Supporting Information for

Organo-Cation Catalyzed Enantioselective α-Hydroxylation of Pyridinone-Fused Lactones: Asymmetric Synthesis of SN-38 and Irinotecan

Jin-Rui Tian,[a] Yu-Hao Qiao,[a] Qing-Bo Zhuang,[a,b] Rong Fan,[a] Zhen Li,[a] Xiao-Ming Zhang,[a*] Fu-Min Zhang,[a] and Yong-Qiang Tu [a*]

[a]State Key Laboratory of Applied Organic Chemistry & College of Chemistry and Chemical Engineering, Lanzhou University, Lanzhou 730000, P. R. China.

[b]School of Pharmaceutical Sciences, National Key Laboratory of Innovative Immunotherapy, Shanghai Jiao Tong University, Shanghai, 200240, China.

Email: zhangxiaom@lzu.edu.cn, tuyq@lzu.edu.cn

Table of Contents

1. General Information

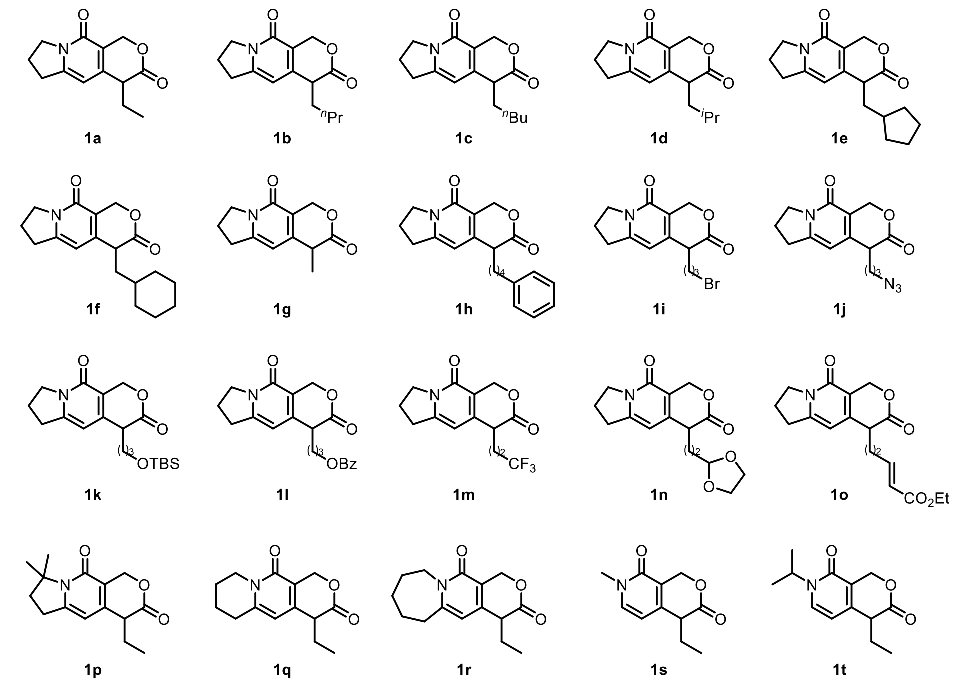
All moisture or air sensitive reactions were carried out under an argon atmosphere in oven-dried flasks. Except for commercially available ultradry solvents, all solvents were purified by standard methods as indicated and were transferred under argon. Toluene and THF were distilled from sodium, while DCM was distilled from CaH_2. All other commercially available reagents were used as received without further purification unless otherwise noted. All reactions were monitored by thin-layer chromatography (TLC) on silica gel F_{254} plates using UV light as visualizing agent (if applicable). The products were purified by flash column chromatography on silica gel (200-300 meshes).

^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra were recorded in $CDCl_3$ or DMSO-d6 solution on Bruker AVANCE^{III} 400 MHz, Bruker AVANCE^{III} HD 400 MHz or Bruker AVANCE NEO 600 MHz instrument. Chemical shifts were denoted in ppm (δ) and calibrated by using residual undeuterated solvent ($CHCl_3$ (7.26 ppm), tetramethylsilane (0.00 ppm)) as Sernal reference for ^{1}H NMR and the deuterated solvent ($CDCl_3$ (77.0 ppm), DMSO-d6 (39.5 ppm)) as Sernal standard for ^{13}C NMR. The following abbreviations were used to represent the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, hept = heptet, dd = doublet of doublets, dt = doublet of triplet, td= triplet of doublets, qd = quartet of doublets, brs = broad singlet, ddd = doublet of doublet of doublets, m = multiplet. High-resolution mass spectral analysis (HRMS) data were measured on a Bruker Apex^{II} mass spectrometer by means of the ESI technique. The FT-IR spectra were recorded on Nicolet Nexus 670 FT-IR spectrometer using neat thin film technique with potassium bromide (KBr) salt plates. The X-ray single-crystal data were recorded on Bruker APEX^{II} X-ray single crystal diffractometer.

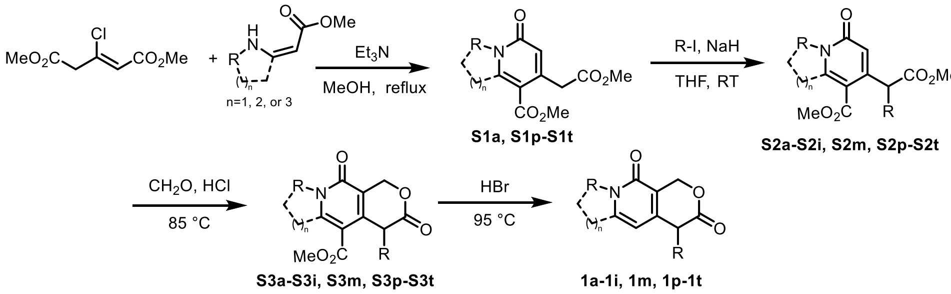
Optical rotations were measured using a 0.1 mL cell with a 1 cm path length on Rudolph Autopol^{IV} automatic polarimeter, and concentrations (c) were reported in g × (100 mL)$^{-1}$. Enantiomeric excesses (ee) were determined by UPC^{2} and HPLC equipped with Waters 2998 Photodiode Array Detector.

2. Experimental Details for the Synthesis of Pyridinone-Fused Lactones.

Table S1. Pyridinone-fused lactones



Procedure A:



Note：2-Pyridinone-fused lactones ***1a-1i, 1m, 1p-1t*** *were synthesized following literature procedure A.*[4,5]

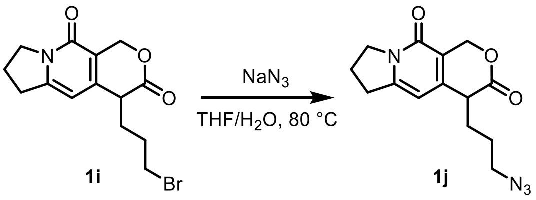
Synthesis of compound S1 (S1a, or S1p-S1t): To a stirred solution of amide[1,2] (20 mmol, 1.0 equiv.) and diester[3] (24 mmol, 1.2 equiv.) in methanol (30 mL) was added triethylamine (24 mmol, 1.2 equiv.). The resultant solution was refluxed for 29 h. Then, the solvent was evaporated, and dichloromethane was added followed by addition of water (3 × 50 mL). The organic phase was separated, dried over Na_2SO_4, and evaporated. The residue was purified by flash chromatography on silica gel to give **S1 (S1a, or S1p-S1t)**.

Synthesis of compound S2 (S2a-S2i, or S2m, or S2p-S2t): Under an argon atmosphere, NaH (60%, 11 mmol, 1.1 equiv.) was dissolved in dry THF followed by portion-wise addition of **S1 (S1a, or S1p-S1t)** (10 mmol, 1.0 equiv.). After being stirred for 30 min at room temperature, the mixture was added a solution of iodide (30 mmol, 3.0 equiv.) in THF (10 ml) dropwise over a course of 10 min. The resulting mixture was stirred for another 40 h until consumption of **S1 (S1a, or S1p-S1t)**

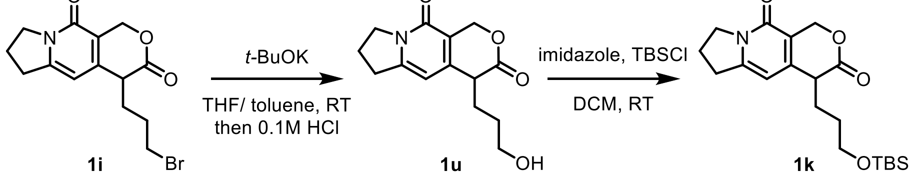
indicated by TLC. The reaction was quenched with 20 mL of 0.1 M HCl and extracted with chloroform (4 × 25 mL). The combined organic layers were dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by flash chromatography on silica gel to give **S2 (S2a-S2i, or S2m, or S2p-S2t)**.

Synthesis of compound S3 (S3a-S3i, or S3m, or S3p-S3t): A stirred mixture of **S2 (S2a-S2i, or S2m, or S2p-S2t)** (10 mmol), acetic acid (17.2 mL), concentrated HCl (5.7 mL) and formalin (8 mL, 37%) was heated at 80 °C for 72 h. The mixture was cooled to 0 °C. Then, the reaction was neutralized with 10% NaOH and extracted with DCM (3×30 mL). The combined organic phases were washed with brine (100 mL), dried over Na_2SO_4, filtered, and concentrated in vacuo. The crude products were purified by flash chromatography on silica gel to give **S3 (S3a-S3i, or S3m, or S3p-S3t)**.

Synthesis of compound 1 (1a-1i, or 1m, or 1p-1t): A stirred solution of **S3 (S3a-S3i, or S3m, or S3p-S3t)** (10 mmol) in 40% hydrobromic acid (30 mL) was heated at 90 °C for 10 h. Then, the mixture was cooled to room temperature followed by removement of the solvent in vacuo. The residue was neutralized with saturated aqueous $NaHCO_3$ solution (20 mL) and extracted with chloroform (3 × 50 mL). The organic phases were washed with brine (30 mL), dried over Na_2SO_4, filtered, and concentrated in vacuo. The crude product was purified by flash chromatography on silica gel to give the lactone products.

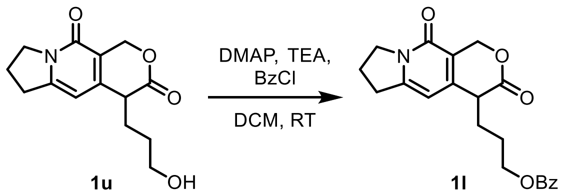


Synthesis of compound 1j: A solution of **1i** (10 mmol, 1.0 equiv.) in THF (10 mL) was added to a solution of sodium azide (10 mmol, 1.0 equiv.) in water (0.5 mL) in a round bottomed flask equipped with a stirring bar and reflux condenser. The mixture was pumped and refilled with argon three times. The resulting solution was heated at 80 °C for 5 h. When **1i** was consumed completely, the reaction mixture was allowed to cool to room temperature and extracted with DCM (3×50 mL). The combined organic phases were washed with brine (100 mL), dried over Na_2SO_4, filtered, and concentrated in vacuo. The crude product was purified by flash chromatography to give **1j**.

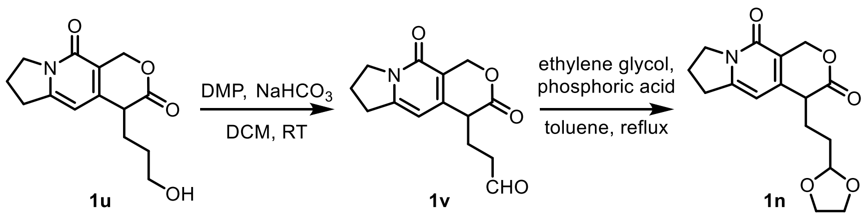


Synthesis of compound 1u: To a solution of **1i** (4 mmol, 1.0 equiv.) in THF/toluene (10 mL/5 mL) was added *t*-BuOK (8 mmol, 2.0 equiv.) under an argon atmosphere. The resultant solution was stirred for 8 h at room temperature. Then, the mixture was evaporated and purified by flash chromatography on silica gel (DCM: MeOH = 30:1). The resulting solution was concentrated under vacuum followed by addition of MeOH (5 mL) and 0.1M HCl (1 mL). After being stirred for 24 h at room temperature, the solution was evaporated and purified by flash chromatography on silica gel to give **1u**.

Synthesis of compound 1k: To a stirred solution of **1u** (1 mmol, 1.0 equiv.) in dry DCM (10 mL) was added imidazole (2 mmol, 2.0 equiv.), followed by addition of *tert*-butyldimethylsilyl chloride (1.2 mmol, 1.2 equiv.). After being stirred for an additional 6 h, the reaction mixture was quenched with saturated aqueous NH_4Cl and extracted with DCM (3 × 25 mL). The combined organic layers were dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by flash chromatography on silica gel to give **1k**.

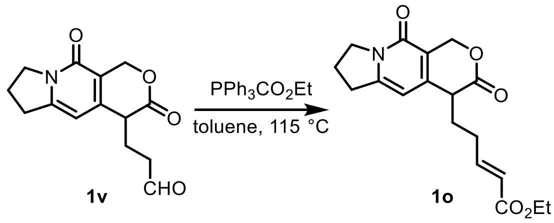


Synthesis of compound 1l: To a solution of **1u** (1mmol, 1.0 equiv.), DMAP (4-dimethylaminepyridine) (0.2 mmol, 0.2 equiv.) and triethylamine (1.5 mmol, 1.5 equiv.) was added benzoyl chloride (1 mmol, 1.2 equiv.) in DCM (10 mL) at 0 °C. The reaction mixture was warmed to room temperature, stirred for 6 h, and quenched with H_2O (2 mL). The water phase was extracted three times with DCM (20 mL). The combined organic layers were dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by flash chromatography on silica gel to give **1l**.

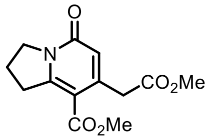


Synthesis of compound 1v: To a solution of **1u** (3 mmol, 1.0 equiv.) in DCM (20 mL) was added Dess-Martin periodinane (4.5 mmol, 1.5 equiv.) and $NaHCO_3$ (15 mmol, 5.0 equiv.). The resultant solution was stirred for 40 min at room temperature. After completion of the reaction, the mixture was quenched with sodium thiosulfate, and the solvent was removed under reduced pressure. The residue was purified by flash chromatography on silica gel to give **1v**.

Synthesis of compound 1n: Ethylene glycol (1.3 mmol, 1.3 equiv.) was added to a solution of **1v** (1 mmol, 1.0 equiv.) in toluene (10 mL), followed by addition of phosphoric acid (0.04 mmol, 0.04 equiv.). The reaction mixture was heated at reflux (110 °C) for 4 h, cooled to room temperature, and evaporated under reduced pressure. The residue was purified by flash chromatography on silica gel to give **1n**.

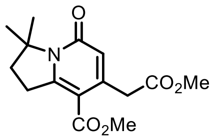


Synthesis of compound 1o: Under an argon atmosphere, **1v** (1 mmol, 1.0 equiv.) and ethyl (triphenylphosphoranylidene) acetate (1.1 mmol, 1.1 equiv.) were dissolved in toluene and heated at 112 ℃ for 12 h. After completion of the reaction, the solvent was evaporated under reduced pressure. The residue was purified by flash chromatography on silica gel to give **1o**.



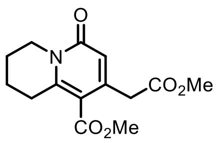
S1a

S1a was a known compound according to the literature.[4]



S1p

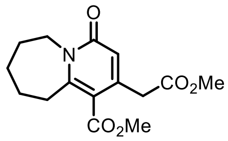
S1p was obtained in 68% yield as a pale yellow solid.
m.p.: 85.0-86.5 °C.
TLC: R_f = 0.5 (DCM: MeOH = 40:1).
^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.19 (s, 1H), 3.78 (s, 3H), 3.73 (s, 2H), 3.71 (s, 3H), 3.35 (t, *J* = 7.6 Hz, 2H), 2.04 (t, *J* = 8.0 Hz, 2H), 1.68 (s, 6H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 170.9, 166.1, 161.4, 157.2, 145.9, 121.7, 105.9, 69.1, 51.9, 51.4, 40.7, 37.2, 30.7, 25.5.
HRMS (ESI): *m/z* calcd for $C_{15}H_{19}NNaO_5$ $[M+Na]^+$: 316.1155, found 316.1155.
FT-IR (cm^{-1}): 1741, 1525, 1438, 1343, 1283, 863, 797, 675.



S1q

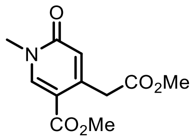
S1q was obtained in 76% yield as a yellow solid.
m.p.: 57.8-58.9 °C.
TLC: R_f = 0.4 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.32 (s, 1H), 4.28 (q, *J* = 7.2 Hz, 1H), 4.03 (t, *J* = 6.4 Hz, 2H), 3.81 (s, 1H), 3.69 (s, 3H), 3.63 (d, *J* = 8. 4 Hz, 2H), 3.03-2.97 (m, 2H), 1.93 (quint, *J* = 6.6 Hz, 2H), 1.81 (quint, *J* = 6.6 Hz, 2H), 1.34 (t, *J* = 6.6 Hz, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.3, 170.2, 167.0, 166.6, 161.9, 150.9, 150.6, 143.9, 143.8, 118.4, 111.4, 110.9, 61.2, 52.0, 51.8, 41.7, 40.2, 40.0, 27.0, 21.2, 18.2, 13.9.
HRMS (ESI): *m/z* calcd for $C_{14}H_{18}NO_5$ $[M+H]^+$: 280.1179, found 280.1177.
FT-IR (cm^{-1}): 1740, 1518, 1436, 1288, 1141, 1015, 857, 743.



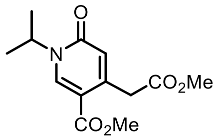
S1r

S1r was obtained in 75% yield as a pale yellow solid.
m.p.: 55.6-56.9 °C.
TLC: R_f = 0.4 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.33 (s, 1H), 4.41 (s, 2H), 3.81 (s, 3H), 3.70 (s, 3H), 3.57 (s, 2H), 2.94-2.90 (m, 2H), 1.85-1.78 (m, 4H), 1.77-1.74 (m, 2H).
^{13}C NMR (150 MHz, Chloroform-d): δ 170.1, 167.7, 162.0, 153.8, 119.2, 43.4, 39.8, 29.0, 27.1, 25.8.
HRMS (ESI): *m/z* calcd for $C_{15}H_{19}NNaO_5$ $[M+Na]^+$: 316.1155, found 316.1159.
FT-IR (cm^{-1}): 1739, 1721, 1657, 1435, 1131, 870, 725, 636.



S1s

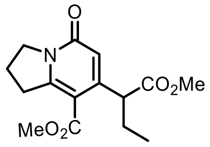
S1s was obtained in 82% yield as a white solid.
m.p.: 129.5-131.9 °C.
TLC: R_f = 0.4 (DCM: MeOH = 100:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 8.24 (s, 1H), 3.82 (s, 2H), 3.81 (s, 3H), 3.72 (s, 3H), 3.59 (s, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.5, 164.6, 162.1, 146.4, 144.6, 121.8, 108.9, 52.0, 51.8, 40.1, 37.7.
HRMS (ESI): *m/z* calcd for $C_{11}H_{13}NNaO_5$ $[M+Na]^+$: 262.0686, found 262.0677.
FT-IR (cm^{-1}): 1736, 1667, 1461, 1346, 1139, 1054, 769, 664.



S1t

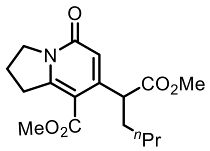
S1t was obtained in 51% yield as a light yellow oil.
TLC: R_f = 0.5 (DCM: MeOH = 100:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 8.25 (s, 1H), 6.37 (s, 1H), 5.22 (quint, *J* = 6.8 Hz, 1H), 3.81 (s, 3H), 3.80 (s, 2H), 3.72 (s, 3H), 1.41 (s, 3H), 1.40 (s, 3H), 1.39 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*): δ 170.6, 164.8, 161.4, 145.3, 139.7, 121.9, 109.2, 52.0, 51.7, 47.0, 40.1, 21.9.
HRMS (ESI): *m/z* calcd for $C_{13}H_{17}NNaO_5$ $[M+Na]^+$: 290.0999, found 290.1005.
FT-IR (cm^{-1}): 1716, 1659, 1460, 1297, 1160, 1038, 964, 770, 655.



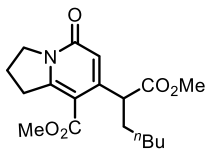
S2a

S2a was known compounds according to the literature. [4]



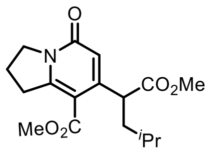
S2b

S2b was obtained from **S1a** in 61% yield as a saffron yellow oil.
TLC: R_f = 0.5 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.39 (s, 1H), 4.16 (td, *J* = 12.6, 6.6 Hz, 2H), 4.09 (t, *J* = 7.2 Hz, 1H), 3.83 (s, 3H), 3.66 (s, 3H), 3.47-3.36 (m, 2H), 2.21 (q, *J* = 7.8 Hz, 2H), 2.09-2.03 (m, 1H), 1.75-1.69 (m, 1H), 1.34-1.25(m, 4H), 0.88 (t, *J* = 7.2 Hz, 3H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 173.0, 166.0, 161.0, 156.1, 151.6, 117.2, 106.8, 52.0, 51.6, 49.0, 48.0, 34.3, 31.8, 29.8, 22.4, 20.6, 13.7.
HRMS (ESI): *m/z* calcd for $C_{17}H_{24}NO_5$ $[M+H]^+$: 322.1649, found 322.1647.
FT-IR (cm^{-1}): 1736, 1657, 1587, 1436, 1291, 1020, 865, 791.



S2c

S2c was obtained from **S1a** in 91% yield as a brownish oil.
TLC: R_f = 0.5 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.31 (s, 1H), 4.13-4.06 (m, 2H), 4.02 (t, *J* = 7.2 Hz, 1H), 3.76 (s, 3H), 3.59 (s, 3H), 3.35 (td, *J* = 18.6, 10.8 Hz, 2H), 2.20-2.10 (m, 2H), 2.04-1.95 (m, 1H), 1.68-1.60 (m, 1H), 1.31-1.15 (m, 8H), 0.82-0.77 (m, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 172.9, 160.9, 156.0, 151.6, 51.9, 51.5, 48.9, 48.0, 34.2, 32.0, 31.3, 28.9, 27.5, 22.3, 20.5, 13.8.
HRMS (ESI): *m/z* calcd for $C_{19}H_{27}NNaO_5$ $[M+Na]^+$: 372.1781, found 372.1778.
FT-IR (cm^{-1}): 1713, 1660, 1436, 1291, 1090, 863, 791.



S2d

S2d was obtained from **S1a** in 54% yield as a yellow oil.

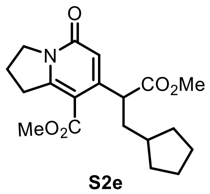
TLC: R_f = 0.6 (DCM: MeOH = 40:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.36 (s, 1H), 4.18 (t, *J* = 7.2 Hz, 1H), 4.11 (td, *J* = 10.8, 5.4 Hz, 2H), 3.79 (s, 3H), 3.61 (s, 3H), 3.43-3.30 (m, 2H), 2.16 (quint, *J* = 7.8 Hz, 2H), 1.92-1.84 (m, 1H), 1.49-1.47 (m, 2H), 0.86 (d, *J* = 6.6 Hz, 3H), 0.84 (d, *J* = 6.6 Hz, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*): δ 173.1, 166.0, 161.0, 156.0, 151.6, 117.2, 52.0, 51.6, 49.0, 45.8, 41.0, 34.2, 25.8, 22.5, 22.0, 20.6.

HRMS (ESI): *m/z* calcd for $C_{17}H_{23}NNaO_5$ $[M+Na]^+$: 344.1468, found 344.1471.

FT-IR (cm^{-1}): 1642, 1461, 1123, 1090, 1040, 749.



S2e

S2e was obtained from **S1a** in 45% yield as a colorless oil.

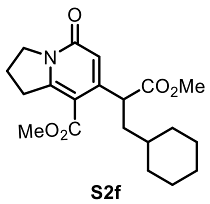
TLC: R_f = 0.5 (DCM: MeOH = 40:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.42 (s, 1H), 4.20-4.10(m, 3H), 3.83 (s, 3H), 3.66 (s, 3H), 3.47-3.50 (m, 2H), 2.20 (quint, *J* = 7.8 Hz, 2H), 2.09-2.03 (m, 1H), 1.77-1.71 (m, 4H), 1.64-1.57 (m, 2H), 1.53- 1.45 (m, 2H), 1.15-1.05 (m, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 173.1, 166.1, 161.1, 156.1, 151.7, 117.5, 106.9, 52.1, 51.7, 49.1, 47.4, 38.3, 37.9, 34.3, 32.6, 32.2, 25.0, 24.9, 20.6.

HRMS (ESI): *m/z* calcd for $C_{19}H_{25}NNaO_5$ $[M+Na]^+$: 370.1625, found 370.1627.

FT-IR (cm^{-1}): 1714, 1659, 1436, 1289, 1090, 863.



S2f

S2f was obtained from **S1a** in 48% yield as a colorless oil.

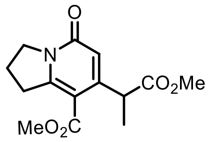
TLC: R_f = 0.6 (DCM: MeOH = 40:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.26 (s, 1H), 4.14 (t, *J* = 7.2 Hz, 1H), 4.09-4.00 (m, 2H), 3.70 (s, 3H), 3.54 (s, 3H), 3.36-3.23 (m, 2H), 2.08 (quint, *J* = 7.6 Hz, 2H), 1.80 (quint, *J* = 7.2, 1H), 1.63-1.52 (m, 4H), 1.51-1.42 (m, 2H), 1.15-0.99 (m, 4H), 0.83-0.72(m, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 172.9, 165.7, 160.7, 155.8, 151.6, 116.7, 116.7, 106.6, 51.7, 51.4, 48.8, 44.7, 39.4, 35.0, 34.0, 32.9, 32.6, 26.1, 25.7, 25.7, 20.3.

HRMS (ESI): *m/z* calcd for $C_{20}H_{27}NNaO_5$ $[M+Na]^+$: 384.1781, found 384.1780.

FT-IR (cm^{-1}): 1714, 1660, 1436, 1288, 1127, 862.



S2g

S2g was obtained from **S1a** in 90% yield as a colorless oil.

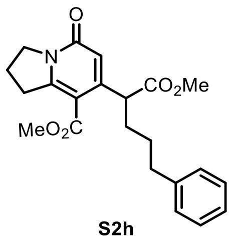
TLC: R_f = 0.5 (DCM: MeOH = 40:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.37 (s, 1H), 4.21 (q, *J* = 7.2 Hz, 1H), 4.16 (td, *J* = 7.2, 4.4 Hz, 2H), 3.81 (s, 3H), 3.68 (s, 3H), 3.50-3.40 (m, 2H), 2.23-2.18 (m, 2H), 1.49 (dd, *J* = 7.2, 3.4 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 173.6, 166.0, 161.2, 156.4, 152.8, 116.8, 106.5, 51.5, 49.0, 42.9, 20.6, 17.0, 14.5.

HRMS (ESI): *m/z* calcd for $C_{14}H_{18}NO_5$ $[M+H]^+$: 280.1179, found 280.1179.

FT-IR (cm^{-1}): 1649, 1437, 1111, 1061, 998, 668.



S2h

S2h was obtained from **S1a** in 64% yield as a saffron yellow oil.

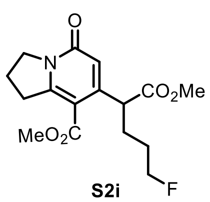
TLC: R_f = 0.5 (DCM: MeOH = 40:1).

^{1}H NMR (400 MHz, Chloroform-*d*): δ 7.29-7.22 (m, 2H), 7.20-7.10 (m, 3H), 6.40 (s, 1H), 4.16 (td, *J* = 7.4, 3.2 Hz, 2H), 4.09 (t, *J* = 7.2 Hz, 1H), 3.80 (s, 3H), 3.65 (s, 3H), 3.49-3.32 (m, 2H), 2.58 (t, *J* = 7.8 Hz, 2H), 2.19 (quint, *J* = 7.6 Hz, 2H), 2.13-2.03 (m, 1H), 1.84-1.71 (m, 1H), 1.67-1.54 (m, 2H), 1.41-1.30 (m, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.3, 164.8, 157.7, 157.6, 146.1, 118.5, 104.2, 64.8, 52.0, 49.5, 41.7, 35.0, 32.2, 32.0, 31.8, 31.6, 23.7, 20.6.

HRMS (ESI): *m/z* calcd for $C_{23}H_{27}NNaO_5$ $[M+Na]^+$: 420.1781, found 420.1778.

FT-IR (cm^{-1}): 1736, 1658, 1436, 1291, 749, 700.



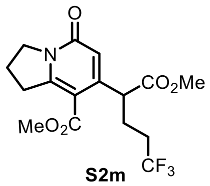
S2i

S2i was obtained from **S1a** in 79% yield as a yellow oil.

TLC: R_f = 0.5 (DCM: MeOH = 40:1).

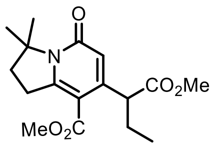
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.36 (s, 1H), 4.49 (s, 1H), 4.41 (s, 1H), 4.24-4.10 (m, 3H), 3.84 (s, 3H), 3.68 (s, 3H), 3.50-3.36 (m, 2H), 2.25-2.14 (m, 3H), 1.90-1.82 (m, 1H), 1.81-1.64 (m, 2H).

^{13}**C NMR** (150 MHz, Chloroform-*d*): δ 172.5, 165.8, 160.9, 156.5, 151.3, 117.0, 106.5, 83.9, 82.8, 52.1, 51.6, 49.0, 47.4, 34.4, 28.5, 28.3, 28.0, 27.9, 20.5.
^{19}**F NMR** (376 MHz, Chloroform-*d*): δ 18.37.
HRMS (ESI): *m/z* calcd for $C_{16}H_{20}FNNaO_5$ $[M+Na]^+$: 348.1218, found 348.1221.
FT-IR (cm^{-1}): 1736, 1659, 1519,1437, 1293, 1211, 1095, 999, 864.



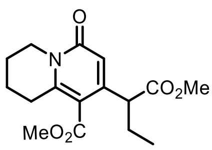
S2m

S2m was obtained from **S1a** in 55% yield as a yellow oil.
TLC: R_f = 0.4 (DCM: MeOH = 40:1).
^{1}**H NMR** (600 MHz, Chloroform-*d*): δ 6.35 (s, 1H), 4.25-4.11 (m, 3H), 3.84 (s, 3H), 3.69 (s, 3H), 3.52-3.46(m, 1H), 3.45-3.38 (m, 1H), 2.37-2.28 (m, 1H), 2.27-2.16 (m, 3H), 2.15-2.06 (m, 1H), 2.03-1.94 (m, 1H).
^{13}**C NMR** (150 MHz, Chloroform-*d*): δ 172.0, 165.7, 160.8, 157.1, 150.7, 126.7 (q, *J* = 400.5 Hz), 117.2, 106.2, 52.3, 51.8, 49.2, 46.7, 34.7, 31.9 (q, *J* = 28.5 Hz), 24.5, 20.5.
^{19}**F NMR** (376 MHz, Chloroform-*d*) δ -66.33.
HRMS (ESI): *m/z* calcd for $C_{16}H_{18}F_3NNaO_5$ $[M+Na]^+$: 384.1029, found 384.1016.
FT-IR (cm^{-1}): 1736, 1713, 1655, 1293, 1138, 1022, 865, 653.



S2p

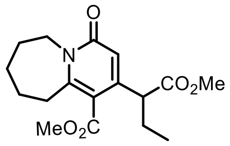
S2p was obtained from **S1p** in 80% yield as a light yellow oil.
TLC: R_f = 0.7 (DCM: MeOH = 40:1).
^{1}**H NMR** (400 MHz, Chloroform-*d*): δ 6.29 (s, 1H), 3.93 (t, *J* = 7.2 Hz, 1H), 3.83 (s, 3H), 3.68 (s, 3H), 3.35-3.18 (m, 2H), 2.10 (dd, *J* = 14.4, 7.0 Hz, 1H), 2.03 (d, *J* = 7.8 Hz, 2H), 1.76 (dd, *J* = 14.2, 7.2 Hz, 1H), 1.69 (s, 3H), 1.67 (s, 3H), 0.94 (t, *J* = 7.4 Hz, 3H).
^{13}**C NMR** (100 MHz, Chloroform-*d*): δ 172.9, 166.3, 161.5, 155.8, 150.2, 118.7, 106.5, 69.1, 51.9, 51.5, 49.4, 37.2, 30.4, 25.5, 25.3, 25.2, 12.3.
HRMS (ESI): *m/z* calcd for $C_{17}H_{24}NO_5$ $[M+H]^+$: 322.1649, found 322.1642.
FT-IR (cm^{-1}): 1713, 1659, 1519, 1437, 1293, 1133, 999, 864.



S2q

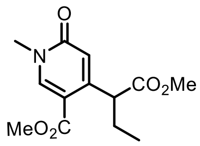
S2q was obtained from **S1q** in 75% yield as a light yellow oil.
TLC: R_f = 0.5 (DCM: MeOH = 40:1).

^{1}**H NMR** (600 MHz, Chloroform-*d*): δ 6.47 (s, 1H), 4.35 (t, *J* = 7.2 Hz, 1H), 4.01 (t, *J* = 6.6 Hz, 2H), 3.86 (s, 1H), 3.67 (s, 3H), 3.48 (dt, *J* = 20.4, 7.4 Hz, 1H), 2.92-2.80 (m, 2H), 2.04 (hept, *J* = 7.8 Hz, 1H), 1.99-1.91 (m, 2H), 1.85-1.72(m, 3H), 1.37 (t, *J* = 7.2 Hz, 2H), 0.92 (t, *J* = 7.4 Hz, 3H).
^{13}**C NMR** (150 MHz, Chloroform-*d*): δ 172.4, 167.5, 167.1, 162.3, 148.3, 147.9, 147.8, 115.4, 115.2, 112.8, 112.3, 61.5, 52.2, 49.7, 49.4, 41.9, 26.9, 25.6, 25.3, 21.4, 18.3, 14.0, 12.2.
HRMS (ESI): *m/z* calcd for $C_{16}H_{21}NNaO_5$ $[M+Na]^+$: 330.1312, found 330.1315.
FT-IR (cm^{-1}): 1737, 1656, 1517, 1435, 1290, 1140, 859, 789, 651.



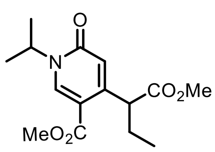
S2r

S2r was obtained from **S1r** in 64% yield as a light yellow oil.
TLC: R_f = 0.5 (DCM: MeOH = 40:1)
^{1}**H NMR** (400 MHz, Chloroform-*d*): δ 6.47 (s, 1H), 4.48-4.39 (m, 1H), 4.36-4.31 (m, 1H), 3.85 (s, 3H), 3.68 (s, 3H), 3.38 (t, *J* = 6.8 Hz, 3H 1H), 2.85-2.77 (m, 2H), 2.07-1.97 (m, 1H), 1.82-1.74 (m, 7H), 0.92 (t, *J* = 7.4 Hz, 3H).
^{13}**C NMR** (150 MHz, Chloroform-*d*): δ 172.3, 168.0, 162.2, 151.6, 147.6, 116.2, 113.1, 108.1, 52.3, 52.2, 49.6, 43.4, 31.7, 29.0, 27.1, 25.9, 25.5, 12.2.
HRMS (ESI): *m/z* calcd for $C_{17}H_{23}NNaO_5$ $[M+Na]^+$: 344.1468, found 344.1478.
FT-IR (cm^{-1}): 1736, 1659, 1589, 1526, 1437, 1297, 1131, 997, 862.



S2s

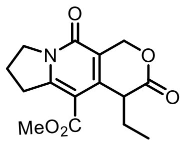
S2s was obtained from **S1s** in 48% yield as a saffron yellow oil.
TLC: R_f = 0.7 (DCM: MeOH = 100:1).
^{1}**H NMR** (400 MHz, Chloroform-*d*): δ 8.24 (s, 1H), 6.50 (s, 1H), 4.31 (t, *J* = 7.2 Hz, 1H), 3.83 (s, 3H), 3.68 (s, 3H), 3.59 (s, 3H), 2.09 (hept, *J* = 7.2, 1H), 1.79 (hept, *J* = 7.6, 1H), 0.95 (t, *J* = 7.4 Hz, 3H).
^{13}**C NMR** (100 MHz, Chloroform-*d*): δ 172.8, 164.6, 162.3, 151.4, 144.8, 119.2, 108.7, 52.0, 51.8, 48.9, 37.7, 25.1, 12.3.
HRMS (ESI): *m/z* calcd for $C_{13}H_{17}NNaO_5$ $[M+Na]^+$: 290.0999, found 290.0999.
FT-IR (cm^{-1}): 1720, 1667, 1453, 1293, 1138, 1053, 776, 664.



S2t

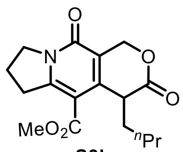
S2t was obtained from **S1t** in 41% yield as a pale yellow oil.

TLC: R_f = 0.7 (DCM: MeOH = 100:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 8.24 (s, 1H), 6.48 (s, 1H), 5.21 (quint, *J* = 6.8 Hz, 1H), 4.33-4.26 (m, 1H), 3.84 (s, 3H), 3.68 (s, 3H), 2.09 (hept, *J* = 7.2 Hz, 1H), 1.78 (hept, *J* = 6.6 Hz, 1H), 1.41 (d, *J* = 2.4 Hz, 3H), 1.40 (d, *J* = 2.4 Hz, 3H), 0.96 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 173.0, 164.9, 161.6, 150.3, 139.9, 119.3, 109.0, 52.0, 51.9, 49.0, 47.1, 25.2, 21.9, 21.9, 12.4.
HRMS (ESI): *m/z* calcd for $C_{15}H_{21}NNaO_5$ $[M+Na]^+$: 318.1312, found 318.1307.
FT-IR (cm^{-1}): 1720, 1666, 1521, 1455, 1297, 1195, 1046, 871, 774.



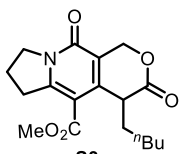
S3a

S3a was known compounds according to the literature.[4]



S3b

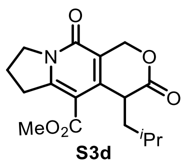
S3b was obtained from **S2b** in 76% yield as a colorless oil.
TLC: R_f = 0.6 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.50 (d, *J* = 15.6 Hz, 1H), 5.15 (d, *J* = 15.6 Hz, 1H), 4.42 (dd, *J* = 9.6, 5.4 Hz, 1H), 4.24-4.15 (m, 2H), 3.87 (s, 3H), 3.55-3.44 (m, 2H), 2.30-2.21 (m, 2H), 1.90-1.84 (m, 1H), 1.78-1.72 (m, 1H), 1.49-1.44 (m, 2H), 1.42-1.36 (m, 1H), 1.35-1.29 (m, 1H), 0.90 (t, *J* = 7.2 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.4, 165.1, 157.9, 156.9, 147.5, 118.4, 104.7, 64.8, 51.9, 49.3, 43.0, 34.7, 31.3, 29.2, 22.2, 20.6, 13.7.
HRMS (ESI): *m/z* calcd for $C_{17}H_{21}NNaO_5$ $[M+Na]^+$: 342.1312, found 342.1309.
FT-IR (cm^{-1}): 1635, 1417, 1308, 1122, 664.



S3c

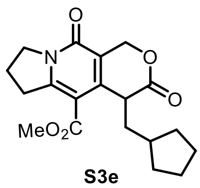
S3c was obtained from **S2c** in 64% yield as a saffron yellow oil.
TLC: R_f = 0.6 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.33 (d, *J* = 15.6 Hz, 1H), 5.01 (d, *J* = 15.6 Hz, 1H), 4.29 (dd, *J* = 9.0, 4.8 Hz, 1H), 4.12-4.03 (m, 2H), 3.75 (s, 3H), 3.46-3.30 (m, 2H), 2.18-2.07 (m, 2H), 1.78-1.68 (m, 1H), 1.66-1.57 (m, 1H), 1.38-1.29 (m, 2H), 1.26-1.20 (m, 1H), 1.19-1.09 (m, 5H), 0.74 (t, *J* = 6.8 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.3, 165.0, 157.8, 157.0, 147.4, 118.1, 104.6, 64.7, 51.8, 49.3, 42.9, 34.7, 31.5, 31.4, 28.7, 27.0, 22.4, 20.6, 13.9.
HRMS (ESI): *m/z* calcd for $C_{19}H_{25}NNaO_5$ $[M+Na]^+$: 370.1625, found 370.1616.
FT-IR (cm^{-1}): 1714, 1650, 1306, 1113, 788.



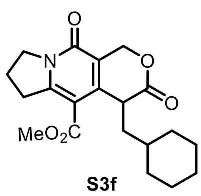
S3d

S3d was obtained from **S2d** in 65% yield as a white solid.
m.p.: 232.9-235.8 °C.
TLC: R_f = 0.7 (DCM: MeOH = 40:1).
^{1}H NMR (400 MHz, Chloroform-*d*): δ 5.47 (d, *J* = 15.6 Hz, 1H), 5.12 (d, *J* = 15.6 Hz, 1H), 4.50 (dd, *J* = 11.6, 4.8 Hz, 1H), 4.23-4.06 (m, 2H), 3.83 (s, 1H), 3.57-3.35 (m, 2H), 2.30-2.11 (m, 2H), 1.83-1.63 (m, 2H), 1.54-1.42 (m, 1H), 1.05 (d, *J* = 6.4 Hz, 3H), 0.89 (d, *J* = 6.6 Hz, 3H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 171.0, 164.9, 157.8, 157.0, 147.8, 118.4, 104.6, 64.5, 51.8, 49.3, 41.5, 39.4, 34.6, 26.0, 23.2, 21.0, 20.6.
HRMS (ESI): *m/z* calcd for $C_{17}H_{21}NNaO_5$ $[M+Na]^+$: 342.1312, found 342.1315.
FT-IR (cm^{-1}): 1645, 1437, 1308, 1116, 763, 636.



S3e

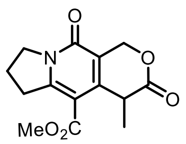
S3e was obtained from **S2e** in 65% yield as a yellow solid.
m.p.: 113.2-115.1 °C.
TLC: R_f = 0.6 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.52 (d, *J* = 15.6 Hz, 1H), 5.17 (d, *J* = 15.6 Hz, 1H), 4.48 (dd, *J* = 11.4, 4.8 Hz, 1H), 4.28-4.15 (m, 2H), 3.87 (s, 3H), 3.60-3.41 (m, 2H), 2.28-2.17 (m, 2H), 2.07-2.00 (m, 1H), 1.98-1.91 (m, 1H), 1.92-1.83 (m, 1H), 1.82-1.75 (m, 1H), 1.70-1.55 (m, 5H), 1.28-1.24 (m, 1H), 1.17-1.06 (m, 1H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.3, 165.1, 158.0, 156.9, 148.0, 118.6, 104.9, 51.9, 49.4, 42.9, 37.8, 37.0, 34.7, 33.0, 31.8, 25.1, 25.0, 20.7.
HRMS (ESI): *m/z* calcd for $C_{19}H_{23}NNaO_5$ $[M+Na]^+$: 368.1468, found 368.1466.
FT-IR (cm^{-1}): 1740, 1649, 1545, 1307, 1125, 734, 627.



S3f

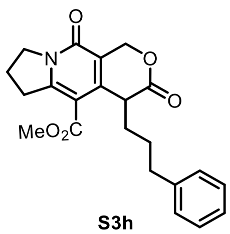
S3f was obtained from **S2f** in 71% yield as a colorless oil.

TLC: R_f = 0.7 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.49 (d, *J* = 15.6 Hz, 1H), 5.16 (d, *J* = 15.6 Hz, 1H), 4.58 (dd, *J* = 11.2, 4.8 Hz, 1H), 4.27-4.13 (m, 2H), 3.88 (s, 3H), 3.57-3.50 (m, 1H), 3.50-3.42 (m, 1H), 2.31-2.18 (m, 2H), 2.13 (d, *J* = 12.6 Hz, 1H), 1.74 (d, *J* = 12.6 Hz, 1H), 1.71-1.54 (m, 5H), 1.45 (qd, *J* = 10.8, 3.6 Hz, 1H), 1.34-1.21 (m, 2H), 1.19-1.10 (m, 1H), 0.99-0.89 (m, 2H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.0, 164.8, 156.9, 147.9, 118.3, 64.3, 51.7, 49.2, 40.6, 38.1, 35.0, 34.6, 33.7, 31.7, 26.1, 25. 9, 25.7, 20.5.
HRMS (ESI): *m/z* calcd for $C_{20}H_{25}NNaO_5$ $[M+Na]^+$: 382.1625, found 382.1614.
FT-IR (cm^{-1}): 1713, 1650, 1307, 1080, 793, 734.



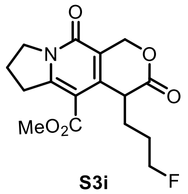
S3g

S3g was obtained from **S2g** in 76% yield as a white solid.
m.p.: 151.2-152.9 °C.
TLC: R_f = 0.7 (DCM: MeOH = 40:1).
^{1}H NMR (400 MHz, Chloroform-*d*): δ 5.53 (d, *J* = 15.6 Hz, 1H), 5.15 (d, *J* = 15.6 Hz, 1H), 4.46 (q, *J* = 7.4 Hz, 1H), 4.27-4.16 (m, 2H), 3.88 (s, 3H), 3.60-3.42 (m, 2H), 2.31-2.20 (m, 2H), 1.55 (dd, *J* = 7.4, 3.2 Hz, 3H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 157.1, 118.0, 104.5, 64.4, 51.9, 49.5, 37.8, 34.7, 20.5, 16.9.
HRMS (ESI): *m/z* calcd for $C_{14}H_{16}NO_5$ $[M+H]^+$: 278.1023, found 278.1024.
FT-IR (cm^{-1}): 1711, 1642, 1311, 1138, 1047, 630.



S3h

S3h was obtained from **S2h** in 72% yield as a light yellow oil.
TLC: R_f = 0.6 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.26 (t, *J* = 7.2 Hz, 2H), 7.15 (t, *J* = 5.6 Hz, 3H), 5.49 (d, *J* = 15.6 Hz, 1H), 5.12 (d, *J* = 15.6 Hz, 1H), 4.42 (dd, *J* = 9.6, 5.0 Hz, 1H), 4.28-4.11 (m, 2H), 3.82 (s, 3H), 3.59-3.41 (m, 2H), 2.61 (t, *J* = 7.8 Hz, 2H), 2.33-2.15 (m, 2H), 1.92-1.83 (m, 1H), 1.80-1.73 (m, 1H), 1.68 (dt, *J* = 14.6, 7.2 Hz, 1H), 1.61-1.57 (m, 1H), 1.58-1.47 (m, 2H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 171.2, 165.0, 157.8, 156.9, 147.3, 142.0, 128.2, 128.2, 125.6, 118.3, 104.6, 64.7, 51.8, 49.3, 42.9, 35.5, 34.7, 31.3, 30.9, 26.7, 20.5.
HRMS (ESI): *m/z* calcd for $C_{23}H_{25}NNaO_5$ $[M+Na]^+$: 418.1625, found 418.1620.
FT-IR (cm^{-1}): 1709, 1646, 1437, 1307, 1090, 750, 701.



S3i

S3i was obtained from **S2i** in 79% yield as a yellow oil.

TLC: R_f = 0.6 (DCM: MeOH = 40:1).

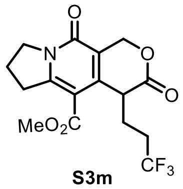
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.53 (d, *J* = 15.8 Hz, 1H), 5.17 (d, *J* = 15.8 Hz, 1H), 4.62-4.44 (m, 3H), 4.27-4.16 (m, 2H), 3.88 (s, 3H), 3.63-3.51 (m, 1H), 3.51-3.43 (m, 1H), 2.34-2.22 (m, 2H), 2.06-1.84 (m, 4H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.0, 165.0, 157.8, 157.3, 147.0, 118.4, 104.5, 83.3, 82.2, 64.8, 52.0, 49.4, 42.3, 34.8, 28.2, 28.0, 27.1, 27.1, 20.6.

^{19}F NMR (376 MHz, Chloroform-*d*): δ 16.69.

HRMS (ESI): *m/z* calcd for $C_{16}H_{18}FNNaO_5$ $[M+Na]^+$: 346.1061, found 346.1062.

FT-IR (cm^{-1}): 1713, 1657, 1438, 1293, 1133, 999, 864, 792.



S3m

S3m was obtained from **S2m** in 77% yield as a saffron yellow oil.

TLC: R_f = 0.6 (DCM: MeOH = 40:1).

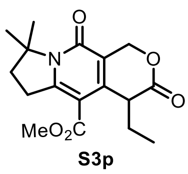
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.54 (d, *J* = 16.2 Hz, 1H), 5.17 (d, *J* = 16.2 Hz, 1H), 4.38 (dd, *J* = 10.8, 4.2 Hz, 1H), 4.28-4.22 (m, 1H), 4.20-4.13 (m, 1H), 3.88 (s, 3H), 3.62-3.54 (m , 1H), 3.52-3.42 (m, 1H), 2.47-2.37 (m, 2H), 2.30-2.21 (m, 2H), 2.17-2.10 (m, 1H), 1.93 (qd, *J* = 11.6, 5.4 Hz, 1H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.3, 164.8, 157.7, 157.6, 146.1, 125.7 (d, *J* = 226.5 Hz), 118.5, 104.2, 64.8, 52.0, 49.5, 41.7, 35.0, 31.9 (q, *J* = 30.0 Hz), 23.7, 20.6.

^{19}F NMR (376 MHz, Chloroform-*d*): δ -66.57.

HRMS (ESI): *m/z* calcd for $C_{16}H_{16}F_3NNaO_5$ $[M+Na]^+$: 382.0873, found 382.0873.

FT-IR (cm^{-1}): 1649, 1440, 1308, 1126, 979, 636.



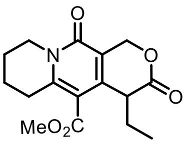
S3p

S3p was obtained from **S2p** in 80% yield as a colorless oil.

TLC: R_f = 0.7 (DCM: MeOH = 60:1).

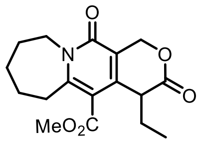
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.48 (d, *J* = 15.8 Hz, 1H), 5.13 (d, *J* = 15.8 Hz, 1H), 4.25 (dd, *J* = 9.6, 4.8 Hz, 1H), 3.86 (s, 3H), 3.42-3.26 (m, 2H), 2.07 (t, *J* = 7.8 Hz, 2H), 1.96 (td, *J* = 13.2, 7.2 Hz, 1H), 1.80 (td, *J* = 14.4, 7.8 Hz, 1H), 1.71 (s, 3H), 1.68 (s, 3H), 1.09 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.4, 165.4, 158.4, 156.7, 146.3, 119.5, 104.6, 69.9, 65.0, 51.9, 44.1, 37.2, 30.8, 25.8, 25.4, 25.2, 11.8.
HRMS (ESI): *m/z* calcd for $C_{17}H_{21}NNaO_5$ [M+Na]$^+$: 342.1312, found 342.1312.
FT-IR (cm^{-1}): 1711, 1650, 1543. 1438, 1303, 1191, 794, 730.



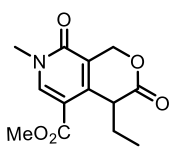
S3q

S3q was obtained from **S2q** in 65% yield as a light yellow oil.
TLC: R_f = 0.6 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.49 (d, *J* = 17.6 Hz, 1H), 5.17 (d, *J* = 17.6 Hz, 1H), 4.40-4.31 (m, 1H), 4.15-4.07 (m, 1H), 4.07-4.00 (m, 1H), 3.75-3.70 (m, 1H), 2.95 (t, *J* = 6.6 Hz, 2H), 2.04-1.93 (m, 3H), 1.87-1.74 (m, 3H), 1.39 (t, *J* = 7.2 Hz, 2H), 1.05 (td, *J* = 7.4, 2.8 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.7, 165.8, 158.8, 149.5, 143.5, 116.8, 109.9, 65.7, 61.7, 52.4, 44.0, 42.0, 27.0, 25.4, 21.2, 14.1.
HRMS (ESI): *m/z* calcd for $C_{16}H_{19}NNaO_5$ [M+Na]$^+$: 328.1155, found 328.1158.
FT-IR (cm^{-1}): 1717, 1651, 1537, 1299, 1170, 1048, 786, 732, 580.



S3r

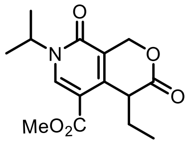
S3r was obtained from **S2r** in 69% yield as a colorless oil.
TLC: R_f = 0.6 (DCM: MeOH = 40:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.46 (d, *J* = 16.0 Hz, 1H), 5.15 (d, *J* = 16.0 Hz, 1H), 4.55 (dd, *J* = 14.6, 7.2 Hz, 1H), 4.31 (dd, *J* = 14.4, 8.4 Hz, 1H), 3.88 (s, 3H), 3.60 (dd, *J* = 9.0, 4.8 Hz, 1H), 2.96-2.89 (m, 1H), 2.89-2.80 (m, 1H), 2.02-1.93 (m, 1H), 1.88-1.72 (m, 7H), 1.05 (td, *J* = 7.4, 2.2 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.6, 166.8, 158.7, 152.9, 143.2, 117.7, 110.3, 66.0, 52.5, 43.9, 43.5, 31.6, 28.8, 27.0, 25.8, 25.5, 11.5.
HRMS (ESI): *m/z* calcd for $C_{17}H_{23}NNaO_5$ [M+Na]$^+$: 344.1468, found 344.1478.
FT-IR (cm^{-1}): 1722, 1654, 1545, 1438, 1301, 1168, 906, 795, 732.



S3s

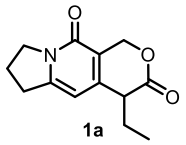
S3s was obtained from **S2s** in 37% yield as a white solid.
m.p.: 167.2-168.5 °C.
TLC: R_f = 0.8 (DCM: MeOH = 100:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 8.29 (s, 1H), 5.48 (d, *J* = 16.2 Hz, 1H), 5.16 (d, *J* = 16.2 Hz, 1H), 4.57 (dd, *J* = 9.0, 5.4 Hz, 1H), 3.86 (s, 3H), 3.63 (s, 3H), 1.99-1.93 (m, 1H), 1.87-1.80 (m, 1H), 1.64 (s, 1H), 1.09 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.7, 163.9, 159.1, 146.6, 144.6, 120.6, 106.9, 65.3, 52.1, 43.0, 37.9, 25.6, 11.6.
HRMS (ESI): *m/z* calcd for $C_{13}H_{15}NNaO_5$ $[M+Na]^+$: 288.0842, found 288.0836.
FT-IR (cm^{-1}): 1714, 1657, 1310, 1017, 856, 660.



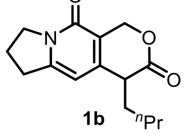
S3t

S3t was obtained from **S2t** in 38% yield as a white solid.
m.p.: 110.4-112.7 °C.
TLC: R_f = 0.8 (DCM: MeOH = 100:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 8.30 (s, 1H), 5.49 (d, *J* = 16.2 Hz, 1H), 5.24 (quint, *J* = 6.8 Hz, 1H), 5.16 (d, *J* = 16.2 Hz, 1H), 4.56 (dd, *J* = 9.0, 4.8 Hz, 1H), 3.88 (s, 3H), 2.00-1.94 (m, 1H), 1.87-1.79 (m, 1H), 1.43 (d, *J* = 4.2 Hz, 3H), 1.42 (d, *J* = 4.2 Hz, 3H), 1.10 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.9, 164.1, 158.4, 145.7, 139.7, 120.5, 107.2, 65.5, 52.1, 47.7, 43.0, 25.6, 21.9, 21.8, 11.7.
HRMS (ESI): *m/z* calcd for $C_{15}H_{19}NNaO_5$ $[M+Na]^+$: 316.1155, found 316.1166.
FT-IR (cm^{-1}): 1720, 1657, 1455, 1260, 1089, 1018, 798, 661.



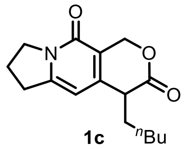
1a

1a was known compounds according to the literature.[4]



1b

1b was obtained from **S3b** in 54% yield as a yellow oil.
TLC: R_f = 0.4 (DCM: MeOH = 30:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.00 (s, 1H), 5.42 (d, *J* = 15.6 Hz, 1H), 5.23 (d, *J* = 15.6 Hz, 1H), 4.15 (t, *J* = 7.2 Hz, 2H), 3.42 (t, *J* = 6.8 Hz, 1H), 3.12 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.6 Hz, 2H), 1.89-1.82 (m, 2H), 1.47-1.32 (m, 4H), 0.90 (t, *J* = 7.0 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.4, 158.3, 150.4, 146.9, 116.9, 100.1, 65.9, 48.5, 44.6, 31.7, 31.3, 28.8, 22.3, 21.3, 13.7.
HRMS (ESI): *m/z* calcd for $C_{15}H_{19}NNaO_3$ $[M+Na]^+$: 284.1257, found 284.1253.
FT-IR (cm^{-1}): 1740, 1653, 1574, 1233, 1072, 733.



1c

1c was obtained from **S3c** in 58% yield as a pale yellow solid.

m.p.: 77.9-79.2 °C.

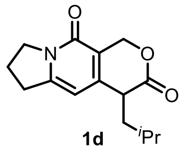
TLC: R_f = 0.4 (DCM: MeOH = 30:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.00 (s, 1H), 5.39 (d, *J* = 15.6 Hz, 1H), 5.20 (d, *J* = 15.6 Hz, 1H), 4.12 (t, *J* = 7.4 Hz, 2H), 3.39 (t, *J* = 6.6 Hz, 1H), 3.09 (t, *J* = 7.8 Hz, 2H), 2.25-2.17 (m, 2H), 1.88 -1.81 (m, 2H), 1.40-1.31 (m, 2H), 1.30-1.20 (m, 6H), 0.84 (t, *J* = 6.6 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.5, 150.4, 146.9, 100.1, 65.9, 48.5, 44.6, 31.7, 31.6, 31.4, 28.9, 26.6, 22.4, 21.3, 13.9.

HRMS (ESI): *m/z* calcd for $C_{17}H_{23}NNaO_3$ $[M+Na]^+$: 312.1570, found 312.1566.

FT-IR (cm^{-1}): 1655, 1579, 1460, 1121, 1040, 858, 669.



1d

1d was obtained from **S3d** in 44% yield as a light yellow oil.

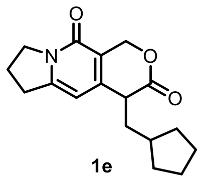
TLC: R_f = 0.4 (DCM: MeOH = 30:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.96 (s, 1H), 5.43 (d, *J* = 15.6 Hz, 1H), 5.20 (d, *J* = 15.6 Hz, 1H), 4.12 (t, *J* = 7.2 Hz, 2H), 3.46 (t, *J* = 7.4 Hz, 1H), 3.09 (t, *J* = 7.8 Hz, 2H), 2.21 (quint, *J* = 7.6 Hz, 2H), 1.78-1.66 (m, 2H), 1.57-1.49 (m, 1H), 0.96 (t, *J* = 6.0 Hz, 6H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.5, 150.6, 147.6, 117.0, 100.1, 65.6, 48.6, 43.2, 40.1, 31.7, 25.5, 22.3, 22.1, 21.3.

HRMS (ESI): *m/z* calcd for $C_{15}H_{19}NNaO_3$ $[M+Na]^+$: 284.1257, found 284.1253.

FT-IR (cm^{-1}): 1734, 1653, 1576, 1465, 1074, 750, 669.



1e

1e was obtained from **S3e** in 43% yield as a saffron yellow solid.

m.p.: 110.1-111.5 °C.

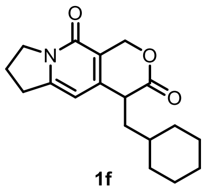
TLC: R_f = 0.4 (DCM: MeOH = 30:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.99 (s, 1H), 5.46 (d, *J* = 15.6 Hz, 1H), 5.22 (d, *J* = 15.6 Hz, 1H), 4.15 (t, *J* = 7.2 Hz, 1H), 3.44 (t, *J* = 7.2 Hz, 1H), 3.11 (t, *J* = 7.8 Hz, 2H), 2.24 (q, *J* = 7.6 Hz, 2H), 1.94-1.87 (m, 3H), 1.86-1.75 (m, 2H), 1.86-1.76 (m, 2H), 1.75-1.71 (m, 1H), 1.66-1.61 (m, 2H), 1.58-1.51 (m, 2H), 1.19-1.11 (m, 2H).

^{13}C NMR (100 MHz, Chloroform-*d*): δ 171.6, 158.5, 150.5, 147.5, 116.9, 100.2, 65.7, 48.6, 44.6, 37.7, 37.2, 32.6, 32.4, 31.7, 25.1, 25.1, 21.4.

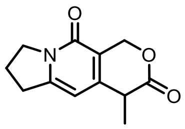
HRMS (ESI): *m/z* calcd for $C_{17}H_{21}NNaO_3$ $[M+Na]^+$: 310.1414, found 310.1402.

FT-IR (cm^{-1}): 1640, 1462, 1121, 1039, 662.



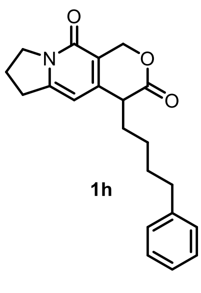
1f

1f was obtained from **S3f** in 51% yield as a white foam.
TLC: R_f = 0.4 (DCM: MeOH = 30:1).
^{1}H NMR (400 MHz, Chloroform-*d*): δ 5.95 (s, 1H), 5.43 (d, *J* = 15.6 Hz, 1H), 5.21 (d, *J* = 15.6 Hz, 1H), 4.13 (t, *J* = 7.2 Hz, 2H), 3.50 (t, *J* = 7.6 Hz, 1H), 3.10 (t, *J* = 7.8 Hz, 2H), 2.22 (quint, *J* = 7.6 Hz, 2H), 1.82 (d, *J* = 10.8 Hz, 1H), 1.77-1.62 (m, 5H), 1.59-1.49 (m, 1H), 1.45-1.32 (m, 1H), 1.30-1.09 (m, 3H), 1.01-0.84 (m, 2H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 171.6, 158.5, 150.6, 147.8, 117.0, 100.1, 65.6, 48.6, 42.4, 38.6, 34.7, 33.1, 32.8, 31.7, 26.2, 25.9, 25.8, 21.3.
HRMS (ESI): *m/z* calcd for $C_{18}H_{23}NNaO_3$ $[M+Na]^+$:324.1570, found 324.1581.
FT-IR (cm^{-1}): 1740, 1647, 1576, 1448, 1074, 669.



1g

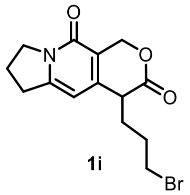
1g was obtained from **S3g** in 52% yield as a white solid.
m.p.: 177.7-179.8 °C.
TLC: R_f = 0.4 (DCM: MeOH = 30:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.11 (s, 1H), 5.42 (d, *J* = 15.0 Hz, 1H), 5.22 (d, *J* = 15.0 Hz, 1H), 4.16 (t, *J* = 7.8 Hz, 2H), 3.48 (q, *J* = 7.4 Hz, 1H), 3.13 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.8 Hz, 2H), 1.55 (dd, *J* = 7.4, 1.4 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 172.2, 158.2, 151.0, 147.8, 117.2, 98.6, 65.0, 48.6, 38.6, 31.8, 21.3, 14.3.
HRMS (ESI): *m/z* calcd for $C_{12}H_{14}NO_3$ $[M+H]^+$: 220.0968, found 220.0968.
FT-IR (cm^{-1}): 1738, 1649, 1572, 1243, 1033, 636.



1h

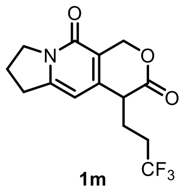
1h was obtained from **S3h** in 56% yield as a brownish oil.
TLC: R_f = 0.4 (DCM: MeOH = 30:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.27 (t, *J* = 7.4 Hz, 2H), 7.20-7.11 (m, 3H), 5.92 (s, 1H), 5.41 (d, *J* = 15.6 Hz, 1H), 5.21 (d, *J* = 15.6 Hz, 1H), 4.14 (t, *J* = 7.4 Hz, 2H), 3.40 (t, *J* = 6.8 Hz,

1H), 3.08 (t, J = 7.8 Hz, 2H), 2.60 (td, J = 7.6, 3.8 Hz, 2H), 2.23 (quint, J = 7.4 Hz, 2H), 1.92-1.83 (m, 2H), 1.70-1.59 (m, 2H), 1.45 (quint, J = 7.8 Hz, 2H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.4, 158.3, 150.5, 146., 141.9, 128.3, 128.2, 125.7, 117.0, 100.0, 65.8, 48.5, 44.5, 35.4, 31.7, 31.3, 30.9, 26.2, 21.3.
HRMS (ESI): *m/z* calcd for $C_{21}H_{23}NNaO_3$ [M+Na]$^+$: 360.1570, found 360.1581.
FT-IR (cm^{-1}): 1634, 1417, 1121, 673.



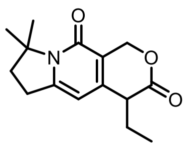
1i

1i was obtained from **S3i** in 48% yield as a yellow oil.
TLC: R_f = 0.4 (DCM: MeOH = 30:1).
^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.06 (s, 1H), 5.40 (d, J = 15.6 Hz, 1H), 5.28 (d, J = 15.6 Hz, 1H), 4.16 (t, J = 7.2 Hz, 2H), 3.47 (q, J = 6.8 Hz, 3H), 3.14 (t, J = 7.8 Hz, 2H), 2.25 (quint, J = 7.6 Hz, 2H), 2.09-1.94 (m, 4H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 170.8, 158.2, 150.9, 146.1, 117.0, 99.6, 65.8, 48.5, 43.2, 32.7, 31.7, 29.3, 29.2, 21.3.
HRMS (ESI): *m/z* calcd for $C_{14}H_{16}BrNNaO_3$ [M+Na]$^+$: 348.0217, found 348.0206.
FT-IR (cm^{-1}): 1712, 1649, 1260, 668, 530.



1m

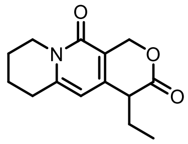
1m was obtained from **S3m** in 64% yield as a light yellow solid.
m.p.: 105.6-106.4 °C.
TLC: R_f = 0.4 (DCM: MeOH = 30:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.04 (s, 1H), 5.38 (s, 2H), 4.17 (t, J = 7.2 Hz, 2H), 3.47 (t, J = 6.8 Hz, 1H), 3.14 (t, J = 7.8 Hz, 2H), 2.44-2.23 (m, 4H), 2.21-2.09 (m, 2H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.2, 151.4, 145.1, 126.5 (d, J = 274.5 Hz), 65.7, 48.8, 42.6, 31.9, 31.1 (q, J = 28.5 Hz), 22.7, 22.7, 21.3.
^{19}F NMR (564 MHz, Chloroform-*d*): δ -66.33.
HRMS (ESI): *m/z* calcd for $C_{14}H_{14}F_3NNaO_3$ [M+Na]$^+$: 324.0818, found 324.0810.
FT-IR (cm^{-1}): 1650, 1441, 1257, 1140, 736.



1p

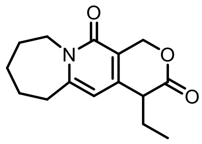
1p was obtained from **S3p** in 65% yield as a pale yellow solid.

m.p.: 129.3-131.9 °C.
TLC: R_f = 0.7 (DCM: MeOH = 30:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.92 (s, 1H), 5.38 (d, *J* = 15.6 Hz, 1H), 5.22 (d, *J* = 15.6 Hz, 1H), 3.35 (t, *J* = 6.6 Hz, 1H), 3.00 (t, *J* = 7.8 Hz, 2H), 2.08 (t, *J* = 7.8 Hz, 2H), 2.00-1.89 (m, 2H), 1.70 (s, 3H), 1.68 (s, 3H), 1.02 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 171.4, 158.8, 150.4, 146.0, 118.2, 99.9, 68.7, 66.0, 45.3, 37.6, 28.3, 25.5, 25.3, 24.8, 11.2.
HRMS (ESI): *m/z* calcd for $C_{15}H_{19}NNaO_3$ $[M+Na]^+$: 284.1257, found284.1260.
FT-IR (cm^{-1}): 1738, 1656, 1573, 1226, 1046, 733.



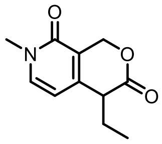
1q

1q was obtained from **S3q** in 54% yield as a pale yellow solid.
m.p.: 140.1-142.6 °C.
TLC: R_f = 0.6 (DCM: MeOH = 30:1).
^{1}H NMR (400 MHz, Chloroform-*d*): δ 5.89 (s, 1H), 5.41 (d, *J* = 16.8 Hz, 1H), 5.24 (d, *J* = 16.8 Hz, 1H), 4.10-3.92 (m, 2H), 3.35 (t, *J* = 6.4 Hz, 1H), 2.81 (t, *J* = 6.8 Hz, 2H), 2.09-1.90 (m, 4H), 1.83 (quint, *J* = 6.8 Hz, 2H), 1.01 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 171.3, 159.5, 147.6, 144.7, 116.3, 103.6, 66.4, 45.0, 41.5, 28.8, 25.1, 21.9, 18.4, 11.5.
HRMS (ESI): *m/z* calcd for $C_{14}H_{18}NO_3$ $[M+H]^+$: 248.1281, found 248.1288.
FT-IR (cm^{-1}): 1739, 1650, 1566, 1454, 1042, 668.



1r

1r was obtained from **S3r** in 63% yield as a pale yellow solid.
m.p.: 188.3-189.4 °C.
TLC: R_f = 0.6 (DCM: MeOH = 30:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 5.87 (s, 1H), 5.38 (d, *J* = 15.8 Hz, 1H), 5.23 (d, *J* = 15.8 Hz, 1H), 4.50-4.42 (dd, *J* = 14.4, 8.6 Hz, 1H), 4.27 (dd, *J* = 14.4, 8.6 Hz, 1H), 3.34 (t, *J* = 6.6 Hz, 1H), 2.83-2.78 (m, 2H), 2.03-1.95 (m, 1H), 1.95-1.90 (m, 1H), 1.85-1.73 (m, 6H), 1.01 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (100 MHz, Chloroform-*d*): δ 171.2, 159.5, 152.3, 144.8, 117.1, 104.1, 66.7, 44.9, 43.4, 35.0, 29.5, 27.6, 27.0, 25.1, 11.1.
HRMS (ESI): *m/z* calcd for $C_{15}H_{20}NO_3$ $[M+H]^+$: 262.1438, found 262.1443.
FT-IR (cm^{-1}): 1648, 1055, 1014, 743.



1s

1s was obtained from **S3s** in 15% yield as a white solid.

m.p.: 98.5-100.1 °C.

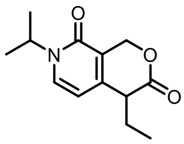
TLC: R$_f$ = 0.5 (DCM: MeOH = 30:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.31 (d, *J* = 7.2 Hz, 1H), 6.05 (d, *J* = 7.2 Hz, 1H), 5.43 (d, *J* = 16.2 Hz, 1H), 5.26 (d, *J* = 16.2 Hz, 1H), 3.57 (s, 3H), 3.41 (t, *J* = 6.6 Hz, 1H), 2.04-1.97 (m, 1H), 1.96-1.90 (m, 1H), 1.01 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.8, 159.3, 145.6, 137.9, 120.5, 104.8, 66.3, 44.9, 37.3, 25.2, 11.0.

HRMS (ESI): *m/z* calcd for $C_{11}H_{13}NNaO_3$ $[M+Na]^+$: 230.0788, found 230.0798.

FT-IR (cm^{-1}): 1737, 1656, 1410, 1124, 658.



1t

1t was obtained from **S3t** in 17% yield as a white solid.

m.p.: 102.5-103.3 °C.

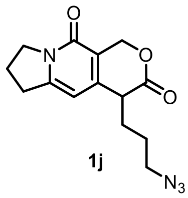
TLC: R$_f$ = 0.4 (DCM: MeOH = 30:1).

^{1}H NMR (400 MHz, Chloroform-*d*): δ 7.35 (d, *J* = 7.2 Hz, 1H), 6.10 (d, *J* = 7.2 Hz, 1H), 5.43 (d, *J* = 16.4 Hz, 1H), 5.26 (d, *J* = 16.4 Hz, 1H), 5.27-5.22 (m, 1H), 3.40 (t, *J* = 6.4 Hz, 1H), 2.08-1.88 (m, 2H), 1.38 (d, *J* = 5.6 Hz, 1H), 1.35 (d, *J* = 5.6 Hz, 1H)1.02 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.0, 158.5, 144.6, 132.5, 120.3, 105.1, 66.5, 46.5, 44.8, 25.1, 21.9, 11.1.

HRMS (ESI): *m/z* calcd for $C_{13}H_{18}NO_3$ $[M+H]^+$: 236.1281, found 236.1293

FT-IR (cm^{-1}): 1738, 1652, 1600, 1461, 1230, 1048, 657.



1j

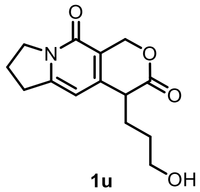
1j was obtained in 73% yield as a light yellow oil.

TLC: R$_f$ = 0.4 (DCM: MeOH = 30:1).

^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.03 (s, 1H), 5.40 (d, *J* = 16.0 Hz, 1H), 5.28 (d, *J* = 16.0 Hz, 1H), 4.17 (t, *J* = 7.2 Hz, 2H), 3.45 (t, *J* = 6.8 Hz, 1H), 3.37 (t, *J* = 6.4 Hz, 2H), 3.12 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.6 Hz, 3H), 2.01-1.93 (m, 2H), 1.79-1.65 (m, 2H).

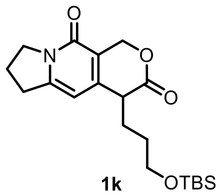
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.8, 158.2, 150.9, 146.1, 117.1, 99.5, 99.5, 65.8, 50.7, 48.6, 43.6, 31.7, 28.1, 26.0, 21.3.

HRMS (ESI): *m/z* calcd for $C_{14}H_{16}N_4NaO_3$ $[M+Na]^+$: 311.1115, found 311.1114.
FT-IR (cm^{-1}): 1649, 1573, 1440, 1236, 1074, 643.



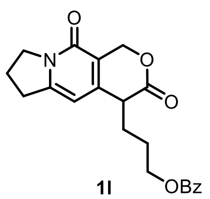
1u

1u was obtained in 32% yield as a green oil.
TLC: R_f = 0.2 (DCM: MeOH = 15:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.06 (s, 1H), 5.39 (d, *J* = 15.6 Hz, 1H), 5.25 (d, *J* = 15.6 Hz, 1H), 4.15 (t, *J* = 7.8 Hz, 2H), 3.69 (td, *J* = 10.2, 4.8 Hz, 2H), 3.49 (t, *J* = 6.6 Hz, 1H), 3.11 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.6 Hz, 2H), 1.99 (quint, *J* = 7.0 Hz, 2H), 1.69 (hept, *J* = 7.4 Hz, 2H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.4, 158.4, 150.7, 146.7, 117.0, 100.0, 65.8, 61.9, 48.6, 44.1, 31.7, 29.5, 27.8, 21.3.
HRMS (ESI): *m/z* calcd for $C_{14}H_{17}NNaO_4$ $[M+Na]^+$: 286.1050, found 286.1050.
FT-IR (cm^{-1}): 3443, 2923, 1633, 1421, 703.



1k

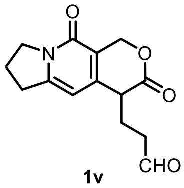
1k was obtained in 81% yield as a light yellow oil.
TLC: R_f = 0.5 (DCM: MeOH = 15:1).
^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.03 (s, 1H), 5.39 (d, *J* = 15.6 Hz, 1H), 5.25 (d, *J* = 15.6 Hz, 1H), 4.14 (t, *J* = 7.2 Hz, 2H), 3.63 (t, *J* = 6.0 Hz, 2H), 3.45 (t, *J* = 6.8 Hz, 1H), 3.10 (t, *J* = 5.2 Hz, 2H), 2.22 (quint, *J* = 7.6 Hz, 2H), 1.96 (q, *J* = 7.0 Hz, 2H), 1.73-1.53 (m, 3H), 0.87 (s, 9H), 0.03 (s, 6H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.4, 158.4, 150.5, 146.9, 117.2, 100.0, 65.8, 62.1, 48.6, 31.8, 29.6, 27.6, 25.8, 21.4, 18.2, -5.3.
HRMS (ESI): *m/z* calcd for $C_{20}H_{31}NNaO_4Si$ $[M+Na]^+$: 400.1915, found 400.1913.
FT-IR (cm^{-1}): 1633, 1467, 1411, 1076, 703.



1l

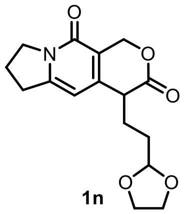
1l was obtained in 78% yield as a pale yellow solid.
m.p.: 141.9-143.5 °C.
TLC: R_f = 0.4 (DCM: MeOH = 15:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 8.02 (d, *J* = 8.4 Hz, 2H), 7.57 (t, *J* = 7.4 Hz, 1H), 7.46 (d, *J* = 7.6 Hz, 2H), 6.02 (s, 1H), 5.41 (d, *J* = 15.6 Hz, 1H), 5.29 (d, *J* = 15.6 Hz, 1H), 4.42-4.31 (m, 2H), 4.14 (t, *J* = 7.2 Hz, 2H), 3.51 (t, *J* = 6.8 Hz, 1H), 3.08 (t, *J* = 7.8 Hz, 2H), 2.22 (quint, *J* = 7.8 Hz, 2H), 2.09-2.00 (m, 2H), 1.97-1.86 (m, 2H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.9, 166.4, 158.3, 150.8, 146.3, 133.0, 130.0, 129.5, 128.4, 117.3, 99.7, 65.9, 63.9, 48.6, 43.9, 31.7, 27.7, 26.1, 21.3.
HRMS (ESI): *m/z* calcd for $C_{21}H_{21}NNaO_5$ $[M+Na]^+$: 390.1312, found 390.1302.
FT-IR (cm^{-1}): 1715, 1651, 1574, 1276, 1115, 715.



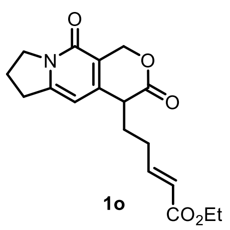
1v

1v was obtained in 43% yield as a pale yellow oil.
TLC: R_f = 0.3 (DCM: MeOH = 15:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 9.82 (s, 1H), 6.08 (s, 1H), 5.38 (d, *J* = 15.6 Hz, 1H), 5.30 (d, *J* = 15.6 Hz, 1H), 4.15 (t, *J* = 7.2 Hz, 2H), 3.45 (dd, *J* = 9.2, 4.8 Hz, 1H), 3.12 (t, *J* = 7.2 Hz, 2H), 2.84-2.77 (m, 1H), 2.73-2.67 (m, 1H), 2.24 (quint, *J* = 7.2 Hz, 3H), 2.11-2.05 (m, 1H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 200.5, 170.7, 158.3, 151.1, 146.1, 117.2, 99.4, 65.8, 48.6, 42.9, 40.6, 31.8, 22.9, 21.4.
HRMS (ESI): *m/z* calcd for $C_{14}H_{16}NO_4$ $[M+H]^+$: 262.1074, found 262.1075.
FT-IR (cm^{-1}): 1727, 1647, 1574, 1237, 1039, 750.



1n

1n was obtained in 38% yield as a yellow oil.
TLC: R_f = 0.4 (DCM: MeOH = 15:1).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.08 (s, 1H), 5.40 (d, *J* = 15.6 Hz, 1H), 5.27 (d, *J* = 15.6 Hz, 1H), 4.90 (t, *J* = 4.2 Hz, 1H), 4.15 (m, 2H), 3.98-3.94 (m, 2H), 3.88-3.83 (m, 2H), 3.49 (t, *J* = 7.0 Hz, 1H), 3.11 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.8 Hz, 2H), 2.06-1.98 (m, 2H), 2.12-2.04 (m, 2H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.2, 158.4, 150.6, 146.6, 117.3, 103.5, 100.1, 65.8, 64.9, 48.6, 44.1, 31.8, 30.6, 25.0, 21.4.
HRMS (ESI): *m/z* calcd for $C_{16}H_{19}NNaO_5$ $[M+Na]^+$: 328.1155, found 328.1141.
FT-IR (cm^{-1}): 1737, 1650, 1573, 1440, 1235, 1139, 1036, 749.



1o

1o was obtained in 51% yield as a white oil.

TLC: R_f = 0.2 (DCM: MeOH = 15:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.01-6.83 (m, 1H), 5.88 (d, *J* = 16.2 Hz, 1H), 5.40 (d, *J* = 15.6 Hz, 1H), 5.27 (d, *J* = 15.6 Hz, 1H), 4.19 (q, *J* = 7.2 Hz, 2H), 4.15 (t, *J* = 7.8 Hz, 3H), 3.44 (t, *J* = 6.6 Hz, 1H), 3.12 (t, *J* = 7.8 Hz, 2H), 2.36 (q, *J* = 7.2 Hz, 2H), 2.24 (quint, *J* = 7.8 Hz, 2H), 2.09-1.97 (m, 2H), 1.29 (t, *J* = 7.2 Hz, 3H).

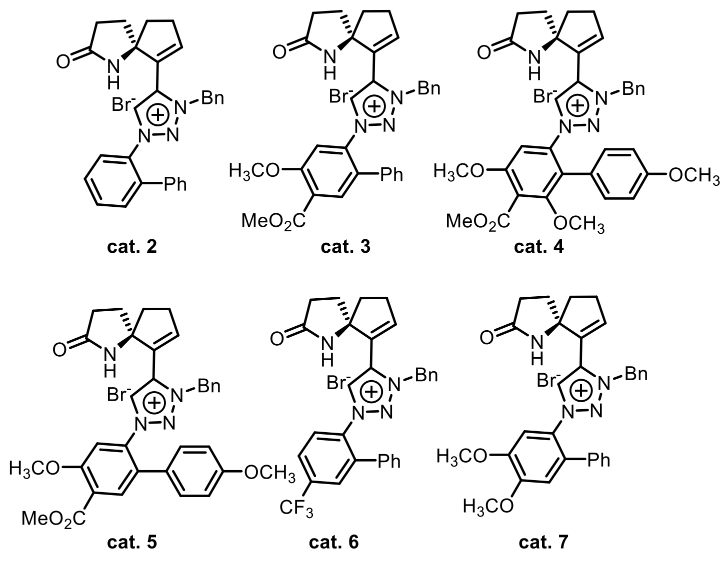
^{13}C NMR (150 MHz, Chloroform-*d*): δ 170.7, 166.2, 158.3, 150.9, 146.2, 146.0, 122.8, 117.3, 99.5, 65.9, 60.3, 48.6, 43.5, 31.8, 29.3, 29.0, 21.4, 14.2.

HRMS (ESI): *m/z* calcd for $C_{18}H_{21}NNaO_5$ [M+Na]$^+$: 354.1312, found 354.1304.

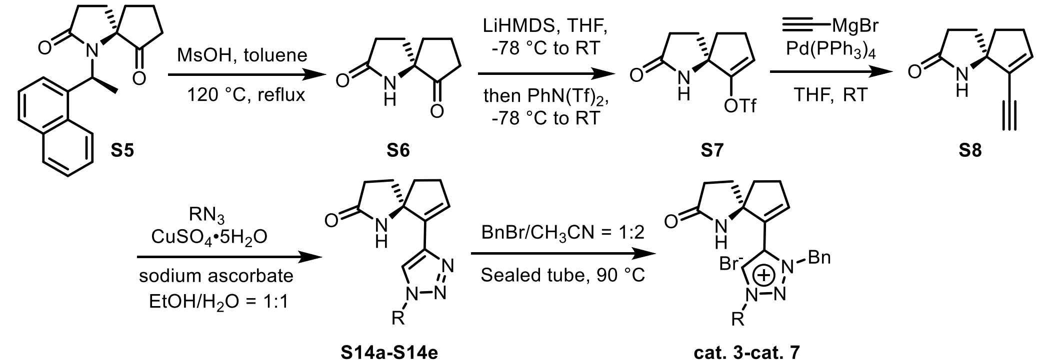
FT-IR (cm^{-1}): 1717, 1651, 1576, 1369, 1038, 749.

3. Experimental Details for the Synthesis of Catalysts

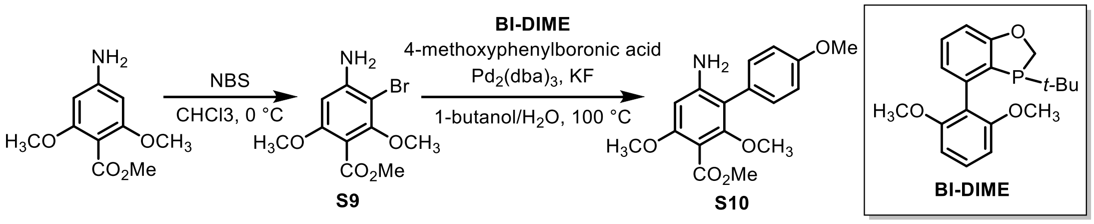
Table S2. Chiral SPA-triazolium bromide catalysts



General procedure for the preparation of catalysts

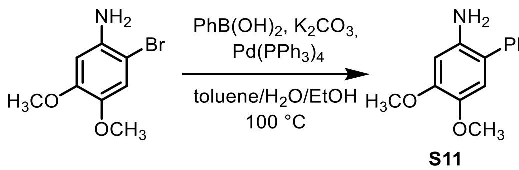


Note: ***cat. 2*** *and* ***S5-S8*** *were prepared according to our previous work.*[6]

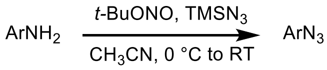


Synthesis of compound S9: To a stirred solution of methyl 4-amino-2,6-dimethoxybenzoate (10 mmol, 1.0 equiv.) in 40 mL $CHCl_3$ was slowly added NBS (10 mmol, 1.0 equiv.) in 1 hour at 0 °C. Then, the reaction mixture was stirred at 0 °C for another 30 minutes, quenched with water, and extracted with DCM (3 × 50 mL). The combined organic layers were dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by flash chromatography on silica gel to give **S9.**

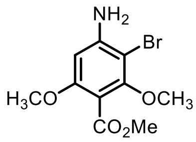
Synthesis of compound S10:[7] An oven-dried round-bottom flask was charged with arylboronic acid (3 mmol, 1.5 equiv.), potassium fluoride (6 mmol, 3.0 equiv.), $Pd_2(dba)_3$ (2 mol%), BI-DIME (4 mol%), and degassed *n*-butanol/water (12 mL/3 mL) under argon. The mixture was pumped and refilled with argon three times before aryl halide (2 mmol, 1.5 equiv.) was added. The resulting mixture was stirred at 100 °C for 24 h, cooled to room temperature, partitioned with water (20 mL) and dichloromethane (40 mL). The organic layer was separated, dried over Na_2SO_4, concentrated, and purified by silica gel column chromatography to provide biaryl compound **S10**.



Synthesis of compound S11: To a mixture of arylboronic acid (2.6 mmol, 1.3 equiv.), potassium carbonate (8 mmol, 4.0 equiv.), $Pd(PPh_3)_4$ (1 mol%), was charged degassed toluene/H_2O/EtOH (9 mL/6 mL/3 mL). The mixture was pumped and refilled with nitrogen three times before aryl halide (2 mmol, 1.0 equiv.) was added. The resulting mixture was stirred at 95 °C under nitrogen for 24 h, and then cooled to room temperature, partioned with water (20 mL) and dichloromethane (40 mL). The organic layer was separated, dried over Na_2SO_4, concentrated, and purified by silica gel column chromatography to provide biaryl compound **S11**.



Note: ***Compound S12*** *and* ***S13*** *were prepared following the procedure of literature,[8] other azides were known compounds according to the literature.[9]*



S9

S9 was obtained in 44% yield as a white solid.

m.p.: 122.6-125.1 °C.

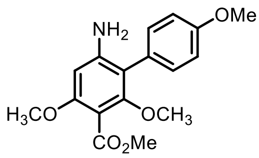
TLC: $R_f = 0.6$ (DCM: EA = 4:1).

^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.11 (s, 1H), 4.36 (brs, 2H), 3.88 (s, 3H), 3.85 (s, 3H), 3.76 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*): δ 166.1, 157.4, 156.1, 147.1, 108.9, 95.0, 93.9, 61.9, 55.9, 52.3.

HRMS (ESI): *m/z* calcd for $C_{10}H_{12}BrNNaO_4$ $[M+Na]^+$: 311.9842, found 311.9842.

FT-IR (cm^{-1}): 3473, 3373, 2944, 1719, 1619, 1407, 1269, 1224, 1105, 814, 664.



S10

S10 was obtained in 82% yield as a white solid.

m.p.: 198.3-199.9 °C.

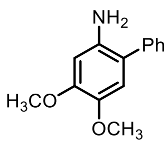
TLC: $R_f = 0.6$ (DCM: EA = 4:1).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.36-7.22 (m, 3H), 6.98 (d, J = 8.6 Hz, 2H), 3.89 (s, 3H), 3.85 (s, 3H), 3.80 (s, 3H), 3.34 (s, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*): δ 167.2, 158.8, 157.3, 157.1, 147.6, 131.7, 125.8, 114.3, 113.0, 107.9, 93.7, 61.2, 55.8, 55.2, 52.2.

HRMS (ESI): *m/z* calcd for $C_{17}H_{19}NNaO_5$ $[M+Na]^+$: 340.1155 found 340.1166.

FT-IR (cm^{-1}): 3470, 2923, 2851, 1721, 1602, 1573, 1463, 1245, 1105, 1027, 801, 635, 539.



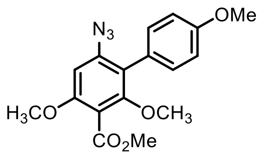
S11

S11 was obtained in 85% yield as a light yellow oil.

TLC: $R_f = 0.3$ (PE: EA = 3:1).

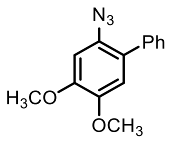
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.49-7.39 (m, 4H), 7.34-7.29 (m, 1H), 6.71 (s, 1H), 6.37 (s, 1H), 3.86 (s, 3H), 3.82 (s, 3H), 3.54 (brs, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 149.3, 142.1, 139.4, 137.2, 129.1, 128.7, 126.8, 119.1, 114.4, 100.7, 56.5, 55.8.
HRMS (ESI): *m/z* calcd for $C_{14}H_{15}NNaO_2$ $[M+Na]^+$: 252.0995 found 252.0985.
FT-IR (cm^{-1}): 3443, 3363, 2934, 1613, 1516, 1490, 1441, 1405, 1283, 1217, 1153, 1022, 767, 568.



S12

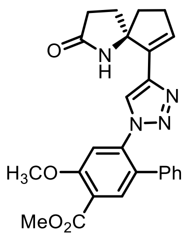
S12 was obtained in 83% yield as a colorless oil.
TLC: $R_f = 0.5$ (PE: EA = 2:1)
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.37-7.21 (m, 3H), 6.96 (d, *J* = 7.2 Hz, 2H), 3.92 (s, 3H), 3.89 (s, 3H), 3.85 (s, 3H), 3.32 (s, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 166.3, 159.0, 157.0, 156.6, 140.8, 131.7, 124.8, 120.0, 115.1, 113.5, 97.2, 61.3, 56.1, 55.1, 52.5.
HRMS (ESI): *m/z* calcd for $C_{17}H_{17}N_3NaO_5$ $[M+Na]^+$: 366.1060 found 366.1054.
FT-IR (cm^{-1}): 2940, 2838, 2112, 1734, 1598, 1482, 1338, 1246, 1110, 1029, 950, 797, 628, 532.



S13

S13 was obtained in 87% yield as a yellow oil.
TLC: $R_f = 0.3$ (PE).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.50-7.38 (m, 4H), 7.37-7.30 (m, 1H), 6.84 (s, 1H), 6.73 (s, 1H), 3.95 (s, 3H), 3.88 (s, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 149.2, 146.4, 138.0, 129.4, 128.9, 128.1, 127.2, 125.9, 113.9, 102.4, 56.2, 56.1.
HRMS (ESI): *m/z* calcd for $C_{14}H_{13}N_3NaO_2$ $[M+Na]^+$: 278.0900 found 278.0888.
FT-IR (cm^{-1}): 2845, 2102, 1608, 1524, 1490, 1441, 1390, 1355, 1237, 1209, 1176, 1113, 1039, 862, 826, 770, 750, 700, 662.

*Note: **Compounds S14a-S14e** were synthesized following the literature procedure.*[6]



S14a

S14a was obtained in 47% yield as a pale yellow solid.
TLC: $R_f = 0.4$ (DCM: MeOH = 20:1).

m.p.: 93.3-94.5 °C.

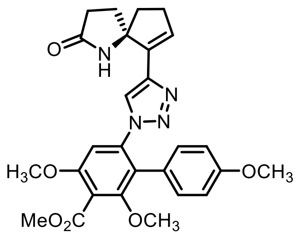
$[\alpha]_D^{26}$ = +18.0 (c = 0.5, $CHCl_3$).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.94 (s, 1H), 7.37 (s, 1H), 7.34-7.29 (m, 3H), 7.06 (dd, *J* = 6.4, 3.0 Hz, 2H), 7.04 (s, 1H), 6.52 (t, *J* = 2.6 Hz, 1H), 5.60 (s, 1H), 4.01 (s, 3H), 3.93 (s, 3H), 2.53-2.48 (m, 1H), 2.45-2.39 (m, 1H), 2.37-2.30 (m, 1H), 2.24 (ddd, *J* = 13.2, 7.8, 2.6 Hz, 1H), 2.02-1.90 (m, 3H), 1.76-1.68 (m, 1H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 177.0, 165.3, 159.1, 141.0, 138.1, 136.4, 134.8, 134.4, 131.6, 128.8, 128.7, 127.9, 127.6, 121.2, 120.8, 109.5, 71.0, 56.5, 52.3, 39.5, 30.9, 29.8, 29.1.

HRMS (ESI): *m/z* calcd for $C_{25}H_{24}N_4NaO_4$ $[M+Na]^+$: 467.1681, found 467.1690.

FT-IR (cm^{-1}): 2950, 2849, 1641, 1468, 1297, 1235, 1090, 705.



S14b

S14b was obtained in 37% yield as a white solid.

TLC: R_f = 0.4 (DCM: MeOH = 20:1).

m.p.: 94.5-95.8 °C.

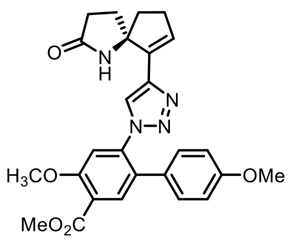
$[\alpha]_D^{26}$ = +7.5 (c = 0.5, $CHCl_3$).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.09 (s, 1H), 6.97 (s, 1H), 6.86 (d, *J* = 8.4 Hz, 2H), 6.53 (t, *J* = 2.6 Hz, 1H), 5.28 (s, 1H), 3.96 (s, 3H), 3.92 (s, 3H), 3.83 (s, 3H), 3.37 (s, 3H), 2.50 (ddt, *J* = 17.4, 9.0, 3.0 Hz, 1H), 2.45-2.33 (m, 2H), 2.25 (ddd, *J* = 13.2, 7.8, 2.4 Hz, 1H), 2.10 (ddd, *J* = 17.2, 9.8, 2.4 Hz, 1H), 1.96-1.88 (m, 2H), 1.71 (dt, *J* = 13.2, 9.6 Hz, 1H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 176.9, 165.8, 159.2, 156.4, 156.4, 140.7, 137.5, 134.8, 131.4, 131.0, 124.1, 122.6, 121.3, 119.5, 114.2, 104.7, 71.0, 61.7, 56.4, 55.2, 52.7, 39.3, 30.9, 29.6, 29.1.

HRMS (ESI): *m/z* calcd for $C_{27}H_{28}N_4NaO_6$ $[M+Na]^+$: 527.1902 found 527.1901.

FT-IR (cm^{-1}): 2937, 2850, 1643, 1464, 1298, 1248, 1108, 793.



S14c

S14c was obtained in 45% yield as a white solid.

TLC: R_f = 0.4 (DCM: MeOH = 20:1).

m.p.: 87.5-89.9 °C.

$[\alpha]_D^{26}$ = +12.0 (c = 0.5, $CHCl_3$).

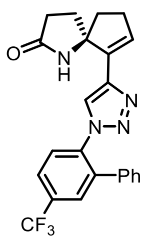
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.92 (s, 1H), 7.36 (s, 1H), 7.08 (s, 1H), 6.98 (d, *J* = 8.6 Hz, 2H), 6.85 (d, *J* = 8.6 Hz, 2H), 6.56 (t, *J* = 2.6 Hz, 1H), 5.38 (s, 1H), 4.00 (s, 3H), 3.93 (s, 3H), 3.83

(s, 3H), 2.55-2.48 (m, 1H), 2.47-2.41 (m, 1H), 2.35 (dt, J = 17.4, 9.6 Hz, 1H), 2.26 (ddd, J = 13.2, 7.8, 2.4 Hz, 1H), 2.03 (ddd, J = 10.8, 9.6, 3.0 Hz, 1H), 1.98-1.91 (m, 2H), 1.79 (dt, J = 13.2, 9.8 Hz, 1H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 177.0, 165.5, 159.3, 158.8, 141.0, 138.1, 134.9, 134.5, 131.6, 129.8, 128.6, 127.4, 121.2, 120.8, 114.3, 109.4, 71.1, 56.5, 55.2, 52.3, 39.5, 31.0, 29.6, 29.2.

HRMS (ESI): *m/z* calcd for $C_{26}H_{26}N_4NaO_5$ $[M+Na]^+$: 497.1795 found 497.1773.

FT-IR (cm^{-1}): 2947, 2844, 1657, 1498, 1433, 1235, 1089, 1026, 687.



S14d

S14d was obtained in 49% yield as a brownish solid.

TLC: R_f = 0.4 (DCM: MeOH = 20:1).

m.p.: 85.4-86.7 °C.

$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\boldsymbol{26}}$ = +12.0 (c = 0.5, $CHCl_3$).

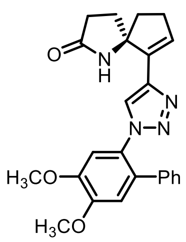
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.87 (d, J = 8.4 Hz, 1H), 7.81 (d, J = 8.4 Hz, 1H), 7.77 (s, 1H), 7.40-7.35 (m, 3H), 7.26 (s, 1H), 7.13-7.09 (m, 2H), 7.07 (s, 1H), 6.56 (t, J = 3.0 Hz, 1H), 5.45 (s, 1H), 2.55-2.48 (m, 1H), 2.46-2.41 (m, 1H), 2.38-2.31 (m, 1H), 2.27-2.23 (m, 1H), 2.03-1.92 (m, 3H), 1.74-1.70 (m, 1H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 177.0, 141.1, 137.1, 136.2, 134.8, 131.7, 129.0, 128.6, 128.5, 128.2 (d, J = 4.5 Hz), 126.6, 125.7 (d, J = 4.5 Hz), 121.1, 71.1, 39.5, 31.0, 29.8, 29.2.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.07, -73.37.

HRMS (ESI): *m/z* calcd for $C_{23}H_{20}F_3N_4O$ $[M+H]^+$: 425.1584 found 425.1563.

FT-IR (cm^{-1}): 2921, 2343, 1642, 1416, 1140, 1042, 668.



S14e

S14e was obtained in 57% yield as a white solid.

TLC: R_f = 0.4 (DCM: MeOH = 20:1).

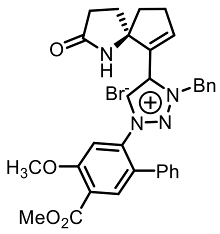
m.p.: 90.0-91.5 °C.

$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\boldsymbol{26}}$ = +18.0 (c = 0.5, $CHCl_3$).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.32-7.27 (m, 3H), 7.18 (s, 1H), 7.09-7.05 (m, 2H), 7.04 (s, 1H), 6.93 (s, 1H), 6.52 (t, J = 2.6 Hz, 1H), 5.52 (s, 1H), 3.97 (d, J = 1.2 Hz, 6H), 2.52-2.48 (m, 1H), 2.46-2.37 (m, 2H), 2.35-2.31 (m, 1H), 2.25-2.22 (m, 1H), 1.99-1.90 (m, 3H), 1.75-1.67 (m, 2H).

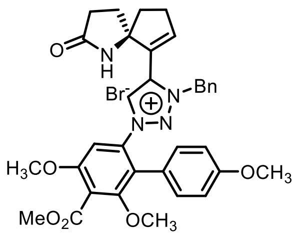
^{13}**C NMR** (150 MHz, Chloroform-*d*): δ 177.0, 149.8, 148.9, 140.7, 137.5, 135.1, 131.1, 129.1, 128.7, 128.6, 127.6, 121.9, 112.8, 109.2, 71.1, 56.3, 56.2, 39.6, 31.0, 29.8, 29.2.
HRMS (ESI): *m/z* calcd for $C_{24}H_{24}N_4NaO_3$ $[M+Na]^+$: 439.1741 found 439.1722.
FT-IR (cm^{-1}): 2923, 2062, 1642, 1217, 1015, 703.

Note: Compounds ***cat. 3-cat. 7*** *were synthesized following the literature procedure.*[6]



cat. 3

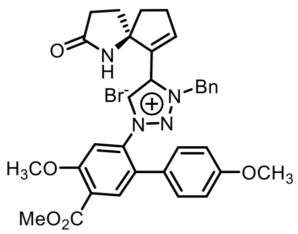
cat. 3 was obtained in 74% yield as a pale yellow solid.
TLC: R_f = 0.2 (DCM: MeOH = 10:1)
m.p.: 137.8-138.5 °C.
$[\alpha]_D^{26}$ = +40.0 (c = 0.5, $CHCl_3$).
^{1}**H NMR** (600 MHz, Chloroform-*d*): δ 8.97 (s, 1H), 8.08 (s, 1H), 7.92 (s, 1H), 7.41-7.29 (m, 6H), 7.14 (d, *J* = 7.4 Hz, 3H), 6.92 (d, *J* = 8.4 Hz, 2H), 6.66 (s, 1H), 5.97 (d, *J* = 15.2 Hz, 1H), 5.78 (d, *J* = 15.2 Hz, 1H), 4.07 (s, 3H), 3.93 (s, 3H), 2.67-2.60 (m, 1H), 2.44 (dt, *J* = 18.2, 7.8 Hz, 1H), 2.20-2.14 (m, 1H), 2.12-2.03 (m, 2H), 1.99-1.92 (m, 1H), 1.74-1.67 (m, 1H), 1.45-1.39 (m, 1H).
^{13}**C NMR** (150 MHz, Chloroform-*d*): δ 159.1, 137.1, 135.8, 135.1, 133.9, 131.7, 130.8, 129.5, 129.3, 129.0, 128.6, 128.3, 128.2, 127.9, 123.5, 57.8, 56.0, 30.6, 30.0.
HRMS (ESI): *m/z* calcd for $C_{32}H_{31}N_4O_4$ $[M-Br]^+$: 535.2340 found 535.2318.
FT-IR (cm^{-1}): 2923, 2851, 1640, 1185, 1083, 705.



cat. 4

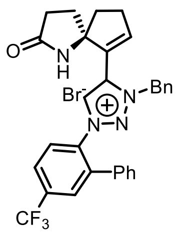
cat. 4 was obtained in 65% yield as a yellow solid.
TLC: R_f = 0.2 (DCM: MeOH = 10:1).
m.p.: 132.1-133.3 °C.
$[\alpha]_D^{26}$ = +35.0 (c = 0.5, $CHCl_3$).
^{1}**H NMR** (600 MHz, Chloroform-*d*): δ 8.84 (s, 1H), 7.74 (s, 1H), 7.42-7.37 (m, 2H), 7.35-7.32 (m, 2H), 7.15-7.03 (m, 2H), 6.88 (d, *J* =7.2 Hz, 2H), 6.84 (d, *J* = 6.0 Hz, 2H), 6.65 (s, 1H), 5.94 (d, *J* = 15.0 Hz, 1H), 5.78 (d, *J* = 15.0Hz, 1H), 3.99 (s, 2H), 3.97 (d, *J* = 5.4 Hz, 6H), 3.91 (s, 1H), 3.82 (s, 3H), 3.39 (s, 3H), 2.64-2.59 (m, 1H), 2.46-2.41 (m, 1H), 2.21-2.12 (m, 2H), 2.12-2.04 (m, 2H), 1.64 (ddd, *J* = 13.0, 9.2, 3.6 Hz, 1H), 1.31-1.20 (m, 1H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 176.7, 165.2, 159.6, 158.2, 156.8, 156.2, 144.4, 136.8, 135.3, 131.7, 131.1, 131.0, 129.5, 129.4, 129.2, 128.1, 127.9, 127.6, 124.5, 122.7, 121.8, 114.3, 106.9, 98.8, 72.3, 61.9, 57.4, 55.8, 55.2, 52.8, 46.0, 38.3, 31.4, 30.5, 29.8.
HRMS (ESI): *m/z* calcd for $C_{32}H_{31}N_4O_4$ [M-Br]$^+$: 595.2551 found 595.2533.
FT-IR (cm^{-1}): 2923, 2852, 1640, 1314, 1108, 668.



cat. 5

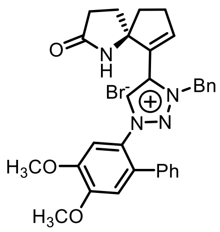
cat. 5 was obtained in 72% yield as a brownish solid.
TLC: R_f = 0.2 (DCM: MeOH = 10:1).
m.p.: 135.9-136.4 °C.
$[\alpha]_D^{26}$ = +46.0 (c = 0.5, $CHCl_3$).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 8.96 (s, 1H), 8.01 (s, 1H), 7.88 (s, 1H), 7.38 (d, *J* = 7.3 Hz, 1H), 7.35 (d, *J* = 7.8 Hz, 2H), 7.03 (d, *J* = 8.6 Hz, 2H), 6.94 (d, *J* = 8.4 Hz, 2H), 6.82 (d, *J* = 7.2 Hz, 2H), 5.98 (d, *J* = 15.2 Hz, 1H), 5.80 (d, *J* = 15.2 Hz, 1H), 4.04 (s, 3H), 3.93 (s, 3H), 3.81 (s, 3H), 2.67-2.59 (m, 1H), 2.48-2.41 (m, 1H), 2.19-2.13 (m, 1H), 2.12-2.05 (m, 2H), 1.98 (ddd, *J* = 17.0, 9.4, 3.2 Hz, 1H), 1.72-1.66 (m, 1H), 1.46-1.40 (m, 1H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 176.9, 165.2, 159.6, 158.7, 144.5, 137.1, 135.8, 133.9, 131.7, 130.9, 129.8, 129.5, 129.3, 128.2, 127.9, 127.1, 123.4, 112.1, 72.5, 57.7, 56.0, 55.3, 52.5, 38.4, 31.5, 30.6, 29.8.
HRMS (ESI): *m/z* calcd for $C_{33}H_{33}N_4O_5$ [M-Br]$^+$: 565.2445 found 565.2419.
FT-IR (cm^{-1}): 2922, 2851, 1692, 1247, 696.



cat. 6

cat. 6 was obtained in 54% yield as a brownish solid.
TLC: R_f = 0.2 (DCM: MeOH = 10:1).
m.p.: 124.6-125.8 °C.
$[\alpha]_D^{26}$ = +76.0 (c = 0.5, $CHCl_3$).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 9.21 (s, 1H), 8.39 (d, *J* = 8.4 Hz, 1H),7.89 (d, *J* = 8.4 Hz, 1H), 7.80 (s, 1H), 7.42 (t, *J* = 7.4 Hz, 2H), 7.37 (q, *J* = 7.8 Hz, 3H), 7.33 (t, *J* = 7.8 Hz, 2H), 7.21 (d, *J* = 7.2 Hz, 2H), 6.88 (d, *J* = 8.4 Hz, 2H), 6.60 (s, 1H), 5.97 (d, *J* = 15.6 Hz, 1H), 5.79 (d, *J* = 15.6 Hz, 1H), 2.68-2.60 (m, 1H), 2.49-2.42 (m, 1H), 2.23-2.18 (m, 1H), 2.14-2.10 (m, 2H), 1.79-1.72 (m, 1H), 1.58-1.49 (m, 1H), 0.91-0.86 (m, 1H).

^{13}**C NMR** (150 MHz, Chloroform-*d*): δ 137.4, 135.4, 134.8, 134.2 (q, *J* = 33.0 Hz), 131.8, 131.1, 129.4, 129.3, 129.2, 129.0, 128.8, 128.5, 128.2 (d, *J* = 4.5 Hz), 127.7, 126.4 (d, *J* = 4.5 Hz), 123.9, 122.0, 72.5, 56.2, 31.4, 30.6, 30.1, 29.6, 22.6.
^{19}**F NMR** (564 MHz, Chloroform-d): δ -62.90.
HRMS (ESI): *m/z* calcd for $C_{30}H_{26}F_3N_4O$ $[M-Br]^+$: 515.2053 found 515.2051.
FT-IR (cm^{-1}): 2925, 2853, 1649, 1414, 1336, 1134, 728.

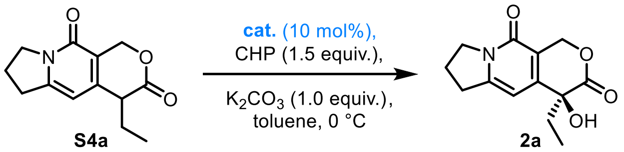


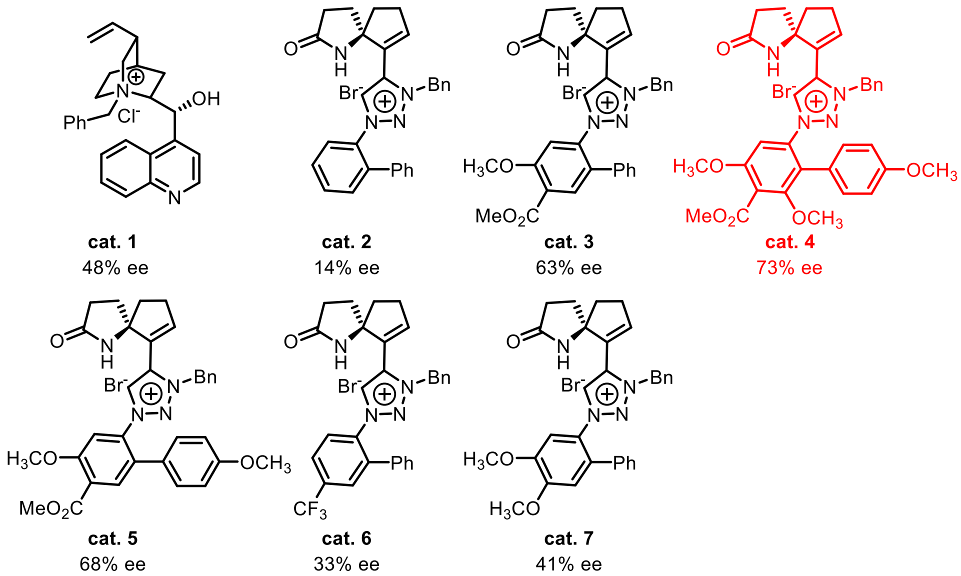
cat. 7

cat. 7 was obtained in 79% yield as a brownish solid.
TLC: R_f = 0.2 (DCM: MeOH = 10:1).
m.p.: 135.0-136.4 °C.
$[\alpha]_D^{26}$ = +32.0 (c = 0.5, $CHCl_3$).
^{1}**H NMR** (600 MHz, Chloroform-*d*): δ 8.73 (s, 1H), 7.78 (s, 1H), 7.41-7.28 (m, 6H), 7.15 (d, *J* = 8.6 Hz, 2H), 6.96-6.87 (m, 3H), 5.98 (d, *J* = 15.0 Hz, 1H), 5.79 (d, *J* = 15.0 Hz, 1H), 4.02 (s, 3H), 3.97 (s, 3H), 2.66-2.58 (m, 1H), 2.48-2.40 (m, 1H), 2.22-2.15 (m, 1H), 2.10-2.07 (m, 1H), 1.91 (ddd, *J* = 17.2, 9.0, 3.4 Hz, 1H), 1.71-1.64 (m, 1H), 1.35-1.30 (m, 1H), 1.26 (t, *J* = 7.2 Hz, 1H).
^{13}**C NMR** (150 MHz, Chloroform-*d*): δ 144.4, 136.2, 131.9, 130.9, 130.6, 129.4, 129.3, 129.0, 128.6, 128.2, 128.2, 127.9, 125.2, 112.6, 110.4, 56.3, 55.9, 31.5, 30.5, 30.0.
HRMS (ESI): *m/z* calcd for $C_{31}H_{31}N_4O_3$ $[M-Br]^+$: 507.2391 found 507.2380.
FT-IR (cm^{-1}): 2923, 1642, 1453, 1215, 1013, 748.

4. Optimization Studies of α-Hydroxylation of Pyridinone-Fused Lactones

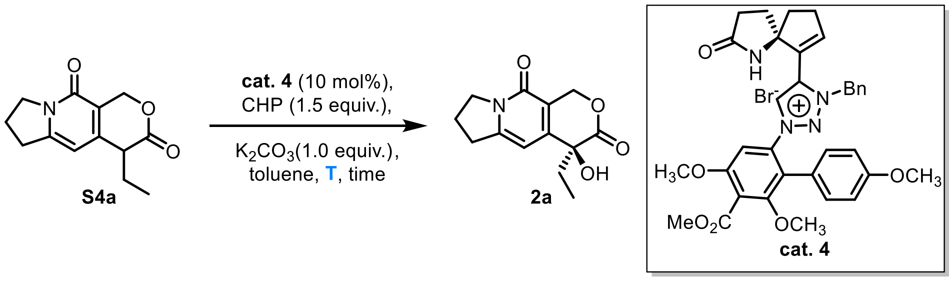
Table S3. Optimization of catalysts[a, b, c]





[a]Unless otherwise noted, the reaction was conducted with **1a** (0.1 mmol, 1.0 equiv.), **cat.** (10 mol%), CHP (1.5 equiv.), K_2CO_3 (1.0 equiv.) in 2 mL toluene at 0 °C for 48 h. [b]Isolated yield. [c]ee determined by UPC[2].

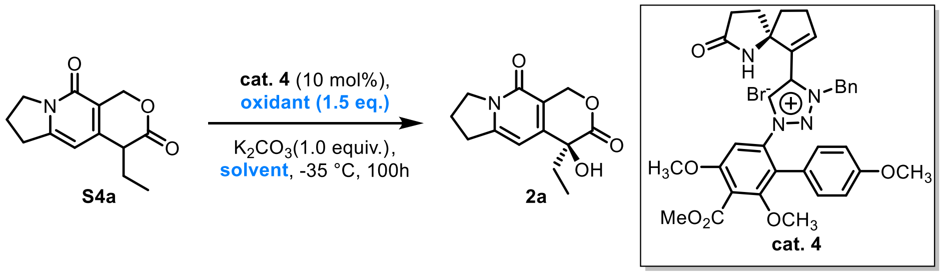
Table S4. Optimization of temperatures[a]



entry	T (°C)	time (hour)	yield (%)[b]	ee (%)[c]
1	20	24	93	68
2	0	48	93	73
3	-35	100	92	81

[a]Unless otherwise noted, the reaction was conducted with **1a** (0.1 mmol, 1.0 equiv.), **cat. 4** (10 mol%), CHP (1.5 equiv.), K_2CO_3 (1.0 equiv.) in 2 mL toluene. [b]Isolated yield. [c]ee determined by UPC^2.

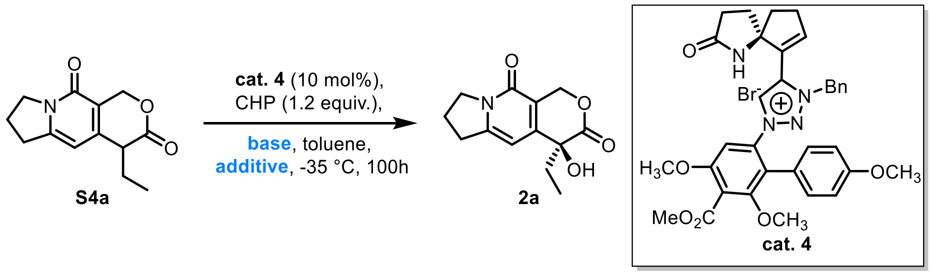
Table S5. Optimization of solvent and oxidant[a]



entry	solvent	oxidant	yield (%)[b]	ee (%)[c]
1	toluene	CHP	92	81
2	ethylbenzene	CHP	81	74
3	m-xylene	CHP	63	56
4	mesitylene	CHP	85	80
5	1,2-difluorobenzene	CHP	54	69
6	chlorobenzene	CHP	75	78
7	DCM	CHP	15	21
8	THF	CHP	trace	6
9	MTBE	CHP	trace	17
10	EA	CHP	trace	0
11	toluene	*t*-BuOOH	21	31
12	toluene	H_2O_2	--	NR
13	toluene	Oxone	11	3
14	toluene	UHP	trace	17
15[d]	toluene	CHP	92	83
16[e]	toluene	CHP	85	80

[a]Unless otherwise noted, the reaction was conducted with **1a** (0.1 mmol, 1.0 equiv.), **cat. 4** (10 mol%), CHP (0.15 mmol, 1.5 equiv.), K_2CO_3 (0.1 mmol, 1.0 equiv.) in 2 mL solvent. [b]Isolated yield. [c]ee determined by UPC^2. [d]CHP (0.12 mmol, 1.2 equiv.) was used. [e]CHP (0.2 mmol, 2.0 equiv.) was used.

Table S6. Optimization of base and additives[a]

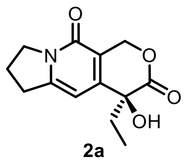


entry	base	additive	yield(%)[b]	ee%[c]
1	K_2HPO_4	--	34	54
2	K_3PO_4	--	91	84
3	$K_3PO_4 \cdot H_2O$	--	85	83
4	Cs_2CO_3	--	31	60
5	$CsOH \cdot H_2O$	--	trace	17
6	K_2CO_3	--	92	83
7	Na_2CO_3	--	54	80
8	DBU	--	--	ND
9	K_3PO_4	DMF(20µl)	30	50
10	K_3PO_4	DMSO(20µl)	30	33
11	K_3PO_4	1,4-Dioxane(20µl)	42	55
12	K_3PO_4	18-Crown-6(3mg)	92	0
13	K_3PO_4	$MgSO_4$(5mg)	90	83
14	K_3PO_4	Phenol(3mg)	33	25
15	K_3PO_4	Span 20(4mg)	87	80
16	K_3PO_4	$CHCl_3$(50µl)	91	87
[d]22	K_3PO_4	$CHCl_3$(50µl) +4Å MS(5mg)	92	90, 99[c]
21	K_3PO_4	$CHCl_3$(200µl)+4Å MS(5mg)	81	83

[a]Unless otherwise noted, the reaction was conducted with **1a** (0.1 mmol, 1.0 equiv.), **cat. 4** (10 mol%), CHP (0.12 mmol, 1.2 equiv.), base (0.1 mmol, 1.0 equiv.), and additive in 2 mL toluene. [b]Isolated yield. [c]ee determined by UPC^2. [d]ee increased to 99% after a single recrystallization

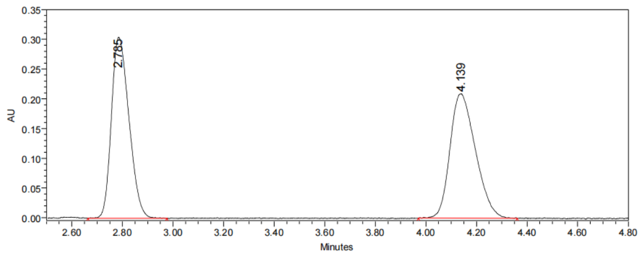
5. Experimental Details for the Synthesis of Lactones 2a-2t

To a solution of **1a** (0.1 mmol, 1.0 equiv.) in toluene (1 mL) was added $CHCl_3$ (50 μl), K_2CO_3 (0.1 mmol, 1.0 equiv.), and 4 Å MS (activated powder, 5 mg) at room temperature. The mixture was stirred at room temperature for 5 min and cooled to -35 °C followed by dropwise addition of a suspension of **cat. 4** (10 mol%) in toluene (1 mL) over a course of 5 min. The mixture was stirred for another 30 min and was added cumene hydroperoxide (0.12 mmol, 1.2 equiv.). The resulting mixture was stirred at -35 °C for 100 h. The reaction was quenched by $Na_2S_2O_3$ and NH_4Cl solution and stirred at room temperature for 1 h. The organic phase was separated, and the aqueous phase was extracted with chloroform (30 mL × 3). The organic layers were combined, dried over Na_2SO_4, and concentrated in vacuo. The residue was purified by flash chromatography on silica gel to give **2a-2t**



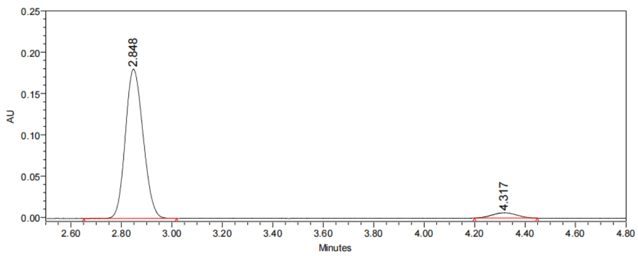
2a

2a was obtained in 92% yield as a white solid.[4]
TLC: R_f = 0.3 (DCM: MeOH =30:1).
$[\alpha]_D^{23}$ = +123.3 (c = 0.3, $CHCl_3$).
Enantiomeric excess was 90% and increased to >99% after a single recrystallization determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 2.848 min, t_{minor} = 4.317 min).



