

Supporting Information

KOtBu-Promoted Michael/Aldol/Ring-Opening Cascade Reaction of Cyclobutanones with Chalcones

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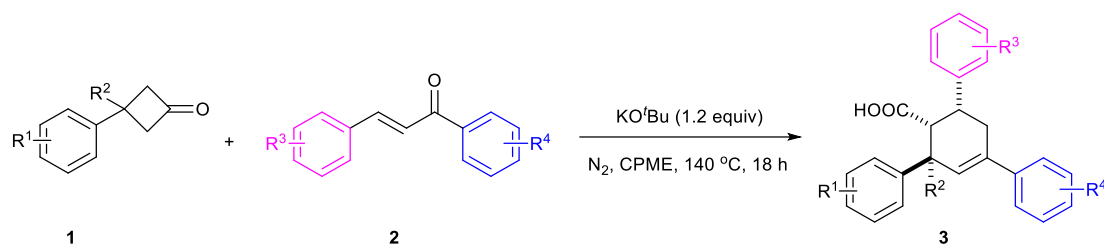
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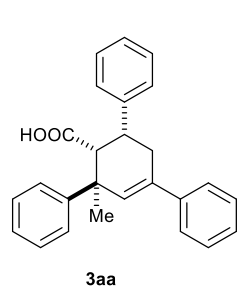
1. General Information

All the Cyclobutanone **1**¹ and Chalcone **2**² have been synthesized following procedures reported in the literature. Other chemical reagent was obtained from commercial sources and was used without further purification. The ¹H and ¹³C NMR spectra were recorded on JEOL at 400 MHz for ¹H or at 100 MHz for ¹³C, respectively. The chemical shifts (δ) for ¹H and ¹³C are given in ppm relative to residual signals of the solvent (CDCl₃: $\delta_{\text{H}} = 7.26$ ppm ¹H NMR, $\delta_{\text{C}} = 77.16$ ppm ¹³C NMR; DMSO-*d*₆: $\delta_{\text{H}} = 2.50$ ppm ¹H NMR, $\delta_{\text{C}} = 39.52$ ppm ¹³C NMR). The following abbreviations (or combinations thereof) were used to explain multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br s = broad singlet, dd = doublet of doublets. ESI high-resolution mass spectra were measured on Thermo-DFS mass spectrometer TFor thin layer chromatography (TLC) analysis throughout this work, Merck precoated TLC plates (silica gel 60 GF₂₅₄, 0.25 mm) were used, Silica gel 60 H (200-300 mesh) manufactured by Qingdao Haiyang Chemical Group Co. (China) were used for general chromatography, using UV light as the visualizing agent.

2. General Procedure for Synthesis of 3

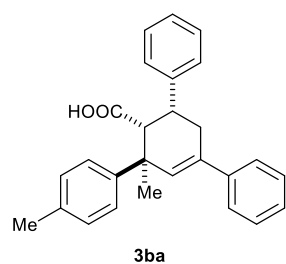


A standard Schlenk tube was charged with cyclobutanone **1** (0.1 mmol), chalcone **2** (0.15 mmol) and KO^tBu (13.5 mg, 1.2 equiv) and evacuated under high vacuum and backfilled with N₂ at least three times, followed by the addition of anhydrous CPME (1 mL). The reaction mixture was performed at 140 °C and continuous stirring for 18 hours. After cooling to ambient temperature, the reaction was quenched with HCl/EtOAc (2 mL). Then, the crude mixture was purified first by preparative TLC (DCM/MeOH = 25/1) to remove the major impurities, then the mixture was purified again by preparative TLC (PE/EA = 3/1 to 1/1) to remove the minor impurities to afford the desired product **3**.



1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (**3aa**)

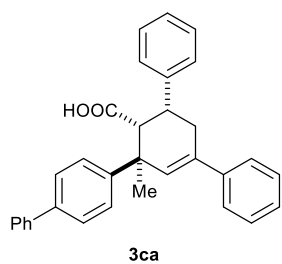
The general procedure was followed using substrate **1a** (16.0 mg, 0.1 mmol) and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3aa** (25.8 mg, 70%) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 7.52 (d, *J* = 7.6 Hz, 2H), 7.43 (d, *J* = 7.6 Hz, 2H), 7.30 (q, *J* = 7.6 Hz, 4H), 7.24 – 7.09 (m, 5H), 7.01 (d, *J* = 7.2 Hz, 2H), 5.98 (s, 1H), 3.28 (dd, *J* = 16.4, 12.8 Hz, 1H), 3.12 (d, *J* = 3.6 Hz, 1H), 2.99 – 2.94 (m, 1H), 2.55 (dd, *J* = 17.2, 5.2 Hz, 1H), 1.49 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 178.7, 148.6, 142.6, 141.5, 138.0, 128.7, 128.6, 128.0, 127.5, 127.4, 127.1, 127.0, 126.8, 125.6, 57.4, 43.9, 38.3, 29.4, 27.1 ppm. HR – MS (ESI) *m/z* calcd for C₂₆H₂₄O₂ [M + H]⁺ 369.1849, found 369.1851.



1',4-dimethyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (**3ba**)

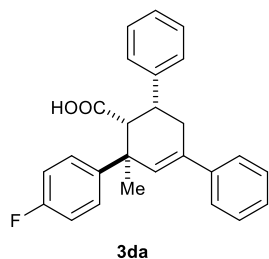
The general procedure was followed using substrate **1b** (17.4 mg, 0.1 mmol) and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ba** (20.0 mg, 52%) as white solid. ¹H NMR (400 MHz,) δ 7.61 – 7.58 (m, 2H), 7.41 – 7.36 (m, 4H), 7.32 – 7.28

(m, 1H), 7.24 – 7.15 (m, 5H), 7.11 – 7.08 (m, 2H), 6.04 (s, 1H), 3.34 (dd, $J = 17.2, 12.0$ Hz, 1H), 3.17 (d, $J = 3.6$ Hz, 1H), 3.09 – 3.02 (m, 1H), 2.61 (dd, $J = 17.6, 5.6$ Hz, 1H), 2.36 (s, 3H), 1.54 (s, 3H) ppm. ^{13}C NMR (100 MHz,) δ 178.1, 145.7, 142.8, 141.6, 137.8, 136.3, 129.3, 128.7, 128.6, 128.2, 127.5, 127.4, 127.0, 126.9, 125.6, 57.3, 43.6, 38.3, 29.4, 27.2, 21.1 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{27}\text{H}_{26}\text{O}_2$ [$\text{M} + \text{Na}$] $^+$ 405.1825, found 405.1819.



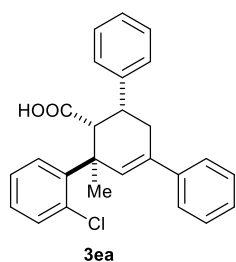
3'-methyl-5'-phenyl-1',2',3',6'-tetrahydro-[1,1':3',1'':4'',1''']-quaterphenyl]-2'-carboxylic acid (3ca). The general procedure was followed using substrate **1c** (23.6 mg, 0.1 mmol) and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ca** (30.2 mg, 68%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.65 – 7.57 (m, 8H), 7.47 – 7.31 (m, 6H), 7.27

– 7.16 (m, 3H), 7.14 (d, $J = 7.2$ Hz, 2H), 6.10 (s, 1H), 3.39 (dd, $J = 16.8, 12.8$ Hz, 1H), 3.25 (d, $J = 2.4$ Hz, 1H), 3.17 – 3.07 (m, 1H), 2.67 (dd, $J = 17.2, 5.2$ Hz, 1H), 1.61 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.9, 147.8, 142.7, 141.5, 140.8, 139.5, 138.1, 129.0, 128.7, 128.6, 128.0, 127.6, 127.5, 127.4, 127.2, 127.0, 125.7, 57.4, 43.8, 38.4, 29.5, 27.2 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{32}\text{H}_{28}\text{O}_2$ [$\text{M} + \text{Na}$] $^+$ 467.1982, found 467.1974.



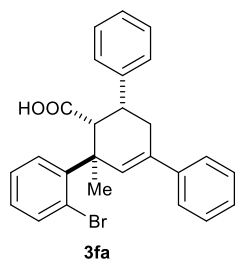
4-fluoro-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1'']-terphenyl]-2'-carboxylic acid (3da). The general procedure was followed using substrate **1d** (17.8 mg, 0.1 mmol) and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3da** (22.0 mg, 57%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.58 (d, $J = 7.6$ Hz, 2H), 7.47 (dd, $J = 8.4, 5.2$

Hz, 2H), 7.39 (t, $J = 7.6$ Hz, 2H), 7.32 (d, $J = 7.2$ Hz, 1H), 7.24 – 7.19 (m, 3H), 7.09 – 7.03 (m, 4H), 6.02 (s, 1H), 3.34 (dd, $J = 17.2, 12.4$ Hz, 1H), 3.12 (d, $J = 2.8$ Hz, 1H), 3.04 – 2.98 (m, 1H), 2.63 (dd, $J = 17.6, 5.6$ Hz, 1H), 1.54 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 178.0, 161.6 (d, $J = 244.4$ Hz), 144.4 (d, $J = 2.7$ Hz), 142.5, 141.3, 138.3, 128.8, 128.7, 128.6, 127.7 (d, $J = 8.1$ Hz), 127.4, 127.1, 125.6, 115.3 (d, $J = 20.9$ Hz), 57.6, 43.5, 38.3, 29.4, 27.2 ppm. ^{19}F NMR (376 MHz, CDCl_3) δ -116.42 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{23}\text{O}_2\text{F}$ [$\text{M} + \text{Na}$] $^+$ 409.1574, found 409.1566.



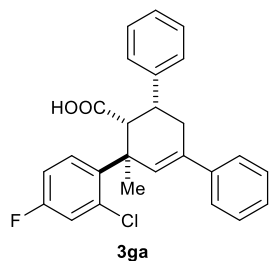
2-chloro-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3,1''-terphenyl]-2'-carboxylic acid (3ea).

The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ea** (33.8 mg, 84%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.54 – 7.51 (m, 3H), 7.40 – 7.36 (m, 1H), 7.32 (t, $J = 7.6$ Hz, 2H), 7.24 (t, $J = 7.6$ Hz, 1H), 7.21 – 7.09 (m, 5H), 7.05 (d, $J = 7.2$ Hz, 2H), 5.95 (s, 1H), 3.97 (d, $J = 3.6$ Hz, 1H), 3.30 – 3.22 (m, 1H), 2.87 – 2.82 (m, 1H), 2.53 (dd, $J = 17.2, 5.6$ Hz, 1H), 1.71 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.9, 143.8, 142.7, 141.3, 137.6, 132.8, 132.0, 129.3, 128.7, 128.6, 128.5, 127.6, 127.4, 127.0, 126.7, 125.7, 51.3, 44.9, 39.1, 29.4, 24.1 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{23}\text{O}_2^{35}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 425.1279, found 425.1272; $\text{C}_{26}\text{H}_{23}\text{O}_2^{37}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 427.1249, found 427.1238.



2-bromo-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3,1''-terphenyl]-2'-carboxylic acid (3fa).

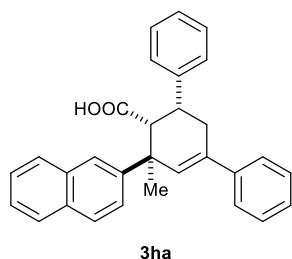
The general procedure was followed using substrate **1f** (23.9 mg, 0.1 mmol) and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3fa** (30.0 mg, 67%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.69 (d, $J = 7.6$ Hz, 1H), 7.63 – 7.60 (m, 3H), 7.40 (t, $J = 7.6$ Hz, 2H), 7.34 – 7.19 (m, 5H), 7.15 – 7.11 (m, 3H), 6.03 (s, 1H), 4.17 (s, 1H), 3.37 – 3.30 (m, 1H), 2.92 (d, $J = 11.2$ Hz, 1H), 2.61 (dd, $J = 17.2, 4.0$ Hz, 1H), 1.81 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.4, 144.9, 142.6, 141.3, 137.5, 136.6, 132.4, 129.5, 128.73, 128.66, 128.6, 127.6, 127.4, 127.3, 127.0, 125.7, 121.8, 51.1, 45.5, 39.0, 29.3, 24.2 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{23}\text{O}_2^{79}\text{Br}$ $[\text{M} + \text{Na}]^+$ 469.0774, found 469.0766; $\text{C}_{26}\text{H}_{23}\text{O}_2^{81}\text{Br}$ $[\text{M} + \text{Na}]^+$ 471.0753, found 471.0742.



2-chloro-4-fluoro-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3,1''-terphenyl]-2'-carboxylic acid (3ga).

The general procedure was followed using substrate **1g** (21.3 mg, 0.1 mmol) and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ga** (29.5 mg, 70%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.60 – 7.54 (m, 3H), 7.42 – 7.38 (m, 2H), 7.34 – 7.31 (m, 1H), 7.29 – 7.20 (m, 4H), 7.13 (d, $J = 7.6$ Hz, 2H), 6.96 – 6.92 (m, 1H), 5.99 (s, 1H), 3.96 (d, $J = 3.2$ Hz, 1H), 3.33 (dd, $J = 17.2, 12.4$ Hz, 1H), 2.93 – 2.84 (m, 1H), 2.62 (dd, $J = 17.2, 5.2$ Hz, 1H), 1.76 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 178.0, 161.3 (d, $J = 248.6$ Hz), 142.4, 141.1, 139.7 (d, $J = 3.2$

Hz), 137.9, 133.4 (d, $J = 9.8$ Hz), 133.1 (d, $J = 8.1$ Hz), 129.0, 128.8, 128.7, 127.8, 127.4, 127.1, 125.7, 119.9 (d, $J = 24.2$ Hz), 113.6 (d, $J = 19.7$ Hz), 51.4, 44.5, 39.1, 29.3, 24.1 ppm. ^{19}F NMR (376 MHz, CDCl_3) δ -114.37 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{22}\text{O}_2^{35}\text{ClF}$ $[\text{M} + \text{H}]^+$ 421.1365, found 421.1356; $\text{C}_{26}\text{H}_{22}\text{O}_2^{37}\text{ClF}$ $[\text{M} + \text{H}]^+$ 423.1336, found 423.1320.



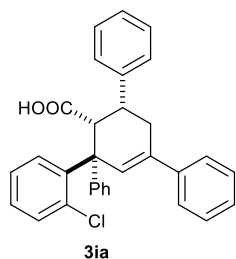
5'-methyl-5'-(naphthalen-2-yl)-2',3',4',5'-tetrahydro-[1,1':3',1''-terphen-yl]-

4'-carboxylic acid (3ha). The general procedure was followed using substrate **1h**

(21.0 mg, 0.1 mmol) and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ha** (21.6 mg, 52%) as white

solid. ^1H NMR (400 MHz, CDCl_3) δ 7.90 – 7.81 (dd, $J = 21.6, 7.9$ Hz, 4H), 7.67

(d, $J = 7.6$ Hz, 3H), 7.50 – 7.41 (m, 4H), 7.34 (t, $J = 7.6$ Hz, 1H), 7.23 – 7.15 (m, 3H), 7.07 (d, $J = 6.4$ Hz, 2H), 6.18 (s, 1H), 3.40 (dd, $J = 16.2, 13.0$ Hz, 1H), 3.33 (br s, 1H), 3.14 – 3.04 (m, 1H), 2.68 (dd, $J = 17.2, 5.2$ Hz, 1H), 1.65 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 178.3, 145.9, 142.6, 141.5, 138.3, 133.2, 132.3, 128.7, 128.3, 127.9, 127.6, 127.4, 127.0, 126.7, 126.4, 126.1, 125.7, 124.7, 57.0, 44.2, 38.5, 29.5, 27.1 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{30}\text{H}_{26}\text{O}_2$ $[\text{M} + \text{Na}]^+$ 441.1825, found 441.1813.



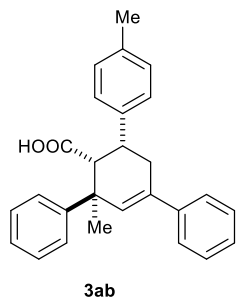
2-chloro-3',5'-diphenyl-3',4'-dihydro-2'H-[1,1':1',1''-terphenyl]-2'-carboxylic

acid (3ia). The general procedure was followed using substrate **1i** (25.7 mg, 0.1 mmol)

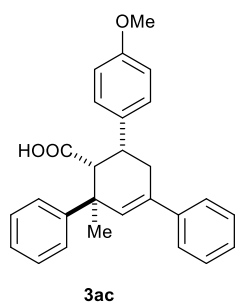
and **2a** (31.2 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ia** (39.5 mg, 85%) as white solid. ^1H NMR (400 MHz,

CDCl_3) δ 7.79 (d, $J = 8.0$ Hz, 1H), 7.57 (d, $J = 7.6$ Hz, 2H), 7.47 – 7.28 (m, 11H), 7.27

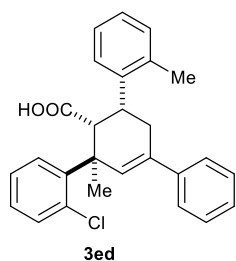
– 7.22 (m, 1H), 7.17 – 7.05 (m, 5H), 3.99 (s, 1H), 3.81 (d, $J = 10.4$ Hz, 1H), 3.41 (dd, $J = 16.0, 13.2$ Hz, 1H), 2.62 (dd, $J = 16.8, 5.2$ Hz, 1H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 175.7, 144.1, 143.1, 142.2, 141.9, 139.3, 134.7, 133.4, 129.0, 128.5, 128.3, 128.1, 127.9, 127.5, 127.4, 127.3, 126.9, 126.6, 125.8, 125.0, 53.6, 52.3, 39.4, 29.7 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{31}\text{H}_{25}\text{O}_2^{35}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 487.1435, found 487.1428; $\text{C}_{31}\text{H}_{25}\text{O}_2^{37}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 489.1406, found 489.1386.



1',4''-dimethyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3ab). The general procedure was followed using substrate **1a** (16.0 mg, 0.1 mmol) and **2b** (33.3 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ab** (28.2 mg, 73%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.61 (d, $J = 8.0$ Hz, 2H), 7.51 (d, $J = 8.0$ Hz, 2H), 7.41 – 7.27 (m, 6H), 7.04 (d, $J = 8.0$ Hz, 2H), 6.99 (d, $J = 8.0$ Hz, 2H), 6.06 (s, 1H), 3.34 (dd, $J = 16.0, 13.6$ Hz, 1H), 3.17 (s, 1H), 3.00 (d, $J = 10.0$ Hz, 1H), 2.61 (dd, $J = 17.2, 4.4$ Hz, 1H), 2.29 (s, 3H), 1.57 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 178.3, 148.6, 141.5, 139.6, 138.0, 136.5, 129.4, 128.6, 128.5, 127.9, 127.5, 127.2, 127.1, 126.7, 125.6, 57.4, 43.9, 37.9, 29.5, 27.1, 21.2 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{27}\text{H}_{26}\text{O}_2$ [$\text{M} + \text{Na}$] $^+$ 405.1825, found 405.1818.

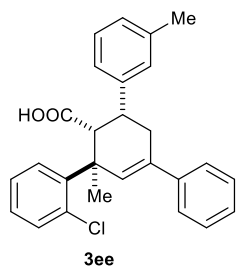


4''-methoxy-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3ac). The general procedure was followed using substrate **1a** (16.0 mg, 0.1 mmol) and **2c** (35.7 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ac** (28.0 mg, 70%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.63 (d, $J = 8.0$ Hz, 2H), 7.53 (d, $J = 7.6$ Hz, 2H), 7.41 (q, $J = 8.0$ Hz, 4H), 7.36 – 7.27 (q, $J = 8.0$ Hz, 2H), 7.04 (d, $J = 8.4$ Hz, 2H), 6.80 (d, $J = 8.4$ Hz, 2H), 6.08 (s, 1H), 3.77 (s, 3H), 3.34 (dd, $J = 17.2, 12.4$ Hz, 1H), 3.19 (d, $J = 3.2$ Hz, 1H), 3.05 – 3.00 (m, 1H), 2.63 (dd, $J = 17.2, 5.2$ Hz, 1H), 1.60 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 178.7, 158.5, 148.7, 141.5, 138.1, 134.7, 128.6, 128.6, 128.3, 128.0, 127.5, 127.1, 126.7, 125.6, 114.0, 57.6, 55.3, 43.9, 37.9, 29.7, 27.1 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{27}\text{H}_{26}\text{O}_3$ [$\text{M} + \text{Na}$] $^+$ 421.1774, found 421.1773.



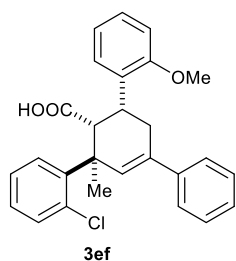
2-chloro-1',2''-dimethyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3ed). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2d** (33.3 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ed** (27.2 mg, 65%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 10.98 (br s, 1H), 7.67 – 7.59 (m, 3H), 7.45 – 7.38 (m, 3H), 7.31 – 7.34 (m, 2H), 7.26 – 7.21 (m, 2H), 7.15 – 7.06 (m, 3H), 6.03 (s, 1H), 3.80 (s, 1H), 3.50 – 3.37 (m, 1H), 3.17 (dd, $J = 12.0, 2.4$ Hz, 1H), 2.47 (dd, $J = 16.8, 4.0$ Hz, 1H), 1.81 (s, 3H), 1.66 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.6, 143.6, 141.3, 140.3, 138.1, 136.0, 133.1, 132.6, 132.2, 131.0, 129.2,

128.6, 128.5, 127.6, 126.8, 126.7, 126.3, 125.9, 125.7, 49.8, 45.1, 34.6, 28.9, 23.8, 18.2 ppm. HR – MS (ESI) m/z calcd for $C_{27}H_{25}O_2^{35}Cl$ $[M + Na]^+$ 439.1435, found 439.1429; $C_{27}H_{25}O_2^{37}Cl$ $[M + Na]^+$ 441.1406, found 441.1393.



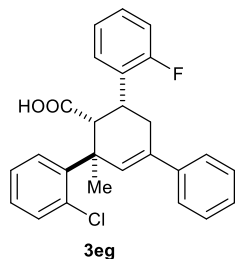
2-chloro-1',3''-dimethyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphen-yl]-2'-carboxylic acid (3ee). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2e** (33.3 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ee** (31.5 mg, 76%) as white solid. 1H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.57 (m, 3H), 7.47 – 7.37 (m, 3H), 7.35 – 7.29 (m, 1H),

7.24 – 7.19 (m, 2H), 7.14 (t, $J = 7.6$ Hz, 1H), 7.01 (d, $J = 7.6$ Hz, 1H), 6.96 – 6.90 (m, 2H), 6.02 (s, 1H), 4.02 (d, $J = 3.2$ Hz, 1H), 3.33 (dd, $J = 16.0, 13.2$ Hz, 1H), 2.93 – 2.81 (m, 1H), 2.59 (dd, $J = 17.2, 5.6$ Hz, 1H), 2.26 (s, 3H), 1.78 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$) δ 178.0, 143.8, 142.6, 141.3, 138.3, 137.6, 132.8, 132.0, 129.2, 128.6, 128.4, 128.2, 127.8, 127.6, 126.7, 125.7, 124.3, 51.2, 44.9, 39.1, 29.5, 24.1, 21.6 ppm. HR – MS (ESI) m/z calcd for $C_{27}H_{25}O_2^{35}Cl$ $[M+Na]^+$ 439.1435, found 439.1427; $C_{27}H_{25}O_2^{37}Cl$ $[M + Na]^+$ 441.1406, found 441.1391.



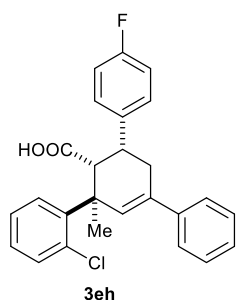
2-chloro-2''-methoxy-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3ef). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2f** (35.7 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ef** (31.0 mg, 72%) as white solid. 1H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.58 (m, 3H), 7.48 – 7.44 (m, 1H),

7.39 (dd, $J = 8.4, 7.2$ Hz, 2H), 7.31 (t, $J = 7.2$ Hz, 1H), 7.25 – 7.15 (m, 4H), 6.86 (t, $J = 7.6$ Hz, 1H), 6.75 (d, $J = 8.0$ Hz, 1H), 6.01 (s, 1H), 4.11 (s, 1H), 3.48 (s, 3H), 3.41 – 3.28 (m, 2H), 2.41 (d, $J = 14.0$ Hz, 1H), 1.75 (s, 3H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$) δ 178.0, 157.0, 144.0, 141.6, 137.9, 133.3, 132.1, 130.4, 129.6, 128.6, 128.1, 127.7, 127.5, 126.5, 125.7, 120.5, 110.2, 54.8, 48.6, 45.0, 31.9, 27.6, 23.8 ppm. HR – MS (ESI) m/z calcd for $C_{27}H_{25}O_3^{35}Cl$ $[M + Na]^+$ 455.1384, found 455.1379; $C_{27}H_{25}O_3^{37}Cl$ $[M+Na]^+$ 457.1355, found 457.1341.



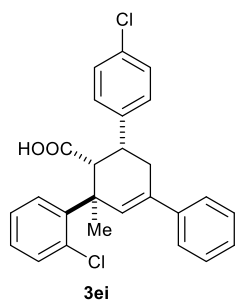
2-chloro-2''-fluoro-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3eg). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2g** (33.9 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3eg** (29.5 mg, 70%) as white solid.

^1H NMR (400 MHz, CDCl_3) δ 7.60 (d, $J = 7.2$ Hz, 3H), 7.47 – 7.44 (m, 1H), 7.40 (t, $J = 7.6$ Hz, 2H), 7.34 – 7.28 (m, 2H), 7.24 – 7.20 (m, 2H), 7.19 – 7.14 (m, 1H), 7.03 (t, $J = 7.6$ Hz, 1H), 6.94 (t, $J = 9.6$ Hz, 1H), 6.03 (s, 1H), 4.06 (s, 1H), 3.40 – 3.29 (m, 2H), 2.51 (q, $J = 14.0$ Hz, 1H), 1.79 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ 177.6, 160.9 (d, $J = 246.0$ Hz), 143.5, 141.3, 137.4, 133.1, 132.7, 131.9, 129.52 (d, $J = 13.6$ Hz), 129.51, 128.6, 128.5, 128.4, 127.73, 127.66, 126.6, 125.7, 124.2 (d, $J = 3.0$ Hz), 115.6 (d, $J = 22.5$ Hz), 49.7, 44.9, 31.6, 28.0, 24.0 ppm. ^{19}F NMR (376 MHz, CDCl_3) δ -118.55. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{22}\text{O}_2^{35}\text{ClF} [\text{M} + \text{Na}]^+$ 443.1185, found 443.1178; $\text{C}_{26}\text{H}_{22}\text{O}_2^{37}\text{ClF} [\text{M} + \text{Na}]^+$ 445.1155, found 445.1148.



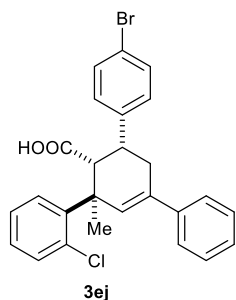
2-chloro-4''-fluoro-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3eh). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2h** (33.9 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3eh** (34.5 mg, 82%) as white solid.

^1H NMR (400 MHz, CDCl_3) δ 7.62 – 7.57 (m, 3H), 7.49 – 7.44 (m, 1H), 7.41 (t, $J = 7.2$ Hz, 2H), 7.33 (t, $J = 7.2$ Hz, 1H), 7.24 – 7.19 (m, 2H), 7.13 – 7.05 (m, 2H), 6.94 (t, $J = 8.0$ Hz, 2H), 6.03 (s, 1H), 4.01 (s, 1H), 3.30 (dd, $J = 17.2, 12.0$ Hz, 1H), 2.95 – 2.86 (m, 1H), 2.60 (dd, $J = 17.2, 5.2$ Hz, 1H), 1.77 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.7, 161.8 (d, $J = 245.0$ Hz), 143.5, 141.1, 138.2 (d, $J = 2.8$ Hz), 137.4, 132.8, 132.7, 132.0, 129.2, 128.9 (d, $J = 7.8$ Hz), 128.6, 128.5, 127.7, 126.8, 125.6, 115.5 (d, $J = 21.0$ Hz), 51.4, 44.8, 38.3, 29.3, 24.0 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{22}\text{O}_2^{35}\text{ClF} [\text{M} + \text{Na}]^+$ 443.1185, found 443.1176; $\text{C}_{26}\text{H}_{22}\text{O}_2^{37}\text{ClF} [\text{M} + \text{Na}]^+$ 445.1155, found 445.1141.

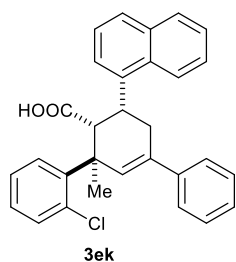


2,4''-dichloro-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3ei). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2i** (36.4 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ei** (34.8 mg, 80%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.59 (t, $J = 7.6$ Hz, 3H), 7.47 – 7.38 (m, 3H), 7.32 (t, $J = 7.2$ Hz,

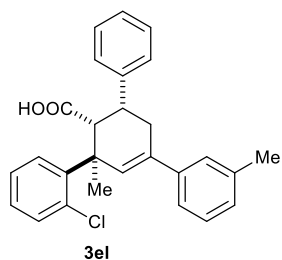
1H), 7.22 (d, $J = 8.0$ Hz, 4H), 7.06 (d, $J = 8.0$ Hz, 2H), 6.02 (s, 1H), 4.01 (d, $J = 2.7$ Hz, 1H), 3.29 (dd, $J = 16.8, 12.4$ Hz, 1H), 2.89 (d, $J = 11.6$ Hz, 1H), 2.59 (dd, $J = 17.2, 5.2$ Hz, 1H), 1.77 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.8, 143.6, 141.1, 141.1, 137.4, 132.9, 132.7, 132.0, 129.3, 128.9, 128.8, 128.7, 128.6, 127.7, 126.8, 125.7, 51.3, 44.9, 38.5, 29.2, 24.1 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{22}\text{O}_2^{35}\text{Cl}_2$ $[\text{M} + \text{Na}]^+$ 459.0889, found 459.0886; $\text{C}_{26}\text{H}_{22}\text{O}_2^{37}\text{Cl}^{35}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 461.0860, found 461.0851; $\text{C}_{26}\text{H}_{22}\text{O}_2^{37}\text{Cl}_2$ $[\text{M} + \text{Na}]^+$ 463.0830, found 463.0810.



4''-bromo-2-chloro-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3ej). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2j** (43.1 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ej** (36.5 mg, 76%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.62 – 7.55 (m, 3H), 7.49 – 7.31 (m, 6H), 7.24 – 7.19 (m, 2H), 7.00 (d, $J = 8.0$ Hz, 2H), 6.02 (s, 1H), 4.01 (s, 1H), 3.29 (dd, $J = 16.8, 12.4$ Hz, 1H), 2.94 – 2.82 (m, 1H), 2.58 (dd, $J = 17.2, 5.2$ Hz, 1H), 1.77 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.7, 143.5, 141.6, 141.1, 137.3, 132.9, 132.7, 132.0, 131.8, 129.3, 129.2, 128.7, 128.6, 127.7, 126.8, 125.7, 120.9, 51.2, 44.9, 38.6, 29.1, 24.1 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{22}\text{O}_2^{79}\text{Br}^{35}\text{Cl}$ $[\text{M} + \text{H}]^+$ 481.0564, found 481.0560; $\text{C}_{26}\text{H}_{22}\text{O}_2^{81}\text{Br}^{35}\text{Cl}$ $[\text{M} + \text{H}]^+$ 483.0544 or $\text{C}_{26}\text{H}_{22}\text{O}_2^{79}\text{Br}^{37}\text{Cl}$ $[\text{M} + \text{H}]^+$ 483.0535, found 483.0536; $\text{C}_{26}\text{H}_{22}\text{O}_2^{81}\text{Br}^{37}\text{Cl}$ $[\text{M} + \text{H}]^+$ 485.0515, found 485.0498.



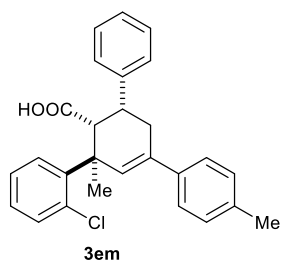
2''-chloro-3'-methyl-5'-(naphthalen-1-yl)-3',4',5',6'-tetrahydro-[1,1':3',1''-terphen-yl]-4'-carboxylic acid (3ek). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2k** (38.8 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ek** (32.5 mg, 72%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.83 – 7.71 (m, 3H), 7.65 – 7.55 (m, 3H), 7.47 – 7.30 (m, 8H), 7.13 (t, $J = 8.0$ Hz, 1H), 6.78 (d, $J = 8.8$ Hz, 1H), 6.08 (s, 1H), 4.10 (s, 1H), 3.80 (d, $J = 11.4$ Hz, 1H), 3.61 (t, $J = 14.4$ Hz, 1H), 2.59 (d, $J = 16.4$ Hz, 1H), 1.81 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.36, 143.63, 141.40, 138.20, 137.70, 134.19, 133.54, 132.61, 132.39, 131.48, 129.40, 129.23, 128.75, 128.63, 127.69, 127.65, 126.95, 126.08, 125.74, 125.50, 125.43, 123.42, 121.88, 77.48, 77.16, 76.84, 50.35, 45.33, 33.84, 28.74, 23.80 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{30}\text{H}_{25}\text{O}_2^{35}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 475.1435, found 475.1430; $\text{C}_{30}\text{H}_{25}\text{O}_2^{37}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 477.1406, found 477.1392.



2-chloro-1'-methyl-5'-(m-tolyl)-1',2',3',4'-tetrahydro-[1,1':3',1''-terphen-yl]-2'-carboxylic acid (3el). The general procedure was followed using substrate **1e**

(19.5 mg, 0.1 mmol) and **2l** (33.3 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3el** (28.6 mg, 69%) as white solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.59 (s, 1H), 7.47 – 7.38 (m, 3H), 7.33 – 7.10

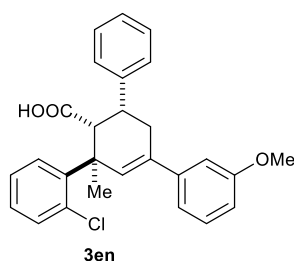
(m, 9H), 6.00 (s, 1H), 4.03 (s, 1H), 3.40 – 3.24 (m, 1H), 2.91 (d, $J = 10.8$ Hz, 1H), 2.60 (dd, $J = 16.8, 4.0$ Hz, 1H), 2.40 (s, 3H), 1.78 (s, 3H) ppm. $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 177.9, 143.8, 142.7, 141.3, 138.2, 137.7, 132.8, 132.1, 129.1, 128.7, 128.5, 128.4, 128.4, 127.4, 127.0, 126.7, 126.4, 122.8, 51.3, 44.9, 39.2, 29.4, 24.1, 21.7 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{27}\text{H}_{25}\text{O}_2^{35}\text{Cl}$ [$\text{M} + \text{Na}$] $^+$ 439.1435, found 439.1429; $\text{C}_{27}\text{H}_{25}\text{O}_2^{37}\text{Cl}$ [$\text{M} + \text{Na}$] $^+$ 441.1406, found 441.1390.



2-chloro-1'-methyl-5'-(p-tolyl)-1',2',3',4'-tetrahydro-[1,1':3',1''-terphen-yl]-2'-carboxylic acid (3em). The general procedure was followed using substrate **1e**

(19.5 mg, 0.1 mmol) and **2m** (33.3 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3em** (30.0 mg, 72%) as white solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.61 – 7.56 (m, 1H), 7.50 (d, $J = 6.8$ Hz, 2H),

7.46 – 7.42 (m, 1H), 7.25 – 7.18 (m, 7H), 7.12 (d, $J = 7.2$ Hz, 2H), 5.98 (s, 1H), 4.02 (s, 1H), 3.30 (dd, $J = 17.2, 12.4$ Hz, 1H), 2.95 – 2.84 (m, 1H), 2.59 (dd, $J = 17.2, 5.2$ Hz, 1H), 2.38 (s, 3H), 1.77 (s, 3H) ppm. $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 178.1, 143.9, 142.7, 138.4, 137.4, 137.3, 132.3, 132.1, 129.3, 128.7, 128.5, 128.4, 127.4, 126.9, 126.7, 125.5, 51.3, 44.9, 39.1, 29.3, 24.1, 21.3 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{27}\text{H}_{25}\text{O}_2^{35}\text{Cl}$ [$\text{M} + \text{Na}$] $^+$ 439.1435, found 439.1428; $\text{C}_{27}\text{H}_{25}\text{O}_2^{37}\text{Cl}$ [$\text{M} + \text{Na}$] $^+$ 441.1406, found 441.1391.

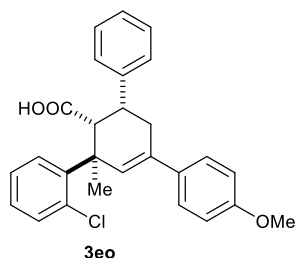


2-chloro-5'-(3-methoxyphenyl)-1'-methyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3en). The general procedure was followed using

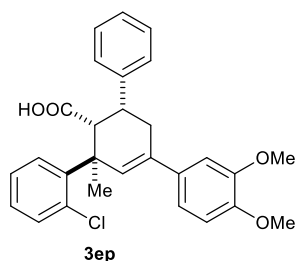
substrate **1e** (19.5 mg, 0.1 mmol) and **2n** (35.7 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3en** (31.0 mg, 72%) as white solid. $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.61 – 7.55 (m, 1H), 7.49

– 7.42 (m, 1H), 7.35 – 7.19 (m, 7H), 7.16 – 7.11 (m, 3H), 6.87 (dd, $J = 8.4, 2.4$ Hz, 1H), 6.03 (s, 1H), 4.03 (s, 1H), 3.86 (s, 3H), 3.32 (dd, $J = 17.2, 12.4$ Hz, 1H), 2.97 – 2.86 (m, 1H), 2.60 (d, $J = 16.0$ Hz, 1H), 1.78

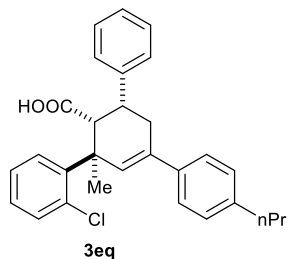
(s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.9, 159.8, 143.7, 142.8, 142.6, 137.4, 132.8, 132.0, 129.6, 129.5, 128.7, 128.5, 127.4, 127.0, 126.7, 118.2, 112.7, 111.7, 55.5, 51.3, 44.9, 39.1, 29.4, 24.0 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{27}\text{H}_{25}\text{O}_3^{35}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 455.1384, found 455.1377; $\text{C}_{27}\text{H}_{25}\text{O}_3^{37}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 457.1355, found 457.1339.



