SUPPORTING INFORMATION

Gold-catalysed facile access to indene scaffold via sequential C-H functionalization and 5-*endo*-*dig* carbocyclization

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Content:

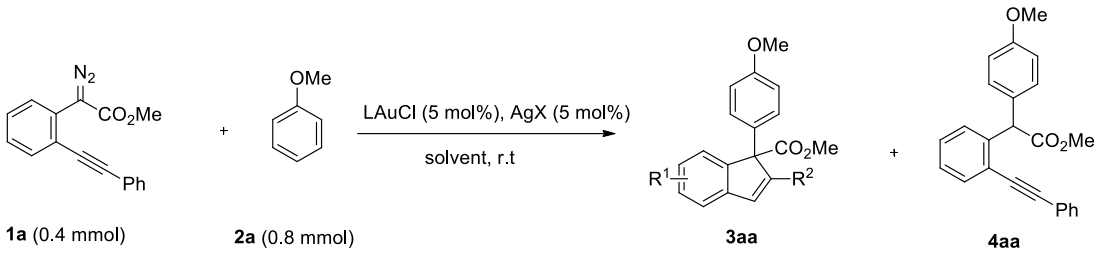
1. General Information:

Unless otherwise noted, all reactions were carried out in standard Schlenk techniques with magnetic stirring bar under air. Materials obtained from commercial suppliers were used directly without further purification. ^{1}H NMR spectra were recorded on a BRUKER 400 (400 MHz) spectrometer or a Bruker 300 MHz spectrometer in $CDCl_3$. Chemical shifts are reported in ppm with tetramethylsilane (TMS: 0 ppm) with the solvent resonance as the internal standard. Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz), and integration. ^{13}C NMR spectra were recorded on a BRUKER 400 (100 MHz) spectrometer and a Bruker 300 (75.0 MHz) spectrometer in $CDCl_3$ with complete proton decoupling. Chemical shifts are reported in ppm with the deuterium solvent as the internal standard (e.g. $CDCl_3$: 77.0 ppm).

Anhydrous tetrahydrofuran (THF), toluene, 1,2-Dimethoxyethane (DME) and diethyl ether (Et_2O) were distilled from sodium and benzophenone to use; AgOTf, $AgSbF_6$, $AgNTf_2$, $AgBF_4$, and $AgPF_6$ were purchased from Alfa-Aesar Company and used directly .

Reactions were monitored by thin layer chromatography (TLC) using silicycle pre-coated silica gel plates. Flash column chromatography was performed on silica gel 60 (particle size 200-400 mesh ASTM, purchased from Yantai, China) and eluted with hexane/ethyl acetate or hexane/ CH_2Cl_2.

2. **Table S1**. Optimization of Reaction Conditions. [a]



1a (0.4 mmol) **2a** (0.8 mmol) **3aa** **4aa**

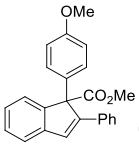
Entry	AuLCl	AgX	Solvent	**3 :4**[b]	Yield (%) [c] (**3aa: 4aa**)
1	(2,4-^{t}Bu$_2$C$_6$H$_3$O)$_3$PAuCl	$AgSbF_6$	DCM	5 : 1	(75/15)
2	(2,4-^{t}Bu$_2$C$_6$H$_3$O)$_3$PAuCl	$AgSbF_6$	DCE	6 : 1	77/13
3	(2,4-^{t}Bu$_2$C$_6$H$_3$O)$_3$PAuCl	$AgSbF_6$	$CHCl_3$	5 : 1	75/15
4	(2,4-^{t}Bu$_2$C$_6$H$_3$O)$_3$PAuCl	$AgSbF_6$	THF	6 : 1	60/10
5	(2,4-^{t}Bu$_2$C$_6$H$_3$O)$_3$PAuCl	$AgSbF_6$	Et_2O	8 : 1	70/9
6	(2,4-^{t}Bu$_2$C$_6$H$_3$O)$_3$PAuCl	$AgSbF_6$	Toluene	>20 : 1	(80/3)
7	$AuCl_3$	$AgSbF_6$	DCM	-	-
8	IPrAuCl	$AgSbF_6$	DCM	4 : 1	75/17
9	PicAuCl	$AgSbF_6$	DCM	2 : 1	50/25
10	Ph_3PAuCl	$AgSbF_6$	DCM	>20 : 1	(75/3)
11	**Ph_3PAuCl**	**AgOTf**	**DCM**	**>20 : 1**	**(87/3)**
12	Ph_3PAuCl	$AgNTf_2$	DCM	>20 : 1	83/4
13	Ph_3PAuCl	$AgBF_4$	DCM	15 : 1	80/6
14	Ph_3PAuCl	AgOMs	DCM	10 : 1	75/7
16	Ph_3PAuCl	AgOTf	DCE	>20 : 1	(85/4)
17	Ph_3PAuCl	AgOTf	$CHCl_3$	>20 : 1	85/3
18	Ph_3PAuCl	AgOTf	THF	5 : 1	65/13
19	Ph_3PAuCl	AgOTf	Toluene	>20 : 1	(87/4)
20	-	AgOTf	DCM	<1 : 20	(0/60)
21	Ph_3PAuCl	-	DCM	-	-

[a] Reaction conditions: **1a** (0.2 mmol), **2a** (0.4 mmol), Ph_3PAuCl (5.5 mol%), AgOTf (5 mol%) in dry solvent (2 mL) at room temperature under Ar. [b] Determined by NMR of crude products. [c] NMR yield. the numbers in parenthesis are isolate yields.

3. General procedure for the cascade reactions

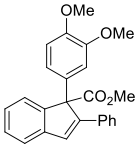
In a dried glass tube, a solution of Ph_3PAuCl (10.97 mg, 0.022 mmol, 5.5 mol%), AgOTf (5.13 mg, 5 mol%) in DCM (2 mL) was stirred at room temperature for 15 mins. After AgCl was filtered off, anisole (86.4 mg, 0.8 mmol) was added to the reaction mixture at room temperature. Then a solution of methyl 2-diazo-2-(2-(phenylethynyl)phenyl)acetate **1a** (110 mg, 0.4 mmol) in 1 mL DCM was introduced into the reaction mixture by a syringe in 5 mins. The resulting mixture was continually stirred at room temperature for 10 min and **1a** was consumed completely determined by TLC analysis. After being filtrated through celite and concentrated, the residue was purified by column chromatography on silica gel to afford the desired product.

1) Methyl 1-(4-methoxyphenyl)-2-phenyl-1H-indene-1-carboxylate (3aa)



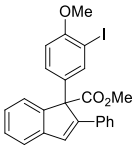
The general procedure was followed using **1a** (0.4 mmol) and **2a** (0.8 mmol). After purification by column chromatography (PE/EtOAc 10:1), **3aa** (123.8 mg, 87%) was obtained as a white solid, m.p. 139-140 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.43-7.35 (m, 5H), 7.30-7.16 (m, 7H), 6.75 (d, *J* = 8.8 Hz, 2H), 3.74 (s, 3H), 3.60 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.5, 158.5, 150.3, 149.2, 142.6, 134.3, 130.3, 129.4, 128.7, 128.2, 127.9, 127.6, 127.1, 126.3, 123.8, 121.5, 113.7, 68.1, 55.1, 52.7; **MS** (EI): m/z (%): 356 (M^+, 50.66), 297 (100); **HRMS** (EI) calculated for [$C_{24}H_{20}O_3$]: 356.1412, found: 356.1415.

2) Methyl 1-(3, 4-dimethoxyphenyl)-2-phenyl-1H-indene-1-carboxylate (3ab)



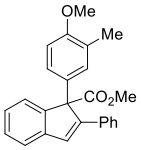
The general procedure was followed using **1a** (0.4 mmol) and **2b** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **3ab** (134.4 mg, 87%) was obtained as a white solid, m.p. 149-150 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.42-7.16 (m, 10 H), 6.95-6.91 (m, 2H), 6.70 (d, *J* = 8.0 Hz, 1H), 3.80 (s, 3H), 3.70 (s, 3H), 3.60 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.5, 150.4, 148.9, 148.5, 148.2, 142.6, 134.5, 130.6, 129.5, 128.2, 128.0, 127.6, 127.2, 126.2, 123.8, 121.6, 119.9, 111.4, 110.9, 68.3, 55.8, 55.7, 52.7; **MS** (EI): m/z (%): 386 (M^+, 62.46), 327 (100); **HRMS** (EI) calculated for [$C_{25}H_{22}O_4$]: 386.1518, found: 386.1520.

3) Methyl 1-(3-iodo-4-methoxyphenyl)-2-phenyl-1H-indene-1-carboxylate (3ac)



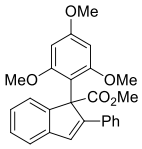
The general procedure was followed using **1a** (0.4 mmol) and **2c** (0.8 mmol). After purification by column chromatography (PE/EtOAc 10:1), **3ac** (150.3 mg, 78%) was obtained as a white solid, m.p. 131-132 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 2.4 Hz, 1H), 7.45-7.10 (m, 11H), 6.61 (d, *J* = 8.8 Hz, 1H), 3.77 (s, 3H), 3.58 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ172.1, 157.2, 149.9 148.7, 142.6, 138.5, 134.0, 132.4, 129.6, 128.8, 128.3, 128.1, 127.7, 127.1, 126.4, 123.6, 121.7, 110.5, 85.7, 67.3, 56.2, 52.7; **MS** (EI): m/z (%): 482 (M^+, 83.65), 423 (100); **HRMS** (EI) calculated for [$C_{24}H_{19}O_3I$]: 482.0379, found: 482.0375.

4) Methyl 1-(4-methoxy-3-methylphenyl)-2-phenyl-1H-indene-1-carboxylate (3ad)



The general procedure was followed using **1a** (0.4 mmol) and **2d** (0.8 mmol). After purification by column chromatography (PE/EtOAc 10:1), **3ad** (111.1mg, 75%) was obtained as a white solid, m.p. 151-152 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.43-7.35 (m, 5H), 7.28-7.11 (m, 7H), 6.63 (d, *J* = 8.4 Hz, 1H), 3.72 (s, 3H), 3.58 (s, 3H), 2.09 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.6, 156.7, 150.2, 149.3, 142.5, 134.3, 129.71, 129.68, 129.3, 128.1, 127.8, 127.5, 127.1, 126.3, 126.2, 125.9, 123.8, 121.4, 109.5, 68.1, 55.1, 52.6, 16.5; **MS** (EI): m/z (%): 370 (M^+, 42.94), 311 (100); **HRMS** (EI) calculated for [$C_{25}H_{22}O_3$]: 370.1569, found: 370.1573.

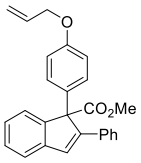
5) Methyl 2-phenyl-1-(2, 4, 6-trimethoxyphenyl)-1H-indene-1-carboxylate (3ae).



The general procedure was followed using **1a** (0.4 mmol) and **2e** (0.8 mmol). After purification by column chromatography (PE/EtOAc 3:1), **3ae** (161.4 mg, 97%) was obtained as a white solid, m.p. 189-190 °C.**^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52-7.40 (m, 3H), 7.33 (d, *J* = 7.2 Hz, 1H), 7.26-7.04 (m, 6H), 6.21 (s, 1H), 5.98 (s, 1H), 3.78 (s, 3H), 3.73 (s, 3H), 3.53 (s, 3H), 3.11 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 160.2, 159.5, 159.1, 150.2, 148.1, 130.0, 129.7, 128.7, 127.3, 125.1, 124.3, 123.8, 120.6, 120.5, 119.6, 116.7, 109.0, 92.4, 91.9, 55.8, 55.5, 55.4, 55.2; **MS** (EI): m/z (%): 416 (M^+, 40.87), 417 (M^+, 10.90), 384 (100); **HRMS** (EI) calculated for

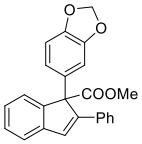
[$C_{26}H_{24}O_5$]: 416.1624, found: 416.1625.

6) Methyl 1-(4-(allyloxy)phenyl)-2-phenyl-1H-indene-1-carboxylate (3af)



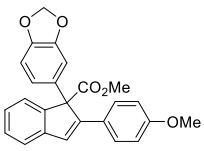
The general procedure was followed using **1a** (0.4 mmol) and **2f** (0.8 mmol). After purification by column chromatography (PE/EtOAc 10:1), **3af** (91.6 mg, 60%) was obtained as a white solid, m.p. 109-110 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.46-7.32 (m, 5H), 7.31-7.12 (m, 7H), 6.75 (dd, *J* = 6.4, 2.4 Hz, 2H), 6.05-5.96 (m, 1H), 5.36 (dd, *J* = 17.2, 1.6 Hz, 1H), 5.24 (dd, *J* = 10.8, 1.6 Hz, 1H), 4.45 (dt, *J* = 6.4, 1.6 Hz, 2H), 3.59 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.5, 157.6, 150.3, 149.2, 142.6, 134.2, 133.2, 130.5, 129.4, 128.7, 128.2, 127.9, 127.6, 127.1, 126.3, 123.8, 121.5, 117.7, 114.4, 68.7, 68.1, 52.7; **MS** (EI): m/z (%): 382 (M^+, 100); **HRMS** (EI) calculated for [$C_{26}H_{22}O_3$]: 382.1569, found: 382.1571.

7) Methyl 1-(benzo[d][1,3]dioxol-5-yl)-2-phenyl-1H-indene-1-carboxylate (3ag)



The general procedure was followed using **1a** (0.4 mmol) and **2g** (0.8 mmol). After purification by column chromatography (PE/EtOAc 10:1), **3ag** (121.3 mg, 82%) was obtained as a white solid, m.p. 189-190 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.46-7.34 (m, 5H), 7.30-7.14 (m, 5H), 6.90 (dd, *J* = 8.0, 2.0 Hz, 1H), 6.84 (d, *J* = 2.0 Hz, 1H), 6.64 (d, *J* = 8.0 Hz, 1H), 5.86 (s, 2H), 3.59 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.3, 150.3, 149.1, 147.5, 146.6, 142.5, 134.2, 132.0, 129.5, 128.2, 128.0, 127.6, 127.2, 126.3, 123.8, 121.6, 120.9, 108.2, 108.0, 101.0, 68.4, 52.7; **MS** (EI): m/z (%): 370 (M^+, 54.41), 311 (100); **HRMS** (EI) calculated for [$C_{24}H_{18}O_4$]: 370.1205, found: 370.1208.

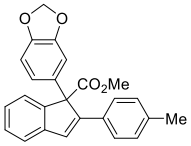
8) Methyl 1-(benzo[d][1,3]dioxol-5-yl)-2-(4-methoxyphenyl)-1H-indene-1-carboxylate (3bg)



The general procedure was followed using **1b** (0.4 mmol) and **2g** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **3bg** (139.2 mg, 87%) was obtained as a white solid, m.p. 158-159 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.39-7.31 (m, 6H), 7.26-7.21 (m, 1H), 6.92-6.90 (m, 1H), 6.85-6.80 (m, 3H), 6.65 (d, *J* = 8.0 Hz, 1H), 5.87 (dd, *J* =

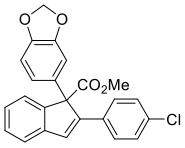
2.4, 1.6 Hz, 2H), 3.78 (s, 3H), 3.59 (s, 3H) ; **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.4, 159.2, 149.9, 148.9, 147.5, 146.6, 142.8, 132.2, 128.5, 127.9, 127.7, 126.8, 125.9, 123.7, 121.2, 120.9, 113.7, 108.3, 108.0, 101.0, 68.3, 55.2, 52.7; **MS** (EI): m/z (%): 400 (M^+, 57.60), 341 (100); **HRMS** (EI) calculated for [$C_{24}H_{18}O_4$]: 400.1311, found: 400.1315.

9) Methyl 1-(benzo[d][1,3]dioxol-5-yl)-2-(p-tolyl)-1H-indene-1-carboxylate (3cg)



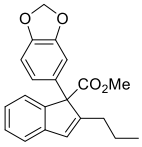
The general procedure was followed using **1c** (0.4 mmol) and **2g** (0.8 mmol). After purification by column chromatography (PE/EtOAc 8:1), **3cg** (130.5 mg, 85%) was obtained as a white solid, m.p. 186-187 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.37-7.24 (m, 6H), 7.16-7.10 (m, 1H), 7.07 (d, *J* = 8.0 Hz, 2H), 6.91 (dd, *J* = 8.4, 2.0 Hz, 1H), 6.86 (d, *J* = 2.0 Hz, 1H), 6.64 (d, *J* = 8.4 Hz, 1H), 5.85 (s, 2H), 3.58 (s, 3H), 2.30 (s, 3H) ; **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.3, 150.2, 149.0, 147.5, 146.6, 142.7, 137.6, 132.1, 131.3, 129.0, 128.6, 127.9, 127.0, 126.1, 123.7, 121.4, 120.9, 108.3, 108.0, 100.9, 68.2, 52.6, 21.2; **MS** (EI): m/z (%): 384 (M^+, 4.65), 152 (100); **HRMS** (EI) calculated for [$C_{25}H_{20}O_4$]: 384.1362, found: 384.1360.

10) Methyl 1-(benzo[d][1,3]dioxol-5-yl)-2-(4-chlorophenyl)-1H-indene-1-carboxylate (3dg)



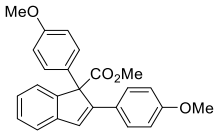
The general procedure was followed using **1d** (0.4 mmol) and **2g** (0.8 mmol). After purification by column chromatography (PE/EtOAc 8:1), **3dg** (121.2 mg, 75%) was obtained as a red solid, m.p. 152-153 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.42-7.15 (m, 9H), 6.86 (dd, *J* = 8.4, 2.0 Hz, 1H), 6.77 (d, *J* = 2.0 Hz, 1H), 6.66 (d, *J* = 8.4 Hz, 1H), 5.89 (dd, *J* = 2.4, 1.6 Hz, 2H), 3.60 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.0, 149.0, 147.7, 146.8, 142.2, 133.4, 132.7, 131.7, 130.0, 128.4, 128.1, 126.6, 124.0, 121.7, 120.7, 108.1, 108.0, 101.1, 68.5, 52.8; **MS** (EI): m/z (%): 404 (M^+, 43.72), 406 ([M+2]$^+$, 11.97), 345 (100); **HRMS** (EI) calculated for [$C_{24}H_{17}O_4Cl$]: 404.0815, found: 404.0811.

11) Methyl 1-(benzo[d][1,3]dioxol-5-yl)-2-propyl-1H-indene-1-carboxylate (3eg)



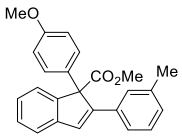
The general procedure was followed using **1e** (0.4 mmol) and **2g** (0.8 mmol). After purification by column chromatography (PE/EtOAc 10:1), **3eg** (100.8 mg, 75%) was obtained as a yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.40-7.36 (m, 1H), 7.29-7.23 (m, 2H), 7.15-7.09 (m, 1H), 6.70 (d, *J* = 8.4 Hz, 1H), 6.56-6.50 (m, 2H), 6.43 (d, *J* = 1.6 Hz, 1H), 5.90 (dd, *J* = 2.8, 1.6 Hz, 2H), 3.72 (s, 3H), 2.44-2.34 (m, 1H), 2.10-1.98 (m, 1H), 1.70-1.58 (m, 1H), 1.56-1.47 (m, 1H), 0.93 (t, *J* = 7.2 Hz, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.4, 154.5, 147.6, 146.7, 146.6, 144.3, 133.0, 128.0, 126.4, 125.1, 124.8, 120.6, 120.4, 108.1, 107.8, 101.0, 70.4, 52.6, 30.3, 20.9, 14.1; **MS** (EI): m/z (%): 336 (M^+, 100); **HRMS** (EI) calculated for [$C_{21}H_{20}O_4$]: 336.1362, found: 336.1363.

12) Methyl 1, 2-bis (4-methoxyphenyl)-1H-indene-1-carboxylate (3ba)



The general procedure was followed using **1b** (0.4 mmol) and **2a** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **3ba** (134.2 mg, 87%) was obtained as a white solid, m.p. 157-158 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.40-7.24 (m, 8H), 7.14-7.01 (m, 1H), 6.81-6.72 (m, 4H), 3.77 (s, 3H), 3.73 (s, 3H), 3.59 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.7, 159.1, 158.5, 150.0, 149.1, 142.9, 130.6, 128.7, 128.5, 127.8, 127.6, 127.0, 125.8, 123.6, 121.1, 113.7, 113.6, 68.1, 55.2, 55.1, 52.6; **MS** (EI): m/z (%): 386 (M^+, 55.93), 327 (100); **HRMS** (EI) calculated for [$C_{25}H_{22}O_4$]: 386.1518, found: 386.1522.

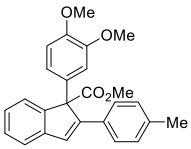
13) Methyl 1-(4-methoxyphenyl)-2-(m-tolyl)-1H-indene-1-carboxylate (3fa)



The general procedure was followed using **1f** (0.4 mmol) and **2g** (0.8 mmol). After purification by column chromatography (PE/EtOAc 10:1), **3fa** (119.8 mg, 81%) was obtained as a white solid, m.p. 142-143 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.39-7.24 (m, 7H), 7.16-7.01 (m, 4H), 6.75-6.71 (m, 2H), 3.72 (s, 3H), 3.59 (s, 3H), 2.29 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.6, 158.5, 150.6, 149.2, 142.7, 137.6, 134.2, 130.4, 129.2, 128.8, 128.4, 128.1, 127.9, 127.7, 126.2, 124.4, 123.7, 121.4, 113.6, 68.1, 55.1, 52.6, 21.5; **MS** (EI): m/z (%): 370 (M^+,

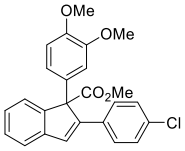
53.30), 311 (100); **HRMS** (EI) calculated for [$C_{25}H_{22}O_3$]: 370.1569, found: 370.1565.

14) Methyl 1-(3,4-dimethoxyphenyl)-2-(p-tolyl)-1H-indene-1-carboxylate (3cb)



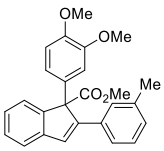
The general procedure was followed using **1c** (0.4 mmol) and **2b** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **3cb** (120 mg, 75%) was obtained as a white solid, m.p. 132-133 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.45-7.26 (m, 6H), 7.17-7.13 (m, 1H), 7.07 (d, *J* = 2.0 Hz, 2H), 6.98 (d, *J* = 2.0 Hz, 1H), 6.93 (dd, *J* = 8.4, 2.0 Hz, 1H), 6.69 (d, *J* = 8.4 Hz, 1H), 3.80 (s, 3H), 3.72 (s, 3H), 3.59 (s, 3H), 2.31 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.6, 150.2, 148.8, 148.3, 147.9, 142.7, 137.5, 131.4, 130.7, 128.9, 128.6, 127.9, 127.0, 126.0, 123.6, 121.4, 119.7, 111.1, 110.6, 68.0, 55.7, 55.6, 52.7, 21.2; **MS** (EI): m/z (%): 400 (M^+, 5.02), 311 (100); **HRMS** (EI) calculated for [$C_{26}H_{24}O_4$]: 400.1675, found: 400.1673.

15) Methyl 2-(4-chlorophenyl)-1-(3,4-dimethoxyphenyl)-1H-indene-1-carboxylate (3db)



The general procedure was followed using **1d** (0.4 mmol) and **2b** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **3db** (120.9 mg, 72%) was obtained as a white solid, m.p. 156-157 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.43-7.15 (m, 9H), 6.91-6.86 (m, 2H), 6.71 (d, *J* = 9.2 Hz, 1H), 3.81 (s, 3H), 3.72 (s, 3H), 3.61 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.2, 148.9, 148.8, 148.5, 148.1, 142.2, 133.4, 132.8, 130.2, 130.0, 128.4, 128.3, 128.0, 126.5, 123.8, 121.7, 119.6, 110.8, 68.3, 55.7, 55.6, 52.8; **MS** (EI): m/z (%): 420 (M^+, 7.42), 422 ([M+2]$^+$, 2.89), 311 (100); **HRMS** (EI) calculated for [$C_{25}H_{21}O_4Cl$]: 420.1128, found: 420.1125.

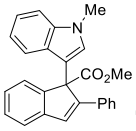
16) Methyl 1-(3,4-dimethoxyphenyl)-2-(m-tolyl)-1H-indene-1-carboxylate (3fb)



The general procedure was followed using **1f** (0.4 mmol) and **2b** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **3fb** (115.2 mg, 72%) was obtained as a white solid, m.p. 158-159 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.40-7.26 (m, 5H), 7.16-7.13 (m, 3H), 7.04-7.03 (m, 1H), 6.98 (d, *J* = 2.0 Hz, 1H), 6.90 (dd, *J* = 8.4, 2.0 Hz, 1H), 6.68 (d, *J* = 8.4

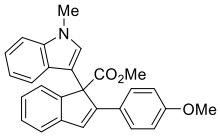
Hz, 1H), 3.79 (s, 3H), 3.71 (s, 3H), 3.60 (s, 3H), 2.30 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.5, 150.5, 148.8, 148.3, 148.0, 142.6, 137.6, 134.2, 130.6, 129.2, 128.5, 128.0, 127.9, 127.7, 126.1, 124.4, 123.6, 121.5, 119.8, 111.2, 110.6, 68.1, 55.7, 55.6, 52.7, 21.5; **MS** (EI): m/z (%): 400 (M^+, 65.2), 341 (100); **HRMS** (EI) calculated for [$C_{26}H_{24}O_4$]: 400.1675, found: 400.1672.