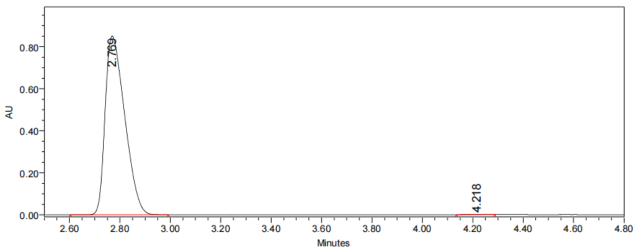
peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.785	1467316	50.05	304023
2	4.139	1464244	49.95	209267



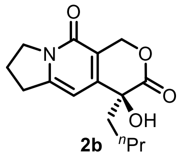
peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.848	885028	95.34	180669
2	4.317	43243	4.66	6401



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	2.769	4590612	99.87	850628
2	4.218	5991	0.13	1211



2b

2b was obtained in 89% yield as a white solid.

TLC: $R_f = 0.3$ (DCM: MeOH =30:1).

m.p.: 186.0-187.0 °C.

$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = +74.0 (c = 0.5, $CHCl_3$).

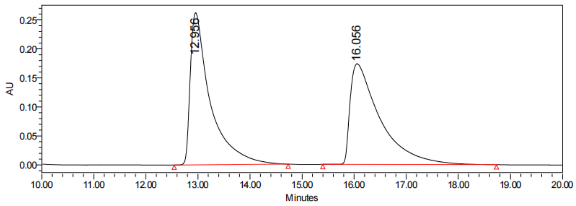
^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.49 (s, 1H), 5.59 (d, J = 15.8 Hz, 1H), 5.17 (d, J = 15.8 Hz, 1H), 4.17 (td, J = 7.2, 3.2 Hz, 2H), 3.73 (s, 1H), 3.14 (t, J = 8.8 Hz, 1H), 2.23 (q, J = 7.6 Hz, 2H), 1.79-1.69 (m, 2H), 1.38-1.26 (m, 4H), 0.88 (t, J = 7.2 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.3, 158.2, 151.1, 149.6, 115.3, 98.1, 72.3, 66.3, 48.8, 37.9, 31.9, 25.2, 22.4, 21.4, 13.7.

HRMS (ESI): *m/z* calcd for $C_{15}H_{19}NNaO_4$ $[M+Na]^+$: 300.1206, found 300.1214.

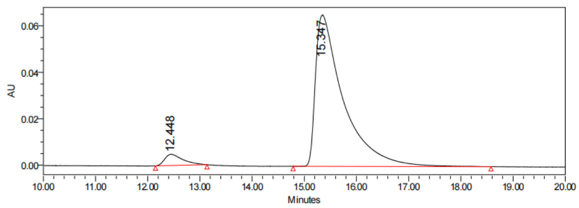
FT-IR (cm^{-1}): 3396, 2924, 1743, 1649, 1572, 1119, 669.

Enantiomeric excess was 91% determined by the chiral HPLC analysis (IA-3, Hexane/Isopropanol = 80/20, v = 1.0 mL/min, λ = 235.0 nm, t_{minor} = 12.448 min, t_{major} = 15.347).



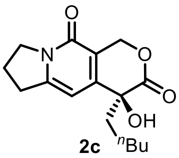
peak information

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	12.956	6993055	50.23	261815
2	16.056	6929460	49.77	173379



peak information

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	12.448	117521	4.63	4844
2	15.347	2418977	95.37	65153



2c

2c was obtained in 80% yield as a yellow oil.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

$[\alpha]_D^{25}$ = +33.3 (c = 0.3, $CHCl_3$).

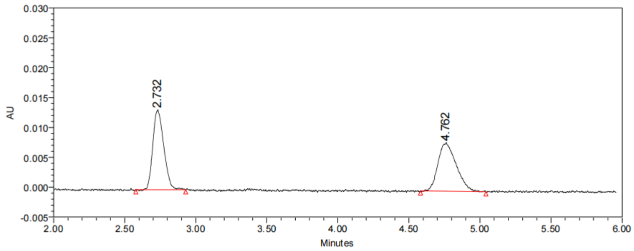
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.46 (s, 1H), 5.55 (d, *J* = 15.8 Hz, 1H), 5.13 (d, *J* = 15.8 Hz, 1H), 4.19-4.10 (m, 2H), 3.83 (s, 1H), 3.12 (t, *J* = 7.8 Hz, 2H), 2.21 (quint, *J* = 7.2 Hz, 2H), 1.73 (td, *J* = 14.4, 5.4 Hz, 1H), 1.68 (td, *J* = 11.4, 5.4 Hz, 1H), 1.42-1.29 (m, 2H), 1.29-1.16 (m, 6H), 0.83 (t, *J* = 6.6 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.2, 158.1, 151.0, 149.5, 115.2, 97.9, 72.3, 66.3, 48.7, 38.1, 31.9, 31.4, 28.9, 23.1, 22.4, 21.4, 13.9.

HRMS (ESI): *m/z* calcd for $C_{17}H_{23}NNaO_4$ $[M+Na]^+$: 328.1519, found 328.1513.

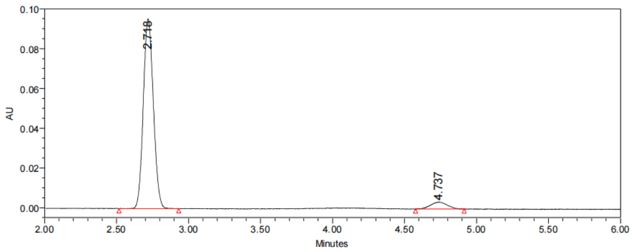
FT-IR (cm^{-1}): 3375, 2928, 2856, 1747, 1650, 1573, 1467, 1149, 828, 726.

Enantiomeric excess was 89% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 2.718 min, t_{minor} = 4.737 min).



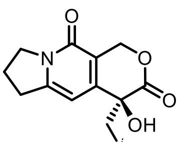
peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.732	72221	49.95	13323
2	4.762	72354	50.05	8097



peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.718	461397	94.31	95330
2	4.737	27841	5.69	3425



2d

2d was obtained in 53% yield as a white solid.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

m.p.: 151.5-153.2 °C.

$[\alpha]_D^{25}$ = +26.7 (c = 0.3, $CHCl_3$).

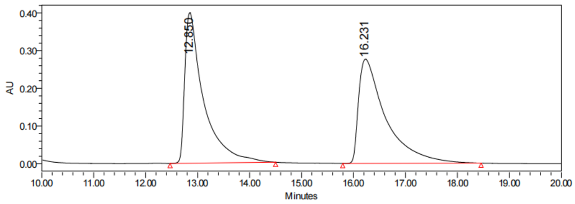
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.51 (s, 1H), 5.61 (d, *J* = 15.6 Hz, 1H), 5.15 (d, *J* = 15.6 Hz, 1H), 4.21-4.10 (m, *J* = 6.8 Hz, 2H), 3.70 (s, 1H), 3.14 (t, *J* = 7.8 Hz, 2H), 2.23 (quint, *J* = 7.6 Hz, 2H), 1.86-1.77 (m, 1H), 1.73 (dd, *J* = 14.4, 5.0 Hz, 1H), 1.57 (dd, *J* = 14.4, 6.9 Hz, 1H), 0.96 (d, *J* = 6.6 Hz, 3H), 0.89 (d, *J* = 6.6 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.7, 158.2, 151.2, 150.3, 115.3, 97.8, 72.7, 66.2, 48.8, 46.3, 31.9, 24.4, 23.9, 23.3, 21.4.

HRMS (ESI): *m/z* calcd for $C_{15}H_{19}NNaO_4$ $[M+Na]^+$: 300.1206, found 300.1218.

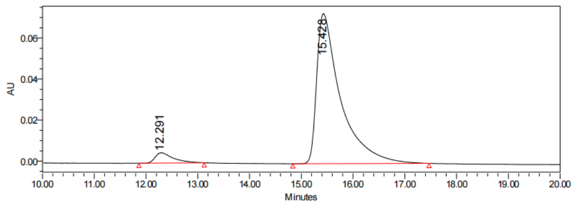
FT-IR (cm^{-1}): 3442, 2923, 1746, 1650, 1573, 1468, 1125, 1039, 751, 637.

Enantiomeric excess was 90% determined by the chiral HPLC analysis (IA-3, Hexane/Isopropanol = 80/20, v = 1.0 mL/min, λ = 305.0 nm, t_{minor} = 12.291, t_{major} = 15.428 min).



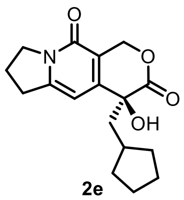
peak information

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	12.850	10059024	50.08	398798
2	16.231	10028206	49.92	276210



peak information

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	12.291	123137	4.98	5066
2	15.428	2348060	95.02	73084



2e

2e was obtained in 65% yield as a pale yellow solid.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

m.p.: 168.2-169.5 °C.

$[\alpha]_D^{25}$ = +17.5 (c = 0.4, $CHCl_3$).

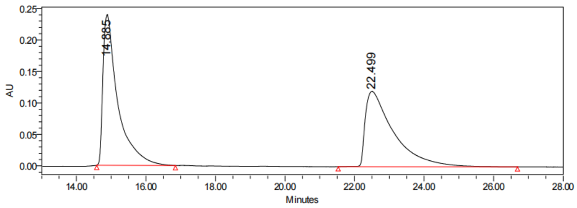
^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.50 (s, 1H), 5.61 (d, *J* = 15.6 Hz, 1H), 5.16 (d, *J* = 15.6 Hz, 1H), 4.16 (td, *J* = 7.2, 2.4 Hz, 2H), 3.69 (s, 1H), 3.14 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.6 Hz, 2H), 1.96-1.82 (m, 3H), 1.79-1.71 (m, 2H), 1.66-1.43 (m, 5H), 1.13-1.03 (m, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.7, 158.2, 151.2, 150.2, 115.3, 97.8, 72.7, 66.2, 48.7, 44.3, 35.2, 33.9, 33.3, 31.9, 25.0, 24.9, 21.4.

HRMS (ESI): *m/z* calcd for $C_{17}H_{21}NNaO_4$ $[M+Na]^+$: 326.1363, found 326.1360.

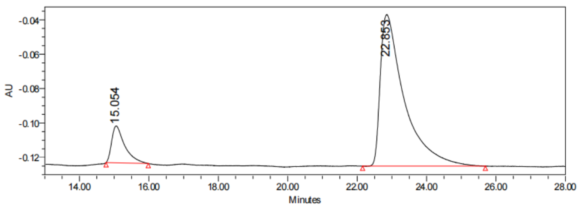
FT-IR (cm^{-1}): 3443, 2923, 2853, 1745, 1650, 1573, 1467, 1141, 1075, 751, 669.

Enantiomeric excess was 77% determined by the chiral HPLC analysis (IA-3, Hexane/Isopropanol = 80/20, v = 1.0 mL/min, λ = 305.0 nm, t_{minor} = 15.054, t_{major} = 22.853 min).



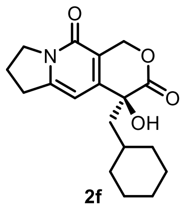
peak information

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	14.885	7083952	51.06	239129
2	22.499	6789059	48.94	119722



peak information

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	15.054	556845	11.66	21402
2	22.853	4218629	88.34	88001



2f

2f was obtained in 71% yield as a pale yellow solid.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

m.p.: 170.0-171.6 °C.

$[\alpha]_D^{25}$ = +20.0 (c = 0.5, $CHCl_3$).

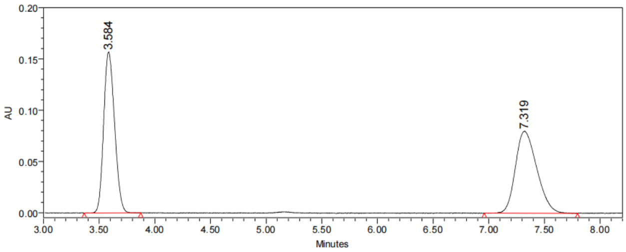
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.50 (s, 1H), 5.58 (d, *J* = 15.6 Hz, 1H), 5.13 (d, *J* = 15.6 Hz, 1H), 4.15 (h, *J* = 5.8 Hz, 2H), 3.81 (s, 1H), 3.12 (t, *J* = 7.8 Hz, 2H), 2.22 (quint, *J* = 7.5 Hz, 2H), 1.77 (d, *J* = 12.4 Hz, 1H), 1.71-1.55 (m, 6H), 1.52-1.44 (m, 1H), 1.25-1.16 (m, 2H), 1.13-1.04 (m, 1H), 0.96-0.86 (m, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.6, 151.2, 115.3, 97.8, 72.5, 66.1, 48.8, 45.2, 34.8, 33.8, 32.9, 31.9, 26.0, 25.9, 21.4.

HRMS (ESI): *m/z* calcd for $C_{18}H_{23}NNaO_4$ $[M+Na]^+$: 340.1519, found 340.1529.

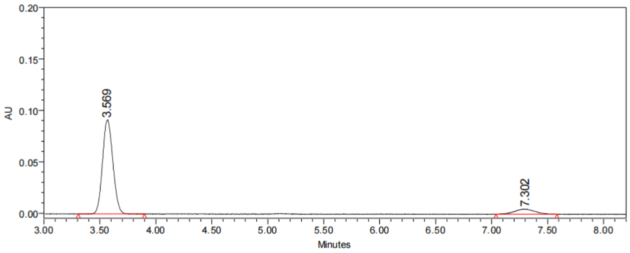
FT-IR (cm^{-1}): 3441, 2923, 2850, 1746, 1650, 1573, 1447, 1221, 1147, 1037, 948, 828, 733.

Enantiomeric excess was 81% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 3.569 min, t_{minor} = 7.302 min).



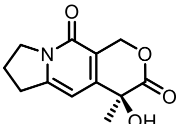
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	3.584	1068804	50.01	156881
2	7.319	1068402	49.99	79927



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	3.569	588095	90.60	91253
2	7.302	60984	9.40	4819



2g

2g was obtained in 45% yield as a white solid.

TLC: $R_f = 0.3$ (DCM: MeOH =30:1).

m.p.: 207.0-208.4 °C.

$[\boldsymbol{\alpha}]_D^{25}$ = +10.0 (c = 0.3, $CHCl_3$).

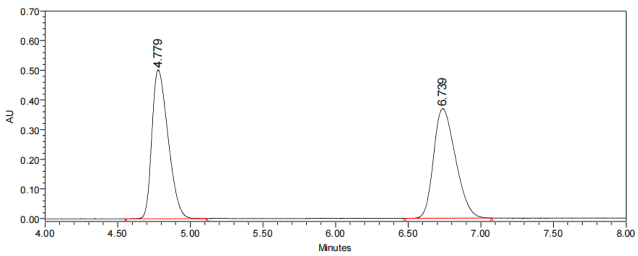
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.52 (s, 1H), 5.62 (d, *J* = 15.8 Hz, 1H), 5.15 (d, *J* = 15.8 Hz, 1H), 4.17 (h, *J* = 5.6 Hz, 2H), 3.14 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.2 Hz, 2H), 1.55 (s, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.8, 158.1, 151.6, 149.9, 115.1, 97.1, 69.3, 66.2, 48.8, 32.0, 26.0, 21.4.

HRMS (ESI): *m/z* calcd for $C_{12}H_{13}NO_4$ $[M+H]^+$: 236.0917, found 236.0917.

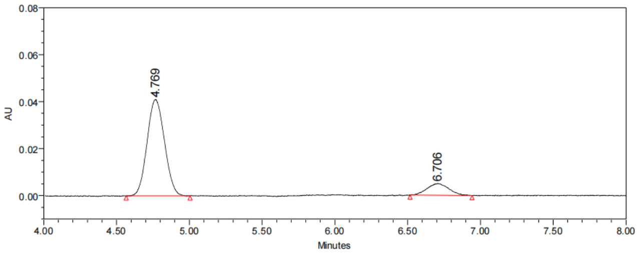
FT-IR (cm^{-1}): 3448, 2923, 2851, 1737, 1641, 1552, 1258, 1075, 749, 668.

Enantiomeric excess was 74% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 85/15, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 4.769 min, t_{minor} = 6.706 min).



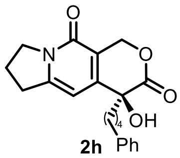
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	4.779	3885331	49.99	501245
2	6.739	3887442	50.01	369676



peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	4.769	342003	86.84	40963
2	6.706	51821	13.16	4993



2h was obtained in 83% yield as a white oil.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

$[\alpha]_D^{25}$ = +13.3 (c = 0.3, $CHCl_3$).

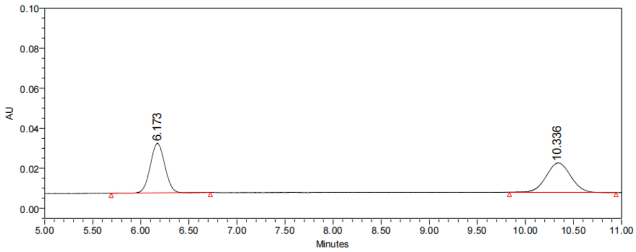
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.28-7.24 (m, 3H), 7.17 (t, *J* = 7.8 Hz, 1H), 7.12 (d, *J* = 7.8 Hz, 1H), 6.45 (s, 1H), 5.59 (d, *J* = 15.8 Hz, 1H), 5.14 (d, *J* = 15.8 Hz, 1H), 4.16 (d, *J* = 7.2 Hz, 2H), 3.66 (s, 1H), 3.12 (t, *J* = 8.4 Hz, 2H), 2.57 (t, *J* = 8.4 Hz, 2H), 2.23 (t, *J* = 8.0 Hz, 2H), 1.83-1.70 (m, 2H), 1.65-1.52 (m, 3H), 1.49-1.37 (m, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.2, 158.1, 151.1, 149.4, 141.9, 128.3, 128.3, 125.8, 115.3, 97.9, 72.2, 66.4, 48.7, 37.8, 35.6, 31.9, 31.1, 22.9, 21.4.

HRMS (ESI): *m/z* calcd for $C_{21}H_{23}NNaO_4$ $[M+Na]^+$: 376.1519, found 376.1525.

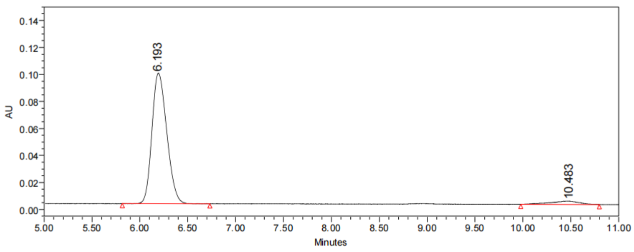
FT-IR (cm^{-1}): 3450, 2967, 2924, 1737, 1657, 1572, 1460, 1366, 1225, 1045, 796, 663.

Enantiomeric excess was 90% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 6.193 min, t_{minor} = 10.483 min).



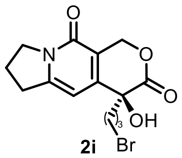
peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	6.173	260210	49.94	24742
2	10.336	260815	50.06	14722



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	6.193	1041454	95.13	96539
2	10.483	53354	4.87	2438



2i

2i was obtained in 81% yield as a yellow oil.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = +20.0 (c = 0.5, $CHCl_3$).

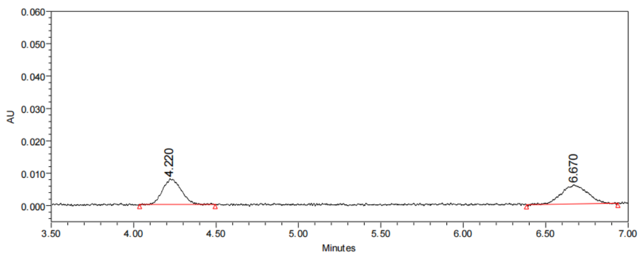
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.47 (s, 1H), 5.63 (d, J = 15.6 Hz, 1H), 5.20 (d, J = 15.6 Hz, 1H), 4.17 (h, J = 7.2 Hz, 2H), 3.71 (s, 1H), 3.40 (t, J = 6.0 Hz, 2H), 3.15 (t, J = 7.8 Hz, 2H), 2.24 (q, J = 7.8 Hz, 2H), 2.03-1.98 (m, 1H), 1.96-1.87 (m, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.0, 158.1, 151.4, 149.0, 115.4, 97.7, 71.8, 66.4, 48.8, 36.3, 32.8, 32.0, 26.4, 21.4.

HRMS (ESI): *m/z* calcd for $C_{14}H_{16}BrNNaO_4$ $[M+Na]^+$: 364.0155, found 364.0168.

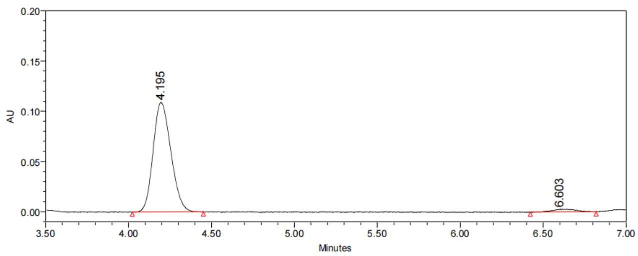
FT-IR (cm^{-1}): 3563, 2962, 2851, 1745, 1580, 1468, 1180, 1029, 799, 668.

Enantiomeric excess was 94% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 4.195 min, t_{minor} = 6.603 min).



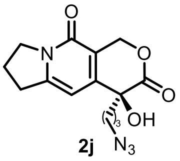
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	4.220	62630	49.21	7930
2	6.670	64634	50.79	5837



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	4.195	814764	96.94	109086
2	6.603	25722	3.06	2696



2j

2j was obtained in 85% yield as a white oil.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

$[\alpha]_D^{25}$ = +14.0 (c = 0.5, $CHCl_3$).

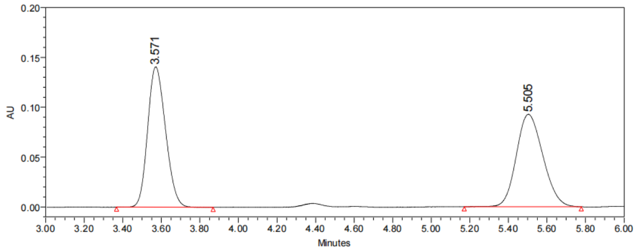
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.47 (s, 1H), 5.61 (d, *J* = 15.6 Hz, 1H), 5.17 (d, *J* = 15.6 Hz, 1H), 4.19-4.10 (m, 2H), 3.76 (s, 1H), 3.36-3.26 (m, 2H), 3.15 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.8 Hz, 2H), 1.87-1.76 (m, 2H), 1.75-1.66 (m, 2H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.0, 158.1, 151.4, 148.9, 115.4, 97.7, 71.8, 66.4, 50.9, 48.7, 34.9, 32.0, 23.0, 21.4.

HRMS (ESI): *m/z* calcd for $C_{14}H_{16}N_4NaO_4$ $[M+Na]^+$: 327.1064, found 327.1063.

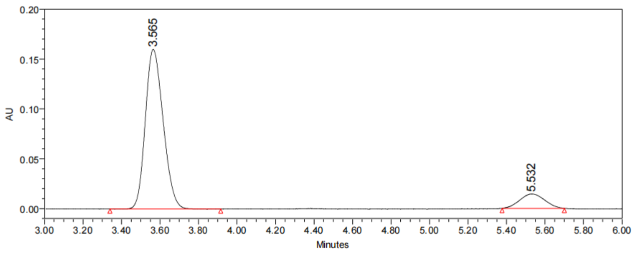
FT-IR (cm^{-1}): 3444, 2926, 2098, 1744, 1648, 1573, 1466, 1231, 1142, 1035, 795, 665.

Enantiomeric excess was 78% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 3.565 min, t_{minor} = 5.532 min).



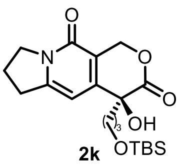
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	3.571	910260	50.62	140701
2	5.505	888062	49.38	92602



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	3.565	1033235	88.80	160112
2	5.532	130255	11.20	14454



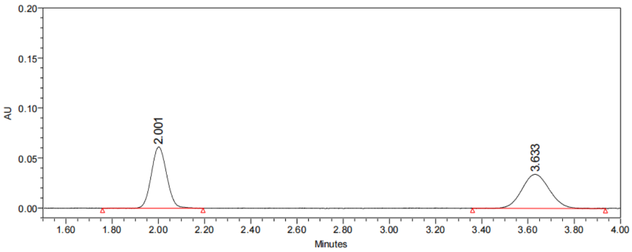
2k

2k was obtained in 88% yield as a light yellow oil.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

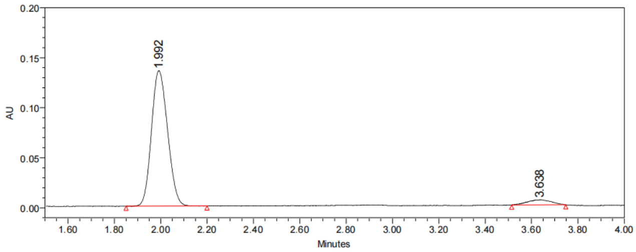
$[\alpha]_D^{25}$ = +38.0 (c = 0.5, $CHCl_3$).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.51 (s, 1H), 5.60 (d, *J* = 15.8 Hz, 1H), 5.16 (d, *J* = 15.8 Hz, 1H), 4.22-4.13 (m, 2H), 4.04 (s, 1H), 3.61 (t, *J* = 6.0 Hz, 2H), 3.14 (t, *J* = 7.8 Hz, 2H), 2.24 (quint, *J* = 7.2 Hz, 2H), 1.90-1.78 (m, 2H), 1.68-1.60 (m, 2H), 0.87 (s, 9H), 0.03 (s, 6H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.4, 158.4, 150.5, 146.9, 117.2, 100.0, 65.8, 62.1, 48.6, 44.1, 31.8, 29.6, 27.6, 25.8, 21.4, 18.2, -5.3.
HRMS (ESI): *m/z* calcd for $C_{20}H_{31}NNaO_5Si$ $[M+Na]^+$: 416.1864, found 416.1854.
FT-IR (cm^{-1}): 3441, 2923, 1734, 1653, 1576, 1465, 1410, 1088, 1035, 798, 750.
Enantiomeric excess was 90% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 1.992 min, t_{minor} = 3.638 min).



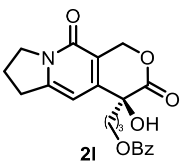
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	2.001	285158	50.41	61362
2	3.633	280489	49.59	34066



peak information:

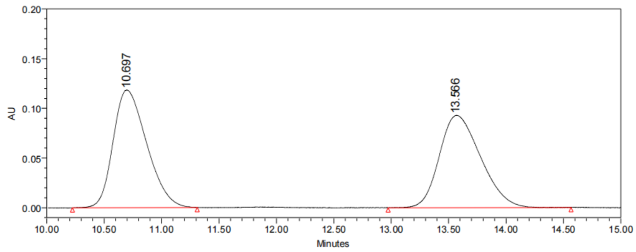
	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	1.992	655218	94.85	135327
2	3.638	35570	5.15	4927



2l was obtained in 40% yield as a pale yellow solid.
TLC: R_f = 0.3 (DCM: MeOH =30:1).
m.p.: 141.9-143.5 °C.
$[\alpha]_D^{25}$ = +6.7 (c = 0.3, $CHCl_3$).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.99 (d, *J* = 6.6 Hz, 2H), 7.57 (t, *J* = 7.4 Hz, 1H), 7.44 (t, *J* = 7.8 Hz, 2H), 6.50 (s, 1H), 5.63 (d, *J* = 15.6 Hz, 1H), 5.18 (d, *J* = 15.6 Hz, 1H), 4.32 (t, *J* = 4.4 Hz, 2H), 4.16 (td, *J* = 7.2, 3.0 Hz, 2H), 3.73 (s, 1H), 3.15 (t, *J* = 8.4 Hz, 2H), 2.24 (quint, *J* = 7.2 Hz, 3H), 1.93-1.87 (m, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.1, 151.4, 133.1, 129.5, 128.4, 71.9, 66.4, 64.0, 48.8, 34.5, 32.0, 22.9, 21.4.
HRMS (ESI): *m/z* calcd for $C_{21}H_{21}NNaO_6$ $[M+Na]^+$: 406.1261, found 406.1250.

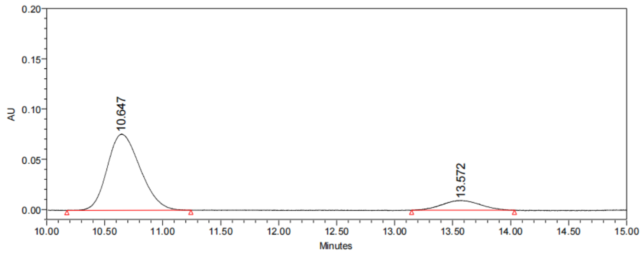
FT-IR (cm^{-1}): 3447, 1645, 1455, 1276, 1119, 1040, 714.

Enantiomeric excess was 74% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 10.647 min, t_{minor} = 13.572 min).



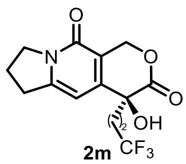
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	10.697	2409337	50.98	118280
2	13.566	2316593	49.02	92734



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	10.647	1493649	87.15	75781
2	13.572	220184	12.85	9603



2m

2m was obtained in 84% yield as a white solid.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

m.p.: 213.7-214.8 °C.

$[\alpha]_D^{25}$ = +26.7 (c = 0.3, $CHCl_3$).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.45 (s, 1H), 5.64 (d, *J* = 16.0 Hz, 1H), 5.19 (d, *J* = 16.0 Hz, 1H), 4.17 (td, *J* = 7.2, 4.8 Hz, 2H), 3.78 (s, 1H), 3.16 (t, *J* = 7.4 Hz, 2H), 2.35-2.23 (m, 3H), 2.22-2.14 (m, 1H), 1.98 (dtd, *J* = 26.2, 13.6, 6.8 Hz, 1H).

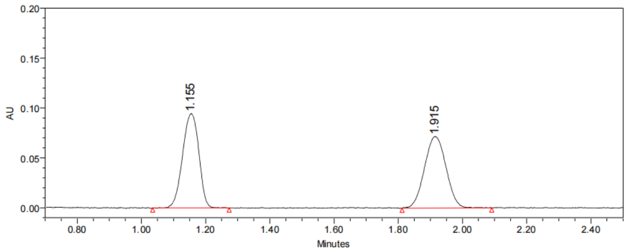
^{13}C NMR (150 MHz, Chloroform-*d*): δ 173.4, 158.1, 151.8, 148.1, 126.6 (q, *J* = 273.0 Hz), 115.6, 97.5, 70.7, 66.5, 48.9, 32.0, 30.1, 28.3 (d, *J* = 28.5 Hz), 21.4.

^{19}F NMR (564 MHz, Chloroform-*d*): δ -66.16.

HRMS (ESI): *m/z* calcd for $C_{14}H_{14}F_3NNaO_4$ $[M+Na]^+$: 340.0767, found 340.0774.

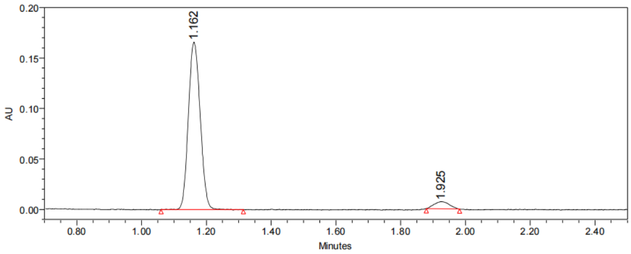
FT-IR (cm^{-1}): 3440, 2924, 2853, 1749, 1652, 1576, 1448, 1256, 1140,1103, 751, 636.

Enantiomeric excess was 90% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 1.162 min, t_{minor} = 1.925 min).



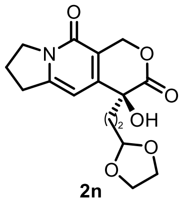
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	1.155	333402	49.93	94388
2	1.915	334305	50.07	71525



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	1.162	419056	94.78	165615
2	1.925	23103	5.22	7079



2n

2n was obtained in 79% yield as a light yellow solid.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

m.p.: 192.4-193.5 °C.

$[\alpha]_D^{25}$ = +70.0 (c = 0.3, $CHCl_3$).

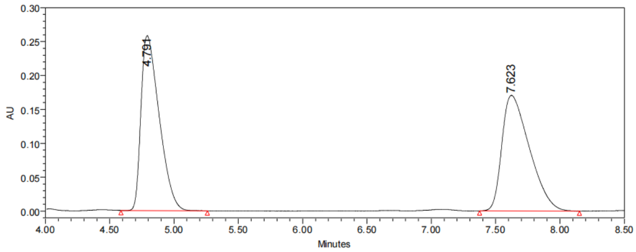
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.47 (s, 1H), 5.60 (d, *J* = 15.8 Hz, 1H), 5.18 (d, *J* = 15.8 Hz, 1H), 4.87 (t, *J* = 4.2 Hz, 1H), 4.20-4.11 (m, 2H), 3.94 (s, 2H), 3.84 (d, *J* = 7.4 Hz, 3H), 3.13 (t, *J* = 7.8 Hz, 2H), 2.24 (q, *J* = 7.6 Hz, 2H), 1.91-1.83 (m, 3H), 1.73-1.68 (m, 1H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.1, 158.2, 151.1, 149.1, 115.6, 103.3, 97.9, 71.7, 66.3, 65.0, 48.7, 31.9, 31.6, 27.5, 21.4.

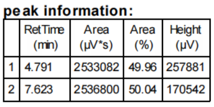
HRMS (ESI): *m/z* calcd for $C_{16}H_{19}NNaO_6$ $[M+Na]^+$: 344.1105, found 344.1104.

FT-IR (cm^{-1}): 3442, 1642, 1467, 1413, 1141, 1033, 749.

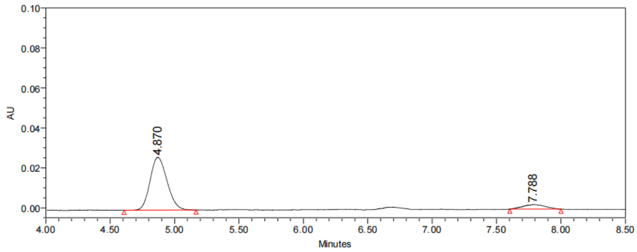
Enantiomeric excess was 80% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 4.870 min, t_{minor} = 7.788 min).



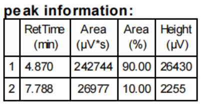
peak information:



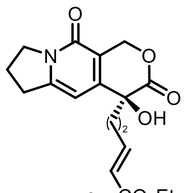
	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	4.791	2533082	49.96	257881
2	7.623	2536800	50.04	170542



peak information:



	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	4.870	242744	90.00	26430
2	7.788	26977	10.00	2255



2o

2o was obtained in 82% yield as a white oil.

TLC: R_f = 0.3 (DCM: MeOH =30:1).

$[\alpha]_D^{28}$ = +28.0 (c = 0.5, $CHCl_3$).

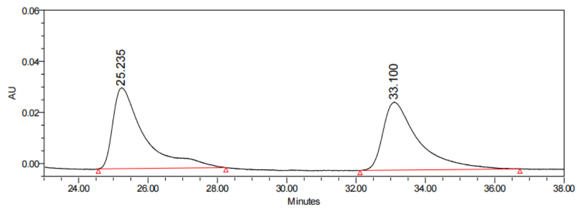
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.87 (dt, *J* = 14.4, 6.8 Hz, 1H), 6.48 (s, 1H), 5.80 (d, *J* = 15.6 Hz, 1H), 5.62 (d, *J* = 16.0 Hz, 1H), 5.17 (d, *J* = 16.0 Hz, 1H), 4.17 (q, *J* = 7.0 Hz, 4H), 3.77 (s, 1H), 3.15 (t, *J* = 8.4 Hz, 2H), 2.39-2.28 (m, 2H), 2.24 (quint, *J* = 7.4 Hz, 2H), 1.92 (td, *J* = 13.8, 5.4 Hz, 1H), 1.84 (td, *J* = 10.8, 6.0Hz, 1H), 1.27 (t, *J* = 7.2 Hz, 4H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 173.8, 166.2, 158.1, 151.4, 148.8, 146.3, 122.4, 115.4, 97.9, 71.8, 66.5, 60.3, 48.9, 36.0, 32.0, 26.1, 21.4, 14.2.

HRMS (ESI): *m/z* calcd for $C_{18}H_{21}NNaO_6$ $[M+Na]^+$: 406.1261, found 406.1250.

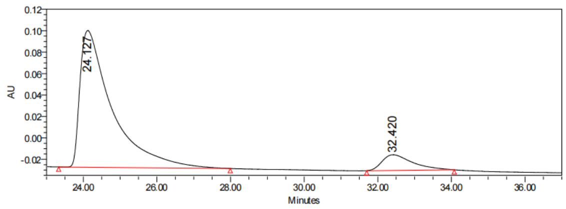
FT-IR (cm^{-1}): 3448, 2061, 1639, 1260, 1036, 749.

Enantiomeric excess was 80% determined by the chiral HPLC analysis (IA-3, Hexane/Isopropanol = 80/20, v = 1.0 mL/min, λ = 305.0 nm, t_{major} = 24.127, t_{minor} = 32.420 min).



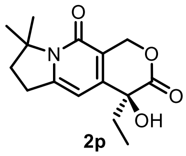
peak information

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	25.235	1989436	51.23	31612
2	33.100	1893654	48.77	26634



peak information

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	24.127	7729360	90.17	127520
2	32.420	842542	9.83	14678



2p

2p was obtained in 91% yield as a white solid.

TLC: R_f = 0.6 (DCM: MeOH =30:1).

m.p.: 66.5-68.0 °C.

$[\alpha]_D^{25}$ = +58.3 (c = 0.5, $CHCl_3$).

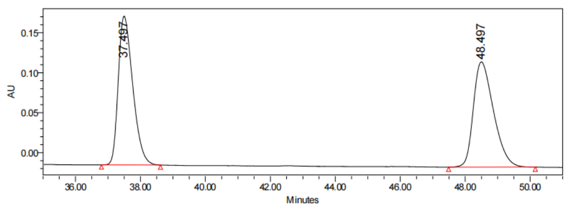
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.38 (s, 1H), 5.58 (d, *J* = 15.8 Hz, 1H), 5.15 (d, *J* = 15.8 Hz, 1H), 3.63 (s, 1H), 3.02 (t, *J* = 7.8 Hz, 2H), 2.08 (t, *J* = 5.4 Hz, 2H), 1.83-1.76 (m, 2H), 1.71 (s, 3H), 1.67 (s, 3H), 0.97 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.3, 158.8, 151.2, 148.9, 116.7, 97.8, 72.4, 69.1, 66.5, 37.8, 31.3, 28.6, 25.6, 25.4, 7.7.

HRMS (ESI): *m/z* calcd for $C_{15}H_{20}NO_4$ $[M+H]^+$: 278.1387, found 278.1379.

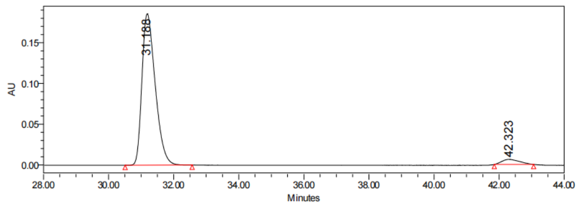
FT-IR (cm^{-1}): 3393, 2971, 2935, 1745, 1650, 1570, 1456, 1229, 1148, 1045, 798, 734, 668.

Enantiomeric excess was 92% determined by the chiral HPLC analysis (IA-3, Hexane/Isopropanol = 80/20, v = 1.0 mL/min, λ = 240.0 nm, t_{major} = 31.188, t_{minor} = 42.323 min).



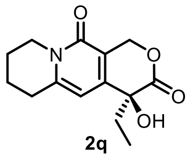
peak information

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	37.497	5767991	50.40	185764
2	48.497	5675406	49.60	131586



peak information

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	31.188	5277505	95.80	185807
2	42.323	231462	4.20	6252



2q

2q was obtained in 65% yield as a light yellow oil.

TLC: R_f = 0.5 (DCM: MeOH =30:1).

$[\alpha]_D^{25}$ = +20.0 (c = 0.3, $CHCl_3$).

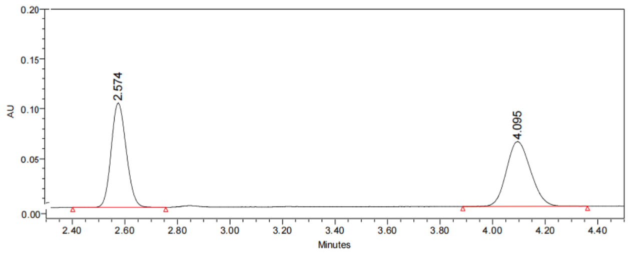
^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.36 (s, 1H), 5.58 (d, *J* = 16.0 Hz, 1H), 5.16 (d, *J* = 16.0 Hz, 1H), 4.10-3.94 (m, 2H), 3.63 (s, 1H), 2.85 (t, *J* = 6.4 Hz, 2H), 2.04-1.91 (m, 2H), 1.87-1.76 (m, 4H), 0.97 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 174.2, 159.5, 148.4, 147.5, 114.6, 101.5, 72.2, 66.8, 41.8, 31.6, 29.1, 22.0, 18.5, 7.7.

HRMS (ESI): *m/z* calcd for $C_{14}H_{17}NNaO_4$ $[M+Na]^+$: 286.1050, found 286.1061.

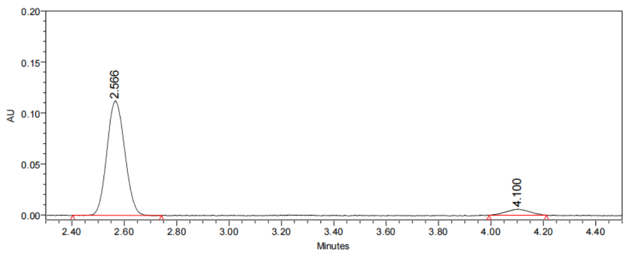
FT-IR (cm^{-1}): 3448, 2924, 1740, 1644, 1560, 1464, 1156, 1036, 840, 667.

Enantiomeric excess was 87% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 2.566 min, t_{minor} = 4.100 min).



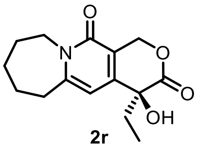
peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.574	406244	50.06	102001
2	4.095	405204	49.94	63306



peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.566	533453	93.52	112171
2	4.100	36985	6.48	5932



2r

2r was obtained in 51% yield as a white solid.

TLC: R_f = 0.5 (DCM: MeOH =30:1).

m.p.: 79.6-81.0 °C.

$[\alpha]_D^{25}$ = +43.3 (c = 0.3, $CHCl_3$).

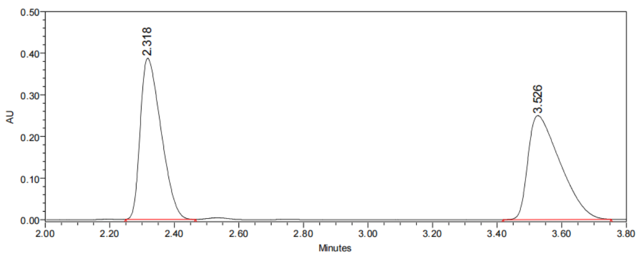
^{1}H NMR (400 MHz, Chloroform-*d*): δ 6.35 (s, 1H), 5.55 (d, J = 16.0 Hz, 1H), 5.15 (d, J = 16.0 Hz, 1H), 4.50 (dd, J = 14.4, 7.4 Hz, 1H), 4.25 (dd, J = 14.4, 8.8 Hz, 1H), 3.60 (s, 1H), 2.90-2.78 (m, 2H), 1.88-1.66 (m, 9H), 0.96 (t, J = 7.4 Hz, 3H).

^{13}C NMR (100 MHz, Chloroform-*d*): δ 174.1, 159.5, 153.0, 147.6, 115.4, 101.9, 72.1, 67.1, 43.7, 35.3, 31.6, 29.6, 27.6, 26.9, 7.7.

HRMS (ESI): m/z calcd for $C_{15}H_{20}NO_4$ $[M+H]^+$: 278.1387, found 278.1390.

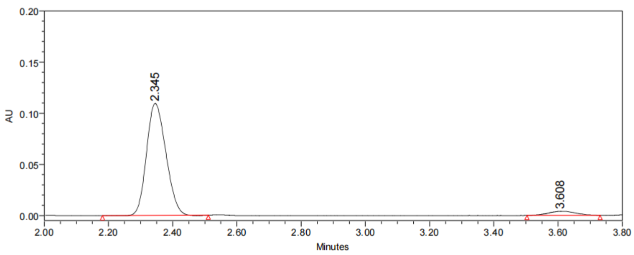
FT-IR (cm^{-1}): 3448, 2056, 1638, 1122, 710.

Enantiomeric excess was 90% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 210.0 nm, t_{major} = 2.345 min, t_{minor} = 3.608 min).



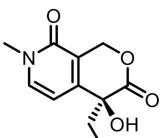
peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.318	1727983	49.99	386757
2	3.526	1728509	50.01	249562



peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.345	460228	95.13	109466
2	3.608	23547	4.87	4010



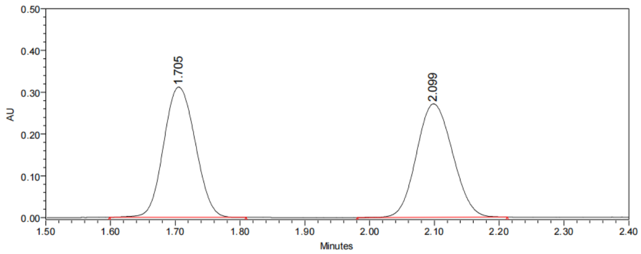
2s

2s was obtained in 35% yield as a white solid.

TLC: R_f = 0.4 (DCM: MeOH =30:1).

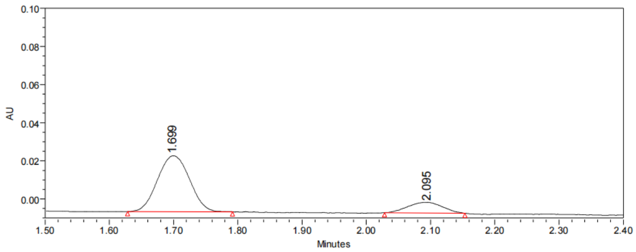
m.p.: 150.0-151.7 °C.

$[\alpha]_D^{25}$ = +20.0 (c = 0.3, $CHCl_3$).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.38 (d, *J* = 6.6 Hz, 1H), 6.51 (d, *J* = 7.2 Hz, 1H), 5.60 (d, *J* = 16.2 Hz, 1H), 5.18 (d, *J* = 16.2 Hz, 1H), 3.62 (s, 1H), 3.59 (s, 3H), 1.83-1.76 (m, 2H), 0.97 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 148.5, 138.4, 118.7, 102.7, 72.1, 66.6, 37.6, 31.6, 7.6.
HRMS (ESI): *m/z* calcd for $C_{11}H_{14}NO_4$ $[M+H]^+$: 224.0917, found 224.0917.
FT-IR (cm^{-1}): 3448, 2921, 2851, 1641, 1412, 1118, 668.
Enantiomeric excess was 66% determined by the chiral UPC^2 analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 1.699 min, t_{minor} = 2.095 min).



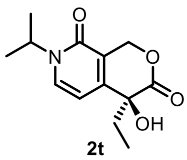
peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	1.705	1057759	50.16	311480
2	2.099	1051051	49.84	271348



peak information:

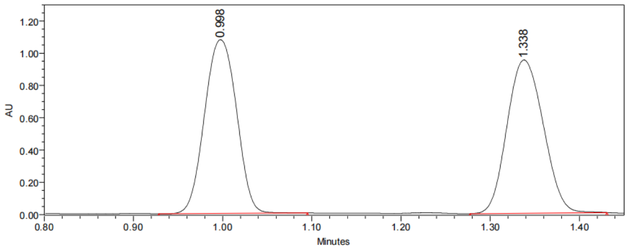
	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	1.699	101439	82.91	29330
2	2.095	20905	17.09	5574



2t

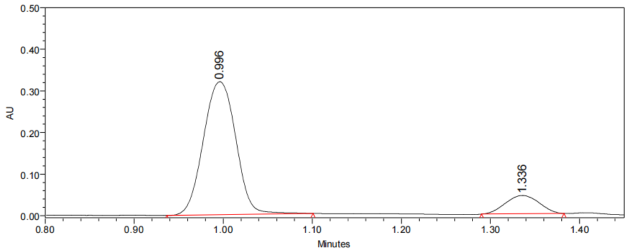
2t was obtained in 31% yield as a white solid.
TLC: R_f = 0.4 (DCM: MeOH =30:1).
m.p.: 155.7-157.6 °C.
$[\alpha]_D^{25}$ = +40.0 (c = 0.3, $CHCl_3$).
^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.43 (d, *J* = 7.2 Hz, 1H), 6.57 (d, *J* = 7.2 Hz, 1H), 5.61 (d, *J* = 16.2 Hz, 1H), 5.28 (quint, *J* = 6.6 Hz, 1H), 5.18 (d, *J* = 16.2 Hz, 1H), 3.59 (s, 1H), 1.84-1.76 (m, 2H), 1.39 (d, *J* = 6.8 Hz, 3H), 1.37 (d, *J* = 6.8 Hz, 3H), 0.98 (t, *J* = 7.4 Hz, 3H).
^{13}C NMR (150 MHz, Chloroform-*d*): δ 173.9, 158.3, 147.5, 133.1, 118.5, 102.9, 72.0, 66.9, 46.8, 31.5, 22.0, 21.9, 7.7.
HRMS (ESI): *m/z* calcd for $C_{13}H_{17}NNaO_4$ $[M+Na]^+$: 274.1050, found 274.1053.
FT-IR (cm^{-1}): 3442, 2977, 2853, 1744, 1651, 1562, 1462, 1154, 1044, 882, 796, 659.

Enantiomeric excess was 75% determined by the chiral UPC[2] analysis (Trefoil® CEL 2, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 0.996 min, t_{minor} = 1.336 min)



peak information:

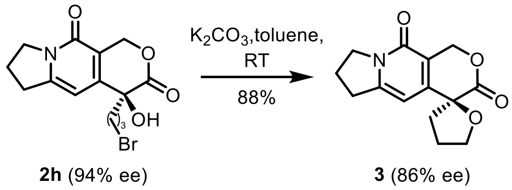
	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	0.998	2687679	50.00	1076858
2	1.338	2687592	50.00	949460



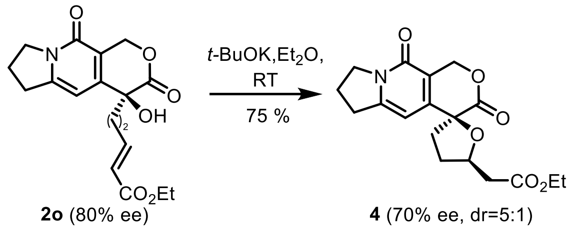
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	0.996	808626	87.51	319476
2	1.336	115360	12.49	43874

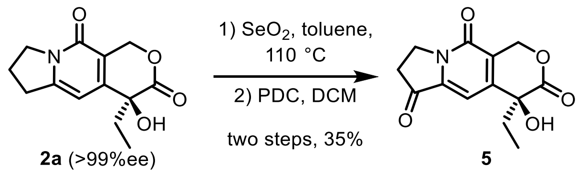
6. Experimental Details for Transformations of the Products



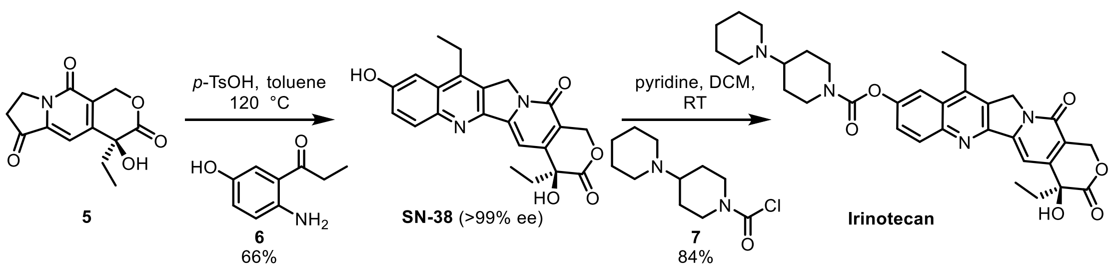
Synthesis of compound 3: To a stirred solution of **2h** (0.1 mmol, 1.0 equiv.) in toluene (1 mL) was added K_2CO_3 (0.1mmol, 1.0 equiv.) under an argon atmosphere. The resultant solution was stirred for 24 h at room temperature. Then, the mixture was evaporated and purified by flash chromatography on silica gel (DCM: MeOH = 50:1) to give **3**.



Synthesis of compound 4: To a stirred solution of **2o** (0.1 mmol, 1.0 equiv.) in Et_2O (1 mL) was added *t*-BuOK (0.1mmol, 1.0 equiv.) under an argon atmosphere. The resultant solution was stirred for 1 h at room temperature. Then, the mixture was evaporated and purified by flash chromatography on silica gel (DCM: MeOH = 50:1) to give **4**.



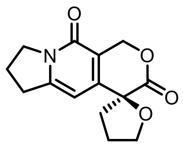
Synthesis of compound 5:[4] A mixture of **2a** (1 mmol, 1.0 equiv.) and SeO_2 (3 mmol, 3.0 equiv.) in dioxane/H_2O (8 mL/0.3 mL) was heated together in a sealed tube at 110 °C for 24 h. The solution was then poured So water and extracted with trichloromethane (4 × 30 mL). The combined extracts were dried over $MgSO_4$, filtered, and concentrated. The dark solid residue was then chromatographed (DCM/MeOH = 40:1) to afford **7-Hydroxy-de-AB-camptothecin**. To the suspension of **7-Hydroxy-de-AB-camptothecin** (0.7 mmol, 1.0 equiv.) and Å MS (415 mg) in DCM (5 mL) at 0 °C was added pyridinium dichromate (1.4 mmol, 2.0 equiv.). After 3.5h, 30 mL of EtOAc was added to the mixture, and the slurry was filtered through a plug of silica gel and Celite. Evaporation of the filtrate and chromatography ($CHCl_3$/EtOAc = 1:1) gave **4**.



*Note: **SN-38** and **Irinotecan** were synthesized following the literature procedure.*[12]

Synthesis of SN-38: A solution of ketone **4** (0.3 mmol, 1.0 equiv.) and amino ketone **5**[10] (0.39 mmol, 1.3 equiv.) in 5 mL of toluene were heated together for 30 min before the addition of 3 mg of *p*-TsOH. The resulting red solution was heated at 120 °C with Dean-Stark apparatus for 7.25 h. The solvent was removed, and the residue was purified by flash chromatography on silica gel to give **SN-38**. ($CHCl_3$/ MeOH = 40:1)

Synthesis of Irinotecan: To a solution of **SN-38** (0.1 mmol, 1.0 equiv.) in 0.4 mL pyridine was added carbonyl chloride **6**[11] (0.15 mmol, 1.0 equiv.) in 5 mL DCM. After stirring for 2 h, the solution was quenched with a saturated aqueous solution of $NaHCO_3$ (1 mL) and extracted by DCM (2×5 mL). The organic phase was dried with Na_2SO_4 and concentrated in vacuum. The residue was purified by silica gel column chromatography (DCM/MeOH＝20:1) to afford **Irinotecan**.



3

3 was obtained in 88% yield as a light yellow solid.

TLC: R_f = 0.4 (DCM: MeOH =30:1).

m.p.: 152.0-153.8 °C.

$[\alpha]_D^{25}$ = +30.0 (c = 0.3, $CHCl_3$).

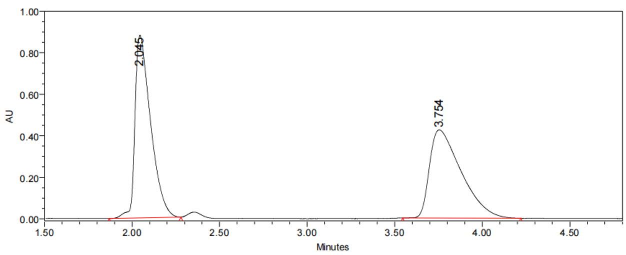
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.40 (s, 1H), 5.56 (d, *J* = 15.6 Hz, 1H), 5.10 (d, *J* = 15.6 Hz, 1H), 4.41 (q, *J* = 7.8 Hz, 1H), 4.26 (q, *J* = 6.6 Hz, 1H), 4.16 (td, *J* = 6.6, 2.8 Hz, 2H), 3.12 (t, *J* = 7.8 Hz, 2H), 2.53-2.47 (m, 1H), 2.23 (quint, *J* = 7.2 Hz, 2H), 2.21-2.16 (m, 1H), 2.11-2.05 (m, 1H), 1.92 -1.87 (m, 1H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.9, 158.2, 151.3, 150.2, 116.7, 96.7, 80.1, 71.1, 65.3, 48.8, 36.6, 32.0, 25.2, 21.4.

HRMS (ESI): *m/z* calcd for $C_{14}H_{15}NO_4$ $[M+H]^+$: 262.1074, found 262.1075.

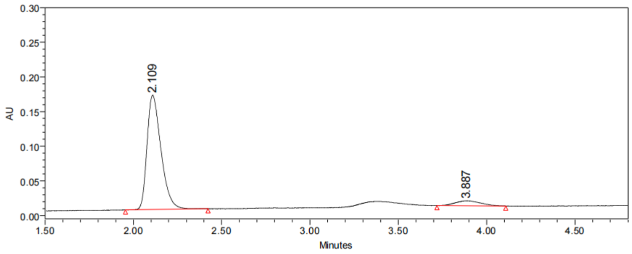
FT-IR (cm^{-1}): 1747, 1572, 1439, 1069, 798, 568.

Enantiomeric excess was 86% determined by the chiral UPC^2 analysis (Trefoil® CEL 1, CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 2.109 min, t_{minor} = 3.887 min)



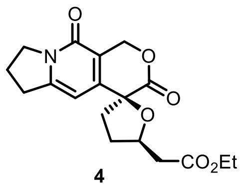
peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	2.045	5472218	50.63	878894
2	3.754	5335079	49.37	424365



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	2.109	908462	92.80	165043
2	3.887	70474	7.20	7026



4

4 was obtained in 75% yield as a white oil.

TLC: R_f = 0.4 (DCM: MeOH =30:1).

$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = +20.0 (c = 0.3, $CHCl_3$).

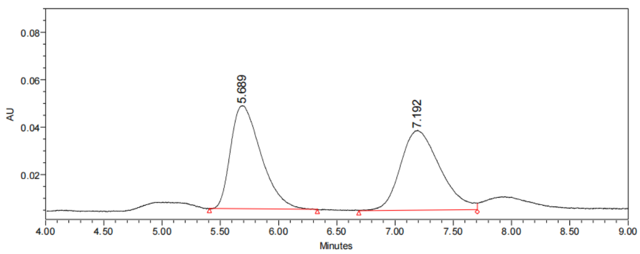
^{1}H NMR (600 MHz, Chloroform-*d*): δ 6.47 (s, 1H), 5.55 (d, *J* = 15.6 Hz, 1H), 5.08 (d, *J* = 15.6 Hz, 1H), 4.99 (quint, *J* = 6.6 Hz, 1H), 4.21-4.14 (m, 5H), 3.13 (t, *J* = 7.6 Hz, 2H), 2.82 (dd, *J* = 14.8, 6.2 Hz, 1H), 2.67 (dd, *J* = 15.0, 6.6 Hz, 1H), 2.51-2.47 (m, 1H), 2.40-2.35 (m, 1H), 2.23 (quint, *J* = 7.6 Hz, 3H), 1.97-1.93 (m, 1H), 1.90-1.85 (m, 1H), 1.30 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 171.6, 170.5, 158.2, 151.4, 149.6, 116.7, 96.8, 80.6, 79.1, 78.2, 60.6, 40.6, 40.2, 36.9, 35.8, 32.1, 30.9, 29.9.

HRMS (ESI): *m/z* calcd for $C_{18}H_{21}NNaO_6$ $[M+Na]^+$: 370.1261, found 370.1252.

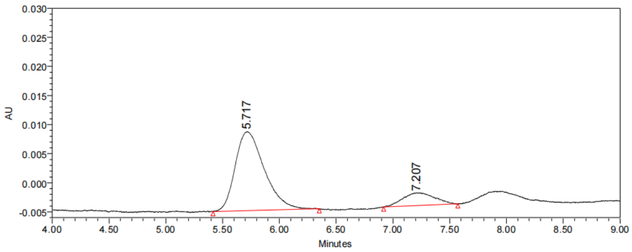
FT-IR (cm^{-1}): 1732, 1650, 1466, 1260, 1033, 799, 704.

Enantiomeric excess was 70% determined by the chiral UPC^2 analysis (Trefoil® CEL 1, CO_2/MeOH = 90/10, v = 2.0 mL/min, λ = 205.0 nm, t_{major} = 5.717 min, t_{minor} = 7.207 min)



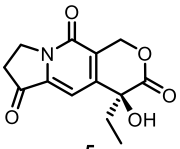
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	5.689	788545	49.80	43493
2	7.192	794783	50.20	33656



peak information:

	RetTime (min)	Area (μV*s)	Area (%)	Height (μV)
1	5.717	241416	85.18	13564
2	7.207	41992	14.82	2166

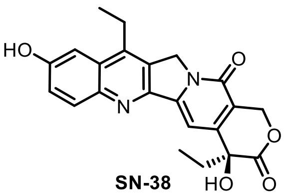


5

5 was known compound according to the literature.[4]

$[\alpha]_D^{25}$ = +112.0 (c = 0.3, $CHCl_3$).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 7.22 (s, 1H), 5.68 (d, *J* = 17.4 Hz, 1H), 5.25 (d, *J* = 17.4 Hz, 1H), 4.38-4.30 (m, 2H), 3.65 (s, 1H), 2.97 (dd, *J* = 7.8, 6.0 Hz, 2H), 1.85-1.78 (m, 2H), 0.98 (t, *J* = 7.4 Hz, 3H).



SN-38

SN-38 was obtained in 66% yield as a light yellow solid.

TLC: R_f = 0.4 (DCM: MeOH =20:1).

m.p.: 228.1-229.2 °C.

$[\alpha]_D^{25}$ = +26.0 (c = 0.3, $CHCl_3$/MeOH= 4:1).

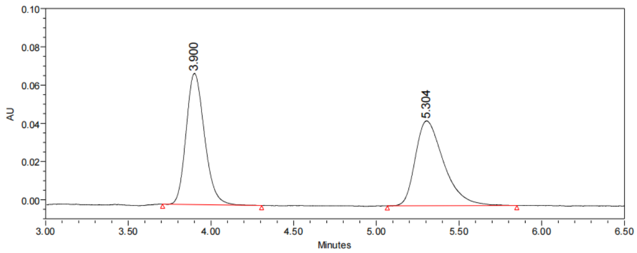
^{1}H NMR (600 MHz, DMSO-d_6): δ 10.29 (s, 1H), 8.03 (dt, *J* = 8.6, 4.2 Hz, 1H), 7.43-7.38 (m, 2H), 7.25 (s, 1H), 6.49 (s, 1H), 5.42 (s, 2H), 5.30-5.25 (m, 2H), 3.14-3.03 (m, 1H), 1.91-1.82 (m, 2H), 1.30 (t, *J* = 7.6 Hz, 3H), 0.88 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (150 MHz, DMSO-d_6): δ 172.6, 156.8, 156.7, 150.0, 148.8, 146.4, 143.6, 142.7, 131.5, 128.2, 128.0, 122.4, 118.0, 104.8, 95.8, 72.4, 65.2, 49.4, 40.0, 30.2, 22.2, 13.3, 7.7.

HRMS (ESI): *m/z* calcd for $C_{22}H_{21}N_2O_5$ $[M+H]^+$: 393.1445, found 393.1446.

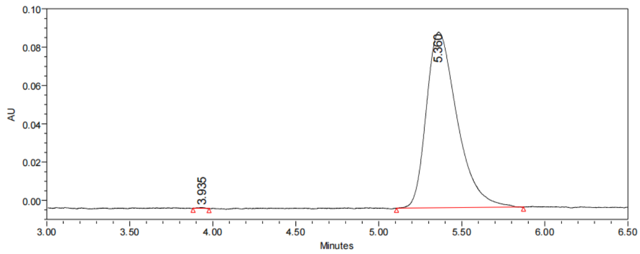
FT-IR (cm^{-1}): 3576, 1732, 1650, 1566, 1466, 1246, 1189, 1033, 852, 833, 719.

Enantiomeric excess was >99% determined by the chiral UPC^2 analysis (Trefoil® Amy-1 CO_2/MeOH = 80/20, v = 2.0 mL/min, λ = 220.0 nm, t_{minor} = 3.935 min, t_{major} = 5.360 min)



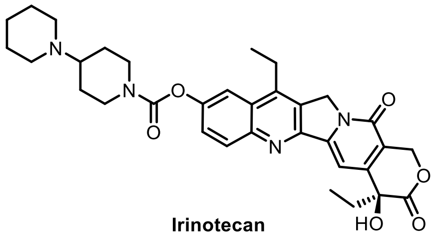
peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	3.900	530133	49.90	68581
2	5.304	532186	50.10	44434



peak information:

	RetTime (min)	Area (µV*s)	Area (%)	Height (µV)
1	3.935	1236	0.10	482
2	5.360	1181809	99.90	91727



Irinotecan

Irinotecan was obtained in 84% yield as a light yellow solid.

TLC: R_f = 0.2 (DCM: MeOH =10:1).

m.p.: 215.0-217.0 °C.

$[\alpha]_D^{25}$ = +25.0 (c = 0.6, $CHCl_3$).

^{1}H NMR (600 MHz, Chloroform-*d*): δ 8.18 (d, *J* = 9.0 Hz, 1H), 7.82 (d, *J* = 2.4 Hz, 1H), 7.62 (s, 1H), 7.54 (dd, *J* = 9.0, 2.6 Hz, 1H), 5.73 (d, *J* = 16.2 Hz, 1H), 5.29 (d, *J* = 16.2 Hz, 1H), 5.24 (s, 2H), 4.53 (dd, *J* = 46.2, 14.4 Hz, 2H), 4.07 (brs, 1H), 3.29 (t, *J* = 11.4 Hz, 1H), 3.20-3.09 (m, 6H), 3.05 (q, *J* = 7.2 Hz, 1H), 2.96 (t, *J* = 13.2 Hz, 1H), 2.47 (d, *J* = 11.8 Hz, 1H), 2.29 (d, *J* = 12.0 Hz, 1H), 2.10 (s, 4H), 2.00-1.80 (m, 5H), 1.48 (t, *J* = 7.2 Hz, 1H), 1.40 (d, *J* = 7.0 Hz, 3H), 1.03 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (150 MHz, Chloroform-*d*): δ 173.8, 157.6, 152.9, 151.7, 150.2, 150.0, 147.2, 146.8, 145.2, 131.8, 127.4, 127.2, 125.5, 118.5, 114.5, 97.9, 72.7, 66.3, 63.4, 50.1, 49.4, 45.8, 43.4, 42.2, 31.6, 26.7, 25.8, 23.1, 140, 11.2, 8.6, 7.8.

HRMS (ESI): *m/z* calcd for $C_{33}H_{39}N_4O_6$ $[M+H]^+$: 587.2864, found 587.2854.

FT-IR (cm^{-1}): 3443, 2925, 2852, 2363, 1648, 1447, 1408, 1309, 1077, 1024, 905, 752.

7. X-ray Crystal Structures of Compounds 2a

X-Ray data for (+)-2a (CCDC: 2362885)

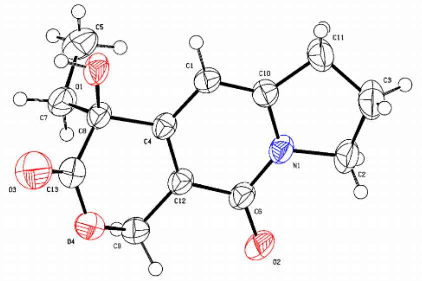


Table S7. Crystal Data and Structure Refinement for **(+)-2a**

Empirical formula	C13H15NO4
Formula weight	249.26
Temperature/K	302.44(10)
Crystal system	monoclinic
Space group	P21
a/Å	7.5054(2)
b/Å	10.0086(2)
c/Å	8.5104(2)
α/°	90
β/°	110.518(2)
γ/°	90
Volume/Å3	598.73(3)
Z	2
ρcalcg/cm3	1.383
μ/mm-1	0.858
F(000)	264.0
Crystal size/mm3	0.18 × 0.15 × 0.12
Radiation	Cu Kα (λ = 1.54184)
2Θ range for data collection/°	11.1 to 151.992
Index ranges	-8 ≤ h ≤ 9, -10 ≤ k ≤ 12, -10 ≤ l ≤ 10
Reflections collected	7782
Independent reflections	2258 [RS = 0.0256, Rsigma = 0.0183]
Data/restraSs/parameters	2258/1/165
Goodness-of-fit on F2	1.067
Final R indexes [I>=2σ (I)]	R1 = 0.0316, wR2 = 0.0822
Final R indexes [all data]	R1 = 0.0323, wR2 = 0.0832
Largest diff. peak/hole / e Å-3	0.19/-0.14
Flack parameter	0.06(6)

8. References

(1) B. Brož, Z. Růžičková and P. Šimůnek, *ARKIVOC*, 2016, **5**, 118-141.

(2) J. Aleksić, M. Stojanović and M. Baranac-Stojanović, *Chem. Asian J.*, 2018, **13**, 1811-1830.

(3) T. A. Bryson and T. M. Dolak, *Org. Synth.*, 1977, **57**, 62-64.

(4) W. Shen, C. A. Coburn, W. G. Bornmann and S. J. Danishefsky, *J. Org. Chem.*, 1993, **58**, 611-617.

(5) X.-L. Wang, L.-J. Xu, F.-J. Xiong, Y. Wu and F.-E. Chen, *Tetrahedron: Asymmetry*, 2017, **28**, 843-848.

(6) S.-K. Chen, W.-Q. Ma, Z.-B. Yan, F.-M. Zhang, S.-H. Wang, Y.-Q. Tu, X.-M. Zhang and J.-M. Tian, *J. Am. Chem. Soc.*, 2018, **140**, 10099-10103.

(7) W.-J. Tang, A. Capacci, X.-D. Wei, W.-J. Li, A. White, N. Patel, J. Savoie, J. Gao, S. Rodriguez, B. Qu, N. Haddad, B. Lu, D. Krishnamurthy, N. Yee and C. Senanayake, *Angew. Chem. Int. Ed.*, 2010, **49**, 5879-5883.

(8) K. Barral, A. D. Moorhouse and J. E. Moses, *Org. Lett.*, 2007, **9**, 1809-1811.

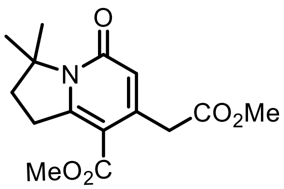
(9) (a) L.-Z. Yang, Y.-P. Zhang, X.-D. Zou, H.-J. Lu and G.-G. Li, *Green Chem.*, 2018, **20**, 1362-1366; (b) B. J. Stokes, B. Jovanović, H.-J. Dong, K. J. Richert, R. D. Riell, and T.G. Driver, *J. Org. Chem.*, 2009, **74**, 3225-3228.

(10) X.-D. Xiong, W.-X. Chen, Y.-Y. Kuang and F.-E. Chen, *Org. Prep. Proced. S.*, 2009, **41**, 423-427.

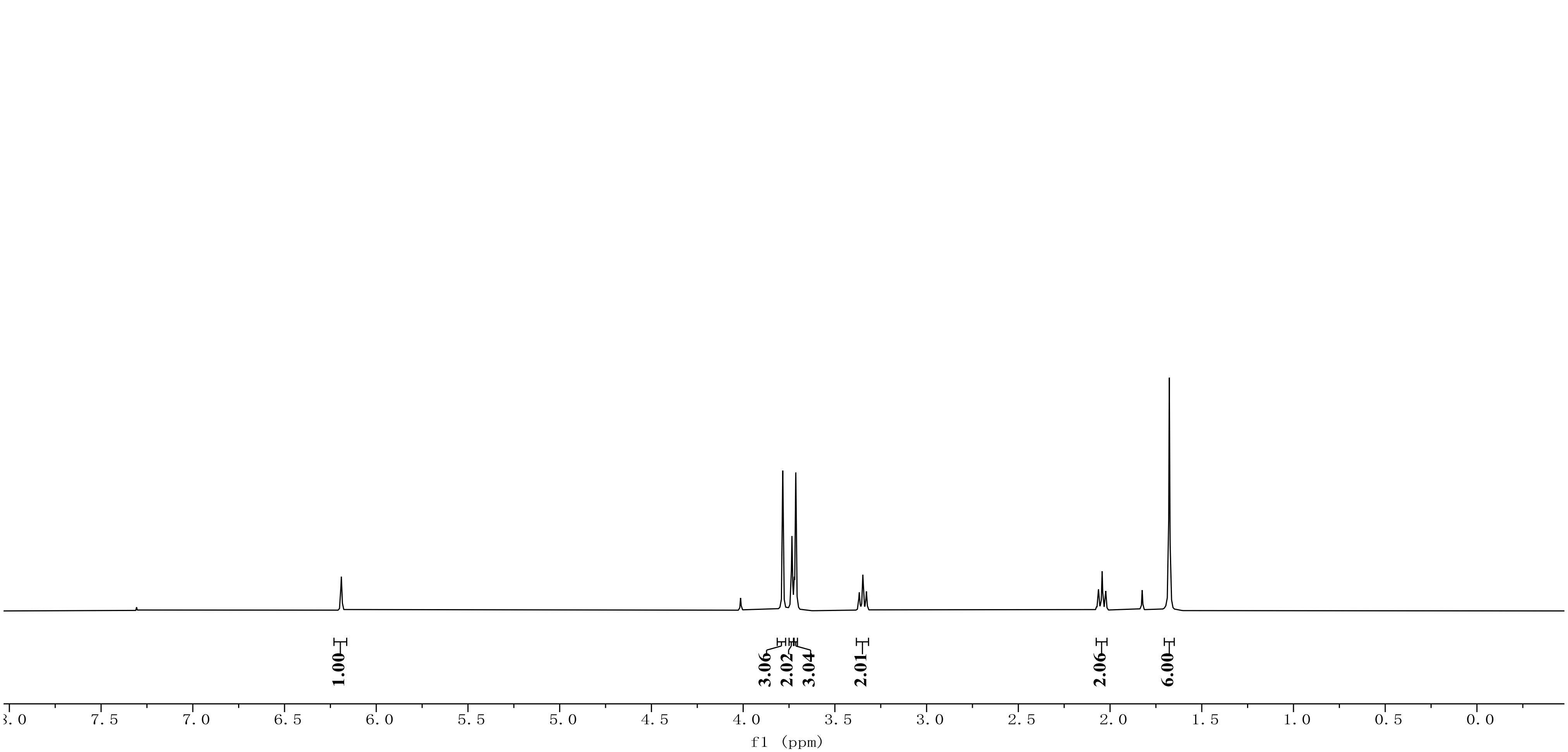
(11) X.-L. Hu, Q.-W. He, H. Long, L.-X. Zhang, R. Wang, B.-L. Wang, J.-H. Feng, Q.Wang, J.-Q. Hou, X.-Q. Zhang, W.-C. Ye and H. Wang, *J. Nat. Prod.*, 2021, **84**, 1954-1966.

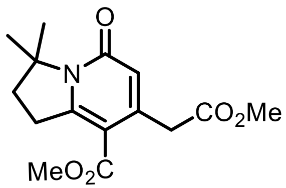
(12)(a) K. E. Henegar, S.W. Ashford, T. A. Baughman, J. C. Sih and R.-L. Gu, *J. Org. Chem.*, 1997, **62**, 19, 6588-6597; (b) Y. Yuan, W.-H. Dong, X.-S. Gao, X.-M. Xie, D. P. Curran and Z.-G. Zhang, *Chin. J. Chem.*, 2018, **36**, 1035-1040.

9. Copies of NMR Spectra

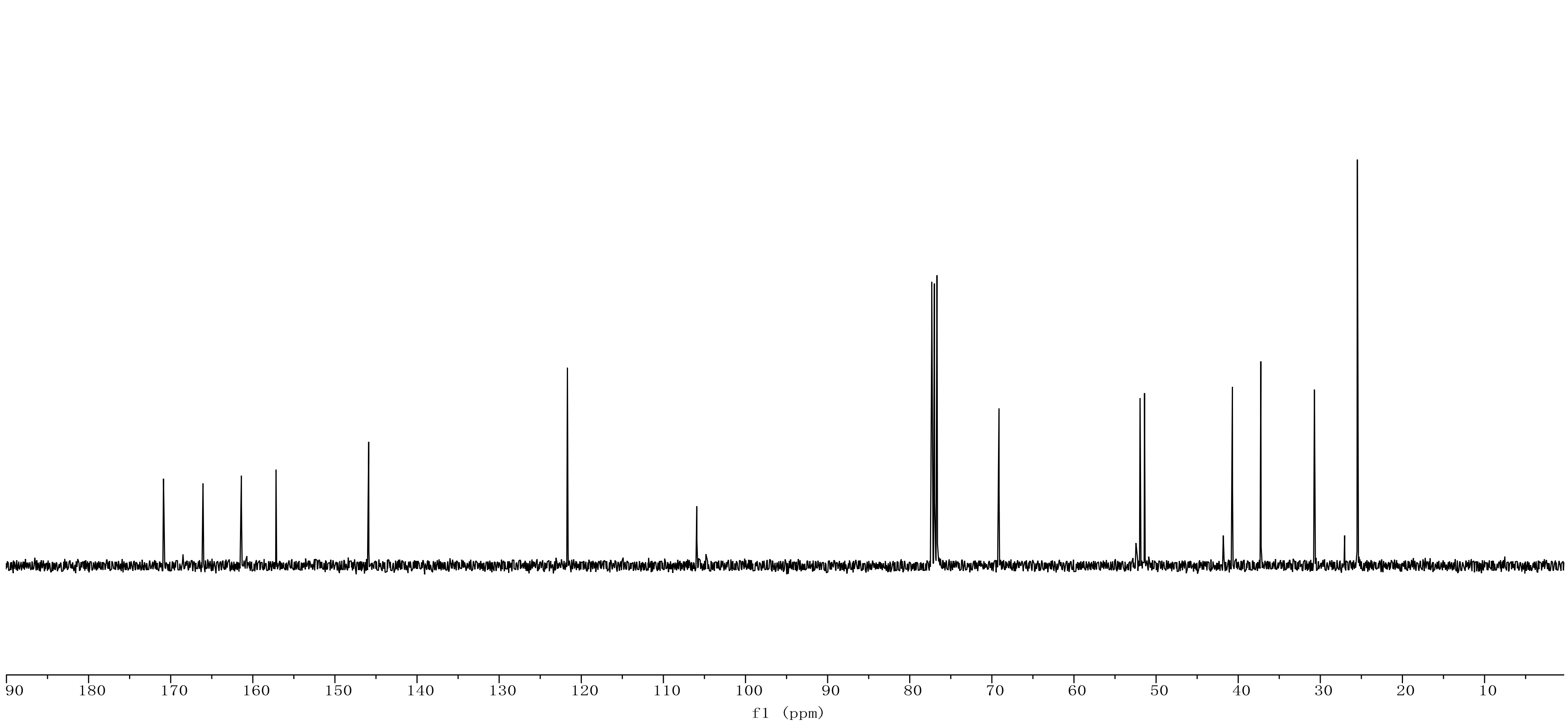


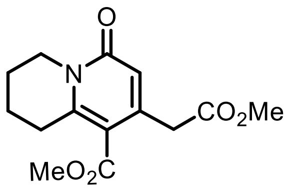
S1p



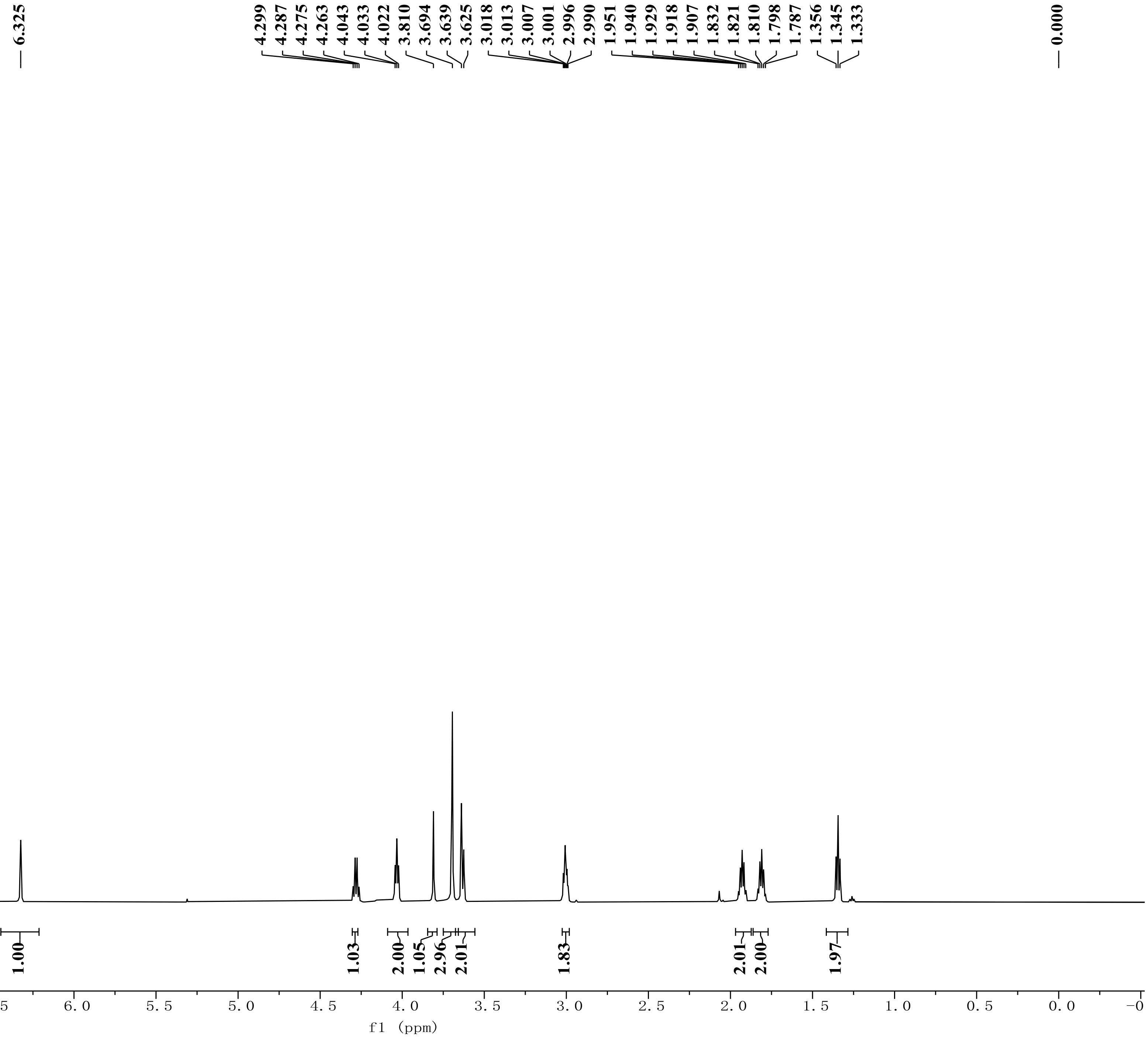

O
N
CO_2Me
MeO_2C

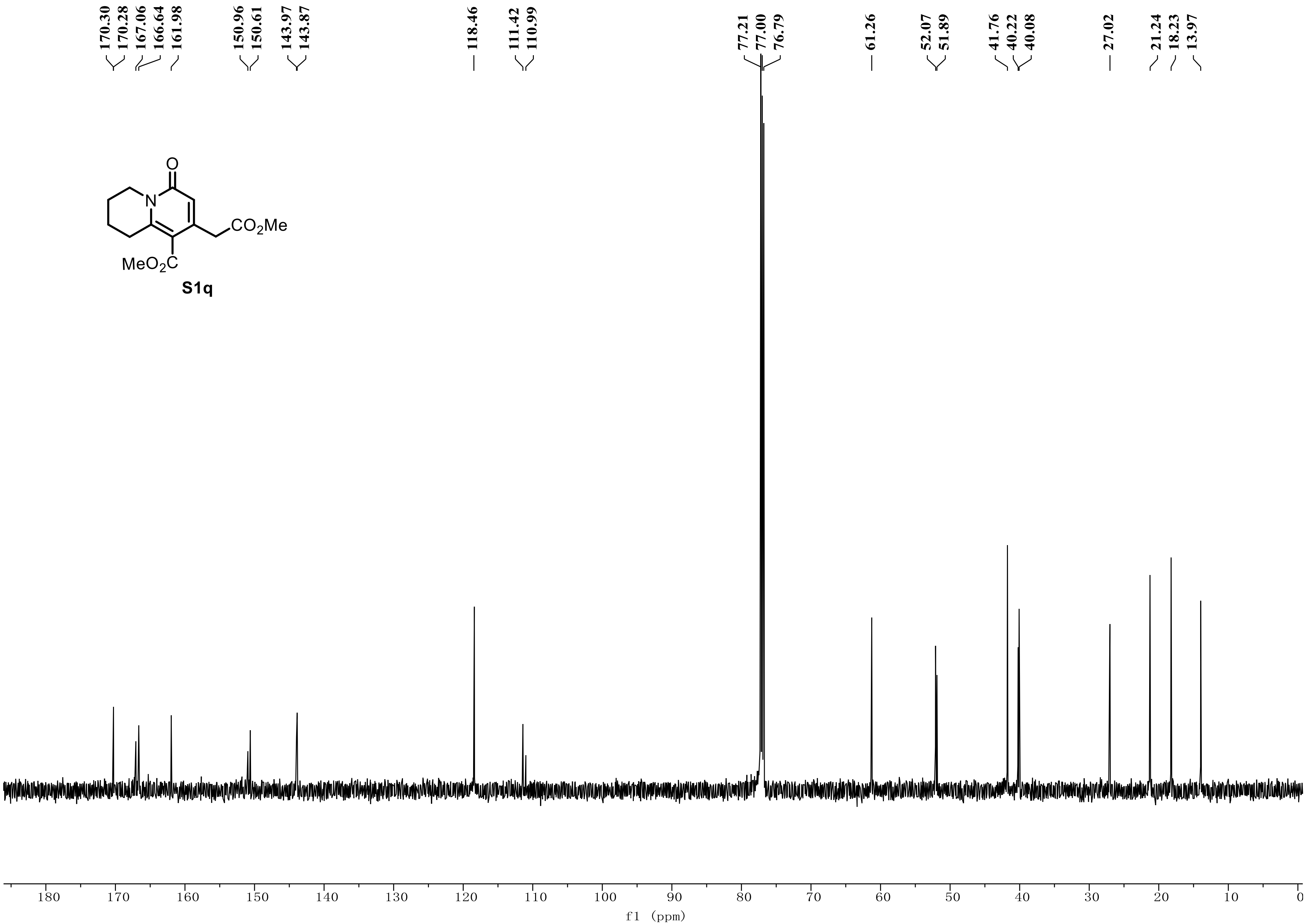
S1p

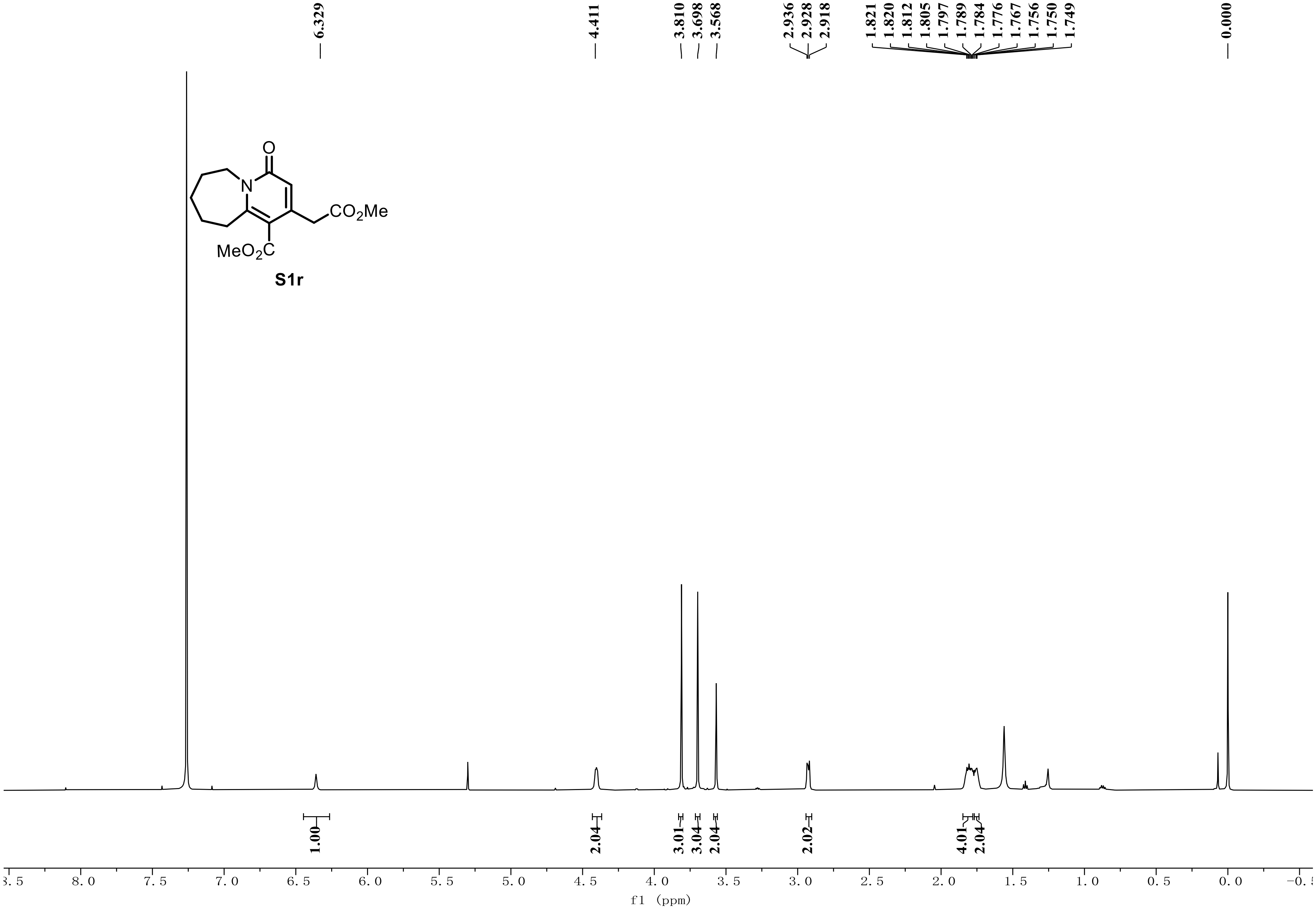

170.88
166.07
161.39
157.17
145.89
121.69
105.93
77.32
77.00
76.68
69.13
51.95
51.41
40.71
37.24
30.72
25.49
90 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

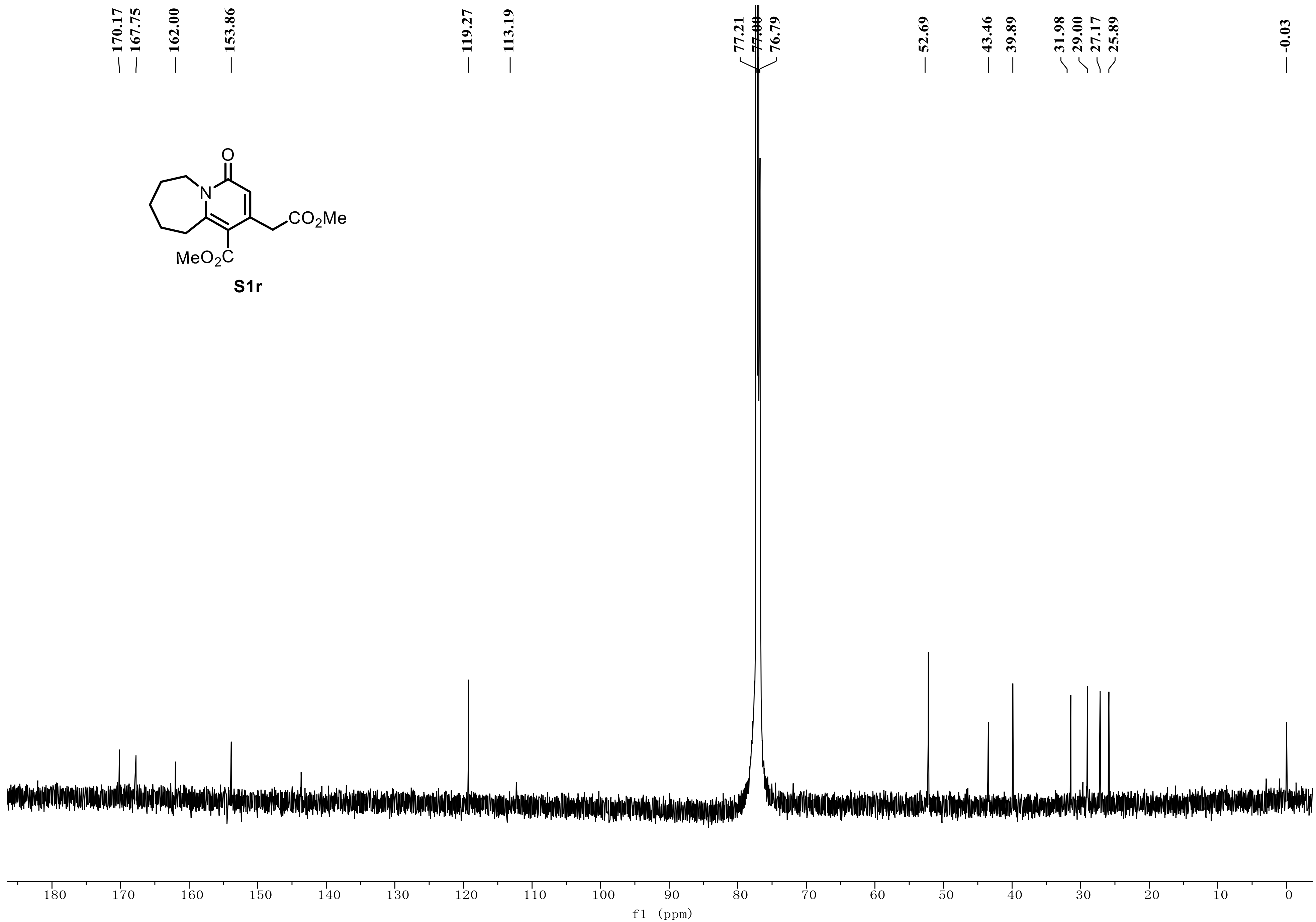


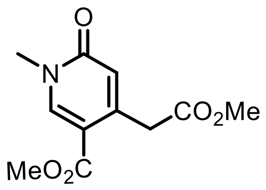
S1q


6.325
4.299
4.287
4.275
4.263
4.043
4.033
4.022
3.810
3.694
3.639
3.625
3.018
3.013
3.007
3.001
2.996
2.990
1.951
1.940
1.929
1.918
1.907
1.832
1.821
1.810
1.798
1.787
1.356
1.345
1.333
0.000
1.00
1.03
2.00
1.05
2.96
2.01
1.83
2.01
2.00
1.97
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)


170.30
170.28
167.06
166.64
161.98
150.96
150.61
143.97
143.87
118.46
111.42
110.99
77.21
77.00
76.79
61.26
52.07
51.89
41.76
40.22
40.08
27.02
21.24
18.23
13.97
O
N
CO2Me
MeO2C
S1q
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

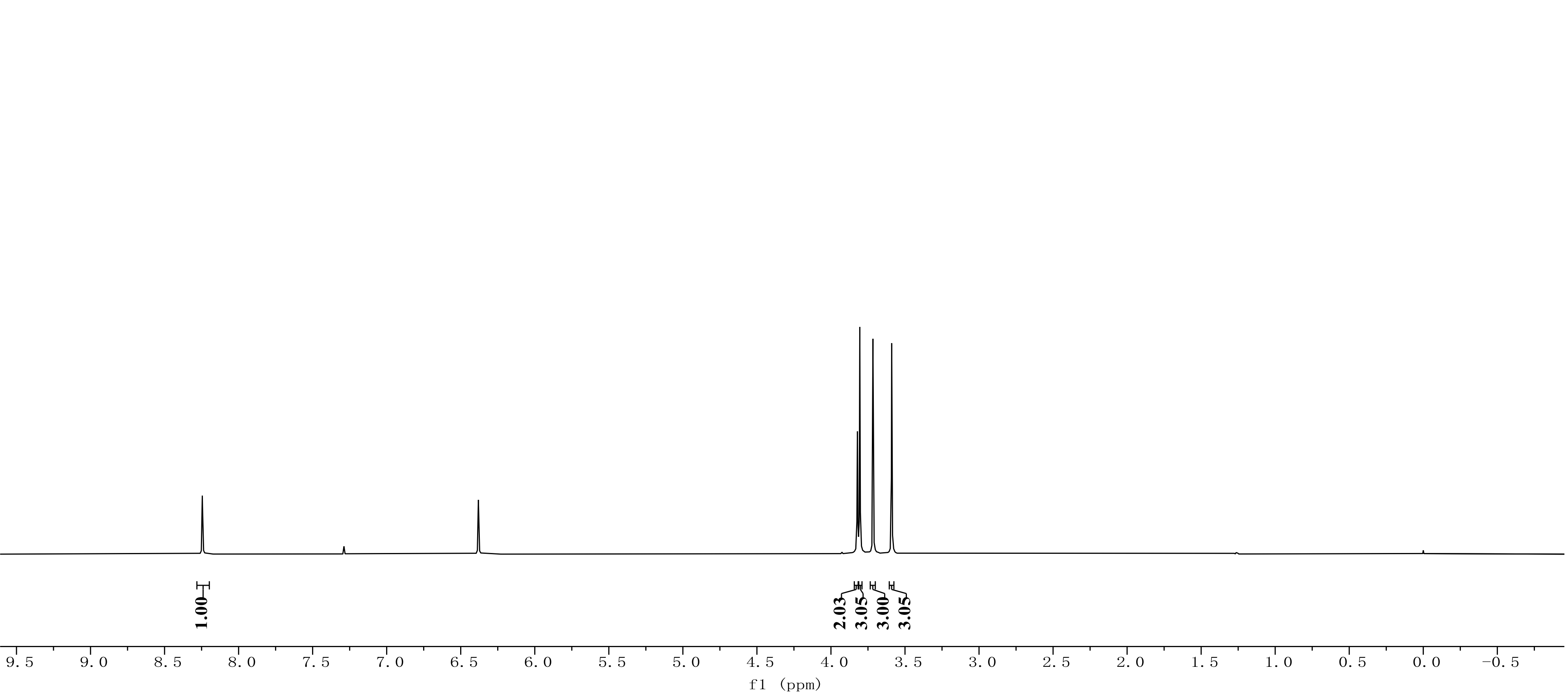

6.329
4.411
3.810
3.698
3.568
2.936
2.928
2.918
1.821
1.820
1.812
1.805
1.797
1.789
1.784
1.776
1.767
1.756
1.750
1.749
0.000
O
N
CO2Me
MeO2C
S1r
1.00
2.04
3.01
3.04
2.04
2.02
4.01
2.04
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


170.17
167.75
162.00
153.86
119.27
113.19
77.21
77.00
76.79
52.69
43.46
39.89
31.98
29.00
27.17
25.89
-0.03
O
N
CO_2Me
MeO_2C
S1r
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

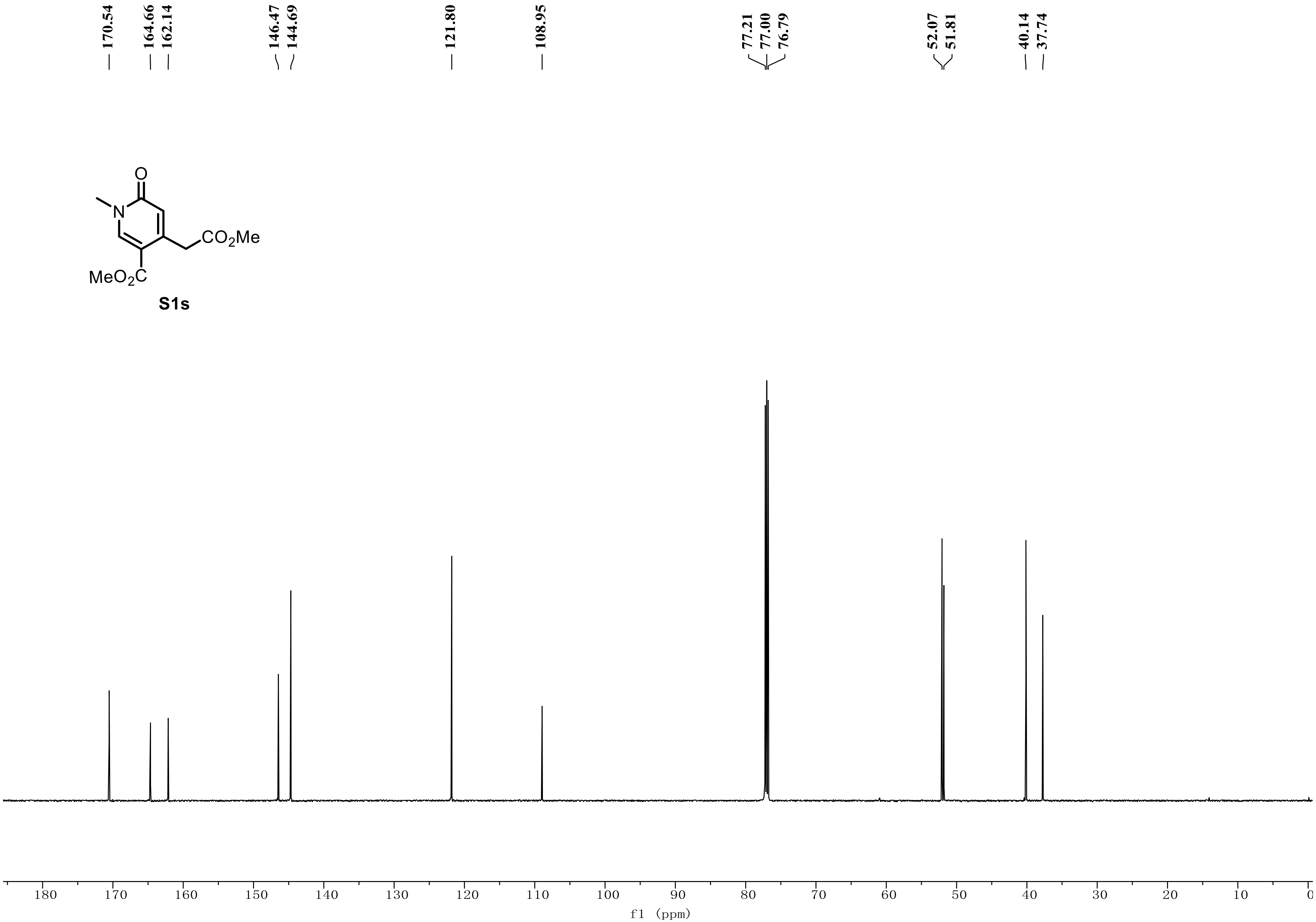


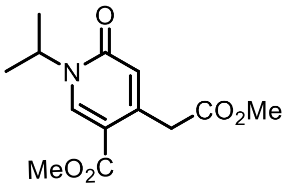
O
N
CO2Me
MeO2C

S1s



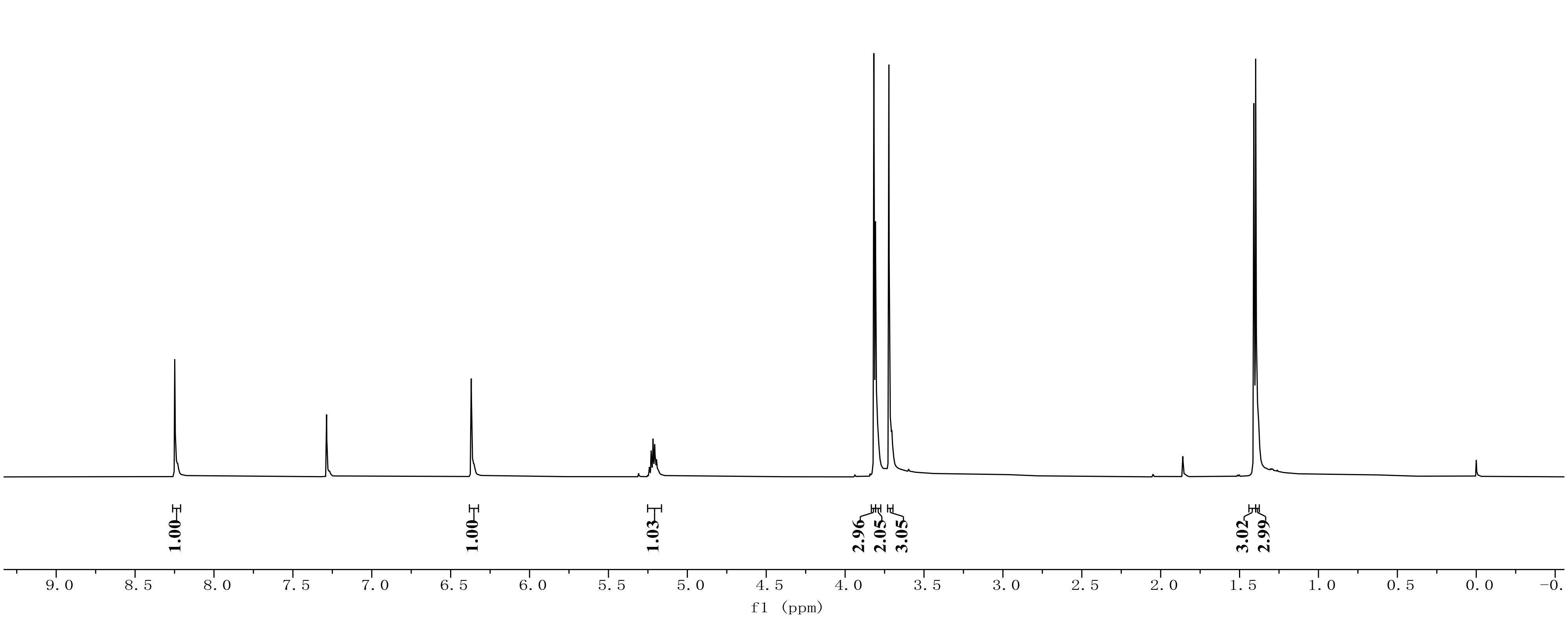
8.245
6.381
3.821
3.805
3.716
3.590
0.000
1.00
2.03
3.05
3.00
3.05
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5
f1 (ppm)


170.54
164.66
162.14
146.47
144.69
121.80
108.95
77.21
77.00
76.79
52.07
51.81
40.14
37.74
O
N
CO2Me
MeO2C
S1s
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

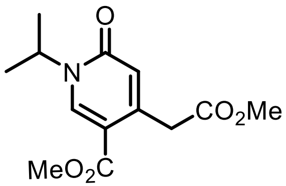


O
N
CO2Me
MeO2C

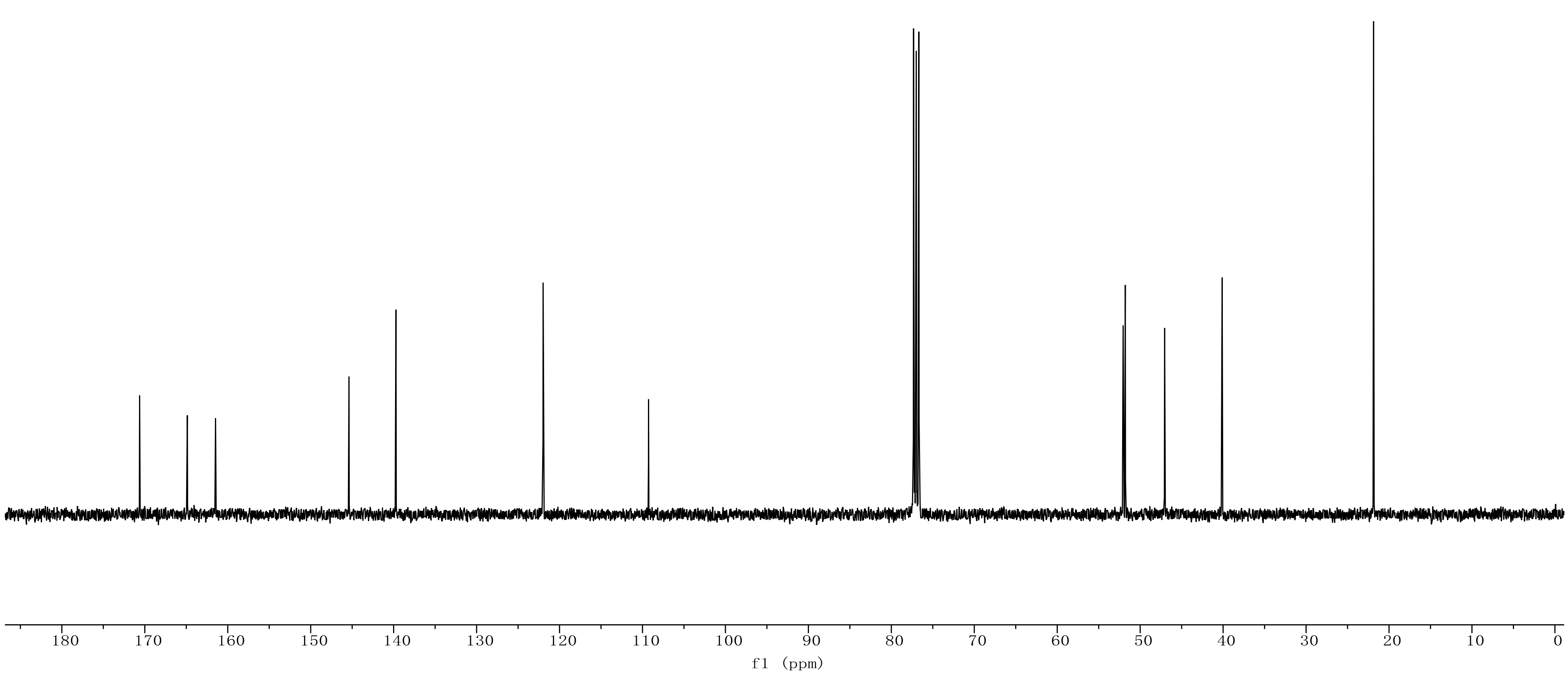
S1t

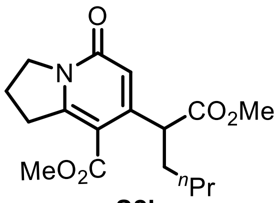


8.248
6.369
5.241
5.229
5.218
5.207
5.195
5.184
3.818
3.808
3.723
1.409
1.398
-0.000
1.00
1.00
1.03
2.96
2.05
3.05
3.02
2.99
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.
f1 (ppm)

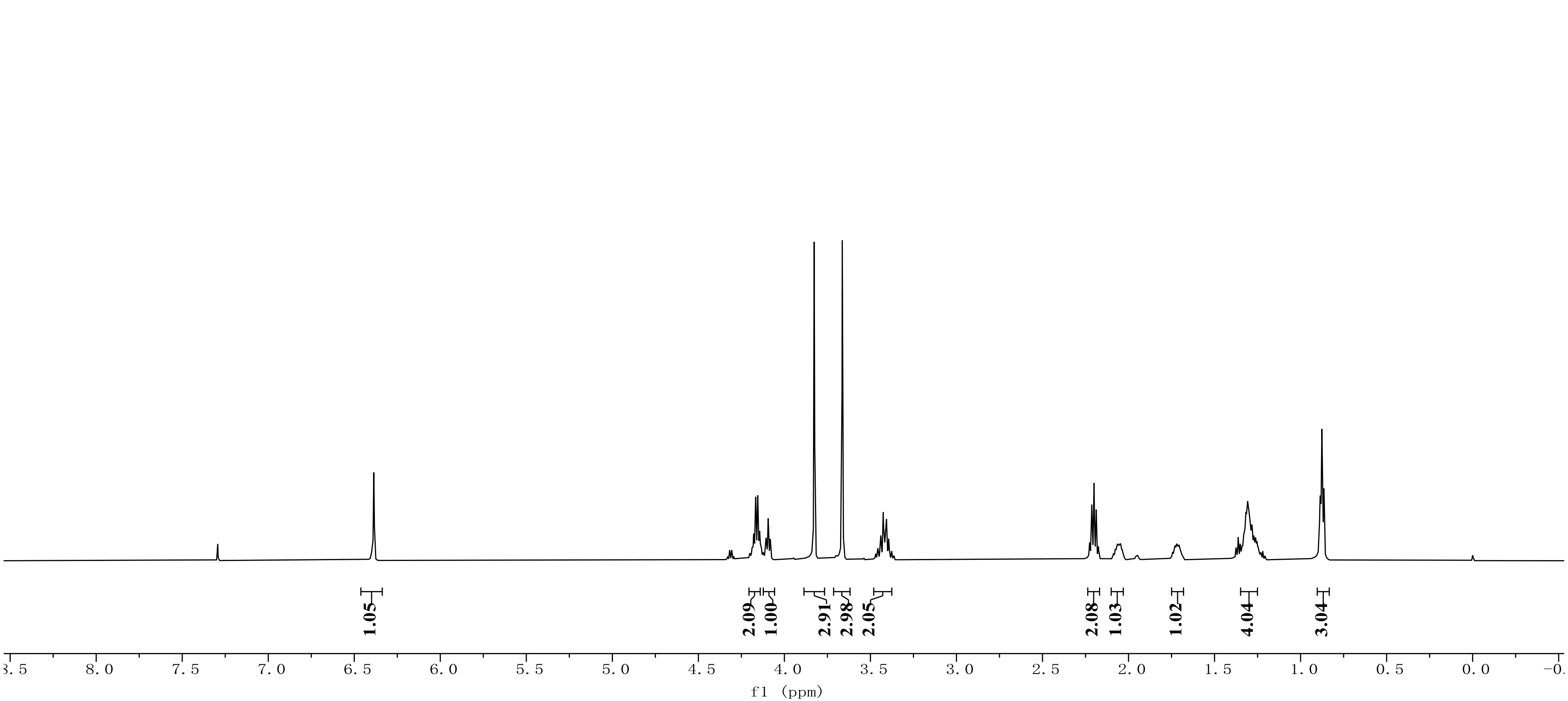


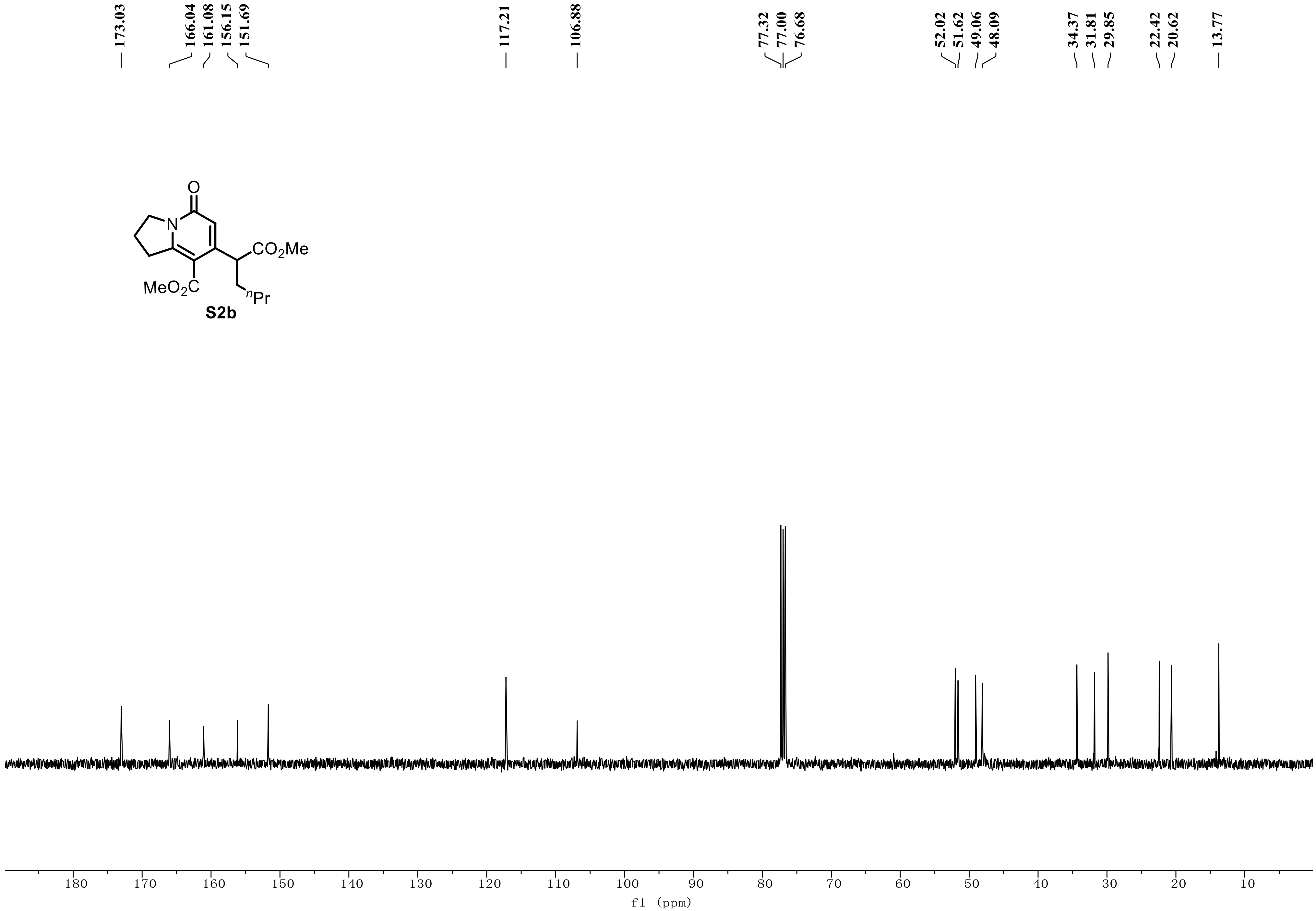
S1t

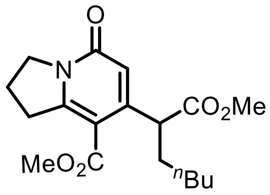

170.62
164.87
161.47
145.38
139.72
121.98
109.27
77.32
77.00
76.68
52.05
51.79
47.05
40.12
21.86
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


