# Supporting Information

## Synthesis of Indoles and Carbazoles from Lignin Model Compound α-Hydroxyacetophenones

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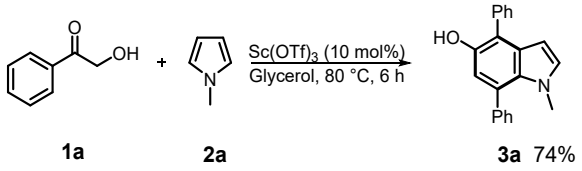
## 1. General information

The chemical compositions of samples were characterized by FT-IR spectra using KBr (EQUINOX55, Bruker Compass) in the wavenumber range of 4000–400 $cm^{-1}$. $^{1}H$ and $^{13}C$ NMR spectra of organic compounds were recorded on Bruker AV-400 or Bruker AV-600 spectrometer. Chemical shifts are expressed in ppm relative to tetramethylsilane in $CDCl_3$ or DMSO-$d_6$. ICP-MS data were recorded on a PerkinElmer ELAN DRC-e spectrometer. High-resolution mass spectra (HRMS) were recorded on Bruker Compass Data Analysis 4.0. The data of liquid chromatography mass spectrometry (LC-MS) were obtained on Bruker UltiMate 3000-microTOFII. High performance liquid chromatography (HPLC) was tested on Thermo Scientific Ultimate 3000. All reagents and solvents were purchased from available commercial suppliers and used without further purification unless other noted.

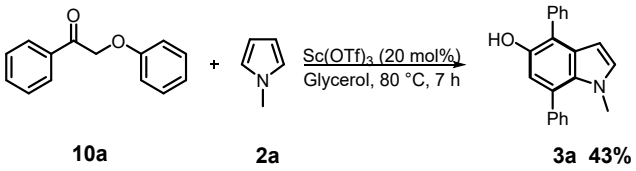
## 2. Experimental Section

### 2.1 Synthesis of 3a




**Scheme S1**. Synthesis of indole derivative **3a**.

In a glass tube, 2-hydroxyacetophenone **1a** (0.6 mmol) was mixed with 1-methylpyrrole **2a** (0.4 mmol) in 1 mL glycerol, and then $Sc(OTf)_3$ (24.6 mg, 10 mol%) was added. The tube reactor equipped with triangular magnetic stirrer was then sealed to react at 80 ℃ for 6 h. After that, the reaction mixture was extracted with a mixture of ethyl acetate and heptane (5 mL × 3). The product **3a** was isolated from combined organic phase by column chromatography (eluent: petroleum ether/ethyl acetate = 10/1 (v/v)). The product of **3a** was obtained in 74% (88.5 mg) yield.




**Scheme S2**. Synthesis of indole derivative **3a**.

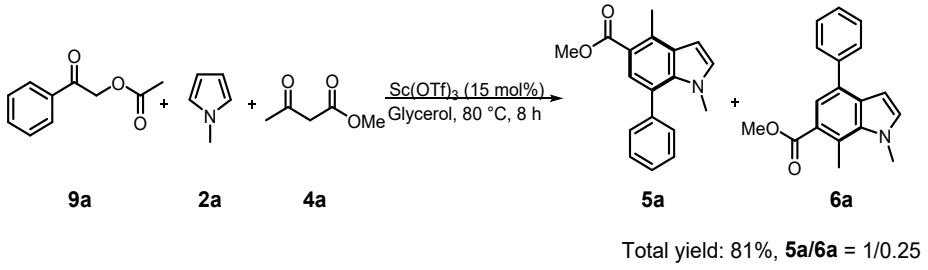
In a glass tube, 2-phenoxyacetophenone **10a** (0.6 mmol) was mixed with 1-methylpyrrole **2a** (0.4 mmol) in 1 mL glycerol, and then, $Sc(OTf)_3$ (49.2 mg, 20 mol%) was added. The tube reactor equipped with triangular magnetic stirrer was then sealed to react at 80 ℃ for 7 h. After reaction, the reaction mixture was extracted with a mixture of ethyl acetate and heptane (5 mL × 3). After reaction, the amount of **3a** was analyzed by HPLC, and the mixed solution was diluted with a suitable ratio of mobile phase, then filtered and analyzed by HPLC. The HPLC instrument was equipped with a UV detector and a C18 column (250 mm × 4.6 mm); the flow phase was $CH_3OH/H_2O$ (9/1, v/v) and the flow rate was 1 mL/min. The column temperature was 30 ℃ and the wavelength of UV detector for product analysis was set at

290 nm. The compound of **3a** was obtained in 43% (51.4 mg) yield.

### 2.2 Synthesis of 5a and 6a


**Scheme S3**. Synthesis of indole derivative **5a** and **6a**.

In a glass tube, 2-hydroxyacetophenone **1a** (0.4 mmol) was mixed with 1-methylpyrrole **2a** (0.8 mmol) and methyl acetoacetate **4a** (0.8 mmol) in 1 mL glycerol, and then the catalyst $Sc(OTf)_3$ (19.7 mg, 10 mol%) was added. The tube reactor equipped with triangular magnetic stirrer was then sealed to react at 80 ℃ for 8 h. The solution was extracted with a mixture of ethyl acetate and heptane, and the reaction was detected by TLC. After the completion of the reaction, the product **5a** and **6a** was isolated respectively by column chromatography (eluent: petroleum ether/ethyl acetate = 8/1 (v/v)). The mixture of **5a** and **6a** was obtained in 83% yield (92.6 mg), and the molar ratio of **5a**/**6a** is ca. 1/0.66.

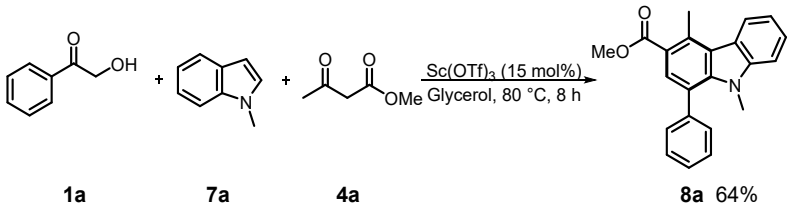



**Scheme S4**. Synthesis of indole derivative **5a** and **6a**.

In a glass tube, acetate of 2-hydroxyacetophenone **9a** (0.4 mmol) was mixed with 1-methyl-pyrrole **2a** (0.8 mmol) and methyl acetoacetate **4a** (0.8 mmol) in 1 mL glycerol, and then the catalyst $Sc(OTf)_3$ (29.5 mg, 15 mol%) was added. The tube reactor equipped with triangular magnetic stirrer was then sealed to react at 80 ℃ for 8 h. The solution was extracted with a mixture of ethyl acetate and heptane, and the reaction was detected by TLC. After the completion of the reaction, the product **5a** and **6a** was isolated respectively by column chromatography (eluent: petroleum ether/ethyl acetate = 8/1 (v/v)). The mixture

of **5a** and **6a** was obtained in 81% yield (90.4 mg), and the molar ratio of **5a**/**6a** is ca. 1/0.25.

**2.3 Synthesis of 8a**

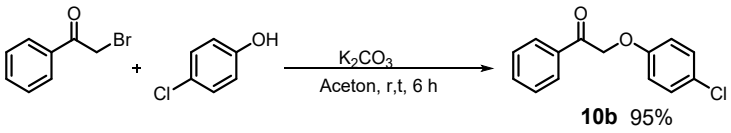



**1a** **7a** **4a** **8a** 64%

**Scheme S5**. Synthesis of indole derivative **8a**.

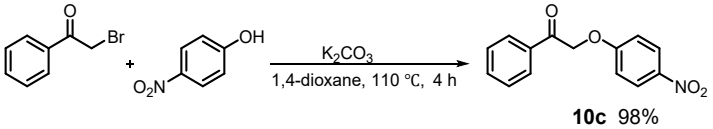
In a glass tube, 2-hydroxyacetophenone **1a** (0.4 mmol) was mixed with methyl acetoacetate **4a** (0.8 mmol) in 1 mL glycerol, and the 1-methyl-indole **7a** (0.6 mmol) was added dropwise to the solution over 30 minutes after the catalyst $Sc(OTf)_3$ (29.5 mg, 15 mol%) was performed. The tube reactor equipped with triangular magnetic stirrer was then sealed to react at 60 ℃ for 8 h. The solution was extracted with a mixture of ethyl acetate and heptane, and the reaction was detected by TLC. After the completion of the reaction, the product **8a** was isolated by column chromatography (eluent: petroleum ether/ethyl acetate = 8/1 (v/v)). Compound **8a** was obtained in 64% yield (84.3 mg).

**2.4 Synthesis of 10b and 10c**




**10b** 95%

**Scheme S6**. Synthesis of 2-phenoxyacetophenone derivative **10b**.[1]



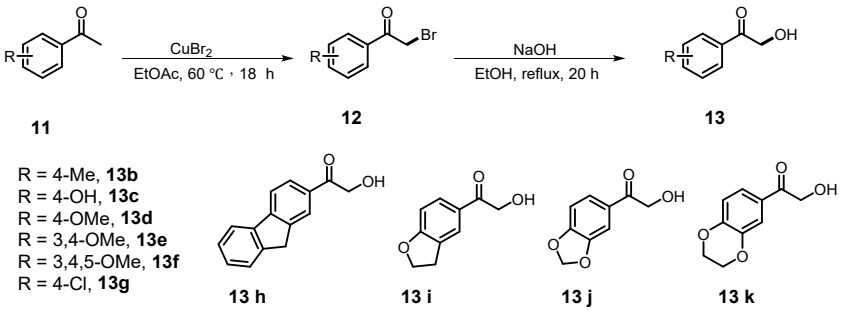

**10c** 98%

**Scheme S7**. Synthesis of 2-phenoxyacetophenone derivative **10c**.[2]

In a 250 ml round bottom flask equipped with a reflux condenser, 4-chlorophenol (33 mmol) was mixed with $K_2CO_3$ (45.6 mmol) in acetone (30 mL). Then, 2-bromoacetophenone (30 mmol) was added

dropwise to the solution over 30 minutes at room temperature. After 6 h of stirring, the filtration operation was started and the volatile components were removed by evaporation under reduced pressure. The desired product **10b** was obtained by silica gel column chromatography using a mixture of ethyl acetate and petroleum ether as the eluting solvent (the ratio of ethyl acetate/petroleum ether is 1/50). Changing the substrate and solvent, and following the similar steps to obtain the desired product **10c**.

**2.5 Synthesis of α-hydroxyacetophenone derivatives 13b-k**



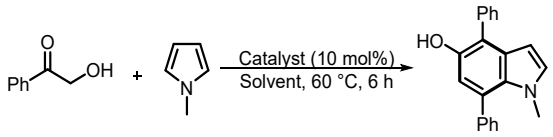

**Scheme S8**. Synthesis of α-hydroxyacetophenone derivatives **13b-k**.[3-4]

1) In a 250 ml round bottom flask equipped with a reflux condenser, the acetophenone compound **11** (20 mmol) was mixed copper bromide (24 mmol) in EtOAc (100 mL). The reactor equipped with magnetic stirrer was then sealed to react at 60 °C for 18 h. Upon completion, the mixture was extracted with ethyl acetate (20 mL × 3). The organic layers were filtered and concentrated by rotary evaporation. The product was purified by preparative TLC (eluting solution: petroleum ether/ethyl acetate = 20/1 (v/v)), to obtain 2-bromoacetophenone derivative. Similar compounds were prepared following the standard procedure.

2) In a 250 ml round bottom flask with a reflux condenser, 2-bromoacetophenone compound **12** (10 mmol) was mixed with NaOH (16 mmol) in 50 ml EtOH, and refluxed for 20 h in an oil bath. Upon completion, the mixture was diluted with water (50 mL) and extracted with ethyl acetate (20 mL × 3). The combined organic layers were dried over $Na_2SO_4$, filtered and concentrated by rotary evaporation. The residue was purified by preparative TLC (eluting solution: petroleum ether/ethyl acetate = 20/1 (v/v)), to obtain target product. Similar compounds were prepared following the standard procedure.

**3. Condition optimization**

**Table S1** Optimization of the reaction of lignin model compound and **2a**.[a]

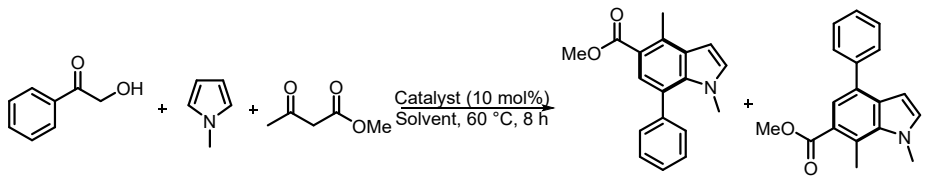



**1a** **2a** **3a**

| Entry[a] | Catalyst | Solvent | Yield (%)[e] |
|---|---|---|---|
| 1 | $ScCl_3$ | EtOH | 20 |
| 2[b] | $ScCl_3$ | EtOH | 16 |
| 3[c] | $ScCl_3$ | EtOH | 23 |
| 4[d] | $ScCl_3$ | EtOH | 21 |
| 5 | $Sc(OTf)_3$ | EtOH | 46 |
| 6[b] | $Sc(OTf)_3$ | EtOH | 33 |
| 7[c] | $Sc(OTf)_3$ | EtOH | 46 |
| 8[d] | $Sc(OTf)_3$ | EtOH | 51 |
| 9 | $Sc(OTf)_3$ | Glycerol | 45 |
| 10[b] | $Sc(OTf)_3$ | Glycerol | 37 |
| 11[c] | $Sc(OTf)_3$ | Glycerol | 50 |
| 12[d] | $Sc(OTf)_3$ | Glycerol | 54 |

[a] Reaction conditions: **1a** (0.6 mmol), **2a (**0.3 mmol), catalyst (10 mol%), solvent (1.0 mL), 60 °C, 6 h, N.R. = no reaction; [b] **1a/2a** is 1/1; [c]**1a/2a** is 3/1; [d]**1a/2a** is 3/2; [e]: Isolated yield.