17) Methyl 1-(1-methyl-1H-indol-3-yl)-2-phenyl-1H-indene-1-carboxylate (3ah)



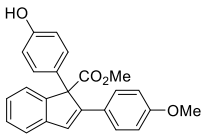
The general procedure was followed using **1a** (0.4 mmol) and **2h** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **3ah** (125.8 mg, 83%) was obtained as a white solid, m.p. 89-90 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.69 (s, 1H), 7.50-7.44 (m, 4H), 7.34-7.00 (m, 8H), 6.92 (d, *J* = 8.0 Hz, 1H), 6.78-6.76 (m, 1H), 3.74 (s, 3H), 3.59 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.9, 149.8, 148.4, 142.8, 136.8, 134.5, 129.2, 128.9, 128.2, 127.9, 127.4, 126.6, 126.2, 125.8, 123.5, 121.4, 121.1, 120.2, 118.8, 109.8, 109.0, 63.8, 52.7, 32.9; **MS** (EI): m/z (%): 379 (M^+, 42.72), 320 (100); **HRMS** (EI) calculated for [$C_{26}H_{21}NO_2$]: 379.1572, found: 379.1576.

18) Methyl 2-(4-methoxyphenyl)-1-(1-methyl-1H-indol-3-yl)-1H-indene-1-carboxylate (3bh)



The general procedure was followed using **1b** (0.4 mmol) and **2h** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **3bh** (139.1 mg, 85%) was obtained as a yellow solid, m.p. 167-168 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.66 (s, 1H), 7.54-7.40 (m, 4H), 7.34-7.20 (m, 2H), 7.16 (d, *J* = 8.0 Hz, 1H), 7.06-6.95 (m, 3H), 6.79-6.70 (m, 3H), 3.73 (s, 3H), 3.71 (s, 3H), 3.58 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 173.0, 159.0, 149.6, 148.3, 143.1, 136.9, 129.1, 127.9, 127.8, 127.4, 127.1, 125.9, 125.7, 123.4, 121.2, 121.0, 120.3, 118.9, 113.7, 110.3, 108.9, 63.9, 55.1, 52.6, 32.8; **MS** (EI): m/z (%): 409 (M^+, 52.13), 350 (100); **HRMS** (EI) calculated for [$C_{27}H_{23}NO_3$]: 409.1678, found: 409.1672.

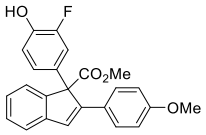
19) Methyl 1-(4-hydroxyphenyl)-2-(4-methoxyphenyl)-1H-indene-1-carboxylate (6a)



The general procedure was followed using **1b** (0.4 mmol) and **5a** (0.8 mmol).

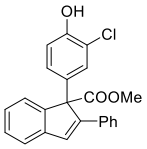
After purification by column chromatography (PE/EtOAc 3:1), **6ba** (108.6 mg, 73%) was obtained as a white solid, m.p. 90-91 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.36-7.31 (m, 4H), 7.27-7.21 (m, 4H), 7.13-7.09 (m, 1H), 6.68 (dd, *J* = 6.8, 2.0 Hz, 2H), 6.64 (dd, *J* = 6.8, 2.0 Hz, 2H), 5.18 (s, 1H), 3.76 (s, 3H), 3.58 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.8, 159.1, 154.7, 149.9, 149.0, 142.9, 130.6, 128.9, 128.5, 127.8, 127.6, 127.0, 125.8, 123.6, 121.2, 115.2, 113.7, 68.1, 55.2, 52.7; **MS** (EI): m/z (%): 372 (M^+, 55.42), 313 (100); **HRMS** (EI) calculated for [$C_{24}H_{20}O_4$]: 372.1362, found: 372.1368.

20) Methyl 1-(3-fluoro-4-hydroxyphenyl)-2-(4-methoxyphenyl)-1H-indene-1-carboxylate (6b)



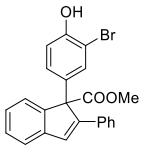
The general procedure was followed using **1b** (0.4 mmol) and **5b** (0.8 mmol). After purification by column chromatography (PE/EtOAc 3:1), **6bb** (117.0 mg, 75%) was obtained as a red oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.37-7.19 (m, 7H), 7.15-7.11 (m, 1H), 7.07-7.04 (m, 1H), 6.83-6.79 (m, 3H), 5.13 (d, *J* = 2.4 Hz, 1H), 3.78 (s, 3H), 3.58 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.3, 159.3, 149.5 (d, *J* = 18.1 Hz), 148.6, 142.9, 142.5 (d, *J* = 14.3 Hz), 131.5 (d, *J* = 6.0 Hz), 128.4, 128.1, 127.7, 126.6, 125.9, 124.0, 123.5, 121.3, 116.9, 115.1 (d, *J* = 20.2 Hz), 113.8, 67.6, 55.2, 52.7; **^{19}F NMR** (282 MHz, $CDCl_3$) δ -139.977; **MS** (EI): m/z (%): 390 (M^+, 56.80), 84 (100); **HRMS** (EI) calculated for [$C_{24}H_{19}O_4F$]: 390.1267, found: 390.1264.

21) Methyl 1-(3-chloro-4-hydroxyphenyl)-2-phenyl-1H-indene-1-carboxylate (6c)



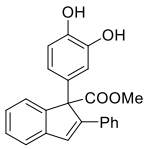
The general procedure was followed using **1a** (0.4 mmol) and **5c** (0.8 mmol). After purification by column chromatography (PE/EtOAc 3:1), **6ac** (108.2 mg, 72%) was obtained as a white solid, m.p. 136-137 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.45 (d, *J* = 2.4 Hz, 1H), 7.41-7.38 (m, 4H), 7.34-7.22 (m, 5H), 7.19-7.14 (m, 2H), 6.82 (d, *J* = 8.8 Hz, 1H), 5.48 (s, 1H), 3.59 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.1, 150.4, 149.9, 148.7, 142.6, 133.9, 131.6, 129.6, 128.3, 128.2, 128.1, 127.8, 127.7, 127.0, 126.4, 123.6, 121.7, 119.6, 116.0, 67.5, 52.8; **MS** (EI): m/z (%): 376 (M^+, 49.84), 378 ([M+2]$^+$, 15.68), 317 (100); **HRMS** (EI) calculated for [$C_{23}H_{17}O_3Cl$]: 376.0866, found: 376.0869.

22) Methyl 1-(3-bromo-4-hydroxyphenyl)-2-phenyl-1H-indene-1-carboxylate (6d)



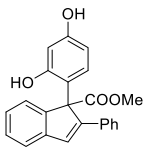
The general procedure was followed using **1a** (0.4 mmol) and **5d** (0.8 mmol). After purification by column chromatography (PE/EtOAc 3:1), **6ad** (132.7 mg, 79%) was obtained as a white solid, m.p. 189-190 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 2.4 Hz, 1H), 7.42-7.16 (m, 11H), 6.83 (d, *J* = 8.4 Hz, 1H), 5.42 (s, 1H), 3.59 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.1, 151.3, 149.9, 148.7, 142.6, 133.9, 132.0, 131.0, 129.6, 128.6, 128.4, 128.2, 127.8, 127.0, 126.5, 123.6, 121.7, 115.8, 110.0, 67.4, 52.8; **MS** (EI): m/z (%): 420 (M^+, 52.16), 422 ($[M+2]^+$, 52.41), 361 (100); **HRMS** (EI) calculated for [$C_{23}H_{17}O_3Br$]: 420.0361, found: 420.0368.

23) Methyl 1-(3, 4-dihydroxyphenyl)-2-phenyl-1H-indene-1-carboxylate (6e)



The general procedure was followed using **1a** (0.4 mmol) and **6e** (0.8 mmol). After purification by column chromatography (PE/EtOAc 2:1), **6ae** (97.4 mg, 68%) was obtained as a white solid, m.p. 100-101 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.47-7.15 (m, 10H), 6.93 (d, *J* = 2.0 Hz, 1H), 6.86 (dd, *J* = 8.4, 2.0 Hz, 1H), 6.70 (d, *J* = 8.4 Hz, 1H), 5.48 (br, 1H), 5.42 (br, 1H),3.60 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.5, 150.3, 149.1, 143.1, 142.9, 142.5, 134.3, 131.0, 129.4, 128.2, 128.0, 127.6, 127.2, 126.3, 123.8, 121.5, 120.5, 115.2, 114.9, 68.1, 52.7; **MS** (EI): m/z (%): 358 (M^+, 63.92), 299 (100); **HRMS** (EI) calculated for [$C_{23}H_{18}O_4$]: 358.1205, found: 358.1201.

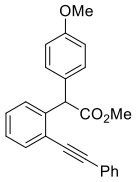
24) Methyl 1-(2, 4-dihydroxyphenyl)-2-phenyl-1H-indene-1-carboxylate (6f)



The general procedure was followed using **1a** (0.4 mmol) and **5f** (0.8 mmol). After purification by column chromatography (PE/EtOAc 5:1), **6af** (90.2 mg, 63%) was obtained as a white solid, m.p. 128-129 °C. **^{1}H NMR** (400 MHz, DMSO-d_6) δ 9.78 (s, 1H), 9.22 (s, 1H), 7.69 (t, *J* = 7.2 Hz, 3H), 7.51 (s, 1H), 7.38-7.13 (m, 6H), 6.42-6.36 (m, 2H), 5.98 (dd, *J* = 8.4, 2.0 Hz, 1H), 3.45 (s, 3H), 3.38 (s, 3H); **^{13}C NMR** (100 MHz, DMSO-d_6) δ 171.4, 157.5, 156.3, 150.4, 148.0, 141.8, 134.1, 130.7, 128.0, 127.8, 127.5, 127.3, 127.2, 125.9, 124.2, 121.2, 116.4, 105.9, 103.4,

66.9, 51.9 ; **MS** (EI): m/z (%): 358 (M^+, 9.51), 59 (100); **HRMS** (EI) calculated for [$C_{23}H_{18}O_4$]: 358.1205, found: 358.1209.

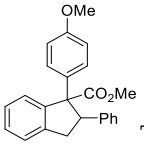
25) Methyl 2-(4-methoxyphenyl)-2-(2-(phenylethynyl)phenyl)acetate (4aa)



The general procedure was followed using **1f** (0.4 mmol) and **2b** (0.8 mmol). After purification by column chromatography (PE/EtOAc 10:1), **4aa** (4.7 mg, 3%) was obtained as a yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.57-7.50 (m, 3H), 7.38-7.22 (m, 8H), 6.87 (dd, *J* = 6.8, 2.4 Hz, 2H), 5.60 (s, 1H), 3.76 (s, 3H), 3.70 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 173.0, 158.8, 140.9, 132.2, 131.5, 129.9, 129.7, 128.5, 128.4, 128.3, 128.1, 127.0, 123.0, 114.0, 94.5, 87.5, 55.2, 54.2, 52.3; **MS** (EI): m/z (%): 356 (M^+, 6.94), 297 (100); **HRMS** (EI) calculated for [$C_{23}H_{18}O_4$]: 356.1412, found: 356.1414.

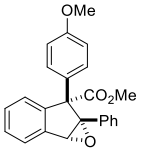
4. Transformation of products

1) Methyl 1-(4-methoxyphenyl)-2-phenyl-2,3 dihydro-1H-indene-1-carboxylate (7)



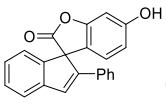
The solution of compound **3aa** (0.2 mmol) and Pd/C (contain 10% Pd) (5 mol%) in CH_3OH (2 mL) under 1atm pressure of hydrogen at room temperature for 5 hours and the reaction purified by silica chromatography, **7** (68.7 mg, 96%) was obtained as a colorless oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52-7.50 (m, 1H), 7.33-7.29 (m, 3H), 7.22-7.16 (m, 5H), 7.05-7.03 (m, 2H), 6.85-6.81 (m, 2H), 3.95 (t, *J* = 6.8 Hz, 1H), 3.79 (s, 3H), 3.42 (dd, *J* = 15.2, 6.4 Hz, 1H), 3.32 (s, 3H), 3.27 (dd, *J* = 15.2, 7.2 Hz, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 172.7, 158.5, 143.5, 141.2, 134.4, 129.1, 128.6, 127.8, 127.7, 127.5, 126.7, 126.6, 124.7, 113.4, 68.4, 58.7, 55.2, 51.4, 37.4; **MS** (EI): m/z (%): 358 (M^+, 12.07), 299 (100); **HRMS** (EI) calculated for [$C_{24}H_{22}O_3$]: 358.1569, found: 358.1573.

2) Methyl 1-(4-methoxyphenyl)-2-phenyl-2,3 dihydro-1H-indene-1-carboxylate (8)



Added *m*-CPBA (0.4 mmol, 2 eq) to the solution of compound **3aa** (0.2 mmol) in CH_2Cl_2 (2 mL), and then reflux for 5 hours **3aa** was consumed completely determined by TLC analysis. Purified by silica chromatography, **8** (dr: 1.4 : 1, 68.7 mg, 75%) was obtained as a white solid (only one isomer can isolated 23.8 mg, 32%), m.p. 185-186 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.59 (dd, *J* = 10.0, 7.2 Hz, 2H), 7.41-7.35 (m, 2H), 7.18-7.10 (m, 5H), 6.64-6.56 (m, 4H), 4.27 (s, 1H), 3.83 (s, 3H), 3.72 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 171.7, 158.8, 145.6, 140.9, 134.6, 131.6, 129.4, 129.3, 129.2, 128.9, 127.7, 127.6, 127.1, 124.6, 113.4, 73.5, 68.2, 64.4, 55.2, 52.5; **MS** (EI): m/z (%): 372 (M^+, 6.37), 313 (100); **HRMS** (EI) calculated for [$C_{24}H_{20}O_4$]: 372.1362, found: 372.1359.

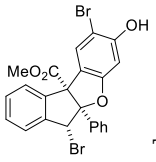
3) 6-hydroxy-2'-phenyl-2H-spiro[benzofuran-3,1'-inden]-2-one (9)[2]



The solution of compound **5a** (0.2 mmol) and TFA (0.21 mmol) in toluene (6 mL) was heated to 90 °C for 3 hours and the reaction purified by silica chromatography, **9** (60.6 mg, 93%) was obtained as a white solid, m.p. 167-168 °C. **^{1}H NMR** (400 MHz, DMSO-d_6) δ 10.1 (s,

1H), 7.81 (s, 1H), 7.55 (d, *J* = 7.6 Hz, 1H), 7.38-7.18 (m, 7H), 6.99 (d, *J* = 7.6 Hz, 1H), 6.92 (d, *J* = 2.0 Hz, 1H), 6.61 (d, *J* = 8.4 Hz, 1H), 6.62 (dd, *J* = 8.4, 2.4 Hz, 1H); **^{13}C NMR** (100 MHz, DMSO-d_6) δ 174.9, 159.0, 154.4, 146.4, 145.5, 143.1, 138.8, 132.1, 129.0, 128.8, 128.2, 126.8, 125.4, 124.1, 122.1, 121.9, 117.0, 112.3, 99.3, 62.8; **MS** (EI): m/z (%): 326 (M^+, 4.14), 197 (100); **HRMS** (EI) calculated for [$C_{22}H_{14}O_3$]: 326.0943, found: 326.0948.

4) Methyl 2,6-dibromo-3-hydroxy-5a-phenyl-5a,6-dihydro-10bH-indeno[2,1-b]benzofuran-10b-carboxylate6-hydroxy-2'-phenyl-2H-spiro[benzofuran-3,1'-inden]-2-one (10)



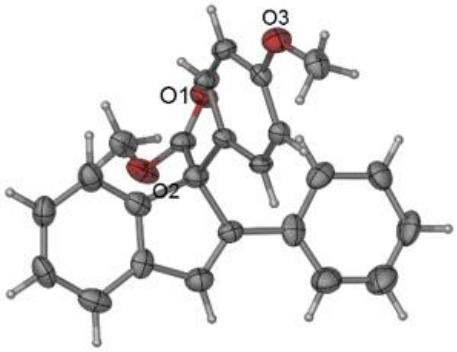
To the solution of compound **5a** (0.2 mmol) in CH_2Cl_2 (1 mL) added Br_2 (dissolved in 1mL CH_2Cl_2) slowly, then the mixture stirred for 30 mins monitored by TLC and quenched by saturated solution of $Na_2S_2O_3$ at room temperature. The extracts with ethyl acetate were dried over anhydrous sodium sulfate and the solvent was removed under reduced pressure. The crude product was purified by column chromatography to give white solid **10** (60.6 mg, 93%), m.p. 177-178 ^oC. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.6 Hz, 1H), 7,75-7.44 (m, 3H), 7.28-7.24 (m, 5H), 7.16 (s, 1H), 6.80 (s, 1H), 5.78 (s, 1H), 5.62 (s, 1H), 3.11 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ 169.8, 159.0, 153.7, 140.3, 139.1, 137.2, 129.8, 129.0, 128.5, 127.6, 126.4, 125.8, 125.5, 125.0, 122.2, 106.9, 102.4, 99.9, 69.6, 61.2, 52.2; **MS** (EI): m/z (%): 514 (M^+, 23.23), 516 ([M+2]$^+$, 59.66), 518 ([M+4]$^+$, 30.47), 377 (100); **HRMS** (EI) calculated for [$C_{23}H_{16}Br_2O_4$]: 516.1543, found: 516.1548.

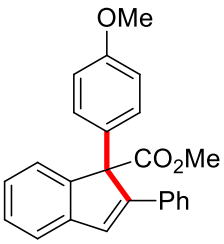
5 References

[1] P. Cheng, J.-J. Cheng and J.-B. Wang, *Adv. Synth. Catal.*, 2008, **350**, 2359.

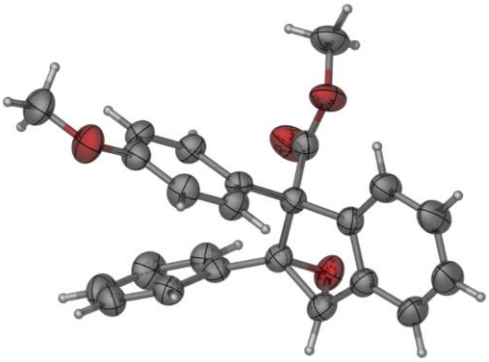
[2] X. Li, S.-S. Hu, Z.-G. Xi, L. Zhang, S.-Z. Luo and J.-P. Cheng. *J. Org. Chem.* 2010, **75**, 8697.

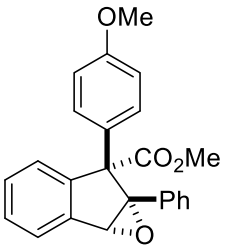
6 Figure S1. X-ray structure of 3aa, 8 and 10.



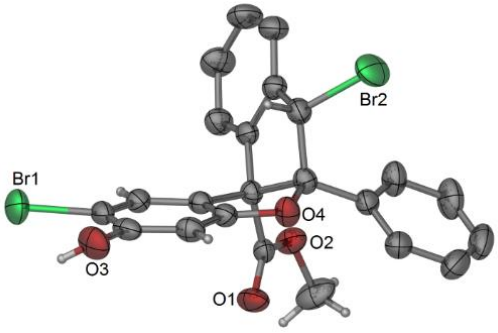


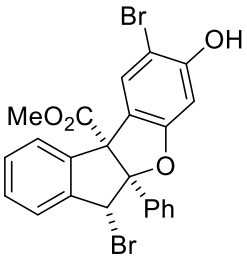
3aa





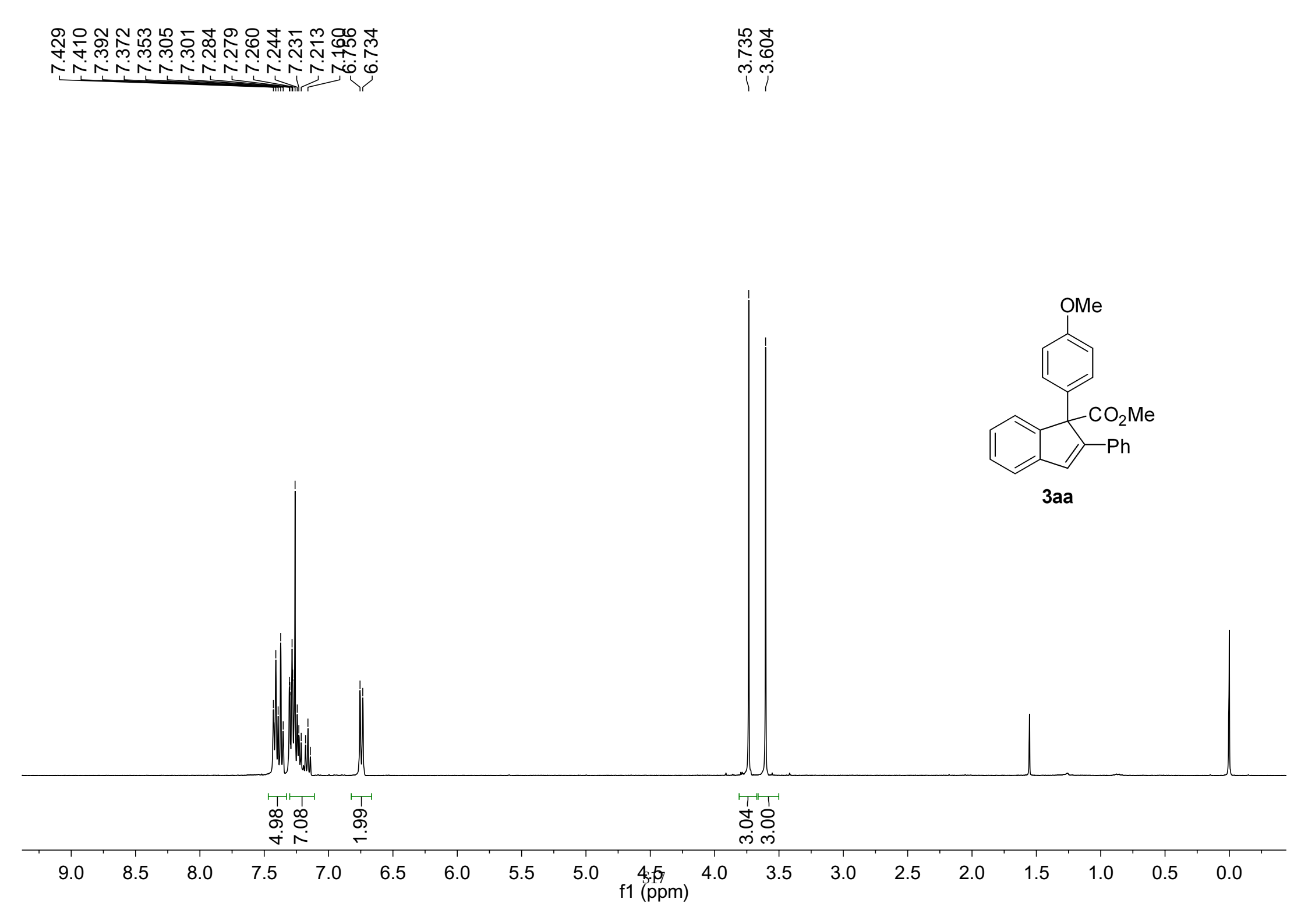
8





10

7 NMR spectra of new compounds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7.260
7.244
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7.213
7.160
6.756
6.734
3.735
3.604
OMe
CO2Me
Ph
3aa
4.98
7.08
1.99
3.04
3.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
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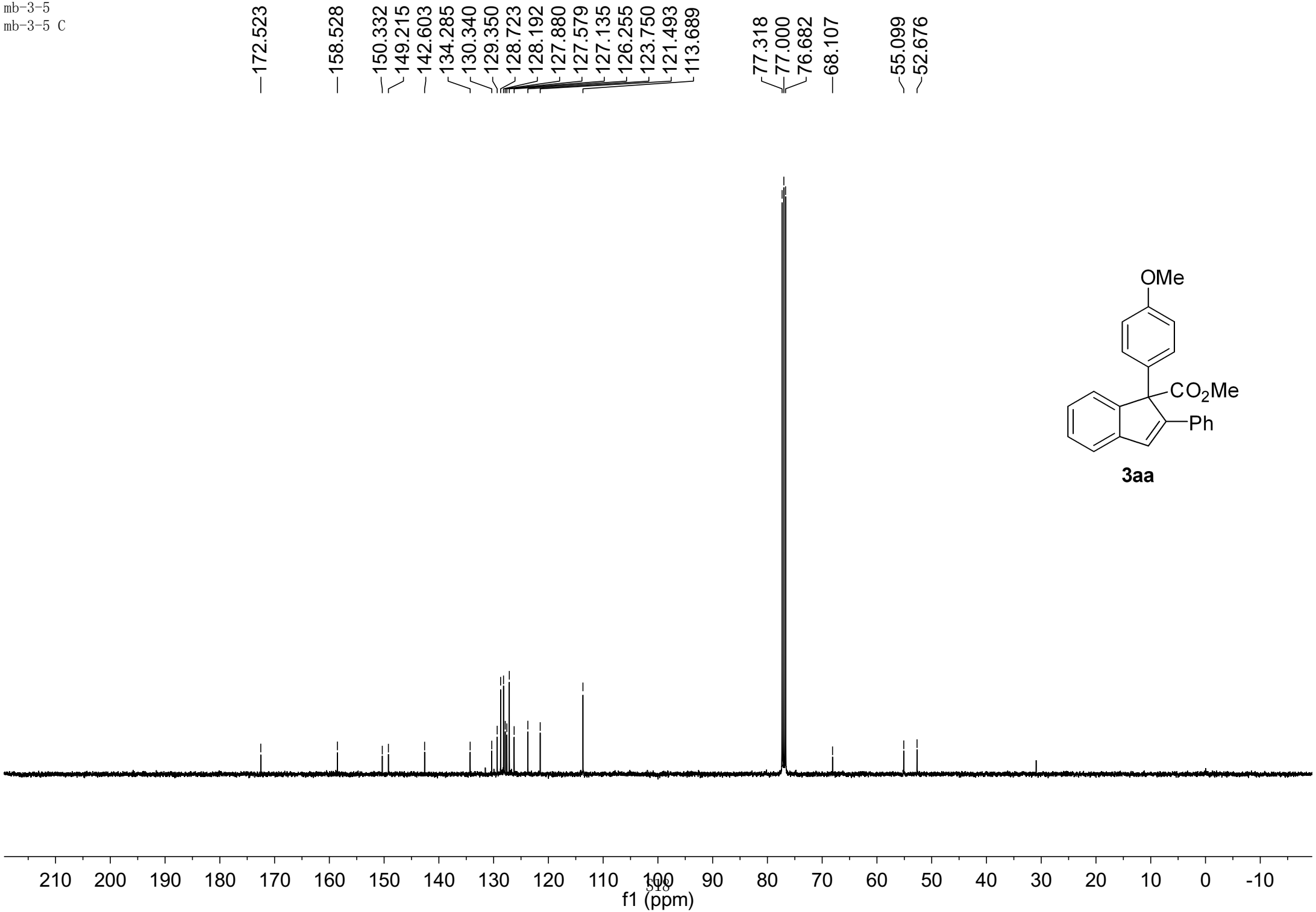
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