O
N
CO2Me
MeO2C
nPr

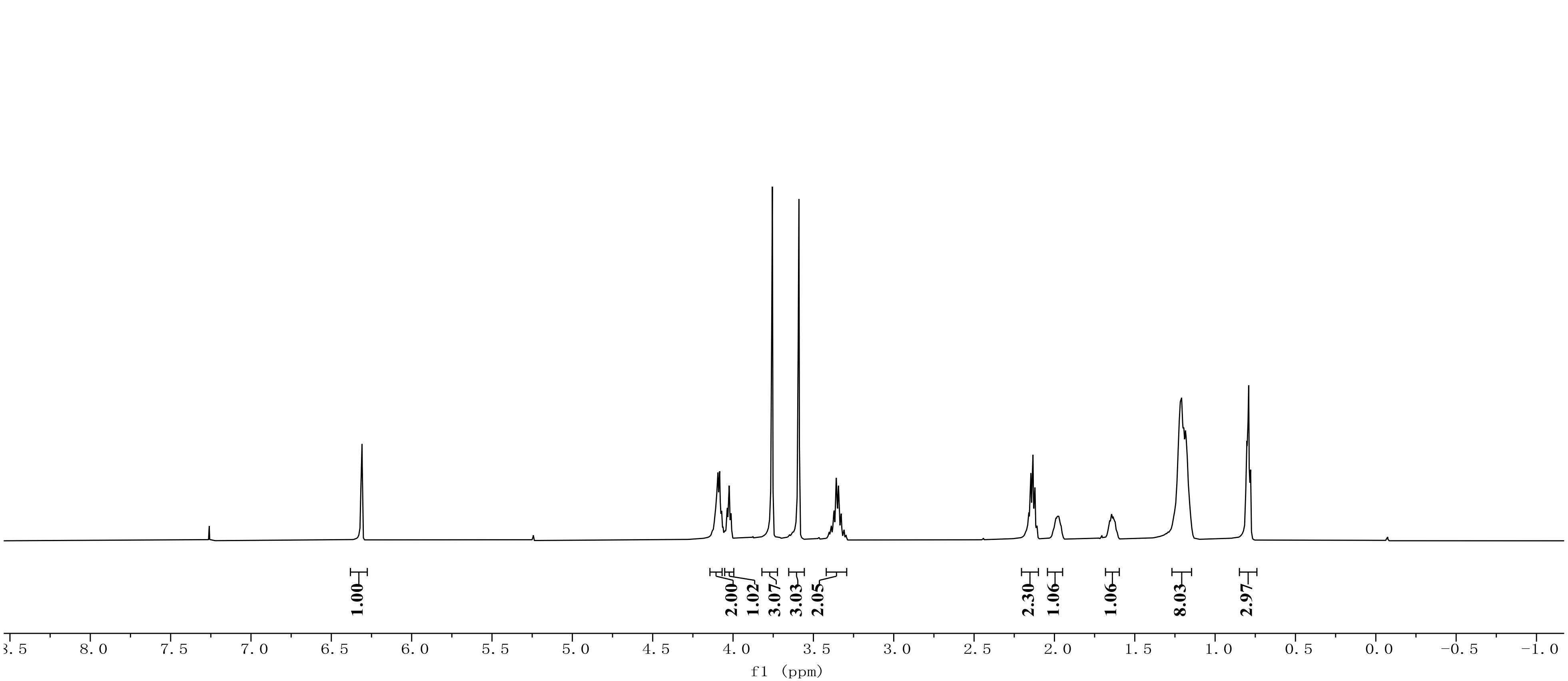
S2b

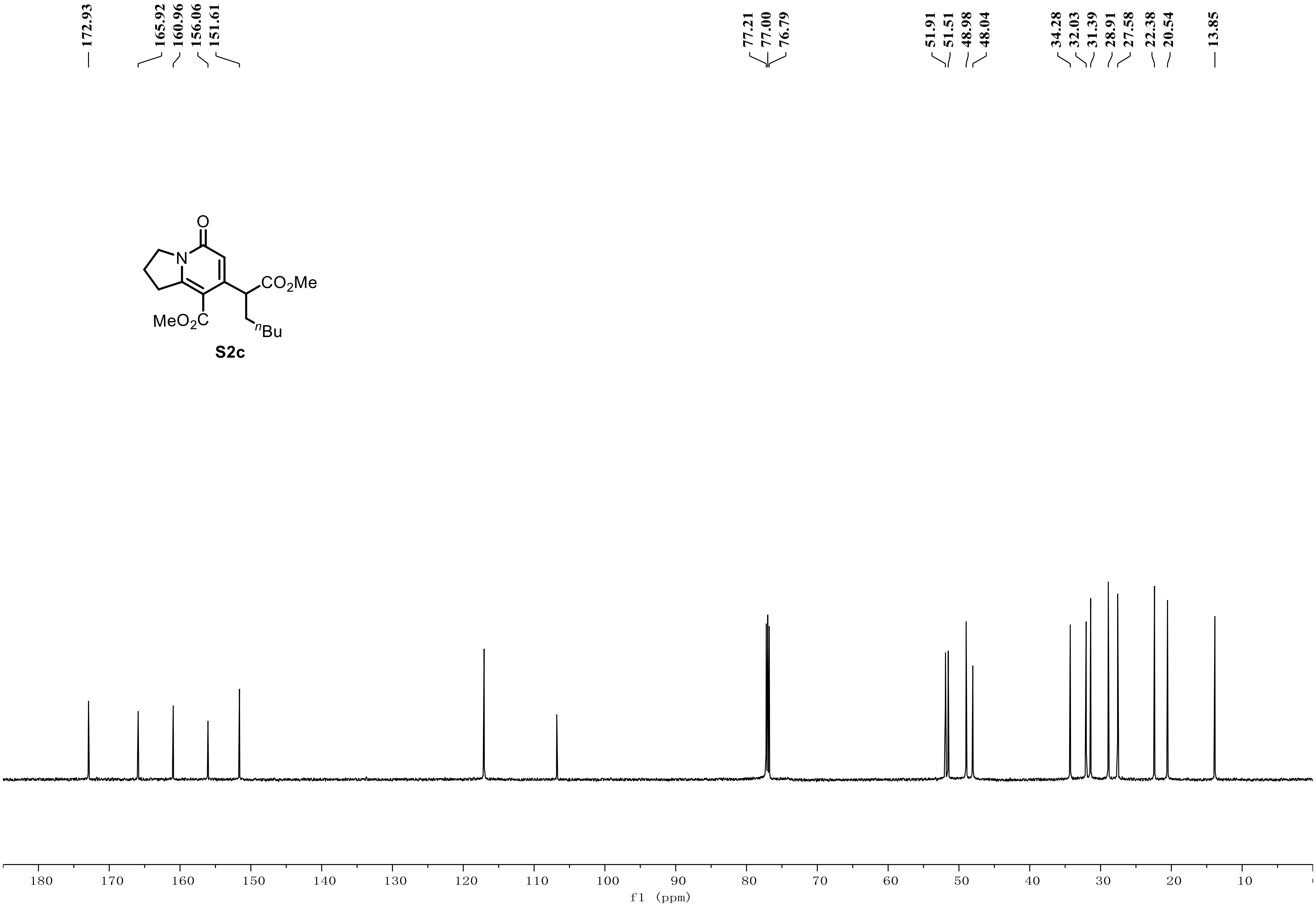

6.386
4.199
4.188
4.177
4.167
4.155
4.144
4.134
4.106
4.094
4.082
3.827
3.664
3.457
3.440
3.426
3.420
3.413
3.407
3.394
2.226
2.213
2.201
2.188
2.175
2.088
2.079
2.065
2.063
2.054
2.049
2.045
2.038
2.028
1.744
1.729
1.722
1.713
1.701
1.690
1.340
1.329
1.319
1.307
1.297
1.283
1.272
1.270
1.262
1.253
0.888
0.876
0.864
0.000
1.05
2.09
1.00
2.91
2.98
2.05
2.08
1.03
1.02
4.04
3.04
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)

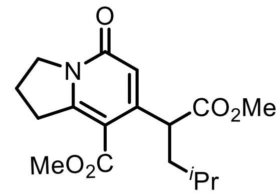

173.03
166.04
161.08
156.15
151.69
117.21
106.88
77.32
77.00
76.68
52.02
51.62
49.06
48.09
34.37
31.81
29.85
22.42
20.62
13.77
O
N
CO_2Me
MeO_2C
^{n}Pr
S2b
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


O
N
CO2Me
MeO2C
nBu

S2c

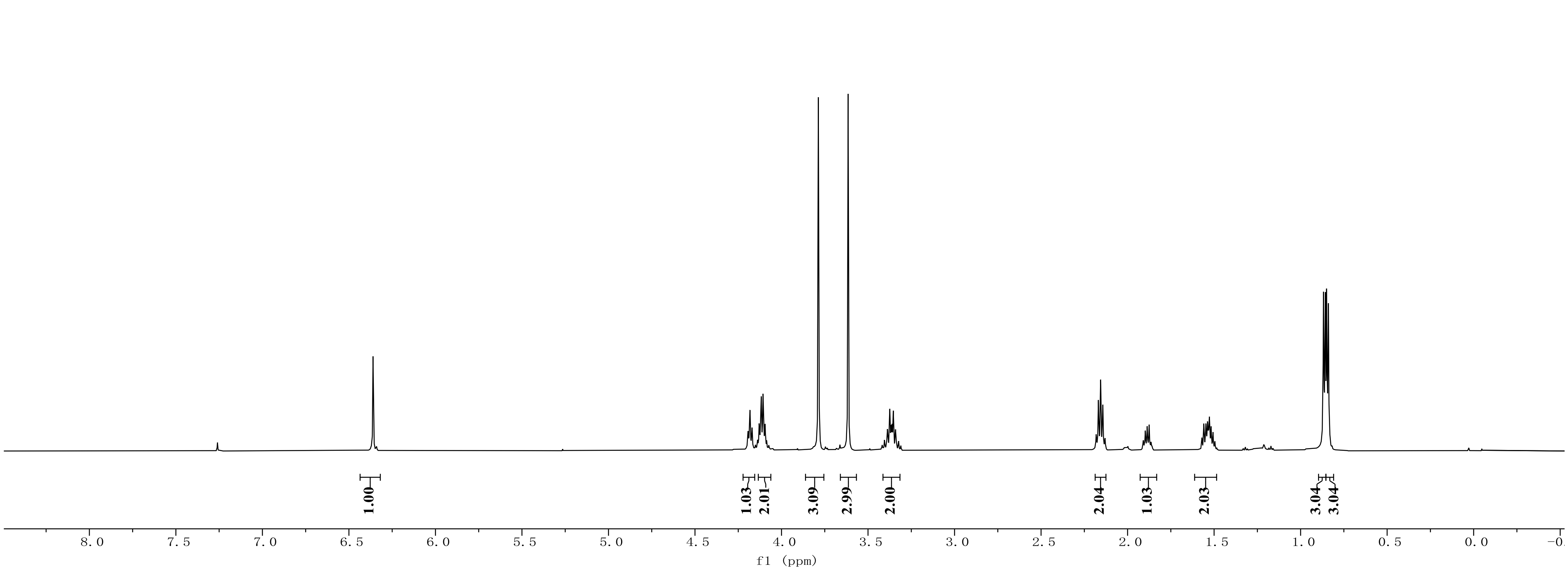

7.260
6.309
4.127 4.114 4.106 4.094 4.083 4.071 4.062 4.036 4.024 4.011 3.755 3.590 3.389 3.371 3.358 3.340 3.327 3.309 2.159 2.151 2.146 2.138 2.134 2.125 2.121 2.008 1.985 1.969 1.956 1.660 1.656 1.640 1.627 1.611 1.606 1.226 1.218 1.208 1.195 1.185 1.177 0.809 0.806 0.802 0.798 0.794 0.791 0.783 0.779
1.00
2.00
1.02
3.07
3.03
2.05
2.30
1.06
1.06
8.03
2.97
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 -1.0
f1 (ppm)


172.93
165.92
160.96
156.06
151.61
77.21
77.00
76.79
51.91
51.51
48.98
48.04
34.28
32.03
31.39
28.91
27.58
22.38
20.54
13.85
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

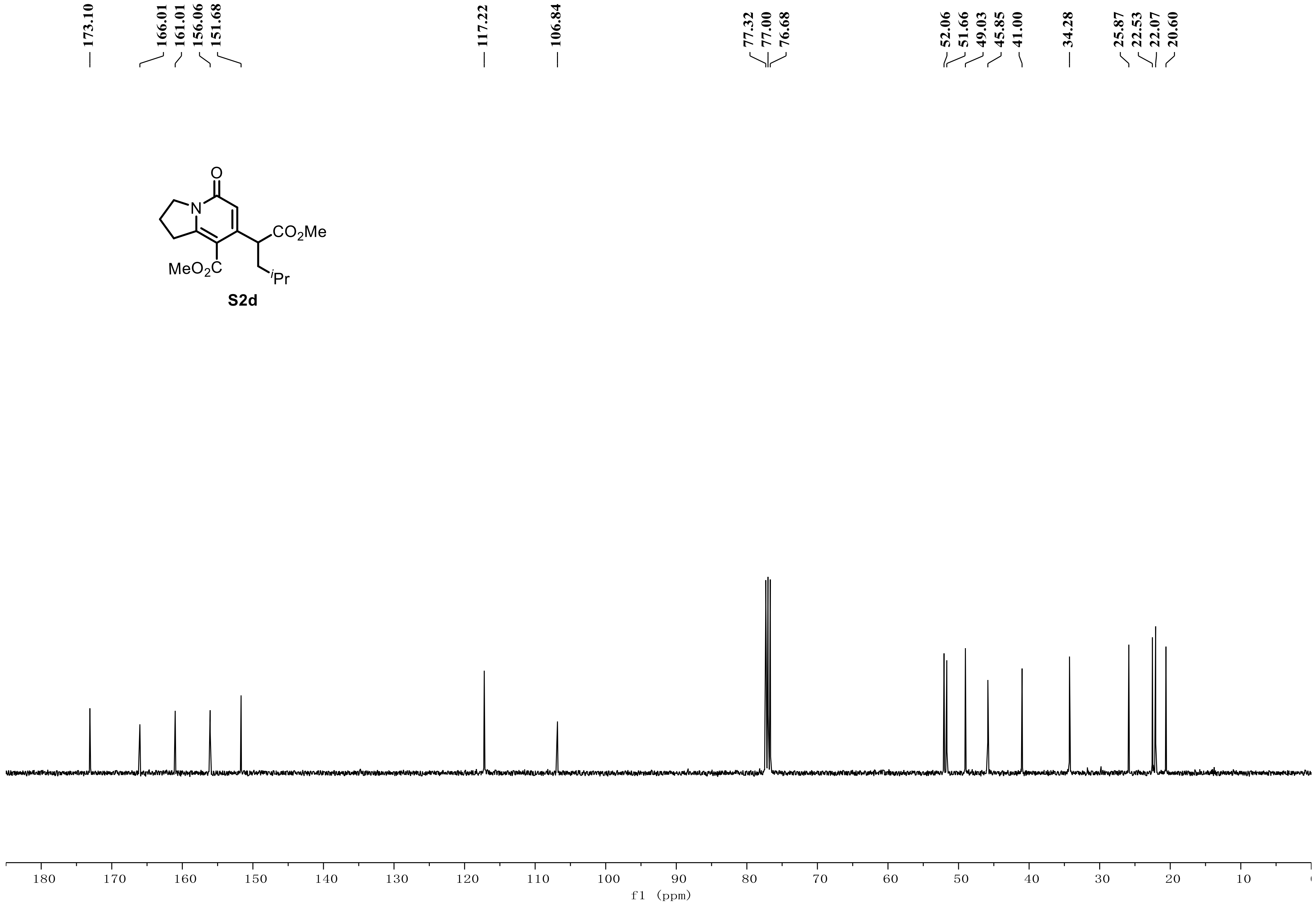


CO2Me
MeO2C
iPr

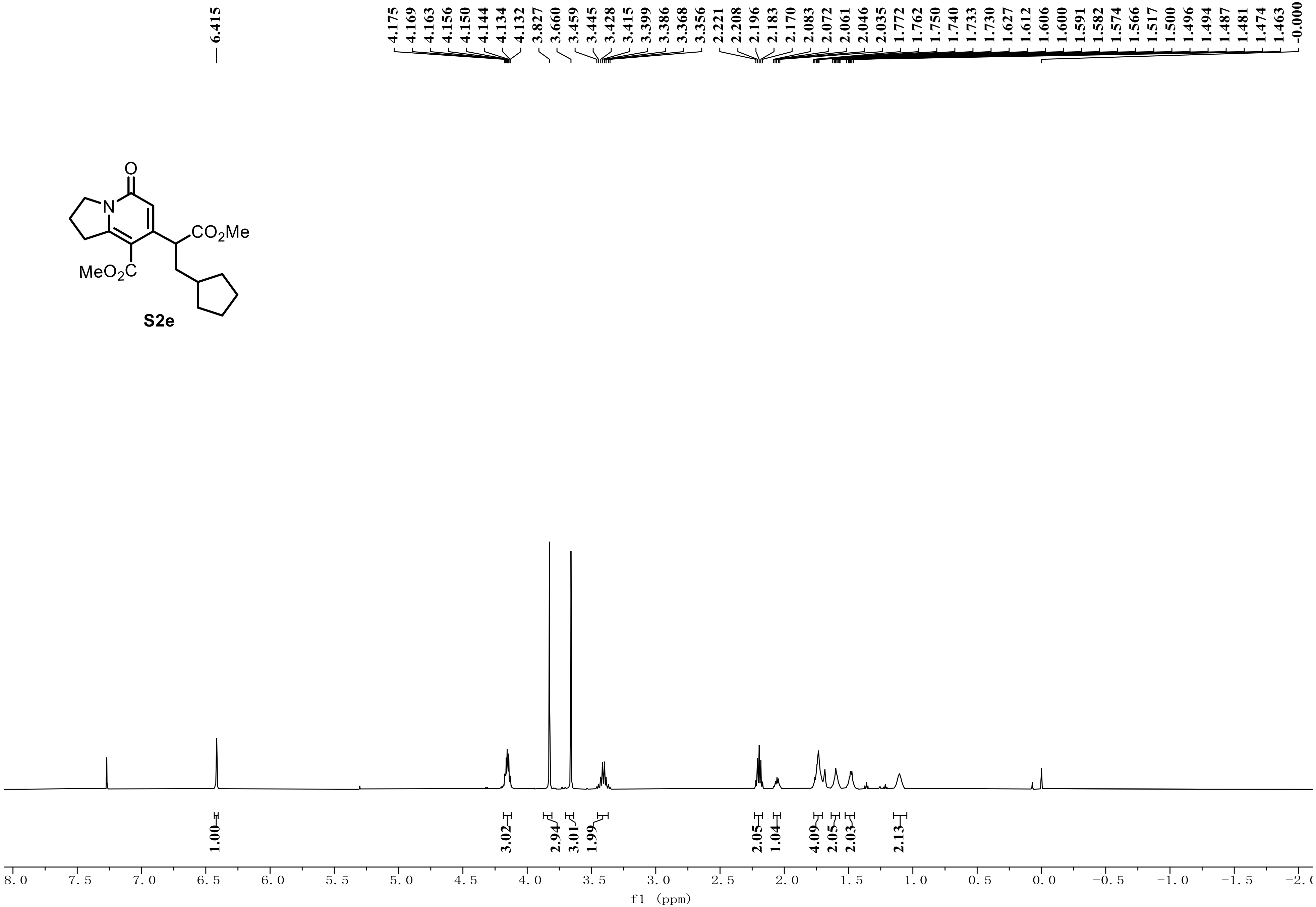
S2d

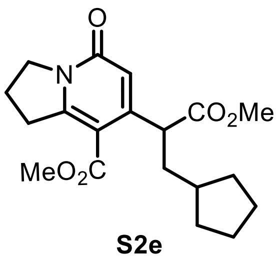


7.260
6.361
4.194
4.182
4.170
4.138
4.129
4.120
4.104
4.095
4.086
3.787
3.615
3.388
3.374
3.367
3.361
3.354
3.341
2.182
2.169
2.156
2.143
2.130
1.909
1.898
1.887
1.875
1.864
1.571
1.559
1.548
1.544
1.538
1.533
1.527
1.517
1.507
1.496
0.868
0.857
0.850
0.839
1.00
1.03
2.01
3.09
2.99
2.00
2.04
1.03
2.03
3.04
3.04
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)

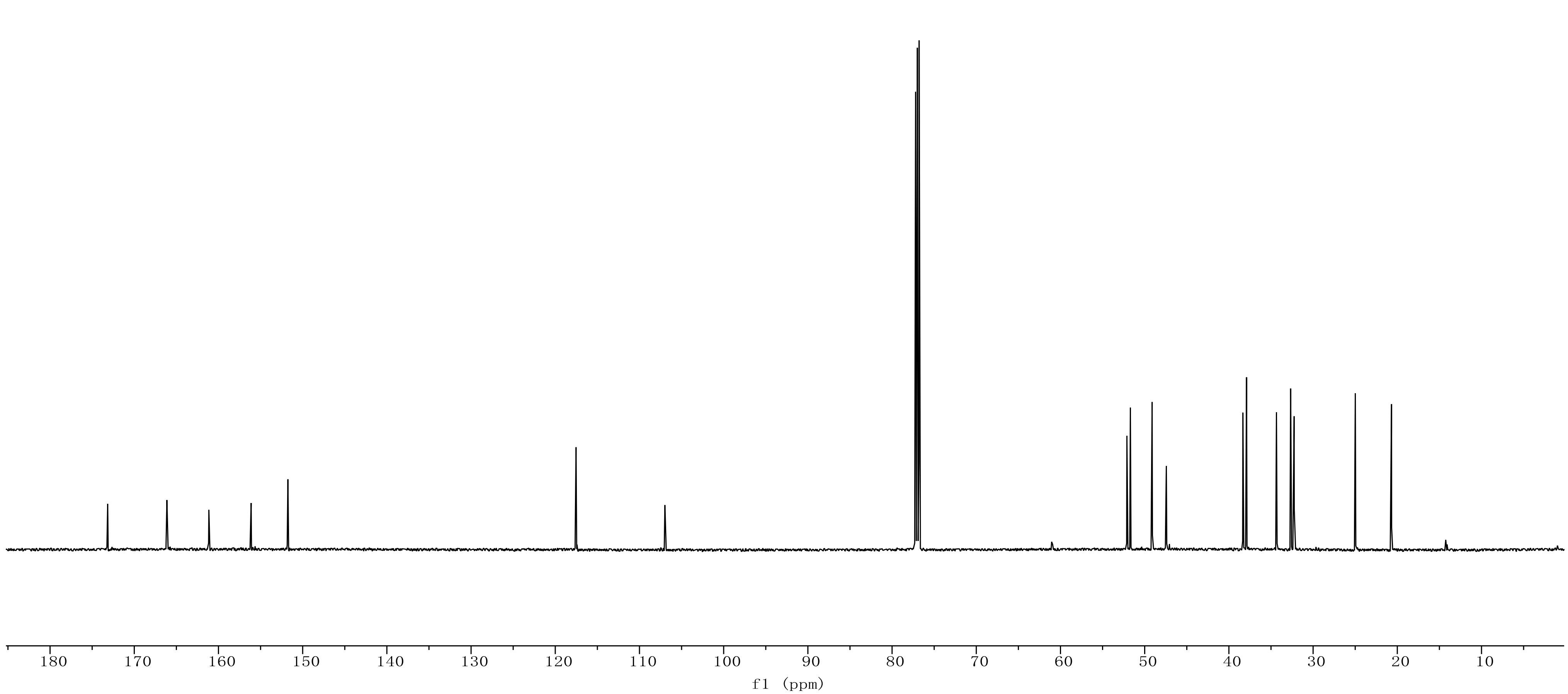


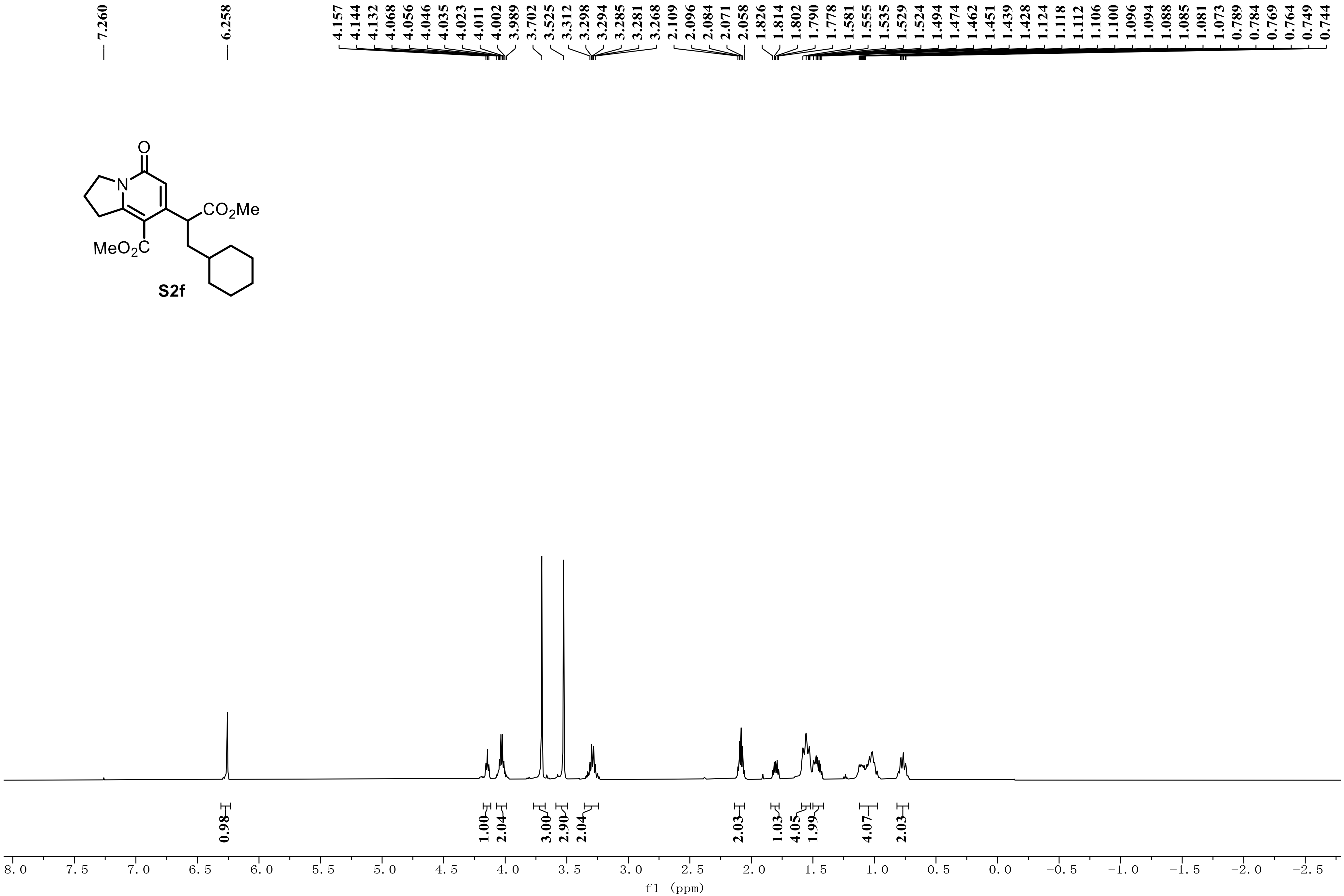
173.10
166.01
161.01
156.06
151.68
117.22
106.84
77.32
77.00
76.68
52.06
51.66
49.03
45.85
41.00
34.28
25.87
22.53
22.07
20.60
O
N
CO_2Me
MeO_2C
^{i}Pr
S2d
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

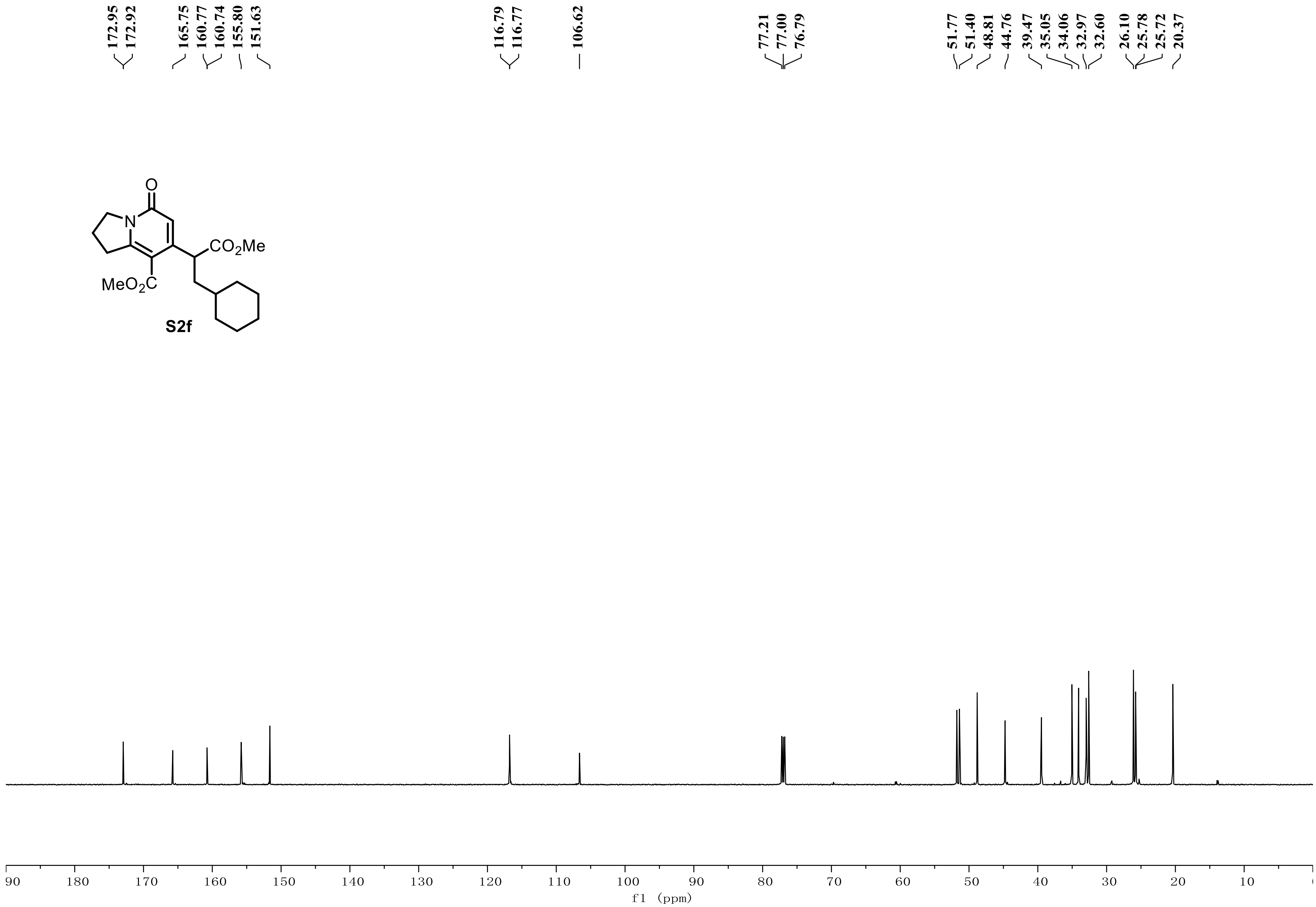

S2e
6.415
4.175
4.169
4.163
4.156
4.150
4.144
4.134
4.132
3.827
3.660
3.459
3.445
3.428
3.415
3.399
3.386
3.368
3.356
2.221
2.208
2.196
2.183
2.170
2.083
2.072
2.061
2.046
2.035
1.772
1.762
1.750
1.740
1.733
1.730
1.627
1.612
1.606
1.600
1.591
1.582
1.574
1.566
1.517
1.500
1.496
1.494
1.487
1.481
1.474
1.463
-0.000
1.00
3.02
2.94
3.01
1.99
2.05
1.04
4.09
2.05
2.03
2.13
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
-1.0
-1.5
f1 (ppm)

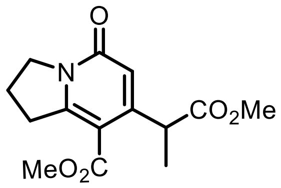

O
N
CO_2Me
MeO_2C

S2e

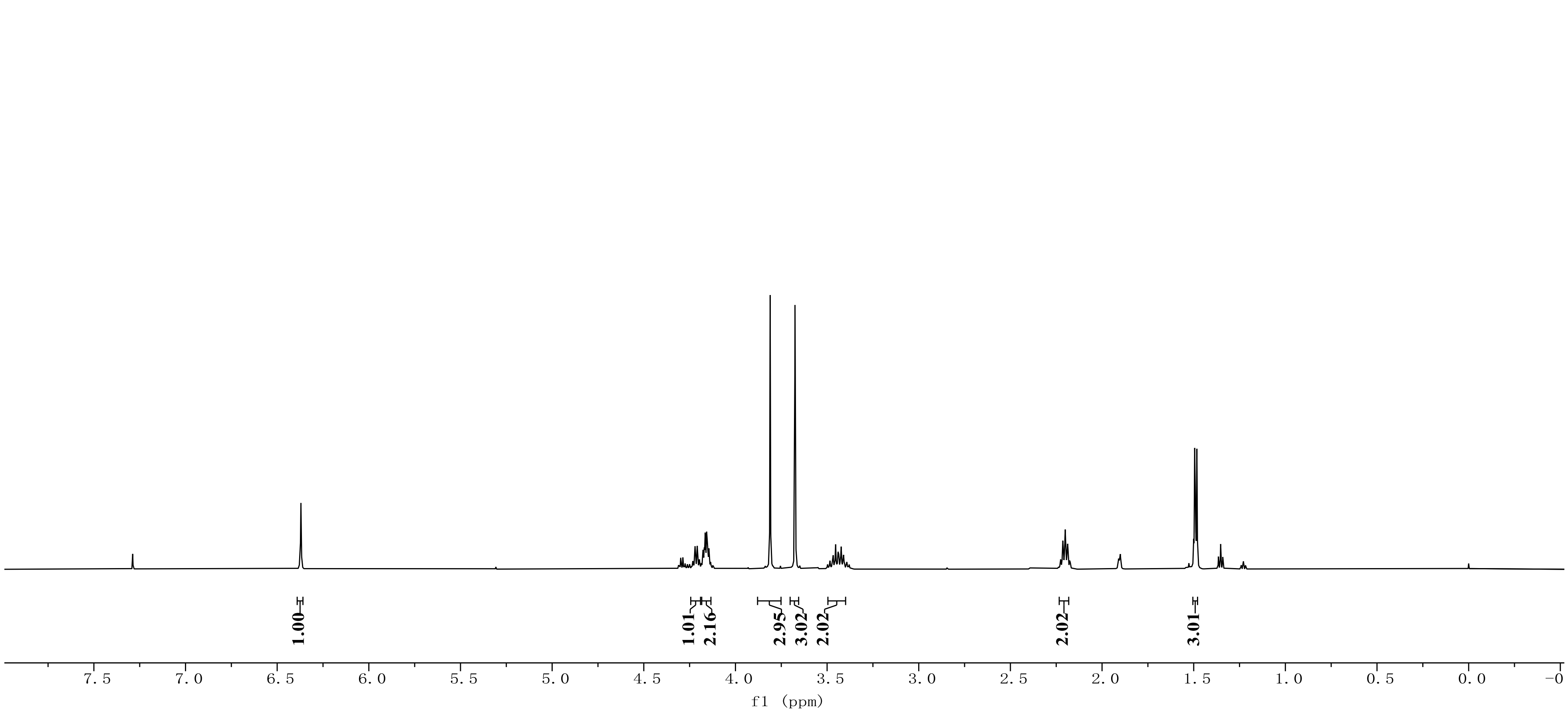

173.16
166.12
161.14
156.12
151.75
117.53
106.98
77.21
77.00
76.79
52.12
51.70
49.12
47.43
38.34
37.90
34.35
32.67
32.25
25.03
24.99
20.69
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

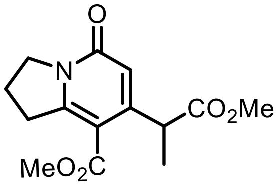

7.260
6.258
4.157
4.144
4.132
4.068
4.056
4.046
4.035
4.023
4.011
4.002
3.989
3.702
3.525
3.312
3.298
3.294
3.285
3.281
3.268
2.109
2.096
2.084
2.071
2.058
1.826
1.814
1.802
1.790
1.778
1.581
1.555
1.535
1.529
1.524
1.494
1.474
1.462
1.451
1.439
1.428
1.124
1.118
1.112
1.106
1.100
1.096
1.094
1.088
1.085
1.081
1.073
0.789
0.784
0.769
0.764
0.749
0.744
O
N
CO_2Me
MeO_2C
S2f
0.98
1.00
2.04
3.00
2.90
2.04
2.03
1.03
4.05
1.99
4.07
2.03
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
-1.0
-1.5
-2.0
-2.5
f1 (ppm)


172.95
172.92
165.75
160.77
160.74
155.80
151.63
116.79
116.77
106.62
77.21
77.00
76.79
51.77
51.40
48.81
44.76
39.47
35.05
34.06
32.97
32.60
26.10
25.78
25.72
20.37
O
N
CO2Me
MeO2C
S2f
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


O
N
CO2Me
MeO2C

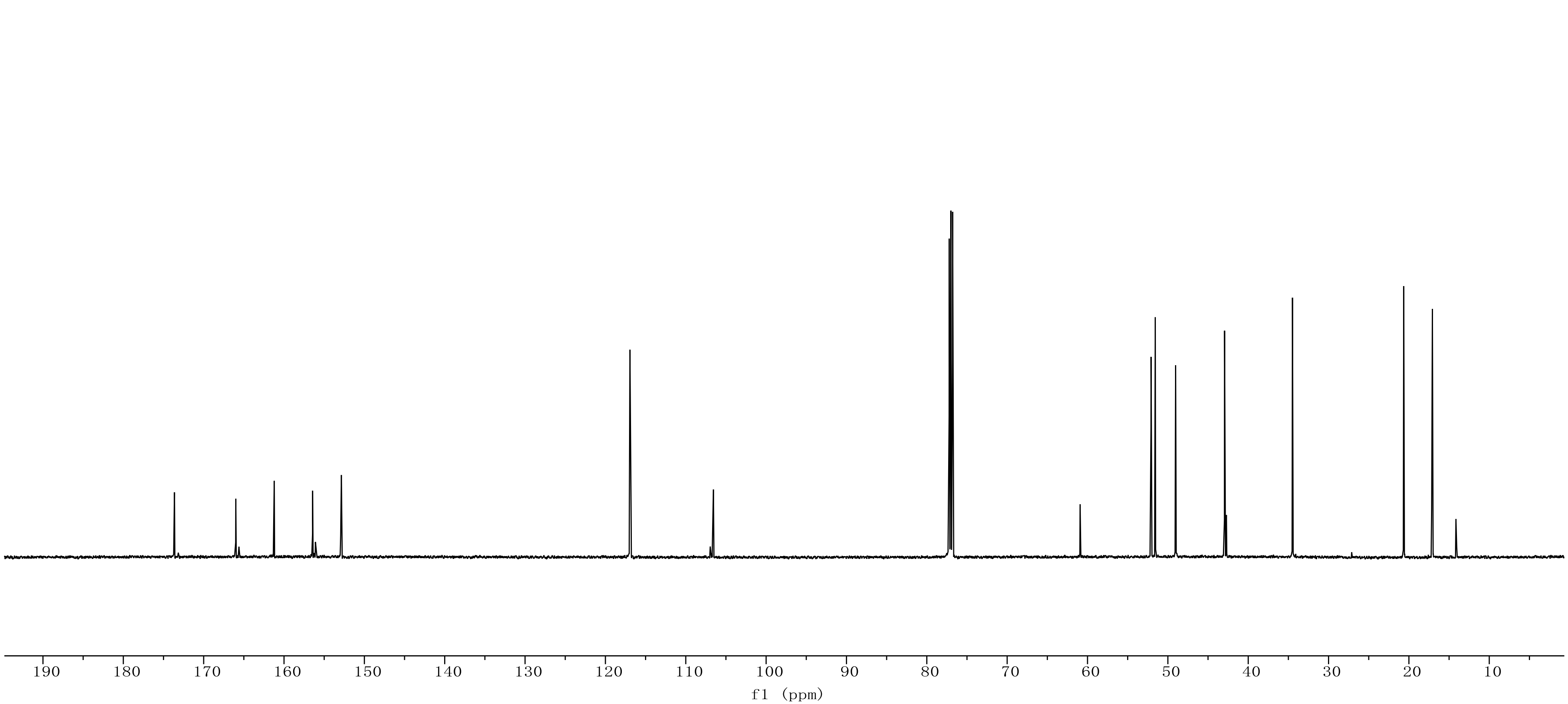
S2g


6.371
4.232
4.220
4.208
4.197
4.177
4.170
4.165
4.157
4.152
4.145
4.136
3.811
3.675
3.497
3.484
3.467
3.454
3.440
3.436
3.423
3.415
3.405
3.398
2.226
2.213
2.202
2.191
2.186
2.177
1.500
1.495
1.489
1.483
0.000
1.00
1.01
2.16
2.95
3.02
2.02
2.02
3.01
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)

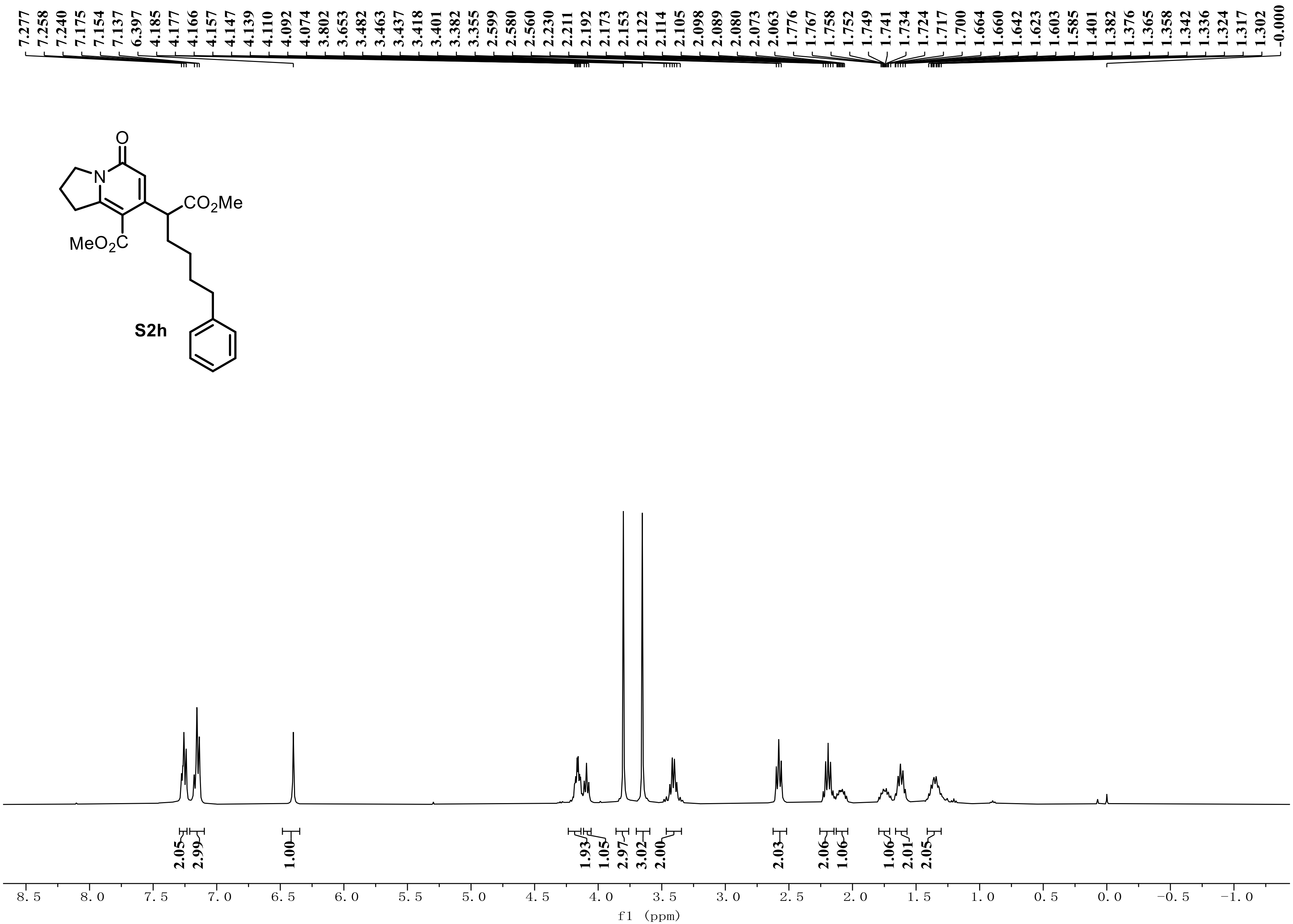


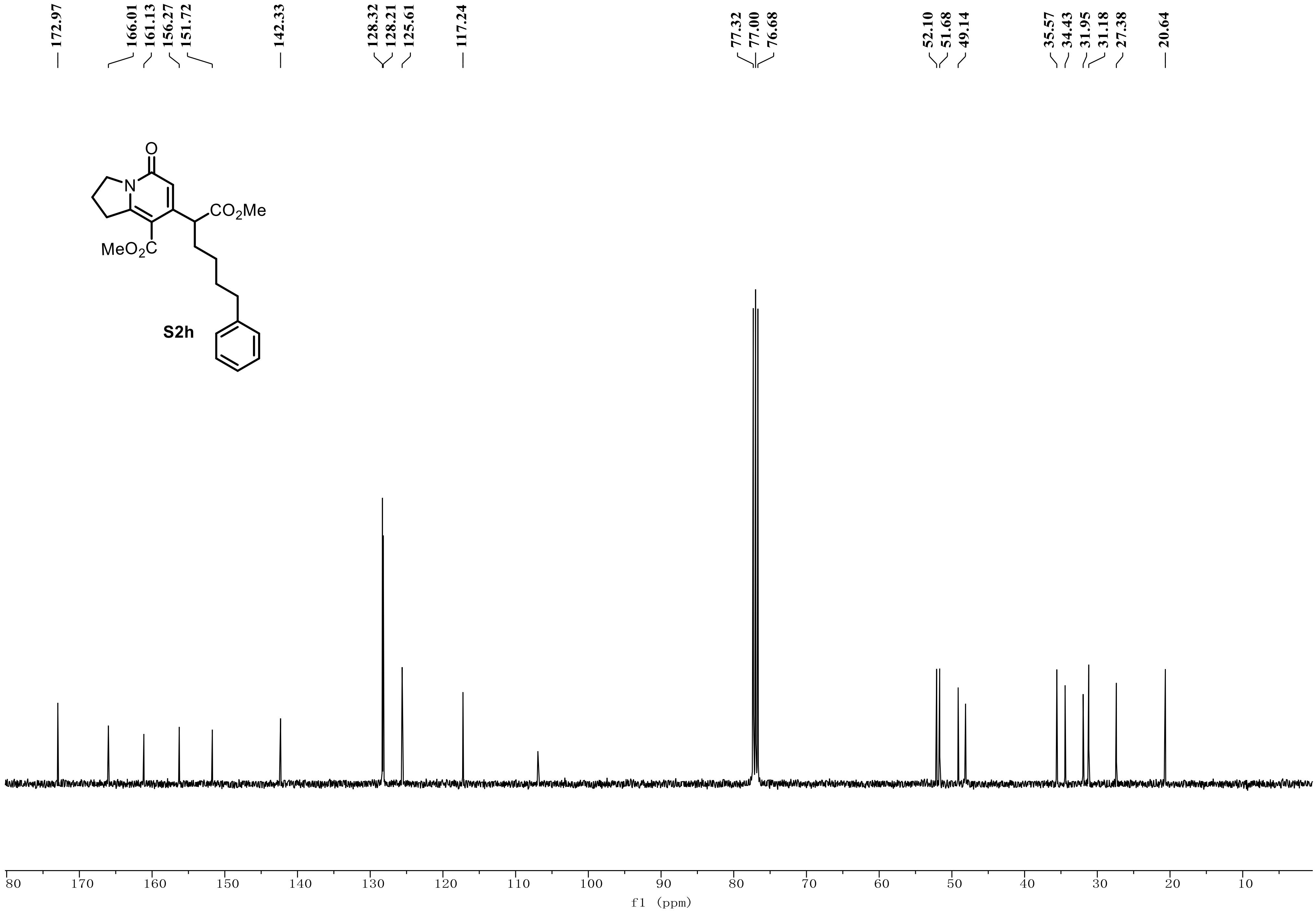
O
N
CO_2Me
MeO_2C

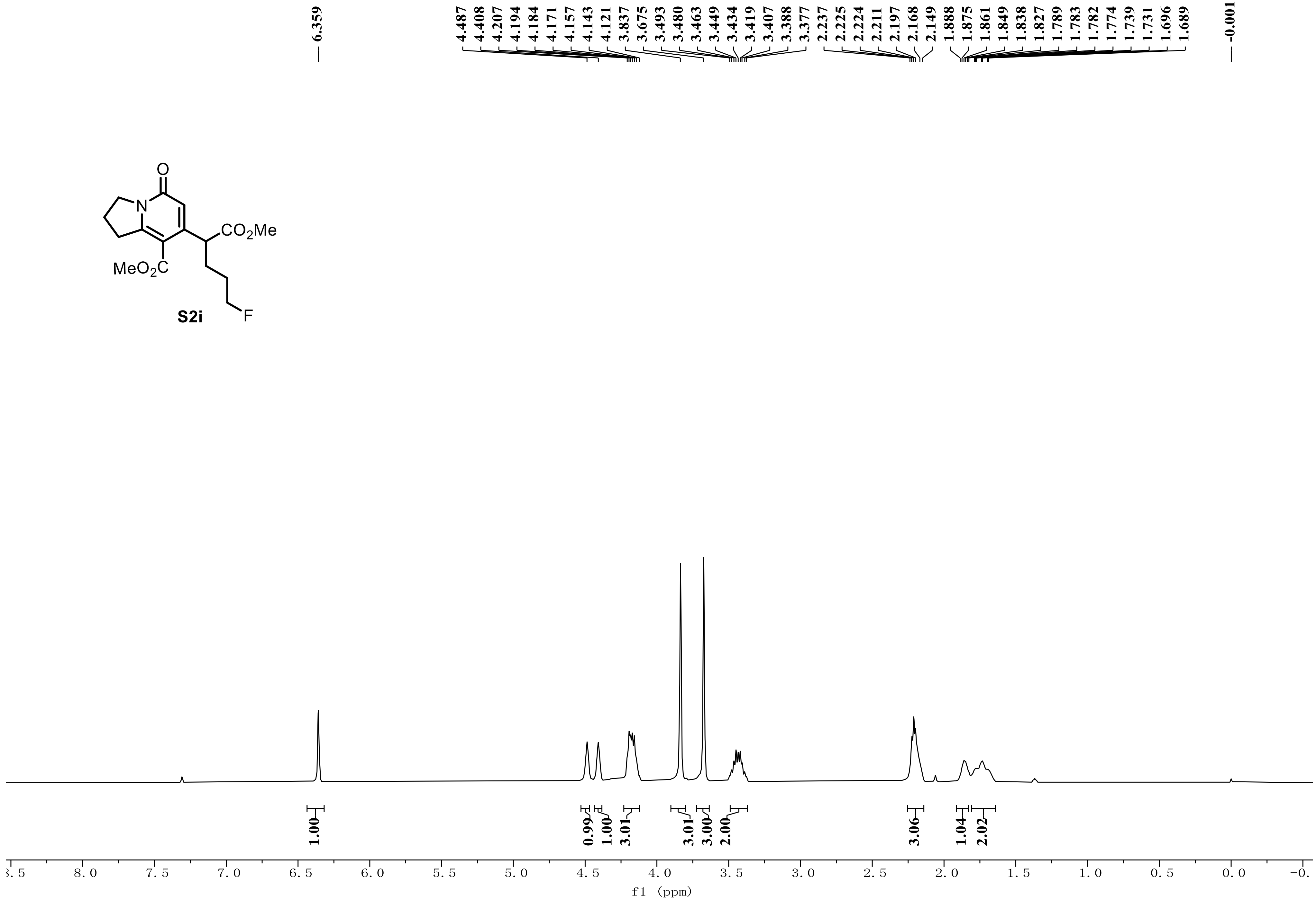
S2g



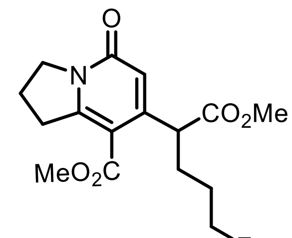
173.63
166.00
161.22
156.44
152.86
116.81
106.56
77.21
77.00
76.79
61.59
52.85
51.57
49.00
42.94
35.24
20.64
17.08
14.53
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


7.277
7.258
7.240
7.175
7.154
7.137
6.397
4.185
4.177
4.166
4.157
4.147
4.139
4.110
4.092
4.074
3.802
3.653
3.482
3.463
3.437
3.418
3.401
3.382
3.355
2.599
2.580
2.560
2.230
2.211
2.192
2.173
2.153
2.122
2.114
2.105
2.098
2.089
2.080
2.073
2.063
1.776
1.767
1.758
1.752
1.749
1.741
1.734
1.724
1.717
1.700
1.664
1.660
1.642
1.623
1.603
1.585
1.401
1.382
1.376
1.365
1.358
1.342
1.336
1.324
1.317
1.302
-0.000
2.05
2.99
1.00
1.93
1.05
2.97
3.02
2.00
2.03
2.06
1.06
1.06
2.01
2.05
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
-1.0
f1 (ppm)
O
N
CO_2Me
MeO_2C
S2h

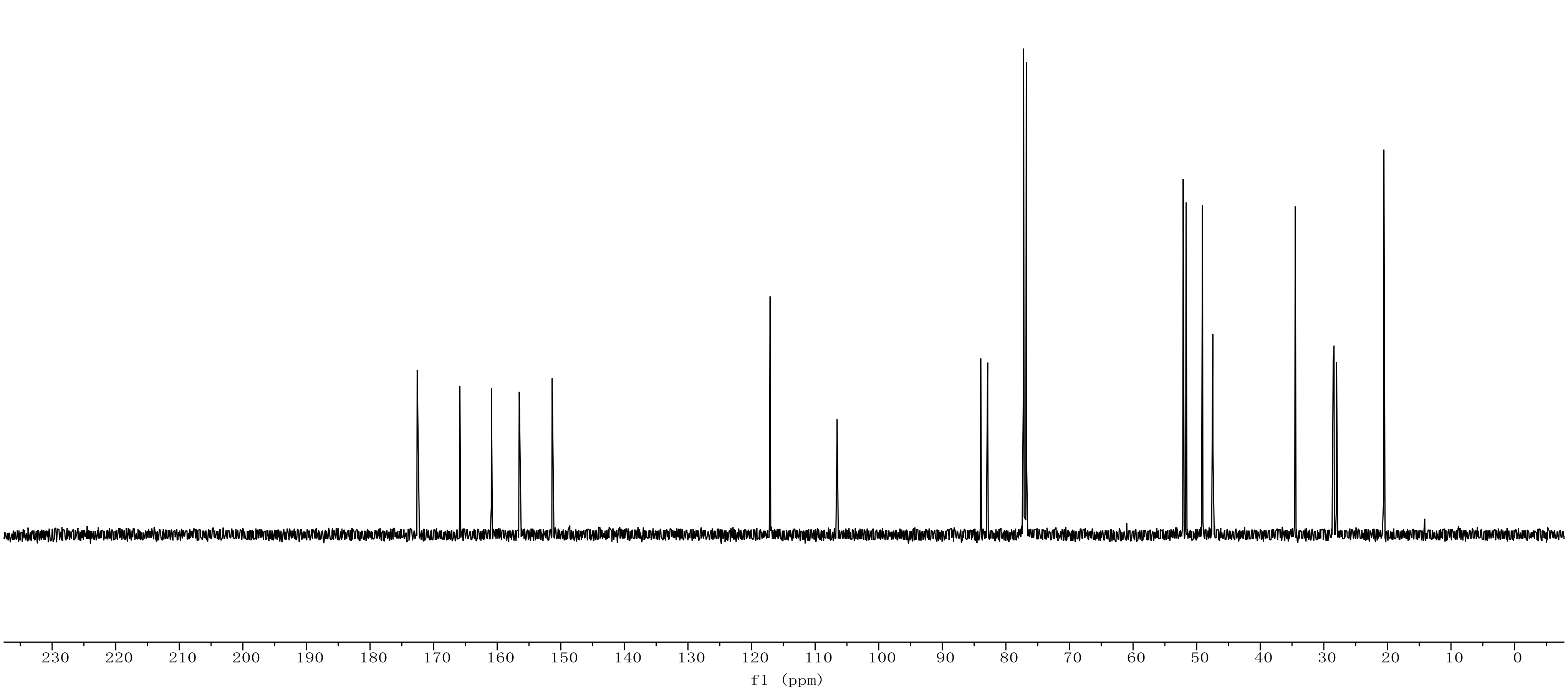

172.97
166.01
161.13
156.27
151.72
142.33
128.32
128.21
125.61
117.24
77.32
77.00
76.68
52.10
51.68
49.14
35.57
34.43
31.95
31.18
27.38
20.64
O
N
CO_2Me
MeO_2C
S2h
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

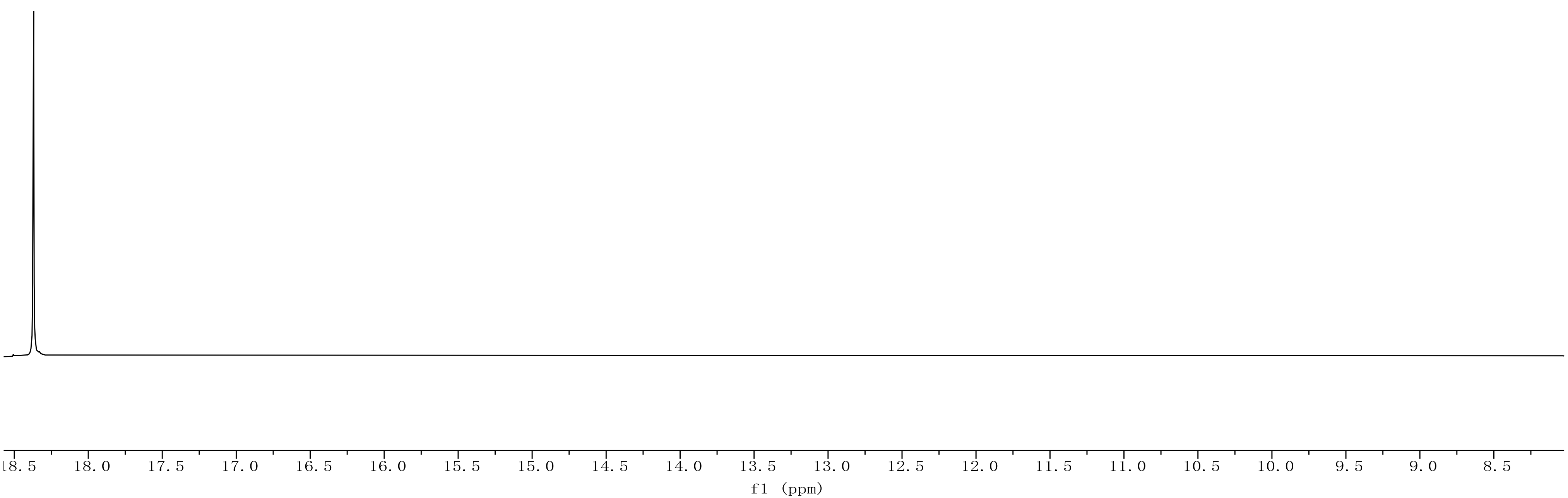


6.359
4.487
4.408
4.207
4.194
4.184
4.171
4.157
4.143
4.121
3.837
3.675
3.493
3.480
3.463
3.449
3.434
3.419
3.407
3.388
3.377
2.237
2.225
2.224
2.211
2.197
2.168
2.149
1.888
1.875
1.861
1.849
1.838
1.827
1.789
1.783
1.782
1.774
1.739
1.731
1.696
1.689
-0.001
O
N
CO2Me
MeO2C
F
S2i
1.00
0.99
1.00
3.01
3.01
3.00
2.00
3.06
1.04
2.02
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)

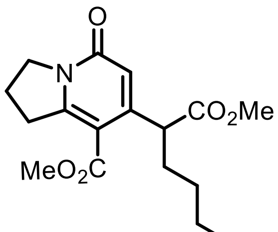

O
N
CO2Me
MeO2C
F

S2i


172.59
165.87
160.91
156.54
151.36
117.09
106.55
83.95
82.86
77.21
77.00
76.79
52.12
51.66
49.07
47.45
34.49
28.52
28.39
28.00
27.96
20.55
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

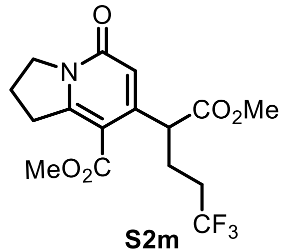


18.37
18.5
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
f1 (ppm)



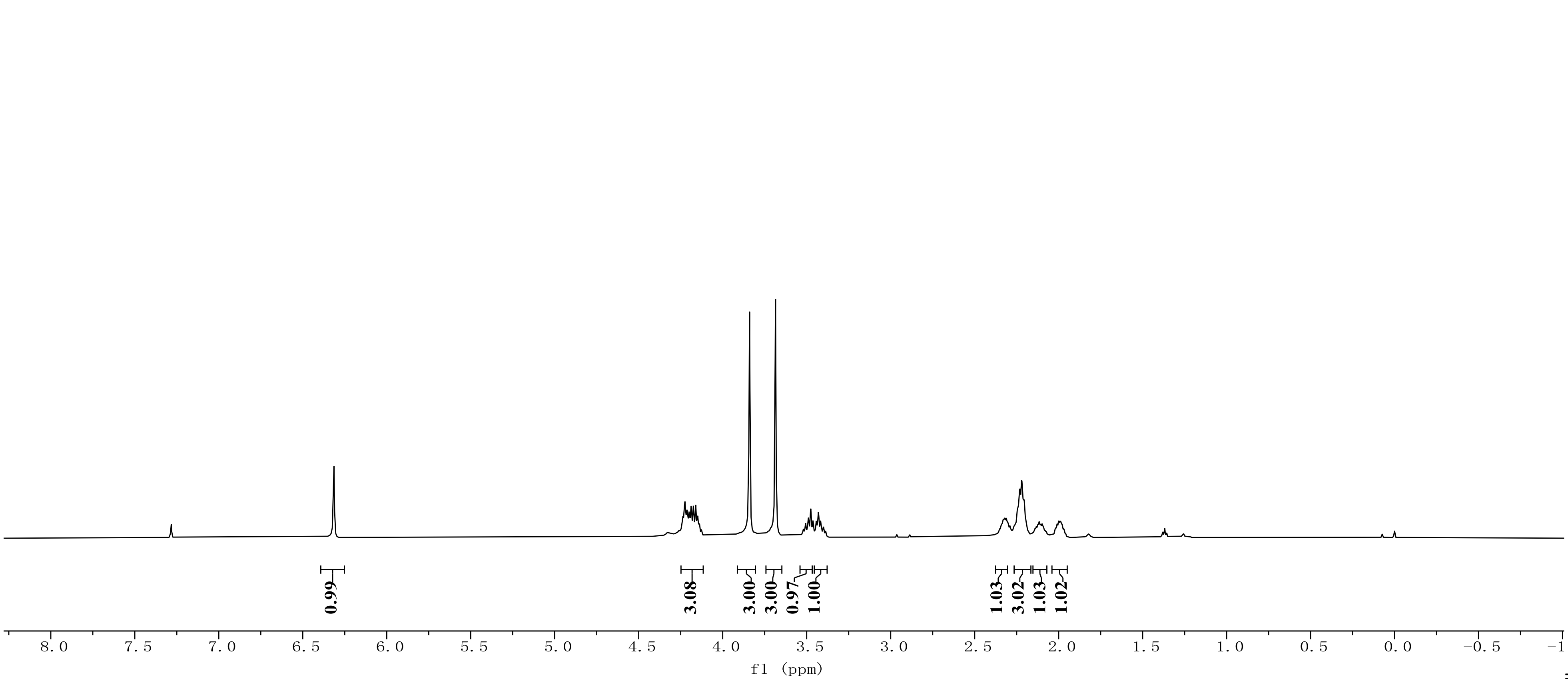
O
N
CO2Me
MeO2C
F

S2i

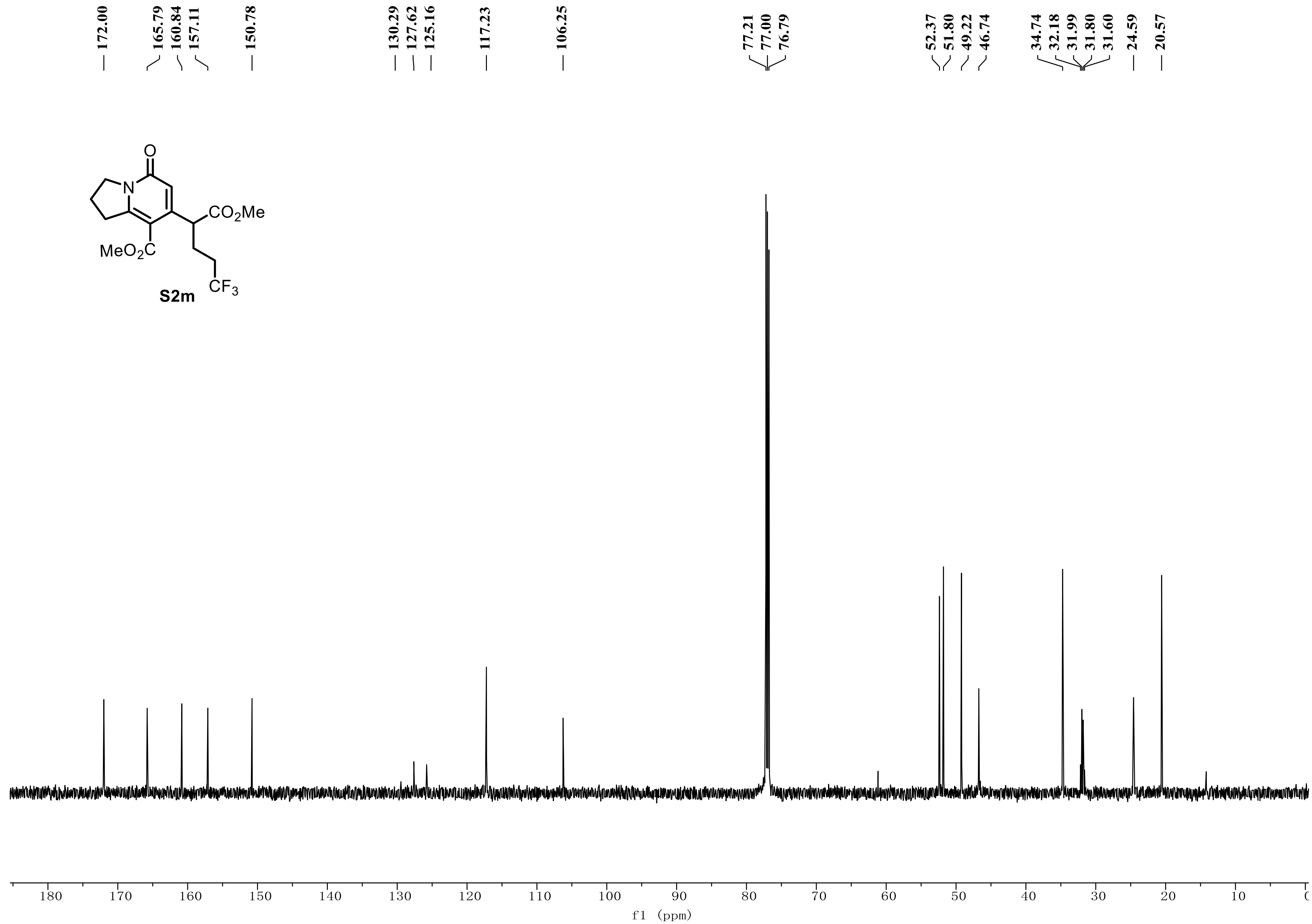


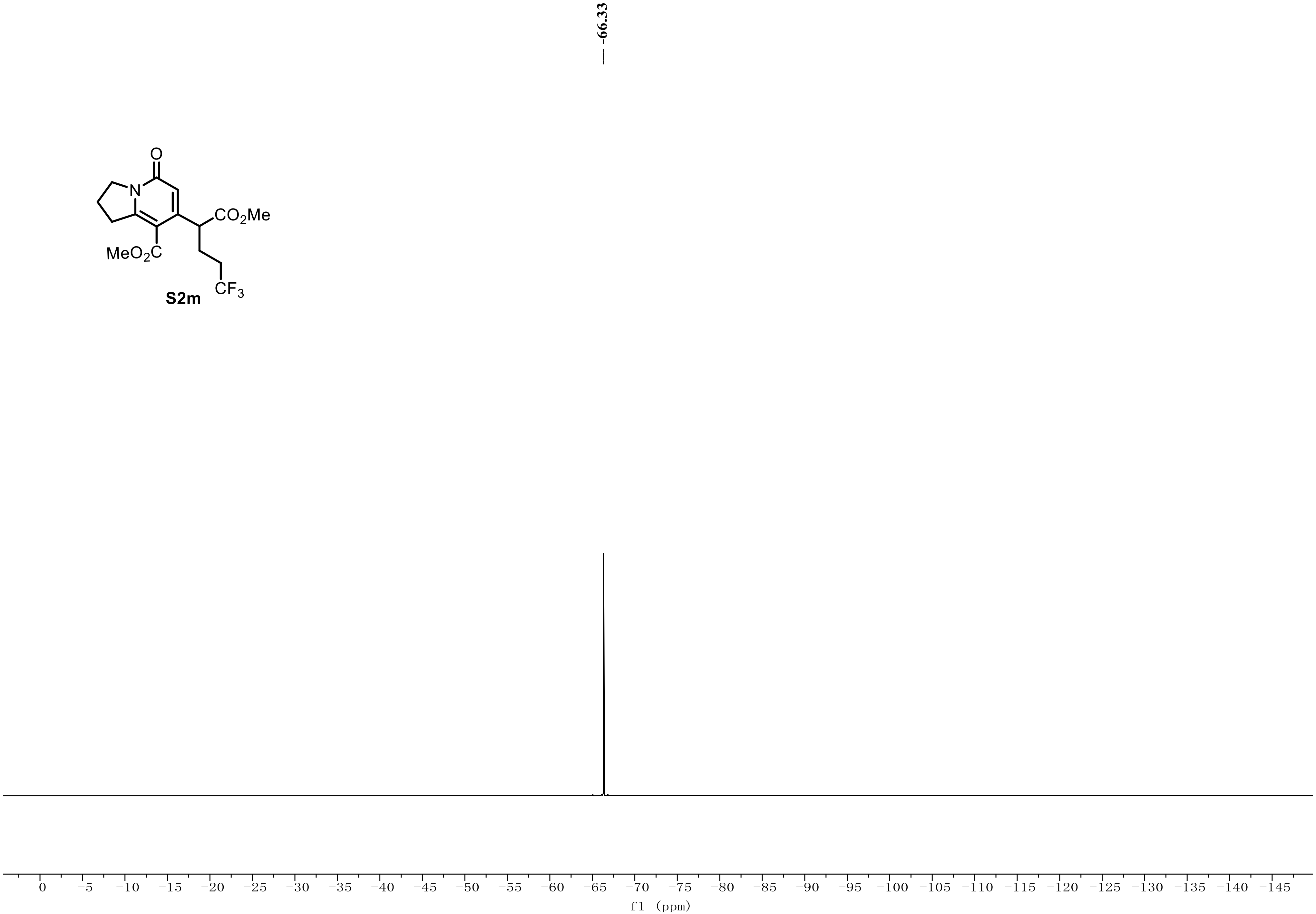
O
N
CO_2Me
MeO_2C
CF_3

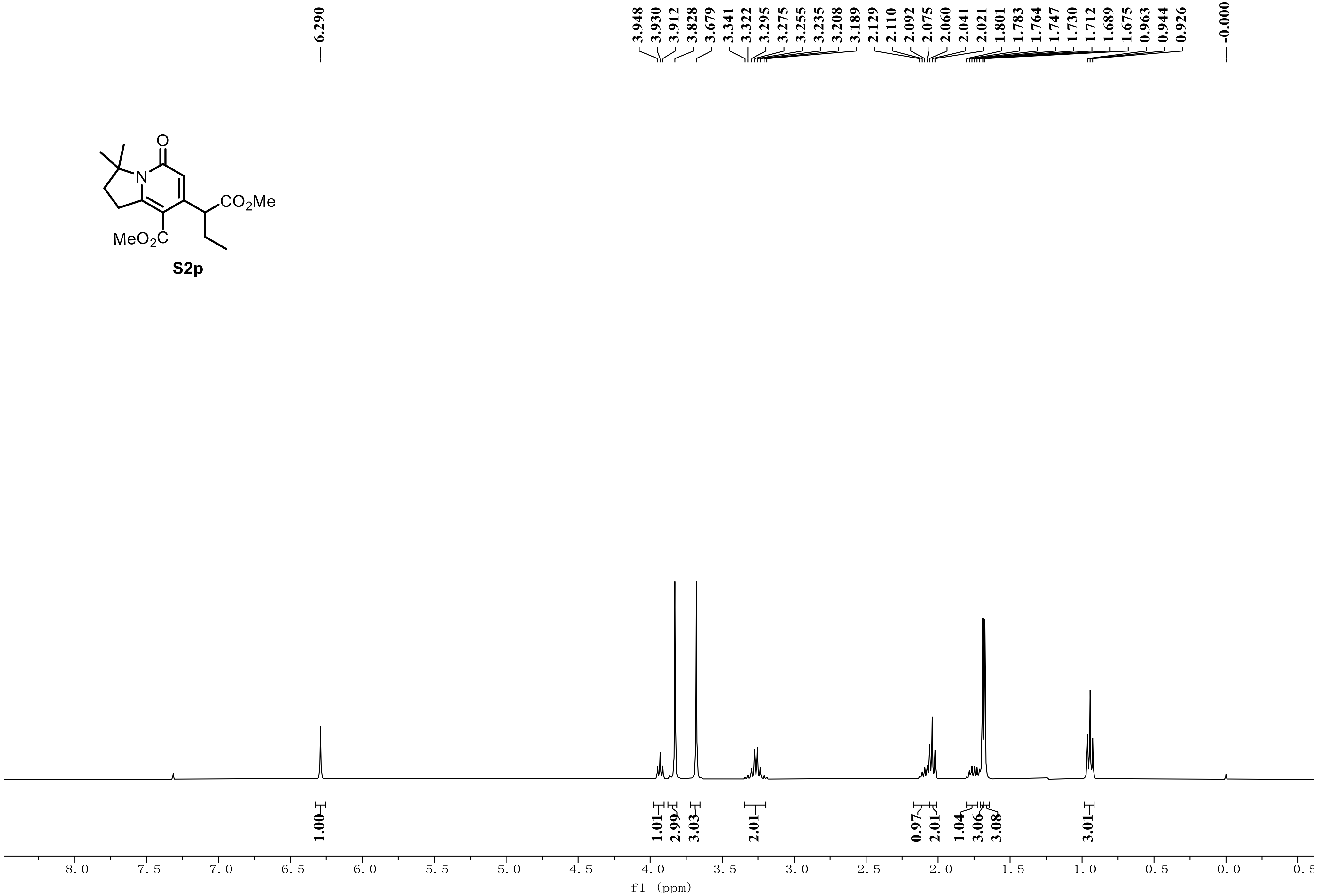
S2m



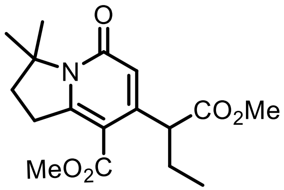
6.349
4.237
4.225
4.211
4.200
4.188
4.175
4.161
4.151
4.139
4.127
3.840
3.686
3.519
3.506
3.490
3.475
3.462
3.443
3.430
3.417
3.399
3.387
2.352
2.343
2.333
2.321
2.311
2.298
2.289
2.265
2.257
2.241
2.231
2.221
2.207
2.141
2.133
2.124
2.115
2.107
2.098
2.090
2.081
2.073
2.020
2.009
1.999
1.989
1.978
1.968
1.958
0.000
0.99
3.08
3.00
3.00
0.97
1.00
1.03
3.02
1.03
1.02
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
−1
f1 (ppm)


172.00
165.79
160.84
157.11
150.78
130.29
127.62
125.16
117.23
106.25
77.21
77.00
76.79
52.37
51.80
49.22
46.74
34.74
32.18
31.99
31.80
31.60
24.59
20.57
O
N
CO2Me
MeO2C
CF3
S2m
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

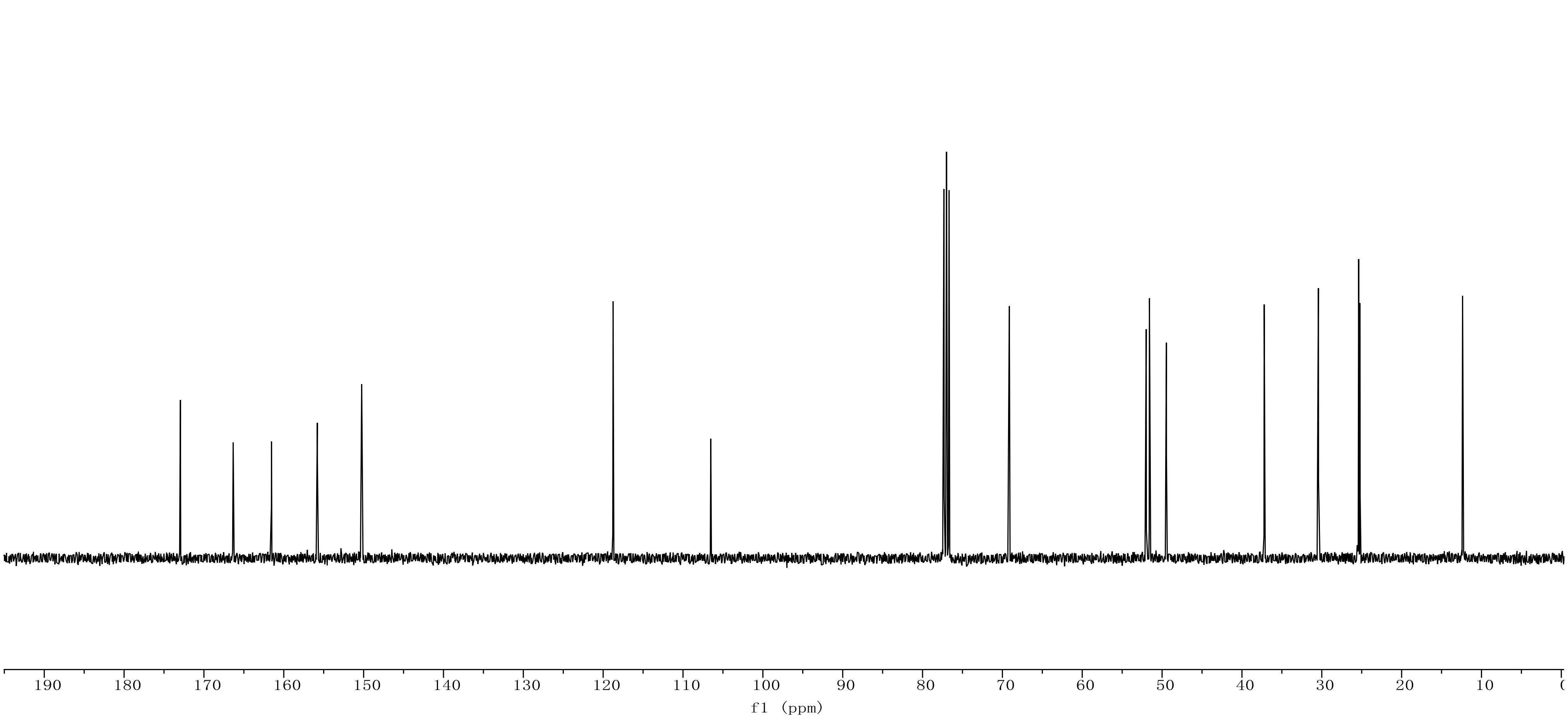

-66.33
O
N
CO2Me
MeO2C
CF3
S2m
0 −5 −10 −15 −20 −25 −30 −35 −40 −45 −50 −55 −60 −65 −70 −75 −80 −85 −90 −95 −100 −105 −110 −115 −120 −125 −130 −135 −140 −145
f1 (ppm)

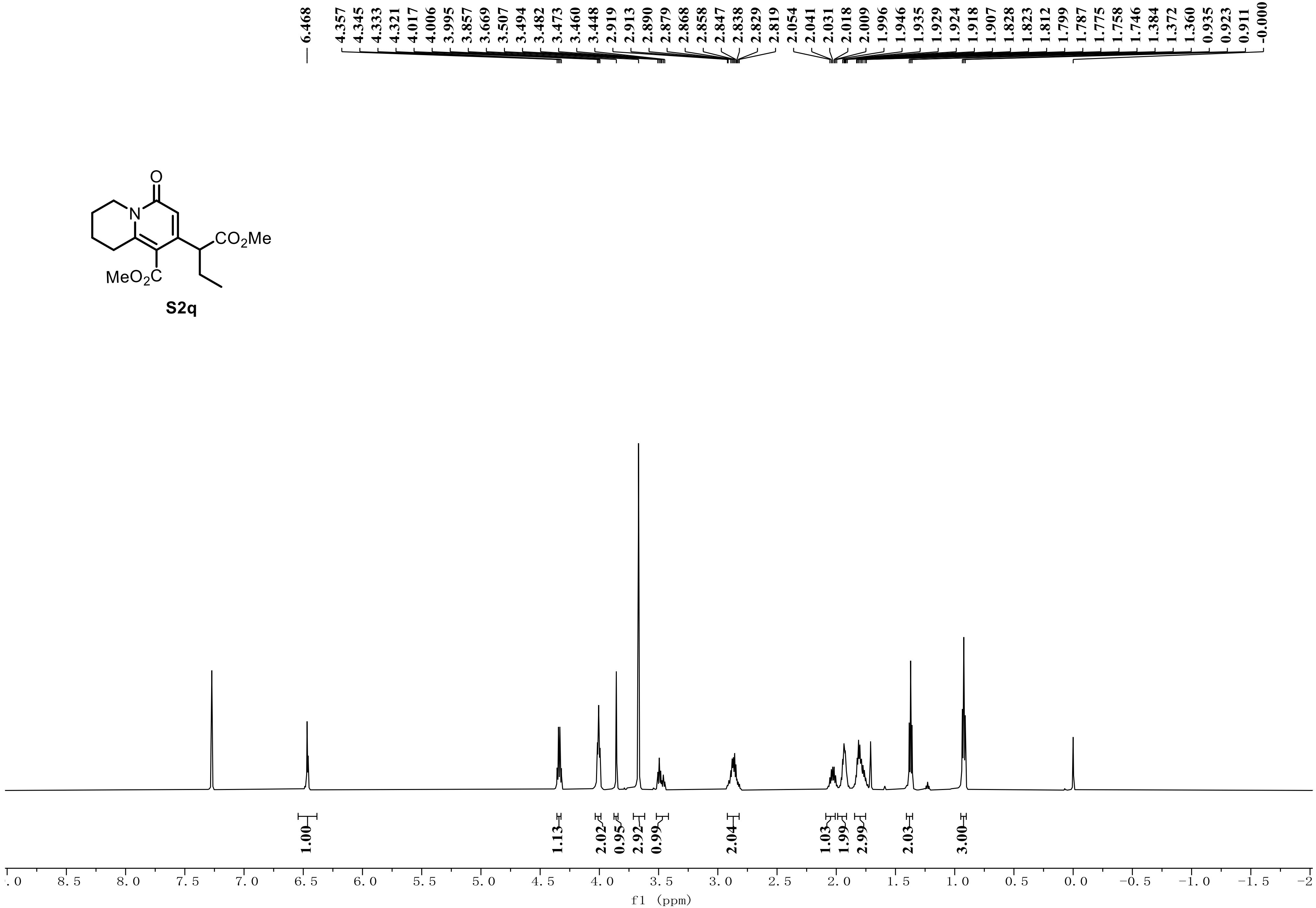


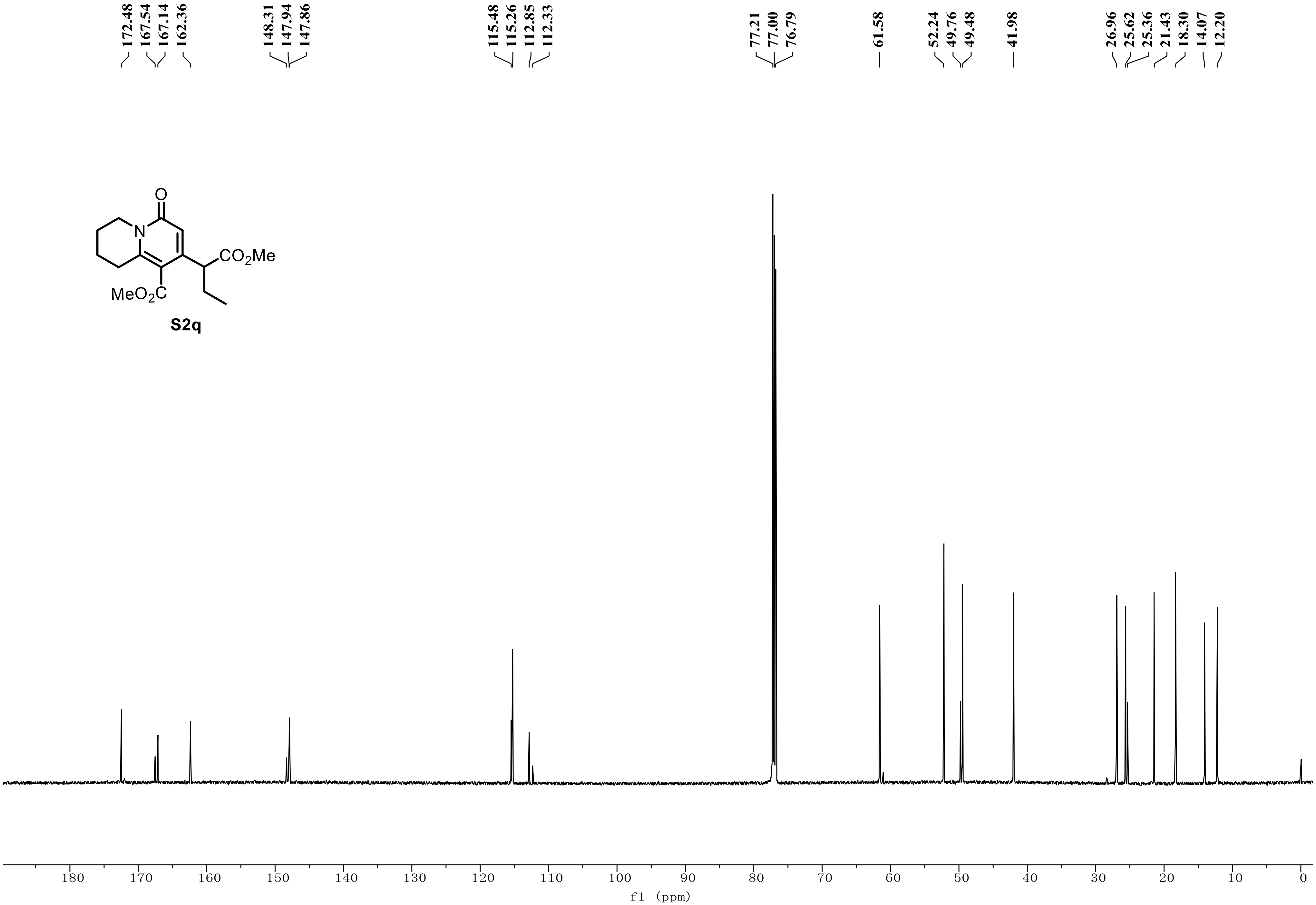
6.290
3.948
3.930
3.912
3.828
3.679
3.341
3.322
3.295
3.275
3.255
3.235
3.208
3.189
2.129
2.110
2.092
2.075
2.060
2.041
2.021
1.801
1.783
1.764
1.747
1.730
1.712
1.689
1.675
0.963
0.944
0.926
-0.000
O
N
CO2Me
MeO2C
S2p
1.00
1.01
2.99
3.03
2.01
0.97
2.01
1.04
3.06
3.08
3.01
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


O
N
CO2Me
MeO2C

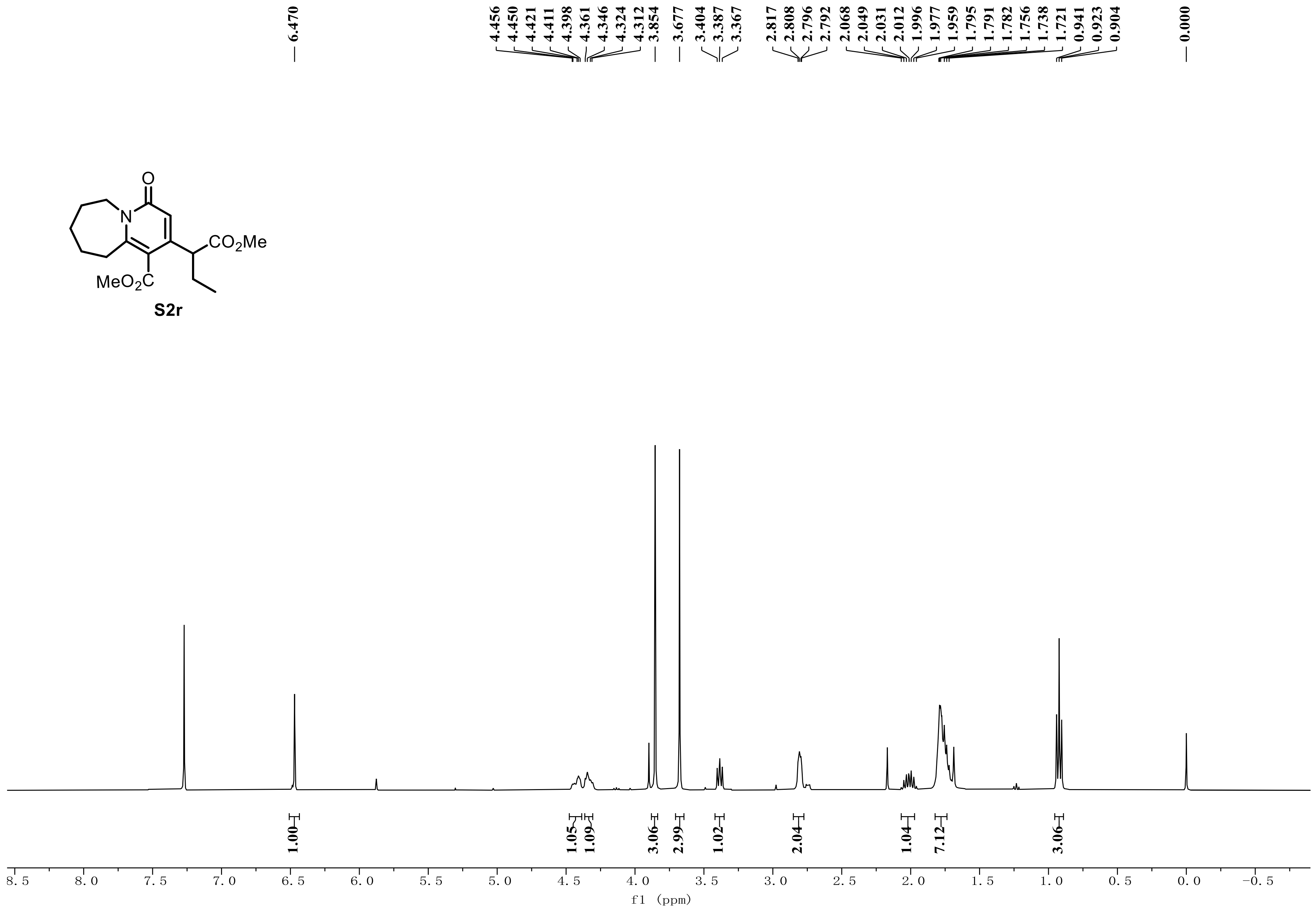
S2p

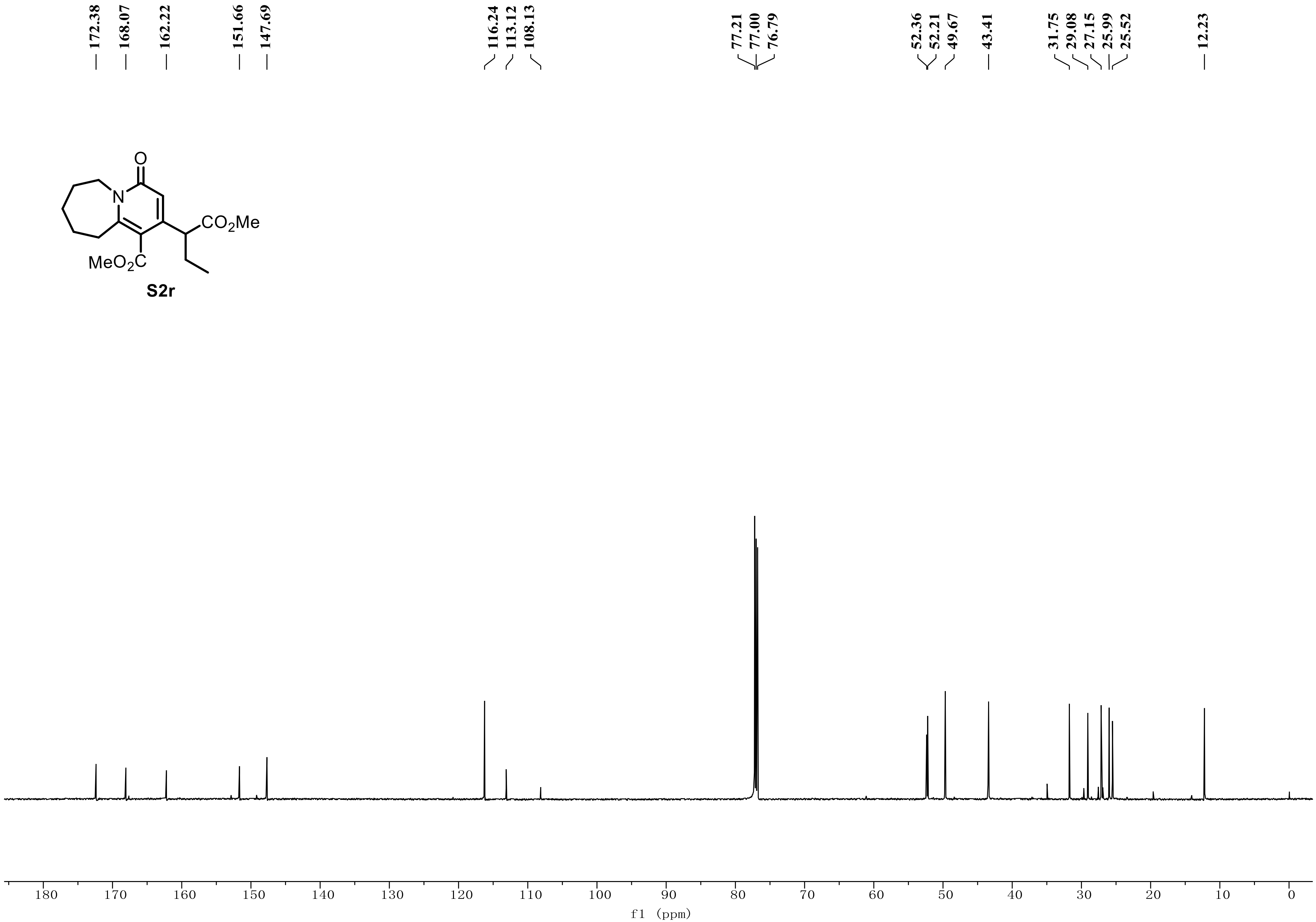

172.95
166.34
161.54
155.80
150.24
118.76
106.52
77.32
77.00
76.68
69.13
51.99
51.59
49.46
37.21
30.42
25.53
25.38
25.21
12.37
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


O
N
CO2Me
MeO2C
S2q
6.468
4.357
4.345
4.333
4.321
4.017
4.006
3.995
3.857
3.669
3.507
3.494
3.482
3.473
3.460
3.448
2.919
2.913
2.890
2.879
2.868
2.858
2.847
2.838
2.829
2.819
2.054
2.041
2.031
2.018
2.009
1.996
1.946
1.935
1.929
1.924
1.918
1.907
1.828
1.823
1.812
1.799
1.787
1.775
1.758
1.746
1.384
1.372
1.360
0.935
0.923
0.911
-0.000
1.00
1.13
2.02
0.95
2.92
0.99
2.04
1.03
1.99
2.99
2.03
3.00
f1 (ppm)

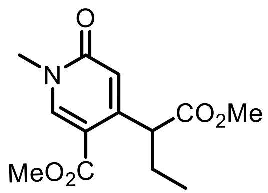


172.48
167.54
167.14
162.36
148.31
147.94
147.86
115.48
115.26
112.85
112.33
77.21
77.00
76.79
61.58
52.24
49.76
49.48
41.98
26.96
25.62
25.36
21.43
18.30
14.07
12.20
O
N
CO_2Me
MeO_2C
S2q
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

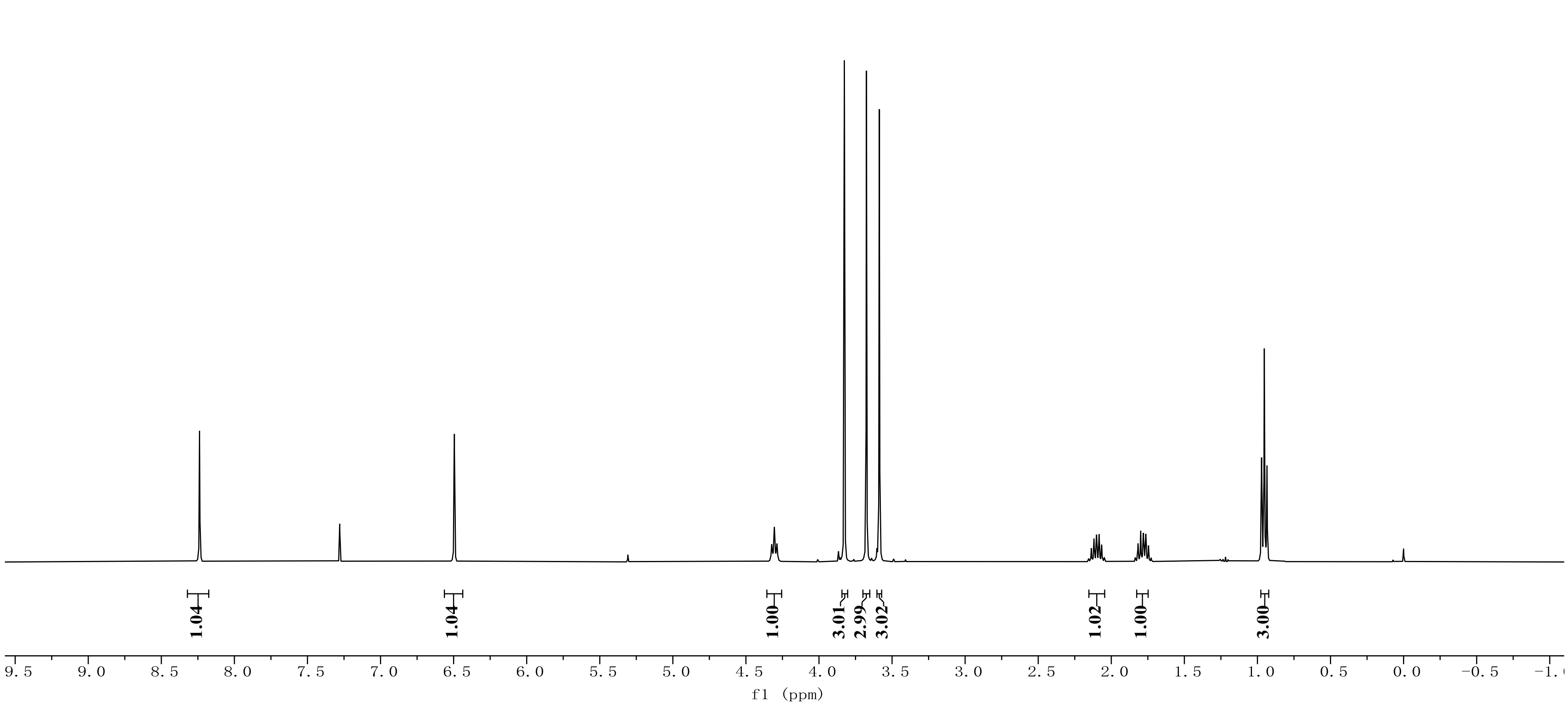

6.470
4.456
4.450
4.421
4.411
4.398
4.361
4.346
4.324
4.312
3.854
3.677
3.404
3.387
3.367
2.817
2.808
2.796
2.792
2.068
2.049
2.031
2.012
1.996
1.977
1.959
1.795
1.791
1.782
1.756
1.738
1.721
0.941
0.923
0.904
0.000
O
N
CO_2Me
MeO_2C
S2r
1.00
1.05
1.09
3.06
2.99
1.02
2.04
1.04
7.12
3.06
8.5 8.0 7.5 7.0 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)



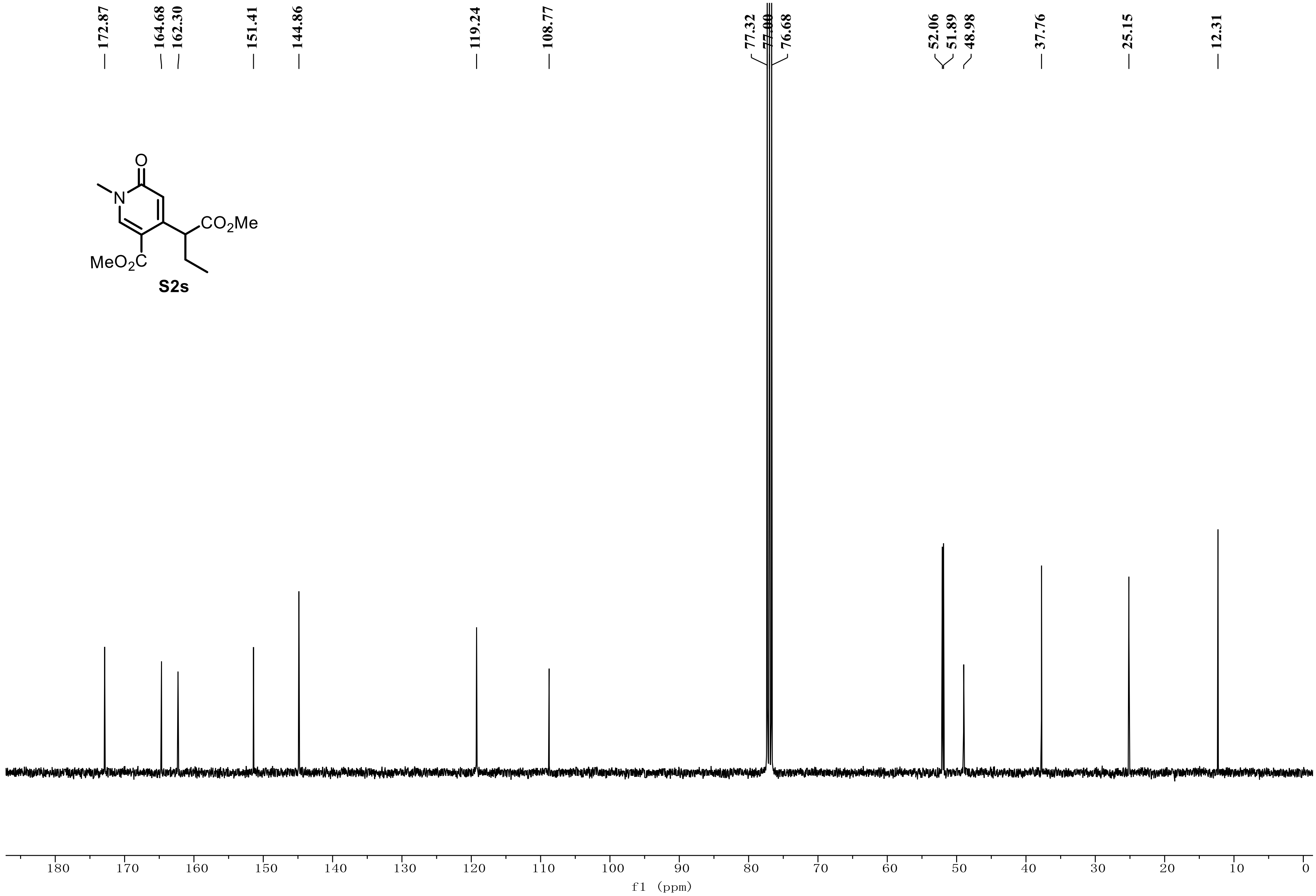
172.38
168.07
162.22
151.66
147.69
116.24
113.12
108.13
77.21
77.00
76.79
52.36
52.21
49.67
43.41
31.75
29.08
27.15
25.99
25.52
12.23
O
N
CO2Me
MeO2C
S2r
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

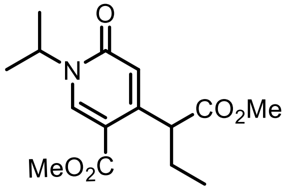


S2s

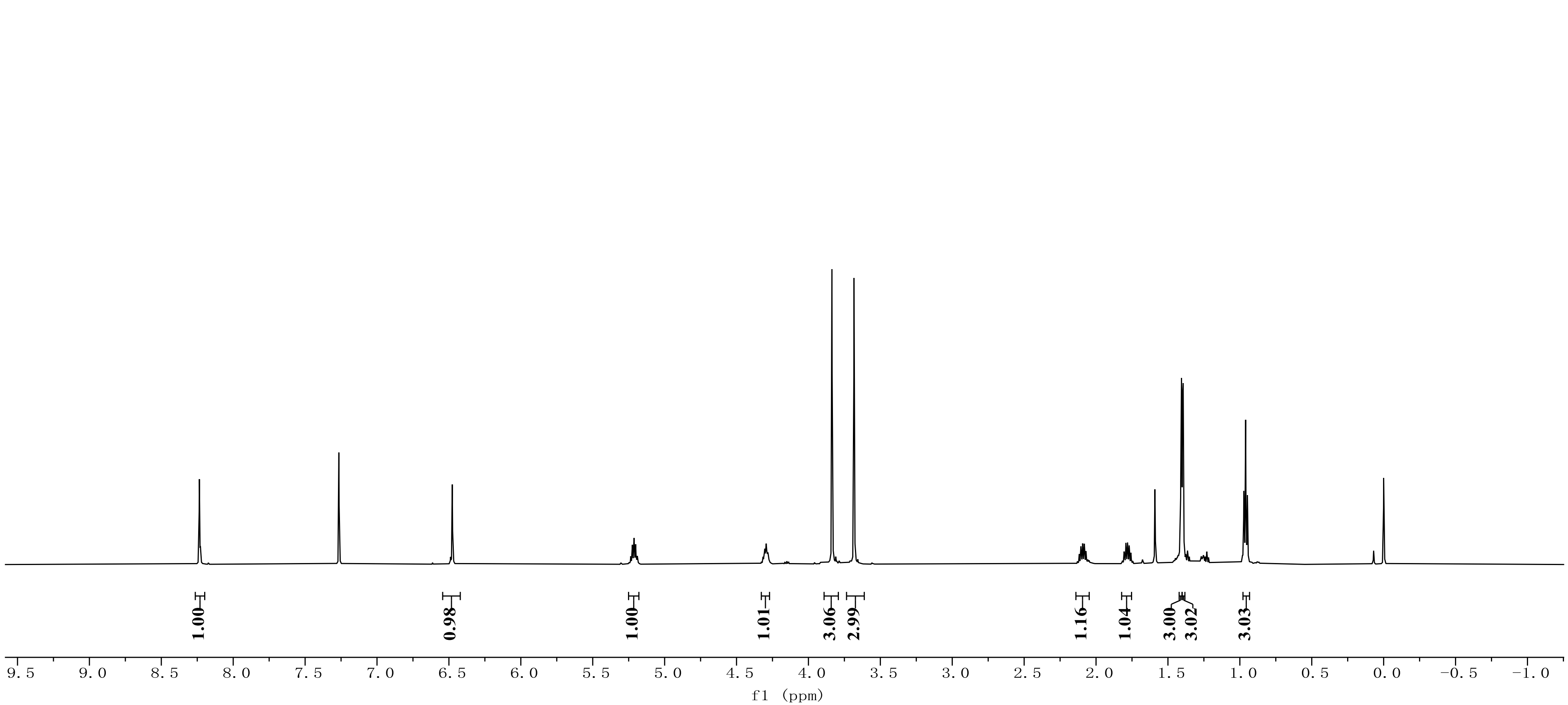


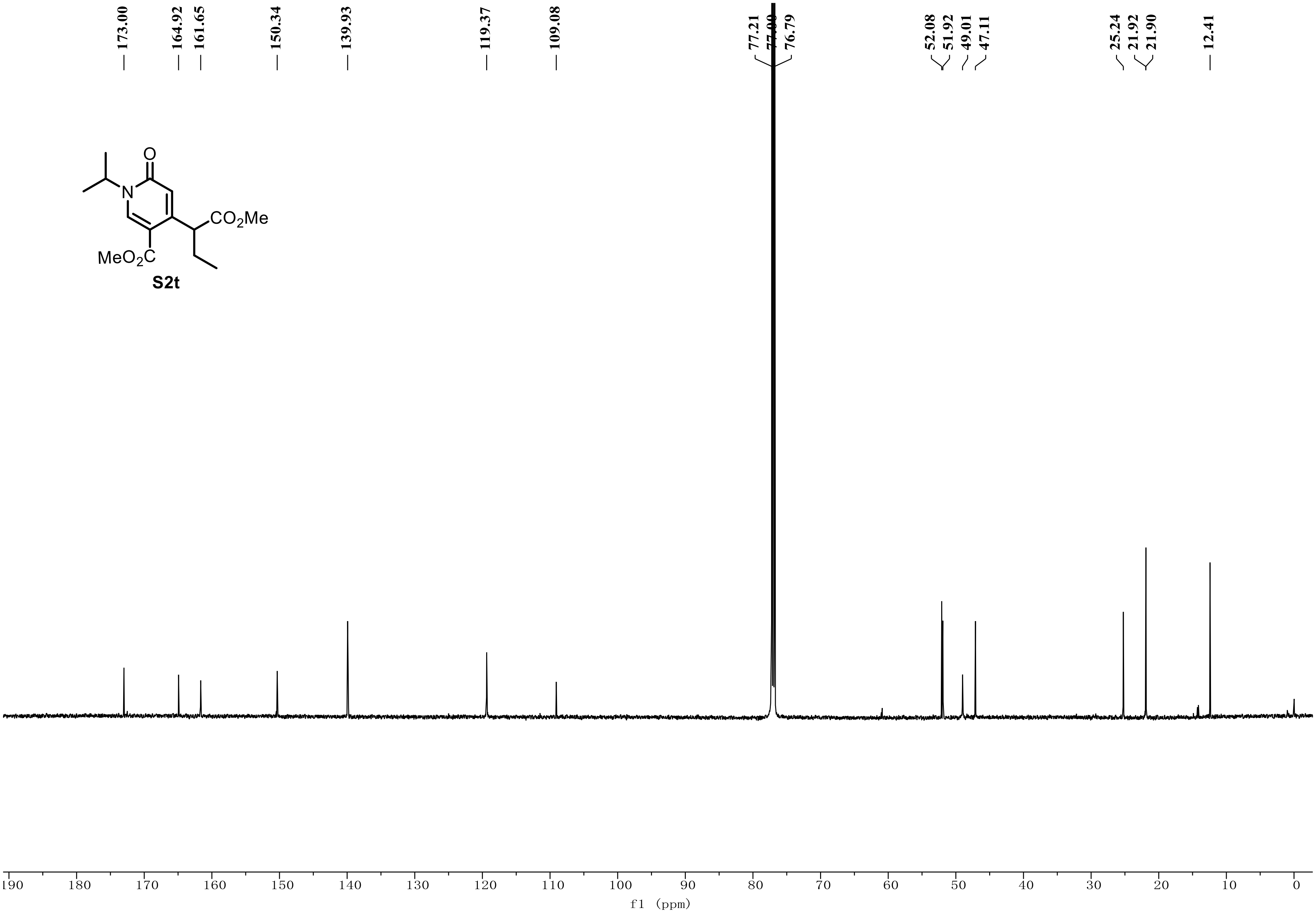
8.239
6.495
4.324
4.306
4.288
3.827
3.675
3.587
2.155
2.137
2.119
2.101
2.084
2.066
2.047
1.836
1.817
1.799
1.782
1.764
1.746
1.727
0.972
0.953
0.935
-0.000
1.04
1.04
1.00
3.01
2.99
3.02
1.02
1.00
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

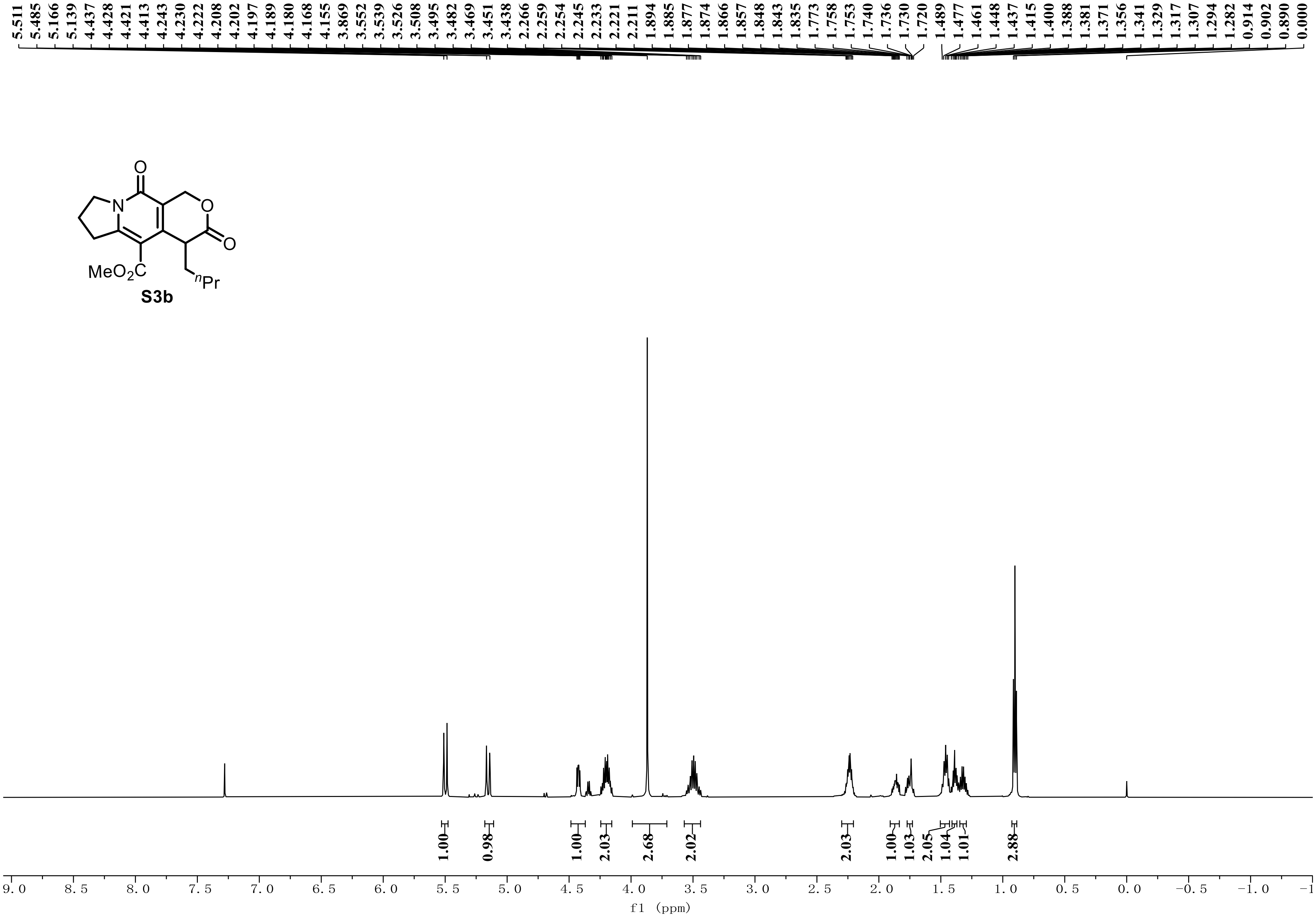

172.87
164.68
162.30
151.41
144.86
119.24
108.77
77.32
77.00
76.68
52.06
51.89
48.98
37.76
25.15
12.31
O
N
CO2Me
MeO2C
S2s
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

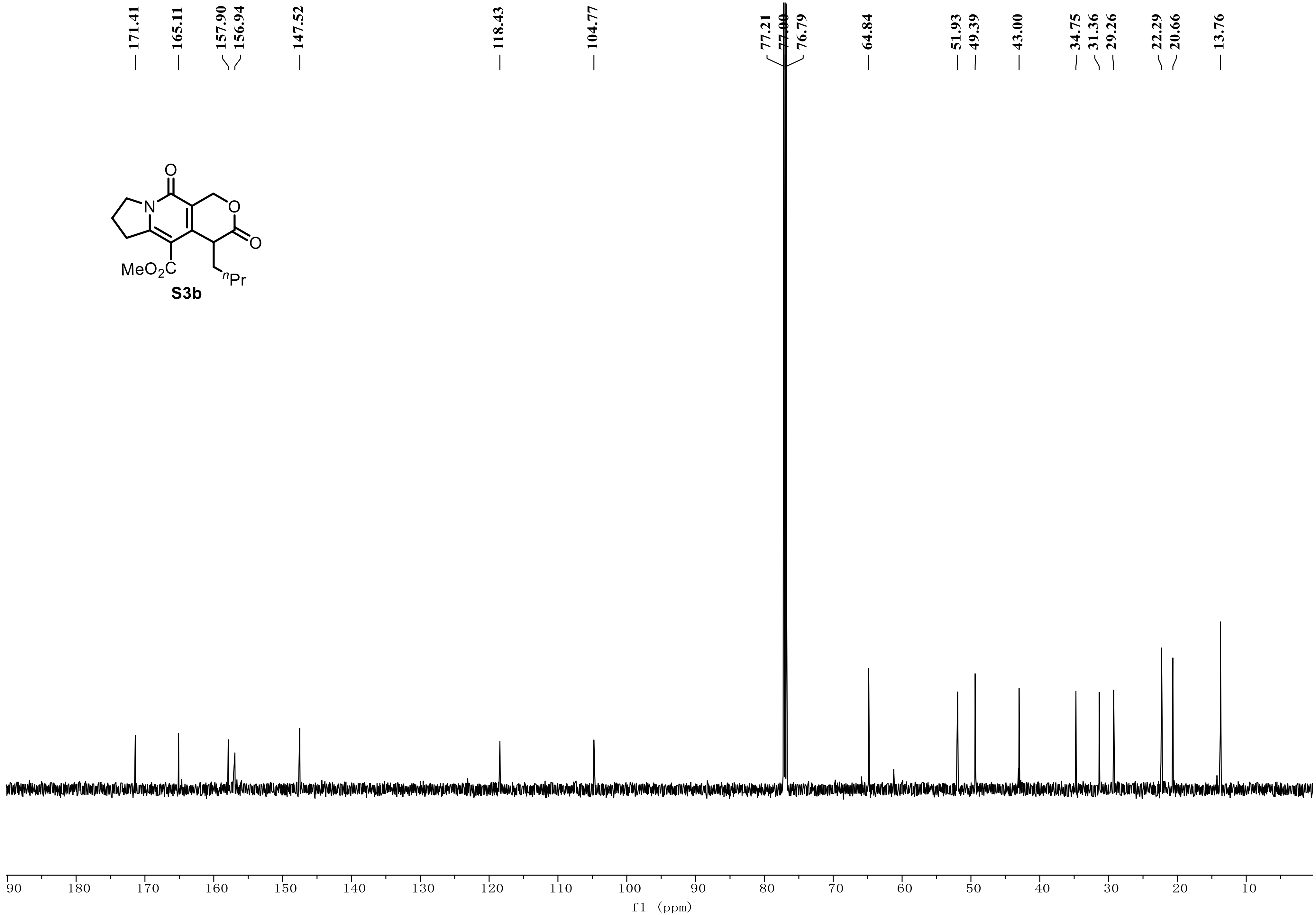

O
N
CO_2Me
MeO_2C

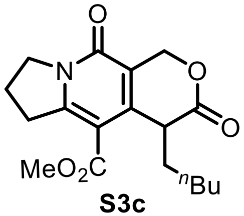
S2t


8.235
6.477
5.235
5.224
5.213
5.201
5.190
4.327
4.315
4.304
4.294
4.282
3.836
3.683
2.129
2.117
2.105
2.093
2.082
2.070
2.058
1.813
1.802
1.793
1.781
1.769
1.757
1.745
1.410
1.406
1.398
1.394
-0.000
1.00
0.98
1.00
1.01
3.06
2.99
1.16
1.04
3.00
3.02
3.03
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 -1.0
f1 (ppm)

