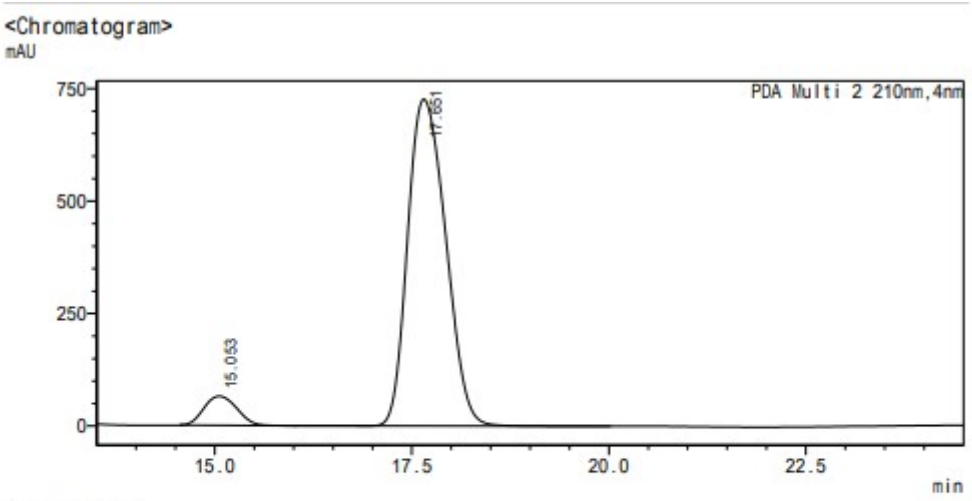
<Chromatogram>




<Peak Table>

PDA Ch2 210nm

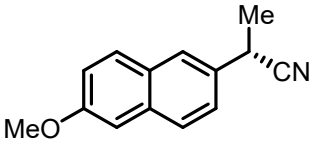
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 15.522 | 855901 | 52.782 | 25628097 | 49.783 |
| 2 | 18.207 | 765677 | 47.218 | 25851391 | 50.217 |
| Total | | 1621577 | 100.000 | 51479488 | 100.000 |




<Peak Table>
PDA Ch2 210nm

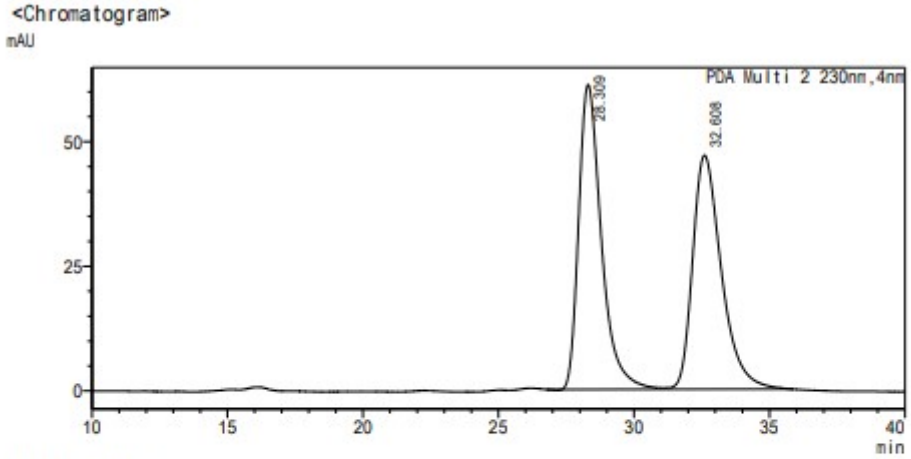
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 15.053 | 64631 | 8.174 | 1876246 | 7.152 |
| 2 | 17.651 | 726055 | 91.826 | 24359357 | 92.848 |
| Total | | 790687 | 100.000 | 26235603 | 100.000 |

**(*S*)-2-(6-Methoxynaphthalen-2-yl)propanenitrile (2aa)**




Prepared according to general procedure, constant voltage is 3.0 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2aa** as a white solid (27.4 mg, 65% yield) with 91 er. m.p. 84.3-84.6 °C; $[\alpha]_D^{20}$ = -31.6 (c 0.47, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.80 – 7.70 (m, 3H), 7.39 (dd, *J* = 8.3, 2.1 Hz, 1H), 7.19 (dd, *J* = 8.9, 2.5 Hz, 1H), 7.14 (d, *J* = 2.7 Hz, 1H), 4.03 (q, *J* = 7.2 Hz, 1H), 3.93 (s, 3H), 1.71 (d, *J* = 7.2 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 158.1, 134.0, 132.0, 129.3, 128.8, 127.9, 125.4, 124.9, 121.7, 119.6, 105.7, 55.3, 31.2, 21.4. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{14}H_{13}NO$: 211.0997, found 211.0991. HPLC (Daicel Chiralpak AS-H column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 230 nm): $t_r$ = 28.0 min (major), $t_r$ = 32.5 min (minor).

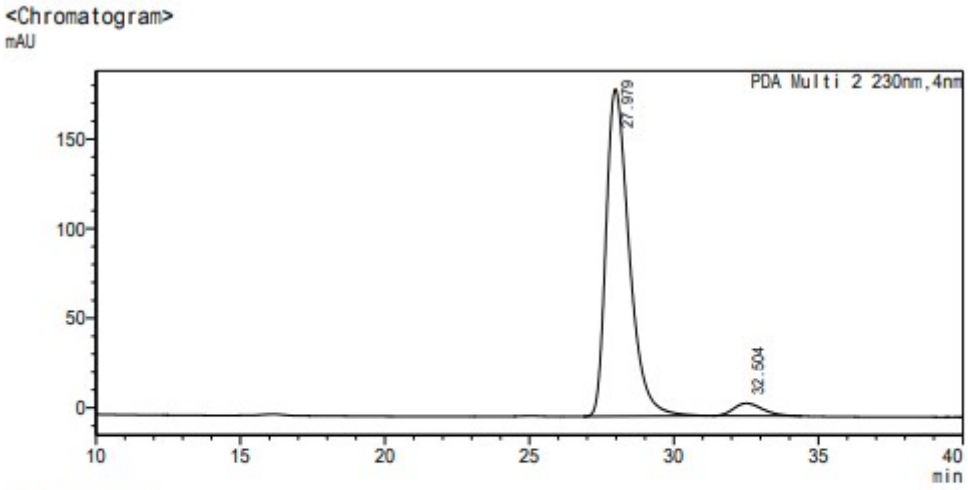
<Chromatogram>




<Peak Table>
PDA Ch2 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 28.309 | 61130 | 56.576 | 3556099 | 50.587 |
| 2 | 32.608 | 46919 | 43.424 | 3473610 | 49.413 |
| Total | | 108049 | 100.000 | 7029709 | 100.000 |

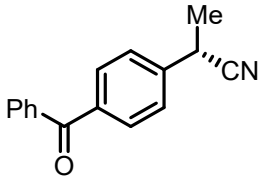
<Chromatogram>



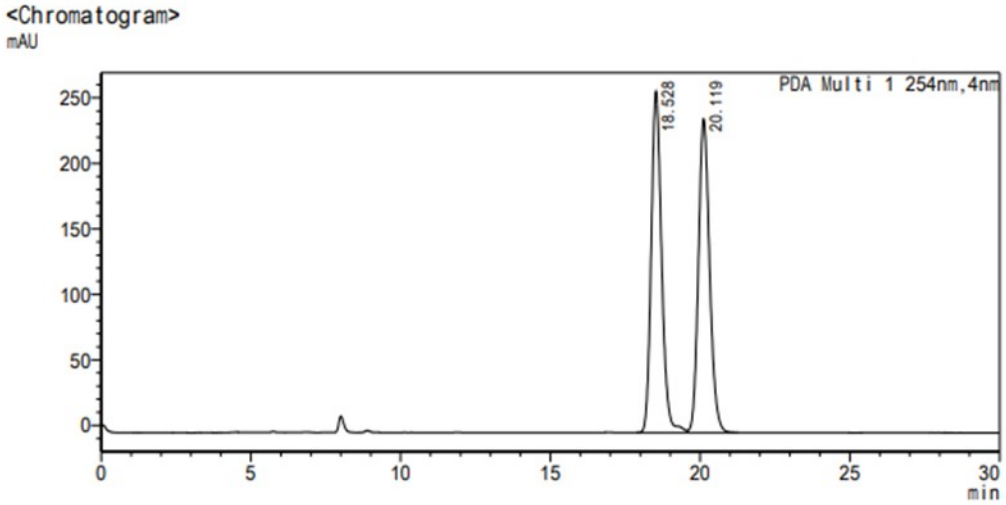

<Peak Table>
PDA Ch2 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 27.979 | 182518 | 96.281 | 10159323 | 95.344 |
| 2 | 32.504 | 7050 | 3.719 | 496093 | 4.656 |
| Total | | 189567 | 100.000 | 10655416 | 100.000 |

**(*S*)-2-(4-Benzoylphenyl)propanenitrile (2ab)**



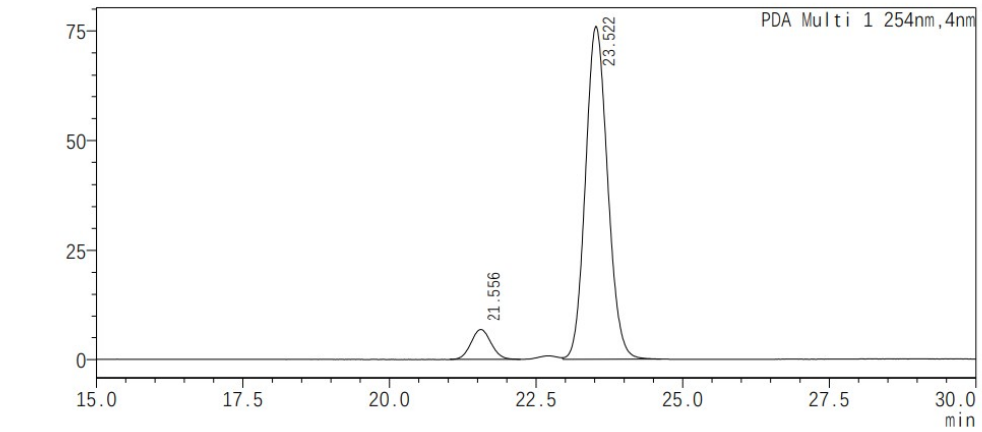
Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2ab** as a white solid (33.4 mg, 71% yield) with 85% ee. m.p. 54-55 °C; $[\alpha]_D^{20}$ = -12.1 (c 0.50, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.85 – 7.76 (m, 3H), 7.76 – 7.70 (m, 1H), 7.66 – 7.56 (m, 2H), 7.51 (q, *J* = 7.3 Hz, 3H), 3.98 (q, *J* = 7.2 Hz, 1H), 1.68 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 195.9, 138.5, 137.5, 137.1, 132.7, 130.5, 130.0, 129.8, 129.1, 128.4, 128.1, 121.0, 31.1, 21.3. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{18}H_{13}NO$: 235.0997, found 235.0992. HPLC (Daicel Chiralpak IG column, hexane/isopropanol = 80/20, flow rate 0.7 mL/min, 254 nm): $t_r$ = 21.6 min (minor), $t_r$ = 23.5 min (major).




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 18.528 | 260152 | 52.055 | 6296753 | 50.361 |
| 2 | 20.119 | 239611 | 47.945 | 6206572 | 49.639 |
| Total | | 499763 | 100.000 | 12503325 | 100.000 |

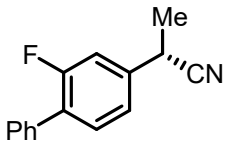
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

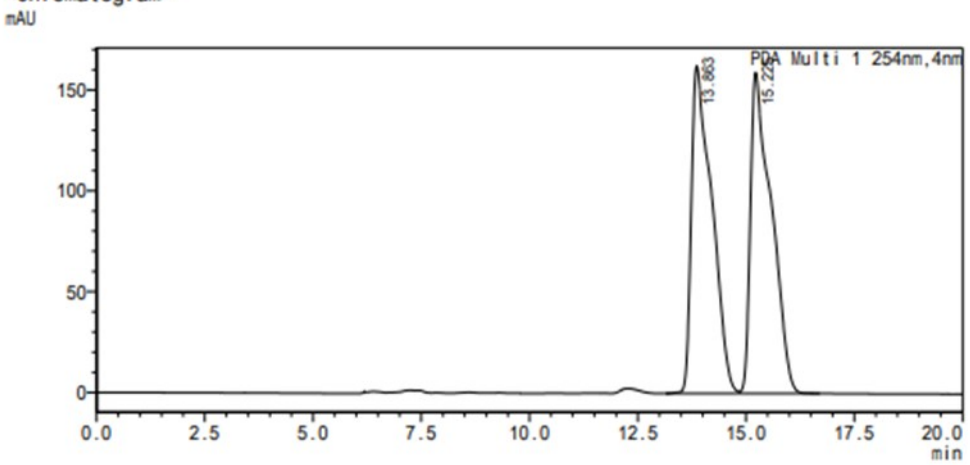
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 21.556 | 6843 | 8.260 | 162917 | 7.538 |
| 2 | 23.522 | 75998 | 91.740 | 1998369 | 92.462 |
| Total | | 82841 | 100.000 | 2161287 | 100.000 |

**(*S*)-2-(2-Fluoro-[1,1'-biphenyl]-4-yl)propanenitrile (2ac)**




Prepared according to general procedure, constant voltage is 2.3 V, after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2ac** as a yellow liquid (27.5 mg, 64% yield) with 90% ee; $[\alpha]_D^{20}$ = -9.4 (c 0.58, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.54 (dd, *J* = 6.8, 1.6 Hz, 2H), 7.51 – 7.43 (m, 3H), 7.42 – 7.36 (m, 1H), 7.25 – 7.13 (m, 2H), 3.94 (q, *J* = 7.3 Hz, 1H), 1.69 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 159.8 (d, $^1J_{C\text{-}F}$ = 248.1 Hz), 138.1 (d, $^3J_{C\text{-}F}$ = 7.6 Hz), 134.9, 131.5 (d, $^4J_{C\text{-}F}$ = 3.8 Hz), 129.0 (d, $^4J_{C\text{-}F}$ = 2.9 Hz), 128.9, 128.5, 128.0, 122.7 (d, $^4J_{C\text{-}F}$ = 3.5 Hz), 121.0, 114.8 (d, $^2J_{C\text{-}F}$ = 24.3 Hz), 30.7, 21.2. **$^{19}$F NMR** (376 MHz, $CDCl_3$) δ -116.23. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{15}H_{12}FN$: 225.0954, found 225.0949. HPLC (Daicel Chiralpak AS-H column, hexane/isopropanol = 90/10, flow rate 0.5 mL/min, 254 nm): $t_r$ = 13.8 min (minor), $t_r$ = 15.1 min (major).

<Chromatogram>

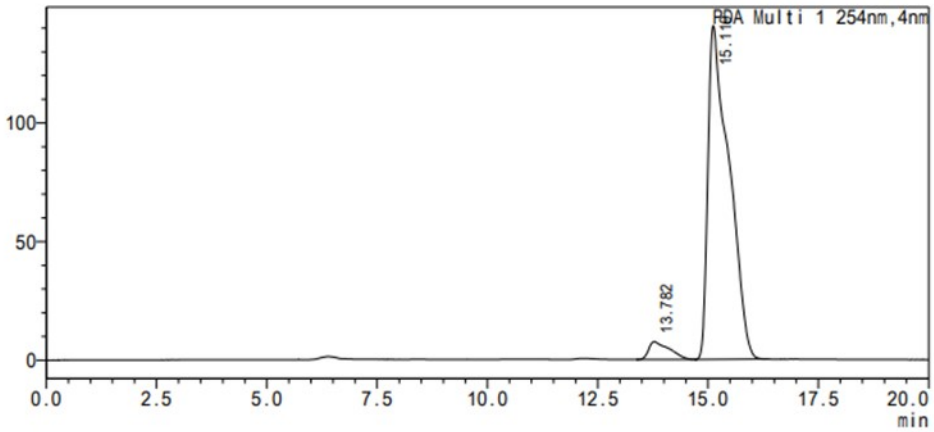



<Peak Table>

PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 13.863 | 162191 | 50.488 | 5361499 | 49.992 |
| 2 | 15.225 | 159057 | 49.512 | 5363136 | 50.008 |
| Total | | 321248 | 100.000 | 10724634 | 100.000 |

<Chromatogram>

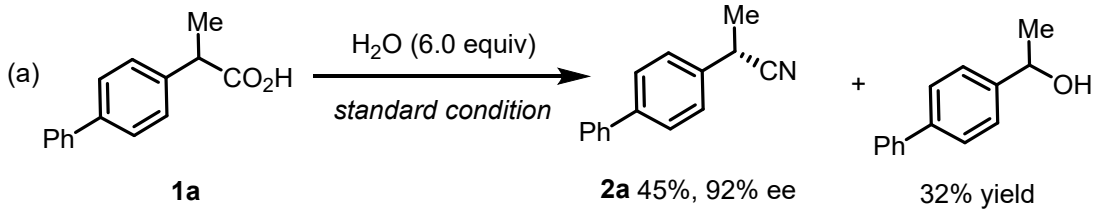



<Peak Table>

PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 13.782 | 7505 | 5.067 | 243356 | 4.918 |
| 2 | 15.119 | 140624 | 94.933 | 4704590 | 95.082 |
| Total | | 148129 | 100.000 | 4947947 | 100.000 |

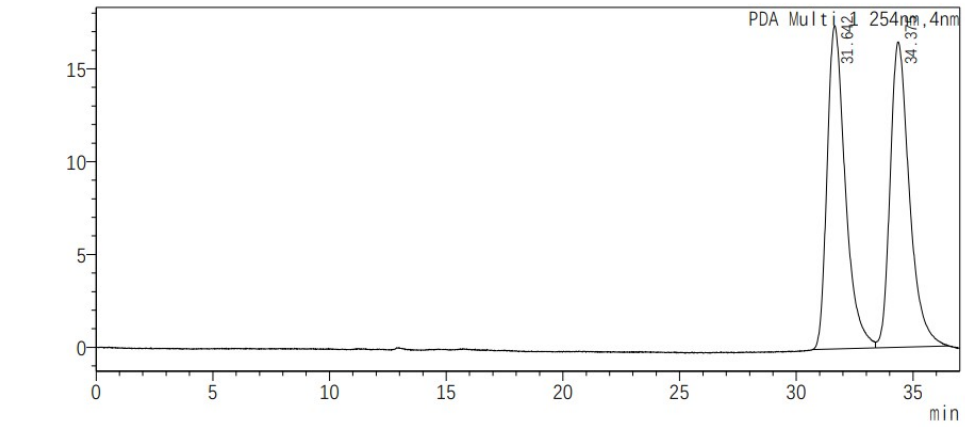
## 4. Mechanistic studies




**1a** **2a** 45%, 92% ee 32% yield

Prepared according to general procedure, but adding 6 equivalents of water，constant voltage is 2.3 V， after a flash column chromatograph（hexanes: EA = 20:1-10:1) afforded the product **2a** and the product 1-(4-biphenyl)ethanol as a white solid. **$^{1}$H NMR** (400 MHz, $CDCl_3$) δ 7.60 (dd, *J* = 13.1, 8.2 Hz, 4H), 7.49 – 7.40 (m, 4H), 7.37 (t, *J* = 7.3 Hz, 1H), 3.95 (q, *J* = 7.3 Hz, 1H), 1.69 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.1, 140.3, 136.0, 128.9, 127.8, 127.6, 127.1, 127.1, 121.5, 30.9, 21.4. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{14}H_{14}O$: 198.1045, found 198.1036.

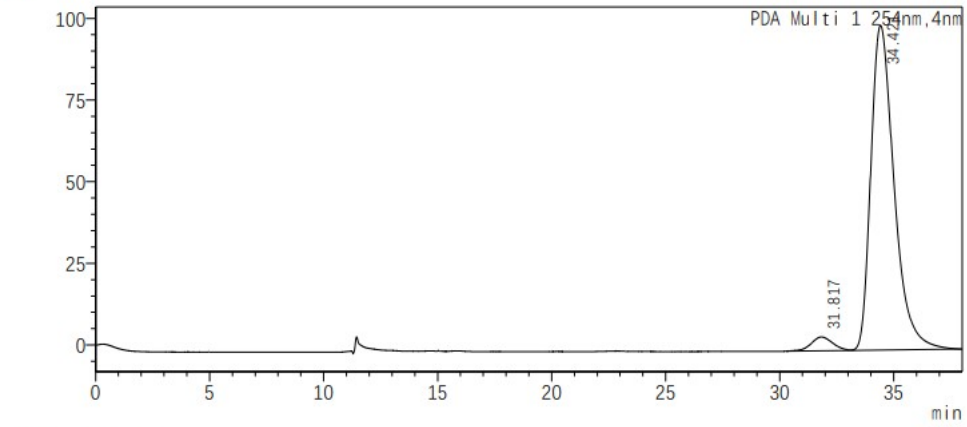
<Chromatogram>




<Peak Table>
PDA Ch1 254nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 31.642 | 17414 | 51.425 | 946432 | 50.030 |
| 2 | 34.375 | 16449 | 48.575 | 945283 | 49.970 |
| Total | | 33863 | 100.000 | 1891716 | 100.000 |

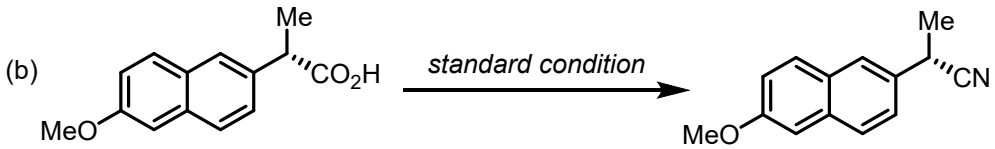
<Chromatogram>




<Peak Table>

PDA Ch1 254nm

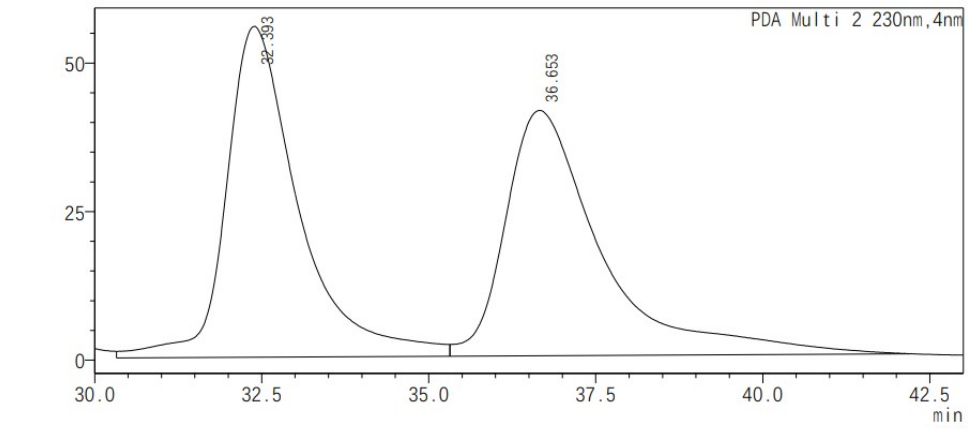
| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 31.817 | 4219 | 4.071 | 275260 | 3.759 |
| 2 | 34.421 | 99431 | 95.929 | 7048239 | 96.241 |
| Total | | 103650 | 100.000 | 7323499 | 100.000 |




*ent*-**1aa** **2aa** 58%, 91% ee

Prepared according to general procedure, the reaction of ent-1aa (0.2 mmol) gave 2aa (24.5mg, 58% yield, 91% ee) as a white solid. HPLC (Daicel Chiralpak AS-H column, hexane/isopropanol = 99/1, flow rate 0.5 mL/min, 230 nm): $t_r$ = 32.3 min (major), $t_r$ = 36.8 min (minor).

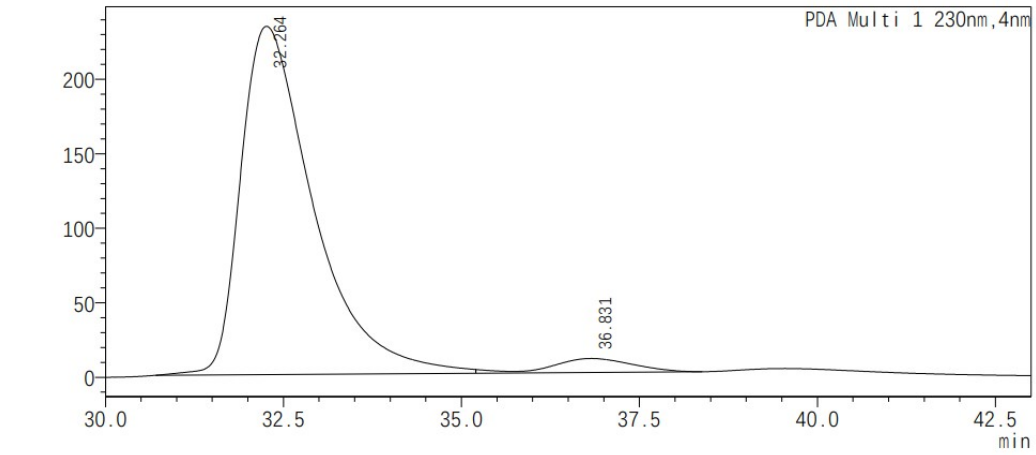
<Chromatogram>




<Peak Table>
PDA Ch2 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 32.393 | 55677 | 57.433 | 4213843 | 50.492 |
| 2 | 36.653 | 41265 | 42.567 | 4131720 | 49.508 |
| Total | | 96942 | 100.000 | 8345564 | 100.000 |

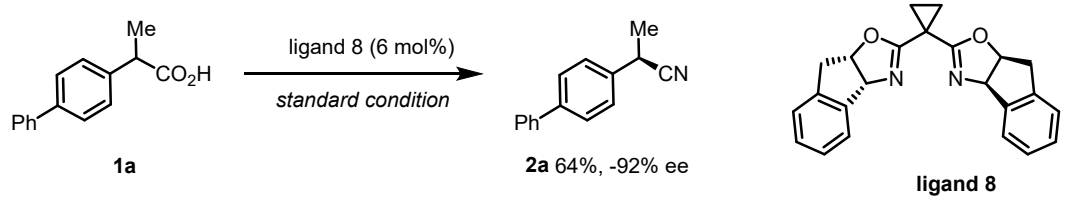
<Chromatogram>




<Peak Table>
PDA Ch1 230nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 32.264 | 233721 | 96.136 | 16610732 | 95.702 |
| 2 | 36.831 | 9393 | 3.864 | 745946 | 4.298 |
| Total | | 243114 | 100.000 | 17356677 | 100.000 |

(c)

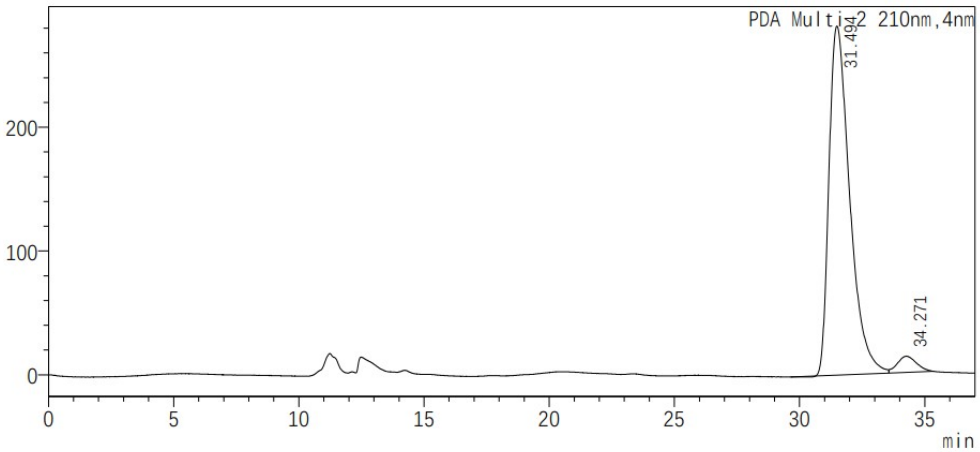



**1a** **2a** 64%, -92% ee **ligand 8**

Prepared according to general procedure, the reaction of **1a** (0.2 mmol) with **ligand 8** gave (R)-**2a** (26.5 mg, 64% yield, -92% ee) as a white solid. m.p. 79.2-79.4 °C; $[\alpha]_D^{20}$

= 13 (c 0.50, $CHCl_3$); **$^1$H NMR** (400 MHz, $CDCl_3$) δ 7.60 (dd, *J* = 13.1, 8.2 Hz, 4H), 7.49 – 7.40 (m, 4H), 7.37 (t, *J* = 7.3 Hz, 1H), 3.95 (q, *J* = 7.3 Hz, 1H), 1.69 (d, *J* = 7.3 Hz, 3H). **$^{13}$C NMR** (101 MHz, $CDCl_3$) δ 141.1, 140.3, 136.0, 128.9, 127.8, 127.6, 127.1, 127.1, 121.5, 30.9, 21.4. **HRMS** (EI): m/z: $[M]^+$ Calcd for $C_{15}H_{13}N$: 207.1048, found 207.1046. HPLC (Daicel Chiralpak AS-H column, hexane/isopropanol = 99/1, flow rate 0.3 mL/min, 254 nm): $t_r$ = 31.5 (major), $t_r$ = 34.3 min (minor).