mb-3-5
mb-3-5 C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134.285
130.340
129.350
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128.192
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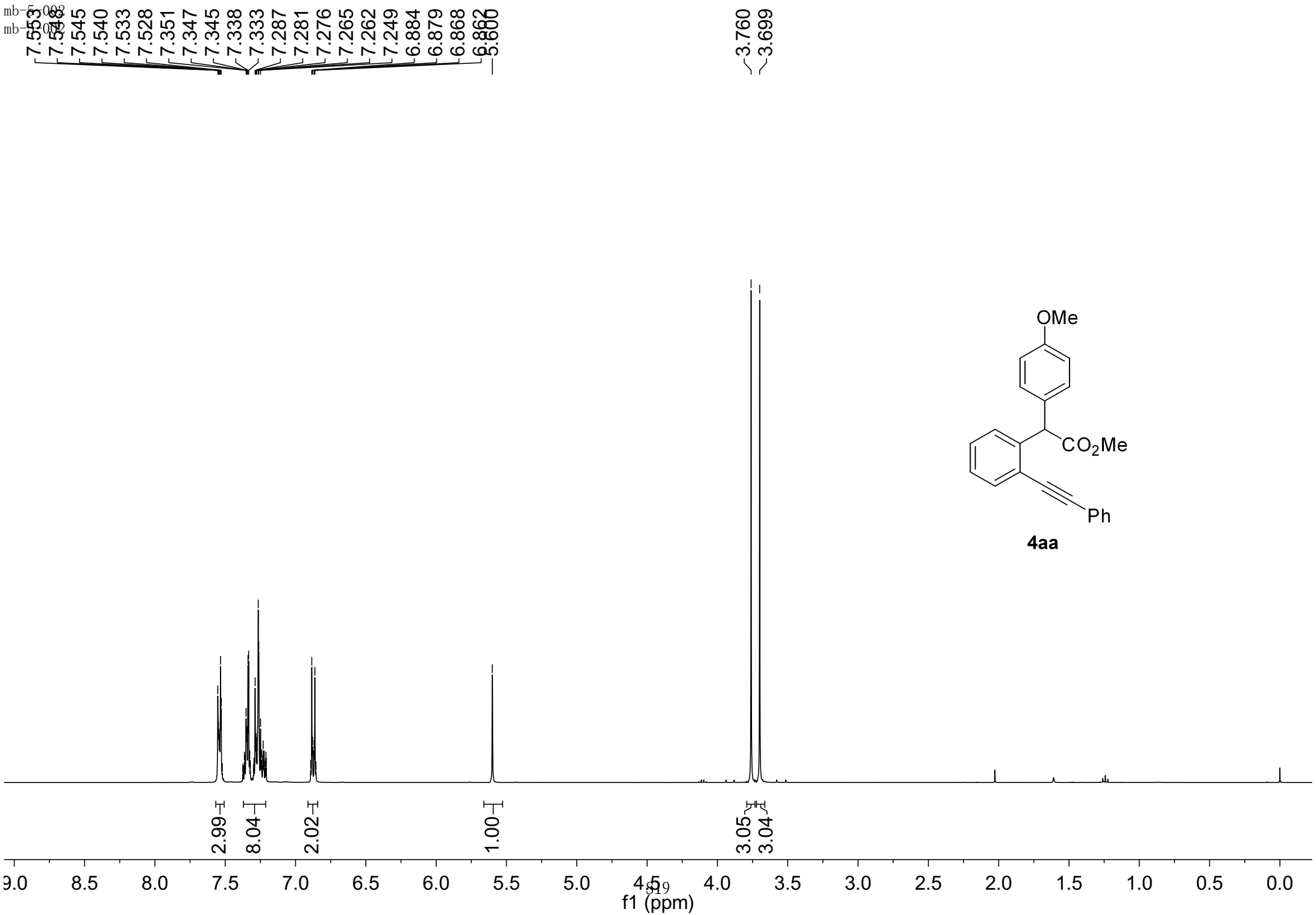
127.579
127.135
126.255
123.750
121.493
113.689
77.318
77.000
76.682
68.107
55.099
52.676
OMe
CO2Me
Ph
3aa
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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7.338
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7.287
7.281
7.276
7.265
7.262
7.249
6.884
6.879
6.868
6.862
5.600
3.760
3.699
OMe
CO2Me
Ph
4aa
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8.04
2.02
1.00
3.05
3.04
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
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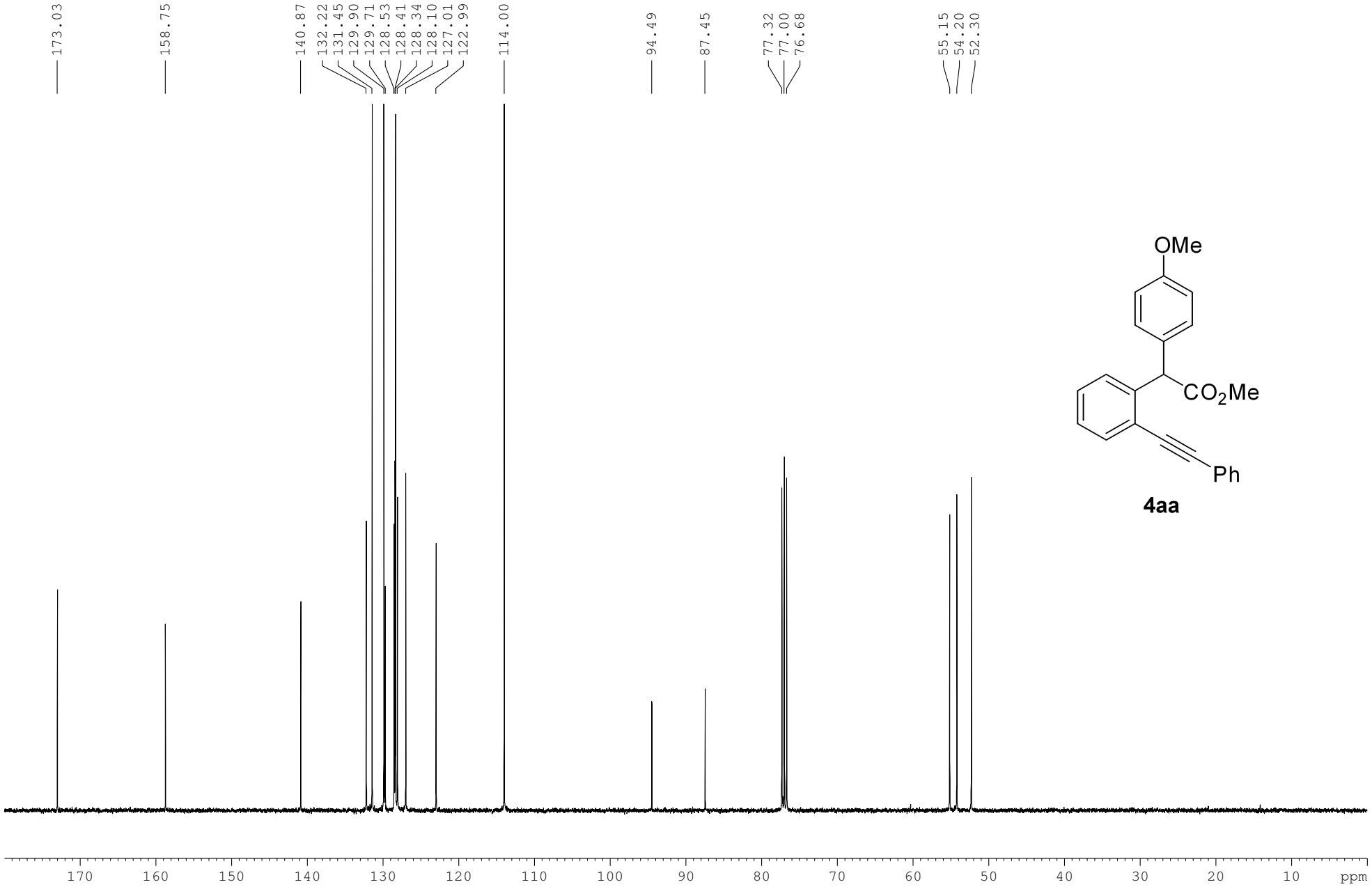
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

mb-5-002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114.00
94.49
87.45
77.32
77.00
76.68
55.15
54.20
52.30
OMe
CO2Me
Ph
4aa
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150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

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wza-1-82-3

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7.307
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7.288
7.280
7.274
7.272
7.270
7.257
7.243
7.239
7.234
7.230
7.226
7.213
7.185
7.183
7.167
7.164
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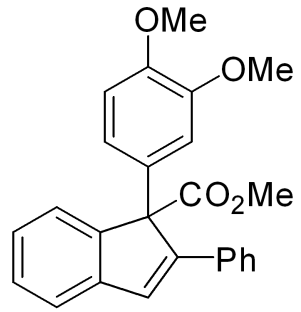
3.598



3ab

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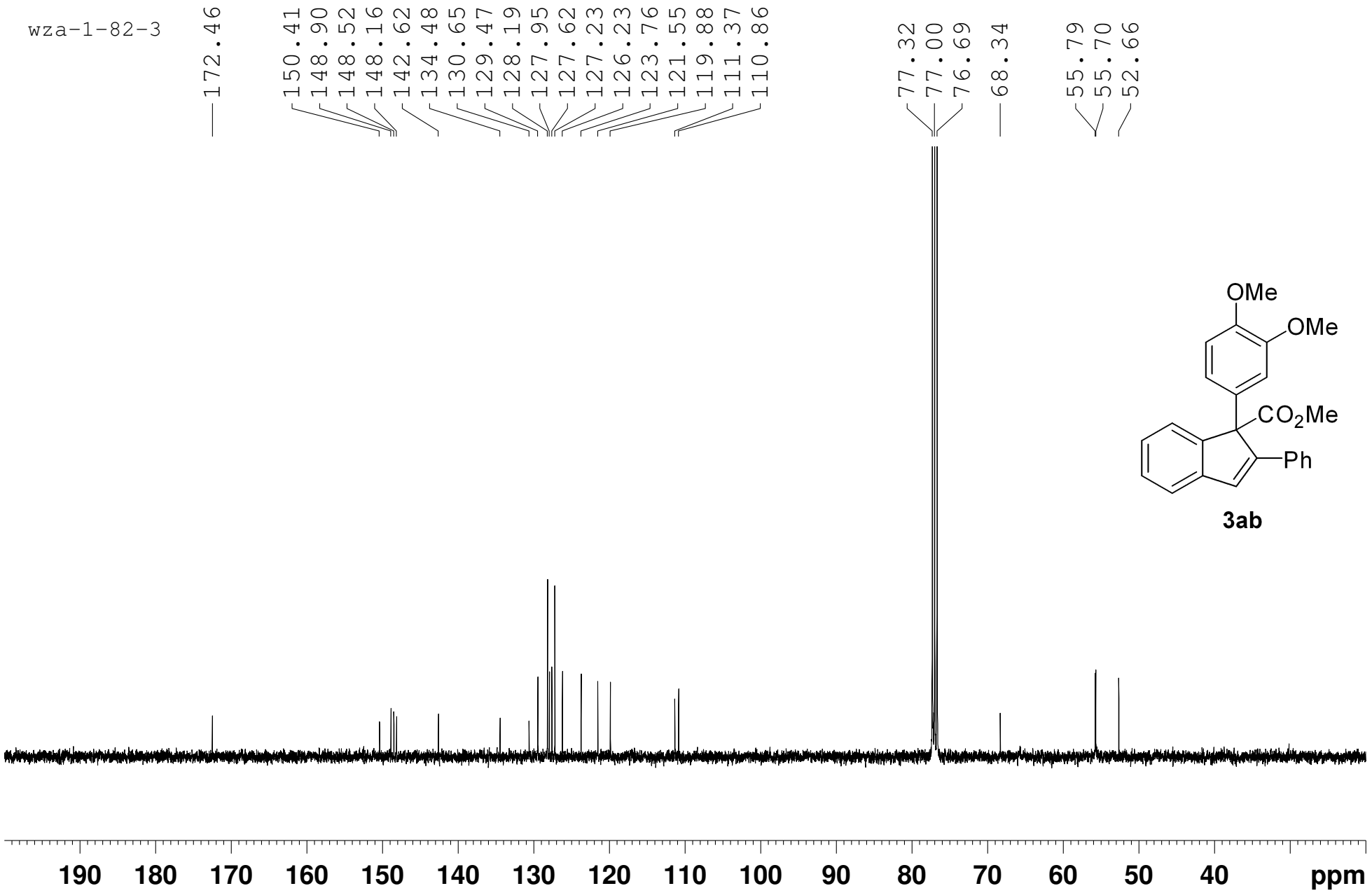
1.04
3.11
3.11
3.11

1.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

f1 (ppm)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127.62
127.23
126.23
123.76
121.55
119.88
111.37
110.86
77.32
77.00
76.69
68.34
55.79
55.70
52.66
OMe
OMe
CO2Me
Ph
3ab
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
ppm

mbw-1-92
mbw-1-92

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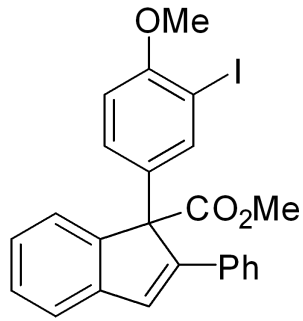
3.772 3.578

0.000



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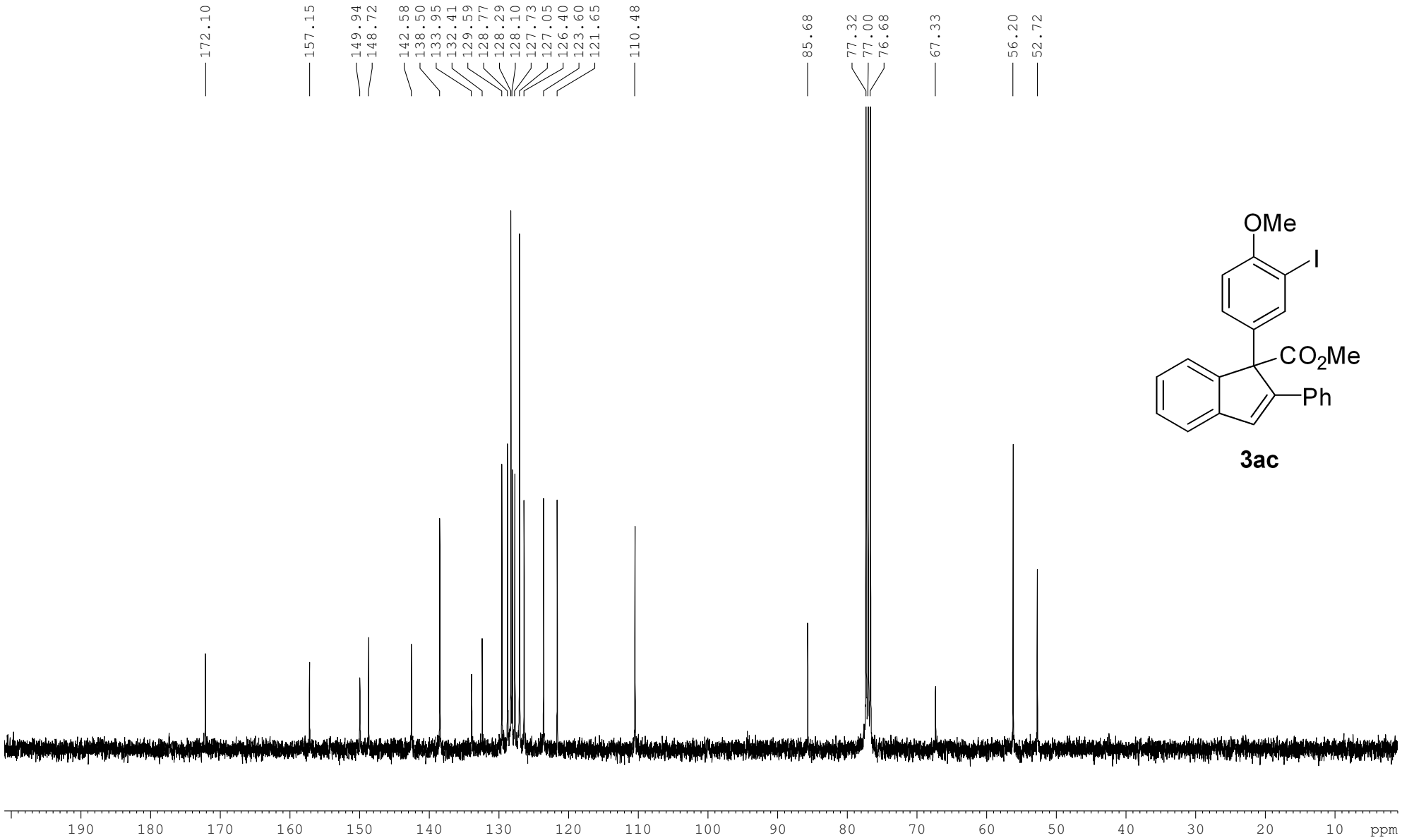
f1 (ppm)

mbw-1-92-1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123.60
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77.00
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67.33
56.20
52.72
OMe
I
CO2Me
Ph
3ac
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150
140
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ppm

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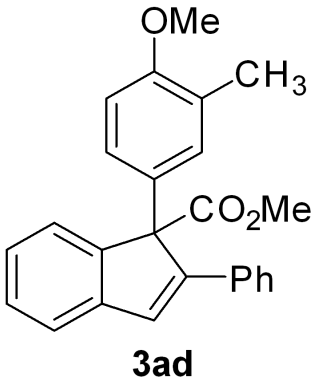
mb-5-138-1



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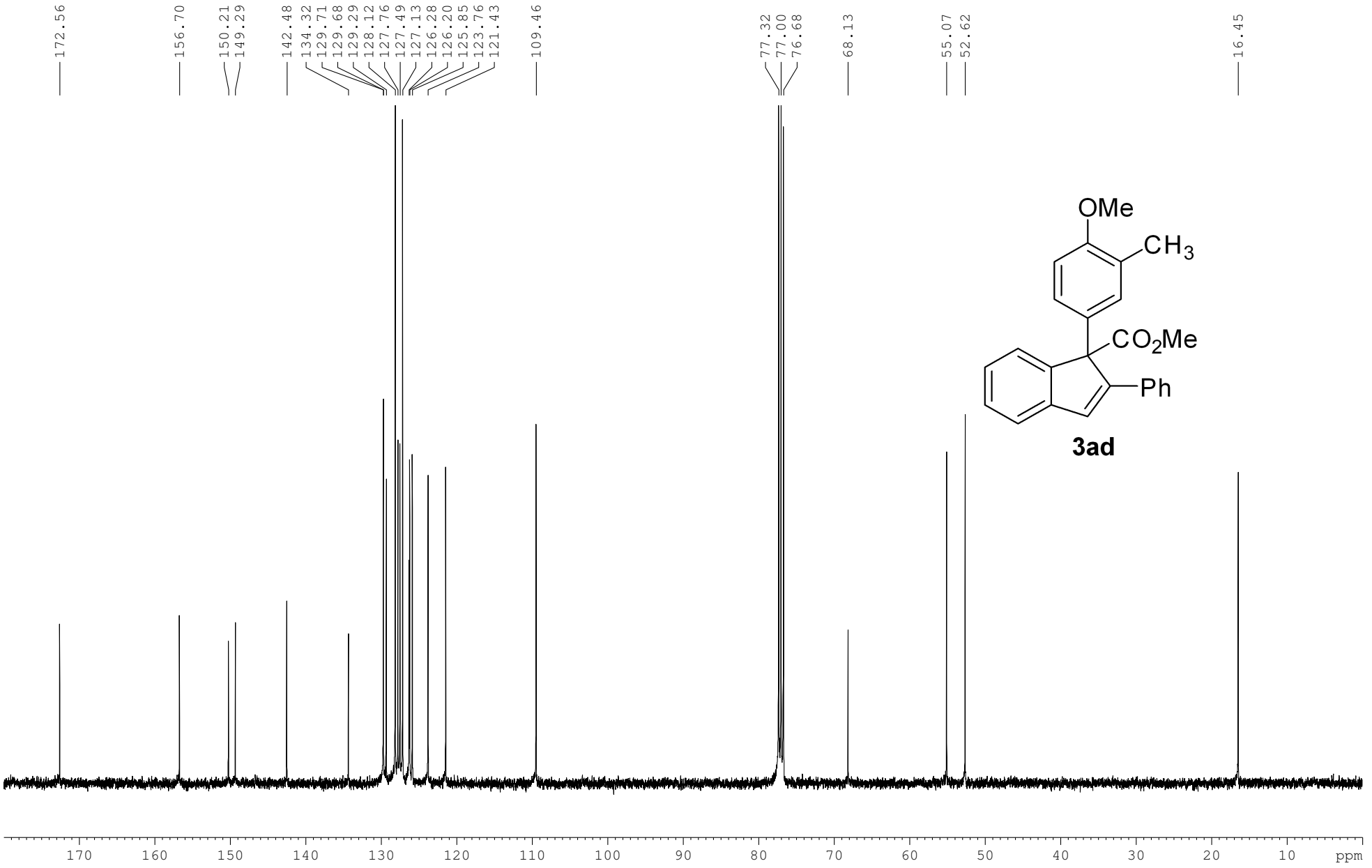
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121.43
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52.62
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CH3
CO2Me
Ph
3ad
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150
140
130
120
110
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10
ppm

mb-4-138
mb-4-138

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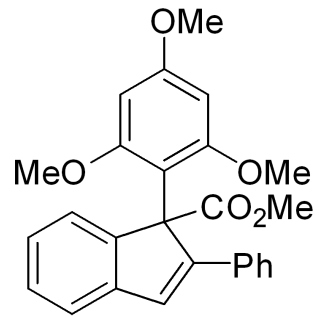

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3.01

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f1 (ppm)

mb-4-136
mb-4-136

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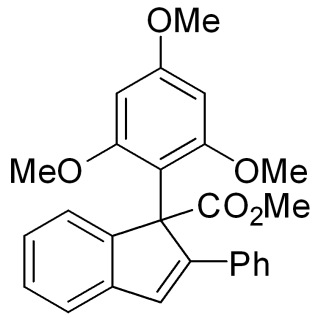