2-chloro-5'-(4-methoxyphenyl)-1'-methyl-1',2',3',4'-tetrahydro-[1,1':3,1''-terphenyl]-2'-carboxylic acid (3eo). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2o** (35.7 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3eo** (30.5 mg, 70%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.61 – 7.51 (m, 3H), 7.46 – 7.42 (m, 1H), 7.26 – 7.17 (m, 5H), 7.12 (d, $J = 7.2$ Hz, 2H), 6.93 (d, $J = 6.8$ Hz, 2H), 5.93 (s, 1H), 4.02 (s, 1H), 3.84 (s, 3H), 3.29 (dd, $J = 16.8, 12.8$ Hz, 1H), 2.90 (d, $J = 11.6$ Hz, 1H), 2.58 (dd, $J = 17.2, 4.4$ Hz, 1H), 1.77 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.8, 159.3, 144.0, 142.8, 136.9, 133.9, 132.82, 132.78, 132.1, 128.7, 128.4, 127.8, 127.4, 126.9, 126.7, 114.0, 55.5, 51.3, 44.9, 39.2, 29.4, 24.2 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{27}\text{H}_{25}\text{O}_3^{35}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 455.1384, found 455.1379; $\text{C}_{27}\text{H}_{25}\text{O}_3^{37}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 457.1355, found 457.1341.

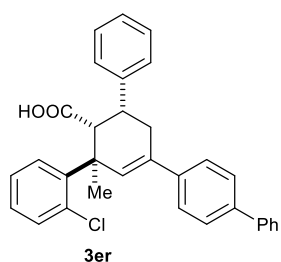


2-chloro-5'-(3,4-dimethoxyphenyl)-1'-methyl-1',2',3',4'-tetrahydro-[1,1':3,1''-terphenyl]-2'-carboxylic acid (3ep). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2p** (40.3 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ep** (33.6 mg, 73%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.59 (dd, $J = 6.0, 3.6$ Hz, 1H), 7.45 (dd, $J = 6.0, 3.6$ Hz, 1H), 7.28 – 7.20 (m, 6H), 7.18 – 7.10 (m, 4H), 6.90 (d, $J = 8.4$ Hz, 1H), 5.95 (s, 1H), 4.02 (d, $J = 2.8$ Hz, 1H), 3.94 (s, 3H), 3.91 (s, 3H), 3.29 (dd, $J = 16.4, 12.8$ Hz, 1H), 2.95 – 2.87 (m, 1H), 2.60 (dd, $J = 17.2, 5.6$ Hz, 1H), 1.79 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 178.2, 149.0, 148.9, 143.8, 142.7, 137.0, 134.2, 132.8, 132.0, 128.7, 128.4, 128.0, 127.4, 127.0, 126.7, 118.1, 111.2, 108.9, 56.2, 56.1, 51.3, 44.9, 39.2, 29.5, 24.1 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{28}\text{H}_{27}\text{O}_4^{35}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 485.1490, found 485.1482; $\text{C}_{28}\text{H}_{27}\text{O}_4^{37}\text{Cl}$ $[\text{M} + \text{Na}]^+$ 487.1461, found 487.1439.



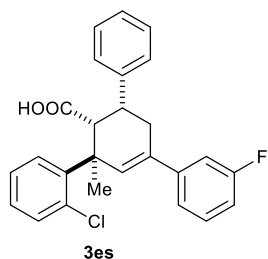
2-chloro-1'-methyl-5'-(4-propylphenyl)-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3eq). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2q** (37.6 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3eq** (33.2 mg, 75%) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 7.62 – 7.42 (m, 4H), 7.27

– 7.18 (m, 7H), 7.12 (d, *J* = 7.6 Hz, 2H), 6.00 (s, 1H), 4.02 (s, 1H), 3.32 (dd, *J* = 16.4, 12.8 Hz, 1H), 2.90 (d, *J* = 11.6 Hz, 1H), 2.64 – 2.56 (m, 3H), 1.77 (s, 3H), 1.71 – 1.62 (m, 2H), 0.97 (t, *J* = 7.6 Hz, 3H) ppm. ¹³C NMR (100 MHz, CDCl₃) δ 177.6, 143.9, 142.7, 142.3, 138.6, 137.3, 132.8, 132.8, 132.1, 128.7, 128.5, 128.4, 127.4, 126.9, 126.7, 125.5, 51.3, 44.9, 39.1, 37.9, 29.3, 24.8, 24.1, 14.0 ppm. HR – MS (ESI) *m/z* calcd for C₂₉H₂₉O₂³⁵Cl [M+Na]⁺ 467.1748, found 467.1742; C₂₉H₂₉O₂³⁷Cl [M+Na]⁺ 469.1719, found 469.1705.



5'-(2-chlorophenyl)-5'-methyl-1',2',5',6'-tetrahydro-[1,1':3',1''':4'',1''''-quarterphenyl]-6'-carboxylic acid (3er). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2r** (42.7 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3er** (35.4 mg, 74%) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 12.19 (s, 1H), 7.79 – 7.70 (m,

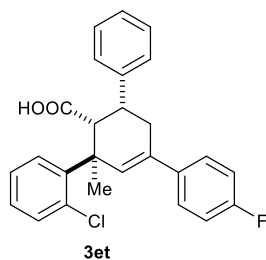
6H), 7.61 – 7.47 (m, 4H), 7.40 – 7.27 (m, 5H), 7.21 (t, *J* = 7.6 Hz, 1H), 7.12 (d, *J* = 7.2 Hz, 2H), 6.21 (s, 1H), 3.83 (s, 1H), 3.30 (dd, *J* = 15.6, 12.4 Hz, 1H), 2.78 (d, *J* = 10.8 Hz, 1H), 2.62 (dd, *J* = 16.8, 4.4 Hz, 1H), 1.71 (s, 3H) ppm. ¹³C NMR (100 MHz, CDCl₃) δ 172.9, 143.6, 143.0, 139.8, 139.6, 139.1, 136.0, 132.5, 132.0, 131.6, 129.0, 128.8, 128.5, 127.5, 127.2, 127.1, 126.7, 126.63, 126.57, 125.8, 50.9, 44.5, 38.6, 28.6, 23.7 ppm. HR – MS (ESI) *m/z* calcd for C₃₂H₂₇O₂³⁵Cl [M + Na]⁺ 501.1592, found 501.1584; C₃₂H₂₇O₂³⁷Cl [M + Na]⁺ 503.1562, found 503.1543.



2-chloro-5'-(3-fluorophenyl)-1'-methyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3es). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2s** (33.9 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3es** (30.0 mg, 71%) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 7.62 – 7.55 (m, 3H), 7.47 – 7.43 (m, 1H),

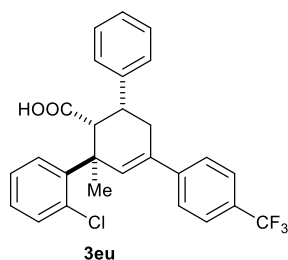
7.40 (t, *J* = 7.6 Hz, 2H), 7.32 (t, *J* = 7.2 Hz, 1H), 7.25 – 7.17 (m, 3H), 6.92 – 6.83 (m, 3H), 6.02 (s, 1H),

4.03 (d, $J = 2.8$ Hz, 1H), 3.29 (dd, $J = 17.2, 12.4$ Hz, 1H), 2.97 – 2.86 (m, 1H), 2.60 (dd, $J = 17.2, 5.6$ Hz, 1H), 1.78 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 178.1, 163.1 (d, $J = 245.7$ Hz), 145.3 (d, $J = 6.9$ Hz), 143.6, 141.1, 137.3, 132.9, 132.8, 132.0, 130.2 (d, $J = 8.3$ Hz), 129.3, 128.6, 128.6, 127.7, 126.8, 125.7, 123.1 (d, $J = 2.3$ Hz), 114.4 (d, $J = 21.5$ Hz), 113.9 (d, $J = 21.1$ Hz), 51.2, 44.9, 38.9, 29.2, 24.0 ppm. ^{19}F NMR (376 MHz, CDCl_3) δ -112.7 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{22}\text{O}_2^{35}\text{ClF}$ $[\text{M} + \text{H}]^+$ 421.1365, found 421.1357; $\text{C}_{26}\text{H}_{22}\text{O}_2^{37}\text{ClF}$ $[\text{M} + \text{H}]^+$ 423.1336, found 423.1319.



2-chloro-5'-(4-fluorophenyl)-1'-methyl-1',2',3',4'-tetrahydro-[1,1':3,1''-terphen-yl]-2'-carboxylic acid (3et). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2t** (33.9 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3et** (28.1 mg, 67%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.58 – 7.52 (m, 3H), 7.48 – 7.42 (m, 1H),

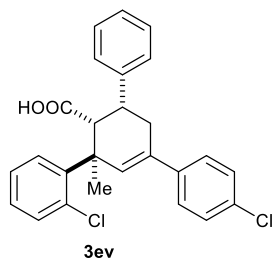
7.29 – 7.17 (m, 5H), 7.13 – 7.05 (m, 4H), 5.95 (s, 1H), 4.03 (s, 1H), 3.29 (dd, $J = 16.8, 12.4$ Hz, 1H), 2.97 – 2.85 (m, 1H), 2.56 (dd, $J = 16.8, 5.2$ Hz, 1H), 1.77 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 178.1, 162.5 (d, $J = 246.5$ Hz), 143.6, 142.5, 137.4 (d, $J = 2.9$ Hz), 136.8, 132.9, 132.8, 131.9, 129.2, 128.8, 128.5, 127.4, 127.2 (d, $J = 7.9$ Hz), 127.0, 126.8, 115.4 (d, $J = 21.3$ Hz), 51.2, 44.9, 39.1, 29.5, 24.1 ppm. ^{19}F NMR (376 MHz, CDCl_3) δ -115.05 ppm. HR – MS (ESI) m/z calcd for $\text{C}_{26}\text{H}_{22}\text{O}_2^{35}\text{ClF}$ $[\text{M} + \text{Na}]^+$ 443.1185, found 443.1177; $\text{C}_{26}\text{H}_{22}\text{O}_2^{37}\text{ClF}$ $[\text{M} + \text{H}]^+$ 445.1155, found 445.1140.



2-chloro-1'-methyl-5'-(4-(trifluoromethyl)phenyl)-1',2',3',4'-tetrahydro-[1,1':3,1''-terphenyl]-2'-carboxylic acid (3eu). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2u** (41.4 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3eu** (40.0 mg, 85%) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 7.67 (dd, $J =$

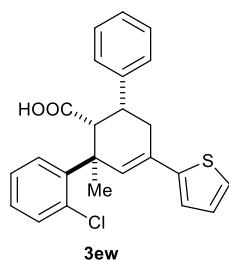
20.0, 8.0 Hz, 4H), 7.56 – 7.43 (m, 2H), 7.31 – 7.19 (m, 5H), 7.12 (d, $J = 7.2$ Hz, 2H), 6.10 (s, 1H), 4.06 (d, $J = 2.4$ Hz, 1H), 3.33 (dd, $J = 16.4, 12.8$ Hz, 1H), 3.00 – 2.88 (m, 1H), 2.61 (dd, $J = 17.2, 4.8$ Hz, 1H), 1.79 (s, 3H) ppm. ^{13}C NMR (100 MHz, CDCl_3) δ 177.9, 144.8, 143.3, 142.3, 136.8, 133.0, 132.8, 131.8, 131.3, 129.6 (q, $J = 32.4$ Hz), 128.8, 128.7, 127.4, 127.1, 126.8, 126.0, 125.58, 125.55, 124.4 (q, $J = 272.0$ Hz), 51.2, 45.0, 39.1, 29.3, 24.0 ppm. ^{19}F NMR (376 MHz, CDCl_3) δ -62.31 ppm. HR – MS (ESI) m/z calcd for

$C_{27}H_{22}O_2^{35}ClF_3$ [M + Na]⁺ 493.1153, found 493.1149; $C_{27}H_{22}O_2^{37}ClF_3$ [M + Na]⁺ 495.1123, found 495.1111.



2-chloro-5'-(4-chlorophenyl)-1'-methyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3ev). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2v** (36.4 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ev** (33.8 mg, 77%) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 7.55 – 7.49 (m, 3H), 7.47 – 7.44 (m,

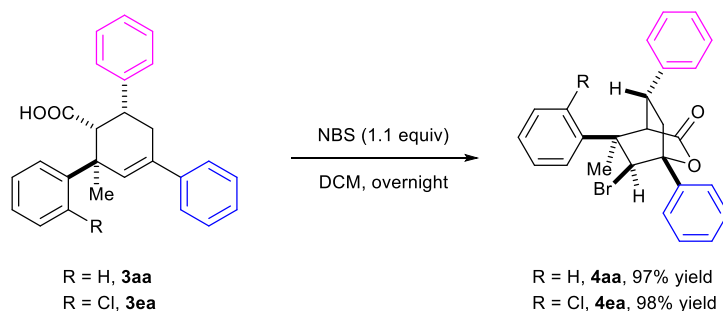
1H), 7.36 (d, *J* = 8.4 Hz, 2H), 7.29 – 7.19 (m, 5H), 7.11 (d, *J* = 7.2 Hz, 2H), 6.00 (s, 1H), 4.04 (s, 1H), 3.29 (dd, *J* = 16.0, 13.6 Hz, 1H), 2.91 (dd, *J* = 6.8, 3.6 Hz, 1H), 2.56 (dd, *J* = 17.2, 4.0 Hz, 1H), 1.77 (s, 3H) ppm. ¹³C NMR (100 MHz, CDCl₃) δ 178.0, 143.5, 142.4, 139.7, 136.6, 133.4, 132.9, 132.8, 131.9, 123.0, 128.8, 128.7, 128.6, 127.4, 127.1, 126.9, 126.8, 51.2, 45.0, 39.1, 29.3, 24.0 ppm. HR – MS (ESI) *m/z* calcd for $C_{26}H_{22}O_2^{35}Cl_2$ [M + Na]⁺ 459.0889, found 459.0881; $C_{26}H_{22}O_2^{37}Cl^{35}Cl$ [M + Na]⁺ 461.0860, found 461.0846; $C_{26}H_{22}O_2^{37}Cl_2$ [M + Na]⁺ 463.0830, found 463.0806.



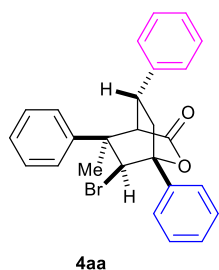
2-chloro-1'-methyl-5'-(thiophen-2-yl)-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic acid (3ew). The general procedure was followed using substrate **1e** (19.5 mg, 0.1 mmol) and **2w** (32.1 mg, 0.15 mmol) to afford the product. The title compound was isolated by preparative TLC yielded **3ew** (24.0 mg, 59%) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 7.57 – 7.52 (m, 1H), 7.47 – 7.42 (m, 1H),

7.29 – 7.18 (m, 6H), 7.16 – 7.09 (m, 3H), 7.06 – 7.01 (m, 1H), 6.08 (s, 1H), 4.02 (d, *J* = 2.0 Hz, 1H), 3.32 (dd, *J* = 16.0, 13.2 Hz, 1H), 2.97 – 2.85 (m, 1H), 2.64 (dd, *J* = 17.2, 5.2 Hz, 1H), 1.77 (s, 3H) ppm. ¹³C NMR (100 MHz, CDCl₃) δ 177.8, 145.4, 143.5, 142.3, 132.8, 132.7, 132.0, 128.8, 128.5, 128.0, 127.6, 127.4, 127.1, 126.8, 123.9, 122.8, 51.4, 44.9, 38.9, 29.4, 24.0 ppm. HR – MS (ESI) *m/z* calcd for $C_{24}H_{21}O_2^{35}ClS$ [M + Na]⁺ 431.0843, found 431.0836; $C_{24}H_{21}O_2^{37}ClS$ [M + Na]⁺ 433.0813, found 433.0798.

3. Product Derivatization



To a solution of **3** (0.1 mmol) and NBS (19.6 mg, 1.1 equiv) in CH₂Cl₂ (2 mL) was stirred at room temperature overnight. The crude mixture was direct purified by preparative TLC with petroleum ether/ethyl acetate to afford the product **4**.



6-bromo-5-methyl-1,5,8-triphenyl-2-oxabicyclo[2.2.2]octan-3-one (4aa). The title

compound **4aa** was prepared according to General Procedure and purified by preparative TLC with petroleum ether/ethyl acetate to afford the white solid (43.5 mg,

97% yield). ¹H NMR (400 MHz, CDCl₃) δ 7.59 (d, *J* = 7.6 Hz, 2H), 7.44 – 7.36 (m, 9H),

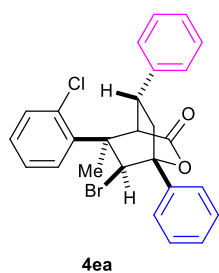
7.33 – 7.27 (m, 4H), 4.54 (s, 1H), 3.93 (t, *J* = 9.6 Hz, 1H), 3.53 (dd, *J* = 14.0, 9.6 Hz,

1H), 3.44 (s, 1H), 2.21 (dd, *J* = 14.0, 9.2 Hz, 1H), 1.72 (s, 3H) ppm. ¹³C NMR (100 MHz, CDCl₃) δ 173.1,

144.1, 142.6, 138.7, 129.4, 129.1, 129.0, 128.5, 127.9, 127.6, 127.3, 127.2, 126.6, 86.6, 62.9, 51.1, 45.9,

36.9, 35.9, 34.2 ppm. HR – MS (ESI) *m/z* calcd for C₂₆H₂₃O₂Br [M+Na]⁺ 469.0774, found 469.0769;

C₂₆H₂₃O₂⁸¹Br [M+Na]⁺ 471.0753, found 471.0745.



6-bromo-5-(2-chlorophenyl)-5-methyl-1,8-diphenyl-2-oxabicyclo[2.2.2]octan-3-

one (4ea). The title compound **4ea** was prepared according to General Procedure and purified by preparative TLC with petroleum ether/ethyl acetate to afford the white solid

(47.0 mg, 98% yield). ¹H NMR (400 MHz, CDCl₃) δ 7.62 (d, *J* = 6.8 Hz, 2H), 7.50 –

7.38 (m, 8H), 7.36 – 7.25 (m, 3H), 7.19 (dd, *J* = 7.6, 0.8 Hz, 1H), 4.78 (s, 1H), 3.98 (t,

J = 9.6 Hz, 1H), 3.60 (dd, *J* = 14.0, 9.6 Hz, 1H), 3.45 (s, 1H), 2.20 (dd, *J* = 12.8, 10.0 Hz, 1H), 1.94 (s, 3H)

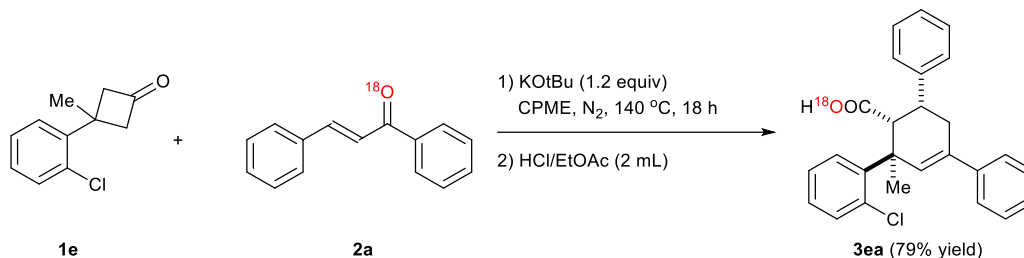
ppm. ¹³C NMR (100 MHz, CDCl₃) δ 173.3, 142.3, 141.3, 138.4, 136.3, 132.9, 129.4, 129.2, 128.8, 128.6,

127.7, 127.4, 127.3, 126.9, 126.8, 86.9, 61.9, 52.9, 46.7, 38.8, 35.5, 27.3 ppm. HR – MS (ESI) *m/z* calcd

for C₂₆H₂₂O₂⁷⁹Br³⁵Cl [M + Na]⁺ 503.0384, found 503.0379; C₂₆H₂₂O₂⁸¹Br³⁵Cl [M+Na]⁺ 505.0363, found

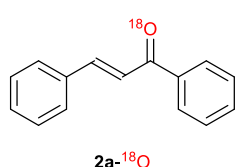
505.0353; C₂₆H₂₂O₂⁷⁹Br³⁷Cl [M+Na]⁺ 505.0354 or C₂₆H₂₂O₂⁸¹Br³⁵Cl [M+Na]⁺ 505.0363, found 505.0353; C₂₆H₂₂O₂⁸¹Br³⁷Cl [M+Na]⁺ 507.0334 found 507.0319.

4. ¹⁸O Labeling Experiment

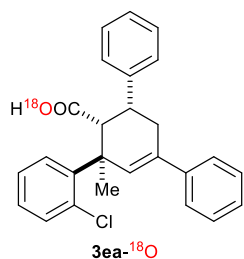


2a-¹⁸O was prepared according to the literatures.^{2b} The ratio of **2a-¹⁶O** and **2a-¹⁸O** was 12 : 88.

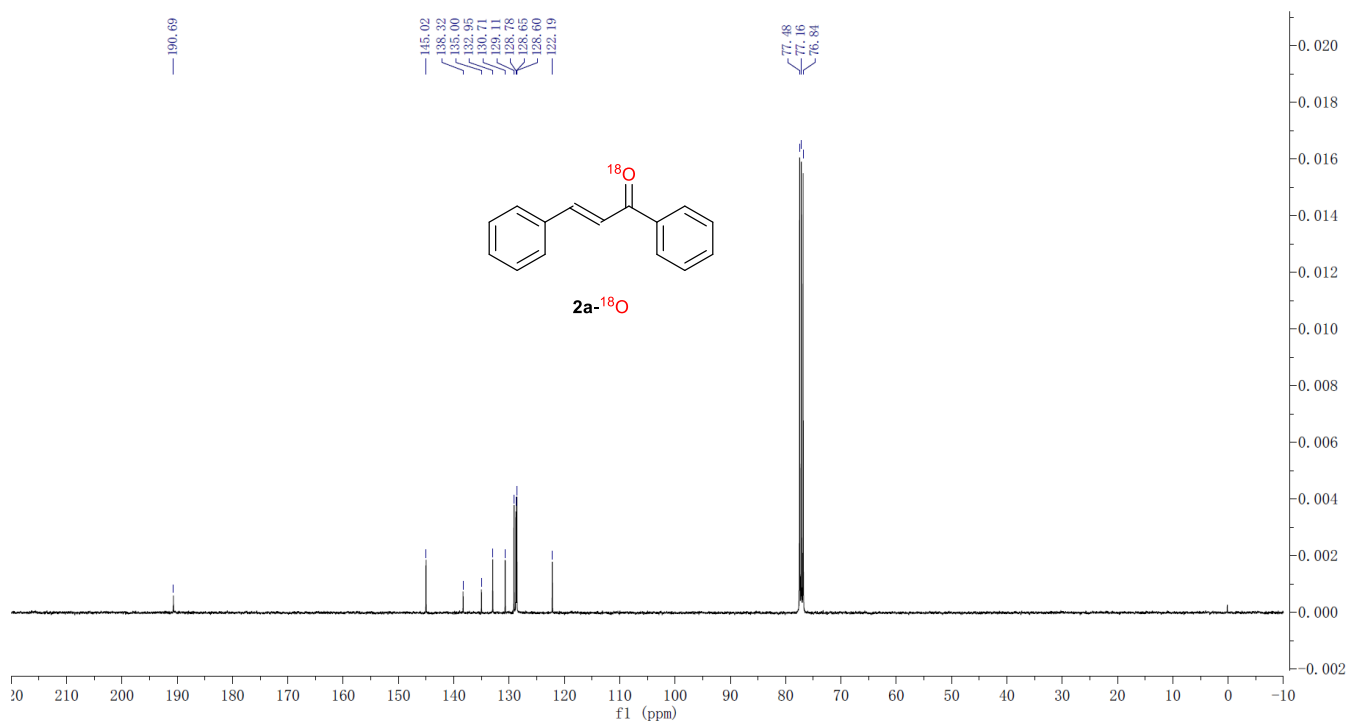
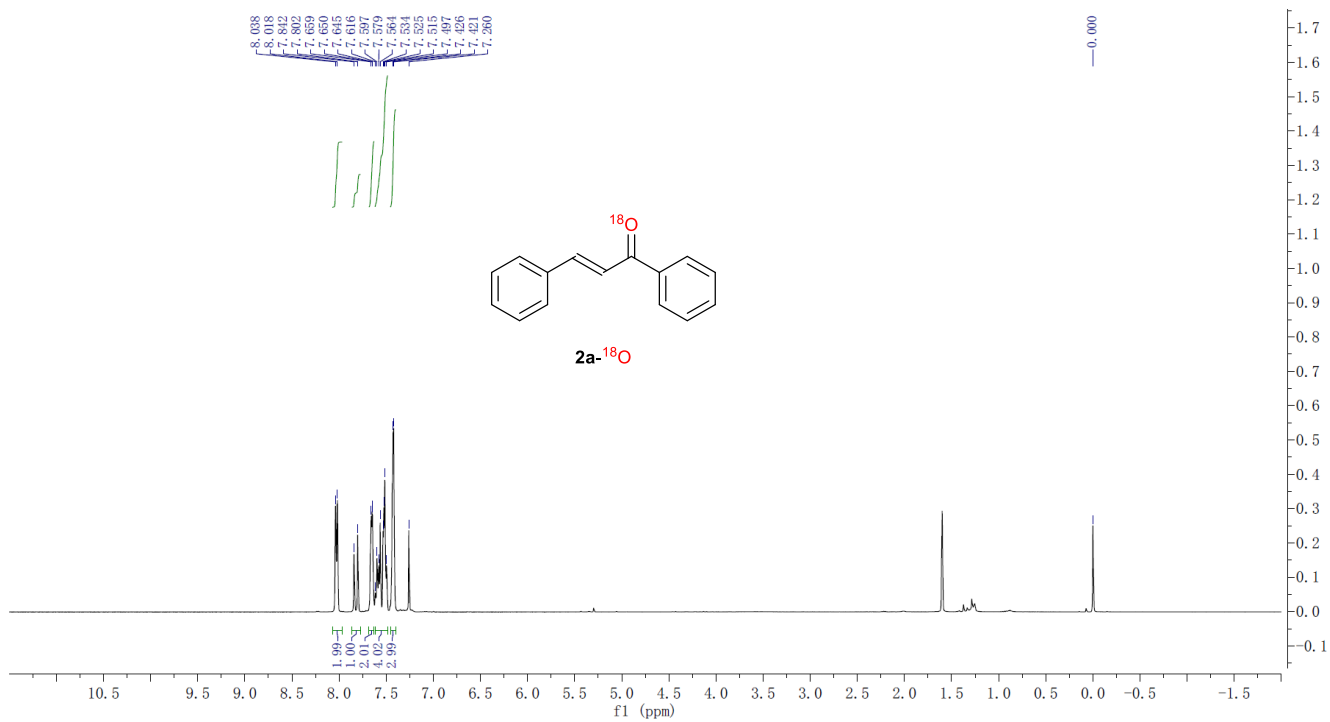
The reaction carried out with Cyclobutanone **1e** (19.5 mg, 0.1 mmol), Chalcone **2a-¹⁸O** (31.5 mg, 0.15 mmol) and KO^tBu (13.5 mg, 1.2 equiv). The mixture was added anhydrous CPME (1 mL) at 140 °C and continuous stirring for 18 hours under N₂ atmosphere. The reaction was dealt with HCl/EtOAc (2 mL) after cooling to ambient temperature. The crude mixture was purified by preparative TLC to afford product **3ea-¹⁸O**. The ratio of **3ea-¹⁶O** and **3ea-¹⁸O** was 47 : 53.

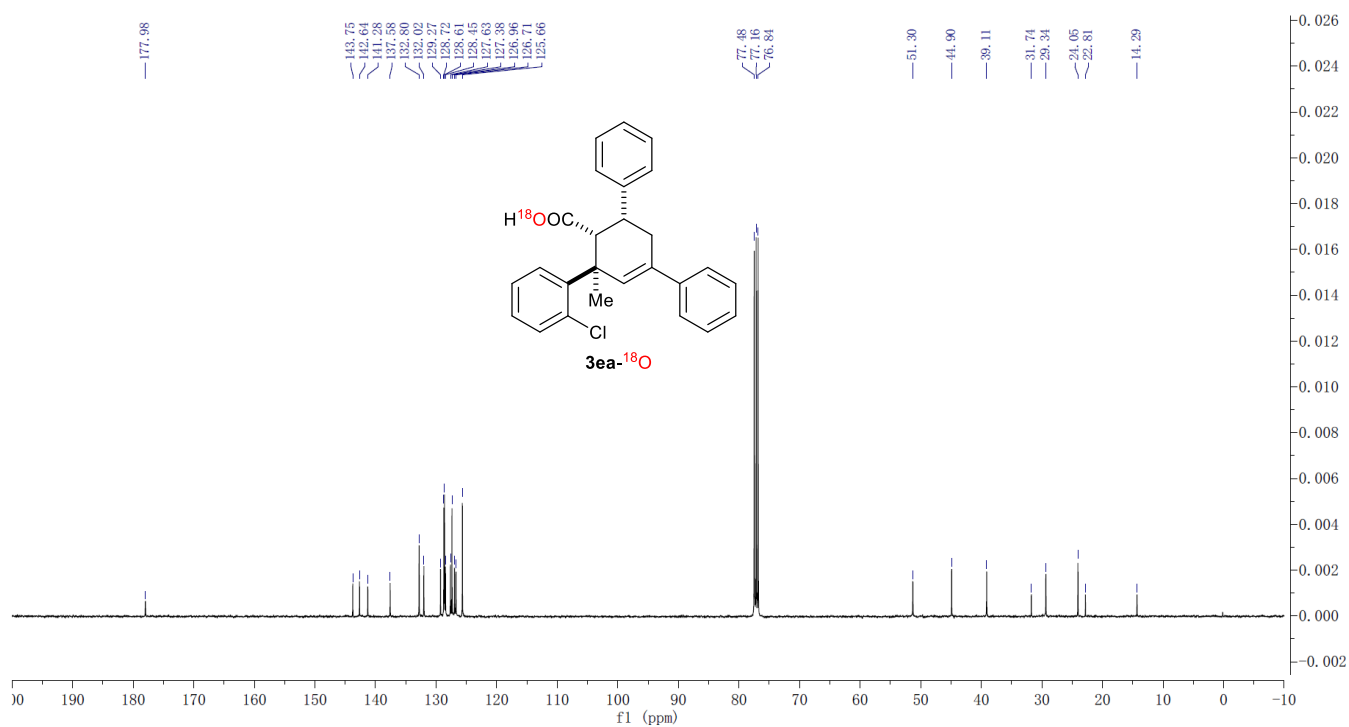
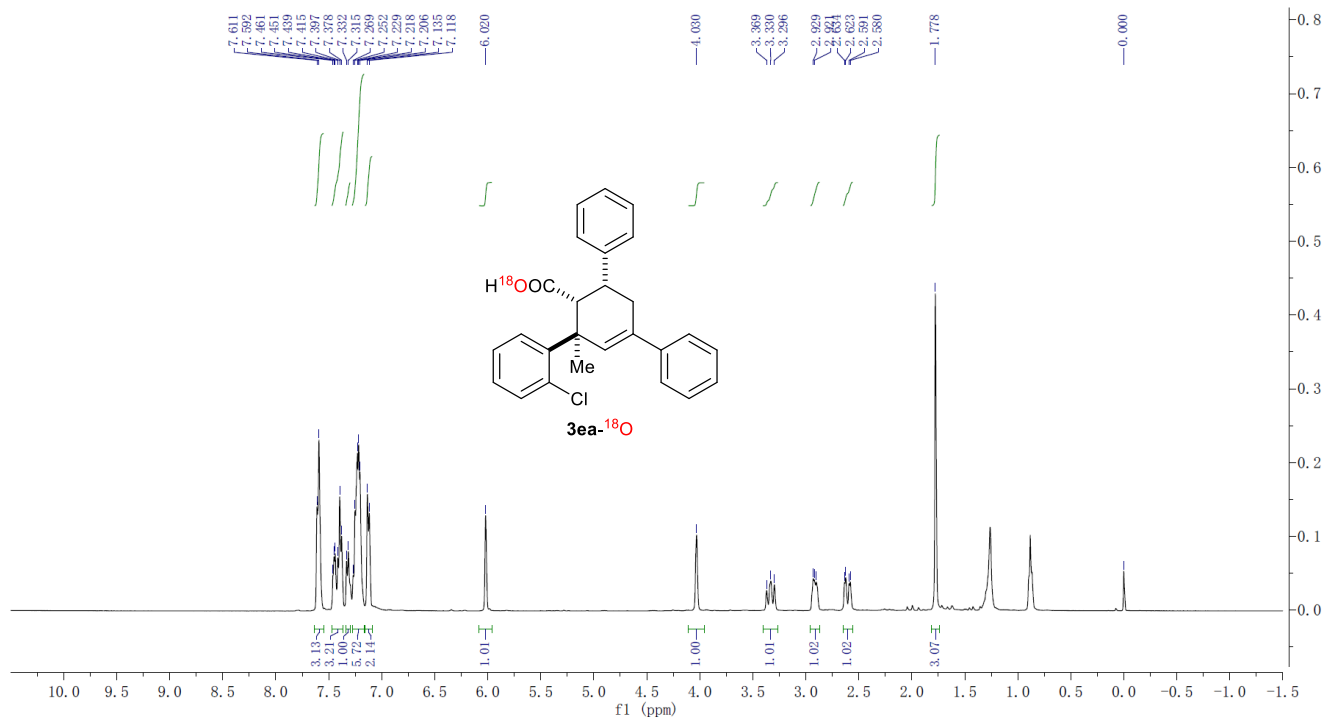


(E)-chalcone-¹⁸O (2a-¹⁸O). ¹H NMR (400 MHz, CDCl₃): δ 8.03 (d, *J* = 8.0 Hz, 2H), 7.82 (d, *J* = 16.0 Hz, 1H), 7.68 – 7.63 (m, 2H), 7.62 – 7.50 (m, 4H), 7.46 – 7.40 (d, *J* = 2.3 Hz, 3H) ppm. ¹³C NMR (100 MHz, CDCl₃): δ 190.7, 145.0, 138.3, 135.0, 133.0, 130.7, 129.1, 128.8, 128.7, 128.6, 122.2 ppm. HR – MS (ESI) *m/z* calcd for C₁₅H₁₂¹⁸O [M+H]⁺ 211.0823, found 211.1005.

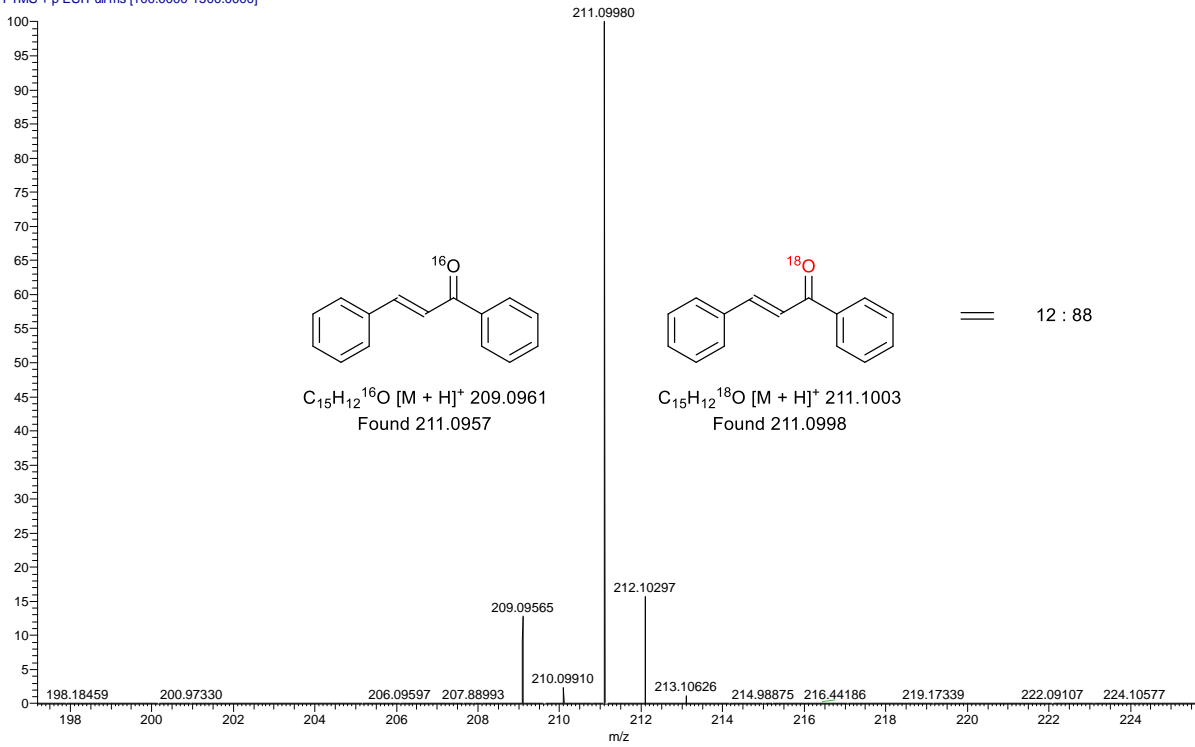


2-chloro-1'-methyl-5'-phenyl-1',2',3',4'-tetrahydro-[1,1':3',1''-terphenyl]-2'-carboxylic-¹⁸O acid (3ea-¹⁸O). ¹H NMR (400 MHz, CDCl₃): δ 7.63 – 7.56 (m, 3H), 7.46 – 7.28 (m, 3H), 7.32 (d, *J* = 6.8 Hz, 1H), 7.28 – 7.17 (m, 5H), 7.13 (d, *J* = 6.8 Hz, 2H), 6.02 (s, 1H), 4.03 (s, 1H), 3.40 – 3.26 (m, 1H), 2.96 – 2.87 (m, 1H), 2.61 (dd, *J* = 17.2, 4.4 Hz, 1H), 1.78 (s, 3H) ppm. ¹³C NMR (100 MHz, CDCl₃): δ 178.0, 143.8, 142.6, 141.3, 137.6, 132.8, 132.0, 129.3, 128.7, 128.6, 128.5, 127.6, 127.4, 127.0, 126.7, 125.7, 51.3, 44.9, 39.1, 31.7, 29.3, 24.1, 22.8, 14.3 ppm. HR – MS (ESI) *m/z* calcd for C₂₆H₂₃OC¹⁸O [M+Na]⁺ 427.1321, found 427.1327.

