# Preparation of Highly Substituted (*β*-Acylamino)acrylates *via* Iron-catalyzed Alkoxycarbonylation of *N*-Vinylacetamides with Carbazates

Ran Ding,[a] Qiu-Chi Zhang,[a] Yun-He Xu,[a]* and Teck-Peng Loh[a,b]*

[a]*Hefei National Laboratory for Physical Science at the Microscale, Department of Chemistry, University of Sciences and Technology of China, Hefei, Anhui 230026, P.R. China.*
[b]*Division of Chemistry and Biological Chemistry, School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore 637371.*

## Supporting Information

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## 1. General information

Unless otherwise noted, all reagents and solvents were purchased from commercial suppliers and used without further purification. $^{1}$H-NMR and $^{13}$C-NMR spectra were recorded at 25 ºC on Bruker Advance 400M NMR spectrometers ($CDCl_3$ as solvent). Chemical shifts for $^{1}$H NMR spectra are reported as δ in units of parts per million (ppm) downfield from $SiMe_4$ (δ 0.0) and relative to the signal of $SiMe_4$ (δ 0.00 singlet). Multiplicities were given as: s (singlet); d (doublet); t (triplet); q (quartet); dd (doublet of doublets); dt (doublet of triplets); m (multiplets) and etc. Coupling constants are reported as a *J* value in Hz. $^{13}$C NMR spectra are reported as δ in units of parts per million (ppm) downfield from $SiMe_4$ (δ 0.0) and relative to the signal of chloroform-*d* (δ 77.00 triplet). High resolution mass spectral analysis (HRMS) was performed on Waters-XEVOG2 Q-TOF (Waters Corporation). IR spectra were recorded on a commercial FT/IR spectrometer. Flash chromatography was performed using 200-300 mesh silica gel with the indicated solvent system.

## 2. Procedure for the synthesis of compound 3a - 3r.

To a stirred solution of **1** (0.3 mmol), **2** (0.6 mmol), $Cs_2CO_3$ (0.3 mmol) and [Fe(Pc)] (0.03 mmol) in MeCN (1.5 mL) was added TBHP (120 μL , 5-6 M in decane ) slowly under an air atmosphere at room temperature. The mixture was heated at 60 °C for 2 h and then cooled to room temperature. The excess solvent was removed under vacuum, then the residue was directly purified by silica gel column chromatography (petroleum/ethyl acetate = 4:1) to give the desired product. The stereoselectivity (E/Z) was determined from the $^{1}$H NMR spectra recorded for the crude products.

## 3. Procedure for the synthesis of compound 4a – 4l.

To a stirred solution of **1** (0.3 mmol), **2** (0.6 mmol), $K_2CO_3$ (0.3 mmol) and [Fe(Pc)] (0.03 mmol) in MeCN (1.5 mL) was added TBHP (120 μL , 5-6 M in decane ) slowly under an air atmosphere at room temperature. The mixture was continued to react at

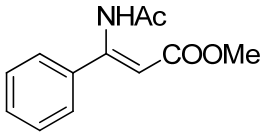
room temperature for 1 h. The excess solvent was removed under vacuum, and the residue was directly purified by silica gel column chromatography (petroleum/ethyl acetate = 4:1) to afford the desired product.

## 4. Procedure for the gram-scale synthesis of compound 3a.

To a stirred solution of **1a** (1g, 6.2 mmol), **2a** (1.12g, 12.4 mmol), $Cs_2CO_3$ (2.02g, 0.3 mmol) and [Fe(Pc)] (0.35g, 0.62 mmol) in MeCN (30 mL) was added TBHP (2.48mL , 5-6 M in decane ) slowly under an air atmosphere at room temperature. The mixture was heated at 60 °C for 2 h and then cooled to room temperature. The excess solvent was removed under vacuum, then the residue was directly purified by silica gel column chromatography (petroleum/ethyl acetate = 4:1) to give the desired product **3a** in 61% yield, 0.83g. The stereoselectivity (E/Z) was determined by the $^1$H NMR spectra recorded for the crude product.

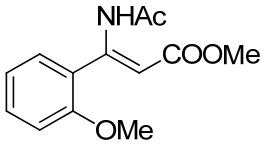
## 5. Characterization data for the products

## (Z)-methyl 3-acetamido-3-phenylacrylate (3a)




**3a**[2] was obtained as white solid . $^1$H NMR (400 MHz, $CDCl_3$) δ 10.61 (s, 1H), 7.40 – 7.35 (m, 5H), 5.29 (s, 1H), 3.77 (s, 3H), 2.17 (s, 3H). $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 169.12, 168.51, 154.86, 135.97, 129.75, 128.18, 127.19, 100.67, 51.53, 24.92 ppm. HRMS (ESI): m/z calculated for $C_{12}H_{13}NO_3$ $[M+Na]^+$: 242.0793, found: 242.0790. FTIR: 3289, 3059, 2950, 1723, 1678, 1624, 1289, 1174, 770, 697, 585, 517 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(2-methoxyphenyl)acrylate (3b)

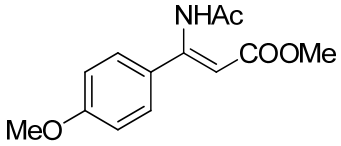



**3b** was obtained as a white solid .$^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.92 (s, 1H), 7.35 (ddd, *J* = 8.3, 7.5, 1.8 Hz, 1H), 7.17 (dd, *J* = 7.5, 1.8 Hz, 1H), 6.95 (td, *J* = 7.5, 1.0 Hz, 1H), 6.85 (dd, *J* = 8.3, 1.0 Hz, 1H), 5.08 (s, 1H), 3.79 (s, 3H), 3.75 (s, 3H), 2.10 (s, 3H).$^{13}$C NMR (100 MHz, $CDCl_3$) δ = 169.56, 167.53, 156.83, 152.73, 130.63, 128.84, 125.74, 120.50, 110.35, 98.86, 55.74, 51.39, 24.81 ppm.

HRMS (ESI): m/z calculated for $C_{13}H_{15}NO_4$ $[M+Na]^+$: 272.0899, found: 272.0893.

FTIR: 3263, 3078, 2958, 1728, 1667, 1625, 1491, 1302, 1194, 750, 588, 502 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(4-methoxyphenyl)acrylate (3c)

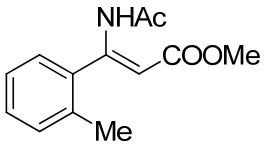



**3c** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.56 (s, 1H), 7.33 (d, *J* = 8.8 Hz, 2H), 6.88 (d, *J* = 8.8 Hz, 2H), 5.27 (s, 1H), 3.82 (s, 3H), 3.75 (s, 3H), 2.17 (s, 3H). $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 169.23, 168.74, 161.05, 154.51, 128.79, 128.03, 113.65, 99.62, 55.41, 51.44, 25.03 ppm.

HRMS (ESI): m/z calculated for $C_{13}H_{15}NO_4$ $[M+Na]^+$: 272.0899, found: 272.0895.

FTIR: 3332, 2969, 2833, 1682, 1624, 1508, 1286, 1165, 1026, 823, 560, 489 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(o-tolyl)acrylate (3d)



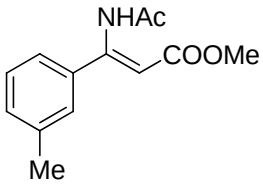

**3d** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 11.03 (s, 1H), 7.29 –7.25 (m, 1H), 7.22 – 7.09 (m, 3H), 5.01 (s, 1H), 3.77 (s, 3H), 2.26 (s, 3H), 2.10 (s,

3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 169.53, 167.52, 155.00, 136.21, 135.23, 129.76, 128.82, 127.48, 125.61, 98.83, 51.44, 24.73, 19.54 ppm.

HRMS (ESI): m/z calculated for$C_{13}H_{15}NO_3$ $[M+Na]^+$: 256.0950, found: 256.0952.

FTIR: 3278, 3063, 2951, 1727,1677, 1620,1487, 1295, 1175, 770, 602, 585, 472 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(m-tolyl)acrylate (3e)

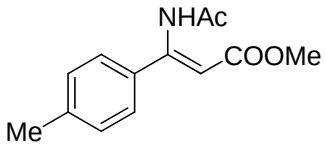



**3e** was obtained as white solid. $^1$H NMR (400 MHz, $CDCl_3$) δ 10.57 (s, 1H), 7.32 – 7.13 (m, 4H), 5.28 (s, 1H), 3.76 (s, 3H), 2.36 (s, 3H), 2.16 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 169.15, 168.54, 155.03, 137.88, 135.93, 130.60, 128.05, 127.73, 124.39, 100.56, 51.51, 24.93, 21.55 ppm.

HRMS (ESI): m/z calculated for $C_{13}H_{15}NO_3$[M+Na]$^+$: 256.0950, found: 219.0948.

FTIR: 3289, 3059, 2950, 1723,1678, 1624, 1289, 1174, 770, 697,5 85, 517 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(p-tolyl)acrylate (3f)

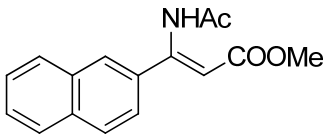



**3f** was obtained as white solid. $^1$H NMR (400 MHz, $CDCl_3$) δ 10.57 (s, 1H), 7.28 (d, *J* = 8.1 Hz, 2H), 7.17 (d, *J* = 7.9 Hz, 2H), 5.28 (s, 1H), 3.76 (s, 3H), 2.37 (s, 3H), 2.16 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 169.16, 168.60, 154.88, 139.99, 133.00, 128.92, 127.14, 100.16, 51.46, 24.94, 21.50 ppm.

HRMS (ESI): m/z calculated for $C_{13}H_{15}NO_3$ $[M+Na]^+$: 256.0950, found: 256.0944.

FTIR: 3263, 3078, 2958, 1728, 1667, 1625, 1491, 1275, 1022, 750, 588, 502 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(naphthalen-2-yl)acrylate (3g)

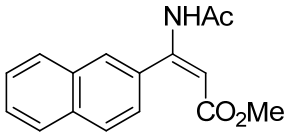



**3g** was obtained as white solid.$^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.71 (s, 1H), 7.94 – 7.77 (m, 4H), 7.57 – 7.40 (m, 3H), 5.41 (s, 1H), 3.79 (s, 3H), 2.20 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 169.17, 168.60, 154.86, 134.00, 133.70, 133.00, 128.63, 127.85, 127.57, 127.02, 126.53, 124.93, 100.91, 51.60, 24.94 ppm.

HRMS (ESI): m/z calculated for $C_{16}H_{15}NO_3$ $[M+Na]^+$: 292.0950, found: 292.0950.

FTIR: 3277, 3057, 2922, 1722,1674, 1617, 1286, 1167, 818, 745, 480 $cm^{-1}$.

## (E)-methyl 3-acetamido-3-(naphthalen-2-yl)acrylate (3g')

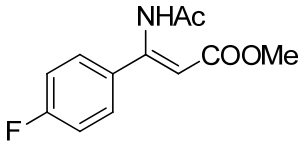



**3g'** obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.86 (t, *J* = 6.5 Hz, 3H), 7.79 (s, 1H), 7.58 – 7.48 (m, 2H), 7.40 (dd, *J* = 8.5, 1.8 Hz, 1H), 7.15 (s, 1H), 6.88 (s, 1H), 3.52 (s, 3H), 2.09 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 169.02, 167.72, 149.19, 134.15, 133.65, 133.01, 128.39, 128.19, 127.99, 127.15, 127.13, 126.73, 126.15, 103.88, 51.16, 25.14ppm.

HRMS (ESI): m/z calculated for $C_{16}H_{15}NO_3$ $[M+Na]^+$: 292.0950, found: 292.0952.

FTIR: 3276, 3135, 2947, 1716, 1678, 1513, 1284, 1142, 820, 747, 474 $cm^{-1}$.

## (Z)-methyl 3-acetamido-3-(4-fluorophenyl)acrylate(3h)

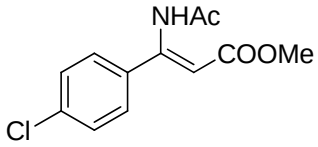



**3h** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.62 (s, 1H), 7.48 – 7.30 (m, 2H), 7.04 (t, *J* = 8.6 Hz, 2H), 5.25 (s, 1H), 3.77 (s, 3H), 2.17 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 169.03, 168.58, 163.66 (d, *J* = 249 Hz), 153.73, 131.92 (d, *J* = 4 Hz), 129.16 (d, *J* = 9 Hz), 115.31 (d, *J* = 22 Hz), 100.66, 51.59, 24.95 ppm.

HRMS (ESI): m/z calculated for $C_{12}H_{12}FNO_3$ $[M+Na]^+$: 260.0699, found: 260.0694.

FTIR: 3263, 3044, 2956, 1724, 1623, 1509, 1295, 1172, 844, 779, 544 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(4-chlorophenyl)acrylate (3i)

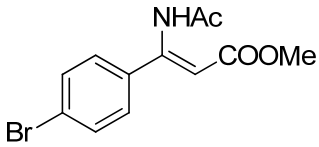



**3i** was obtained as white solid. $^1$H NMR (400 MHz, $CDCl_3$) δ 10.60 (s, 1H), 7.33 (d, *J* = 8.8 Hz, 2H), 7.29 (d, *J* = 8.8 Hz, 2H), 5.26 (s, 1H), 3.76 (s, 3H), 2.17 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.93, 168.53, 153.54, 135.73, 134.38, 128.49, 128.45, 100.93, 51.61, 24.87 ppm.

HRMS (ESI): m/z calculated for $C_{12}H_{12}ClNO_3$ $[M+Na]^+$: 276.0403, found: 276.0401.

FTIR: 3270, 2952, 1723, 1673, 1624, 1491, 1290, 1177, 813, 529, 474 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(4-bromophenyl)acrylate (3j)

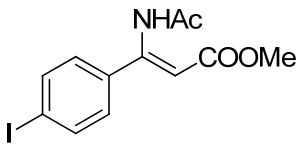



**3j** was obtained as white solid. $^1$H NMR (400 MHz, $CDCl_3$) δ 10.60 (s, 1H), 7.49 (d, *J* = 8.4 Hz, 2H), 7.23 (d, *J* = 8.5 Hz, 2H), 5.26 (s, 1H), 3.77 (s, 3H), 2.17 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.94, 168.55, 153.62, 134.88, 131.43, 128.74, 124.05, 100.95, 51.64, 24.89 ppm.

HRMS (ESI): m/z calculated for $C_{12}H_{12}BrNO_3$ $[M+Na]^+$: 319.9898, found: 319.9898

FTIR: 3286, 2950, 1723, 1681, 1622, 1488, 1288, 1176, 820, 717, 522 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(4-iodophenyl)acrylate (3k)

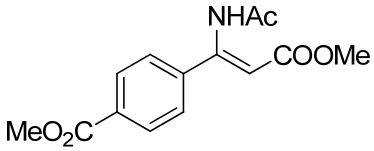


**3k** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.59 (s, 0H), 7.69 (d, *J* = 8.5 Hz, 1H), 7.10 (d, *J* = 8.3 Hz, 1H), 5.26 (s, 0H), 3.76 (d, *J* = 2.2 Hz, 1H), 2.16 (d, *J* = 2.4 Hz, 1H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.94, 168.54, 153.74, 137.36, 135.51, 128.82, 100.96, 95.99, 51.65, 24.88 ppm.

HRMS (ESI): m/z calculated for $C_{12}H_{12}INO_3$ $[M+Na]^+$: 367.9760, found: 367.9758

FTIR: 3435, 3242, 2957, 1727,1673, 1619, 1848, 1288, 1176, 816, 697, 520, 467 $cm^{-1}$

## (Z)-methyl 4-(1-acetamido-3-methoxy-3-oxoprop-1-en-1-yl)benzoate (3l)

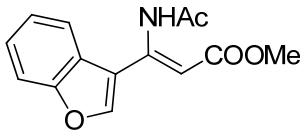



**3l** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.63 (s, 1H), 8.02 (d, *J* = 8.3 Hz, 2H), 7.42 (d, *J* = 8.3 Hz, 2H), 5.30 (s, 1H), 3.91 (s, 3H), 3.77 (s, 3H), 2.17 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.87, 168.46, 166.62, 153.64, 140.49, 131.02, 129.48, 127.16, 101.59, 52.34, 51.69, 24.79 ppm.

HRMS (ESI): m/z calculated for $C_{14}H_{15}NO_5$ $[M+Na]^+$: 300.0848, found: 300.0847.

FTIR: 3326, 2953, 1710, 1680, 1628, 1501, 1432, 1285, 1172, 1109, 855, 776, 709, 566 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(benzofuran-3-yl)acrylate (3m)

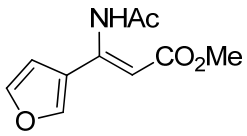



**3m** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.15 (s, 1H), 7.58 (d, *J* = 7.7 Hz, 1H), 7.46 (d, *J* = 8.3 Hz, 1H), 7.33 (t, *J* = 7.5 Hz, 1H), 7.23 (t, *J* = 7.5 Hz, 1H), 7.08 (s, 1H), 5.92 (s, 1H), 3.78 (s, 3H), 2.23 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.75, 168.74, 155.02, 149.67, 142.47, 128.00, 126.10, 123.29, 121.93, 111.46, 109.77, 101.27, 51.64, 24.59 ppm.

HRMS (ESI): m/z calculated for $C_{14}H_{13}NO_4$ $[M+Na]^+$: 282.0742, found: 282.0739.

FTIR: 3293, 3014, 2946, 1711, 1692, 1630, 1556, 1283, 1217, 816, 755, 628, 512 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(furan-3-yl)acrylate (3n)

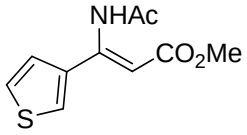



**3n** was obtained as white solid. $^{1}H$ NMR (400 MHz, $CDCl_3$) δ 10.28 (s, 1H), 7.39 (dd, *J* = 5.1, 1.2 Hz, 1H), 7.27 (dd, *J* = 3.6, 1.3 Hz, 1H), 7.02 (dd, *J* = 5.0, 3.7 Hz, 1H), 5.52 (s, 1H), 3.76 (s, 3H), 2.19 (s, 3H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ = 169.03, 168.78, 147.38, 137.74, 128.58, 128.10, 127.38, 100.89, 51.59, 24.90 ppm.

HRMS (ESI): m/z calculated for $C_{10}H_{11}NO_4$ $[M+Na]^+$: 232.0586, found: 232.0583.

FTIR: 3290, 3101, 2949, 1681, 1616, 1510, 1273, 1171, 1042, 827, 710 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-(thiophen-3-yl)acrylate (3o)

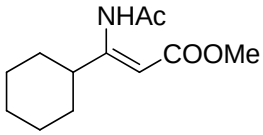



**3o** was obtained as white solid. $^{1}H$ NMR (400 MHz, $CDCl_3$) δ 10.17 (s, 1H), 7.46 (d, *J* = 1.8 Hz, 1H), 6.75 (d, *J* = 3.5 Hz, 1H), 6.46 (dd, *J* = 3.3, 1.8 Hz, 1H), 5.68 (s, 1H), 3.75 (s, 3H), 2.20 (s, 3H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ = 169.22, 168.78, 148.08, 144.23, 142.54, 113.93, 112.02, 98.73, 51.61, 24.77 ppm.

HRMS (ESI): m/z calculated for $C_{10}H_{11}NO_3S$ $[M+Na]^+$: 248.0357, found: 248.0358.

FTIR: 3303, 3143, 2951, 1718, 1629, 1475, 1289, 1199, 822, 748, 592, 504 $cm^{-1}$

## (Z)-methyl 3-acetamido-3-cyclohexylacrylate (3p)

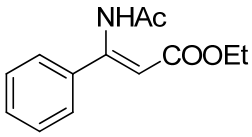


**3p** was obtained as white solid.1H NMR (400 MHz, $CDCl_3$) δ 11.10 (s, 1H), 5.01 (s, 1H), 3.67 (s, 3H), 3.58 – 3.40 (m, 1H), 2.11 (s, 3H), 1.90 –1.86 (m, 2H), 1.80 – 1.65 (m, 3H), 1.40 – 1.31 (m, 2H), 1.21 – 1.02 (m, 3H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ = 170.22, 168.52, 164.68, 92.69, 51.16, 39.41, 32.18, 26.40, 26.30, 25.72 ppm.

HRMS (ESI): m/z calculated for $C_{12}H_{19}NO_3$ $[M+Na]^+$: 248.1263, found: 248.1260.

FTIR: 3429, 2927, 2853, 1717, 1674, 1628, 1493, 1250, 1222, 1165, 814, 670 $cm^{-1}$

## (Z)-ethyl 3-acetamido-3-phenylacrylate (3q)

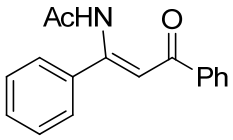



**3q** was obtained as colorless oil. $^1H$ NMR (400 MHz, $CDCl_3$) δ 10.64 (s, 1H), 7.49 – 7.29 (m, 5H), 5.28 (s, 1H), 4.22 (q, *J* = 7.1 Hz, 2H), 2.16 (s, 3H), 1.32 (t, *J* = 7.2 Hz, 3H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ = 168.70, 168.52, 154.59, 136.00, 129.65, 128.13, 127.15, 101.18, 60.39, 24.88, 14.36 ppm.

HRMS (ESI): m/z calculated for $C_{13}H_{15}NO_3$ $[M+Na]^+$: 256.0950, found: 256.0948.

FTIR: 3293, 2979, 1723, 1672, 1622, 1491, 1285, 1179, 1036, 769, 697 $cm^{-1}$

## (Z)-N-(3-oxo-1,3-diphenylprop-1-en-1-yl)acetamide (3r)

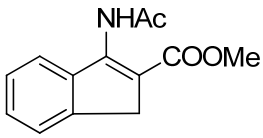



**3r** was obtained as yellow solid. $^1H$ NMR (400 MHz, $CDCl_3$) δ 12.27 (s, 1H), 8.00 – 7.93 (m, 2H), 7.61 – 7.53 (m, 1H), 7.52 – 7.38 (m, 7H), 6.33 (s, 1H), 2.24 (s, 3H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ = 191.79, 169.03, 156.36, 138.71, 136.33, 132.87, 129.93, 128.78, 128.21, 127.93, 127.50, 104.90, 25.21 ppm.

HRMS (ESI): m/z calculated for $C_{17}H_{15}NO_2$ $[M+Na]^+$: 288.1000, found: 288.0009.

FTIR: 3294, 3059, 1718, 1623, 1570, 1442, 1289, 1211, 1043, 759, 694, 525 $cm^{-1}$

## methyl 3-acetamido-1H-indene-2-carboxylate (4a)

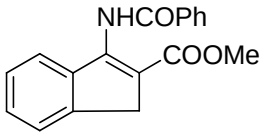



**4a** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.18 (s, 1H), 8.15 – 8.17 (m, 1H), 7.52 – 7.32 (m, 3H), 3.85 (s, 3H), 3.62 (s, 2H), 2.30 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.56, 167.74, 151.38, 143.75, 137.96, 128.79, 126.94, 126.72, 124.10, 112.89, 51.57, 35.51, 24.75 ppm.

HRMS (ESI): m/z calculated for $C_{13}H_{13}NO_3$ $[M+Na]^+$: 254.0793, found: 254.0795.

FTIR: 3288, 2953, 1703, 1674, 1618, 1501, 1379, 1329, 1198, 762, 636, 528 $cm^{-1}$

## methyl 3-benzamido-1H-indene-2-carboxylate (4b)

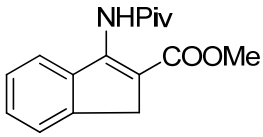



**4b** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 11.20 (s, 1H), 8.48 – 8.25 (m, 1H), 8.22 – 8.01 (m, 2H), 7.65 – 7.34 (m, 6H), 3.86 (s, 3H), 3.67 (s, 2H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.15, 165.13, 151.98, 143.92, 137.87, 133.86, 132.62, 129.03, 128.89, 128.07, 127.23, 126.80, 124.17, 113.29, 51.71, 35.61 ppm.

