Supporting Information

Ni-Catalysed Reductive Arylalkylation of Unactivated Alkenes

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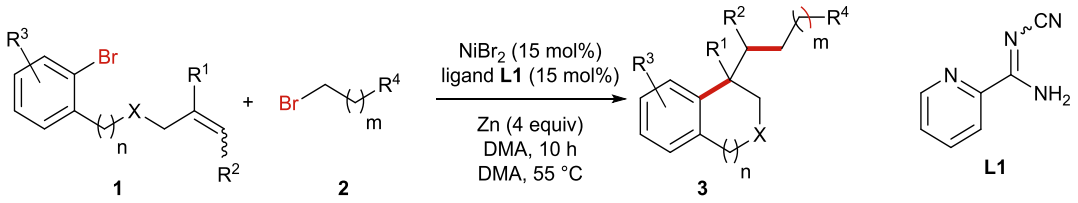
General Methods and Materials

^{1}H NMR and ^{13}C NMR spectra were recorded on a Bruker Advance 400M NMR spectrometers at ambient temperature in $CDCl_3$ at 400 and 101 MHz. The chemical shifts are given in ppm relative to tetramethylsilane [^{1}H: δ= ($SiMe_4$)= 0.00 ppm] as an internal standard or relative to the resonance of the solvent [^{1}H: δ=($CDCl_3$)= 7.26, ^{13}C: δ= ($CDCl_3$)= 77.16 ppm]. Multiplicities were given as: s (singlet); d (doublet); t (triplet); q (quartet); dd (doublet of doublets); dt (doublet of triplets); m (multiplets), etc. Coupling constants are reported as *J* values in Hz. High resolution mass spectral analysis (HRMS) was performed on Waters XEVO G2 Q-TOF. HPLC was performed on Thermo UltiMate 3000. Flash chromatography was performed using 200-300 mesh silica gel with the indicated solvent system.

Alkenes **1**,[1] Alkyl bromides **2**,[2] and Ligands **L1**, **L3** and **L5**[3] were prepared according to literature procedures. All other reagents and starting materials, unless otherwise noted, were purchased from commercial vendors and used without further purification.

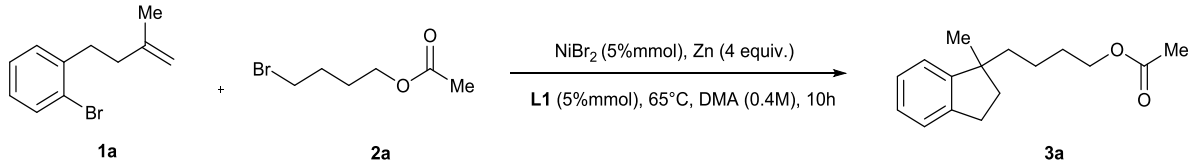
General Procedure for the Ni-Catalyzed Reductive Arylalkylation of Unactivated Olefins



A sealed test tube charged with $NiBr_2$ (13.2 mg, 0.06 mmol, 15 mol%), ligand **L1** (9.0 mg, 0.06 mmol, 15 mol%), Zn-powder (104 mg, 1.6 mmol, 4.0 equiv) and a stir bar was evacuated and filled with nitrogen (three cycles) before adding DMA (1.0 mL) under nitrogen atmosphere. Then the reaction mixture was stirred at 55 ℃ or 70 ℃[a] for 15 minutes. Next, alkyl bromides **2** (0.8 mmol, 2.0 equiv) and alkenes **1** (0.4 mmol, 1.0 equiv.) were added and the resulting mixture was stirred at 55 ℃ or 70℃[a]for 10 hours. The mixture was then filtered through a pad of Celite and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (petroleum ether/ethyl acetate) to afford the corresponding products.

[a] 70 ℃ for 3**i**, 3**j**, 3**m-o** and 3**q**, 55 ℃ for the other products.

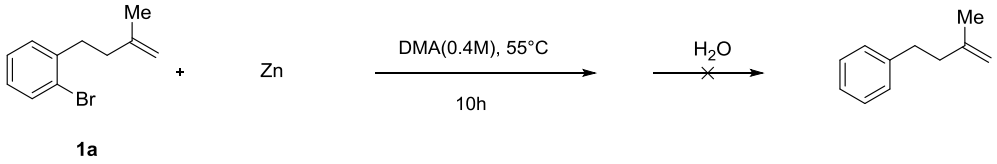
Reaction on 5 mmol scale



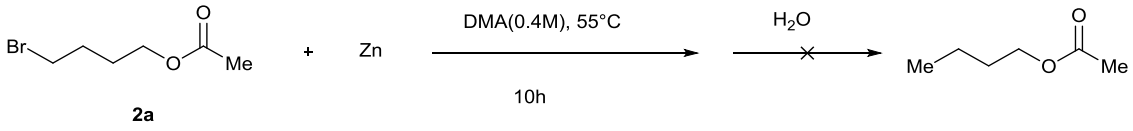
$NiBr_2$ (54.6 mg, 5 mol%) , ligand **L1** (36.3 mg, 5 mol%), and Zn (1.3 g, 4.0 equiv.) were placed in a flask equipped with a stir bar, which was evacuated and filled with nitrogen (three cycles). Then DMA (12.5 mL) were added and the resulting mixture was stirred at 65 ℃ for 30 minutes. Next, 4-bromobutyl acetate (**2a)** (10 mmol, 1.95 g, 2.0 equiv) and 1-bromo-2-(3-methylbut-3-en-1-yl)benzene (**1a**) (5 mmol, 1.12 g, 1.0 equiv.) were added and stirred at 65 ℃ for 10 hours under nitrogen

atmosphere. The mixture was then filtered through a pad of Celite and treated with water. The aqueous phase was extracted with EtOAc (3x30ml) and the combined organic phases were washed with water and aqueous saturated NaCl solution, dried over $MgSO_4$, filtered and concentrated under reduced pressure. The residue was purified by silica gel column chromatography with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) to give the 5-(1-methyl-2,3-dihydro-1*H*-inden-1-yl)pentyl acetate **3a** (0.85g, 65% yield) as a yellow oil.

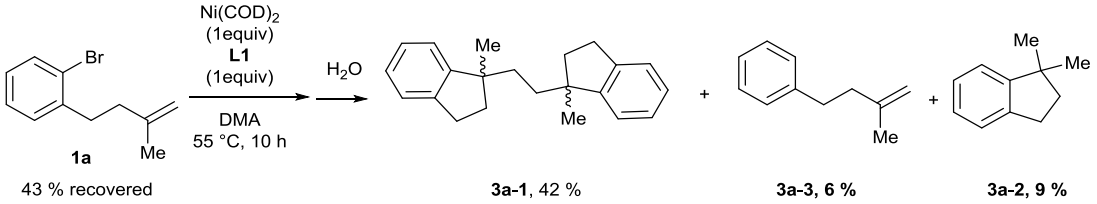
Control experiments for the Ni-catalyzed reductive arylalkylation



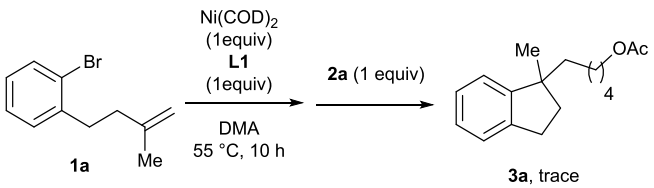
To a sealed test tube containing Zn (52 mg, 0.8 mmol, 4.0 equiv) were sequentially added DMA (0.5 mL) and 1-bromo-2-(3-methylbut-3-en-1-yl)benzene (**1a**) (45 mg, 0.2 mmol, 1.0 equiv)**.** The mixture was stirred at 55 ℃ for 10 h and then quenched with H_2O and the aqueous phase was then extracted with DCM (3 x 20 mL). The combined organic layers were washed with H_2O (3 x 20 mL), dried over MgSO4 and concentrated in vacuum. The residue was then subjected to GC analysis.



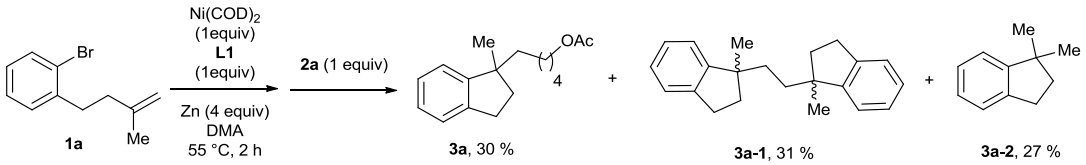
To a sealed test tube containing Zn (52 mg, 0.8 mmol, 4.0 equiv) were sequentially added DMA (0.5 mL) and 4-bromobutyl acetate (**2a**) (78 mg, 0.4 mmol, 2.0 equiv)**.** The mixture was stirred at 55 ℃ for 10 h and then quenched with H_2O and the aqueous phase was then extracted with DCM (3 x 20 mL). The combined organic layers were washed with H_2O (3 x 20 mL), dried over $MgSO_4$, filtered and concentrated in vacuum. The residue was then subjected to GC analysis.



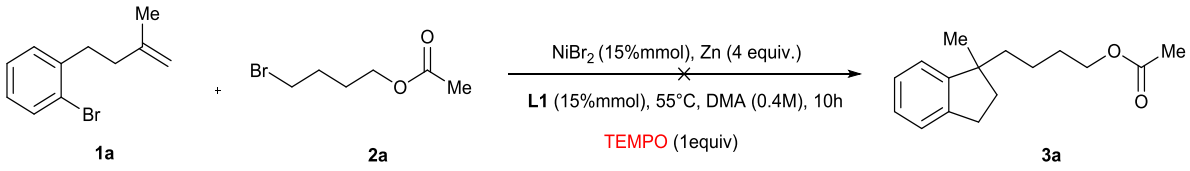
To a sealed test tube containing $Ni(COD)_2$ (55 mg ,0.2 mmol, 1.0 equiv.), **L1** (29.2 mg, 0.2 mmol, 1.0 equiv) were sequentially added DMA (0.5 mL) and 1-bromo-2-(3-methylbut-3-en-1-yl)benzene (**1a**) (44.8mg, 0.2 mmol, 1.0 equiv)**.** The mixture was stirred at 55 ℃ for 10 h and was then quenched with 3 mL H_2O. The aqueous phase was then extracted with DCM (3 x 5 mL), and the combined organic layers were washed with H_2O (3 x 5 mL), dried over $MgSO_4$, filtered and concentrated in vacuum. The residue was then subjected to GC analysis.



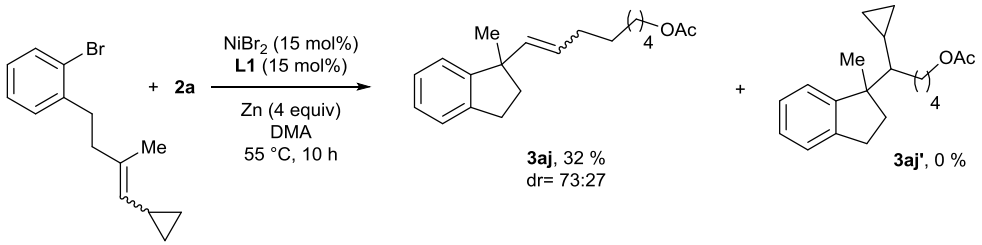
To a sealed test tube containing $Ni(COD)_2$ (55 mg ,0.2 mmol, 1.0 equiv), **L1** (29.2 mg, 0.2 mmol, 1.0 equiv) were sequentially added DMA (0.5 mL) and 1-bromo-2-(3-methylbut-3-en-1-yl)benzene (**1a**) (44.8mg, 0.2 mmol, 1.0 equiv)**.** The mixture was stirred at 55 ℃ for 10 h, before 4-bromobutyl acetate (**2a**) (78mg, 0.4mmol, 2.0 equiv.) was added**.** After stirring at this temperature for another 10 h the reaction was quenched with 3 mL H_2O and the aqueous phase was then extracted with DCM (3 x 5 mL). The combined organic layers were washed with H_2O (3 x 5 mL), dried over $MgSO_4$, filtered and concentrated in vacuum. The residue was then subjected to GC analysis.



To a sealed test tube containing $Ni(COD)_2$ (55 mg ,0.2 mmol, 1.0 equiv), **L1** (29.2 mg, 0.2 mmol, 1.0 equiv) were sequentially added DMA (0.5 mL) and 1-bromo-2-(3-methylbut-3-en-1-yl)benzene (**1a**) (44.8 mg, 0.2 mmol, 1.0 equiv)**.** The mixture was stirred at 55 ℃ for 2 h, before 4-bromobutyl acetate (**2a**) (78mg, 0.4mmol, 2.0 equiv.) was added**.** After stirring at this temperature for another 10 h the reaction was quenched with 3 mL H_2O and the aqueous phase was then extracted with DCM (3 x 5 mL). The combined organic layers were washed with H_2O (3 x 5 mL), dried over $MgSO_4$, filtered and concentrated in vacuum. The residue was then subjected to GC analysis.



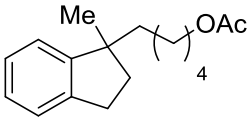
A sealed test tube charged with $NiBr_2$ (6.6 mg, 0.03 mmol, 15mol%), ligand **L1** (4.5 mg, 0.03 mmol, 15 mol%), TEMPO (31.2 mg, 0.2 mmol, 1.0 equiv), Zn-powder (52 mg, 0.8 mmol, 4.0 equiv.) and a stir bar was evacuated and filled with nitrogen (three cycles) before adding DMA (0.5ml) under nitrogen atmosphere. Then the reaction mixture was stirred at 55 ℃ for 15 minutes. Next, 4-bromobutyl acetate (**2a)** (78 mg, 0.4 mmol, 2.0 equiv) and 1-bromo-2-(3-methylbut-3-en-1-yl)benzene (**1a**) (44.8 mg, 0.2 mmol, 1.0 equiv) were added and the resulting mixture was stirred at 55 ℃ for 10 hours, before it was quenched with H_2O. The aqueous phase was then extracted with DCM (3 x 5 mL). The combined organic layers were washed with H_2O (3 x 5 mL), dried over $MgSO_4$, filtered and concentrated in vacuum. The residue was then subjected to GC analysis.



A sealed test tube charged with $NiBr_2$ (6.6 mg, 0.03 mmol, 15mol%), ligand **L1** (4.5 mg, 0.03 mmol, 15 mol%), Zn-powder (52 mg, 0.8 mmol, 4.0 equiv) and a stir bar was evacuated and filled with nitrogen (three cycles) before adding DMA (0.5ml) under nitrogen atmosphere. Then the reaction mixture was stirred at 55 ℃ for 15 minutes. Next, 4-bromobutyl acetate (**2a)** (78 mg, 0.4 mmol, 2.0 equiv) and 1-bromo-2-(4-cyclopropyl-3-methylbut-3-en-1-yl)benzene (52.8 mg, 0.2 mmol, 1.0 equiv)were added and the resulting mixture was stirred at 55 ℃ for 10 hours, before it was quenched with H_2O. The aqueous phase was then extracted with DCM (3 x 5 mL). The combined organic layers were washed with H_2O (3 x 5 mL), dried over $MgSO_4$, filtered and concentrated in vacuum. The residue was purified by silica gel column chromatography with eluent of

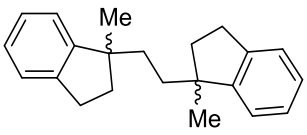
petroleum ether to the mixture of ethyl acetate and petroleum ether (20:1) to afford the product **3aj** (19 mg, 32% yield) as a yellow oil.

Analytical Data for the Products



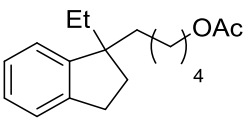
3a

5-(1-Methyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3a**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (69 mg, 67%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.23-7.00 (m, 4H), 4.02 (t, *J* = 6.7 Hz, 2H), 2.96-2.79 (m, 2H), 2.10-1.94 (m, 1H), 2.03(s, 3H),1.87-1.76 (m, 1H), 1.66-1.54 (m, 3H), 1.53-1.42 (m, 1H), 1.39-1.15 (m, 1H), 1.23(s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 151.5, 143.2, 126.2, 126.1, 124.5, 122.6, 64.7, 47.3, 41.3, 38.6, 30.3, 28.6, 26.8, 26.7, 24.6, 21.0 ppm. HRMS (ESI): calcd. for $C_{17}H_{24}NaO_2$ [M+Na]$^+$:283.1669, found: 283.1671.



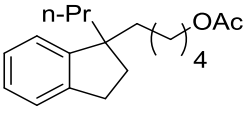
3a-1

1,2-Bis(1-methyl-2,3-dihydro-1H-inden-1-yl)ethane (**3a-1**) was isolated through column chromatography on silica gel with petroleum ether as a colorless oil. ^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.19-7.08 (m, 6H), 7.07-7.01 (m, 2H), 2.91-2.75 (m, 4H), 2.03-1.92 (m, 2H), 1.72-1.83 (m, 2H), 1.68-1.53 (m, 2H), 1.52-1.37 (m, 2H), 1.19 (s, 3H), 1.18 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-d): δ (mixture of two diastereomers)= 151.8, 151.7, 143.2, 143.1, 126.24, 126.21, 126.20, 126.18, 124.5 (2C), 122.61, 122.59, 47.24, 47.15, 38.2, 38.1, 36.01, 35.96, 30.3 (2C), 27.0, 26.9 ppm. HRMS (EI): calcd. for $C_{22}H_{26}$ [M]: 290.2035, found: 290.2030.



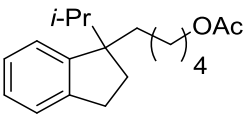
3b

5-(1-Ethyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3b**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (67 mg, 61%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.21-7.09 (m, 3H), 7.08-7.00 (m, 1H), 4.01 (t, *J* = 6.8 Hz, 2H), 2.95-2.80 (m, 2H), 2.02 (s, 3H), 1.96-1.87 (m, 2H), 1.71-1.46 (m, 6H), 1.34 – 1.23 (m, 3H), 1.19-1.05 (m, 1H), 0.77 (t, *J* = 7.4 Hz, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 149.7, 143.9, 126.2, 125.8, 124.5, 123.5, 64.7, 51.1, 38.9, 35.9, 31.7, 30.6, 28.6, 26.8, 24.1, 21.0, 8.9 ppm. HRMS (ESI): calcd. for $C_{18}H_{26}NaO_2$ [M+Na]$^+$: 297.1825, found: 297.1828.



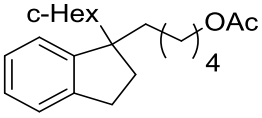
3c

5-(1-Propyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3c**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (63 mg, 55%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.20-7.08 (m, 3H), 7.08-7.00 (m, 1H), 4.01 (t, *J* = 6.8 Hz, 2H), 2.93-2.78 (m, 2H), 2.01 (s, 3H), 1.92 (t, *J* = 7.2 Hz, 2H), 1.68-1.53 (m, 4H), 1.52-1.41 (m, 2H), 1.33-1.21 (m, 4H), 1.20-1.07 (m, 2H), 0.85 (t, *J* = 7.3 Hz, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.2, 150.0, 143.8, 126.2, 125.8, 124.5, 123.4, 64.7, 50.9, 42.1, 39.5, 36.5, 30.6, 28.6, 26.8, 24.2, 21.0, 17.7, 14.9 ppm. HRMS (ESI): calcd. for $C_{19}H_{28}NaO_2$ [M+Na]$^+$: 311.1982, found: 311.1986.



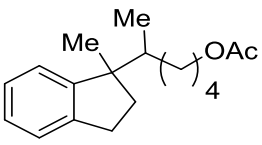
3d

5-(1-Isopropyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3d**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (53 mg, 46%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.21-7.07 (m, 3H), 7.07-6.98 (m, 1H), 3.98 (t, *J* = 6.7 Hz, 2H), 2.91-2.78 (m, 2H), 2.08-1.95 (m, 2H), 2.01 (s, 3H), 1.78-1.68 (m, 1H), 1.66-1.60 (m, 1H), 1.59-1.48 (m, 3H), 1.33-1.12 (m, 3H), 1.10-0.98 (m, 1H), 0.89 (d, *J* = 6.7 Hz, 3H), 0.69 (d, *J* = 6.8 Hz, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.2, 148.7, 144.3, 126.1, 125.7, 124.3, 123.9, 64.7, 54.7, 38.9, 34.6, 31.4, 31.1, 28.6, 26.8, 23.9, 21.0, 18.3, 17.7 ppm. HRMS (ESI): calcd. for $C_{19}H_{28}NaO_2$ $[M+Na]^+$: 311.1982, found: 311.1990.



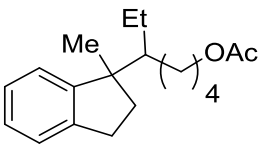
3e

5-(1-Cyclohexyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3e**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (76 mg, 58%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.12-7.00 (m, 3H), 6.98-6.91 (m, 1H), 3.91 (t, *J* = 6.7 Hz, 2H), 2.82-2.72 (m, 2H), 2.04-1.96 (m, 1H), 1.94 (s, 3H), 1.80-1.62 (m, 3H), 1.61-1.41 (m, 7H), 1.31-0.93 (m, 8H), 0.91-0.75 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.2, 148.6, 144.3, 126.1, 125.6, 124.3, 124.1, 64.7, 54.5, 45.4, 38.6, 32.6, 31.3, 28.6, 27.9, 27.6, 27.1, 26.9, 26.8, 26.7, 23.8, 21.0 ppm. HRMS (ESI): calcd. for $C_{22}H_{32}NaO_2$ $[M+Na]^+$:351.2295, found: 351.2292.



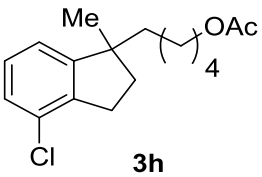
3f

5-(1-Methyl-2,3-dihydro-1H-inden-1-yl)hexyl acetate (**3f**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (64 mg, 58%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.14-6.99 (m, 4H), 3.95 (t, *J* = 6.7 Hz, 2H), 2.86-2.73 (m, 2H), 1.98-1.88 (m, 1H), 1.96 (s, 3H), 1.81-1.69 (m, 1H), 1.58-1.46 (m, 3H), 1.46-1.37 (m, 1H), 1.27-1.09 (m, 6H), 1.15 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 151.6, 143.2, 126.2, 126.1, 124.5, 122.6, 64.6, 47.3, 41.3, 38.6, 30.3, 30.0, 28.6, 26.8, 25.9, 24.8, 21.0 ppm. HRMS (ESI): calcd. for $C_{18}H_{26}NaO_2$ $[M+Na]^+$: 297.1825, found: 297.1827.



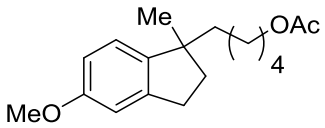
3g

5-(1-Methyl-2,3-dihydro-1H-inden-1-yl)heptyl acetate (**3g**) was isolated through column chromatography on with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (58 mg, 50%).^{1}H NMR: (400 MHz, Chloroform-d) δ= 7.14-6.97 (m, 4H), 3.96 (t, *J* = 6.8 Hz, 2H), 2.85-2.72 (m, 2H), 1.99-1.88 (m, 1H), 1.96 (s, 3H), 1.80-1.67 (m, 1H), 1.60-1.35 (m, 4H), 1.28-1.06 (m, 8H), 1.15 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 151.7, 143.2, 126.2, 126.1, 124.5, 122.6, 64.6, 47.3, 41.4, 38.6, 30.3 (2C), 29.2, 28.6, 26.8, 25.9, 24.9, 21.1 ppm. HRMS (ESI): calcd. for $C_{19}H_{28}NaO_2$ $[M+Na]^+$: 311.1982, found: 311.1985.



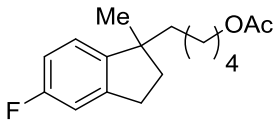
3h

5-(4-Chloro-1-methyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3h**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (76 mg, 65%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.16-7.06 (m, 2H), 6.99-6.94 (m, 1H), 4.02 (t, *J* = 6.7 Hz, 2H), 2.97-2.86 (m, 2H),2.08-1.98 (m, 1H), 2.03 (s, 3H), 1.89-1.79 (m, 1H), 1.63-1.55 (m, 3H), 1.54-1.45 (m, 1H), 1.37-1.25 (m, 3H), 1.23 (s, 3H), 1.20-1.11 (m, 1H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.2, 153.6, 141.3, 130.6, 127.9, 126.3, 120.9, 64.6, 48.6, 41.4, 37.7, 29.6, 28.6, 27.0, 26.6, 24.6, 21.0 ppm. HRMS (ESI): calcd. for $C_{17}H_{23}ClNaO_2$ $[M+H]^+$: 317.1279, found: 317.1278.



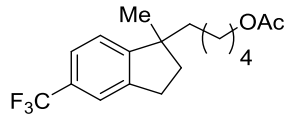
3i

5-(5-Methoxy-1-methyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3i**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (60 mg, 52%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 6.98 (d, *J* = 8.1 Hz, 1H), 6.77-6.67 (m, 2H), 4.02 (t, *J* = 6.8 Hz, 2H), 3.78 (s, 3H), 2.89-2.79 (m, 2H), 2.09-1.94 (m, 1H), 2.03 (s, 3H), 1.88-1.78 (m, 1H), 1.68-1.42 (m, 4H), 1.36-1.24 (m, 4H), 1.20 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 158.6, 144.7, 143.7, 123.1, 112.0, 109.8, 64.7, 55.4, 46.6, 41.5, 39.0, 30.4, 28.6, 27.0, 26.7, 24.7, 21.0 ppm. HRMS (ESI): calcd. for $C_{18}H_{26}NaO_3$ $[M+Na]^+$:313.1774, found: 313.1780.



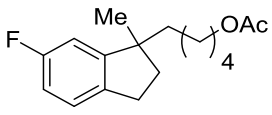
3j

5-(6-Fluoro-1-methyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (3**j**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (59 mg, 53%).^{1}H NMR: (400 MHz, Chloroform-d) δ= 6.99 (m, 1H), 6.91-6.74 (m, 2H), 4.02 (t, *J* = 6.7 Hz, 3H), 2.90-2.72 (m, 2H), 2.09-1.94 (m, 1H), 2.03 (s, 3H), 1.89-1.79 (m, 1H), 1.66-1.51 (m, 3H), 1.53-1.41 (m, 1H), 1.35-1.25 (m, 3H), 1.21 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-d): δ= 171.2, 161.9 (d, *J* = 242.3 Hz), 146.9 (d, *J* = 2.3 Hz), 145.2 (d, *J* = 7.9 Hz), 123.4 (d, *J* = 8.9 Hz), 112.9 (d, *J* = 22.3 Hz), 111.3 (d, *J* = 21.5 Hz), 64.6, 46.7, 41.4, 38.9, 30.6, 30.2, 28.6, 27.0, 26.7, 24.6, 21.0 ppm. HRMS (ESI): calcd. for $C_{17}H_{24}FO_2$ $[M+H]^+$: 279.1755, found: 279.1758.



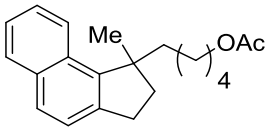
3k

5-(1-Methyl-5-(trifluoromethyl)-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3k**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (80 mg, 61%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.49-7.39 (m, 2H), 7.18 (d, *J* = 7.9 Hz, 1H), 4.04 (t, *J* = 6.7 Hz, 2H), 3.00-2.87 (m, 2H), 2.16-1.99 (m, 1H), 2.04 (s, 3H), 1.95-1.81 (m, 1H), 1.69-1.46 (m, 4H), 1.38-1.30 (m, 3H), 1.28-1.18 (m, 1H), 1.26 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 155.6, 143.9, 128.6 (q, *J* = 31.3 Hz), 123.4 (q, *J* = 273.7 Hz), 123.5 (q, *J*= 4.2 Hz), 122.8, 121.4 (q, *J*= 4.2 Hz), 64.6, 47.4, 41.0, 38.5, 30.1, 28.5, 26.7, 26.6, 24.5, 21.0 ppm. HRMS (ESI): calcd. for $C_{18}H_{24}F_3O_2$ $[M+H]^+$: 329.1723, found: 329.1722.



3l

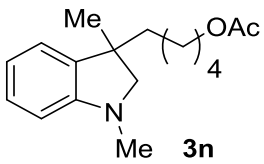
5-(5-Fluoro-1-methyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3l**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (64 mg, 58%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.02 (dd, *J* = 8.2, 5.3 Hz, 1H), 6.79-6.62 (m, 2H), 3.95 (t, *J* = 6.7 Hz, 2H), 2.82-2.65 (m, 2H), 2.01-1.91 (m, 1H), 1.96 (s, 3H), 1.85-1.71 (m, 1H), 1.58-1.37 (m, 4H), 1.31-1.16 (m, 4H), 1.14 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 162.1 (d, *J*= 243.4 Hz), 153.8 (d, *J*= 7.1 Hz), 138.3 (d, *J*= 2.0 Hz), 125.2 (d, *J*= 8.1 Hz), 112.9 (d, *J*= 22.2Hz), 109.6 (d, *J*= 22.2Hz), 64.6, 47.6, 41.2, 39.0, 29.6, 28.6, 26.72, 26.66, 24.5, 21.0 ppm. HRMS (ESI): calcd. for $C_{17}H_{24}FO_2$ $[M+H]^+$: 279.1755, found: 279.1757.



3m

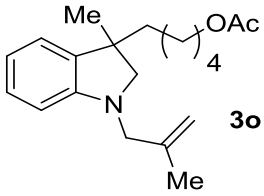
5-(1-Methyl-2,3-dihydro-1H-cyclopenta[a]naphthalen-1-yl)pentyl acetate (**3m**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (50 mg, 40%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 8.10 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.87-7.81 (m, 1H), 7.65 (d, *J* = 8.2 Hz, 1H), 7.49-7.35 (m, 2H), 7.31 (d, *J* = 8.3 Hz, 1H), 3.96 (t, *J* = 6.7 Hz, 2H), 3.05-2.90 (m, 2H), 2.29-2.15 (m, 1H), 2.10-2.02 (m, 1H), 1.99 (s, 3H), 1.97-1.79 (m, 2H), 1.57-1.47 (m, 2H), 1.54 (s, 3H), 1.36-1.24 (m, 3H), 1.12-1.00 (m, 1H) ppm. ^{13}C

NMR (101 MHz, Chloroform-*d*): δ= 171.3, 143.9, 141.2, 133.6, 130.4, 129.2, 127.6, 125.5, 124.2, 123.6, 123.6, 64.7, 49.9, 41.5, 39.3, 31.1, 28.5, 27.9, 26.7, 24.8, 21.0 ppm. HRMS (ESI): calcd. for $C_{21}H_{26}NaO_2$ $[M+Na]^+$:333.1825, found: 333.1833.



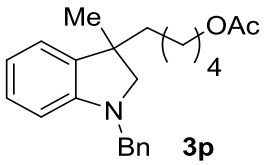
3n

5-(1,3-Dimethylindolin-3-yl)pentyl acetate (**3n**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (67 mg, 61%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.09 (td, *J* = 7.6, 1.3 Hz, 1H), 6.96 (dd, *J* = 7.3, 1.3 Hz, 1H), 6.68 (td, *J* = 7.4, 1.0 Hz, 1H), 6.47 (d, *J* = 7.8 Hz, 1H), 4.02 (t, *J* = 6.7 Hz, 2H), 3.18 (d, *J* = 8.6 Hz, 1H), 2.97 (d, *J* = 8.7 Hz, 1H), 2.74 (s, 3H), 2.02 (s, 3H), 1.67-1.50 (m, 3H), 1.44-1.16 (m, 5H), 1.27 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.2, 152.3, 138.1, 127.5, 122.1, 117.6, 107.2, 68.3, 64.6, 43.6, 40.3, 35.9, 28.5, 26.6, 25.4, 24.4, 21.0 ppm. HRMS (ESI): calcd. for $C_{17}H_{25}NNaO_2$ $[M+Na]^+$: 298.1778, found: 298.1786.



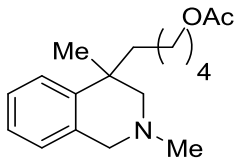
3o

5-(3-Methyl-1-(2-methylallyl)indolin-3-yl)pentyl acetate (**3o**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (57 mg, 57%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.05 (td, *J* = 7.7, 1.3 Hz, 1H), 6.95 (dd, *J* = 7.2, 1.2 Hz, 1H), 6.65 (td, *J* = 7.3, 1.0 Hz, 1H), 6.44 (dd, *J* = 7.8, 0.9 Hz, 1H), 5.01-4.79 (m, 2H), 4.02 (t, *J* = 6.7 Hz, 2H), 3.68-3.47 (m, 2H), 3.19 (d, *J* = 8.8 Hz, 1H), 2.99 (d, *J* = 8.9 Hz, 1H), 2.02 (s, 3H), 1.76 (s, 3H), 1.65-1.49 (m, 3H), 1.44-1.10 (m, 5H), 1.27 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 151.6, 142.4, 137.5, 127.4, 122.3, 117.1, 111.9, 106.6, 65.7, 64.6, 55.4, 43.4, 40.7, 28.6, 26.6, 25.9, 24.5, 21.0, 20.4 ppm. HRMS (ESI): calcd. for $C_{20}H_{30}NO_2$ $[M+H]^+$:316.2271, found: 316.2271.



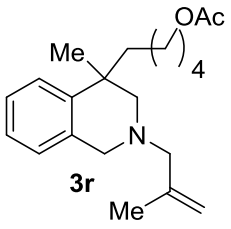
3p

5-(1-Benzyl-3-methylindolin-3-yl)pentyl acetate (**3p**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (70 mg, 50%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.43-7.35 (m, 2H), 7.36-7.28 (m, 2H), 7.30-7.20 (m, 2H), 7.21-7.12 (m, 1H), 7.13-7.04 (m, 1H), 7.01-6.93 (m, 1H), 4.00 (t, *J* = 6.8 Hz, 2H), 3.74-3.46 (m, 4H), 2.66-2.52 (m, 1H), 2.37-2.22 (m, 1H), 2.03 (s, 3H), 1.84-1.71 (m, 1H), 1.58-1.47 (m, 3H), 1.30-1.16 (m, 2H), 1.21 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 143.5, 138.9, 134.5, 128.9 (2C), 128.2, 127.0, 126.3 (2C), 126.1, 125.4, 64.7, 62.9, 61.3, 57.7, 41.9, 38.2, 28.6, 27.1, 26.7, 24.0, 21.1 ppm. HRMS (ESI): calcd. for $C_{23}H_{30}NO_2$ $[M+H]^+$:352.2271, found: 352.2274.



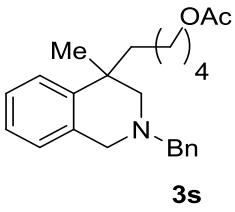
3q

5-(2,4-Dimethyl-1,2,3,4-tetrahydroisoquinolin-4-yl)pentyl acetate (**3q**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (75 mg, 65%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.24 (dd, *J* = 7.8, 1.4 Hz, 1H), 7.16 (td, *J* = 7.5, 1.5 Hz, 1H), 7.09 (td, *J* = 7.3, 1.4 Hz, 1H), 6.99 (dd, *J* = 7.6, 1.4 Hz, 1H), 4.02 (t, *J* = 6.7 Hz, 2H), 3.67-3.32 (m, 2H), 2.52 (d, *J* = 11.3 Hz, 1H), 2.39 (s, 3H), 2.29 (d, *J* = 11.3 Hz, 1H), 2.02 (s, 3H), 1.78-1.67 (m, 1H), 1.65-1.47 (m, 3H), 1.37-1.24 (m, 3H), 1.26 (s, 3H), 1.22-1.11 (m, 1H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 142.7, 134.4, 126.3, 126.2, 126.1, 125.4, 64.63, 64.59, 59.3, 46.6, 42.1, 38.0, 28.6, 27.8, 26.7, 24.1, 21.0 ppm. HRMS (ESI): calcd. for $C_{18}H_{27}NNaO_2$ $[M+Na]^+$:312.1934, found: 312.1942.



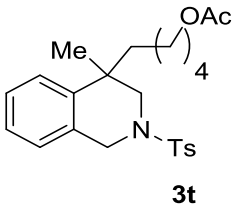
3r

5-(4-Methyl-2-(2-methylallyl)-1,2,3,4-tetrahydroisoquinolin-4-yl)pentyl acetate (**3r**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (99 mg, 70%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.24 (dd, *J* = 7.8, 1.5 Hz, 1H), 7.16 (td, *J* = 7.4, 1.5 Hz, 1H), 7.09 (td, *J* = 7.4, 1.4 Hz, 1H), 6.99 (dd, *J* = 7.6, 1.4 Hz, 1H), 5.01-4.83 (m, 2H), 4.01 (t, *J* = 6.7 Hz, 2H), 3.64-3.40 (m, 2H), 3.08-2.87 (m, 2H), 2.62-2.46 (m, 1H), 2.32-2.18 (m, 1H), 2.02 (s, 3H), 1.82-1.70 (m, 4H), 1.64-1.51 (m, 3H), 1.33-1.24 (m, 3H), 1.25 (s, 3H), 1.20-1.08 (m, 1H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.2, 143.4, 143.1, 134.7, 126.3, 126.2, 126.1, 125.3, 113.1, 65.5, 64.7, 61.5, 57.7, 42.0, 38.1, 28.6, 27.5, 26.7, 24.1, 21.0, 20.8 ppm. HRMS (ESI): calcd. for $C_{21}H_{31}NNaO_2$ [M+Na]$^+$:352.2247, found: 352.2255.



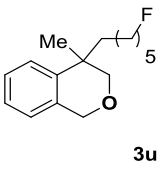
3s

5-(2-Benzyl-4-methyl-1,2,3,4-tetrahydroisoquinolin-4-yl)pentyl acetate (**3s**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (74 mg, 51%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.42-7.36 (m, 2H), 7.36-7.29 (m, 2H), 7.29-7.21 (m, 2H), 7.19-7.13 (m, 1H), 7.11-7.05 (m, 1H), 7.01-6.93 (m, 1H), 4.00 (t, *J* = 6.8 Hz, 2H), 3.71-3.62 (m, 2H), 3.61-3.51 (m, 2H), 2.59 (d, *J* = 11.3 Hz, 1H), 2.27 (d, *J* = 11.3 Hz, 1H), 2.03 (s, 3H), 1.83-1.72 (m, 1H), 1.59-1.44 (m, 3H), 1.31-1.15 (m, 3H), 1.21(s, 3H), 1.04-0.89 (m, 1H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 171.3, 143.5, 138.9, 134.5, 128.9 (2C), 128.2 (2C), 127.0, 126.3 (2C), 126.1, 125.4, 64.7, 62.9, 61.3, 57.7, 41.9, 38.2, 28.6, 27.1, 26.7, 24.0, 21.1 ppm. HRMS (ESI): calcd. for $C_{24}H_{31}NNaO_2$ [M+Na]$^+$:388.2247, found: 388.2254.



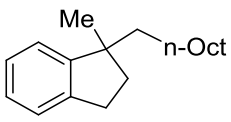
3t

5-(4-Methyl-2-tosyl-1,2,3,4-tetrahydroisoquinolin-4-yl)pentyl acetate (**3t**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (105 mg, 61%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.80-7.68 (m, 2H), 7.36 (d, *J* = 8.0 Hz, 2H), 7.27-7.08 (m, 3H), 7.00 (dd, *J* = 7.6, 1.4 Hz, 1H), 4.47-3.86 (m, 4H), 3.34 (d, *J* = 11.5 Hz, 1H), 2.73 (d, *J* = 11.5 Hz, 1H), 2.43 (s, 3H), 2.03 (s, 3H), 1.83-1.71 (m, 1H), 1.66-1.54 (m, 3H), 1.36-1.18 (m, 4H), 1.27 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 174.7, 147.1, 145.4, 136.3, 134.2, 133.2 (2C), 131.2 (2C), 130.4, 129.7, 129.5 (2C), 68.0, 56.7, 51.8, 44.5, 41.5, 31.9, 29.9, 29.1, 27.2, 24.9, 24.5 ppm. HRMS (ESI): calcd. for $C_{24}H_{31}NNaO_4S$ [M+Na]$^+$:452.1866, found: 452.1873.



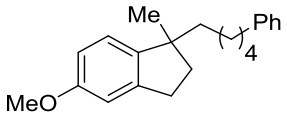
3u

4-(6-Fluorohexyl)-4-methylisochromane (**3u**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (62 mg, 62%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.29-7.24 (m, 1H), 7.23-7.17 (m, 1H), 7.13 (td, *J* = 7.4, 1.5 Hz, 1H), 6.99-6.90 (m, 1H), 4.77 (s, 2H), 4.52-4.40 (m, 1H), 4.38-4.27 (m, 1H), 3.80 (d, *J* = 11.2 Hz, 1H), 3.54 (d, *J* = 11.3 Hz, 1H), 1.77-1.49 (m, 4H), 1.42-1.10 (m, 6H), 1.21 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 142.0, 133.9, 126.6, 125.9, 125.7, 124.0, 84.9, 83.4, 74.6, 68.9, 40.8, 36.4 (d, *J* = 20.2Hz), 30.3, 29.9, 25.1 (d, *J* = 5.1Hz), 24.6 (d, *J* = 56 Hz) ppm. HRMS (ESI): calcd. for $C_{16}H_{24}FO$ [M+H]$^+$:251.1806, found: 251.1805.



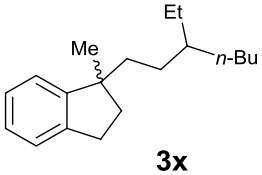
3v

1-Methyl-1-nonyl-2,3-dihydro-1H-indene (**3v**) was isolated through column chromatography on silica gel with petroleum ether as a colorless oil (75 mg, 73%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.22-7.06 (m, 4H), 2.91-2.77 (m, 2H), 2.10-1.94 (m, 1H), 1.87-1.75 (m, 1H), 1.62-1.42 (m, 2H), 1.38-1.12 (m, 13H), 1.22 (s, 3H), 0.93-0.77 (m, 4H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 151.8, 143.2, 126.13,126.10, 124.5, 122.7, 47.4, 41.5, 38.6, 31.9, 30.5, 30.3, 29.7(2C), 29.4, 26.8, 24.9, 22.7, 14.2 ppm. HRMS (ESI): calcd. for $C_{19}H_{31}$ [M+H]$^+$:259.2420, found: 259.2426.



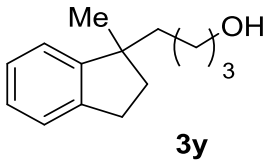
3w

5-Methoxy-1-methyl-1-(5-phenylpentyl)-2,3-dihydro-1H-indene (**3w**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (80 mg, 65%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.20-7.15 (m, 2H), 7.13-7.03 (m, 3H), 6.90 (d, *J* = 8.1 Hz, 1H), 6.69-6.59 (m, 2H), 3.70 (s, 3H), 2.79-2.72 (m, 2H), 2.49 (t, *J* = 7.3 Hz, 2H), 1.98-1.88 (m, 1H), 1.79-1.69 (m, 1H), 1.56-1.44 (m, 3H), 1.42-1.33 (m, 1H), 1.28-1.17 (m, 4H), 1.12 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 158.5, 144.7, 143.9, 142.9, 128.4 (2C), 128.2 (2C), 125.6, 123.1, 112.0, 109.8, 55.4, 46.6, 41.6, 39.0, 36.0, 31.5, 30.4, 30.1, 27.0, 24.8 ppm. HRMS (ESI): calcd. for $C_{22}H_{29}O$ $[M+H]^+$:309.2213, found: 309.2221.



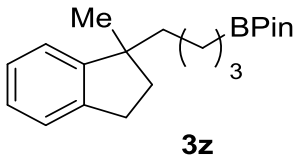
3x

1-(3-Ethylheptyl)-1-methyl-2,3-dihydro-1H-indene (**3x**) was isolated through column chromatography on silica gel with petroleum ether as a colorless oil (73 mg, 71%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.22-7.04 (m, 4H), 2.93-2.80 (m, 2H), 2.07-1.95 (m, 1H), 1.87-1.74 (m, 1H), 1.62-1.40 (m, 2H), 1.32-1.10 (m, 14H), 0.92-0.83 (m, 3H), 0.84-0.74 (m, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 151.9, 143.1, 126.1(2C), 124.5, 122.6, 47.34, 39.40(39.36), 38.30(38.27), 38.00(37.98), 32.90(32.82), 30.3, 29.1(28.98), 27.84(27.80), 26.83(26.80), 25.89(25.77), 23.17, 14.22, 10.99(10.86) ppm. Inside the brackets are the chemical shifts of another diastereomer. HRMS (ESI): calcd. for $C_{19}H_{31}$ $[M+H]^+$:259.2420, found: 259.2426.



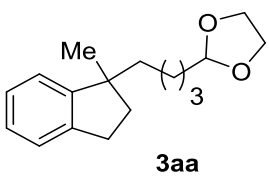
3y

4-(1-Methyl-2,3-dihydro-1H-inden-1-yl)butan-1-ol (**3y**) was isolated through column chromatography on silica gel (petroleum ether: EtOAc= 10:1) as a colorless oil (42 mg, 51%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.23-7.05 (m, 4H), 3.61 (t, *J* = 6.6 Hz, 2H), 2.92-2.81 (m, 2H), 2.06-1.96 (m, 1H), 1.89-1.76 (m, 1H), 1.67-1.57 (m, 1H), 1.57-1.47 (m, 3H), 1.44-1.32 (m, 1H), 1.31-1.19 (m, 2H), 1.24(s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-d): δ= 151.5, 143.2, 126.2, 126.2, 124.5, 122.6, 62.9, 47.3, 41.2, 38.6, 33.5, 30.3, 26.8, 21.2 ppm. HRMS (ESI): calcd. for $C_{14}H_{20}NaO^+$ [M+Na]:227.1406, found: 227.1405.



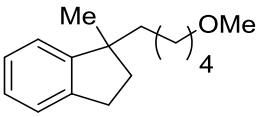
3z

4,4,5,5-Tetramethyl-2-(4-(1-methyl-2,3-dihydro-1H-inden-1-yl)butyl)-1,3,2-dioxaborolane (**3z**) was isolated through column chromatography on silica gel with petroleum ether as a colorless oil (53 mg, 42%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.21-7.04 (m, 4H), 2.92-2.80 (m, 2H), 2.06-1.91 (m, 1H), 1.86-1.74 (m, 1H), 1.64-1.56 (m, 1H), 1.54-1.44 (m, 1H), 1.41-1.24 (m, 5H), 1.23-1.19(m, 2H), 1.21 (s, 12H), 0.80-0.70 (m, 2H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 151.8, 143.2, 126.07, 126.06, 124.4, 122.7, 82.9, 47.3, 41.2, 38.6, 30.3, 27.6, 26.9, 24.8 (7C) ppm. HRMS (ESI): calcd. for $C_{20}H_{32}BO_2$ $[M+H]^+$:315.2490, found: 315.2492.



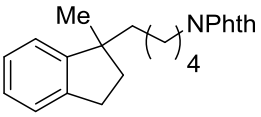
3aa

5-(1-Methyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3aa**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (69 mg, 67%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.23-7.05 (m, 4H), 4.81 (t, *J* = 4.8 Hz, 1H), 3.99-3.89 (m, 2H), 3.87-3.78 (m, 2H), 2.94-2.79 (m, 2H), 2.07-1.95 (m, 1H), 1.86-1.76 (m, 1H), 1.68-1.56 (m, 3H), 1.55-1.46 (m, 1H), 1.42-1.31 (m, 3H), 1.28-1.16 (m, 1H), 1.22 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 151.6, 143.2, 126.2, 126.1, 124.5, 122.6, 104.6, 64.8 (2C), 47.3, 41.3, 38.5, 33.9, 30.3, 26.8, 24.9, 24.8 ppm. HRMS (ESI): calcd. for $C_{17}H_{25}O_2$ $[M+H]^+$:261.1849, found: 240.261.1850.