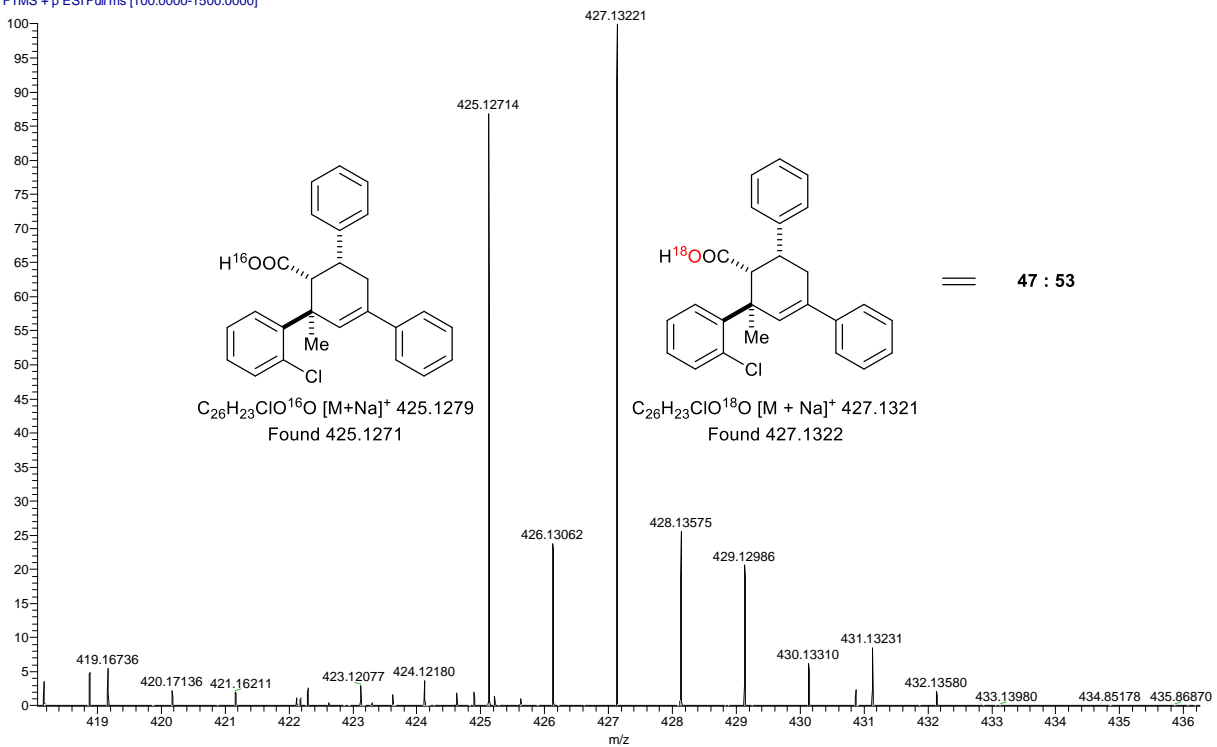


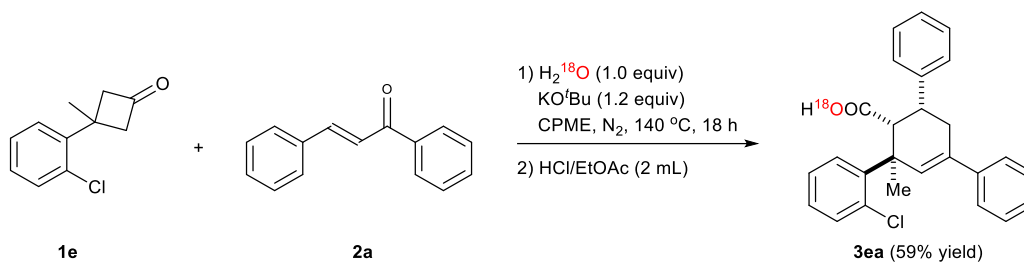


WB-2 #11-23 RT: 0.05-0.11 AV: 13 NL: 4.14E9
T: FTMS + p ESI Full ms [100.0000-1500.0000]

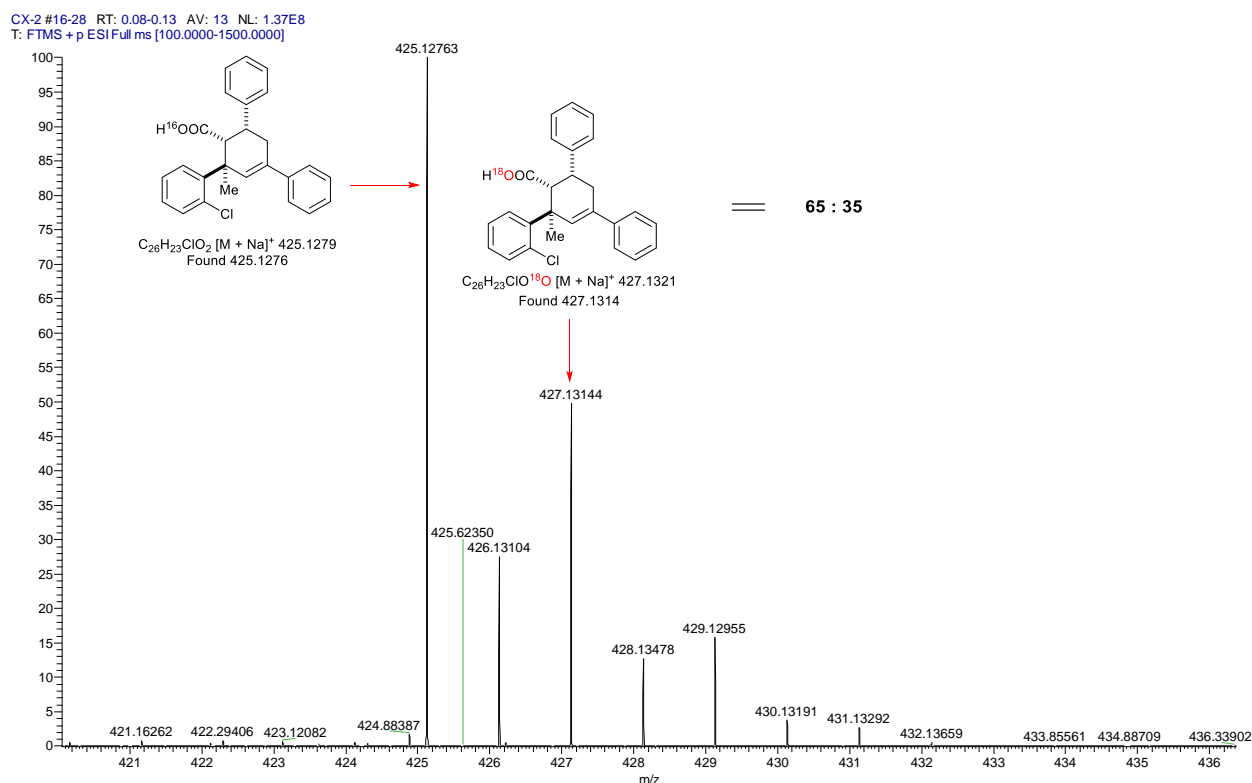


WB-1 #19-32 RT: 0.09-0.15 AV: 14 NL: 3.33E7
T: FTMS + p ESI Full ms [100.0000-1500.0000]

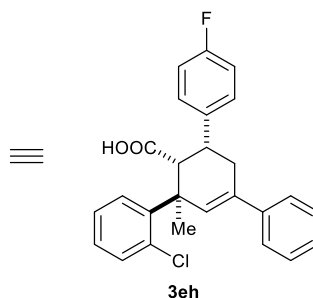
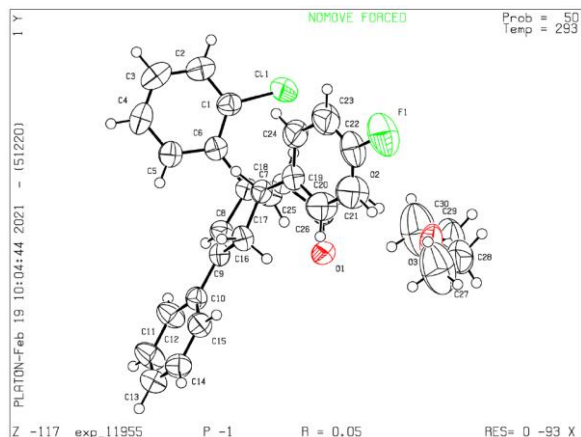




The reaction carried out with Cyclobutanone **1e** (19.5 mg, 0.1 mmol), Chalcone **2a** (31.2 mg, 0.15 mmol), H_2^{18}O (2 mg, 1.0 equiv) and KO^tBu (13.5 mg, 1.2 equiv). The mixture was added anhydrous CPME (1 mL) at 140 °C and continuous stirring for 18 hours under N_2 atmosphere. The reaction was dealt with HCl/EtOAc (2 mL) after cooling to ambient temperature. The crude mixture was purified by preparative TLC to afford product **3ea- ^{18}O** (59% yield), which was analyzed HR – MS.

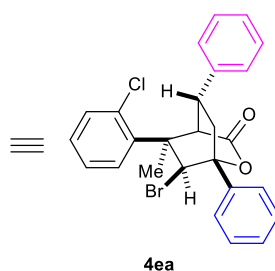
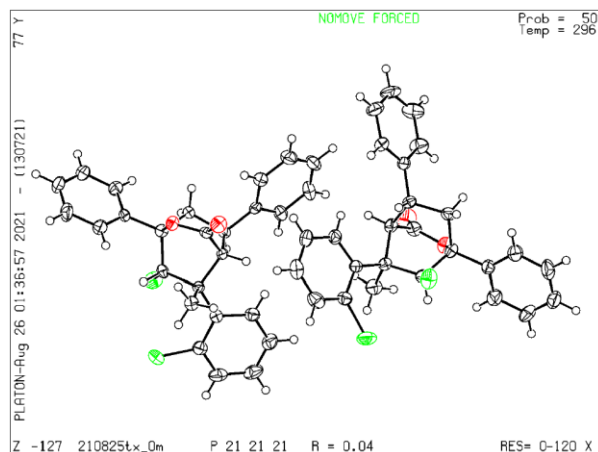


5. Crystal data



Crystal data and structure refinement for **3eh**

Empirical formula	C ₃₀ H ₃₂ O ₃ FCI
Formula weight	495.00
Temperature/K	293(2)
Crystal system	triclinic
Space group	P-1
a/Å	9.4244(8)
b/Å	9.7735(8)
c/Å	16.0599(13)
α/°	105.511(7)
β/°	106.708(7)
γ/°	93.809(7)
Volume/Å ³	1348.7(2)
Z	2
ρ _{calc} /cm ³	1.219
μ/mm ⁻¹	1.538
F(000)	524.0
Crystal size/mm ³	0.140 × 0.130 × 0.110
Radiation	CuKα (λ = 1.54184)
2θ range for data collection/°	6.022 to 134.5
Index ranges	-11 ≤ h ≤ 11, -11 ≤ k ≤ 11, -19 ≤ l ≤ 19
Reflections collected	8428
Independent reflections	4832 [R _{int} = 0.0344, R _{sigma} = 0.0606]
Data/restraints/parameters	4832/0/321
Goodness-of-fit on F ²	1.041
Final R indexes [I ≥ 2σ (I)]	R ₁ = 0.0546, wR ₂ = 0.1265
Final R indexes [all data]	R ₁ = 0.0886, wR ₂ = 0.1503
Largest diff. peak/hole / e Å ⁻³	0.22/-0.24

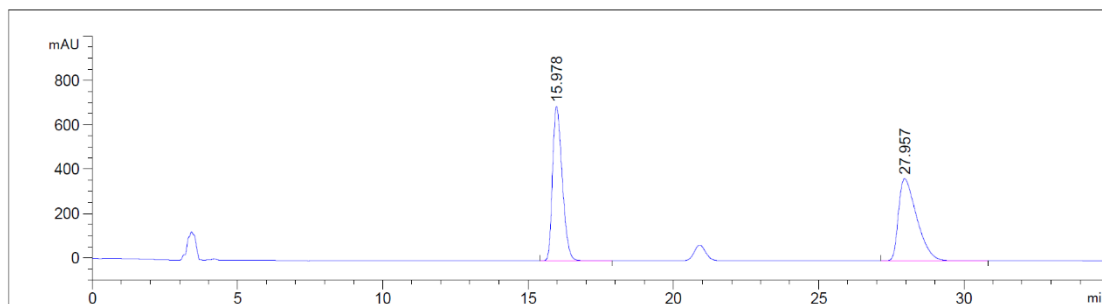


Crystal data and structure refinement for **4ea**

Empirical formula	C ₂₆ H ₂₂ BrClO ₂
Formula weight	481.79
Temperature/K	296.15
Crystal system	orthorhombic
Space group	P2 ₁ 2 ₁ 2 ₁
a/Å	7.0573(7)
b/Å	18.127(2)
c/Å	33.894(4)
α/°	90
β/°	90
γ/°	90
Volume/Å ³	4336.0(8)
Z	8
ρ _{calc} /cm ³	1.476
μ/mm ⁻¹	2.040
F(000)	1968.0
Crystal size/mm ³	0.2 × 0.15 × 0.1
Radiation	MoKα (λ = 0.71073)
2θ range for data collection/°	2.548 to 54.906
Index ranges	-8 ≤ h ≤ 9, -22 ≤ k ≤ 23, -30 ≤ l ≤ 43
Reflections collected	26041
Independent reflections	9783 [R _{int} = 0.0498, R _{sigma} = 0.0923]
Data/restraints/parameters	9783/0/543
Goodness-of-fit on F ²	0.975
Final R indexes [I ≥ 2σ (I)]	R ₁ = 0.0418, wR ₂ = 0.0811
Final R indexes [all data]	R ₁ = 0.0802, wR ₂ = 0.1079
Largest diff. peak/hole / e Å ⁻³	0.28/-0.46
Flack parameter	0.006(5)

We think the flack parameter [0.006(5)] was probably affected by the crystallization of the racemic mixtures, in some cases, a spontaneous crystallization of a mixture of enantiomerically pure crystals occurs. This method is to mechanically separate the crystals in such a mixture based on differences in their shapes, and it is first used by Louis Pasteur.³ The another is Andreas Seidel-Morgenstern.⁴ In addition, the rest of the crystal **4ea** was analyzed by HPLC, and 75% *ee* was obtained.

The HPLC spectrum of **4ea**

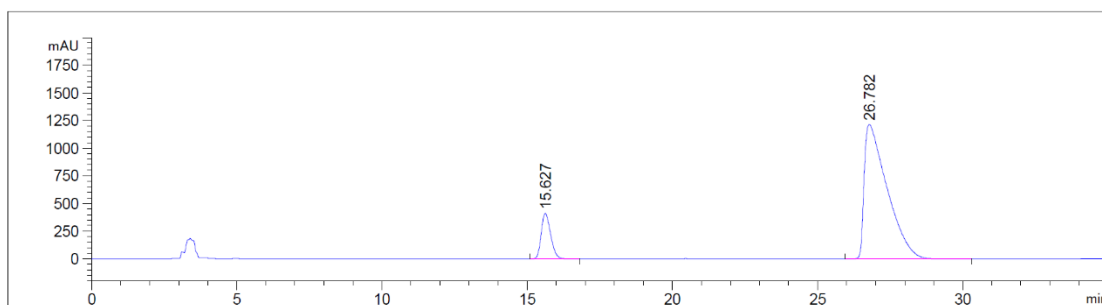


Signal 1: DAD1 A, Sig=215,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.978	BB	0.3596	1.60727e4	695.54797	49.9248
2	27.957	BB	0.6665	1.61211e4	369.89978	50.0752

Totals : 3.21939e4 1065.44775

The HPLC spectrum of crystal **4ea**



Signal 1: DAD1 A, Sig=215,4 Ref=off

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.627	BB	0.3500	9211.55469	410.15604	12.1985
2	26.782	BB	0.7942	6.63023e4	1215.77380	87.8015

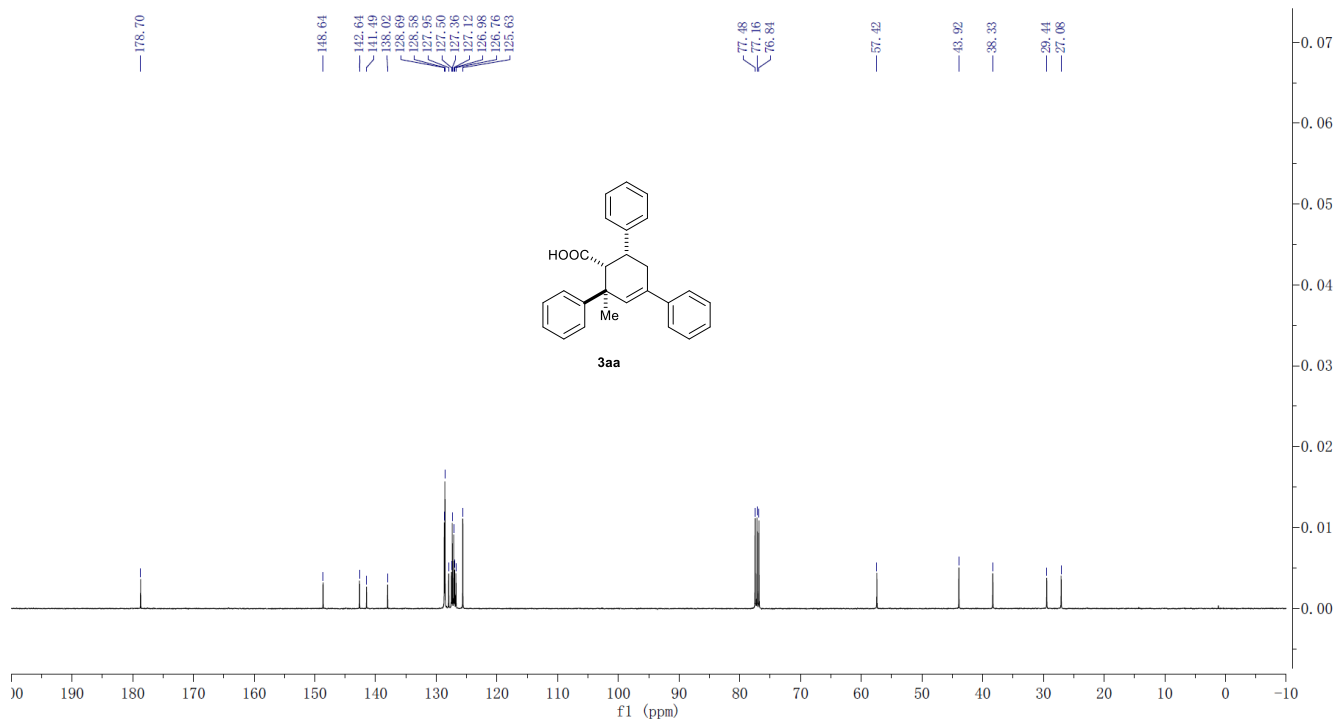
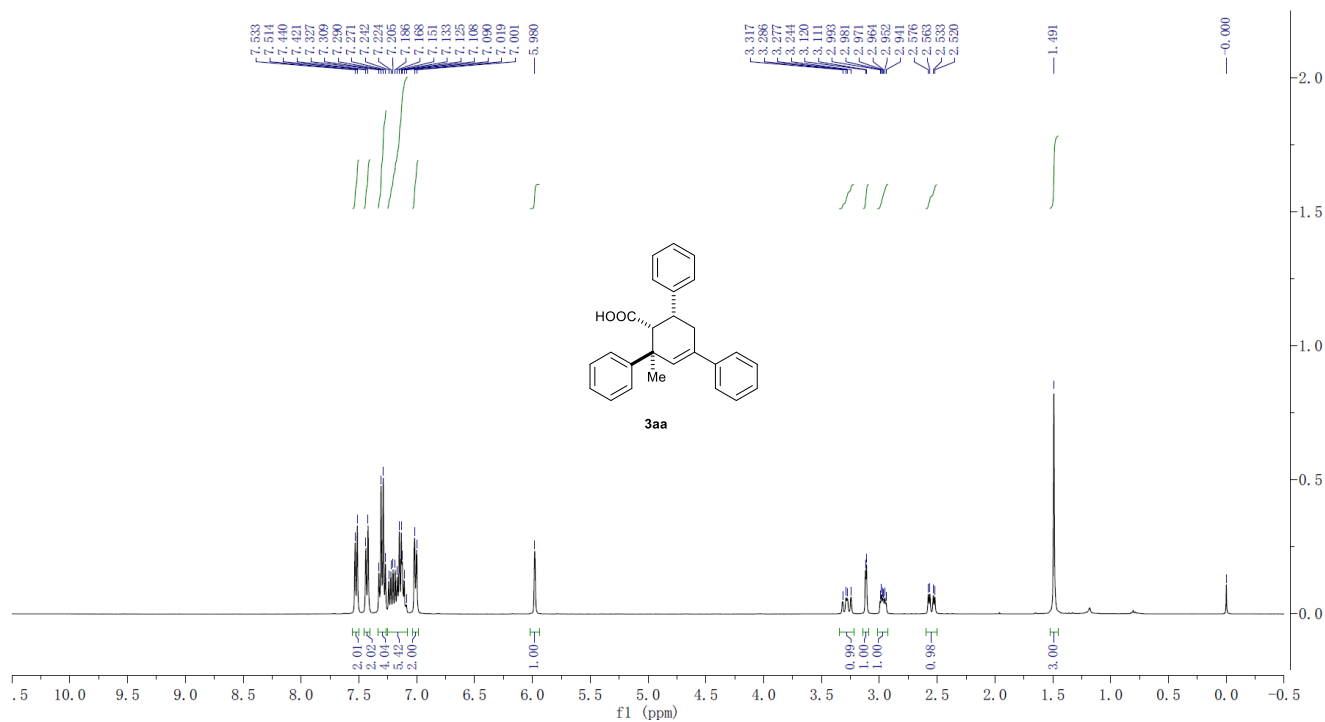
Totals : 7.55138e4 1625.92984

6. References

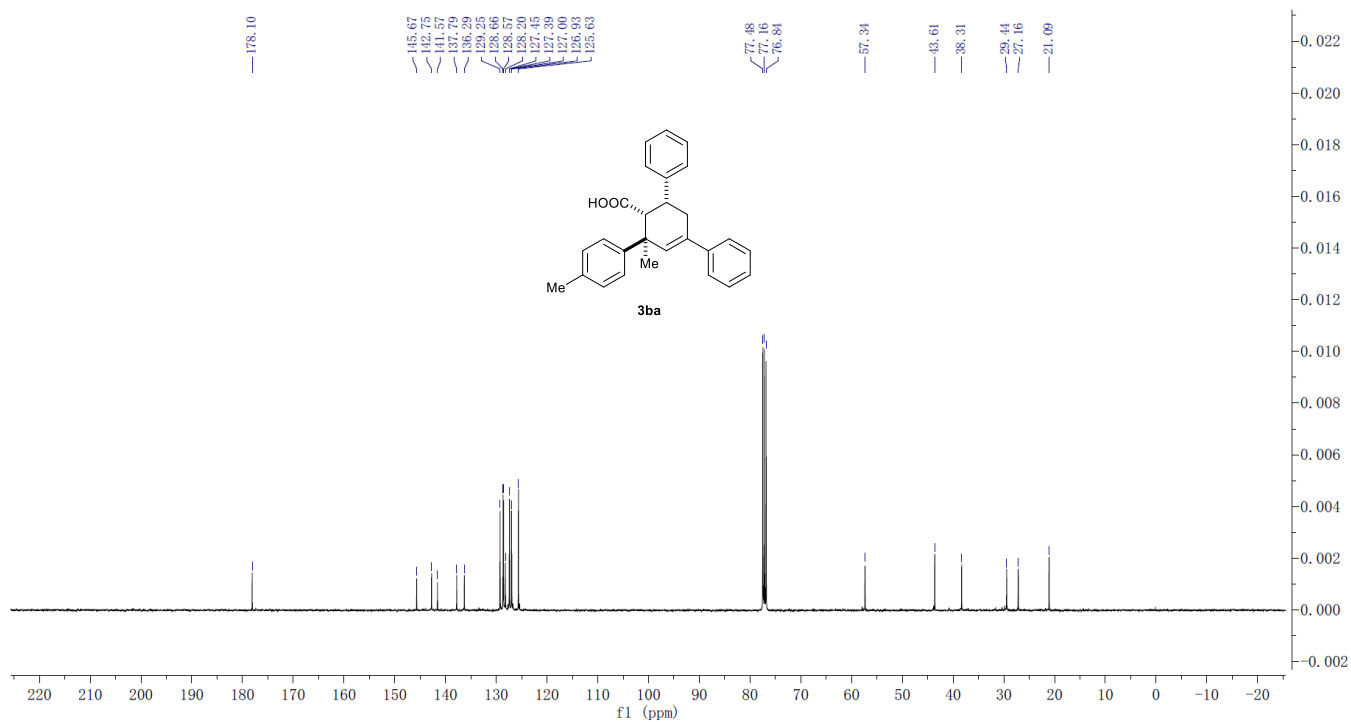
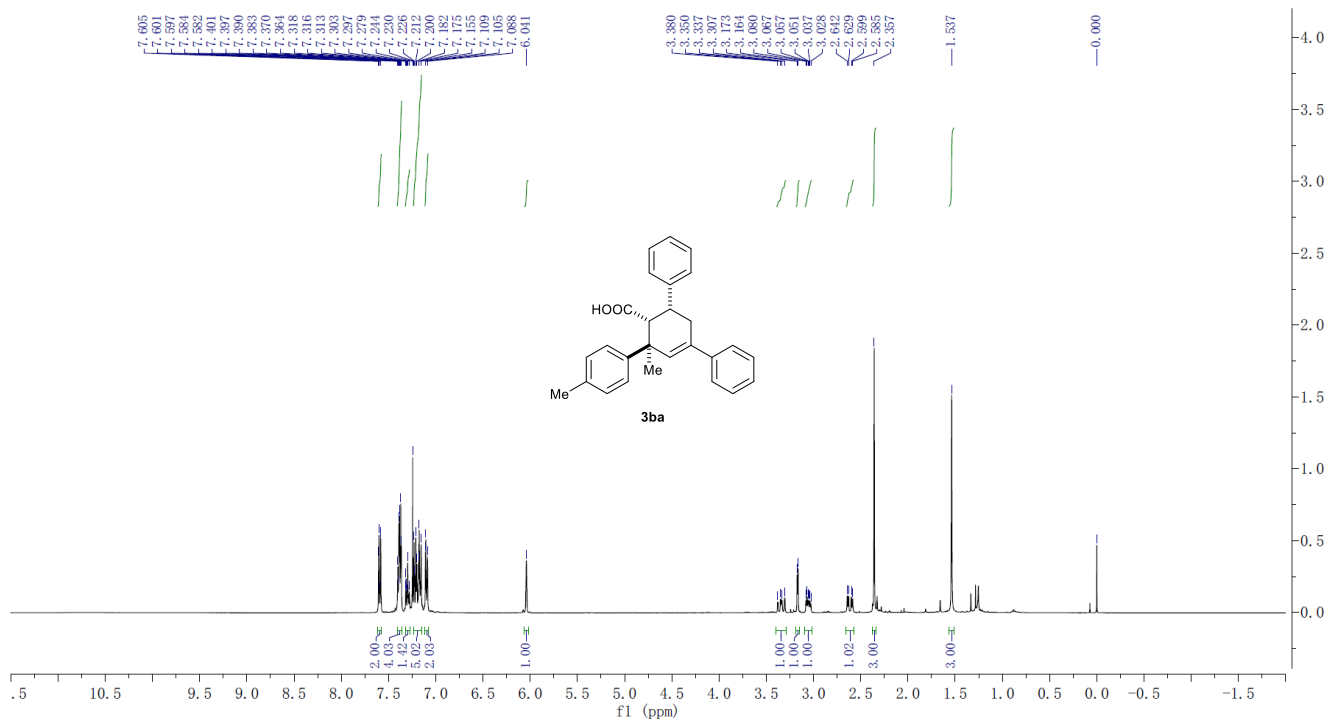
1. (a) Y.-L. Sun, X.-B. Wang, F.-N. Sun, Q.-Q. Chen, J. Cao, Z. Xu and L.-W. Xu, *Angew. Chem., Int. Ed.*, 2019, **58**, 6747; (b) X.-Y. Yu, P.-Z. Wang, D.-M. Yan, B. Lu, J.-R. Chen and W.-J. Xiao, *Adv. Synth. Catal.*, 2018, **360**, 3601; (c) T. Matsuda and I. Yuihara, *Chem. Commun.*, 2015, **51**, 7393; (d) H.-J. Xu, F.-F. Zhu, Y.-Y. Shen, X. Wan and Y.-S. Feng, *Tetrahedron*, 2012, **68**, 4145; (e) M. Murakami, S. Ashida and T. Matsuda, *Tetrahedron*, 2006, **62**, 7540.
2. (a) D. Bai, Y. Yu, H. Guo, J. Chang and X. Li, *Angew. Chem., Int. Ed.*, 2020, **59**, 2740; (b) P. Das and A. T. Hamme, *Tetrahedron Lett.*, 2017, **58**, 1086; (c) M. Rehan, S. Maity, L. K. Morya, K. Pal and P. Ghorai, *Angew. Chem., Int. Ed.*, 2016, **55**, 7728; (d) Q. Jiang, T. Guo, K. Wu and Z. Yu, *Chem. Commun.*, 2016, **52**, 2913; (e) Y. Li, H. Xu, M. Xing, F. Huang, J. Jia and J. Gao, *Org. Lett.*, 2015, **17**, 3690.
3. L. Pasteur, *Ann. Chim. Phys.*, 1848, **24**, 442.
4. H. Lorenz, A. Perlberg, D. Sapoundjiev, M. P. Elsner and A. Seidel-Morgenstern, *Chem. Eng. Process.*, 2006, **45**, 863.

7. NMR Spectra

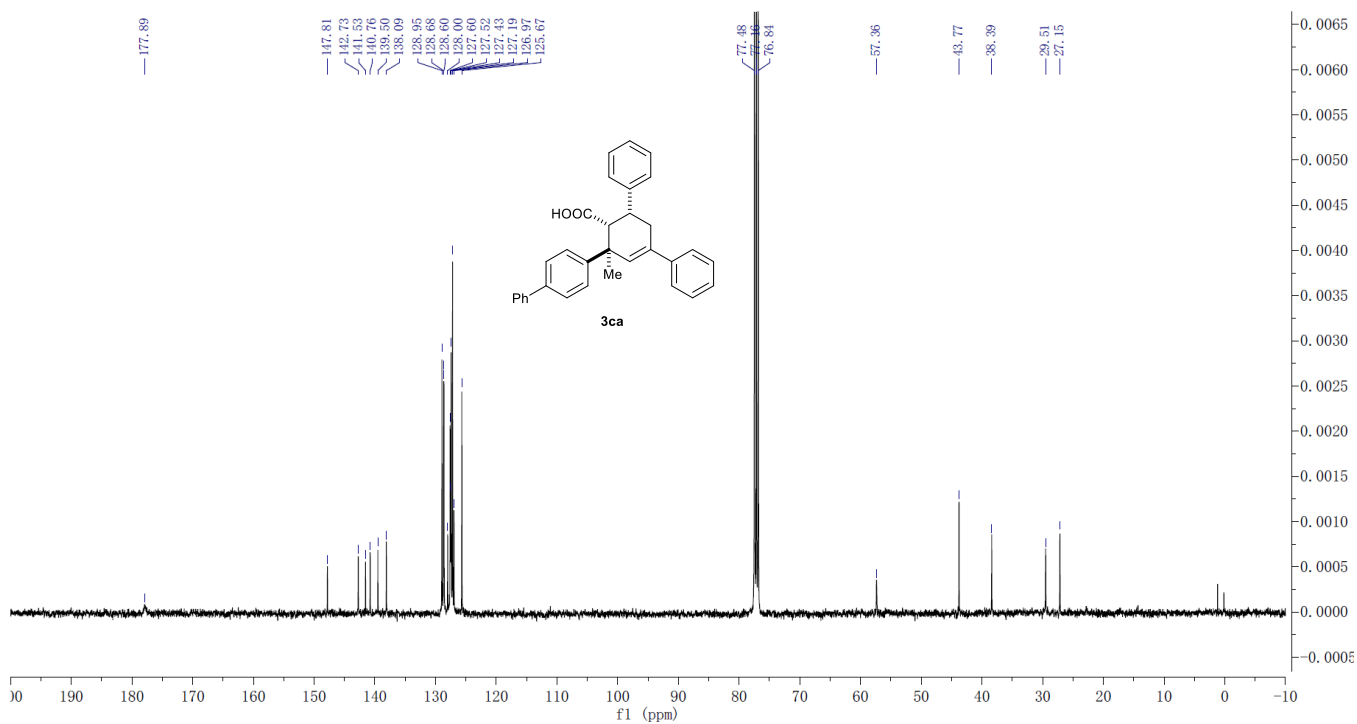
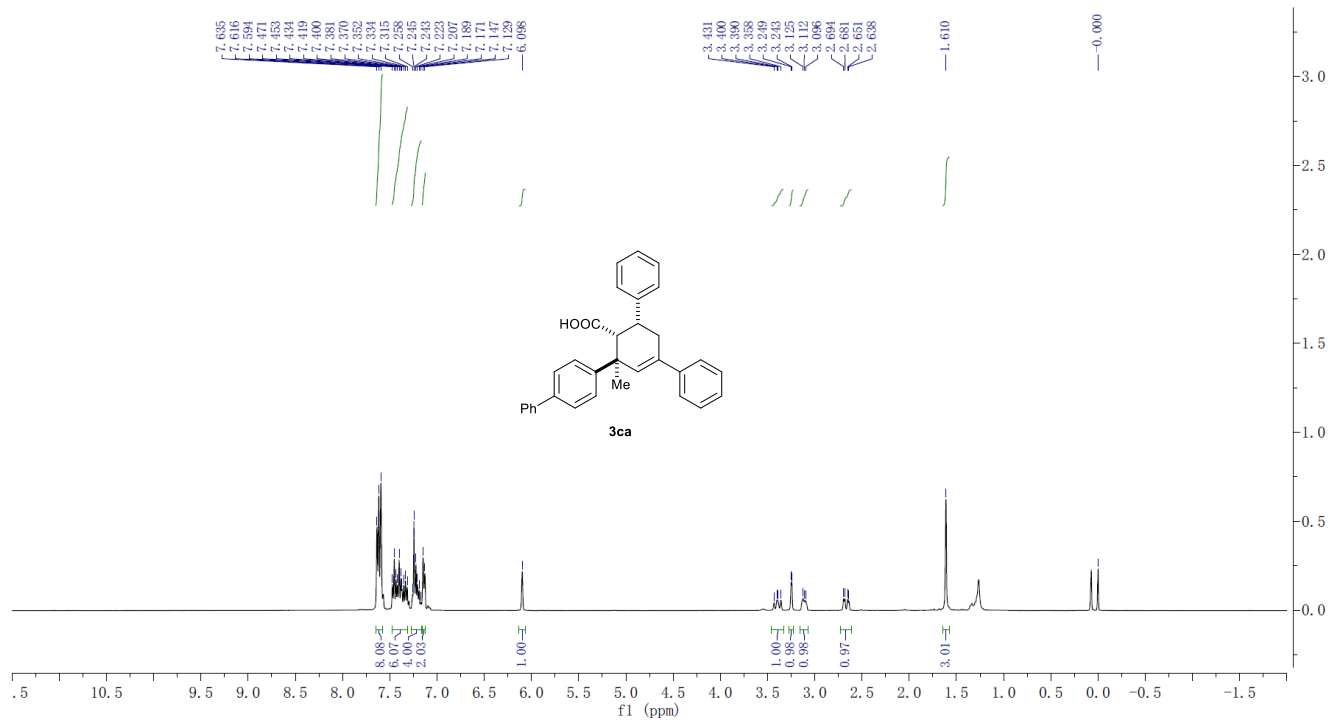
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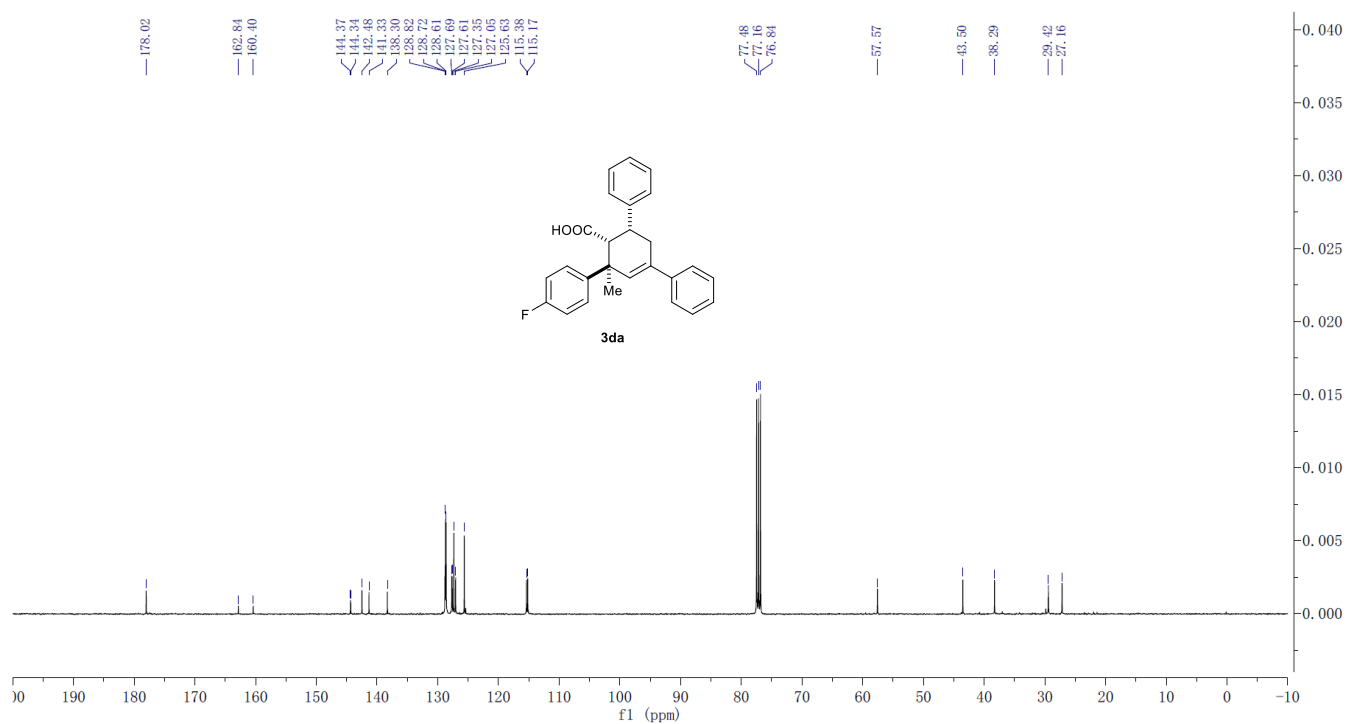
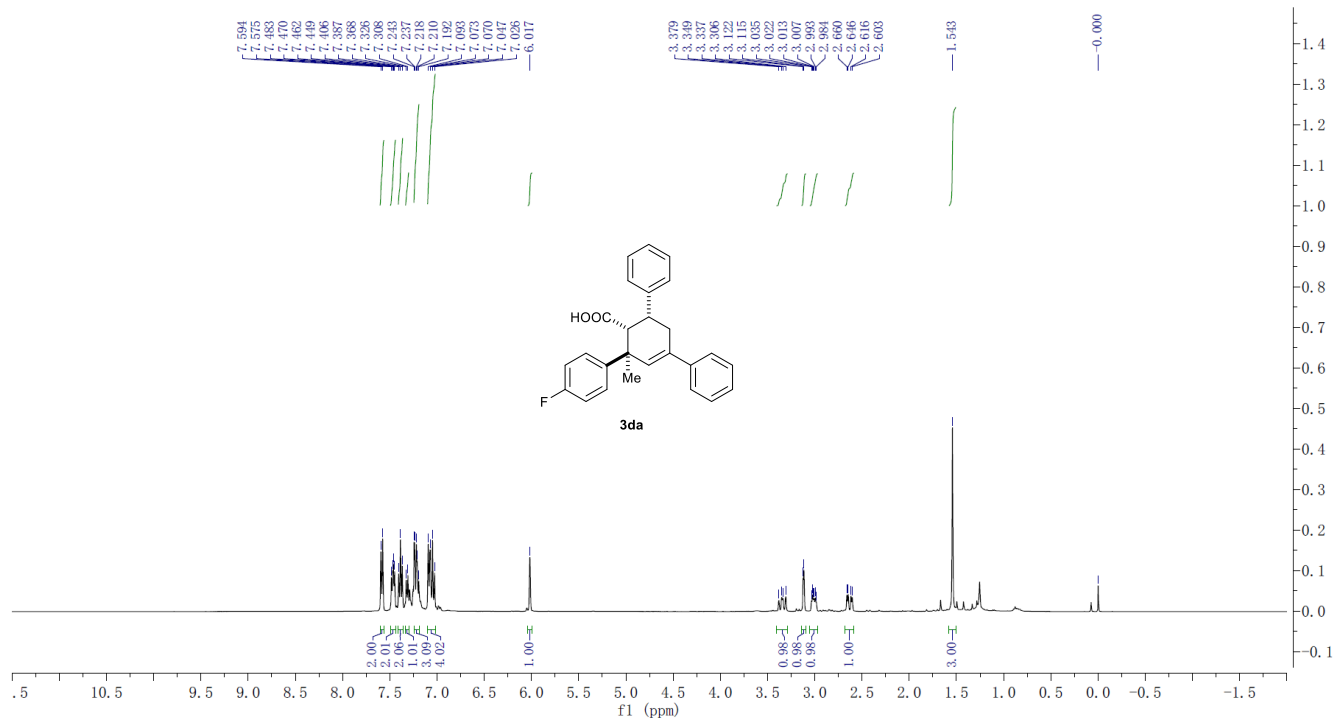
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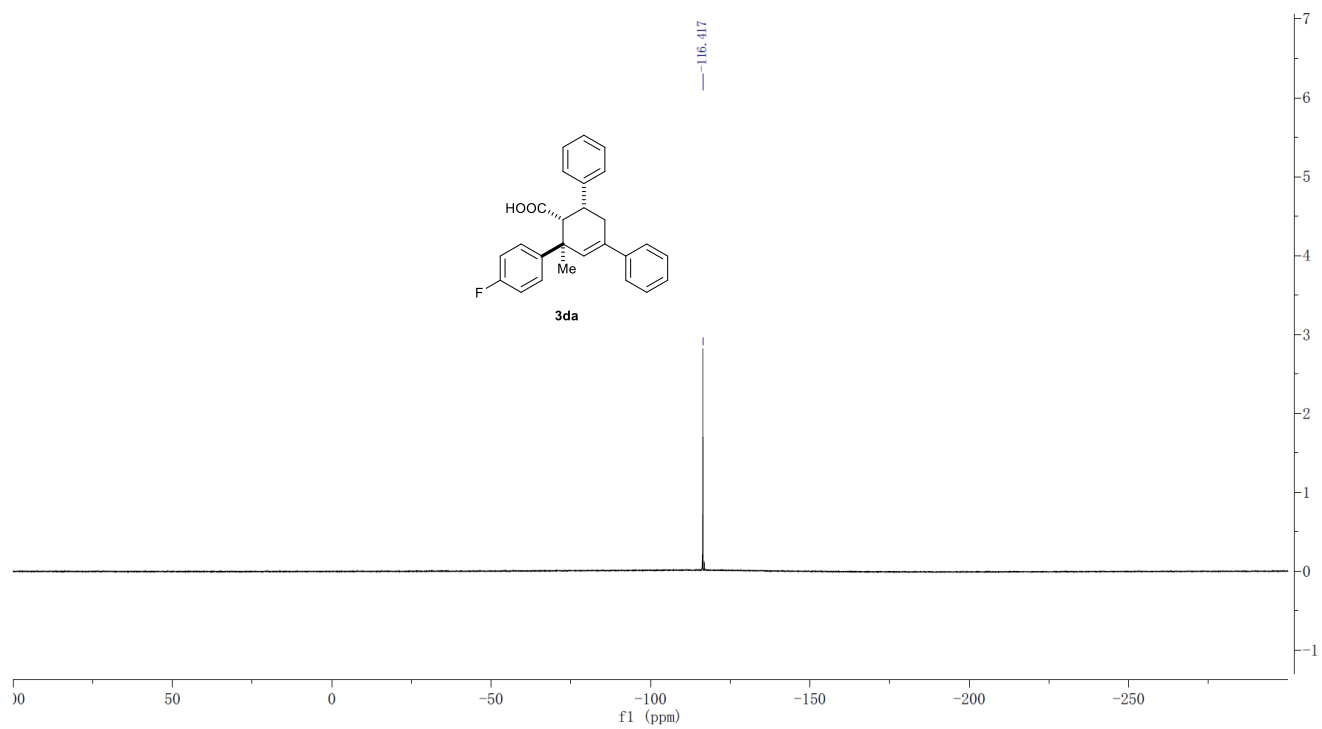