**Table S2** Optimization of the three-component reaction of **1a**, **2a** and 1,3-dicarbonyl compound.[a]

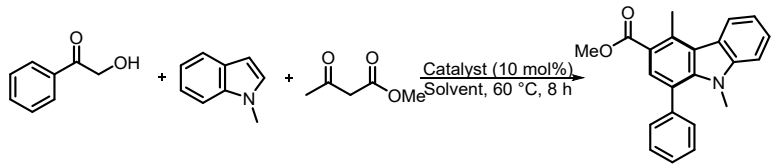



**1a** **2a** **4a** **5a** **6a**

| Entry[a] | Catalyst | Solvent | Yield (**5a** and **6a**, %)[f] |
|---|---|---|---|
| 1 | — | EtOH | N.R. |
| 2 | $MnCl_2$ | EtOH | N.R. |
| 3 | $ZrCl_4$ | EtOH | 15 |
| 4 | $AlCl_3$ | EtOH | <10 |
| 5 | $ScCl_3$ | EtOH | 28(35[b]) |
| 6 | *p*-TSA | EtOH | N.R. |
| 7 | TfOH | EtOH | <10 |
| 8 | $Fe(OTf)_3$ | EtOH | N.R. |
| 9 | $Sc(OTf)_3$ | EtOH | 56 |
| 10 | $Al(OTf)_3$ | EtOH | <10 |
| 11 | $Sc(OTf)_3$ | 1,4-Dioxane | 49 |
| 12 | $Sc(OTf)_3$ | $CH_3OH$ | 52 |
| 13 | $Sc(OTf)_3$ | Glycerol | 60 |
| 14 | $Sc(OTf)_3$ | $CH_3CN$ | 45 |
| 15 | $Sc(OTf)_3$ | Toluene | 39 |
| 16[b] | $Sc(OTf)_3$ | Glycerol | 83(79[c]) |
| 17[d] | $Sc(OTf)_3$ | Glycerol | 82 |
| 18[b, d] | $Sc(OTf)_3$ | Glycerol | 79 |
| 19[b, e] | $Sc(OTf)_3$ | Glycerol | 59 |

[a]Reaction condition: **1a (**0.4 mmol), **2a (**0.8 mmol), **4a (**0.8 mmol), catalyst (10 mol%), solvent (1.0 mL), 60 °C, 8 h, N.R. = no reaction; [b]: 80 °C; [c]: 100 °C; [d]: catalyst (15 mol%); [e] **1a/2a/4a** is 1/2/1, [f]: Isolated yield.

**Table S3** Optimization of the three-component reaction of **1a**, **4a** and 1-methyl-1*H*-indole.[a]

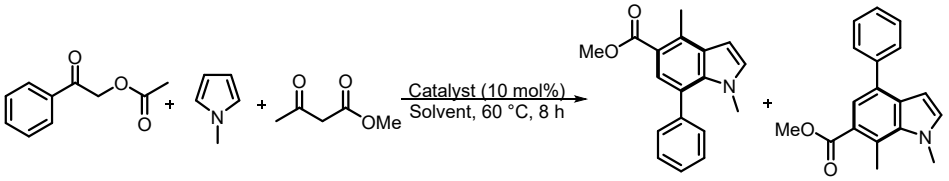



**1a** **7a** **4a** **8a**

| Entry[a] | Catalyst | Solvent | Yield (%)[f] |
|---|---|---|---|
| 1 | — | EtOH | N.R. |
| 2 | $MnCl_2$ | EtOH | N.R. |
| 3 | $ZrCl_4$ | EtOH | 21 |
| 4 | $AlCl_3$ | EtOH | 13 |
| 5 | $ScCl_3$ | EtOH | 24 |
| 6 | *p*-TSA | EtOH | N.R. |
| 7 | TfOH | EtOH | <10 |
| 8 | $Fe(OTf)_3$ | EtOH | N.R. |
| 9 | $Sc(OTf)_3$ | EtOH | 39 |
| 10 | $Al(OTf)_3$ | EtOH | <10 |
| 11 | $Sc(OTf)_3$ | 1,4-Dioxane | 36 |
| 12 | $Sc(OTf)_3$ | $CH_3OH$ | 41 |
| 13 | $Sc(OTf)_3$ | Glycerol | 47 |
| 14 | $Sc(OTf)_3$ | $CH_3CN$ | 28 |
| 15 | $Sc(OTf)_3$ | Toluene | 19 |
| 16[b] | $Sc(OTf)_3$ | Glycerol | 54(49[c]) |
| 17[d] | $Sc(OTf)_3$ | Glycerol | 49 |
| 18[b, d] | $Sc(OTf)_3$ | Glycerol | 64 |
| 19[b, d, e] | $Sc(OTf)_3$ | Glycerol | 60 |

[a]Reaction condition: **1a (**0.4 mmol), **4a (**0.8 mmol), **7a (**0.6 mmol), catalyst (10 mol%), solvent (1.0 mL), 60 °C, 8 h, N.R. = no reaction; [b]: 80 °C; [c]: 100 °C; [d]: catalyst (15 mol%); [e] **1a/4a/7a** is 1/2/2, [f]: Isolated yield.

**Table S4** Optimization of the three-component reaction of **2a**, **4a** and lignin model compound derivative.[a]

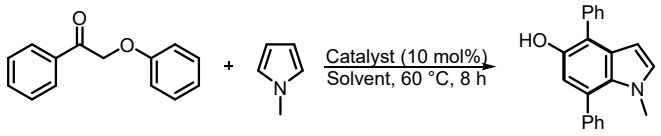



**9a** **2a** **4a** **5a** **6a**

| Entry[a] | Catalyst | Solvent | Yield (**5a** and **6a**, %)[f] |
|---|---|---|---|
| 1 | — | EtOH | N.R. |
| 2 | $MnCl_2$, $AlCl_3$ | EtOH | N.R. |
| 3 | $ZrCl_4$ | EtOH | 13 |
| 4 | $ScCl_3$ | EtOH | 27(38[b]) |
| 5 | *p*-TSA | EtOH | N.R. |
| 6 | TfOH | EtOH | N.R. |
| 7 | $Fe(OTf)_3$ | EtOH | N.R. |
| 8 | $Sc(OTf)_3$ | EtOH | 55 |
| 9 | $Sc(OTf)_3$ | 1,4-Dioxane | 47 |
| 10 | $Sc(OTf)_3$ | $CH_3OH$ | 56 |
| 11 | $Sc(OTf)_3$ | Glycerol | 62 |
| 12 | $Sc(OTf)_3$ | $CH_3CN$ | 26 |
| 13 | $Sc(OTf)_3$ | Toluene | 33 |
| 14[b] | $Sc(OTf)_3$ | Glycerol | 78(74[c]) |
| 15[d] | $Sc(OTf)_3$ | Glycerol | 79 |
| 16[b, d] | $Sc(OTf)_3$ | Glycerol | 81 |
| 17[b, e] | $Sc(OTf)_3$ | Glycerol | 72 |

[a]Reaction condition: **9a (**0.4 mmol), **2a (**0.8 mmol), **4a (**0.8 mmol), catalyst (10 mol%), solvent (1.0 mL), 60 °C, 8 h, N.R. = no reaction; [b]: 80 °C; [c]: 100 °C; [d]: catalyst (15 mol%); [e] **9a/2a/4a** is 1/2/1, [f]: Isolated yield.

**Table S5** Optimization of the three-component reaction of lignin model compound derivative and **2a**.[a]




**10a** **2a** **3a**

| Entry[a] | Catalyst | Solvent | Yield (%)[f] |
|---|---|---|---|
| 1 | — | EtOH | N.R. |
| 2 | $MnCl_2$, $ZrCl_4$, $AlCl_3$ | EtOH | N.R. |
| 3 | $ScCl_3$ | EtOH | <10 (11[b]) |
| 4 | *p*-TSA | EtOH | N.R. |
| 5 | TfOH | EtOH | N.R. |
| 6 | $Fe(OTf)_3$ | EtOH | N.R. |
| 7 | $Sc(OTf)_3$ | EtOH | 17 |
| 8 | $Al(OTf)_3$ | EtOH | N.R. |
| 9 | $Sc(OTf)_3$ | 1,4-Dioxane | <10 |
| 10 | $Sc(OTf)_3$ | $CH_3OH$ | 19 |
| 11 | $Sc(OTf)_3$ | Glycerol | 21 |
| 12 | $Sc(OTf)_3$ | $CH_3CN$ | <10 |
| 13 | $Sc(OTf)_3$ | Toluene | N.R. |
| 14[b] | $Sc(OTf)_3$ | Glycerol | 37 (34[c]) |
| 15[d] | $Sc(OTf)_3$ | Glycerol | 39 |
| 16[b, d] | $Sc(OTf)_3$ | Glycerol | 43 |
| 17[b, e] | $Sc(OTf)_3$ | Glycerol | 31 |

[a]Reaction condition: **10a (**0.6 mmol), **2a (**0.4 mmol), catalyst (10 mol%), solvent (1.0 mL), 60 °C, 8 h, N.R. = no reaction; [b]: 80 °C; [c]: 100 °C; [d]: catalyst (20 mol%); [e] **10a/2a** is 2/1 [f]: product analysis was determined by HPLC analysis.

## 4. Crystal data

**5s**

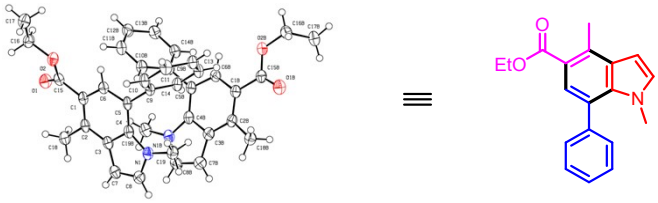



**Table S6** Crystal data and structure refinement for **5s**.

| | |
|---|---|
| Empirical formula | $C_{19}H_{19}NO_2$ |
| Formula weight | 293.35 |
| Temperature/K | 100.00(10) |
| Crystal system | triclinic |
| Space group | P-1 |
| a/Å | 7.9813(6) |
| b/Å | 11.4019(10) |
| c/Å | 17.8408(8) |
| α/° | 92.730(5) |
| β/° | 90.852(5) |
| γ/° | 108.525(7) |
| Volume/Å$^3$ | 1536.9(2) |
| Z | 4 |
| $\rho_{calc}$g/cm$^3$ | 1.268 |
| μ/mm$^{-1}$ | 0.651 |
| F(000) | 624.0 |
| Crystal size/mm$^3$ | 0.15 × 0.13 × 0.12 |
| Radiation | CuKα (λ = 1.54184) |
| 2Θ range for data collection/° | 4.962 to 148.146 |
| Index ranges | -9 ≤ h ≤ 9, -14 ≤ k ≤ 13, -11 ≤ l ≤ 21 |
| Data/restraints/parameters | 6028/0/403 |
| Final R indexes [I>=2σ (I)] | $R_1$ = 0.0753, $wR_2$ = 0.1509 |
| Final R indexes [all data] | $R_1$ = 0.0935, $wR_2$ = 0.2178 |

It is worth noting that **5s** shows the structure of a bi-molecular sample. Crystal Data for Compound **5s**: CCDC 2131808 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic.

**6s**

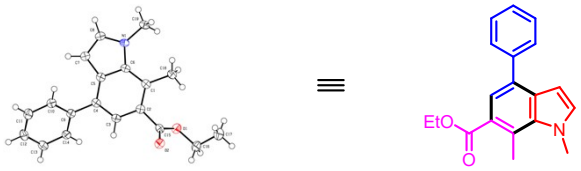



**Table S7** Crystal data and structure refinement for **6s**.

| | |
|---|---|
| Empirical formula | $C_{19}H_{19}NO_2$ |
| Formula weight | 293.35 |
| Temperature/K | 99.99(10) |
| Crystal system | monoclinic |
| Space group | $P2_1/n$ |
| a/Å | 12.6474(9) |
| b/Å | 7.3679(5) |
| c/Å | 17.5437(13) |
| α/° | 90 |
| β/° | 110.655(9) |
| γ/° | 90 |
| Volume/Å$^3$ | 1529.7(2) |
| Z | 4 |
| $\rho_{calc}$g/cm$^3$ | 1.274 |
| μ/mm$^{-1}$ | 0.654 |
| F(000) | 624.0 |
| Crystal size/mm$^3$ | 0.12 × 0.11 × 0.09 |
| Radiation | CuKα (λ = 1.54184) |
| 2Θ range for data collection/° | 7.512 to 147.002 |
| Index ranges | -15 ≤ h ≤ 14, -6 ≤ k ≤ 8, -18 ≤ l ≤ 21 |
| Data/restraints/parameters | 2986/0/202 |
| Final R indexes [I>=2σ (I)] | $R_1$ = 0.0474, $wR_2$ = 0.1173 |
| Final R indexes [all data] | $R_1$ = 0.0589, $wR_2$ = 0.1276 |

Crystal Data for Compound **6s**: CCDC 2131809 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic.

**5a**

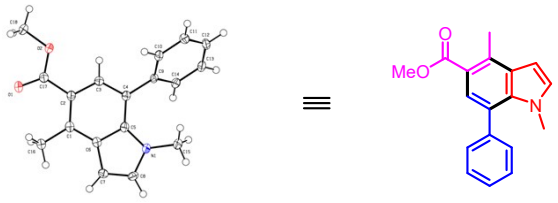



**Table S8** Crystal data and structure refinement for **5a**.

| | |
|---|---|
| Empirical formula | $C_{18}H_{17}NO_2$ |
| Formula weight | 279.32 |
| Temperature/K | 293.75(10) |
| Crystal system | triclinic |
| Space group | P-1 |
| a/Å | 8.2100(4) |
| b/Å | 9.4039(6) |
| c/Å | 10.1909(8) |
| α/° | 111.938(7) |
| β/° | 99.562(5) |
| γ/° | 97.455(5) |
| Volume/Å$^3$ | 703.68(9) |
| Z | 2 |
| $\rho_{calc}$g/cm$^3$ | 1.318 |
| μ/mm$^{-1}$ | 0.086 |
| F(000) | 296.0 |
| Crystal size/mm$^3$ | 0.12 × 0.11 × 0.1 |
| Radiation | MoKα (λ = 0.71073) |
| 2Θ range for data collection/° | 4.432 to 49.988 |
| Index ranges | -9 ≤ h ≤ 9, -11 ≤ k ≤ 11, -12 ≤ l ≤ 12 |
| Data/restraints/parameters | 2474/0/193 |
| Final R indexes [I>=2σ (I)] | $R_1$ = 0.0407, w$R_2$ = 0.1009 |
| Final R indexes [all data] | $R_1$ = 0.0469, w$R_2$ = 0.1065 |

Crystal Data for Compound **5a**: CCDC 2131810 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic.