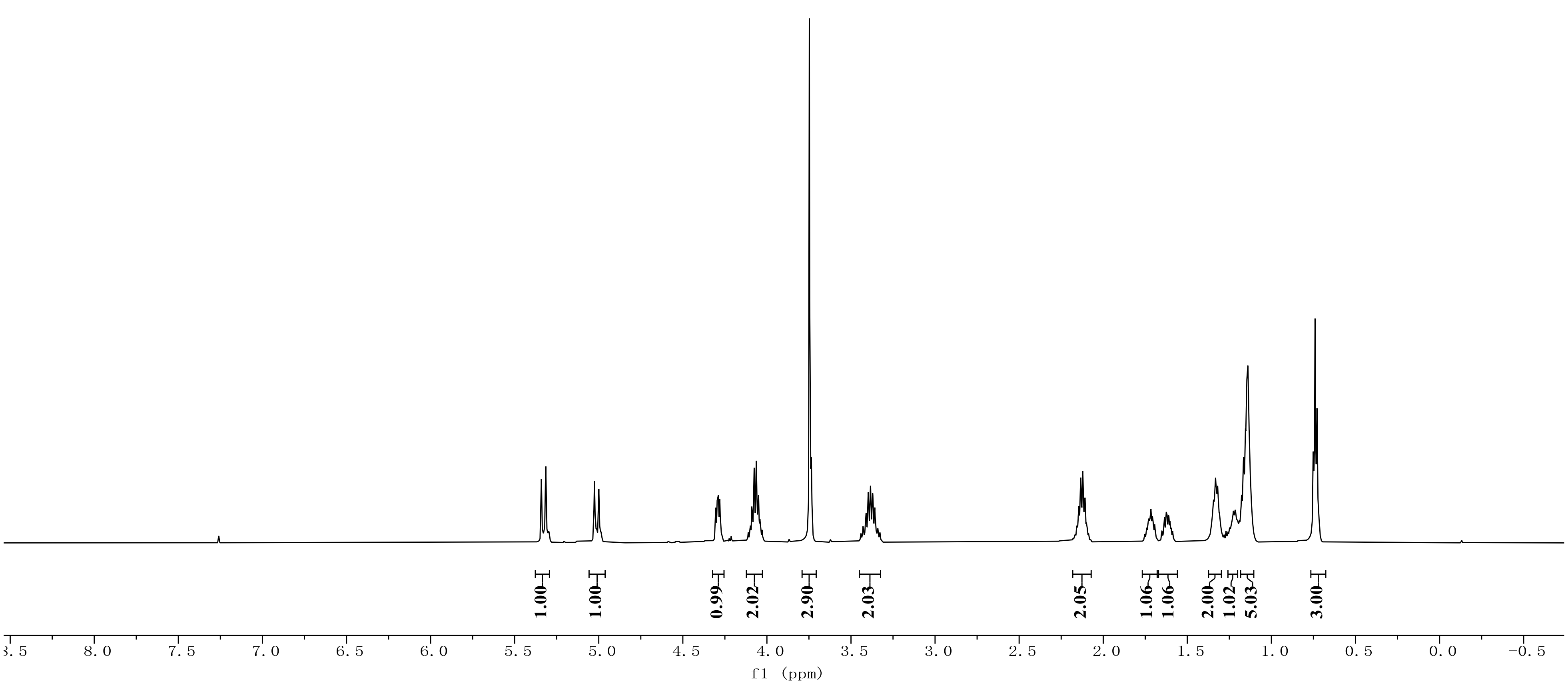

173.00
164.92
161.65
150.34
139.93
119.37
109.08
77.21
77.00
76.79
52.08
51.92
49.01
47.11
25.24
21.92
21.90
12.41
O
N
CO2Me
MeO2C
S2t
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


5.511 5.485 5.166 5.139 4.437 4.428 4.421 4.413 4.243 4.230 4.222 4.208 4.202 4.197 4.189 4.180 4.168 4.155 3.869 3.552 3.539 3.526 3.508 3.495 3.482 3.469 3.451 3.438 2.266 2.259 2.254 2.245 2.233 2.221 2.211 1.894 1.885 1.877 1.874 1.866 1.857 1.848 1.843 1.835 1.773 1.758 1.753 1.740 1.736 1.730 1.720 1.489 1.477 1.461 1.448 1.437 1.415 1.400 1.388 1.381 1.371 1.356 1.341 1.329 1.317 1.307 1.294 1.282 0.914 0.902 0.890 0.000
O
N
O
O
MeO2C
nPr
S3b
1.00
0.98
1.00
2.03
2.68
2.02
2.03
1.00
1.03
2.05
1.04
1.01
2.88
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 −1.0 −1
f1 (ppm)

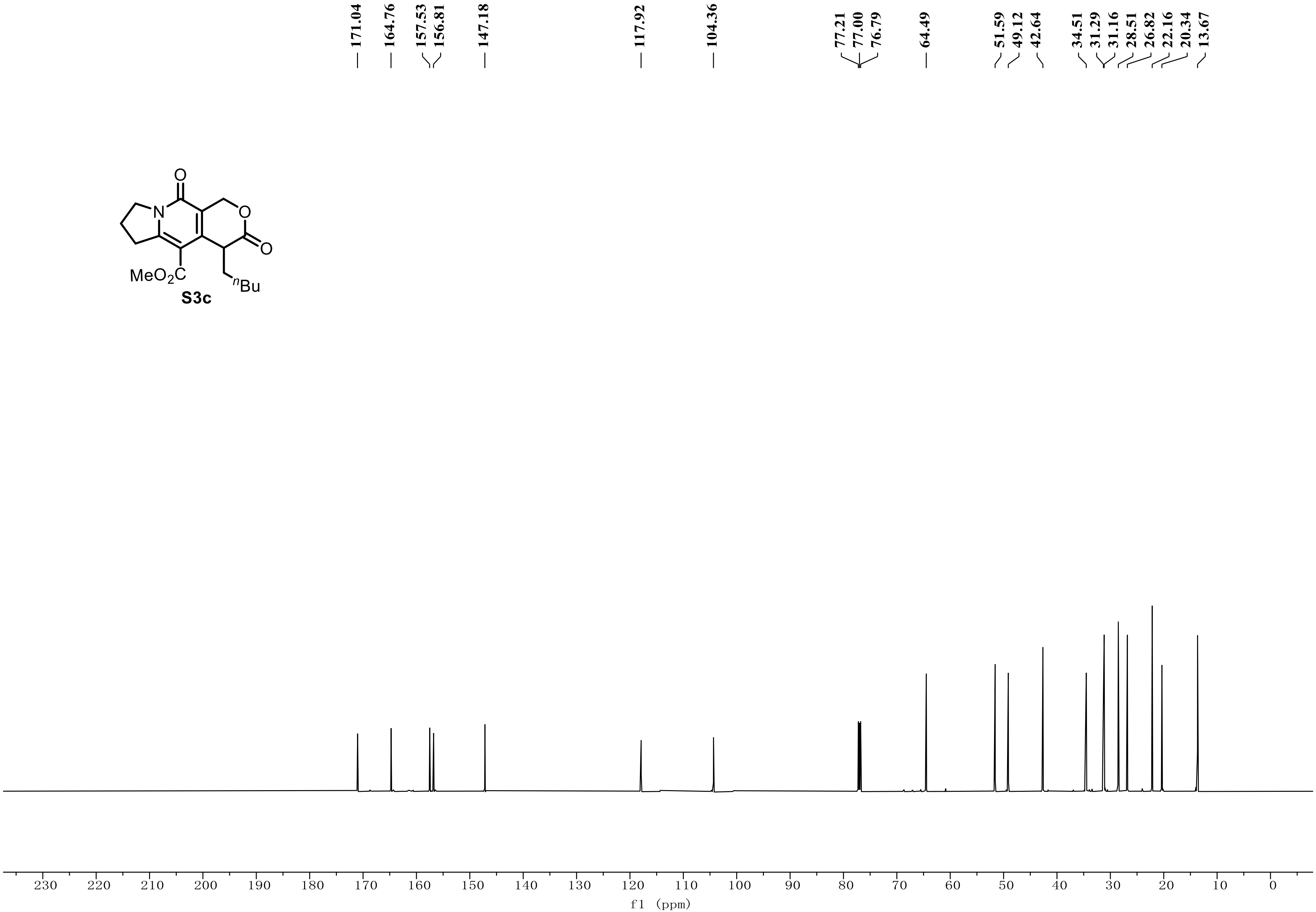

171.41
165.11
157.90
156.94
147.52
118.43
104.77
77.21
77.00
76.79
64.84
51.93
49.39
43.00
34.75
31.36
29.26
22.29
20.66
13.76
O
N
O
O
MeO2C
nPr
S3b
90 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



S3c

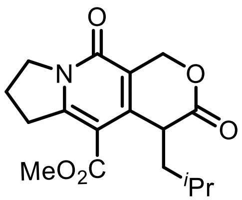


7.260 5.341 5.315 5.025 4.999 4.304 4.296 4.289 4.280 4.090 4.087 4.079 4.076 4.063 4.054 4.050 4.041 3.747 3.410 3.397 3.384 3.373 3.370 3.359 2.168 2.147 2.144 2.133 2.119 2.108 2.097 2.087 1.733 1.730 1.727 1.725 1.722 1.716 1.708 1.702 1.636 1.629 1.625 1.620 1.613 1.610 1.603 1.350 1.345 1.333 1.324 1.319 1.309 1.226 1.220 1.215 1.212 1.166 1.155 1.146 1.140 1.133 1.128 0.751 0.741 0.729
1.00 1.00 0.99 2.02 2.90 2.03 2.05 1.06 1.06 2.00 1.02 5.03 3.00
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)

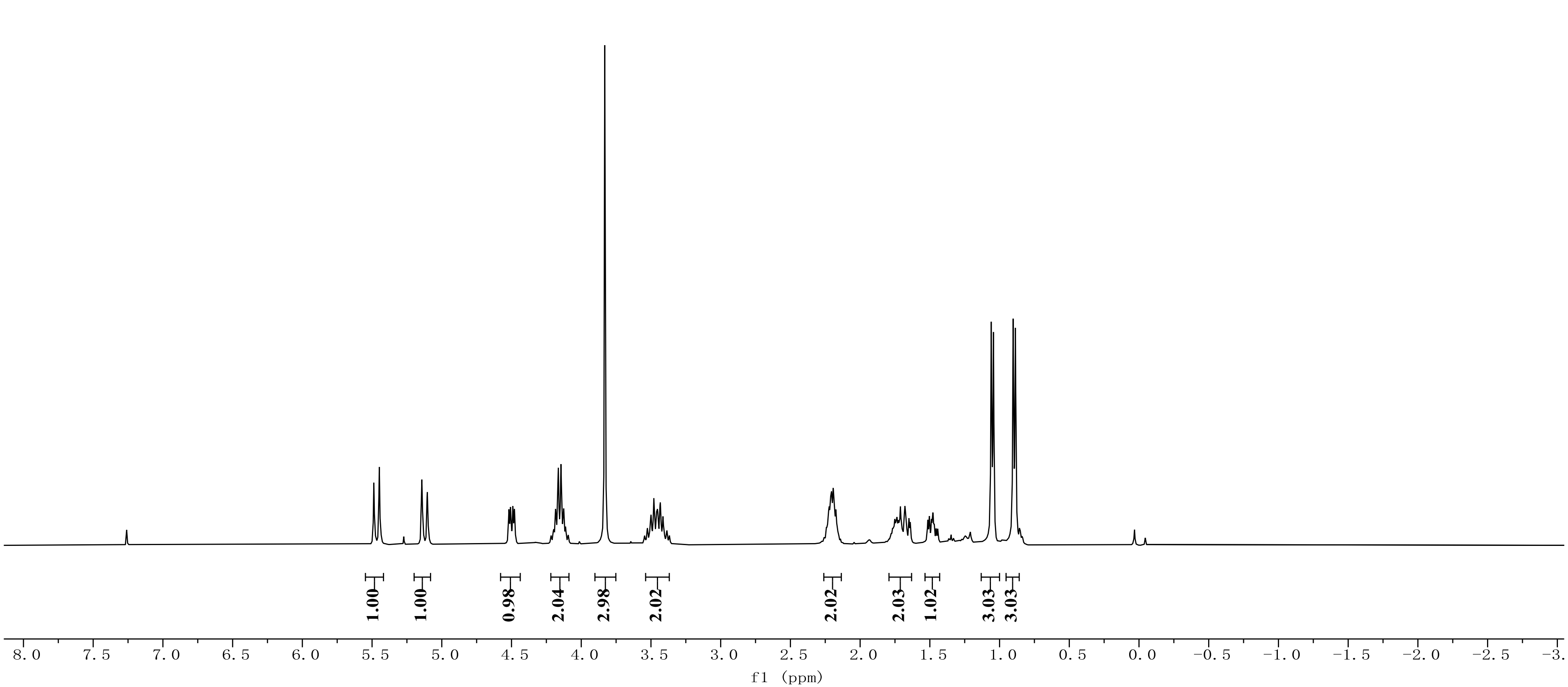

MeO2C
nBu

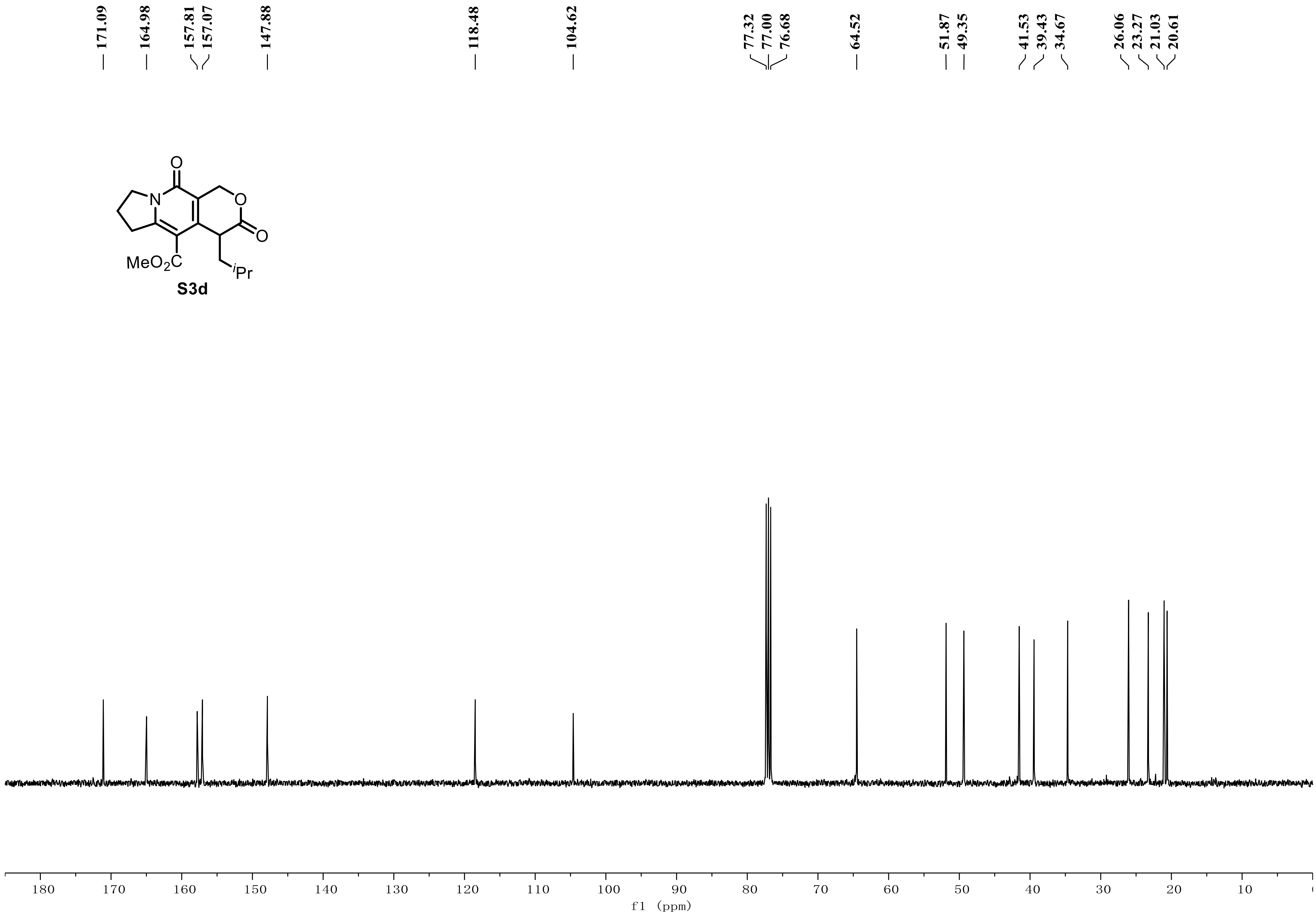
S3c

171.04
164.76
157.53
156.81
147.18
117.92
104.36
77.21
77.00
76.79
64.49
51.59
49.12
42.64
34.51
31.29
31.16
28.51
26.82
22.16
20.34
13.67
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

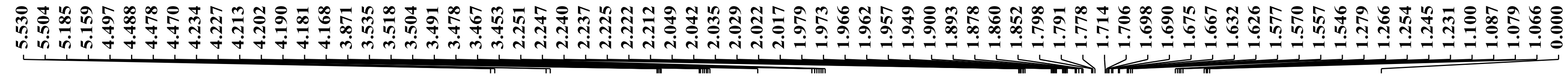

O
N
O
O
MeO2C
iPr

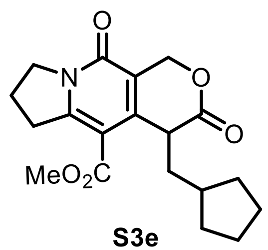
S3d


7.260
5.487
5.448
5.143
5.103
4.519
4.507
4.490
4.479
4.184
4.179
4.168
4.164
4.145
4.132
4.125
3.831
3.526
3.506
3.499
3.479
3.459
3.452
3.433
3.414
3.405
2.240
2.233
2.226
2.222
2.211
2.204
2.194
2.189
2.184
2.173
1.778
1.768
1.761
1.752
1.743
1.735
1.726
1.720
1.711
1.703
1.684
1.678
1.670
1.650
1.640
1.515
1.503
1.489
1.481
1.477
1.469
1.455
1.443
1.060
1.044
0.903
0.886
1.00
1.00
0.98
2.04
2.98
2.02
2.02
2.03
1.02
3.03
3.03
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
-1.0
-1.5
-2.0
-2.5
-3.
f1 (ppm)

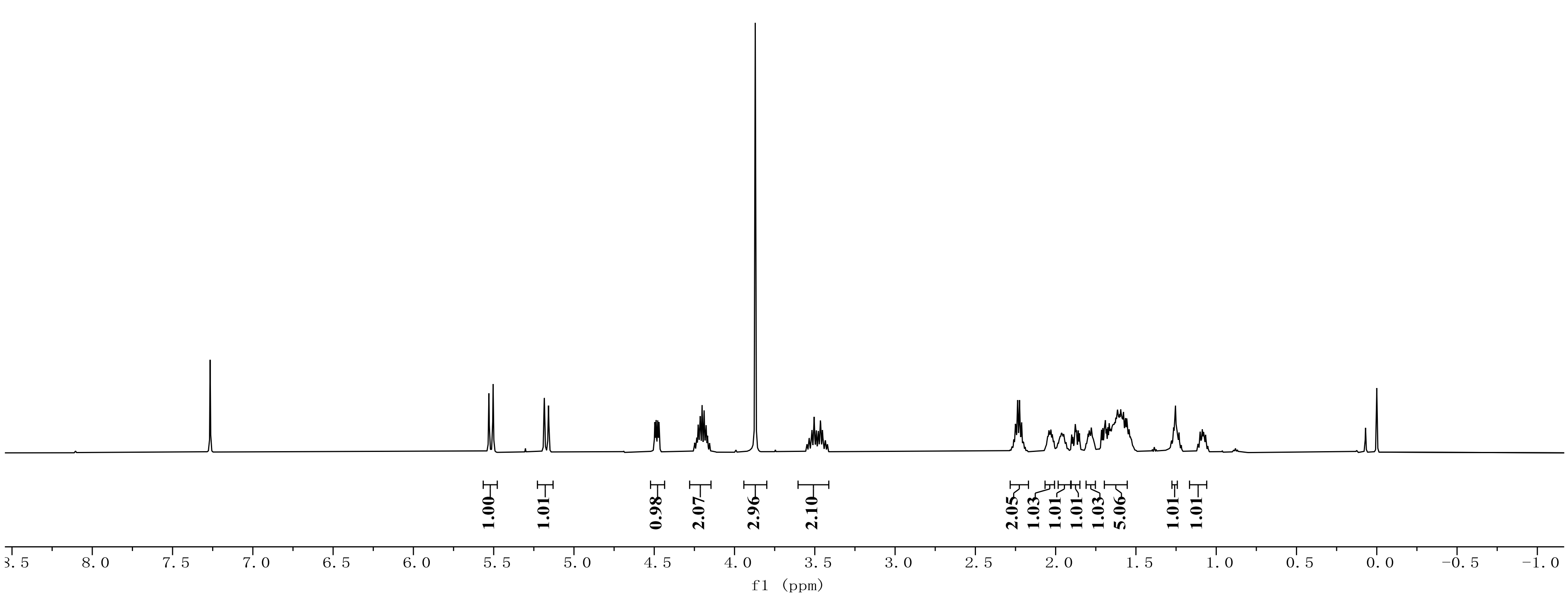


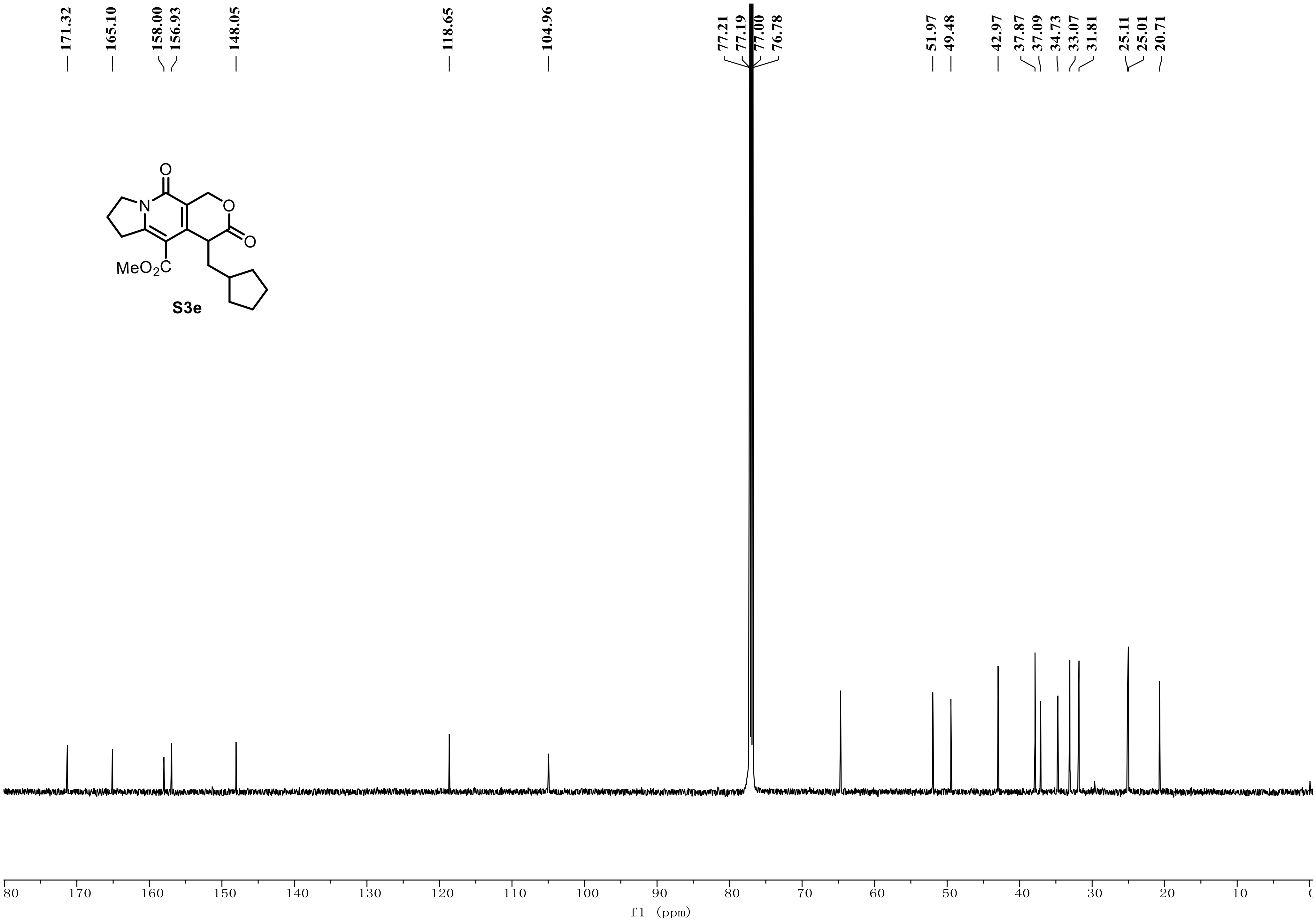
171.09
164.98
157.81
157.07
147.88
118.48
104.62
77.32
77.00
76.68
64.52
51.87
49.35
41.53
39.43
34.67
26.06
23.27
21.03
20.61
MeO2C
iPr
S3d
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


5.530 5.504 5.185 5.159 4.497 4.488 4.478 4.470 4.234 4.227 4.213 4.202 4.190 4.181 4.168 3.871 3.535 3.518 3.504 3.491 3.478 3.467 3.453 2.251 2.247 2.240 2.237 2.225 2.222 2.212 2.049 2.042 2.035 2.029 2.022 2.017 1.979 1.973 1.966 1.962 1.957 1.949 1.900 1.893 1.878 1.860 1.852 1.798 1.791 1.778 1.714 1.706 1.698 1.690 1.675 1.667 1.632 1.626 1.577 1.570 1.557 1.546 1.279 1.266 1.254 1.245 1.231 1.100 1.087 1.079 1.066 0.000

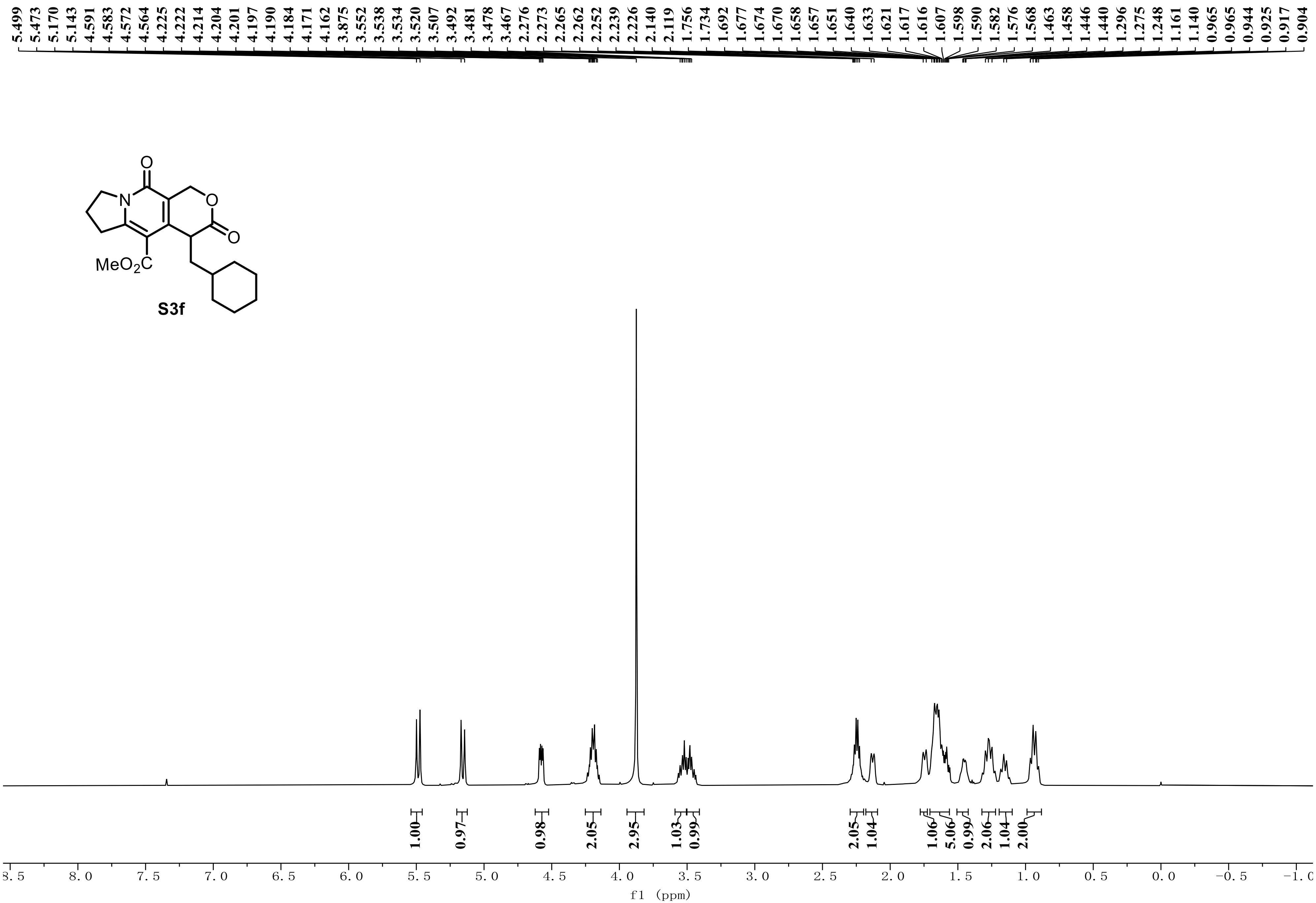

MeO2C

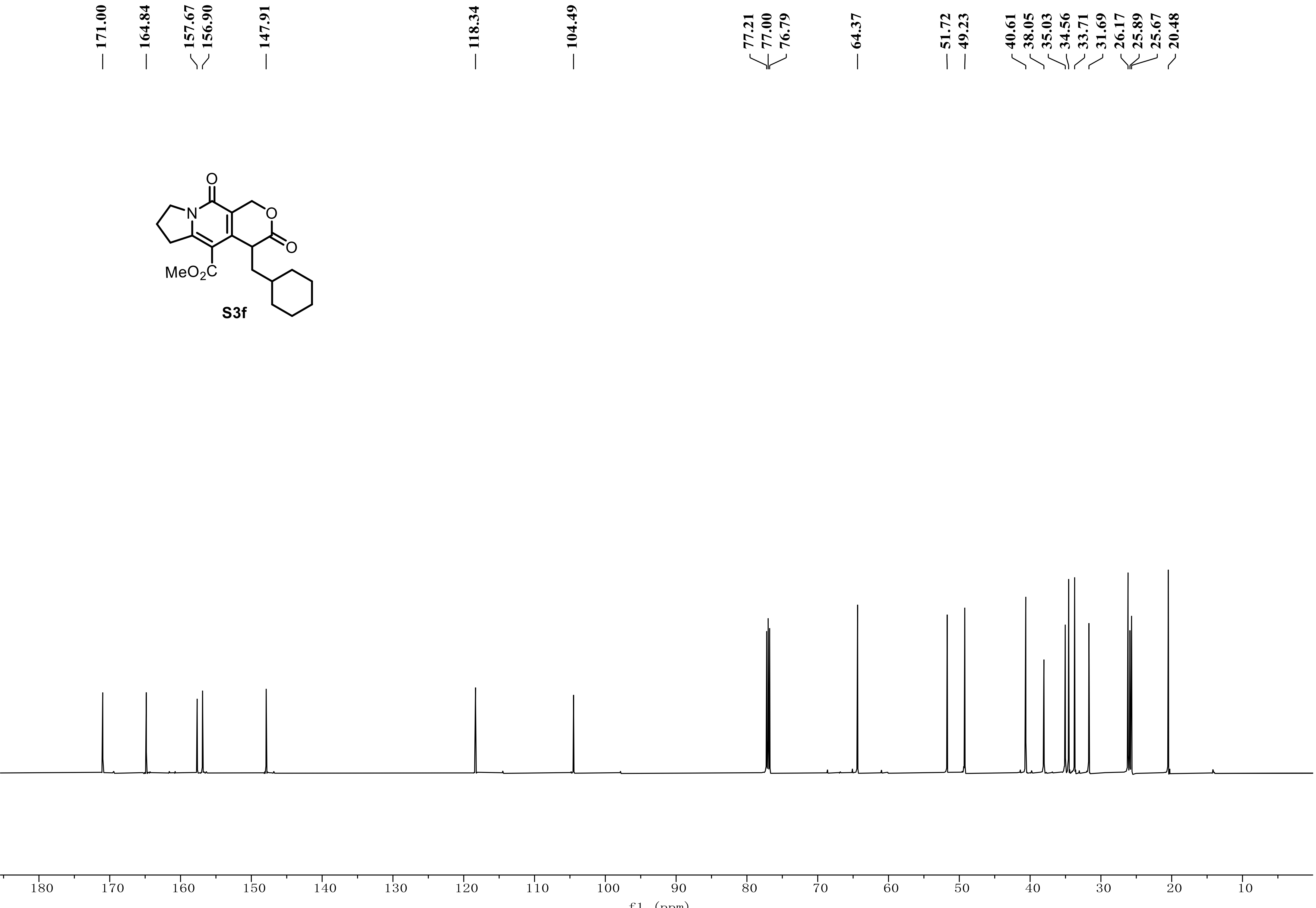
S3e


1.00
1.01
0.98
2.07
2.96
2.10
2.05
1.03
1.01
1.01
1.03
5.06
1.01
1.01
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 −1.0
f1 (ppm)

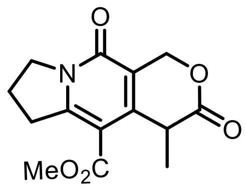


171.32
165.10
158.00
156.93
148.05
118.65
104.96
77.21
77.19
77.00
76.78
51.97
49.48
42.97
37.87
37.09
34.73
33.07
31.81
25.11
25.01
20.71
MeO2C
S3e
80 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

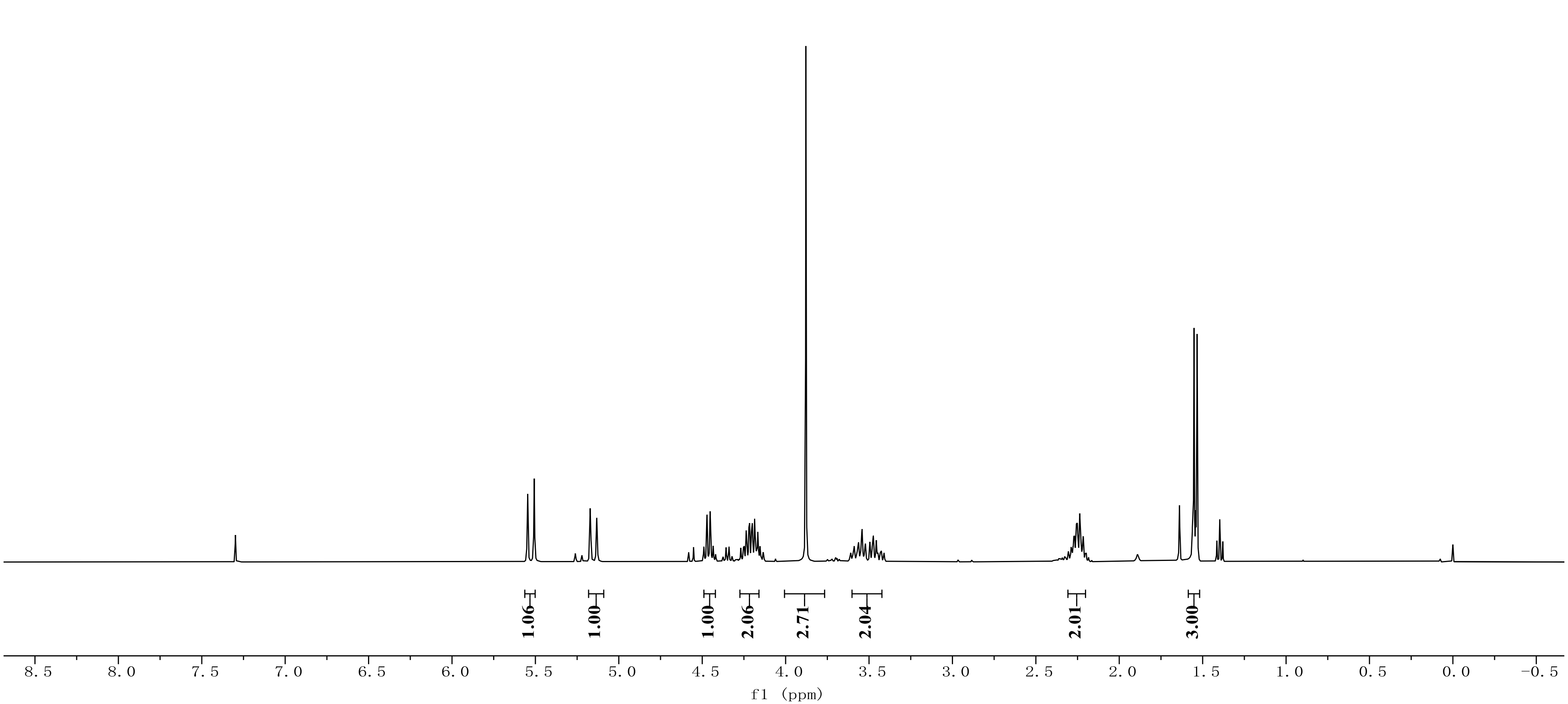

5.499 5.473 5.170 5.143 4.591 4.583 4.572 4.564 4.225 4.222 4.214 4.204 4.201 4.197 4.190 4.184 4.171 4.162 3.875 3.552 3.538 3.534 3.520 3.507 3.492 3.481 3.478 3.467 2.276 2.273 2.265 2.262 2.252 2.239 2.226 2.140 2.119 1.756 1.734 1.692 1.677 1.674 1.670 1.658 1.657 1.651 1.640 1.633 1.621 1.617 1.616 1.607 1.598 1.590 1.582 1.576 1.568 1.463 1.458 1.446 1.440 1.296 1.275 1.248 1.161 1.140 0.965 0.965 0.944 0.925 0.917 0.904
O
N
O
O
MeO2C
S3f
1.00
0.97
0.98
2.05
2.95
1.03
0.99
2.05
1.04
1.06
5.06
0.99
2.06
1.04
2.00
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 −1.0
f1 (ppm)

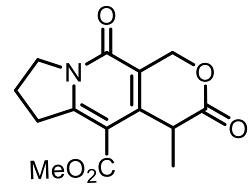


171.00
164.84
157.67
156.90
147.91
118.34
104.49
77.21
77.00
76.79
64.37
51.72
49.23
40.61
38.05
35.03
34.56
33.71
31.69
26.17
25.89
25.67
20.48
O
N
O
O
MeO$_2$C
S3f
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

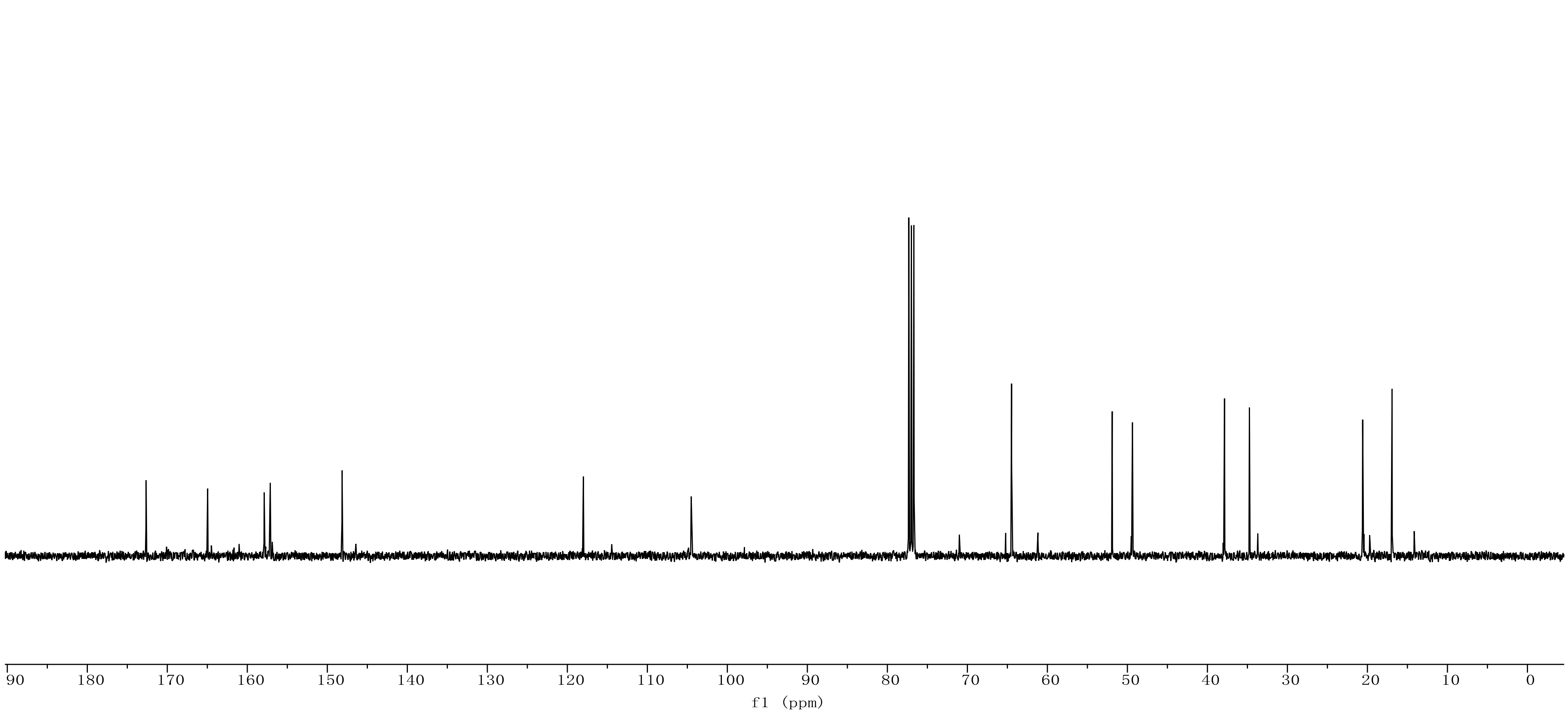

O
N
O
O
MeO2C

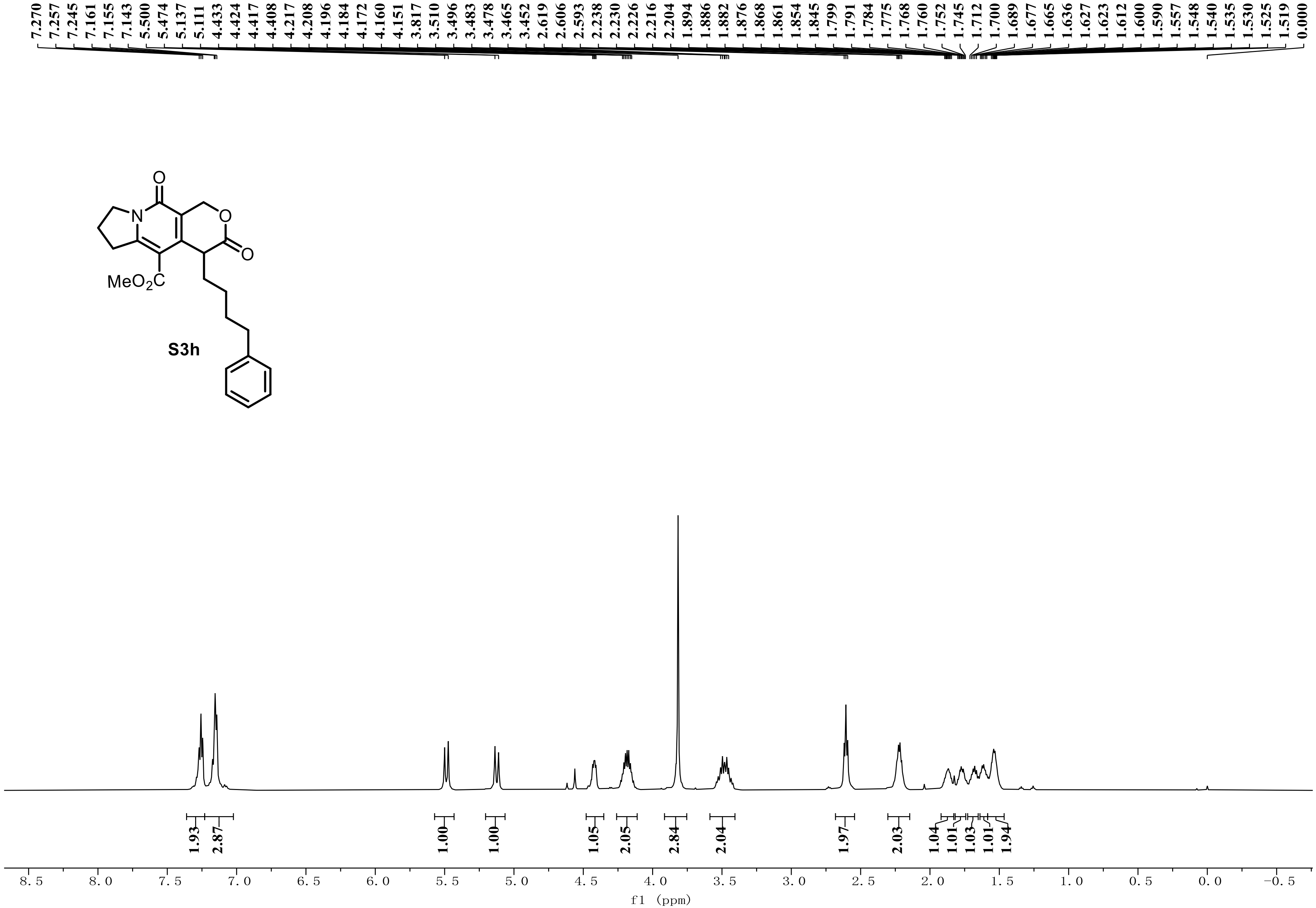
S3g

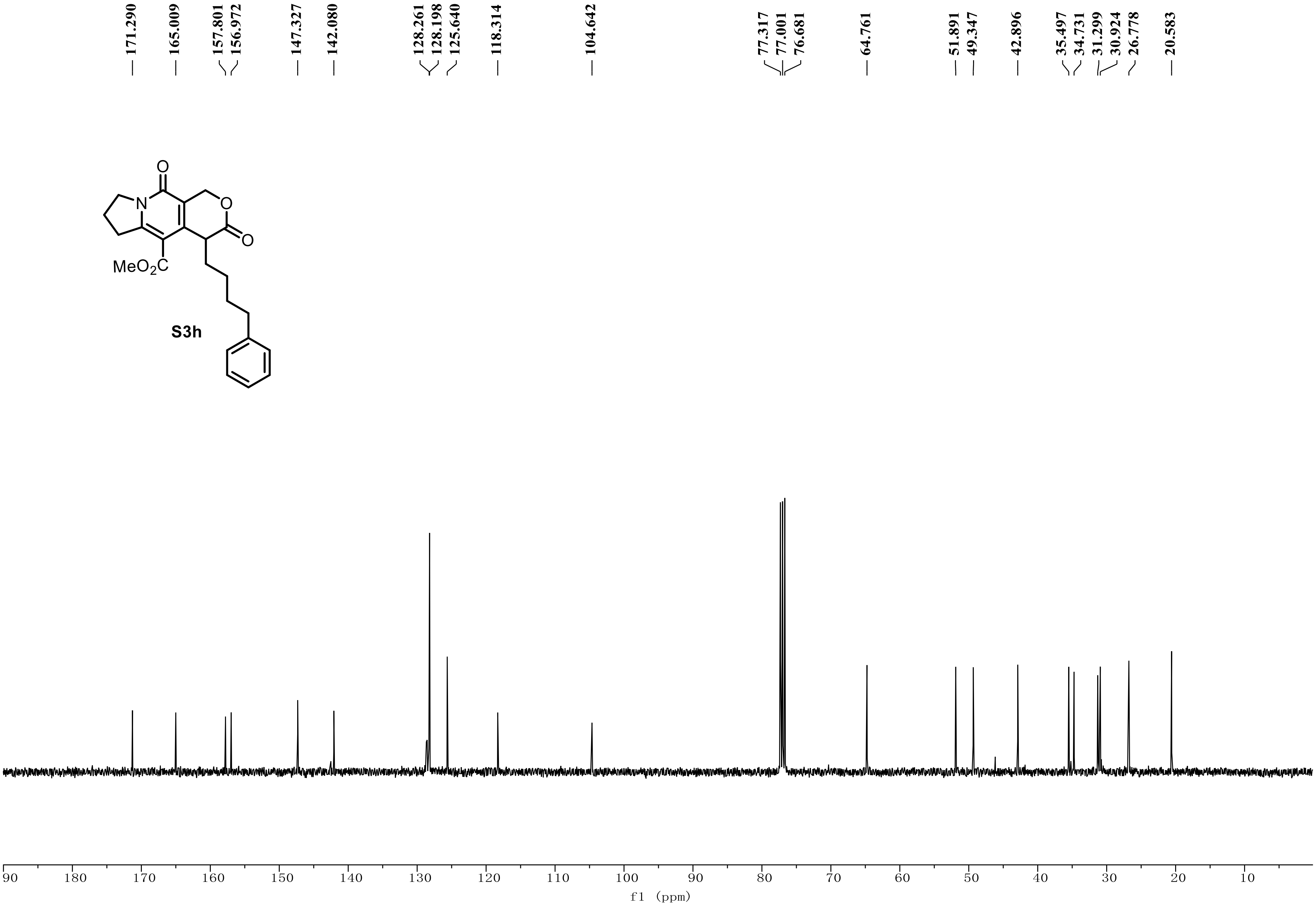

5.546
5.507
5.172
5.133
4.490
4.471
4.452
4.434
4.269
4.253
4.237
4.216
4.205
4.199
4.187
4.167
4.153
4.144
3.879
3.610
3.589
3.562
3.542
3.522
3.495
3.472
3.457
3.430
3.410
2.301
2.284
2.272
2.251
2.237
2.216
2.198
2.186
1.560
1.552
1.542
1.533
0.000
1.06
1.00
1.00
2.06
2.71
2.04
2.01
3.00
8.5
8.0
7.5
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)

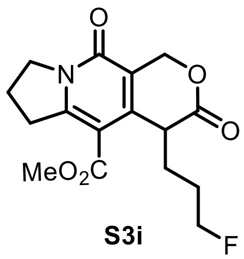


S3g

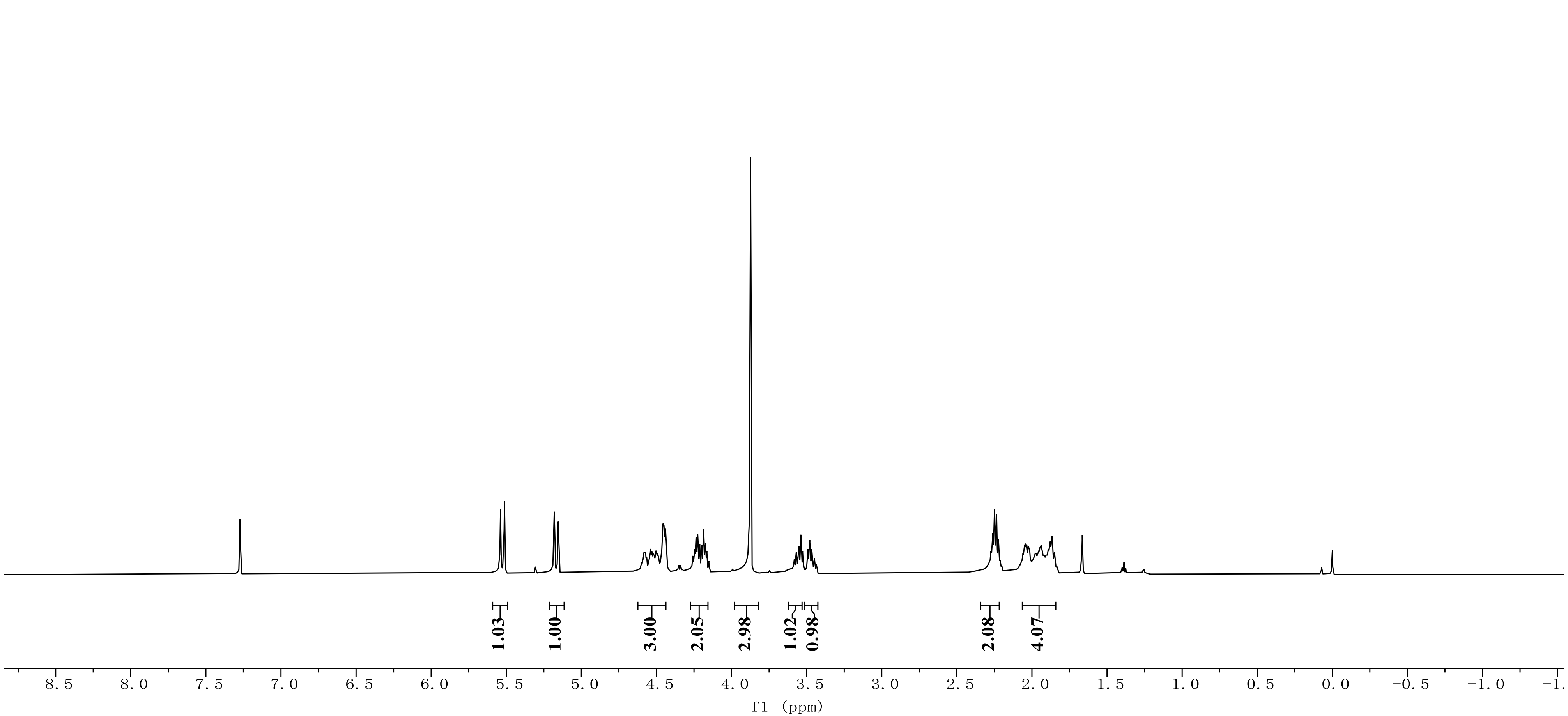

173.28
165.63
158.51
157.13
149.17
118.00
104.52
77.32
77.00
76.68
64.48
51.90
49.51
37.86
34.75
20.59
16.92
90 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.270 7.257 7.245 7.161 7.155 7.143 5.500 5.474 5.137 5.111 4.433 4.424 4.417 4.408 4.217 4.208 4.196 4.184 4.172 4.160 4.151 3.817 3.510 3.496 3.483 3.478 3.465 3.452 2.619 2.606 2.593 2.238 2.230 2.226 2.216 2.204 1.894 1.886 1.882 1.876 1.868 1.861 1.854 1.845 1.799 1.791 1.784 1.775 1.768 1.760 1.752 1.745 1.712 1.700 1.689 1.677 1.665 1.636 1.627 1.623 1.612 1.600 1.590 1.557 1.548 1.540 1.535 1.530 1.525 1.519 0.000
O
N
O
O
MeO2C
S3h
1.93
2.87
1.00
1.00
1.05
2.05
2.84
2.04
1.97
2.03
1.04
1.01
1.03
1.01
1.94
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)

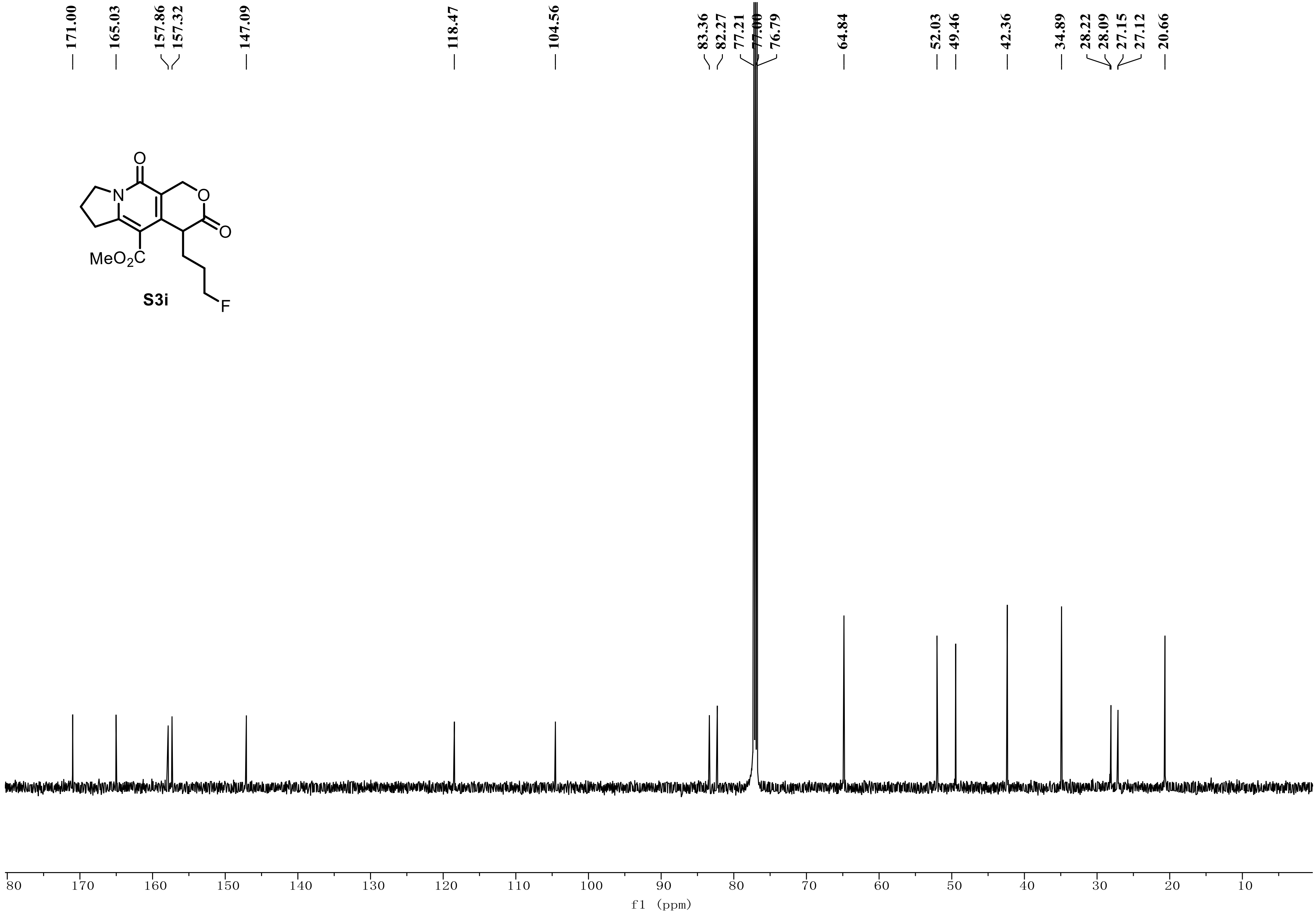

171.290
165.009
157.801
156.972
147.327
142.080
128.261
128.198
125.640
118.314
104.642
77.317
77.001
76.681
64.761
51.891
49.347
42.896
35.497
34.731
31.299
30.924
26.778
20.583
O
N
O
O
MeO2C
S3h
90 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



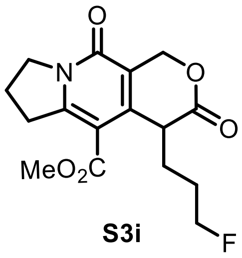
S3i



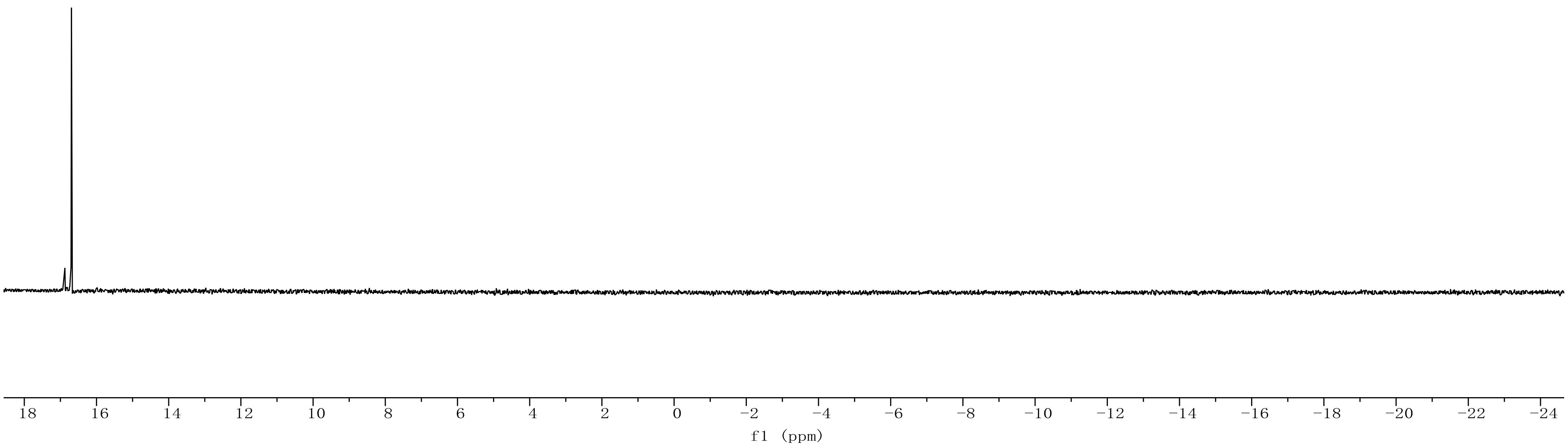
5.538 5.512 5.180 5.154 4.599 4.583 4.576 4.565 4.547 4.537 4.530 4.521 4.514 4.504 4.497 4.486 4.458 4.449 4.439 4.433 4.258 4.244 4.236 4.223 4.212 4.199 4.186 4.177 4.165 4.152 3.881 3.582 3.569 3.553 3.538 3.524 3.492 3.477 3.466 3.450 3.435 2.274 2.263 2.249 2.238 2.224 2.213 2.200 2.043 2.035 2.032 2.015 2.001 1.985 1.973 1.956 1.948 1.941 1.930 1.907 1.892 1.878 1.865 1.850 1.834 0.000
1.03
1.00
3.00
2.05
2.98
1.02
0.98
2.08
4.07
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 −1.0 −1.
f1 (ppm)

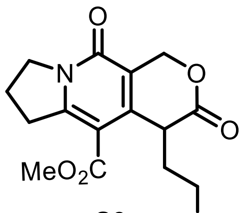

171.00
165.03
157.86
157.32
147.09
118.47
104.56
83.36
82.27
77.21
77.00
76.79
64.84
52.03
49.46
42.36
34.89
28.22
28.09
27.15
27.12
20.66
MeO2C
S3i
80 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

— 16.69

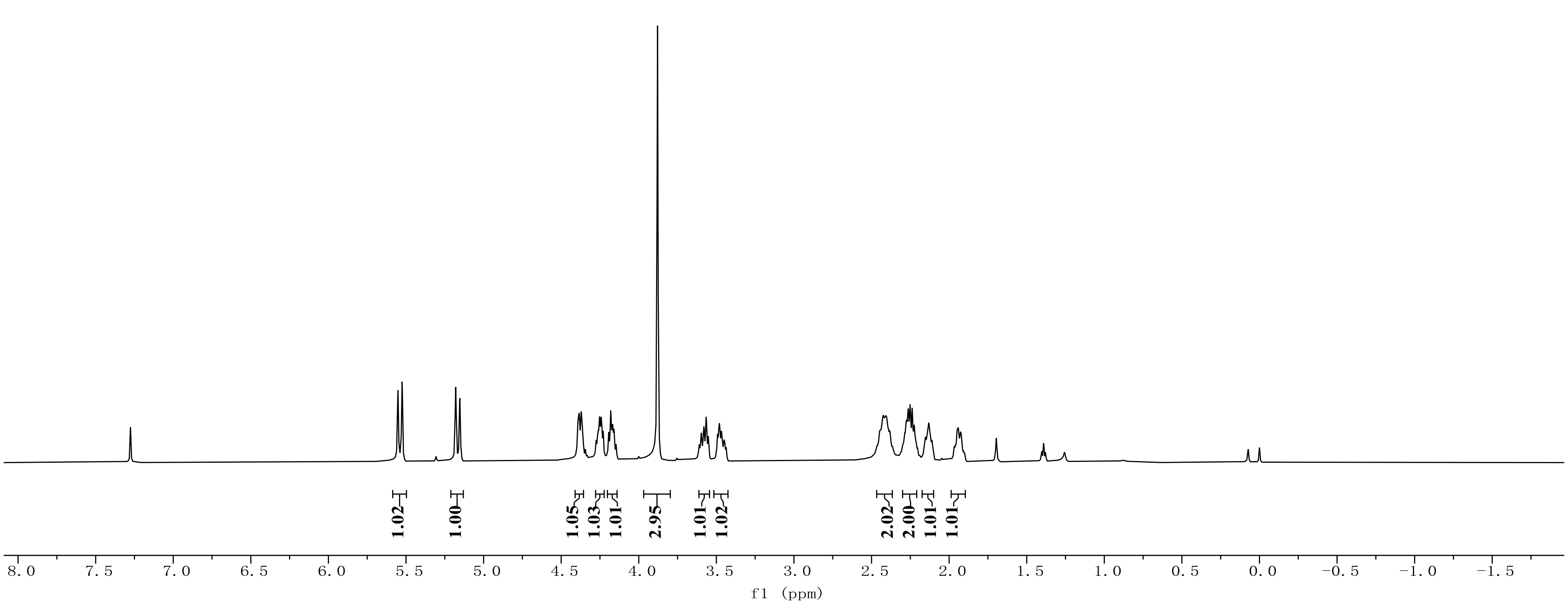


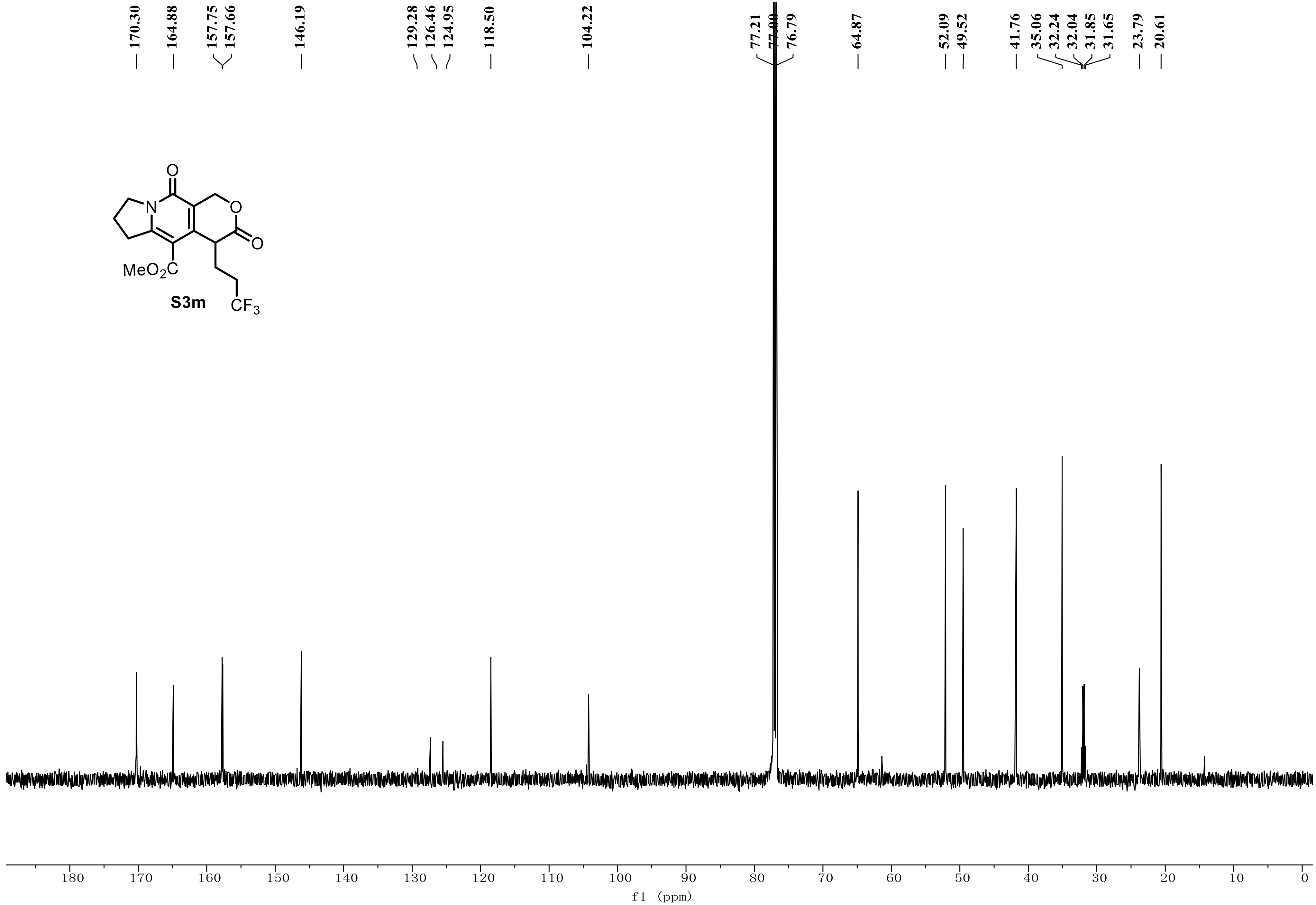
S3i

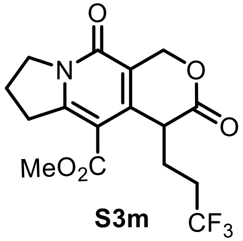




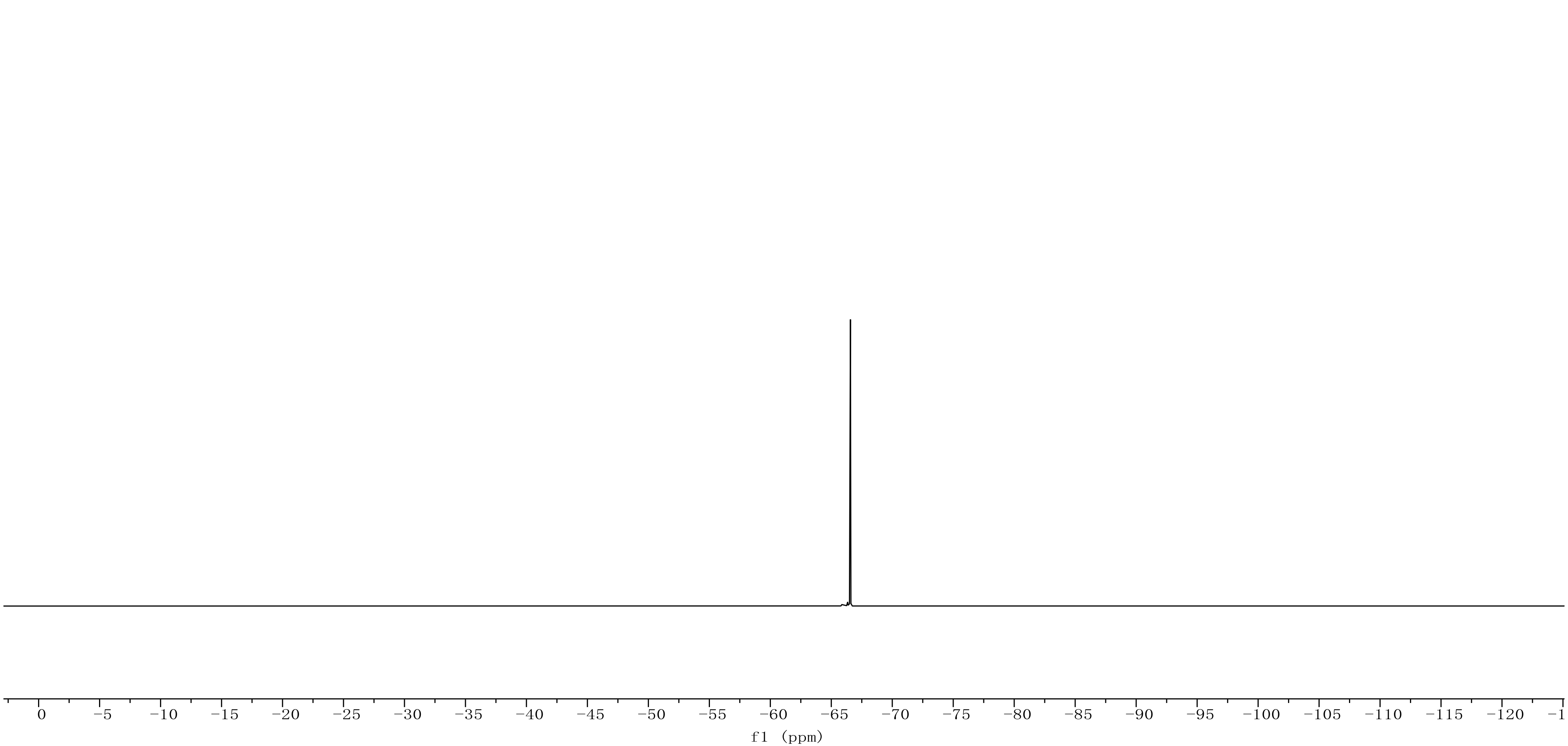
S3m

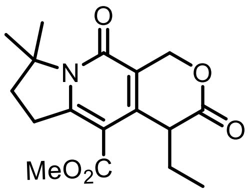

5.552
5.525
5.180
5.153
4.390
4.383
4.372
4.365
4.275
4.265
4.252
4.243
4.229
4.194
4.181
4.168
4.159
4.146
3.879
3.611
3.597
3.581
3.566
3.552
3.492
3.482
3.467
3.451
3.436
2.465
2.444
2.429
2.407
2.390
2.365
2.299
2.287
2.277
2.273
2.251
2.238
2.225
2.153
2.140
2.110
1.968
1.959
1.949
1.941
1.926
1.919
1.908
1.900
-0.000
1.02
1.00
1.05
1.03
1.01
2.95
1.01
1.02
2.02
2.00
1.01
1.01
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 −1.0 −1.5
f1 (ppm)


170.30
164.88
157.75
157.66
146.19
129.28
126.46
124.95
118.50
104.22
77.21
77.00
76.79
64.87
52.09
49.52
41.76
35.06
32.24
32.04
31.85
31.65
23.79
20.61
O
N
O
O
MeO2C
CF3
S3m
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

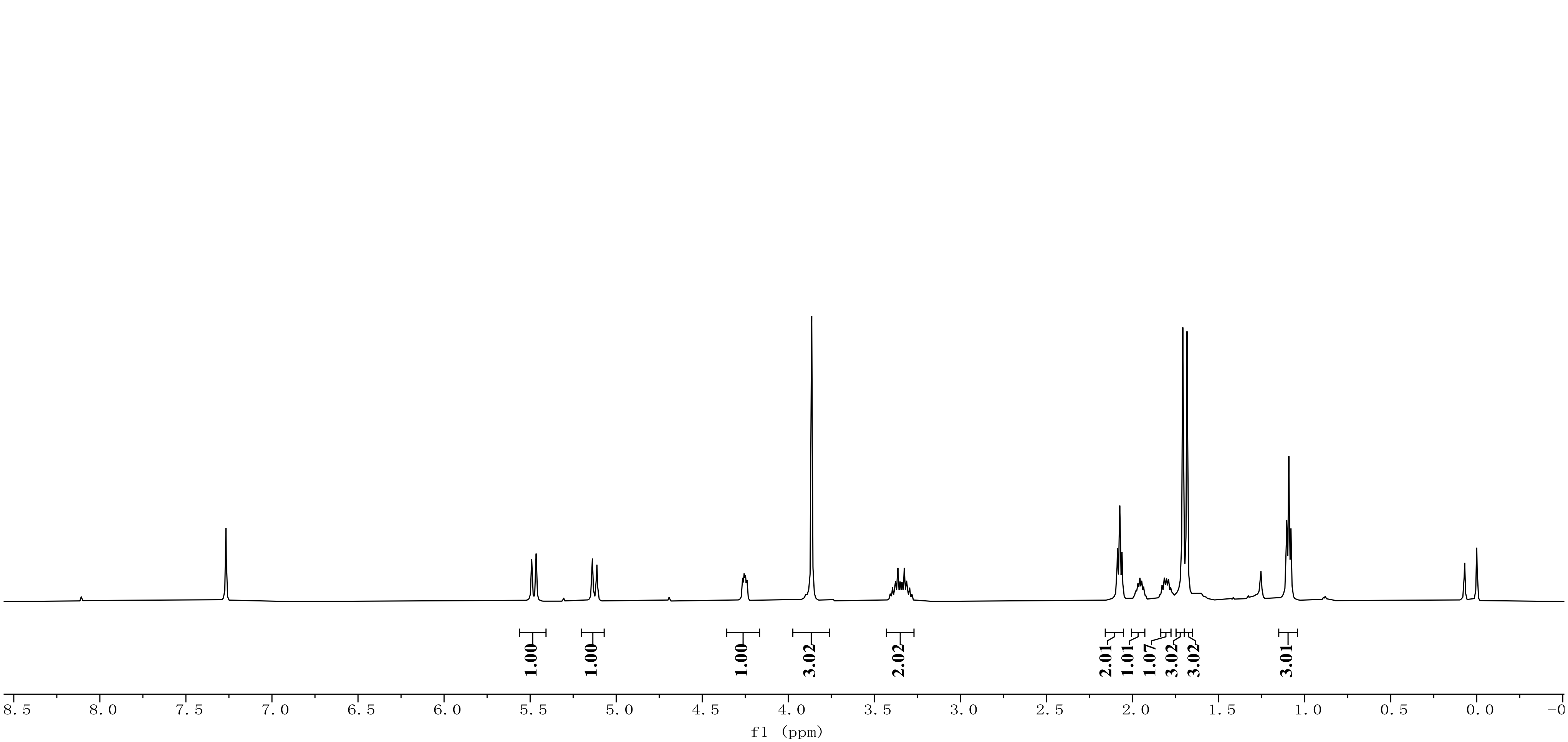

MeO2C
CF3

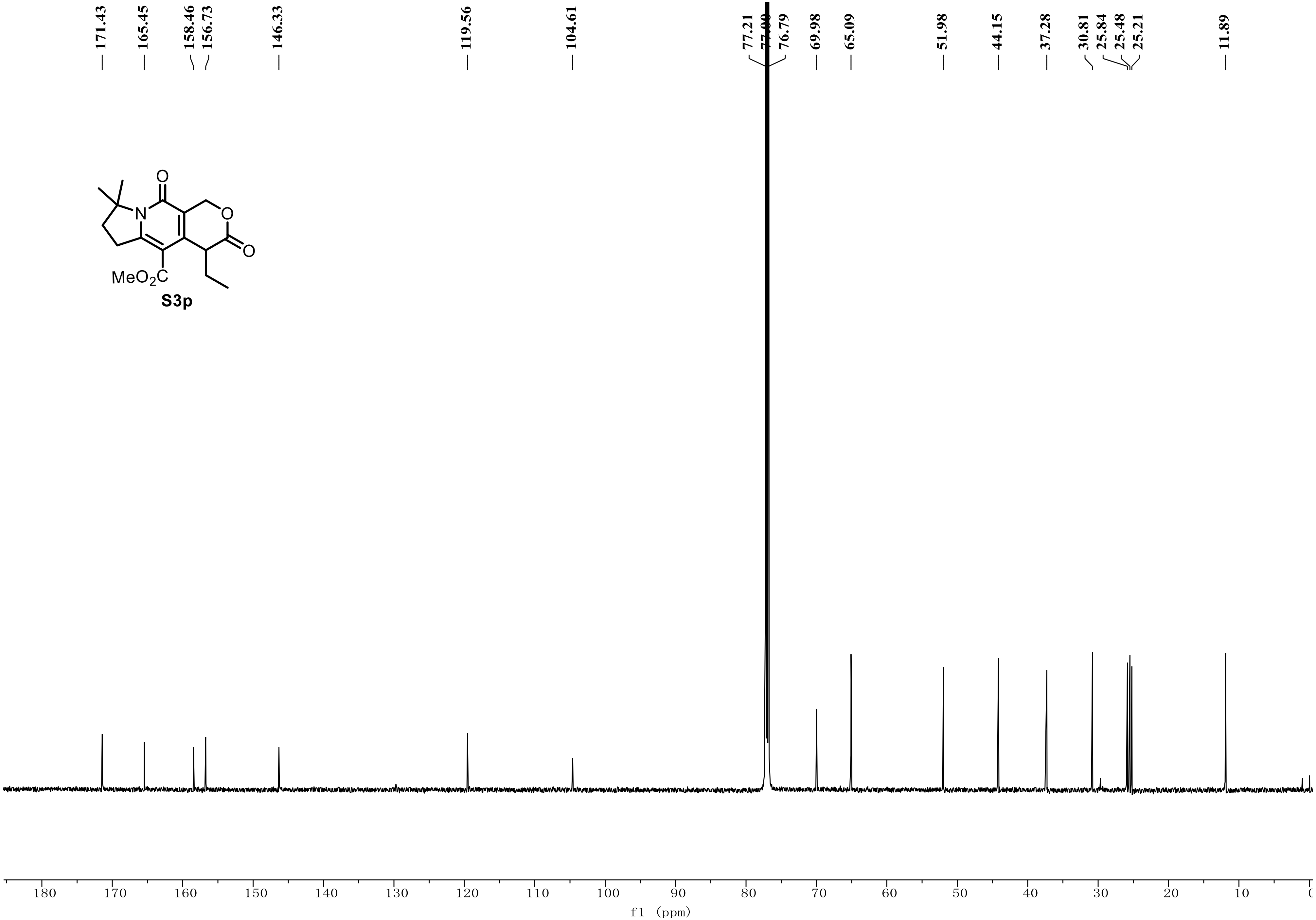
S3m

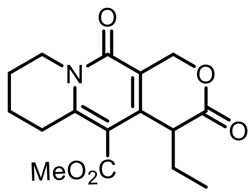

-66.57
0 −5 −10 −15 −20 −25 −30 −35 −40 −45 −50 −55 −60 −65 −70 −75 −80 −85 −90 −95 −100 −105 −110 −115 −120 −1
f1 (ppm)



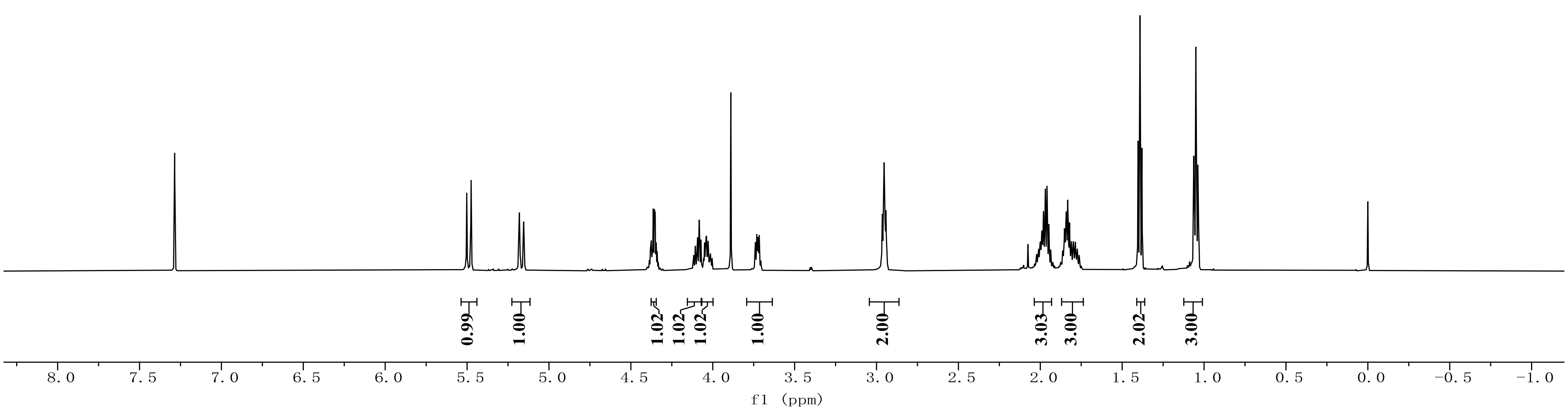
S3p


5.491
5.465
5.138
5.112
4.265
4.257
4.249
4.241
3.864
3.408
3.394
3.377
3.363
3.350
3.339
3.326
3.313
3.295
3.282
2.087
2.074
2.061
1.992
1.980
1.971
1.957
1.948
1.935
1.841
1.828
1.817
1.805
1.791
1.779
1.708
1.683
1.104
1.092
1.080
0.000
1.00
1.00
1.00
3.02
2.02
2.01
1.01
1.07
3.02
3.02
3.01
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)

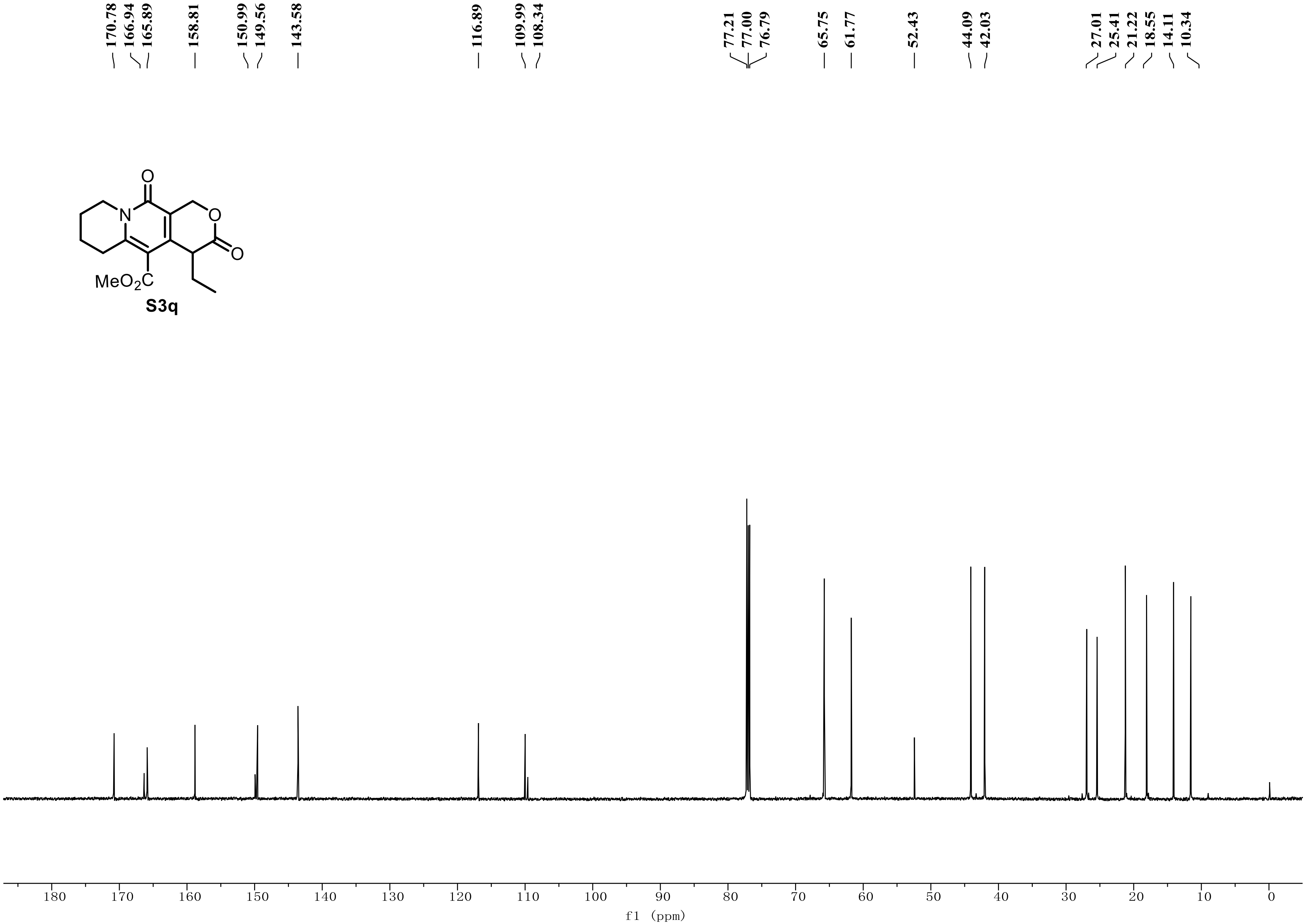

171.43
165.45
158.46
156.73
146.33
119.56
104.61
77.21
77.00
76.79
69.98
65.09
51.98
44.15
37.28
30.81
25.84
25.48
25.21
11.89
O
N
O
O
MeO_2C
S3p
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



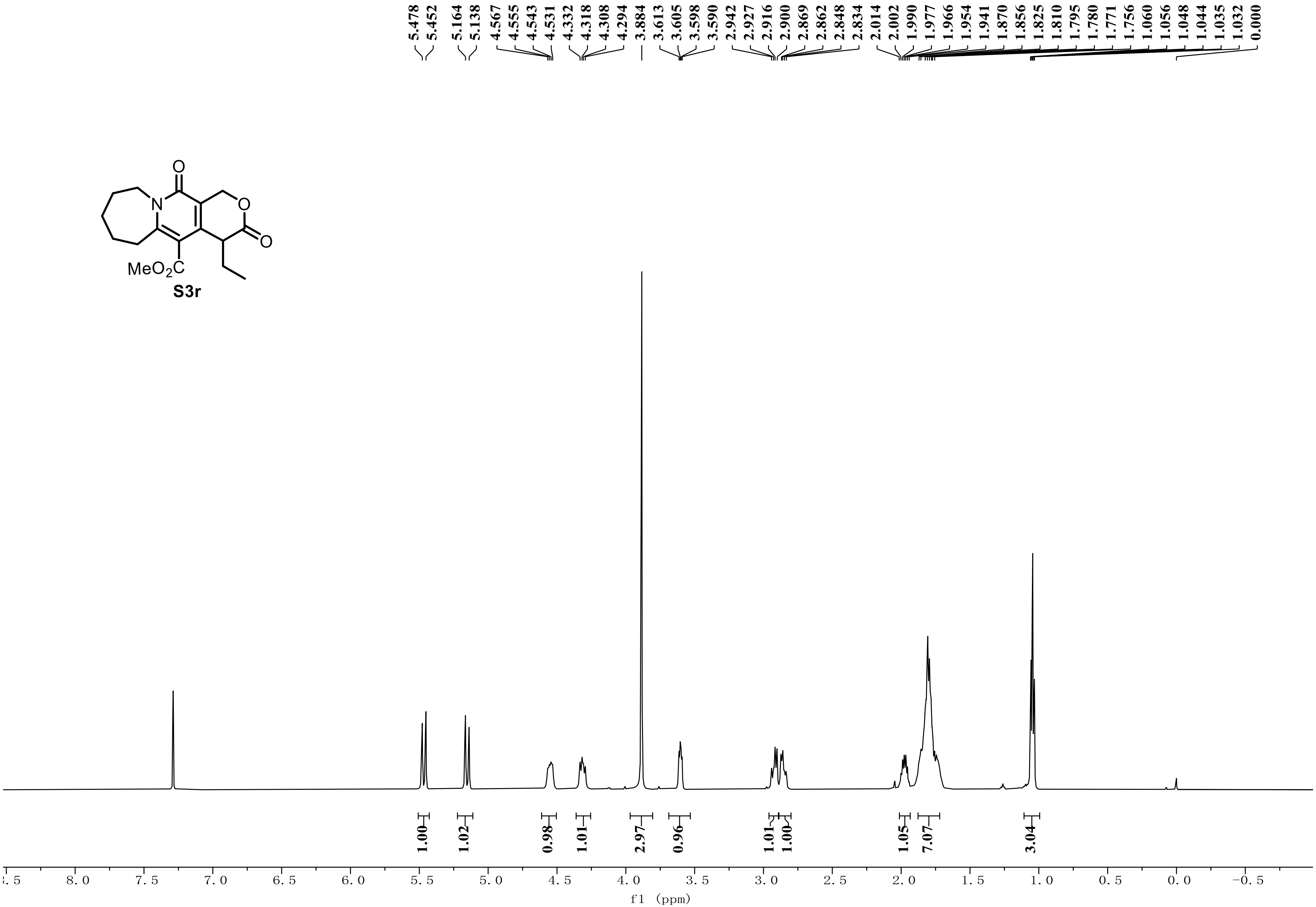
S3q



5.502
5.475
5.183
5.153
4.387
4.381
4.375
4.369
4.363
4.357
4.351
4.345
4.340
4.333
4.117
4.106
4.092
4.082
4.072
4.055
4.050
4.038
4.026
4.014
4.004
3.740
3.731
3.725
3.716
3.706
2.965
2.954
2.942
2.022
2.010
1.999
1.991
1.981
1.971
1.959
1.947
1.936
1.860
1.852
1.842
1.833
1.821
1.810
1.801
1.789
1.786
1.774
1.762
1.403
1.391
1.379
1.063
1.058
1.050
1.046
1.038
1.033
-0.000
0.99
1.00
1.02
1.02
1.02
1.00
2.00
3.03
3.00
2.02
3.00
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
-1.0
f1 (ppm)

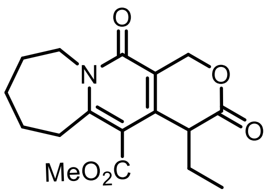


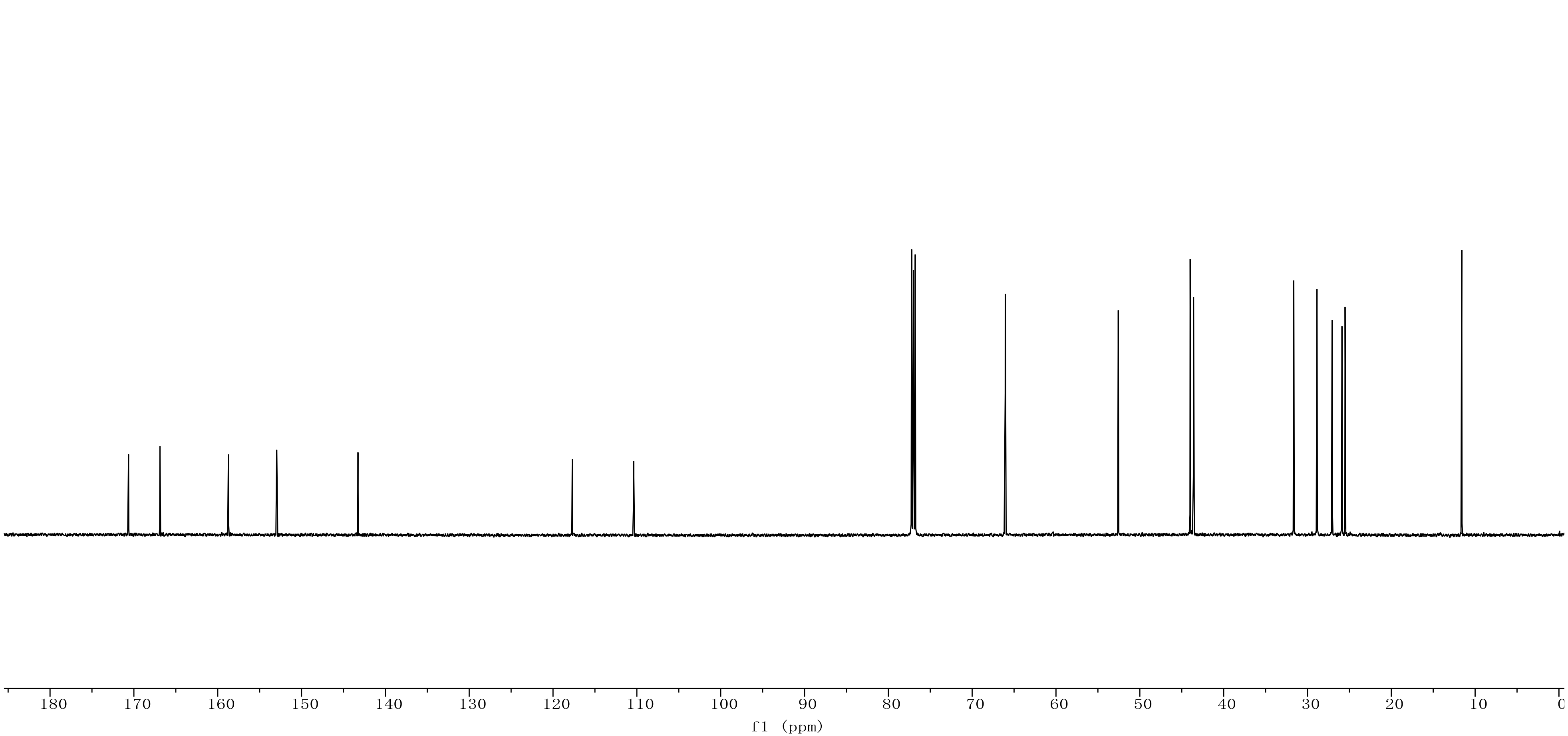
170.78
166.94
165.89
158.81
150.99
149.56
143.58
116.89
109.99
108.34
77.21
77.00
76.79
65.75
61.77
52.43
44.09
42.03
27.01
25.41
21.22
18.55
14.11
10.34
O
N
O
O
MeO2C
S3q
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

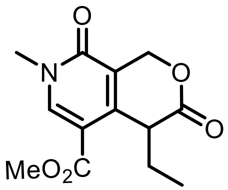


S3r

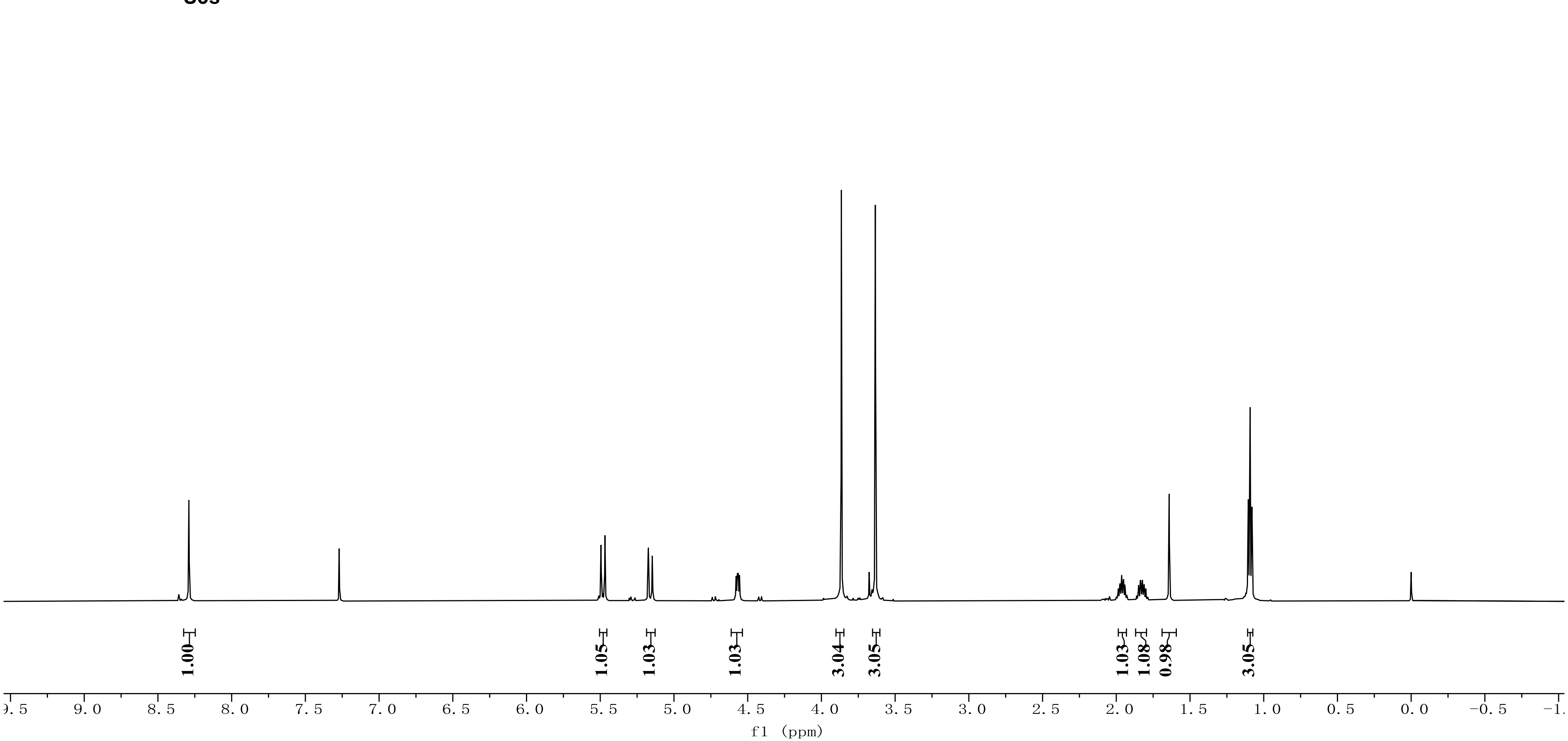
5.478
5.452
5.164
5.138
4.567
4.555
4.543
4.531
4.332
4.318
4.308
4.294
3.884
3.613
3.605
3.598
3.590
2.942
2.927
2.916
2.900
2.869
2.862
2.848
2.834
2.014
2.002
1.990
1.977
1.966
1.954
1.941
1.870
1.856
1.825
1.810
1.795
1.780
1.771
1.756
1.060
1.056
1.048
1.044
1.035
1.032
0.000
1.00
1.02
0.98
1.01
2.97
0.96
1.01
1.00
1.05
7.07
3.04
f1 (ppm)

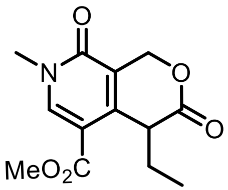

O
N
O
O
MeO2C
S3r


170.64
166.89
158.72
152.96
143.27
117.70
110.39
77.22
77.00
76.79
66.05
52.57
43.99
43.59
31.63
28.86
27.06
25.89
25.51
11.59
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

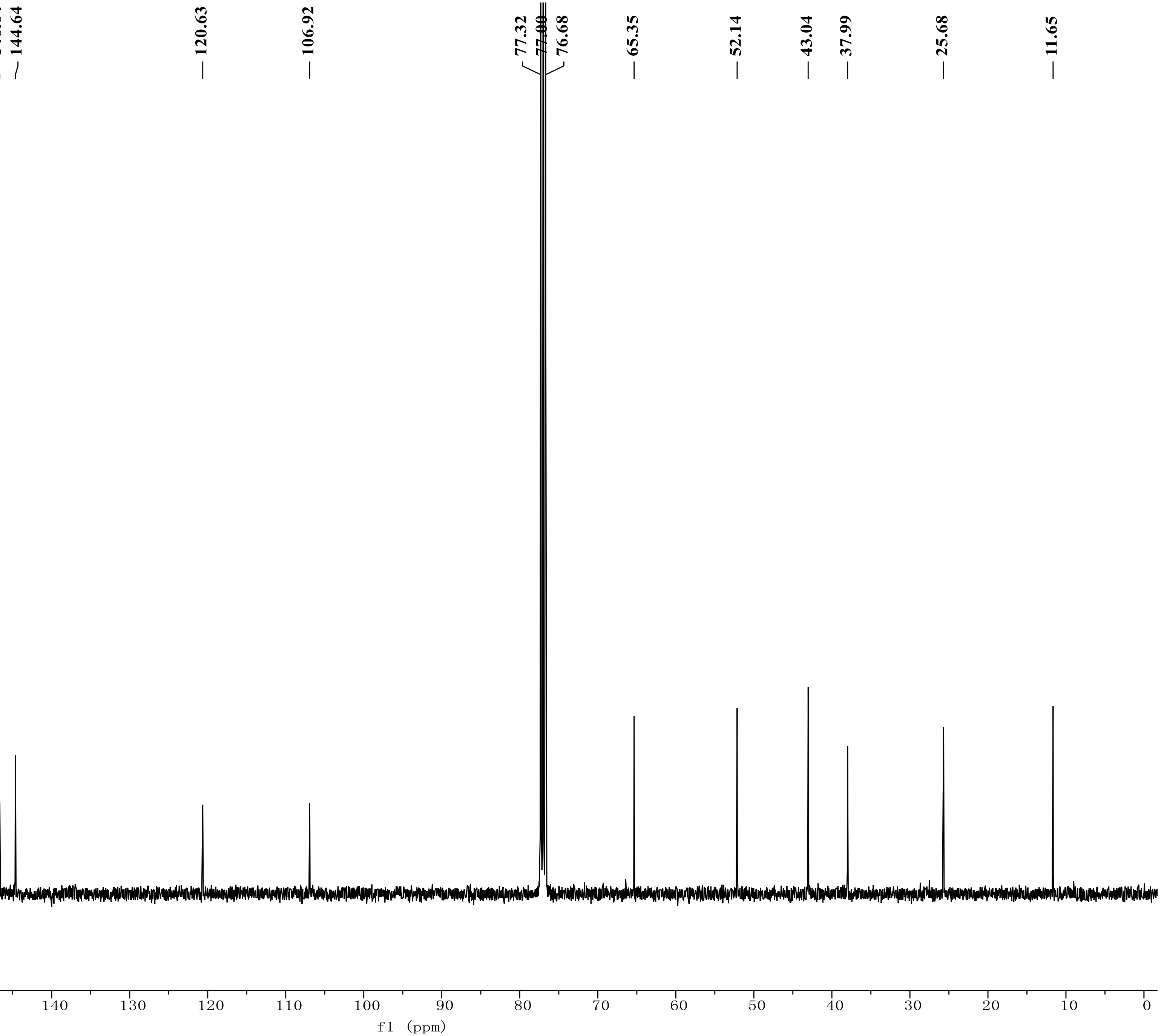

O
N
O
O
MeO2C

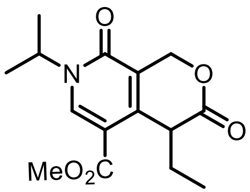
S3s


8.290
5.495
5.468
5.174
5.147
4.579
4.570
4.564
4.555
3.865
3.634
1.998
1.986
1.974
1.963
1.950
1.942
1.929
1.861
1.849
1.837
1.822
1.811
1.799
1.787
1.641
1.105
1.092
1.080
-0.000
1.00
1.05
1.03
1.03
3.04
3.05
1.03
1.08
0.98
3.05
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
-1.
f1 (ppm)

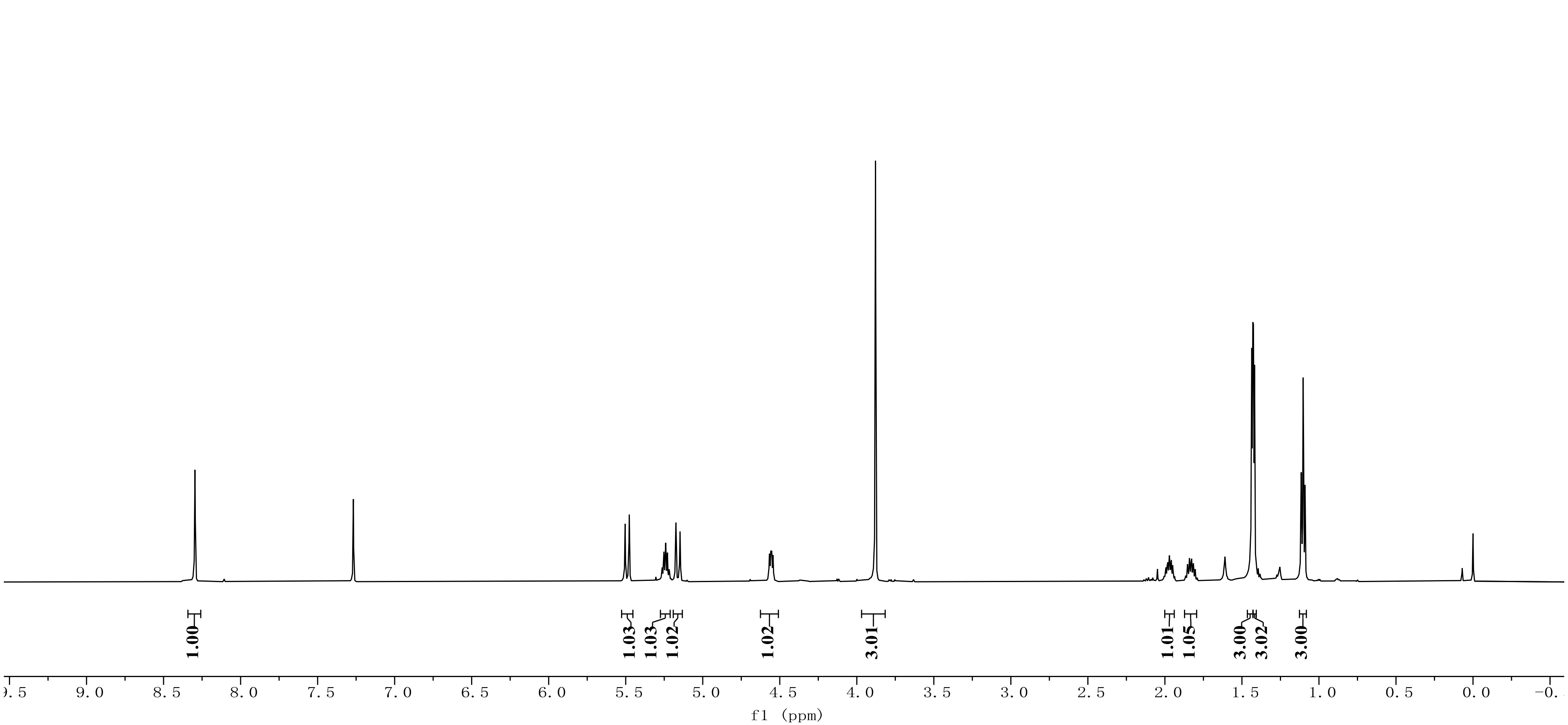

O
N
O
O
MeO2C

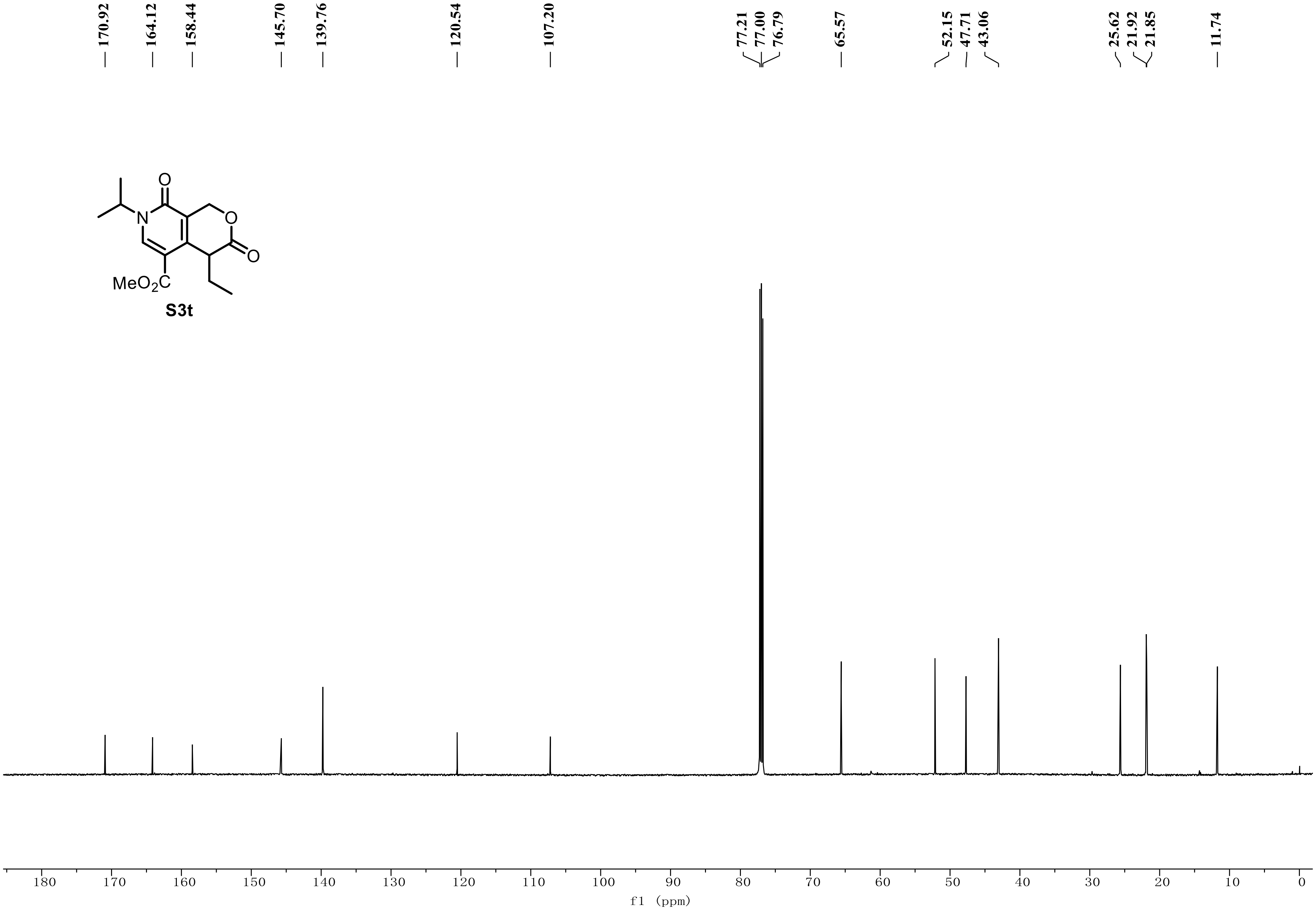
S3s


170.77
163.90
159.10
146.64
144.64
120.63
106.92
77.32
77.00
76.68
65.35
52.14
43.04
37.99
25.68
11.65
90
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


O
N
O
O
MeO2C

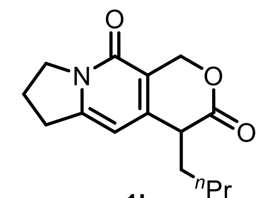
S3t


8.296
5.504
5.477
5.263
5.252
5.241
5.229
5.218
5.174
5.147
4.567
4.559
4.552
4.544
3.878
2.006
1.993
1.981
1.971
1.962
1.950
1.937
1.865
1.853
1.841
1.826
1.815
1.803
1.791
1.437
1.430
1.425
1.418
1.115
1.103
1.090
-0.000
1.00
1.03
1.03
1.02
1.02
3.01
1.01
1.05
3.00
3.02
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
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)



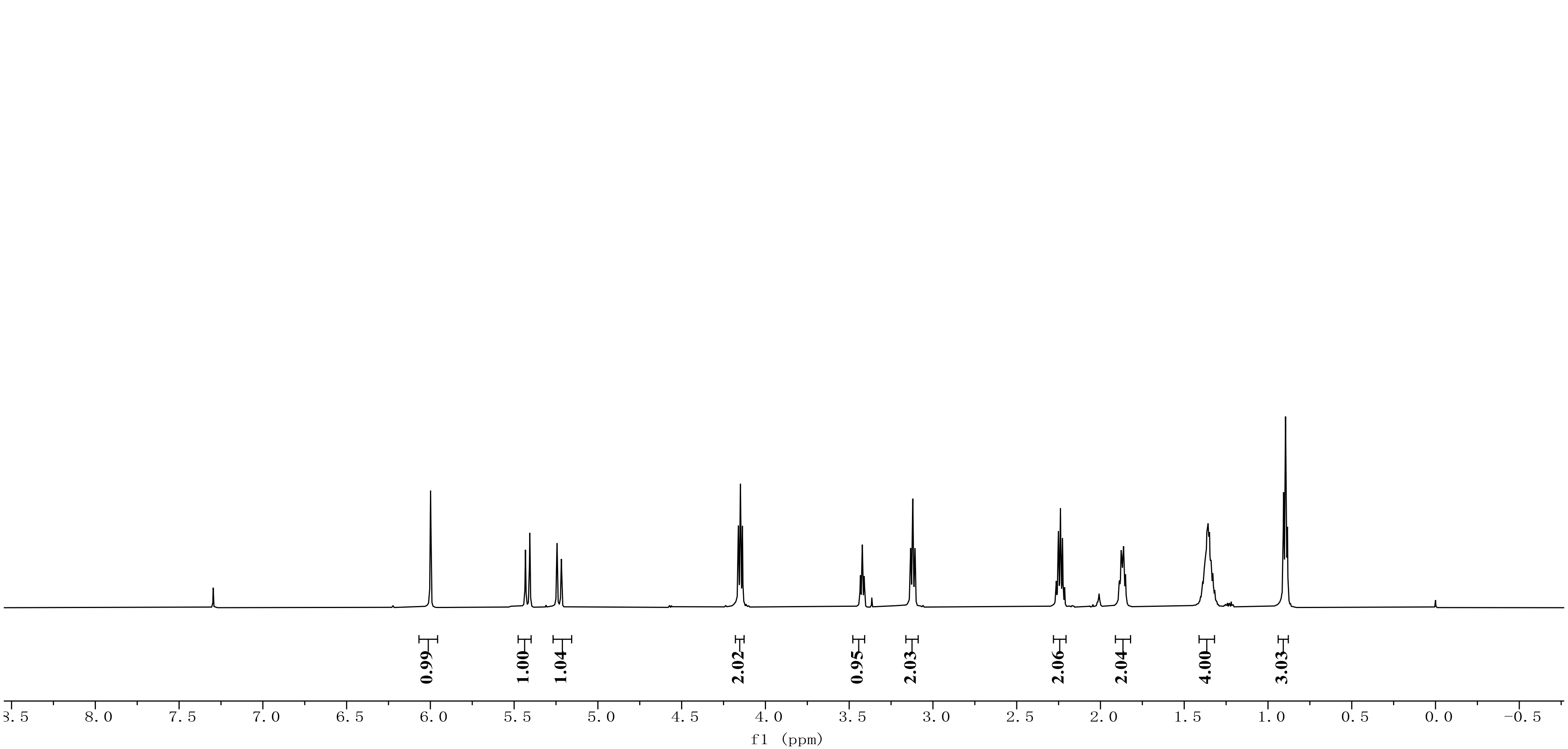
S3t

170.92
164.12
158.44
145.70
139.76
120.54
107.20
77.21
77.00
76.79
65.57
52.15
47.71
43.06
25.62
21.92
21.85
11.74
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