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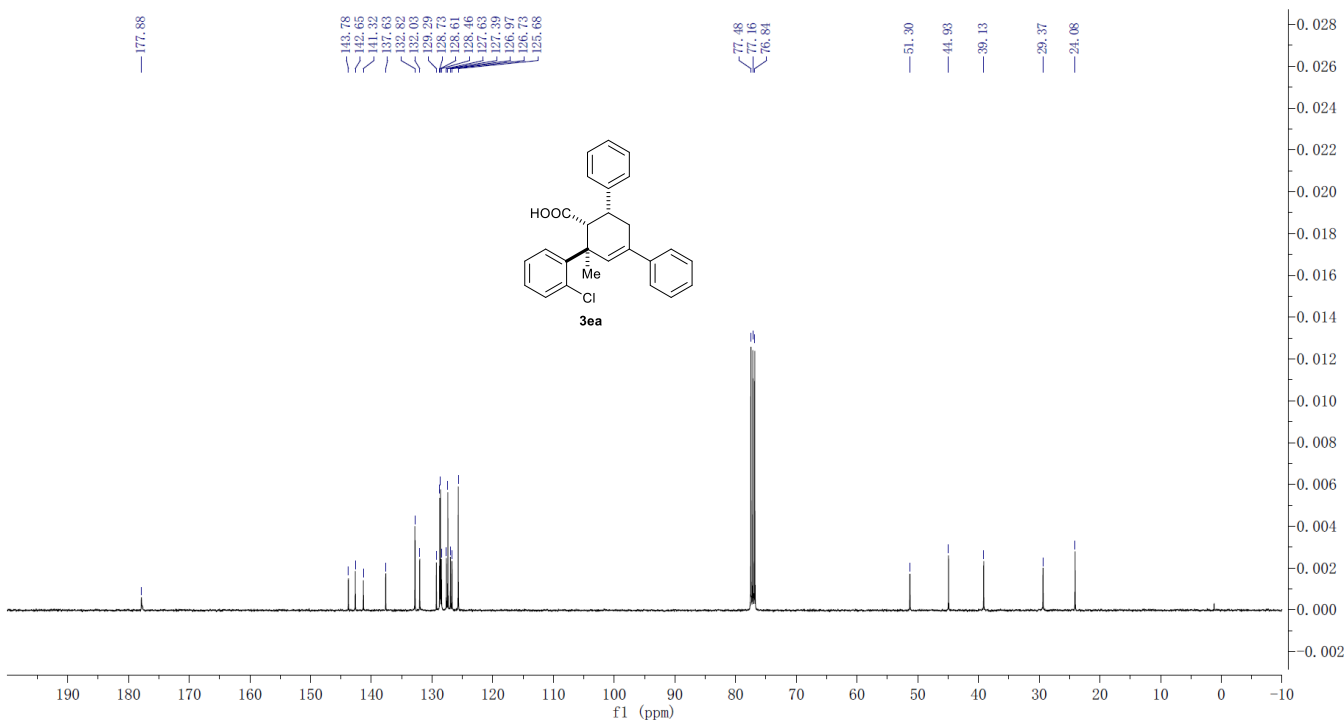
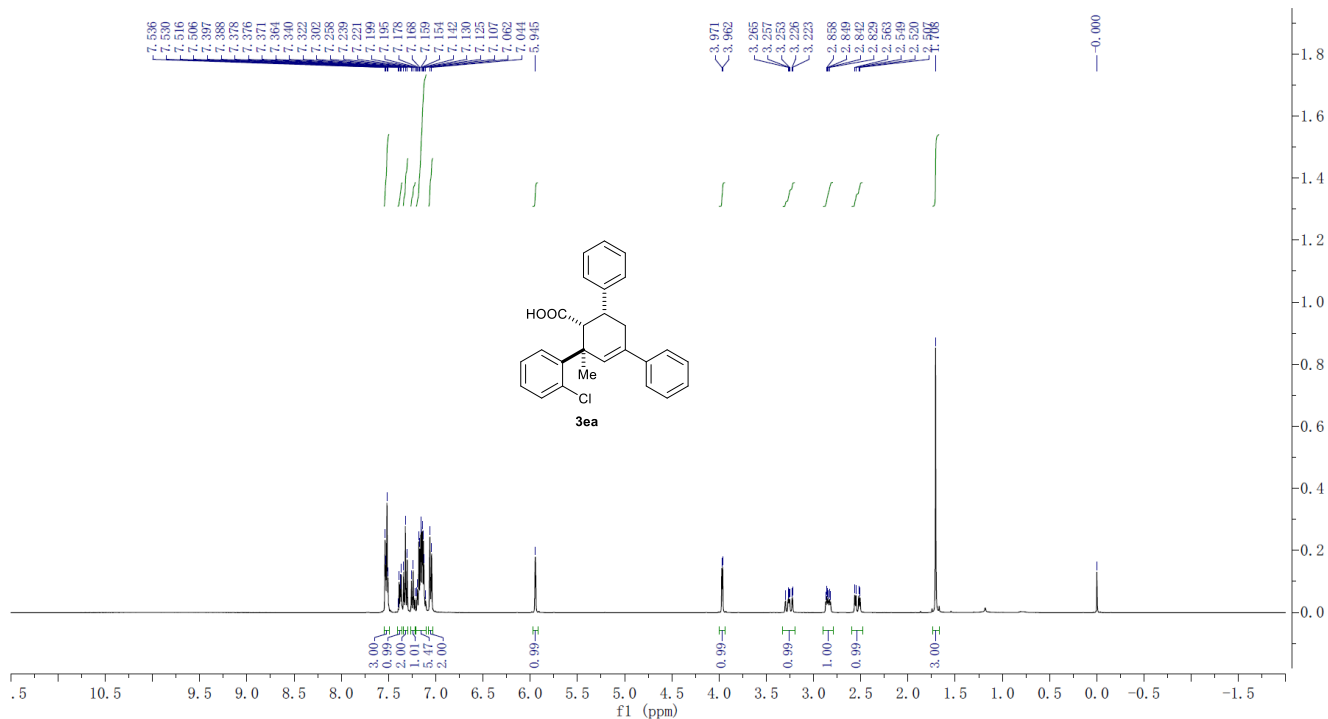


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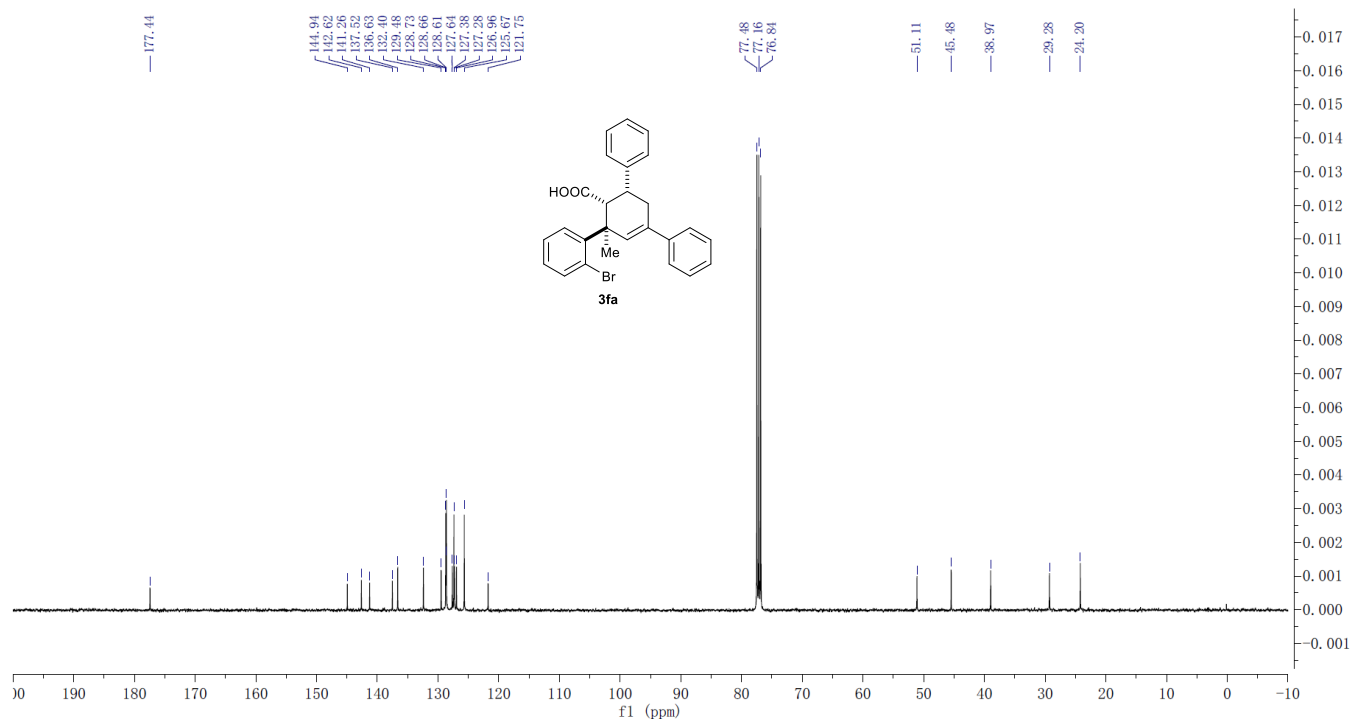
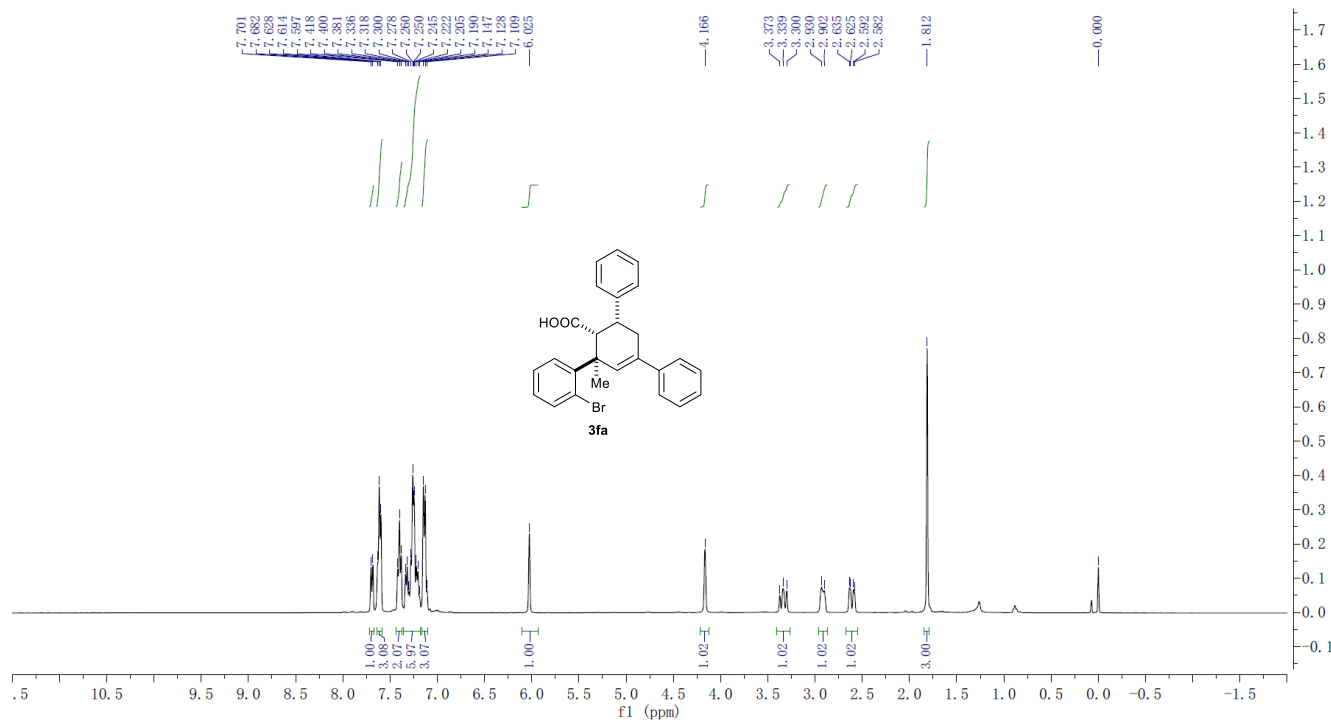




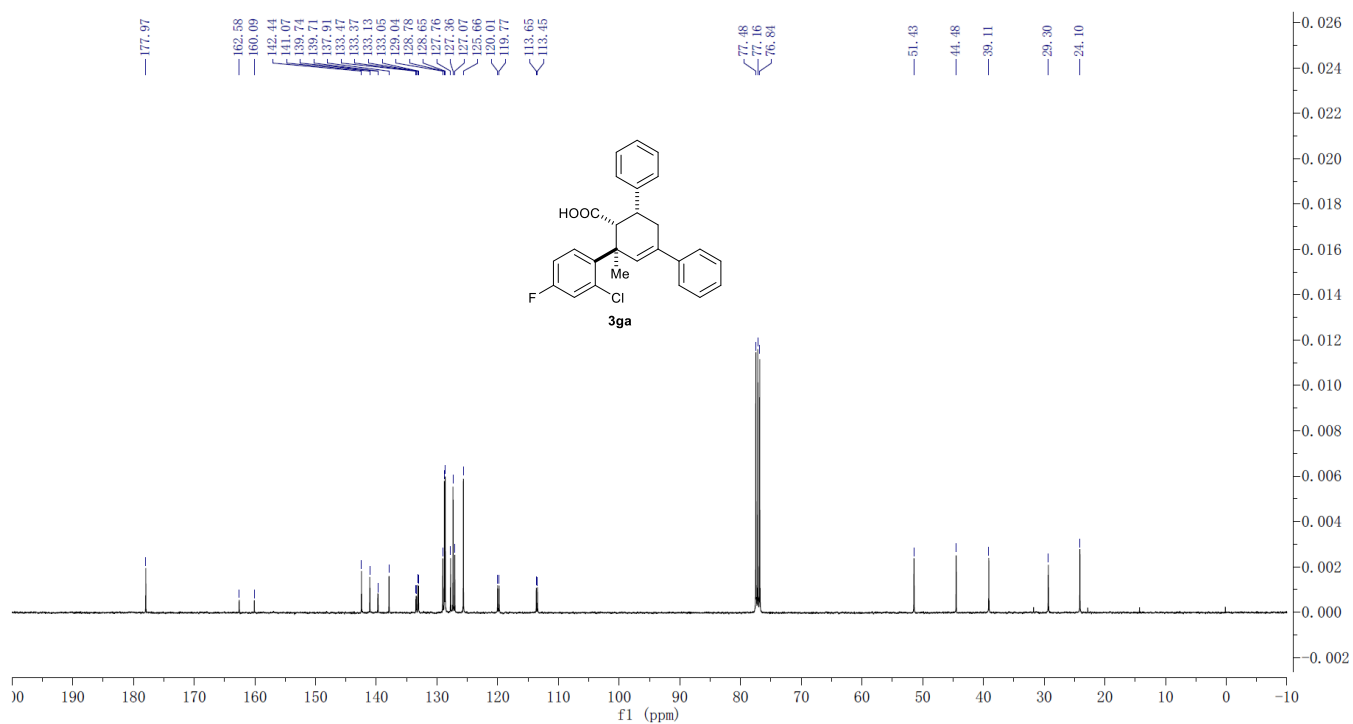
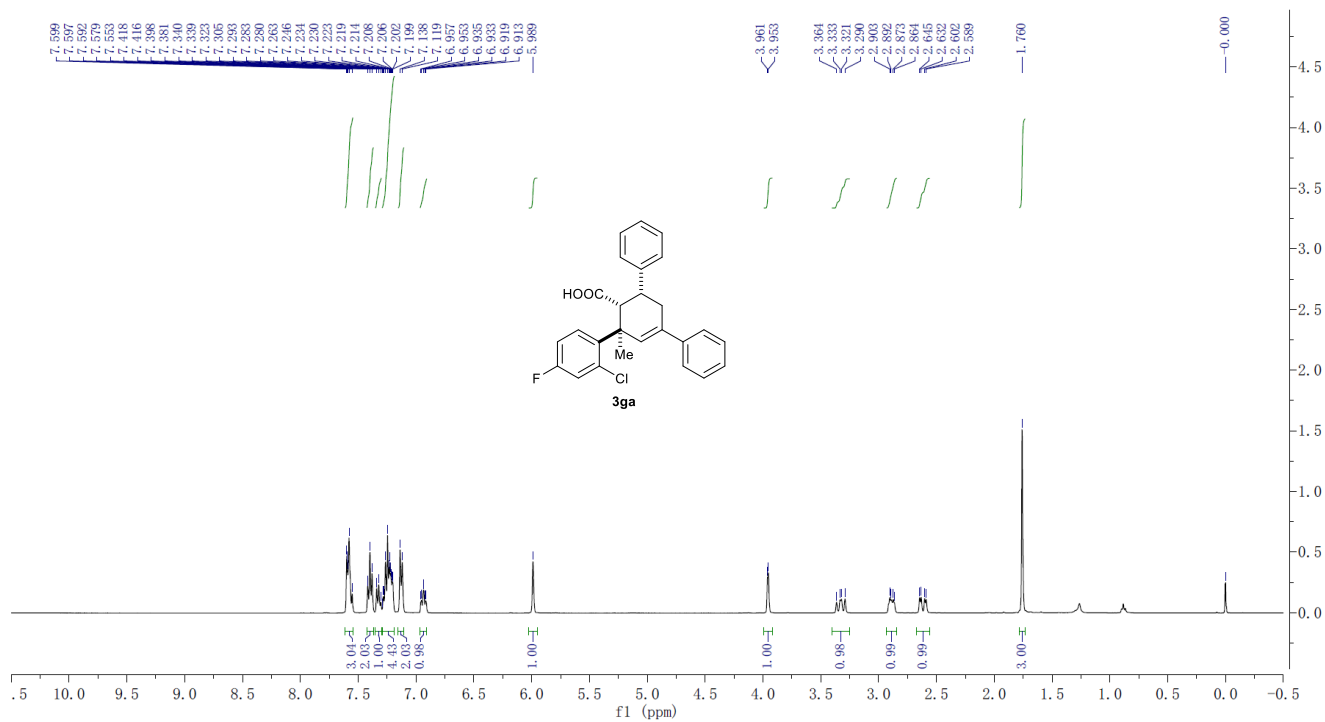
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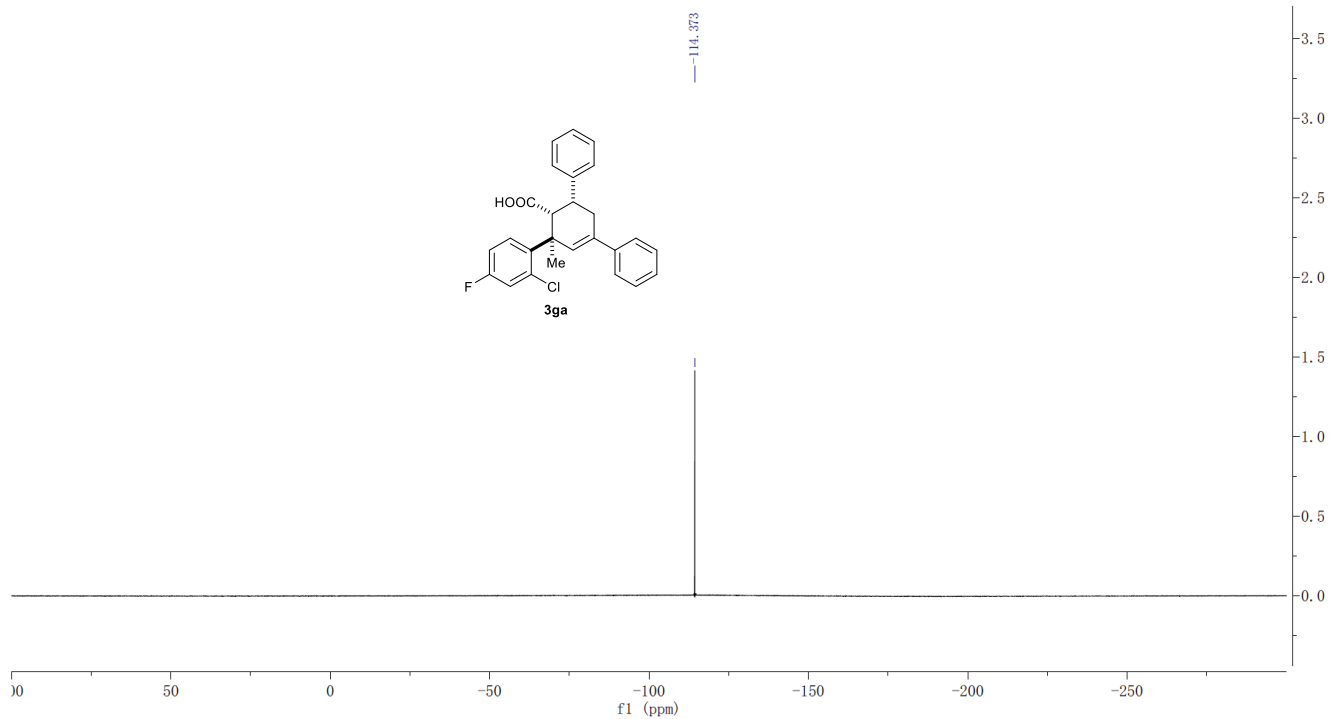


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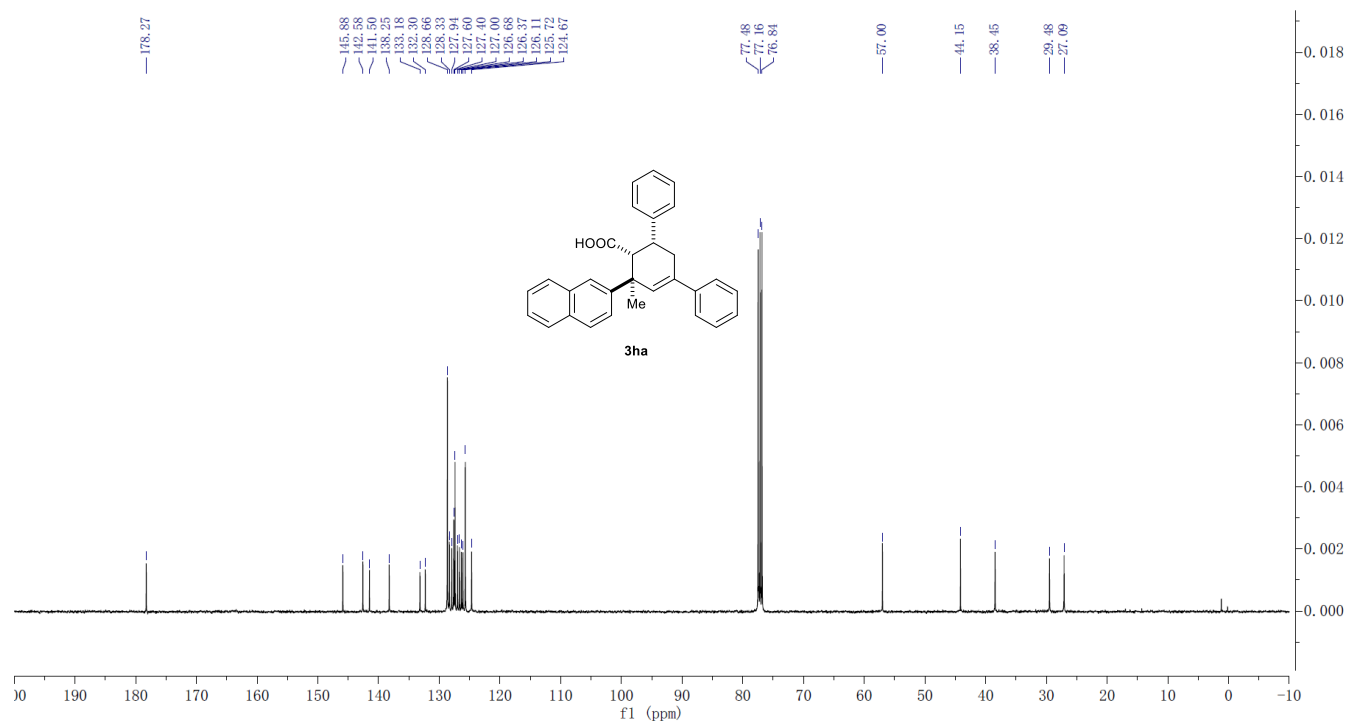
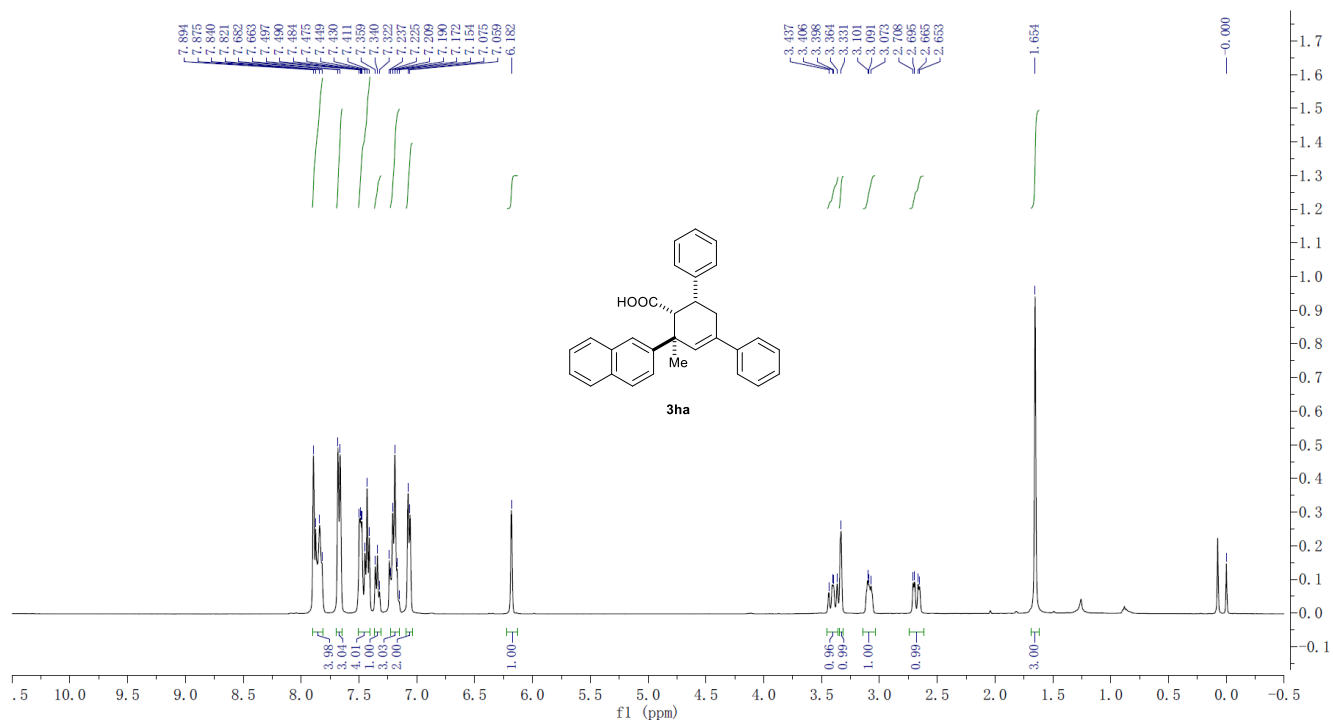


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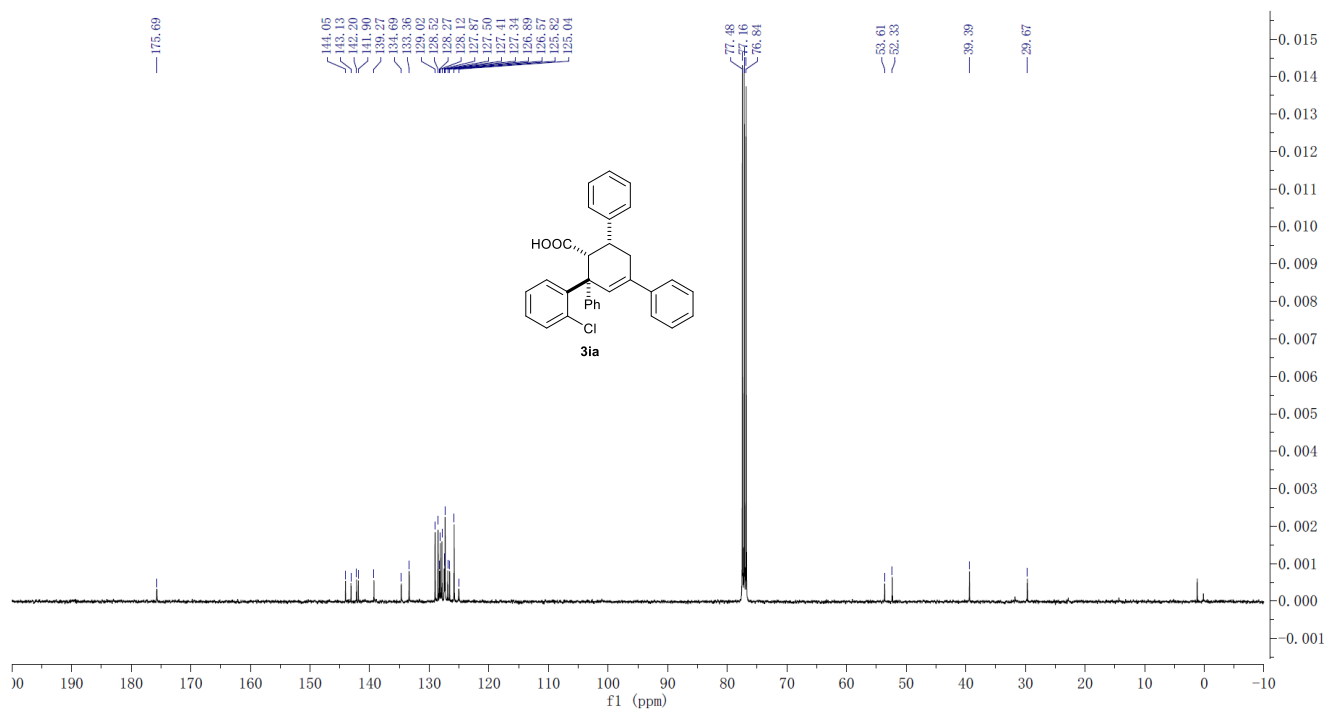
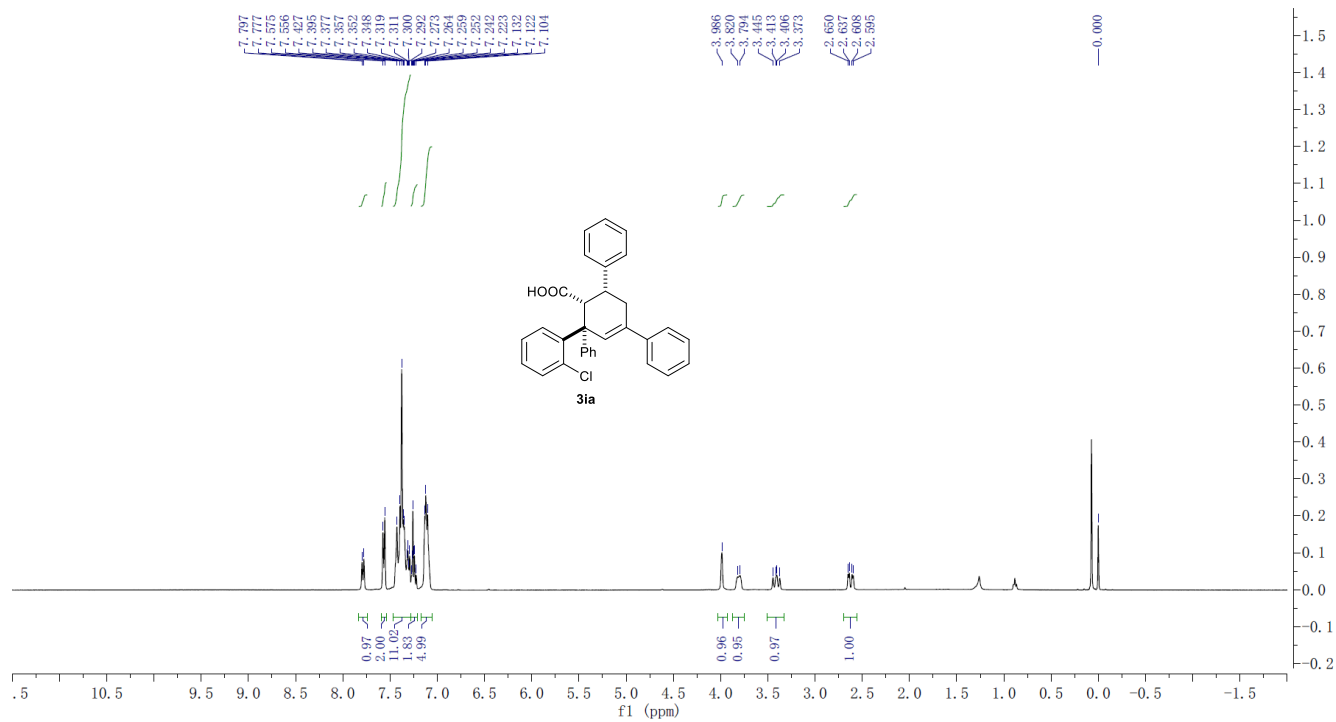