**6a**

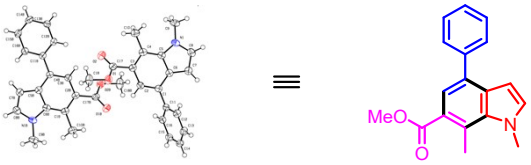



**Table S9** Crystal data and structure refinement for **6a**.

| | |
|---|---|
| Empirical formula | $C_{18}H_{17}NO_2$ |
| Formula weight | 279.32 |
| Temperature/K | 293.75(10) |
| Crystal system | monoclinic |
| Space group | $P2_1/n$ |
| a/Å | 11.7113(6) |
| b/Å | 9.8511(5) |
| c/Å | 25.2850(14) |
| α/° | 90 |
| β/° | 97.144(5) |
| γ/° | 90 |
| Volume/Å$^3$ | 2894.5(3) |
| Z | 8 |
| $\rho_{calc}$g/cm$^3$ | 1.282 |
| μ/mm$^{-1}$ | 0.084 |
| F(000) | 1184.0 |
| Crystal size/mm$^3$ | 0.14 × 0.13 × 0.12 |
| Radiation | MoKα (λ = 0.71073) |
| 2Θ range for data collection/° | 4.042 to 49.998 |
| Index ranges | $-13 \le h \le 13$, $-11 \le k \le 9$, $-30 \le l \le 29$ |
| Data/restraints/parameters | 5094/0/385 |
| Final R indexes [I>=2σ (I)] | $R_1$ = 0.0479, $wR_2$ = 0.1163 |
| Final R indexes [all data] | $R_1$ = 0.0595, $wR_2$ = 0.1250 |

It is worth noting that **6a** shows the structure of a bi-molecular sample. Crystal Data for Compound **6a**: CCDC 2131811 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from The Cambridge Crystallographic.

## 5. Mechanism study and Kinetic data

### 5.1 The key intermediates detected by HRMS for the synthesis of 3a

The reactions were conducted in a 10 mL of V-type flask equipped with oil bath and triangle magnetic stirring. The mixture of **1a** (0.6 mmol), **2a** (0.4 mmol) and $Sc(OTf)_3$ (0.04 mmol, 10 mol%) in glycerol (2.0 mL) was stirred at 80 °C for 1 h. After the completion of the reaction, the mixture cooled to room temperature, and the resulting mixture was extracted with ethyl acetate and heptane, and then the crude mixture was detected by HRMS (ESI, m/z: calcd for $C_{13}H_{14}NO^+$, $[M + H]^+$ 200.1070, found 200.1071).

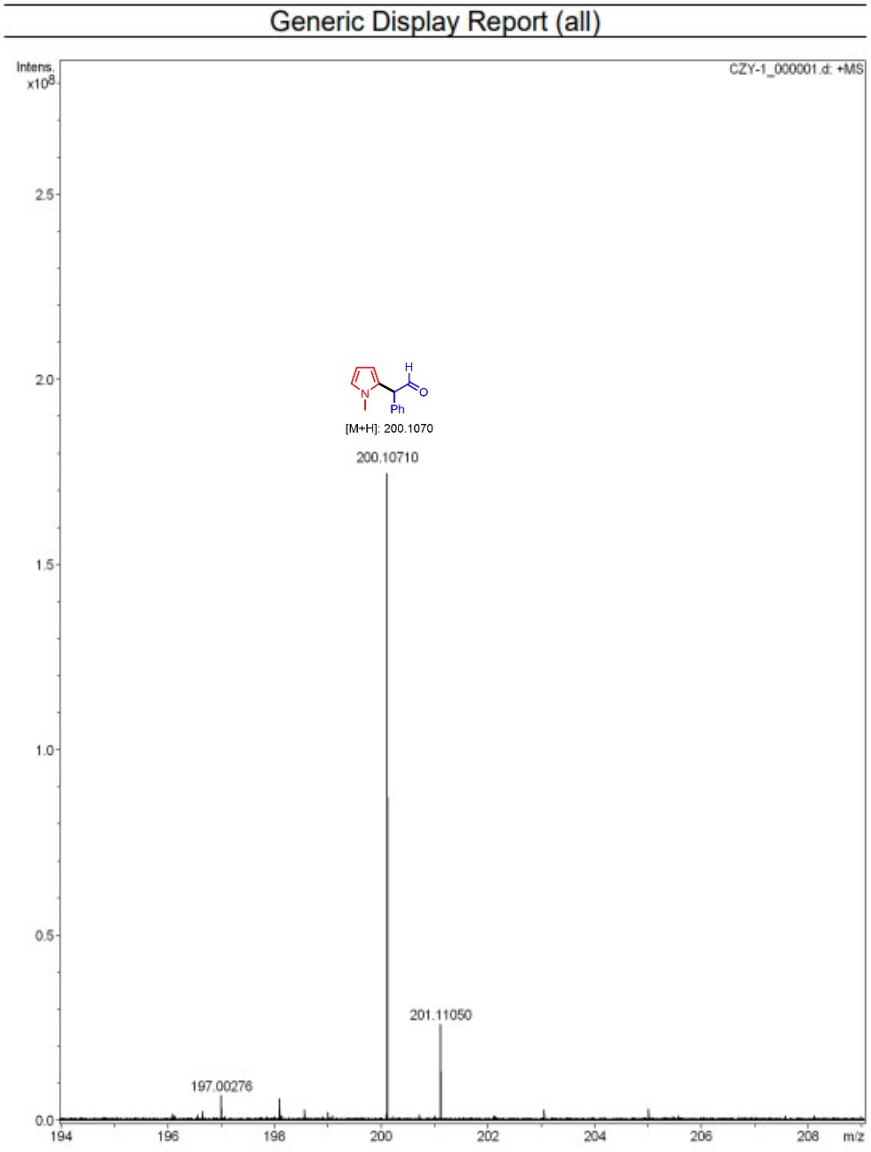



**Figure S1.** The

key intermediates detected by HRMS after 1 h of the reaction.

### 5.2 Proposed mechanism for the formation of 5a and 6a

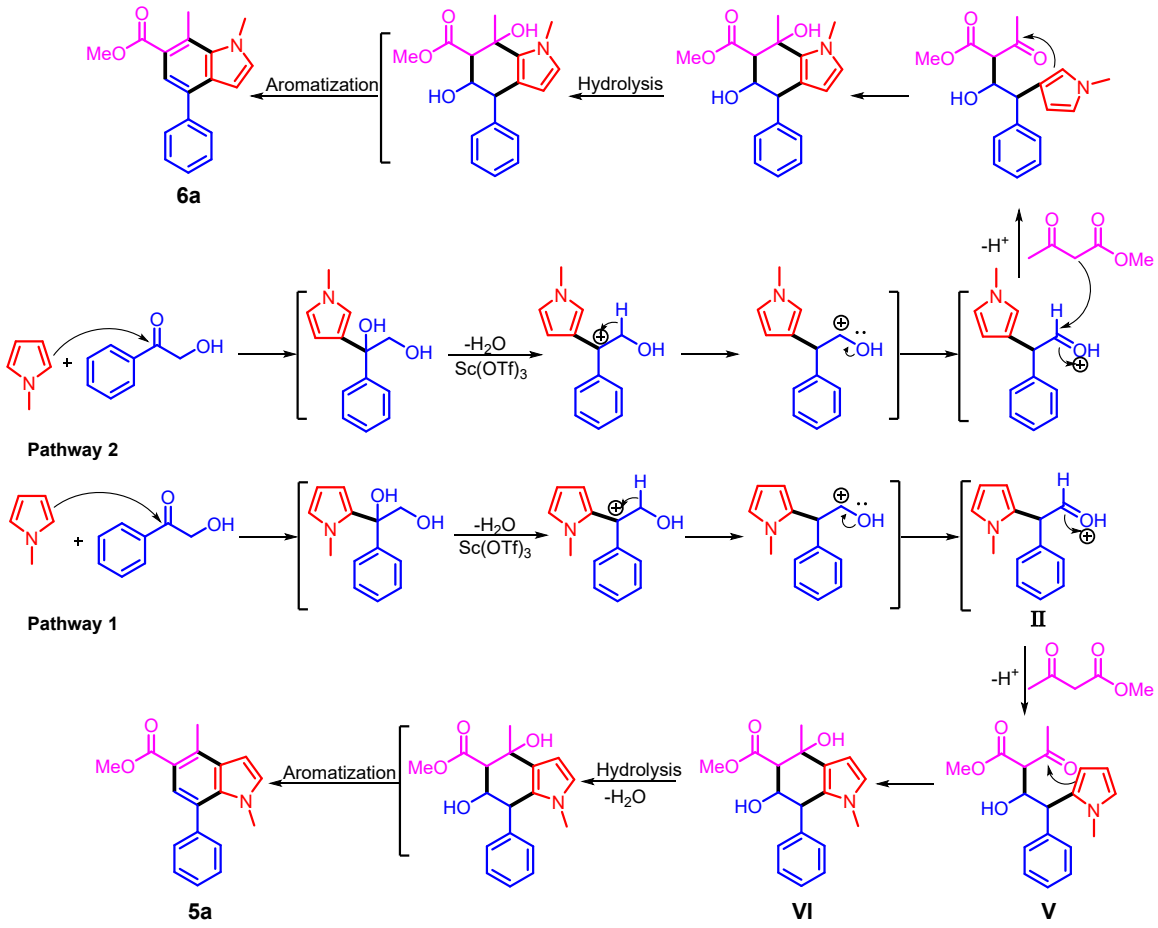
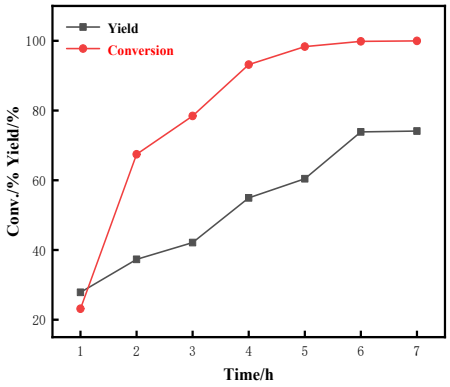



**Figure S2** Plausible mechanism for the formation of **5a** and **6a**

On the basis of the experiments, we provided the mechanism for the formation of **5a** and **6a**. The results were described in **Figure S1**. With respect to the pathway 1: given that we have described the reaction process of **1a** and **2a** to form the intermediate **II**, (as you can see the details in **Scheme 2**) and we will not repeat it here. The intermediate **II** presumably undergoes the attack of the 1,3-dicarbonyl compounds which can be activated under the standard conditions to generate the pivotal intermediate **V**. Subsequently, the carbonyl group of the 1,3-dicarbonyl compounds was attacked by the C3 position of pyrrole to give the intermediate **VI**. It should be noted that formation of six-membered ring transition state helps stabilize intermediate product, thereby promoting the formation of intermediate **VI**. Finally, after a series of chemical reactions, including hydrolysis, dehydration and aromatization, the promising product of **5a** is finally formed. As for the pathway 2, the prime principle and mechanism is similar to the pathway 1, however, the differences between them are mainly the order of the event which reacted

with pyrrole. In pathway 1, the reactivity of pyrrole at the C2 position is superior to C3 position, but opposite in pathway 2.[3-5]

## 5.3 Kinetic data



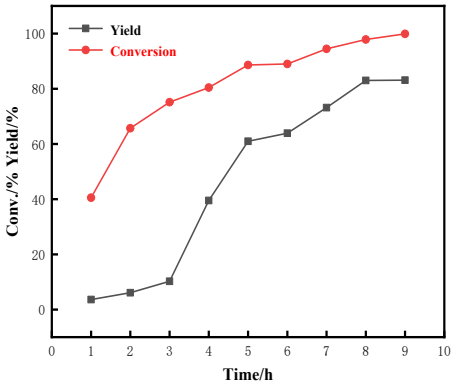



**Figure S3** Kinetic analysis (a) Based on the conversion of **1a** and yields of **3a** (b) Based on the conversion of **1a** and yields of **5a** and **6a**

On the basis of the results obtained, we found that the yield of the two-component reaction increased at a gentle rate over time, while the yield of the three-component reaction increased substantially, which may be due to the stronger competitiveness of 1,3-dicarbonyl compound compared with **1a**, resulting in the formation of more products. Within 2 h, the conversion rate of **1a** was higher in both the two-component and three-component reactions, while the overall conversion rate of the two-component reaction **1a** changed significantly compared with the three-component reaction, which was mainly due to the reaction generate 1 molecule of product, requiring 2 molecules of **1a**.

## 6. Recovery experiments information

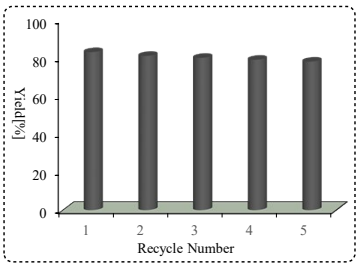



**Figure S4**

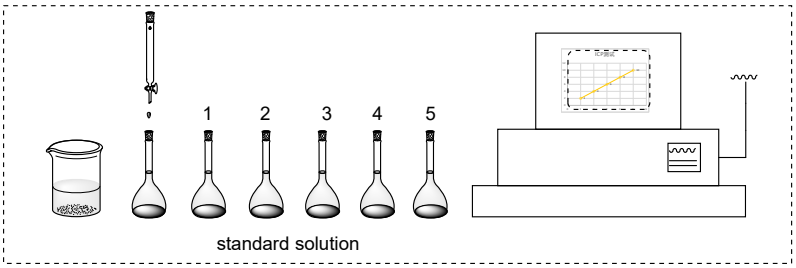


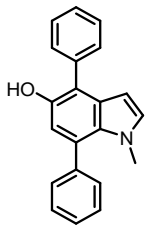

**Figure S5**

We also conducted repeated experiments on the recovery of glycerol and $Sc(OTf)_3$. Indeed, as for the recovery of $Sc(OTf)_3$ and glycerol, the main experiments include two aspects, the first was the reuse of glycerol containing $Sc(OTf)_3$, and the second is the recovery of Sc content.

