Metal-Free Acceptorless Dehydrogenative Cross-Coupling of Aldehydes/Alcohols with Alcohols

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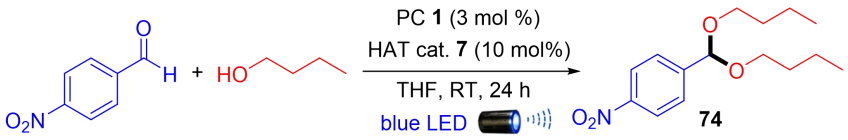
I. General Information

Chemicals and solvents were purchased from commercial suppliers and used as received. ^{1}H NMR, ^{13}C NMR spectra were recorded on a Bruker AV-III400 (400 MHZ) spectrometer. ^{1}H and ^{13}C NMR spectra were recorded in $CDCl_3$ (δ 7.26, 77.0 ppm) or benzene-d_6 (δ 7.16, 128.0 ppm) with tetramethylsilane (TMS) as the internal standard. Multiplicity was indicated as follows: s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), dd (doublet of doublet), br s (broad singlet). All high resolution mass spectra (HRMS) were obtained by either ESI mode with the mass analyzer of TOF used or by MALDI-TOF. The Blue LED strips were used in 2 meter, 18 W (maximum Emission at around 470 nm). Further visualization was achieved by staining with DNP.

II. Survey of Reaction Conditions

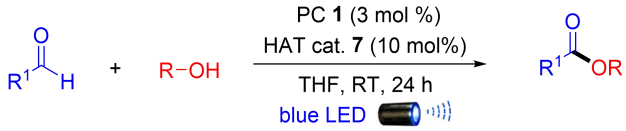
Table S1. Survey of conditions for the acetalization reaction[a]



Entry	Deviation from the standard conditions	Yield of **74** (%)[b]
1	None	93
2	CH_3CN instead of THF	61
3	DCM instead of THF	62
4	DCE instead of THF	82
5	dioxane instead of THF	64
6	PhMe instead of THF	80
7	PC **2**, **3**, **4** instead of PC **1**	trace
8	PC **5** instead of PC **1**	50
9	HAT cat. **6** instead of **7**	46
10	HAT cat. **8** instead of **7**	46
11	HAT cat. **10** instead of **7**	64
12	HAT cat. **11** or **12** instead of **7**	N.D.
13	Without PC, HAT cat. or light	N.D.

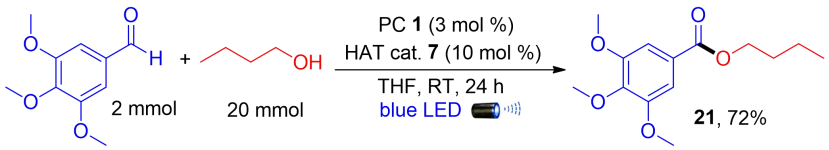
[a] Reaction conditions: *para*-methylbenzaldehyde (0.2 mmol), 1-butanol (2 mmol), 4CzIPN (PC **1**, 0.006 mmol), ethyl 2-mercaptopropionate (HAT cat. **7**, 0.02 mmol), THF (2 mL), 18 W blue LED, rt, 24 h. [b] Isolated yield.

III. Typical Procedure for Dehydrogenative Esterification of Aldehydes with Alcohols



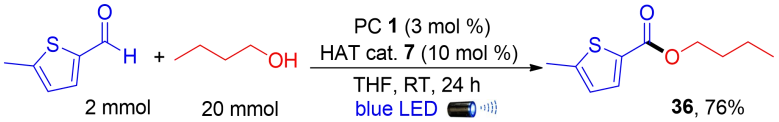
To a 25 mL Schlenk tube equipped with a magnetic stir bar was added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfilled with argon for three times. After that anhydrous THF (2 mL), alcohol (2 mmol), aldehyde (0.2 mmol) (for 4-nitrobenzaldehyde, DBU (15 μL, 0.1 mmol) was added) and ethyl 2-mercaptopropanoate (HAT cat. **7**, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane / ethyl acetate (40:1-20:1) or by prepared TLC to give the ester product.

IV. Large Scale Synthesis



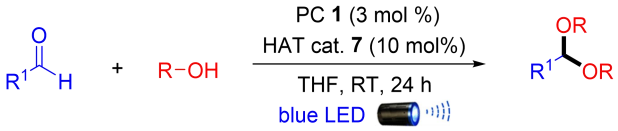
To a 50 mL eggplant-shaped reactor equipped with a magnetic stir bar were added the photocatalyst **1** 4CzIPN (47 mg, 0.06 mmol) and 3,4,5-trimethoxybenzaldehyde (392.4 mg, 2 mmol). The reactor was sealed and degassed via vacuum evacuation and subsequent backfilled with argon for three times. After that anhydrous THF (20 mL), 1-butanol (1.83 mL, 20 mmol), and ethyl 2-mercaptopropanoate (HAT cat. **7**, 0.2 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane / ethyl acetate (40:1-20:1) or by prepared TLC to give the ester product **21** (386.4 mg) in 72 % yield as a colorless oil.

To a 50 mL eggplant-shaped reactor equipped with a magnetic stir bar were added the photocatalyst **1** 4CzIPN (47 mg, 0.06 mmol) and 4-nitrobenzaldehyde (300 mg, 2 mmol). The reactor was sealed and degassed via vacuum evacuation and subsequent backfilled with argon for three times. After that anhydrous THF (20 mL), 1-butanol (1.83 mL, 20 mmol), ethyl 2-mercaptopropanoate (HAT cat. **7**, 0. 2 mmol) and DBU (150 µL, 1 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane / ethyl acetate (40:1-20:1) or by prepared TLC to give the ester product **30** (334.8 mg) in 75 % yield as a yellow oil.



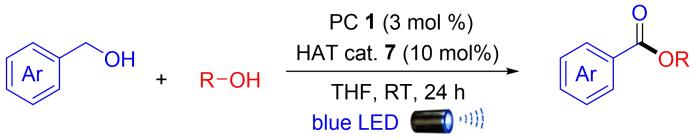
To a 50 mL eggplant-shaped reactor equipped with a magnetic stir bar was added the photocatalyst **1** 4CzIPN (47 mg, 0.06 mmol). The reactor was sealed and degassed via vacuum evacuation and subsequent backfilled with argon for three times. After that anhydrous THF (20 mL), 1-butanol (1.83 mL, 20 mmol), 5-methylthiophene-2-carboxaldehyde (220 µL, 2 mmol) and ethyl 2-mercaptopropanoate (HAT cat. **7**, 0. 2 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane / ethyl acetate (40:1-20:1) or by prepared TLC to give the ester product **36** (301.4 mg) in 76 % yield as a colorless oil.

V. Typical Procedure for Acetalization of Aldehydes with Alcohols



To a 25 mL Schlenk tube equipped with a magnetic stir bar was added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfilled with argon for three times. After that anhydrous THF (2 mL), alcohol (2 mmol), aldehyde (0.2 mmol) and ethyl 2-mercaptopropanoate (HAT cat. **7**, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane / ethyl acetate (40:1-20:1) or by prepared TLC to give the acetal product.

VI. Typical Procedure for Esterification of Two Different Alcohols



To a 25 mL Schlenk tube equipped with a magnetic stir bar was added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfilled with argon for three times. After that anhydrous THF (2 mL), alkyl alcohol (2 mmol), benzylic alcohols (0.2 mmol) and ethyl 2-mercaptopropanoate (HAT cat. **7**, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane/ethyl acetate (40:1-20:1) or by prepared TLC to give the ester product.

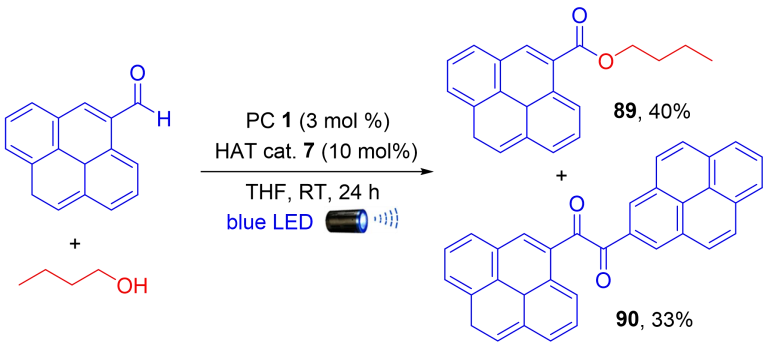
VII. Mechanistic Investigations

1) Control experiments

To a 25 mL Schlenk tube equipped with a magnetic stir bar was added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfill with argon for three times. After that anhydrous THF (2 mL), 4-methoxybenzoic acid (30 mg, 0.2 mmol), 1-butanol(183 μL, 2 mmol) and ethyl 2-mercaptopropanoate (HAT cat. **7**, 2.6 μL, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h, and there is no corresponding products were observed according to TLC analysis.

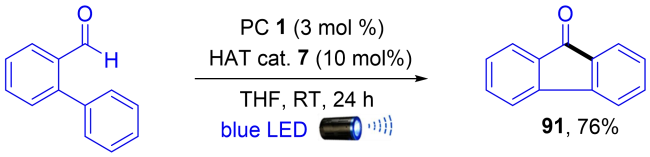
To a 25 mL Schlenk tube equipped with a magnetic stir bar was added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfill with argon for three times. After that anhydrous THF (2.0 mL), 4-methoxybenzaldehyde (0.2 mmol), 1-butanol(183 μL, 2 mmol) , TEMPO (0.5 mmol) and ethyl 2-mercaptopropanoate (HAT cat. 7, 2.6 μL, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h, and there is no corresponding products were observed according to TLC analysis.

2) Trapping the Acyl Radical under the Standard Esterification Conditions with Pyrene-1-carbaldehyde and 1-Butanol

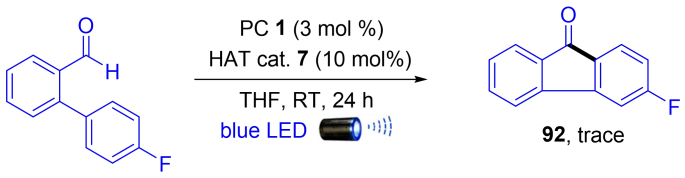


To a 25 mL Schlenk tube equipped with a magnetic stir bar were added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol) and pyrene-1-carbaldehyde (46 mg, 0.2 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfill with argon for three times. After that anhydrous THF (2.0 mL), 1-butanol (183 μL, 2 mmol) and ethyl 2-mercaptopropanoate (HAT cat. **7**, 2.6 μL, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane / ethyl acetate (40:1-20:1) to give the the ester **89** and the dimer **90** in 40% and 33% yields, respectively.

3) Trapping the Acyl Cation with 2-Phenylbenzaldehyde and 2-(4-Fluorophenyl)benzaldehyde



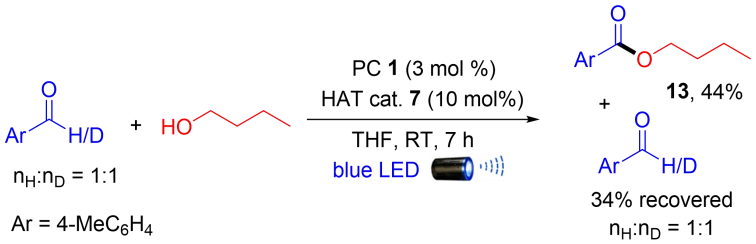
To a 25 mL Schlenk tube equipped with a magnetic stir bar were added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol) and 2-phenylbenzaldehyde (36 mg, 0.2 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfill with argon for three times. After that anhydrous THF (1.5 mL), ethyl 2-mercaptopropanoate (HAT cat. **7**, 2.6 μL, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane / ethyl acetate (20:1) to give the 9-fluorenone **91** in 76% yield.



To a 25 mL Schlenk tube equipped with a magnetic stir bar were added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol) and 2-(4-fluorophenyl)benzaldehyde (40 mg, 0.2 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfill with argon for three times. After that anhydrous THF (1.5 mL), ethyl 2-mercaptopropanoate (HAT cat. **7**, 2.6 μL, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 24 h, which led to the formation of 9-fluorenone **92** in only a trace amount.

4) KIE studies

The deuterated *para*-methylbenzaldehyde-d_1 (100%-*D* incorporation) was prepared according to a known method. [S1]



To a 25 mL Schlenk tube equipped with a magnetic stir bar were added the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), *para*-methylbenzaldehyde (12 μL, 0.1 mmol), and *para*-methylbenzaldehyde-d_1 (26 μL, 0.1 mmol). The Schlenk tube was sealed and degassed via vacuum evacuation and subsequent backfill with argon for three times. After that anhydrous THF (2.0 mL), 1-butanol (2 mmol), and ethyl 2-mercaptopropanoate (HAT cat. **7**, 2.6 μL, 0.02 mmol) were added sequentially by means of syringe. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 7 h. The solvent was removed on a rotary evaporator under reduced pressure and the crude product was purified by column chromatography isolation on silica gel via gradient elution with hexane / ethyl acetate (40:1-20:1) to give the recovered *para*-methylbenzaldehyde and the ester product **13** in 34% and 44% yields, respectively. A remained C-H/D ratio was observed in the recovered *para*-methylbenzaldehyde according to ^{1}H NMR.

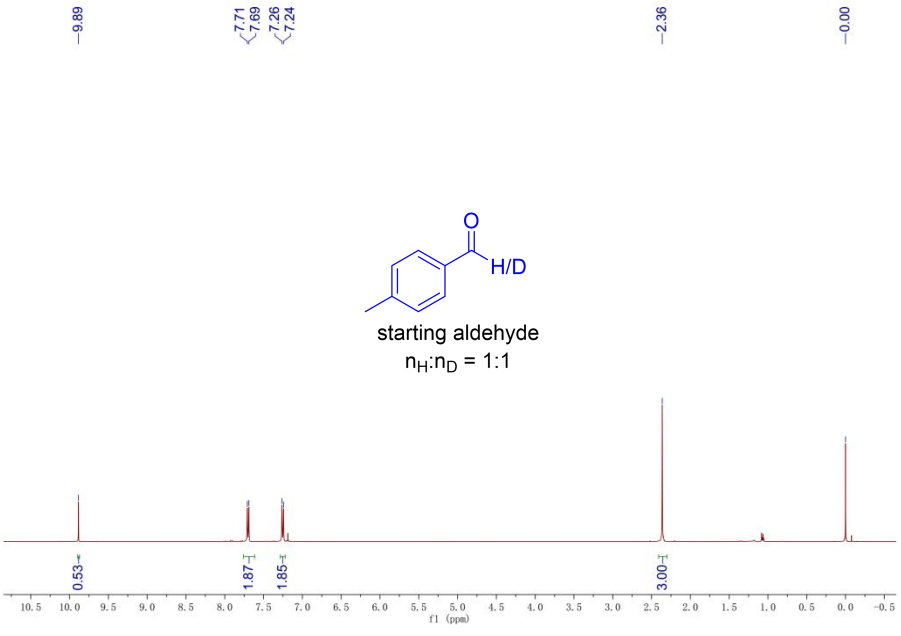


Figure S1. ^{1}H NMR spectra of the starting aldehyde (n_H:n_D = 1:1)

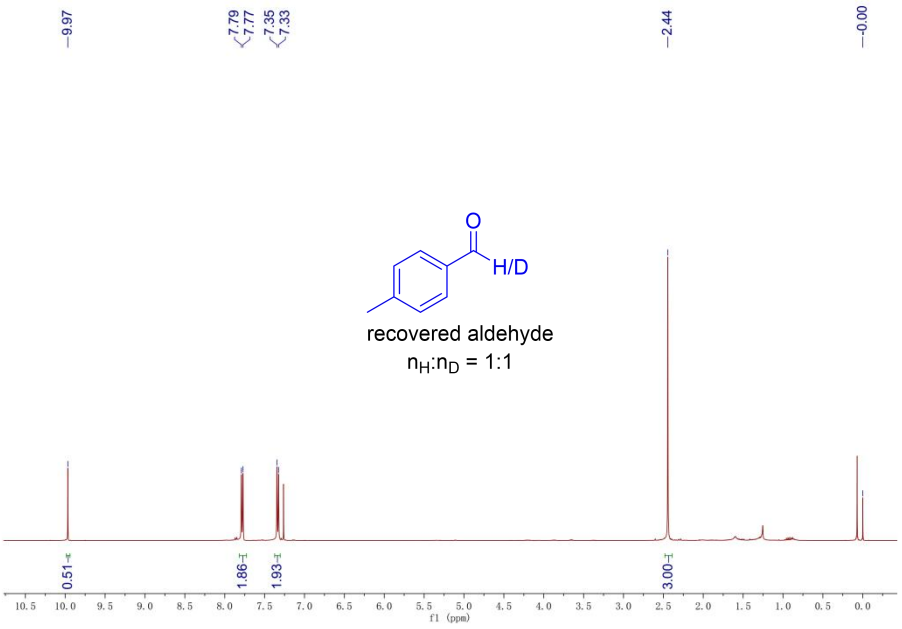
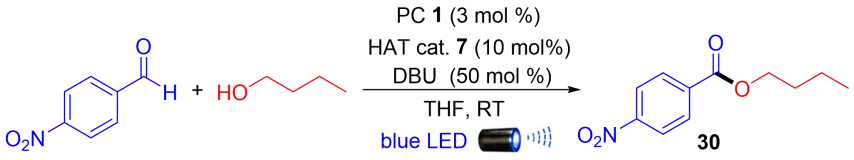


Figure S2. ^{1}H NMR spectra of the recovered aldehyde (n_H:n_D = 1:1)

5) Light on-off experiments



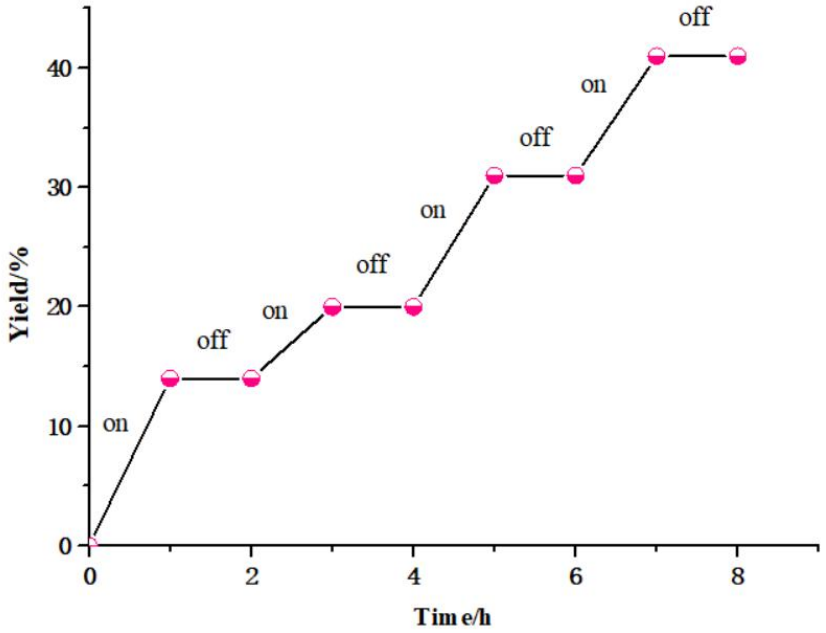


Figure S3. Light on-off experiments for esterification of 4-nitrobenzaldehyde with 1-butanol

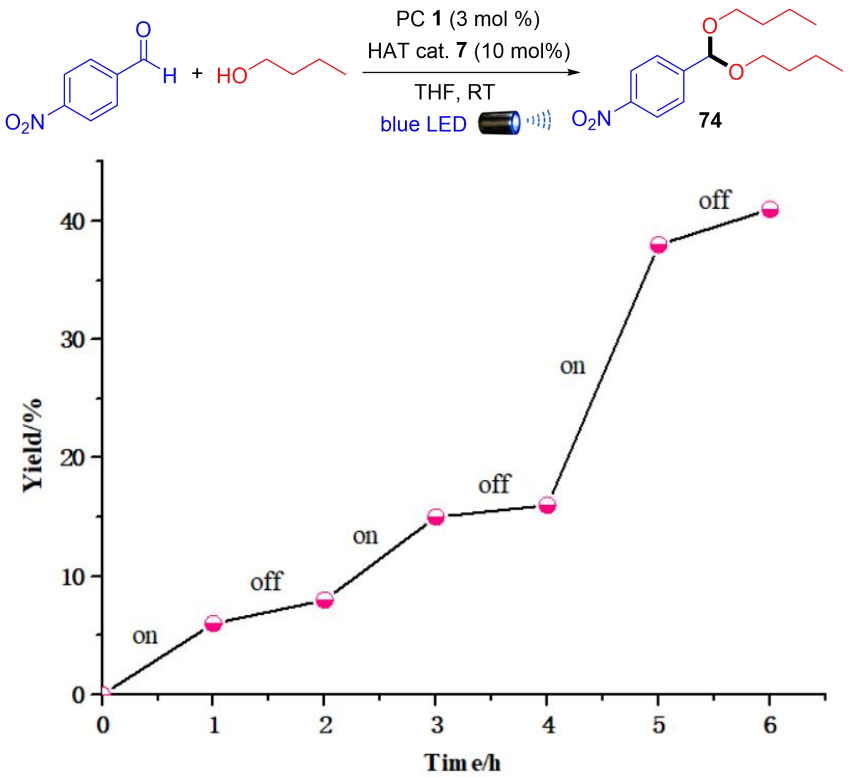


Figure S4. Light on-off experiments for the acetalization of 4-nitrobenzaldehyde with 1-butanol

6) Determination of quantum yields by standard ferrioxalate actinometry

Determination of the light intensity at 470 nm: Following Yoon's procedure,[S2] the photon flux of the spectrophotometer was determined by standard ferrioxalate actinometry. A 0.15 M solution of ferrioxalate was prepared by dissolving 2.21 g of potassium ferrioxalate hydrate in 30

mL of 0.05 M H_2SO_4. A buffered solution of phenanthroline was prepapred by dissoving 50 mg of phenanthroline and 11.25 g of sodium aceate in 50 mL of 0.5 M H_2SO_4. Both solution were stored in the dark. To determine the photon flux of the spectrophotometer, 2.0 mL of the ferrioxalate solution was placed solution was placed in a cuvette and irradiated for 93.0 second at λ = 470 nm with an emssion slit width at 10.0 nm. After irradiation, 0.35 mL of the phenanthroline solution was added to the cuvette. The solution was then allowed to rest for 1 h to allow the ferrous ions to completely coordinate to the phenanthroline. The absorbance of the solution was measured at 510 nm. A non-irradinated sample was also prepared and the absorbance at 510 nm measured. Conversion was calculates using eq (1).

$$molFe^{2+} = \frac{\mathrm{V} \cdot \Delta \mathrm{A}}{l\,\varepsilon} \qquad (1)$$

Where V is the total volume (0.00235 L) of the solution after of phenanthroline, ΔA is the difference in absorbance at 510 nm between the irradiated and non-irradiated solution, l is the path length (1.000 cm), and ε is the molar absorptivity at 510 nm (11,100 L mol^{-1} cm^{-1}). The photon flux can be calculated using eq (2).

$$Photo\ flux = \frac{\mathrm{mol}\ Fe^{2+}}{\Phi\ t\ f} \qquad (2)$$

Where Φ is the quantum yield for the ferrioxalate actinometer (0.92 for a 0.15 M solution at λ = 468 nm), t is the time (93.0 s), and f is the fraction of light absorbed at λ = 470 nm (0.648, vide infra). The photo flux was calculated (average of three experiments) to be 4.3952 × 10^{-9} $einstein^{-1}$.

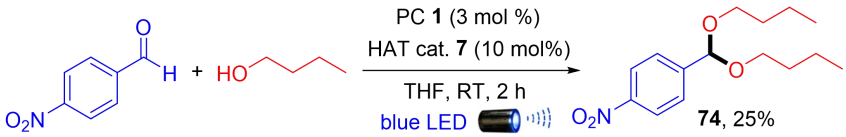
$$molFe^{2+} = \frac{0.00235\ \mathrm{L} \cdot 1.151}{1.000\ \mathrm{cm} \cdot 11100\ \mathrm{L}\,mol^{-1}\,cm^{-1}} = 2.4368 \times 10^{-7}\ mol$$

$$Photo\ flux = \frac{2.4368 \times 10^{-7}}{0.92 \cdot 93.0\ s \cdot 0.648} = 4.3952 \times 10^{-9}\ mol$$

Determination of quantum yield:

A cuvette was charged with the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol) and the 4-nitrobenzaldehyde (30 mg, 0.2mmol). The cuvette was sealed with plastic wrap, a balloon containing argon gas was inserted into the cuvette for about ten minutes to ensure that the cuvette

was filled with argon. After that acetonitrile-d_3 (2.0 mL), 1-butanol (183 µL, 2 mmol), DBU (15 µL, 0.1 mmol), and ethyl 2-mercaptopropanoate (HAT cat. **7**, 2.6 µL, 0.02 mmol) were added sequentially by means of syringe. The cuvette was then capped with a PTFE stopper. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 7200 s (2 h). After that, and the yield of product **30** was determined as 10% by crude ^{1}H NMR analysis using 1,3,5-trimethoxybenzene as a internal standard. The quantum yield was determined using eq (3). Essentially all incident light (f > 0.999, vide infra) is absorbed by the 4CzIPN at the reaction conditions described above.



A cuvette was charged with the photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol) and the 4-nitrobenzaldehyde (30 mg, 0.2mmol). The cuvette was sealed with plastic wrap, a balloon containing argon gas was inserted into the cuvette for about ten minutes to ensure that the cuvette was filled with argon. After that acetonitrile-d_3 (2.0 mL), 1-butanol (183 µL, 2 mmol), and ethyl 2-mercaptopropanoate (HAT cat. **7**, 2.6 µL, 0.02 mmol) were added sequentially by means of syringe. The cuvette was then capped with a PTFE stopper. Then the reaction was placed under a blue LED (2 meter strips, 18 W) with an argon balloon and irradiated for 7200 s (2 h). After that, and the yield of product **74** was determined as 25% by crude ^{1}H NMR analysis using 1,3,5-trimethoxybenzene as a internal standard. The quantum yield was determined using eq (3). Essentially all incident light (f > 0.999, vide infra) is absorbed by the 4CzIPN at the reaction conditions described above.

$$\Phi = \frac{\text{mol product}}{\text{flu}\ t\ f} \qquad (3)$$

$$\Phi_1 = \frac{2.0 \times 10^{-5}\ mol}{4.3952 \times 10^{-9}\ \text{einstein s}\ \cdot 8280\ \text{s} \cdot 1.00} = 0.63$$

$$\Phi_2 = \frac{5.0 \times 10^{-5}\ mol}{4.3952 \times 10^{-9}\ \text{einstein s}\ \cdot 8280\ \text{s} \cdot 1.00} = 1.58$$

7) Stern-Volmer fluorescence quenching experiments

In a typical experiment, a solution of photocatalyst **1** 4CzIPN in anhydrous THF (1.25×10^{-4} M) was added with an appropriate amount of quencher in a quartz cuvette. Then the

emission of the sample was collected. The emission intensity at 554 nm was collected with excited wavelength of 465 nm.

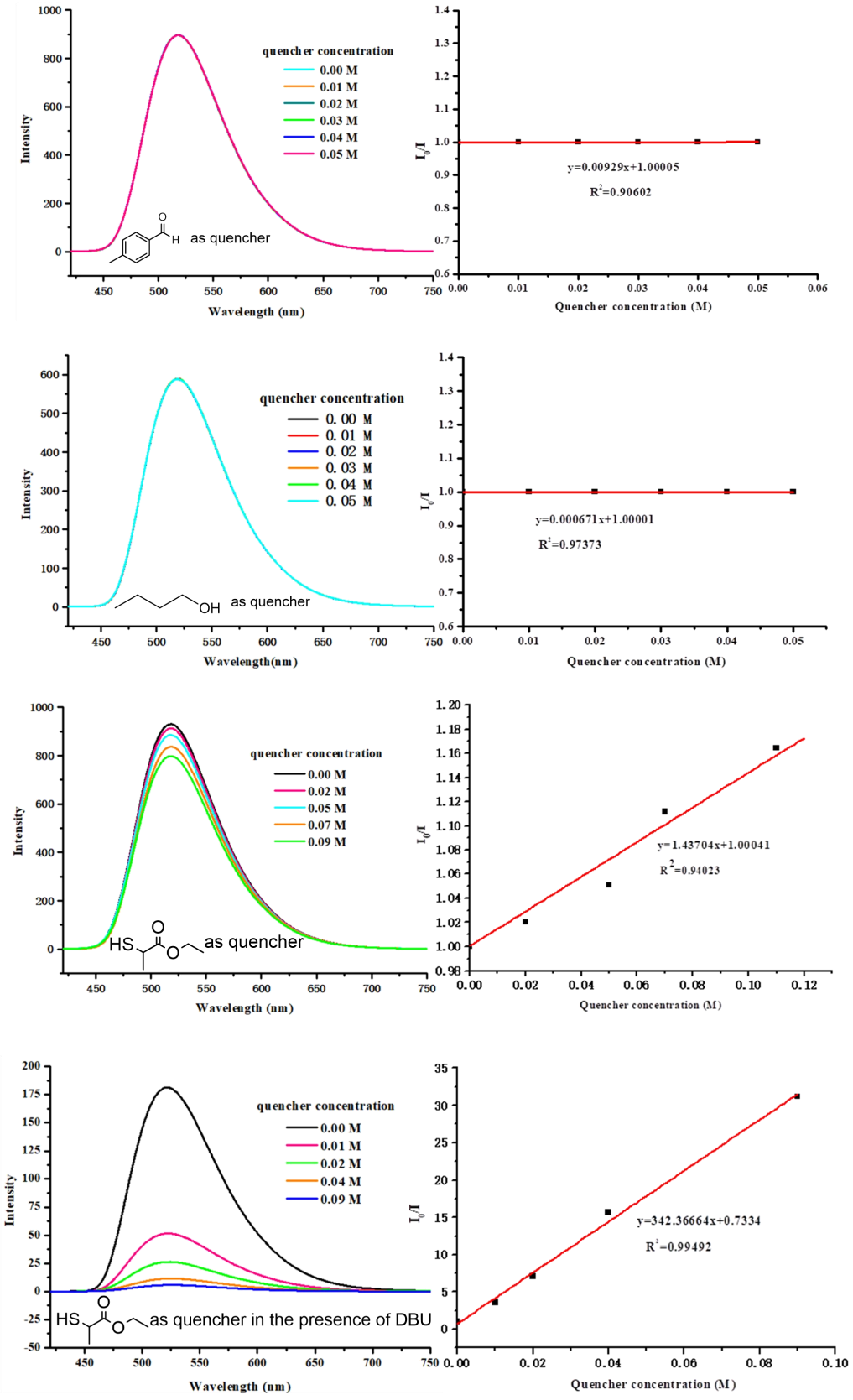
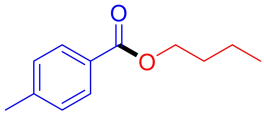
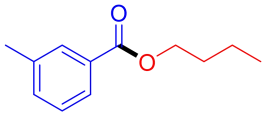


Figure S5. Stern-Volmer fluorescence quenching studies

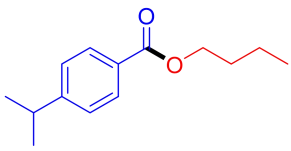
VIII. Analytical Data of the Products



13; A known compound and the characterization data are in accordance with the literature.[S3] Following the typical procedure **III**, *p*-tolualdehyde (24 µL,0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **13** (35 mg) in 90 % yield as a colorless oil. ^{1}H NMR (400 MHz, C_6D_6) δ 7.86 (d, *J* = 8.2 Hz, 2H), 6.61 (d, *J* = 7.9 Hz, 2H), 3.90 (t, *J* = 6.6 Hz, 2H), 1.68 (s, 3H), 1.22 – 1.14 (m, 2H), 0.93 (dq, *J* = 14.7, 7.4 Hz, 2H), 0.47 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, C_6D_6) δ 166.4, 143.23, 130.0, 129.3, 128.7, 64.6, 31.1, 21.3, 19.5, 13.8 ppm.

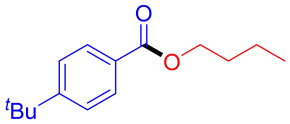


14; A known compound and the characterization data are in accordance with the literature.[S4] Following the typical procedure **III**, 3-methylbenzaldehyde (24 µL, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **14** (32 mg) in 84 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (d, *J* = 8.6 Hz, 2H), 7.34 (dt, *J* = 14.8, 7.5 Hz, 2H), 4.32 (t, *J* = 6.6 Hz, 2H), 2.40 (s, 3H), 1.76 (dt, *J* = 14.6, 6.7 Hz, 2H), 1.48 (dq, *J* = 14.7, 7.4 Hz, 2H), 0.98 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.9, 138.1, 133.5, 130.4, 130.0, 128.2, 126.6, 64.8, 30.8, 21.3, 19.3, 13.8 ppm.

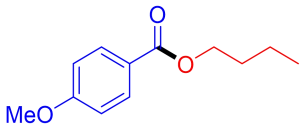


15; Following the typical procedure **III**, 4-isopropylbenzaldehyde (30 µL,0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **15** (27 mg) in 61 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.0 Hz, 2H), 7.29 (d, *J* = 7.9 Hz, 2H), 4.31 (t, *J* = 6.5 Hz, 2H), 2.96 (dt, *J* = 13.7, 6.9 Hz, 1H), 1.80 – 1.69 (m, 2H), 1.51 – 1.42 (m, 2H),

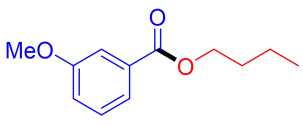
1.27 (d, J = 6.9 Hz, 6H), 0.98 (t, J = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8, 154.2, 129.7, 128.1, 126.4, 64.6, 34.2, 30.8, 23.7, 19.3, 13.8 ppm. HRMS: calcd. for $C_{14}H_{20}O_2$ $[M+H]^+$: 221.1536; found: 221.1536.



16; Following the typical procedure **III**, 4-*tert*-butylbenzaldehyde (34 µL, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **16** (33 mg) in 70 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, J = 8.4 Hz, 2H), 7.37 (d, J = 8.5 Hz, 2H), 4.23 (t, J = 6.6 Hz, 2H), 1.66 (tt, J = 11.4, 5.8 Hz, 2H), 1.40 (dd, J = 15.0, 7.5 Hz, 2H), 1.26 (s, 9H), 0.90 (t, J = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.7, 156.4, 129.4, 127.7, 125.2, 64.6, 35.0, 31.1, 30.8, 19.3, 13.7 ppm. HRMS: calcd. for $C_{15}H_{22}O_2$ $[M+H]^+$: 235.1693; found: 235.1693.

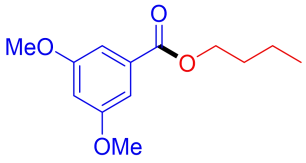


17; A known compound and the characterization data are in accordance with the literature.[S5] Following the typical procedure **III**, 4-methoxybenzaldehyde (25 µL,0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **17** (35 mg) in 84 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 – 7.96 (m, 2H), 6.96 – 6.87 (m, 2H), 4.29 (t, J = 6.6 Hz, 2H), 3.86 (s, 3H), 1.74 (dt, J = 14.5, 6.6 Hz, 2H), 1.53 – 1.41 (m, 2H), 0.98 (t, J = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.5, 163.2, 131.5, 122.9, 113.5, 64.5, 55.4, 30.8, 19.3, 13.8 ppm.

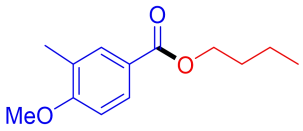


18; A known compound and the characterization data are in accordance with the literature.[S6] Following the typical procedure **III**, 3-methoxybenzaldehde (29 µL,0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **18** (37 mg) in 90 % yield as a

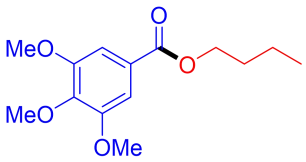
colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 7.7 Hz, 1H), 7.56 (dd, *J* = 7.5, 6.0 Hz, 1H), 7.34 (dd, *J* = 10.2, 5.7 Hz, 1H), 7.09 (dd, *J* = 8.2, 2.6 Hz, 1H), 4.32 (t, *J* = 6.6 Hz, 2H), 3.85 (s, 3H), 1.80 – 1.68 (m, 2H), 1.48 (dq, *J* = 14.7, 7.4 Hz, 2H), 0.98 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.5, 159.5, 131.8, 129.3, 121.9, 119.2, 114.0, 64.9, 55.4, 30.7, 19.2, 13.7 ppm.



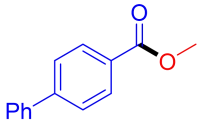
19; A known compound and the characterization data are in accordance with the literature.[S7] Following the typical procedure **III**, 3, 5-dimethoxybenzaldehyde (30 µL, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **19** (43 mg) in 90 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.19 (d, *J* = 2.3 Hz, 2H), 6.64 (t, *J* = 2.3 Hz, 1H), 4.31 (t, *J* = 6.6 Hz, 2H), 3.83 (s, 6H), 1.75 (dt, *J* = 14.6, 6.7 Hz, 2H), 1.47 (dd, *J* = 15.2, 7.4 Hz, 2H), 0.98 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.4, 160.6, 132.4, 107.1, 105.4, 65.0, 55.5, 30.7, 19.2, 13.7 ppm.



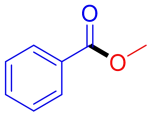
20; Following the typical procedure **III**, 3-methyl-4-anisaldehyde (28 µL,0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7mg, 0.006mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **20** (40 mg) in 89 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (dd, *J* = 7.7, 1.3 Hz, 1H), 7.48 (s, 1H), 7.17 (d, *J* = 7.7 Hz, 1H), 4.31 (t, *J* = 6.6 Hz, 2H), 3.88 (s, 3H), 2.26 (s, 3H), 1.81 – 1.70 (m, 2H), 1.53 – 1.41 (m, 2H), 1.04 – 0.94 (m, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8, 157.5, 132.3, 130.3, 129.2, 121.8, 110.4, 64.7, 55.4, 30.8, 19.3, 16.5, 13.8 ppm. HRMS: calc. for $C_{13}H_{18}O_3$ $[M+H]^+$: 223.1329; found: 223.1329.



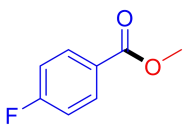
21; Following the typical procedure **III**, 3,4,5-trimethoxybenzaldehyde (40 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7mg, 0.006mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **21** (48 mg) in 90 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 (s, 2H), 4.32 (t, *J* = 6.7 Hz, 2H), 3.93 (dd, *J* = 12.5, 2.9 Hz, 9H), 1.76 (dt, *J* = 14.6, 6.8 Hz, 2H), 1.48 (dt, *J* = 14.9, 7.4 Hz, 2H), 0.99 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.2, 152.8, 142.0, 125.5, 106.7, 65.0, 60.8, 56.1, 30.7, 19.2, 13.7 ppm. HRMS: calc. for $C_{14}H_{20}O_5$ $[M+H]^+$: 269.1384; found: 269.1384.



22; A known compound and the characterization data are in accordance with the literature.[S8] Following the typical procedure **III**, 4-phenylbenzaldehyde (36 mg, 0.2 mmol), methanol (162 µL, 4 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **22** (32 mg) in 75 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 (d, *J* = 8.4 Hz, 2H), 7.61 – 7.51 (m, 4H), 7.38 (t, *J* = 7.4 Hz, 2H), 7.30 (t, *J* = 7.3 Hz, 1H), 3.85 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.0, 145.6, 139.9, 130.1, 128.9, 128.8, 128.1, 127.2, 127.0, 52.1 ppm.

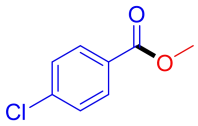


23; A known compound and the characterization data are in accordance with the literature.[S9] Following the typical procedure **III**, benzaldehyde (20 µL, 0.2 mmol), methanol (162 µL, 4 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **23** (16 mg) in 60 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (dd, *J* = 5.2, 3.3 Hz, 2H), 7.52 (ddd, *J* = 8.6, 2.5, 1.2 Hz, 1H), 7.40 (dd, *J* = 10.5, 4.7 Hz, 2H), 3.88 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8, 132.7, 130.0, 129.3, 128.1, 51.8 ppm.

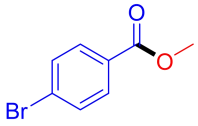


24; A known compound and the characterization data are in accordance with the literature.[S10] Following the typical procedure **III**, *p*-fluorobenzaldehyde (22 µL, 0.2 mmol), methanol (162 µL,

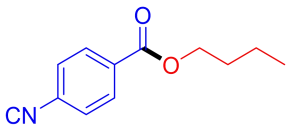
4 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **24** (20 mg) in 65 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 – 7.94 (m, 2H), 7.16 – 7.00 (m, 2H), 3.89 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.8, 165.5 (d, J = 253.7 Hz), 131.9 (d, J = 9.3 Hz), 126.2 (d, J = 3.0 Hz), 115.2 (d, J = 22.0 Hz), 51.89 ppm.



25; A known compound and the characterization data are in accordance with the literature.[S9] Following the typical procedure **III**, 4-chlorobenzaldehyde (24 µL, 0.2 mmol), methanol (162 µL, 4 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **25** (19 mg) in 55 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, J = 8.5 Hz, 2H), 7.41 (d, J = 8.5 Hz, 2H), 3.91 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.2, 139.3, 130.9, 128.7, 128.5, 52.2 ppm.

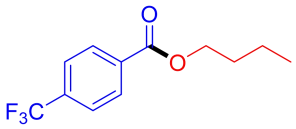


26; A known compound and the characterization data are in accordance with the literature.[S9] Following the typical procedure **III**, 4-bromobenzaldehyde (37mg, 0.2 mmol), methanol (162 µL, 4 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **26** (30 mg) in 70% yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 – 7.82 (m, 2H), 7.64 – 7.47 (m, 2H), 3.91 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.3, 131.7, 131.1, 129.0, 128.0, 52.3 ppm.

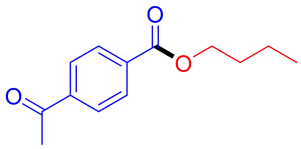


27; A known compound and the characterization data are in accordance with the literature.[S11] Following the typical procedure **III**, 4-cyanobenzaldehyde (26 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **27** (30 mg) in 74 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, J = 8.4 Hz, 2H), 7.75 (d, J = 8.4 Hz, 2H), 4.36 (t, J = 6.6 Hz, 2H), 1.84 – 1.71 (m, 2H), 1.48 (dq, J = 14.7, 7.4 Hz, 2H), 0.99 (t, J = 7.4 Hz,

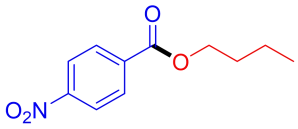
3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.0, 134.3, 132.2, 130.0, 118.0, 116.3, 65.7, 30.6, 19.2, 13.7 ppm.



28; A known compound and the characterization data are in accordance with the literature.[S6] Following the typical procedure **III**, 4-(trifluoromethyl)Benzaldehyde (35 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **28** (30 mg) in 61 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (dd, *J* = 13.5, 8.2 Hz, 2H), 7.81 (d, *J* = 8.2 Hz, 1H), 7.70 (d, *J* = 8.2 Hz, 1H), 4.36 (t, *J* = 6.6 Hz, 2H), 1.86 – 1.72 (m, 2H), 1.57 – 1.43 (m, 2H), 1.06 – 0.93 (m, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.4, 134.3 (q, *J* = 32.6 Hz), 130.3, 129.9, 125.3 (q, *J* = 3.7 Hz),123.6 (d, *J* = 272.7 Hz), 65.4, 30.7, 19.2, 13.7 ppm.

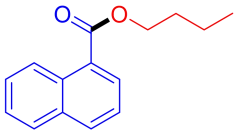


29; A known compound and the characterization data are in accordance with the literature.[S12] Following the typical procedure **III**, 4-acetylbenzaldehyde (30 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **29** (29 mg) in 66 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 – 8.09 (m, 2H), 8.04 – 7.97 (m, 2H), 4.36 (t, *J* = 6.6 Hz, 2H), 2.65 (s, 3H), 1.78 (dt, *J* = 14.5, 6.7 Hz, 2H), 1.48 (dt, *J* = 14.8, 7.4 Hz, 2H), 0.99 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 197.6, 165.8, 140.1, 134.3, 129.8, 128.2, 65.3, 30.7, 26.9, 19.2, 13.7 ppm.

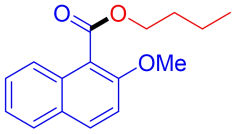


30; A known compound and the characterization data are in accordance with the literature.[S13] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL,

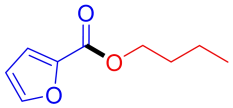
0.02 mmol) , and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **30** (37 mg) in 83 % yield as a yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.9 Hz, 2H), 8.14 (d, *J* = 8.9 Hz, 2H), 4.31 (t, *J* = 6.6 Hz, 2H), 1.77 – 1.62 (m, 2H), 1.41 (tt, *J* = 12.6, 6.4 Hz, 2H), 0.92 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.7, 150.4, 135.8, 130.6, 123.5, 65.8, 30.6, 19.2, 13.7 ppm.



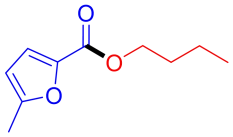
31; A known compound and the characterization data are in accordance with the literature.[S14] Following the typical procedure **III**, 1-naphthaldehyde (31 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **31** (40 mg) in 88 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.60 (s, 1H), 8.07 (dd, *J* = 8.6, 1.7 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.88 (d, *J* = 8.6 Hz, 2H), 7.56 (dtd, *J* = 14.7, 6.9, 1.3 Hz, 2H), 4.39 (t, *J* = 6.6 Hz, 2H), 1.81 (dt, *J* = 14.6, 6.7 Hz, 2H), 1.58 – 1.47 (m, 2H), 1.01 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8, 135.5, 132.5, 130.9, 129.3, 128.2, 128.1, 127.7, 126.6, 125.2, 65.0, 30.8, 19.3, 13.8 ppm.



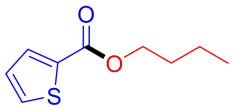
32; Following the typical procedure **III**, 2-methoxy-1-naphthaldehyde (37 mg, 0.2 mmol), 1-butanol (183µL, 2mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **32** (31 mg) in 60 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 9.1 Hz, 1H), 7.77 (dd, *J* = 18.5, 8.4 Hz, 2H), 7.49 (t, *J* = 7.6 Hz, 1H), 7.37 (t, *J* = 7.5 Hz, 1H), 7.28 (t, *J* = 6.8 Hz, 1H), 4.47 (t, *J* = 6.7 Hz, 2H), 3.97 (s, 3H), 1.85 – 1.73 (m, 2H), 1.53 – 1.47 (m, 2H), 0.99 (t, *J* = 7.4 Hz, 3H) ppm;^{13}C NMR (101 MHz, $CDCl_3$) δ 168.2, 154.3, 131.5, 131.0, 128.5, 128.1, 127.5, 124.1, 123.7, 113.2, 65.3, 56.7, 30.8, 19.2, 13.7 ppm. HRMS calcd for $C_{16}H_{18}O_3$: $[M+Na]^+$ 281.1148, found: 281.1148.



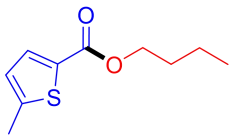
33; A known compound and the characterization data are in accordance with the literature.[S14] Following the typical procedure **III**, 2-furaldehyde (17 µL,0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **33** (28 mg) in 84% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.31 (d, *J* = 3.2 Hz, 1H), 6.25 (dd, *J* = 3.0, 1.8 Hz, 1H), 5.44 (s, 1H), 3.49 – 3.41 (m, 2H), 1.53 – 1.47 (m, 2H), 1.35 – 1.29 (m, 2H), 0.85 – 0.81 (m, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.8, 142.1, 109.8, 107.8, 96.4, 65.2, 31.6, 19.2, 13.7 ppm.



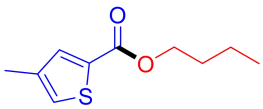
34; Following the typical procedure **III**, 5-methylfurfural (20 µL, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **34** (29 mg) in 80 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.07 (d, *J* = 2.7 Hz, 1H), 6.11 (d, *J* = 1.4 Hz, 1H), 4.40 – 4.23 (m, 2H), 2.46 – 2.31 (m, 3H), 1.79 – 1.65 (m, 2H), 1.43 (dt, *J* = 12.1, 6.2 Hz, 2H), 0.96 (dd, *J* = 8.6, 7.6 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.0, 157.1, 143.2, 119.1, 108.3, 64.5, 30.8, 19.1, 14.0, 13.7 ppm. HRMS calcd for $C_{10}H_{14}O_3$ $[M+H]^+$: 183.1016, found: 183.1016.



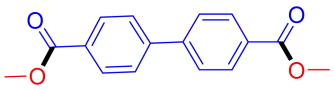
35; A known compound and the characterization data are in accordance with the literature.[S5] Following the typical procedure **III**, (18 µL, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **35** (31 mg) in 84 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 – 7.75 (m, 1H), 7.58 – 7.49 (m, 1H), 7.14 – 7.00 (m, 1H), 4.30 (t, *J* = 6.6 Hz, 2H), 1.72 (dq, *J* = 13.0, 6.6 Hz, 2H), 1.46 (dq, *J* = 14.6, 7.4 Hz, 2H), 0.97 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.3, 134.1, 133.2, 132.1, 127.7, 65.0, 30.7, 19.2, 13.7 ppm.



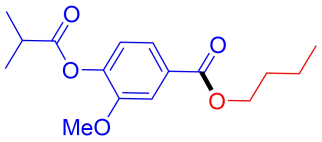
36; Following the typical procedure **III**, 5-methylthiophene-2-carboxaldehyde (22 µL, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **36** (36 mg) in 90 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 1.2 Hz, 1H), 7.12 (s, 1H), 4.28 (t, *J* = 6.6 Hz, 2H), 2.27 (s, 3H), 1.72 (dt, *J* = 14.5, 6.7 Hz, 2H), 1.45 (dt, *J* = 10.0, 5.1 Hz, 2H), 0.97 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 182.9, 162.4, 138.3, 135.0, 127.8, 64.8, 30.7, 19.1, 15.5, 13.7 ppm. HRMS: $C_{10}H_{14}O_2S$ $[M+H]^+$, Calc. for: 199.0787; Found: 199.0787.



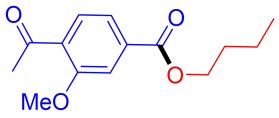
37; A known compound and the characterization data are in accordance with the literature.[S15] Following the typical procedure **III**, 4-methylthiophene-2-carbaldehyde (25 µL,0.2 mmol), 1-butanol (183 µL, 2mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **37** (35 mg) in 89 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (t, *J* = 3.8 Hz, 1H), 6.76 (d, *J* = 3.6 Hz, 1H), 4.27 (t, *J* = 6.6 Hz, 2H), 2.52 (s, 3H), 1.77 – 1.66 (m, 2H), 1.44 (dt, *J* = 14.8, 7.6 Hz, 2H), 0.97 (t, *J* = 7.4 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 182.6, 162.4, 147.7, 133.6, 126.3, 64.7, 30.8, 19.2, 15.7, 13.7 ppm.



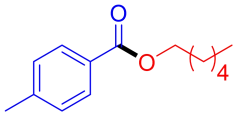
38; A known compound and the characterization data are in accordance with the literature.[S9] Following the typical procedure **III**, 4,4-biphenyldicarboxaldehyde (42 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **38** (43 mg) in 80 % yield as a white power. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 – 8.01 (m, 4H), 7.66 – 7.58 (m, 4H), 3.88 (s, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8, 144.3, 130.2, 130.0, 127.2, 52.2 ppm.



39; Following the typical procedure **III**, vanillin isobutyrate (39 µL, 0.2 mmol), 1-butanol (183 µL, 2mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **39** (47 mg) in 80 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 10.2 Hz, 2H), 7.00 (dd, *J* = 7.8, 3.0 Hz, 1H), 4.35 – 4.16 (m, 2H), 3.79 (d, *J* = 2.9 Hz, 3H), 2.87 – 2.67 (m, 1H), 1.75 – 1.62 (m, 2H), 1.40 (d, *J* = 5.7 Hz, 2H), 1.32 – 1.17 (m, 6H), 0.96 – 0.84 (m, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 166.0, 151.1, 143.8, 129.0, 122.6, 122.5, 113.4, 65.01, 56.0, 34.0, 30.7, 19.2, 18.9, 13.7 ppm. HRMS: $C_{16}H_{22}O_5$ $[M+H]^+$, Calcd for: 295.1540; Found: 295.1540.

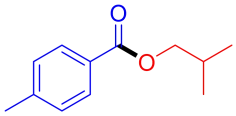


40; Following the typical procedure **III**, vanillin acetate (39 mg,0.2 mmol), 1-butanol (183 µL, 2mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **40** (45 mg) in 85 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.54 (m, 2H), 7.07 – 6.96 (m, 1H), 4.31 – 4.17 (m, 2H), 3.89 – 3.70 (m, 3H), 2.33 – 2.16 (m, 3H), 1.73 – 1.61 (m, 2H), 1.46 – 1.31 (m, 2H), 0.96 – 0.81 (m, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.5, 166.0, 151.0, 143.4, 129.2, 122.7, 122.5, 113.3, 65.0, 56.0, 30.7, 20.6, 19.2, 13.7 ppm. HRMS: $C_{14}H_{18}O_5$ $[M+H]^+$, Calcd: 267.1227; Found: 267.1227.

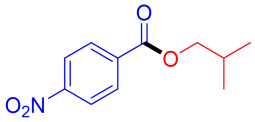


41; A known compound and the characterization data are in accordance with the literature.[S15] Following the typical procedure **III**, *p*-tolualdehyde (24 µL,0.2 mmol), 1-hexanol (251 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **41** (37 mg) in 83% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 8.2 Hz, 2H), 7.23 (d, *J* = 8.0 Hz, 2H), 4.30 (t, *J* = 6.7 Hz, 2H), 2.41 (s, 3H), 1.80 – 1.70 (m, 2H), 1.48 – 1.41 (m, 2H), 1.34 (td, *J* = 7.1, 3.7 Hz, 4H), 0.94 – 0.88 (m, 3H) ppm;^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8, 143.4, 129.5, 129.0,

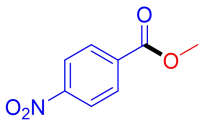
127.8, 64.9, 31.5, 28.7, 25.7, 22.5, 21.6, 14.0 ppm.



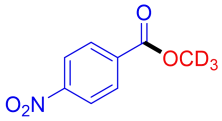
42; A known compound and the characterization data are in accordance with the literature.[S16] Following the typical procedure **III**, 4-methylbenzaldehyde(24 μL, 0.2 mmol), isobutanol (185 μL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) in THF (2 mL) were employed to give the product **42** (32 mg) in 83 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.2 Hz, 2H), 7.23 (d, *J* = 8.0 Hz, 2H), 4.09 (d, *J* = 6.6 Hz, 2H), 2.41 (s, 3H), 2.08 (dp, *J* = 13.4, 6.7 Hz, 1H), 1.02 (d, *J* = 6.7 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.7, 143.4, 129.5, 129.0, 127.8, 70.8, 27.9, 21.6, 19.2 ppm.



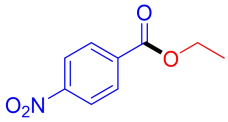
43; A known compound and the characterization data are in accordance with the literature.[S17] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), isobutyl alcohol (185 μL, 2 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) , and DBU (15 μL, 0.1 mmol) in THF (2 mL) were employed to give the product **43** (25 mg) in 56 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (d, *J* = 8.9 Hz, 2H), 8.22 (d, *J* = 8.9 Hz, 2H), 4.16 (d, *J* = 6.6 Hz, 2H), 2.11 (dp, *J* = 13.4, 6.7 Hz, 1H), 1.04 (d, *J* = 6.7 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.7, 150.5, 135.9, 130.6, 123.5, 71.9, 27.8, 19.1 ppm.



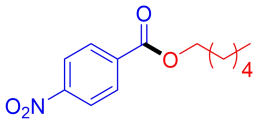
44; A known compound and the characterization data are in accordance with the literature.[S13] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), methanol (162 μL, 4 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) , and DBU (15 μL, 0.1 mmol) in THF (2 mL) were employed to give the product **44** (30 mg) in 83 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (d, *J* = 8.6 Hz, 2H), 8.22 (d, *J* = 8.7 Hz, 2H), 3.99 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.2, 150.5, 135.5, 130.7, 123.5, 52.8 ppm.



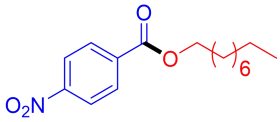
45; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), methanol-d_4 (163 µL, 4 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) , and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **45** (28 mg) in 76 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33 – 8.26 (m, 2H), 8.25 – 8.18 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.2, 150.5, 135.5, 130.7, 123.5, 29.7. HRMS m/z: calcd for $C_8H_4D_3NO_4$ $[M+H]^+$: 185.0636, found: 185.0636.



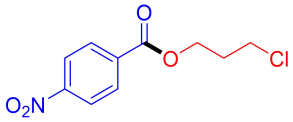
46; A known compound and the characterization data are in accordance with the literature.[S13] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), ethanol (234 µL, 4 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) , and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **46** (25 mg) in 64 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33 – 8.27 (m, 2H), 8.26 – 8.19 (m, 2H), 4.49 – 4.40 (m, 2H), 1.44 (dd, J = 13.0, 7.0 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.7, 150.5, 135.8, 130.7, 123.5, 62.0, 14.2 ppm.



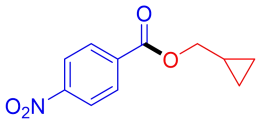
47; A known compound and the characterization data are in accordance with the literature.[S18] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 1-hexanol (251 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **47** (25 mg) in 50 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33 – 8.26 (m, 2H), 8.25 – 8.15 (m, 2H), 4.37 (t, J = 6.7 Hz, 2H), 1.86 – 1.73 (m, 2H), 1.50 – 1.41 (m, 2H), 1.39 – 1.31 (m, 4H), 0.97 – 0.88 (m, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.8, 150.5, 135.9, 130.7, 123.5, 66.1, 31.4, 28.6, 25.6, 22.5, 14.0 ppm.



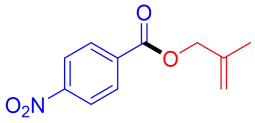
48; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 1-nonanol (349 µL, 2 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) , and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **48** (31 mg) in 53 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.37 – 8.27 (m, 2H), 8.26 – 8.15 (m, 2H), 4.37 (t, *J* = 6.7 Hz, 2H), 1.86 – 1.74 (m, 2H), 1.45 (dt, *J* = 15.3, 6.5 Hz, 2H), 1.37 – 1.25 (m, 10H), 0.88 (t, *J* = 6.8 Hz, 3H) ppm; ^{13}C NMR (101 MHz, CDCl3) δ 164.8, 150.5, 135.9, 130.6, 123.5, 66.1, 31.8, 29.5, 29.3, 29.2, 28.6, 26.0, 22.7, 14.1 ppm. HRMS *m/z*: calcd for $C_{16}H_{23}NO_4$: $[M+H]^+$: 294.1700, found: 294.1700.



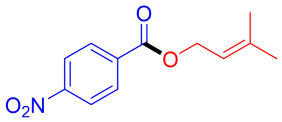
49; A known compound and the characterization data are in accordance with the literature.[S13] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 3-chloro-1-propanol (167 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) , and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **49** (33 mg) in 68 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 – 8.20 (m, 2H), 8.17 – 8.11 (m, 2H), 4.48 (t, *J* = 6.1 Hz, 2H), 3.64 (dd, *J* = 10.3, 4.0 Hz, 2H), 2.21 (p, *J* = 6.2 Hz, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.5, 150.6, 135.3, 130.7, 123.6, 62.7, 41.0, 31.5 ppm.



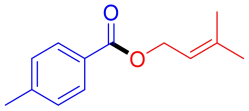
50; A known compound and the characterization data are in accordance with the literature.[S17] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), cyclopropyl carbinol (162 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) , and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **50** (37 mg) in 84 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 – 8.27 (m, 2H), 8.26 – 8.22 (m, 2H), 4.21 (d, *J* = 7.3 Hz, 2H), 1.35 – 1.20 (m, 1H), 0.71 – 0.60 (m, 2H), 0.44 – 0.36 (m, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.8, 150.5, 135.9, 130.7, 123.5, 70.8, 9.8, 3.4 ppm.



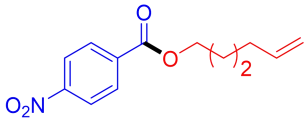
51; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 2-methyl-2-propen-1-ol (174 μL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) , and DBU (15 μL, 0.1 mmol) in THF (2 mL) were employed to give the product **51** (33 mg) in 75 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.35 – 8.28 (m, 2H), 8.27 – 8.21 (m, 2H), 5.06 (d, *J* = 24.4 Hz, 2H), 4.80 (s, 2H), 1.86 (s, 3H) ppm;^{13}C NMR (101 MHz, $CDCl_3$) δ 164.3, 150.6, 139.3, 135.5, 130.7, 123.6, 113.8, 69.0, 19.6 ppm. HRMS (ESI) *m/z* $[M+H]^+$: calcd for $C_{11}H_{11}NO_4$: 222.0761, found: 222.0761.



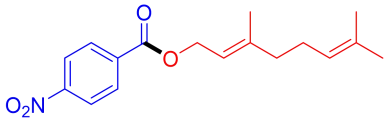
52; A known compound and the characterization data are in accordance with the literature.[S18] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 3,3-dimethylallyl alcohol (204 μL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol), and DBU (15 μL, 0.1 mmol) in THF (2 mL) were employed to give the product **52** (42 mg) in 90 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 – 8.19 (m, 2H), 8.17 – 8.12 (m, 2H), 5.45 – 5.36 (m, 1H), 4.80 (d, *J* = 7.3 Hz, 2H), 1.73 (d, *J* = 7.2 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.7, 150.4, 140.2, 135.9, 130.7, 123.5, 117.9, 62.8, 25.8, 18.1ppm.



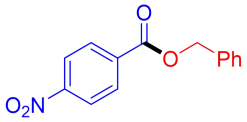
53; A known compound and the characterization data are in accordance with the literature.[S19] Following the typical procedure **III**, *p*-tolualdehyde (24 μL, 0.2 mmol), 3,3-dimethylallyl alcohol (204 μL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) , and DBU (15 μL, 0.1 mmol) in THF (2 mL) were employed to give the product **53** (31 mg) in 75 % yield a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 – 7.89 (m, 2H), 7.22 (d, J = 7.9 Hz, 2H), 5.50 – 5.42 (m, 1H), 4.80 (d, *J* = 7.2 Hz, 2H), 2.40 (s, 3H), 1.83 – 1.76 (m, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.8, 143.4, 139.0, 129.6, 129.0, 127.8, 118.8, 61.7, 25.8, 21.6, 18.1 ppm.



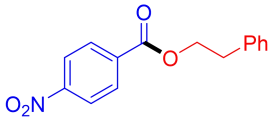
54; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 5-hexen-1-ol (237 µL, 2 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **54** (40 mg) in 80 % yield a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.8 Hz, 2H), 8.14 (d, *J* = 8.9 Hz, 2H), 5.75 (ddt, *J* = 16.9, 10.2, 6.7 Hz, 1H), 4.95 (ddd, *J* = 17.8, 9.6, 5.8 Hz, 2H), 4.31 (t, *J* = 6.6 Hz, 2H), 2.17 – 2.00 (m, 2H), 1.74 (dt, *J* = 13.8, 6.8 Hz, 2H), 1.49 (dt, *J* = 15.0, 7.5 Hz, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.7, 150.5, 138.1, 135.8, 130.6, 123.5, 115.0, 65.8, 33.2, 28.0, 25.2 ppm.



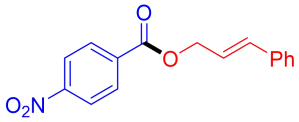
55; A known compound and the characterization data are in accordance with the literature.[S20] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 3,7-dimethyl-2,6-Octadien-1-ol (347 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) , and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **55** (45 mg) in 75 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 – 8.25 (m, 2H), 8.22 (dd, *J* = 8.9, 1.8 Hz, 2H), 5.48 (t, *J* = 6.9 Hz, 1H), 5.09 (s, 1H), 4.90 (d, *J* = 7.1 Hz, 2H), 2.17 – 2.06 (m, 4H), 1.79 (s, 3H), 1.68 (s, 3H), 1.61 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.7, 150.4, 143.4, 135.9, 131.9, 130.7, 123.6, 123.5, 117.6, 62.7, 39.5, 26.2, 25.7, 17.7, 16.6 ppm.



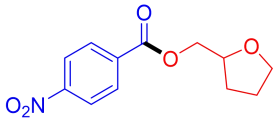
56; A known compound and the characterization data are in accordance with the literature.[S13] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), benzyl alcohol (207 µL, 2 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) , and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **56** (30 mg) in 58 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (q, *J* = 8.9 Hz, 4H), 7.49 – 7.35 (m, 5H), 5.41 (s, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.5, 150.6, 135.5, 135.2, 130.8, 128.7, 128.6, 128.4, 123.5, 67.7 ppm.



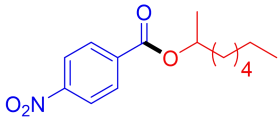
57; A known compound and the characterization data are in accordance with the literature.[S21] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), phenethyl alcohol (239 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **57** (25 mg) in 46 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (d, J = 8.6 Hz, 2H), 8.16 (d, J = 8.6 Hz, 2H), 7.37 – 7.26 (m, 5H), 4.59 (t, J = 6.9 Hz, 2H), 3.11 (t, J = 6.9 Hz, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.6, 150.5, 137.4, 135.6, 130.7, 128.9, 128.6, 126.8, 123.5, 66.3, 35.1 ppm.



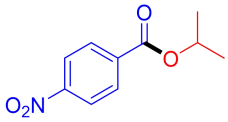
58; A known compound and the characterization data are in accordance with the literature.[S13] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), cinnamic alcohol (257 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **58** (33 mg) in 58 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (dt, J = 13.7, 6.8 Hz, 4H), 7.39 – 7.21 (m, 5H), 6.70 (d, J = 15.9 Hz, 1H), 6.34 (dt, J = 15.8, 6.6 Hz, 1H), 4.96 (d, J = 6.6 Hz, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.5, 150.6, 135.9, 135.6, 135.3, 130.8, 128.7, 128.4, 126.7, 123.6, 122.3, 66.5 ppm.



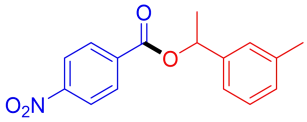
59; A known compound and the characterization data are in accordance with the literature.[S13] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), tetrahydrofurfuryl alcohol (194 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **59** (25 mg) in 50 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 – 8.27 (m, 2H), 8.26 – 8.21 (m, 2H), 4.44 (m, J = 10.5, 2.6 Hz, 1H), 4.36 – 4.25 (m, 2H), 3.98 – 3.82 (m, 2H), 2.17 – 2.06 (m, 1H), 2.02 – 1.90 (m, 2H), 1.79 – 1.65 (m, 1H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.6, 150.6, 135.4, 130.8, 123.5, 76.4, 68.6, 67.8, 28.0, 25.7 ppm.



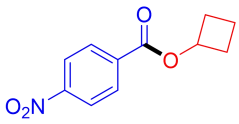
60; A known compound and the characterization data are in accordance with the literature.[S22] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 2-octanol (318 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **60** (52 mg) in 93 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 – 8.25 (m, 2H), 8.24 – 8.17 (m, 2H), 5.25 – 5.14 (m, 1H), 1.82 – 1.71 (m, 1H), 1.64 (ddd, *J* = 14.2, 10.0, 4.5 Hz, 1H), 1.38 – 1.26 (m, 11H), 0.88 (t, *J* = 6.8 Hz, 3H) ppm;^{13}C NMR (101 MHz, $CDCl_3$) δ 164.3, 150.4, 136.3, 130.6, 123.5, 73.1, 35.9, 31.7, 29.1, 25.4, 22.6, 20.0, 14.0 ppm.



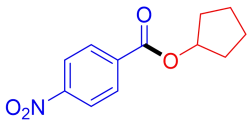
61; A known compound and the characterization data are in accordance with the literature.[S13] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), isopropyl alcohol (153 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **61** (25 mg) in 60 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 – 8.19 (m, 2H), 8.16 – 8.11 (m, 2H), 5.28 – 5.16 (m, 1H), 1.33 (d, *J* = 6.3 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.2, 150.4, 136.3, 130.6, 123.4, 69.7, 21.8 ppm.



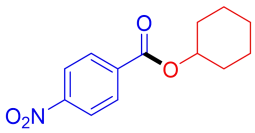
62; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 1-(2-methylphenyl)ethanol (41 mg, 0.3 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **62** (29 mg) in 50 % yield as a white powder. Mp: 100 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.34 – 8.20 (m, 4H), 7.51 – 7.45 (m, 1H), 7.28 – 7.16 (m, 3H), 6.35 (q, *J* = 6.6 Hz, 1H), 2.45 (s, 3H), 1.68 (d, *J* = 6.6 Hz, 3H) ppm;^{13}C NMR (101 MHz, $CDCl_3$) δ 163.9, 150.5, 139.4, 135.9, 134.8, 130.7, 130.6, 128.0, 126.5, 125.2, 123.5, 71.2, 21.4, 19.1 ppm. HRMS m/z: calcd for $C_{16}H_{15}NO_4$ $[M+Na]^+$: 308.0893, found: 308.0893.



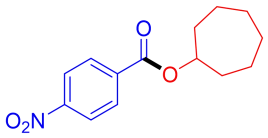
63; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), cyclobutanol (157 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **63** (33 mg) in 75 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 – 8.26 (m, 2H), 8.24 – 8.18 (m, 2H), 5.31 – 5.20 (m, 1H), 2.49 (m, *J* = 12.4, 9.8, 5.6, 2.6 Hz, 2H), 2.31 – 2.18 (m, 2H), 1.98 – 1.84 (m, 1H), 1.80 – 1.65 (m, 1H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.0, 150.5, 135.8, 130.7, 123.5, 70.2, 30.3, 13.5 ppm.



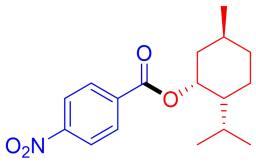
64; A known compound and the characterization data are in accordance with the literature.[S23] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), cyclopentanol (182 µL, 2 mmol) , photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **64** (37 mg) in 79 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (d, *J* = 8.8 Hz, 2H), 8.18 (d, *J* = 8.8 Hz, 2H), 5.48 – 5.42 (m, 1H), 2.05 – 1.95 (m, 2H), 1.88 (d, *J* = 1.9 Hz, 1H), 1.86 – 1.77 (m, 3H), 1.70 (dt, *J* = 8.8, 6.2 Hz, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.4, 150.4, 136.2, 130.6, 123.5, 78.9, 32.8, 23.8 ppm.



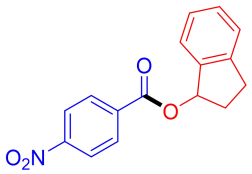
65; A known compound and the characterization data are in accordance with the literature.[S15] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), cyclohexanol (211 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **65** (25 mg) in 50 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 – 8.18 (m, 2H), 8.17 – 8.10 (m, 2H), 5.00 (ddd, *J* = 12.8, 8.7, 3.8 Hz, 1H), 1.91 (dd, *J* = 12.2, 5.1 Hz, 2H), 1.74 (dd, *J* = 9.5, 3.5 Hz, 2H), 1.59 – 1.52 (m, 2H), 1.39 (tdd, *J* = 10.2, 8.3, 3.4 Hz, 2H), 1.31 – 1.14 (m, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.1, 150.4, 136.4, 130.6, 123.5, 74.4, 31.5, 25.3, 23.6 ppm.



66; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), cycloheptanol (242 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **66** (30 mg) in 57 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (d, *J* = 8.8 Hz, 2H), 8.20 (d, *J* = 8.8 Hz, 2H), 5.23 (ddd, *J* = 12.5, 8.3, 4.4 Hz, 1H), 2.04 (ddd, *J* = 13.0, 7.7, 3.4 Hz, 2H), 1.91 – 1.79 (m, 2H), 1.79 – 1.69 (m, 2H), 1.68 – 1.59 (m, 4H), 1.25 (s, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.0, 150.4, 136.4, 130.6, 123.5, 33.8, 28.3, 22.8 ppm.

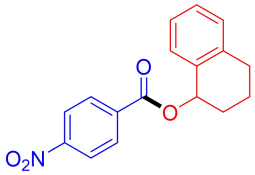


67; A known compound and the characterization data are in accordance with the literature.[S24] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), L-menthol (47 mg, 0.3 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **67** (26 mg) in 43 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 – 8.04 (m, 2H), 8.03 – 7.94 (m, 2H), 4.76 (td, *J* = 10.9, 4.4 Hz, 1H), 1.97 – 1.87 (m, 1H), 1.71 (dtd, *J* = 13.9, 7.0, 2.7 Hz, 1H), 1.59 – 1.46 (m, 2H), 1.36 (ddd, *J* = 12.5, 6.3, 3.2 Hz, 4H), 0.74 – 0.70 (m, 6H), 0.58 (d, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.2, 150.4, 136.2, 130.7, 123.5, 76.1, 47.2, 40.8, 34.2, 31.5, 26.6, 23.6, 22.0, 20.7, 16.5 ppm.

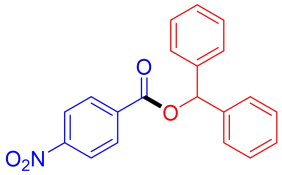


68; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 1-indanol (40 mg, 0.3 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **68** (23 mg) in 41 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.9 Hz, 2H), 7.98 (d, *J* = 8.7 Hz, 2H), 7.28 (d, *J* = 7.5 Hz, 1H), 7.13 (d, *J* = 4.2 Hz, 2H), 7.08 – 7.04 (m,

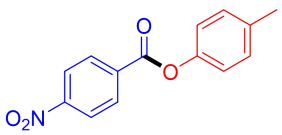
1H), 6.26 (dd, *J* = 7.0, 3.6 Hz, 1H), 3.08 – 2.94 (m, 1H), 2.76 (ddd, *J* = 16.1, 8.6, 4.7 Hz, 1H), 2.43 (dd, *J* = 14.7, 7.9 Hz, 1H), 2.06 (ddd, *J* = 13.8, 8.4, 4.2 Hz, 1H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.7, 144.6, 140.4, 135.9, 130.8, 129.3, 128.1, 126.9, 125.7, 125.0, 123.5, 80.1, 32.4, 30.3 ppm. HRMS *m/z*: calcd for $C_{16}H_{13}NO_4$ $[M+H]^+$: 284.0917, found: 284.0917.



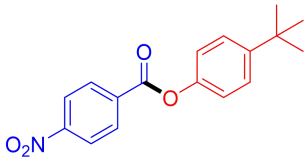
69; A known compound and the characterization data are in accordance with the literature.[S25] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), tetrahydro-1-naphthol (44 mg, 0.3 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **69** (20 mg) in 34 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 – 8.02 (m, 2H), 8.02 – 7.96 (m, 2H), 7.13 (d, *J* = 7.6 Hz, 1H), 7.08 – 7.04 (m, 1H), 6.98 (t, *J* = 7.5 Hz, 2H), 6.07 (t, *J* = 4.4 Hz, 1H), 2.81 – 2.53 (m, 2H), 1.98 – 1.89 (m, 2H), 1.89 – 1.78 (m, 1H), 1.70 (ddd, *J* = 9.6, 7.7, 4.8 Hz, 1H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 164.3, 150.5, 138.1, 136.1, 133.9, 130.8, 129.6, 129.2, 128.5, 126.2, 123.5, 71.9, 30.3, 29.1, 18.9 ppm.



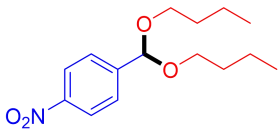
70; A known compound and the characterization data are in accordance with the literature.[S26] Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), benzhydrol (55 mg, 0.3 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol), and DBU (15 µL, 0.1 mmol) in THF (2 mL) were employed to give the product **70** (38 mg) in 57 % yield as a white powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (s, 4H), 7.36 (ddt, *J* = 19.2, 13.5, 8.3 Hz, 10H), 7.14 (s, 1H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.7, 150.6, 139.5, 135.6, 130.9, 128.7, 128.3, 127.1, 123.6, 78.5 ppm.



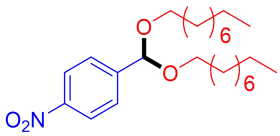
72; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), *p*-methylphenol (32 mg, 0.3 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol), and DBU (15 μL, 0.1 mmol) in THF (2 mL) were employed to give the product **72** (12 mg) in 24 % yield as a white powder. Mp: 104 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (t, *J* = 5.6 Hz, 4H), 7.18 (d, *J* = 7.9 Hz, 2H), 7.04 (d, *J* = 8.2 Hz, 2H), 2.32 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.5, 150.8, 148.3, 136.1, 135.1, 131.3, 130.2, 123.7, 121.0, 20.9 ppm. HRMS m/z: calcd for $C_{14}H_{11}NO_4$ $[M+H]^+$: 258.0761, found: 258.0761.



73; Following the typical procedure **III**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 4-*tert*-butylphenol (45 mg, 0.3 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol), and DBU (15 μL, 0.1 mmol) in THF (2 mL) were employed to give the product **73** (13 mg) in 22 % yield as a yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.41 – 8.34 (m, 4H), 7.49 – 7.43 (m, 2H), 7.18 – 7.12 (m, 2H), 1.35 (s, 9H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 163.5, 150.8, 149.3, 148.1, 135.1, 131.3, 126.6, 123.7, 120.7, 34.6, 31.4 ppm. HRMS *m/z*: calcd for $C_{17}H_{17}NO_4$ $[M+Na]^+$: 322.1050, found: 322.1050.

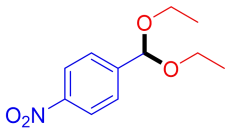


74; Following the typical procedure **IV**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 1-butanol (183 μL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) in THF (2 mL) were employed to give the product **74** (52 mg) in 93 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 – 8.18 (m, 2H), 7.65 (d, *J* = 8.4 Hz, 2H), 5.57 (s, 1H), 3.62 – 3.38 (m, 4H), 1.64 – 1.57 (m, 4H), 1.46 – 1.35 (m, 4H), 0.93 (t, *J* = 7.4 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.8, 146.2, 127.7, 123.4, 100.1, 65.3, 31.7, 19.4, 13.9 ppm. HRMS calc. for $C_{15}H_{23}NO_4$ $[M+Na]^+$: 304.1519, found: 304.1519.

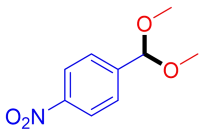


75; Following the typical procedure **IV**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 1-nonanol (349

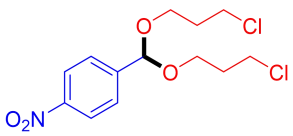
μL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) in THF (2 mL) were employed to give the product **75** (65 mg) in 77 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 – 8.07 (m, 2H), 7.57 (d, *J* = 8.5 Hz, 2H), 5.49 (s, 1H), 3.49 – 3.34 (m, 4H), 1.61 – 1.49 (m, 4H), 1.32 – 1.16 (m, 24H), 0.86 – 0.76 (m, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.8, 146.2, 127.7, 123.3, 100.1, 65.7, 31.9, 29.7, 29.5, 29.4, 29.3, 26.2, 22.6, 14.1ppm. HRMS calc. for $C_{25}H_{43}NO_4$ $[M+Na]^+$: 444.3084, found: 444.3084.



76; Following the typical procedure **IV**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), ethanol (234 μL, 4 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) in THF (2 mL) were employed to give the product **76** (37 mg) in 82 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.8 Hz, 2H), 7.66 (d, *J* = 8.7 Hz, 2H), 5.58 (s, 1H), 3.66 – 3.52 (m, 4H), 1.26 (t, *J* = 7.1 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.9, 146.1, 127.7, 123.4, 100.1, 61.3, 15.1 ppm. HRMS calc. for $C_{11}H_{15}NO_4$ $[M+Na]^+$: 248.0893, found: 248.0893.

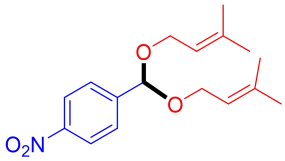


77; Following the typical procedure **IV**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), methanol (162 μL, 4 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) in THF (2 mL) were employed to give the product **77** (35 mg) in 89 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 (d, *J* = 8.4 Hz, 2H), 7.65 (d, *J* = 8.4 Hz, 2H), 5.48 (s, 1H), 3.34 (s, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 148.0, 145.0, 127.8, 123.4, 101.5, 52.7 ppm. HRMS calc. for $C_9H_{11}NO_4$ $[M-CH_3O]^+$: 166.0499, found: 166.0463.

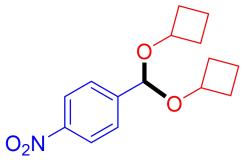


78; Following the typical procedure **IV**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 3-chloro-1-propanol (167 μL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) in THF (2 mL) were employed to give the product **78**

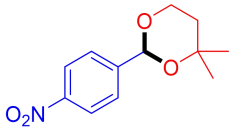
(44 mg) in 68% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.34 – 8.17 (m, 2H), 7.64 (d, *J* = 8.1 Hz, 2H), 5.62 (s, 1H), 3.76 – 3.61 (m, 8H), 2.08 (p, *J* = 5.9 Hz, 4H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 148.0, 145.1, 127.7, 123.5, 100.3, 61.9, 41.7, 32.4 ppm. HRMS calc. for $C_{13}H_{16}NO_4Cl_2$ $[M+H]^+$: 323.0291, found: 323.0289.



79; Following the typical procedure **IV**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), 3,3-dimethylallyl alcohol (204 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **79** (54 mg) in 88 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.4 Hz, 2H), 7.61 (d, *J* = 8.5 Hz, 2H), 5.57 (s, 1H), 5.30 (t, *J* = 6.6 Hz, 2H), 4.08 – 3.91 (m, 4H), 1.69 (s, 6H), 1.59 (s, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.9, 146.1, 137.8, 127.8, 123.4, 120.2, 98.8, 62.0, 25.8, 18.0 ppm. HRMS calc. for $C_{17}H_{23}NO_4$ $[M+Na]^+$: 328.1519, found: 328.1519.

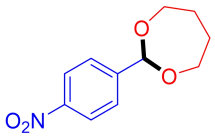


80; Following the typical procedure **IV**, 4-nitrobenzaldehyde (30 mg, 0.2 mmol), cyclobutanol (157 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **80** (40 mg) in 72 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.7 Hz, 2H), 7.64 (d, *J* = 8.7 Hz, 2H), 5.47 (s, 1H), 4.22 – 4.11 (m, 2H), 2.26 – 2.15 (m, 2H), 2.13 – 1.91 (m, 6H), 1.75 – 1.62 (m, 2H), 1.47 (qt, *J* = 10.6, 8.1 Hz, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.9, 146.6, 127.7, 123.4, 97.6, 69.7, 31.3, 31.0, 12.8 ppm. HRMS calc. for $C_{15}H_{19}NO_4$ $[M+Na]^+$: 300.1260, found: 300.1260.

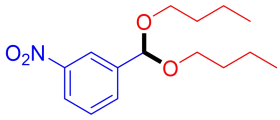


81; Following the typical procedure **IV**, 4-nitro-benzaldehyd (30mg, 0.2 mmol), 3-methyl-1,3-butanediol (213 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the

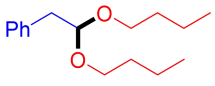
product **81** (31 mg) in 65 % yield as a white powder. Mp: 70 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.8 Hz, 2H), 7.67 (d, *J* = 8.7 Hz, 2H), 5.79 (s, 1H), 4.21 (q, *J* = 7.1 Hz, 1H), 4.15 – 4.08 (m, 2H), 2.02 (ddd, *J* = 13.1, 11.7, 7.2 Hz, 1H), 1.46 (s, 3H), 1.36 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 148.0, 145.9, 127.3, 123.4, 93.7, 72.7, 63.6, 35.7, 31.6, 21.5 ppm. HRMS calc. for $C_{12}H_{15}NO_4$ [M+Na]$^{+}$: 260.0893, found: 260.0893.



82; Following the typical procedure **IV**, 4-nitro-benzaldehyde (30mg, 0.2 mmol), 1,4-butanediol (177 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **82** (34 mg) in 76 % yield as a white powder. Mp: 80 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, *J* = 8.7 Hz, 2H), 7.68 (d, *J* = 8.7 Hz, 2H), 5.75 (s, 1H), 3.94 – 3.87 (m, 2H), 3.79 (dt, *J* = 11.6, 3.5 Hz, 2H), 1.88 – 1.71 (m, 4H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.8, 147.0, 127.5, 123.3, 99.6, 65.8, 29.2 ppm. HRMS calc. for $C_{11}H_{13}NO_4$ [M+H]$^{+}$: 224.0917, found: 224.0917.

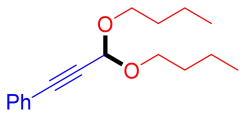


83; Following the typical procedure **IV**, 3-nitrobenzaldehyde (30 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **83** (39 mg) in 70 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.35 (s, 1H), 8.24 – 8.12 (m, 1H), 7.81 (t, *J* = 8.9 Hz, 1H), 7.55 (t, *J* = 7.9 Hz, 1H), 5.58 (s, 1H), 3.59 – 3.44 (m, 4H), 1.62 (dt, *J* = 14.5, 6.7 Hz, 4H), 1.42 (dq, *J* = 14.4, 7.3 Hz, 4H), 0.93 (t, *J* = 7.4 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 148.2, 141.4, 132.8, 129.1, 123.1, 121.9, 100.0, 65.3, 31.7, 19.4, 13.8 ppm. HRMS calc. for $C_{15}H_{23}NO_4$ [M+Na]$^{+}$: 304.1519, found: 304.1519.

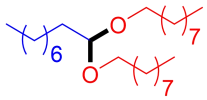


84; Following the typical procedure **IV**, phenylacetaldehyde (24 µL, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **84** (43 mg) in 85 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 (d, *J* = 7.3 Hz, 1H), 7.26 – 7.22 (m, 4H), 4.61 (t,

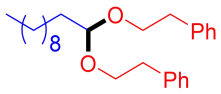
J = 5.7 Hz, 1H), 3.61 (dt, J = 9.2, 6.5 Hz, 2H), 3.38 (dt, J = 9.3, 6.6 Hz, 2H), 2.92 (d, J = 5.7 Hz, 2H), 1.52 (tt, J = 13.6, 6.6 Hz, 4H), 1.33 (dq, J = 14.3, 7.2 Hz, 4H), 0.88 (t, J = 7.4 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 137.4, 129.6, 128.1, 126.2, 104.0, 66.0, 40.7, 31.9, 19.3, 13.9 ppm. HRMS calc. for $C_{16}H_{26}O_2$ $[M+Na]^+$: 273.1825, found: 273.1825.



85; Following the typical procedure **IV**, phenylpropiolaldehyde (24 µL, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **85** (34 mg) in 66 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 – 7.46 (m, 2H), 7.35 – 7.28 (m, 3H), 5.48 (s, 1H), 3.77 (dt, J = 9.4, 6.7 Hz, 2H), 3.59 (dt, J = 9.4, 6.6 Hz, 2H), 1.67 – 1.59 (m, 4H), 1.43 (dq, J = 14.6, 7.3 Hz, 4H), 0.94 (t, J = 7.4 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 131.9, 128.7, 128.2, 121.9, 92.0, 85.2, 84.5, 65.2, 31.6, 19.4, 13.9 ppm. HRMS calc. for $C_{17}H_{24}O_2$ $[M+Na]^+$: 283.1669, found: 283.1669.

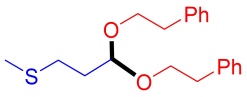


86; Following the typical procedure **IV**, 1-nonanal (34 µL, 0.2 mmol), 1-nonanol (349 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **86** (33 mg) in 40 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.46 (t, J = 5.8 Hz, 1H), 3.56 (dt, J = 9.3, 6.6 Hz, 2H), 3.40 (dt, J = 9.3, 6.7 Hz, 2H), 1.64 – 1.51 (m, 6H), 1.28 (d, J = 11.1 Hz, 36H), 0.88 (t, J = 6.8 Hz, 9H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 103.1, 65.4, 33.4, 31.9, 29.9, 29.6, 29.5, 29.4, 29.3, 29.2, 26.3, 24.8, 22.7, 14.1ppm. HRMS calc. for $C_{27}H_{56}O_2$ $[M+Na]^+$: 435.4173, found: 435.4173.

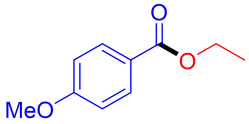


87; Following the typical procedure **IV**, undecanylaldehyde (41 µL, 0.2 mmol), phenethyl alcohol (240 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **87** (46 mg) in 58 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.19 – 7.06 (m, 10H), 4.37 (t, J = 5.8 Hz, 1H), 3.65 – 3.54 (m, 2H), 3.47 (dt, J = 9.4, 7.2 Hz, 2H), 2.73 (t, J = 7.1 Hz, 4H), 1.52 – 1.44 (m, 2H),

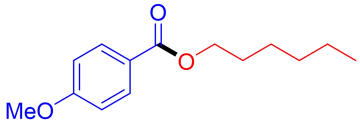
1.17 (d, J = 7.9 Hz, 16H), 0.80 (t, J = 6.8 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.0, 128.9, 128.2, 126.1, 103.2, 66.2, 36.4, 33.3, 31.9, 29.7, 29.6, 29.5, 29.4, 29.3, 24.6, 22.7, 14.1 ppm. HRMS calc. for $C_{27}H_{40}O_2$ [M+Na]$^+$: 419.2921, found: 419.2921.



88; Following the typical procedure **IV**, 3-(methylthio)propionaldehyde (20 µL, 0.2 mmol), phenethyl alcohol (240 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **88** (36 mg) in 55 % yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 – 7.24 (m, 4H), 7.21 – 7.16 (m, 6H), 4.57 (t, J = 5.7 Hz, 1H), 3.72 (dt, J = 9.3, 6.9 Hz, 2H), 3.58 (dt, J = 9.4, 7.1 Hz, 2H), 2.83 (t, J = 7.0 Hz, 4H), 2.43 – 2.35 (m, 2H), 2.03 (s, 3H), 1.89 – 1.79 (m, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 138.9, 128.9, 128.3, 126.2, 101.9, 66.8, 36.4, 33.0, 29.2, 15.5 ppm. HRMS calc. for $C_{20}H_{26}O_2S$ [M+Na]$^+$: 353.1546, found: 353.1546.

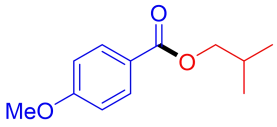


89; A known compound and the characterization data are in accordance with the literature.[7] Following the typical procedure **V**, 4-methoxybenzyl alcohol (24 µL,0.2 mmol), ethanol (234 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **89** (24 mg) in 67% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 – 7.85 (m, 2H), 7.02 – 6.75 (m, 2H), 4.34 (q, J = 7.1 Hz, 2H), 3.85 (s, 3H), 1.38 (t, J = 7.1 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.3, 163.2, 131.5, 122.9, 113.5, 60.6, 55.3, 14.3 ppm.

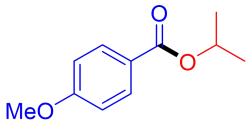


90; A known compound and the characterization data are in accordance with the literature.[S28] Following the typical procedure **V**, 4-methoxybenzyl alcohol (24 µL,0.2 mmol), 1-hexanol (251 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **90** (30 mg) in 63% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 (d, J = 8.9 Hz, 2H), 6.92 (d, J = 8.9 Hz, 2H),

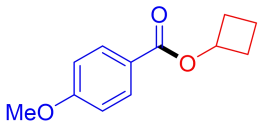
4.28 (t, J = 6.7 Hz, 2H), 3.85 (s, 3H), 1.80 – 1.69 (m, 2H), 1.47 – 1.40 (m, 2H), 1.33 (ddd, J = 10.1, 6.9, 3.4 Hz, 4H), 0.95 – 0.85 (m, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.4, 163.2, 131.5, 123.0, 113.5, 64.8, 55.4, 31.5, 28.7, 25.7, 22.5, 14.0 ppm.



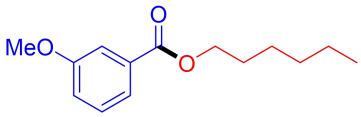
91; A known compound and the characterization data are in accordance with the literature.[S29] Following the typical procedure **V**, 4-methoxybenzyl alcohol (24 µL,0.2 mmol), isobutanol (185 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **91** (29 mg) in 70% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 – 7.83 (m, 2H), 6.90 – 6.71 (m, 2H), 4.00 (d, J = 6.6 Hz, 2H), 3.77 (s, 3H), 1.99 (dp, J = 13.4, 6.7 Hz, 1H), 0.94 (d, J = 6.7 Hz, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.3, 163.2, 131.5, 122.9, 113.5, 77.3, 55.4, 27.9, 19.2 ppm.



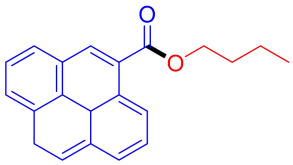
92; A known compound and the characterization data are in accordance with the literature.[S14] Following the typical procedure **V**, 4-methoxybenzyl alcohol (24 µL,0.2 mmol), isopropyl alcohol (153 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **92** (29 mg) in 77% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 – 7.71 (m, 2H), 6.94 – 6.60 (m, 2H), 5.22 – 4.92 (m, 1H), 3.91 – 3.52 (m, 3H), 1.29 – 1.19 (m, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.8, 163.1, 131.4, 123.3, 113.4, 67.9, 55.3, 21.9 ppm.