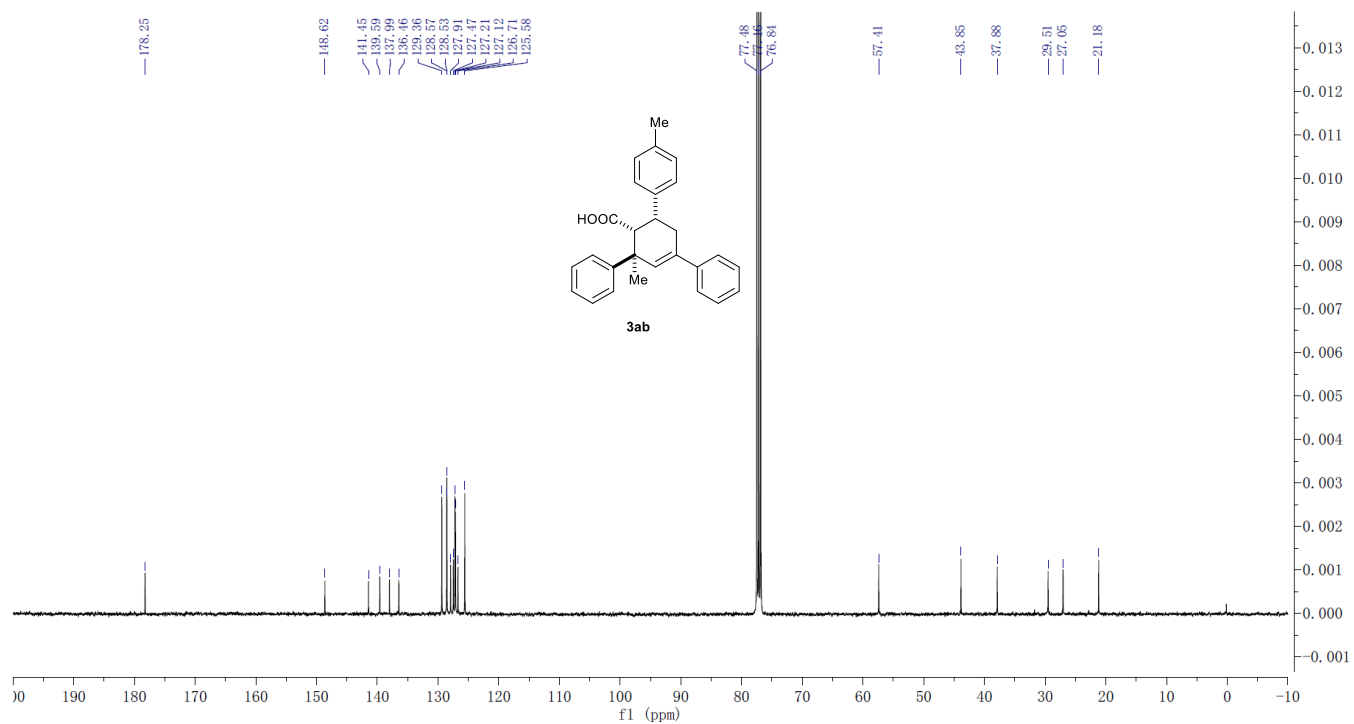
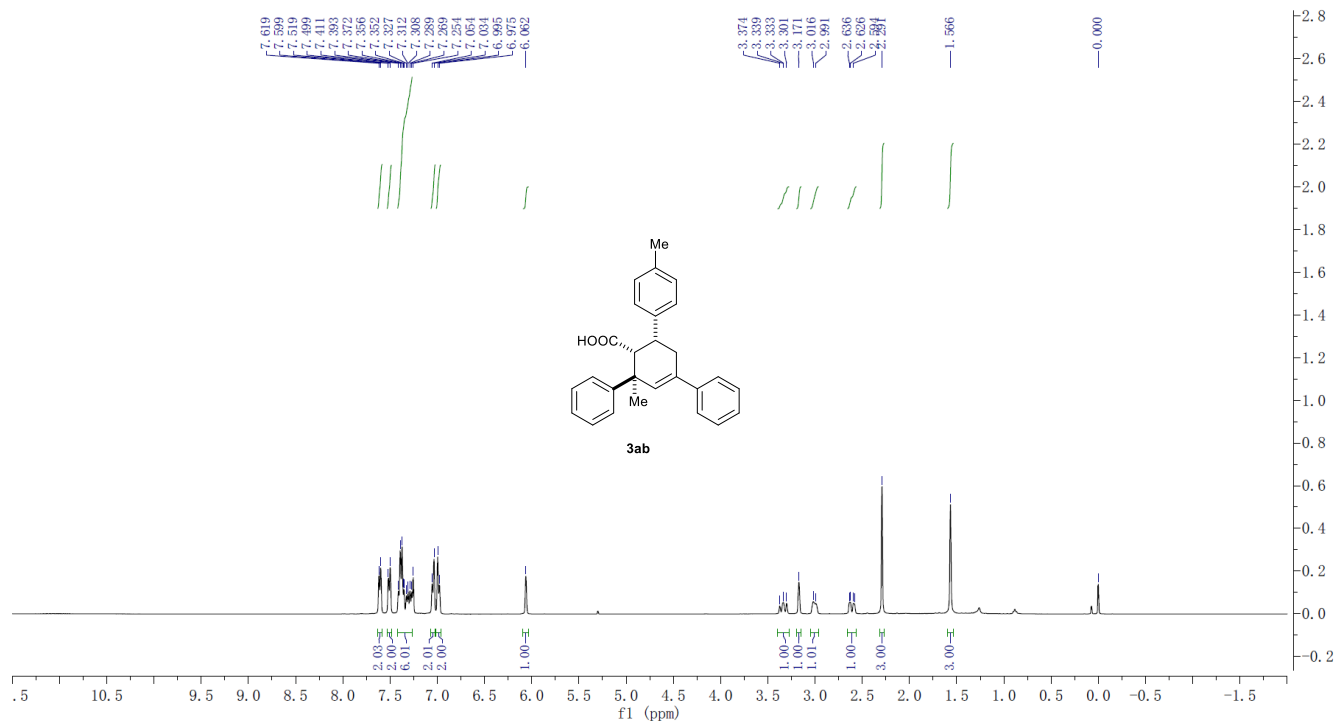
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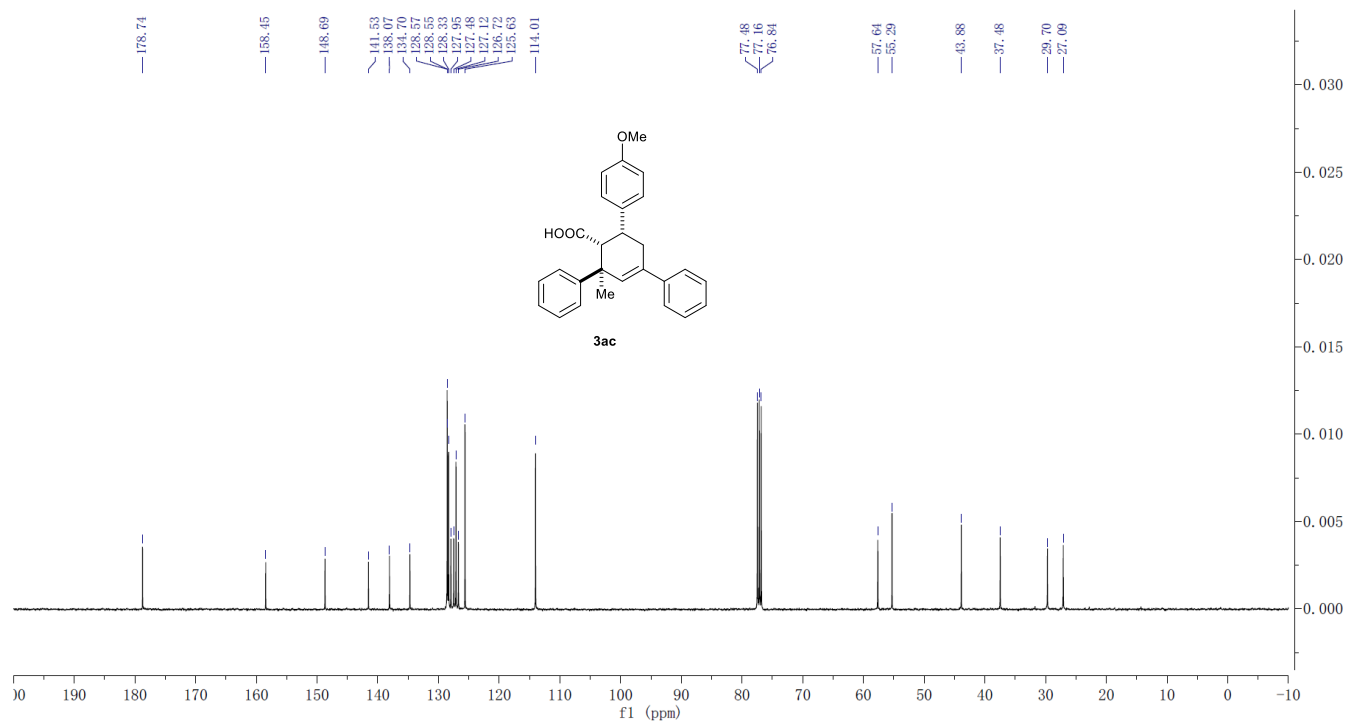
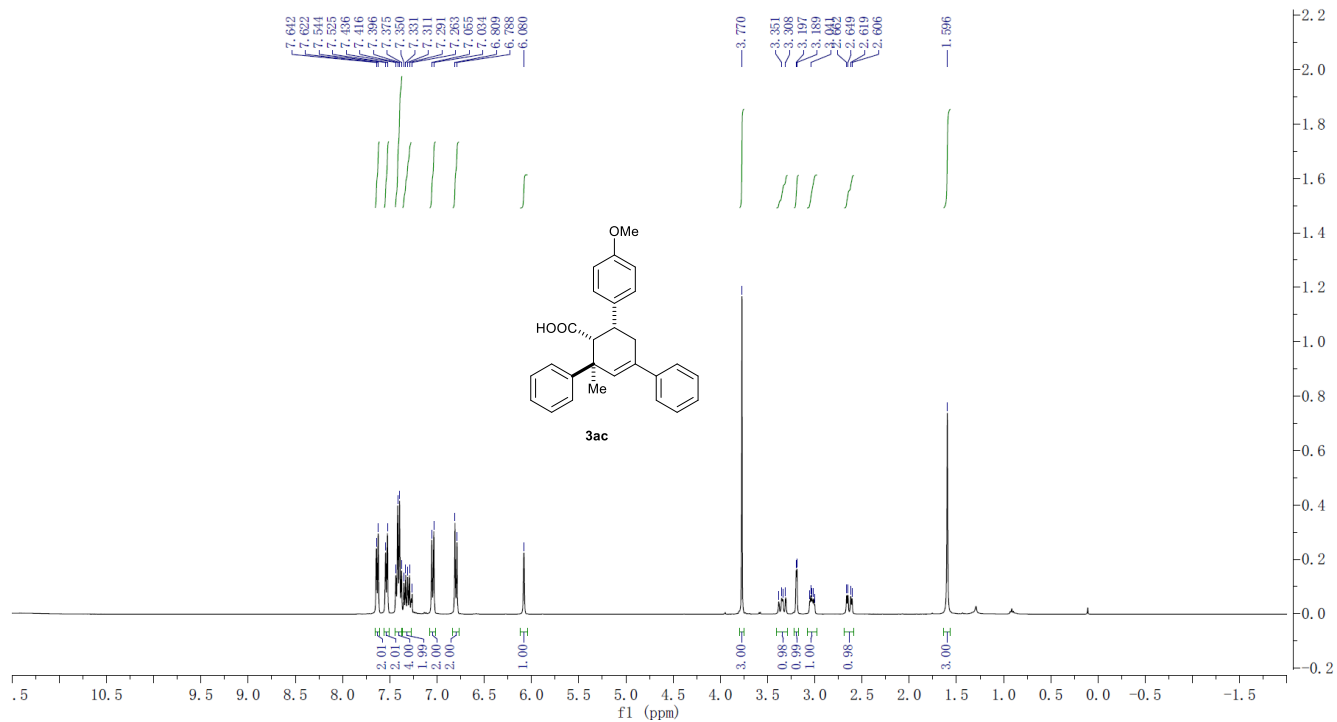
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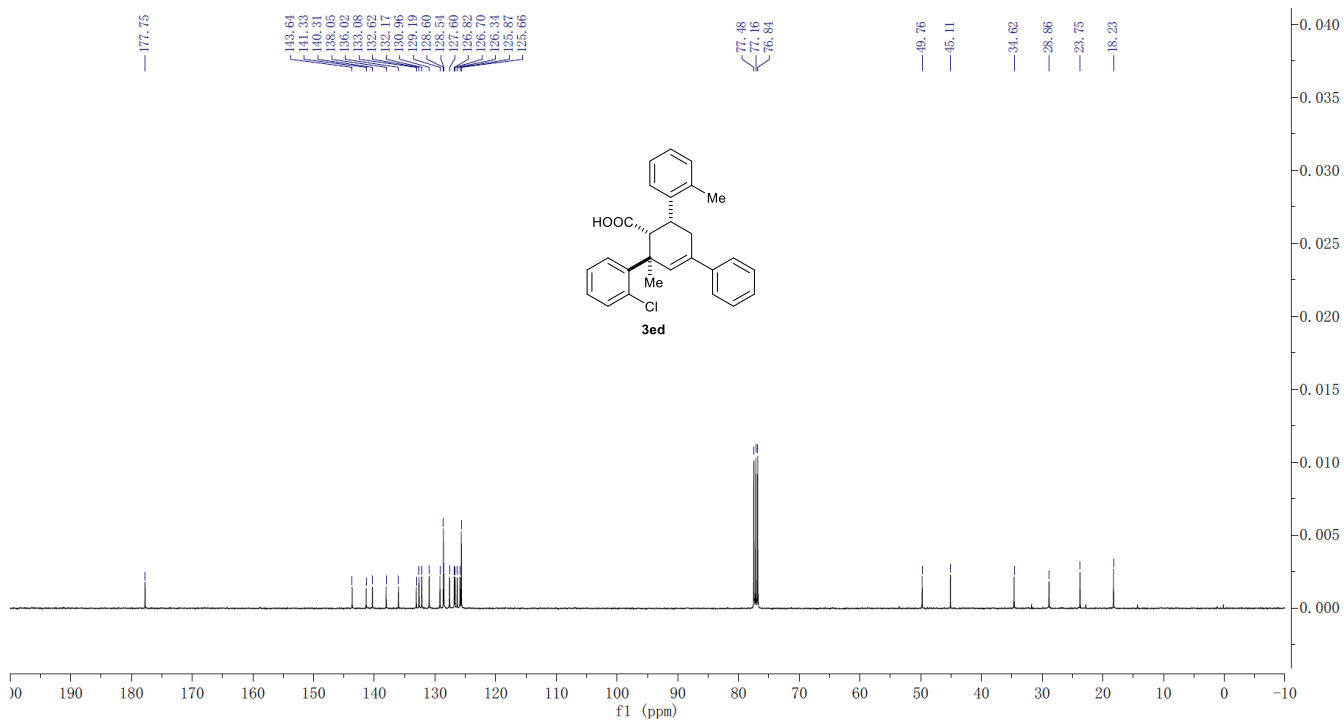
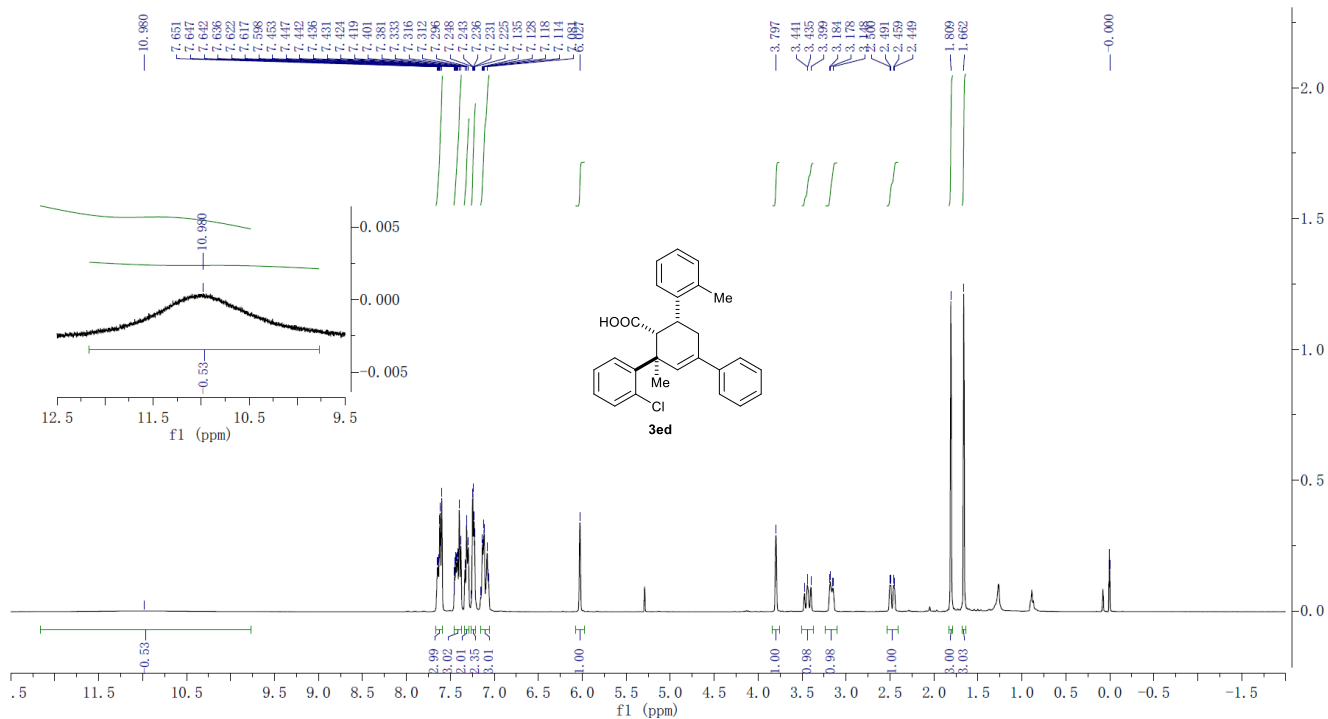
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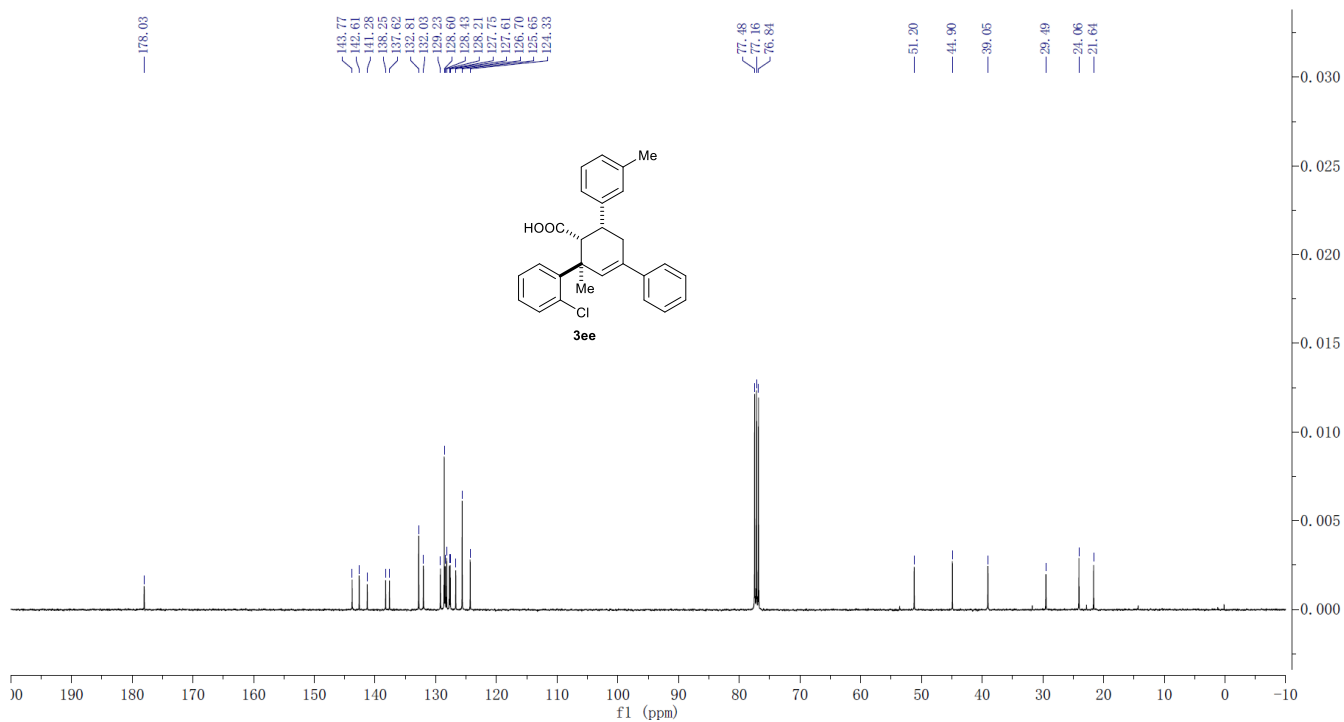
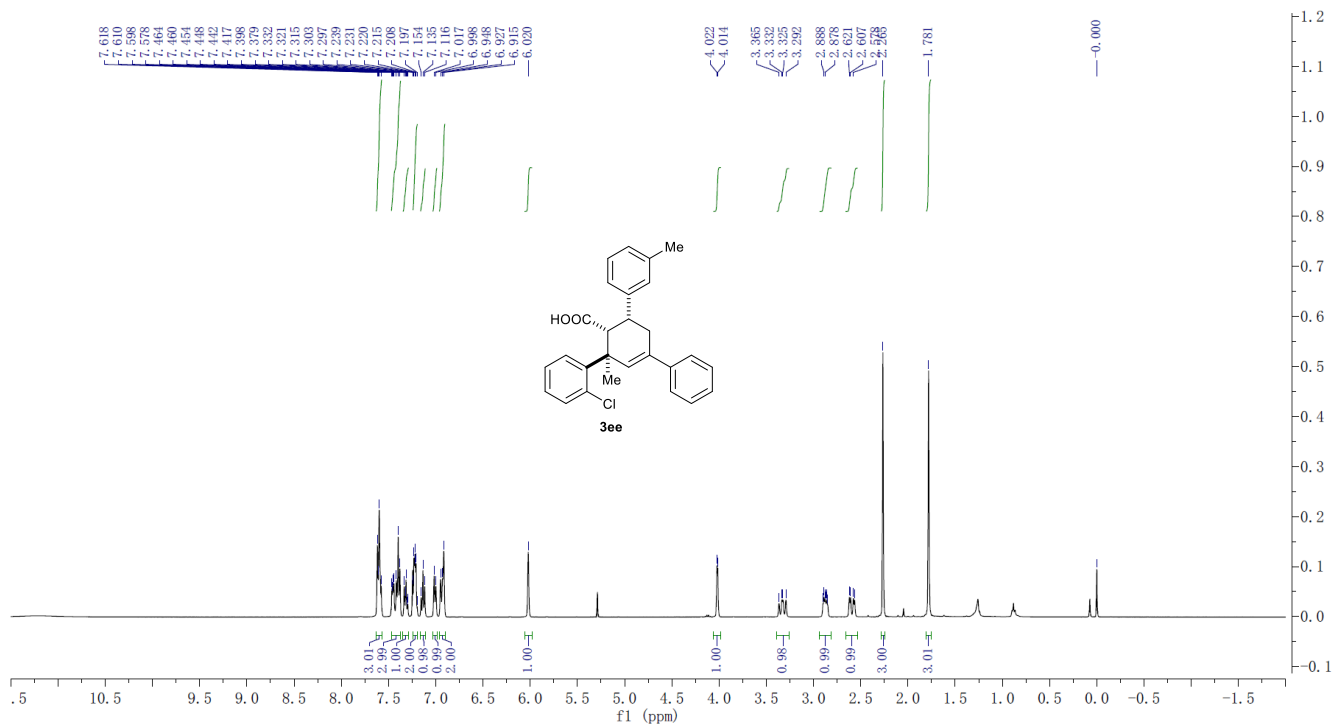
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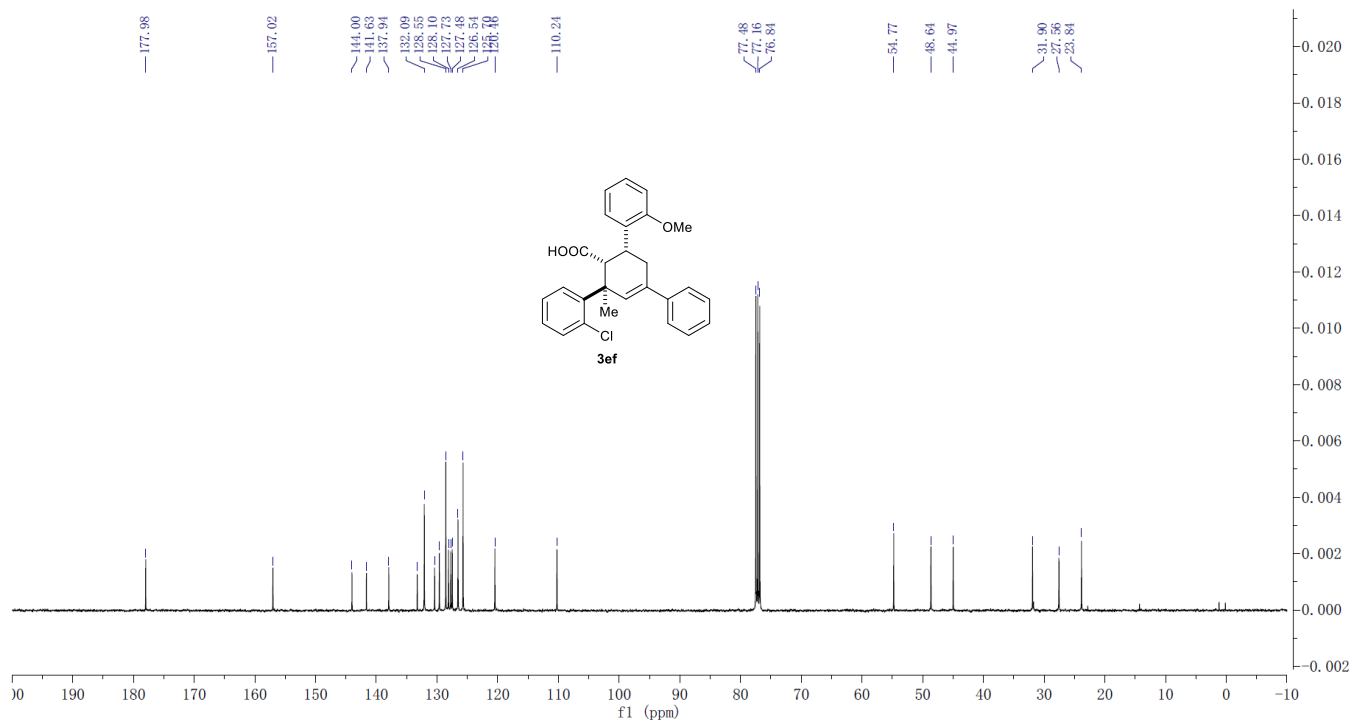
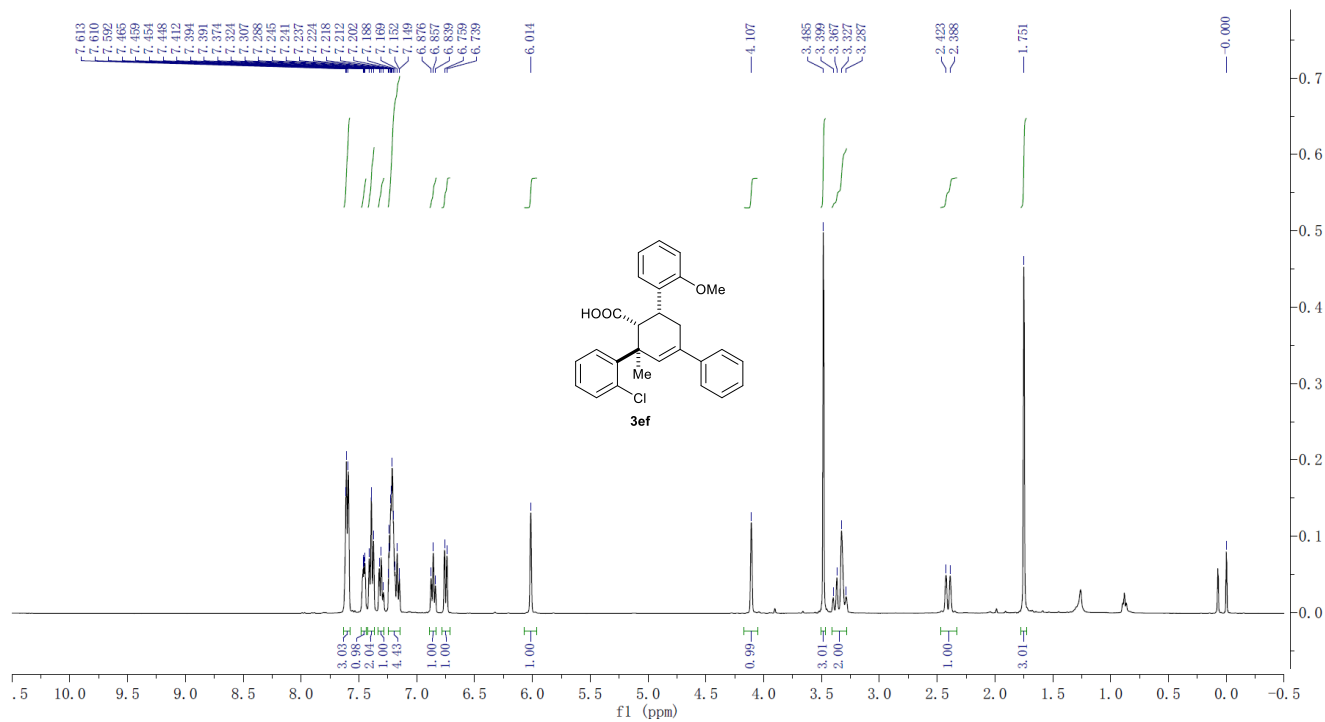
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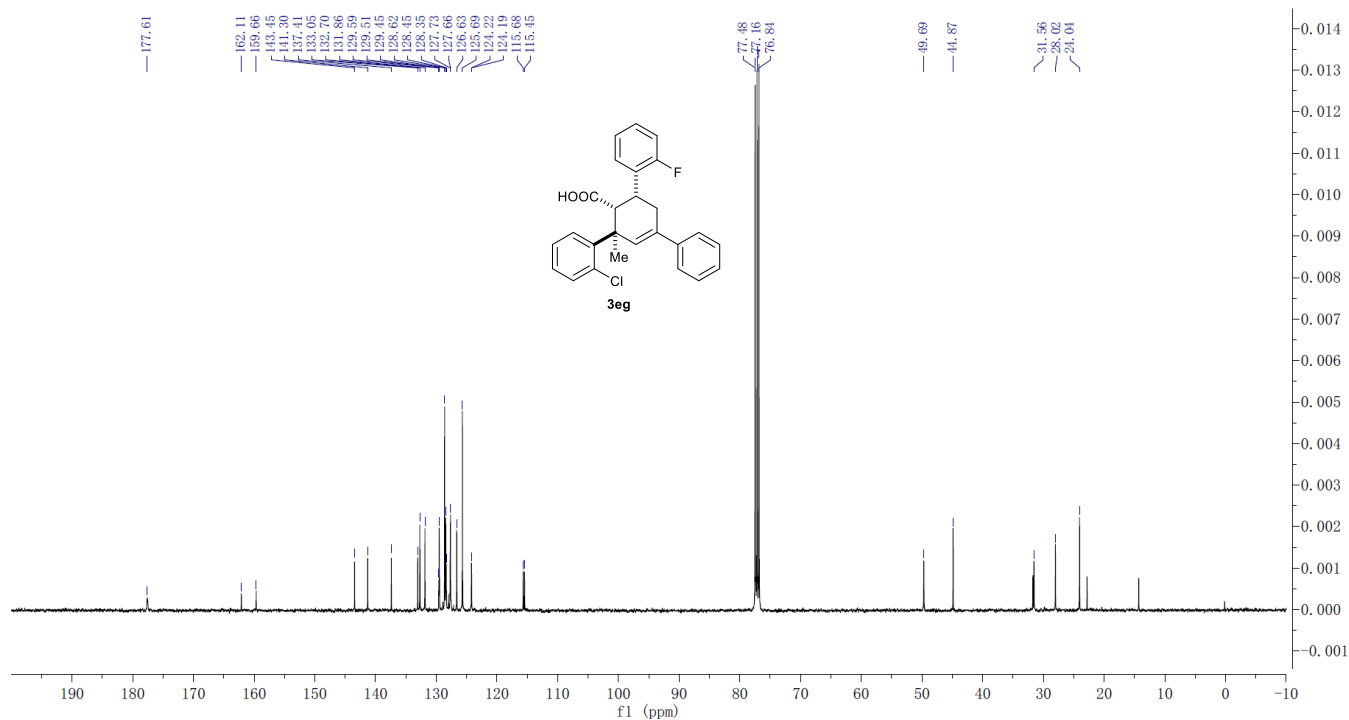
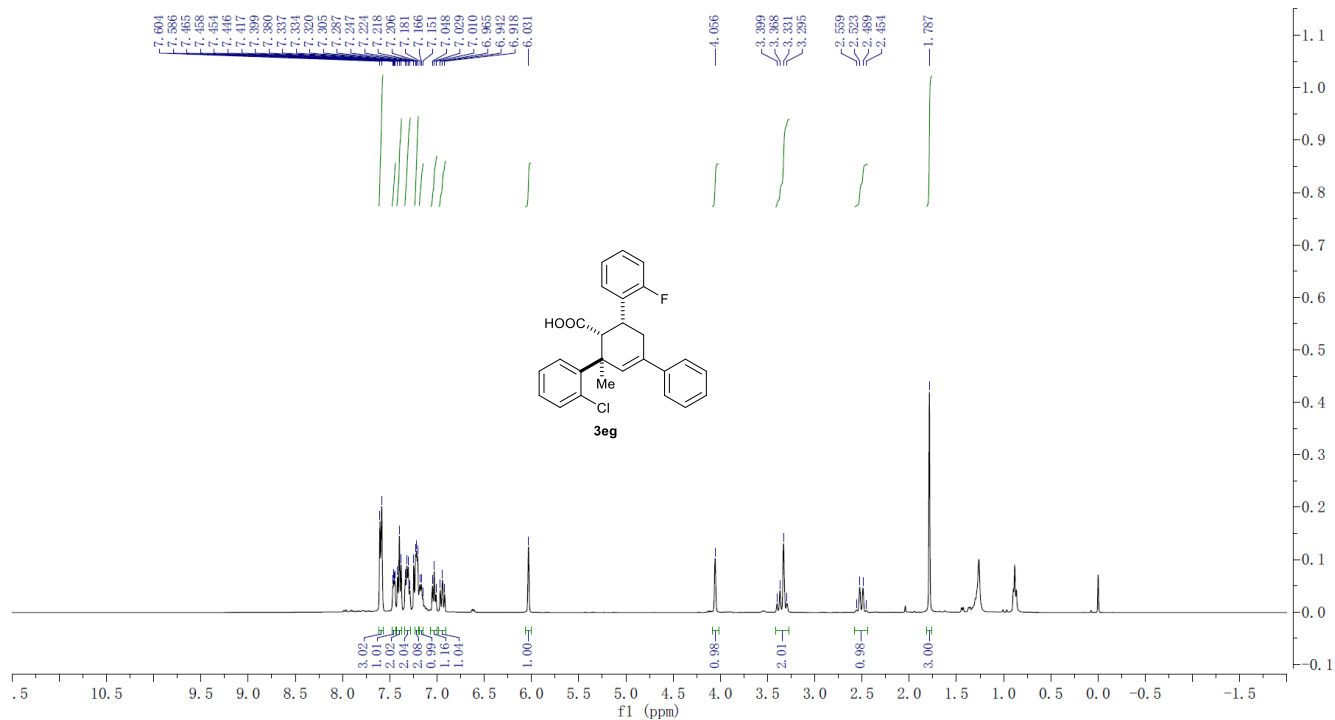
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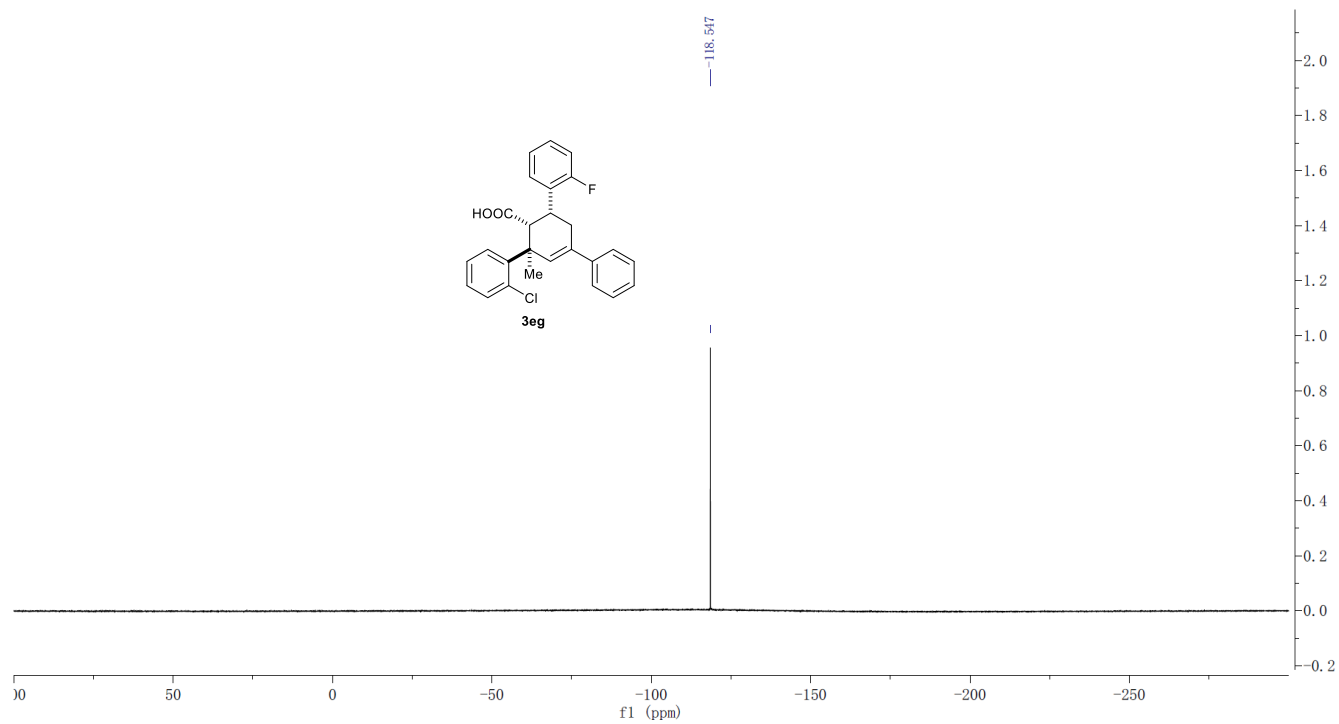