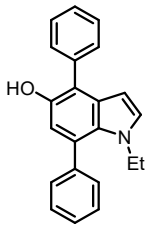
Details as follow: I) first, a small amount of ethyl acetate was added to the reaction system under the standard condition, and the reaction product was detected by TLC. Next, the reacted solution (glycerol containing $Sc(OTf)_3$) was washed with ethyl acetate and heptane and stand for a few minutes. The supernatant was removed for purification operation, and a small amount of ethyl acetate was added to the remaining part again. The cycle operation was carried out until the products were completely extracted and TCL analysis showed no products in the upper organic ethyl acetate phase. After removing the volatile components under reduced pressure, the starting materials are added into the glycerol phase for the next round of reaction. The results show that the combination of $Sc(OTf)_3$ and glycerol can be used continuously for many times.

Ⅱ)The results in **Figure S4** show that the catalyst can be reused more than 5 times and displayed high catalytic performance throughout the repetitive process. As you can found that, after 5 runs, the yield of the product can be obtained in 78%. At the same time, the ICP test procedure was shown in **Figure S5**. The ICP result shows that the recovery rate of catalyst can reach 95%. The detailed operation steps are as follows: 1) dilute the standard solution (100 ug/mL) of scandium, prepare solutions with different concentration gradients in different 50 mL volumetric flask (2 ppm, 4 ppm, 6 ppm, 8 ppm, 10 ppm). 2) Put the reacted sample into a beaker, then, add slowly $HNO_3$ about 5 mL. After 30 minutes, place the beaker on an electric heating device to heat and digest the sample. Keeping the temperature at 70 $^{o}$C, and holding this state for about 30 minutes. After the temperature of the sample returns to room temperature, remove the black solid impurities with filter membrane, and then dilute the solution to a 50 mL volumetric flask for testing. 3) Test the sample and obtain a standard curve, then calculate the metal content in the solution. Ultimately, the conclusion we got through theoretical calculations is that, in this special system, the recoverability of the catalyst can reach 95%.

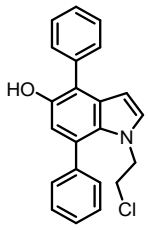
**7. Characterization data of all new compounds**



**1-Methyl-4,7-diphenyl-1*H*-indol-5-ol** (**3a**): yellow oil, yield 74%, 88.5 mg; $^{1}$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 7.61 (d, *J* = 6.6 Hz, 2H), 7.55 (t, *J* = 7.6 Hz, 2H), 7.49 (dd, *J* = 7.8, 1.8 Hz, 2H), 7.46 – 7.40 (m, 4H), 6.93 (d, *J* = 3.1 Hz, 1H), 6.80 (s, 1H), 6.28 (d, *J* = 3.1 Hz, 1H), 4.96 (s, 1H), 3.29 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 145.1, 139.8, 135.6, 131.8, 130.1, 130.0, 129.6, 129.3, 127.7, 127.4, 117.1, 114.0, 99.9, 36.8 ppm; IR (KBr) *v* = 3549, 3449, 3056, 3025, 2923, 2852, 1600, 1508, 1482, 1327, 1169, 1088, 1016, 913, 866, 757, 702 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{21}H_{18}NO^{+}$, $[M + H]^{+}$ 300.1383, found 300.1381.

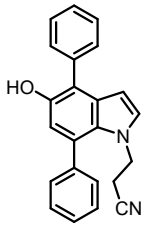


**1-Ethyl-4,7-diphenyl-1*H*-indol-5-ol** (**3b**): yellow oil, yield 76%, 95.2 mg; $^{1}$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 7.61 (d, *J* = 6.5 Hz, 2H), 7.58 – 7.49 (m, 4H), 7.43 (d, *J* = 7.4 Hz, 4H), 7.03 (d, *J* = 3.2 Hz, 1H), 6.78 (s, 1H), 6.31 (d, *J* = 3.2 Hz, 1H), 4.96 (s, 1H), 3.68 (q, *J* = 7.1 Hz, 2H), 0.98 ppm (t, *J* = 7.2 Hz, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 145.1, 140.2, 135.6, 130.2, 129.9, 129.6, 129.3, 127.9, 127.7, 127.4, 117.2, 114.1, 100.6, 42.9, 16.0 ppm; IR (KBr) *v* = 3545, 3056, 3024, 2918, 1599, 1508, 1481, 1402, 1376, 1327, 1274, 1168, 1088, 1016, 910, 866, 758, 730, 702 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{22}H_{20}NO^{+}$, $[M + H]^{+}$ 314.1539, found 314.1538.

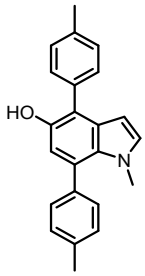


**1-(2-Chloroethyl)-4,7-diphenyl-1*H*-indol-5-ol** (**3c**): yellow oil, yield 61%, 84.7 mg; $^{1}$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 7.61 – 7.52 (m, 2H), 7.47 – 7.41 (m, 6H), 7.04 (d, *J* = 3.2 Hz, 1H), 6.79 (s, 1H), 6.31 (d, *J* = 3.2 Hz, 1H), 5.01 (s, 1H), 3.97 (t, *J* = 6.6 Hz, 2H), 3.22 ppm (t, *J* = 6.6

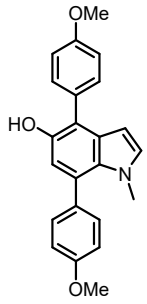
Hz, 2H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 145.5, 139.5, 135.3, 131.4, 130.1, 129.5, 129.4, 128.3, 127.9, 127.0, 117.6, 114.3, 101.0, 49.7, 42.9 ppm; IR (KBr) $v$ = 3546, 3102, 2957, 2924, 2852, 1724, 1598, 1480, 1444, 1359, 1293, 1167, 1132, 1076, 1031, 912, 865, 758, 728, 702 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{22}H_{19}ClNO^+$, $[M + H]^+$ 348.1150, found 348.1147.



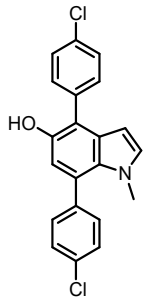

**3-(5-Hydroxy-4,7-diphenyl-1*H*-indol-1-yl)propanenitrile** (**3d**): white solid, yield 55%, 74.4 mg, m.p.: 105–107 ℃; $^1$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 7.56 (dt, $J$ = 15.2, 7.2 Hz, 4H), 7.49 – 7.41 (m, 6H), 7.04 (d, $J$ = 3.2 Hz, 1H), 6.79 (s, 1H), 6.31 (d, $J$ = 3.2 Hz, 1H), 5.02 (s, 1H), 3.97 (t, $J$ = 6.6 Hz, 2H), 3.22 ppm (t, $J$ = 6.6 Hz, 2H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 145.5, 139.5, 135.3, 131.4, 130.1, 129.5, 129.4, 128.3, 127.9, 127.8, 127.0, 117.6, 114.3, 101.0, 49.7, 42.9 ppm; IR (KBr) $v$ = 3422, 3057, 3025, 2960, 2252, 1713, 1588, 1481, 1364, 1347, 1288, 1225, 1073, 1031, 913, 866, 760, 731, 704 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{23}H_{19}N_2O^+$, $[M + H]^+$ 339.1492, found 339.1491.



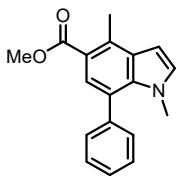

**1-Methyl-4,7-di-p-tolyl-1*H*-indol-5-ol** (**3e**): white solid, yield 58%, 75.9 mg, m.p.: 114–118 ℃; $^1$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 7.53 – 7.45 (m, 3H), 7.39 – 7.33 (m, 5H), 6.92 (d, $J$ = 3.1 Hz, 1H), 6.78 (s, 1H), 6.27 (d, $J$ = 3.0 Hz, 1H), 4.97 (s, 1H), 3.30 (s, 3H), 2.44 (d, $J$ = 5.2 Hz, 6H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 145.2, 137.4, 137.0, 136.9, 131.6, 130.0, 129.9, 129.8, 129.2, 128.4, 114.0, 99.9, 36.8, 21.3 ppm; IR (KBr) $v$ = 3553, 3022, 2921, 2855, 2246, 1701, 1587, 1490, 1406, 1373, 1324, 1266, 1222, 1167, 1068, 1023, 817, 731 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{23}H_{22}NO^+$, $[M + H]^+$ 328.1696, found 328.1696.




**4,7-Bis(4-methoxyphenyl)-1-methyl-1*H*-indol-5-ol** (**3f**): colorless oil, yield 53%, 76.1 mg; $^1$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 7.52 (d, $J$ = 8.6 Hz, 2H), 7.40 (d, $J$ = 8.5 Hz, 2H), 7.09 (d, $J$ = 8.6 Hz, 2H), 6.97 (d, $J$ = 8.6 Hz, 2H), 6.92 (d, $J$ = 3.1 Hz, 1H), 6.77 (s, 1H), 6.26 (d, $J$ = 3.1 Hz, 1H), 4.93 (s, 1H), 3.89 (d, $J$ = 4.3 Hz, 6H), 3.31 (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 159.1, 159.0, 145.2, 131.6, 131.3, 131.0, 127.5, 126.8, 116.6, 114.8, 114.0, 113.1, 99.9, 55.3, 36.8 ppm; IR (KBr) $v$ = 3451, 2953, 2931, 2836, 1609, 1531, 1492, 1464, 1373, 1324, 1285, 1245, 1089, 1034, 912，832, 741 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{23}H_{22}NO_3^+$, $[M + H]^+$ 360.1594, found 360.1594.

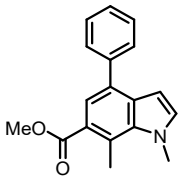



**4,7-Bis(4-chlorophenyl)-1-methyl-1*H*-indol-5-ol** (**3g**): colorless oil, yield 41%, 60.2 mg; $^1$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 7.53 (s, 4H), 7.42 (s, 4H), 6.95 (d, $J$ = 3.1 Hz, 1H), 6.74 (s, 1H), 6.25 (d, $J$ = 3.2 Hz, 1H), 4.80 (s, 1H), 3.31 (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 145.1, 138.1, 133.9, 133.6, 133.5, 132.2, 131.5, 131.2, 129.5, 128.0, 114.1, 99.9, 37.0 ppm; IR (KBr) $v$ = 3449, 2922, 1907, 1732, 1589, 1485, 1405, 1374, 1297, 1223, 1168, 1092, 1014, 911, 871, 828, 729 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{21}H_{16}Cl_2NO^+$, $[M + H]^+$ 368.0603, found 368.0604.

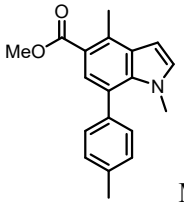



**Methyl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5a**): white solid, yield 50%, 55.8 mg, m.p.: 99–101 ℃; $^1$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 7.67 (s, 1H), 7.39 (s, 5H), 6.97

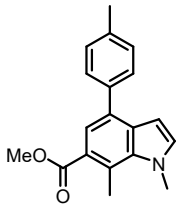
(d, $J$ = 3.2 Hz, 1H), 6.69 (d, $J$ = 3.2 Hz, 1H), 3.86 (s, 3H), 3.28 (s, 3H), 2.87 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 168.9, 139.7, 135.2, 134.0, 131.3, 130.7, 130.2, 127.8, 127.4, 126.6, 124.2, 119.7, 101.7, 51.6, 36.8, 17.1 ppm; IR (KBr) $v$ = 2949, 2927, 2855, 1711, 1577, 1438, 1341, 1233, 1165, 1053, 768, 705, 648 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{18}H_{18}NO_2^+$, $[M + H]^+$ 280.1332, found 280.1332.



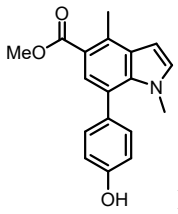

**Methyl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6a**): white solid, yield 33%, 36.8 mg, m.p.: 95–97 ℃; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.68 – 7.58 (m, 3H), 7.46 (t, $J$ = 7.7 Hz, 2H), 7.36 (t, $J$ = 7.4 Hz, 1H), 7.08 (d, $J$ = 3.2 Hz, 1H), 6.58 (d, $J$ = 3.2 Hz, 1H), 4.13 (s, 3H), 3.91 (s, 3H), 3.02 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.6, 140.5, 136.3, 134.2, 131.9, 130.4, 128.8, 128.5, 127.0, 124.7, 123.6, 121.6, 100.6, 51.9, 38.3, 15.9; IR (KBr) $v$ = 2950, 2927, 1712, 1607, 1435, 1302, 1237, 1198, 1056, 764, 703 cm$^{-1}$. HRMS (APCI, TOF): m/z: calcd for $C_{18}H_{18}NO_2^+$, $[M + H]^+$ 280.1332, found 280.1332.



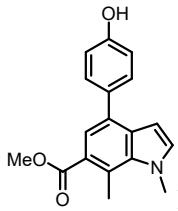

**Methyl 1,4-dimethyl-7-(p-tolyl)-1*H*-indole-5-carboxylate** (**5b**): white solid; yield 68%, 79.7 mg, m.p.: 133–135 ℃; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.66 (s, 1H), 7.29 (d, $J$ = 8.0 Hz, 2H), 7.20 (d, $J$ = 7.7 Hz, 2H), 6.97 (d, $J$ = 3.2 Hz, 1H), 6.68 (d, $J$ = 3.2 Hz, 1H), 3.85 (s, 3H), 3.30 (s, 3H), 2.87 (s, 3H), 2.41 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.9, 137.1, 136.7, 135.3, 133.8, 131.2, 130.6, 130.0, 128.5, 126.7, 124.1, 119.6, 101.6, 51.5, 36.8, 21.3, 17.1 ppm; IR (KBr) $v$ = 2949, 2924, 1712, 1577, 1435, 1341, 1234, 1164, 1053, 822, 736, 720. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_2^+$: 294.1489 $[M + H]^+$; found: 294.1489.