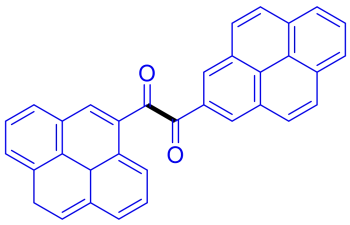
93; Following the typical procedure **V**, 4-methoxybenzyl alcohol (24 µL,0.2 mmol), cyclobutanol (157 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **93** (33 mg) in 80% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 (d, J = 8.4 Hz, 2H), 6.91 (d, J = 8.5 Hz, 2H), 5.33 – 5.04 (m, 1H), 3.85 (s, 3H), 2.51 – 2.39 (m, 2H), 2.24 – 2.13 (m, 2H), 1.89 – 1.81 (m, 1H), 1.72 – 1.65 (m, 1H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.7, 163.3, 131.5, 122.8, 113.5, 69.0, 55.4, 30.4, 13.6 ppm. HRMS (ESI+, *m/z*) calc. for $C_{12}H_{14}O_3$ $[M+H]^+$: 207.1016, found: 207.1016.



94; A known compound and the characterization data are in accordance with the literature.[S4] Following the typical procedure **V**, (3-methoxyphenyl)methanol (25 µL, 0.2 mmol), 1-hexanol (251 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **94** (23 mg) in 48% yield as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (t, *J* = 9.7 Hz, 1H), 7.57 (d, *J* = 1.1 Hz, 1H), 7.33 (t, *J* = 7.9 Hz, 1H), 7.12 – 7.05 (m, 1H), 4.31 (t, *J* = 6.7 Hz, 2H), 3.84 (d, *J* = 1.1 Hz, 3H), 1.81 – 1.68 (m, 2H), 1.43 (dd, *J* = 13.9, 6.5 Hz, 2H), 1.39 – 1.28 (m, 4H), 0.90 (dd, *J* = 6.9, 6.1 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.4, 159.4, 131.8, 129.2, 121.8, 119.1, 114.0, 65.1, 55.3, 31.4, 28.6, 25.6, 22.5, 13.9 ppm.

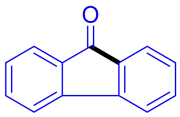


95; Following the typical procedure **III**, 1-pyrenecarboxaldehyde (46 mg, 0.2 mmol), 1-butanol (183 µL, 2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 µL, 0.02 mmol) in THF (2 mL) were employed to give the product **95** (24 mg) in 40 % yield as a yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.15 (dd, *J* = 9.4, 1.6 Hz, 1H), 8.51 (dd, *J* = 8.1, 1.9 Hz, 1H), 8.12 (t, *J* = 8.6 Hz, 3H), 8.05 – 8.00 (m, 2H), 7.96 – 7.89 (m, 2H), 4.42 (td, *J* = 6.6, 1.3 Hz, 2H), 1.86 – 1.73 (m, 2H), 1.55 – 1.45 (m, 2H), 0.95 (td, *J* = 7.3, 1.3 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.1, 134.1, 131.0, 130.9, 130.3, 129.4, 129.3, 128.3, 127.1, 126.2, 126.1, 126.0, 124.9, 124.1, 124.0, 123.8, 99.9, 65.1, 30.9, 19.4, 13.8 ppm. HRMS calc. for $C_{21}H_{18}O_2$ $[M^{\cdot}+H]^{+}$: 303.1380, found: 303.1380.



96; Following the typical procedure **III**, the product **96** (33 mg) in 33 % yield as a yellow powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.80 (s, 2H), 9.45 (d, *J* = 9.3 Hz, 2H), 8.47 (d, *J* = 7.9 Hz, 2H), 8.34 (dd, *J* = 8.3, 4.2 Hz, 4H), 8.30 (d, *J* = 5.4 Hz, 2H), 8.27 (d, *J* = 4.2 Hz, 1H), 8.24 (s, 1H), 8.11

(dd, J = 12.3, 4.7 Hz, 4H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 193.1, 135.5, 131.4, 131.0, 130.9, 130.8, 130.7, 130.4, 127.3, 127.2, 127.0, 126.8, 126.5, 124.6, 124.5, 124.0, 123.0 ppm. HRMS calc. for $C_{34}H_{18}O_2$ $[M\text{-}C_{17}H_9O^{\cdot}+H]^+$: 230.0726, found: 230.0726.



97; A known compound and the characterization data are in accordance with the literature.[S27] 2-biphenylcarboxaldehyde (36 mg, 0.2 mmol), photocatalyst **1** 4CzIPN (4.7 mg, 0.006 mmol), and ethyl 2-mercaptopropionate (2.6 μL, 0.02 mmol) in THF (1.5 mL) were employed to give the product **91** (28 mg) in 76 % yield as a yellow powder. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, J = 7.3 Hz, 2H), 7.50 (dt, J = 15.0, 7.4 Hz, 4H), 7.30 (t, J = 7.3 Hz, 2H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ 193.9, 144.4, 134.7, 134.1, 129.1, 124.3, 120.1 ppm.

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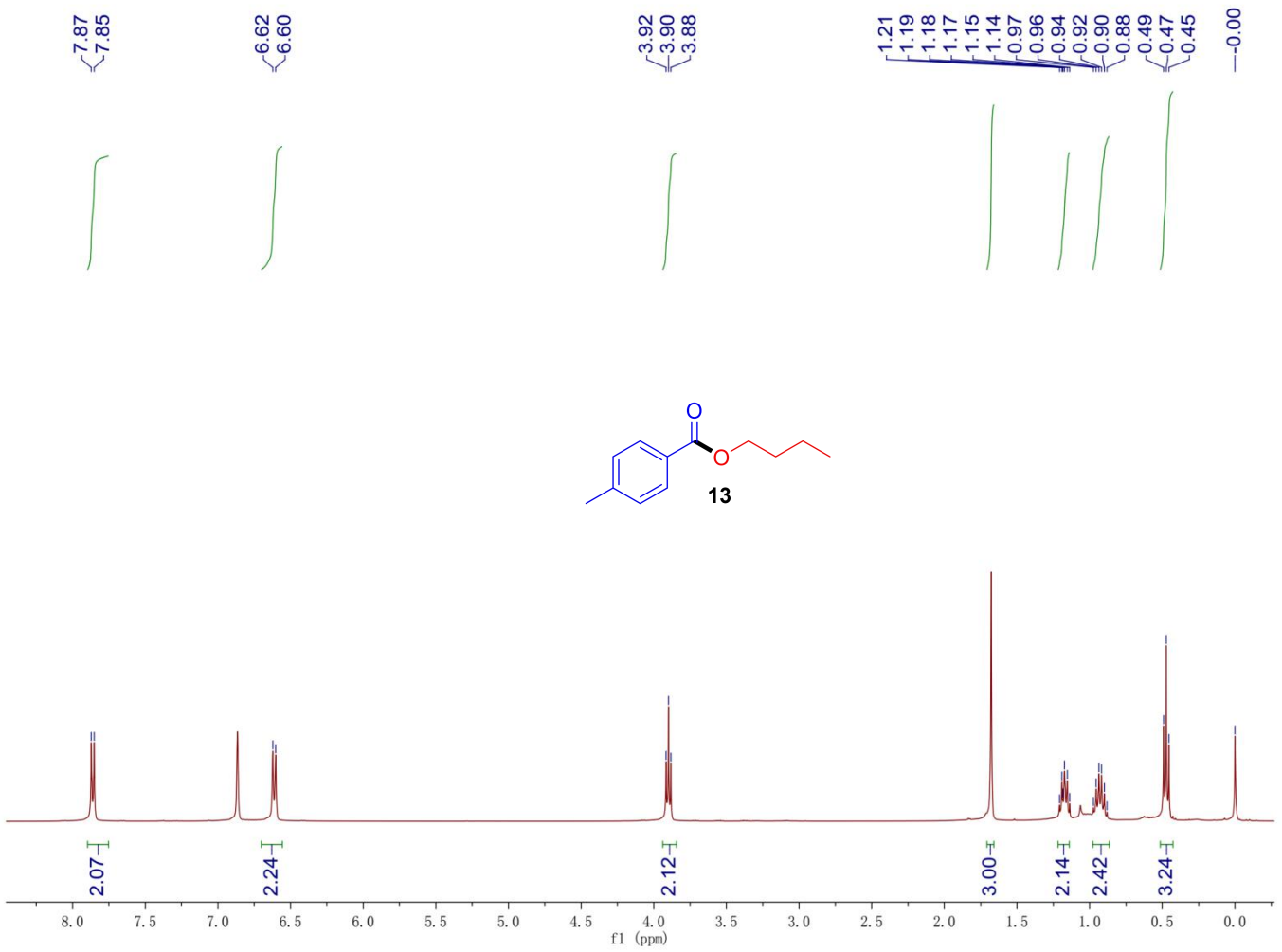
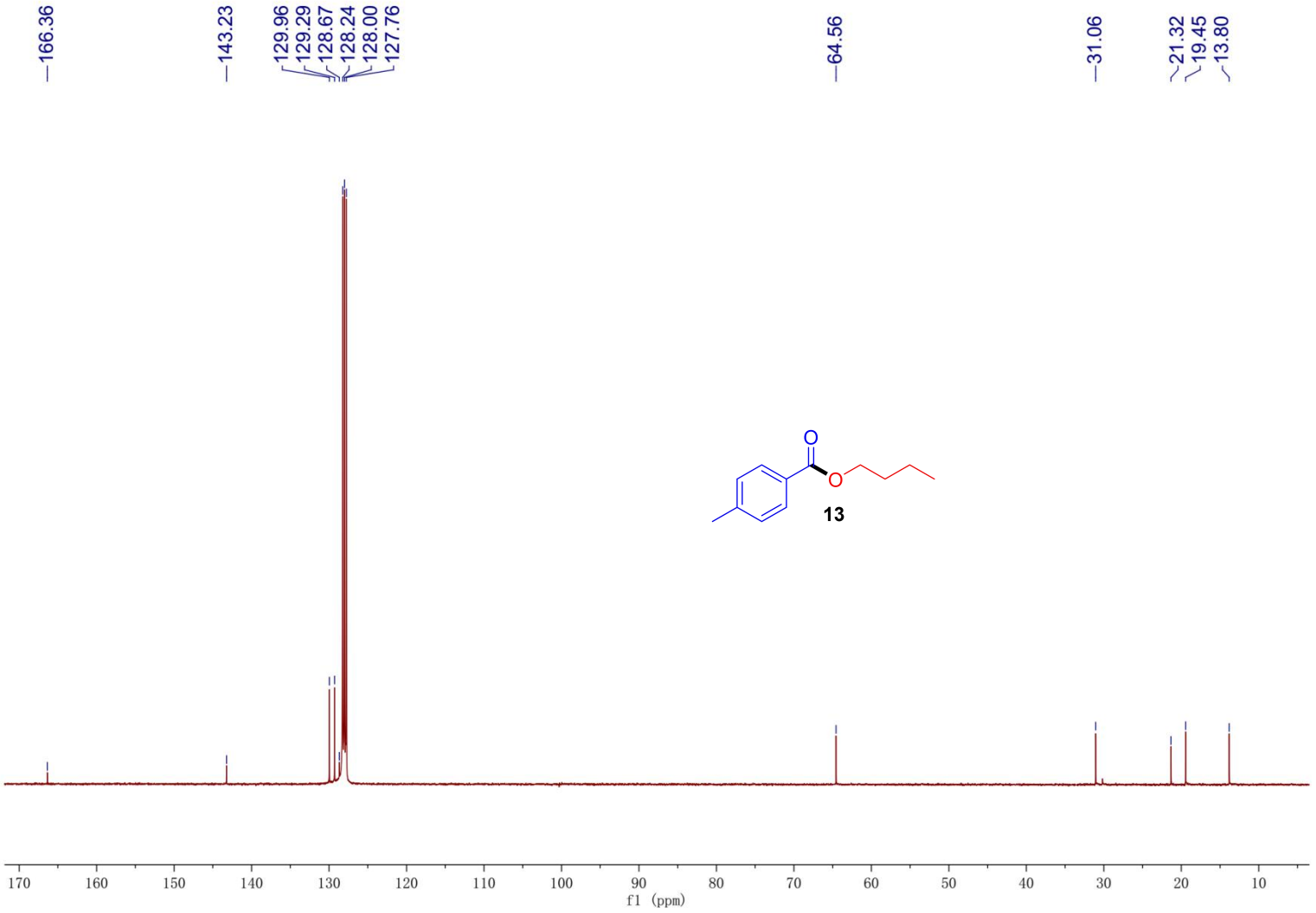
X. ^{1}H, ^{13}C NMR Spectra of Products

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O
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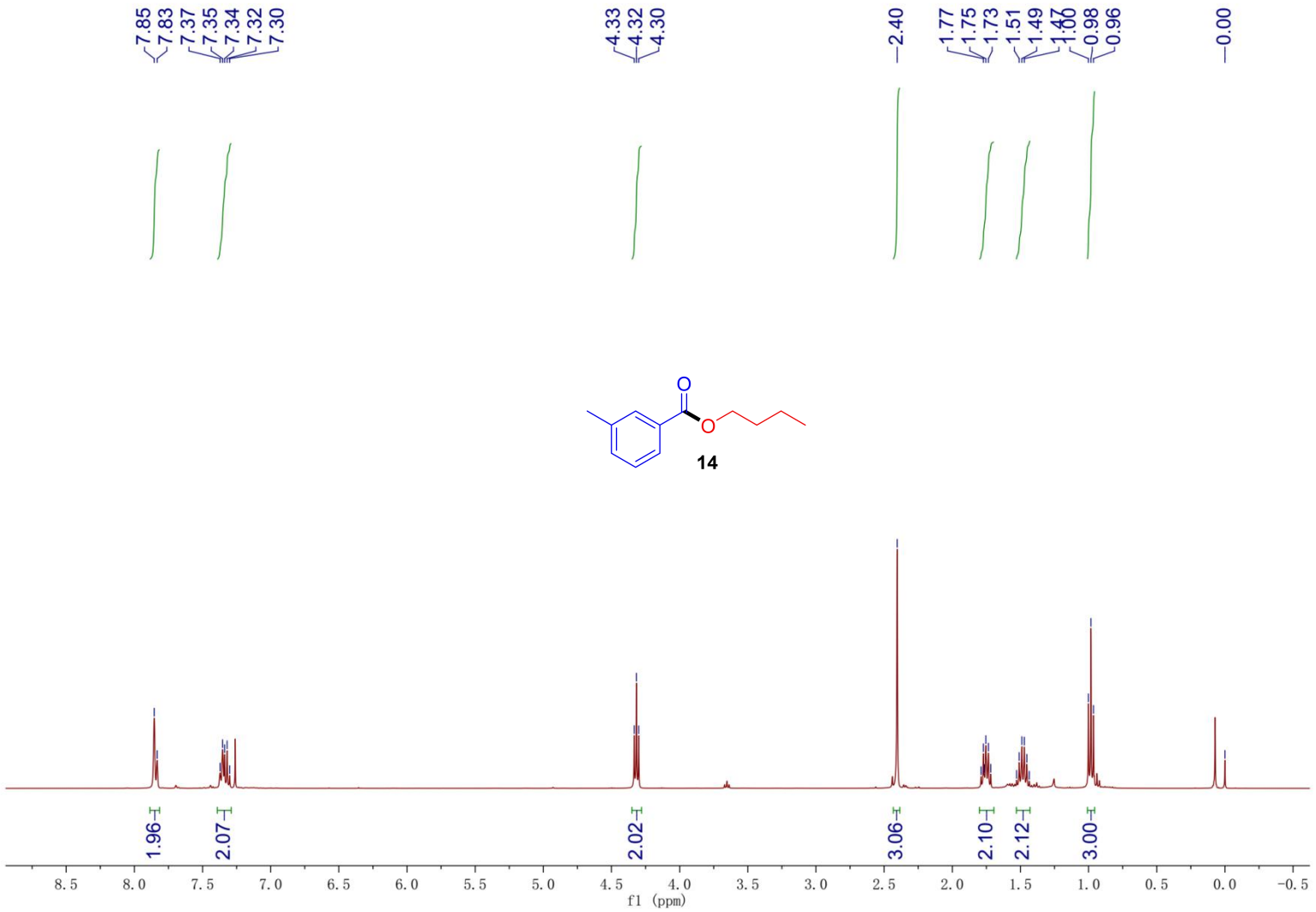
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O
14
1.96
2.07
2.02
3.06
2.10
2.12
3.00
8.5
8.0
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5.0
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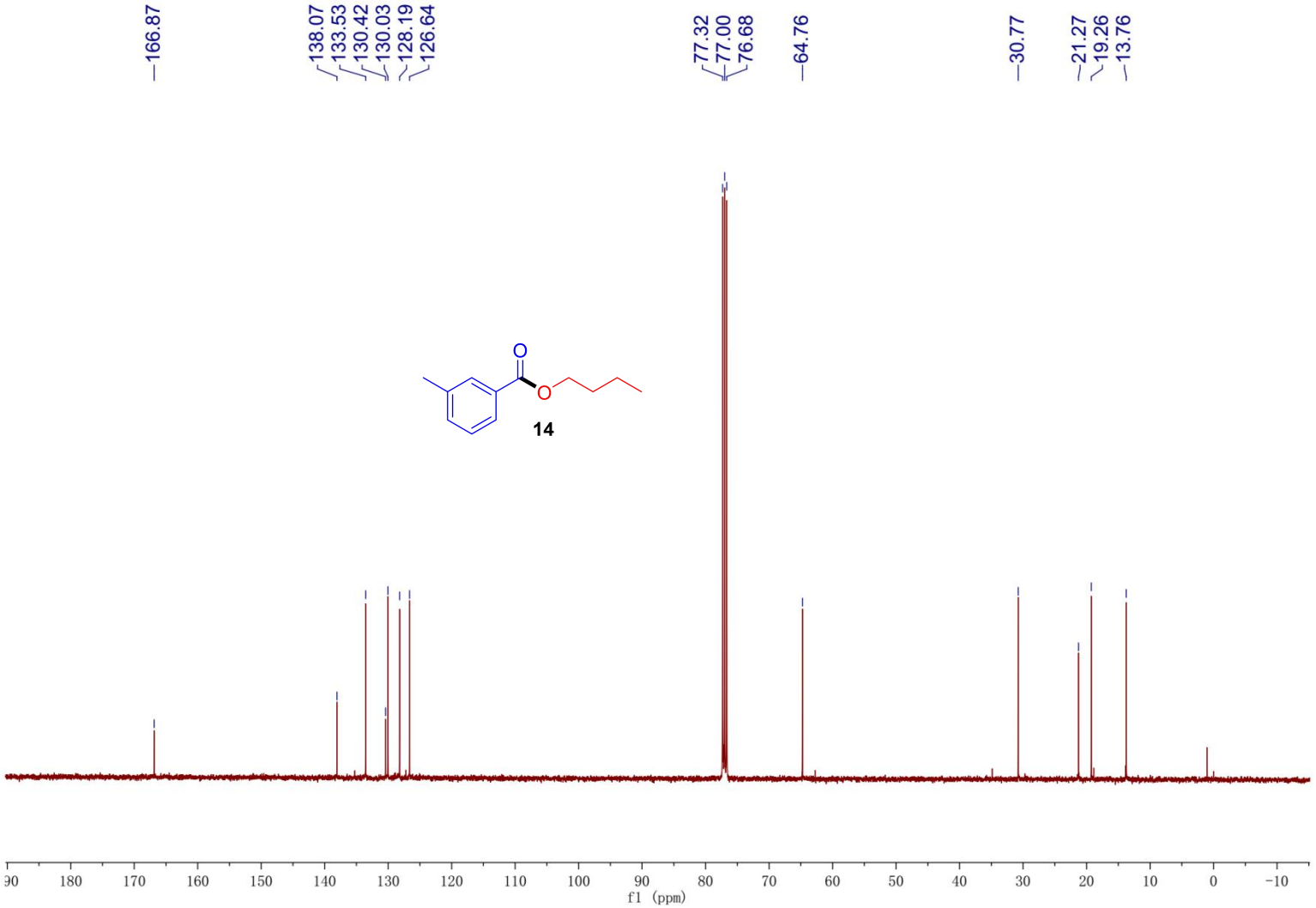
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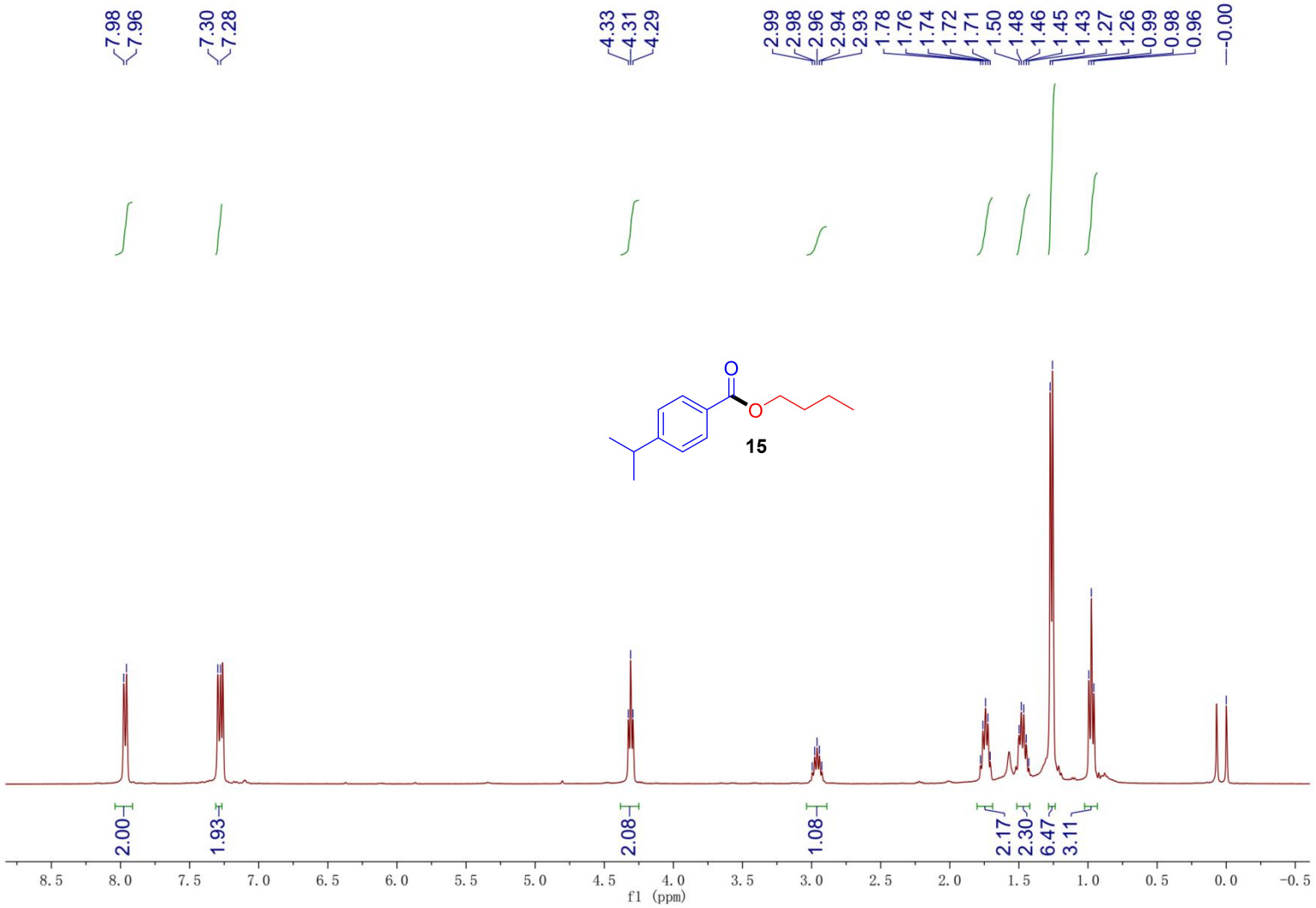
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1.71
1.50
1.48
1.46
1.45
1.43
1.27
1.26
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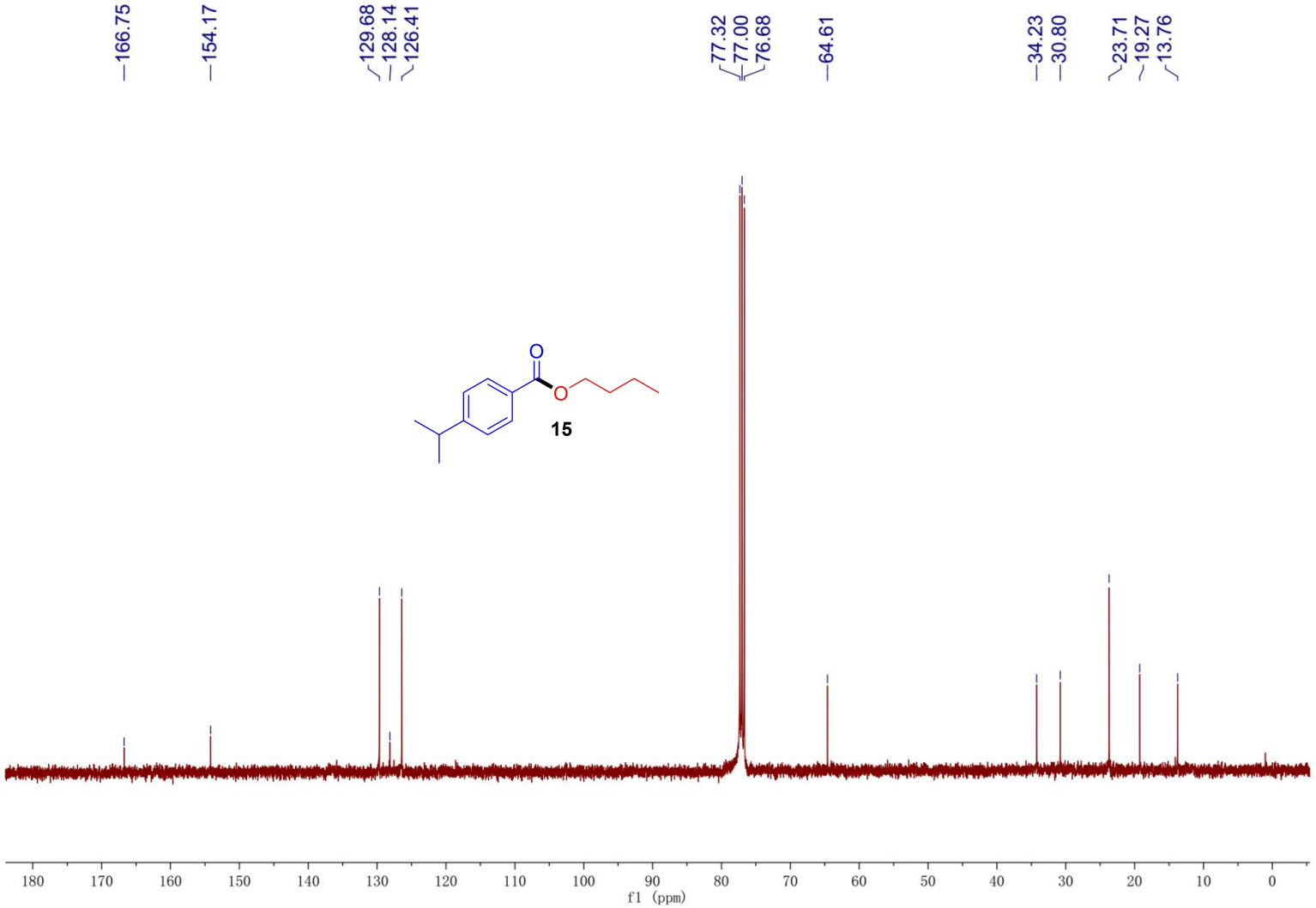
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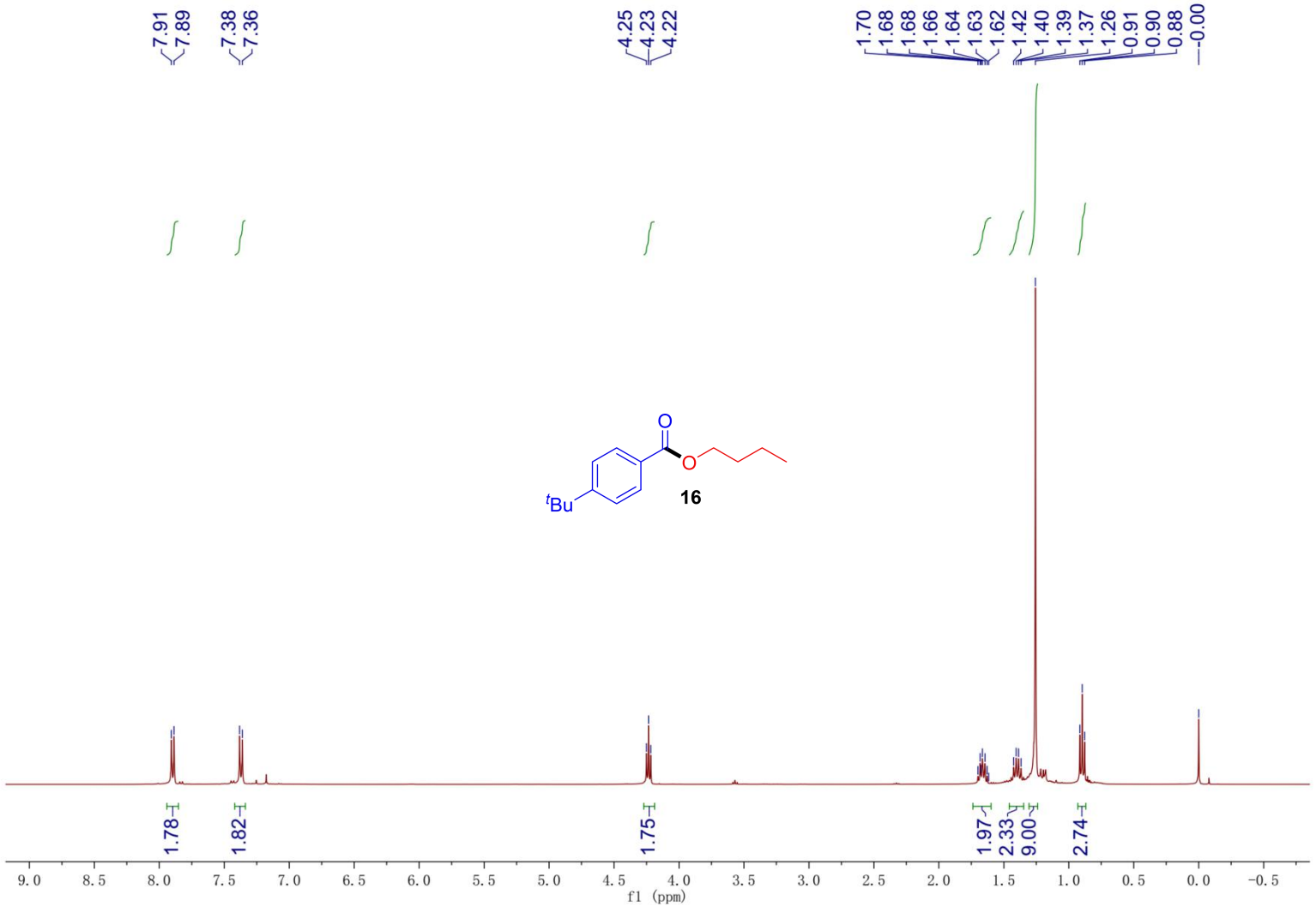
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O
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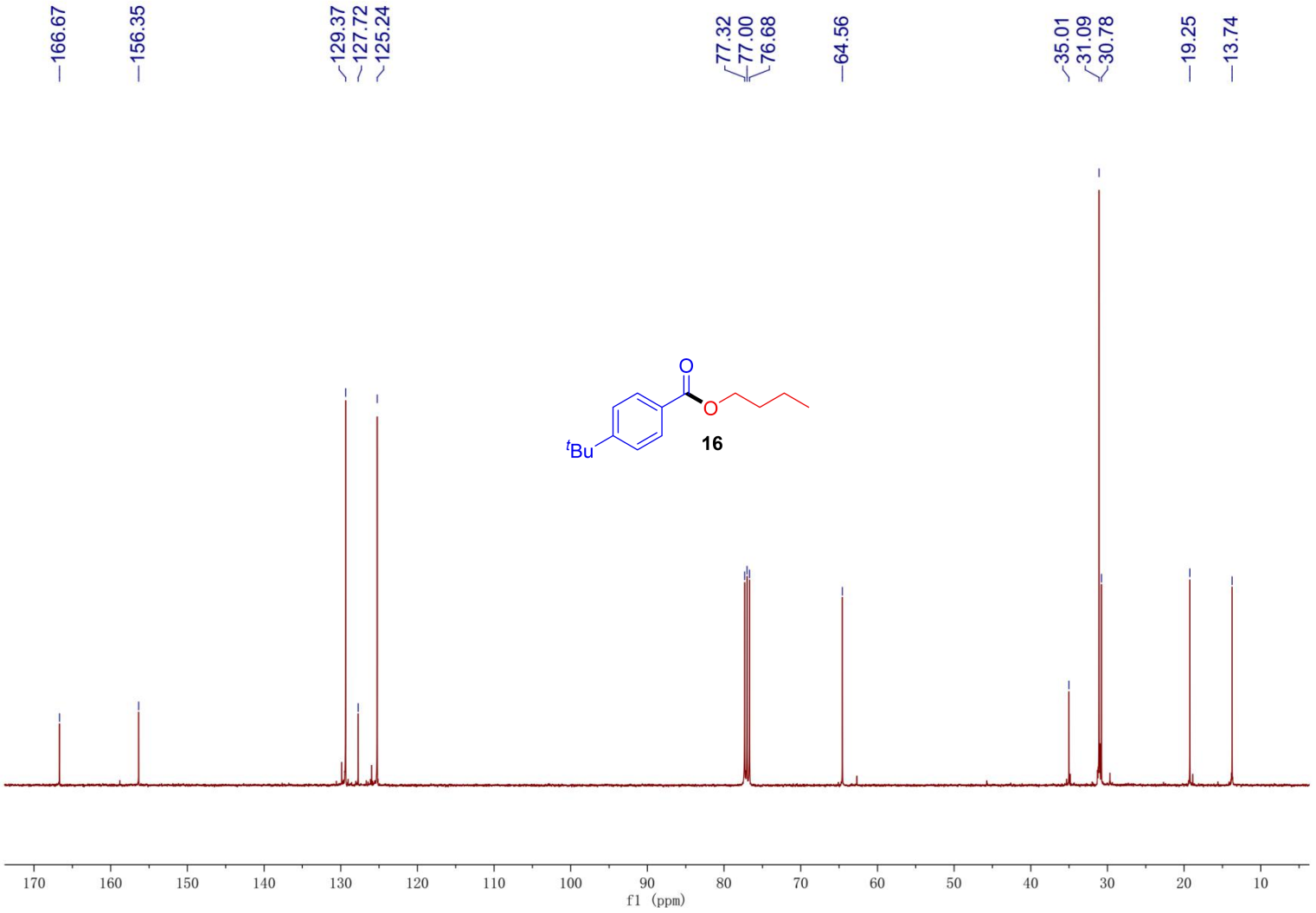
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O
O
tBu
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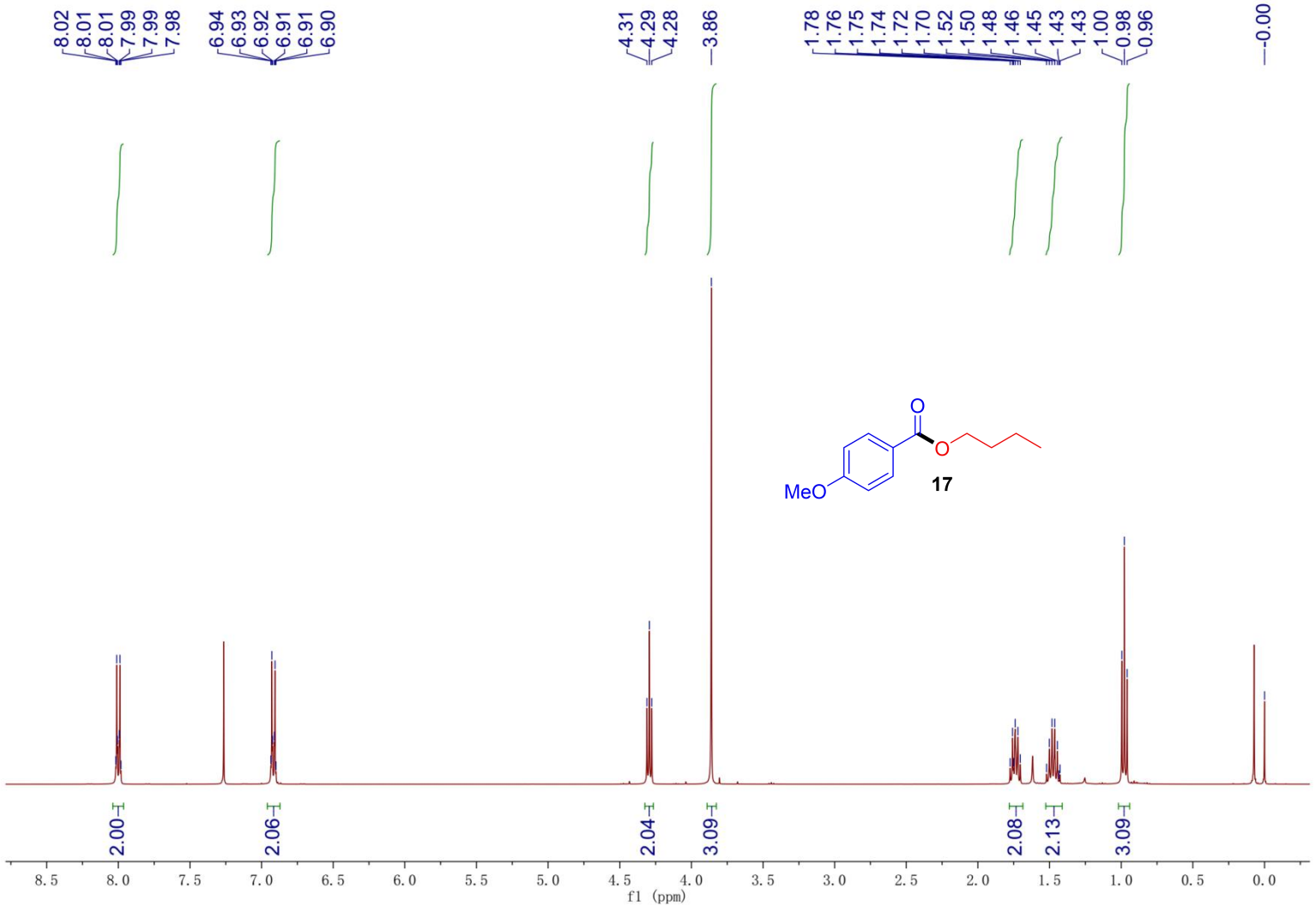
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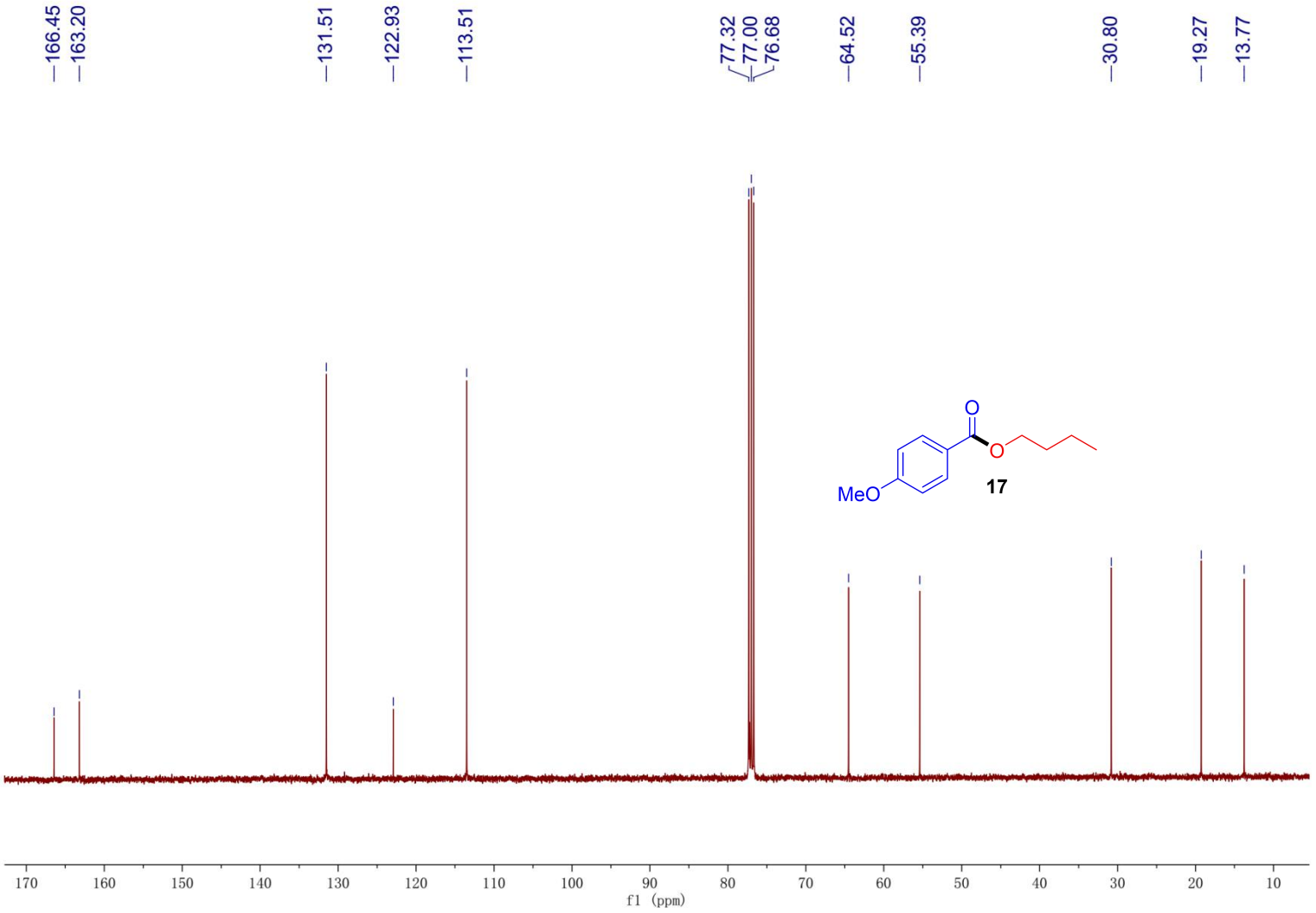
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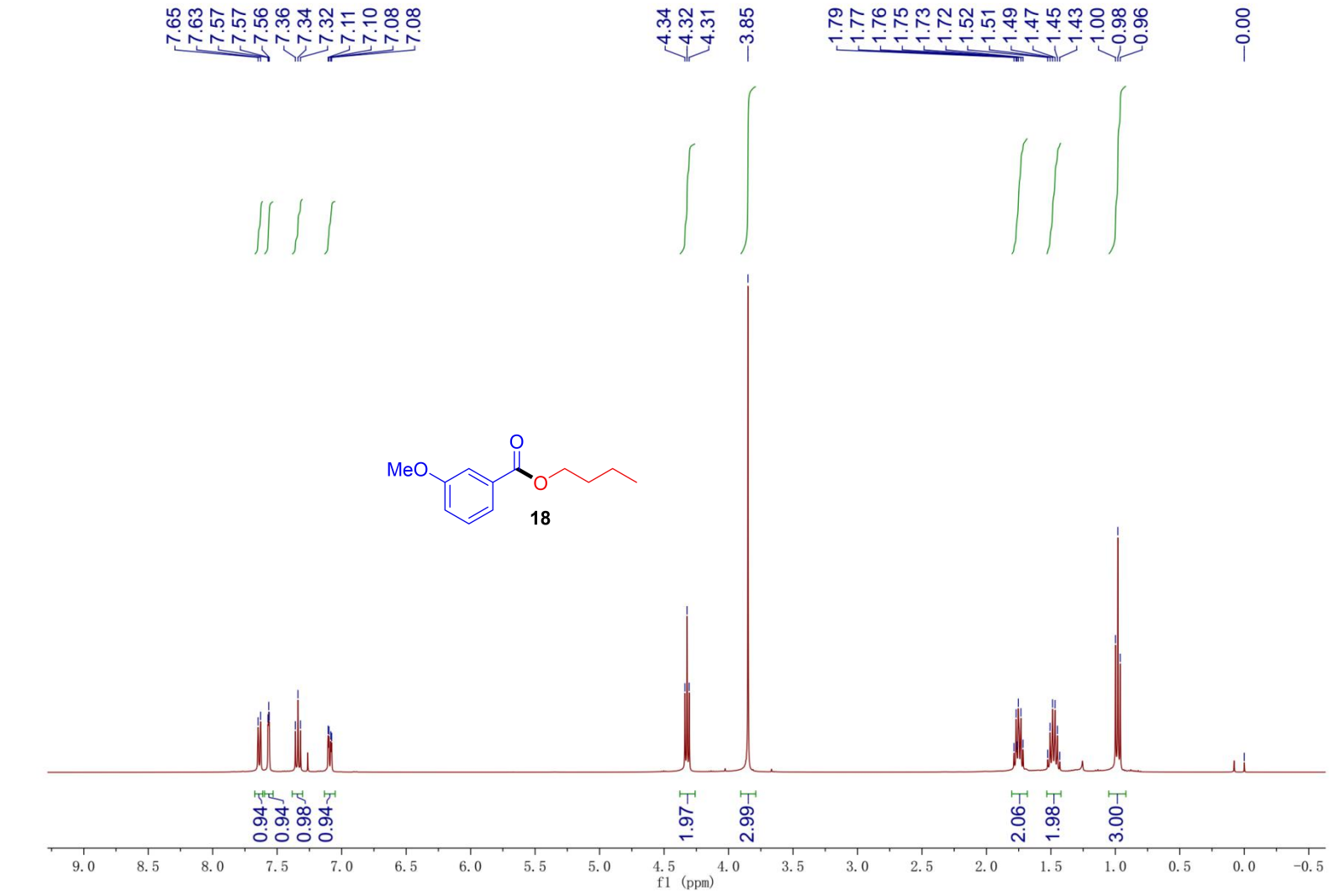
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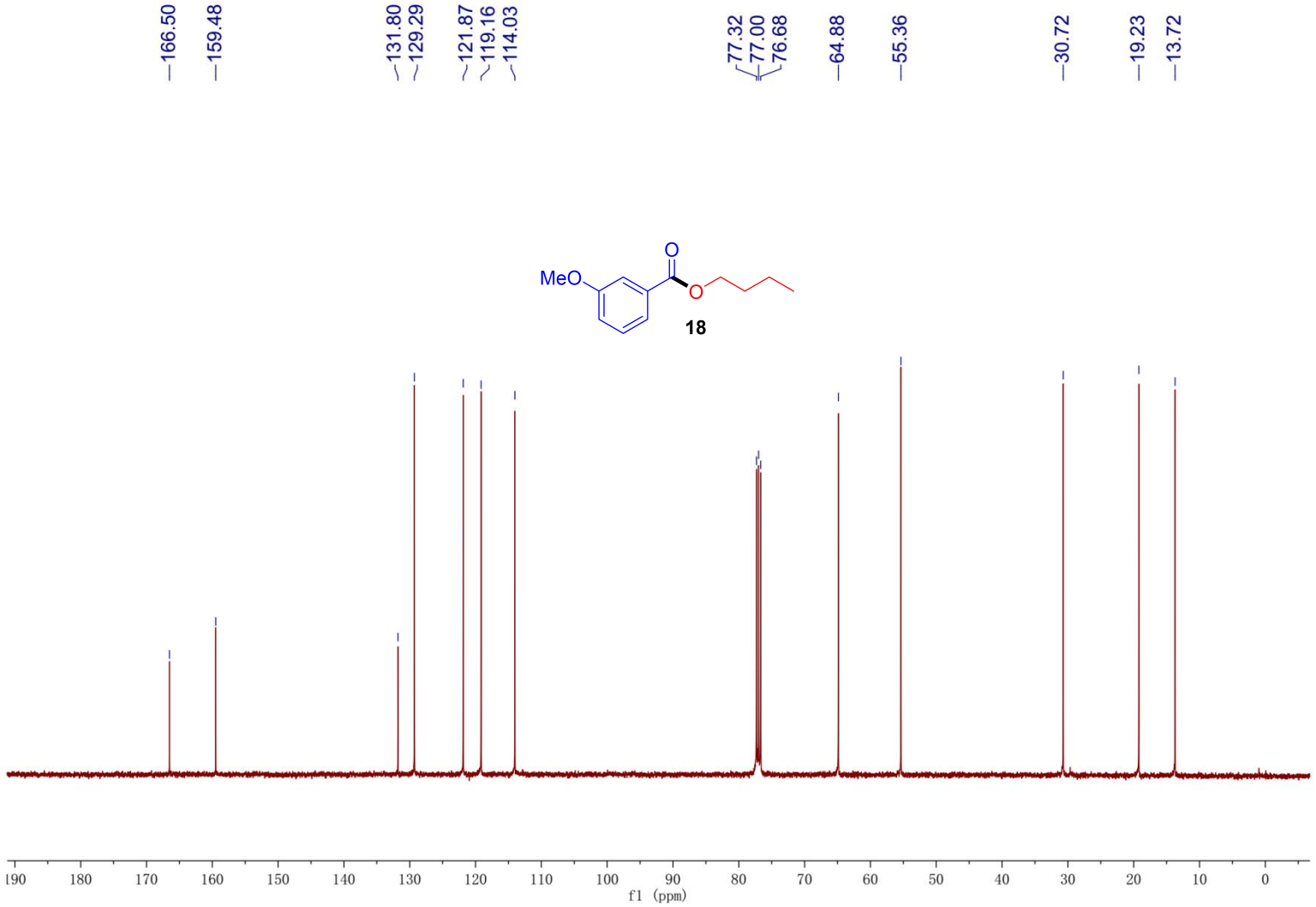
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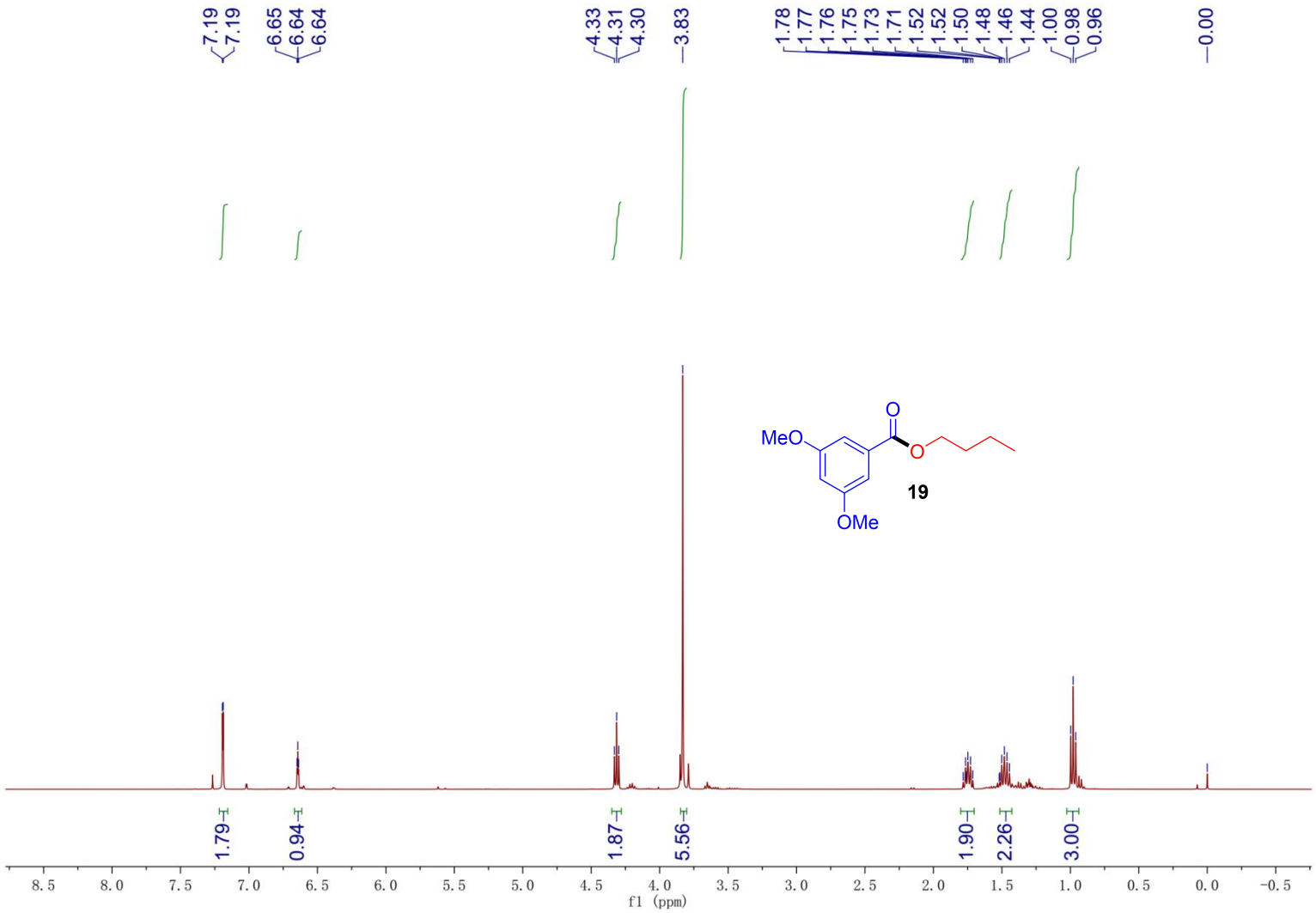
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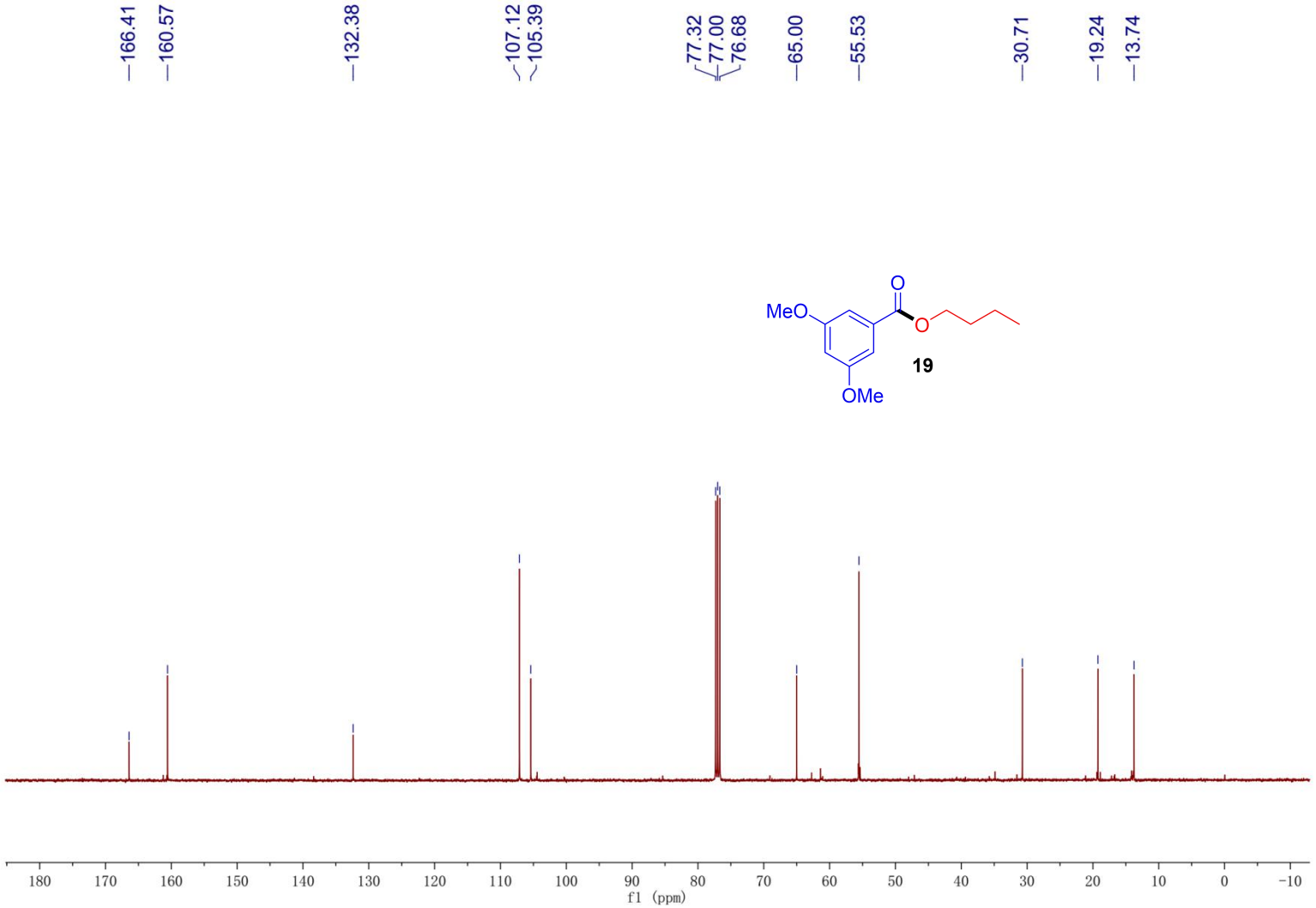
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OMe
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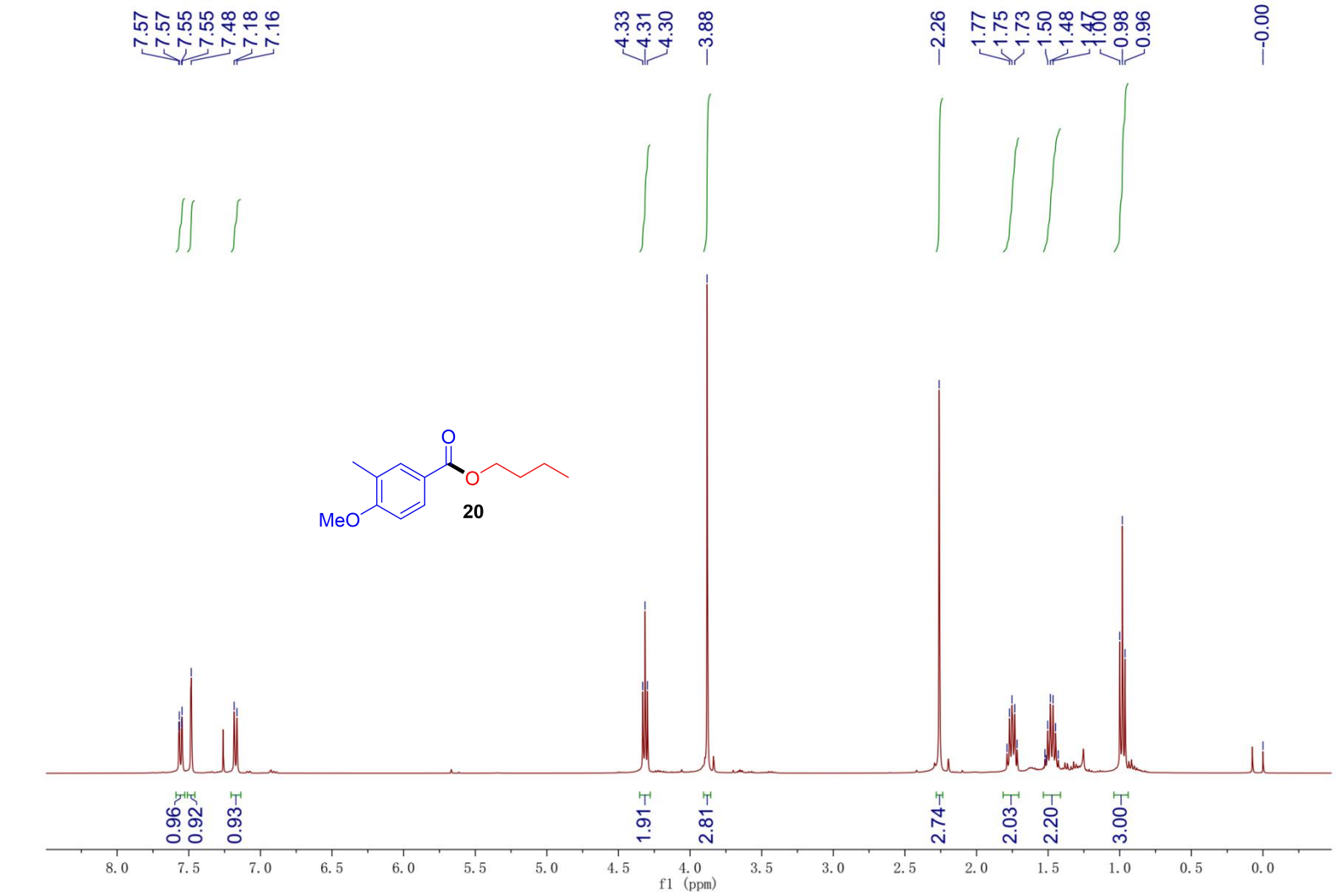
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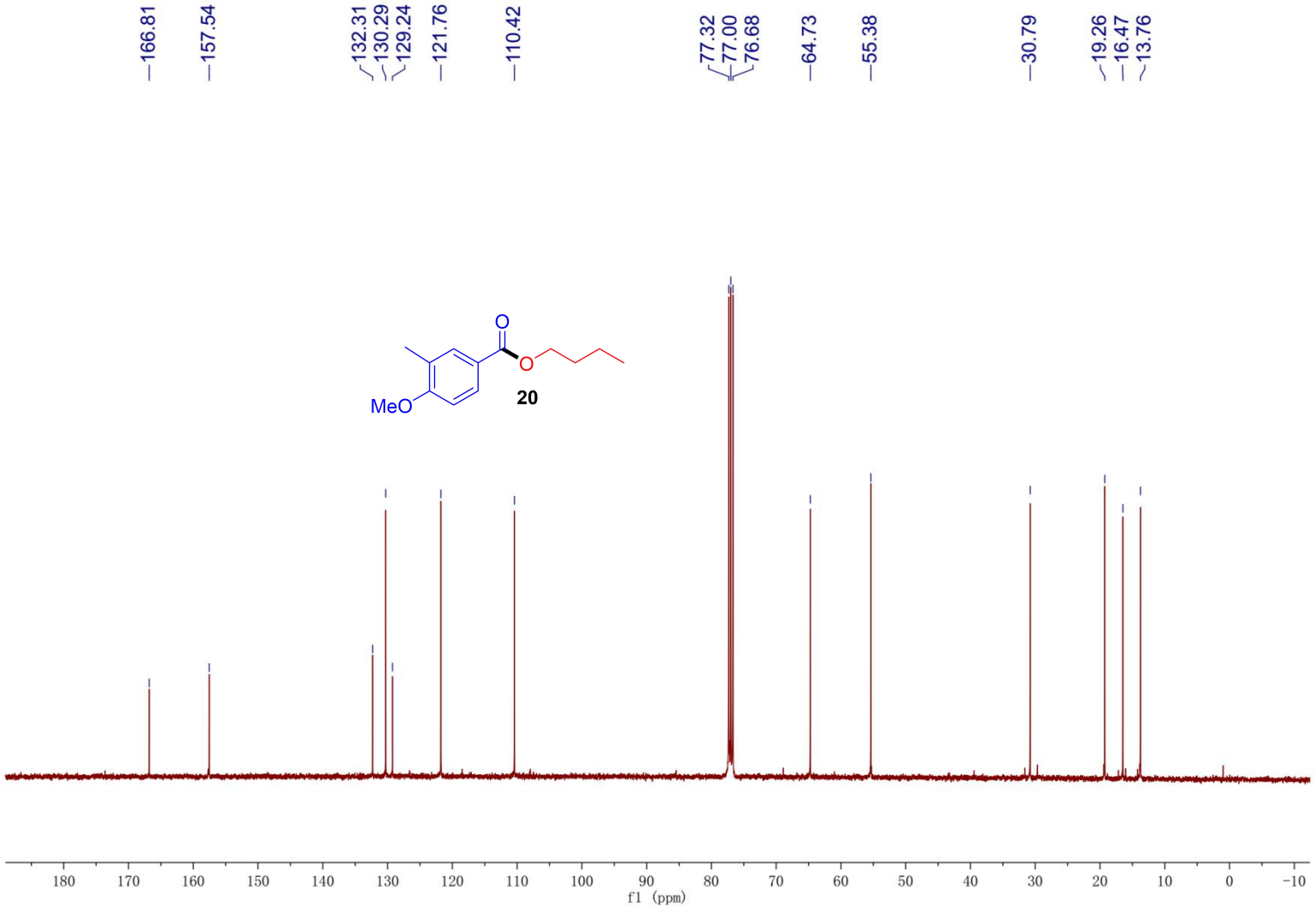
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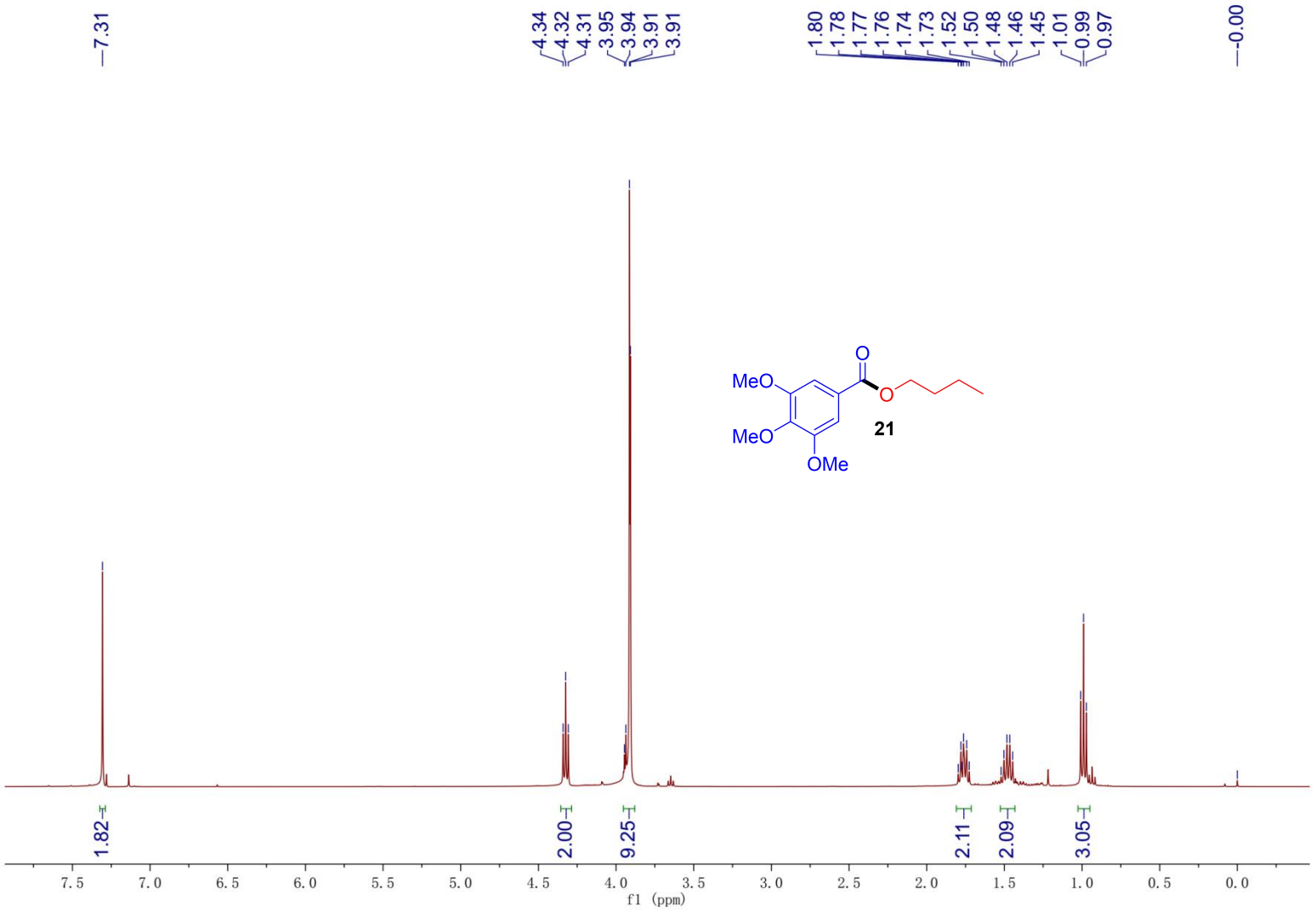
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0.97
0.00
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MeO
OMe
O
O
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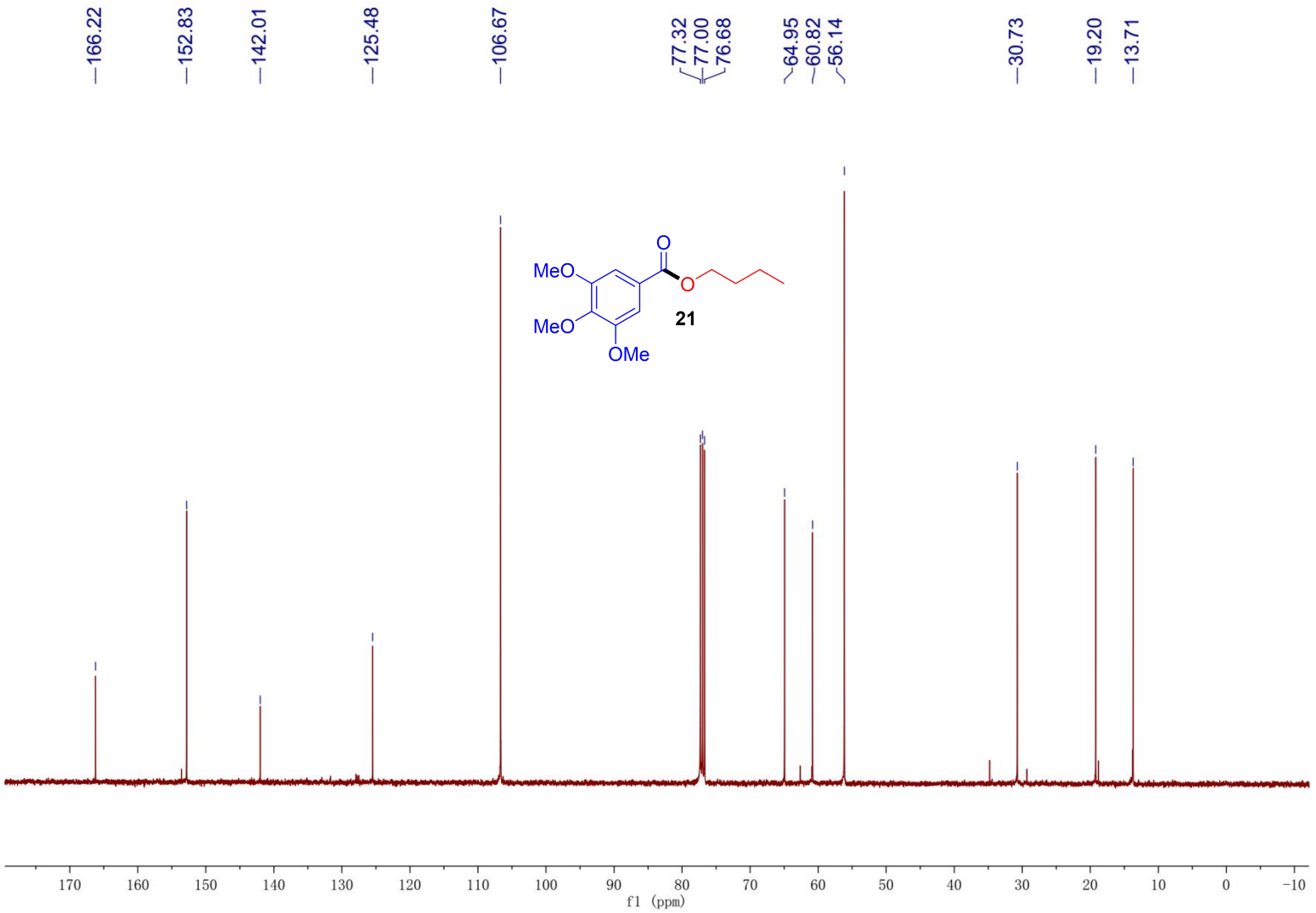
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MeO
OMe
O
O
21
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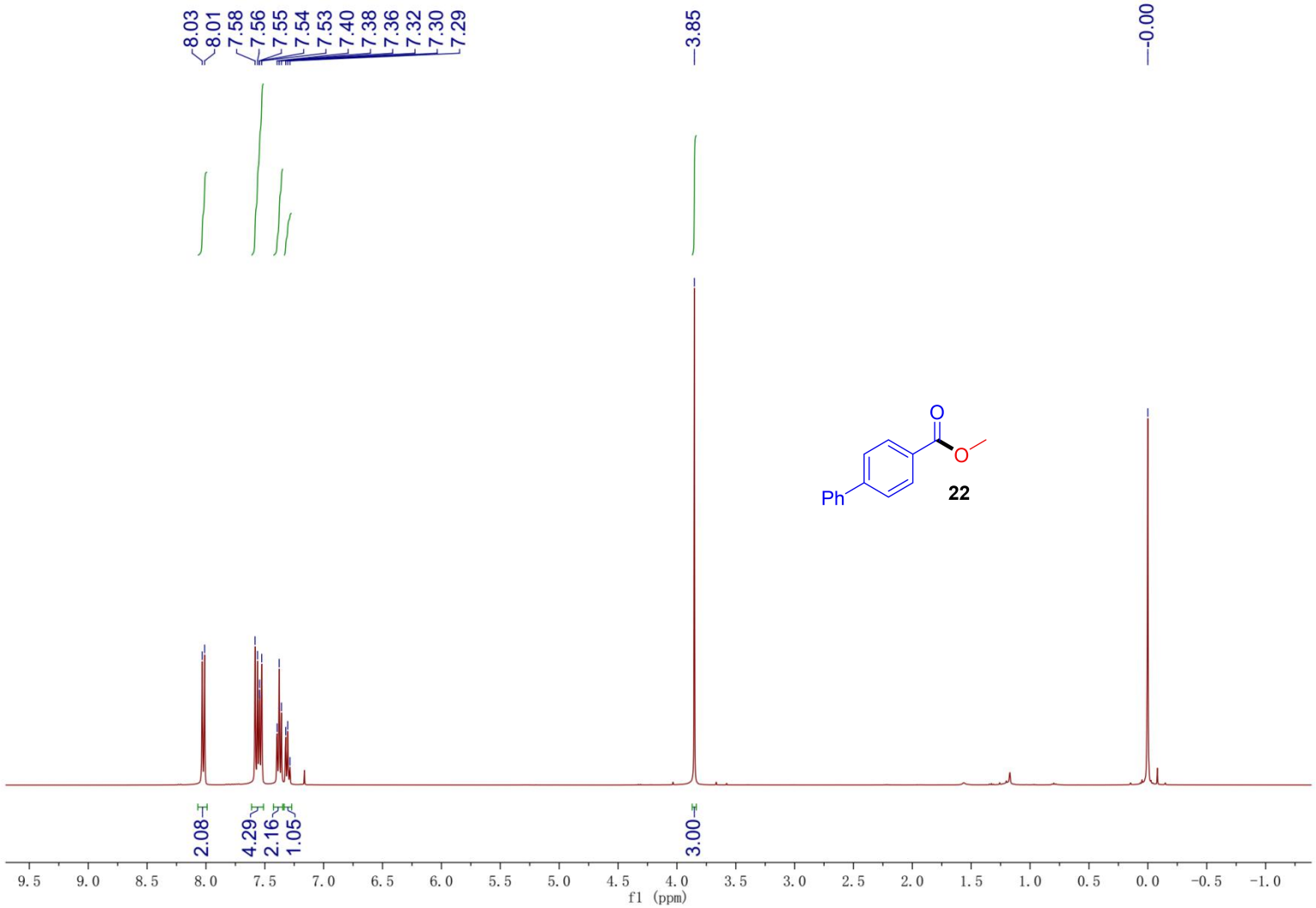
f1 (ppm)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4.29
2.16
1.05
3.00
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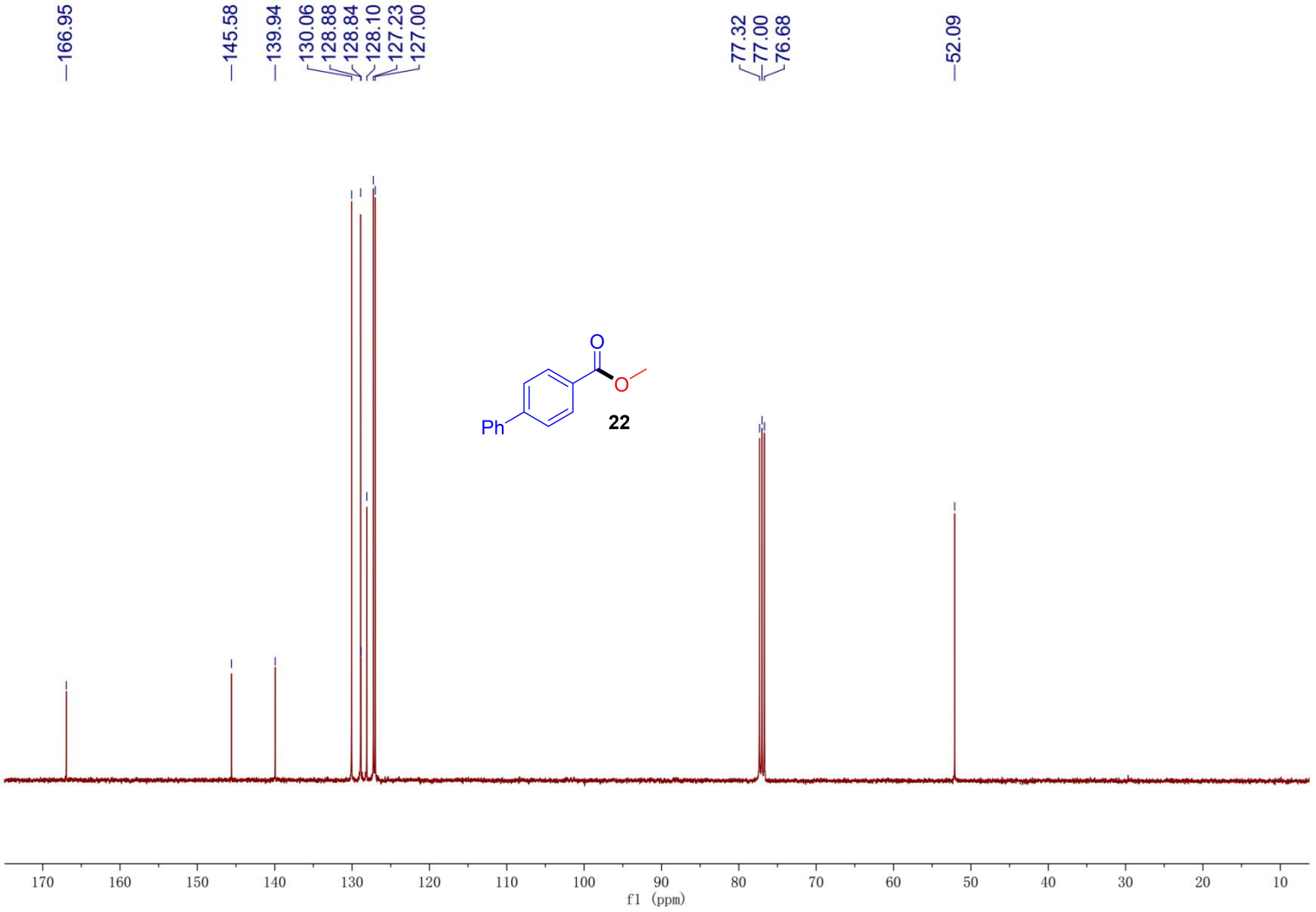
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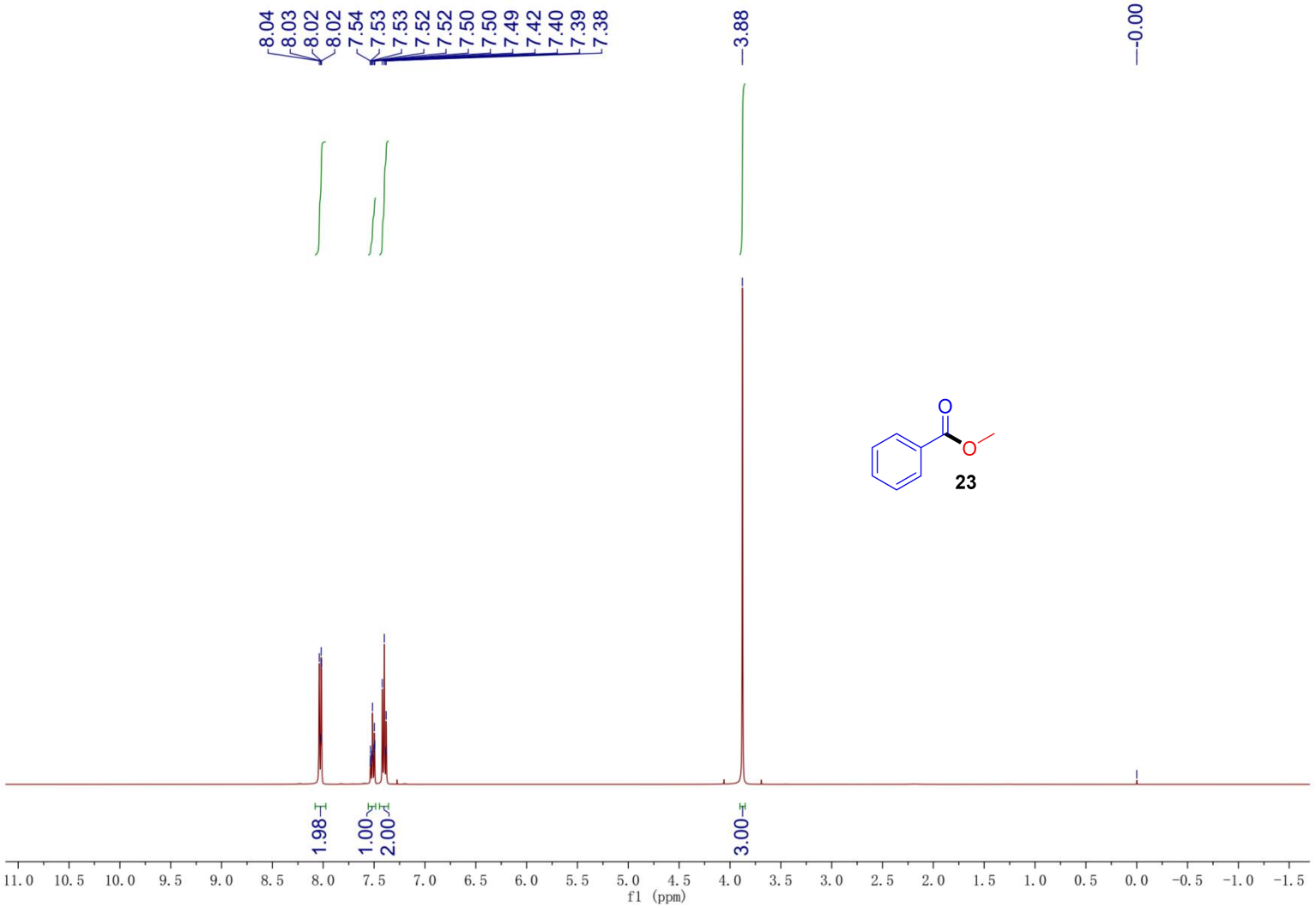
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2.00
3.00
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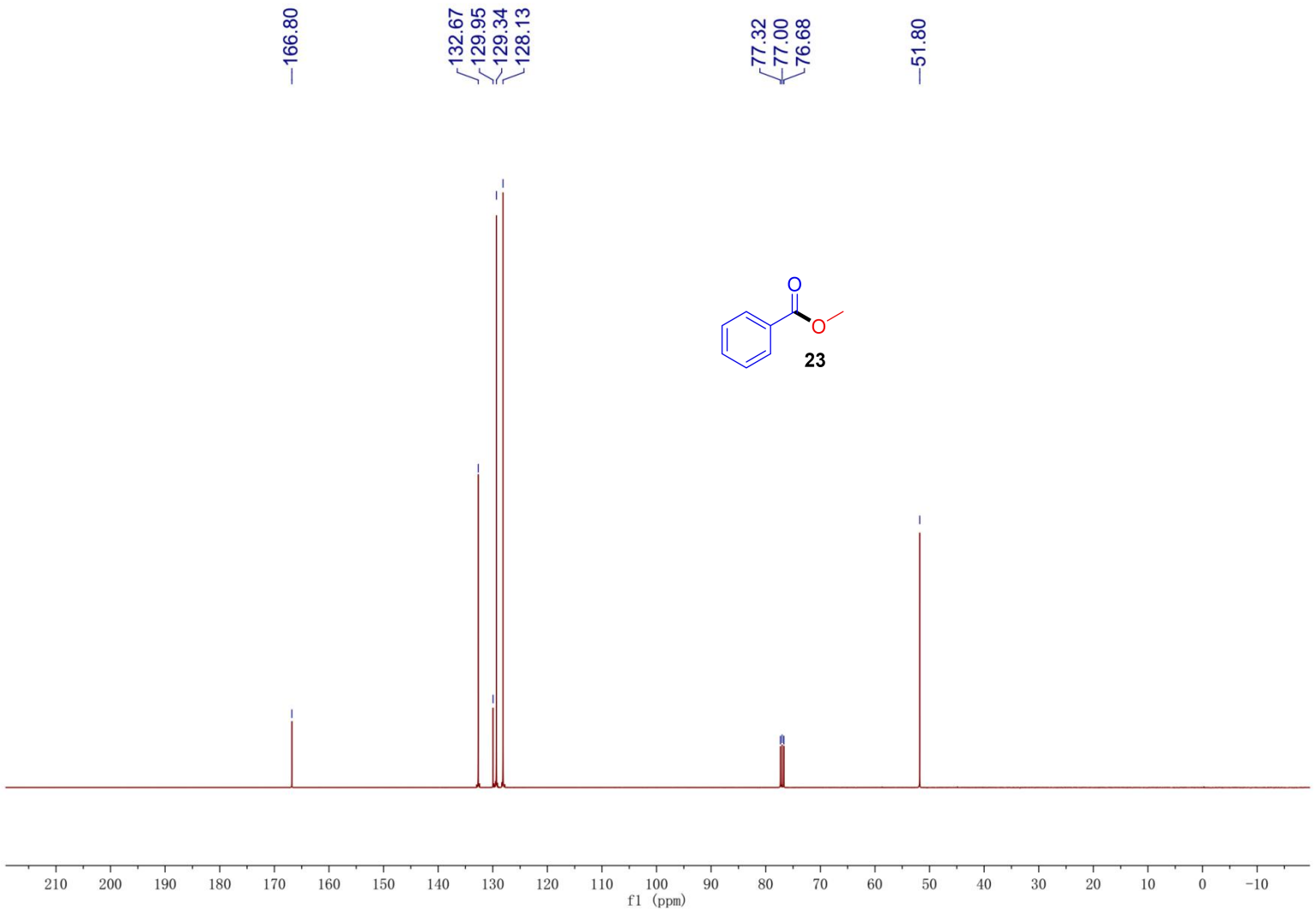
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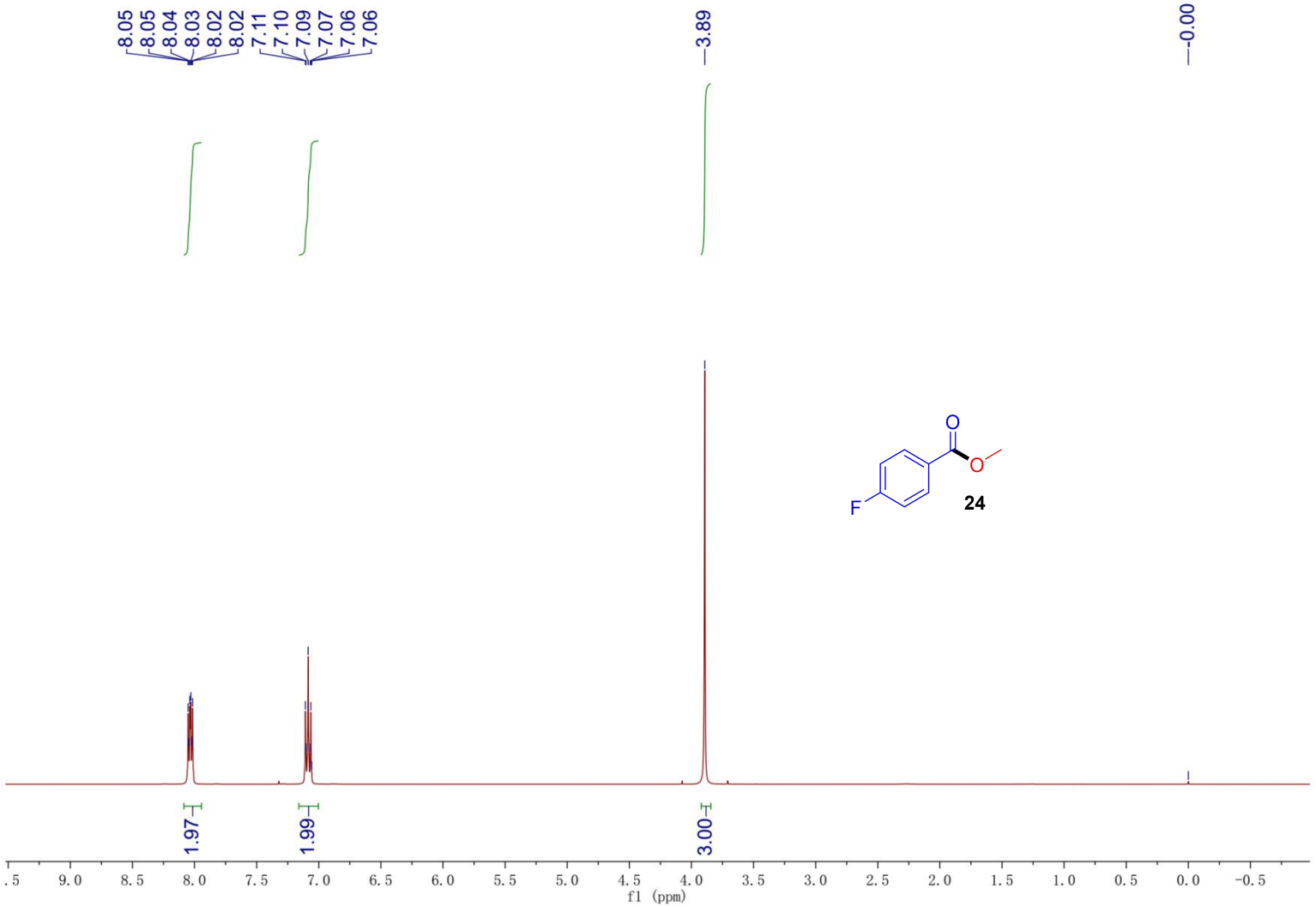
f1 (ppm)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F
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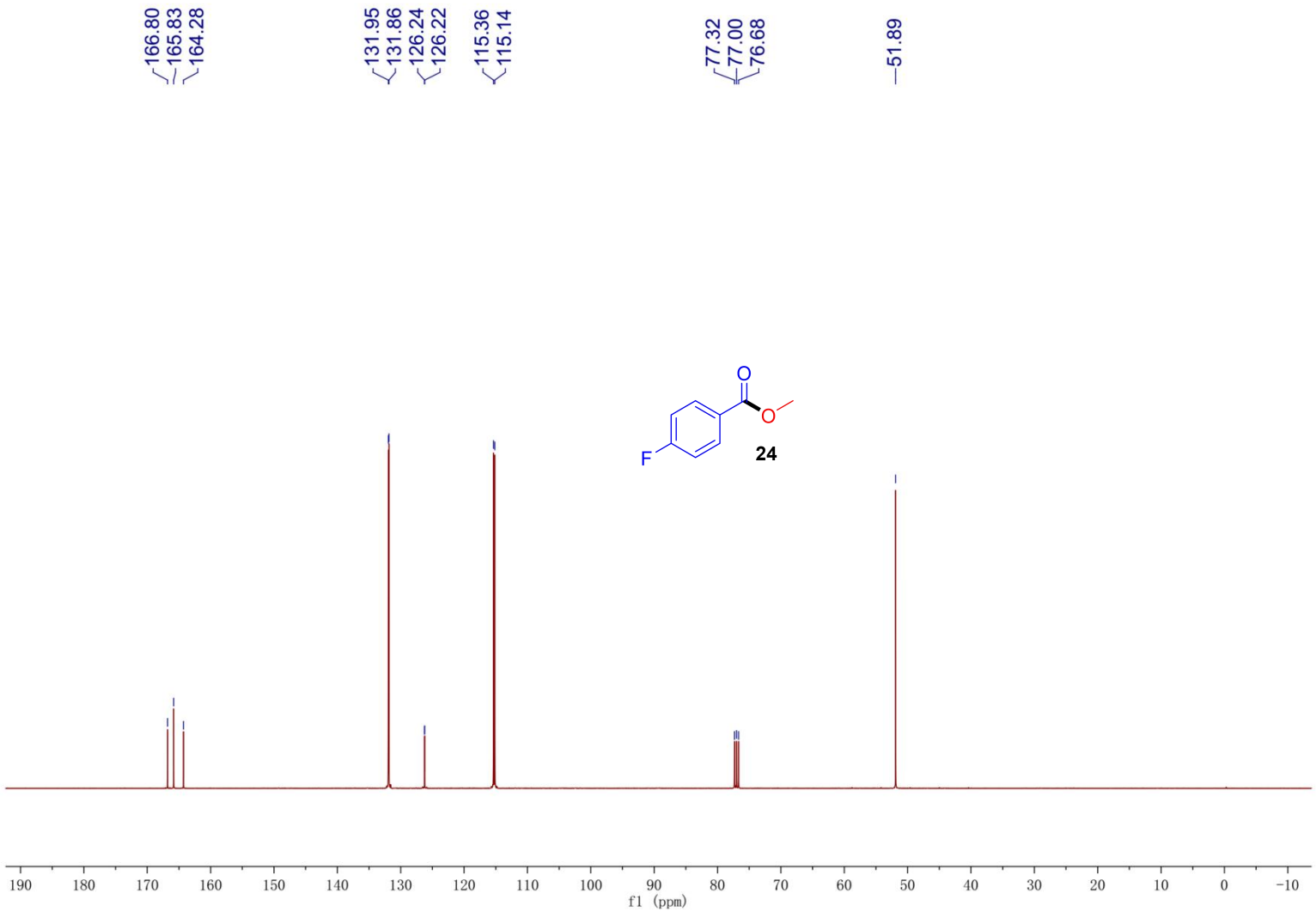
1.99
3.00
f1 (ppm)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24
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180
170
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30
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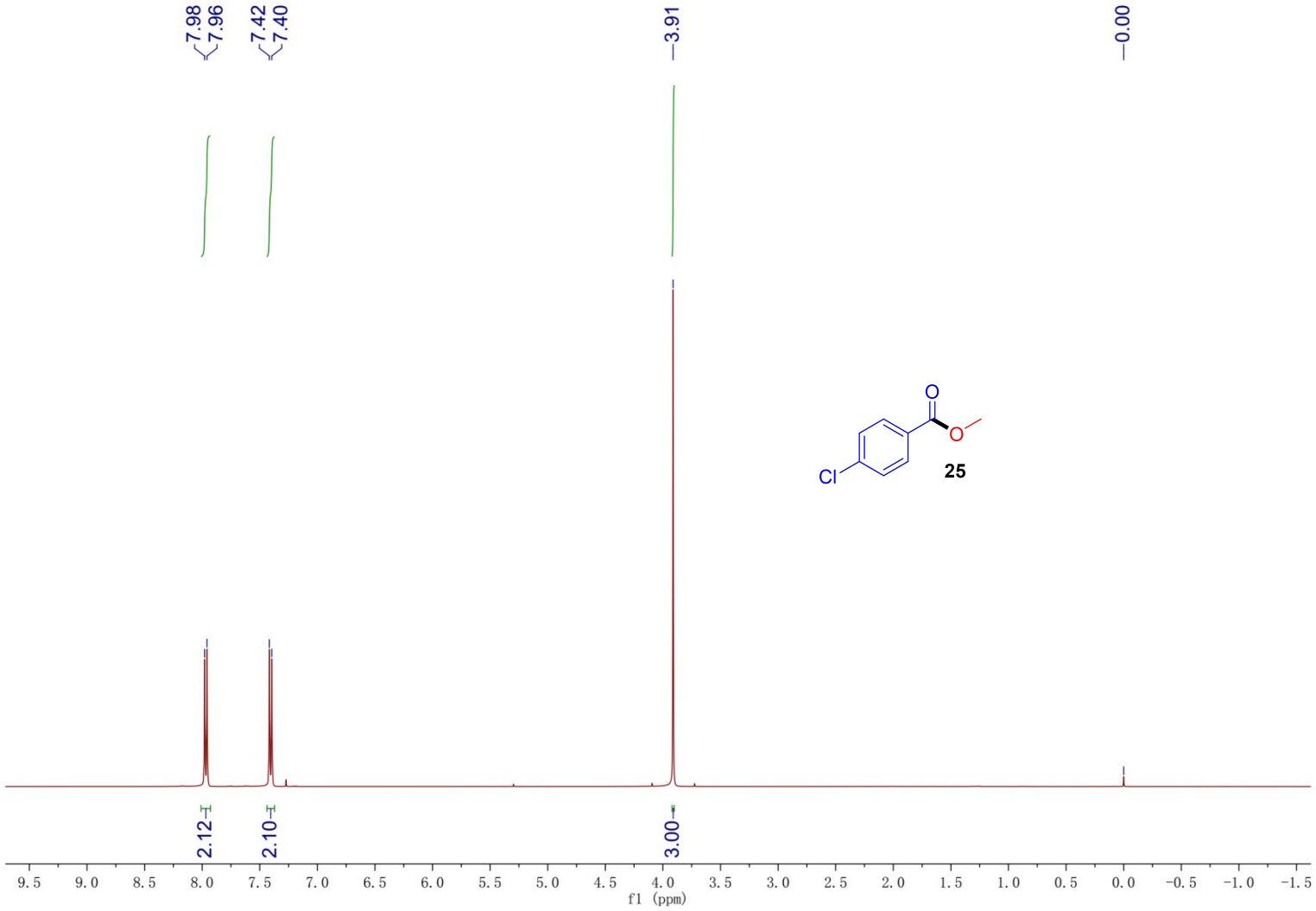
0
−10
f1 (ppm)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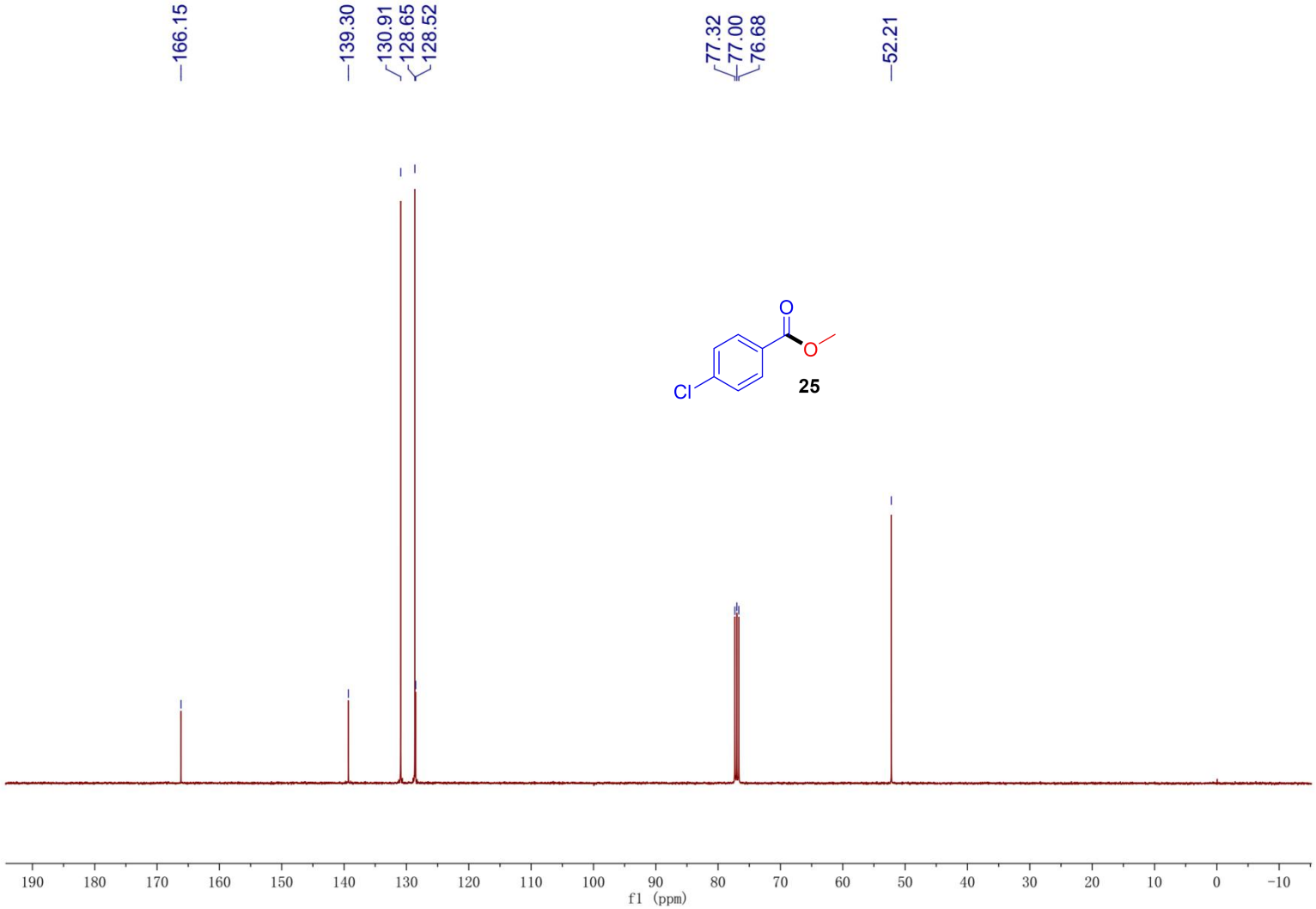
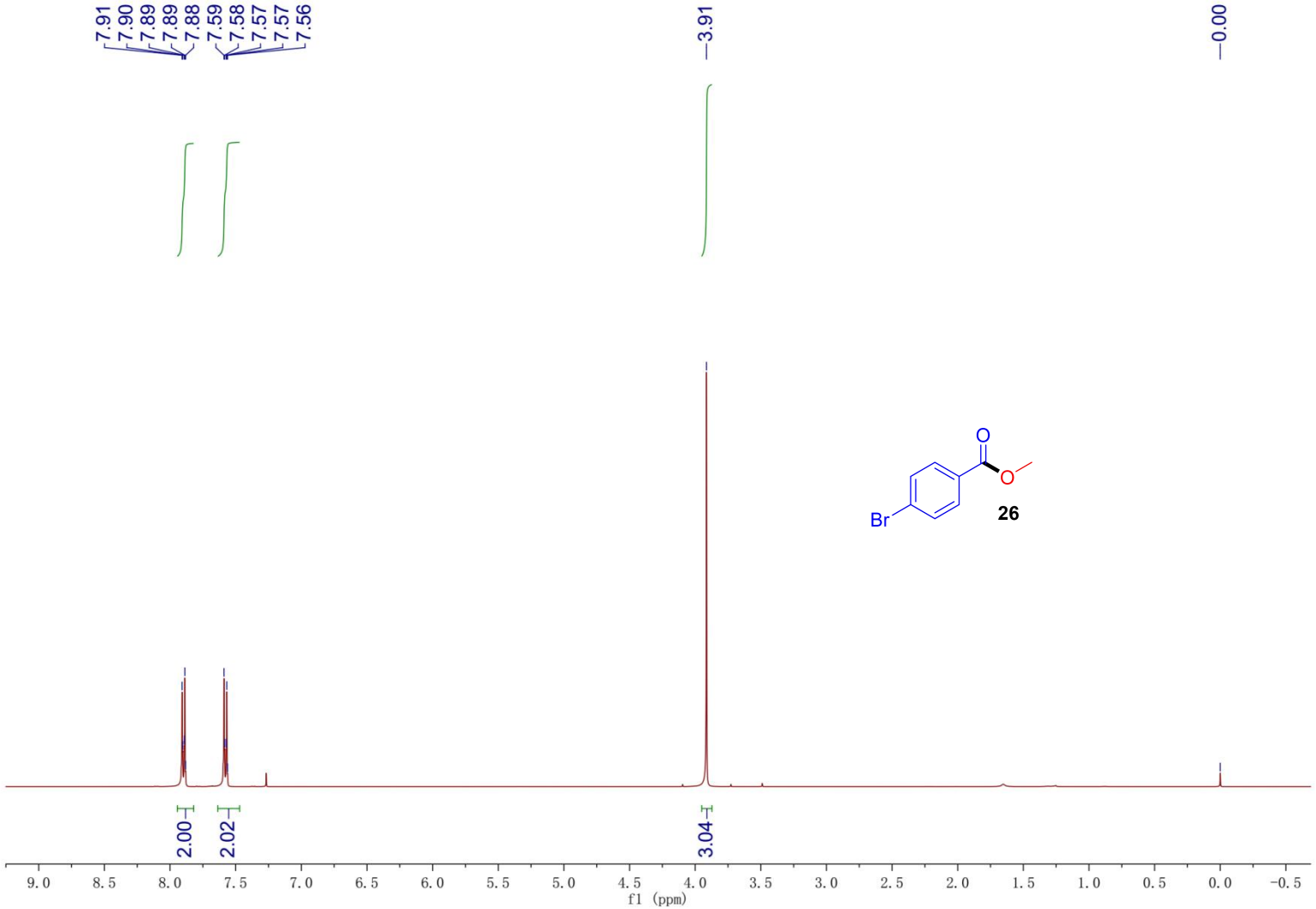
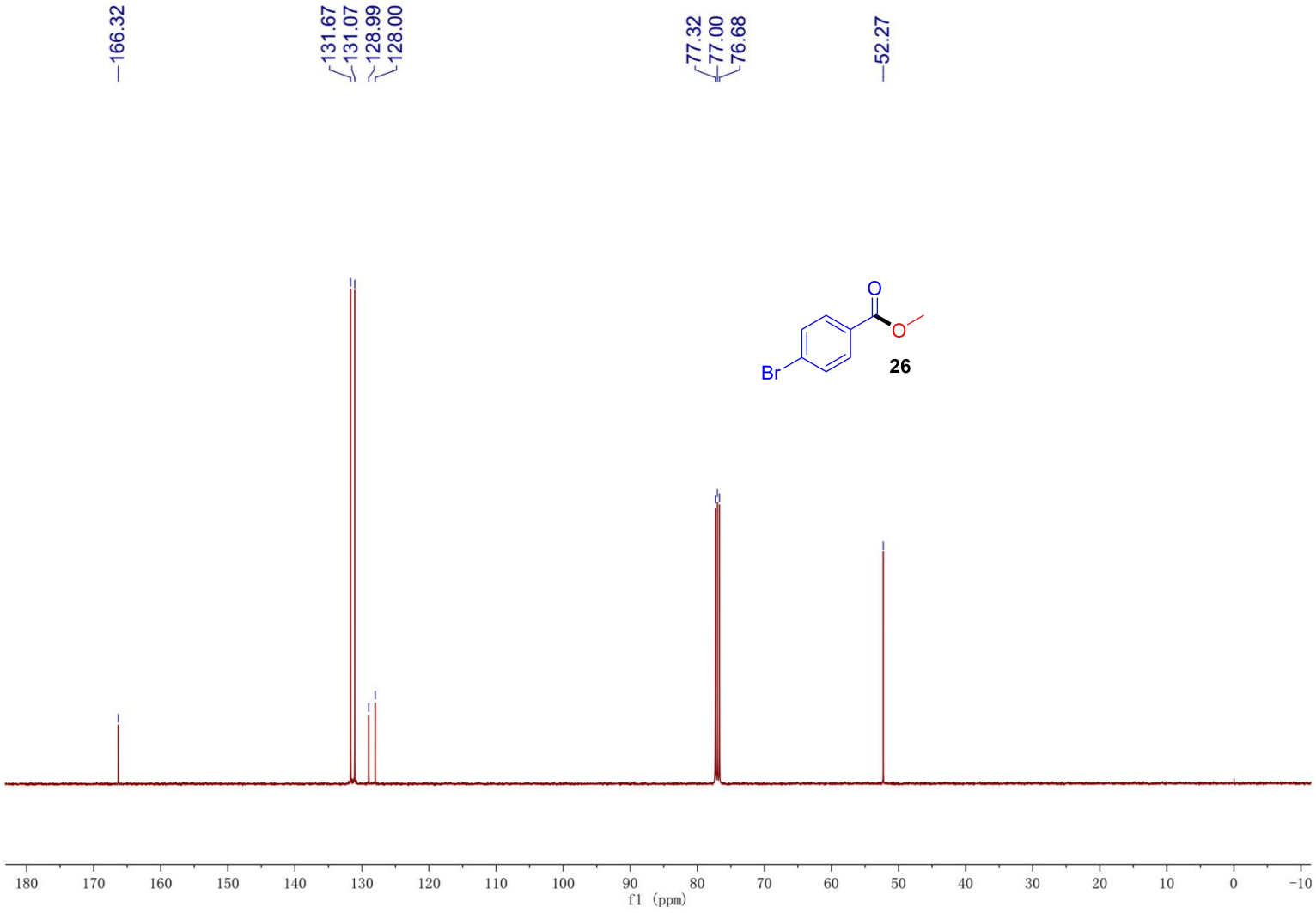
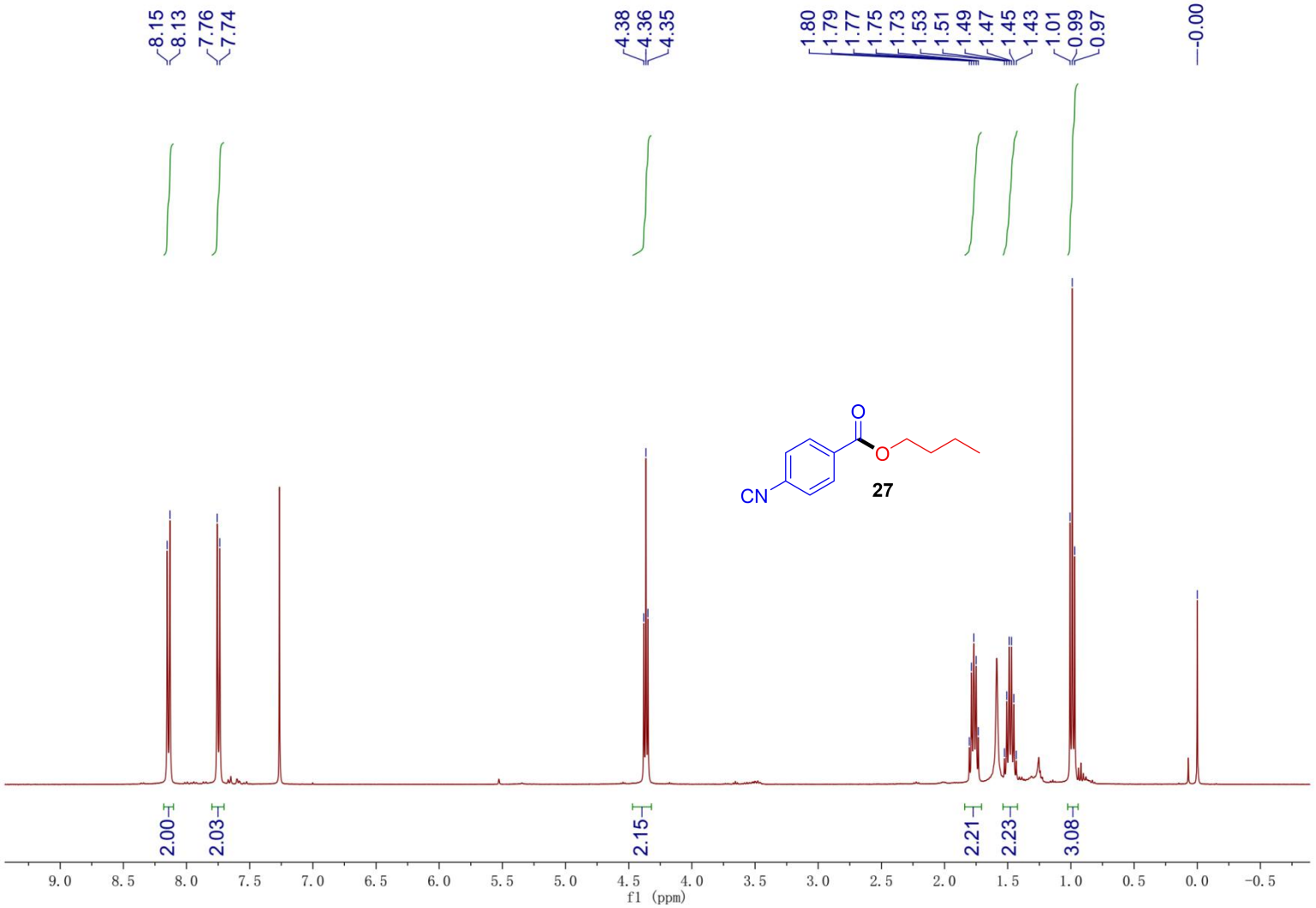
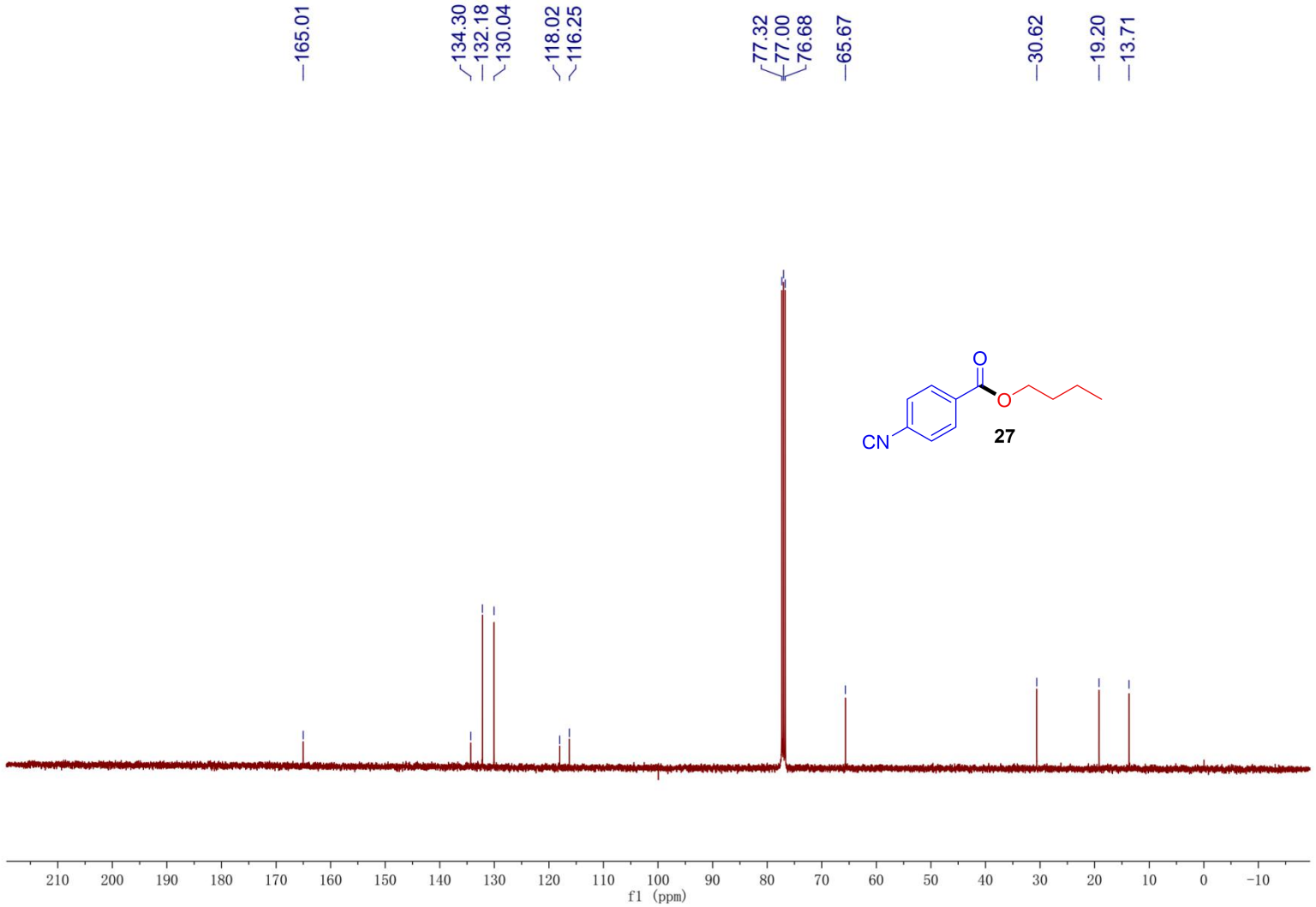
2.10
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5 −1.0 −1.5
f1 (ppm)
O
O
Cl
25

