Supporting Information

Synthesis of Substituted Pyridines from Cascade [1+5] Cycloaddition of Isonitriles to N-Formylmethyl-substituted Enamides, Aerobic Oxidative Aromatization and Acyl Transfer Reaction

Chuan-Hu Lei,[†] De-Xian Wang,[†] Liang Zhao,[‡] Jieping Zhu,[§] and Mei-Xiang Wang[‡]*

[†]Beijing National Laboratory for Molecular Sciences, CAS Key Laboratory of Molecular Recognition and Function, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China

[‡]Key Laboratory of Bioorganic Phosphorous and Chemical Biology (Ministry of Education), Tsinghua University, Beijing 100184 China

[§]Ecole Polytechnique Fédérale de Lausanne, EPFL-SB-ISIC-LSPN, BCH 5304, 1015 Lausanne, Switzerland

E-mail: wangmx@mail.tsinghua.edu.cn

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1. General Information

Unless otherwise noted, all reactions were carried out in oven dried glasswares. Anhydrous solvents were purified and dried following standard procedures. All commercially available reagents were used as received. TLC analysis was performed on pre-coated, glass-backed silica gel plates and visualized with UV light. Flash column chromatography was performed on silica gel (200-300 mesh).

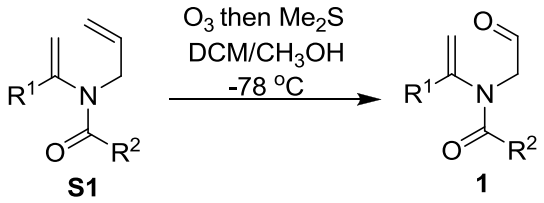
Melting points were uncorrected. The ^{1}H NMR and ^{13}C NMR spectra were recorded on a JEOL ECX-400 400 MHz spectrometers or ECX-300 300 MHz spectrometers. ^{1}H NMR chemical shifts were reported relative to residual $CDCl_3$ (7.26 ppm) or acetone-d_6 (2.05 ppm). ^{13}C NMR chemical shifts were reported relative to the central line of $CDCl_3$ (77.2 ppm) or acetone-d_6 (29.8 ppm, 206.2 ppm). Abbreviations are used in the description of NMR data as follows: chemical shift (δ, ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, m = multiplet), coupling constant (*J*, Hz). Low-resolution mass spectra (MS) were recorded on a shimadzu GC-MS QP 2010 Plus spectrometer. The high resolution mass spectra (HRMS) were recorded on a GCT-MS Micromass UK spectrometer or a micrOTOF-Q spectrometer. Infrared spectra were recorded using a PerkinElmer Spectrum 100 FT-IR spectrometer with KBr pellets in the 4000-400 cm^{-1} region.

2. Preparation of Substrates

The compounds **S1** were prepared according to a slightly modified published procedure[1].

2.1 General Procedure for the Synthesis of Substrates 1.

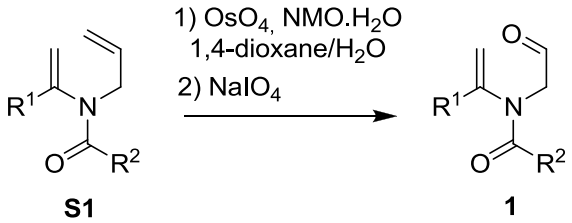
Method A:



Scheme S1 Synthesis of substrates **1**

S1 (5 mmol) was dissolved in CH_2Cl_2/MeOH (v:v = 5:1) (48 mL). After cooling to -78 ^oC, ozone and oxygen gas were bubbled into the solution, After 2 h, the ozone was evacuated with nitrogen for 15 min at -78 ^oC, and dimethyl sulfide (5.0 mL) was added. The resulting solution was allowed to warm to rt over 1 h. The clear solution was concentrated *in vacuo* and then purified by flash column chromatography on silica gel (petroleum ether/EtOAc, 5:1) to afford substrate **1**

Method B:

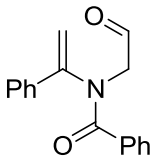


Scheme S2 Synthesis of substrates **2**

To a mixture of **S1** (5 mmol) and aqueous NMO (50%) solution (15 mmol) in 1,4-dioxane/H_2O (2:1) (60 mL) at rt was added OsO_4 (0.075 M in water) (0.67 mL, 0.05 mmol). After the mixture was stirred at rt overnight, $NaIO_4$ (10 mmol, 2.14 g) was added. Upon stirring at rt for another 2 h, the reaction mixture was quenched with water, extracted with EtOAc (3×20 mL), washed with water and brine, dried over $MgSO_4$, filtered, concentrated and purified by flash column chromatography on silica gel (petroleum ether/EtOAc) to give compound **1**.

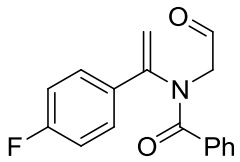
2.2 Characterization of substrates

N-(2-oxoethyl)-N-(1-phenylvinyl)benzamide (1a)



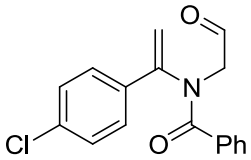
Following method A. White solid (782 mg, yield: 59%). **m.p.** 98-99 ^{o}C. **^{1}H NMR** (300 MHz, $CDCl_3$) δ 9.70 (s, 1H), 7.59-7.22 (m, 10H), 5.41 (s, 1H), 4.98 (s, 1H), 4.30 (s, 2H).**^{13}C NMR** (75 MHz, $CDCl_3$) δ 196.5, 171.8, 148.0, 135.6, 134.6, 130.7, 129.5, 129.2, 128.1, 128.0, 126.4, 113.9, 57.8. **IR** (KBr, cm^{-1}) ν 2814, 1736, 1643, 1615, 1368. **MS** (CI) 266 $[M+1]^+$ (10), 265 $[M]^+$ (12), 146 (33), 105 (100). **HRMS** (EI) calcd. for $C_{17}H_{15}NO_2$ [M] 265.1103, found 265.1106.

N-(1-(4-fluorophenyl)vinyl)-N-(2-oxoethyl)benzamide (1b)



Following method B. White solid (835 mg, yield: 59%). **m.p.** 88-89 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.71 (s, 1H), 7.53 (dd, *J* = 8.2, 1.2, 2H), 7.48-7.45 (m, 2H), 7.34(t, *J* = 7.5 1H), 7.26-7.22 (m, 2H), 7.05 (t, *J* = 8.6, 2H), 5.33 (s, 1H), 4.98 (s, 1H), 4.34 (s, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.1, 171.6, 164.5, 162.0, 147.2, 134.5, 131.9, 130.7, 128.2 (d, *J* = 8.2), 128.0 (d, *J* = 6.6), 116.2, 115.9, 113.2, 57.8. **IR** (KBr, cm^{-1}) ν 2848, 1647, 1601, 1505, 1365. **MS** (CI) 284 $[M+1]^+$ (26), 283 $[M]^+$ (16), 164 (27), 105 (100). **HRMS** (EI) calcd. for $C_{17}H_{14}NO_2F$ [M] 283.1009, found 283.1013.

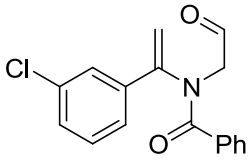
N-(1-(4-chlorophenyl)vinyl)-N-(2-oxoethyl)benzamide (1c)



Following method A. White solid (945 mg, yield: 63%). **m.p.** 102-104 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.70 (s, 1H), 7.52 (dd, *J* = 5.3, 3.3, 2H), 7.45-7.42 (m, 2H),

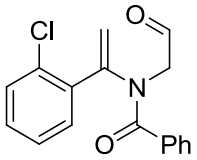
7.37-7.33 (m, 3H), 7.27-7.23 (m, 2H), 5.38 (d, *J* = 1.0, 1H), 5.02 (d, *J* = 0.7, 1H), 4.33 (s, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.0, 171.6, 147.1, 135.3, 134.4, 134.3, 130.7, 129.2, 128.0, 127.9, 127.6, 113.9, 57.8. **IR** (KBr, cm^{-1}) ν 2930, 2829, 1733, 1637, 1376. **MS** (CI) 301 $[M+2]^+$ (4), 300 $[M+1]^+$ (9), 299 $[M]^+$ (10), 180 (17), 105 (100). **HRMS** (EI) calcd. for $C_{17}H_{14}NO_2Cl$ [M] 299.0713, found 299.0717.

N-(1-(3-chlorophenyl)vinyl)-N-(2-oxoethyl)benzamide (1d)



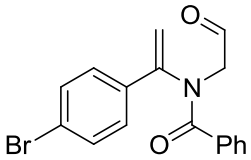
Following method A. White solid (1.169 g, yield: 78%). **m.p.** 78-79 ^oC. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.70 (s, 1H), 7.53-7.51 (m, 2H), 7.44 (d, *J* = 1.8, 1H), 7.38-7.23 (m, 6H), 5.41 (d, *J* = 0.7, 1H), 5.04 (s, 1H), 4.34 (s, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.1, 171.7, 147.0, 137.9, 135.2, 134.4, 130.8, 130.4, 129.5, 128.2, 128.1 126.6, 124.5, 114.7, 58.0. **IR** (KBr, cm^{-1}) ν 2808, 1756, 1639, 1381. **MS** (CI) 301 $[M+2]^+$ (14), 300 $[M+1]^+$ (38), 299 $[M]^+$ (22), 180 (20), 105 (100). **HRMS** (EI) calcd. for $C_{17}H_{14}NO_2Cl$ [M] 299.0713, found 299.0716.

N-(1-(2-chlorophenyl)vinyl)-N-(2-oxoethyl)benzamide (1e)



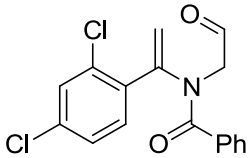
Following method A. White solid (688 mg, yield: 46%). Yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.75 (s, 1H), 7.38-7.36 (m, 2H), 7.23-7.11 (m, 4H), 7.05-7.01 (m, 1H), 6.92-6.90 (m, 2H), 5.18 (s, 1H), 5.09 (s, 1H), 4.63 (s, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.0, 171.1, 147.4, 136.4, 136.0, 131.6, 131.4, 130.3, 130.1, 129.6, 128.0, 127.5, 126.8, 113.1, 60.9. **IR** (KBr, cm^{-1}) ν 2924, 1732, 1653, 1618, 1360. **MS** (CI) 301 $[M+2]^+$ (2), 300 $[M+1]^+$ (2), 299 $[M]^+$ (3), 180 (12), 105 (100). **HRMS** (EI) calcd. for $C_{17}H_{14}NO_2Cl$ [M] 299.0713, found 299.0717.

N-(1-(4-bromophenyl)vinyl)-N-(2-oxoethyl)benzamide (1f)



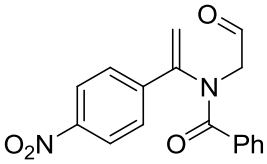
Following method A. White solid (583 mg, yield: 34%). **m.p.** 126-128 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.70 (s, 1H), 7.53-7.49 (m, 4H), 7.38-7.33 (m, 3H), 7.27– 7.23 (m, 2H), 5.40 (d, *J* = 0.7, 1H), 5.02 (d, *J* = 0.6, 1H), 4.33 (s, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.1, 171.7, 147.3, 134.9, 134.5, 132.3, 130.9, 128.2, 128.1, 128.0, 123.7, 114.2, 57.9. **IR** (KBr, cm^{-1}) ν 2830, 1734, 1638, 1377. **MS** (CI) 345 $[M+2]^+$ (27), 344 $[M+1]^+$ (34), 343 $[M]^+$ (23), 105 (100). HRMS calcd. for $C_{17}H_{14}NO_2{}^{79}Br$, $C1_7H_{14}NO_2{}^{81}Br$ [M] 343.0208, [M+2] 345.0187 found 343.0212, 345.0193.

N-(1-(2,4-dichlorophenyl)vinyl)-N-(2-oxoethyl)benzamide (1g)



Following method A. Yellow solid (1.200 g, yield: 72%). **m.p.** 86-88 ^{o}C. **^{1}H NMR** (300 MHz, $CDCl_3$) δ 9.81 (s, 1H), 7.37 (dd, *J* = 8.3, 1.3, 2H), 7.32-7.28 (m, 1H), 7.24-7.18 (m, 3H), 6.95-6.84 (m, 2H), 5.22 (d, *J* = 1.1, 1H), 5.12 (d, *J* = 1.1, 1H), 4.68 (s, 2H). **^{13}C NMR** (150 MHz, $CDCl_3$) δ 196.6, 171.0, 146.8, 136.0, 135.2, 134.8, 132.6, 132.1, 130.5, 130.0, 128.2, 127.6, 127.1, 113.2, 61.0. **IR** (KBr, cm^{-1}) ν 3076, 2842, 1731, 1651, 1615, 1359. **MS** (CI) 334 $[M+1]^+$ (5), 333 $[M]^+$ (7), 214 (14), 105 (100). **HRMS** (EI) calcd. for $C_{17}H_{13}NO_2Cl_2$ [M] 333.0323, found 333.0327.

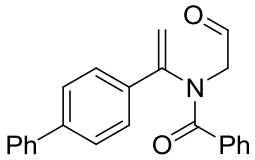
N-(1-(4-nitrophenyl)vinyl)-N-(2-oxoethyl)benzamide (1h)



Following method A. Yellow solid (837 mg, yield: 54%). **m.p.** 146-147 ^{o}C. **^{1}H NMR** (300 MHz, $CDCl_3$) δ 9.73 (s, 1H), 8.16 (d, *J* = 8.8, 2H), 7.61 (d, *J* = 8.8, 2H), 7.47-7.44 (dd, *J* = 5.2, 3.3, 2H), 7.34-7.19 (m, 3H), 5.52 (d, *J* = 1.3, 1H), 5.25 (d, *J* =

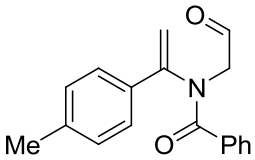
1.3, 1H), 4.47 (s, 2H). **^{13}C NMR** (75 MHz, $CDCl_3$) δ 195.6, 171.4, 148.0, 147.0, 142.8, 134.4, 131.0, 128.2, 128.0, 127.2, 124.2, 116.0, 58.6. **IR** (KBr, cm^{-1}) ν 2840, 1727, 1638, 1513, 1369. **MS** (CI) 311 $[M+1]^+$ (6), 310 $[M]^+$ (7), 191 (7), 105 (100). **HRMS** (EI) calcd. for $C_{17}H_{14}N_2O_4$ [M] 310.0954, found 310.0957.

N-(1-(biphenyl-4-yl)vinyl)-N-(2-oxoethyl)benzamide (1i)



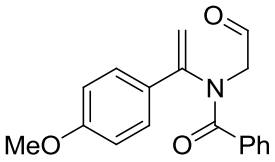
Following method B. White solid (1.108 g, yield: 65%). **m.p.** 115-116 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.73 (s, 1H), 7.65-7.58 (m, 8H), 7.47 (t, *J* = 7.5, 2H), 7.41-7.34 (m, 2H), 7.29-7.26 (m, 5H), 5.47 (s, 1H), 5.01 (s, 1H), 4.35 (s, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.5, 171.9, 147.7, 142.4, 140.2, 134.54, 134.47, 130.8, 129.1, 128.2, 128.1, 128.0, 127.9, 127.2, 126.9, 114.0, 57.8. **IR** (KBr, cm^{-1}) ν 1753, 1724, 1640, 1385, 1373. **MS** (CI) 342 $[M+1]^+$ (37), 341 $[M]^+$ (35), 222 (38), 105 (100). **HRMS** (EI) calcd. for $C_{23}H_{19}NO_2$ [M] 341.1416, found 341.1421.

N-(2-oxoethyl)-N-(1-p-tolylvinyl)benzamide (1j)



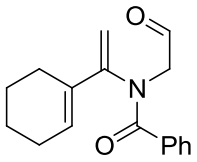
Following method B. White solid (781 mg, yield: 56%). **m.p.** 101-102 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.69 (s, 1H), 7.60-7.58 (m, 2H), 7.43-7.41 (m, 2H), 7.35-7.33 (m, 1H), 7.28-7.20 (m, 4H), 5.37 (d, *J* = 0.6, 1H), 4.92 (s, 1H), 4.27 (s, 2H), 2.38 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.7, 171.9, 147.8, 139.7, 134.5, 132.7, 130.7, 129.9, 128.2, 128.1, 126.4, 113.4, 57.6, 21.4. **IR** (KBr, cm^{-1}) ν 2931, 2821, 1732, 1639, 1375. **MS** (CI) 280 $[M+1]^+$ (31), 280 $[M]^+$ (22), 160 (39), 105 (100). **HRMS** (EI) calcd. for $C_{18}H_{17}NO_2$ [M] 279.1259, found 279.1263.

N-(1-(4-methoxyphenyl)vinyl)-N-(2-oxoethyl)benzamide (1k)



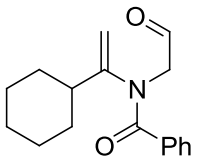
Following method B. White solid (1.018 g, yield: 69%). **m.p.** 67-69 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.69 (s, 1H), 7.58 (d, *J* = 7.6, 2H), 7.45 (d, *J* = 8.7, 2H), 7.35 (t, *J* = 7.4, 1H), 7.26 (t, *J* = 7.6, 3H), 6.92 (d, *J* = 8.7, 2H), 5.30 (s, 1H), 4.87 (s, 1H), 4.28 (s, 2H), 3.84 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.7, 171.8, 160.7, 147.5, 134.6, 130.7, 128.13, 128.06, 128.0, 127.8, 114.6, 112.3, 57.7, 55.5. **IR** (KBr, cm^{-1}) ν 2840, 2816, 1732, 1634, 1511, 1374. **MS** (CI) 296 $[M+1]^+$ (4), 295 $[M]^+$ (16), 176 (30), 105 (100). **HRMS** (EI) calcd. for $C_{18}H_{17}NO_3$ [M] 295.1208, found 295.1212.

N-(1-cyclohexenylvinyl)-N-(2-oxoethyl)benzamide (1l)



Following method B. Colorless oil (740 mg, yield: 55%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.68 (s, 1H), 7.54-7.56 (m, 2H), 7.39-7.35 (m, 1H), 7.31-7.27 (m, 2H), 6.13 (t, *J* = 4.0, 1H), 5.04 (s, 1H), 4.88 (s, 1H), 4.26 (s, 2H), 2.18-2.16 (m, 2H), 2.01-1.99 (m, 2H), 1.58 (ddt, *J* = 10.5, 8.6, 2.9, 4H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.4, 171.7, 149.6, 135.1, 132.9, 130.5, 128.6, 127.9, 127.8, 112.4, 58.7, 25.8, 25.6, 22.5, 22.0. **IR** (KBr, cm^{-1}) ν 2929, 1732, 1638, 1372. **MS** (CI) 270 $[M+1]^+$ (7), 269 $[M]^+$ (10), 240 (22), 105 (100). **HRMS** (ESI) calcd. for $C_{17}H_{19}NO_2$ [M+H] 270.1489, found 270.1487

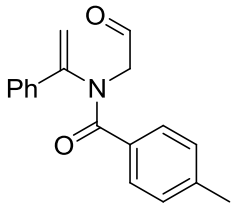
N-(1-cyclohexylvinyl)-N-(2-oxoethyl)benzamide (1m)



Following method B. Colorless oil (772 mg, yield: 57%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.70 (s, 1H), 7.60-7.58 (m, 2H), 7.40-7.32 (m, 3H), 5.00 (s, 1H), 4.91 (s, 1H), 4.38 (s, 2H), 1.67– 1.57 (m, 6H), 1.04-0.97 (m, 5H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 197.3,

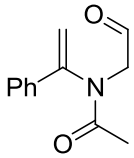
170.6, 156.0, 135.8, 130.5, 128.2, 128.1, 110.6, 60.9, 44.1, 32.0, 26.4, 26.1. **IR** (KBr, cm^{-1}) ν 2928, 2853, 1734, 1630, 1367. **MS** (ESI) 272 [M+H]. **HRMS** (ESI) calcd. for $C_{17}H_{21}NO_2$ [M+H] 272.1645, found 272.1645.

4-methyl-N-(2-oxoethyl)-N-(1-phenylvinyl)benzamide (1n)



Following method A. Light yellow oil (279 mg, yield: 20%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.69 (s, 1H), 7.54-7.48 (m, 4H), 7.41-7.39 (m 3H), 7.26 (s, 2H), 7.06 (d, *J* = 7.9, 2H), 5.42 (d, *J* = 0.7, 1H), 4.97 (d, *J* = 0.6, 1H), 4.26 (s, 2H), 2.31 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.8, 171.9, 148.1, 141.2, 135.6, 131.5, 129.5, 129.2, 128.8, 128.4, 126.5, 114.0, 57.7, 21.6. **IR** (KBr, cm^{-1}) ν 2923, 1732, 1645, 1370. **MS** (CI) 280 $[M+1]^+$ (7), 279 $[M]^+$ (10), 146 (22), 105 (100). **HRMS** (ESI) calcd. for $C_{18}H_{17}NO_2$ [M+H] 280.1332, found 280.1337.

N-(2-oxoethyl)-N-(1-phenylvinyl)acetamide (1o)



Following method B. Colorless Oil (578 mg, yield: 57%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.61 (s, 1H), 7.43-7.39 (m, 5H), 5.75 (s, 1H), 5.41 (s, 1H), 4.18 (s, 2H), 2.12 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 196.7, 171.6, 147.6, 135.2, 129.7, 129.2, 125.9, 114.2, 57.4, 21.5. **IR** (KBr, cm^{-1}) ν 2921, 1734, 1660, 1630, 1379. **MS** (CI) 204 $[M+1]^+$ (14), 203 $[M]^+$ (17), 105 (100). **HRMS** (ESI) calcd. for $C_{12}H_{13}NO_2$ [M+H] 204.1019, found 204.1019.

3. ^{1}H NMR Spectroscopic Study of 2a, 2e and 2f Associated with Zinc Ion.

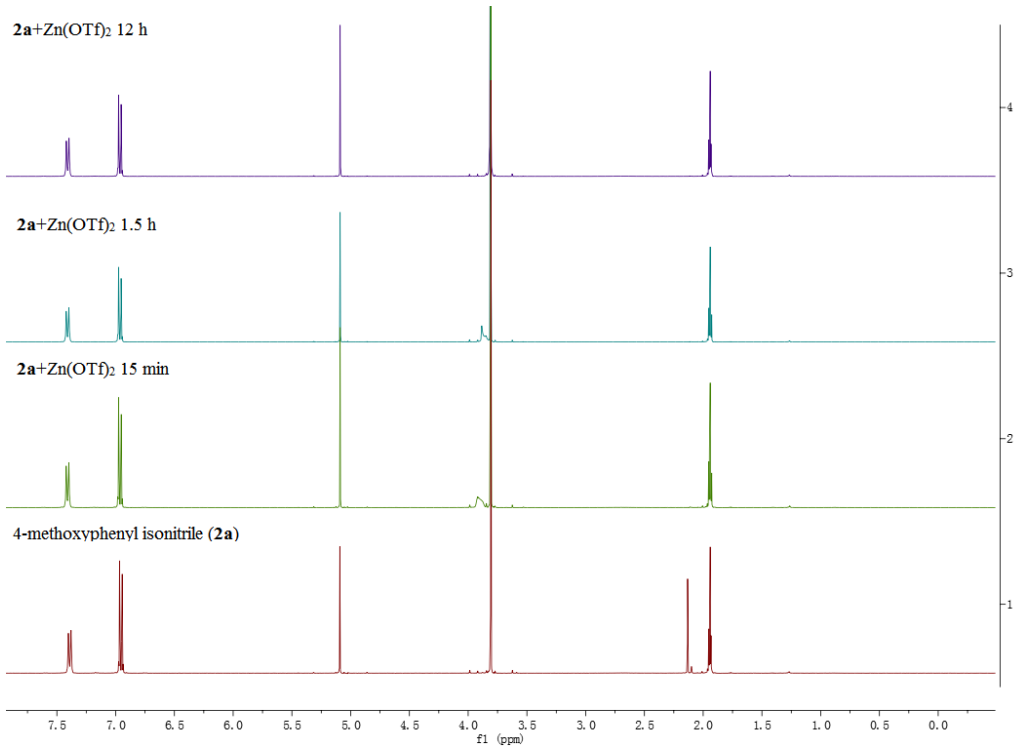


Figure S1. ^{1}H NMR spectra of **2a** in CD_3CN with the addition of $Zn(OTf)_2$ at different time.

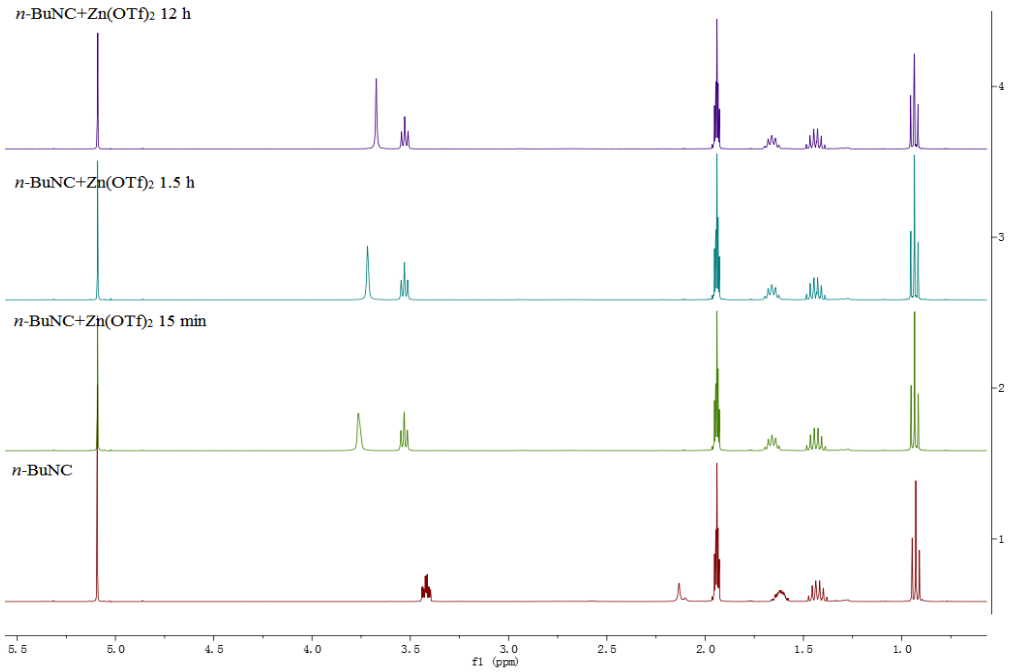


Figure S2. ^{1}H NMR spectra of *n*-BuNC (**2e**) in CD_3CN with the addition of $Zn(OTf)_2$ at different time.

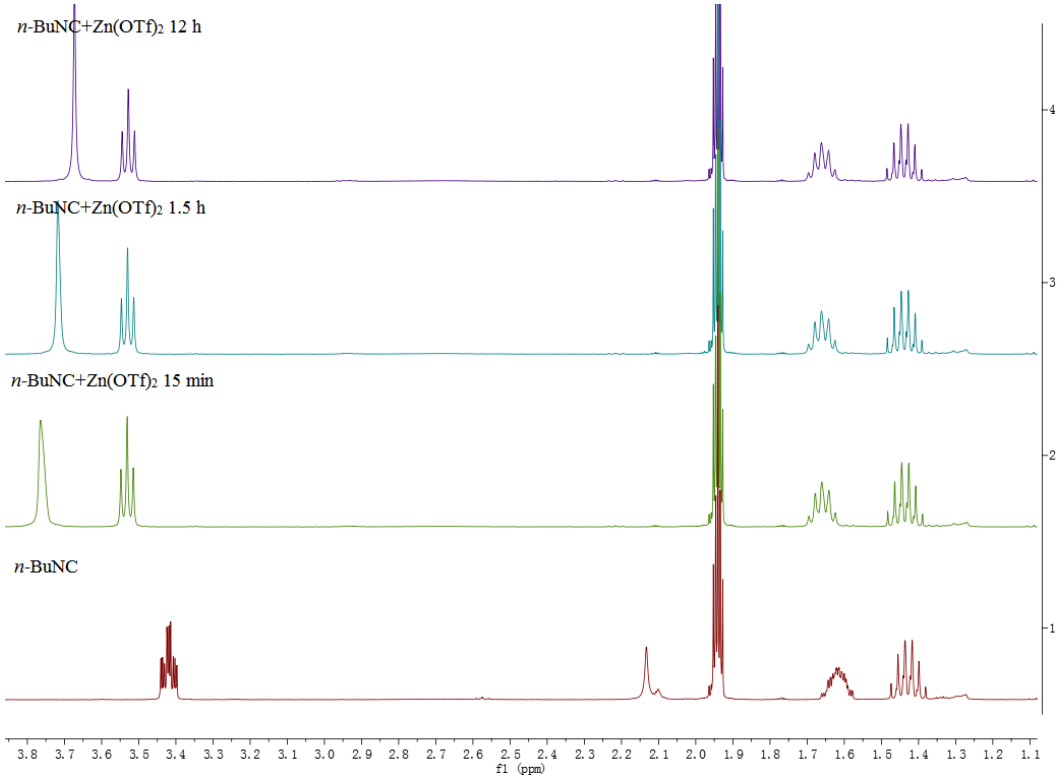


Figure S3. Partial view for the ^{1}H NMR spectra of *n*-BuNC (**2e**) in CD_3CN with the addition of $Zn(OTf)_2$ at different time.

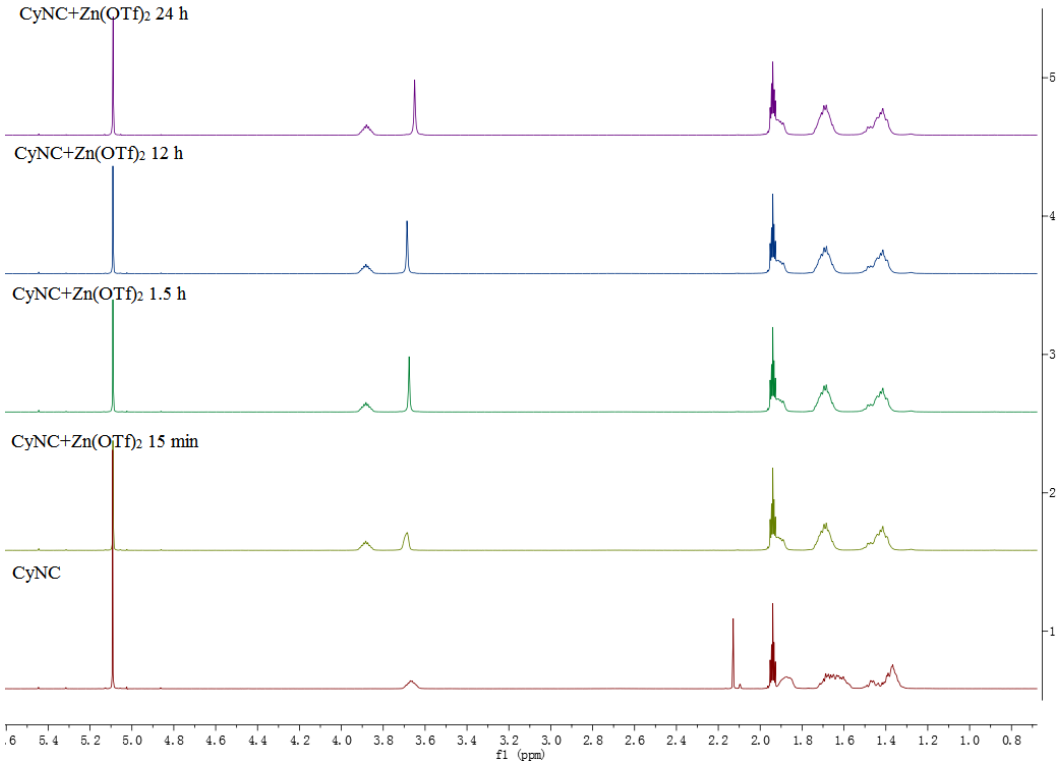


Figure S4. ^{1}H NMR spectra of CyNC (**2f**) in CD_3CN with the addition of $Zn(OTf)_2$ at different time.

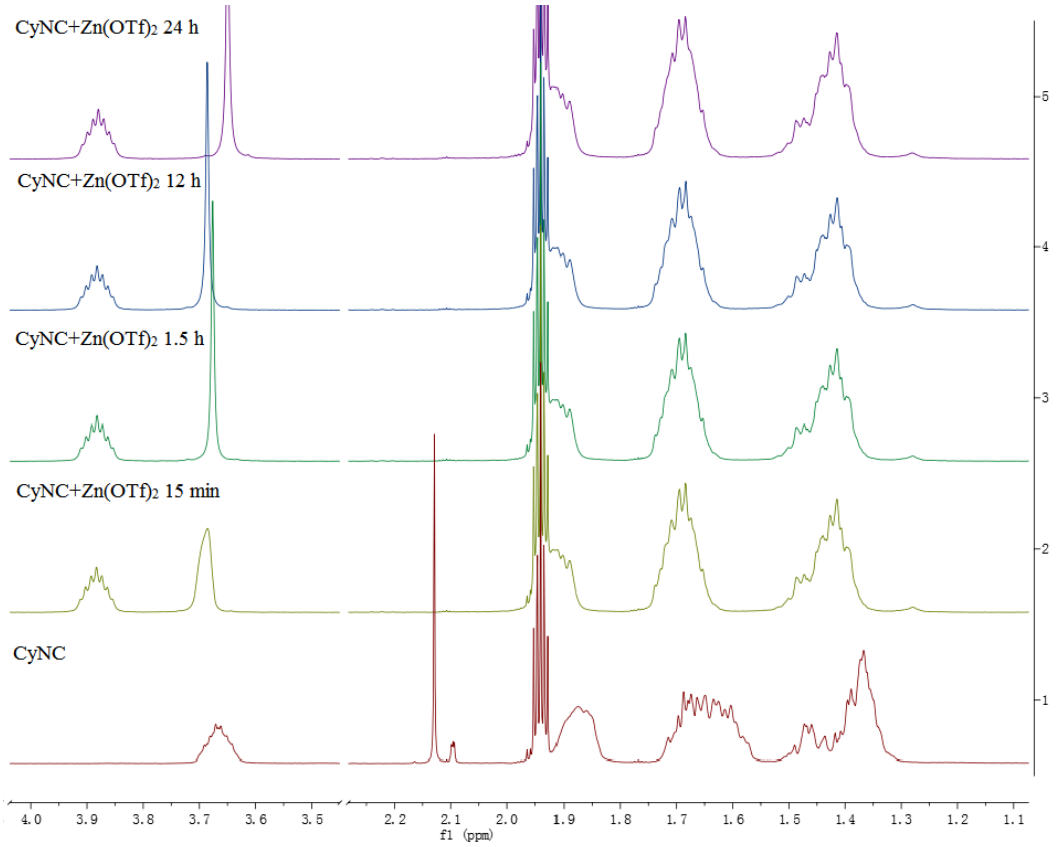
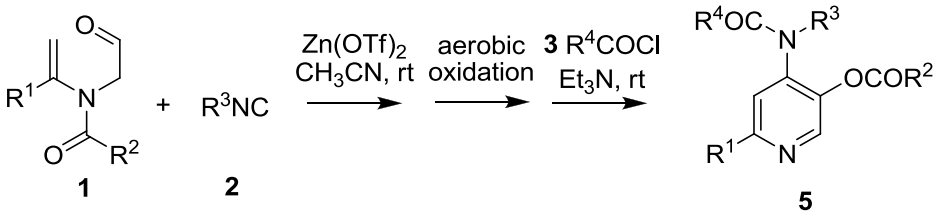


Figure S5. Partial view for the ^{1}H NMR spectra of CyNC (**2f**) in CD_3CN with the addition of $Zn(OTf)_2$ at different time.

4. Scope of the Reactions



Scheme S3. Reaction scope

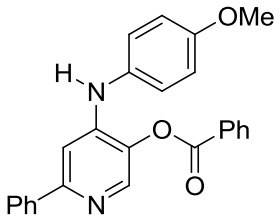
4.1 General Procedure for the Synthesis of Substituted Pyridine Derivatives

To a solution of **2** (0.36 mmol) in acetonitrile (15 mL) was added **1** (0.3 mmol), 4 Å molecular sieves (300 mg) and $Zn(OTf)_2$ (0.3 mmol, 109.1 mg). The reaction mixture

was stirred at ambient temperature until the disappearance of **1** (monitored by TLC), then quenched with saturated aqueous $NaHCO_3$ (5 mL), filtrated through a pad of Celite and extracted with CH_2Cl_2 (3×15 mL). The combined organic extracts were washed with brine, dried over $MgSO_4$. The dried organic extracts were left under atmospheric conditions overnight. Et_3N (1.2 mmol) and acyl chloride (1.2 mmol) were added, and resulting mixture was stirred for 2 hours. After filtration and concentration *in vacuo*, the residue was purified by flash column chromatography on silica gel (petroleum ether/ethyl acetate/dichloromethane) to give the product **5**.

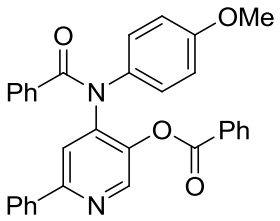
4.2 Characterization of Products

4-(4-Methoxyphenylamino)-6-phenylpyridin-3-yl benzoate (4a)



White solid (75 mg, yield: 63%). **m.p.** 130-131 °C. **^{1}H NMR** (400 MHz, acetone-d_6) δ 8.32 (s, 1H), 8.25-8.17 (m, 2H), 7.95-7.91 (m, 2H), 7.82 (s, 1H), 7.77-7.70 (m, 1H), 7.64-7.57 (m, 2H), 7.45-7.35 (m, 4H), 7.30-7.23 (m, 2H), 7.02-6.95 (m, 2H), 3.81 (s, 3H). **^{13}C NMR** (100 MHz, acetone-d_6) δ 164.6, 157.2, 155.1, 145.6, 143,7, 139.7, 134.7, 133.8, 132.4, 130.3, 129.5, 128.7, 128.5, 128.5, 126.6, 125.7, 114.7, 104.0, 54.9. **IR** (KBr, cm^{-1}) ν 3384, 1732, 1598, 1519, 1246. **MS** (ESI) 397 $[M+H]^+$ **HRMS** (EI) calcd. for $C_{25}H_{20}N_2O_3$ [M] 396.1474, found 396.1479.

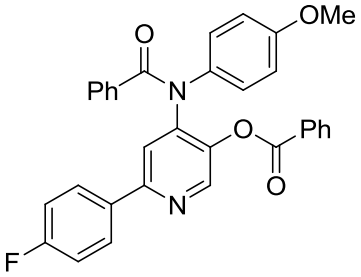
4-(N-(4-methoxyphenyl)benzamido)-6-phenylpyridin-3-yl benzoate (5a)



White solid (136 mg, yield: 91%). **m.p.** 125-126 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ

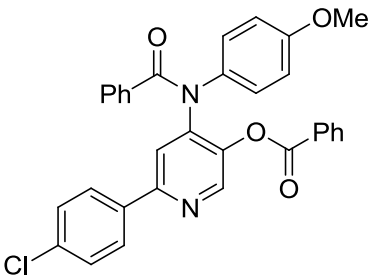
8.64 (s, 1H), 8.08-7.97 (m, 2H), 7.84-7.73 (m, 2H), 7.62-7.49 (m, 1H), 7.48-7.32 (m, 8H), 7.31-7.21 (m, 1H), 7.14 (t, *J* = 7.7, 2H), 7.10-7.02 (m, 2H), 6.76-6.67 (m, 2H), 3.72 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.2, 164.6, 158.3, 156.4, 145.6, 144.6, 141.2, 138.3, 135.1, 134.6, 134.0, 130.9, 130.4, 129.2, 129.1, 128.7, 128.6, 128.5, 128.2, 128.0, 126.9, 119.6, 114.6, 55.4. **IR** (KBr, cm^{-1}) ν 1735, 1681, 1509, 1227. **MS** (ESI) 501 $[M+1]^+$. **HRMS** (EI) calcd. for $C_{32}H_{24}N_2O_4$ [M] 500.1736, found 500.1743.

6-(4-Fluorophenyl)-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5b)



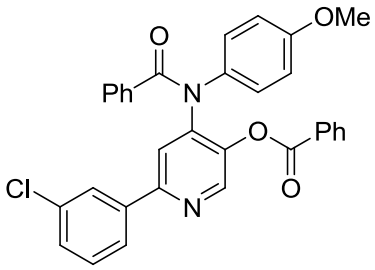
Foam-like solid (132 mg, yield: 85%**)**. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 8.03 (d, *J* = 7.3, 2H), 7.77 (dd, *J* = 8.7, 5.4, 2H), 7.54 (m, 1H), 7.44-7.31 (m, 5H), 7.17-7.01 (m, 6H), 6.71 (m, 2H), 3.72 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.8, 164.6, 162.3, 158.3, 155.4, 145.6, 144.7, 141.1, 135.1, 134.5, 134.5, 134.0, 130.9, 130.4, 129.2, 128.8, 128.8, 128.6, 128.5, 128.1, 128.0, 119.2, 115.8, 115.6, 114.6, 55.4. **IR** (KBr, cm^{-1}) ν 1743, 1671, 1509, 1249. **MS** (CI) 519 $[M+1]^+$ (26), 518 $[M]^+$ (54), 397 (16), 105 (100). **HRMS** (EI) calcd. for $C_{32}H_{23}N_2O_4F$ [M] 518.1642, found 518.1647.

6-(4-Chlorophenyl)-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5c)



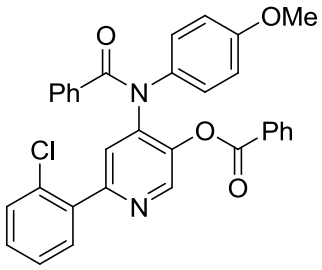
White solid (120 mg, yield: 91%). **m.p.** 142-144 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 8.02 (dd, *J* = 8.3, 1.1, 2H), 7.74 (d, *J* = 8.5, 2H), 7.59 - 7.50 (m, 1H), 7.46-7.31 (m, 7H), 7.14 (t, *J* = 7.6, 2H), 7.05 (d, *J* = 8.9, 2H), 6.71 (d, *J* = 8.9, 2H), 3.73 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.6, 158.3, 155.1, 145.7, 144.7, 141.3, 136.8, 135.4, 135.1, 134.6, 134.1, 131.0, 130.5, 129.3, 129.0, 128.7, 128.6, 128.3, 128.2, 128.1, 119.3, 114.7, 55.4. **IR** (KBr, cm^{-1}) ν 1744, 1672, 1510, 1248. **MS** (CI) 536 $[M+2]^+$ (6), 534 $[M]^+$ (14), 413 (5), 105 (100). **HRMS** (EI) calcd. for $C_{32}H23ClN_2O_4$ [M] 534.1346, found 534.1352.

6-(3-Chlorophenyl)-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5d)



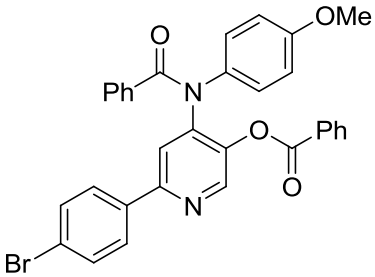
White solid (144 mg, yield: 90%). **m.p.** 151-152 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.64 (s, 1H), 8.03 (d, *J* = 8.0, 2H), 7.81 (s, 1H), 7.72-7.61 (m, 1H), 7.55 (t, *J* = 7.5, 1H), 7.46-7.32 (m, 7H), 7.31-7.21 (m, 3H), 7.15 (t, *J* = 7.7, 2H), 7.06 (d, *J* = 8.9, 2H), 6.72 (d, *J* = 8.9, 2H), 3.73 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.5, 158.3, 154,9, 145.8, 144.7, 141.6, 140.1, 135.0, 134.8, 134.5, 134.0, 131.0, 130.4, 130.0, 129.2, 129.1, 128.6, 128.5, 128.1, 128.0, 127.1, 125.0, 119.6, 114.7, 55.4. **IR** (KBr, cm^{-1}) ν 1738. 1674, 1510, 1247. **MS** (CI) 536 $[M+2]^+$ (13), 535 $[M+1]^+$ (14), 534 $[M]^+$ (33), 413 (8), 105 (100). **HRMS** (EI) calcd. for $C_{32}H_{23}N_2O_4Cl$ [M] 534.1346, found 534.1354.

6-(2-Chlorophenyl)-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5e)



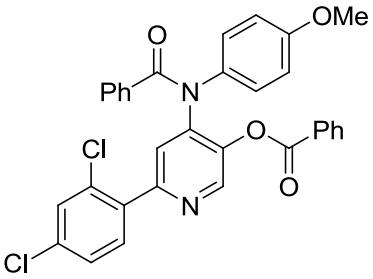
White solid (131 mg, yield: 82%). **m.p.** 169-171 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.66 (s, 1H), 8.08-7.97 (m, 2H), 7.62-7.53 (m, 2H), 7.46 (d, J = 7.5, 2H), 7.42-7.36 (m, 4H), 7.35-7.26 (m, 3H), 7.16 (t, J = 7.7, 2H), 7.06 (d, J = 8.8, 2H), 6.71 (d, J = 8.8, 2H), 3.72 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.4, 158.3, 155.1, 145.5, 143.7, 141.1, 137.9, 135.0, 134.6, 134.0, 132.1, 131.6, 131.0, 130.4, 130.1, 129.9, 129.4, 128.6, 128.5, 128.1, 128.0, 127.0, 124.1, 114.6, 55.4. **IR** (KBr, cm^{-1}) ν 1738, 1672, 1510, 1250. **MS** (CI) 536 $[M+2]^+$ (20), 535 $[M+1]^+$ (20), 534 $[M]^+$ (46), 413 (9), 105 (100). **HRMS** (EI) calcd. for $C_{32}H_{23}N_2O_4Cl$ [M] 534.1346, found 534.1355.

6-(4-Bromophenyl)-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5f)



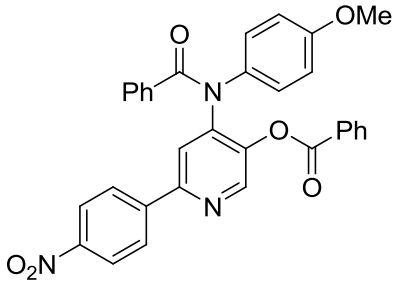
White solid (158 mg, yield: 91%). **m.p.** 161-163 ^{o}C.**^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.63 (s, 1H), 8.06-7.96 (m, 2H), 7.67 (d, J = 8.4, 2H), 7.58-7.51 (m, 3H), 7.44-7.32 (m, 5H), 7.14 (t, J = 7.6, 2H), 7.08-7.02 (m, 2H), 6.77-6.64 (m, 2H), 3.73 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.6, 158.3, 155.1, 145.7, 144.7, 141.4, 137.1, 135.0, 134.5, 134.0, 131.9, 131.0, 130.4, 129.2, 128.6, 128.5, 128.1, 128.0, 123.7, 119.3, 114.7, 55.4. **IR** (KBr, cm^{-1}) ν 1741, 1681, 1509, 1476, 1228. **MS** (CI) 580 $[M+2]^+$ (20), 579 $[M+1]^+$ (8), 578 $[M]^+$ (20), 105 (100). **HRMS** (EI) calcd. for $C_{32}H_{23}N_2O_4{}^{79}Br$ [M] $C_{32}H_{23}N_2O_4{}^{81}Br$ [M+2] 578.0841, 580.0821, found 578.0849, 580.0828.

6-(2,4-Dichlorophenyl)-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5g)



White solid (149 mg, yield: 87%). **m.p.** 164-165 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.65 (s, 1H), 8.02 (dd, *J* = 8.4, 1.3, 2H), 7.60-7.52 (m, 2H), 7.49-7.43 (m, 2H), 7.41 (d, *J* = 2.0, 1H), 7.40-7.34 (m, 3H), 7.32 (dd, *J* = 8.4, 2.1, 1H), 7.28 (s, 1H), 7.16 (t, *J* = 7.7, 2H), 7.04 (d, *J* = 9.0, 2H), 6.71 (d, *J* = 9.0, 2H), 3.72 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.4, 158.3, 153.9, 145.7, 143.8, 141.2, 136.3, 135.2, 135.0, 134.4, 134.1, 132.8, 132.5, 131.0, 130.4, 129.8, 129.4, 128.6, 128.5, 128.1, 127.4, 124.0, 114.6, 55.4. **IR** (KBr, cm^{-1}) ν 1743, 1664, 1508, 1245. **MS** (CI) 570 $[M+2]^+$ (24), 569 $[M+1]^+$ (16), 568 $[M]^+$ (34), 447 (5), 105 (100). **HRMS** (EI) calcd. for $C_{32}H_{22}N_2O_4Cl_2$ [M] 568.0957, found 568.0963.

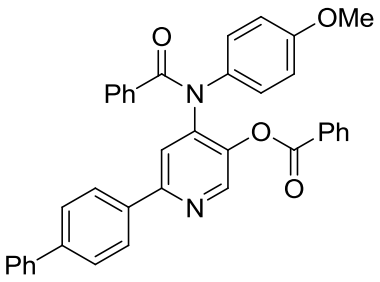
4-(N-(4-methoxyphenyl)benzamido)-6-(4-nitrophenyl)pyridin-3-yl benzoate (5h)



Yellow solid (105 mg, yield: 64%). **m.p.** 173-174 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.71 (s, 1H), 8.28 (d, *J* = 8.8, 2H), 8.08-7.96 (m, 4H), 7.58-7.52 (m, 1H), 7.46 (s, 1H), 7.44-7.34 (m, 4H), 7.32-7.27 (m, 1H), 7.15 (t, *J* = 7.7, 2H), 7.06 (d, *J* = 8.9, 2H), 6.73 (d, *J* = 8.9, 2H), 3.73 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.4, 158.5, 153.4, 148.2, 145.9, 145.2, 143.7, 142.2, 134.8, 134.2, 131.1, 130.4, 129.3, 128.6, 128.5, 128.1, 127.9, 127.8, 124.0, 120.2, 114.8, 55.4. **IR** (KBr, cm^{-1}) ν 1748, 1682,

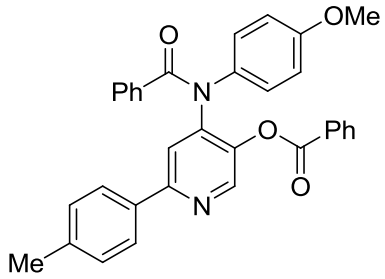
1519, 1226. **MS** (CI) 546 $[M+1]^+$ (18), 545 $[M]^+$ (29), 439 (29), 105 (100). **HRMS** (EI) calcd. for $C_{32}H_{23}N_3O_6$ [M] 545.1587, found 545.1594.