HRMS (ESI): m/z calculated for $C_{18}H_{15}NO_3$ $[M+Na]^+$: 316.0950, found: 316.0948.

FTIR: 3274, 2947, 1692, 1662, 1613, 1565, 1328, 1271, 1204, 1010, 757, 705, 762 $cm^{-1}$

## methyl 3-pivalamido-1H-indene-2-carboxylate (4c)

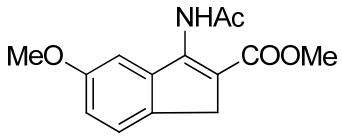



**4c** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.51 (s, 1H), 8.22 – 8.13 (m, 1H), 7.52 – 7.28 (m, 3H), 3.85 (s, 3H), 3.61 (s, 2H), 1.40 (s, 9H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 177.42, 167.86, 151.99, 143.87, 138.06, 128.72, 127.11, 126.65, 124.06, 112.83, 51.59, 40.18, 35.54, 27.77 ppm.

HRMS (ESI): m/z calculated for $C_{16}H_{19}NO_3$ $[M+Na]^+$: 296.1263, found: 296.1254.

FTIR: 3306, 2965, 1702, 1677, 1617, 1491, 1255, 1204, 759, 554 $cm^{-1}$

## methyl 3-acetamido-5-methoxy-1H-indene-2-carboxylate (4d)

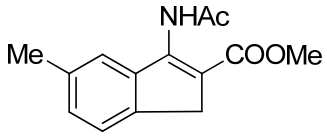



**4d** was obtained as white solid. $^{1}H$ NMR (400 MHz, $CDCl_3$) δ 10.25 (s, 1H), 7.80 (d, *J* = 2.6 Hz, 1H), 7.31 (d, *J* = 8.3 Hz, 1H), 6.97 (d, *J* = 8.2 Hz, 1H), 3.85 (s, 3H), 3.84 (s, 3H), 3.53 (s, 2H), 2.30 (s, 3H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ = 168.60, 167.75, 158.75, 151.41, 139.03, 136.19, 124.56, 116.97, 113.85, 110.75, 55.66, 51.56, 34.75, 24.80 ppm.

HRMS (ESI): m/z calculated for $C_{14}H_{15}NO_4$ $[M+Na]^+$: 284.0899, found: 284.0896

FTIR: 3286, 2957, 1717, 1668, 1594, 1570, 1303, 1258, 1230, 1030, 819, 764, 554 $cm^{-1}$

## methyl 3-acetamido-5-methyl-1H-indene-2-carboxylate(4e)

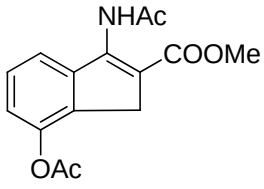



**4e** was obtained as white solid. $^{1}H$ NMR (400 MHz, $CDCl_3$) δ 10.14 (s, 1H), 7.95 (s, 1H), 7.32 (d, *J* = 7.7 Hz, 1H), 7.19 (d, *J* = 7.7 Hz, 1H), 3.83 (s, 3H), 3.55 (s, 2H), 2.41 (s, 3H), 2.30 (s, 3H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ = 168.59, 167.76, 151.36, 140.97, 138.13, 136.38, 129.90, 127.15, 123.78, 113.29, 51.52, 35.11, 24.74 21.74 ppm.

HRMS (ESI): m/z calculated for $C_{14}H_{15}NO_3$ $[M+Na]^+$: 268.0950, found: 268.0946.

FTIR: 3278, 2946, 1688, 1593, 1432, 1304, 1253, 1193, 1084, 813, 682 $cm^{-1}$

## methyl 3-acetamido-7-acetoxy-1H-indene-2-carboxylate (4f)

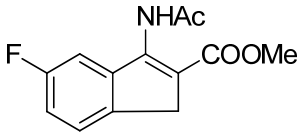


**4f** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.13 (s, 1H), 8.07 (d, *J* = 7.7 Hz, 1H), 7.37 (t, *J* = 8.0 Hz, 1H), 7.12 (d, *J* = 8.0 Hz, 1H), 3.84 (s, 3H), 3.51 (s, 2H), 2.35 (s, 3H), 2.29 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.80, 168.55, 167.44, 150.80, 146.43, 140.11, 135.20, 128.22, 125.09, 121.99, 113.04, 51.66, 32.87, 24.73, 21.02 ppm.

HRMS (ESI): m/z calculated for $C_{15}H_{15}NO_5$ $[M+Na]^+$: 312.0848, found: 312.0845.

FTIR: 3288, 2954, 1766, 1701, 1673, 1504, 1385, 1210, 953, 750, 672, 551 $cm^{-1}$

## methyl 3-acetamido-5-fluoro-1H-indene-2-carboxylate(4g)

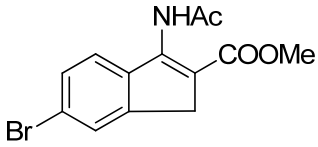



**4g** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.17 (s, 1H), 7.92 (dd, *J* = 10.1, 2.5 Hz, 1H), 7.34 (dd, *J* = 8.3, 5.1 Hz, 1H), 7.07 (td, *J* = 8.6, 2.5 Hz, 1H), 3.84 (s, 3H), 3.55 (s, 2H), 2.29 (s, 3H). $^{13}$C NMR (101 MHz, $CDCl_3$) δ = 168.58, 167.47, 161.85 (*J* = 241), 150.58 (*J* = 3), 139.55 (*J* = 10), 139.06 (*J* = 2), 124.85 (*J* = 8), 116.05 (*J* = 23), 114.55, 114.03 (*J* = 25), 51.68, 34.88, 24.68ppm.

HRMS (ESI): m/z calculated for $C_{13}H_{12}FNO_3$ $[M+Na]^+$: 272.0699, found: 272.0696

FTIR: 3219, 2955, 1713, 1663, 1575, 1431, 1298, 1207, 823, 771, 549 $cm^{-1}$

## methyl 3-acetamido-6-bromo-1H-indene-2-carboxylate (4h)

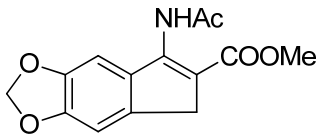



**4h** was obtained as white solid.$^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.20 (s, 1H), 8.06 (d, *J* = 8.5 Hz, 1H), 7.58 (s, 1H), 7.48 (d, *J* = 8.6, 1H), 3.85 (s, 3H), 3.59 (s, 2H), 2.29 (s, 3H).$^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.62, 167.50, 150.64, 145.57, 136.89, 130.01, 128.40, 127.34, 123.53, 112.82, 51.70, 35.38, 24.75 ppm.

HRMS (ESI): m/z calculated for $C_{13}H_{12}BrNO_3$ $[M+Na]^+$: 331.9898, found: 331.9895.

FTIR: 3284, 2958, 1685, 1681, 1613, 1326, 1247, 1201, 854, 649 $cm^{-1}$

## methyl 7-acetamido-5H-indeno[5,6-d][1,3]dioxole-6-carboxylate (4i)

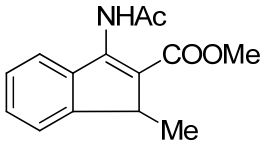



**4i** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.20 (s, 1H), 7.67 (s, 1H), 6.89 (s, 1H), 6.00 (s, 2H), 3.82 (s, 3H), 3.52 (s, 2H), 2.28 (s, 3H). $^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.63, 167.41, 151.54, 149.37, 147.01, 139.63, 131.60, 111.71, 107.13, 104.65, 101.64, 51.41, 35.34, 24.76 ppm.

HRMS (ESI): m/z calculated for $C_{14}H_{13}NO_5$ $[M+Na]^+$: 298.0691, found: 298.0695

FTIR: 3289, 2950, 1688, 1671, 1587, 1469, 1385, 1231, 1035, 933, 669 $cm^{-1}$

## methyl 3-acetamido-1-methyl-1H-indene-2-carboxylate (4j)

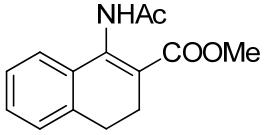



**4j** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.26 (s, 1H), 8.19 – 8.04 (m, 1H), 7.46 – 7.29 (m, 3H), 3.86 (s, 3H), 3.69 (q, *J* = 7.3 Hz, 1H), 2.29 (s, 3H), 1.41 (d, *J* = 7.3 Hz, 3H).$^{13}$C NMR (100 MHz, $CDCl_3$) δ = 168.62, 167.86, 151.03, 150.18, 136.38, 129.06, 126.99, 126.79, 123.00, 118.34, 51.47, 41.47, 24.78, 17.33 ppm.

HRMS (ESI): m/z calculated for $C_{14}H_{15}NO_3$ $[M+Na]^+$: 268.0950, found: 268.0947

FTIR: 3302, 2950, 1715, 1664, 1614, 1568, 1385, 1254, 1196, 1091, 756, 536 $cm^{-1}$

## methyl 1-acetamido-3,4-dihydronaphthalene-2-carboxylate (4k)



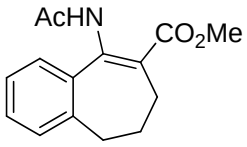

**4k** was obtained as white solid. $^{1}$H NMR (400 MHz, $CDCl_3$) δ 10.14 (s, 1H), 7.33 (dd, *J* = 7.6, 1.5 Hz, 1H), 7.27 – 7.13 (m, 3H), 3.80 (s, 3H), 2.77 (t, *J* = 7.6 Hz, 2H), 2.57 (t, *J* = 7.6 Hz, 2H), 2.22 (s, 3H).$^{13}$C NMR (100 MHz, $CDCl_3$) δ = 169.64, 169.12,

145.71, 137.87, 130.22, 129.73, 127.41, 127.01, 126.00, 113.71, 52.02, 27.72, 24.65, 22.38 ppm.

HRMS (ESI): m/z calculated for $C_{14}H_{15}NO_3$ $[M+Na]^+$: 268.0950, found: 268.0942

FTIR: 3259, 2945, 2835, 1696, 1664, 1527, 1313, 1122, 997, 766, 729, 575 $cm^{-1}$

## methyl 9-acetamido-6,7-dihydro-5H-benzo[7]annulene-8-carboxylate (4l)




**4l** was obtained as white solid. $^1H$ NMR (400 MHz, $CDCl_3$) δ 10.61 (s, 1H), 7.31 – 7.19 (m, 4H), 3.80 (s, 3H), 2.66 (t, *J* = 6.6 Hz, 2H), 2.21 – 1.98 (m, 7H). $^{13}C$ NMR (100 MHz, $CDCl_3$) δ = 169.94, 168.76, 148.81, 140.53, 135.96, 129.18, 128.85, 127.45, 125.83, 110.51, 51.90, 34.65, 31.42, 24.77, 23.92 ppm.

HRMS (ESI): m/z calculated for $C_{15}H_{17}NO_3$ $[M+Na]^+$: 282.1106, found: 282.1102

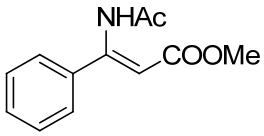
FTIR: 3252, 3016, 2935, 1708, 1669, 1620, 1530, 1427, 1324, 1199, 767, 561$cm^{-1}$

## 4. References

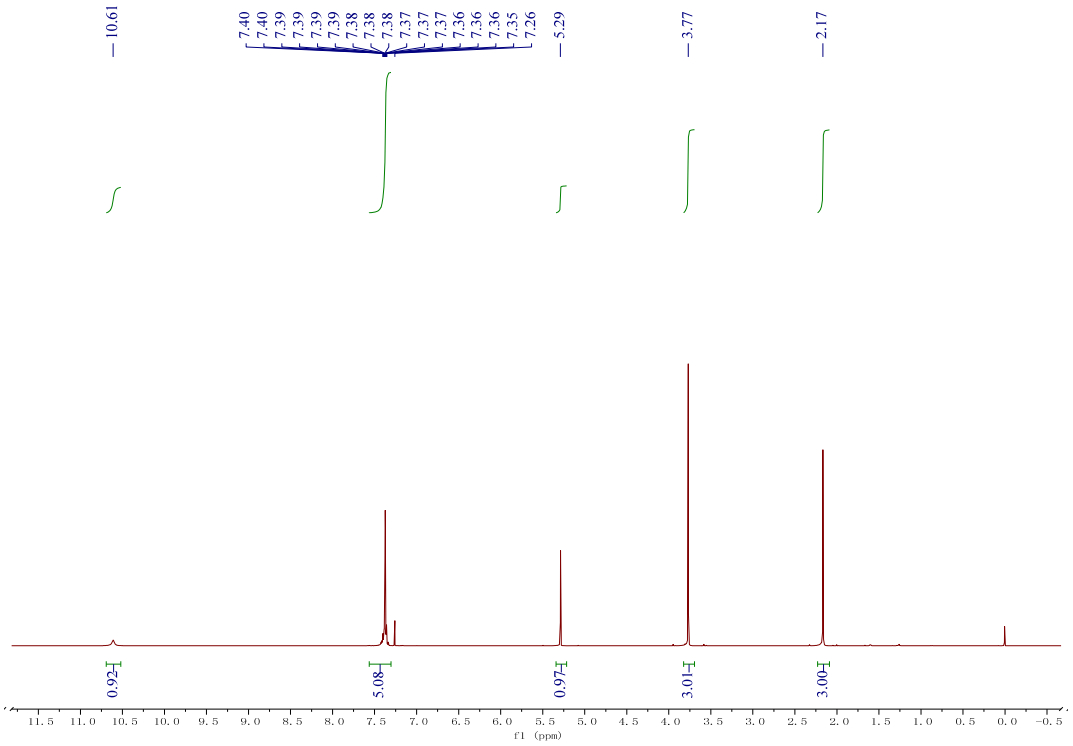
[1] Taniguchi, T.; Sugiura, Y.; Zaimoku, H.; Ishibashi, H. *Angew.Chem., Int. Ed.* 2010 , 49 , 10154.

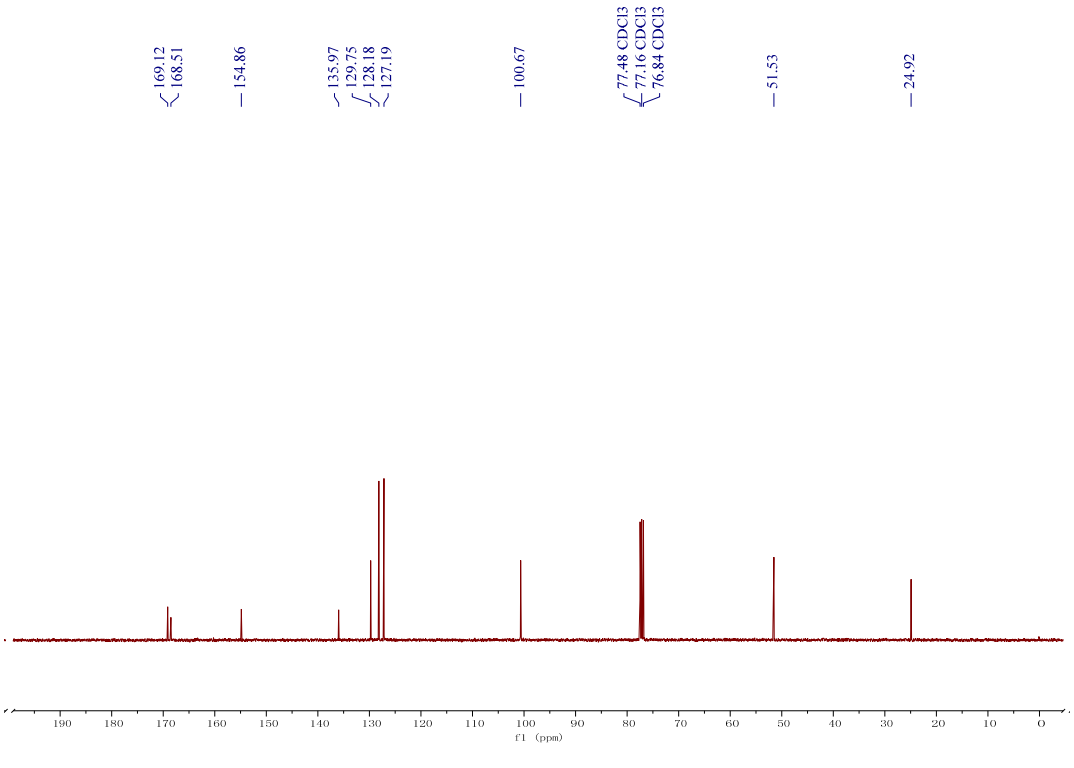
[2] Ch Chen.; E Zhan.; Y Li.;W Shen. *J. Mole .Cat A:Chemical*.2013, 379,117.

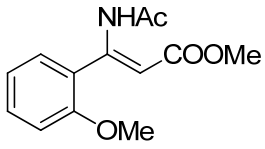
# 6. NMR spectra for the products



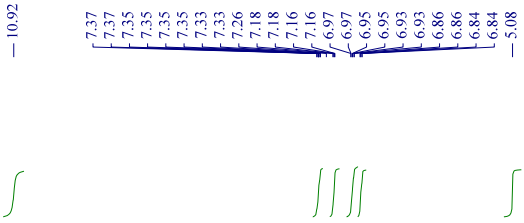

3a




NHAc
COOMe
OMe

3b


10.92
7.37
7.37
7.35
7.35
7.35
7.33
7.33
7.26
7.18
7.18
7.16
7.16
6.97
6.97
6.95
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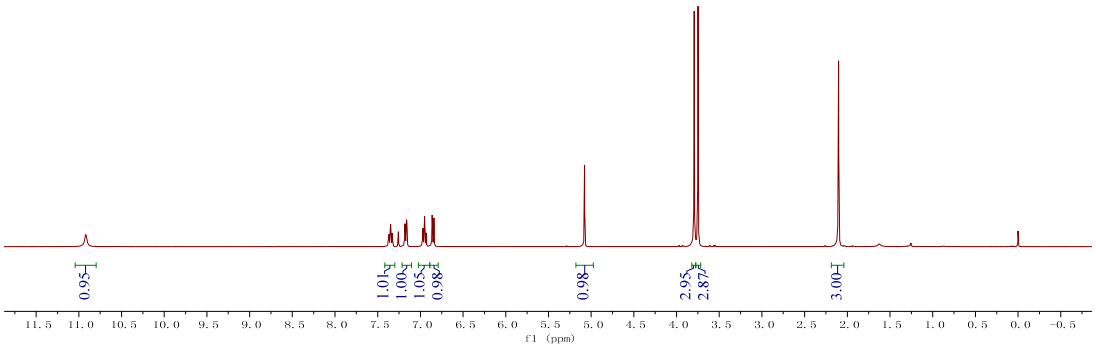
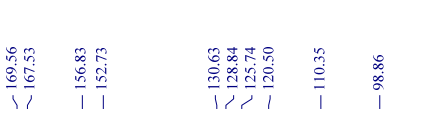
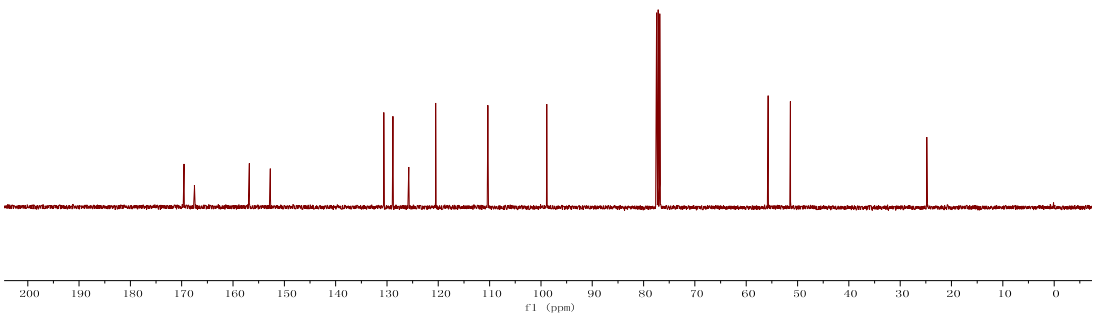
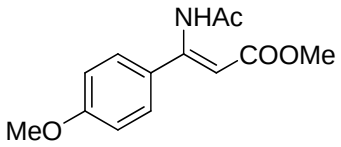
6.86
6.86
6.84
6.84
5.08
3.79
3.75
2.10

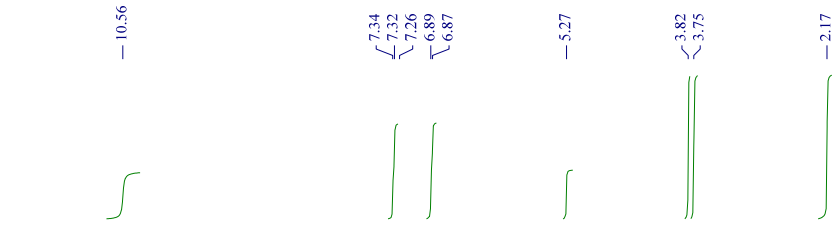

0.95
1.01
1.00
1.05
0.98
0.98
2.95
2.87
3.00
f1 (ppm)


169.56
167.53
156.83
152.73
130.63
128.84
125.74
120.50
110.35
98.86
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
55.74
51.39
24.81


f1 (ppm)


NHAc
COOMe
MeO

3c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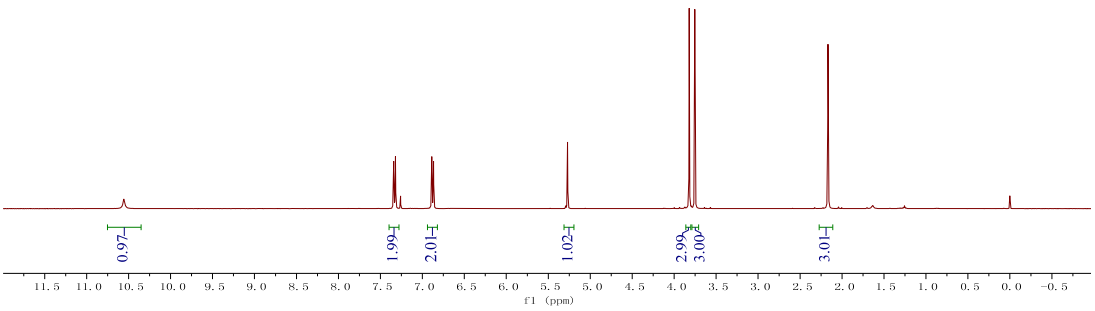
7.26
6.89
6.87
5.27
3.82
3.75
2.17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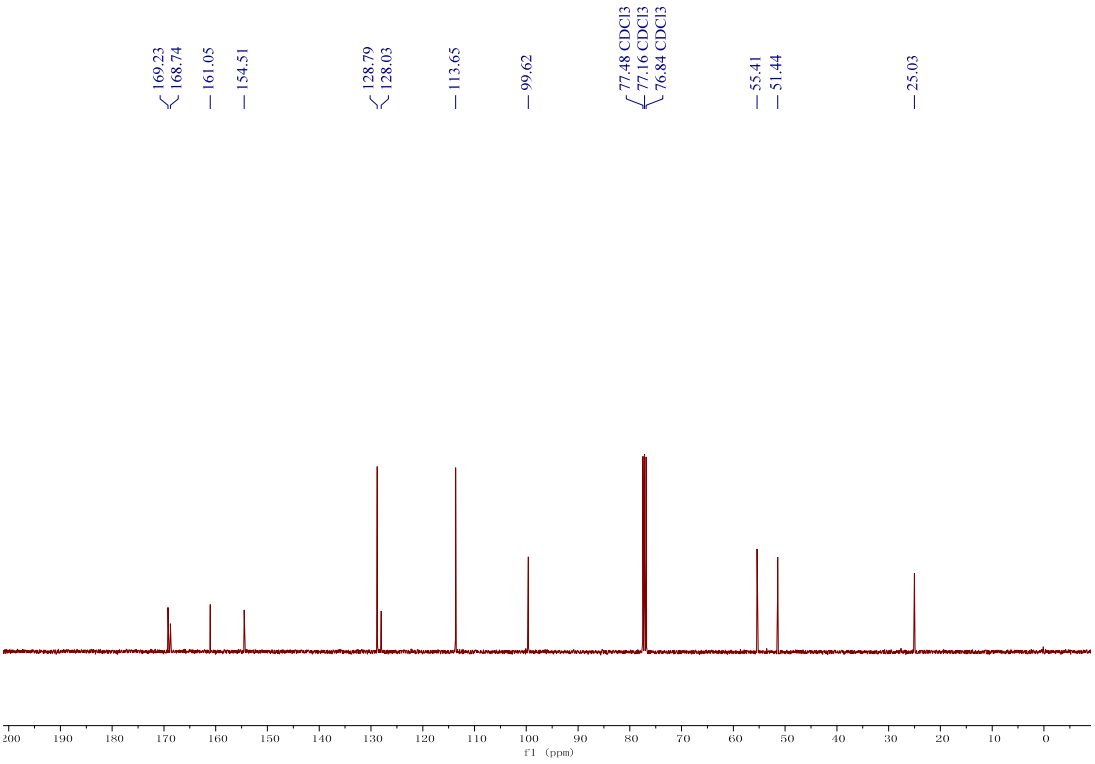
1.02
2.99
3.00
3.01
f1 (ppm)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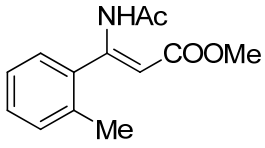
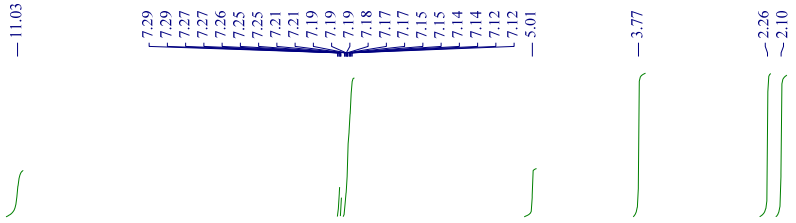
168.74
161.05
154.51
128.79
128.03
113.65
99.62
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
55.41
51.44
25.03
f1 (ppm)