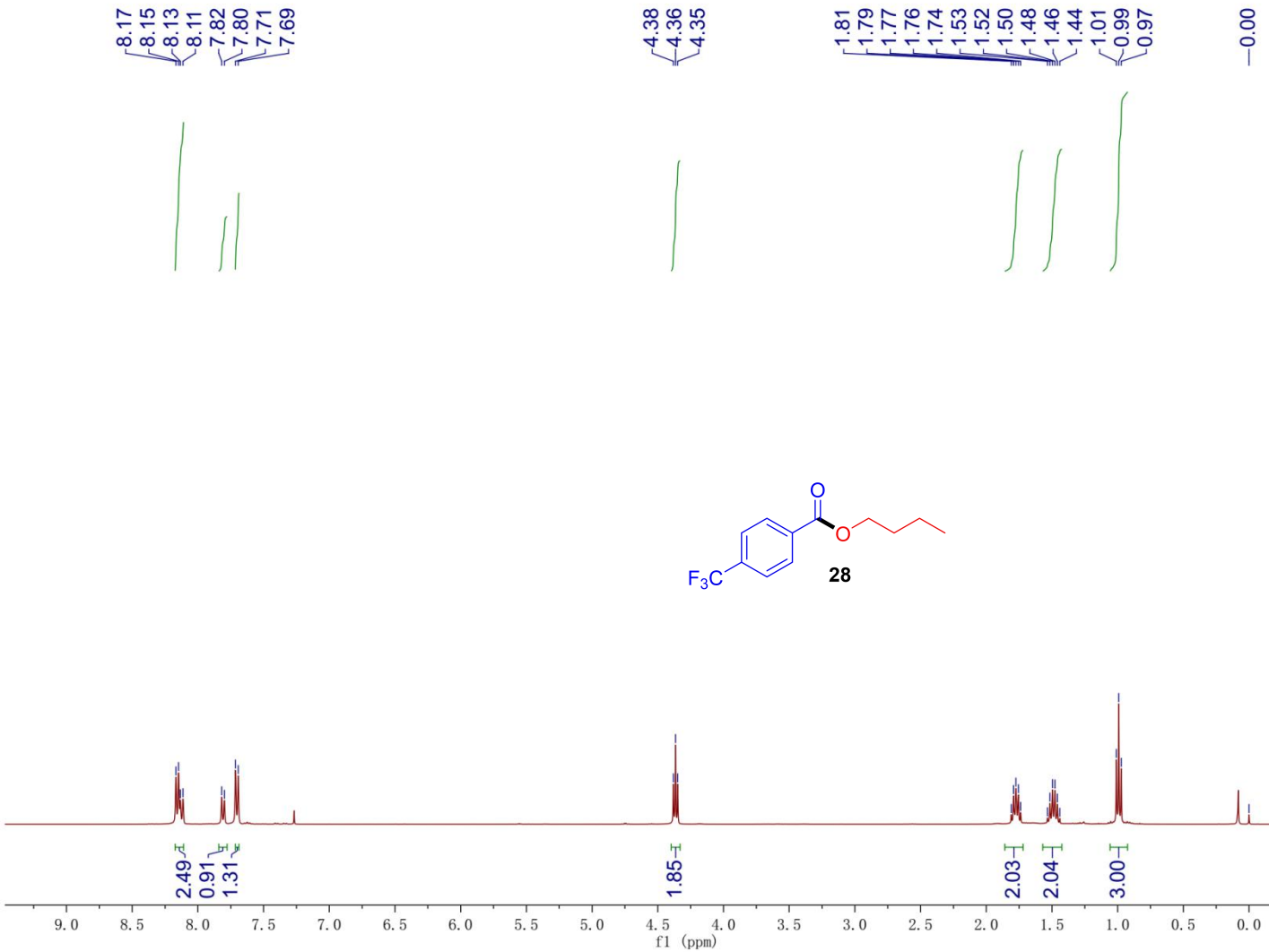

166.15
139.30
130.91
128.65
128.52
77.32
77.00
76.68
52.21
O
O
Cl
25
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

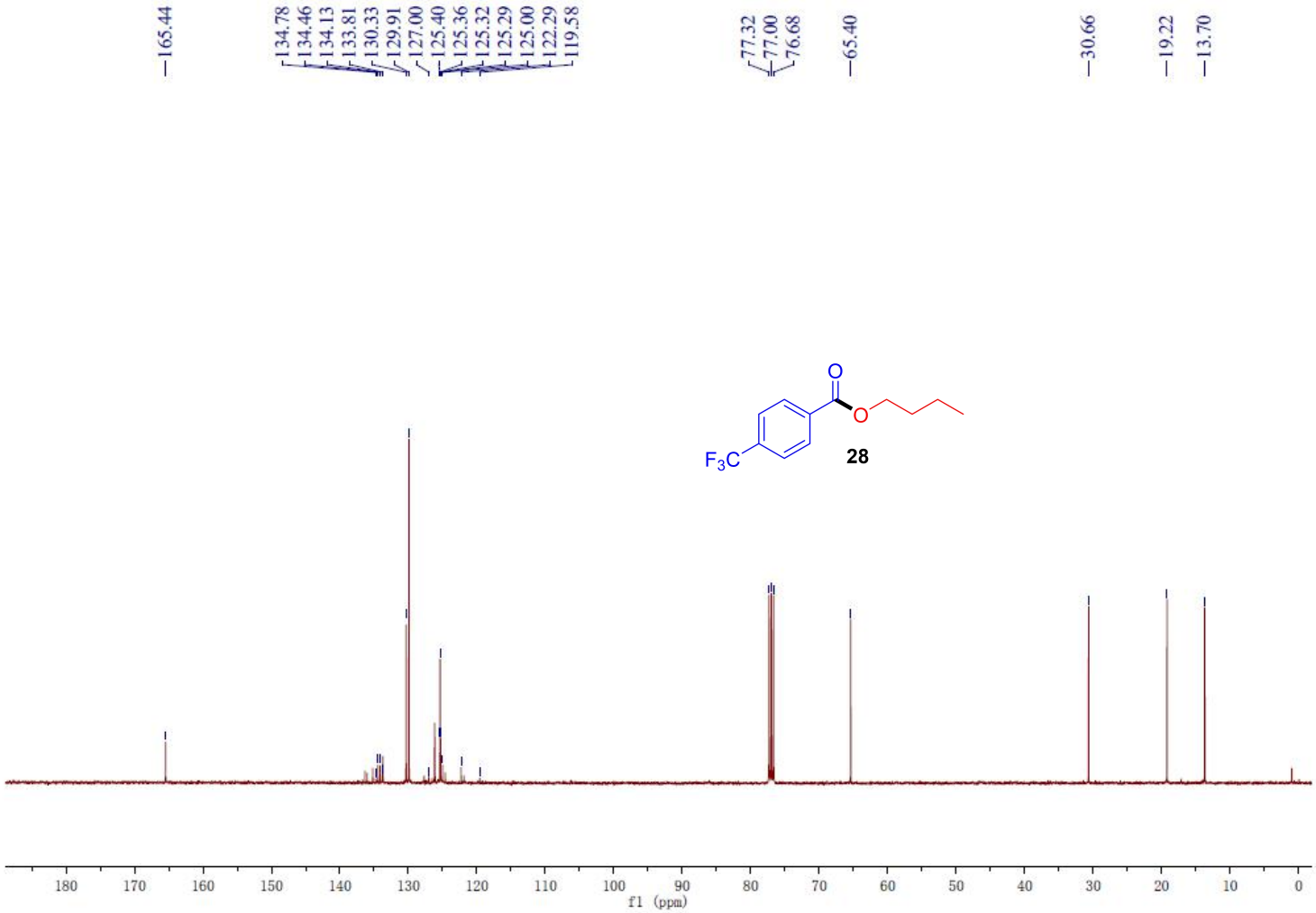

7.91
7.90
7.89
7.89
7.88
7.59
7.58
7.57
7.57
7.56
3.91
0.00
O
O
Br
26
2.00
2.02
3.04
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

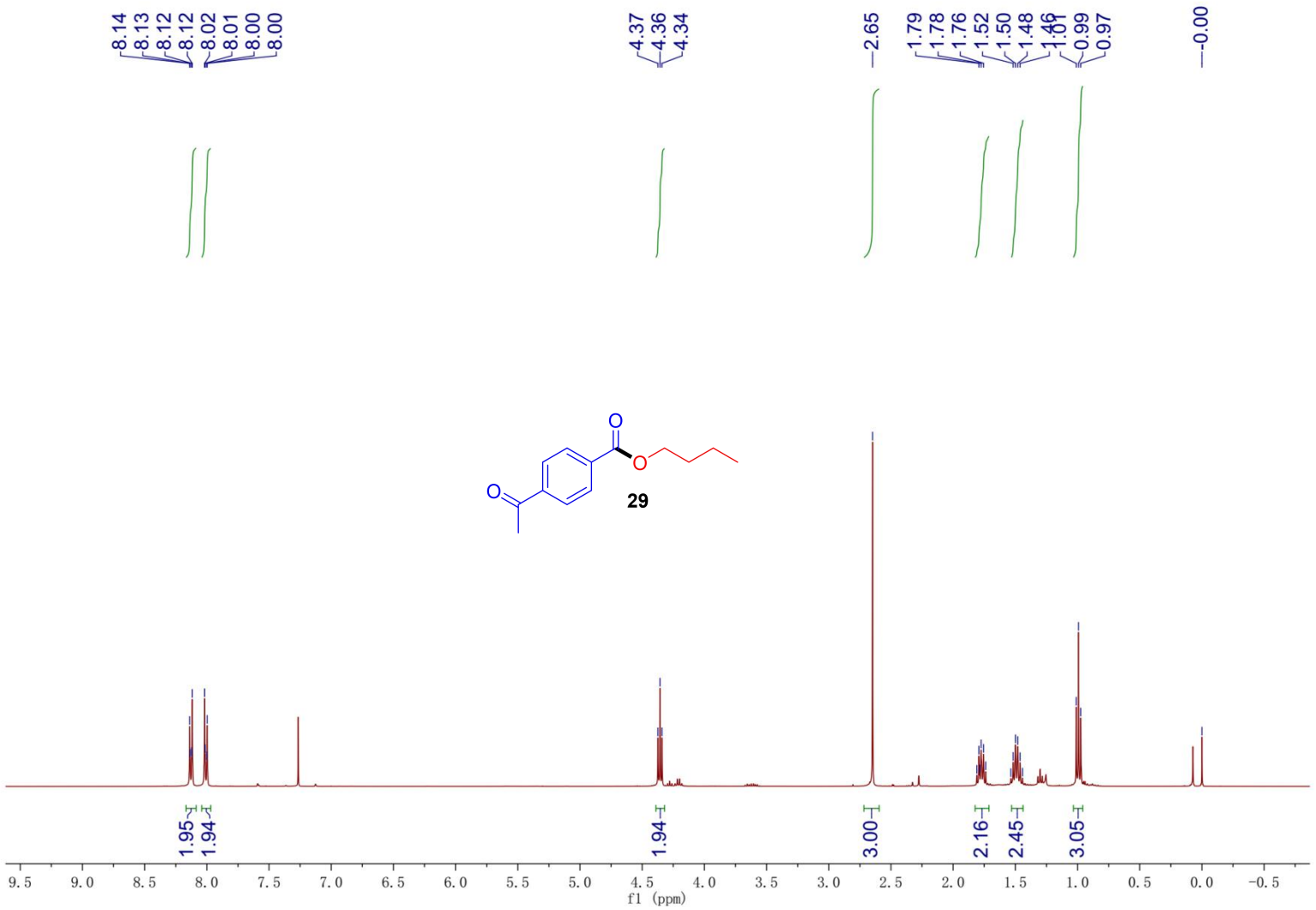

166.32
131.67
131.07
128.99
128.00
77.32
77.00
76.68
52.27
O
O
Br
26
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

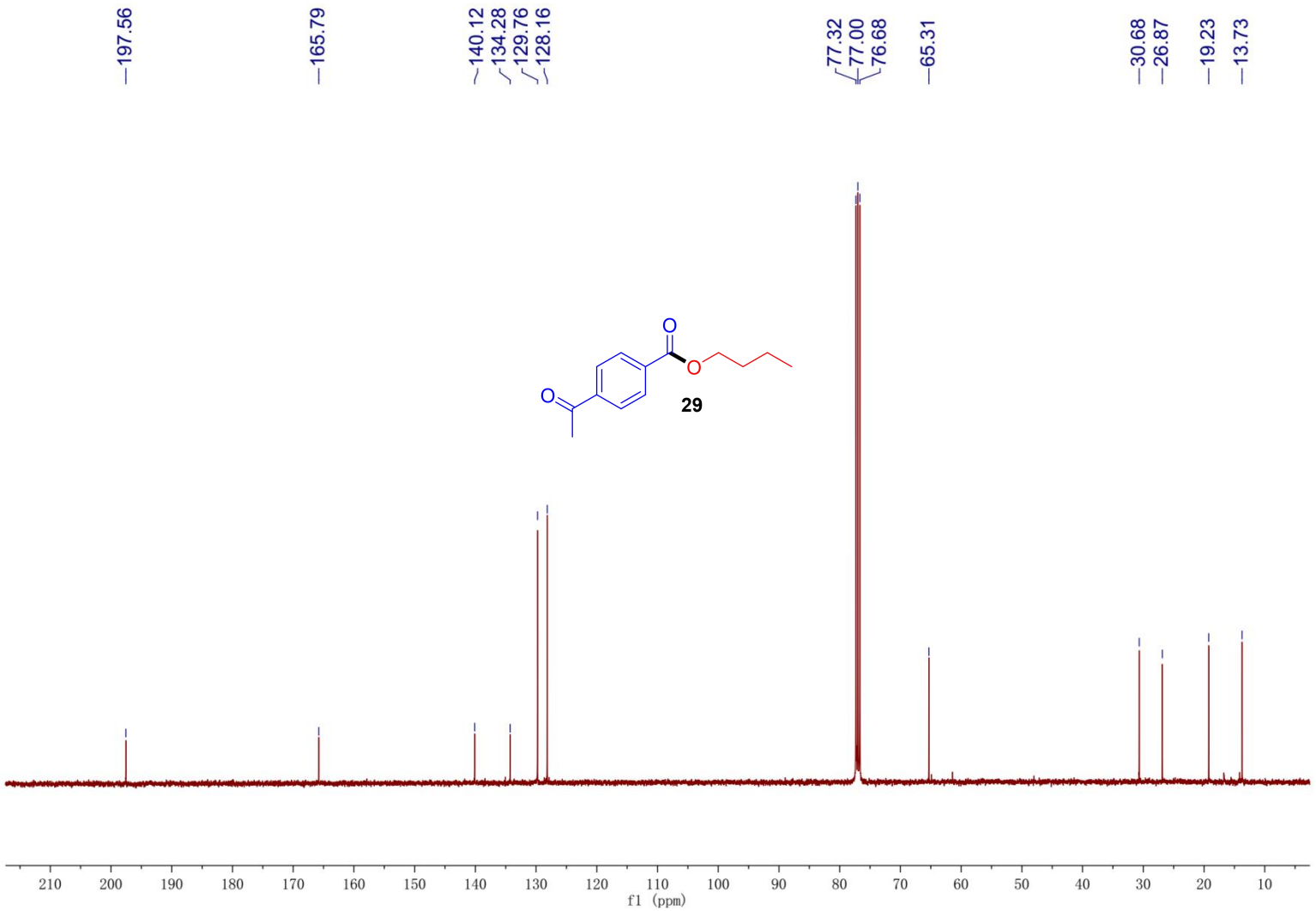

8.15
8.13
7.76
7.74
4.38
4.36
4.35
1.80
1.79
1.77
1.75
1.73
1.53
1.51
1.49
1.47
1.45
1.43
1.01
0.99
0.97
-0.00
O
O
CN
27
2.00
2.03
2.15
2.21
2.23
3.08
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

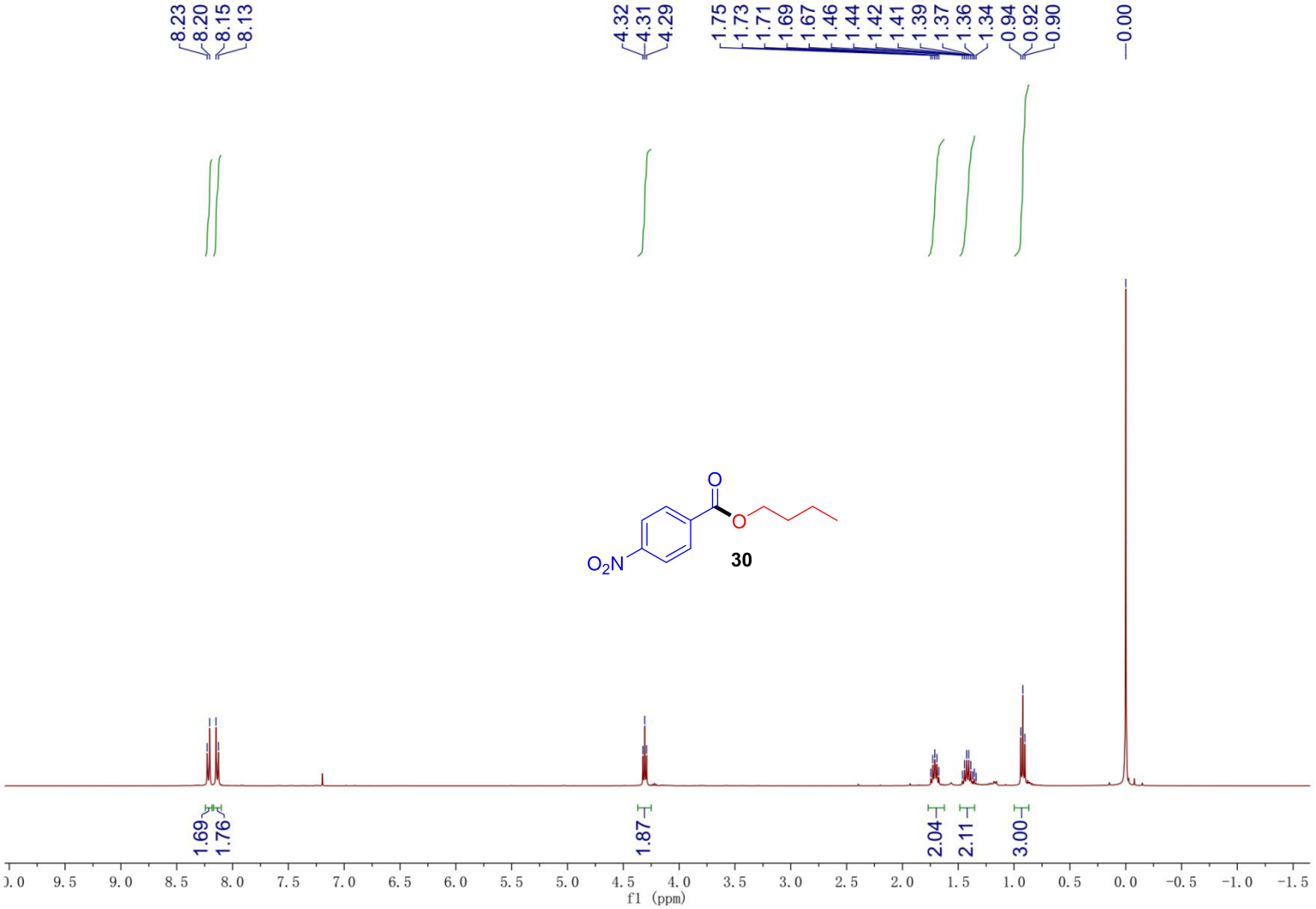

165.01
134.30
132.18
130.04
118.02
116.25
77.32
77.00
76.68
65.67
30.62
19.20
13.71
O
O
CN
27
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

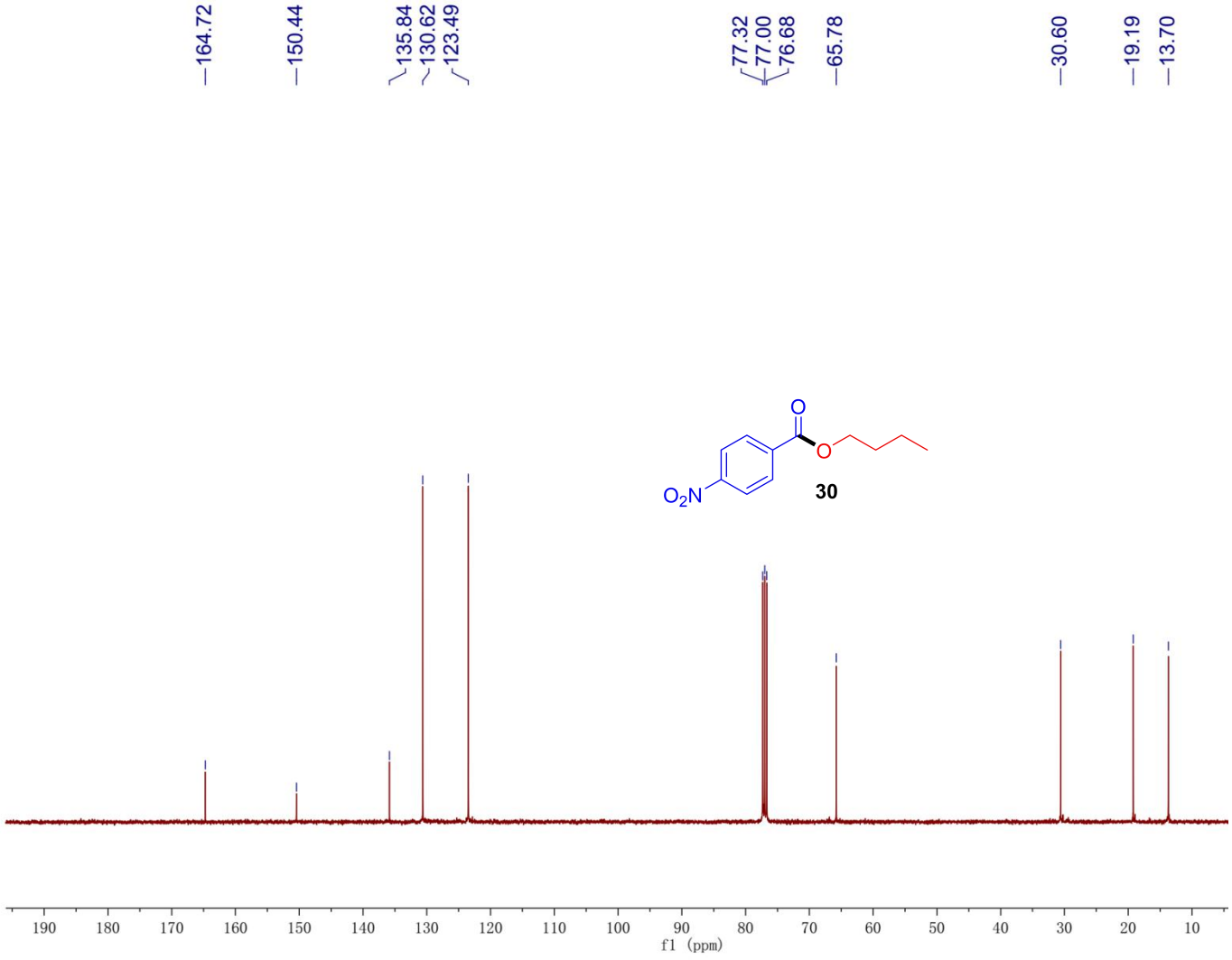

8.17
8.15
8.13
8.11
7.82
7.80
7.71
7.69
4.38
4.36
4.35
1.81
1.79
1.77
1.76
1.74
1.53
1.52
1.50
1.48
1.46
1.44
1.01
0.99
0.97
0.00
O
O
F3C
28
2.49
0.91
1.31
1.85
2.03
2.04
3.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

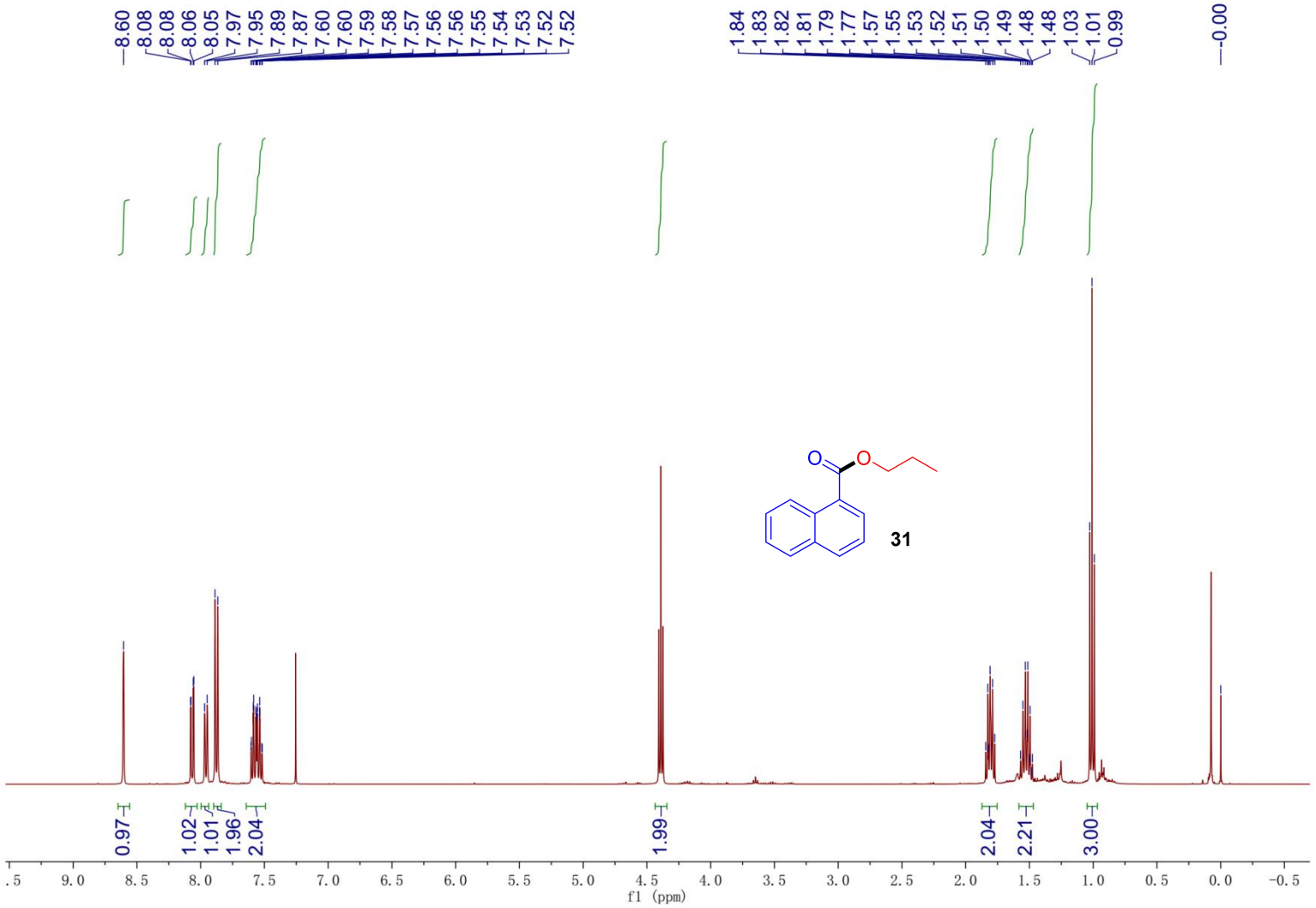

165.44
134.78
134.46
134.13
133.81
130.33
129.91
127.00
125.40
125.36
125.32
125.29
125.00
122.29
119.58
77.32
77.00
76.68
65.40
30.66
19.22
13.70
O
O
F3C
28
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

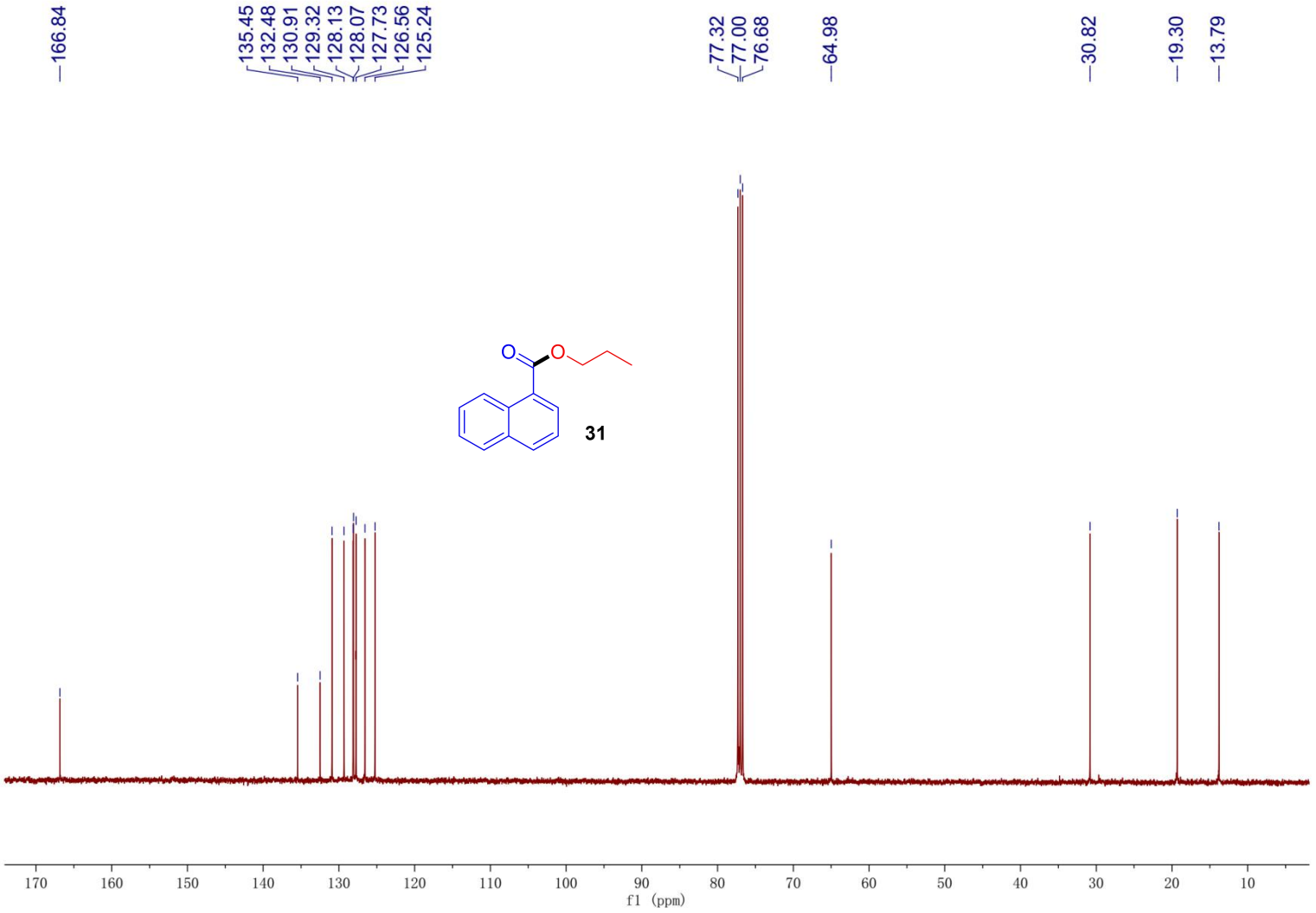

8.14
8.13
8.12
8.12
8.02
8.01
8.00
8.00
4.37
4.36
4.34
2.65
1.79
1.78
1.76
1.52
1.50
1.48
1.46
1.01
0.99
0.97
0.00
O
O
O
29
1.95
1.94
1.94
3.00
2.16
2.45
3.05
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

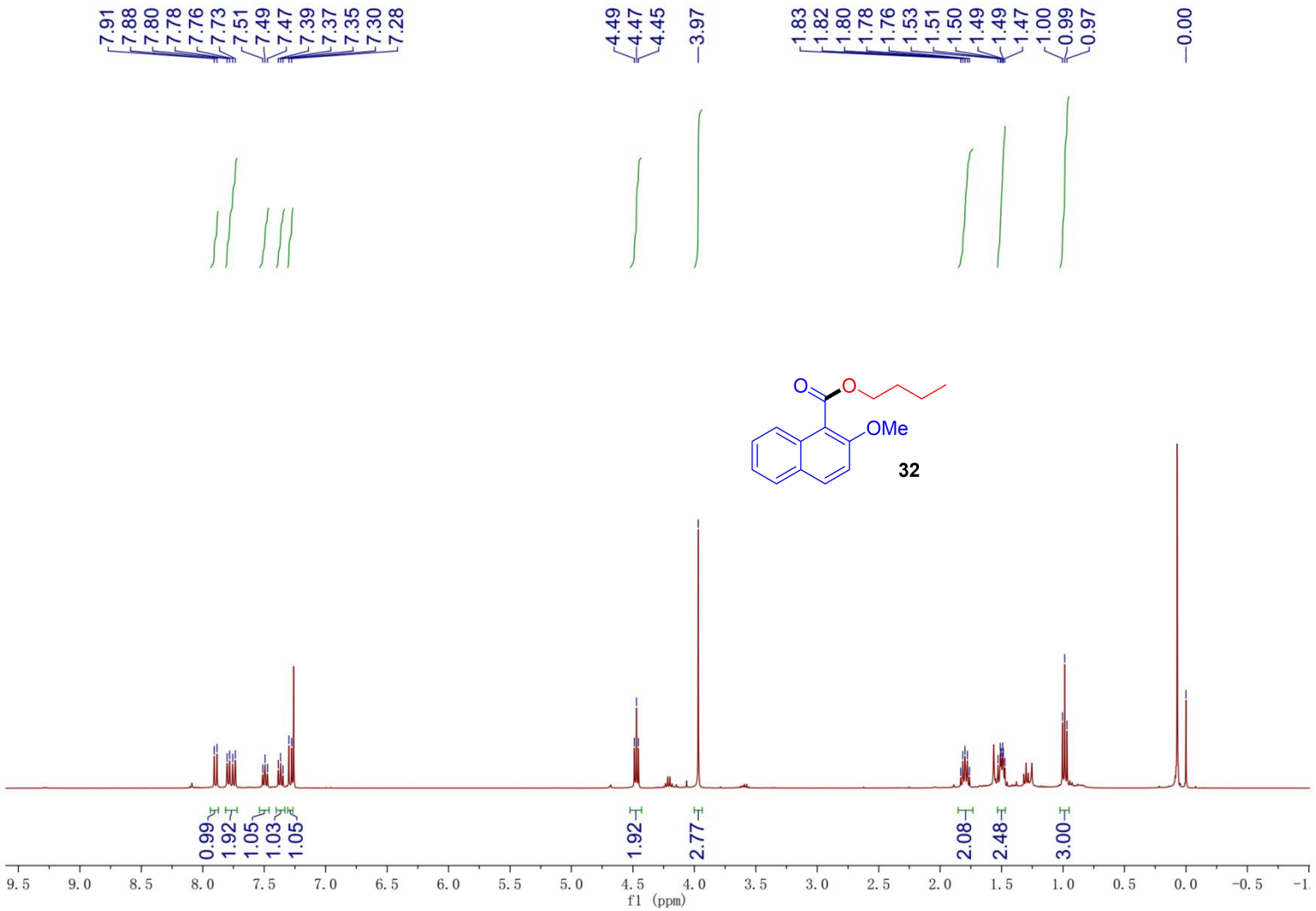

197.56
165.79
140.12
134.28
129.76
128.16
77.32
77.00
76.68
65.31
30.68
26.87
19.23
13.73
O
O
O
29
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

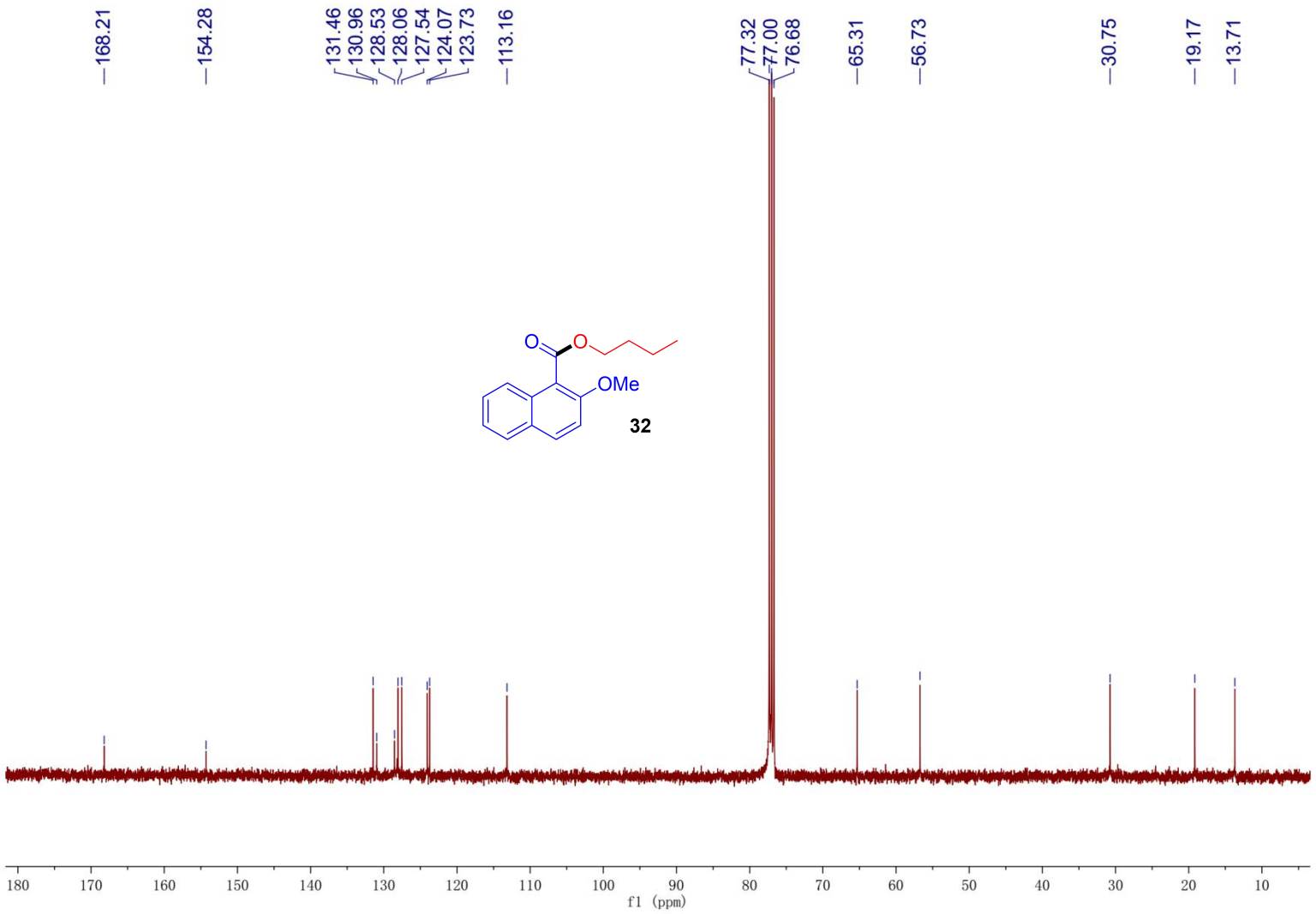

8.23
8.20
8.15
8.13
4.32
4.31
4.29
1.75
1.73
1.71
1.69
1.67
1.46
1.44
1.42
1.41
1.39
1.37
1.36
1.34
0.94
0.92
0.90
0.00
O
O
O2N
30
1.69
1.76
1.87
2.04
2.11
3.00
f1 (ppm)

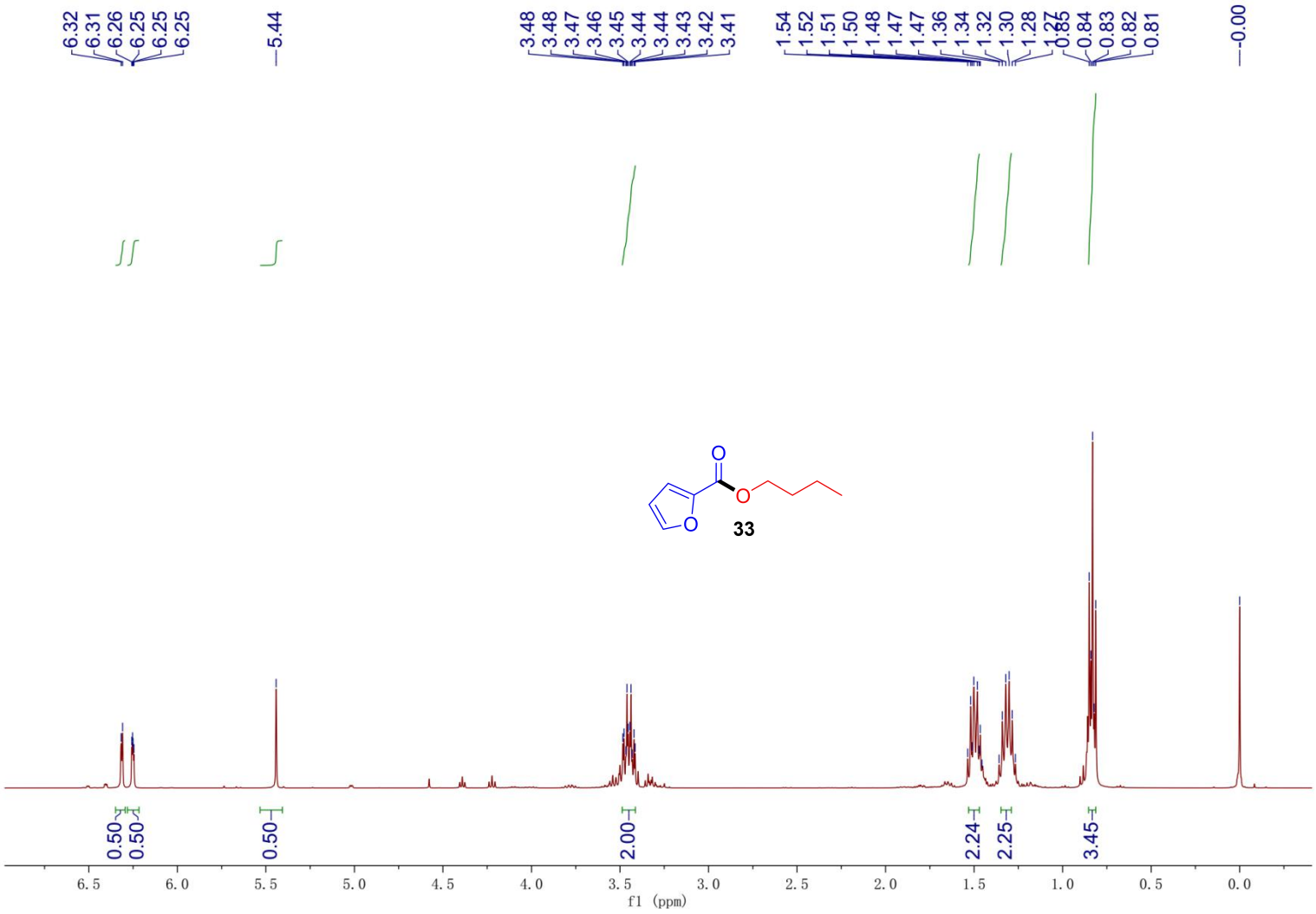

164.72
150.44
135.84
130.62
123.49
77.32
77.00
76.68
65.78
30.60
19.19
13.70
O
O
O2N
30
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

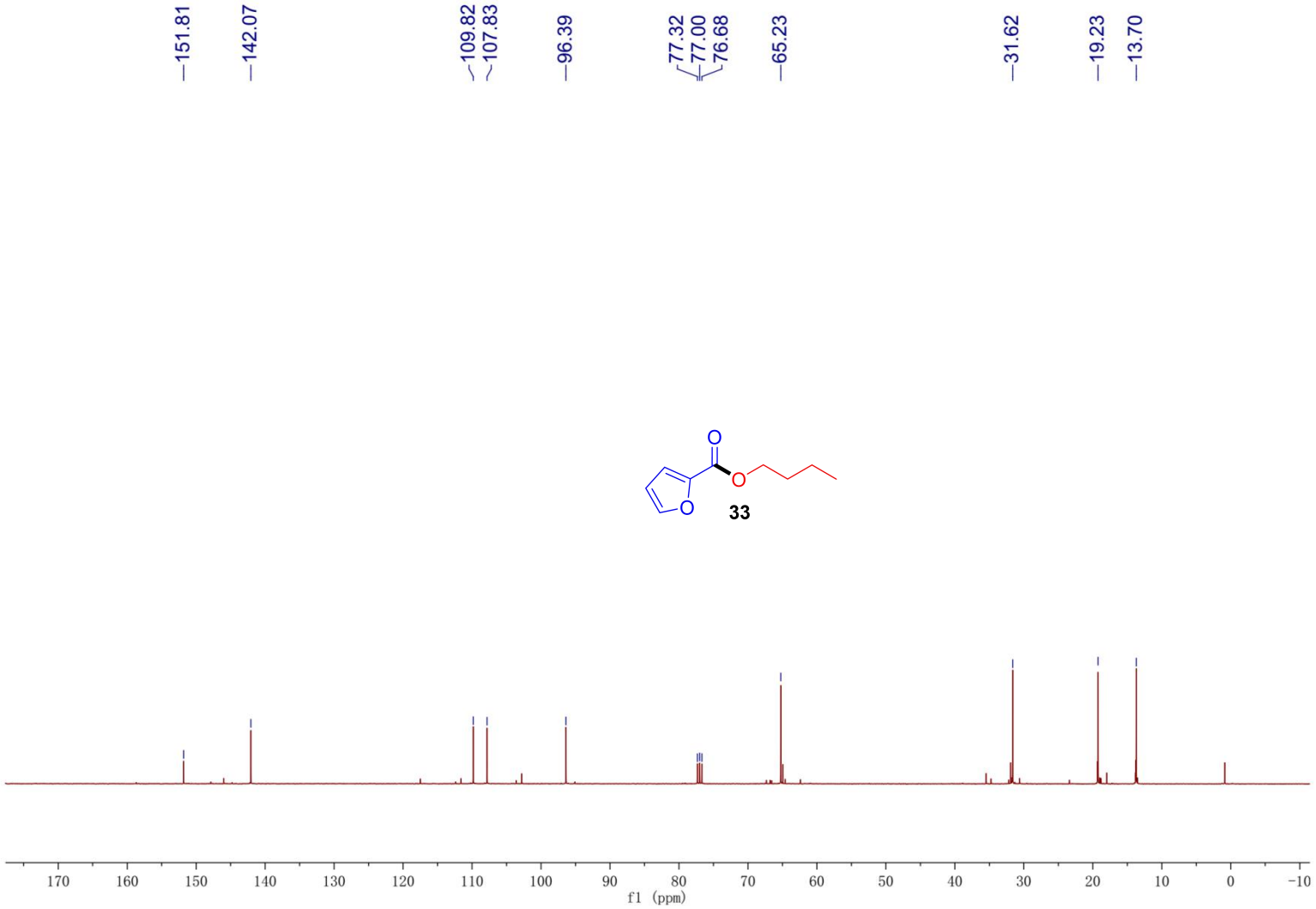

8.60
8.08
8.08
8.06
8.05
7.97
7.95
7.89
7.87
7.60
7.60
7.59
7.58
7.57
7.56
7.56
7.55
7.54
7.53
7.52
7.52
1.84
1.83
1.82
1.81
1.79
1.77
1.57
1.55
1.53
1.52
1.51
1.50
1.49
1.48
1.48
1.03
1.01
0.99
-0.00
O
O
31
0.97
1.02
1.01
1.96
2.04
1.99
2.04
2.21
3.00
f1 (ppm)

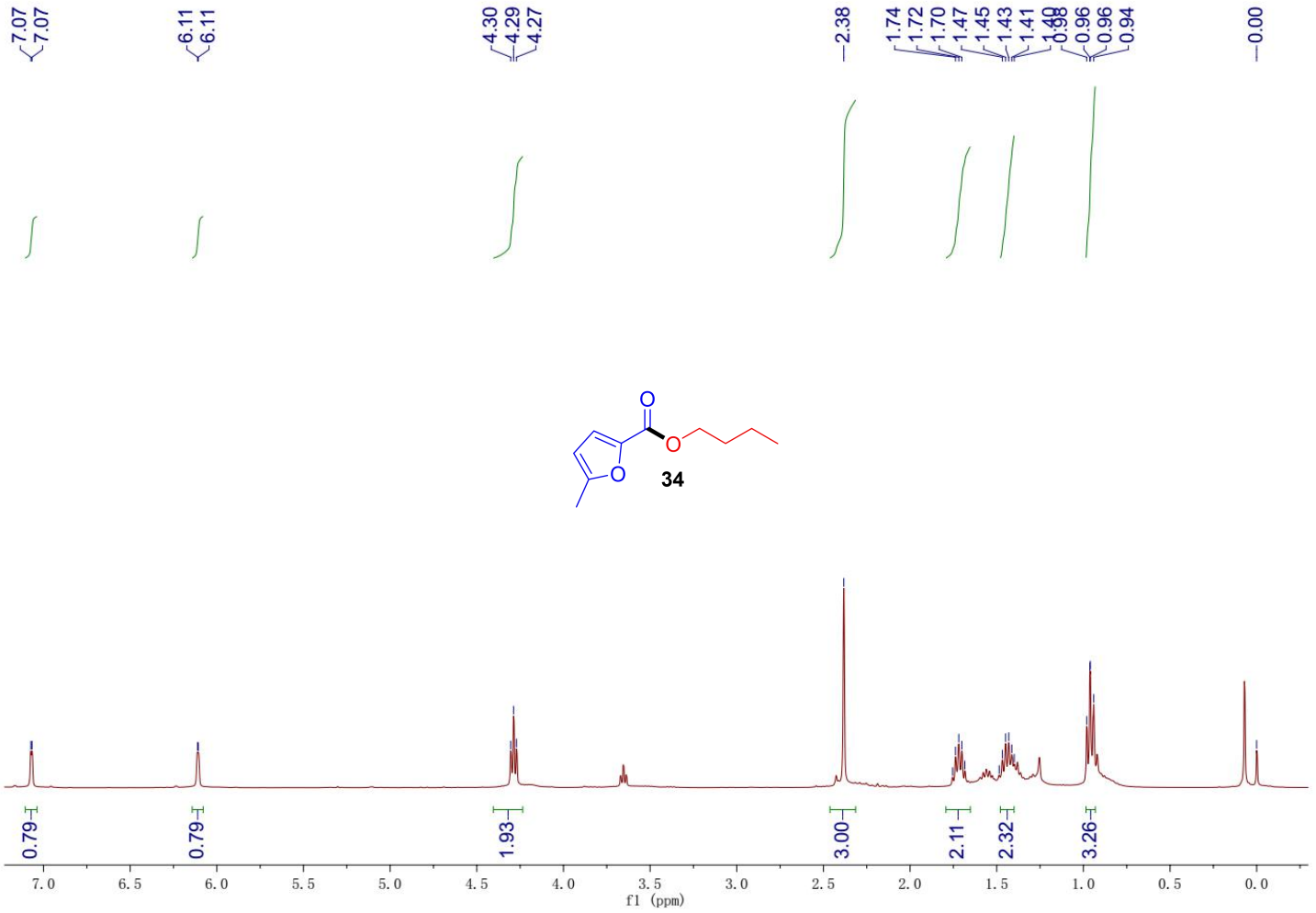

166.84
135.45
132.48
130.91
129.32
128.13
128.07
127.73
126.56
125.24
77.32
77.00
76.68
64.98
30.82
19.30
13.79
O
O
31
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

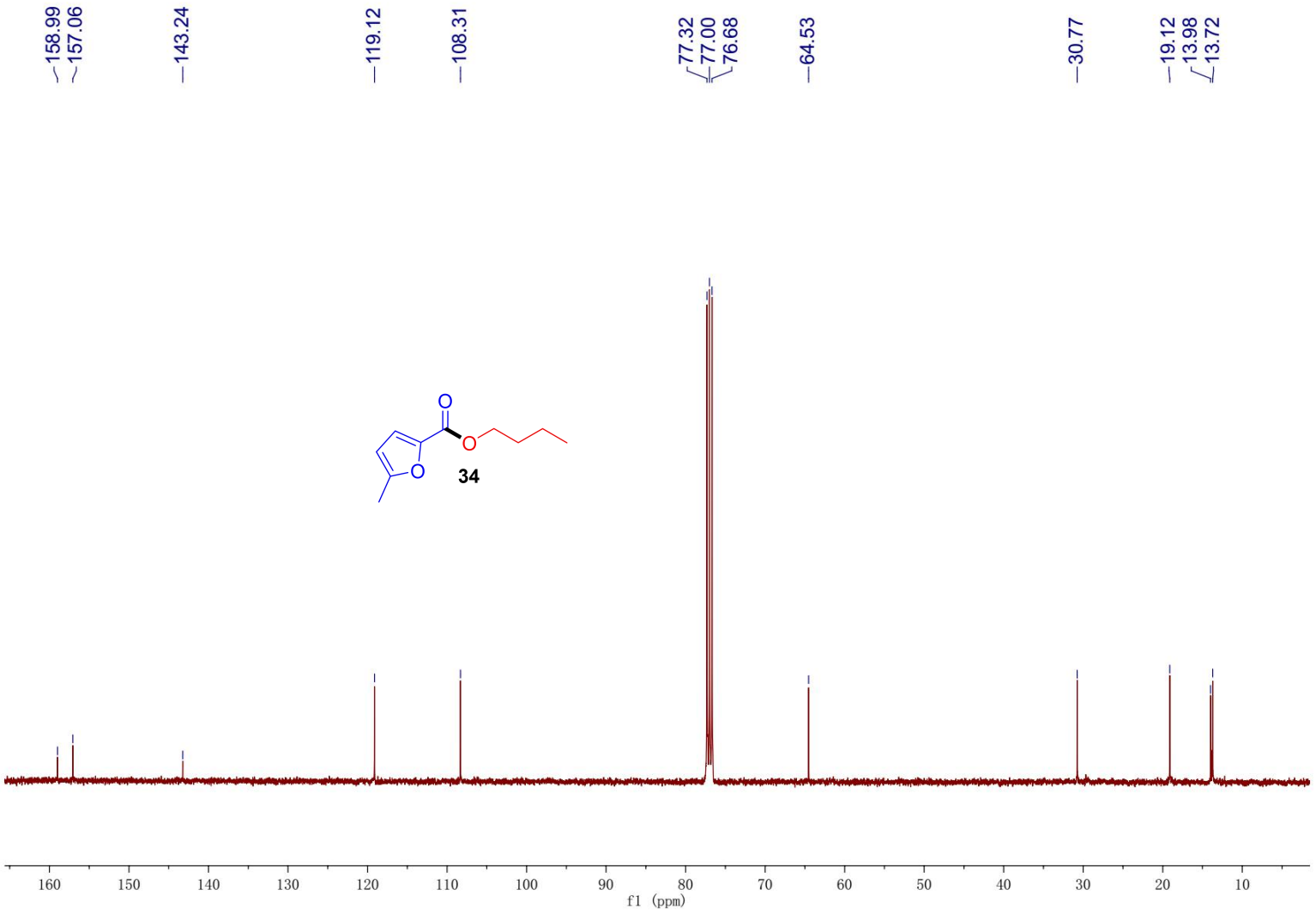

7.91
7.88
7.80
7.78
7.76
7.73
7.51
7.49
7.47
7.39
7.37
7.35
7.30
7.28
4.49
4.47
4.45
3.97
1.83
1.82
1.80
1.78
1.76
1.53
1.51
1.50
1.49
1.49
1.47
1.00
0.99
0.97
0.00
O
O
OMe
32
0.99
1.92
1.05
1.03
1.05
1.92
2.77
2.08
2.48
3.00
f1 (ppm)

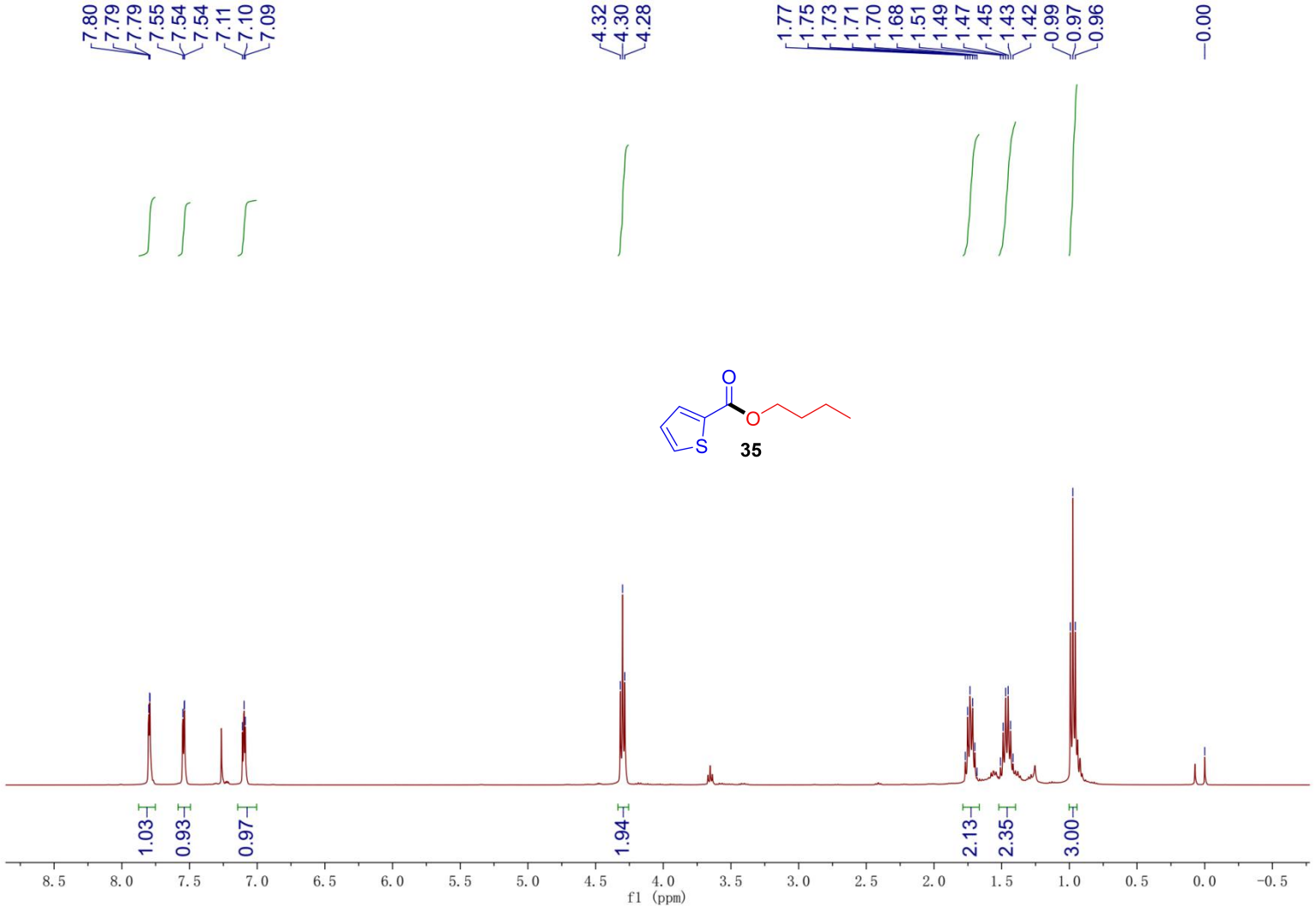

168.21
154.28
131.46
130.96
128.53
128.06
127.54
124.07
123.73
113.16
77.32
77.00
76.68
65.31
56.73
30.75
19.17
13.71
O
O
OMe
32
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

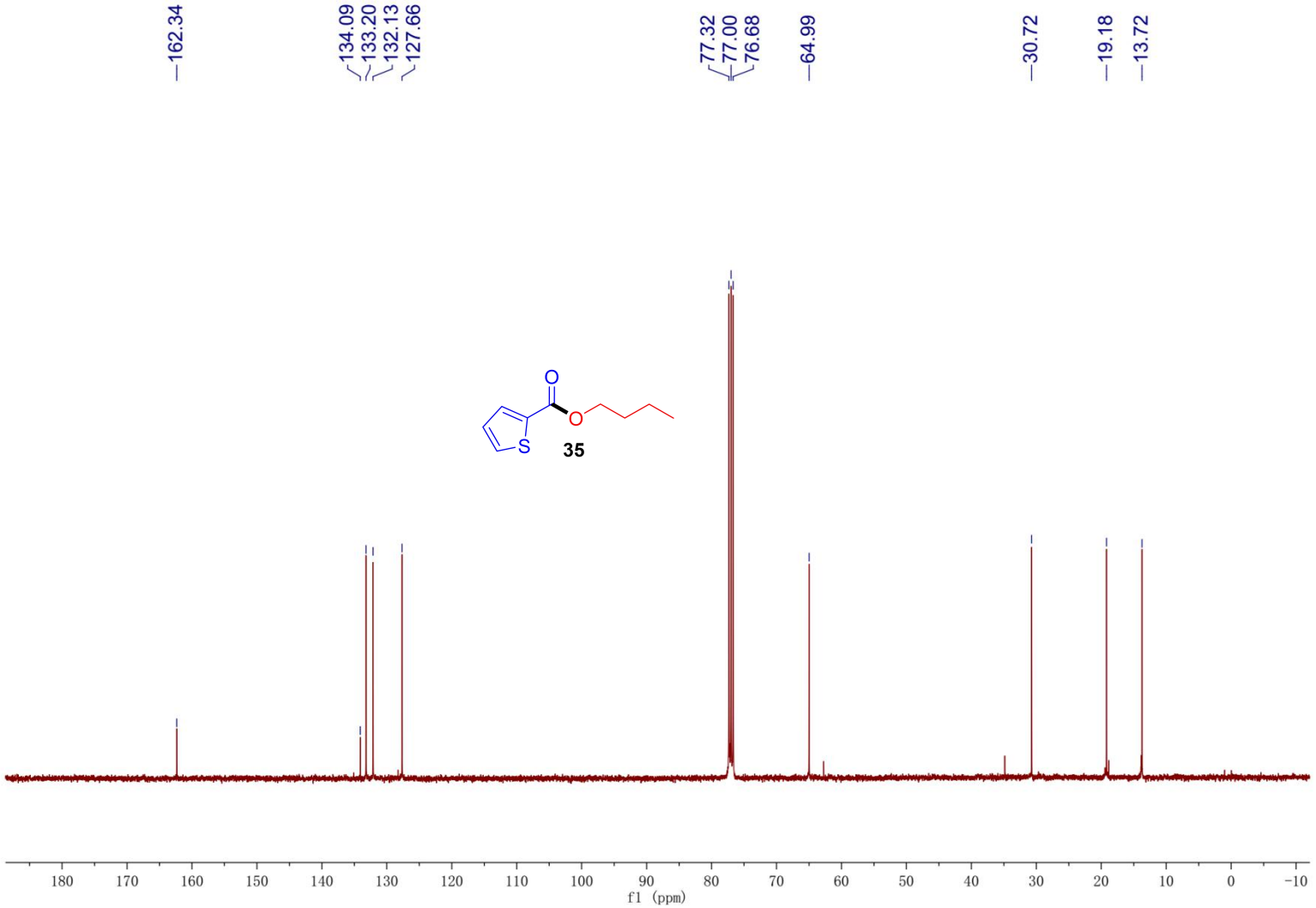

6.32
6.31
6.26
6.25
6.25
6.25
5.44
3.48
3.48
3.47
3.46
3.45
3.44
3.44
3.43
3.42
3.41
1.54
1.52
1.51
1.50
1.48
1.47
1.47
1.36
1.34
1.32
1.30
1.28
0.85
0.84
0.83
0.82
0.81
0.00
O
O
O
33
0.50
0.50
0.50
2.00
2.24
2.25
3.45
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

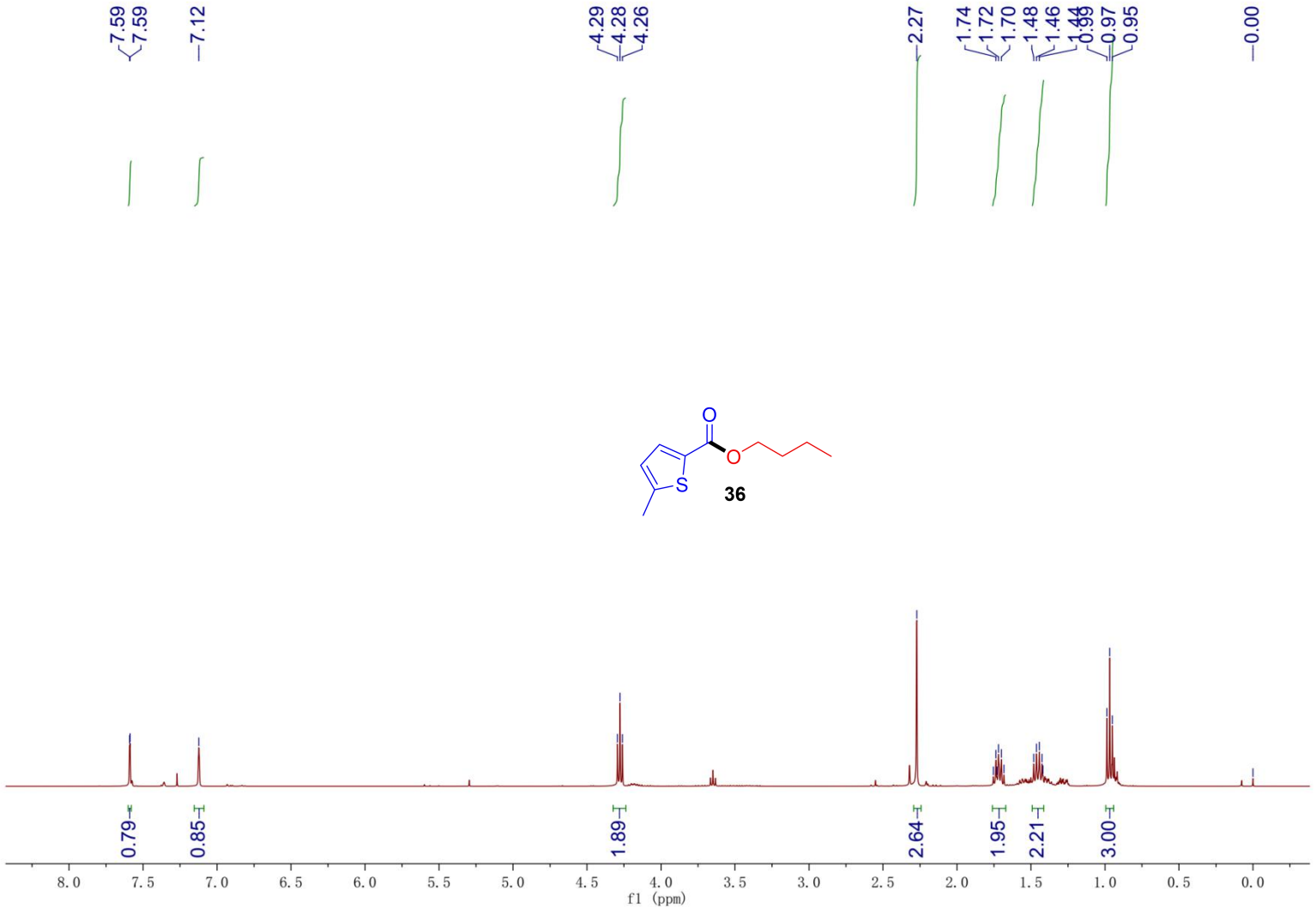

151.81
142.07
109.82
107.83
96.39
77.32
77.00
76.68
65.23
31.62
19.23
13.70
O
O
O
33
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

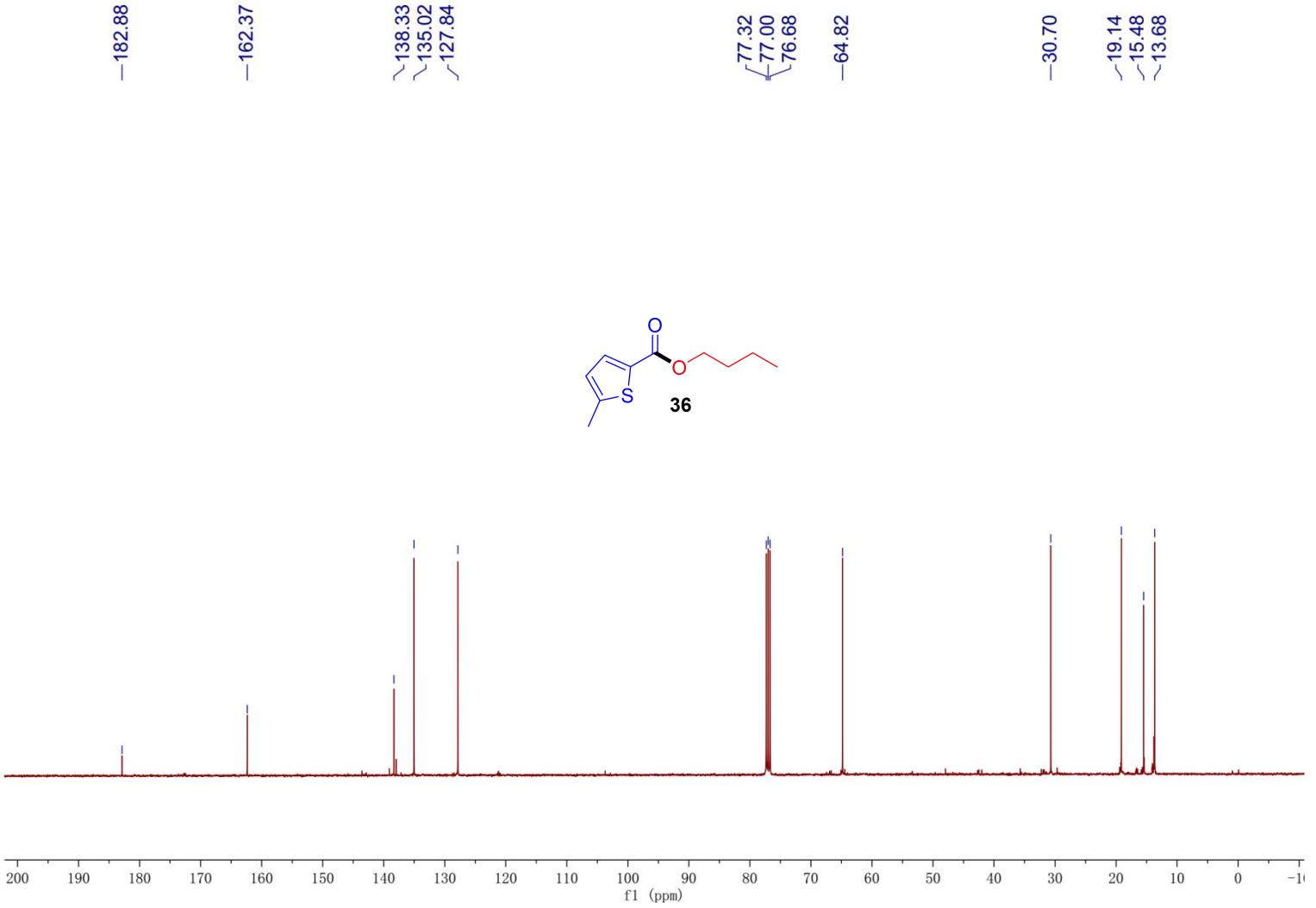

7.07
7.07
6.11
6.11
4.30
4.29
4.27
2.38
1.74
1.72
1.70
1.47
1.45
1.43
1.41
0.98
0.96
0.96
0.94
0.00
O
O
O
34
0.79
0.79
1.93
3.00
2.11
2.32
3.26
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