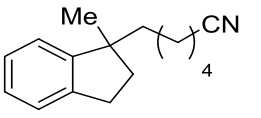
3ab

1-(5-Methoxypentyl)-1-methyl-2,3-dihydro-1H-indene (**3ab**) was isolated through column chromatography on silica gel to the mixture eluent of ethyl acetate and petroleum ether (50:1) as a colorless oil (53 mg, 57%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.22-7.05 (m, 4H), 3.38-3.28 (m, 2H), 3.31(s, 3H), 2.92-2.81 (m, 2H), 2.06-1.95 (m, 1H), 1.88-1.74 (m, 1H), 1.61-1.44 (m, 4H), 1.36-1.26 (m, 3H), 1.24-1.13 (m, 1H), 1.22(s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 151.6, 143.2, 126.2, 126.1, 124.5, 122.6, 72.9, 58. 5, 47.3, 41.4, 38.6, 30.3, 29.6, 26.9, 26.8, 24.8 ppm. HRMS (ESI): calcd. for $C_{16}H_{25}O$ $[M+H]^+$:233.1900, found: 233.1899.



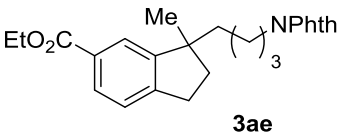
3ac

2-(5-(1-Methyl-2,3-dihydro-1H-inden-1-yl)pentyl)isoindoline-1,3-dione (**3ac**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (10:1) as a colorless oil (69 mg, 50%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.76 (dd, *J* = 5.4, 3.1 Hz, 2H), 7.63 (dd, *J* = 5.5, 3.0 Hz, 2H), 7.13-6.93 (m, 4H), 3.58 (t, *J* = 7.3 Hz, 2H), 2.85-2.71 (m, 2H), 2.00-1.85 (m, 1H), 1.78-1.68 (m, 1H), 1.62-1.55 (m, 2H), 1.52-1.34 (m, 2H), 1.30-1.17 (m, 4H), 1.14 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 168.5 (2C), 151.5, 143.1, 133.9 (3C), 132.2, 126.2, 126.1, 124.5, 123.2 (2C), 122.6, 47.3, 41.2, 38.5, 38.1, 30.3, 28.6, 27.6, 26.8, 24.5 ppm. HRMS (ESI): calcd. for $C_{23}H_{26}NO_2$ $[M+H]^+$:348.1958, found: 348.1955.



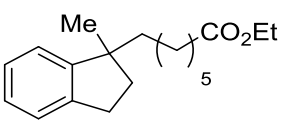
3ad

6-(1-Methyl-2,3-dihydro-1H-inden-1-yl)hexanenitrile (**3ad**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a colorless oil (55 mg, 60%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.16-7.04 (m, 3H), 7.05-6.98 (m, 1H), 2.80 (t, *J* = 7.3 Hz, 2H), 2.27-2.17 (m, 2H), 1.98-1.87 (m, 1H), 1.81-1.70 (m, 1H), 1.60-1.49 (m, 3H), 1.48-1.39 (m, 1H), 1.38-1.29 (m, 2H), 1.29-1.21 (m, 1H), 1.20-1.09 (m, 1H), 1.16(s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 143.2, 126.3, 126.2, 124.6 (2C), 122.6, 47.2, 41.1, 38.5, 30.3, 29.4 (2C), 26.9, 25.3, 24.2, 17.1 ppm. HRMS (ESI): calcd. for $C_{16}H_{22}N$ $[M+H]^+$:228.1747, found: 228.1736.



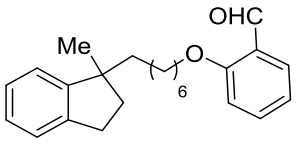
3ae

Methyl-1-(5-(1,3-dioxoisoindolin-2-yl)pentyl)-1-methyl-2,3-dihydro-1H-indene-5-carboxylate (**3ae**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (10:1) as a yellow oil (92 mg, 57%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.87-7.78 (m, 3H), 7.76-7.66 (m, 3H), 7.24-7.18 (m, 1H), 3.90 (s, 3H), 3.65 (t, *J* = 7.2 Hz, 2H), 2.90 (t, *J* = 7.3 Hz, 2H), 2.09-1.97 (m, 1H), 1.90-1.80 (m, 1H), 1.79-1.55 (m, 4H), 1.55-1.43 (m, 1H), 1.38-1.12 (m, 6H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 168.4 (2C), 167.5, 151.9, 149.0, 133.8 (2C), 132.1(2C), 128.4, 128.1, 124.4, 123.8, 123.1 (2C), 51.9, 47.2, 41.2, 38.4, 37.9, 30.5, 28.5, 27.5, 26.8, 24.5 ppm. HRMS (ESI): calcd. for $C_{25}H_{28}NO_4$ $[M+H]^+$:406.2013, found: 406.2020.



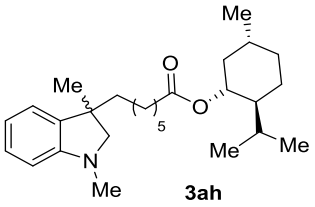
3af

Ethyl 7-(1-methyl-2,3-dihydro-1H-inden-1-yl)heptanoate (**3af**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (73 mg, 63%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.15-6.98 (m, 4H), 4.04 (q, *J* = 7.1 Hz, 2H), 2.87-2.74 (m, 2H), 2.19 (t, *J* = 7.5 Hz, 2H), 1.98-1.87 (m, 1H), 1.78-1.68 (m, 1H), 1.56-1.46 (m, 3H), 1.45-1.35 (m, 1H), 1.27-1.08 (m, 9H), 1.15(s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 173.9, 151.7, 143.2, 126.2, 126.1, 124.5, 122.6, 60.2, 47.3, 41.4, 38.6, 34.4, 30.3, 30.1, 29.2, 26.8, 25.0, 24.8, 14.3 ppm. HRMS (ESI): calcd. for $C_{19}H_{28}NaO_2$ $[M+Na]^+$:311.1982, found: 311.1989.



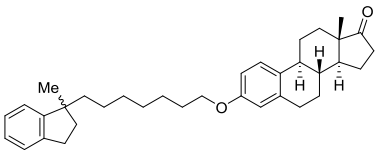
3ag

5-(1-Methyl-2,3-dihydro-1H-inden-1-yl)pentyl acetate (**3ag**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (74 mg, 53%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 10.51 (d, *J* = 0.8 Hz, 1H), 7.83 (dd, *J* = 7.7, 1.8 Hz, 1H), 7.56-7.47 (m, 1H), 7.22-7.06 (m, 4H), 7.04-6.92 (m, 2H), 4.05 (t, *J* = 6.4 Hz, 2H), 2.93-2.80 (m, 2H), 2.07-1.95 (m, 1H), 1.88-1.76 (m, 3H), 1.68-1.39 (m, 5H), 1.40-1.23 (m, 5H), 1.23 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 189.9, 161.6, 151.7, 143.2, 135.9, 128.2, 126.2, 126.1, 124.9, 124.5, 122.6, 120.5, 112.5, 68.5, 47.3, 41.4, 38.6, 30.32, 30.30, 29.3, 29.1, 26.8, 26.1, 24.9 ppm. HRMS (ESI): calcd. for $C_{24}H_{30}NaO_2$ [M+Na]$^+$:373.2138, found: 373.2143.



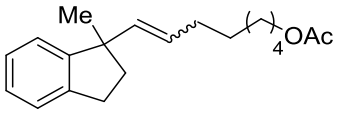
3ah

(1R,2S,5R)-2-Isopropyl-5-methylcyclohexyl 7-(1,3-dimethylindolin-3-yl)heptanoate (**3ah**) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (104 mg, 63%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.01 (td, *J* = 7.7, 1.3 Hz, 1H), 6.89 (dd, *J* = 7.2, 1.2 Hz, 1H), 6.61 (td, *J* = 7.3, 1.0 Hz, 1H), 6.40 (d, *J* = 7.8 Hz, 1H), 4.60 (td, *J* = 10.9, 4.3 Hz, 1H), 3.10 (d, *J* = 8.6 Hz, 1H), 2.90 (d, *J* = 8.6 Hz, 1H), 2.67 (s, 3H), 2.18 (t, *J* = 7.5 Hz, 2H), 1.94-1.87 (m, 1H), 1.85-1.71 (m, 1H), 1.66-1.40 (m, 6H), 1.34-1.08 (m, 10H), 1.03-0.85 (m, 2H), 0.84-0.78 (m, 8H), 0.67 (d, *J* = 7.0 Hz, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 173.5, 152.3, 138.3, 127.4, 122.2, 117.6, 107.2, 73.9, 68.3, 47.0, 43.6, 40.9, 40.3, 36.0, 34.7, 34.3, 31.4, 29.9, 29.1, 26.2, 25.4, 25.1, 24.6, 23.4, 22.1, 20.8, 16.3 ppm. HRMS (ESI): calcd. for $C_{27}H_{44}NO_2$ [M+H]$^+$:414.3367, found: 414.3373.



3ai

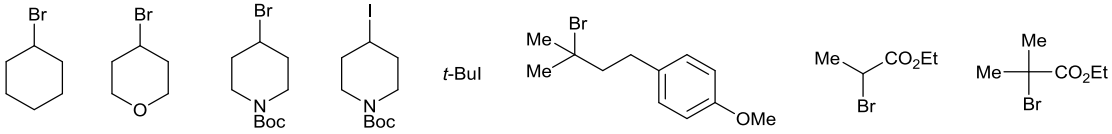
(8R,9S,13S,14S)-13-Methyl-3-((7-(1-methyl-2,3-dihydro-1H-inden-1-yl)heptyl)oxy)-6,7,8,9,11,12,13,14,15,16-decahydro-17H-cyclopenta[a]phenanthren-17-one (**3a*i***) was isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (100 mg, 55%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.22-7.04 (m, 5H), 6.70 (dd, *J* = 8.6, 2.8 Hz, 1H), 6.63 (d, *J* = 2.7 Hz, 1H), 3.90 (t, *J* = 6.6 Hz, 2H), 2.94-2.81 (m, 4H), 2.56-2.44 (m, 1H), 2.43-2.35 (m, 1H), 2.30-2.19 (m, 1H), 2.21-2.09 (m, 1H), 2.11-1.91 (m, 3H), 1.87-1.77 (m, 1H), 1.77-1.68 (m, 2H), 1.68-1.50 (m, 5H), 1.54-1.36 (m, 6H), 1.36-1.24 (m, 6H), 1.22 (s, 3H), 0.90 (s, 3H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ= 157.1, 151.7, 143.2, 137.7, 131.8, 126.3, 126.13, 126.09, 124.5, 122.6, 114.5, 112.1, 67.9, 50.4, 48.1, 47.3, 43.9, 41.4, 38.5, 38.4, 35.9, 31.6, 30.4, 30.3, 29.7 (2C), 29.4, 29.3, 26.8, 26.6, 26.1, 25.9, 24.9, 21.6, 13.9 ppm. HRMS (ESI): calcd. for $C_{35}H_{47}O_2$ [M+H]$^+$:499.3571, found: 499.3578.



3aj

8-(1-methyl-2,3-dihydro-1H-inden-1-yl)oct-7-en-1-yl acetate (**3aj**) were isolated through column chromatography on silica gel with petroleum ether to the mixture eluent of ethyl acetate and petroleum ether (20:1) as a yellow oil (19 mg, 32%).^{1}H NMR: (400 MHz, Chloroform-*d*) δ= 7.17-7.04 (m, 3H), 7.03-6.96 (m, 1H), 5.57-5.39 (m, 1H), 5.27-4.92 (m, 1H), 4.02-3.89 (m, 2H), 2.85-2.75 (m, 2H), 2.06-1.90 (m, 2H), 2.03 (s, 3H), 1.88-1.78 (m, 1H), 1.59-1.45 (m, 2H), 1.33-1.09 (m, 8H), 0.91-0.84 (m, 2H) ppm. ^{13}C NMR (101 MHz, Chloroform-*d*): δ (major isomer)= 171.2, 150.52, 143.21, 138.1, 136.52, 132.8, 126.22, 124.5, 123.27, 64.6, 49.35, 40.9, 36.64, 32.4, 30.1, 29.4, 28.62, 25.88, 23.74, 21.00 ppm; δ (minor isomer)= 171.2, 150.47, 143.19, 138.1, 136.64, 132.8, 126.33, 124.5, 123.25, 64.6, 49.43, 40.94, 36.72, 32.4, 30.1, 29.4, 28.70, 25.73, 23.61, 21.07 ppm. HRMS (ESI): calcd. for $C_{20}H_{28}NaO_2$ [M+Na]$^+$: 323.1982, found: 323.1984.

Unsuccessful Substrates:



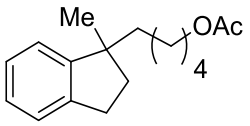
References

1. (*a*) F. Liron and P. Knoche, *Tetrahedron Letters*, 2007, **48**, 4943; (*b*) *J*. Garc á-Fortanet and S. L. Buchwald, *Angew. Chem. Int. Ed.*, 2008, **120**, 8228; (*c*) O. Ren é, D. Lapointe and K. Fagnou, *Org. Lett*, 2009, **11**, 4560;(*d*) M.Wang, F. Xiao, Y. Bai and X. Hu, *Syn. Commun.*, 2015, **45**, 19.

2. (*a*) A. R. H. Narayan, G. Jim énez-Os és, P. Liu, S. Negretti, W.-X. Zhao, M. M. Gilbert, R. O. Ramabhadran, Y.-F. Yang, L.-R. Furan, Z. Li, L. M. Podust, J. Montgomery, K. N. Houk and D. H. Sherman, *Nature Chem.*, 2015, **7**, 653; (*b*) C. W. Cheung, F. E. Zhurkin and X.-L. Hu, *J. Am. Chem. Soc.*, 2015, **137**, 4932; (*c*) X.-B. Yan, C.-L. Li, W.-J. Jin, P. Guo and X.-Z. Shu, *Chem. Sci.*, 2018, **9**, 4529.

3. E. C. Hansen, D. J. Pedro, A. C. Wotal, N. J. Gower, J. D. Nelson1, S. Caron and D. J. Weix, *Nature Chem.*, 2016, **8**, 1126.

^{1}H and ^{13}C NMR Spectra



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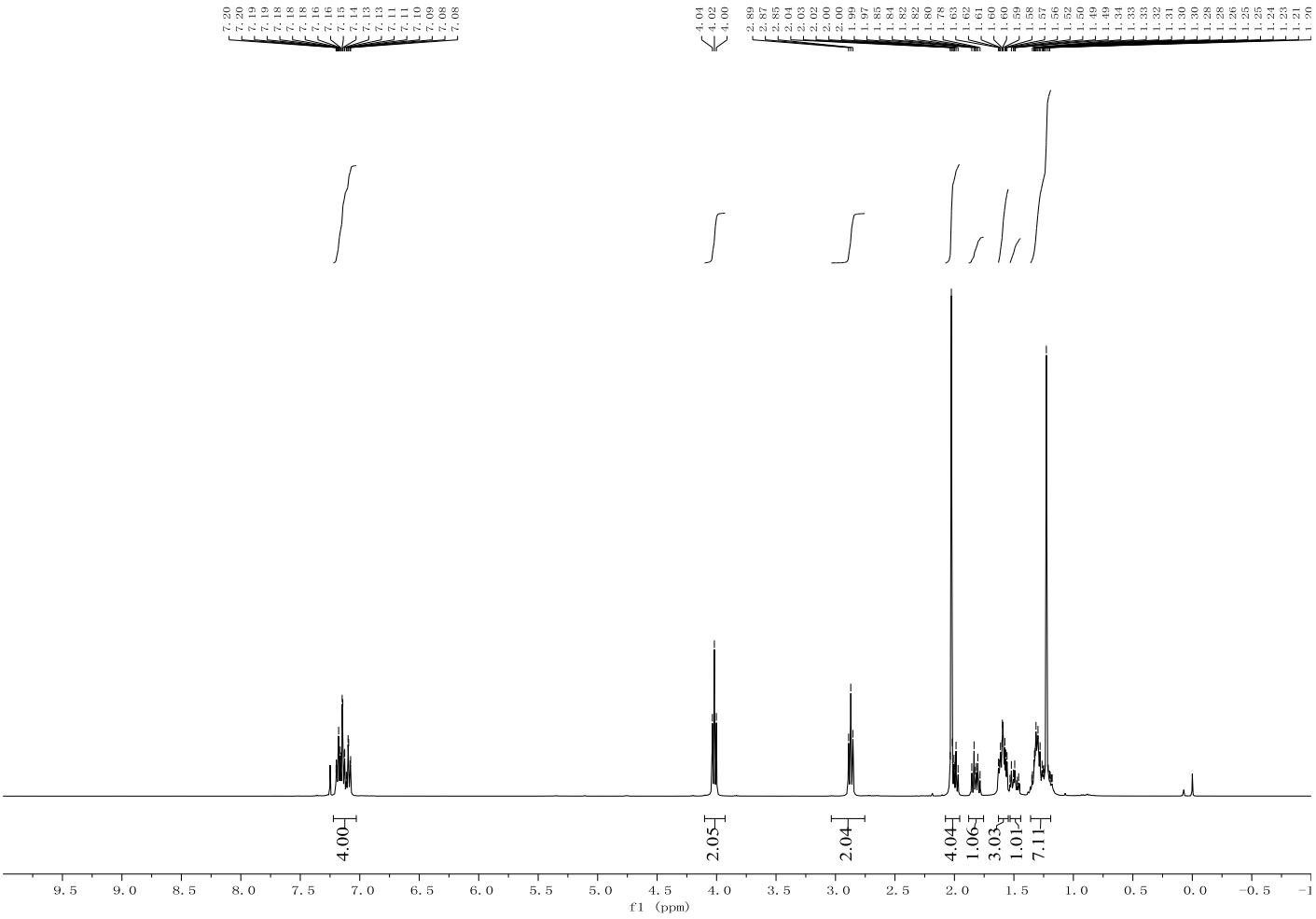

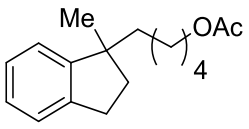
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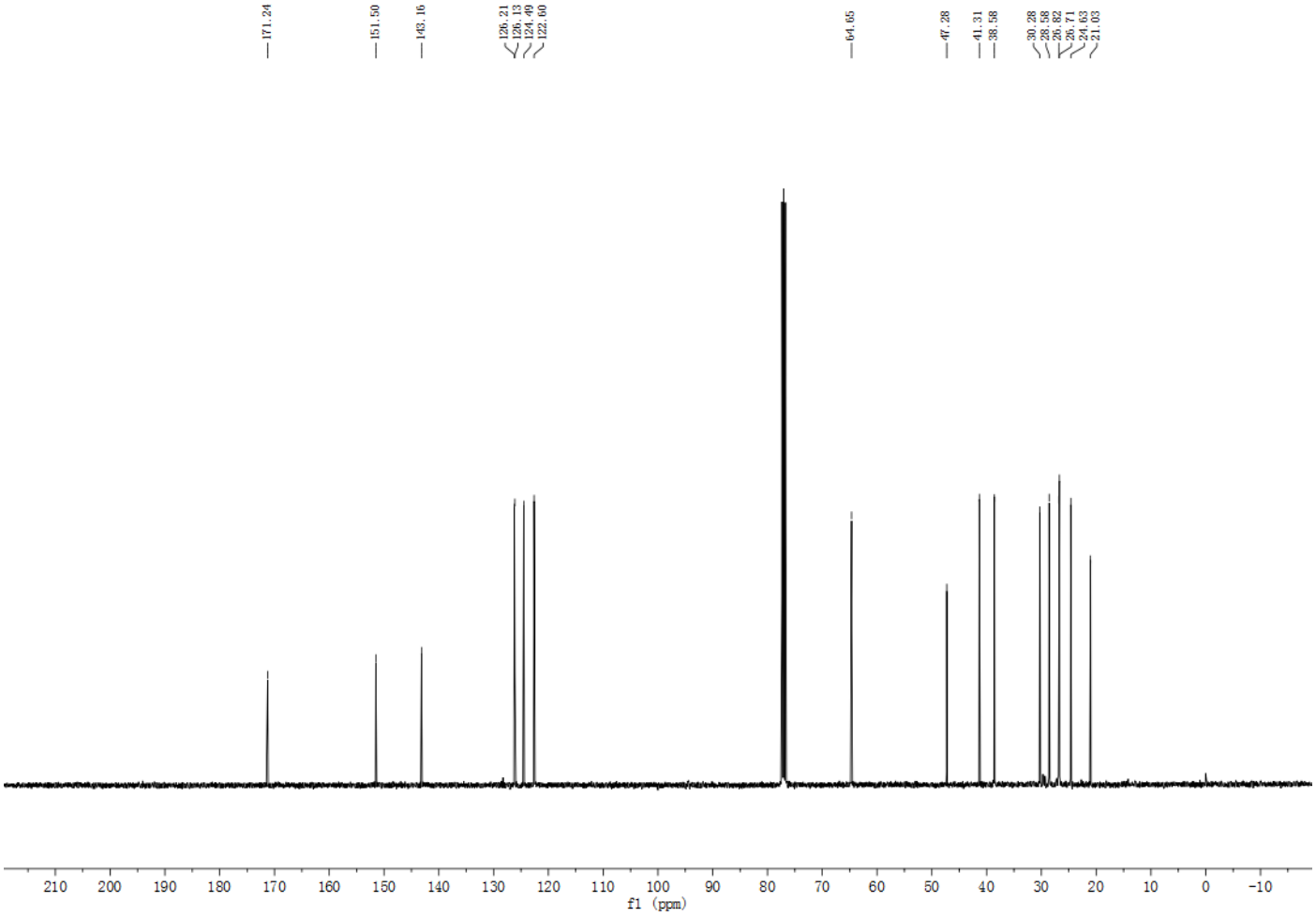
OAc
4

3a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26.71
24.63
21.03
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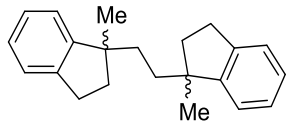
f1 (ppm)



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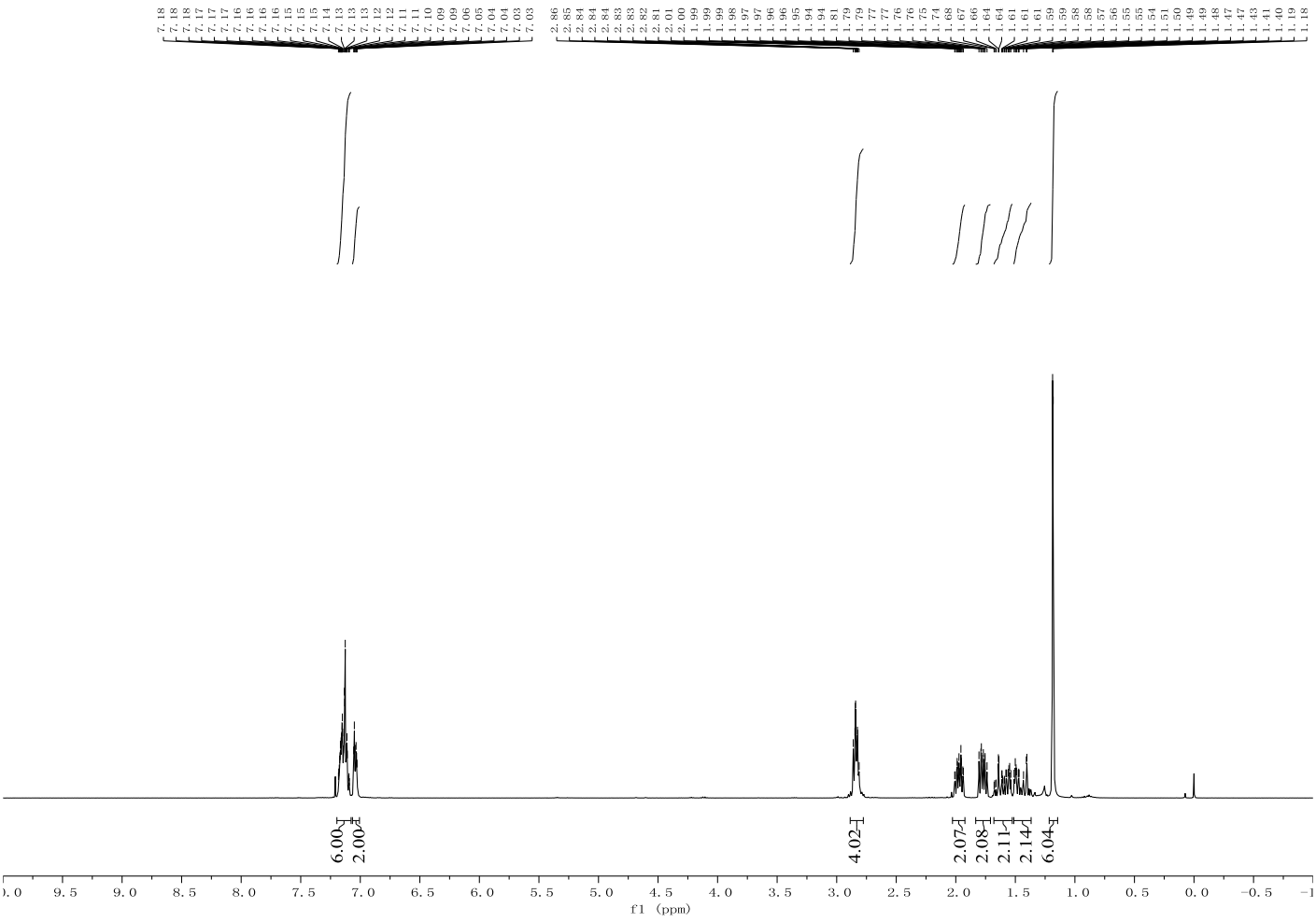

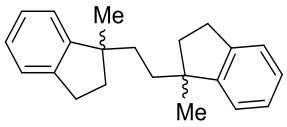
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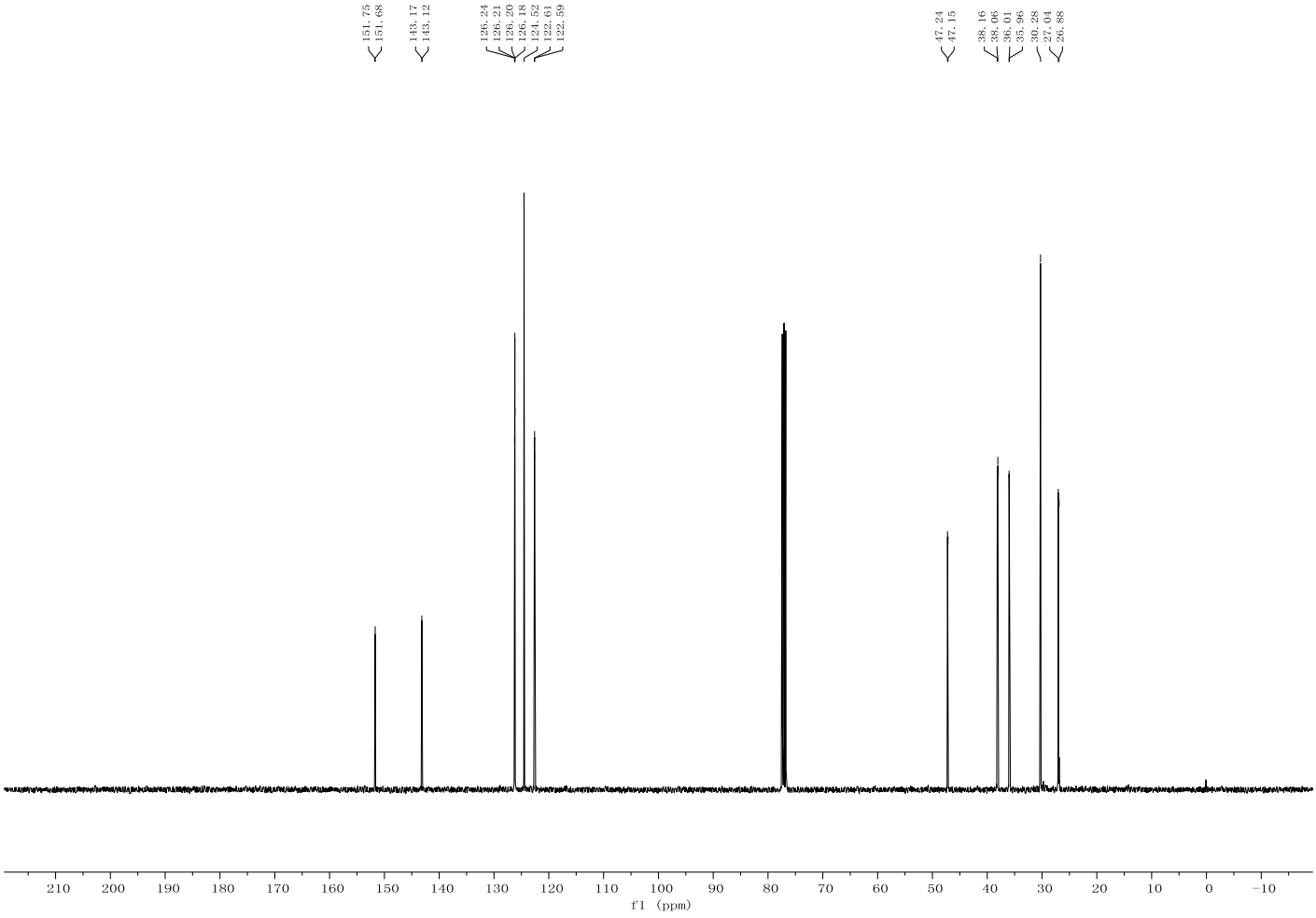
Me

3a-1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27.04
26.88
210
200
190
180
170
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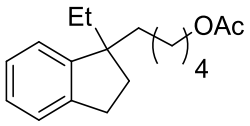
f1 (ppm)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OAc
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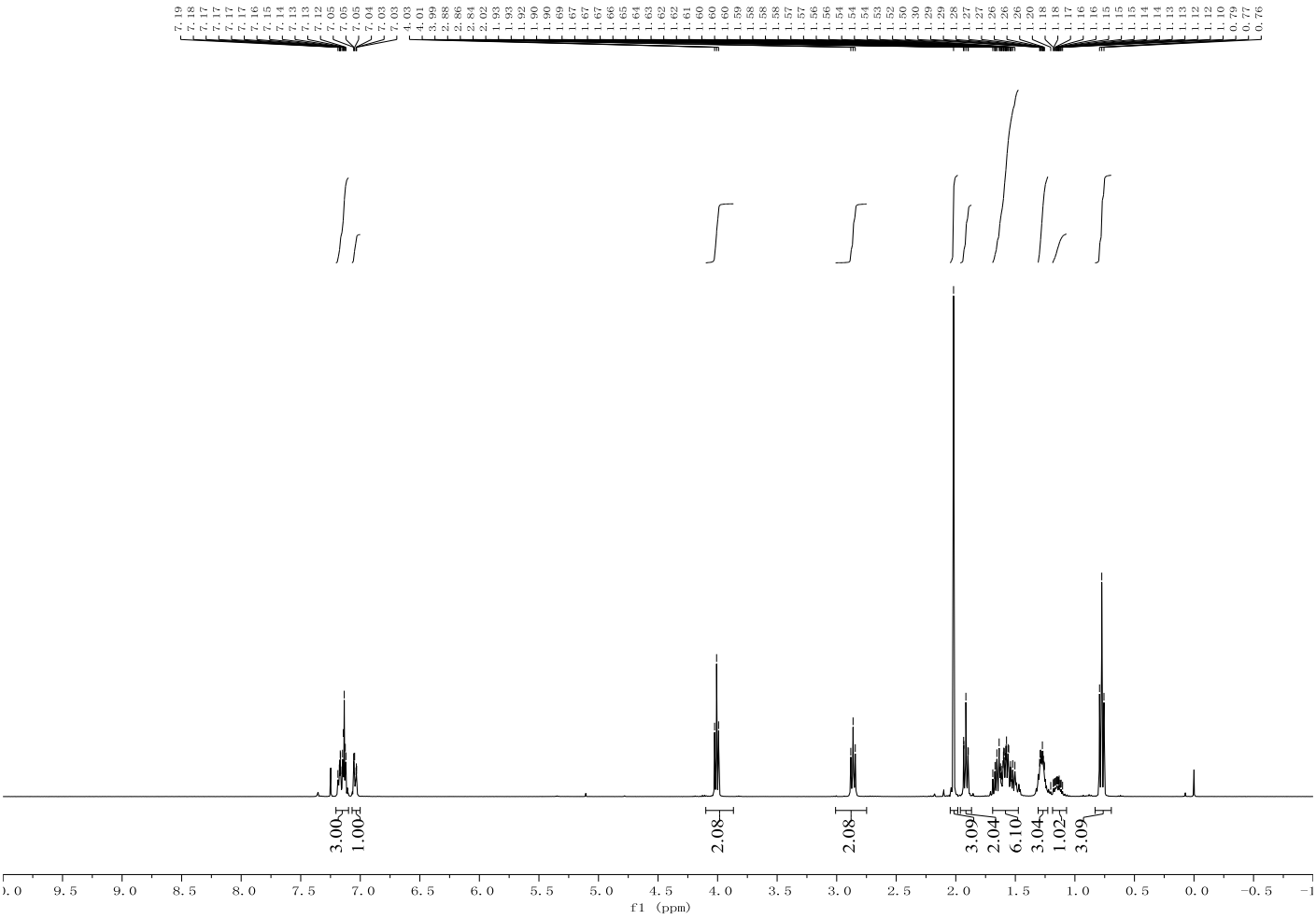
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4.03 4.01 3.99 2.88 2.86 2.84 2.02 1.93 1.93 1.92 1.90 1.90 1.69 1.67 1.67 1.67 1.66 1.65 1.64 1.63 1.62 1.62 1.61 1.60 1.60 1.60 1.59 1.58 1.58 1.58 1.57 1.57 1.56 1.56 1.54 1.54 1.53 1.52 1.50 1.30 1.29 1.29 1.28 1.27 1.27 1.26 1.26 1.26 1.20 1.18 1.18 1.17 1.16 1.16 1.15 1.15 1.15 1.14 1.14 1.13 1.12 1.12 1.10 0.79 0.77 0.76
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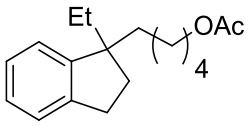
f1 (ppm)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OAc
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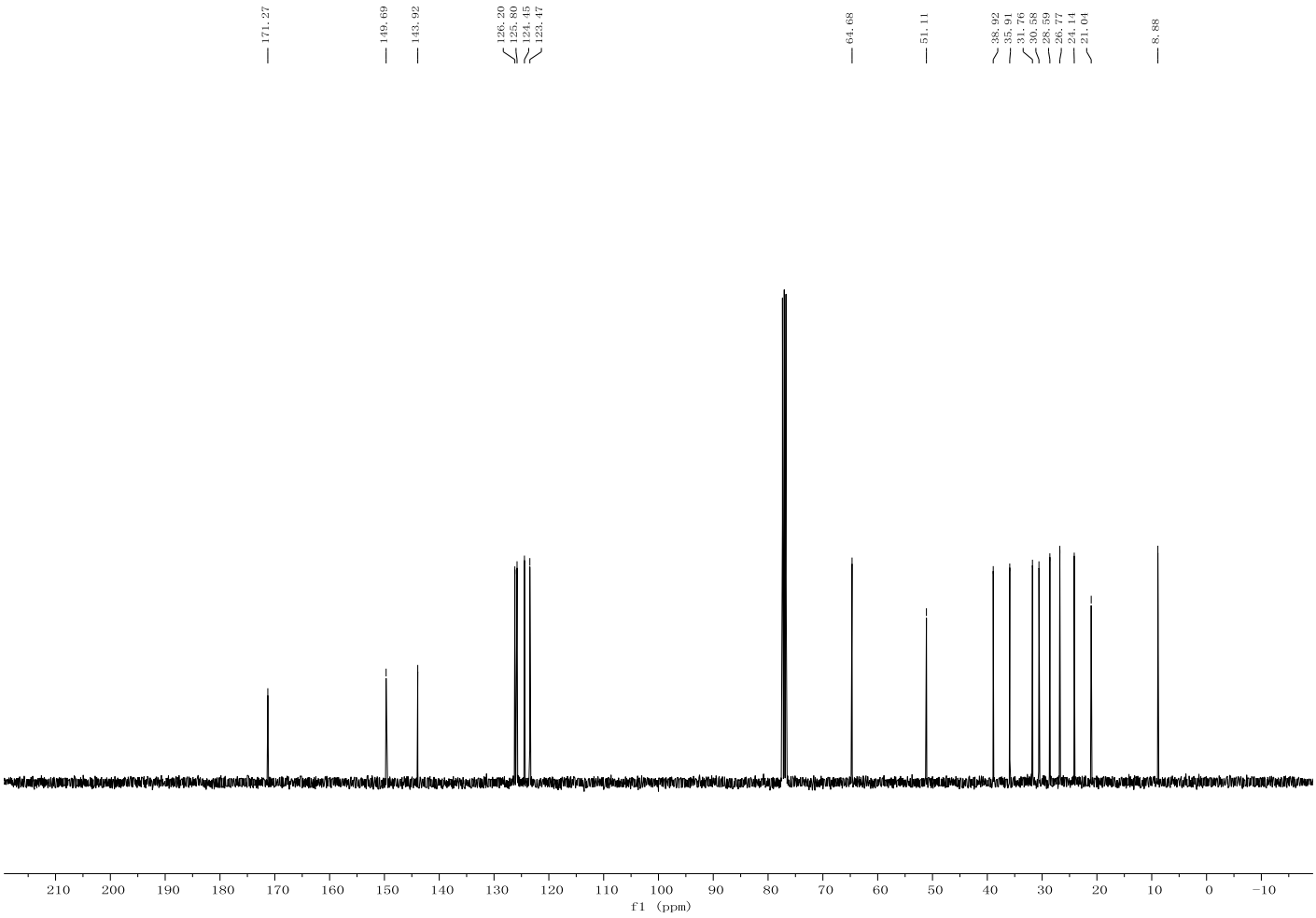
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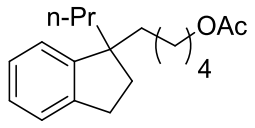
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OAc
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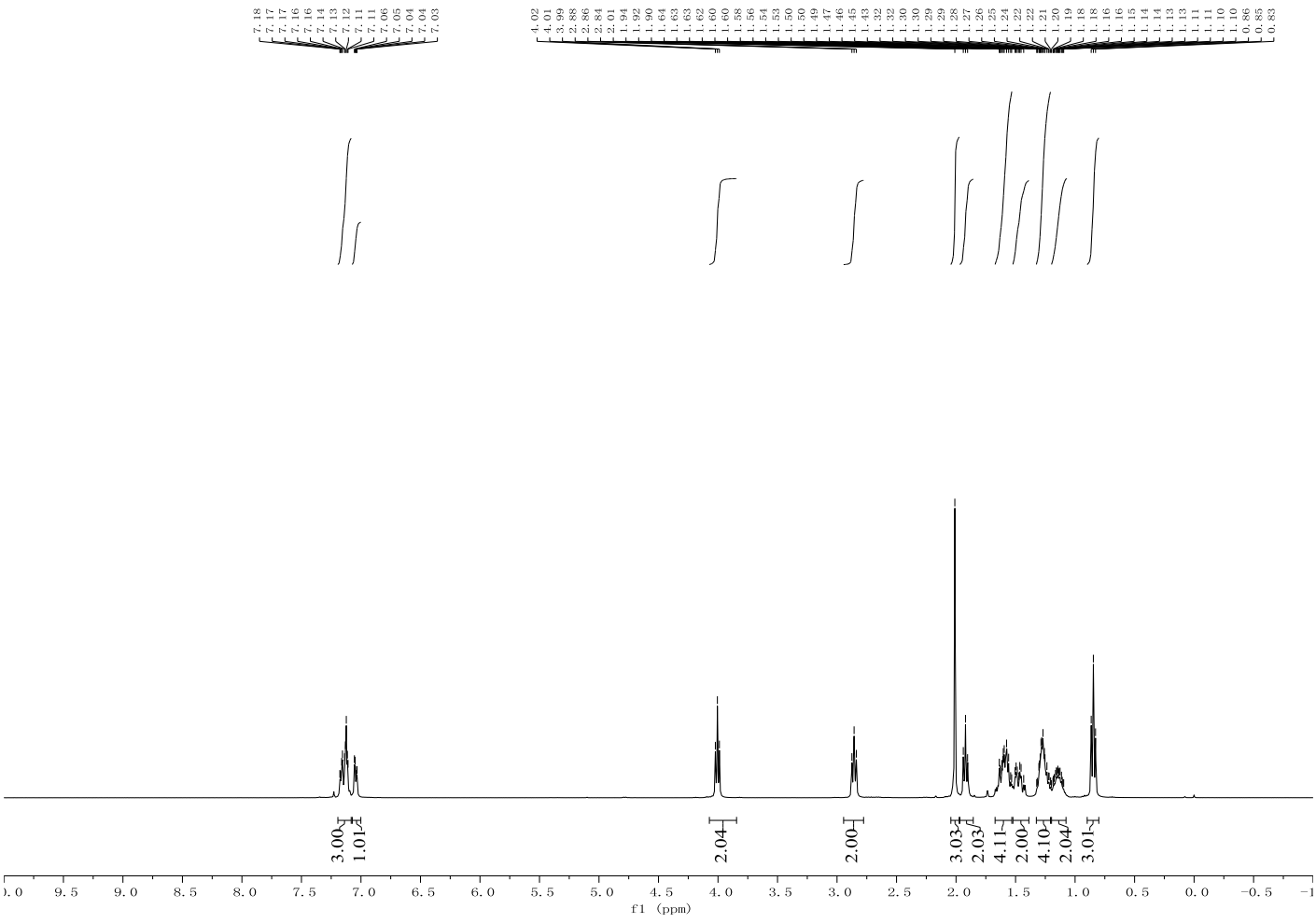
3c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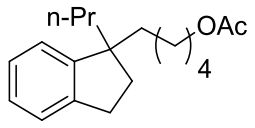
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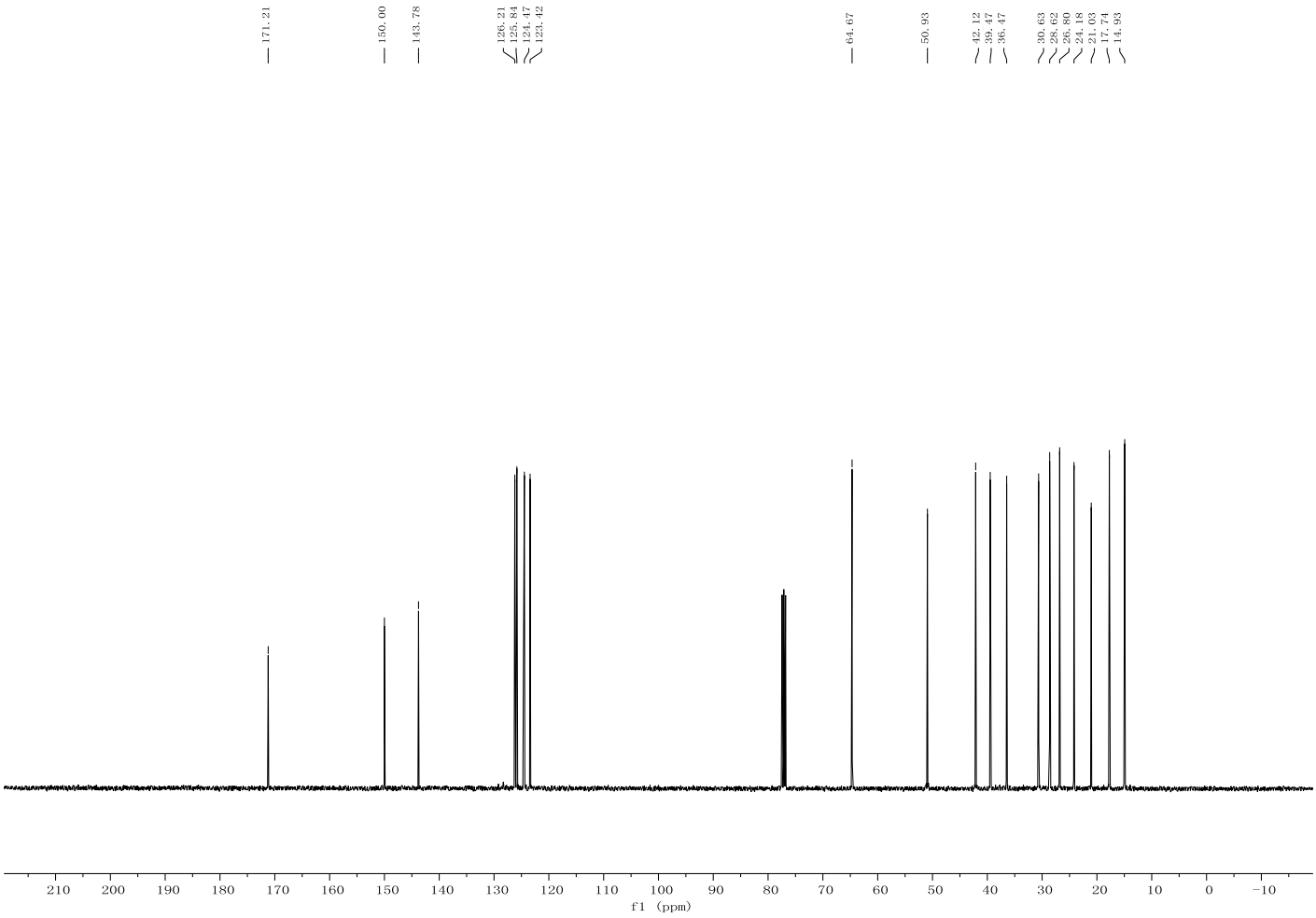
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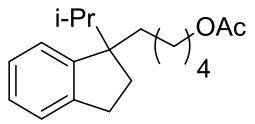