3ae

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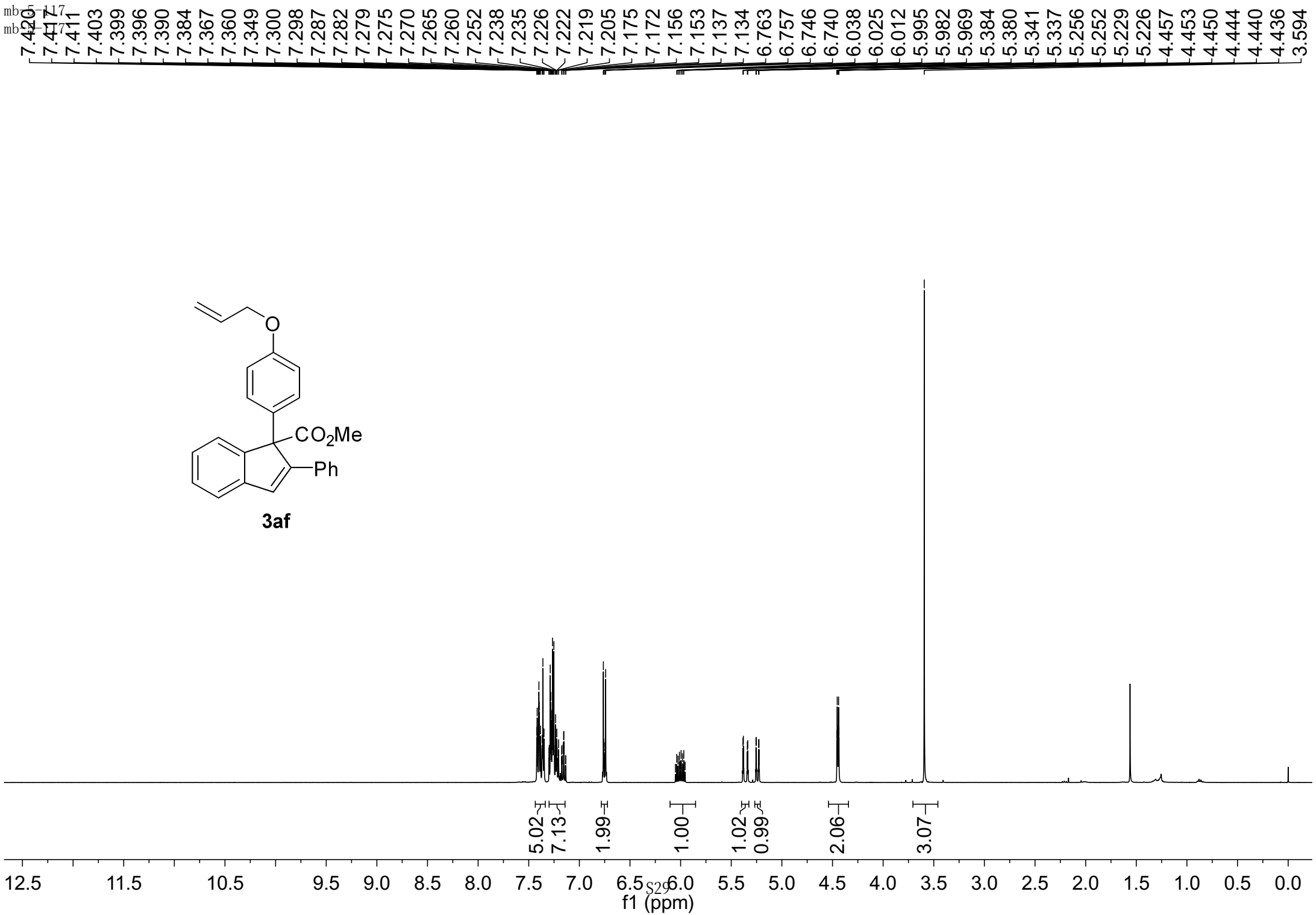
f1 (ppm)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7.222
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7.205
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7.172
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7.137
7.134
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Ph
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1.00
1.02
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3.07
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8.0
7.5
7.0
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6.0
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5.0
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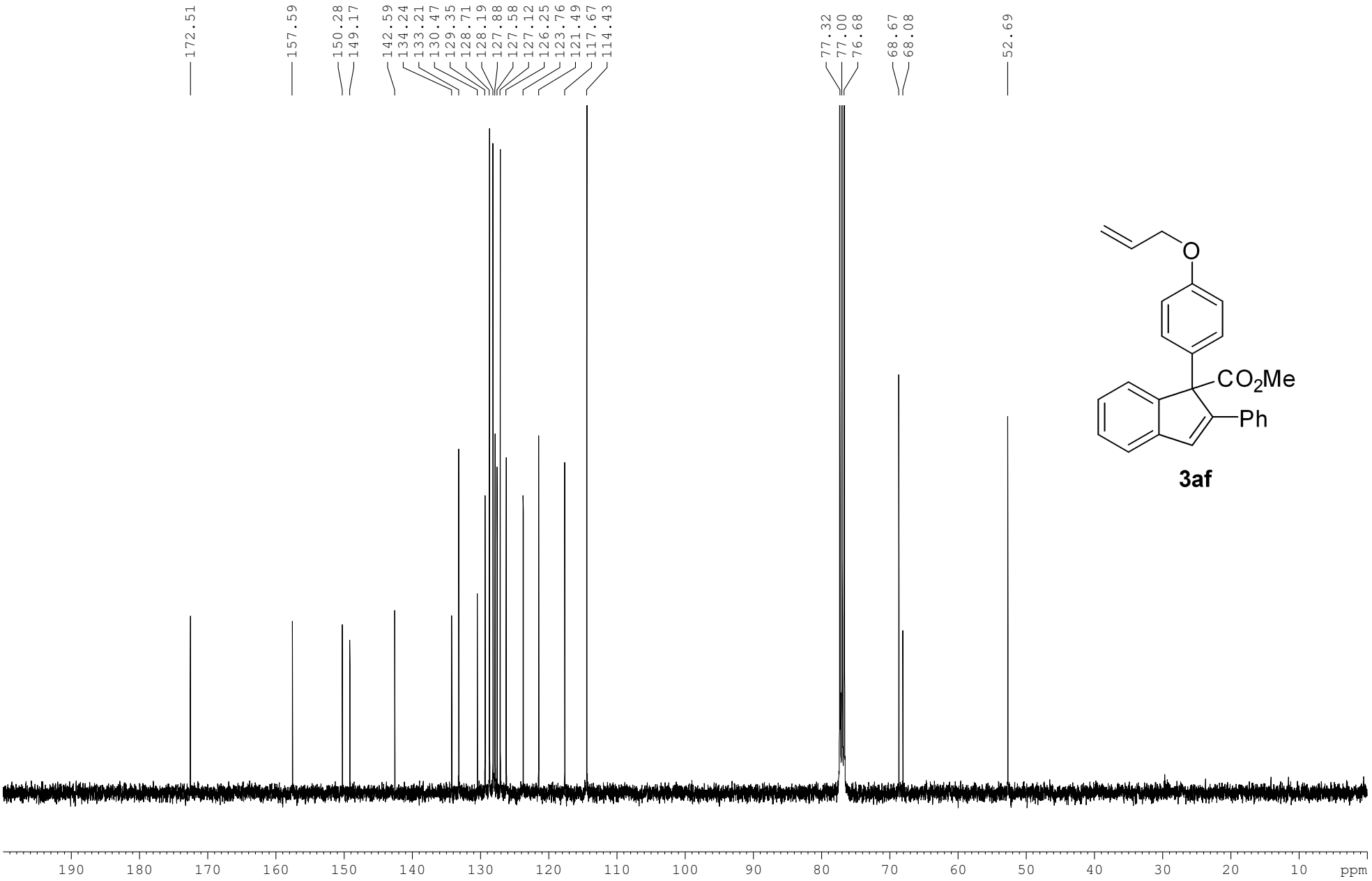
f1 (ppm)

mb-5-117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127.12
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121.49
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68.08
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O
CO2Me
Ph
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150
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70
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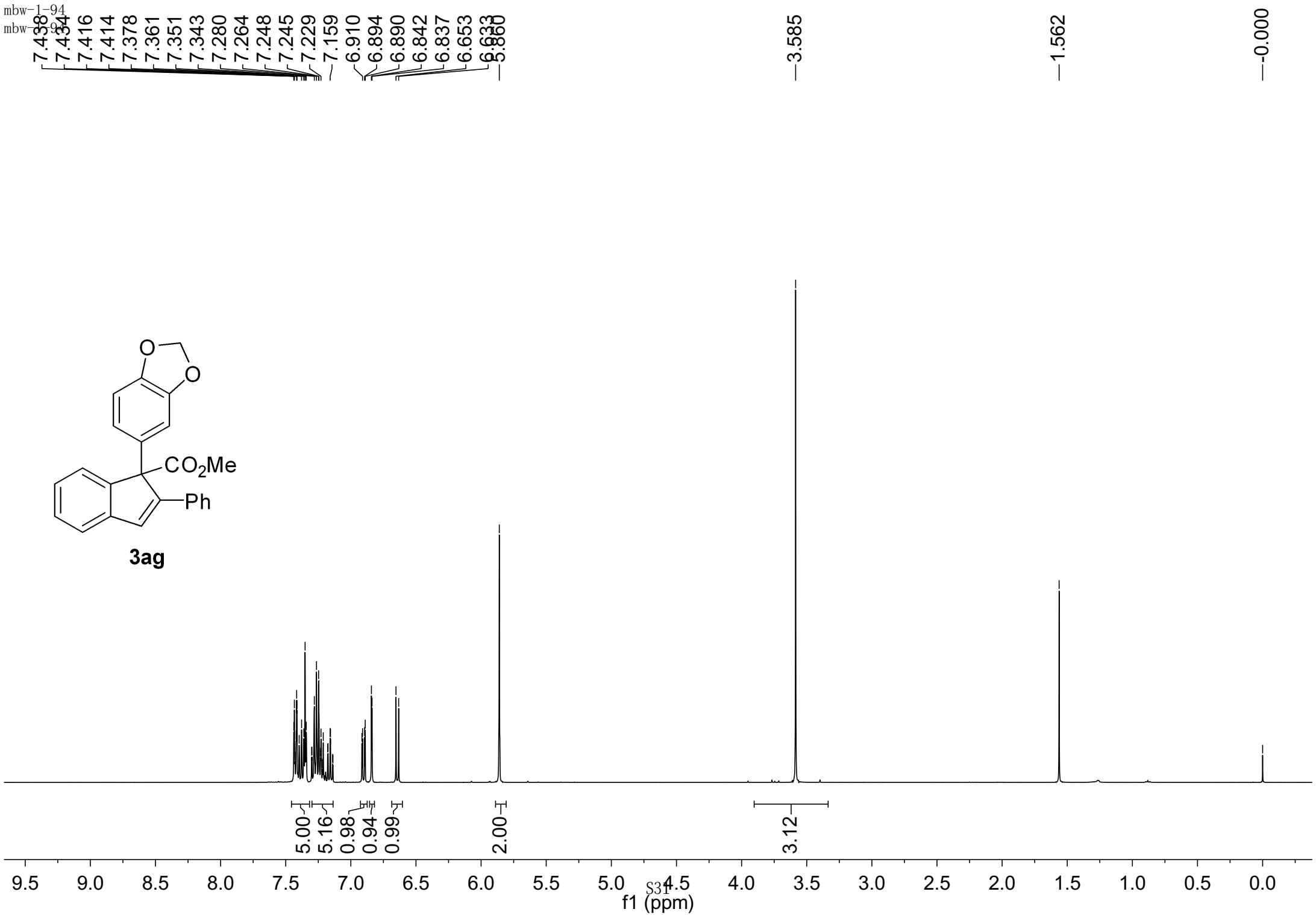
30
20
10
ppm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5.860
3.585
1.562
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O
O
O
CO2Me
Ph
3ag
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0.98
0.94
0.99
2.00
3.12
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8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
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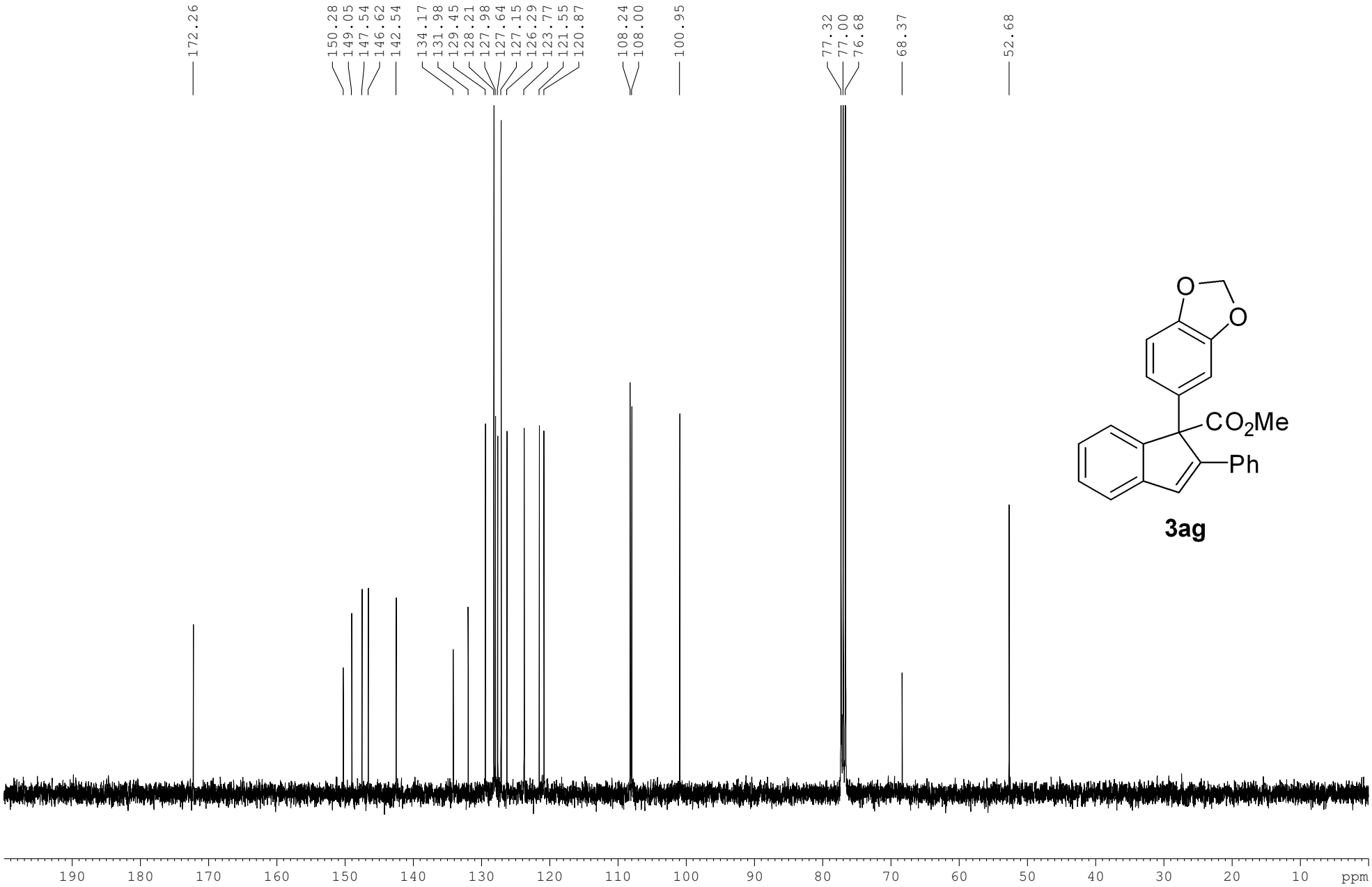
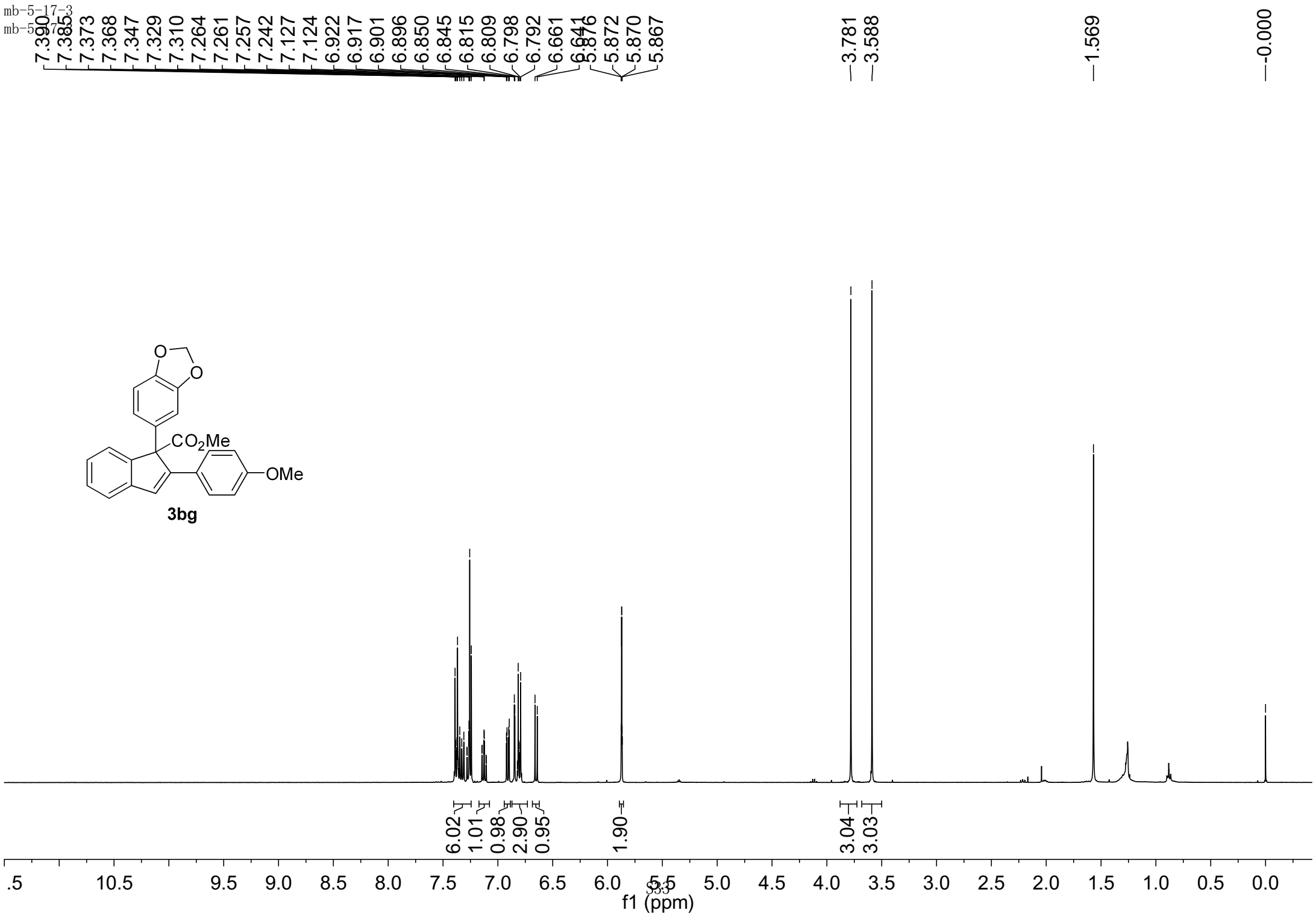
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

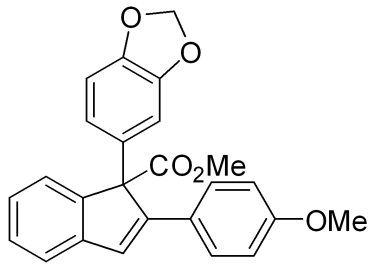
mbw-1-94


172.26
150.28
149.05
147.54
146.62
142.54
134.17
131.98
129.45
128.21
127.98
127.64
127.15
126.29
123.77
121.55
120.87
108.24
108.00
100.95
77.32
77.00
76.68
68.37
52.68
O
O
CO2Me
Ph
3ag
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


mb-5-17-3
mb-5-17
7.390
7.385
7.373
7.368
7.347
7.329
7.310
7.264
7.261
7.257
7.242
7.127
7.124
6.922
6.917
6.901
6.896
6.850
6.845
6.815
6.809
6.798
6.792
6.661
6.641
5.876
5.872
5.870
5.867
3.781
3.588
1.569
-0.000
CO2Me
OMe
3bg
6.02
1.01
0.98
2.90
0.95
1.90
3.04
3.03
f1 (ppm)

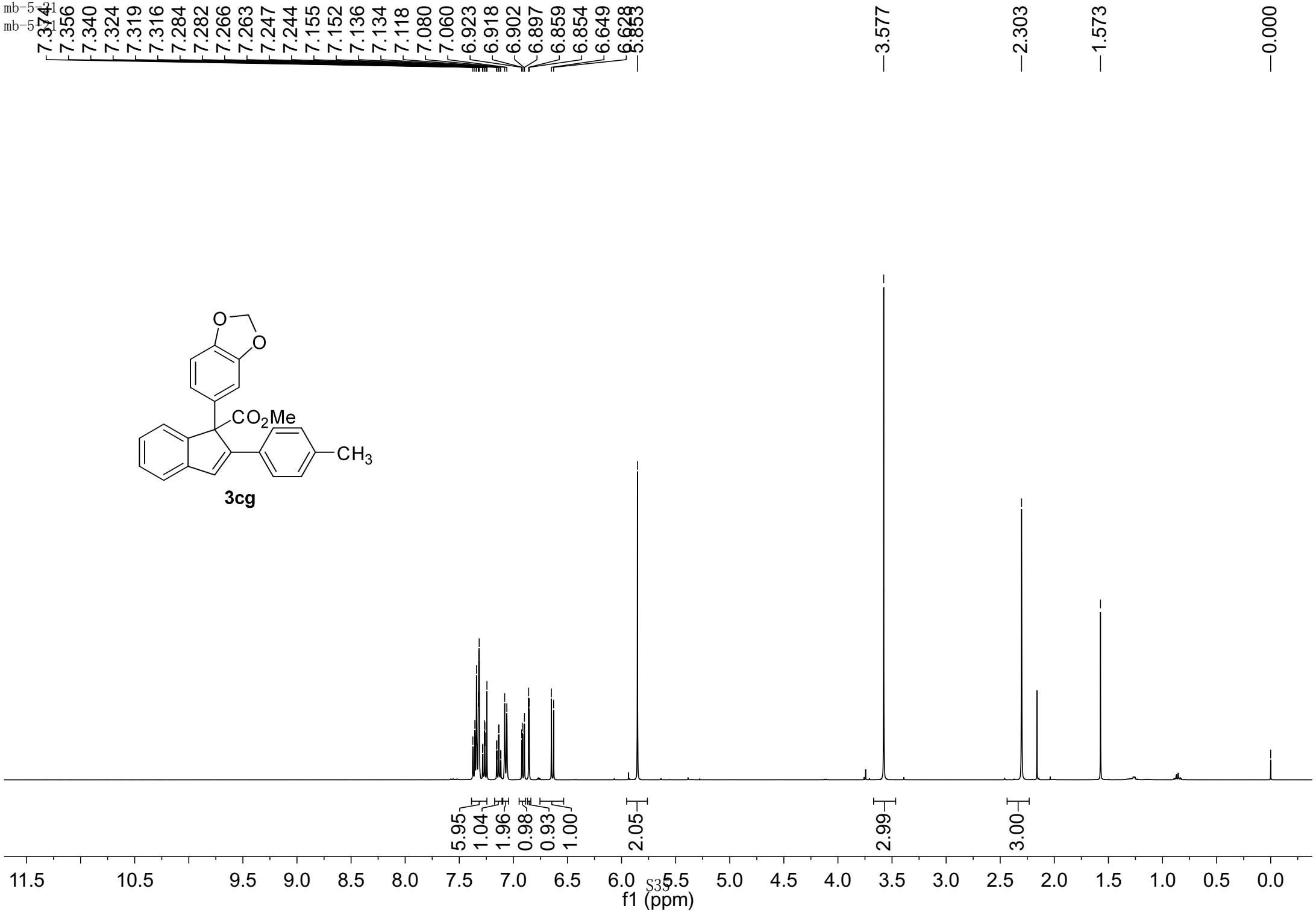
mb-5-17-3
mb-5-17-3

172.411
159.193
149.866
148.887
147.547
146.593
142.823
132.233
128.482
127.914
127.651
126.834
125.855
123.661
121.214
120.855
113.698
108.264
108.003
100.953
77.318
77.000
76.683
68.337
55.191
52.678