6-(Biphenyl-4-yl)-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5i)



White solid (142 mg, yield: 82%). **m.p.** 186-187 ^oC. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.66 (s, 1H), 8.04 (d, *J* = 8.3, 2H), 7.88 (d, *J* = 8.3, 2H), 7.69-7.60 (m, 4H), 7.59-7.52 (m, 1H), 7.50-7.41 (m, 5H), 7.41-7.34 (m, 3H), 7.31 - 7.25 (m, 1H), 7.15 (t, *J* = 7.7, 2H), 7.08 (d, *J* = 8.9, 2H), 6.73 (d, *J* = 8.9, 2H), 3.73 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.2, 164.6, 158.3, 155.9, 145.6, 144.7, 142.0, 141.2, 140.4, 137.1, 135.1, 134.6, 134.0, 130.9, 130.4, 129.3, 128.8, 128.6, 128.5, 128.2, 128.0, 127.6, 127.4, 127.4, 127.1, 119.4, 114.7, 55.4. **IR** (KBr, cm^{-1}) ν 1748, 1662, 1510, 1248. **MS** (CI) 577 $[M+1]^+$ (27), 576 $[M]^+$ (58), 455 (29), 105 (100). **HRMS** (EI) calcd. for $C_{38}H_{28}N_2O_4$ [M] 576.2049, found 576.2056.

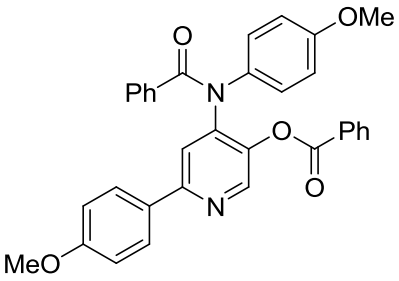
4-(N-(4-methoxyphenyl)benzamido)-6-p-tolylpyridin-3-yl benzoate (5j)



White solid (130 mg, yield: 84%). **m.p.** 130-131 ^oC. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 8.06-7.98 (m, 2H), 7.69 (d, *J* = 8.1, 2H), 7.54 (t, *J* = 7.5, 1H), 7.43 (d, *J* = 7.3, 2H), 7.40-7.33 (m, 3H), 7.30-7.20 (m, 3H), 7.14 (t, *J* = 7.7, 2H), 7.06 (d, *J* = 8.8, 2H), 6.71 (d, *J* = 8.8, 2H), 3.73 (s, 3H), 2.38 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.2, 164.6, 158.2, 156.4, 145.4, 144.5, 140.9, 139.2, 135.5, 135.1, 134.6, 133.9,

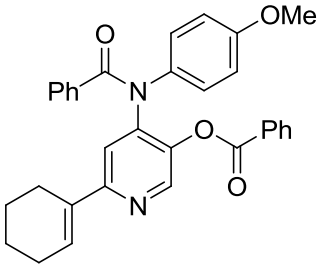
130.9, 130.4, 129.4, 129.2, 128.5, 128.5, 128.2, 128.0, 126.8, 119.3, 114.6, 55.4, 21.3. **IR** (KBr, cm^{-1}) ν 1751, 1659, 1511, 1250. **MS** (CI) 515 $[M+1]^+$ (35), 514 $[M]^+$ (65), 393 (30), 105 (100). **HRMS** (EI) calcd. for $C_{33}H_{26}N_2O_4$ [M] 514.1893, found 514.1898.

6-(4-Methoxyphenyl)-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5k)



White solid (123 mg, yield: 77%). **m.p.** 129-130 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.58 (s, 1H), 8.08-7.98 (m, 2H), 7.74 (d, *J* = 8.8, 2H), 7.54 (t, *J* = 7.5, 1H), 7.42 (d, *J* = 7.2, 2H), 7.37 (t, *J* = 7.8, 2H), 7.31 (s, 1H), 7.29-7.23 (m, 1H), 7.14 (t, *J* = 7.6, 2H), 7.06 (d, *J* = 8.9, 2H), 6.93 (d, *J* = 8.9, 2H), 6.71 (d, *J* = 8.9, 2H), 3.84 (s, 3H), 3.72 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ170.2, 164.6, 160.6, 158.2, 156.1, 145.4, 144.5, 140.6, 135.2, 134.7, 133.9, 131.0, 130.9, 130.4, 129.2, 128.5, 128.4, 128.2, 128.0, 118.8, 114.6, 114.1, 55.4. **IR** (KBr, cm^{-1}) ν 1732, 1679, 1479, 1228. **MS** (CI) 531 $[M+1]^+$ (23), 530 $[M]^+$ (34), 409 (27), 105 (100). **HRMS** (EI) calcd. for $C_{33}H_{26}N_2O_5$ [M] 530.1842, found 530.1848.

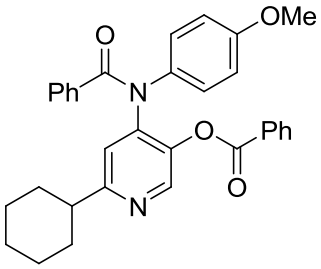
6-Cyclohexenyl-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5l)



White solid (91 mg, yield: 60%). **m.p.** 153-155 °C.**^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.47 (s, 1H), 8.00-7.98 (m, 2H), 7.55-7.52 (m, 1H), 7.41-7.36 (m, 4H), 7.28-7.23 (m, 1H), 7.13 (t, *J* = 7.7, 2H), 7.04-7.00 (m, 3H), 6.70 (d, *J* = 8.9, 2H), 6.51 (br, 1H), 3.72

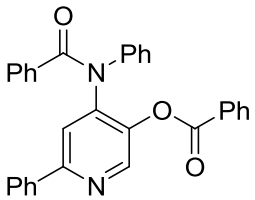
(s, 3H), 2.34 (d, *J* = 1.7, 2H), 2.20 (dt, *J* = 5.8, 3.7, 2H), 1.75-1.72 (m, 2H), 1.65-1.61 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.3, 164.7, 158.3, 158.1, 144.7, 144.1, 140.6, 135.7, 135.3, 134.9, 134.0, 130.9, 130.5, 129.5, 129.3, 128.6, 128.4, 128.1, 118.1, 114.6, 55.5, 26.0, 22.8, 22.1. **IR** (KBr, cm^{-1}) ν 2930, 1736, 1668, 1510, 1322, 1249. **MS** (CI). 505 $[M+1]^+$ (11), 504 $[M]^+$ (17), 105 (60). **HRMS** (ESI) calcd. for $C_{32}H_{28}N_2O_4$ [M+H] 505.2122, found 505.2122.

6-Cyclohexyl-4-(N-(4-methoxyphenyl)benzamido)pyridin-3-yl benzoate (5m)



Sticky Oil (106 mg, yield:70%). **^{1}H NMR** (400 MHz, acetone-d_6) δ 8.51 (s, 1H), 8.02 (dd, *J* = 8.2, 1.2, 2H), 7.65-7.61 (m, 1H), 7.48-7.41 (m, 4H), 7.31-7.27 (m, *J*, 1H), 7.18 (t, *J* = 7.6, 2H), 7.11 (d, *J* = 8.9, 2H), 7.00 (s, 1H), 6.78 (d, *J* = 9.0, 2H), 3.72 (s, 3H), 2.63 (tt, *J* = 1.7, 3.2, 1H), 1.53 (m, 10H). **^{13}C NMR** (100 MHz, acetone-d_6) δ 170.4, 165.8, 165.2, 159.4, 145.8, 145.1, 141.5, 136.6, 136.4, 134.9, 131.5, 131.1, 130.0, 129.8, 129.7, 129.6, 128.8, 121.1, 115.3, 55.8, 33.5, 27.2, 26.8, 19.5. **IR** (KBr, cm^{-1}) ν 2927, 1740, 1670, 1509, 1248. **MS** (CI). 507 $[M+1]^+$ (59), 506 $[M]^+$ (71), 105 (100). **HRMS** (ESI) calcd. for $C_{32}H_{30}N_2O_4$ [M+H] 507.2278, found 507.2278..

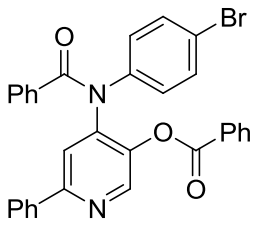
6-Phenyl-4-(N-phenylbenzamido)pyridin-3-yl benzoate (5n)



White solid (109 mg, yield: 77%). **m.p.** 149-150 ^oC. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.65 (s, 1H), 8.03-7.95 (m, 2H), 7.84-7.73 (m, 2H), 7.59-7.49 (m, 1H), 7.47-7.33 (m, 8H), 7.31-7.26 (m, 1H), 7.23-7.11 (m, 7H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.2, 164.5, 156.4, 145.6, 144.5, 142.3, 141.3, 138.2, 134.5, 134.0, 131.1, 130.4, 129.4,

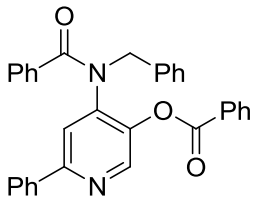
129.3, 129.2, 128.8, 128.5, 128.1, 128.0, 127.2, 127.0, 119.9. **IR** (KBr, cm^{-1}) ν 1750, 1664, 1589, 1483, 1226. **MS** (CI) 471 $[M+1]^+$ (23), 470 $[M]^+$ (32), 349 (33), 105 (100). **HRMS** (ESI) calcd. for $C_{31}H_{22}N_2O_3$ [M+H] 471.1703, found 471.1703.

4-(N-(4-bromophenyl)benzamido)-6-phenylpyridin-3-yl benzoate (5o)



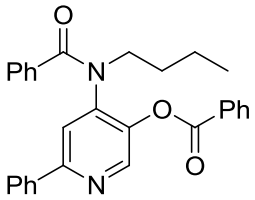
Foam-like Solid (73 mg, yield: 44%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.63 (s, 1H), 8.02-7.92 (m, 2H), 7.76 (dd, *J* = 7.8, 1.6, 2H), 7.66-7.53 (m, 1H), 7.53-7.36 (m, 8H), 7.35-7.29 (m, 3H), 7.19 (t, *J* = 7.7, 2H), 7.01 (d, *J* = 8.8, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.5, 156.6, 145.8, 144.0, 141.3, 141.1, 138.0, 134.1, 134.1, 132.5, 131.4, 130.3, 129.3, 128.8, 128.5, 128.2, 127.9, 126.9, 120.5, 119.8. **IR** (KBr, cm^{-1}) ν 1743, 1674, 1593, 1486, 1258. **MS** (CI) 550 $[M+2]^+$ (3), 548 $[M]^+$ (3), 430 (5), 432 (5) 105 (100). **HRMS** (EI) calcd. for $C_{31}H_{21}N_2O_3{}^{79}Br$ [M], $C_{31}H_{213}N_2O_3{}^{81}Br$ [M+2] 548.0736, 550.0715, found 548.0745, 550.0720.

4-(N-benzylbenzamido)-6-phenylpyridin-3-yl benzoate (5p)



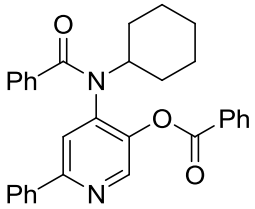
White solid (102 mg, yield: 70%). **m.p.** 149-150 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.51 (s, 1H), 8.08-8.00 (m, 2H), 7.78-7.62 (m, 3H), 7.52 (m 2H), 7.44-7.21 (m, 12H), 7.21-7.15 (m, 2H), 5.12 (s, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.4, 163.7, 155.8, 145.7, 143.8, 141.7, 138.0, 137.0, 134.8, 134.2, 130.9, 130.4, 129.5, 128.81, 128.76, 128.7, 128.4, 128.0, 127.9, 126.9, 120.3, 53.0. **IR** (KBr, cm^{-1}) ν 3063, 3032, 1748, 1658, 1591, 1479, 1258. **MS** (CI) 485 $[M+1]^+$ (21), 484 $[M]^+$ (9), 363 (43), 105 (100). **HRMS** (EI) calcd. for $C_{32}H_{24}N_2O_3$ [M] 484.1787, found 484.1792.

4-(N-butylbenzamido)-6-phenylpyridin-3-yl benzoate (5q)



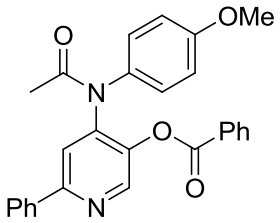
White solid (80 mg, yield: 60%). **m.p.** 118-119 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.57 (s, 1H), 8.14 (d, *J* = 7.8, 2H), 7.88-7.78 (m, 2H), 7.70 (t, *J* = 7.4, 1H), 7.56 (t, *J* = 7.7, 2H), 7.52 (s, 1H), 7.50-7.41 (m, 3H), 7.38 (d, *J* = 7.5, 2H), 7.32 (t, *J* = 7.3, 1H), 7.20 (t, *J* = 7.6, 2H), 3.91 (t, *J* = 7.8, 2H), 1.72-1.58 (m, 2H), 1.42-1.28 (m, 2H), 0.88 (t, *J* = 7.3, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.4, 163.8, 155.9, 145.8, 144.1, 141.6, 137.9, 134.9, 134.4, 130.7, 130.4, 129.4, 128.9, 128.6, 128.2, 128.0, 126.9, 120.4, 49.9, 30.0, 20.2, 13.7. **IR** (KBr, cm^{-1}) ν 2961, 1745, 1648, 1259, 1229. **MS** (CI) 451 $[M+1]^+$ (7), 450 $[M]^+$ (5), 329 (50), 105 (100). **HRMS** (EI) calcd. for $C_{29}H_{26}N_2O_3$ [M] 450.1943, found 450.1949.

4-(N-cyclohexylbenzamido)-6-phenylpyridin-3-yl benzoate (5r)



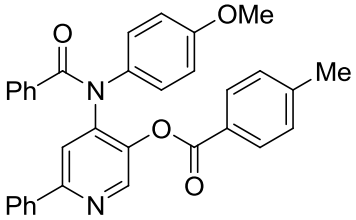
Yellow oil (59 mg, yield: 41%). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 8.20-8.09 (m, 2H), 7.94 (d, *J* = 7.2, 2H), 7.69 (t, *J* = 7.4, 1H), 7.63 (s, 1H), 7.56 (t, *J* = 7.7, 2H), 7.51-7.43 (m, 3H), 7.34-7.29 (m, 2H), 7.26-7.19 (m, 1H), 7.13 (t, *J* = 7.6, 2H), 4.53 (tt, *J* = 8.4, 3.6, 1H), 2.07-1.94 (m, 2H), 1.85-1.74 (m, 2H), 1.63-1.31 (m, 6H), 1.15-1.01 (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.5, 163.6, 155.0, 145.8, 143.3, 141.4, 138.2, 136.0, 134.2, 130.4, 130.3, 129.4, 128.9, 128.8, 128.3, 127.9, 127.0, 122.2, 58.5, 31.5, 26.1, 25.4. **IR** (KBr, cm^{-1}) ν 2930, 1748, 1660, 1258. **MS** (CI) 477 $[M+1]^+$ (5), 476 $[M]^+$ (2), 355 (42), 105 (100). **HRMS** (ESI) calcd. for $C_{31}H_{28}N_2O_3$ [M+H] 477.2173, found 477.2175.

4-(N-(4-methoxyphenyl)acetamido)-6-phenylpyridin-3-yl benzoate (5s)



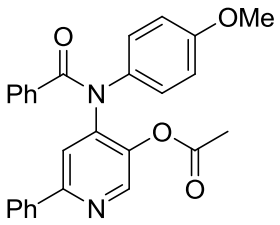
White solid (87 mg, yield: 66%). **m.p.** 149-150 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.51 (s, 1H), 7.75 (dd, *J* = 7.8, 1.5, 2H), 7.58-7.51 (m, 2H), 7.38 (dd, *J* = 14.1, 7.5, 4H), 7.33-7.27 (m, 3H), 7.08 (d, *J* = 8.9, 2H), 6.80 (d, *J* = 8.9, 2H), 3.77 (s, 3H), 2.16 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 169.9, 168.7, 158.4, 156.4, 145.3, 144.5, 140.8, 138.2, 135.2, 134.7, 131.2, 129.3, 129.2, 128.7, 128.6, 128.2, 126.9, 119.3, 114.7, 55.4, 20.6. **IR** (KBr, cm^{-1}) ν 1764, 1670, 1509, 1248. **MS** (CI): 439 $[M+1]^+$ (18), 438 $[M]^+$ (41), 396 (43), 105 (100). **HRMS** (EI) calcd. for $C_{27}H_{22}N_2O_4$ [M] 438.1580, found 438.1585.

4-(N-(4-methoxyphenyl)benzamido)-6-phenylpyridin-3-yl 4-methylbenzoate (5t)



White solid (131 mg, yield: 85%). **m.p.** 79-81 ^{o}C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.62 (s, 1H), 8.03-8.01 (m, 2H), 7.79 (dd, *J* = 8.0, 1.4, 2H), 7.54 (t, *J* = 7.5, 1H), 7.44-7.31 (m, 11H), 7.06 (d, *J* = 8.9, 2H), 6.93 (d, *J* = 8.0, 2H), 6.71 (d, *J* = 8.9, 2H), 3.72 (s, 3H), 2.24 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.2, 164.6, 158.2, 156.3, 145.5, 144.9, 141.4, 141.2, 138.3, 135.4, 133.9, 130.4, 129.4, 129.1, 128.72, 128.66, 128.6, 128.5, 128.3, 127.0, 119.6, 114.6, 55.4, 21.4. **IR** (KBr, cm^{-1}) ν 1741, 1669, 1508, 1248. **MS** (CI) 515 $[M+1]^+$ (45), 514 $[M]^+$ (62), 119 (100), 105 (42). **HRMS** (ESI) calcd. for $C_{33}H_{26}N_2O_4$ [M+H] 515.1965, found 515.1964.

4-(N-(4-methoxyphenyl)benzamido)-6-phenylpyridin-3-yl acetate (5u)

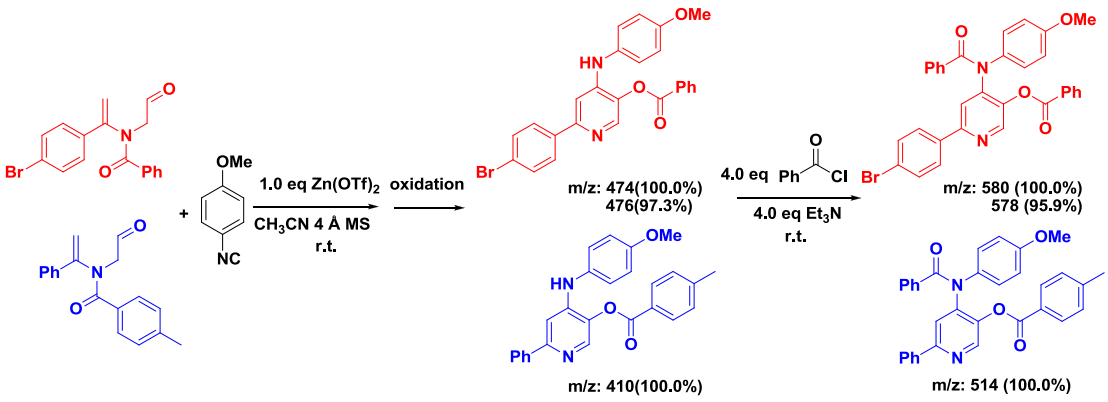


White solid (40 mg, yield: 30%). **m.p.** 159-160. °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.65 (s, 1H), 8.14 (d, *J* = 7.7, 2H), 7.90 (d, *J* = 7.4, 2H), 7.65 (t, *J* = 7.4, 1H), 7.62-7.30 (m, 6H), 7.17 (d, *J* = 8.8, 2H), 6.82 (d, *J* = 8.8, 2H), 3.77 (s, 3H), 2.04 (s, 3H).**^{13}C NMR** (100 MHz, $CDCl_3$) δ 170.1, 164.3, 159.2, 156.4, 145.9, 143.5, 141.8, 138.4, 134.4, 134.1, 130.5, 129.3, 129.0, 128.81, 128.77, 127.0, 119.9, 115.0, 55.6, 23.0. **IR** (KBr, cm^{-1}) ν 1730, 1682, 1509, 1251. **MS** (CI) 439 $[M+1]^+$ (31), 438 $[M]^+$ (58), 396 (45), 105 (100). **HRMS** (ESI) m/z calcd. for $C_{27}H_{22}N_2O_4$ [M+H] 439.1652, found 439.1653.

5. Mechanistic Studies

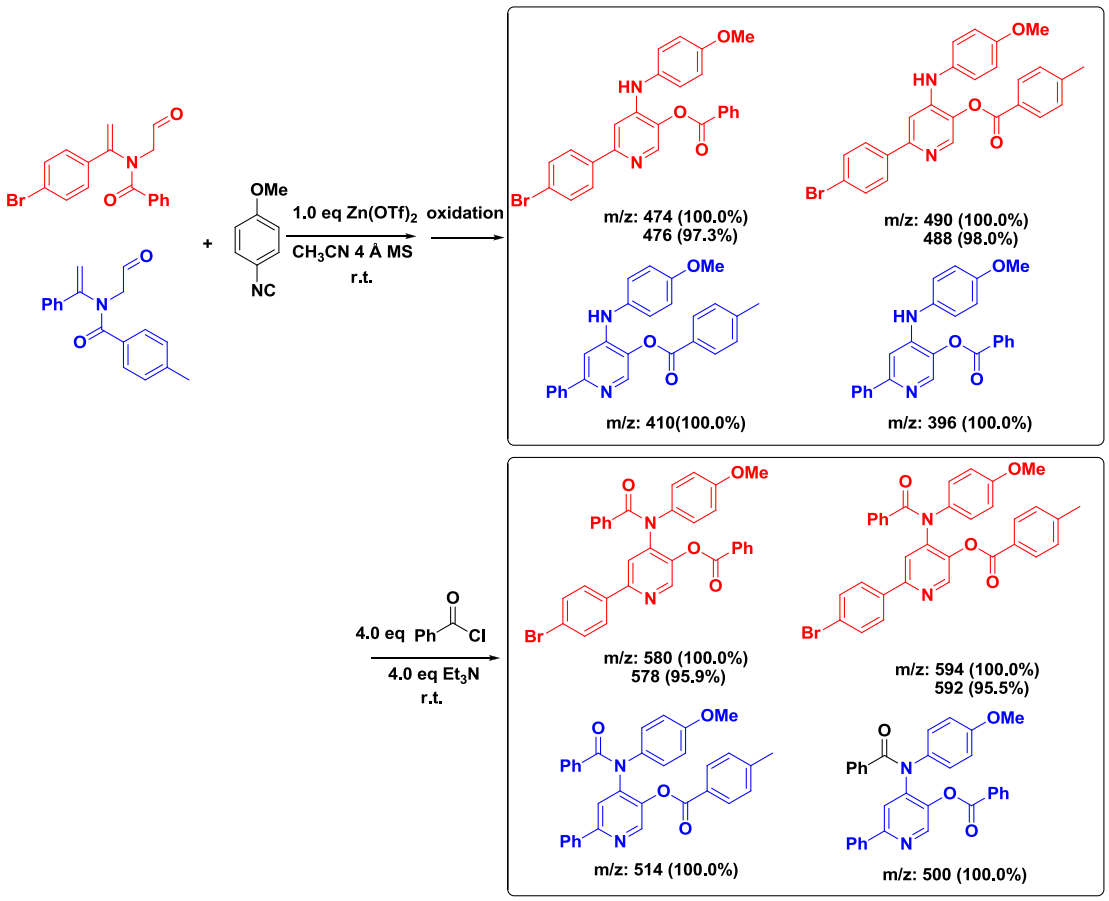
5.1 HPLC-MS analysis of products from a crossover experiment

If the acyl transfer from nitrogen of enamide to hydroxyl oxygen of pyridine occurs in an intramolecular manner, two pyridine products would be detected.



Scheme S4 Intramolecular acyl transfer

If reaction proceeded in an intermolecular manner, two pairs of constitutional isomers would be resulted.



Scheme S5 Intermolecular acyl transfer

As indicated clearly by HPLC-MS analysis, treatment of an equimolar amount of enamides **1f** and **1n** with isonitrile **2a,** followed by auto-oxidation and reaction with benzoyl chloride **3a** led to the formation of a mixture of four pyridine products. The outcomes are in agreement with intermolecular acyl transfer mechanism.

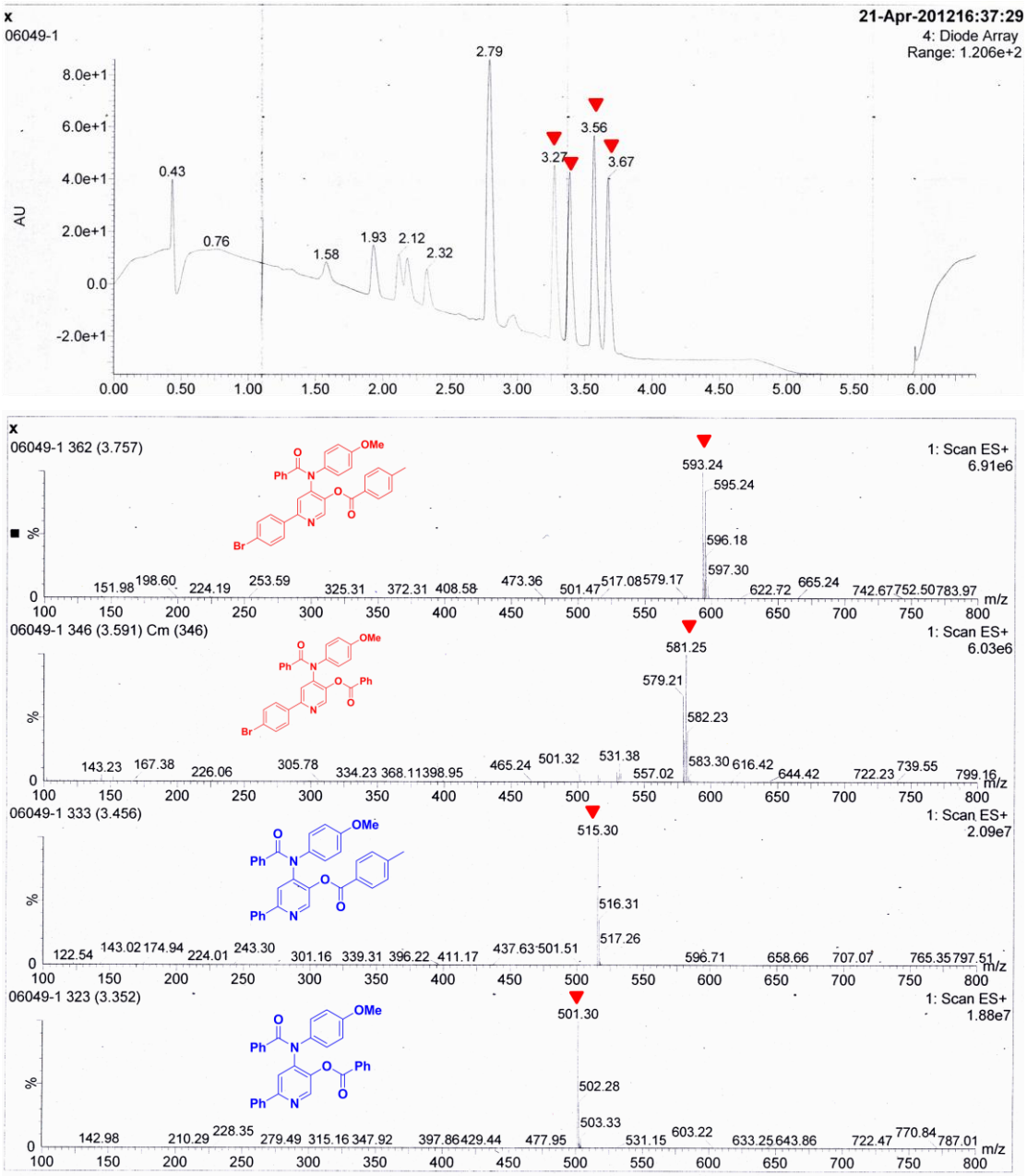
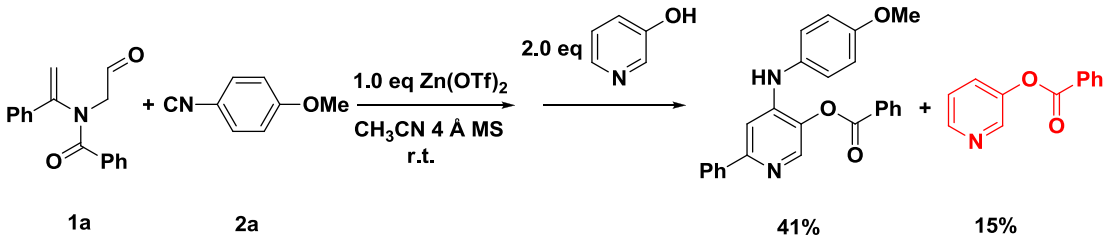


Figure S6 HPLC-MS spectra of crossover experiment

5.2 HPLC-MS Spectra and HPLC Spectra for the Benzoylation of 3-hydroxypyridine

To study the mechanism in more detail, we conducted this control experiment. To a solution of **2a** (0.36 mmol, 47.9 mg) in acetonitrile (15 mL) was added **1** (0.3 mmol, 79.6mg), 4 Å molecular sieves (300 mg) and $Zn(OTf)_2$ (0.3 mmol, 109.1 mg). The reaction mixture was stirred at ambient temperature until the disappearance of **1a** (monitored by TLC), 3-hydroxypyridine was added, then quenched with saturated aqueous $NaHCO_3$ (5 mL), filtrated through a pad of Celite and extracted with CH_2Cl_2

(3×15 mL). The combined organic extracts were washed with brine, dried over $MgSO_4$. The dried organic extracts were left under atmospheric conditions overnight. The residue was subjected to HPLC-MS analysis or HPLC analysis.



Scheme S6 Benzoylation of external 3-hydroxypyridine.

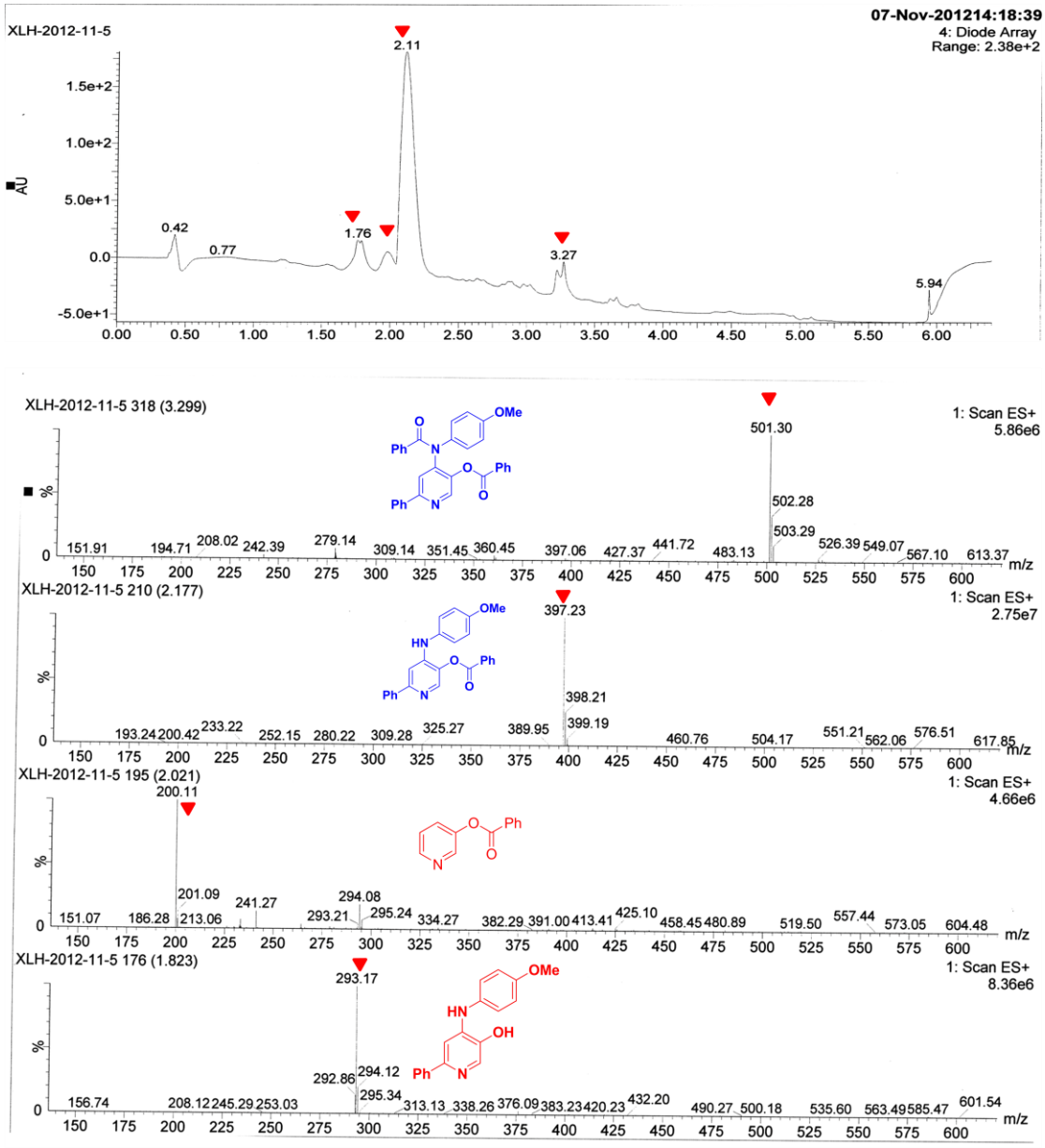


Figure S7 HPLC-MS spectra of experiment by adding external 3-hydroxypyridine into the reaction mixture of **1a** and **2a.**

After crude flash column chromatography on silica gel, A Shimadzu LC-10AVP HPLC system was also used to analyze the mixtures. Chiral columns (ADH) were purchased from DAICEL Chemical Industries, LTD. A mixture of hexane and 2-propanol (2:1) was used as mobile phase with a flow rate of 0.5 ml/min. The temperature of the column chamber was set to 25 ^{o}C. 3-Hydroxypyridine produced in the system has the same retention time and UV-spectrum with the standard sample. see Figure S8.

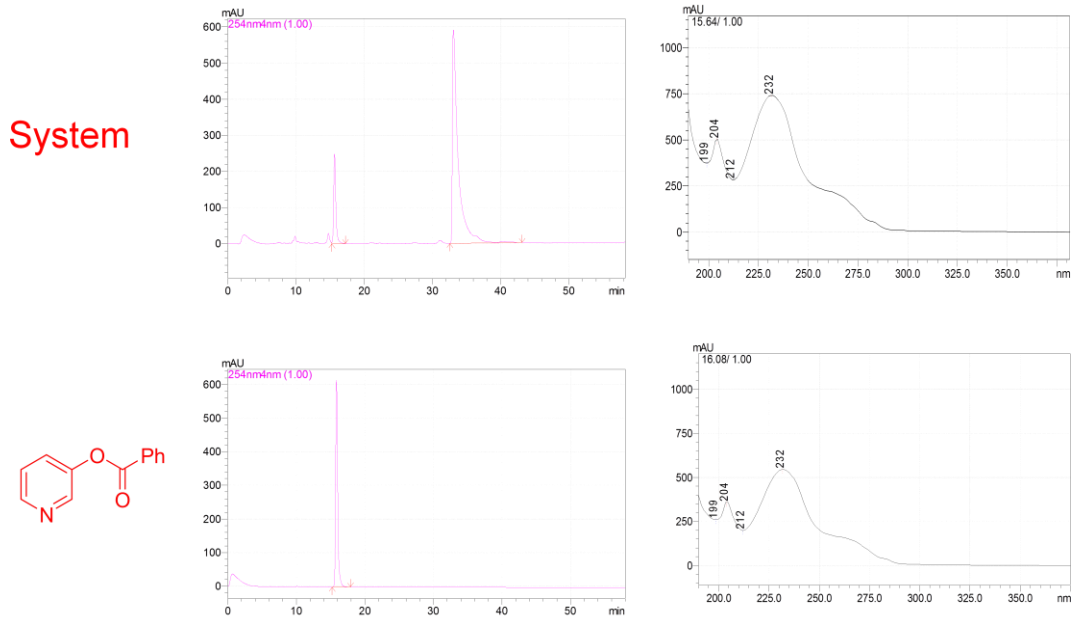


Figure S8 HPLC spectra of experiment by adding external 3-hydroxypyridine into the reaction mixture of **1a** and **2a** after crude column chromatography.

6. Crystallographic Data

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

Identification code	**4a**
Empirical formula	$C_{25}H_{20}N_2O_3$
Formula weight	396.43
Temperature	173(2) K
Wavelength	0.71073 Å

Crystal system	Triclinic
Space group	*P*-1
Unit cell dimensions	a = 7.3246(15) Å α = 82.46(3)°
	b = 8.8640(18) Å β = 84.33(3)°
	c = 15.446(3) Å γ = 74.63(3)°
Volume	956.5(3) Å^3
Z	2
Calculated density	1.376 Mg/m^3
Absorption coefficient	0.091 mm^{-1}
F(000)	416
Crystal size	0.23 × 0.20 × 0.14 mm
Theta range for data collection	2.87 to 27.48°
Limiting indices	-9<=h<=9, -11<=k<=11, 19<=l<=20
Reflections collected/unique	8533/4346 [R(int) = 0.0322]
Completeness to theta = 27.48°	98.7%
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	1.0000 and 0.6831
Refinement method	Full-matrix least-squares on F^2
Data/restraints/parameters	4346/0/272
Goodness-of-fit on F^2	1.123
Final R indices [I>2sigma(I)]	R1 = 0.0580, wR2 = 0.1292
R indices (all data)	R1 = 0.0648, wR2 = 0.1338
Largest diff. peak and hole	0.242 and -0.184 e.Å^{-3}

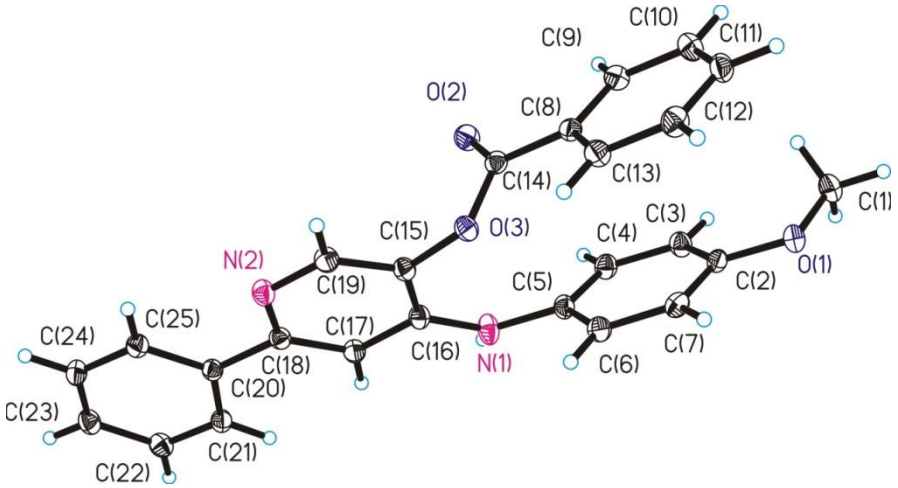


Figure S9 ORTEP presentation of **4a**

Crystal data and structure refinement for **5c**

Identification code	**5c**
Empirical formula	$C_{32}H_{23}ClN_2O_4$
Formula weight	534.97
Temperature	173(2) K
Wavelength	0.71073 Å
Crystal system	Triclinic
Space group	*P*-1
Unit cell dimensions	a = 10.985(2) Å α = 77.49(3)°
	b = 11.022(2) Å β = 76.30 (3)°
	c = 11.542(2) Å γ = 82.60(3)°
Volume	1321.0(5) $Å^3$
Z	2
Calculated density	1.345 Mg/m^3
Absorption coefficient	0.186 mm^{-1}
F(000)	556
Crystal size	0.24 ×0.23 ×0.21 mm
Theta range for data collection	1.85 to 27.46°

Limiting indices	-14<=h<=14, -14<=k<=14, -14<=l<=14
Reflections collected/unique	17913/6028 [R(int) = 0.0566]
Completeness to theta = 27.48°	99.8%
Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	1.0000 and 0.7817
Refinement method	Full-matrix least-squares on F^2
Data/restraints/parameters	6028/0/353
Goodness-of-fit on F^2	1.123
Final R indices [I>2sigma(I)]	R1 = 0.0615, wR2 = 0.1276
R indices (all data)	R1 = 0.0751, wR2 = 0.1350
Largest diff. peak and hole	0.283 and -0.460 e.Å^{-3}

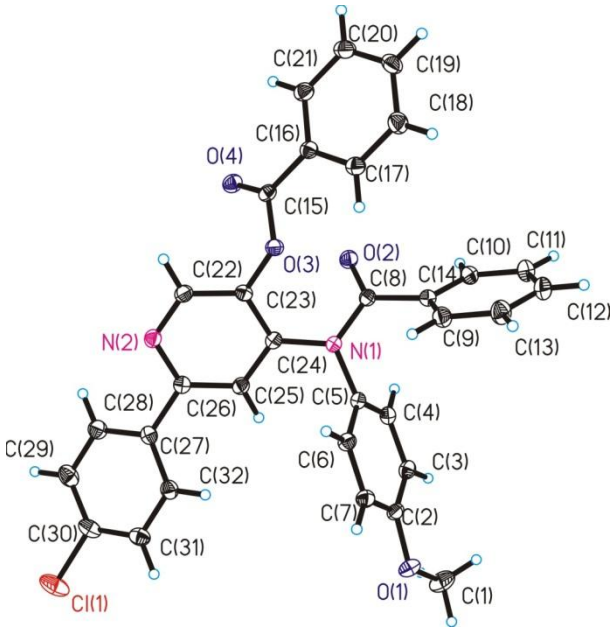
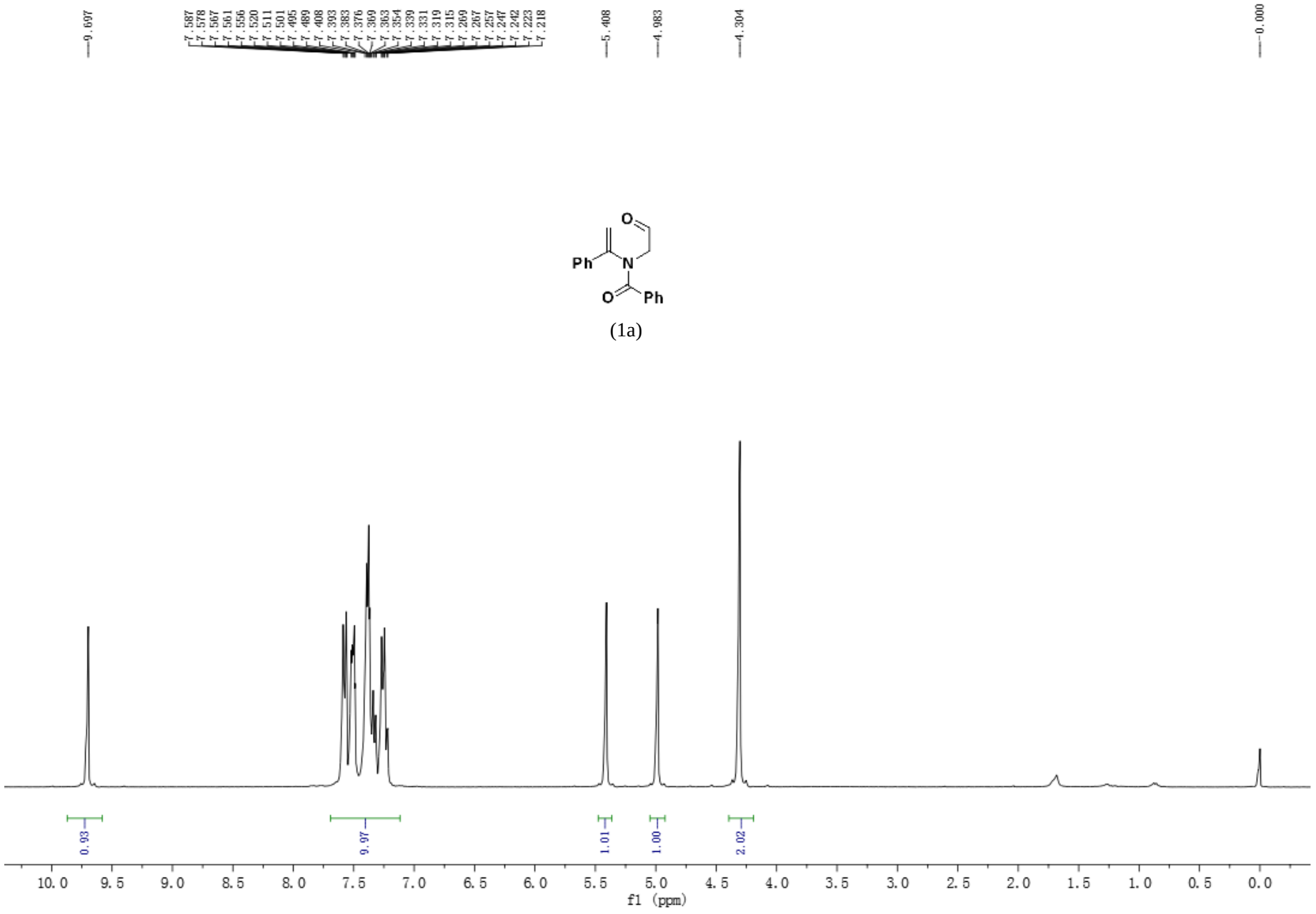


Figure S10 ORTEP presentation of **5c**

7. References

[1] (a) Yang, L., Wang, D.- X.; Huang, Z.- T.; Wang, M.- X. *J. Am. Chem. Soc.* **2009**, *131*, 10390-10391. (b) Yang, L.; Lei, C.- H.; Wang, D.- X.; Huang, Z.- T.; Wang, M.- X. *Org. Lett.* **2010**, *12*, 3918-3921.