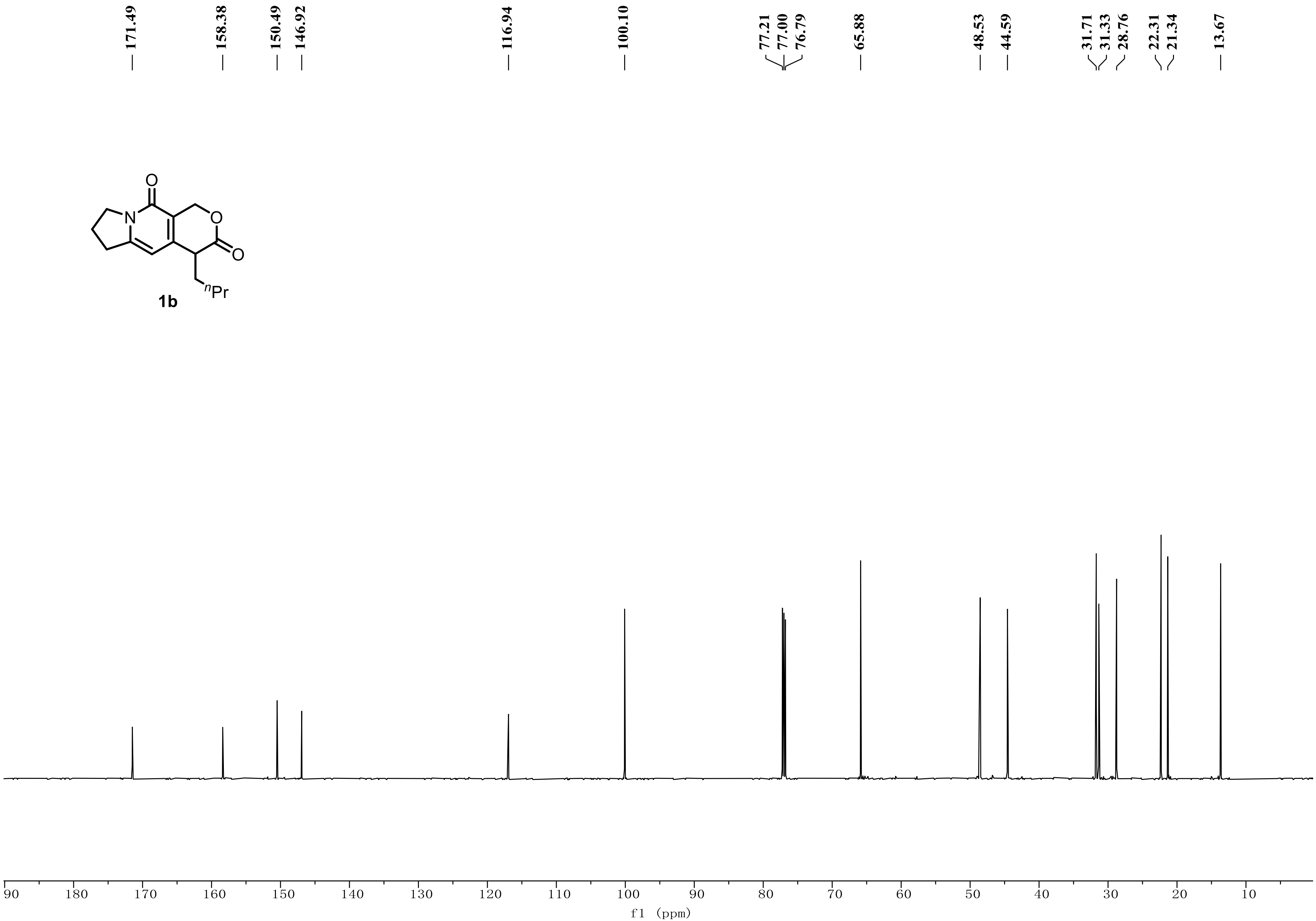


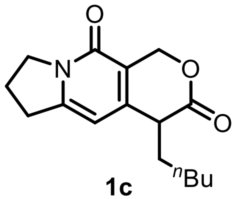
O
N
O
O
^{n}Pr

1b

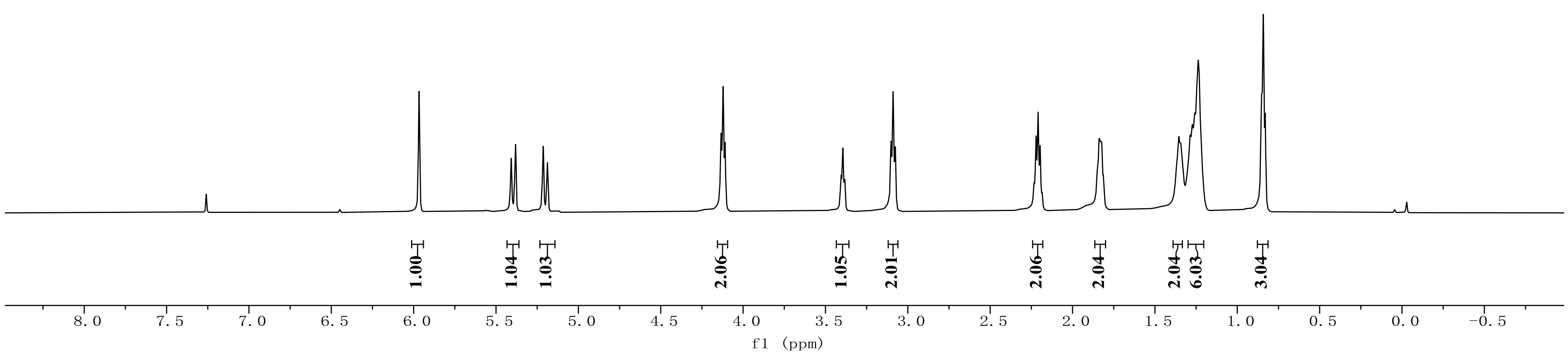


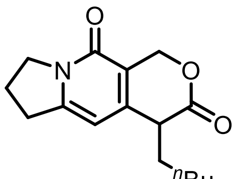
5.999
5.432
5.406
5.244
5.218
4.161
4.149
4.137
3.433
3.422
3.410
3.133
3.120
3.107
2.264
2.251
2.239
2.227
2.214
1.888
1.877
1.866
1.851
1.390
1.379
1.370
1.365
1.357
1.353
1.343
1.336
1.323
0.907
0.895
0.884
-0.000
0.99
1.00
1.04
2.02
0.95
2.03
2.06
2.04
4.00
3.03
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


171.49
158.38
150.49
146.92
116.94
100.10
77.21
77.00
76.79
65.88
48.53
44.59
31.71
31.33
28.76
22.31
21.34
13.67
O
N
O
O
nPr
1b
90 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



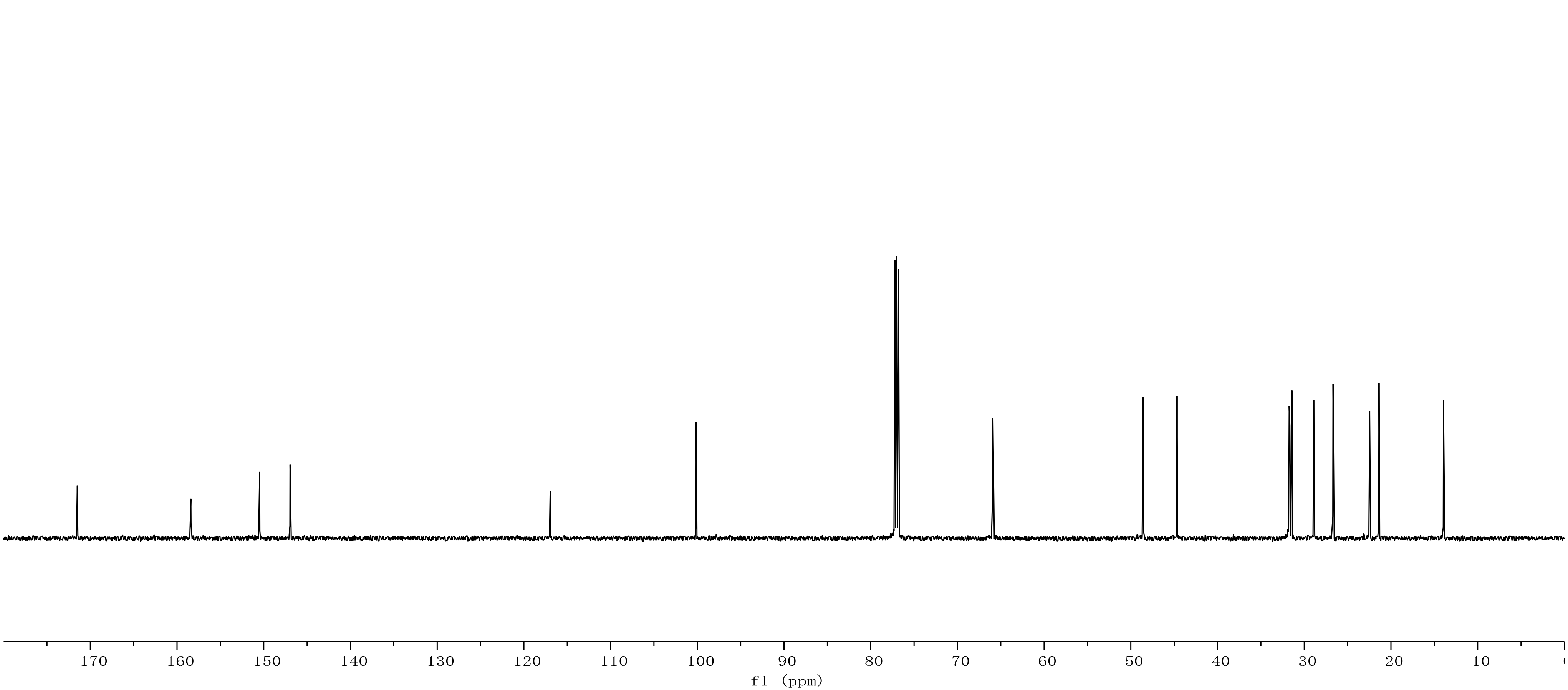
1c


7.260
5.998
5.408
5.382
5.214
5.188
4.134
4.122
4.109
3.405
3.394
3.383
3.102
3.089
3.076
2.234
2.222
2.209
2.197
2.184
1.851
1.840
1.833
1.828
1.822
1.812
1.377
1.367
1.354
1.342
1.335
1.327
1.286
1.274
1.259
1.246
1.237
1.230
1.220
0.853
0.842
0.830
1.00
1.04
1.03
2.06
1.05
2.01
2.06
2.04
2.04
6.03
3.04
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)

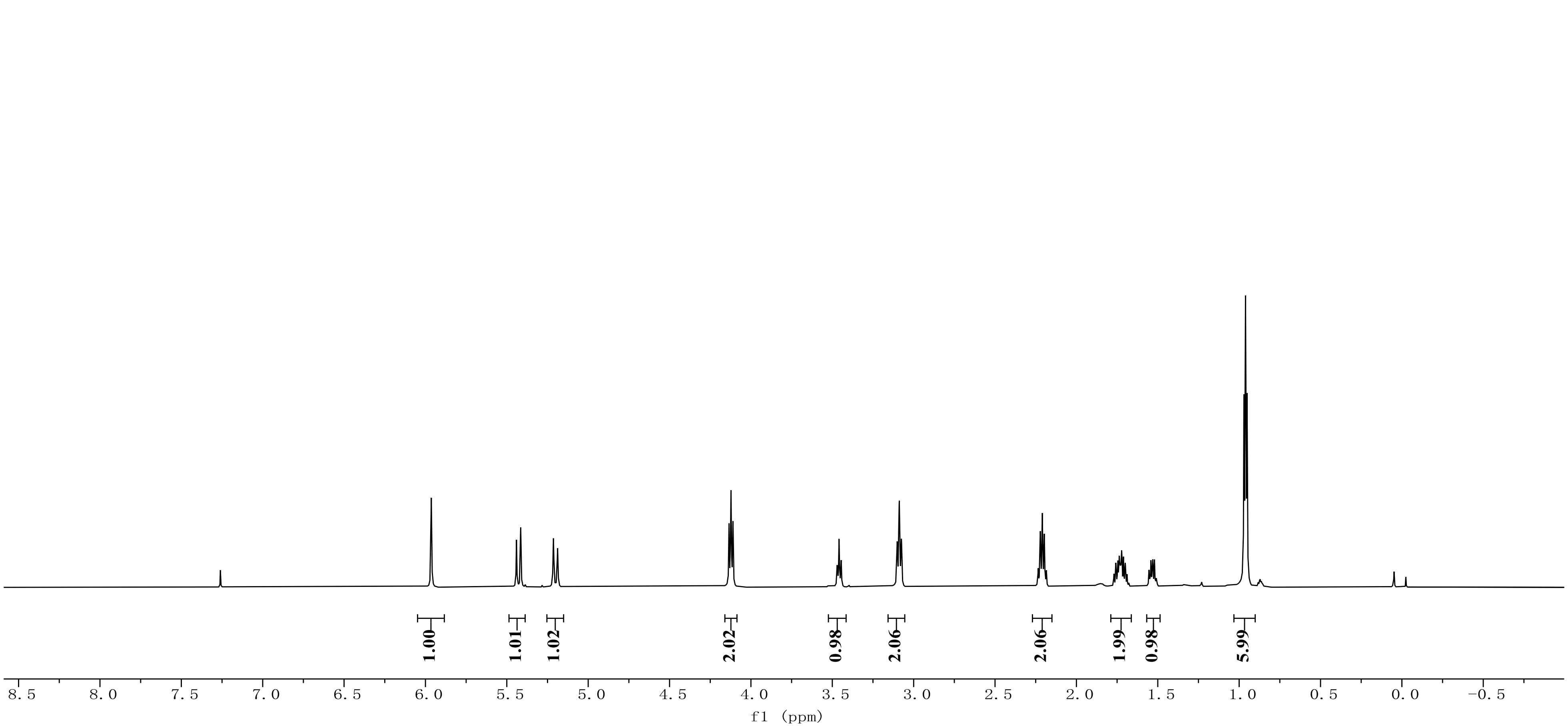


O
N
O
O
nBu

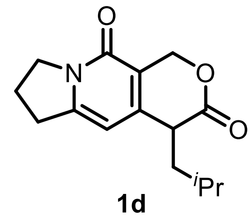
1c



171.50
158.40
150.47
146.97
116.97
100.13
77.21
77.00
76.79
65.91
48.57
44.67
31.74
31.67
31.42
28.90
26.68
22.46
21.38
13.94
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

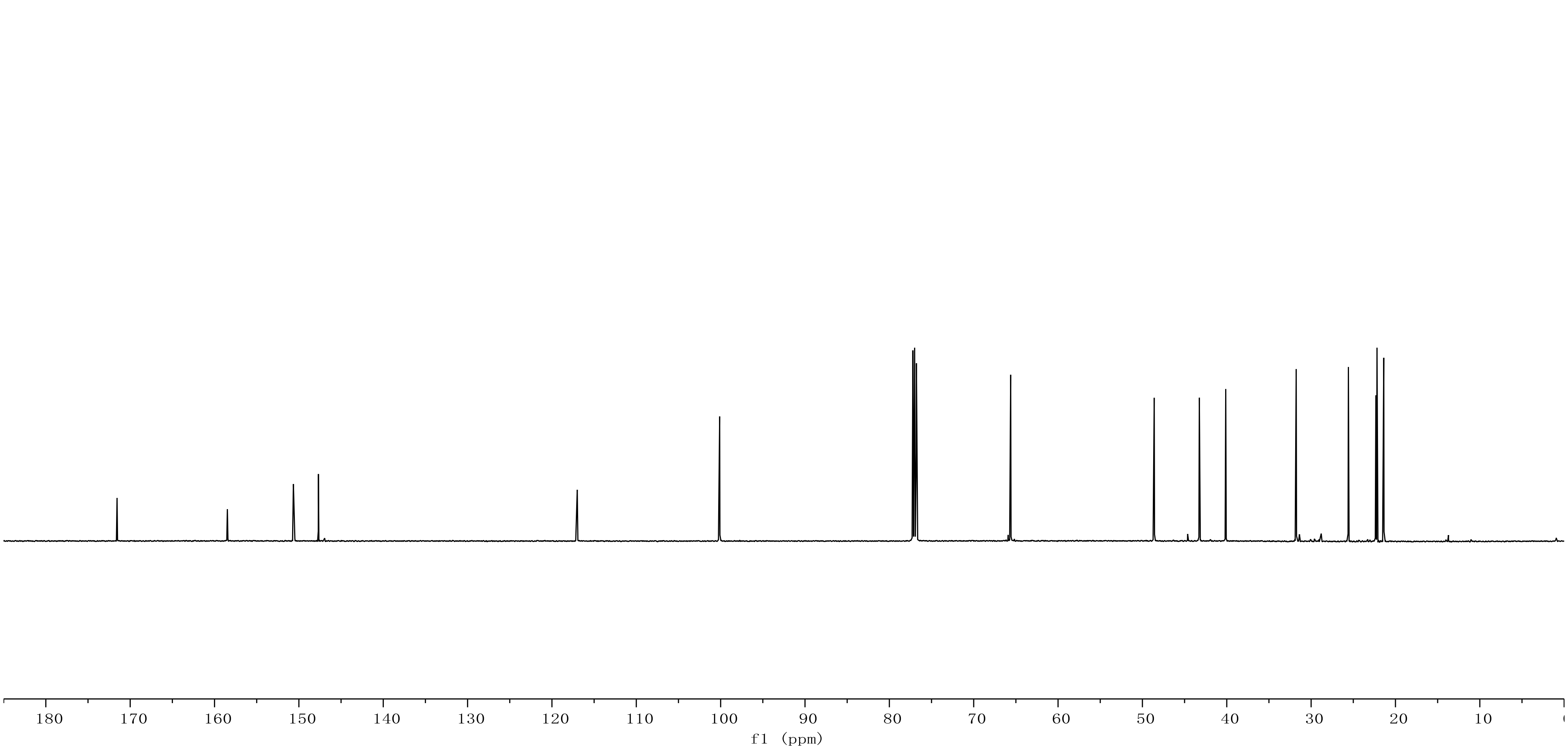


7.260
5.964
5.441
5.415
5.214
5.188
4.135
4.123
4.110
3.470
3.458
3.445
3.101
3.088
3.075
2.235
2.222
2.210
2.197
2.185
1.769
1.758
1.748
1.745
1.736
1.732
1.728
1.722
1.711
1.700
1.689
1.554
1.549
1.542
1.531
1.520
1.509
0.971
0.961
0.952
1.00
1.01
1.02
2.02
0.98
2.06
2.06
1.99
0.98
5.99
8.5
8.0
7.5
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)

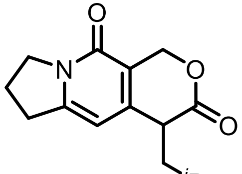


O
N
O
O
iPr

1d

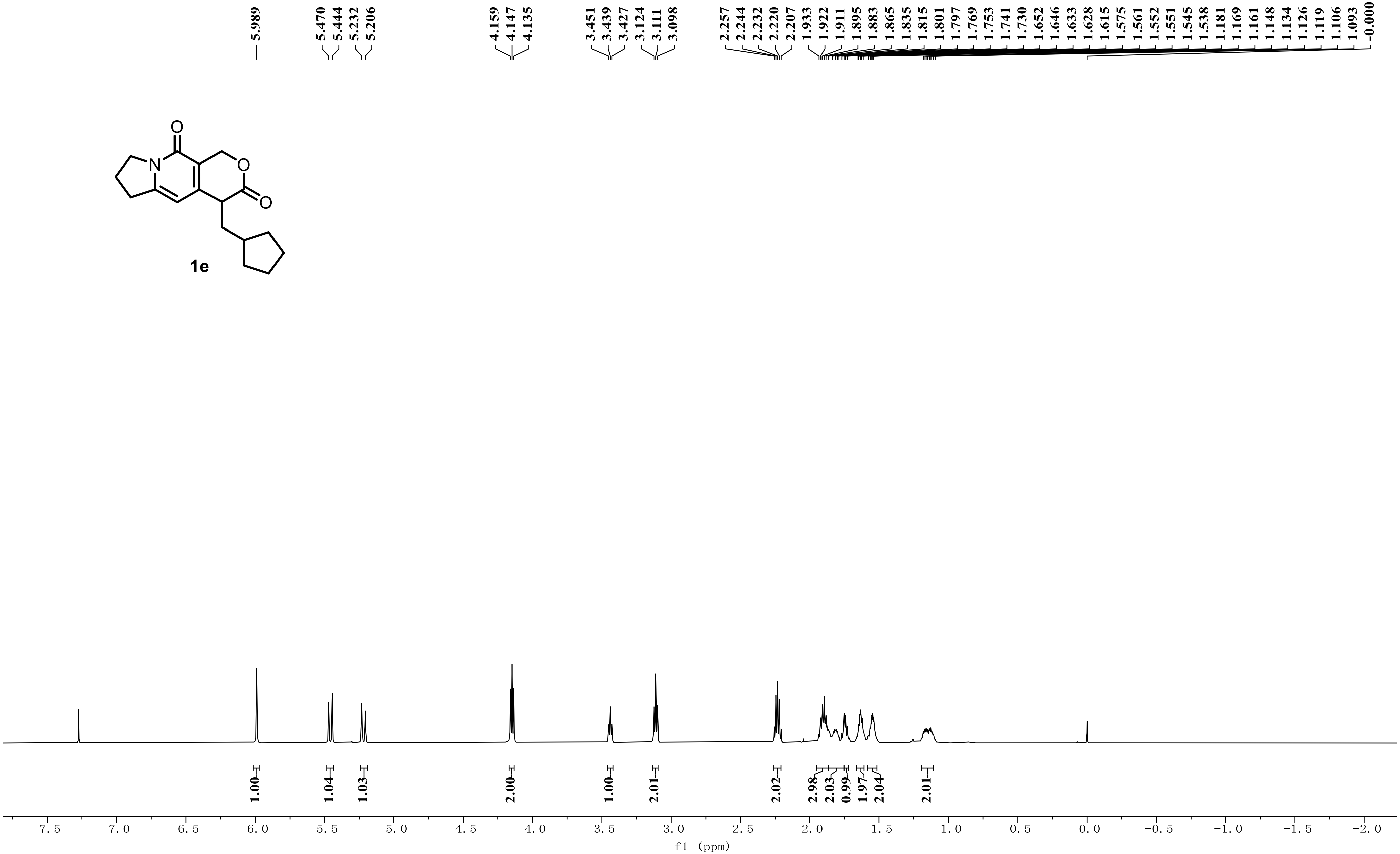


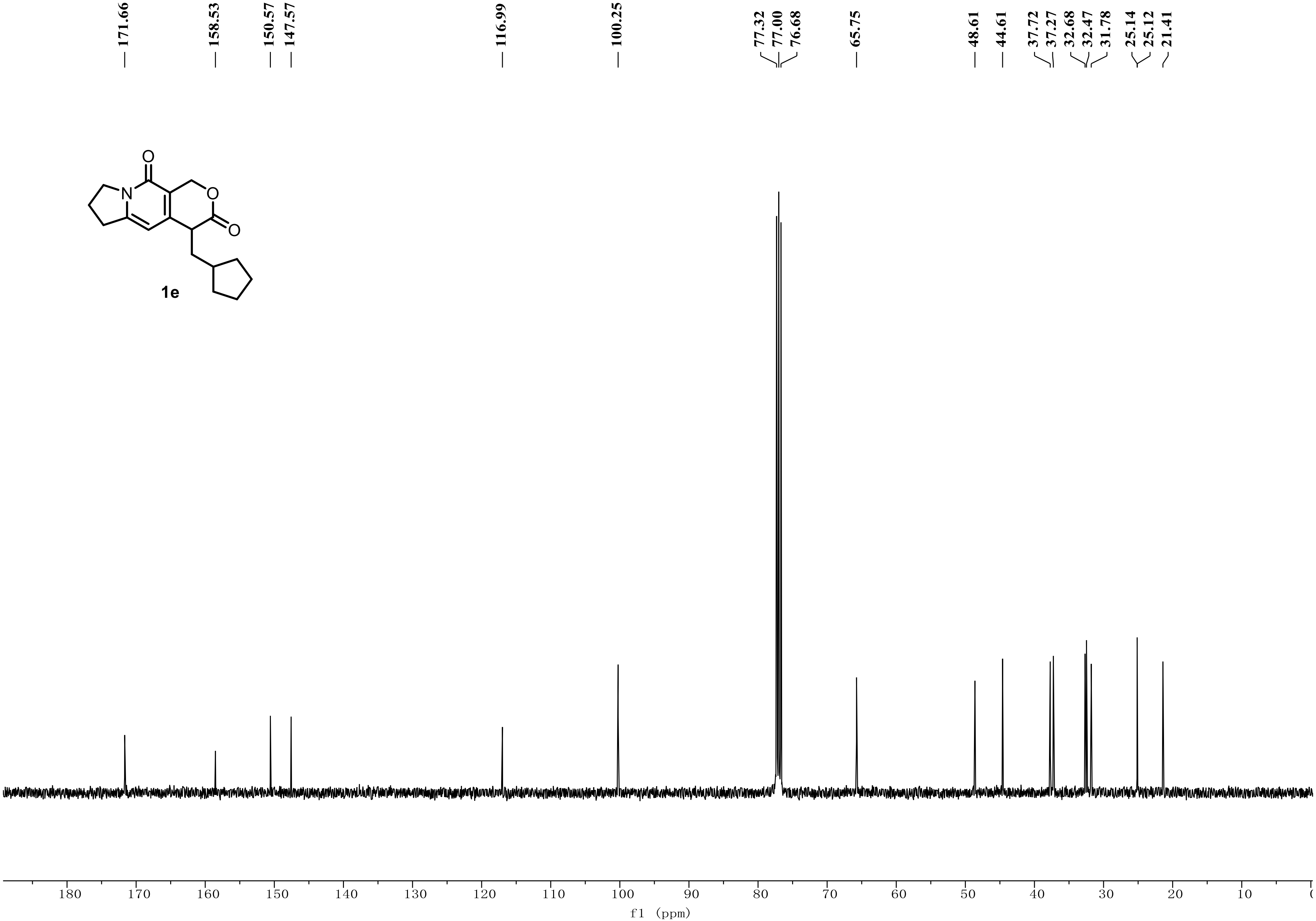
171.56
150.65
147.69
117.00
100.12
77.21
77.00
76.79
65.62
48.60
43.25
40.12
31.77
25.58
22.32
22.19
21.39
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

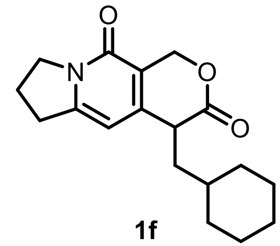


O
N
O
O
^{i}Pr

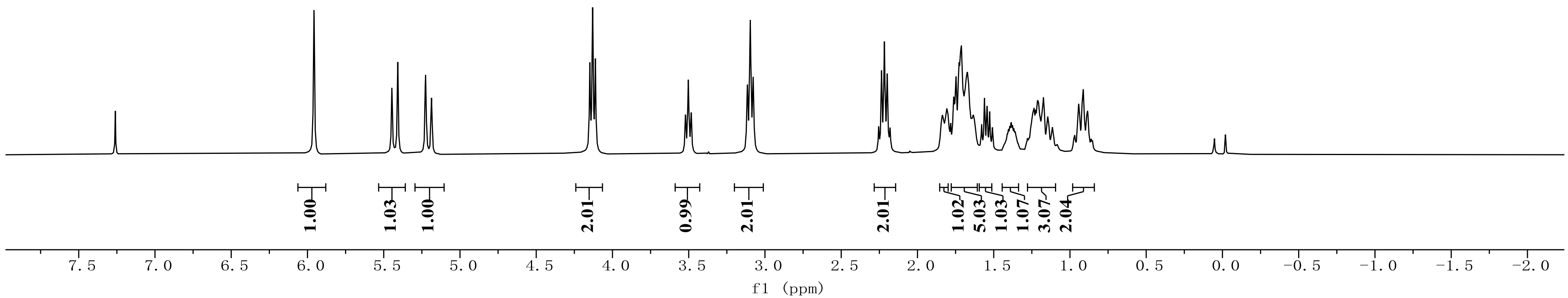
1d

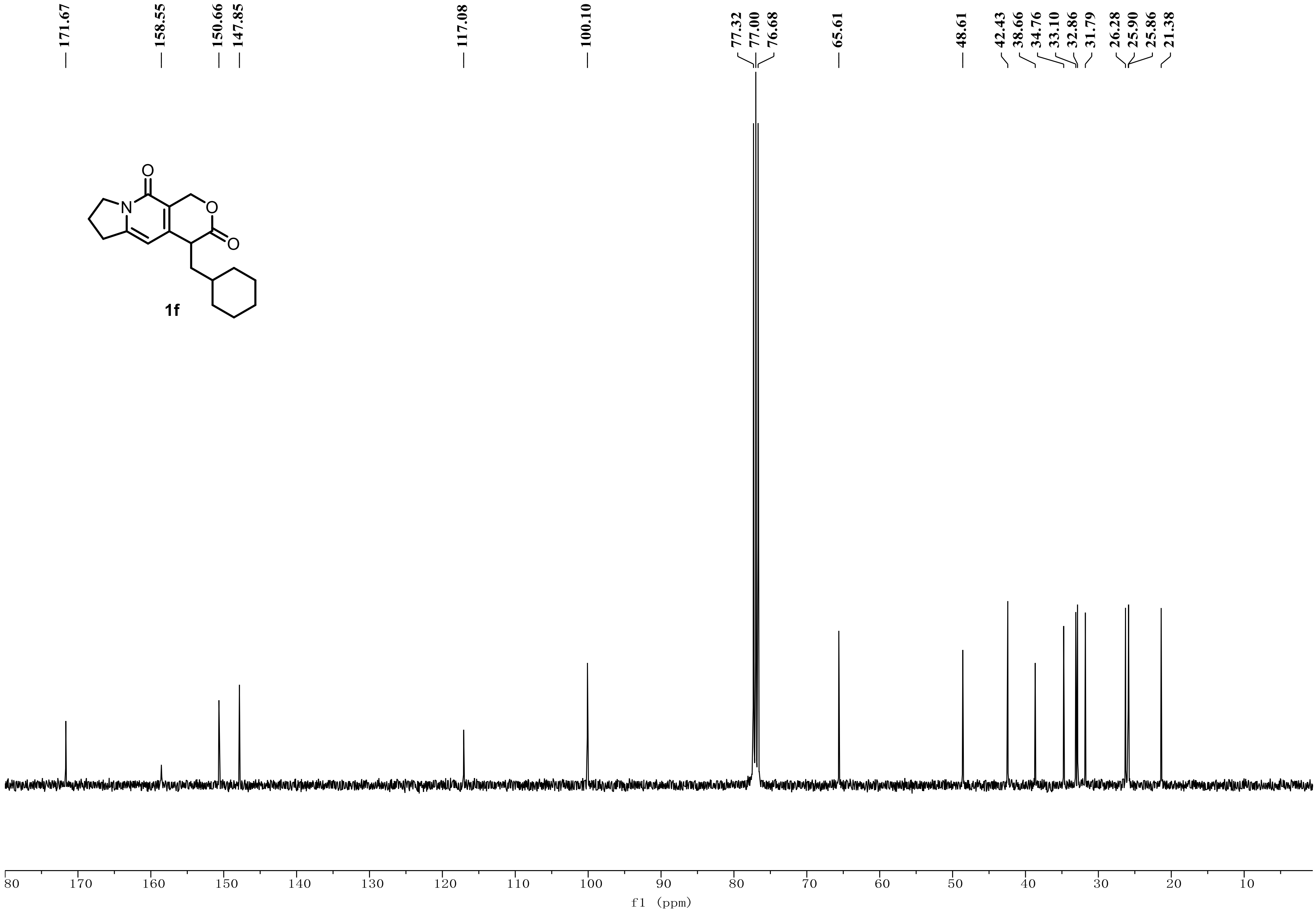

5.989
5.470
5.444
5.232
5.206
4.159
4.147
4.135
3.451
3.439
3.427
3.124
3.111
3.098
2.257
2.244
2.232
2.220
2.207
1.933
1.922
1.911
1.895
1.883
1.865
1.835
1.815
1.801
1.797
1.769
1.753
1.741
1.730
1.652
1.646
1.633
1.628
1.615
1.575
1.561
1.552
1.551
1.545
1.538
1.181
1.169
1.161
1.148
1.134
1.126
1.119
1.106
1.093
-0.000
O
N
O
O
1e
1.00
1.04
1.03
2.00
1.00
2.01
2.02
2.98
2.03
0.99
1.97
2.04
2.01
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
−1.0
−1.5
−2.0
f1 (ppm)

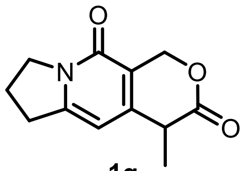

171.66
158.53
150.57
147.57
116.99
100.25
77.32
77.00
76.68
65.75
48.61
44.61
37.72
37.27
32.68
32.47
31.78
25.14
25.12
21.41
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)
O
N
O
O
1e



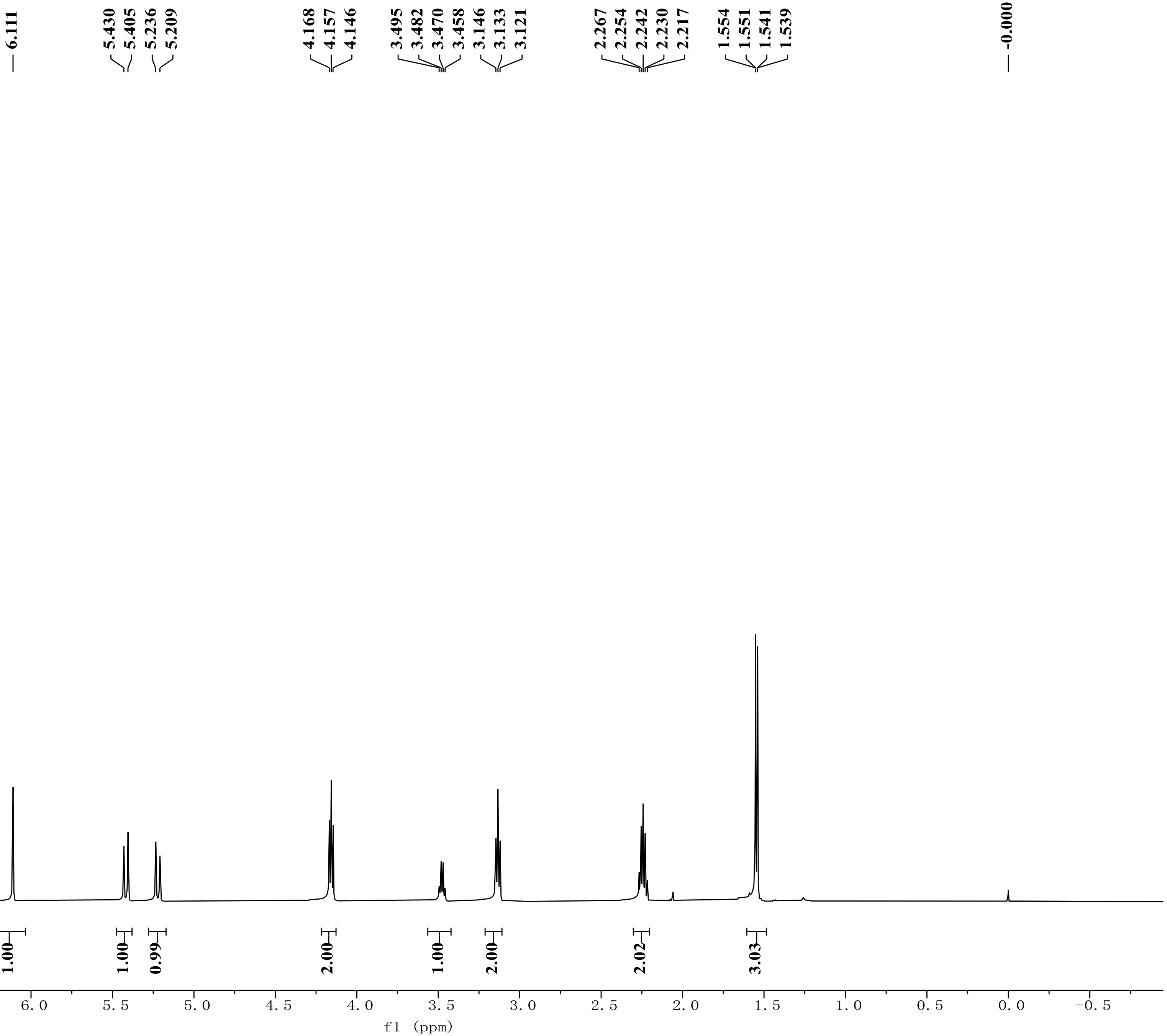
1f

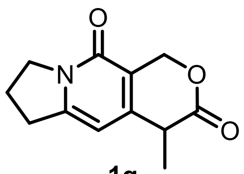

7.260
5.949
5.447 5.408 5.225 5.187
4.148 4.130 4.112
3.522 3.503 3.484 3.116 3.096 3.077
2.254 2.236 2.217 2.198 2.179 1.836 1.809 1.761 1.747 1.717 1.673 1.633 1.579 1.561 1.543 1.526 1.508 1.403 1.395 1.386 1.376 1.367 1.358 1.235 1.211 1.181 1.169 1.153 1.122 0.976 0.937 0.911 0.891 0.861 0.853
1.00
1.03
1.00
2.01
0.99
2.01
2.01
1.02
5.03
1.03
1.07
3.07
2.04
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 -1.0 -1.5 -2.0
f1 (ppm)


171.67
158.55
150.66
147.85
117.08
100.10
77.32
77.00
76.68
65.61
48.61
42.43
38.66
34.76
33.10
32.86
31.79
26.28
25.90
25.86
21.38
1f
80 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

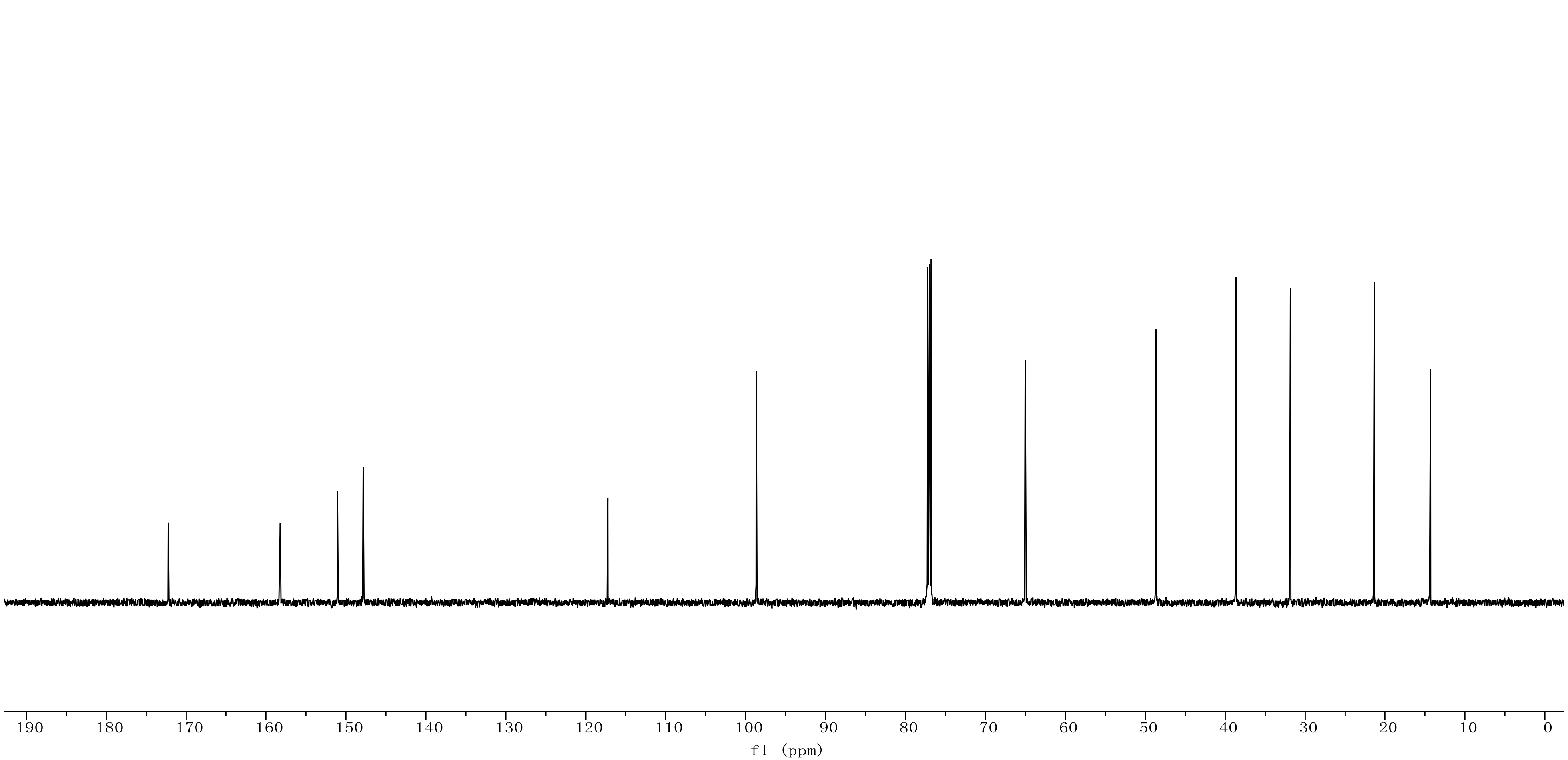


1g

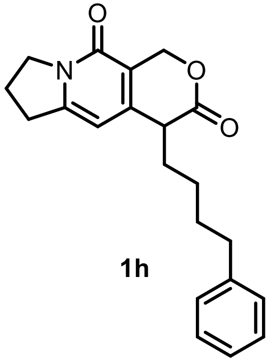

6.111
5.430
5.405
5.236
5.209
4.168
4.157
4.146
3.495
3.482
3.470
3.458
3.146
3.133
3.121
2.267
2.254
2.242
2.230
2.217
1.554
1.551
1.541
1.539
-0.000
1.00
1.00
0.99
2.00
1.00
2.00
2.02
3.03
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)



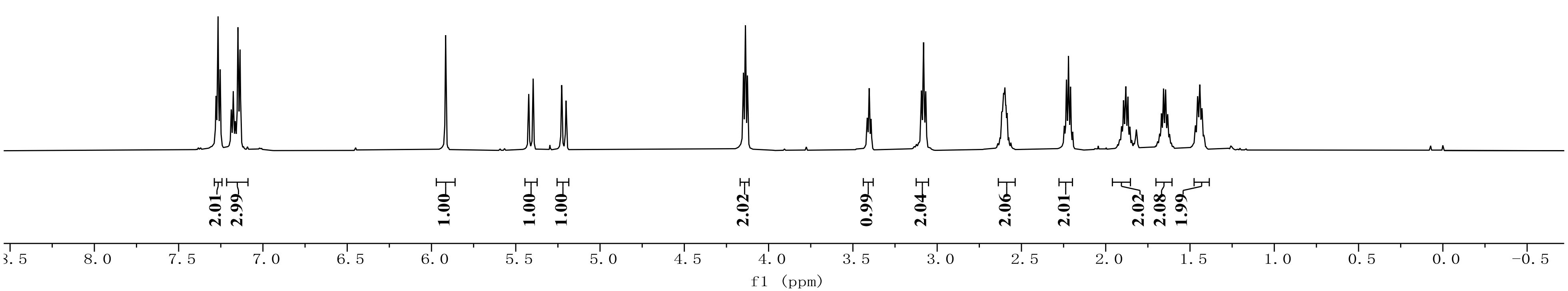
1g

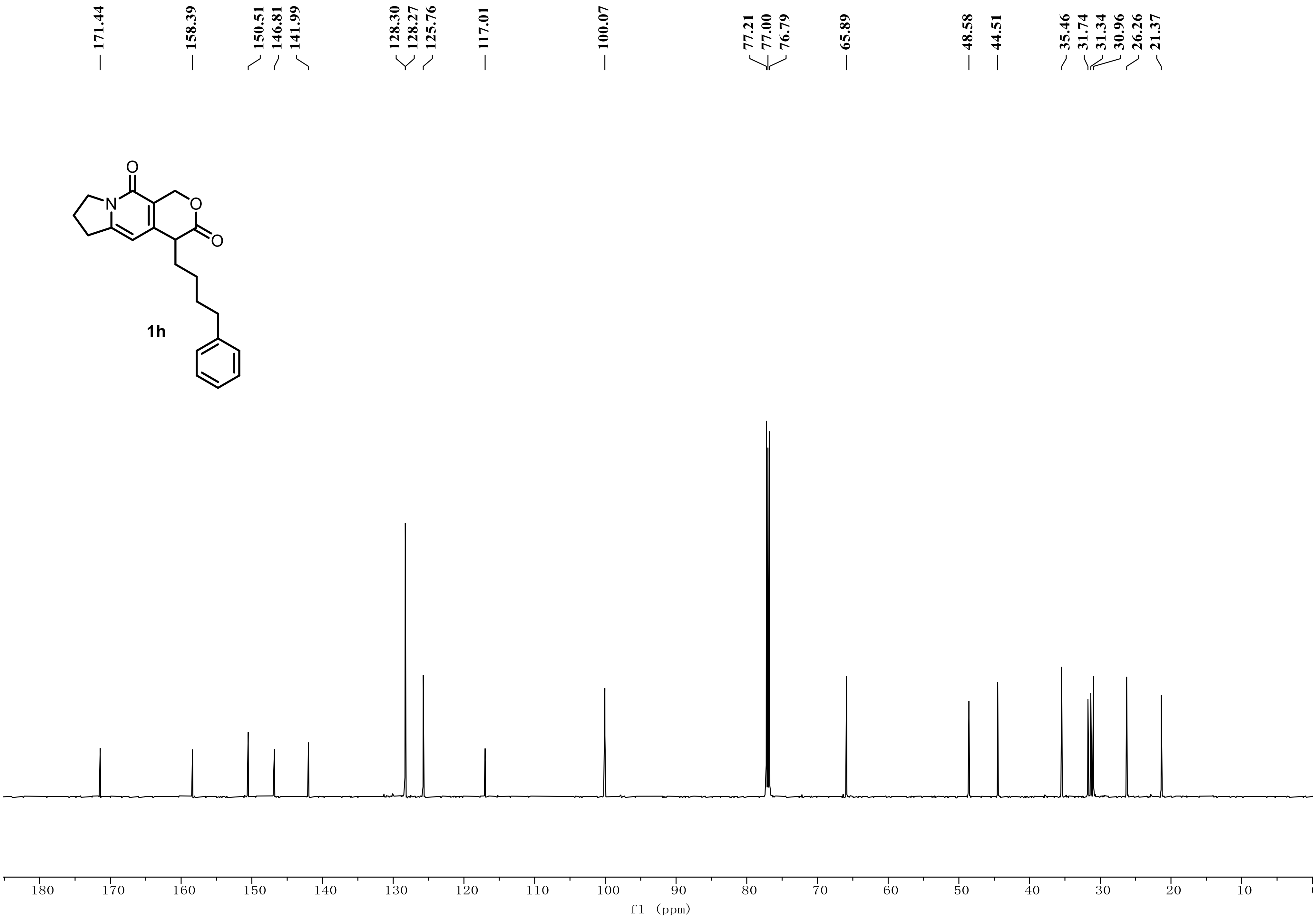


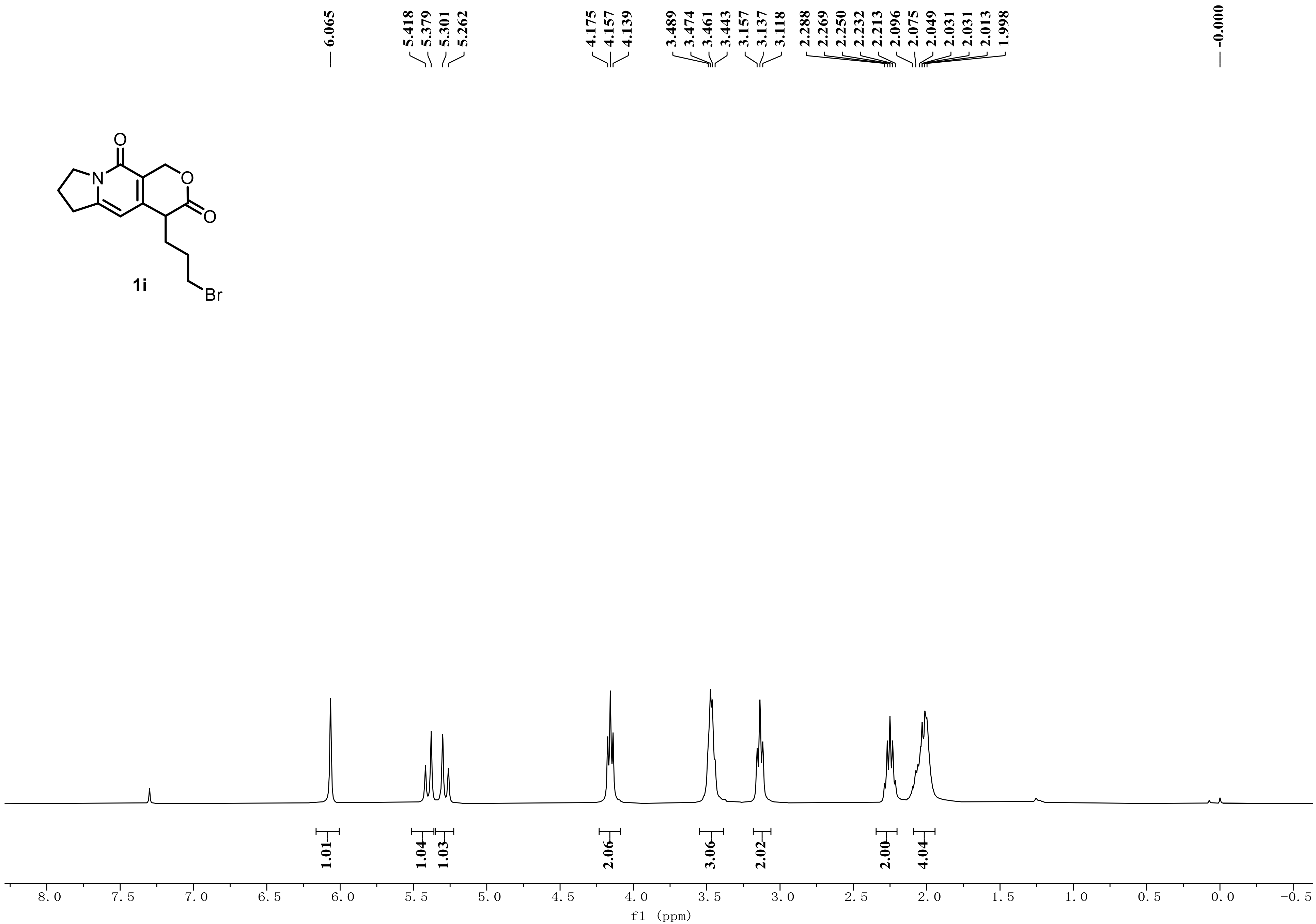
172.25
158.21
151.06
147.84
117.22
98.66
77.21
77.00
76.79
65.00
48.64
38.64
31.85
21.32
14.30
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



1h

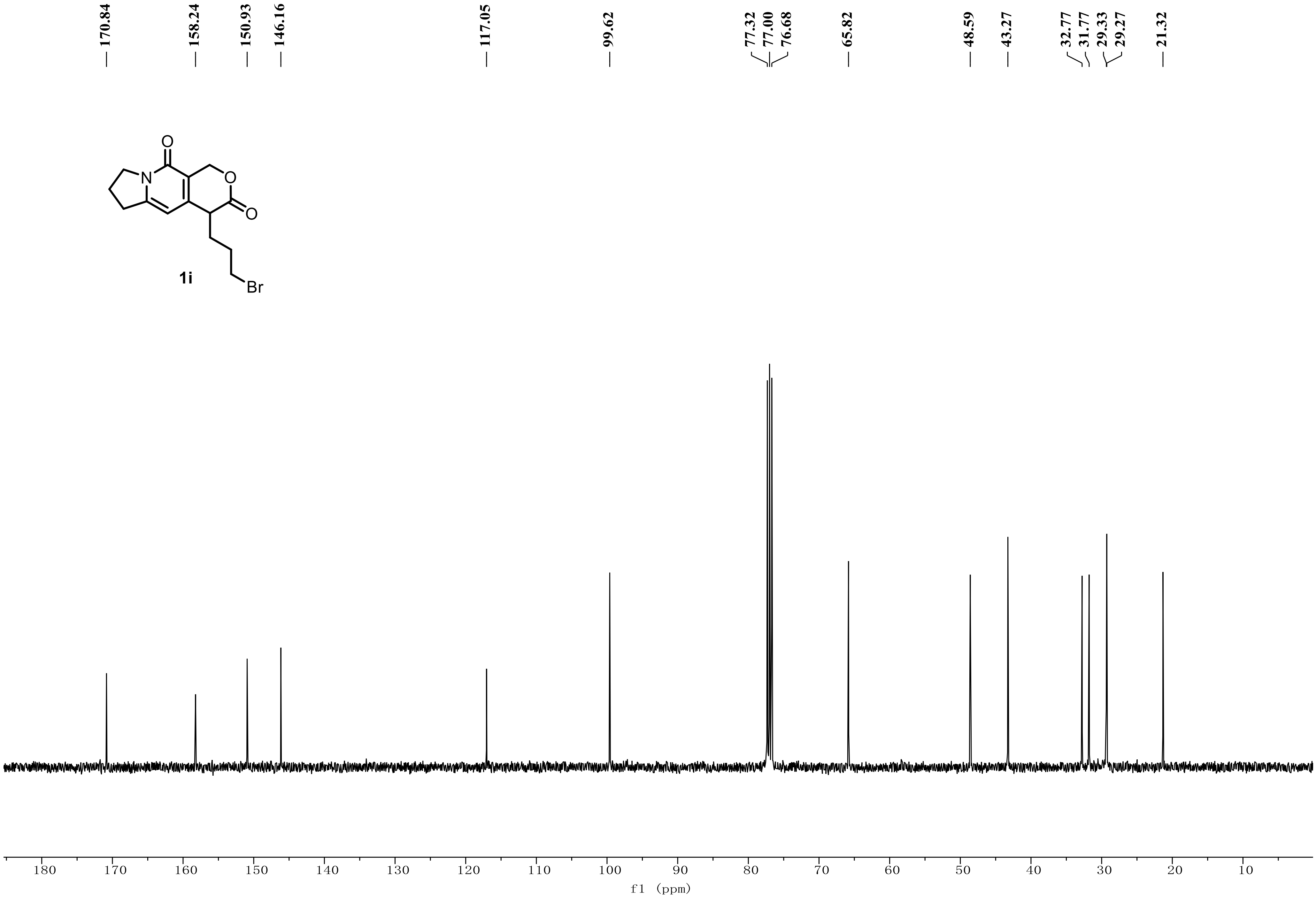

7.278
7.266
7.254
7.188
7.176
7.164
7.148
7.136
5.916
5.423
5.397
5.228
5.202
4.150
4.137
4.125
3.415
3.403
3.392
3.093
3.081
3.068
2.617
2.611
2.605
2.598
2.592
2.585
2.246
2.233
2.221
2.208
2.196
1.906
1.894
1.881
1.868
1.856
1.681
1.670
1.657
1.645
1.632
1.621
1.468
1.455
1.442
1.429
-0.000
2.01
2.99
1.00
1.00
1.00
2.02
0.99
2.04
2.06
2.01
2.02
2.08
1.99
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)

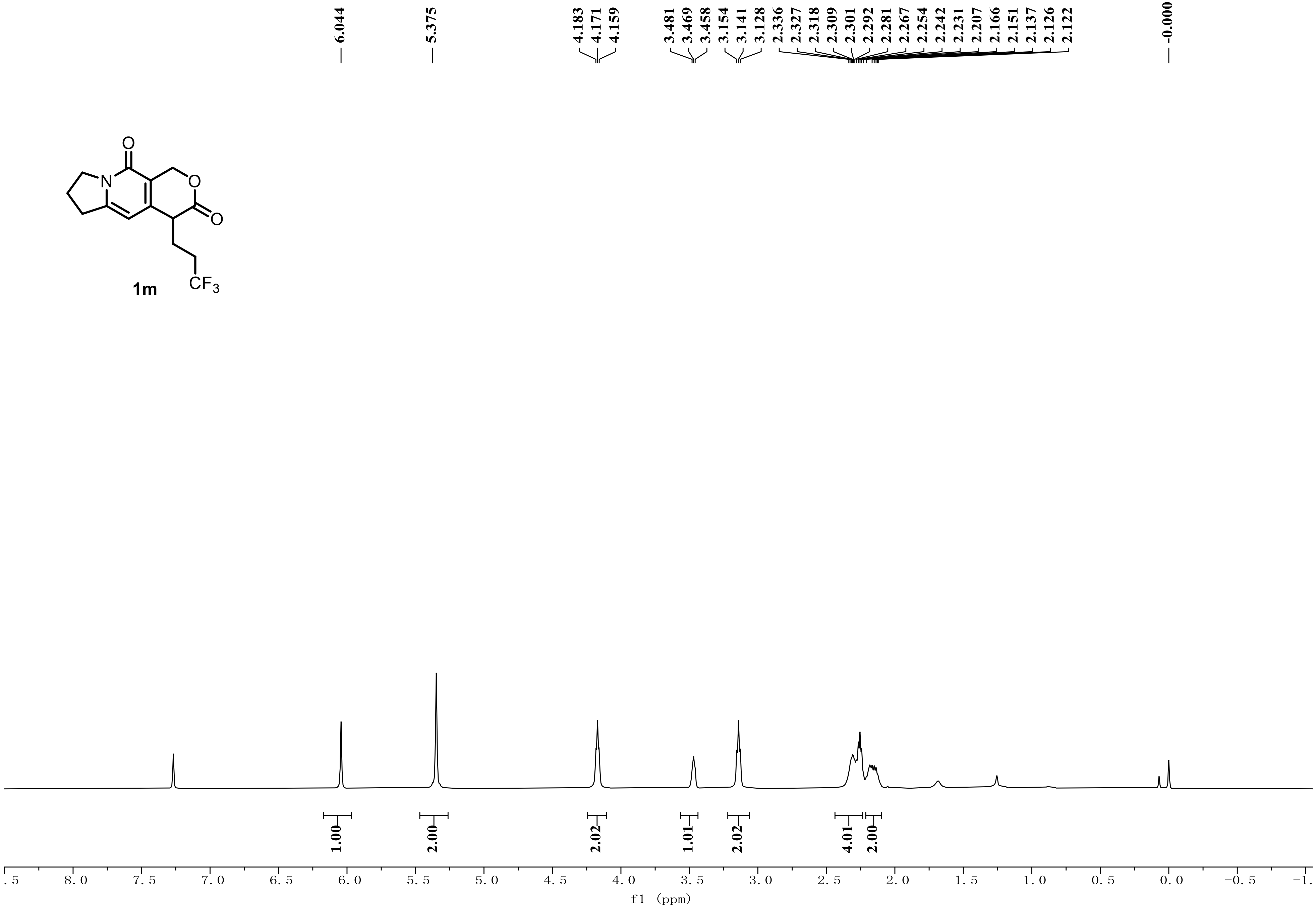

171.44
158.39
150.51
146.81
141.99
128.30
128.27
125.76
117.01
100.07
77.21
77.00
76.79
65.89
48.58
44.51
35.46
31.74
31.34
30.96
26.26
21.37
1h
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



6.065
5.418
5.379
5.301
5.262
4.175
4.157
4.139
3.489
3.474
3.461
3.443
3.157
3.137
3.118
2.288
2.269
2.250
2.232
2.213
2.096
2.075
2.049
2.031
2.031
2.013
1.998
-0.000
1.01
1.04
1.03
2.06
3.06
2.02
2.00
4.04
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)

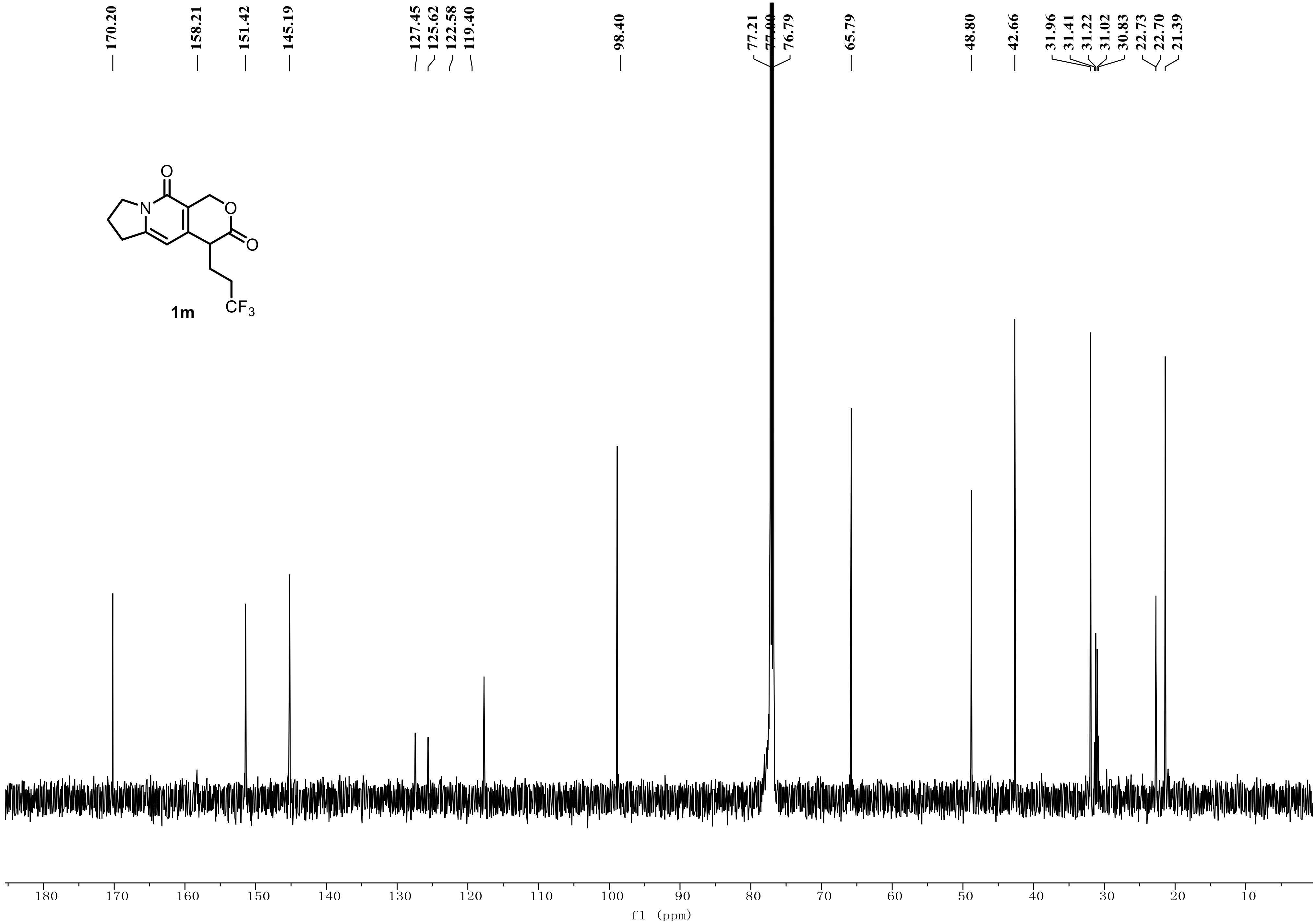
1i


170.84
158.24
150.93
146.16
117.05
99.62
77.32
77.00
76.68
65.82
48.59
43.27
32.77
31.77
29.33
29.27
21.32
1i
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

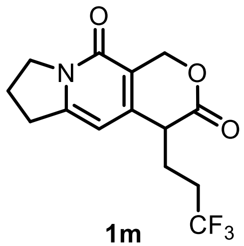


6.044
5.375
4.183
4.171
4.159
3.481
3.469
3.458
3.154
3.141
3.128
2.336
2.327
2.318
2.309
2.301
2.292
2.281
2.267
2.254
2.242
2.231
2.207
2.166
2.151
2.137
2.126
2.122
-0.000
1.00
2.00
2.02
1.01
2.02
4.01
2.00
.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)
O
N
O
O
CF_3

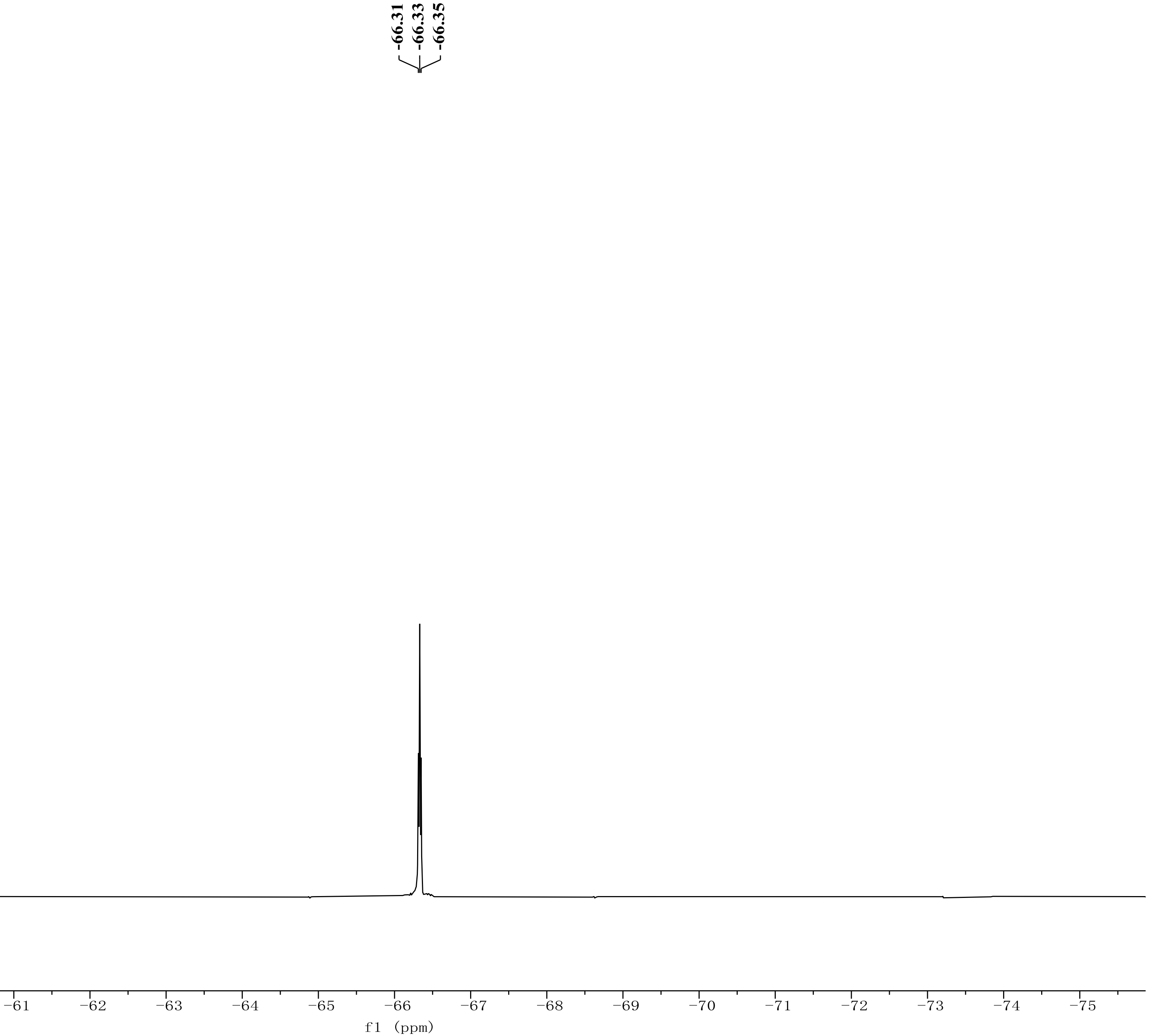
1m



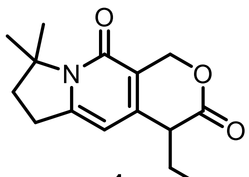
170.20
158.21
151.42
145.19
127.45
125.62
122.58
119.40
98.40
77.21
77.00
76.79
65.79
48.80
42.66
31.96
31.41
31.22
31.02
30.83
22.73
22.70
21.39
1m
CF3
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



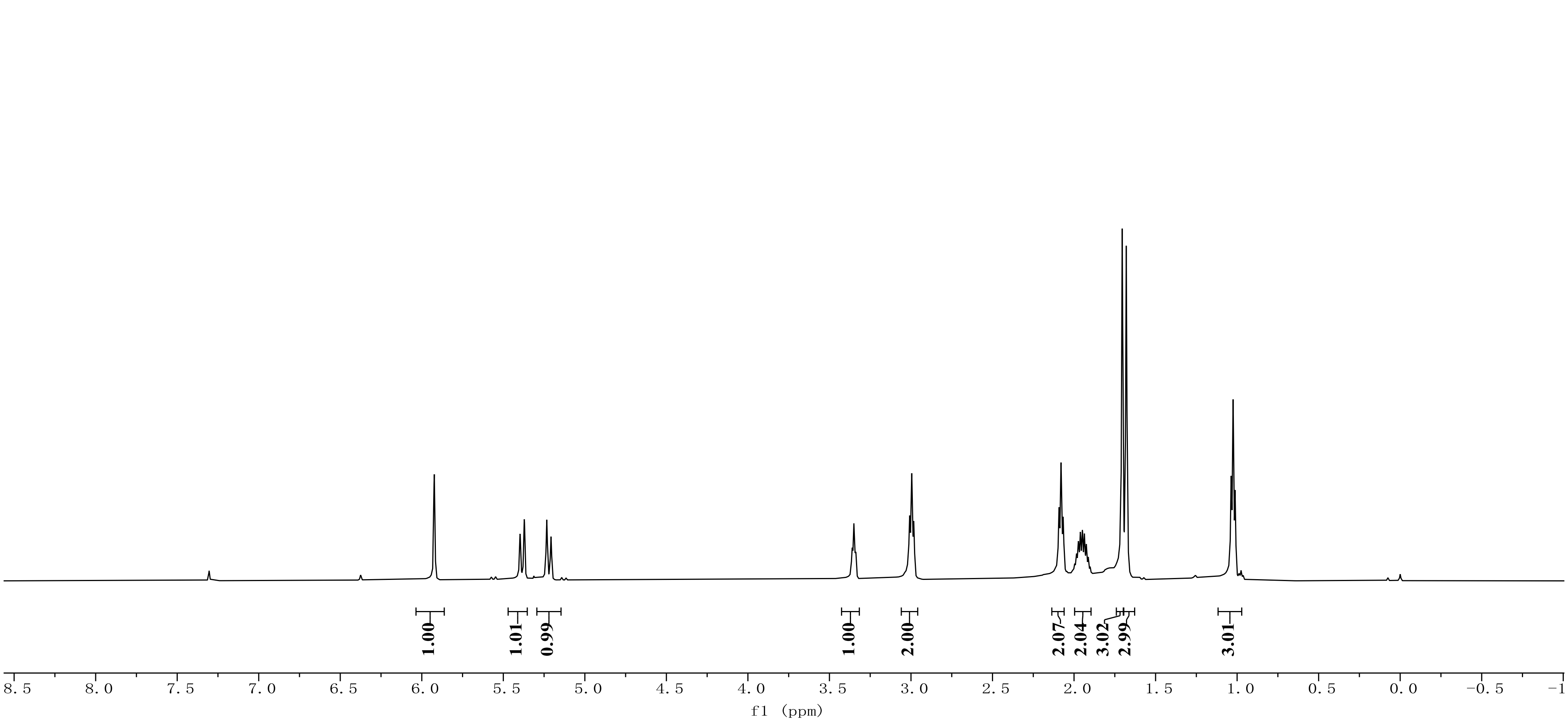
1m

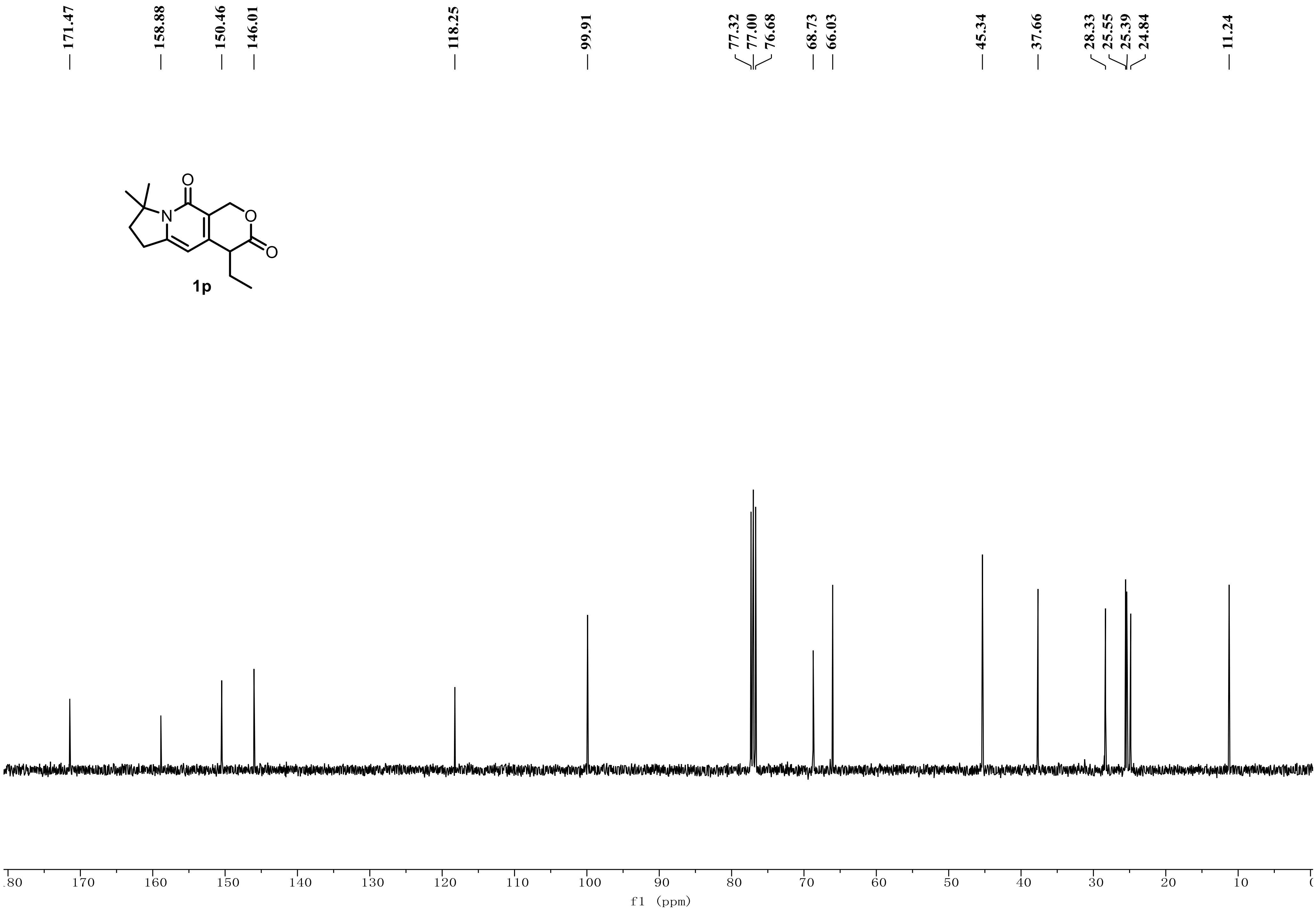


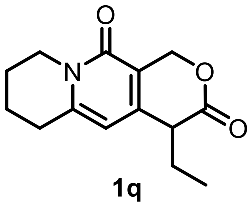
-66.31
-66.33
-66.35
−57
−58
−59
−60
−61
−62
−63
−64
−65
−66
−67
−68
−69
−70
−71
−72
−73
−74
−75
f1 (ppm)



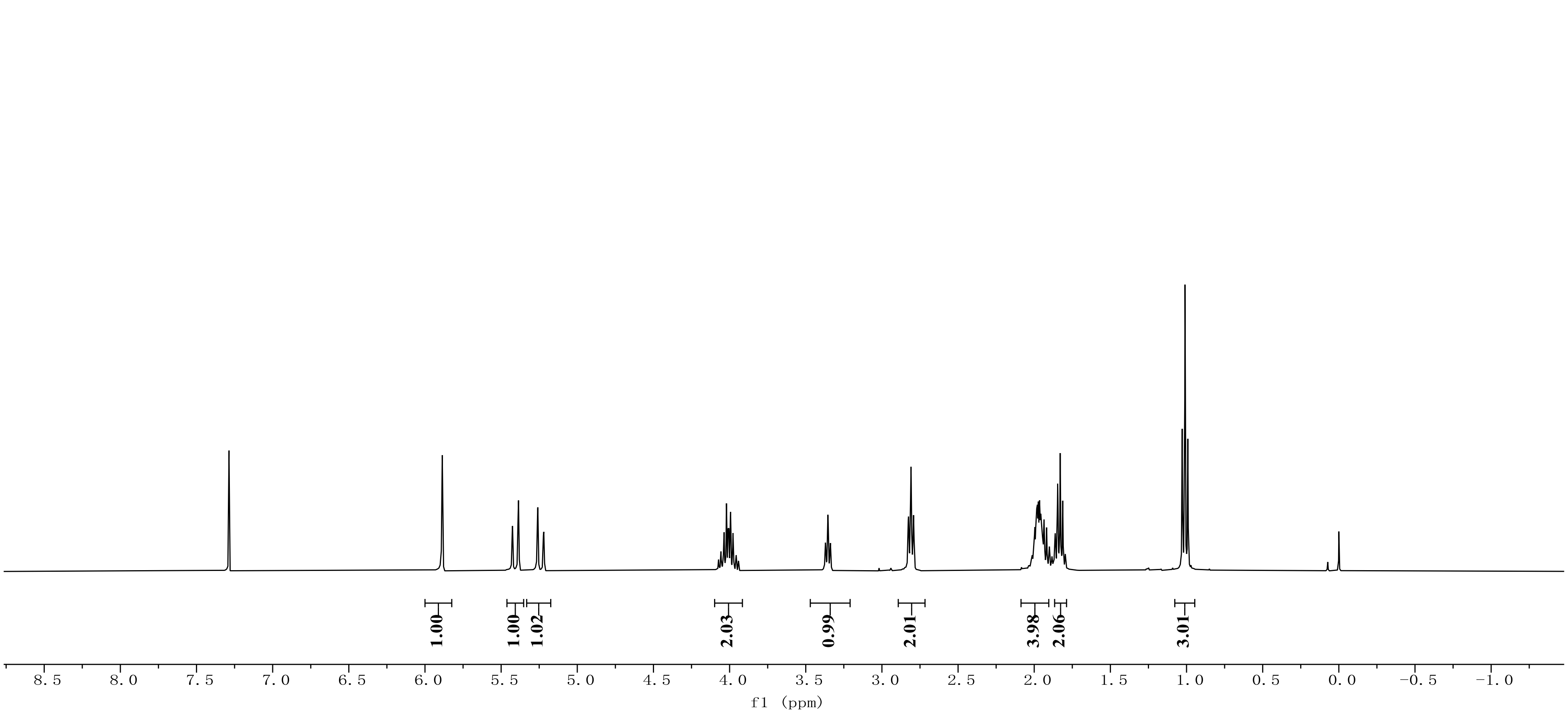
1p

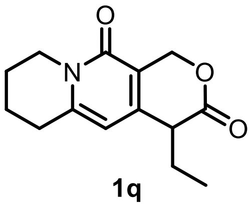

5.923
5.397
5.371
5.234
5.208
3.361
3.350
3.339
3.009
2.995
2.982
2.093
2.079
2.066
1.997
1.985
1.973
1.961
1.949
1.936
1.924
1.913
1.901
1.705
1.680
1.037
1.024
1.012
-0.000
1.00
1.01
0.99
1.00
2.00
2.07
2.04
3.02
2.99
3.01
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


171.47
158.88
150.46
146.01
118.25
99.91
77.32
77.00
76.68
68.73
66.03
45.34
37.66
28.33
25.55
25.39
24.84
11.24
O
N
O
O
1p
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

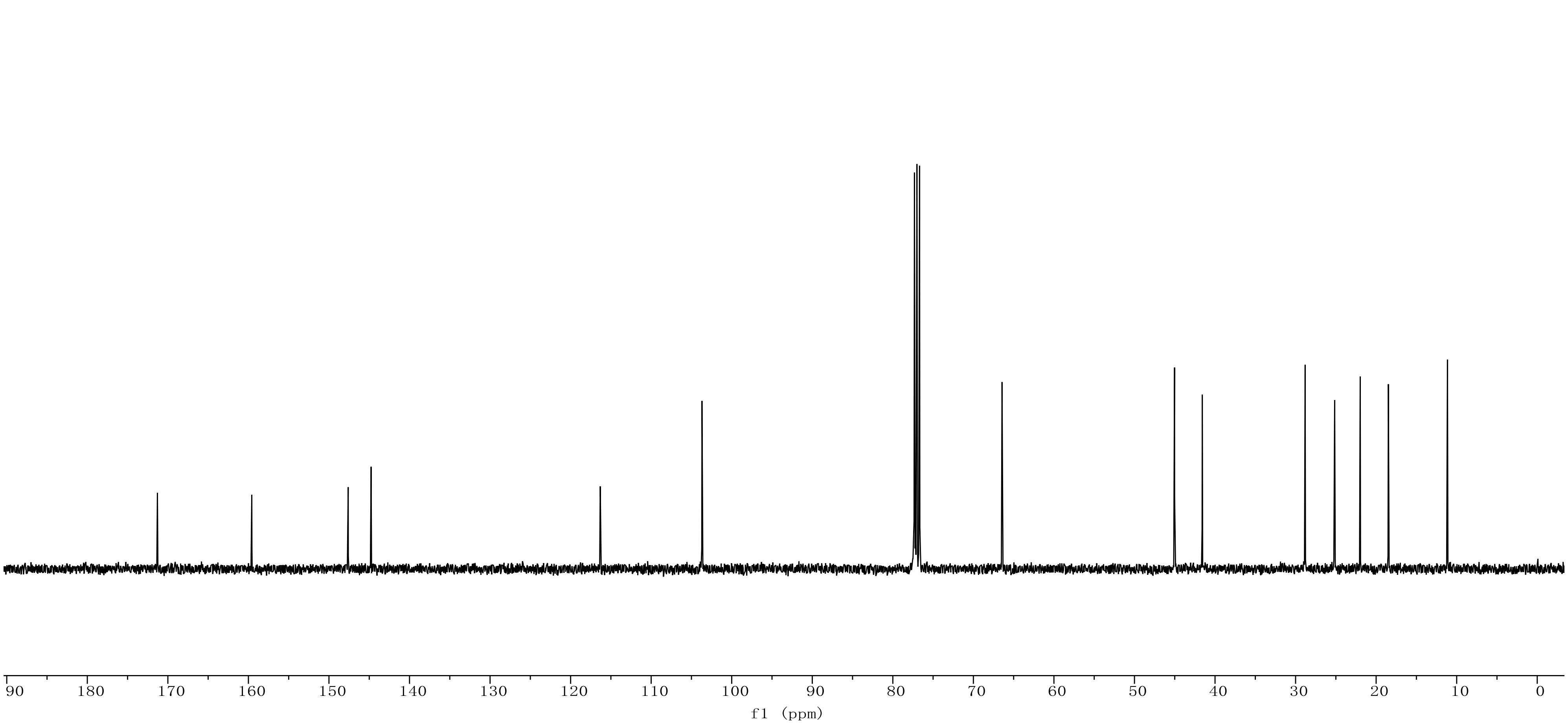

O
N
O
O

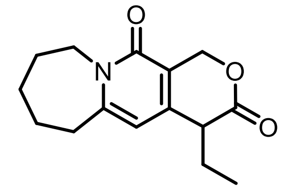
1q


5.886
5.427
5.385
5.259
5.219
4.073
4.057
4.036
4.021
4.010
4.005
3.994
3.978
3.957
3.942
3.371
3.355
3.338
2.826
2.809
2.792
2.006
1.996
1.989
1.968
1.963
1.957
1.949
1.942
1.937
1.918
1.884
1.863
1.846
1.829
1.813
1.795
1.028
1.010
0.991
-0.000
1.00
1.00
1.02
2.03
0.99
2.01
3.98
2.06
3.01
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
−1.0
f1 (ppm)

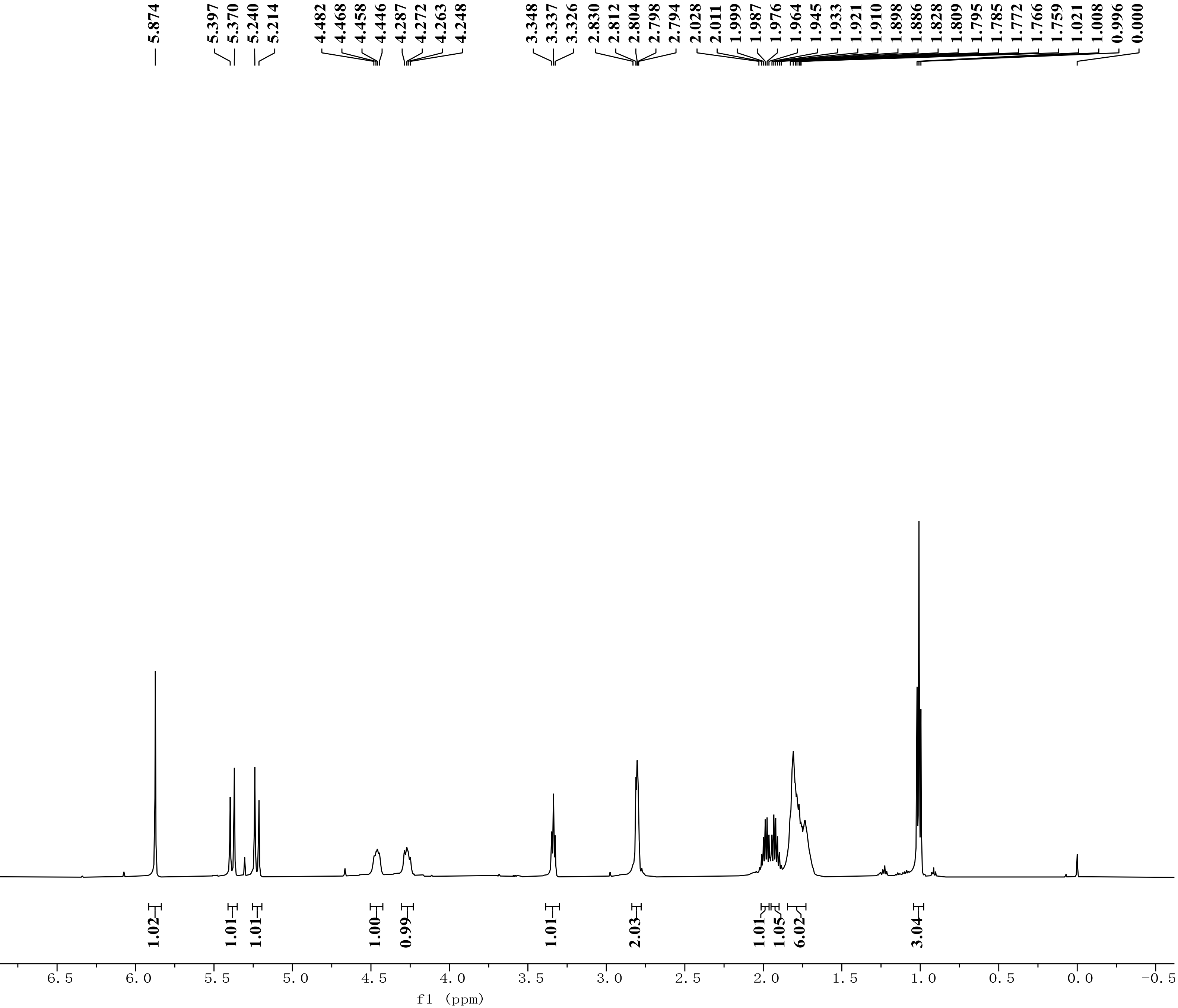


1q

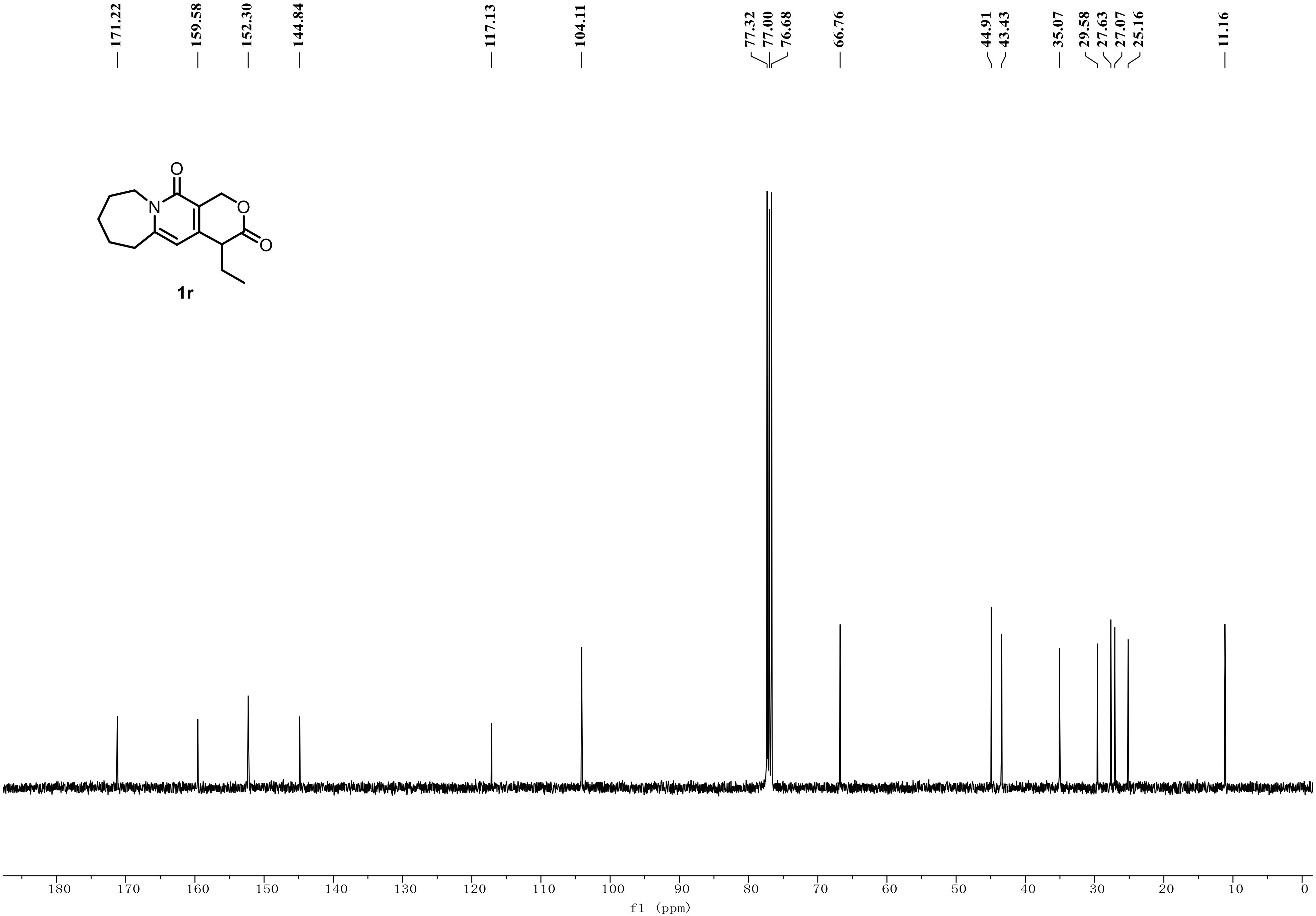

171.30
159.58
147.62
144.77
116.32
103.69
77.32
77.00
76.68
66.44
45.03
41.58
28.81
25.15
21.98
18.48
11.15
90 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



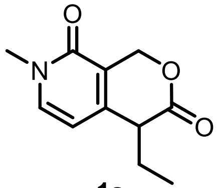
1r



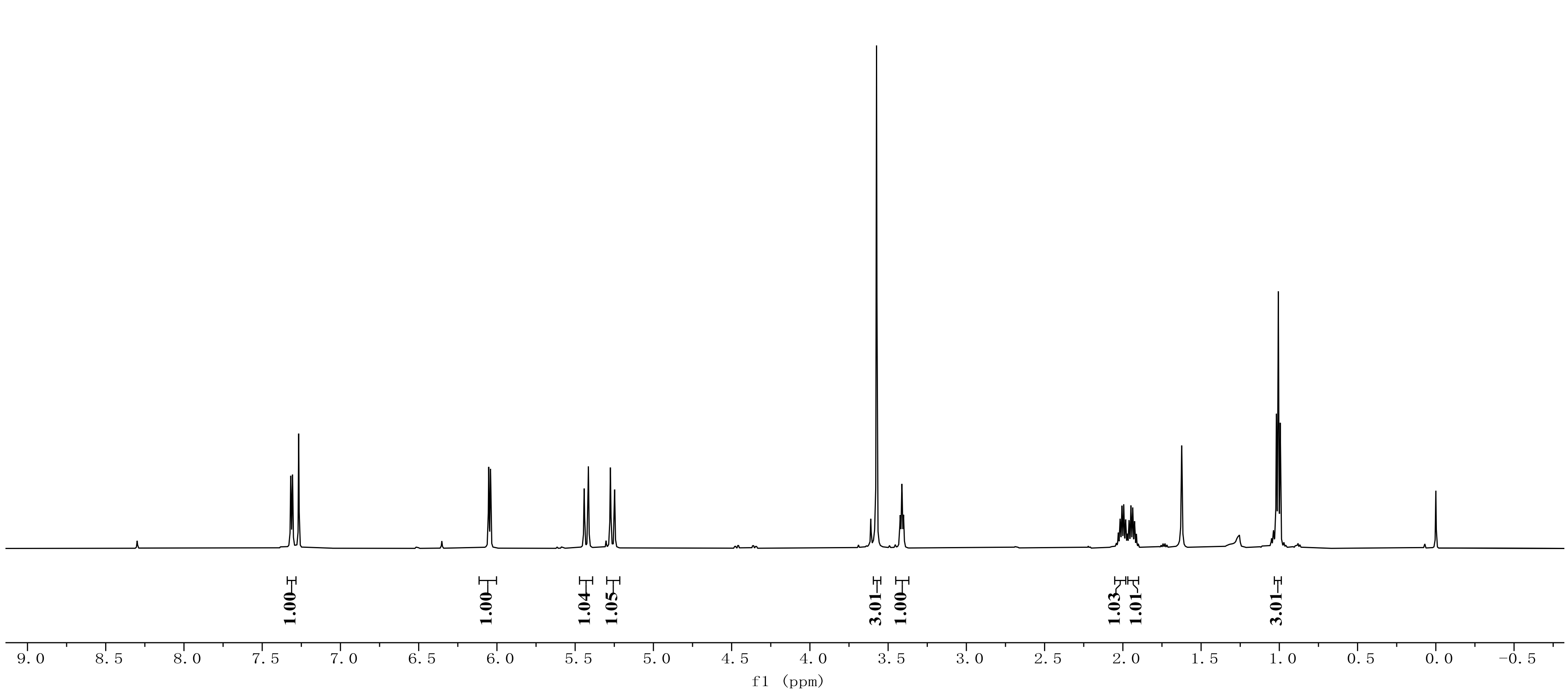
5.874
5.397
5.370
5.240
5.214
4.482
4.468
4.458
4.446
4.287
4.272
4.263
4.248
3.348
3.337
3.326
2.830
2.812
2.804
2.798
2.794
2.028
2.011
1.999
1.987
1.976
1.964
1.945
1.933
1.921
1.910
1.898
1.886
1.828
1.809
1.795
1.785
1.772
1.766
1.759
1.021
1.008
0.996
0.000
1.02
1.01
1.01
1.00
0.99
1.01
2.03
1.01
1.05
6.02
3.04
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)


171.22
159.58
152.30
144.84
117.13
104.11
77.32
77.00
76.68
66.76
44.91
43.43
35.07
29.58
27.63
27.07
25.16
11.16
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

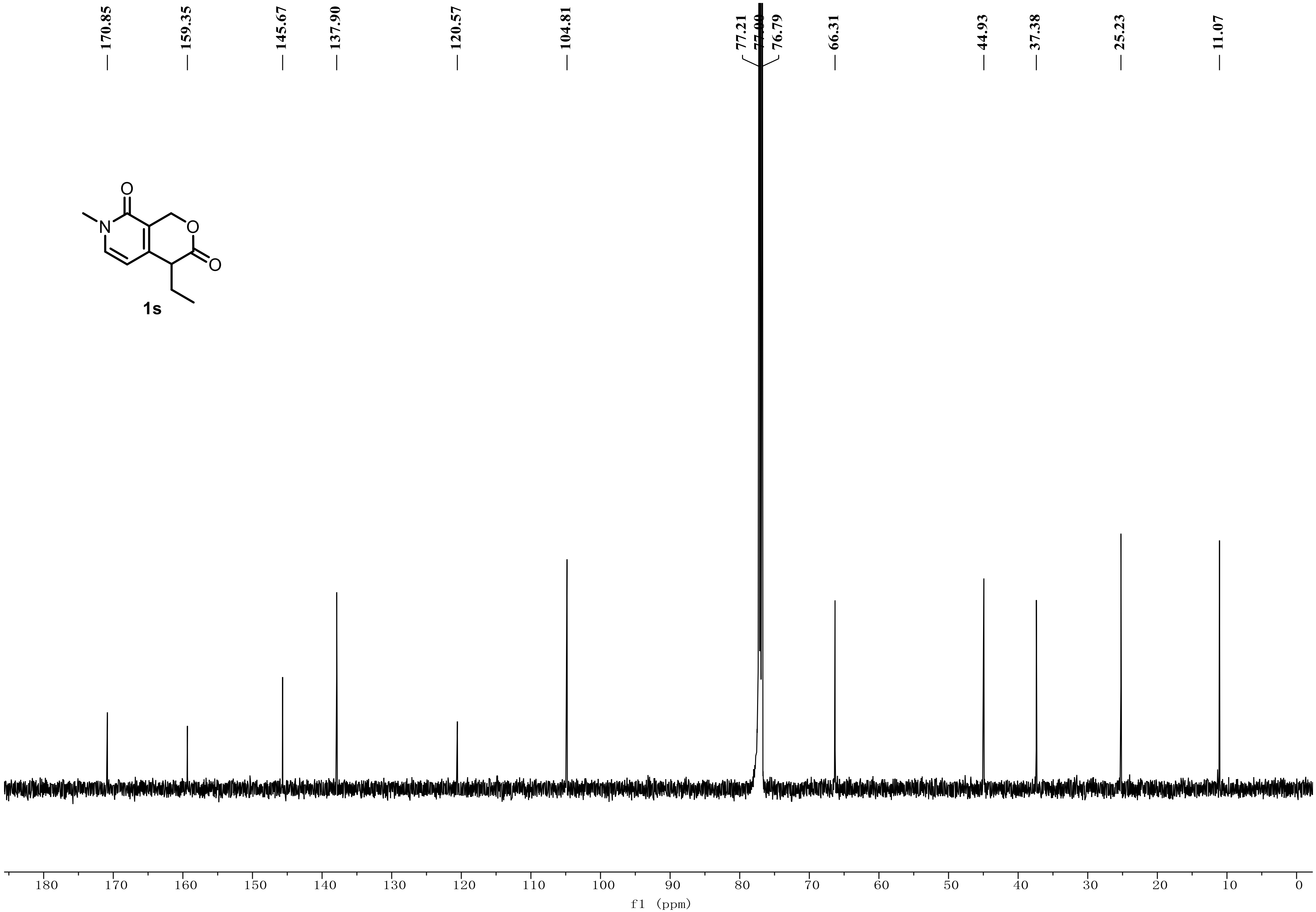
1r



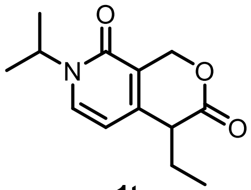
1s



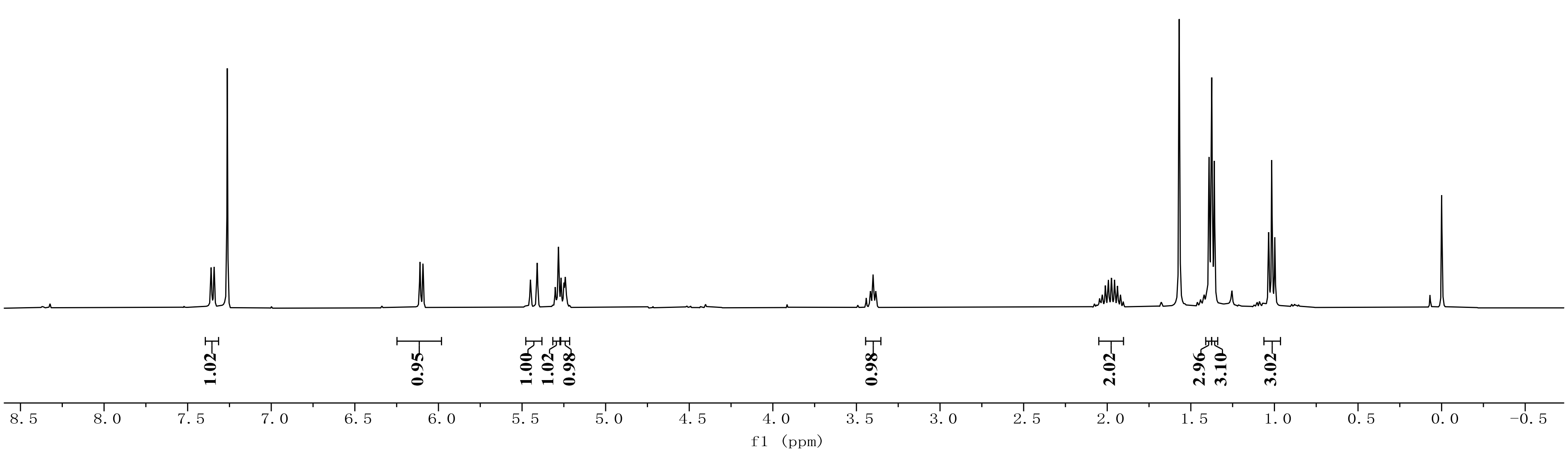
7.318
7.306
6.053
6.041
5.442
5.416
5.275
5.248
3.574
3.423
3.412
3.401
2.041
2.029
2.018
2.006
1.994
1.982
1.971
1.960
1.948
1.937
1.925
1.913
1.019
1.006
0.994
0.000
1.00
1.00
1.04
1.05
3.01
1.00
1.03
1.01
3.01
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

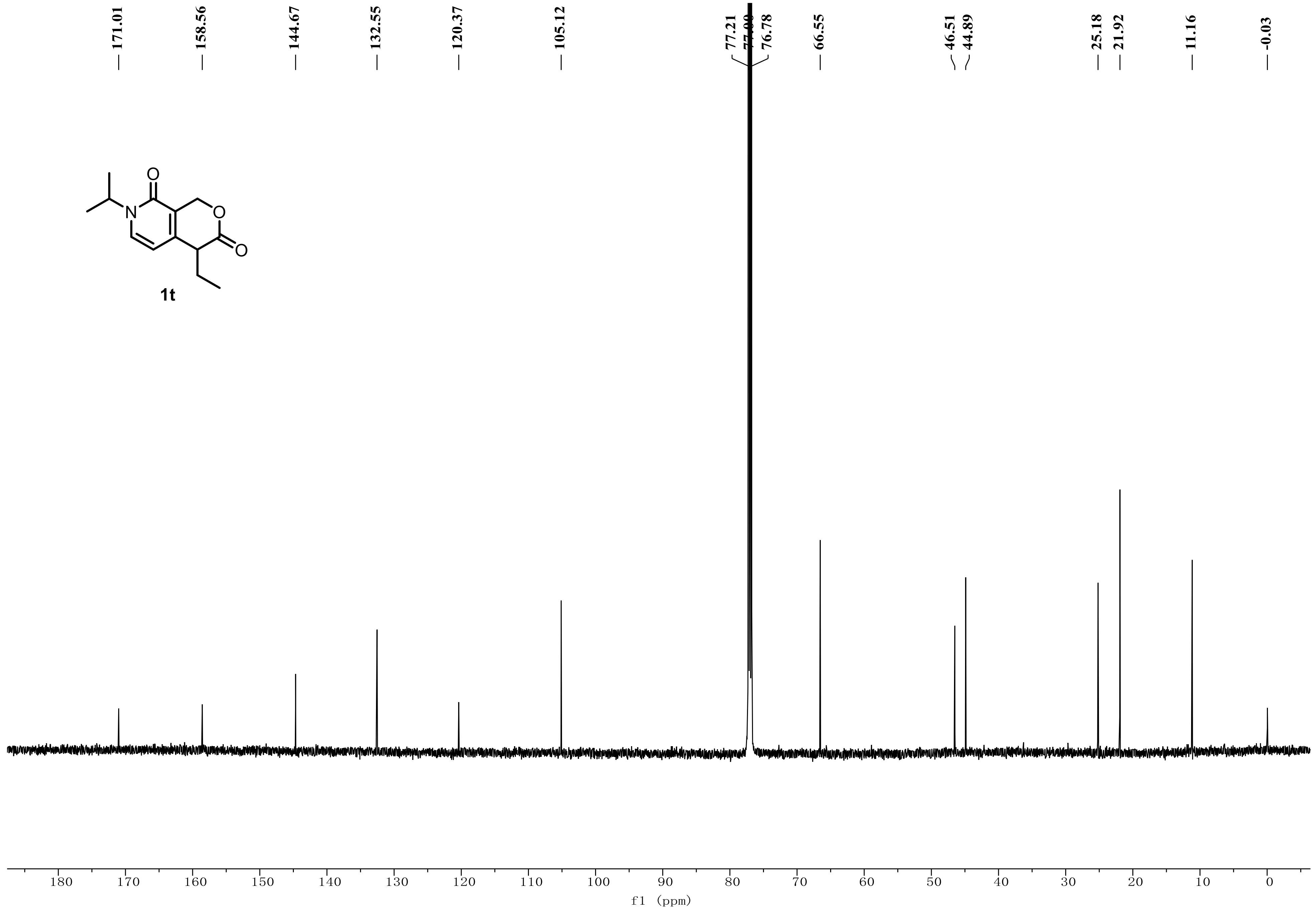


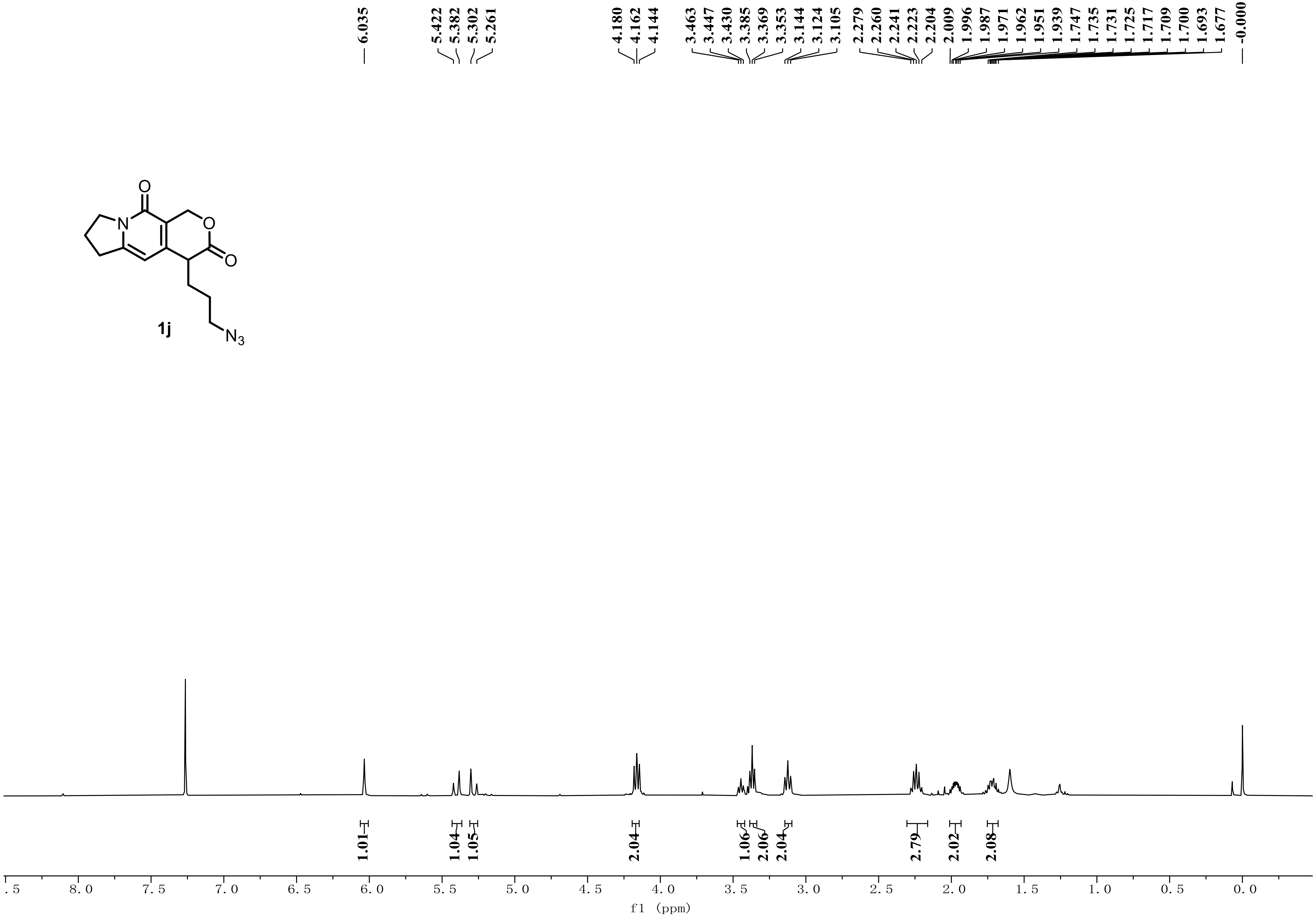
170.85
159.35
145.67
137.90
120.57
104.81
77.21
76.79
66.31
44.93
37.38
25.23
11.07
O
N
O
O
1s
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



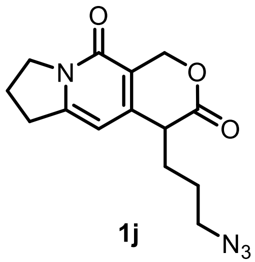
1t


7.360
7.342
6.110
6.093
5.450
5.409
5.301
5.282
5.267
5.250
5.241
5.232
3.416
3.400
3.384
2.065
2.046
2.029
2.011
1.993
1.975
1.956
1.938
1.921
1.904
1.391
1.377
1.374
1.360
1.035
1.016
0.997
-0.000
1.02
0.95
1.00
1.02
0.98
0.98
2.02
2.96
3.10
3.02
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)

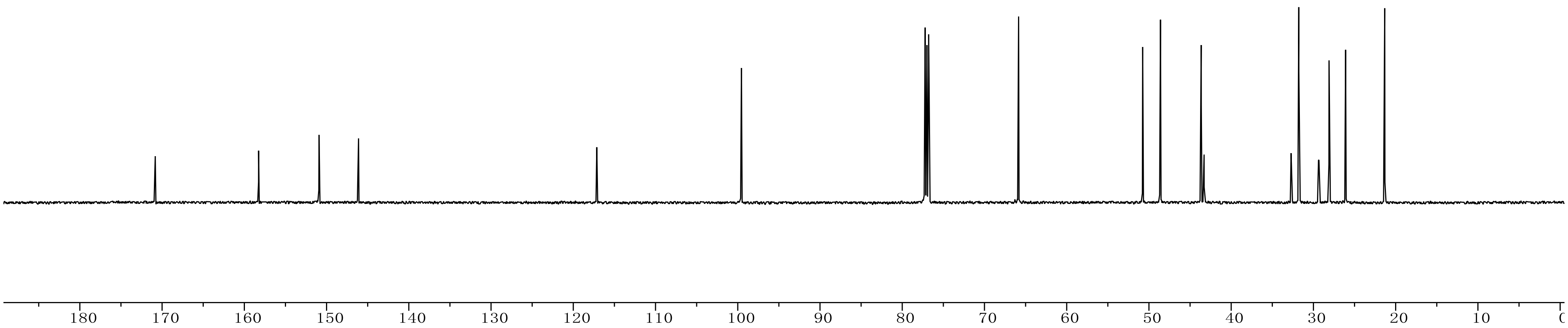

171.01
158.56
144.67
132.55
120.37
105.12
77.21
77.00
76.78
66.55
46.51
44.89
25.18
21.92
11.16
-0.03
1t
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

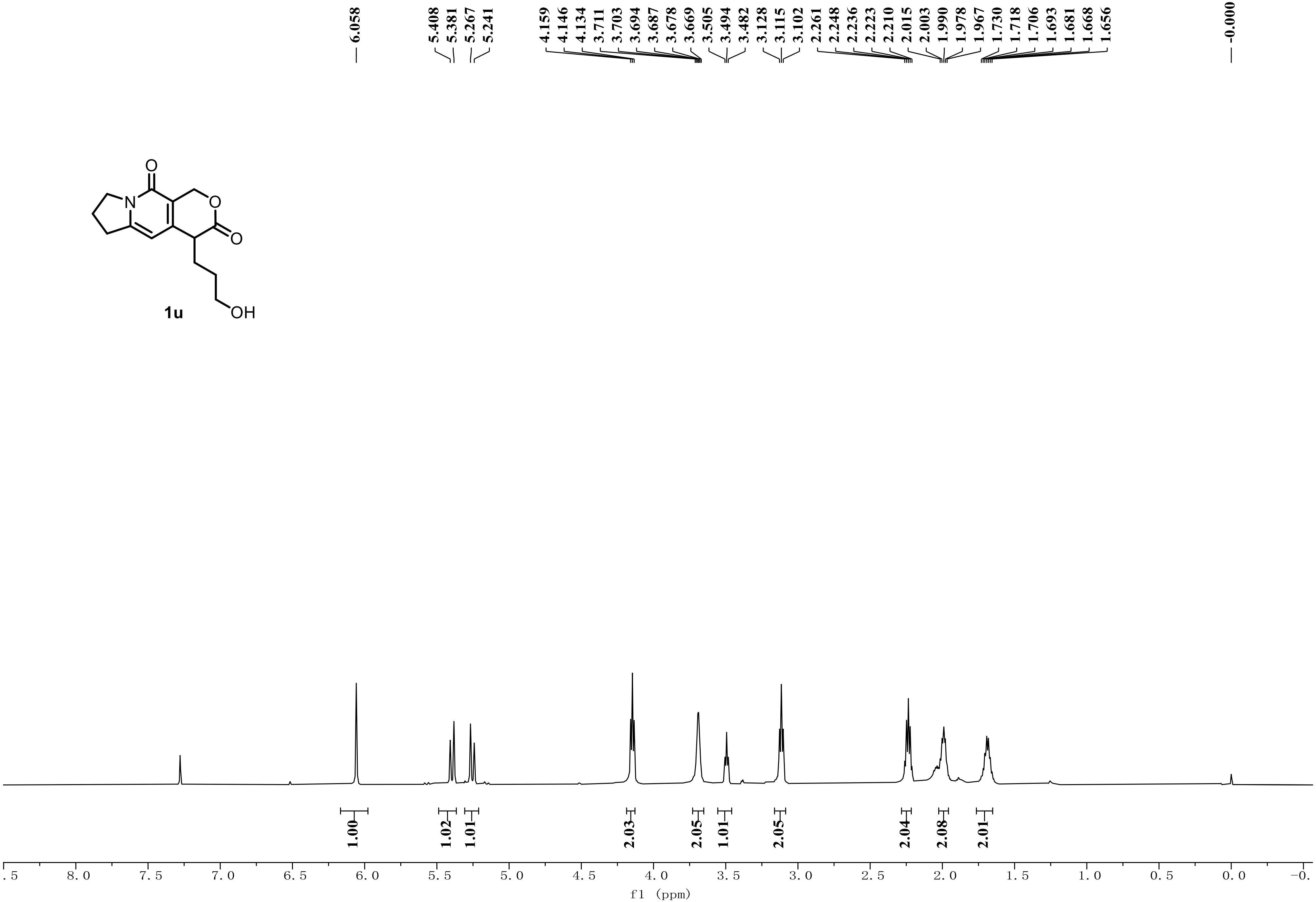

6.035
5.422
5.382
5.302
5.261
4.180
4.162
4.144
3.463
3.447
3.430
3.385
3.369
3.353
3.144
3.124
3.105
2.279
2.260
2.241
2.223
2.204
2.009
1.996
1.987
1.971
1.962
1.951
1.939
1.747
1.735
1.731
1.725
1.717
1.709
1.700
1.693
1.677
-0.000
O
N
O
O
N3
1j
1.01
1.04
1.05
2.04
1.06
2.06
2.04
2.79
2.02
2.08
.5
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)

170.83
158.26
150.91
146.11
117.14
99.57
99.55
77.21
77.00
76.79
65.85
50.76
48.60
43.65
31.78
28.10
26.09
21.33