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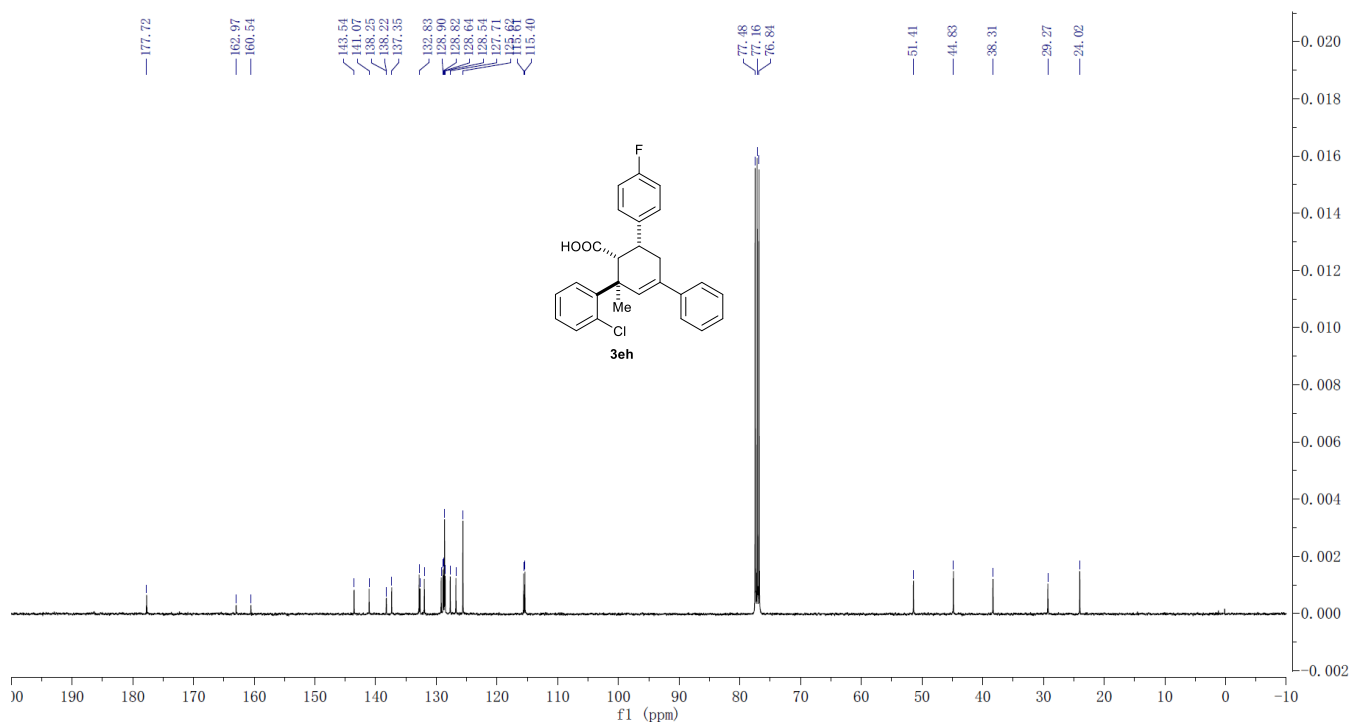
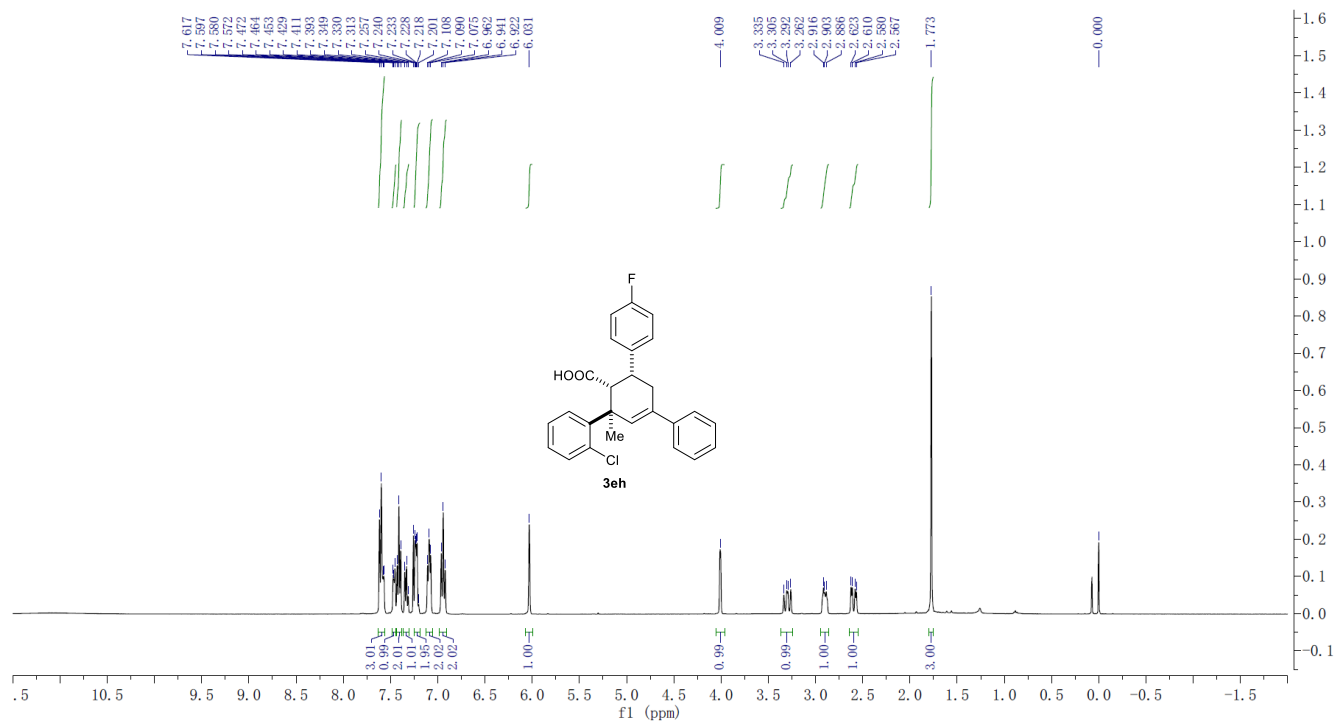


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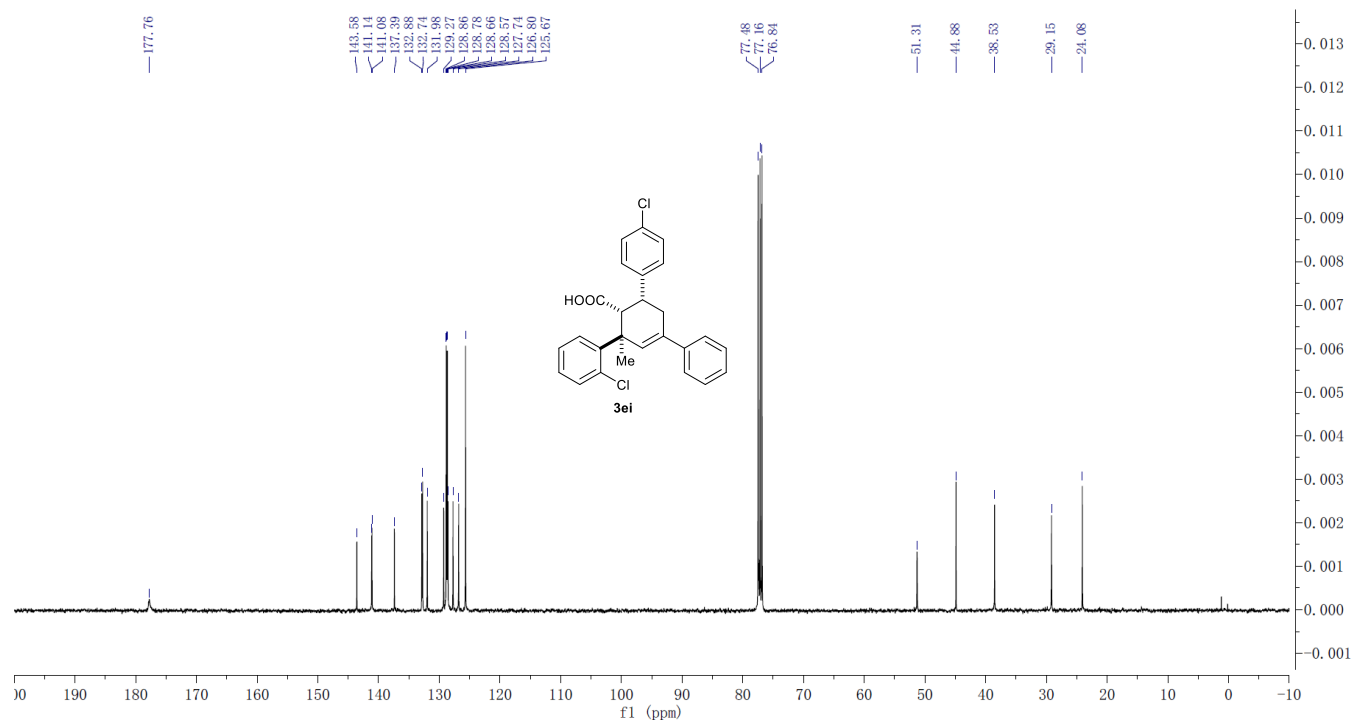
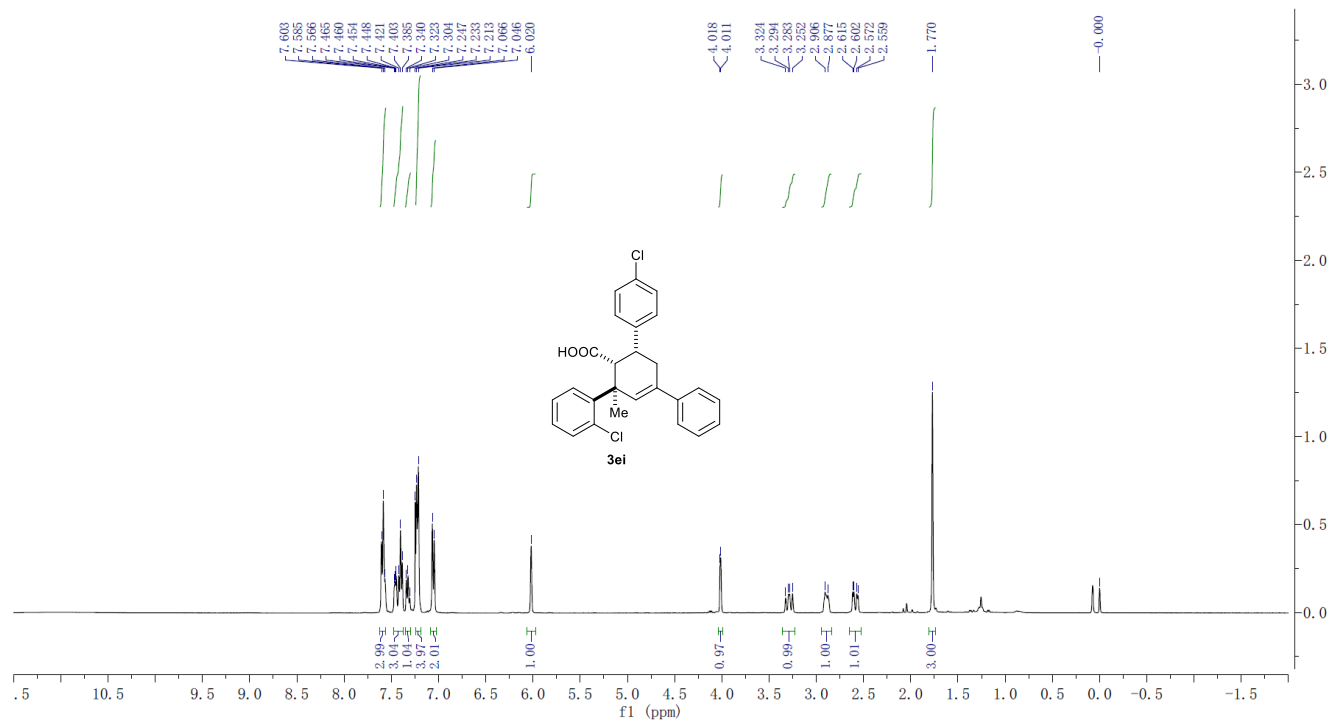