8. Copies of ^{1}H and ^{13}C NMR Spectra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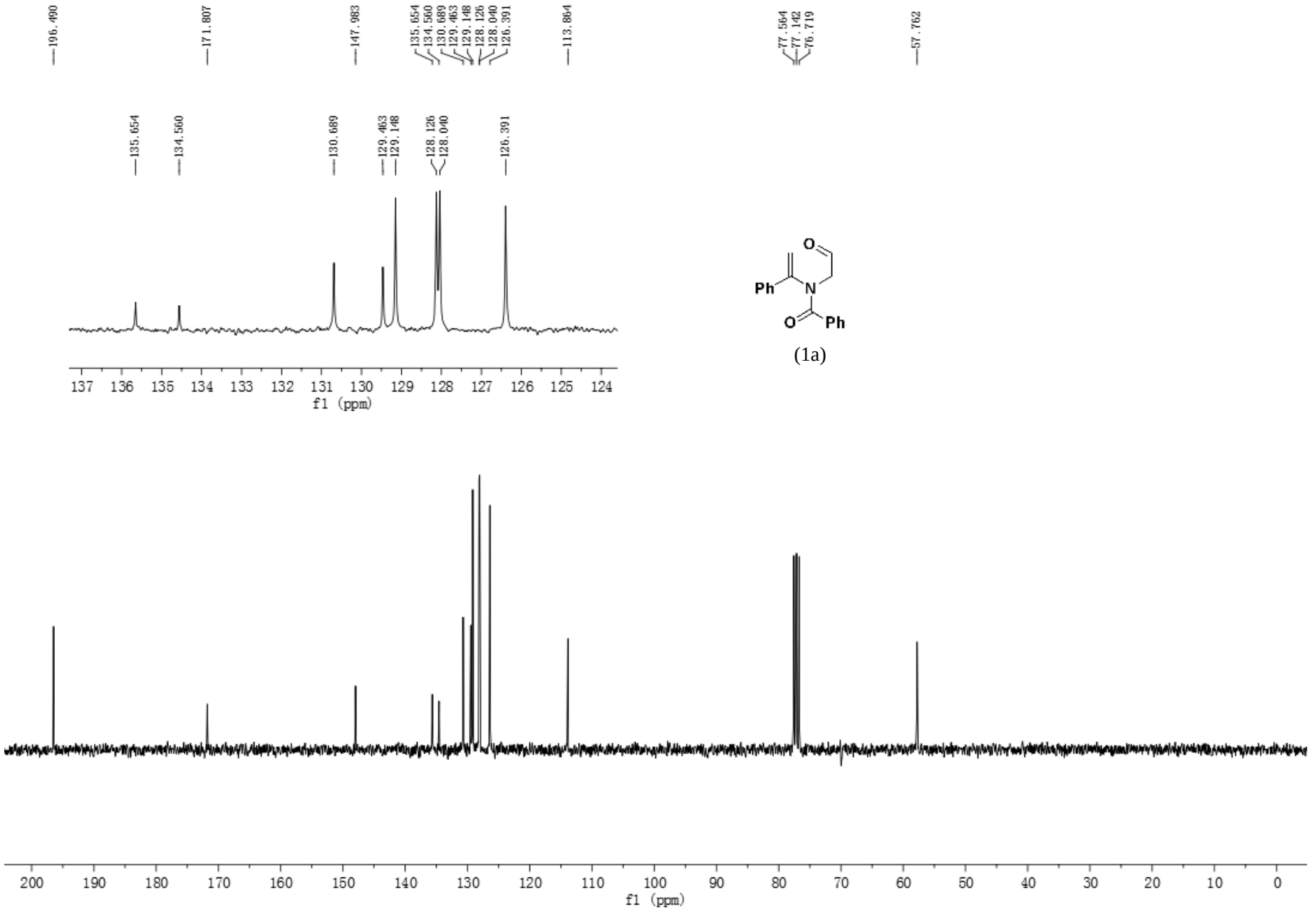
7.567
7.561
7.556
7.520
7.511
7.501
7.495
7.489
7.408
7.393
7.383
7.376
7.369
7.363
7.354
7.339
7.331
7.319
7.315
7.269
7.267
7.257
7.247
7.242
7.223
7.218
5.408
4.983
4.304
0.000
O
Ph
N
O
Ph
0.93
9.97
1.01
1.00
2.02
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

(1a)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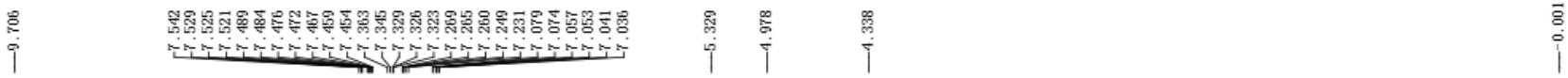
171.807
147.983
135.654
134.560
130.689
129.463
129.148
128.126
128.040
126.391
113.864
77.564
77.142
76.719
57.762
f1 (ppm)
Ph
N
O
Ph
O

(1a)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7.529
7.525
7.521
7.489
7.484
7.476
7.472
7.467
7.459
7.454
7.363
7.345
7.329
7.326
7.323
7.269
7.265
7.260
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7.057
7.053
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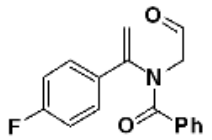
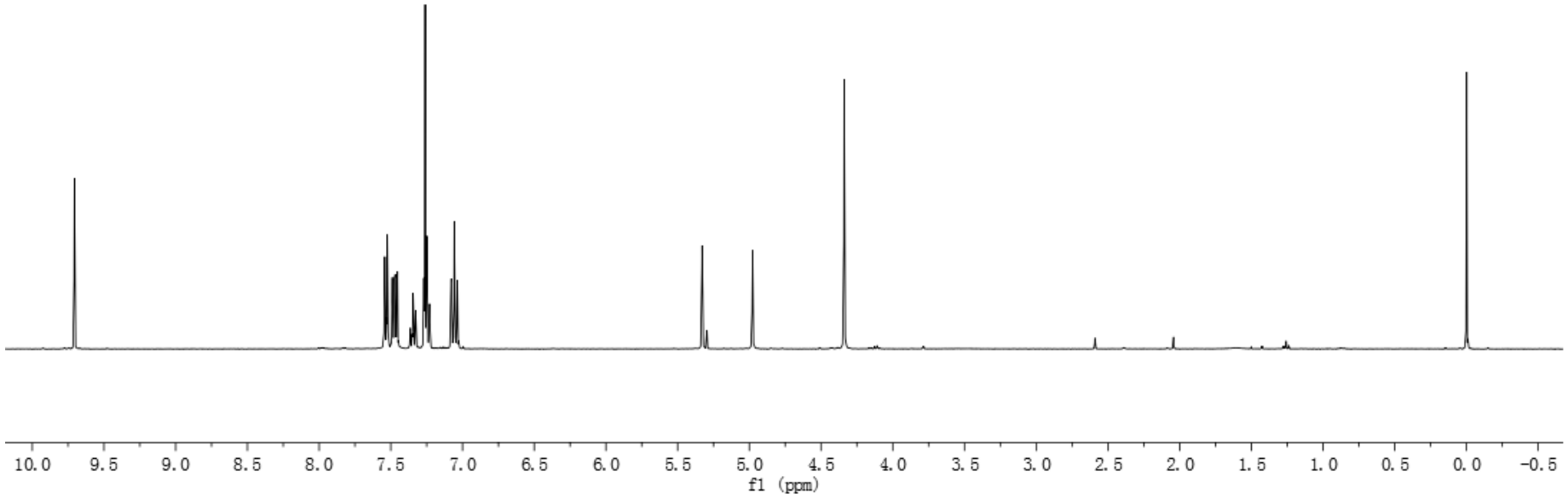
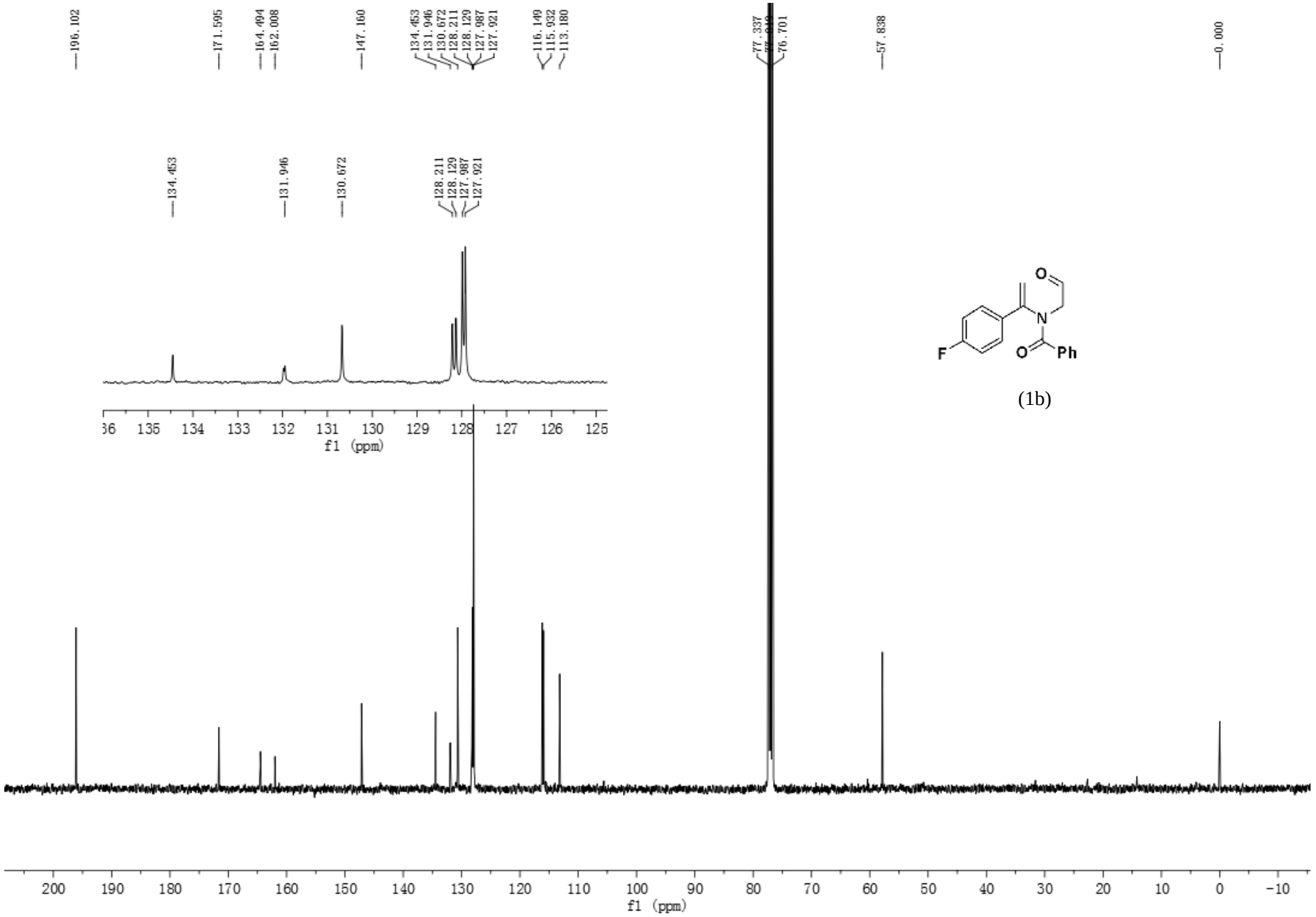
7.036
5.329
4.978
4.338
0.001


O
N
F
O
Ph

(1b)


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)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164.494
162.008
147.160
134.453
131.946
130.672
128.211
128.129
127.987
127.921
116.149
115.932
113.180
77.337
76.701
57.838
0.000
f1 (ppm)
F
O
N
O
Ph

(1b)


9.700
7.534
7.521
7.516
7.512
7.449
7.443
7.438
7.426
7.421
7.415
7.370
7.367
7.361
7.355
7.349
7.344
7.338
7.333
7.330
7.327
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7.262
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7.235
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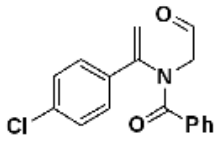
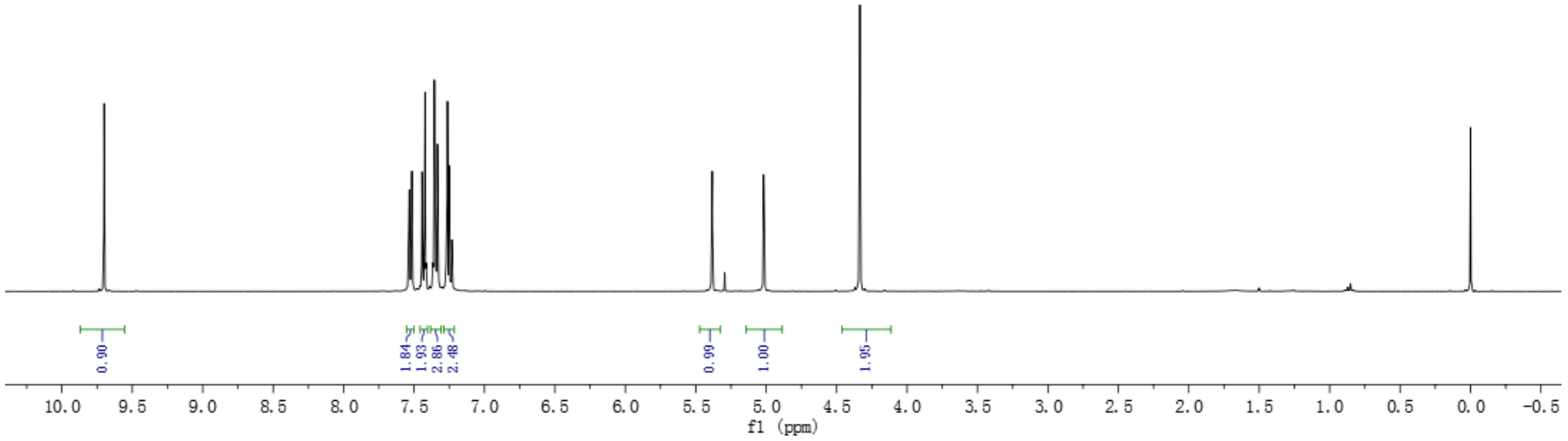
5.383
5.295
5.018
5.016
4.335
0.000


O
N
Cl
O
Ph

(1c)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1.93
2.80
2.48
0.99
1.00
1.95
10.0
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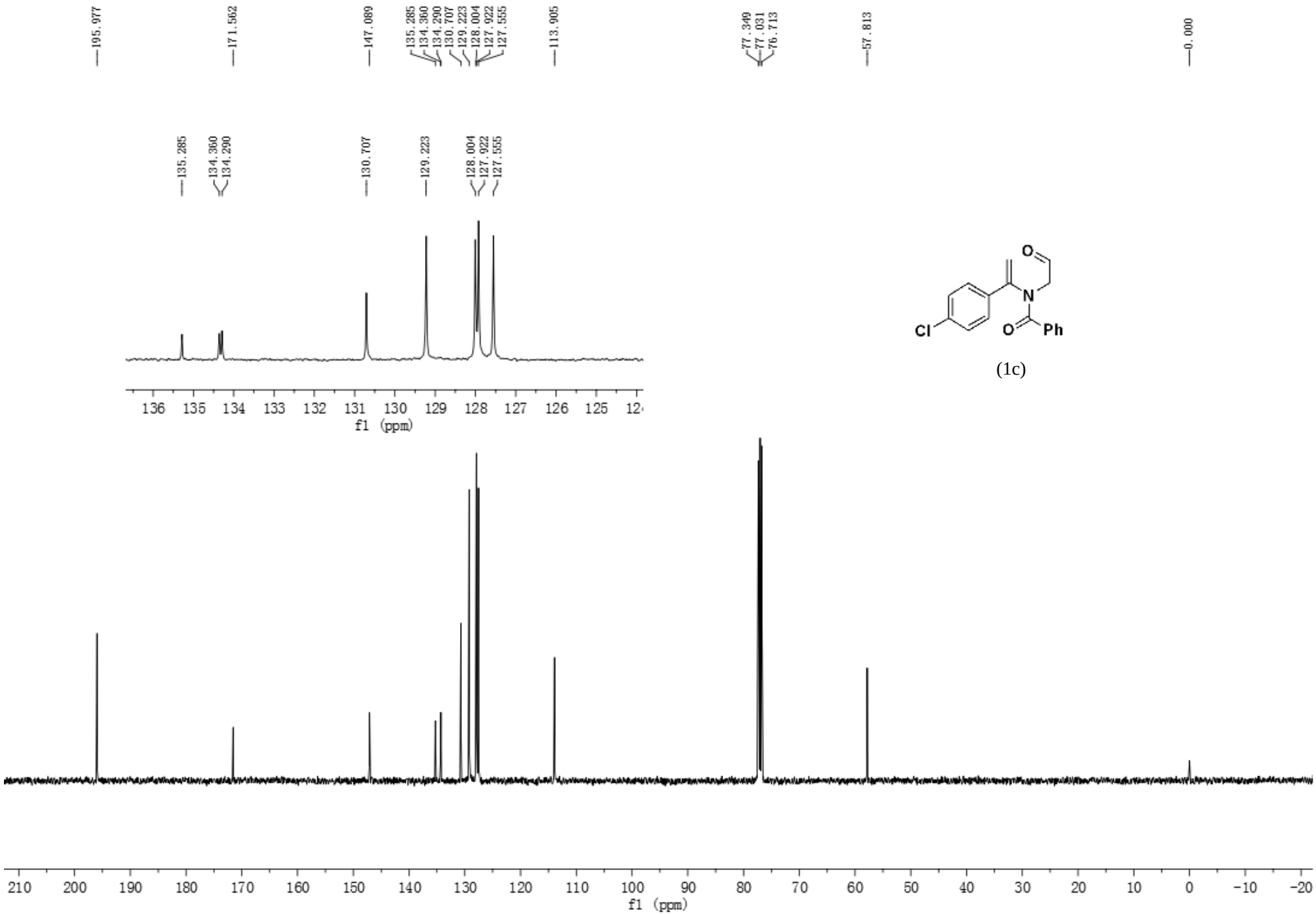
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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129.223
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127.555
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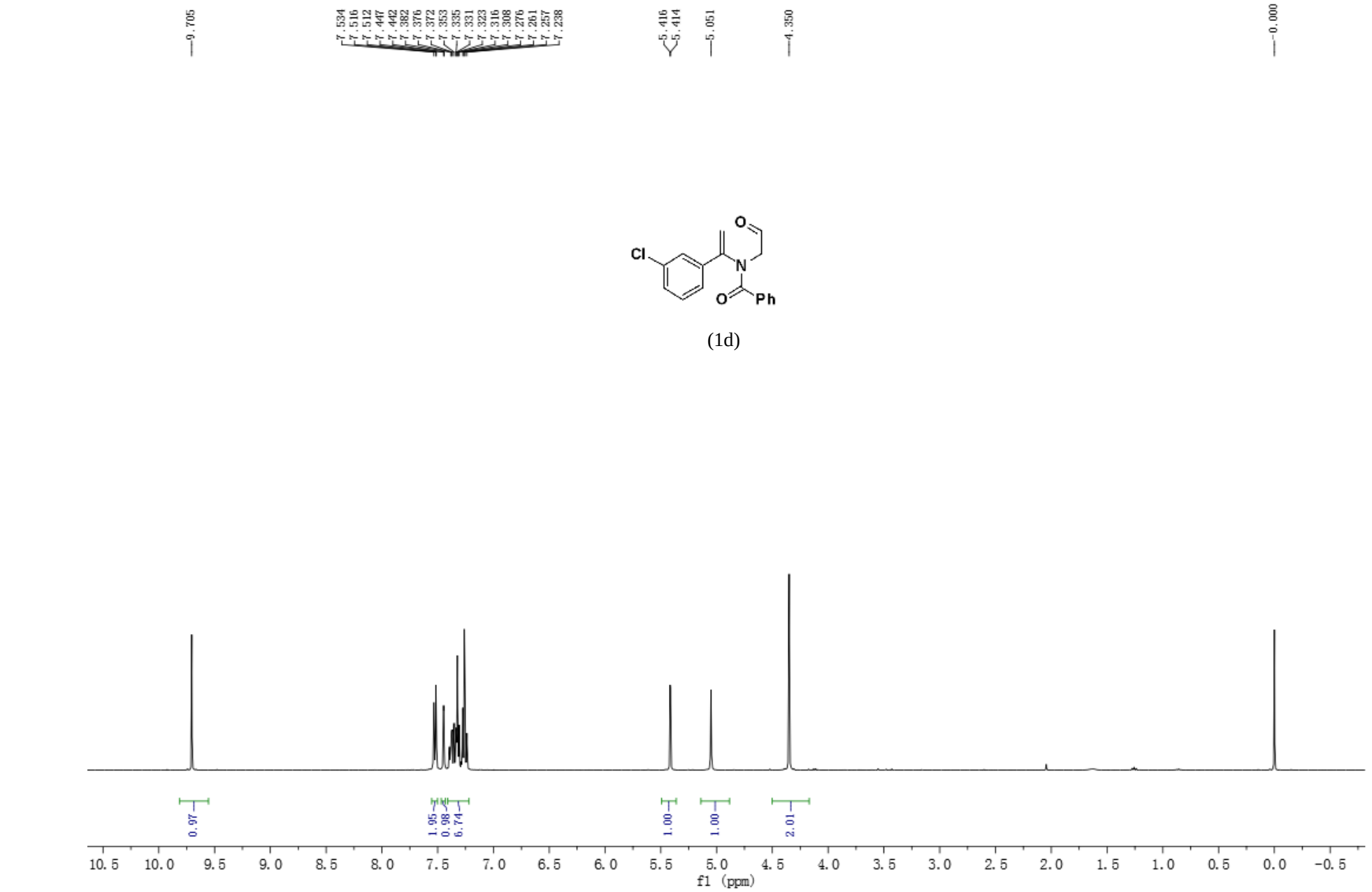
77.031
76.713
57.813
0.000
f1 (ppm)
Cl
O
N
O
Ph

(1c)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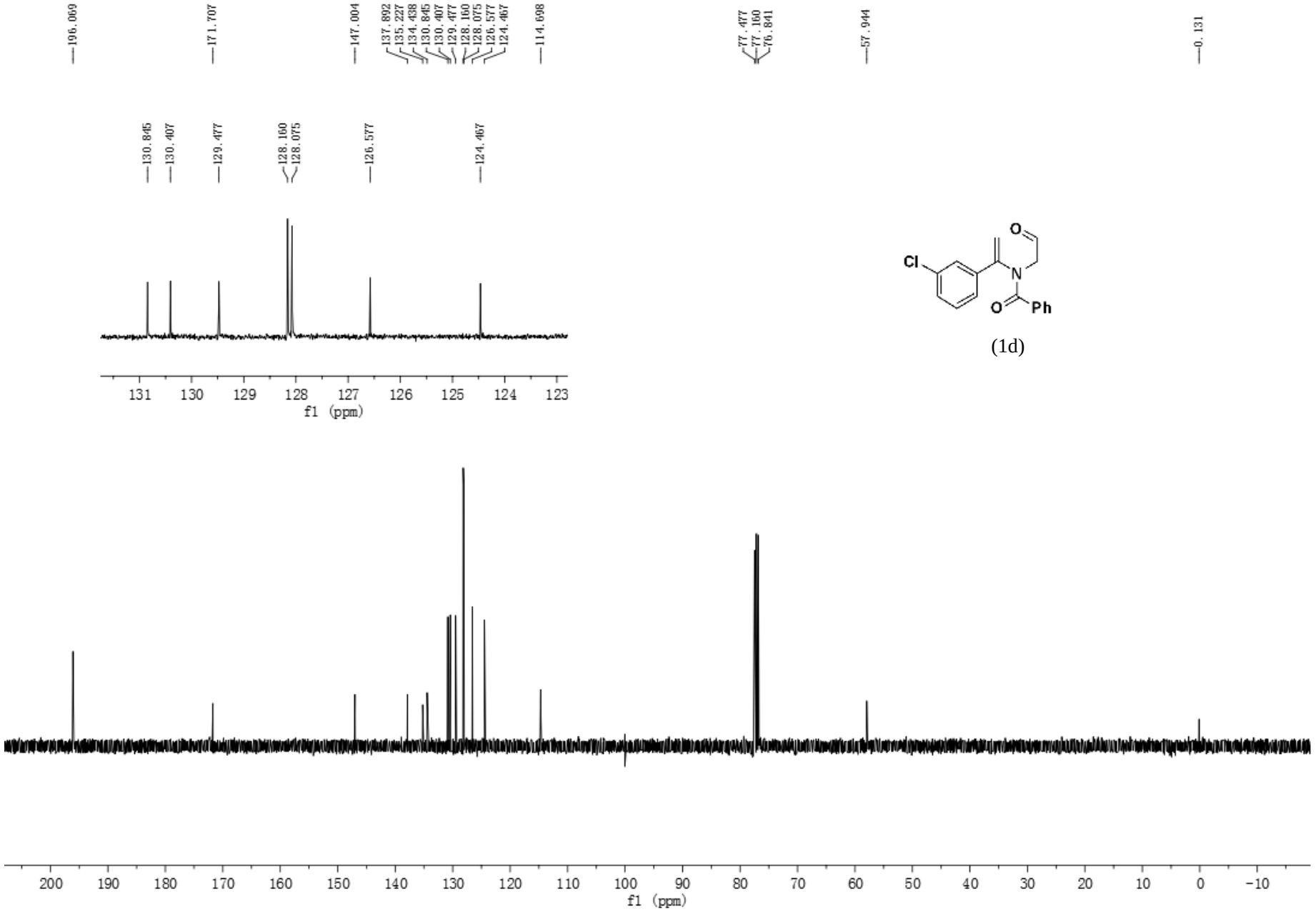
7.516
7.512
7.447
7.442
7.382
7.376
7.372
7.353
7.335
7.331
7.323
7.316
7.308
7.276
7.261
7.257
7.238
5.416
5.414
5.051
4.350
0.000
Cl
O
N
O
Ph
0.97
1.95
0.98
6.74
1.00
1.00
2.01
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

(1d)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147.004
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130.407
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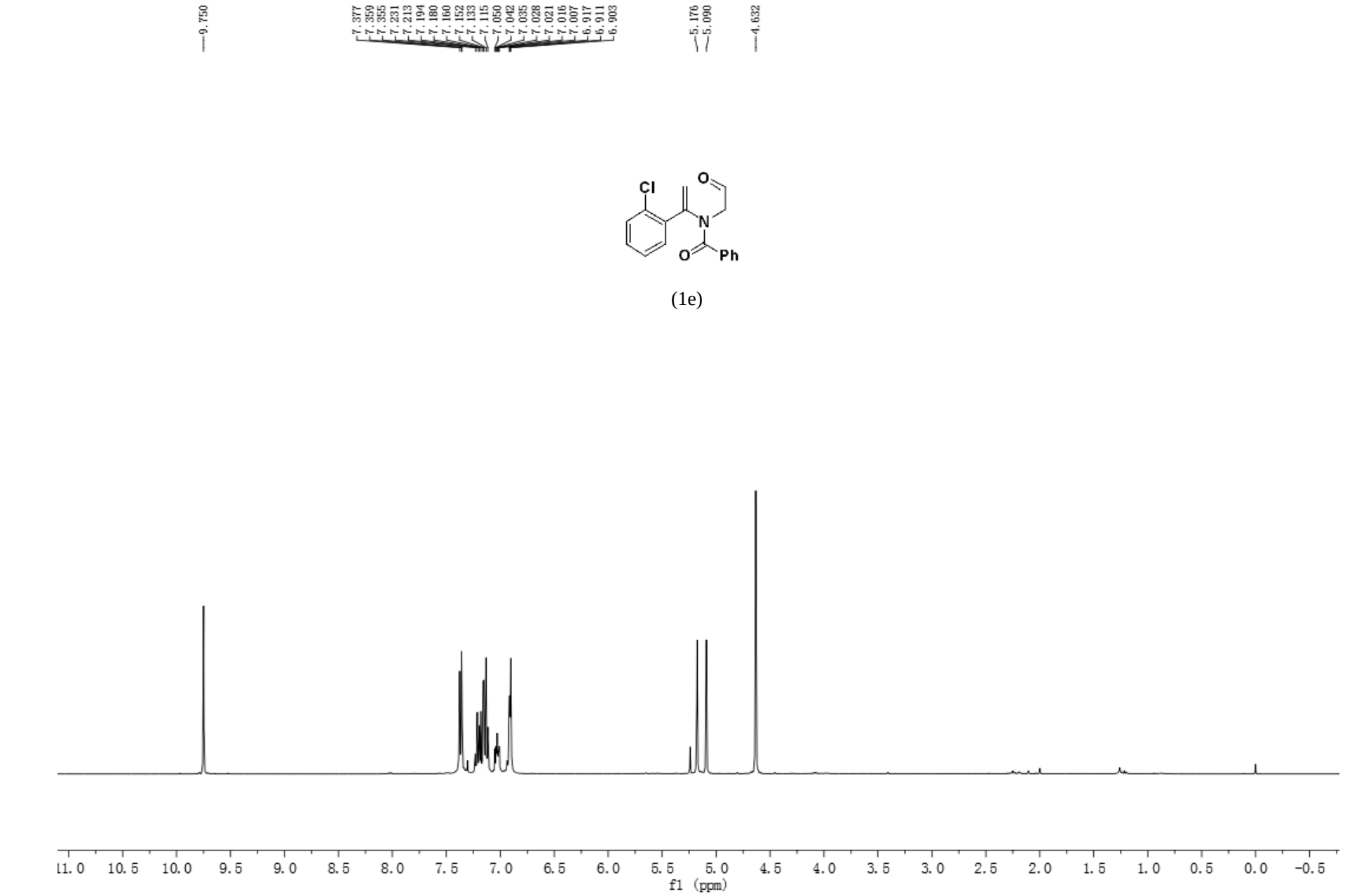
128.160
128.075
126.577
124.467
114.698
77.477
77.160
76.841
57.944
0.131
130.845
130.407
129.477
128.160
128.075
126.577
124.467
131
130
129
128
127
126
125
124
123
f1 (ppm)
Cl
O
N
O
Ph
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

(1d)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7.180
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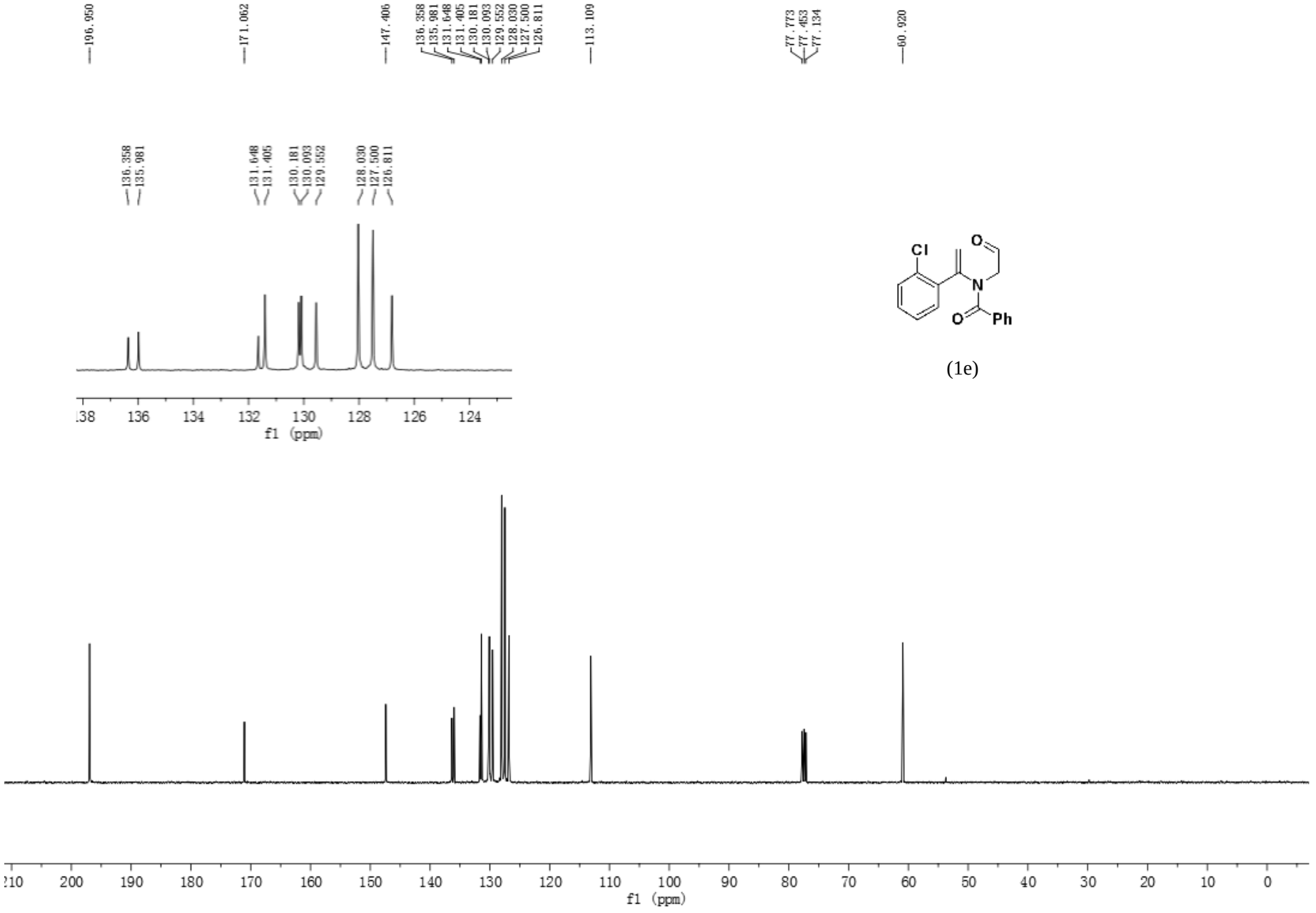
7.115
7.050
7.042
7.035
7.028
7.021
7.016
7.007
6.917
6.911
6.903
5.176
5.090
4.632
Cl
O
N
O
Ph
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

(1e)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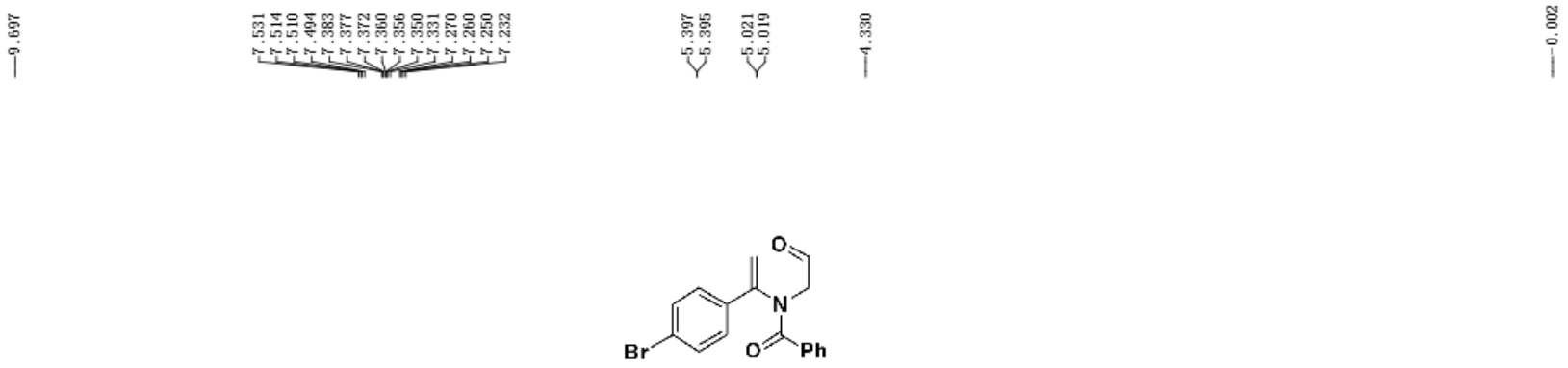
130.181
130.093
129.552
128.030
127.500
126.811
113.109
77.773
77.453
77.134
60.920
Cl
O
N
O
Ph
f1 (ppm)
f1 (ppm)

(1e)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7.531
7.514
7.510
7.494
7.383
7.377
7.372
7.360
7.356
7.350
7.331
7.270
7.260
7.250
7.232
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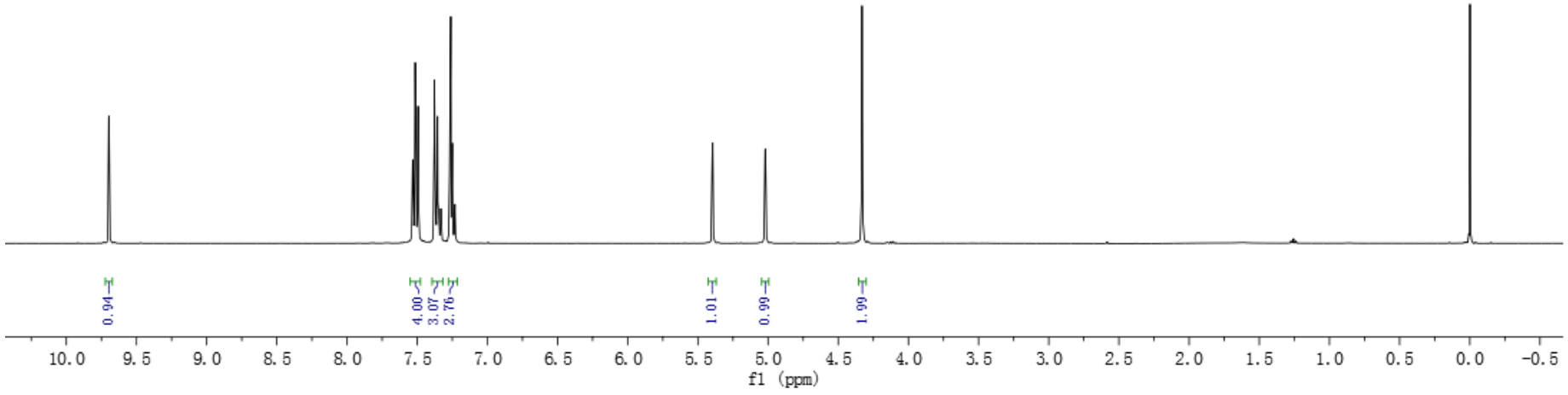
5.395
5.021
5.019
4.330
0.002
O
N
O
Ph
Br

(1f)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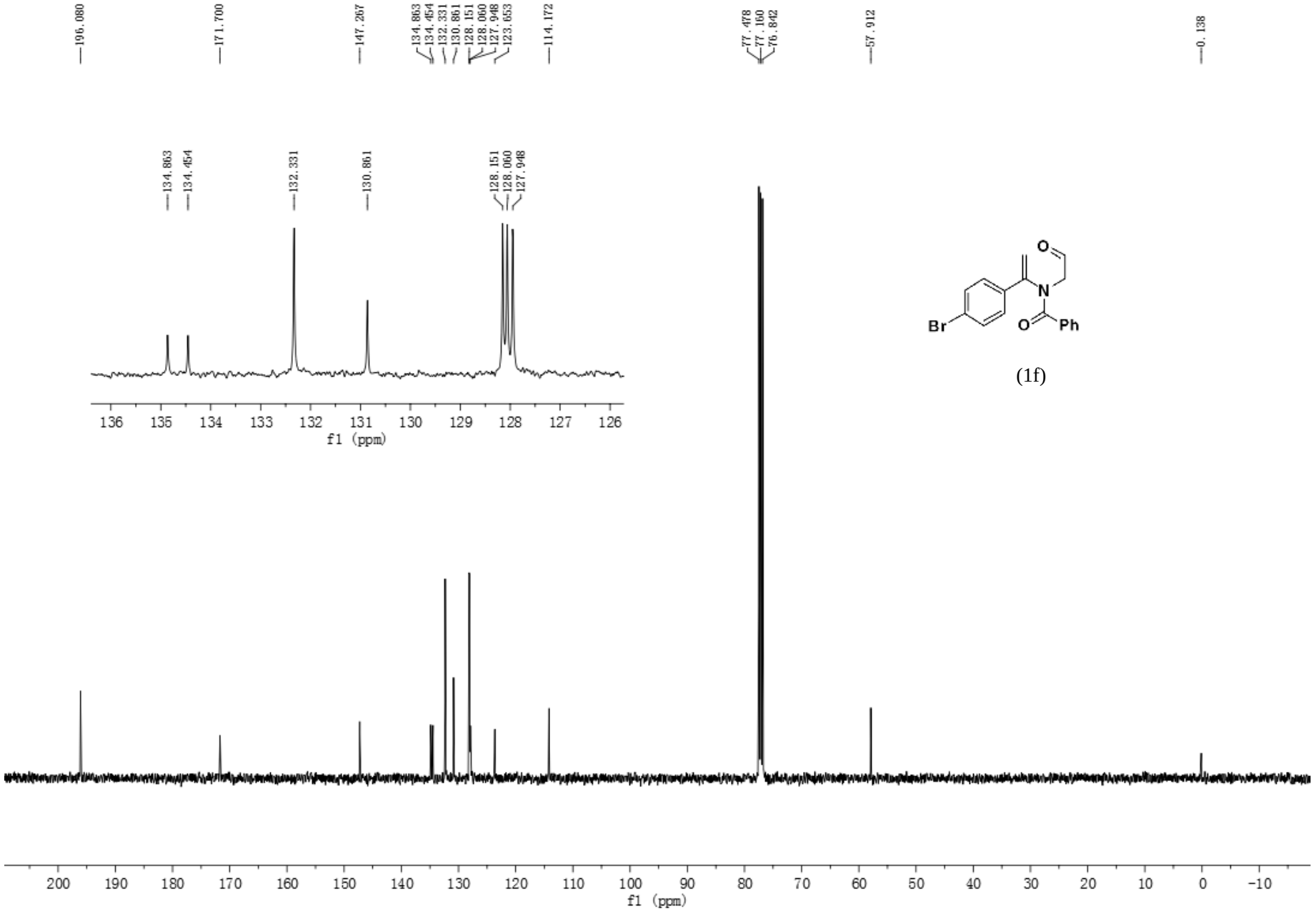
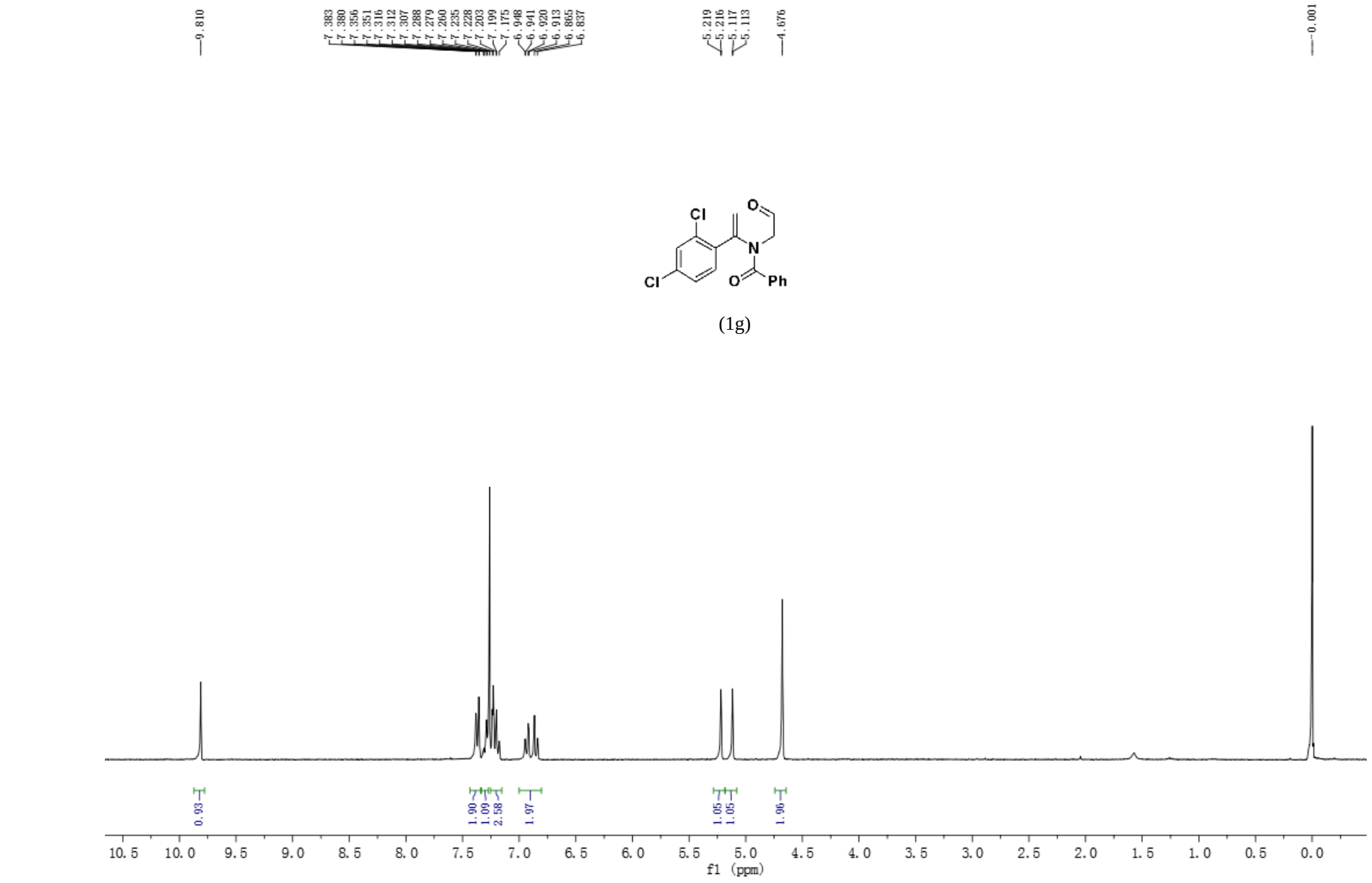
4.00
3.07
2.76
1.01
0.99
1.99
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


196.080
171.700
147.267
134.863
134.454
132.331
130.861
128.151
128.060
127.948
123.653
114.172
77.478
77.160
76.842
57.912
0.138
f1 (ppm)
Br
O
N
O
Ph

(1f)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7.307
7.288
7.279
7.260
7.235
7.228
7.203
7.199
7.175
6.948
6.941
6.920
6.913
6.865
6.837
5.219
5.216
5.117
5.113
4.676
0.001
Cl
Cl
O
N
O
Ph
0.93
1.90
1.09
2.58
1.97
1.05
1.05
1.96
10.5
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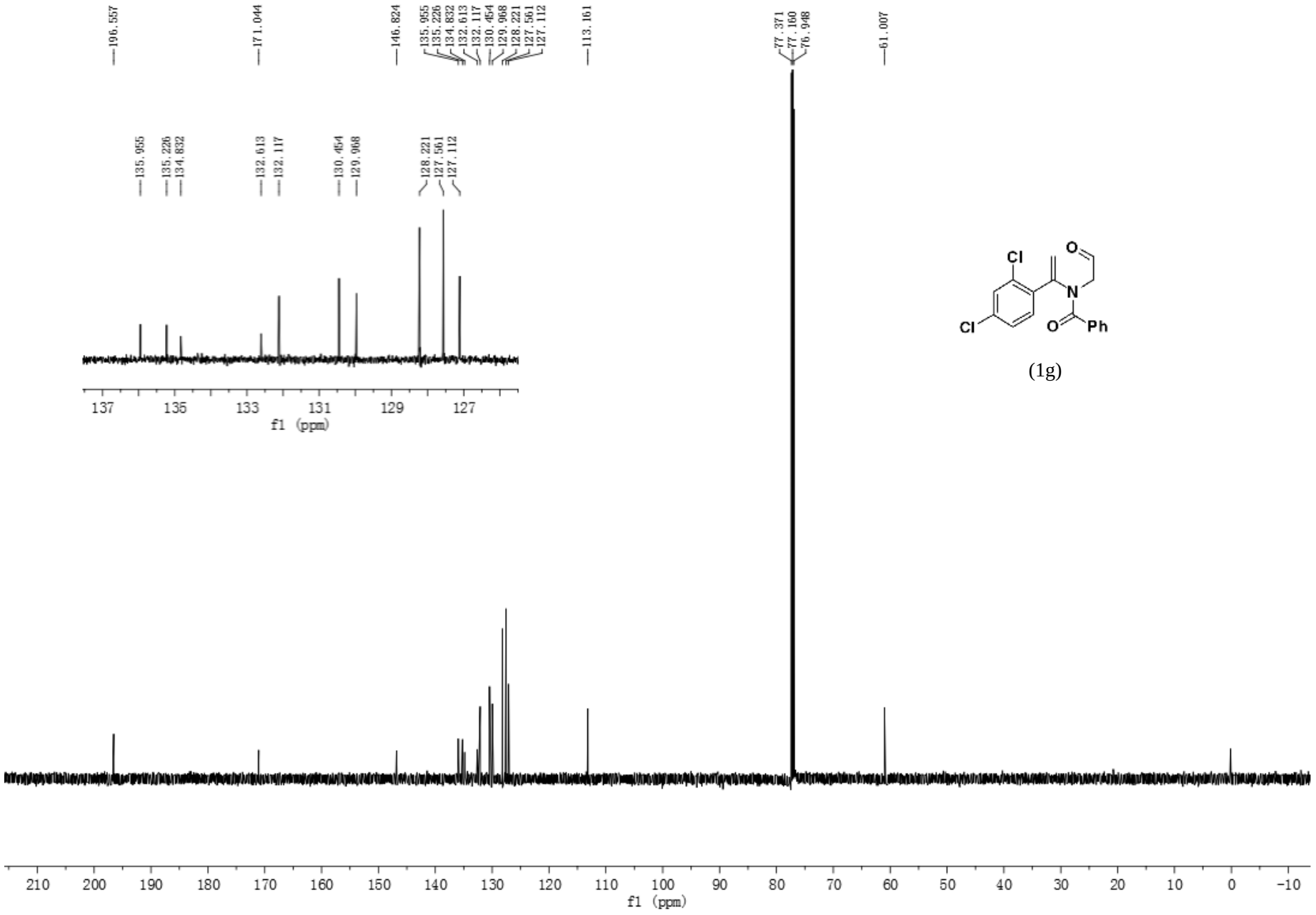
0.5
0.0
f1 (ppm)

(1g)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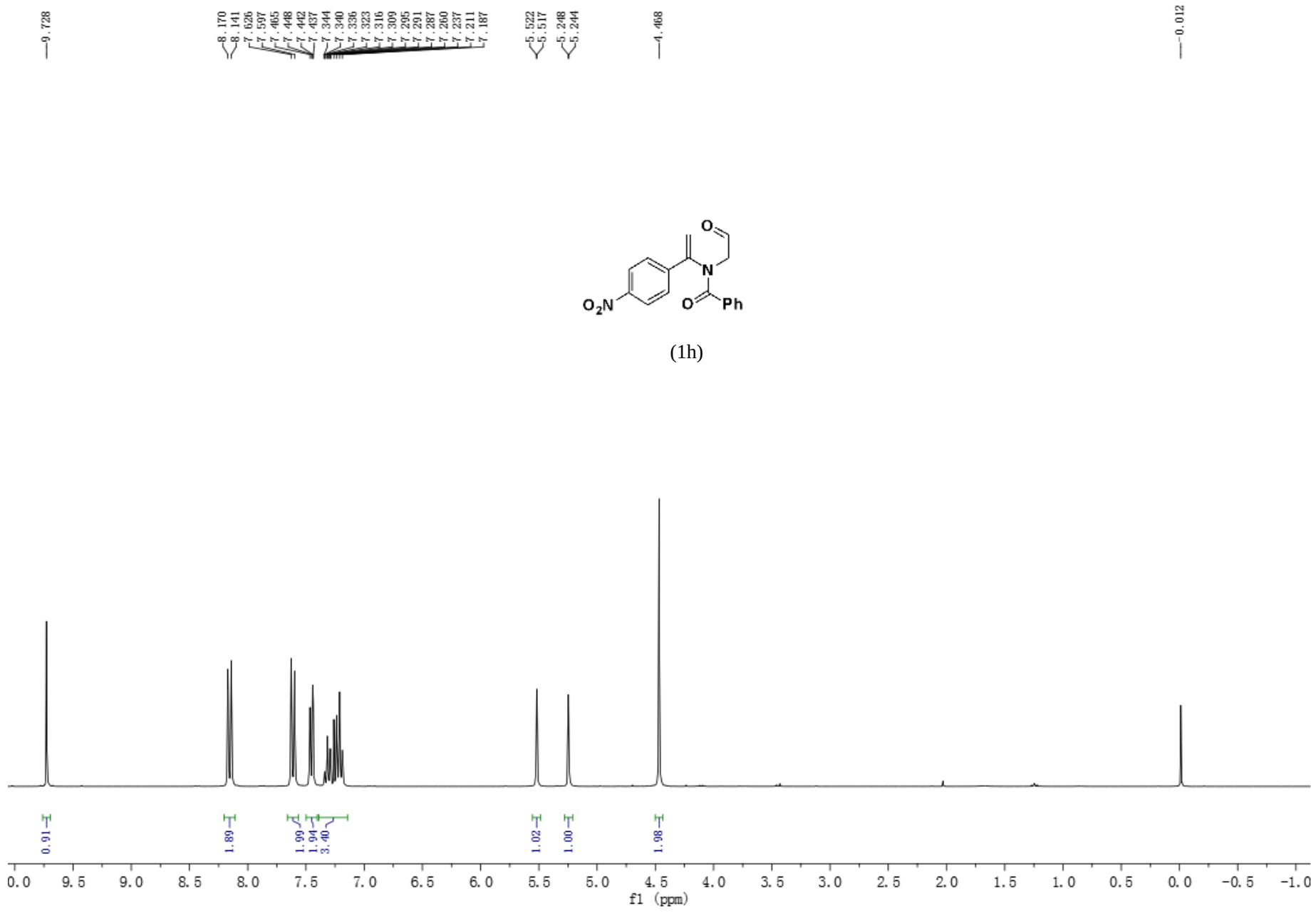
61.007
f1 (ppm)
Cl
Cl
O
N
O
Ph