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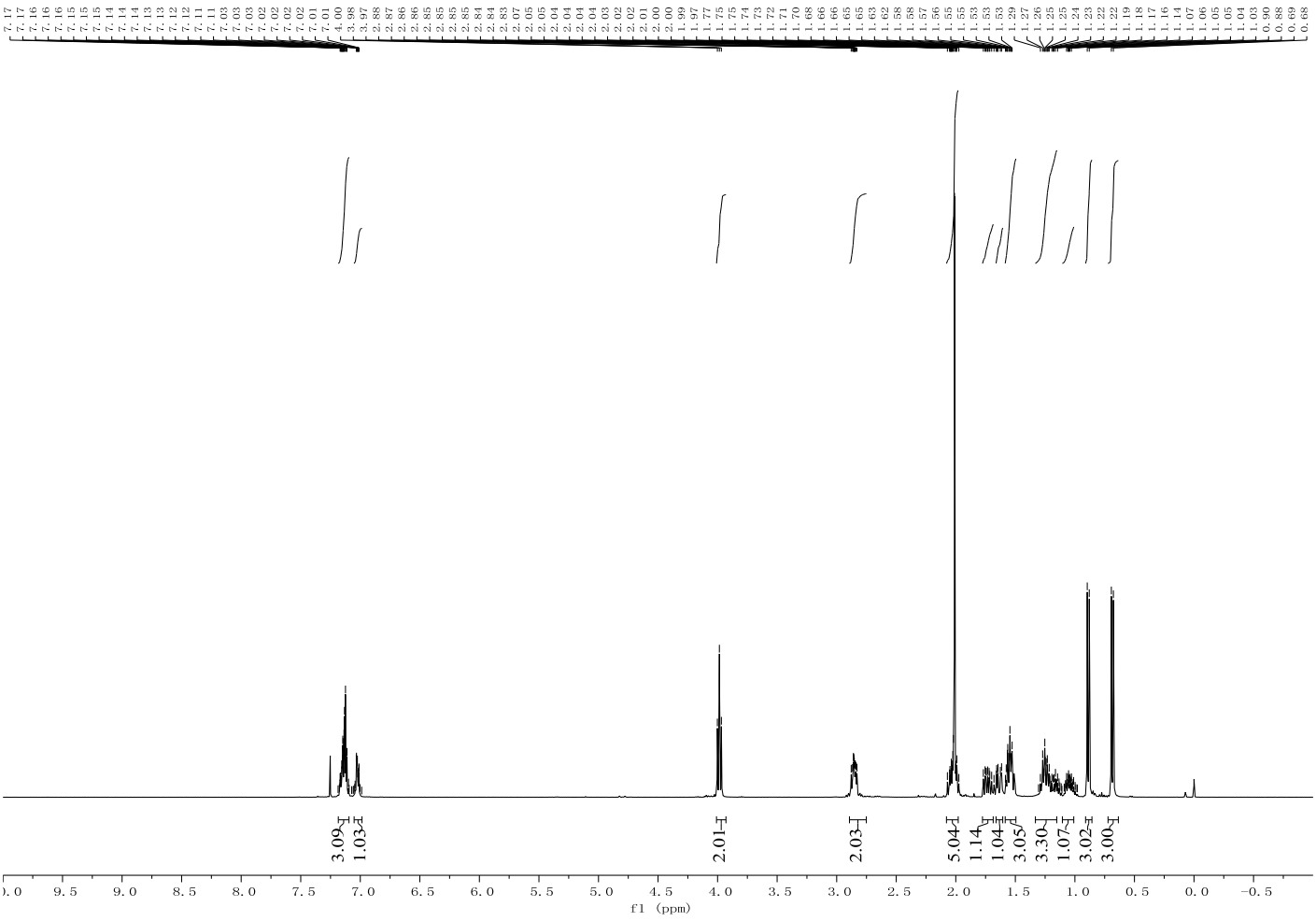

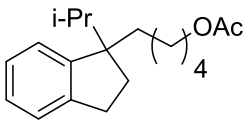
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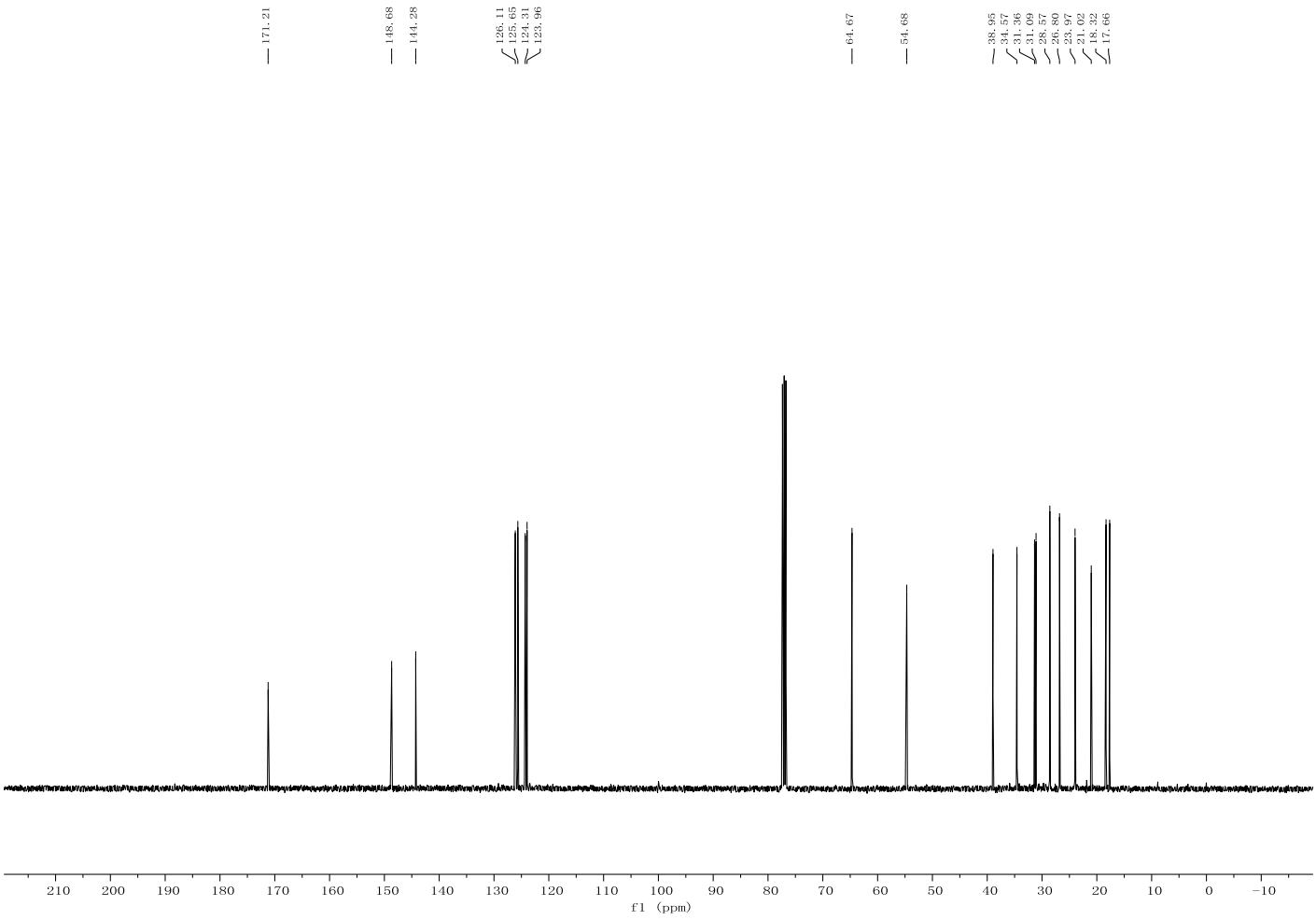
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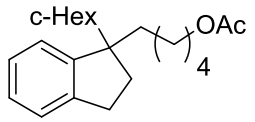

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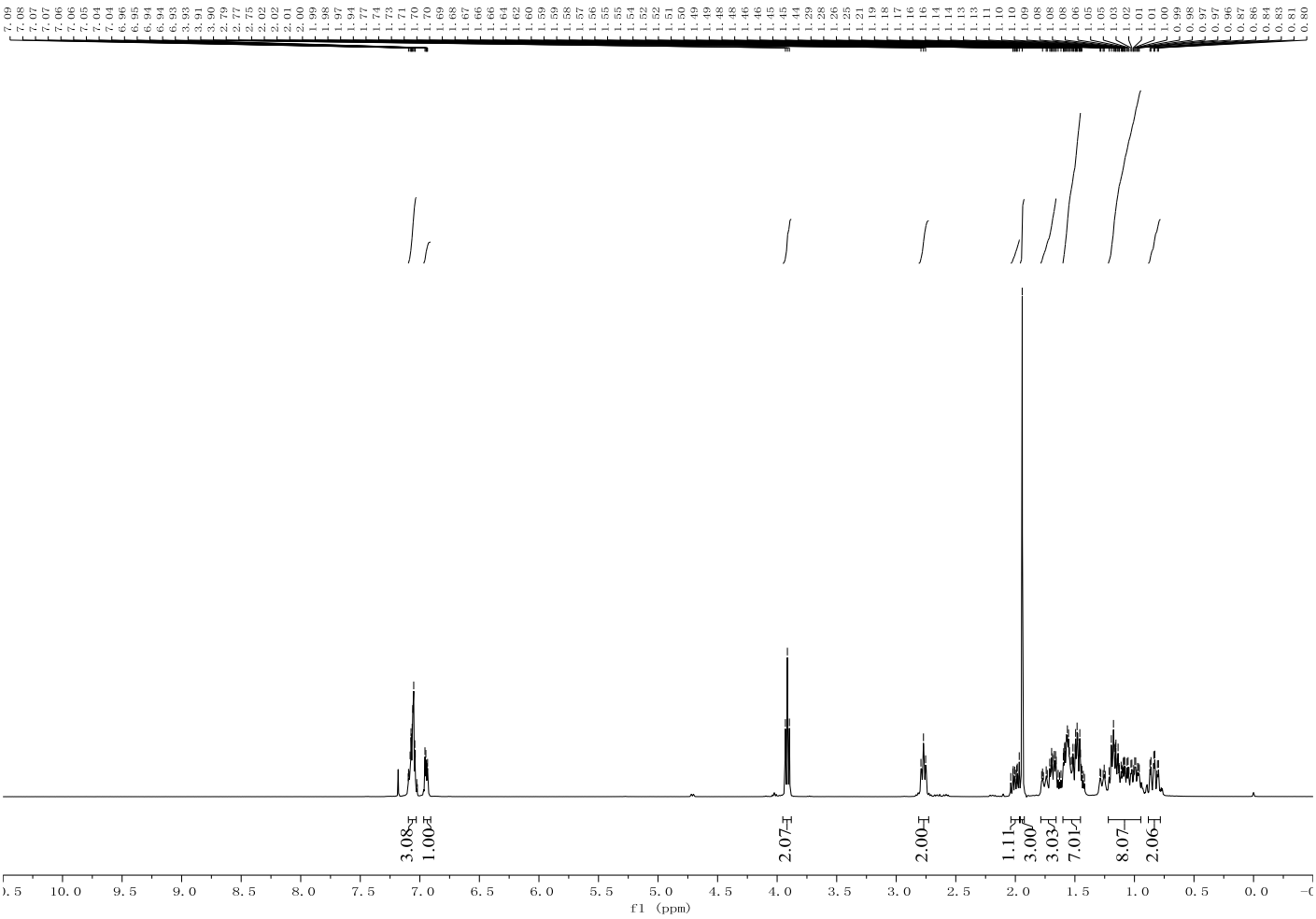

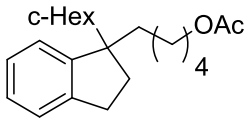
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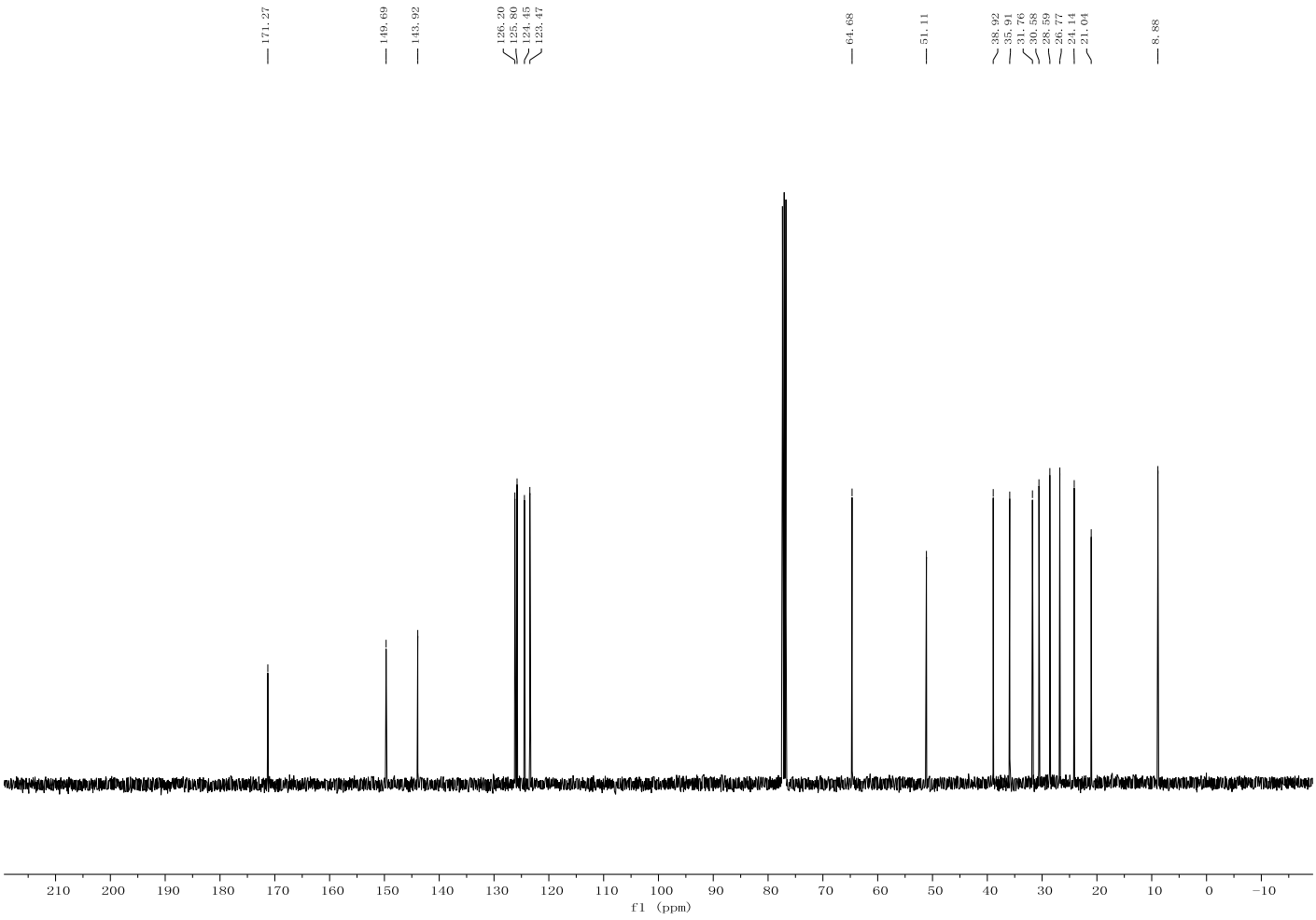
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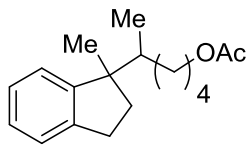
f1 (ppm)



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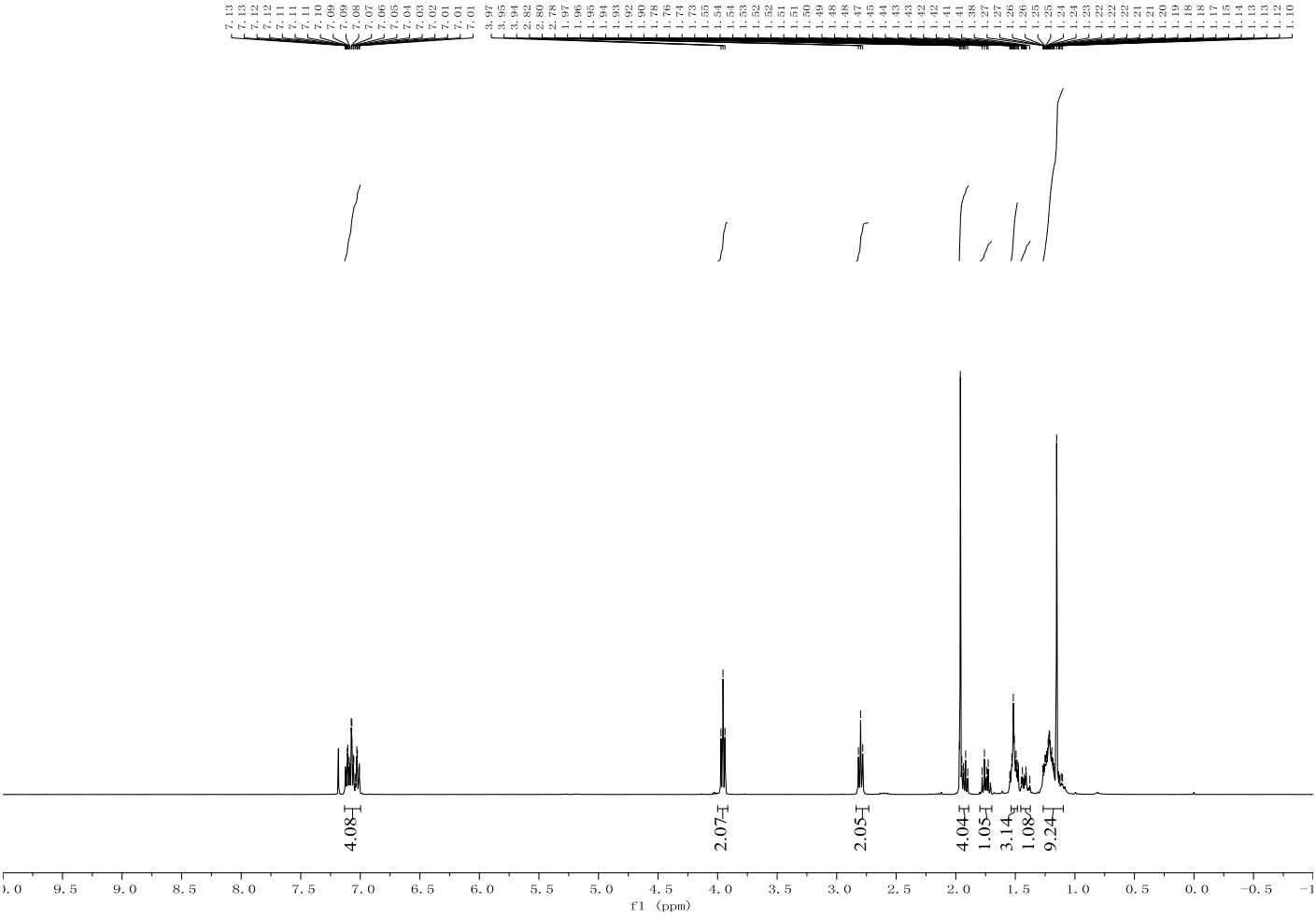

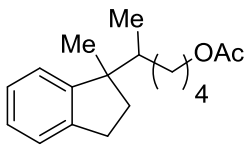
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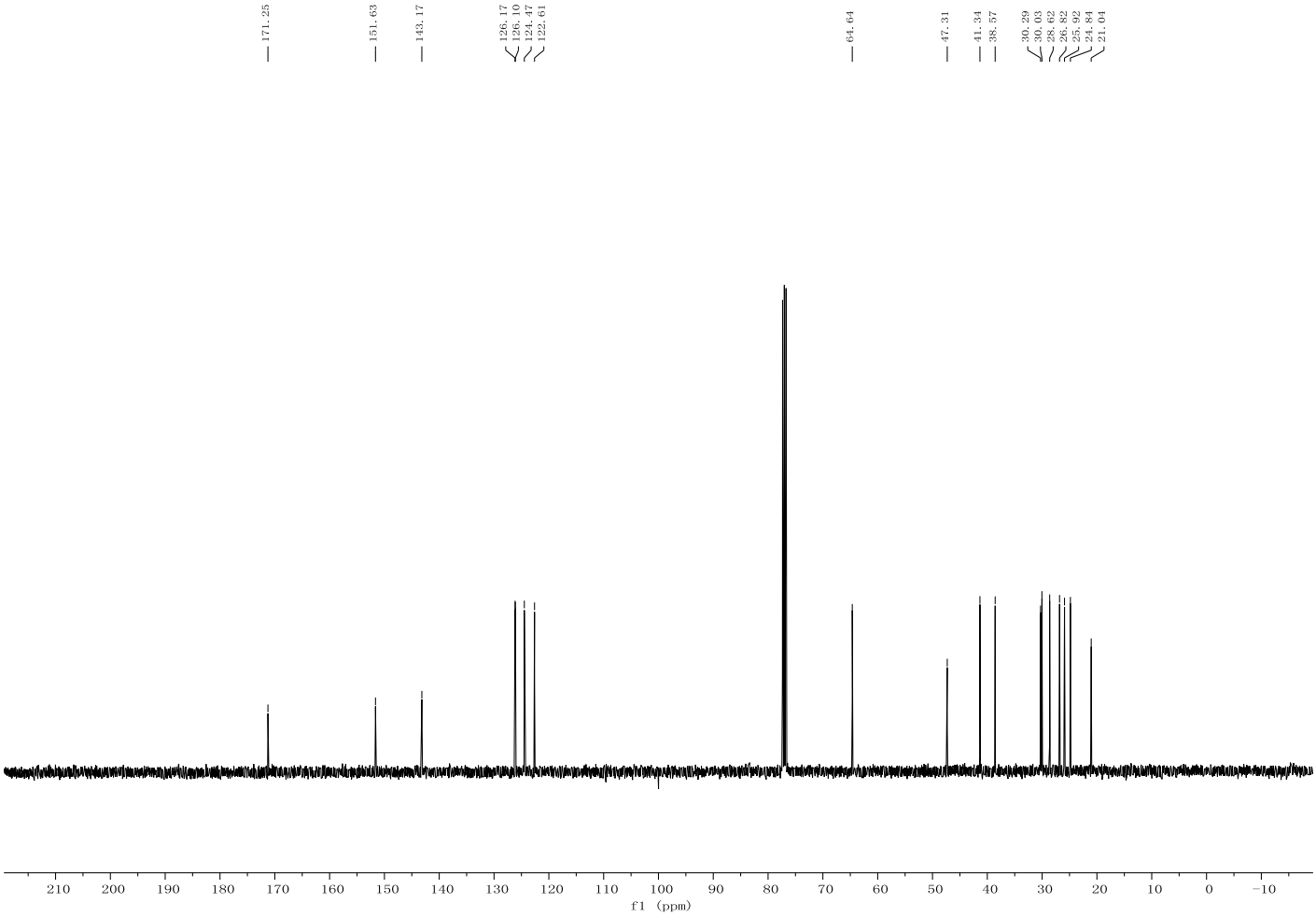
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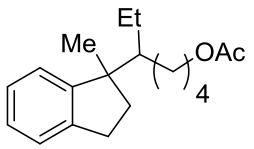
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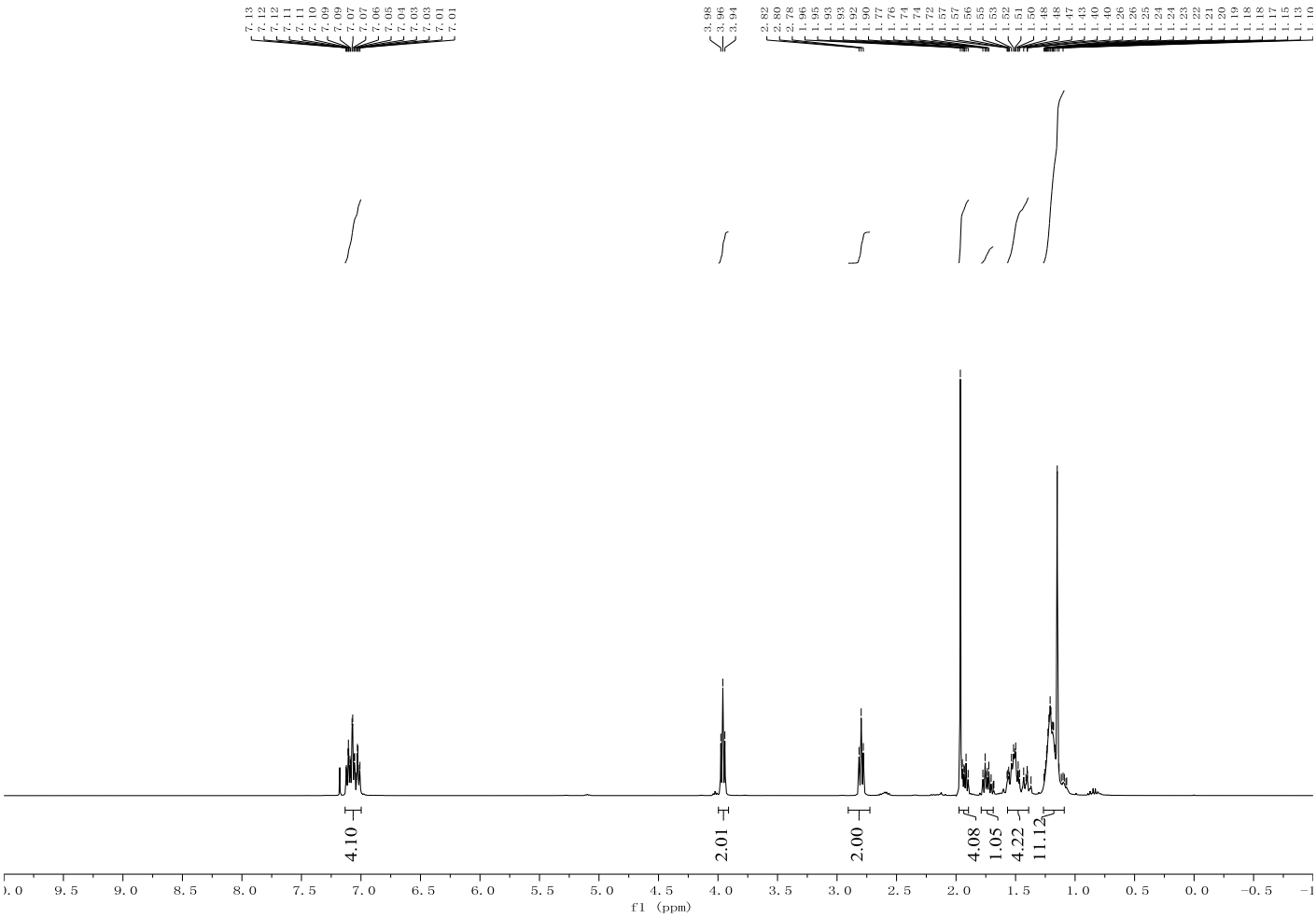
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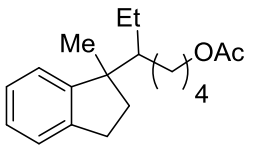
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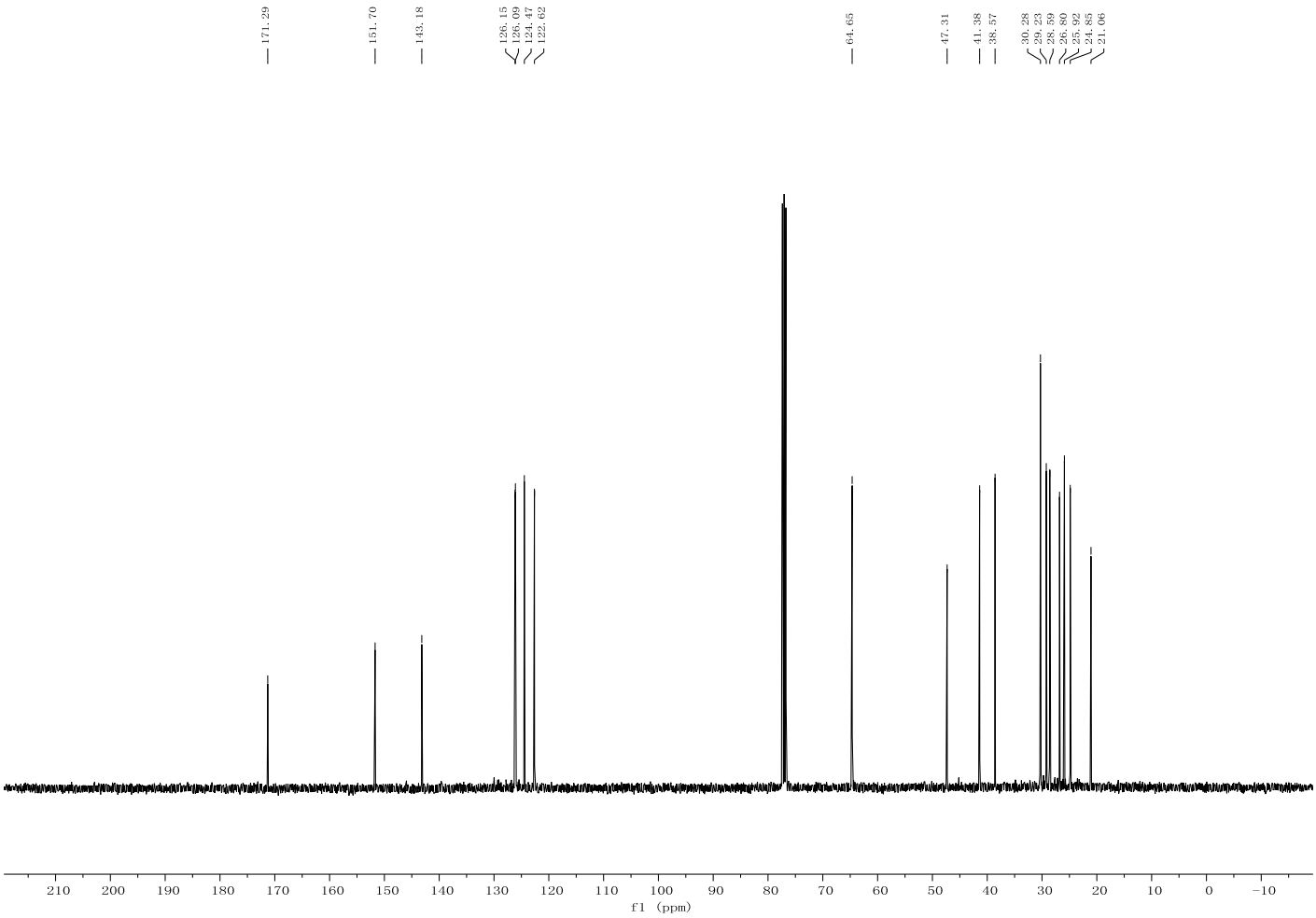
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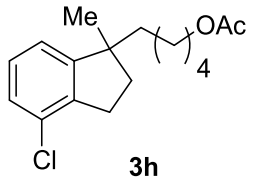

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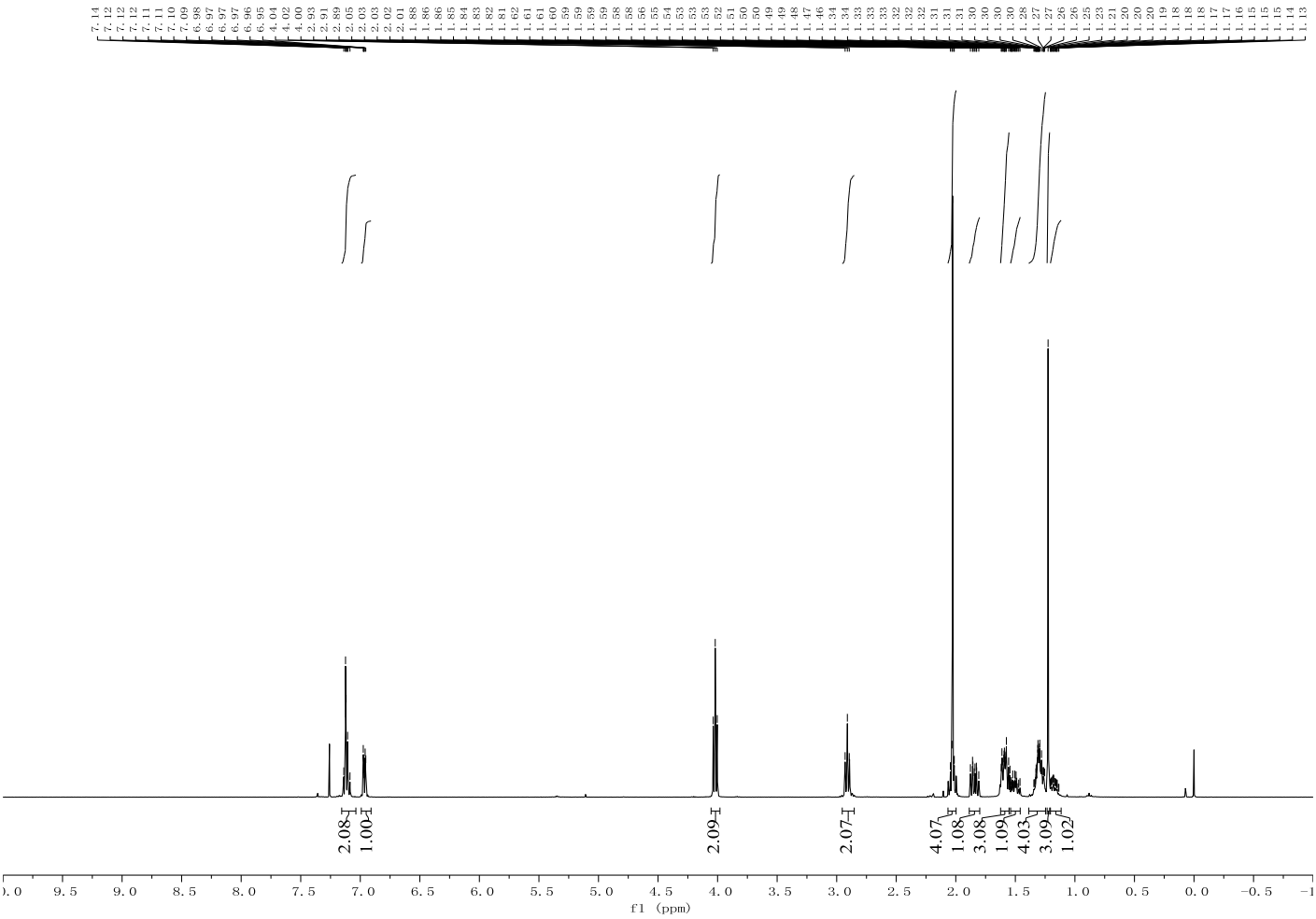

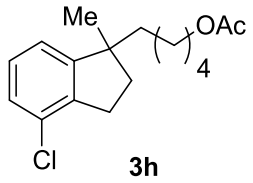
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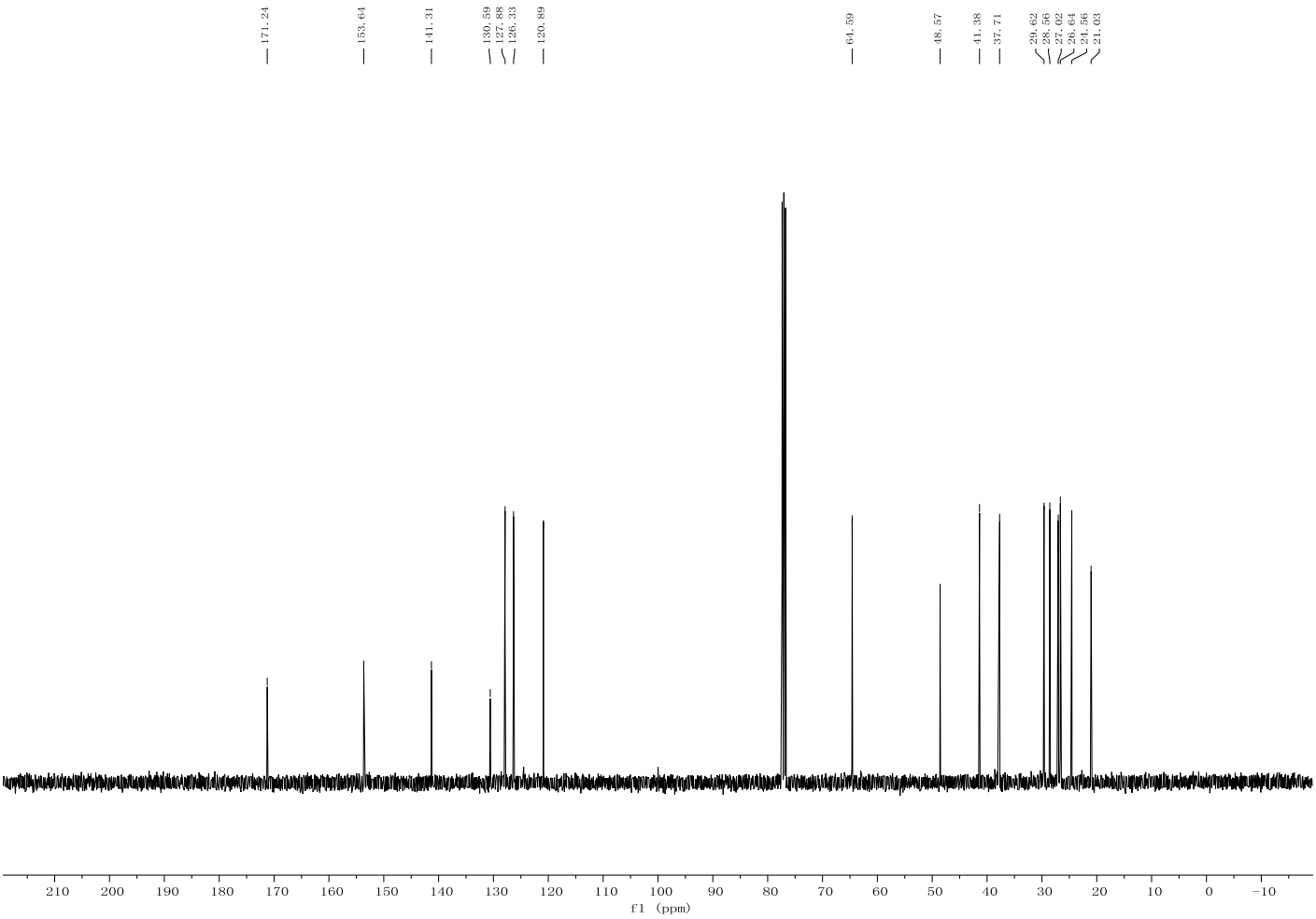
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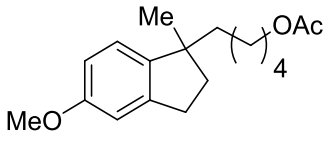
27.02
26.64
24.56
21.03
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)


Me
OAc
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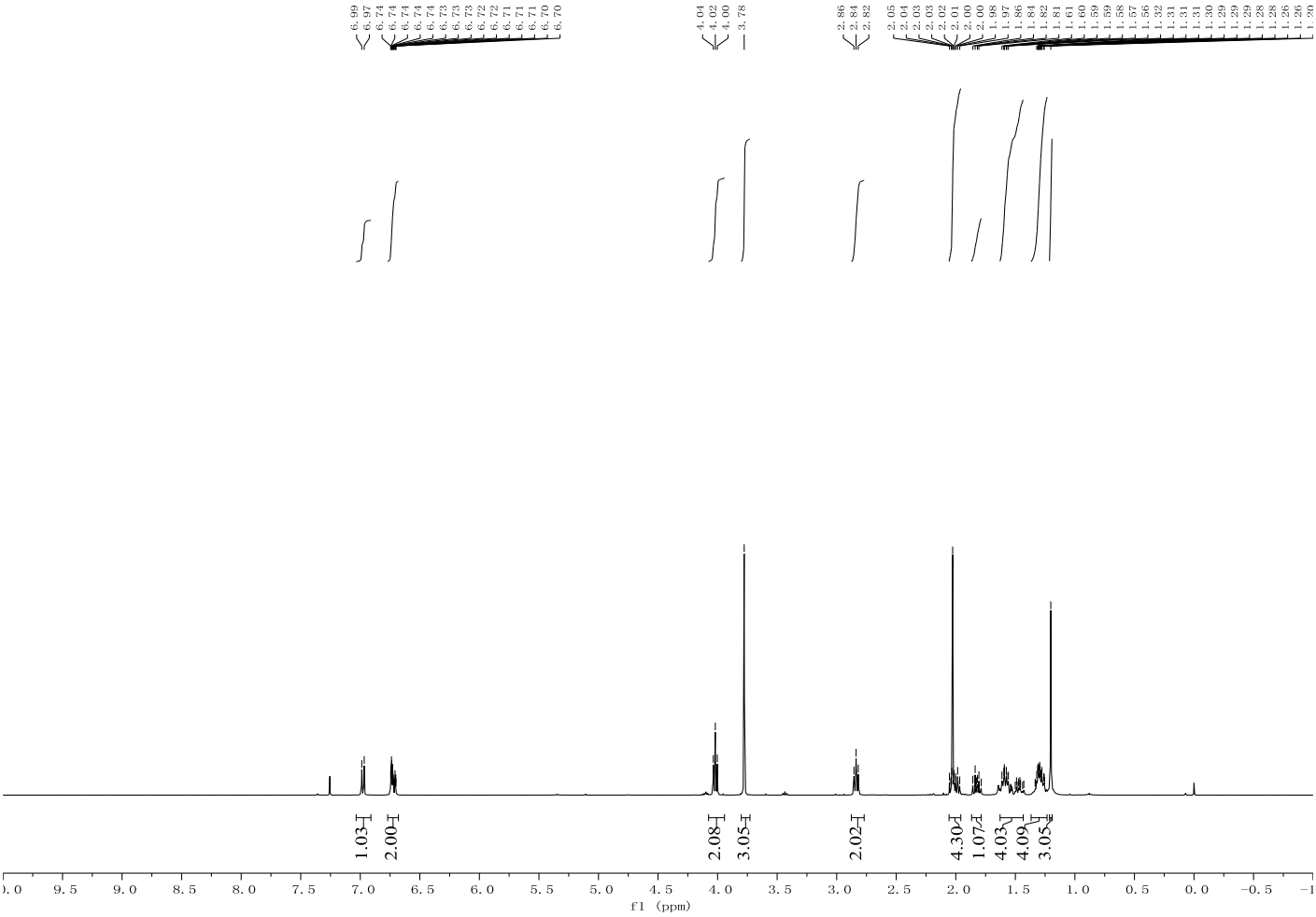
MeO

3i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6.97
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6.74
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6.74
6.73
6.73
6.72
6.72
6.71
6.71
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6.70
4.04
4.02
4.00
3.78
2.86
2.84
2.82
2.05
2.04
2.03
2.03
2.02
2.01
2.00
2.00
1.98
1.97
1.86
1.84
1.82
1.81
1.61
1.60
1.59
1.59
1.58
1.57
1.56
1.32
1.31
1.31
1.30
1.29
1.29
1.29
1.28
1.28
1.26
1.26
1.26
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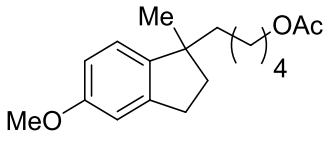
2.08
3.05
2.02
4.30
1.07
4.03
4.09
3.05
f1 (ppm)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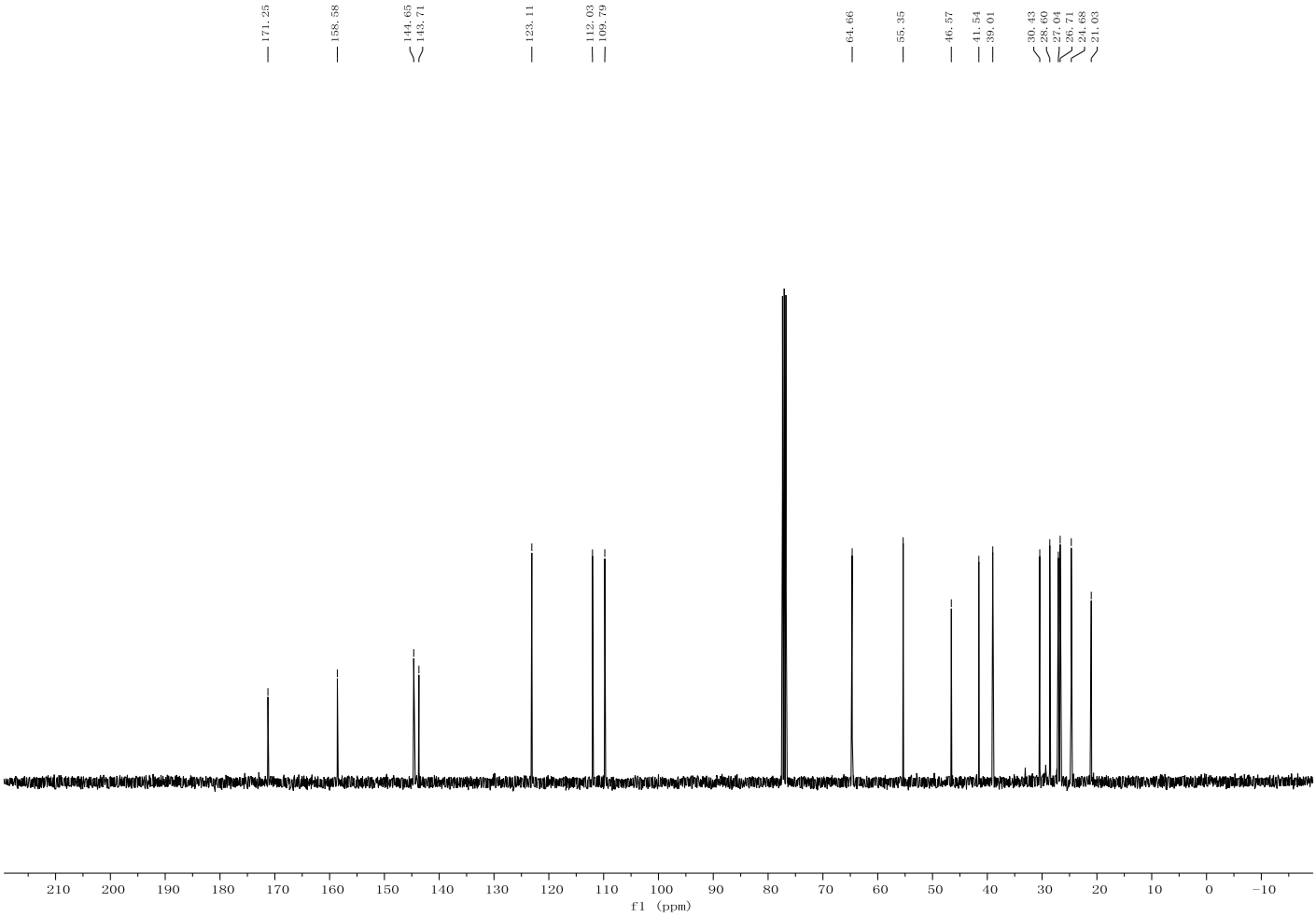
OAc
4
MeO