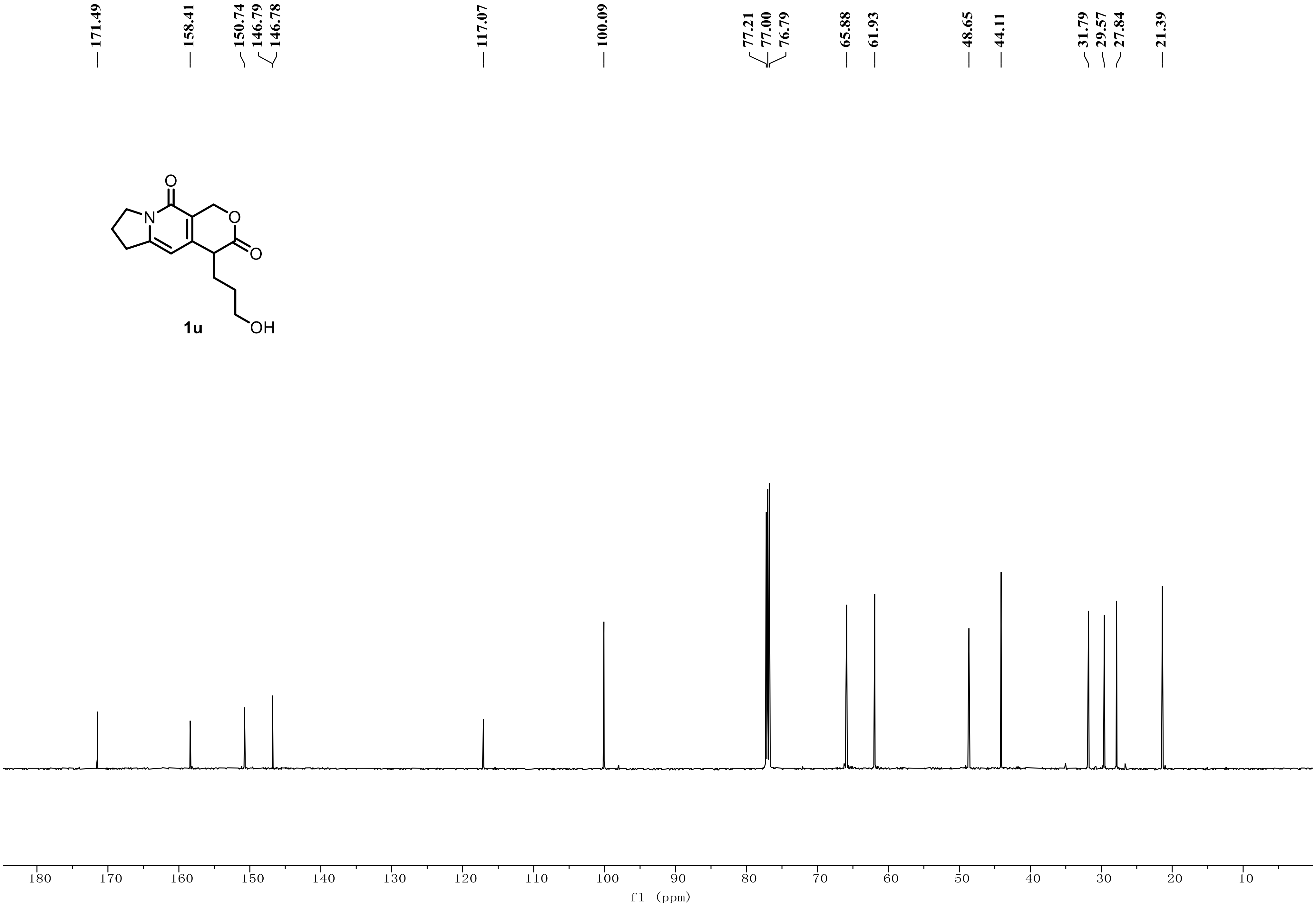


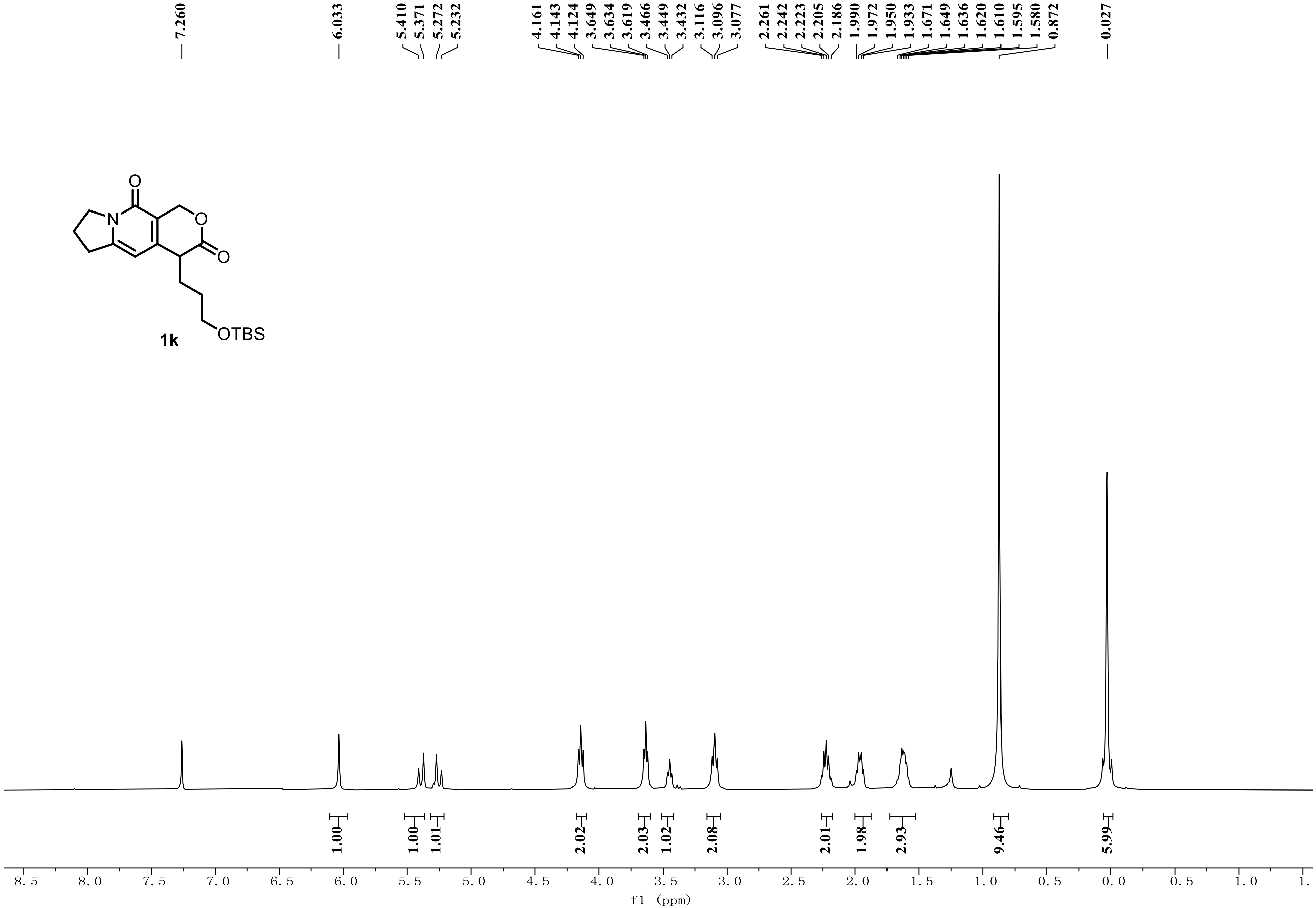
1j

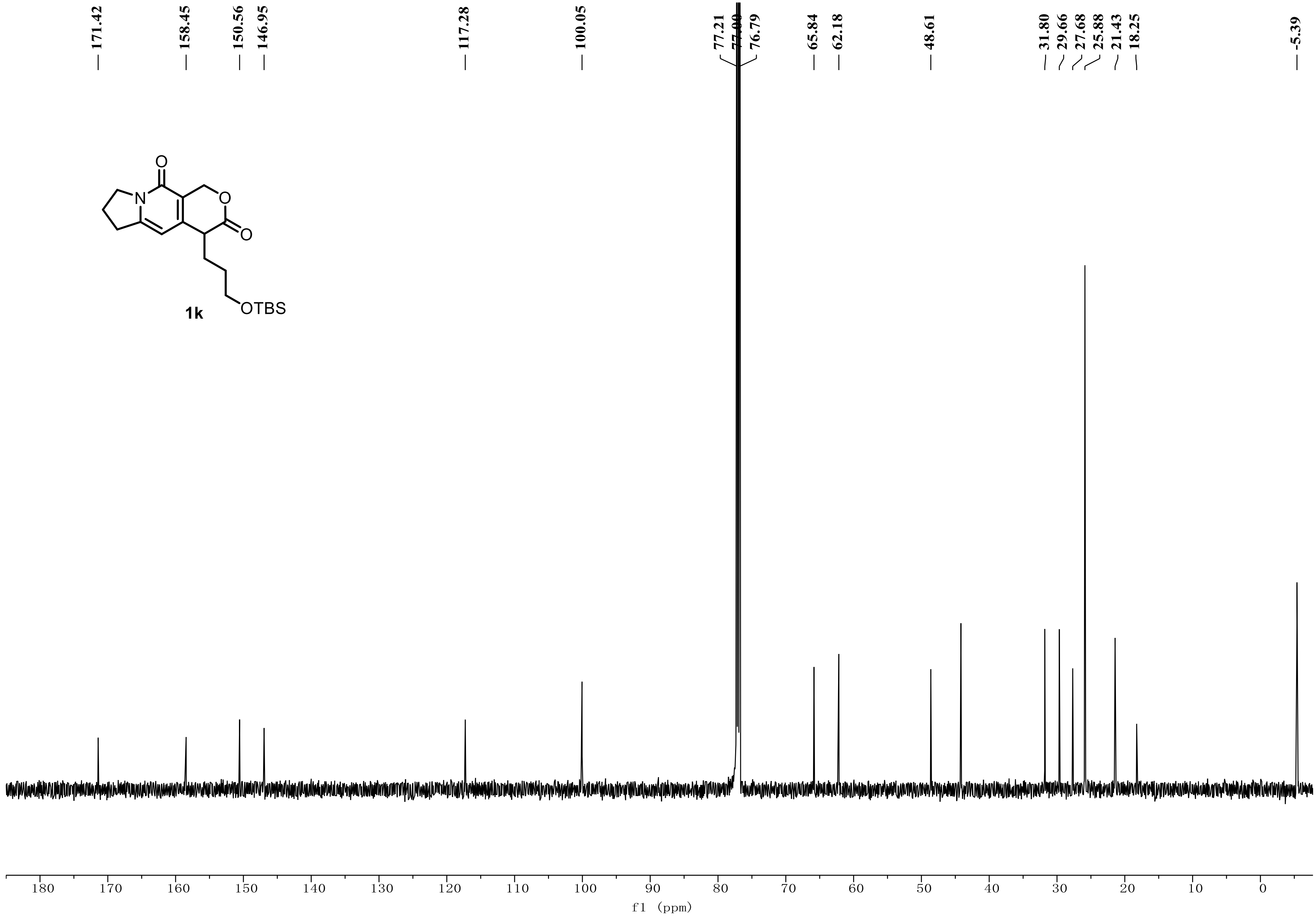




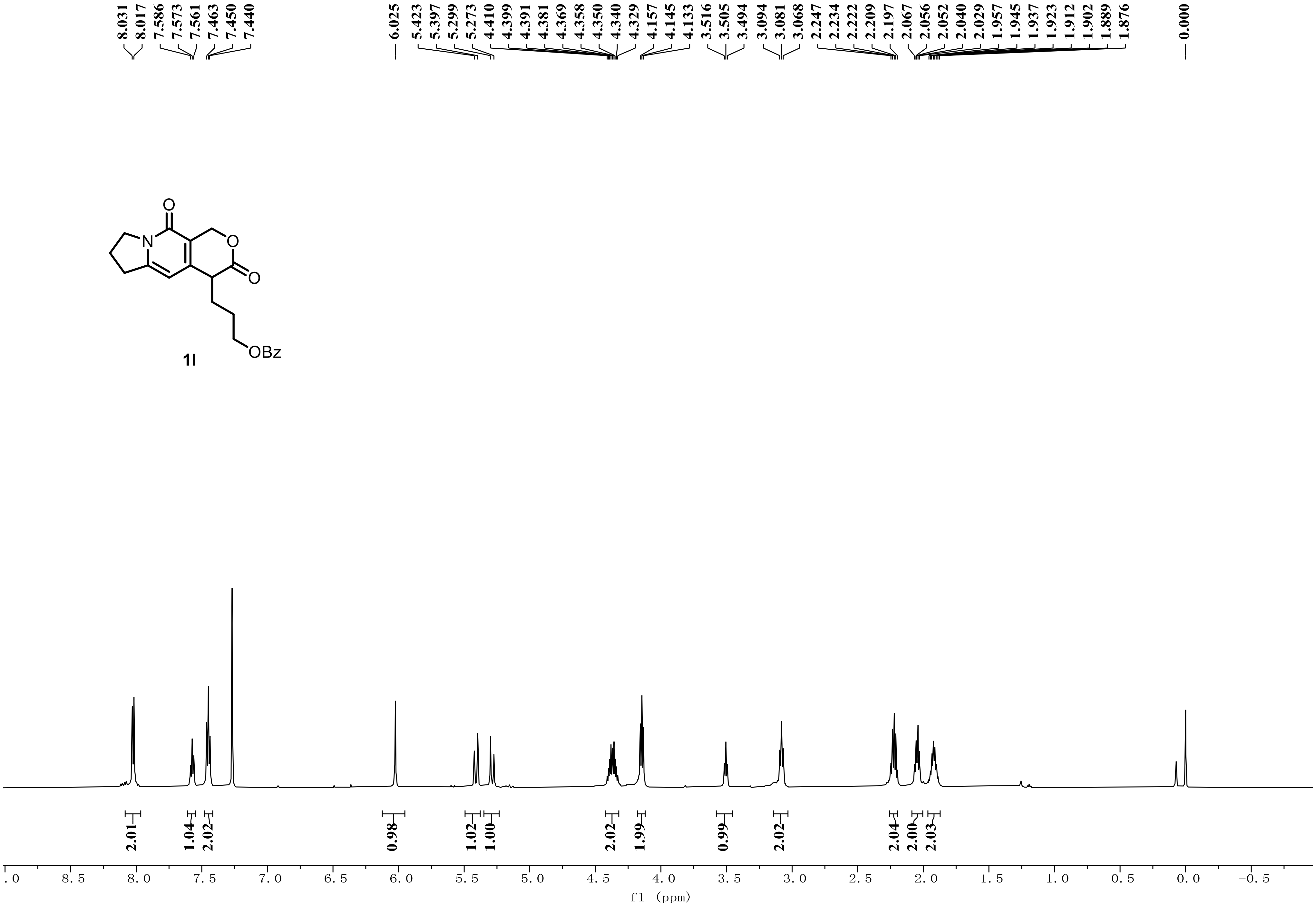
6.058
5.408
5.381
5.267
5.241
4.159
4.146
4.134
3.711
3.703
3.694
3.687
3.678
3.669
3.505
3.494
3.482
3.128
3.115
3.102
2.261
2.248
2.236
2.223
2.210
2.015
2.003
1.990
1.978
1.967
1.730
1.718
1.706
1.693
1.681
1.668
1.656
-0.000
1u
1.00
1.02
1.01
2.03
2.05
1.01
2.05
2.04
2.08
2.01
.5 8.0 7.5 7.0 6.5 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)

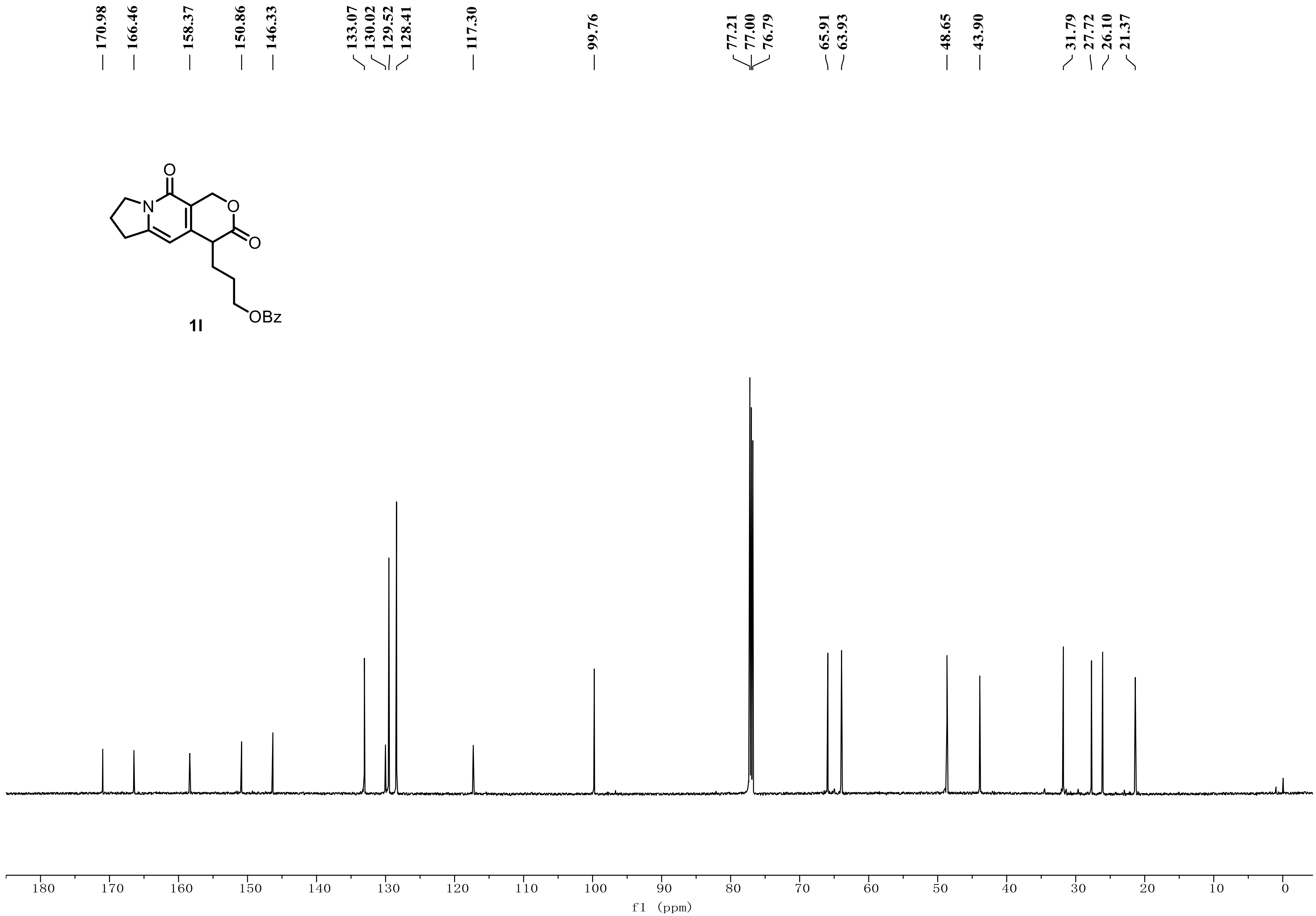

171.49
158.41
150.74
146.79
146.78
117.07
100.09
77.21
77.00
76.79
65.88
61.93
48.65
44.11
31.79
29.57
27.84
21.39
O
N
O
O
OH
1u
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

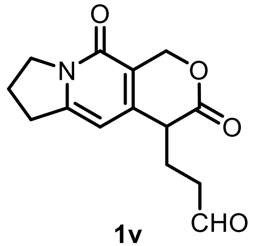

7.260
6.033
5.410
5.371
5.272
5.232
4.161
4.143
4.124
3.649
3.634
3.619
3.466
3.449
3.432
3.116
3.096
3.077
2.261
2.242
2.223
2.205
2.186
1.990
1.972
1.950
1.933
1.671
1.649
1.636
1.620
1.610
1.595
1.580
0.872
0.027
O
N
O
O
OTBS
1k
1.00
1.00
1.01
2.02
2.03
1.02
2.08
2.01
1.98
2.93
9.46
5.99
8.5
8.0
7.5
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
-1.0
-1.
f1 (ppm)



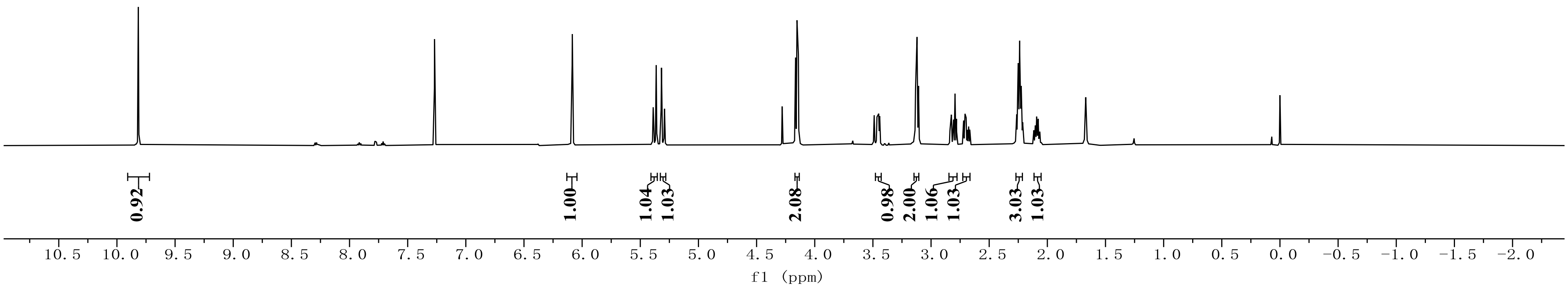
171.42
158.45
150.56
146.95
117.28
100.05
77.21
77.00
76.79
65.84
62.18
48.61
31.80
29.66
27.68
25.88
21.43
18.25
-5.39
OTBS
1k
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

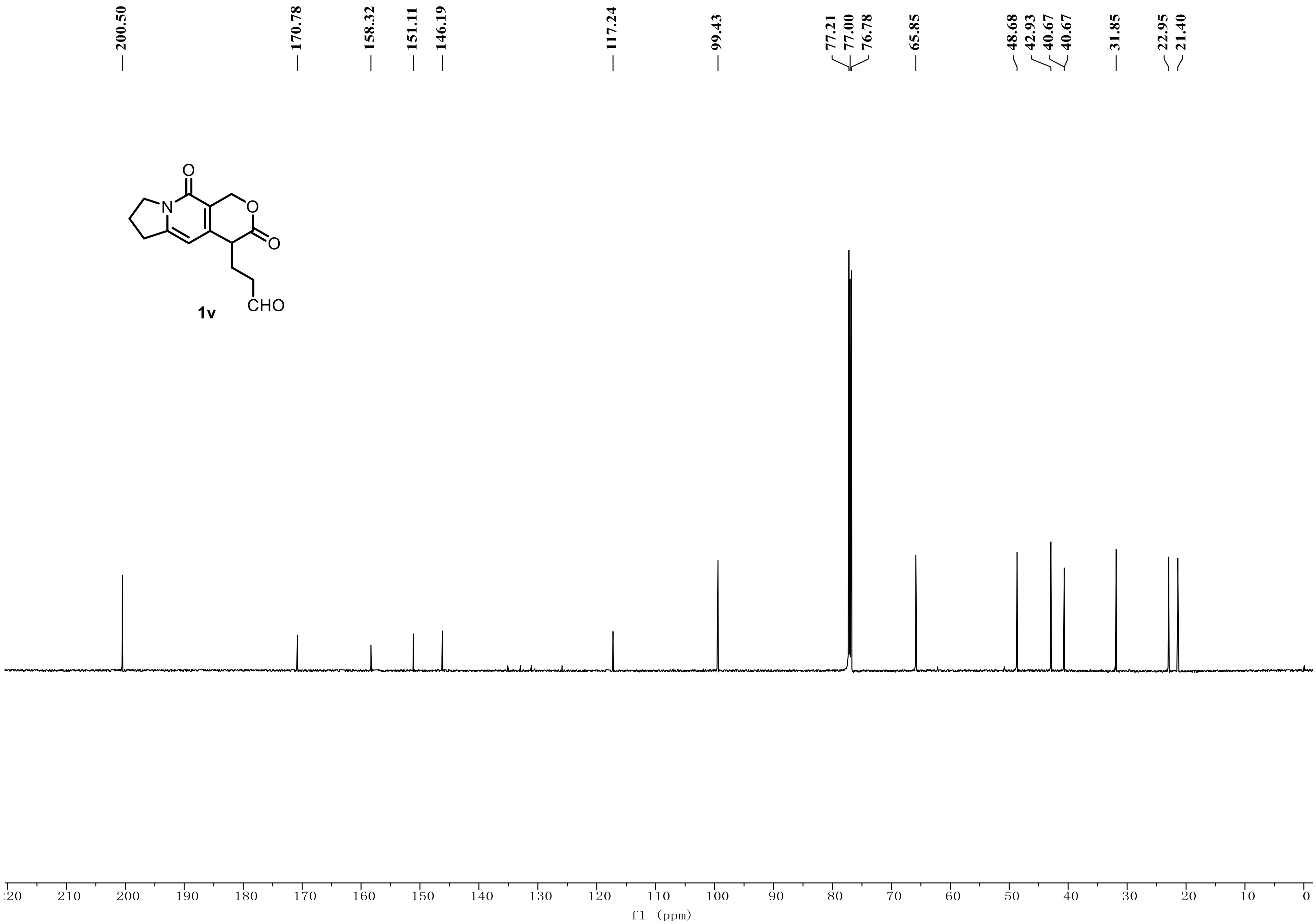

8.031
8.017
7.586
7.573
7.561
7.463
7.450
7.440
6.025
5.423
5.397
5.299
5.273
4.410
4.399
4.391
4.381
4.369
4.358
4.350
4.340
4.329
4.157
4.145
4.133
3.516
3.505
3.494
3.094
3.081
3.068
2.247
2.234
2.222
2.209
2.197
2.067
2.056
2.052
2.040
2.029
1.957
1.945
1.937
1.923
1.912
1.902
1.889
1.876
0.000
O
N
O
O
OBz
1l
2.01
1.04
2.02
0.98
1.02
1.00
2.02
1.99
0.99
2.02
2.04
2.00
2.03
.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)


170.98
166.46
158.37
150.86
146.33
133.07
130.02
129.52
128.41
117.30
99.76
77.21
77.00
76.79
65.91
63.93
48.65
43.90
31.79
27.72
26.10
21.37
O
N
O
O
OBz
1l
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

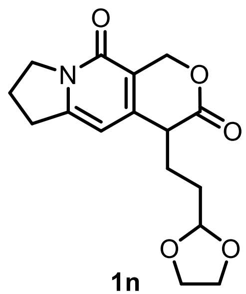


1v

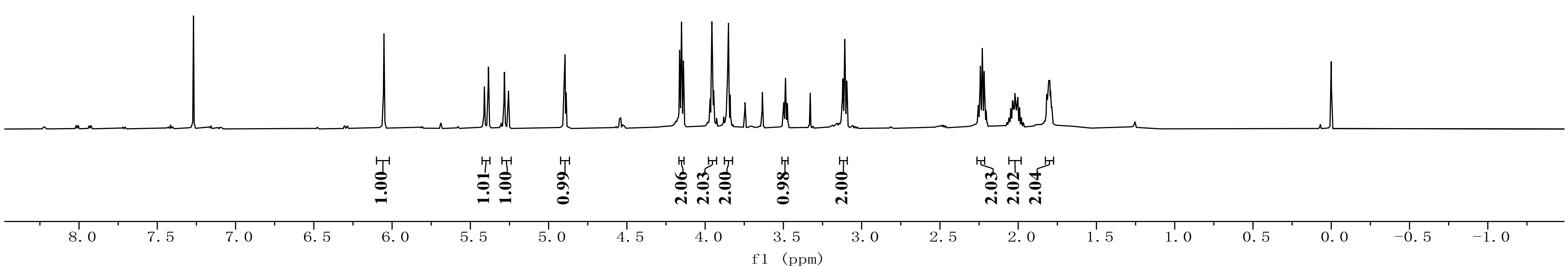

9.816
6.084
5.389
5.363
5.317
5.291
4.165
4.153
4.141
3.465
3.457
3.450
3.441
3.133
3.121
3.108
2.838
2.825
2.813
2.807
2.794
2.781
2.720
2.711
2.698
2.689
2.676
2.667
2.263
2.251
2.238
2.226
2.213
2.116
2.107
2.092
2.088
2.083
2.079
2.071
2.064
2.055
-0.000
0.92
1.00
1.04
1.03
2.08
0.98
2.00
1.06
1.03
3.03
1.03
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
f1 (ppm)

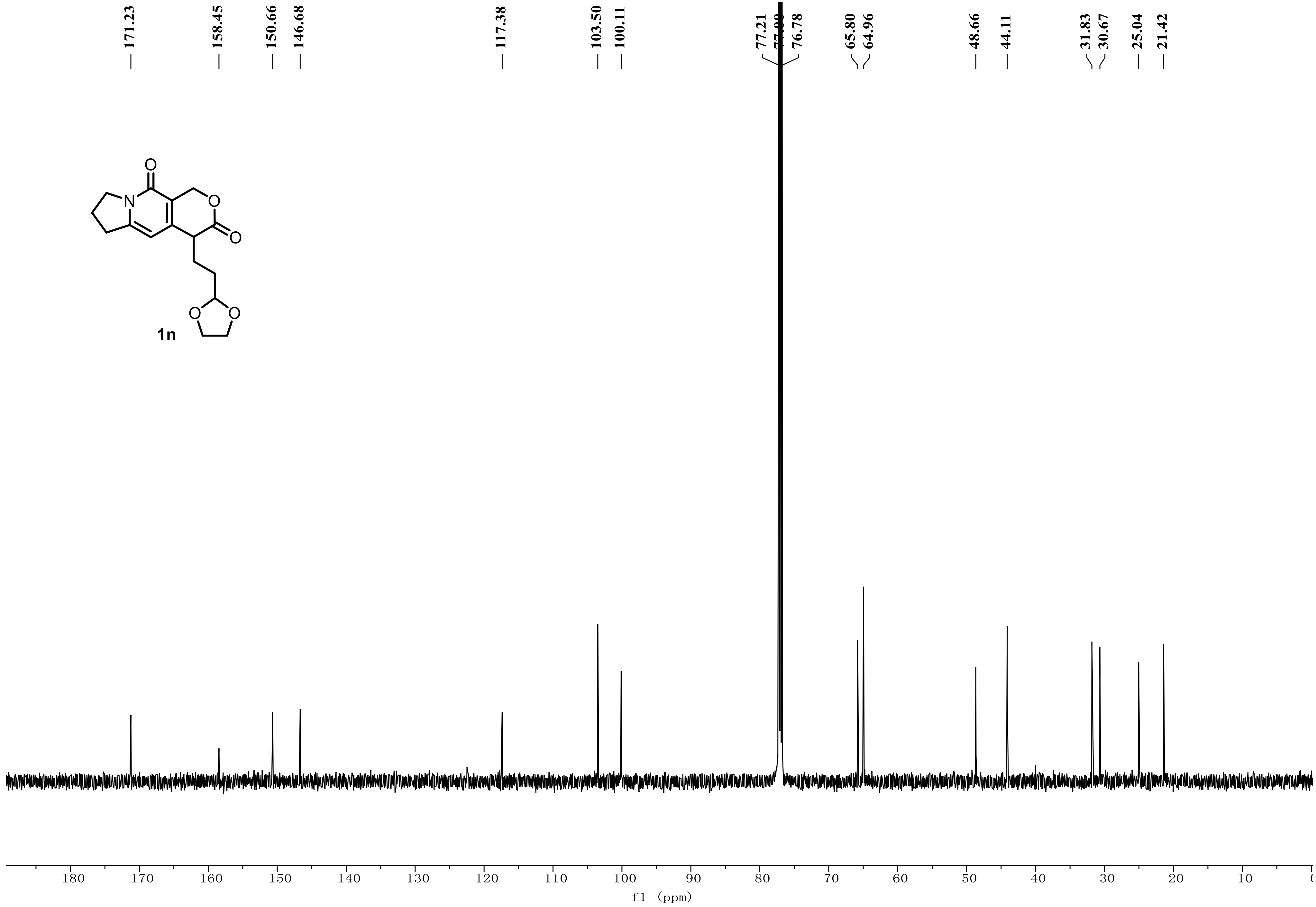


200.50
170.78
158.32
151.11
146.19
117.24
99.43
77.21
77.00
76.78
65.85
48.68
42.93
40.67
40.67
31.85
22.95
21.40
O
N
O
O
CHO
1v
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

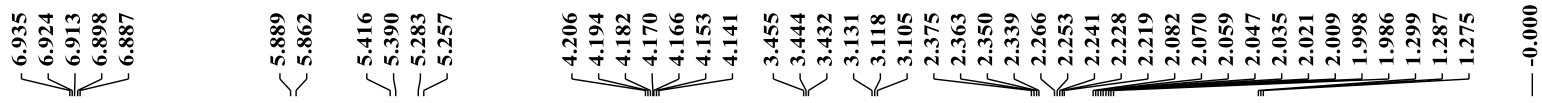


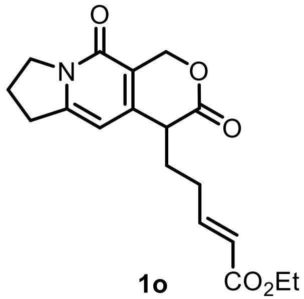
1n


6.084
5.410
5.384
5.282
5.256
4.902
4.895
4.888
4.163
4.151
4.139
3.973
3.961
3.957
3.951
3.945
3.862
3.857
3.851
3.848
3.840
3.498
3.486
3.475
3.121
3.108
3.095
2.255
2.242
2.230
2.217
2.205
2.059
2.048
2.037
2.021
2.002
1.991
1.980
1.818
1.812
1.805
1.801
1.798
1.793
1.790
1.786
1.782
0.000
1.00
1.01
1.00
0.99
2.06
2.03
2.00
0.98
2.00
2.03
2.02
2.04
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
-1.0
f1 (ppm)

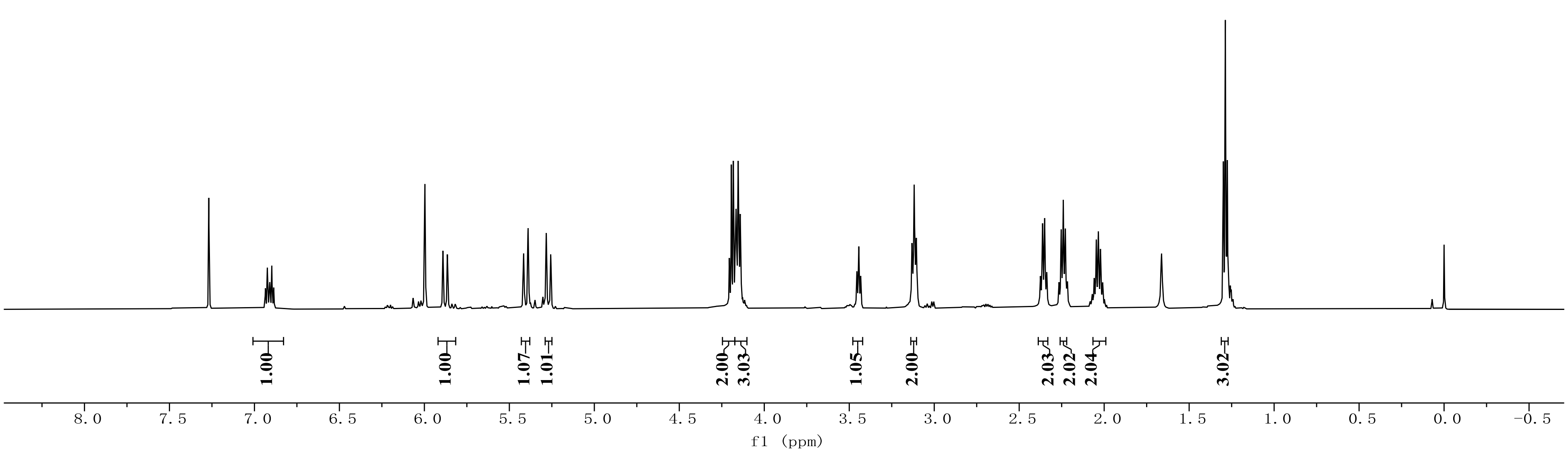


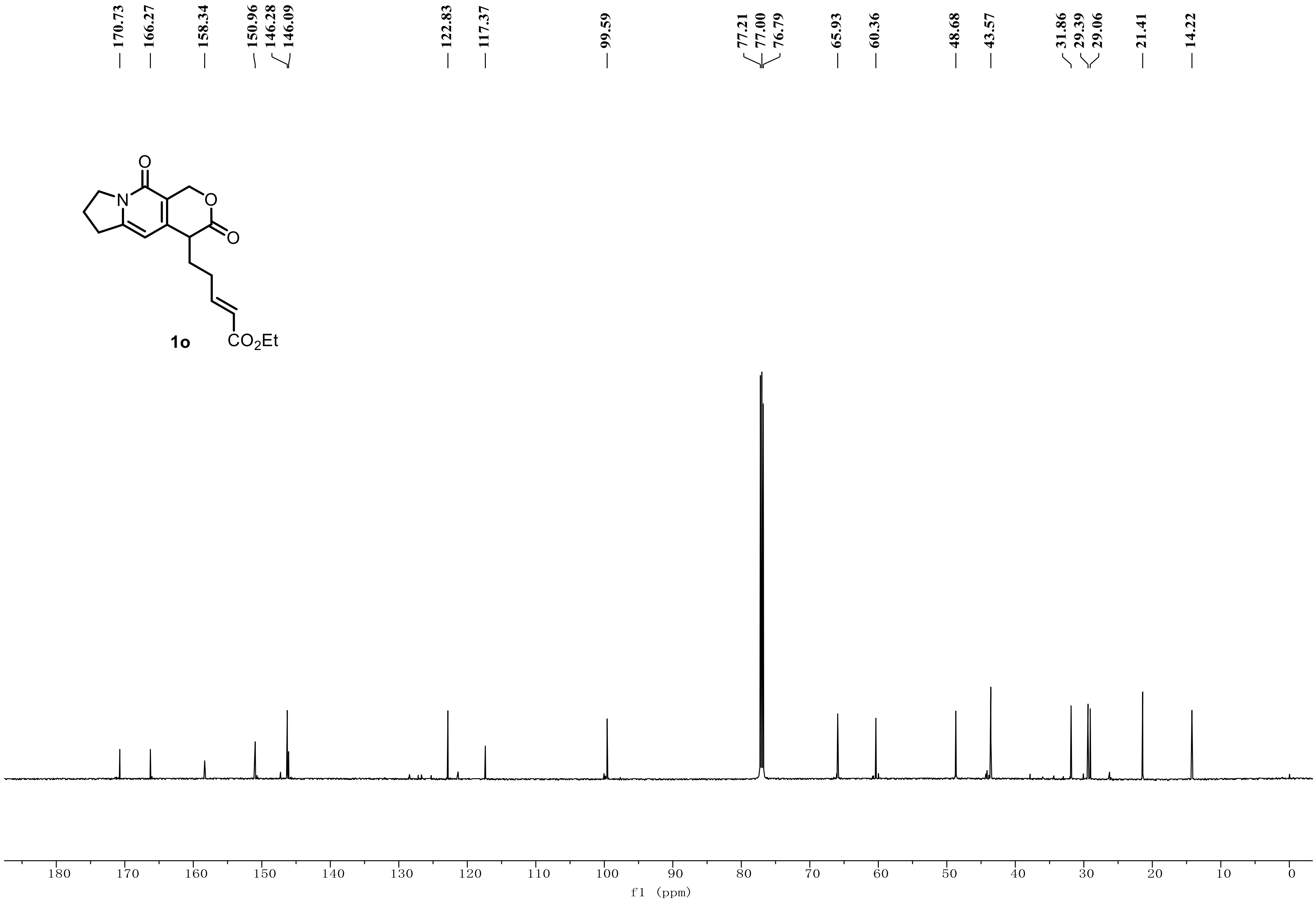
171.23
158.45
150.66
146.68
117.38
103.50
100.11
77.21
77.00
76.78
65.80
64.96
48.66
44.11
31.83
30.67
25.04
21.42
O
N
O
O
O
O
1n
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

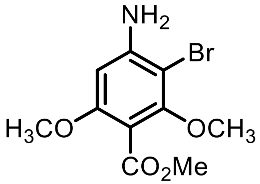

6.935
6.924
6.913
6.898
6.887
5.889
5.862
5.416
5.390
5.283
5.257
4.206
4.194
4.182
4.170
4.166
4.153
4.141
3.455
3.444
3.432
3.131
3.118
3.105
2.375
2.363
2.350
2.339
2.266
2.253
2.241
2.228
2.219
2.082
2.070
2.059
2.047
2.035
2.021
2.009
1.998
1.986
1.299
1.287
1.275
-0.000



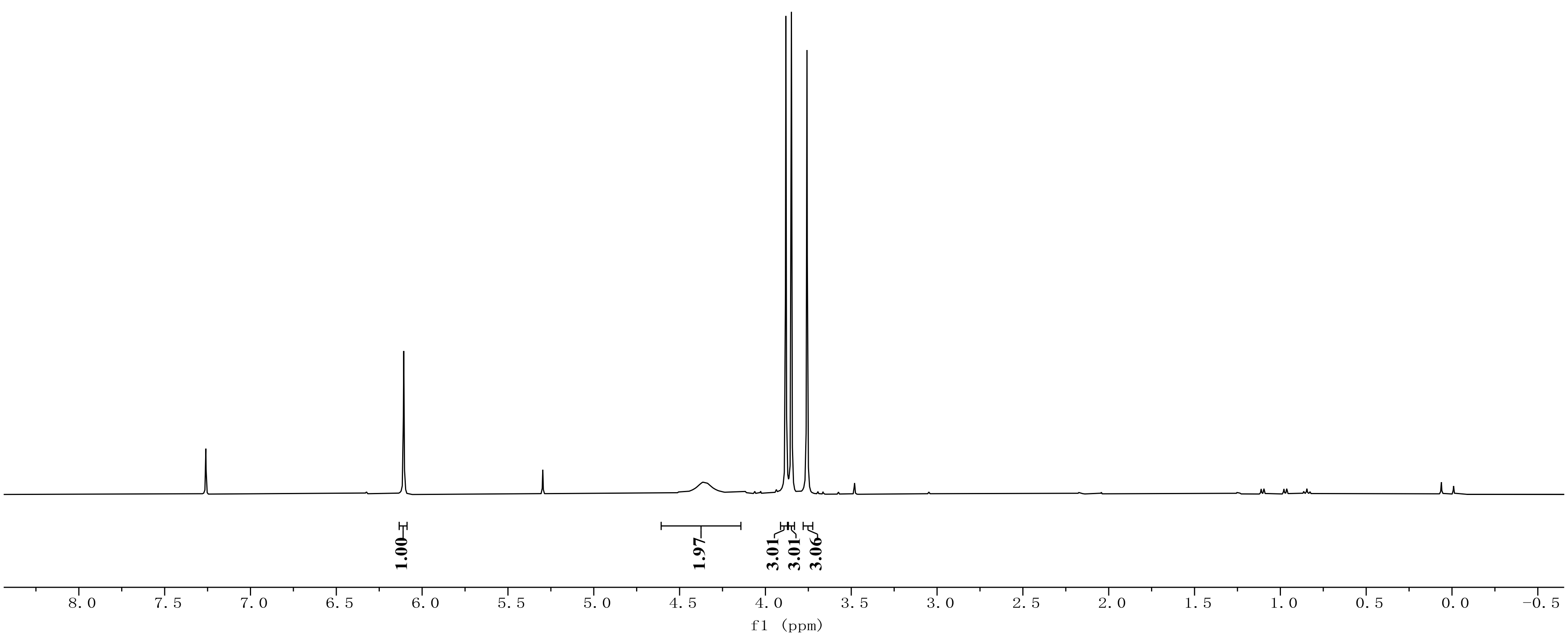
1o

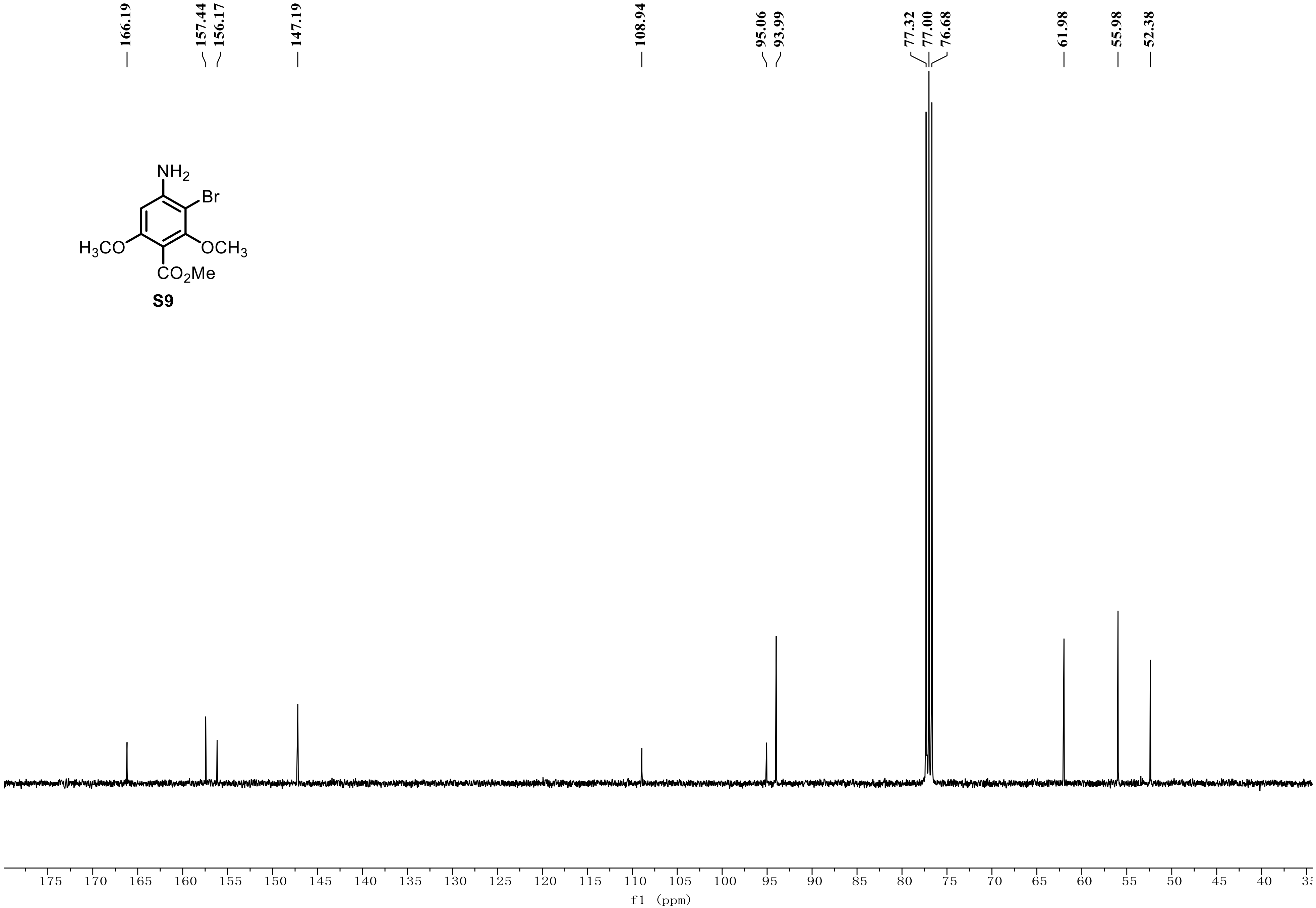

1.00
1.00
1.07
1.01
2.00
3.03
1.05
2.00
2.03
2.02
2.04
3.02
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

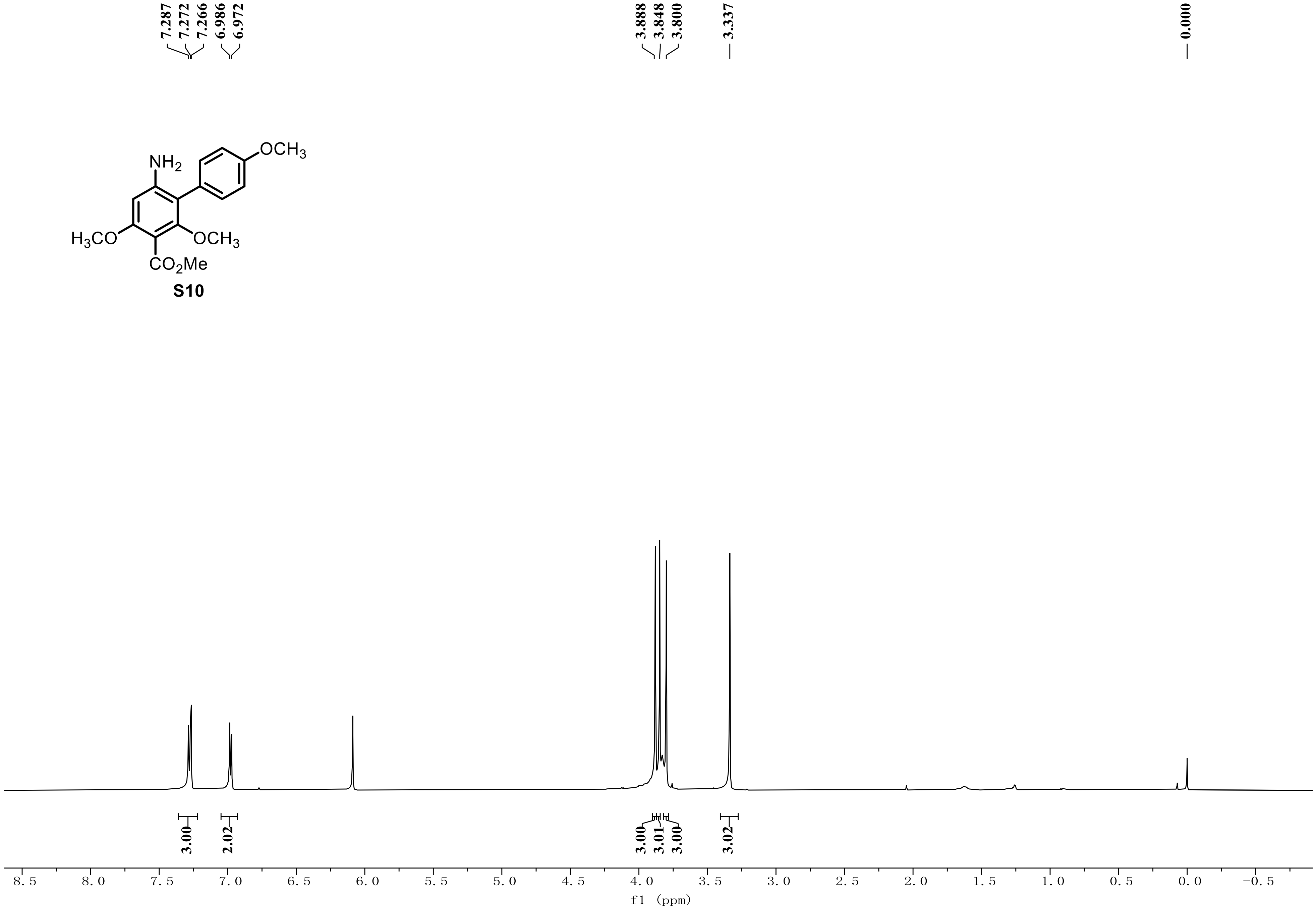

170.73
166.27
158.34
150.96
146.28
146.09
122.83
117.37
99.59
77.21
77.00
76.79
65.93
60.36
48.68
43.57
31.86
29.39
29.06
21.41
14.22
O
N
O
O
CO2Et
1o
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


NH2
Br
H3CO
OCH3
CO2Me

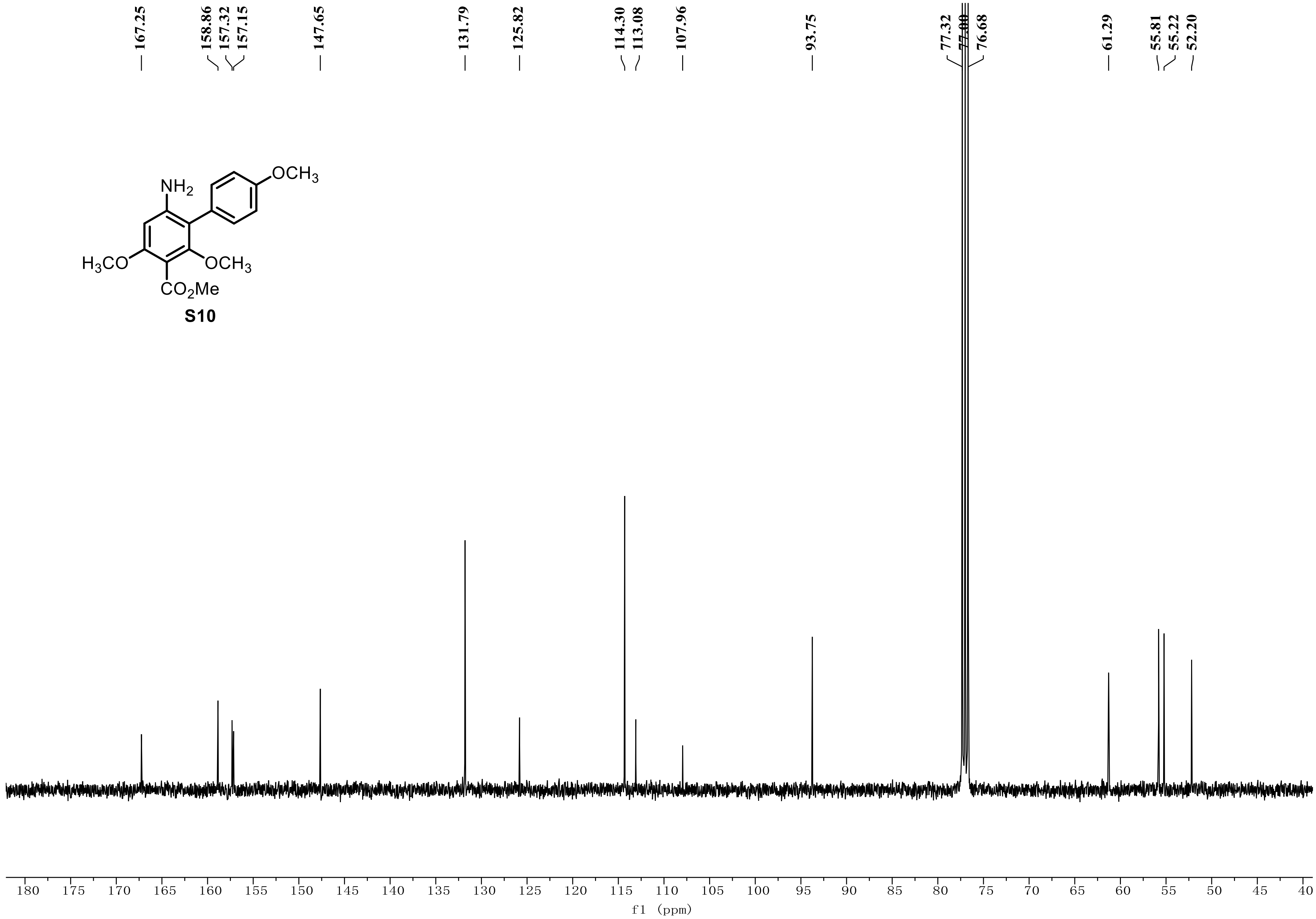
S9

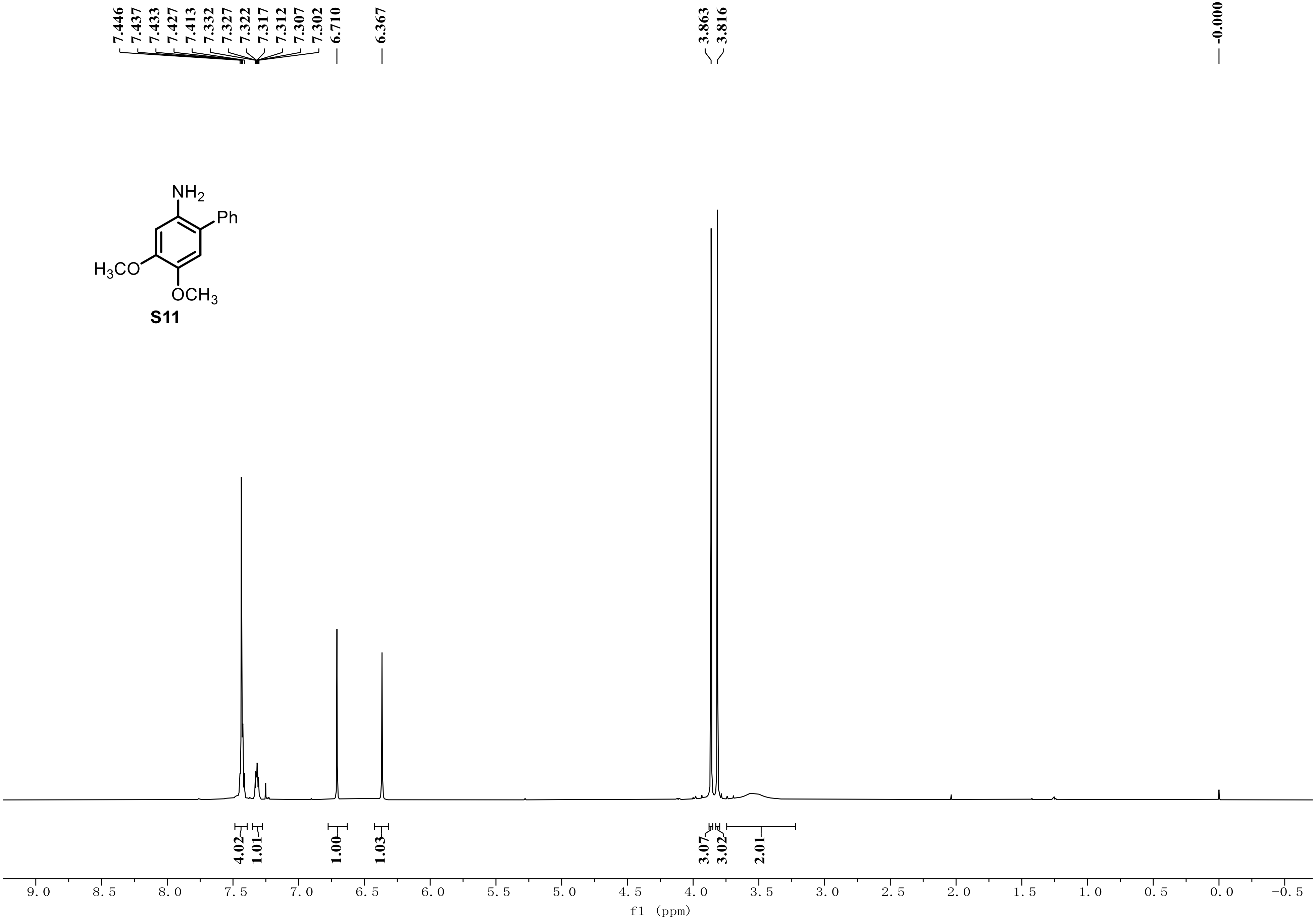

7.260
6.107
4.356
3.881
3.849
3.758
1.00
1.97
3.01
3.01
3.06
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


166.19
157.44
156.17
147.19
108.94
95.06
93.99
77.32
77.00
76.68
61.98
55.98
52.38
NH2
Br
H3CO
OCH3
CO2Me
S9
175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35
f1 (ppm)



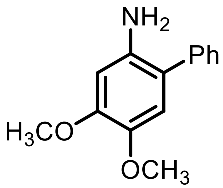
7.287
7.272
7.266
6.986
6.972
3.888
3.848
3.800
3.337
0.000
NH2
OCH3
H3CO
OCH3
CO2Me
S10
3.00
2.02
3.00
3.01
3.00
3.02
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


167.25
158.86
157.32
157.15
147.65
131.79
125.82
114.30
113.08
107.96
93.75
77.32
77.00
76.68
61.29
55.81
55.22
52.20
NH_2
OCH_3
H_3CO
OCH_3
CO_2Me
S10
180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40
f1 (ppm)

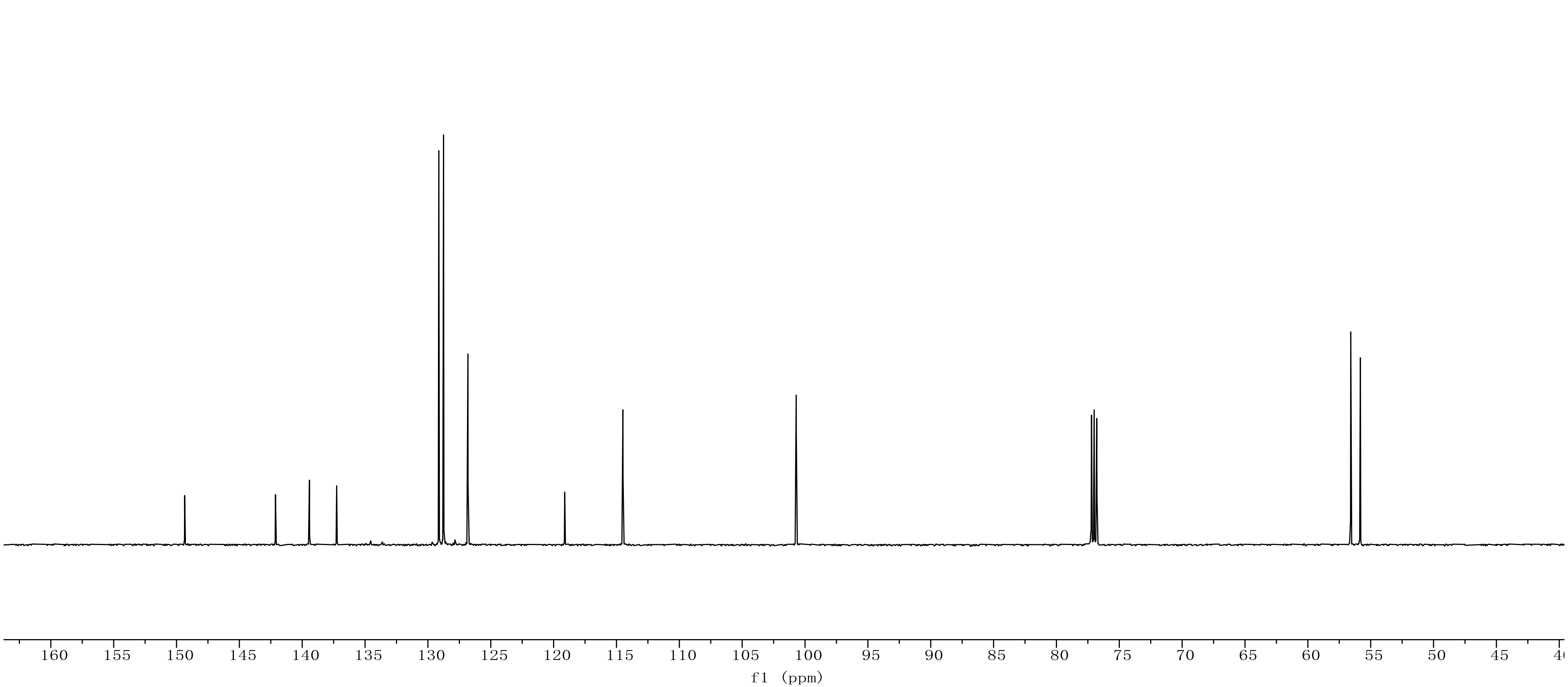


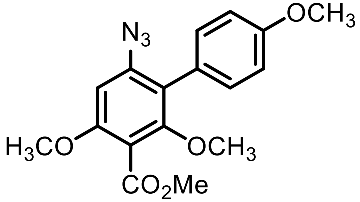
7.446
7.437
7.433
7.427
7.413
7.332
7.327
7.322
7.317
7.312
7.307
7.302
6.710
6.367
3.863
3.816
-0.000
4.02
1.01
1.00
1.03
3.07
3.02
2.01
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

S11

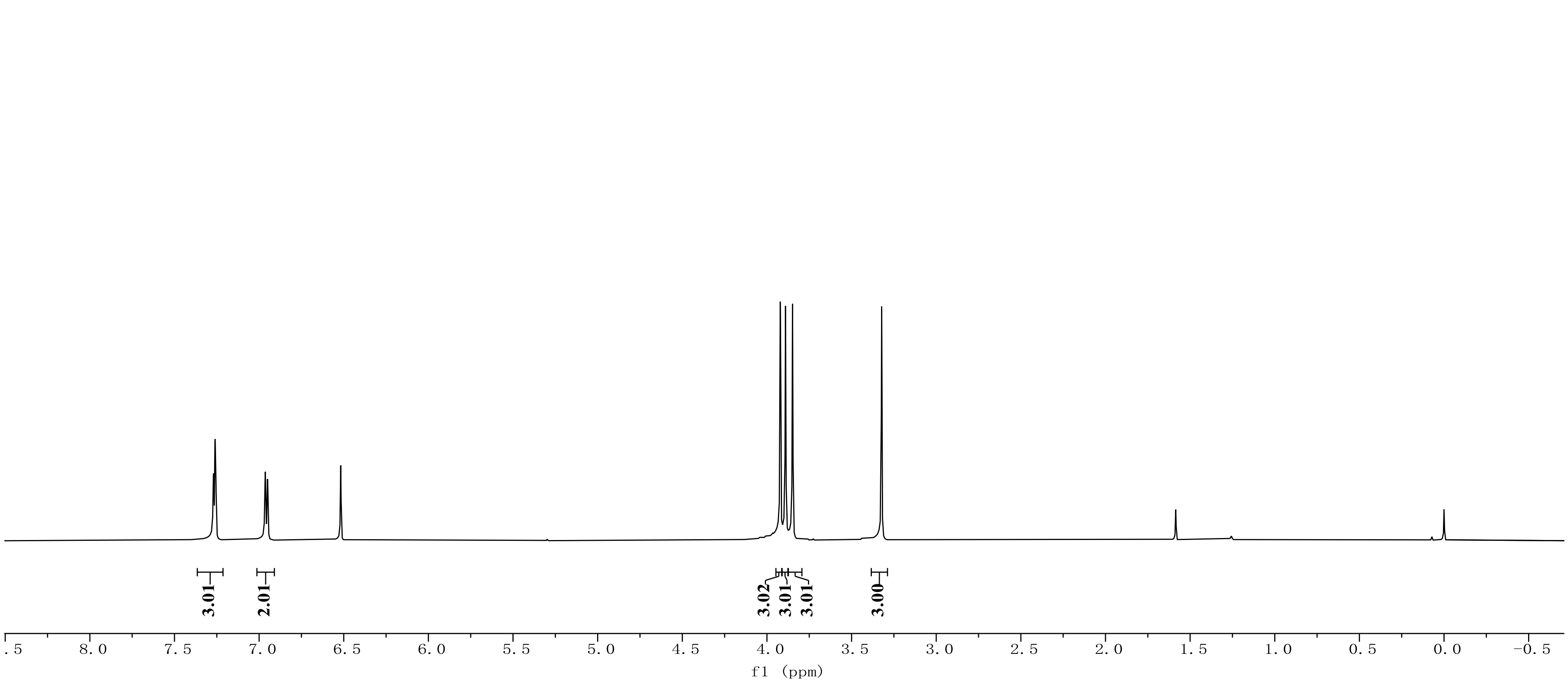

NH2
Ph
H3CO
OCH3

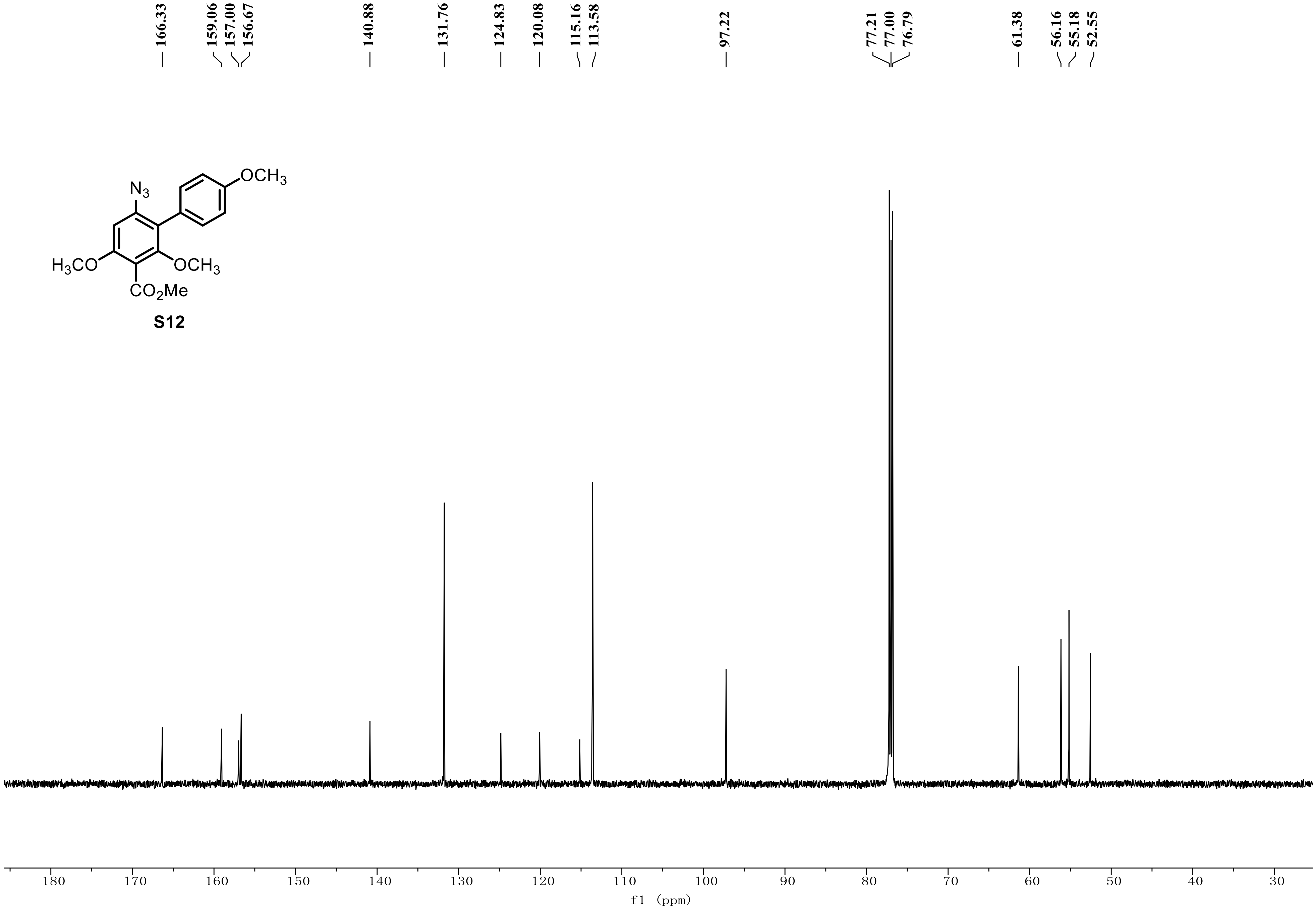
S11


149.35
142.13
139.42
137.26
129.13
128.76
126.82
119.12
114.49
100.70
77.21
77.00
76.79
56.59
55.82
160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45
f1 (ppm)

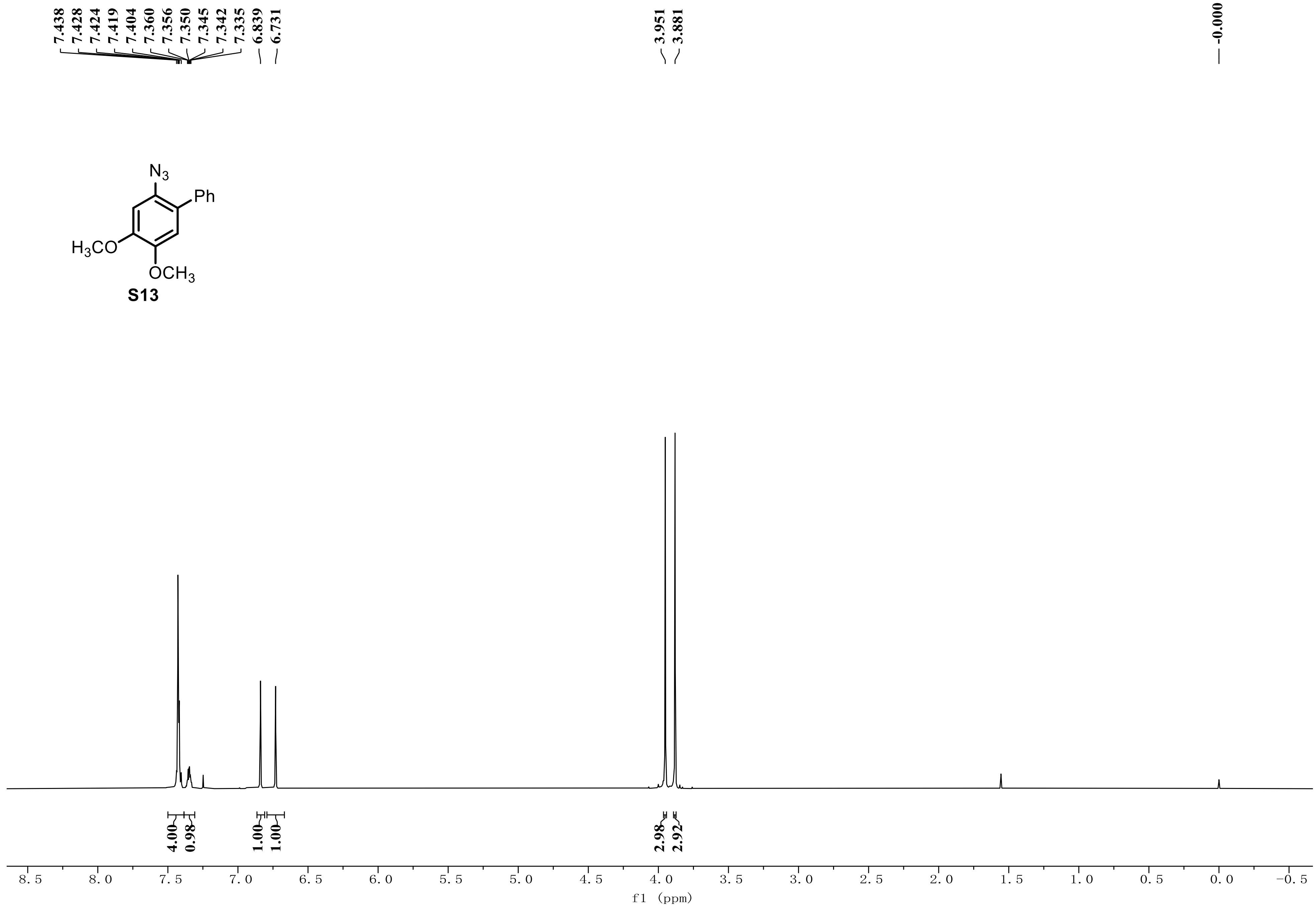

N3
OCH3
H3CO
OCH3
CO2Me

S12

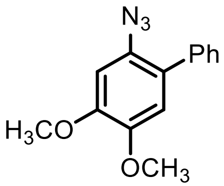

7.271
7.269
7.261
7.259
7.256
6.963
6.951
3.922
3.891
3.849
3.323
0.000
3.01
2.01
3.02
3.01
3.01
3.00
.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)



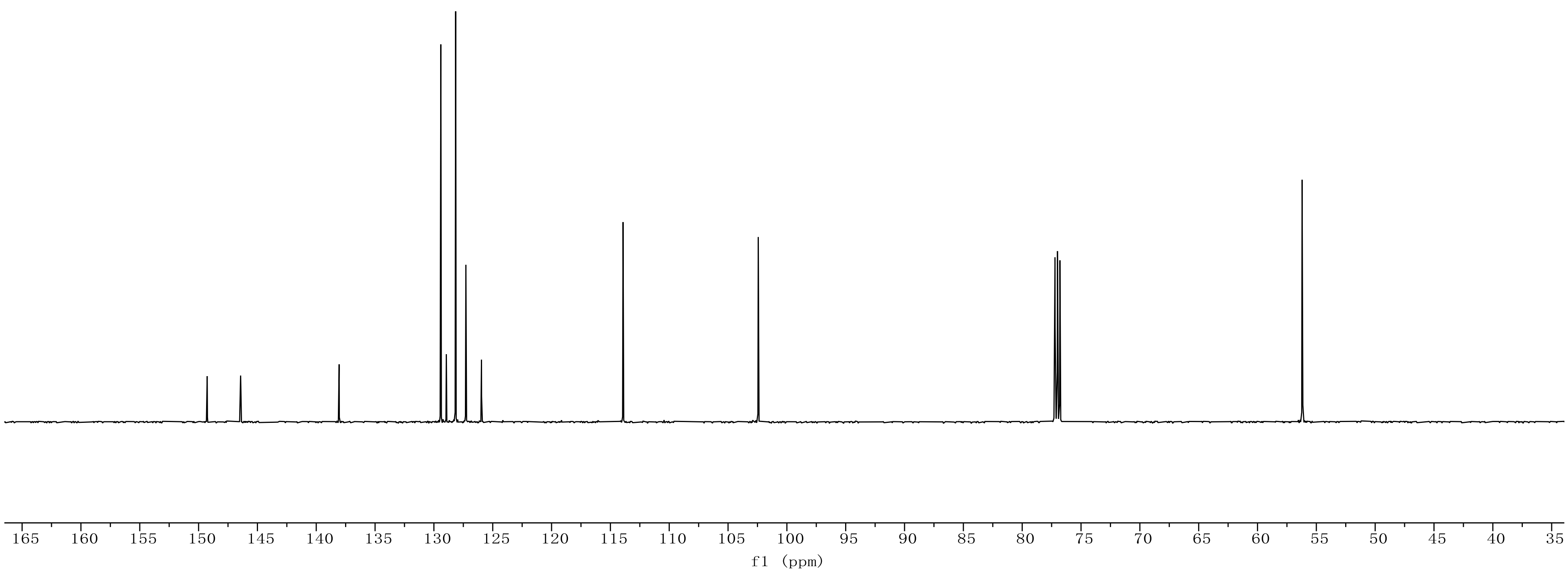
N_3
OCH_3
H_3CO
OCH_3
CO_2Me
S12
166.33
159.06
157.00
156.67
140.88
131.76
124.83
120.08
115.16
113.58
97.22
77.21
77.00
76.79
61.38
56.16
55.18
52.55
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30
f1 (ppm)

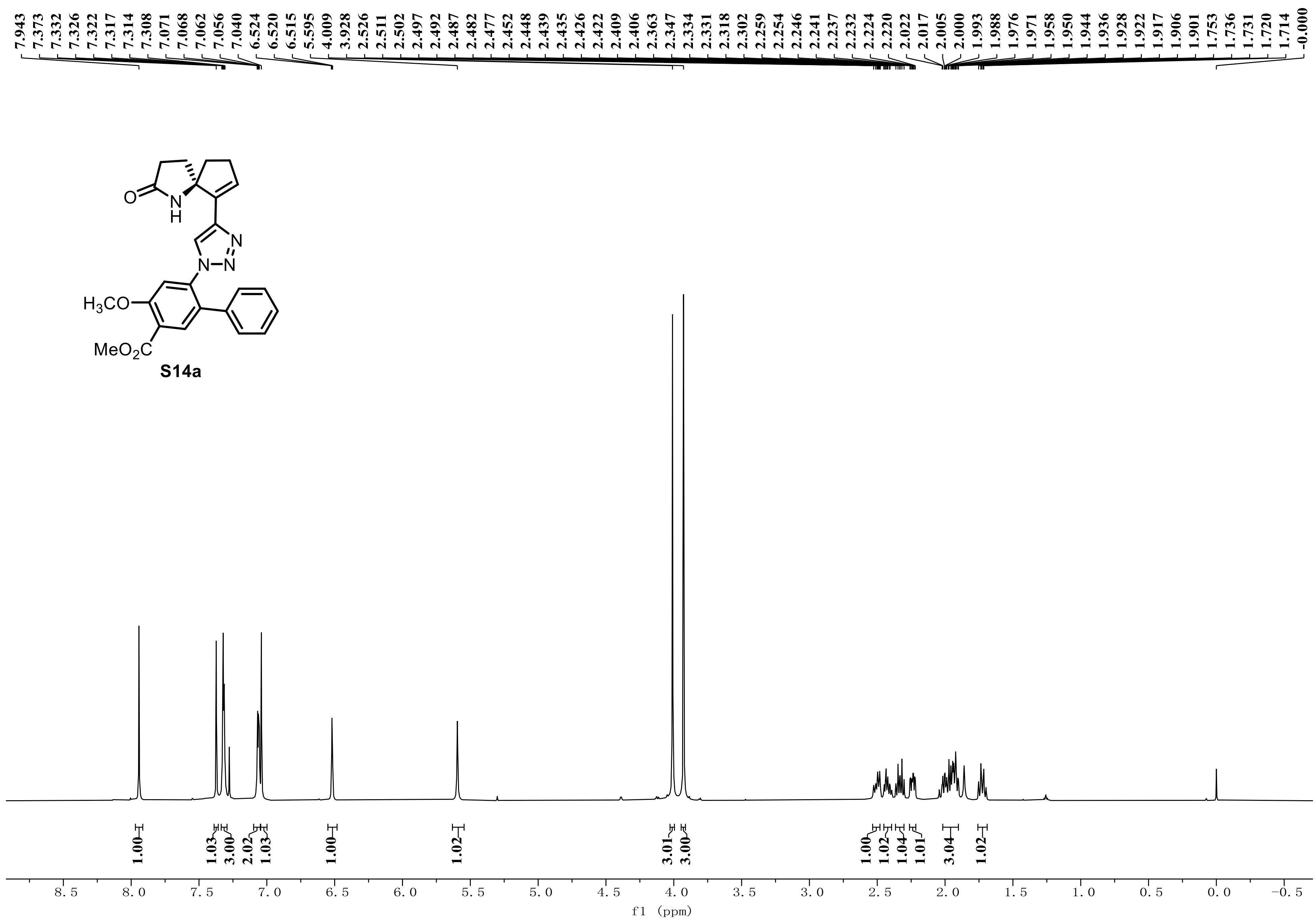


7.438
7.428
7.424
7.419
7.404
7.360
7.356
7.350
7.345
7.342
7.335
6.839
6.731
3.951
3.881
-0.000
N3
Ph
H3CO
OCH3
S13
4.00
0.98
1.00
1.00
2.98
2.92
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)



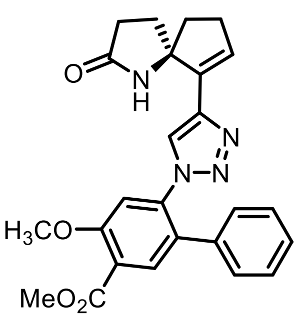
S13


149.26
146.42
138.06
129.41
128.94
128.15
127.28
125.96
113.92
102.43
77.21
77.00
76.79
56.21
56.17
165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35
f1 (ppm)

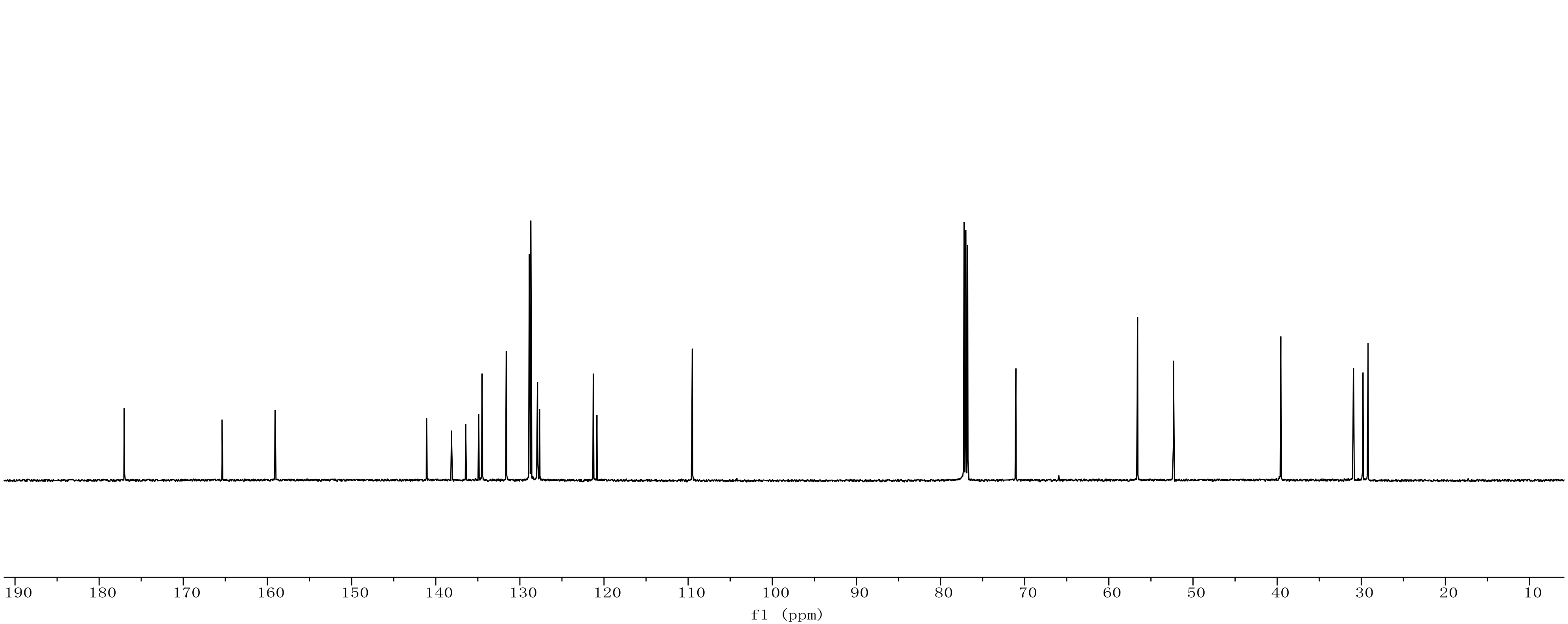


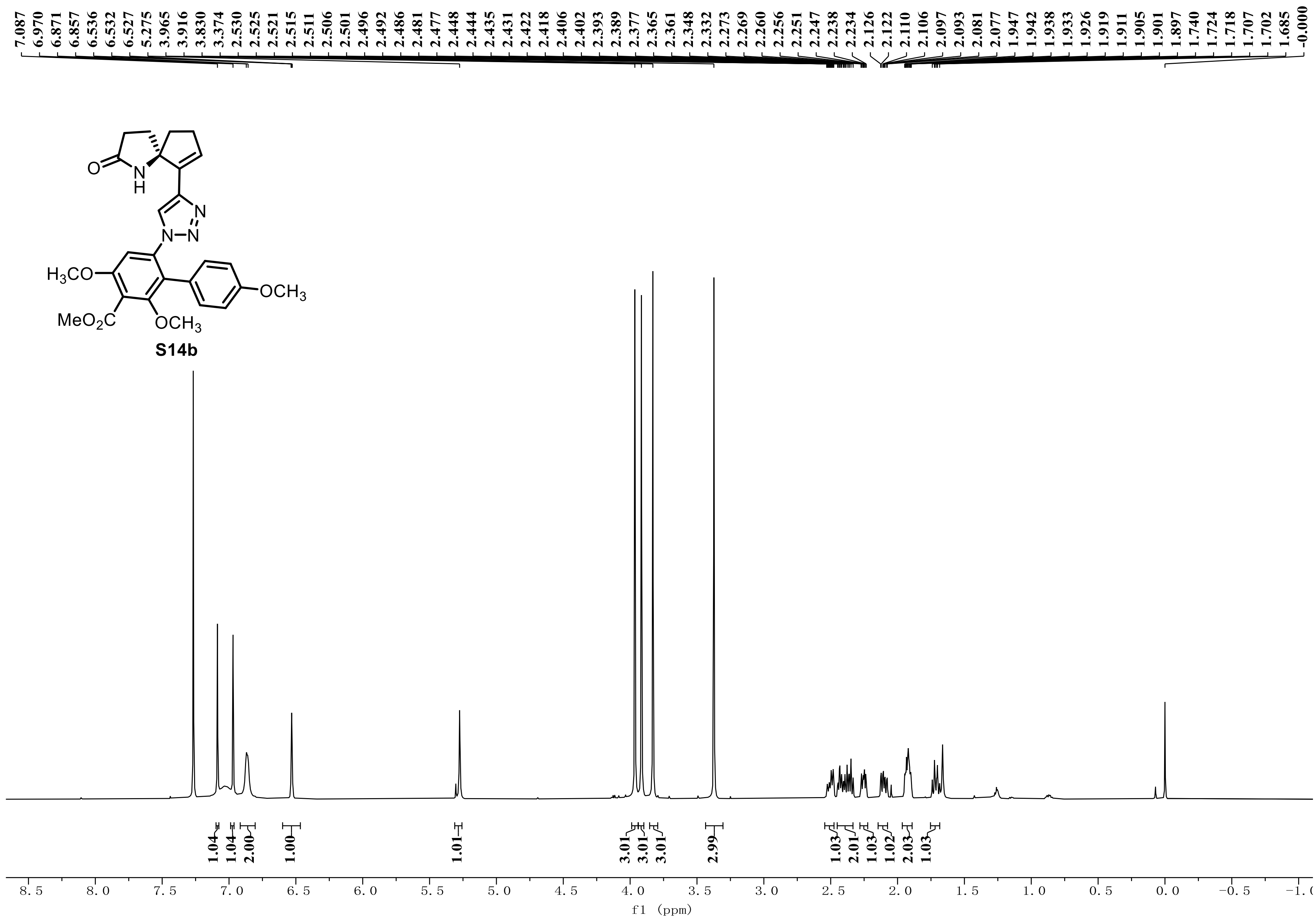
7.943
7.373
7.332
7.326
7.322
7.317
7.314
7.308
7.071
7.068
7.062
7.056
7.040
6.524
6.520
6.515
5.595
4.009
3.928
2.526
2.511
2.502
2.497
2.492
2.487
2.482
2.477
2.452
2.448
2.439
2.435
2.426
2.422
2.409
2.406
2.363
2.347
2.334
2.331
2.318
2.302
2.259
2.254
2.246
2.241
2.237
2.232
2.224
2.220
2.022
2.017
2.005
2.000
1.993
1.988
1.976
1.971
1.958
1.950
1.944
1.936
1.928
1.922
1.917
1.906
1.901
1.753
1.736
1.731
1.720
1.714
-0.000
1.00
1.03
3.00
2.02
1.03
1.00
1.02
3.01
3.00
1.00
1.02
1.04
1.01
3.04
1.02
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)
O
N
H
N
N
N
H_3CO
MeO_2C

S14a

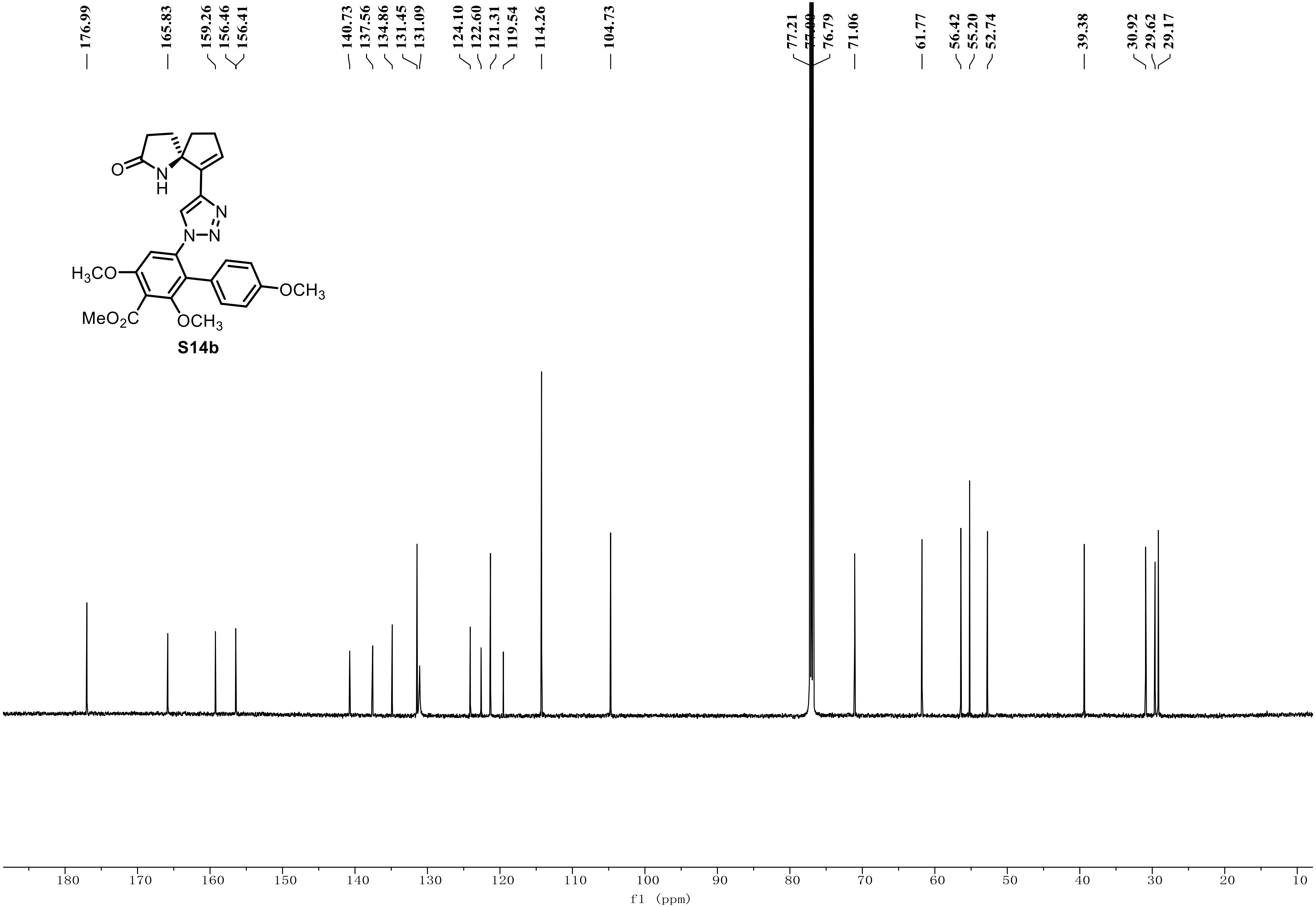

O
N
H
N
N
N
H3CO
MeO2C

S14a

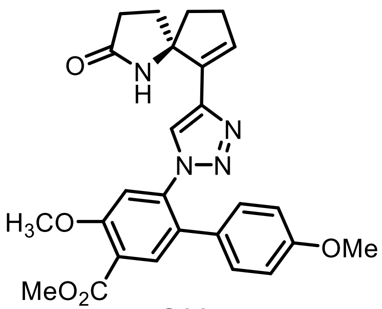

177.02
165.39
159.10
141.09
138.12
136.45
134.89
134.48
131.61
128.87
128.70
127.90
127.64
121.27
120.84
109.51
77.21
77.00
76.97
76.79
71.05
56.58
52.33
39.56
30.92
29.80
29.19
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


7.087
6.970
6.871
6.857
6.536
6.532
6.527
5.275
3.965
3.916
3.830
3.374
2.530
2.525
2.521
2.515
2.511
2.506
2.501
2.496
2.492
2.486
2.481
2.477
2.448
2.444
2.435
2.431
2.422
2.418
2.406
2.402
2.393
2.389
2.377
2.365
2.361
2.348
2.332
2.273
2.269
2.260
2.256
2.251
2.247
2.238
2.234
2.126
2.122
2.110
2.106
2.097
2.093
2.081
2.077
1.947
1.942
1.938
1.933
1.926
1.919
1.911
1.905
1.901
1.897
1.740
1.724
1.718
1.707
1.702
1.685
-0.000
O
N
H
N
N
N
H_3CO
OCH_3
MeO_2C
OCH_3
1.04
1.04
2.00
1.00
1.01
3.01
3.01
3.01
2.99
1.03
2.01
1.03
1.02
2.03
1.03
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
-1.0
f1 (ppm)

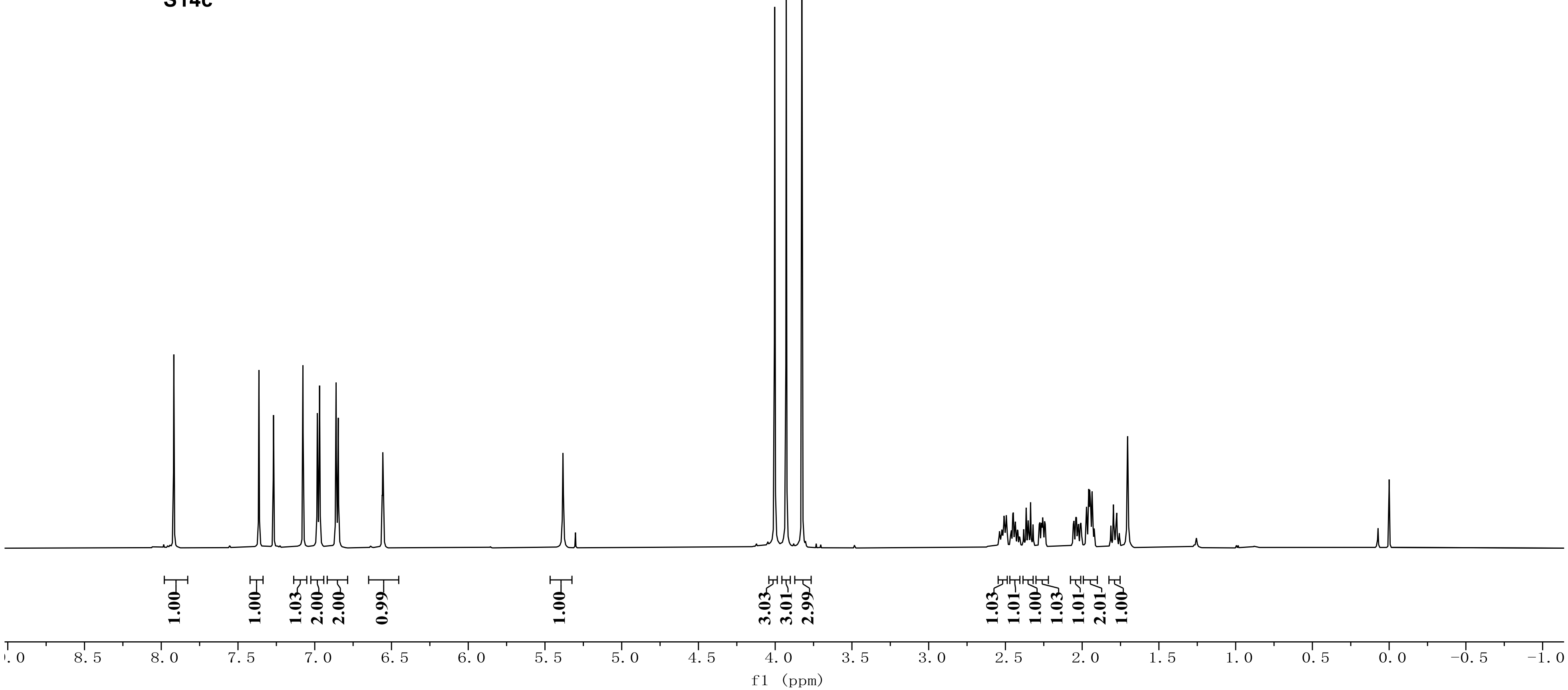
S14b



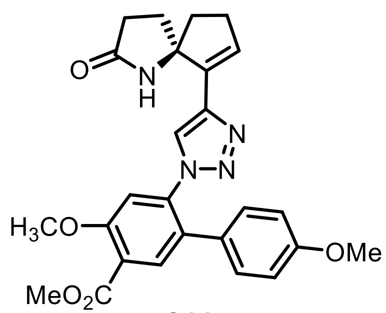
176.99
165.83
159.26
156.46
156.41
140.73
137.56
134.86
131.45
131.09
124.10
122.60
121.31
119.54
114.26
104.73
77.21
77.00
76.79
71.06
61.77
56.42
55.20
52.74
39.38
30.92
29.62
29.17
O
N
H
N
N
N
H_3CO
OCH_3
MeO_2C
OCH_3
S14b
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



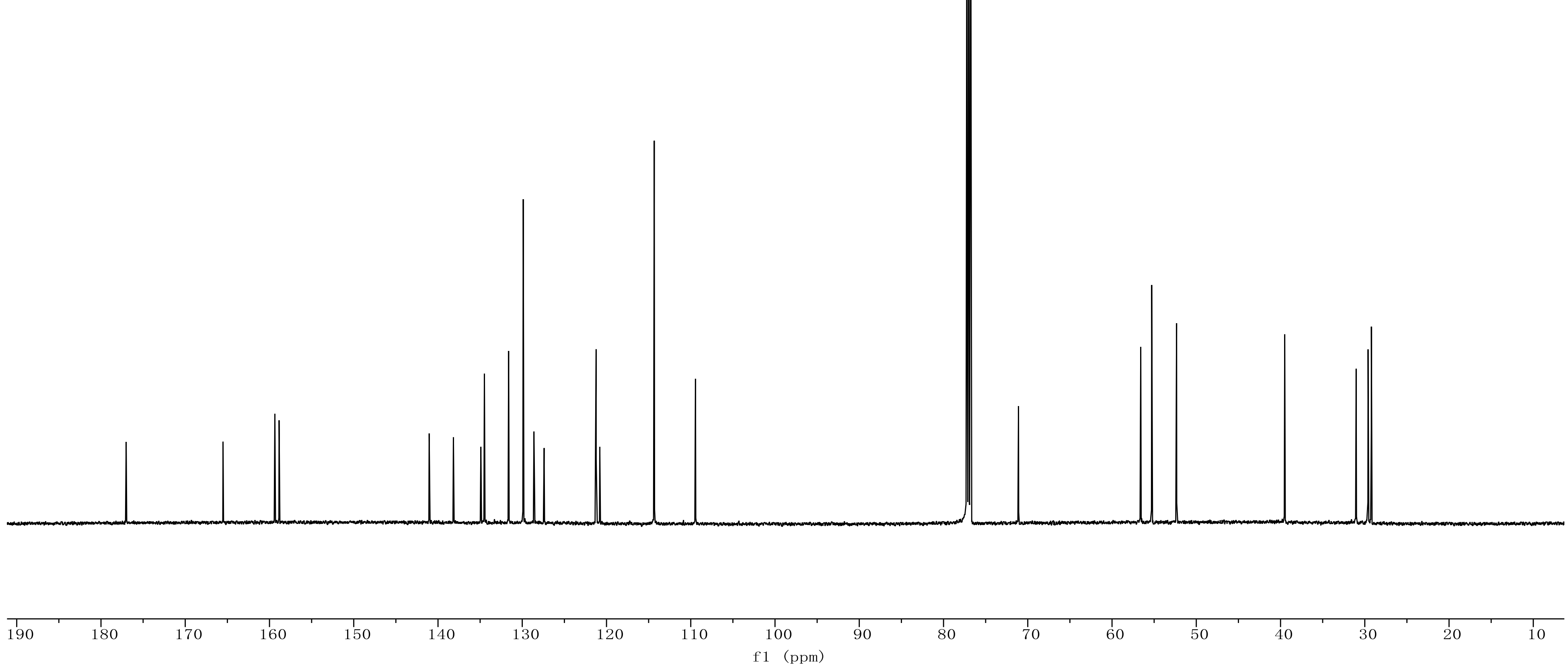
S14c



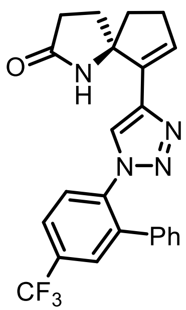
7.918
7.364
7.269
7.077
6.983
6.969
6.861
6.847
6.561
6.556
6.552
5.383
4.003
3.928
3.826
2.543
2.538
2.534
2.528
2.523
2.519
2.514
2.509
2.505
2.499
2.494
2.490
2.465
2.461
2.452
2.448
2.439
2.435
2.423
2.419
2.410
2.381
2.365
2.352
2.349
2.336
2.320
2.279
2.275
2.266
2.262
2.257
2.253
2.244
2.240
2.058
2.053
2.042
2.037
2.029
2.025
2.013
2.008
1.972
1.957
1.951
1.945
1.935
1.930
1.922
1.813
1.796
1.791
1.780
1.774
1.758
0.000
1.00
1.00
1.03
2.00
2.00
0.99
1.00
3.03
3.01
2.99
1.03
1.01
1.00
1.03
1.01
2.01
1.00
f1 (ppm)



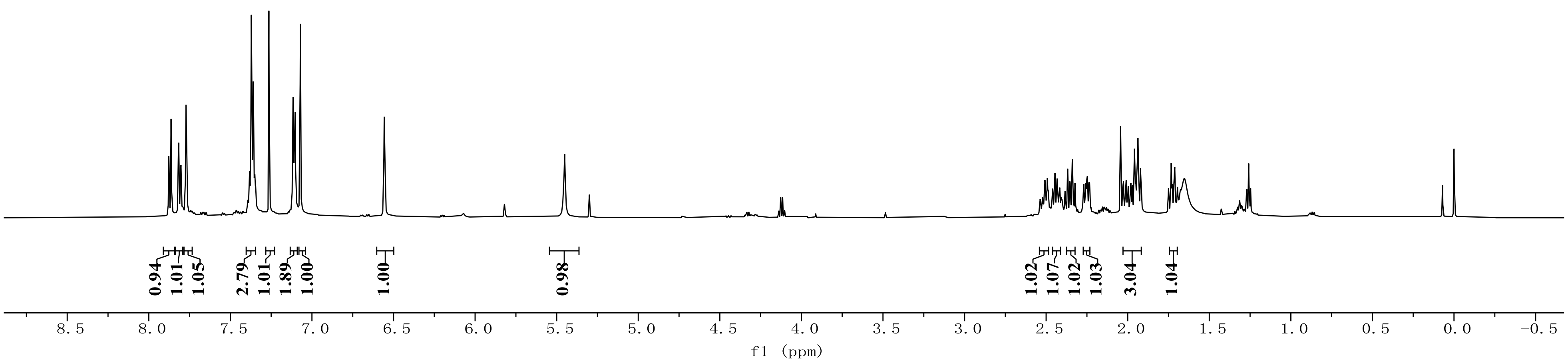
S14c

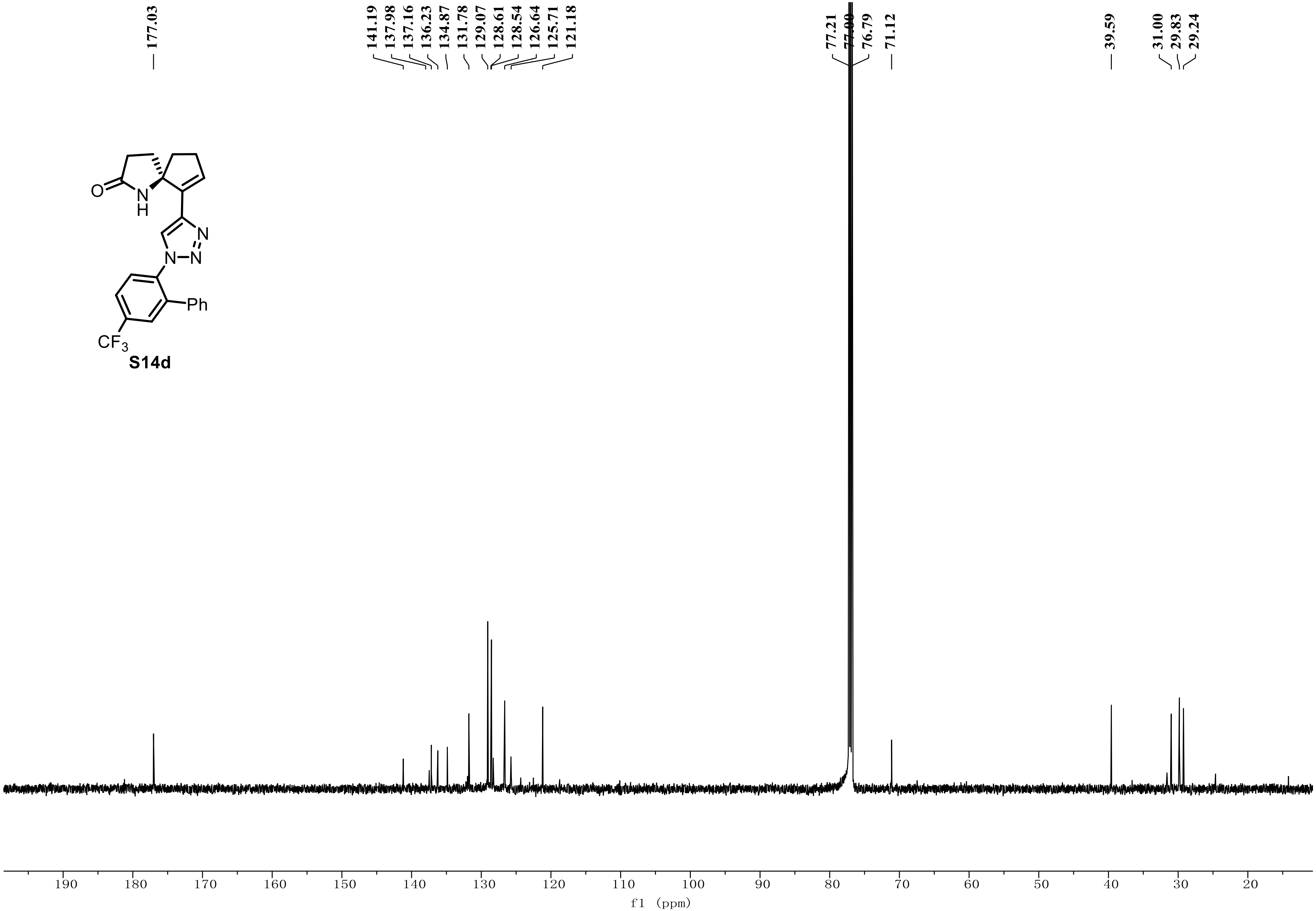

177.01
165.51
159.36
158.86
141.05
138.17
134.91
134.50
131.61
129.89
128.61
127.41
121.23
120.80
114.33
109.45
77.21
77.00
76.79
71.10
56.59
55.29
52.34
39.50
31.02
29.61
29.22
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

7.877
7.864
7.816
7.802
7.773
7.392
7.382
7.372
7.357
7.350
7.345
7.264
7.119
7.116
7.106
7.103
7.071
6.562
6.557
6.553
5.451
2.541
2.526
2.522
2.517
2.512
2.508
2.503
2.497
2.493
2.488
2.404
2.384
2.368
2.352
2.339
2.323
2.273
2.269
2.260
2.256
2.251
2.247
2.238
2.234
2.031
2.026
2.014
2.009
2.002
1.997
1.985
1.981
1.972
1.958
1.951
1.944
1.933
1.922
1.917
1.750
1.734
1.728
1.717
1.711
1.695
-0.000



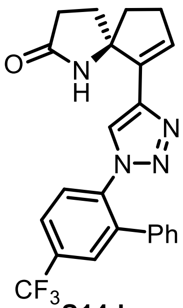
S14d



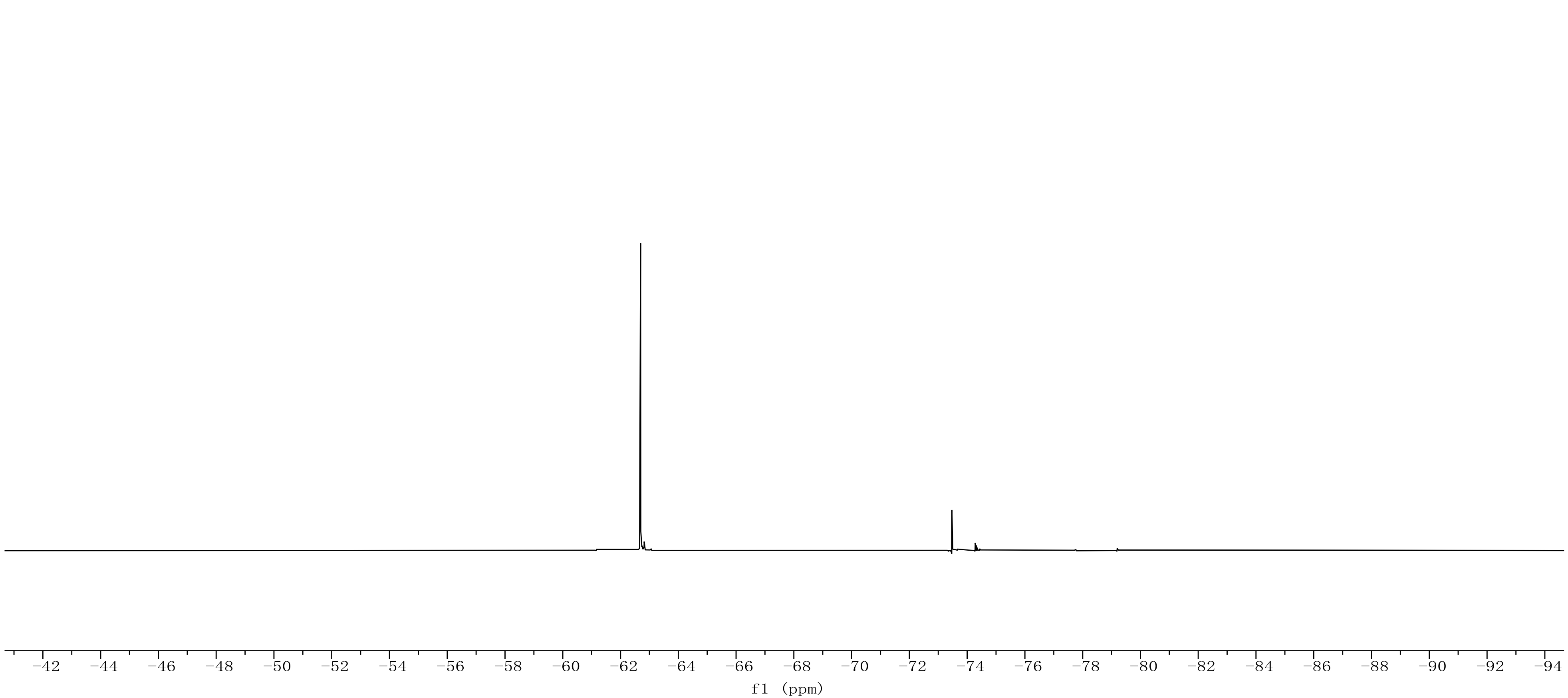


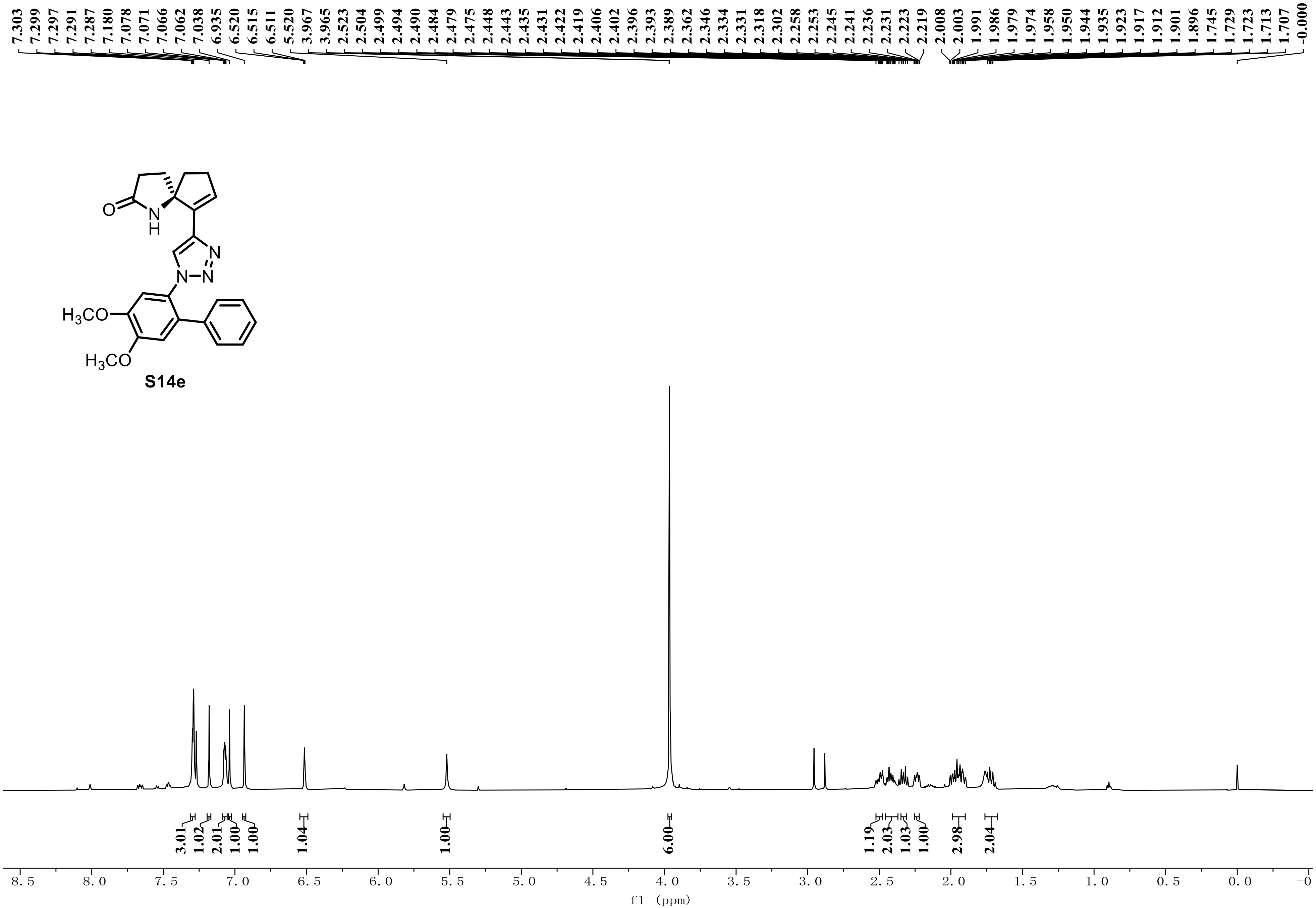
177.03
141.19
137.98
137.16
136.23
134.87
131.78
129.07
128.61
128.54
126.64
125.71
121.18
77.21
77.00
76.79
71.12
39.59
31.00
29.83
29.24
O
N
H
N
N
N
Ph
CF_3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

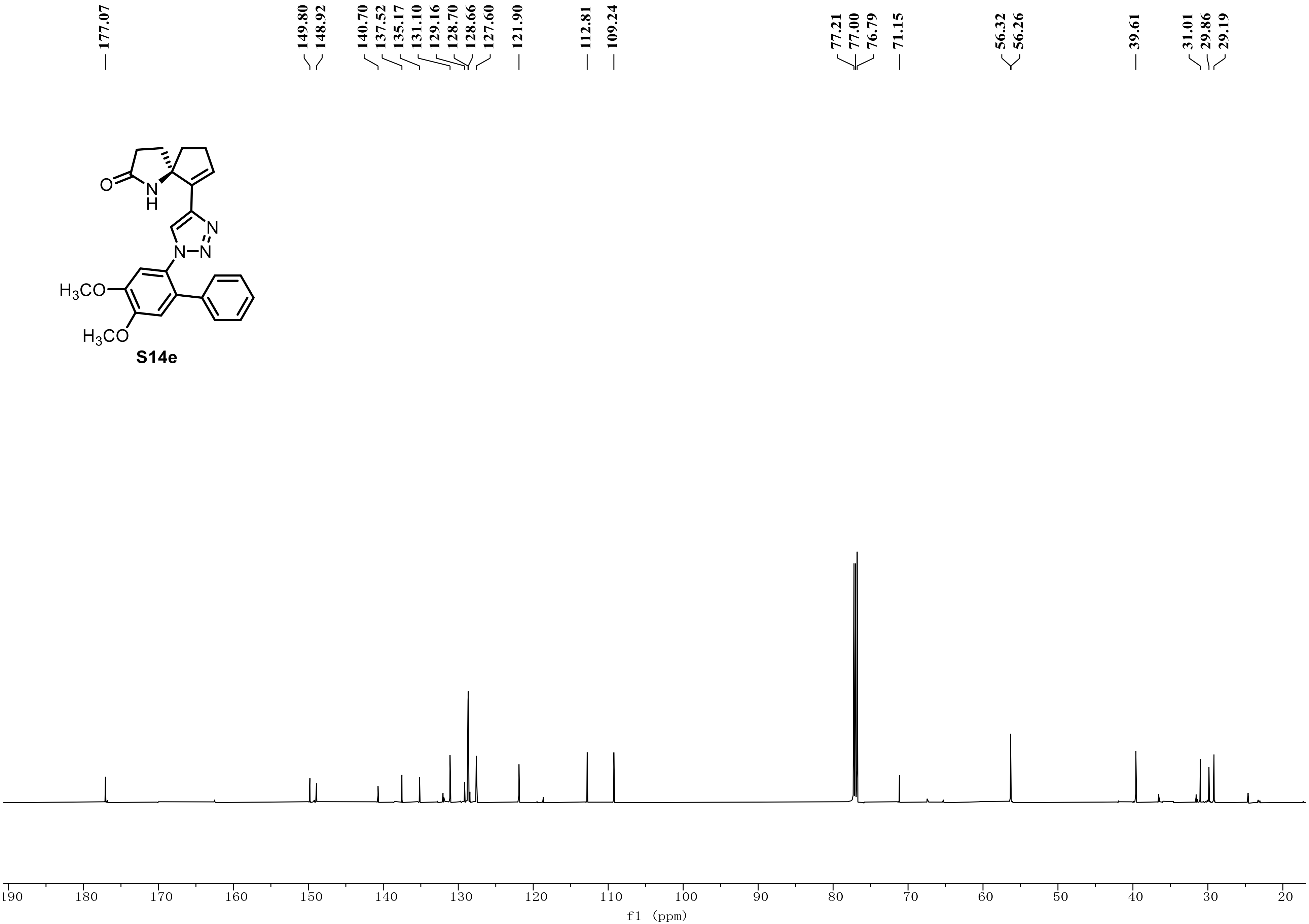
S14d


O
N
H
N
N
N
Ph
CF3

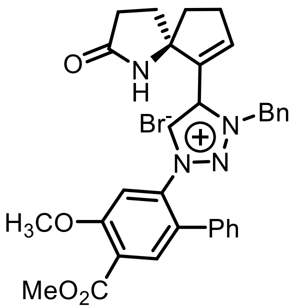
S14d


-62.07
-73.37
−42 −44 −46 −48 −50 −52 −54 −56 −58 −60 −62 −64 −66 −68 −70 −72 −74 −76 −78 −80 −82 −84 −86 −88 −90 −92 −94
f1 (ppm)

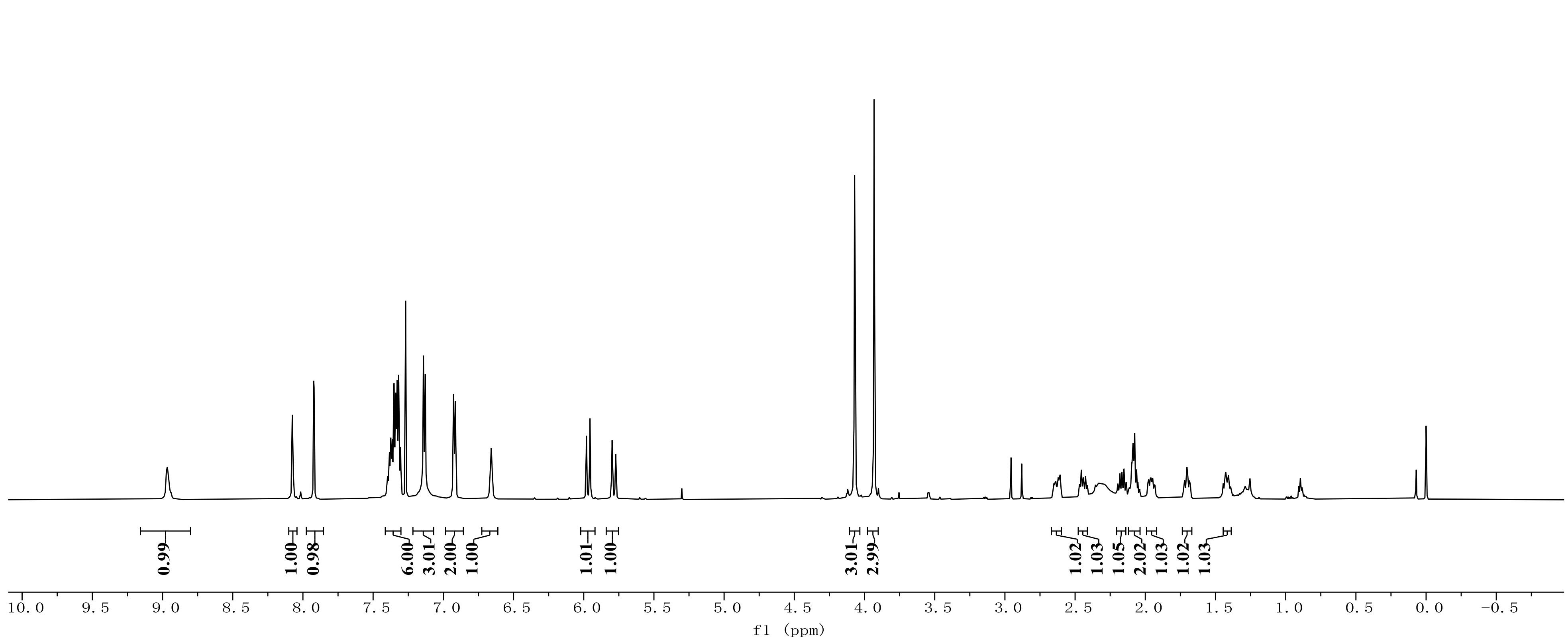

O
N
H
N
N
N
H3CO
H3CO
S14e
7.303
7.299
7.297
7.291
7.287
7.180
7.078
7.071
7.066
7.062
7.038
6.935
6.520
6.515
6.511
5.520
3.967
3.965
2.523
2.504
2.499
2.494
2.490
2.484
2.479
2.475
2.448
2.443
2.435
2.431
2.422
2.419
2.406
2.402
2.396
2.393
2.389
2.362
2.346
2.334
2.331
2.318
2.302
2.258
2.253
2.245
2.241
2.236
2.231
2.223
2.219
2.008
2.003
1.991
1.986
1.979
1.974
1.958
1.950
1.944
1.935
1.923
1.917
1.912
1.901
1.896
1.745
1.729
1.723
1.713
1.707
-0.000
3.01
1.02
2.01
1.00
1.00
1.04
1.00
6.00
1.19
2.03
1.03
1.00
2.98
2.04
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)