(1g)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7.316
7.309
7.295
7.291
7.287
7.260
7.237
7.211
7.187
5.522
5.517
5.248
5.244
4.468
0.012
O
N
O
O2N
Ph
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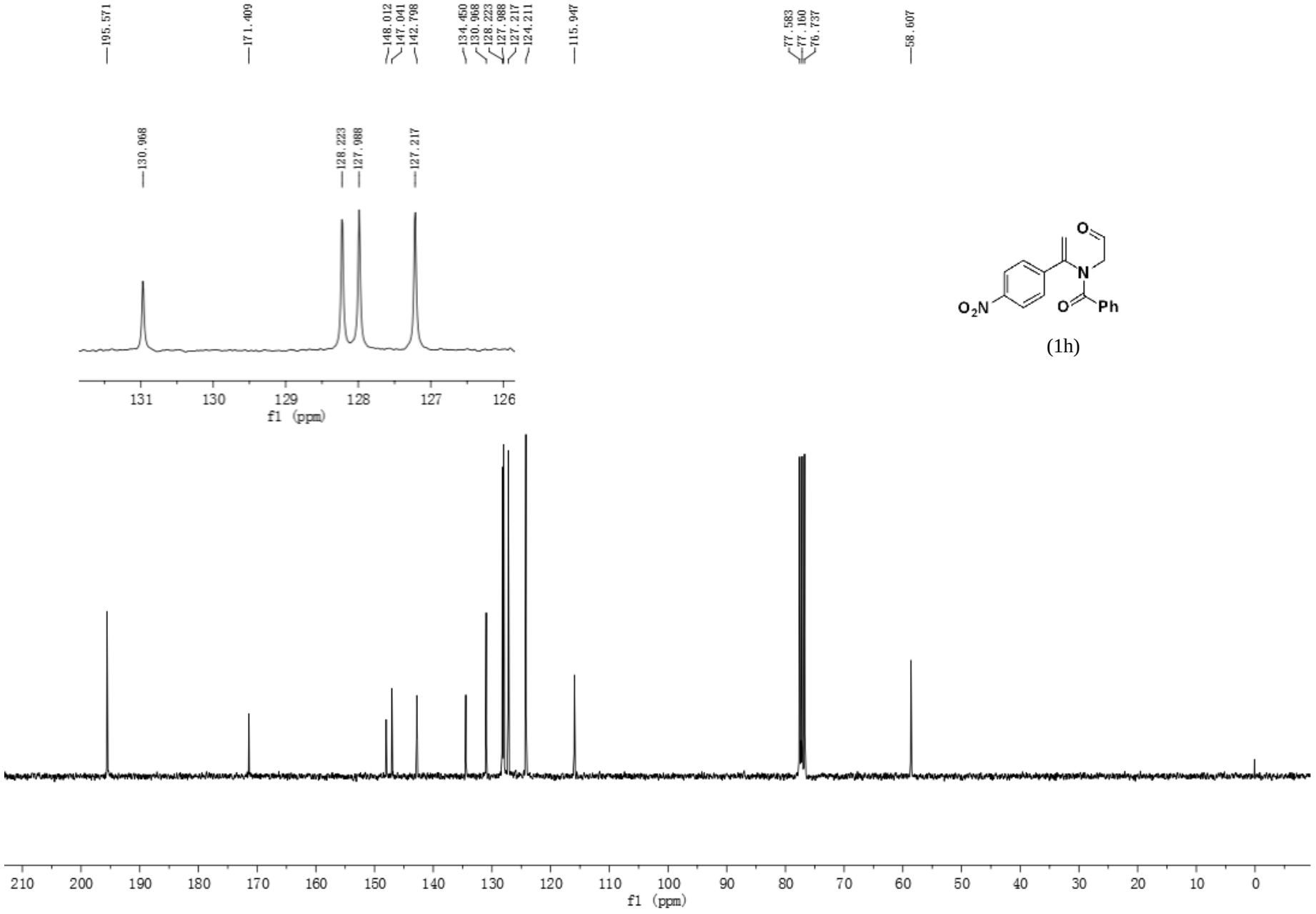
1.89
1.99
1.94
3.40
1.02
1.00
1.98
f1 (ppm)

(1h)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142.798
134.450
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128.223
127.988
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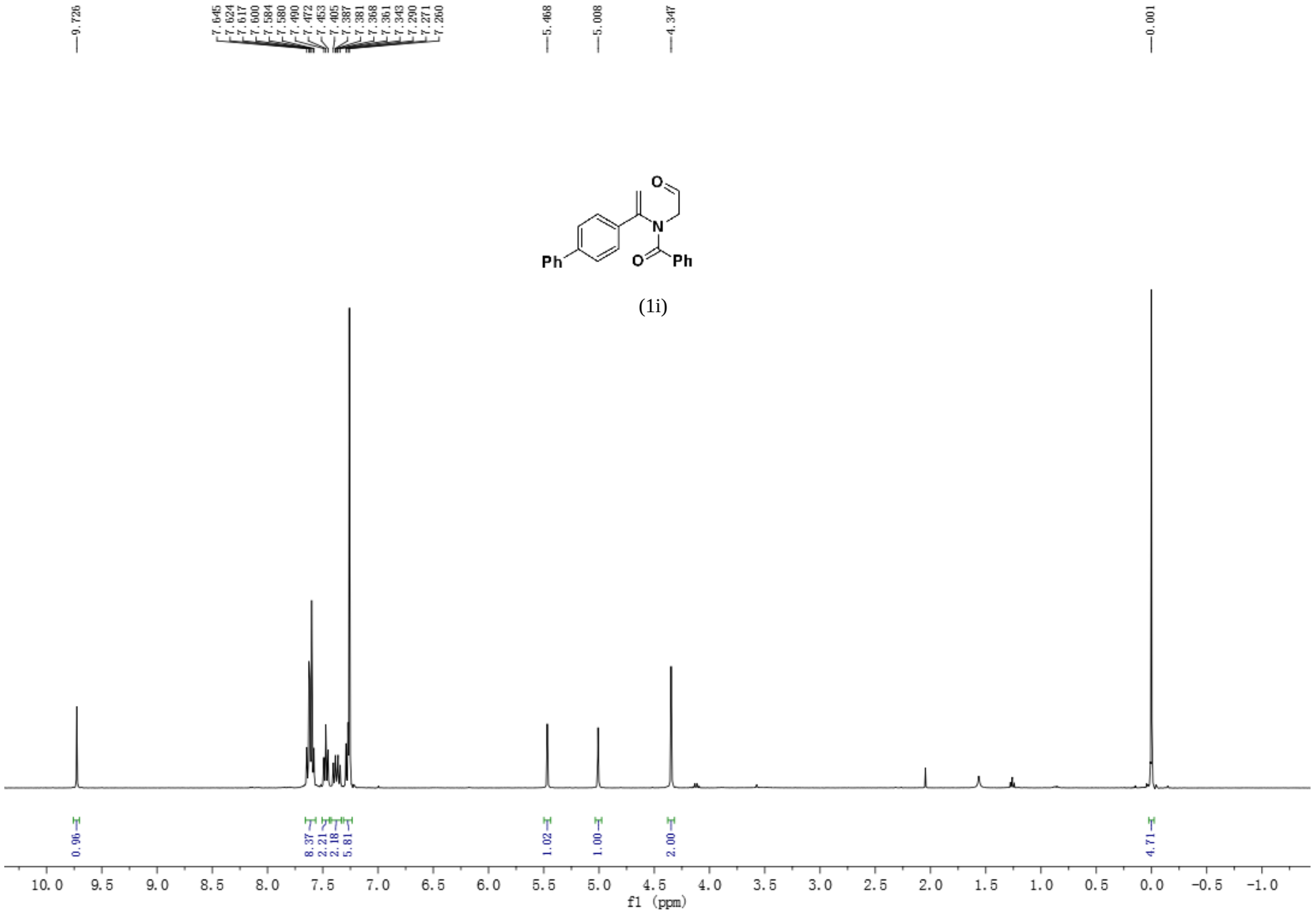
124.211
115.947
77.583
77.160
76.737
58.607
130.968
128.223
127.988
127.217
131
130
129
128
127
126
f1 (ppm)
O
N
O
Ph
O2N
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

(1h)


9.726
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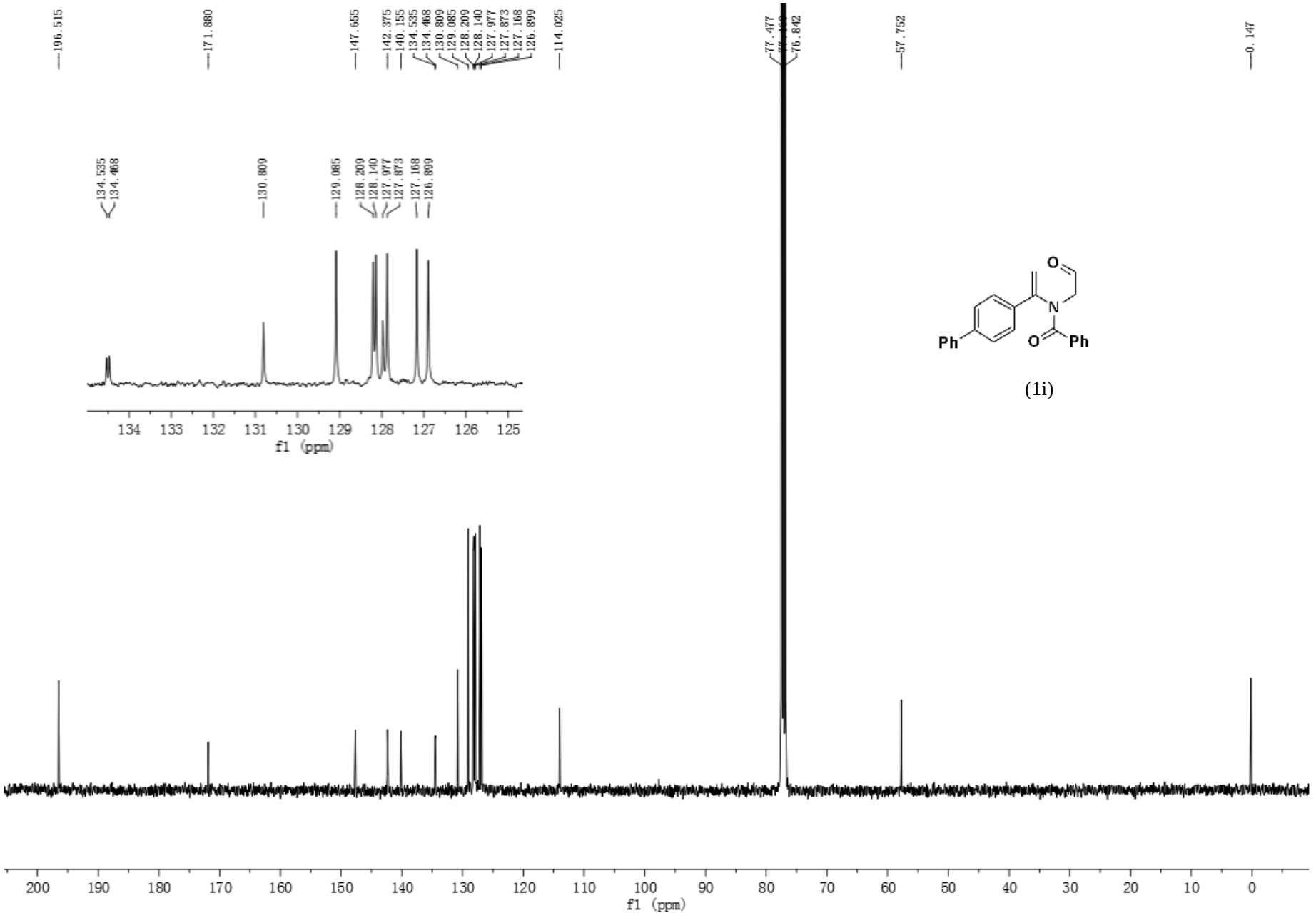
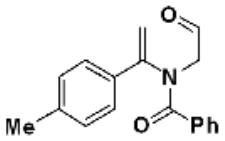
7.624
7.617
7.600
7.584
7.580
7.490
7.472
7.453
7.405
7.387
7.381
7.368
7.361
7.343
7.290
7.271
7.260
5.468
5.008
4.347
0.001
O
N
O
Ph
Ph
0.96
8.37
2.21
2.18
5.81
1.02
1.00
2.00
4.71
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)

(1i)

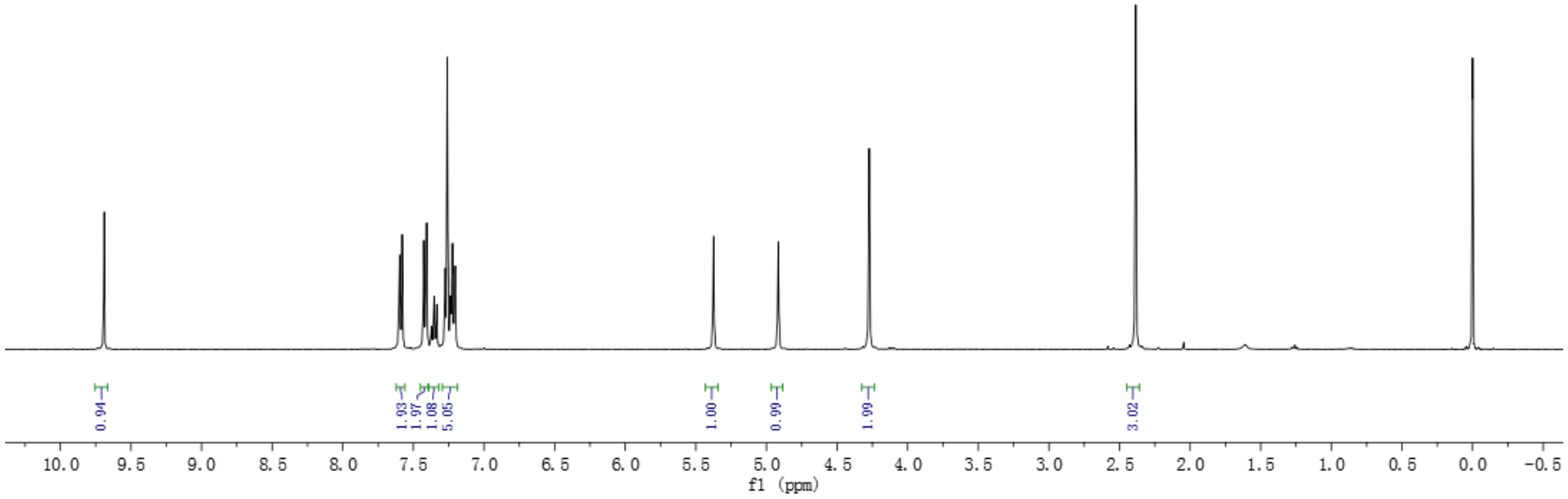

196.515
171.880
147.655
142.375
140.155
134.535
134.468
130.809
129.085
128.209
128.140
127.977
127.873
127.168
126.899
114.025
77.477
76.842
57.752
0.147
134.535
134.468
130.809
129.085
128.209
128.140
127.977
127.873
127.168
126.899
134 133 132 131 130 129 128 127 126 125
f1 (ppm)
O
N
O
Ph
Ph
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

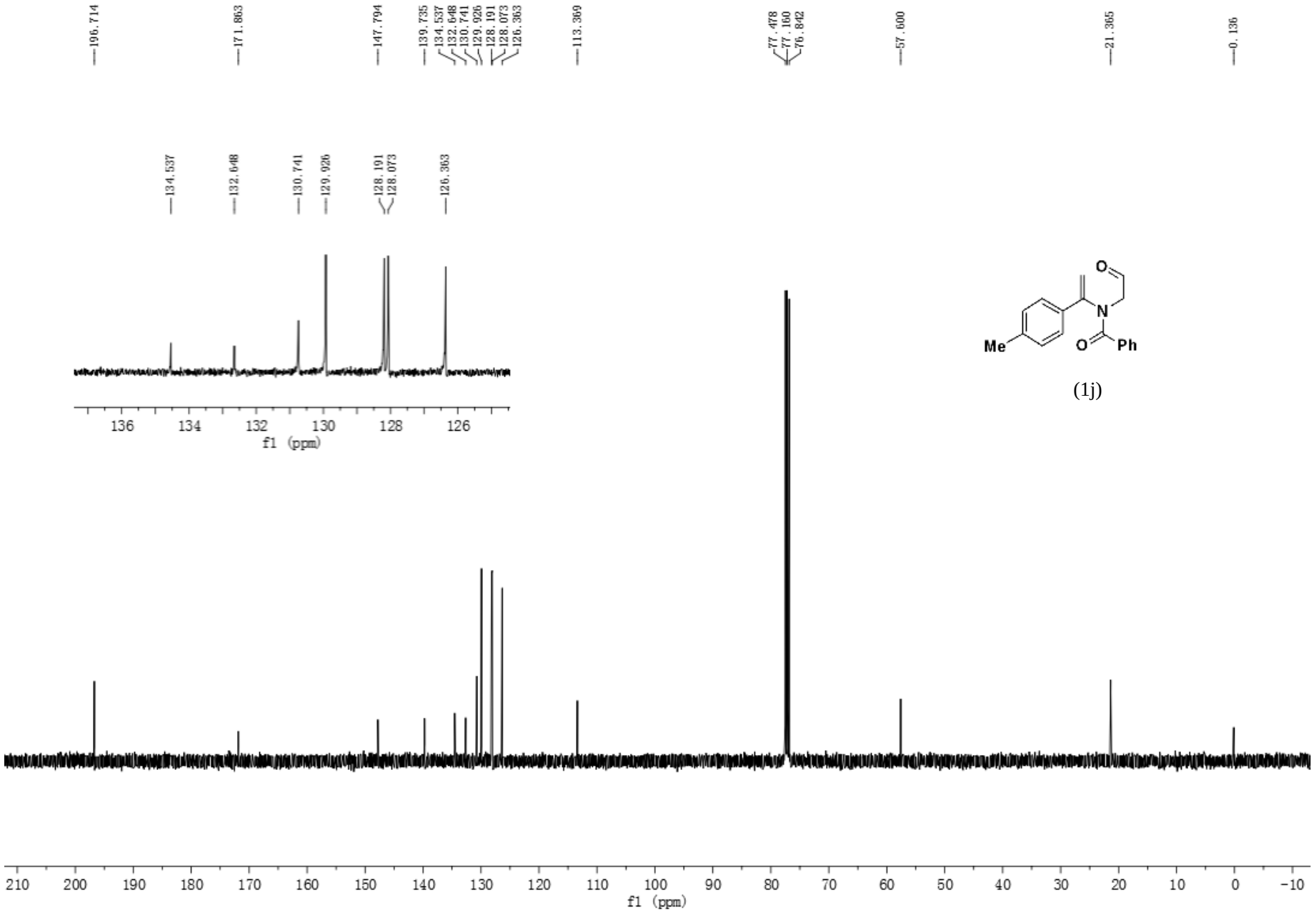
(1i)

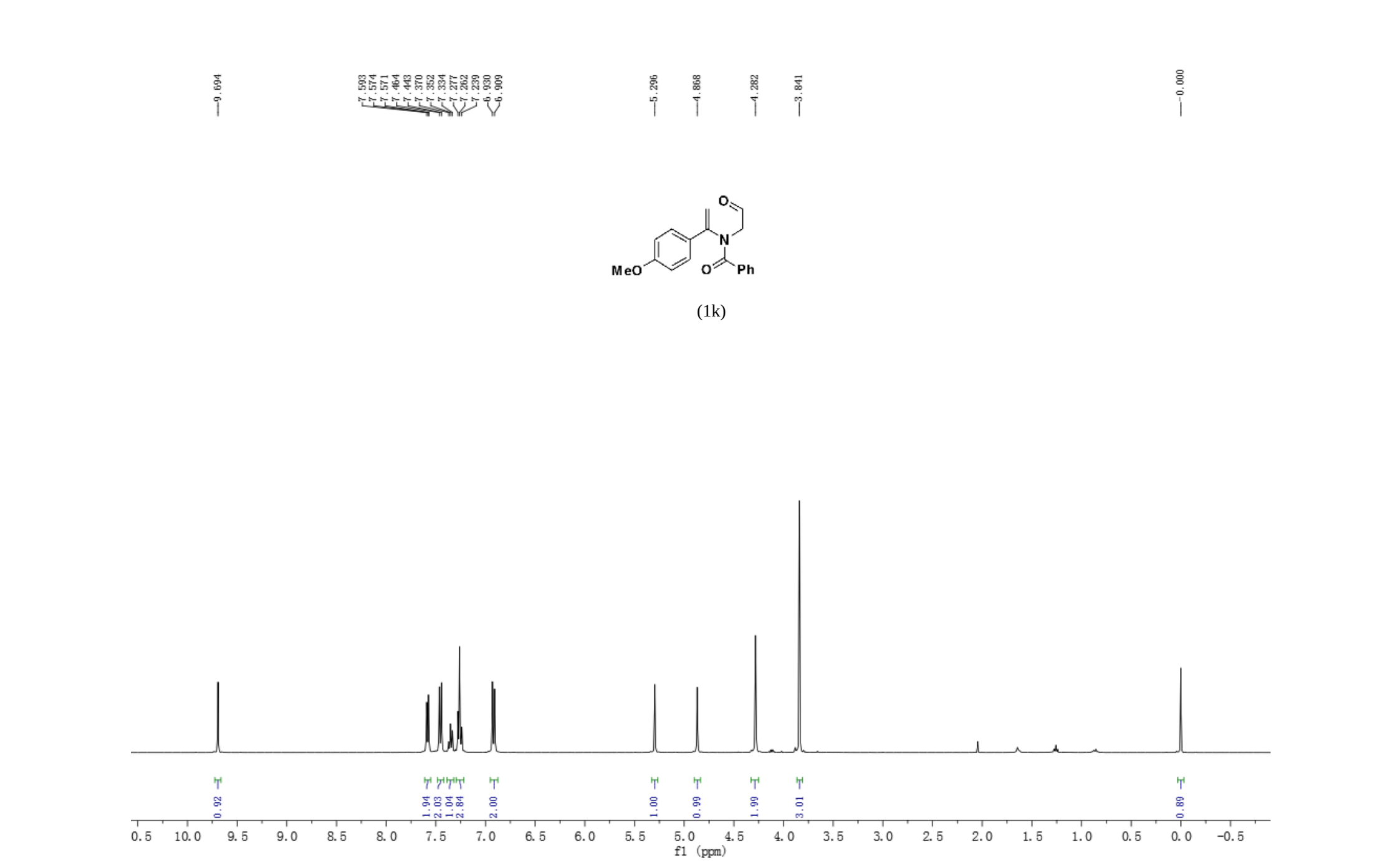

9.689
7.600
7.597
7.584
7.579
7.576
7.427
7.411
7.406
7.353
7.337
7.334
7.279
7.275
7.271
7.266
7.260
7.256
7.241
7.237
7.235
7.225
7.224
7.204
5.374
5.372
4.916
4.272
2.385
0.001


O
N
Me
O
Ph

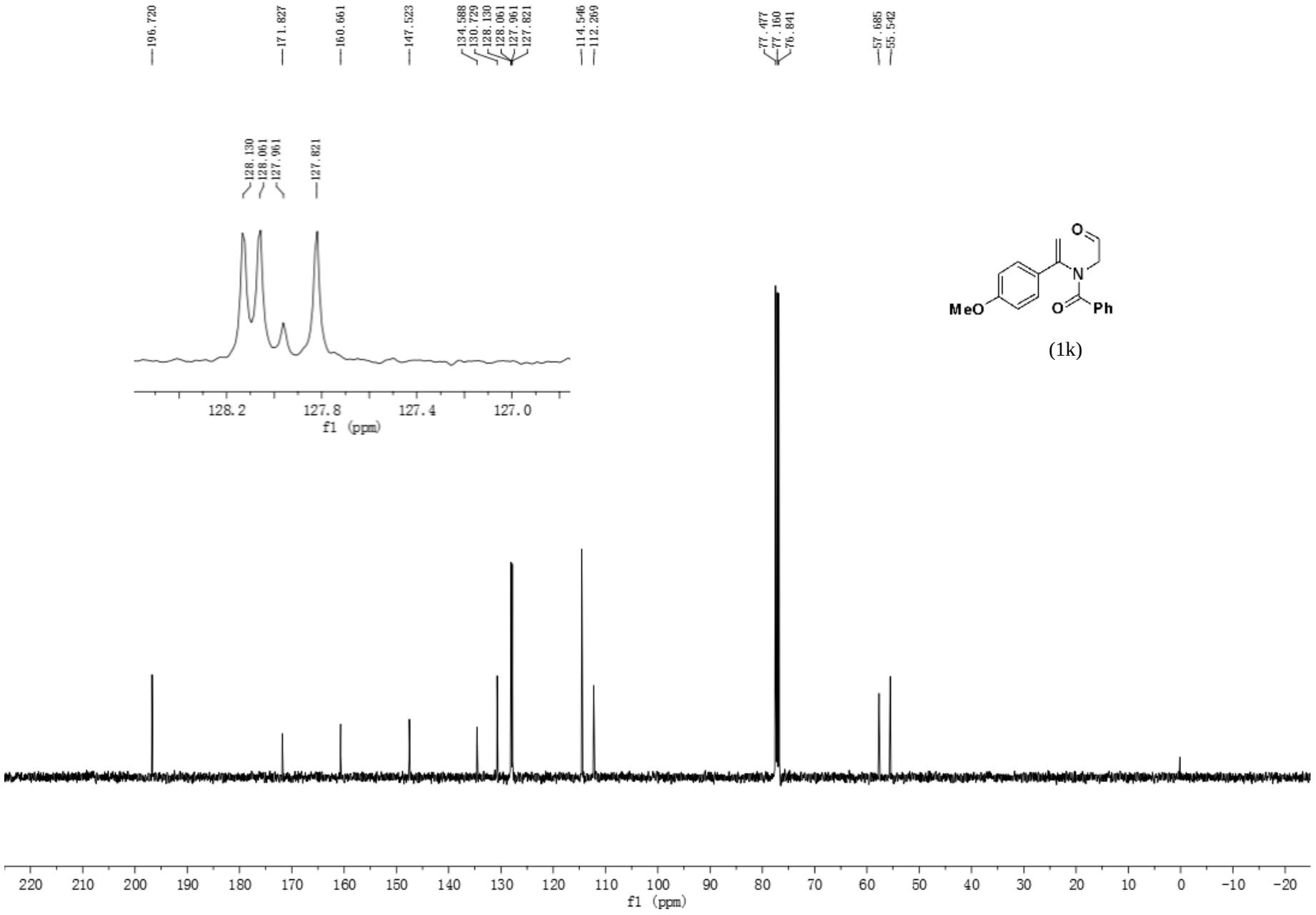
(1j)


0.94
1.93
1.97
1.08
5.05
1.00
0.99
1.99
3.02
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

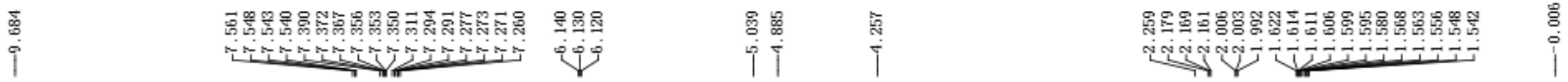

196.714
171.863
147.794
139.735
134.537
132.648
130.741
129.926
128.191
128.073
126.363
113.369
77.478
77.160
76.842
57.600
21.365
0.136
134.537
132.648
130.741
129.926
128.191
128.073
126.363
136
134
132
130
128
126
f1 (ppm)
O
N
O
Ph
Me
(1j)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

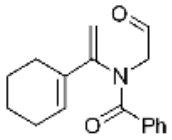

9.694
7.593
7.574
7.571
7.464
7.443
7.370
7.352
7.334
7.277
7.262
7.239
6.930
6.909
5.296
4.868
4.282
3.841
0.000
O
N
O
MeO
Ph
0.92
1.94
2.03
1.04
2.84
2.00
1.00
0.99
1.99
3.01
0.89
f1 (ppm)

(1k)

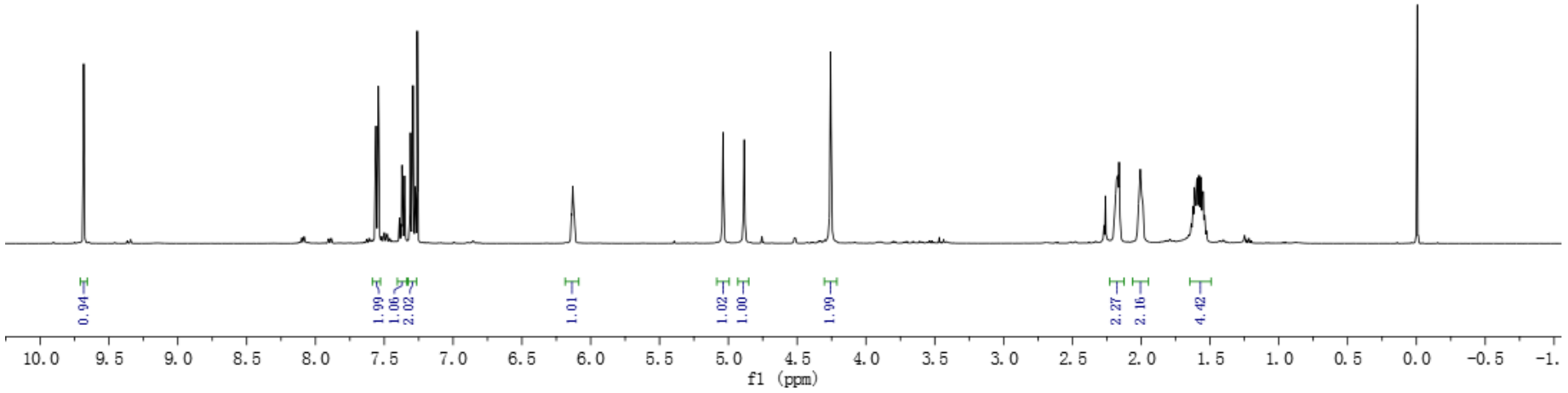

196.720
171.827
160.661
147.523
134.588
130.729
128.130
128.061
127.961
127.821
114.546
112.269
77.477
77.160
76.841
57.685
55.542
128.130
128.061
127.961
127.821
128.2
127.8
127.4
127.0
f1 (ppm)
MeO
O
N
O
Ph
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

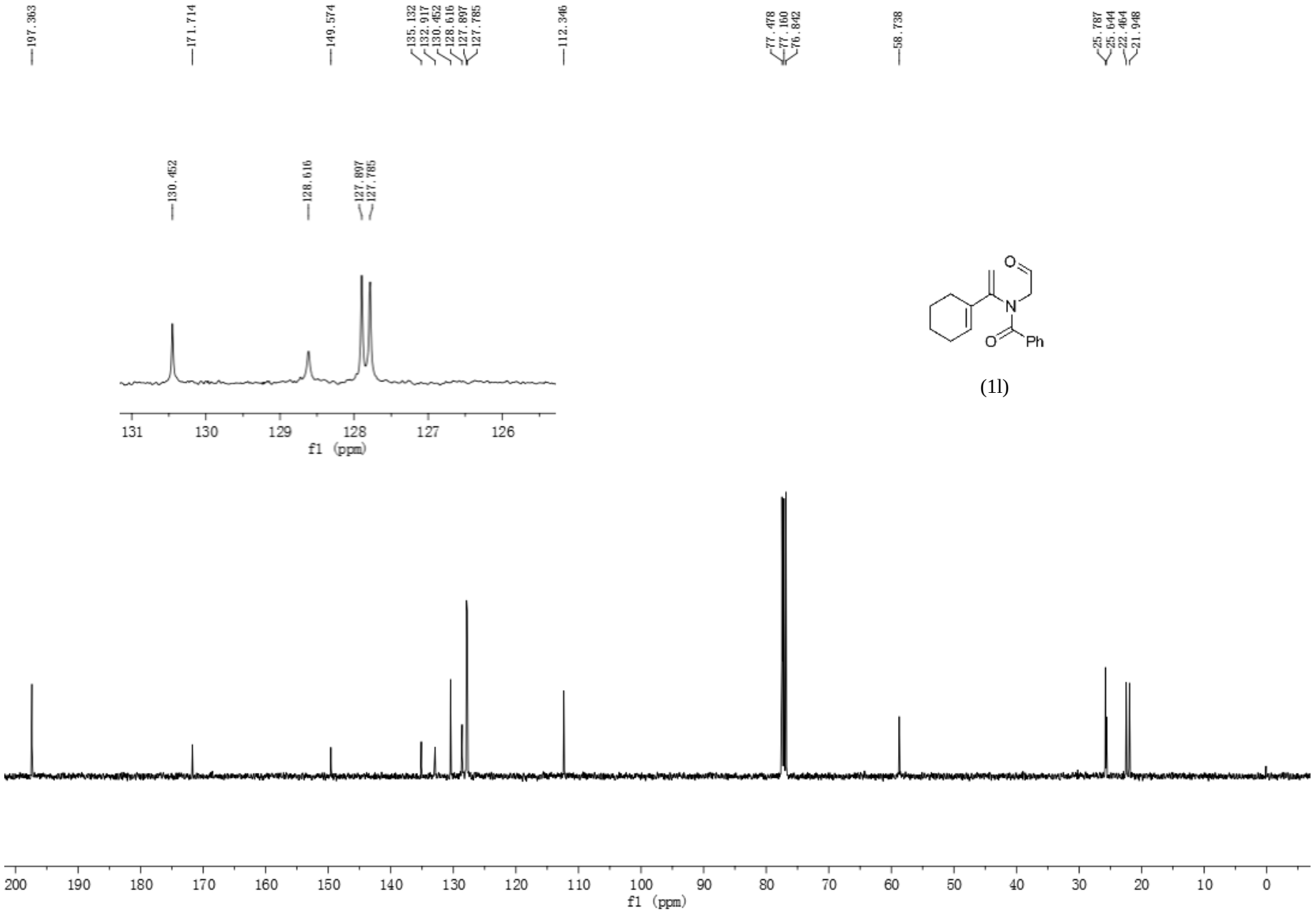
(1k)


9.684
7.561
7.548
7.543
7.540
7.390
7.372
7.367
7.356
7.353
7.350
7.311
7.294
7.291
7.277
7.273
7.271
7.260
6.140
6.130
6.120
5.039
4.885
4.257
2.259
2.179
2.169
2.161
2.006
2.003
1.992
1.622
1.614
1.611
1.606
1.599
1.595
1.580
1.568
1.563
1.556
1.548
1.542
0.006

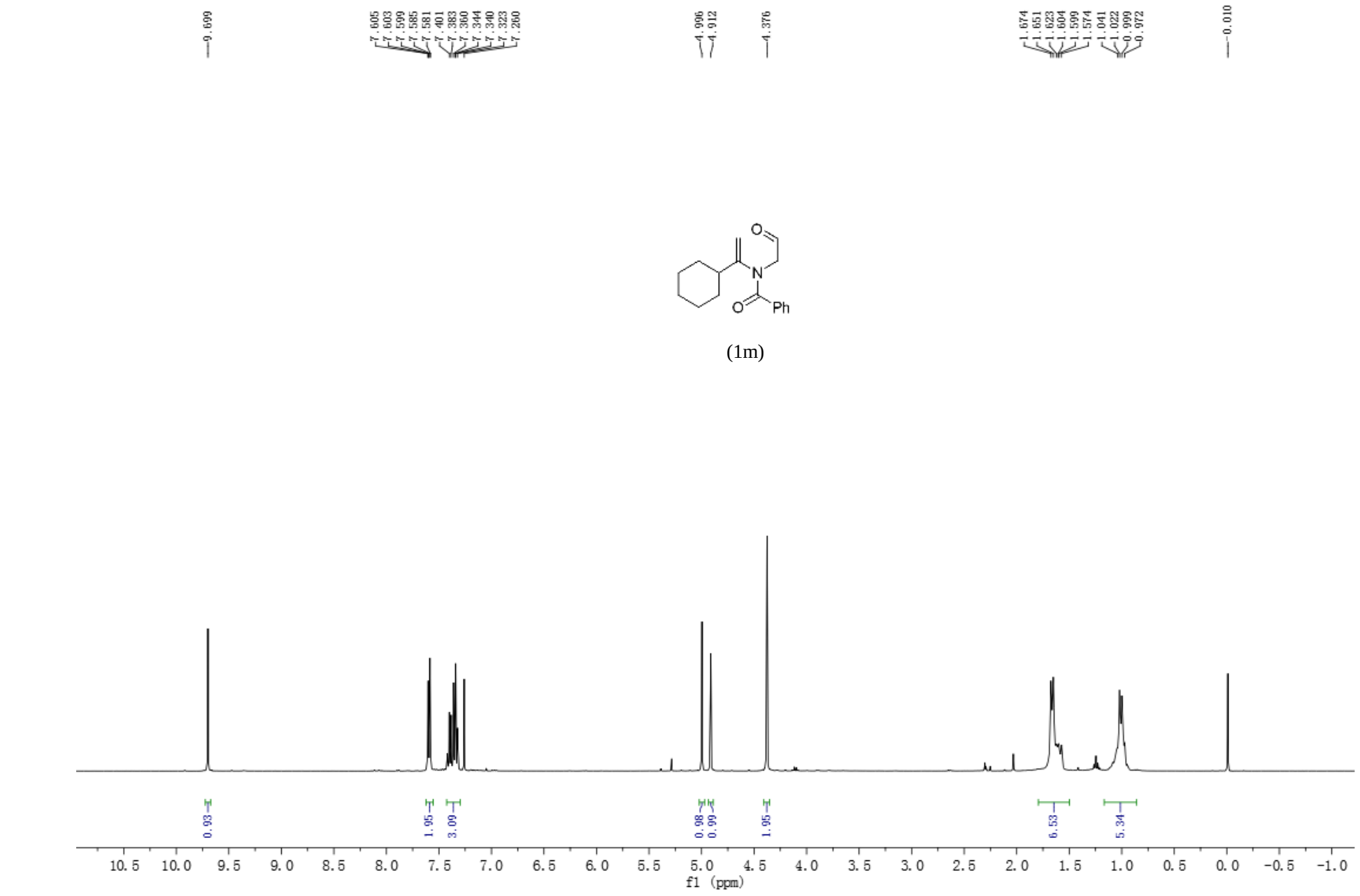

O
N
O
Ph

(1l)

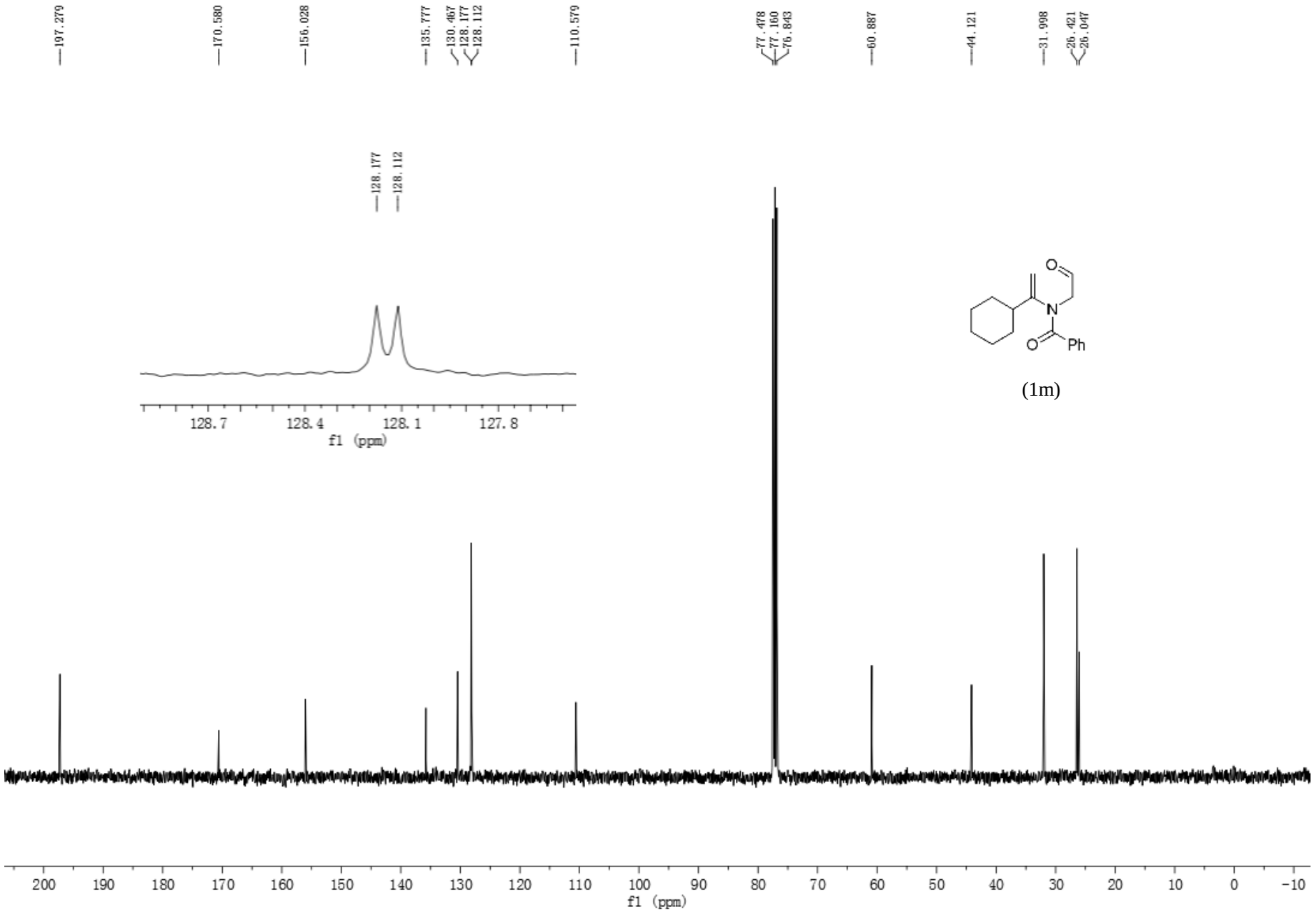

0.94
1.99
1.06
2.02
1.01
1.02
1.00
1.99
2.27
2.16
4.42
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.
f1 (ppm)


197.363
171.714
149.574
135.132
132.917
130.452
128.616
127.897
127.785
112.346
77.478
77.160
76.842
58.738
25.787
25.644
22.464
21.948
130.452
128.616
127.897
127.785
131
130
129
128
127
126
f1 (ppm)
O
N
O
Ph
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

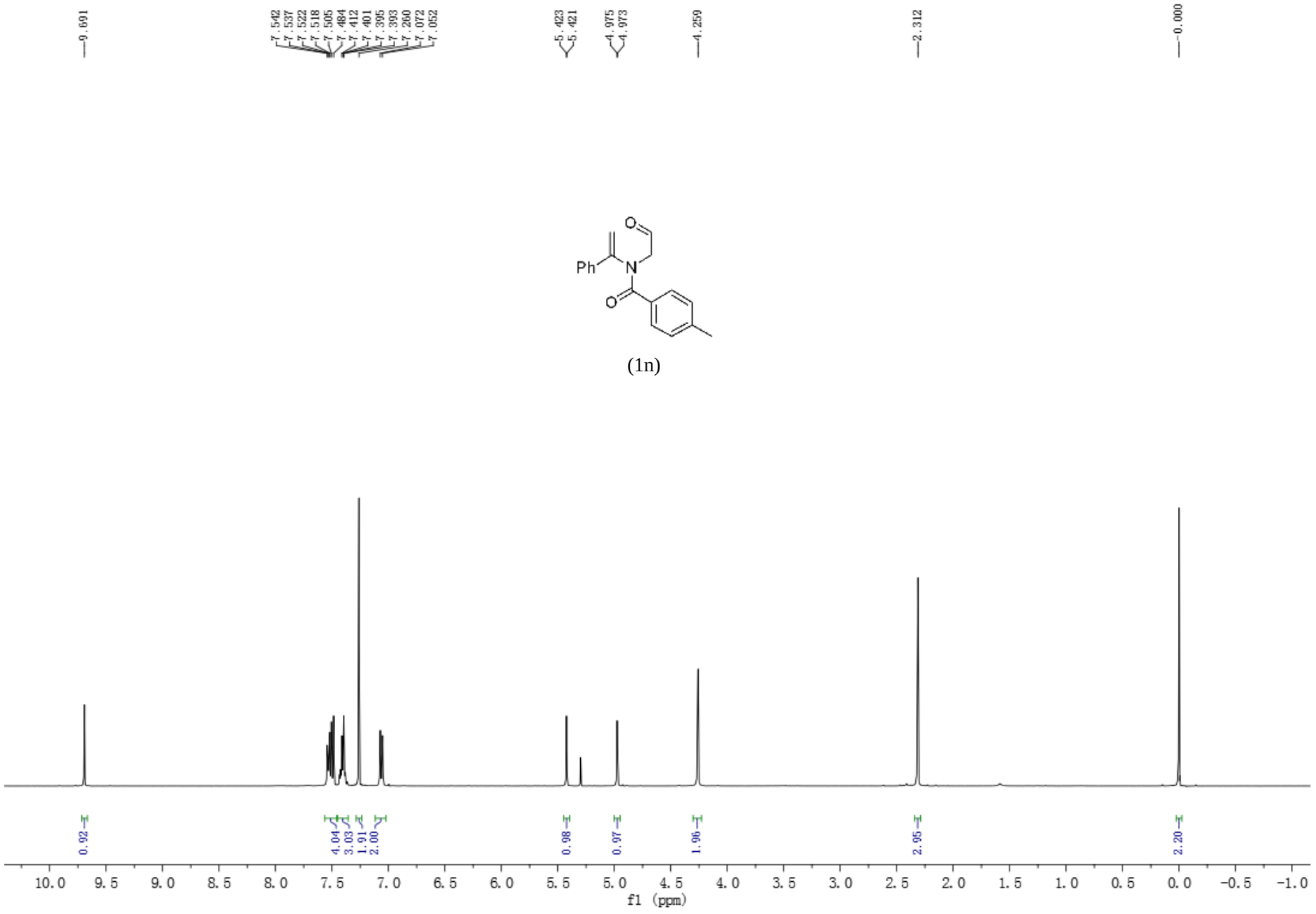
(1l)


9.699
7.605
7.603
7.599
7.585
7.581
7.401
7.383
7.360
7.344
7.340
7.323
7.260
4.996
4.912
4.376
1.674
1.651
1.623
1.604
1.599
1.574
1.041
1.022
0.999
0.972
0.010
O
N
O
Ph
0.93
1.95
3.09
0.98
0.99
1.95
6.53
5.34
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)

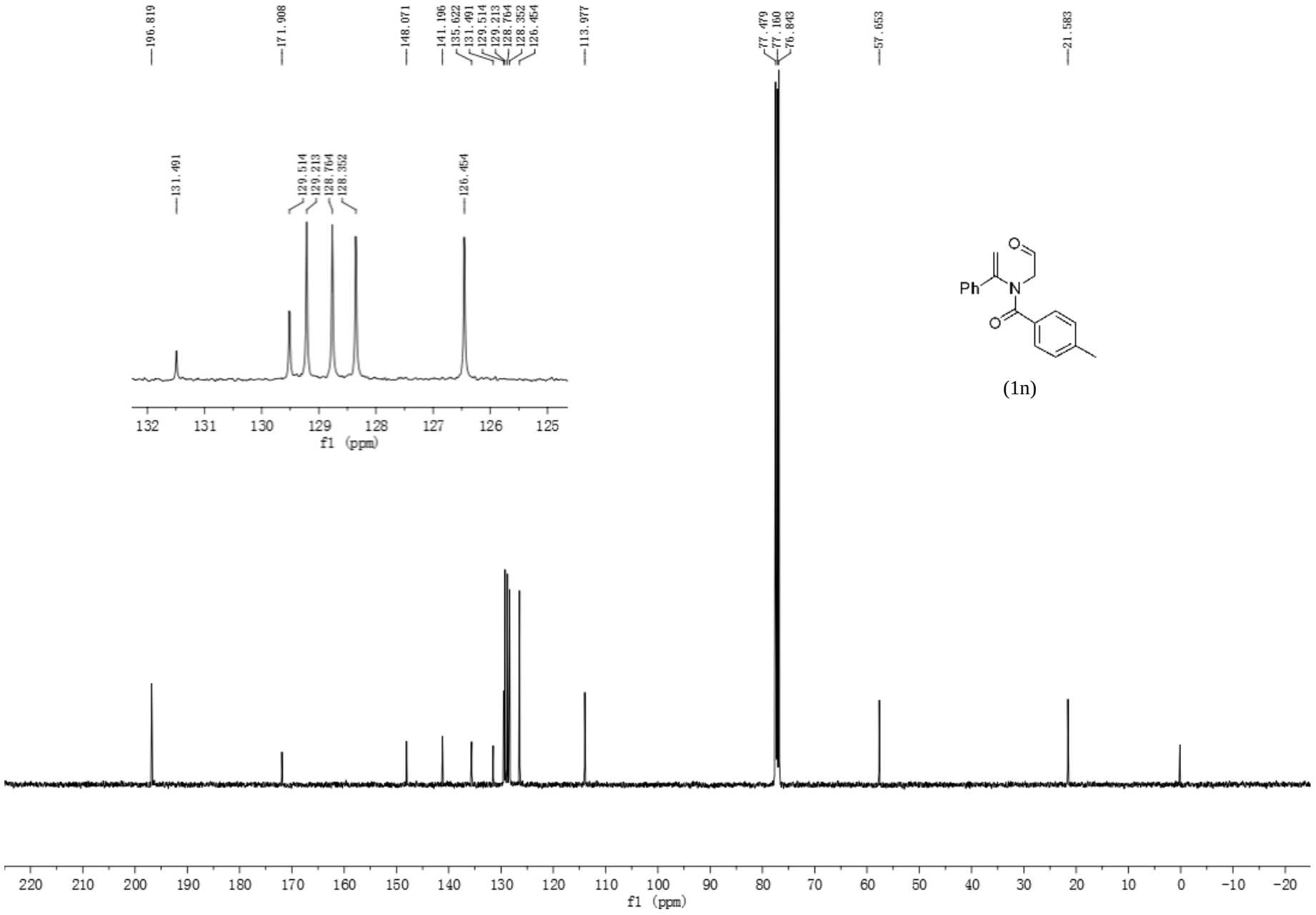
(1m)