<Chromatogram>

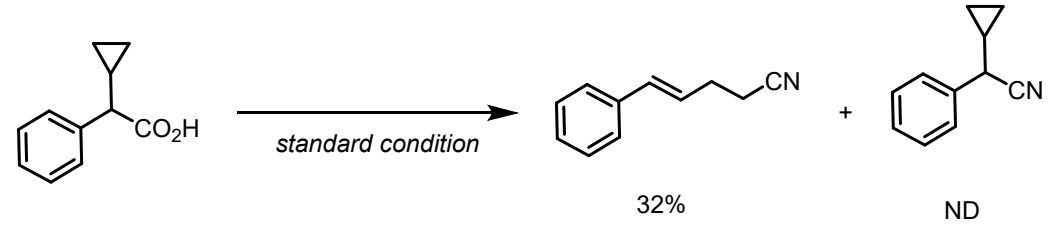



<Peak Table>

PDA Ch2 210nm

| No. | Ret.Time(min) | Height(mAU) | Height% | Area(mAU*min) | Area% |
|---|---|---|---|---|---|
| 1 | 31.494 | 281838 | 95.591 | 16212464 | 95.925 |
| 2 | 34.271 | 13000 | 4.409 | 688721 | 4.075 |
| Total | | 294838 | 100.000 | 16901185 | 100.000 |

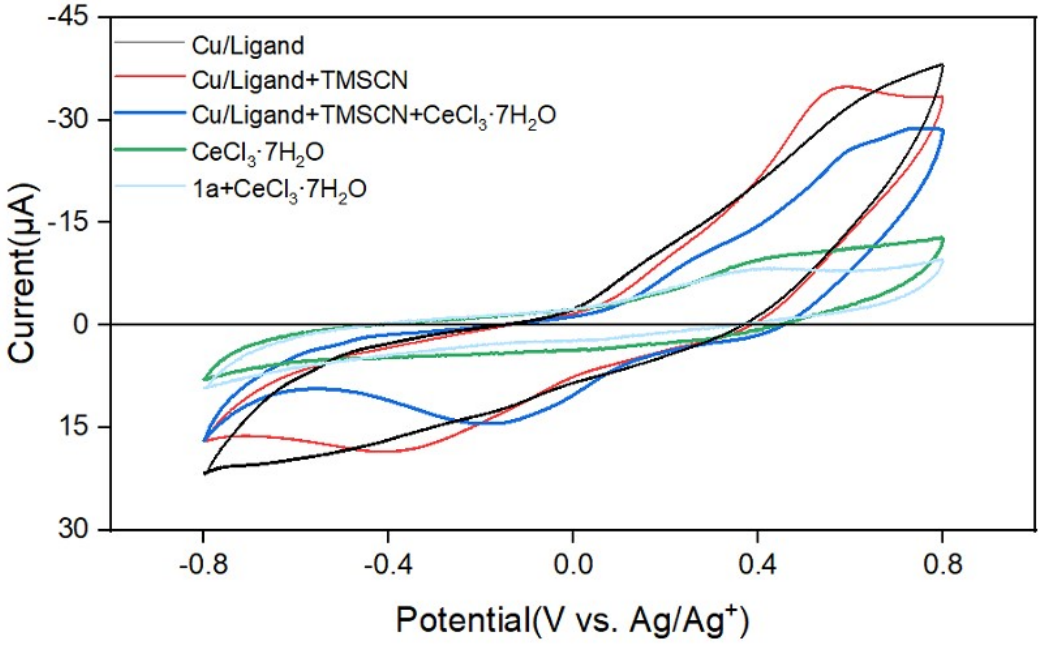
(d)




Prepared according to general procedure, the reaction of 2-cyclopropyl-2-phenylacetic acid (0.2 mmol) gave ring opening product (E)-5-phenylpent-4-enenitrile (10.0 mg, 32% yield) as light yellow oil. $^1$H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.28 (m, 4H), 7.28 – 7.21 (m, 1H), 6.53 (d, J = 16.0 Hz, 1H), 6.19 (dt, J = 16.0, 6.8 Hz, 1H), 2.63 – 2.46 (m, 4H).

(e) Cyclic voltammetry

The cyclic voltammograms were recorded in a solution of 0.1 M $^n$Bu$_4$NPF$_6$ $CH_3CN$ solution using a graphite carbon rod working electrode, a platinum sheet auxiliary electrode and a Ag/AgCl reference electrode. The scan rate was 0.1 V/s. Cyclic voltammetry curves of Cu (1.0 mM), Ligand (1.2 mM), TMSCN (4.0 mM), $CeCl_3 \cdot 7H_2O$ (1.0 mM), 1a (2.0 mM) in 0.1 M $^n$Bu$_4$NPF$_6$ $CH_3CN$ solution.




## 5. DFT Calculations

All the density functional theory (DFT) calculations were performed using Gaussian 09 program.[2] Geometry optimizations were performed with the M06-L functional[3] using a combined basis set (SDD effective core potential[4] for copper and 6-31G(d) basis[5] for the other atoms). Harmonic frequency calculations were performed for each stationary point to ensure that it is either an energy minimum (no imaginary frequency) or a transition state (only one imaginary frequency). For each transition state, intrinsic reaction coordinate (IRC) analysis was performed to ensure that it connects the correct reactant and product. The single-point energy calculations were further performed with the M06-L functional and a combined basis set (SDD effective core potential for copper and the 6-311++G(2df,2p) basis set[6] for all other atoms), using a self-consistent reaction field (SCRF) method called IEFPCM[7] in order to obtain energies in solution. The single-point energies corrected by the thermal correction to Gibbs free energies (TCG, obtained from frequency calculations) were used as the Gibbs free energies reported in this work, corresponding to the reference state of 1 mol/L, 298.15 K. The independent gradient model (IGM) was conducted with Multiwfn and VMD.[8] The 3-D images of the calculated structures were prepared using CYLview.[9]

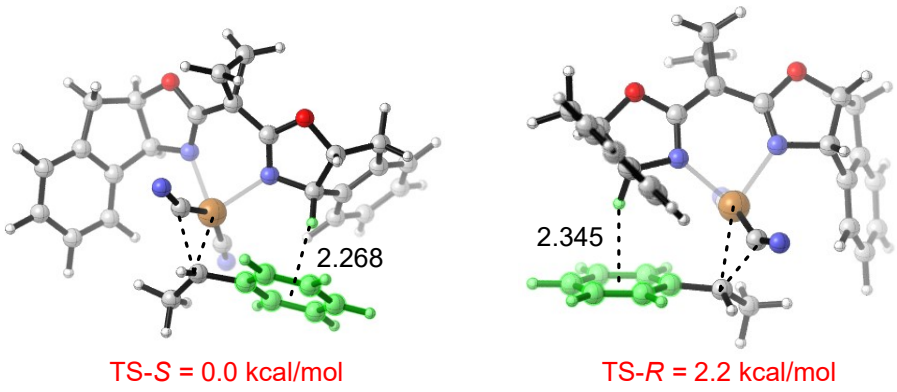



**Figure S1**. Optimized structures and IGM analysis of the transition states TS-*S* and TS-*R* for forming (*S*)-**2i** and (*R*)-**2i**.

We have conducted DFT calculations on the C-C reductive elimination to understand the role of the ligand **L5** on enantioselectivity. The calculation is performed at the M06-L/SDD-6-311+G*// M06-L /SDD-6-31G* level of theory. The solvent effect (acetonitrile) was also taken into account by using IEFPCM method. Reductive

elimination from the Cu(III) intermediate could deliver the cyanation product with the transition state (**TS-*S*** and **TS-*R***) at 0 and 2.2 kcal/mol respectively. the IGM analysis showed that C-H•••π interaction between the benzylic proton of the ligand and the aryl group of the substrate play a significant role on lowering the energy of the transition state.

**Table S6. Energy data (hartrees).**

| Geometry | $E_{M06\text{-}L/6\text{-}31G(d)}$ | TCG | $E_{M06\text{-}L/6\text{-}311+G(d,p)}$ | $TCG+E_{M06\text{-}L/6\text{-}311+G(d,p)}$ | $TCG+G_{(corr\text{-}B3\text{-}LYP)}$ | Imaginary Frequency |
|---|---|---|---|---|---|---|
| TS-*S* | -1841.113473 | 0.482642 | -1842.00581108 | | 0 | |
| TS-*R* | -1841.109622 | 0.483395 | -1842.00310556 | | 2.2 | |

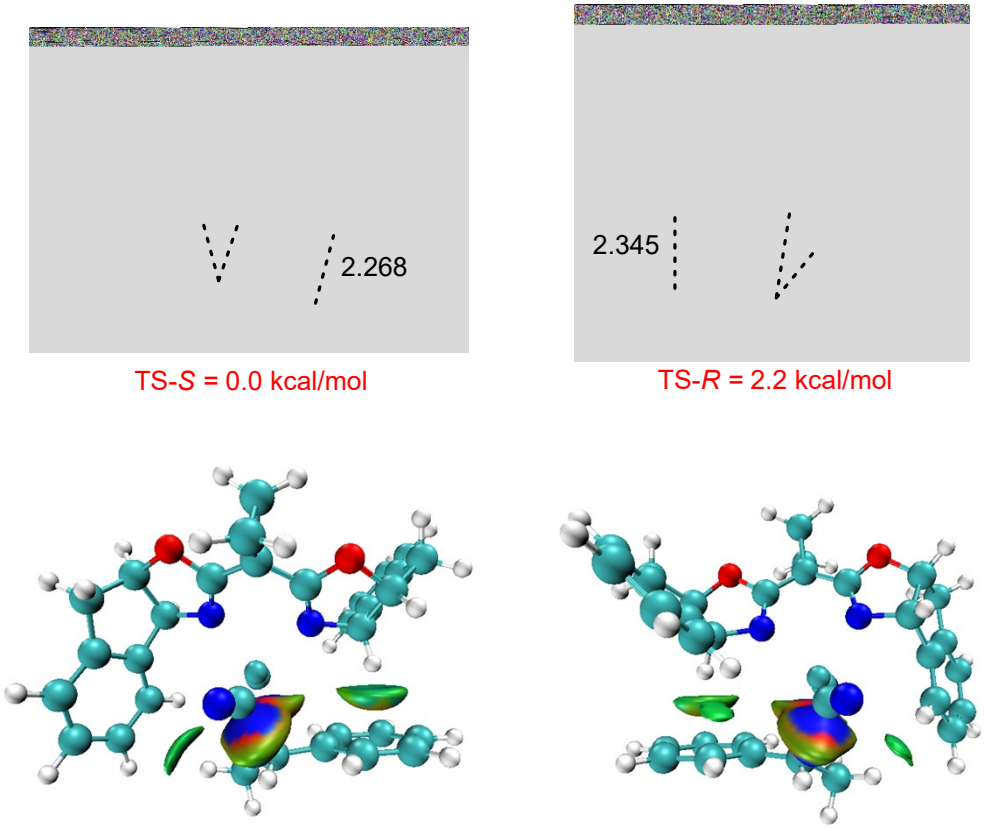



**Figure S2**. Optimized structures and IGM analysis of the transition states TS-*S* and TS-*R* for forming (*S*)-**2i** and (*R*)-**2i**. For IGM analysis, blue, attraction; green, weak interaction; red, steric effect.

**TS-*S***

| | | | |
|---|---|---|---|
| O | 1.94125100 | -2.35099500 | -1.54699500 |
| O | -2.42858300 | -3.05785700 | 0.08189400 |
| N | 1.11465700 | -0.61483500 | -0.36747400 |
| N | -1.52522400 | -1.08642400 | 0.68482400 |
| C | 2.54864800 | -0.32616000 | -0.54411200 |
| H | 2.66383300 | 0.69486600 | -0.91784400 |
| C | 3.35256000 | -0.57312000 | 0.70399500 |
| C | 3.21404000 | 0.04143000 | 1.94515500 |
| H | 2.44845900 | 0.80182300 | 2.10275600 |
| C | 4.05967400 | -0.34782300 | 2.98224100 |
| H | 3.96432500 | 0.11666700 | 3.96209800 |
| C | 5.02908800 | -1.33219400 | 2.77277200 |
| H | 5.68301100 | -1.62733200 | 3.59164000 |
| C | 5.16687500 | -1.94122000 | 1.52593200 |
| H | 5.92509800 | -2.70751100 | 1.36889400 |
| C | 4.32067300 | -1.55703100 | 0.48832700 |
| C | 4.29975400 | -2.03996800 | -0.93564900 |
| H | 4.26976900 | -3.13200900 | -1.03133500 |
| H | 5.19032400 | -1.70693100 | -1.48538900 |
| C | 3.04868200 | -1.39932100 | -1.53099500 |
| H | 3.17224100 | -1.05406200 | -2.56230800 |
| C | 0.91031700 | -1.76517700 | -0.90573000 |
| C | -0.33347400 | -2.55494500 | -0.91216900 |
| C | -0.20007900 | -4.04925500 | -1.20862700 |
| H | 0.81634800 | -4.41242100 | -1.31539200 |
| H | -0.87972300 | -4.69217800 | -0.65938800 |
| C | -0.74973800 | -3.17403800 | -2.25494500 |
| H | -1.81874400 | -3.18881000 | -2.44817100 |
| H | -0.12281800 | -2.90977600 | -3.10156800 |

| | | | |
|---|---|---|---|
| C | -2.80246200 | -1.14846900 | 1.42132900 |
| H | -2.57787200 | -1.14314000 | 2.49589600 |
| C | -3.75835900 | -0.06292400 | 1.01764100 |
| C | -3.67533800 | 1.29811800 | 1.29692300 |
| H | -2.85868500 | 1.68880900 | 1.90617700 |
| C | -4.64967900 | 2.14990700 | 0.77634300 |
| H | -4.60609200 | 3.21706300 | 0.98909100 |
| C | -5.68532400 | 1.64036900 | -0.00968300 |
| H | -6.43942100 | 2.31545900 | -0.41019900 |
| C | -5.76852000 | 0.27453300 | -0.27818400 |
| H | -6.58371600 | -0.11727700 | -0.88537000 |
| C | -4.79773200 | -0.57814200 | 0.24142300 |
| C | -4.69141500 | -2.06925000 | 0.08936500 |
| H | -4.55421600 | -2.37371700 | -0.95691100 |
| H | -5.59132800 | -2.58654100 | 0.44426700 |
| C | -3.45798000 | -2.45534100 | 0.91617900 |
| H | -3.67244300 | -3.18425400 | 1.69991400 |
| C | -1.42704400 | -2.16325700 | -0.00906800 |
| Cu | -0.48511400 | 0.72860500 | 0.30376200 |
| C | -0.14269000 | 1.41786200 | 2.10826500 |
| N | 0.00355000 | 1.83852400 | 3.19845200 |
| C | -1.30572400 | 0.94173700 | -1.40450800 |
| N | -1.90323600 | 0.54837800 | -2.34405000 |
| C | -0.48144600 | 2.79307400 | -1.01286600 |
| H | -0.90601400 | 2.93106900 | -2.00522100 |
| C | 0.98732300 | 2.82443100 | -1.08247100 |
| C | 1.79223000 | 3.13858600 | 0.02633900 |
| C | 1.60517400 | 2.62842500 | -2.33036700 |
| C | 3.16768800 | 3.26904500 | -0.11778500 |
| H | 1.33517000 | 3.27034800 | 1.00549800 |

| | | | |
|---|---|---|---|
| C | 2.98231500 | 2.75603100 | -2.47096900 |
| H | 0.98818800 | 2.38074800 | -3.19420100 |
| C | 3.76811100 | 3.07987100 | -1.36453300 |
| H | 3.77737300 | 3.51809400 | 0.74844600 |
| H | 3.44314400 | 2.60670800 | -3.44513400 |
| H | 4.84605000 | 3.18115200 | -1.47137100 |
| C | -1.23543600 | 3.60687400 | -0.00685700 |
| H | -1.18564700 | 4.65744500 | -0.33202400 |
| H | -2.29204200 | 3.32330600 | 0.01159700 |
| H | -0.84014800 | 3.53822100 | 1.00872500 |

**TS-*R***

| | | | |
|---|---|---|---|
| O | 1.92361700 | -2.42723800 | -1.49143300 |
| O | -2.41196900 | -3.09423100 | 0.24726500 |
| N | 1.09632900 | -0.64841200 | -0.37520700 |
| N | -1.54417300 | -1.06250900 | 0.68797500 |
| C | 2.52111400 | -0.35380600 | -0.60300300 |
| H | 2.62105000 | 0.66047000 | -1.00443600 |
| C | 3.35728900 | -0.58432500 | 0.62934900 |
| C | 3.21195300 | -0.00557200 | 1.88671800 |
| H | 2.41432300 | 0.71223200 | 2.07733700 |
| C | 4.08558300 | -0.38210600 | 2.90484800 |
| H | 3.98430700 | 0.05771000 | 3.89530400 |
| C | 5.08678300 | -1.32619900 | 2.66358500 |
| H | 5.76194400 | -1.61351500 | 3.46784300 |
| C | 5.22262800 | -1.91193800 | 1.40554100 |
| H | 5.99749000 | -2.65640100 | 1.22635500 |
| C | 4.34903900 | -1.53855000 | 0.38716200 |
| C | 4.30314300 | -2.01981000 | -1.03640800 |
| H | 4.32942900 | -3.11156800 | -1.13476900 |
| H | 5.15147600 | -1.63647100 | -1.61954300 |

| | | | |
|---|---|---|---|
| C | 3.00048800 | -1.44350500 | -1.57962500 |
| H | 3.05009500 | -1.13500300 | -2.62832000 |
| C | 0.89888700 | -1.82645000 | -0.85294500 |
| C | -0.33518100 | -2.62809300 | -0.80182900 |
| C | -0.19474400 | -4.13231300 | -1.02741200 |
| H | 0.82274300 | -4.49459700 | -1.12766000 |
| H | -0.86499400 | -4.75370400 | -0.44310800 |
| C | -0.75931400 | -3.31321900 | -2.11133000 |
| H | -1.82953500 | -3.34647600 | -2.29517400 |
| H | -0.13982300 | -3.08741200 | -2.97426100 |
| C | -2.81553700 | -1.09899300 | 1.44153100 |
| H | -2.57770300 | -1.05957900 | 2.51253500 |
| C | -3.77647700 | -0.02957900 | 1.01158400 |
| C | -3.72988000 | 1.33004300 | 1.30145700 |
| H | -2.95330400 | 1.72552100 | 1.95685600 |
| C | -4.69764100 | 2.16832000 | 0.74917600 |
| H | -4.68025600 | 3.23515400 | 0.96609300 |
| C | -5.69645800 | 1.64328600 | -0.07334300 |
| H | -6.44829300 | 2.30658800 | -0.49713700 |
| C | -5.74984100 | 0.27632800 | -0.34574300 |
| H | -6.54030100 | -0.12734500 | -0.97738700 |
| C | -4.78175700 | -0.56114900 | 0.20186800 |
| C | -4.64096700 | -2.04944500 | 0.05217100 |
| H | -4.40478000 | -2.33826900 | -0.98126400 |
| H | -5.55866900 | -2.58661000 | 0.32029400 |
| C | -3.47127700 | -2.41873400 | 0.97783800 |
| H | -3.75741500 | -3.09043000 | 1.78905400 |
| C | -1.42670200 | -2.19022200 | 0.08235700 |
| Cu | -0.57066600 | 0.73383800 | 0.04867800 |
| C | -0.22826800 | 1.43704300 | 1.77280400 |

| | | | |
|---|---|---|---|
| N | -0.19624200 | 1.35860700 | 2.95142300 |
| C | -1.43927300 | 0.88168000 | -1.71754700 |
| N | -1.99351300 | 0.89936600 | -2.75644200 |
| C | 0.07380100 | 3.02412500 | 0.55377600 |
| H | 0.35014600 | 3.44943100 | 1.51713800 |
| C | 1.26482400 | 2.95266400 | -0.31198400 |
| C | 1.18191400 | 2.89897900 | -1.71374300 |
| C | 2.53340300 | 3.04819600 | 0.28481700 |
| C | 2.33390100 | 2.94540100 | -2.48821700 |
| H | 0.20888000 | 2.80942100 | -2.19265800 |
| C | 3.68591700 | 3.08905600 | -0.49198200 |
| H | 2.60570600 | 3.10023200 | 1.37127300 |
| C | 3.58920900 | 3.03787500 | -1.88170200 |
| H | 2.25444400 | 2.90998700 | -3.57269100 |
| H | 4.65961600 | 3.16645600 | -0.01253500 |
| H | 4.48836700 | 3.07018000 | -2.49328100 |
| C | -1.19974000 | 3.64566200 | 0.06175400 |
| H | -1.53584400 | 3.26939200 | -0.90710400 |
| H | -2.00870300 | 3.50946700 | 0.78481600 |
| H | -1.02196200 | 4.72831800 | -0.02528300 |

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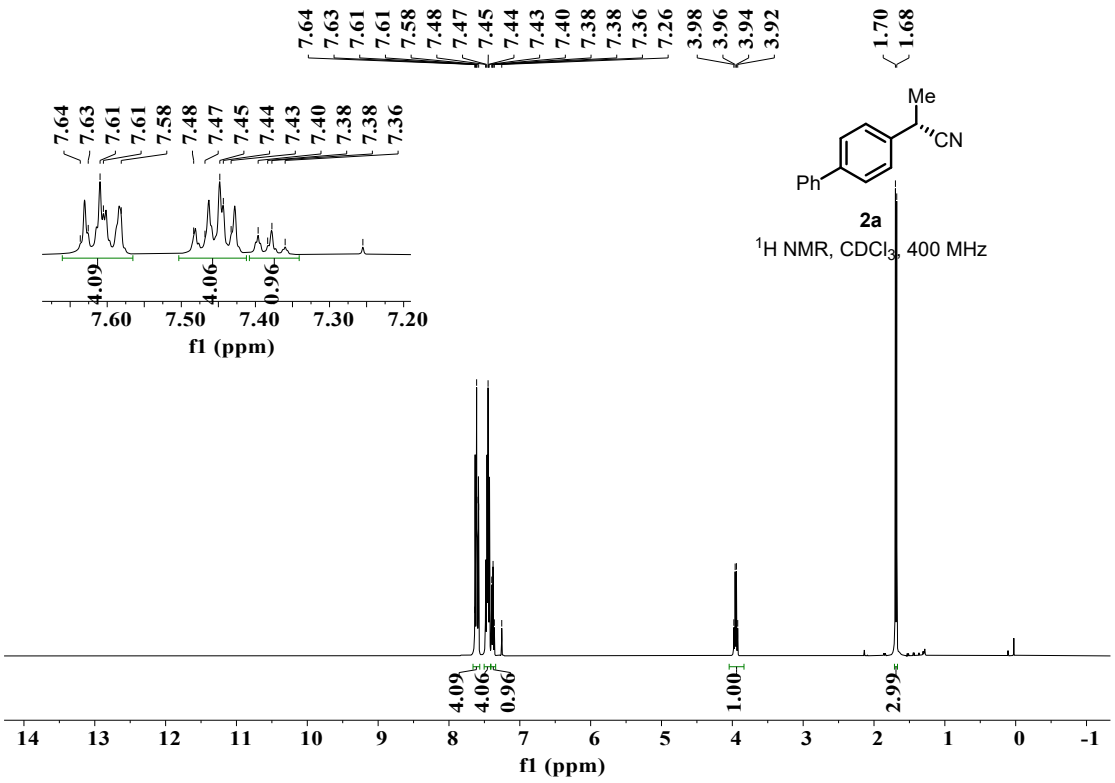
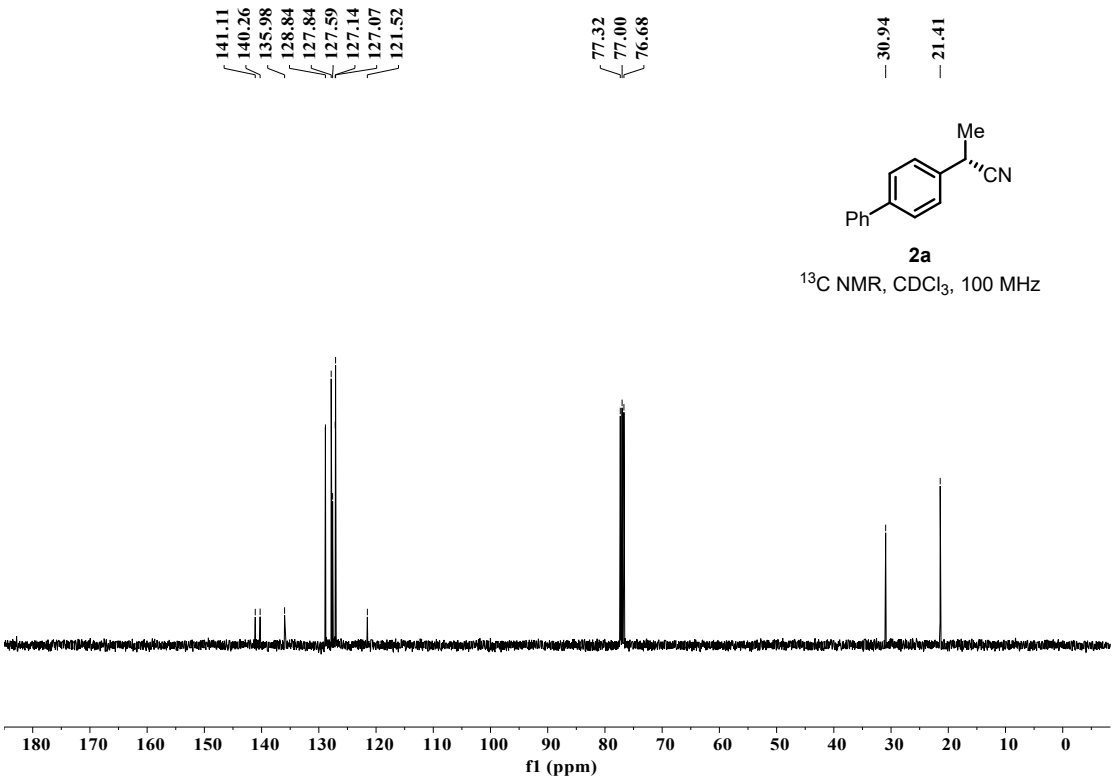
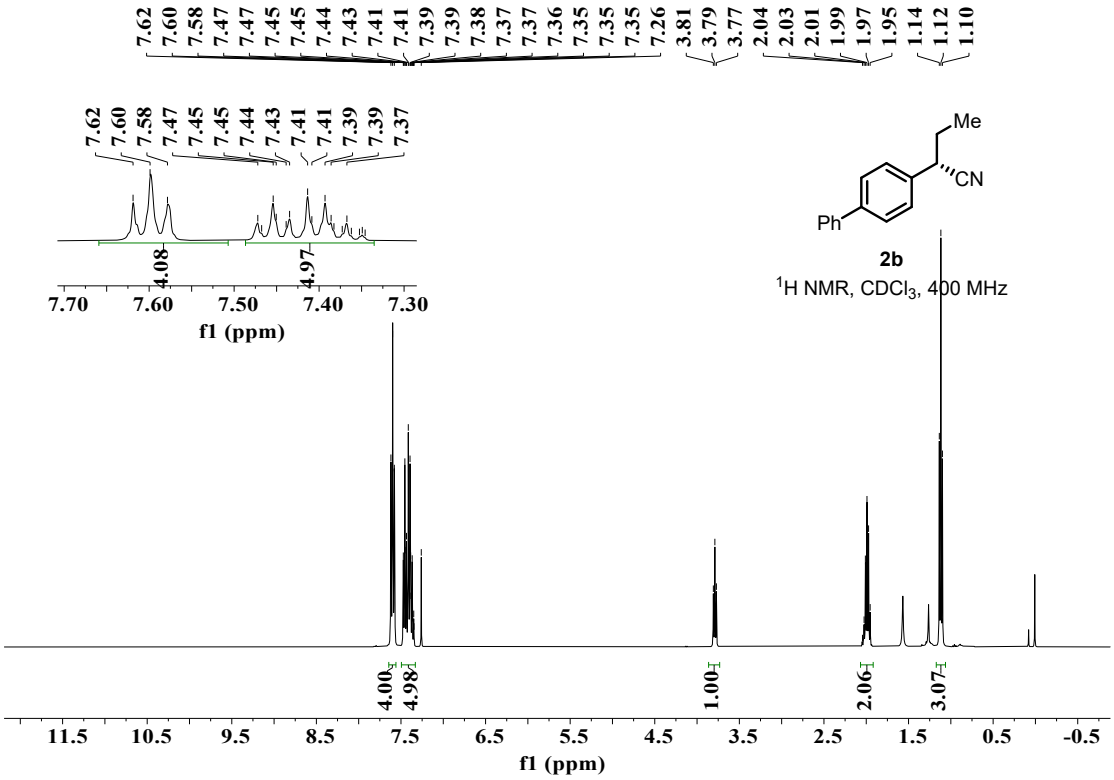
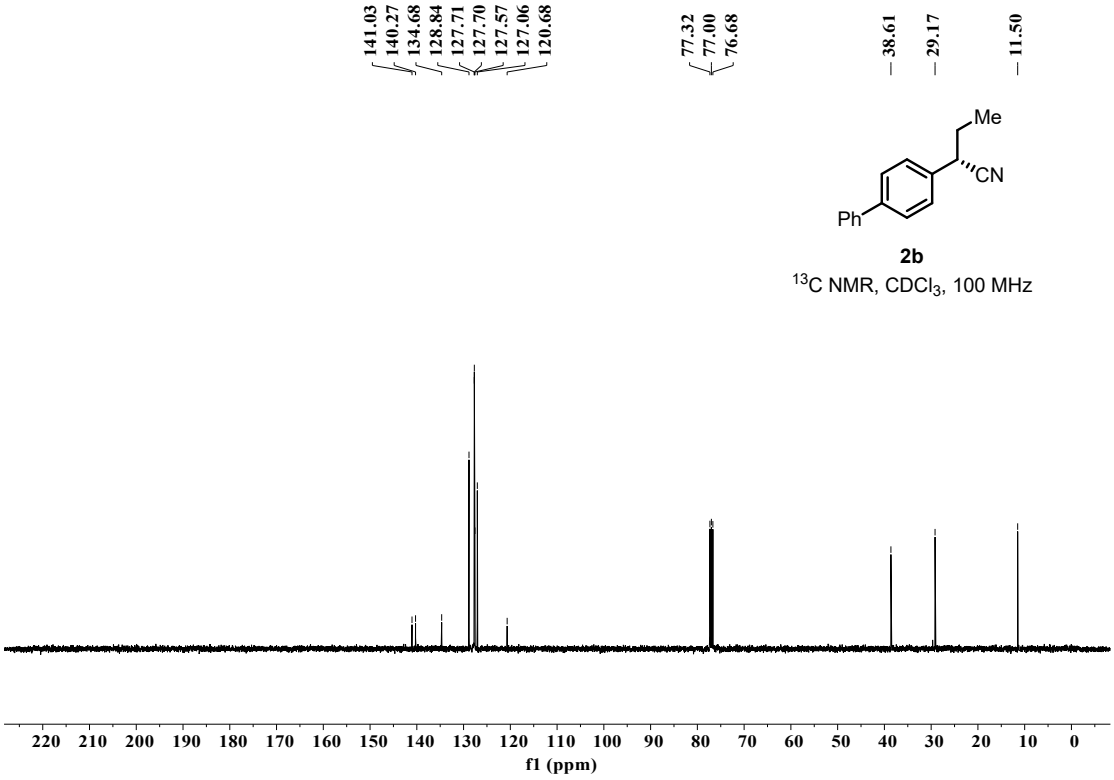
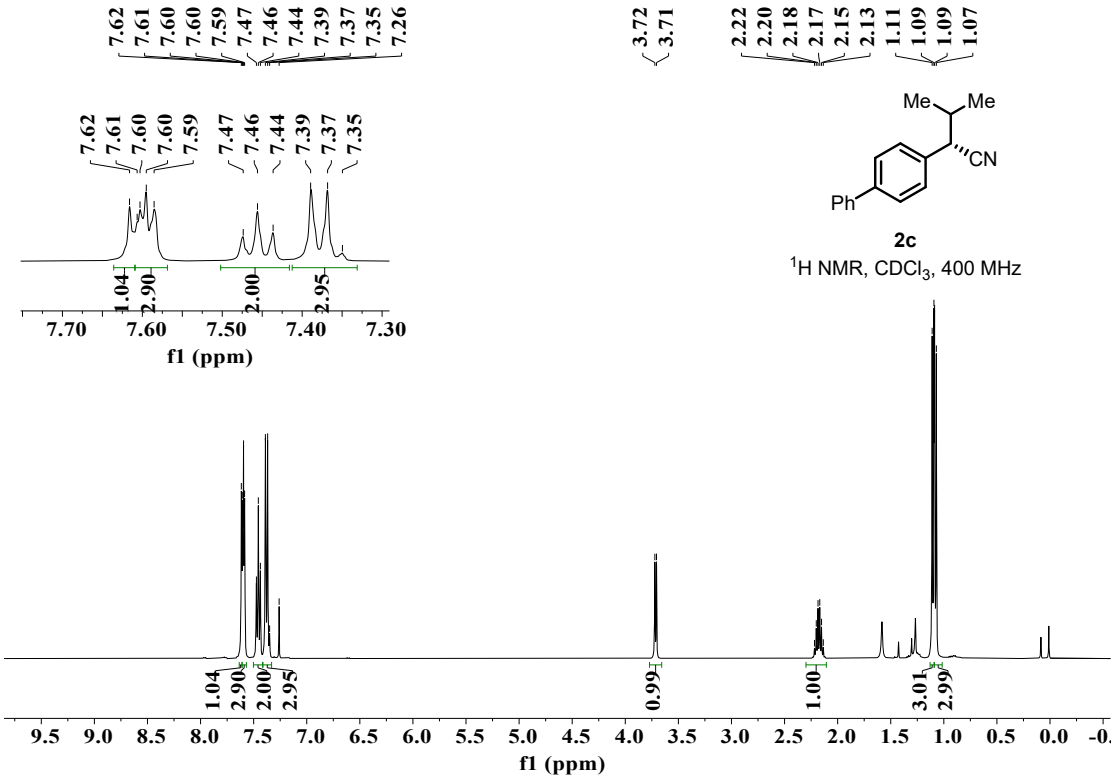
# 7. NMR spectra of products:




7.62 7.60 7.58 7.47 7.47 7.45 7.45 7.44 7.43 7.41 7.41 7.39 7.39 7.38 7.37 7.37 7.36 7.35 7.35 7.35 7.26 3.81 3.79 3.77 2.04 2.03 2.01 1.99 1.97 1.95 1.14 1.12 1.10
4.08
4.97
7.70 7.60 7.50 7.40 7.30
f1 (ppm)
Me
CN
Ph
2b
1H NMR, CDCl3, 400 MHz
4.00
4.98
1.00
2.06
3.07
11.5 10.5 9.5 8.5 7.5 6.5 5.5 4.5 3.5 2.5 1.5 0.5 -0.5
f1 (ppm)


141.03 140.27 134.68 128.84 127.71 127.70 127.57 127.06 120.68
77.32 77.00 76.68
38.61 29.17 11.50
Me
CN
Ph
2b
13C NMR, CDCl3, 100 MHz
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

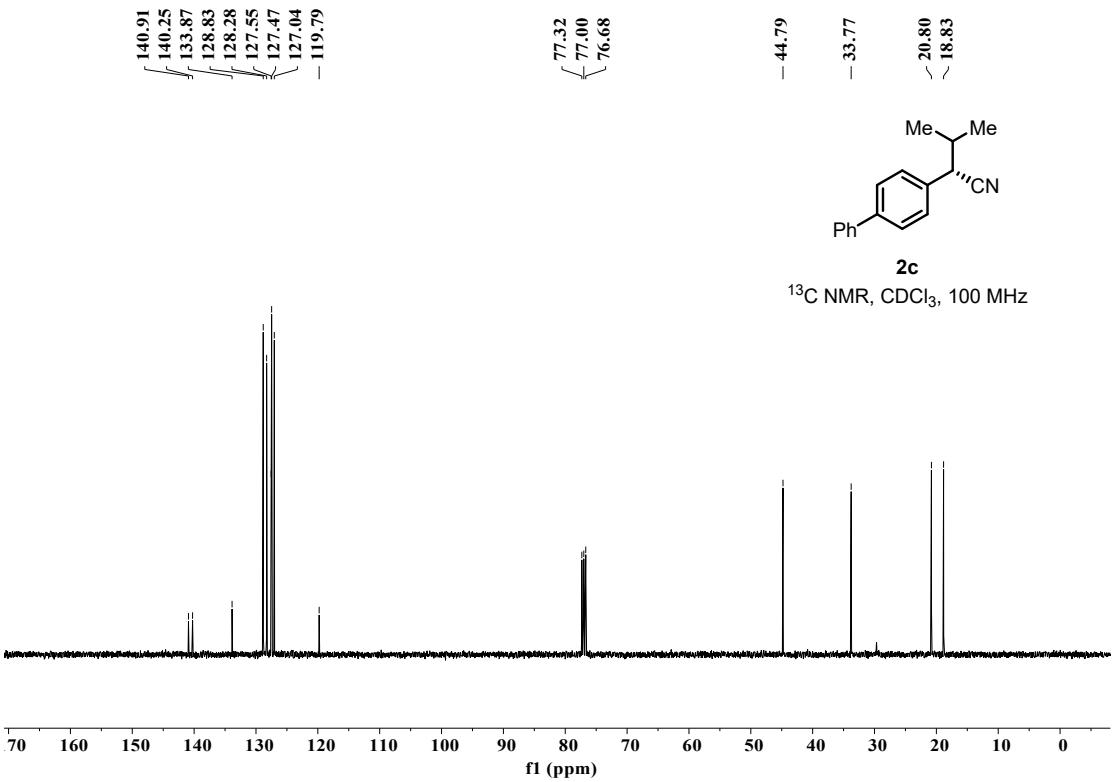






**2c**

$^{1}$H NMR, $CDCl_3$, 400 MHz

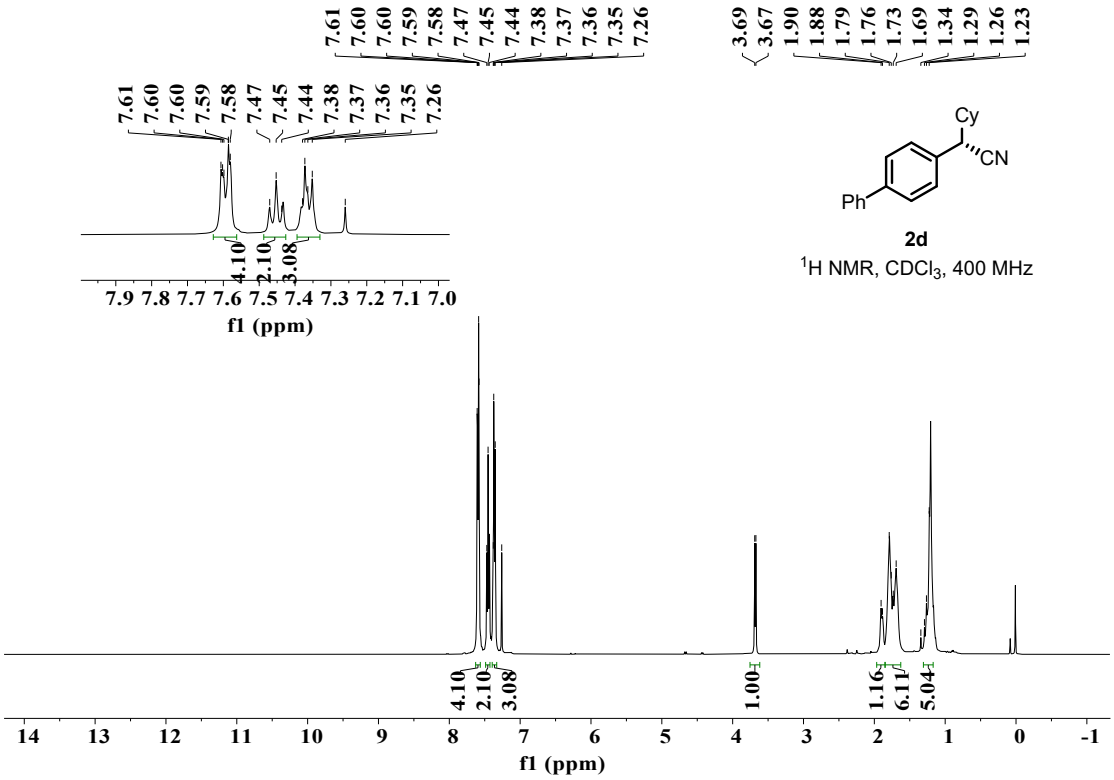






**2c**

$^{13}$C NMR, $CDCl_3$, 100 MHz


7.61 7.60 7.60 7.59 7.58 7.47 7.45 7.44 7.38 7.37 7.36 7.35 7.26
3.69 3.67 1.90 1.88 1.79 1.76 1.73 1.69 1.34 1.29 1.26 1.23
Cy
CN
Ph
2d
1H NMR, CDCl3, 400 MHz
4.10 2.10 3.08
7.9 7.8 7.7 7.6 7.5 7.4 7.3 7.2 7.1 7.0
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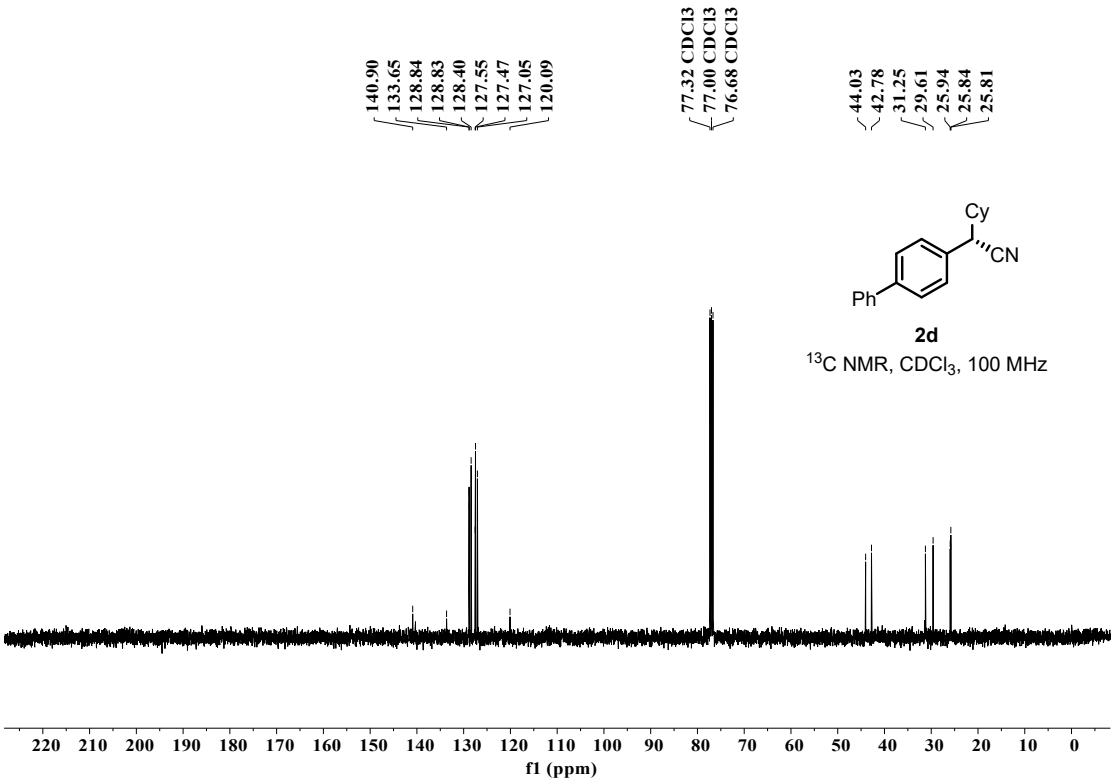
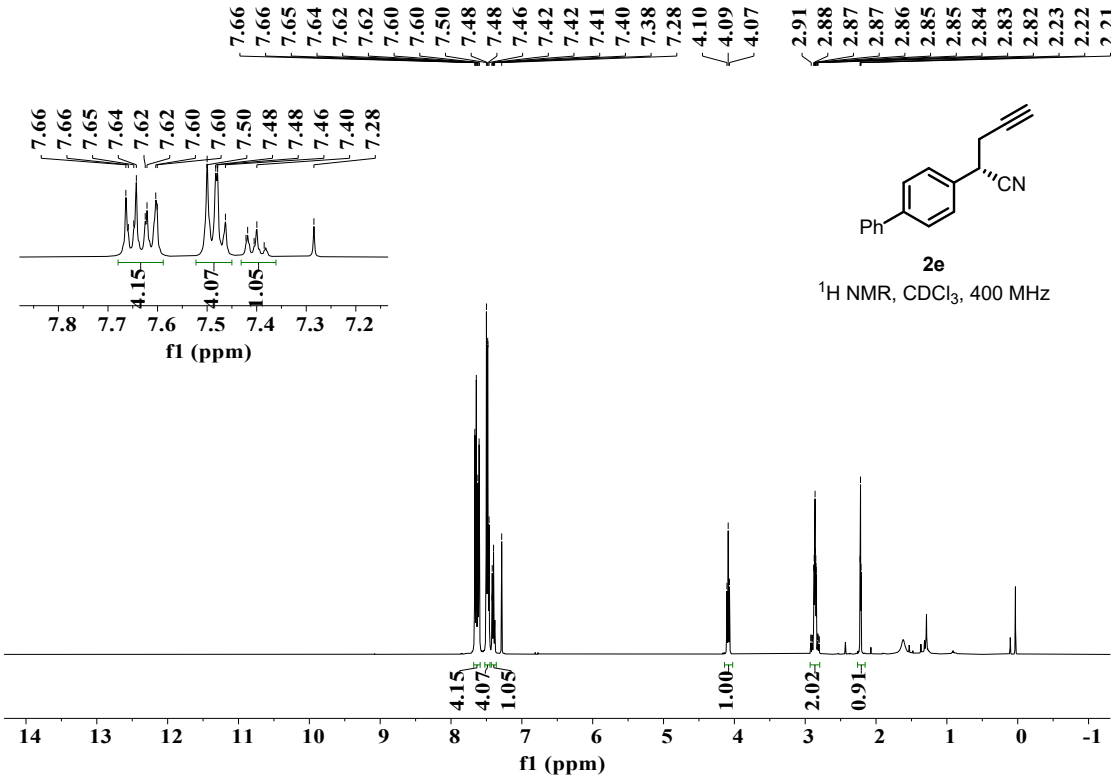
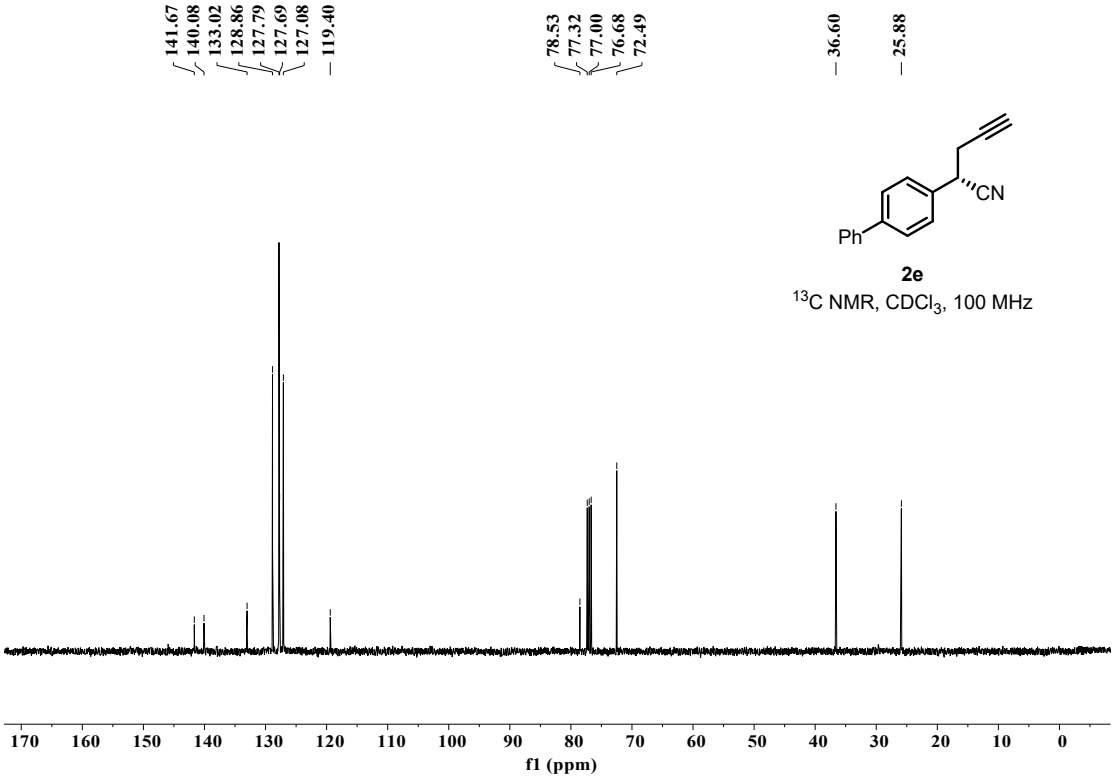
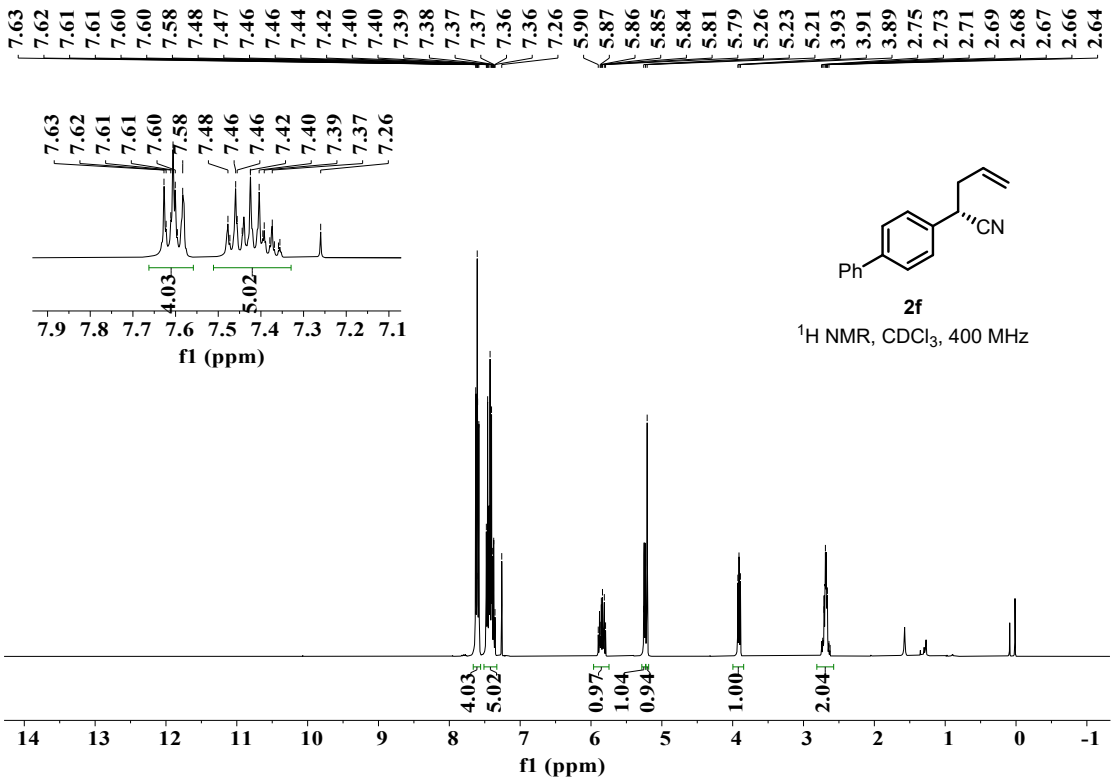
4.10 2.10 3.08 1.00 1.16 6.11 5.04
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)


140.90 133.65 128.84 128.83 128.40 127.55 127.47 127.05 120.09
77.32 CDCl3 77.00 CDCl3 76.68 CDCl3
44.03 42.78 31.25 29.61 25.94 25.84 25.81
Cy
CN
Ph
2d
13C NMR, CDCl3, 100 MHz
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.66 7.66 7.65 7.64 7.62 7.62 7.60 7.60 7.50 7.48 7.48 7.46 7.42 7.42 7.41 7.40 7.38 7.28 4.10 4.09 4.07
2.91 2.88 2.87 2.87 2.86 2.85 2.85 2.84 2.83 2.82 2.23 2.22
7.66 7.66 7.65 7.64 7.62 7.62 7.60 7.60 7.50 7.48 7.48 7.46 7.40 7.28
4.15 4.07 1.05
7.8 7.7 7.6 7.5 7.4 7.3 7.2
f1 (ppm)
CN
Ph
2e
1H NMR, CDCl3, 400 MHz
4.15 4.07 1.05 1.00 2.02 0.91
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)


141.67 140.08 133.02 128.86 127.79 127.69 127.08 119.40
78.53 77.32 77.00 76.68 72.49
36.60 25.88
CN
Ph
2e
13C NMR, CDCl3, 100 MHz
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.63 7.62 7.61 7.61 7.60 7.60 7.58 7.48 7.47 7.46 7.46 7.44 7.42 7.40 7.40 7.39 7.38 7.37 7.37 7.36 7.36 7.26 5.90 5.87 5.86 5.85 5.84 5.81 5.79 5.26 5.23 5.21 3.93 3.91 3.89 2.75 2.73 2.71 2.69 2.68 2.67 2.66 2.64
4.03
5.02
f1 (ppm)
CN
Ph
2f
1H NMR, CDCl3, 400 MHz
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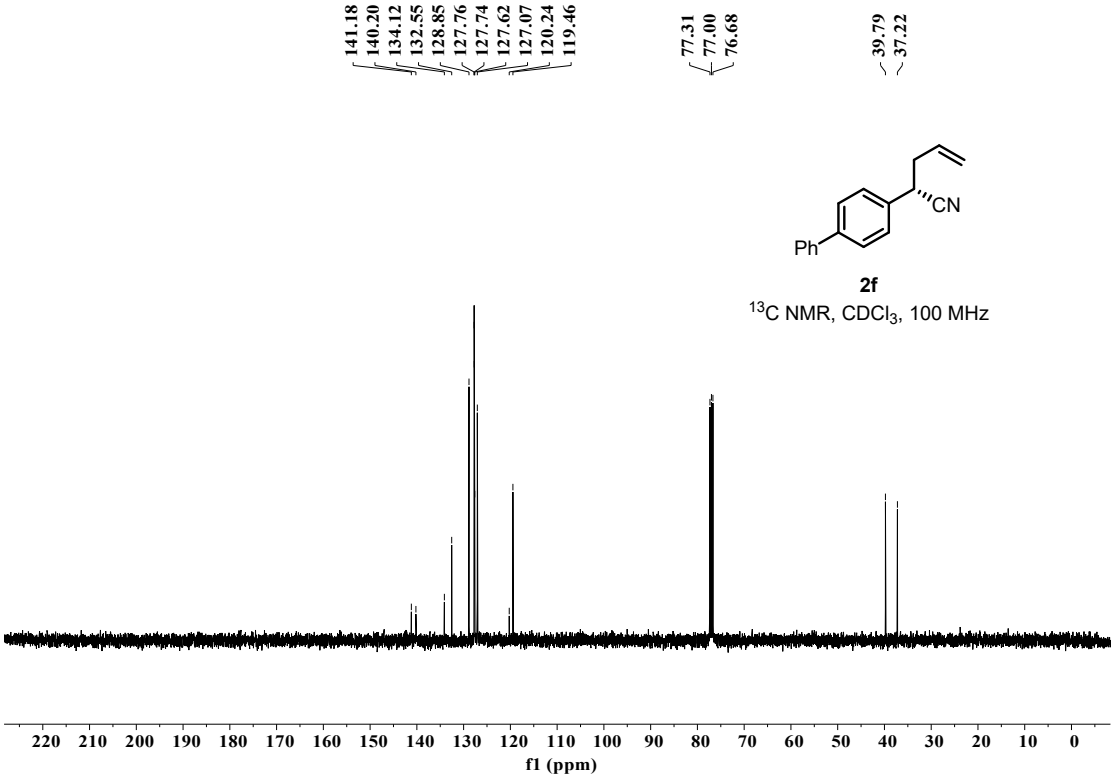
1.04
0.94
1.00
2.04
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)