NHAc
COOMe
Me

3d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7.27
7.26
7.25
7.25
7.21
7.21
7.19
7.19
7.19
7.18
7.17
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7.15
7.15
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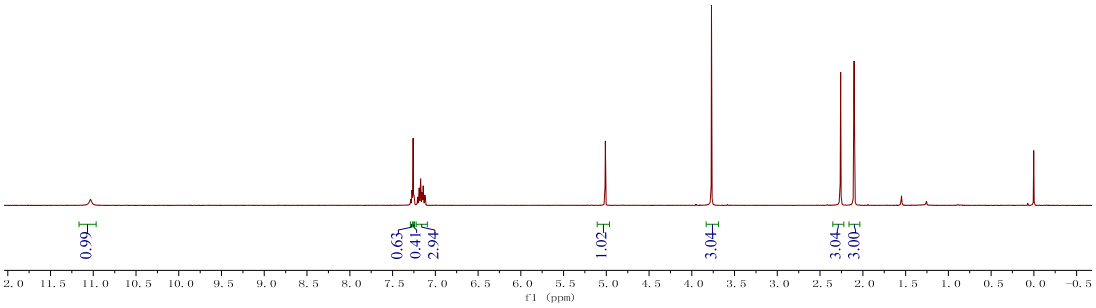
7.14
7.12
7.12
5.01
3.77
2.26
2.10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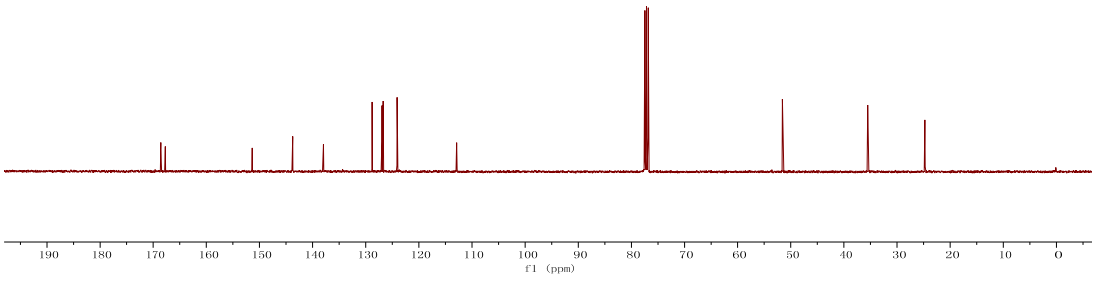
0.63
0.41
2.94
1.02
3.04
3.04
3.00
f1 (ppm)


168.56
143.75
137.96
128.79
126.94
126.72
124.10
112.89
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.57
35.51
24.75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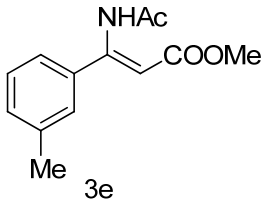
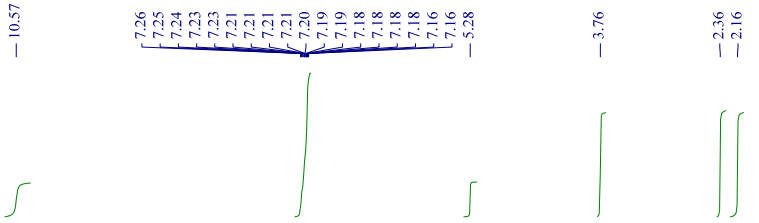

NHAc
COOMe
Me

3e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7.24
7.23
7.23
7.21
7.21
7.21
7.21
7.20
7.19
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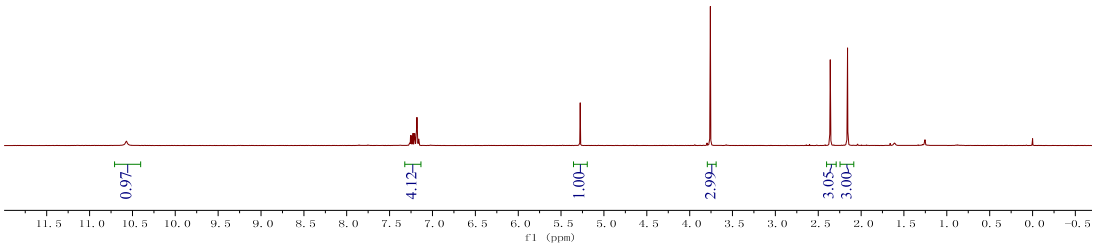
7.16
7.16
5.28
3.76
2.36
2.16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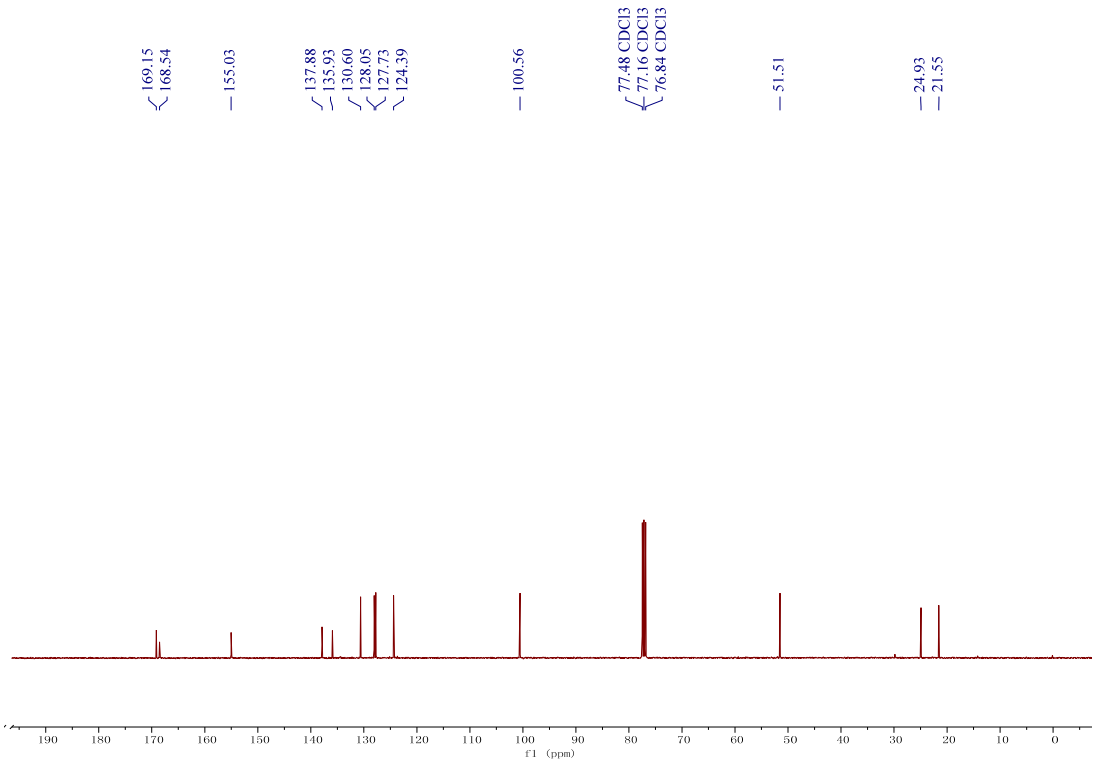
3.00
f1 (ppm)


169.15
168.54
155.03
137.88
135.93
130.60
128.05
127.73
124.39
100.56
77.48 CDCl3
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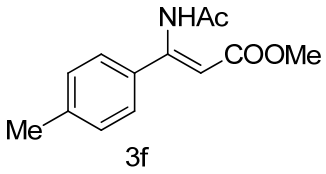
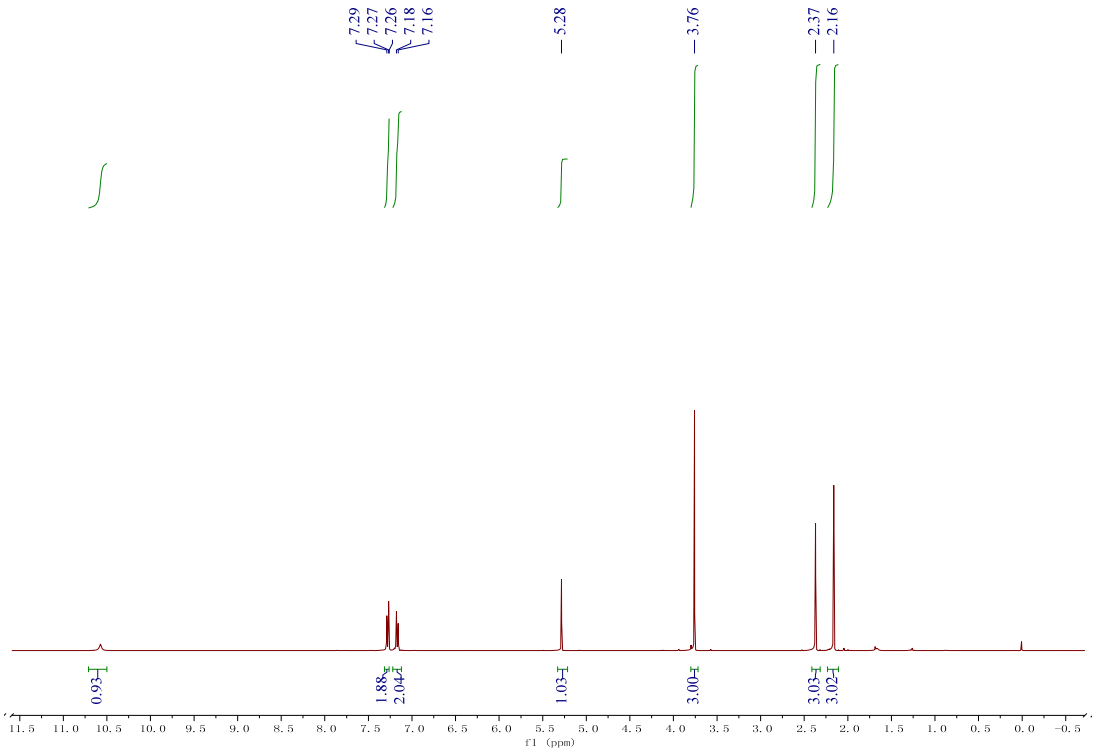
76.84 CDCl3
51.51
24.93
21.55
f1 (ppm)


NHAc
COOMe
Me

3f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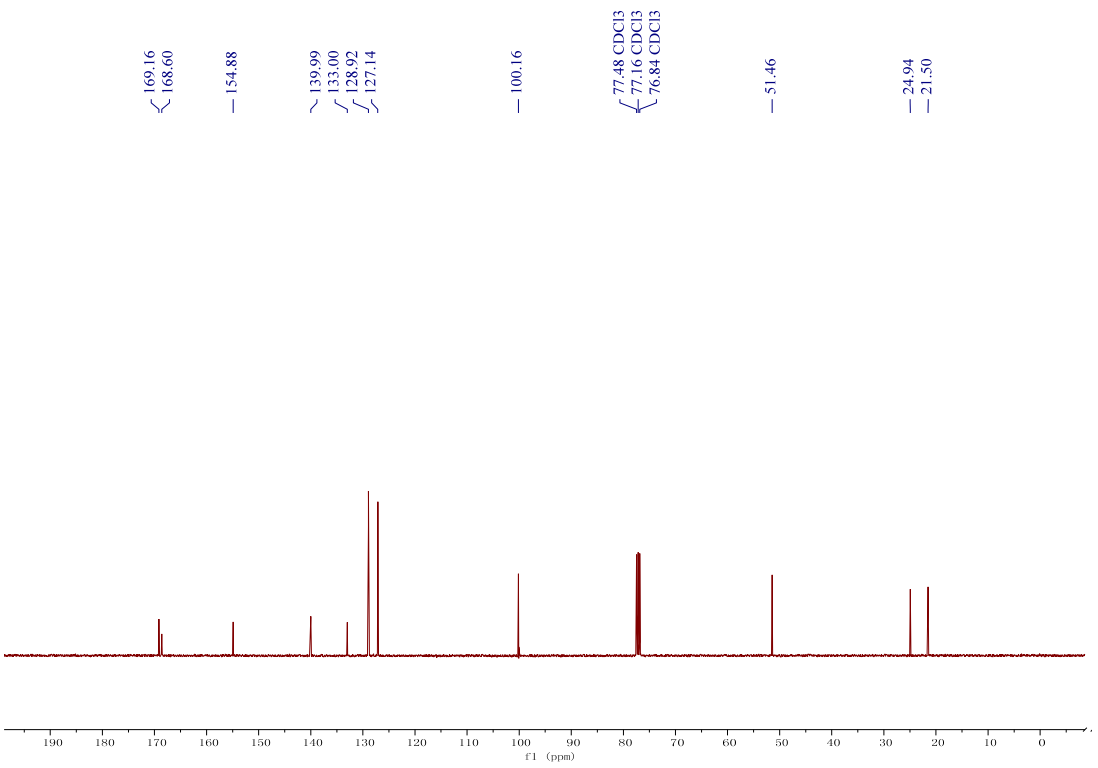
7.27
7.26
7.18
7.16
5.28
3.76
2.37
2.16
0.93
1.88
2.04
1.03
3.00
3.03
3.02
f1 (ppm)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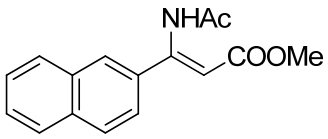
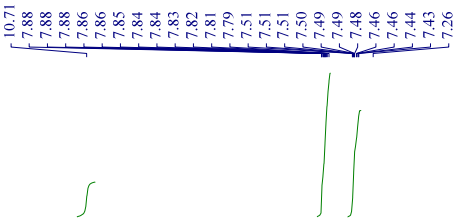
168.60
154.88
139.99
133.00
128.92
127.14
100.16
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.46
24.94
21.50
f1 (ppm)


NHAc
COOMe

3g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7.86
7.86
7.85
7.84
7.84
7.83
7.82
7.81
7.79
7.51
7.51
7.51
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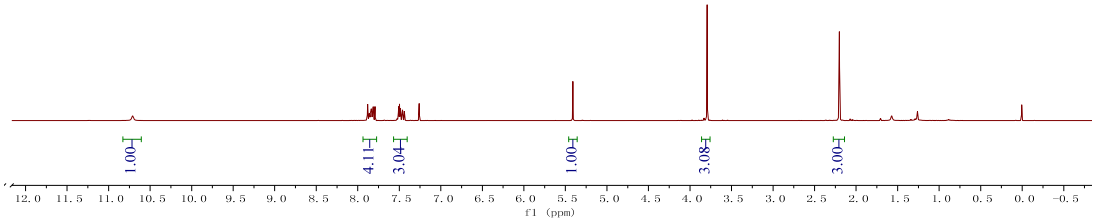
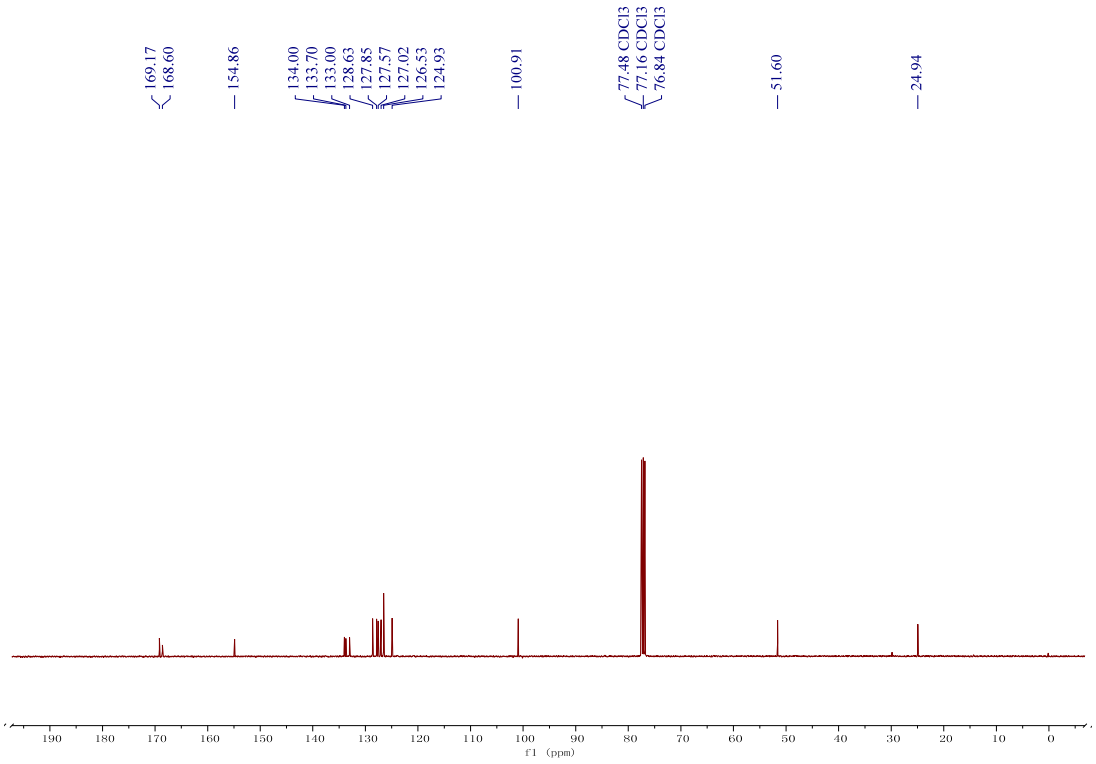
7.44
7.43
7.26
5.41
3.79
2.20


1.00
4.11
3.04
1.00
3.08
3.00
f1 (ppm)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168.60
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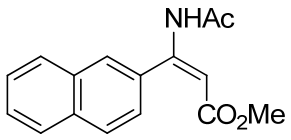
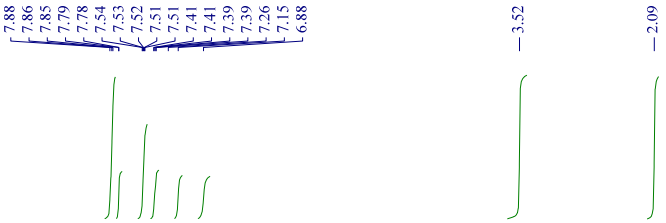
134.00
133.70
133.00
128.63
127.85
127.57
127.02
126.53
124.93
100.91
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.60
24.94
f1 (ppm)