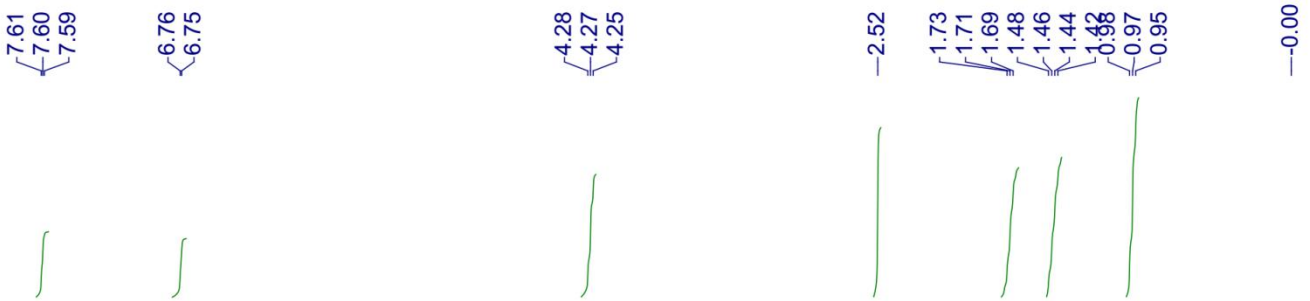

158.99
157.06
143.24
119.12
108.31
77.32
77.00
76.68
64.53
30.77
19.12
13.98
13.72
O
O
O
34
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

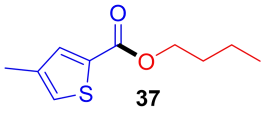

7.80
7.79
7.79
7.55
7.54
7.54
7.11
7.10
7.09
4.32
4.30
4.28
1.77
1.75
1.73
1.71
1.70
1.68
1.51
1.49
1.47
1.45
1.43
1.42
0.99
0.97
0.96
0.00
O
O
S
35
1.03
0.93
0.97
1.94
2.13
2.35
3.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


162.34
134.09
133.20
132.13
127.66
77.32
77.00
76.68
64.99
30.72
19.18
13.72
O
O
S
35
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

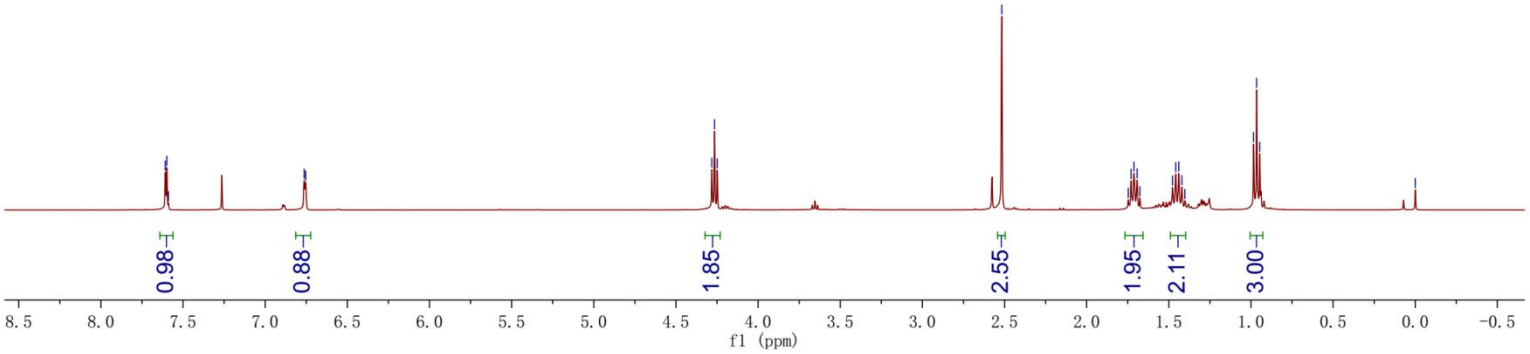

7.59
7.59
7.12
4.29
4.28
4.26
2.27
1.74
1.72
1.70
1.48
1.46
0.97
0.95
0.00
O
O
S
36
0.79
0.85
1.89
2.64
1.95
2.21
3.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

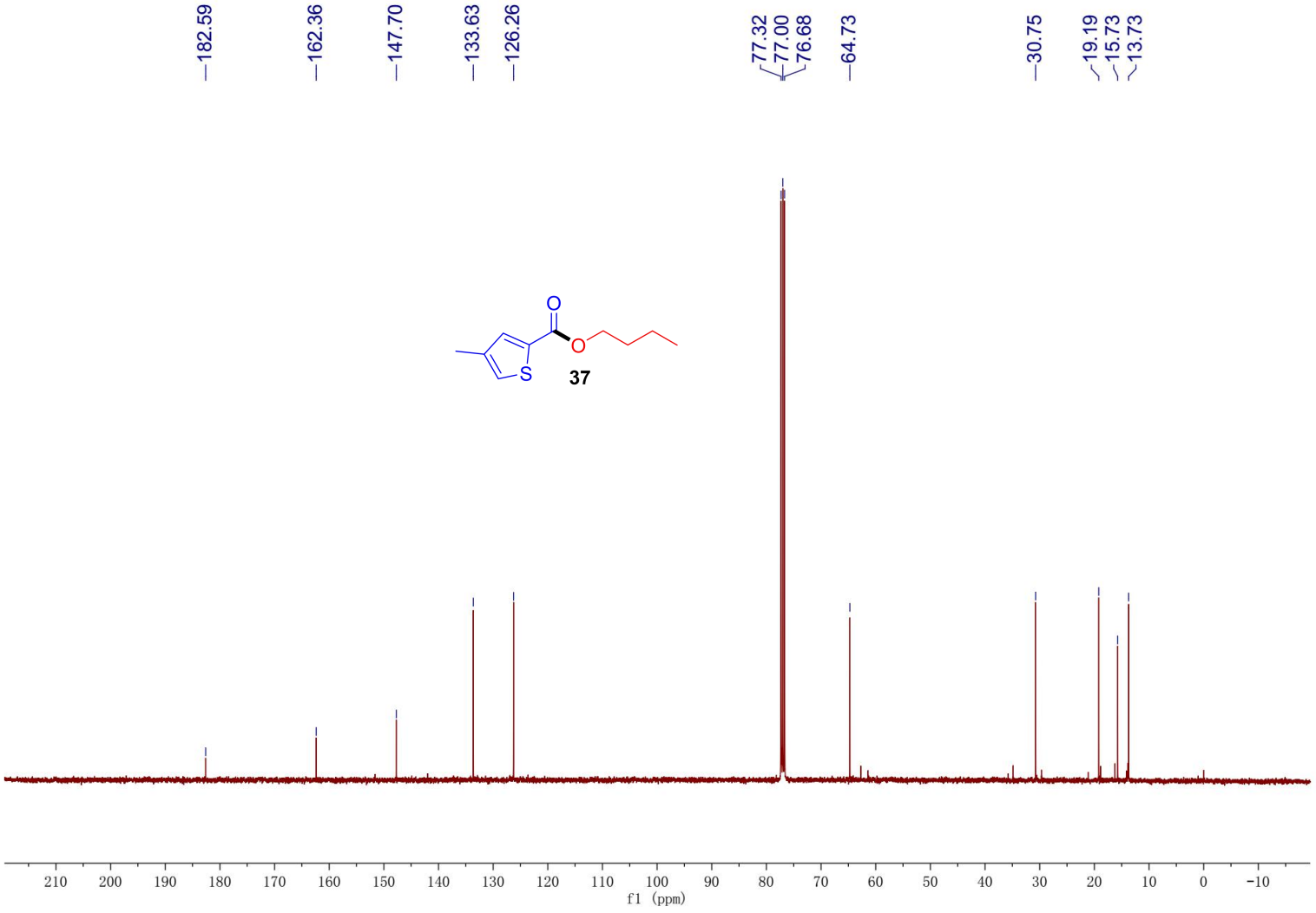

182.88
162.37
138.33
135.02
127.84
77.32
77.00
76.68
64.82
30.70
19.14
15.48
13.68
O
O
S
36
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

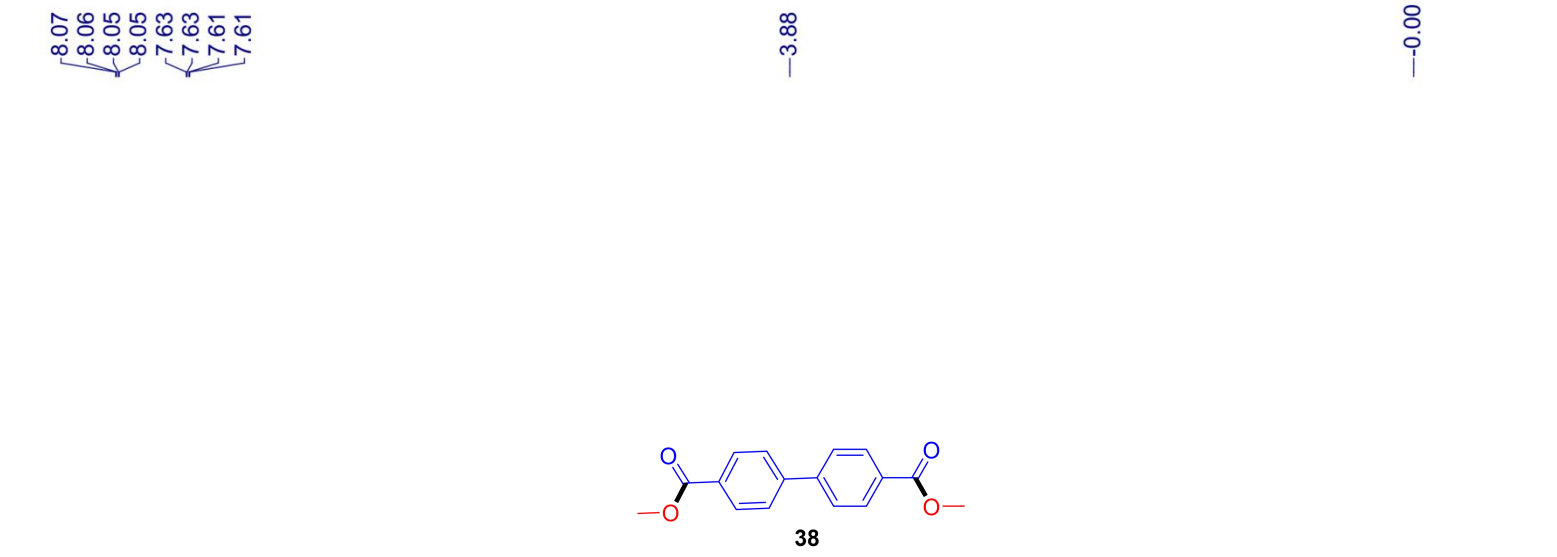

7.61
7.60
7.59
6.76
6.75
4.28
4.27
4.25
2.52
1.73
1.71
1.69
1.48
1.46
1.44
0.97
0.95
0.00

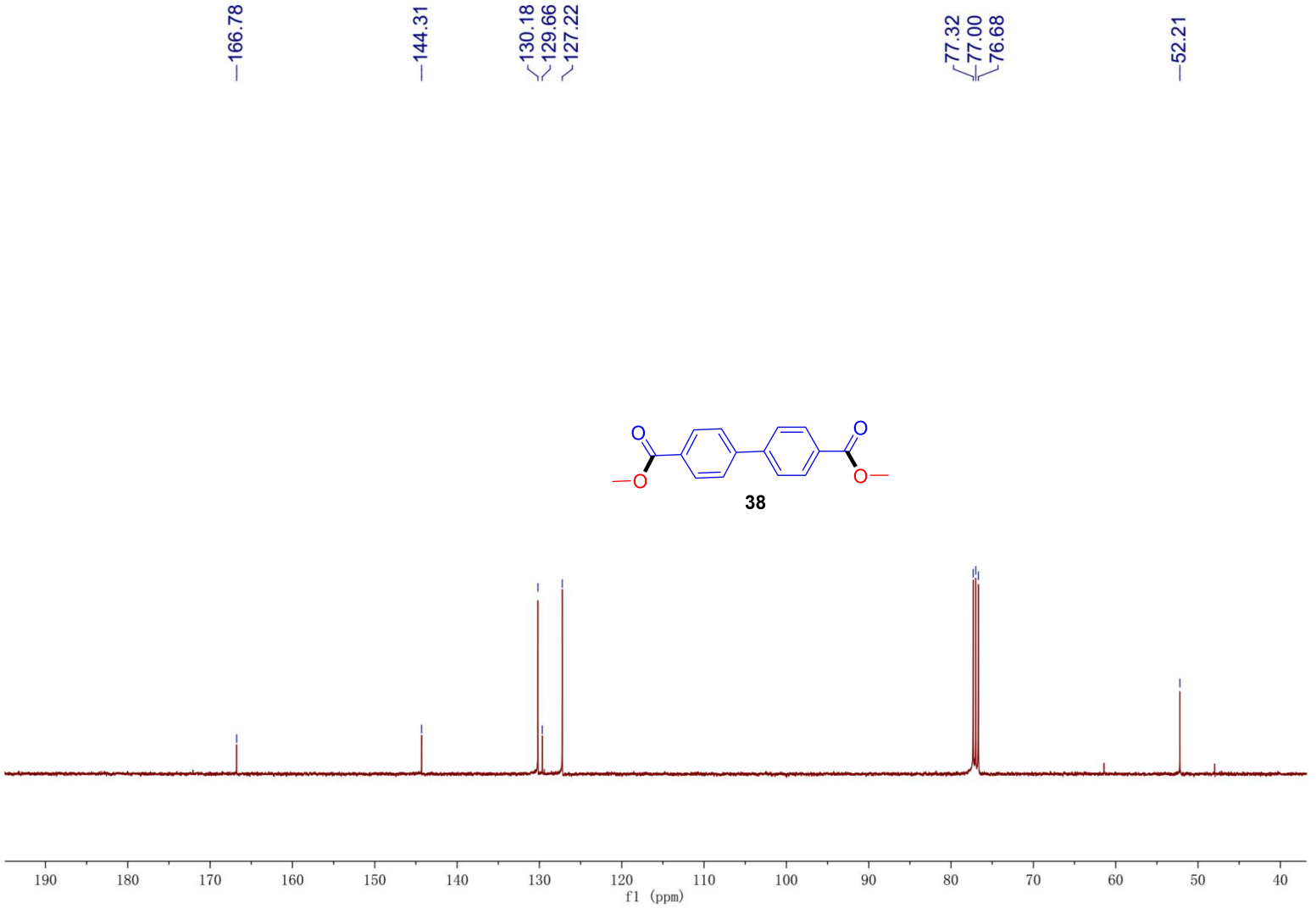

O
O
S

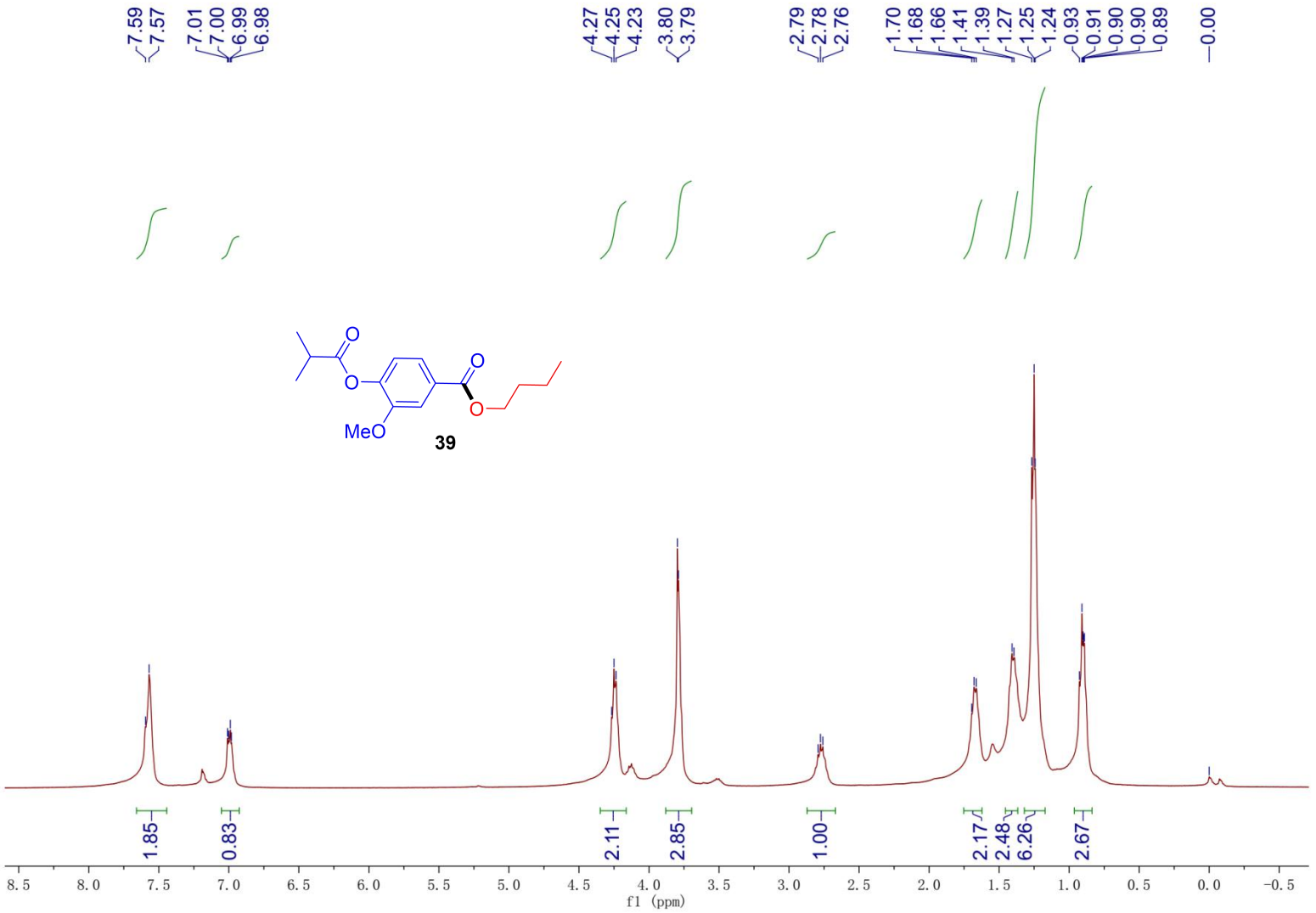
37

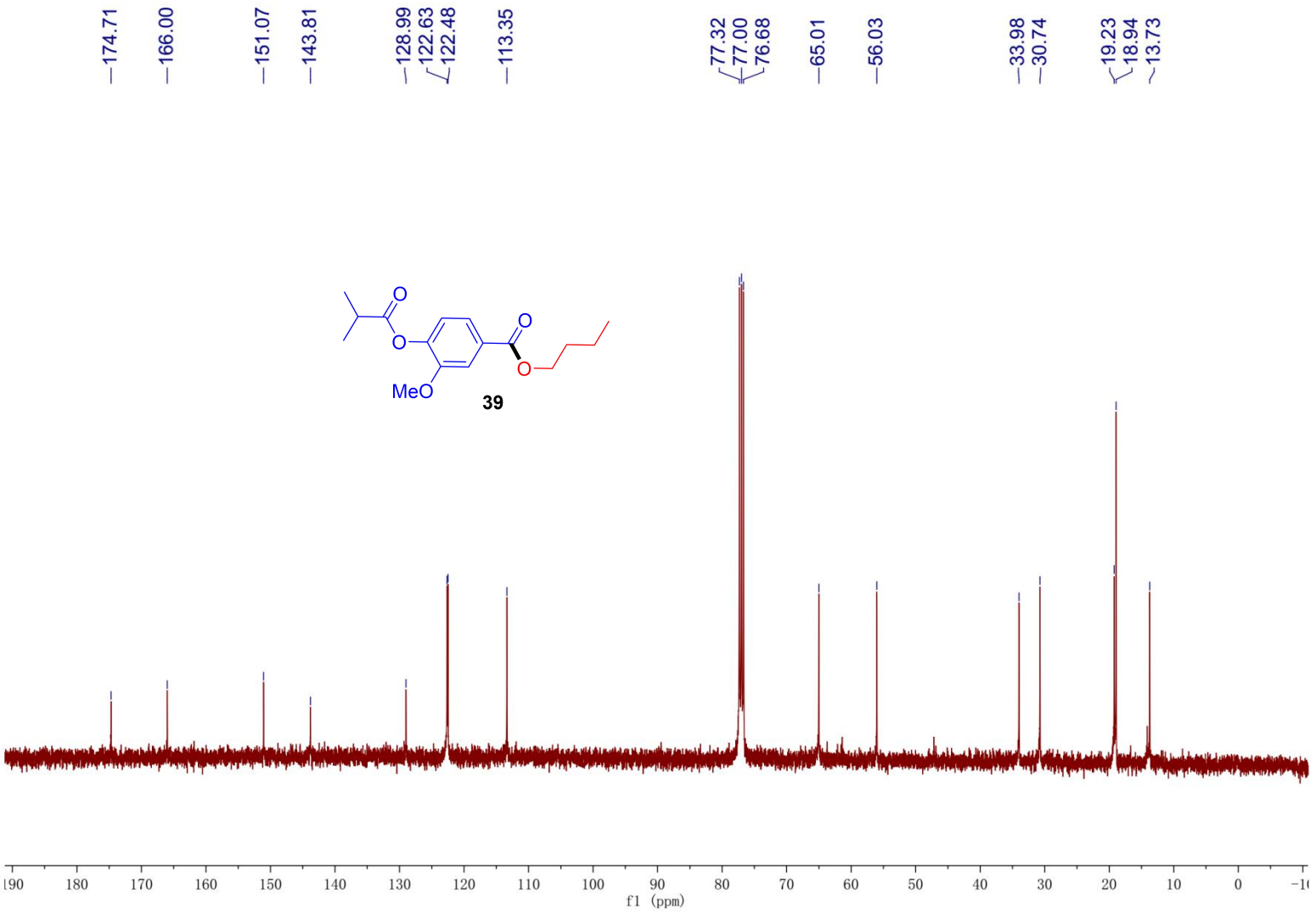

0.98
0.88
1.85
2.55
1.95
2.11
3.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

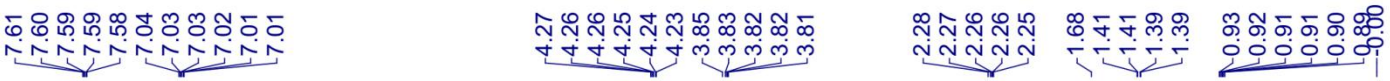

182.59
162.36
147.70
133.63
126.26
77.32
77.00
76.68
64.73
30.75
19.19
15.73
13.73
O
O
S
37
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

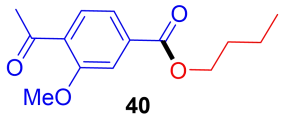

8.07
8.06
8.05
8.05
7.63
7.63
7.61
7.61
3.88
0.00
O
O
O
O
38
3.74
3.80
6.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


166.78
144.31
130.18
129.66
127.22
77.32
77.00
76.68
52.21
O
O
O
O
38
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
f1 (ppm)

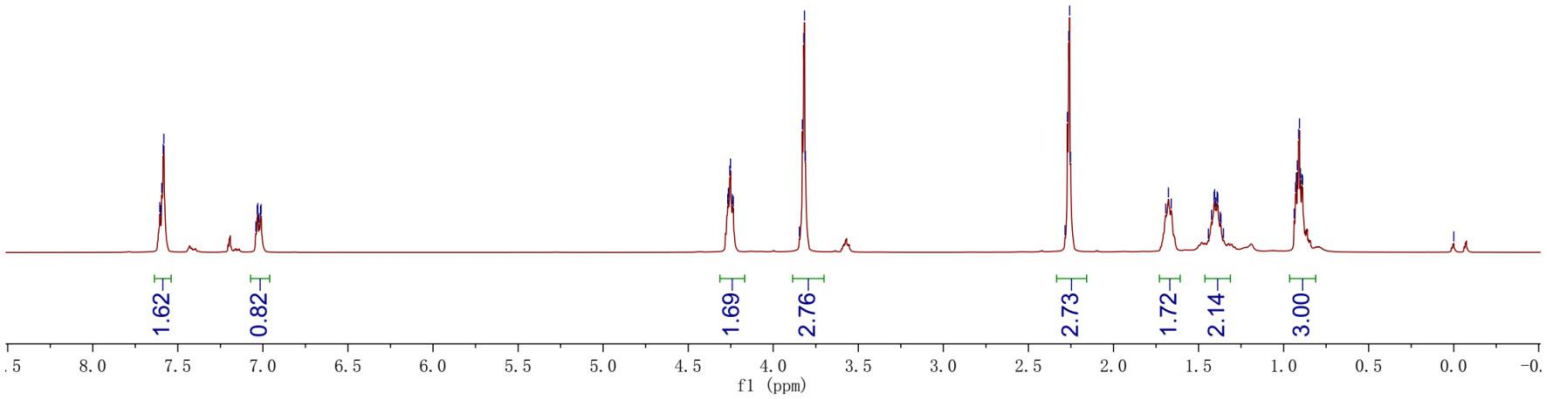

7.59
7.57
7.01
7.00
6.99
6.98
4.27
4.25
4.23
3.80
3.79
2.79
2.78
2.76
1.70
1.68
1.66
1.41
1.39
1.27
1.25
1.24
0.93
0.91
0.90
0.90
0.89
0.00
O
O
O
O
MeO
39
1.85
0.83
2.11
2.85
1.00
2.17
2.48
6.26
2.67
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

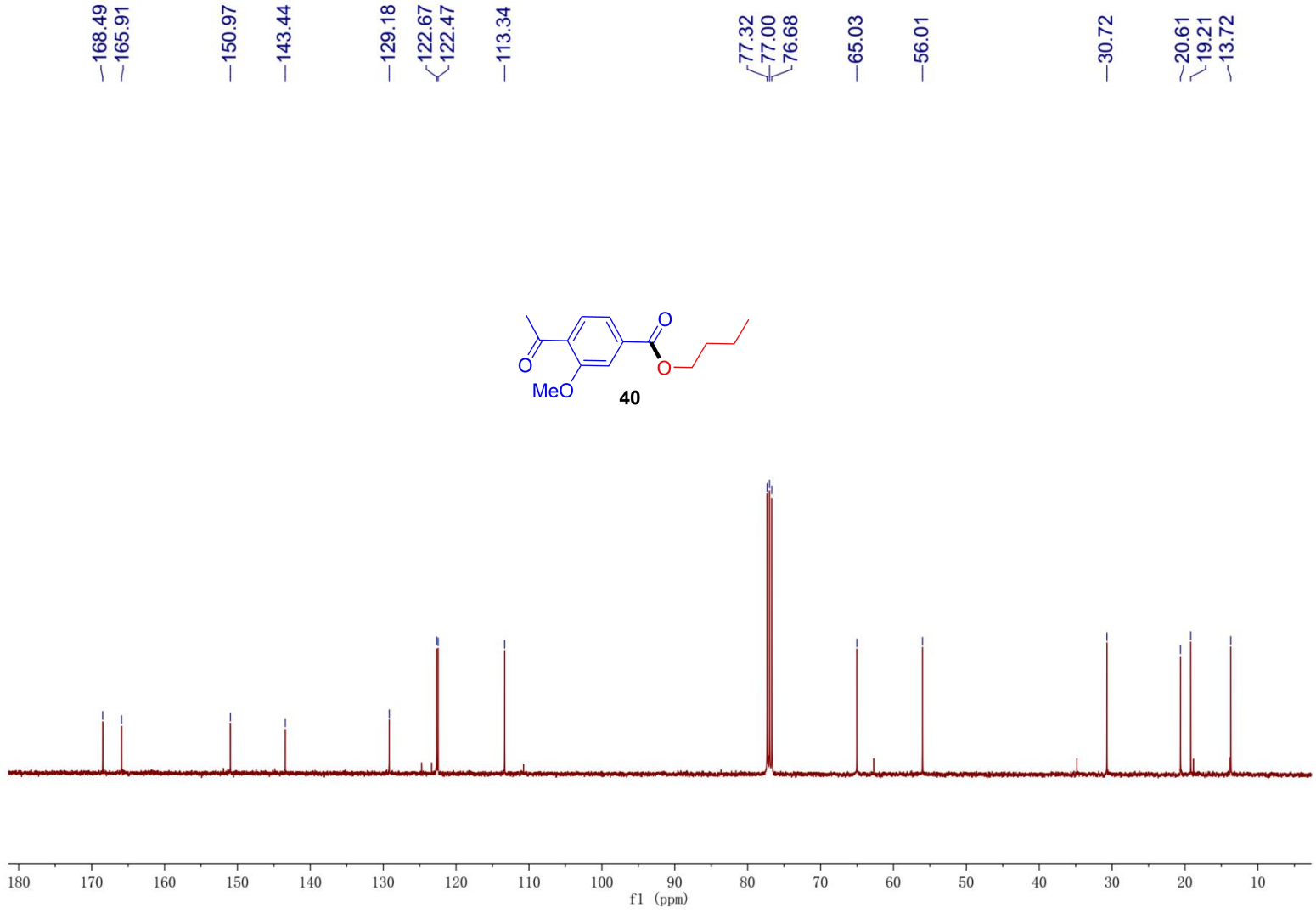

174.71
166.00
151.07
143.81
128.99
122.63
122.48
113.35
77.32
77.00
76.68
65.01
56.03
33.98
30.74
19.23
18.94
13.73
O
O
O
O
MeO
39
f1 (ppm)

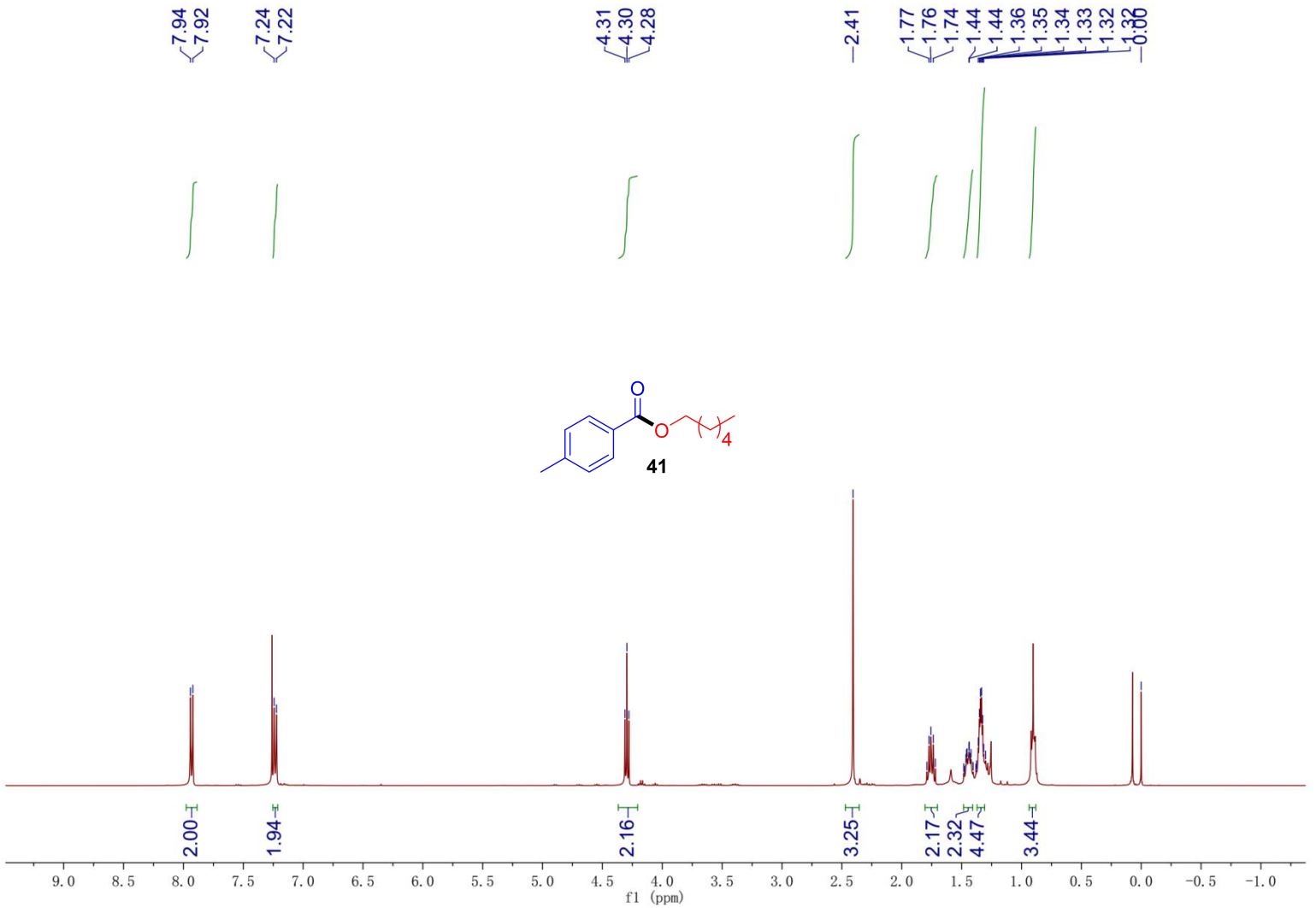

7.61
7.60
7.59
7.59
7.58
7.04
7.03
7.03
7.02
7.01
7.01
4.27
4.26
4.26
4.25
4.24
4.23
3.85
3.83
3.82
3.82
3.81
2.28
2.27
2.26
2.26
2.25
1.68
1.41
1.41
1.39
1.39
0.93
0.92
0.91
0.91
0.90
0.89
0.00

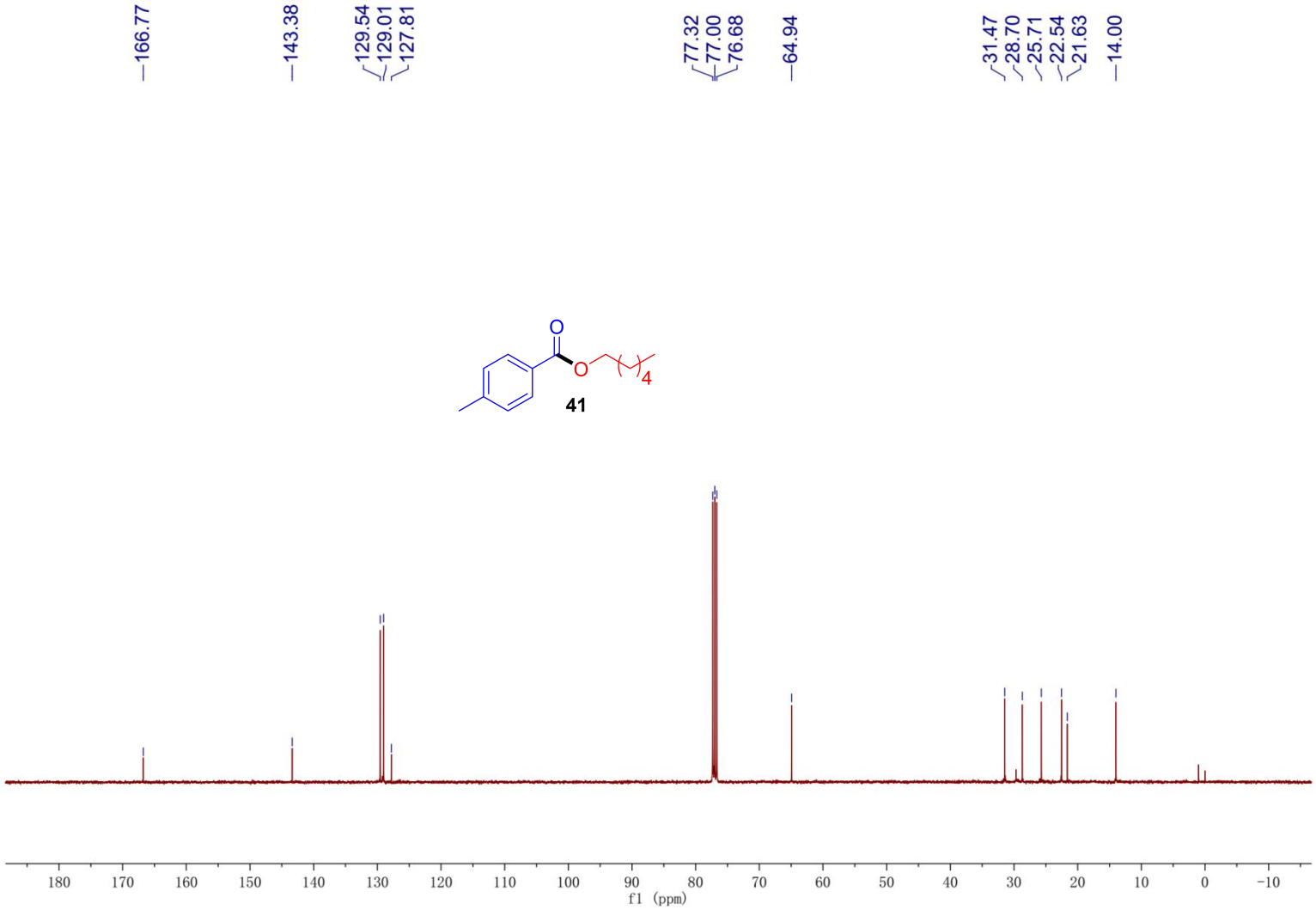

O
O
O
MeO

40


1.62
0.82
1.69
2.76
2.73
1.72
2.14
3.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


168.49
165.91
150.97
143.44
129.18
122.67
122.47
113.34
77.32
77.00
76.68
65.03
56.01
30.72
20.61
19.21
13.72
O
O
MeO
O
40
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


7.94
7.92
7.24
7.22
4.31
4.30
4.28
2.41
1.77
1.76
1.74
1.44
1.44
1.36
1.35
1.34
1.33
1.32
0.00
O
O
4
41
2.00
1.94
2.16
3.25
2.17
2.32
4.47
3.44
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)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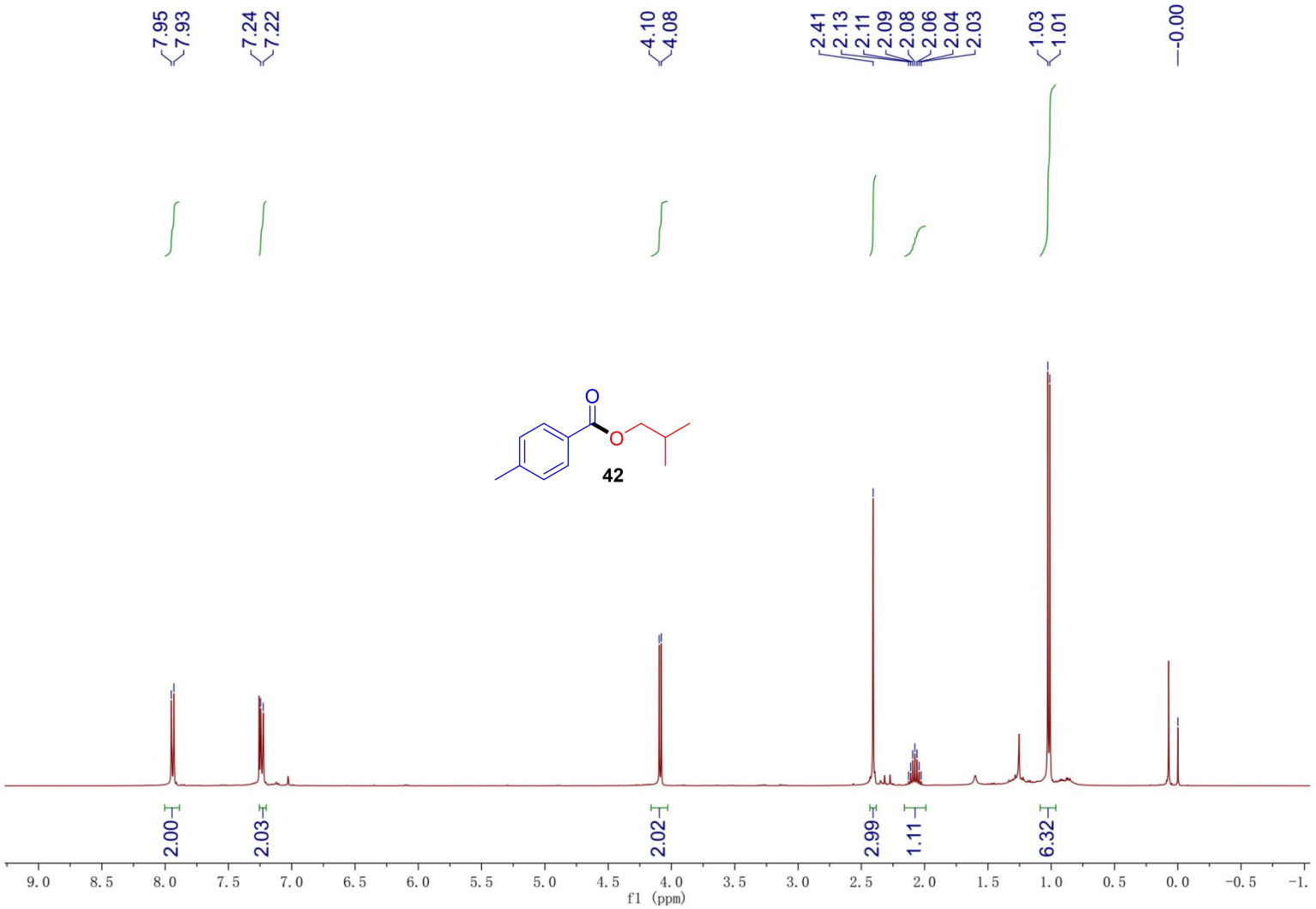
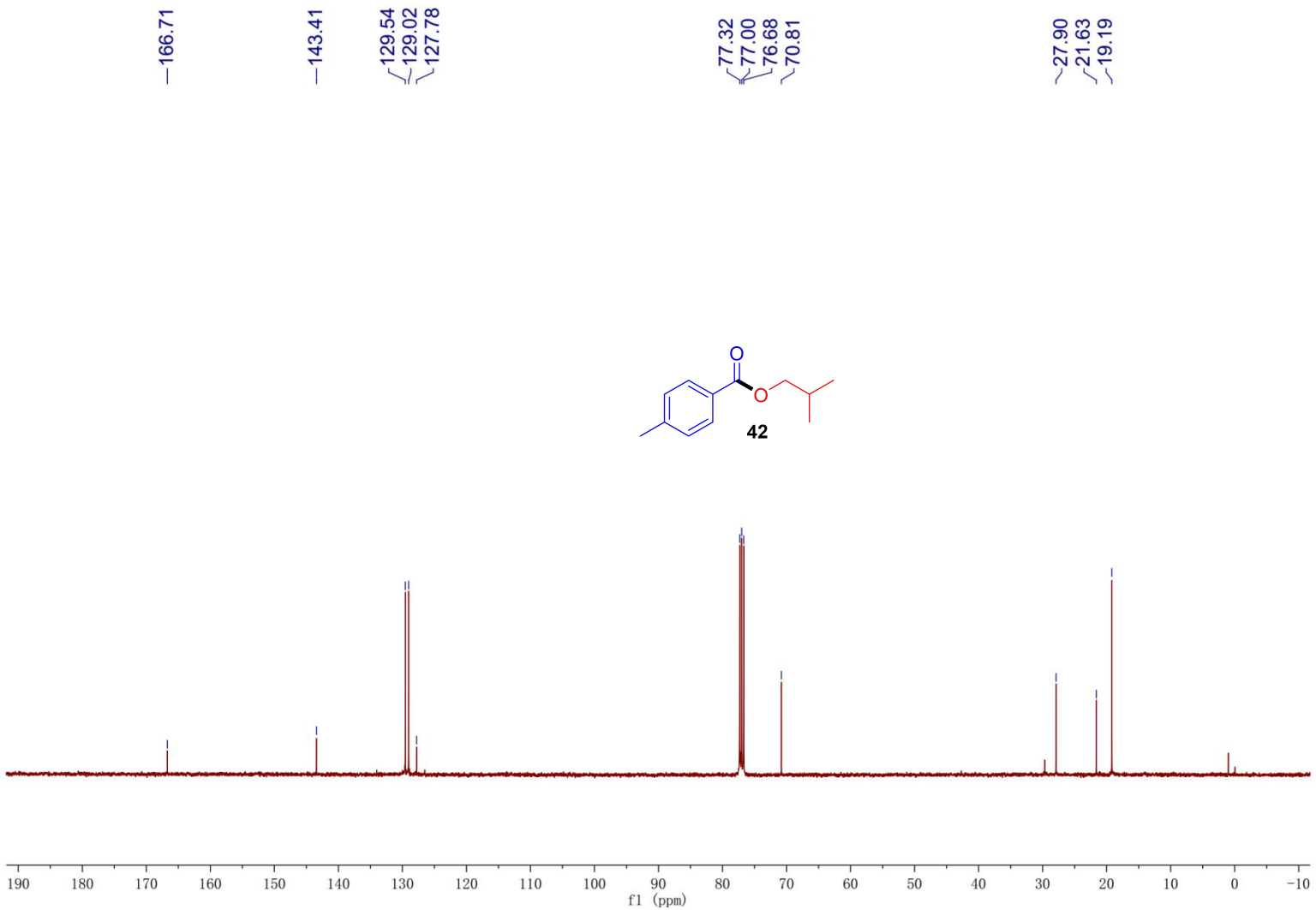
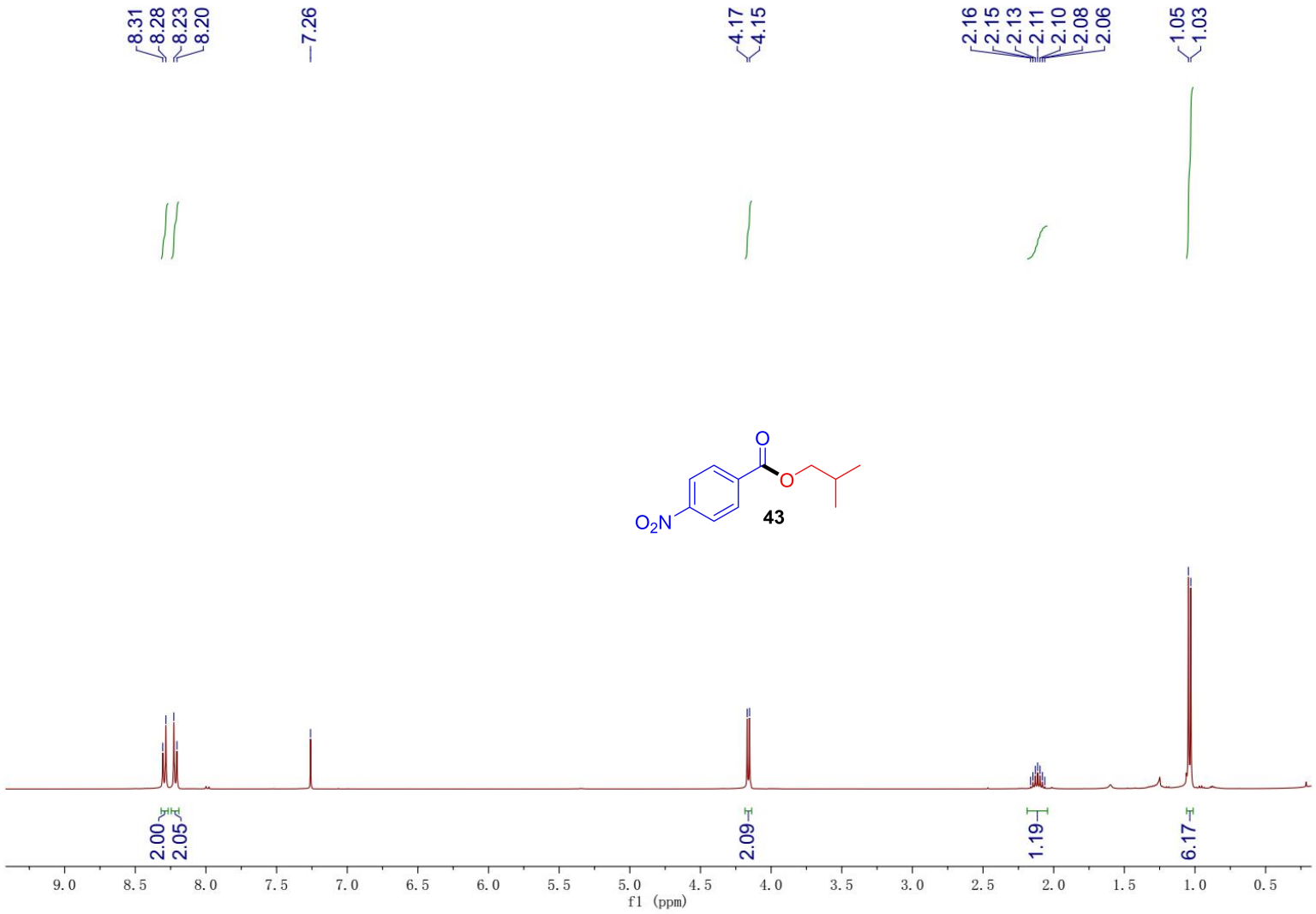
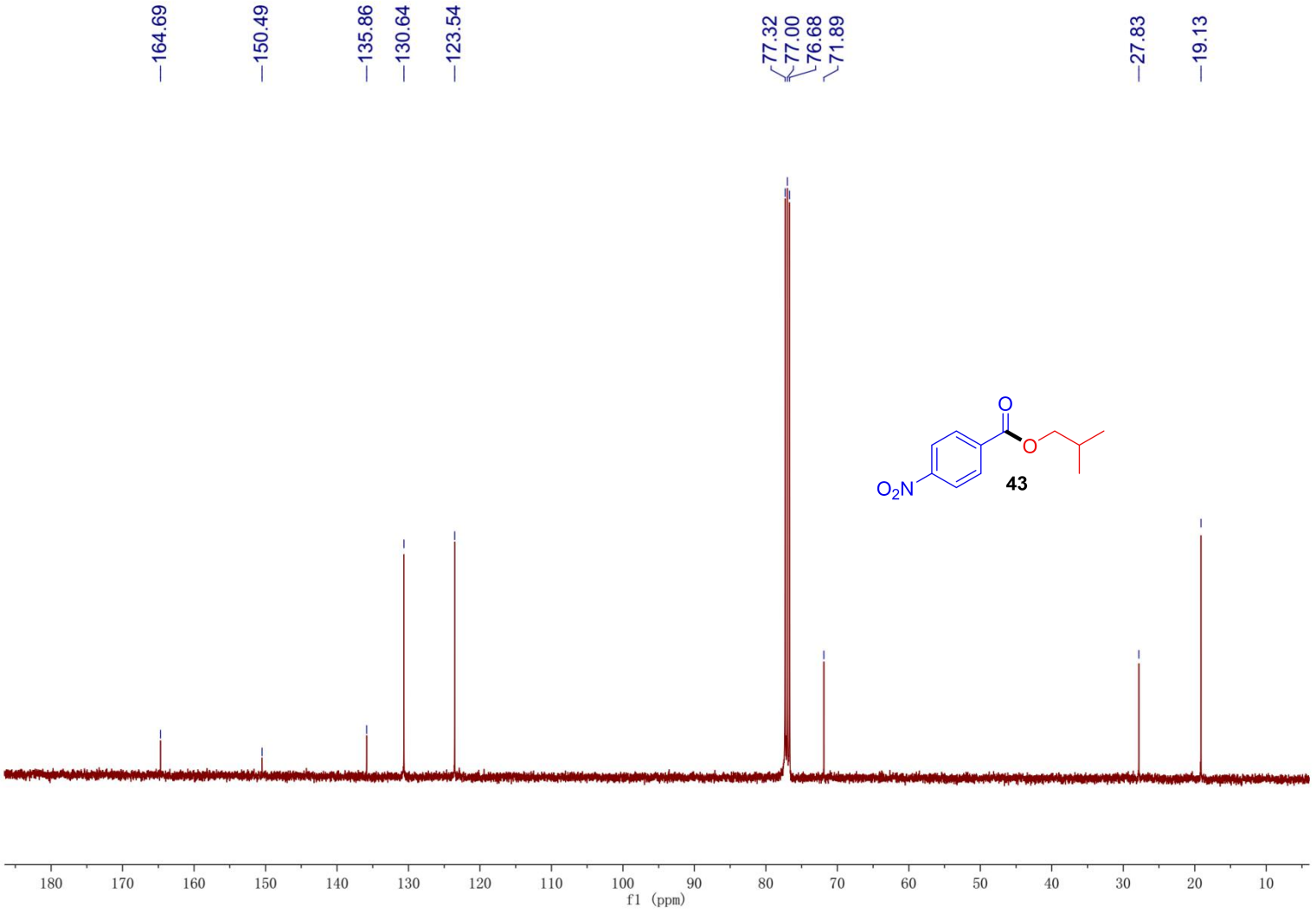
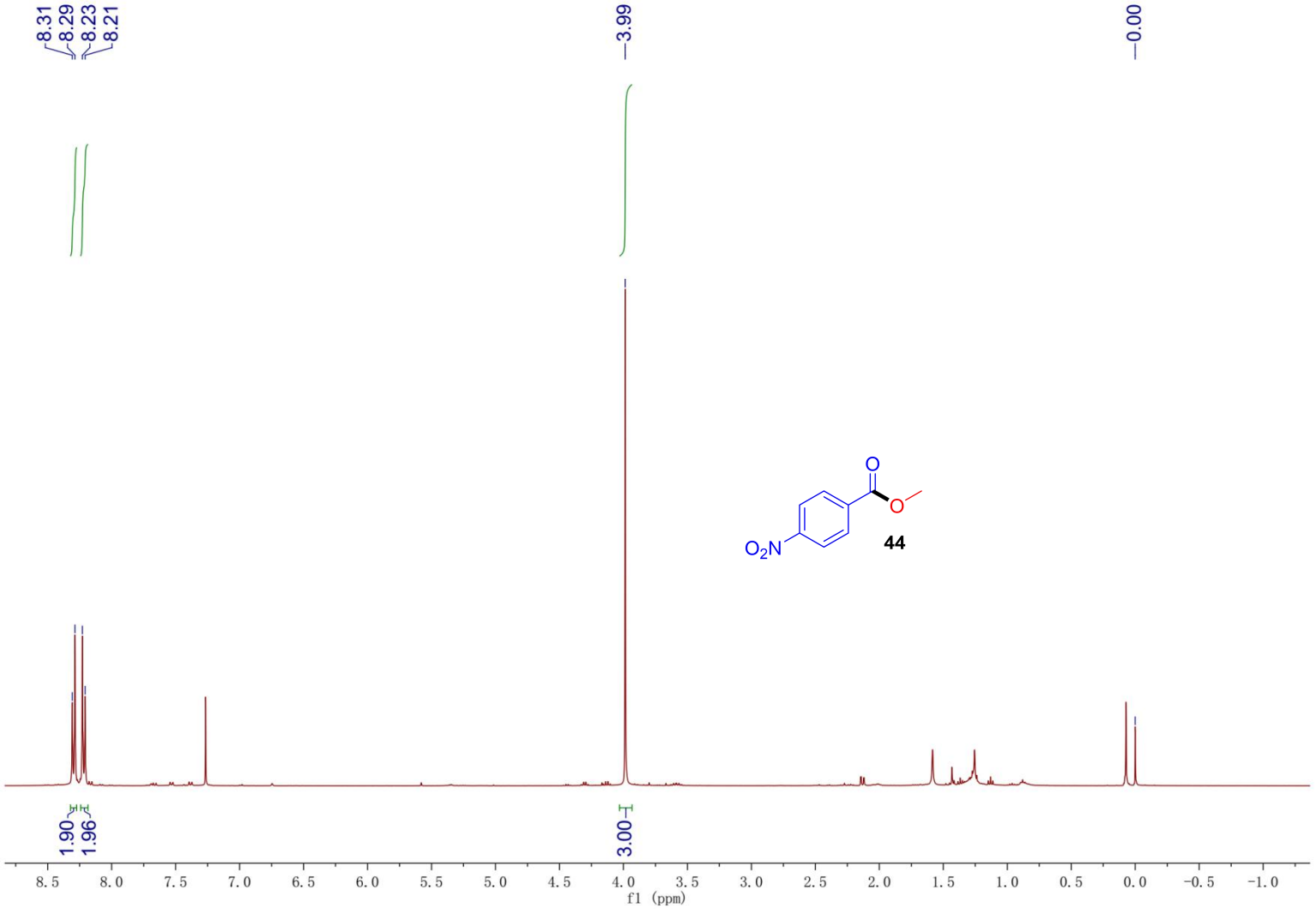
143.38
129.54
129.01
127.81
77.32
77.00
76.68
64.94
31.47
28.70
25.71
22.54
21.63
14.00
O
O
4
41
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)

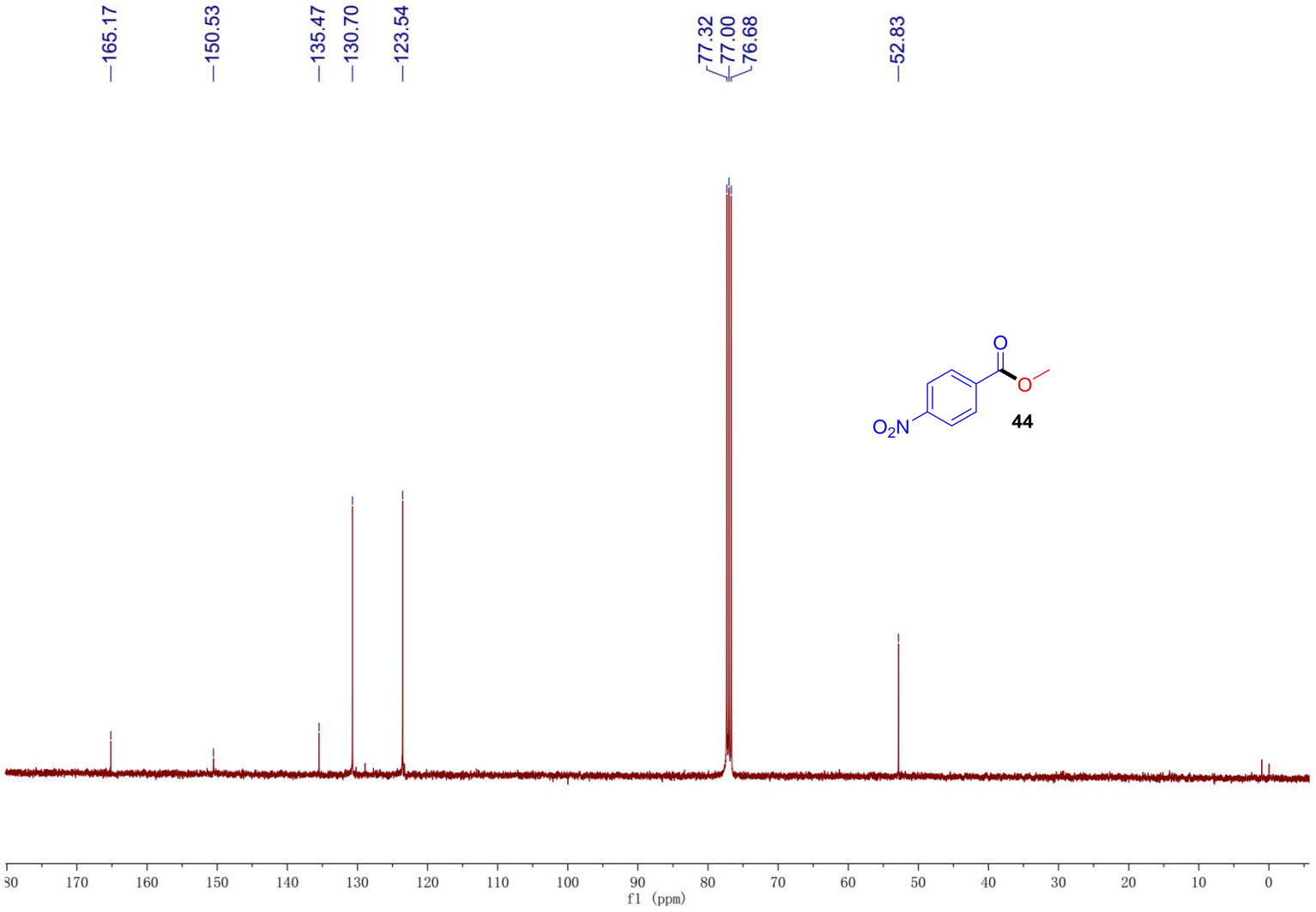

7.95
7.93
7.24
7.22
4.10
4.08
2.41
2.13
2.11
2.09
2.08
2.06
2.04
2.03
1.03
1.01
0.00
O
O
42
2.00
2.03
2.02
2.99
1.11
6.32
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.
f1 (ppm)

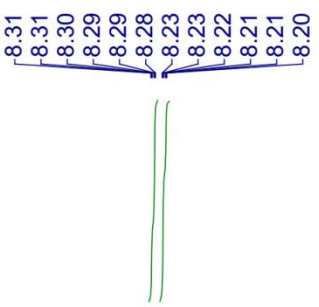

166.71
143.41
129.54
129.02
127.78
77.32
77.00
76.68
70.81
27.90
21.63
19.19
O
O
42
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
f1 (ppm)


8.31
8.28
8.23
8.20
7.26
4.17
4.15
2.16
2.15
2.13
2.11
2.10
2.08
2.06
1.05
1.03
O
O
O2N
43
2.00
2.05
2.09
1.19
6.17
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
f1 (ppm)

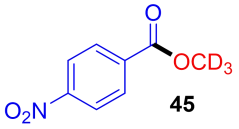

164.69
150.49
135.86
130.64
123.54
77.32
77.00
76.68
71.89
27.83
19.13
O
O
O2N
43
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


8.31
8.29
8.23
8.21
3.99
0.00
O
O
O2N
44
1.90
1.96
3.00
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

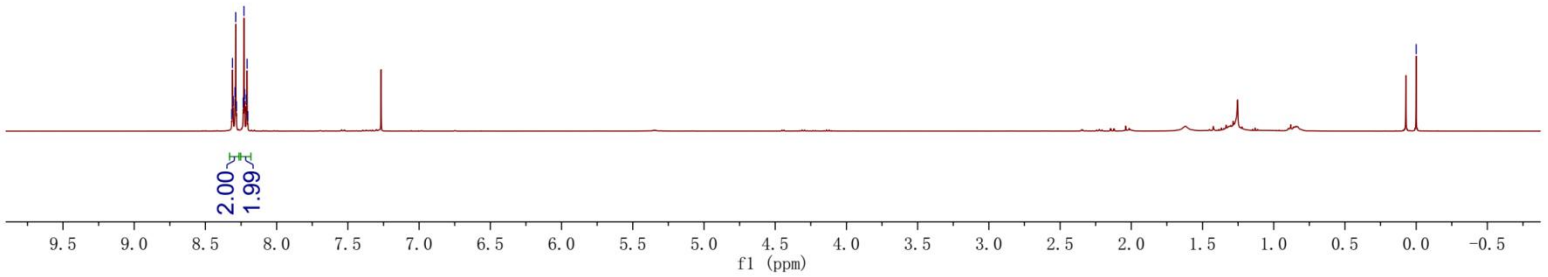

165.17
150.53
135.47
130.70
123.54
77.32
77.00
76.68
52.83
O
O
O2N
44
f1 (ppm)

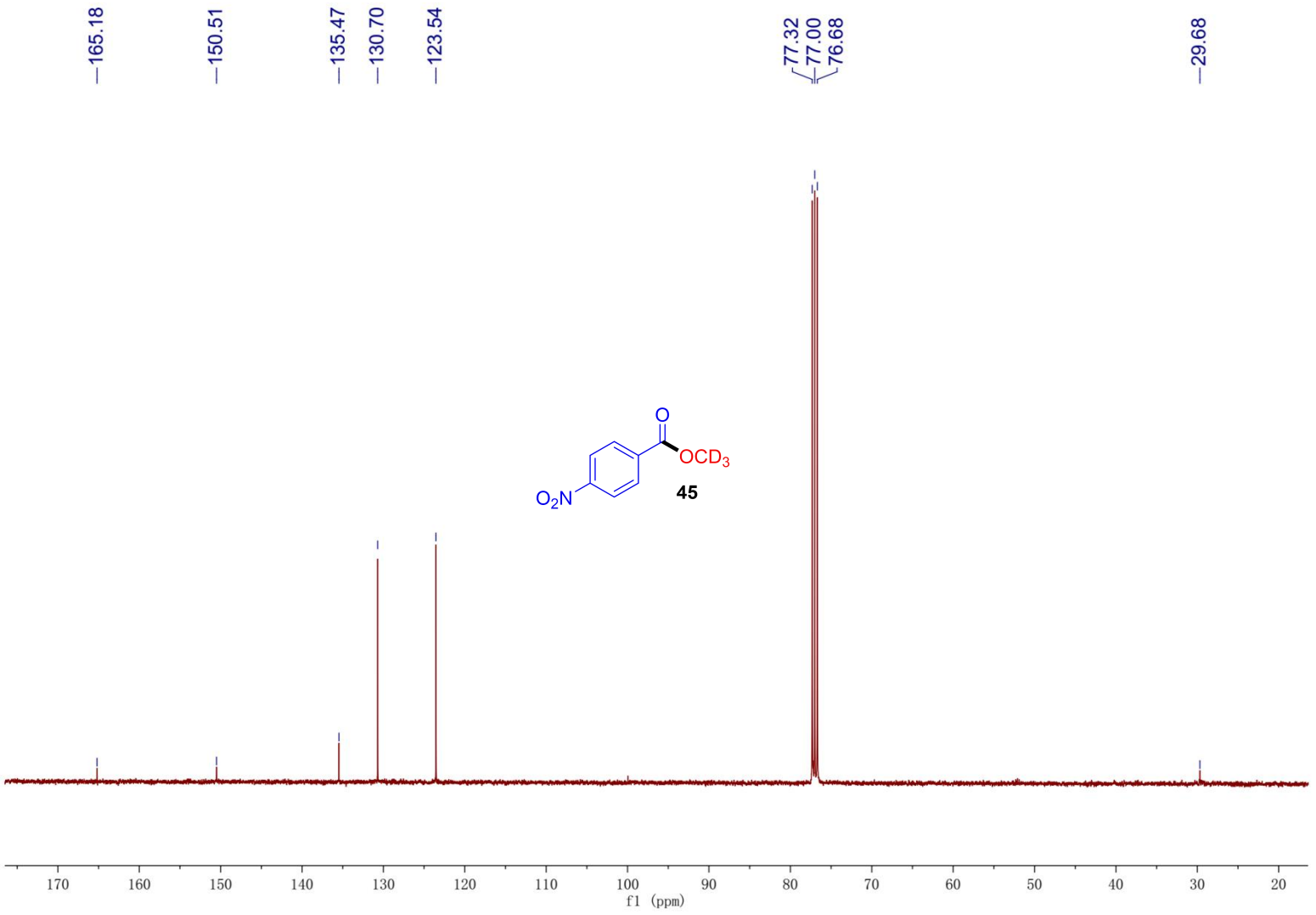

8.31
8.31
8.30
8.29
8.29
8.28
8.23
8.23
8.22
8.21
8.21
8.20

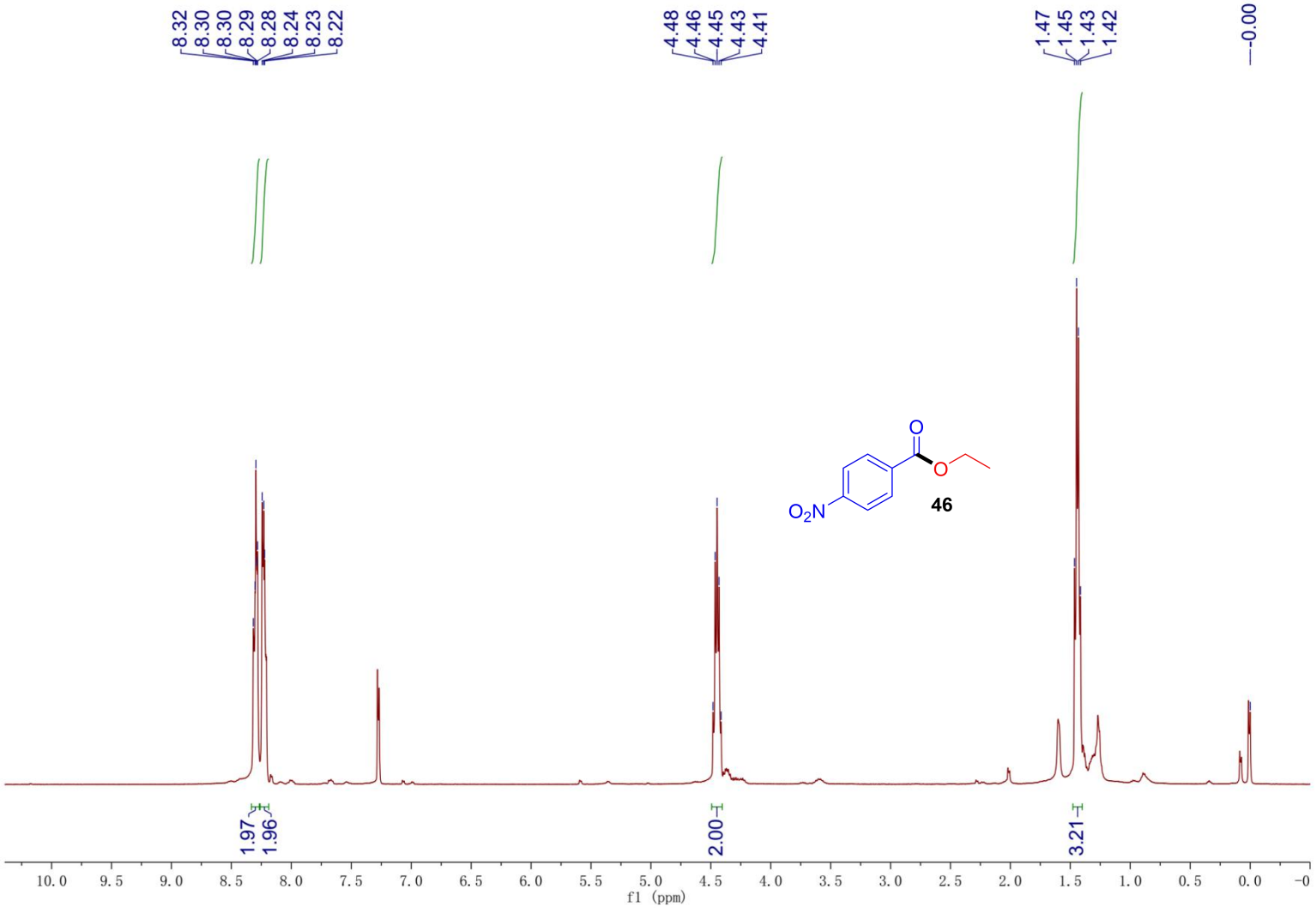

0.00

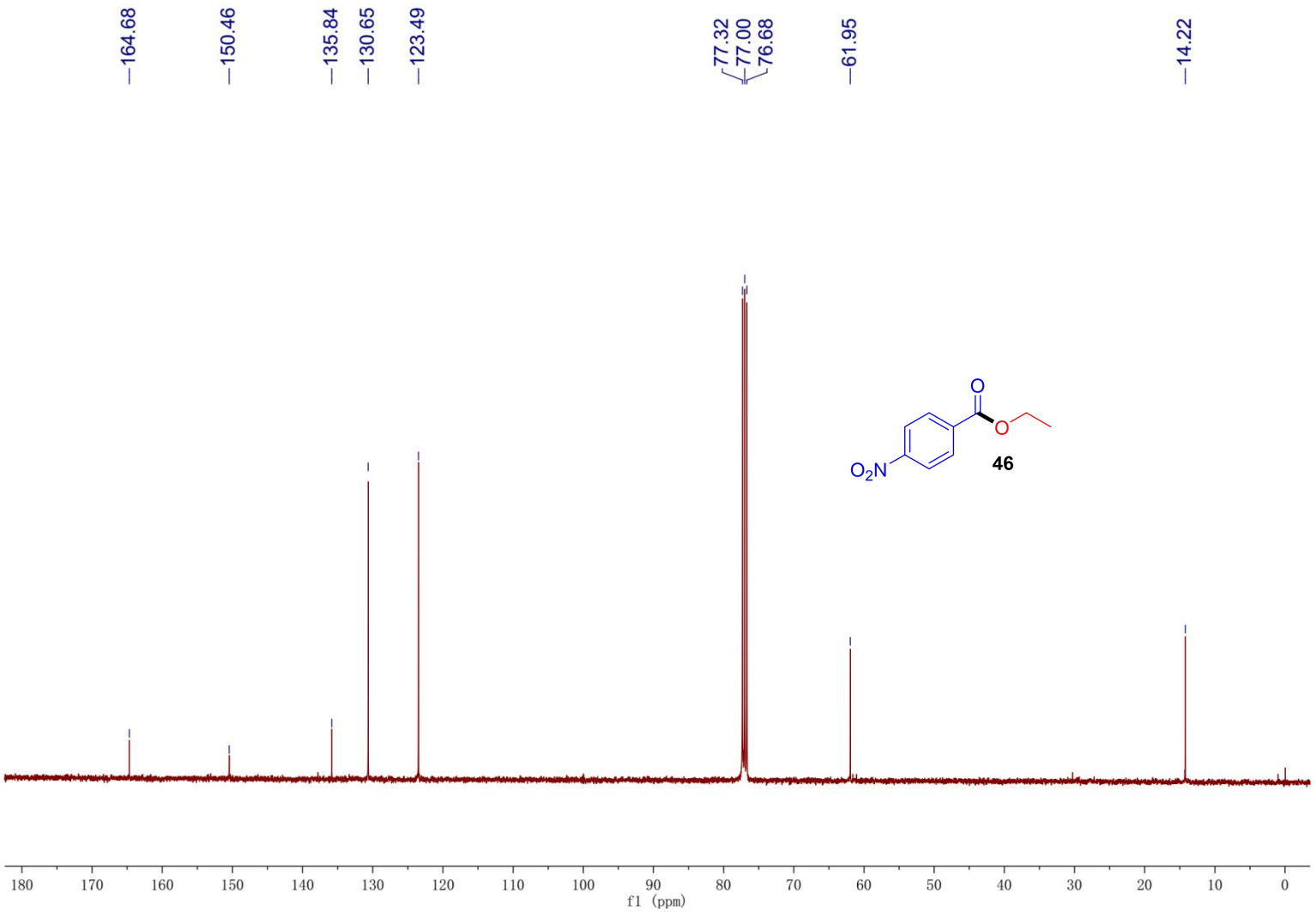

O
OCD3
O2N

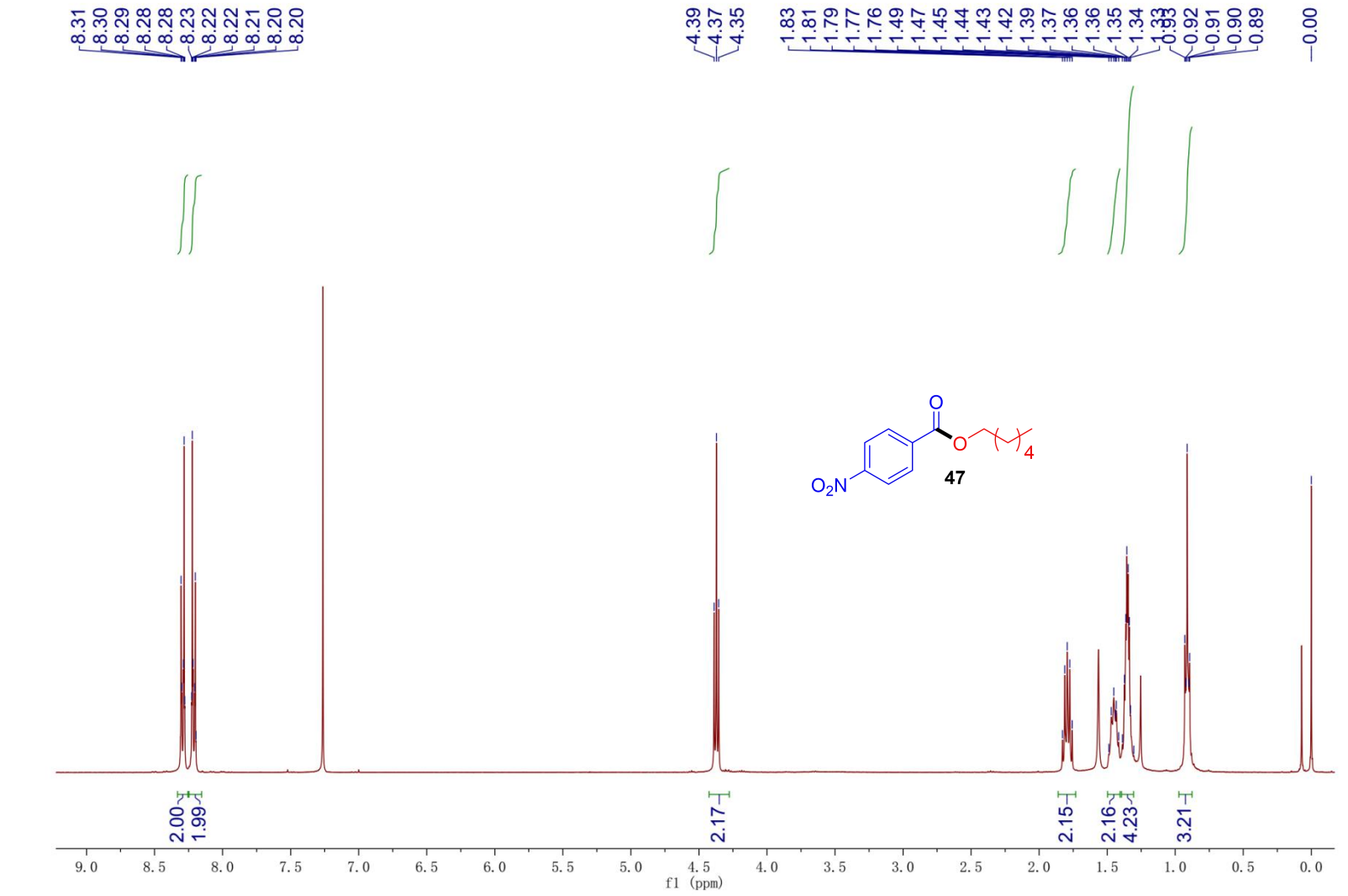
45

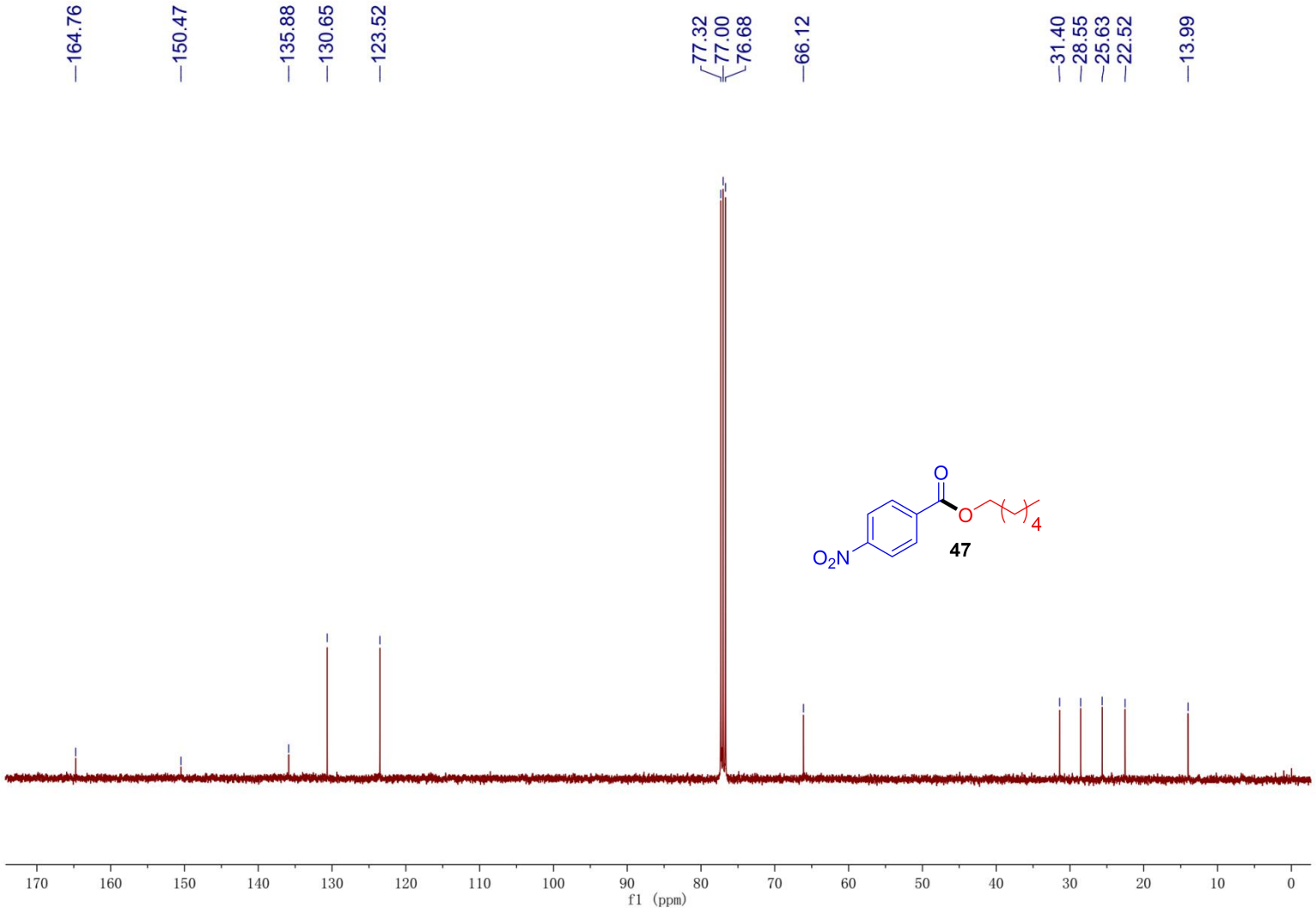

2.00
1.99
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


165.18
150.51
135.47
130.70
123.54
77.32
77.00
76.68
29.68
O
OCD3
O2N
45
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)


8.32
8.30
8.30
8.29
8.28
8.24
8.23
8.22
4.48
4.46
4.45
4.43
4.41
1.47
1.45
1.43
1.42
0.00
O
O
O2N
46
1.97
1.96
2.00
3.21
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)


164.68
150.46
135.84
130.65
123.49
77.32
77.00
76.68
61.95
14.22
O
O
O2N
46
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.31
8.30
8.29
8.28
8.28
8.23
8.22
8.22
8.21
8.20
8.20
4.39
4.37
4.35
1.83
1.81
1.79
1.77
1.76
1.49
1.47
1.45
1.44
1.43
1.42
1.39
1.37
1.36
1.36
1.35
1.34
0.93
0.92
0.91
0.90
0.89
0.00
O
O
4
O2N
47
2.00
1.99
2.17
2.15
2.16
4.23
3.21
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)


164.76
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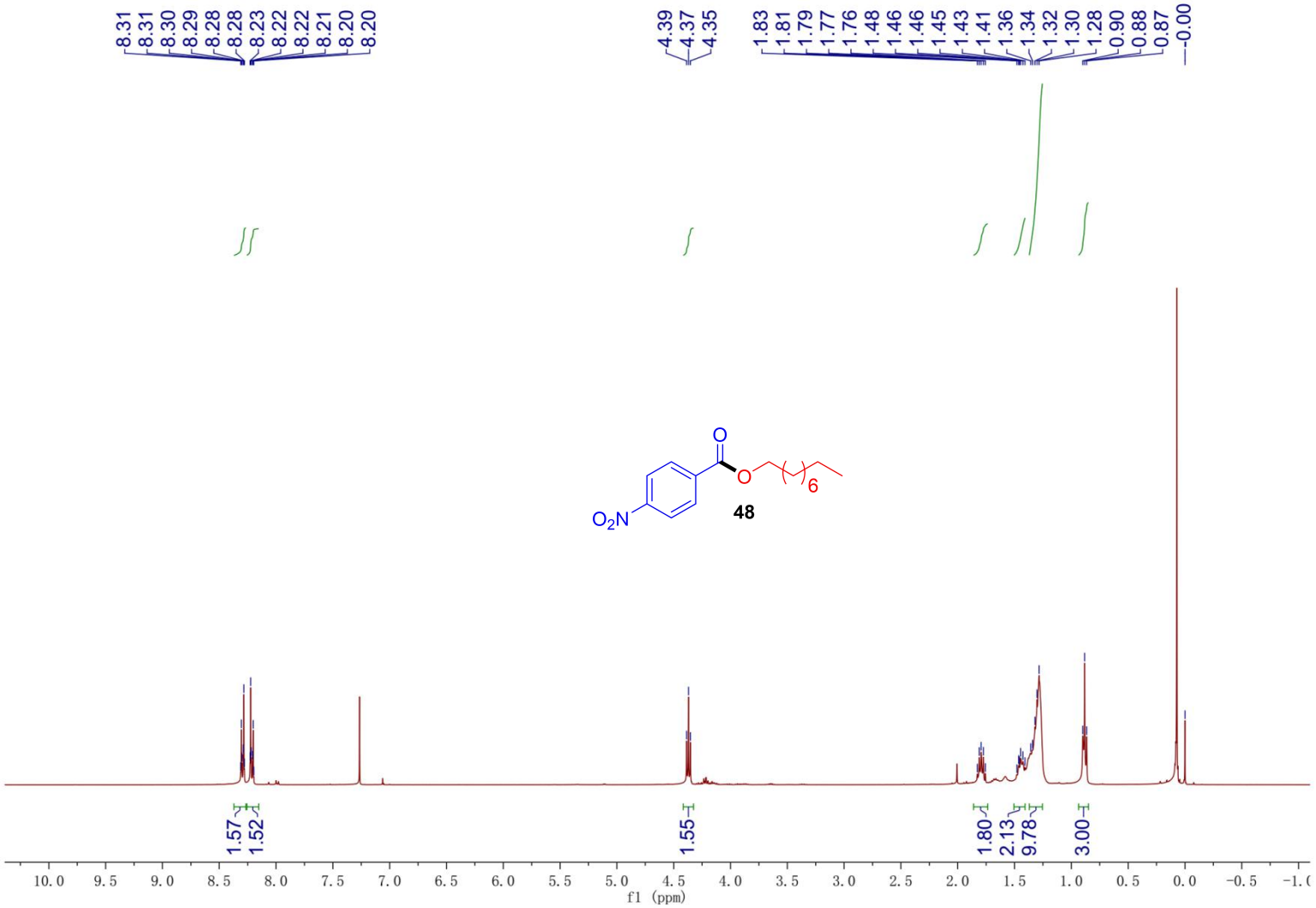
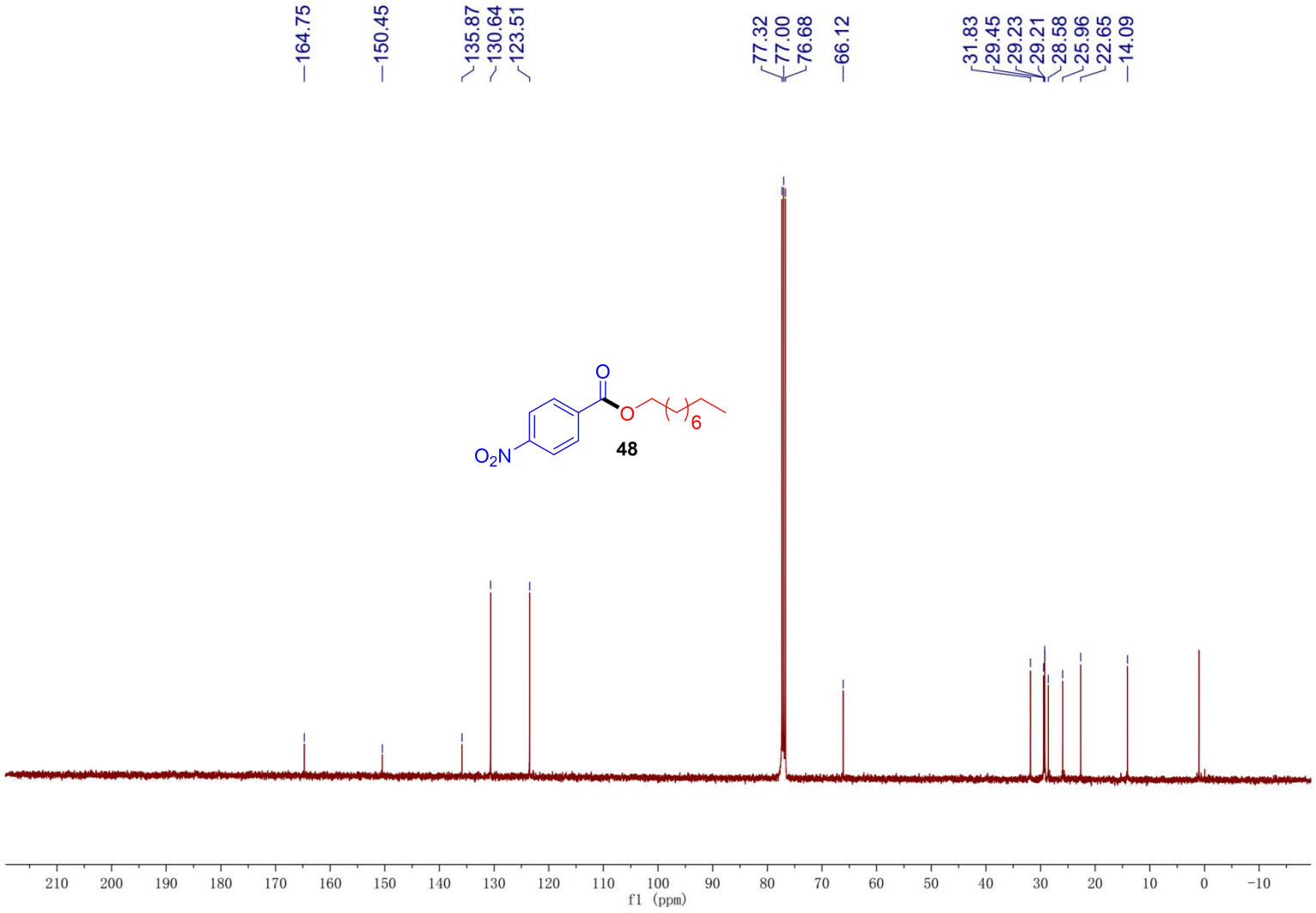
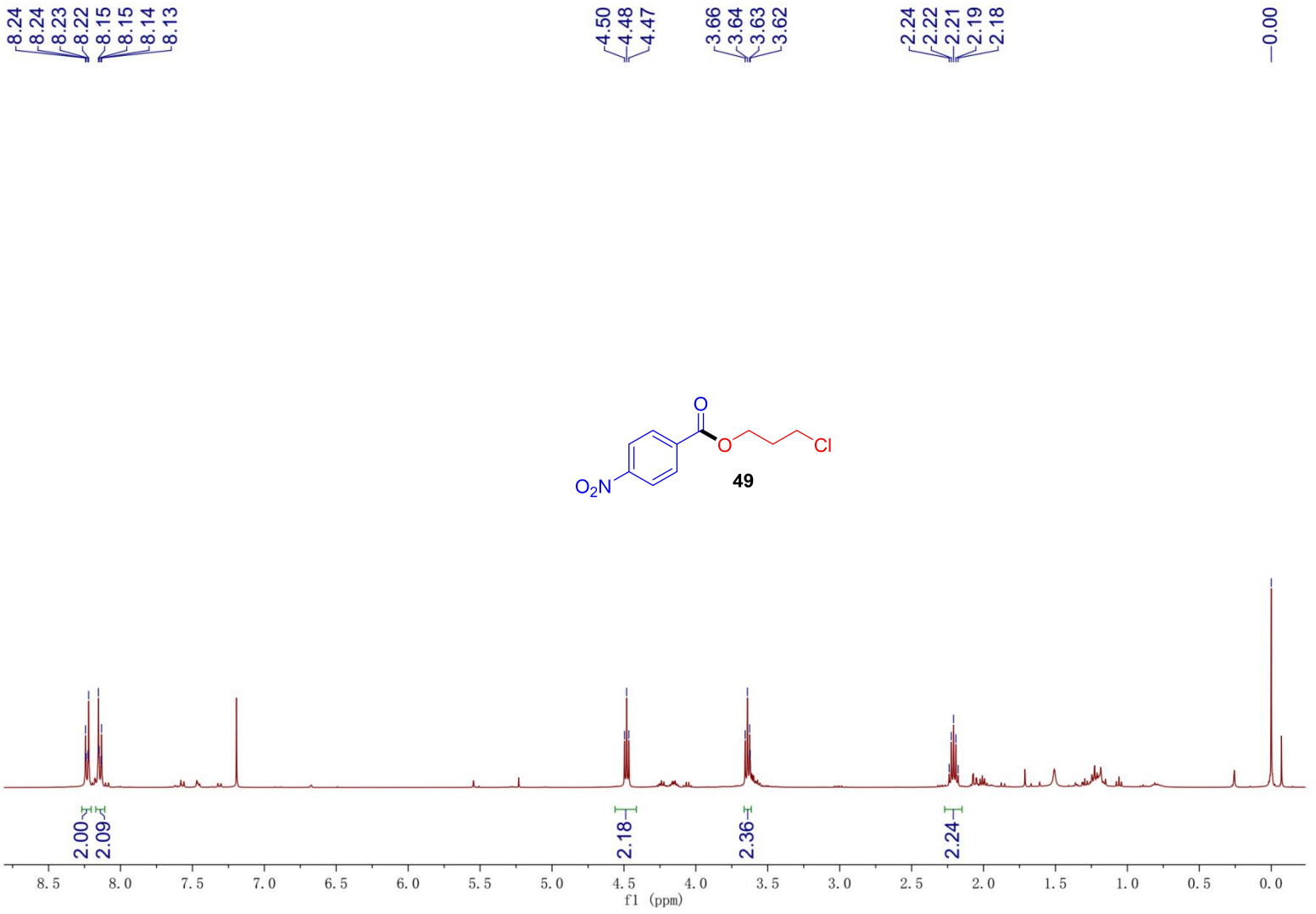
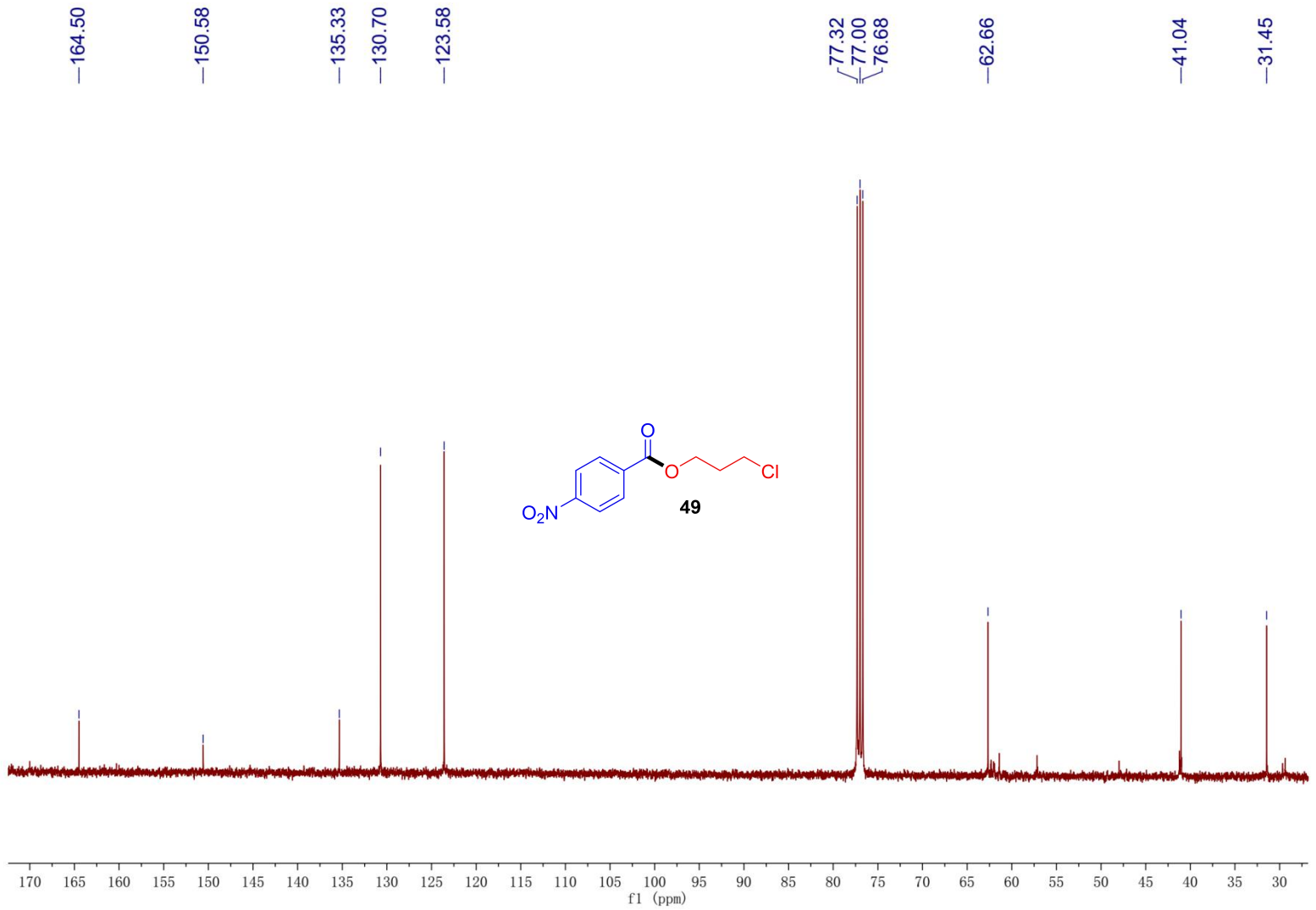
135.88
130.65
123.52
77.32
77.00
76.68
66.12
31.40
28.55
25.63
22.52
13.99
O
O
4
O_2N
47
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.31
8.31
8.30
8.29
8.28
8.28
8.23
8.22
8.22
8.21
8.20
8.20
4.39
4.37
4.35
1.83
1.81
1.79
1.77
1.76
1.48
1.46
1.46
1.45
1.43
1.41
1.36
1.34
1.32
1.30
1.28
0.90
0.88
0.87
-0.00
O
O
6
O2N
48
1.57
1.52
1.55
1.80
2.13
9.78
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)