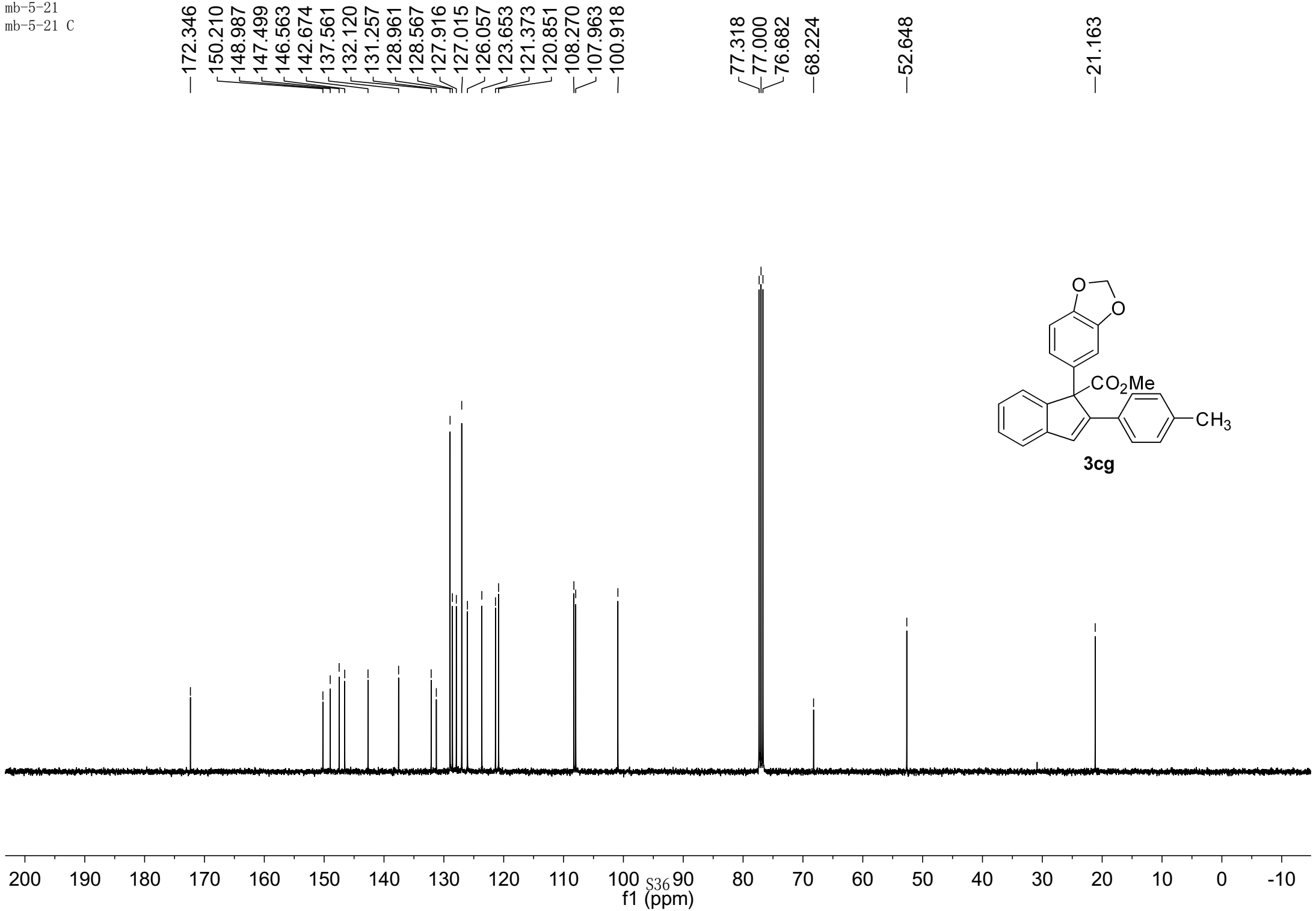


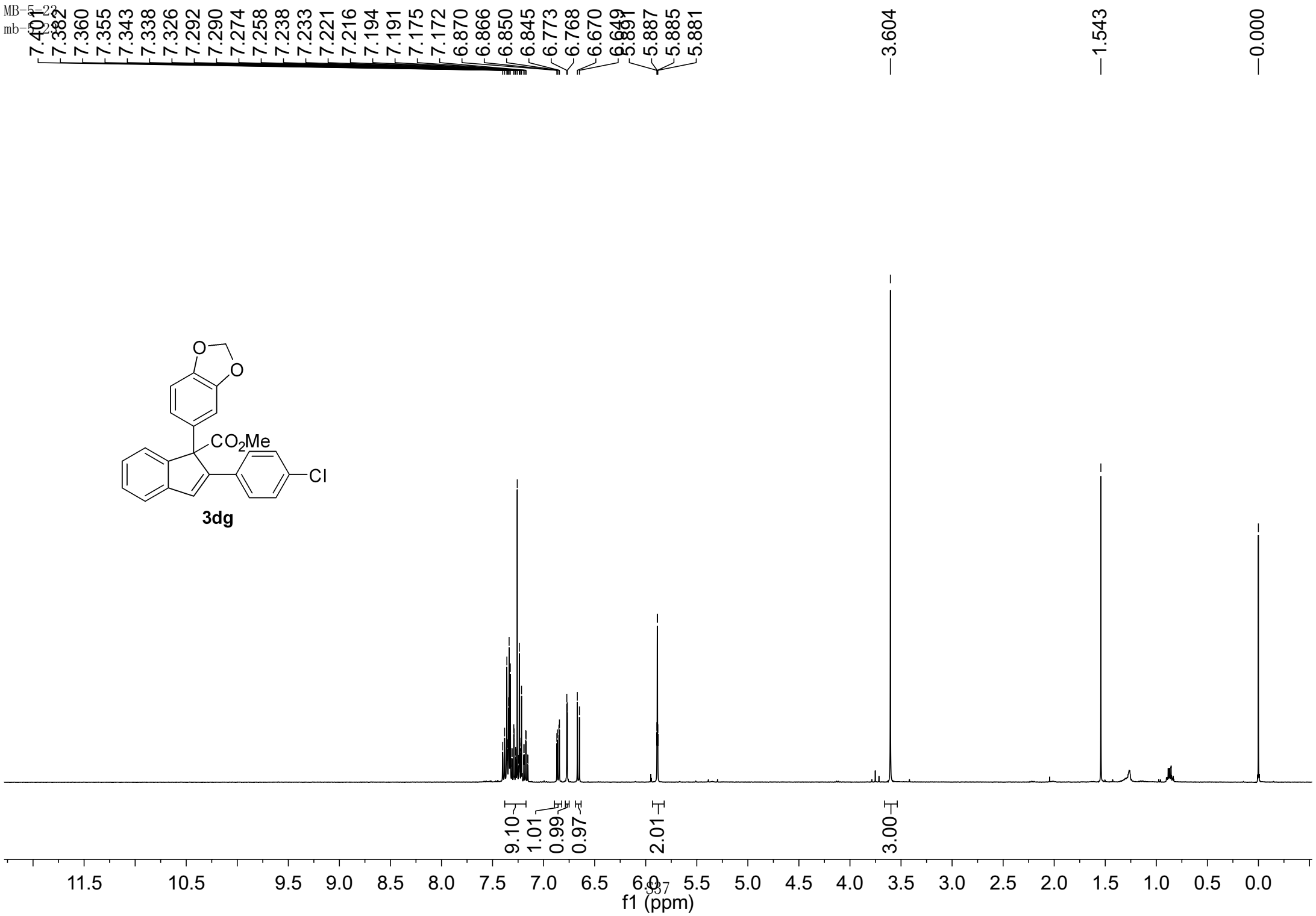
3bg

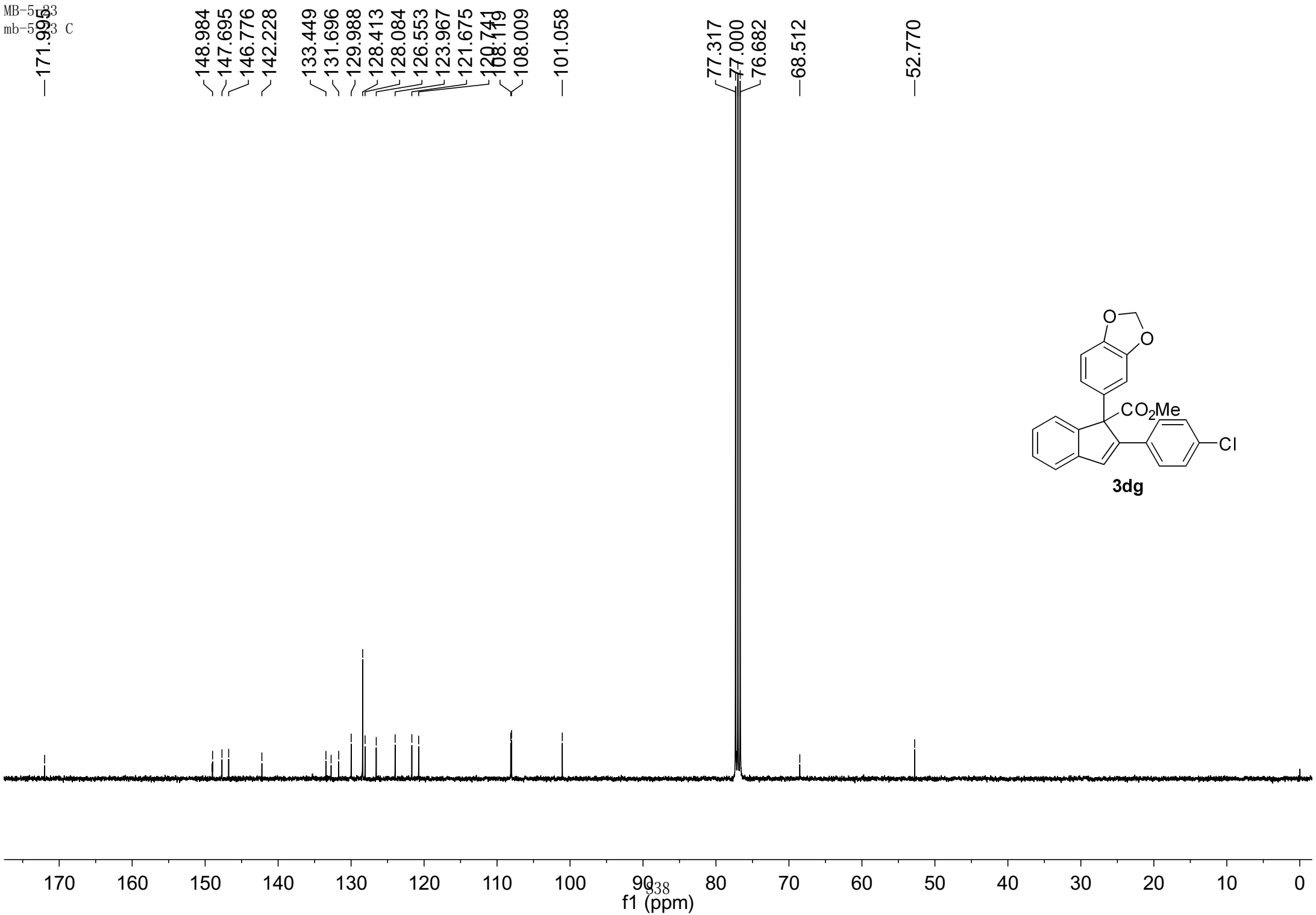
f1 (ppm)

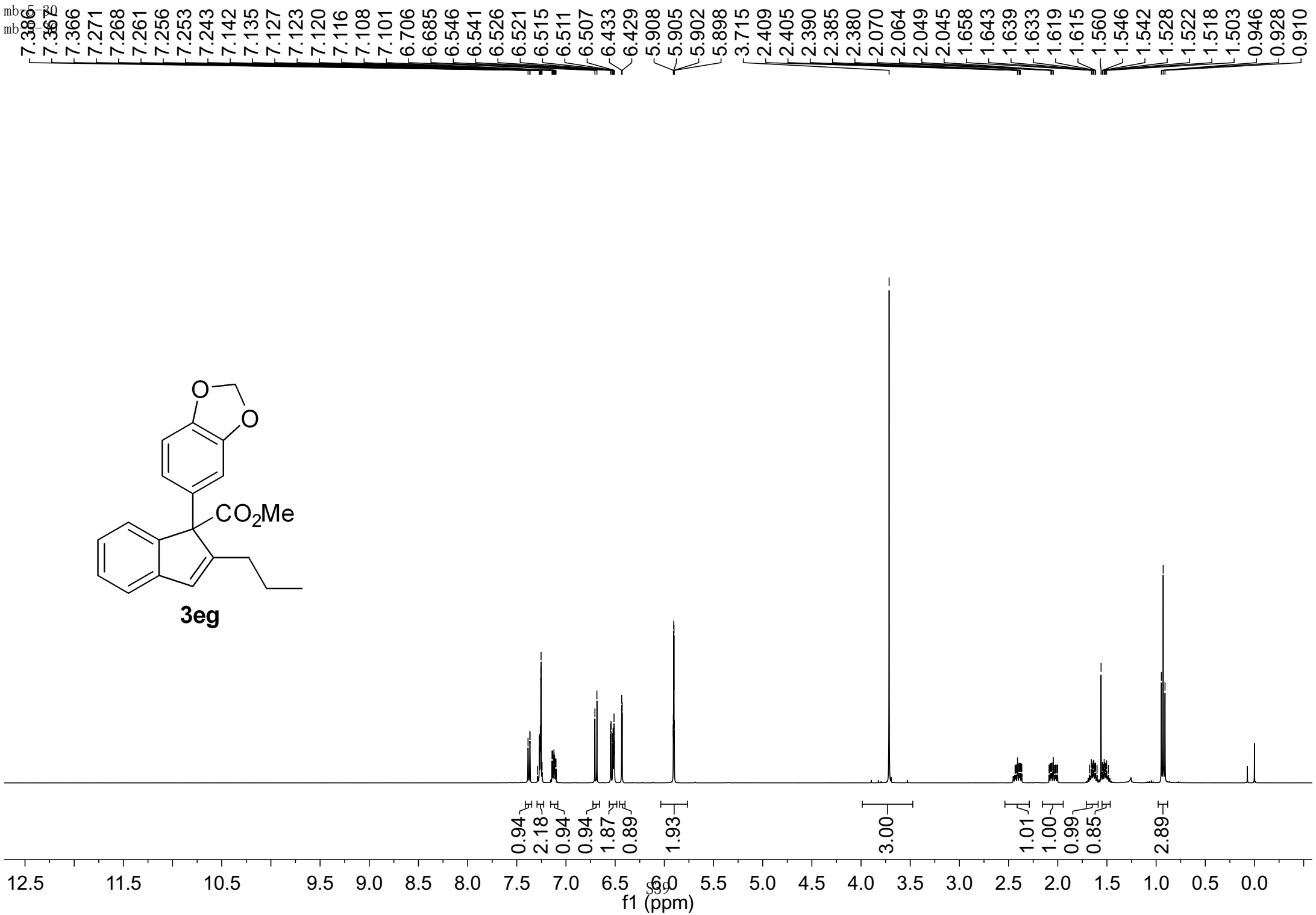

mb-5-21
mb-5-21
7.374
7.356
7.340
7.324
7.319
7.316
7.284
7.282
7.266
7.263
7.247
7.244
7.155
7.152
7.136
7.134
7.118
7.080
7.060
6.923
6.918
6.902
6.897
6.859
6.854
6.649
6.628
6.623
3.577
2.303
1.573
0.000
O
O
O
CO2Me
CH3
3cg
5.95
1.04
1.96
0.98
0.93
1.00
2.05
2.99
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

mb-5-21
mb-5-21 C



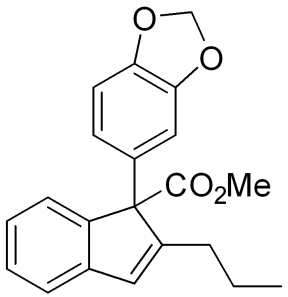

MB-5-22
mb-5-22
7.401
7.382
7.360
7.355
7.343
7.338
7.326
7.292
7.290
7.274
7.258
7.238
7.233
7.221
7.216
7.194
7.191
7.175
7.172
6.870
6.866
6.850
6.845
6.773
6.768
6.670
6.649
6.641
5.891
5.887
5.885
5.881
3.604
1.543
0.000
O
O
O
CO2Me
Cl
3dg
9.10
1.01
0.99
0.97
2.01
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


MB-5-23
mb-5-23 C
171.995
148.984
147.695
146.776
142.228
133.449
131.696
129.988
128.413
128.084
126.553
123.967
121.675
120.741
108.119
108.009
101.058
77.317
77.000
76.682
68.512
52.770
O
O
CO2Me
Cl
3dg
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

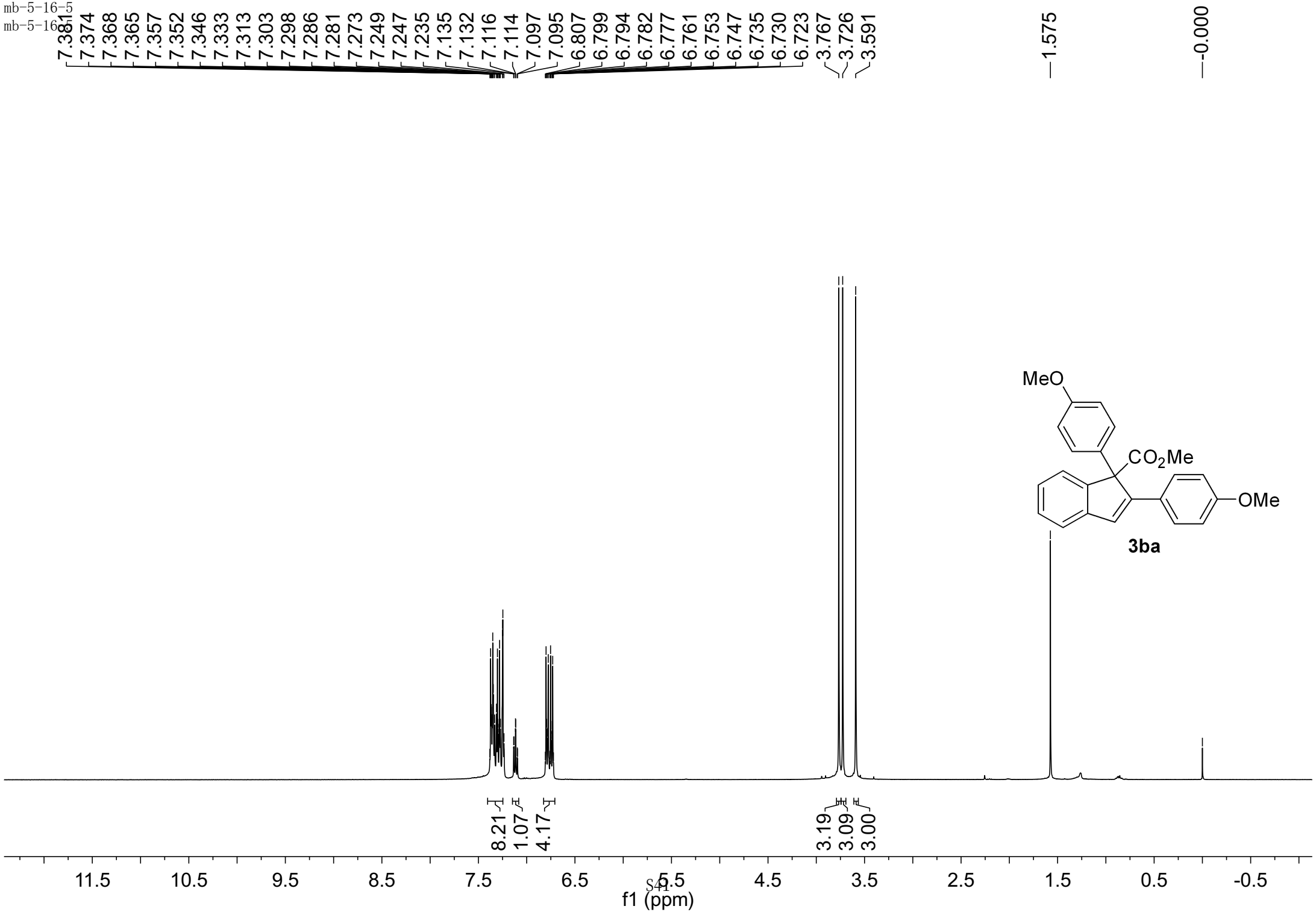

mb-5-30
mb-5-30
7.386
7.367
7.366
7.271
7.268
7.261
7.256
7.253
7.243
7.142
7.135
7.127
7.123
7.120
7.116
7.108
7.101
6.706
6.685
6.546
6.541
6.526
6.521
6.515
6.511
6.507
6.433
6.429
5.908
5.905
5.902
5.898
3.715
2.409
2.405
2.390
2.385
2.380
2.070
2.064
2.049
2.045
1.658
1.643
1.639
1.633
1.619
1.615
1.560
1.546
1.542
1.528
1.522
1.518
1.503
0.946
0.928
0.910
O
O
CO2Me
3eg
0.94
2.18
0.94
0.94
1.87
0.89
1.93
3.00
1.01
1.00
0.99
0.85
2.89
12.5
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

mb-5-30
mb-5-30

172.435
154.513
147.611
146.659
146.582
144.301
132.981
128.011
126.387
125.094
124.804
120.567
120.441
108.107
107.785
101.032
77.317
77.000
76.682
70.389
52.576
30.286
20.851
14.042

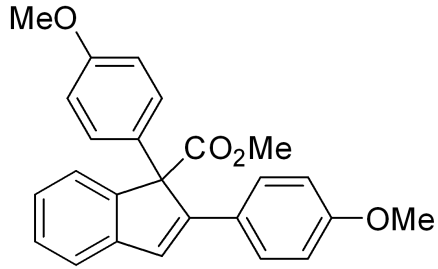


3eg


mb-5-16-5
mb-5-16
7.381
7.374
7.368
7.365
7.357
7.352
7.346
7.333
7.313
7.303
7.298
7.286
7.281
7.273
7.249
7.247
7.235
7.135
7.132
7.116
7.114
7.097
7.095
6.807
6.799
6.794
6.782
6.777
6.761
6.753
6.747
6.735
6.730
6.723
3.767
3.726
3.591
1.575
-0.000
MeO
CO2Me
OMe
3ba
8.21
1.07
4.17
3.19
3.09
3.00
11.5
10.5
9.5
8.5
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
f1 (ppm)

mb-5-16-5
mb-5-16-5

172.653
159.129
158.528
149.946
149.066
142.891
130.600
128.714
128.465
127.798
127.559
126.982
125.809
123.647
121.144
113.706
113.663
77.317
77.000
76.682
68.105
55.163
55.098
52.621



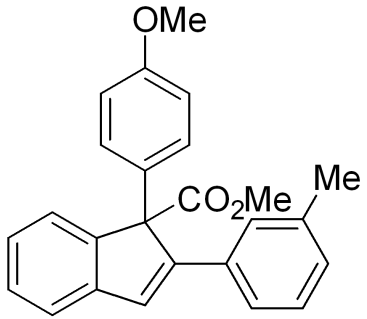
3ba

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1

f1 (ppm)

mb-5-31
mb-5-31

7.386 7.369 7.367 7.360 7.340 7.296 7.291 7.288 7.285 7.279 7.274 7.270 7.267 7.250 7.239 7.160 7.157 7.142 7.139 7.132 7.129 7.122 7.116 7.115 7.096 7.029 7.024 7.019 7.015 7.010 6.748 6.740 6.735 6.723 6.718 6.710 3.716 3.590 2.293 1.547 -0.000



3fa

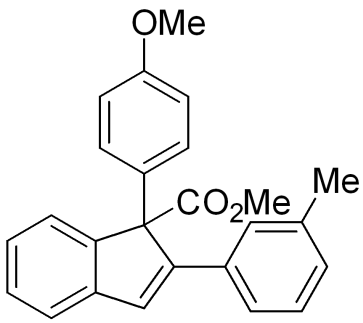
7.18 3.95 1.98 3.04 3.00 3.00

11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

f1 (ppm)

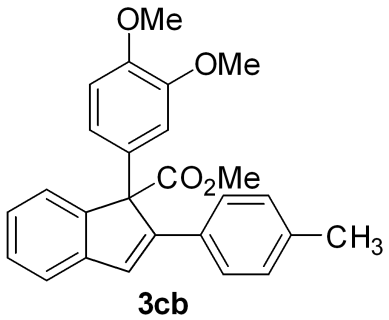
mb-5-31
mb-5-31 C

172.571
158.508
150.592
149.221
142.724
137.619
134.235
130.429
129.162
128.772
128.448
128.055
127.860
127.697
126.159
124.402
123.712
121.416
113.643
77.317
77.000
76.682
68.076
55.086
52.620
21.516



3fa

mb-5-139-1
mb-5-139-1



3cb

mb-5-139-1
mb-5-139-1

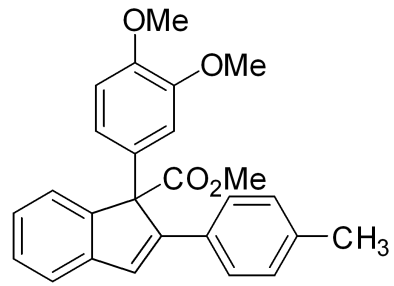
172.583
150.172
148.821
148.344
147.948
142.661
137.549
131.398
130.705
128.936
128.561
127.877
127.023
126.010
123.563
121.386
119.738
111.090
110.634

77.317
77.000
76.682

68.039

55.712
55.627
52.706

21.200



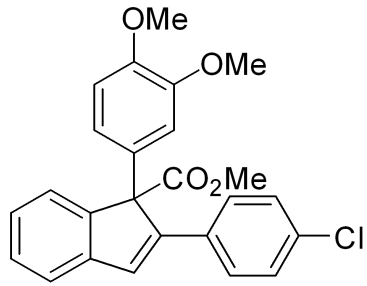
3cb

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

f1 (ppm)

mb-5-139-3
mb-5-139-3

7.413 7.394 7.383 7.364 7.348 7.341 7.331 7.326 7.319 7.316 7.313 7.297 7.295 7.278 7.276 7.261 7.238 7.232 7.227 7.215 7.210 7.198 7.195 7.179 7.176 6.903 6.898 6.890 6.885 6.881 6.875 6.721 6.698 3.816 3.715 3.607



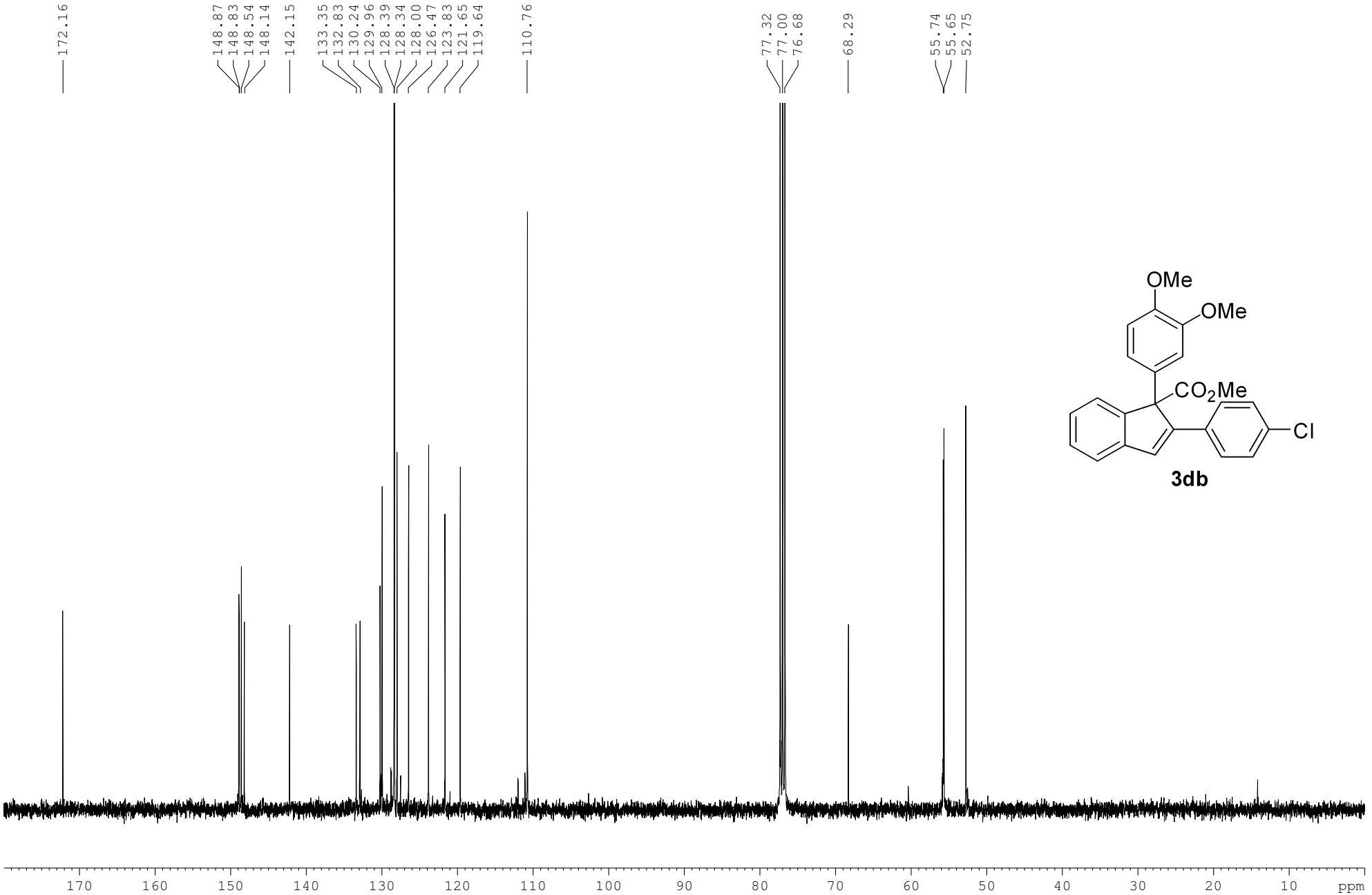
3db

9.16 2.02 1.01 3.00 3.00 3.00

1.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

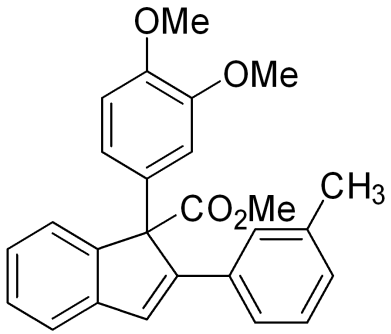
f1 (ppm)

mb-5-139-3


172.16
148.87
148.83
148.54
148.14
142.15
133.35
132.83
130.24
129.96
128.39
128.34
128.00
126.47
123.83
121.65
119.64
110.76
77.32
77.00
76.68
68.29
55.74
55.65
52.75
OMe
OMe
CO2Me
Cl
3db
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

mb-5-139-2
mb-5-139-1

7.411
7.384
7.366
7.342
7.302
7.286
7.283
7.267
7.264
7.248
7.178
7.176
7.160
7.157
7.142
7.140
7.132
7.126
7.107
7.043
7.038
7.032
7.029
6.984
6.979
6.916
6.911
6.895
6.890
6.692
6.671
3.793
3.712
3.595
2.301