**Methyl 1,7-dimethyl-4-(p-tolyl)-1*H*-indole-6-carboxylate** (**6b**): white solid; yield 15%, 17.6 mg, m.p.: 120–122 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.59 (s, 1H), 7.54 (d, $J$ = 8.0 Hz, 2H), 7.28 (s, 1H), 7.26 (d, $J$ = 3.4 Hz, 1H), 7.08 (d, $J$ = 3.2 Hz, 1H), 6.59 (d, $J$ = 3.2 Hz, 1H), 4.14 (s, 3H), 3.91 (s, 3H), 3.02 (s, 3H), 2.42 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.7, 137.6, 136.7, 136.3, 134.1, 131.9, 130.4, 129.2, 128.6, 124.7, 123.3, 121.4, 100.6, 51.9, 38.3, 21.2, 15.9 ppm; IR (KBr) $v$ = 2954, 2925, 2854, 1713, 1607, 1515, 1458, 1377, 1339, 1238, 1196, 1057, 822, 733. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_2^+$: 294.1489 [M + H]$^+$; found: 294.1489.

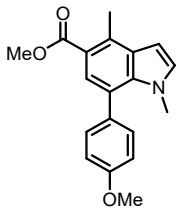


**Methyl 7-(4-hydroxyphenyl)-1,4-dimethyl-1*H*-indole-5-carboxylate** (**5c**): white solid, yield 54%, 63.7 mg, m.p.: 166–168 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.64 (s, 1H), 7.26 (d, $J$ = 2.9 Hz, 1H), 7.24 (s, 1H), 6.99 (d, $J$ = 3.3 Hz, 1H), 6.89 (d, $J$ = 8.5 Hz, 2H), 6.69 (d, $J$ = 3.2 Hz, 1H), 5.75 (s, 1H), 3.89 (s, 3H), 3.33 (s, 3H), 2.86 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.4, 155.3, 135.5, 133.7, 131.8, 131.3, 131.2, 130.6, 126.8, 123.9, 119.6, 114.7, 101.6, 51.7, 36.8, 17.1 ppm; IR (KBr) $v$ = 3386, 2974, 2950, 1709, 1611, 1591, 1510, 1436, 1342, 1255, 1234, 1167, 1051, 837, 719; HRMS (APCI, TOF): *m/z*: calcd for $C_{18}H_{18}NO_3^+$: 296.1281 [M + H]$^+$; found: 296.1281.

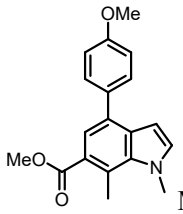


**Methyl 4-(4-hydroxyphenyl)-1,7-dimethyl-1*H*-indole-6-carboxylate** (**6c**): white solid, yield 11%, 13.0 mg, m.p.: 173–175 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.55 (s, 1H), 7.51 (d, $J$ = 8.5 Hz, 2H), 7.08 (d, $J$ = 3.1 Hz, 1H), 6.93 (d, $J$ = 8.5 Hz, 2H), 6.56 (d, $J$ = 3.1 Hz, 1H), 5.14 (s, 1H), 4.14 (s, 3H), 3.92 (s, 3H), 3.01 ppm (s, 3H).; $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.8,

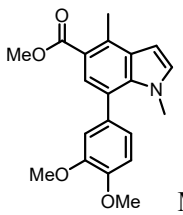
154.9, 136.3, 134.1, 133.1, 131.6, 130.4, 130.0, 124.7, 123.1, 121.2, 115.4, 100.6, 51.9, 38.3, 15.9 ppm; IR (KBr) $v$ = 3380, 2950, 2925, 2852, 1709, 1687, 1611, 1515, 1434, 1341, 1240, 1198, 1054, 836, 731. HRMS (APCI, TOF): *m/z*: calcd for $C_{18}H_{18}NO_3^+$: 296.1281 $[M + H]^+$; found: 296.1281.




**Methyl 7-(4-methoxyphenyl)-1,4-dimethyl-1*H*-indole-5-carboxylate** (**5d**): white solid; yield 57%, 70.4 mg, m.p.: 124–126 ℃; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.64 (s, 1H), 7.32 (d, $J$ = 8.6 Hz, 2H), 6.99 (d, $J$ = 3.2 Hz, 1H), 6.95 (d, $J$ = 8.6 Hz, 2H), 6.68 (d, $J$ = 3.2 Hz, 1H), 3.87 (d, $J$ = 1.8 Hz, 6H), 3.32 (s, 3H), 2.86 ppm (s, 3H); $^{13}$C NMR (101 MHz,Chloroform-*d*, 25 ℃) $\delta$ = 168.9, 159.0, 135.4, 133.7, 131.9, 131.2, 130.6, 126.8, 123.8, 119.6, 113.2, 101.6, 55.3, 51.5, 36.8, 17.0 ppm; IR (KBr) $v$ = 2994, 2949, 2837, 1711, 1601, 1508, 1436, 1341, 1284, 1248, 1165, 1053, 1033, 833, 726. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_3^+$: 310.1438 $[M + H]^+$; found: 310.1437.

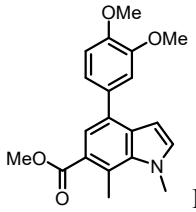



**Methyl 4-(4-methoxyphenyl)-1,7-dimethyl-1*H*-indole-6-carboxylate** (**6d**): white solid; yield 10%, 12.4 mg, m.p.: 70–72 ℃; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.57 (d, $J$ = 8.5 Hz, 3H), 7.08 (d, $J$ = 3.2 Hz, 1H), 7.00 (d, $J$ = 8.7 Hz, 2H), 6.57 (d, $J$ = 3.1 Hz, 1H), 4.14 (s, 3H), 3.91 (s, 3H), 3.87 (s, 3H), 3.01 ppm (s, 3H); $^{13}$C NMR (101 MHz,Chloroform-*d*, 25 ℃) $\delta$ = 169.7, 158.8, 136.3, 134.0, 133.0, 131.6, 130.4, 129.8, 124.7, 123.1, 121.3, 113.9, 100.6, 55.4, 51.9, 38.3, 15.9 ppm; IR (KBr) $v$ = 2992, 2950, 2837, 1712, 1610, 1514, 1436, 1339, 1284, 1245, 1179, 1033, 835, 787, 734. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_3^+$: 310.1438 $[M + H]^+$; found: 310.1437.

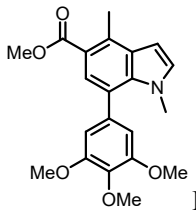



**Methyl 7-(3,4-dimethoxyphenyl)-1,4-dimethyl-1*H*-indole-5-carboxylate** (**5e**): white

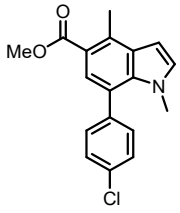
solid, yield 58%, 78.7 mg, m.p.: 123–125 ℃; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.69 (s, 1H), 7.03 (d, *J* = 3.2 Hz, 1H), 7.01 – 6.93 (m, 3H), 6.72 (d, *J* = 3.2 Hz, 1H), 3.97 (s, 3H), 3.91 (s, 6H), 3.38 (s, 3H), 2.89 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.8, 148.4, 148.2, 135.3, 133.9, 132.2, 131.2, 130.6, 126.6, 123.9, 122.5, 119.6, 113.5, 110.5, 101.6, 56.0, 51.5, 36.6, 17.0 ppm; IR (KBr) *v* = 2953, 2926, 2853, 1711, 1585, 1511, 1462, 1438, 1342, 1253, 1240, 1137, 1020, 762, 723. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{22}NO_4^+$: 340.1543 [M + H]$^+$; found: 340.1544.



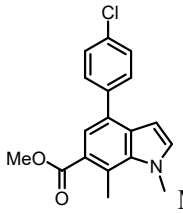

**Methyl 4-(3,4-dimethoxyphenyl)-1,7-dimethyl-1*H*-indole-6-carboxylate (6e)**: yellow oil, yield 20%, 27.1 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.59 (s, 1H), 7.21 (dd, *J* = 10.6, 2.6 Hz, 2H), 7.12 (d, *J* = 3.2 Hz, 1H), 7.00 (d, *J* = 8.1 Hz, 1H), 6.61 (d, *J* = 3.1 Hz, 1H), 4.18 (s, 3H), 3.38 (s, 3H), 3.99 – 3.93 (m, 9H), 3.04 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.8, 148.4, 148.1, 135.3, 133.9, 132.2, 131.2, 130.5, 126.6, 123.8, 122.5, 119.6, 113.5, 110.4, 101.6, 56.0, 51.5, 36.6, 17.0 ppm; IR (KBr) *v* = 2950, 2837, 1711, 1593, 1515, 1461, 1437, 1341, 1259, 1239, 1193, 1167, 1140, 1112, 1027, 787, 730; HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{22}NO_4^+$: 340.1543 [M + H]$^+$; found: 340.1544.



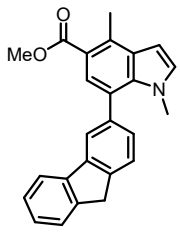

**Methyl 1,4-dimethyl-7-(3,4,5-trimethoxyphenyl)-1*H*-indole-5-carboxylate (5f)**: yellow oil, yield 53%, 70.2 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.68 (s, 1H), 7.03 (d, *J* = 3.2 Hz, 1H), 6.72 (d, *J* = 3.2 Hz, 1H), 6.63 (s, 2H), 3.92 (s, 3H), 3.89 (s, 3H), 3.86 (s, 6H), 3.39 (s, 3H), 2.87 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.8, 152.6, 137.4, 135.1, 135.0, 134.1, 131.2, 130.6, 126.2, 124.0, 119.6, 107.5, 101.7, 61.1, 56.2, 51.6, 36.5, 17.0 ppm; IR (KBr) *v* = 2945, 2836, 1711, 1583, 1503, 1463, 1412, 1354, 1237, 1197, 1127, 1007, 913, 744. HRMS (APCI, TOF): *m/z*: calcd for $C_{21}H_{24}NO_5^+$: 370.1649 [M + H]$^+$; found: 370.1647.



**Methyl 7-(4-chlorophenyl)-1,4-dimethyl-1*H*-indole-5-carboxylate** (**5g**): white solid; yield 45%, 56.3 mg, m.p.: 117–119 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.63 (s, 1H), 7.40 (d, *J* = 8.5 Hz, 2H), 7.35 (d, *J* = 8.5 Hz, 2H), 7.00 (d, *J* = 3.2 Hz, 1H), 6.70 (d, *J* = 3.2 Hz, 1H), 3.87 (s, 3H), 3.32 (s, 3H), 2.87 ppm (s, 3H); $^{13}$C NMR (101 MHz,Chloroform-*d*, 25 ℃) $\delta$ = 168.7, 138.2, 135.0, 134.3, 133.5, 131.4, 131.3, 130.8, 128.0, 126.6, 122.7, 119.8, 101.8, 51.6, 36.9, 17.1 ppm; IR (KBr) *v* = 2948, 1713, 1586, 1525, 1485, 1435, 1341, 1235, 1165, 1089, 1053, 1015, 829, 776, 735. HRMS (APCI, TOF): *m/z*: calcd for $C_{18}H_{17}ClNO_2^+$: 314.0942 [M + H]$^+$; found: 314.0943.

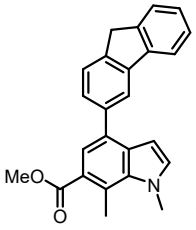


**Methyl 4-(4-chlorophenyl)-1,7-dimethyl-1*H*-indole-6-carboxylate** (**6g**): white solid; yield 19%, 23.8 mg, m.p.: 122–124 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.59 – 7.55 (m, 3H), 7.43 (d, *J* = 8.4 Hz, 2H), 7.11 (d, *J* = 3.2 Hz, 1H), 6.53 (d, *J* = 3.2 Hz, 1H), 4.15 (s, 3H), 3.92 (s, 3H), 3.02 ppm (s, 3H); $^{13}$C NMR (101 MHz,Chloroform-*d*, 25 ℃) $\delta$ = 169.5, 139.0, 136.3, 134.4, 132.9, 130.6, 130.2, 130.0, 128.6, 124.8, 124.0, 121.5, 100.3, 51.9, 38.4, 15.9 ppm; IR (KBr) *v* = 2988, 2950, 1713, 1516, 1487, 1434, 1340, 1304, 1240, 1197, 1116, 1013, 908, 832, 787, 734, 674. HRMS (APCI, TOF): *m/z*: calcd for $C_{18}H_{17}ClNO_2^+$: 314.0942 [M + H]$^+$; found: 314.0943.

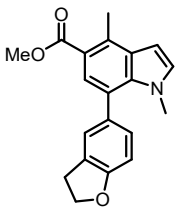


**Methyl 7-(9*H*-fluoren-3-yl)-1,4-dimethyl-1*H*-indole-5-carboxylate** (**5h**): white solid, yield 44%, 64.6 mg, m.p.: 153–155 ℃; $^{1}$H NMR (600 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 7.87 (t, *J* = 7.4 Hz, 2H), 7.77 (s, 1H), 7.62 (d, *J* = 15.1 Hz, 2H), 7.48 – 7.43 (m, 2H), 7.38 (t, *J* = 7.5 Hz, 1H), 7.05 (d, *J* = 3.2 Hz, 1H), 6.76 (d, *J* = 3.3 Hz, 1H), 4.00 (s, 2H), 3.92 (s, 3H), 3.38 (s, 3H), 2.93 ppm (s, 3H); $^{13}$C

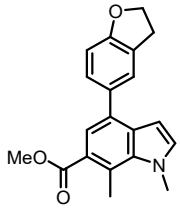
NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.9, 143.4, 142.9, 141.4, 140.9, 138.1, 135.3, 133.9, 131.2, 130.7, 128.9, 126.9, 126.9, 126.8, 126.6, 125.1, 124.4, 120.0, 119.7, 119.1, 101.7, 51.6, 37.0, 36.9, 17.1 ppm; IR (KBr) *v* = 2948, 2258, 1709, 1570, 1431, 1399, 1338, 1237, 1189, 1164, 1049, 916, 845,771, 726; HRMS (APCI, TOF): *m/z*: calcd for $C_{25}H_{22}NO_2^+$: 368.1645 $[M + H]^+$; found: 368.1646.