164.75
150.45
135.87
130.64
123.51
77.32
77.00
76.68
66.12
31.83
29.45
29.23
29.21
28.58
25.96
22.65
14.09
O
O
6
O2N
48
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.24
8.24
8.23
8.22
8.15
8.15
8.14
8.13
4.50
4.48
4.47
3.66
3.64
3.63
3.62
2.24
2.22
2.21
2.19
2.18
0.00
O
O
Cl
O2N
49
2.00
2.09
2.18
2.36
2.24
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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77.32
77.00
76.68
62.66
41.04
31.45
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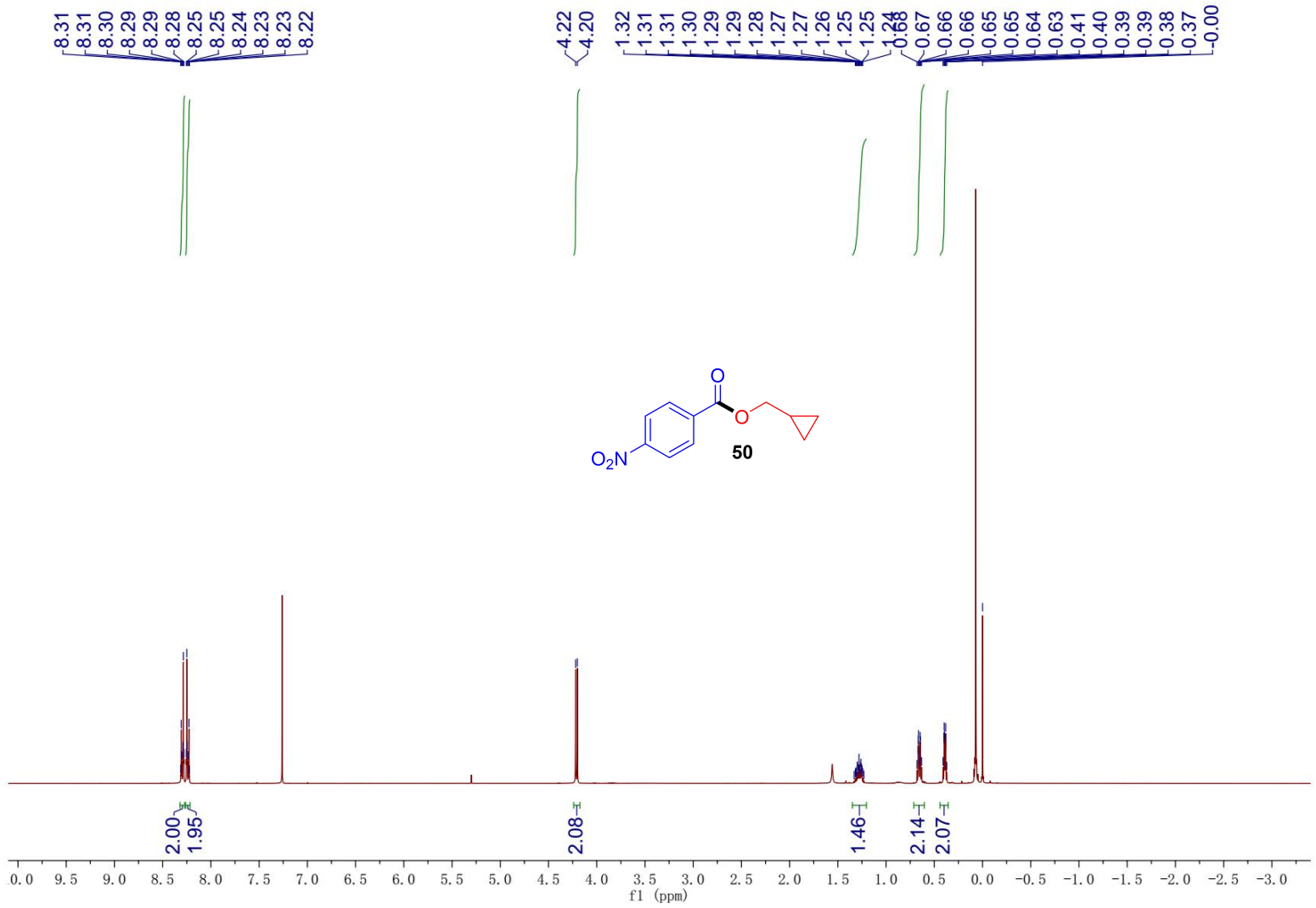
Cl
O2N
49
170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30
f1 (ppm)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8.25
8.24
8.23
8.23
8.22
4.22
4.20
1.32
1.31
1.31
1.30
1.29
1.29
1.28
1.27
1.27
1.26
1.25
1.25
1.24
0.68
0.67
0.66
0.66
0.65
0.65
0.64
0.63
0.41
0.40
0.39
0.39
0.38
0.37
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O
O2N
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2.00
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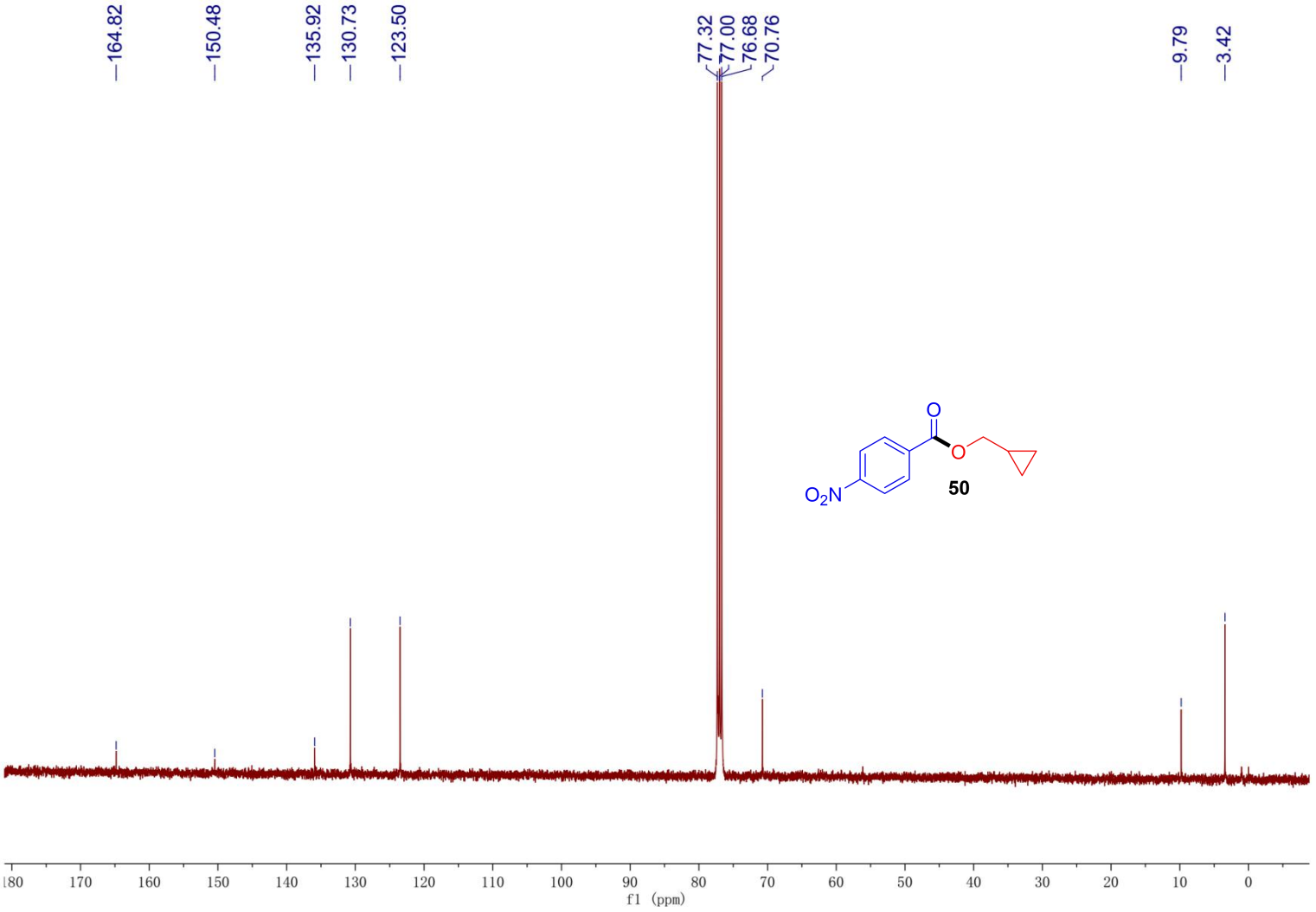
2.08
1.46
2.14
2.07
f1 (ppm)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76.68
70.76
9.79
3.42
O
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O2N
50
180
170
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130
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110
100
90
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70
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50
40
30
20
10
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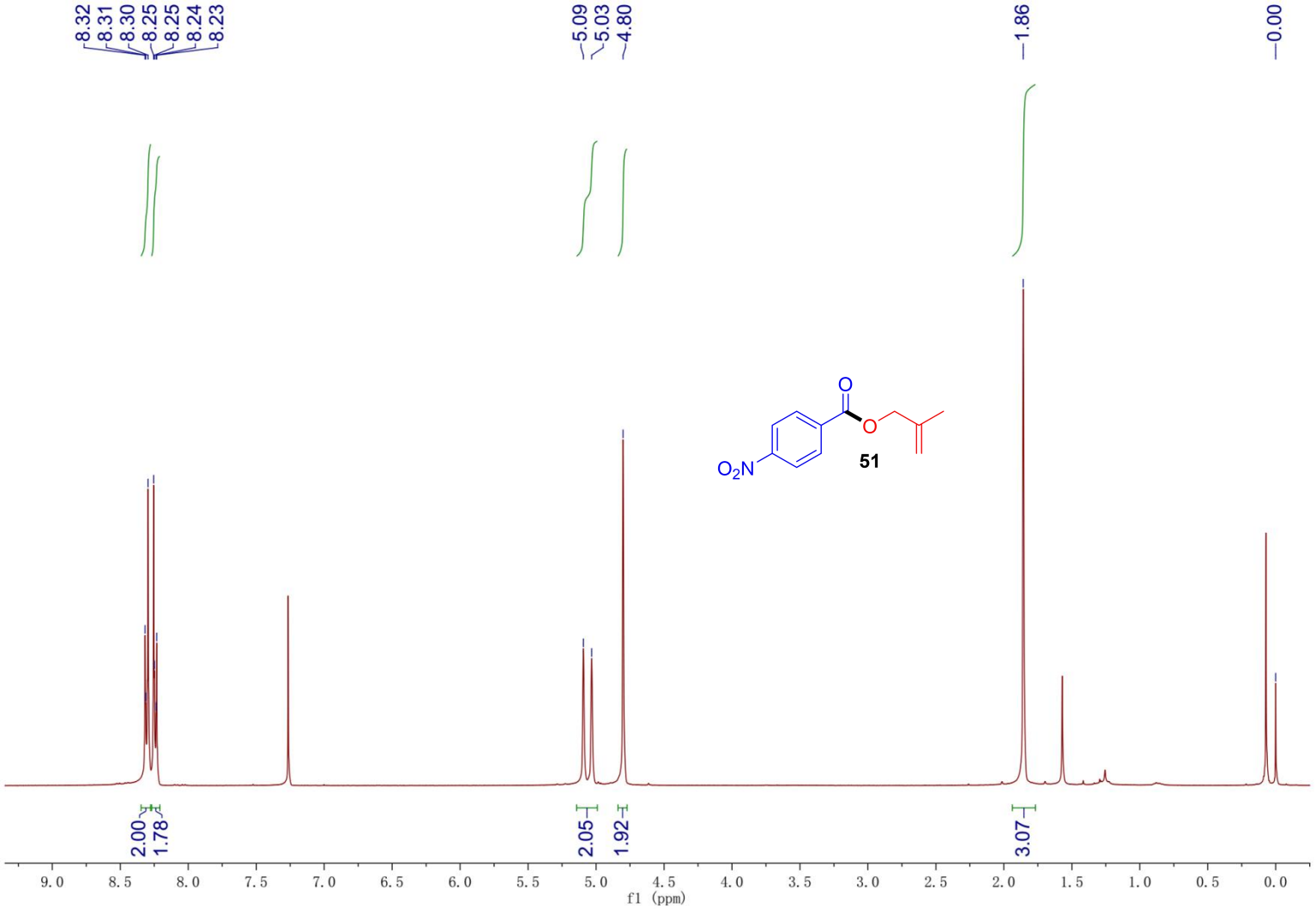
f1 (ppm)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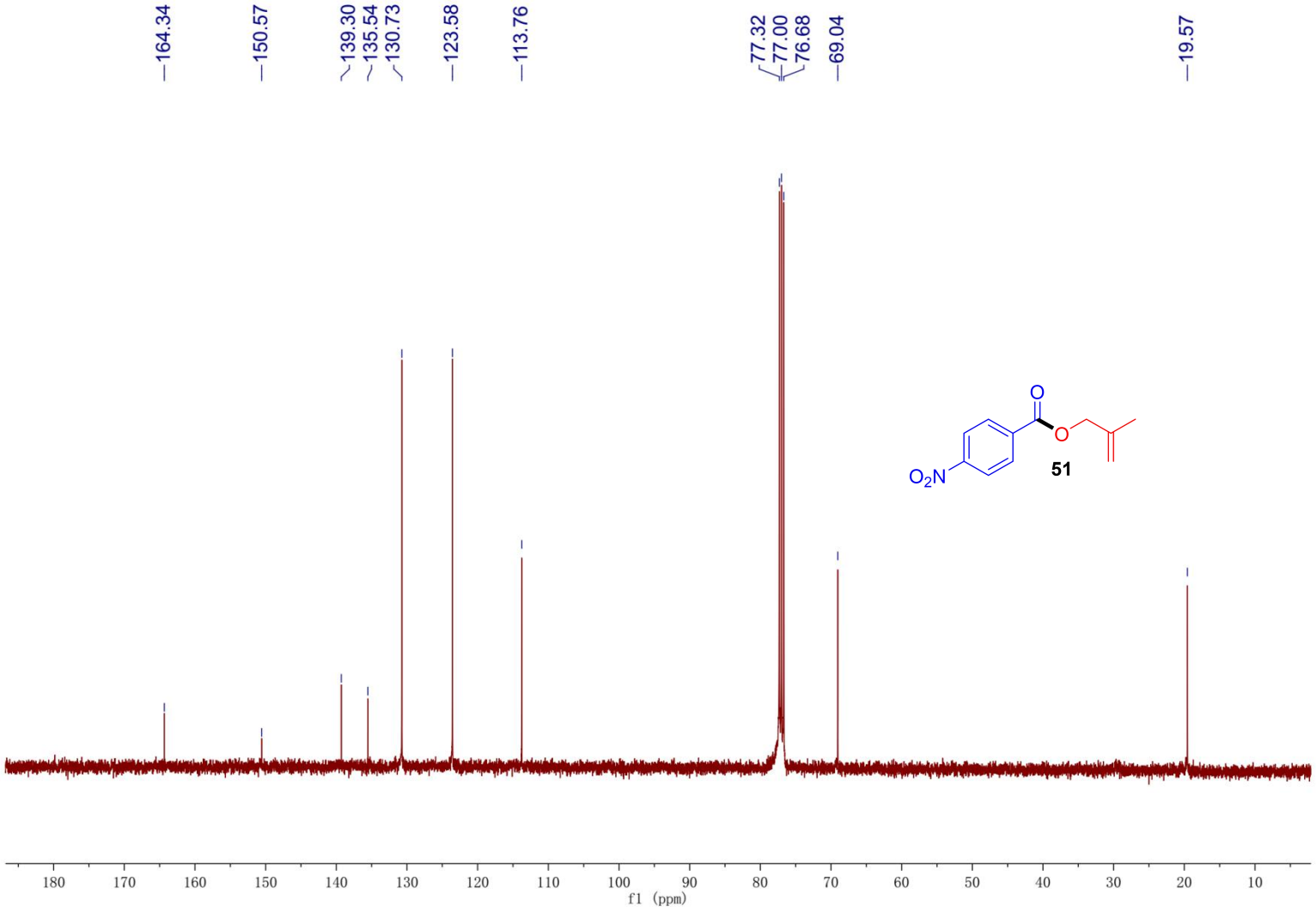
8.25
8.24
8.23
5.09
5.03
4.80
1.86
0.00
O
O
O2N
51
2.00
1.78
2.05
1.92
3.07
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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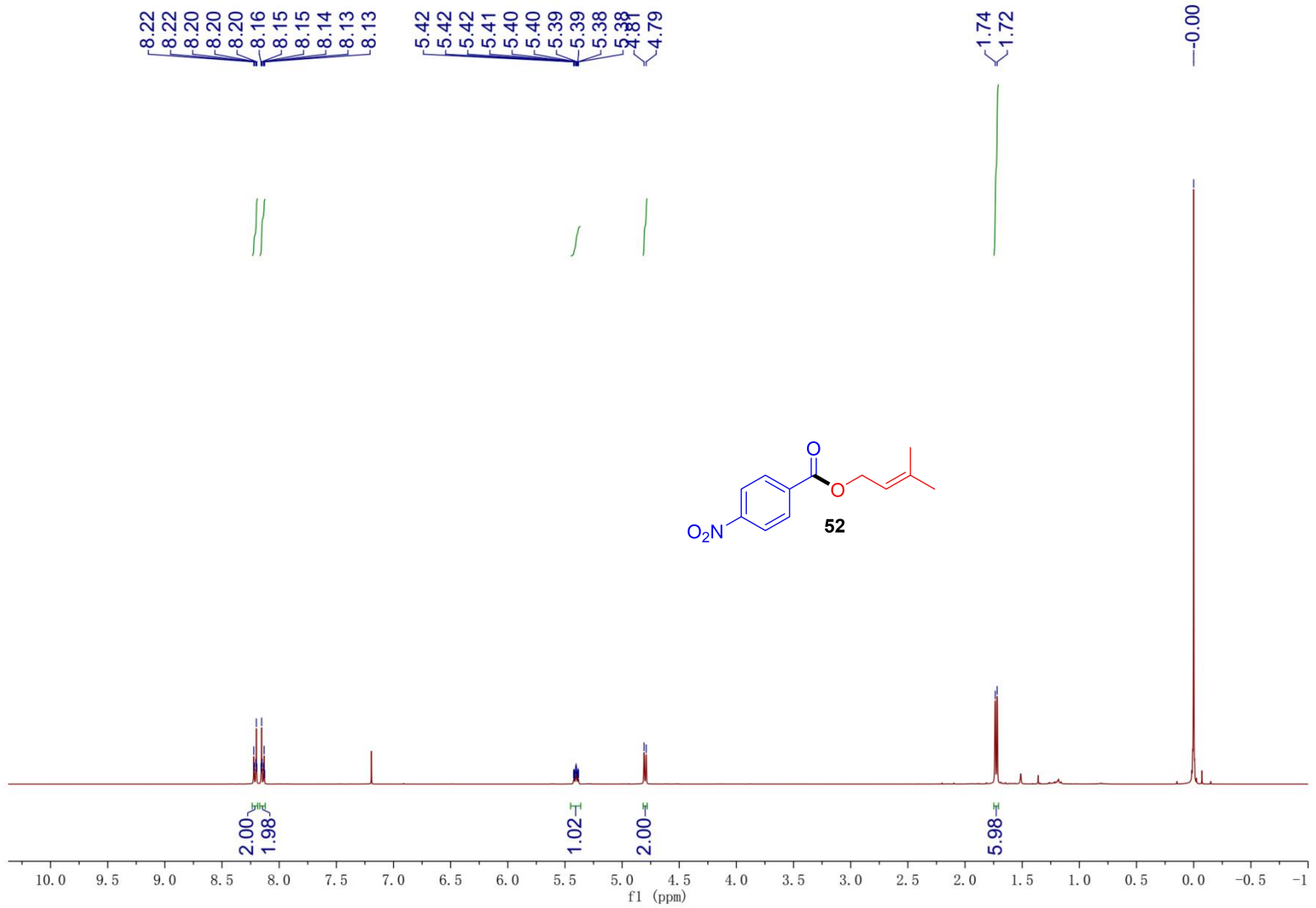
139.30
135.54
130.73
123.58
113.76
77.32
77.00
76.68
69.04
19.57
O
O
O2N
51
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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8.20
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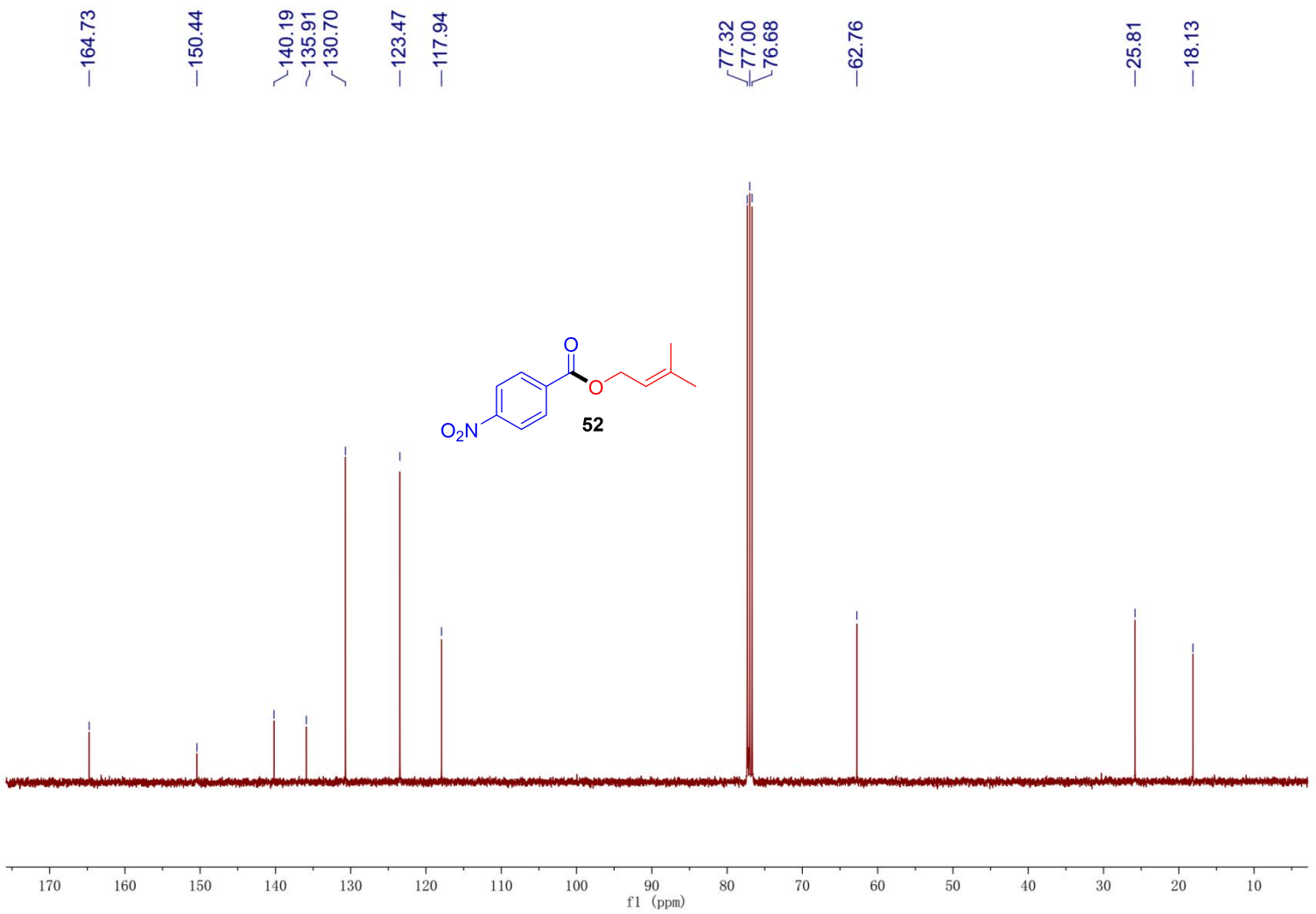
8.15
8.14
8.13
8.13
5.42
5.42
5.42
5.41
5.40
5.40
5.39
5.39
5.38
4.81
4.79
1.74
1.72
0.00
O
O
O2N
52
2.00
1.98
1.02
2.00
5.98
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1
f1 (ppm)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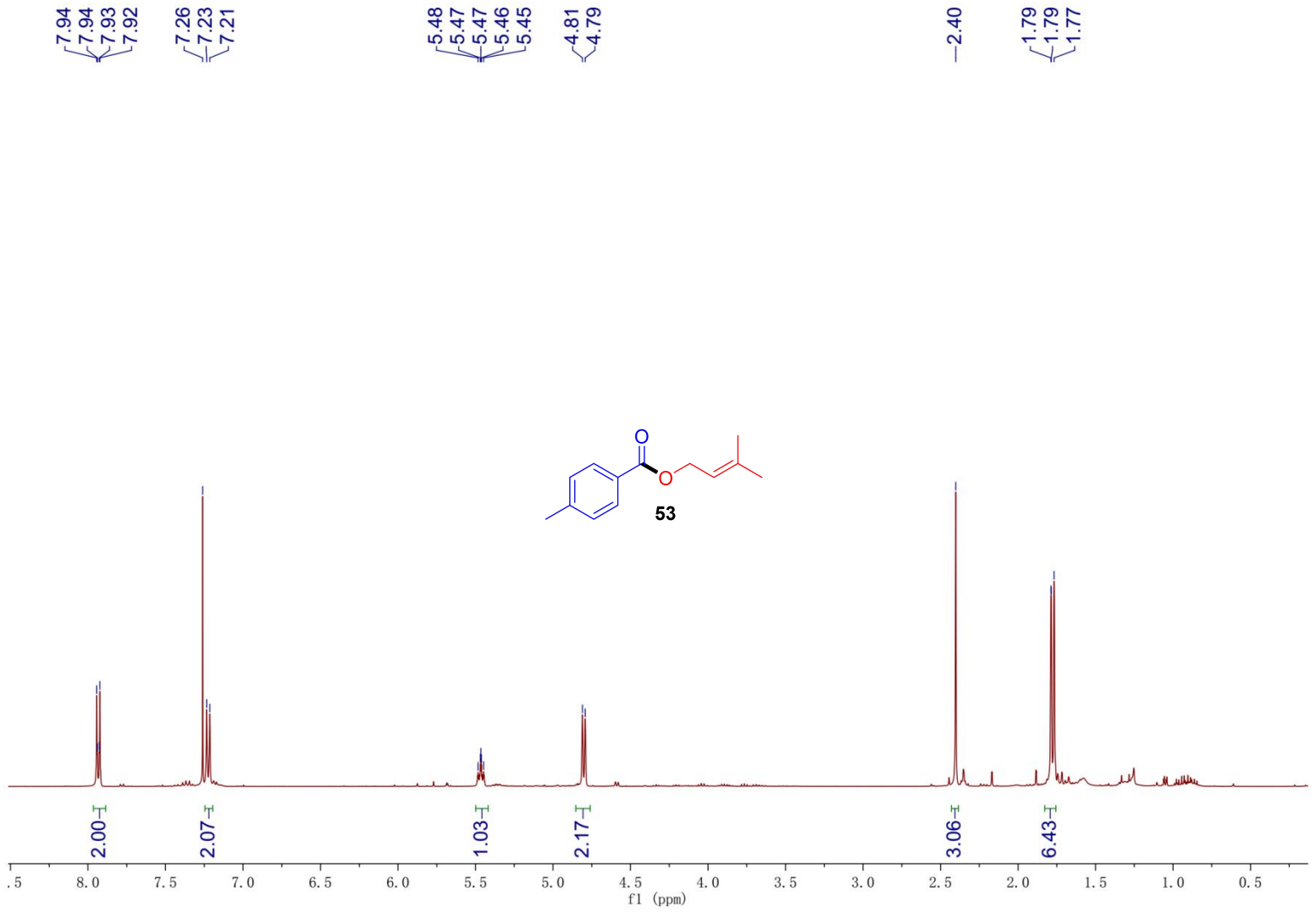
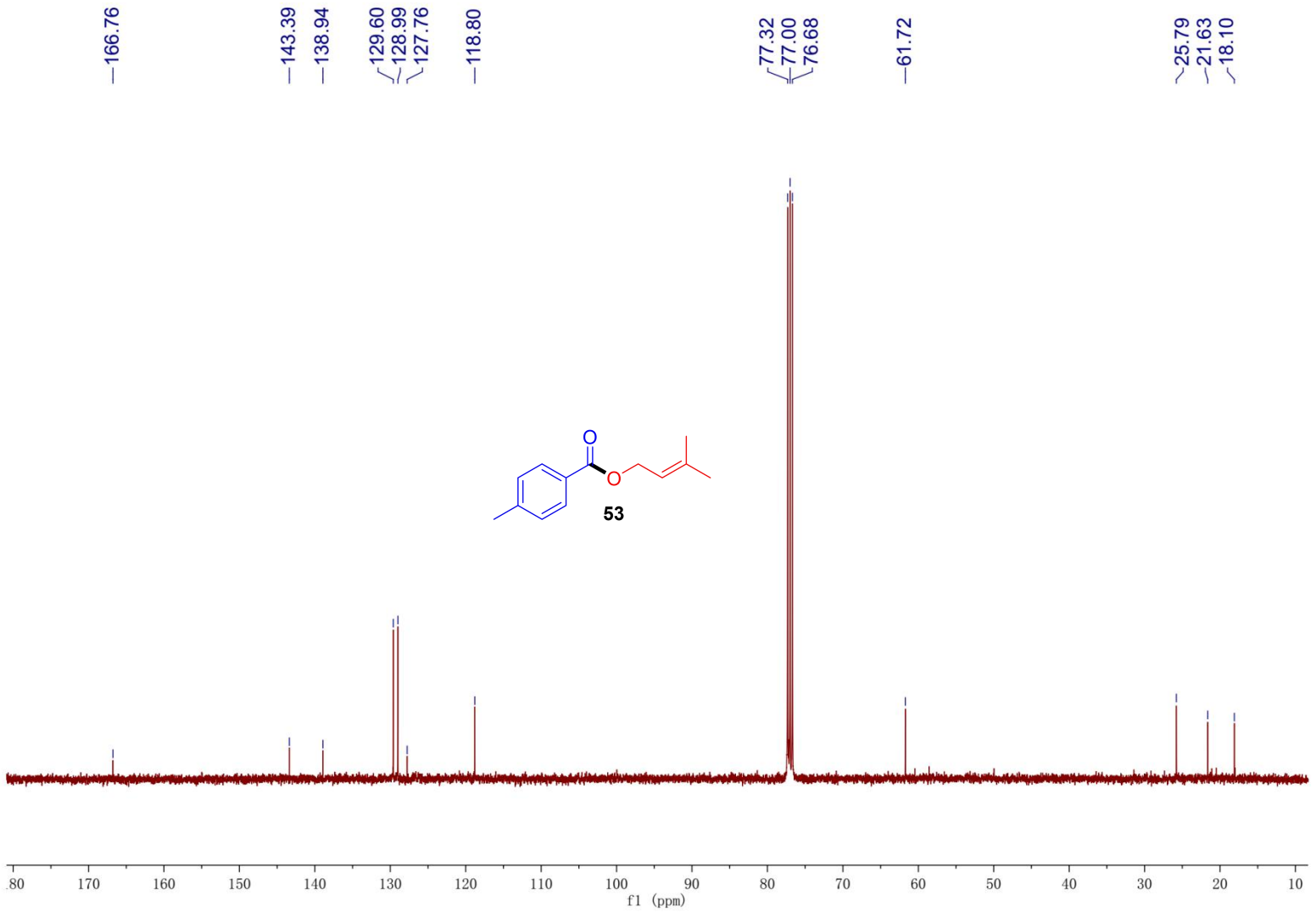
150.44
140.19
135.91
130.70
123.47
117.94
77.32
77.00
76.68
62.76
25.81
18.13
O
O
O2N
52
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


7.94
7.94
7.93
7.92
7.26
7.23
7.21
5.48
5.47
5.47
5.46
5.45
4.81
4.79
2.40
1.79
1.79
1.77
O
O
53
2.00
2.07
1.03
2.17
3.06
6.43
f1 (ppm)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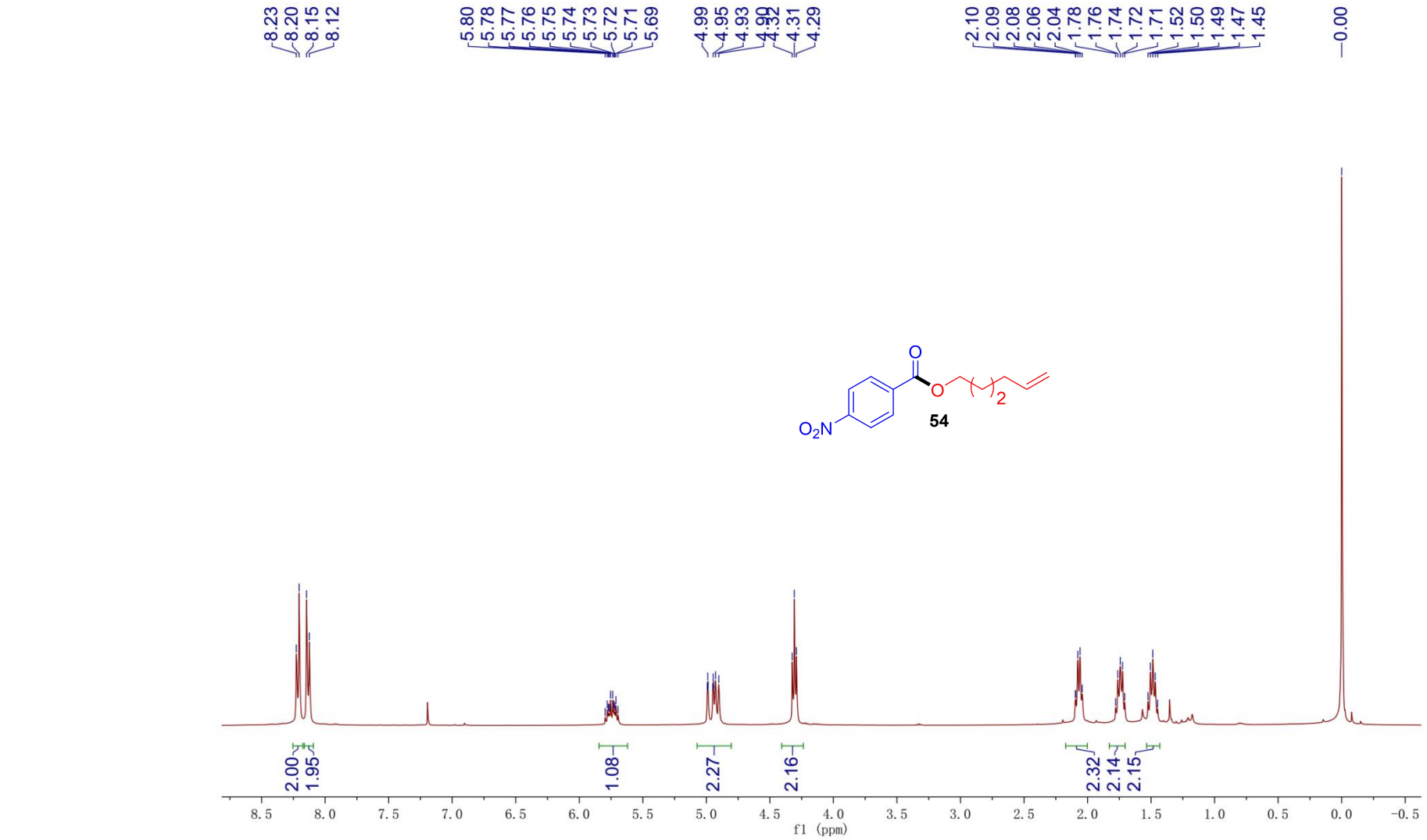
143.39
138.94
129.60
128.99
127.76
118.80
77.32
77.00
76.68
61.72
25.79
21.63
18.10
O
O
53
f1 (ppm)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8.20
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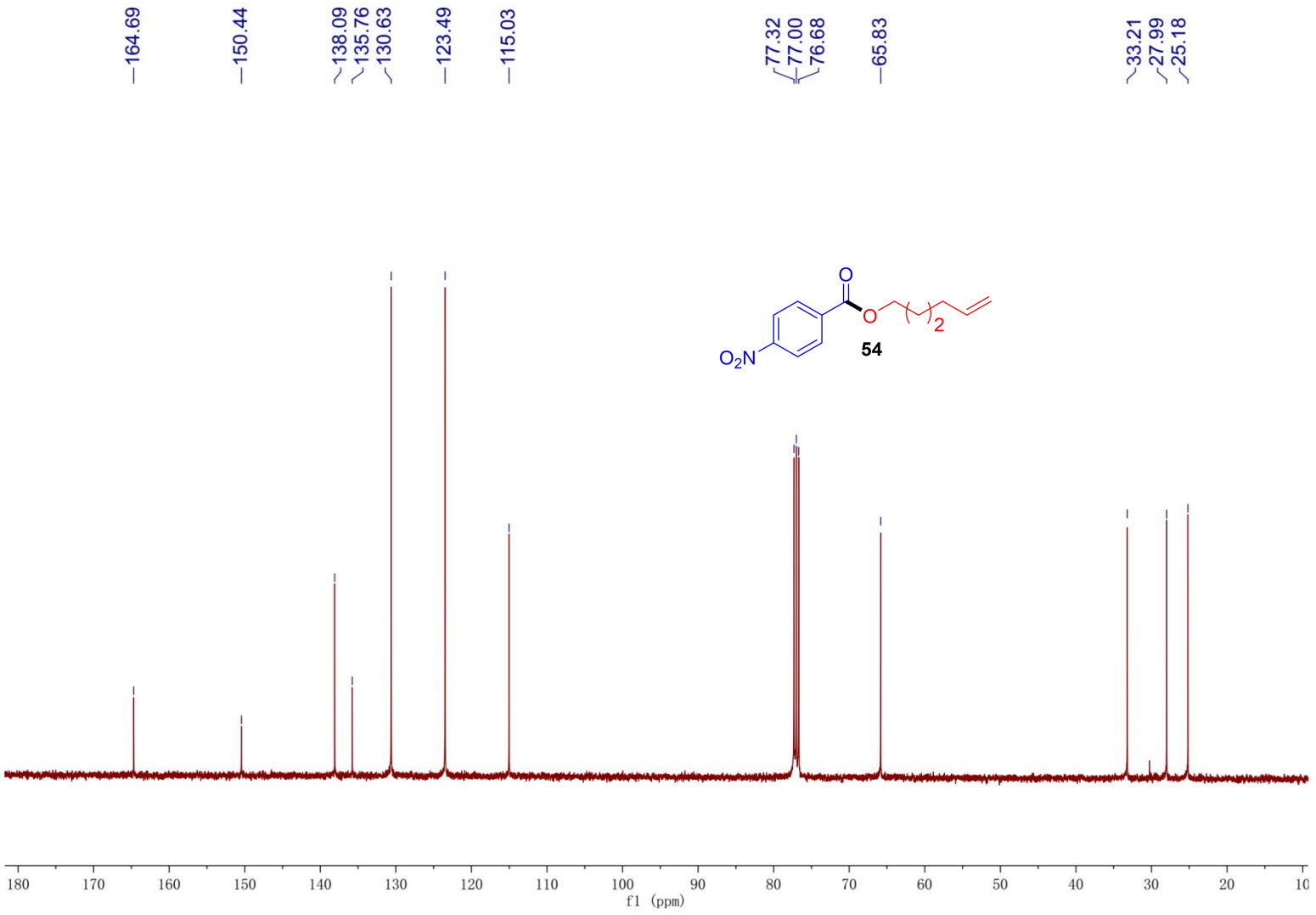
5.78
5.77
5.76
5.75
5.74
5.73
5.72
5.71
5.69
4.99
4.95
4.93
4.32
4.31
4.29
2.10
2.09
2.08
2.06
2.04
1.78
1.76
1.74
1.72
1.71
1.52
1.50
1.49
1.47
1.45
0.00
O
O
2
O2N
54
2.00
1.95
1.08
2.27
2.16
2.32
2.14
2.15
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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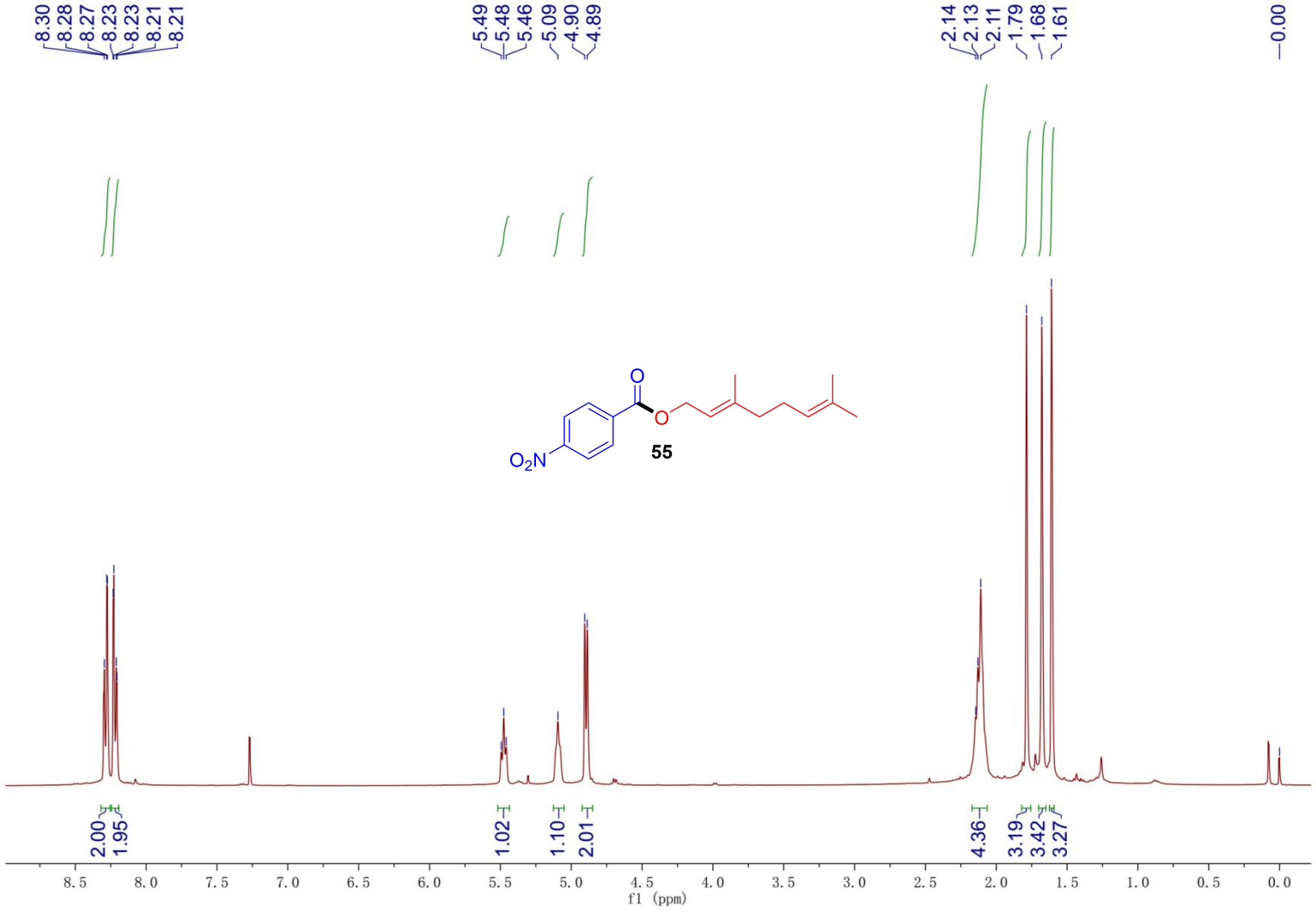
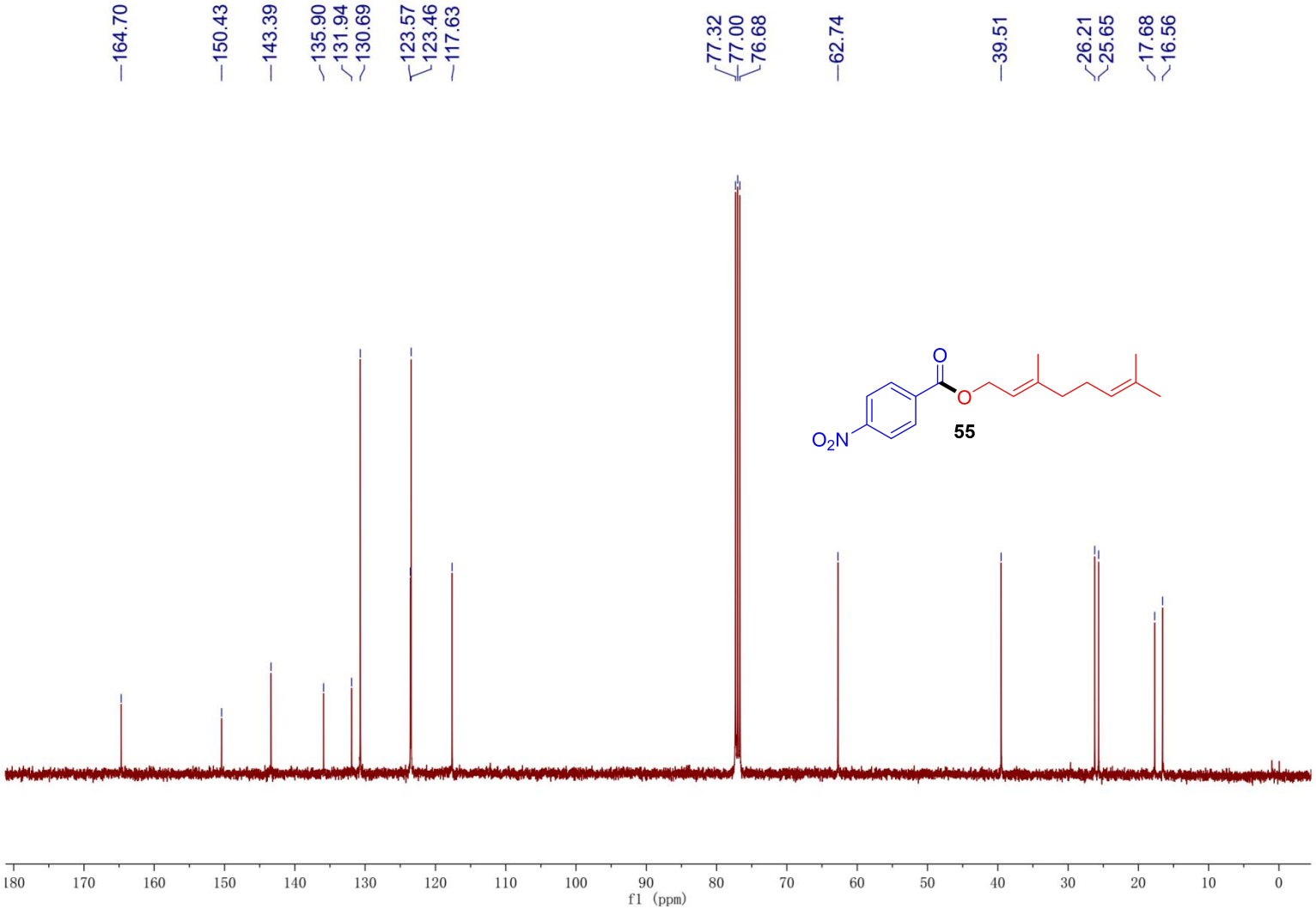
150.44
138.09
135.76
130.63
123.49
115.03
77.32
77.00
76.68
65.83
33.21
27.99
25.18
O
O
2
O2N
54
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


8.30
8.28
8.27
8.23
8.23
8.21
8.21
5.49
5.48
5.46
5.09
4.90
4.89
2.14
2.13
2.11
1.79
1.68
1.61
0.00
O
O
O2N
55
2.00
1.95
1.02
1.10
2.01
4.36
3.19
3.42
3.27
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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143.39
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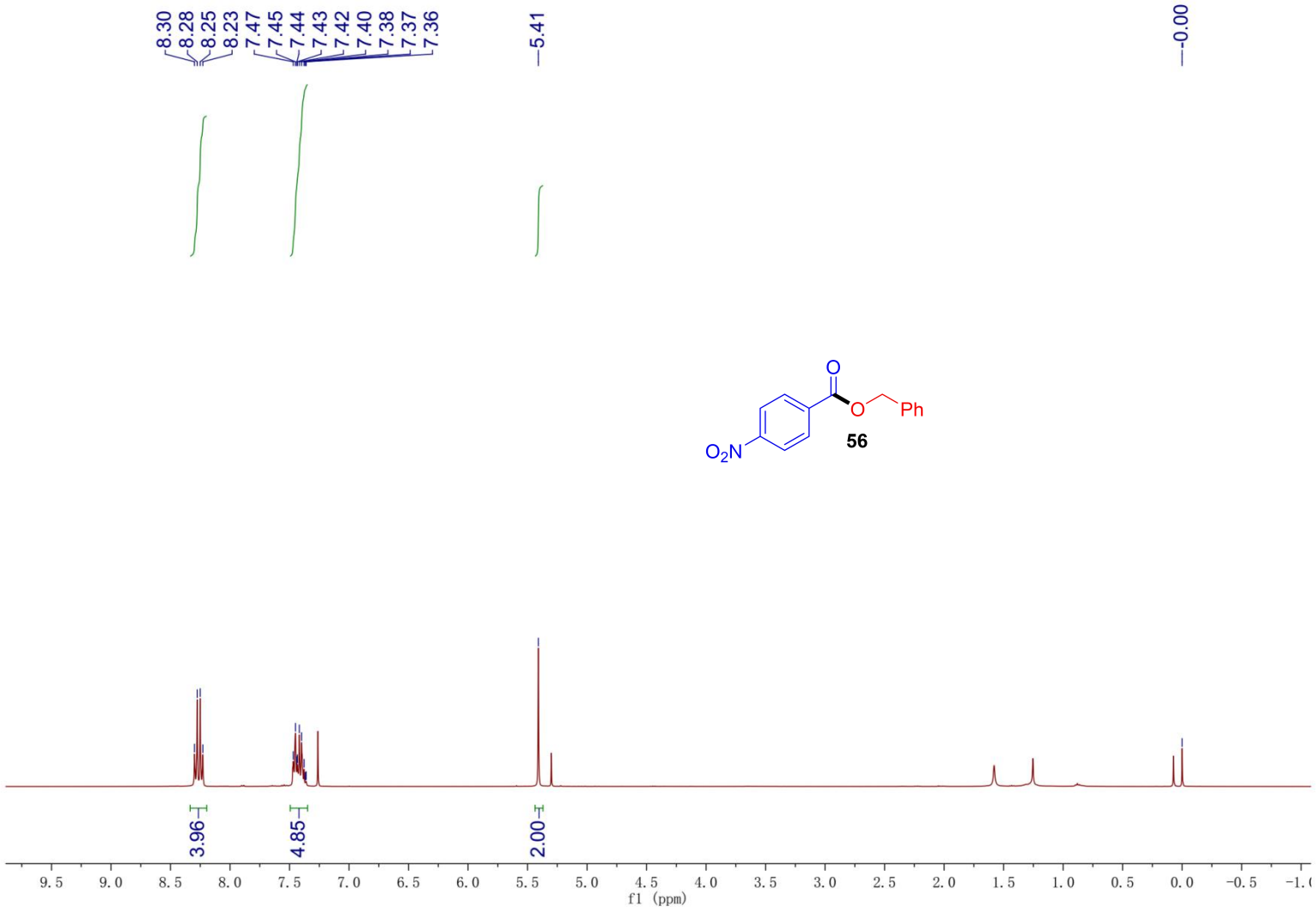
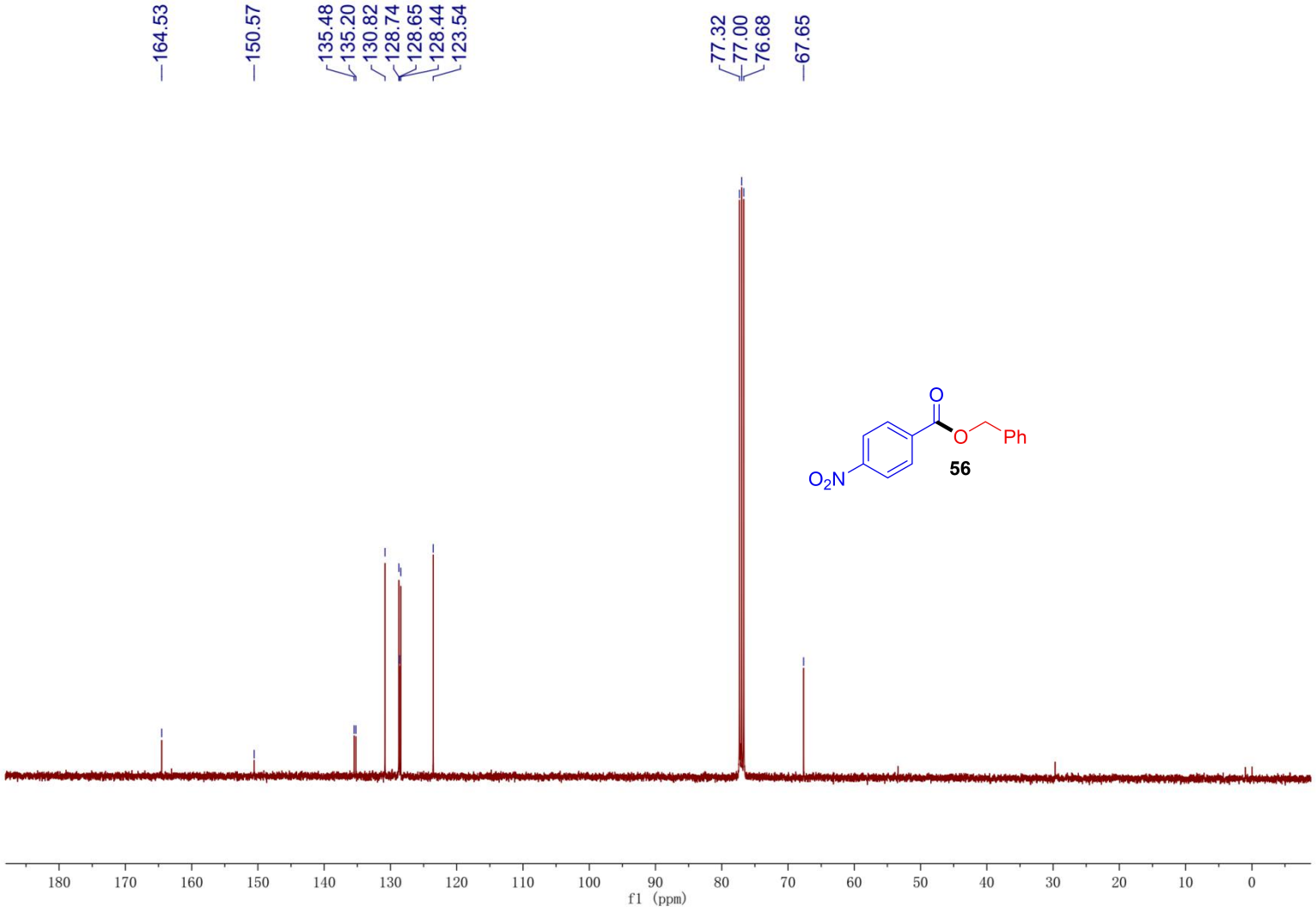
130.69
123.57
123.46
117.63
77.32
77.00
76.68
62.74
39.51
26.21
25.65
17.68
16.56
O
O
O2N
55
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.30
8.28
8.25
8.23
7.47
7.45
7.44
7.43
7.42
7.40
7.38
7.37
7.36
5.41
0.00
O
O
Ph
O2N
56
3.96
4.85
2.00
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)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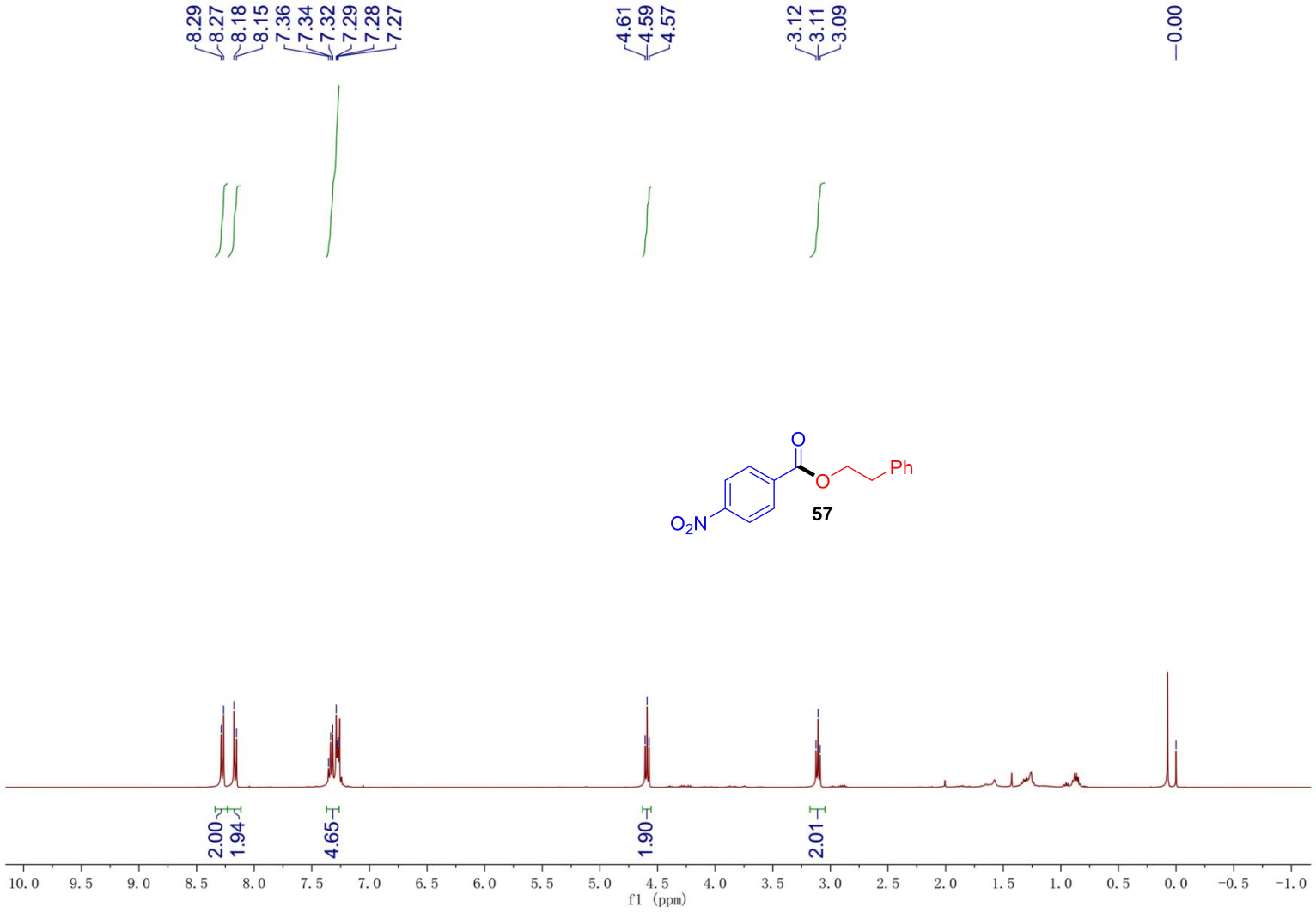
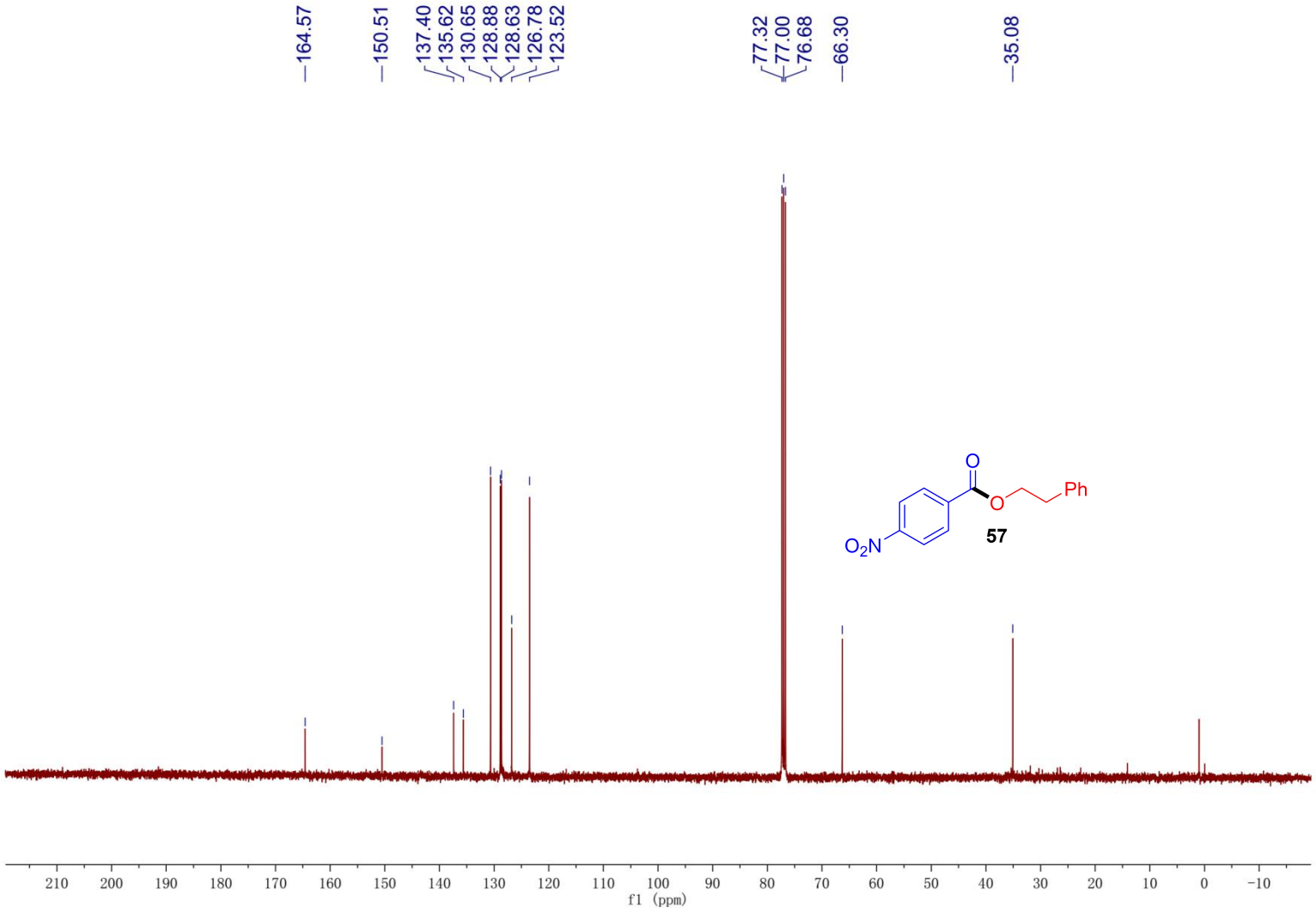
135.20
130.82
128.74
128.65
128.44
123.54
77.32
77.00
76.68
67.65
O
O
Ph
O2N
56
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.29
8.27
8.18
8.15
7.36
7.34
7.32
7.29
7.28
7.27
4.61
4.59
4.57
3.12
3.11
3.09
0.00
O
O
Ph
O2N
57
2.00
1.94
4.65
1.90
2.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)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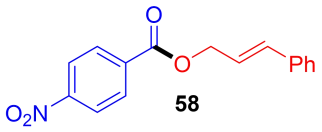
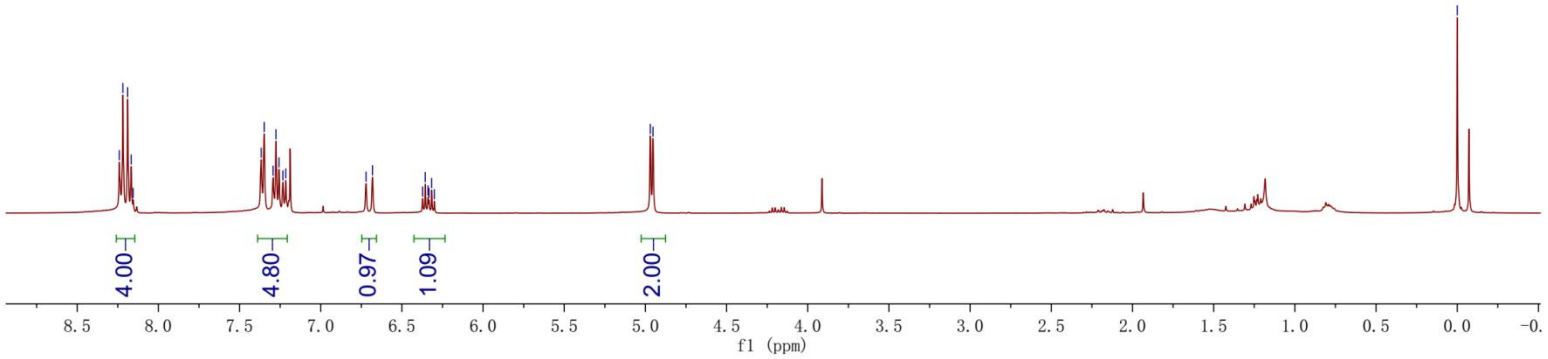
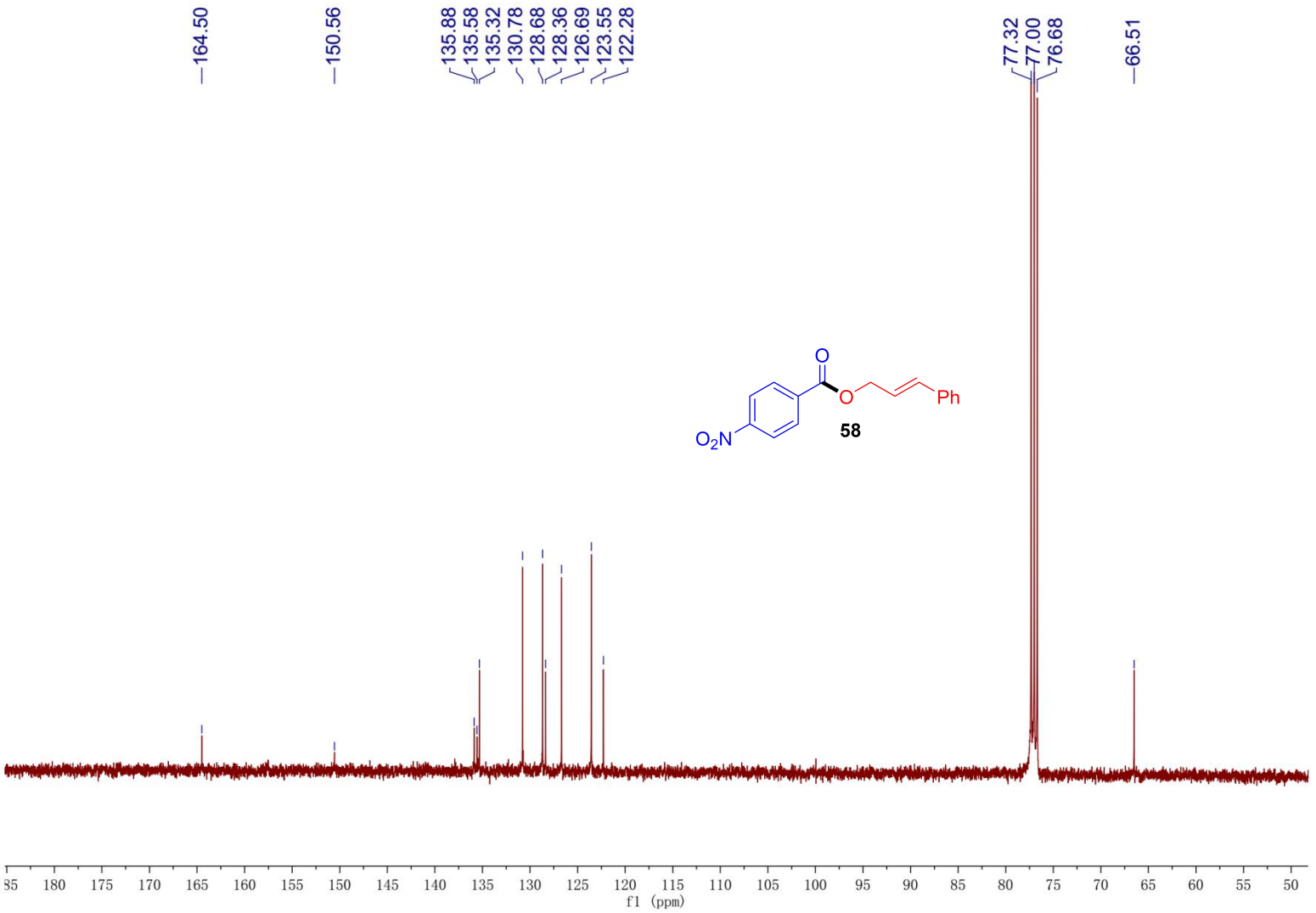
135.62
130.65
128.88
128.63
126.78
123.52
77.32
77.00
76.68
66.30
35.08
O
O
Ph
O2N
57
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.24
8.22
8.19
8.17
8.16
7.37
7.35
7.29
7.28
6.68
6.37
6.36
6.34
6.33
6.32
6.30
4.97
4.95
-0.00


O
O
Ph
O_2N

58


4.00
4.80
0.97
1.09
2.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.
f1 (ppm)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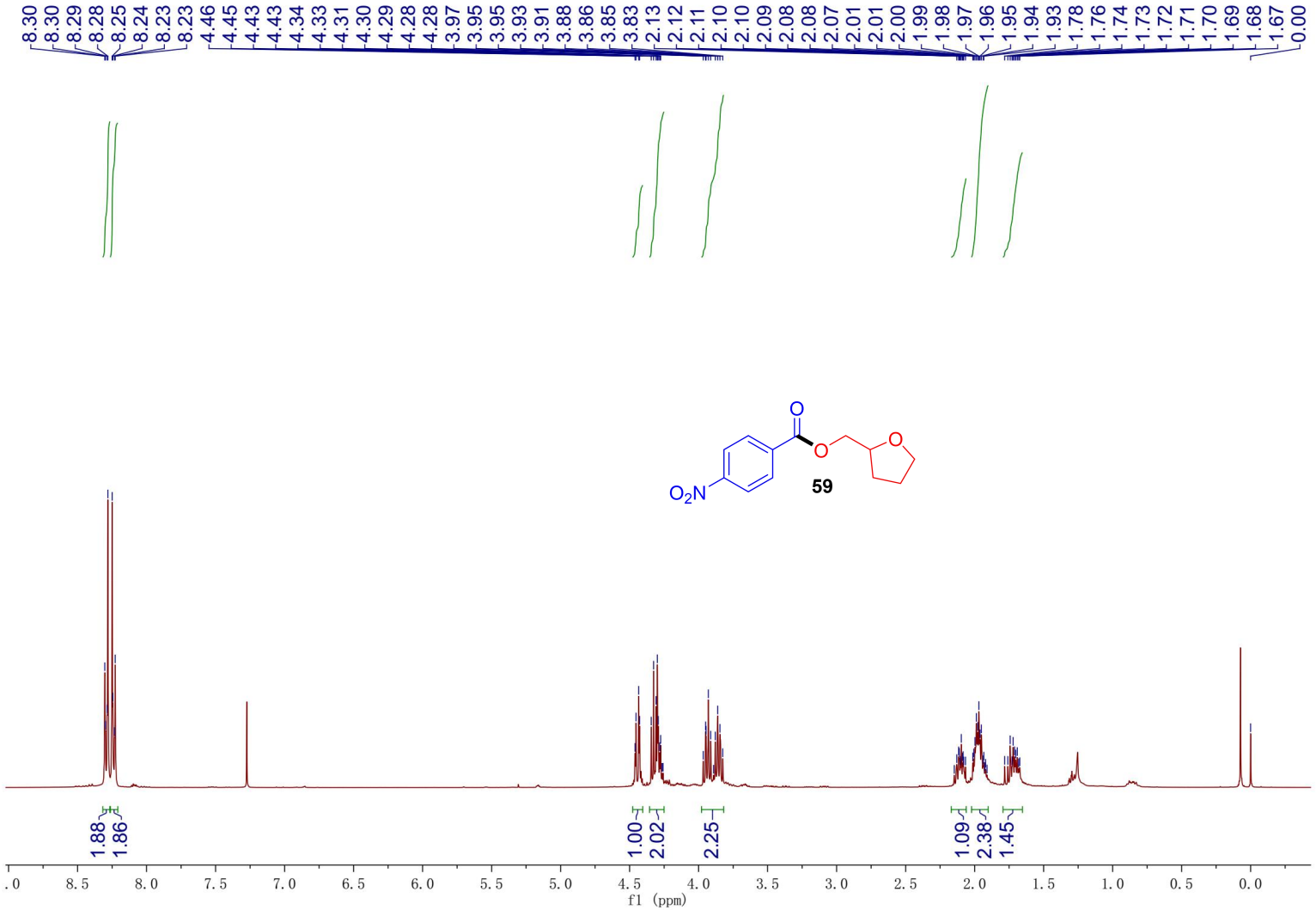
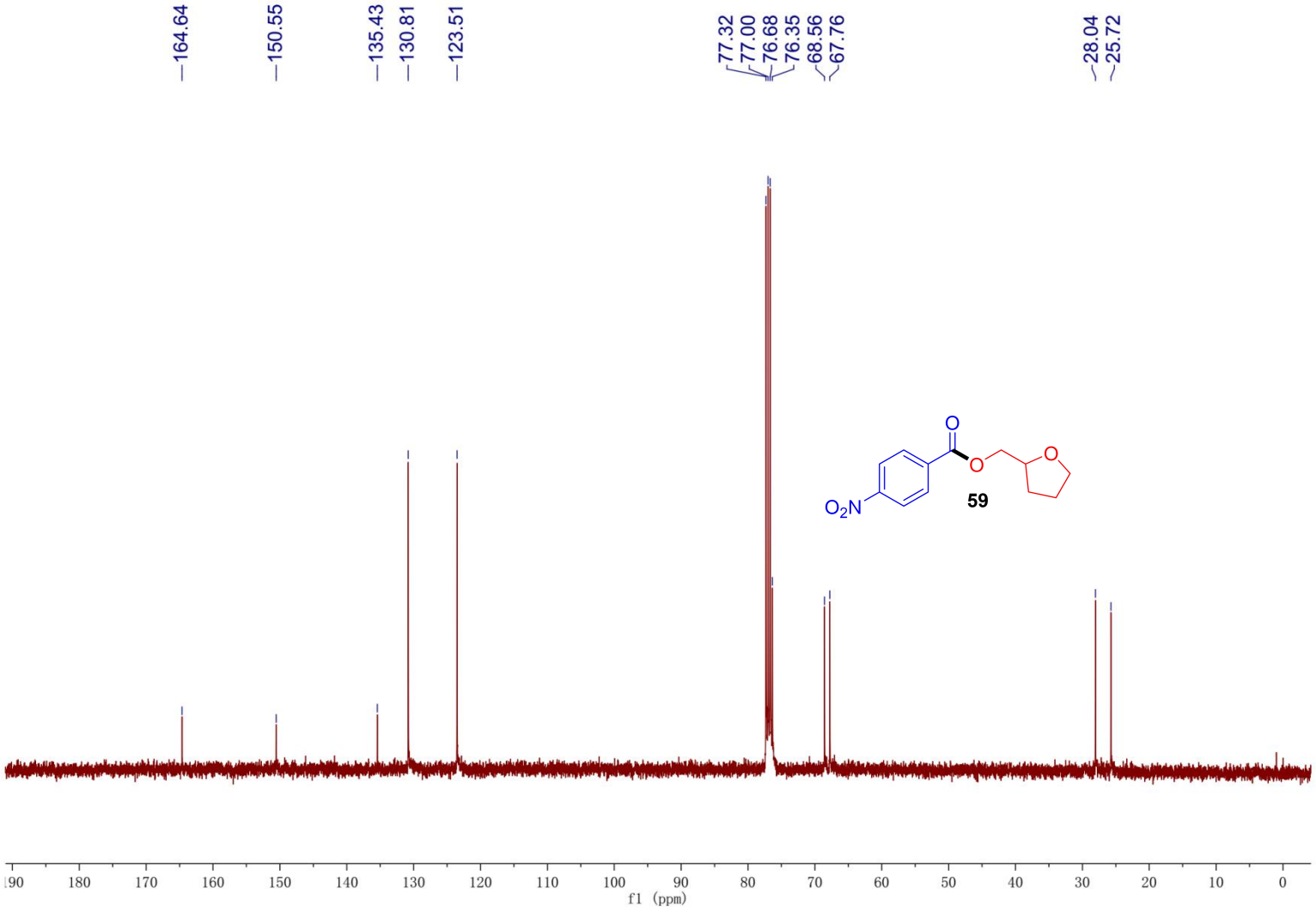
130.78
128.68
128.36
126.69
123.55
122.28
77.32
77.00
76.68
66.51
O
O
Ph
O2N
58
85 180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50
f1 (ppm)


8.30 8.30 8.29 8.28 8.25 8.24 8.23 8.23 4.46 4.45 4.43 4.43 4.34 4.33 4.31 4.30 4.29 4.28 4.28 3.97 3.95 3.95 3.93 3.91 3.88 3.86 3.85 3.83 2.13 2.12 2.11 2.10 2.10 2.09 2.08 2.08 2.07 2.01 2.01 2.00 1.99 1.98 1.97 1.96 1.95 1.94 1.93 1.78 1.76 1.74 1.73 1.72 1.71 1.70 1.69 1.68 1.67 0.00
O
O
O
O2N
59
1.88 1.86 1.00 2.02 2.25 1.09 2.38 1.45
f1 (ppm)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150.55
135.43
130.81
123.51
77.32
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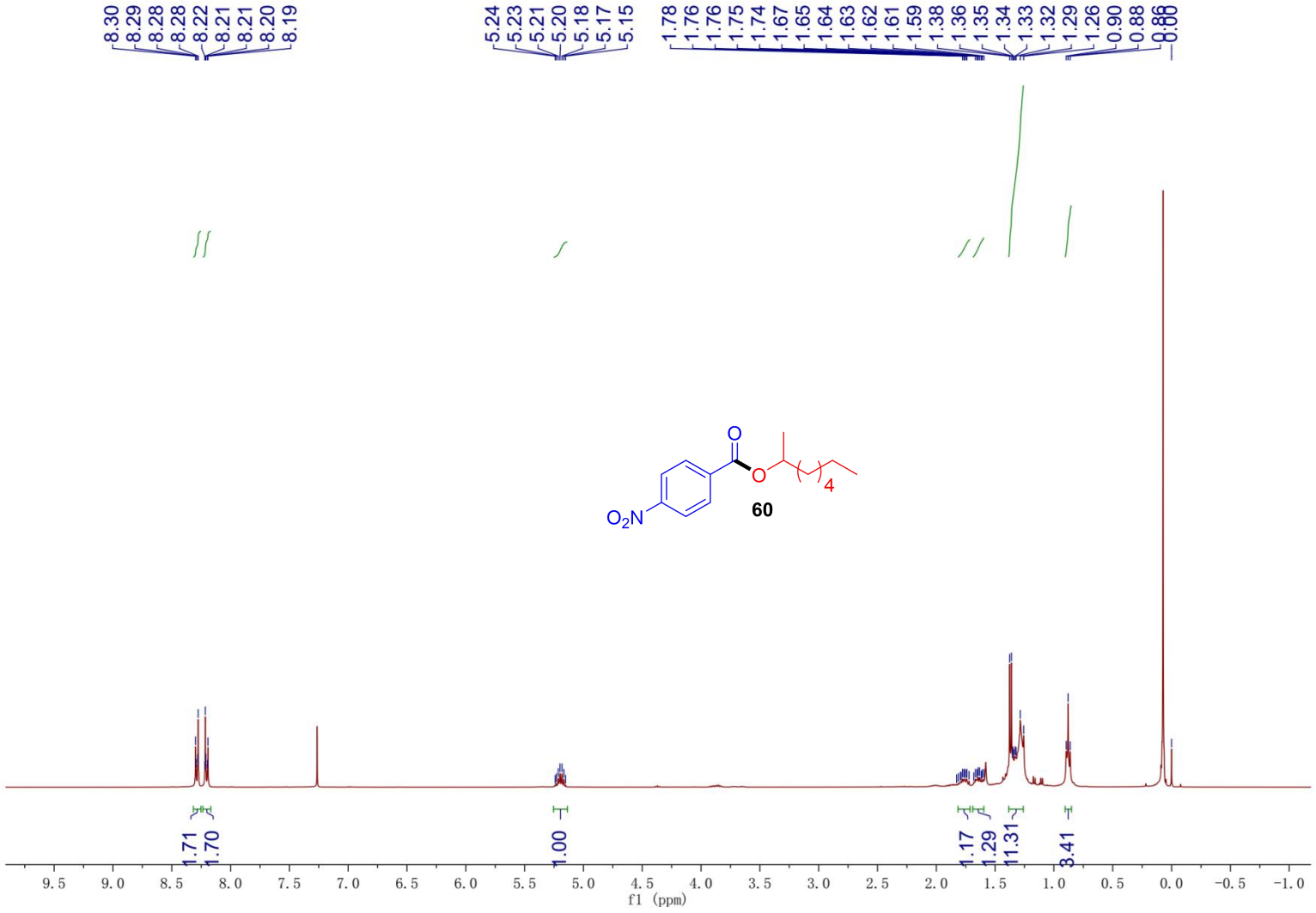
76.68
76.35
68.56
67.76
28.04
25.72
O
O
O
O2N
59
f1 (ppm)


8.30
8.29
8.28
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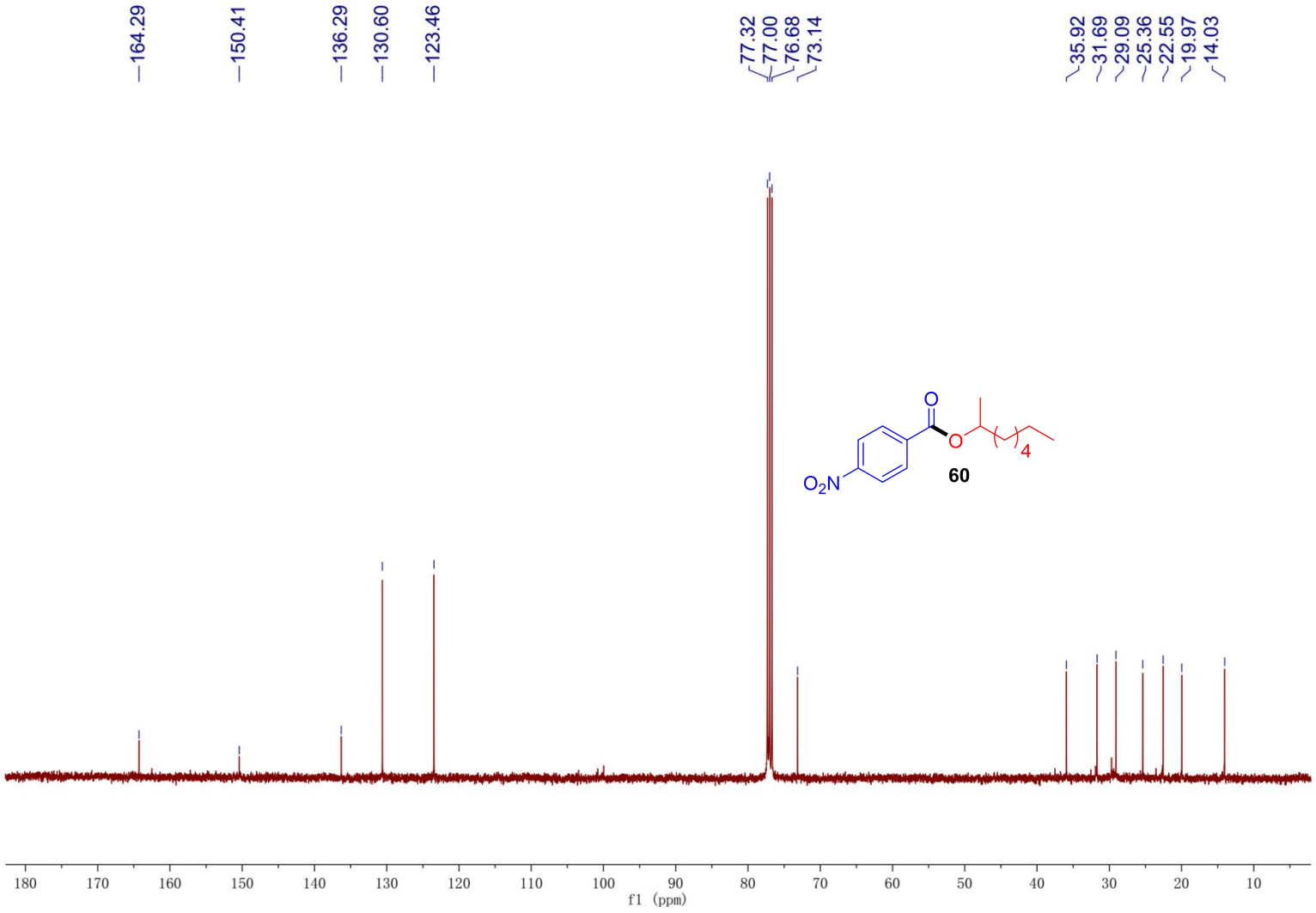
8.21
8.21
8.20
8.19
5.24
5.23
5.21
5.20
5.18
5.17
5.15
1.78
1.76
1.76
1.75
1.74
1.67
1.65
1.64
1.63
1.62
1.61
1.59
1.38
1.36
1.35
1.34
1.33
1.32
1.29
1.26
0.90
0.88
O
O
4
O_2N
60
1.71
1.70
1.00
1.17
1.29
11.31
3.41
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)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123.46
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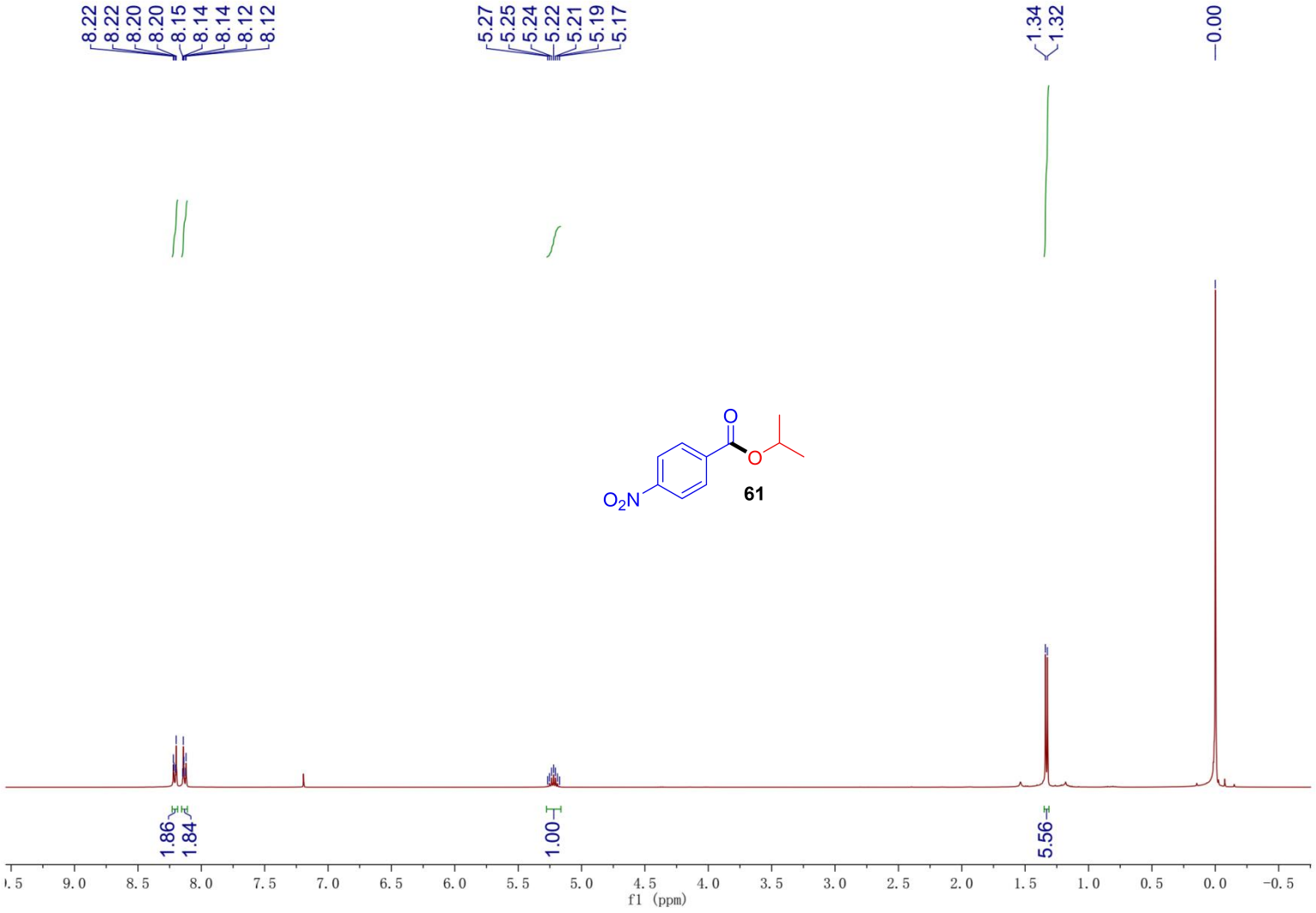
77.00
76.68
73.14
35.92
31.69
29.09
25.36
22.55
19.97
14.03
O
O
4
O2N
60
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