3i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112.03
109.79
64.66
55.35
46.57
41.54
39.01
30.43
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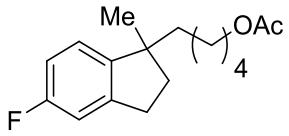
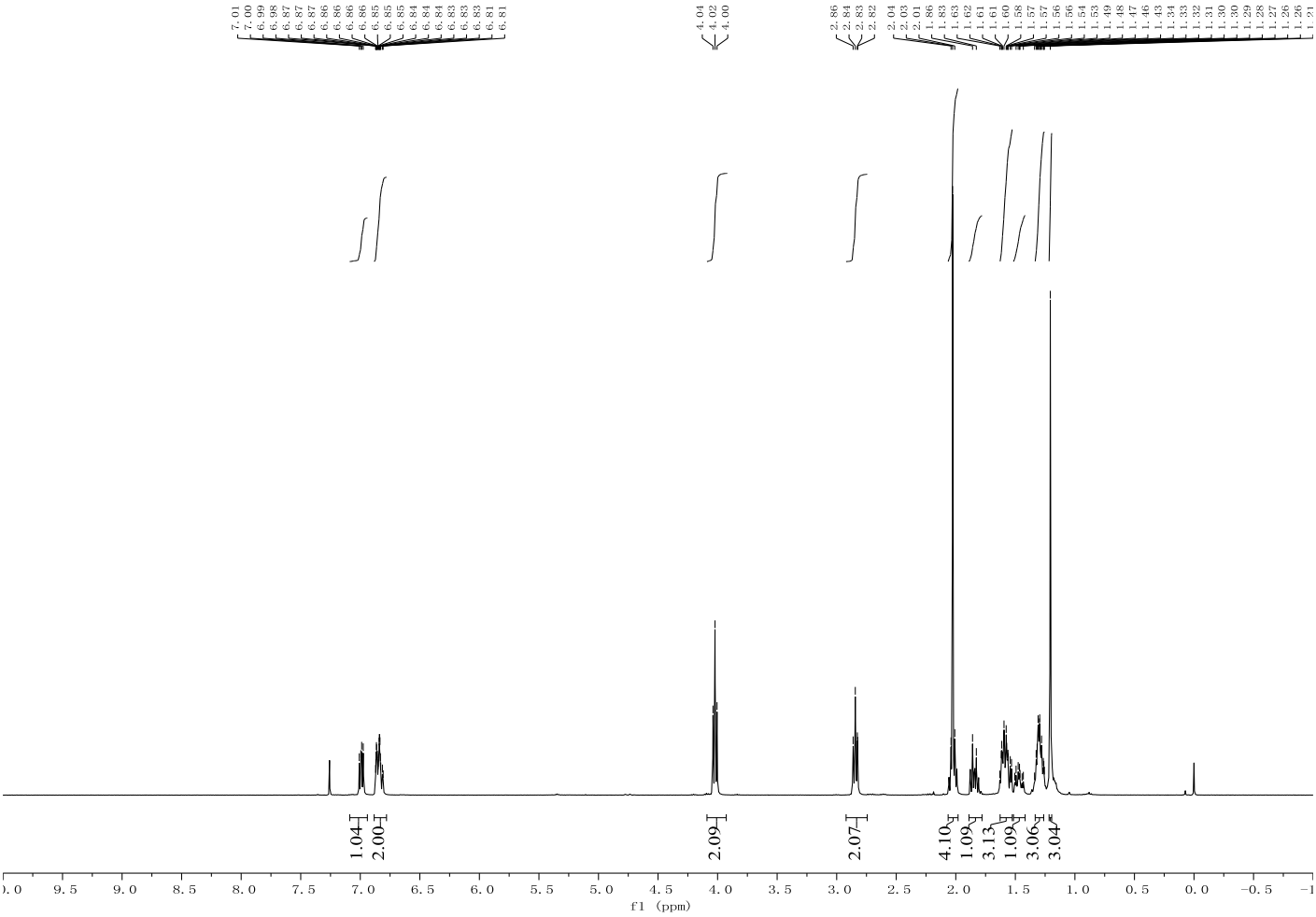
27.04
26.71
24.68
21.03
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)


Me
OAc
4
F

3j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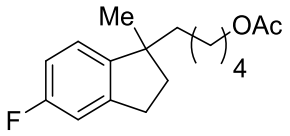
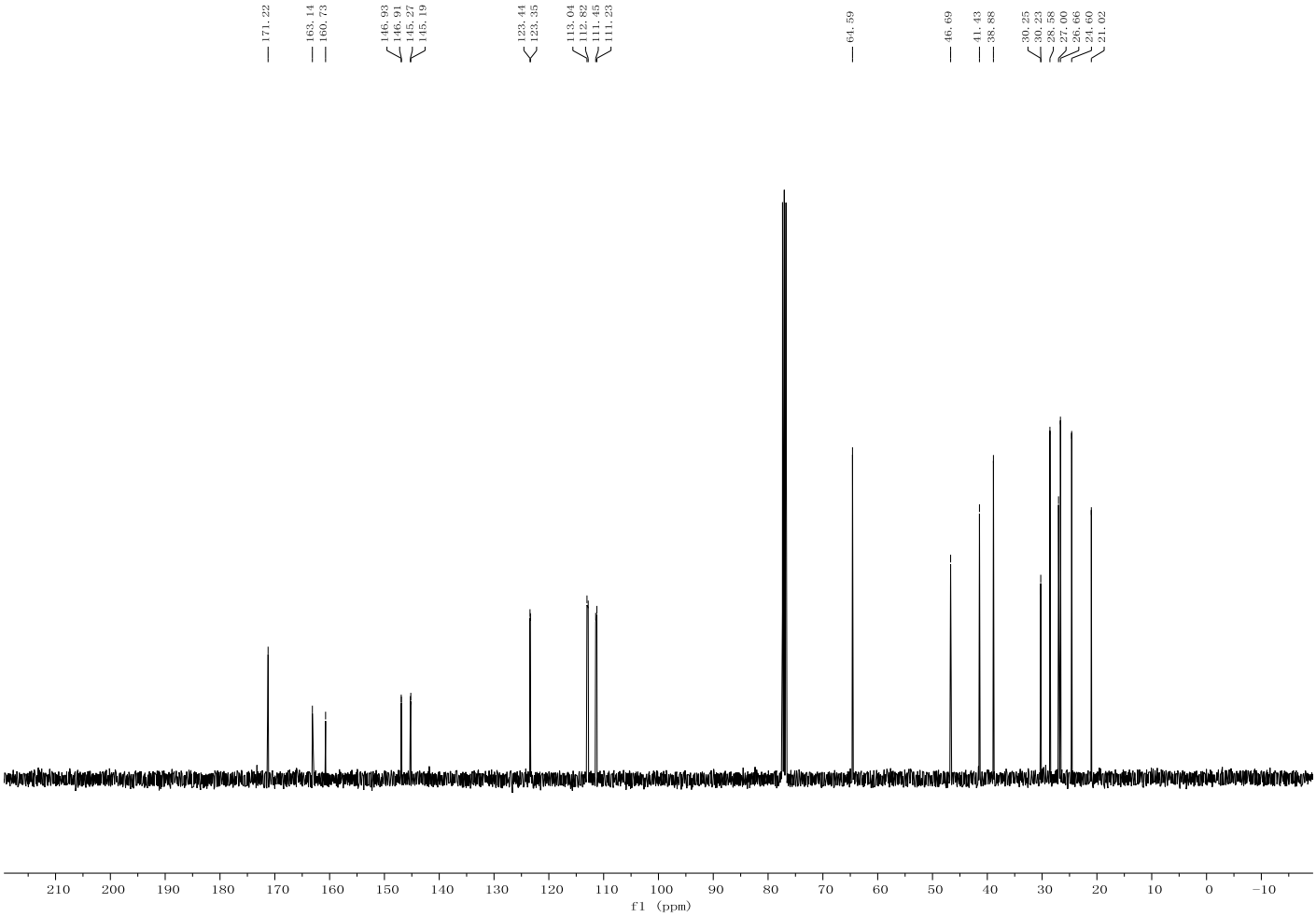
4.04 4.02 4.00
2.86 2.84 2.83 2.82
2.04 2.03 2.01 1.86 1.83 1.63 1.62 1.61 1.61 1.60 1.58 1.57 1.57 1.56 1.56 1.54 1.53 1.49 1.48 1.47 1.46 1.43 1.34 1.33 1.32 1.31 1.30 1.30 1.29 1.28 1.27 1.26 1.26 1.21
1.04 2.00 2.09 2.07 4.10 1.09 3.13 1.09 3.06 3.04
f1 (ppm)


Me
OAc
4
F

3j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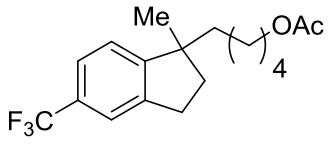
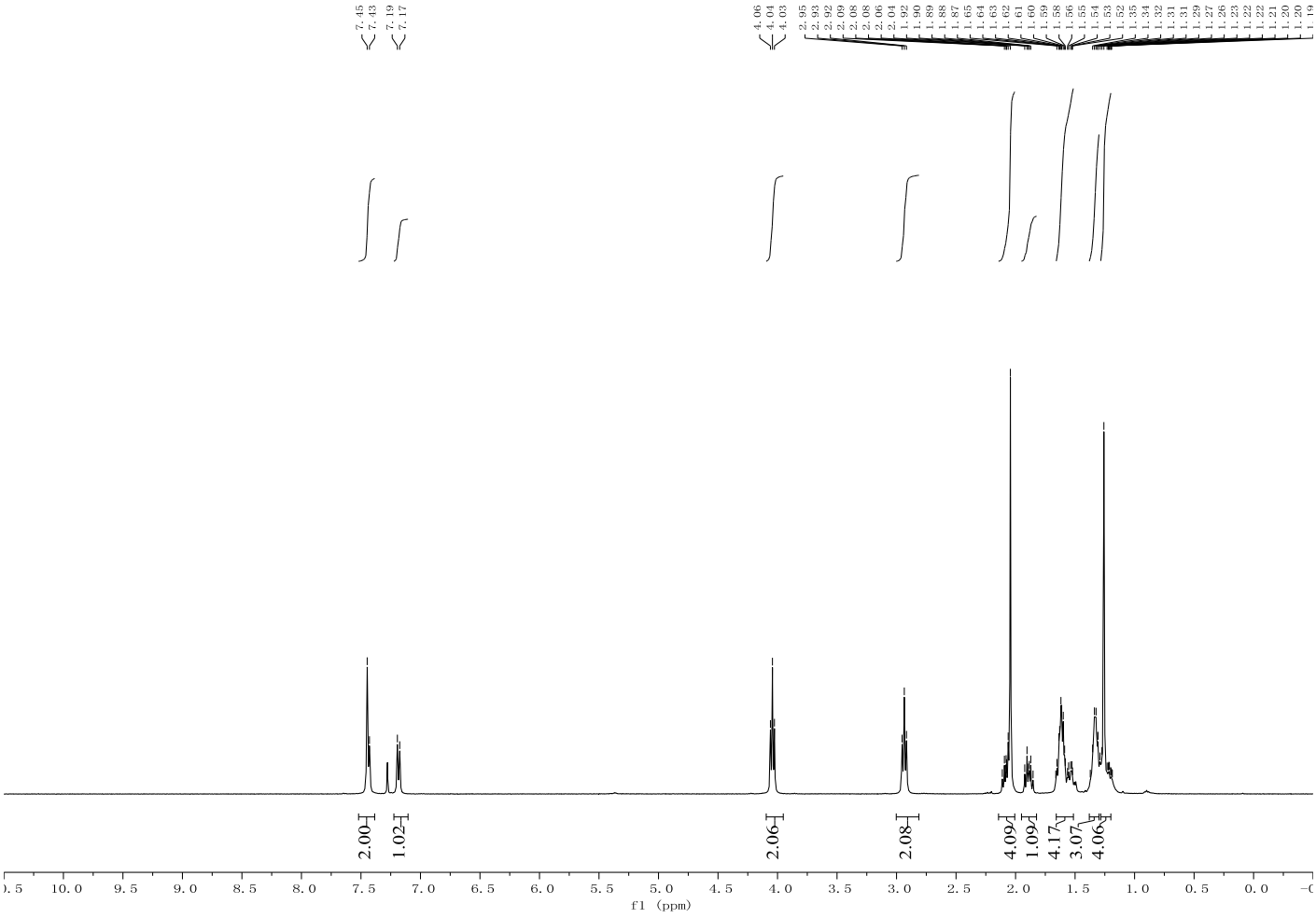
146.91
145.27
145.19
123.44
123.35
113.04
112.82
111.45
111.23
64.59
46.69
41.43
38.88
30.25
30.23
28.58
27.00
26.66
24.60
21.02
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)


Me
OAc
4
F3C

3k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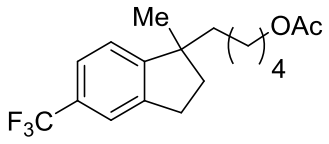
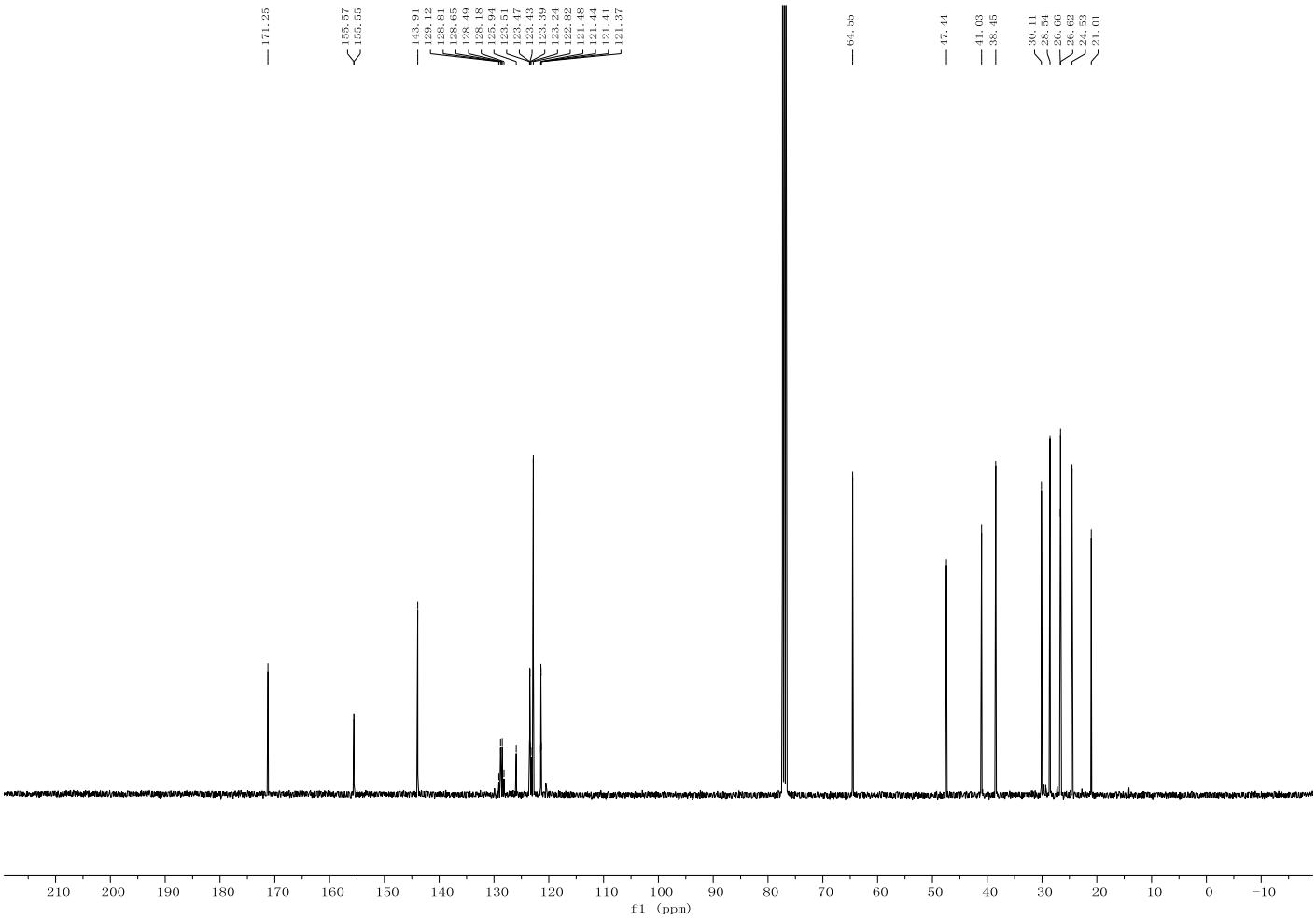
7.43
7.19
7.17
4.06
4.04
4.03
2.95
2.93
2.92
2.09
2.08
2.06
2.04
1.92
1.90
1.89
1.88
1.87
1.65
1.64
1.63
1.62
1.61
1.60
1.59
1.58
1.56
1.55
1.54
1.53
1.52
1.35
1.34
1.32
1.31
1.29
1.27
1.26
1.23
1.22
1.22
1.21
1.20
1.20
1.19
2.00
1.02
2.06
2.08
4.09
1.09
4.17
3.07
4.06
f1 (ppm)


Me
OAc
4
F3C

3k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155.55
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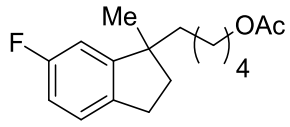
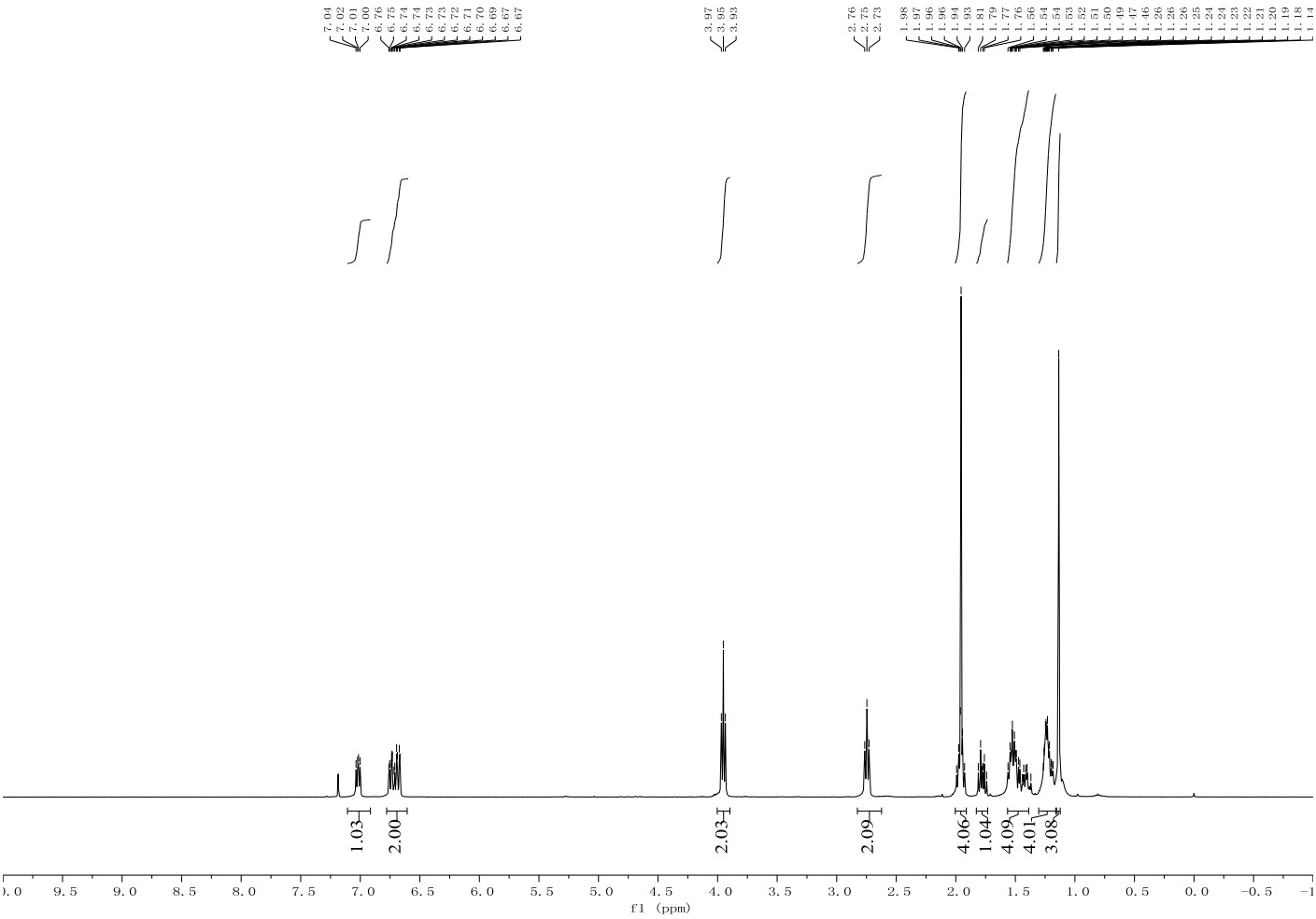
128.81
128.65
128.49
128.18
125.94
123.51
123.47
123.43
123.39
123.24
122.82
121.48
121.44
121.41
121.37
64.55
47.44
41.03
38.45
30.11
28.54
26.66
26.62
24.53
21.01
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)


Me
OAc
F
4

3l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7.01
7.00
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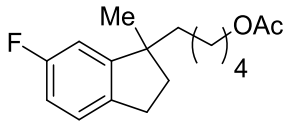
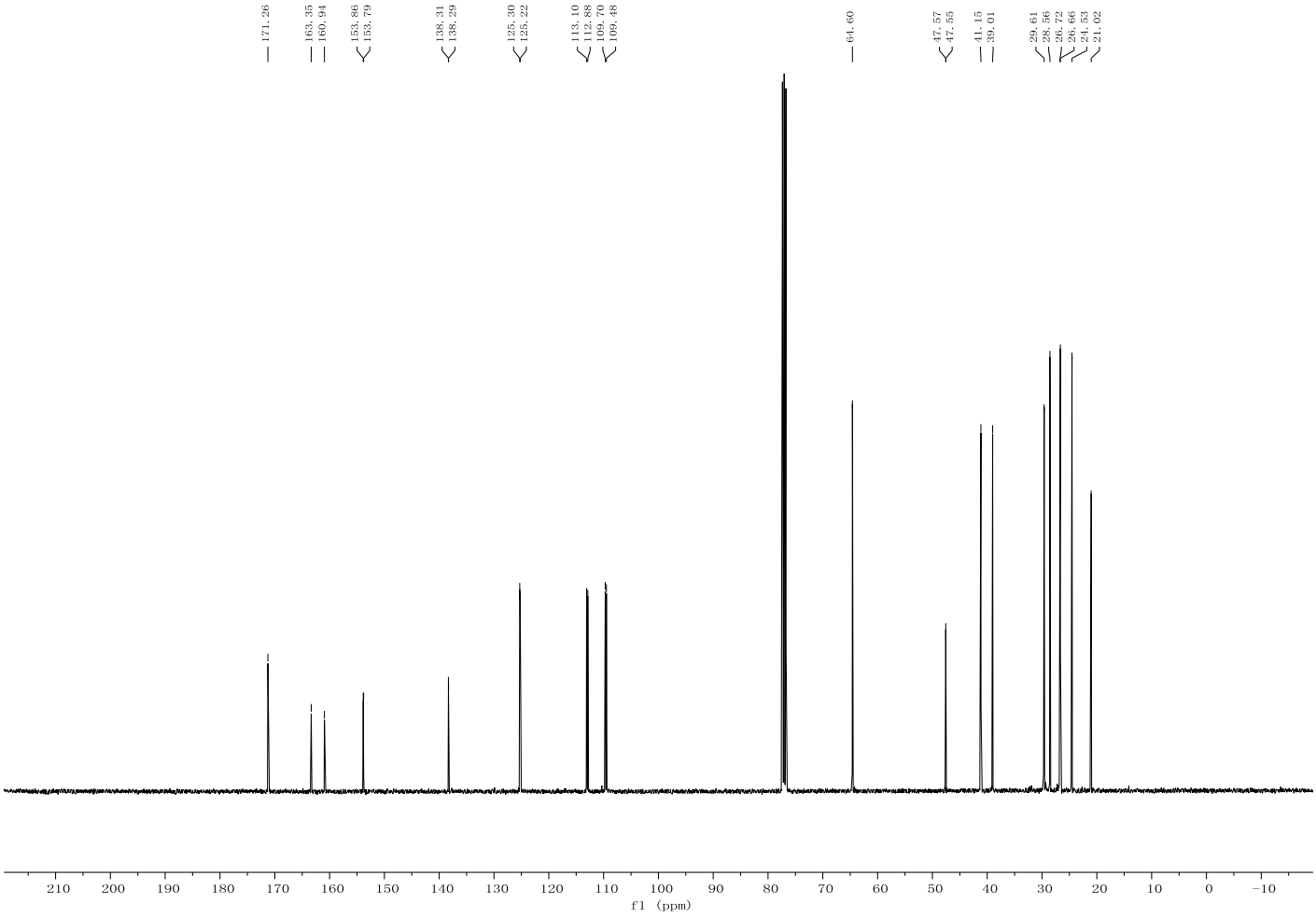
6.75
6.74
6.74
6.73
6.73
6.72
6.71
6.70
6.69
6.67
6.67
3.97
3.95
3.93
2.76
2.75
2.73
1.98
1.97
1.96
1.96
1.94
1.93
1.81
1.79
1.77
1.76
1.56
1.54
1.54
1.53
1.52
1.51
1.50
1.49
1.47
1.46
1.26
1.26
1.26
1.25
1.24
1.24
1.23
1.22
1.21
1.20
1.19
1.18
1.14
1.03
2.00
2.03
2.09
4.06
1.04
4.09
4.01
3.08
f1 (ppm)


Me
OAc
F
4

3l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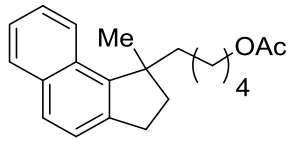
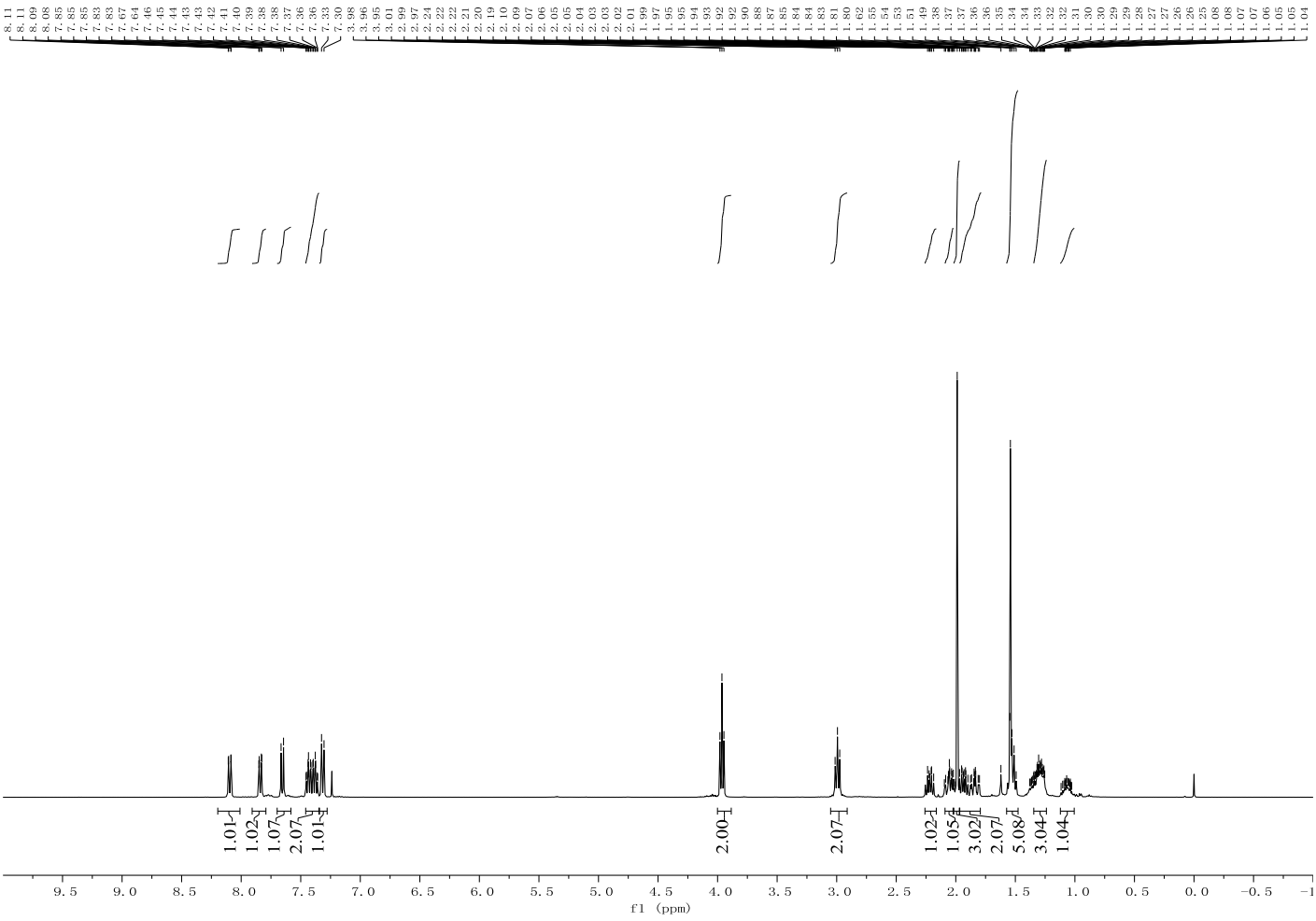
138.31
138.29
125.30
125.22
113.10
112.88
109.70
109.48
64.60
47.57
47.55
41.15
39.01
29.61
28.56
26.72
26.66
24.53
21.02
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)


Me
OAc
4

3m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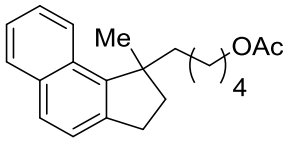
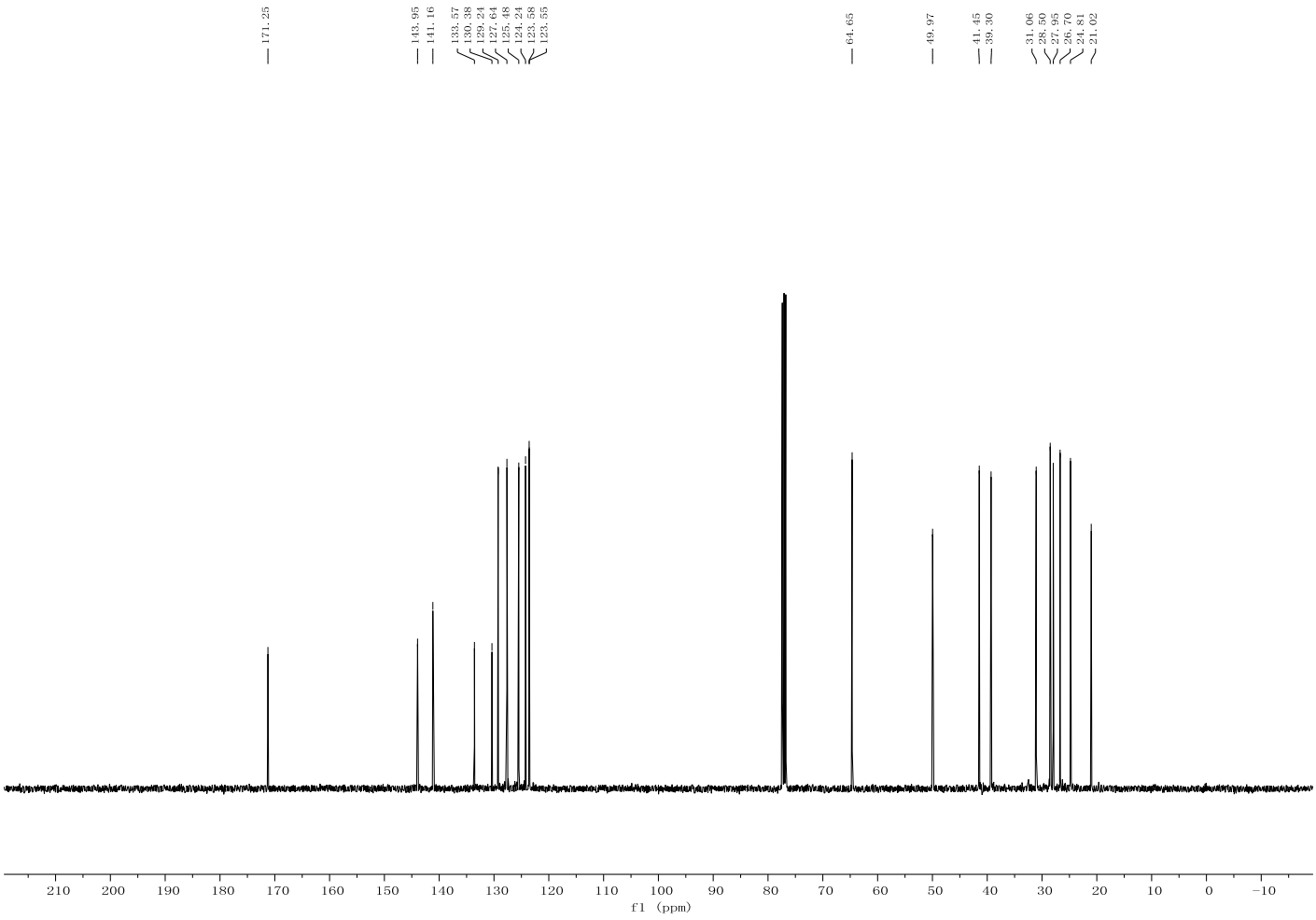
1.02
1.07
2.07
1.01
2.00
2.07
1.02
1.05
3.02
2.07
5.08
3.04
1.04
f1 (ppm)


Me
OAc
4

3m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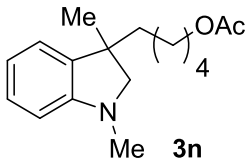
133.57
130.38
129.24
127.64
125.48
124.24
123.58
123.55
64.65
49.97
41.45
39.30
31.06
28.50
27.95
26.70
24.81
21.02
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)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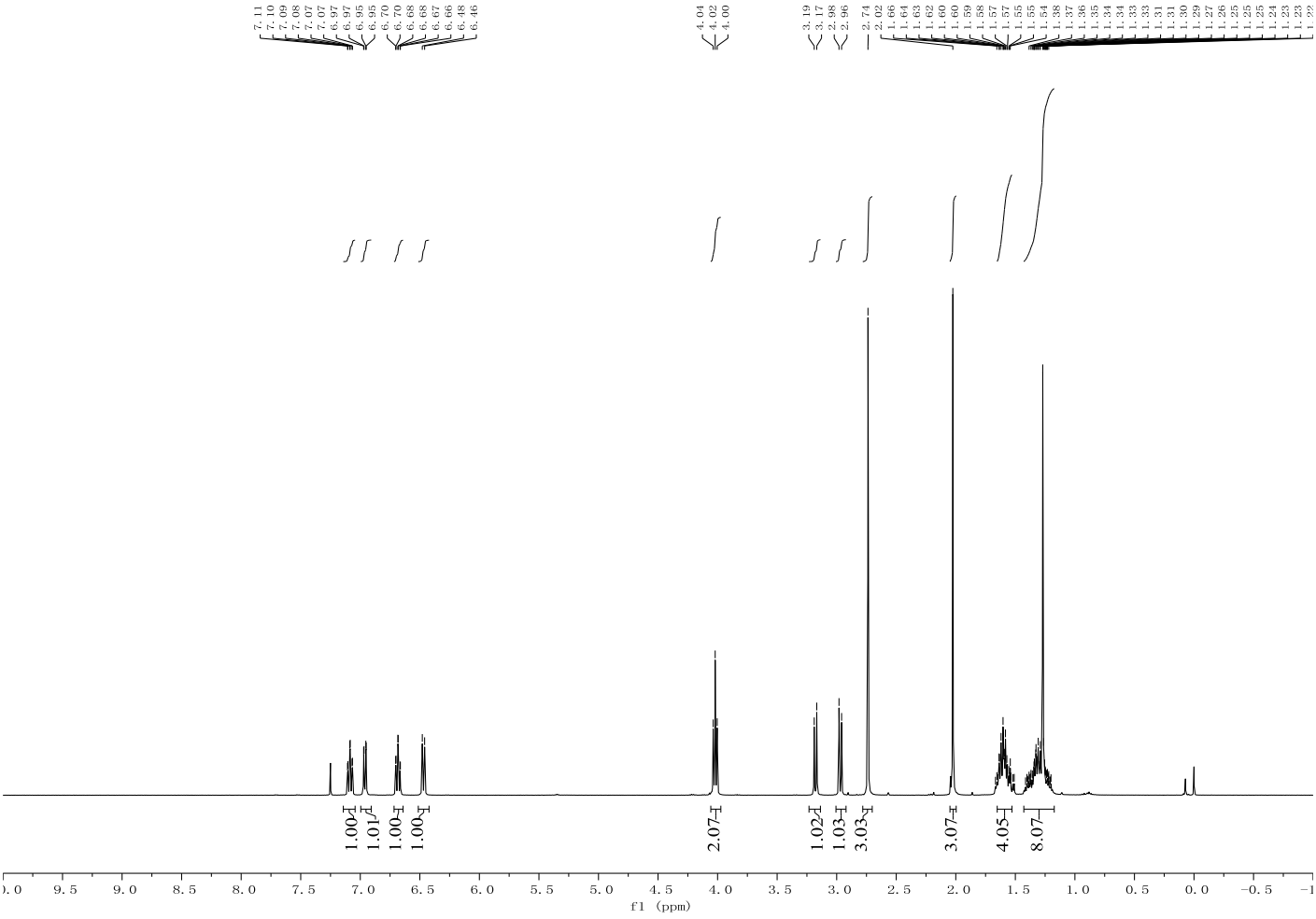
OAc
4
N
Me

3n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7.10
7.09
7.08
7.07
7.07
6.97
6.95
6.95
6.70
6.68
6.67
6.66
6.48
6.46
4.04
4.02
4.00
3.19
3.17
2.98
2.96
2.74
2.02
1.66
1.64
1.63
1.62
1.60
1.60
1.59
1.58
1.57
1.57
1.55
1.55
1.54
1.38
1.37
1.36
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1.33
1.31
1.31
1.30
1.29
1.27
1.26
1.25
1.25
1.25
1.24
1.23
1.23
1.22
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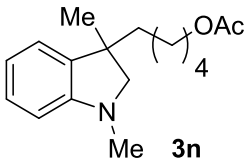
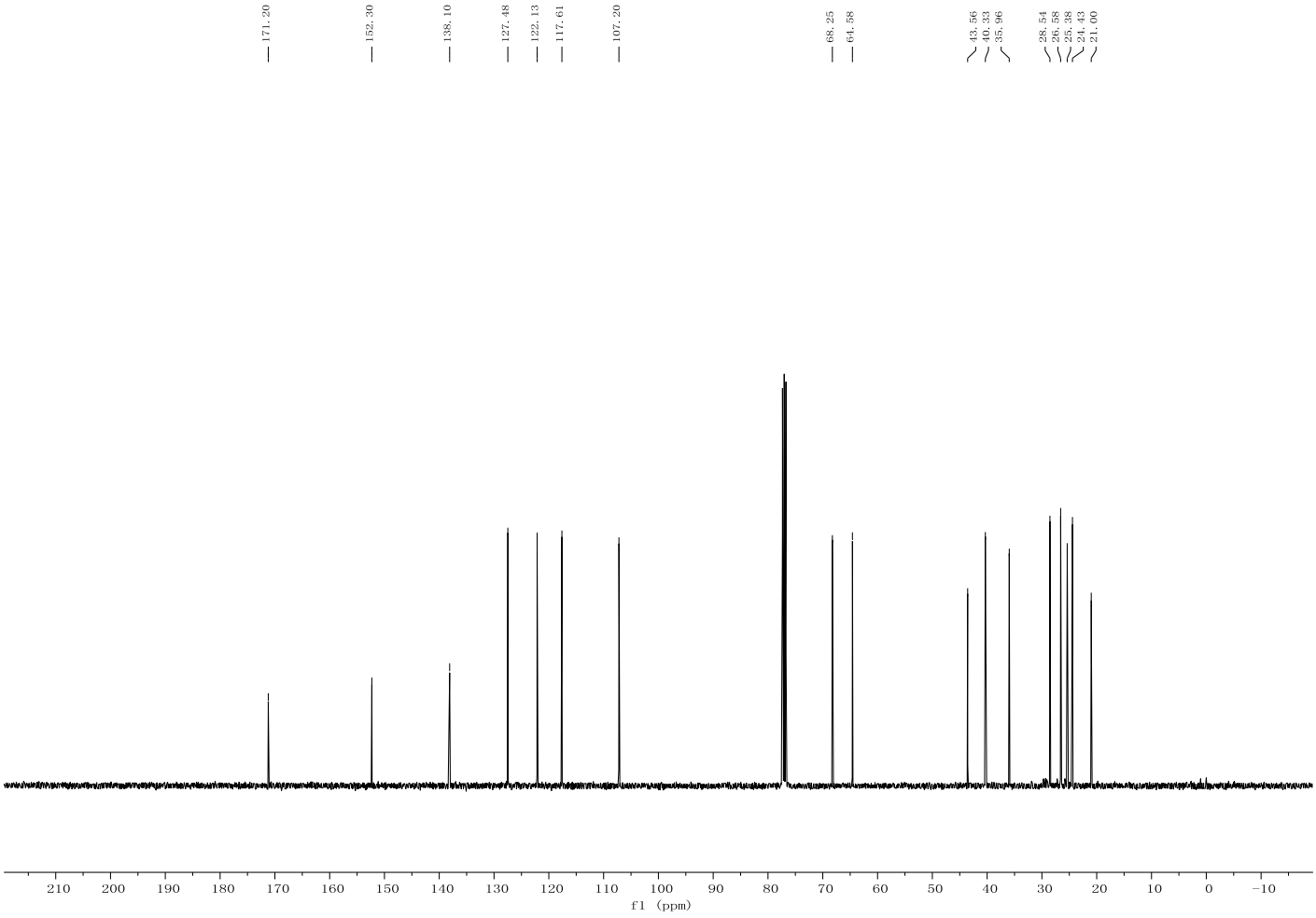
1.00
2.07
1.02
1.03
3.03
3.07
4.05
8.07
f1 (ppm)


Me
OAc
4
N
Me

3n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43.56
40.33
35.96
28.54
26.58
25.38
24.43
21.00
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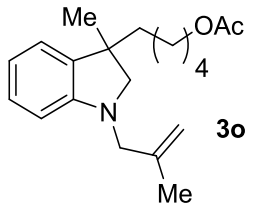
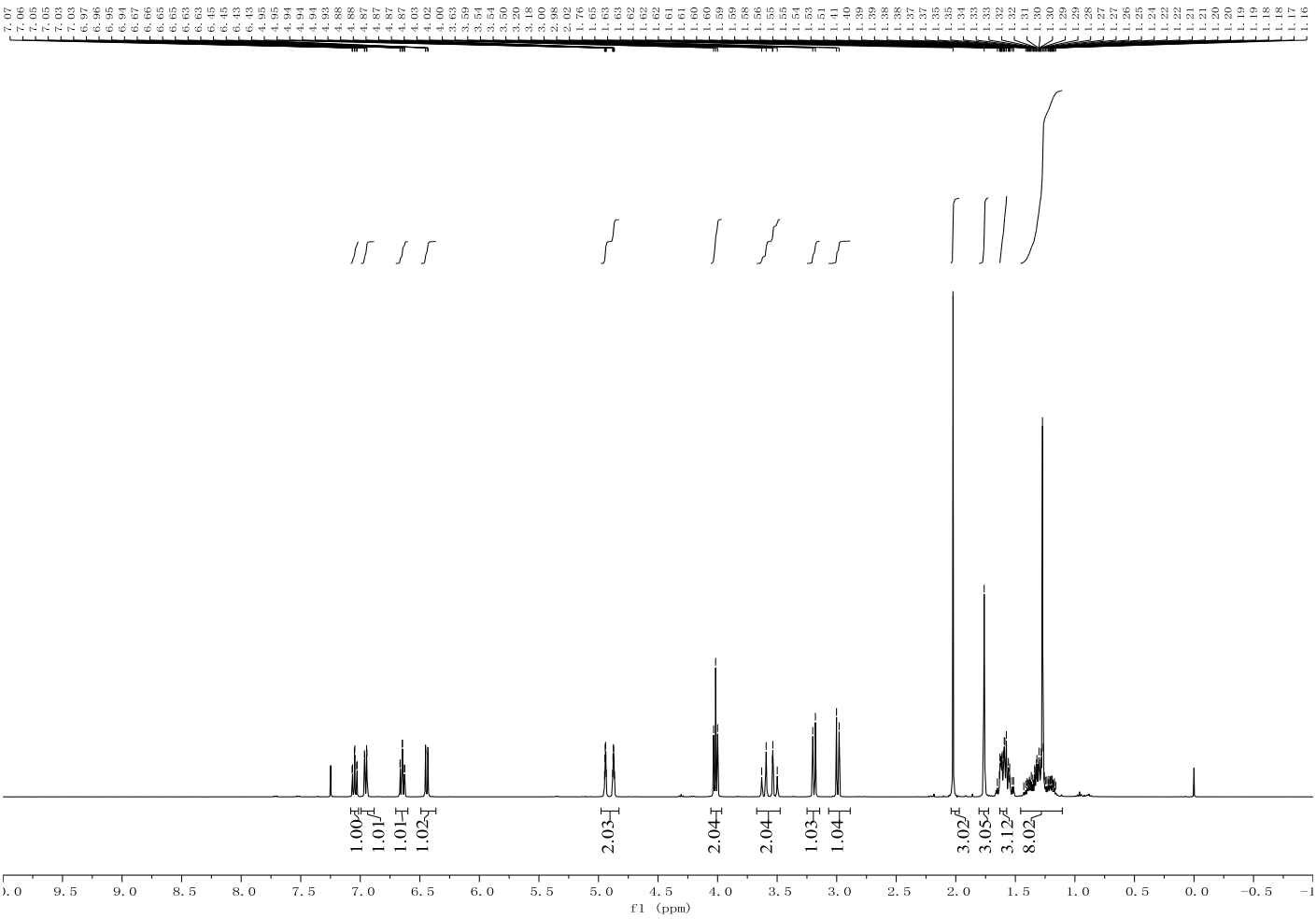
f1 (ppm)


Me
OAc
4
N
Me

3o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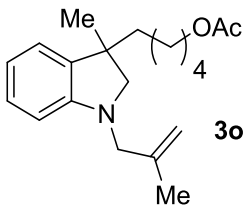
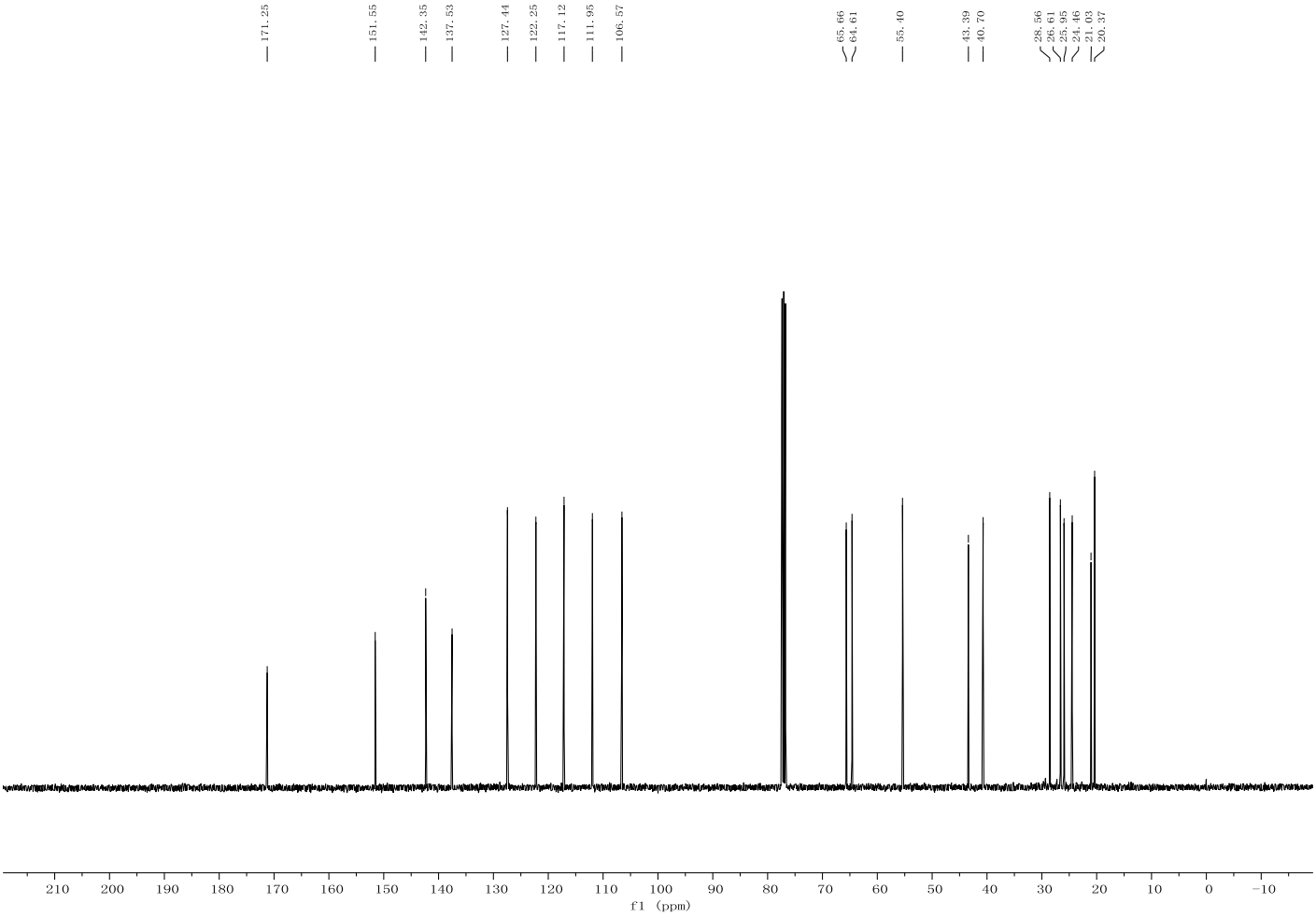
1.01
1.01
1.02
2.03
2.04
2.04
1.03
1.04
3.02
3.05
3.12
8.02
f1 (ppm)