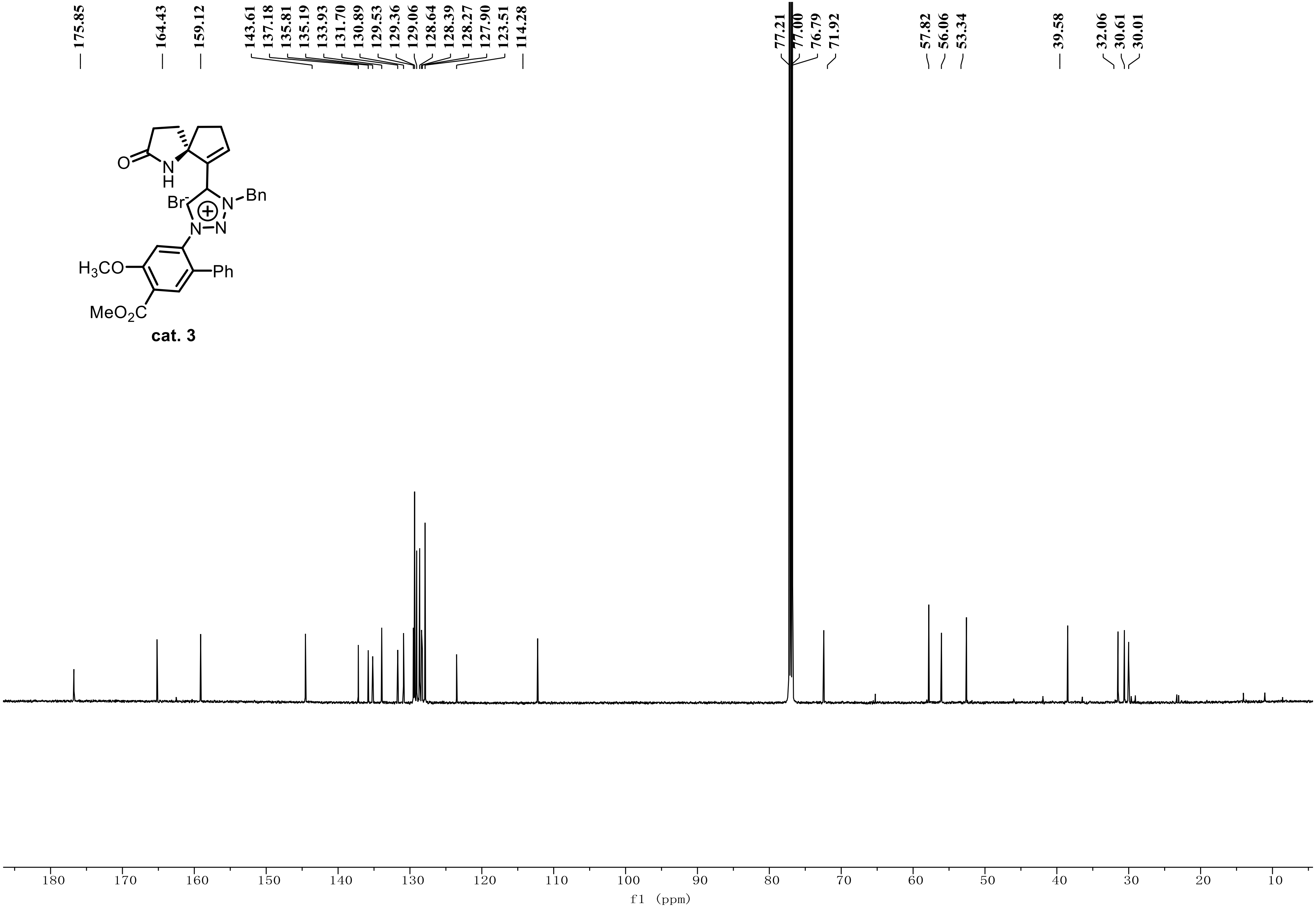


S14e
177.07
149.80
148.92
140.70
137.52
135.17
131.10
129.16
128.70
128.66
127.60
121.90
112.81
109.24
77.21
77.00
76.79
71.15
56.32
56.26
39.61
31.01
29.86
29.19
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)


O
N
H
Br-
N
Bn
N
N
H3CO
Ph
MeO2C

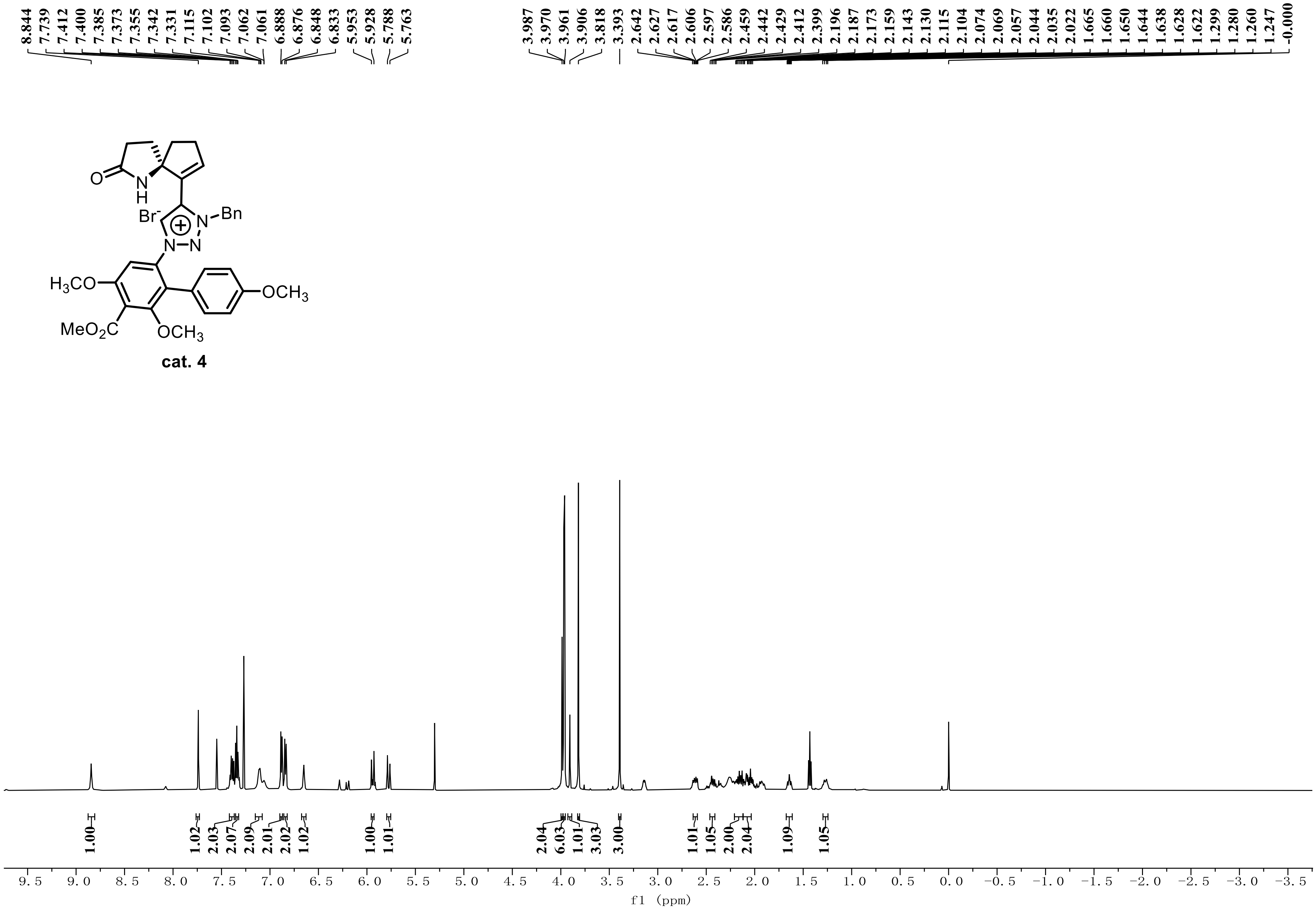
cat. 3


8.972
8.076 7.923 7.397 7.383 7.374 7.362 7.353 7.340 7.329 7.318 7.304 7.141 7.129 6.927 6.913 6.658 5.980 5.955 5.798 5.772
4.071 3.929 2.654 2.643 2.637 2.613 2.607 2.469 2.456 2.443 2.439 2.426 2.413 2.197 2.179 2.166 2.150 2.135 2.112 2.098 2.088 2.075 2.062 2.053 2.040 1.981 1.975 1.965 1.959 1.952 1.936 1.930 1.725 1.720 1.710 1.703 1.697 1.686 1.681 -0.000
0.99
1.00 0.98
6.00 3.01 2.00 1.00
1.01 1.00
3.01 2.99
1.02 1.03 1.05 2.02 1.03 1.02 1.03
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)



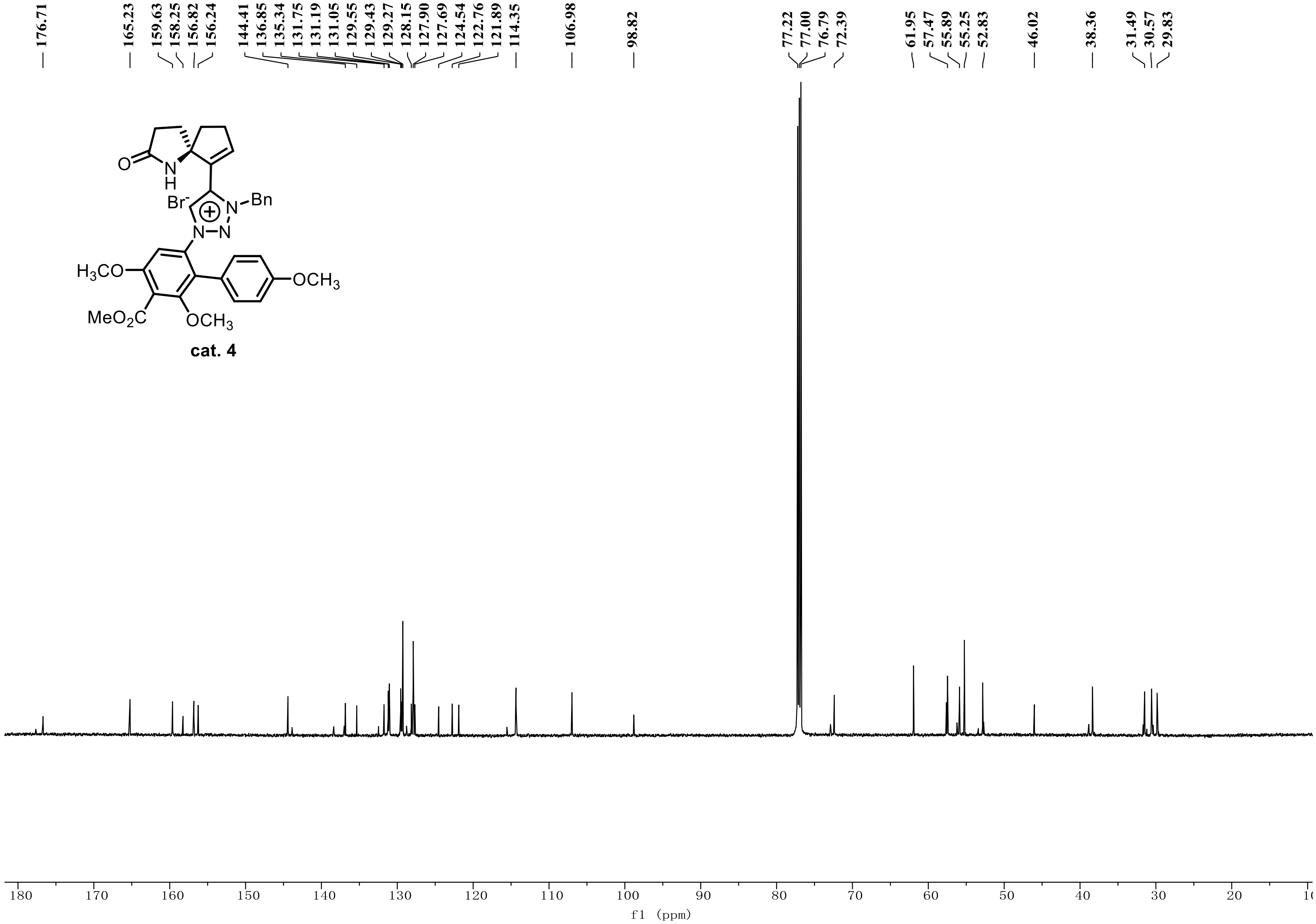
175.85
164.43
159.12
143.61
137.18
135.81
135.19
133.93
131.70
130.89
129.53
129.36
129.06
128.64
128.39
128.27
127.90
123.51
114.28
77.21
77.00
76.79
71.92
57.82
56.06
53.34
39.58
32.06
30.61
30.01
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

cat. 3

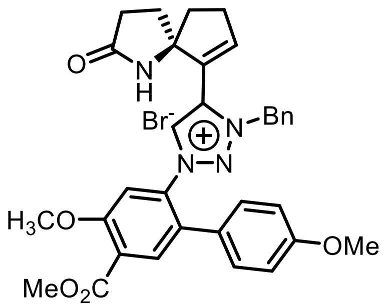


8.844 7.739 7.412 7.400 7.385 7.373 7.355 7.342 7.331 7.115 7.102 7.093 7.062 7.061 6.888 6.876 6.848 6.833 5.953 5.928 5.788 5.763
3.987 3.970 3.961 3.906 3.818 3.393 2.642 2.627 2.617 2.606 2.597 2.586 2.459 2.442 2.429 2.412 2.399 2.196 2.187 2.173 2.159 2.143 2.130 2.115 2.104 2.074 2.069 2.057 2.044 2.035 2.022 1.665 1.660 1.650 1.644 1.638 1.628 1.622 1.299 1.280 1.260 1.247 -0.000
1.00 1.02 2.03 2.07 2.09 2.01 2.02 1.02 1.00 1.01 2.04 6.03 1.01 3.03 3.00 1.01 1.05 2.00 2.04 1.09 1.05
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 −1.0 −1.5 −2.0 −2.5 −3.0 −3.5
f1 (ppm)
O
N
H
Br-
N
Bn
N
N
H3CO
OCH3
MeO2C
OCH3

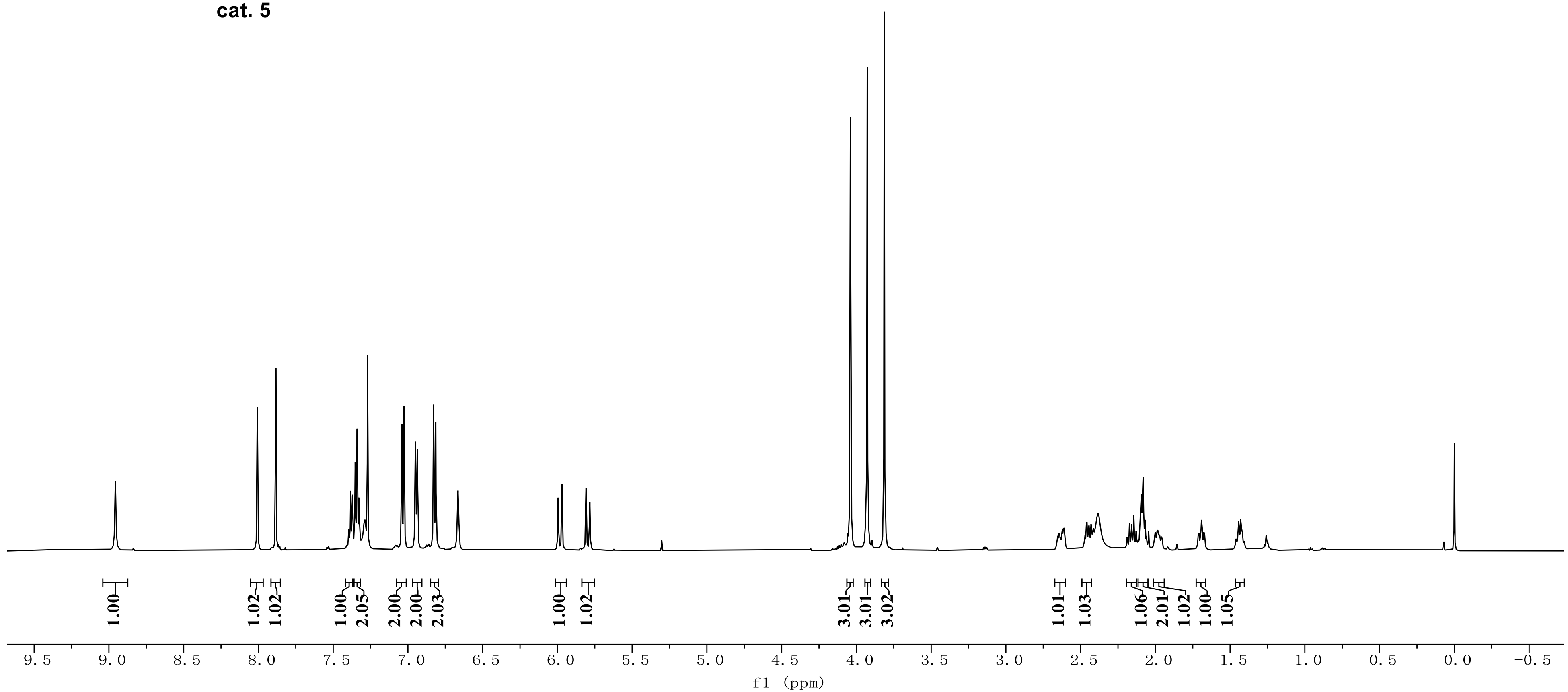
cat. 4

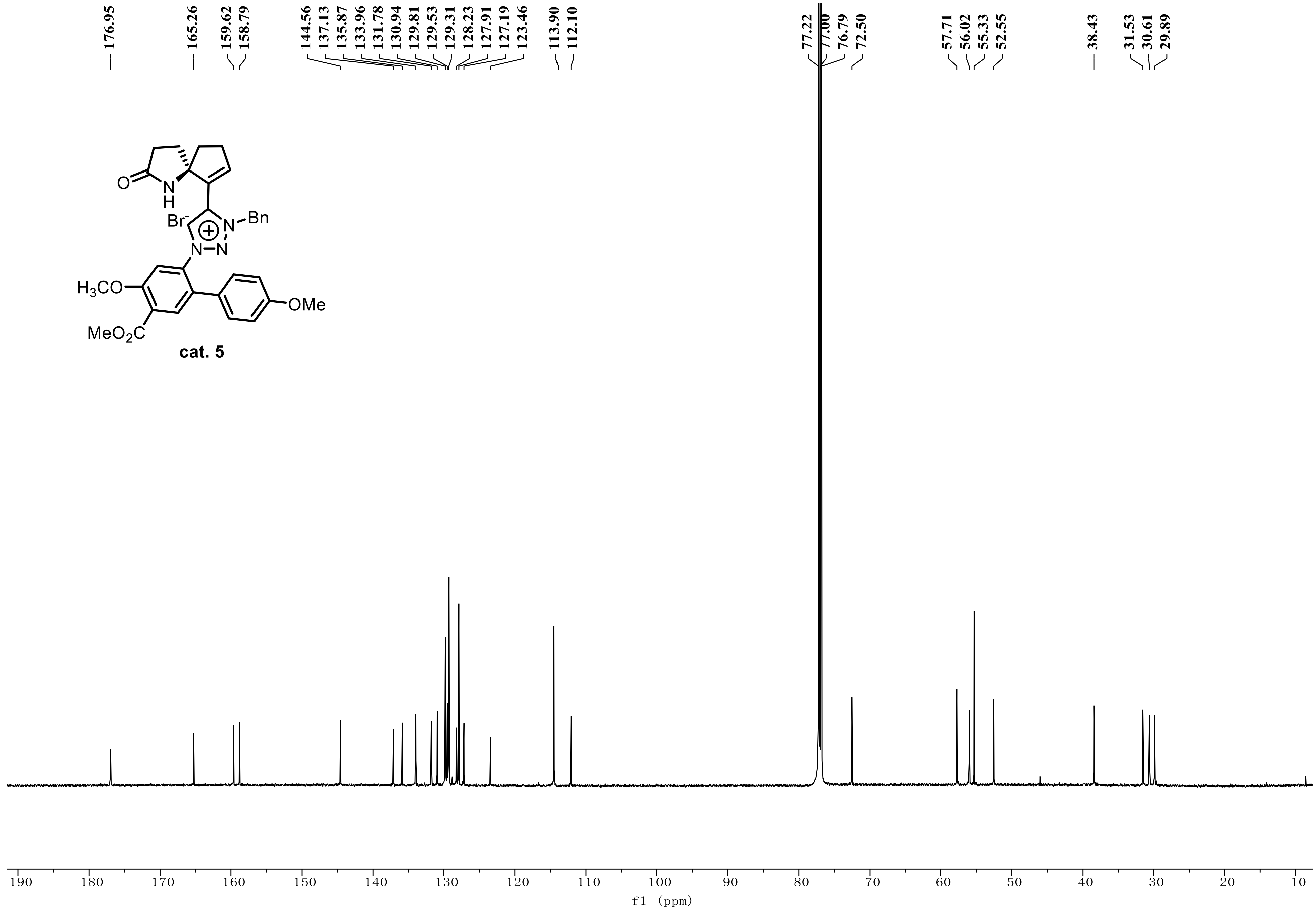


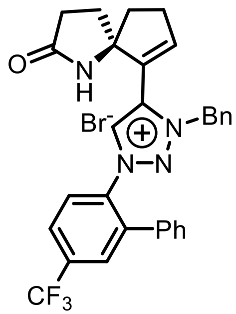
176.71
165.23
159.63
158.25
156.82
156.24
144.41
136.85
135.34
131.75
131.19
131.05
129.55
129.43
129.27
128.15
127.90
127.69
124.54
122.76
121.89
114.35
106.98
98.82
77.22
77.00
76.79
72.39
61.95
57.47
55.89
55.25
52.83
46.02
38.36
31.49
30.57
29.83
O
N
H
Br⁻
N
Bn
N
N
H3CO
OCH3
MeO2C
OCH3
cat. 4
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


Br⁻
N
N
N
Bn
H
O
H_3CO
OMe
MeO_2C

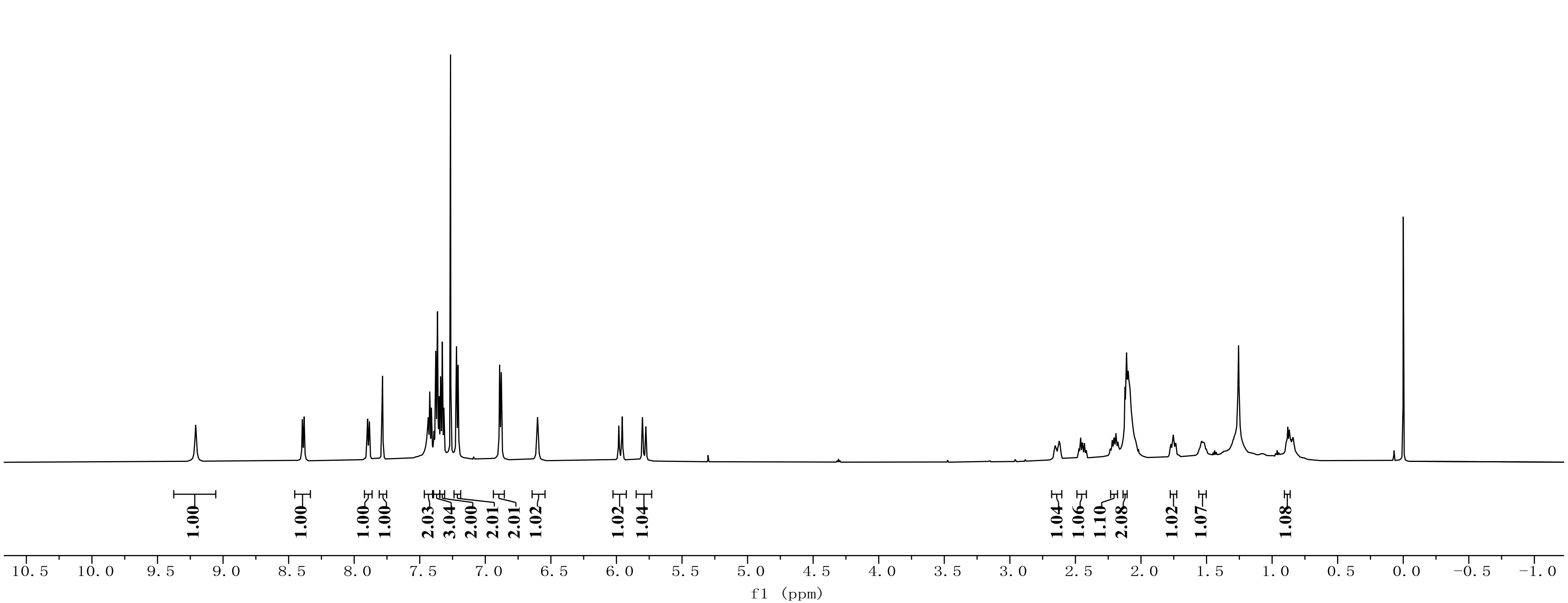
cat. 5

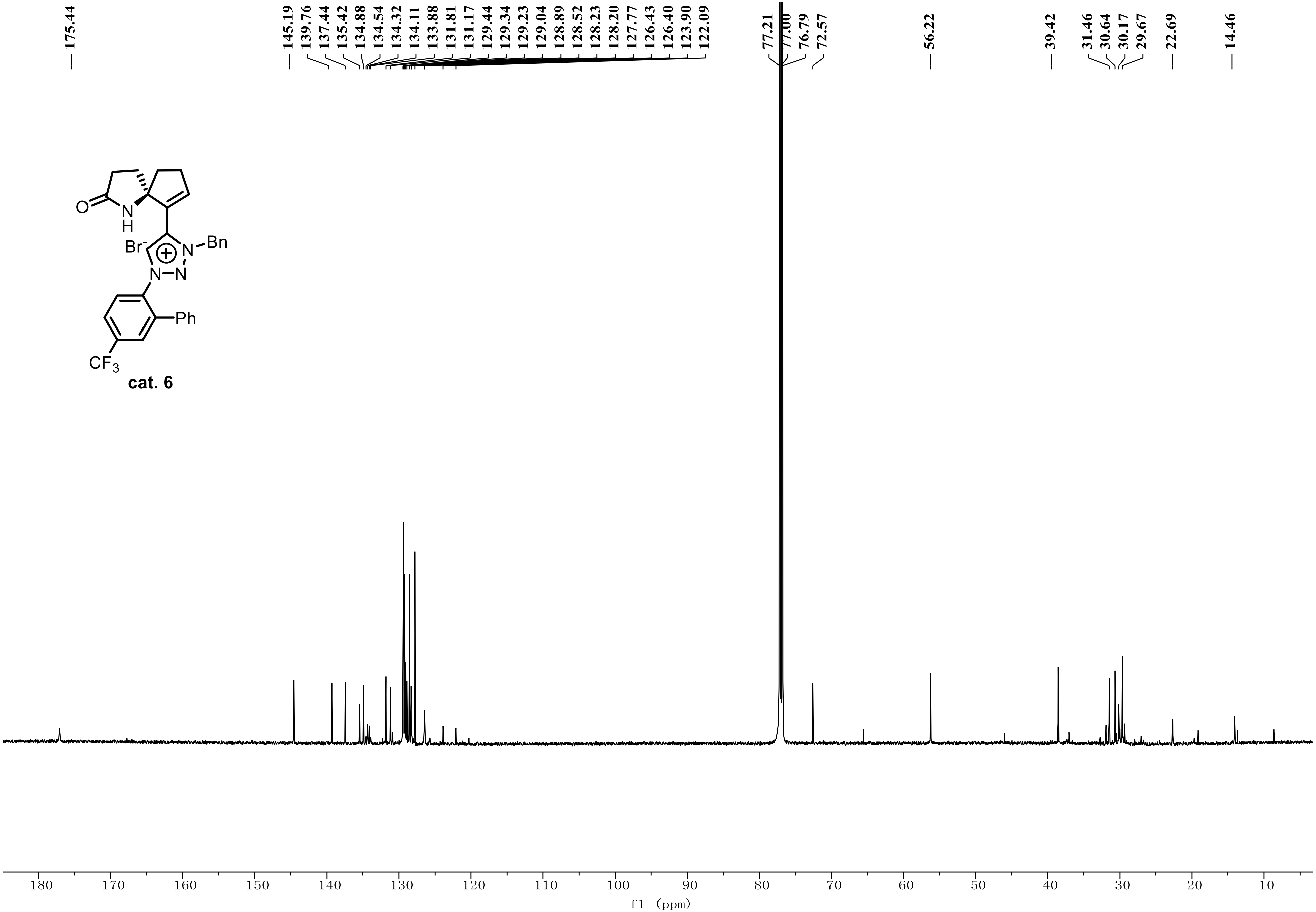

8.957
8.007
7.883
7.397
7.383
7.371
7.353
7.340
7.326
7.040
7.026
6.950
6.938
6.828
6.814
5.995
5.970
5.808
5.783
4.040
3.928
3.813
2.653
2.646
2.640
2.634
2.628
2.622
2.616
2.609
2.603
2.474
2.461
2.457
2.448
2.444
2.431
2.427
2.418
2.189
2.173
2.157
2.144
2.129
2.100
2.094
2.087
2.082
2.069
2.060
2.005
1.999
1.989
1.983
1.976
1.971
1.961
1.955
1.714
1.708
1.698
1.692
1.686
1.676
1.670
1.461
1.443
1.437
1.430
1.423
1.418
-0.000
1.00
1.02
1.02
1.00
2.05
2.00
2.00
2.03
1.00
1.02
3.01
3.01
3.02
1.01
1.03
1.06
2.01
1.02
1.00
1.05
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)


176.95
165.26
159.62
158.79
144.56
137.13
135.87
133.96
131.78
130.94
129.81
129.53
129.31
128.23
127.91
127.19
123.46
113.90
112.10
77.22
77.00
76.79
72.50
57.71
56.02
55.33
52.55
38.43
31.53
30.61
29.89
O
N
H
Br⁻
N
Bn
N
N
H_3CO
OMe
MeO_2C
cat. 5
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

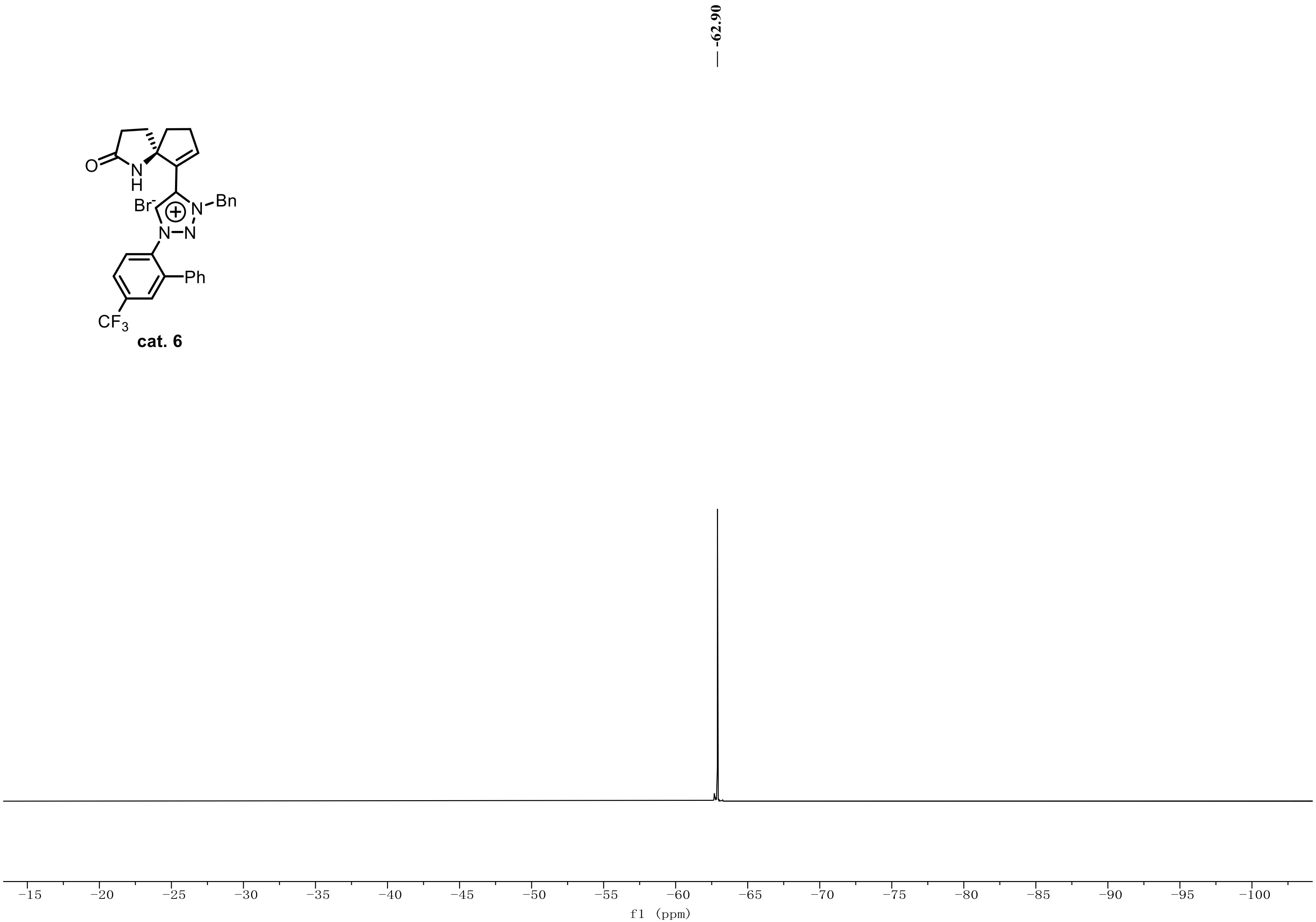

O
N
H
Br⁻
N
Bn
N
N
Ph
CF3

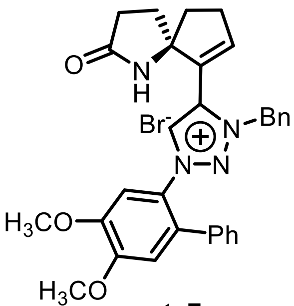
cat. 6


9.209
8.396
8.382
7.901
7.887
7.837
7.801
7.436
7.424
7.411
7.392
7.378
7.365
7.352
7.341
7.328
7.316
7.220
7.208
6.891
6.877
6.602
5.982
5.956
5.802
5.776
2.663
2.660
2.654
2.648
2.635
2.630
2.623
2.617
2.611
2.473
2.463
2.446
2.432
2.429
2.419
2.416
2.235
2.219
2.205
2.191
2.175
2.136
2.122
2.110
2.092
1.772
1.761
1.754
1.748
1.738
1.732
1.538
1.519
1.501
0.909
0.900
0.892
0.881
0.880
0.872
0.868
-0.000
1.00
1.00
1.00
1.00
2.03
3.04
2.00
2.01
2.01
1.02
1.02
1.04
1.04
1.06
1.10
2.08
1.02
1.07
1.08
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
f1 (ppm)

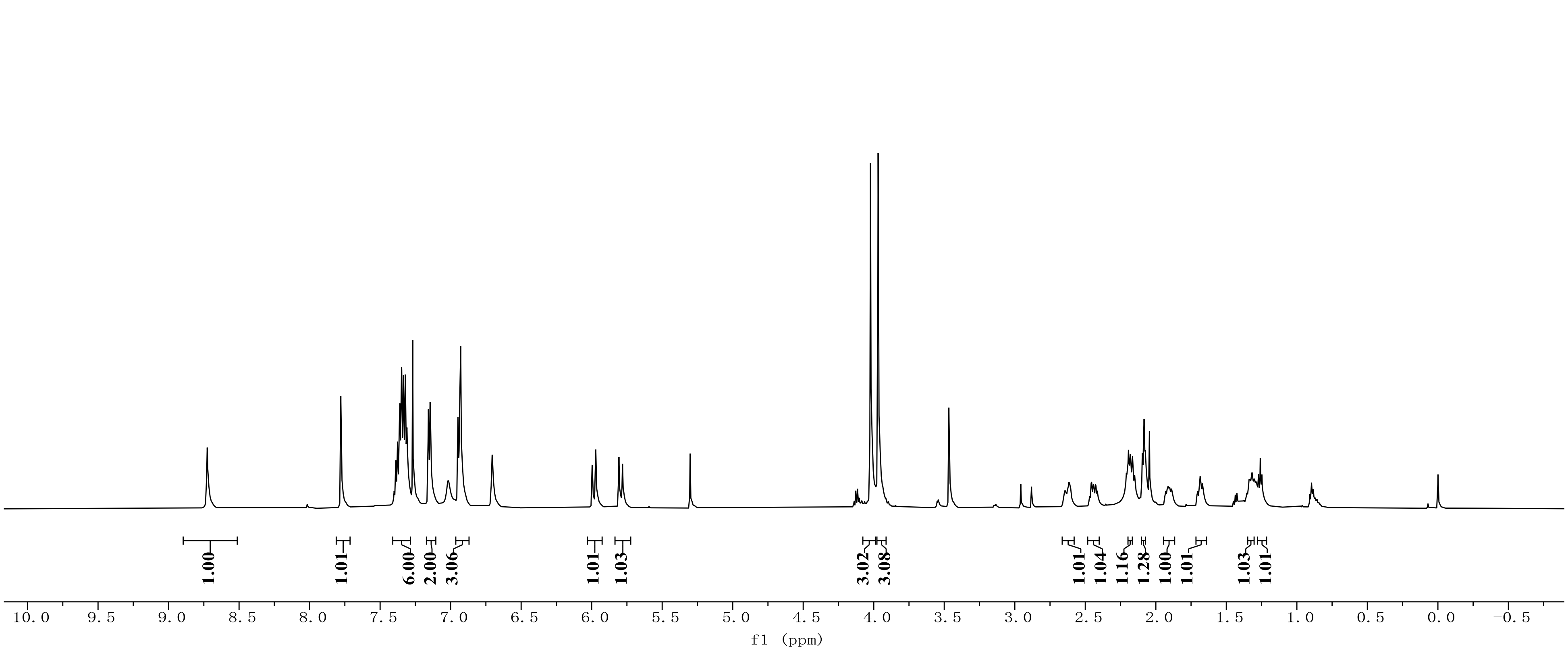

175.44
145.19
139.76
137.44
135.42
134.88
134.54
134.32
134.11
133.88
131.81
131.17
129.44
129.34
129.23
129.04
128.89
128.52
128.23
128.20
127.77
126.43
126.40
123.90
122.09
77.21
77.00
76.79
72.57
56.22
39.42
31.46
30.64
30.17
29.67
22.69
14.46
O
N
H
Br-
N
Bn
N
N
Ph
CF3
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

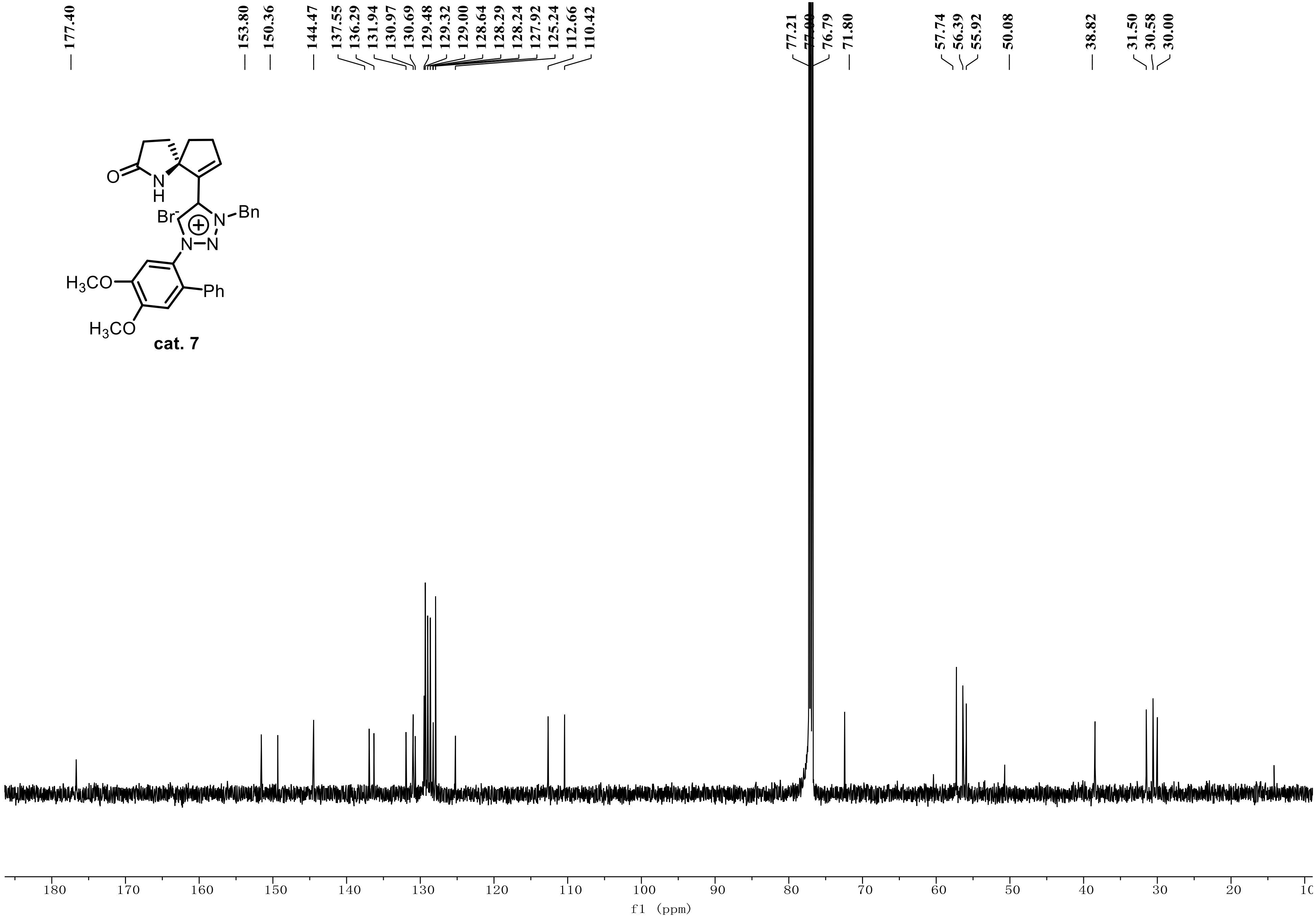
cat. 6

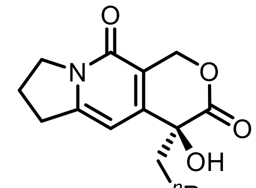

-62.90
O
N
H
Br-
N
Bn
N
N
Ph
CF3
cat. 6
−15
−20
−25
−30
−35
−40
−45
−50
−55
−60
−65
−70
−75
−80
−85
−90
−95
−100
f1 (ppm)


Br⁻
N–Bn
Ph
H_3CO
H_3CO

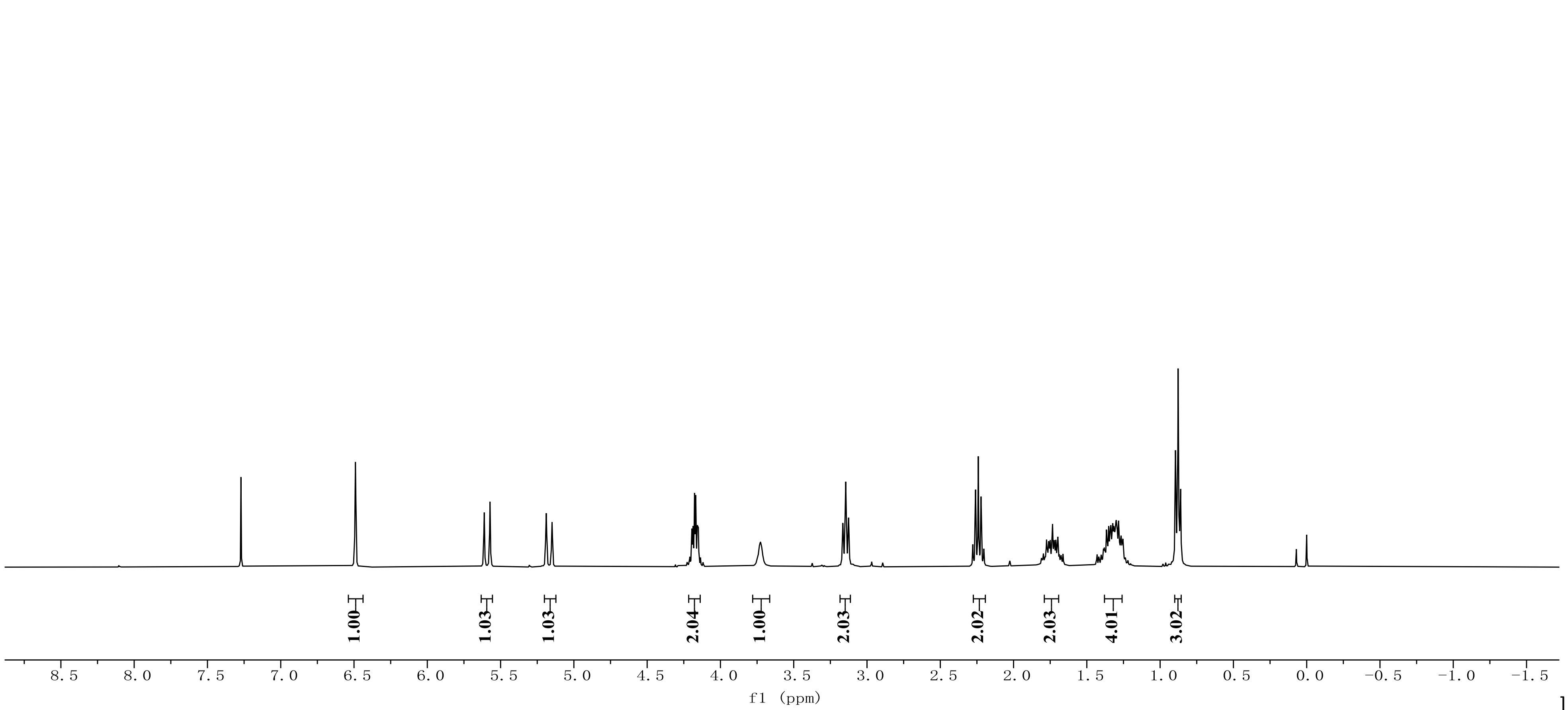
cat. 7


8.726
7.779
7.401
7.388
7.376
7.360
7.347
7.334
7.321
7.310
7.158
7.143
6.948
6.936
6.928
5.996
5.971
5.807
5.781
4.023
3.969
2.651
2.646
2.640
2.633
2.628
2.621
2.615
2.605
2.603
2.468
2.459
2.455
2.446
2.442
2.429
2.425
2.416
2.412
2.209
2.194
2.179
2.165
2.150
2.096
2.083
2.075
2.070
1.934
1.929
1.919
1.913
1.906
1.900
1.890
1.884
1.707
1.702
1.686
1.679
1.670
1.664
1.355
1.339
1.332
1.317
1.301
1.290
1.271
1.259
1.248
-0.000
1.00
1.01
6.00
2.00
3.06
1.01
1.03
3.02
3.08
1.01
1.04
1.16
1.28
1.00
1.01
1.03
1.01
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)

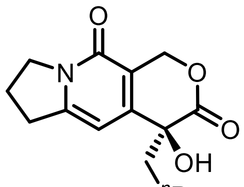

177.40
153.80
150.36
144.47
137.55
136.29
131.94
130.97
130.69
129.48
129.32
129.00
128.64
128.29
128.24
127.92
125.24
112.66
110.42
77.21
77.00
76.79
71.80
57.74
56.39
55.92
50.08
38.82
31.50
30.58
30.00
O
N
H
Br-
N
Bn
N
N
H3CO
Ph
H3CO
cat. 7
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)



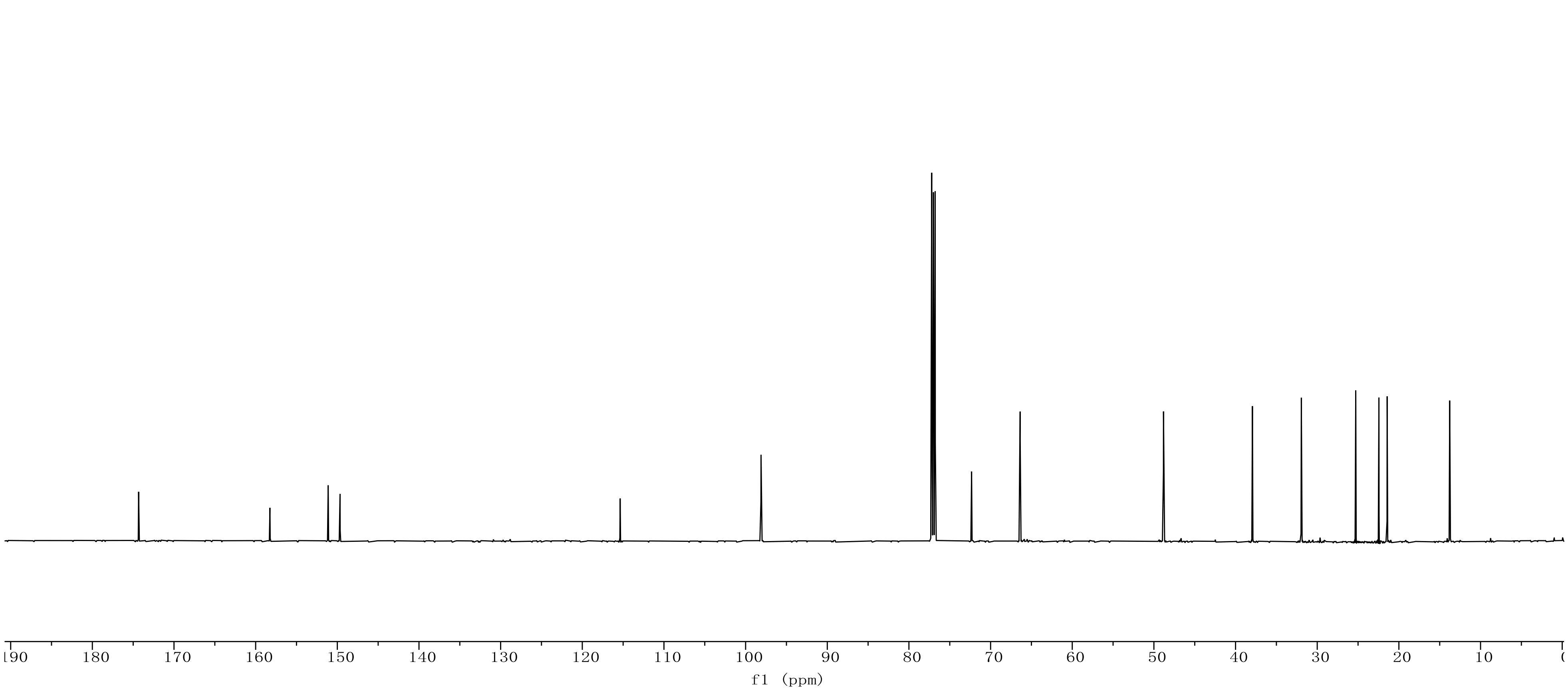
2b

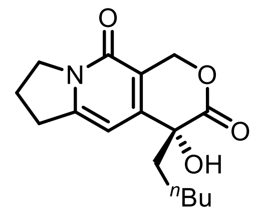


6.490
5.612
5.572
5.192
5.152
4.195
4.187
4.177
4.168
4.158
4.151
3.727
3.165
3.143
3.126
2.278
2.259
2.241
2.222
2.203
1.809
1.796
1.775
1.769
1.760
1.750
1.734
1.722
1.711
1.698
1.688
1.387
1.374
1.366
1.351
1.339
1.323
1.316
1.300
1.283
1.266
0.895
0.877
0.860
-0.000
1.00
1.03
1.03
2.04
1.00
2.03
2.02
2.03
4.01
3.02
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
−1.0
−1.5
f1 (ppm)


O
N
O
O
OH
nPr

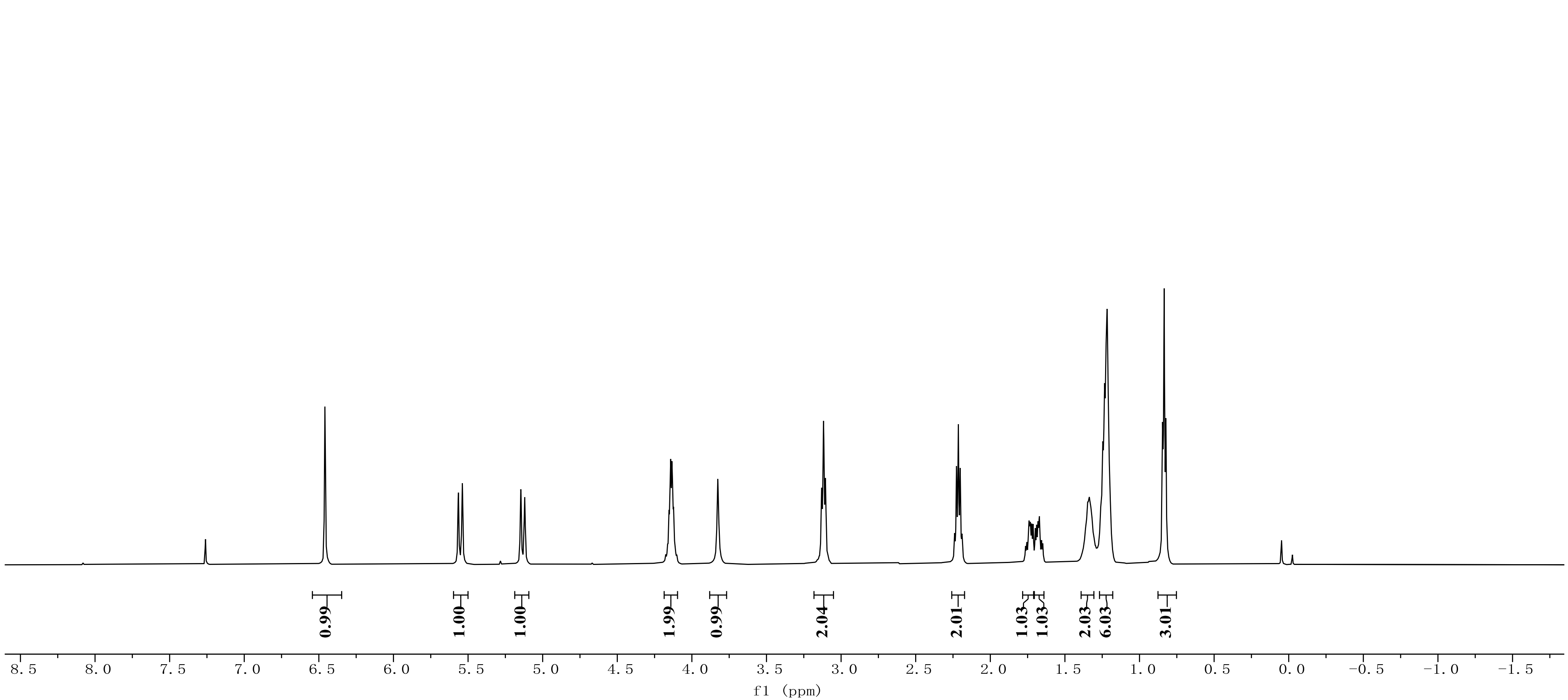
2b


174.33
158.25
151.12
149.66
115.36
98.11
77.21
77.00
76.78
72.32
66.38
48.83
37.93
31.95
25.27
22.43
21.44
13.78
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

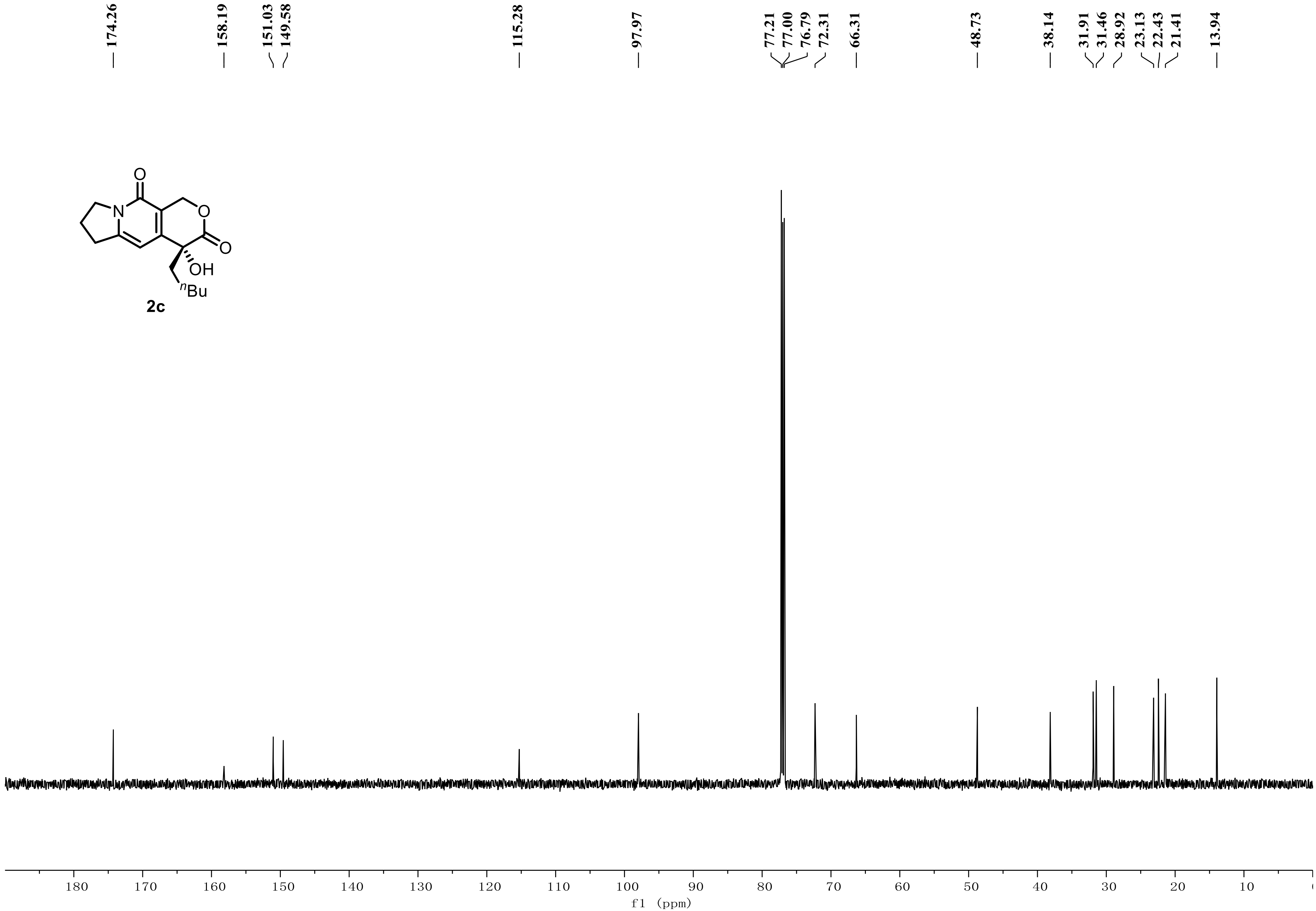


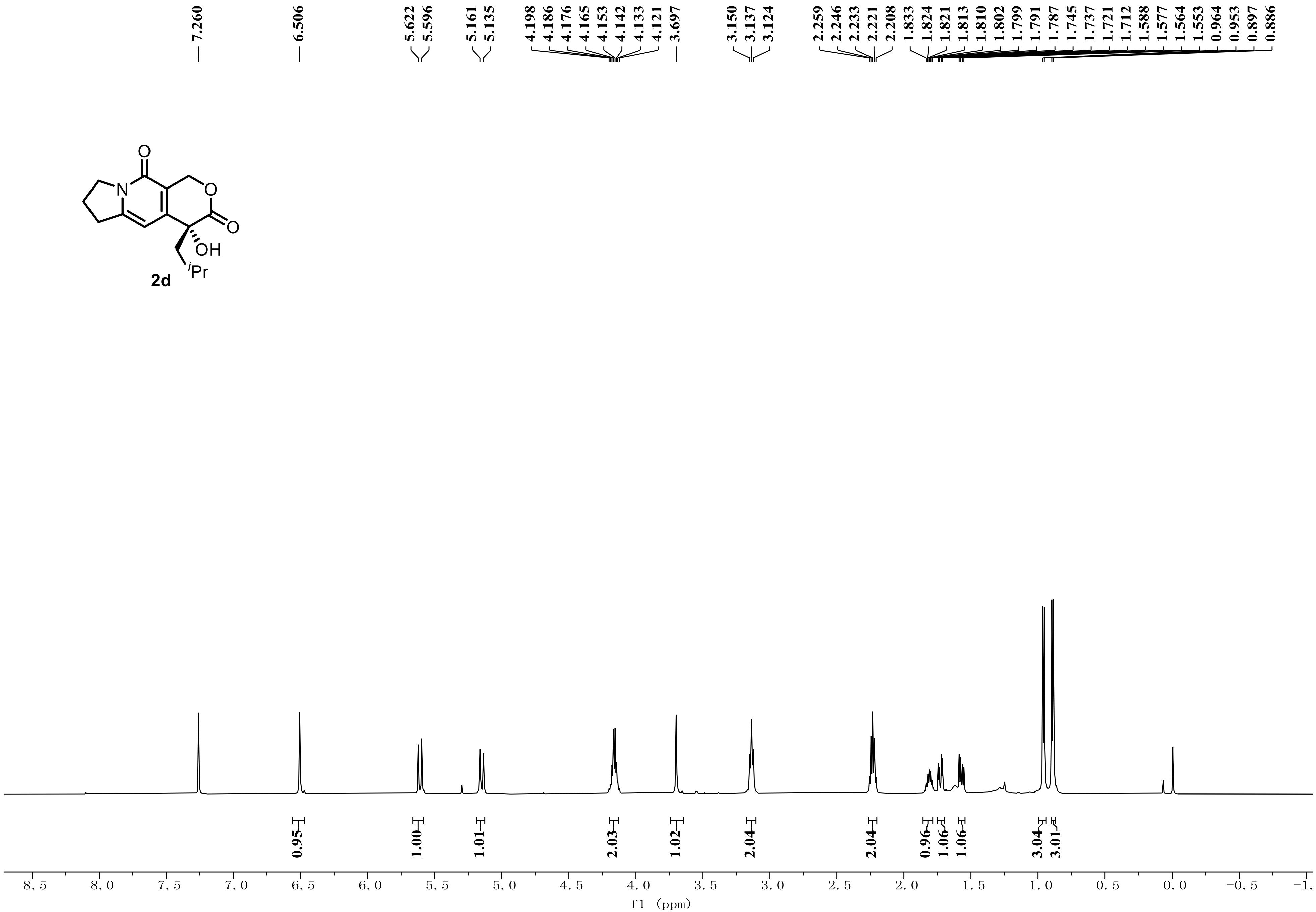
O
N
O
O
OH
nBu

2c

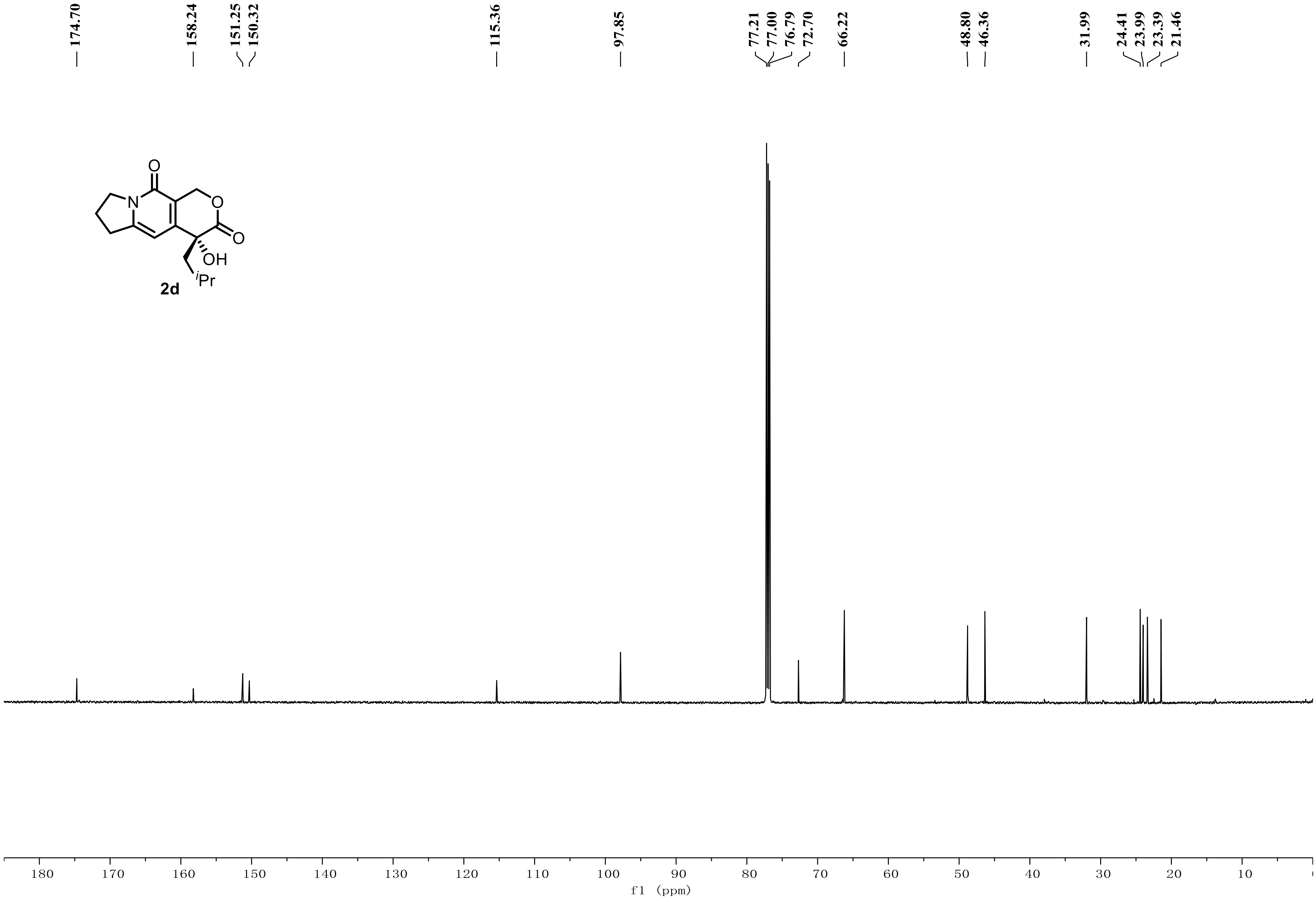


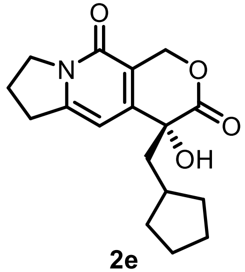
7.260
6.459
5.565
5.539
5.147
5.120
4.154
4.143
4.134
4.130
4.122
3.826
3.131
3.118
3.105
2.239
2.227
2.214
2.202
2.189
1.764
1.755
1.740
1.731
1.722
1.713
1.699
1.689
1.680
1.671
1.657
1.648
1.361
1.348
1.337
1.327
1.311
1.247
1.235
1.224
1.217
1.208
0.846
0.835
0.823
0.99
1.00
1.00
1.99
0.99
2.04
2.01
1.03
1.03
2.03
6.03
3.01
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
-1.0
-1.5
f1 (ppm)


174.26
158.19
151.03
149.58
115.28
97.97
77.21
77.00
76.79
72.31
66.31
48.73
38.14
31.91
31.46
28.92
23.13
22.43
21.41
13.94
O
N
O
O
OH
nBu
2c
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

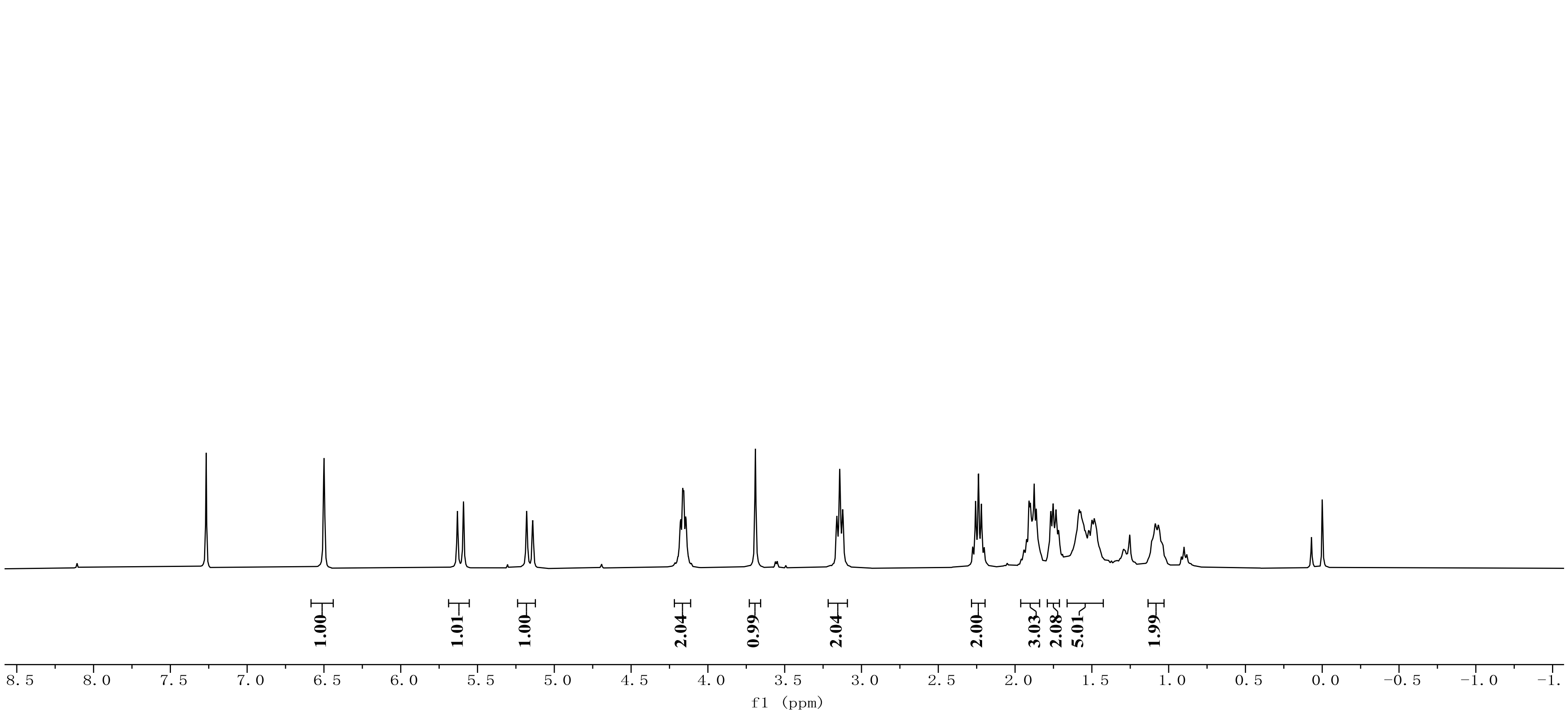


7.260
6.506
5.622
5.596
5.161
5.135
4.198
4.186
4.176
4.165
4.153
4.142
4.133
4.121
3.697
3.150
3.137
3.124
2.259
2.246
2.233
2.221
2.208
1.833
1.824
1.821
1.813
1.810
1.802
1.799
1.791
1.787
1.745
1.737
1.721
1.712
1.588
1.577
1.564
1.553
0.964
0.953
0.897
0.886
O
N
O
O
OH
iPr
2d
0.95
1.00
1.01
2.03
1.02
2.04
2.04
0.96
1.06
1.06
3.04
3.01
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
-1.
f1 (ppm)

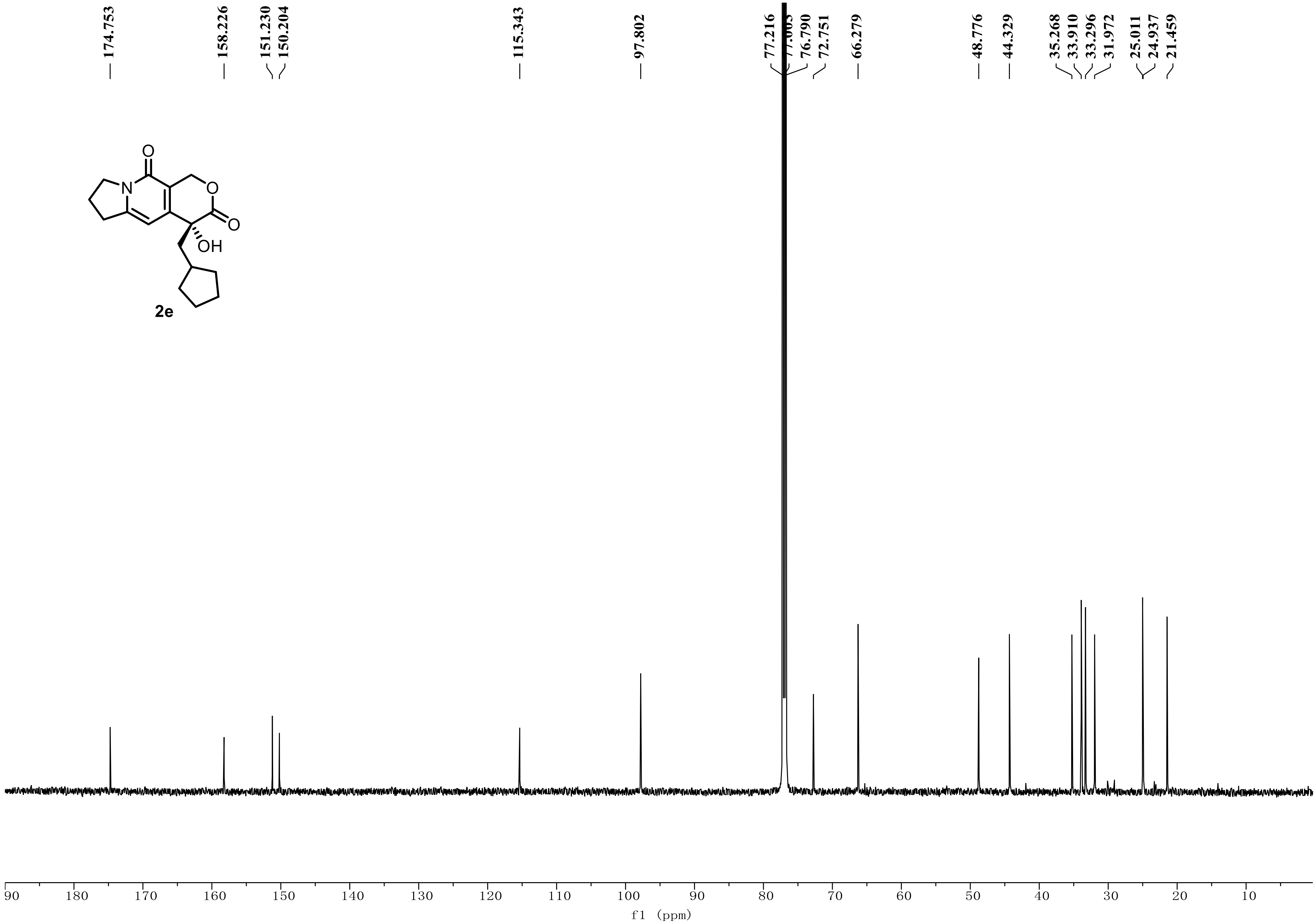

174.70
158.24
151.25
150.32
115.36
97.85
77.21
77.00
76.79
72.70
66.22
48.80
46.36
31.99
24.41
23.99
23.39
21.46
O
N
O
O
OH
iPr
2d
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



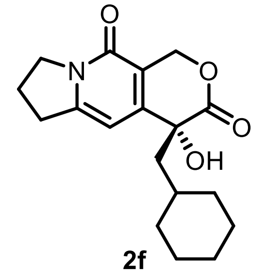
2e



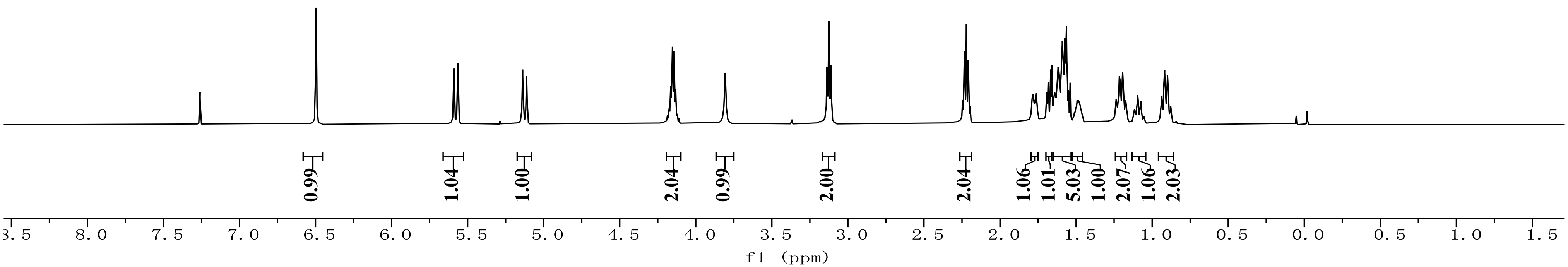
7.267
6.499
5.631
5.592
5.180
5.140
4.182
4.176
4.164
4.157
4.145
4.139
3.691
3.161
3.141
3.122
2.276
2.257
2.238
2.220
2.201
1.960
1.943
1.926
1.909
1.900
1.876
1.861
1.767
1.752
1.733
1.717
1.692
1.603
1.590
1.582
1.572
1.542
1.518
1.500
1.486
1.112
1.111
1.101
1.088
1.067
1.024
1.00
1.01
1.00
2.04
0.99
2.04
2.00
3.03
2.08
5.01
1.99
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
-1.0
f1 (ppm)

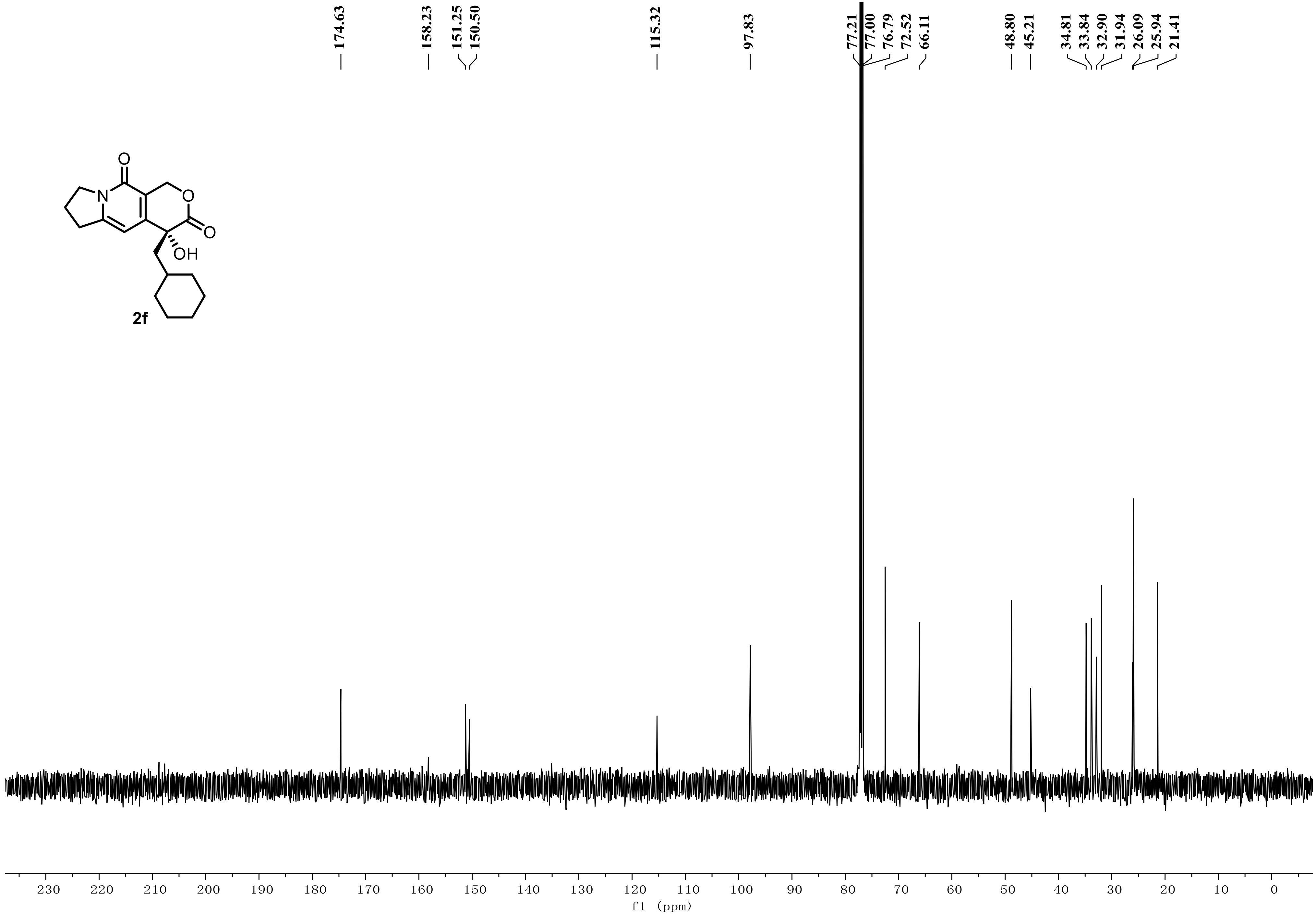

174.753
158.226
151.230
150.204
115.343
97.802
77.216
76.790
72.751
66.279
48.776
44.329
35.268
33.910
33.296
31.972
25.011
24.937
21.459
O
N
O
O
OH
2e
90
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

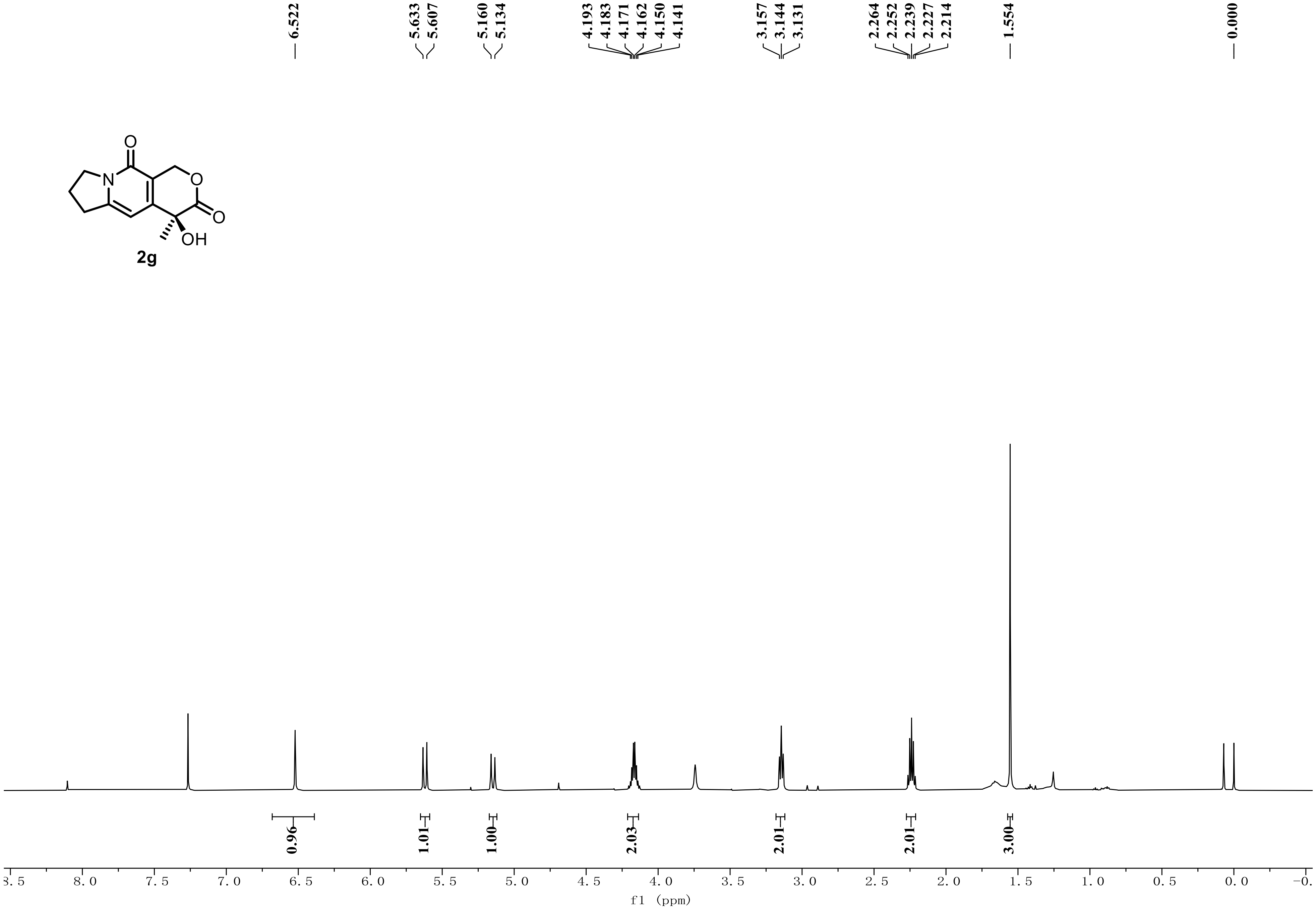
7.260 6.496 5.591 5.565 5.139 5.113 4.175 4.165 4.154 4.143 4.132 4.123 3.807 3.138 3.125 3.112 2.246 2.234 2.221 2.209 2.196 1.784 1.763 1.691 1.683 1.667 1.659 1.646 1.641 1.634 1.618 1.590 1.574 1.563 1.550 1.539 1.511 1.499 1.493 1.487 1.481 1.475 1.466 1.233 1.216 1.210 1.195 1.190 1.174 1.170 1.116 1.110 1.095 1.080 1.074 1.069 0.938 0.932 0.918 0.899 0.884 0.878



2f

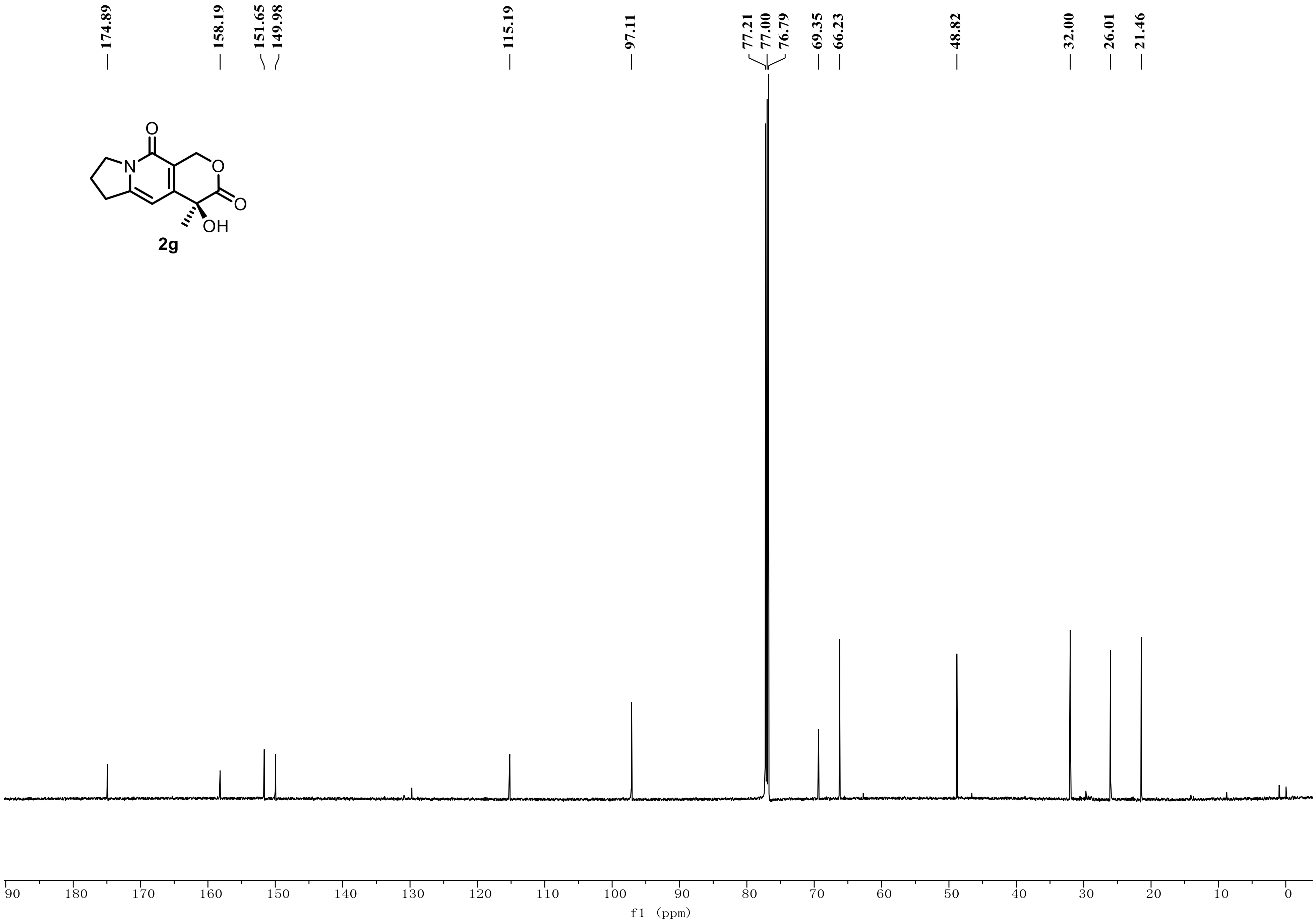


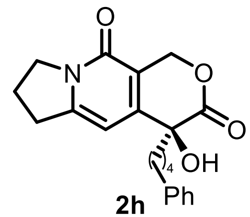

174.63
158.23
151.25
150.50
115.32
97.83
77.21
77.00
76.79
72.52
66.11
48.80
45.21
34.81
33.84
32.90
31.94
26.09
25.94
21.41
2f
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



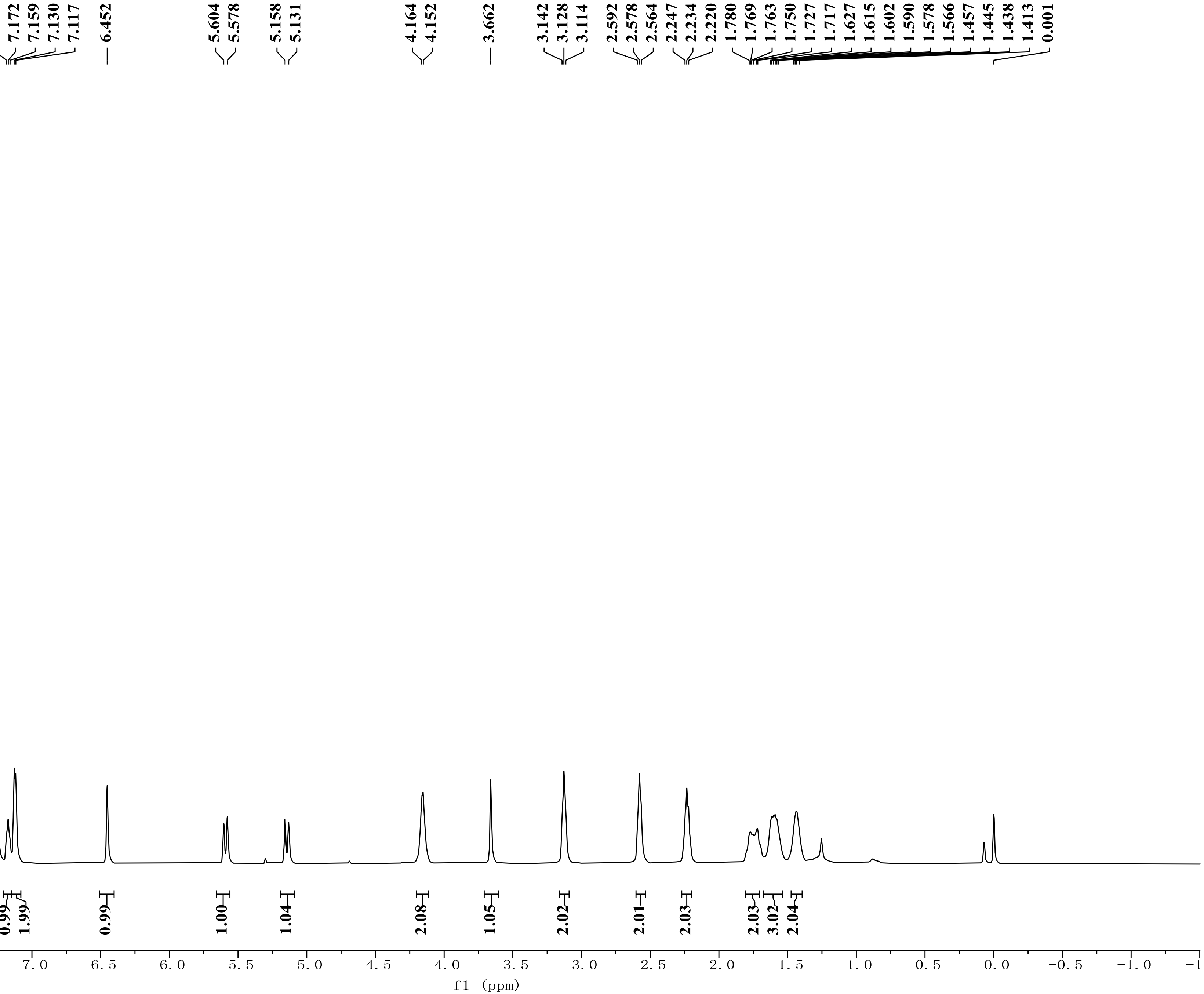
6.522
5.633
5.607
5.160
5.134
4.193
4.183
4.171
4.162
4.150
4.141
3.157
3.144
3.131
2.264
2.252
2.239
2.227
2.214
1.554
0.000
0.96
1.01
1.00
2.03
2.01
2.01
3.00
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.
f1 (ppm)
O
N
O
O
OH

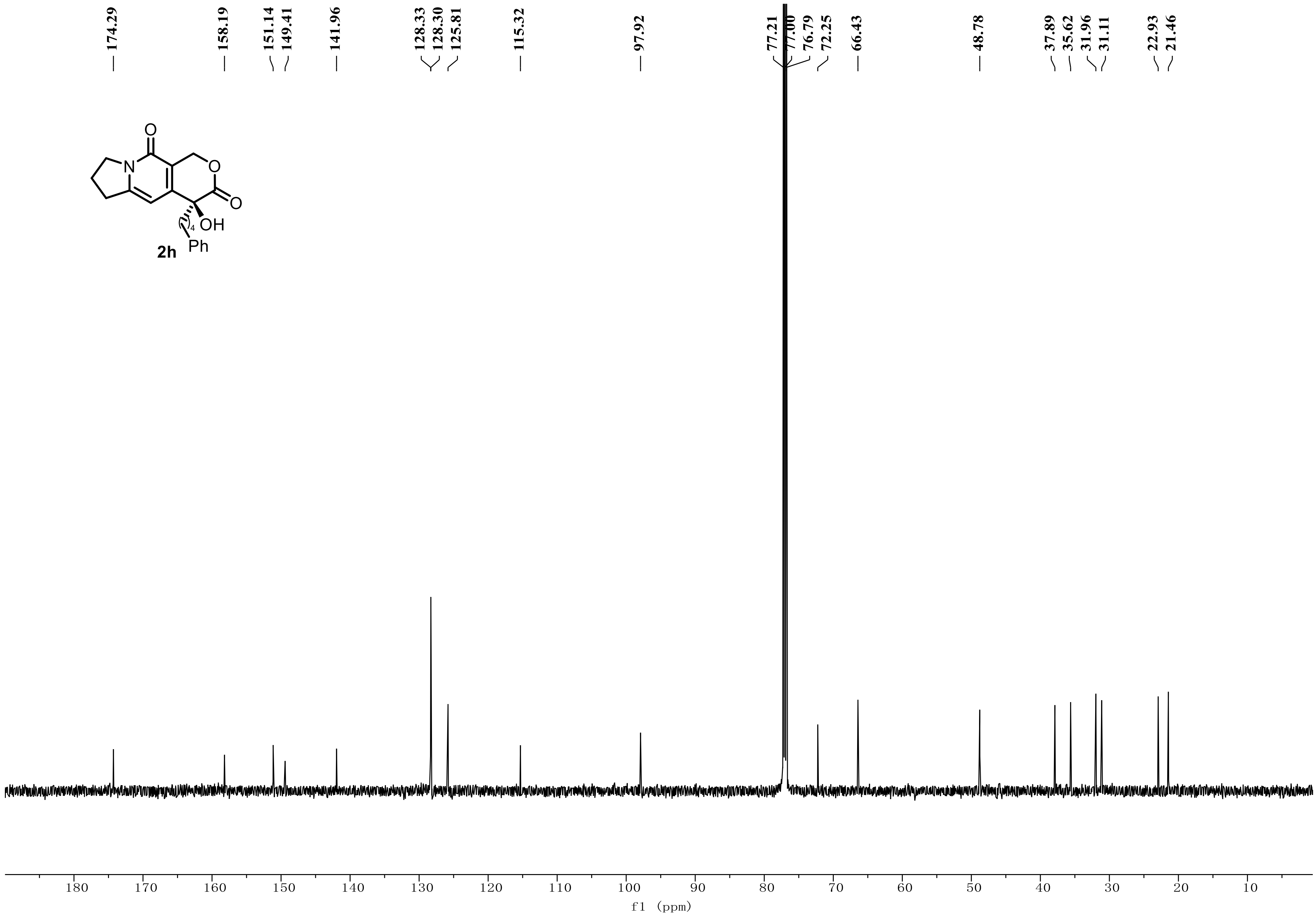
2g


174.89
158.19
151.65
149.98
115.19
97.11
77.21
77.00
76.79
69.35
66.23
48.82
32.00
26.01
21.46
2g
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


O
N
O
O
OH
4
Ph

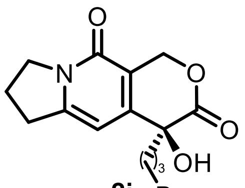
2h


7.266
7.262
7.248
7.185
7.172
7.159
7.130
7.117
6.452
5.604
5.578
5.158
5.131
4.164
4.152
3.662
3.142
3.128
3.114
2.592
2.578
2.564
2.247
2.234
2.220
1.780
1.769
1.763
1.750
1.727
1.717
1.627
1.615
1.602
1.590
1.578
1.566
1.457
1.445
1.438
1.413
0.001
2.01
0.99
1.99
0.99
1.00
1.04
2.08
1.05
2.02
2.01
2.03
2.03
3.02
2.04
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
-1.0
-1
f1 (ppm)

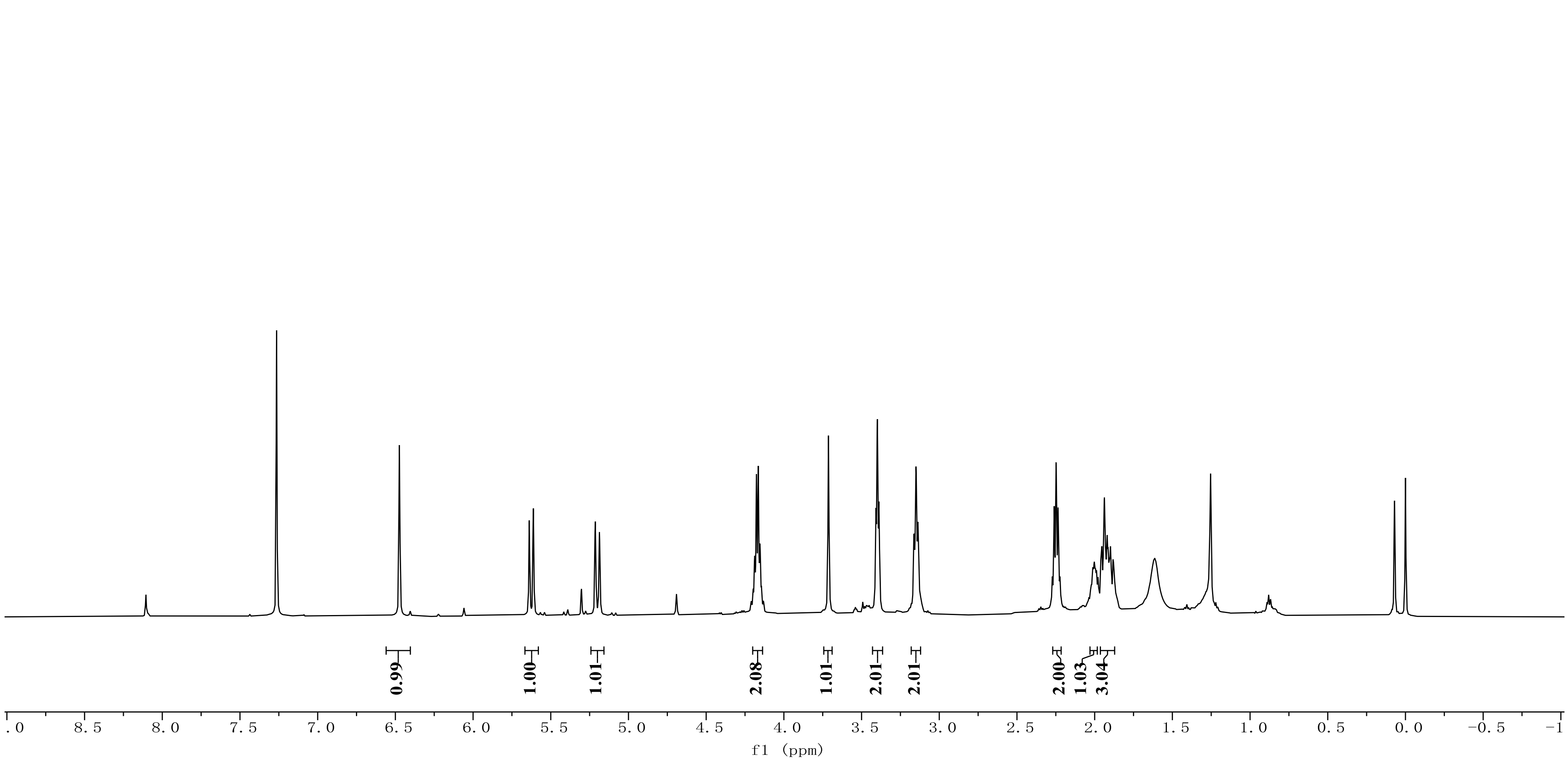


174.29
158.19
151.14
149.41
141.96
128.33
128.30
125.81
115.32
97.92
77.21
77.00
76.79
72.25
66.43
48.78
37.89
35.62
31.96
31.11
22.93
21.46
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

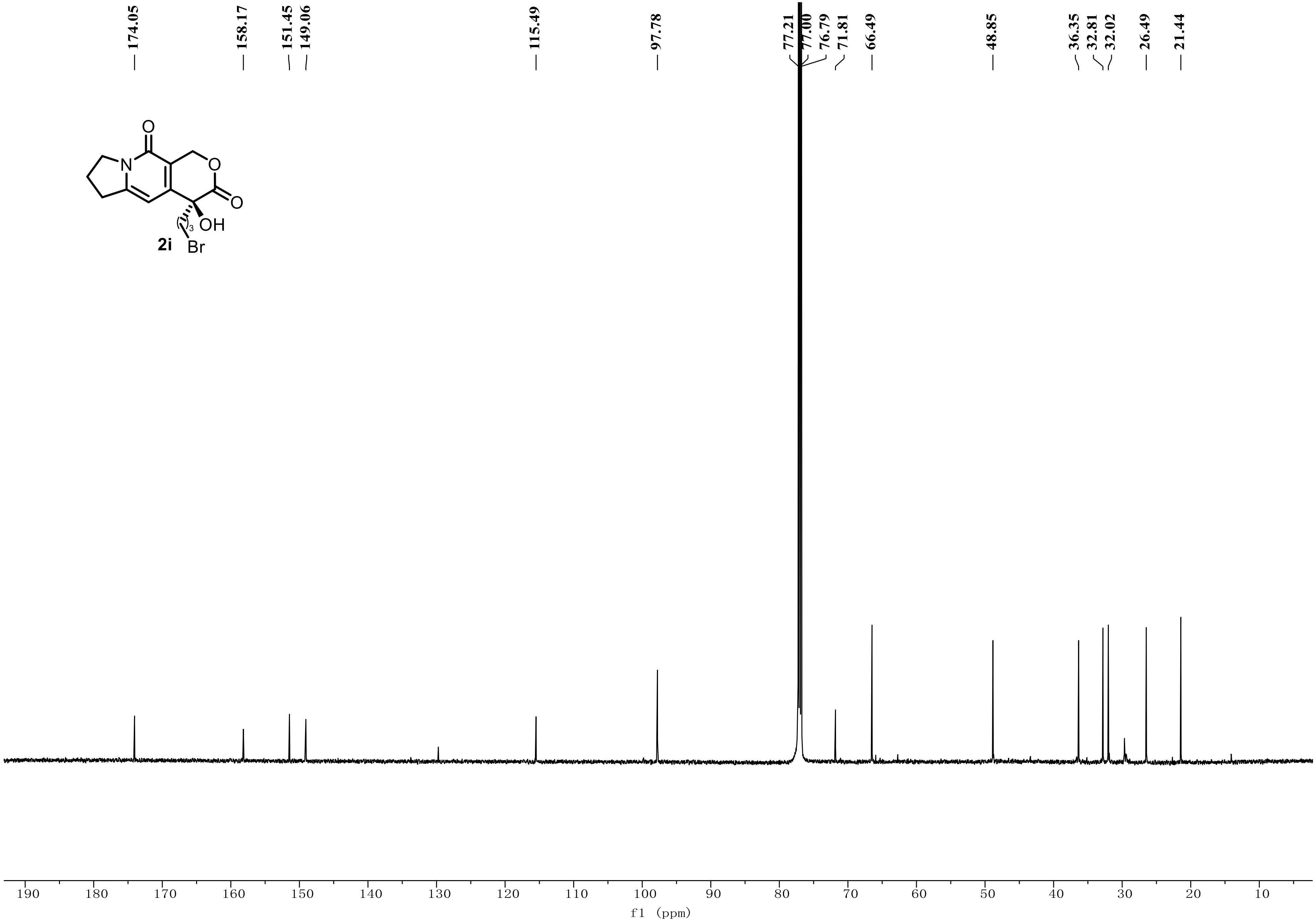
2h

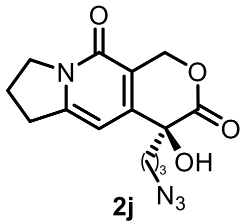


2i

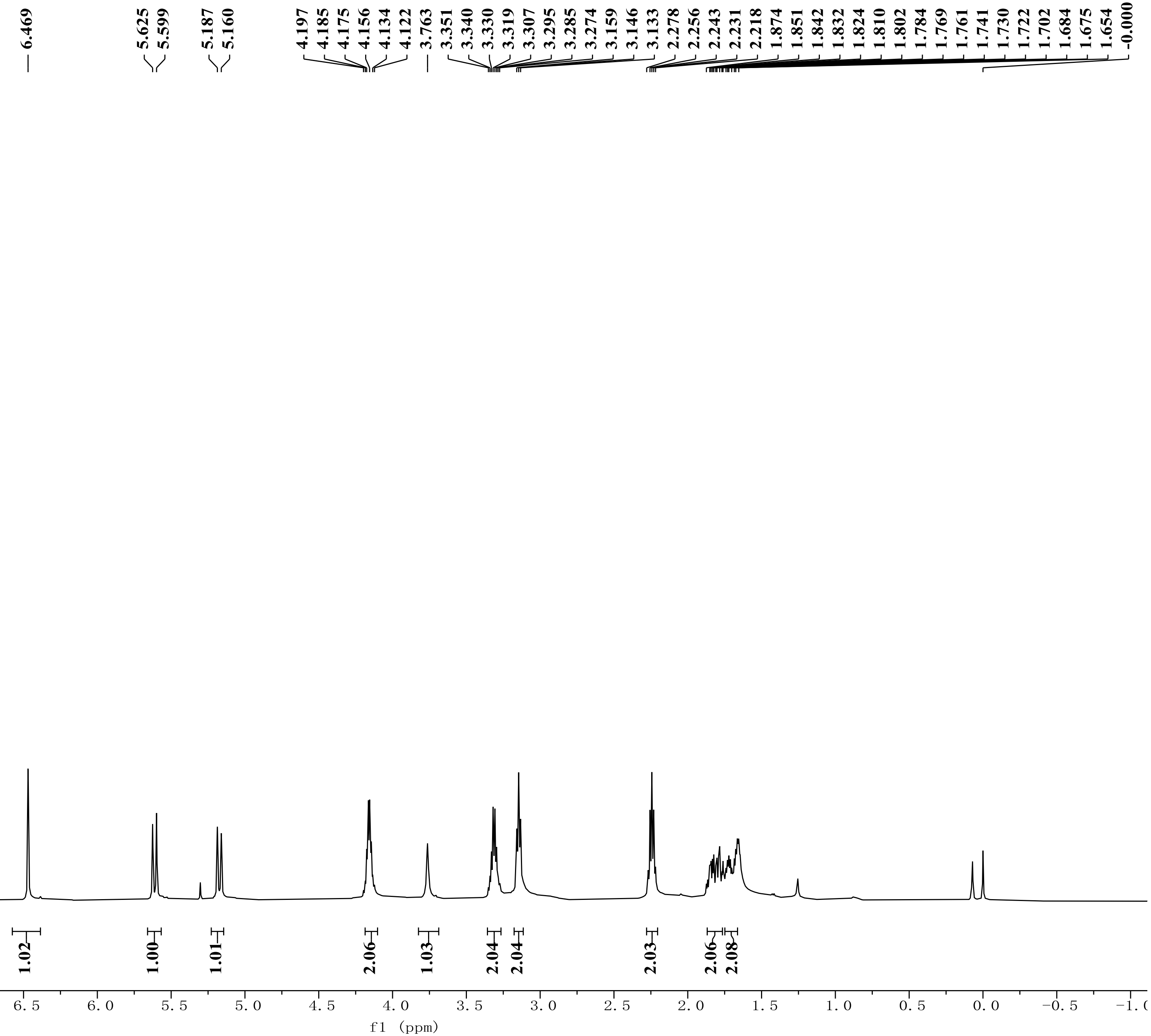


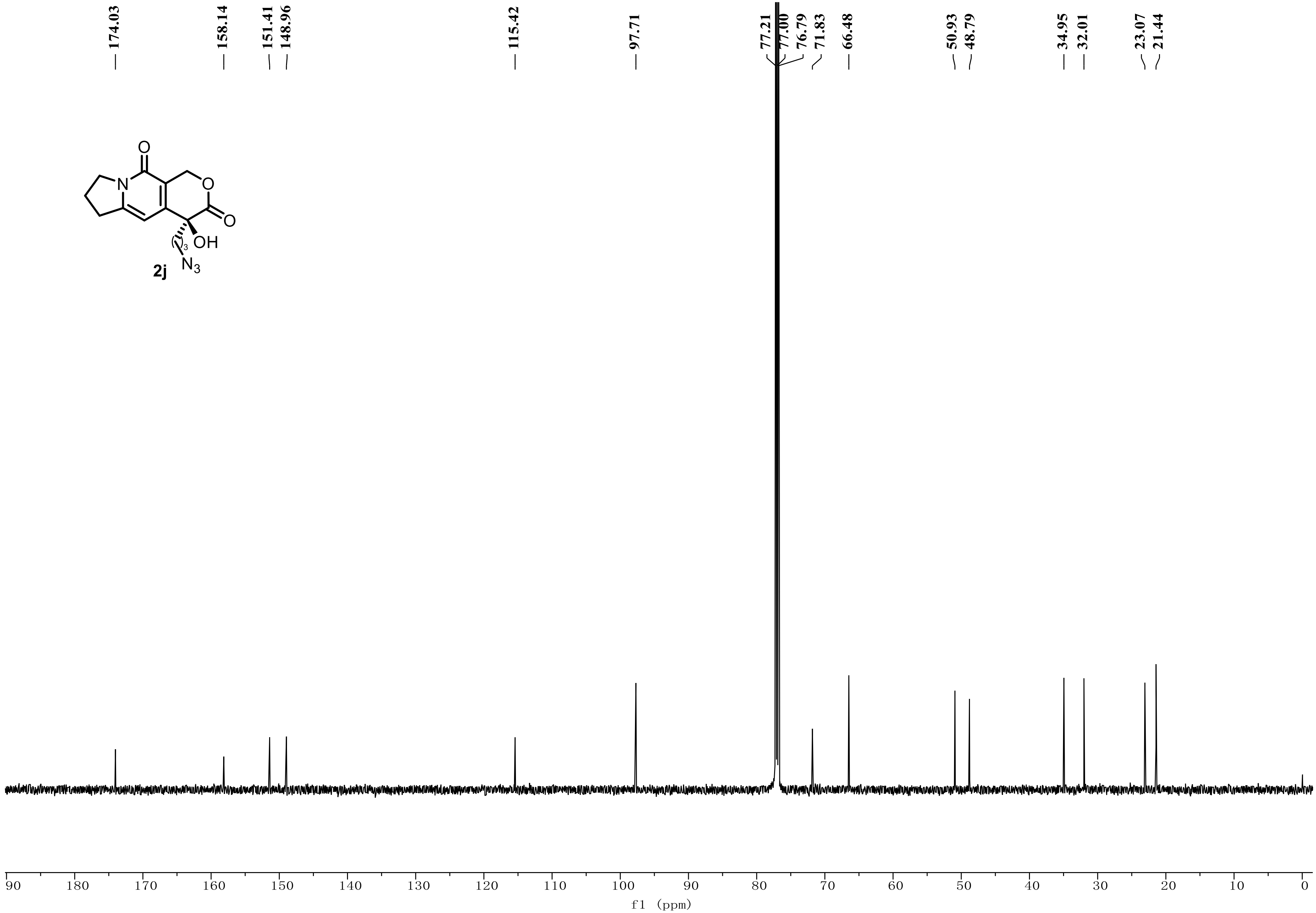
6.474
5.638
5.612
5.213
5.187
4.210
4.198
4.188
4.177
4.165
4.154
4.144
4.131
3.713
3.408
3.398
3.388
3.163
3.150
3.136
2.273
2.260
2.248
2.235
2.223
2.024
2.012
2.002
1.994
1.988
1.978
1.960
1.954
1.938
1.920
1.913
1.906
1.898
1.882
1.875
1.864
-0.000
0.99
1.00
1.01
2.08
1.01
2.01
2.01
2.00
1.03
3.04
f1 (ppm)

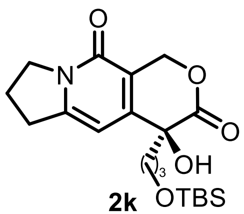

174.05
158.17
151.45
149.06
115.49
97.78
77.21
77.00
76.79
71.81
66.49
48.85
36.35
32.81
32.02
26.49
21.44
O
N
O
O
OH
3
Br
2i
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



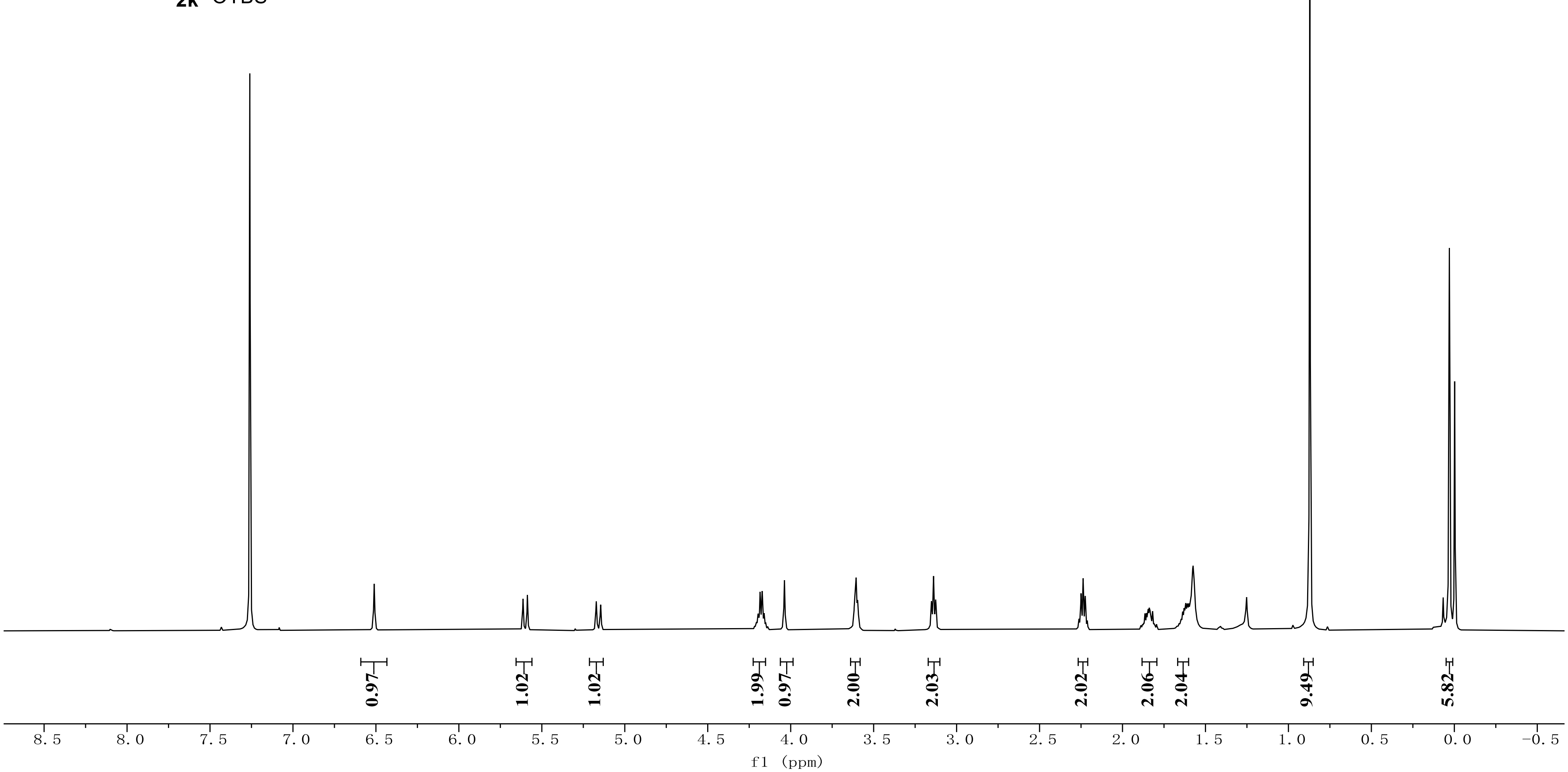
2j


6.469
5.625
5.599
5.187
5.160
4.197
4.185
4.175
4.156
4.134
4.122
3.763
3.351
3.340
3.330
3.319
3.307
3.295
3.285
3.274
3.159
3.146
3.133
2.278
2.256
2.243
2.231
2.218
1.874
1.851
1.842
1.832
1.824
1.810
1.802
1.784
1.769
1.761
1.741
1.730
1.722
1.702
1.684
1.675
1.654
-0.000
1.02
1.00
1.01
2.06
1.03
2.04
2.04
2.03
2.06
2.08
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
-1.0
f1 (ppm)