8.22
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8.20
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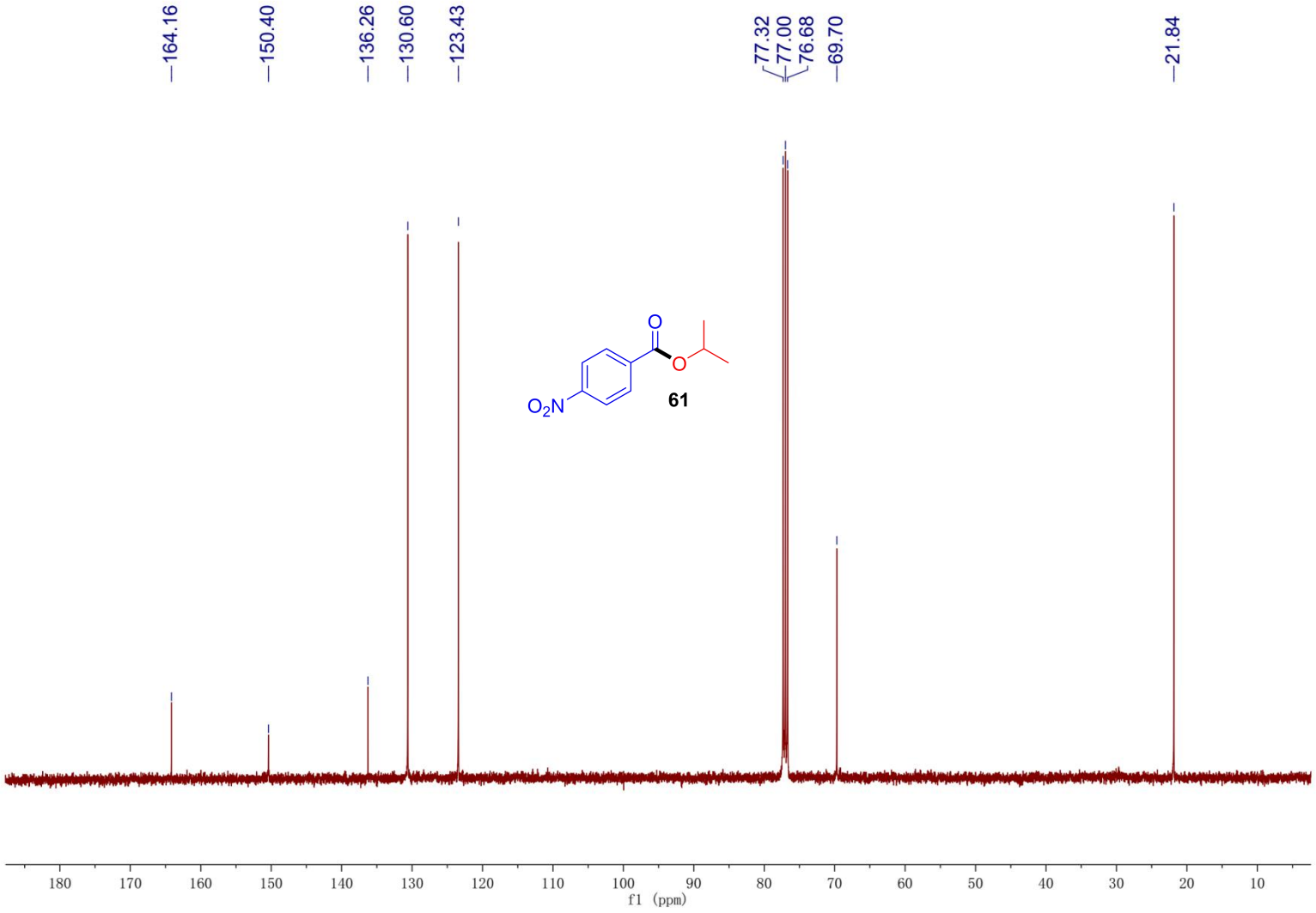
8.14
8.14
8.12
8.12
5.27
5.25
5.24
5.22
5.21
5.19
5.17
1.34
1.32
0.00
O
O
O2N
61
1.86
1.84
1.00
5.56
f1 (ppm)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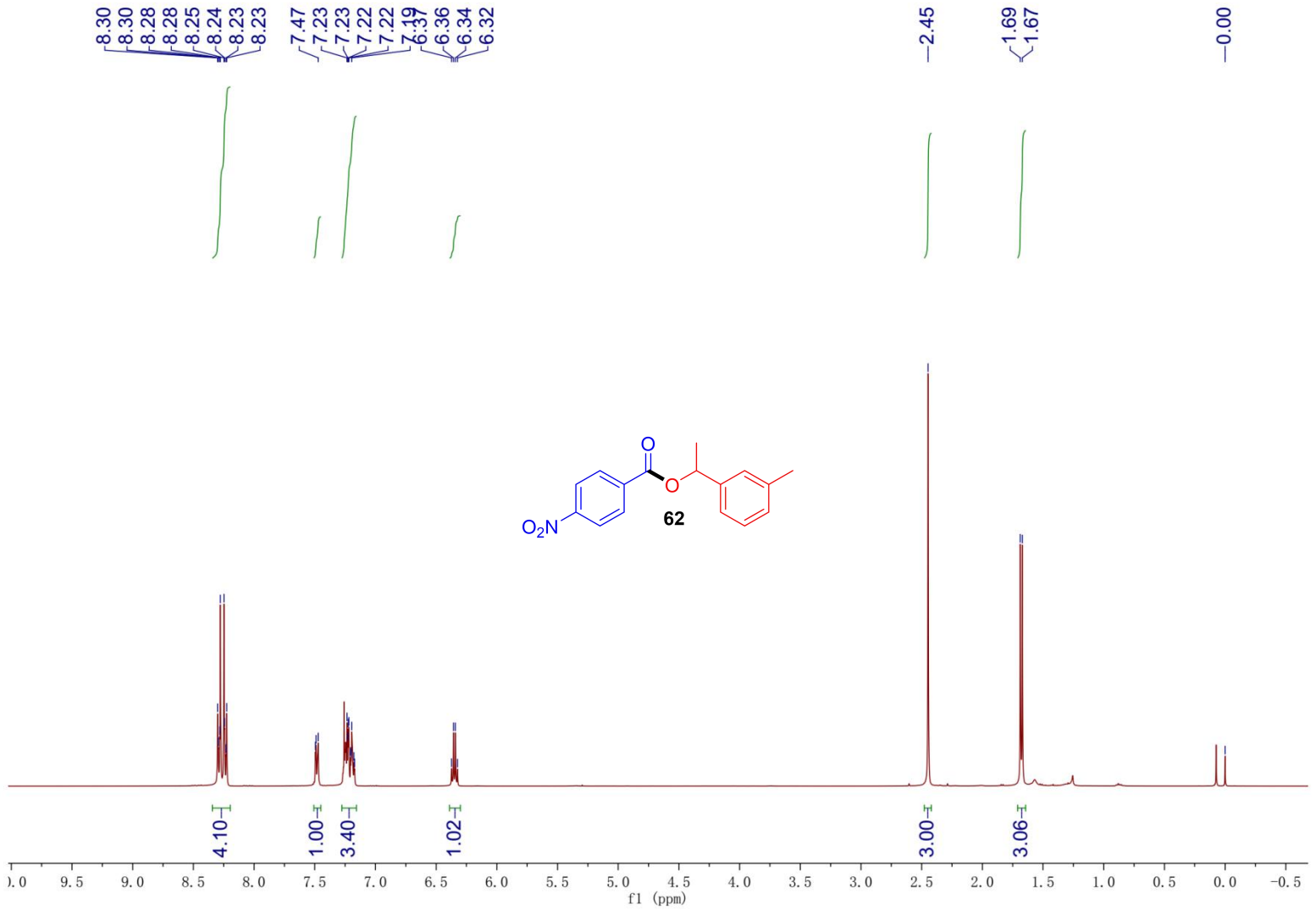
136.26
130.60
123.43
77.32
77.00
76.68
69.70
21.84
O
O
O2N
61
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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8.28
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8.24
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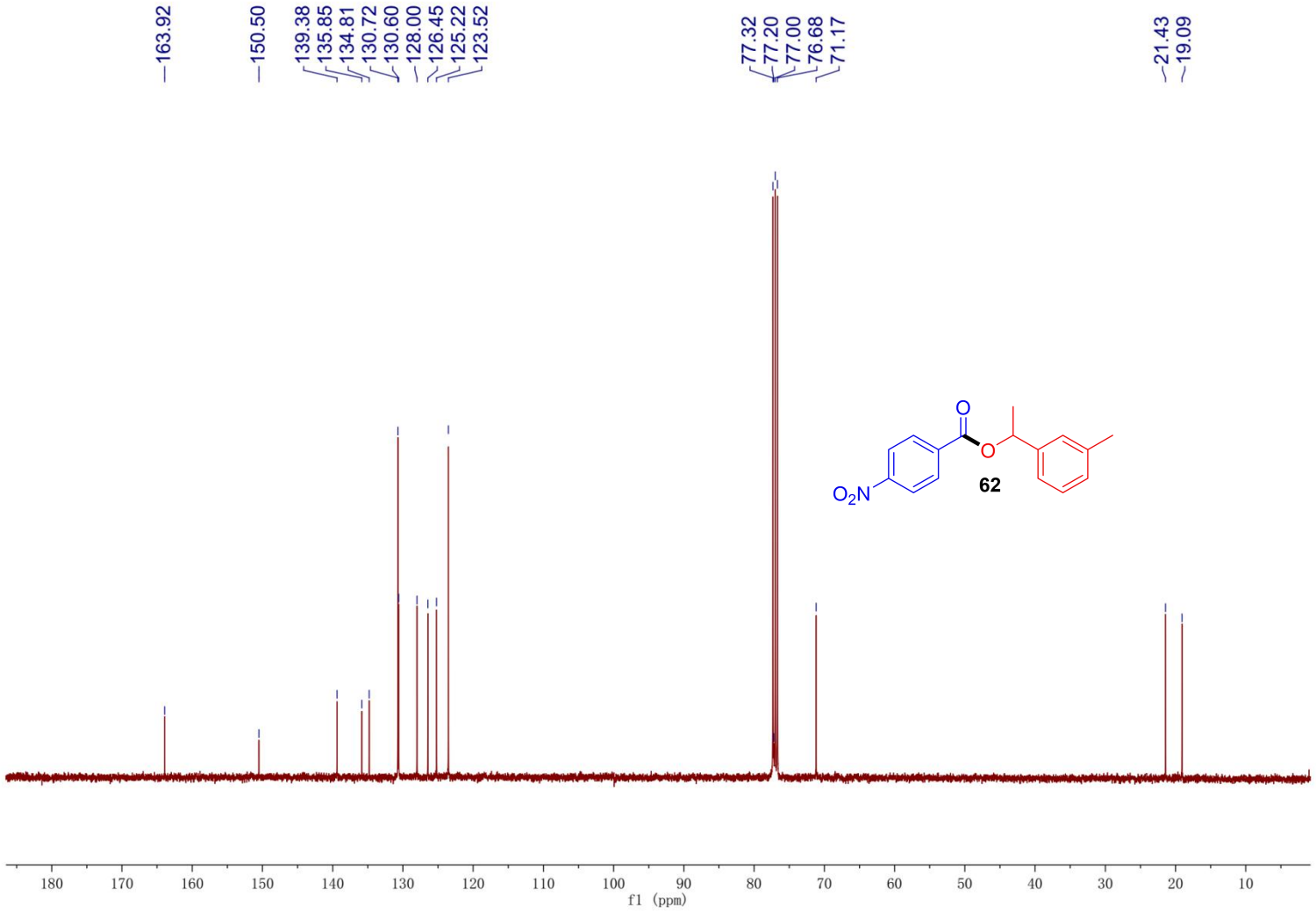
8.23
7.47
7.23
7.23
7.22
7.22
7.19
6.37
6.36
6.34
6.32
2.45
1.69
1.67
0.00
O
O
O2N
62
4.10
1.00
3.40
1.02
3.00
3.06
f1 (ppm)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130.72
130.60
128.00
126.45
125.22
123.52
77.32
77.20
77.00
76.68
71.17
21.43
19.09
O
O
O2N
62
180
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160
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140
130
120
110
100
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80
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60
50
40
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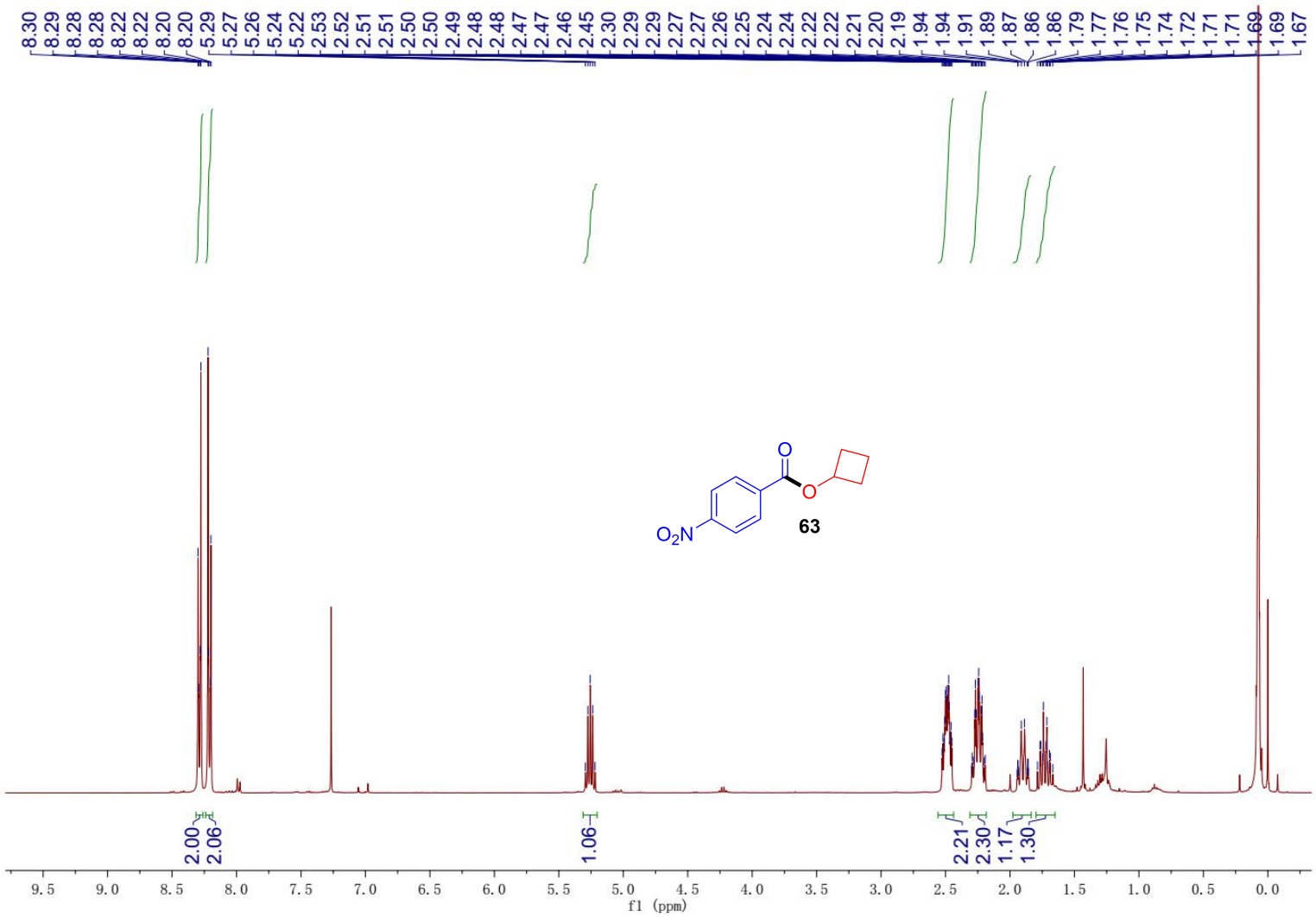
20
10
f1 (ppm)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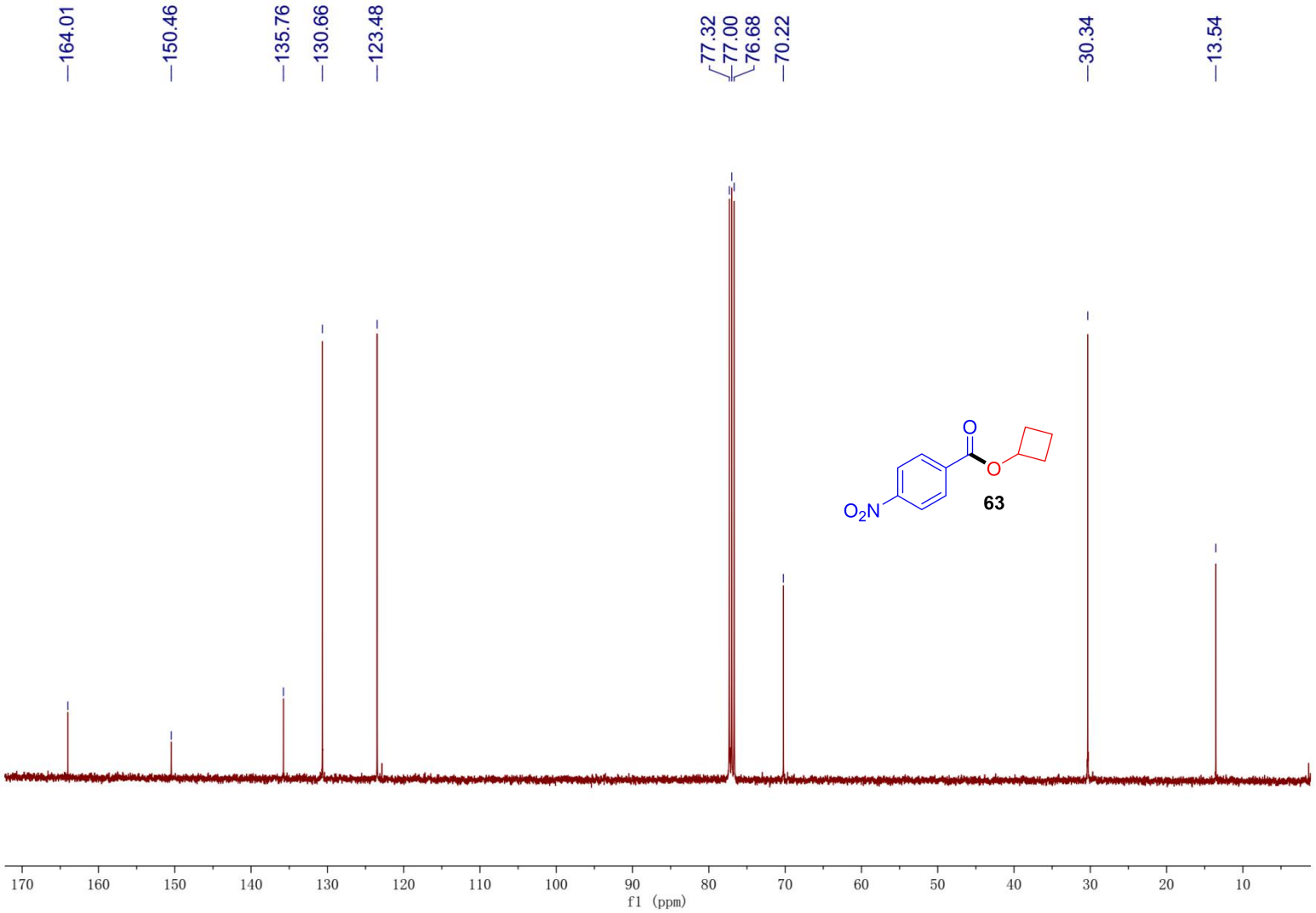
O
O
O2N
63
2.00
2.06
1.06
2.21
2.30
1.17
1.30
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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76.68
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30.34
13.54
O
O
O2N
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140
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120
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100
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80
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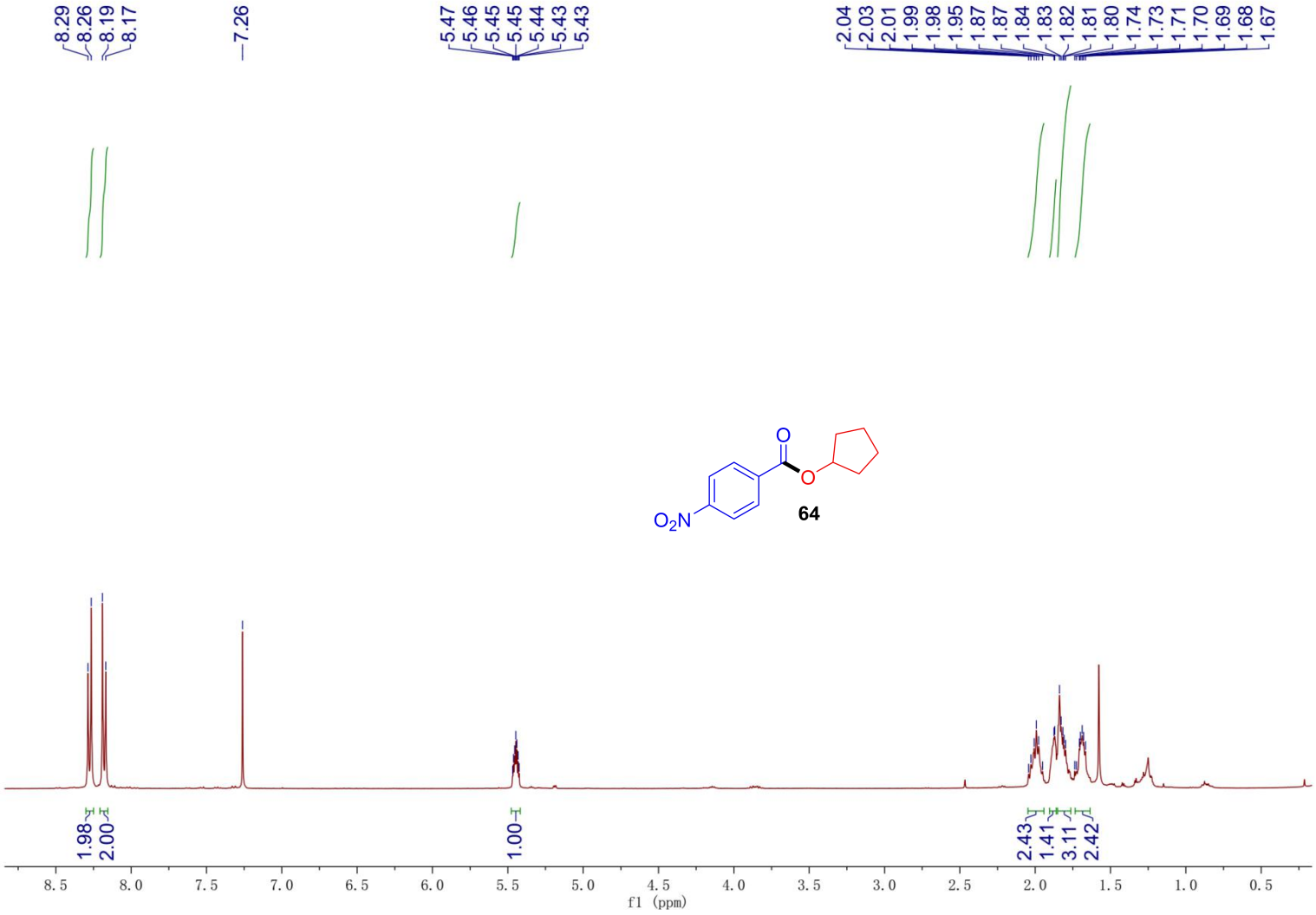
60
50
40
30
20
10
f1 (ppm)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5.46
5.45
5.45
5.44
5.43
5.43
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2.03
2.01
1.99
1.98
1.95
1.87
1.87
1.84
1.83
1.82
1.81
1.80
1.74
1.73
1.71
1.70
1.69
1.68
1.67
O
O
O2N
64
1.98
2.00
1.00
2.43
1.41
3.11
2.42
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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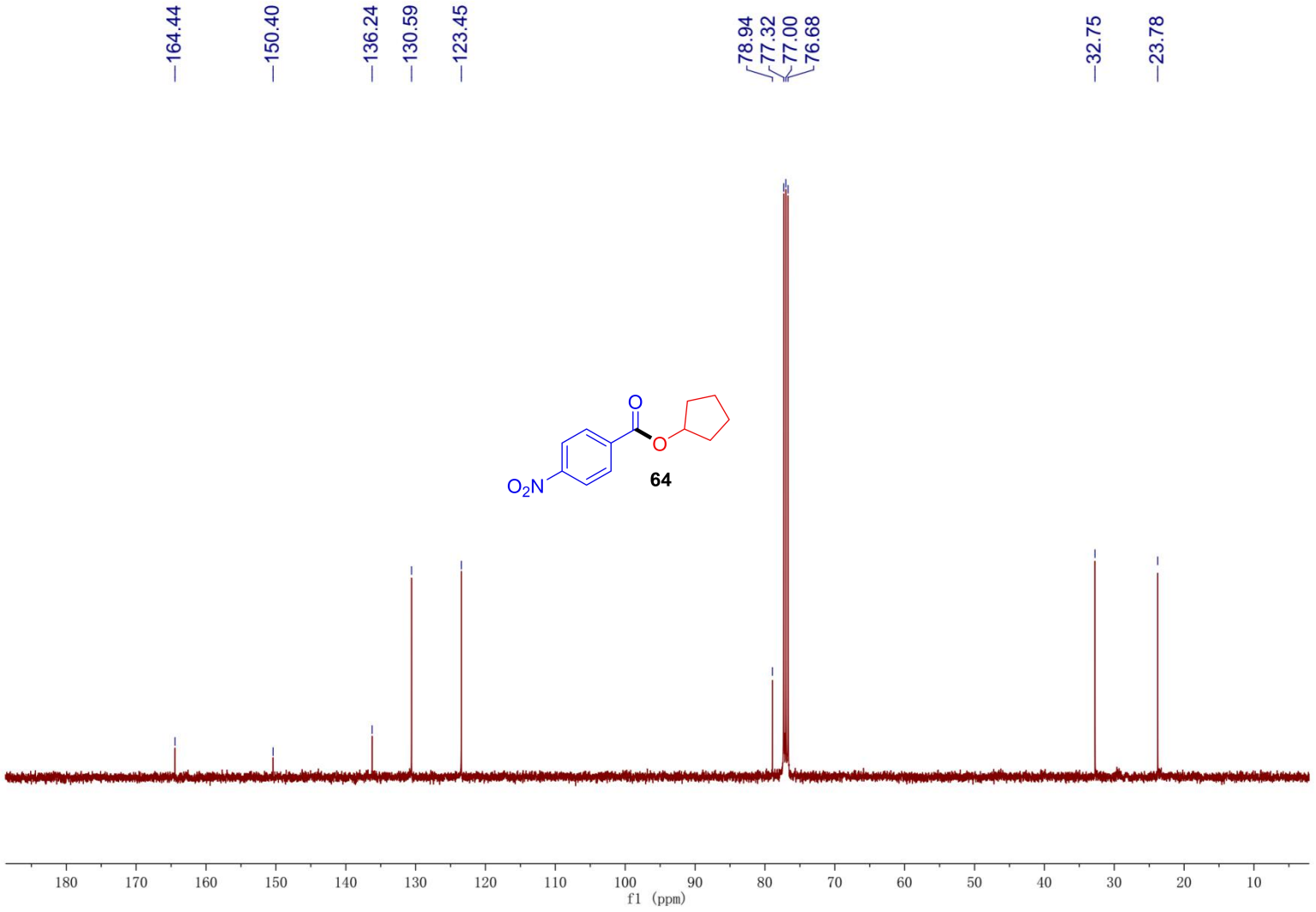
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)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77.00
76.68
32.75
23.78
O
O
O2N
64
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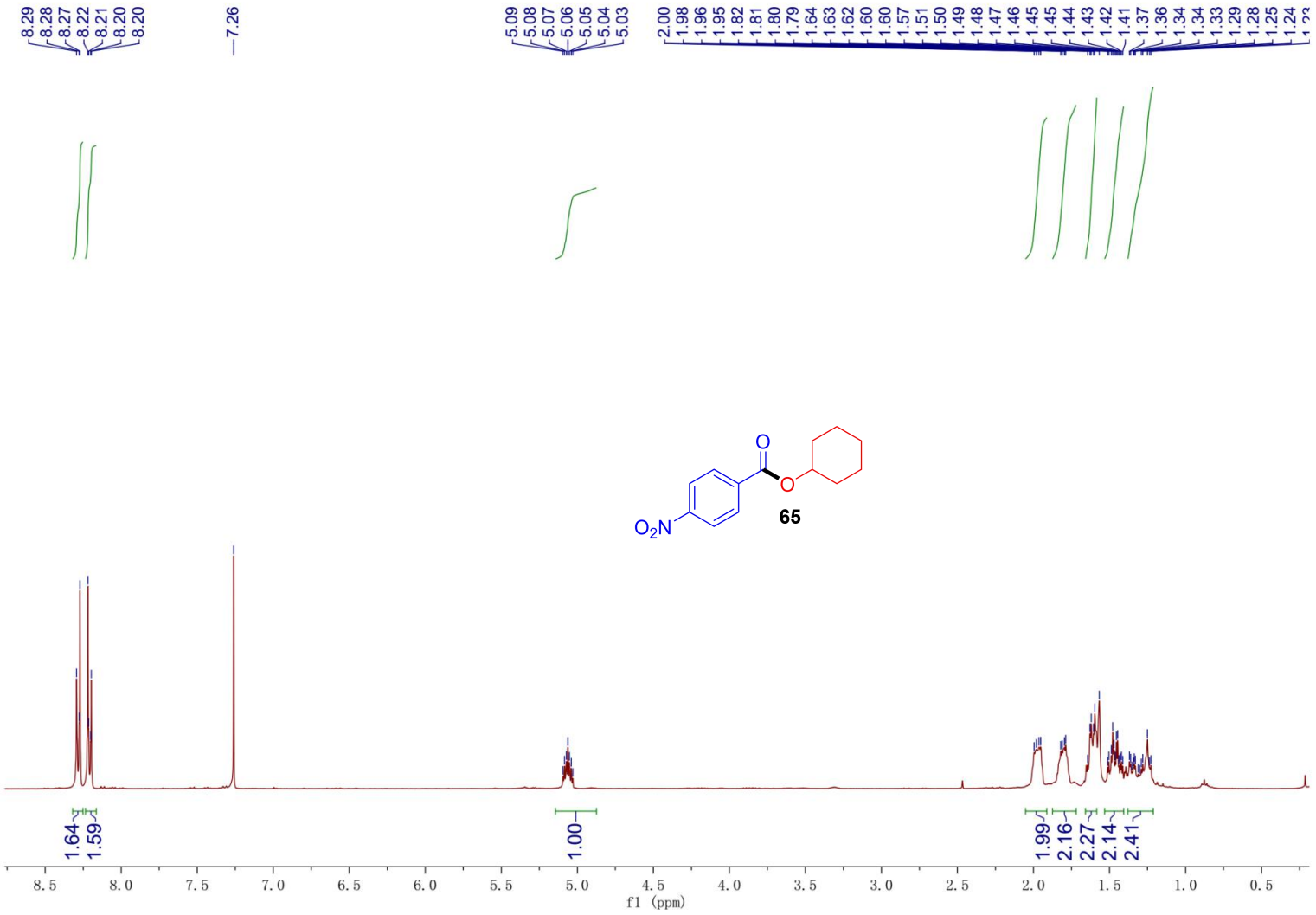
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


8.29
8.28
8.27
8.22
8.21
8.20
8.20
7.26
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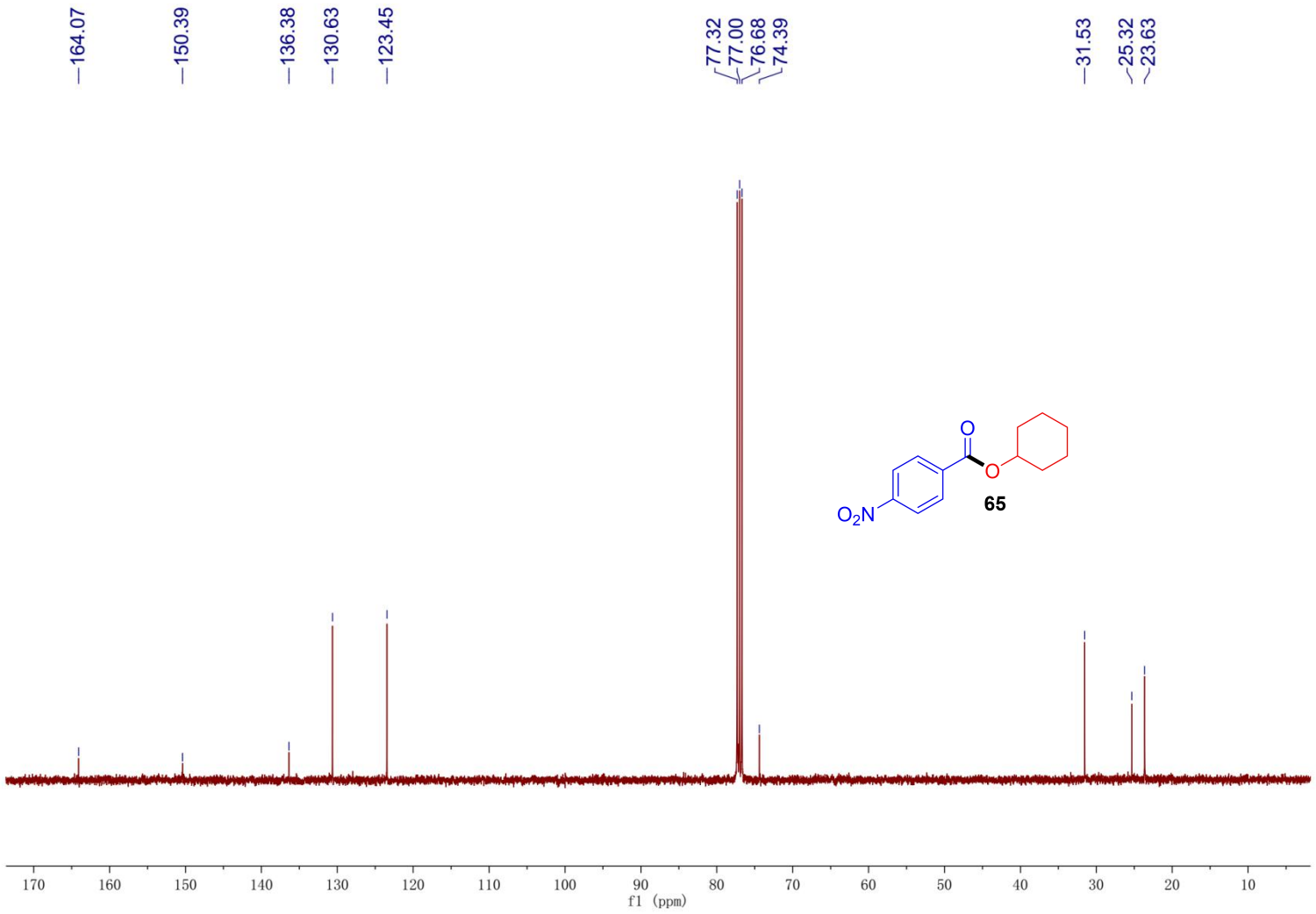
5.08
5.07
5.06
5.05
5.04
5.03
2.00
1.98
1.96
1.95
1.82
1.81
1.80
1.79
1.64
1.63
1.62
1.60
1.60
1.57
1.51
1.50
1.49
1.48
1.47
1.46
1.45
1.45
1.44
1.43
1.42
1.41
1.37
1.36
1.34
1.34
1.33
1.29
1.28
1.25
1.24
O
O
O2N
65
1.64
1.59
1.00
1.99
2.16
2.27
2.14
2.41
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)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123.45
77.32
77.00
76.68
74.39
31.53
25.32
23.63
O
O
O2N
65
170
160
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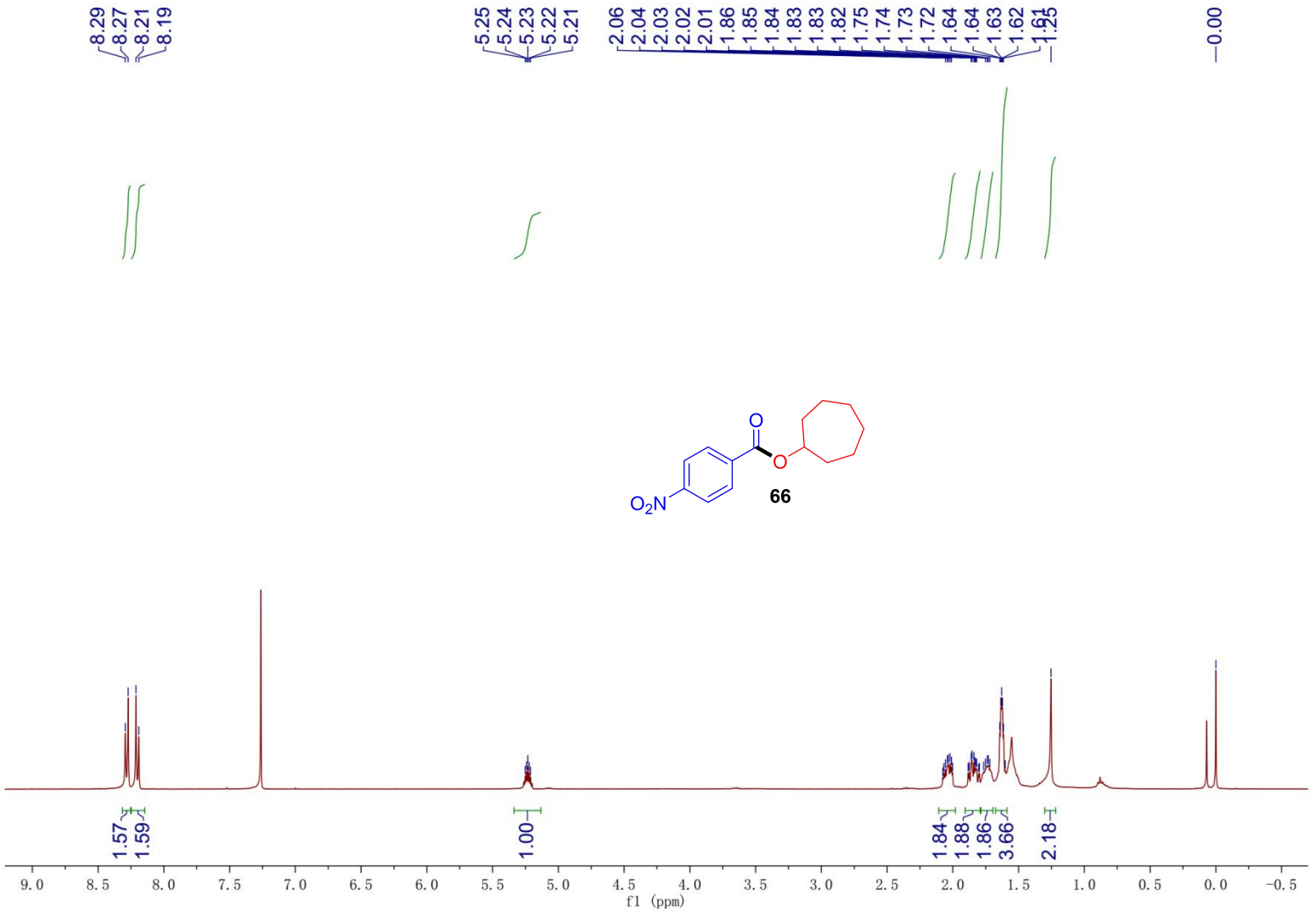
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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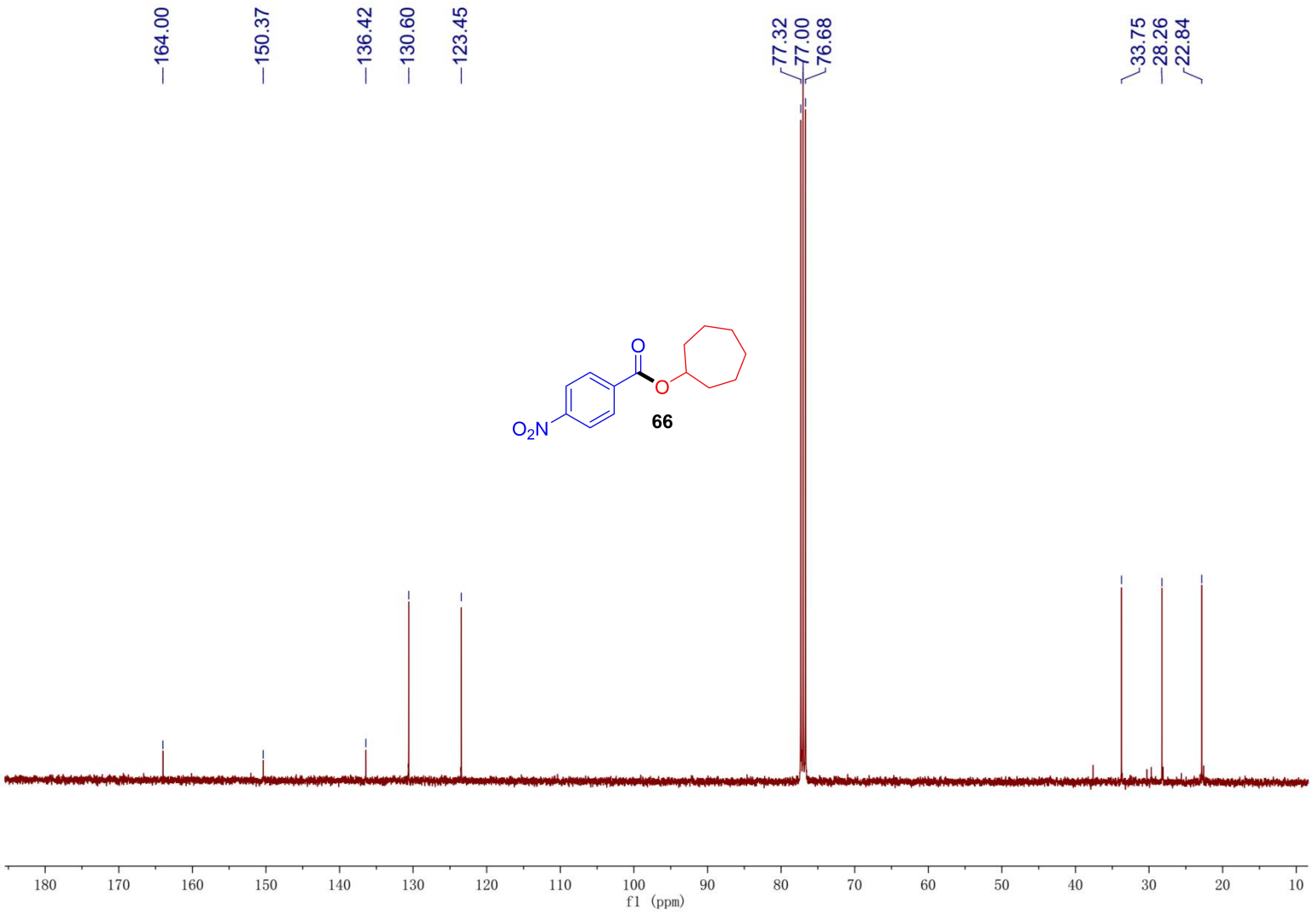
8.27
8.21
8.19
5.25
5.24
5.23
5.22
5.21
2.06
2.04
2.03
2.02
2.01
1.86
1.85
1.84
1.83
1.83
1.82
1.75
1.74
1.73
1.72
1.64
1.64
1.63
1.62
1.61
1.25
0.00
O
O
O2N
66
1.57
1.59
1.00
1.84
1.88
1.86
3.66
2.18
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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136.42
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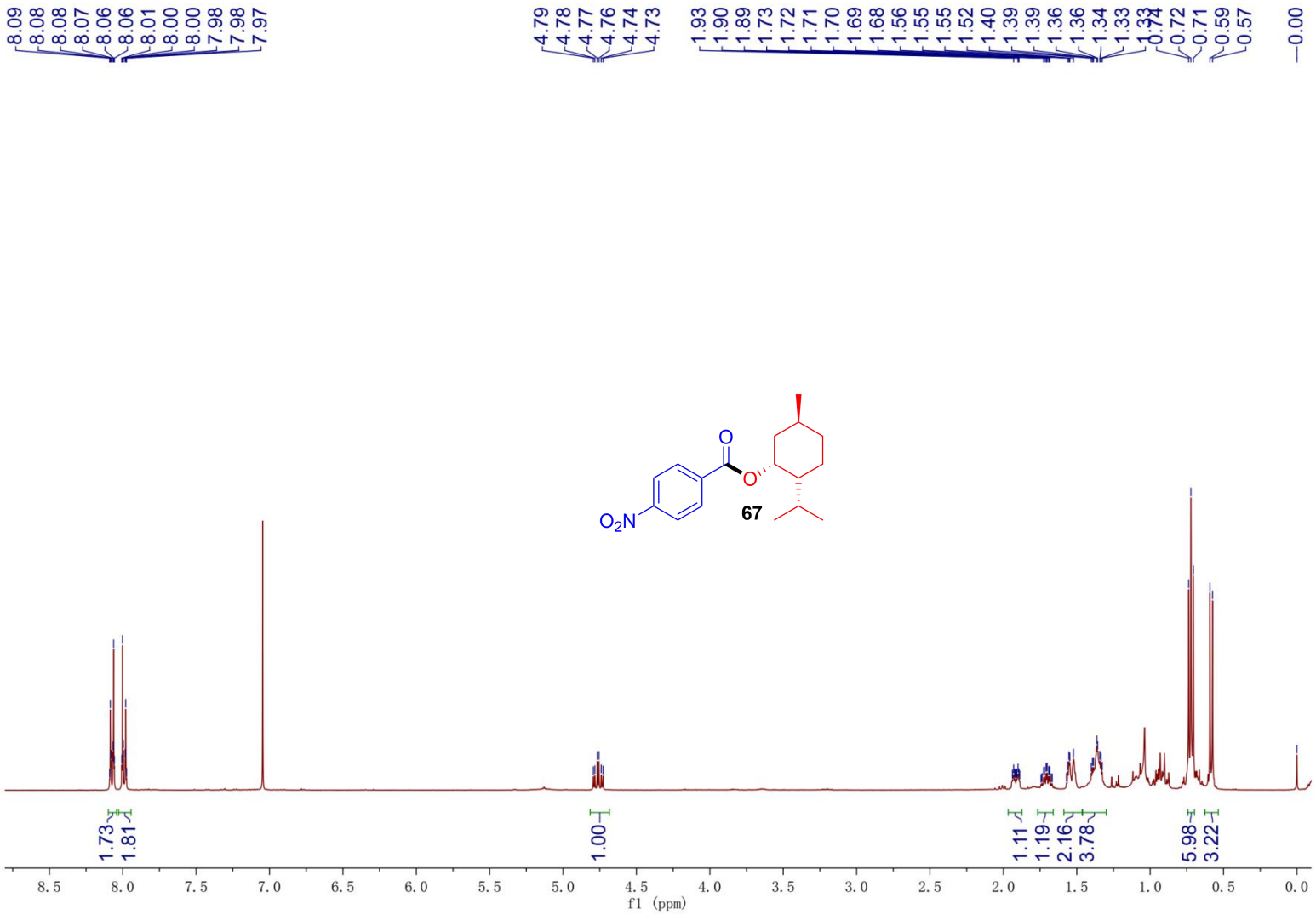
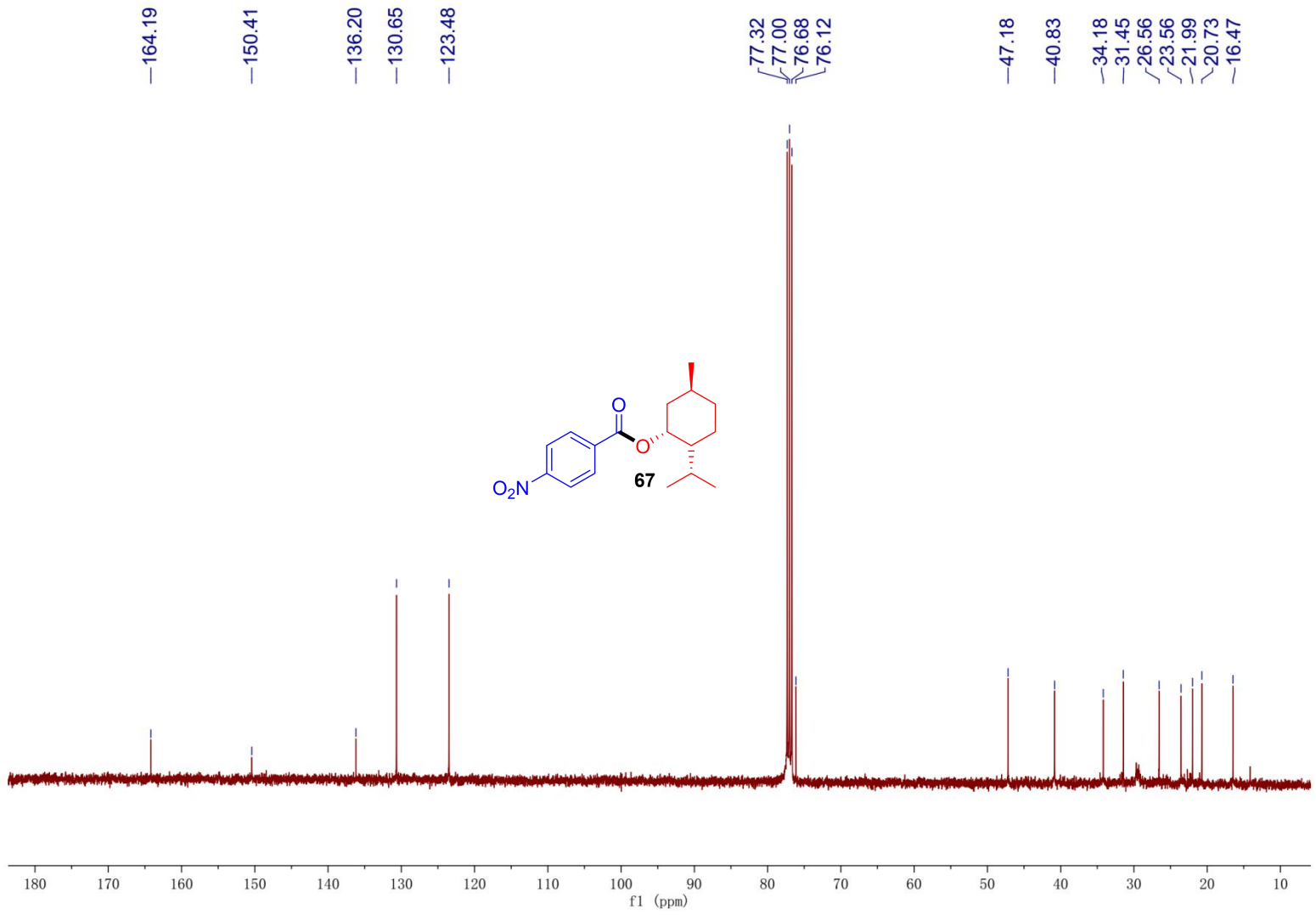
123.45
77.32
77.00
76.68
33.75
28.26
22.84
O
O
O2N
66
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


8.09
8.08
8.08
8.07
8.06
8.06
8.01
8.00
8.00
7.98
7.98
7.97
4.79
4.78
4.77
4.76
4.74
4.73
1.93
1.90
1.89
1.73
1.72
1.71
1.70
1.69
1.68
1.56
1.55
1.55
1.52
1.40
1.39
1.39
1.36
1.36
1.34
1.33
0.72
0.71
0.59
0.57
0.00
O
O
O2N
67
1.73
1.81
1.00
1.11
1.19
2.16
3.78
5.98
3.22
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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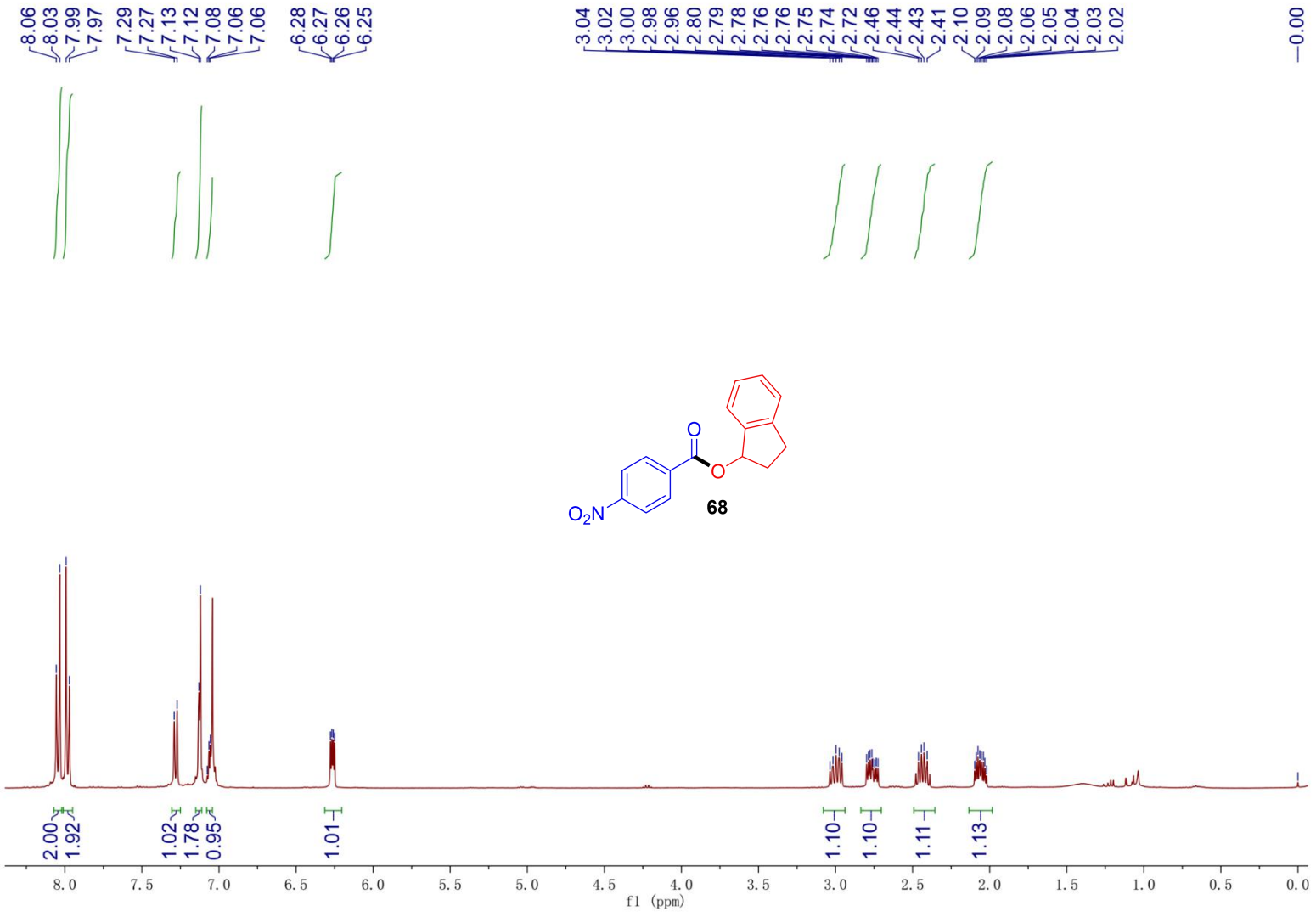
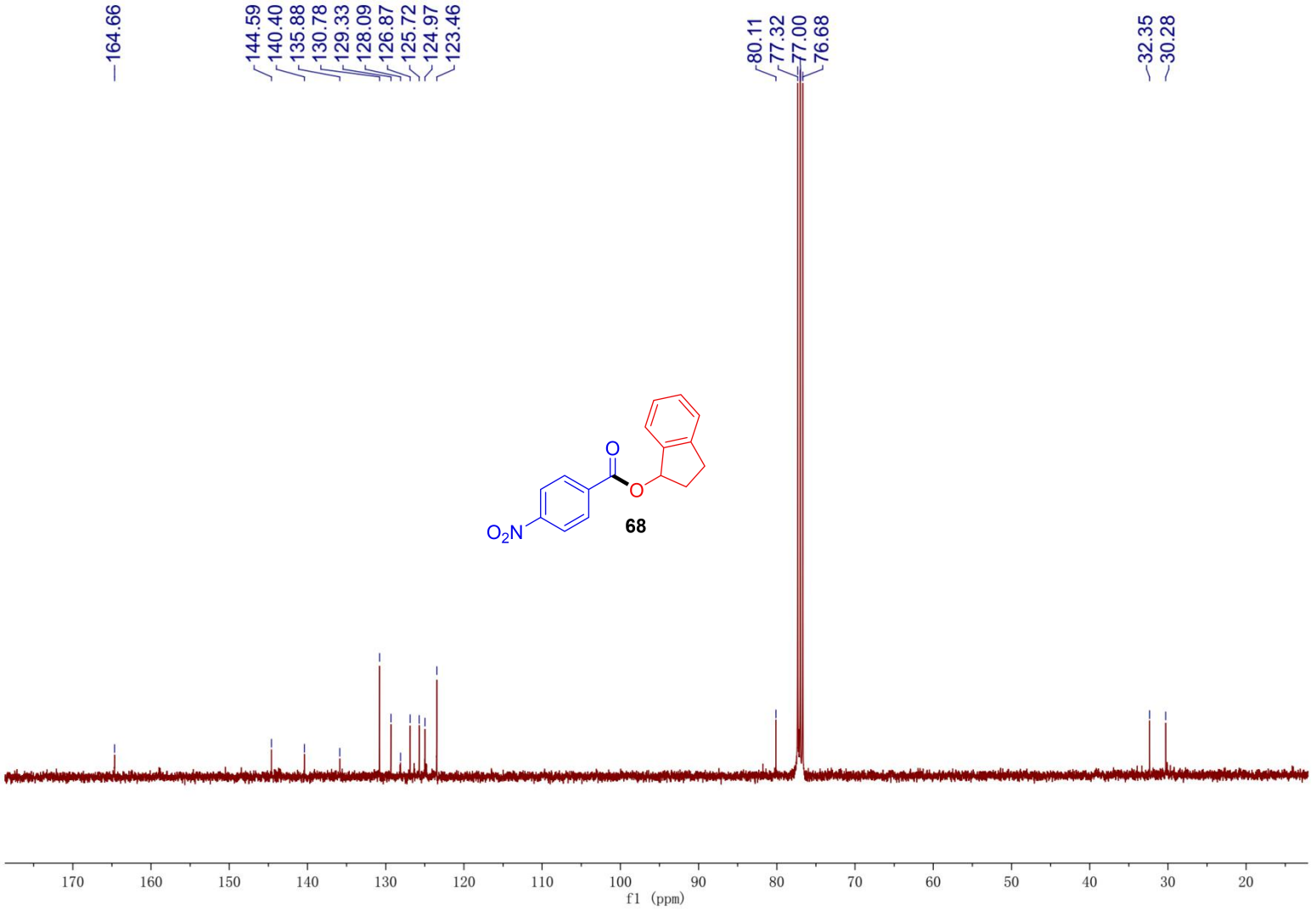
77.32
77.00
76.68
76.12
47.18
40.83
34.18
31.45
26.56
23.56
21.99
20.73
16.47
O
O
O2N
67
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


8.06
8.03
7.99
7.97
7.29
7.27
7.13
7.12
7.08
7.06
7.06
6.28
6.27
6.26
6.25
3.04
3.02
3.00
2.98
2.96
2.80
2.79
2.78
2.76
2.76
2.75
2.74
2.72
2.46
2.44
2.43
2.41
2.10
2.09
2.08
2.06
2.05
2.04
2.03
2.02
0.00
O
O
O2N
68
2.00
1.92
1.02
1.78
0.95
1.01
1.10
1.10
1.11
1.13
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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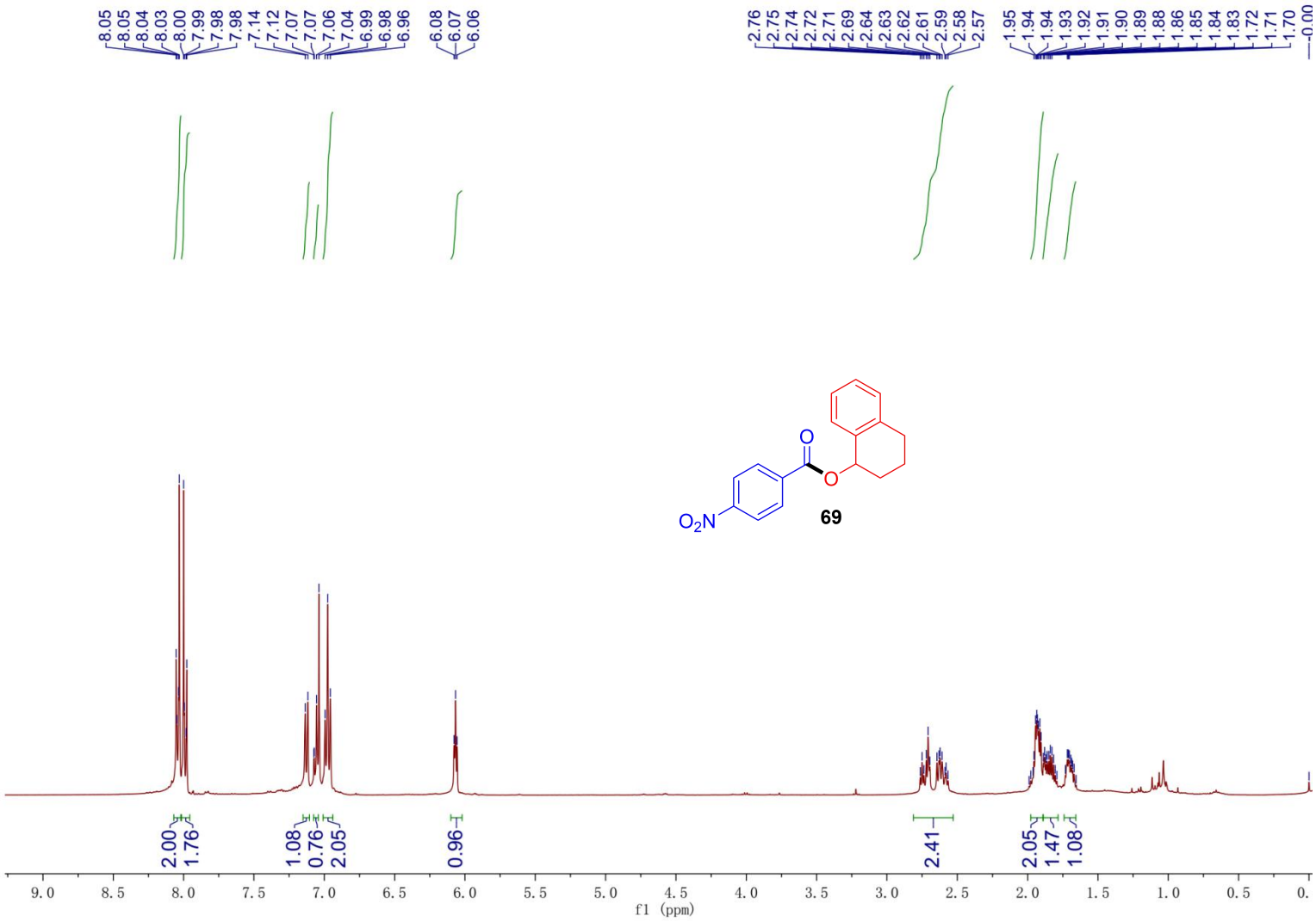
129.33
128.09
126.87
125.72
124.97
123.46
80.11
77.32
77.00
76.68
32.35
30.28
O
O
O2N
68
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)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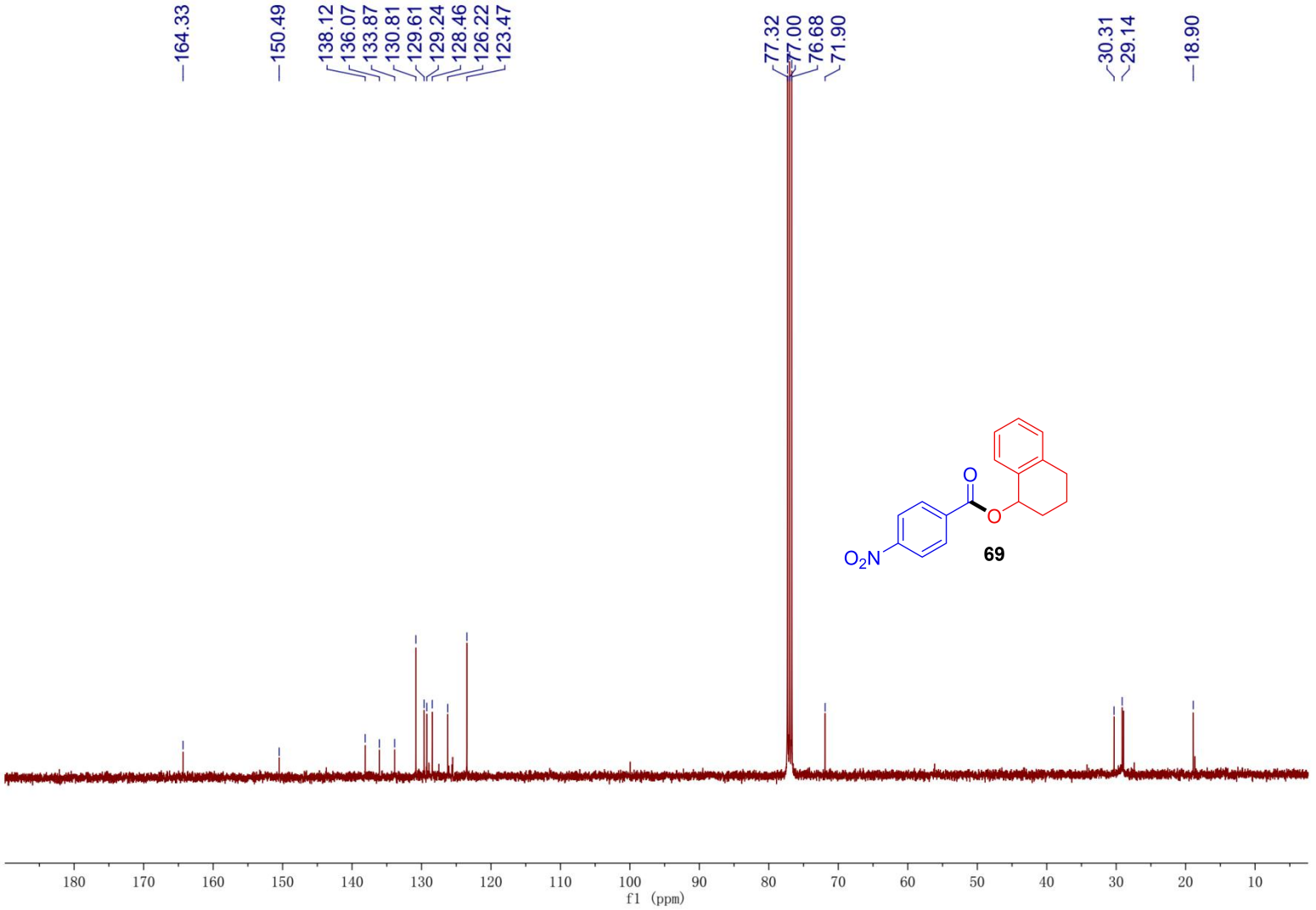
8.05
8.04
8.03
8.00
7.99
7.98
7.98
7.14
7.12
7.07
7.07
7.06
7.04
6.99
6.98
6.96
6.08
6.07
6.06
2.76
2.75
2.74
2.72
2.71
2.69
2.64
2.63
2.62
2.61
2.59
2.58
2.57
1.95
1.94
1.94
1.93
1.92
1.91
1.90
1.89
1.88
1.86
1.85
1.84
1.83
1.72
1.71
1.70
0.00
O
O
O2N
69
2.00
1.76
1.08
0.76
2.05
0.96
2.41
2.05
1.47
1.08
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
f1 (ppm)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130.81
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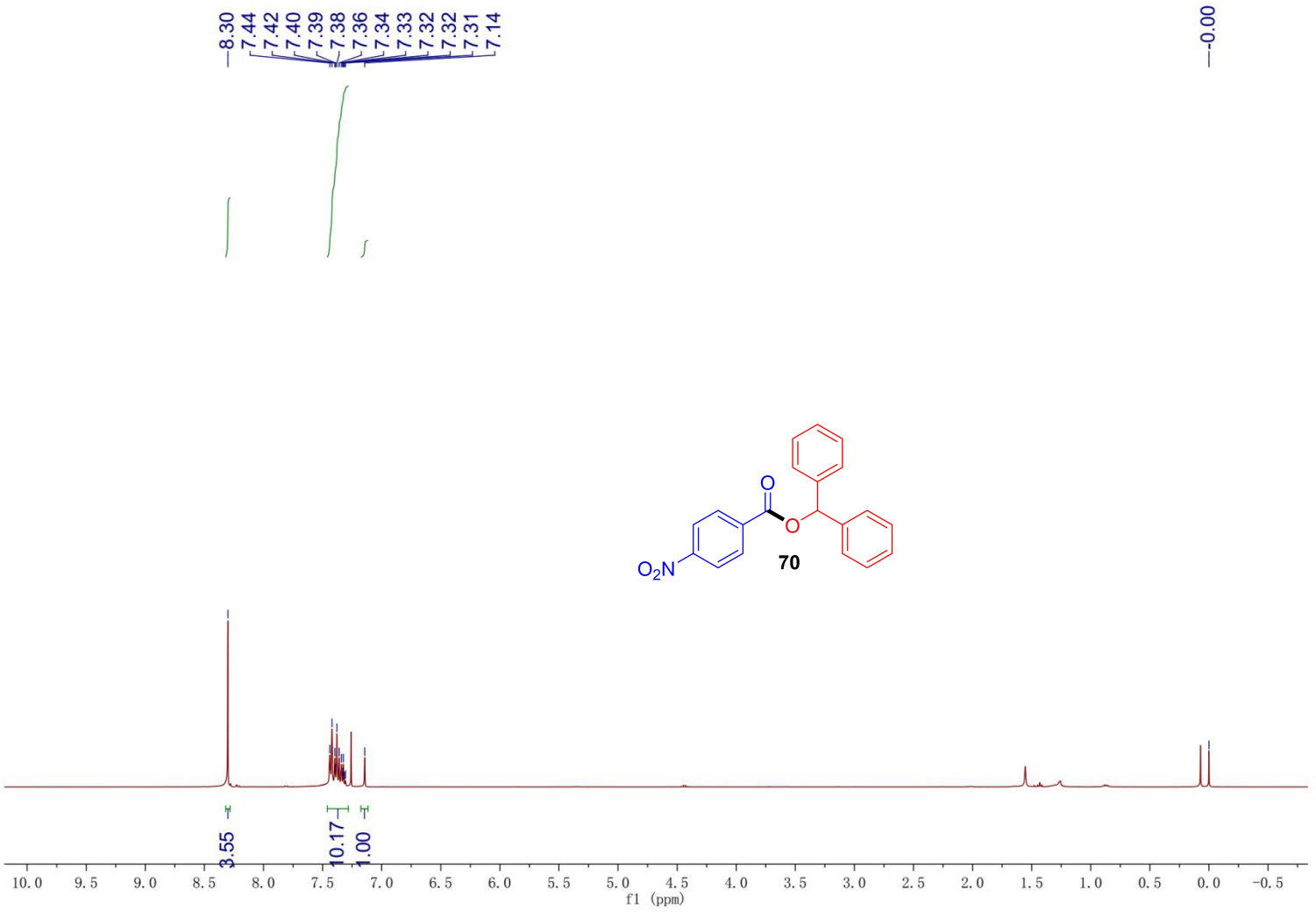
129.24
128.46
126.22
123.47
77.32
77.00
76.68
71.90
30.31
29.14
18.90
O
O
O2N
69
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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7.44
7.42
7.40
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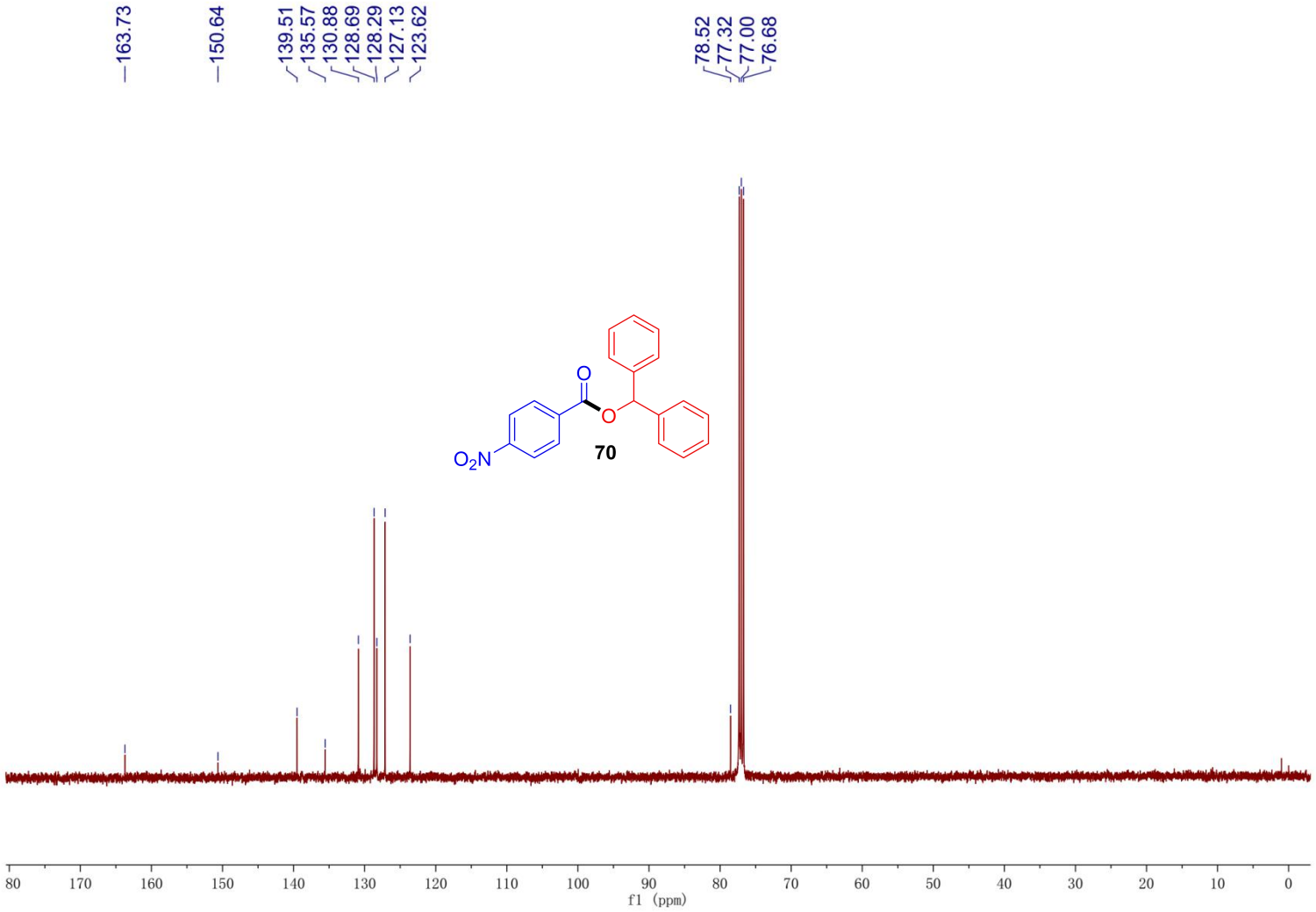
7.38
7.36
7.34
7.33
7.32
7.32
7.31
7.14
0.00
O
O
O2N
70
3.55
10.17
1.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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150.64
139.51
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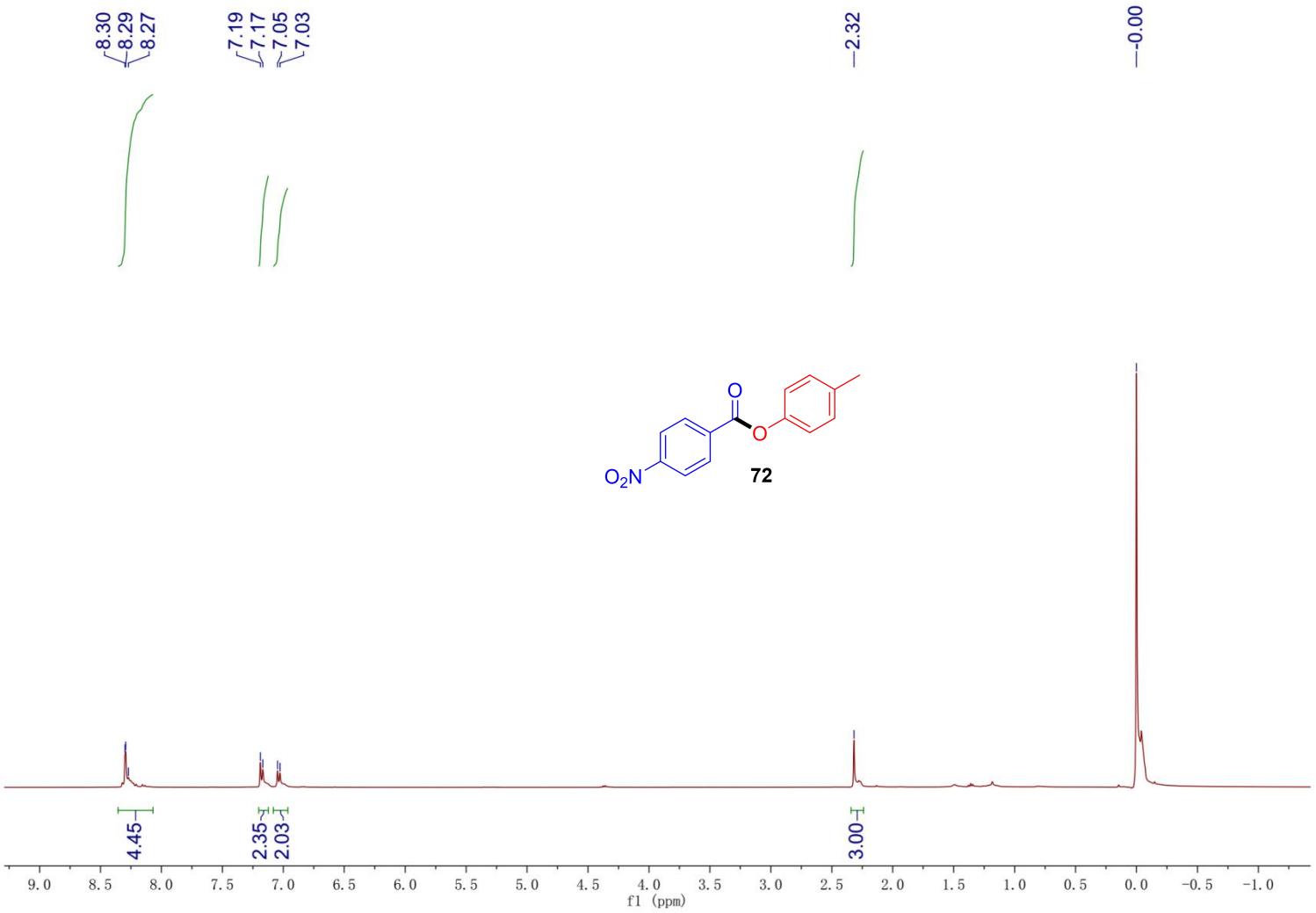
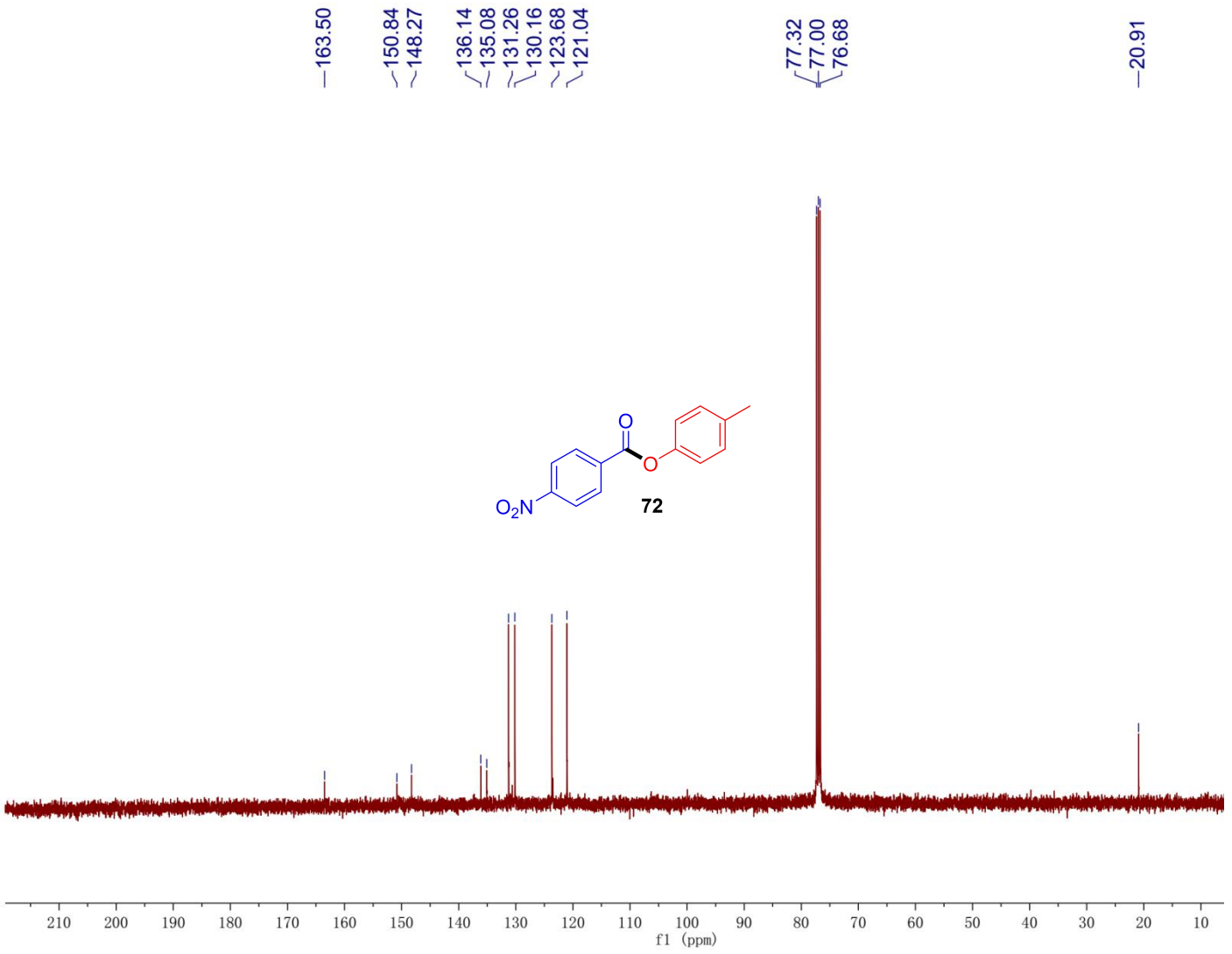
128.69
128.29
127.13
123.62
78.52
77.32
77.00
76.68
O
O
O2N
70
80
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.30
8.29
8.27
7.19
7.17
7.05
7.03
2.32
0.00
O
O
O2N
72
4.45
2.35
2.03
3.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)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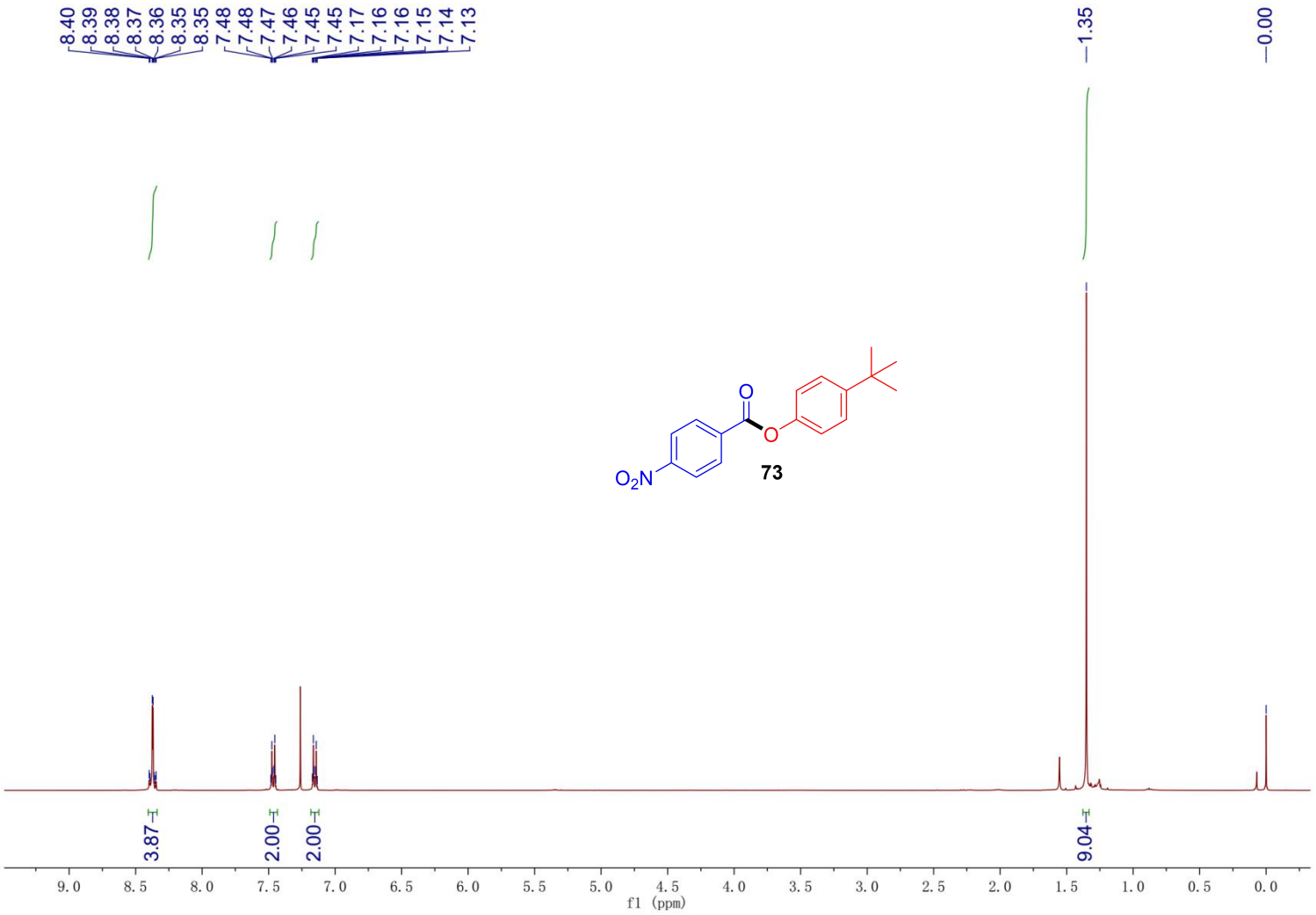
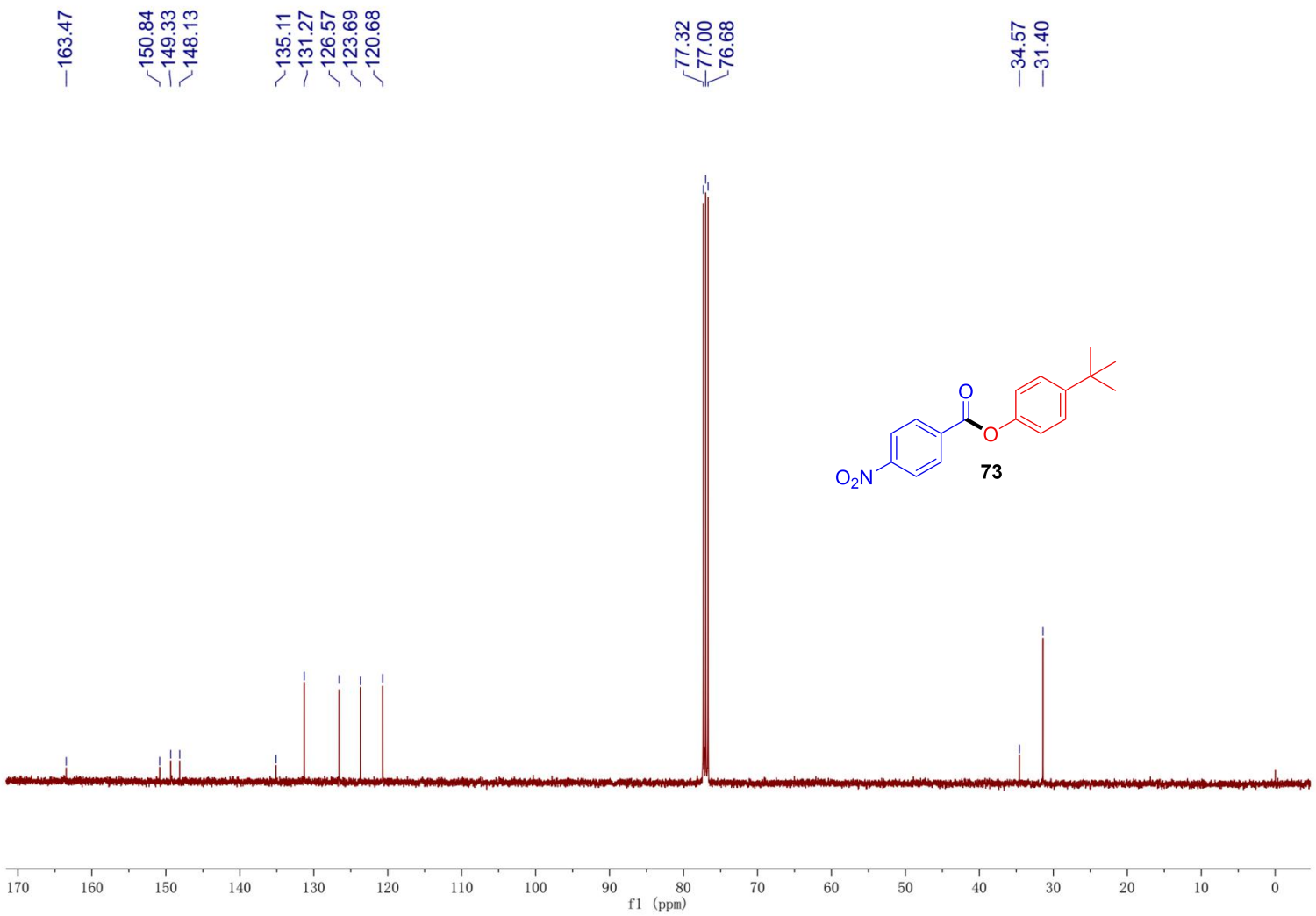
148.27
136.14
135.08
131.26
130.16
123.68
121.04
77.32
77.00
76.68
20.91
O
O
O2N
72
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