Me
OAc
4
N
Me

3o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142.35
137.53
127.44
122.25
117.12
111.95
106.57
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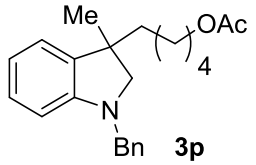
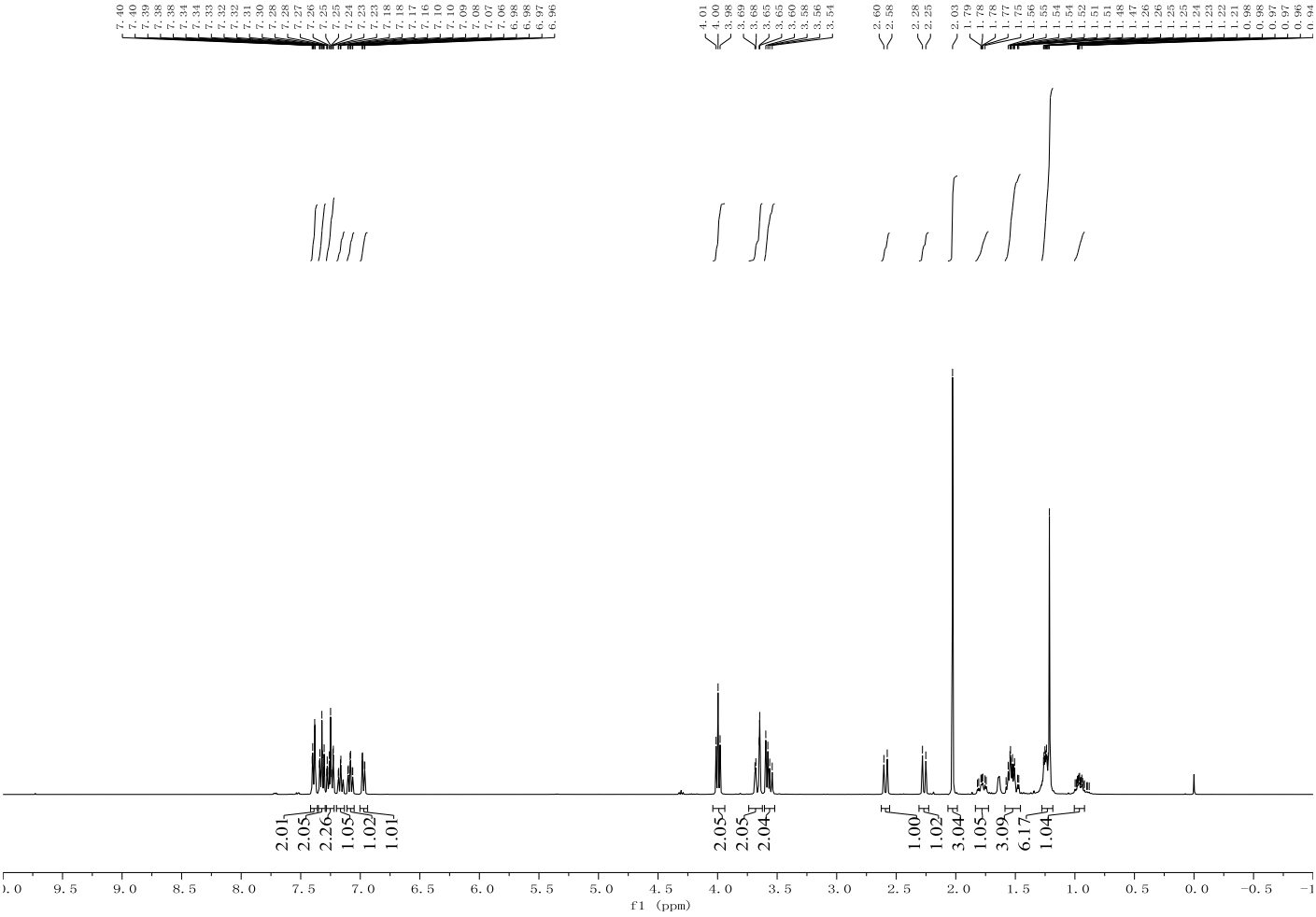
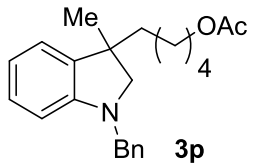
64.61
55.40
43.39
40.70
28.56
26.61
25.95
24.46
21.03
20.37
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

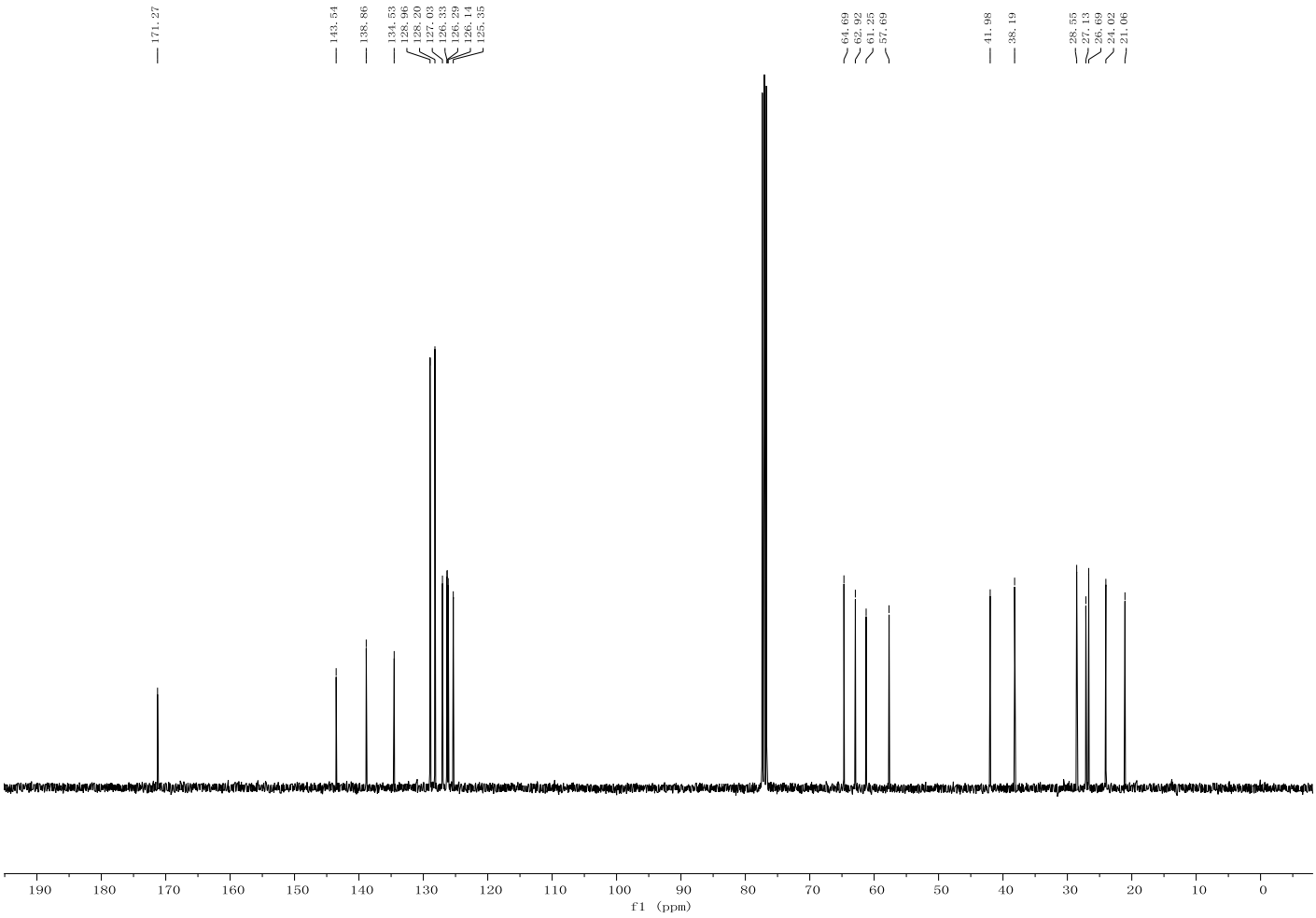

Me
OAc
4
N
Bn

3p


7.40 7.40 7.39 7.38 7.38 7.34 7.34 7.33 7.32 7.31 7.30 7.28 7.28 7.27 7.26 7.25 7.25 7.24 7.23 7.23 7.18 7.18 7.17 7.16 7.10 7.10 7.09 7.08 7.07 7.06 6.98 6.97 6.96
4.01 4.00 3.98 3.69 3.68 3.65 3.65 3.60 3.58 3.56 3.54
2.60 2.58 2.28 2.25 2.03 1.79 1.78 1.78 1.77 1.75 1.56 1.55 1.54 1.54 1.52 1.51 1.51 1.48 1.47 1.26 1.26 1.25 1.25 1.24 1.23 1.22 1.21 0.98 0.98 0.97 0.97 0.96 0.94
2.01 2.05 2.26 1.05 1.02 1.01
2.05 2.05 2.04
1.00 1.02 3.04 1.05 3.09 6.17 1.04
f1 (ppm)


Me
OAc
4
N
Bn

3p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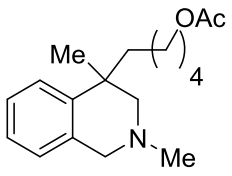
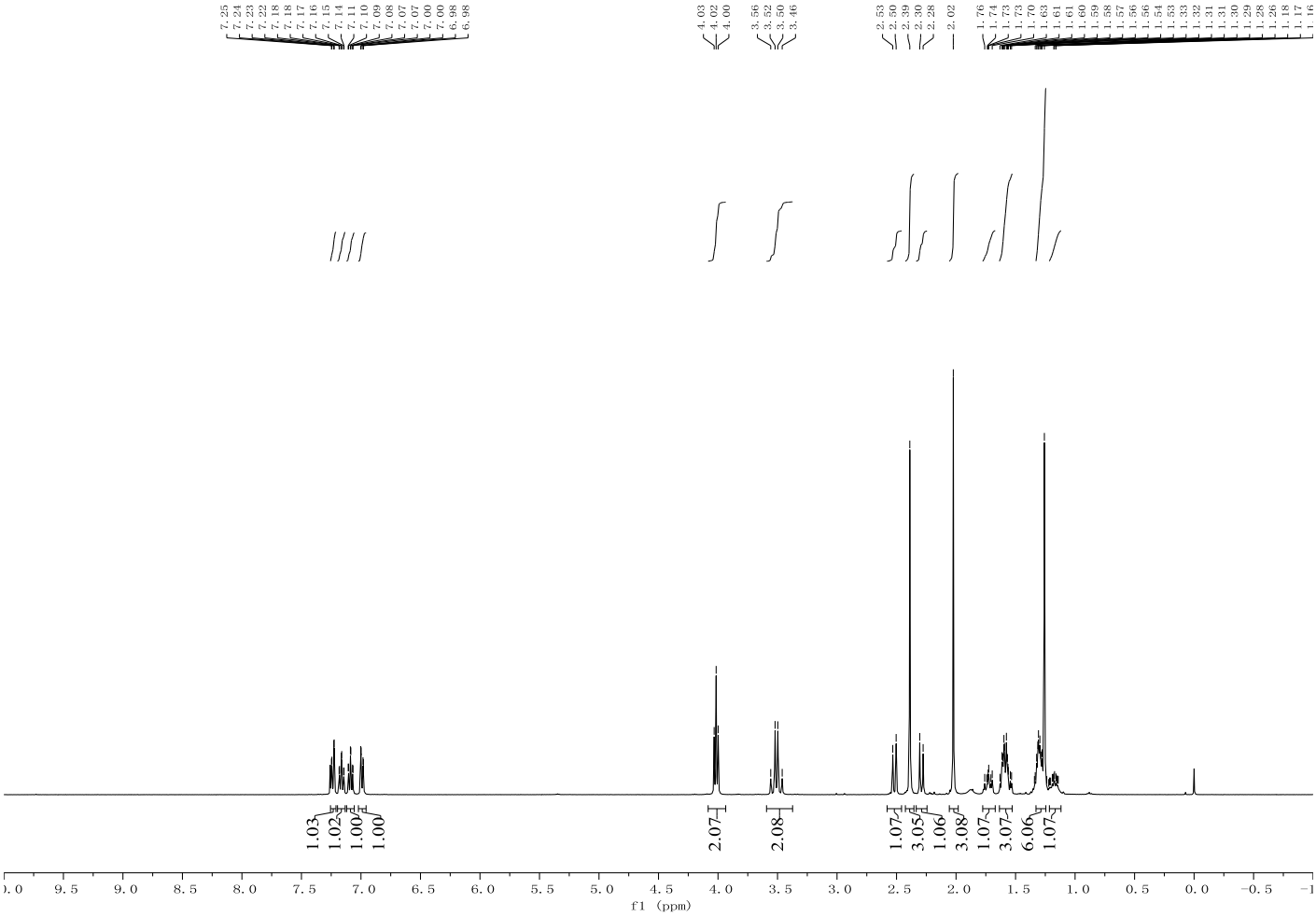
128.20
127.03
126.33
126.29
126.14
125.35
64.69
62.92
61.25
57.69
41.98
38.19
28.55
27.13
26.69
24.02
21.06
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


OAc
Me
4
N
Me

3q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7.23
7.22
7.18
7.17
7.16
7.15
7.14
7.11
7.10
7.09
7.08
7.07
7.07
7.00
7.00
6.98
6.98
4.03
4.02
4.00
3.56
3.52
3.50
3.46
2.53
2.50
2.39
2.30
2.28
2.02
1.76
1.74
1.73
1.73
1.70
1.63
1.61
1.61
1.60
1.59
1.58
1.57
1.56
1.56
1.54
1.53
1.33
1.32
1.31
1.31
1.30
1.29
1.28
1.26
1.18
1.17
1.16
1.03
1.02
1.00
1.00
2.07
2.08
1.07
3.05
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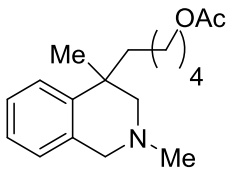
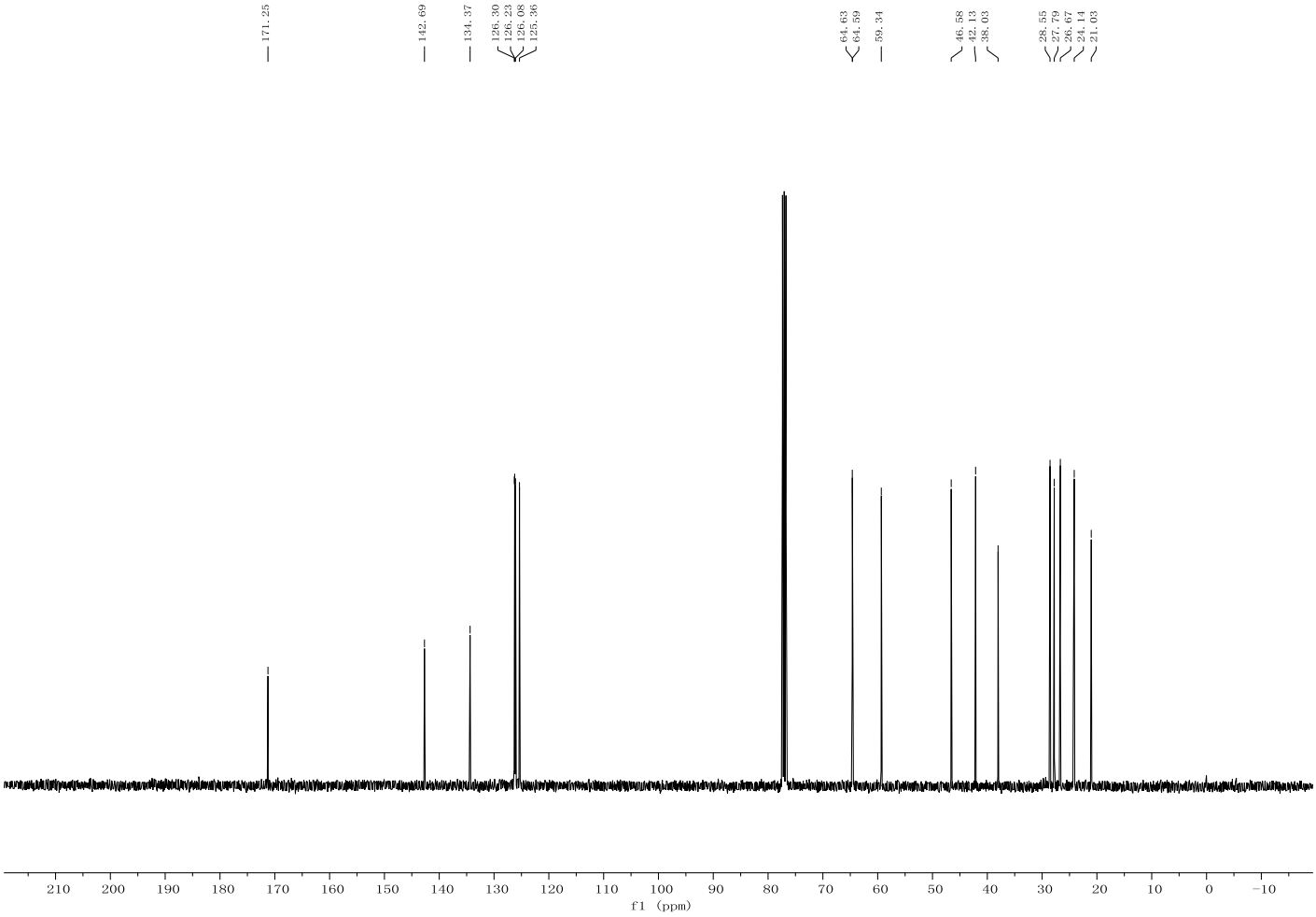
1.07
3.07
6.06
1.07
f1 (ppm)


OAc
Me
4
N
Me

3q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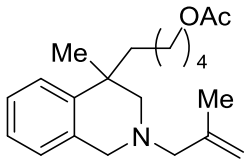
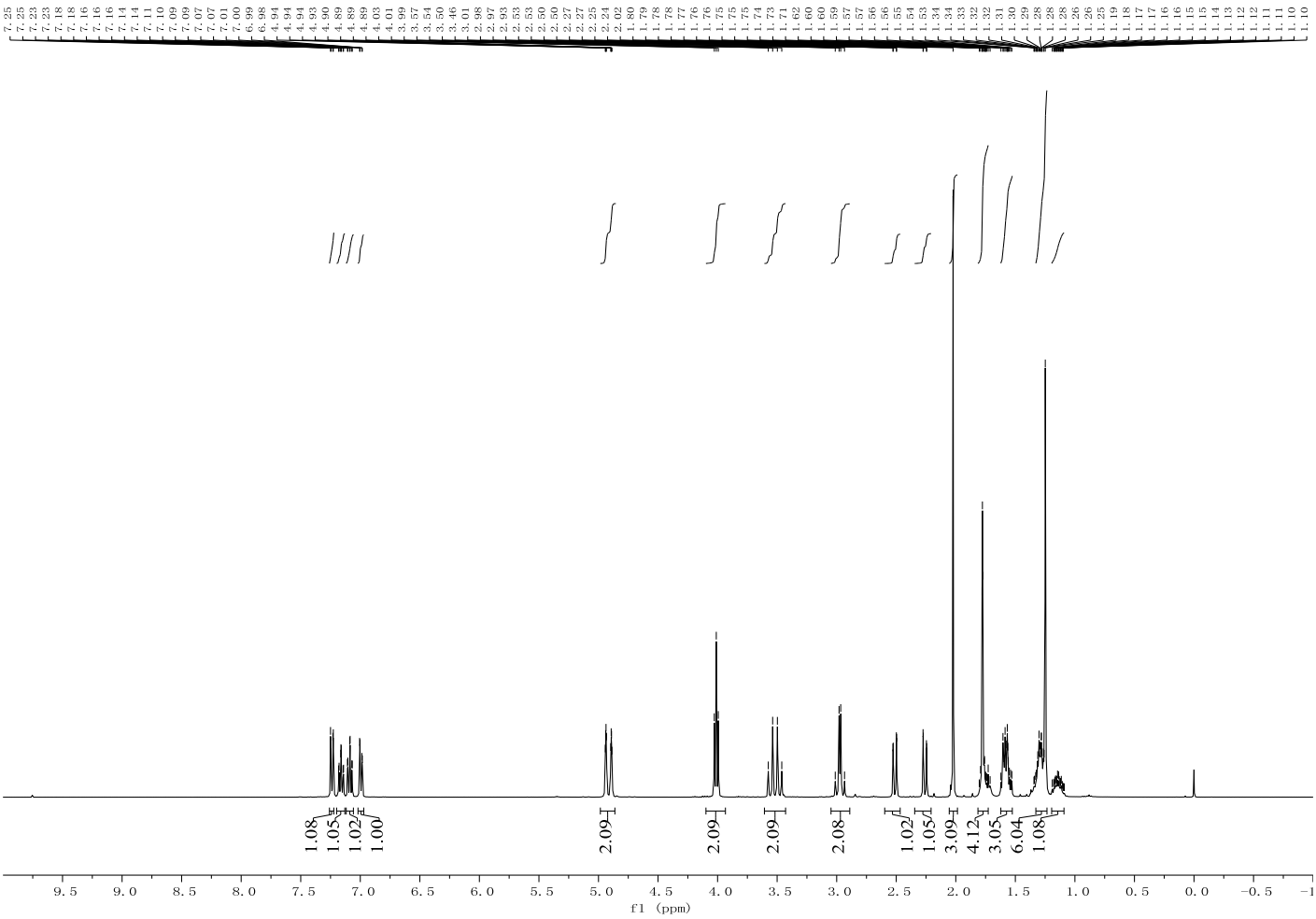
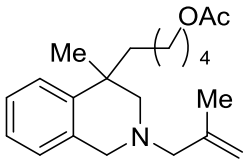
142.69
134.37
126.30
126.23
126.08
125.36
64.63
64.59
59.34
46.58
42.13
38.03
28.55
27.79
26.67
24.14
21.03
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

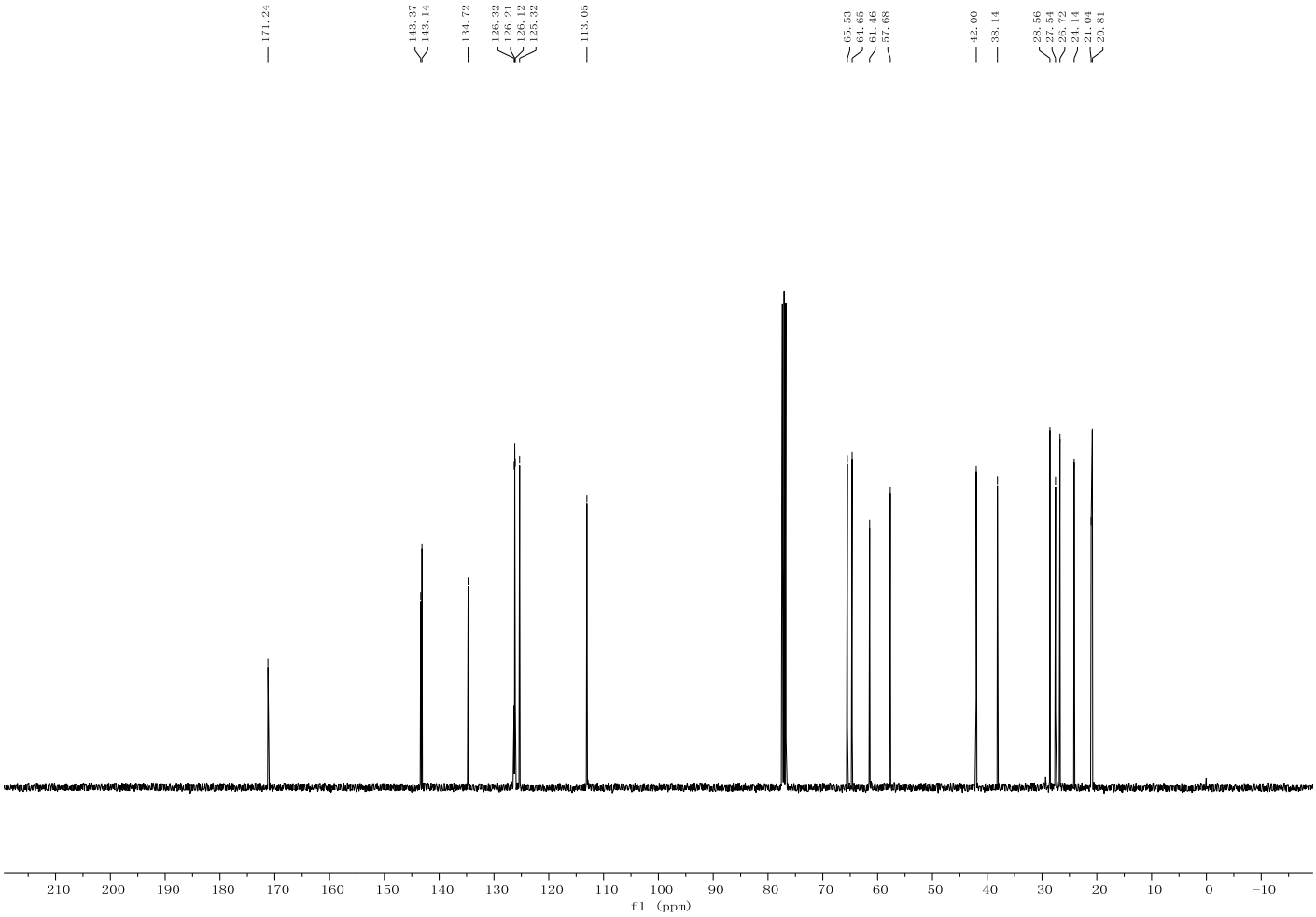

OAc
Me
4
Me
N

3r


1.08
1.05
1.02
1.00
2.09
2.09
2.09
2.08
1.02
1.05
3.09
4.12
3.05
6.04
1.08
f1 (ppm)


OAc
Me
4
Me
N

3r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143.14
134.72
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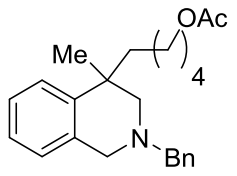
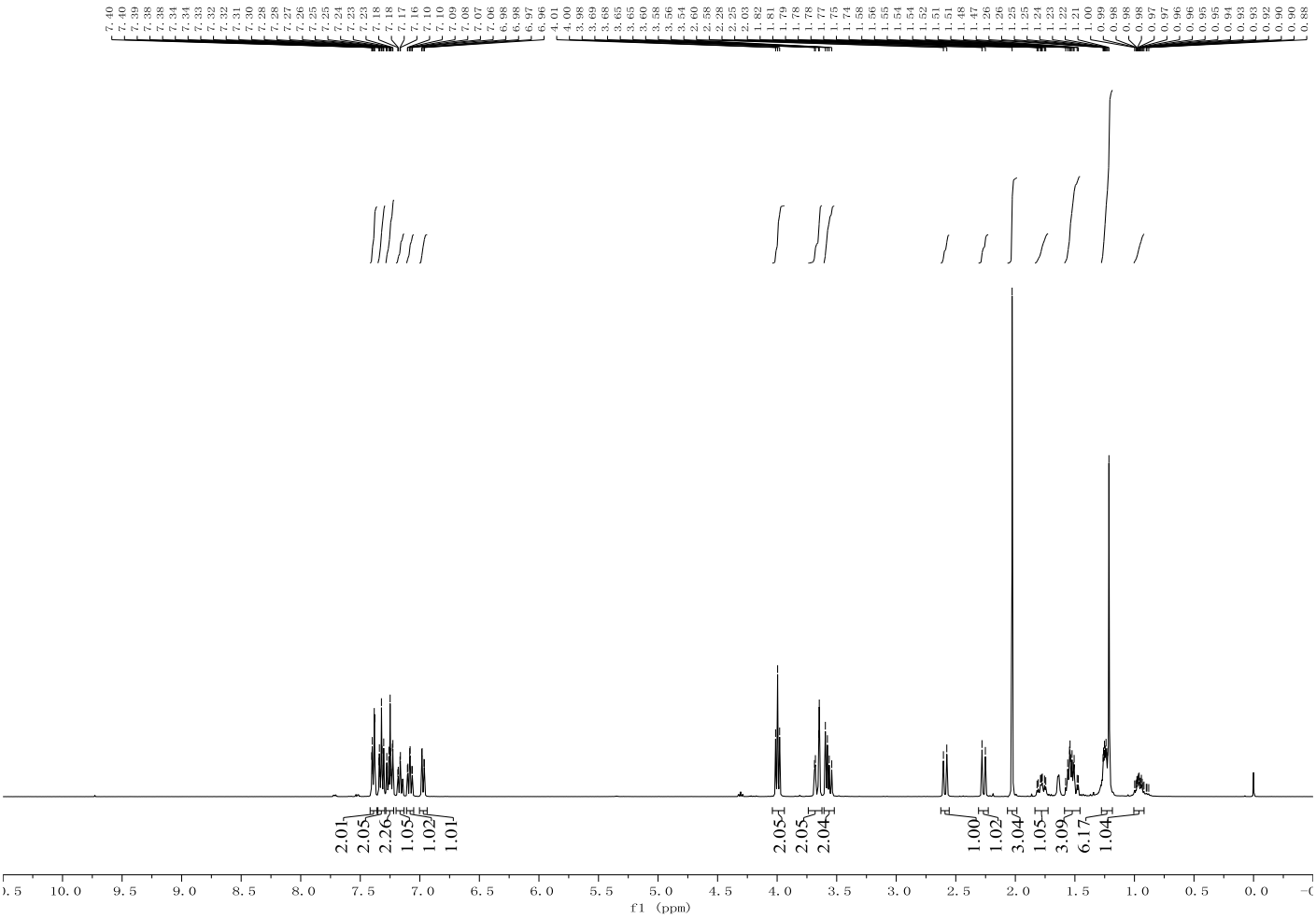
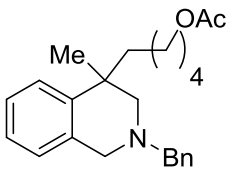
126.21
126.12
125.32
113.05
65.53
64.65
61.46
57.68
42.00
38.14
28.56
27.54
26.72
24.14
21.04
20.81
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

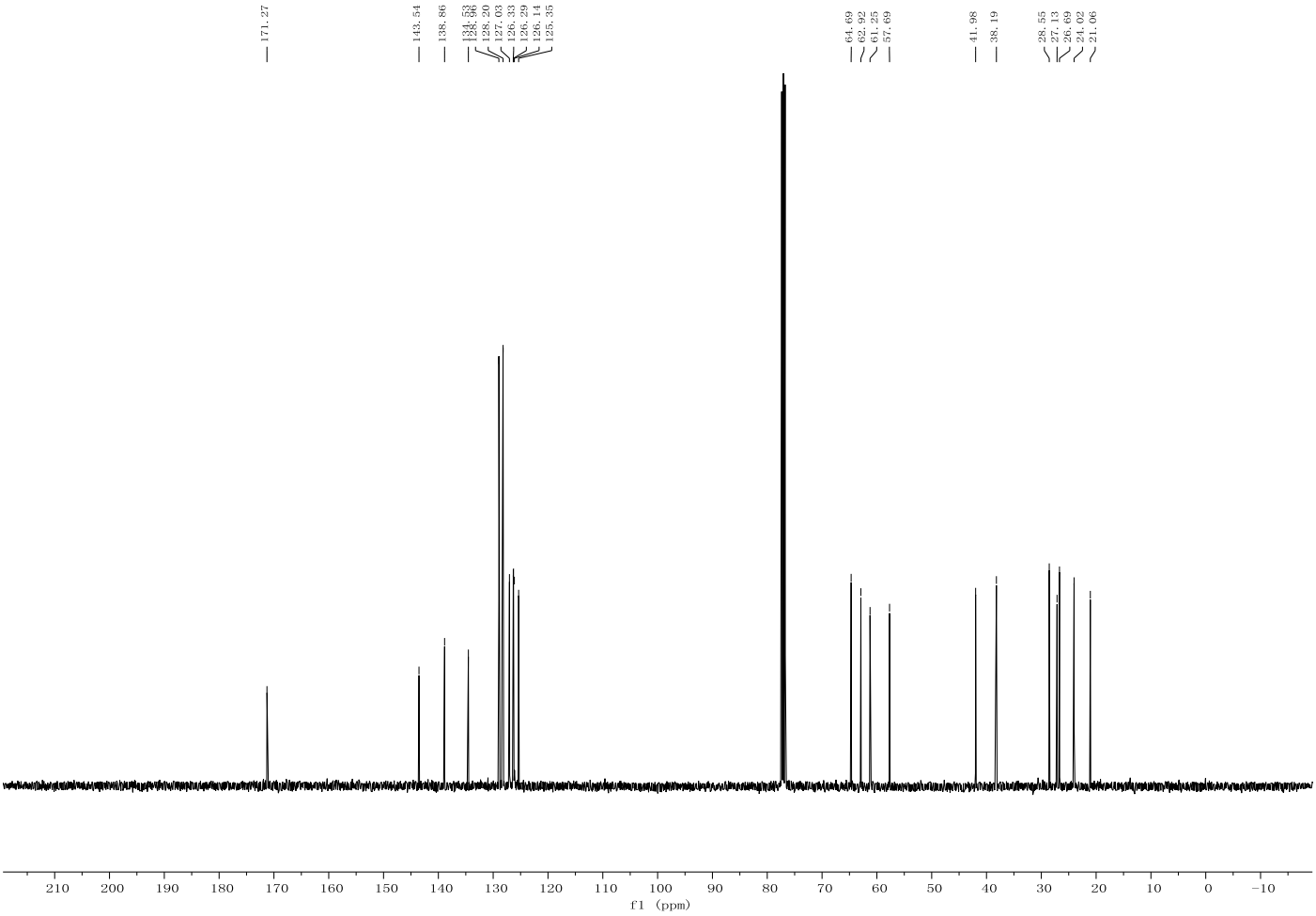


3s




OAc
Me
4
N
Bn

3s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134.53
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128.20
127.03
126.33
126.29
126.14
125.35
64.69
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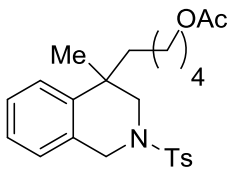
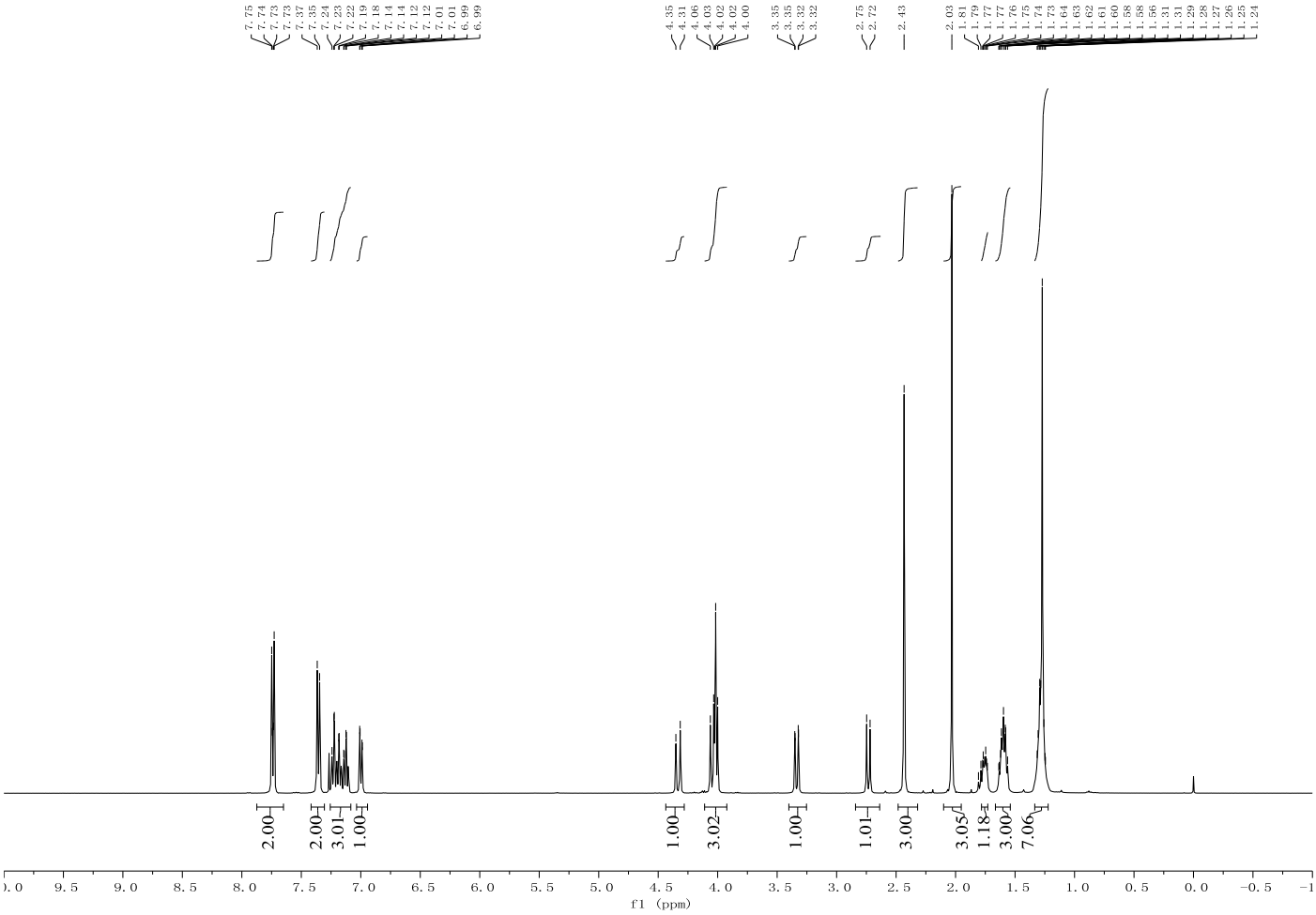
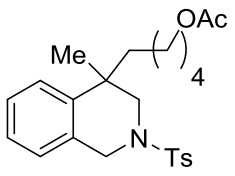
61.25
57.69
41.98
38.19
28.55
27.13
26.69
24.02
21.06
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

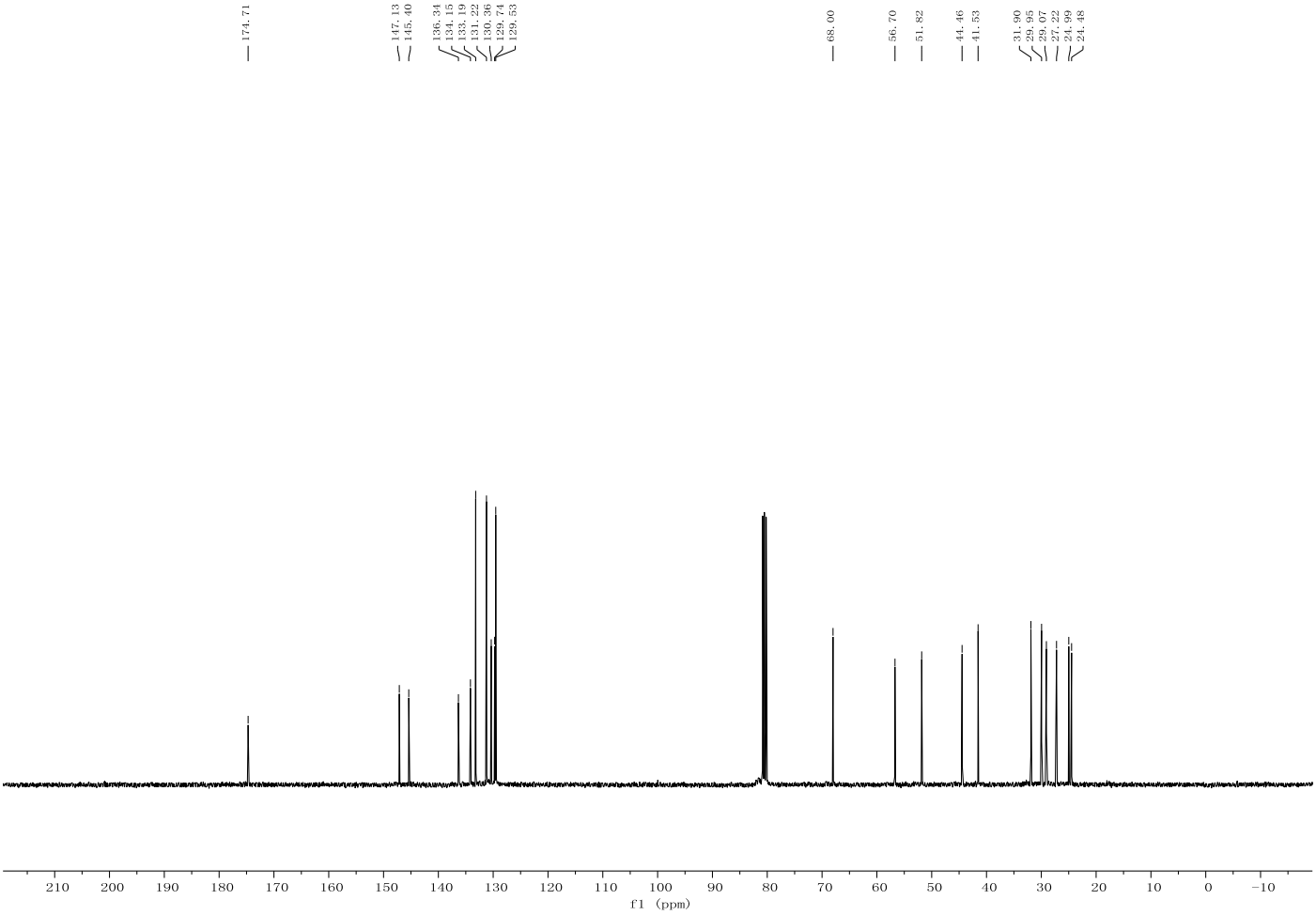

OAc
Me
4
N
Ts

3t


7.75
7.74
7.73
7.73
7.37
7.35
7.24
7.23
7.22
7.19
7.18
7.14
7.14
7.12
7.12
7.01
7.01
6.99
6.99
4.35
4.31
4.06
4.03
4.02
4.02
4.00
3.35
3.35
3.32
3.32
2.75
2.72
2.43
2.03
1.81
1.79
1.77
1.77
1.76
1.75
1.74
1.73
1.64
1.63
1.62
1.61
1.60
1.58
1.58
1.56
1.31
1.31
1.29
1.28
1.27
1.26
1.25
1.24
2.00
2.00
3.01
1.00
1.00
3.02
1.00
1.01
3.00
3.05
1.18
3.00
7.06
f1 (ppm)


OAc
Me
4
N
Ts

3t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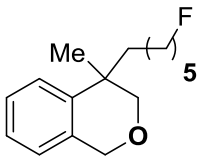
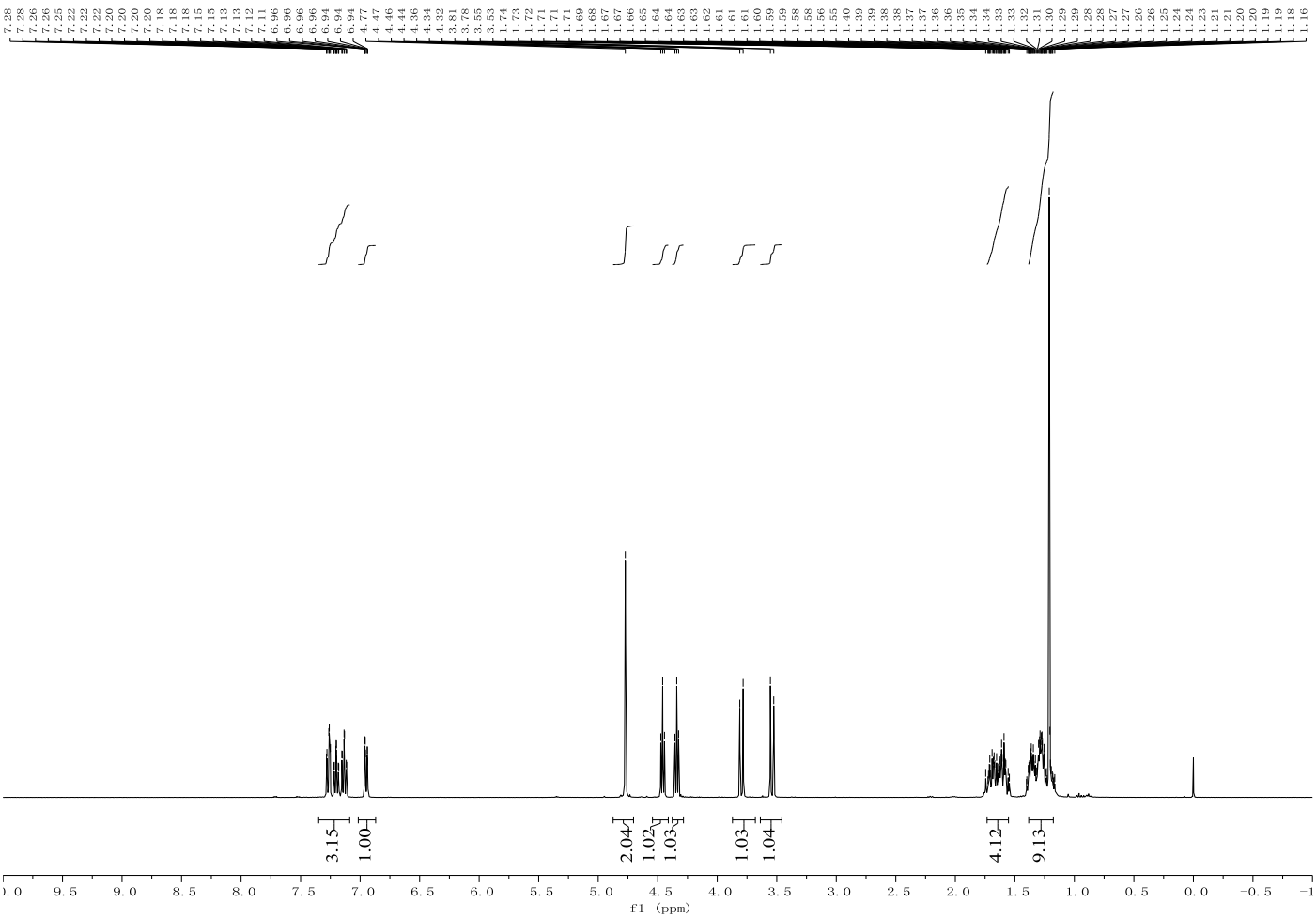
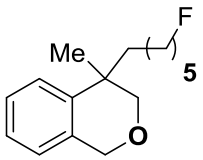
147.13
145.40
136.34
134.15
133.19
131.22
130.36
129.74
129.53
68.00
56.70
51.82
44.46
41.53
31.90
29.95
29.07
27.22
24.99
24.48
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