141.18 140.20 134.12 132.55 128.85 127.76 127.74 127.62 127.07 120.24 119.46
77.31 77.00 76.68
39.79 37.22
CN
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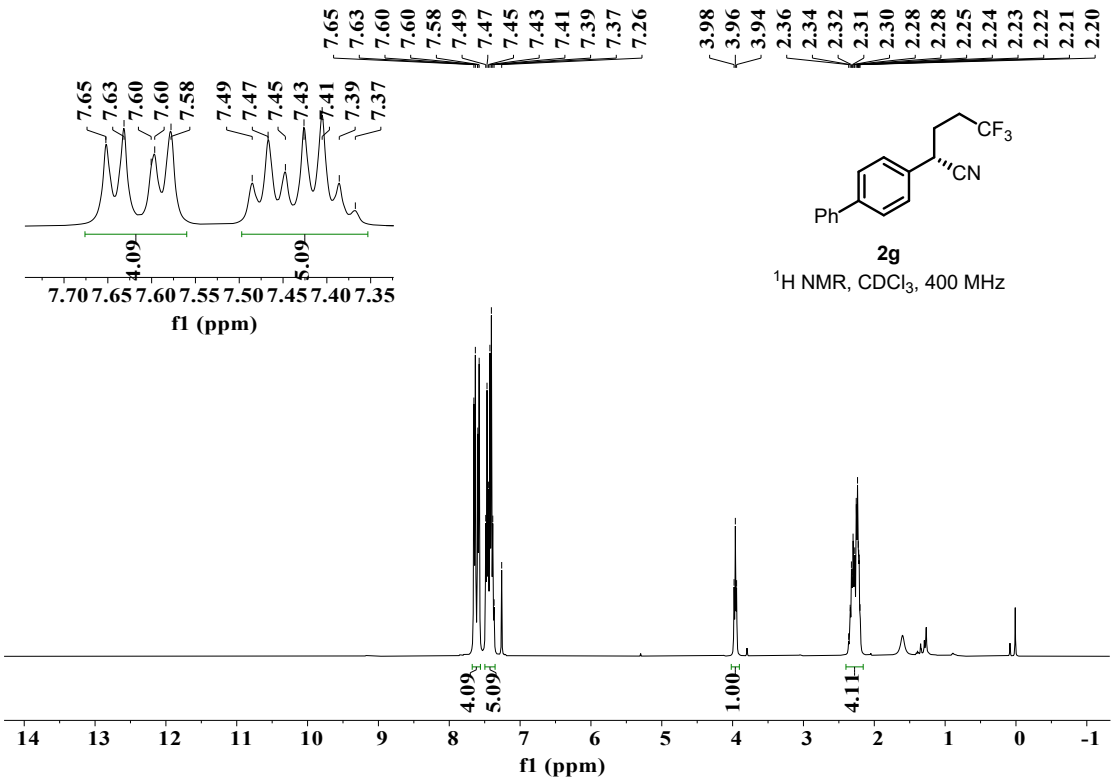
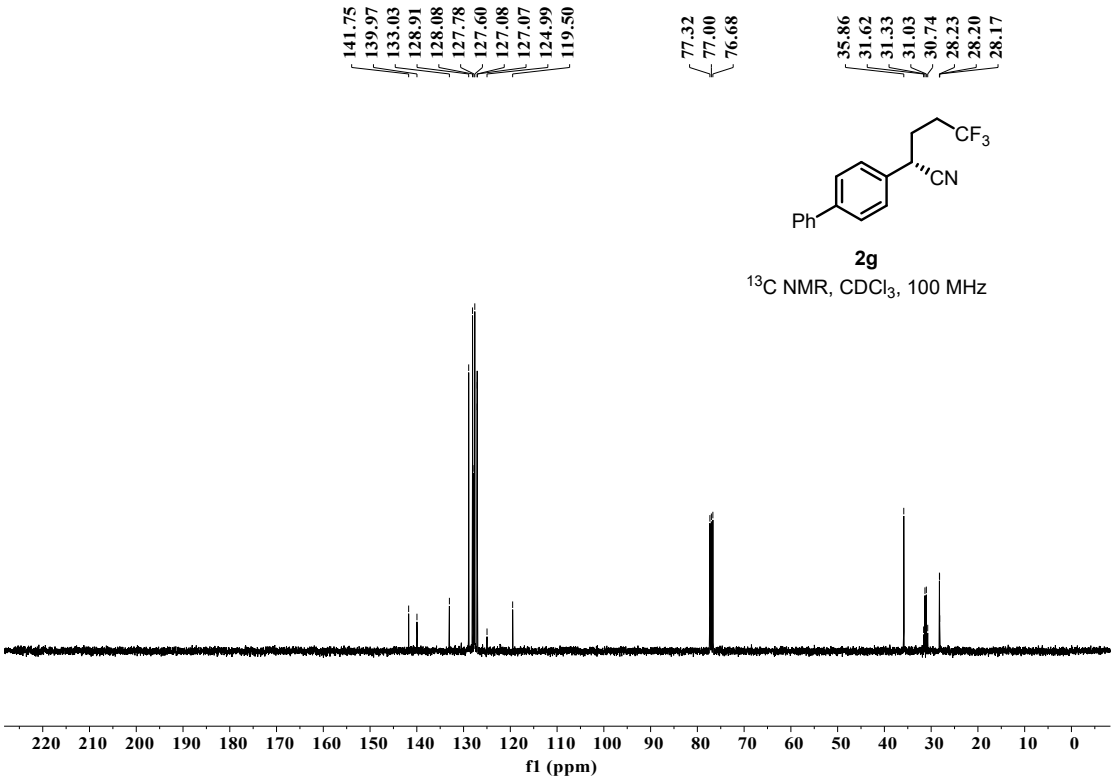
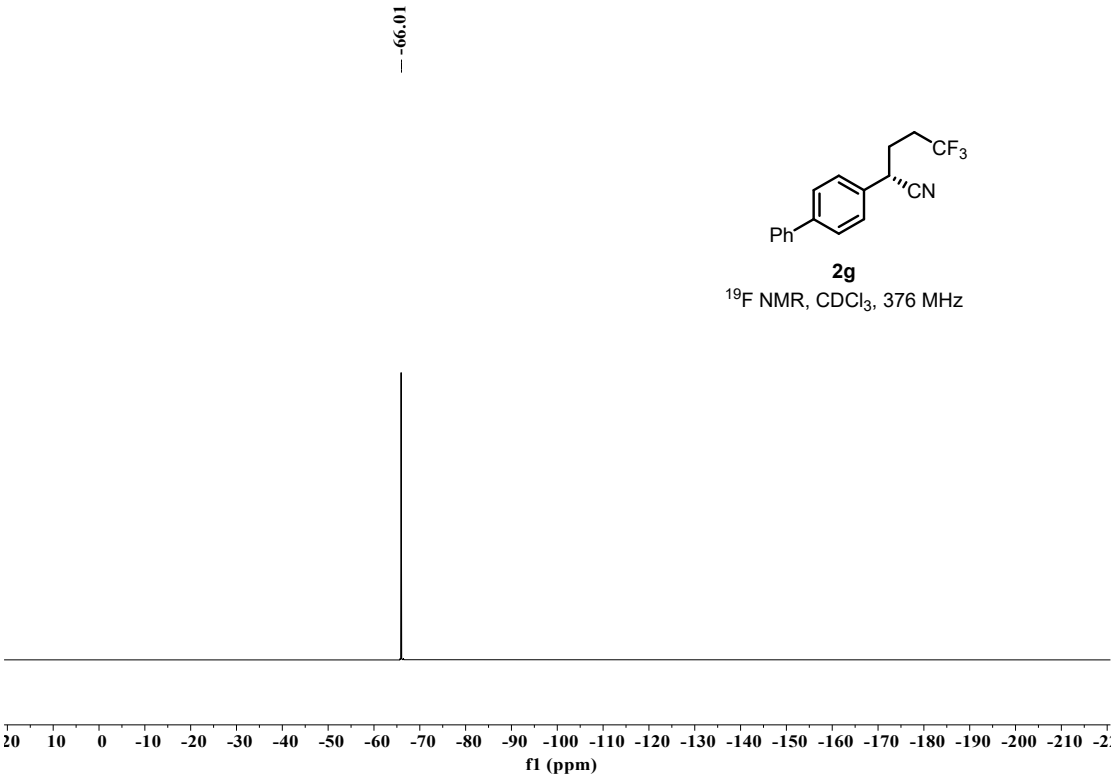
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.65 7.63 7.60 7.60 7.58 7.49 7.47 7.45 7.43 7.41 7.39 7.37 7.26
3.98 3.96 3.94 2.36 2.34 2.32 2.31 2.30 2.28 2.28 2.25 2.24 2.23 2.22 2.21 2.20
CF3
CN
Ph
2g
1H NMR, CDCl3, 400 MHz
4.09
5.09
7.70 7.65 7.60 7.55 7.50 7.45 7.40 7.35
f1 (ppm)
4.09
5.09
1.00
4.11
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)


141.75 139.97 133.03 128.91 128.08 127.78 127.60 127.08 127.07 124.99 119.50
77.32 77.00 76.68
35.86 31.62 31.33 31.03 30.74 28.23 28.20 28.17
CF3
CN
Ph
2g
13C NMR, CDCl3, 100 MHz
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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CF3
CN
Ph
2g
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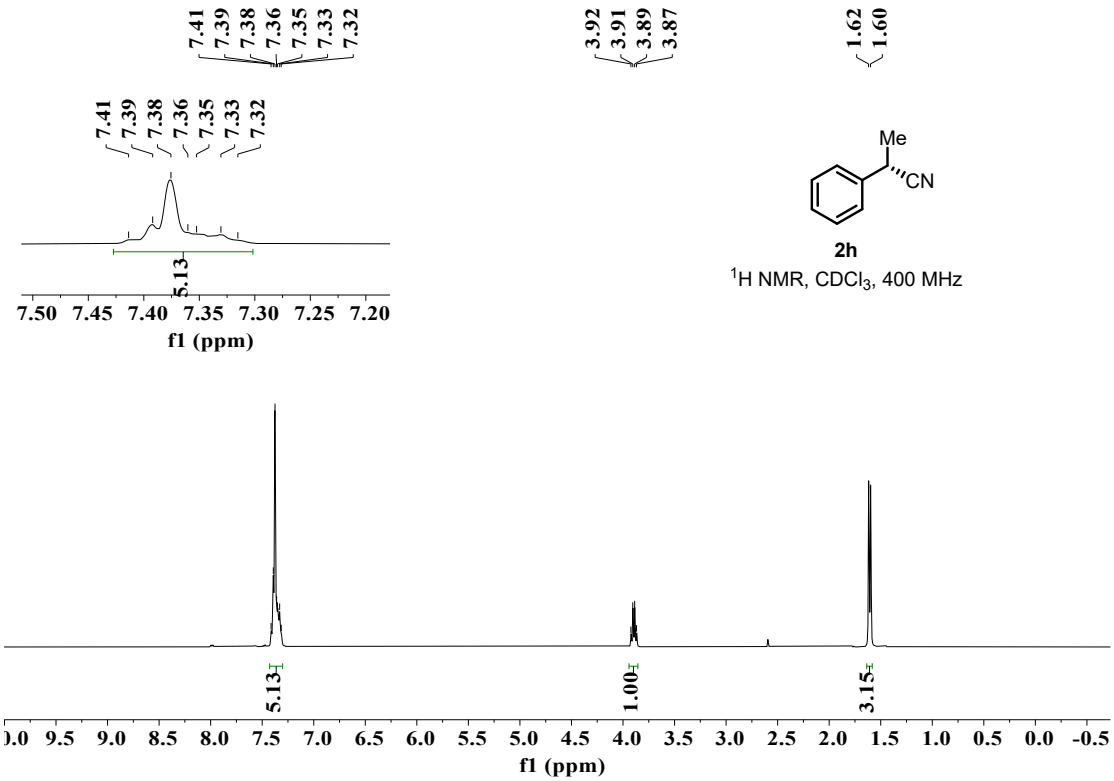
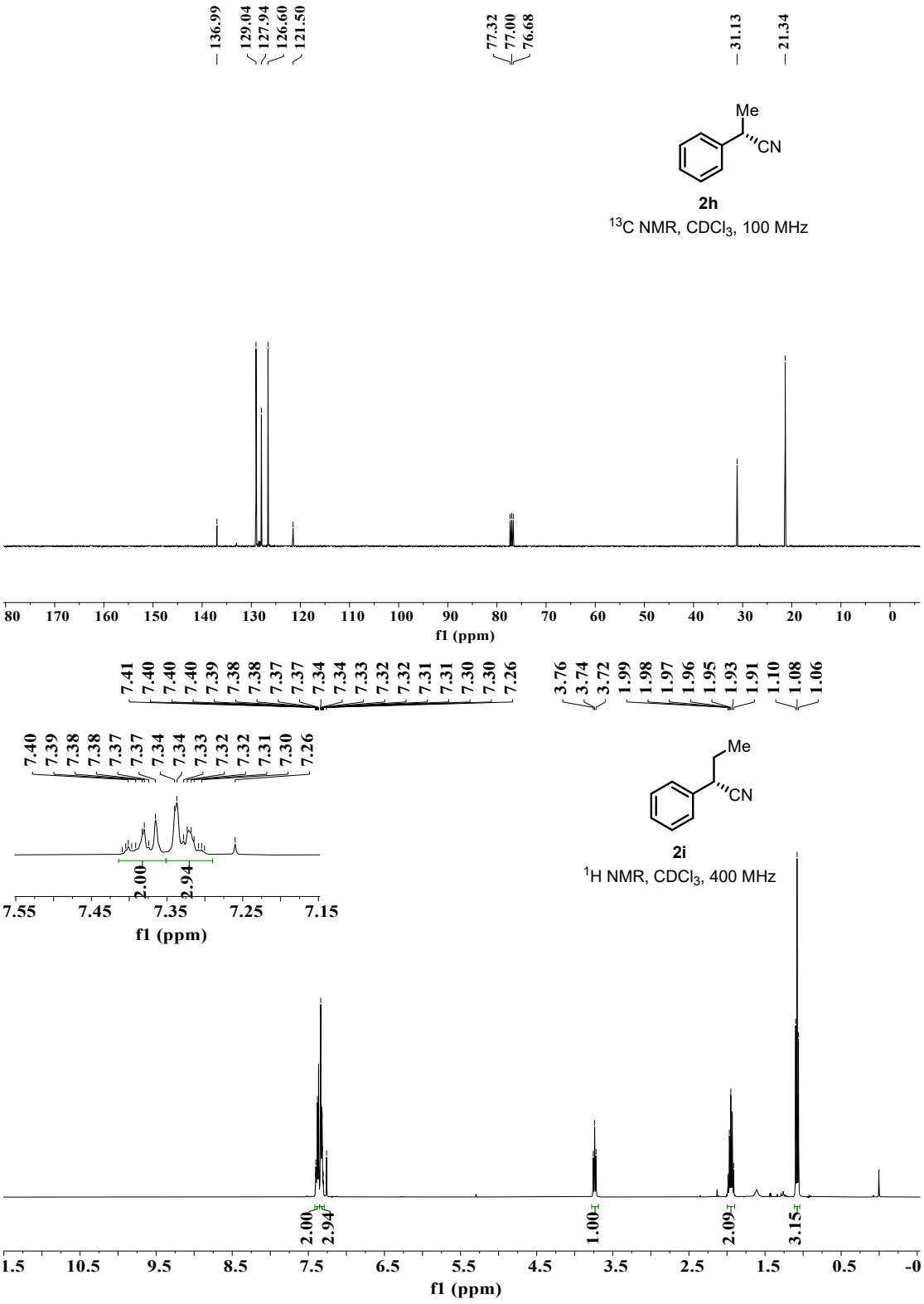
f1 (ppm)


7.41
7.39
7.38
7.36
7.35
7.33
7.32
3.92
3.91
3.89
3.87
1.62
1.60
Me
CN
2h
1H NMR, CDCl3, 400 MHz
5.13
1.00
3.15
f1 (ppm)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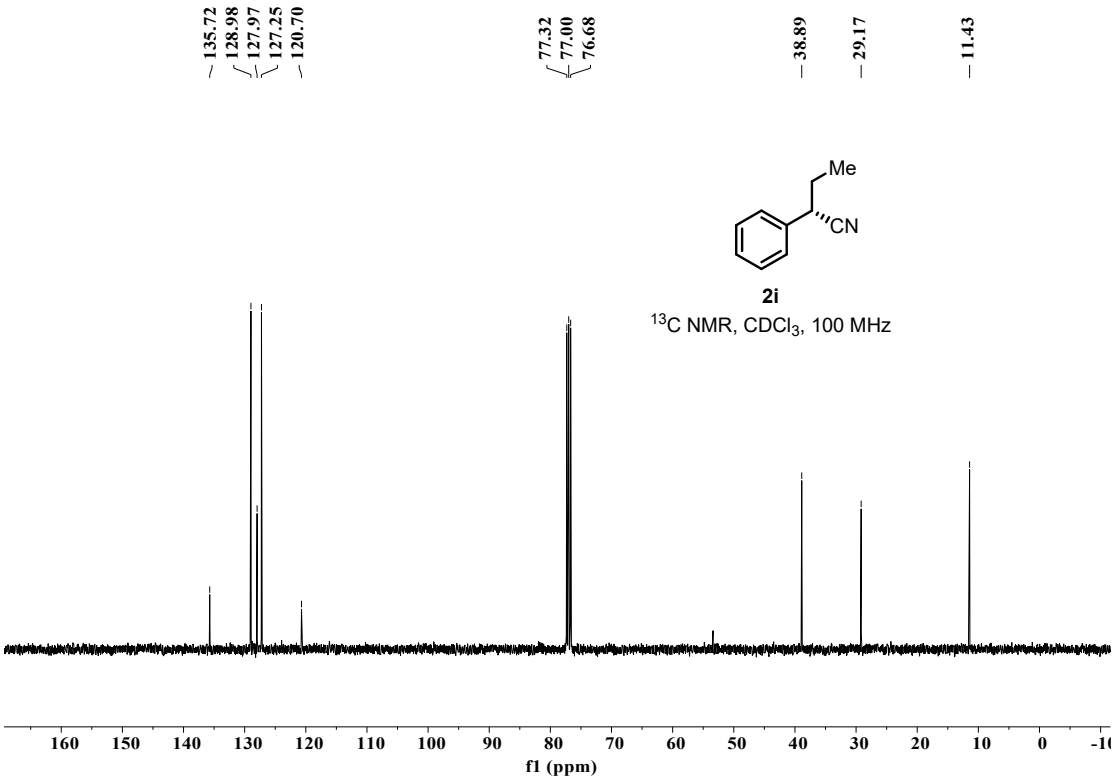
129.04
127.94
126.60
121.50
77.32
77.00
76.68
31.13
21.34
Me
CN
2h
13C NMR, CDCl3, 100 MHz
f1 (ppm)
7.41
7.40
7.40
7.40
7.39
7.38
7.38
7.37
7.37
7.34
7.34
7.33
7.32
7.32
7.31
7.31
7.30
7.30
7.26
3.76
3.74
3.72
1.99
1.98
1.97
1.96
1.95
1.93
1.91
1.10
1.08
1.06
2.00
2.94
Me
CN
2i
1H NMR, CDCl3, 400 MHz
1.00
2.09
3.15
f1 (ppm)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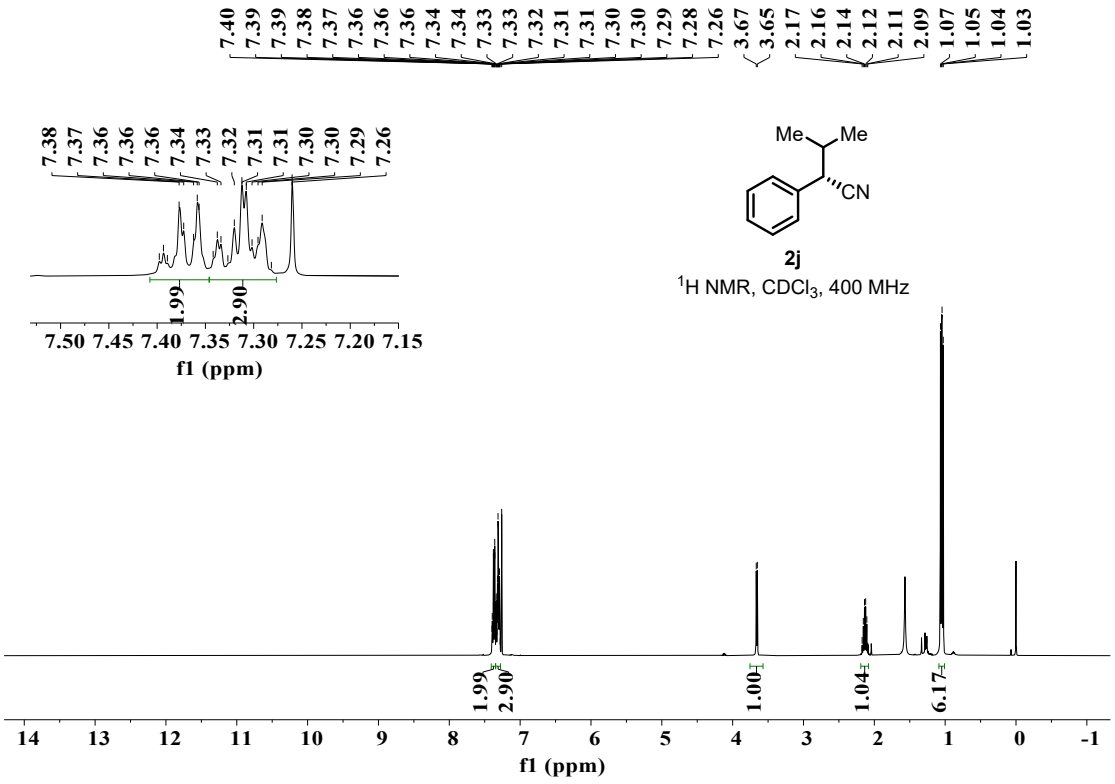
128.98
127.97
127.25
120.70
77.32
77.00
76.68
38.89
29.17
11.43
Me
CN
2i
13C NMR, CDCl3, 100 MHz
f1 (ppm)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7.39
7.39
7.38
7.37
7.36
7.36
7.36
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7.33
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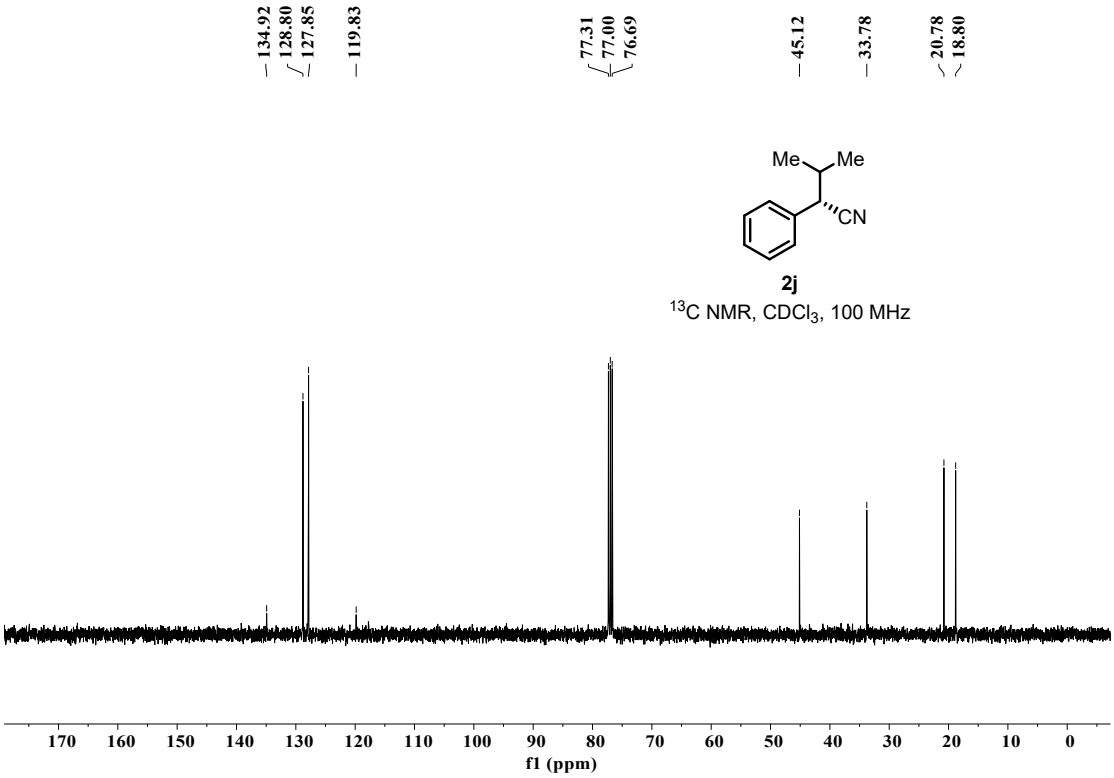
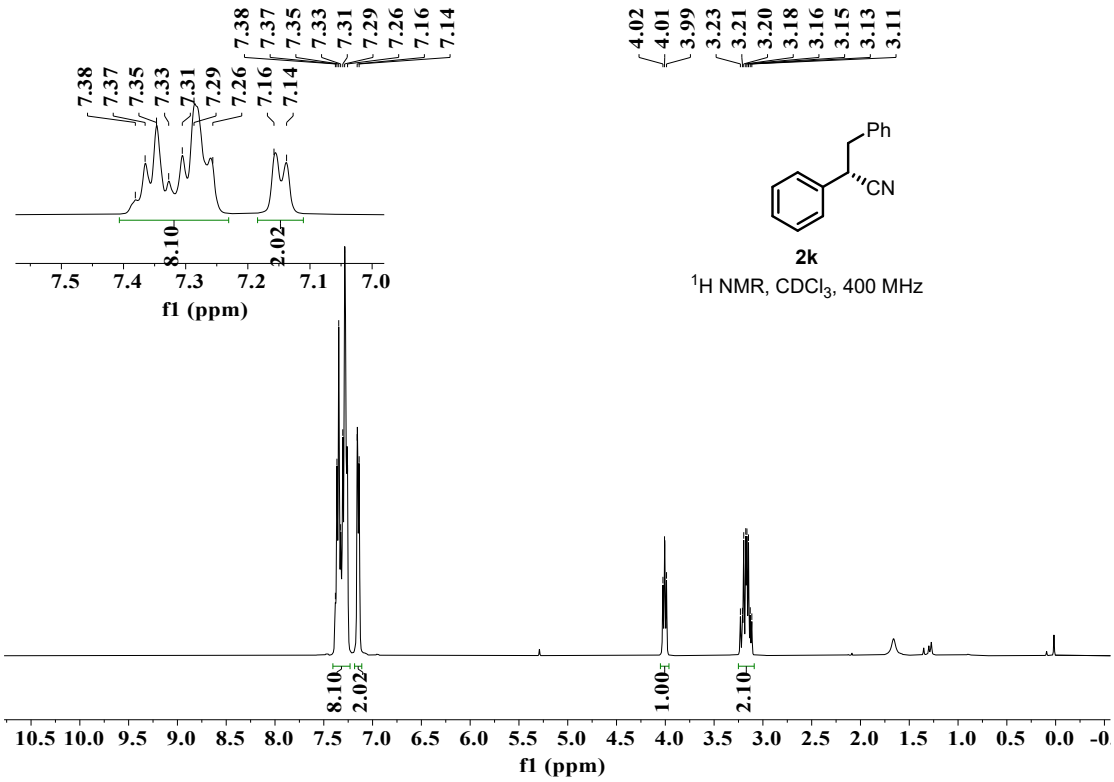
7.32
7.31
7.31
7.30
7.30
7.29
7.28
7.26
3.67
3.65
2.17
2.16
2.14
2.12
2.11
2.09
1.07
1.05
1.04
1.03
Me
Me
CN
2j
1H NMR, CDCl3, 400 MHz
1.99
2.90
1.00
1.04
6.17
f1 (ppm)