8.40
8.39
8.38
8.37
8.36
8.35
8.35
7.48
7.48
7.47
7.46
7.45
7.45
7.17
7.16
7.16
7.15
7.14
7.13
1.35
0.00
O
O
O2N
73
3.87
2.00
2.00
9.04
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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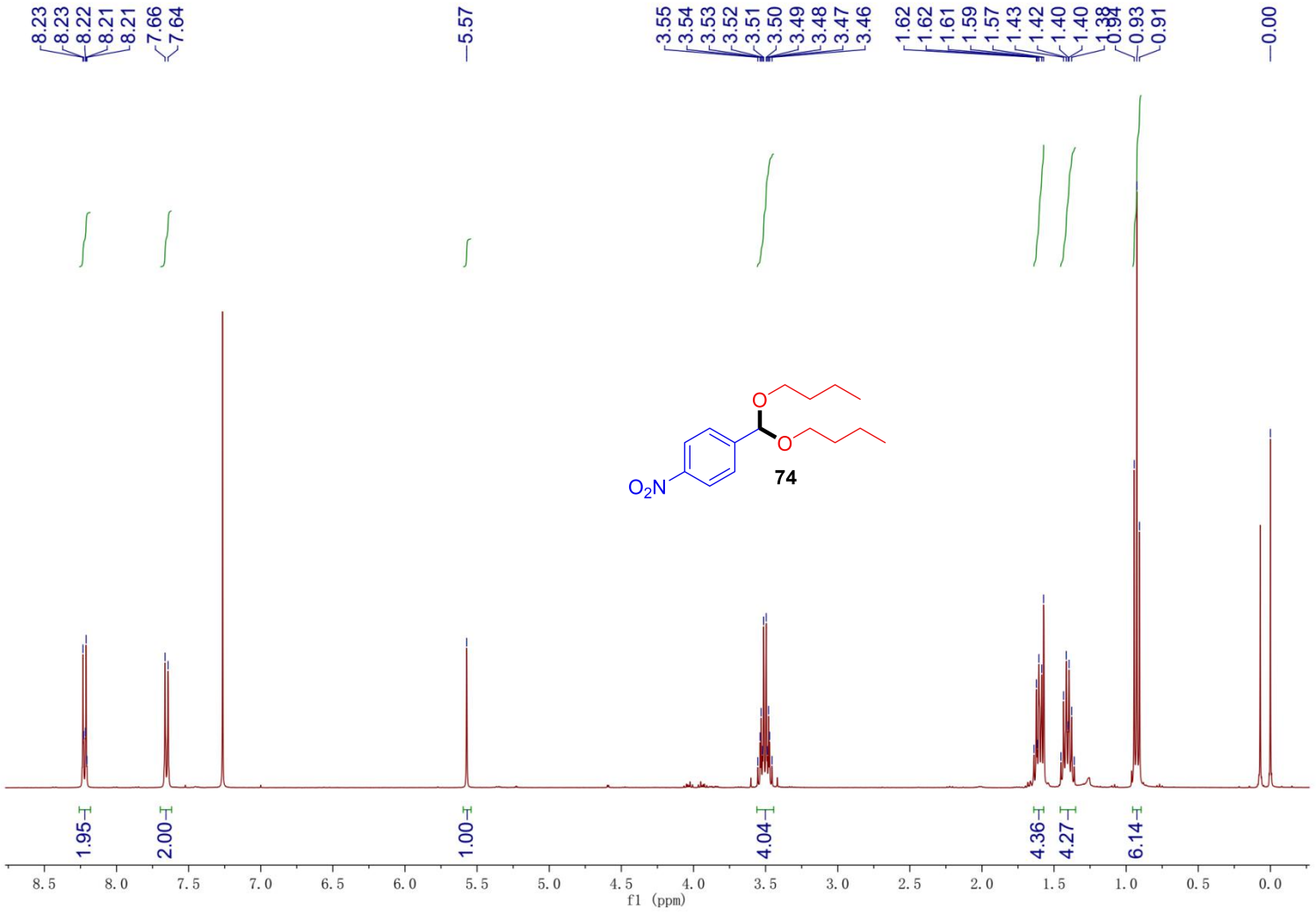
131.27
126.57
123.69
120.68
77.32
77.00
76.68
34.57
31.40
O2N
O
O
73
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.23
8.23
8.22
8.21
8.21
7.66
7.64
5.57
3.55
3.54
3.53
3.52
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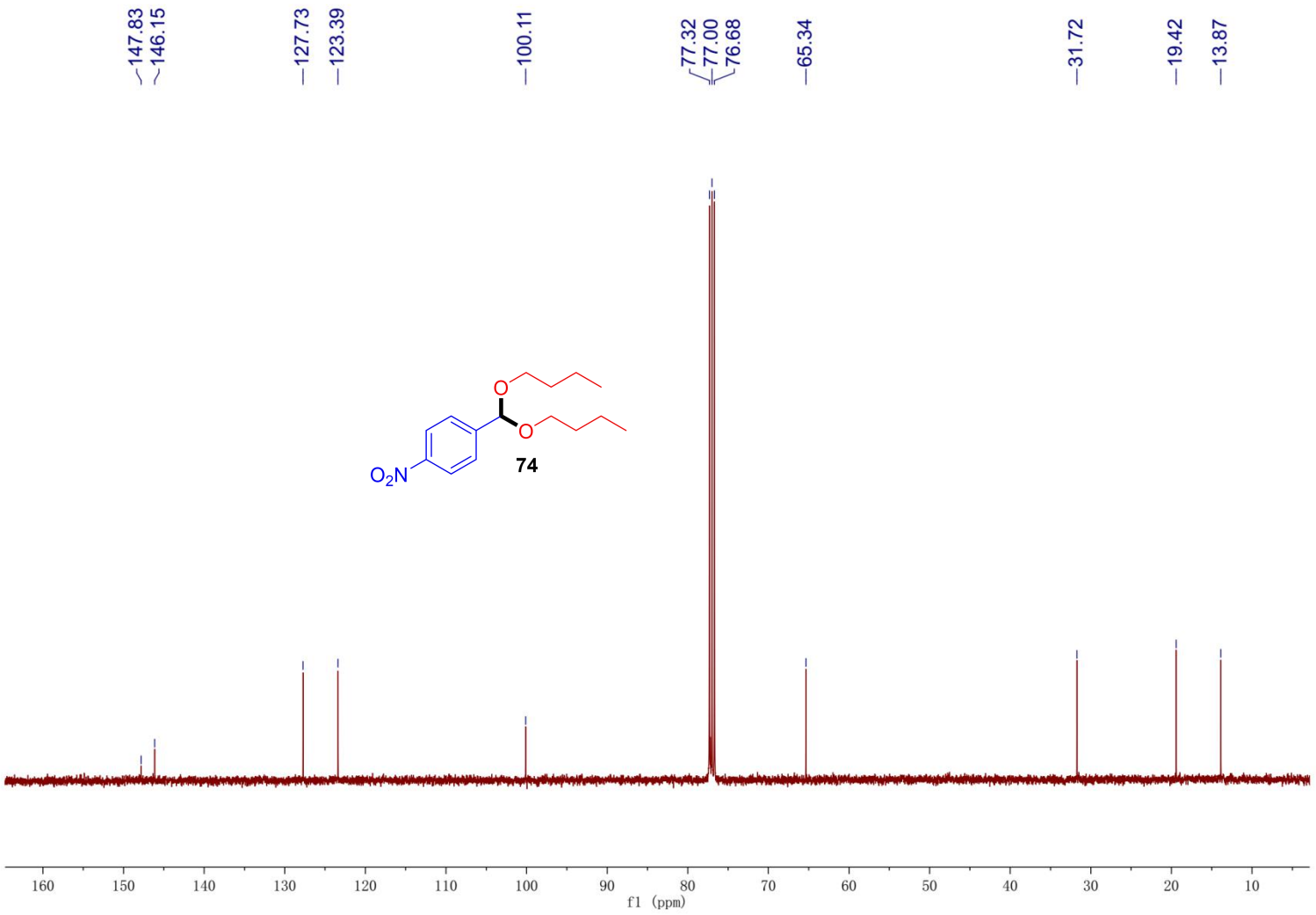
3.50
3.49
3.48
3.47
3.46
1.62
1.62
1.61
1.59
1.57
1.43
1.42
1.40
1.40
0.93
0.91
0.00
O
O
O2N
74
1.95
2.00
1.00
4.04
4.36
4.27
6.14
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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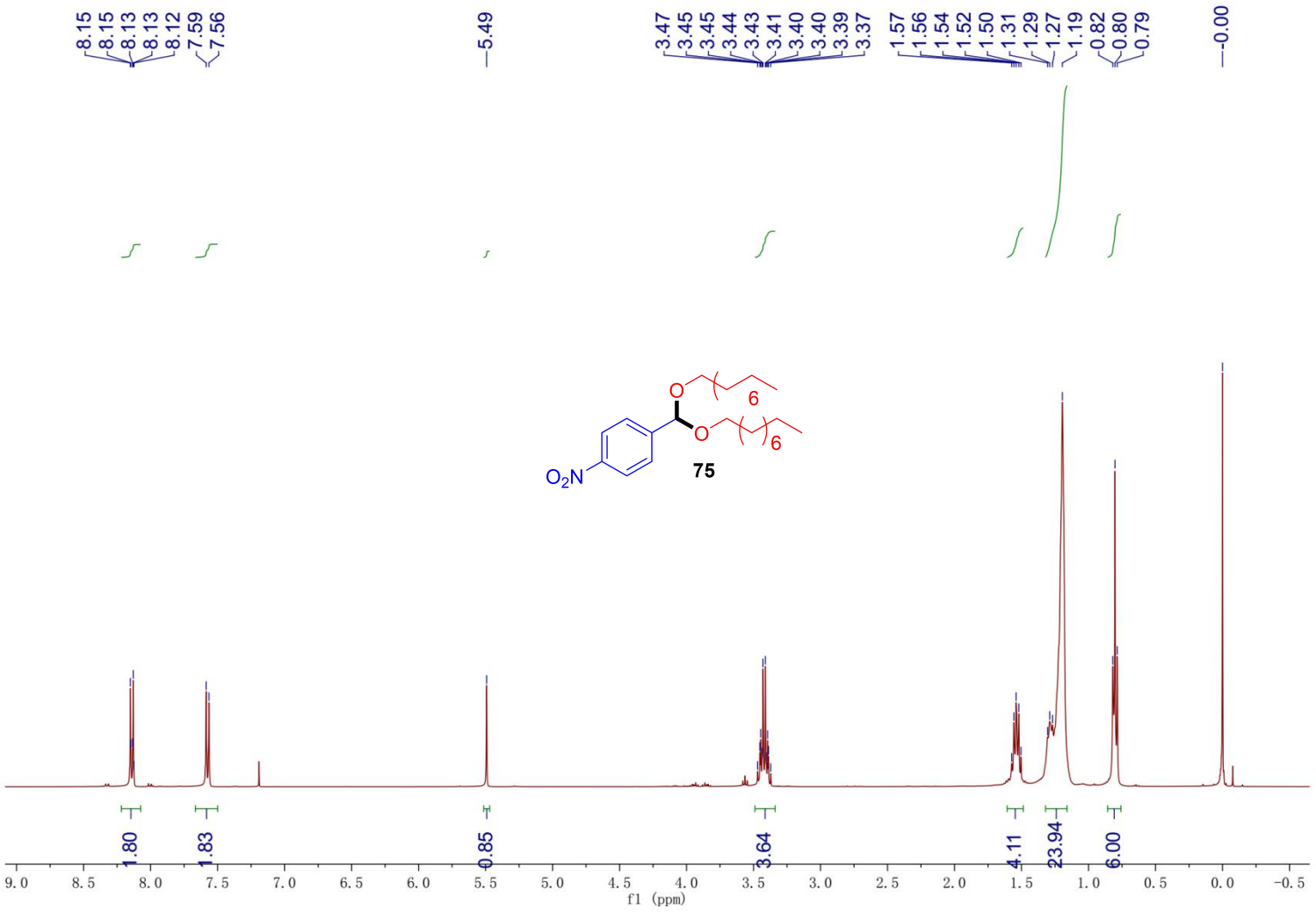
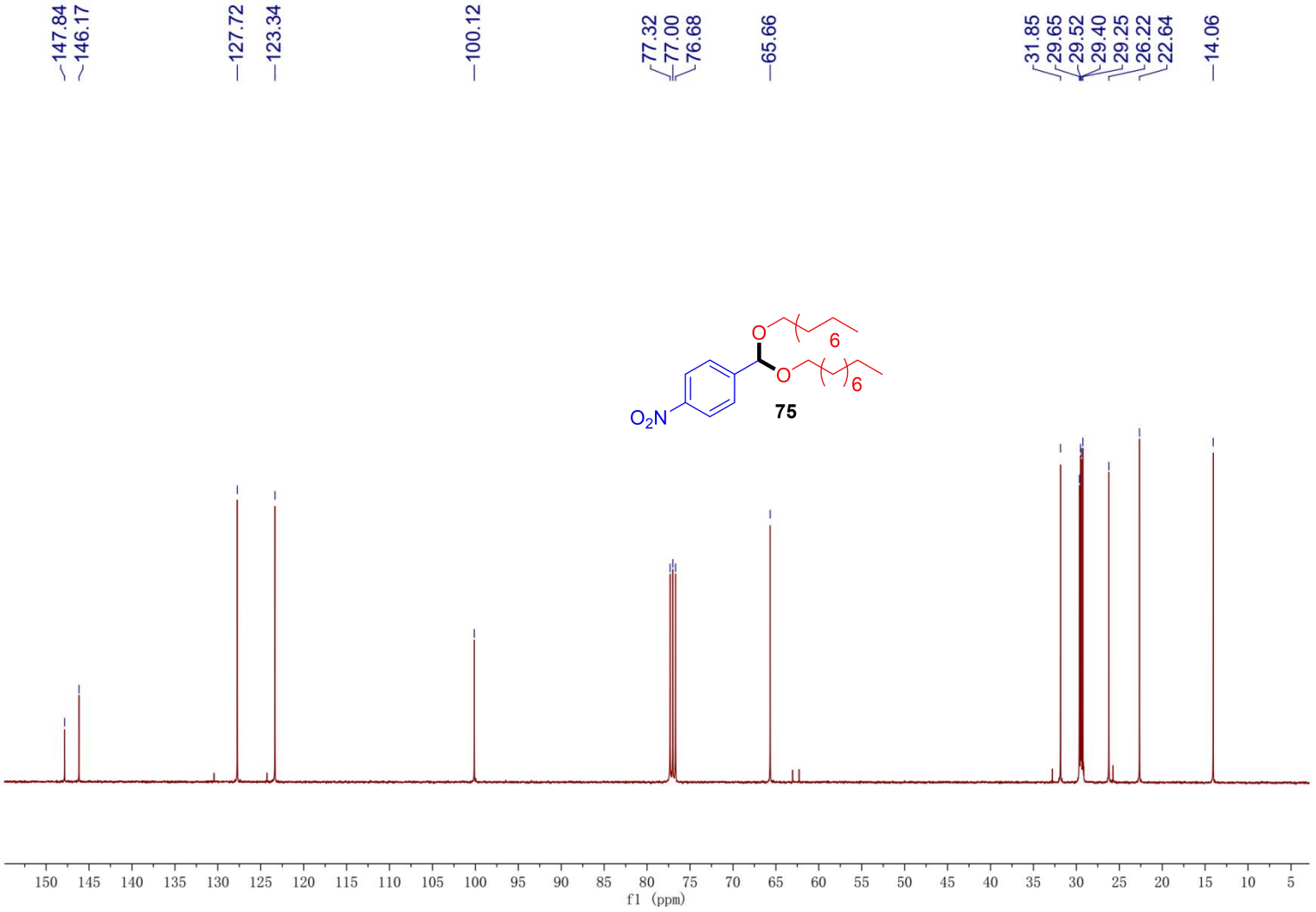
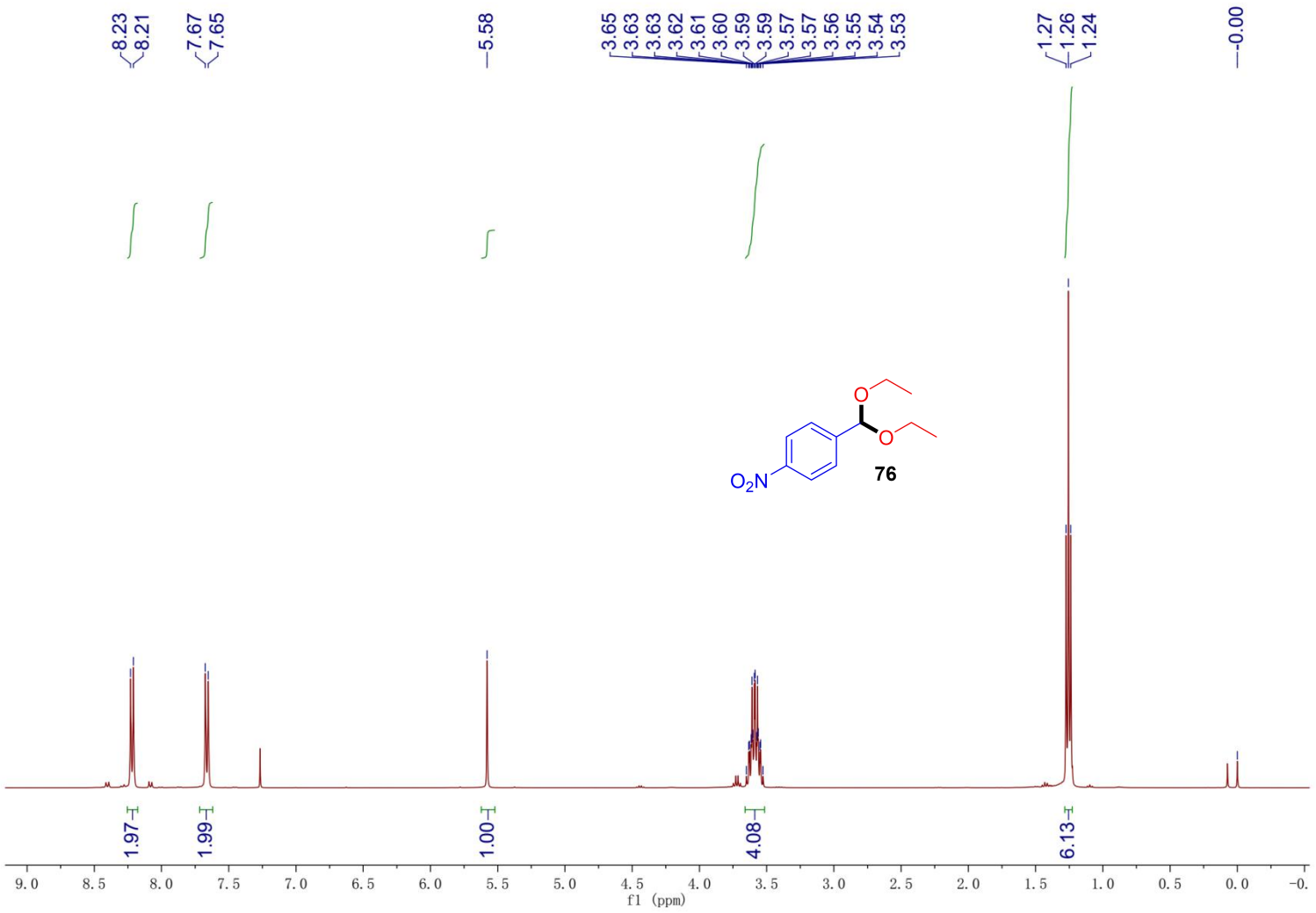
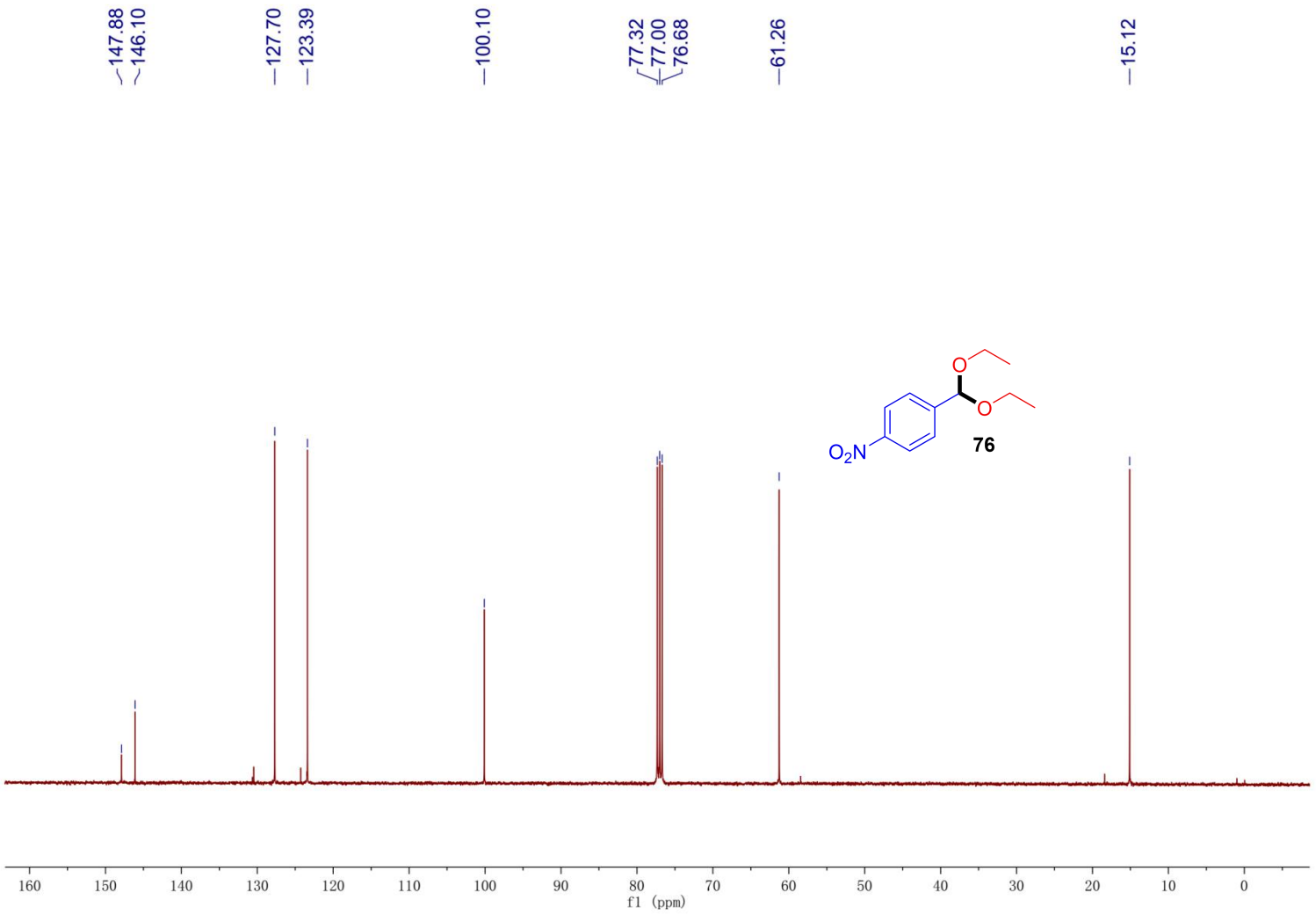
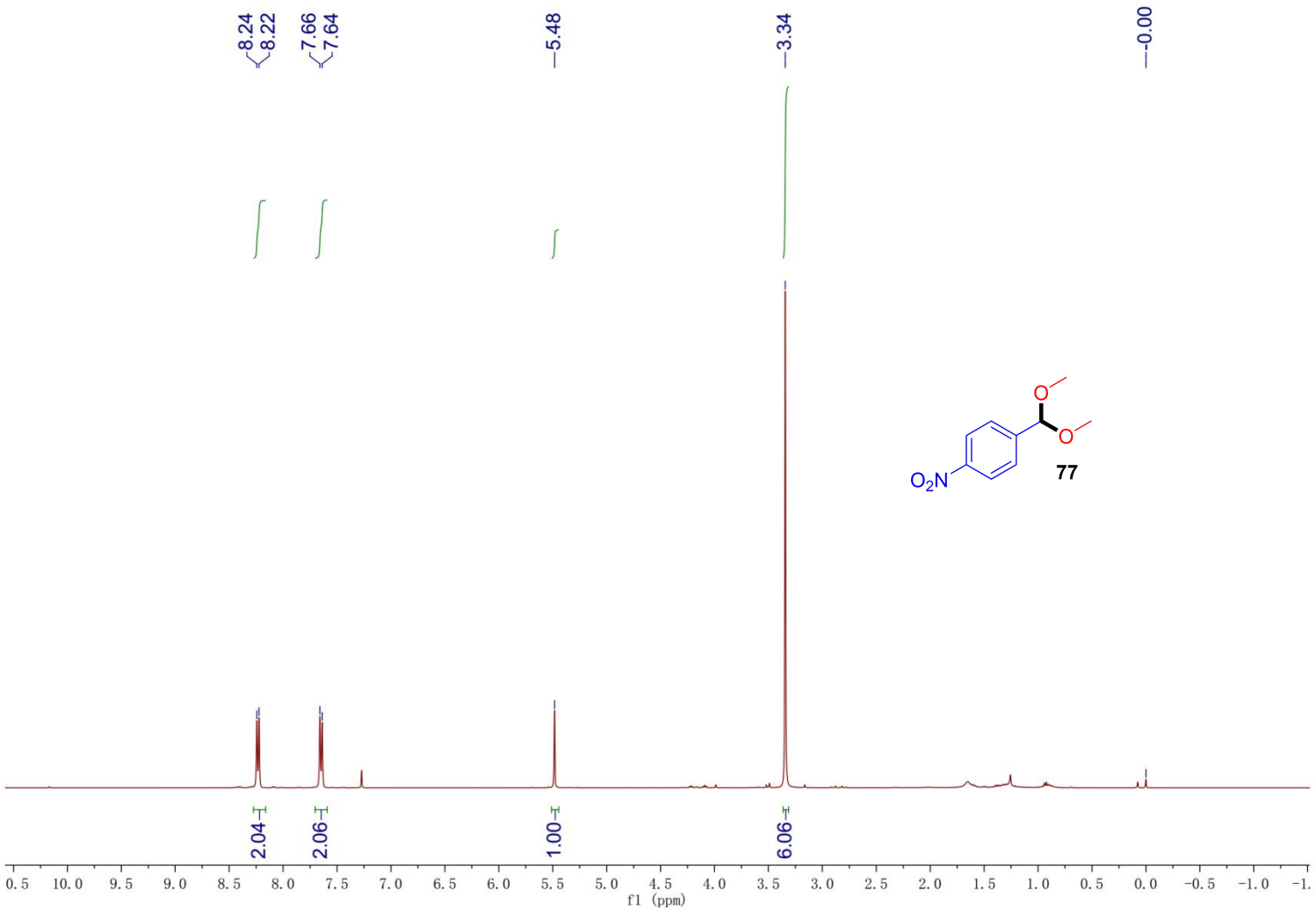
146.15
127.73
123.39
100.11
77.32
77.00
76.68
65.34
31.72
19.42
13.87
O
O
O2N
74
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

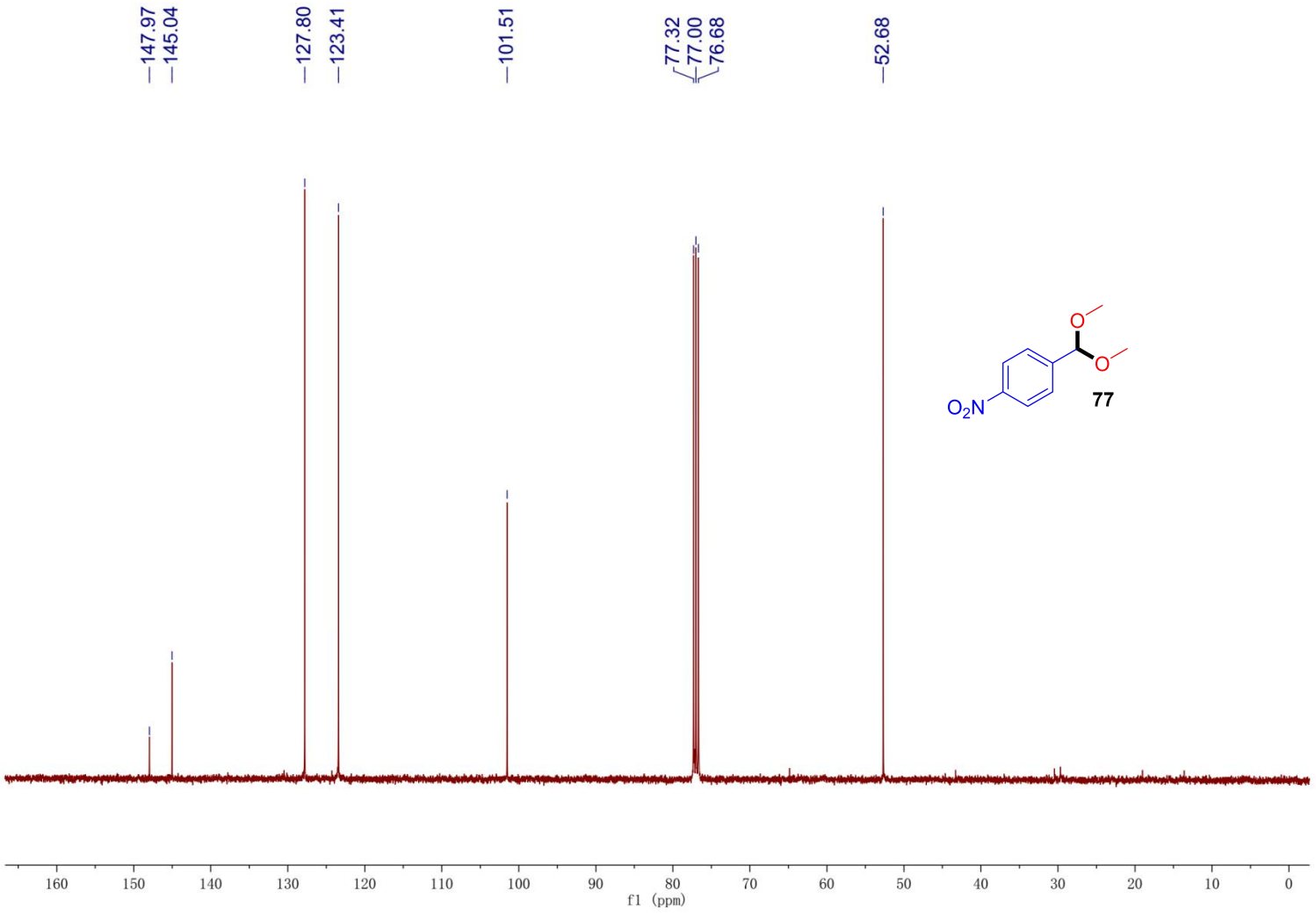

8.15
8.15
8.13
8.13
8.12
7.59
7.56
5.49
3.47
3.45
3.45
3.44
3.43
3.41
3.40
3.40
3.39
3.37
1.57
1.56
1.54
1.52
1.50
1.31
1.29
1.27
1.19
0.82
0.80
0.79
0.00
O
6
O
6
O2N
75
1.80
1.83
0.85
3.64
4.11
23.94
6.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

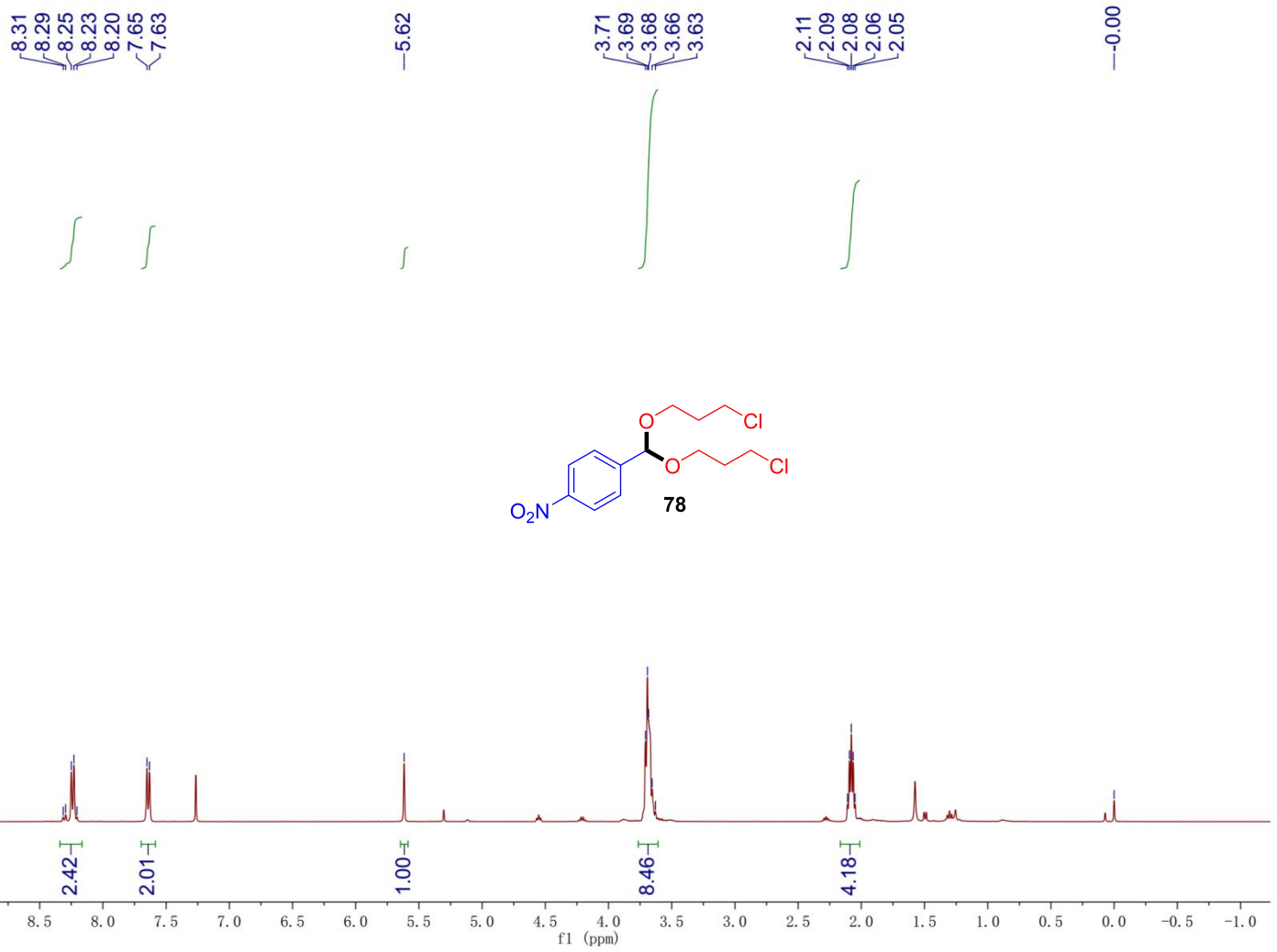

147.84
146.17
127.72
123.34
100.12
77.32
77.00
76.68
65.66
31.85
29.65
29.52
29.40
29.25
26.22
22.64
14.06
O
6
O
6
O2N
75
150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5
f1 (ppm)

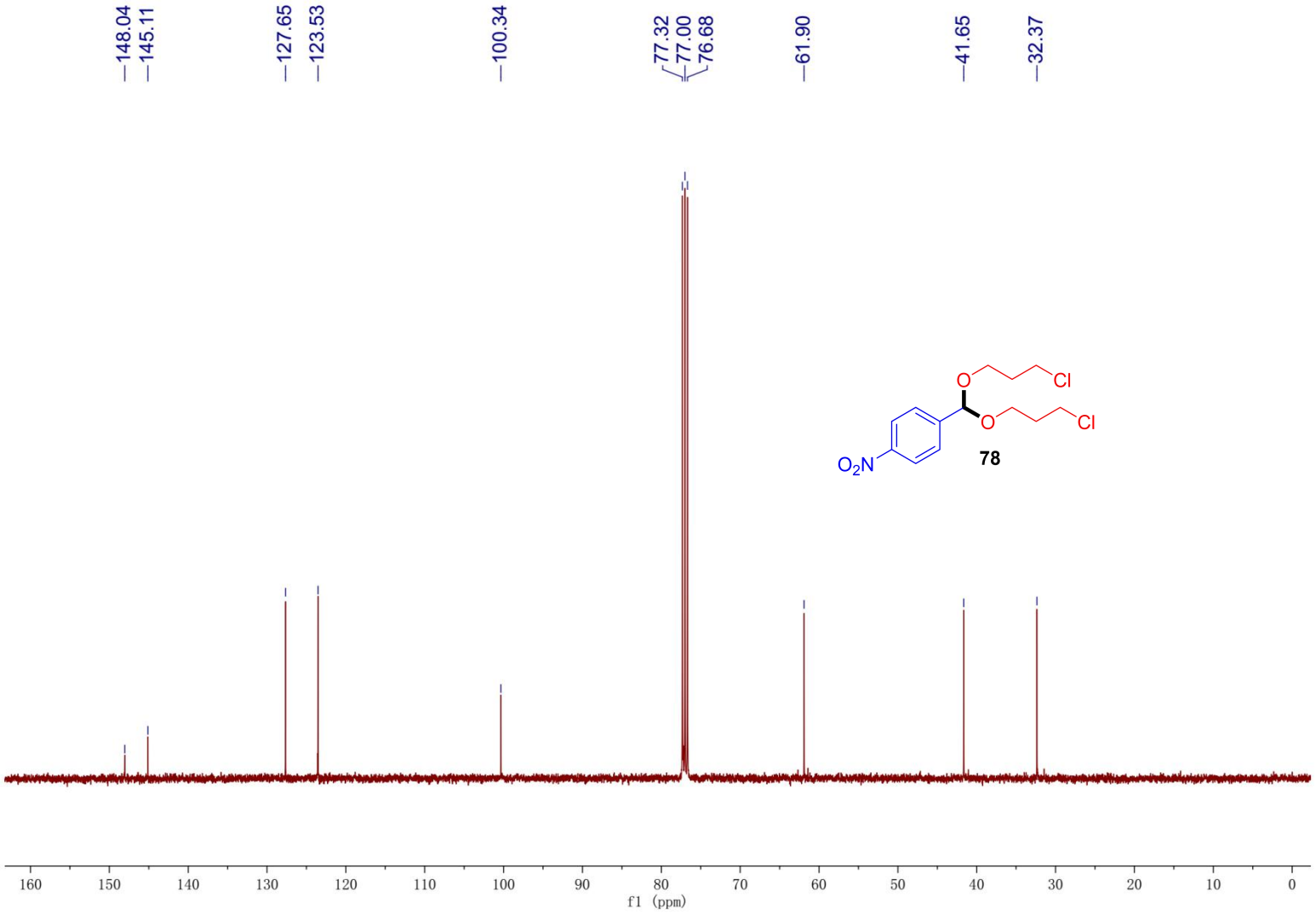

8.23
8.21
7.67
7.65
5.58
3.65
3.63
3.63
3.62
3.61
3.60
3.59
3.59
3.57
3.57
3.56
3.55
3.54
3.53
1.27
1.26
1.24
0.00
O
O
O2N
76
1.97
1.99
1.00
4.08
6.13
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.
f1 (ppm)

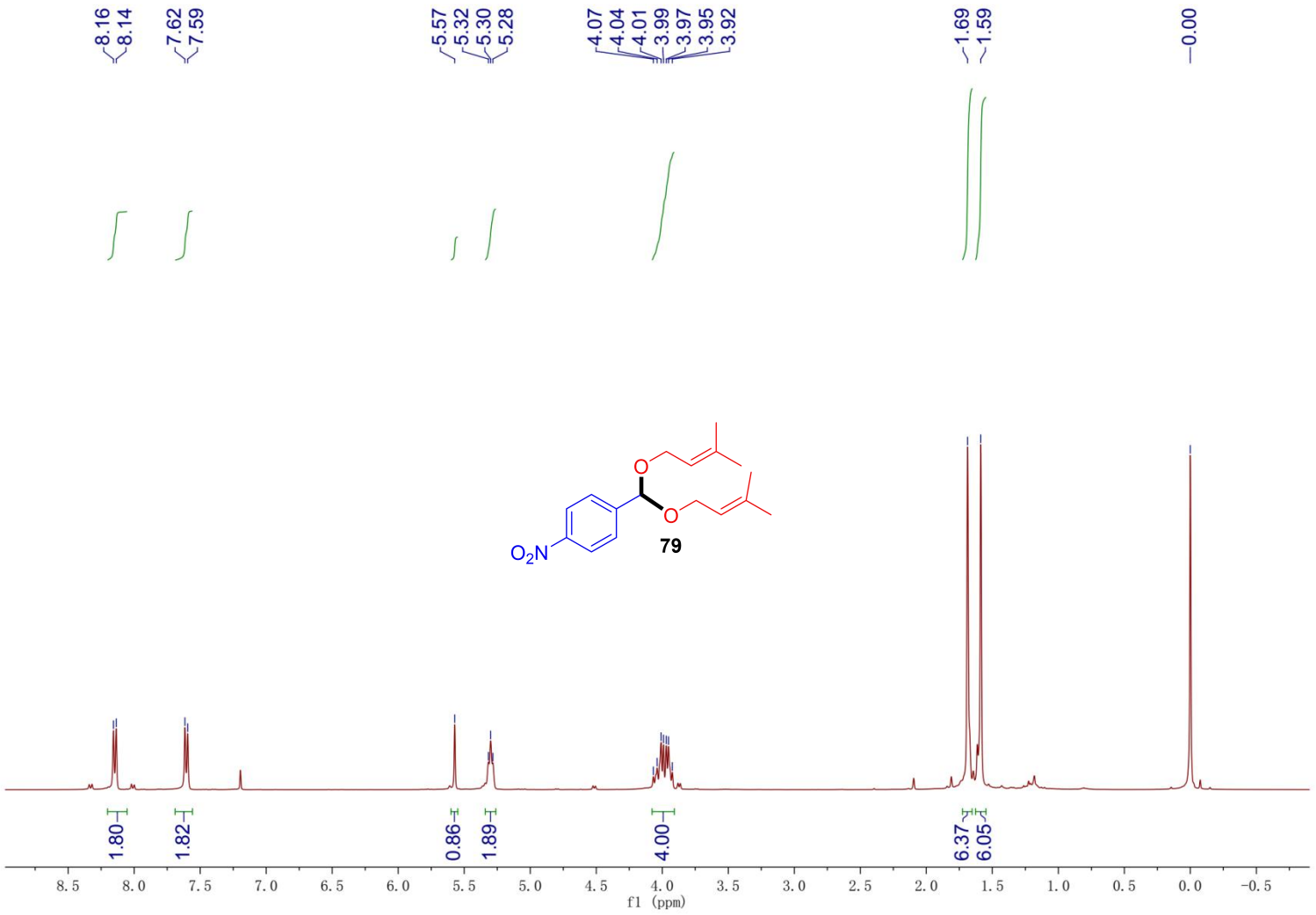

147.88
146.10
127.70
123.39
100.10
77.32
77.00
76.68
61.26
15.12
O
O
O2N
76
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

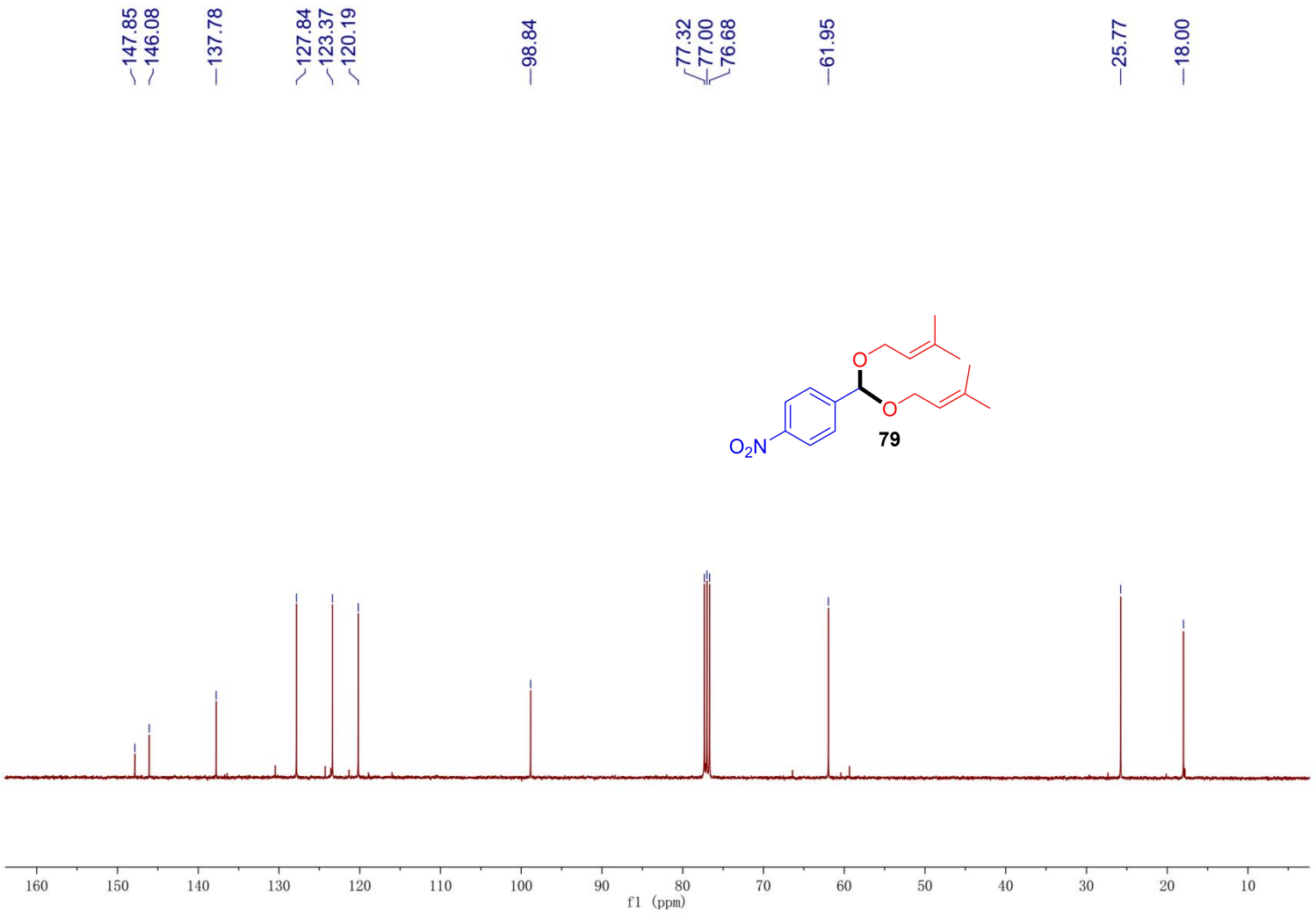

8.24
8.22
7.66
7.64
5.48
3.34
0.00
2.04
2.06
1.00
6.06
f1 (ppm)
O
O
O2N
77

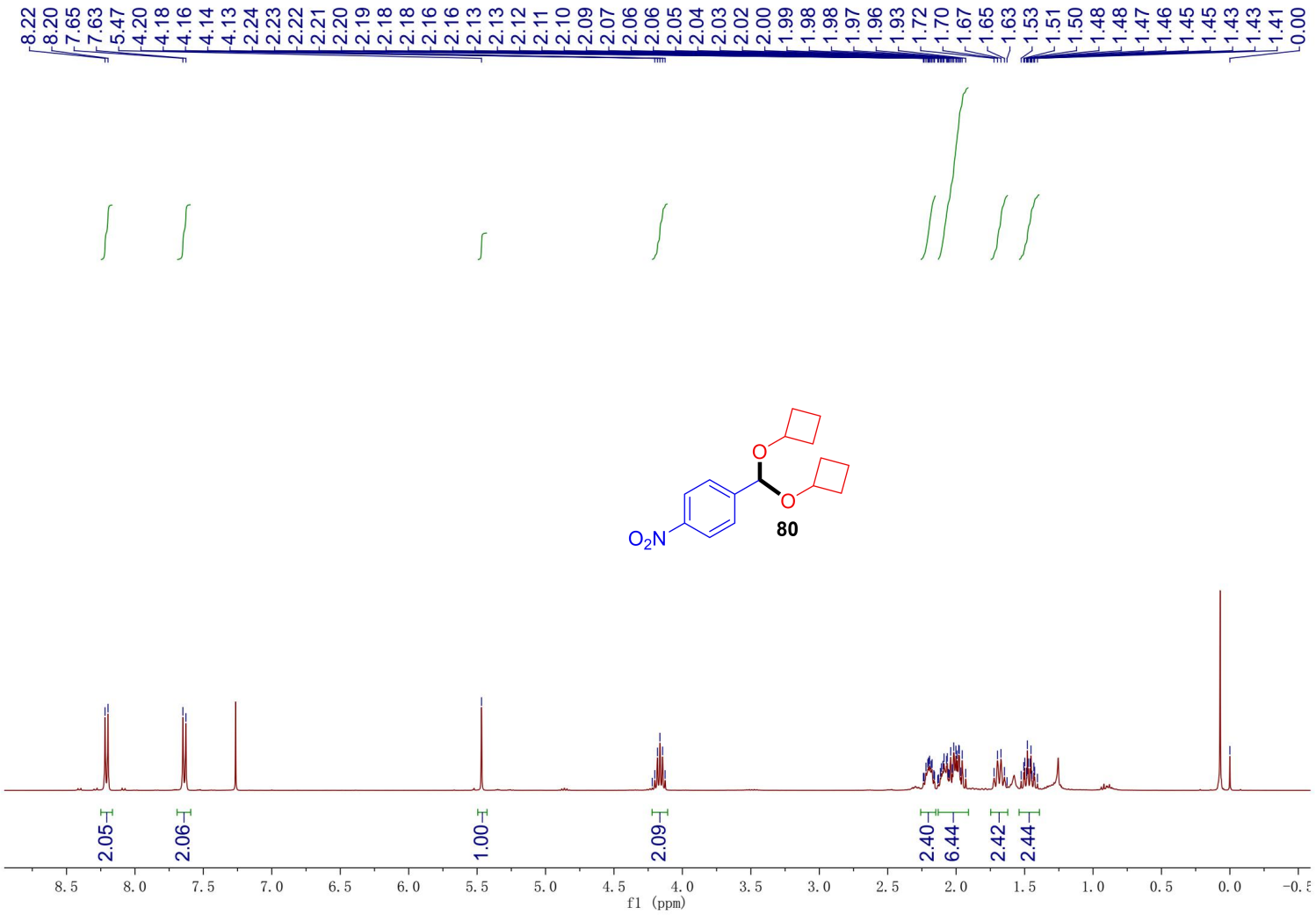

147.97
145.04
127.80
123.41
101.51
77.32
77.00
76.68
52.68
O
O
O2N
77
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

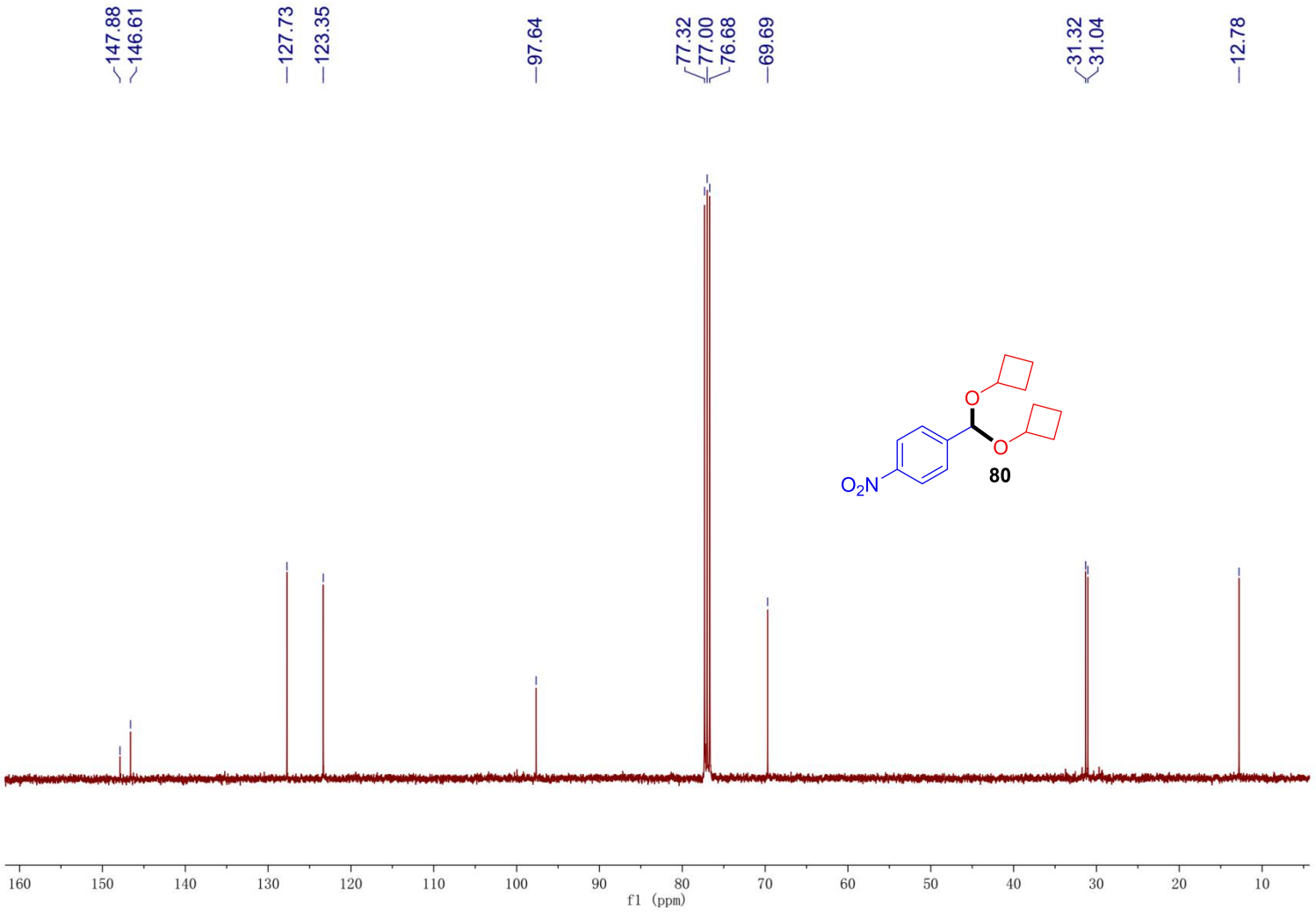

8.31
8.29
8.25
8.23
8.20
7.65
7.63
5.62
3.71
3.69
3.68
3.66
3.63
2.11
2.09
2.08
2.06
2.05
0.00
O
Cl
O
Cl
O2N
78
2.42
2.01
1.00
8.46
4.18
f1 (ppm)

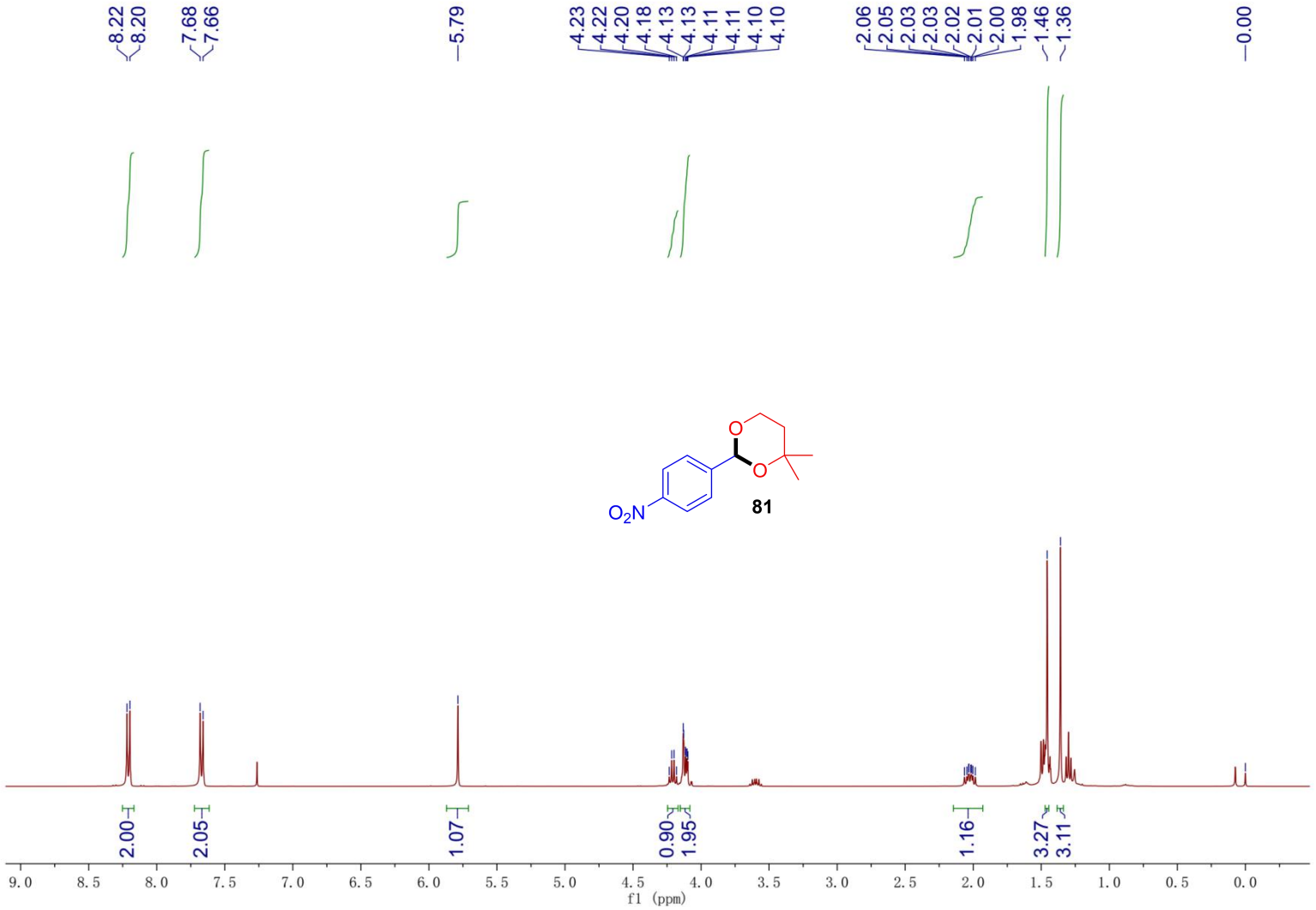

148.04
145.11
127.65
123.53
100.34
77.32
77.00
76.68
61.90
41.65
32.37
O
Cl
O
Cl
O2N
78
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

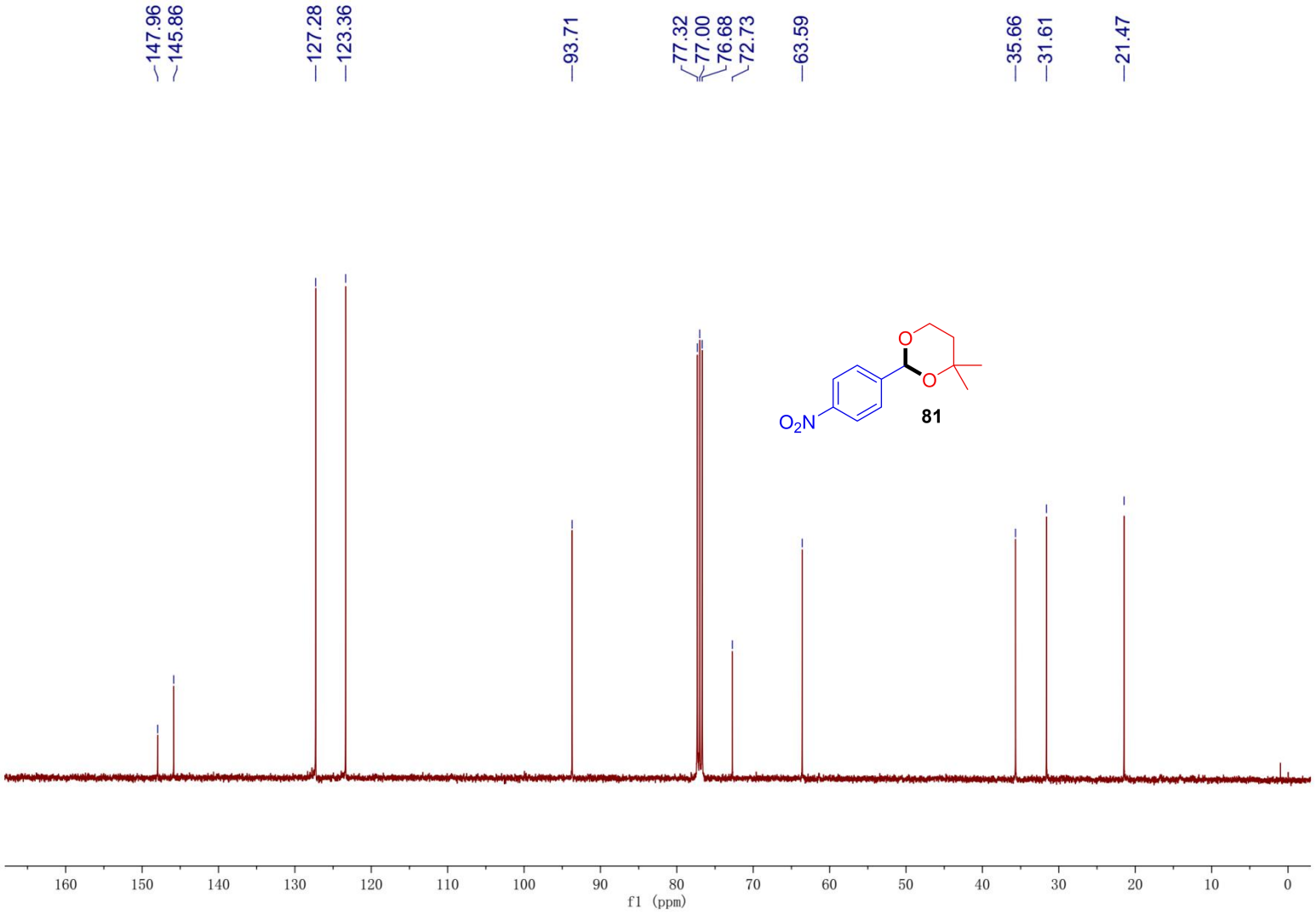

8.16
8.14
7.62
7.59
5.57
5.32
5.30
5.28
4.07
4.04
4.01
3.99
3.97
3.95
3.92
1.69
1.59
0.00
O
O
O2N
79
1.80
1.82
0.86
1.89
4.00
6.37
6.05
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

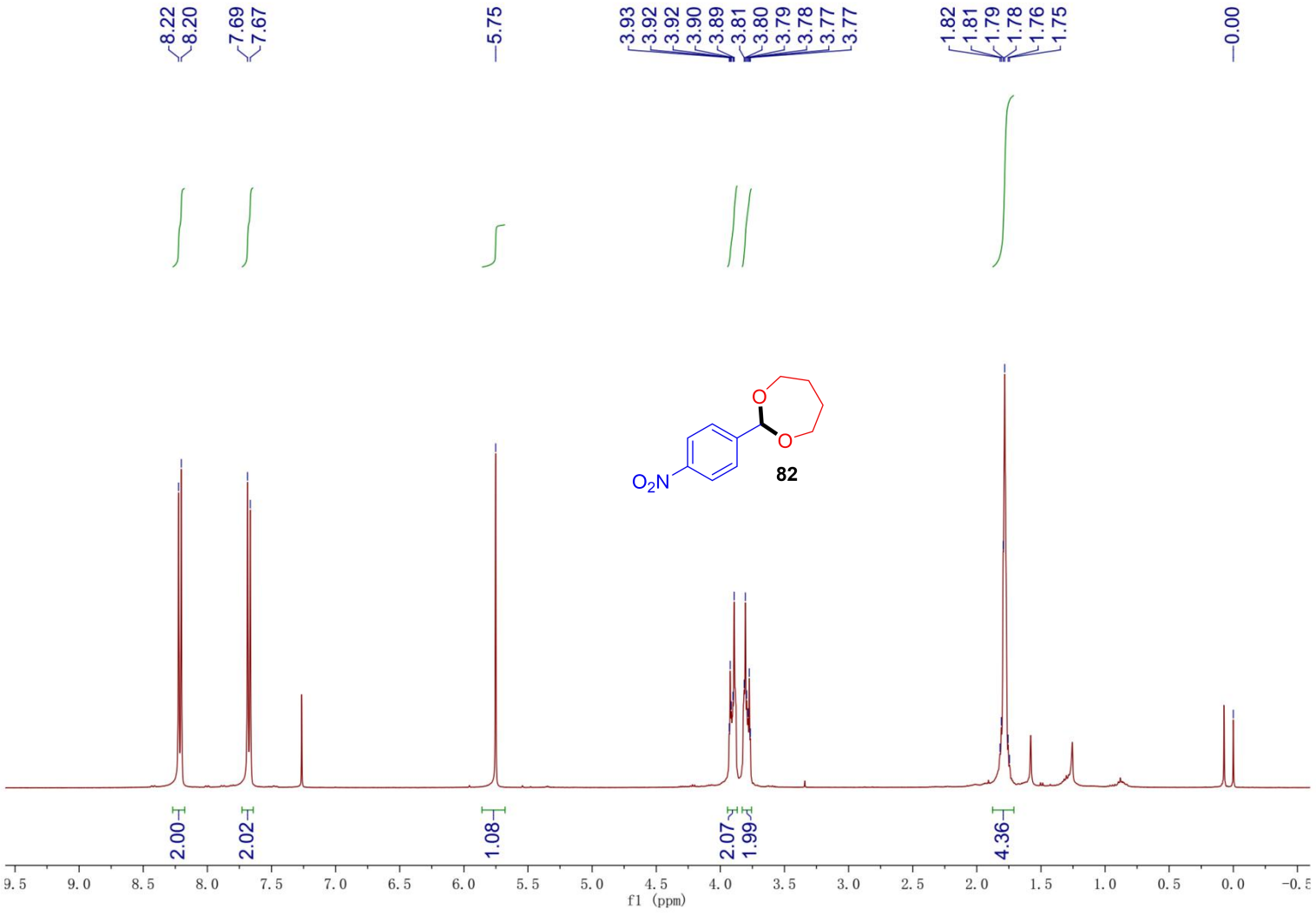

147.85
146.08
137.78
127.84
123.37
120.19
98.84
77.32
77.00
76.68
61.95
25.77
18.00
O
O
O2N
79
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

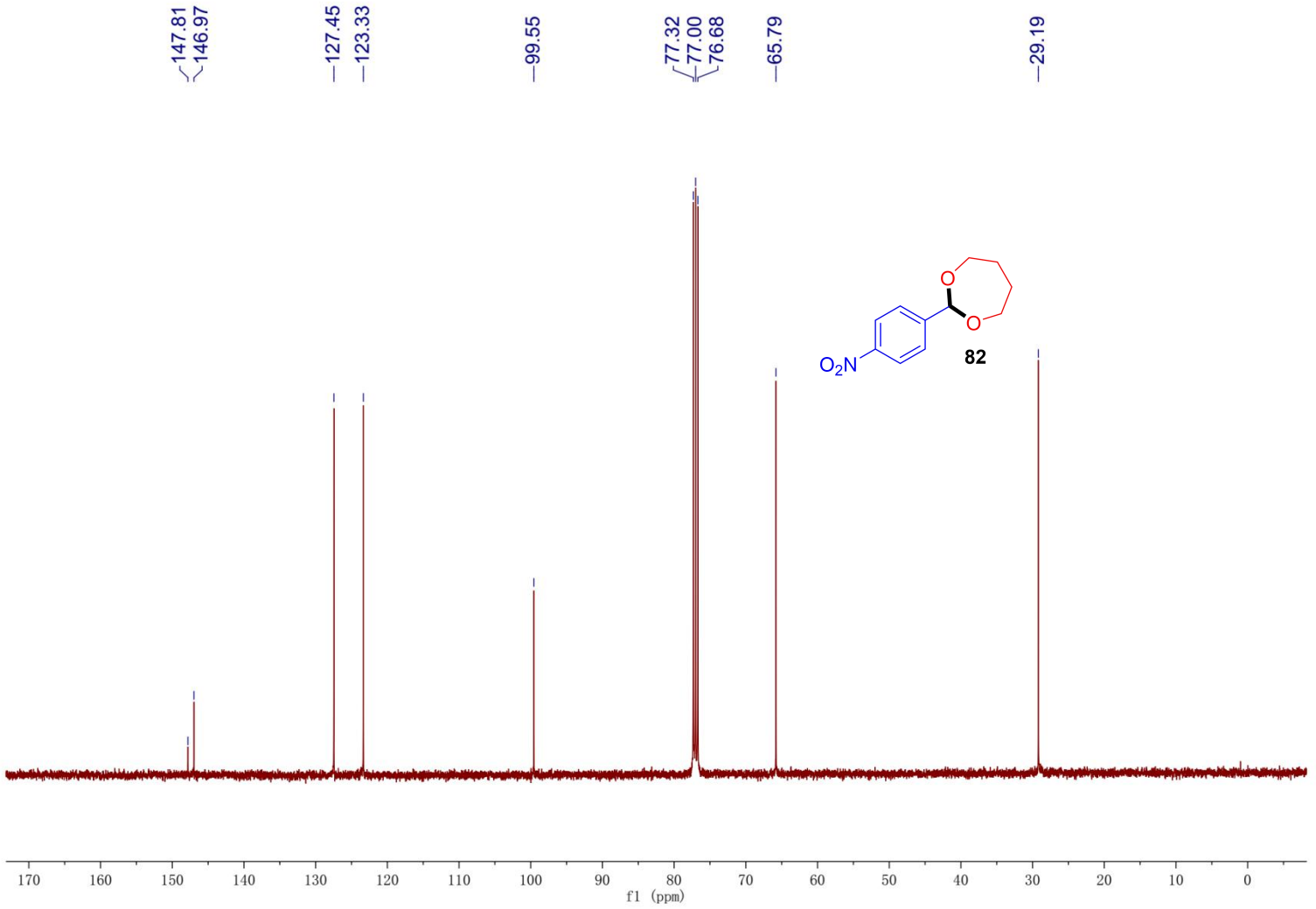

8.22 8.20 7.65 7.63 5.47 4.20 4.18 4.16 4.14 4.13 2.24 2.23 2.22 2.21 2.20 2.19 2.18 2.18 2.16 2.16 2.13 2.13 2.12 2.11 2.10 2.09 2.07 2.06 2.06 2.05 2.04 2.03 2.02 2.00 1.99 1.98 1.98 1.97 1.96 1.93 1.72 1.70 1.67 1.65 1.63 1.53 1.51 1.50 1.48 1.48 1.47 1.46 1.45 1.45 1.43 1.43 1.41 0.00
O
O
O2N
80
2.05
2.06
1.00
2.09
2.40
6.44
2.42
2.44
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)

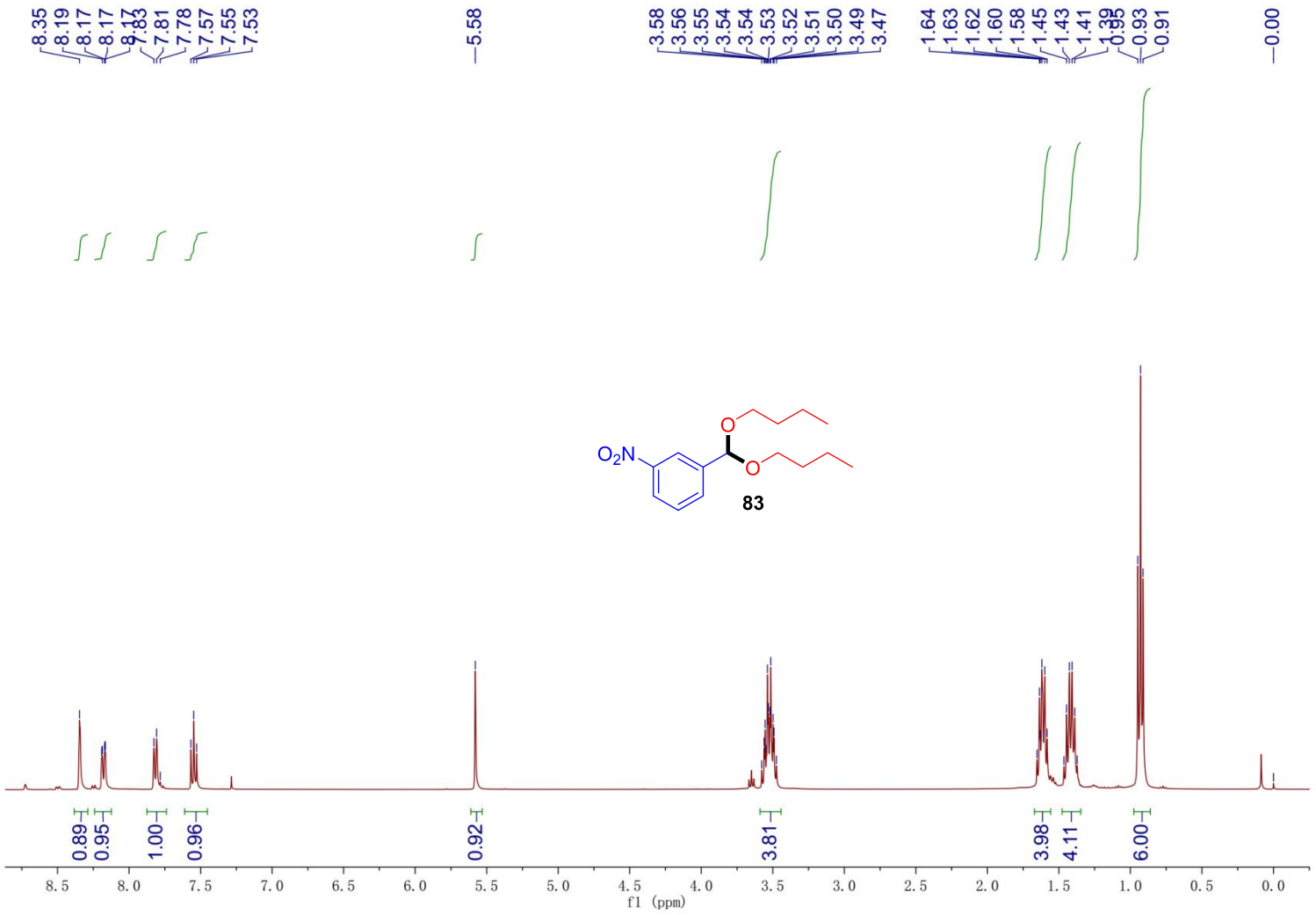

147.88
146.61
127.73
123.35
97.64
77.32
77.00
76.68
69.69
31.32
31.04
12.78
O
O
O2N
80
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


8.22
8.20
7.68
7.66
5.79
4.23
4.22
4.20
4.18
4.13
4.13
4.11
4.11
4.10
4.10
2.06
2.05
2.03
2.03
2.02
2.01
2.00
1.98
1.46
1.36
0.00
O
O
O2N
81
2.00
2.05
1.07
0.90
1.95
1.16
3.27
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)


147.96
145.86
127.28
123.36
93.71
77.32
77.00
76.68
72.73
63.59
35.66
31.61
21.47
O2N
81
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.22
8.20
7.69
7.67
5.75
3.93
3.92
3.92
3.90
3.89
3.81
3.80
3.79
3.78
3.77
3.77
1.82
1.81
1.79
1.78
1.76
1.75
0.00
O
O
O2N
82
2.00
2.02
1.08
2.07
1.99
4.36
f1 (ppm)


147.81
146.97
127.45
123.33
99.55
77.32
77.00
76.68
65.79
29.19
O
O
O2N
82
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.35
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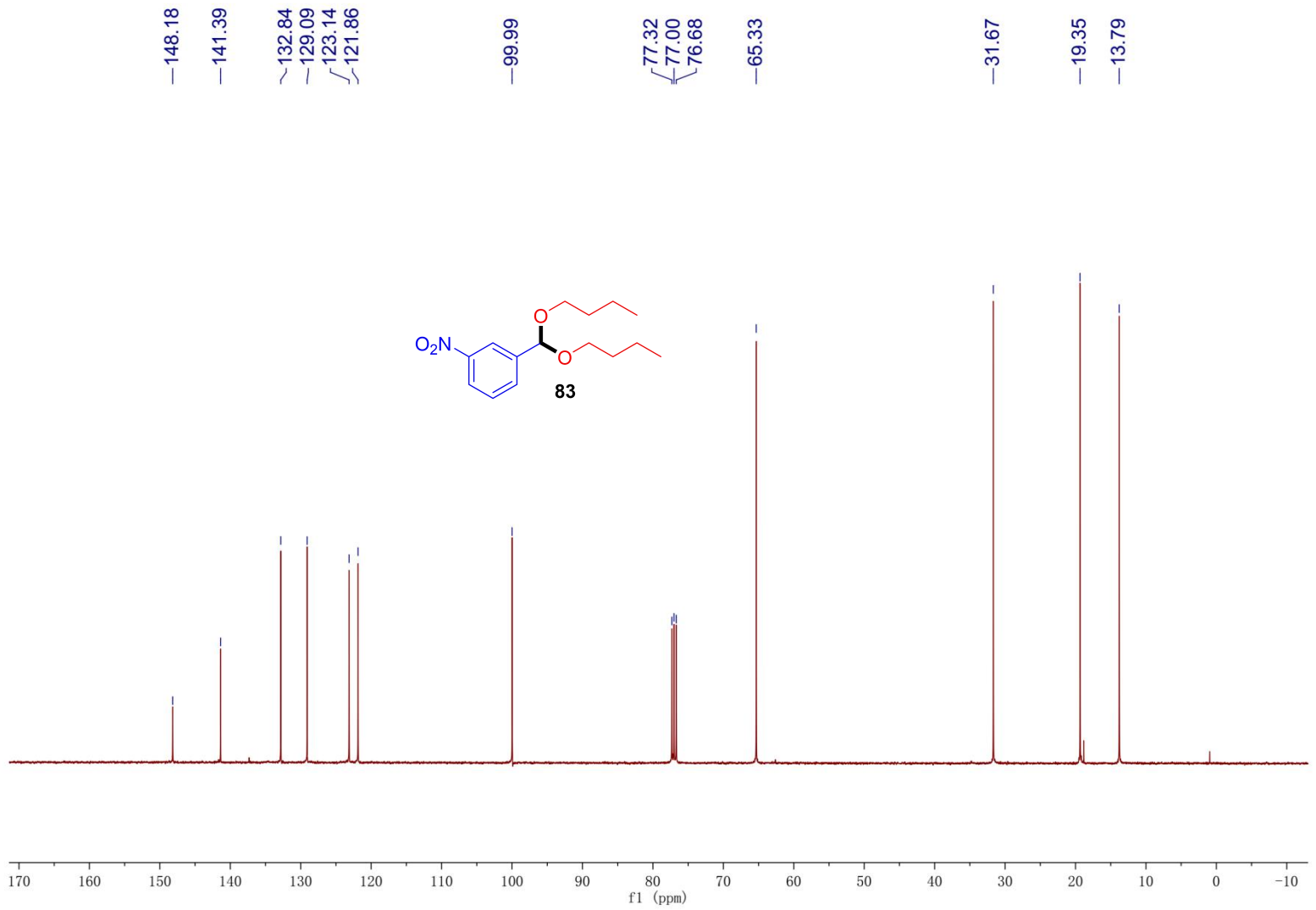
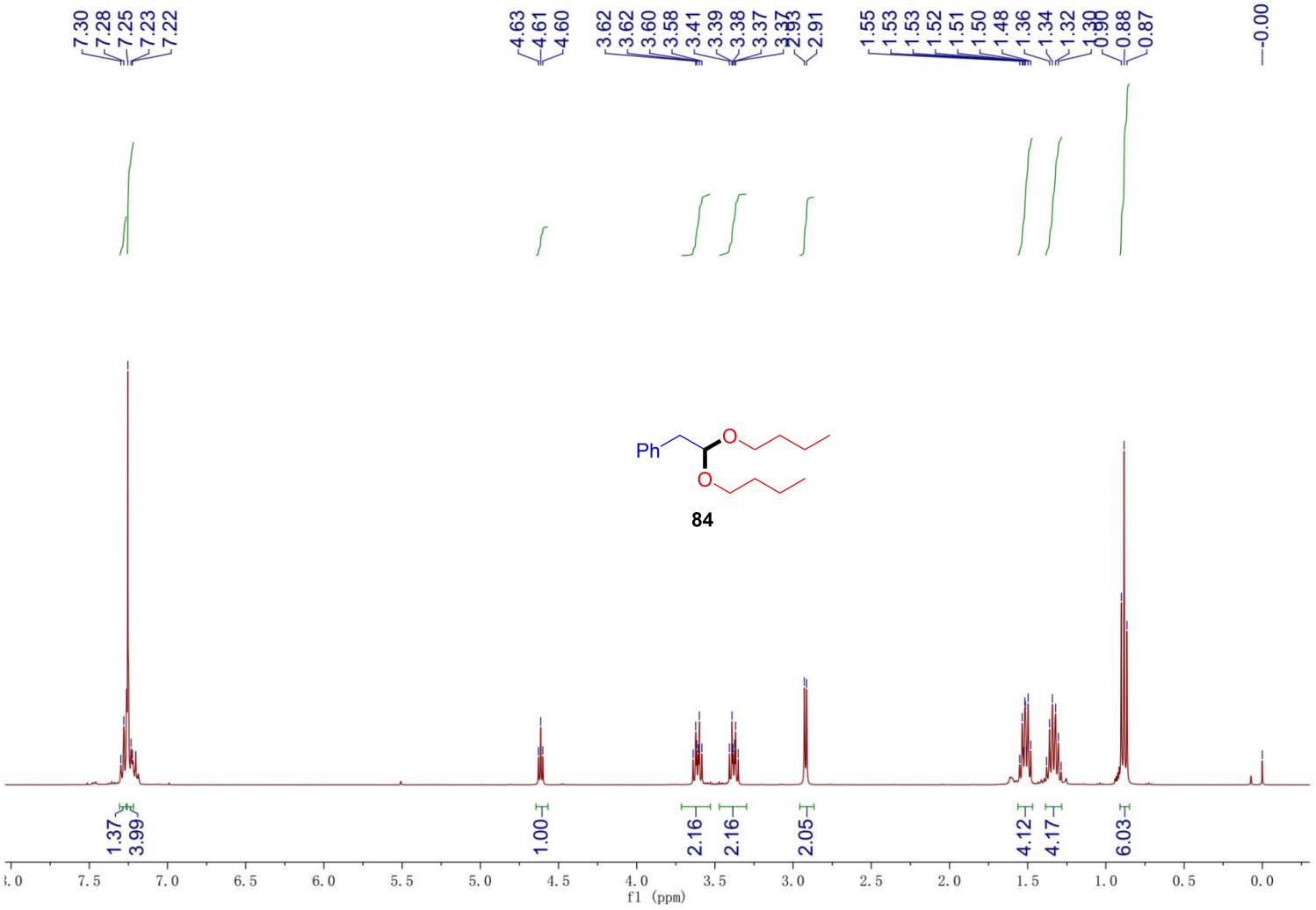
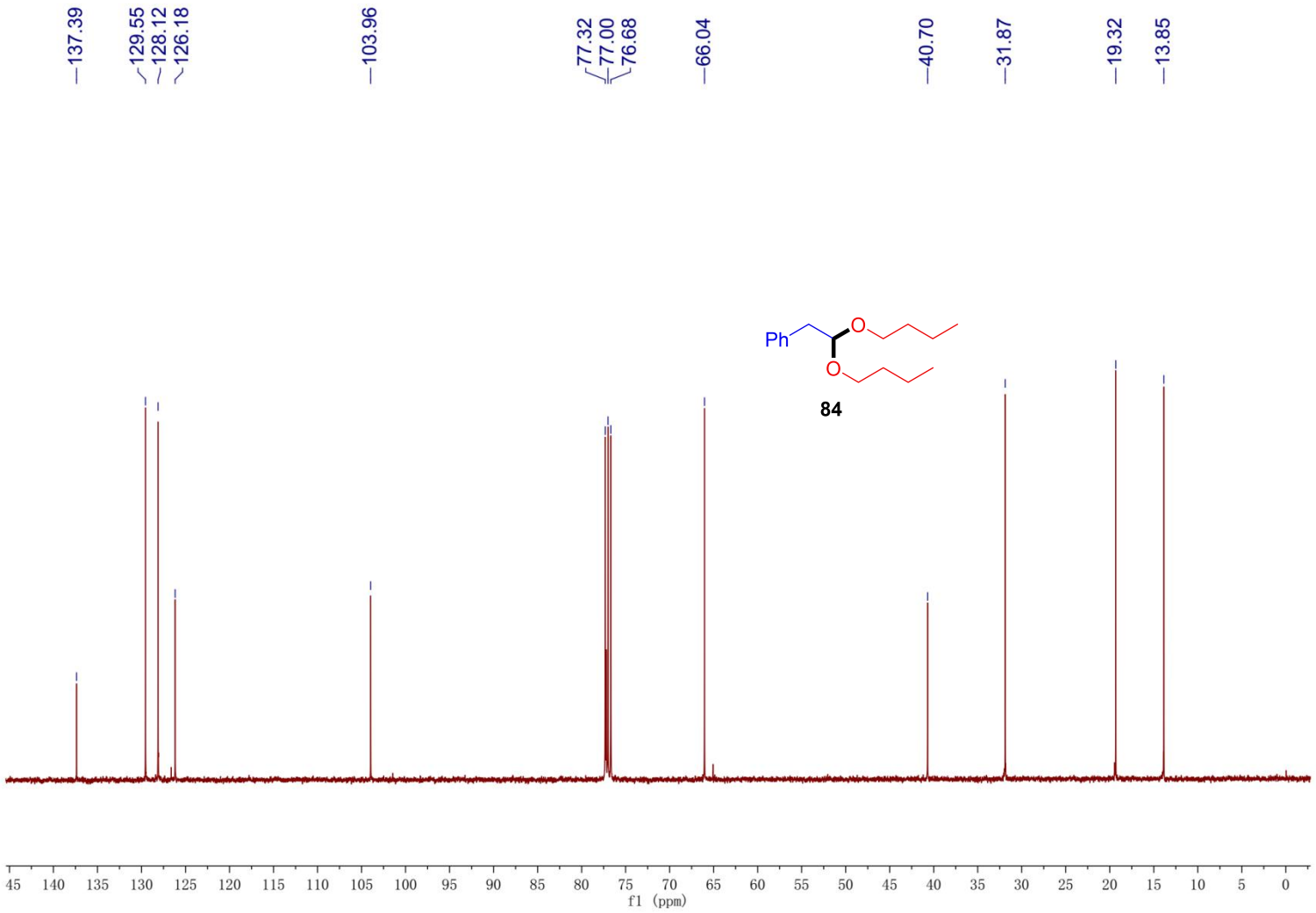
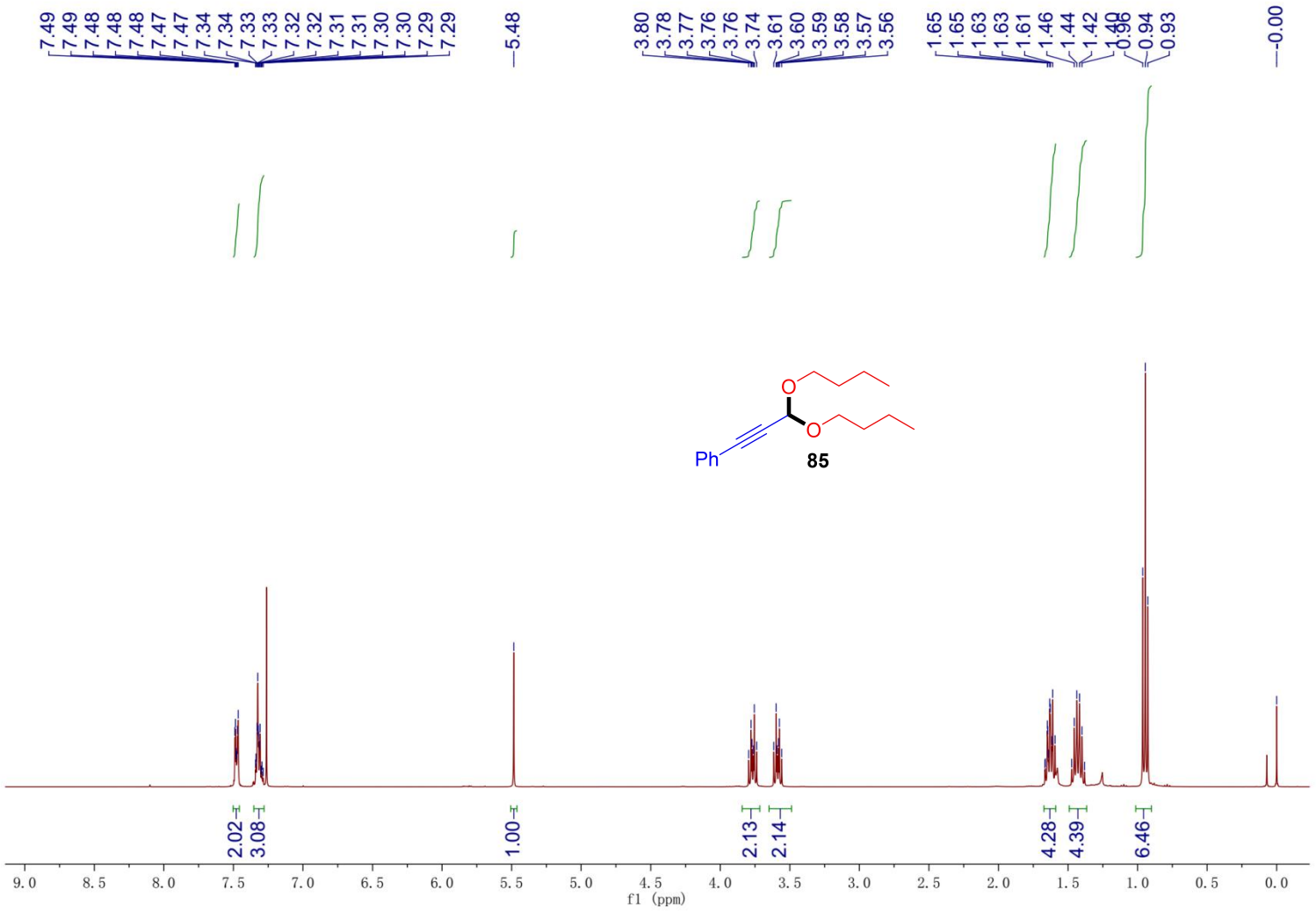
8.17
8.17
7.83
7.81
7.78
7.57
7.55
7.53
5.58
3.58
3.56
3.55
3.54
3.54
3.53
3.52
3.51
3.50
3.49
3.47
1.64
1.63
1.62
1.60
1.58
1.45
1.43
1.41
0.93
0.91
0.00
O2N
O
O
83
0.89
0.95
1.00
0.96
0.92
3.81
3.98
4.11
6.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


148.18
141.39
132.84
129.09
123.14
121.86
99.99
77.32
77.00
76.68
65.33
31.67
19.35
13.79
O2N
O
O
83
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


7.30
7.28
7.25
7.23
7.22
4.63
4.61
4.60
3.62
3.62
3.60
3.58
3.41
3.39
3.38
3.37
2.93
2.91
1.55
1.53
1.53
1.52
1.51
1.50
1.48
1.36
1.34
1.32
0.88
0.87
-0.00
Ph
O
O
84
1.37
3.99
1.00
2.16
2.16
2.05
4.12
4.17
6.03
f1 (ppm)