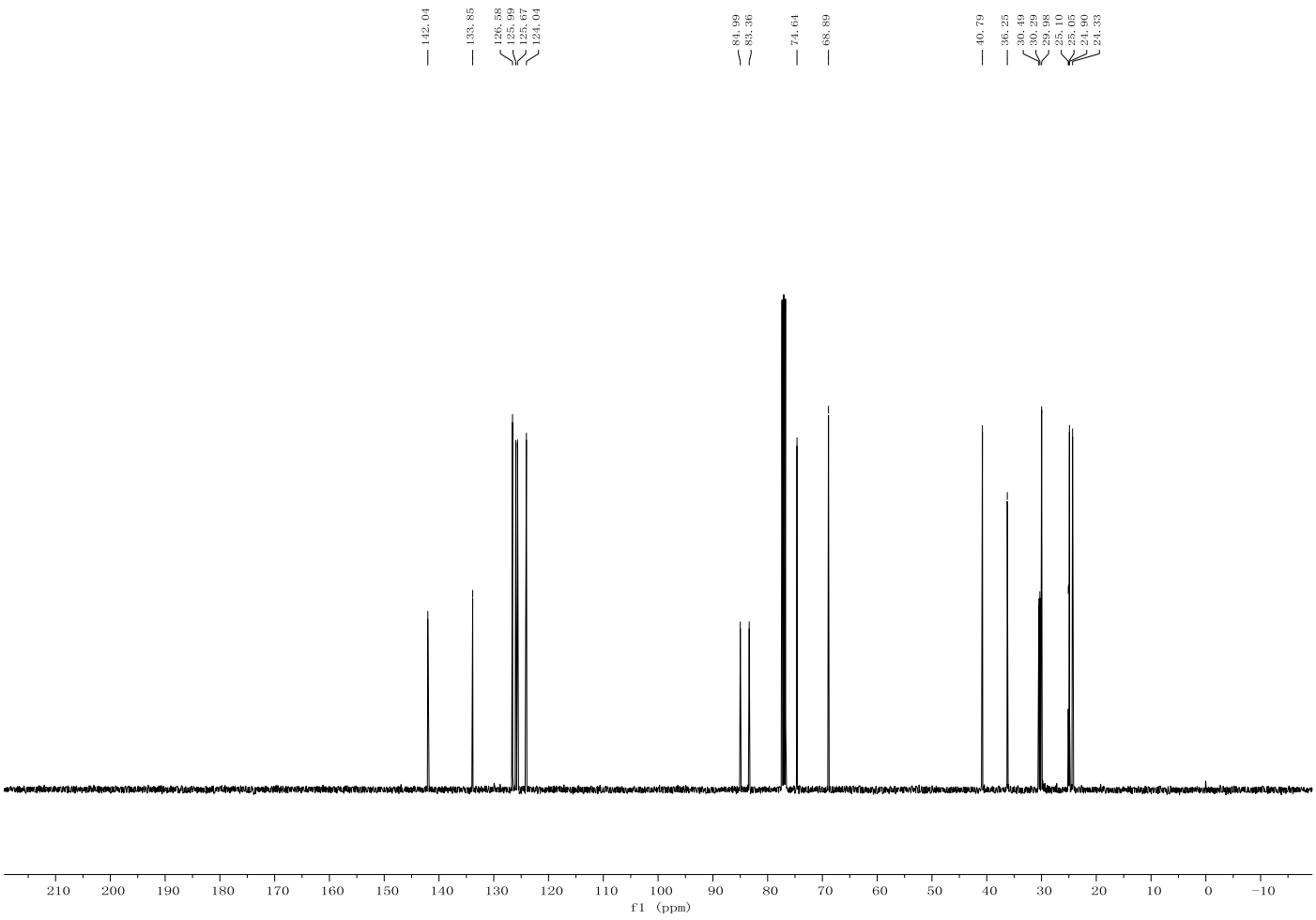


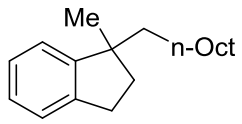
3u



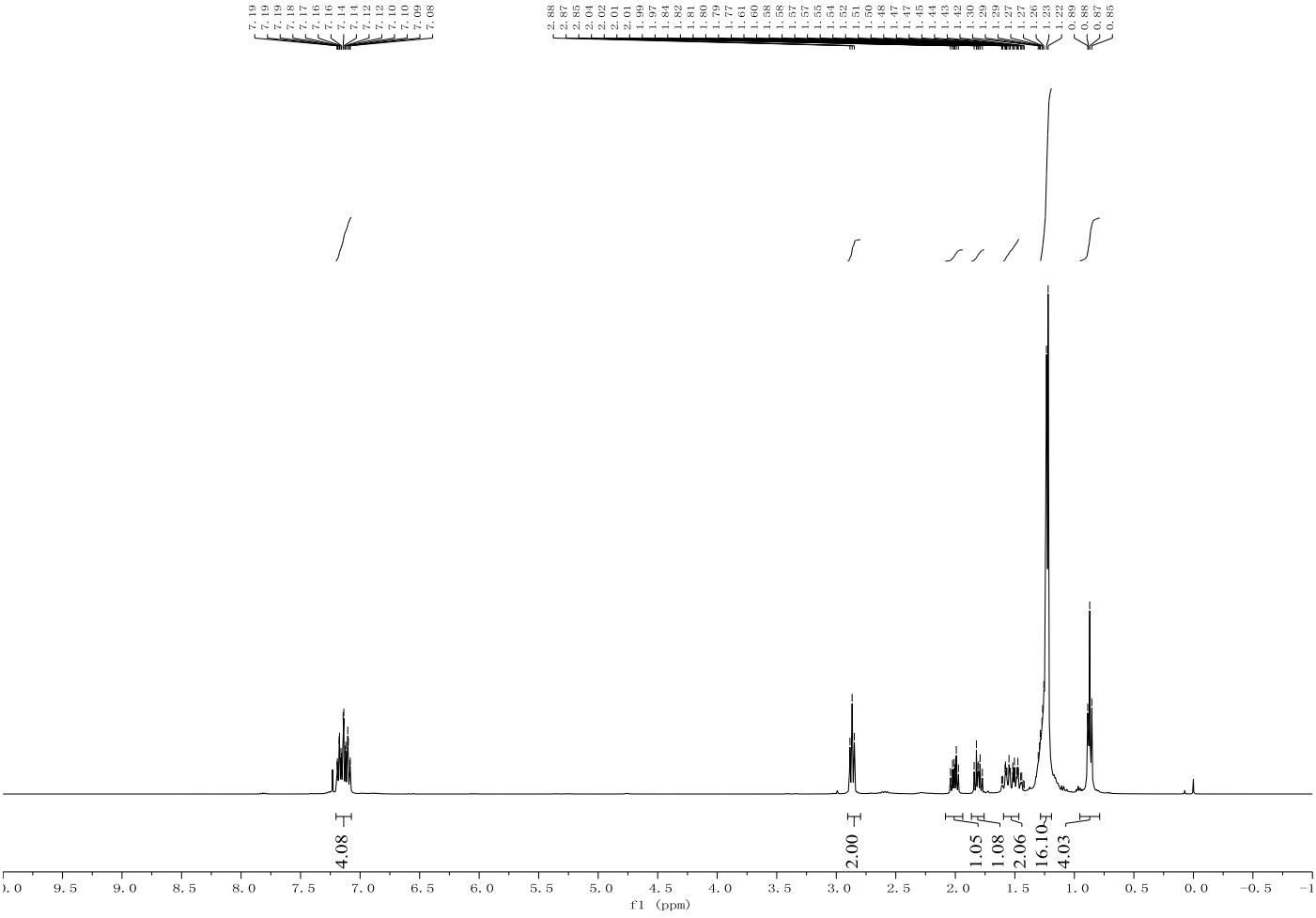

F
Me
5
O

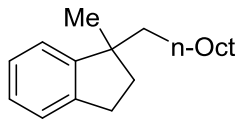
3u


142.04
133.85
126.58
125.99
125.67
124.04
84.99
83.36
74.64
68.89
40.79
36.25
30.49
30.29
29.98
25.10
25.05
24.90
24.33
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

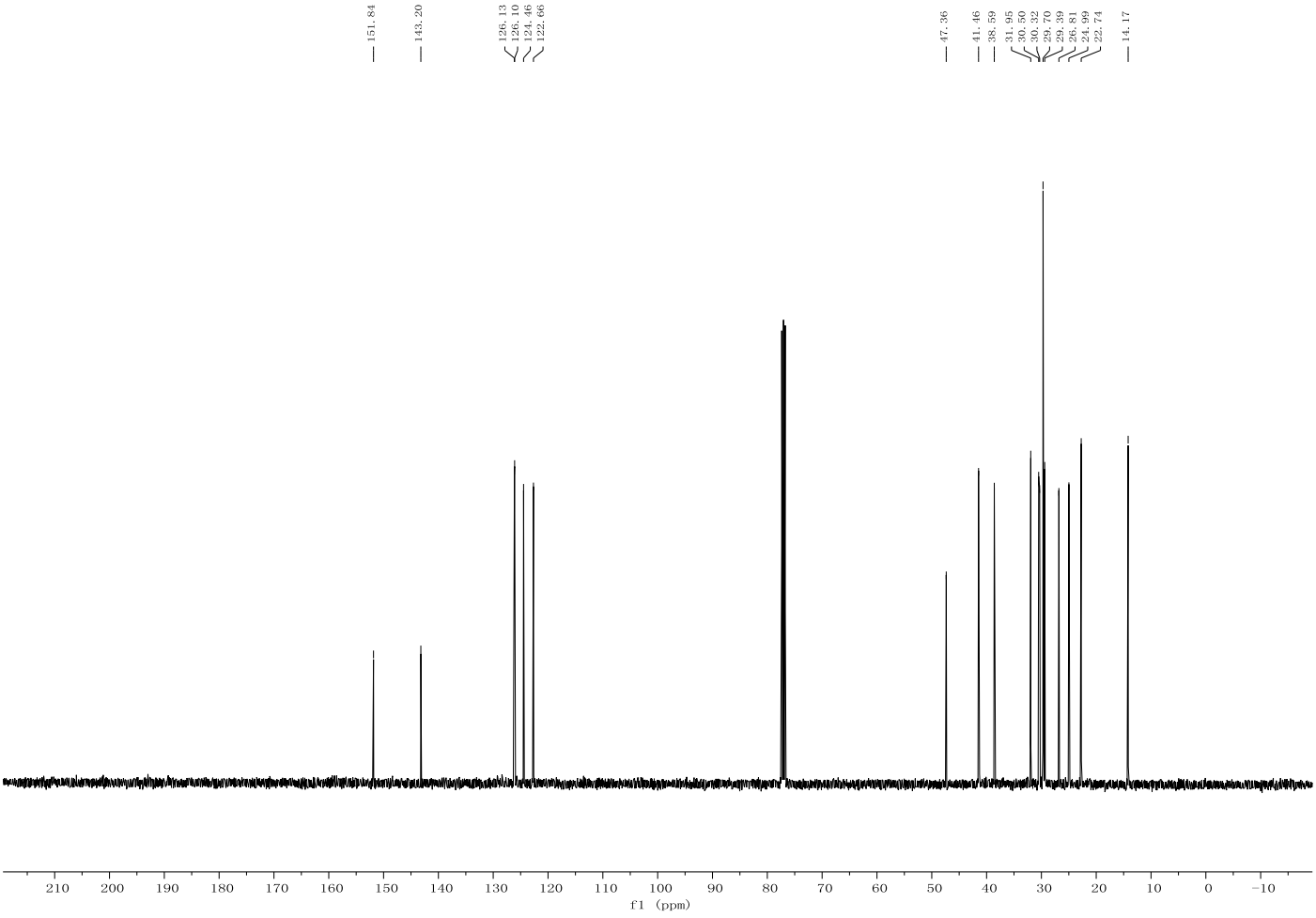

Me
n-Oct

3v


7.19 7.19 7.19 7.18 7.17 7.16 7.16 7.16 7.14 7.14 7.12 7.12 7.10 7.10 7.09 7.08
2.88 2.87 2.85 2.04 2.02 2.01 2.01 1.99 1.97 1.84 1.82 1.81 1.80 1.79 1.77 1.61 1.60 1.58 1.58 1.57 1.57 1.55 1.54 1.52 1.51 1.50 1.48 1.47 1.47 1.45 1.44 1.43 1.42 1.30 1.29 1.29 1.27 1.27 1.26 1.23 1.22 0.89 0.88 0.87 0.85
4.08
2.00
1.05
1.08
2.06
16.10
4.03
f1 (ppm)


Me
n-Oct

3v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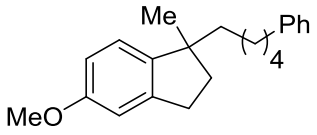
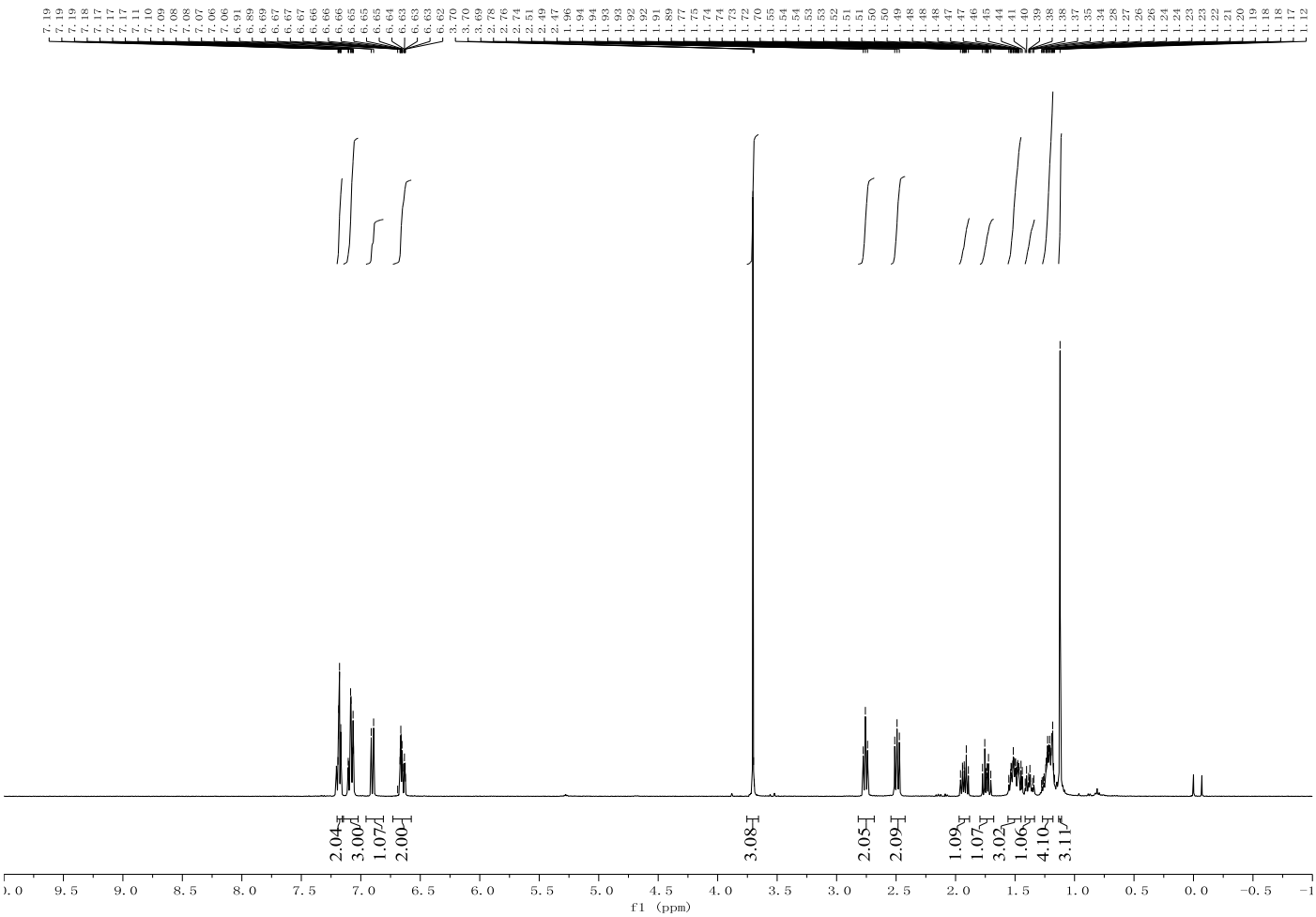
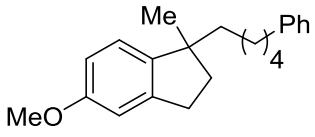
126.13
126.10
124.46
122.66
47.36
41.46
38.59
31.95
30.50
30.32
29.70
29.39
26.81
24.99
22.74
14.17
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

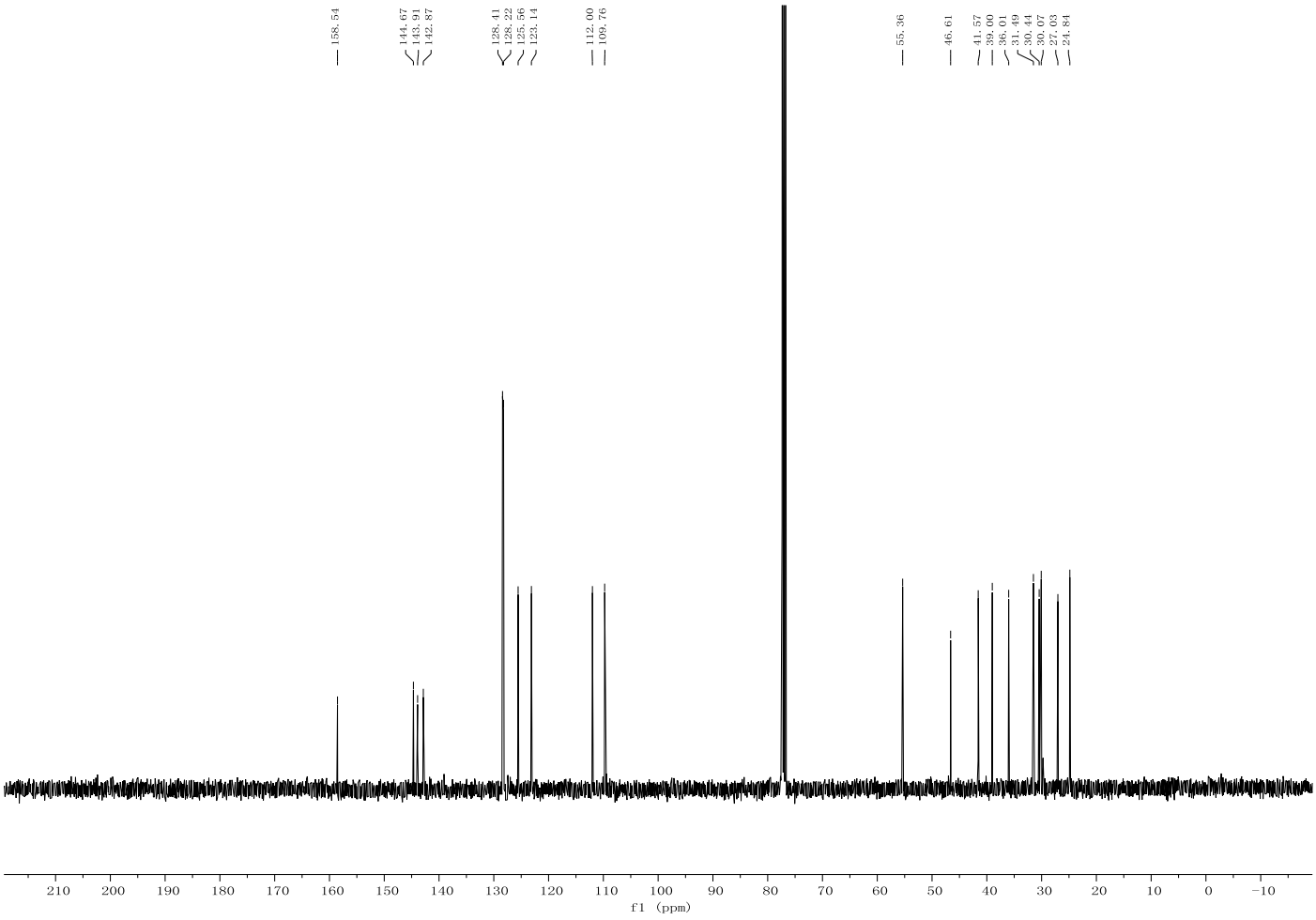

Me
Ph
4
MeO

3w


2.04
3.00
1.07
2.00
3.08
2.05
2.09
1.09
1.07
3.02
1.06
4.10
3.11
f1 (ppm)


Me
Ph
4
MeO

3w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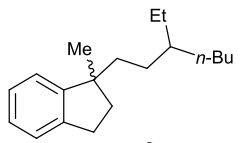
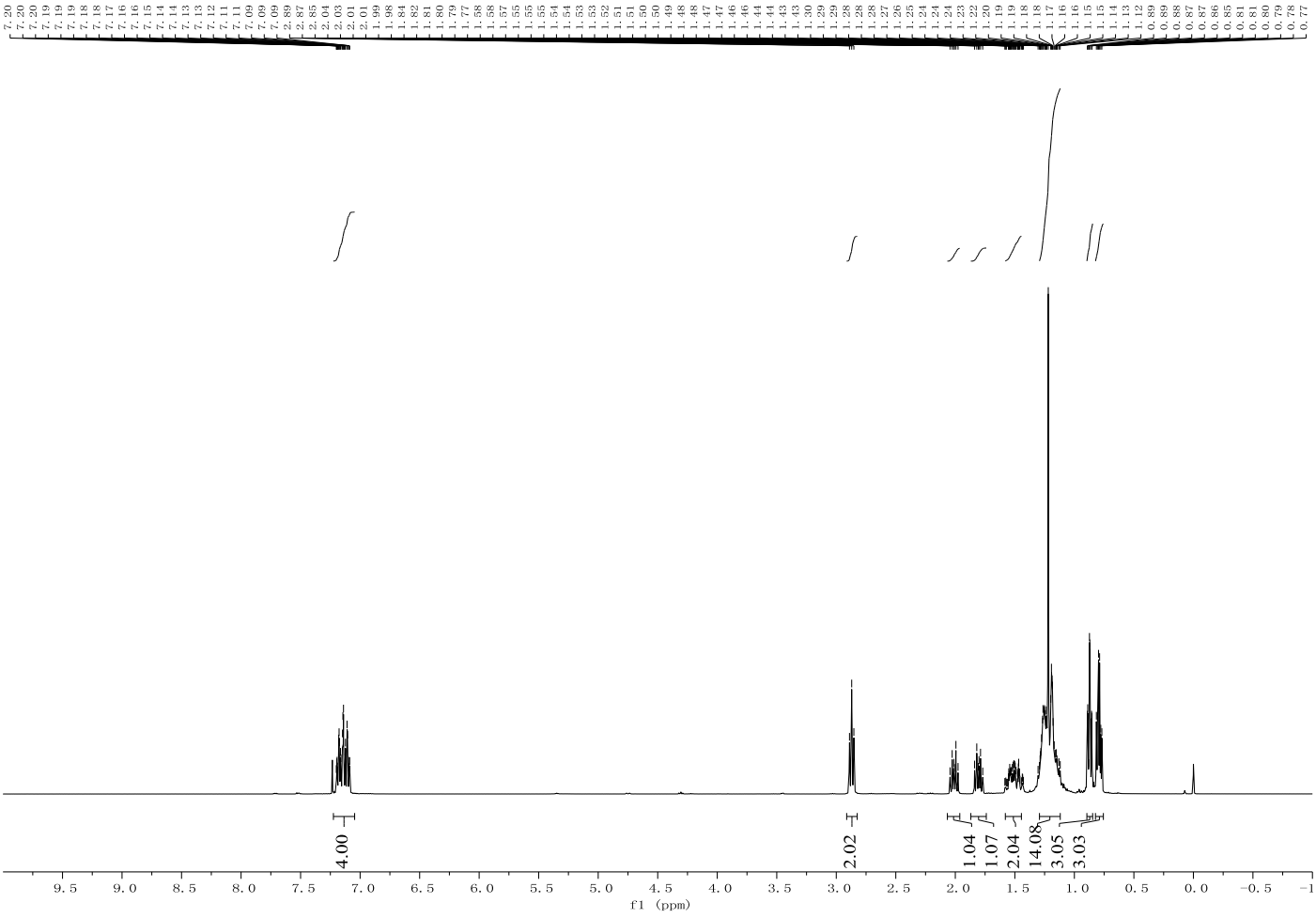
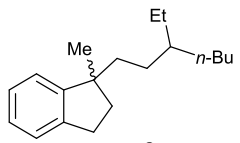
128.22
125.56
123.14
112.00
109.76
55.36
46.61
41.57
39.00
36.01
31.49
30.44
30.07
27.03
24.84
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

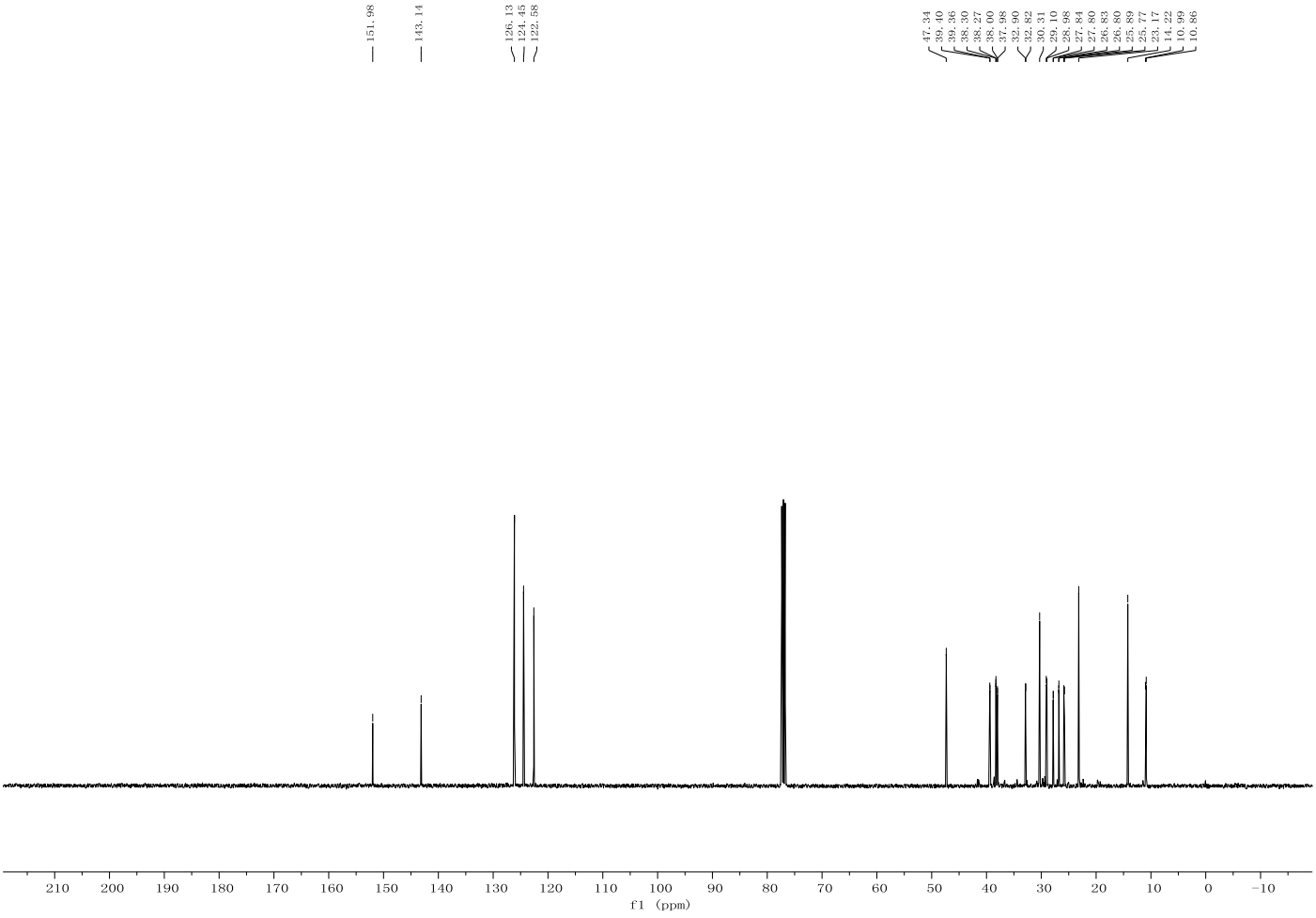


3x




Et
Me
n-Bu

3x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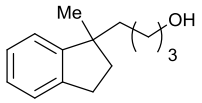
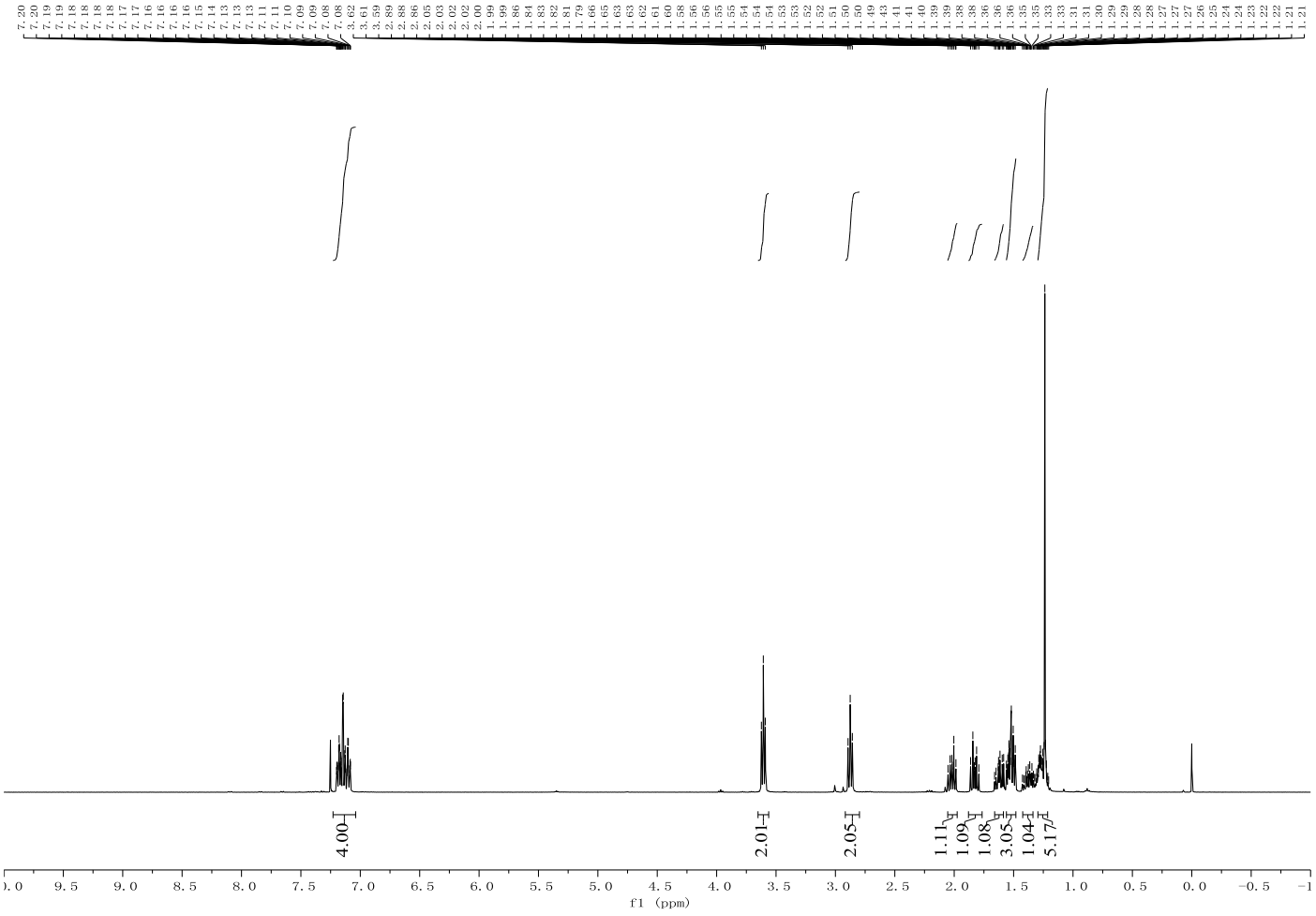
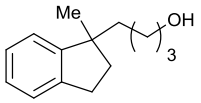
122.58
47.34
39.40
39.36
38.39
38.27
38.00
37.98
32.90
32.82
30.31
29.10
28.98
27.84
27.80
26.83
26.80
25.89
25.77
23.17
14.22
10.99
10.86
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

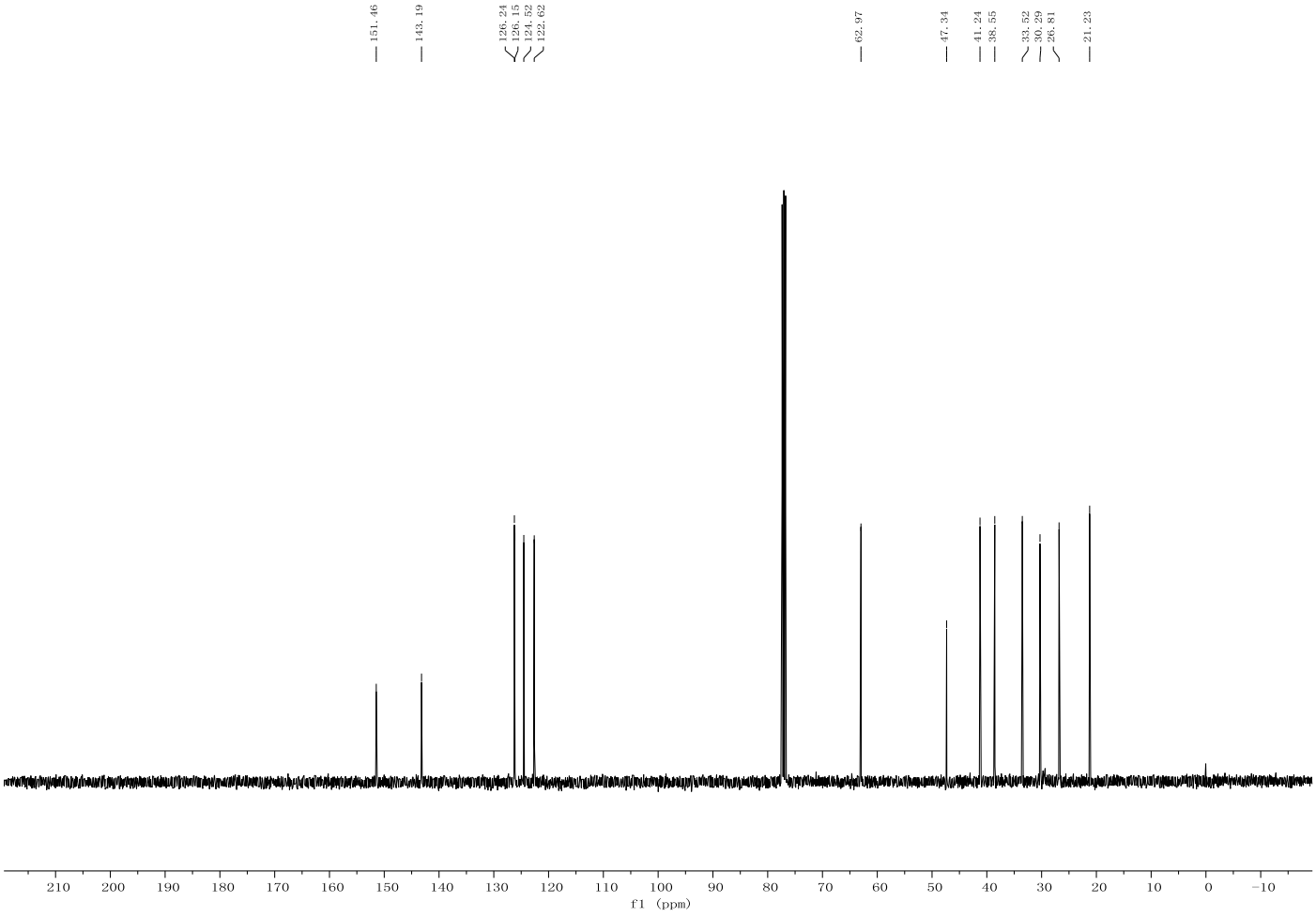


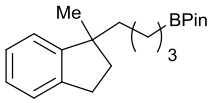
3y



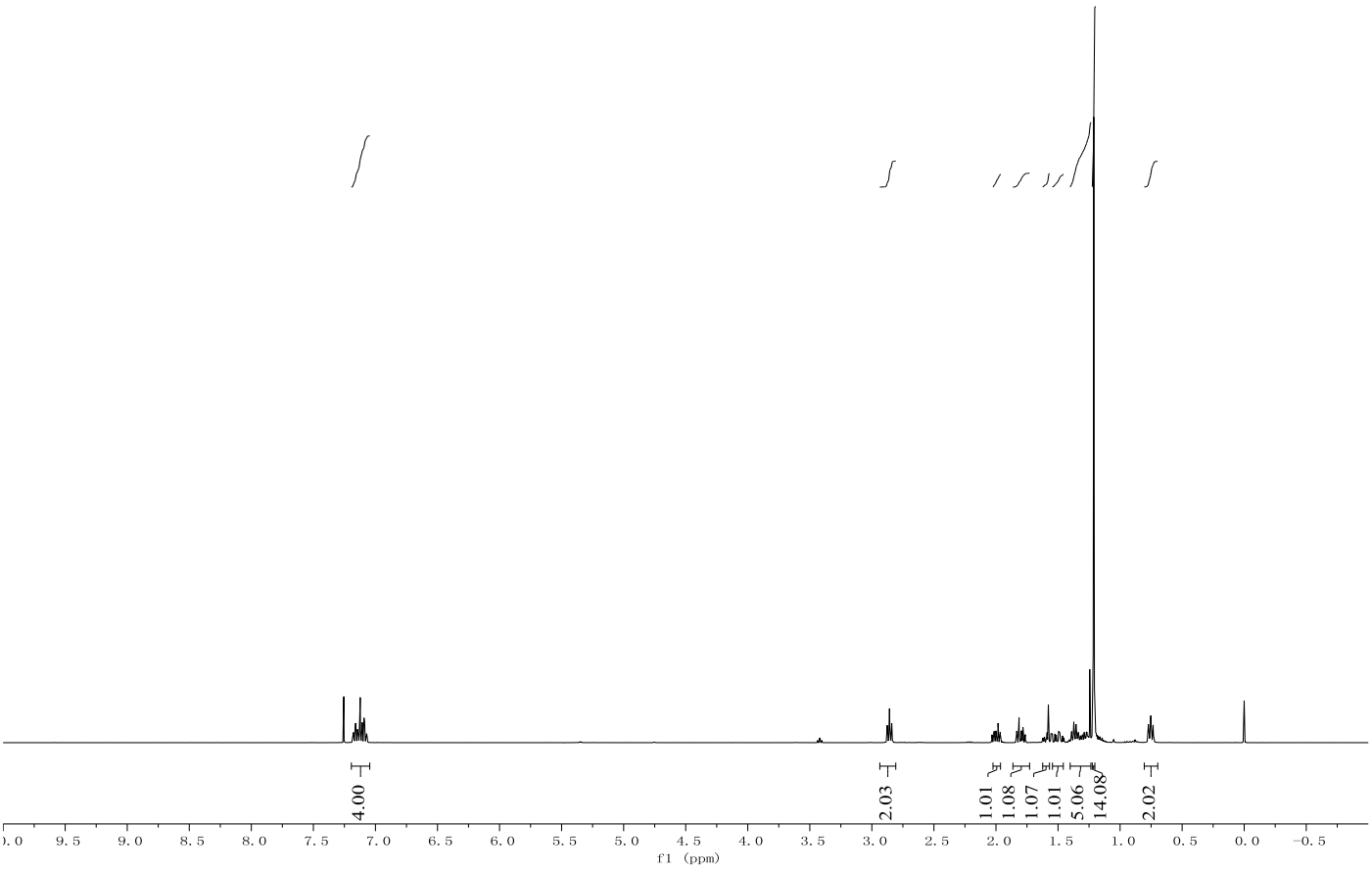

Me
OH
3

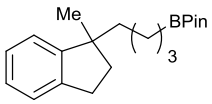
3y


151.46
143.19
126.24
126.15
124.52
122.62
62.97
47.34
41.24
38.55
33.52
30.29
26.81
21.23
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

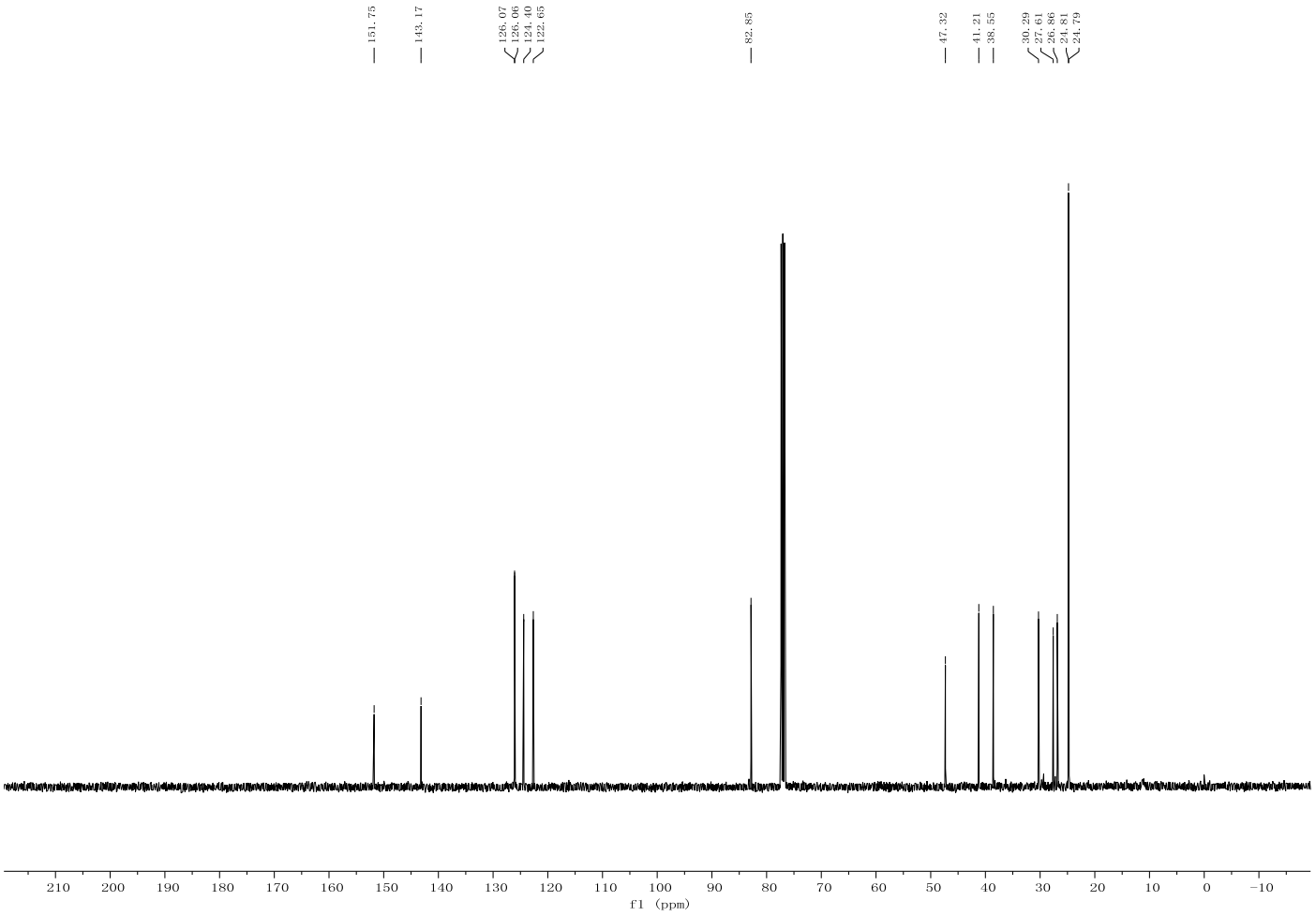


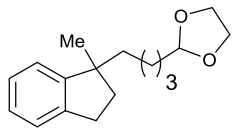
3z



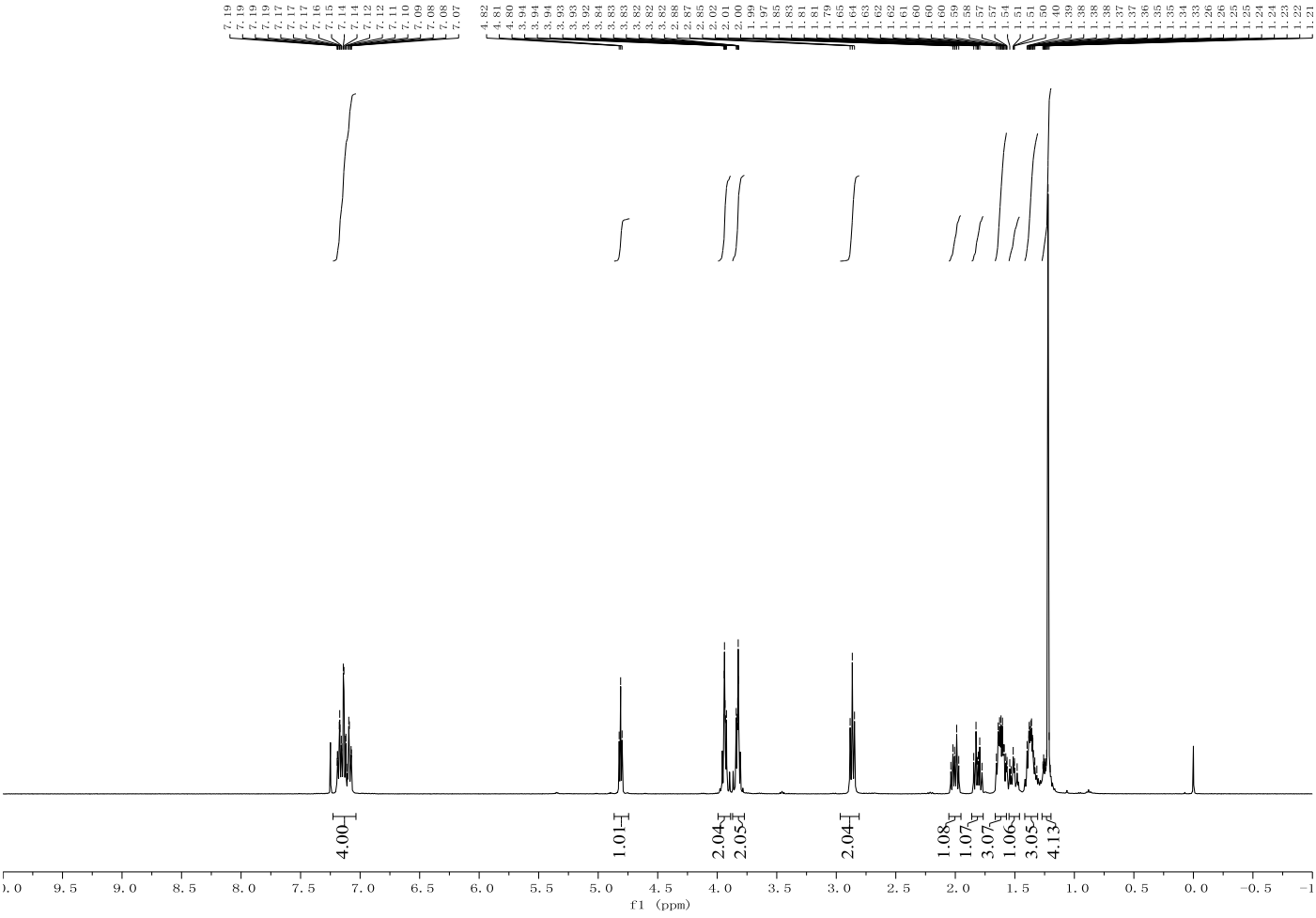

Me
BPin
3

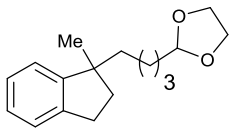
3z


151.75
143.17
126.07
126.06
124.40
122.65
82.85
47.32
41.21
38.55
30.29
27.61
26.86
24.81
24.79
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