NHAc
CO2Me

**3g'**


7.88
7.86
7.85
7.79
7.78
7.54
7.53
7.52
7.51
7.51
7.41
7.41
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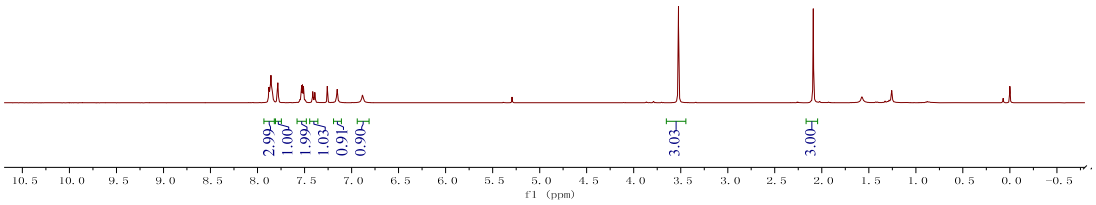
7.39
7.26
7.15
6.88
3.52
2.09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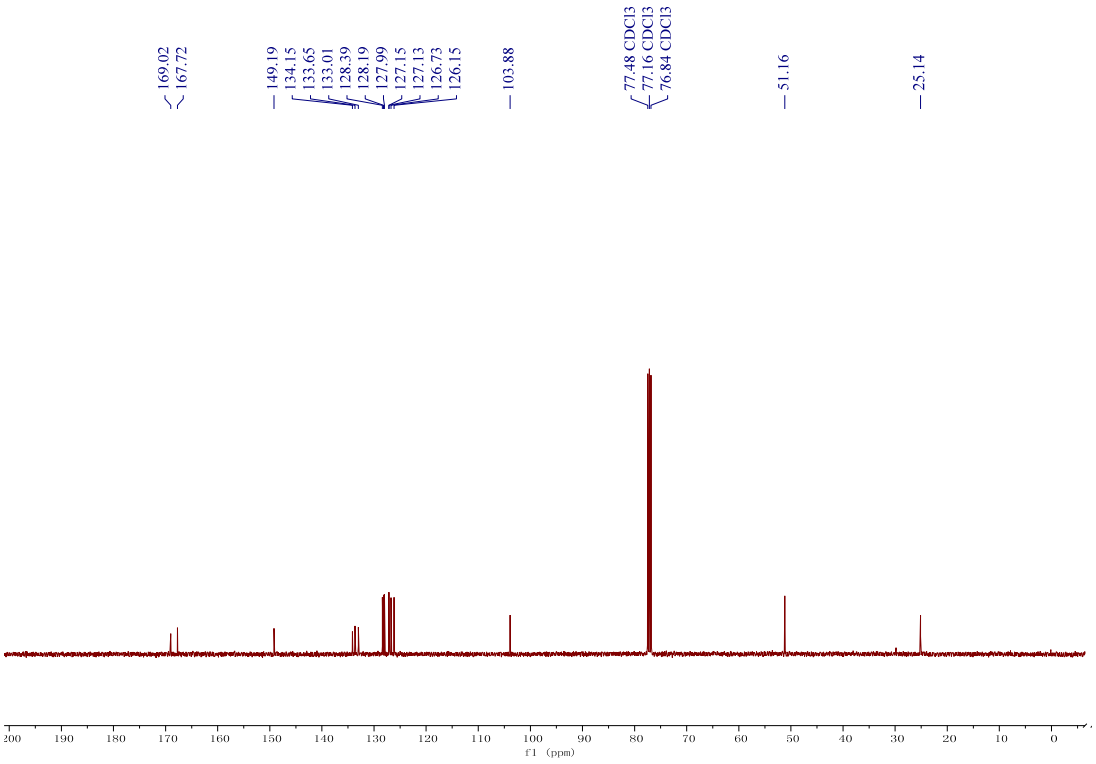
1.00
1.99
1.03
0.91
0.90
3.03
3.00
f1 (ppm)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167.72
149.19
134.15
133.65
133.01
128.39
128.19
127.99
127.15
127.13
126.73
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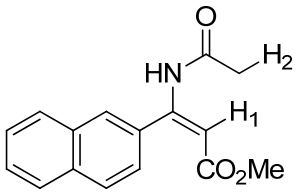
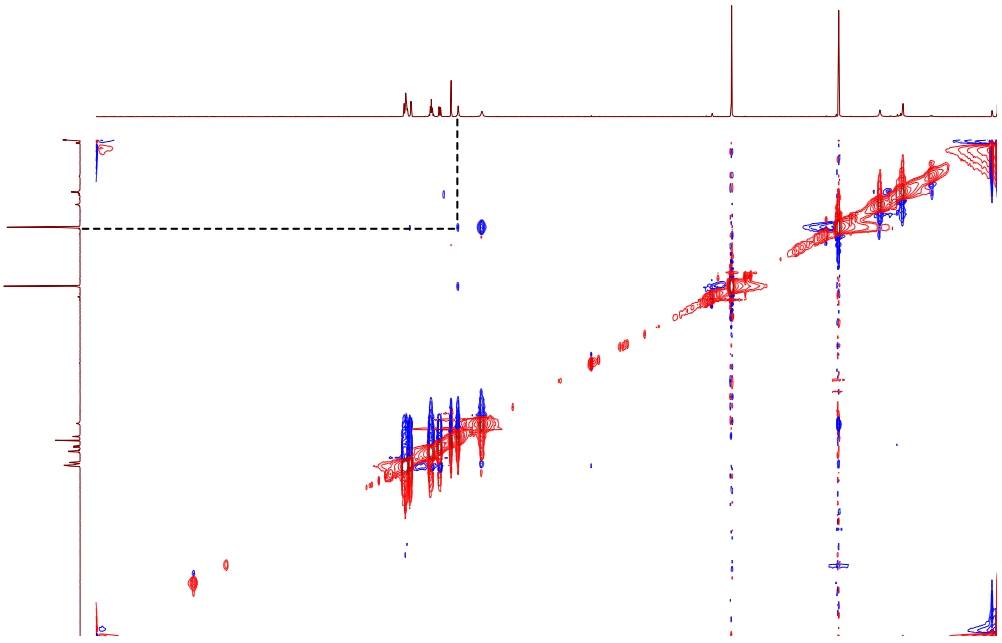
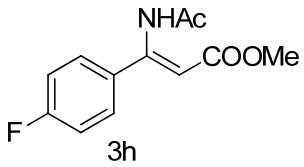
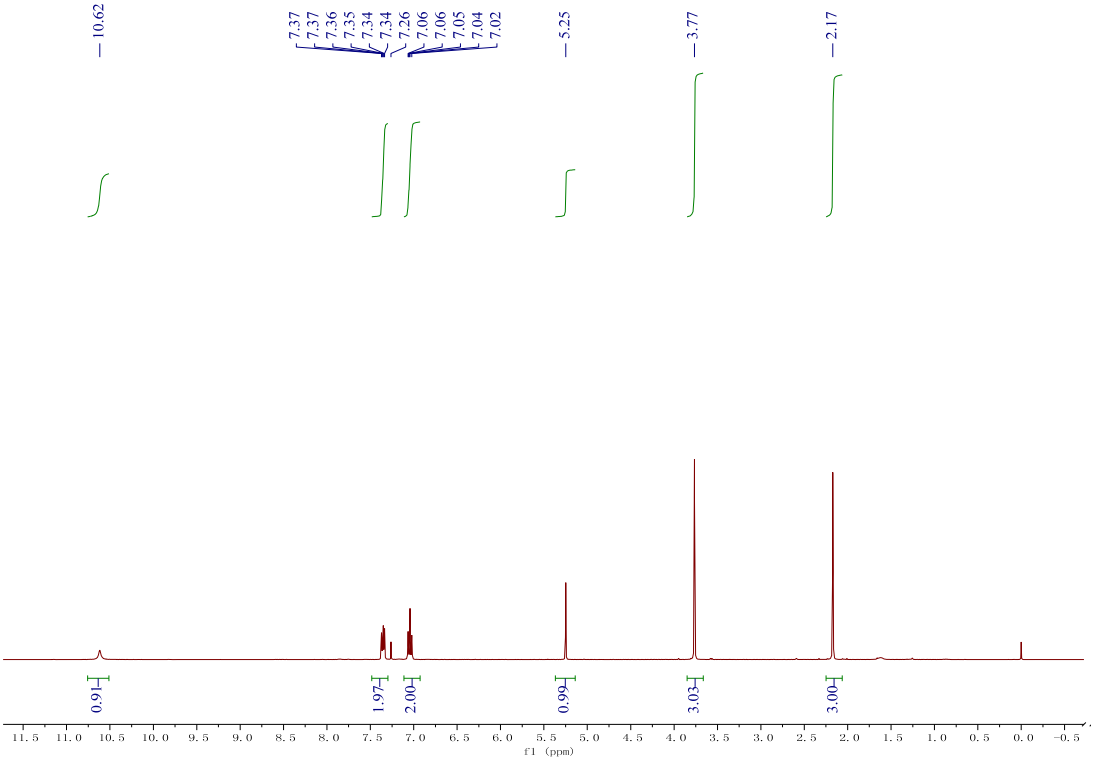
76.84 CDCl3
51.16
25.14
f1 (ppm)


O
HN
H2
H1
CO2Me




NHAc
COOMe
F

3h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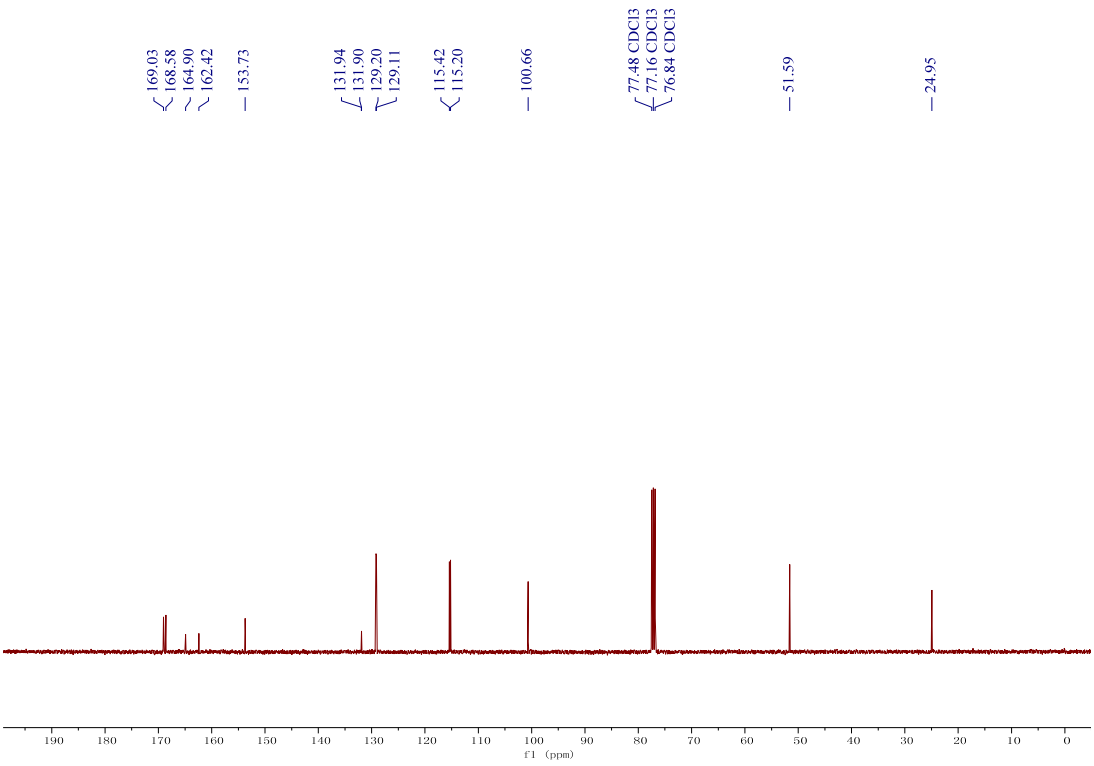
7.35
7.34
7.34
7.26
7.06
7.06
7.05
7.04
7.02
5.25
3.77
2.17
0.91
1.97
2.00
0.99
3.03
3.00
f1 (ppm)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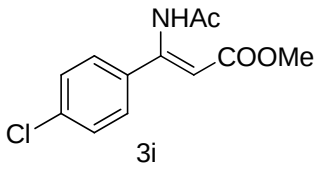
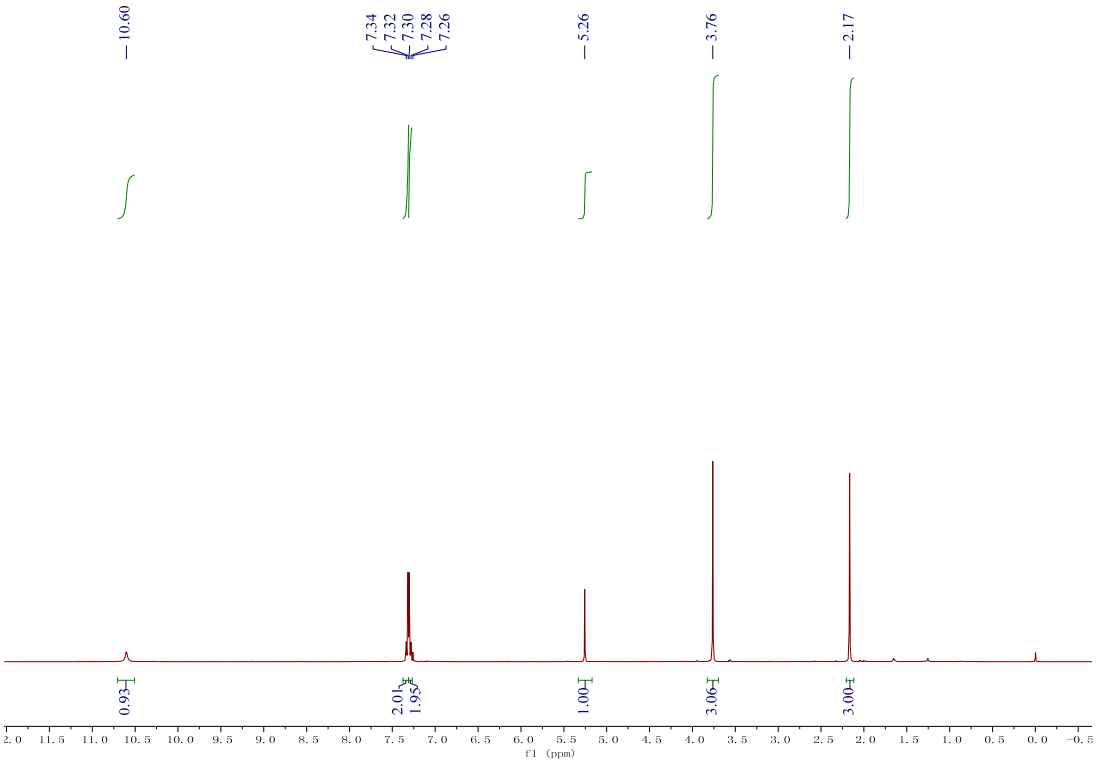
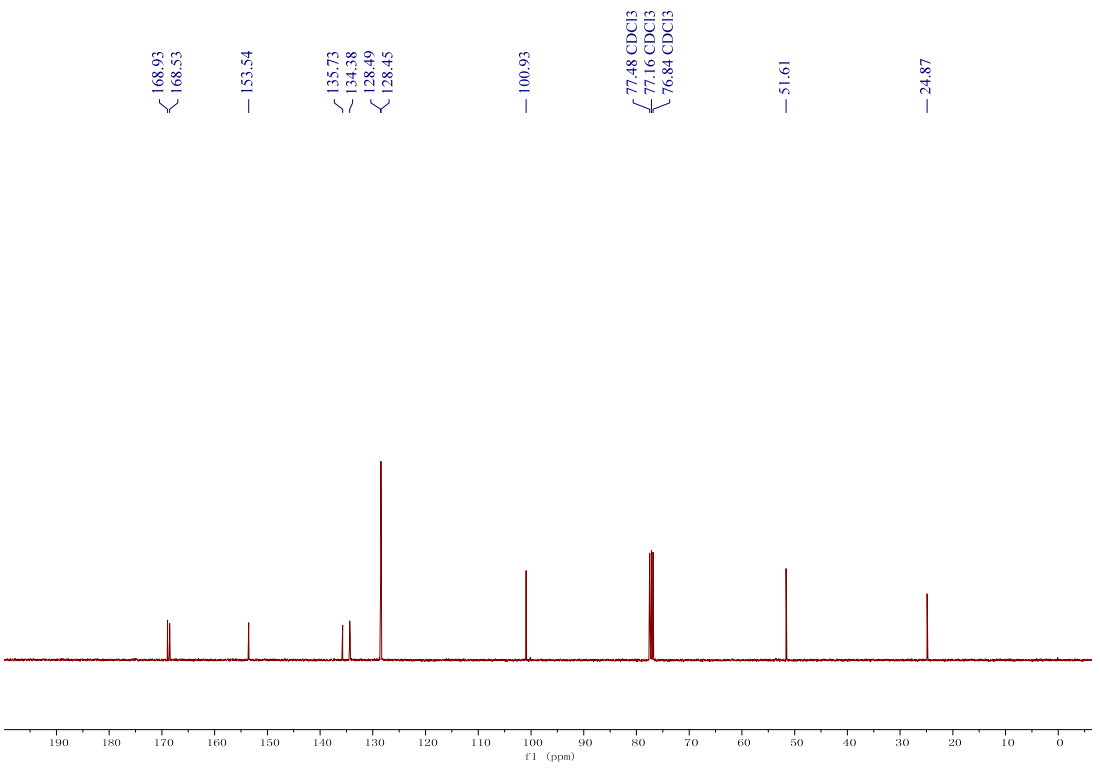
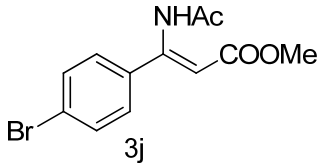
164.90
162.42
153.73
131.94
131.90
129.20
129.11
115.42
115.20
100.66
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.59
24.95
f1 (ppm)


NHAc
COOMe
Cl

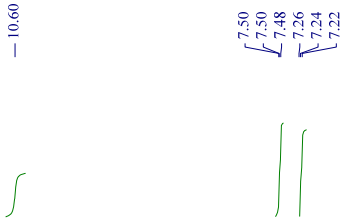
3i


10.60
7.34
7.32
7.30
7.28
7.26
5.26
3.76
2.17
0.93
2.01
1.95
1.00
3.06
3.00
f1 (ppm)


168.93
168.53
153.54
135.73
134.38
128.49
128.45
100.93
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.61
24.87
f1 (ppm)


NHAc
COOMe
Br

3j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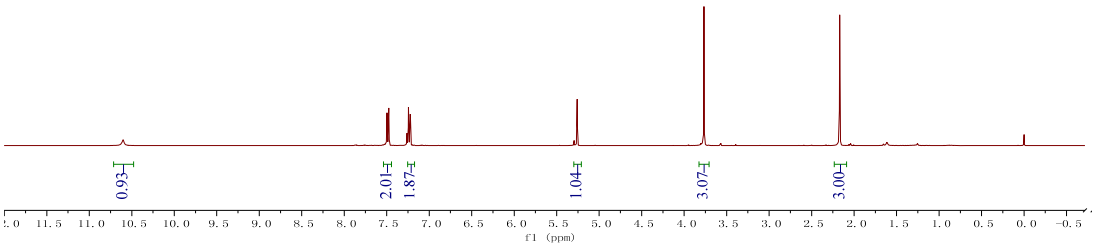
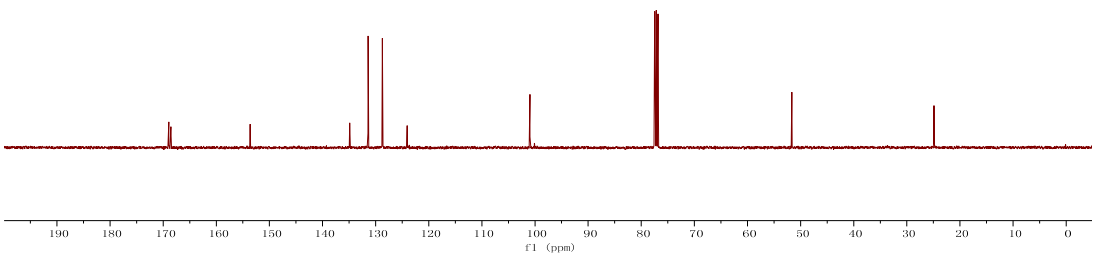
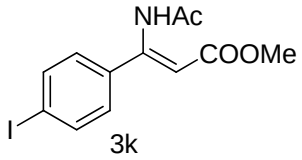
7.50
7.48
7.26
7.24
7.22
5.26
3.77
2.17

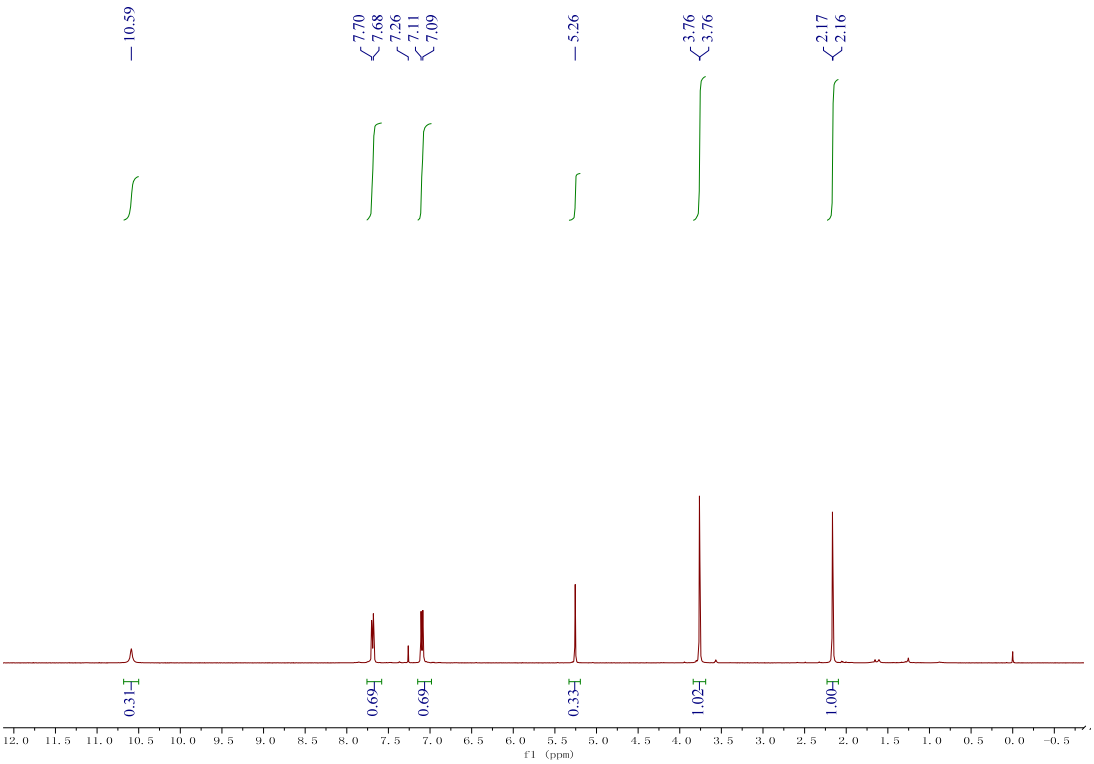

0.93
2.01
1.87
1.04
3.07
3.00
f1 (ppm)

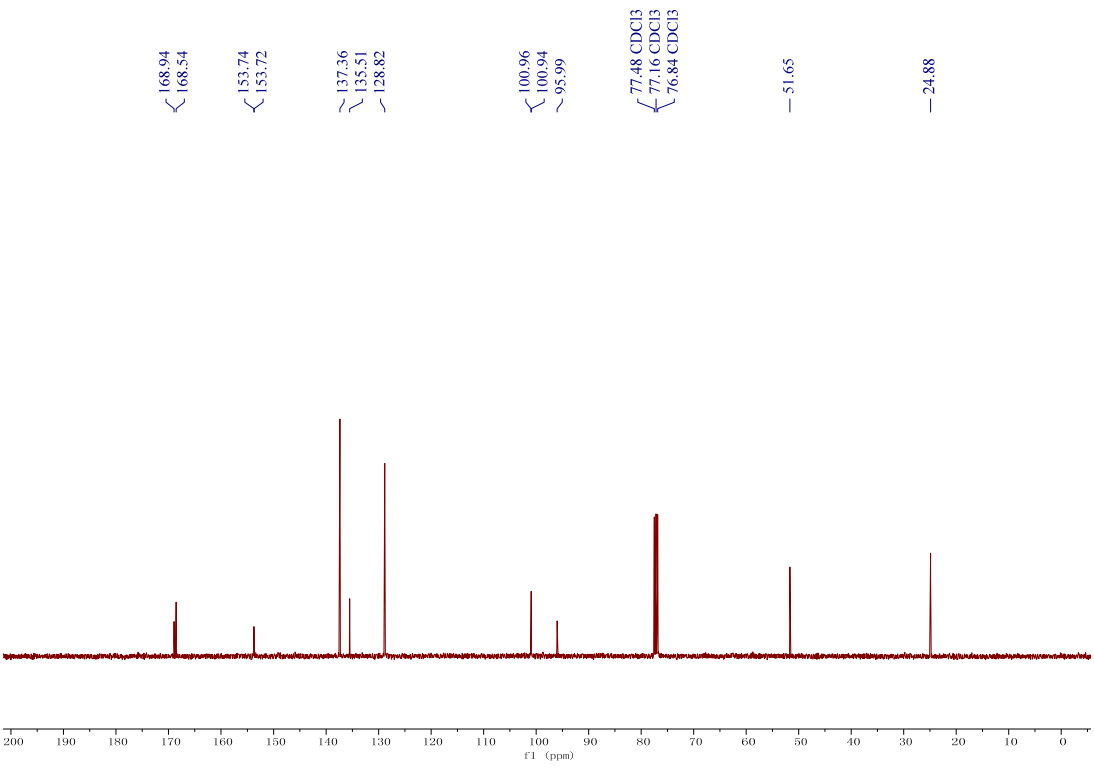

168.94
168.55
153.62
134.88
131.43
128.74
124.05
100.95
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.64
24.89

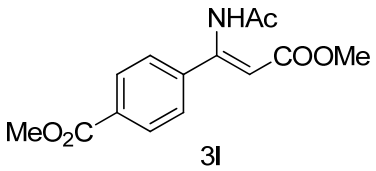

f1 (ppm)


NHAc
COOMe
I

3k


10.59
7.70
7.68
7.26
7.11
7.09
5.26
3.76
3.76
2.17
2.16
0.31
0.69
0.69
0.33
1.02
1.00
f1 (ppm)