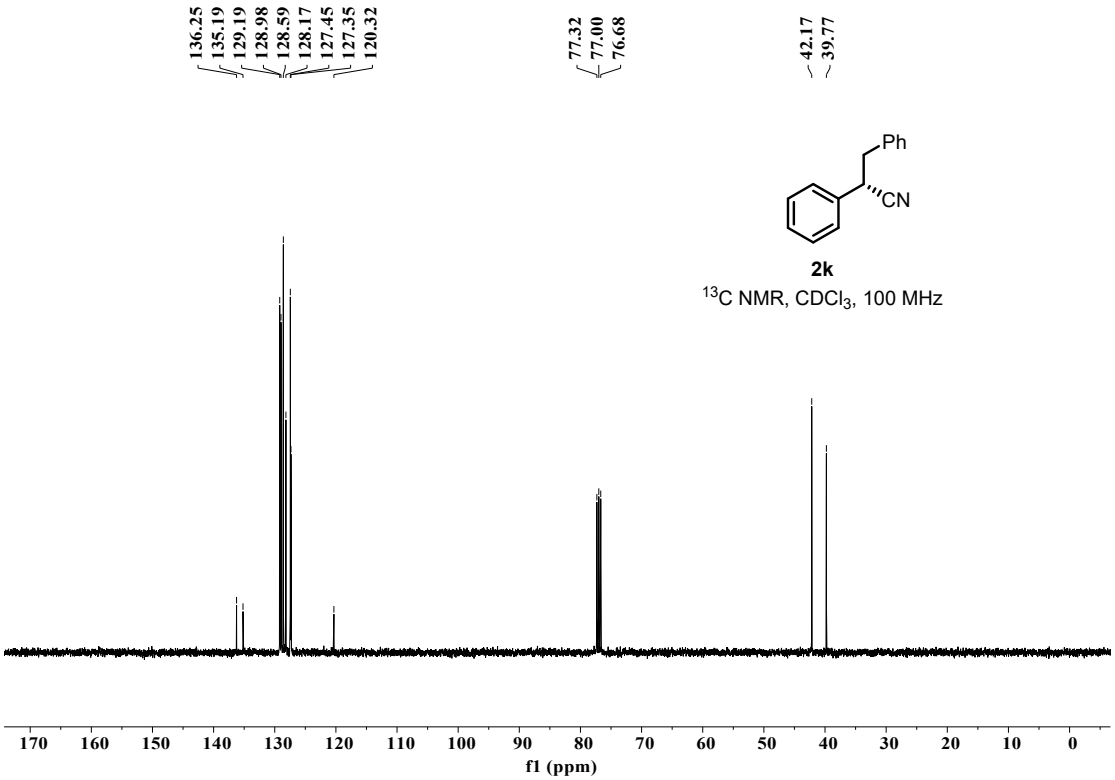

**2j**

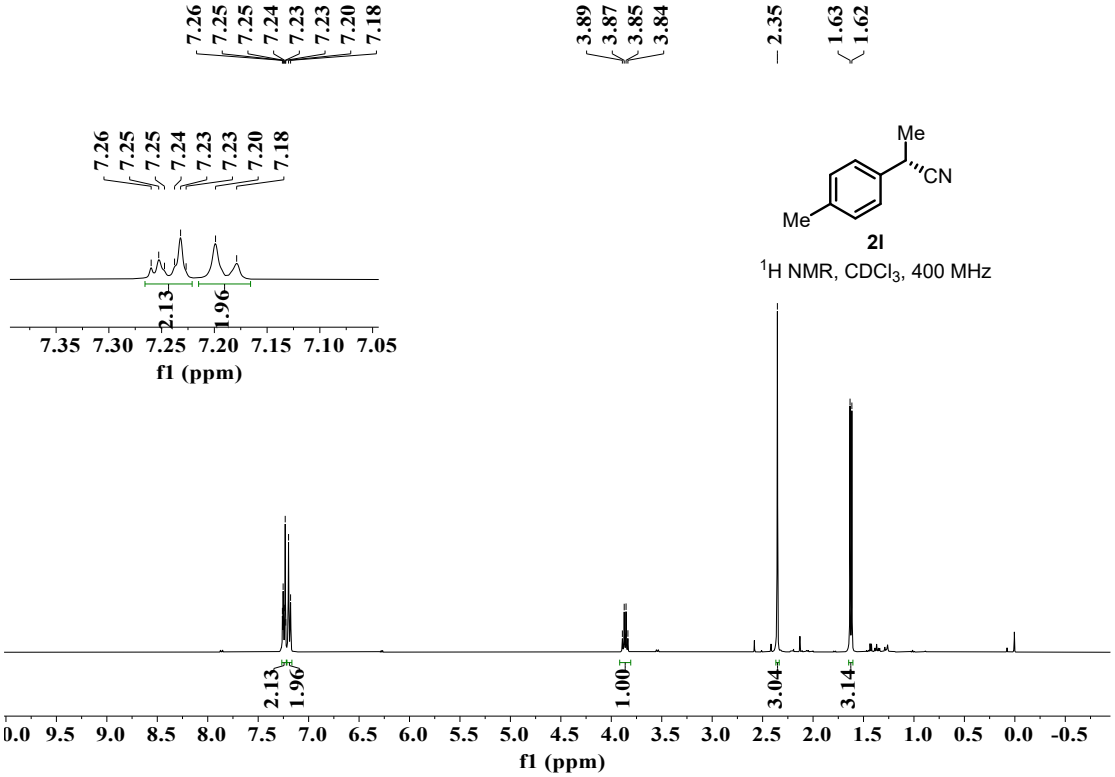
$^{13}$C NMR, $CDCl_3$, 100 MHz

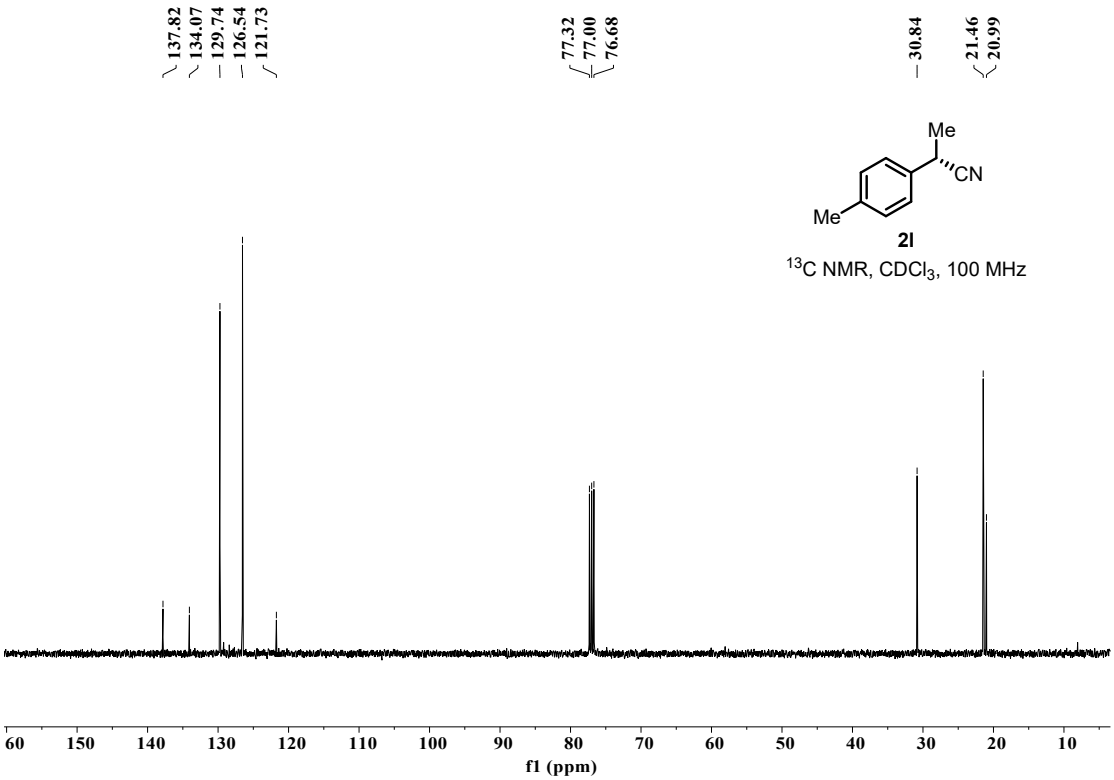


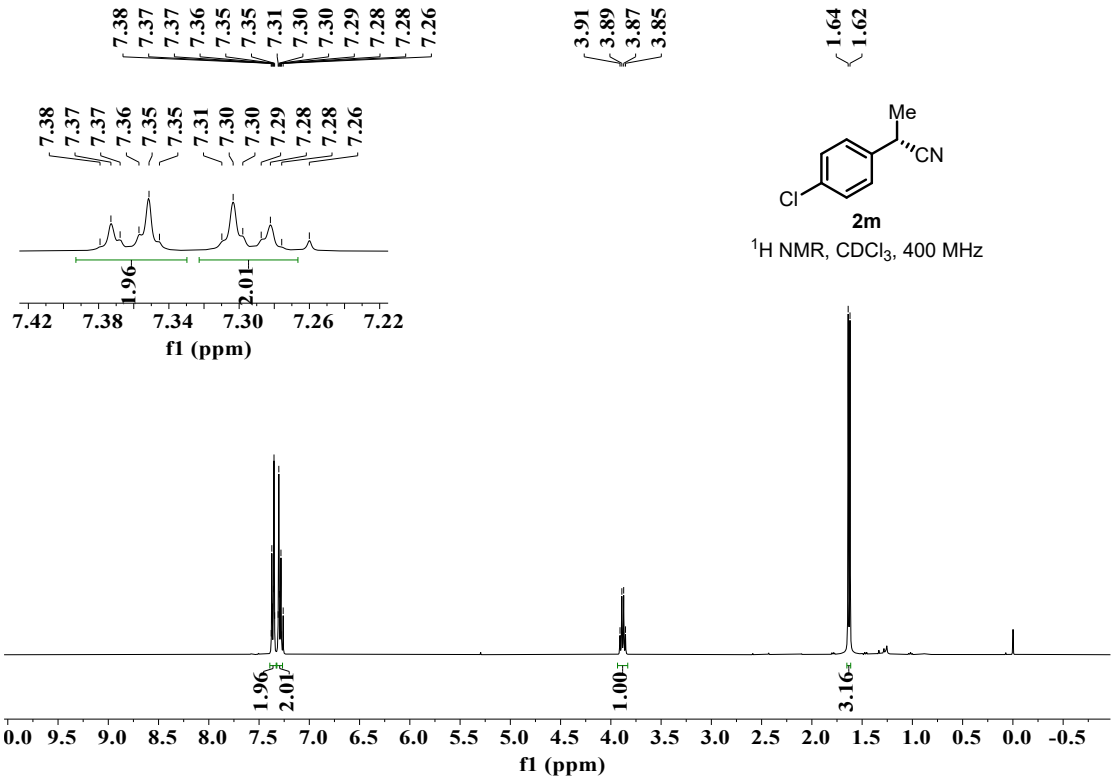

**2k**

$^{1}$H NMR, $CDCl_3$, 400 MHz


136.25
135.19
129.19
128.98
128.59
128.17
127.45
127.35
120.32
77.32
77.00
76.68
42.17
39.77
Ph
CN
2k
13C NMR, CDCl3, 100 MHz
f1 (ppm)


7.26
7.25
7.25
7.24
7.23
7.23
7.20
7.18
3.89
3.87
3.85
3.84
2.35
1.63
1.62
Me
CN
Me
2l
1H NMR, CDCl3, 400 MHz
2.13
1.96
1.00
3.04
3.14
f1 (ppm)


137.82
134.07
129.74
126.54
121.73
77.32
77.00
76.68
30.84
21.46
20.99
Me
CN
Me
2l
13C NMR, CDCl3, 100 MHz
f1 (ppm)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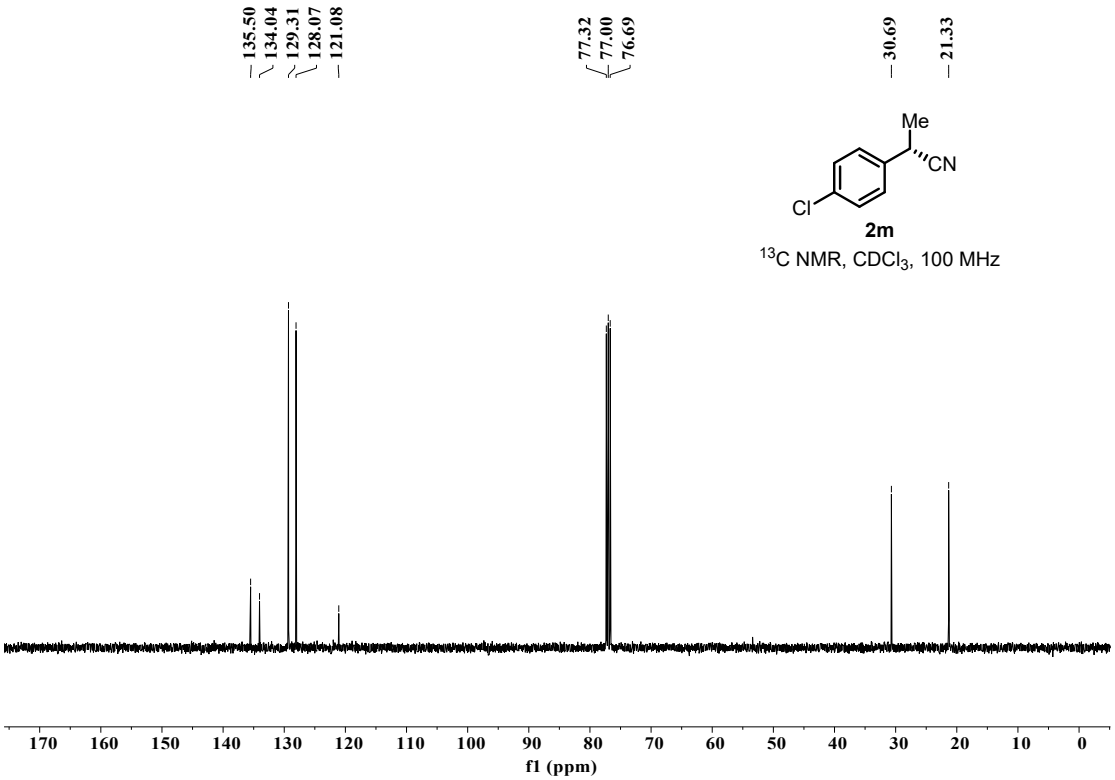
7.37
7.37
7.36
7.35
7.35
7.31
7.30
7.30
7.29
7.28
7.28
7.26
3.91
3.89
3.87
3.85
1.64
1.62
Me
CN
Cl
2m
1H NMR, CDCl3, 400 MHz
1.96
2.01
1.00
3.16
f1 (ppm)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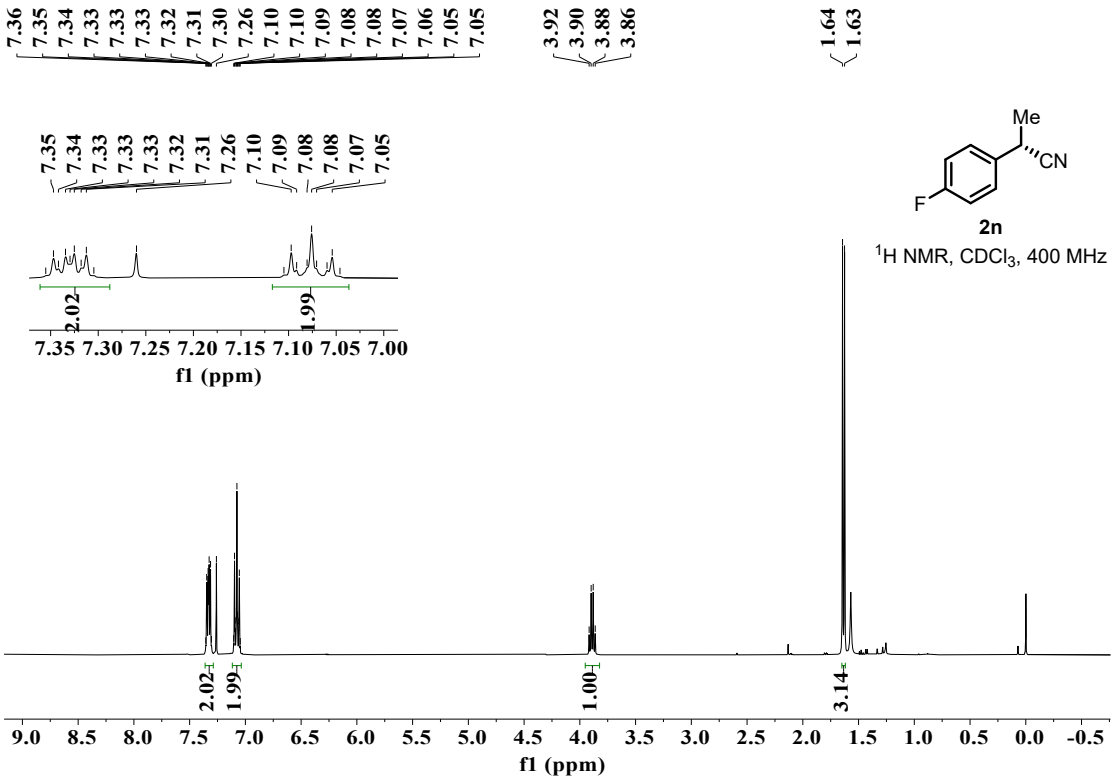
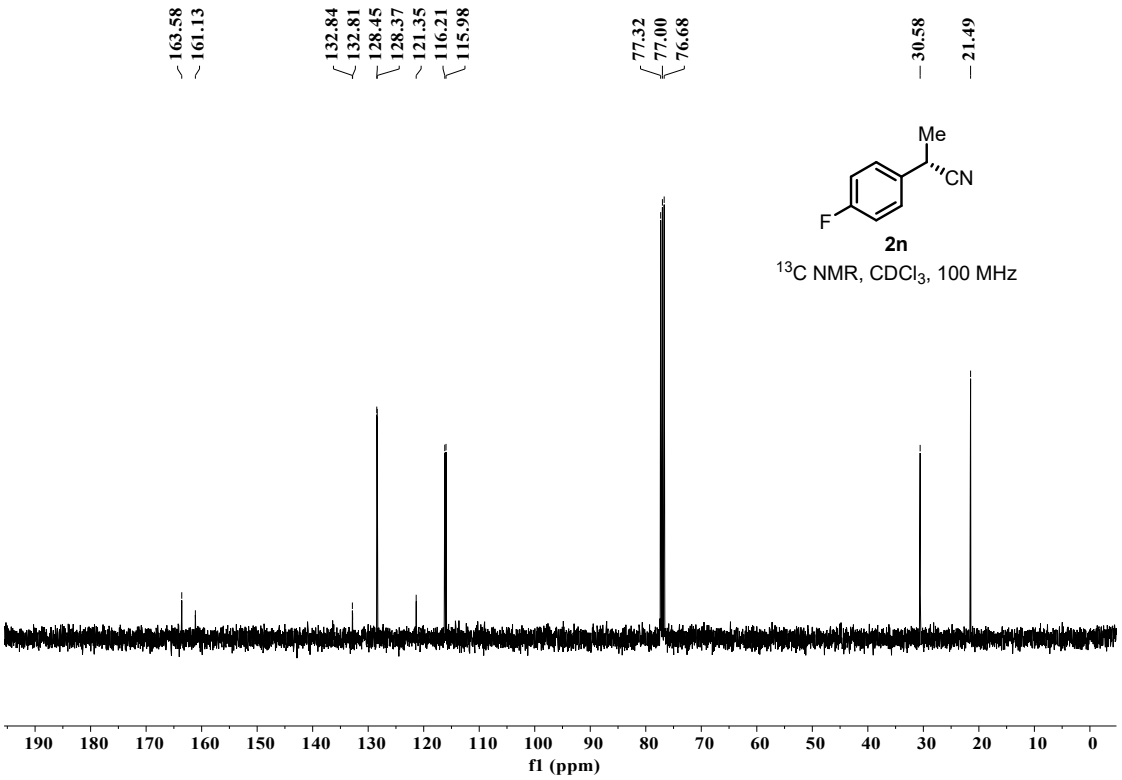
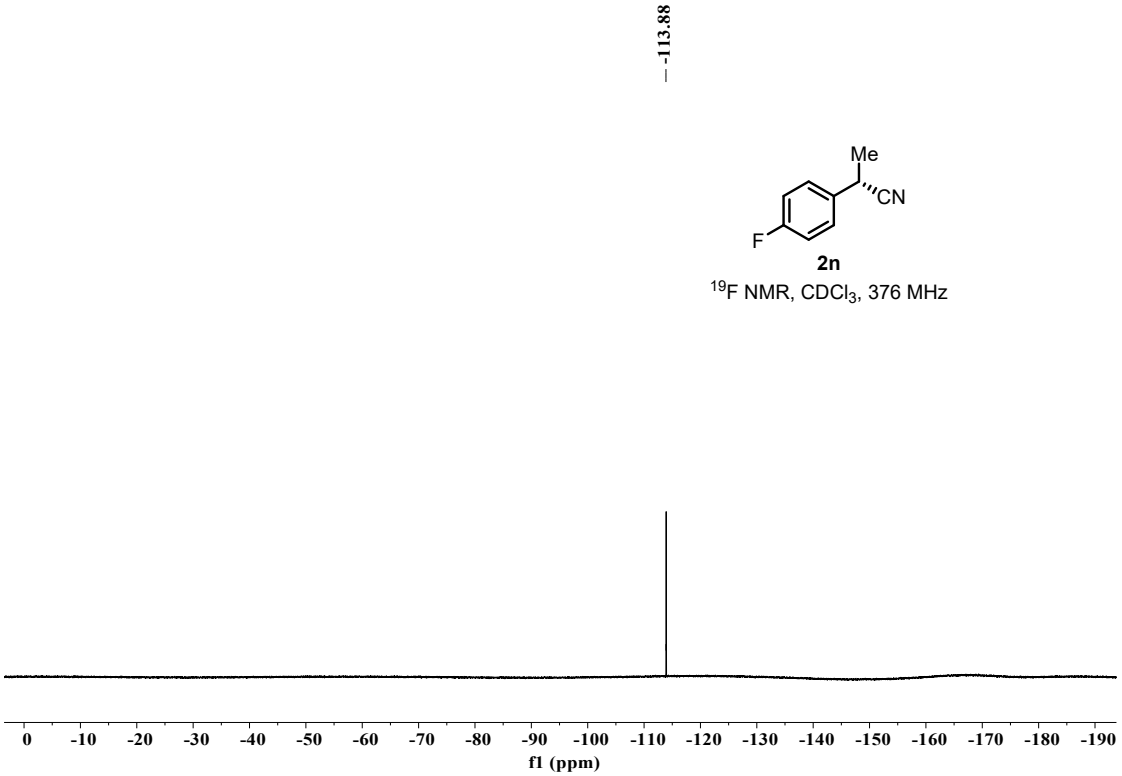
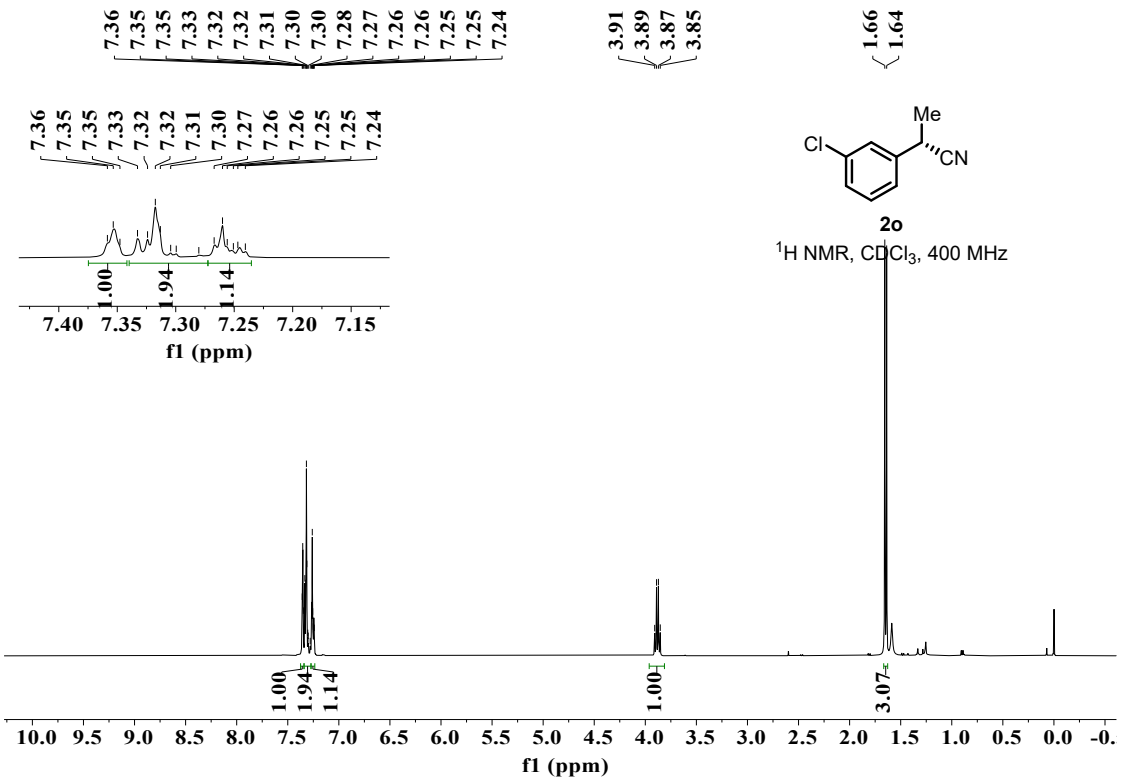
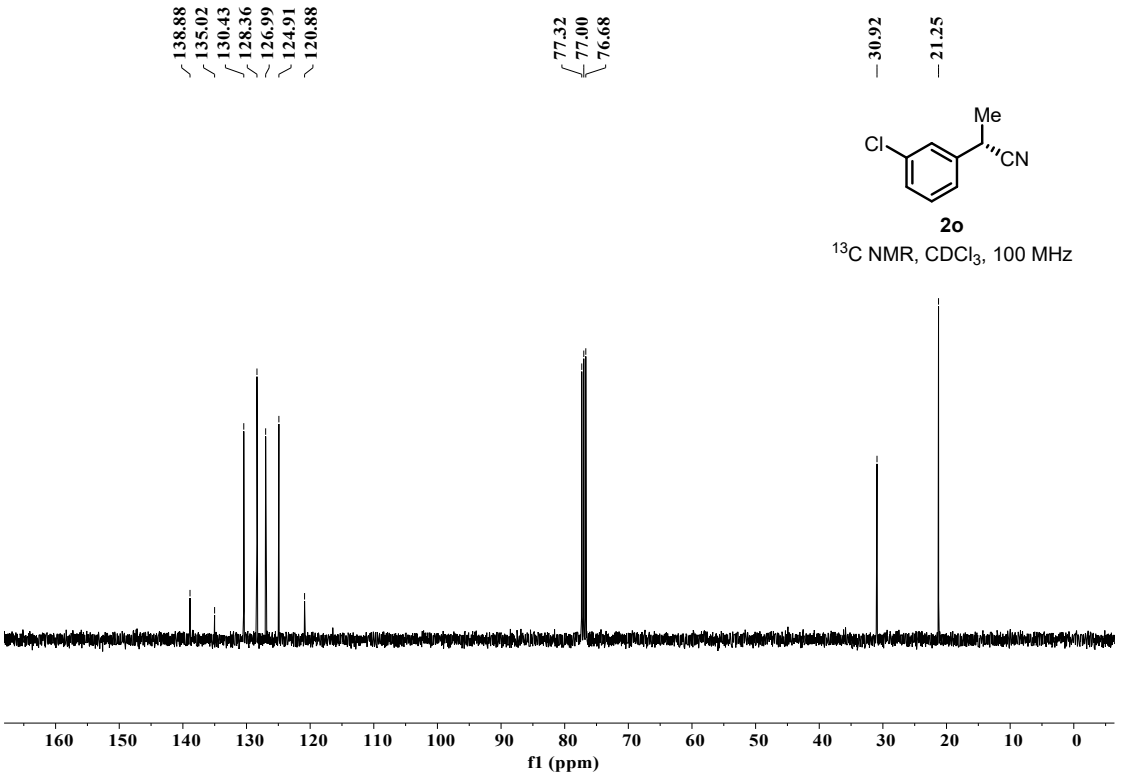
134.04
129.31
128.07
121.08
77.32
77.00
76.69
30.69
21.33
Me
CN
Cl
2m
13C NMR, CDCl3, 100 MHz
f1 (ppm)

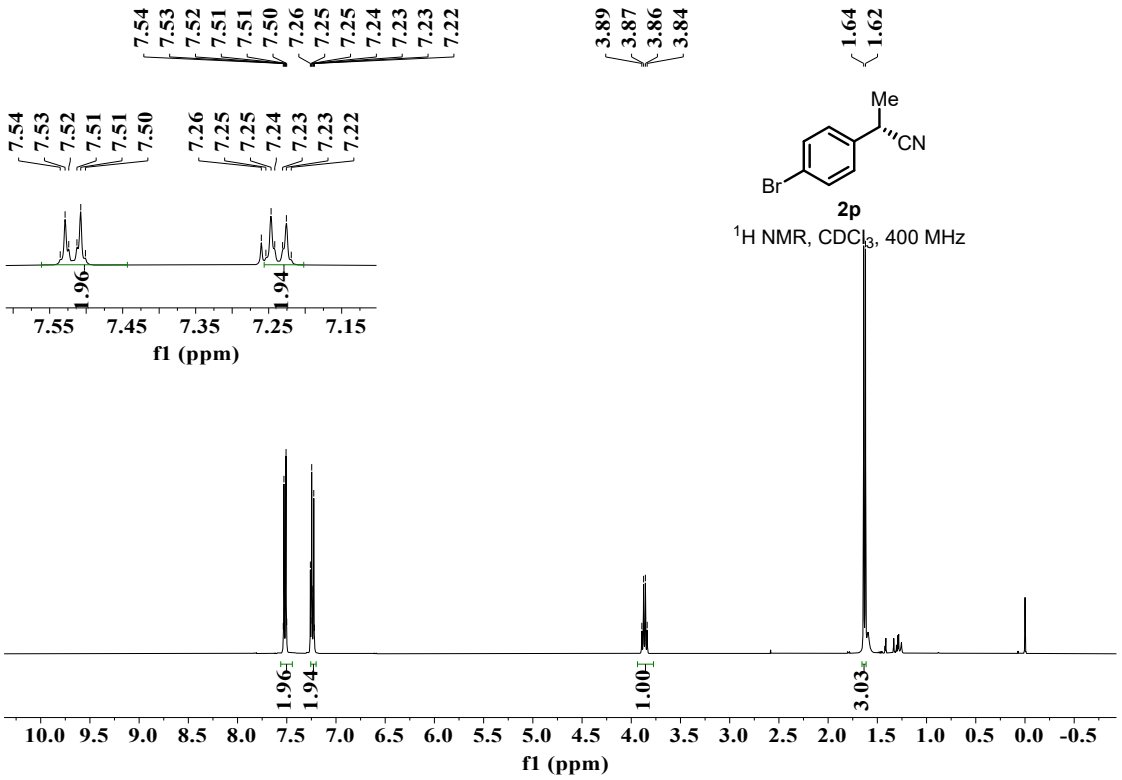

7.36
7.35
7.34
7.33
7.33
7.33
7.32
7.31
7.30
7.26
7.10
7.10
7.09
7.08
7.08
7.07
7.06
7.05
7.05
3.92
3.90
3.88
3.86
1.64
1.63
Me
CN
F
2n
1H NMR, CDCl3, 400 MHz
2.02
1.99
1.00
3.14
f1 (ppm)

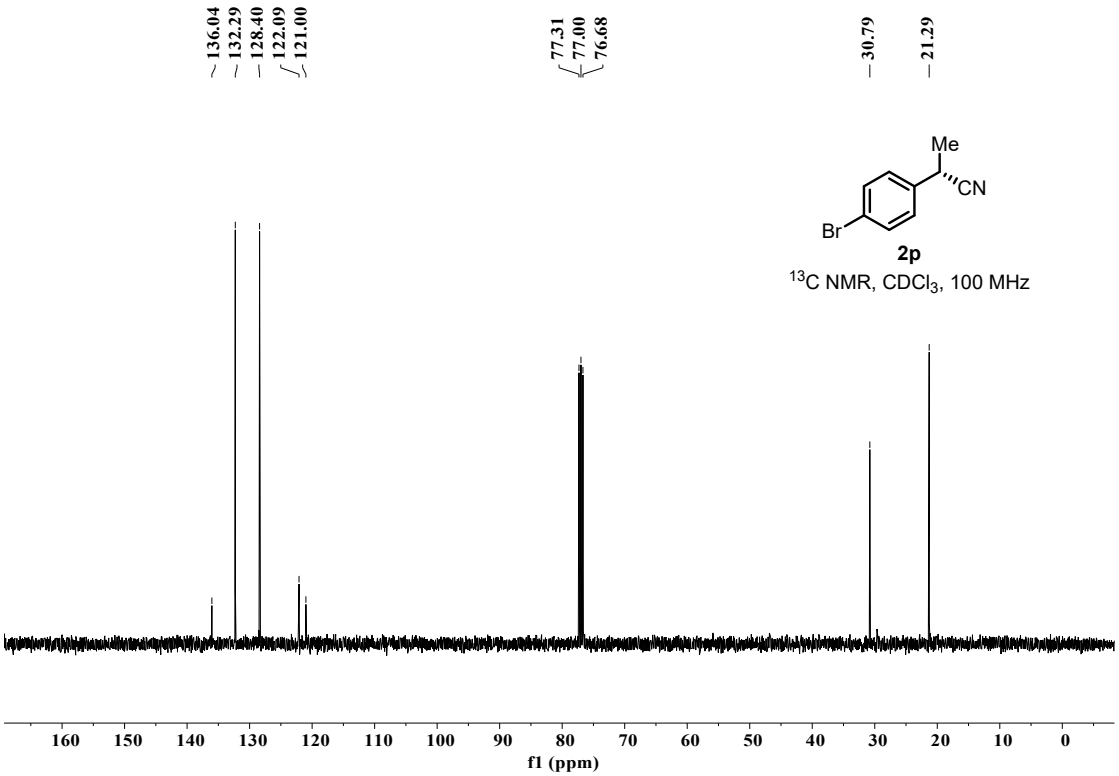

163.58
161.13
132.84
132.81
128.45
128.37
121.35
116.21
115.98
77.32
77.00
76.68
30.58
21.49
Me
CN
F
2n
13C NMR, CDCl3, 100 MHz
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