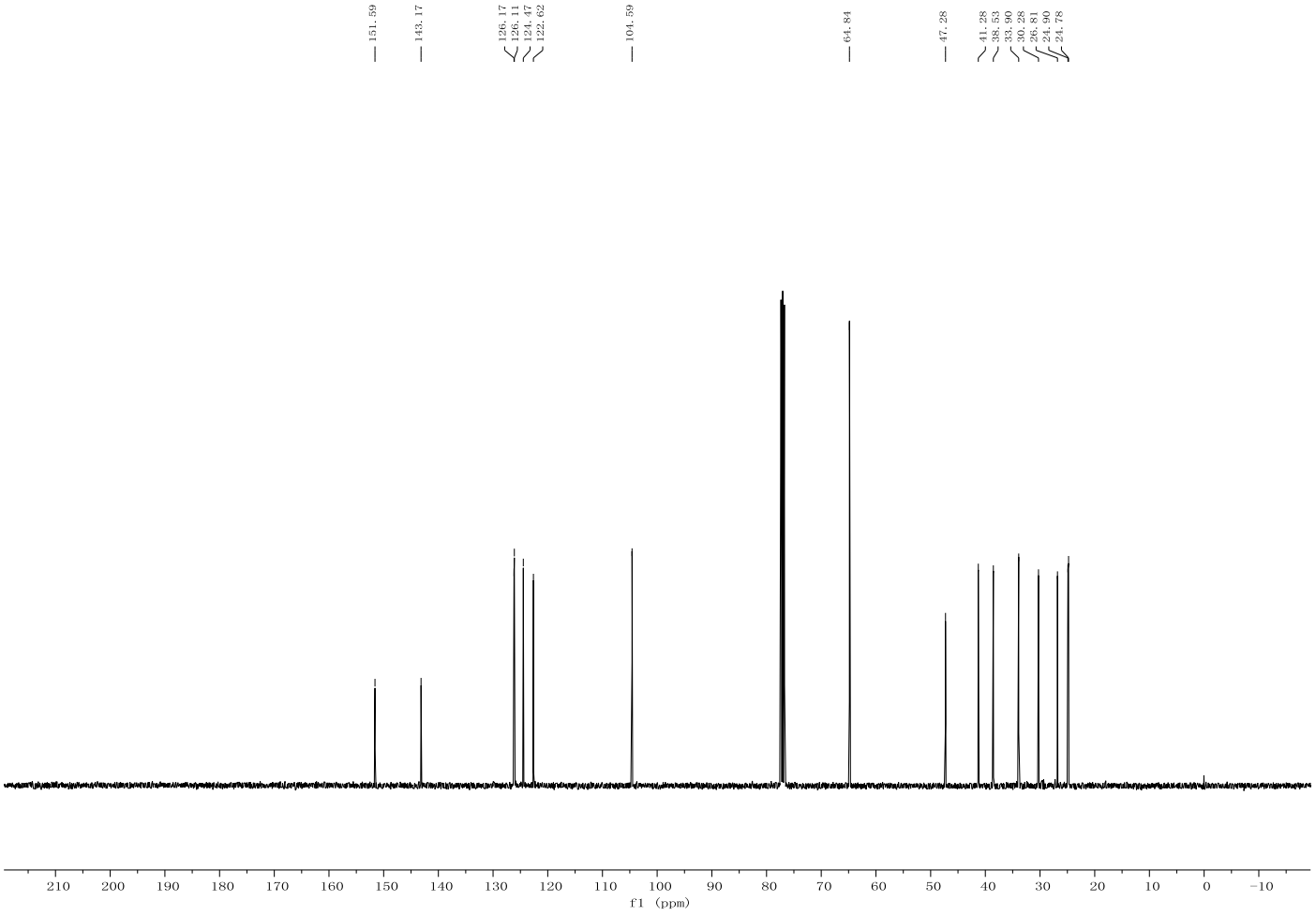


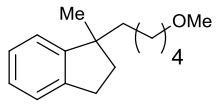
3aa



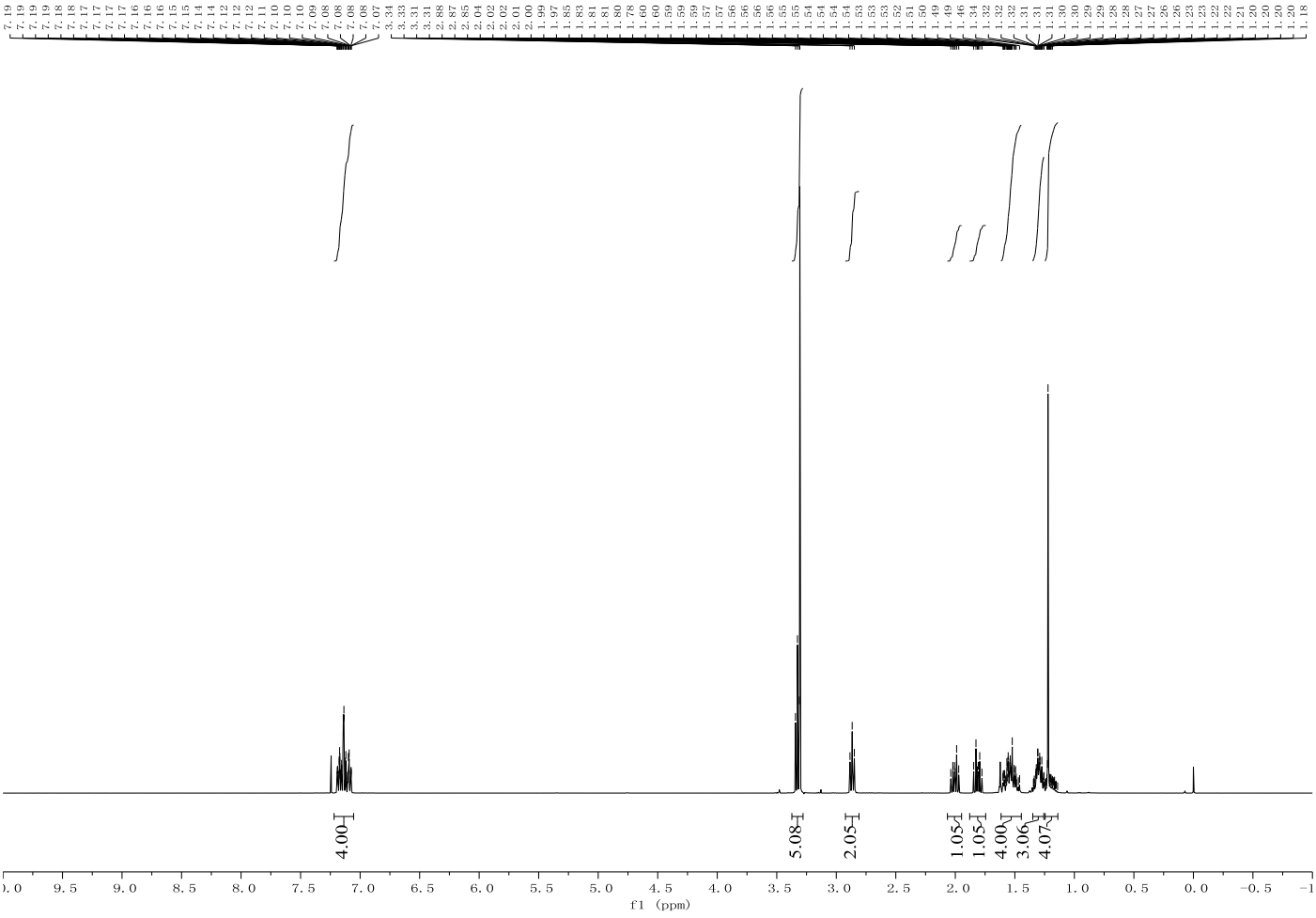

Me
O
O
3

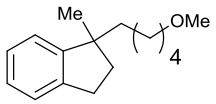
3aa


151.59
143.17
126.17
126.11
124.47
122.62
104.59
64.84
47.28
41.28
38.53
33.90
30.28
26.81
24.90
24.78
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

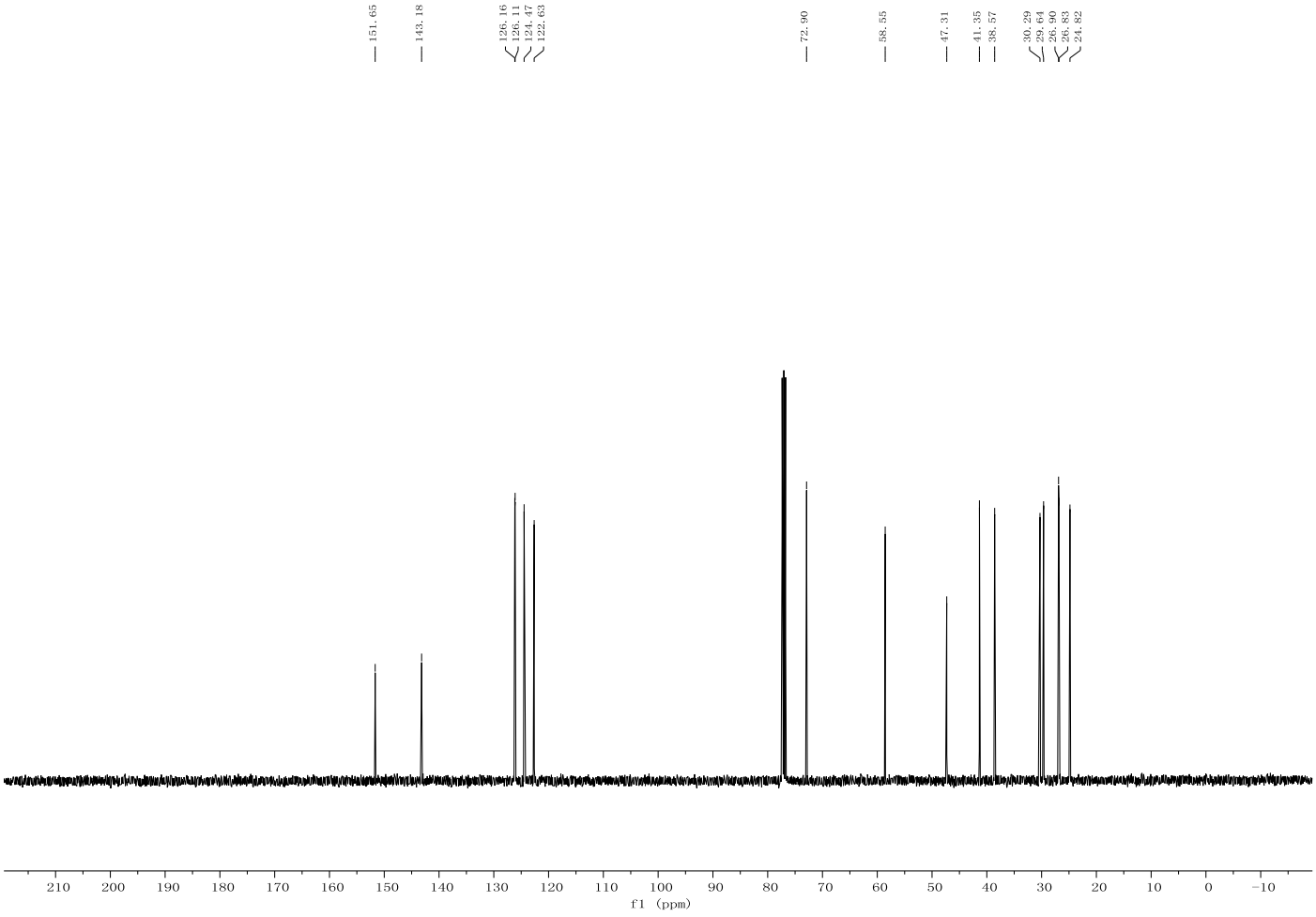


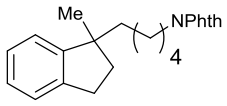
3ab



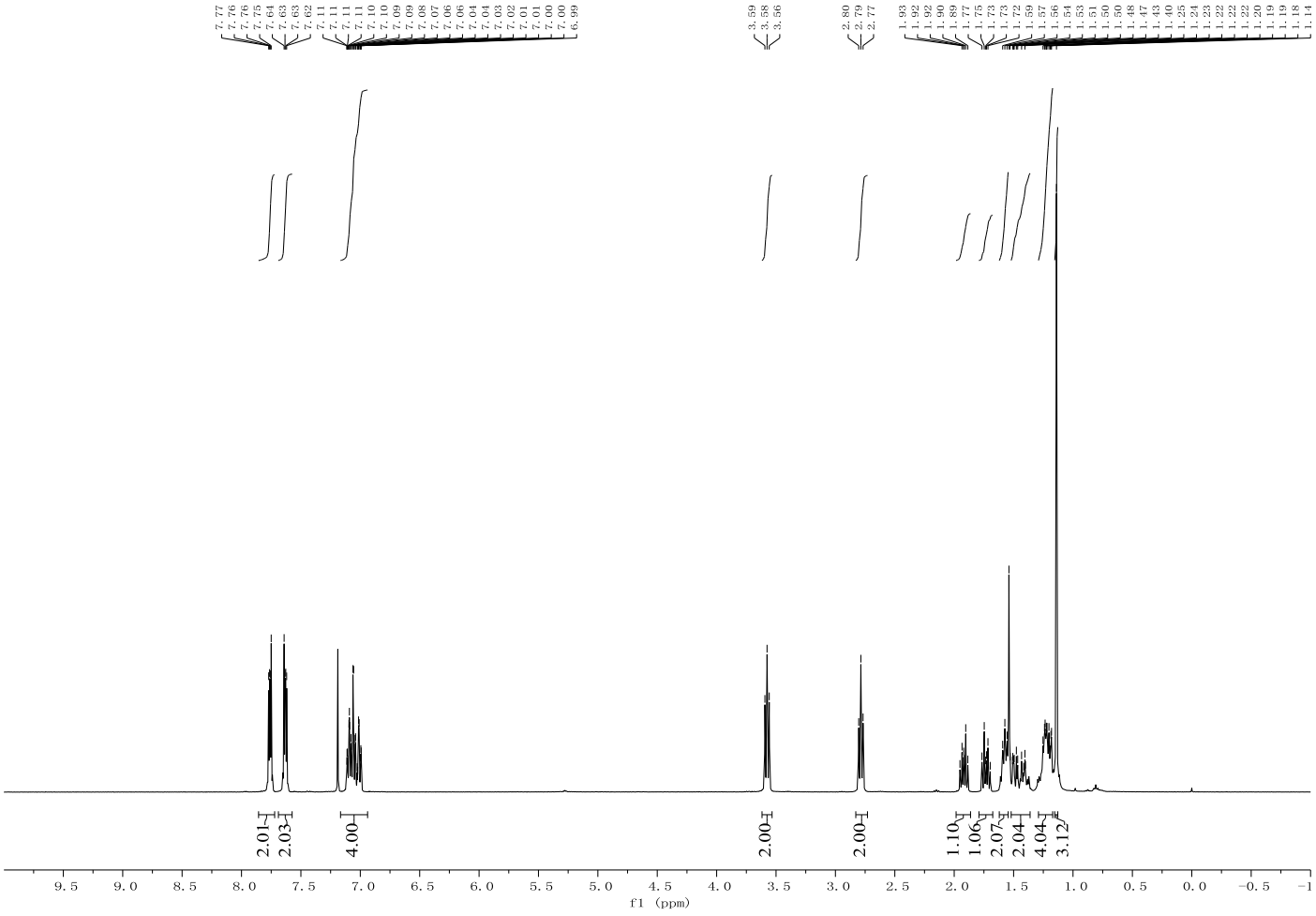

Me
OMe
4

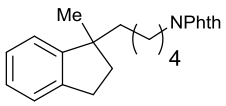
3ab


151.65
143.18
126.16
126.11
124.47
122.63
72.90
58.55
47.31
41.35
38.57
30.29
29.64
26.90
26.83
24.82
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

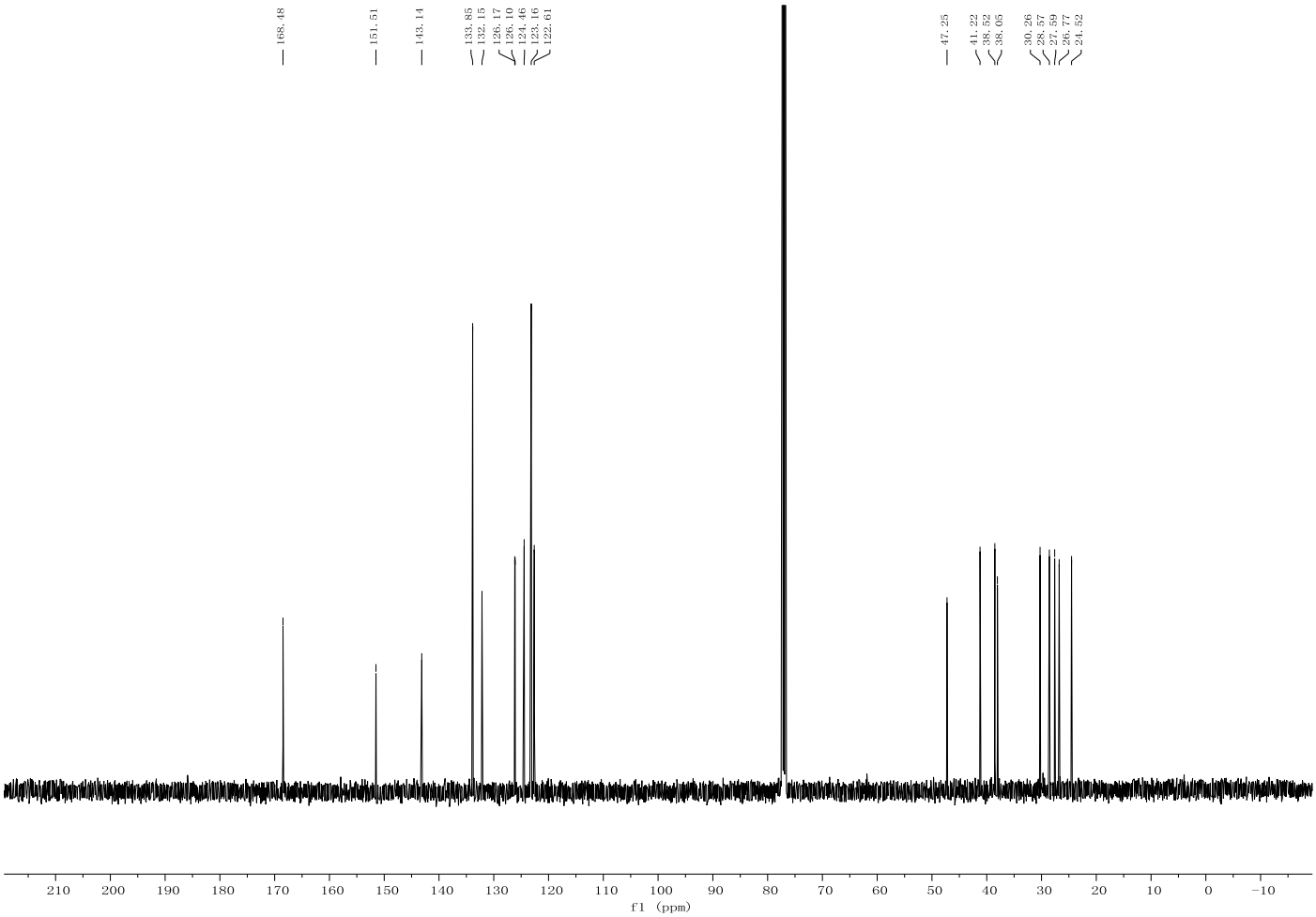

Me
NPhth
4

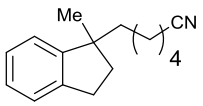
3ac


7.77 7.76 7.76 7.75 7.64 7.63 7.63 7.62 7.11 7.11 7.11 7.10 7.10 7.09 7.09 7.08 7.07 7.06 7.06 7.04 7.04 7.03 7.02 7.01 7.01 7.00 7.00 6.99
3.59 3.58 3.56
2.80 2.79 2.77
1.93 1.92 1.92 1.90 1.89 1.77 1.75 1.73 1.73 1.72 1.59 1.57 1.56 1.54 1.53 1.51 1.50 1.50 1.48 1.47 1.43 1.40 1.25 1.24 1.23 1.22 1.22 1.22 1.20 1.19 1.19 1.18 1.14
2.01
2.03
4.00
2.00
2.00
1.10
1.06
2.07
2.04
4.04
3.12
f1 (ppm)

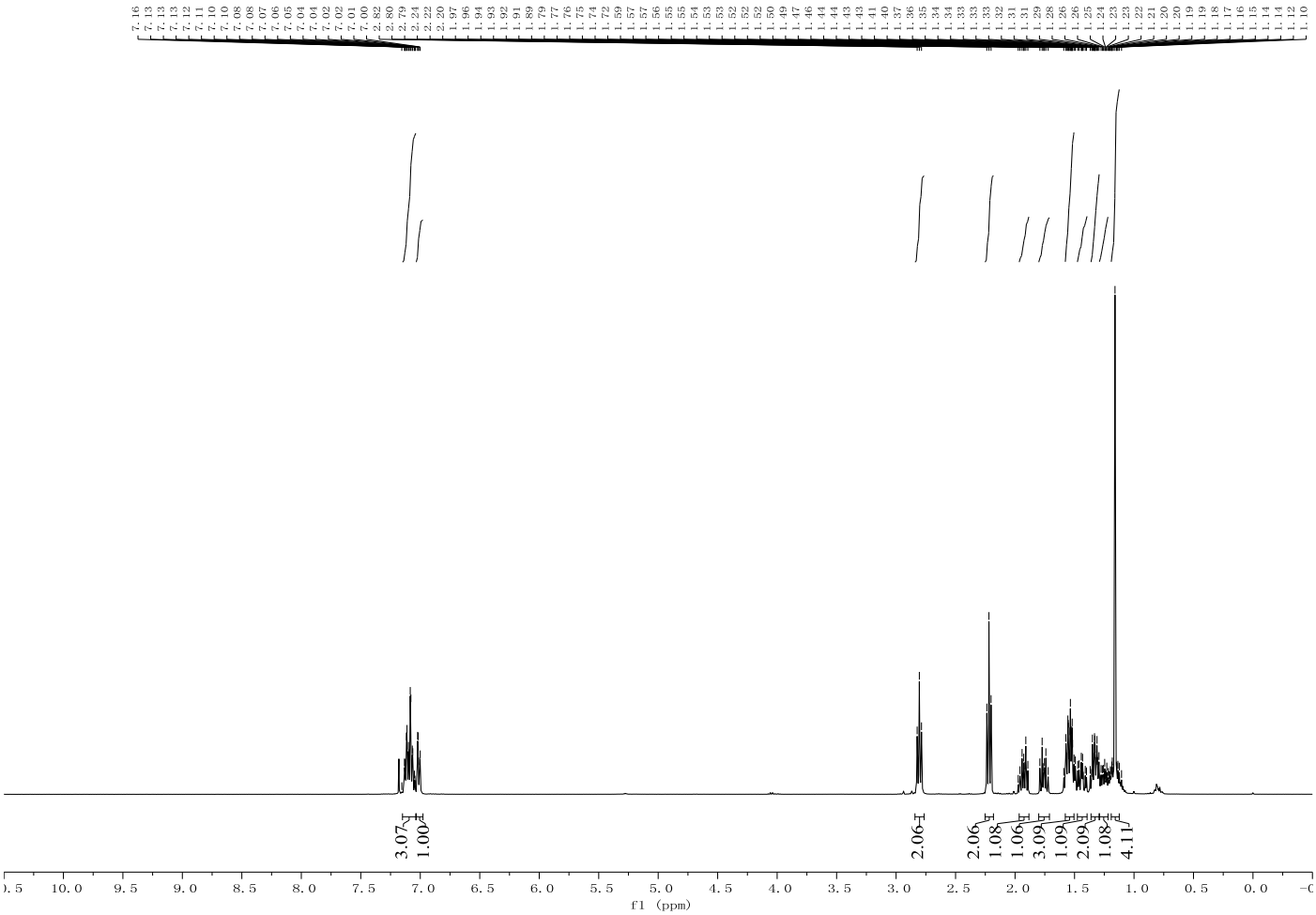

Me
NPhth
4

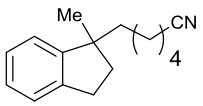
3ac


168.48
151.51
143.14
133.85
132.15
126.17
126.10
124.46
123.16
122.61
47.25
41.22
38.52
38.05
30.26
28.57
27.59
26.77
24.52
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

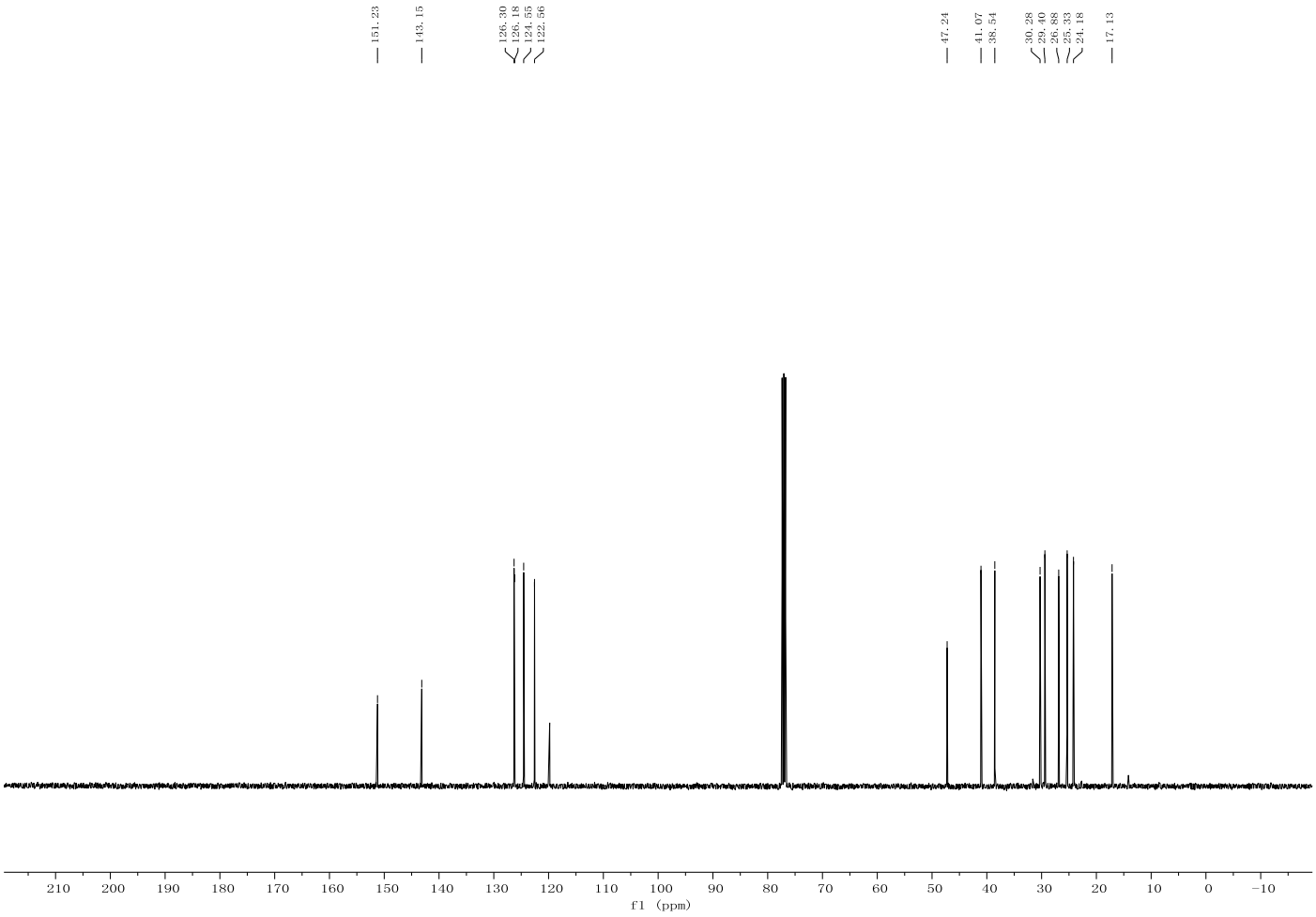


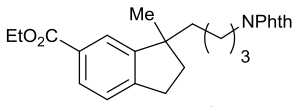
3ad



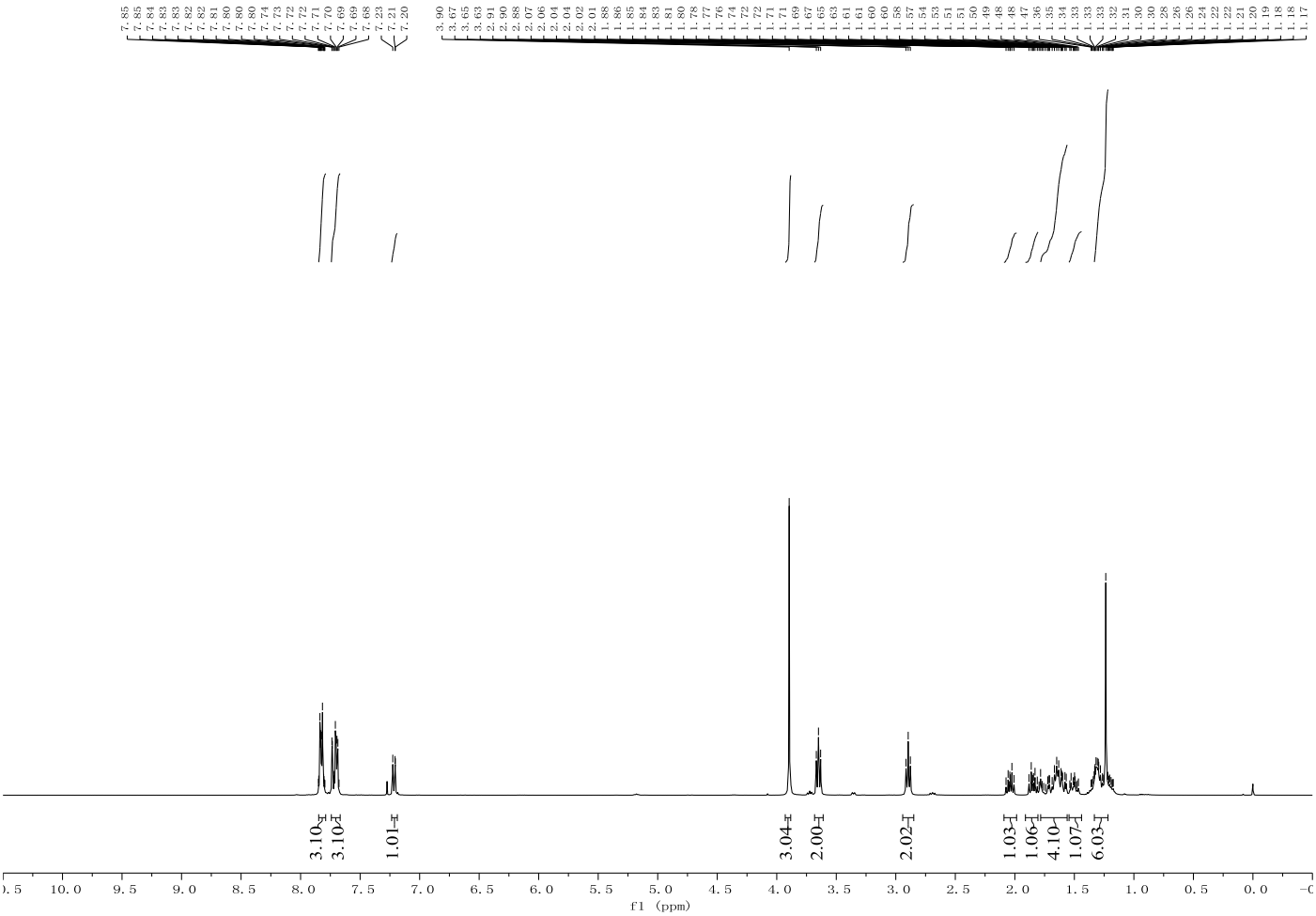

Me
CN
4

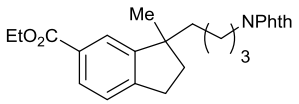
3ad


151.23
143.15
126.30
126.18
124.55
122.56
47.24
41.07
38.54
30.28
29.40
26.88
25.33
24.18
17.13
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

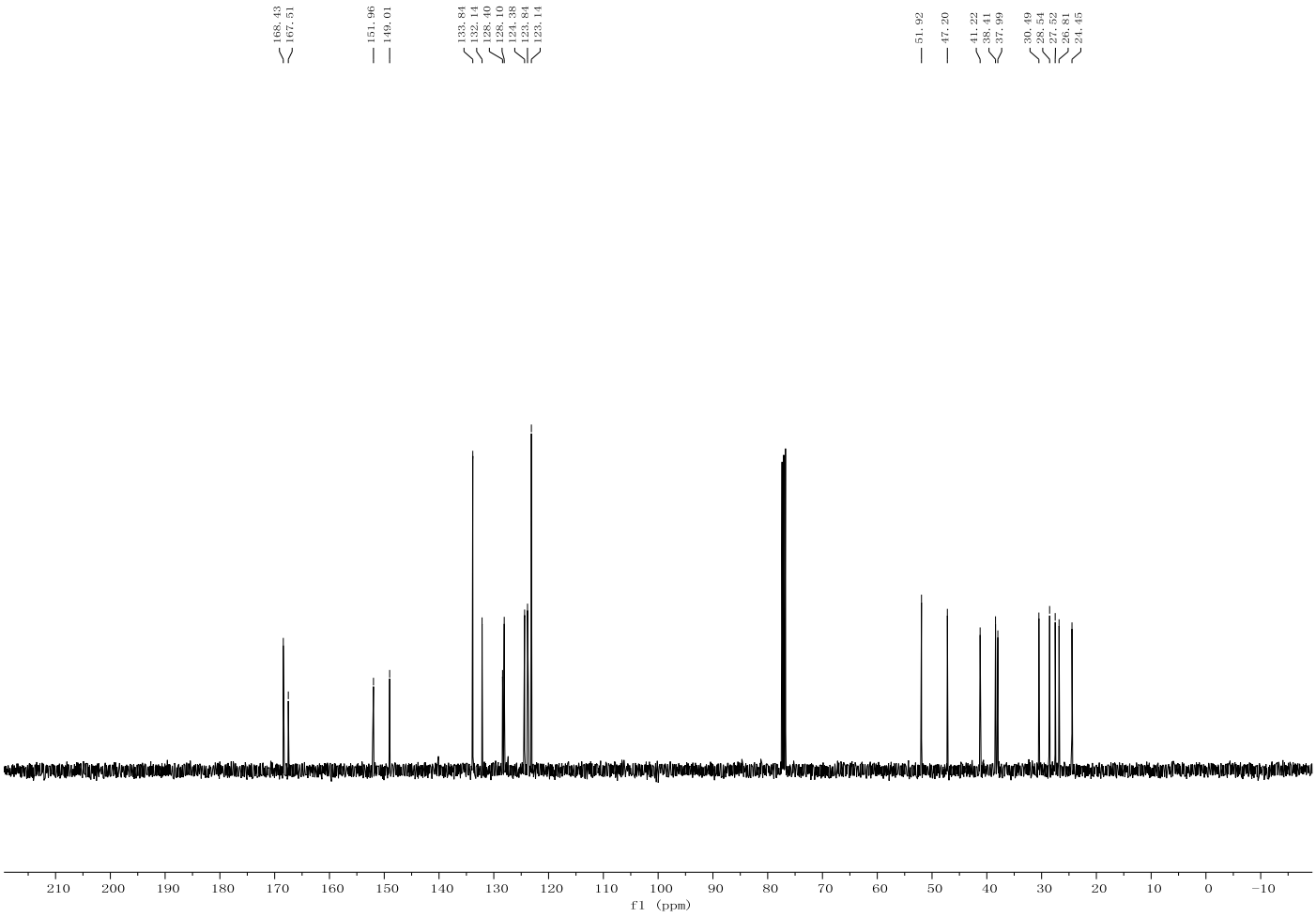

Me
NPhth
EtO2C
3

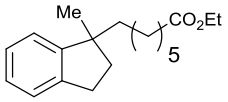
3ae


7.85 7.85 7.84 7.83 7.83 7.82 7.81 7.80 7.80 7.80 7.74 7.73 7.72 7.72 7.71 7.70 7.69 7.69 7.68 7.23 7.21 7.20
3.90 3.67 3.65 3.65 2.91 2.90 2.88 2.07 2.06 2.04 2.04 2.02 2.01 1.88 1.86 1.85 1.84 1.83 1.81 1.80 1.78 1.77 1.76 1.74 1.72 1.72 1.71 1.71 1.69 1.67 1.65 1.63 1.61 1.61 1.60 1.60 1.58 1.57 1.54 1.53 1.51 1.51 1.50 1.49 1.48 1.48 1.47 1.36 1.35 1.34 1.33 1.33 1.33 1.32 1.31 1.30 1.30 1.28 1.26 1.26 1.24 1.22 1.22 1.21 1.20 1.19 1.18 1.18 1.17
3.10
3.10
1.01
3.04
2.00
2.02
1.03
1.06
4.10
1.07
6.03
f1 (ppm)

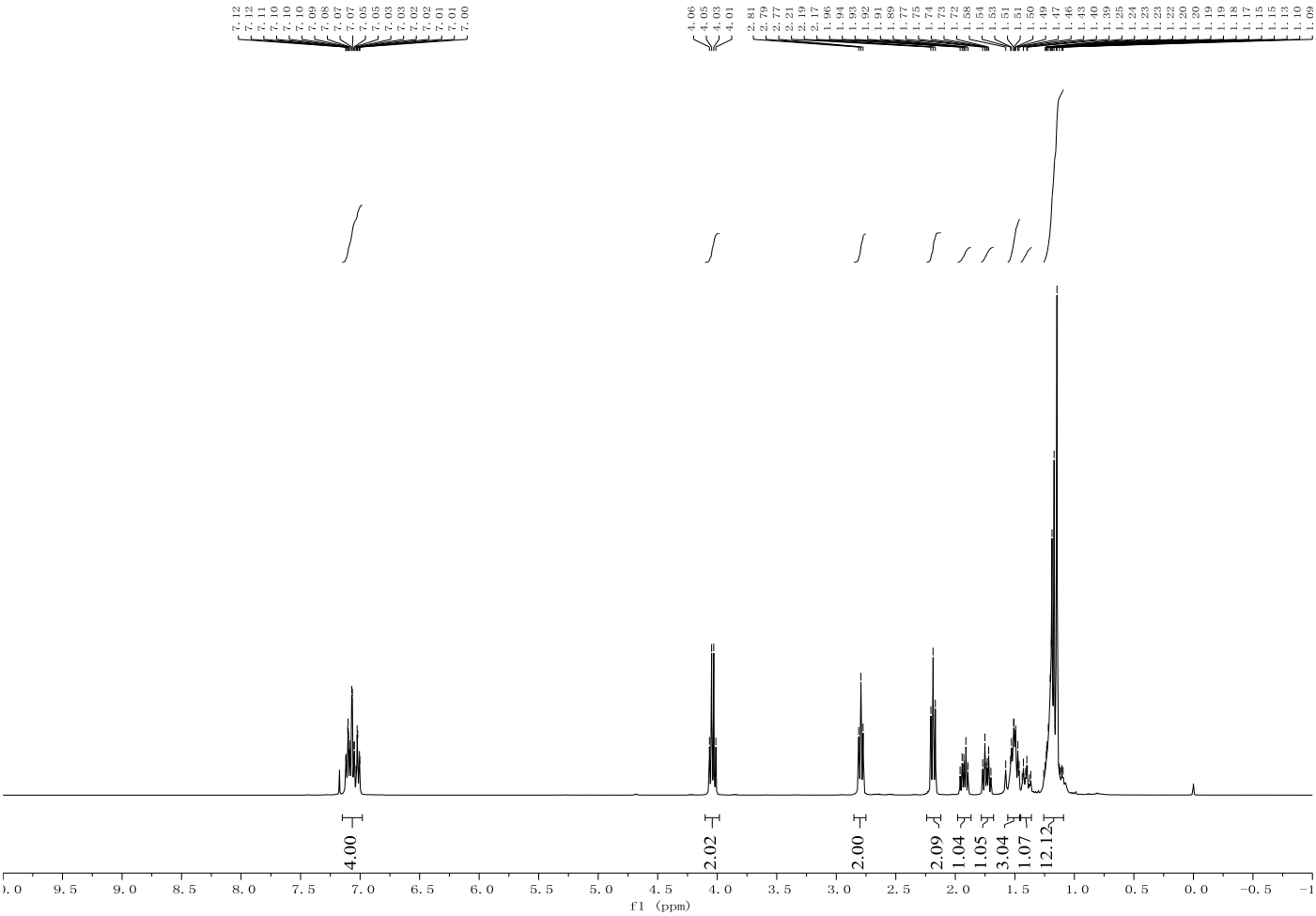

Me
NPhth
EtO2C
3

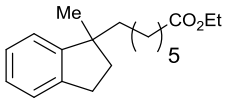
3ae


168.43
167.51
151.96
149.01
133.84
132.14
128.40
128.10
124.38
123.84
123.14
51.92
47.20
41.22
38.41
37.99
30.49
28.54
27.52
26.81
24.45
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

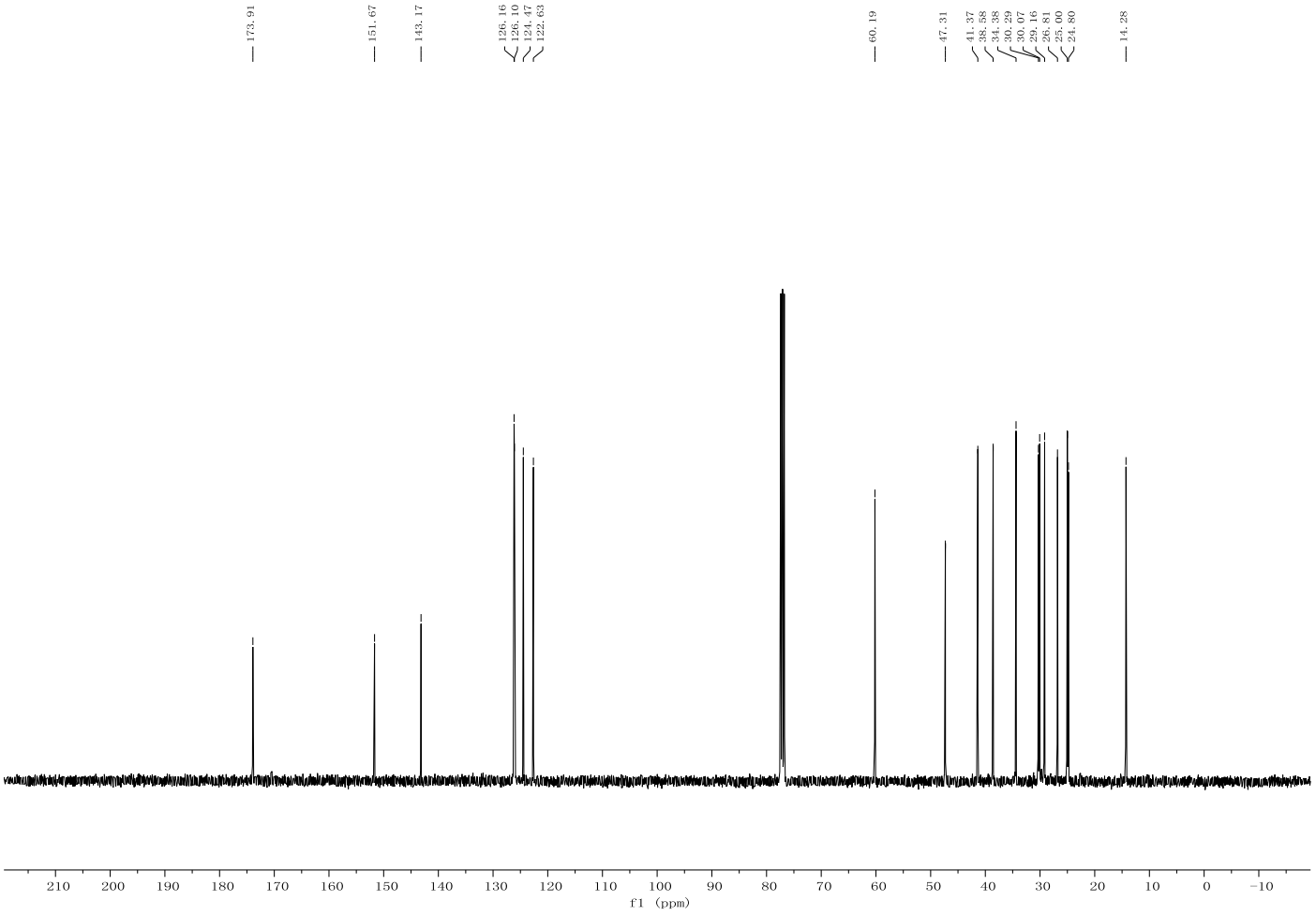

Me
CO2Et
5

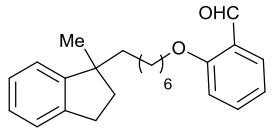
3af


7.12
7.12
7.11
7.10
7.10
7.10
7.09
7.08
7.07
7.07
7.05
7.05
7.03
7.03
7.02
7.02
7.01
7.01
7.00
4.06
4.05
4.03
4.01
2.81
2.79
2.77
2.21
2.19
2.17
1.96
1.94
1.93
1.92
1.91
1.89
1.77
1.75
1.74
1.73
1.72
1.58
1.54
1.53
1.51
1.51
1.50
1.49
1.47
1.46
1.43
1.40
1.39
1.25
1.24
1.23
1.23
1.22
1.20
1.20
1.19
1.19
1.18
1.17
1.15
1.15
1.13
1.10
1.09
4.00
2.02
2.00
2.09
1.04
1.05
3.04
1.07
12.12
f1 (ppm)