168.94
168.54
153.74
153.72
137.36
135.51
128.82
100.96
100.94
95.99
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.65
24.88
f1 (ppm)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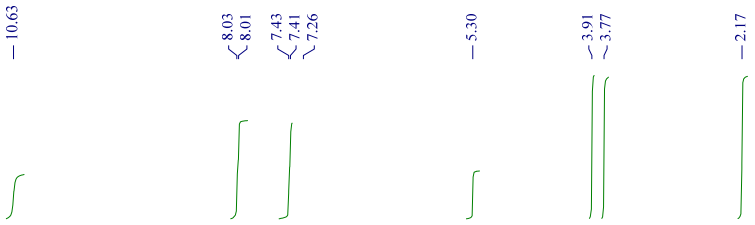
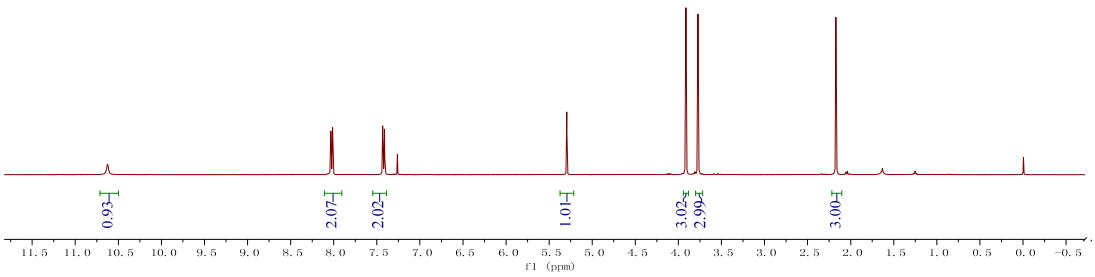
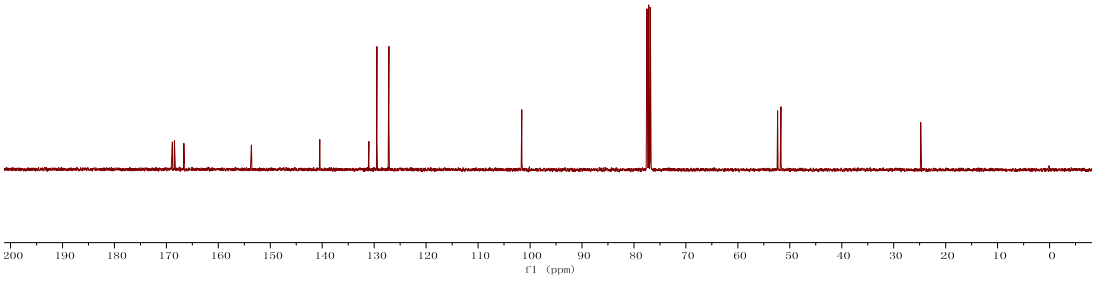
COOMe
MeO2C

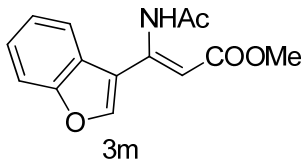
3l


10.63
8.03
8.01
7.43
7.41
7.26
5.30
3.91
3.77
2.17

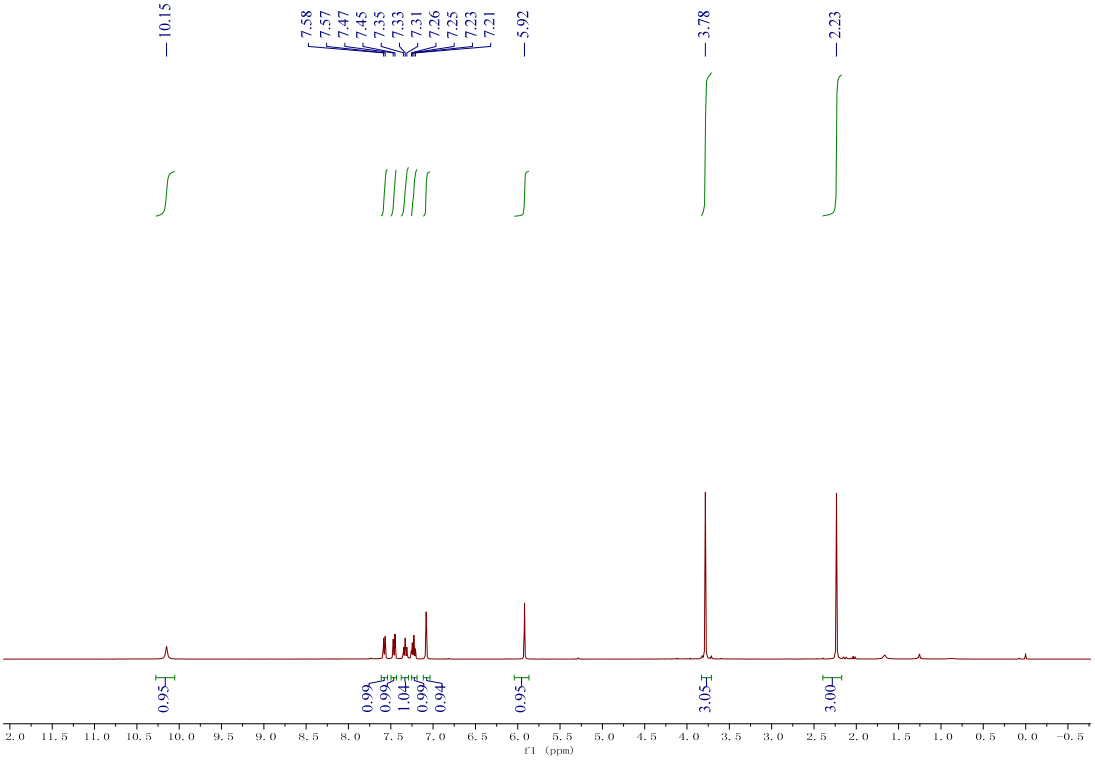

0.93
2.07
2.02
1.01
3.02
2.99
3.00
f1 (ppm)

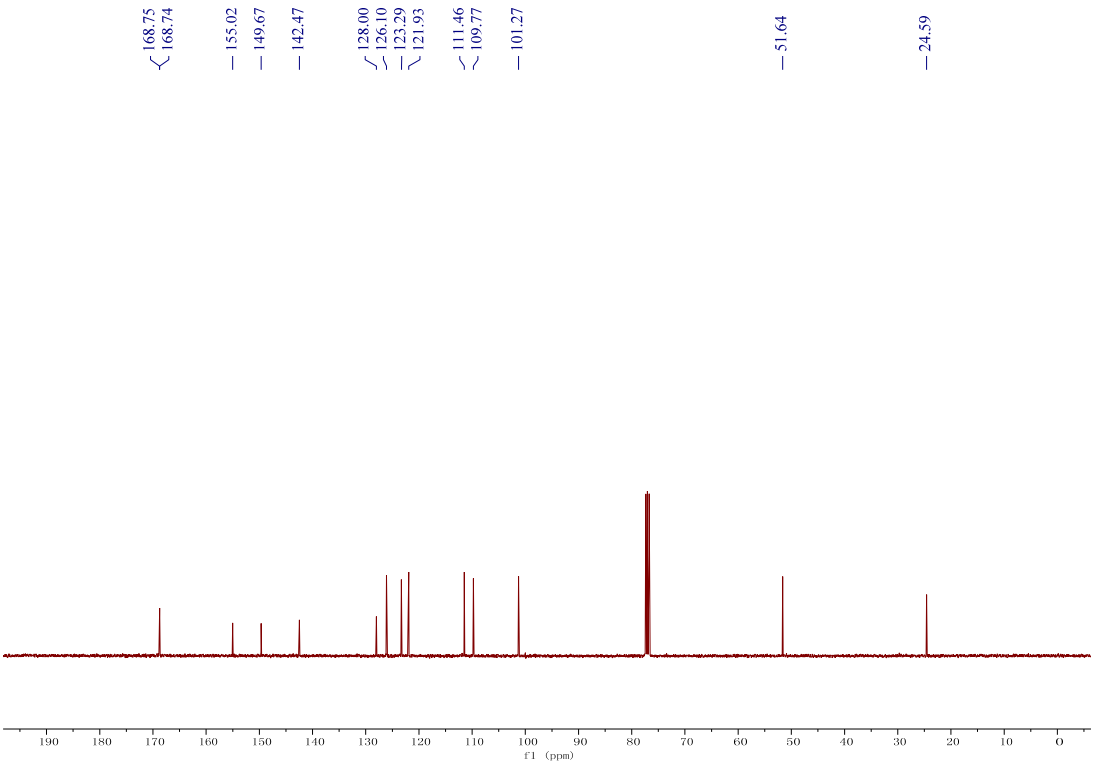

168.87
168.46
166.62
153.64
140.49
131.02
129.48
127.16
101.59
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
52.34
51.69
24.79

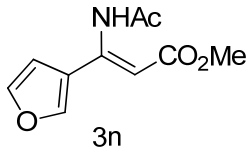

f1 (ppm)


NHAc
COOMe
O

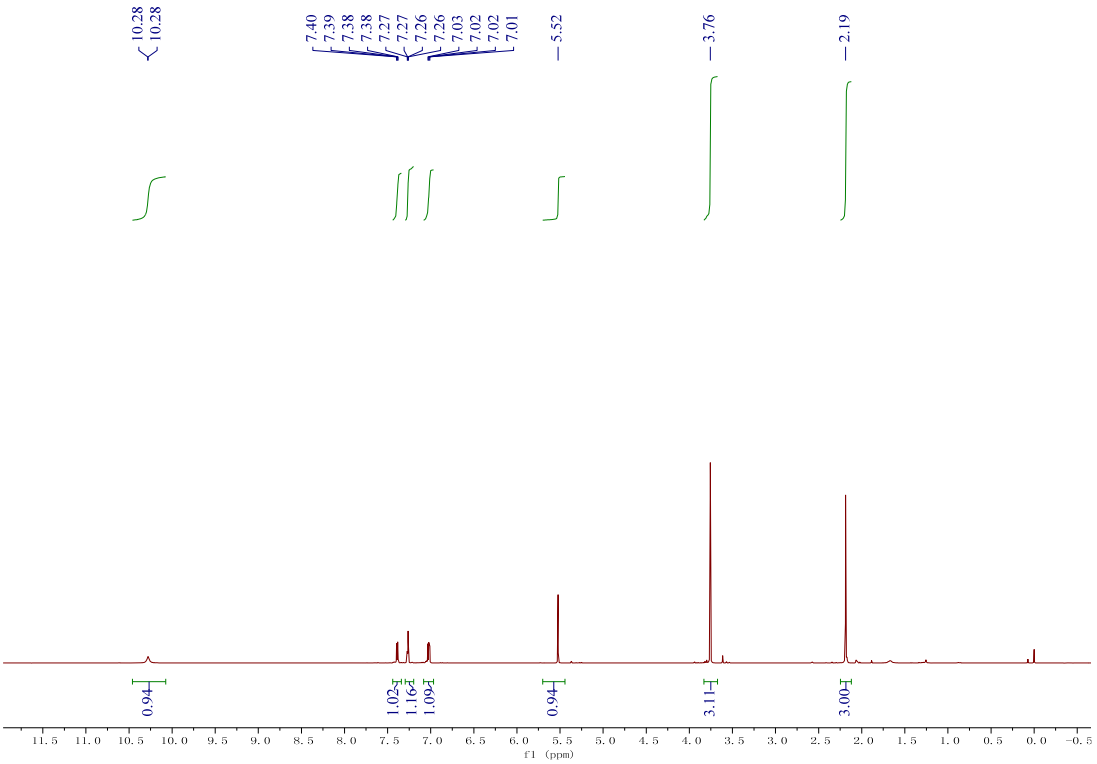
3m

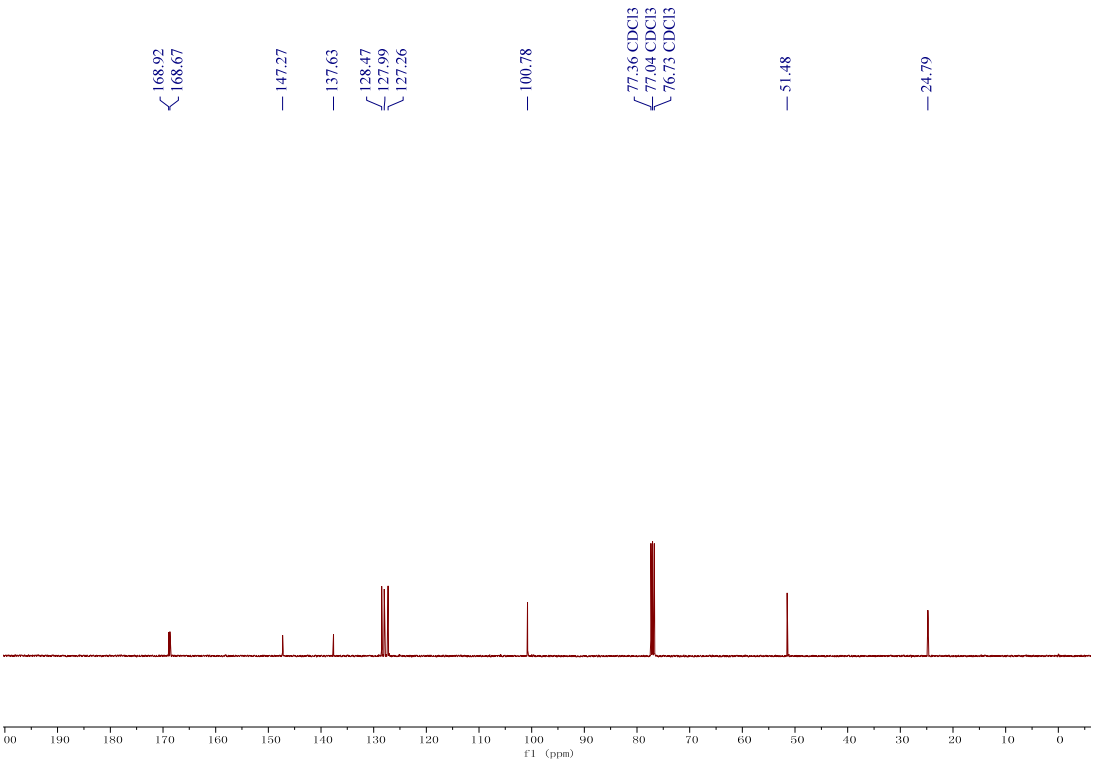

10.15
7.58
7.57
7.47
7.45
7.35
7.33
7.31
7.26
7.25
7.23
7.21
5.92
3.78
2.23
0.95
0.99
0.99
1.04
0.99
0.94
0.95
3.05
3.00
f1 (ppm)

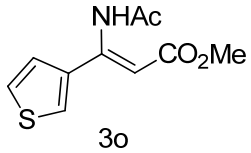

168.75
168.74
155.02
149.67
142.47
128.00
126.10
123.29
121.93
111.46
109.77
101.27
51.64
24.59
f1 (ppm)


NHAc
CO2Me
O

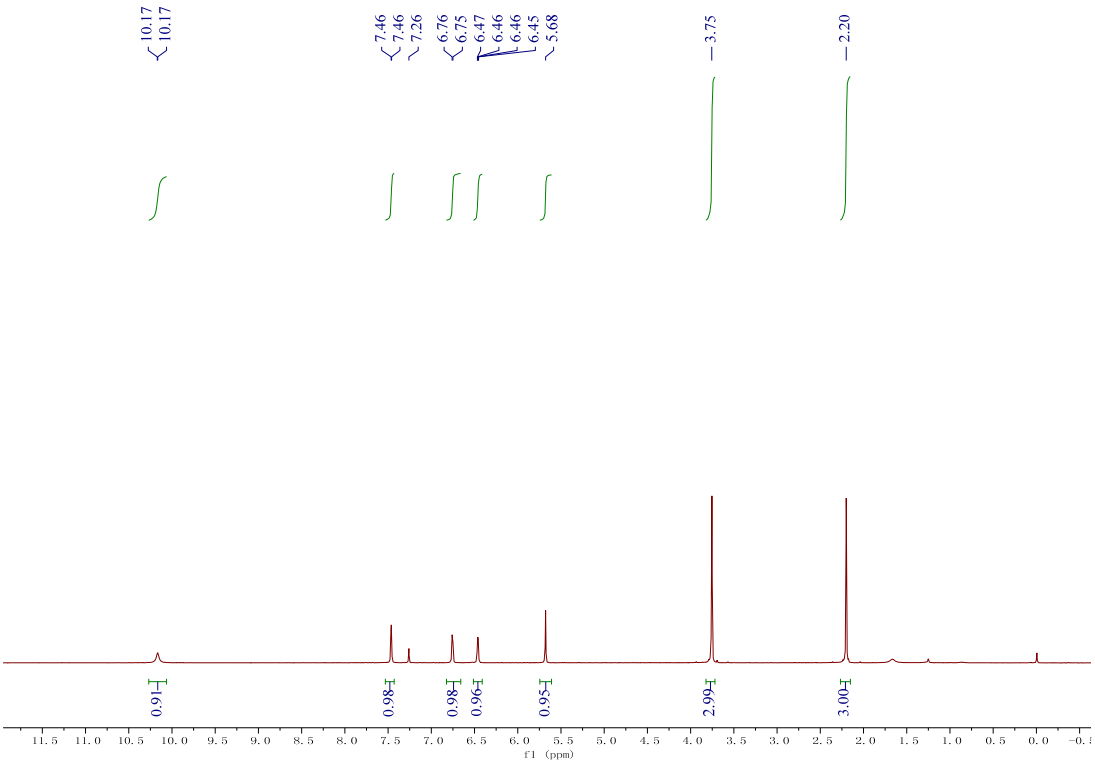
3n

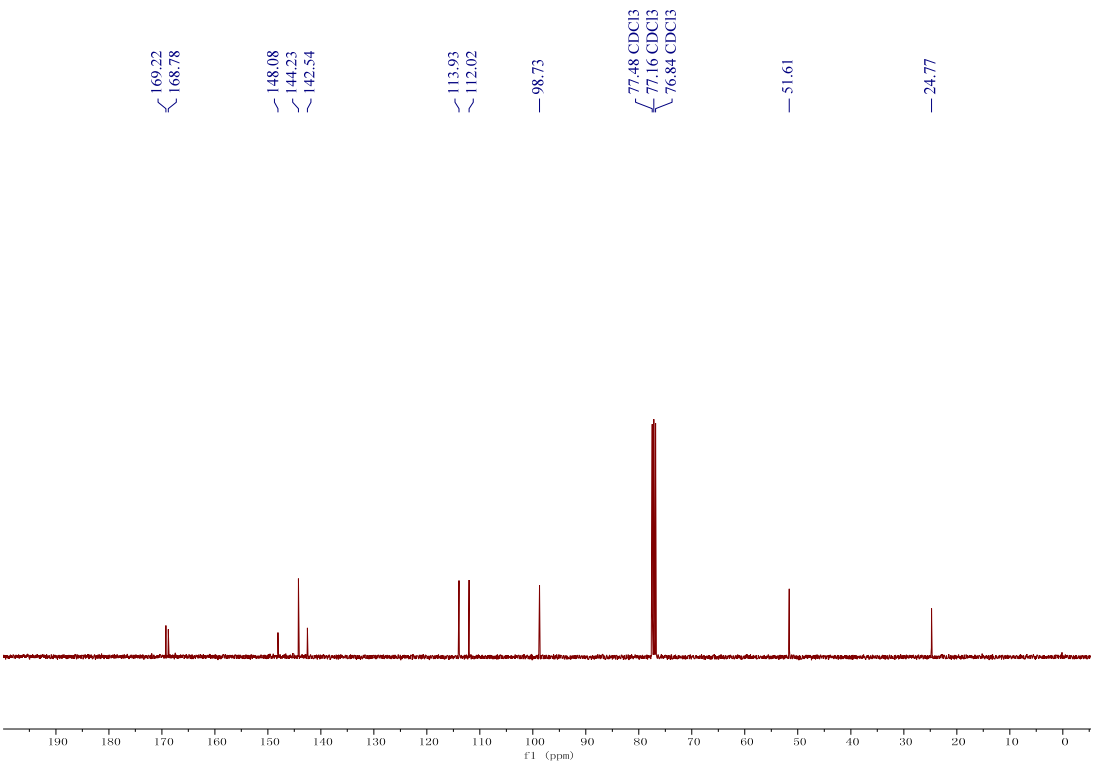

10.28
10.28
7.40
7.39
7.38
7.38
7.27
7.27
7.26
7.26
7.03
7.02
7.02
7.01
5.52
3.76
2.19
0.94
1.02
1.16
1.09
0.94
3.11
3.00
f1 (ppm)

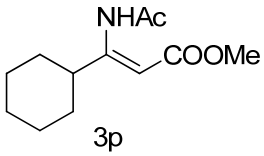

168.92
168.67
147.27
137.63
128.47
127.99
127.26
100.78
77.36 CDCl3
77.04 CDCl3
76.73 CDCl3
51.48
24.79
f1 (ppm)


NHAc
CO2Me
S

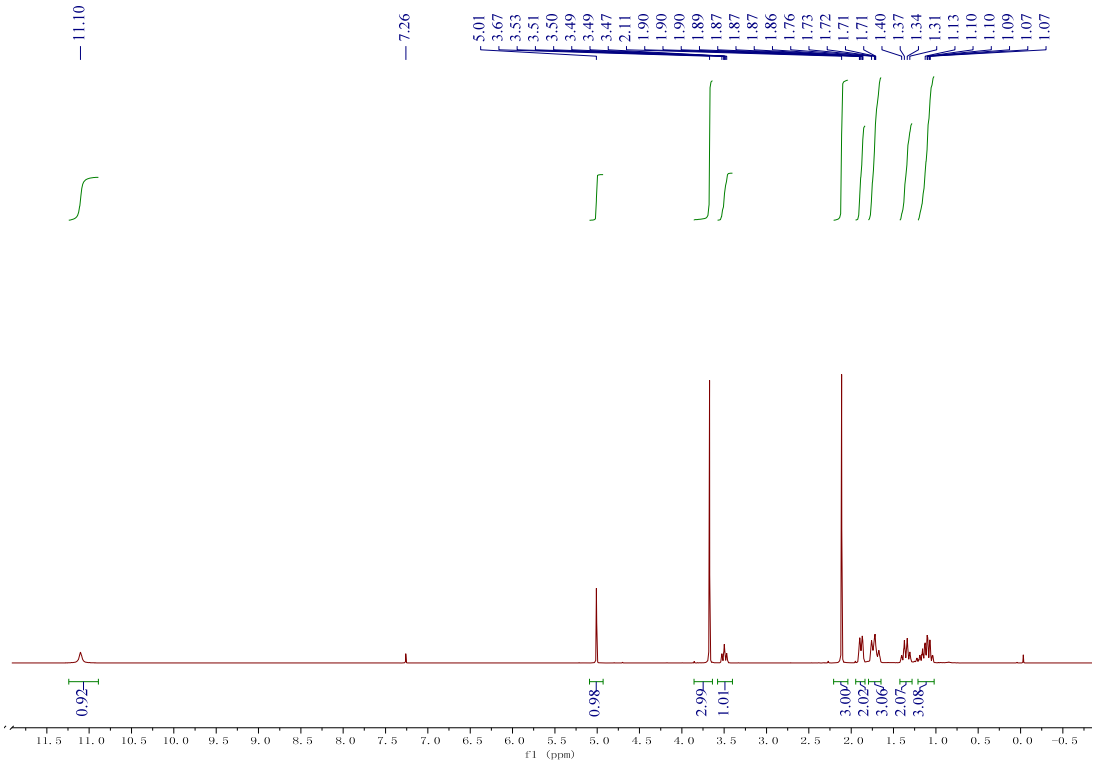
3o

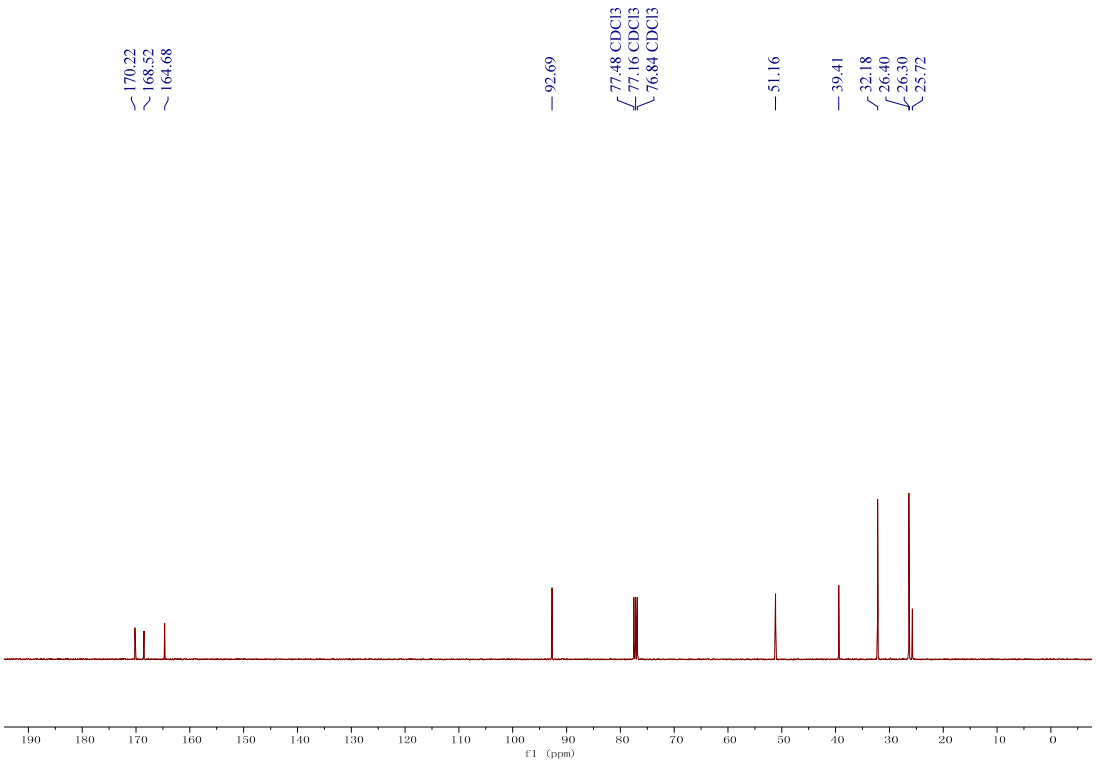

10.17
10.17
7.46
7.46
7.26
6.76
6.75
6.47
6.46
6.46
6.45
5.68
3.75
2.20
0.91
0.98
0.98
0.96
0.95
2.99
3.00
f1 (ppm)