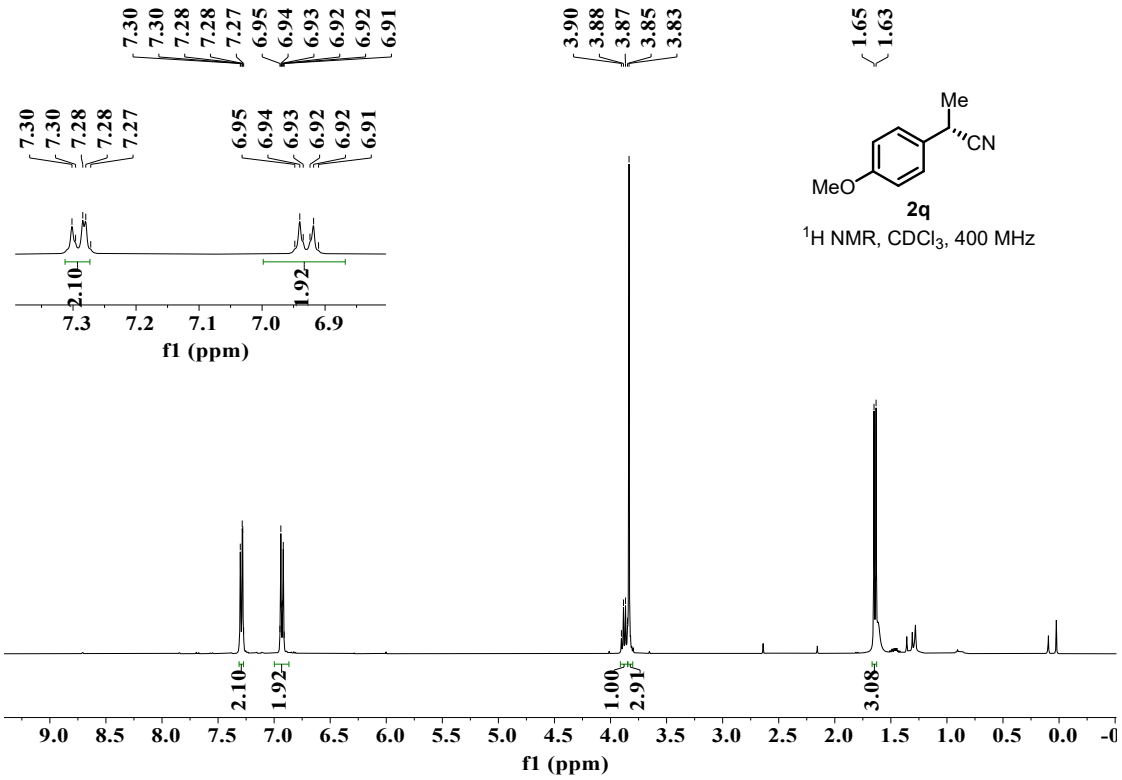

-113.88
Me
CN
F
2n
19F NMR, CDCl3, 376 MHz
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
f1 (ppm)


7.36 7.35 7.35 7.33 7.32 7.32 7.31 7.30 7.30 7.28 7.27 7.26 7.26 7.25 7.25 7.24
3.91 3.89 3.87 3.85
1.66 1.64
Me
Cl
CN
2o
1H NMR, CDCl3, 400 MHz
1.00 1.94 1.14
7.40 7.35 7.30 7.25 7.20 7.15
f1 (ppm)
1.00 1.94 1.14 1.00 3.07
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.
f1 (ppm)


138.88 135.02 130.43 128.36 126.99 124.91 120.88
77.32 77.00 76.68
30.92 21.25
Me
Cl
CN
2o
13C NMR, CDCl3, 100 MHz
160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.54 7.53 7.52 7.51 7.51 7.50 7.26 7.25 7.25 7.24 7.23 7.23 7.22
3.89 3.87 3.86 3.84
1.64 1.62
Me
CN
Br
2p
1H NMR, CDCl3, 400 MHz
1.96
1.94
1.00
3.03
f1 (ppm)


136.04 132.29 128.40 122.09 121.00
77.31 77.00 76.68
30.79 21.29
Me
CN
Br
2p
13C NMR, CDCl3, 100 MHz
f1 (ppm)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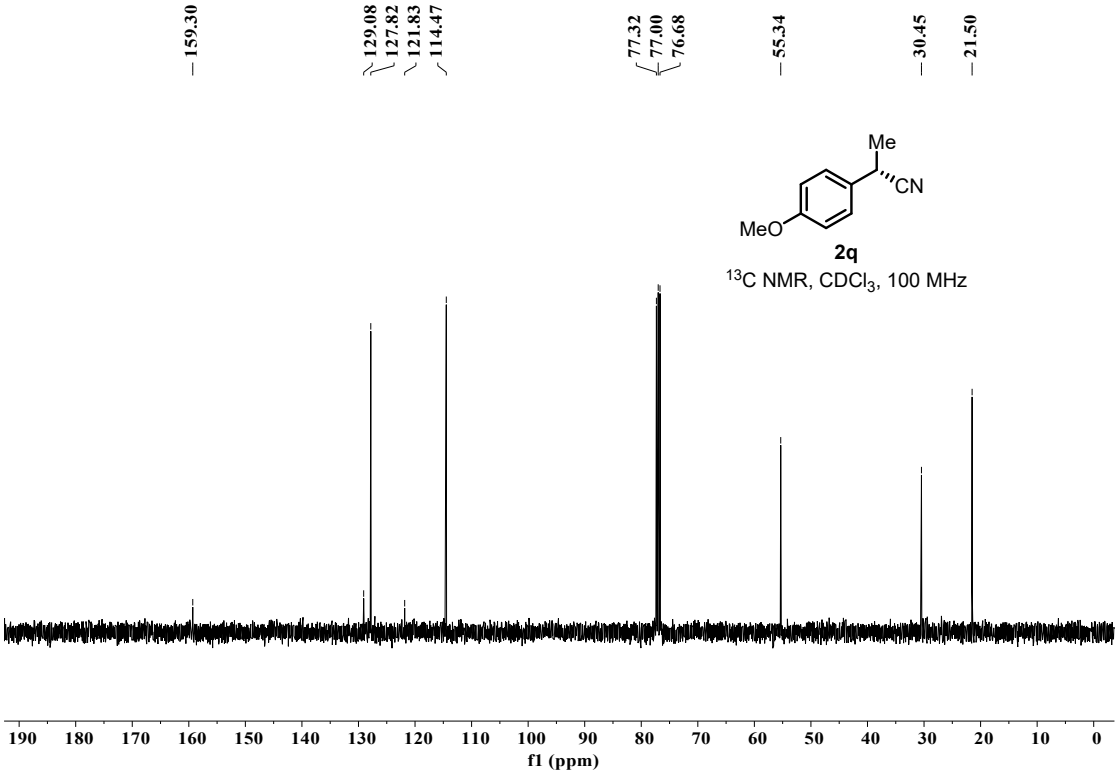
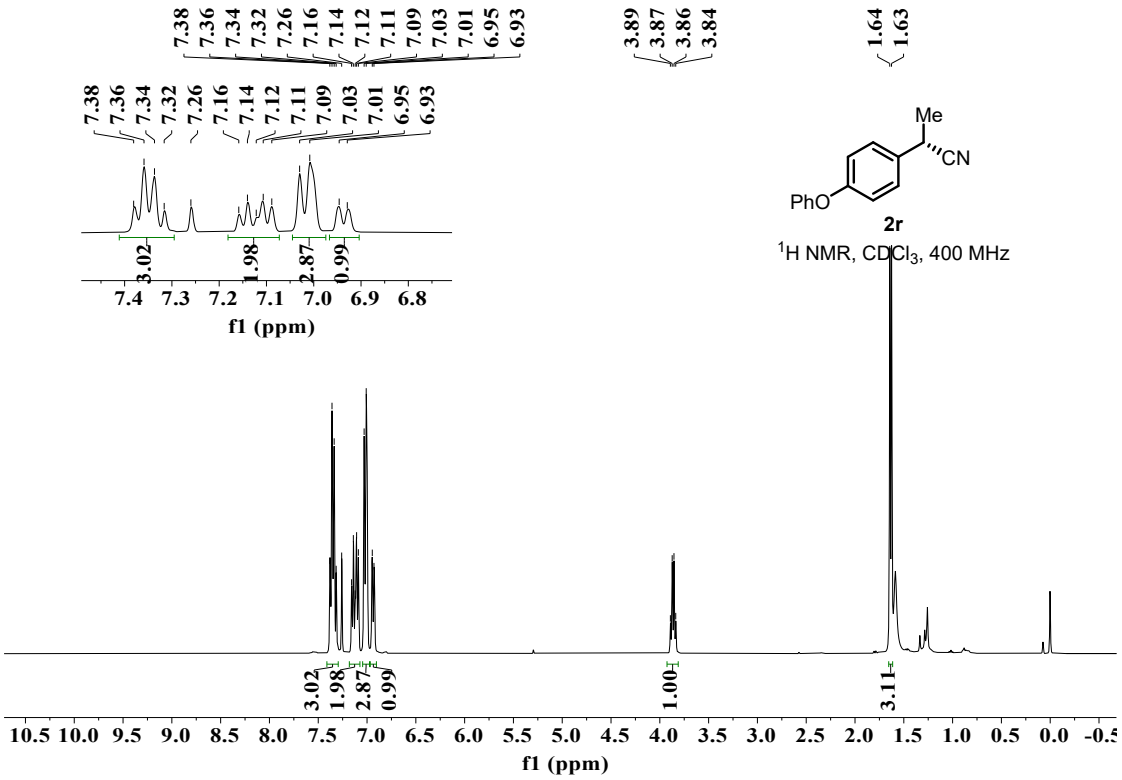
7.30
7.28
7.28
7.27
6.95
6.94
6.93
6.92
6.92
6.91
3.90
3.88
3.87
3.85
3.83
1.65
1.63
Me
CN
MeO
2q
1H NMR, CDCl3, 400 MHz
2.10
1.92
1.00
2.91
3.08
f1 (ppm)


159.30
129.08
127.82
121.83
114.47
77.32
77.00
76.68
55.34
30.45
21.50
Me
CN
MeO
2q
13C NMR, CDCl3, 100 MHz
f1 (ppm)


7.38 7.36 7.34 7.32 7.26 7.16 7.14 7.12 7.11 7.09 7.03 7.01 6.95 6.93
3.89 3.87 3.86 3.84
1.64 1.63
Me
CN
PhO
2r
1H NMR, CDCl3, 400 MHz
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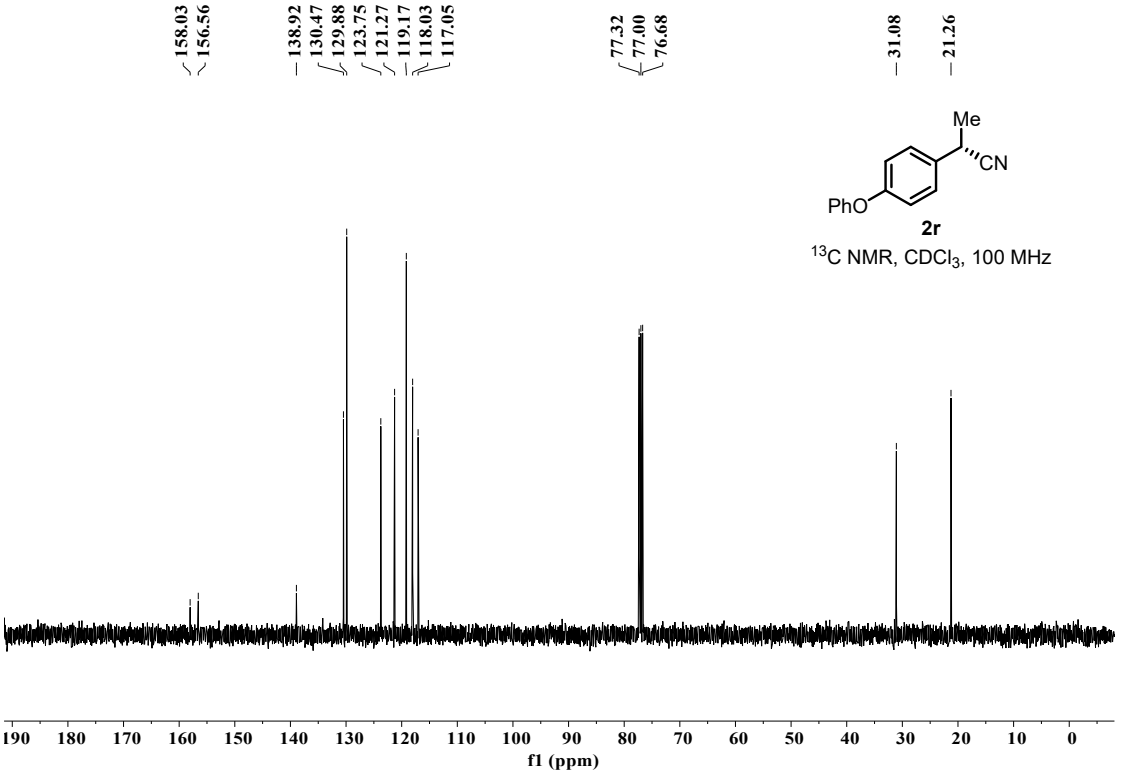
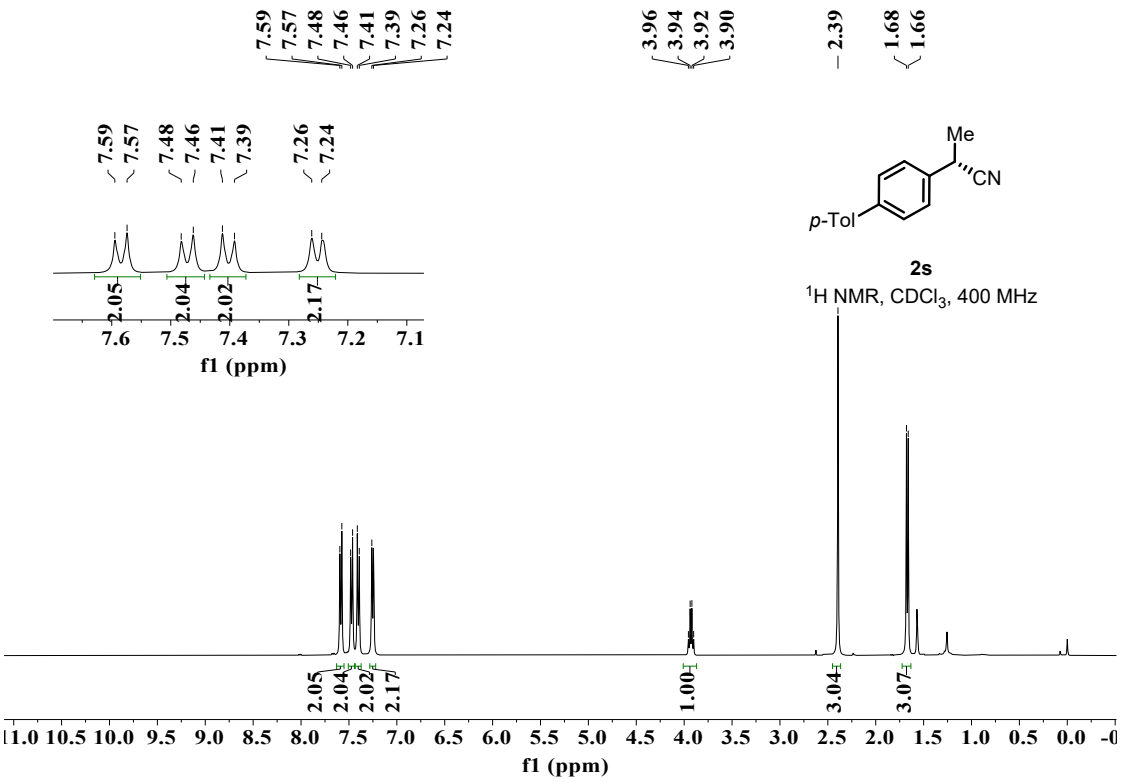
f1 (ppm)


158.03 156.56 138.92 130.47 129.88 123.75 121.27 119.17 118.03 117.05
77.32 77.00 76.68
31.08 21.26
Me
CN
PhO
2r
13C NMR, CDCl3, 100 MHz
f1 (ppm)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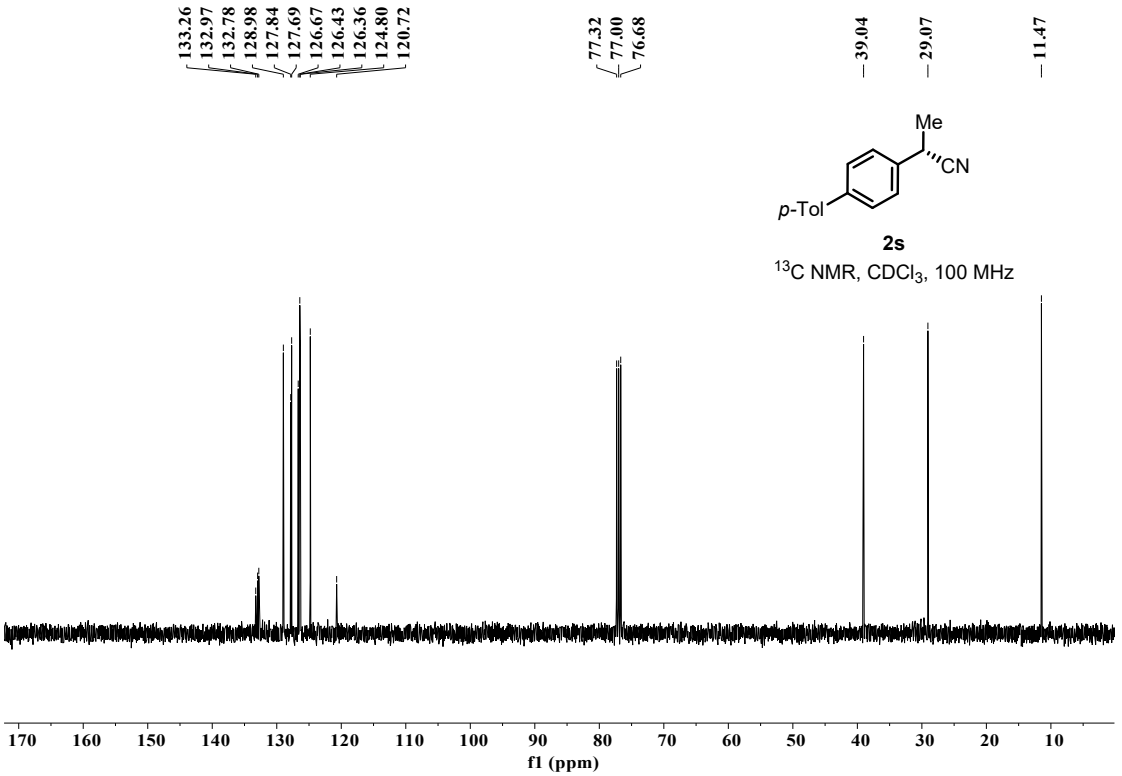
7.46
7.41
7.39
7.26
7.24
3.96
3.94
3.92
3.90
2.39
1.68
1.66
Me
CN
p-Tol
2s
1H NMR, CDCl3, 400 MHz
2.05
2.04
2.02
2.17
1.00
3.04
3.07
f1 (ppm)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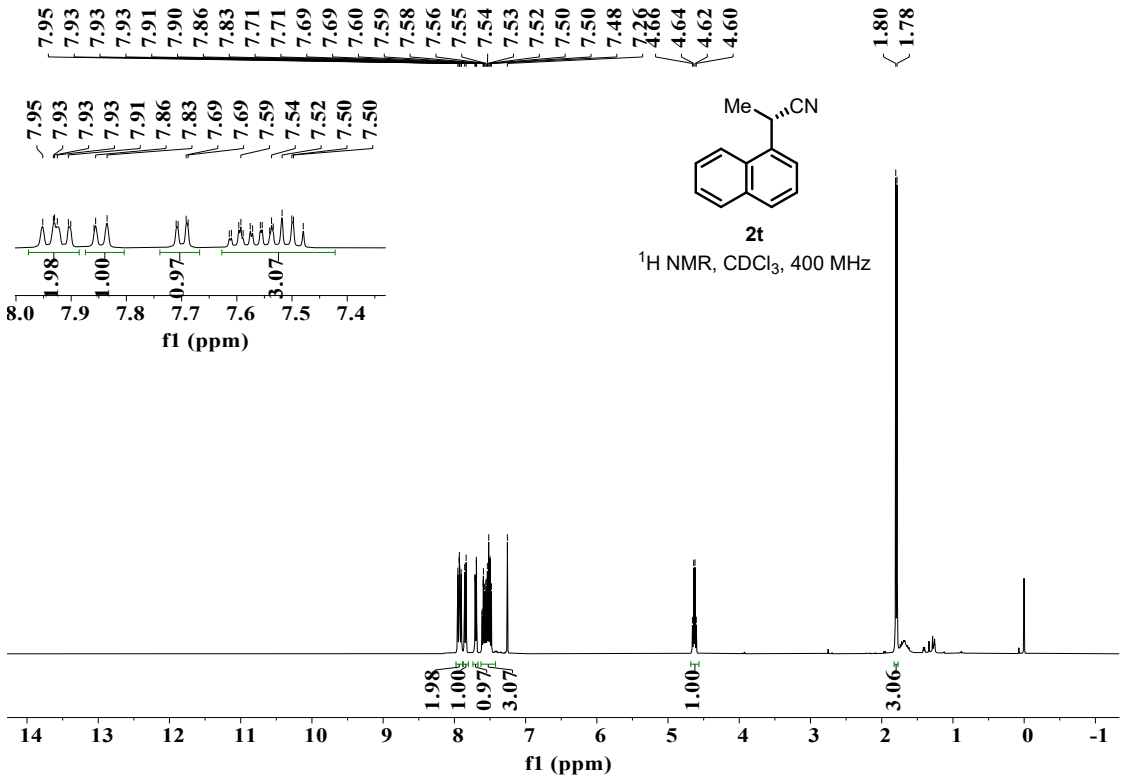
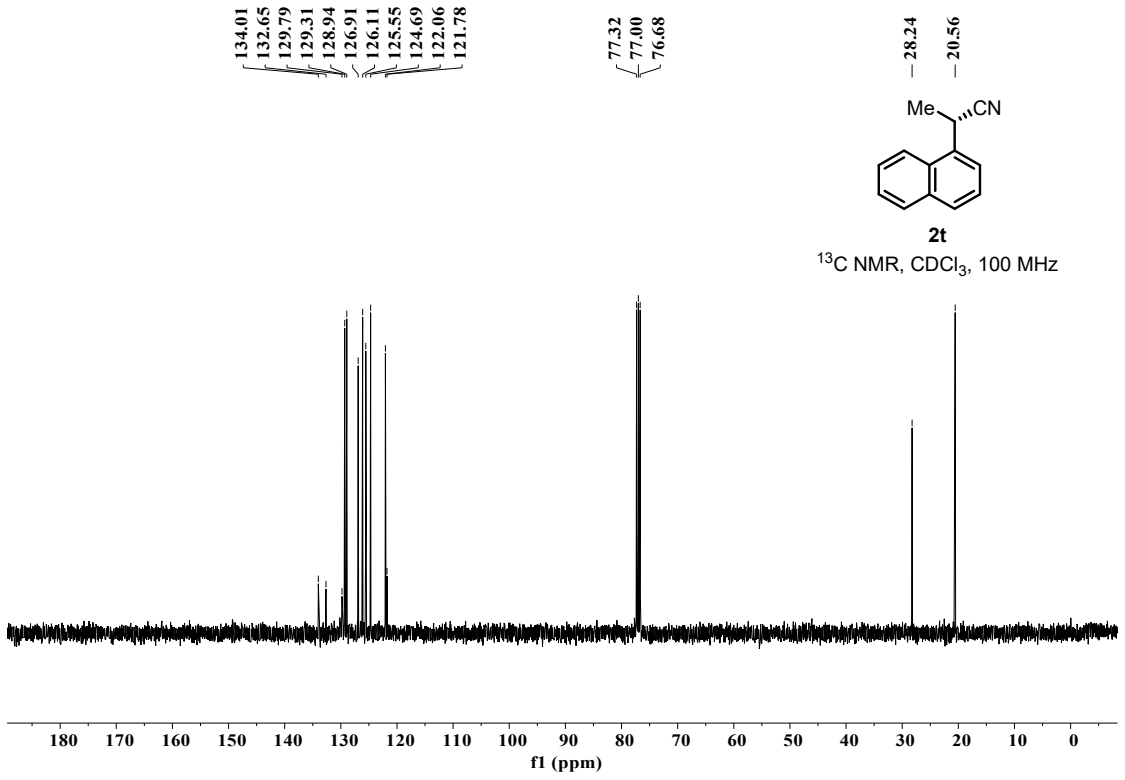
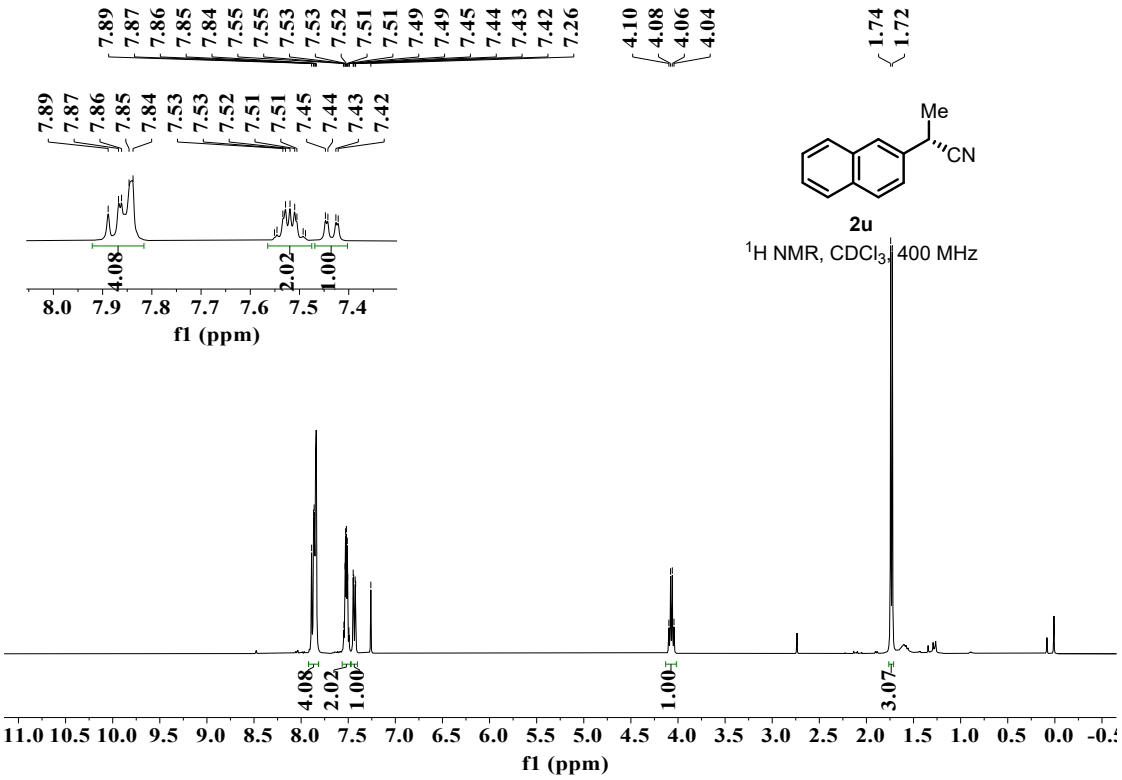
127.84
127.69
126.67
126.43
126.36
124.80
120.72
77.32
77.00
76.68
39.04
29.07
11.47
Me
CN
p-Tol
2s
13C NMR, CDCl3, 100 MHz
f1 (ppm)


7.95 7.93 7.93 7.93 7.91 7.90 7.86 7.83 7.71 7.71 7.69 7.69 7.60 7.59 7.58 7.56 7.55 7.54 7.53 7.52 7.50 7.50 7.48 7.26 4.66 4.64 4.62 4.60
1.80 1.78
Me CN
2t
1H NMR, CDCl3, 400 MHz
1.98 1.00 0.97 3.07
8.0 7.9 7.8 7.7 7.6 7.5 7.4
f1 (ppm)
1.98 1.00 0.97 3.07 1.00 3.06
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)