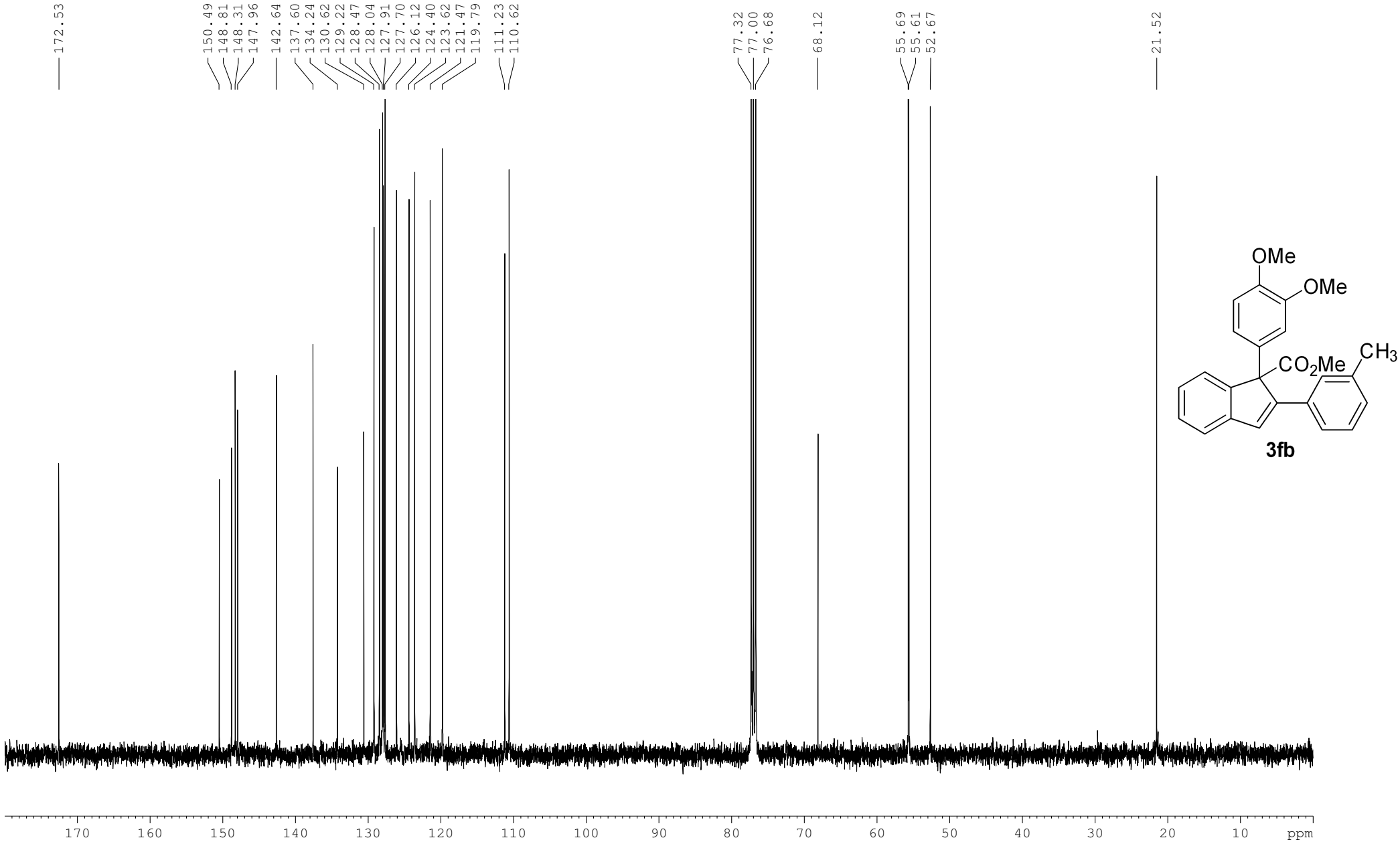
3fb

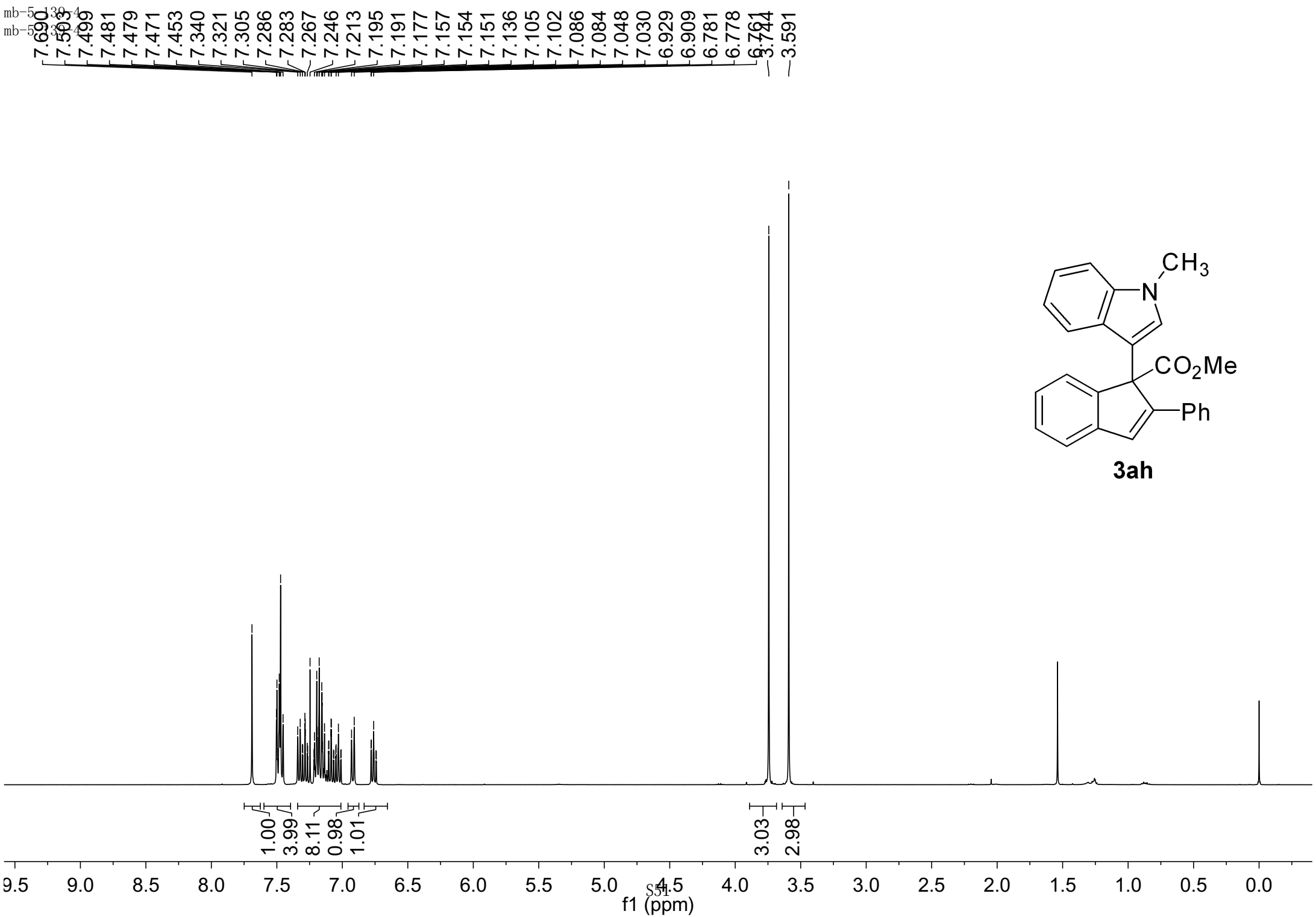
5.09
3.17
1.00
1.00
1.01
1.03
3.13
3.08
3.15
3.12

10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

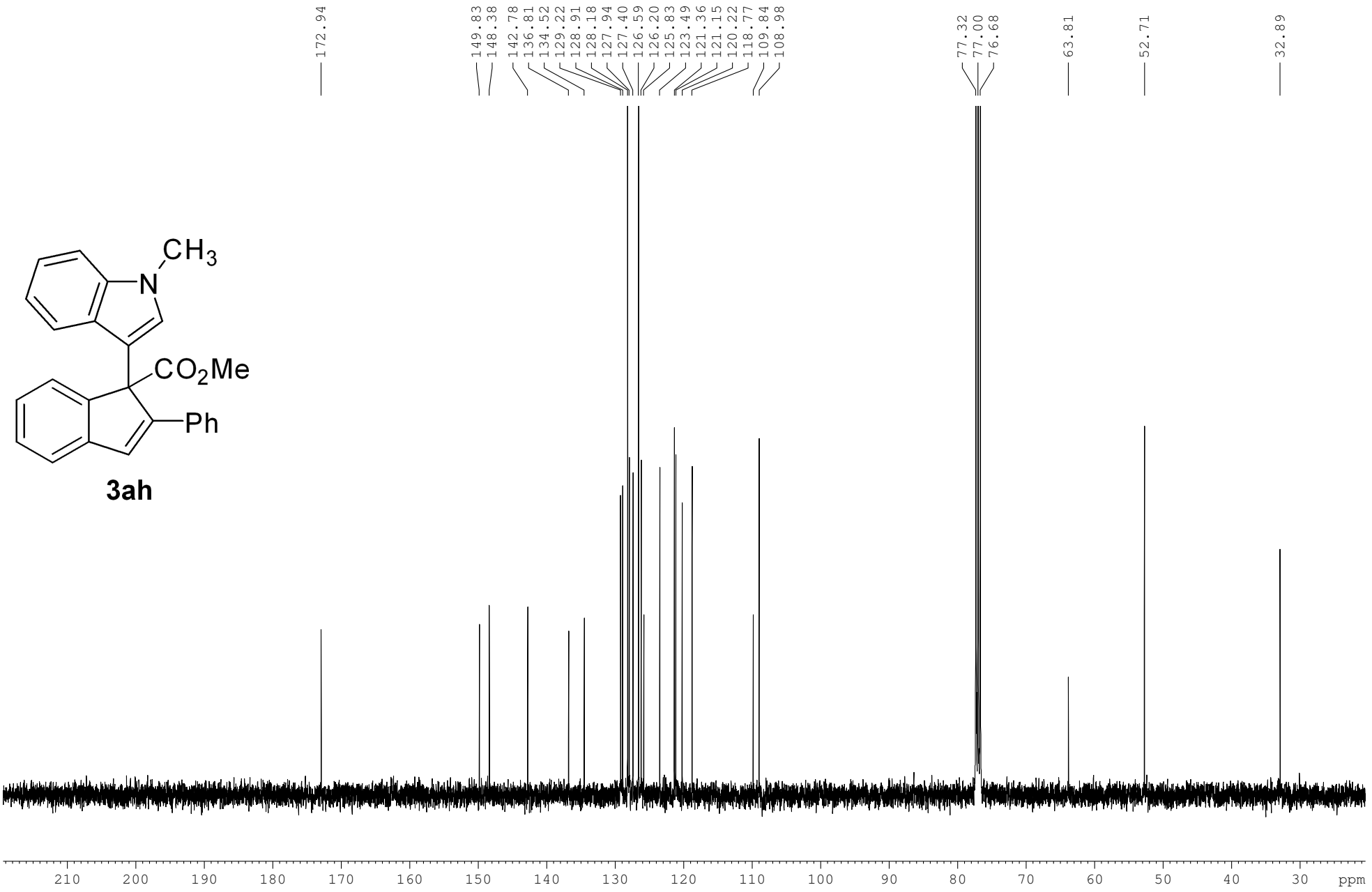
f1 (ppm)

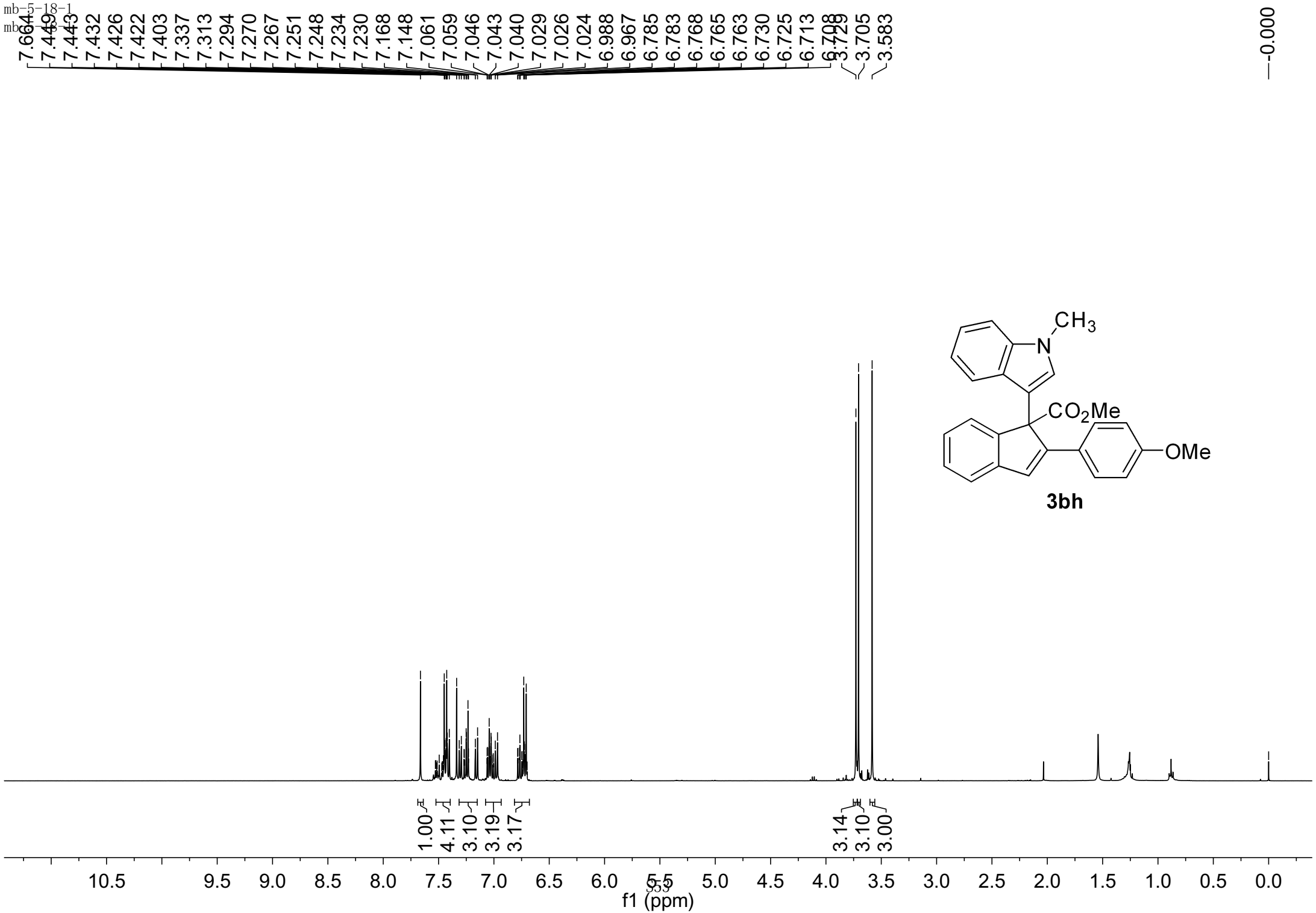
mb-5-139-2


172.53
150.49
148.81
148.31
147.96
142.64
137.60
134.24
130.62
129.22
128.47
128.04
127.91
127.70
126.12
124.40
123.62
121.47
119.79
111.23
110.62
77.32
77.00
76.68
68.12
55.69
55.61
52.67
21.52
OMe
OMe
CO2Me
CH3
3fb
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


mb-5-139-4
mb-5-303-2
7.590
7.503
7.499
7.481
7.479
7.471
7.453
7.340
7.321
7.305
7.286
7.283
7.267
7.246
7.213
7.195
7.191
7.177
7.157
7.154
7.151
7.136
7.105
7.102
7.086
7.084
7.048
7.030
6.929
6.909
6.781
6.778
6.761
3.744
3.591
CH3
N
CO2Me
Ph
3ah
1.00
3.99
8.11
0.98
1.01
3.03
2.98
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

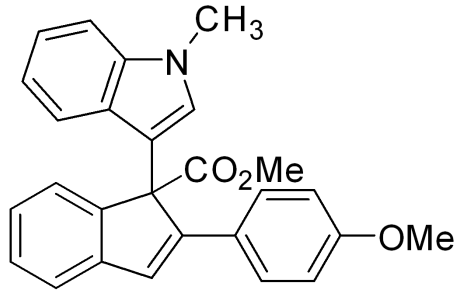
mb-5-139-4


172.94
149.83
148.38
142.78
136.81
134.52
129.22
128.91
128.18
127.94
127.40
126.59
126.20
125.83
123.49
121.36
121.15
120.22
118.77
109.84
108.98
77.32
77.00
76.68
63.81
52.71
32.89
CH3
N
CO2Me
Ph
3ah
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
ppm


mb-5-18-1
mb-5-18-1
7.664
7.449
7.443
7.432
7.426
7.422
7.403
7.337
7.313
7.294
7.270
7.267
7.251
7.248
7.234
7.230
7.168
7.148
7.061
7.059
7.046
7.043
7.040
7.029
7.026
7.024
6.988
6.967
6.785
6.783
6.768
6.765
6.763
6.730
6.725
6.713
6.708
3.729
3.705
3.583
-0.000
CH3
N
CO2Me
OMe
3bh
1.00
4.11
3.10
3.19
3.17
3.14
3.10
3.00
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

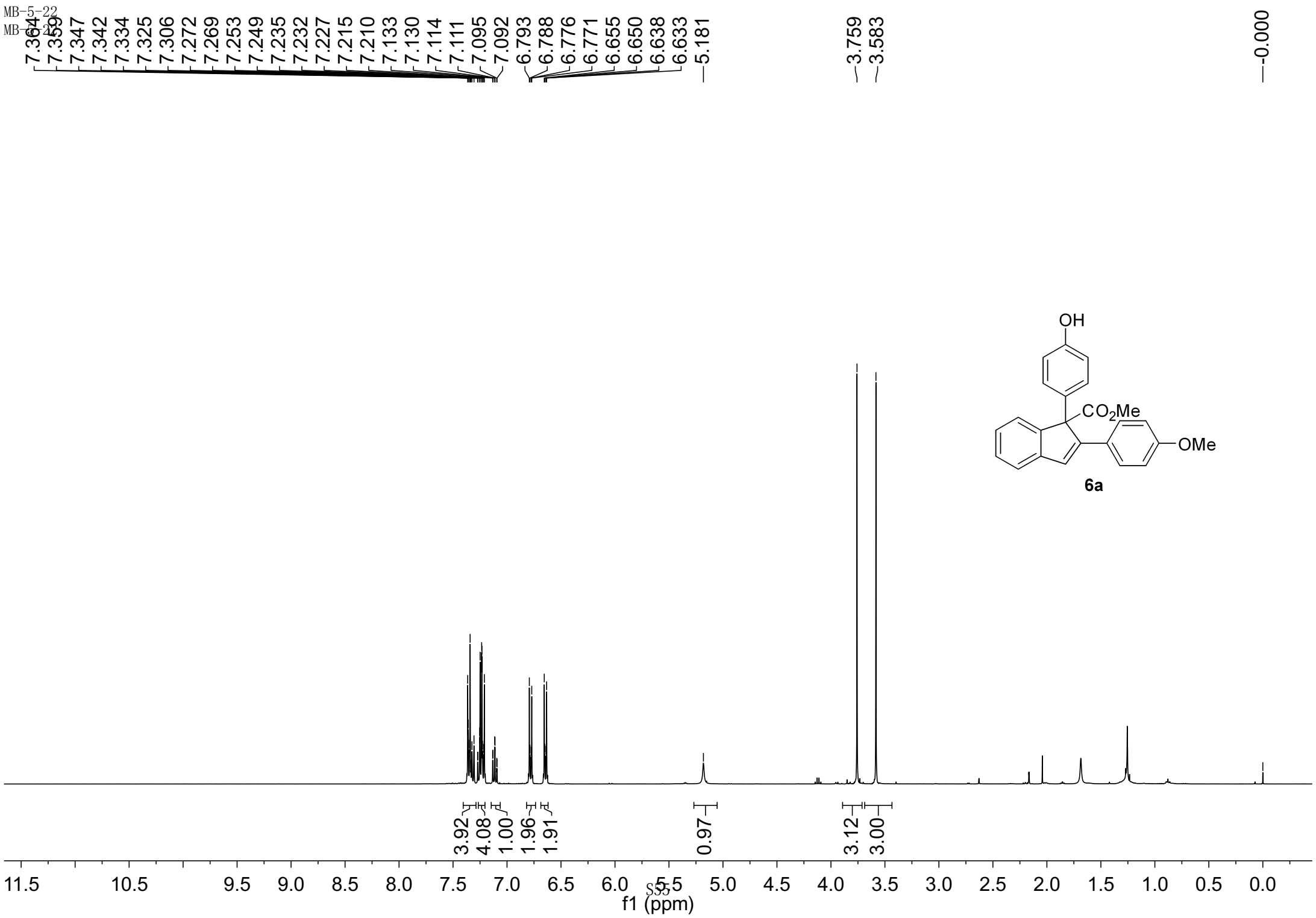
mb-5-18-1
mb-5-18-1

173.020
158.990
149.587
148.251
143.118
136.903
129.110
127.934
127.848
127.424
127.149
125.942
125.737
123.406
121.183
120.986
120.344
118.799
113.656
110.254
108.946
77.318
77.000
76.682
63.910
55.088
52.602
32.828



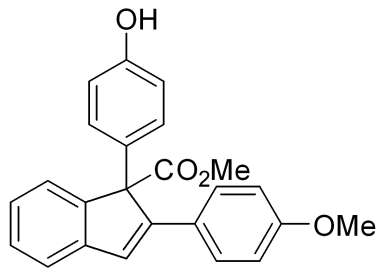
3bh

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


MB-5-22
MB-5-22
7.364
7.359
7.347
7.342
7.334
7.325
7.306
7.272
7.269
7.253
7.249
7.235
7.232
7.227
7.215
7.210
7.133
7.130
7.114
7.111
7.095
7.092
6.793
6.788
6.776
6.771
6.655
6.650
6.638
6.633
5.181
3.759
3.583
-0.000
OH
CO2Me
OMe
6a
3.92
4.08
1.00
1.96
1.91
0.97
3.12
3.00
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