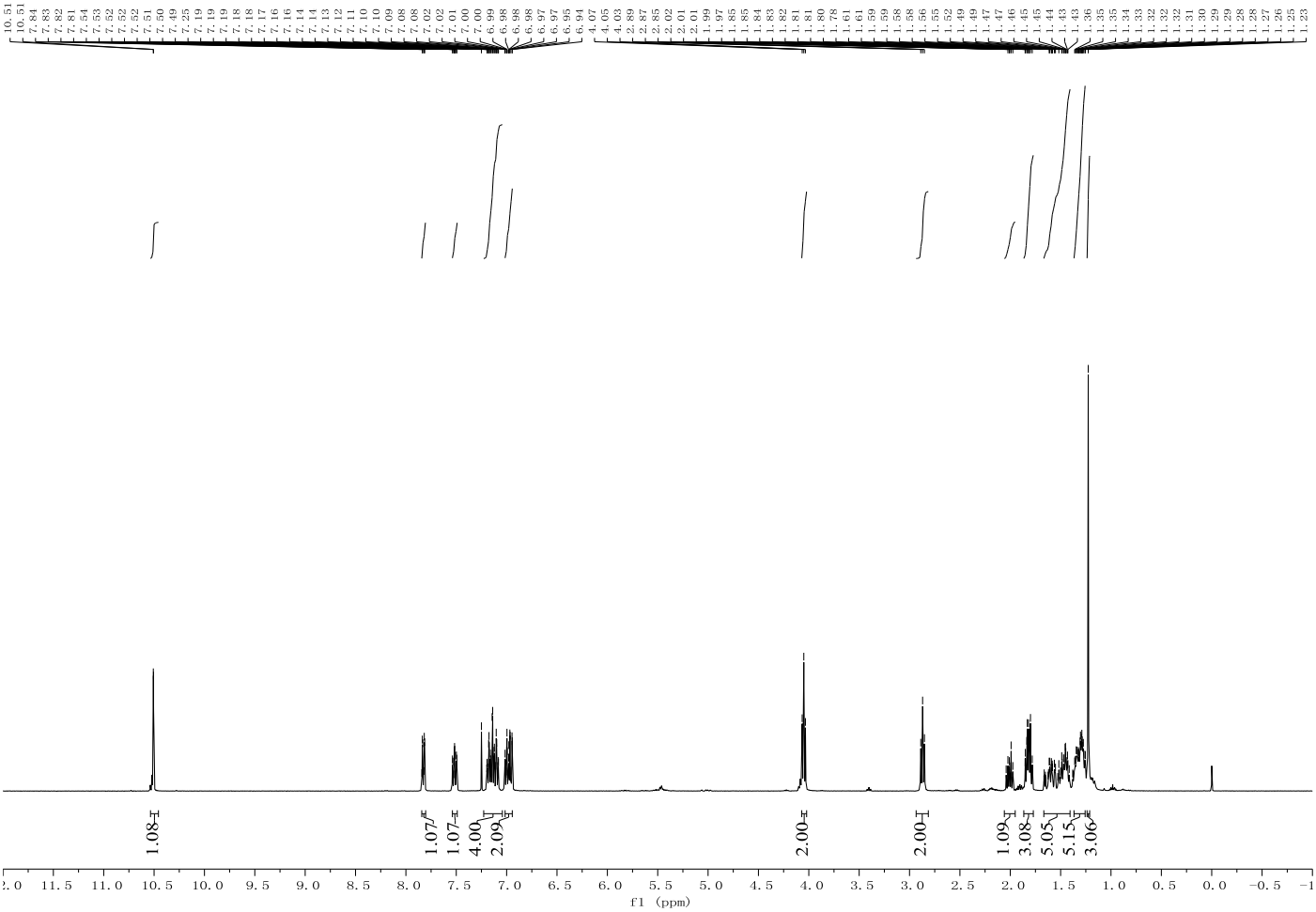

Me
CO2Et
5

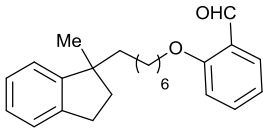
3af


173.91
151.67
143.17
126.16
126.10
124.47
122.63
60.19
47.31
41.37
38.58
34.38
30.29
30.07
29.16
26.81
25.00
24.80
14.28
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

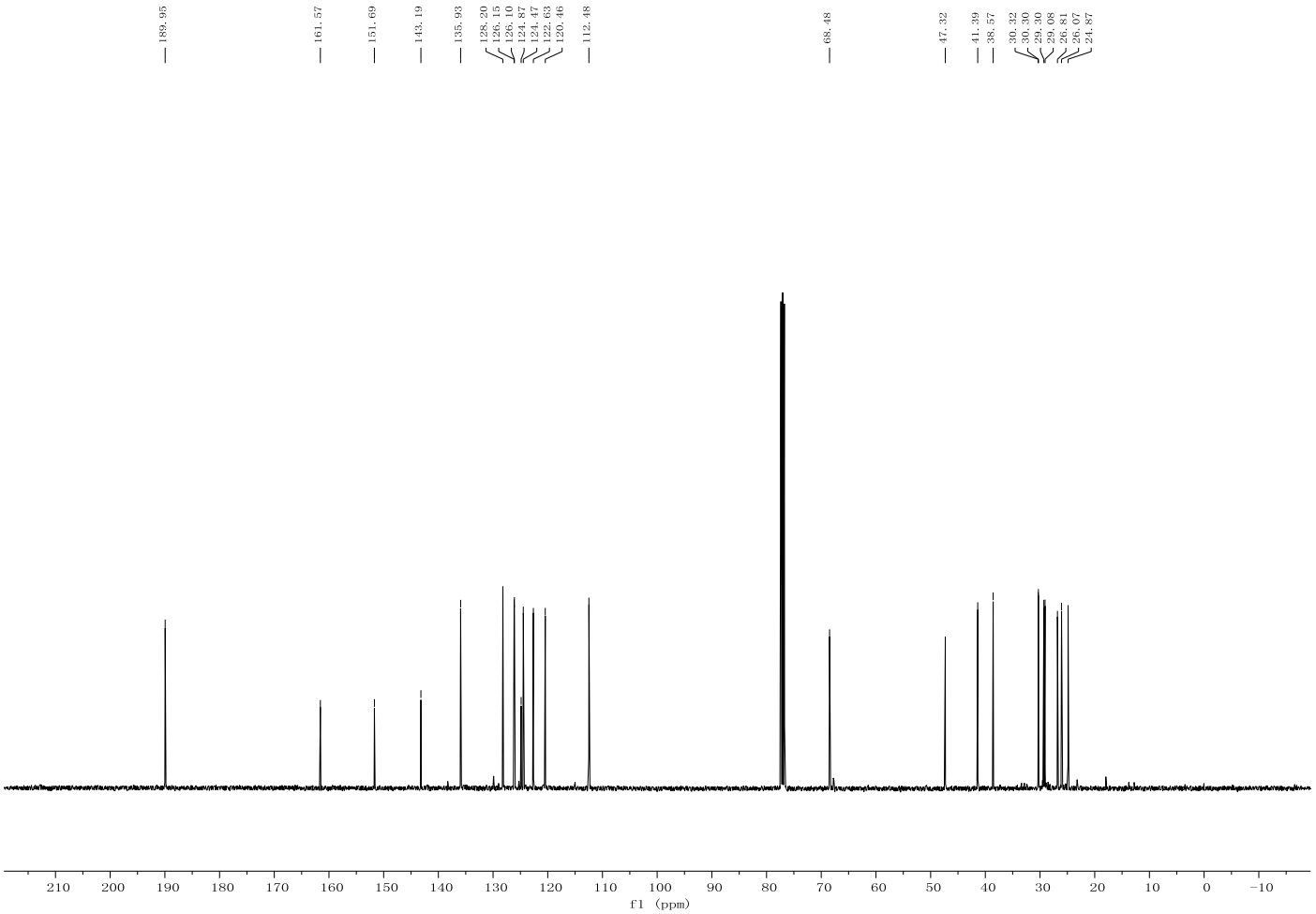

OHC
Me
O
6

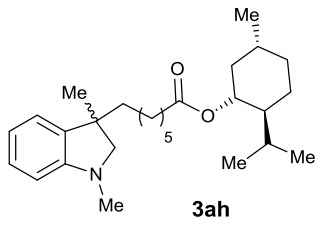
3ag


10.51
10.51
7.84
7.83
7.82
7.81
7.54
7.53
7.52
7.52
7.51
7.50
7.49
7.25
7.19
7.19
7.18
7.18
7.17
7.16
7.16
7.14
7.14
7.13
7.12
7.11
7.10
7.10
7.09
7.08
7.08
7.02
7.02
7.01
7.00
7.00
6.99
6.98
6.98
6.98
6.97
6.95
6.94
4.07
4.05
4.03
2.89
2.87
2.85
2.02
2.01
2.01
1.99
1.97
1.85
1.85
1.84
1.83
1.82
1.81
1.81
1.80
1.78
1.61
1.61
1.59
1.59
1.58
1.58
1.56
1.55
1.52
1.49
1.49
1.47
1.47
1.46
1.45
1.45
1.44
1.43
1.43
1.36
1.35
1.35
1.34
1.33
1.32
1.32
1.32
1.31
1.30
1.29
1.29
1.28
1.28
1.27
1.26
1.25
1.23
1.08
1.07
1.07
4.00
2.09
2.00
2.00
1.09
3.08
5.05
5.15
3.06
f1 (ppm)

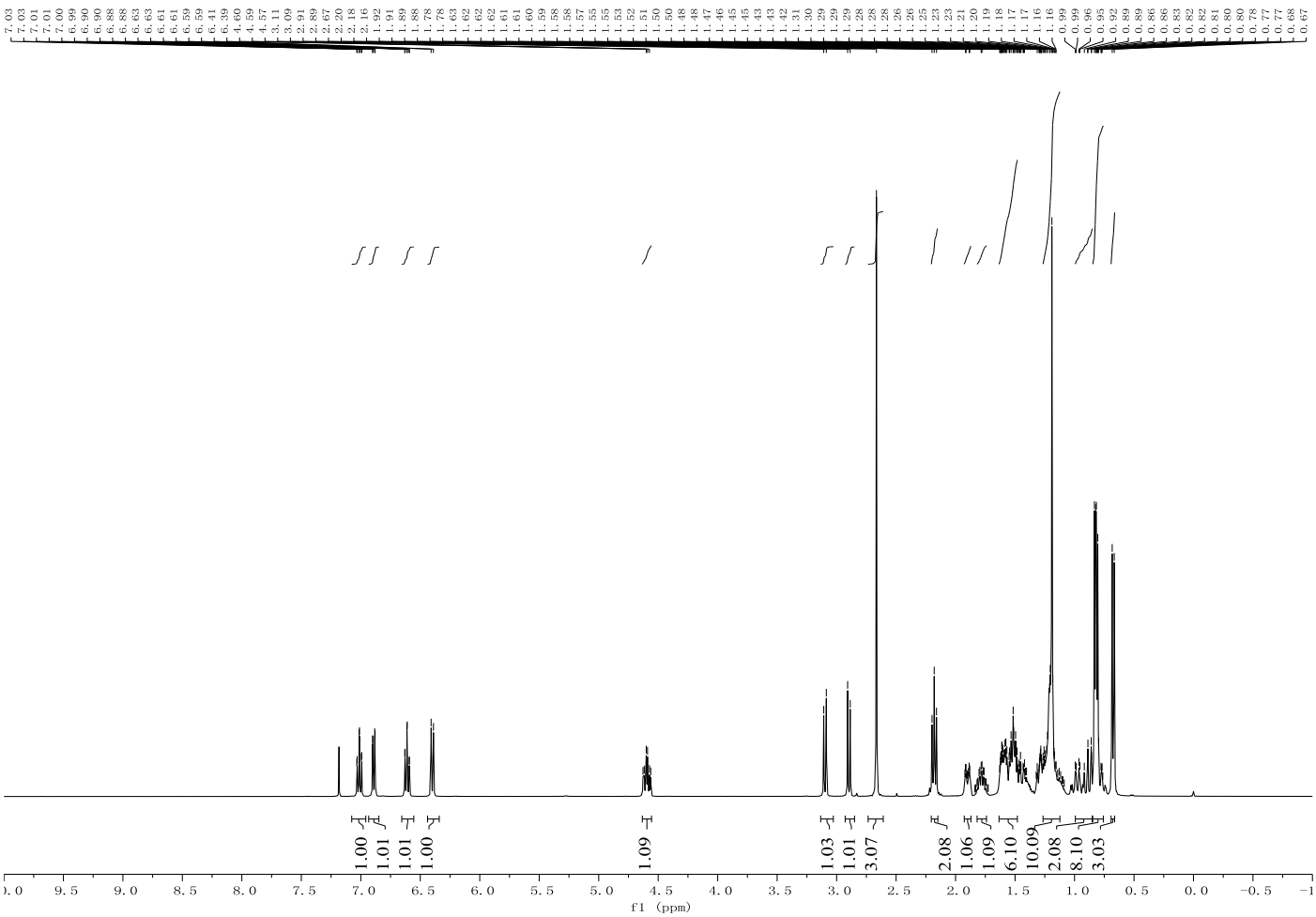

OHC
Me
O
6

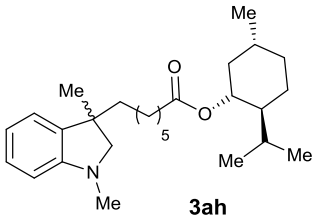
3ag


189.95
161.57
151.69
143.19
135.93
128.20
126.15
126.10
124.87
124.47
122.63
120.46
112.48
68.48
47.32
41.39
38.57
30.32
30.30
29.30
29.08
26.81
26.07
24.87
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

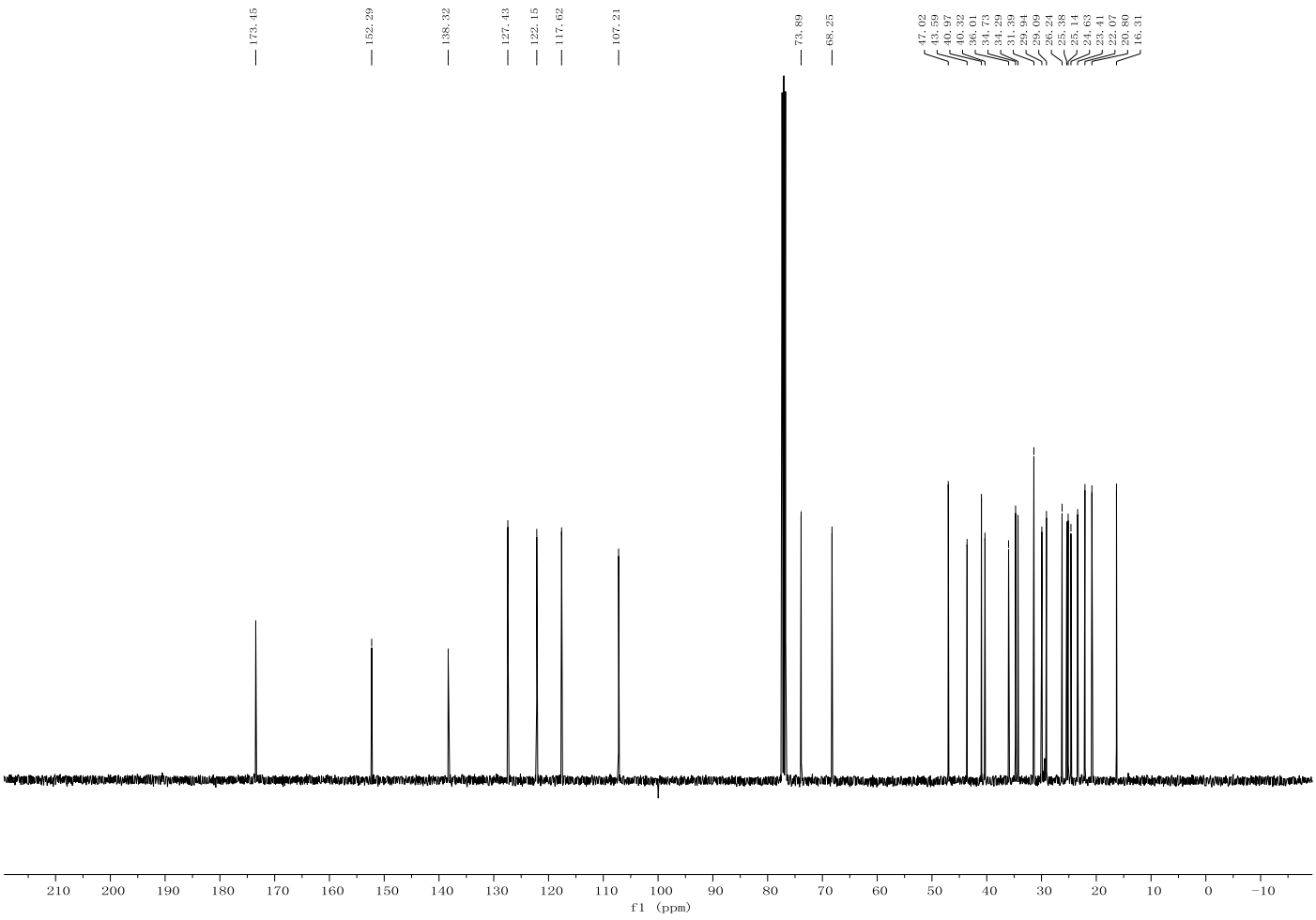

Me
O
Me
5
O
Me
Me
N
Me

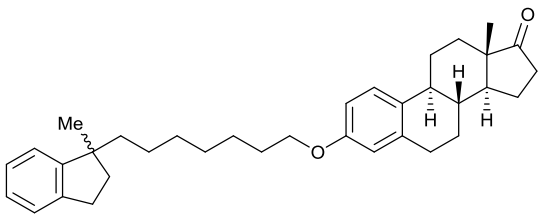
3ah


7.03 7.03 7.01 7.01 7.00 6.99 6.90 6.90 6.88 6.88 6.63 6.63 6.61 6.61 6.59 6.59 6.59 6.41 6.39 4.60 4.59 4.57 3.11 3.09 2.91 2.89 2.67 2.20 2.18 2.16 1.92 1.91 1.89 1.88 1.78 1.78 1.63 1.62 1.62 1.62 1.61 1.61 1.60 1.59 1.58 1.58 1.57 1.55 1.55 1.53 1.52 1.51 1.50 1.50 1.48 1.48 1.47 1.46 1.45 1.45 1.43 1.43 1.42 1.31 1.30 1.29 1.29 1.29 1.28 1.28 1.26 1.26 1.25 1.23 1.23 1.21 1.20 1.19 1.18 1.17 1.17 1.16 1.16 0.99 0.99 0.96 0.95 0.92 0.89 0.89 0.86 0.86 0.83 0.82 0.82 0.81 0.80 0.80 0.78 0.77 0.77 0.68 0.67
1.00 1.01 1.01 1.00 1.09 1.03 1.01 3.07 2.08 1.06 1.09 6.10 10.09 2.08 8.10 3.03
f1 (ppm)

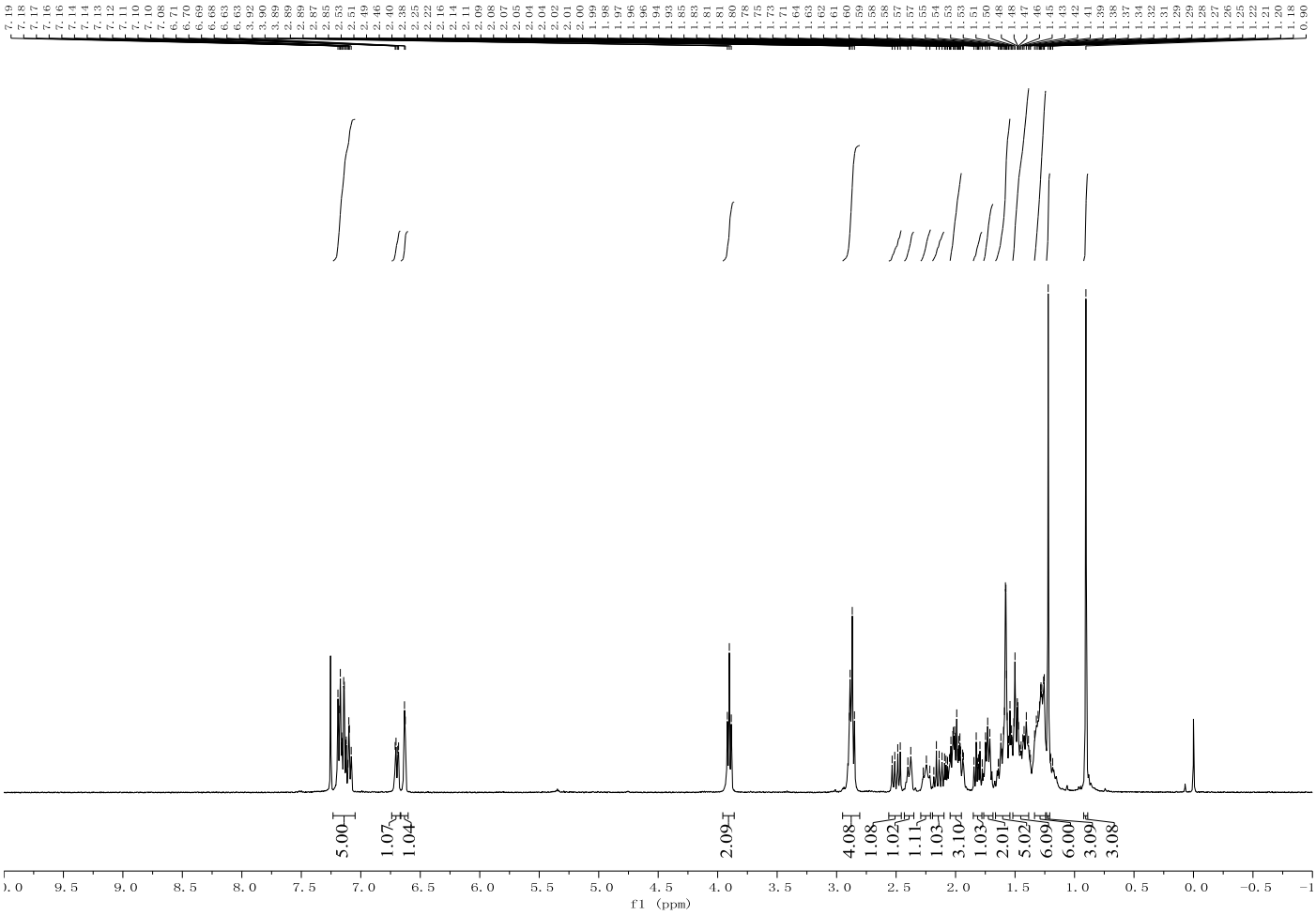

Me
O
Me
5
O
Me
Me
N
Me

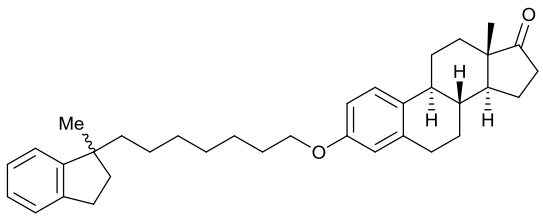
3ah


173.45
152.29
138.32
127.43
122.15
117.62
107.21
73.89
68.25
47.02
43.59
40.97
40.32
36.01
34.73
34.29
31.39
29.94
29.09
26.24
25.38
25.14
24.63
23.41
22.07
20.80
16.31
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

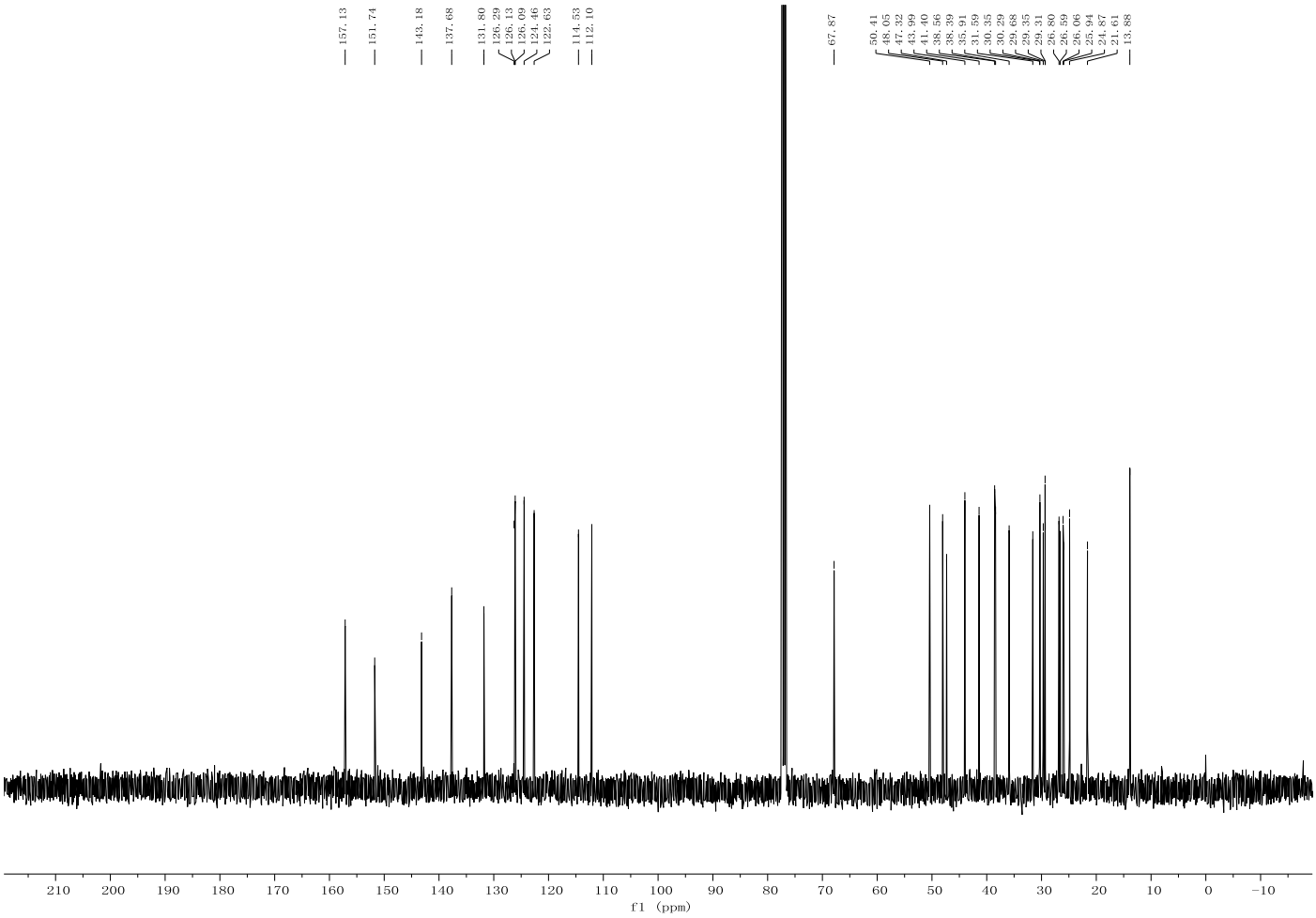

O
H
H
H
Me
O

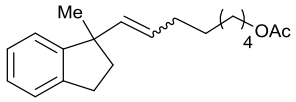
3ai


5.00
1.07
1.04
2.09
4.08
1.08
1.02
1.11
1.03
3.10
1.03
2.01
5.02
6.09
6.00
3.09
3.08
f1 (ppm)

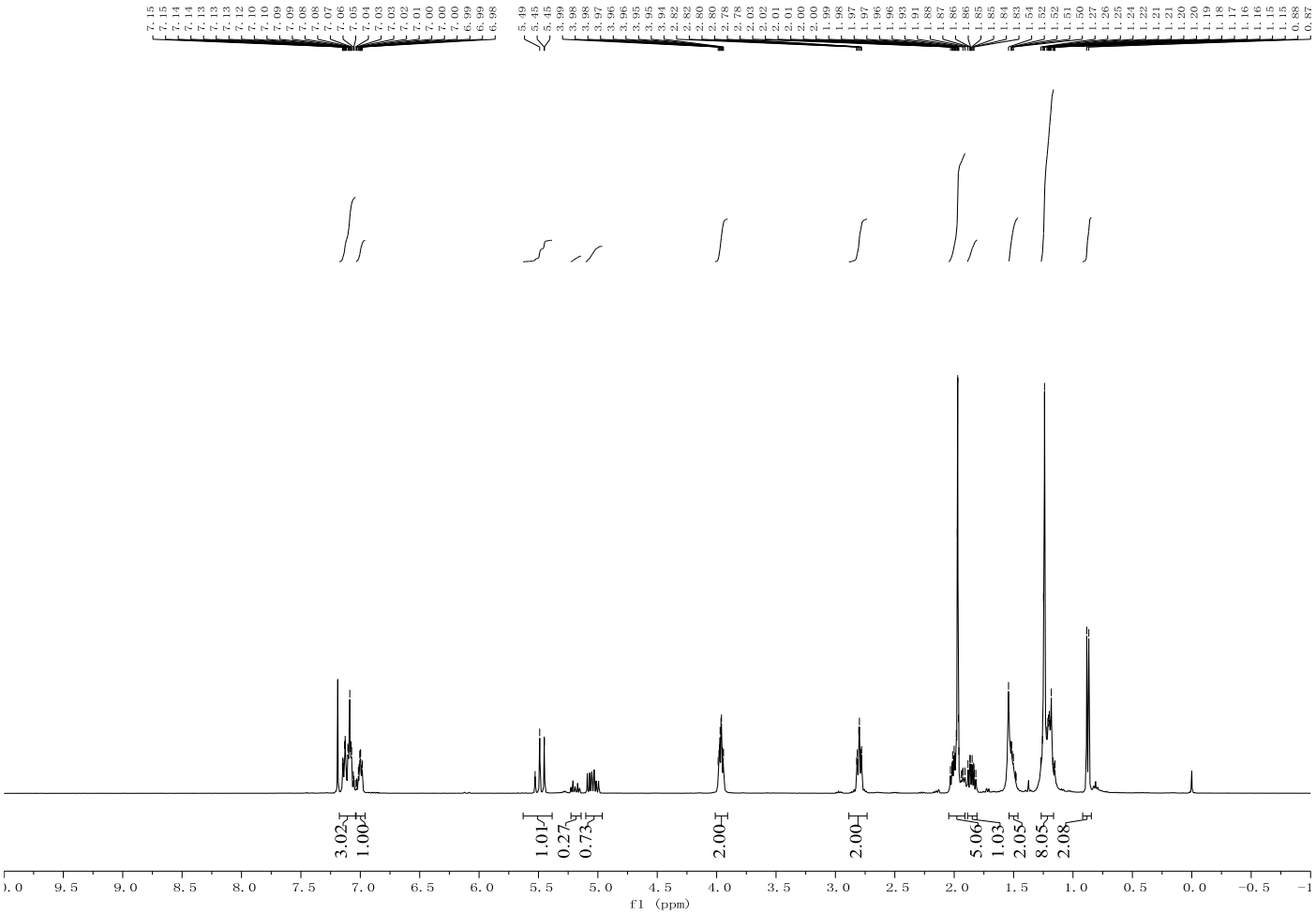

O
H
H
H
Me
O

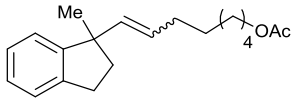
3hi


157.13
151.74
143.18
137.68
131.80
126.29
126.13
126.09
124.46
122.63
114.53
112.10
67.87
50.41
48.65
47.32
43.99
41.40
38.56
38.39
35.91
31.59
30.35
30.29
29.68
29.35
29.31
26.80
26.59
26.06
25.94
24.87
21.61
13.88
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

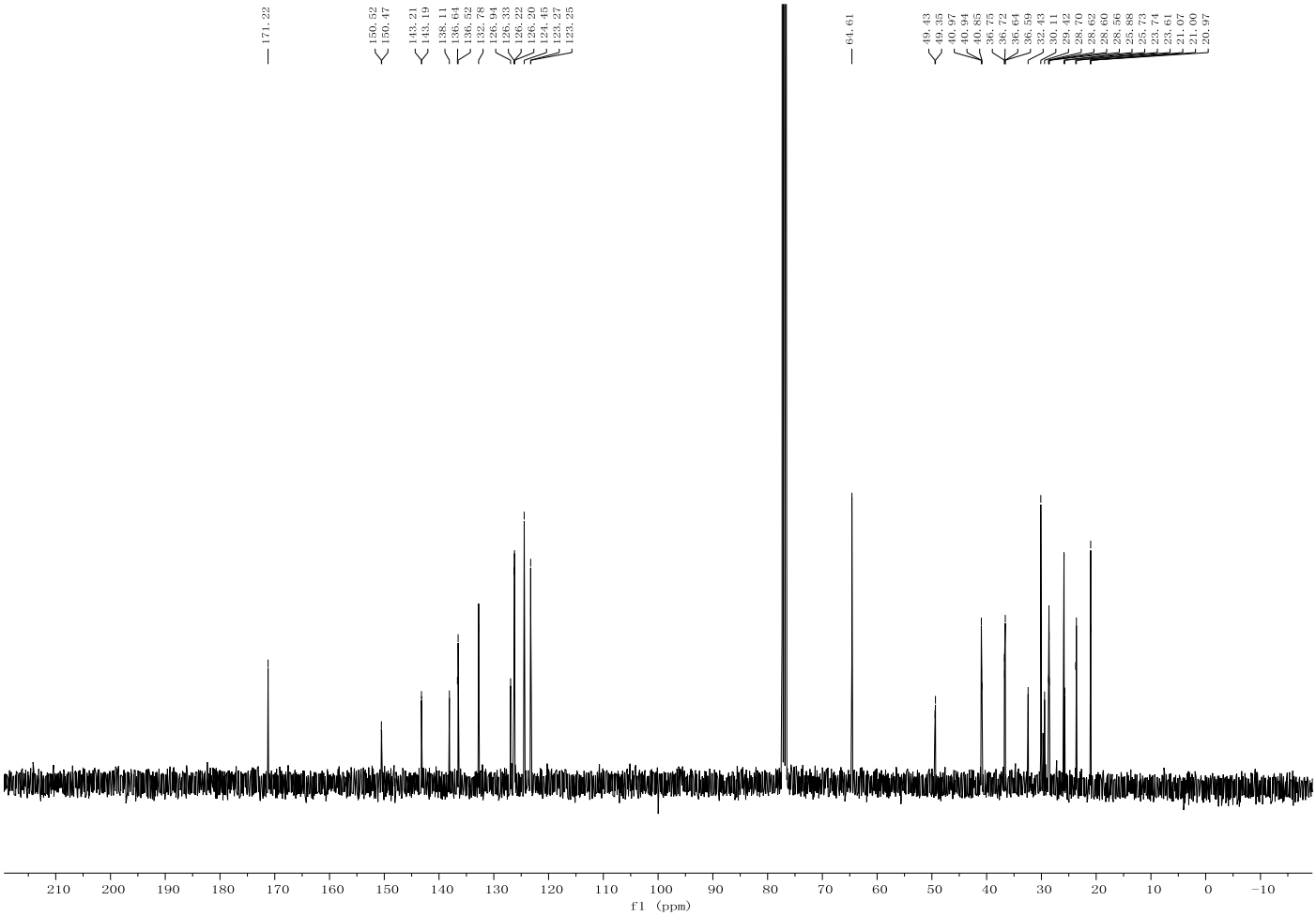

Me
4
OAc

3aj


7.15 7.15 7.14 7.14 7.13 7.13 7.12 7.10 7.09 7.09 7.08 7.08 7.07 7.06 7.05 7.04 7.03 7.03 7.02 7.01 7.00 7.00 7.00 6.99 6.99 6.98
5.49 5.45 5.45 3.99 3.98 3.98 3.97 3.96 3.95 3.95 3.94 2.82 2.80 2.80 2.78 2.03 2.02 2.01 2.01 2.00 2.00 1.99 1.98 1.97 1.97 1.96 1.96 1.93 1.91 1.88 1.87 1.86 1.86 1.85 1.85 1.84 1.83 1.54 1.52 1.52 1.51 1.50 1.27 1.26 1.25 1.24 1.22 1.21 1.21 1.20 1.20 1.19 1.18 1.17 1.16 1.16 1.15 0.88 0.87
3.02
1.00
1.01
0.27
0.73
2.00
2.00
5.06
1.03
2.05
8.05
2.08
f1 (ppm)


Me
4
OAc

3aj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150.47
143.21
143.19
138.11
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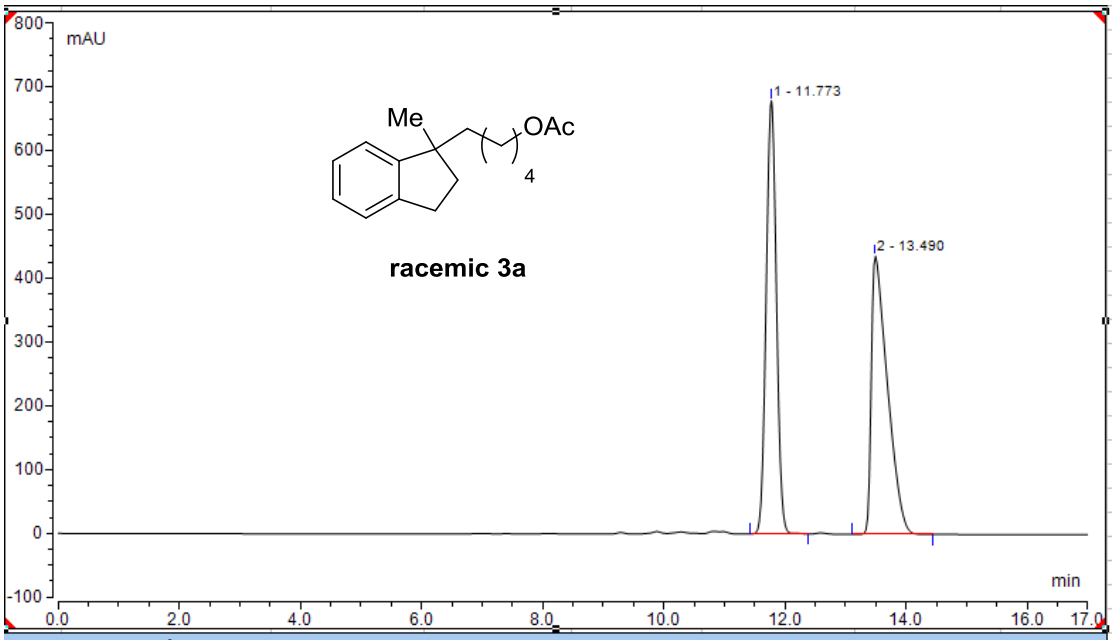
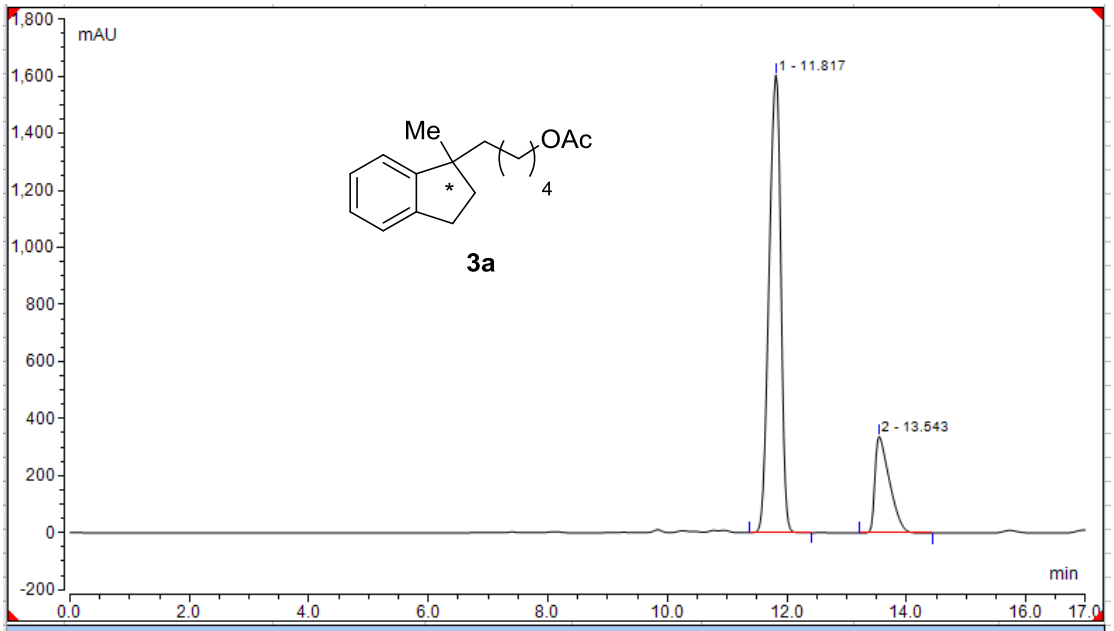
136.52
132.78
126.94
126.33
126.22
126.00
124.45
123.27
123.25
64.61
49.43
49.35
40.97
40.94
40.85
38.75
38.72
38.64
36.59
32.43
30.11
29.42
28.70
28.62
28.60
28.56
25.88
25.73
23.74
23.61
21.07
21.00
20.97
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

Copies of HPLC Traces



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.773	132.821	679.551	49.72	60.88	n.a.
2		13.490	134.344	436.599	50.28	39.12	n.a.
Total:			**267.165**	**1116.149**	**100.00**	**100.00**	

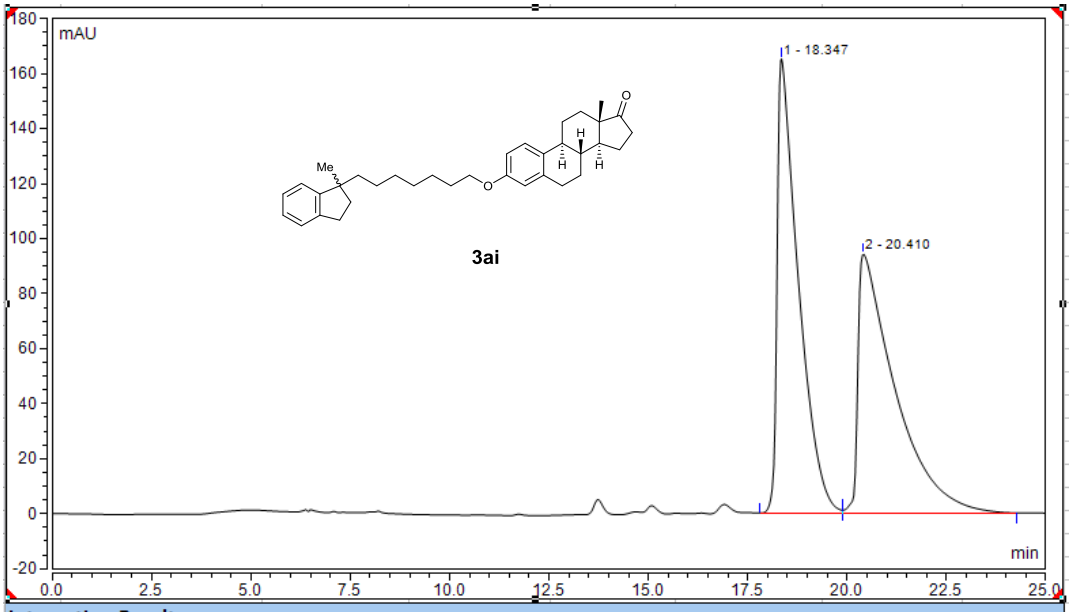


Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		11.817	364.062	1604.503	79.24	82.56	n.a.
2		13.543	95.357	339.046	20.76	17.44	n.a.
Total:			**459.419**	**1943.549**	**100.00**	**100.00**	

HPLC (Chiralpak IB): t_R= 11.8 (major), 13.5 (minor)

Condition: 98:2 n-Hexane:*i*-PrOH, flow rate 0.5 mL/min, 25 °C.

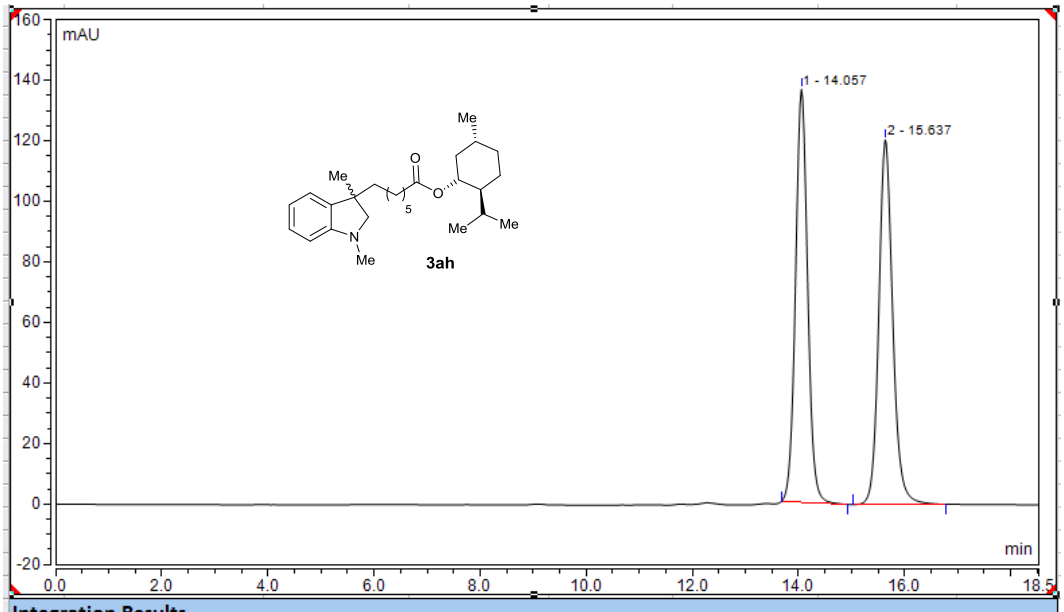


Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		18.347	102.125	165.156	50.16	63.69	n.a.
2		20.410	101.486	94.159	49.84	36.31	n.a.
Total:			**203.610**	**259.314**	**100.00**	**100.00**	

HPLC (Chiralpak IB): t_R= 18.3, 20.4

Condition: 96:4 n-Hexane:*i*-PrOH, flow rate 0.5 mL/min, 25 °C.



Integration Results

No.	Peak Name	Retention Time min	Area mAU*min	Height mAU	Relative Area %	Relative Height %	Amount n.a.
1		14.057	36.138	136.519	49.60	53.12	n.a.
2		15.637	36.722	120.478	50.40	46.88	n.a.
Total:			**72.860**	**256.997**	**100.00**	**100.00**	

HPLC (Chiralpak IF): t_R= 14.1, 15.6

Condition: 98:2 n-Hexane:*i*-PrOH, flow rate 0.5 mL/min, 25 °C.