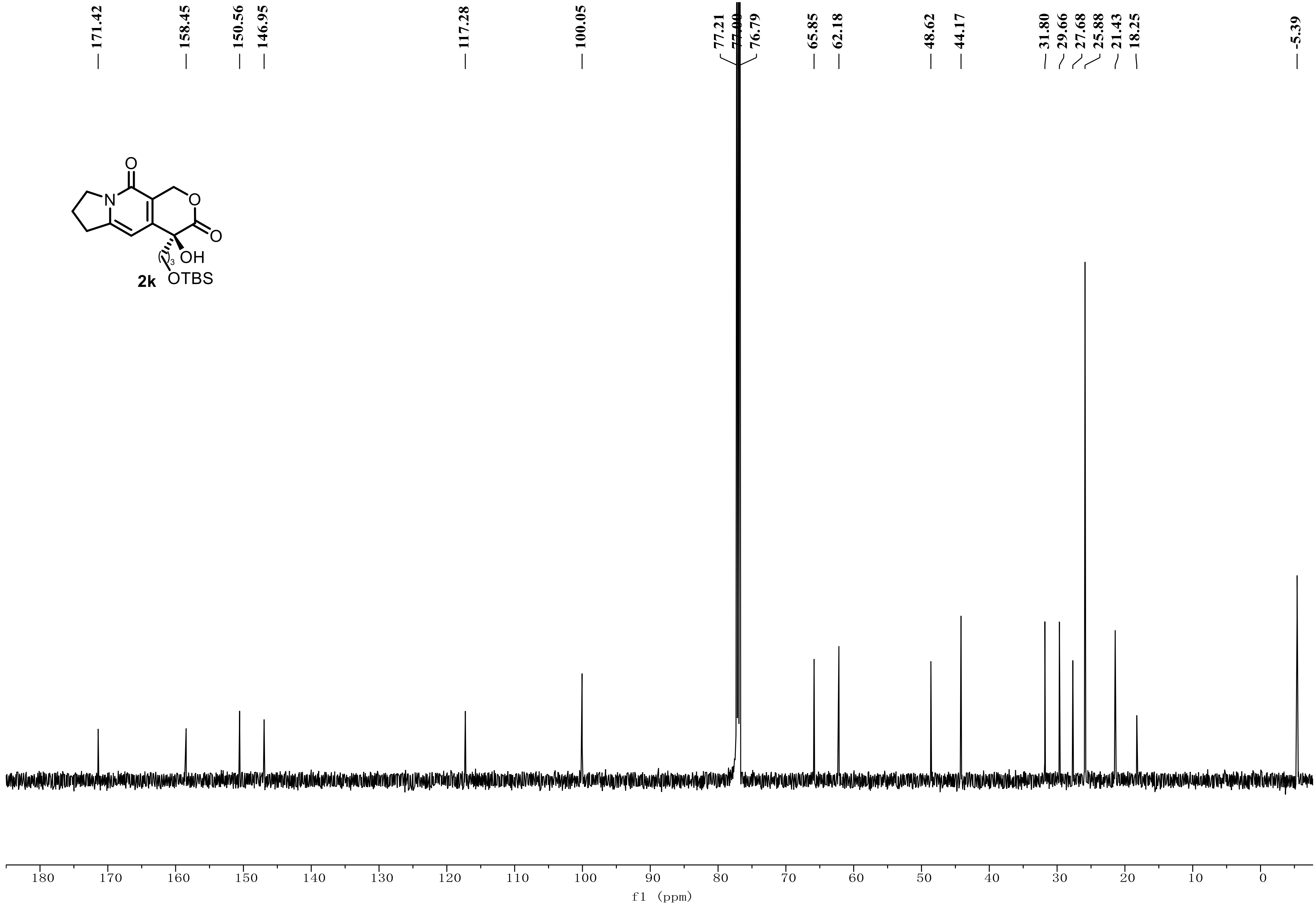

174.03
158.14
151.41
148.96
115.42
97.71
77.21
77.00
76.79
71.83
66.48
50.93
48.79
34.95
32.01
23.07
21.44
O
N
O
O
OH
N3
3
2j
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



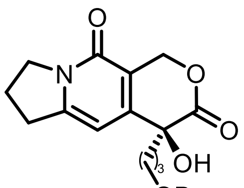
2k



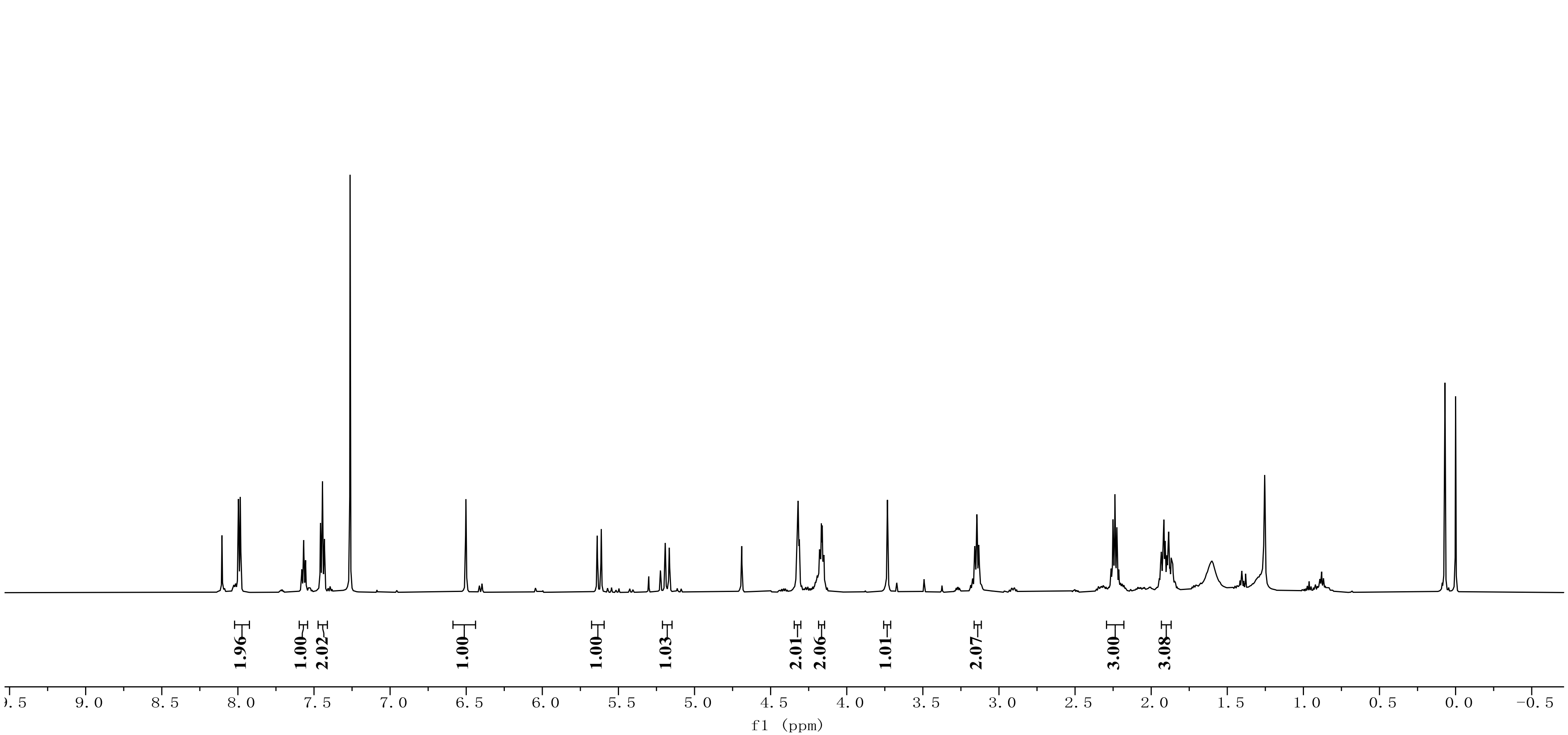
7.260
6.510
5.613
5.587
5.172
5.145
4.218
4.212
4.206
4.196
4.184
4.172
4.160
4.150
4.138
4.038
3.617
3.607
3.597
3.152
3.139
3.126
2.262
2.250
2.237
2.225
2.212
1.864
1.856
1.849
1.845
1.839
1.834
1.828
1.819
1.647
1.637
1.628
1.619
1.611
1.609
0.871
0.030
0.97
1.02
1.02
1.99
0.97
2.00
2.03
2.02
2.06
2.04
9.49
5.82
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)



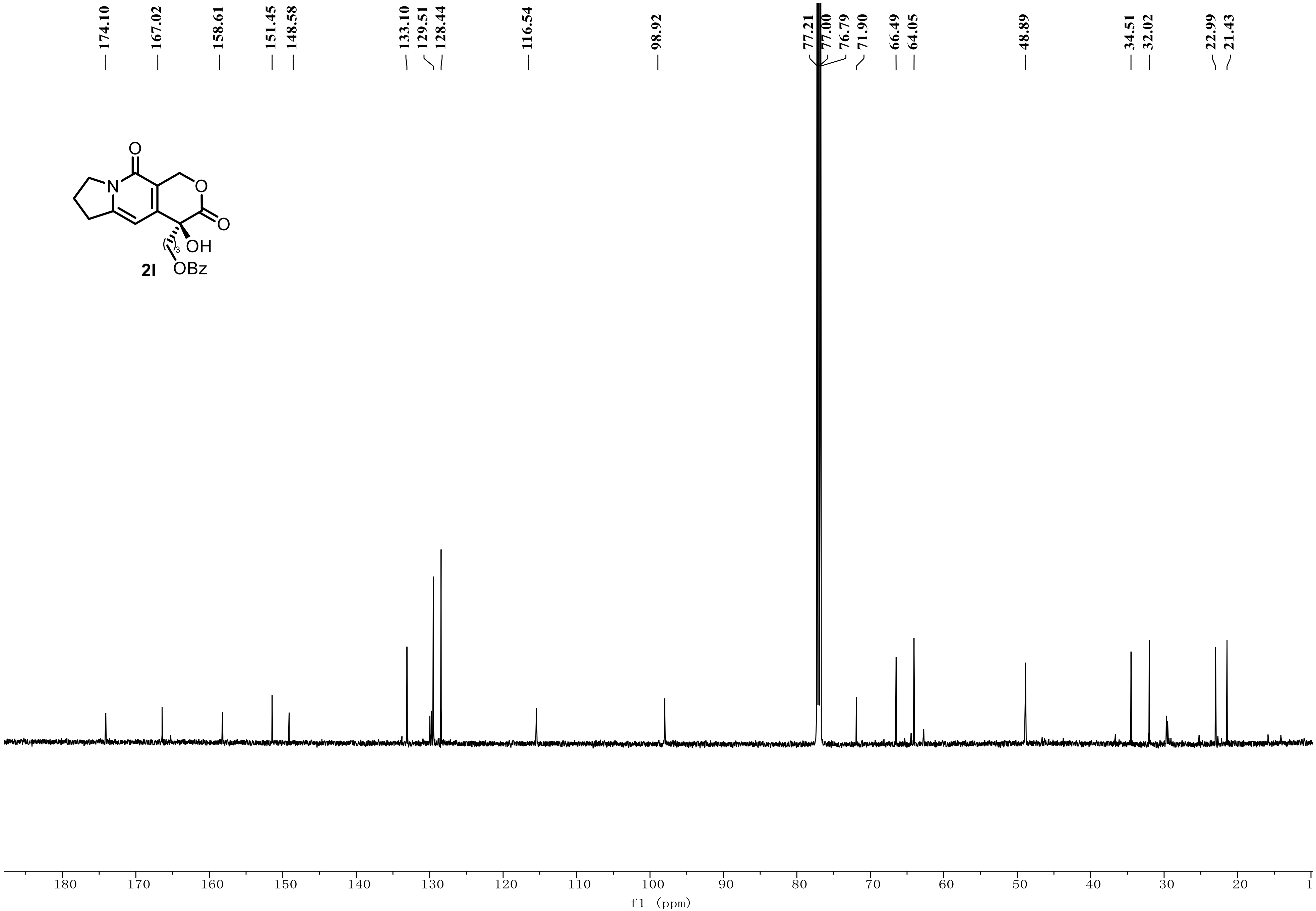
171.42
158.45
150.56
146.95
117.28
100.05
77.21
77.00
76.79
65.85
62.18
48.62
44.17
31.80
29.66
27.68
25.88
21.43
18.25
-5.39
O
N
O
O
OH
3
OTBS
2k
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

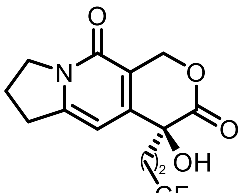


2l

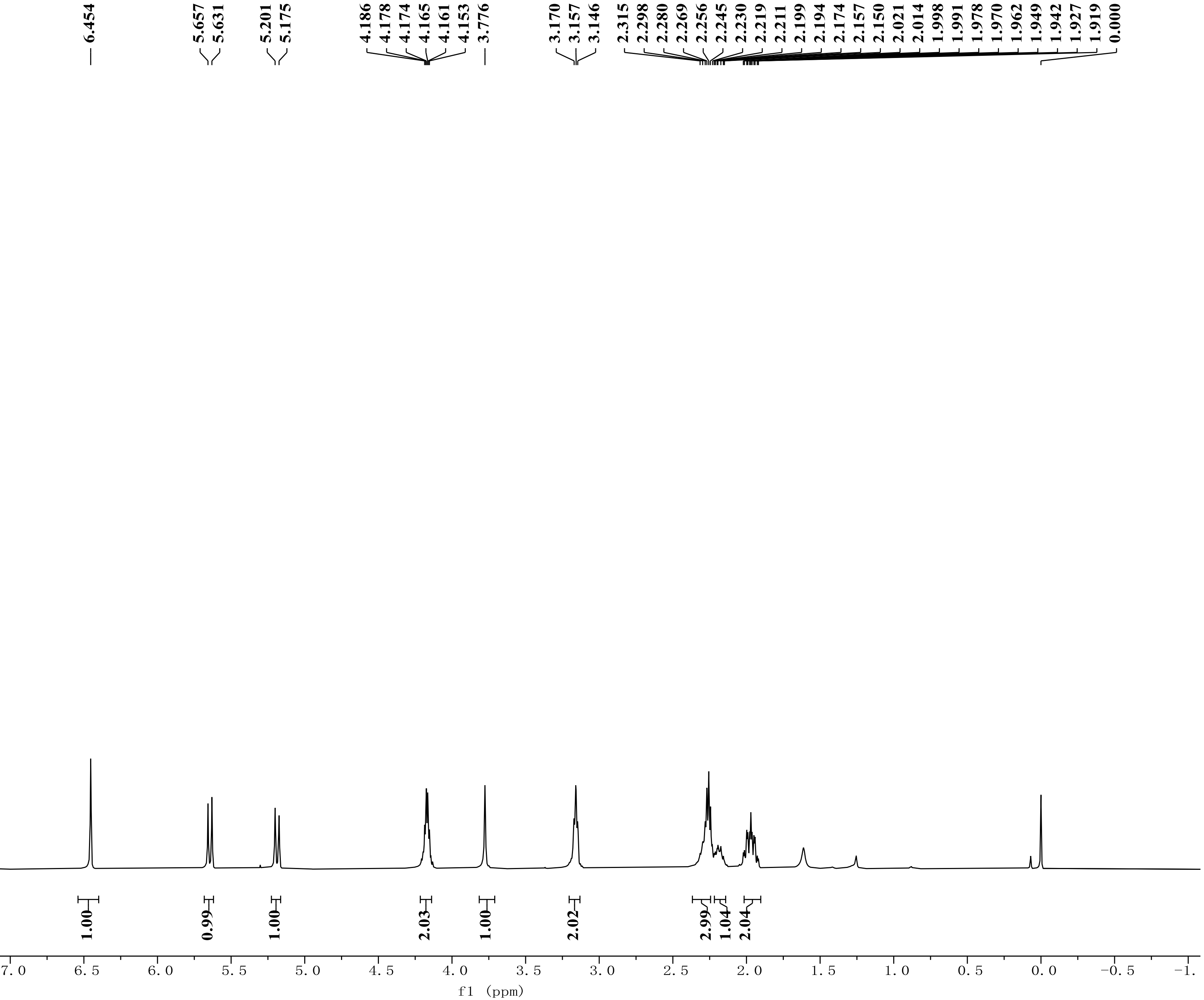


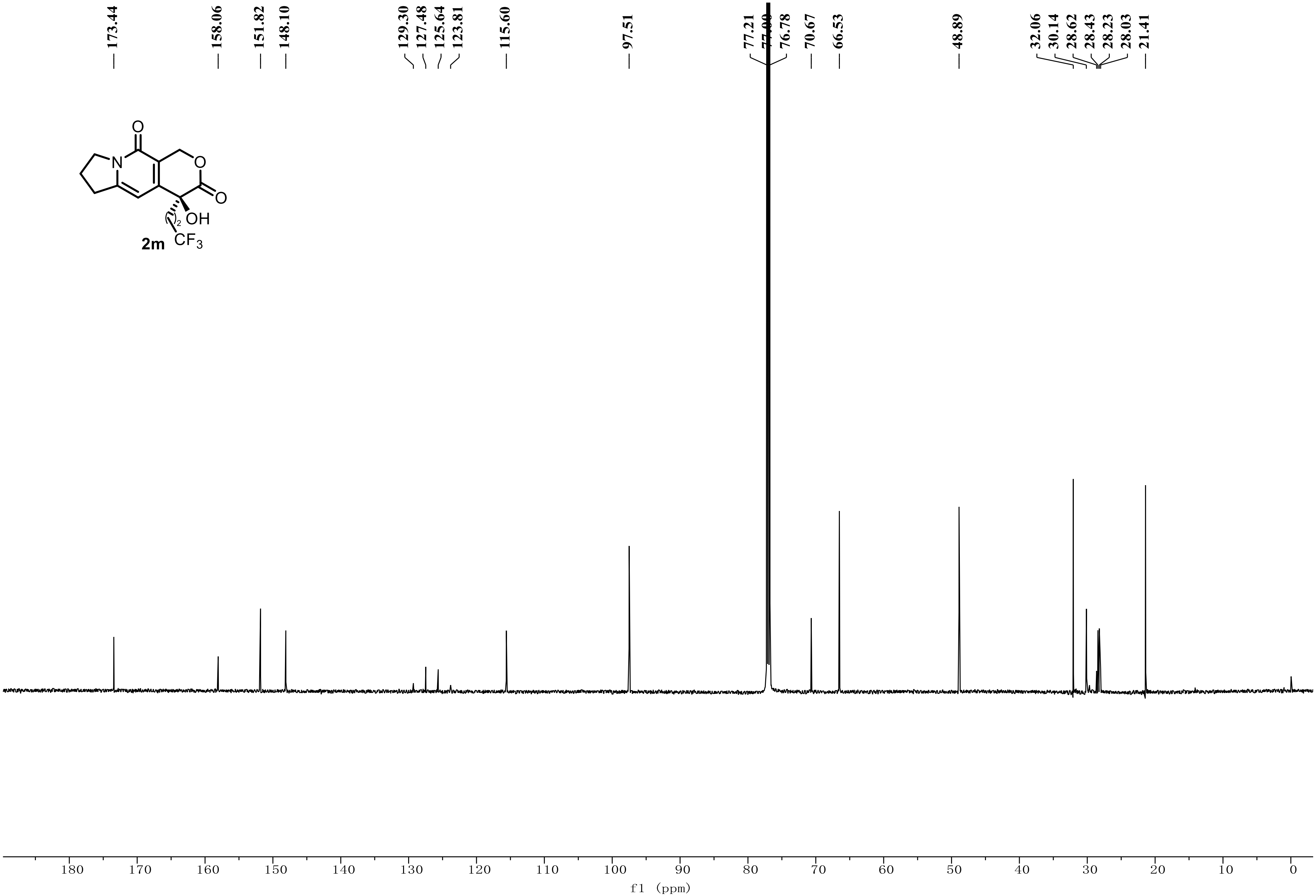
7.996
7.985
7.580
7.568
7.555
7.457
7.444
7.431
6.502
5.639
5.613
5.192
5.166
4.326
4.320
4.312
4.179
4.174
4.167
4.161
4.154
4.150
3.733
3.159
3.145
3.132
2.263
2.251
2.238
2.226
2.213
1.946
1.938
1.933
1.921
1.916
1.909
1.897
1.885
1.869
1.858
0.000
1.96
1.00
2.02
1.00
1.00
1.03
2.01
2.06
1.01
2.07
3.00
3.08
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)


174.10
167.02
158.61
151.45
148.58
133.10
129.51
128.44
116.54
98.92
77.21
77.00
76.79
71.90
66.49
64.05
48.89
34.51
32.02
22.99
21.43
O
N
O
O
OH
3
OBz
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
1
f1 (ppm)
2l

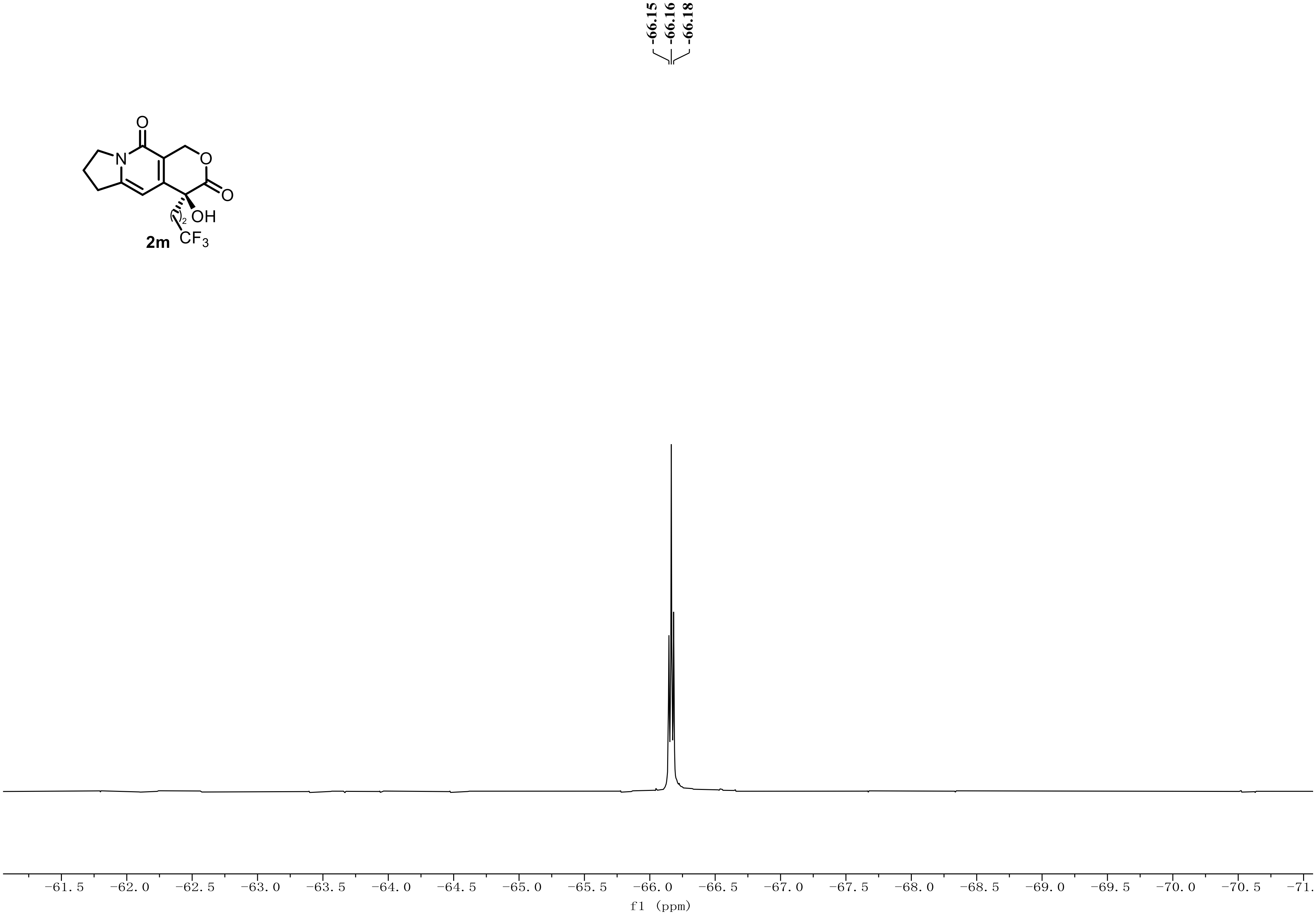

O
N
O
O
OH
2
CF3

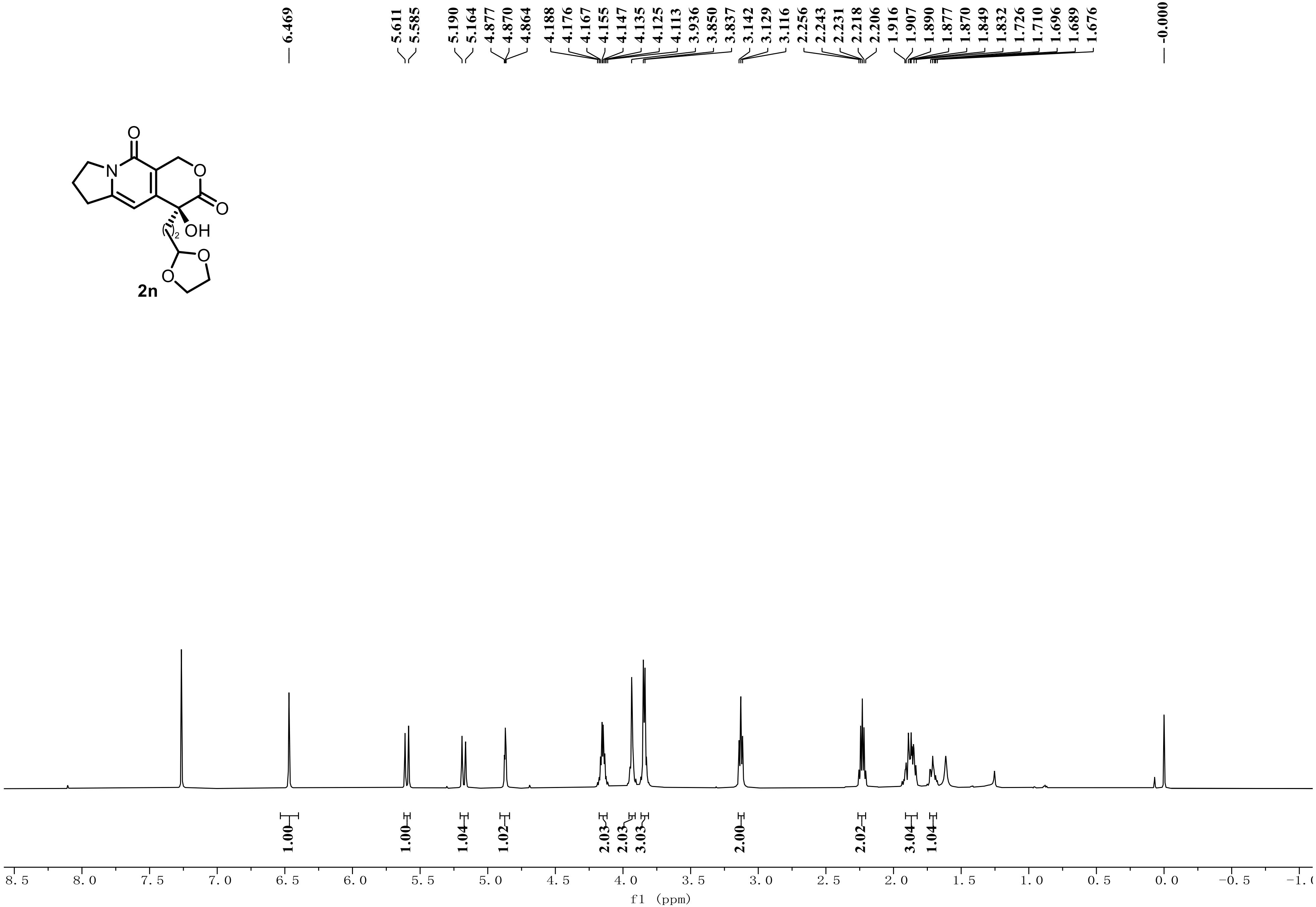
2m


6.454
5.657
5.631
5.201
5.175
4.186
4.178
4.174
4.165
4.161
4.153
3.776
3.170
3.157
3.146
2.315
2.298
2.280
2.269
2.256
2.245
2.230
2.219
2.211
2.199
2.194
2.174
2.157
2.150
2.021
2.014
1.998
1.991
1.978
1.970
1.962
1.949
1.942
1.927
1.919
0.000
1.00
0.99
1.00
2.03
1.00
2.02
2.99
1.04
2.04
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
−1.
f1 (ppm)

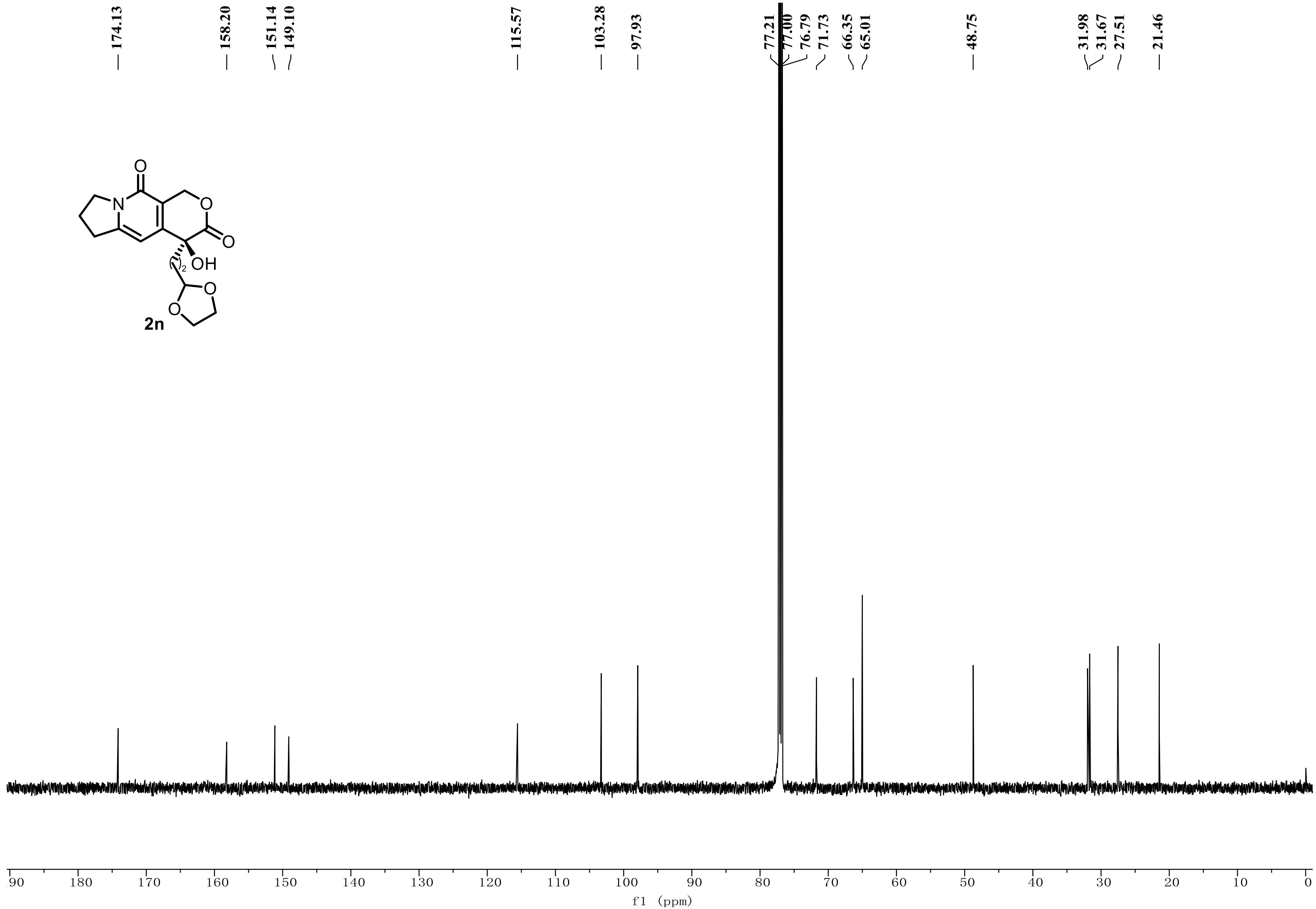


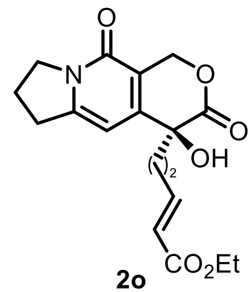
173.44
158.06
151.82
148.10
129.30
127.48
125.64
123.81
115.60
97.51
77.21
77.00
76.78
70.67
66.53
48.89
32.06
30.14
28.62
28.43
28.23
28.03
21.41
O
N
O
O
OH
2
CF3
2m
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-66.15
-66.16
-66.18
2m
-61.5 -62.0 -62.5 -63.0 -63.5 -64.0 -64.5 -65.0 -65.5 -66.0 -66.5 -67.0 -67.5 -68.0 -68.5 -69.0 -69.5 -70.0 -70.5 -71.
f1 (ppm)

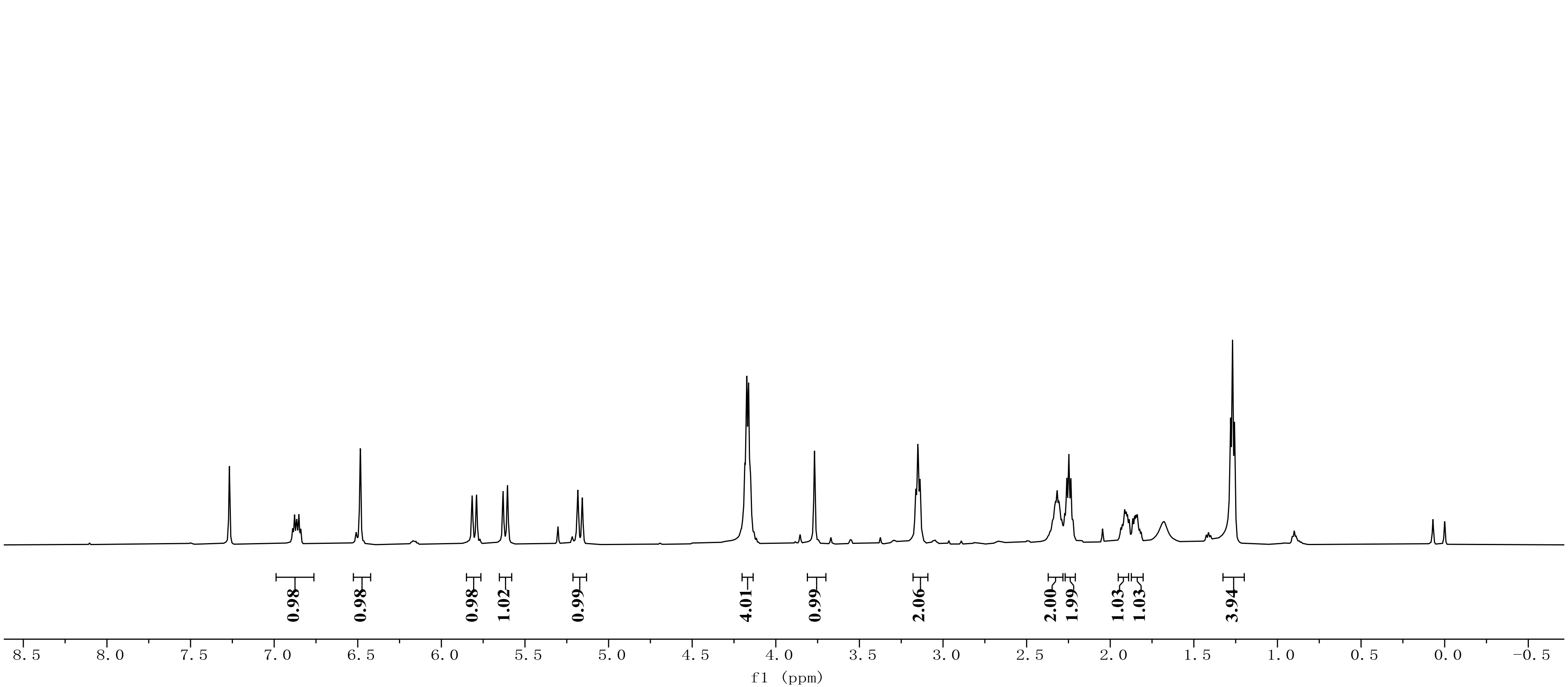


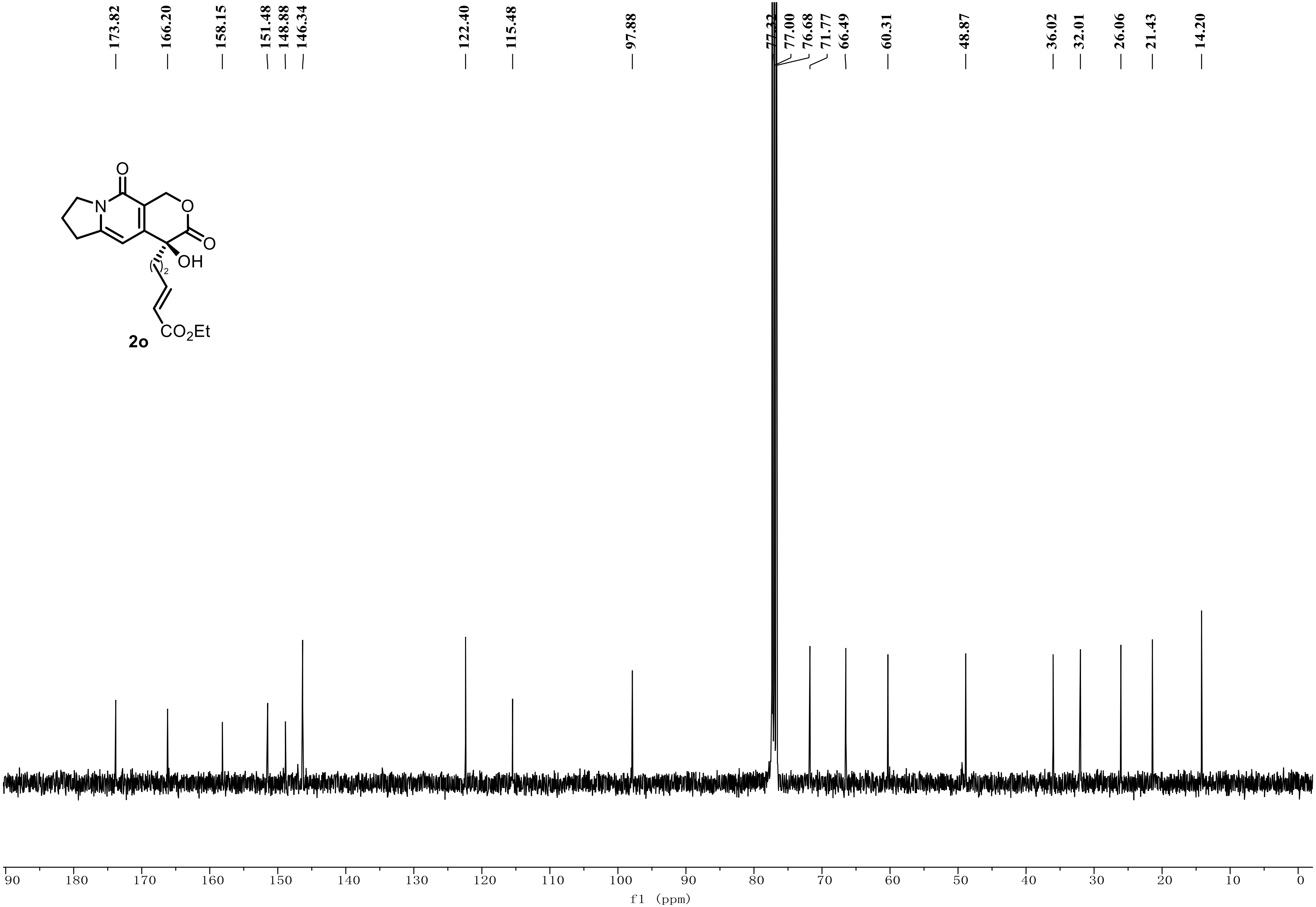
6.469
5.611
5.585
5.190
5.164
4.877
4.870
4.864
4.188
4.176
4.167
4.155
4.147
4.135
4.125
4.113
3.936
3.850
3.837
3.142
3.129
3.116
2.256
2.243
2.231
2.218
2.206
1.916
1.907
1.890
1.877
1.870
1.849
1.832
1.726
1.710
1.696
1.689
1.676
-0.000
O
N
O
O
OH
2
O
O
2n
1.00
1.00
1.04
1.02
2.03
2.03
3.03
2.00
2.02
3.04
1.04
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 -1.0
f1 (ppm)

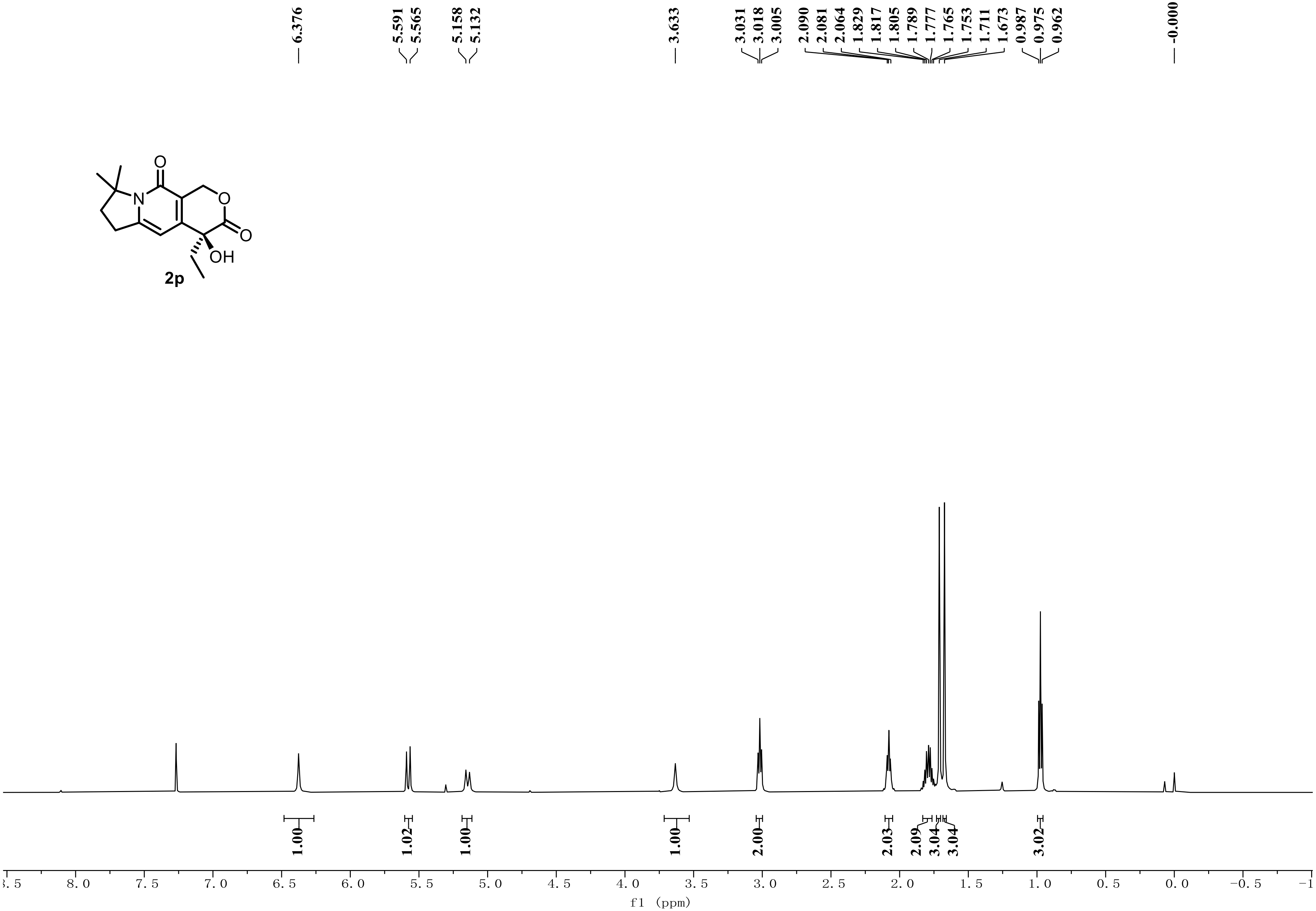

174.13
158.20
151.14
149.10
115.57
103.28
97.93
77.21
77.00
76.79
71.73
66.35
65.01
48.75
31.98
31.67
27.51
21.46
O
N
O
O
OH
2
O
O
2n
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

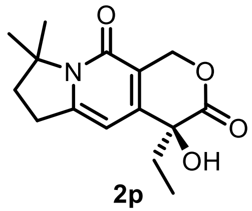


2o

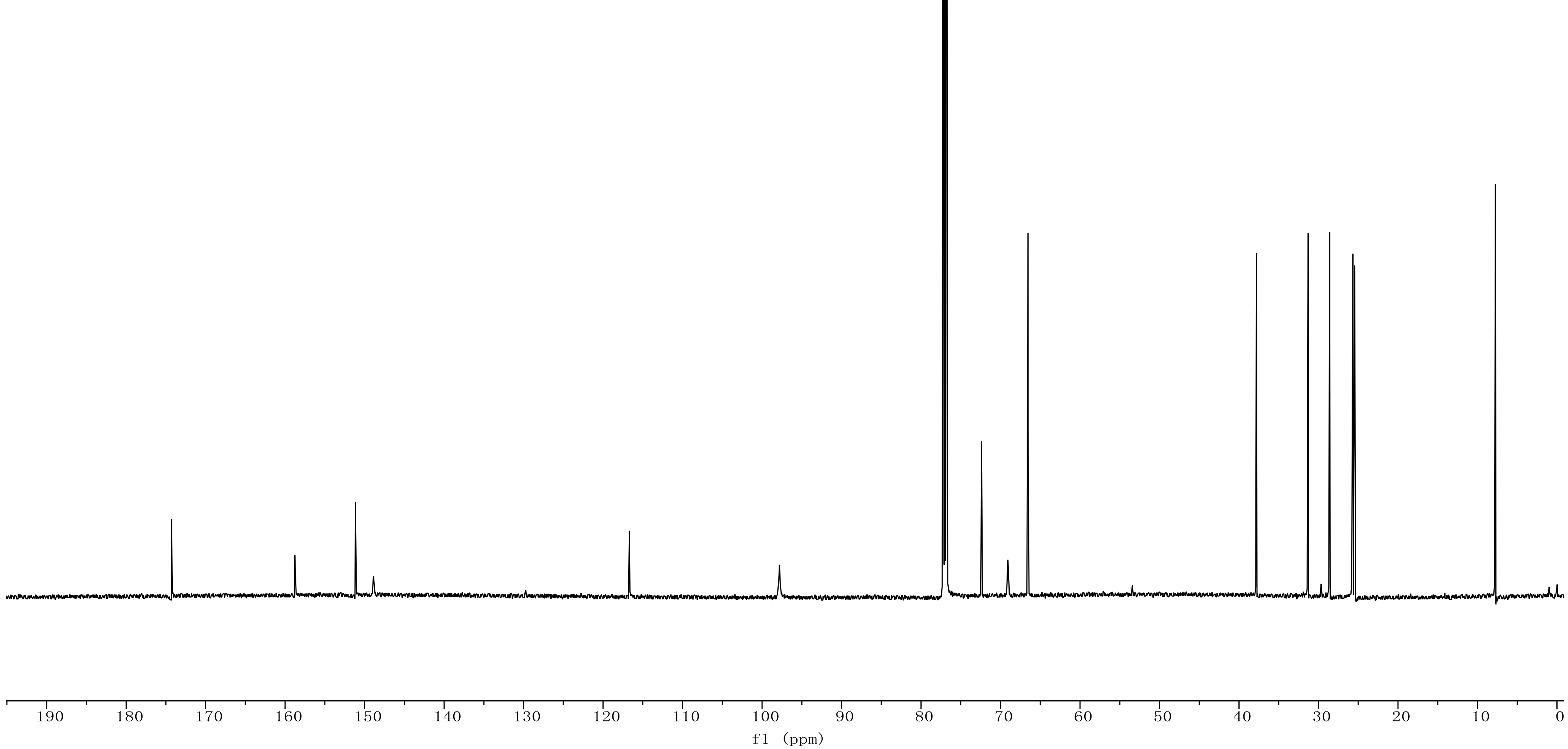

6.889
6.878
6.865
6.852
6.841
6.485
5.816
5.790
5.631
5.604
5.184
5.157
4.186
4.174
4.162
4.151
3.769
3.164
3.150
3.137
2.361
2.345
2.327
2.317
2.307
2.289
2.272
2.260
2.247
2.235
2.223
1.937
1.928
1.914
1.904
1.896
1.887
1.865
1.855
1.847
1.838
1.824
1.814
1.280
1.268
1.257
0.000
0.98
0.98
0.98
1.02
0.99
4.01
0.99
2.06
2.00
1.99
1.03
1.03
3.94
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)


173.82
166.20
158.15
151.48
148.88
146.34
122.40
115.48
97.88
77.32
77.00
76.68
71.77
66.49
60.31
48.87
36.02
32.01
26.06
21.43
14.20
O
N
O
O
OH
2
CO2Et
2o
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

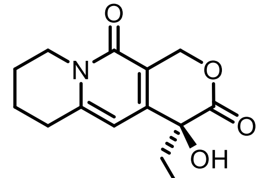

6.376
5.591
5.565
5.158
5.132
3.633
3.031
3.018
3.005
2.090
2.081
2.064
1.829
1.817
1.805
1.789
1.777
1.765
1.753
1.711
1.673
0.987
0.975
0.962
-0.000
OH
2p
1.00
1.02
1.00
1.00
2.00
2.03
2.09
3.04
3.04
3.02
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
f1 (ppm)



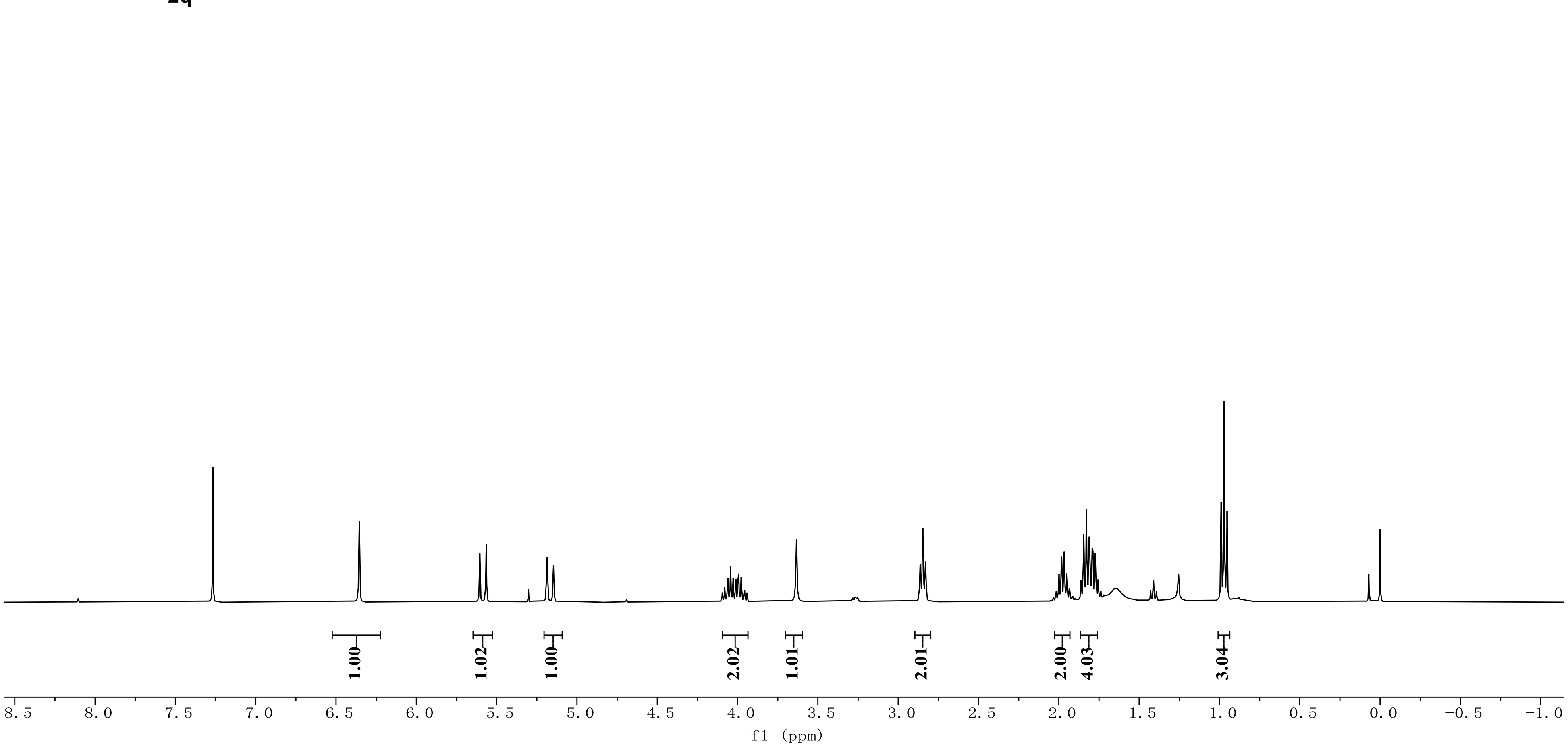
2p



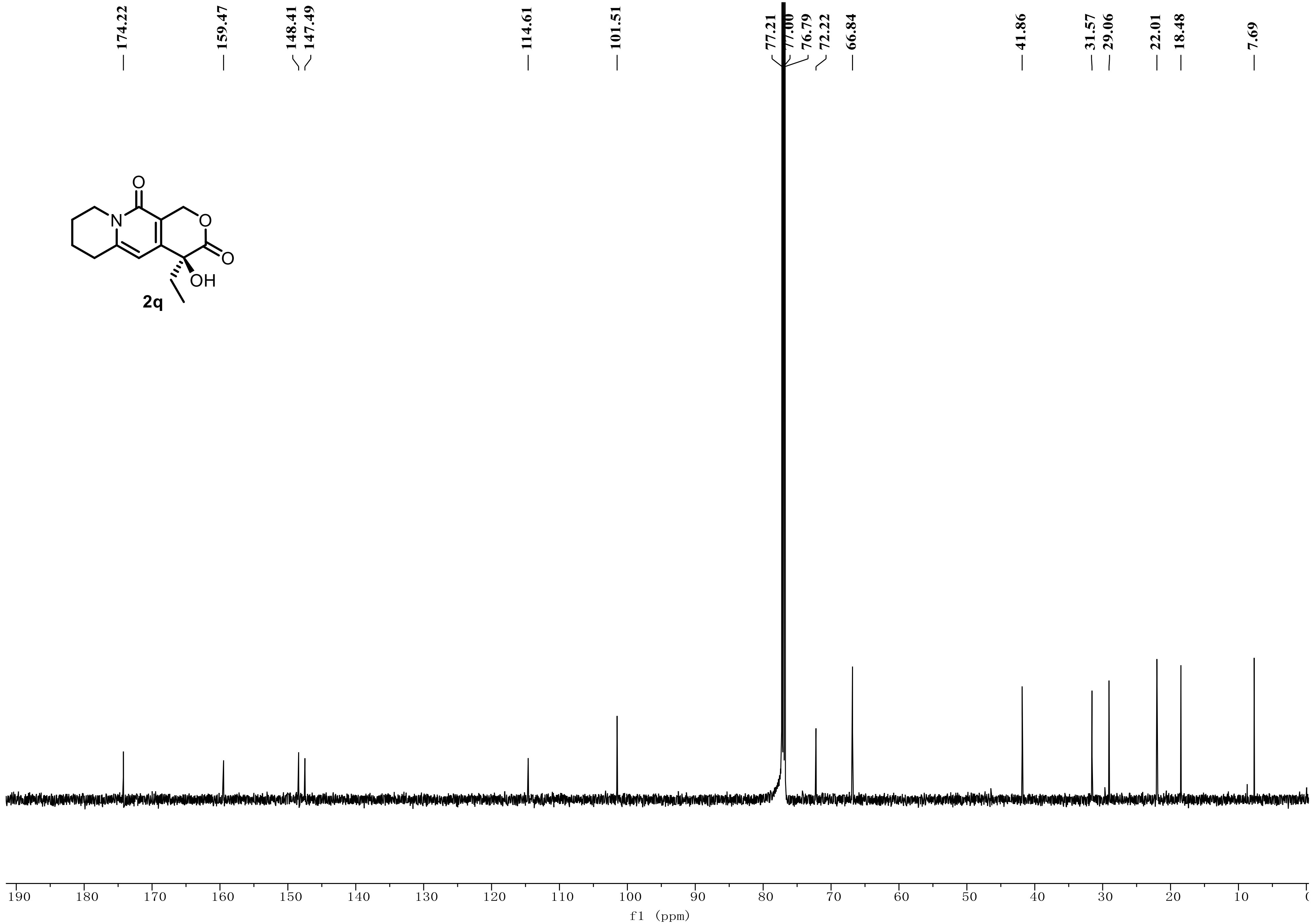
174.28
158.78
151.16
148.88
116.69
97.81
77.21
77.00
76.79
72.39
69.07
66.54
37.81
31.31
28.60
25.68
25.46
7.74
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



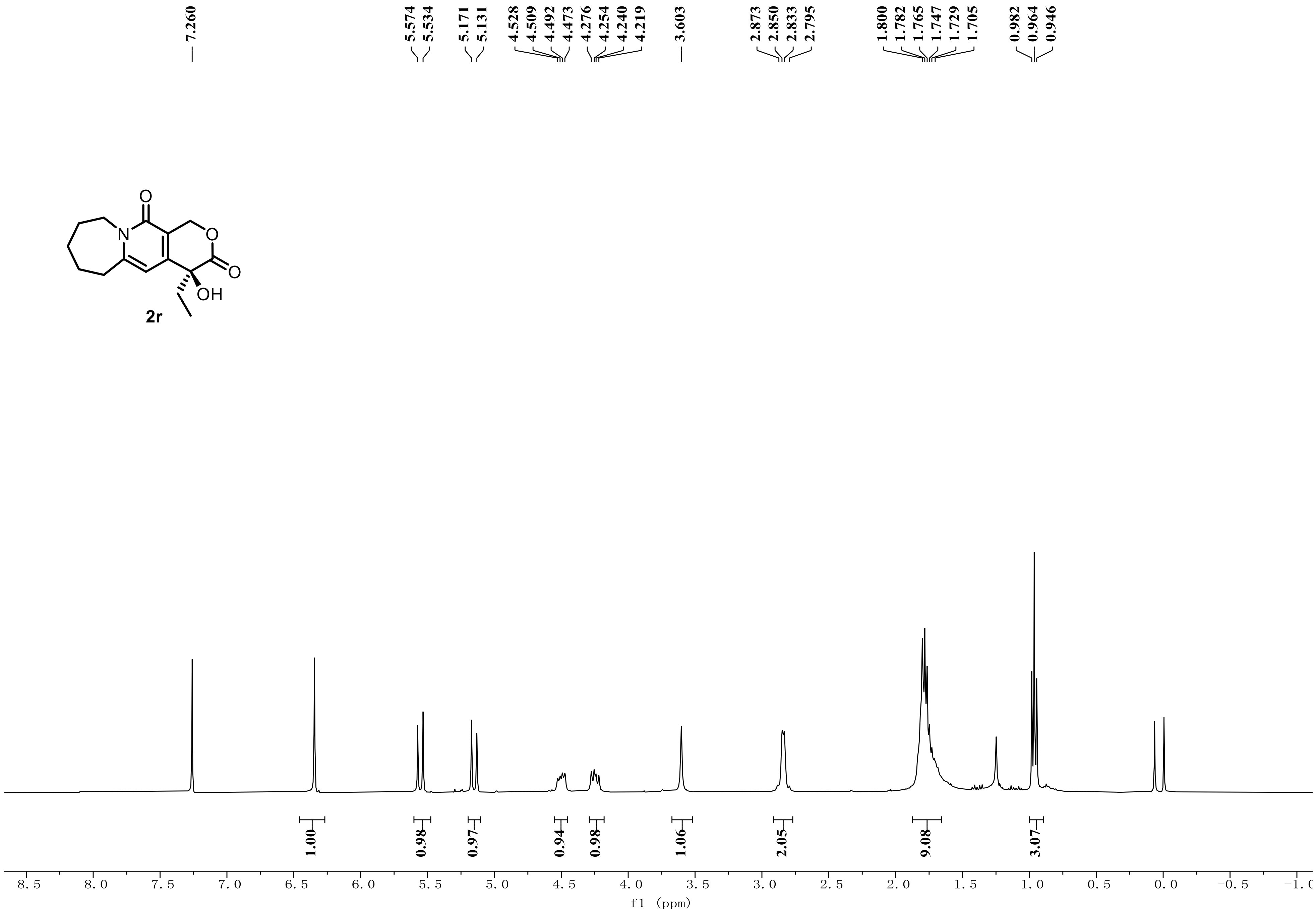
2q



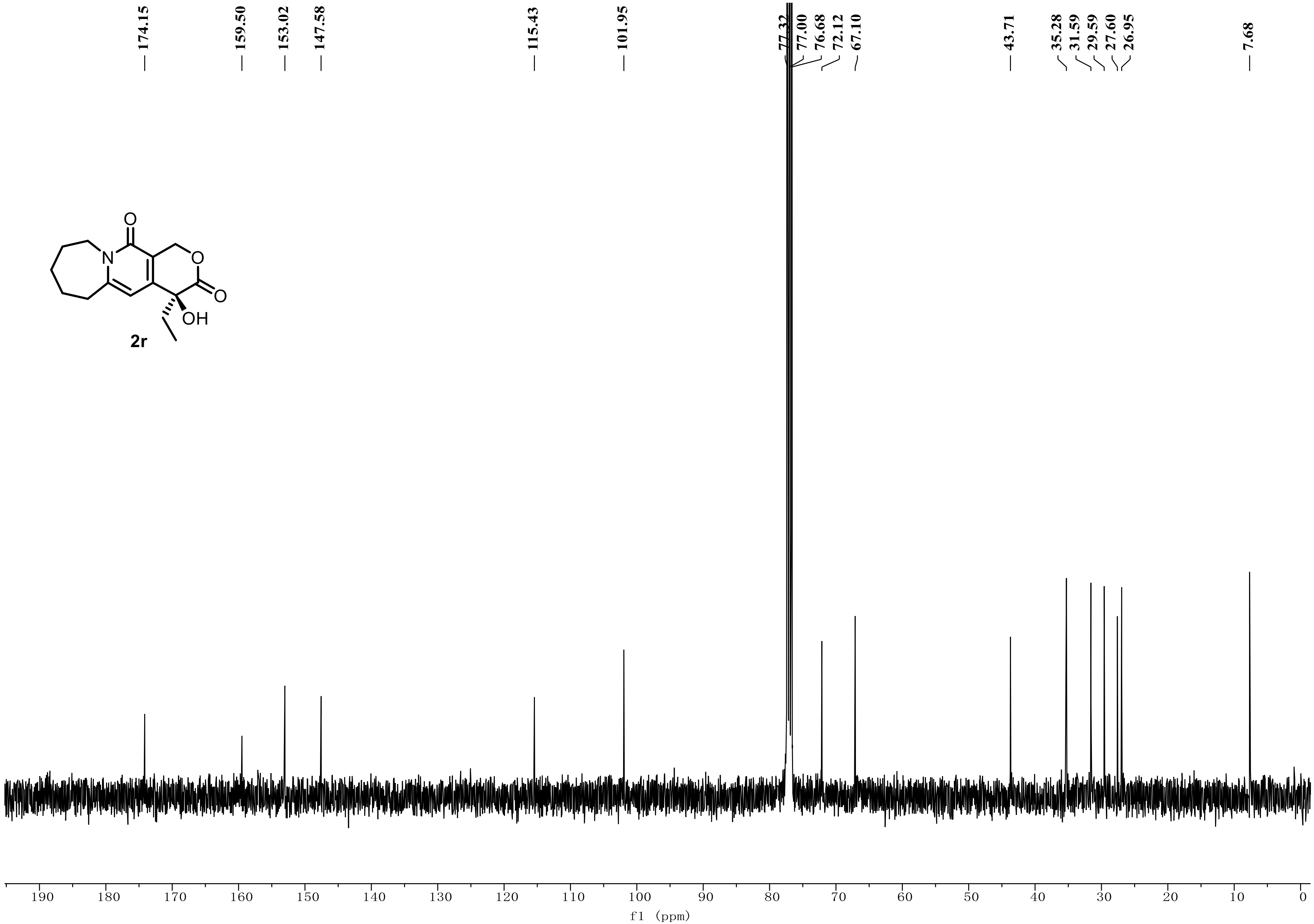
6.358
5.605
5.565
5.186
5.143
4.095
4.079
4.059
4.042
4.028
4.011
3.993
3.978
3.956
3.942
3.633
2.863
2.847
2.830
2.034
1.984
1.966
1.951
1.933
1.917
1.861
1.845
1.828
1.812
1.806
1.793
1.787
1.774
1.756
0.990
0.971
0.953
0.000
1.00
1.02
1.00
2.02
1.01
2.01
2.00
4.03
3.04
f1 (ppm)

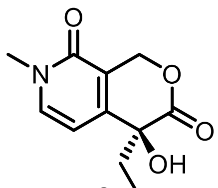


174.22
159.47
148.41
147.49
114.61
101.51
77.21
77.00
76.79
72.22
66.84
41.86
31.57
29.06
22.01
18.48
7.69
O
N
O
O
OH
2q
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

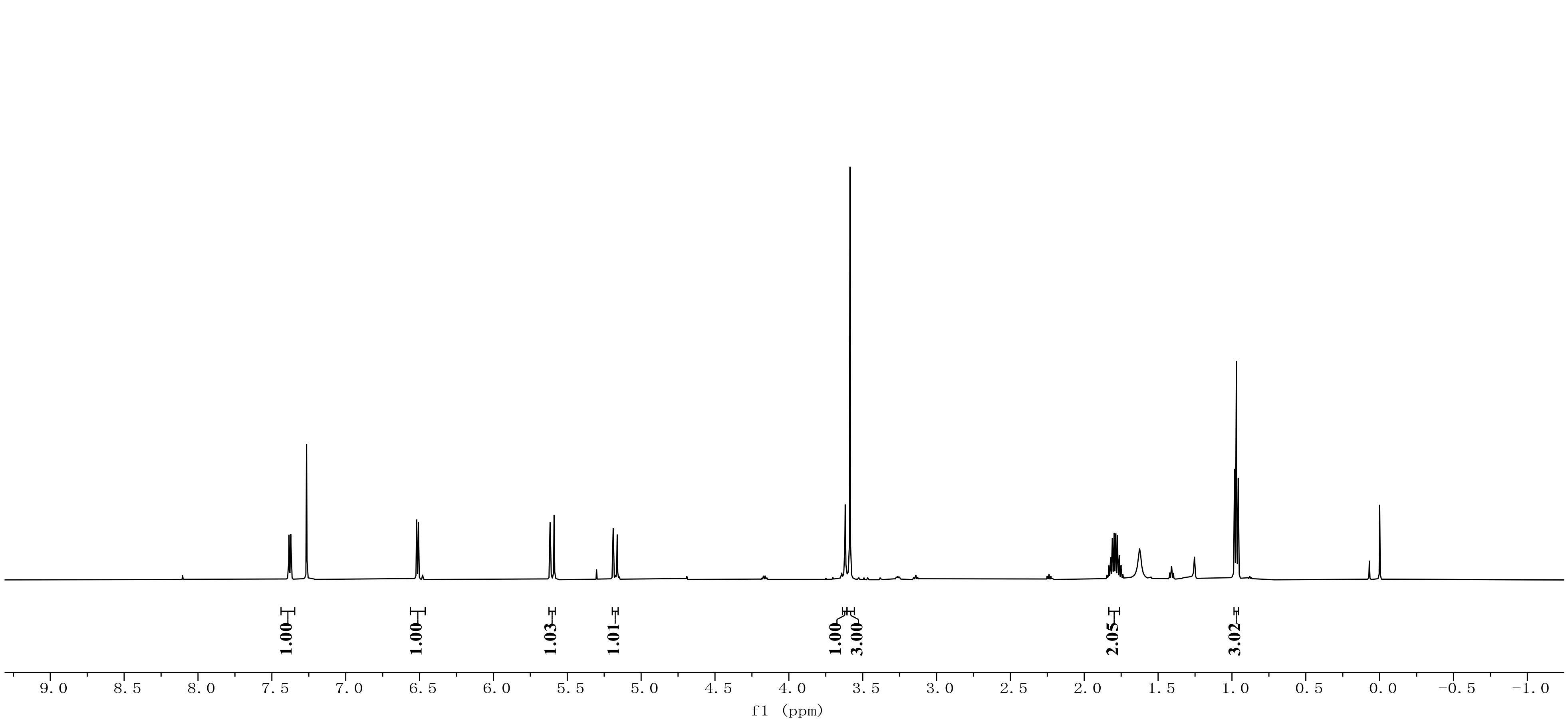


7.260
5.574
5.534
5.171
5.131
4.528
4.509
4.492
4.473
4.276
4.254
4.240
4.219
3.603
2.873
2.850
2.833
2.795
1.800
1.782
1.765
1.747
1.729
1.705
0.982
0.964
0.946
O
N
O
O
OH
2r
1.00
0.98
0.97
0.94
0.98
1.06
2.05
9.08
3.07
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)

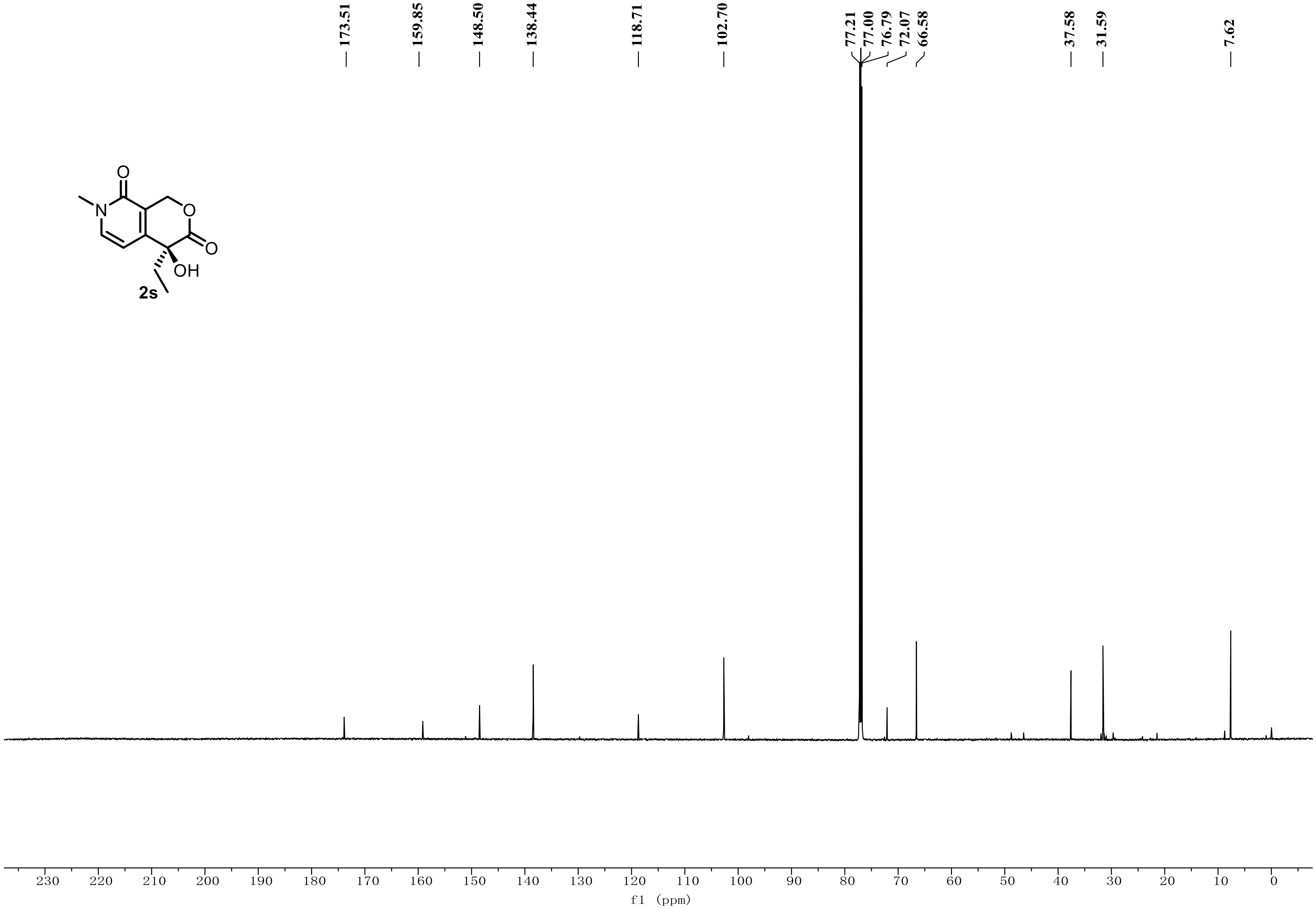

174.15
159.50
153.02
147.58
115.43
101.95
77.32
77.00
76.68
72.12
67.10
43.71
35.28
31.59
29.59
27.60
26.95
7.68
O
N
O
O
OH
2r
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



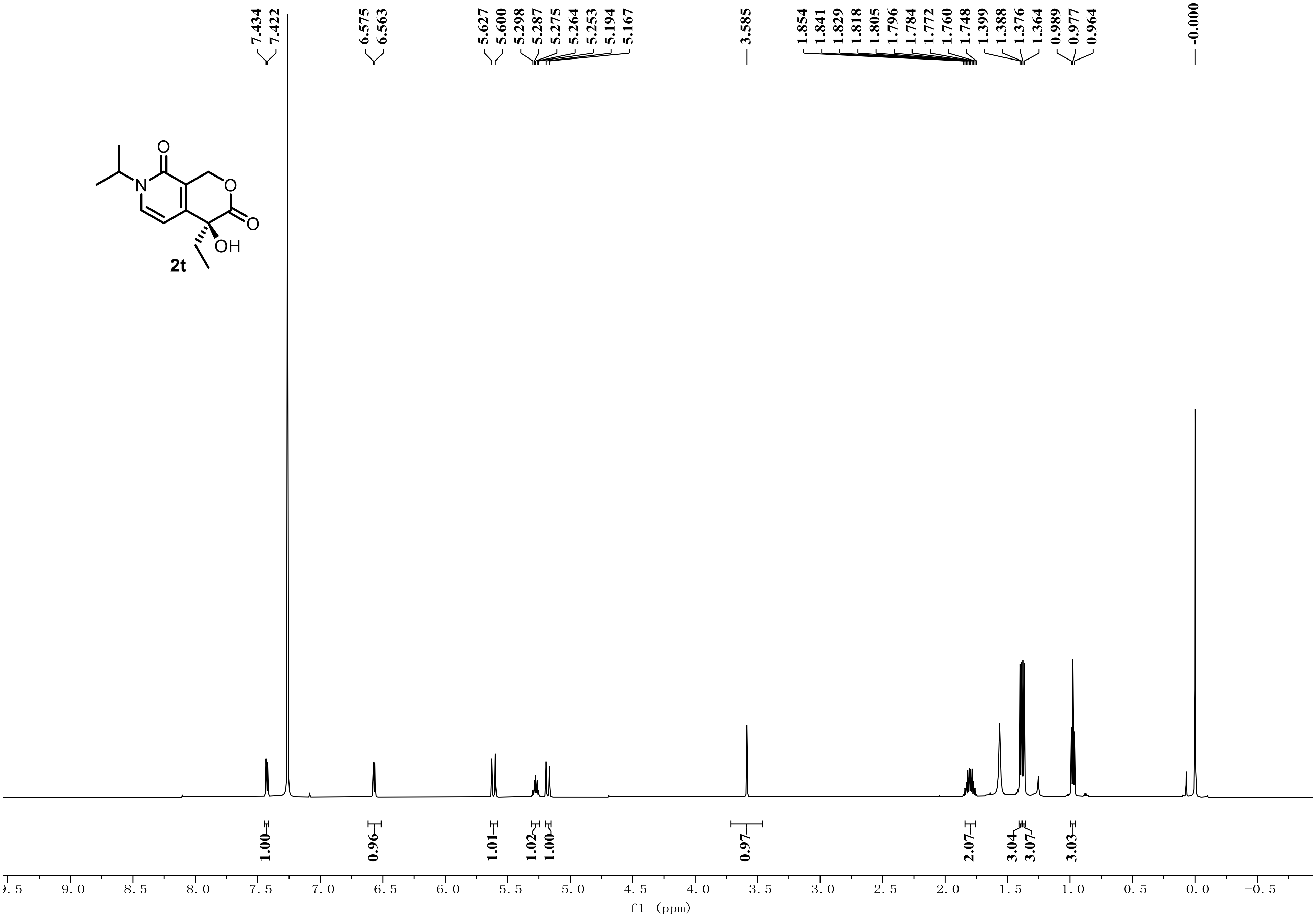
2s

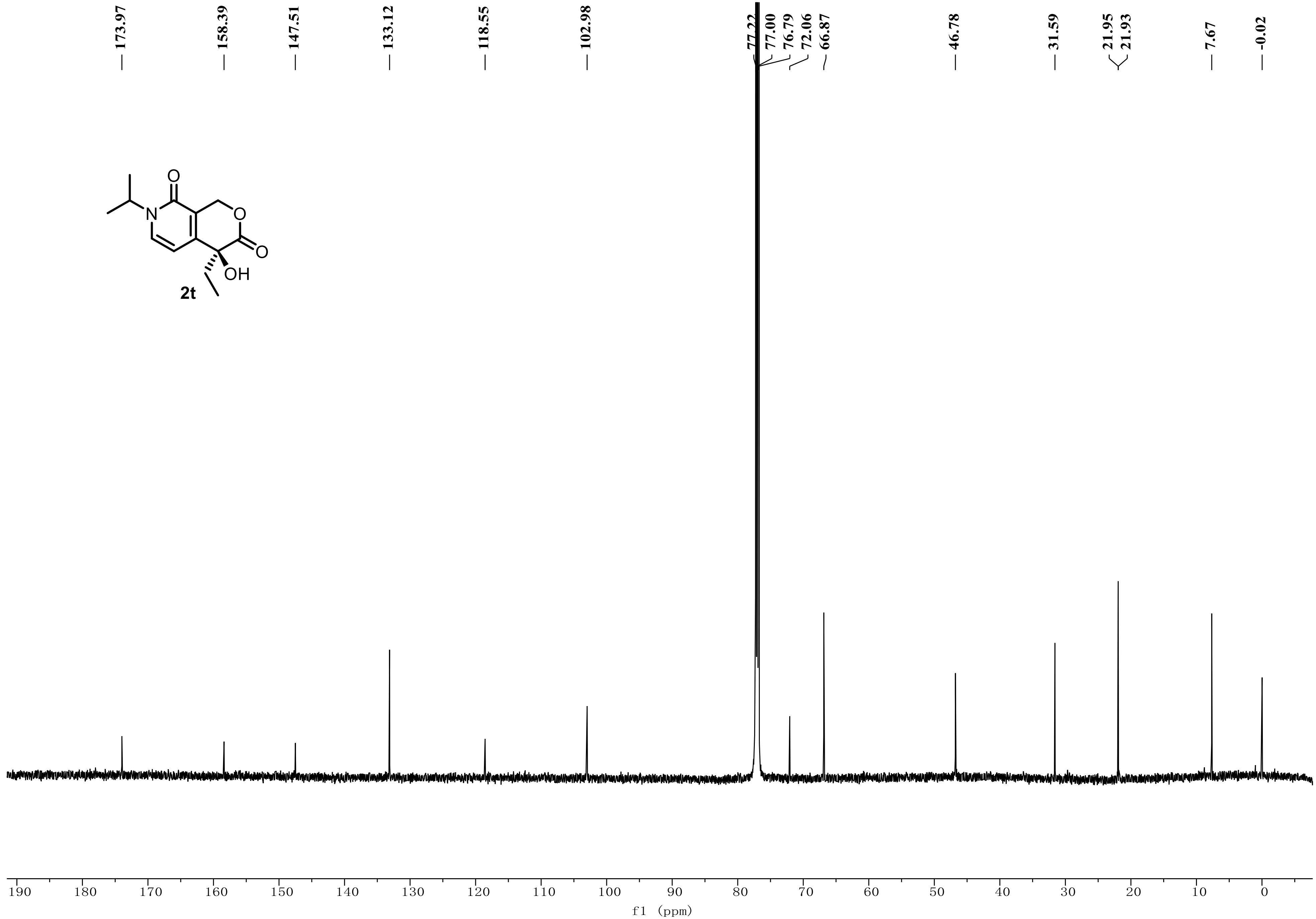


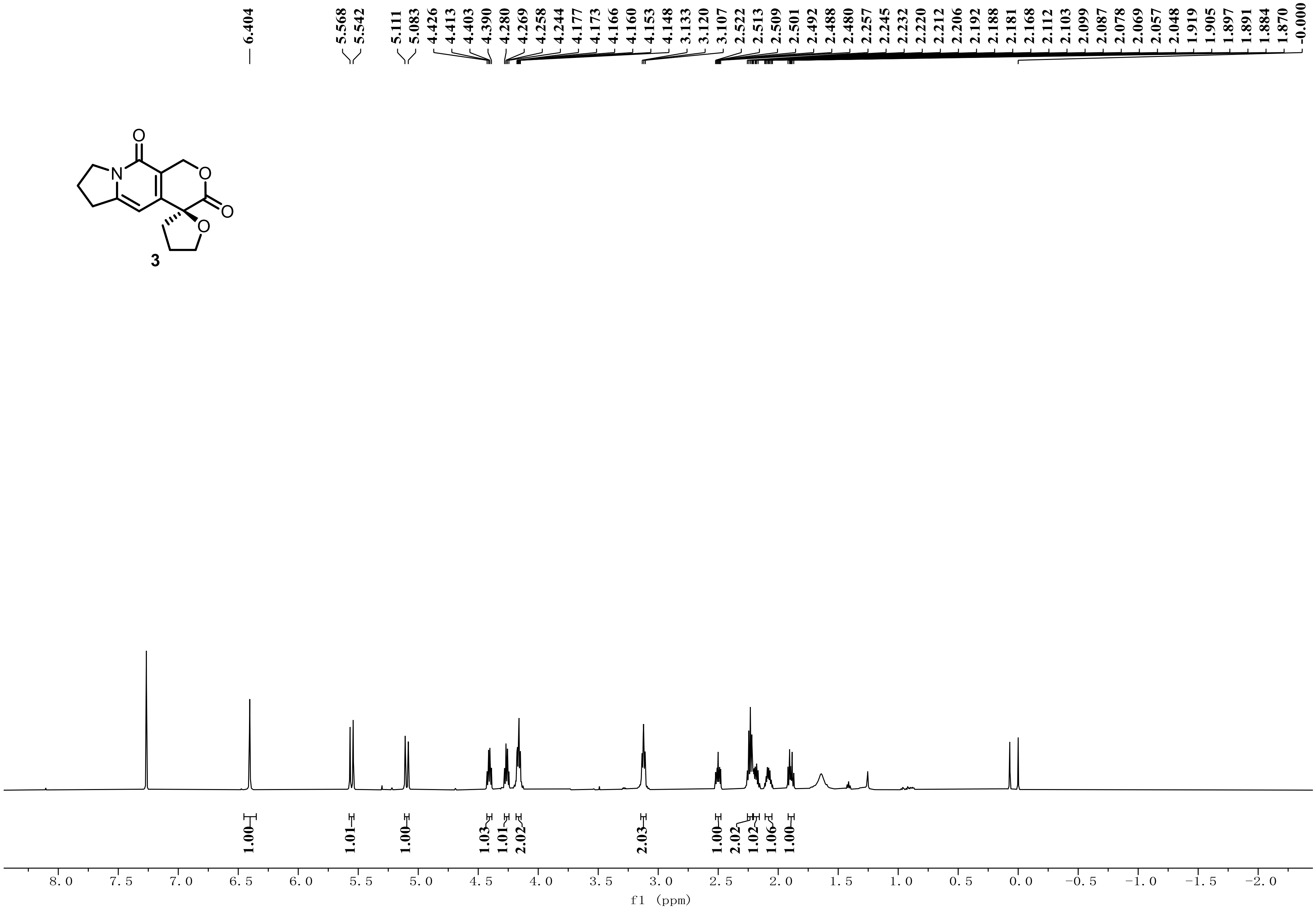
7.383
7.372
6.520
6.508
5.616
5.589
5.189
5.161
3.618
3.586
1.846
1.833
1.822
1.810
1.798
1.786
1.774
1.763
1.751
1.739
0.982
0.970
0.958
-0.000
1.00
1.00
1.03
1.01
1.00
3.00
2.05
3.02
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)



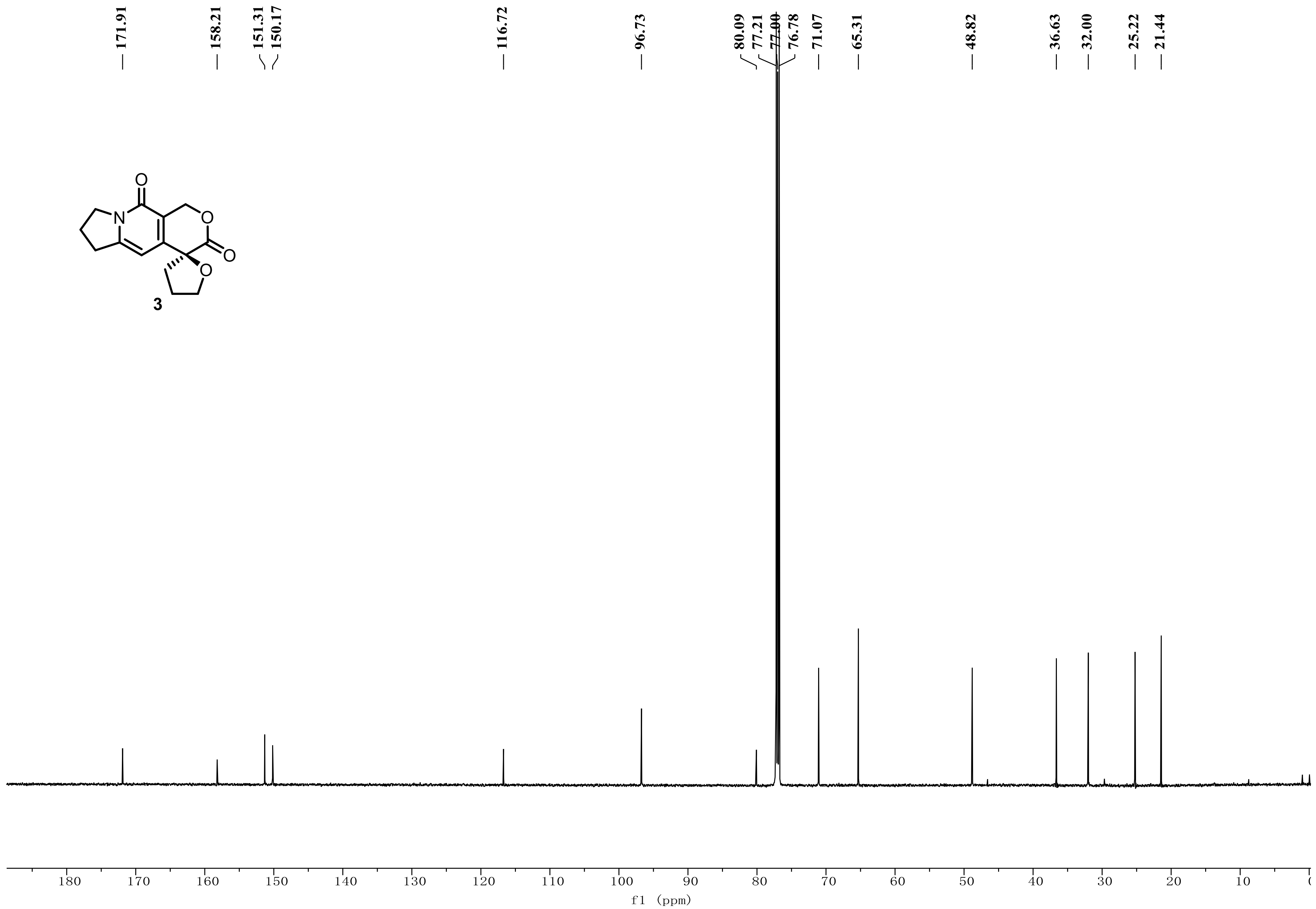
173.51
159.85
148.50
138.44
118.71
102.70
77.21
77.00
76.79
72.07
66.58
37.58
31.59
7.62
O
N
O
O
OH
2s
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.434
7.422
6.575
6.563
5.627
5.600
5.298
5.287
5.275
5.264
5.253
5.194
5.167
3.585
1.854
1.841
1.829
1.818
1.805
1.796
1.784
1.772
1.760
1.748
1.399
1.388
1.376
1.364
0.989
0.977
0.964
-0.000
O
N
O
O
OH
2t
1.00
0.96
1.01
1.02
1.00
0.97
2.07
3.04
3.07
3.03
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)

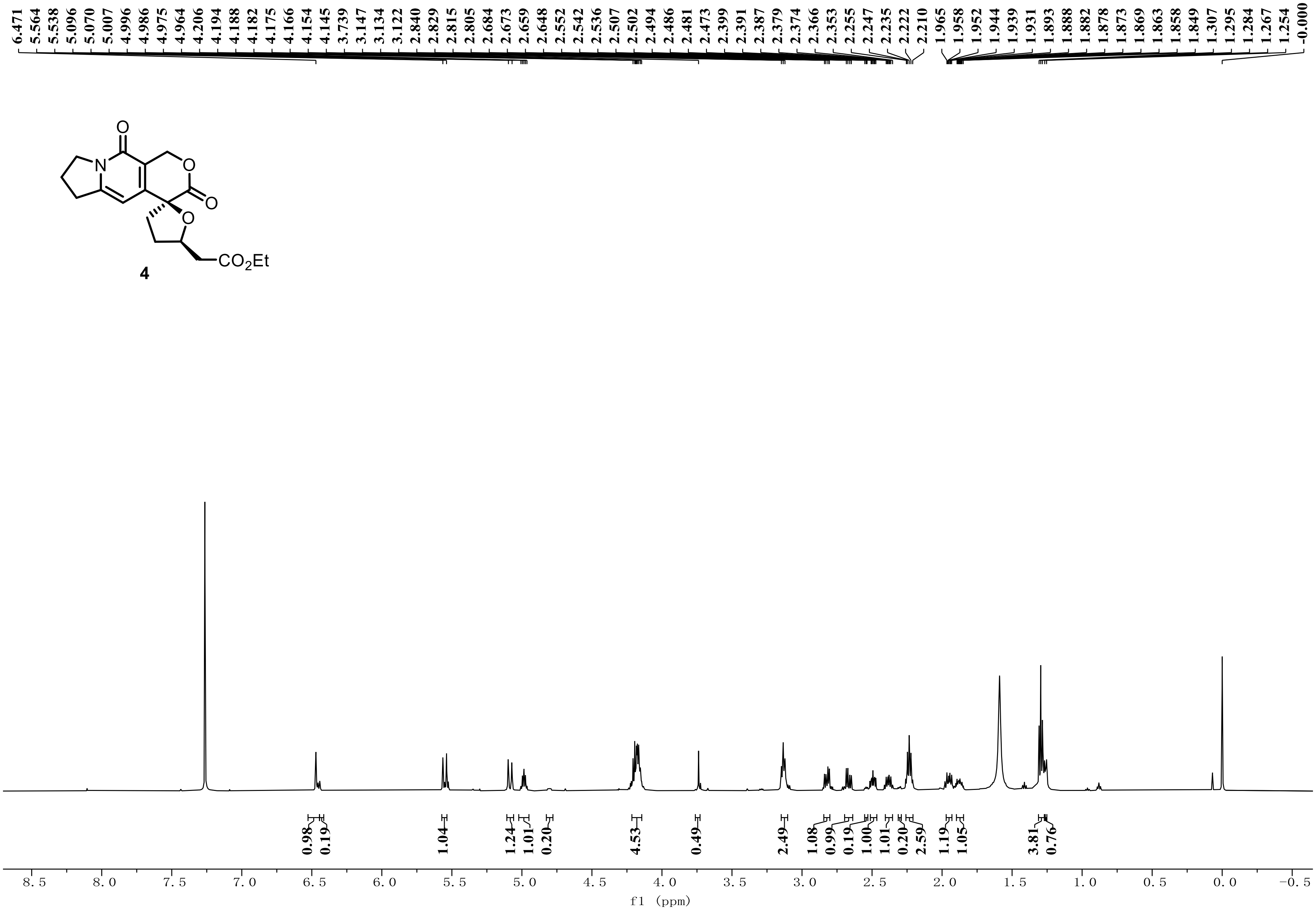

173.97
158.39
147.51
133.12
118.55
102.98
77.22
77.00
76.79
72.06
66.87
46.78
31.59
21.95
21.93
7.67
-0.02
O
N
O
O
OH
2t
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


6.404
5.568
5.542
5.111
5.083
4.426
4.413
4.403
4.390
4.280
4.269
4.258
4.244
4.177
4.173
4.166
4.160
4.153
4.148
3.133
3.120
3.107
2.522
2.513
2.509
2.501
2.492
2.488
2.480
2.257
2.245
2.232
2.220
2.212
2.206
2.192
2.188
2.181
2.168
2.112
2.103
2.099
2.087
2.078
2.069
2.057
2.048
1.919
1.905
1.897
1.891
1.884
1.870
-0.000
O
N
O
O
O
1.00
1.01
1.00
1.03
1.01
2.02
2.03
1.00
2.02
1.02
1.06
1.00
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
−1.0
−1.5
−2.0
f1 (ppm)

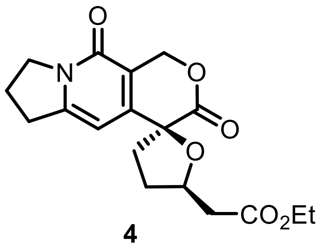
3



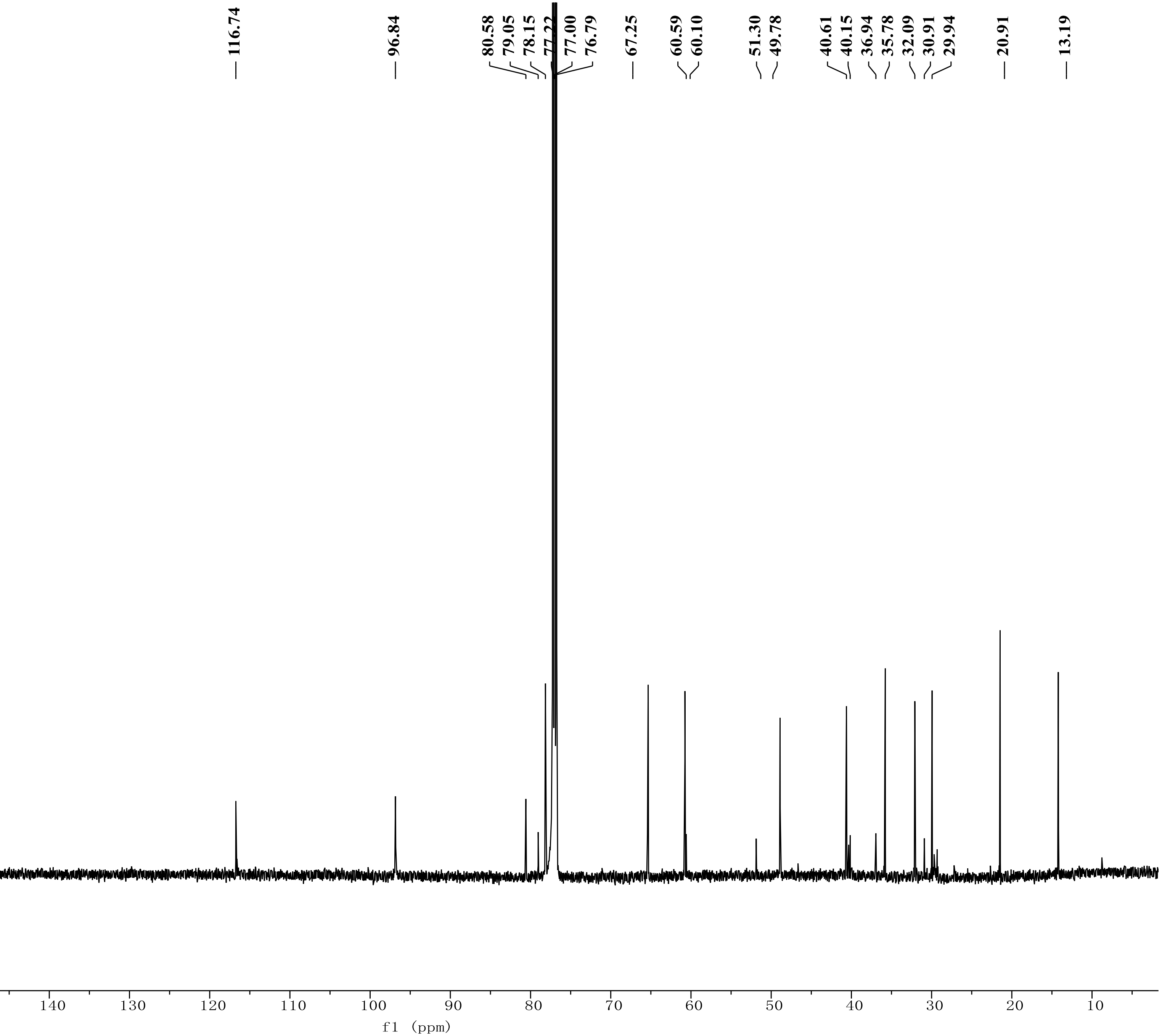
171.91
158.21
151.31
150.17
116.72
96.73
80.09
77.21
77.00
76.78
71.07
65.31
48.82
36.63
32.00
25.22
21.44
3
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)



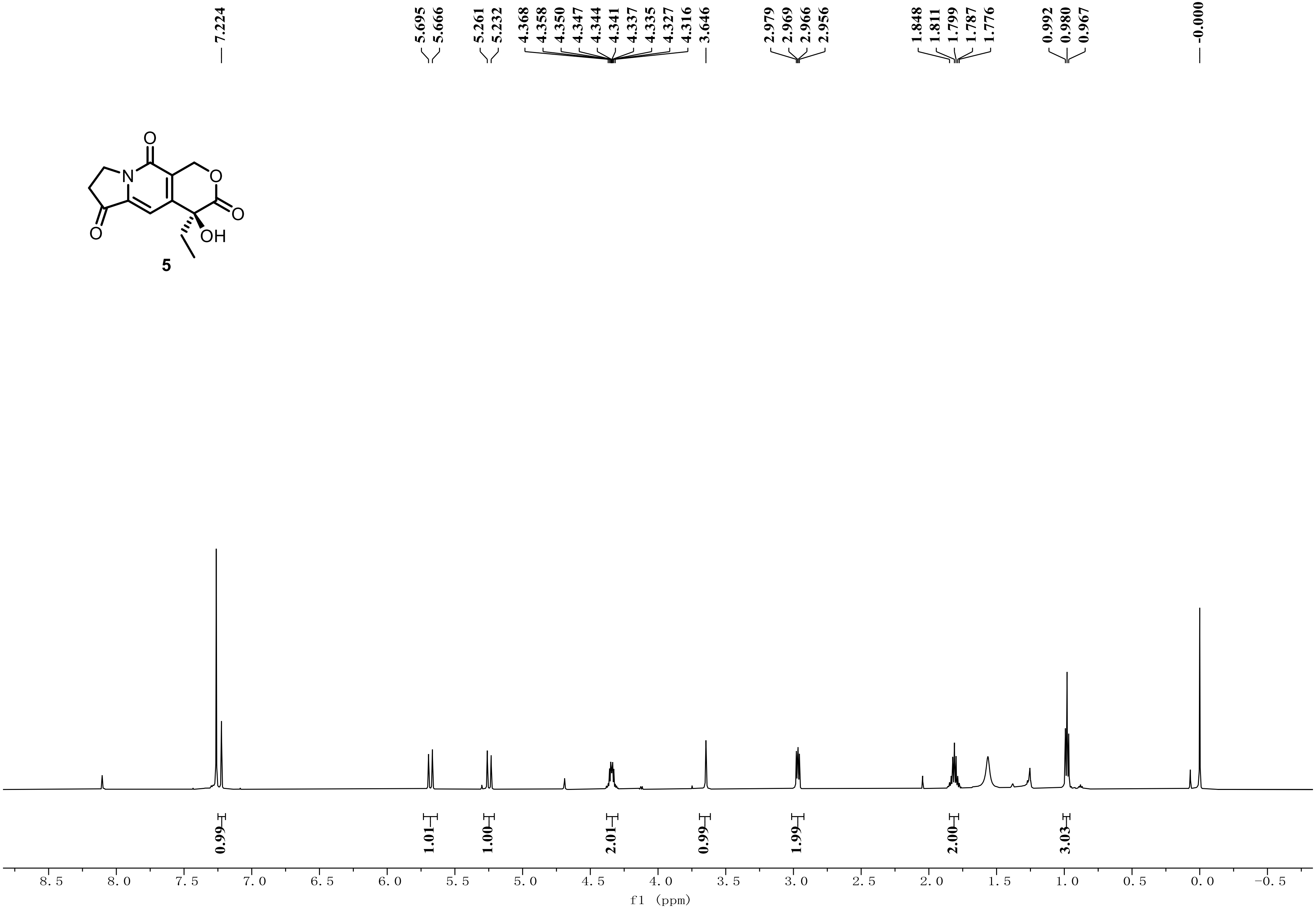
6.471
5.564
5.538
5.096
5.070
5.007
4.996
4.986
4.975
4.964
4.206
4.194
4.188
4.182
4.175
4.166
4.154
4.145
3.739
3.147
3.134
3.122
2.840
2.829
2.815
2.805
2.684
2.673
2.659
2.648
2.552
2.542
2.536
2.507
2.502
2.494
2.486
2.481
2.473
2.399
2.391
2.387
2.379
2.374
2.366
2.353
2.255
2.247
2.235
2.222
2.210
1.965
1.958
1.952
1.944
1.939
1.931
1.893
1.888
1.882
1.878
1.873
1.869
1.863
1.858
1.849
1.307
1.295
1.284
1.267
1.254
-0.000
O
N
O
O
O
CO_2Et
4
0.98
0.19
1.04
1.24
1.01
0.20
4.53
0.49
2.49
1.08
0.99
0.19
1.00
1.01
0.20
2.59
1.19
1.05
3.81
0.76
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)



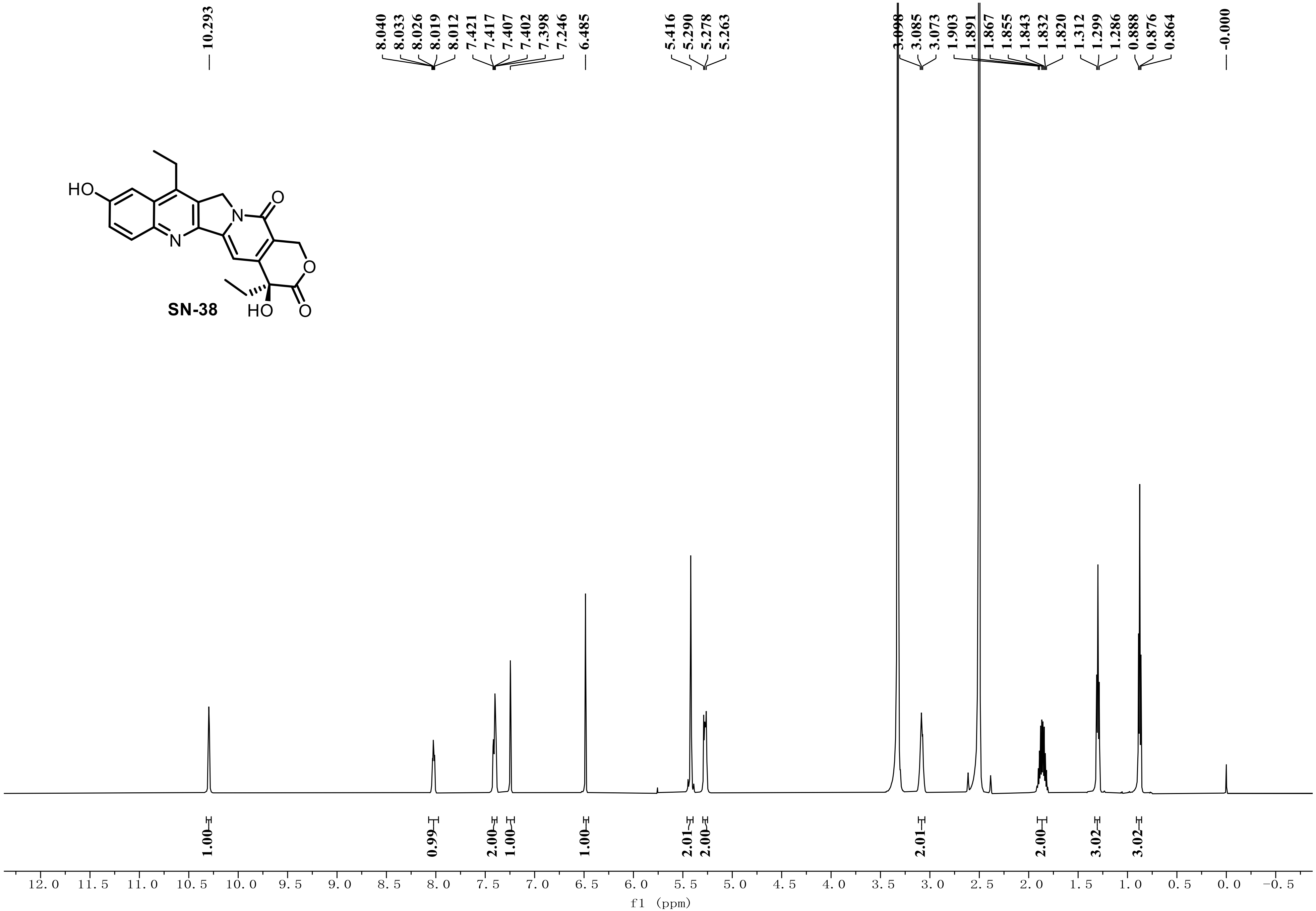
4

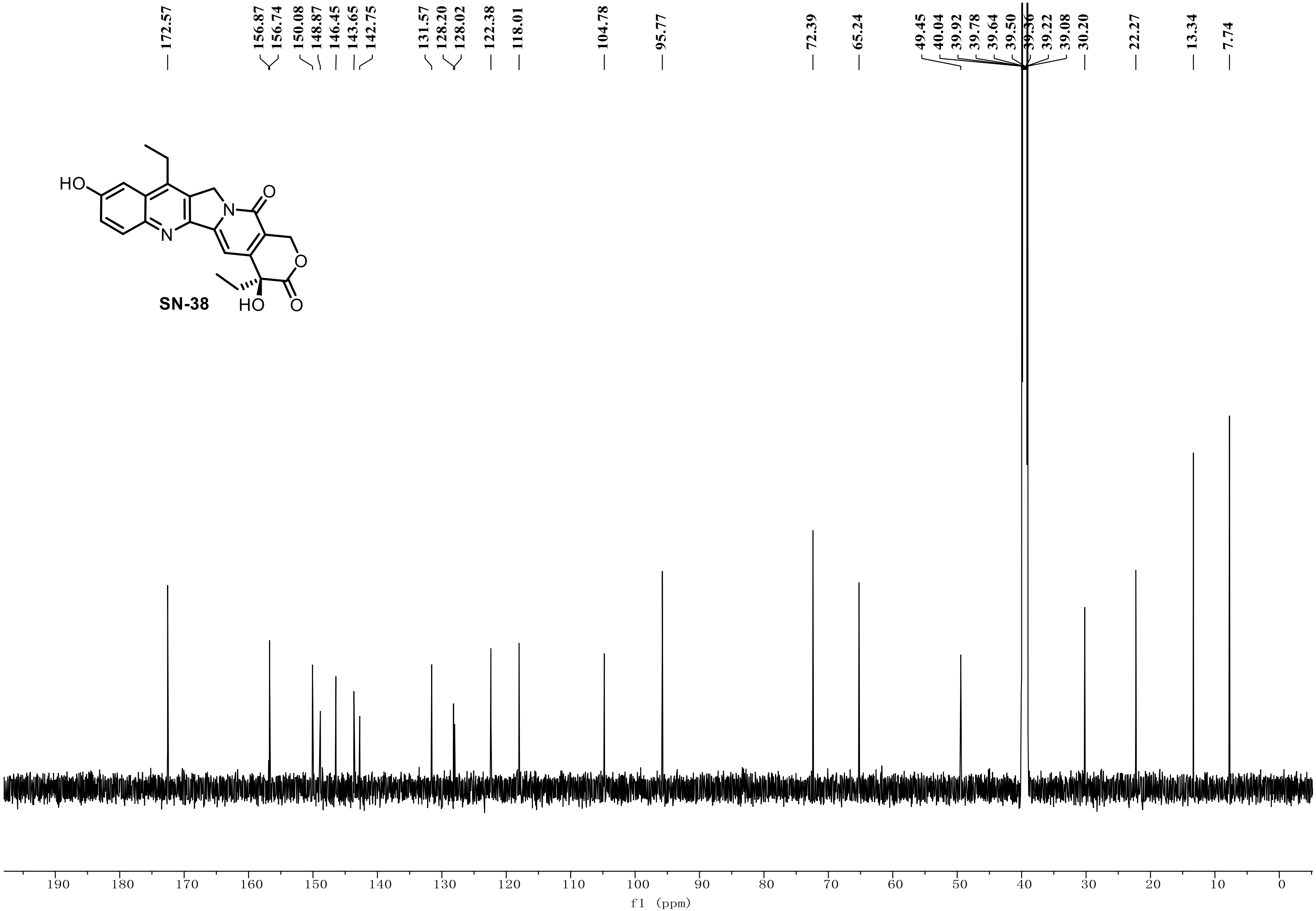


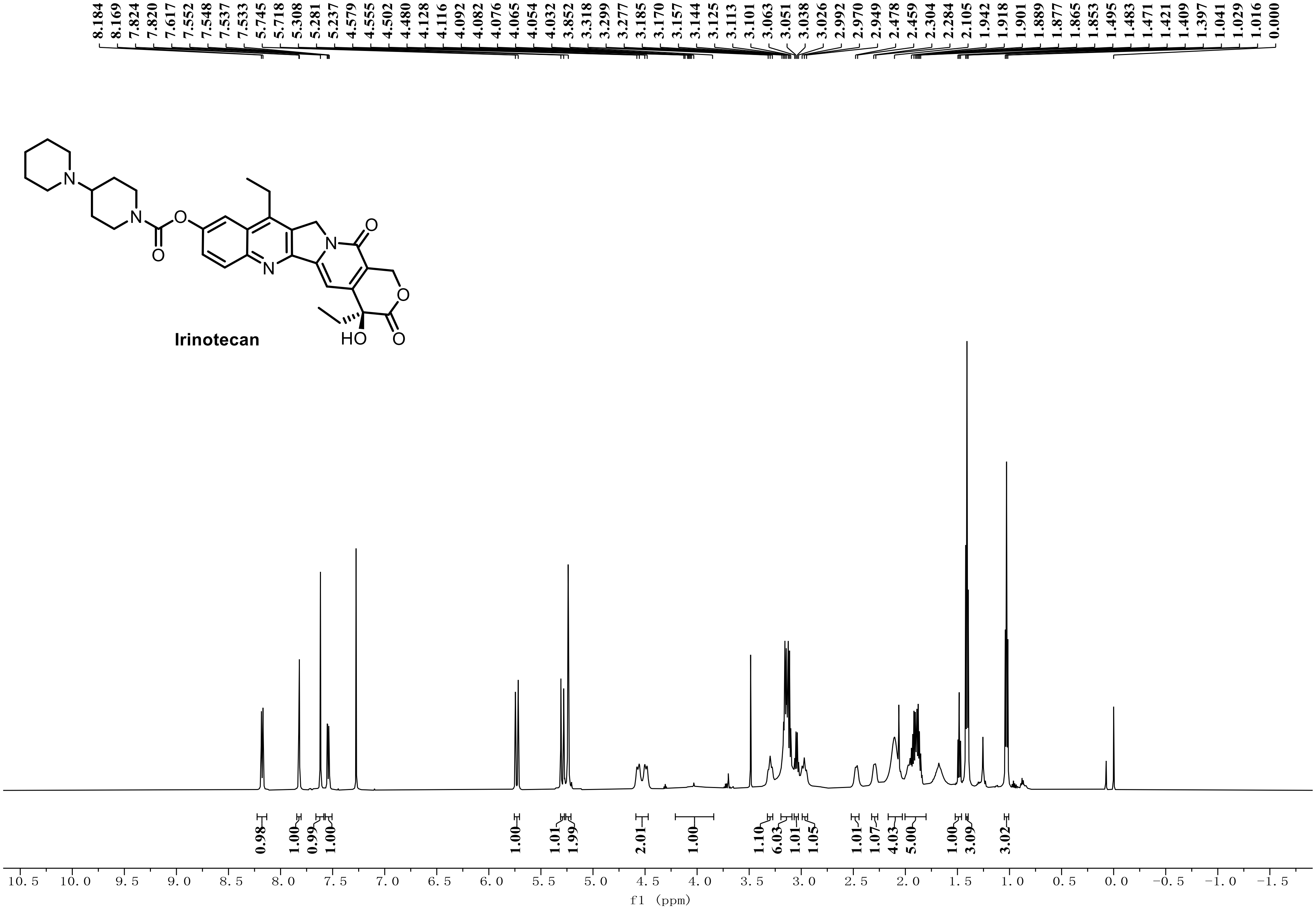
171.61
170.45
158.19
151.40
149.61
116.74
96.84
80.58
79.05
78.15
77.22
77.00
76.79
67.25
60.59
60.10
51.30
49.78
40.61
40.15
36.94
35.78
32.09
30.91
29.94
20.91
13.19
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)



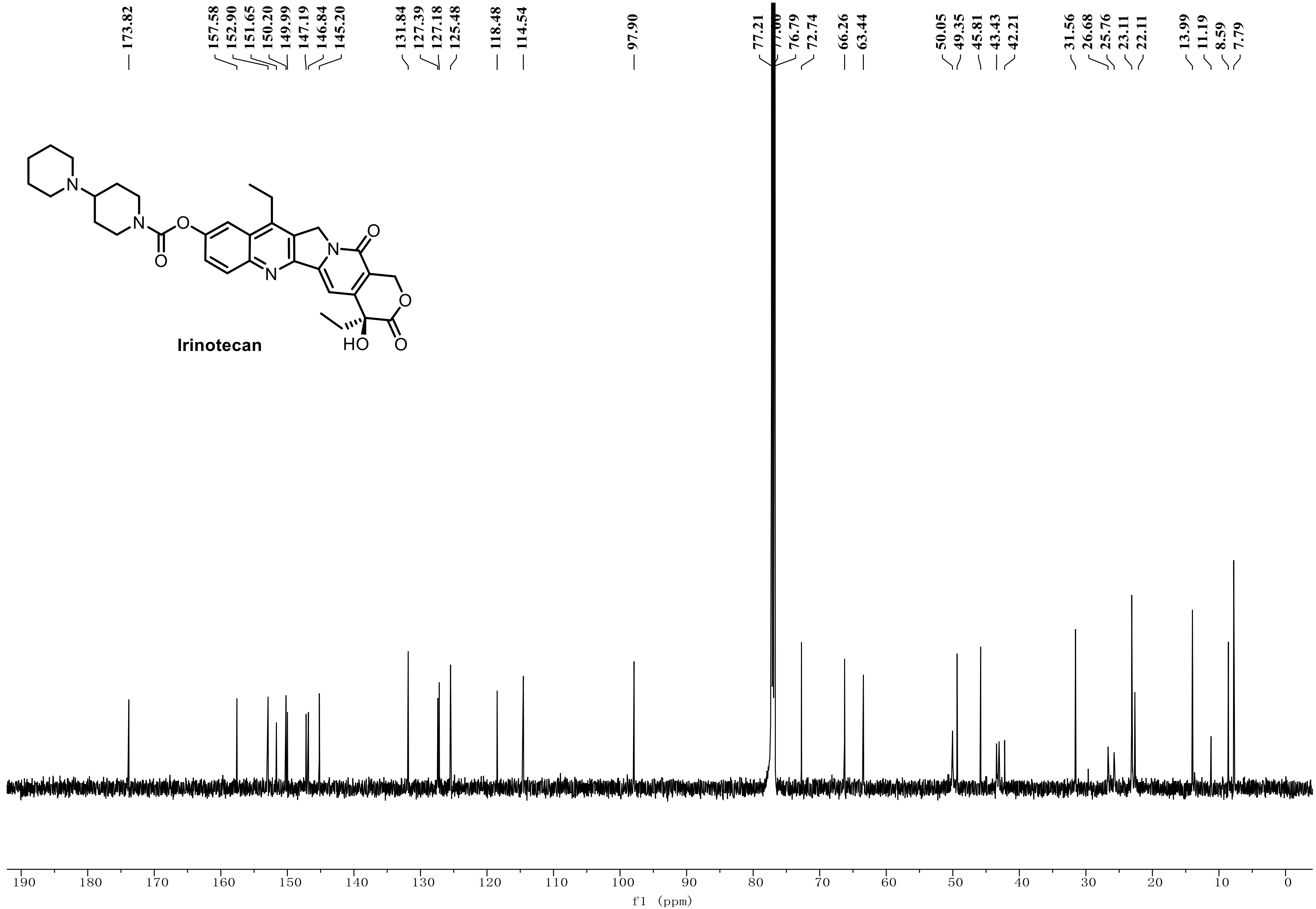
O
N
O
O
O
OH
5
7.224
5.695
5.666
5.261
5.232
4.368
4.358
4.350
4.347
4.344
4.341
4.337
4.335
4.327
4.316
3.646
2.979
2.969
2.966
2.956
1.848
1.811
1.799
1.787
1.776
0.992
0.980
0.967
-0.000
0.99
1.01
1.00
2.01
0.99
1.99
2.00
3.03
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


10.293
8.040
8.033
8.026
8.019
8.012
7.421
7.417
7.407
7.402
7.398
7.246
6.485
5.416
5.290
5.278
5.263
3.098
3.085
3.073
1.903
1.891
1.867
1.855
1.843
1.832
1.820
1.312
1.299
1.286
0.888
0.876
0.864
-0.000
HO
N
N
O
O
O
HO
SN-38
1.00
0.99
2.00
1.00
1.00
2.01
2.00
2.01
2.00
3.02
3.02
12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


172.57
156.87
156.74
150.08
148.87
146.45
143.65
142.75
131.57
128.20
128.02
122.38
118.01
104.78
95.77
72.39
65.24
49.45
40.04
39.92
39.78
39.64
39.50
39.36
39.22
39.08
30.20
22.27
13.34
7.74
SN-38
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



8.184 8.169 7.824 7.820 7.617 7.552 7.548 7.537 7.533 5.745 5.718 5.308 5.281 5.237 4.579 4.555 4.502 4.480 4.128 4.116 4.092 4.082 4.076 4.065 4.054 4.032 3.852 3.318 3.299 3.277 3.185 3.170 3.157 3.144 3.125 3.113 3.101 3.063 3.051 3.038 3.026 2.992 2.970 2.949 2.478 2.459 2.304 2.284 2.105 1.942 1.918 1.901 1.889 1.877 1.865 1.853 1.495 1.483 1.471 1.421 1.409 1.397 1.041 1.029 1.016 0.000
Irinotecan
0.98 1.00 0.99 1.00 1.00 1.01 1.99 2.01 1.00 1.10 6.03 1.01 1.05 1.01 1.07 4.03 5.00 1.00 3.09 3.02
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5 −1.0 −1.5
f1 (ppm)



173.82
157.58
152.90
151.65
150.20
149.99
147.19
146.84
145.20
131.84
127.39
127.18
125.48
118.48
114.54
97.90
77.21
77.00
76.79
72.74
66.26
63.44
50.05
49.35
45.81
43.43
42.21
31.56
26.68
25.76
23.11
22.11
13.99
11.19
8.59
7.79
Irinotecan
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)