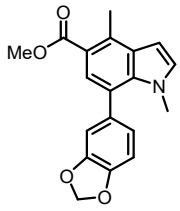

**Methyl 4-(9*H*-fluoren-3-yl)-1,7-dimethyl-1*H*-indole-6-carboxylate** (**6h**): white solid, yield 23%, 33.8 mg, m.p.: 138–140 ℃; $^1$H NMR (400 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 7.87 (d, *J* = 7.9 Hz, 1H), 7.83 (d, *J* = 8.2 Hz, 2H), 7.67 (d, *J* = 4.4 Hz, 2H), 7.57 (d, *J* = 7.5 Hz, 1H), 7.40 (t, *J* = 7.5 Hz, 1H), 7.32 (t, *J* = 6.8 Hz, 1H), 7.11 (d, *J* = 3.1 Hz, 1H), 6.64 (d, *J* = 3.2 Hz, 1H), 4.17 (s, 3H), 3.98 (s, 2H), 3.93 (s, 3H), 3.04 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.9, 143.4, 142.9, 141.4, 140.9, 138.1, 135.3, 133.9, 131.2, 130.7, 128.9, 126.9, 126.9, 126.8, 126.6, 125.1, 124.4, 120.0, 119.7, 119.1, 101.7, 51.6, 37.0, 36.9, 17.1 ppm; IR (KBr) *v* = 2925, 2854, 1710, 1611, 1436, 1377, 1320, 1215, 1155, 1093, 1034, 738, 711; HRMS (APCI, TOF): *m/z*: calcd for $C_{25}H_{22}NO_2^+$: 368.1645 $[M + H]^+$; found: 368.1646.



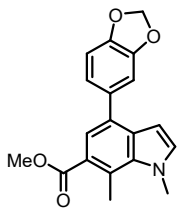

**Methyl 7-(2,3-dihydrobenzofuran-5-yl)-1,4-dimethyl-1*H*-indole-5-carboxylate**（**5i**)：colorless oil, yield 50%, 64.2 mg; $^1$H NMR (400 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 7.64 (s, 1H), 7.24 (d, *J* = 7.8 Hz, 1H), 7.13 (d, *J* = 8.2 Hz, 1H), 6.99 (d, *J* = 3.2 Hz, 1H), 6.82 (d, *J* = 8.1 Hz, 1H), 6.69 (d, *J* = 3.2 Hz, 1H), 4.64 (t, *J* = 8.7 Hz, 2H), 3.87 (s, 3H), 3.36 (s, 3H), 3.26 (t, *J* = 8.7 Hz, 2H), 2.86 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.7, 159.4, 136.3, 134.0, 133.0, 132.1, 130.5, 128.6, 127.2, 125.3, 121.3, 118.5, 109.2, 106.9, 100.7, 71.4, 51.9, 38.3, 29.8, 15.9 ppm; IR (KBr) *v* = 2949, 1711, 1611, 1575, 1488, 1436, 1342, 1241, 1165, 1098, 1053, 983, 824, 738; HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{20}NO_3^+$: 322.1438 $[M + H]^+$; found: 322.1438.



**Methyl 4-(2,3-dihydrobenzofuran-5-yl)-1,7-dimethyl-1*H*-indole-6-carboxylate (6i):** yellow oil, yield 21%, 27.0 mg; $^{1}$H NMR (600 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 7.57 (s, 1H), 7.49 (s, 1H), 7.42 (ddt, *J* = 8.2, 1.8, 0.8 Hz, 1H), 7.10 (d, *J* = 3.2 Hz, 1H), 6.90 (d, *J* = 8.2 Hz, 1H), 6.60 (d, *J* = 3.1 Hz, 1H), 4.66 (t, *J* = 8.6 Hz, 2H), 4.17 (s, 3H), 3.94 (s, 3H), 3.31 (t, *J* = 8.1 Hz, 2H), 3.04 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.9, 159.6, 135.5, 133.6, 131.8, 131.1, 130.6, 129.9, 126.8, 126.6, 126.6, 124.2, 119.6, 108.4, 101.6, 71.4, 51.5, 36.8, 29.8, 17.0 ppm; IR (KBr) *v* = 2950, 2855, 1711, 1611, 1575, 1488, 1435, 1341, 1238, 1196, 1147, 1053, 983, 825, 787, 733; HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{20}NO_3^+$: 322.1438 [M + H]$^+$; found: 322.1438.

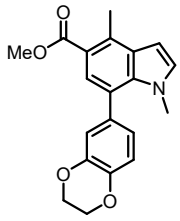


**Methyl 7-(benzo[d][1,3]dioxol-5-yl)-1,4-dimethyl-1*H*-indole-5-carboxylate (5j):** white solid, yield 48%, 62.0 mg, m.p.: 149–151 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 7.67 (d, *J* = 3.5 Hz, 1H), 7.03 (d, *J* = 3.3 Hz, 1H), 6.91 (d, *J* = 13.0 Hz, 3H), 6.72 (d, *J* = 3.2 Hz, 1H), 6.06 (s, 2H), 3.91 (s, 3H), 3.42 (s, 3H), 2.89 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.8, 147.1, 147.0, 135.2, 134.0, 133.3, 131.2, 130.6, 126.7, 123.6, 123.5, 119.6, 110.7, 107.7, 101.6, 101.2, 51.5, 36.7, 17.0 ppm; IR (KBr) *v* = 2949, 2903, 1711, 1576, 1485, 1439, 1344, 1319, 1243, 1200, 1164, 1095, 1039, 935, 736; HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{18}NO_4^+$: 324.1230 [M + H]$^+$; found: 324.1229.

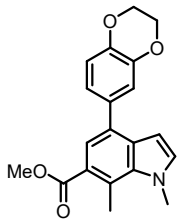


**Methyl 4-(benzo[d][1,3]dioxol-5-yl)-1,7-dimethyl-1*H*-indole-6-carboxylate (6j):** white solid, yield 28%, 36.2 mg, m.p.: 112–114 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 7.58

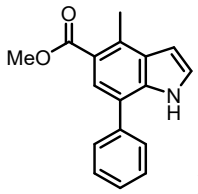
(s, 1H), 7.17 – 7.09 (m, 3H), 6.94 (d, $J$ = 7.9 Hz, 1H), 6.60 (d, $J$ = 3.1 Hz, 1H), 6.04 (s, 2H), 4.16 (s, 3H), 3.94 (s, 3H), 3.03 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.6, 140.5, 136.3, 134.2, 131.9, 130.4, 128.8, 128.5, 127.0, 124.7, 123.6, 121.6, 100.6, 51.9, 38.3, 15.9 ppm; IR (KBr) $v$ = 2949, 1712, 1599, 1516, 1488, 1434, 1378, 1342, 1302, 1239, 1196, 1115, 1057, 786, 737, 703; HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{18}NO_4^+$: 324.1230 [M + H]$^+$; found: 324.1229.



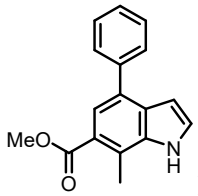
**Methyl 7-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-1,4-dimethyl-1*H*-indole-5-carboxylate** (**5k**): white solid, yield 49%, 66.1 mg, m.p.: 122–124 ℃; $^1$H NMR (400 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 7.64 (s, 1H), 7.00 (d, $J$ = 3.2 Hz, 1H), 6.95 – 6.85 (m, 3H), 6.68 (d, $J$ = 3.2 Hz, 1H), 4.31 (s, 4H), 3.87 (s, 3H), 3.39 (s, 3H), 2.86 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.8, 143.0, 142.8, 135.2, 133.9, 132.9, 131.2, 130.6, 126.7, 123.5, 123.4, 119.6, 116.5, 101.6, 64.4, 51.5, 36.8, 17.0 ppm; IR (KBr) $v$ = 2980, 2947, 2878, 1711, 1581, 1504, 1435, 1341, 1282, 1250, 1223, 1191, 1164, 1067, 821, 780, 736; HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{20}NO_4^+$: 338.1387 [M + H]$^+$; found: 338.1389.



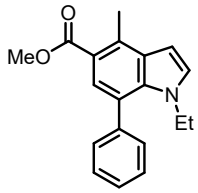
**Methyl 4-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-1,7-dimethyl-1*H*-indole-6-carboxylate** (**6k**): white solid, yield 25%, 33.7 mg, m.p.: 118–120 ℃; $^1$H NMR (400 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 7.56 (s, 1H), 7.18 – 7.11 (m, 2H), 7.08 (d, $J$ = 3.2 Hz, 1H), 6.95 (d, $J$ = 8.3 Hz, 1H), 6.61 (d, $J$ = 3.1 Hz, 1H), 4.31 (s, 4H), 4.14 (s, 3H), 3.90 (s, 3H), 3.01 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.6, 143.4, 142.8, 136.3, 134.1, 131.3, 130.3, 124.6, 123.3, 121.9, 121.3, 117.5, 117.2, 100.6, 64.5, 51.8, 38.3, 15.9 ppm; IR (KBr) $v$ = 2980, 2949, 1712, 1583, 1511, 1435, 1341, 1284, 1240, 1168, 1068, 890, 787, 735; HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{20}NO_4^+$: 338.1387 [M + H]$^+$; found: 338.1389.



**Methyl 4-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**5l**): yellow oil, yield 49%, 51.9 mg; $^1$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 8.60 (s, 1H), 7.86 (s, 1H), 7.60 (d, $J$ = 6.7 Hz, 2H), 7.49 ((t, $J$ = 7.6 Hz, 2H), 7.39 (t, $J$ = 7.4 Hz, 1H), 7.23 (t, $J$ = 3.0 Hz, 1H), 6.80 – 6.74 (m, 1H), 3.89 (s, 3H), 2.88 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 169.0, 138.4, 135.0, 134.1, 129.4, 129.2, 128.2, 127.6, 124.7, 124.6, 123.0, 121.1, 103.4, 51.6, 17.4 ppm; IR (KBr) $v$ = 3359, 3026, 2949, 1699, 1591, 1436, 1345, 1319, 1250, 1160, 1052, 883, 762, 732, 704 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{17}H_{16}NO_2^+$, $[M + H]^+$ 266.1176, found 266.1176.

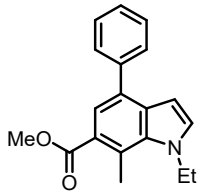


**Methyl 7-methyl-4-phenyl-1*H*-indole-6-carboxylate** (**6l**): yellow oil, yield 20%, 21.2 mg; $^1$H NMR (400 MHz, Chloroform-*d,* 25 °C) $\delta$ = 8.57 (s, 1H), 7.86 (s, 1H), 7.62 (d, $J$ = 6.9 Hz, 2H), 7.50 ((t, $J$ = 7.7 Hz, 2H), 7.40 (t, $J$ = 7.4 Hz, 1H), 7.25 (t, $J$ = 3.0 Hz, 1H), 6.80 – 6.75 (m, 1H), 3.90 (s, 3H), 2.89 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d,* 25 ℃) $\delta$ = 169.0, 138.4, 135.0, 134.1, 129.4, 129.2, 128.2, 127.6, 124.7, 124.6, 123.0, 121.1, 103.4, 51.6, 17.4 ppm; IR (KBr) $v$ = 3359, 3028, 2945, 1700, 1591, 1436, 1345, 1325, 1255, 1160, 1052, 874, 762, 733, 704 cm$^{-1}$. HRMS (APCI, TOF) m/z: calcd for $C_{17}H_{16}NO_2^+$, $[M + H]^+$ 266.1176, found 266.1176.

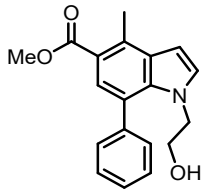


**Methyl 1-ethyl-4-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**5m**): white solid; yield 52%, 60.9 mg, m.p.: 112–114 ℃; $^1$H NMR (600 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.69 (d, $J$ = 8.3 Hz, 2H), 7.66 (s, 1H), 7.51 (t, $J$ = 7.6 Hz, 2H), 7.42 – 7.39 (m, 1H), 7.23 (d, $J$ = 3.2 Hz, 1H), 6.68 (d, $J$ = 3.2 Hz, 1H), 4.52 (q, $J$ = 7.2 Hz, 2H), 3.96 (s, 3H), 3.02 (s, 3H), 1.50 ppm (t, $J$ = 7.2 Hz, 3H); $^{13}$C NMR (151 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.8, 140.6, 135.4, 132.6, 132.0, 130.6, 128.9, 128.5, 127.0, 125.0, 123.0, 121.5, 101.3, 52.0, 44.7, 17.8, 15.9 ppm; IR (KBr) $v$ = 3055, 2998, 2977, 2948, 1707, 1569, 1524,

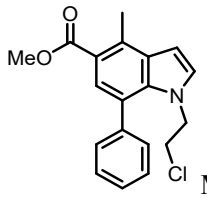
1483, 1430, 1343, 1323, 1229, 1204, 1161, 1054, 773, 739, 709 $cm^{-1}$.HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_2^+$: 294.1489 $[M + H]^+$; found: 294.1487.




**Methyl 1-ethyl-4-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**6m**): white solid; yield 29%, 34.0 mg, m.p.: 102–104 ℃; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.67 – 7.60 (m, 3H), 7.46 (t, *J* = 7.5 Hz, 2H), 7.36 (t, *J* = 7.3 Hz, 1H), 7.18 (d, *J* = 3.2 Hz, 1H), 6.63 (d, *J* = 3.2 Hz, 1H), 4.47 (q, *J* = 7.2 Hz, 2H), 3.91 (s, 3H), 2.97 (s, 3H), 1.46 ppm (t, *J* = 7.2 Hz, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.7, 140.6, 135.4, 132.6, 132.0, 130.6, 128.9, 128.5, 127.0, 125.0, 123.0, 121.5, 101.3, 51.9, 44.6, 17.8, 15.8 ppm; IR (KBr) *v* = 3057, 2978, 2948, 1712, 1602, 1515, 1435, 1343, 1313, 1253, 1226, 1117, 1058, 787, 737, 703 $cm^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_2^+$: 294.1489 $[M + H]^+$; found: 294.1487.