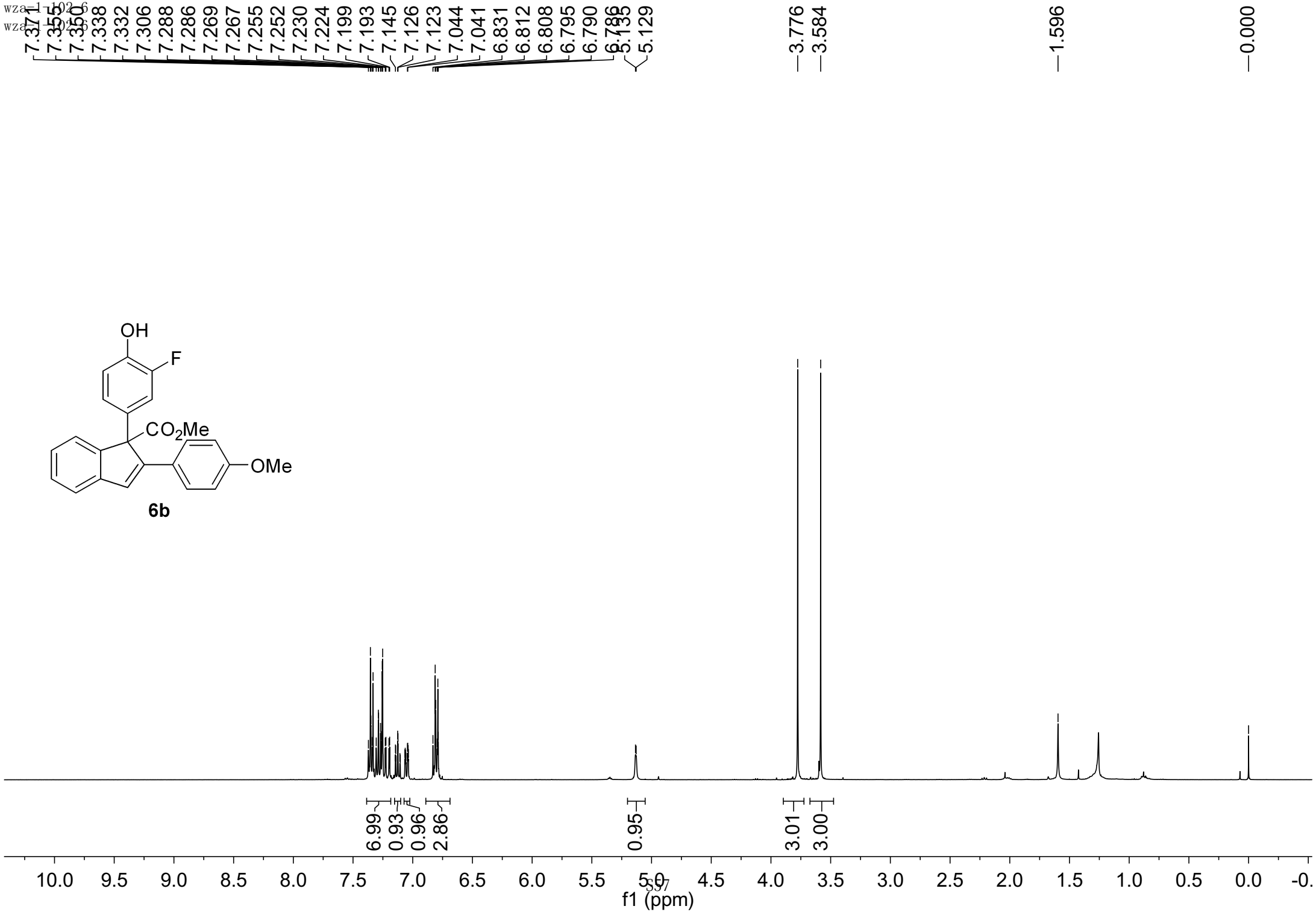
MB-5-22
MB-5-22 C

172.785
159.104
154.662
149.904
148.985
142.891
130.612
128.910
128.471
127.829
127.600
126.951
125.821
123.647
121.158
115.218
113.670
77.318
77.000
76.683
68.111
55.177
52.676



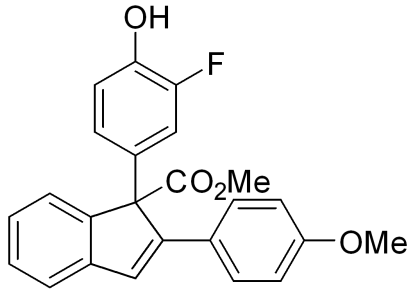
6a

f1 (ppm)


wza-1-102-6
wza-1-102-6
7.371
7.355
7.350
7.338
7.332
7.306
7.288
7.286
7.269
7.267
7.255
7.252
7.230
7.224
7.199
7.193
7.145
7.126
7.123
7.044
7.041
6.831
6.812
6.808
6.795
6.790
6.786
5.135
5.129
3.776
3.584
1.596
0.000
OH
F
CO2Me
OMe
6b
6.99
0.93
0.96
2.86
0.95
3.01
3.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.
f1 (ppm)

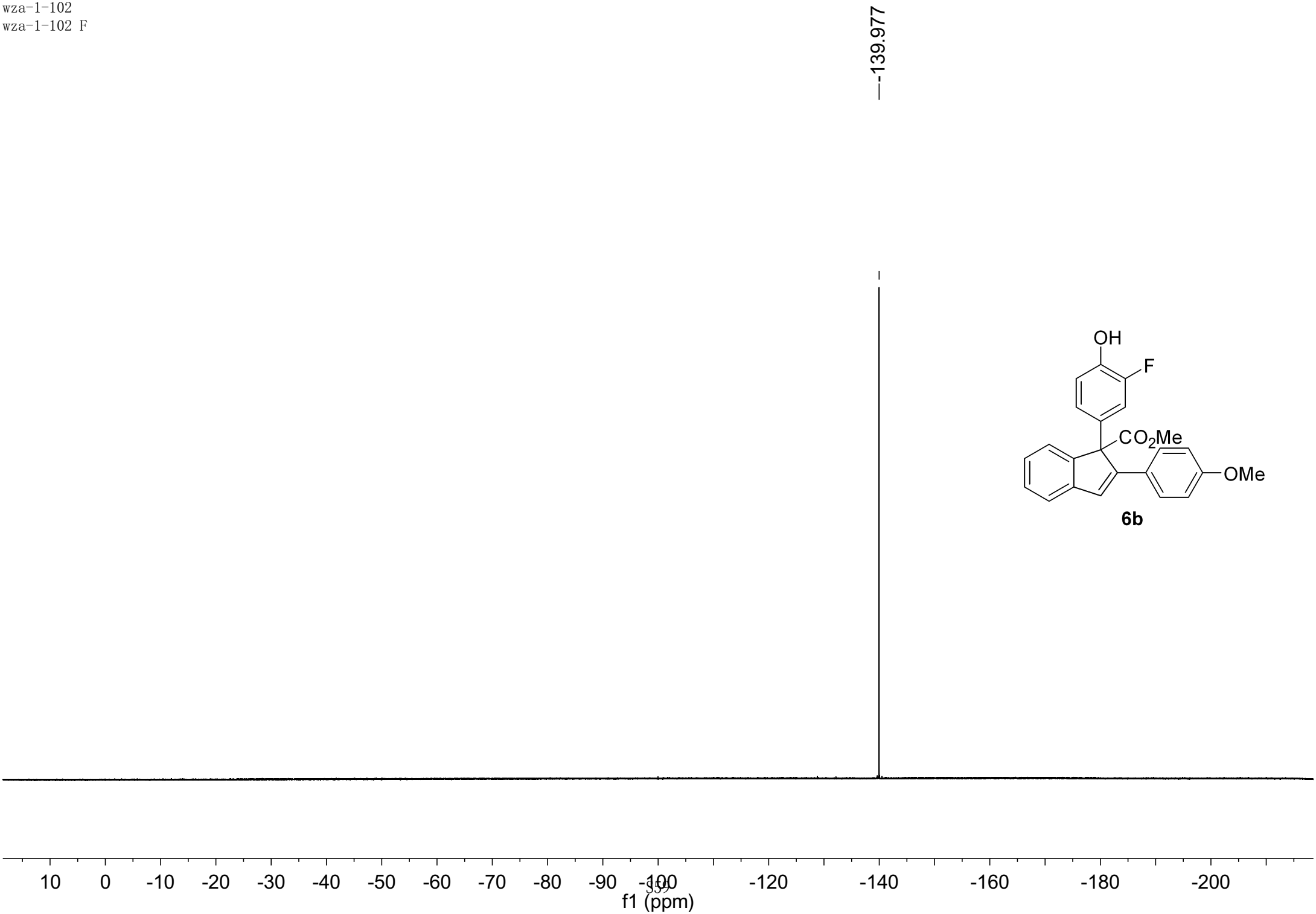
wza-1-102-6
wza-1-102-6

172.322
159.273
149.598
149.417
148.567
142.876
142.583
142.440
131.482
131.422
128.356
128.064
127.716
126.595
125.945
124.021
123.989
123.458
121.317
116.915
115.251
115.049
113.816
77.318
77.000
76.683
67.554
55.204
52.744



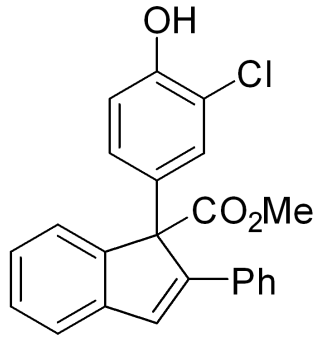
6b

wza-1-102
wza-1-102 F

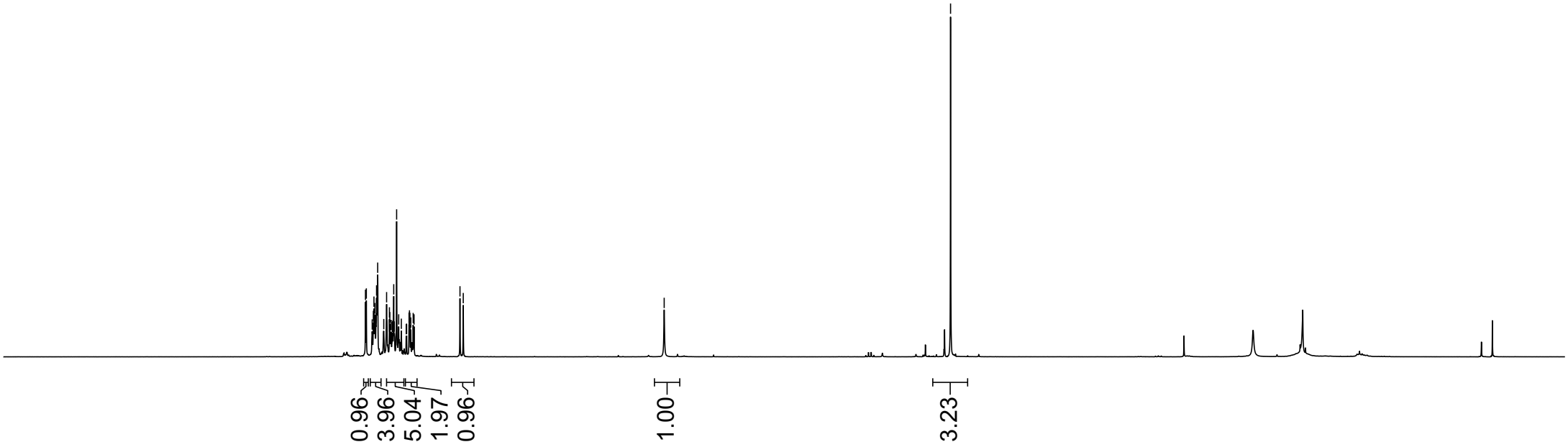


MB-4-145
MB-4-151

7.457
7.451
7.405
7.401
7.395
7.388
7.384
7.381
7.376
7.317
7.299
7.296
7.270
7.251
7.237
7.220
7.169
7.166
7.163
7.157
7.141
7.136
6.832
6.810
5.480
3.585

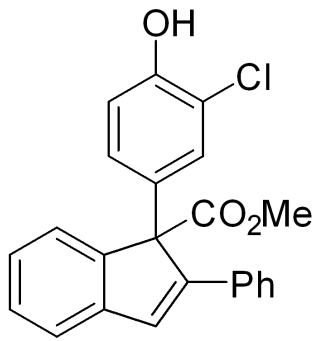


6c

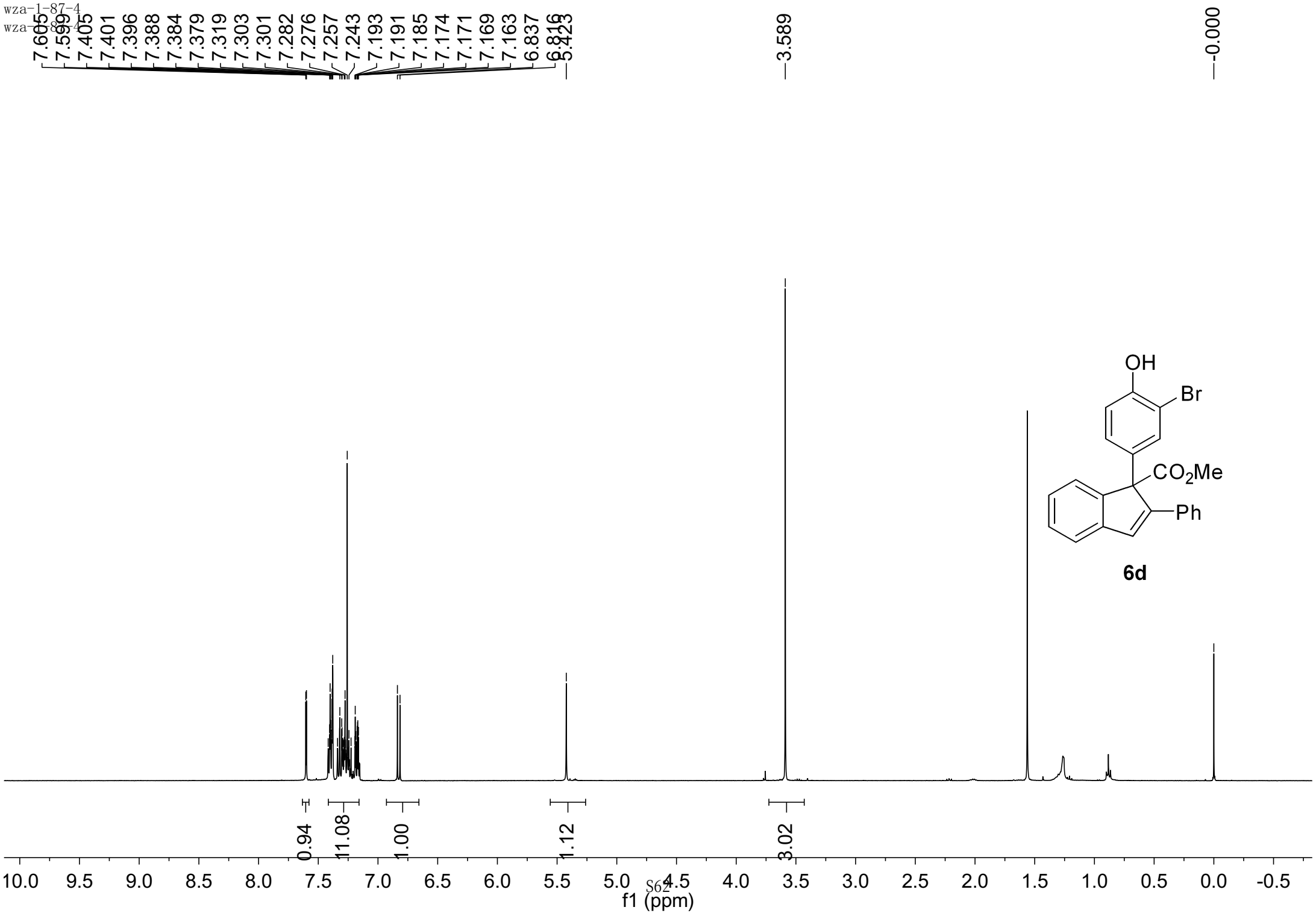


MB-4-145
MB-4-145 C

172.148
150.409
149.917
148.662
142.604
133.869
131.621
129.615
128.343
128.166
128.154
127.787
127.782
127.022
126.435
123.577
121.690
119.633
116.000
77.318
77.000
76.683
67.514
52.787

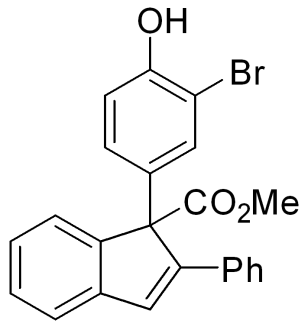


6c

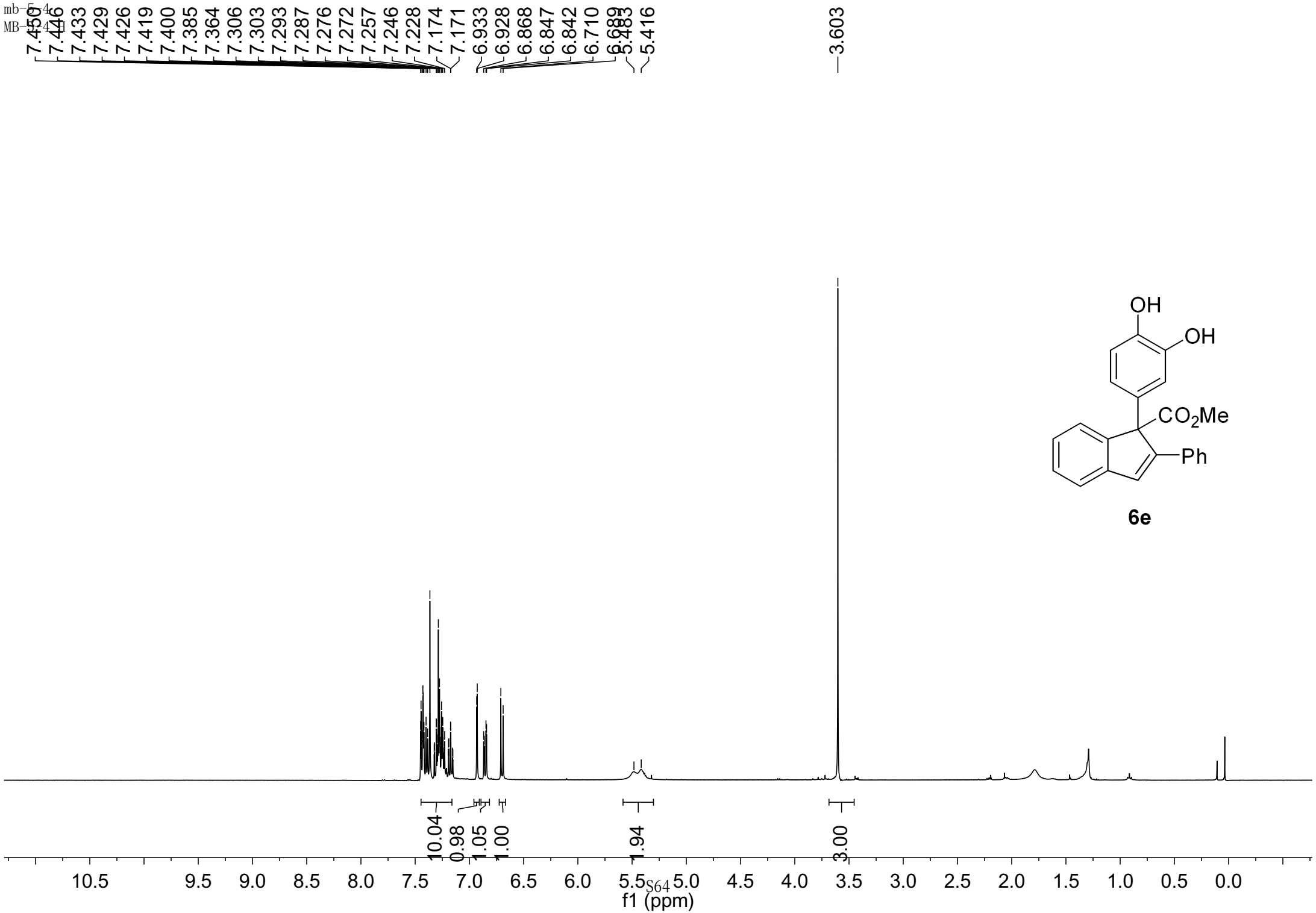

wza-1-87-4
wza-1-87-4
7.605
7.599
7.405
7.401
7.396
7.388
7.384
7.379
7.319
7.303
7.301
7.282
7.276
7.257
7.243
7.193
7.191
7.185
7.174
7.171
7.169
7.163
6.837
6.816
5.423
3.589
-0.000
OH
Br
CO2Me
Ph
6d
0.94
11.08
1.00
1.12
3.02
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

wza-1-87-4
wza-1-87-4

172.147
151.331
149.918
148.658
142.609
133.870
132.011
131.048
129.635
128.571
128.355
128.178
127.804
127.036
126.452
123.589
121.703
115.812
110.014
77.317
77.000
76.683
67.432
52.801

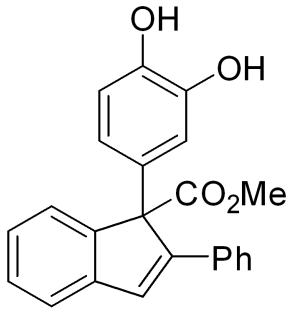


6d


mb-F-4
MB-4-H
7.450
7.446
7.433
7.429
7.426
7.419
7.400
7.385
7.364
7.306
7.303
7.293
7.287
7.276
7.272
7.257
7.246
7.228
7.174
7.171
6.933
6.928
6.868
6.847
6.842
6.710
6.689
6.683
5.483
5.416
3.603
OH
OH
CO2Me
Ph
6e
10.04
0.98
1.05
1.00
1.94
3.00
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

mb-5-4
mb-5-4

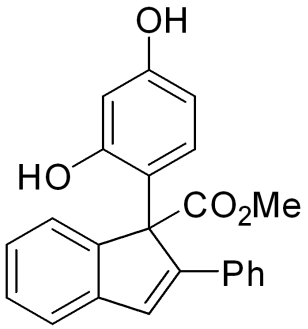
172.495
150.266
149.054
143.105
142.853
142.542
134.273
131.039
129.414
128.192
127.951
127.624
127.161
126.280
123.824
121.506
120.451
115.217
114.857
77.317
77.000
76.682
68.131
52.709



6e

wza-1-107-6
wza-1-107-6

9.781
9.225
7.713
7.694
7.676
7.658
7.512
7.384
7.365
7.276
7.259
7.240
7.233
7.213
7.143
7.125
6.395
6.366
6.361
5.997
5.992
5.976
5.971
3.445
3.379
2.497



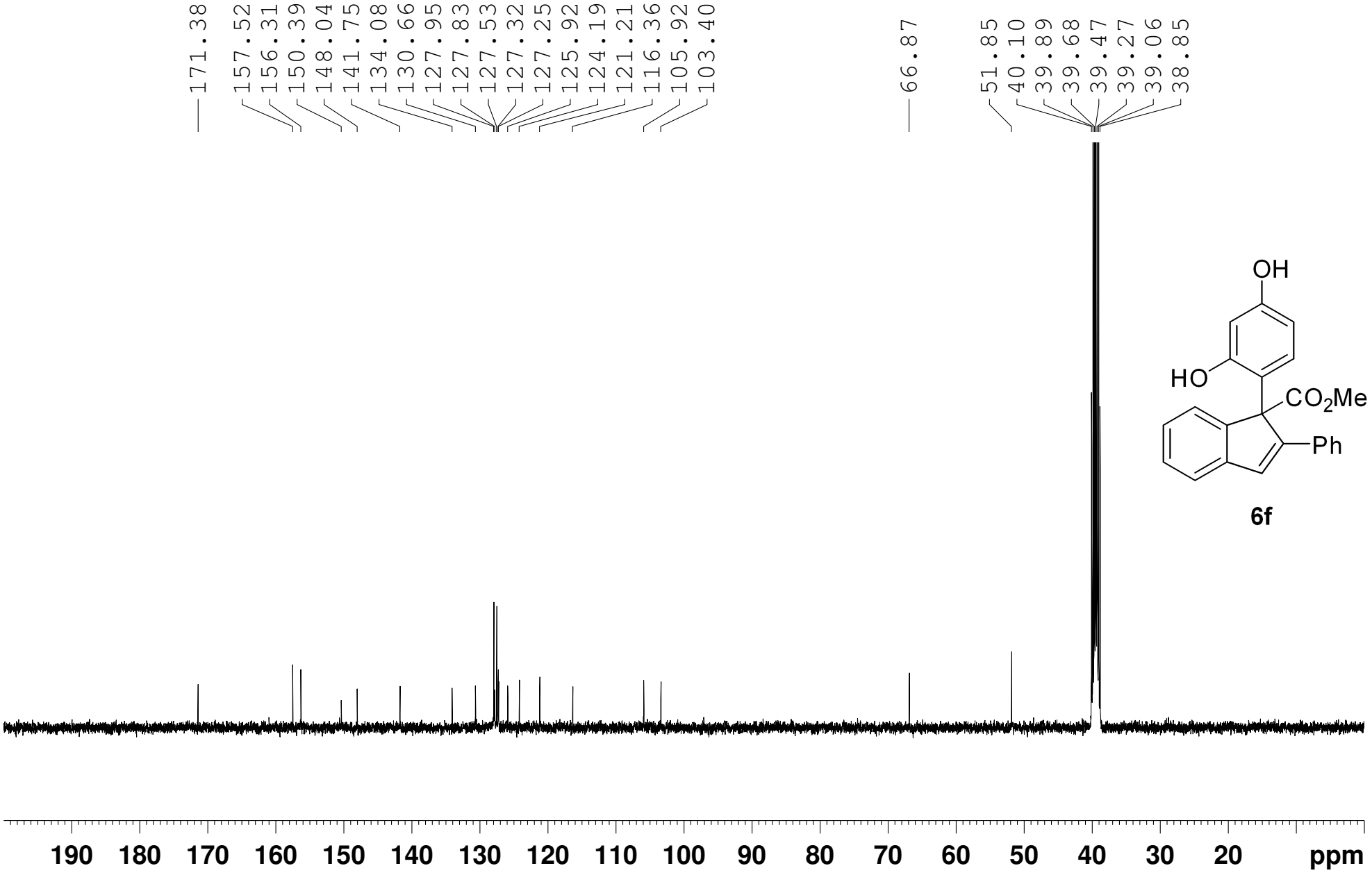
6f

1.03
1.05
3.16
1.14
6.18
2.21
1.08
3.00

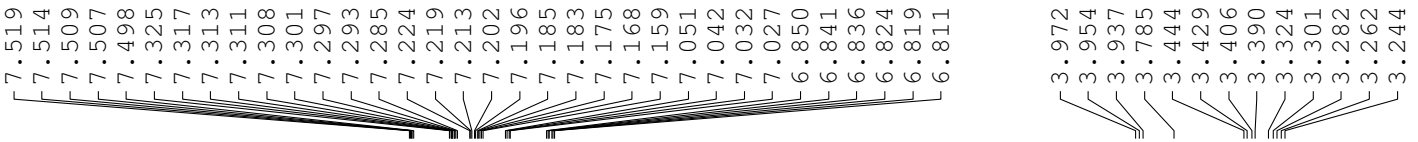
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.