134.01 132.65 129.79 129.31 128.94 126.91 126.11 125.55 124.69 122.06 121.78
77.32 77.00 76.68
28.24 20.56
Me CN
2t
13C NMR, CDCl3, 100 MHz
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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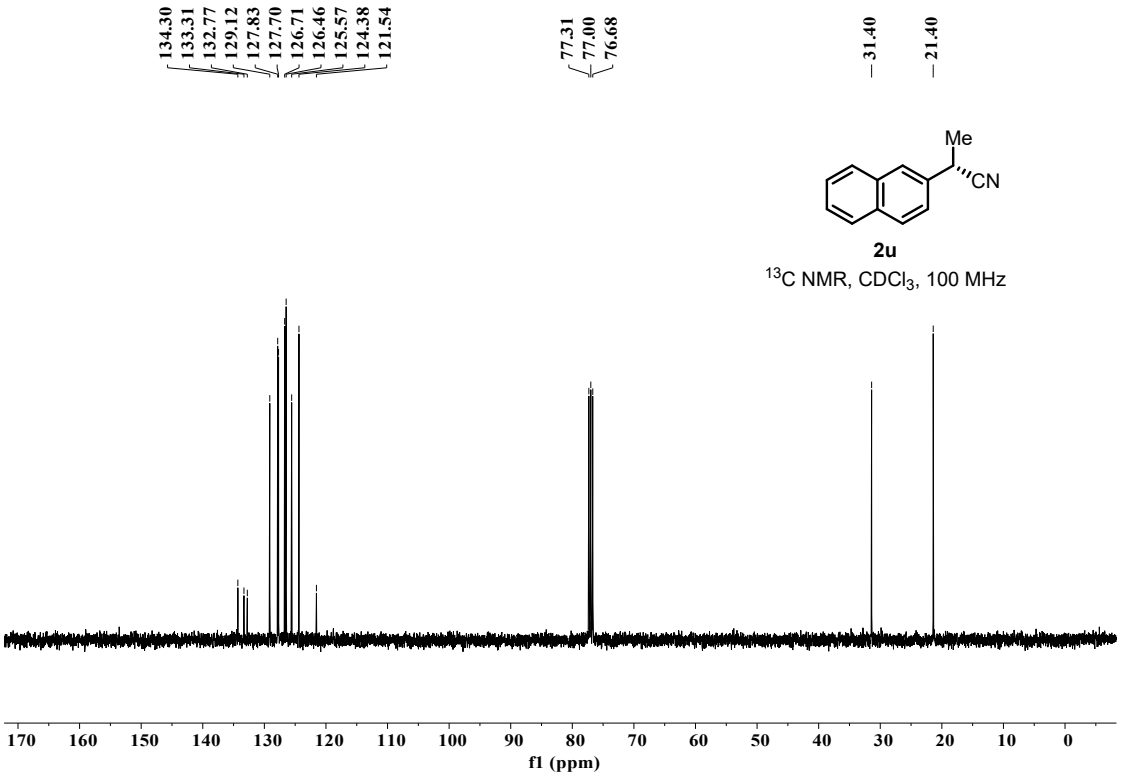
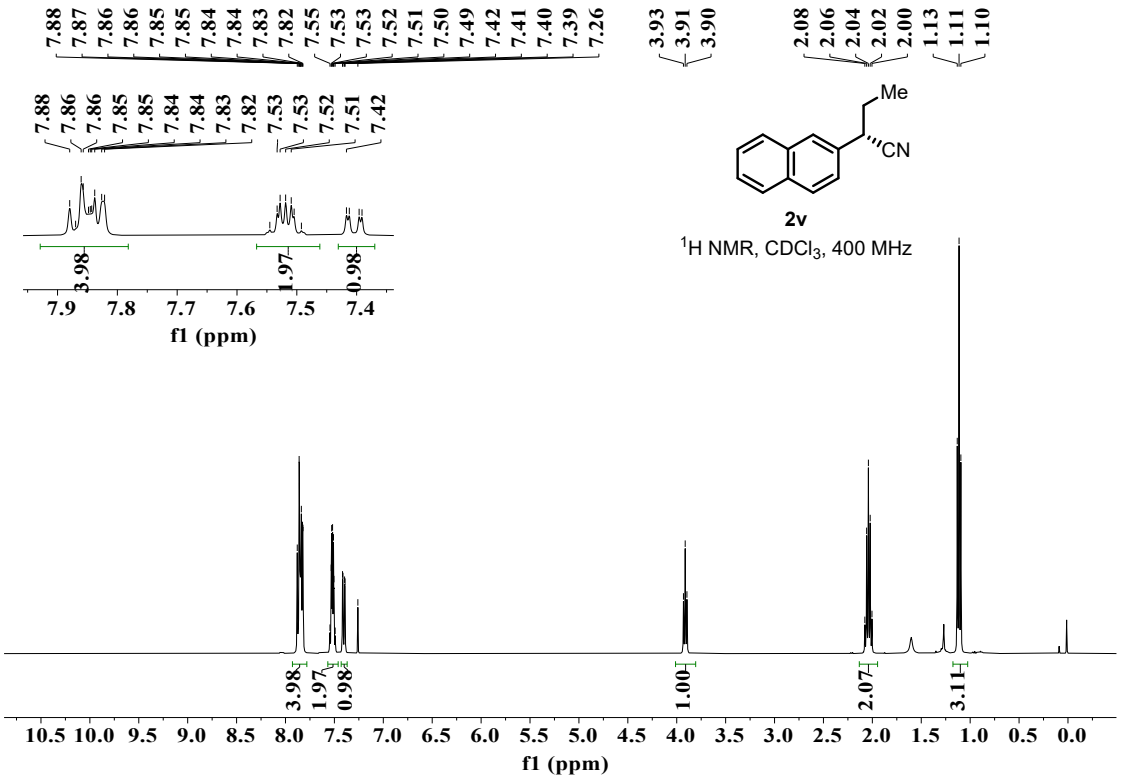
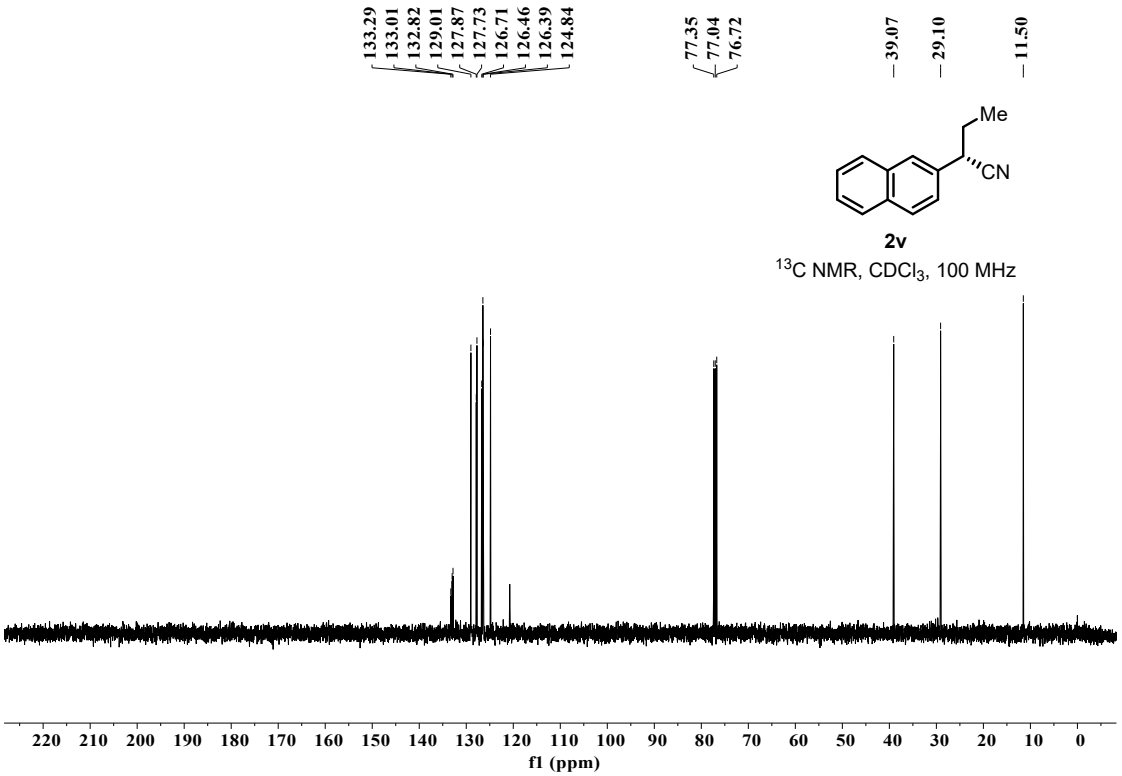
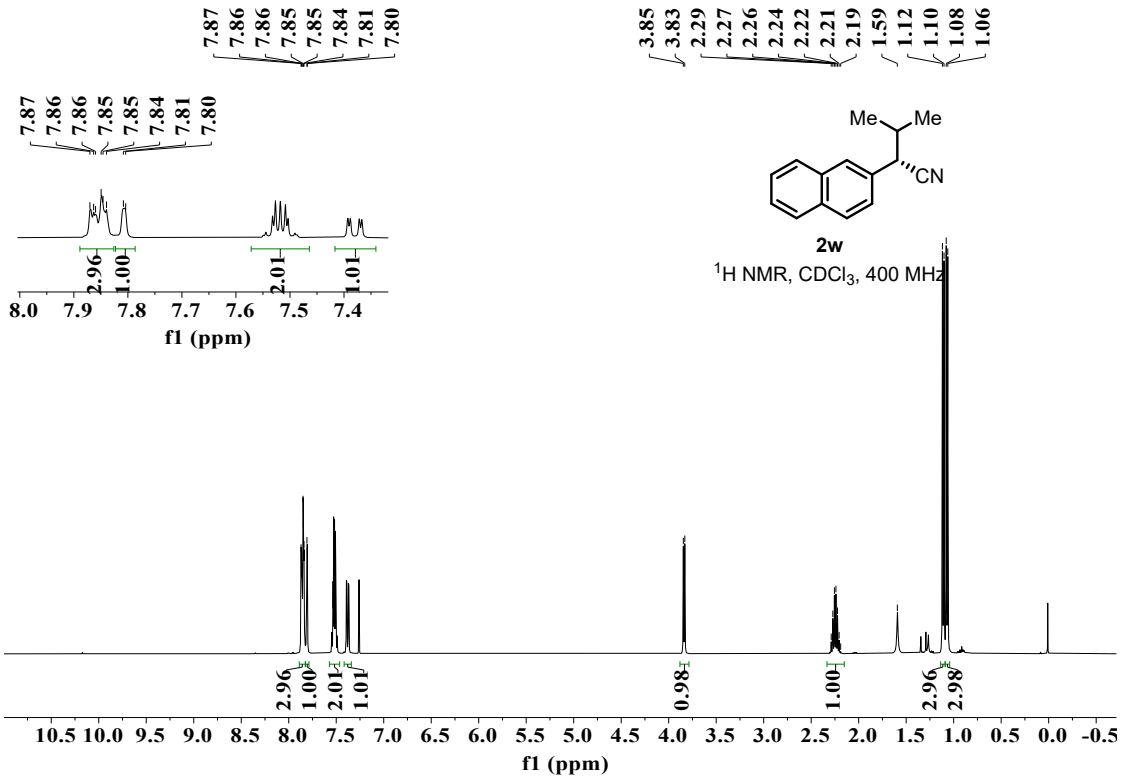
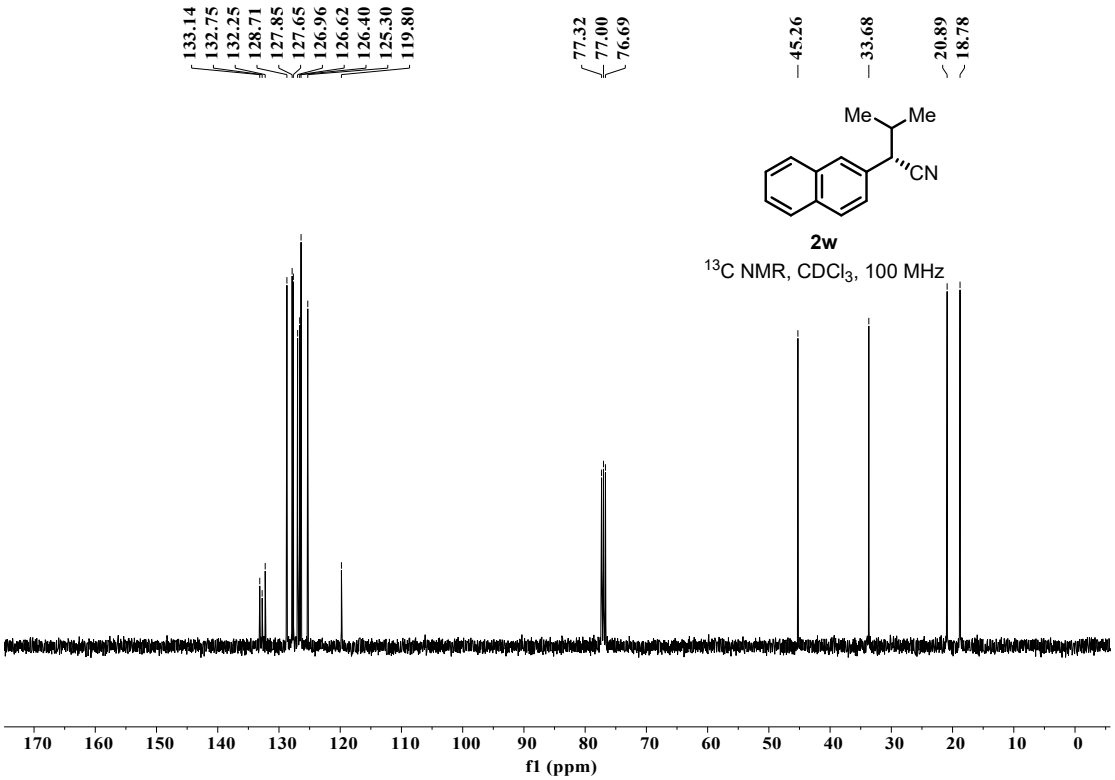
4.10 4.08 4.06 4.04
1.74 1.72
7.89 7.87 7.86 7.85 7.84 7.53 7.53 7.52 7.51 7.51 7.45 7.44 7.43 7.42
4.08 2.02 1.00
8.0 7.9 7.8 7.7 7.6 7.5 7.4
f1 (ppm)
Me
CN
2u
1H NMR, CDCl3, 400 MHz
4.08 2.02 1.00 1.00 3.07
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


134.30 133.31 132.77 129.12 127.83 127.70 126.71 126.46 125.57 124.38 121.54
77.31 77.00 76.68
31.40
21.40
Me
CN
2u
13C NMR, CDCl3, 100 MHz
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.88 7.87 7.86 7.86 7.85 7.85 7.84 7.84 7.83 7.82 7.55 7.53 7.53 7.52 7.51 7.50 7.49 7.42 7.41 7.40 7.39 7.26
3.93 3.91 3.90
2.08 2.06 2.04 2.02 2.00 1.13 1.11 1.10
Me
CN
2v
1H NMR, CDCl3, 400 MHz
3.98 1.97 0.98
1.00 2.07 3.11
f1 (ppm)


133.29 133.01 132.82 129.01 127.87 127.73 126.71 126.46 126.39 124.84
77.35 77.04 76.72
39.07 29.10 11.50
Me
CN
2v
13C NMR, CDCl3, 100 MHz
f1 (ppm)


7.87
7.86
7.86
7.85
7.85
7.84
7.81
7.80
3.85
3.83
2.29
2.27
2.26
2.24
2.22
2.21
2.19
1.59
1.12
1.10
1.08
1.06
Me
Me
CN
2w
1H NMR, CDCl3, 400 MHz
2.96
1.00
2.01
1.01
0.98
1.00
2.96
2.98
f1 (ppm)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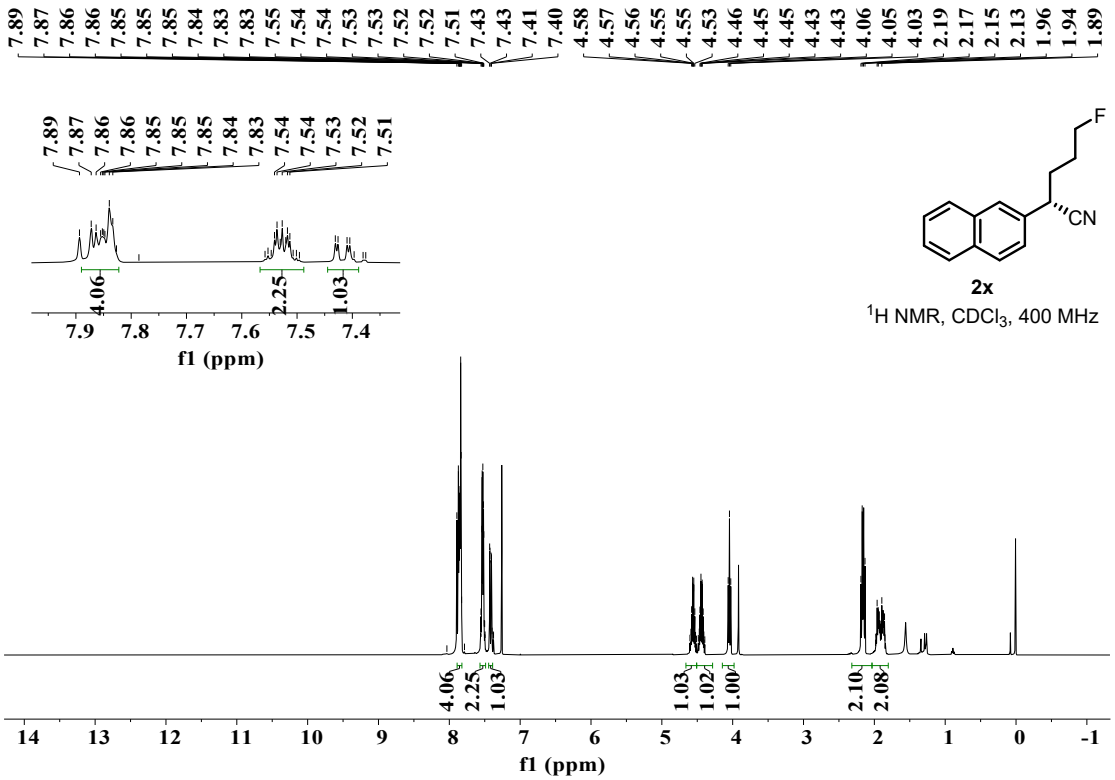
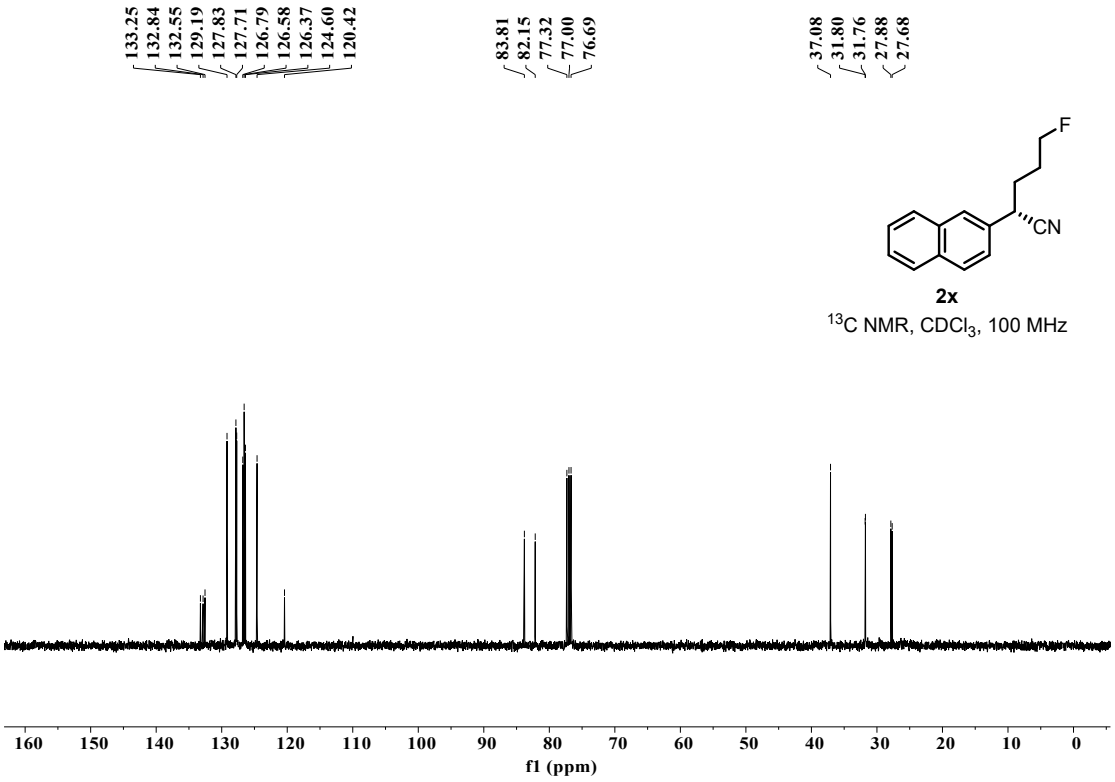
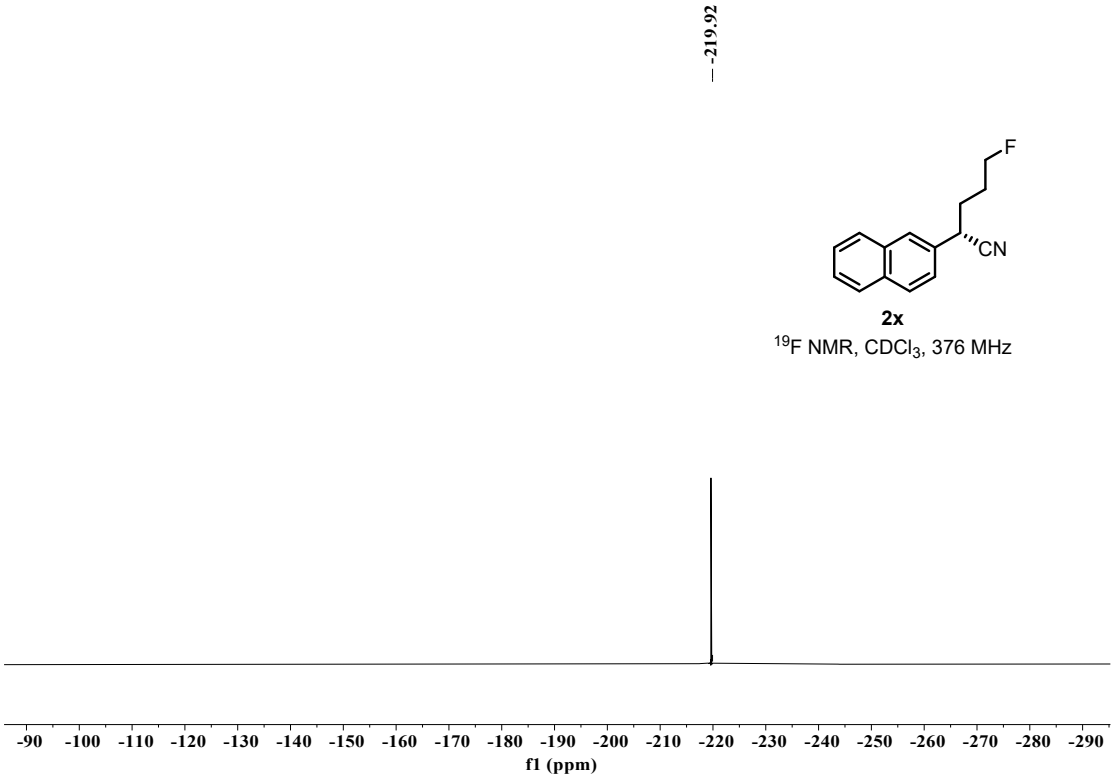
127.65
126.96
126.62
126.40
125.30
119.80
77.32
77.00
76.69
45.26
33.68
20.89
18.78
Me
Me
CN
2w
13C NMR, CDCl3, 100 MHz
f1 (ppm)


7.89
7.87
7.86
7.86
7.85
7.85
7.85
7.84
7.83
7.55
7.54
7.54
7.53
7.53
7.52
7.52
7.51
7.43
7.43
7.41
7.40
4.58
4.57
4.56
4.55
4.55
4.53
4.46
4.45
4.45
4.43
4.43
4.06
4.05
4.03
2.19
2.17
2.15
2.13
1.96
1.94
1.89
4.06
2.25
1.03
f1 (ppm)
F
CN
2x
1H NMR, CDCl3, 400 MHz
4.06
2.25
1.03
1.03
1.02
1.00
2.10
2.08
f1 (ppm)