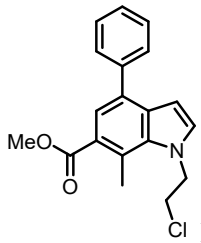



**Methyl 1-(2-hydroxyethyl)-4-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**5n**): yellow oil, yield 54%, 59.0 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.65 – 7.59 (m, 3H), 7.46 (t, *J* = 7.6 Hz, 2H), 7.36 (t, *J* = 7.4 Hz, 1H), 7.24 (d, *J* = 3.3 Hz, 1H), 6.64 (d, *J* = 3.2 Hz, 1H), 4.58 (t, *J* = 5.4 Hz, 2H), 3.94 (t, *J* = 5.4 Hz, 2H), 3.90 (s, 3H), 2.91 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.7, 140.4, 135.5, 133.9, 132.2, 130.8, 128.8, 128.5, 127.1, 125.4, 122.8, 121.7, 101.4, 63.2, 52.0, 51.6, 16.3 ppm; IR (KBr) *v* = 3450, 2980, 2950, 2253, 1739, 1712, 1436, 1334, 1224, 1145, 1090, 1054, 913, 773, 734, 706 $cm^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_3^+$: 310.1438 $[M + H]^+$; found: 310.1438.

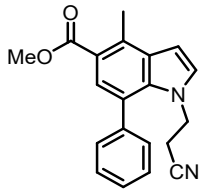



**Methyl 1-(2-chloroethyl)-4-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**5o**): yellow oil, yield 37%, 48.4 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.67 (s, 1H), 7.42 (d, *J* = 3.9 Hz,

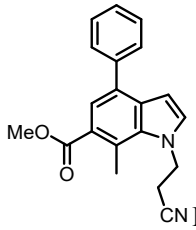
5H), 7.11 (d, *J* = 3.2 Hz, 1H), 6.74 (d, *J* = 3.4 Hz, 1H), 3.99 (t, *J* = 6.5 Hz, 2H), 3.86 (s, 3H), 3.21 (t, *J* = 6.5 Hz, 2H), 2.88 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.7, 139.3, 134.1, 134.1, 131.2, 130.9, 129.8, 128.3, 127.9, 127.1, 123.8, 120.3, 102.5, 51.6, 49.6, 42.9, 17.1 ppm; IR (KBr) *v* = 3058, 2950, 2253, 1711, 1573, 1527, 1482, 1438, 1337, 1236, 1207, 1055, 770, 720 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{19}ClNO_2^+$: 328.1099 [M + H]$^+$; found: 328.1097.



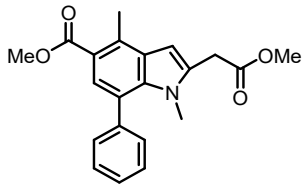

**Methyl 1-(2-chloroethyl)-7-methyl-4-phenyl-1*H*-indole-6-carboxylate** (**6o**): yield yellow oil, yield 34%, 44.5 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.63 (d, *J* = 8.0 Hz, 3H), 7.47 (t, *J* = 7.7 Hz, 2H), 7.37 (t, *J* = 7.4 Hz, 1H), 7.22 (d, *J* = 3.3 Hz, 1H), 6.66 (d, *J* = 3.3 Hz, 1H), 4.74 (t, *J* = 6.8 Hz, 2H), 3.92 (s, 3H), 3.79 (t, *J* = 6.8 Hz, 2H), 2.93 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.6, 140.2, 135.2, 133.6, 132.3, 130.9, 128.9, 128.5, 127.2, 125.7, 122.3, 122.1, 102.0, 52.1, 51.1, 43.5, 16.0 ppm; IR (KBr) *v* = 2952, 2903, 1713, 1601, 1518, 1435, 1346, 1242, 1197, 1068, 912, 788, 740, 704 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{19}ClNO_2^+$: 328.1099 [M + H]$^+$; found: 328.1097.



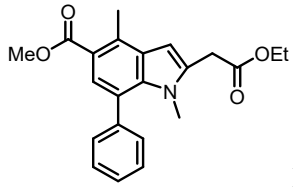

**Methyl 1-(2-cyanoethyl)-4-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**5p**): white solid, yield 35%, 44.5 mg, m.p.: 98–100 ℃; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.68 (s, 1H), 7.44 (dt, *J* = 7.7, 4.5 Hz, 5H), 7.13 (d, *J* = 3.4 Hz, 1H), 6.78 (d, *J* = 3.4 Hz, 1H), 4.00 (t, *J* = 6.8 Hz, 2H), 3.87 (s, 3H), 2.86 (s, 3H), 2.21 ppm (t, *J* = 6.8 Hz, 2H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.6, 139.1, 134.3, 133.8, 131.4, 130.0, 129.7, 128.5, 128.2, 127.3, 123.6, 120.7, 116.8, 103.5, 51.7, 43.9, 19.3, 17.0 ppm; IR (KBr) *v* = 3058, 2952, 2251, 1710, 1573, 1528, 1437, 1337, 1237, 1193, 1160, 1053, 900, 770, 710 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{19}N_2O_2^+$: 319.1441 [M + H]$^+$; found: 319.1441.



**Methyl 1-(2-cyanoethyl)-7-methyl-4-phenyl-1*H*-indole-6-carboxylate (6p)**: white solid, yield 34%, 43.3 mg, m.p.: 123–125 °C; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 °C) $\delta$ = 7.67 – 7.60 (m, 3H), 7.47 (t, *J* = 7.6 Hz, 2H), 7.38 (t, *J* = 7.3 Hz, 1H), 7.24 (d, *J* = 3.3 Hz, 1H), 6.70 (d, *J* = 3.3 Hz, 1H), 4.75 (t, *J* = 6.9 Hz, 2H), 3.93 (s, 3H), 2.93 (s, 3H), 2.81 (t, *J* = 6.8 Hz, 2H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 °C) $\delta$ = 169.4, 140.0, 135.0, 132.9, 131.2, 128.8, 128.6, 127.3, 126.0, 122.5, 122.0, 116.7, 108.8, 103.1, 52.1, 45.3, 20.8, 15.9 ppm; IR (KBr) $\nu$ = 2953, 2251, 1712, 1520, 1437, 1364, 1325, 1245, 1073, 912, 788, 740, 704 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{19}N_2O_2^+$: 319.1441 [M + H]$^+$; found: 319.1441.

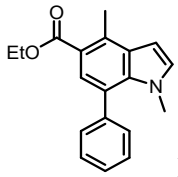


**Methyl 2-(2-methoxy-2-oxoethyl)-1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate (5q)**: yellow oil, yield 49%, 68.8 mg; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 °C) $\delta$ = 7.65 (s, 1H), 7.41 (s, 4H), 6.66 (s, 1H), 3.86 (s, 3H), 3.79 (s, 2H), 3.71 (s, 3H), 3.21 (s, 3H), 2.21 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 °C) $\delta$ = 170.2, 168.8, 139.8, 136.2, 134.1, 133.4, 130.1, 129.4, 127.9, 127.4, 127.0, 123.9, 119.7, 103.0, 52.4, 51.5, 33.3, 17.0 ppm; IR (KBr) $\nu$ = 2991, 2951, 1741, 1711, 1577, 1436, 1332, 1237, 1199, 1139, 1054, 1015, 770, 705 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{21}H_{22}NO_4^+$: 352.1543 [M + H]$^+$; found: 352.1543.

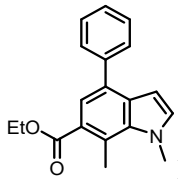


**Methyl 2-(2-methoxy-2-oxoethyl)-1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate (5r)**: yellow oil, yield 54%, 78.8 mg; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 °C) $\delta$ = 7.65 (s, 1H), 7.41 (s, 5H), 6.66 (s, 1H), 4.18 (q, *J* = 7.2 Hz, 2H), 3.86 (s, 3H), 3.78 (s, 2H), 3.21 (s, 3H), 2.84 (s, 3H), 1.26 ppm (t, *J* = 7.2 Hz, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 °C) $\delta$ = 169.8, 168.8, 139.9,

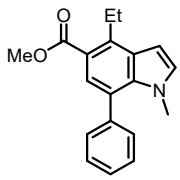
136.2, 134.3, 133.3, 130.1, 129.5, 127.9, 127.3, 126.9, 123.9, 119.7, 102.9, 61.4, 51.5, 33.6, 33.3, 17.0, 14.2 ppm; IR (KBr) $\nu$ = 2952, 2253, 1741, 1711, 1610, 1548, 1436, 1347, 1233, 1173, 1108, 1059, 912, 737, 704 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{22}H_{24}NO_4^+$: 366.1700 [M + H]$^+$; found: 366.1700.



**Ethyl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5s**): yellow oil, yield 58%, 69.0 mg; $^1$H NMR (400 MHz,400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.66 (s, 1H), 7.42 (s, 5H), 7.00 (s, 1H), 6.70 (s, 1H), 4.35 (q, *J* = 7.1 Hz, 2H), 3.30 (s, 3H), 2.87 (s, 3H), 1.38 ppm (t, *J* = 7.1 Hz, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.5, 139.7, 135.1, 133.8, 131.2, 130.6, 130.2, 127.8, 127.4, 126.5, 124.1, 120.1, 101.6, 60.4, 36.8, 17.1, 14.5 ppm; IR (KBr) $\nu$ = 2980, 2950, 1707, 1576, 1525, 1445, 1340, 1328, 1231, 1167, 1052, 768, 706 cm$^{-1}$. HRMS (APCI, TOF): m/z: calcd for $C_{19}H_{20}NO_2^+$, [M + H]$^+$ 294.1489, found: 294.1488.

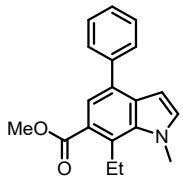


**Ethyl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6s**): yellow oil, yield 24%, 28.6 mg; $^1$H NMR (400 MHz,Chloroform-*d*, 25 ℃) $\delta$ = 7.67 (d, *J* = 8.0 Hz, 2H), 7.62 (s, 1H), 7.50 (t, *J* = 7.6 Hz, 2H), 7.40 (t, *J* = 7.3 Hz, 1H), 7.11 (d, *J* = 3.2 Hz, 1H), 6.61 (d, *J* = 3.1 Hz, 1H), 4.41 (q, *J* = 7.1 Hz, 2H), 4.17 (s, 3H), 3.05 (s, 3H), 1.43 ppm (t, *J* = 7.1 Hz, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.3, 140.6, 136.3, 134.1, 131.9, 130.3, 128.8, 128.5, 127.0, 125.3, 123.3, 121.5, 100.5, 60.7, 38.3, 16.0, 14.4 ppm; IR (KBr) $\nu$ = 2979, 2929, 1707, 1515, 1449, 1367, 1338, 1236, 1192, 1056, 762, 702 cm$^{-1}$. HRMS (APCI, TOF): m/z: calcd for $C_{19}H_{20}NO_2^+$, [M + H]$^+$ 294.1489, found: 294.1488.

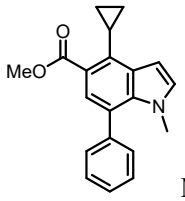


**Methyl 4-ethyl-1-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**5t**): white solid, yield 42%, 49.2 mg, m.p.: 72–74 ℃; $^1$H NMR (600 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.74 (s, 1H), 7.51 – 7.44 (m, 5H), 7.05 (d, *J* = 3.3 Hz, 1H), 6.78 (d, *J* = 3.3 Hz, 1H), 3.95 (s, 3H), 3.44 (q, *J* = 7.5, 7.0 Hz, 2H),

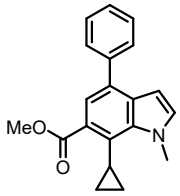
3.36 (s, 3H), 1.46 ppm (t, $J$ = 7.5 Hz, 3H) ; $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.6, 140.2, 139.7, 135.4, 131.3, 130.2, 129.8, 127.8, 127.4, 126.8, 124.3, 119.0, 101.3, 51.6, 36.8, 24.1, 15.5 ppm; IR (KBr) $v$ = 2974, 2950, 2873, 1711, 1575, 1465, 1435, 1345, 1232, 1164, 1092, 1077, 730, 704. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_2^+$, $[M + H]^+$ 294.1489, found: 294.1489.



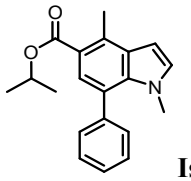

**Methyl 7-ethyl-1-methyl-4-phenyl-1*H*-indole-6-carboxylate** (**6t**): white solid, yield 37%, 43.4 mg, m.p.: 60–62 ℃; $^1$H NMR (600 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.69 – 7.63 (m, 3H), 7.50 (t, $J$ = 7.7 Hz, 2H), 7.40 (t, $J$ = 7.4 Hz, 1H), 7.14 (d, $J$ = 3.2 Hz, 1H), 6.65 (d, $J$ = 3.2 Hz, 1H), 4.17 (s, 3H), 3.95 (s, 3H), 3.49 (q, $J$ = 7.4 Hz, 2H), 1.47 ppm (t, $J$ = 7.4 Hz, 3H) ; $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.4, 140.6, 135.1, 134.4, 132.0, 131.0, 130.1, 128.9, 128.5, 127.0, 123.9, 121.9, 100.7, 51.9, 37.8, 21.3, 17.3 ppm; IR (KBr) $v$ = 2950, 2872, 1713, 1601, 1516, 1433, 1342, 1237, 1193, 1117, 762, 737, 703. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_2^+$, $[M + H]^+$ 294.1489, found: 294.1489.



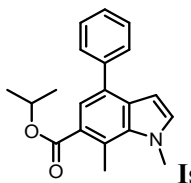

**Methyl 4-cyclopropyl-1-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**5u**): yellow solid, yield 51%, 62.2 mg, m.p.: 87–89 ℃; $^1$H NMR (600 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.43 (d, $J$ = 2.1 Hz, 1H), 7.39 (s, 5H), 6.98 (d, $J$ = 3.2 Hz, 1H), 6.87 (d, $J$ = 3.3 Hz, 1H), 3.90 (d, $J$ = 1.6 Hz, 3H), 3.28 (s, 3H), 2.46 (td, $J$ = 6.1, 2.7 Hz, 1H), 1.07 (d, $J$ = 8.8 Hz, 2H), 0.70 ppm (d, $J$ = 5.7 Hz, 2H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.7, 139.6, 136.2, 135.1, 131.3, 130.8, 130.1, 127.7, 127.4, 125.6, 124.8, 123.4, 102.1, 51.8, 36.8, 13.1, 7.2 ppm; IR (KBr) $v$ = 3080, 2999, 2948, 2250, 1602, 1718, 1571, 1434, 1336, 1247, 1158, 1141, 1089, 1027, 736, 706. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{20}NO_2^+$: 306.1489 $[M + H]^+$; found: 306.1487.