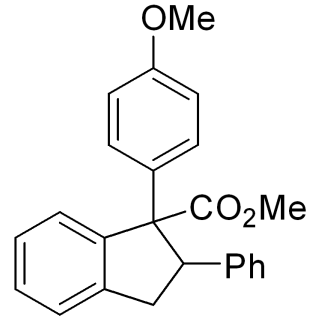
f1 (ppm)

wza-1-103-1

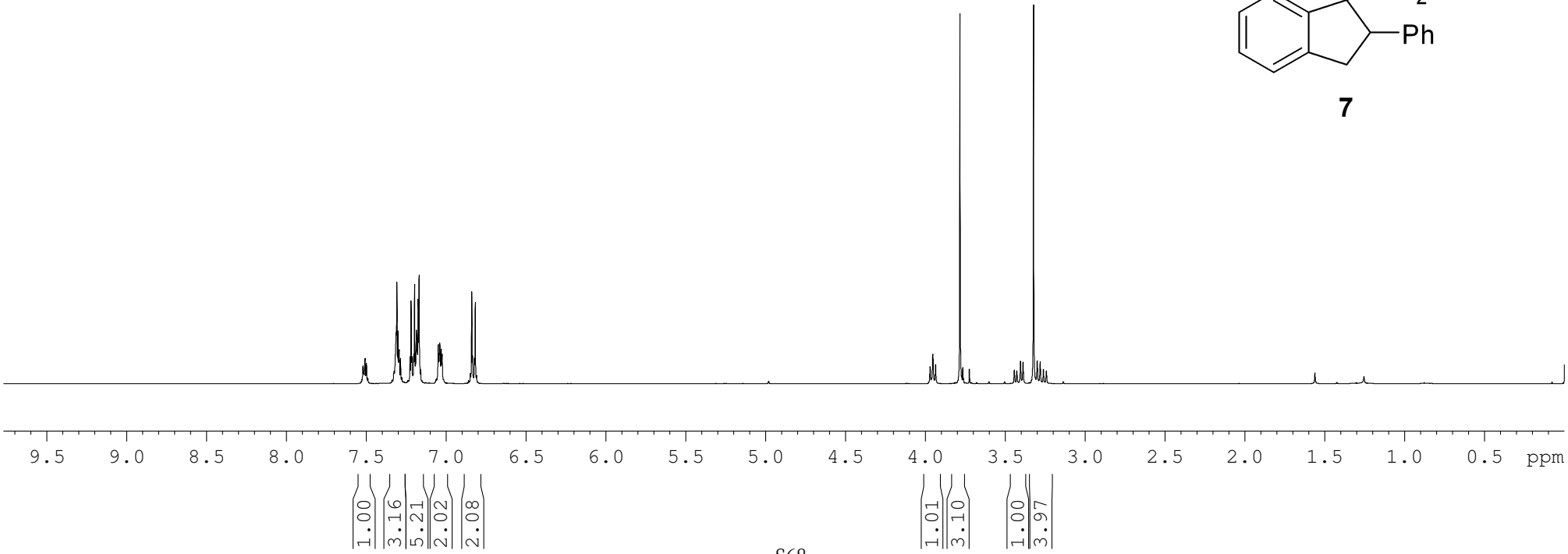

171.38
157.52
156.31
150.39
148.04
141.75
134.08
130.66
127.95
127.83
127.53
127.32
127.25
125.92
124.19
121.21
116.36
105.92
103.40
66.87
51.85
40.10
39.89
39.68
39.47
39.27
39.06
38.85
OH
HO
CO2Me
Ph
6f
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm

mb-5-37-1


7.519
7.514
7.509
7.507
7.498
7.325
7.317
7.313
7.311
7.308
7.301
7.297
7.293
7.285
7.224
7.219
7.213
7.202
7.196
7.185
7.183
7.175
7.168
7.159
7.051
7.042
7.032
7.027
6.850
6.841
6.836
6.824
6.819
6.811
3.972
3.954
3.937
3.785
3.444
3.429
3.406
3.390
3.324
3.301
3.282
3.262
3.244

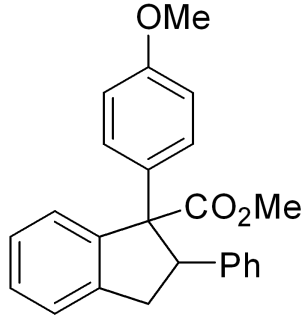

OMe
CO2Me
Ph

7


9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.00
3.16
5.21
2.02
2.08
1.01
3.10
1.00
3.97

mb-5-37
mb-5-37

172.732
158.455
143.478
141.155
134.429
129.102
128.604
127.820
127.685
127.461
126.685
126.656
124.652
113.361
77.317
77.000
76.682
68.429
58.683
55.165
51.439
37.448



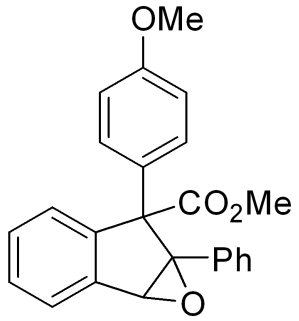
7

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

f1 (ppm)

wza-2-21-3
wza-2-21-3

7.615
7.597
7.590
7.572
7.414
7.395
7.380
7.364
7.345
7.255
7.175
7.163
7.152
7.141
7.131
7.108
7.097
6.643
6.636
6.620
6.612
6.596
6.589
4.270
3.834
3.717



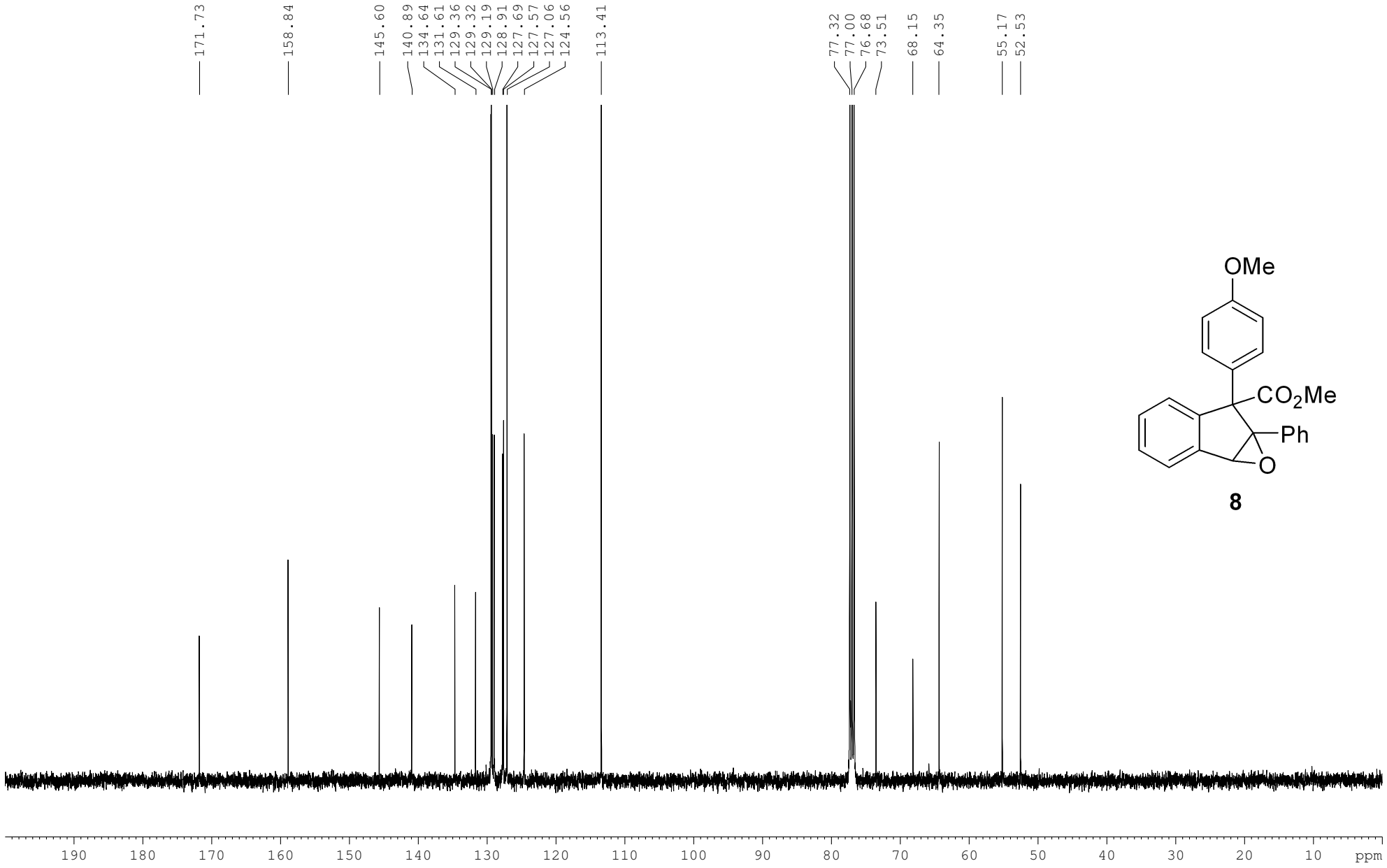
8

2.00
2.04
4.99
4.02
1.00
3.08
3.06

1.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

f1 (ppm)

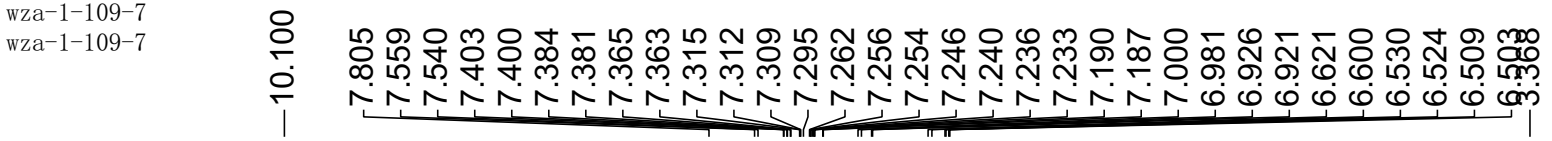
wza-2-21-3

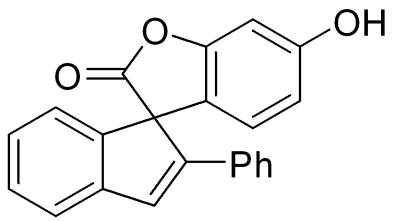

171.73
158.84
145.60
140.89
134.64
131.61
129.36
129.32
129.19
128.91
127.69
127.57
127.06
124.56
113.41
77.32
77.00
76.68
73.51
68.15
64.35
55.17
52.53
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

OMe
CO2Me
Ph
O

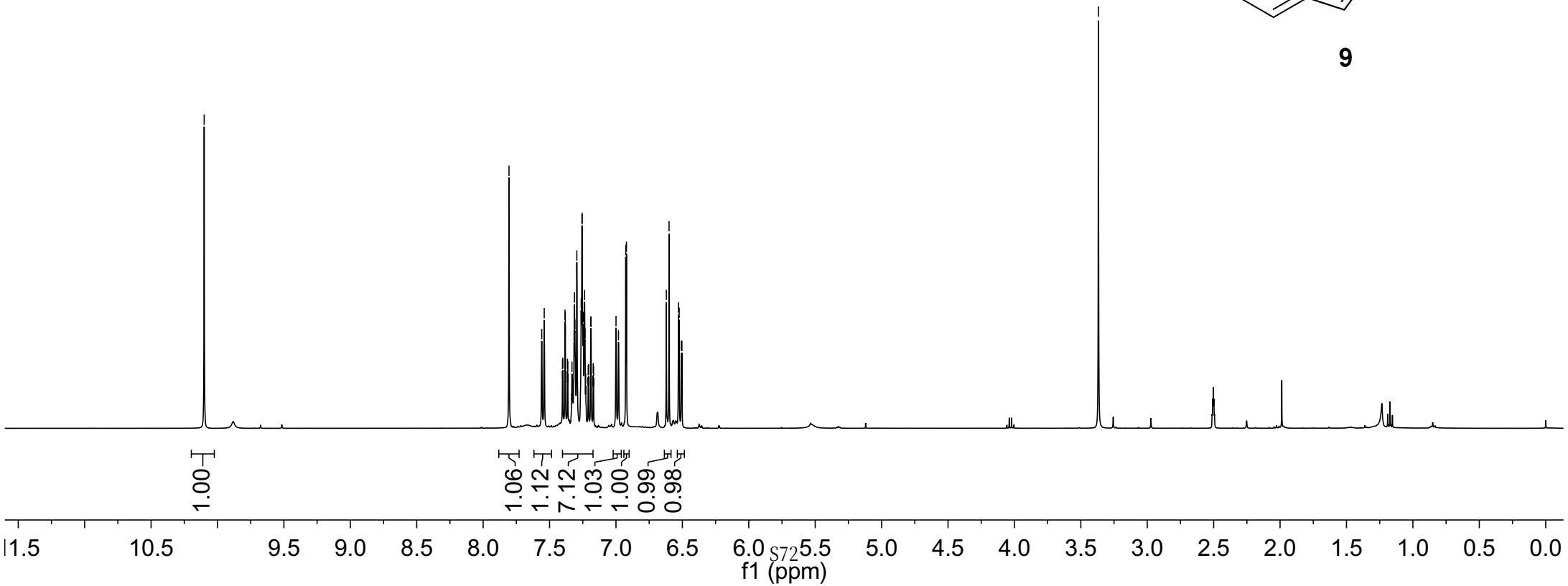
8

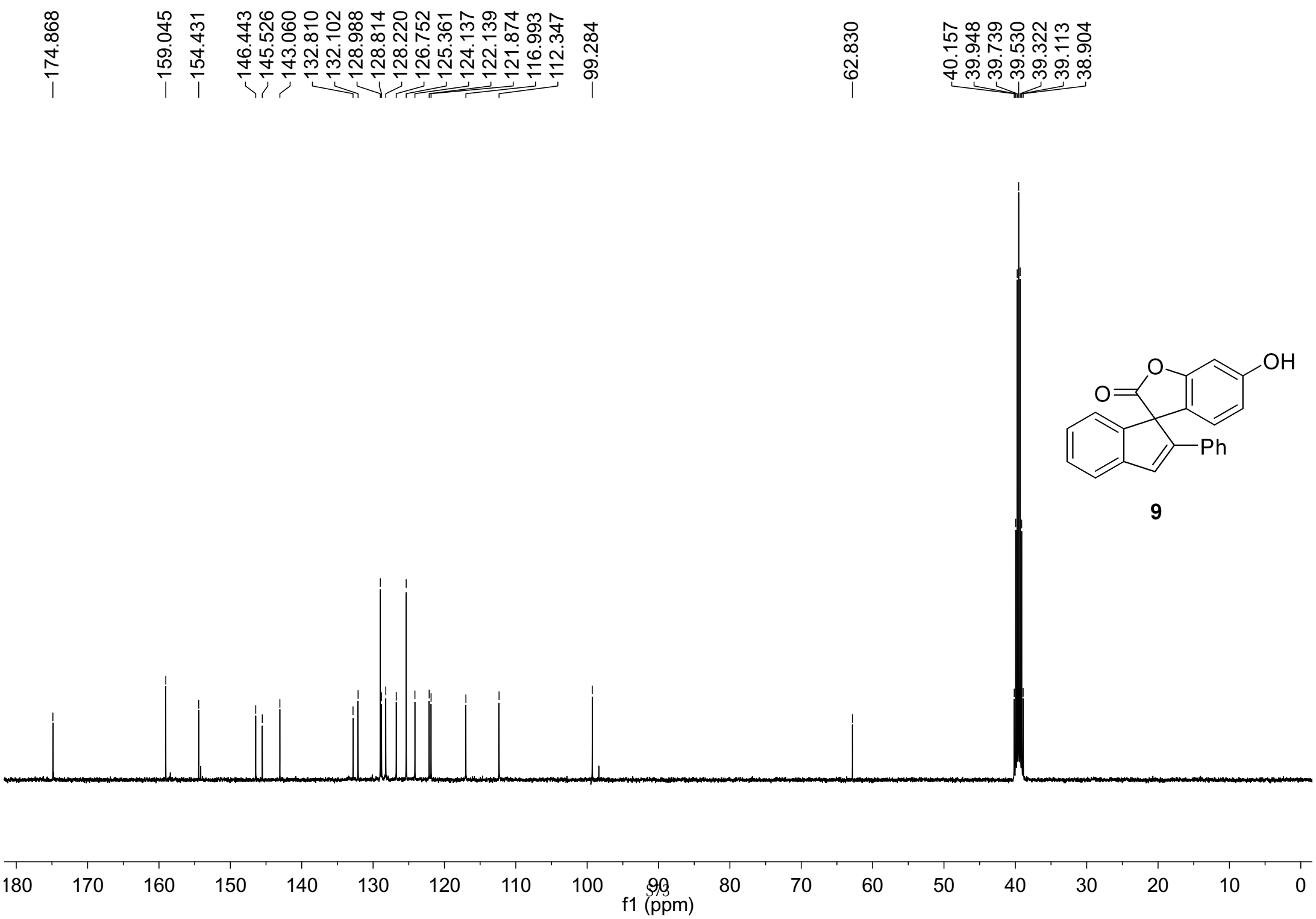
wza-1-109-7
wza-1-109-7



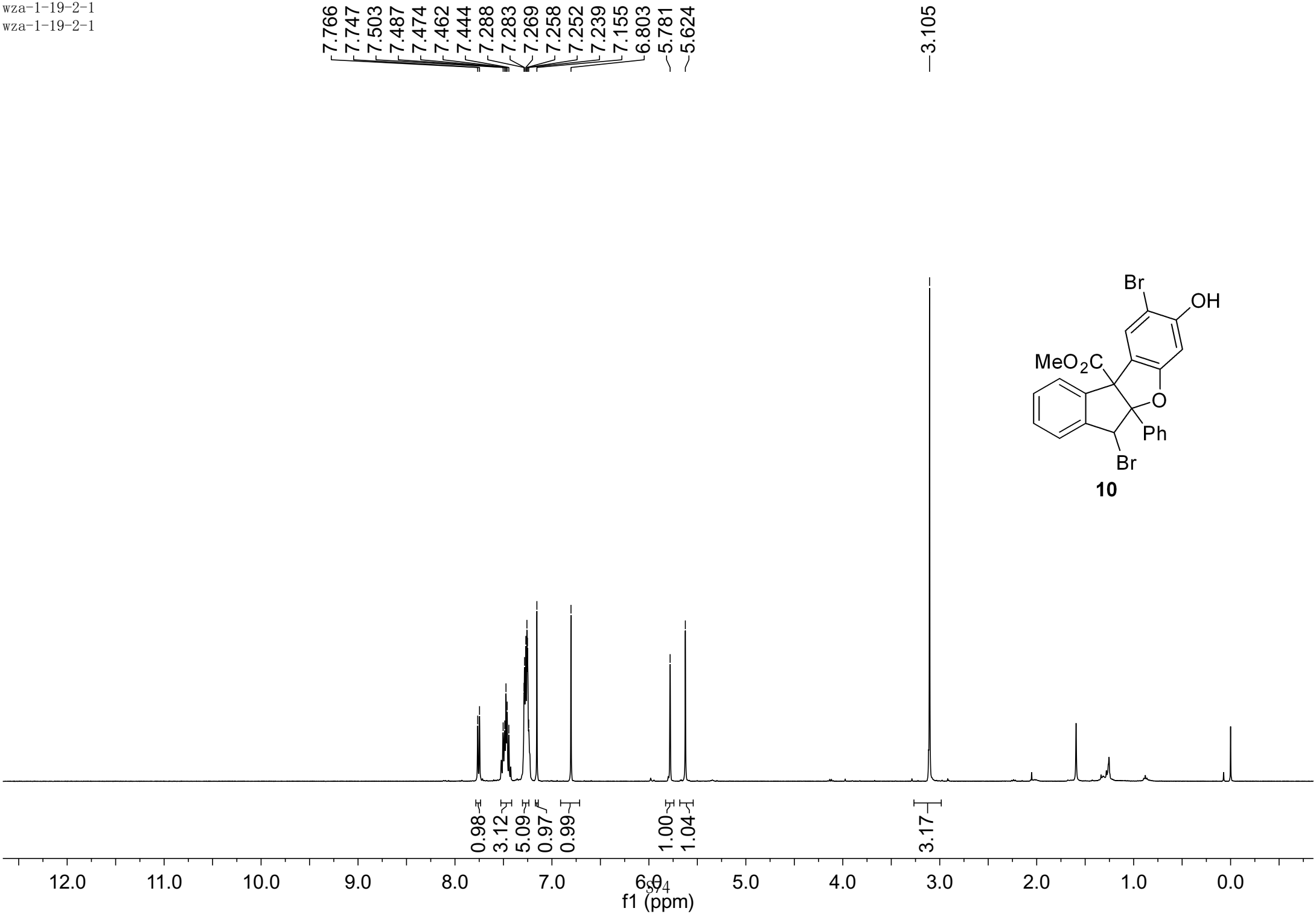


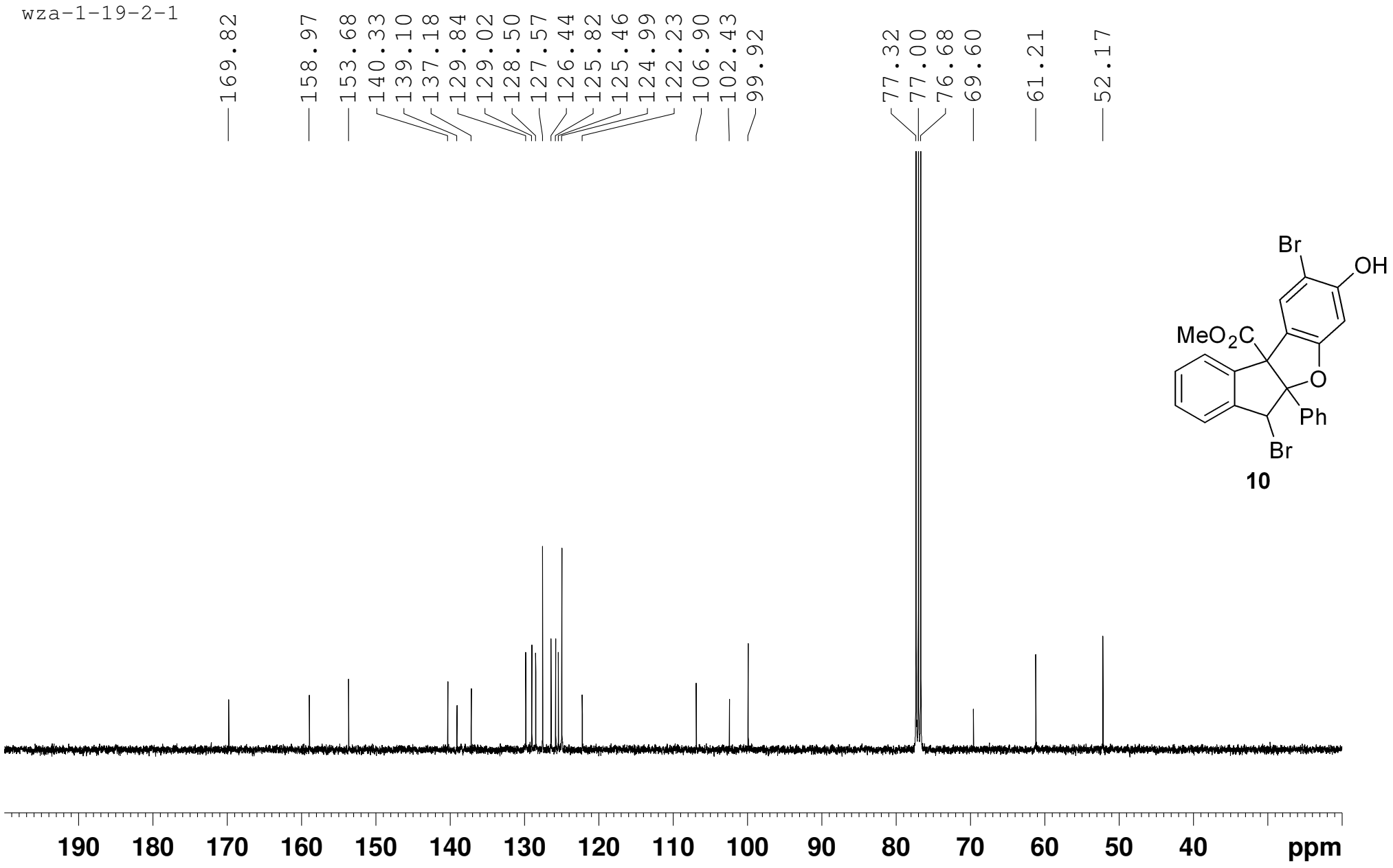
9




174.868
159.045
154.431
146.443
145.526
143.060
132.810
132.102
128.988
128.814
128.220
126.752
125.361
124.137
122.139
121.874
116.993
112.347
99.284
62.830
40.157
39.948
39.739
39.530
39.322
39.113
38.904
O
O
OH
Ph
9
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

wza-1-19-2-1
wza-1-19-2-1




wza-1-19-2-1
169.82
158.97
153.68
140.33
139.10
137.18
129.84
129.02
128.50
127.57
126.44
125.82
125.46
124.99
122.23
106.90
102.43
99.92
77.32
77.00
76.68
69.60
61.21
52.17
Br
OH
MeO2C
O
Ph
Br
10
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
ppm