137.39
129.55
128.12
126.18
103.96
77.32
77.00
76.68
66.04
40.70
31.87
19.32
13.85
Ph
O
O
84
45 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0
f1 (ppm)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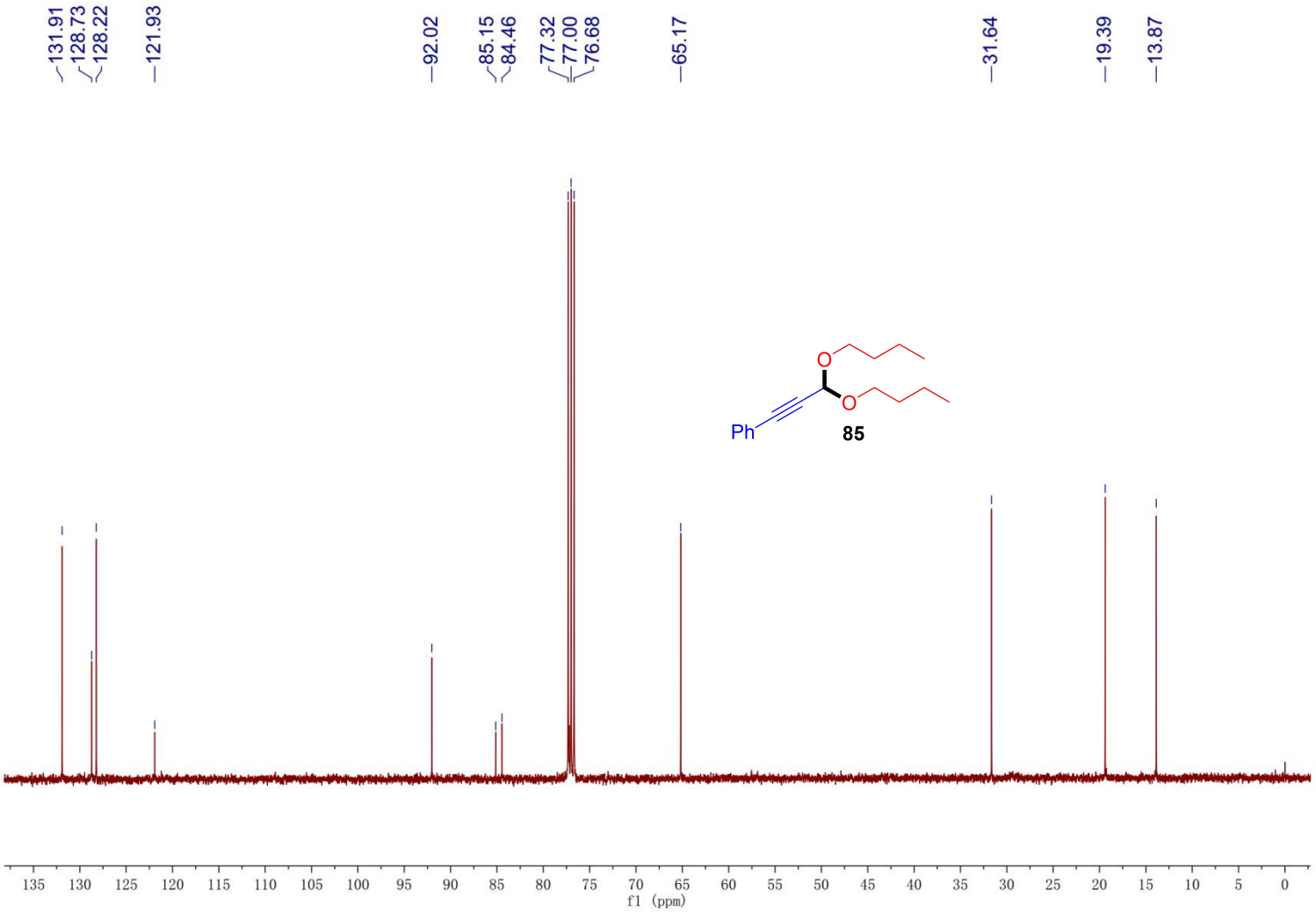
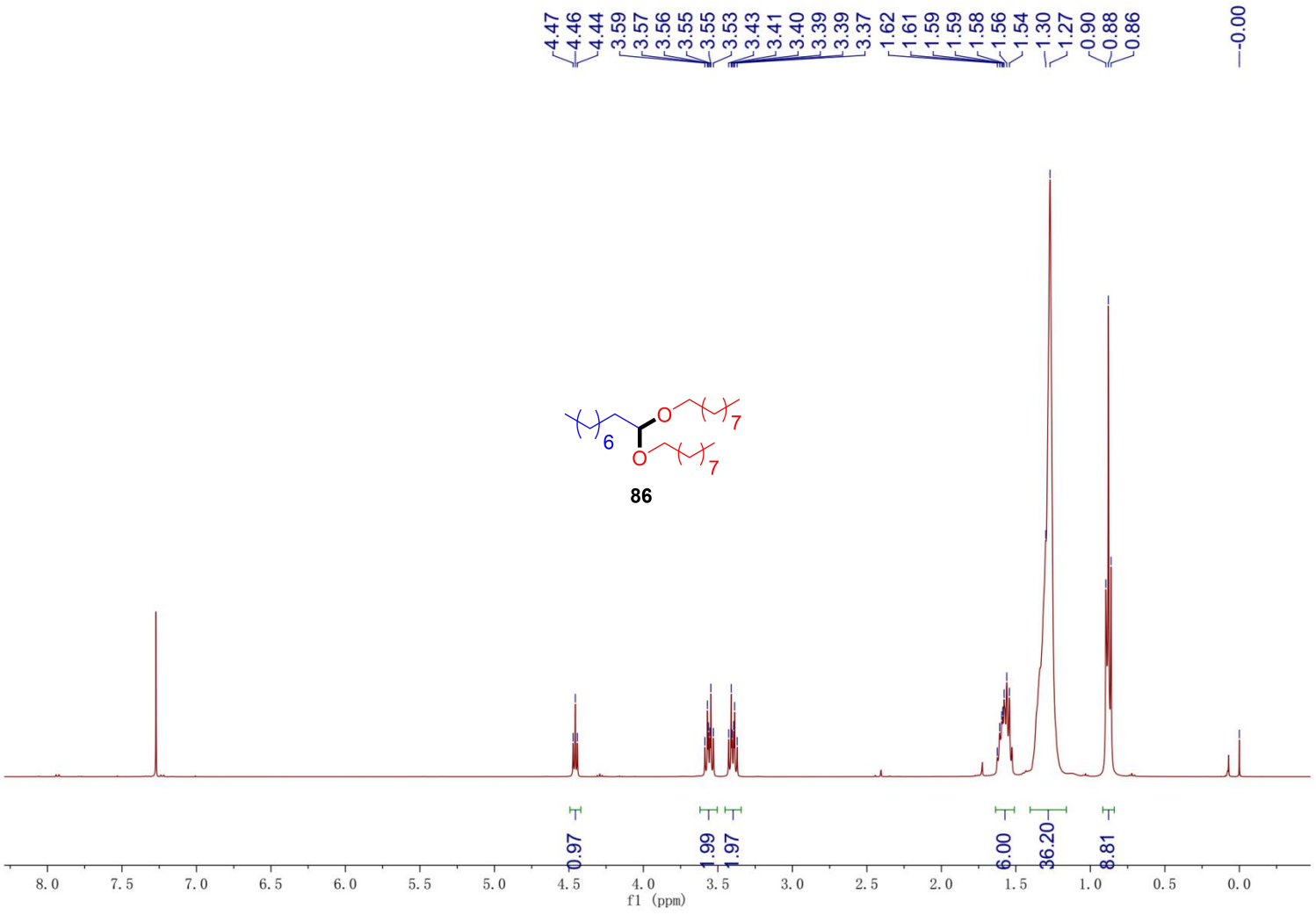
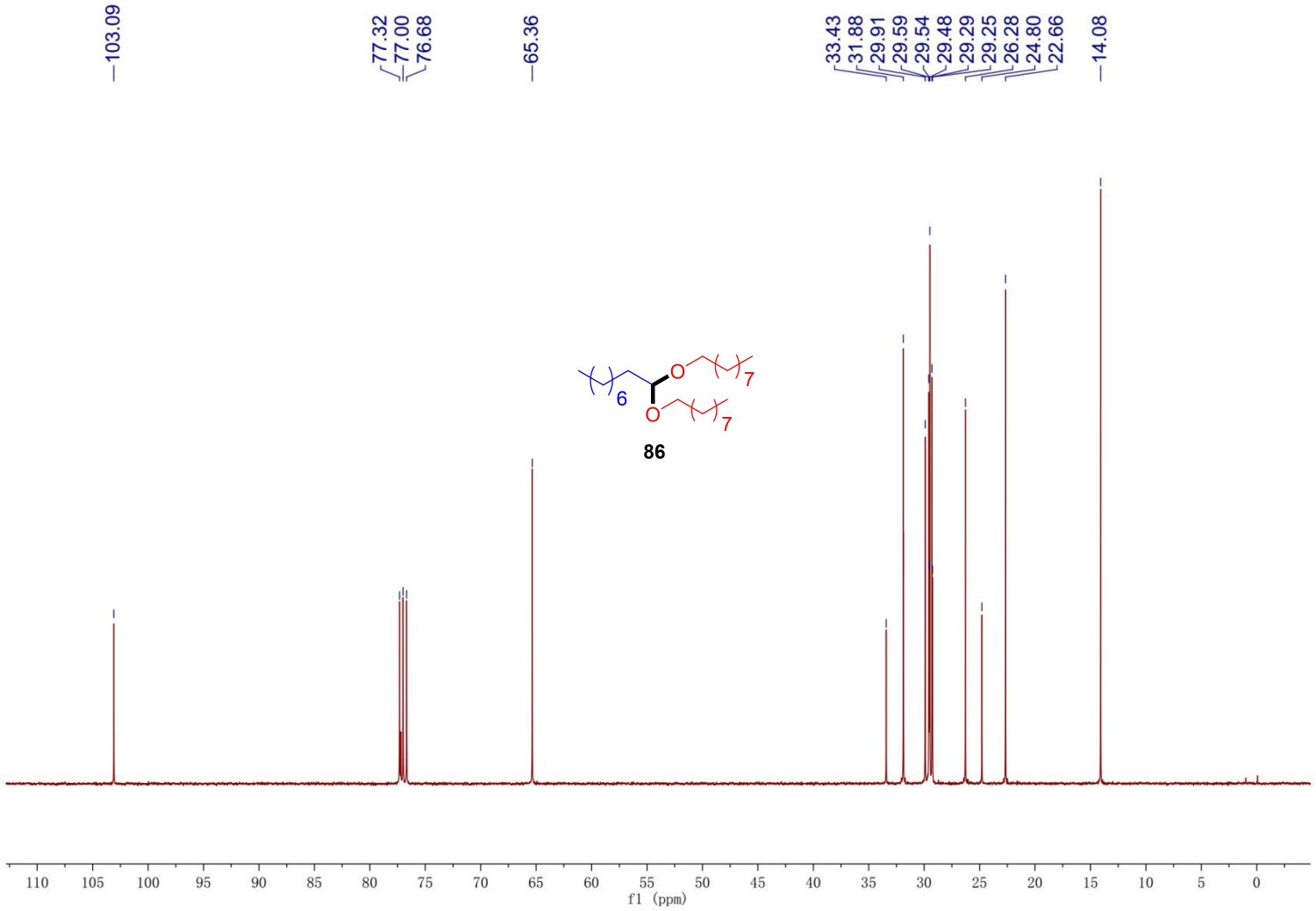
7.48
7.48
7.48
7.47
7.47
7.34
7.34
7.33
7.33
7.32
7.32
7.31
7.31
7.30
7.30
7.29
7.29
5.48
3.80
3.78
3.77
3.76
3.76
3.74
3.61
3.60
3.59
3.58
3.57
3.56
1.65
1.65
1.63
1.63
1.61
1.46
1.44
1.42
0.94
0.93
0.00
O
O
Ph
85
2.02
3.08
1.00
2.13
2.14
4.28
4.39
6.46
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

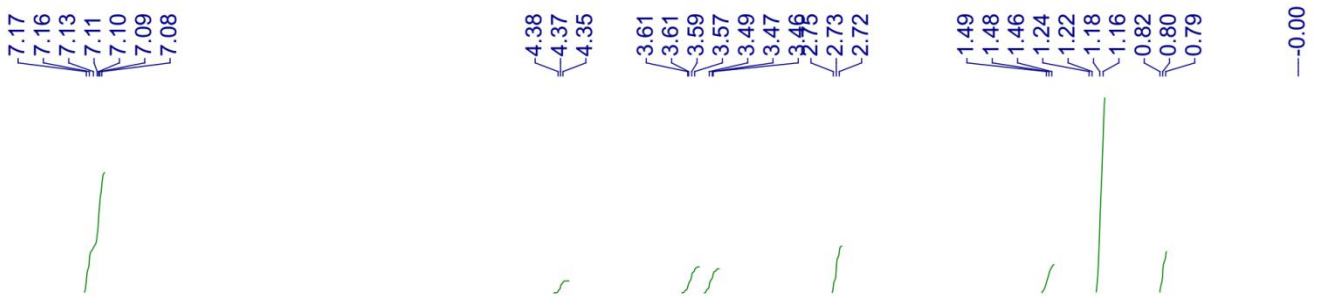

131.91
128.73
128.22
121.93
92.02
85.15
84.46
77.32
77.00
76.68
65.17
31.64
19.39
13.87
O
O
Ph
85
135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0
f1 (ppm)

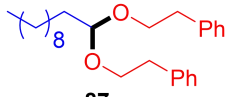

4.47
4.46
4.44
3.59
3.57
3.56
3.55
3.55
3.53
3.43
3.41
3.40
3.39
3.39
3.37
1.62
1.61
1.59
1.59
1.58
1.56
1.54
1.30
1.27
0.90
0.88
0.86
-0.00
O
O
6
7
7
0.97
1.99
1.97
6.00
36.20
8.81
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

86

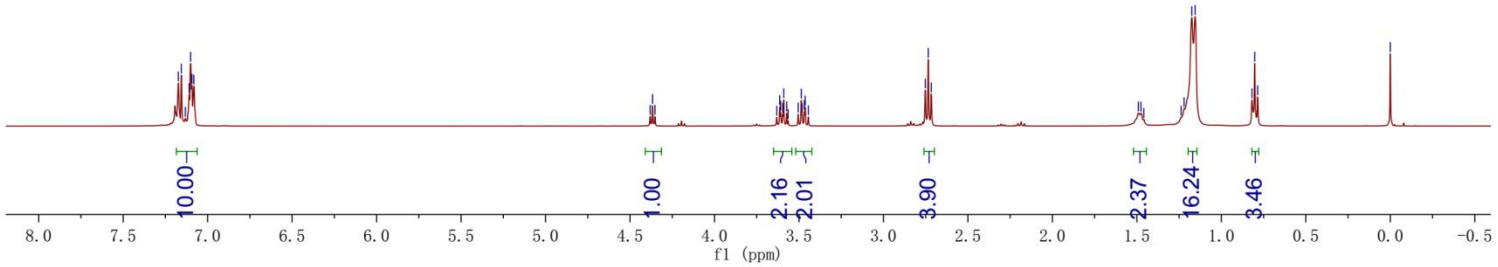

103.09
77.32
77.00
76.68
65.36
33.43
31.88
29.91
29.59
29.54
29.48
29.29
29.25
26.28
24.80
22.66
14.08
6
7
7
O
O
110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0
f1 (ppm)

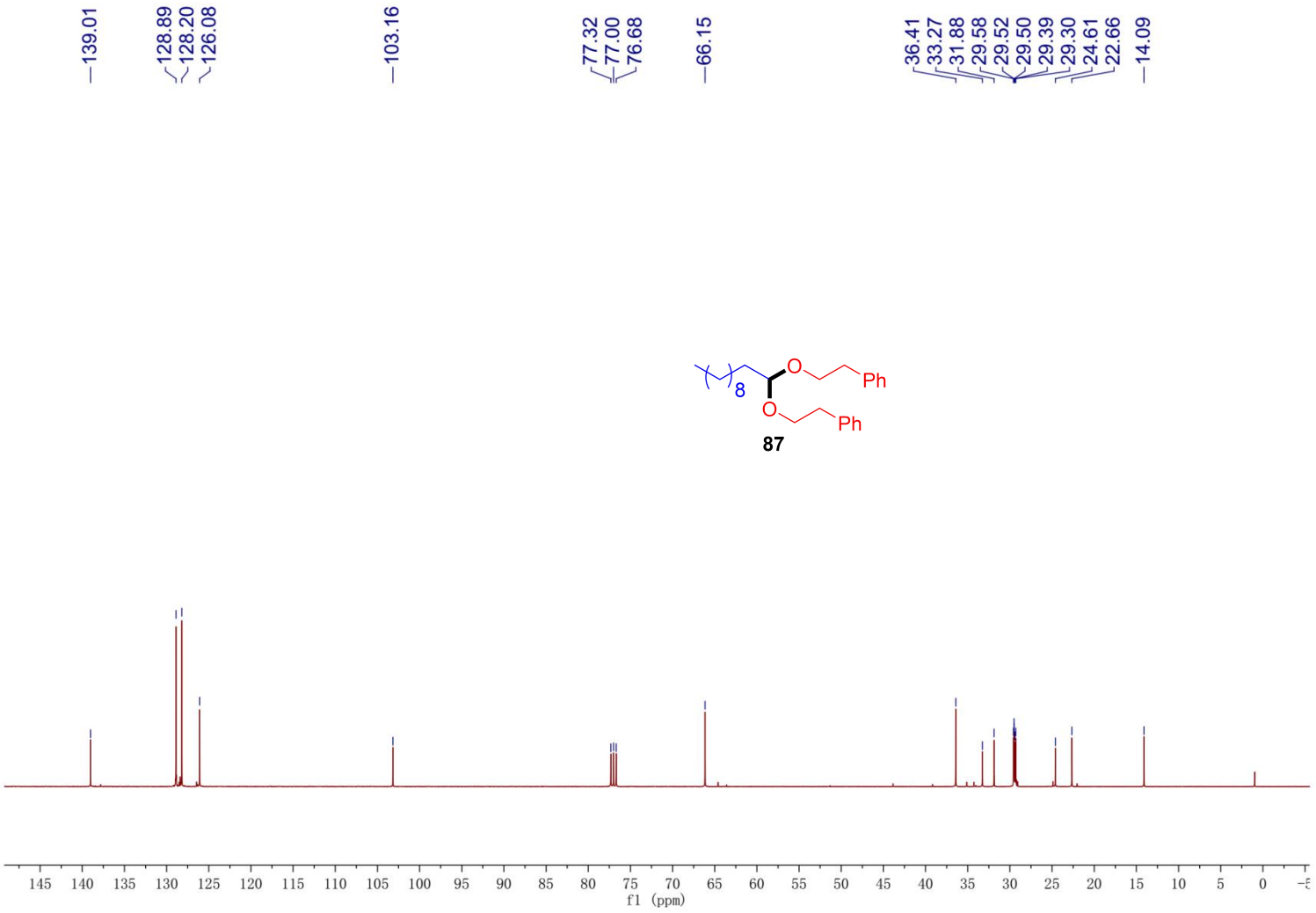
86


7.17
7.16
7.13
7.11
7.10
7.09
7.08
4.38
4.37
4.35
3.61
3.61
3.59
3.57
3.49
3.47
2.73
2.72
1.49
1.48
1.46
1.24
1.22
1.18
1.16
0.82
0.80
0.79
0.00

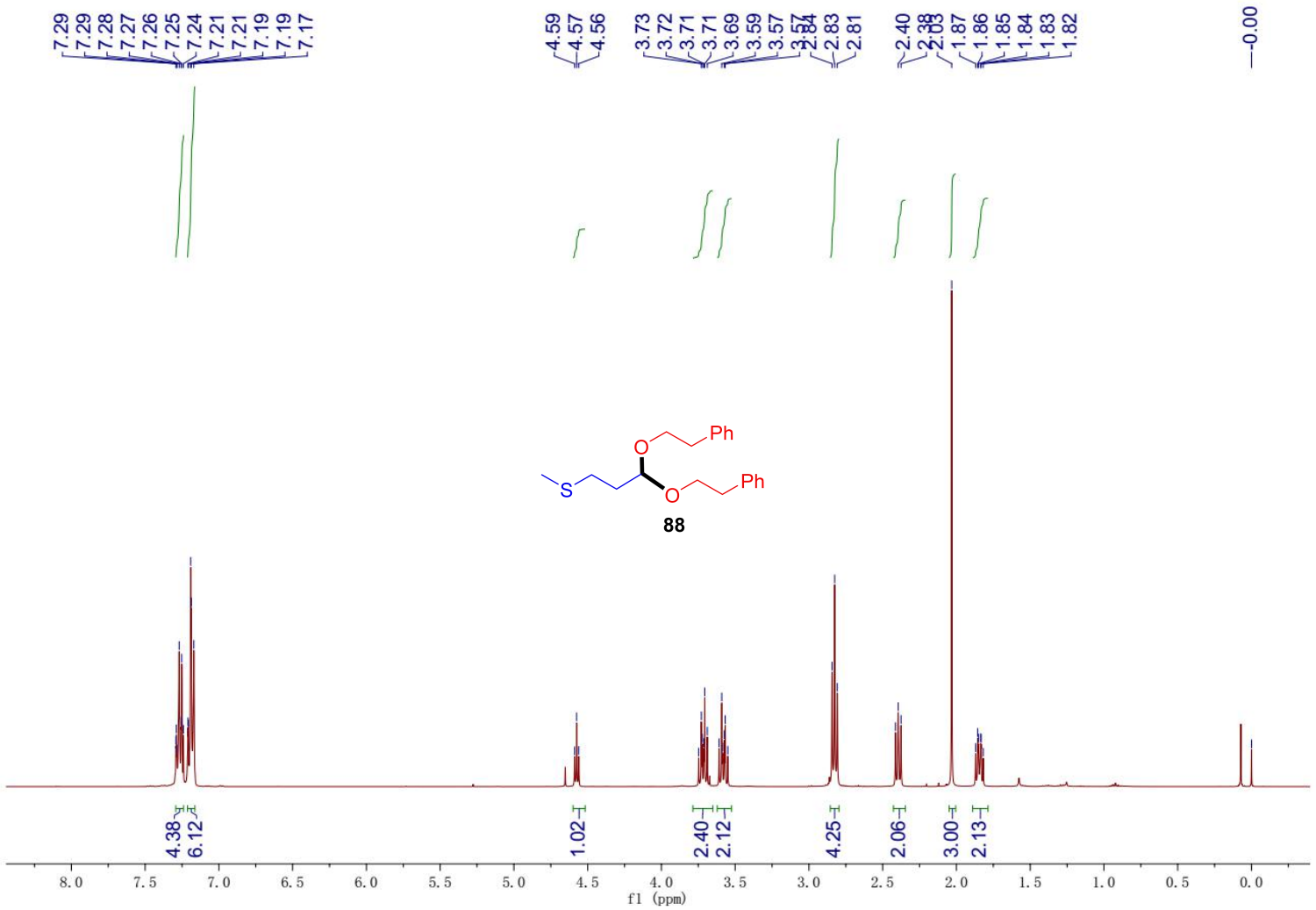

8
O
Ph
O
Ph

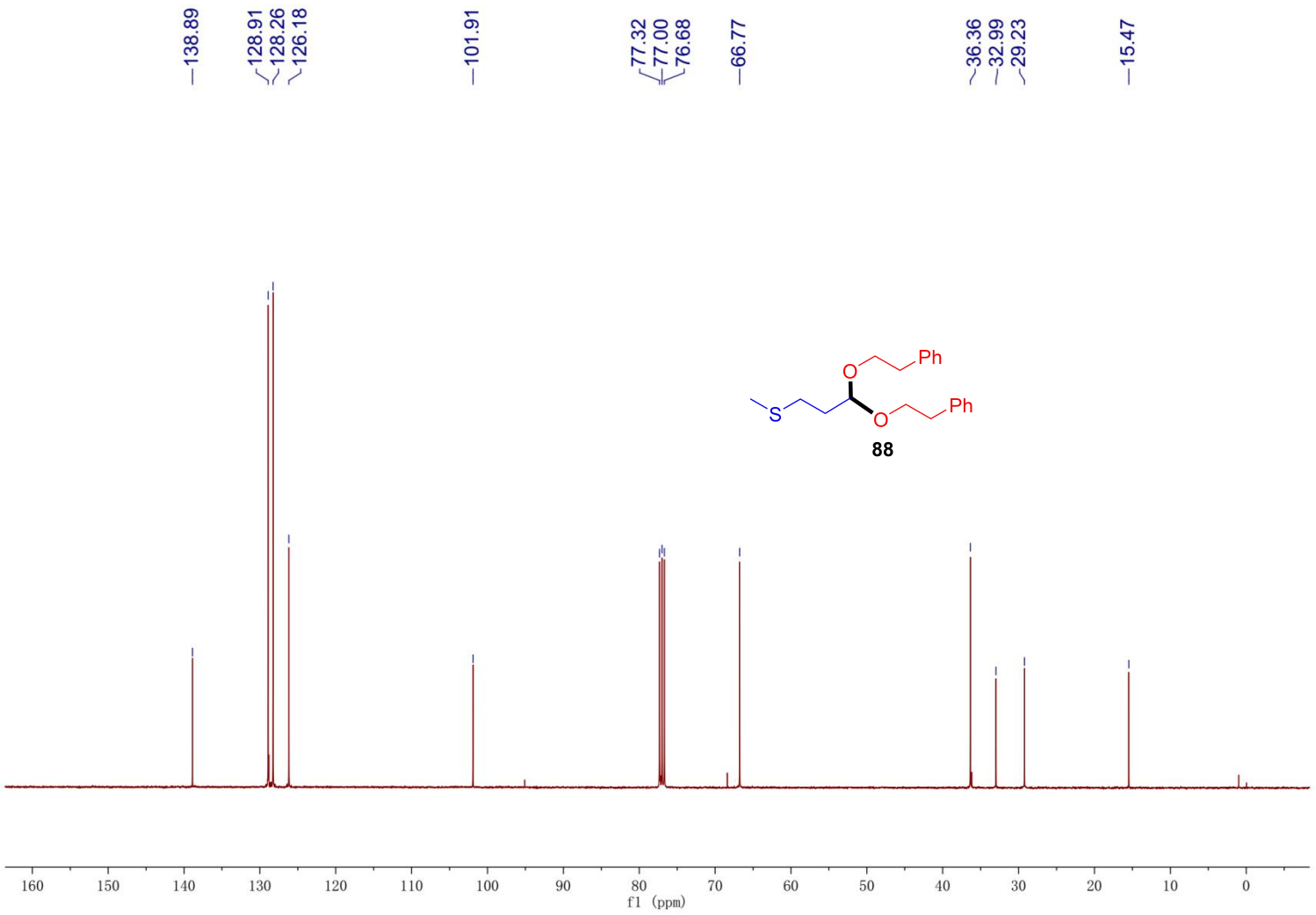
87


10.00
1.00
2.16
2.01
3.90
2.37
16.24
3.46
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)

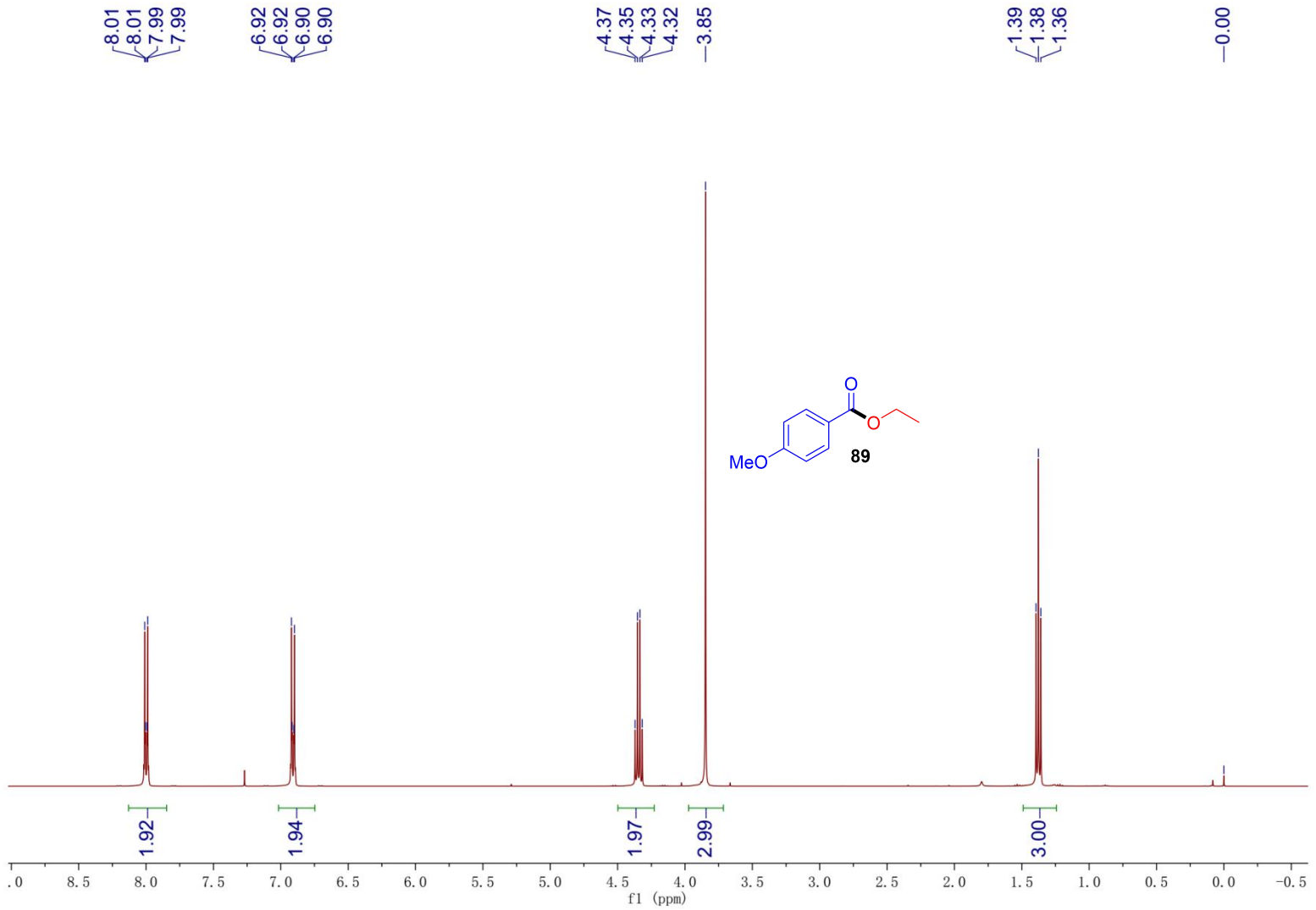

139.01
128.89
128.20
126.08
103.16
77.32
77.00
76.68
66.15
36.41
33.27
31.88
29.58
29.52
29.50
29.39
29.30
24.61
22.66
14.09
8
O
Ph
O
Ph
145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0
f1 (ppm)

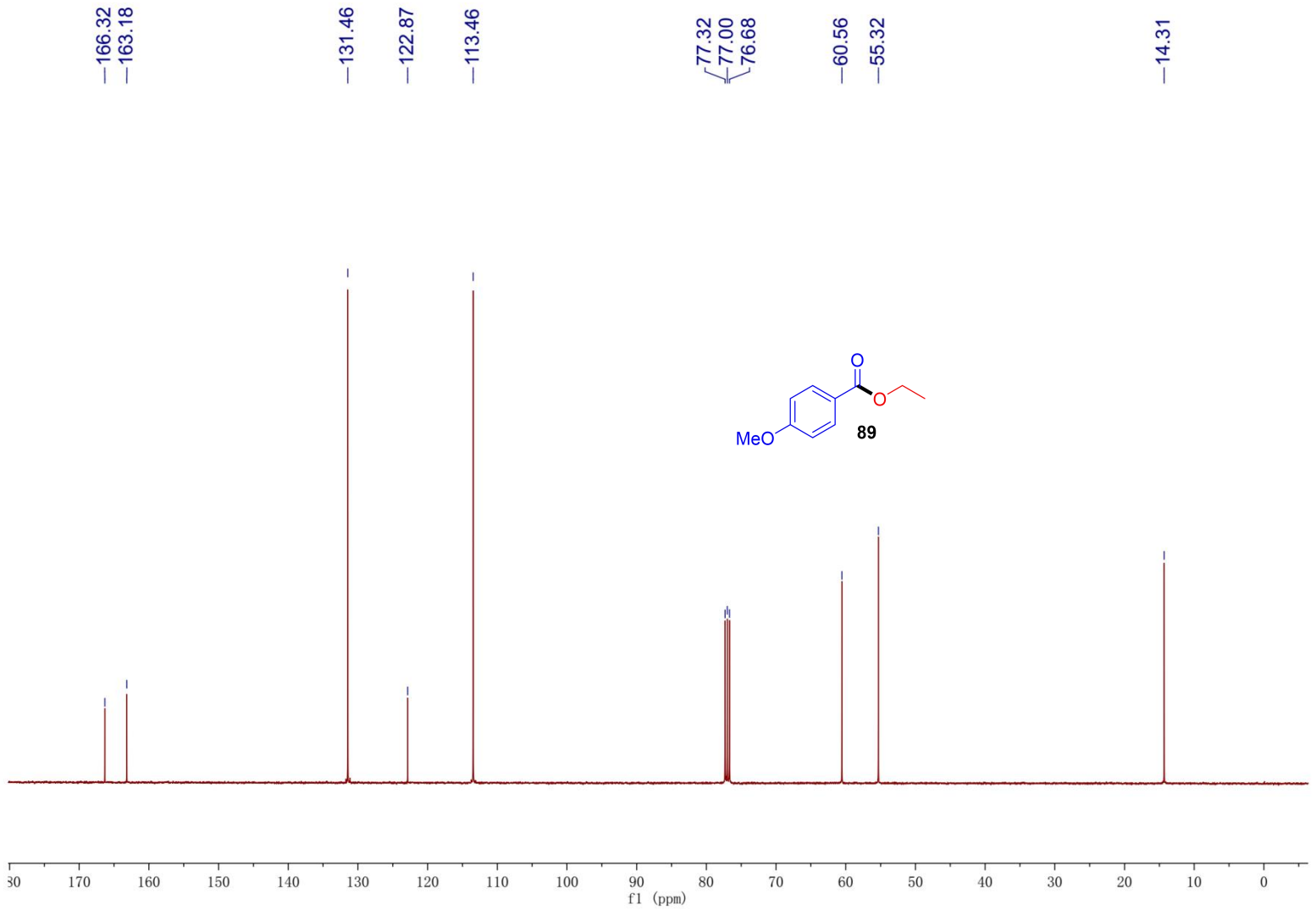
87

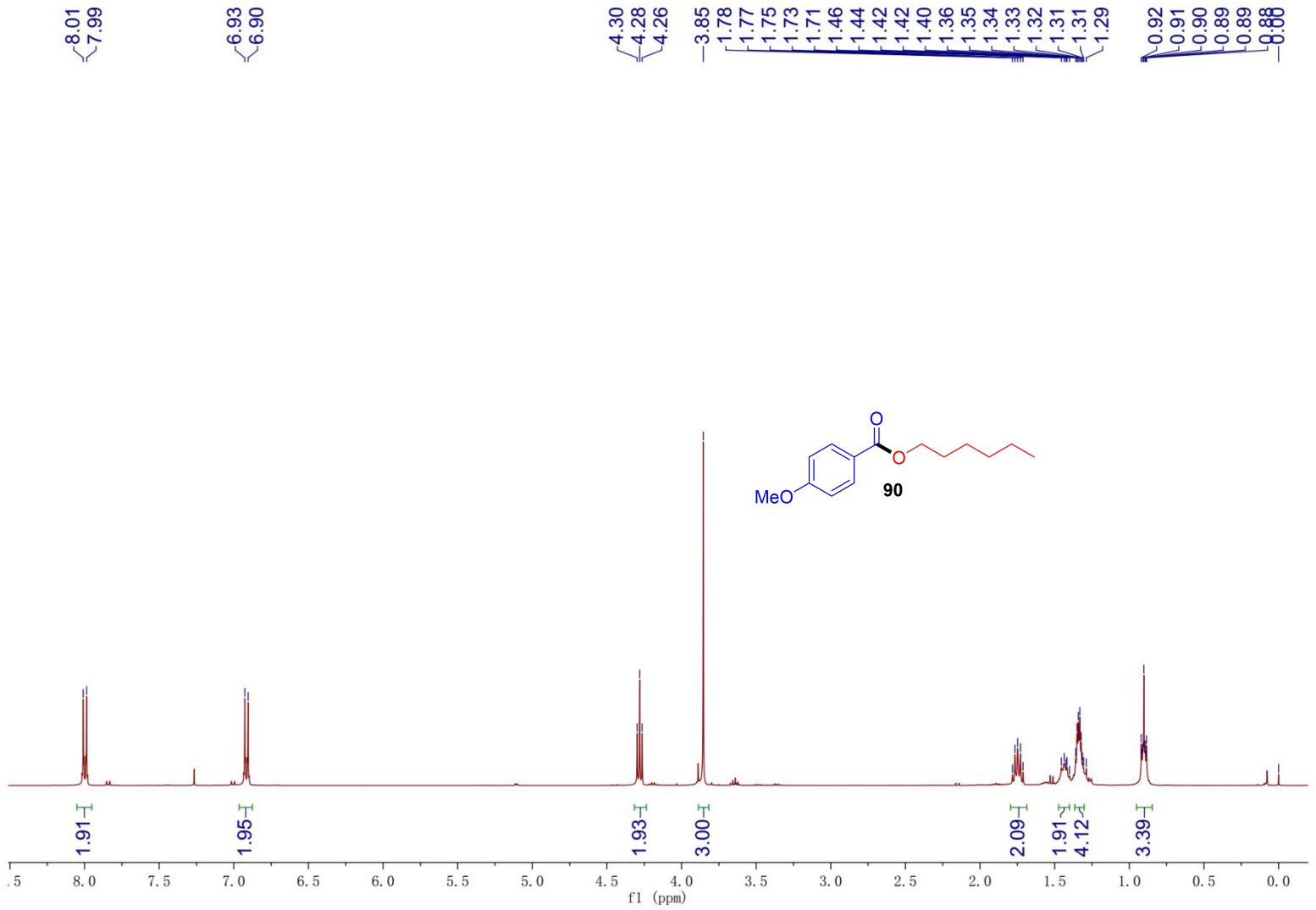

7.29
7.29
7.28
7.27
7.26
7.25
7.24
7.21
7.21
7.19
7.19
7.17
4.59
4.57
4.56
3.73
3.72
3.71
3.71
3.69
3.59
3.57
2.84
2.83
2.81
2.40
1.87
1.86
1.85
1.84
1.83
1.82
0.00
Ph
O
S
O
Ph
88
4.38
6.12
1.02
2.40
2.12
4.25
2.06
3.00
2.13
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

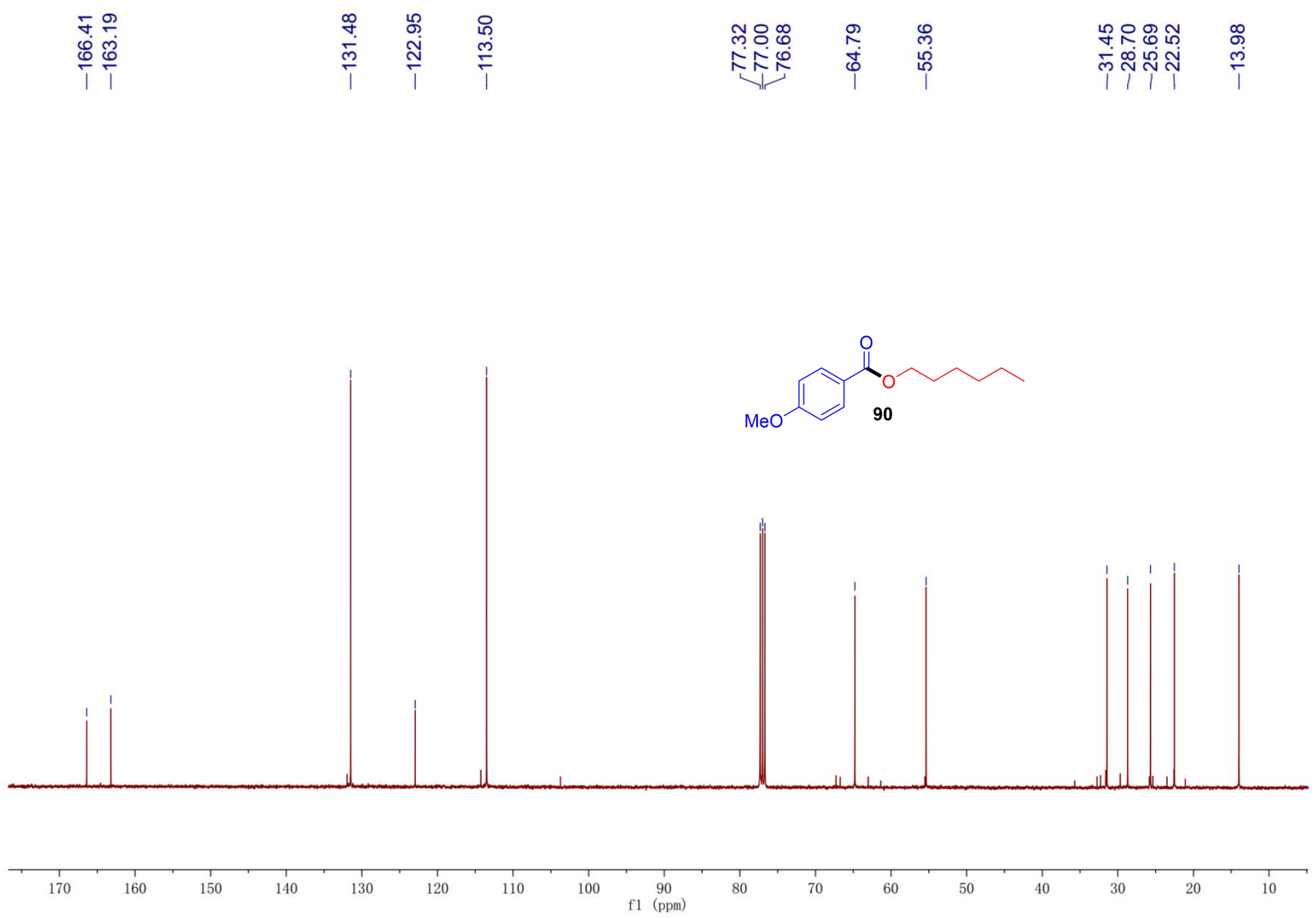

138.89
128.91
128.26
126.18
101.91
77.32
77.00
76.68
66.77
36.36
32.99
29.23
15.47
Ph
O
Ph
S
O
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

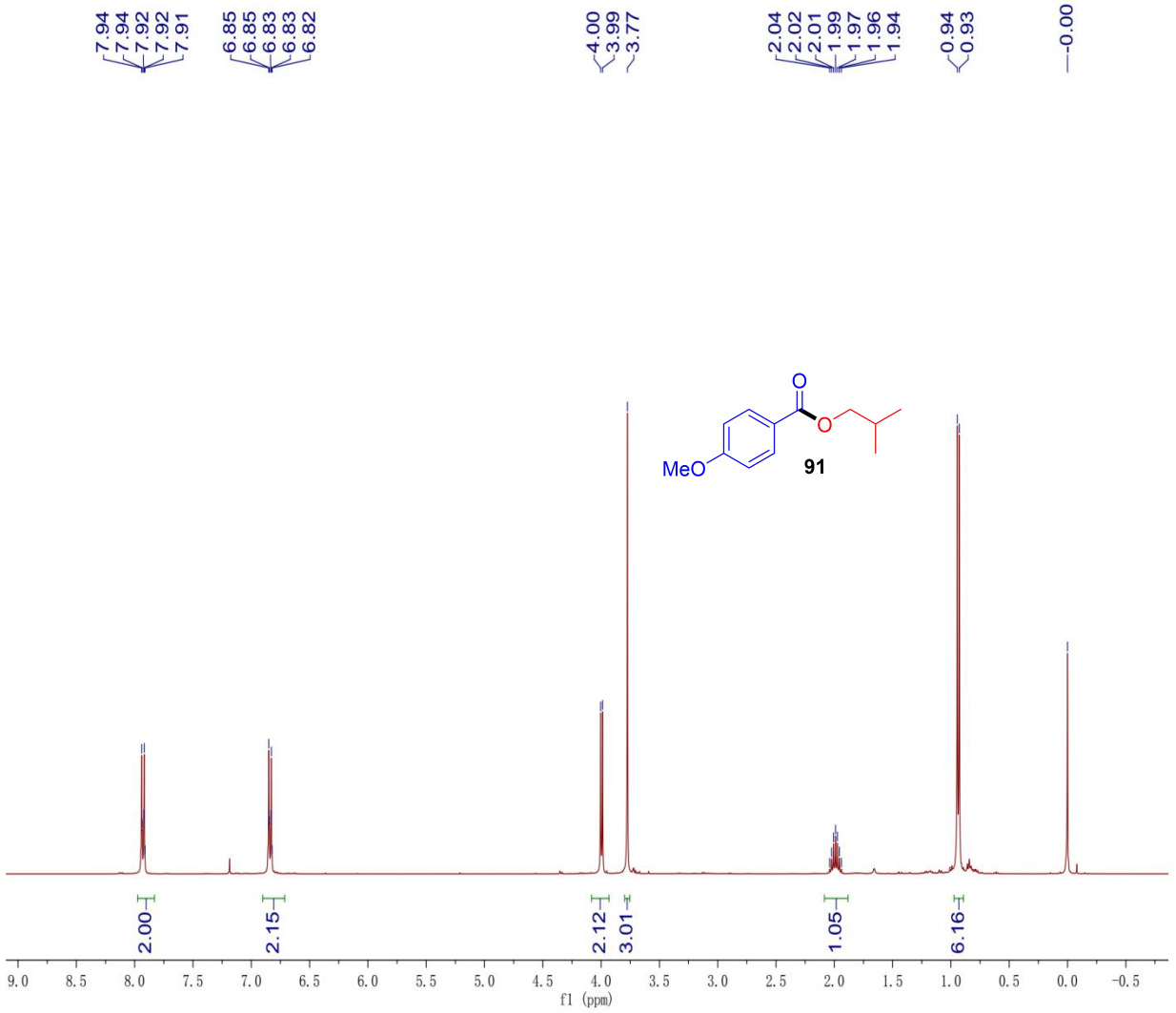
88

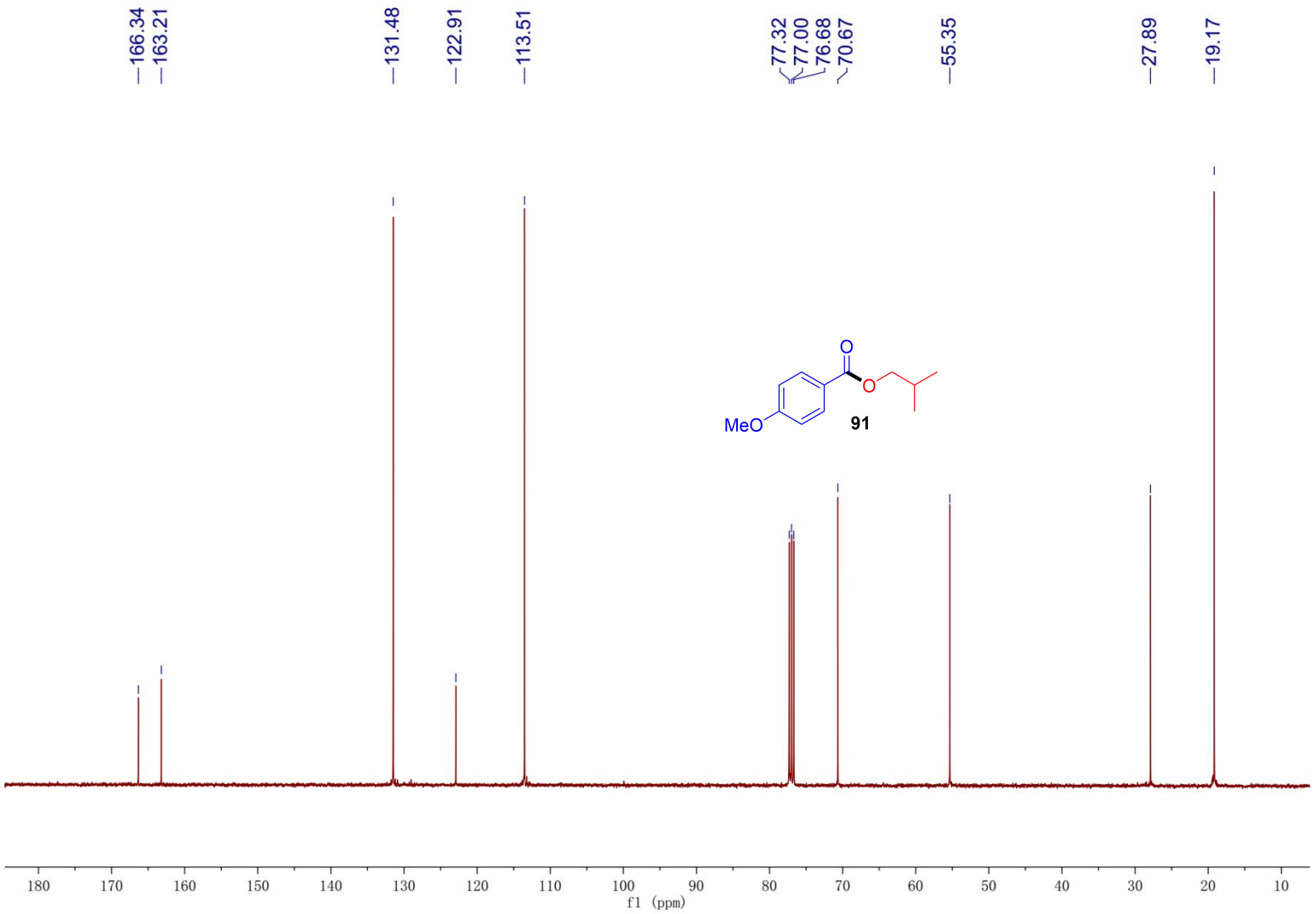

8.01
8.01
7.99
7.99
6.92
6.92
6.90
6.90
4.37
4.35
4.33
4.32
3.85
1.39
1.38
1.36
0.00
MeO
O
O
89
1.92
1.94
1.97
2.99
3.00
f1 (ppm)


166.32
163.18
131.46
122.87
113.46
77.32
77.00
76.68
60.56
55.32
14.31
O
O
MeO
89
f1 (ppm)

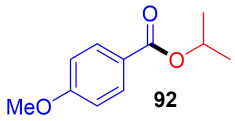

8.01
7.99
6.93
6.90
4.30
4.28
4.26
3.85
1.78
1.77
1.75
1.73
1.71
1.46
1.44
1.42
1.42
1.40
1.36
1.35
1.34
1.33
1.32
1.31
1.31
1.29
0.92
0.91
0.90
0.89
0.89
MeO
O
O
90
1.91
1.95
1.93
3.00
2.09
1.91
4.12
3.39
f1 (ppm)


166.41
163.19
131.48
122.95
113.50
77.32
77.00
76.68
64.79
55.36
31.45
28.70
25.69
22.52
13.98
MeO
90
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

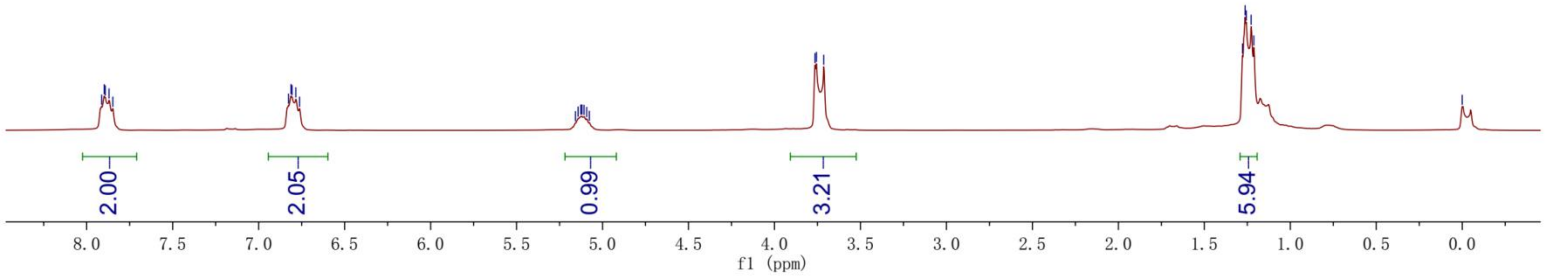

7.94
7.94
7.92
7.92
7.91
6.85
6.85
6.83
6.83
6.82
4.00
3.99
3.77
2.04
2.02
2.01
1.99
1.97
1.96
1.94
0.94
0.93
-0.00
MeO
91
2.00
2.15
2.12
3.01
1.05
6.16
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

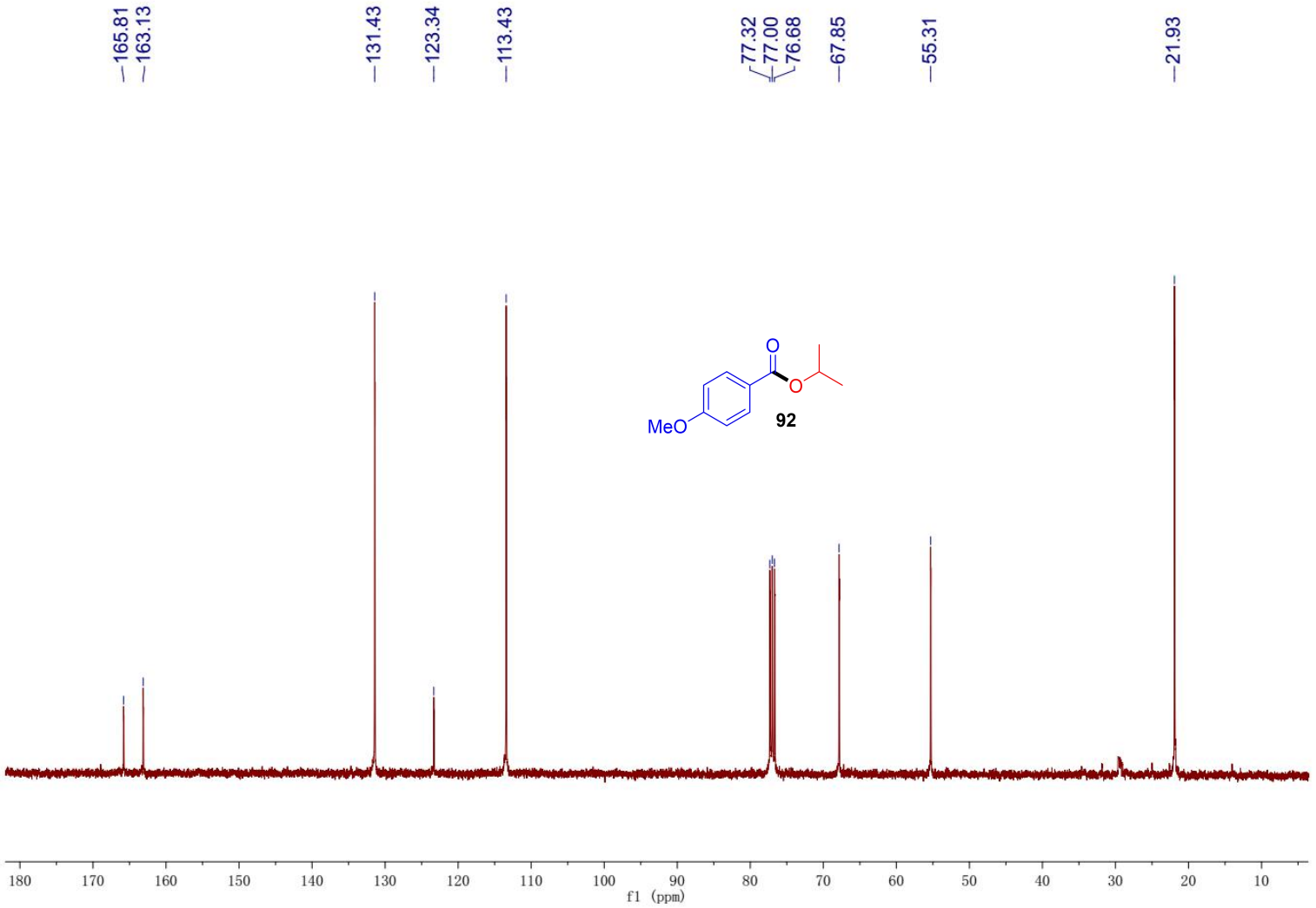

166.34
163.21
131.48
122.91
113.51
77.32
77.00
76.68
70.67
55.35
27.89
19.17
MeO
O
O
91
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

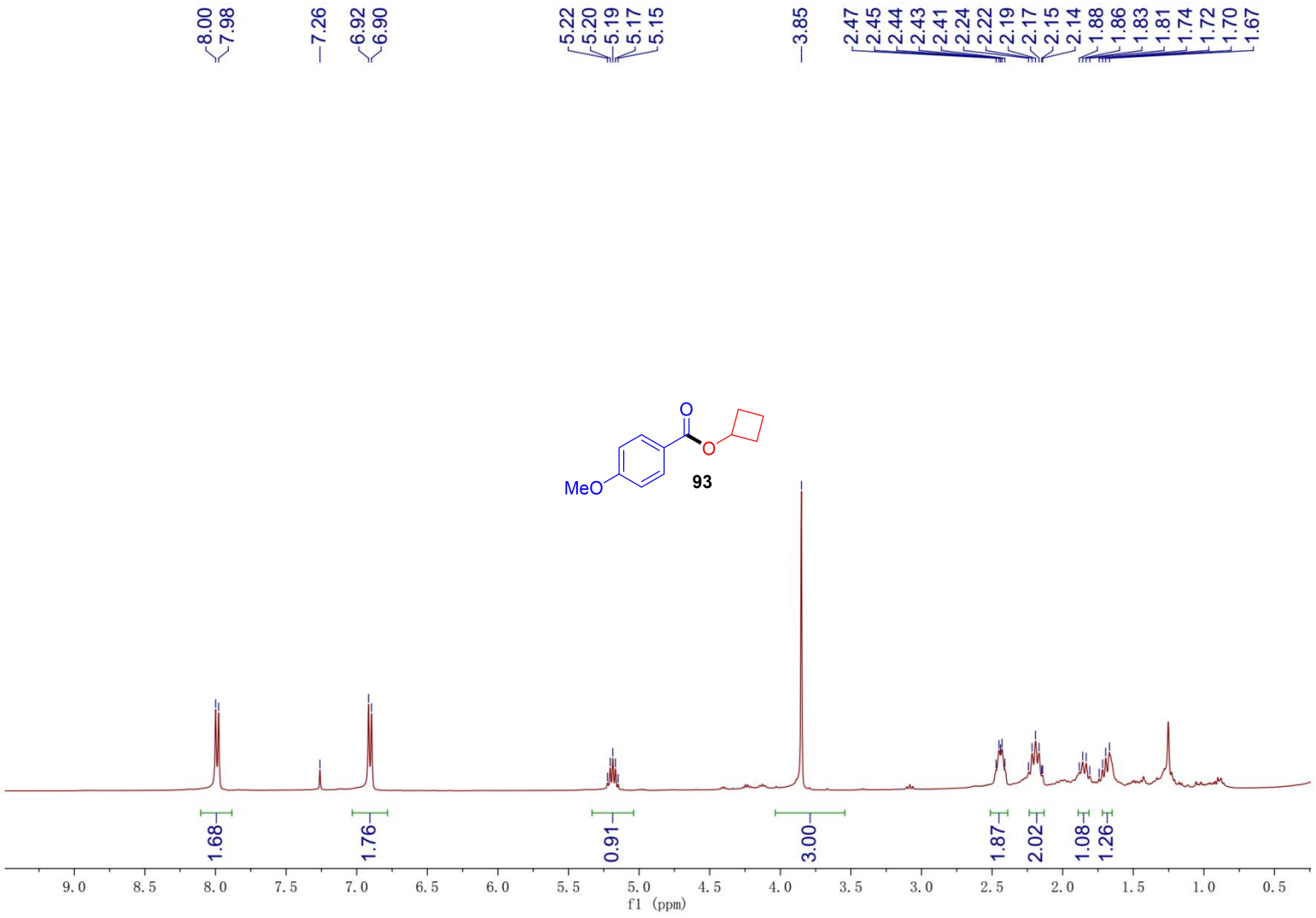

7.91
7.90
7.89
7.87
7.85
6.83
6.81
6.81
6.78
6.76
5.16
5.14
5.13
5.12
5.11
5.09
5.08
3.76
3.76
3.71
1.28
1.26
1.26
1.23
1.21
0.00

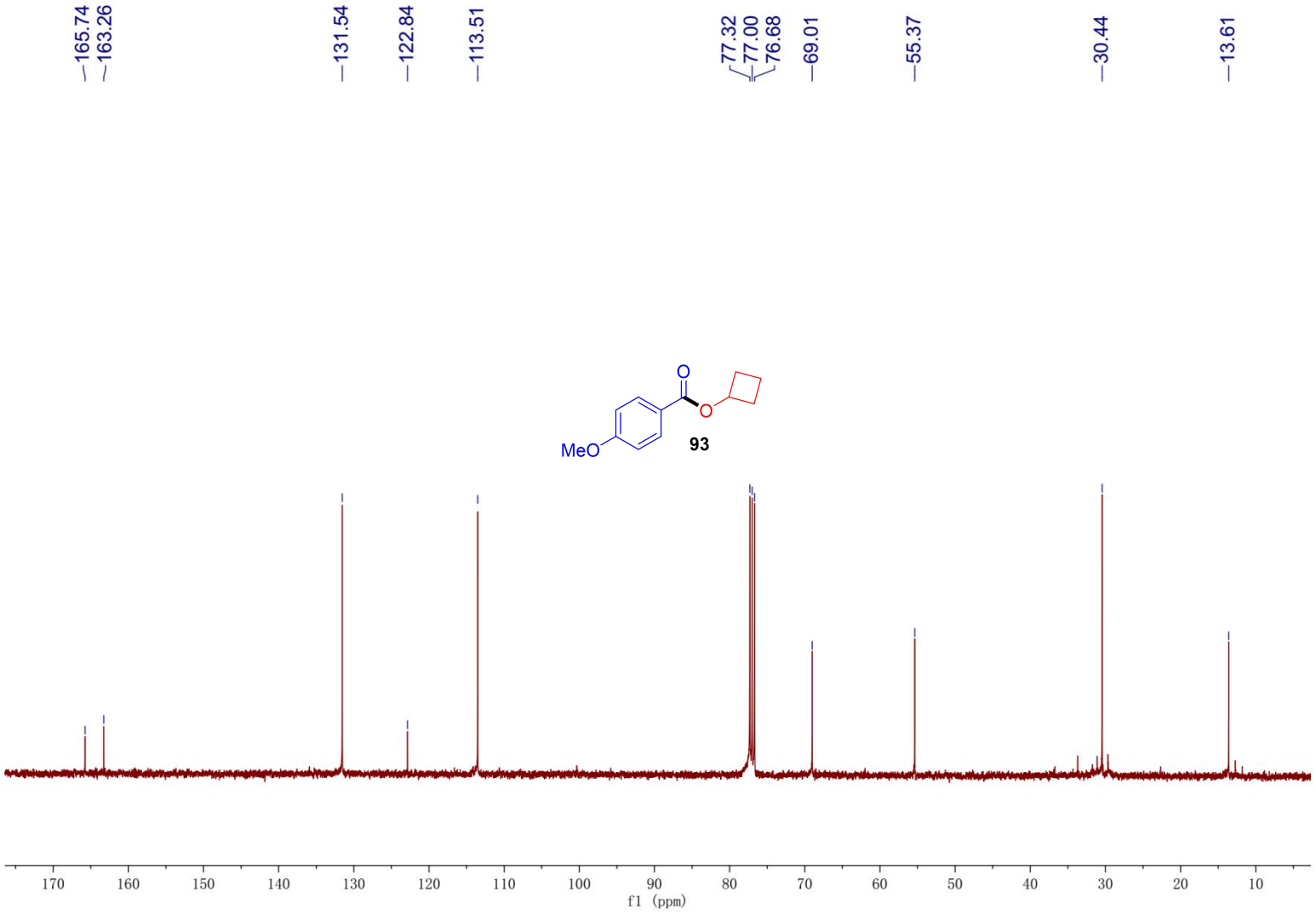

O
O
MeO

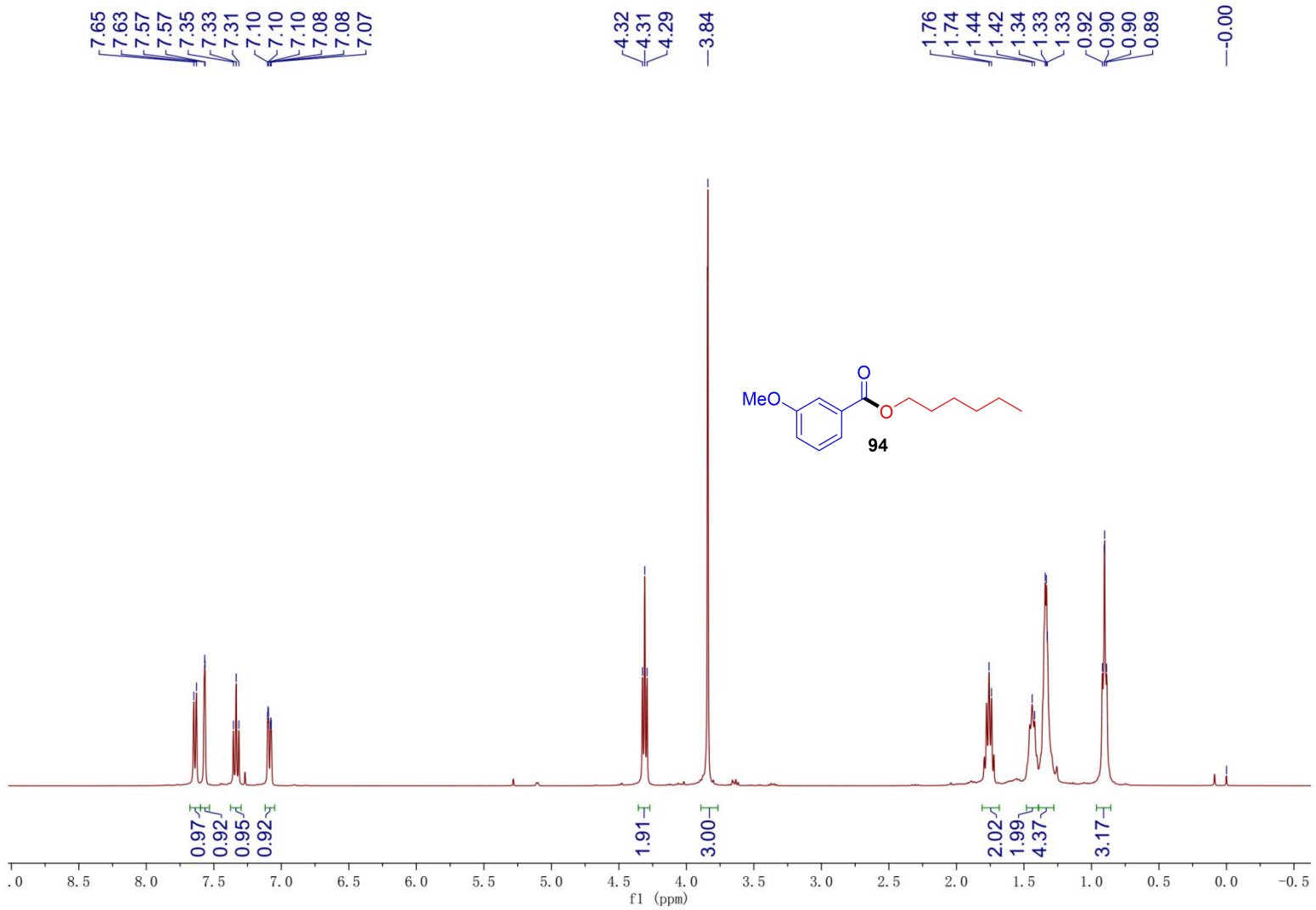
92

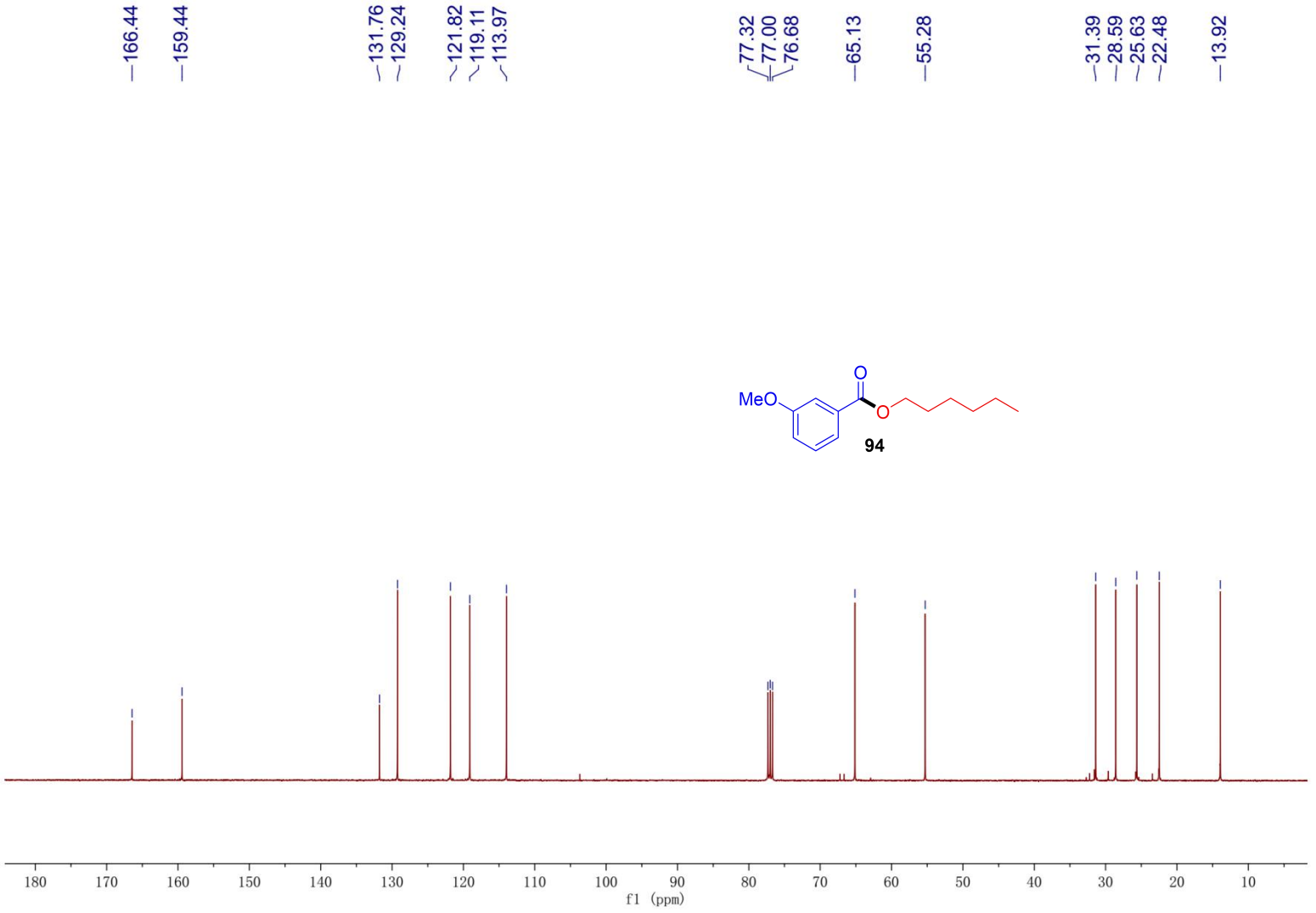

2.00
2.05
0.99
3.21
5.94
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

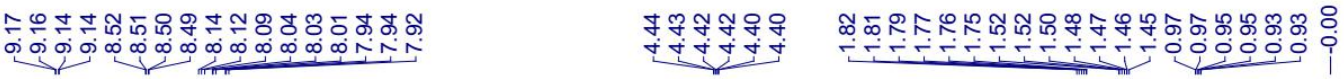

165.81
163.13
131.43
123.34
113.43
77.32
77.00
76.68
67.85
55.31
21.93
O
O
MeO
92
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

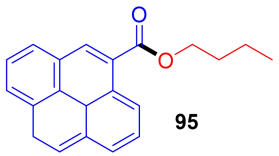

8.00
7.98
7.26
6.92
6.90
5.22
5.20
5.19
5.17
5.15
3.85
2.47
2.45
2.44
2.43
2.41
2.24
2.22
2.19
2.17
2.15
2.14
1.88
1.86
1.83
1.81
1.74
1.72
1.70
1.67
O
O
MeO
93
1.68
1.76
0.91
3.00
1.87
2.02
1.08
1.26
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)


165.74
163.26
131.54
122.84
113.51
77.32
77.00
76.68
69.01
55.37
30.44
13.61
MeO
O
O
93
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

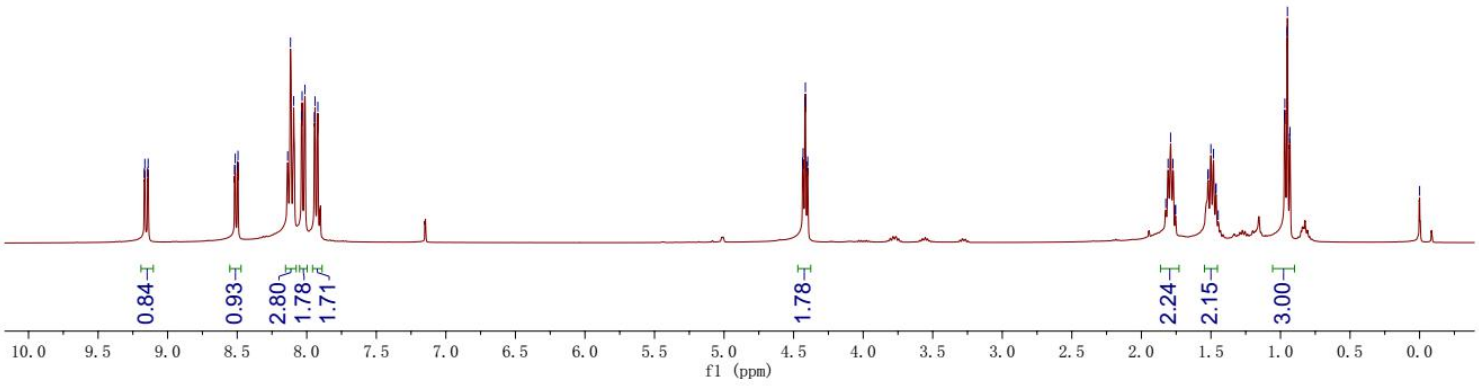

7.65
7.63
7.57
7.57
7.35
7.33
7.31
7.10
7.10
7.10
7.08
7.08
7.07
4.32
4.31
4.29
3.84
1.76
1.74
1.44
1.42
1.34
1.33
1.33
0.92
0.90
0.90
0.89
0.00
MeO
O
O
94
0.97
0.92
0.95
0.92
1.91
3.00
2.02
1.99
4.37
3.17
f1 (ppm)

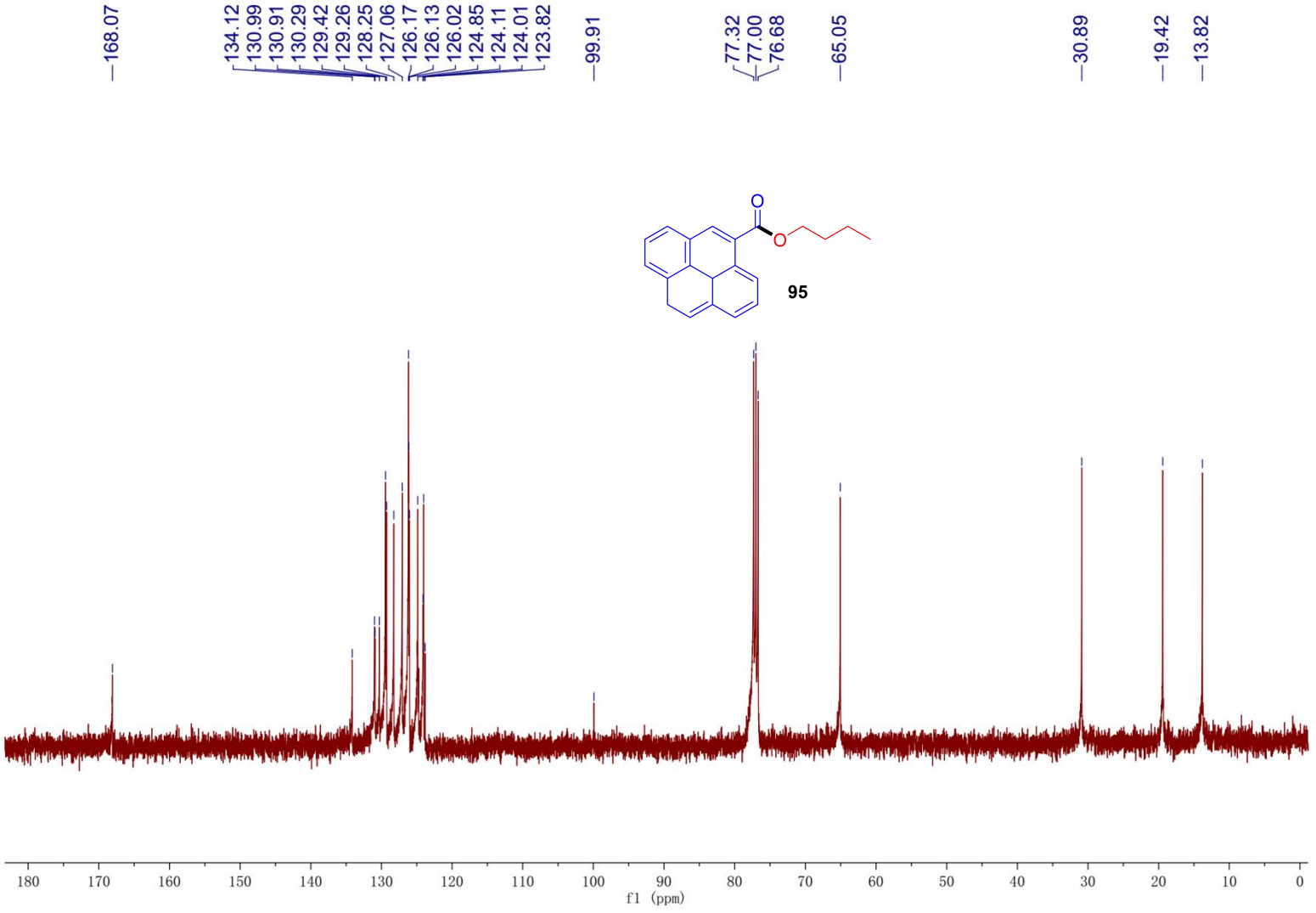

166.44
159.44
131.76
129.24
121.82
119.11
113.97
77.32
77.00
76.68
65.13
55.28
31.39
28.59
25.63
22.48
13.92
MeO
O
O
94
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

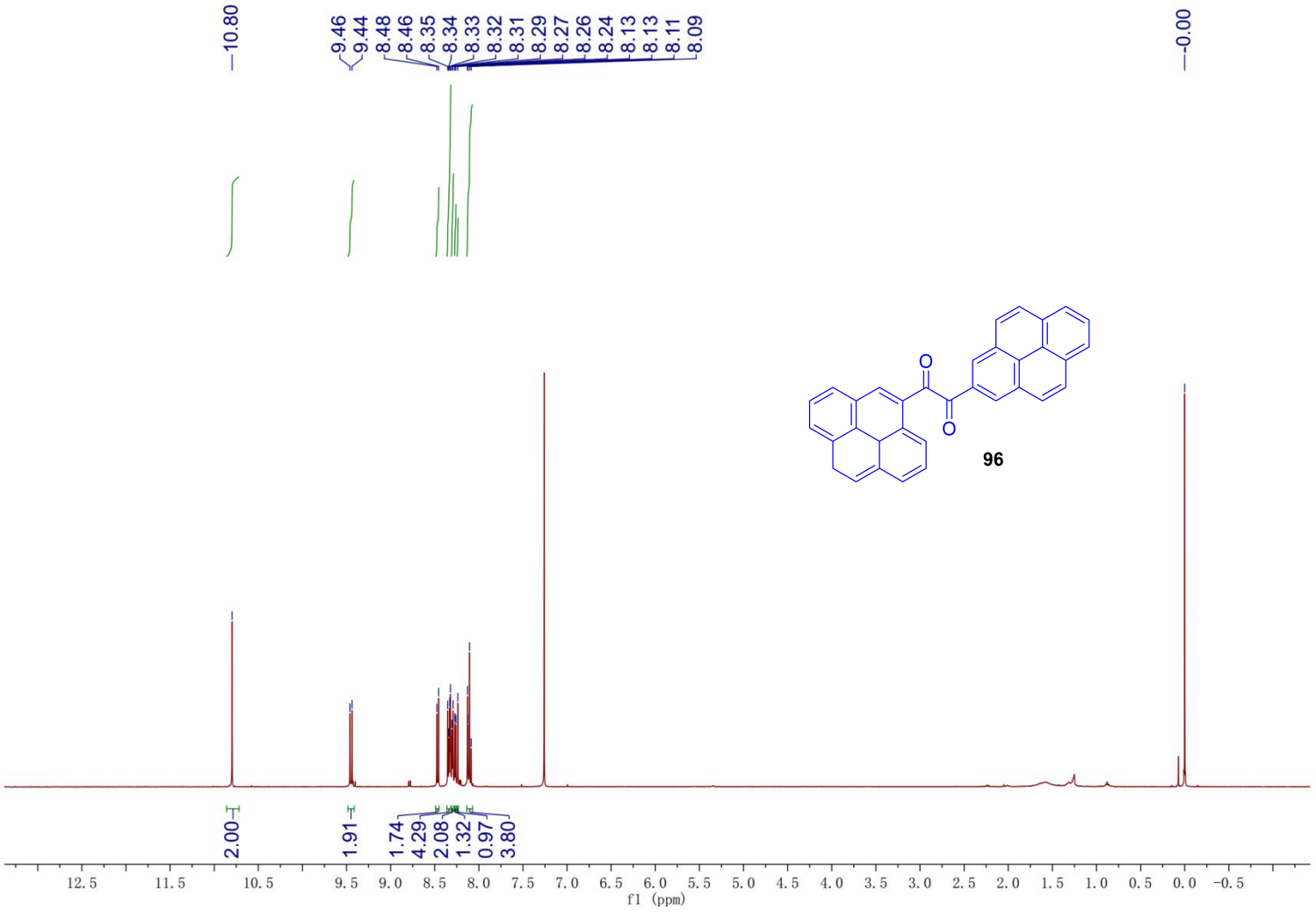

9.17
9.16
9.14
9.14
8.52
8.51
8.50
8.49
8.14
8.12
8.09
8.04
8.03
8.01
7.94
7.94
7.92
4.44
4.43
4.42
4.42
4.40
4.40
1.82
1.81
1.79
1.77
1.76
1.75
1.52
1.52
1.50
1.48
1.47
1.46
1.45
0.97
0.97
0.95
0.95
0.93
0.93
-0.00

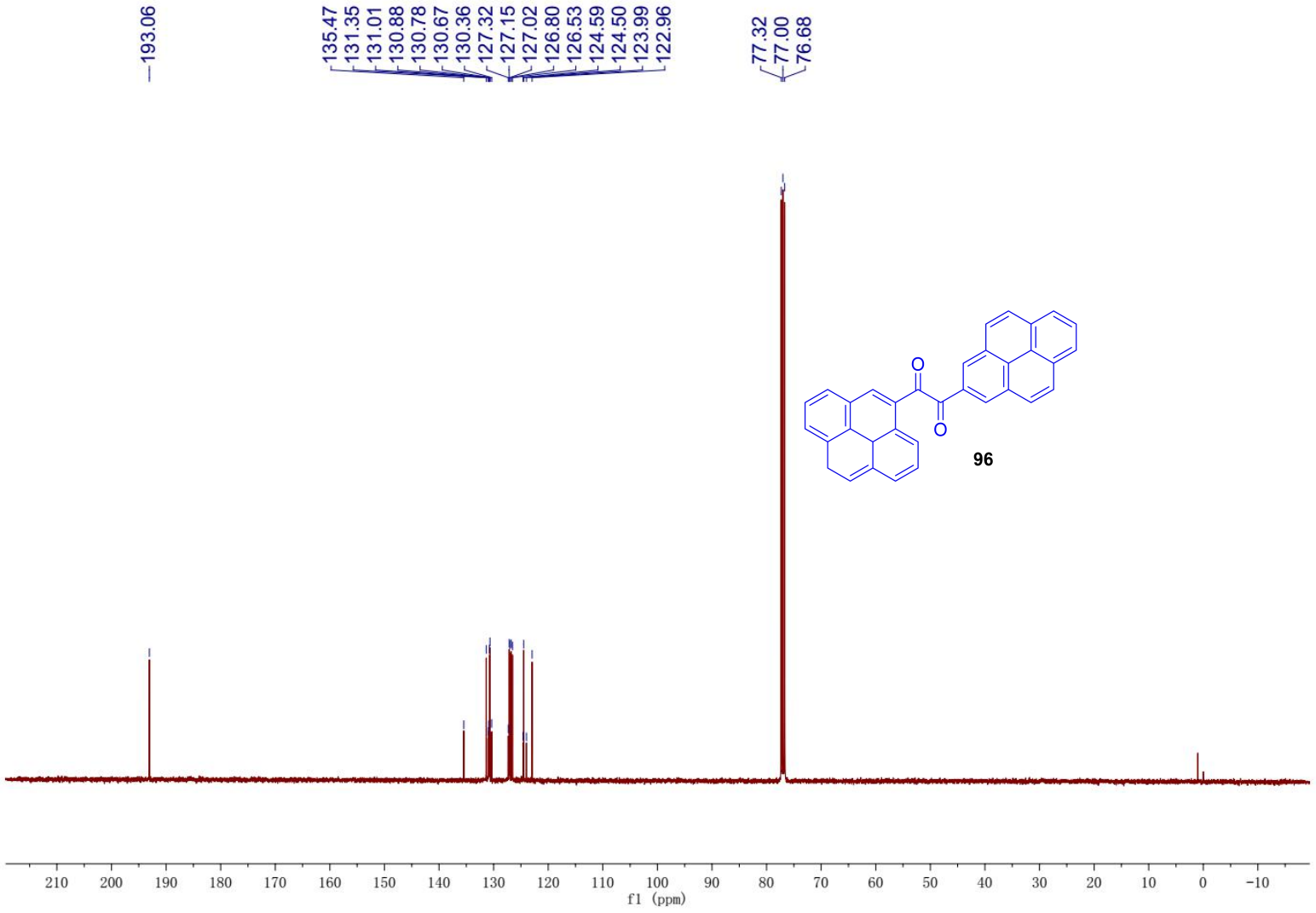

O
O

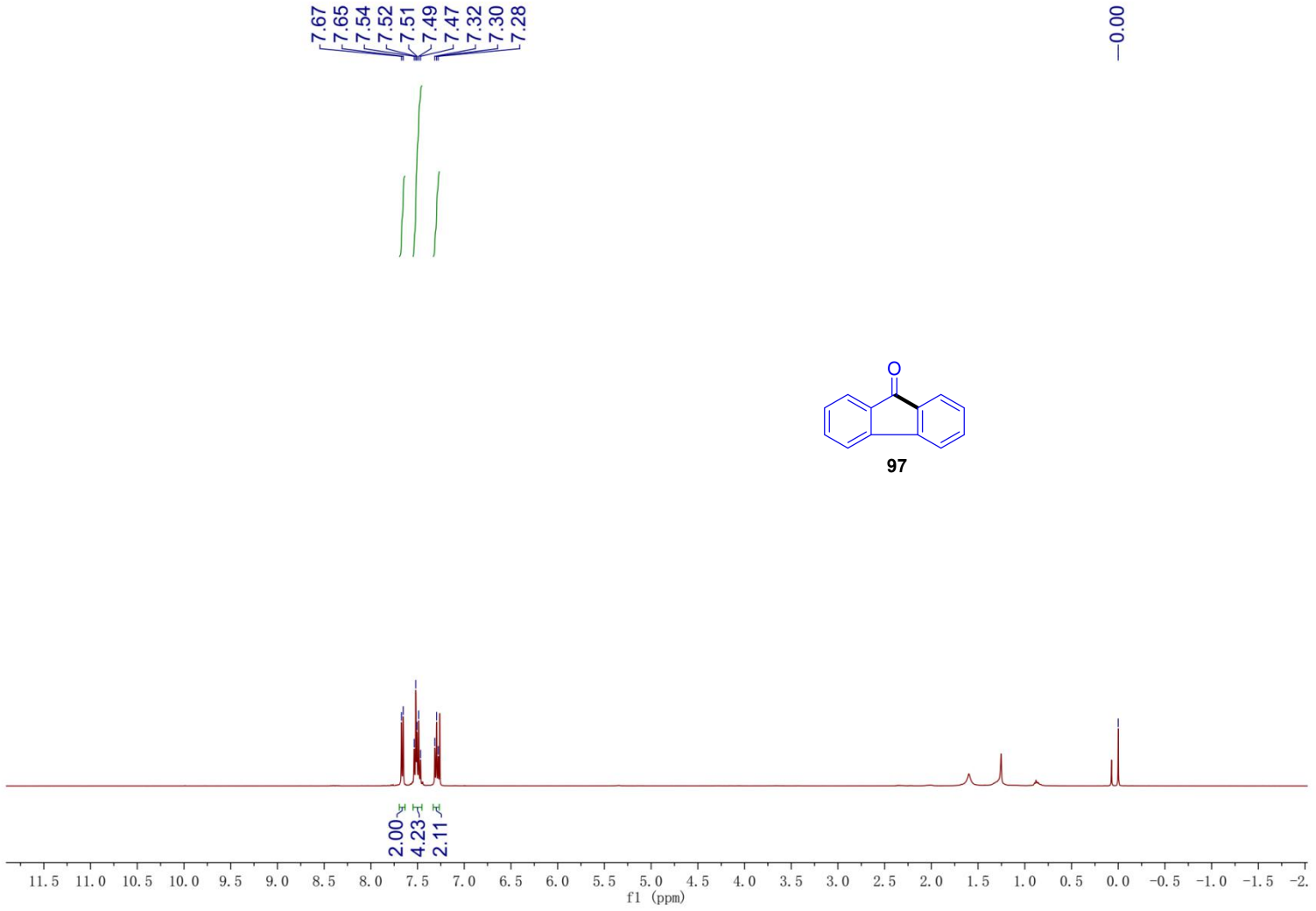
95

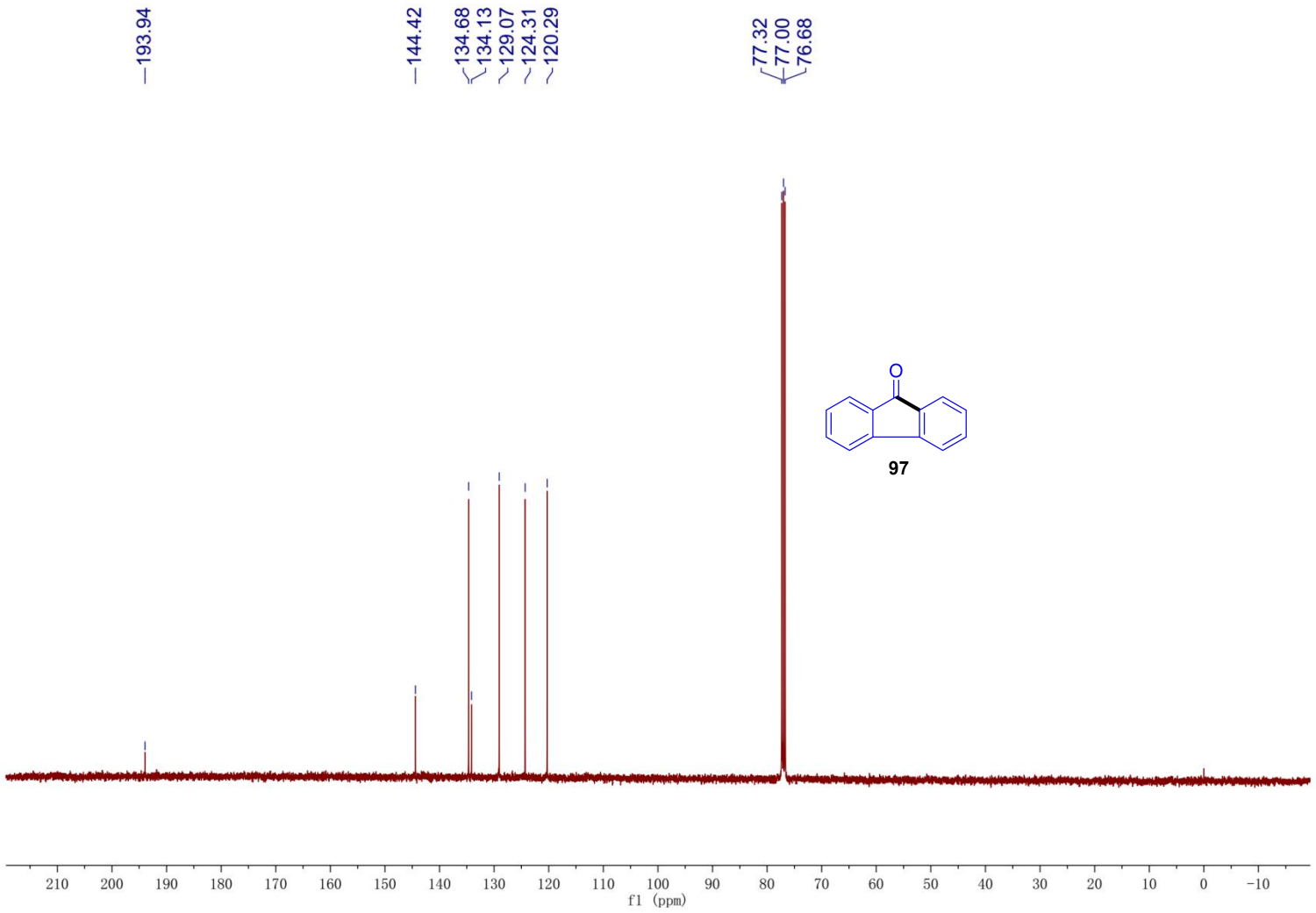

0.84
0.93
2.80
1.78
1.71
1.78
2.24
2.15
3.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


168.07
134.12
130.99
130.91
130.29
129.42
129.26
128.25
127.06
126.17
126.13
126.02
124.85
124.11
124.01
123.82
99.91
77.32
77.00
76.68
65.05
30.89
19.42
13.82
O
O
95
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


10.80
9.46
9.44
8.48
8.46
8.35
8.34
8.33
8.32
8.31
8.29
8.27
8.26
8.24
8.13
8.13
8.11
8.09
0.00
O
O
96
2.00
1.91
1.74
4.29
2.08
1.32
0.97
3.80
12.5
11.5
10.5
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


193.06
135.47
131.35
131.01
130.88
130.78
130.67
130.36
127.32
127.15
127.02
126.80
126.53
124.59
124.50
123.99
122.96
77.32
77.00
76.68
O
O
96
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)


7.67
7.65
7.54
7.52
7.51
7.49
7.47
7.32
7.30
7.28
0.00
O
97
2.00
4.23
2.11
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5 -2.
f1 (ppm)


193.94
144.42
134.68
134.13
129.07
124.31
120.29
77.32
77.00
76.68
O
97
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)