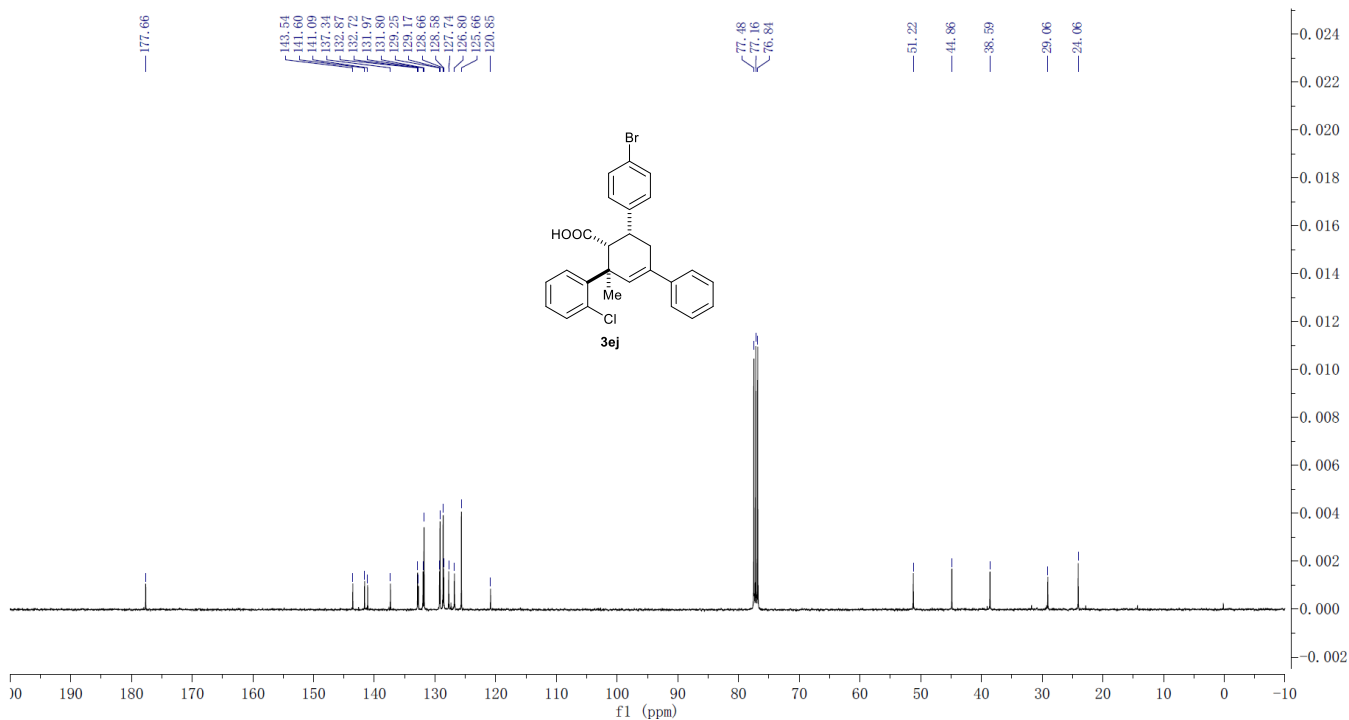
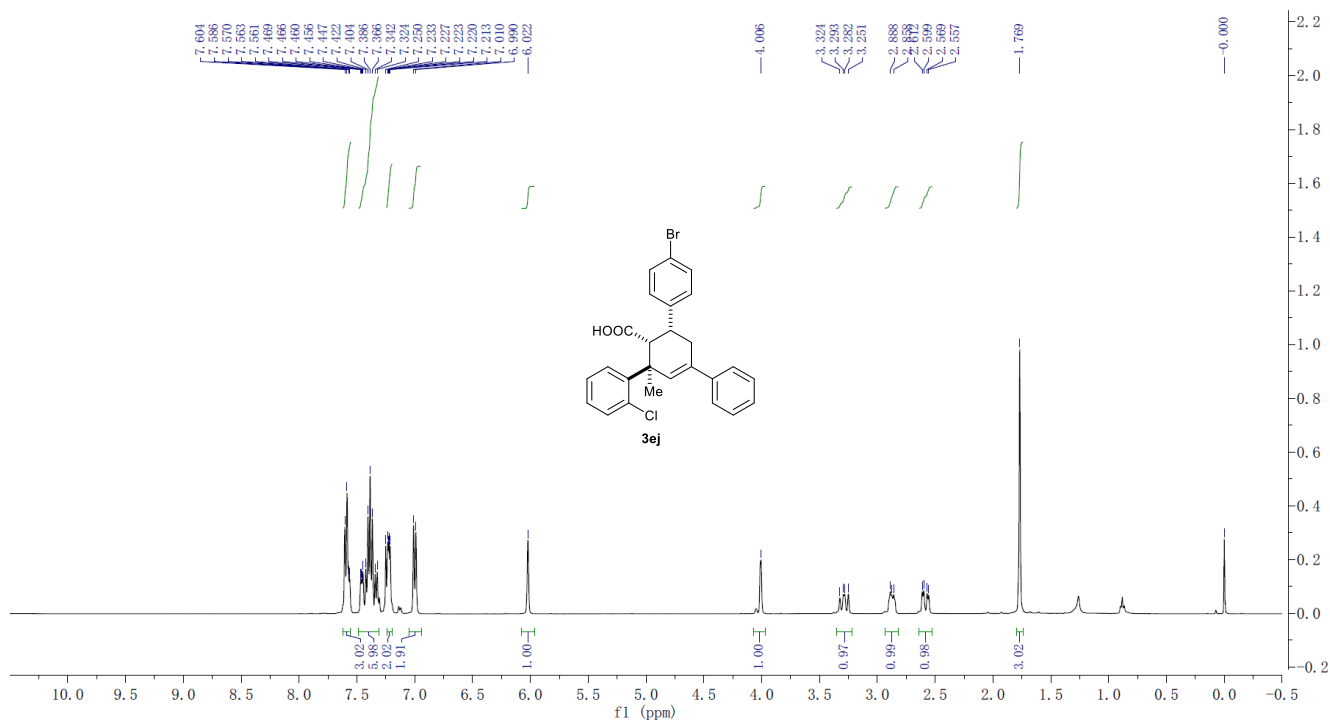
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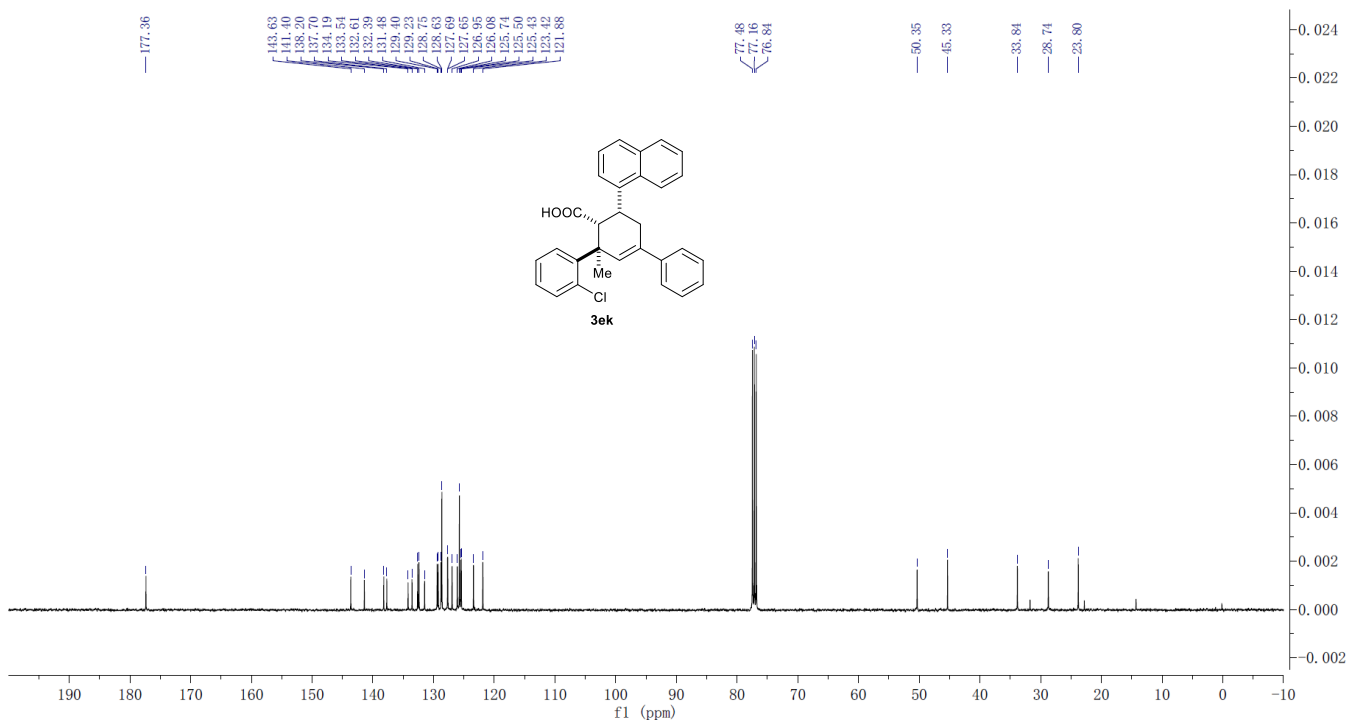
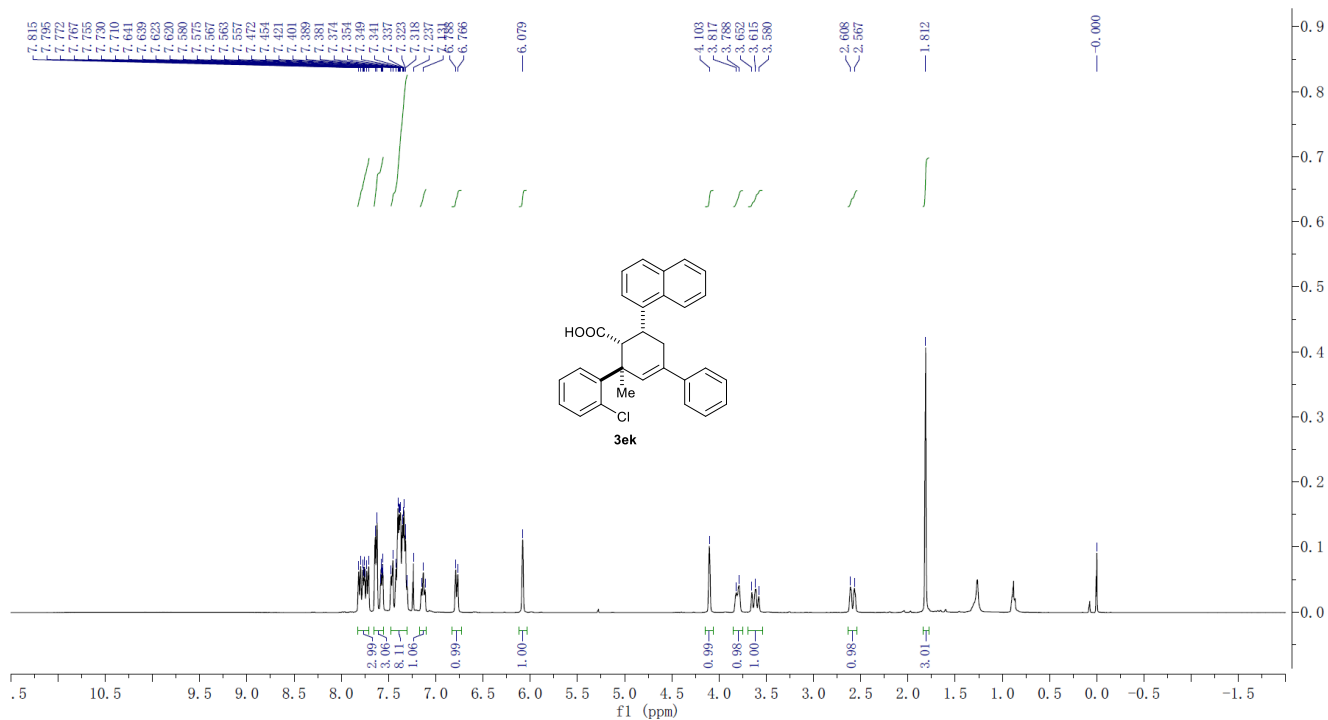
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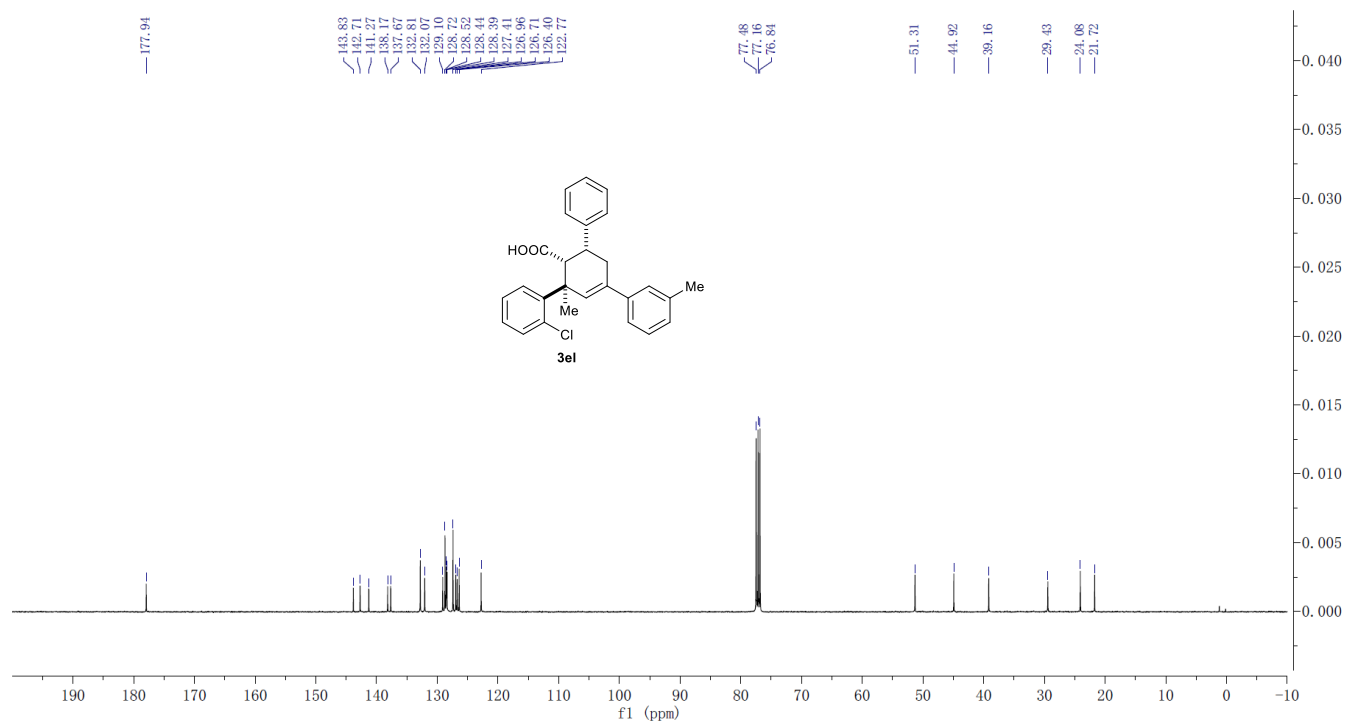
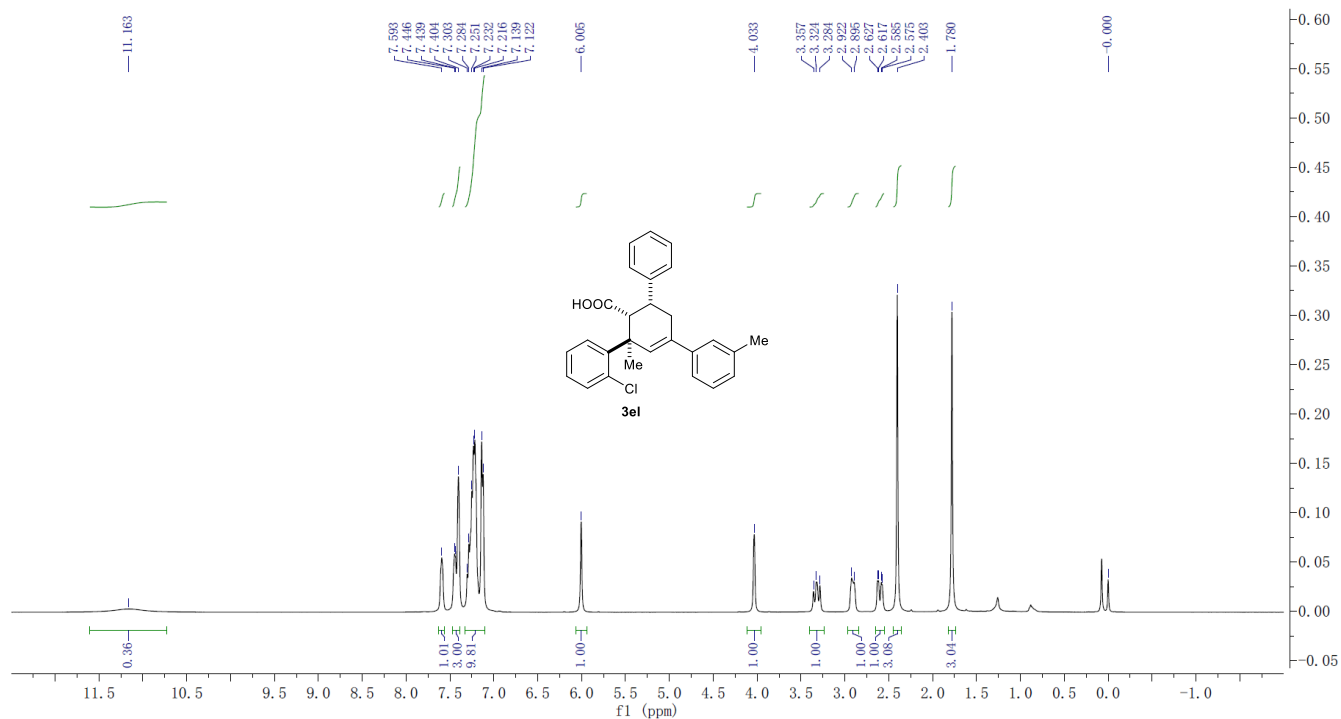
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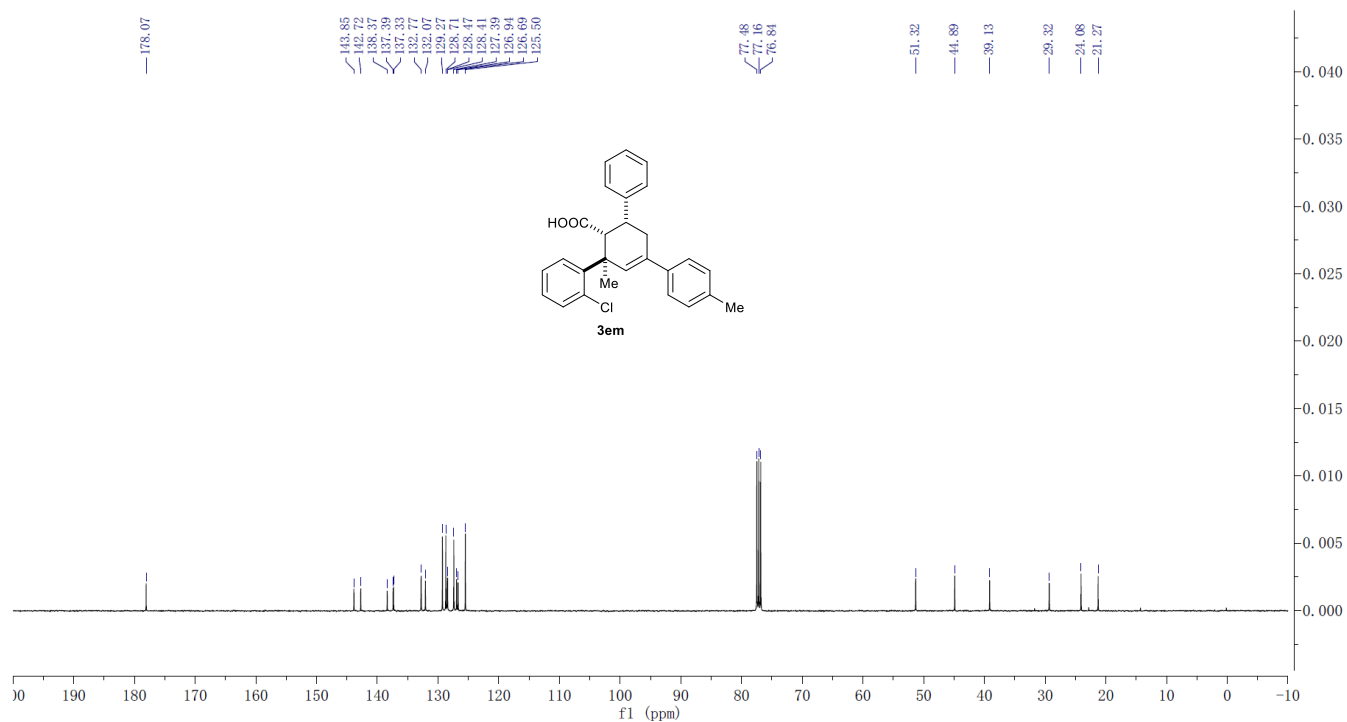
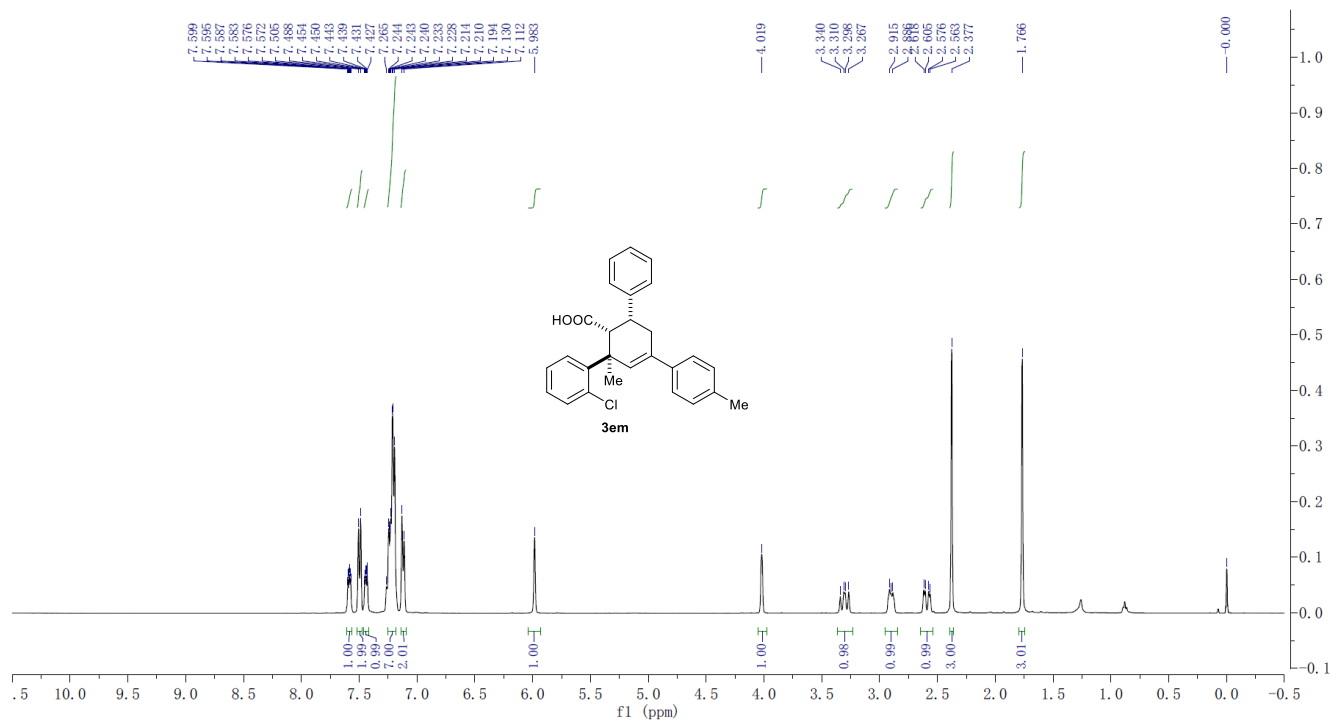
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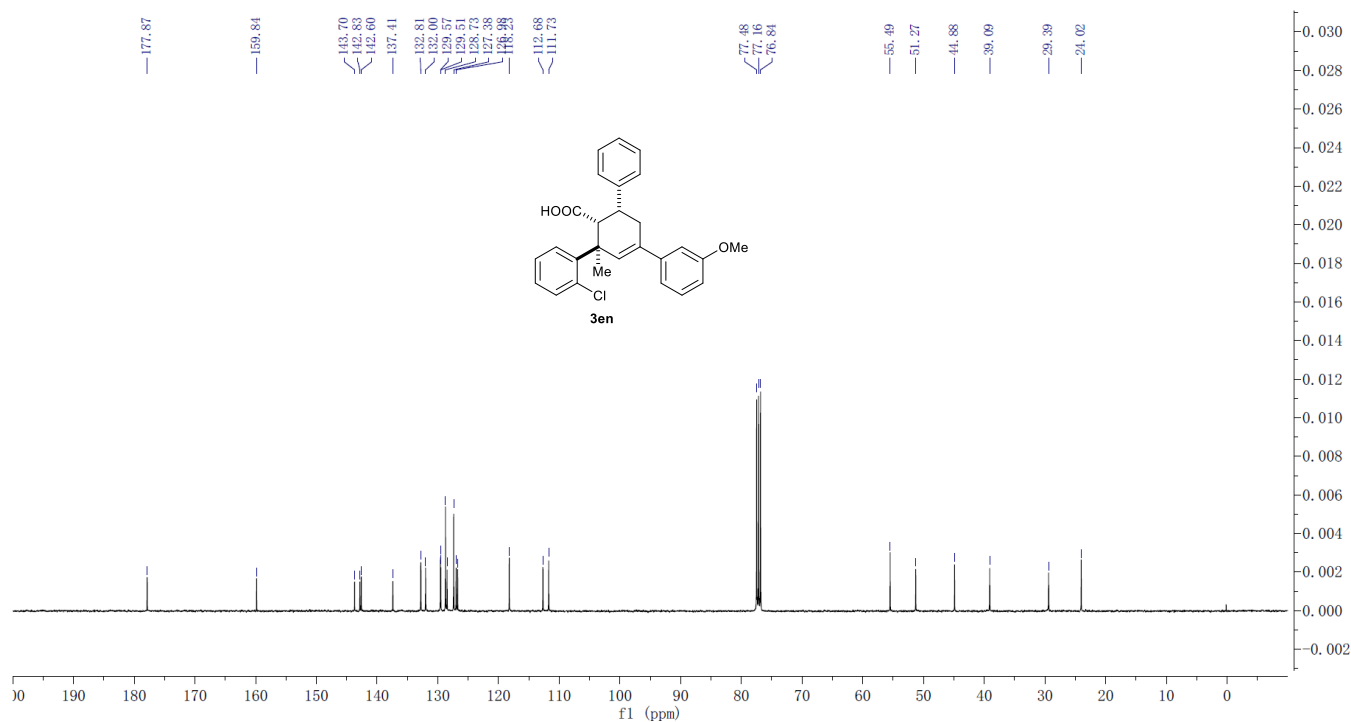
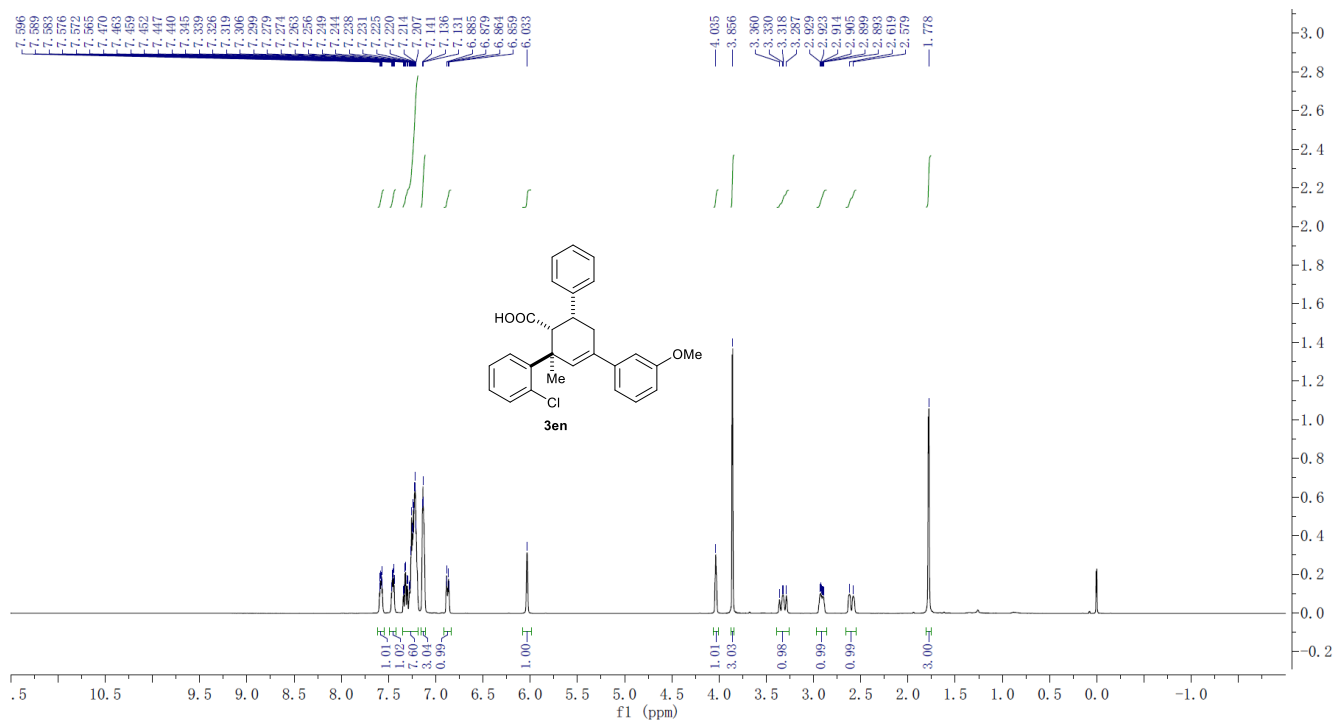
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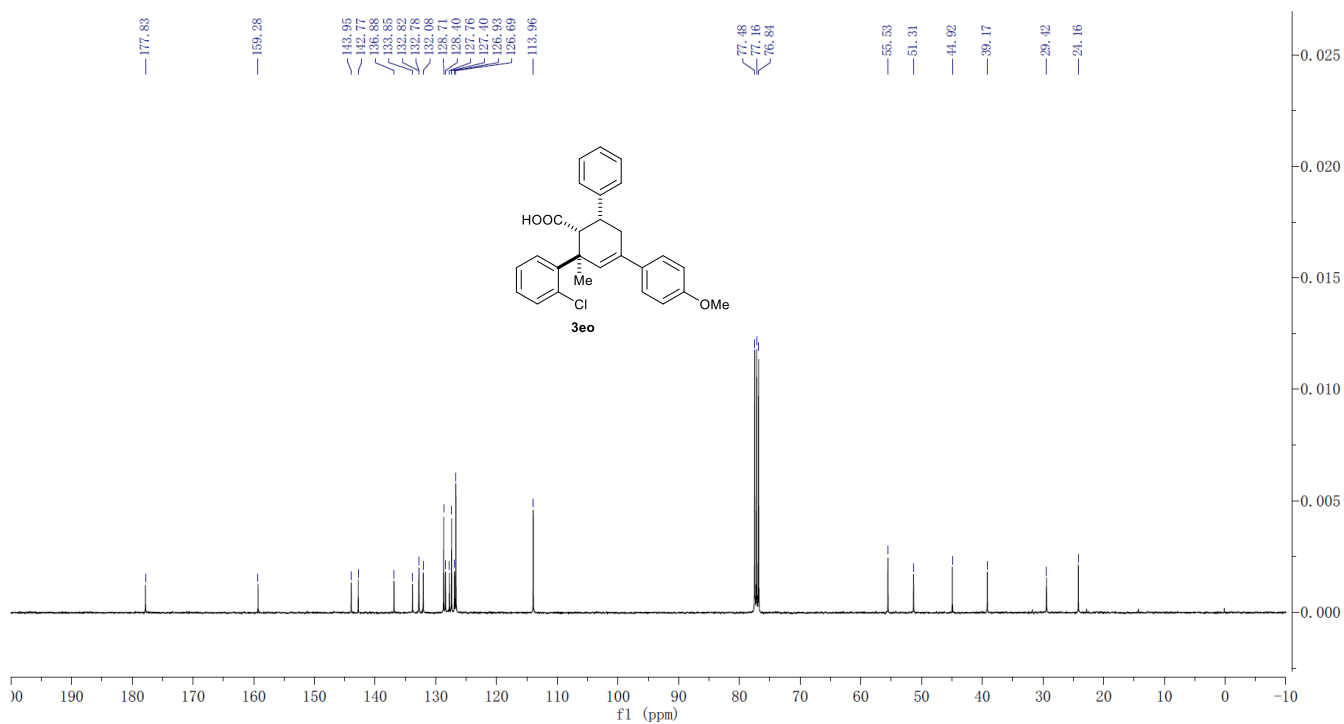
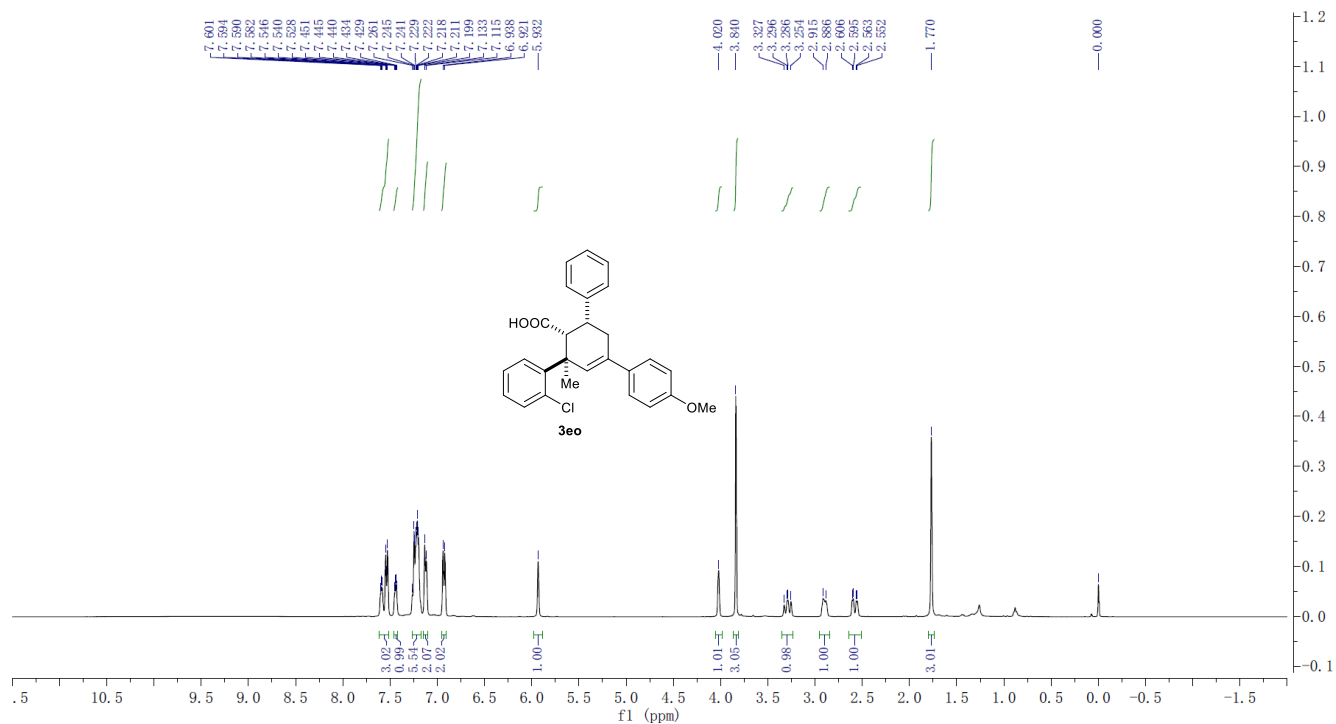
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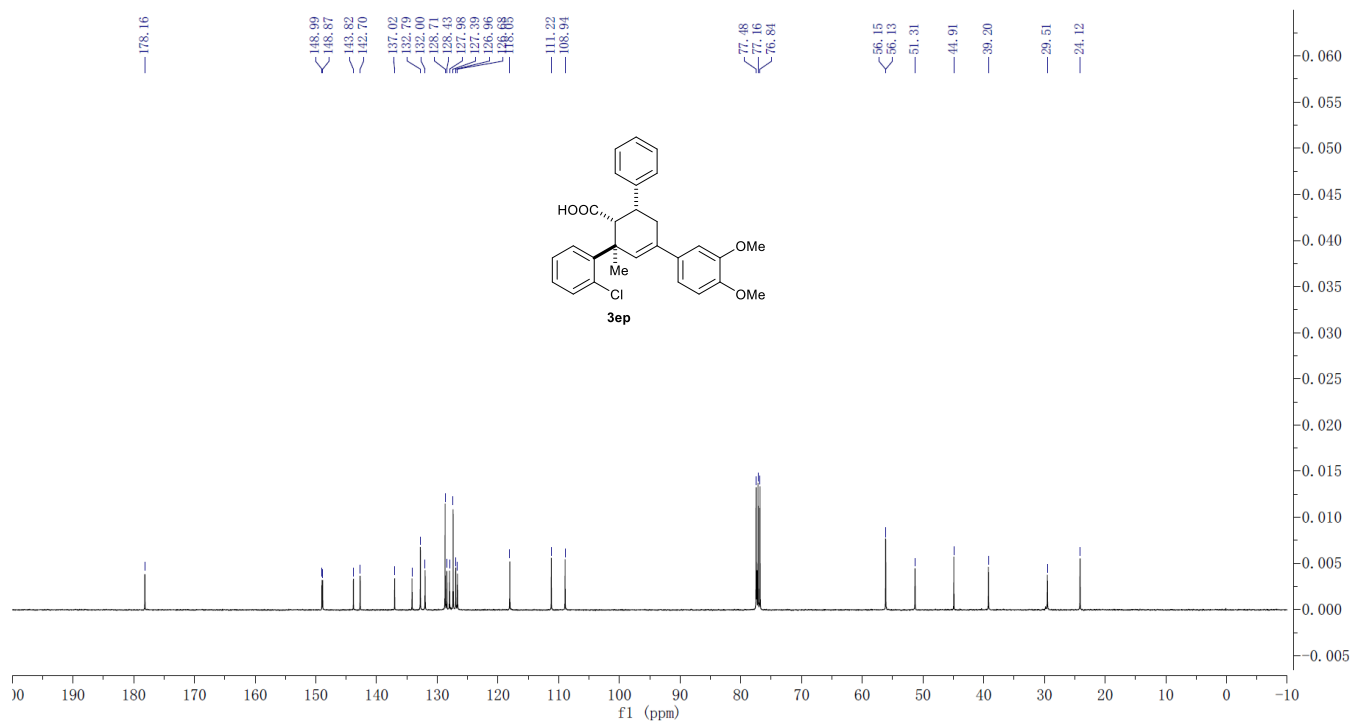
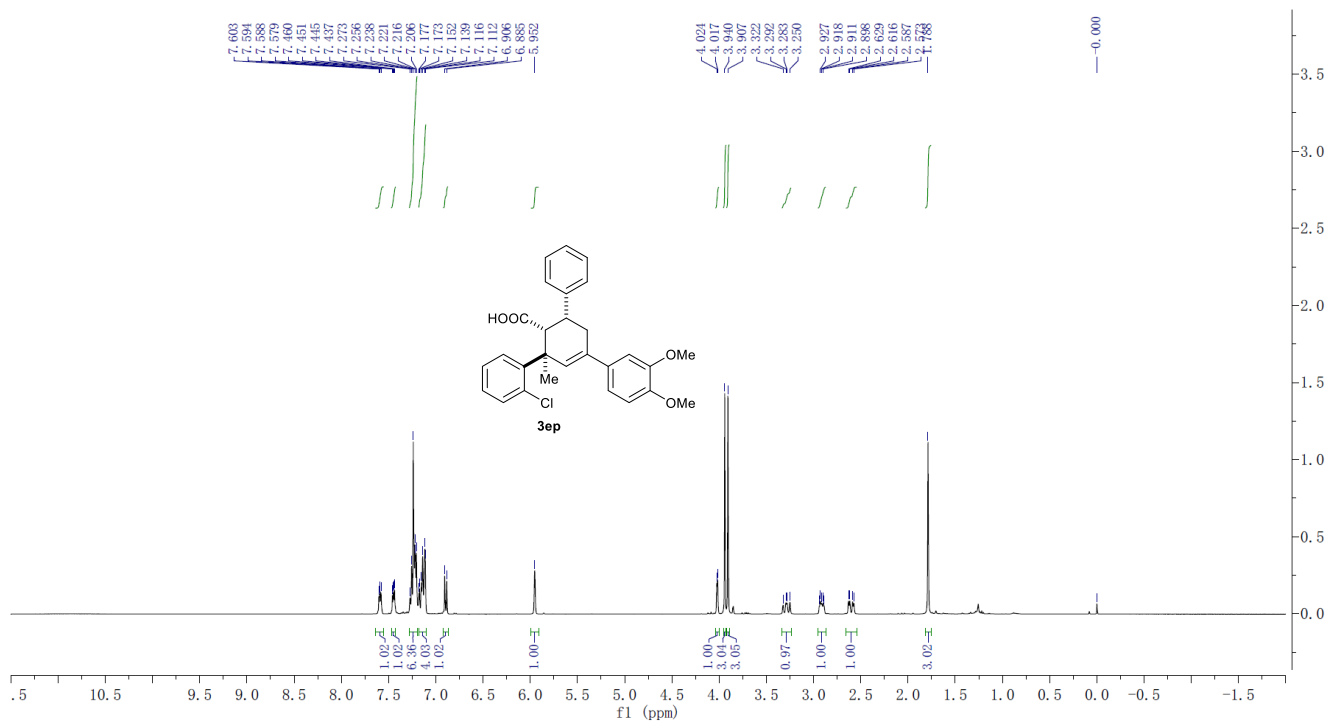
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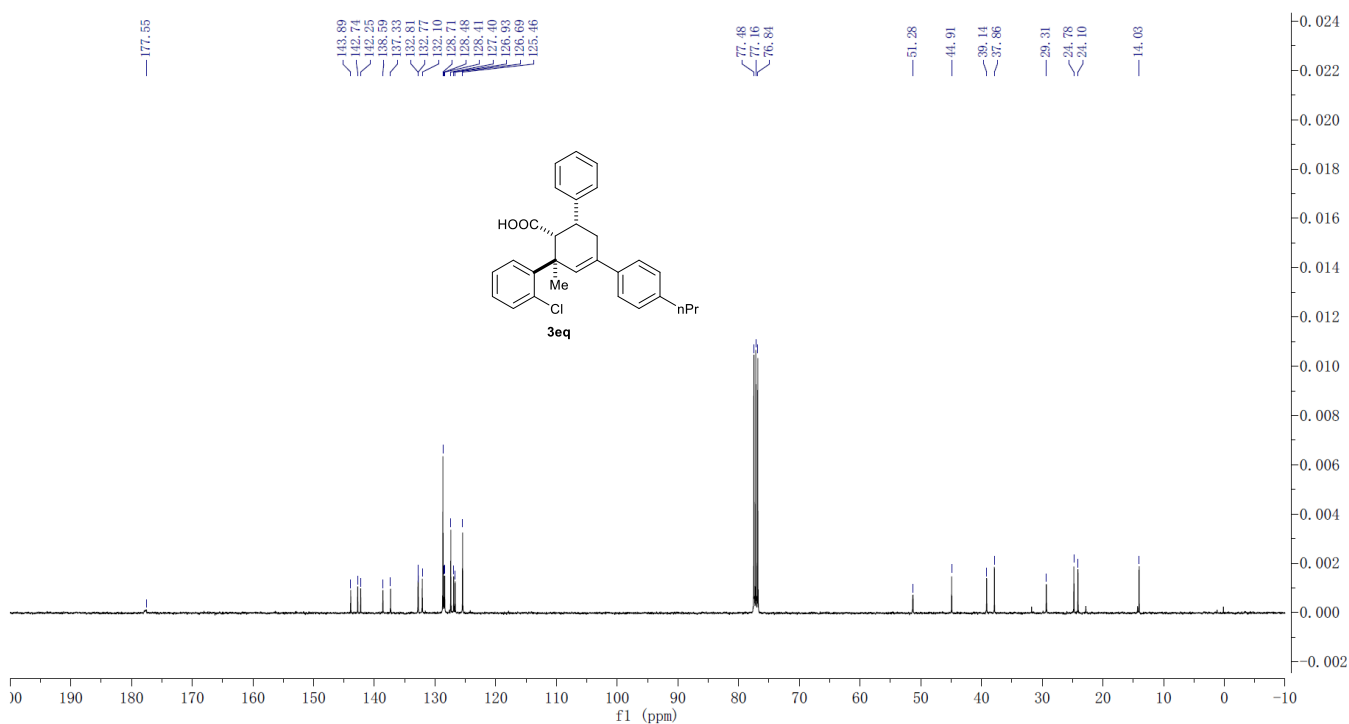
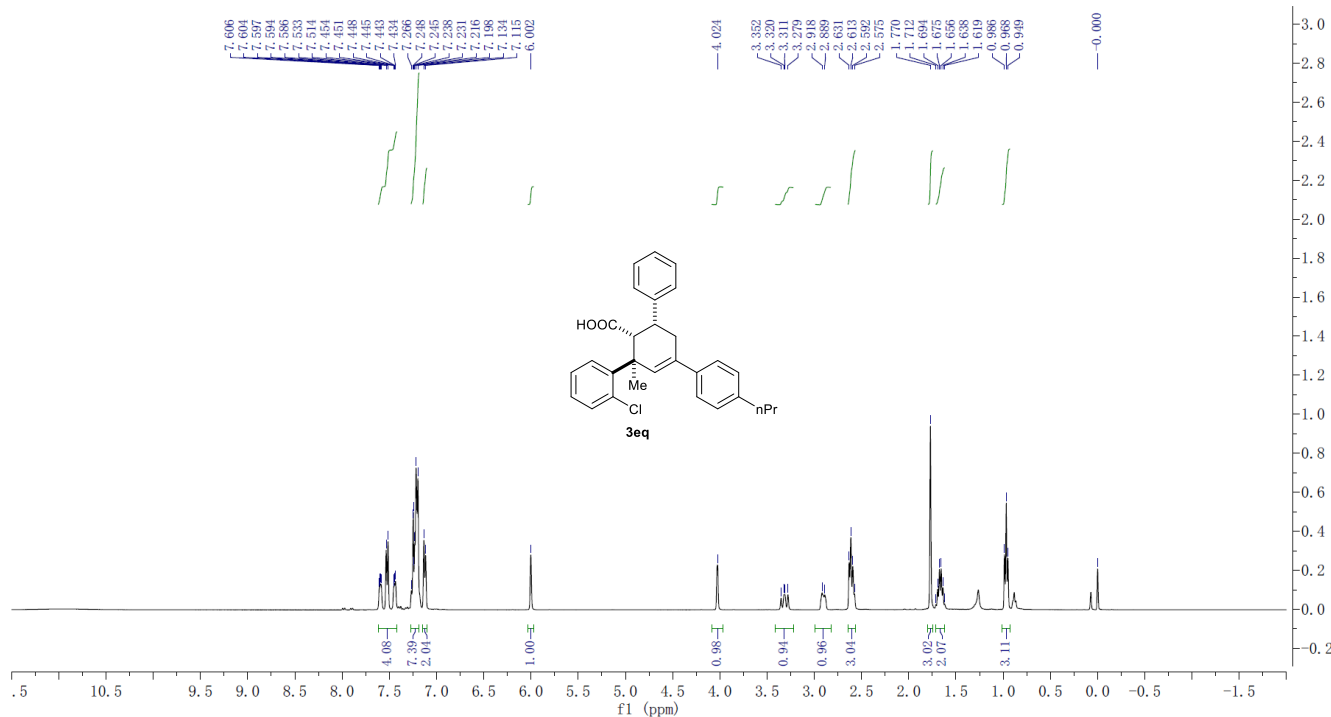
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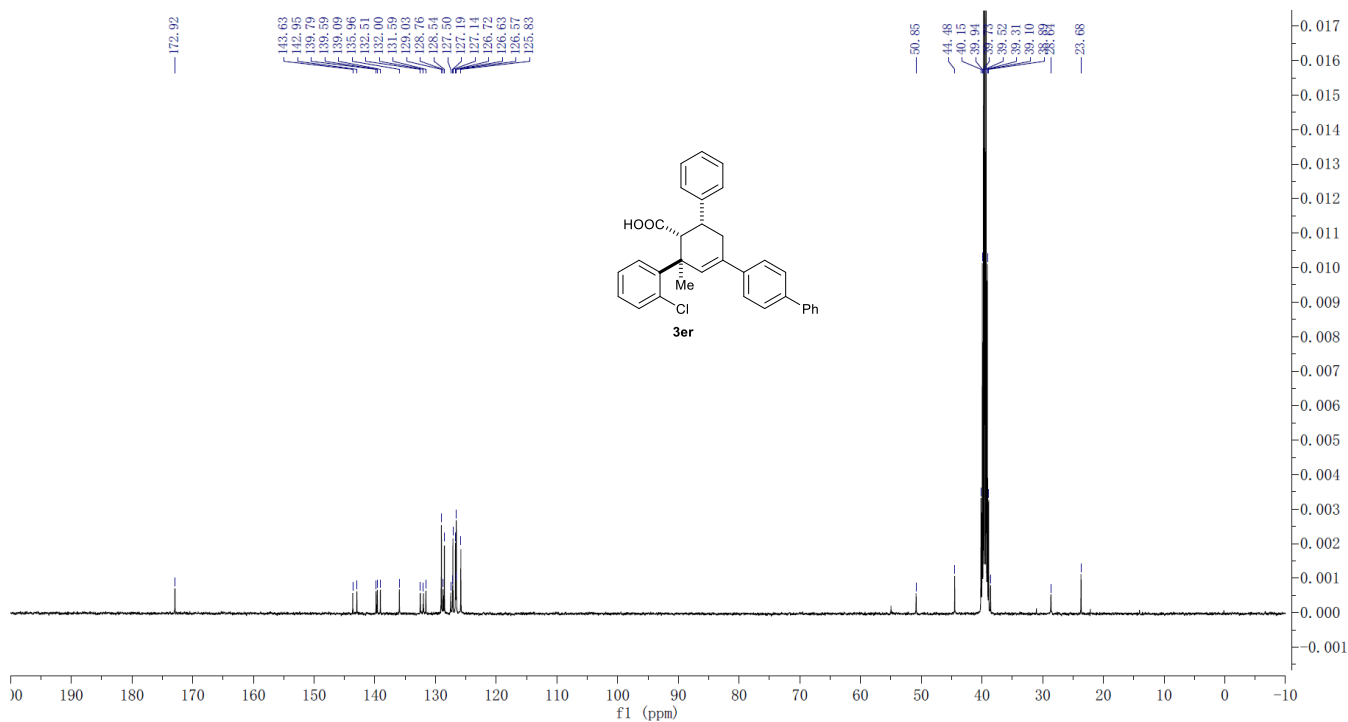
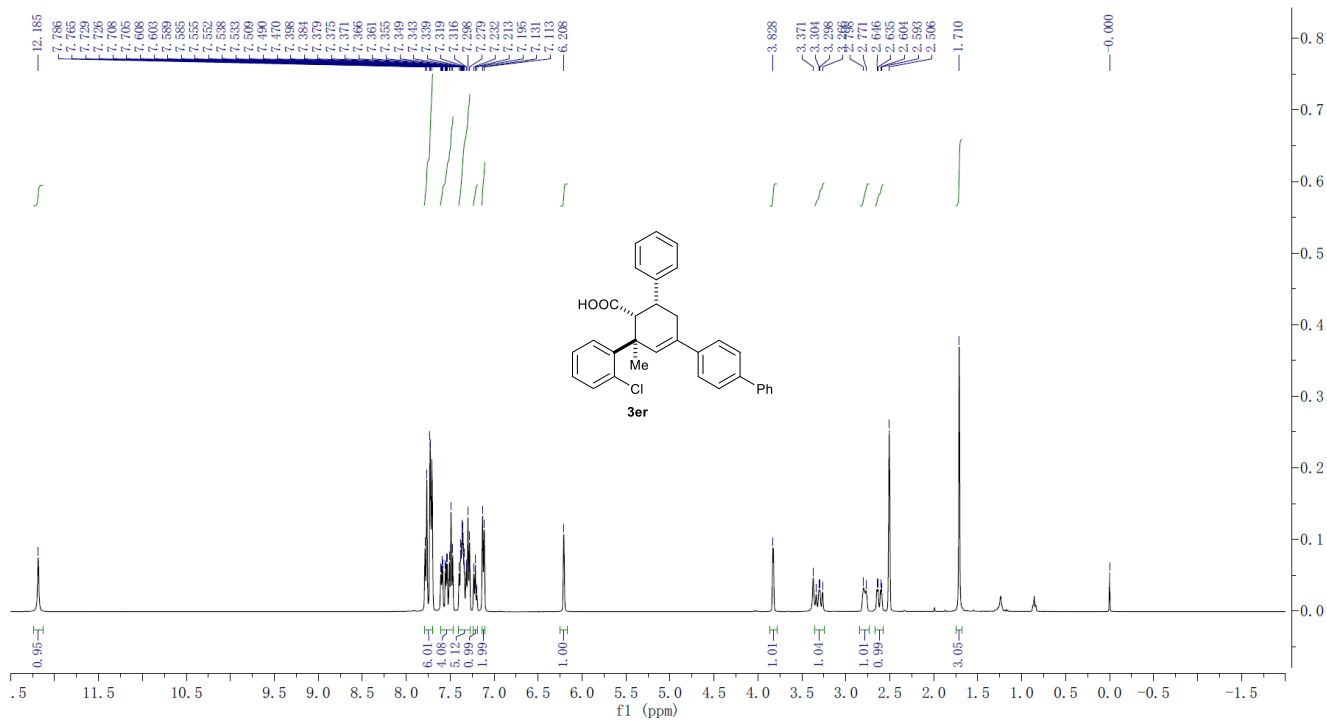
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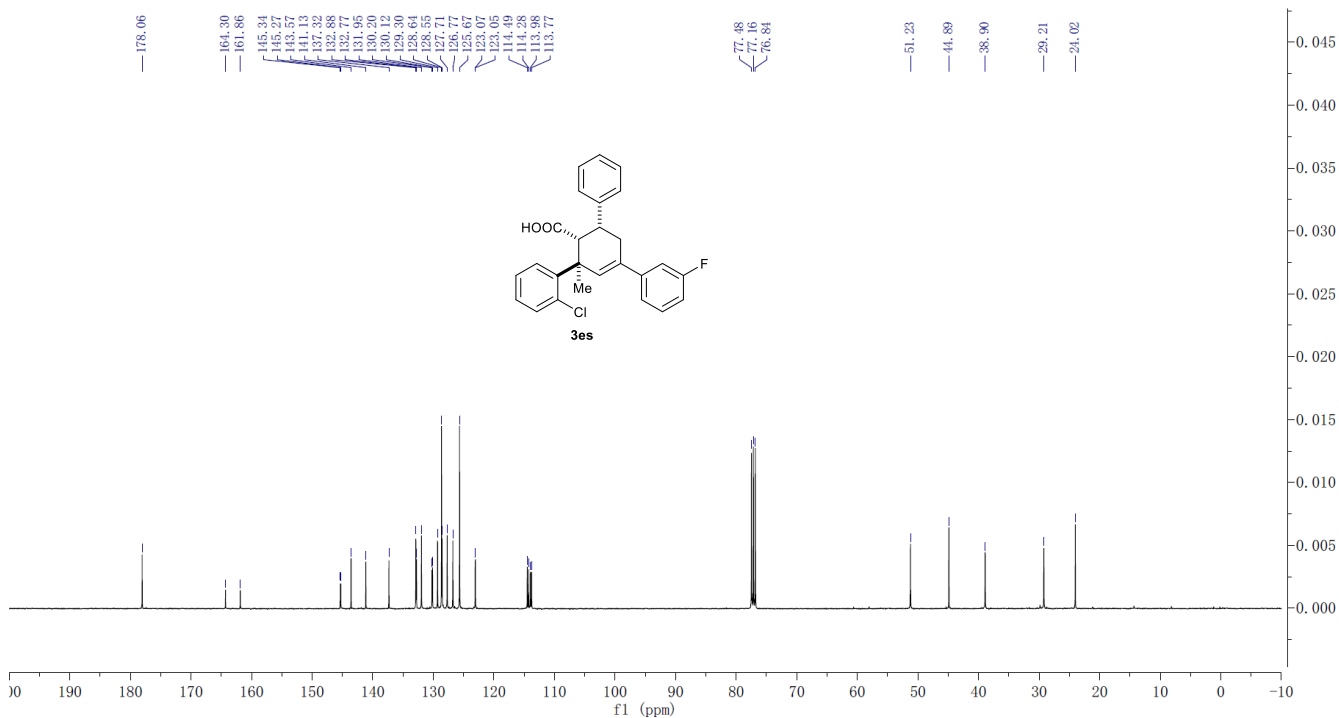
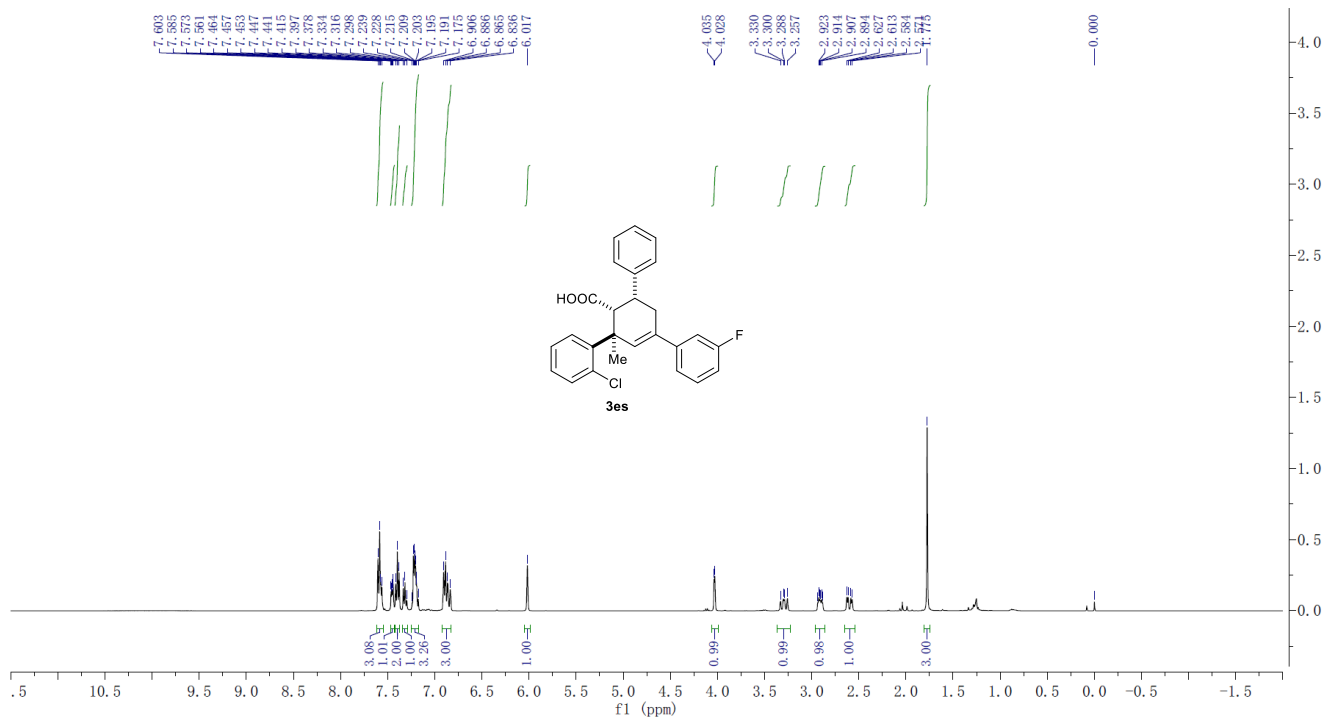
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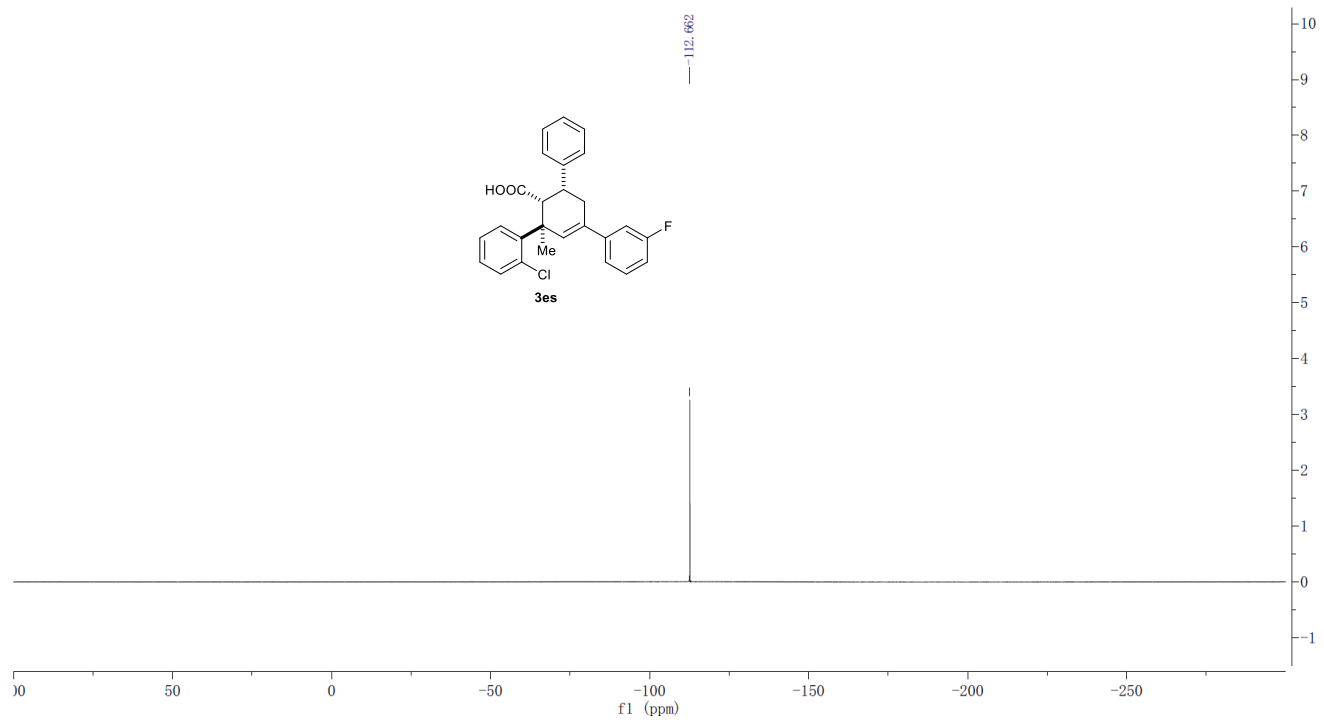