197.279
170.580
156.028
135.777
130.467
128.177
128.112
110.579
77.478
77.160
76.843
60.887
44.121
31.998
26.421
26.047
128.177
128.112
128.7
128.4
128.1
127.8
f1 (ppm)
O
N
O
Ph
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

(1m)

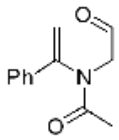

9.691
7.542
7.537
7.522
7.518
7.505
7.484
7.412
7.401
7.395
7.393
7.260
7.072
7.052
5.423
5.421
4.975
4.973
4.259
2.312
0.000
Ph
N
O
O
0.92
4.04
3.03
1.91
2.00
0.98
0.97
1.96
2.95
2.20
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)

(1n)

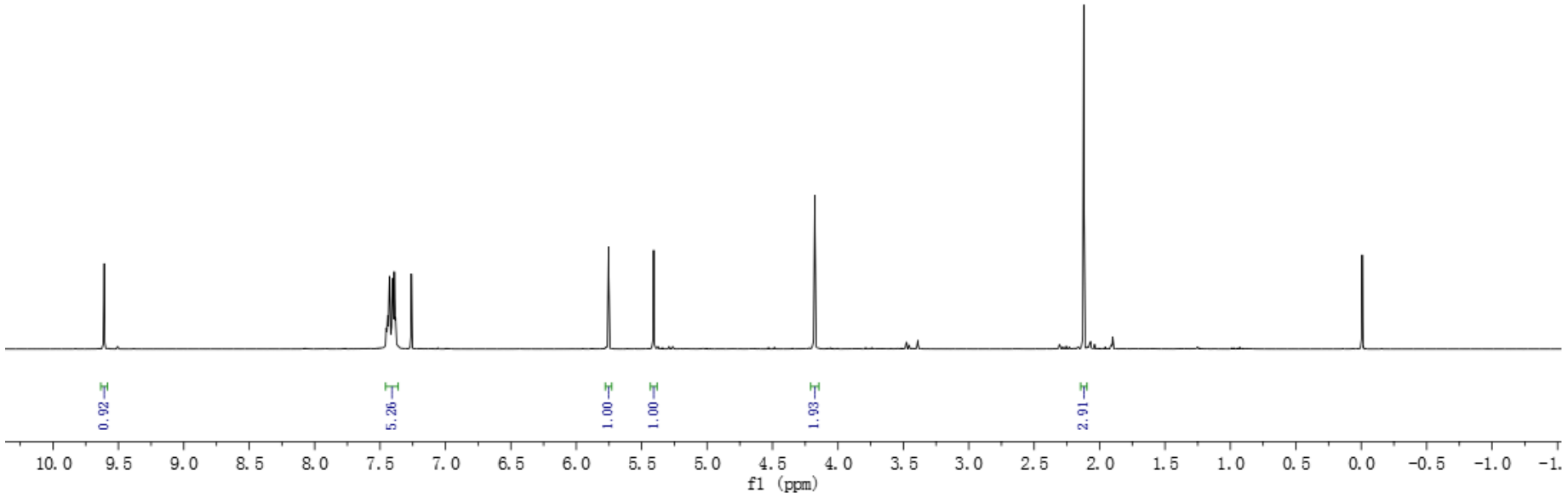

196.819
171.908
148.071
141.196
135.622
131.491
129.514
129.213
128.764
128.352
126.454
113.977
77.479
77.160
76.843
57.653
21.583
131.491
129.514
129.213
128.764
128.352
126.454
132 131 130 129 128 127 126 125
f1 (ppm)
Ph
N
O
O
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

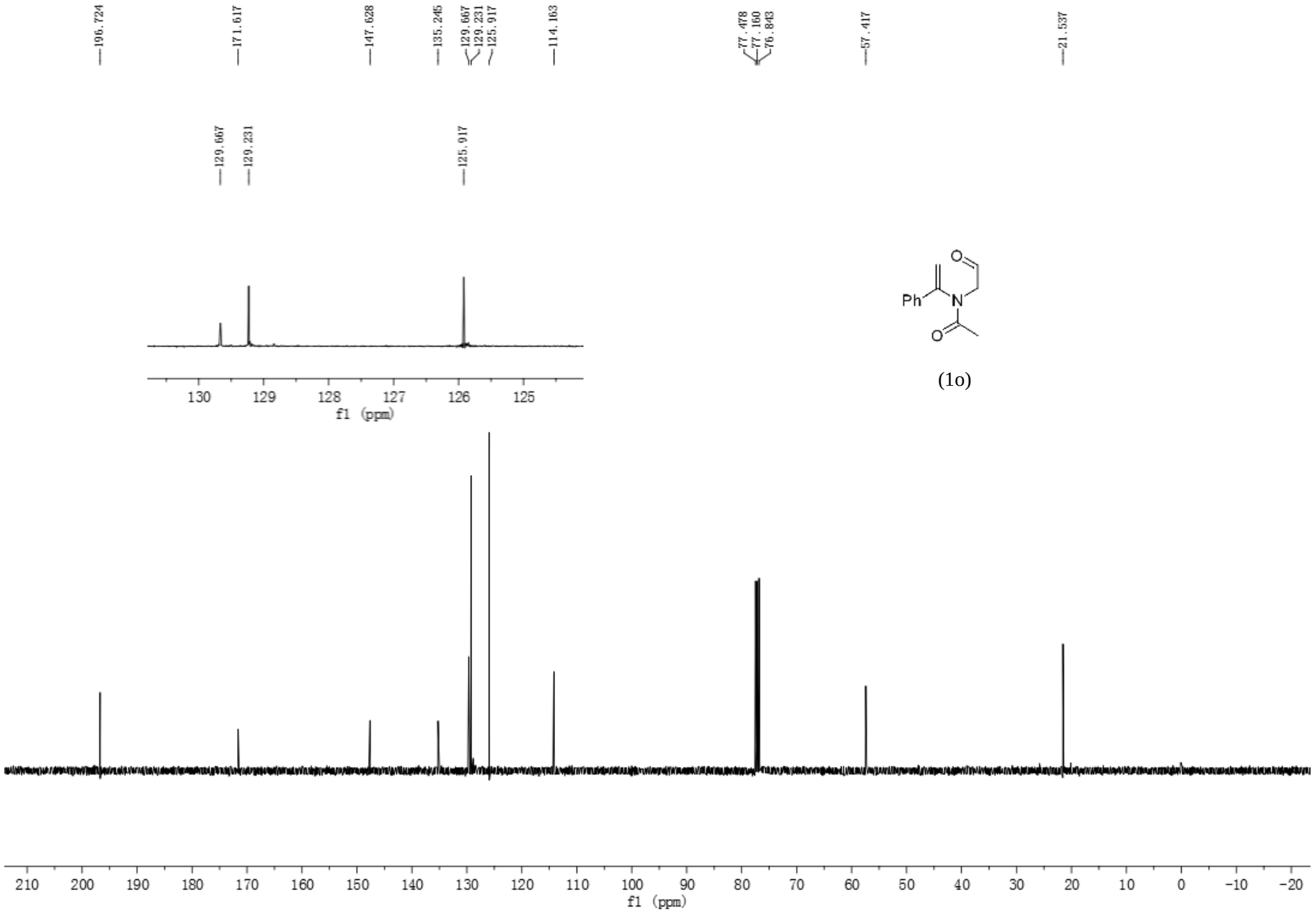
(1n)


9.609
7.432
7.427
7.404
7.398
7.391
7.385
7.260
5.753
5.408
4.177
2.120
0.008


O
Ph
N
O

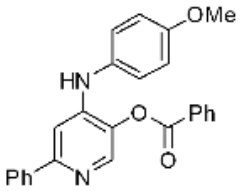
(1o)


0.92
5.26
1.00
1.00
1.93
2.91
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)

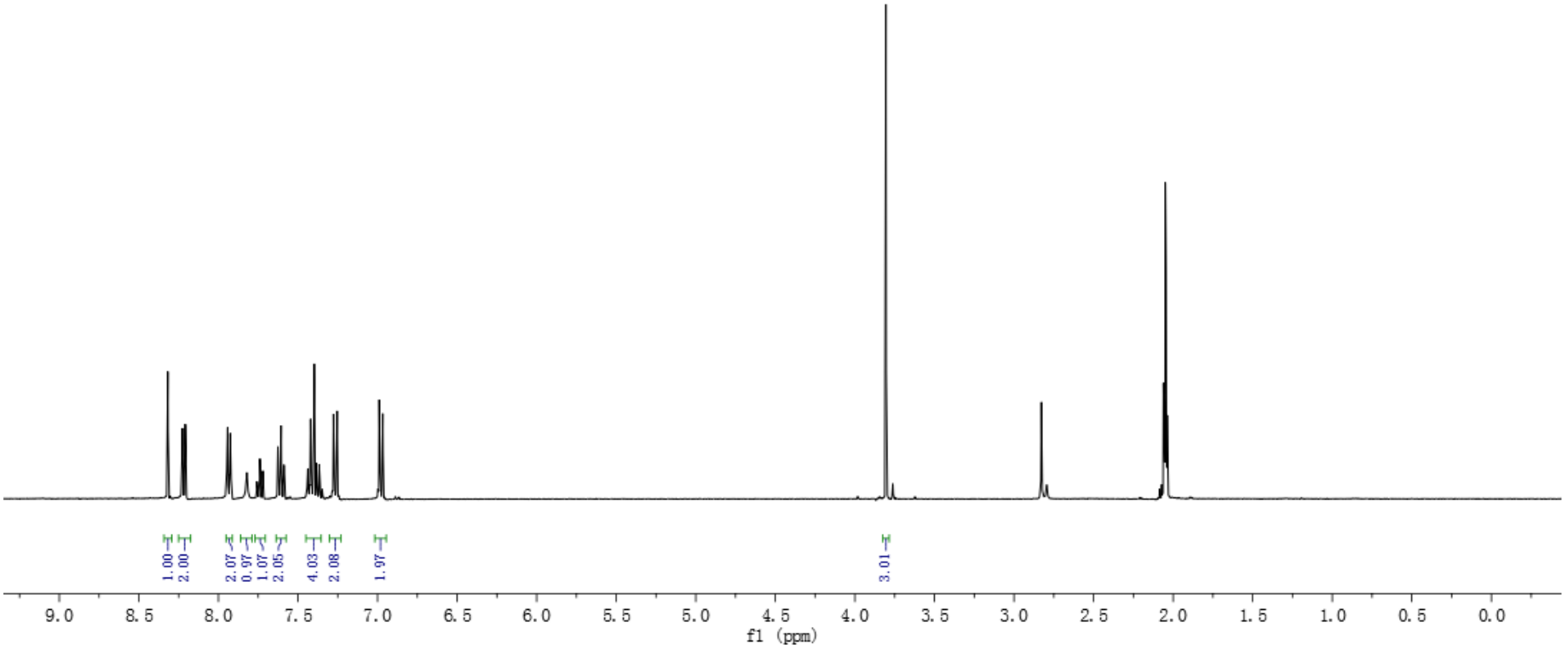

196.724
171.617
147.628
135.245
129.667
129.231
125.917
114.163
77.478
77.160
76.843
57.417
21.537
129.667
129.231
125.917
130
129
128
127
126
125
f1 (ppm)
Ph
N
O
O
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
f1 (ppm)

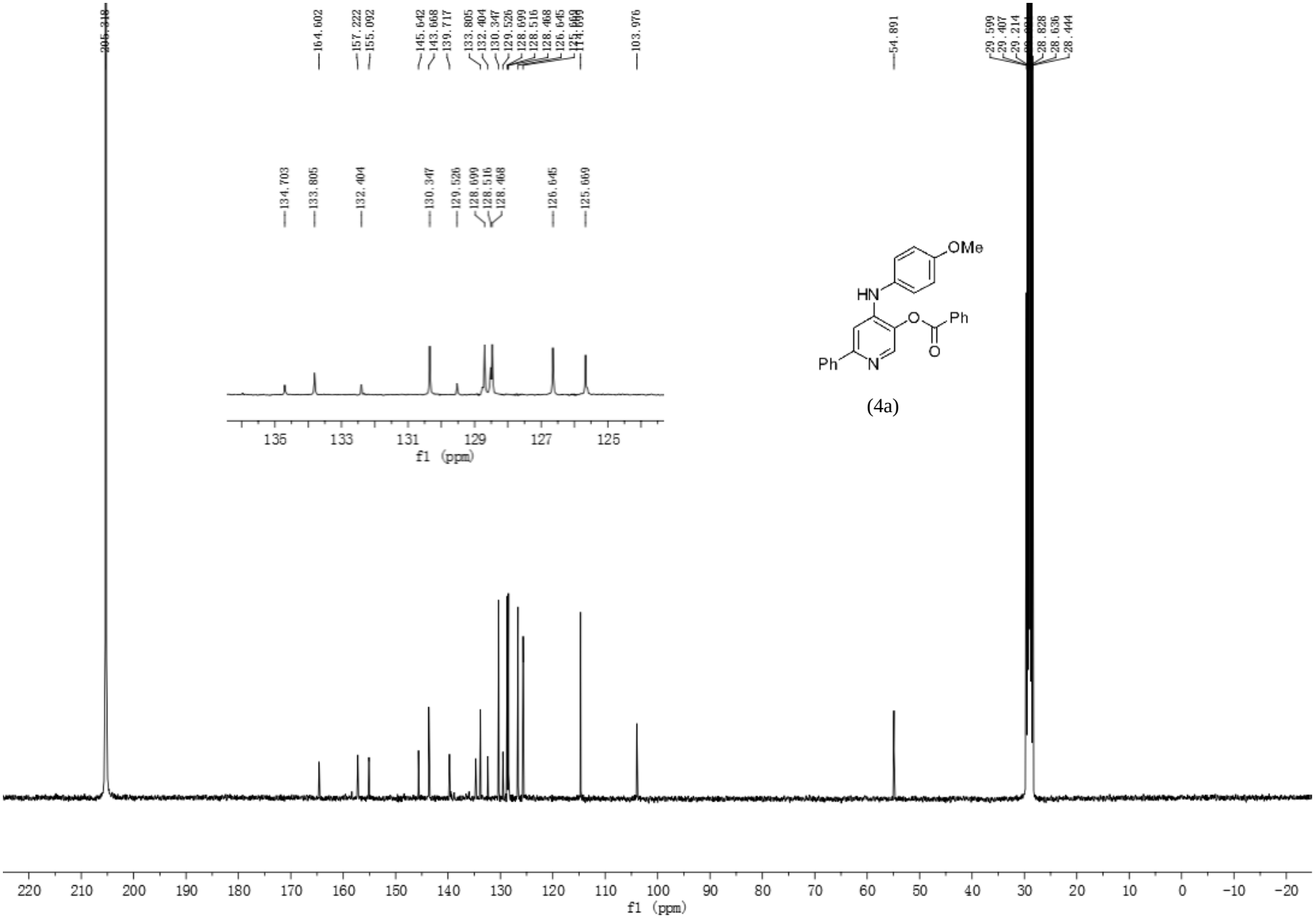
(1o)


8.318
8.229
8.228
8.226
8.213
8.208
8.205
7.942
7.925
7.606
7.421
7.400
7.398
7.276
6.984
6.972
6.967
3.805
2.828
2.061
2.055
2.050
2.044
2.039


OMe
HN
O
Ph
O
Ph
N

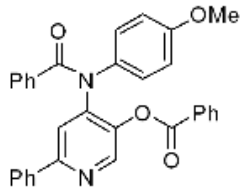
(4a)


1.00
2.00
2.07
0.97
1.07
2.05
4.03
2.08
1.97
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
f1 (ppm)

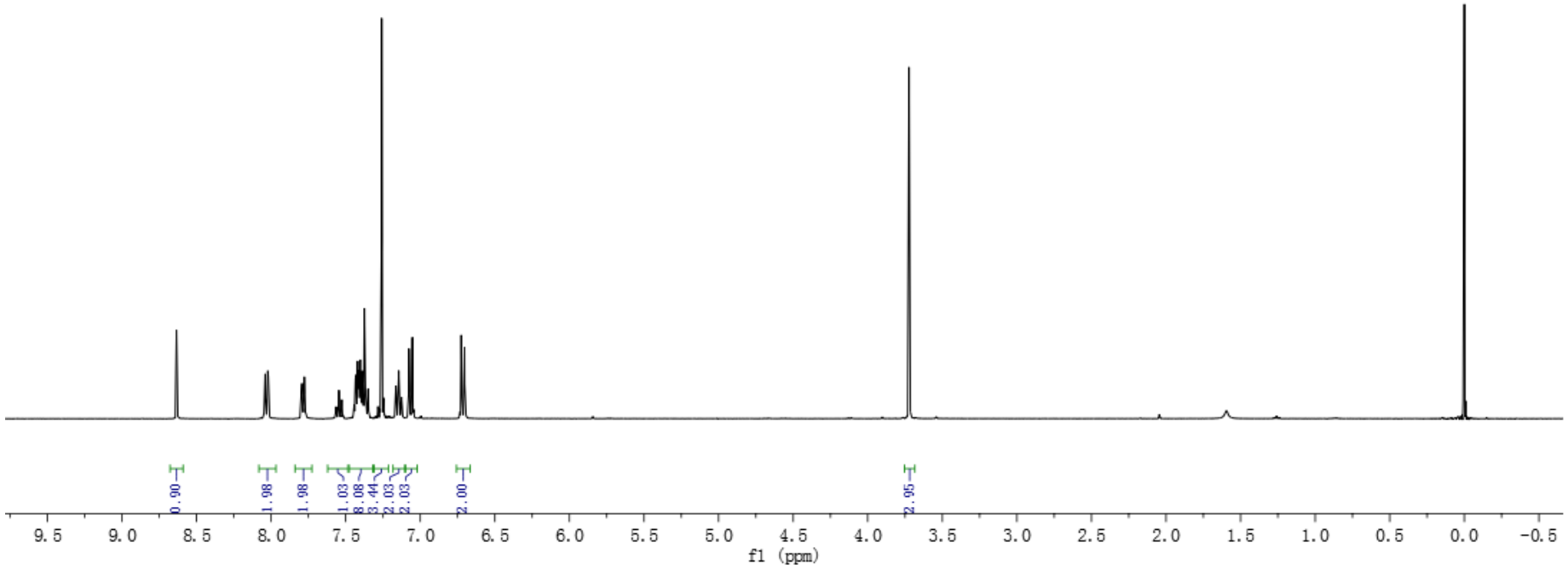

205.318
164.602
157.222
155.092
145.642
143.668
139.717
133.805
132.404
130.347
129.526
128.699
128.516
128.468
126.645
125.669
103.976
54.891
29.599
29.407
29.214
28.828
28.636
28.444
134.703
133.805
132.404
130.347
129.526
128.699
128.516
128.468
126.645
125.669
135
133
131
129
127
125
f1 (ppm)
OMe
HN
O
Ph
O
Ph
N
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
f1 (ppm)

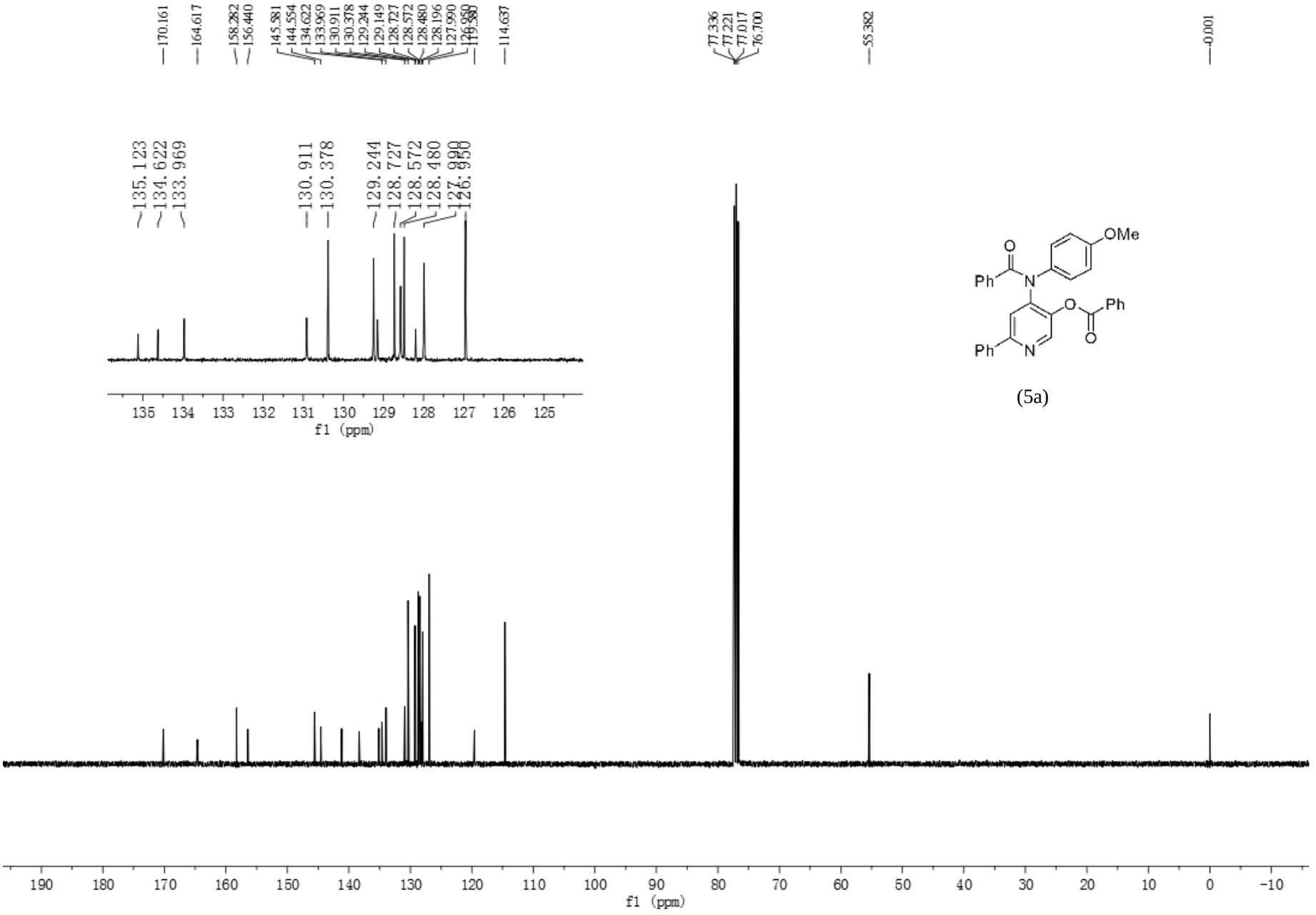
(4a)


8.635
8.040
8.023
7.421
7.415
7.402
7.399
7.390
7.375
7.370
7.369
7.259
7.144
7.076
7.054
7.028
6.720
6.709
6.703
3.723
0.000

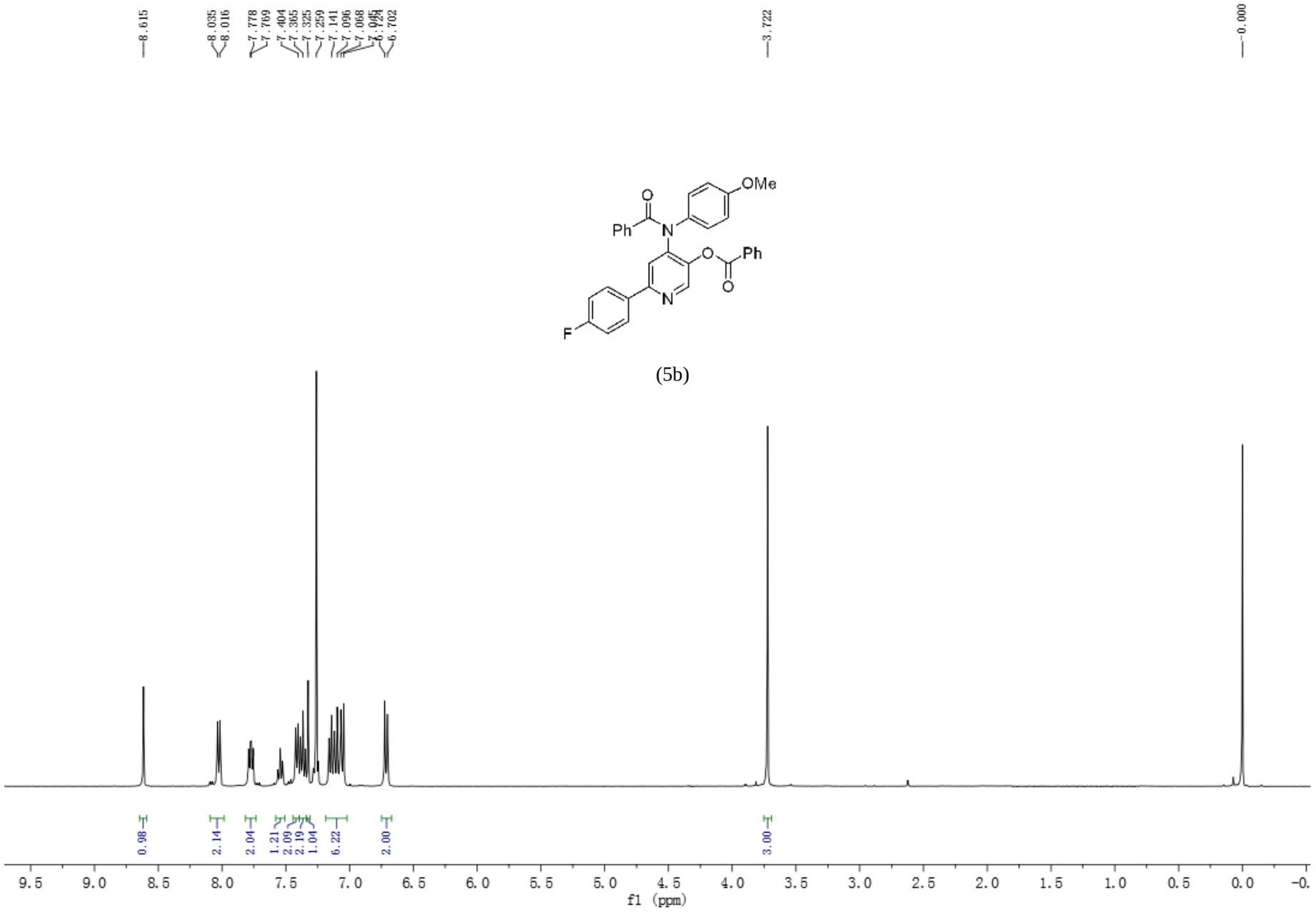

OMe
O
Ph
N
O
Ph
O
Ph
N

(5a)

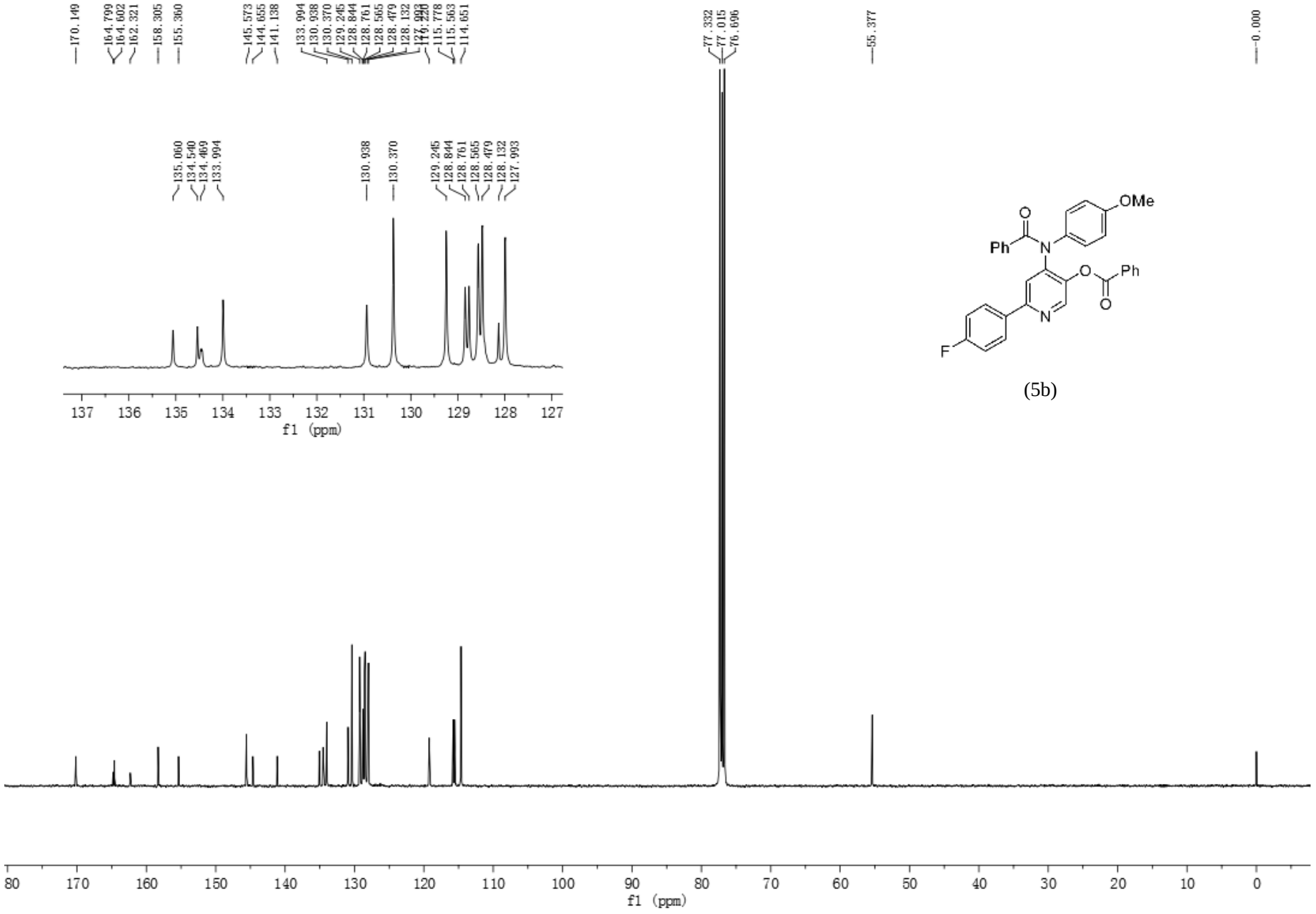

0.90
1.98
1.98
1.03
8.08
3.44
2.03
2.03
2.00
2.95
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


170.161
164.617
158.282
156.440
145.581
144.554
134.622
133.969
130.911
130.378
129.244
129.149
128.727
128.572
128.480
128.196
127.990
114.637
77.336
77.221
77.017
76.700
55.382
-0.001
135.123
134.622
133.969
130.911
130.378
129.244
128.727
128.572
128.480
126.950
135 134 133 132 131 130 129 128 127 126 125
f1 (ppm)
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)
OMe
O
Ph
N
O
Ph
Ph
N
O

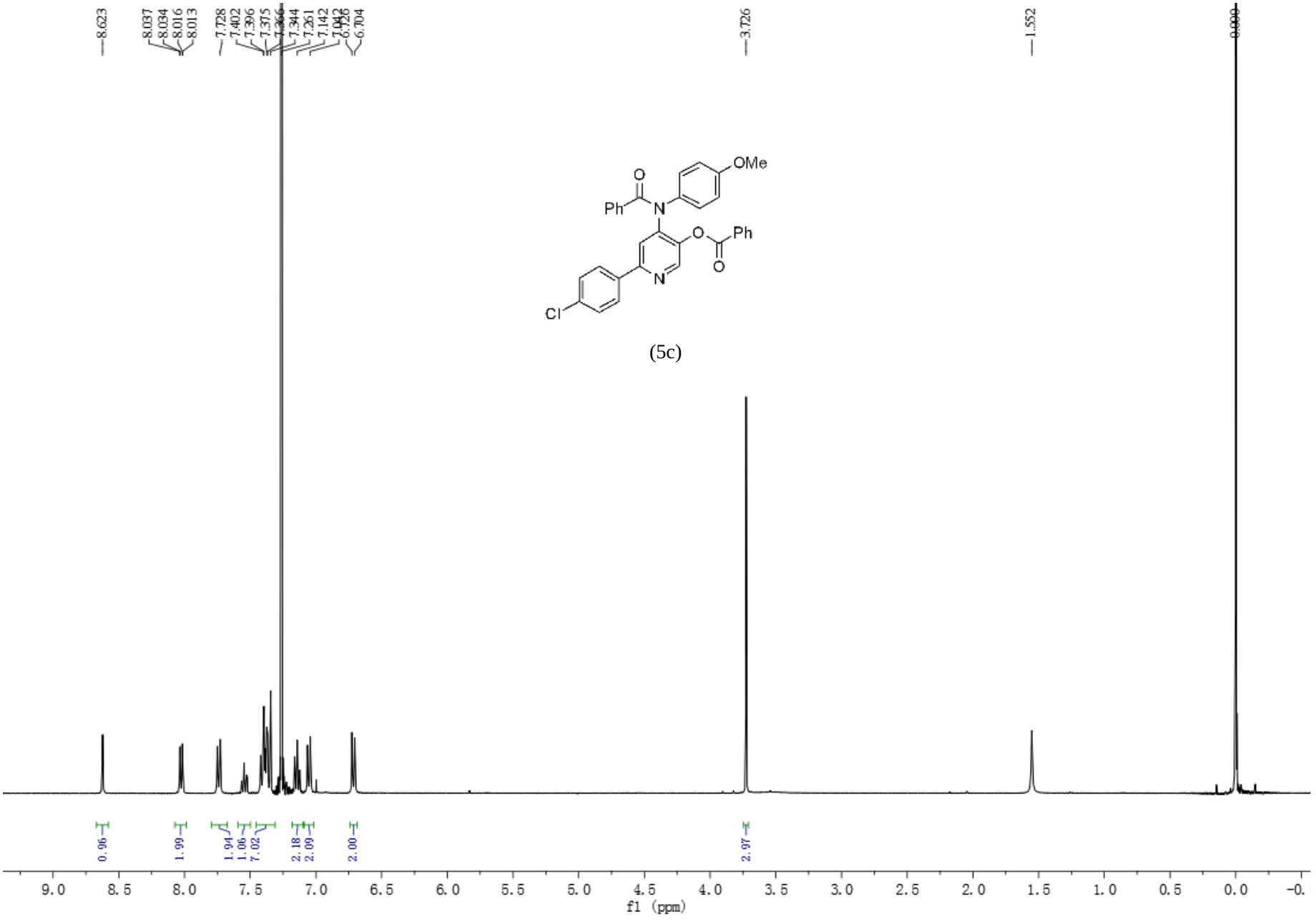
(5a)


8.615
8.035
8.016
7.778
7.769
7.404
7.365
7.325
7.259
7.141
7.096
7.068
6.702
3.722
0.000
OMe
Ph
N
O
Ph
O
N
F
0.98
2.14
2.04
1.21
2.09
2.19
1.04
6.22
2.00
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.
f1 (ppm)

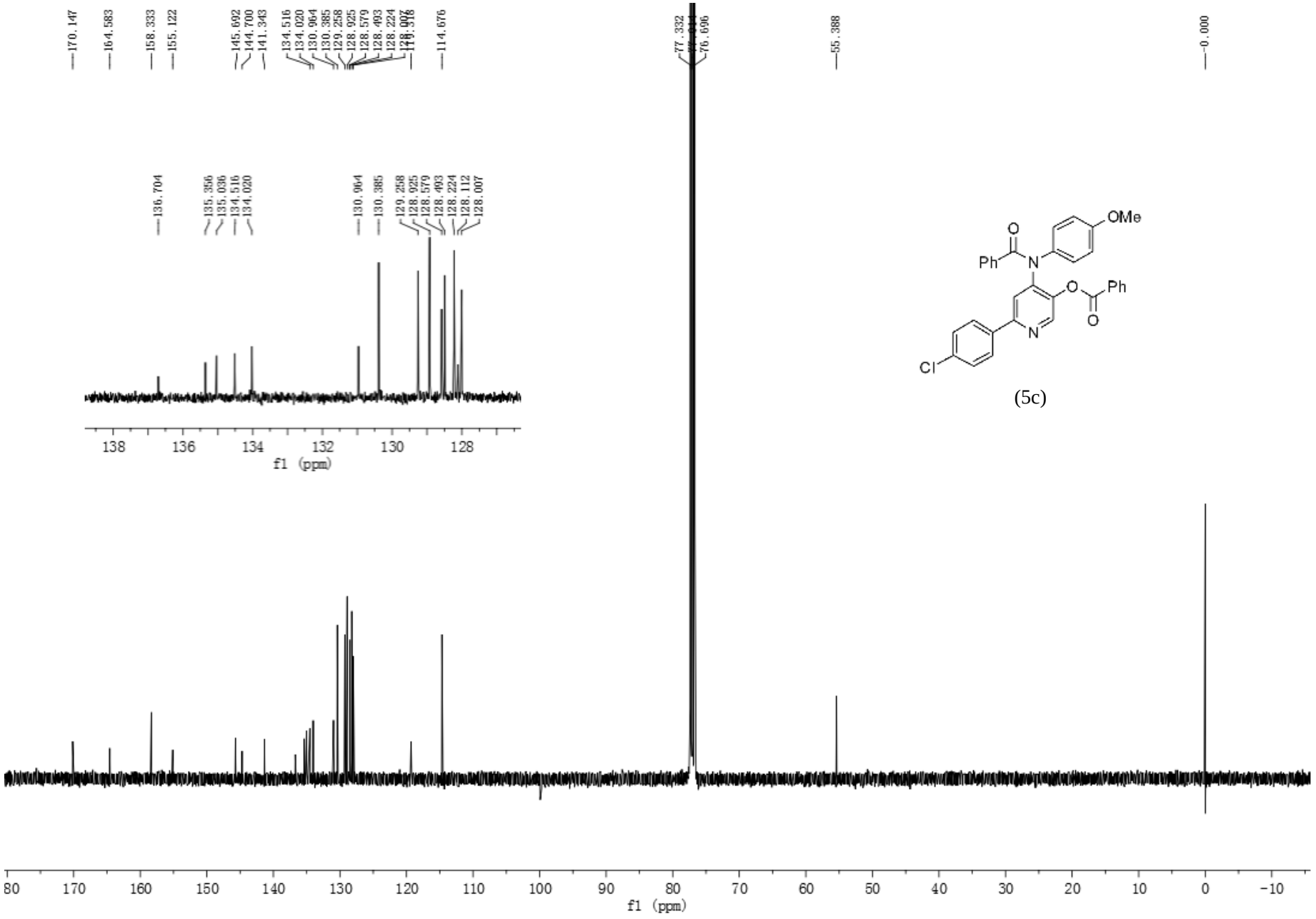
(5b)

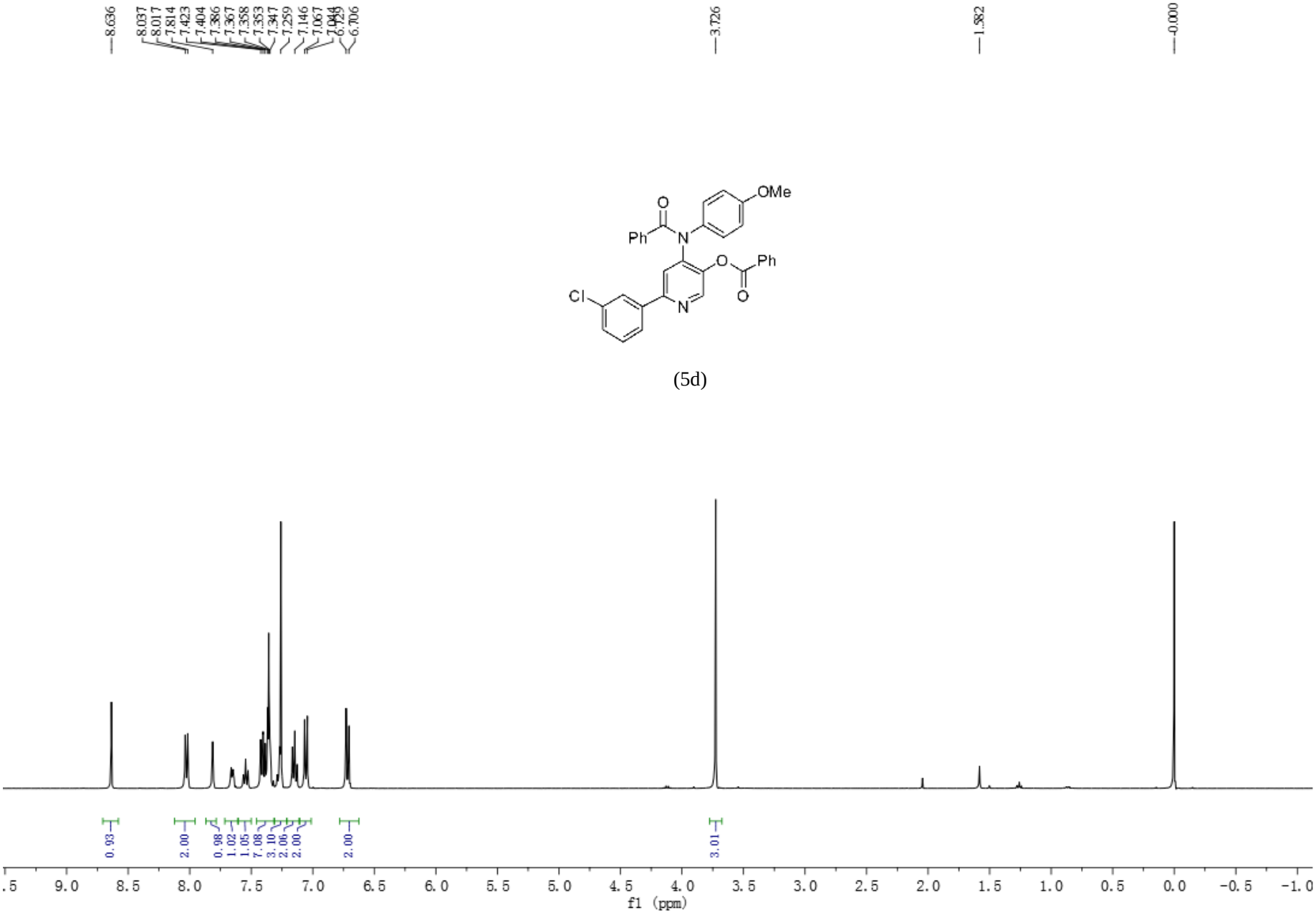

170.149
164.799
164.602
162.321
158.305
155.360
145.573
144.655
141.138
133.994
130.938
130.370
129.245
128.844
128.761
128.565
128.479
128.132
115.778
115.563
114.651
77.332
77.015
76.696
55.377
0.000
135.060
134.540
134.469
133.994
130.938
130.370
129.245
128.844
128.761
128.565
128.479
128.132
127.993
137 136 135 134 133 132 131 130 129 128 127
f1 (ppm)
80 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)
OMe
Ph
N
O
Ph
O
N
F

(5b)

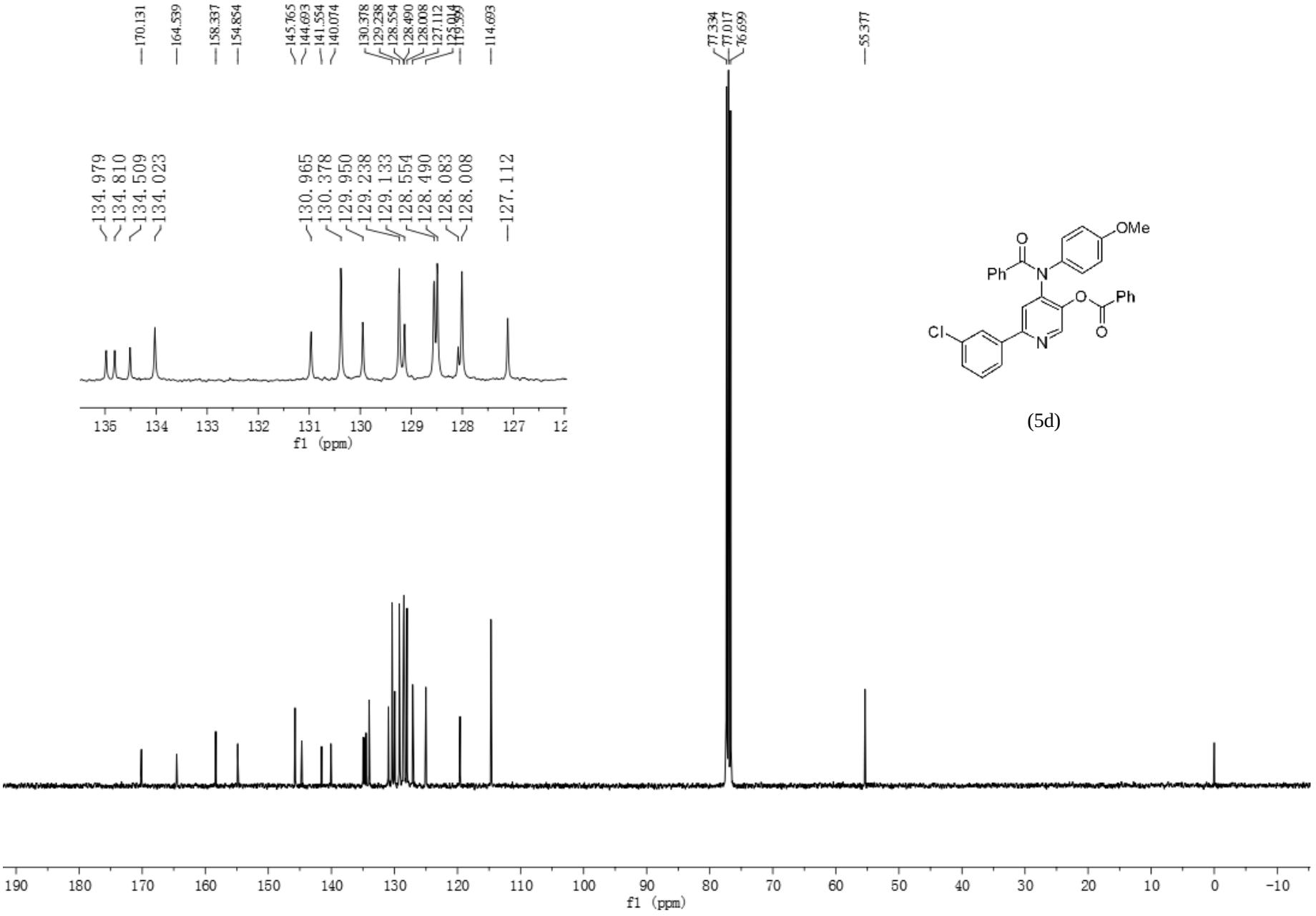

8.623
8.037
8.034
8.016
8.013
7.728
7.402
7.396
7.375
7.366
7.344
7.261
7.142
7.042
6.726
6.704
3.726
1.552
0.000
OMe
O
Ph
N
O
Ph
O
N
Cl
0.96
1.99
1.94
1.06
7.02
2.18
2.09
2.00
2.97
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

(5c)