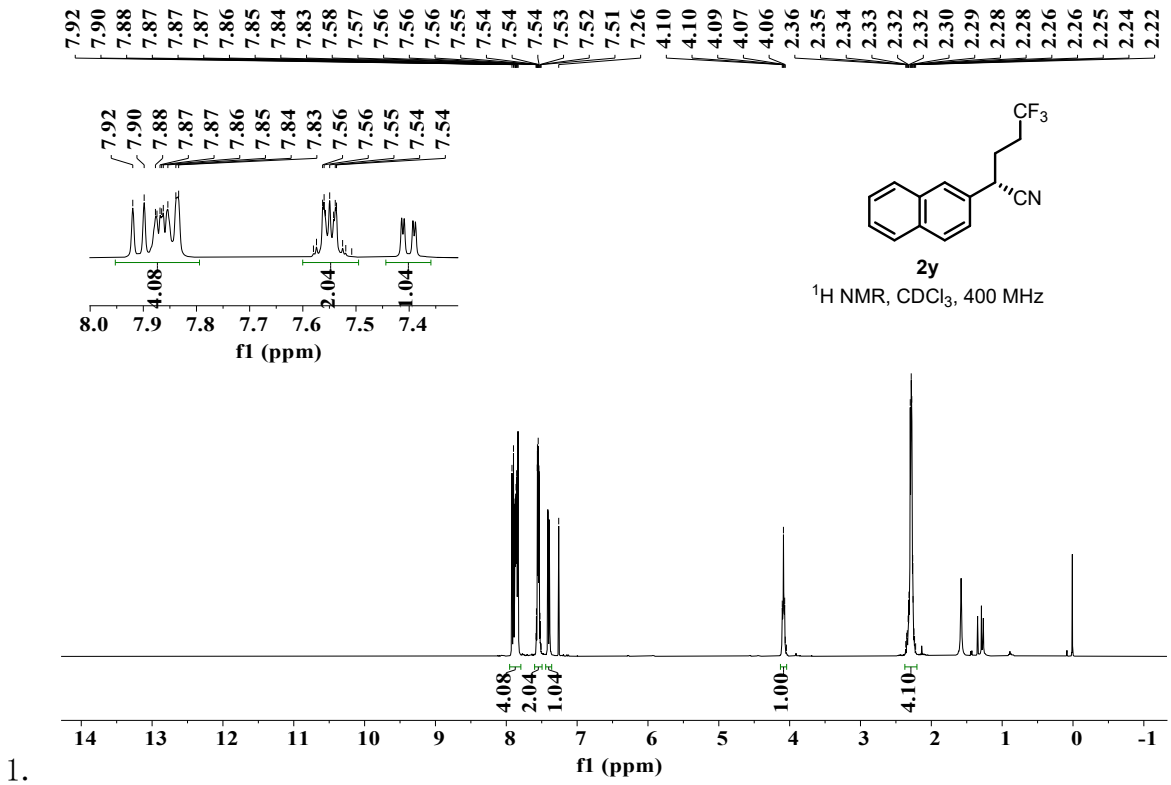

**2x**

$^{13}C$ NMR, $CDCl_3$, 100 MHz

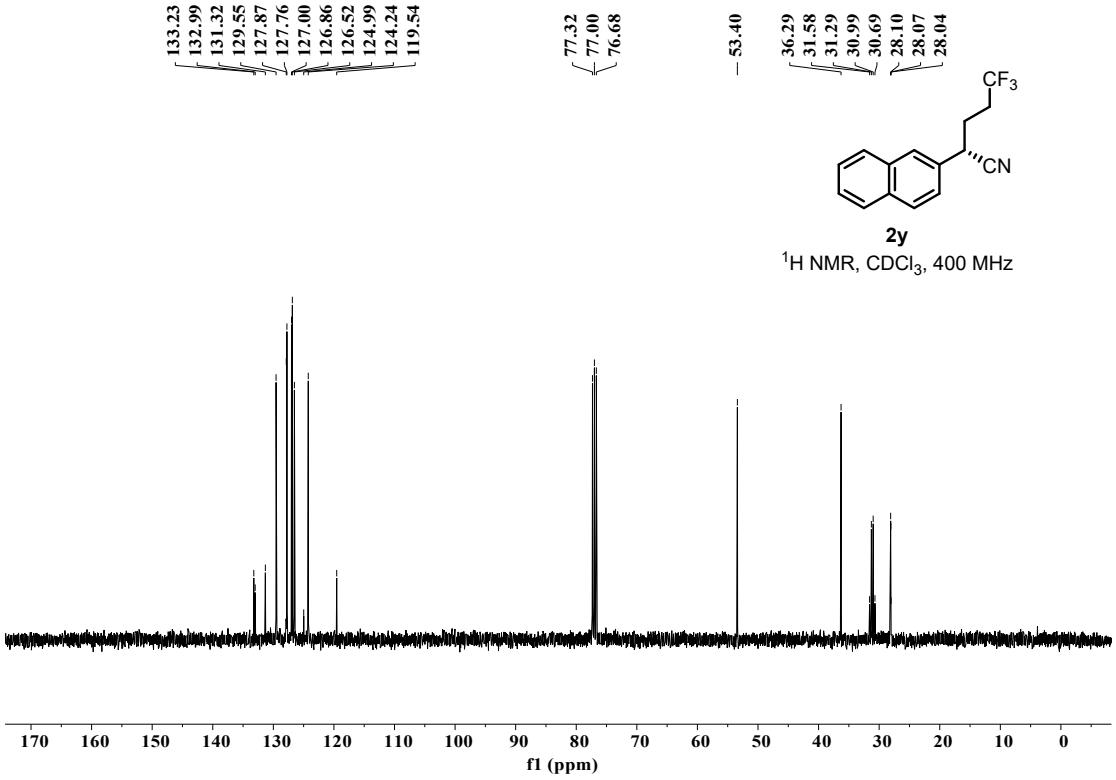


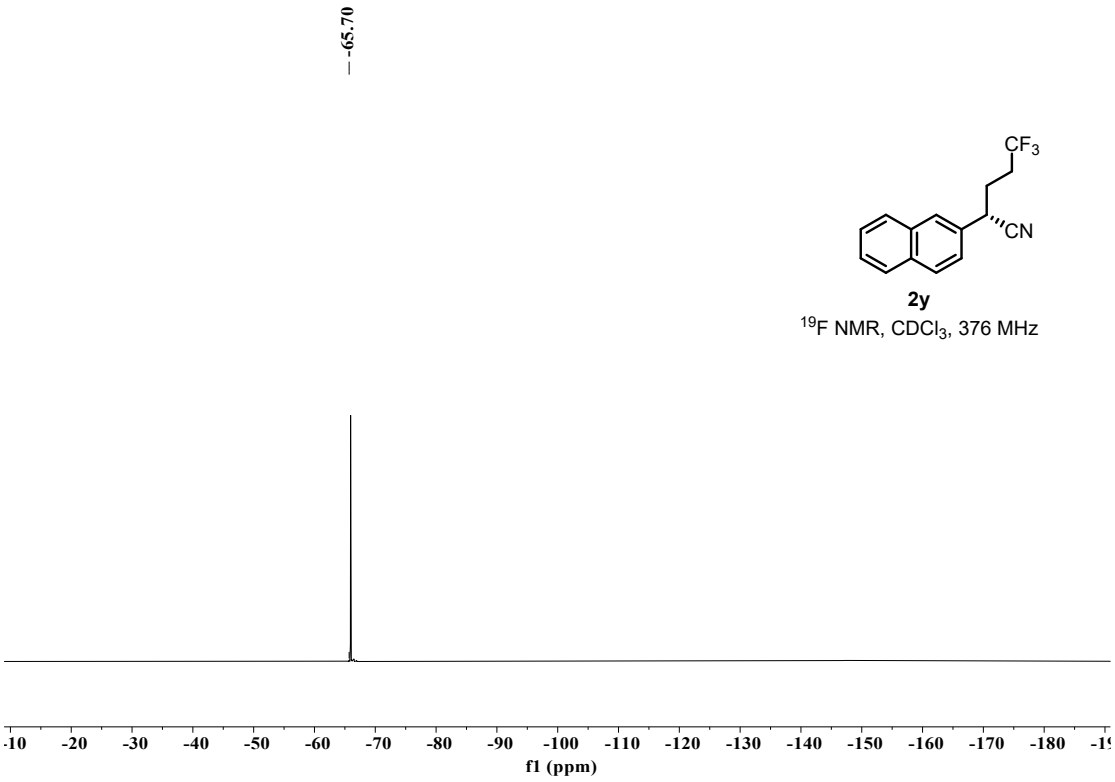

**2x**

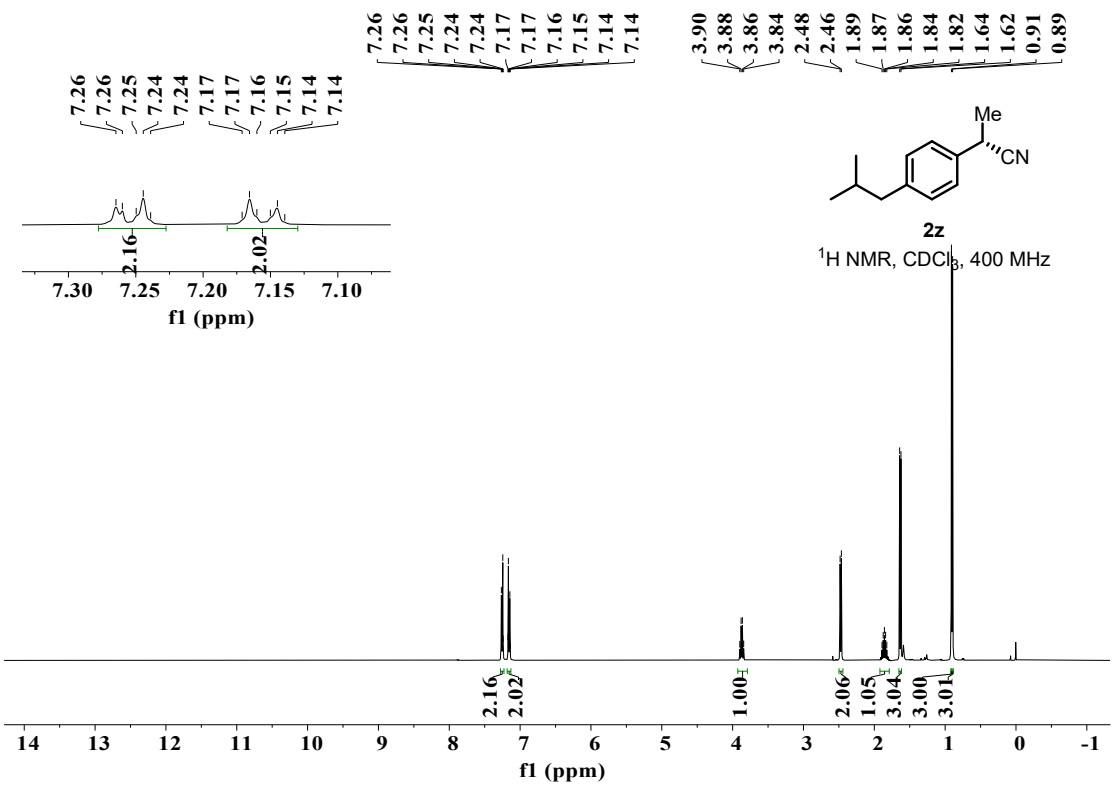
$^{19}F$ NMR, $CDCl_3$, 376 MHz

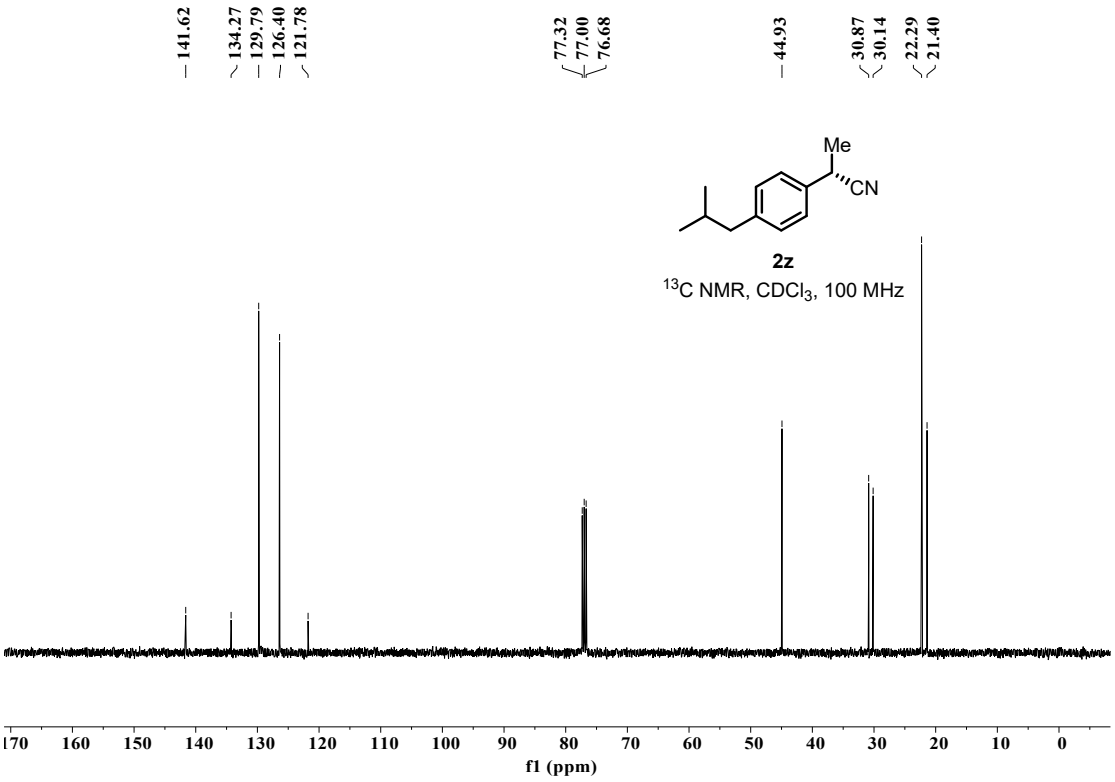

7.92 7.90 7.88 7.87 7.87 7.87 7.86 7.85 7.84 7.83 7.58 7.57 7.56 7.56 7.56 7.55 7.54 7.54 7.54 7.53 7.52 7.51 7.26 4.10 4.10 4.09 4.07 4.06 2.36 2.35 2.34 2.33 2.32 2.32 2.30 2.29 2.28 2.28 2.26 2.26 2.25 2.24 2.22
4.08 2.04 1.04
8.0 7.9 7.8 7.7 7.6 7.5 7.4
f1 (ppm)
CF3
CN
2y
1H NMR, CDCl3, 400 MHz
4.08 2.04 1.04 1.00 4.10
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1
f1 (ppm)

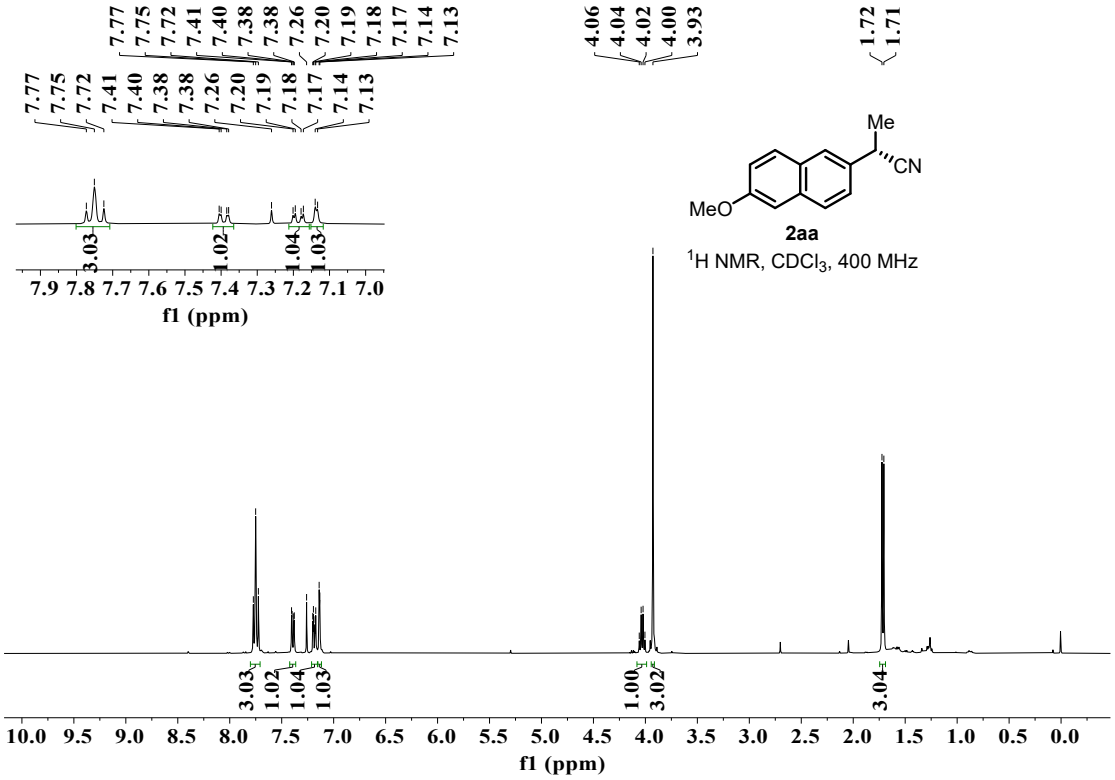
1.

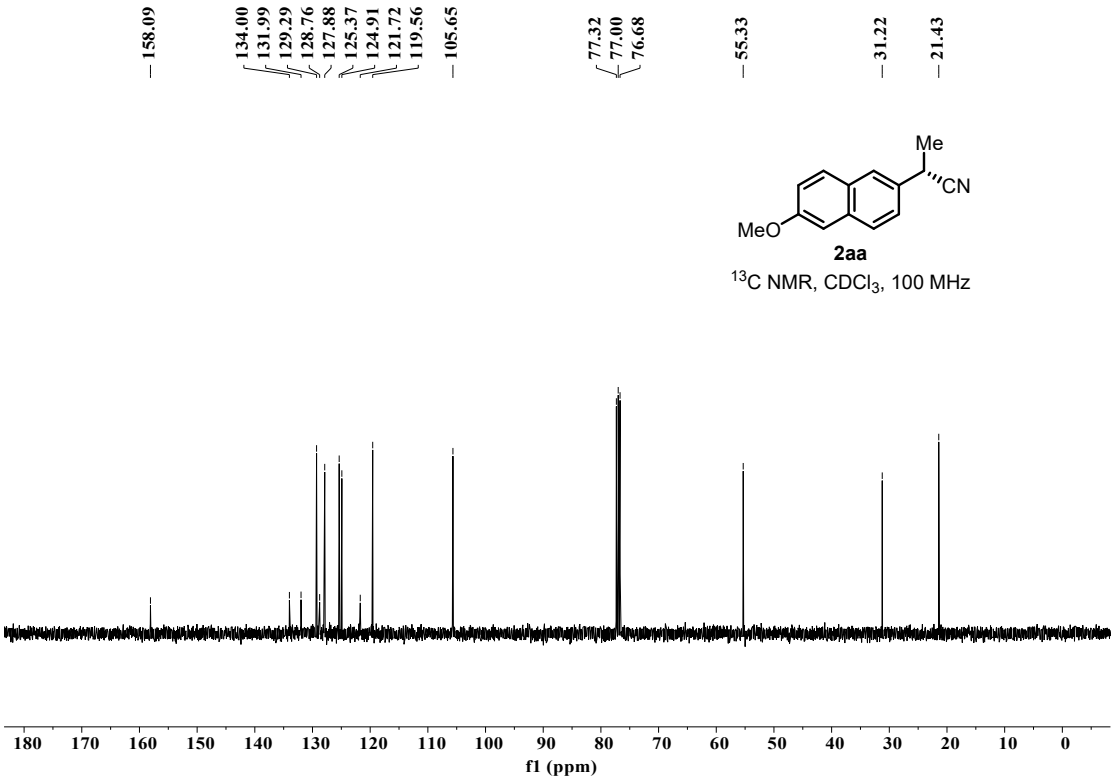

133.23 132.99 131.32 129.55 127.87 127.76 127.00 126.86 126.52 124.99 124.24 119.54
77.32 77.00 76.68
53.40
36.29 31.58 31.29 30.99 30.69 28.10 28.07 28.04
CF3
CN
2y
1H NMR, CDCl3, 400 MHz
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

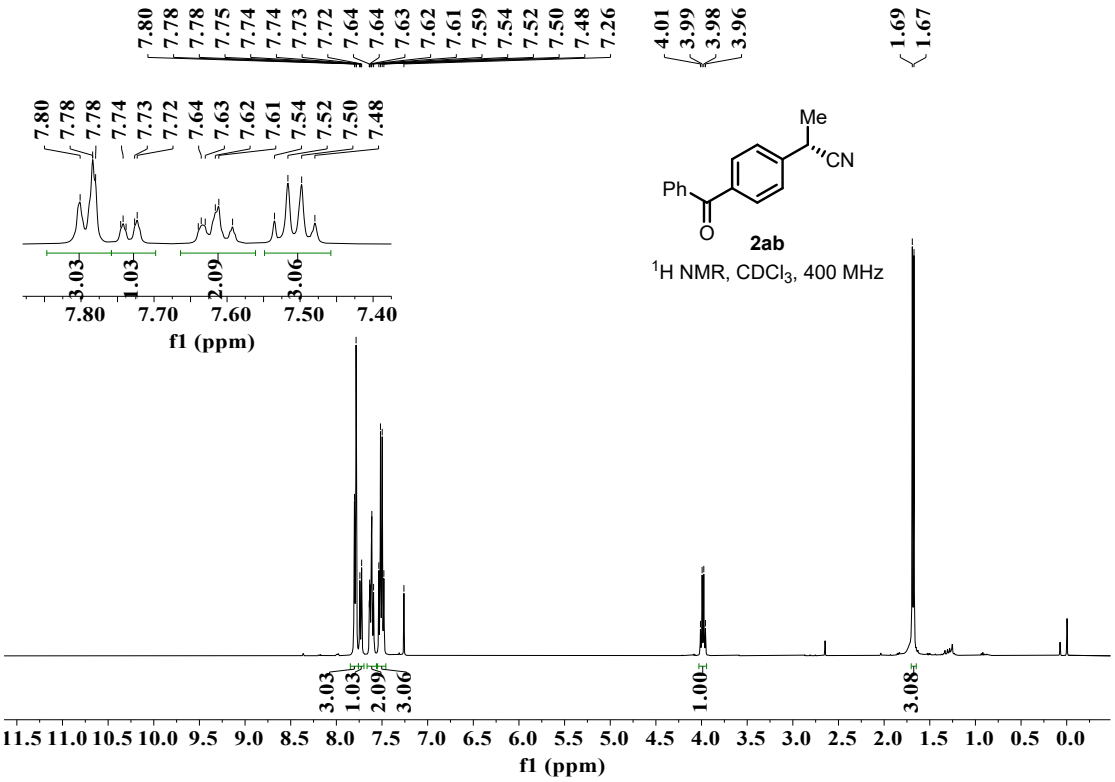

-65.70
CF3
CN
2y
19F NMR, CDCl3, 376 MHz
f1 (ppm)

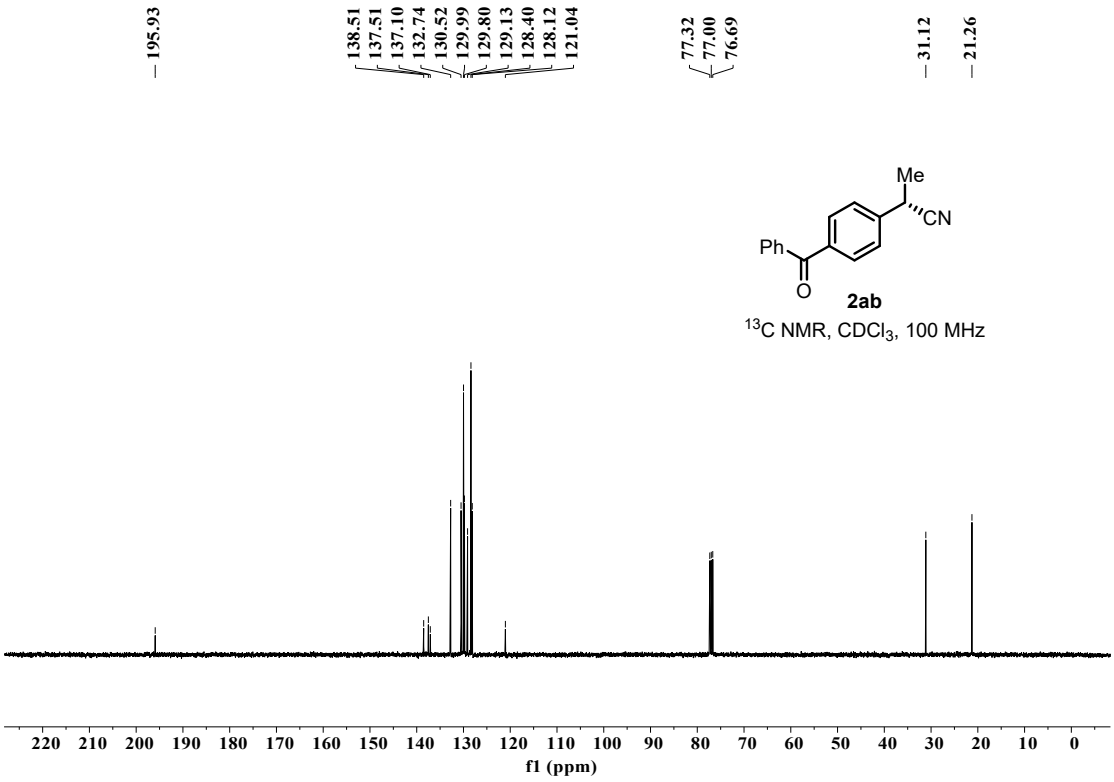

7.26 7.26 7.25 7.24 7.24 7.17 7.17 7.16 7.15 7.14 7.14
3.90 3.88 3.86 3.84 2.48 2.46 1.89 1.87 1.86 1.84 1.82 1.64 1.62 0.91 0.89
Me
CN
2z
1H NMR, CDCl3, 400 MHz
2.16 2.02
f1 (ppm)
2.16 2.02 1.00 2.06 1.05 3.04 3.00 3.01
f1 (ppm)

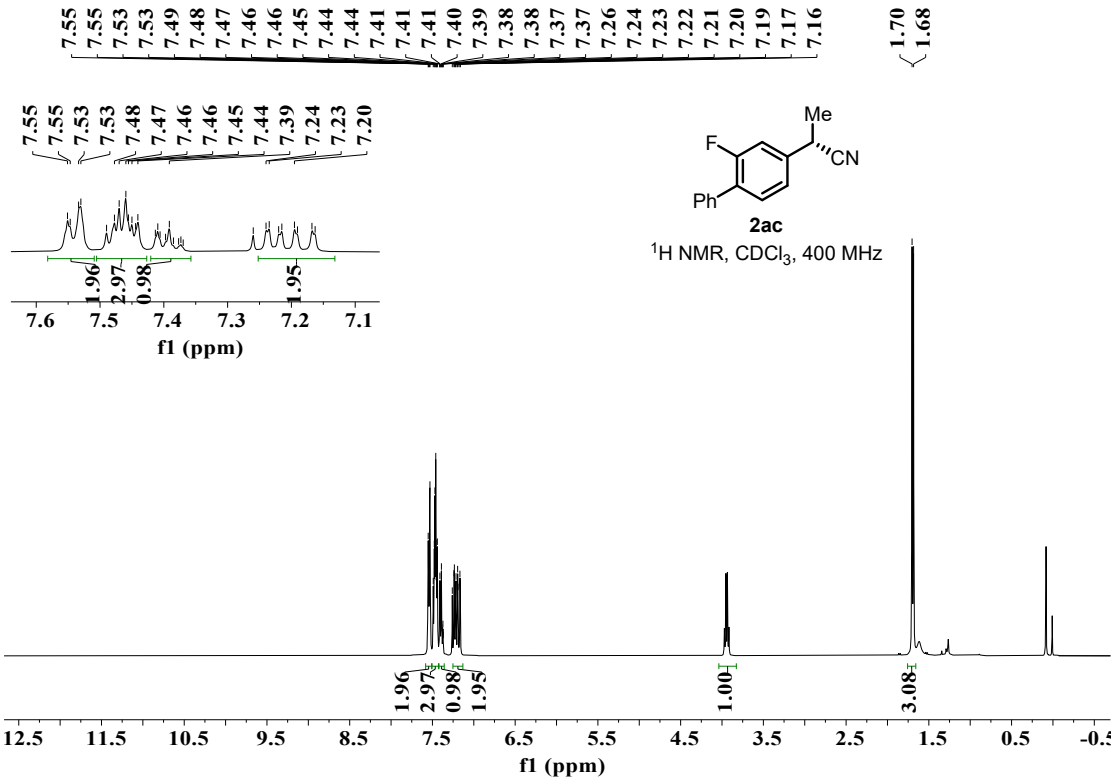

141.62
134.27
129.79
126.40
121.78
77.32
77.00
76.68
44.93
30.87
30.14
22.29
21.40
Me
CN
2z
13C NMR, CDCl3, 100 MHz
f1 (ppm)

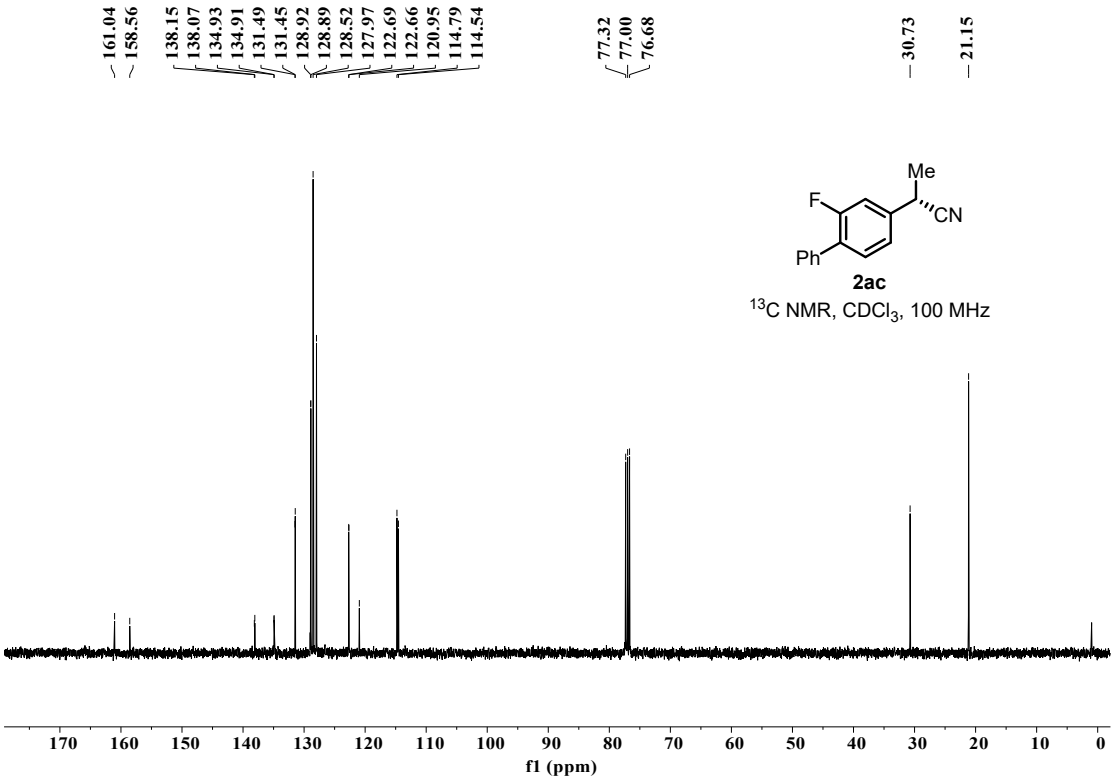

7.77
7.75
7.72
7.41
7.40
7.38
7.38
7.26
7.20
7.19
7.18
7.17
7.14
7.13
4.06
4.04
4.02
4.00
3.93
1.72
1.71
Me
CN
MeO
2aa
1H NMR, CDCl3, 400 MHz
3.03
1.02
1.04
1.03
1.00
3.02
3.04
f1 (ppm)

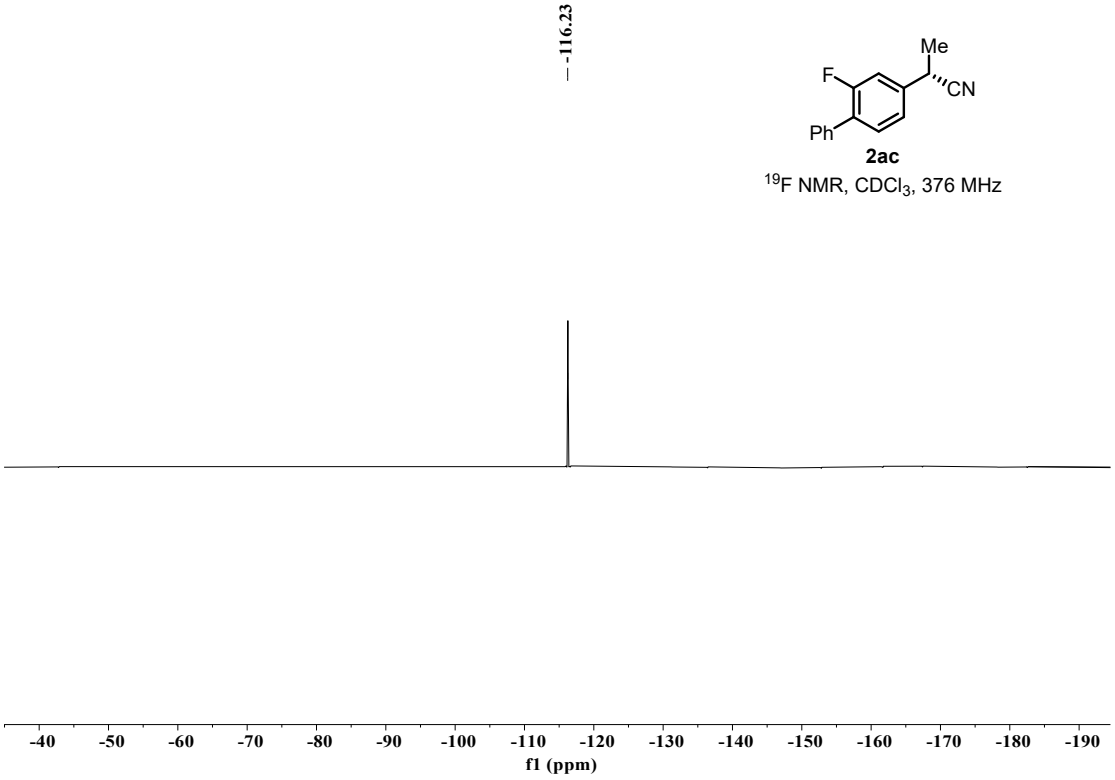

158.09
134.00
131.99
129.29
128.76
127.88
125.37
124.91
121.72
119.56
105.65
77.32
77.00
76.68
55.33
31.22
21.43
Me
CN
MeO
2aa
13C NMR, CDCl3, 100 MHz
f1 (ppm)


7.80
7.78
7.78
7.75
7.74
7.74
7.73
7.72
7.64
7.64
7.63
7.62
7.61
7.59
7.54
7.52
7.50
7.48
7.26
4.01
3.99
3.98
3.96
1.69
1.67
Me
CN
Ph
O
2ab
1H NMR, CDCl3, 400 MHz
3.03
1.03
2.09
3.06
1.00
3.08
f1 (ppm)


195.93
138.51
137.51
137.10
132.74
130.52
129.99
129.80
129.13
128.40
128.12
121.04
77.32
77.00
76.69
31.12
21.26
Me
CN
Ph
O
2ab
13C NMR, CDCl3, 100 MHz
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.55
7.55
7.53
7.53
7.49
7.48
7.47
7.46
7.46
7.45
7.44
7.44
7.41
7.41
7.41
7.40
7.39
7.38
7.38
7.37
7.37
7.26
7.24
7.23
7.22
7.21
7.20
7.19
7.17
7.16
1.70
1.68
1.96
2.97
0.98
1.95
7.6 7.5 7.4 7.3 7.2 7.1
f1 (ppm)
Me
F
CN
Ph
2ac
1H NMR, CDCl3, 400 MHz
1.96
2.97
0.98
1.95
1.00
3.08
12.5 11.5 10.5 9.5 8.5 7.5 6.5 5.5 4.5 3.5 2.5 1.5 0.5
f1 (ppm)


161.04
158.56
138.15
138.07
134.93
134.91
131.49
131.45
128.92
128.89
128.52
127.97
122.69
122.66
120.95
114.79
114.54
77.32
77.00
76.68
30.73
21.15
Me
F
CN
Ph
2ac
13C NMR, CDCl3, 100 MHz
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-116.23
Me
F
CN
Ph
2ac
19F NMR, CDCl3, 376 MHz
-40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
f1 (ppm)