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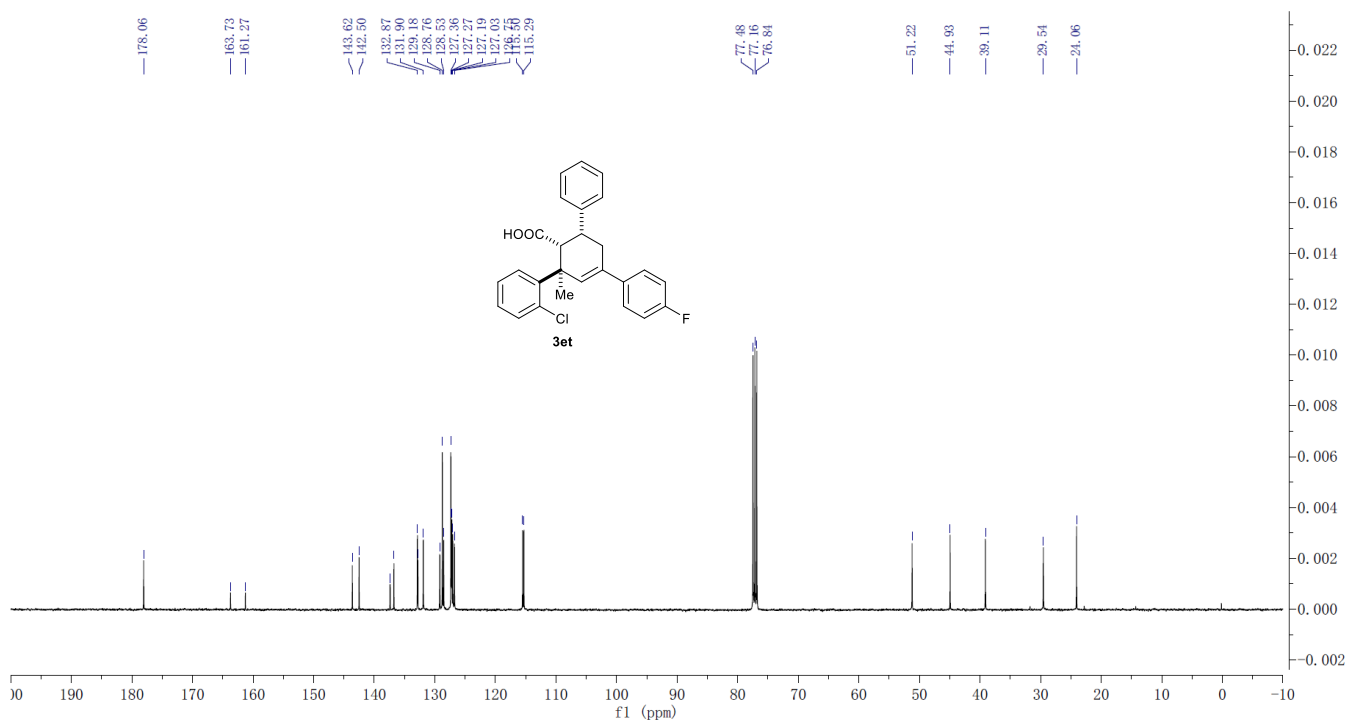
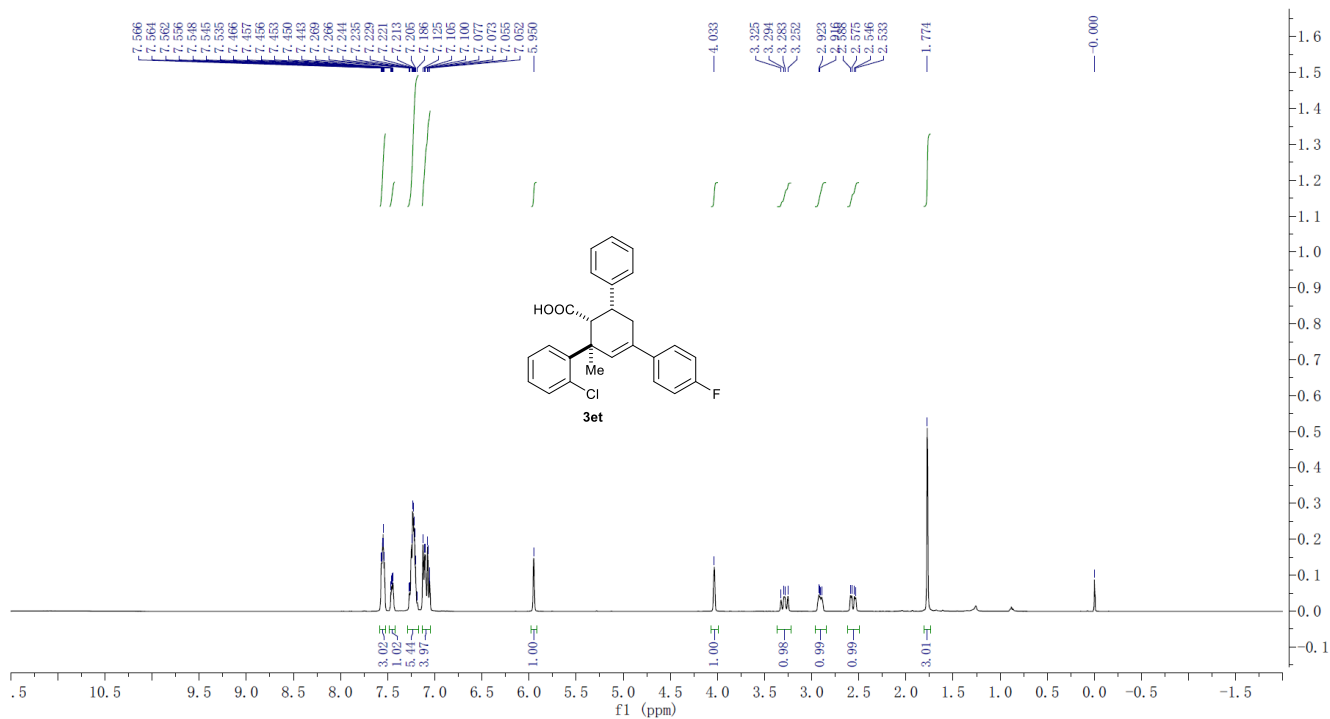


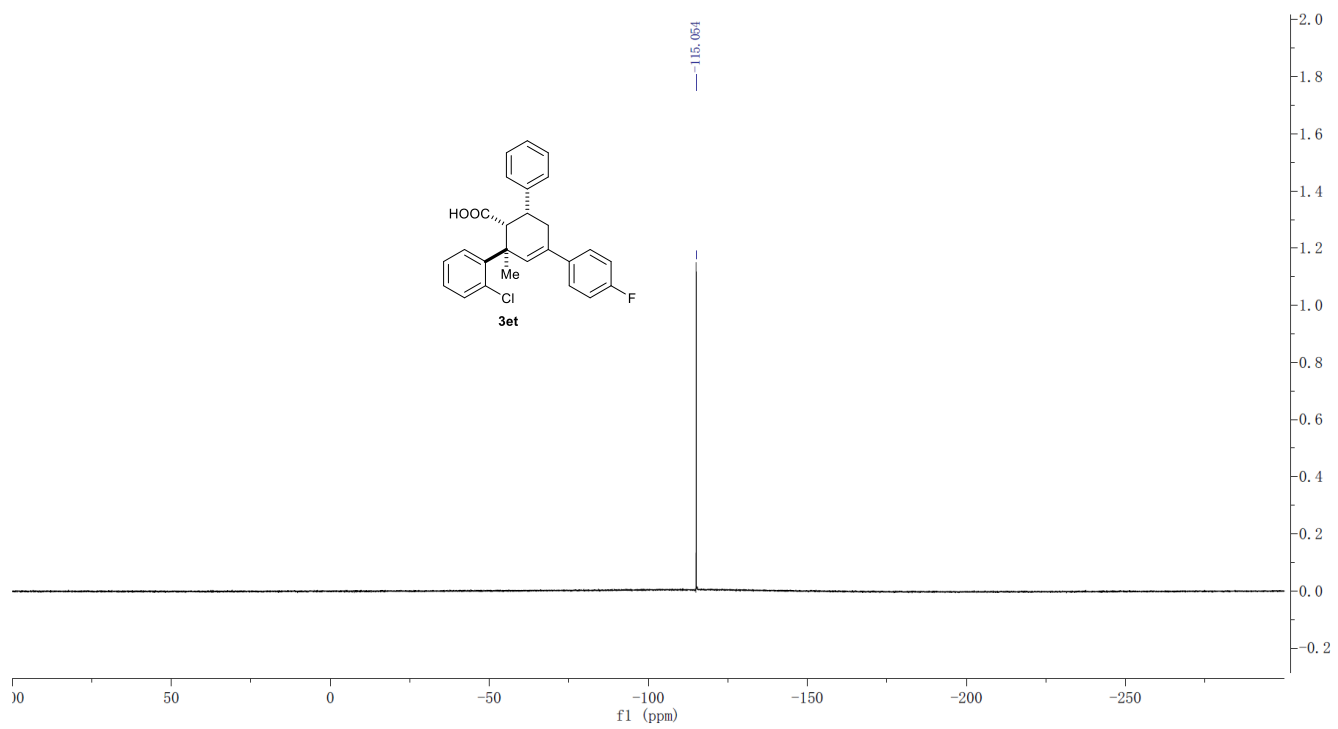
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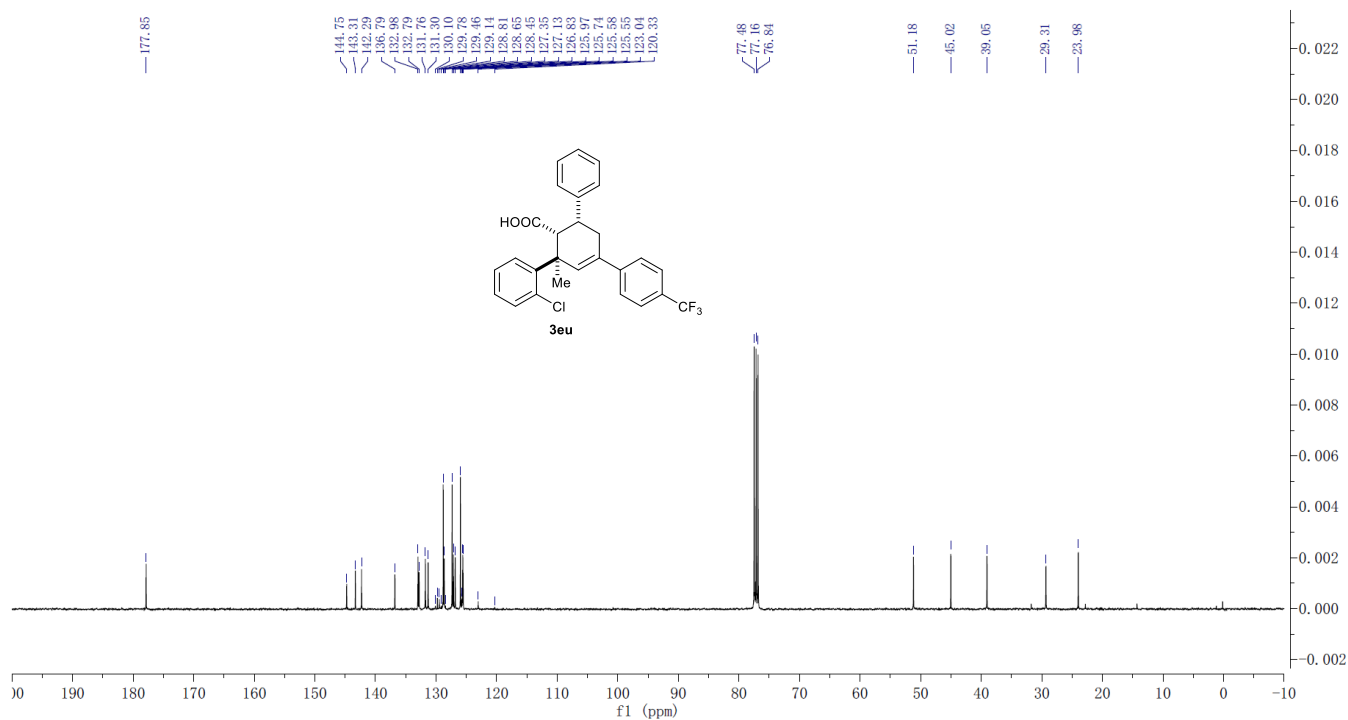
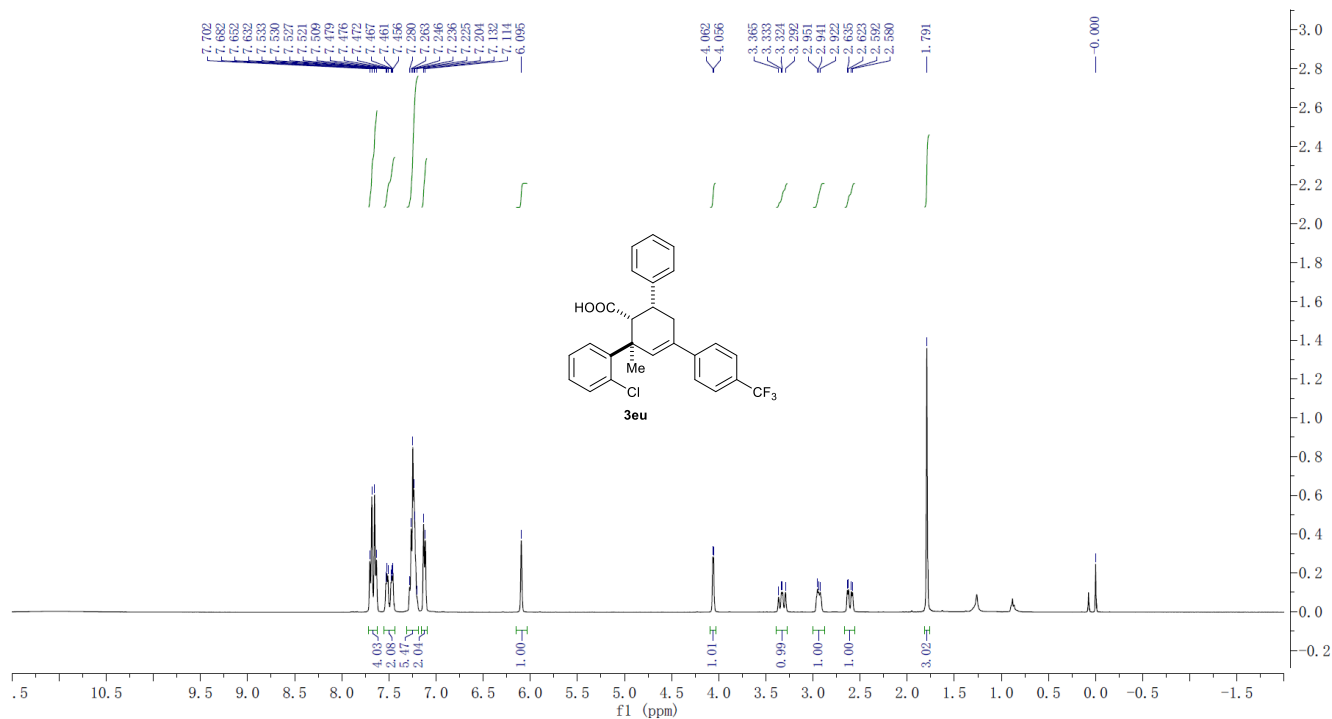


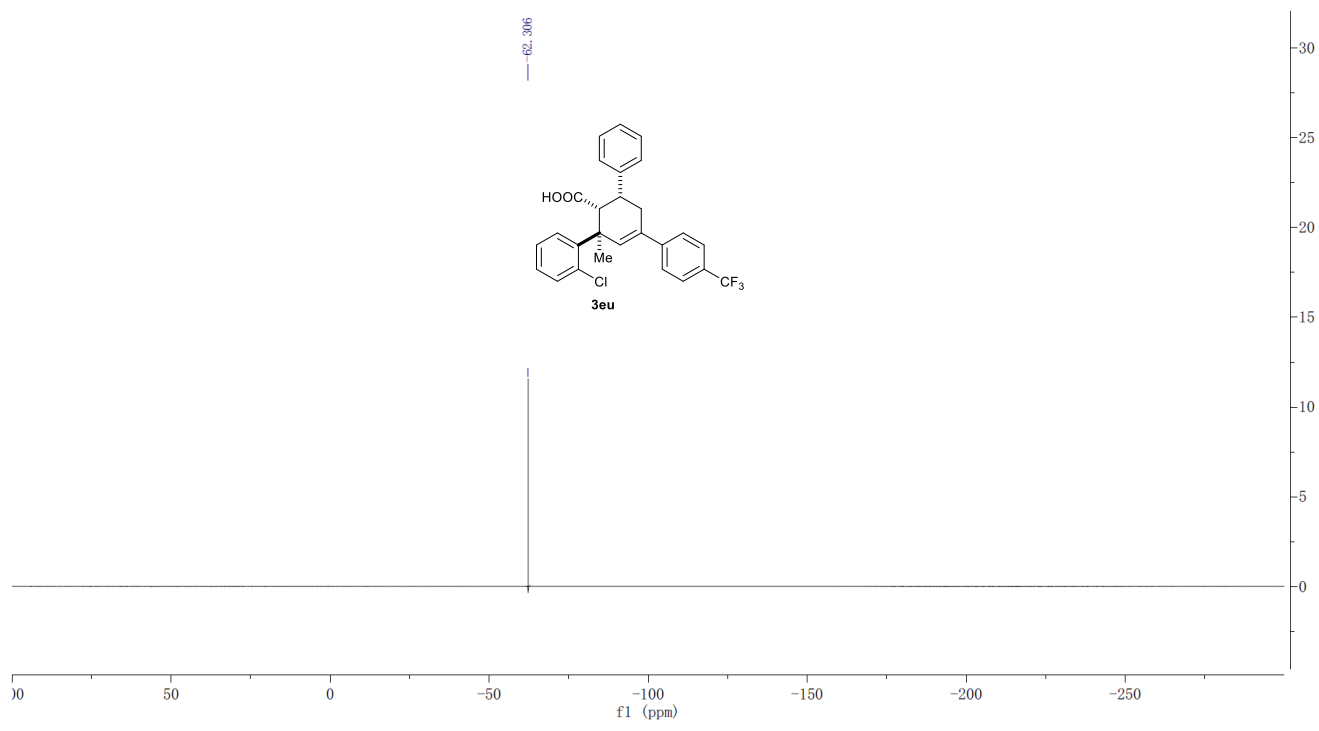
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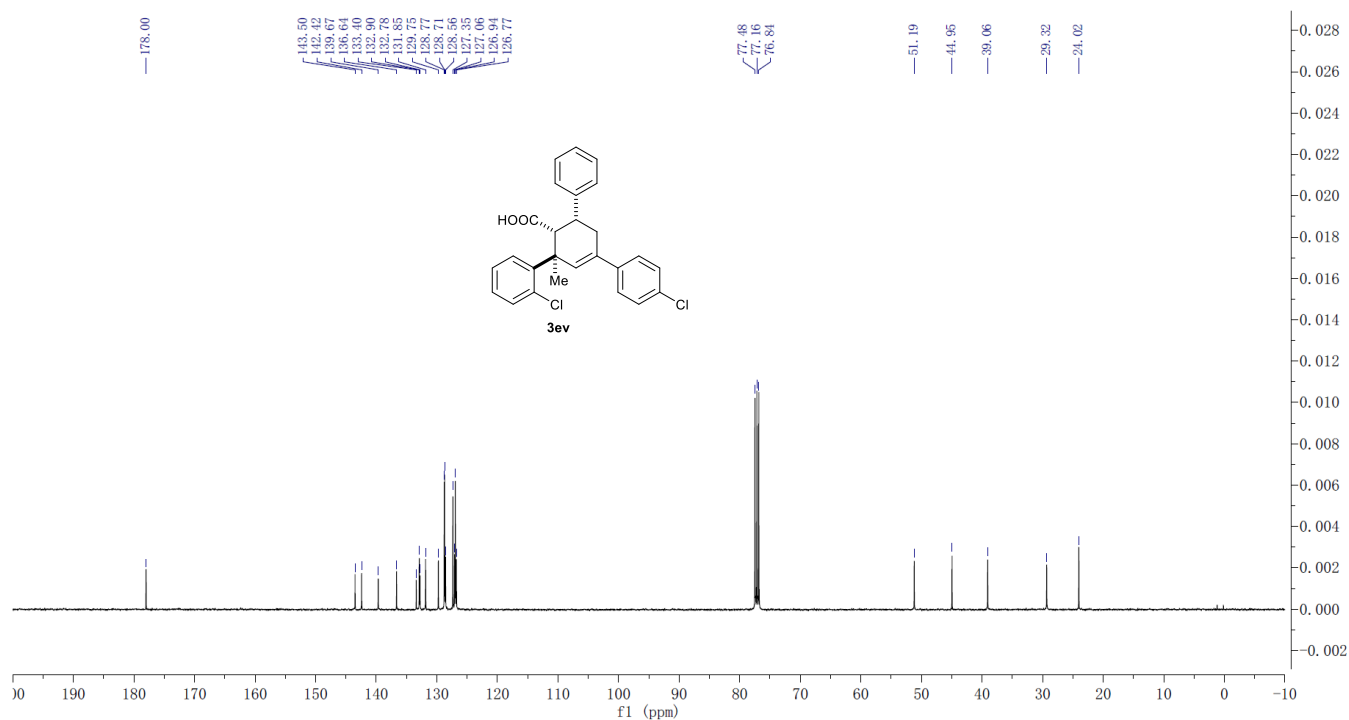
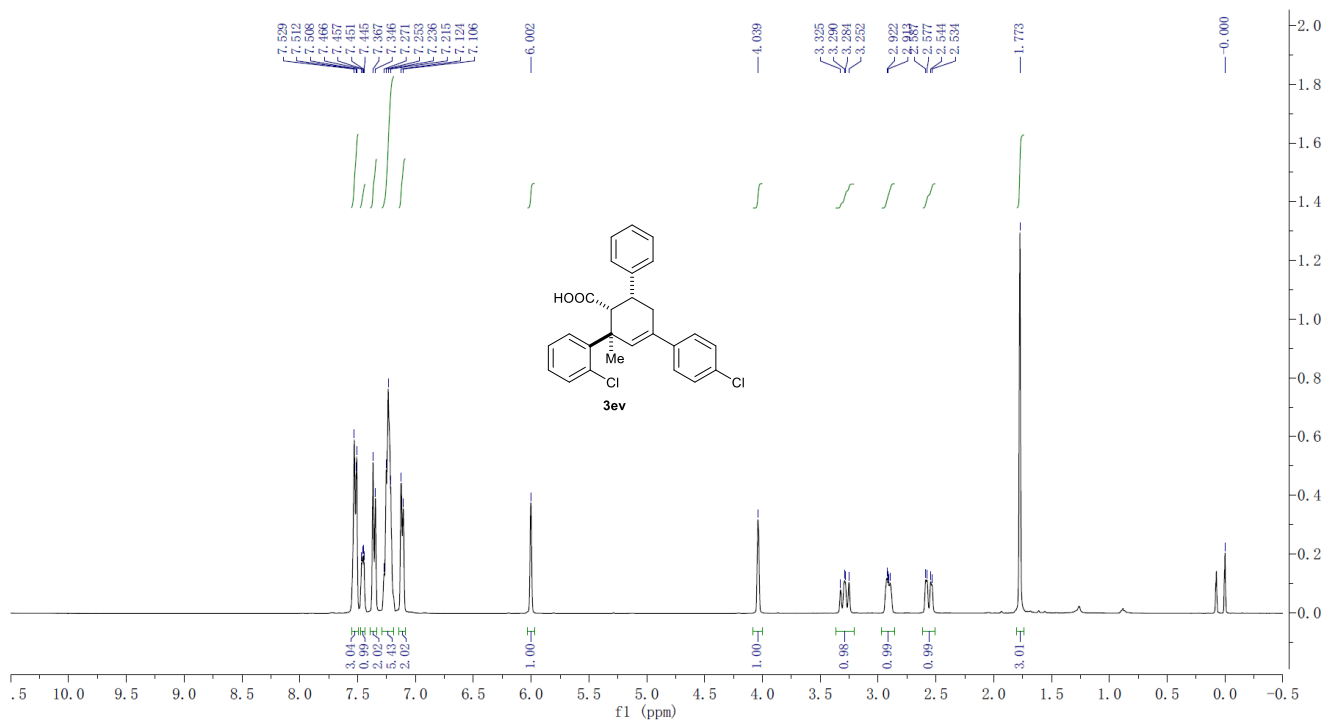


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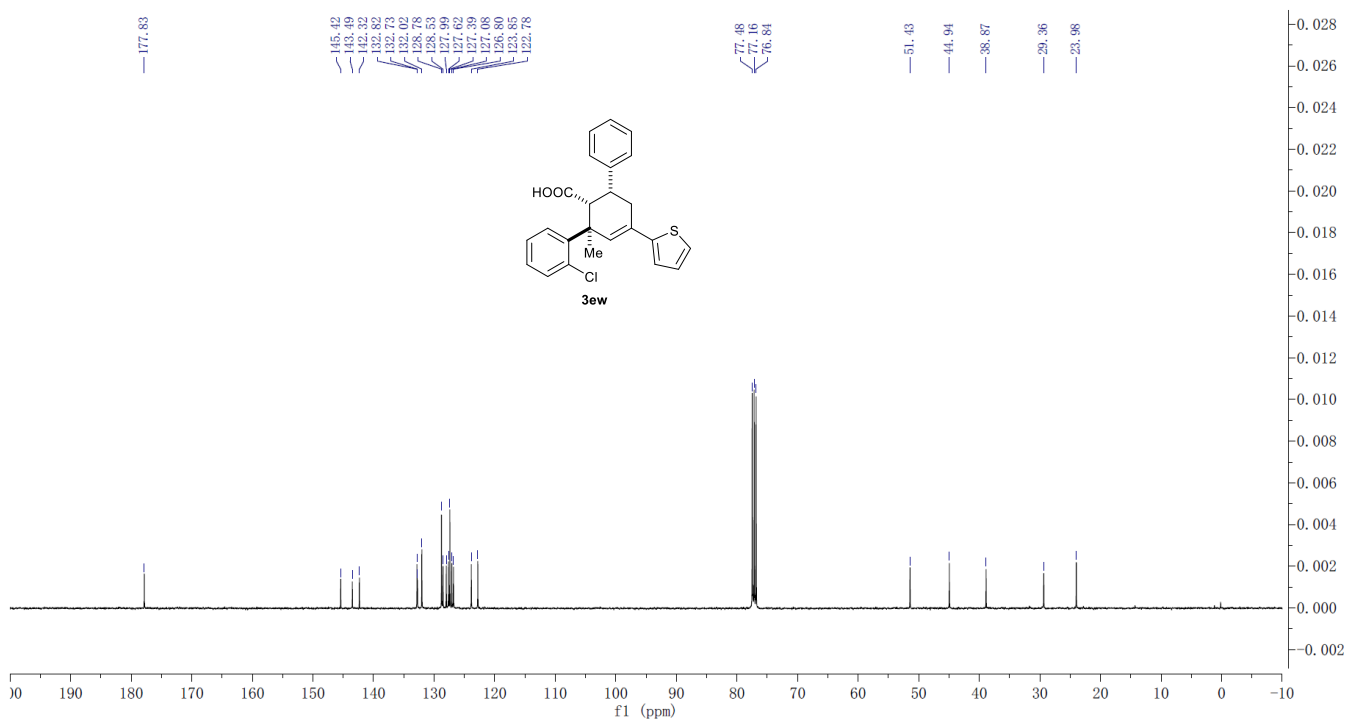
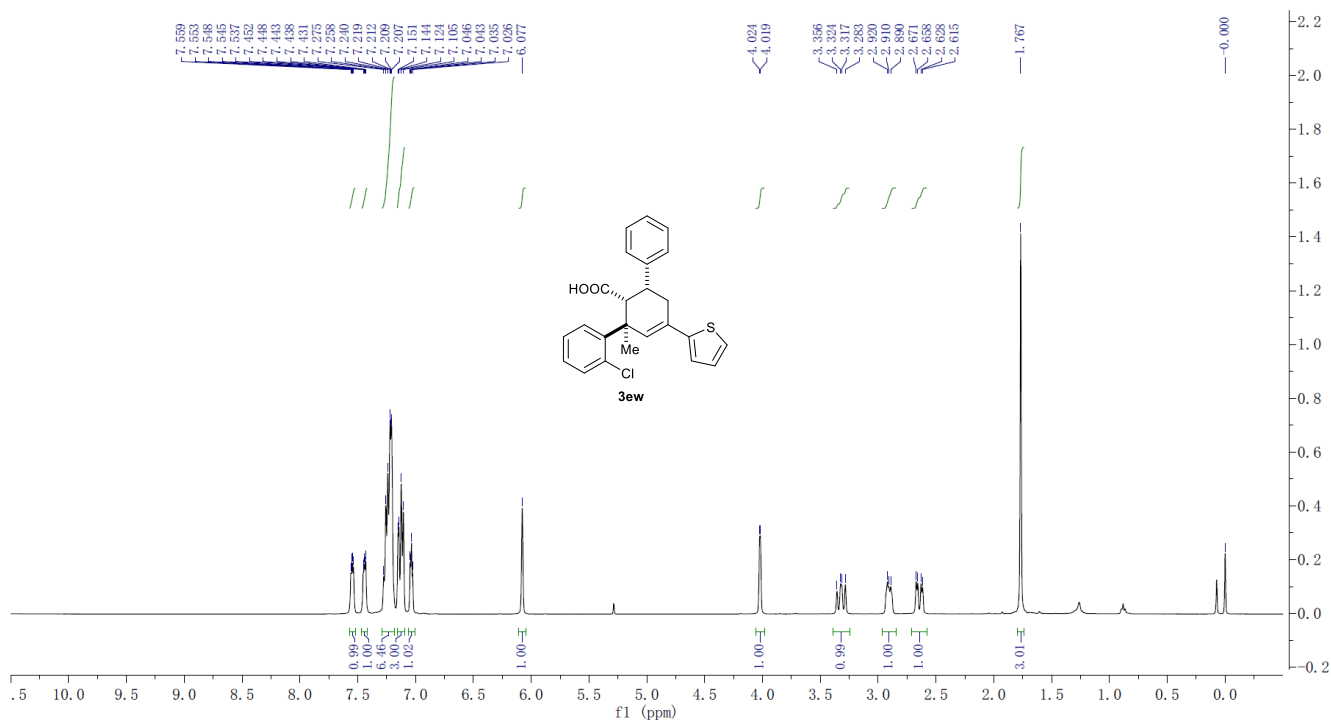




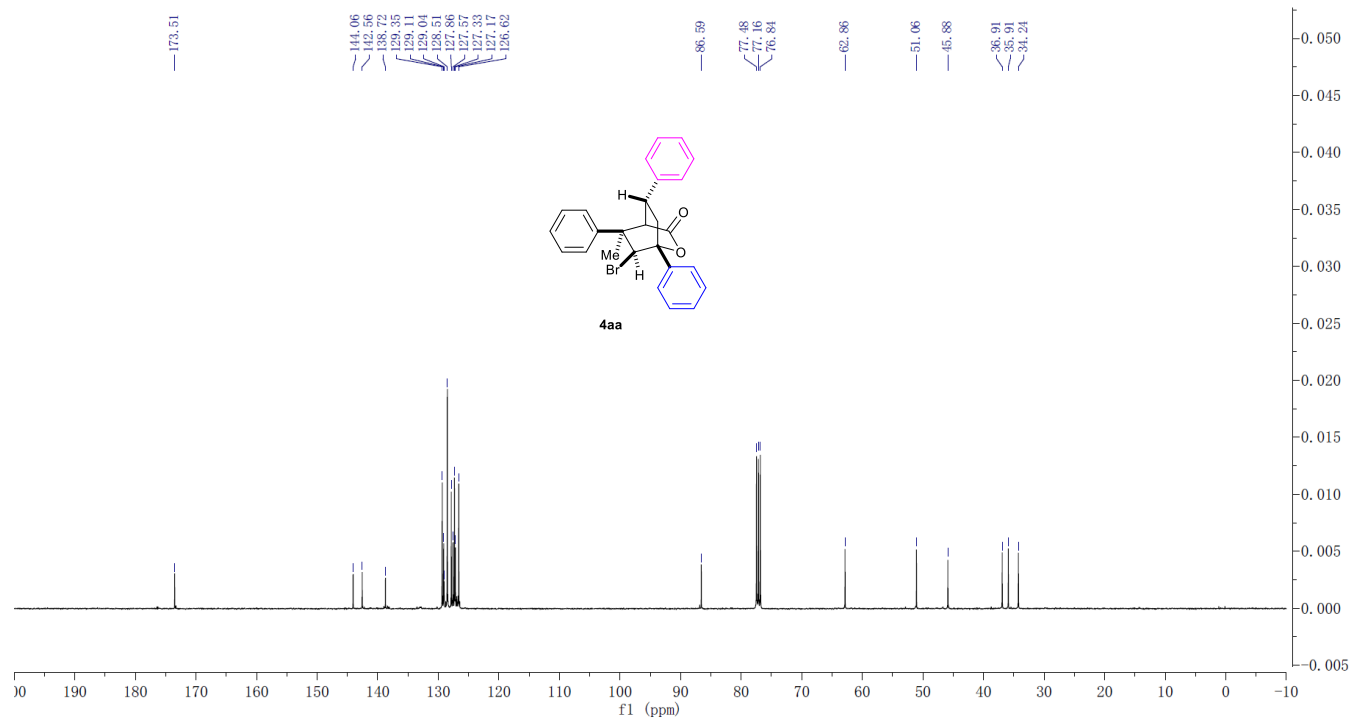
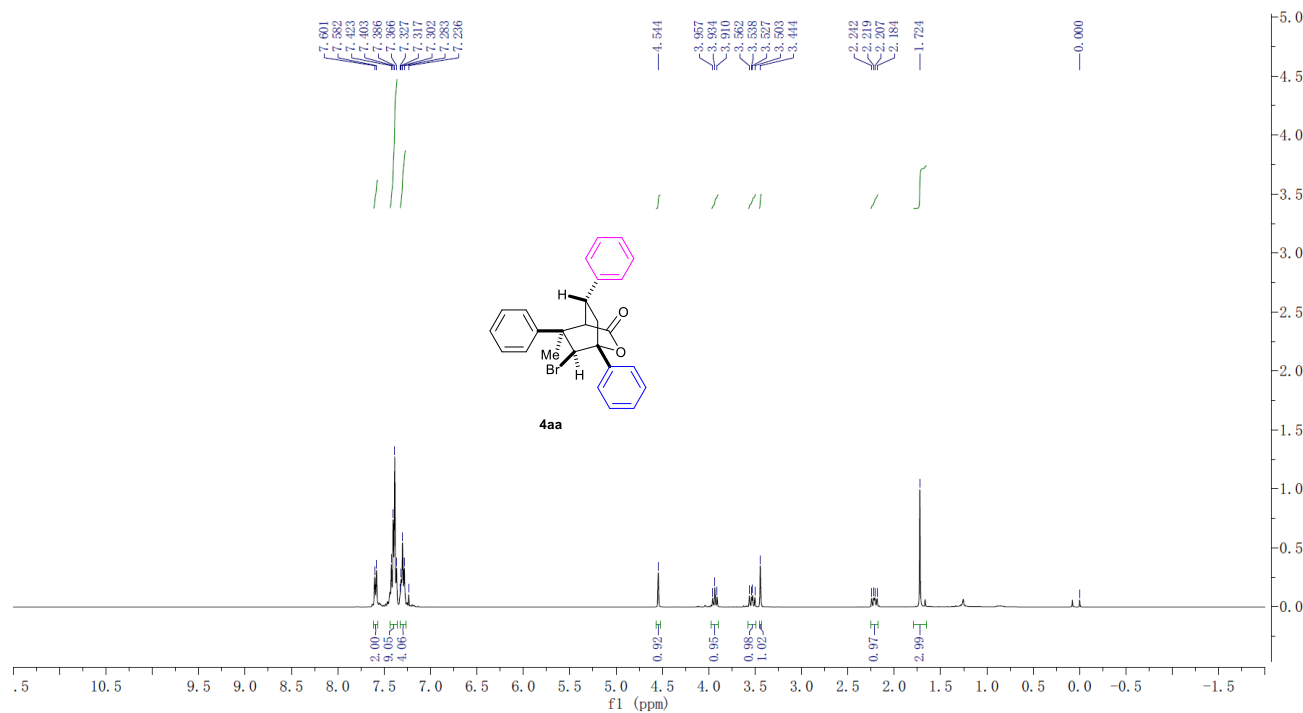
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3ew



4aa



4ea