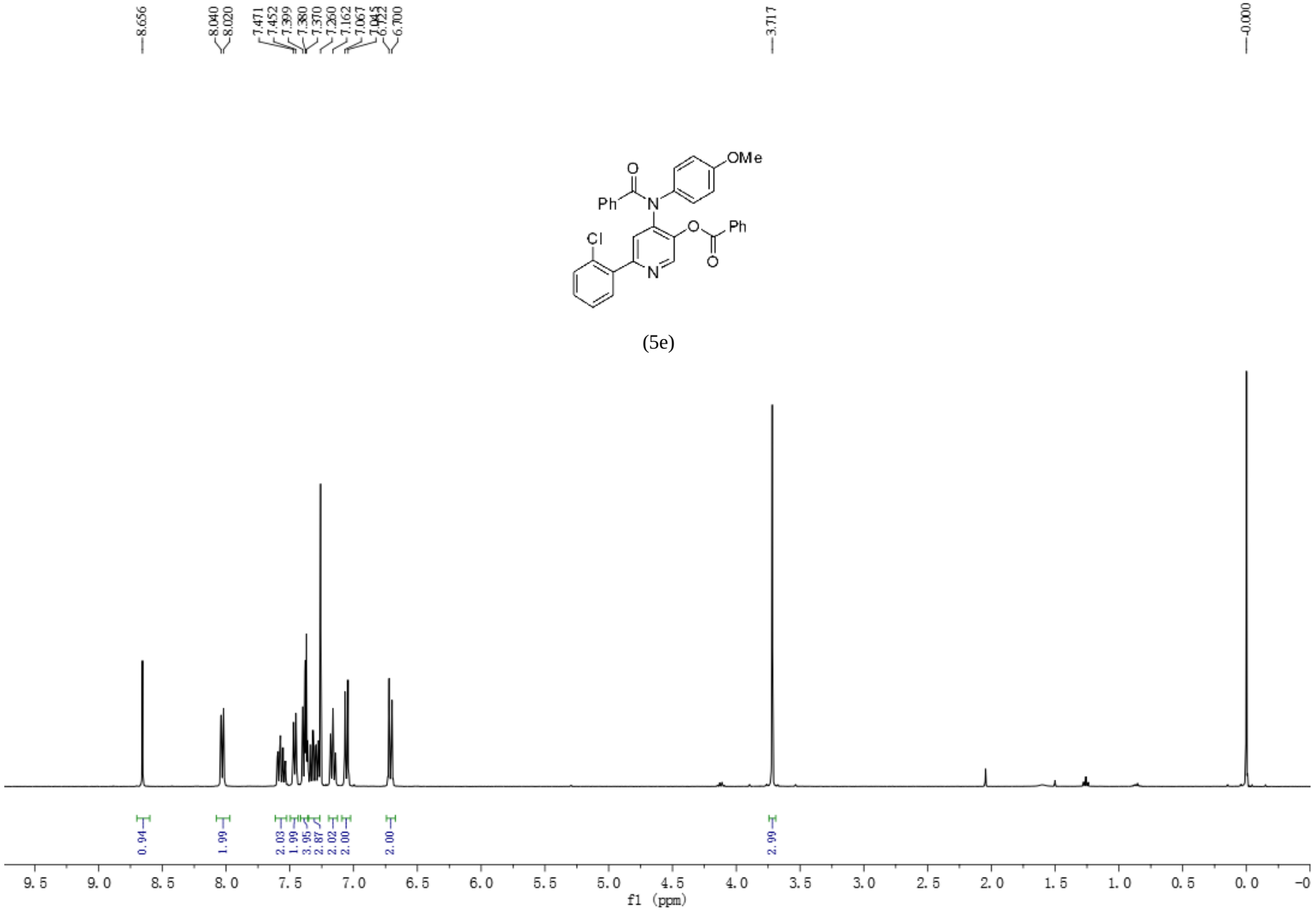

170.147
164.583
158.333
155.122
145.692
144.700
141.343
134.516
134.020
130.964
130.385
129.258
128.925
128.579
128.493
128.224
114.676
77.332
76.696
55.388
-0.000
136.704
135.356
135.036
134.516
134.020
130.964
130.385
129.258
128.925
128.579
128.493
128.224
128.112
128.007
138
136
134
132
130
128
f1 (ppm)
OMe
Ph
N
O
Ph
O
N
Cl
(5c)
80
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


8.636
8.037
8.017
7.814
7.423
7.404
7.386
7.367
7.358
7.353
7.347
7.259
7.146
7.067
6.706
3.726
1.582
0.000
OMe
O
Ph
N
O
Ph
Cl
N
0.93
2.00
0.98
1.02
1.05
7.08
3.10
2.06
2.00
2.00
3.01
f1 (ppm)

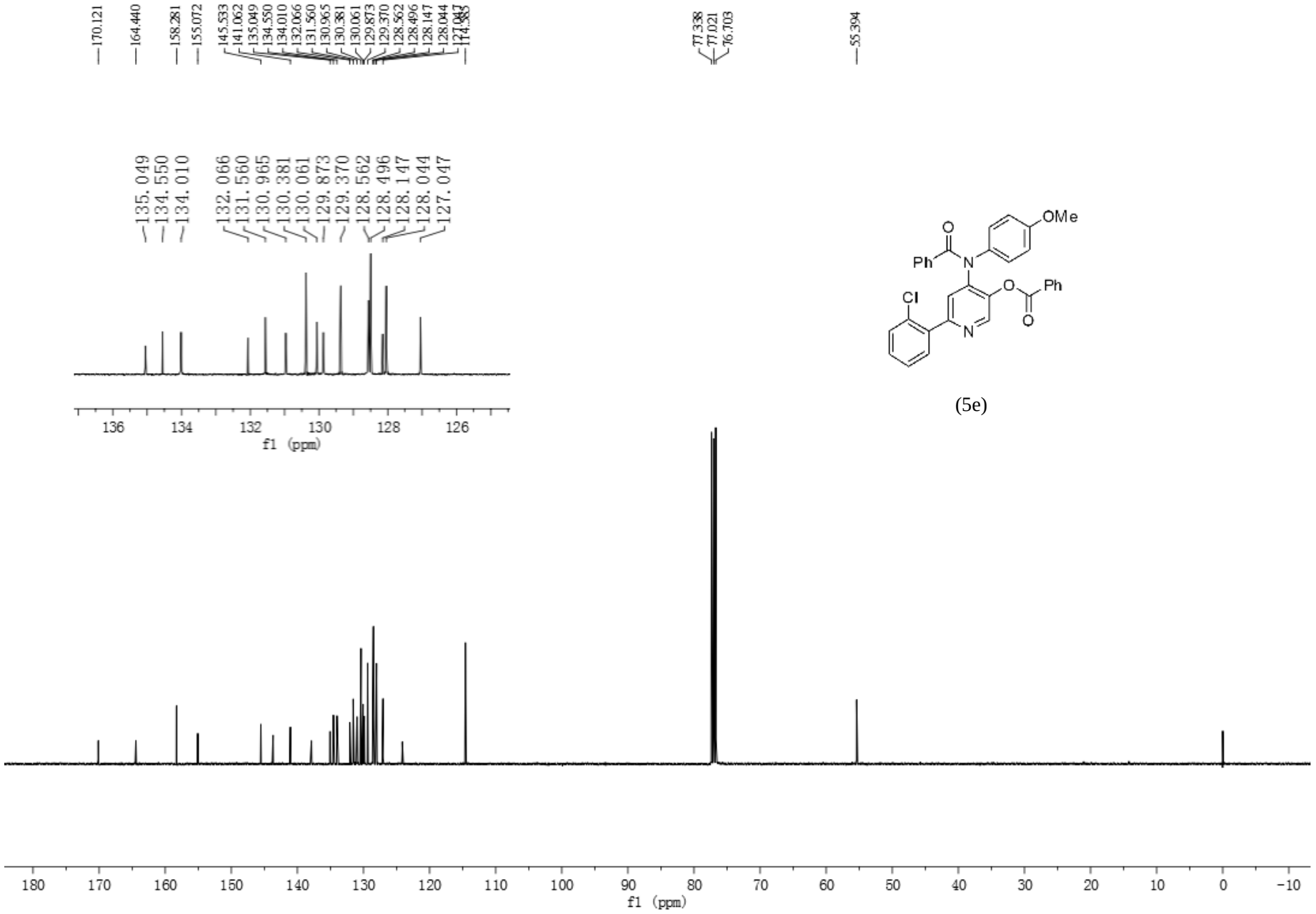
(5d)


170.131
164.539
158.337
154.854
145.765
144.693
141.554
140.074
130.378
129.238
128.554
128.490
128.008
127.112
125.014
119.999
114.693
77.334
77.017
76.699
55.377
134.979
134.810
134.509
134.023
130.965
130.378
129.950
129.238
129.133
128.554
128.490
128.083
128.008
127.112
135 134 133 132 131 130 129 128 127 12
f1 (ppm)
OMe
O
Ph
N
O
Ph
Cl
N
O
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

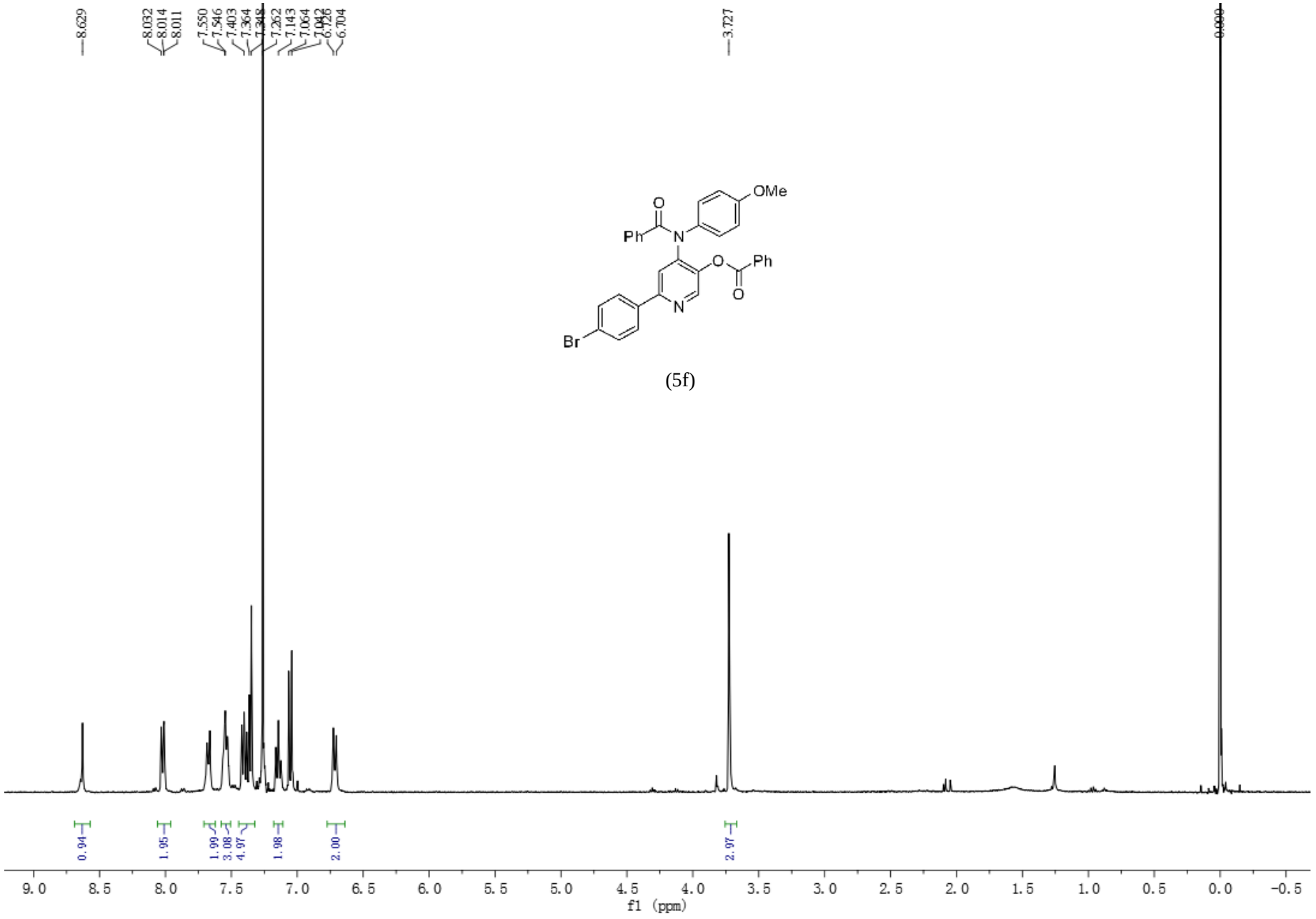
(5d)


8.656
8.040
8.020
7.471
7.452
7.399
7.380
7.370
7.260
7.162
7.067
6.700
3.717
0.000
OMe
O
Ph
N
O
Ph
Cl
N
O
0.94
1.99
2.03
1.99
3.95
2.87
2.02
2.00
2.00
2.99
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

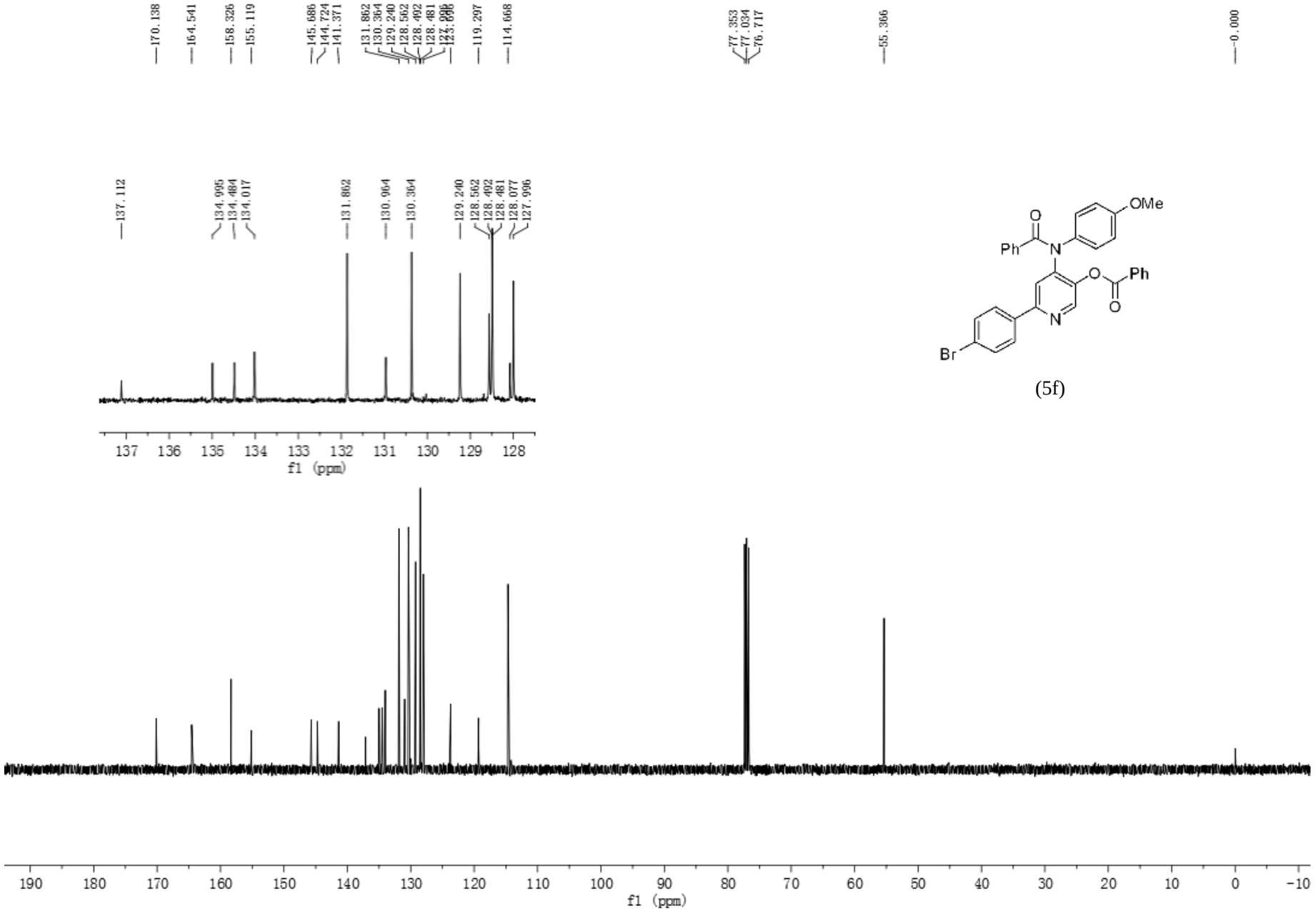
(5e)


170.121
164.440
158.281
155.072
145.533
141.062
135.049
134.550
134.010
132.066
131.560
130.965
130.381
130.061
129.873
129.370
128.562
128.496
128.147
128.044
127.047
77.338
77.021
76.703
55.394
135.049
134.550
134.010
132.066
131.560
130.965
130.381
130.061
129.873
129.370
128.562
128.496
128.147
128.044
127.047
136
134
132
130
128
126
f1 (ppm)
OMe
Ph
O
N
Cl
O
Ph
O
N
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

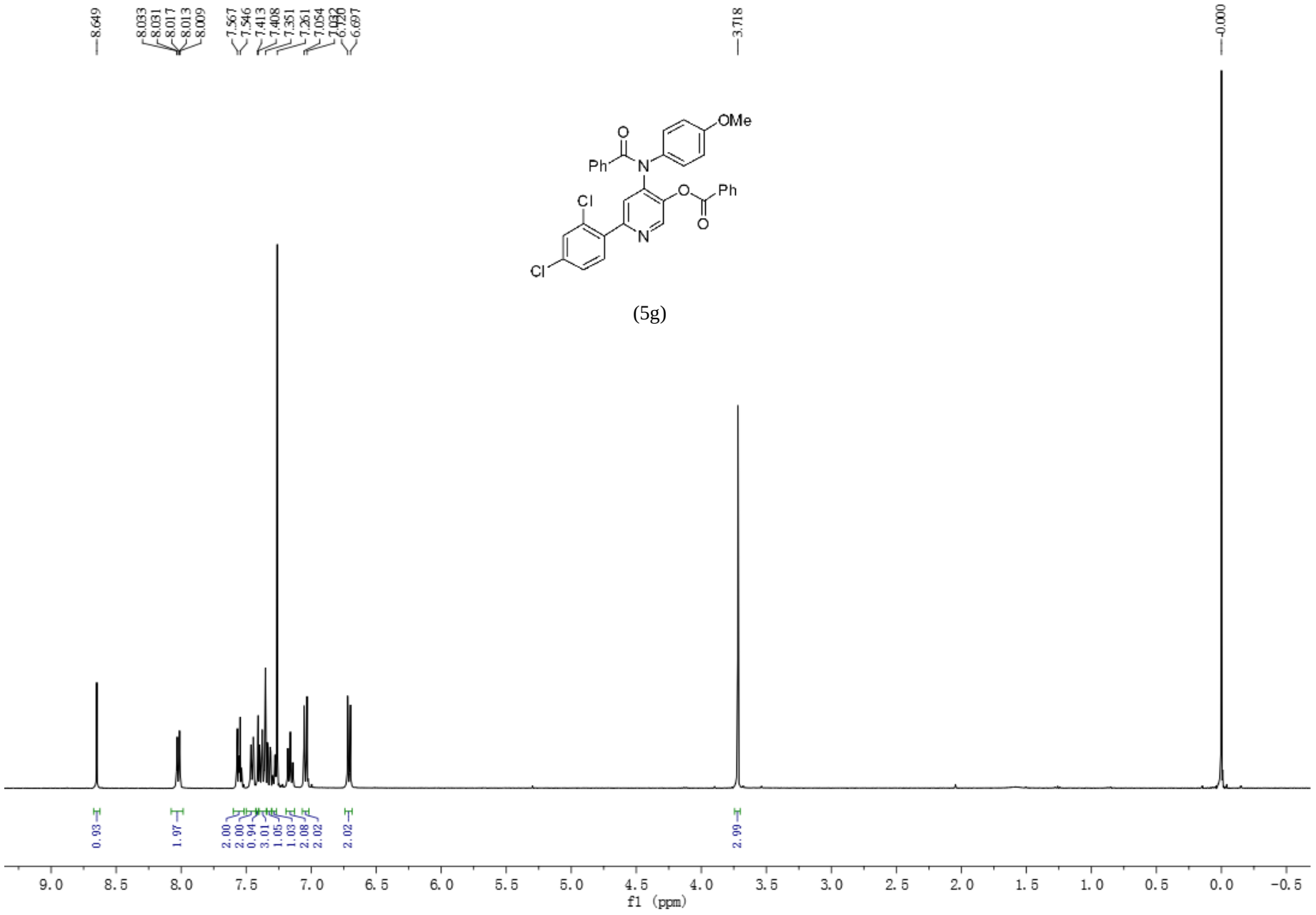
(5e)


8.629
8.032
8.014
8.011
7.550
7.546
7.403
7.364
7.348
7.262
7.143
7.064
7.042
6.726
6.704
3.727
0.000
OMe
Ph
N
O
Ph
O
O
N
Br
0.94
1.95
1.99
3.08
4.97
1.98
2.00
2.97
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)

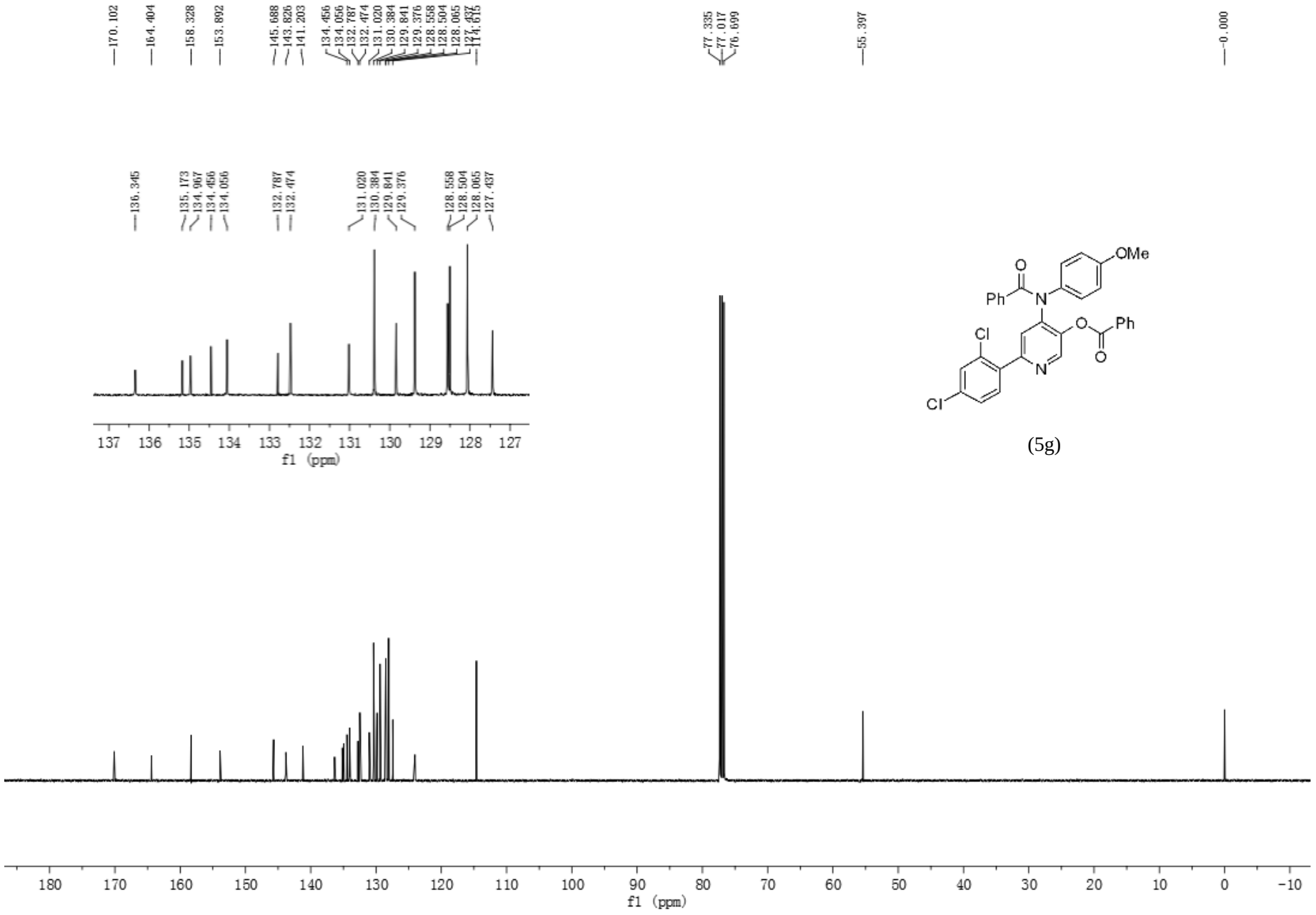
(5f)

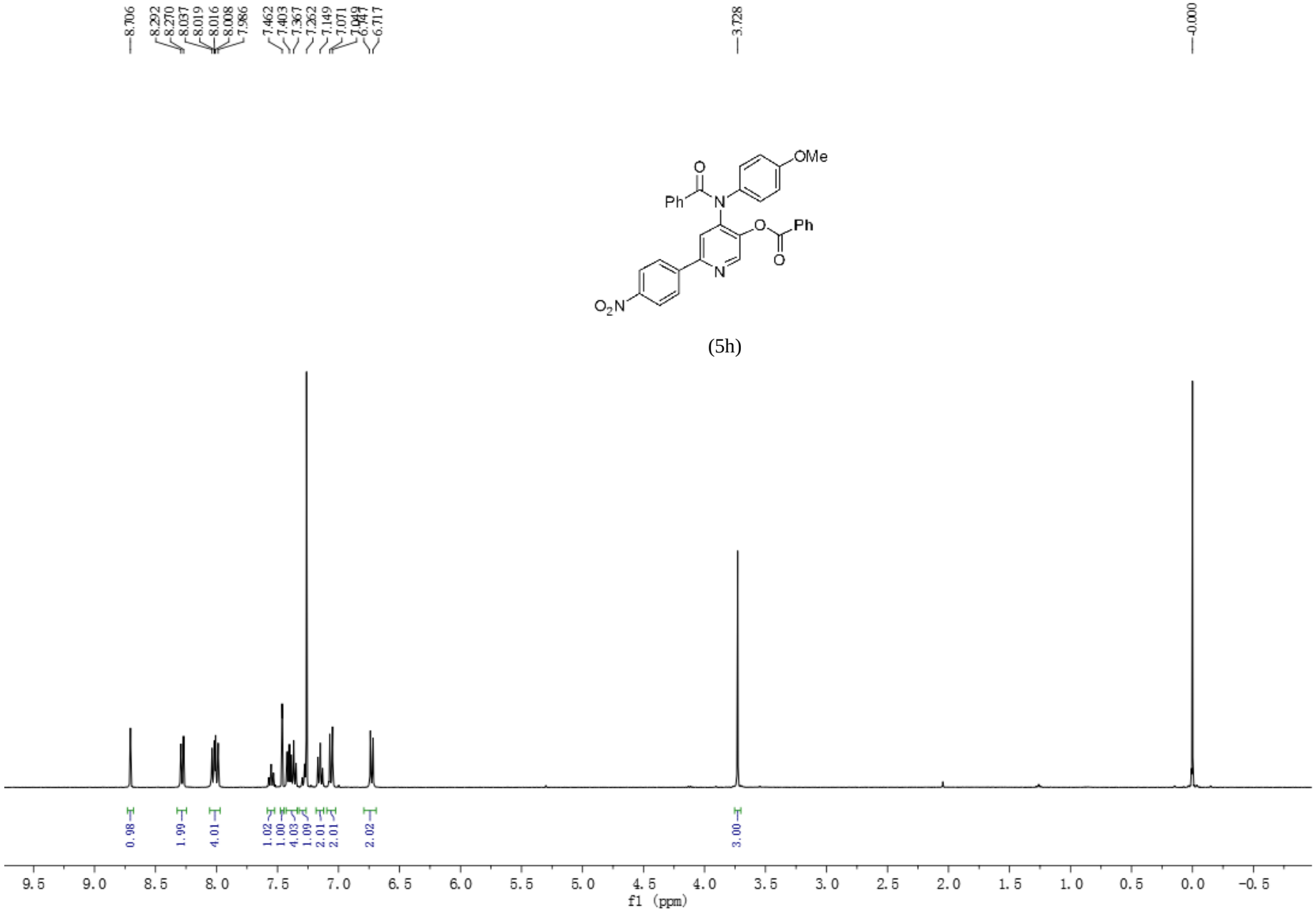

170.138
164.541
158.326
155.119
145.686
144.724
141.371
131.862
130.364
129.240
128.562
128.492
128.481
119.297
114.668
77.353
77.034
76.717
55.366
0.000
137.112
134.995
134.484
134.017
131.862
130.964
130.364
129.240
128.562
128.492
128.481
128.077
127.996
137 136 135 134 133 132 131 130 129 128
f1 (ppm)
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)
OMe
O
Ph
N
O
Ph
O
N
Br

(5f)

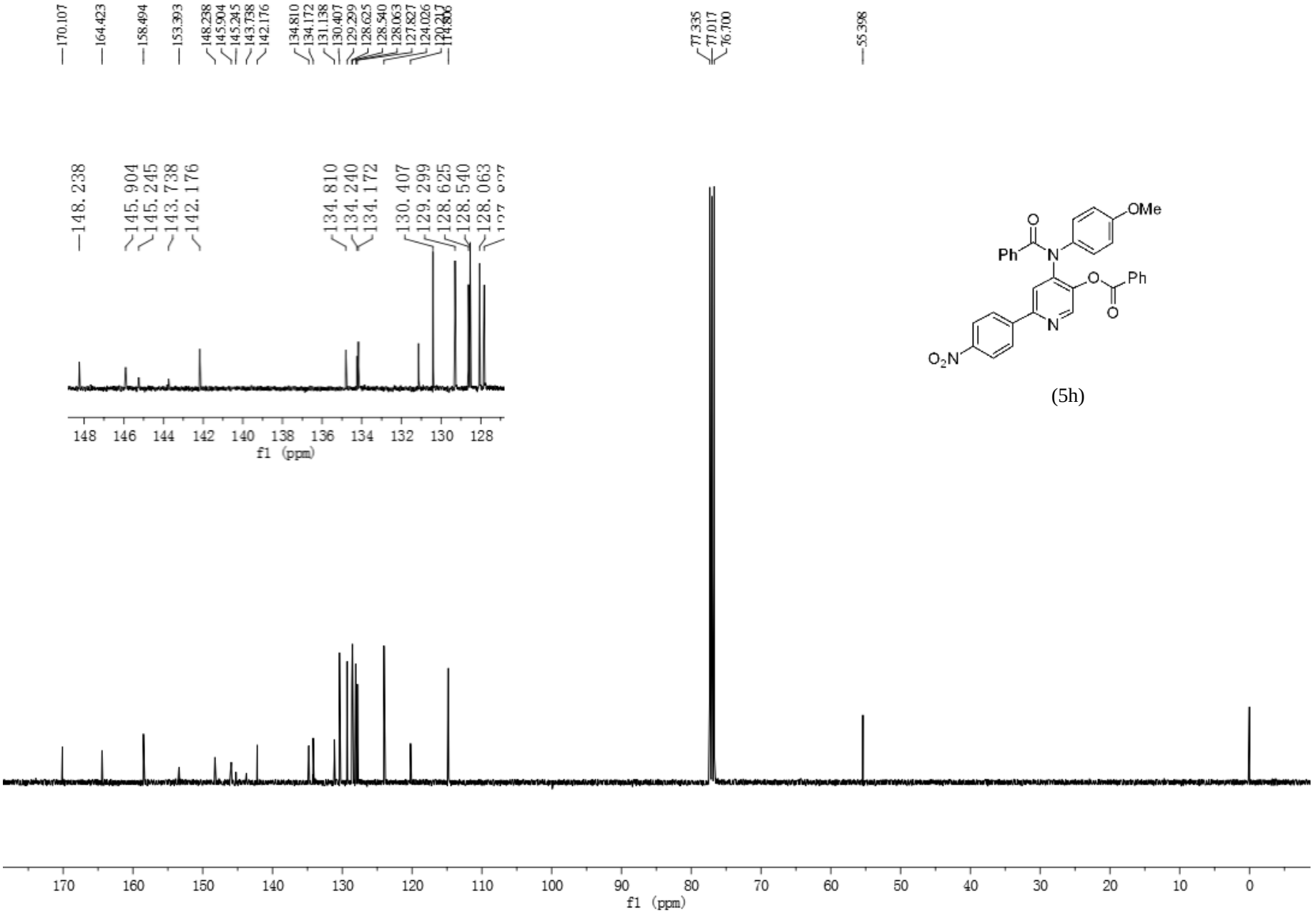

8.649
8.033
8.031
8.017
8.013
8.009
7.567
7.546
7.413
7.408
7.351
7.261
7.054
6.697
3.718
0.000
OMe
Ph
O
N
O
Ph
Cl
Cl
N
0.93
1.97
2.00
2.00
0.94
3.01
1.05
1.03
2.08
2.02
2.02
2.99
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

(5g)


170.102
164.404
158.328
153.892
145.688
143.826
141.203
134.456
134.056
132.787
132.474
131.020
130.384
129.841
129.376
128.558
128.504
128.065
127.437
114.615
77.335
77.017
76.699
55.397
0.000
136.345
135.173
134.967
134.456
134.056
132.787
132.474
131.020
130.384
129.841
129.376
128.558
128.504
128.065
127.437
137 136 135 134 133 132 131 130 129 128 127
f1 (ppm)
OMe
O
Ph
N
O
Ph
Cl
N
O
Cl
(5g)
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

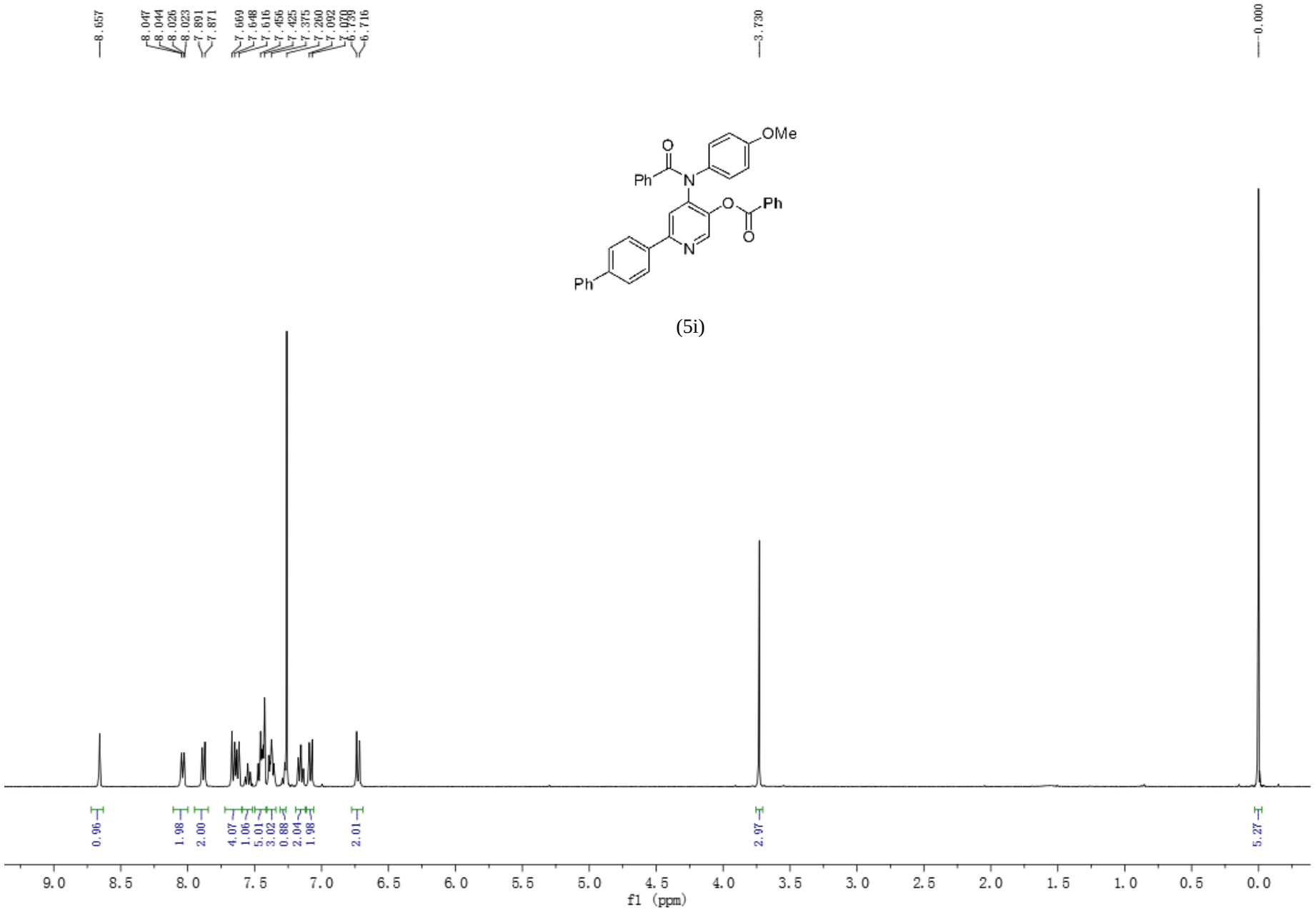

8.706
8.292
8.270
8.037
8.019
8.016
8.008
7.986
7.462
7.403
7.367
7.262
7.149
7.071
7.049
6.947
6.717
3.728
-0.000
OMe
O
Ph
N
O
Ph
O
N
O2N
0.98
1.99
4.01
1.02
1.00
4.03
1.09
2.01
2.01
2.02
3.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

(5h)

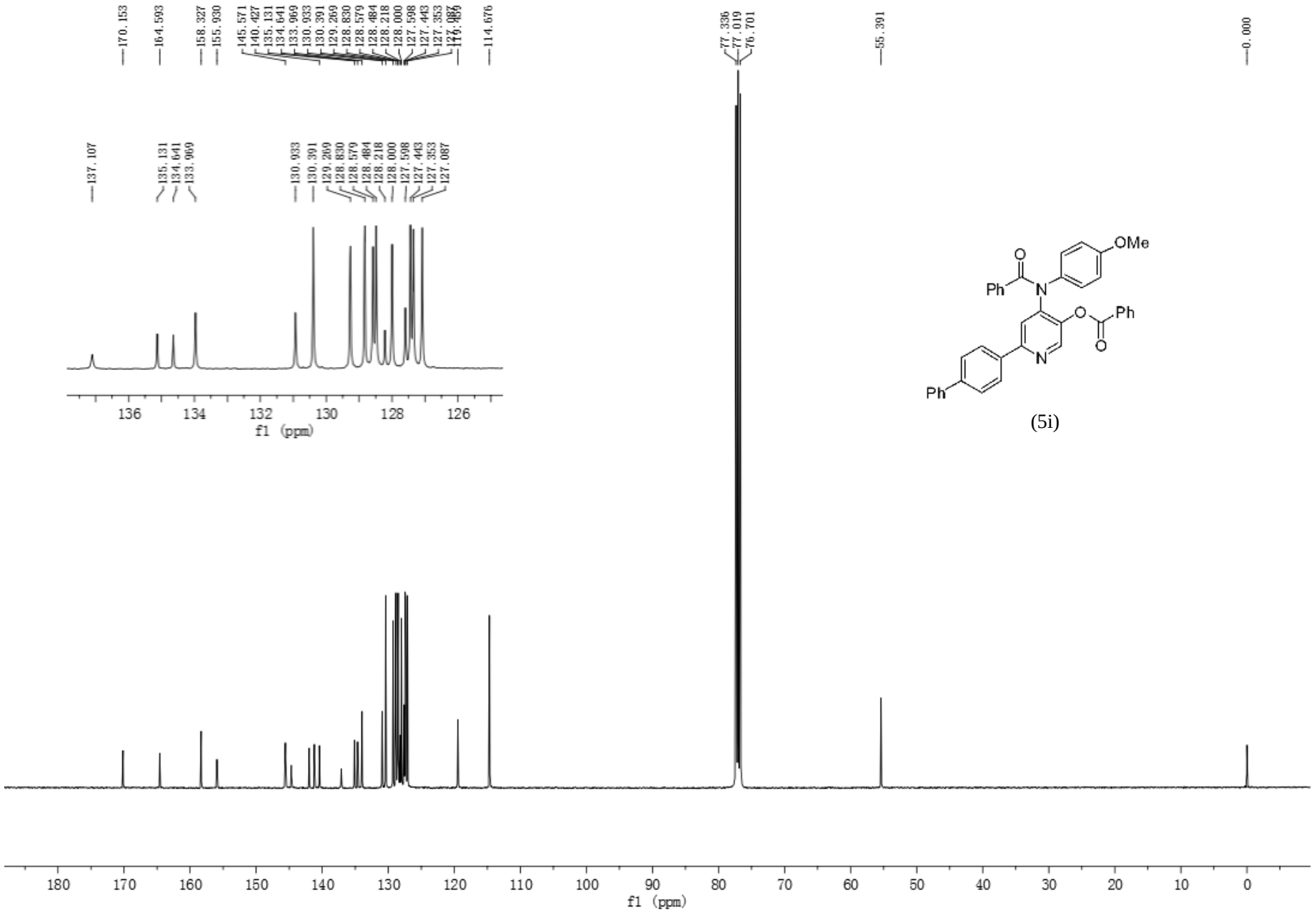

170.107
164.423
158.494
153.393
148.238
145.904
145.245
143.738
142.176
134.810
134.172
131.138
130.407
129.299
128.625
128.540
128.063
127.827
124.026
77.335
77.017
76.700
55.398
148.238
145.904
145.245
143.738
142.176
134.810
134.240
134.172
130.407
129.299
128.625
128.540
128.063
148 146 144 142 140 138 136 134 132 130 128
f1 (ppm)
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

OMe
Ph
N
O
Ph
O
N
O2N

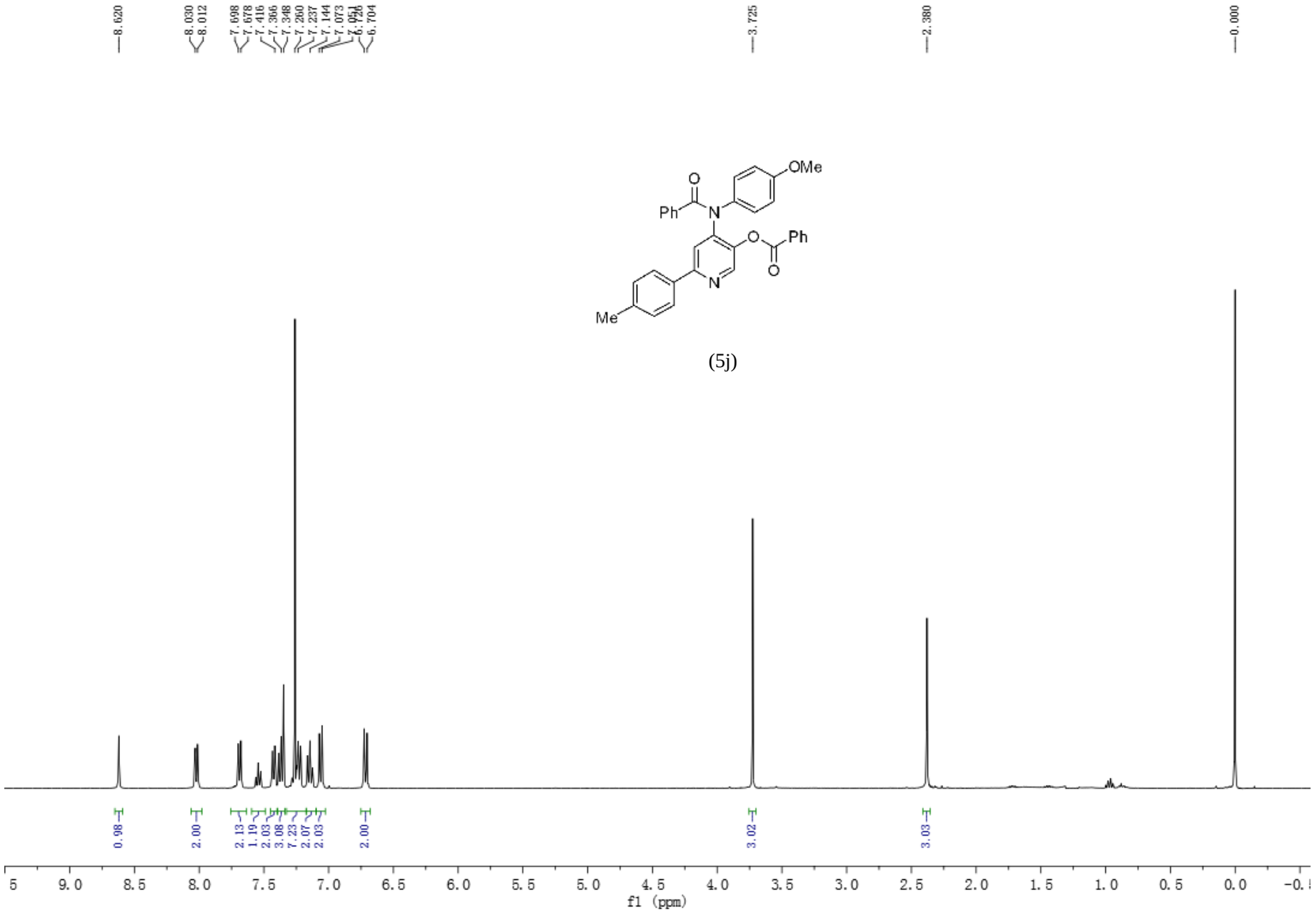
(5h)


8.657
8.047
8.044
8.026
8.023
7.891
7.871
7.669
7.648
7.616
7.456
7.425
7.375
7.260
7.092
7.030
6.716
3.730
0.000
OMe
O
Ph
N
O
Ph
O
N
Ph
0.96
1.98
2.00
4.07
1.06
5.01
3.02
0.88
2.04
1.98
2.01
2.97
5.27
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)

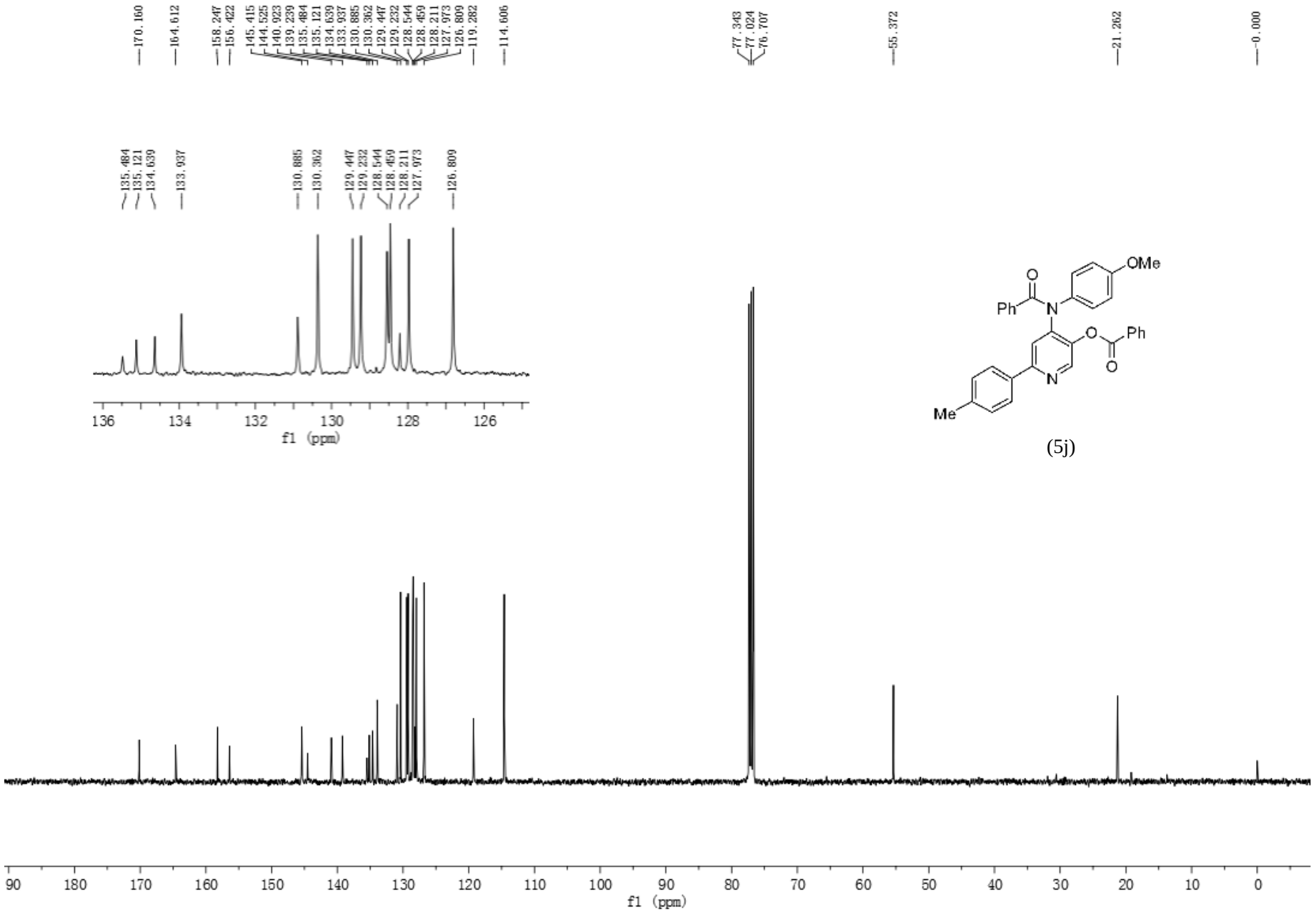
(5i)