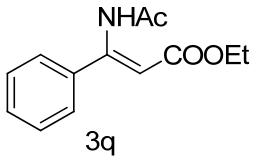

169.22
168.78
148.08
144.23
142.54
113.93
112.02
98.73
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.61
24.77
f1 (ppm)


NHAc
COOMe

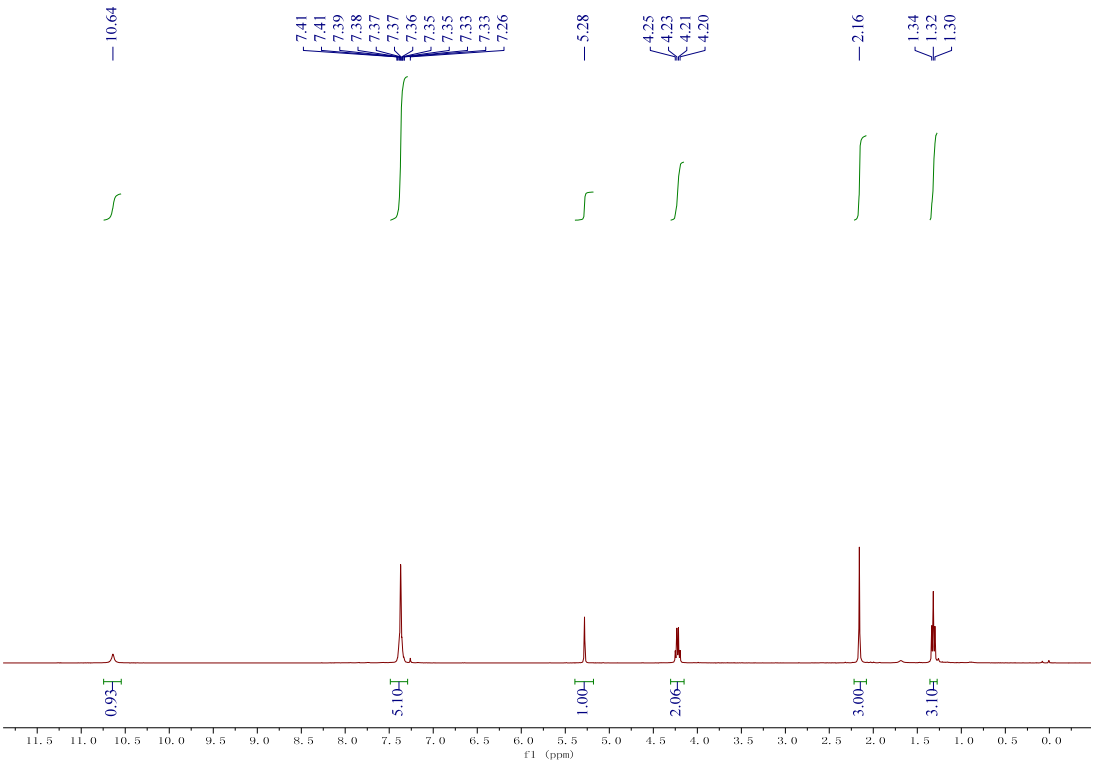
3p

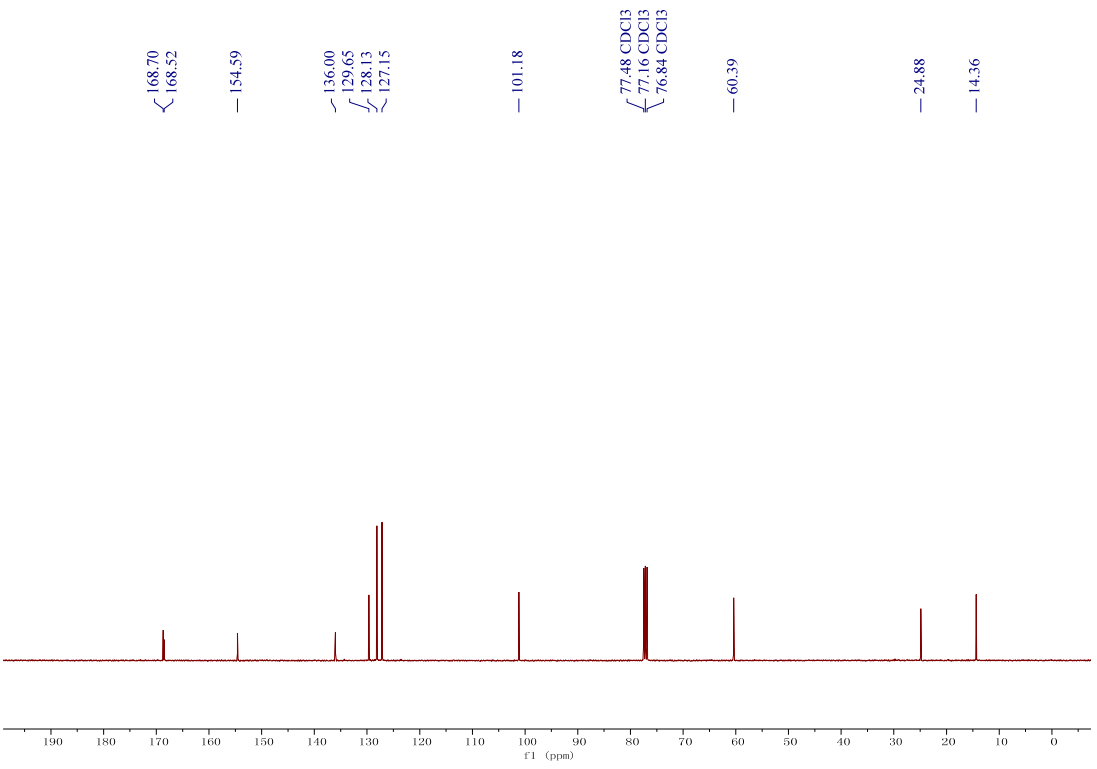

11.10
7.26
5.01
3.67
3.53
3.51
3.50
3.49
3.49
3.47
2.11
1.90
1.90
1.90
1.89
1.87
1.87
1.87
1.86
1.76
1.73
1.72
1.71
1.71
1.40
1.37
1.34
1.31
1.13
1.10
1.10
1.09
1.07
1.07
0.92
0.98
2.99
1.01
3.00
2.02
3.06
2.07
3.08
f1 (ppm)

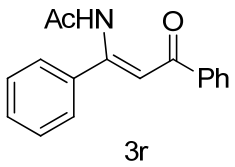

170.22
168.52
164.68
92.69
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.16
39.41
32.18
26.40
26.30
25.72
f1 (ppm)


NHAc
COOEt

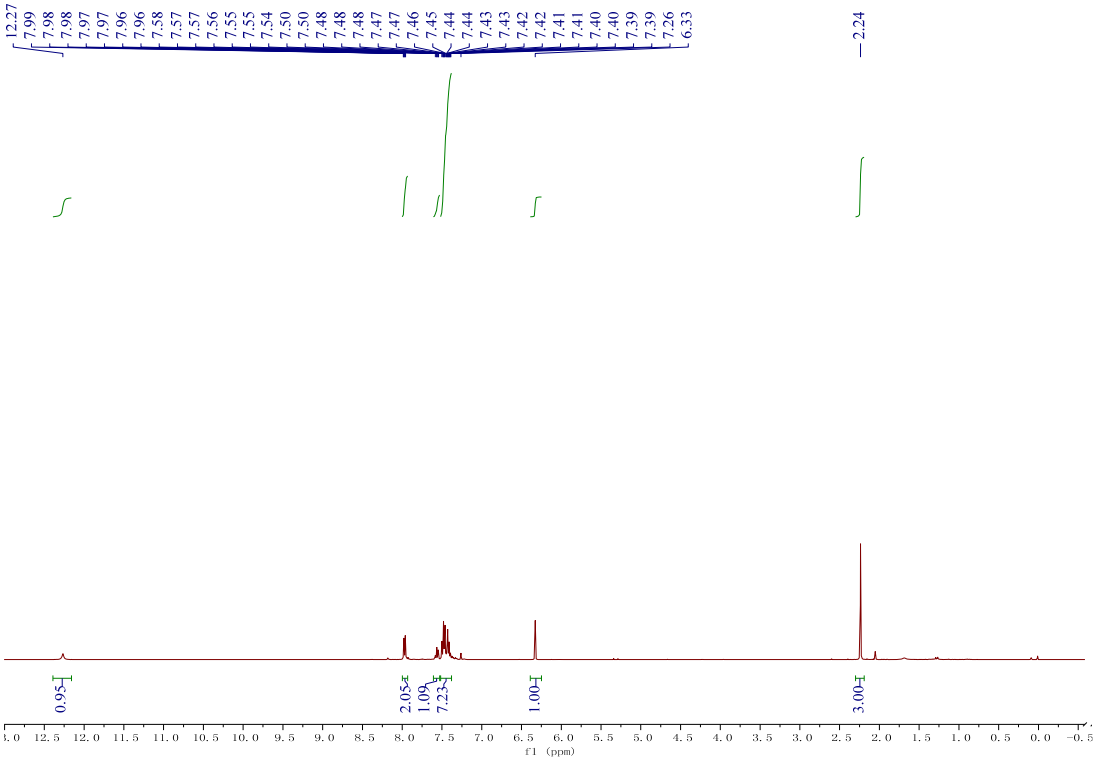
3q

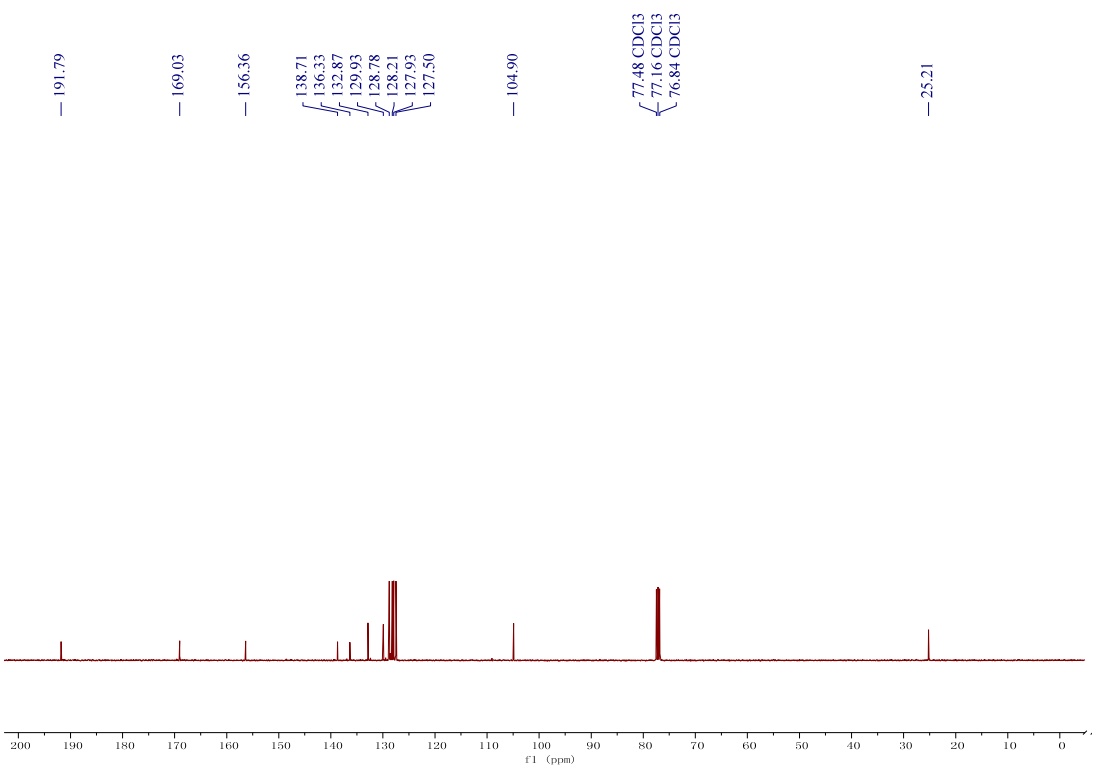

10.64
7.41
7.41
7.39
7.38
7.37
7.37
7.36
7.35
7.35
7.33
7.33
7.26
5.28
4.25
4.23
4.21
4.20
2.16
1.34
1.32
1.30
0.93
5.10
1.00
2.06
3.00
3.10
f1 (ppm)

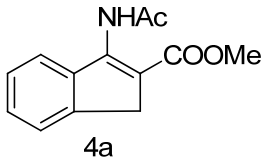

168.70
168.52
154.59
136.00
129.65
128.13
127.15
101.18
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
60.39
24.88
14.36
f1 (ppm)


AcHN
O
Ph

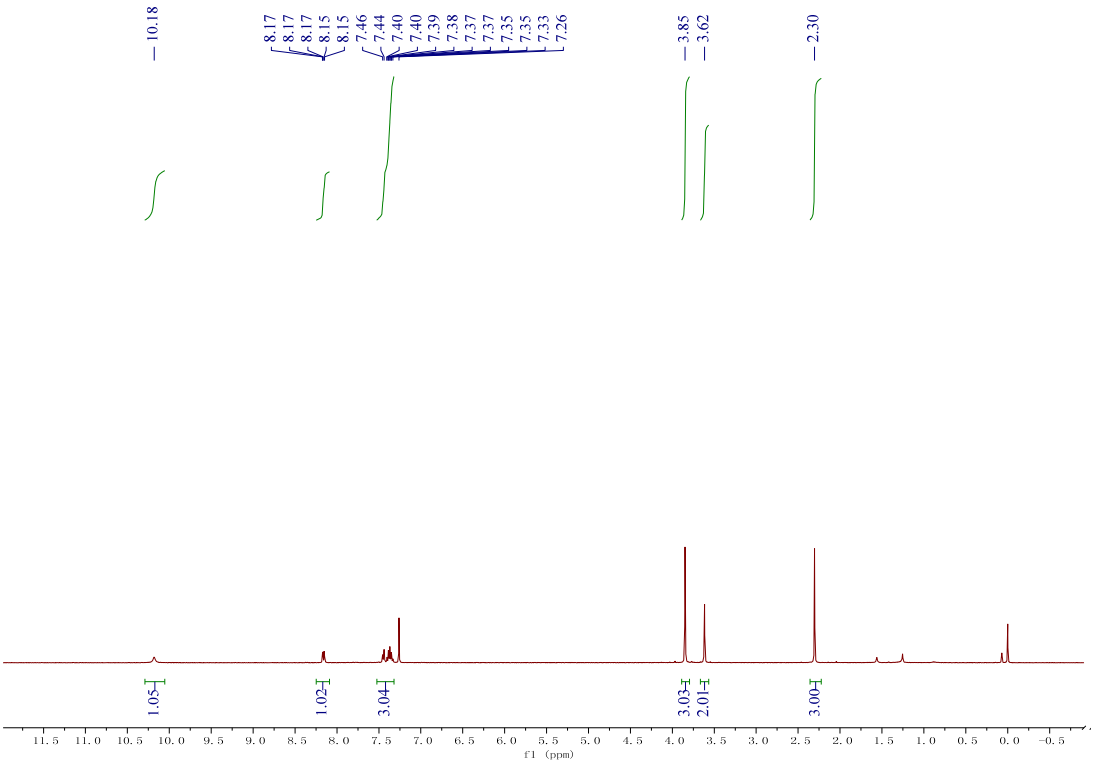
3r

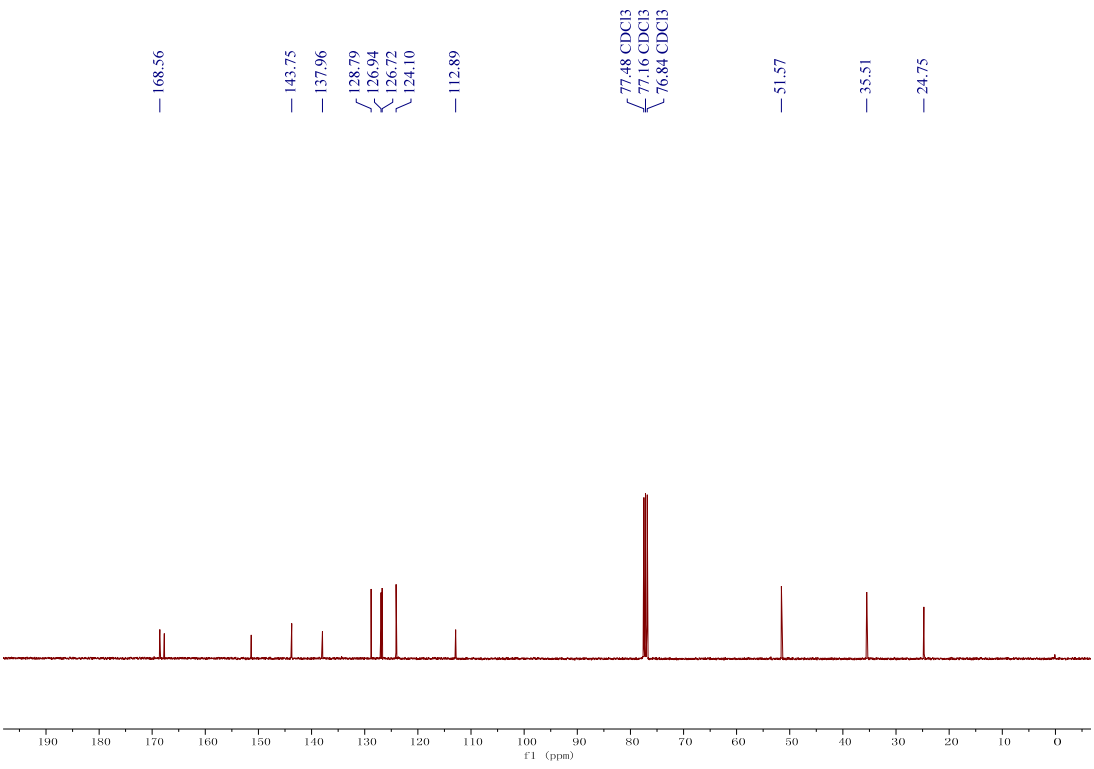

12.27
7.99
7.98
7.98
7.97
7.97
7.96
7.96
7.58
7.57
7.57
7.56
7.55
7.55
7.54
7.50
7.50
7.48
7.48
7.48
7.47
7.47
7.46
7.45
7.44
7.44
7.43
7.43
7.42
7.42
7.41
7.41
7.40
7.40
7.39
7.39
7.26
6.33
2.24
0.95
2.05
1.09
7.23
1.00
3.00
f1 (ppm)

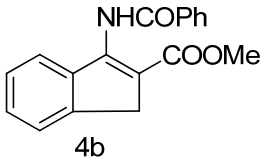

191.79
169.03
156.36
138.71
136.33
132.87
129.93
128.78
128.21
127.93
127.50
104.90
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
25.21
f1 (ppm)


NHAc
COOMe

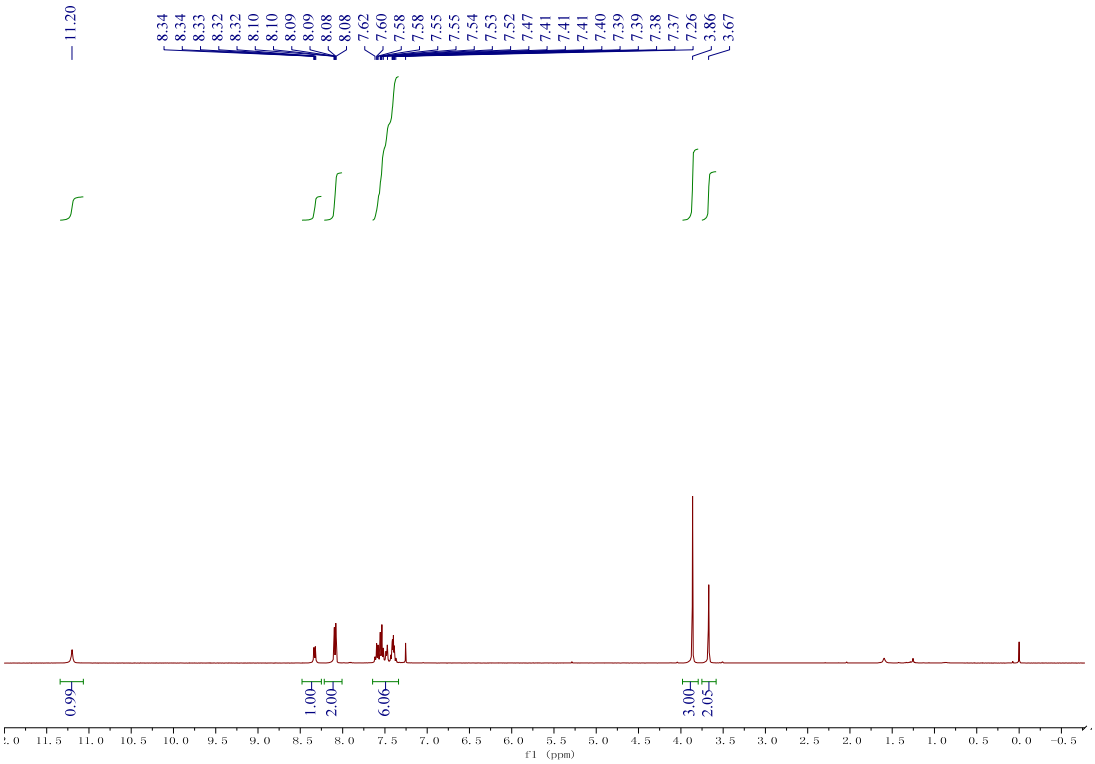
4a

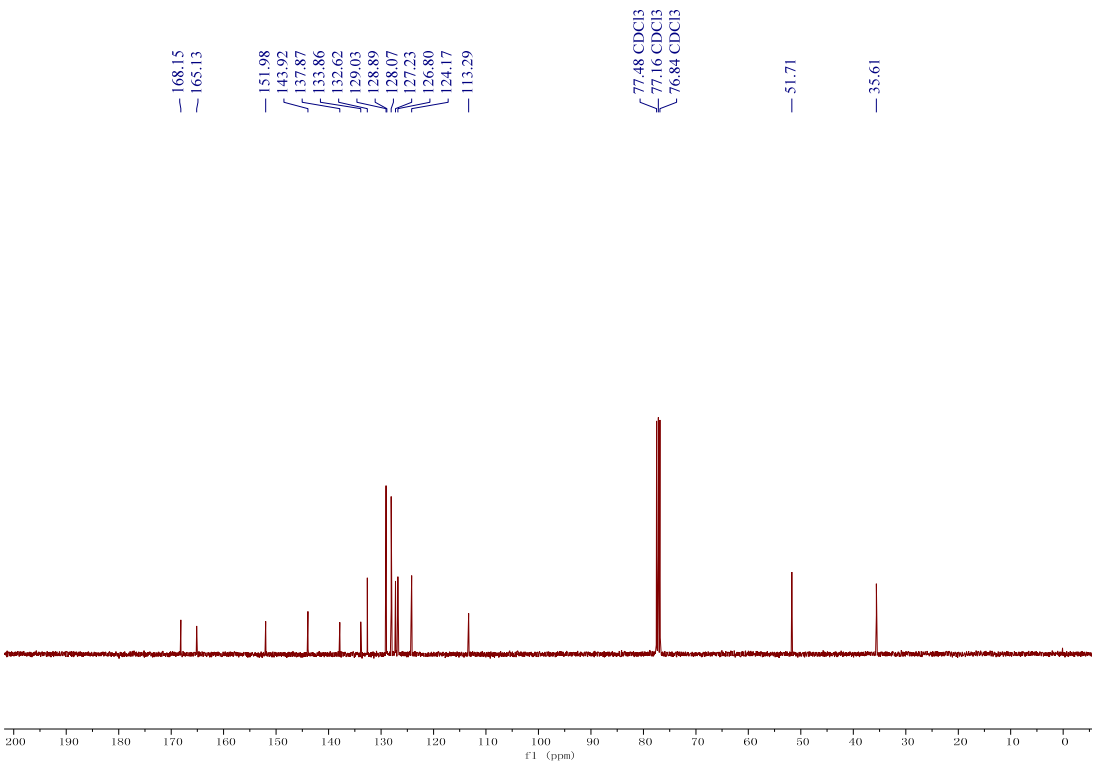

10.18
8.17
8.17
8.17
8.15
8.15
7.46
7.44
7.40
7.40
7.39
7.38
7.37
7.37
7.35
7.35
7.33
7.26
3.85
3.62
2.30
1.05
1.02
3.04
3.03
2.01
3.00
f1 (ppm)