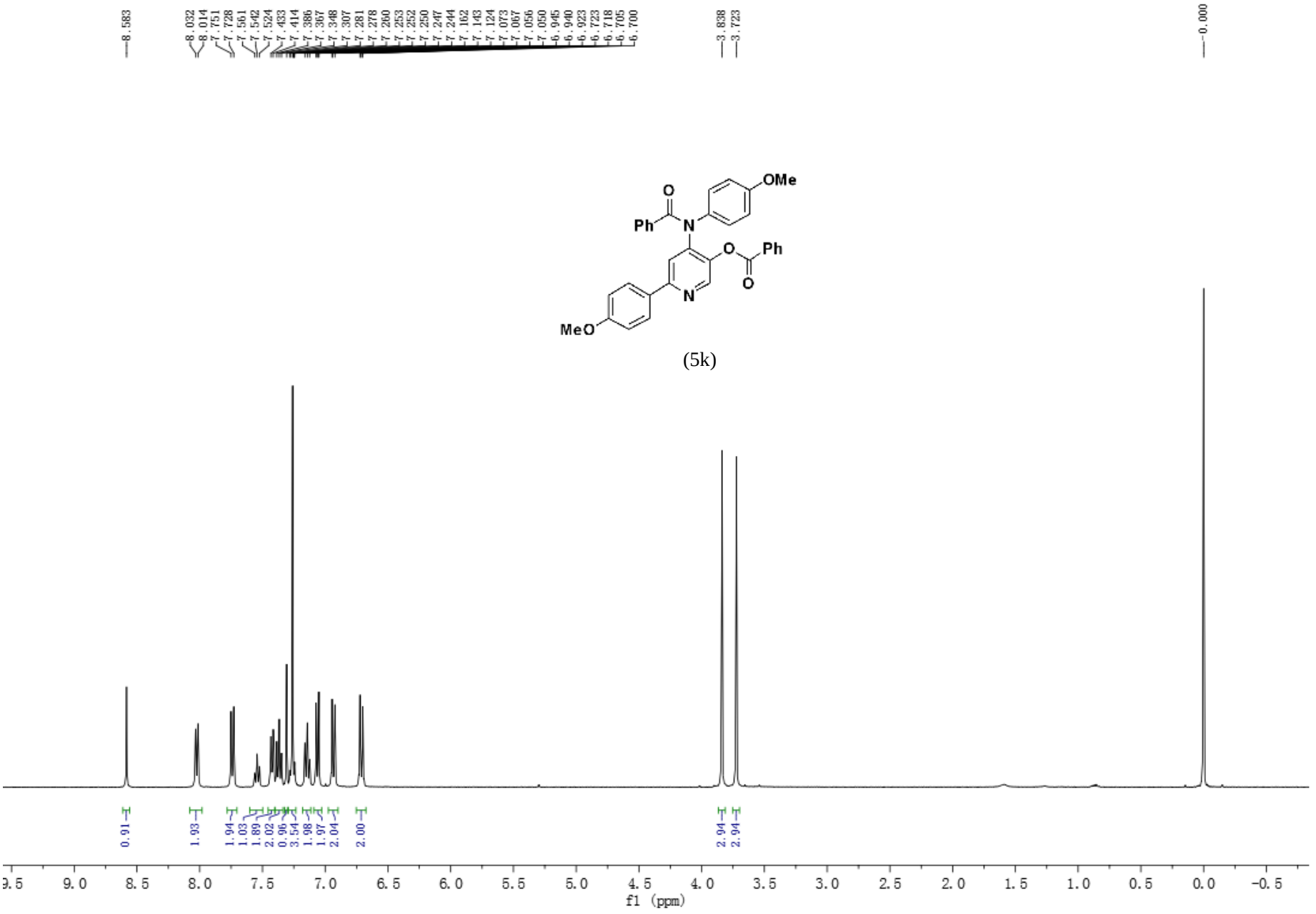

170.153
164.593
158.327
155.930
145.571
140.427
135.131
134.641
133.969
130.933
130.391
129.269
128.830
128.579
128.484
128.218
128.000
127.598
127.443
127.353
127.087
114.676
77.336
77.019
76.701
55.391
0.000
137.107
135.131
134.641
133.969
130.933
130.391
129.269
128.830
128.579
128.484
128.218
128.000
127.598
127.443
127.353
127.087
136
134
132
130
128
126
f1 (ppm)
OMe
Ph
N
O
Ph
O
O
Ph
N
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

(5i)

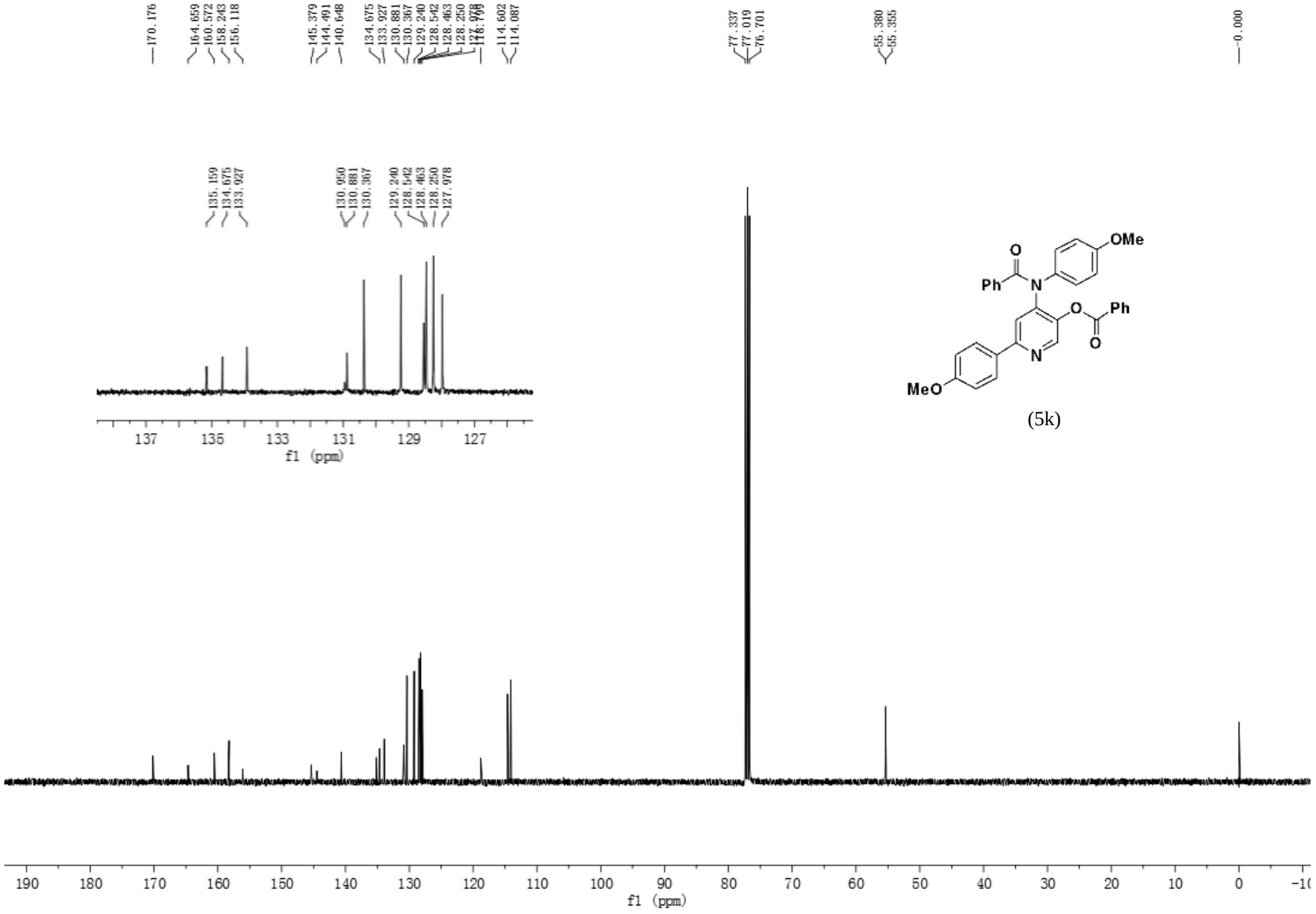

8.620
8.030
8.012
7.698
7.678
7.416
7.366
7.348
7.260
7.237
7.144
7.073
6.704
3.725
2.380
0.000
OMe
Ph
O
N
O
Ph
O
N
Me
0.98
2.00
2.13
1.19
2.03
3.08
7.23
2.07
2.03
2.00
3.02
3.03
f1 (ppm)

(5j)


170.160
164.612
158.247
156.422
145.415
144.525
140.923
139.239
135.484
135.121
134.639
133.937
130.885
130.362
129.447
129.232
128.544
128.459
128.211
127.973
126.809
119.282
114.606
77.343
77.024
76.707
55.372
21.262
0.000
135.484
135.121
134.639
133.937
130.885
130.362
129.447
129.232
128.544
128.459
128.211
127.973
126.809
136
134
132
130
128
126
f1 (ppm)
OMe
Ph
N
O
Ph
O
O
N
Me
(5j)
90
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

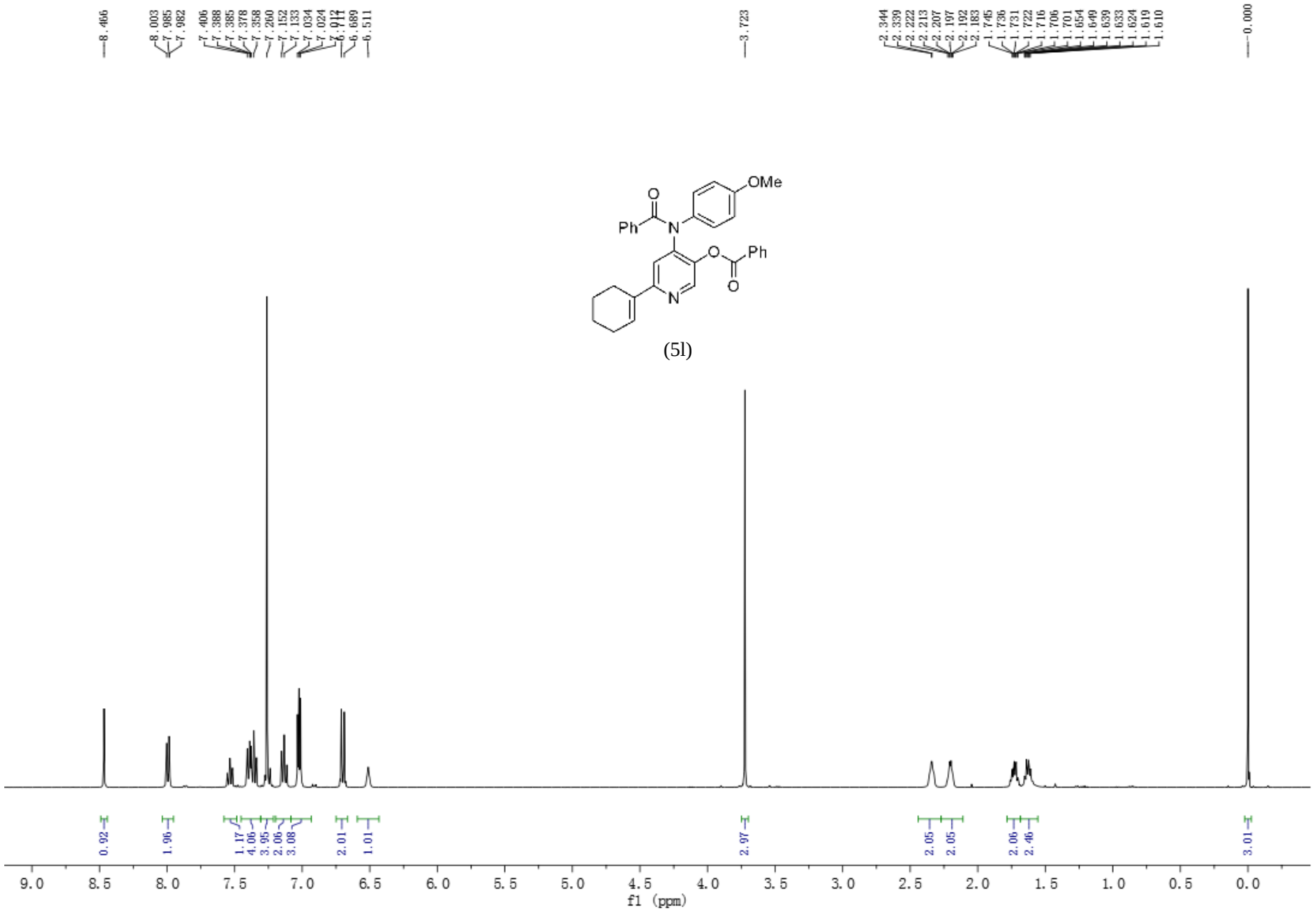

8.583
8.032
8.014
7.751
7.728
7.561
7.542
7.524
7.433
7.414
7.386
7.367
7.348
7.307
7.281
7.278
7.260
7.253
7.252
7.250
7.247
7.244
7.162
7.143
7.124
7.073
7.067
7.056
7.050
6.945
6.940
6.923
6.723
6.718
6.705
6.700
3.838
3.723
0.000
O
Ph
N
OMe
O
Ph
O
N
MeO
0.91
1.93
1.94
1.03
1.89
2.02
0.96
3.54
1.98
1.97
2.04
2.00
2.94
2.94
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)

(5k)

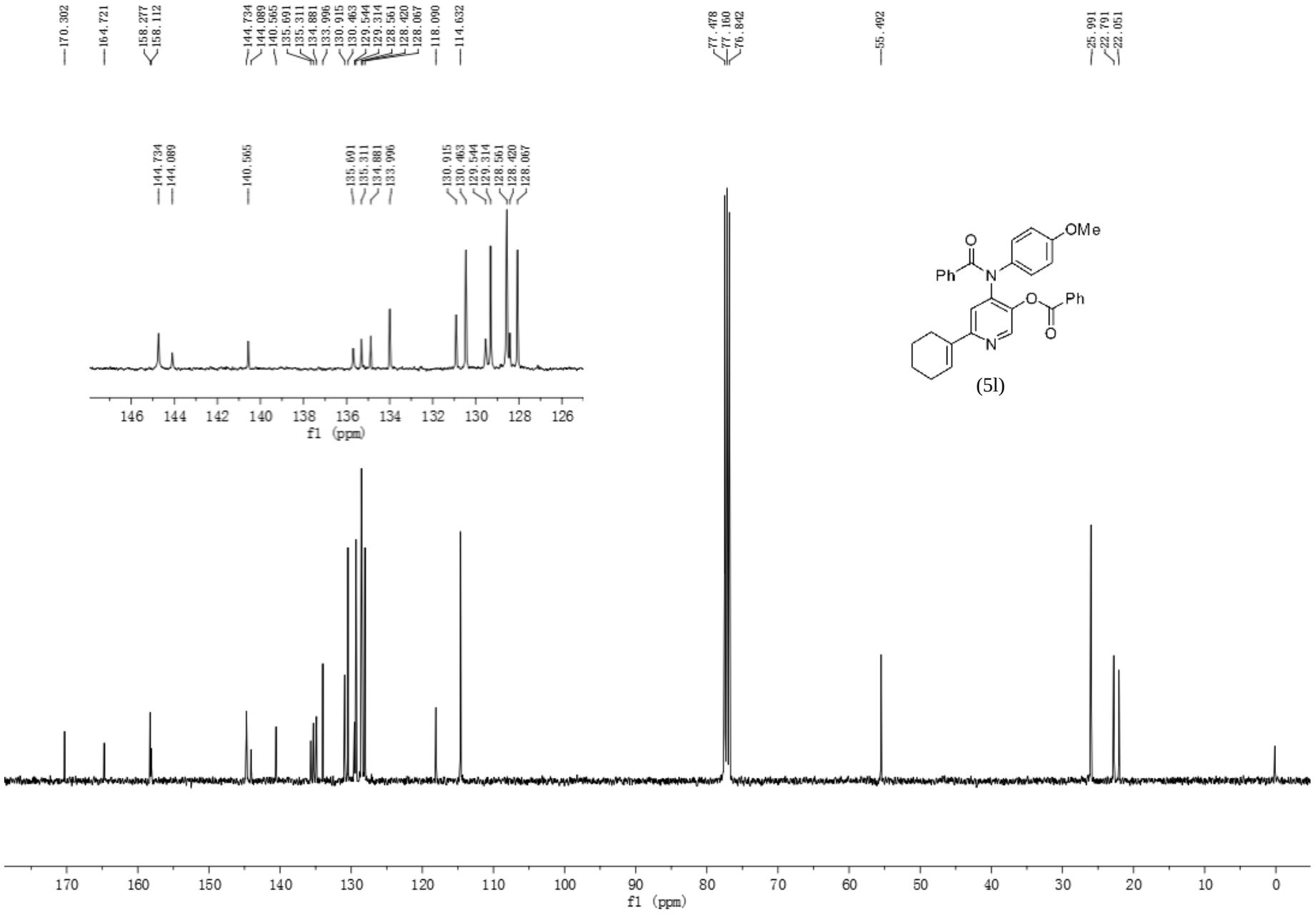

170.176
164.659
160.572
158.243
156.118
145.379
144.491
140.648
134.675
133.927
130.881
130.367
129.240
128.542
128.463
128.250
114.602
114.087
77.337
77.019
76.701
55.380
55.355
0.000
135.159
134.675
133.927
130.950
130.881
130.367
129.240
128.542
128.463
128.250
127.978
137
135
133
131
129
127
f1 (ppm)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

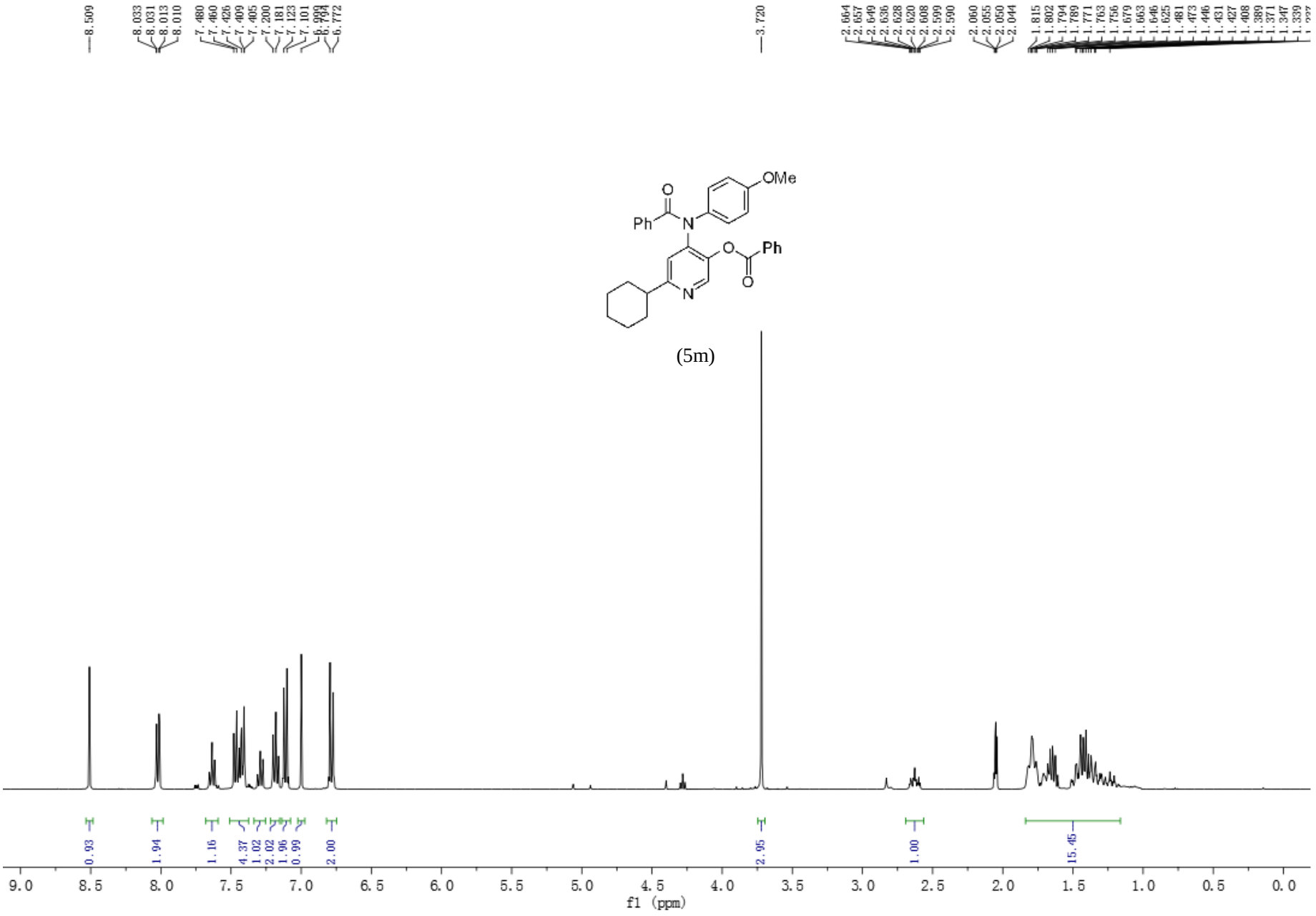
OMe
O
Ph
N
O
Ph
O
N
MeO

(5k)

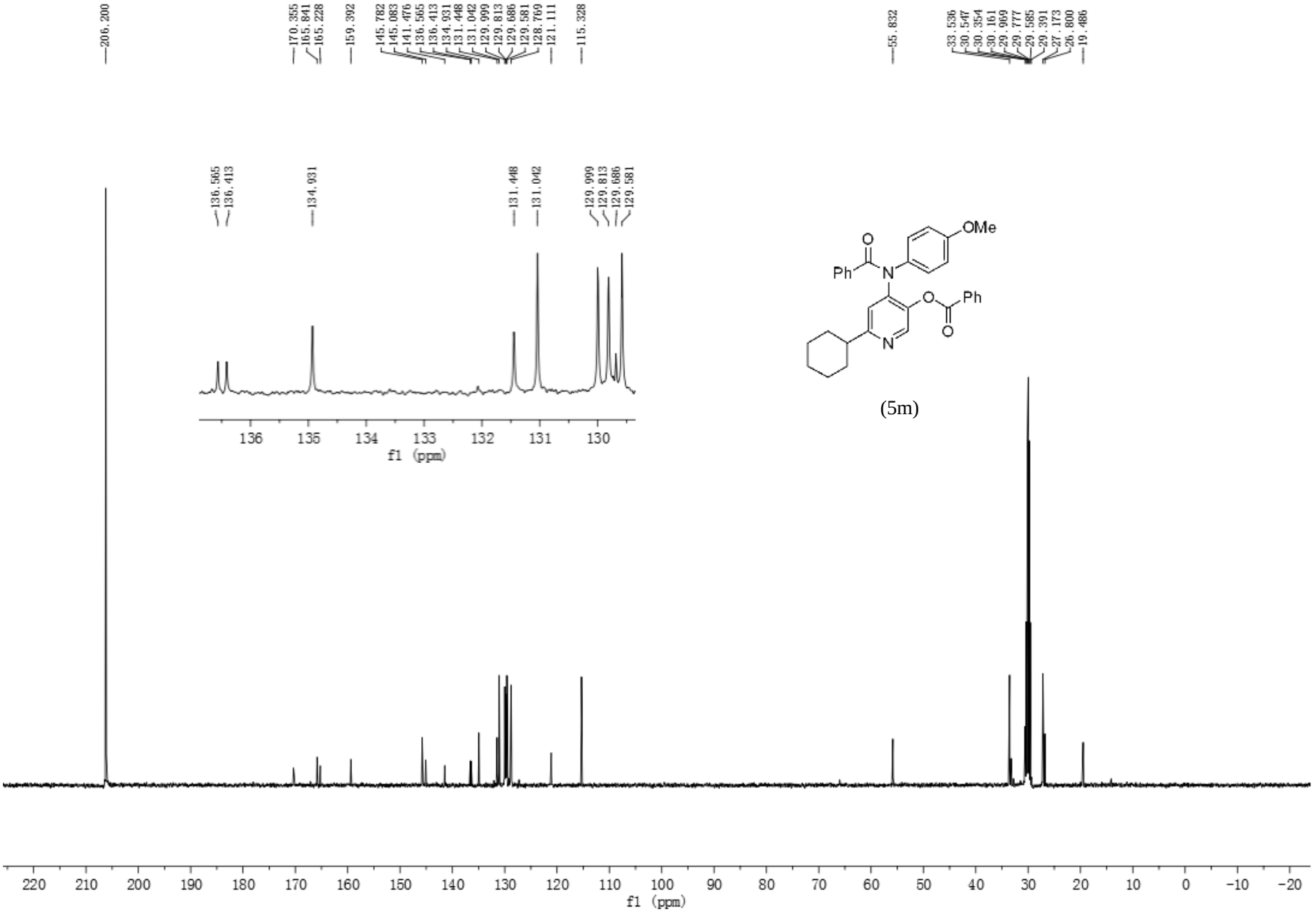

8.466
8.003
7.985
7.982
7.406
7.388
7.385
7.378
7.358
7.260
7.152
7.133
7.034
7.024
6.689
6.511
3.723
2.344
2.339
2.222
2.213
2.207
2.197
2.192
2.183
1.745
1.736
1.731
1.722
1.716
1.706
1.701
1.654
1.649
1.639
1.633
1.624
1.619
1.610
0.000
OMe
Ph
N
O
Ph
O
N
0.92
1.96
1.17
4.06
3.95
2.06
3.08
2.01
1.01
2.97
2.05
2.05
2.06
2.46
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
f1 (ppm)

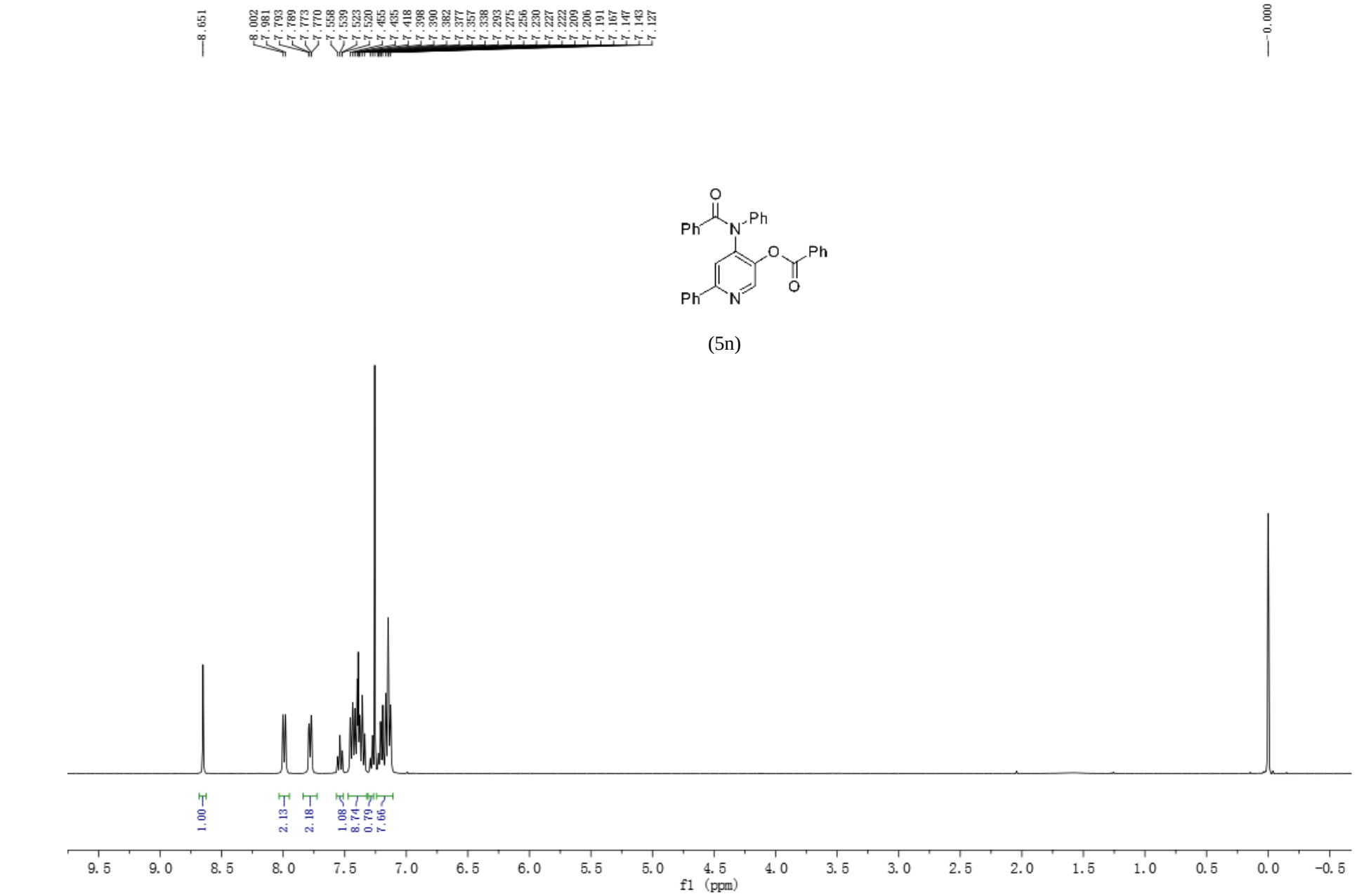
(5l)


170.302
164.721
158.277
158.112
144.734
144.089
140.565
135.691
135.311
134.881
133.996
130.915
130.463
129.544
129.314
128.561
128.420
128.067
118.090
114.632
77.478
77.160
76.842
55.492
25.991
22.791
22.051
146 144 142 140 138 136 134 132 130 128 126
f1 (ppm)
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)
OMe
Ph
N
O
Ph
O
N
O
(5l)

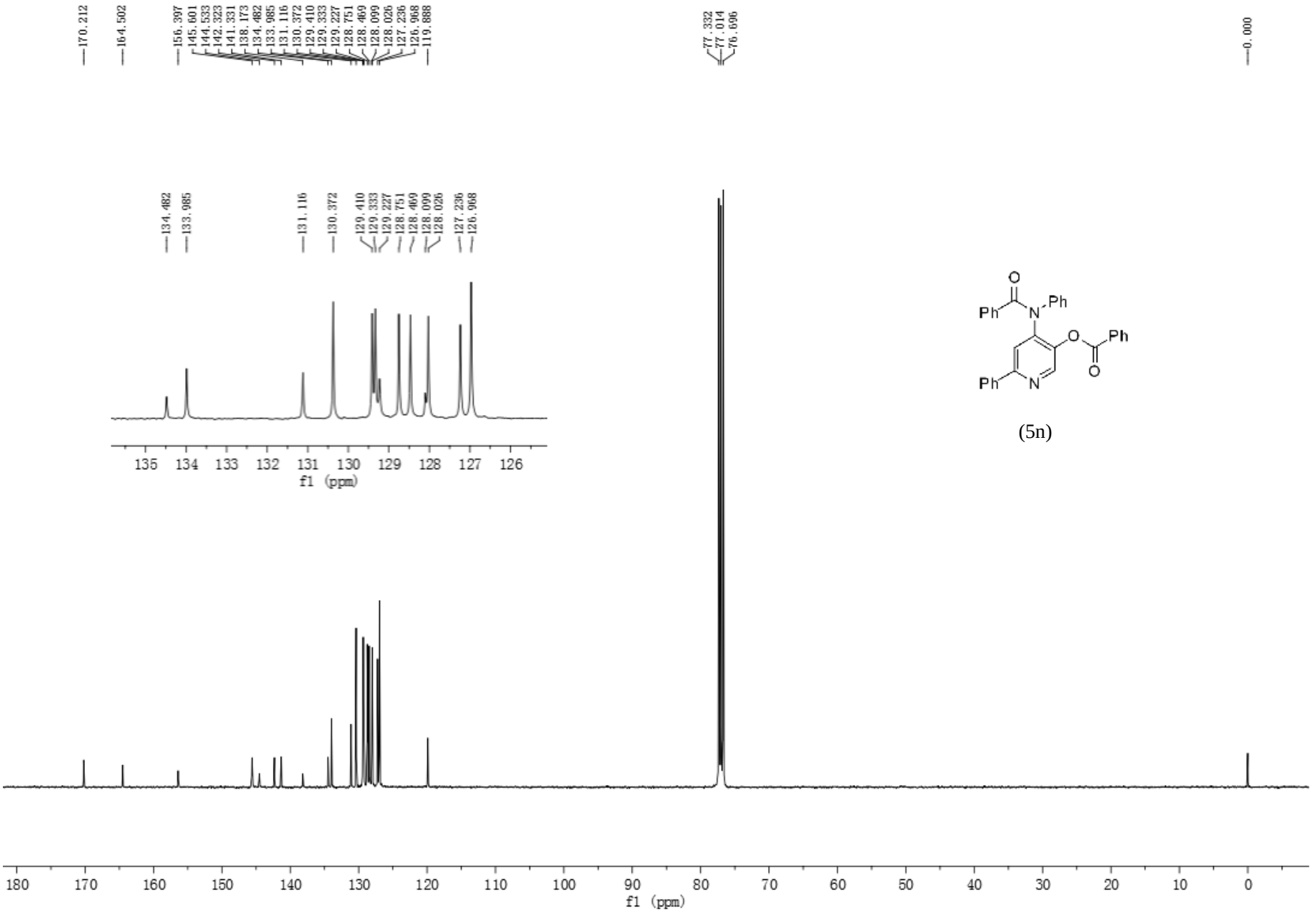

8.509
8.033
8.031
8.013
8.010
7.480
7.460
7.426
7.409
7.405
7.200
7.181
7.123
7.101
6.772
3.720
2.664
2.657
2.649
2.636
2.628
2.620
2.608
2.599
2.590
2.060
2.055
2.050
2.044
1.815
1.802
1.794
1.789
1.771
1.763
1.756
1.679
1.663
1.646
1.625
1.481
1.473
1.446
1.431
1.427
1.408
1.389
1.371
1.347
1.339
OMe
Ph
O
N
O
Ph
O
N
0.93
1.94
1.16
4.37
1.02
2.02
1.96
0.99
2.00
2.95
1.00
15.45
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)

(5m)

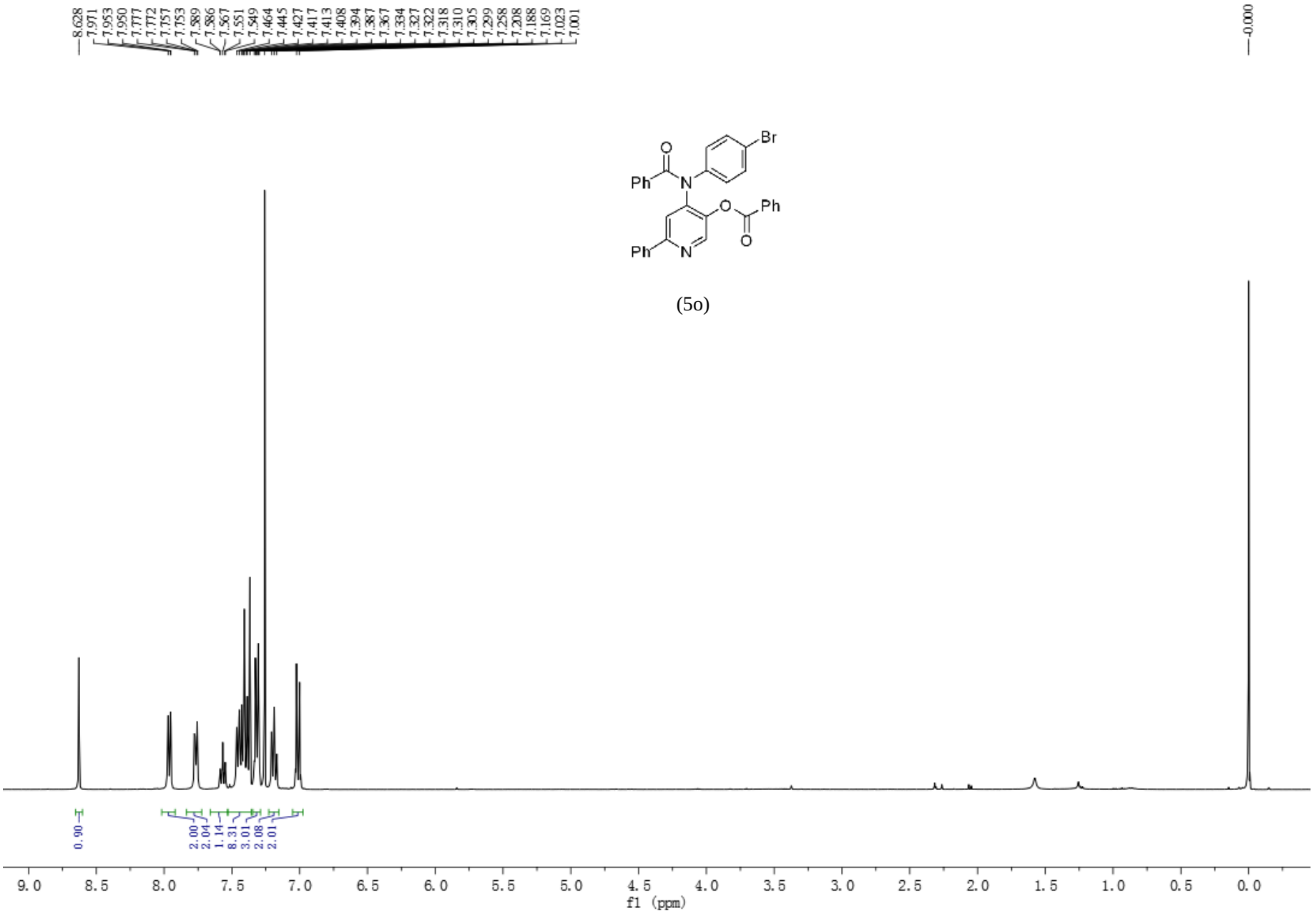

206.200
170.355
165.841
165.228
159.392
145.782
145.083
141.476
136.565
136.413
134.931
131.448
131.042
129.999
129.813
129.686
129.581
128.769
121.111
115.328
55.832
33.536
30.547
30.354
30.161
29.969
29.777
29.585
29.391
27.173
26.800
19.486
136.565
136.413
134.931
131.448
131.042
129.999
129.813
129.686
129.581
136
135
134
133
132
131
130
f1 (ppm)
OMe
O
Ph
N
O
Ph
O
N
(5m)
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
f1 (ppm)


8.651
8.002
7.981
7.793
7.789
7.773
7.770
7.558
7.539
7.523
7.520
7.455
7.435
7.418
7.398
7.390
7.382
7.377
7.357
7.338
7.293
7.275
7.256
7.230
7.227
7.222
7.209
7.206
7.191
7.167
7.147
7.143
7.127
0.000
1.00
2.13
2.18
1.08
8.74
0.79
7.66
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)

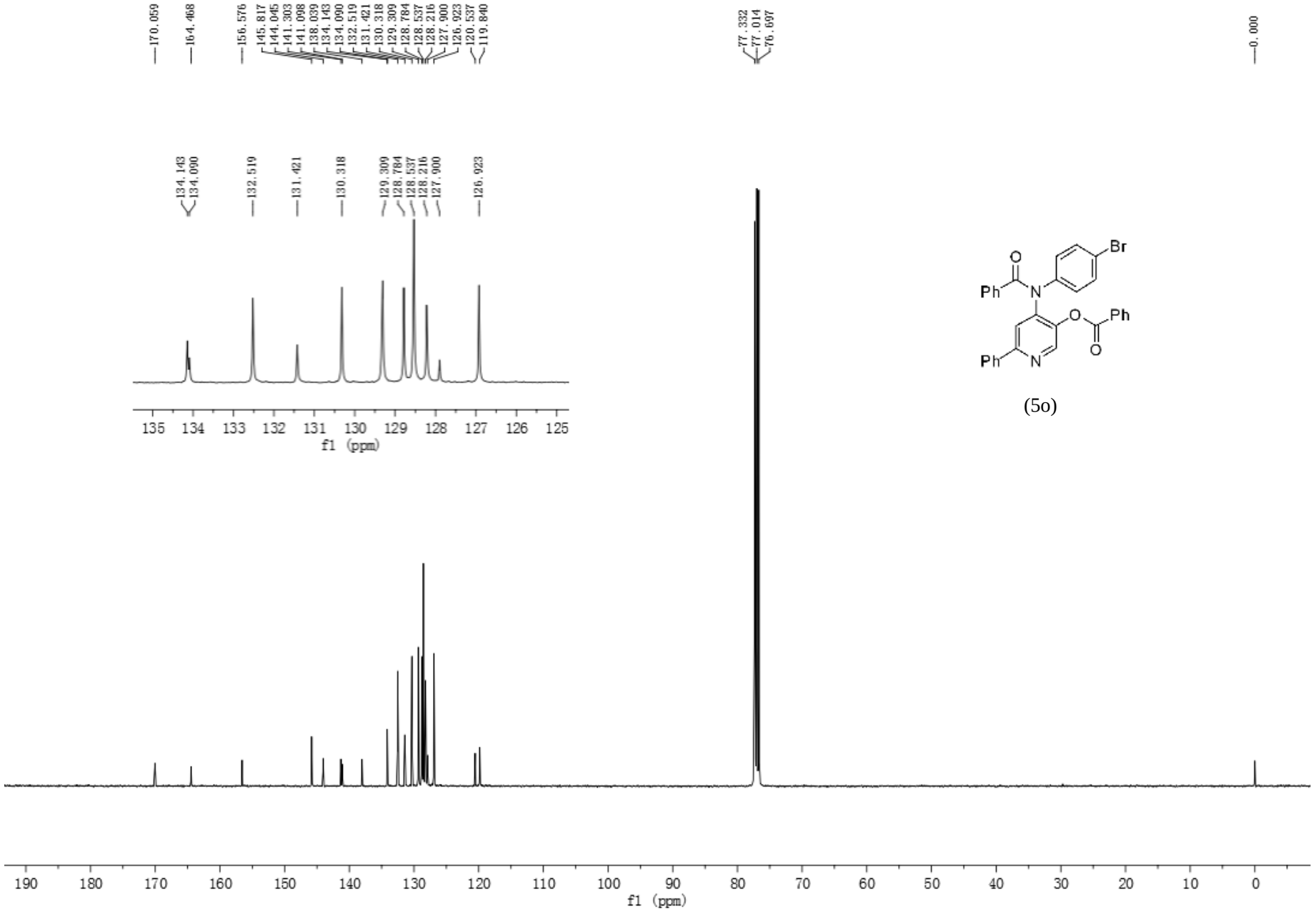
(5n)


170.212
164.502
156.397
145.601
144.533
142.323
141.331
138.173
134.482
133.985
131.116
130.372
129.410
129.333
129.227
128.751
128.469
128.099
128.026
127.236
126.968
119.888
77.332
77.014
76.696
0.000
134.482
133.985
131.116
130.372
129.410
129.333
129.227
128.751
128.469
128.099
128.026
127.236
126.968
135 134 133 132 131 130 129 128 127 126
f1 (ppm)
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)
Ph
N
Ph
O
O
Ph
O
Ph
N

(5n)

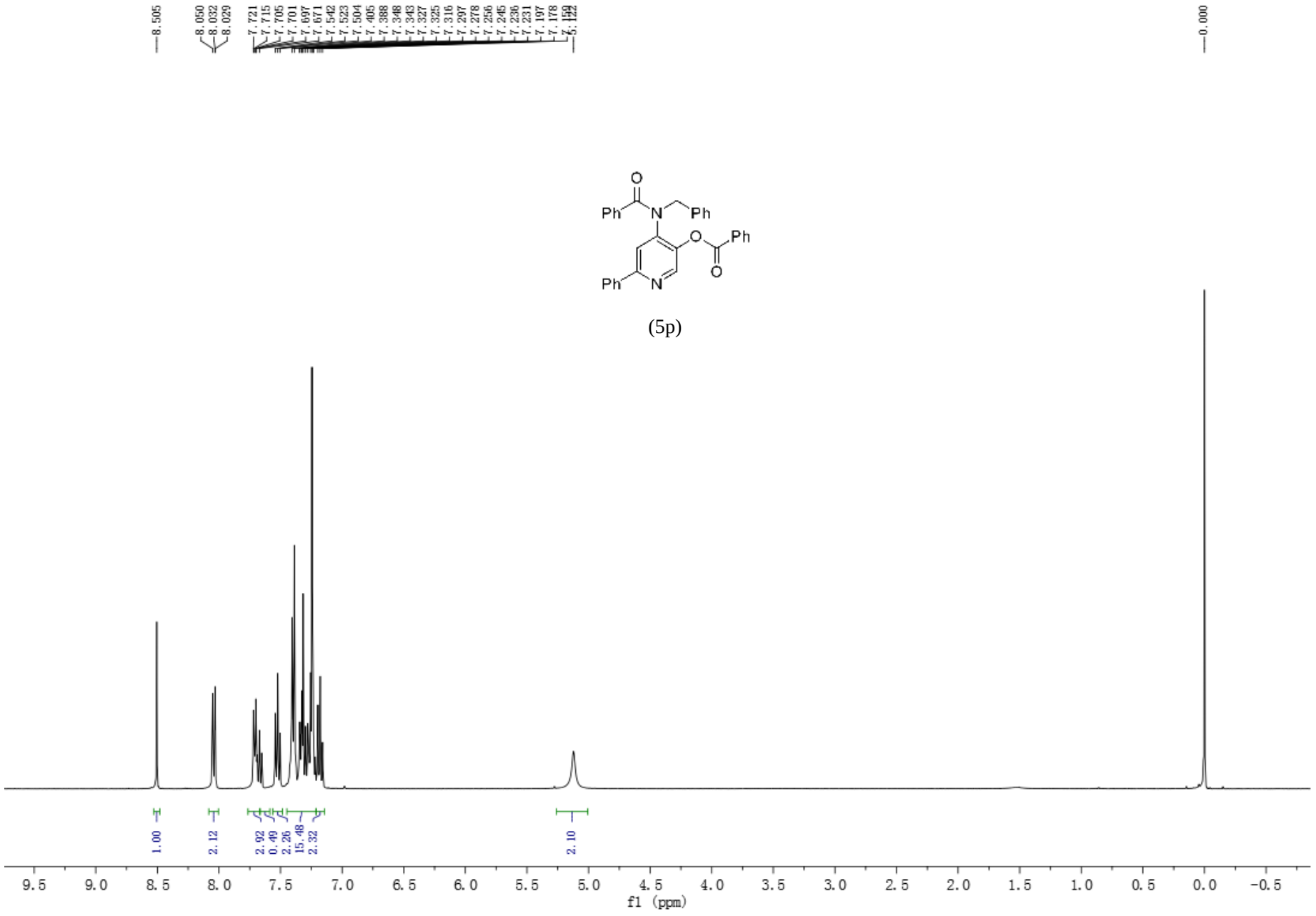

8.628
7.971
7.953
7.950
7.777
7.772
7.757
7.753
7.589
7.586
7.567
7.551
7.549
7.464
7.445
7.427
7.417
7.413
7.408
7.394
7.387
7.367
7.334
7.327
7.322
7.318
7.310
7.305
7.299
7.258
7.208
7.188
7.169
7.023
7.001
0.000
Br
Ph
N
O
Ph
O
Ph
N
0.90
2.00
2.04
1.14
8.31
3.01
2.08
2.01
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

(5o)

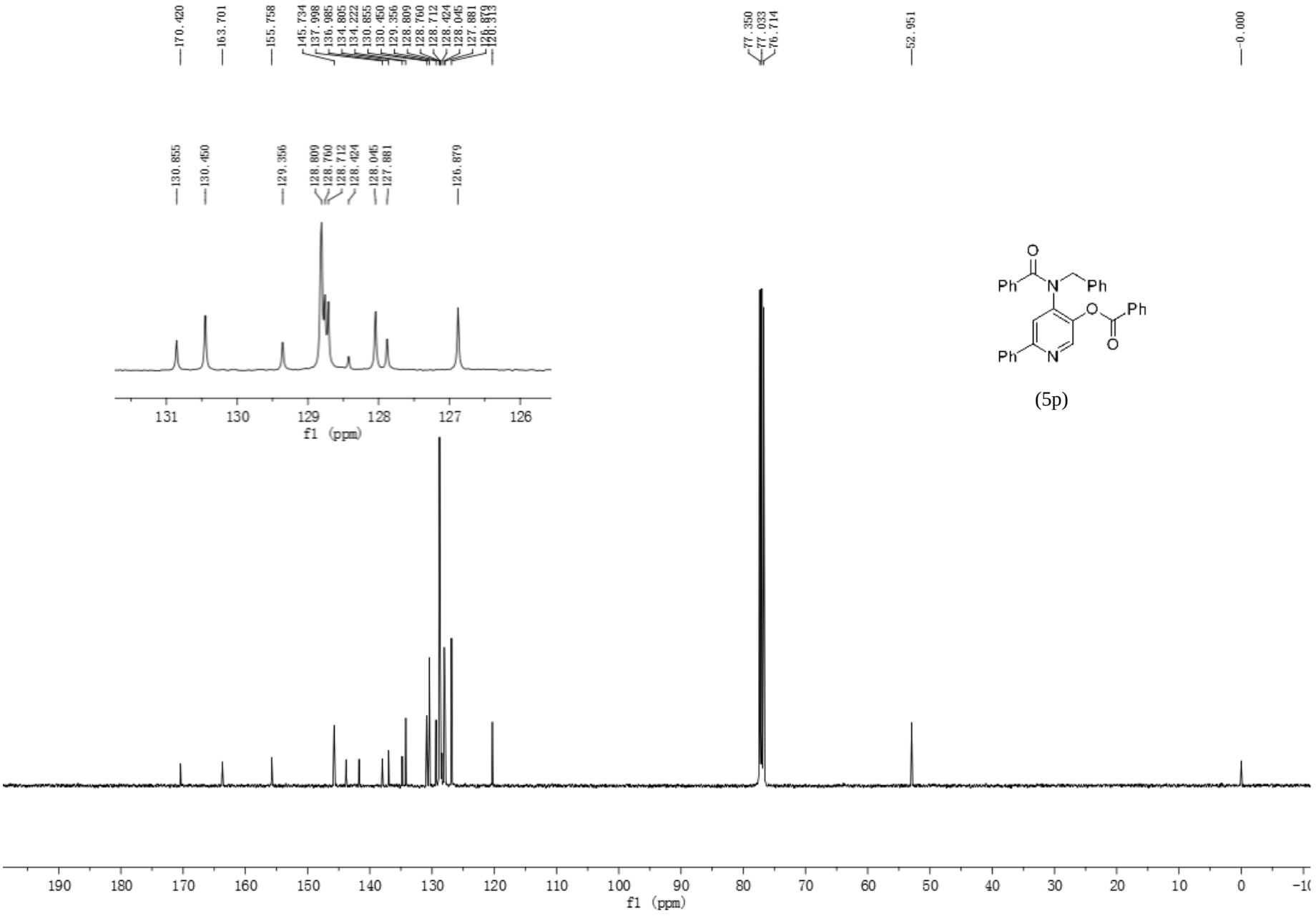

170.059
164.468
156.576
145.817
144.045
141.303
141.098
138.039
134.143
134.090
132.519
131.421
130.318
129.309
128.784
128.537
128.216
127.900
126.923
120.537
119.840
77.332
77.014
76.697
0.000
134.143
134.090
132.519
131.421
130.318
129.309
128.784
128.537
128.216
127.900
126.923
135 134 133 132 131 130 129 128 127 126 125
f1 (ppm)
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