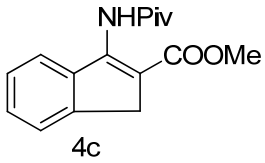

168.56
143.75
137.96
128.79
126.94
126.72
124.10
112.89
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.57
35.51
24.75
f1 (ppm)


NHCOPh
COOMe

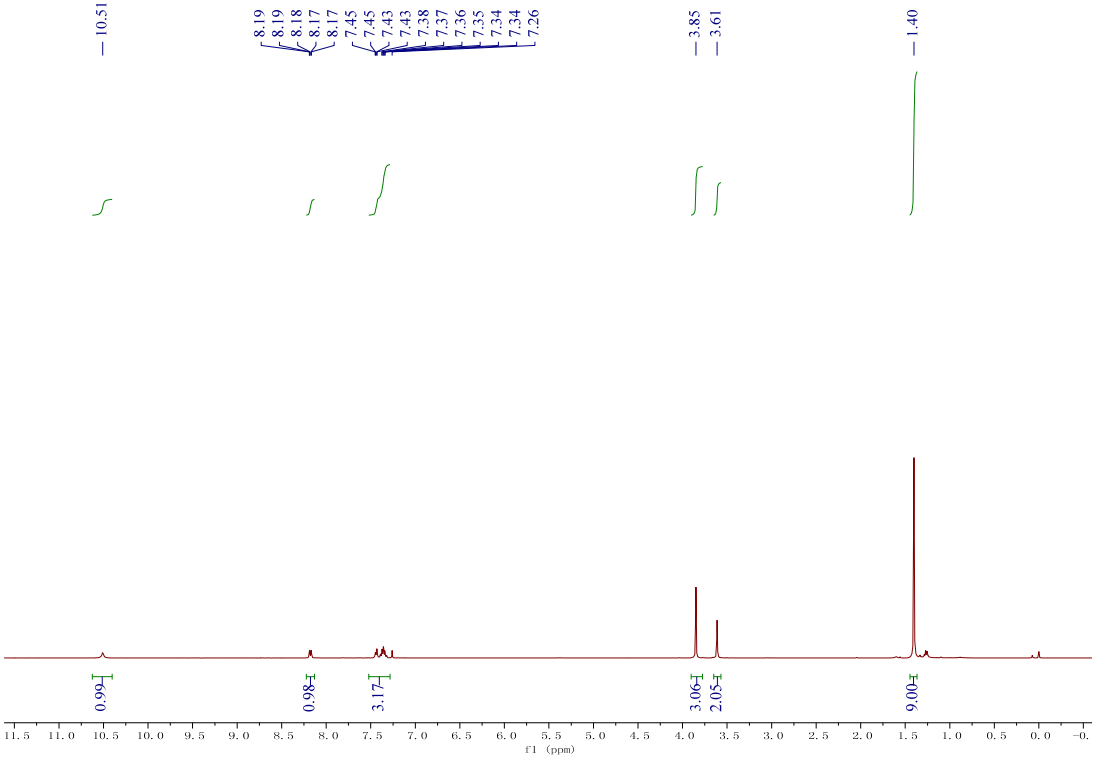
4b

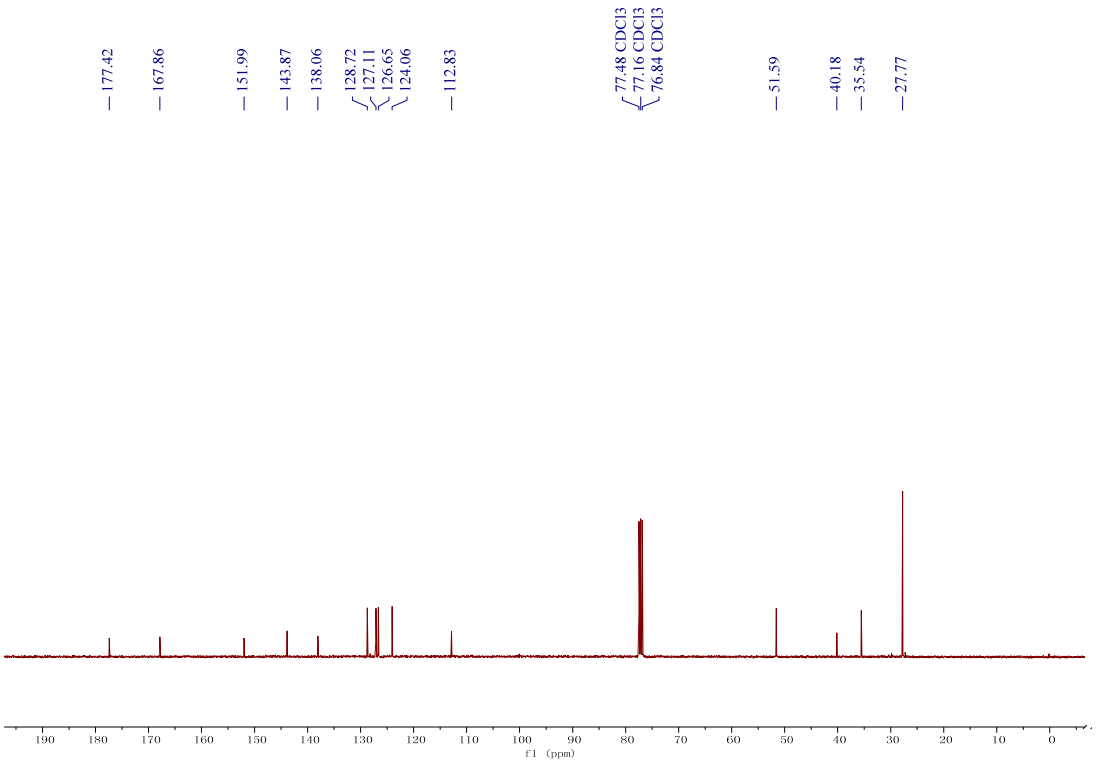

11.20
8.34
8.34
8.33
8.32
8.32
8.10
8.10
8.09
8.09
8.08
8.08
7.62
7.60
7.58
7.58
7.55
7.55
7.54
7.53
7.52
7.47
7.41
7.41
7.41
7.40
7.39
7.39
7.38
7.37
7.26
3.86
3.67
0.99
1.00
2.00
6.06
3.00
2.05
f1 (ppm)

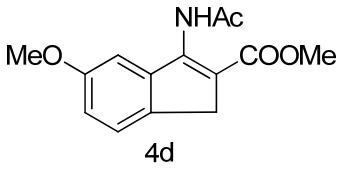

168.15
165.13
151.98
143.92
137.87
133.86
132.62
129.03
128.89
128.07
127.23
126.80
124.17
113.29
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.71
35.61
f1 (ppm)


NHPiv
COOMe

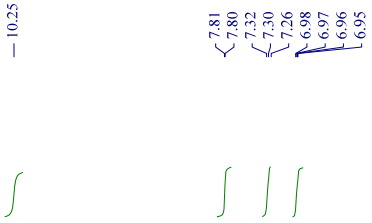
4c

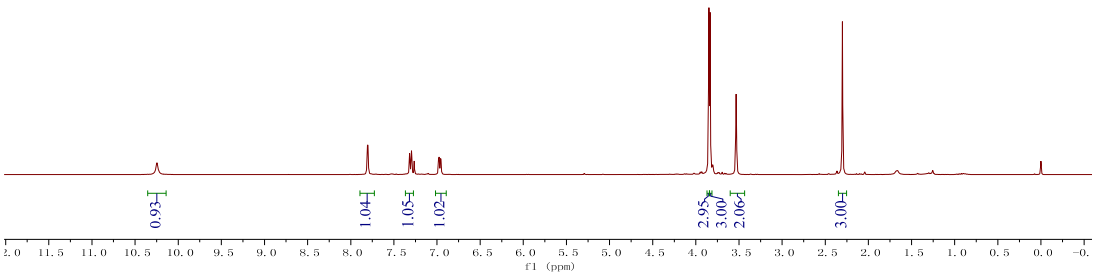

10.51
8.19
8.19
8.18
8.17
8.17
7.45
7.45
7.43
7.43
7.38
7.37
7.36
7.35
7.34
7.34
7.26
3.85
3.61
1.40
0.99
0.98
3.17
3.06
2.05
9.00
f1 (ppm)

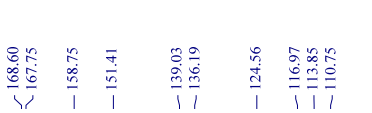

177.42
167.86
151.99
143.87
138.06
128.72
127.11
126.65
124.06
112.83
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.59
40.18
35.54
27.77
f1 (ppm)

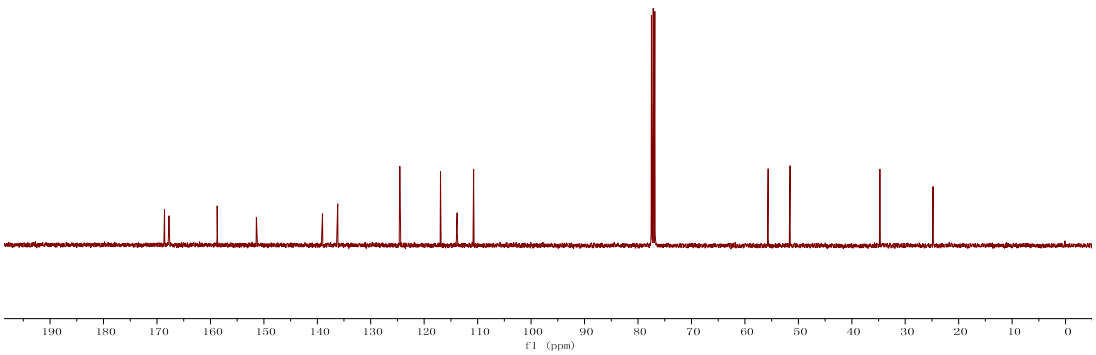

NHAc
MeO
COOMe

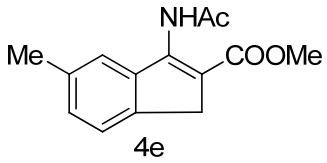
4d


10.25
7.81
7.80
7.32
7.30
7.26
6.98
6.97
6.96
6.95
3.85
3.84
3.53
2.30


0.93
1.04
1.05
1.02
2.95
3.00
2.06
3.00
f1 (ppm)

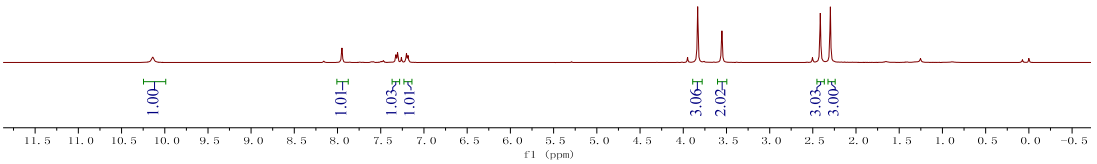

168.60
167.75
158.75
151.41
139.03
136.19
124.56
116.97
113.85
110.75
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
55.66
51.56
34.75
24.80

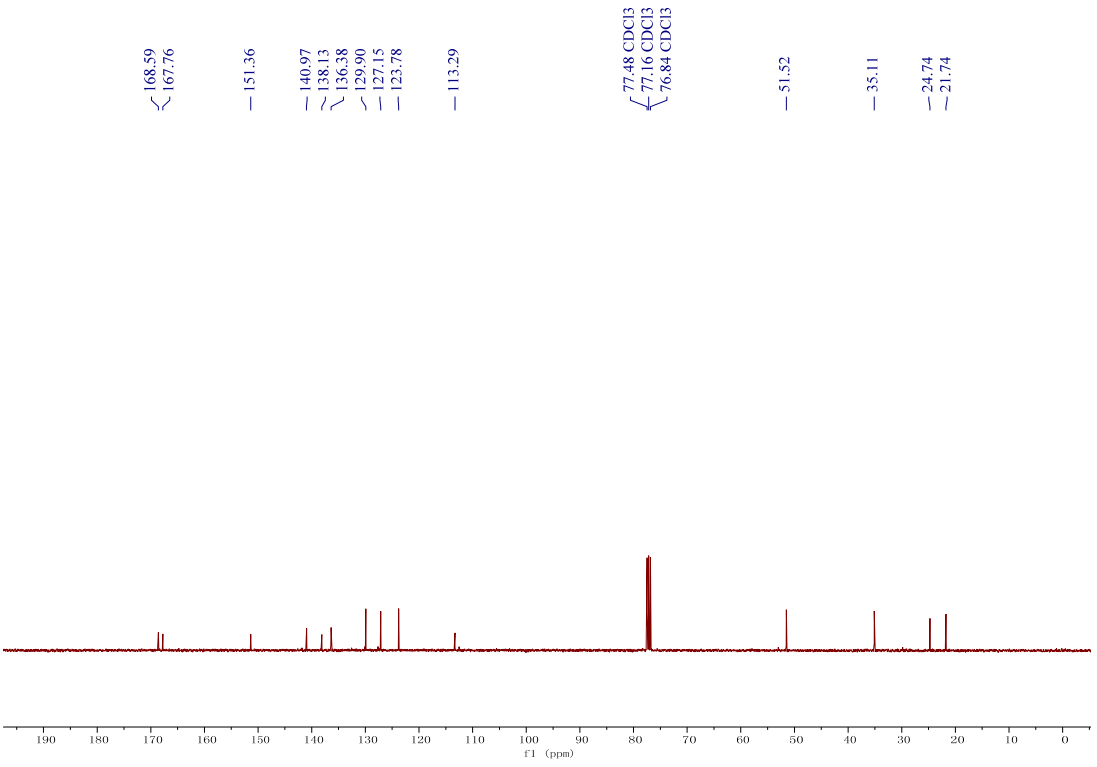

f1 (ppm)

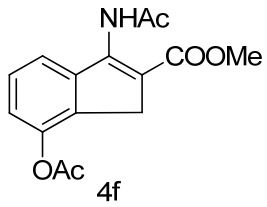

NHAc
Me
COOMe

4e

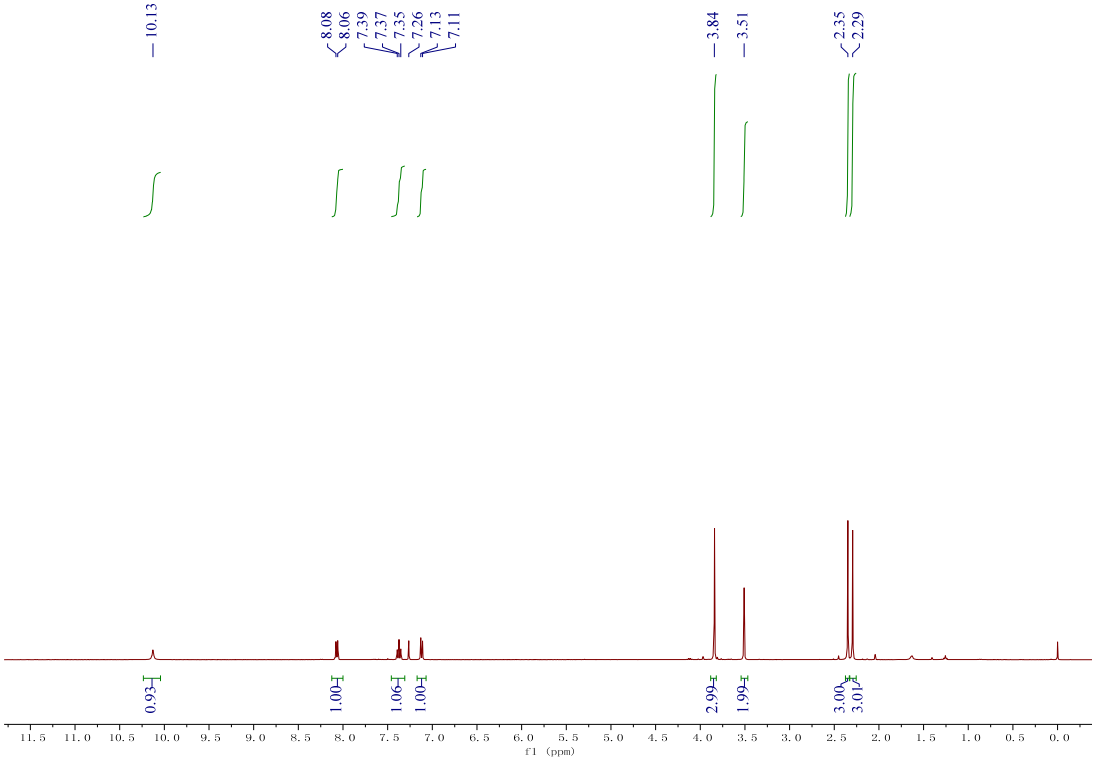

10.14
7.95
7.32
7.31
7.26
7.20
7.18
3.83
3.55
2.41
2.30

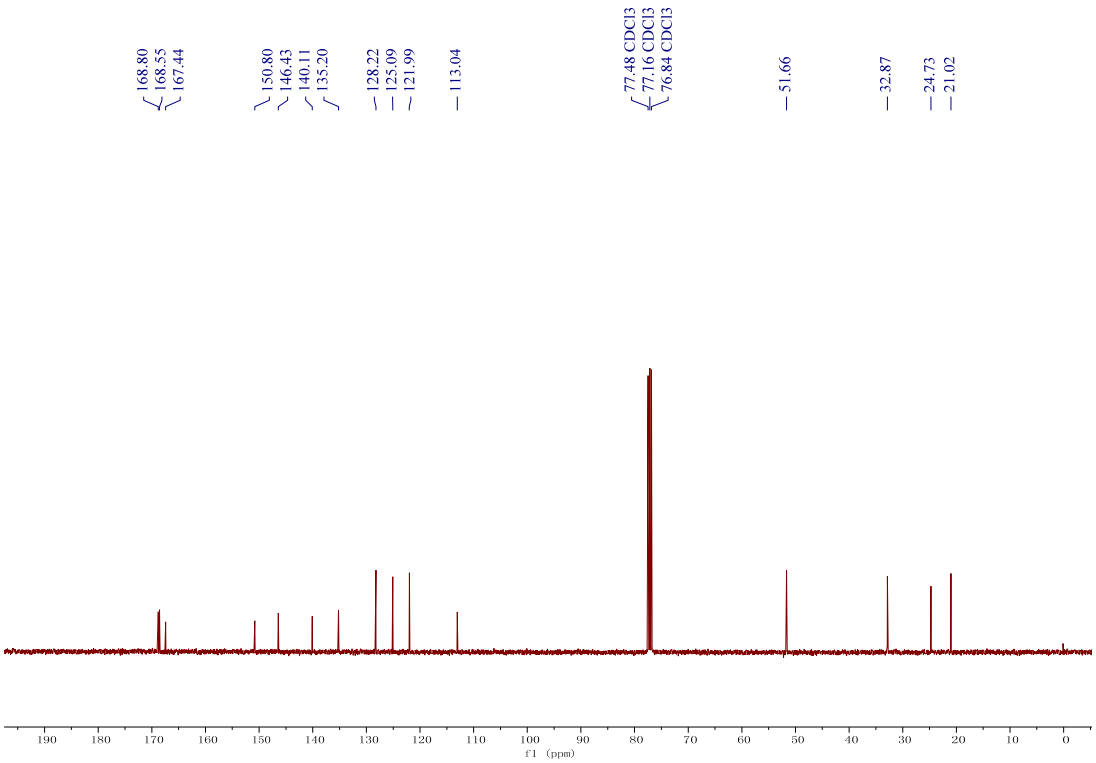

1.00
1.01
1.03
1.01
3.06
2.02
3.03
3.00
f1 (ppm)

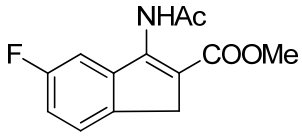

168.59
167.76
151.36
140.97
138.13
136.38
129.90
127.15
123.78
113.29
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.52
35.11
24.74
21.74
f1 (ppm)


NHAc
COOMe
OAc

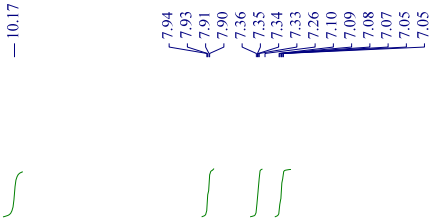
4f

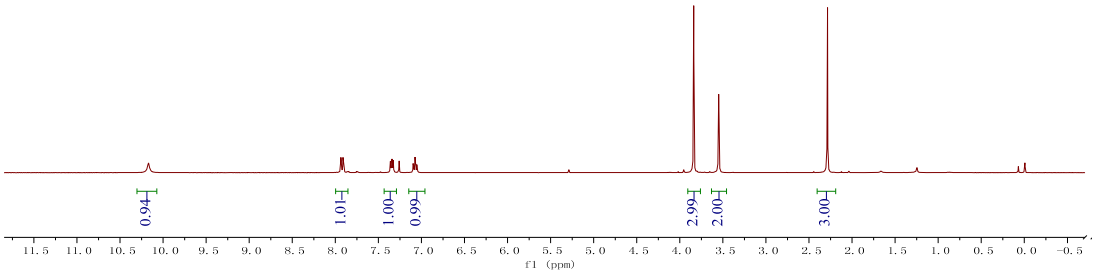

10.13
8.08
8.06
7.39
7.37
7.35
7.26
7.13
7.11
3.84
3.51
2.35
2.29
0.93
1.00
1.06
1.00
2.99
1.99
3.00
3.01
f1 (ppm)