Br
O
Ph
N
O
Ph
Ph
N
O

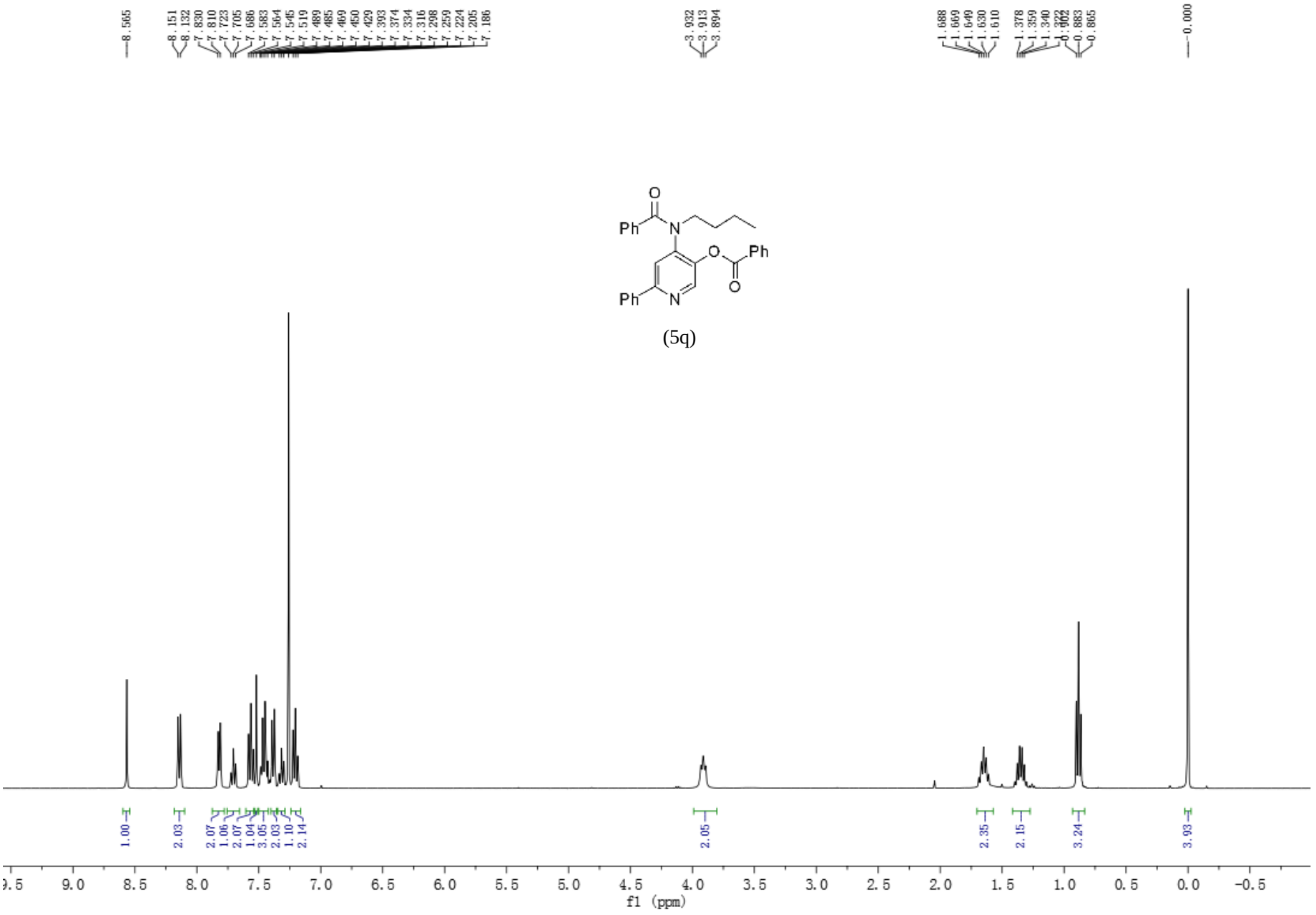
(5o)


8.505
8.050
8.032
8.029
7.721
7.715
7.705
7.701
7.697
7.671
7.542
7.523
7.504
7.405
7.388
7.348
7.343
7.327
7.325
7.316
7.297
7.278
7.256
7.245
7.236
7.231
7.197
7.178
0.000
Ph
N
Ph
O
Ph
O
Ph
N
1.00
2.12
2.92
0.49
2.26
15.48
2.32
2.10
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)

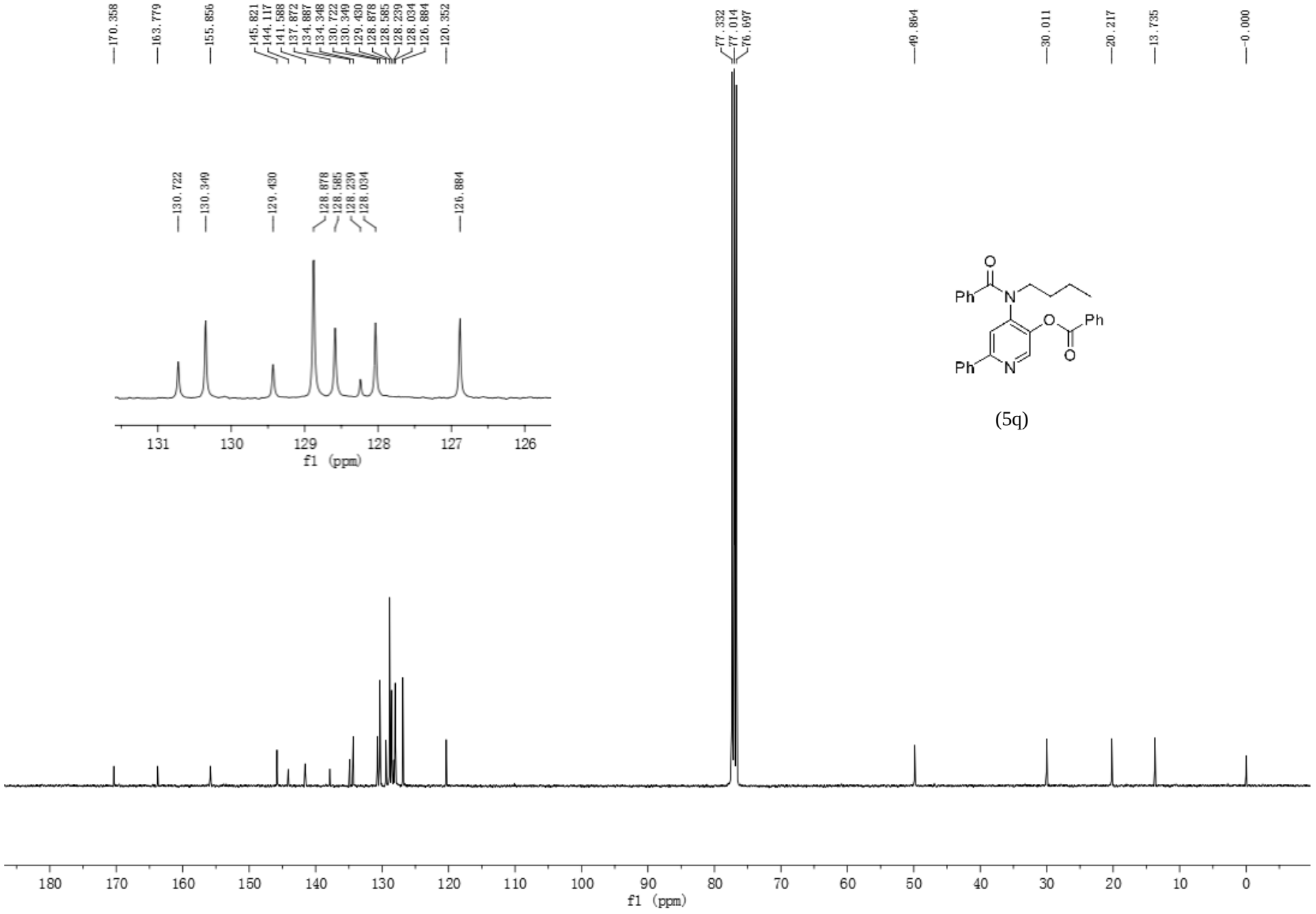
(5p)


170.420
163.701
155.758
145.734
137.998
136.985
134.805
134.222
130.855
130.450
129.356
128.809
128.760
128.712
128.424
128.045
127.881
126.879
126.313
77.350
77.033
76.714
52.951
0.000
130.855
130.450
129.356
128.809
128.760
128.712
128.424
128.045
127.881
126.879
131
130
129
128
127
126
f1 (ppm)
Ph
N
Ph
O
O
Ph
Ph
N
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

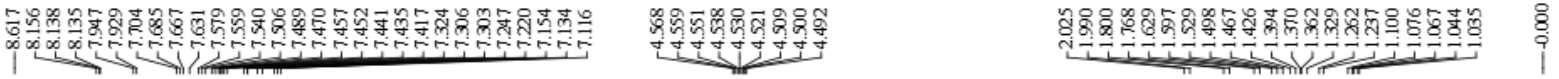
(5p)

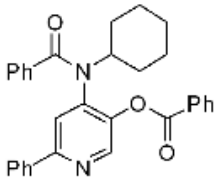

8.565
8.151
8.132
7.830
7.810
7.723
7.705
7.686
7.583
7.564
7.545
7.519
7.489
7.485
7.469
7.450
7.429
7.393
7.374
7.334
7.316
7.298
7.259
7.224
7.205
7.186
3.932
3.913
3.894
1.688
1.669
1.649
1.630
1.610
1.378
1.359
1.340
0.902
0.883
0.865
0.000
Ph
N
O
Ph
O
Ph
N
1.00
2.03
2.07
1.06
2.07
1.04
3.05
2.03
1.10
2.14
2.05
2.35
2.15
3.24
3.93
f1 (ppm)

(5q)

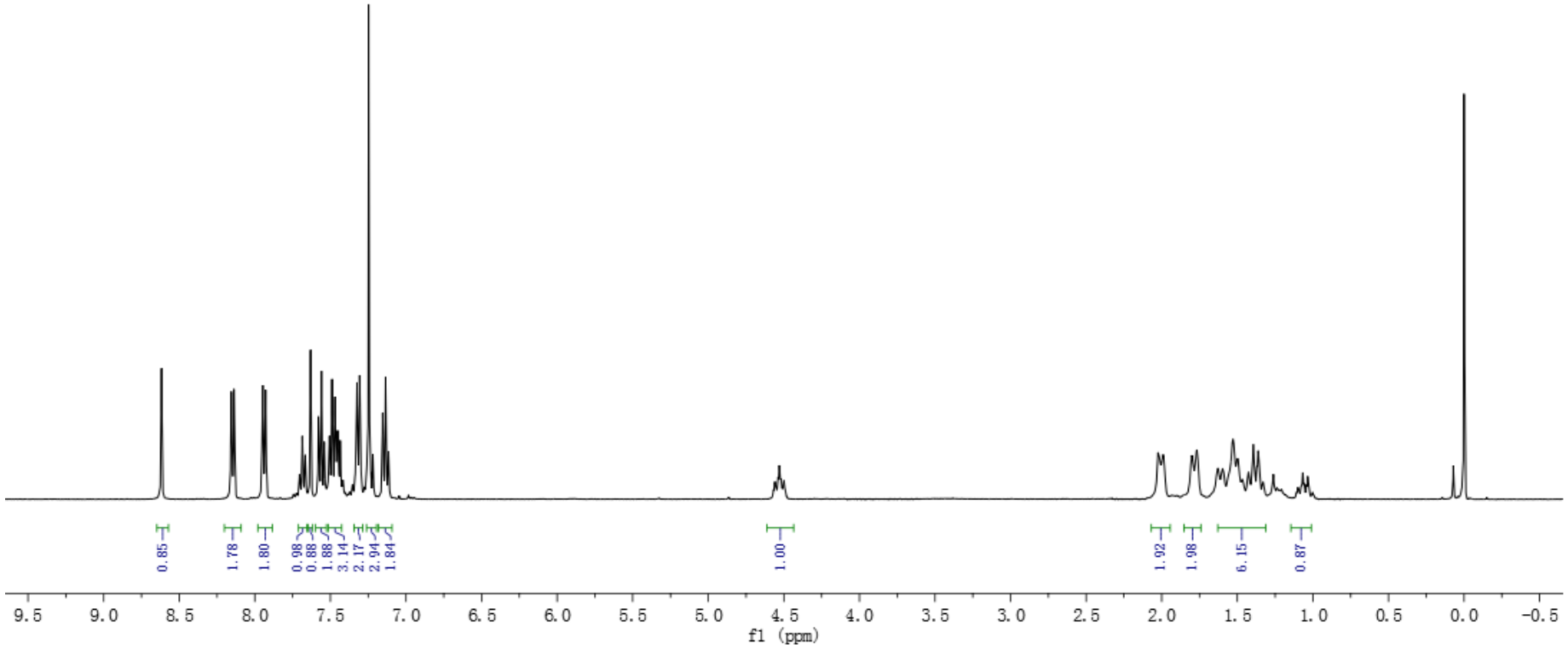

170.358
163.779
155.856
145.821
144.117
141.588
137.872
134.887
134.348
130.722
130.349
129.430
128.878
128.585
128.239
128.034
126.884
120.352
77.332
77.014
76.697
49.864
30.011
20.217
13.735
0.000
130.722
130.349
129.430
128.878
128.585
128.239
128.034
126.884
131
130
129
128
127
126
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

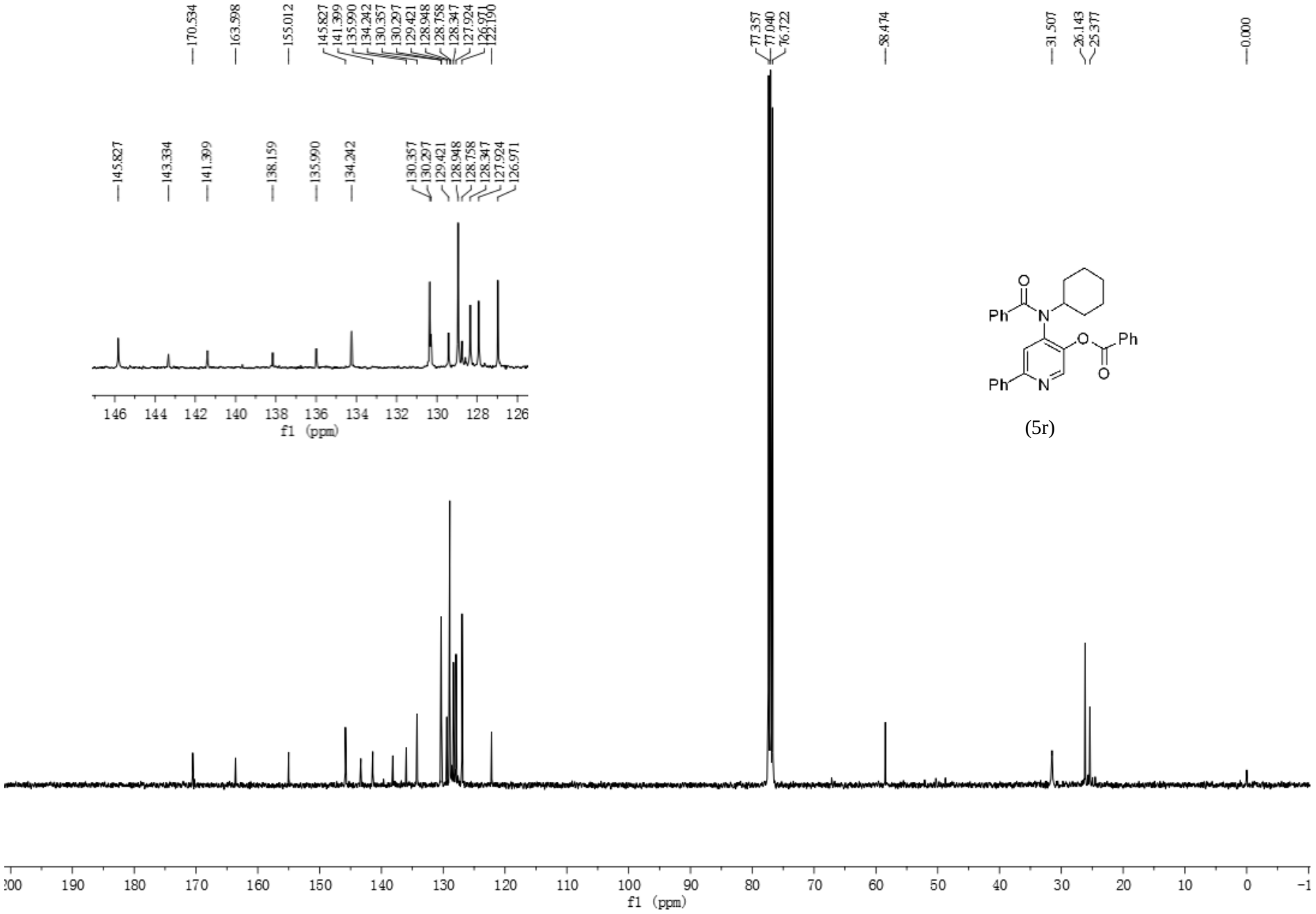
(5q)


8.617
8.156
8.138
8.135
7.947
7.929
7.704
7.685
7.667
7.631
7.579
7.559
7.540
7.506
7.489
7.470
7.457
7.452
7.441
7.435
7.417
7.324
7.306
7.303
7.247
7.220
7.154
7.134
7.116
4.568
4.559
4.551
4.538
4.530
4.521
4.509
4.500
4.492
2.025
1.990
1.800
1.768
1.629
1.597
1.529
1.498
1.467
1.426
1.394
1.370
1.362
1.329
1.262
1.237
1.100
1.076
1.067
1.044
1.035
0.000

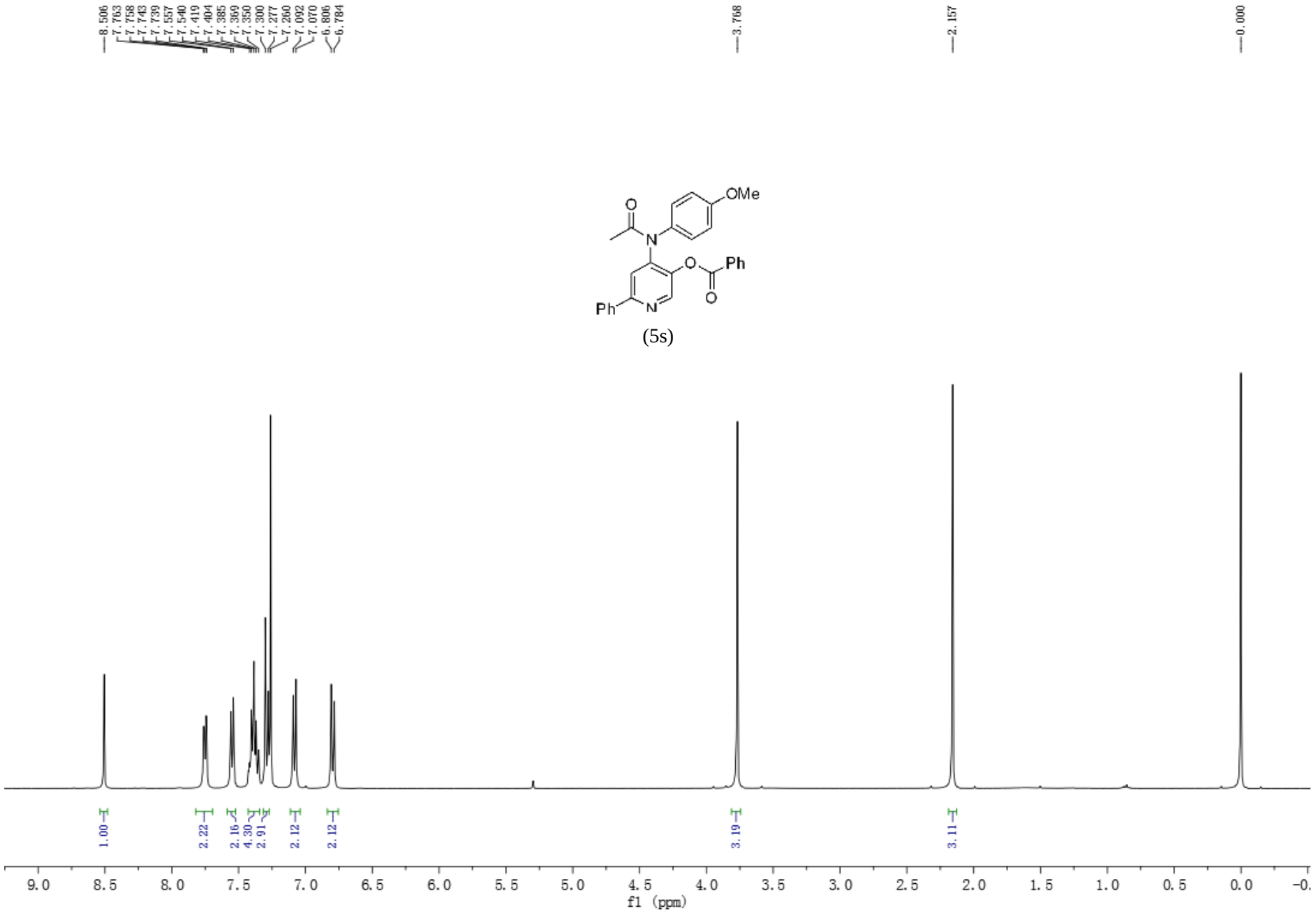

O
Ph
N
O
Ph
O
Ph
N

(5r)

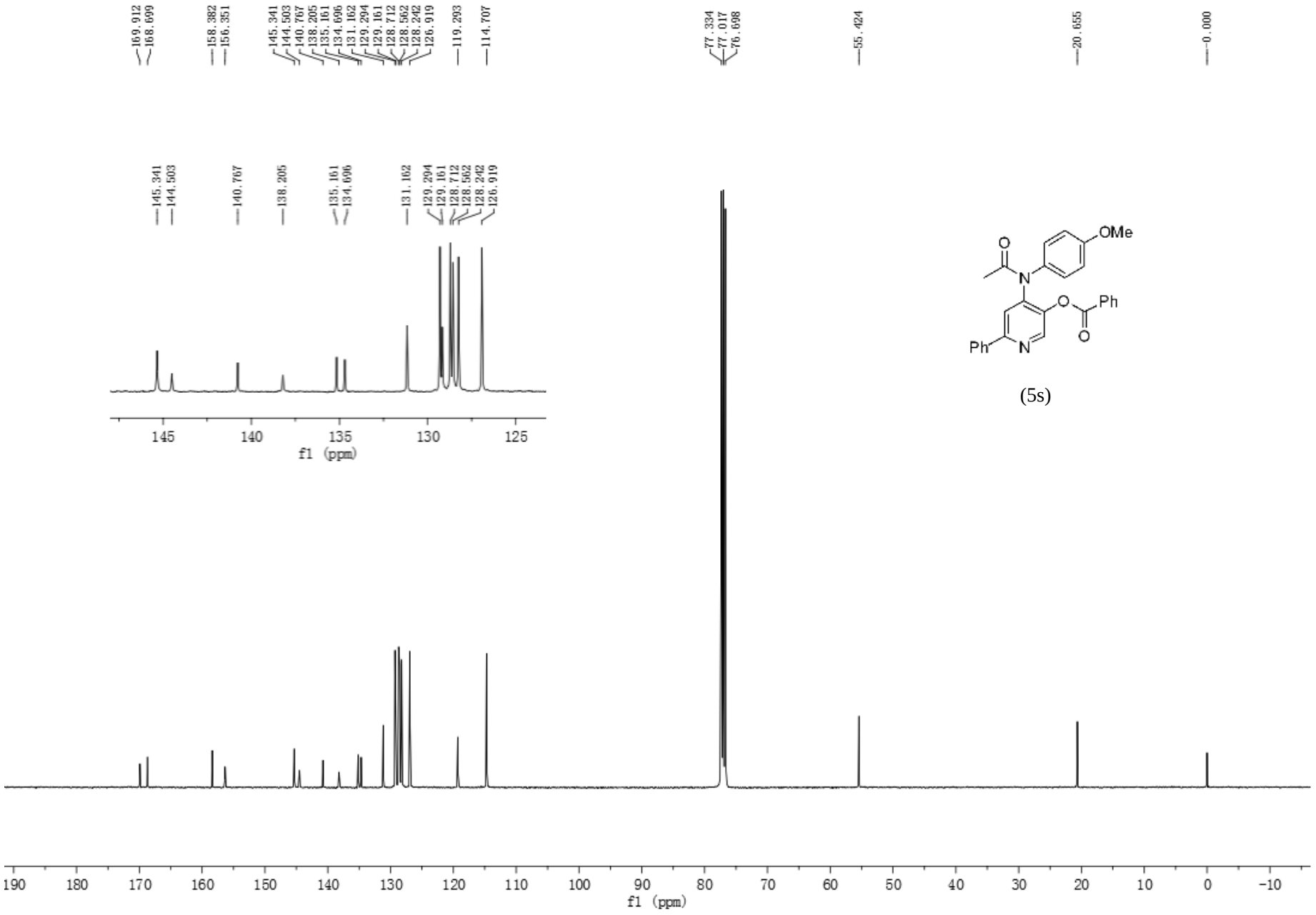

0.85
1.78
1.80
0.98
0.88
1.88
3.14
2.17
2.94
1.84
1.00
1.92
1.98
6.15
0.87
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


170.534
163.998
155.012
145.827
141.399
135.990
134.242
130.357
130.297
129.421
128.948
128.758
128.347
127.924
126.971
122.190
77.357
77.040
76.722
58.474
31.507
26.143
25.377
0.000
145.827
143.334
141.399
138.159
135.990
134.242
130.357
130.297
129.421
128.948
128.758
128.347
127.924
126.971
146 144 142 140 138 136 134 132 130 128 126
f1 (ppm)
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)
Ph
N
O
Ph
O
Ph
N

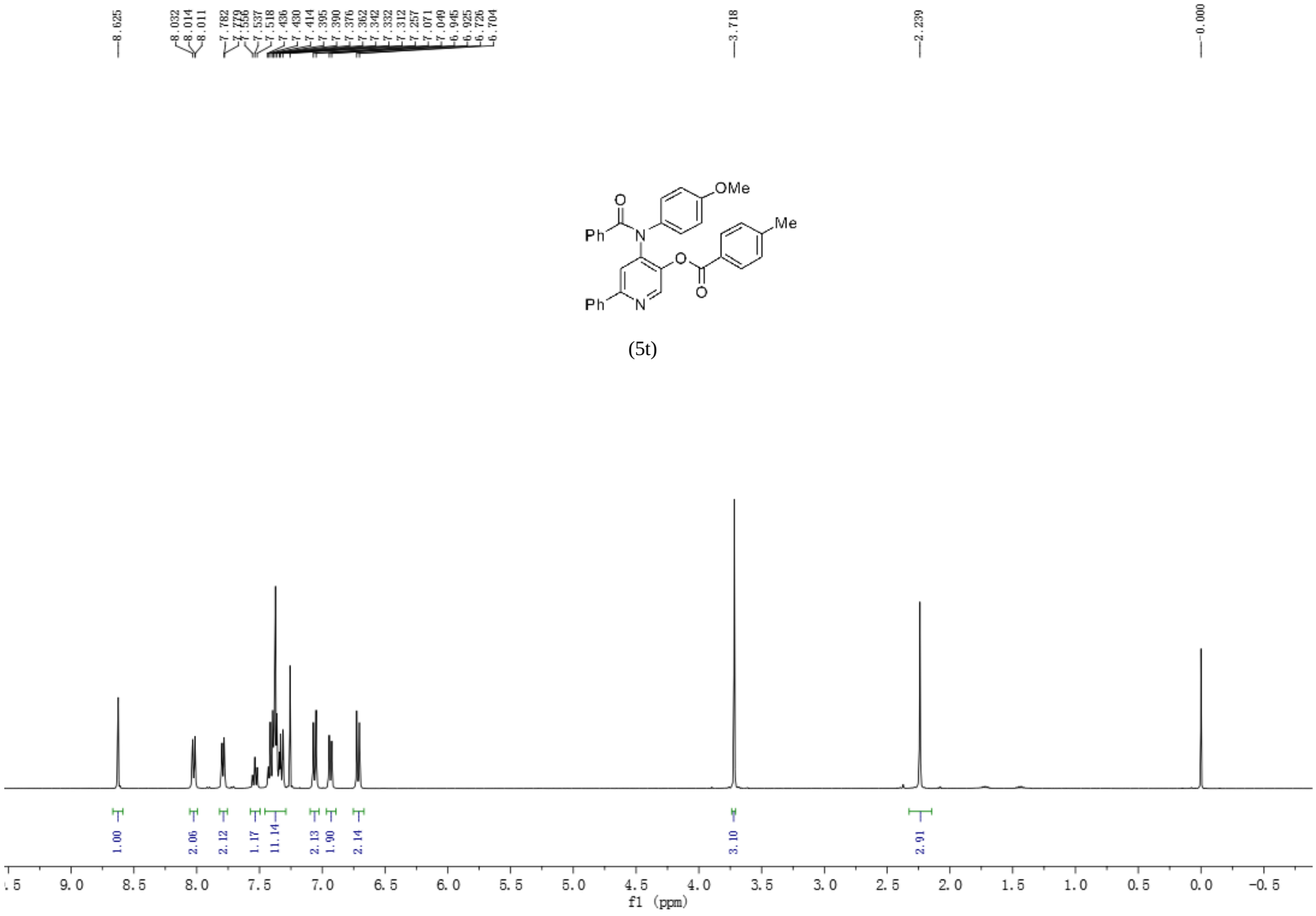
(5r)


8.506
7.763
7.758
7.743
7.739
7.557
7.540
7.419
7.404
7.385
7.369
7.350
7.300
7.277
7.260
7.092
7.070
6.806
6.784
3.768
2.157
0.000
OMe
O
N
O
Ph
O
Ph
N
1.00
2.22
2.16
4.30
2.91
2.12
2.12
3.19
3.11
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)

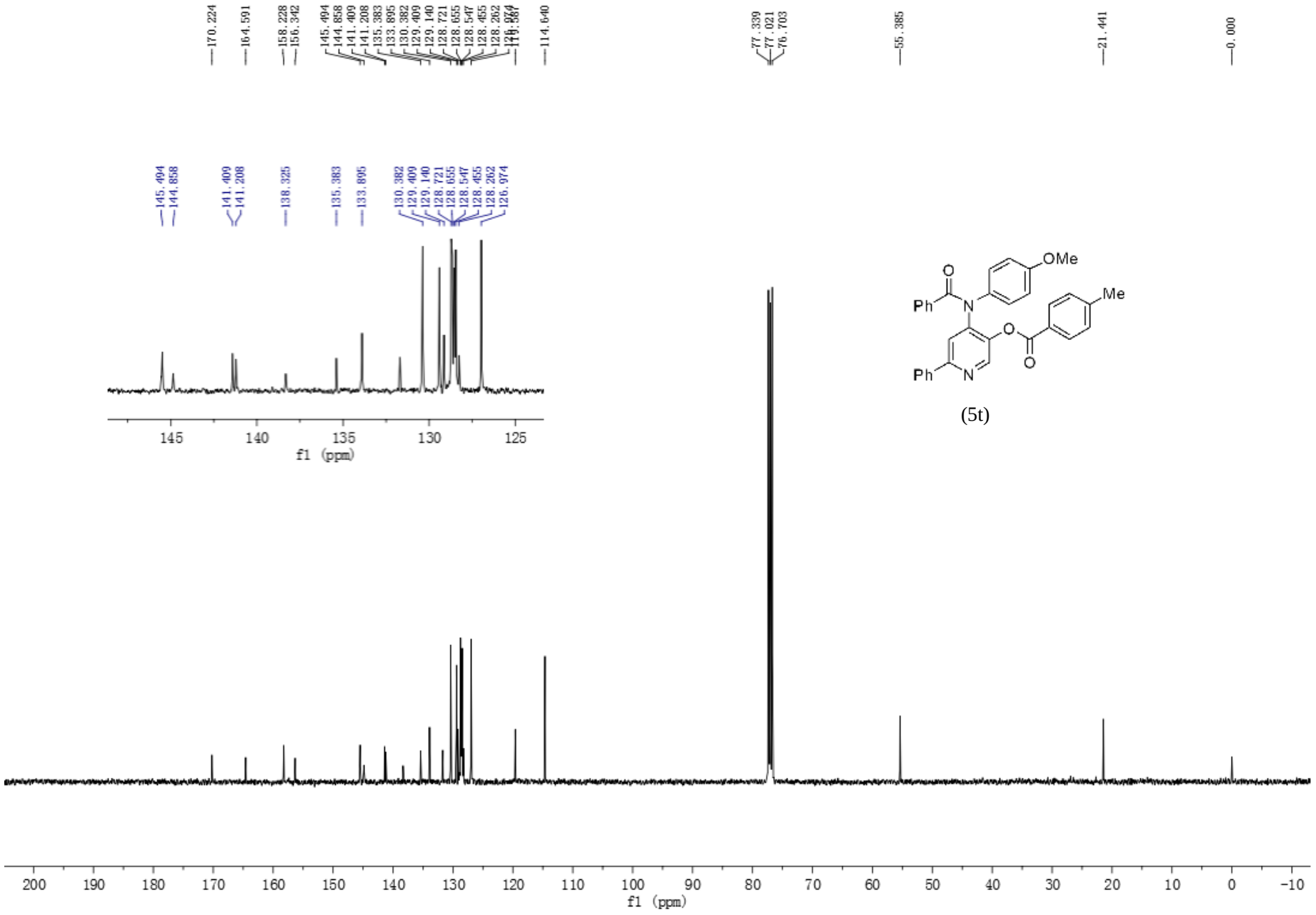
(5s)

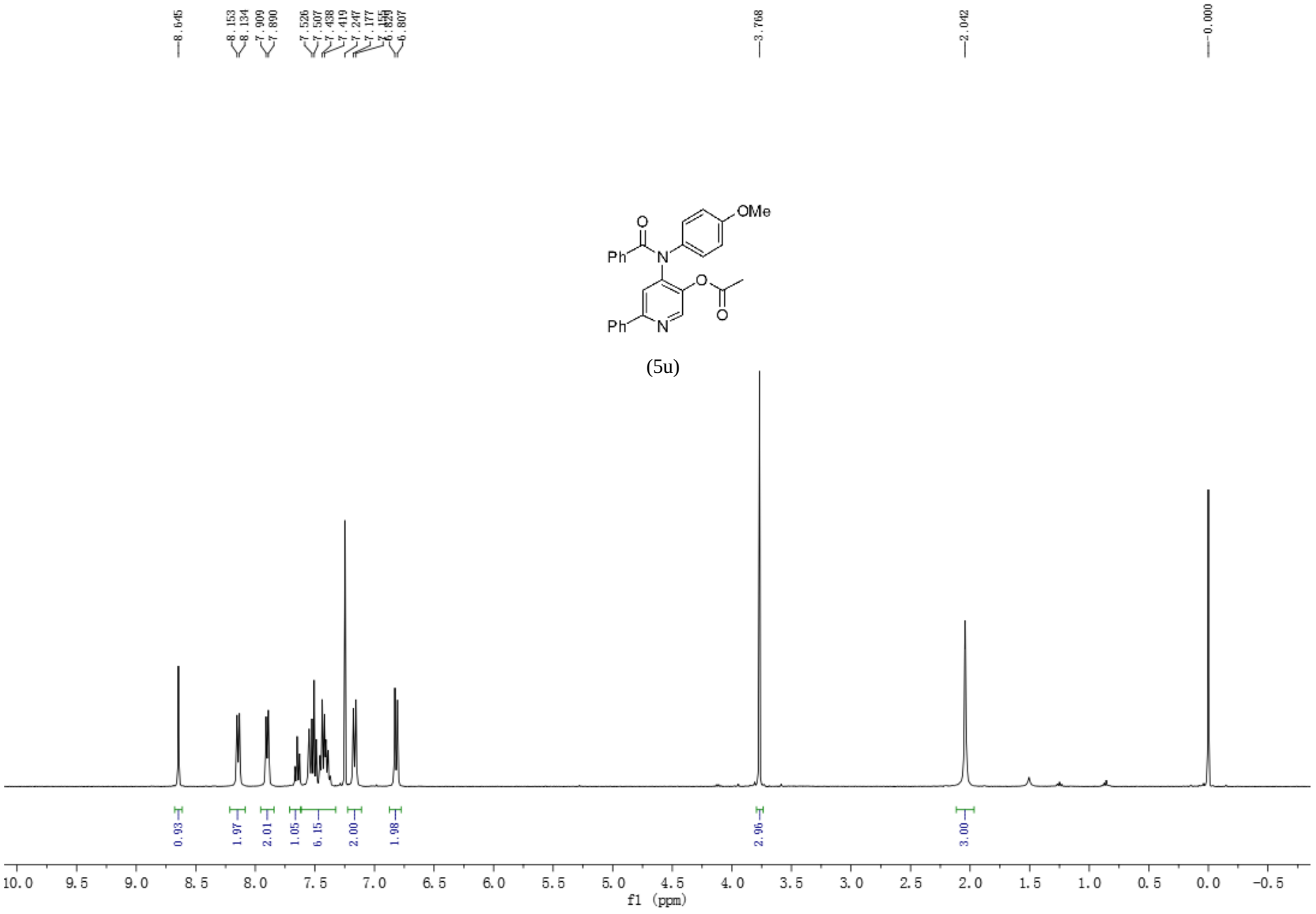

169.912
168.699
158.382
156.351
145.341
144.503
140.767
138.205
135.161
134.696
131.162
129.294
129.161
128.712
128.562
128.242
126.919
119.293
114.707
77.334
77.017
76.698
55.424
20.655
0.000
f1 (ppm)
OMe
Ph
Ph
O
N
O
O
N

(5s)

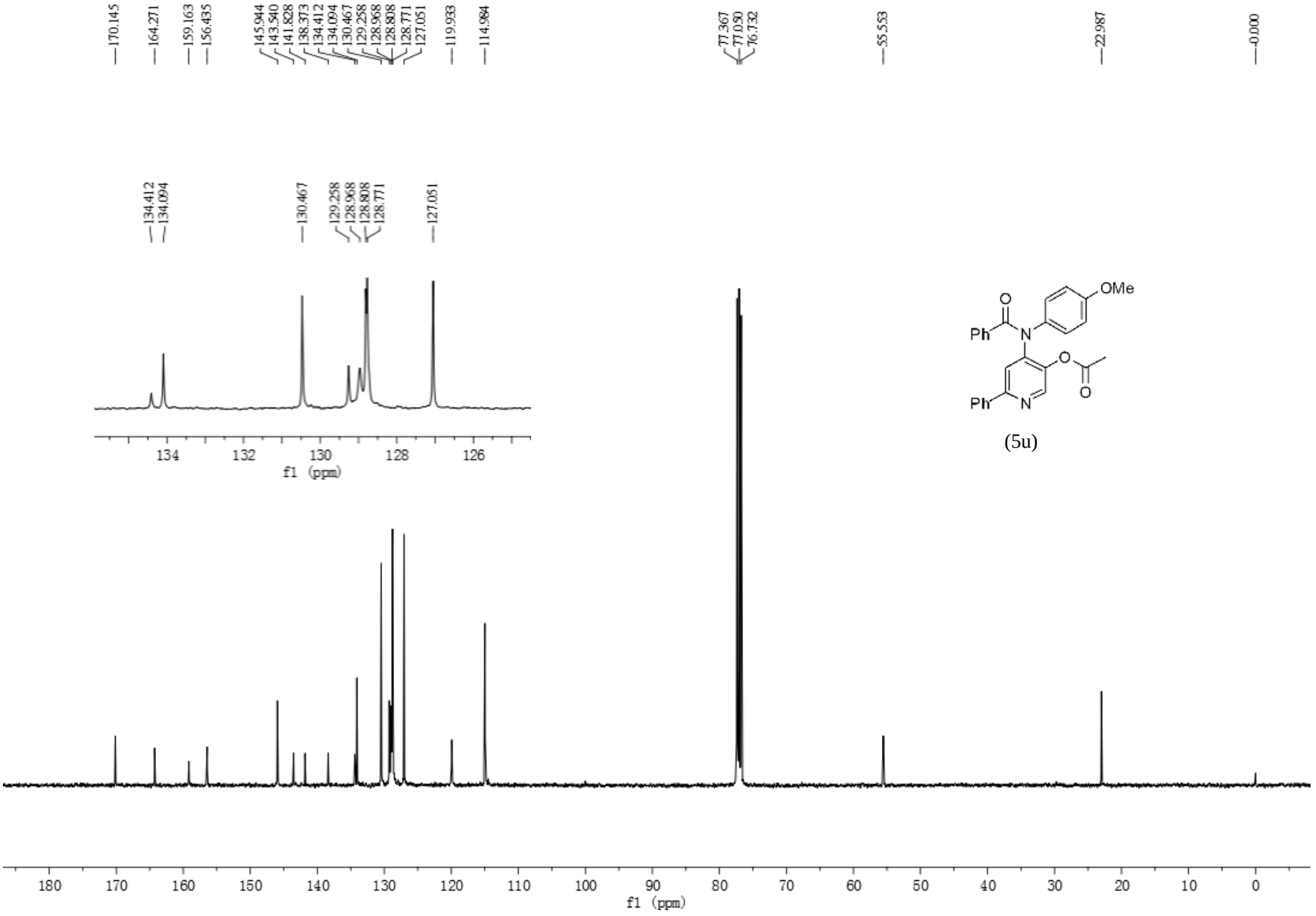

8.625
8.032
8.014
8.011
7.782
7.779
7.558
7.537
7.518
7.436
7.430
7.414
7.395
7.390
7.376
7.362
7.342
7.332
7.312
7.257
7.071
7.049
6.945
6.925
6.726
6.704
3.718
2.239
0.000
OMe
Me
Ph
N
O
O
O
Ph
N
1.00
2.06
2.12
1.17
11.14
2.13
1.90
2.14
3.10
2.91
f1 (ppm)

(5t)

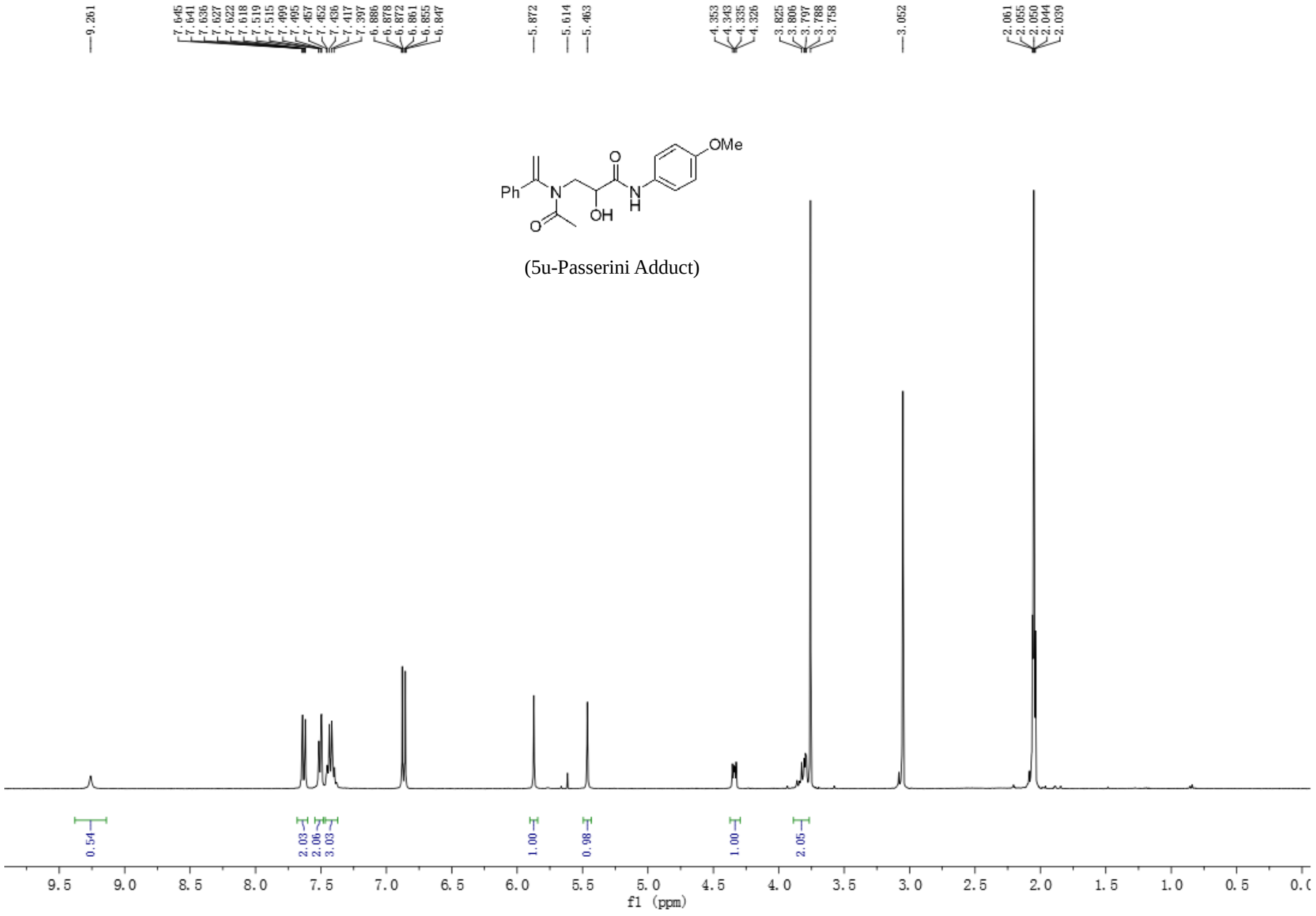

170.224
164.591
158.228
156.342
145.494
144.858
141.409
141.208
135.383
133.895
130.382
129.409
129.140
128.721
128.655
128.547
128.455
128.262
114.640
77.339
77.021
76.703
55.385
21.441
0.000
145.494
144.858
141.409
141.208
138.325
135.383
133.895
130.382
129.409
129.140
128.721
128.655
128.547
128.455
128.262
126.974
145
140
135
130
125
f1 (ppm)
OMe
Me
Ph
Ph
(5t)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


8.645
8.153
8.134
7.909
7.890
7.526
7.507
7.438
7.419
7.247
7.177
6.807
3.768
2.042
0.000
OMe
Ph
N
O
O
O
Ph
N
0.93
1.97
2.01
1.05
6.15
2.00
1.98
2.96
3.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

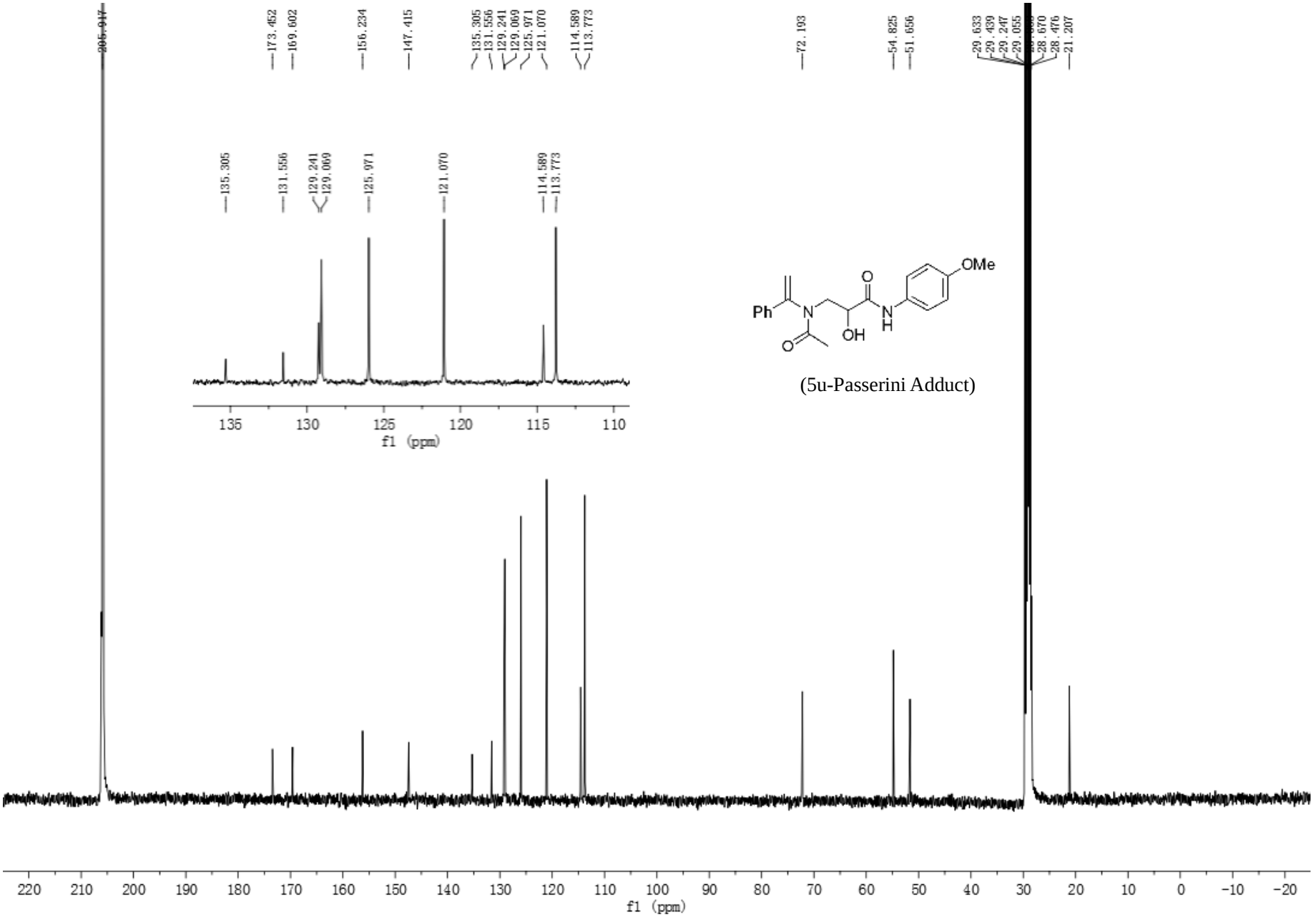
(5u)


170.145
164.271
159.163
156.435
145.944
143.540
141.828
138.373
134.412
134.094
130.467
129.258
128.968
128.808
128.771
127.051
119.933
114.984
77.367
77.050
76.732
55.553
22.987
0.000
OMe
Ph
N
O
O
Ph
N
O
f1 (ppm)
f1 (ppm)

(5u)



(5u-Passerini Adduct)



(5u-Passerini Adduct)