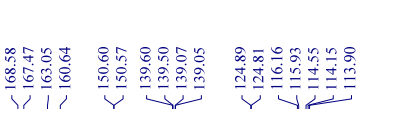

168.80
168.55
167.44
150.80
146.43
140.11
135.20
128.22
125.09
121.99
113.04
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.66
32.87
24.73
21.02
f1 (ppm)

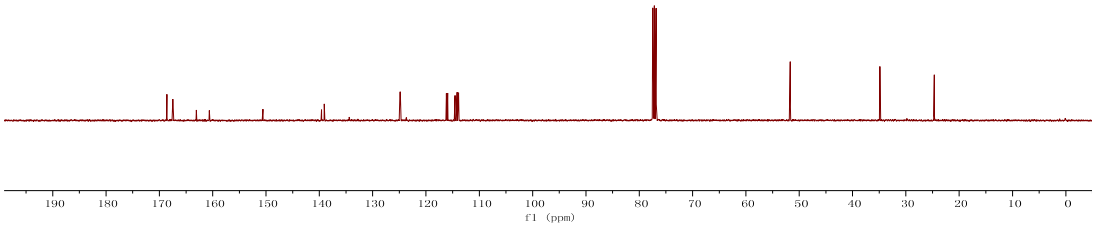

NHAc
F
COOMe

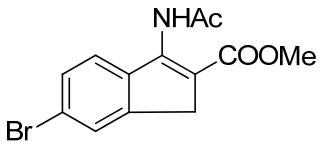
4g


10.17
7.94
7.93
7.91
7.90
7.36
7.35
7.34
7.33
7.26
7.10
7.09
7.08
7.07
7.05
7.05
3.84
3.55
2.29


0.94
1.01
1.00
0.99
2.99
2.00
3.00
f1 (ppm)

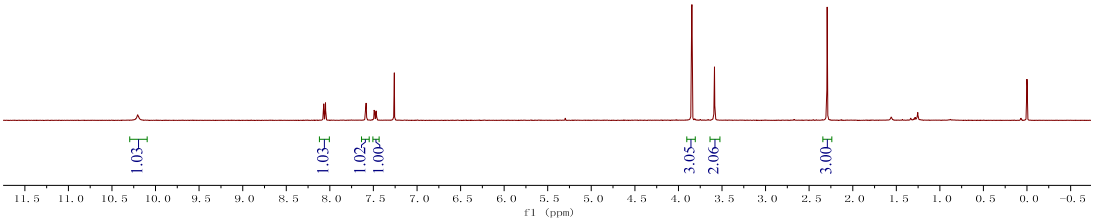

168.58
167.47
163.05
160.64
150.60
150.57
139.60
139.50
139.07
139.05
124.89
124.81
116.16
115.93
114.55
114.15
113.90
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.68
34.88
24.68

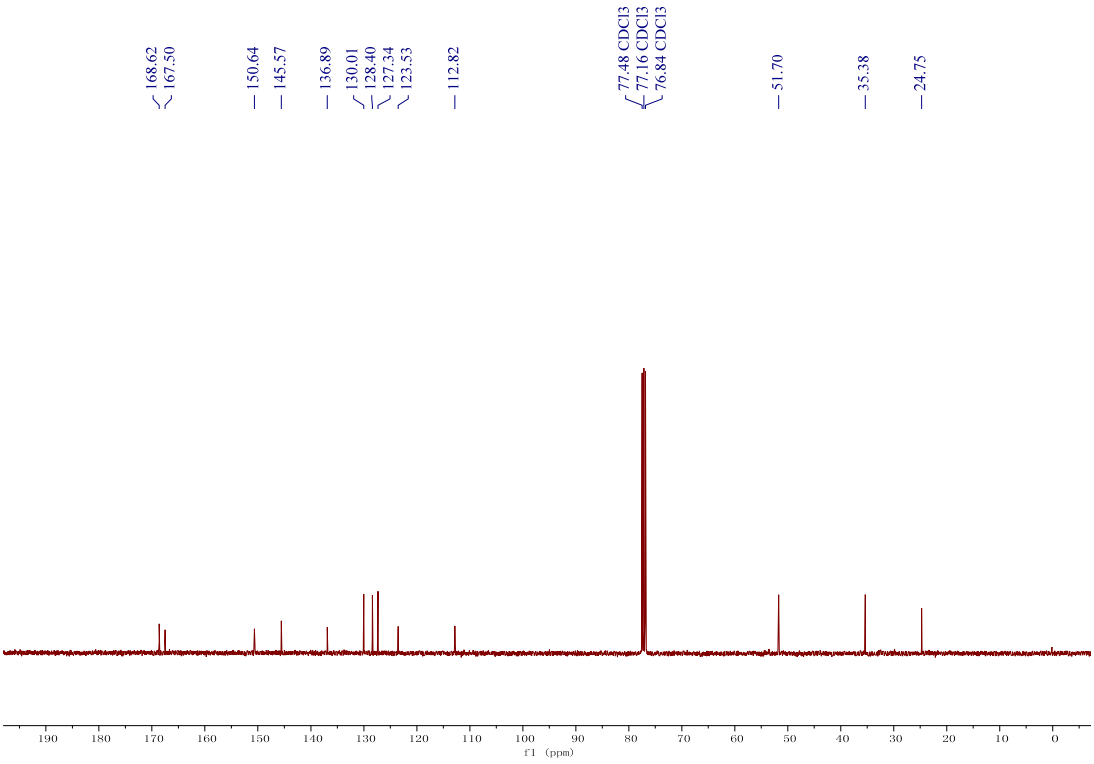

f1 (ppm)

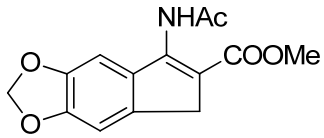

NHAc
COOMe
Br

4h

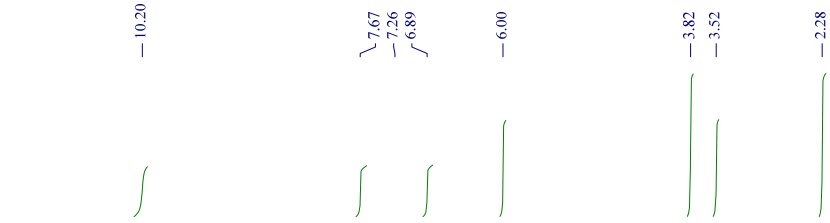

10.20
8.07
8.05
7.58
7.49
7.49
7.47
7.46
7.26
3.85
3.59
2.29

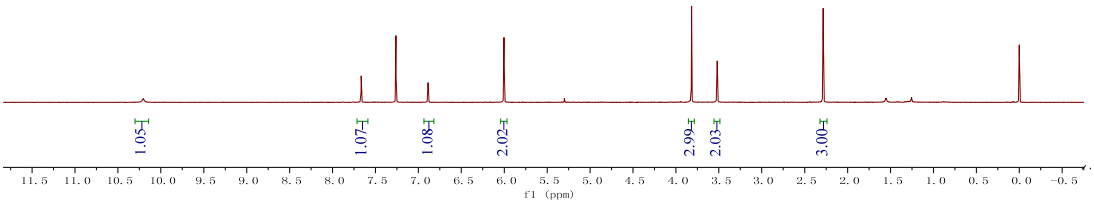

1.03
1.03
1.02
1.00
3.05
2.06
3.00
f1 (ppm)

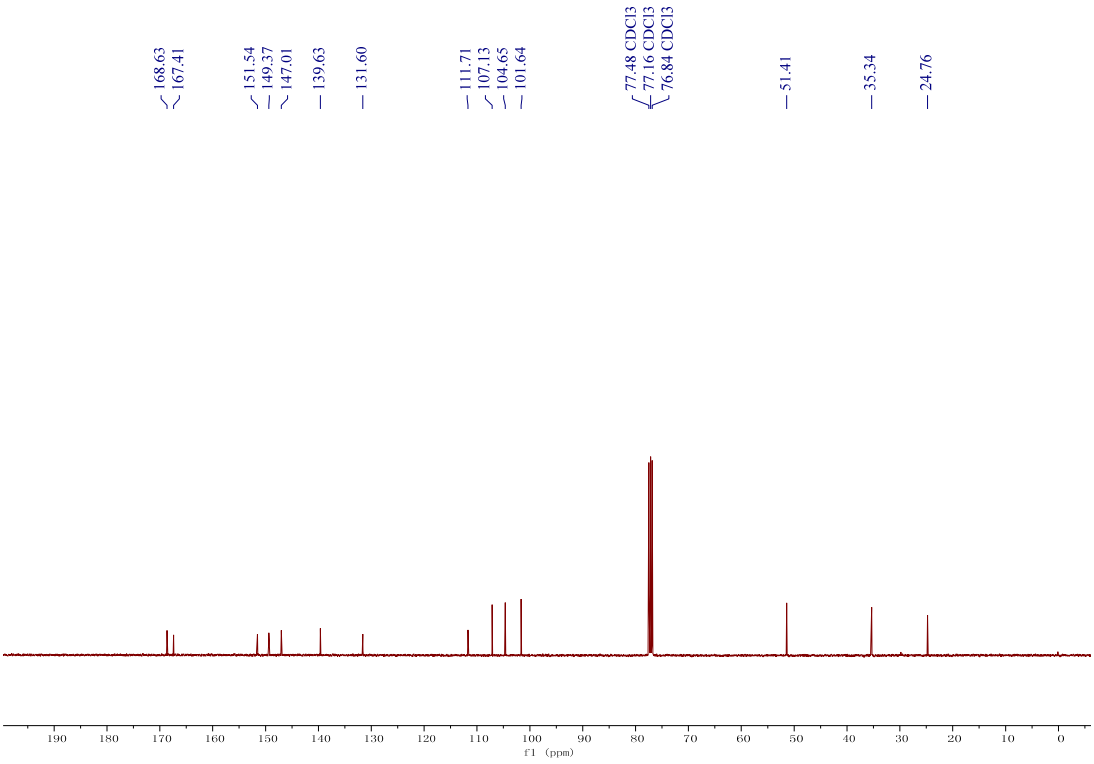

168.62
167.50
150.64
145.57
136.89
130.01
128.40
127.34
123.53
112.82
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.70
35.38
24.75
f1 (ppm)

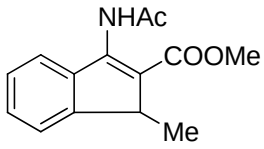

NHAc
COOMe
O
O

4i

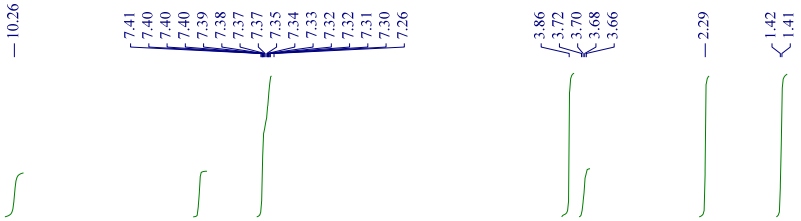

10.20
7.67
7.26
6.89
6.00
3.82
3.52
2.28

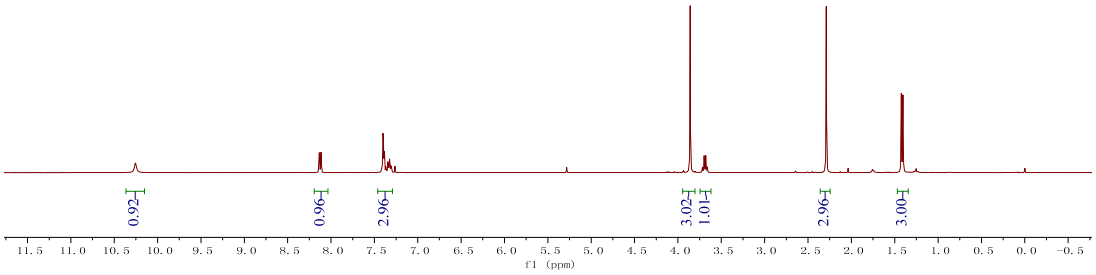

1.05
1.07
1.08
2.02
2.99
2.03
3.00
f1 (ppm)


168.63
167.41
151.54
149.37
147.01
139.63
131.60
111.71
107.13
104.65
101.64
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.41
35.34
24.76
f1 (ppm)

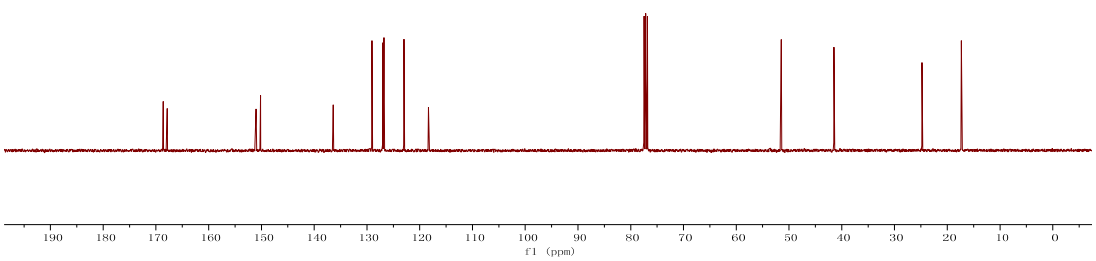

NHAc
COOMe
Me

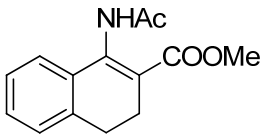
4j


10.26
7.41
7.40
7.40
7.40
7.39
7.38
7.37
7.37
7.35
7.34
7.33
7.32
7.32
7.31
7.30
7.26
3.86
3.72
3.70
3.68
3.66
2.29
1.42
1.41

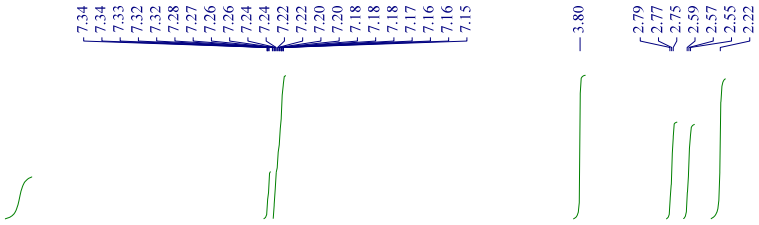

0.92
0.96
2.96
3.02
1.01
2.96
3.00
f1 (ppm)

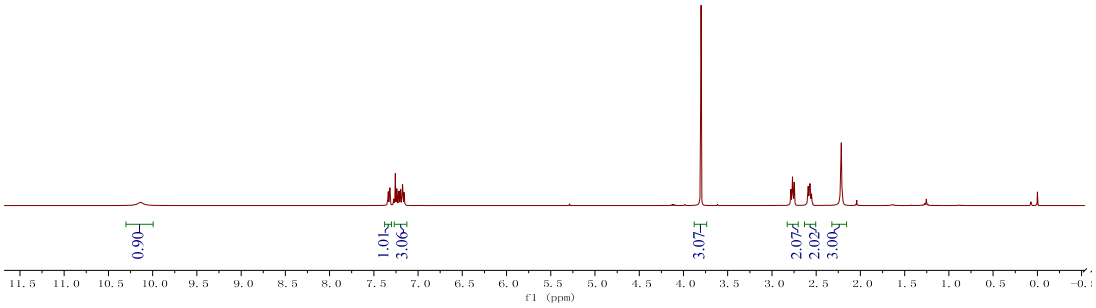

168.62
167.86
151.03
150.18
136.38
129.06
126.99
126.79
123.00
118.34
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.47
41.47
24.78
17.33


f1 (ppm)


NHAc
COOMe

4k


7.34
7.34
7.33
7.32
7.32
7.28
7.27
7.26
7.26
7.24
7.24
7.22
7.22
7.20
7.20
7.18
7.18
7.18
7.17
7.16
7.16
7.15
3.80
2.79
2.77
2.75
2.59
2.57
2.55
2.22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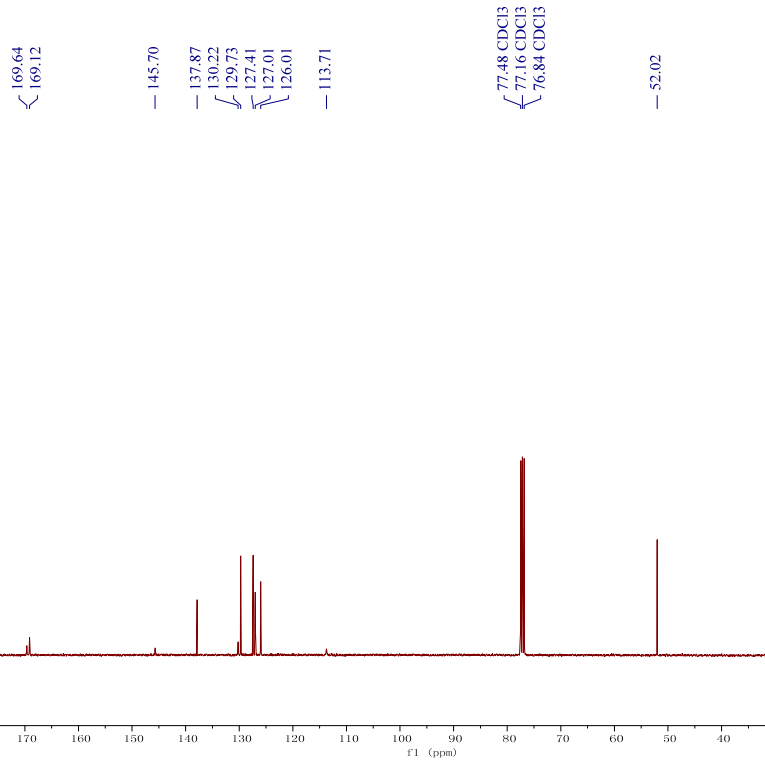
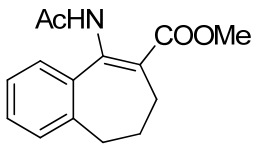
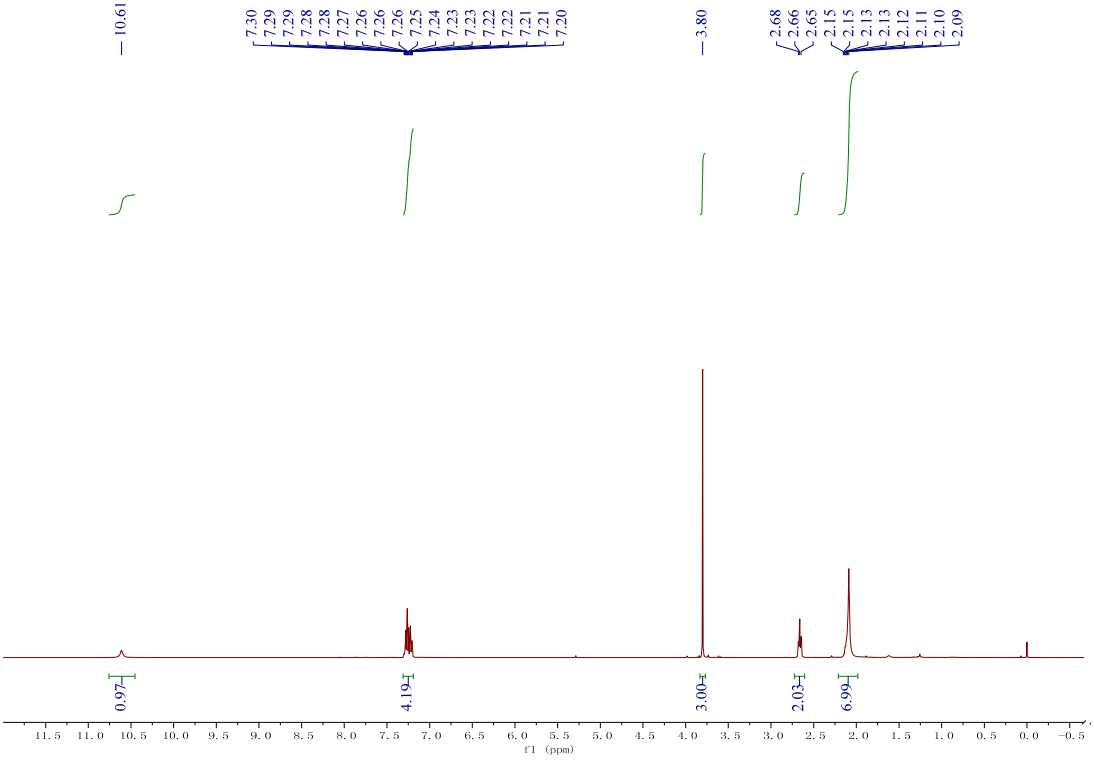
3.06
3.07
2.07
2.02
3.00
f1 (ppm)


169.64
169.12
145.70
137.87
130.22
129.73
127.41
127.01
126.01
113.71
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
52.02
27.72
24.65
22.38
f1 (ppm)


AcHN
COOMe

4l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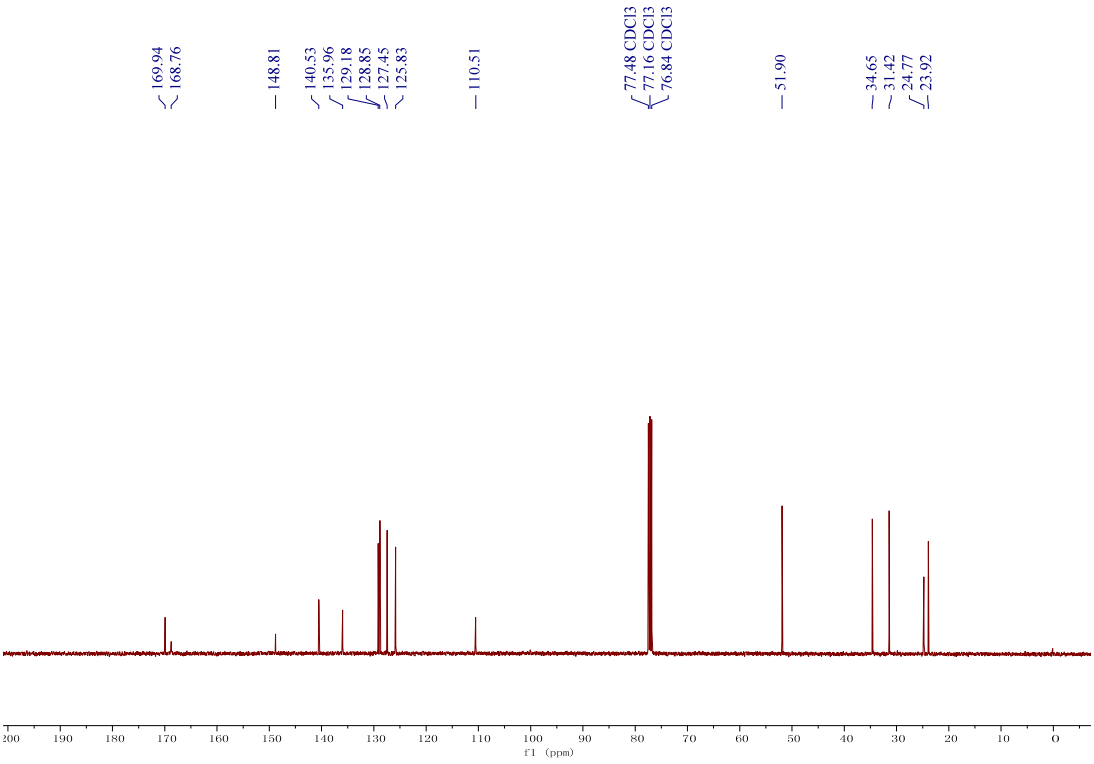
7.30
7.29
7.29
7.28
7.28
7.27
7.26
7.26
7.26
7.25
7.24
7.23
7.23
7.22
7.22
7.21
7.21
7.20
3.80
2.68
2.66
2.65
2.15
2.15
2.13
2.13
2.12
2.11
2.10
2.09
0.97
4.19
3.00
2.03
6.99
f1 (ppm)


169.94
168.76
148.81
140.53
135.96
129.18
128.85
127.45
125.83
110.51
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
51.90
34.65
31.42
24.77
23.92
f1 (ppm)