**Methyl 7-cyclopropyl-1-methyl-4-phenyl-1*H*-indole-6-carboxylate** (**6u**): yellow solid, yield 25%, 30.5 mg, m.p.: 86–88 ℃; $^{1}$H NMR (600 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.49 (s, 1H), 7.46 – 7.42 (m, 5H), 7.03 (d, *J* = 3.2 Hz, 1H), 6.92 (d, *J* = 3.2 Hz, 1H), 3.96 (s, 3H), 3.33 (s, 3H), 2.52 (tt, *J* = 8.7, 5.7 Hz, 1H), 1.15 – 1.11 (m, 2H), 0.77 – 0.74 ppm (m, 2H); $^{13}$C NMR (151 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.7, 139.6, 136.2, 135.1, 131.3, 130.8, 130.1, 127.8, 127.4, 125.6, 124.8, 123.4, 102.1, 51.9, 36.8, 13.2, 7.2 ppm; IR (KBr) *v* = 3080, 3000, 2948, 1719, 1571, 1434, 1336, 1247, 1158, 1141, 1089, 1026, 737, 706. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{20}NO_2^+$: 306.1489 $[M + H]^+$; found: 306.1487.

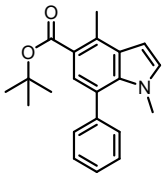


**Isopropyl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5v**): yellow oil, yield 48%, 58.9 mg; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.67 (s, 1H), 7.47 (s, 5H), 7.03 (d, *J* = 3.2 Hz, 1H), 6.73 (d, *J* = 3.2 Hz, 1H), 5.30 (hept, *J* = 6.2 Hz, 1H), 3.33 (s, 3H), 2.91 (s, 3H), 1.40 ppm (d, *J* = 6.2 Hz, 6H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.1, 139.8, 135.0, 133.4, 131.2, 130.6, 130.3, 127.8, 127.4, 126.4, 124.0, 120.6, 101.5, 67.6, 36.8, 22.1, 17.1 ppm; IR (KBr) *v* = 3057, 2979, 2935, 1704, 1577, 1467, 1447, 1375, 1351, 1250, 1232, 1168, 1109, 1043, 892, 725 cm$^{-1}$. HRMS (APCI, TOF): m/z: calcd for $C_{20}H_{22}NO_2^+$, $[M + H]^+$ 308.1645, found: 308.1646.

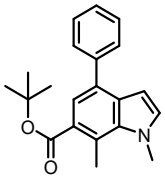


**Isopropyl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6v**): yellow oil, yield 24%, 29.5 mg; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.73 – 7.61 (m, 2H), 7.57 (s, 1H), 7.50 (t, *J* = 7.5 Hz, 2H), 7.40 (t, *J* = 7.4 Hz, 1H), 7.10 (d, *J* = 3.1 Hz, 1H), 6.60 (d, *J* = 3.1 Hz, 1H), 5.31 (hept, *J* = 6.3 Hz, 1H), 4.17 (s, 3H), 3.03 (s, 3H), 1.42 ppm (d, *J* = 6.3 Hz, 6H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.9, 140.6, 136.3, 134.0, 131.9, 130.2, 128.8, 128.5, 127.0, 125.9, 122.9, 121.3, 100.5,

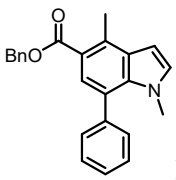
68.1, 38.3, 22.1, 16.0 ppm; IR (KBr) $v$ = 3058, 2978, 2930, 1705, 1601, 1515, 1453, 1376, 1302, 1240, 1194, 1106, 1054, 1029, 786, 703 $cm^{-1}$. HRMS (APCI, TOF): m/z: calcd for $C_{20}H_{22}NO_2^+$, $[M + H]^+$ 308.1645, found: 308.1646.



***Tert*-butyl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5w**): yellow solid, yield 38%, 48.8 mg, m.p.: 89–91 ℃; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.56 (s, 1H), 7.42 (s, 5H), 6.98 (d, $J$ = 3.3 Hz, 1H), 6.67 (d, $J$ = 3.2 Hz, 1H), 3.29 (s, 3H), 2.83 (s, 3H), 1.60 ppm (s, 9H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.2, 139.9, 134.9, 132.7, 131.1, 130.6, 130.3, 127.8, 127.3, 126.4, 124.0, 122.0, 101.5, 80.4, 36.8, 28.5, 17.1 ppm; IR (KBr) $v$ = 3057, 2976, 2929, 1704, 1577, 1472, 1449, 1367, 1341, 1252, 1155, 1092, 1050, 766, 705 $cm^{-1}$. HRMS (APCI, TOF): m/z: calcd for $C_{21}H_{24}NO_2^+$, $[M + H]^+$ 322.1802, found: 322.1802.

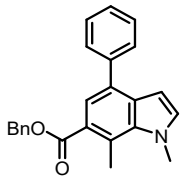


***Tert*-butyl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6w**): yellow oil, yield 21%, 27.1 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.64 (d, $J$ = 7.0 Hz, 2H), 7.49 – 7.44 (m, 3H), 7.36 (t, $J$ = 7.4 Hz, 1H), 7.06 (d, $J$ = 3.2 Hz, 1H), 6.56 (d, $J$ = 3.2 Hz, 1H), 4.13 (s, 3H), 2.98 (s, 3H), 1.62 ppm (s, 9H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.0, 140.7, 136.2, 133.8, 131.9, 129.9, 128.8, 128.5, 127.4, 127.0, 122.1, 121.2, 100.5, 80.9, 38.2, 28.4, 16.0 ppm; IR (KBr) $v$ = 3058, 2976, 2930, 1601, 1704, 1516, 1472, 1368, 1344, 1301, 1250, 1162, 1116, 1056, 909, 702 $cm^{-1}$. HRMS (APCI, TOF): m/z: calcd for $C_{21}H_{24}NO_2^+$, $[M + H]^+$ 322.1802, found: 322.1802.

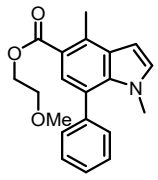


**Benzyl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5x**): yellow oil, yield 57%, 81.0 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.70 (s, 1H), 7.46 – 7.29 (m, 10H), 6.98 (d, $J$ = 3.2 Hz, 1H), 6.69 (d, $J$ = 3.2 Hz, 1H), 5.35 (s, 2H), 3.27 (s, 3H), 2.88 ppm (s, 3H); $^{13}$C NMR (101 MHz,

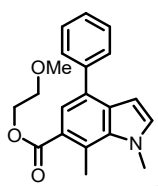
Chloroform-*d*, 25 ℃) $\delta$ = 168.2, 139.6, 136.7, 135.2, 134.2, 131.3, 130.7, 130.2, 128.5, 128.2, 128.0, 127.8, 127.4, 126.5, 124.2, 119.6, 101.7, 66.2, 36.8, 17.2 ppm; IR (KBr) $v$ = 3031, 2948, 1708, 1576, 1525, 1447, 1375, 1341, 1328, 1230, 1162, 1046, 727, 702. HRMS (APCI, TOF): *m/z*: calcd for $C_{24}H_{22}NO_2^+$, $[M + H]^+$ 356.1645, found: 356.1645.




**Benzyl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6x**): yellow oil; yield 24%, 34.0 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.67 – 7.60 (m, 3H), 7.45 (t, $J$ = 7.5 Hz, 4H), 7.40 – 7.29 (m, 4H), 7.08 (d, $J$ = 3.2 Hz, 1H), 6.57 (d, $J$ = 3.2 Hz, 1H), 5.38 (s, 2H), 4.12 (s, 3H), 3.01 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.0, 140.5, 136.4, 136.3, 134.2, 132.0, 130.5, 128.8, 128.6, 128.5, 128.1, 128.1, 127.0, 124.7, 123.7, 121.6, 100.6, 66.5, 38.3, 16.0 ppm. IR (KBr) $v$ = 3032, 2928, 2851, 1709, 1599, 1515, 1489, 1453, 1378, 1340, 1232, 1188, 1113, 736, 700. HRMS (APCI, TOF): *m/z*: calcd for $C_{24}H_{22}NO_2^+$, $[M + H]^+$ 356.1645, found: 356.1643.

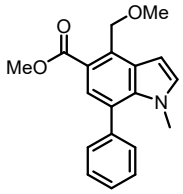



**2-Methoxyethyl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5y**): yellow oil, yield 60%, 77.5 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.73 (s, 1H), 7.45 (s, 5H), 7.03 (d, $J$ = 3.3 Hz, 1H), 6.74 (d, $J$ = 3.2 Hz, 1H), 4.52 – 4.46 (m, 2H), 3.79 – 3.73 (m, 2H), 3.44 (s, 3H), 3.33 (s, 3H), 2.92 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.4, 139.7, 135.2, 134.0, 131.2, 130.6, 130.2, 127.8, 127.4, 126.6, 124.1, 119.6, 101.6, 70.8, 63.4, 59.0, 36.8, 17.1 ppm; IR (KBr) $v$ = 3007, 2934, 2841, 2739, 1736, 1687, 1601, 1578, 1512, 1462, 1315, 1261, 1161, 1027, 833, 599 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{22}NO_3^+$, $[M + H]^+$ 324.1594, found: 324.1594.

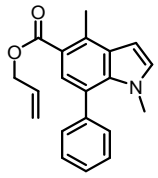



**2-Methoxyethyl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6y**): yellow oil, yield 18%, 23.3 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.70 – 7.63 (m, 3H), 7.49 (t, $J$ = 7.5 Hz,

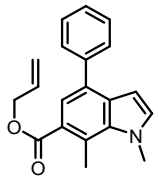
2H), 7.39 (t, $J$ = 7.4 Hz, 1H), 7.11 (d, $J$ = 3.2 Hz, 1H), 6.61 (d, $J$ = 3.1 Hz, 1H), 4.53 – 4.49 (m, 2H), 4.17 (s, 3H), 3.78 – 3.75 (m, 2H), 3.45 (s, 3H), 3.05 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 °C) $\delta$ = 169.2, 140.5, 136.3, 134.2, 131.9, 130.5, 128.8, 128.5, 127.0, 124.8, 123.6, 121.6, 100.6, 70.6, 63.8, 59.0, 38.3, 16.0 ppm; IR (KBr) $v$ = 3057, 2928, 1709, 1600, 1515, 1450, 1377, 1340, 1301, 1236, 1191, 1114, 1058, 907, 786, 703 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{22}NO_3^+$, $[M + H]^+$ 324.1594, found: 324.1594.



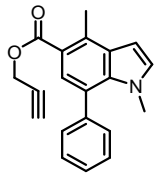

**Methyl 4-(methoxymethyl)-1-methyl-7-phenyl-1*H*-indole-5-carboxylate** (**5z**): yellow oil, yield 64%, 79.1 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 °C) $\delta$ = 7.66 (s, 1H), 7.45 (s, 5H), 7.07 (d, $J$ = 3.3 Hz, 1H), 6.88 (d, $J$ = 3.2 Hz, 1H), 5.22 (s, 2H), 3.92 (s, 3H), 3.49 (s, 3H), 3.33 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 °C) $\delta$ = 168.6, 139.4, 135.7, 132.0, 131.8, 130.5, 130.1, 127.8, 127.6, 126.3, 126.1, 120.7, 101.9, 69.2, 58.4, 51.8, 36.8 ppm; IR (KBr) $v$ = 2985, 2949, 2901, 1715, 1581, 1435, 1397, 1340, 1236, 1198, 1163, 1092, 1042, 955, 910, 733, 705. HRMS (APCI, TOF): *m/z*: calcd for $C_{19}H_{20}NO_3^+$: 310.1438 $[M + H]^+$; found: 310.1438.



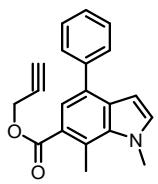

**Allyl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5aa**): yellow oil, yield 51%, 62.2 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 °C) $\delta$ = 7.70 (s, 1H), 7.40 (s, 5H), 6.98 (d, $J$ = 3.3 Hz, 1H), 6.69 (d, $J$ = 3.2 Hz, 1H), 6.04 (ddt, $J$ = 16.1, 10.8, 5.6 Hz, 1H), 5.40 (d, $J$ = 1.5 Hz, 1H), 5.23 (dd, $J$ = 10.4, 1.4 Hz, 1H), 4.80 (d, $J$ = 5.6 Hz, 2H), 3.28 (s, 3H), 2.88 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 °C) $\delta$ = 168.8, 140.5, 136.3, 134.2, 132.6, 132.0, 130.5, 128.8, 128.5, 127.1, 124.7, 123.7, 121.6, 118.1, 100.6, 65.4, 38.3, 16.0 ppm; IR (KBr) $v$ = 3058, 2981, 2946, 1710, 1576, 1444, 1357, 1326, 1230, 1163, 1093, 1046, 769, 706. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{20}NO_2^+$, $[M + H]^+$ 306.1489, found: 306.1489.



**Allyl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6aa**): yellow oil; yield 32%, 39.1 mg; $^{1}$H NMR (600 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.64 (d, *J* = 3.6 Hz, 3H), 7.46 (t, *J* = 6.9 Hz, 2H), 7.36 (t, *J* = 7.4 Hz, 1H), 7.07 (d, *J* = 3.2 Hz, 1H), 6.58 (d, *J* = 3.2 Hz, 1H), 6.13 – 6.00 (m, 1H), 5.42 (d, *J* = 17.2 Hz, 1H), 5.27 (d, *J* = 10.5 Hz, 1H), 4.86 – 4.80 (m, 2H), 4.12 (s, 3H), 3.02 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.8, 140.5, 136.3, 134.2, 132.6, 131.9, 130.5, 128.8, 128.5, 127.1, 124.7, 123.7, 121.6, 118.1, 100.6, 65.4, 38.3, 16.0 ppm; IR (KBr) *v* = 3058, 2932, 1710, 1599, 1515, 1448, 1338, 1234, 1189, 1114, 1055, 1007, 786, 703. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{20}NO_2^+$, $[M + H]^+$ 306.1489, found: 306.1489.

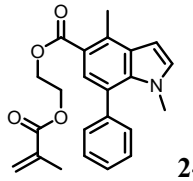


**Prop-2-yn-1-yl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5ab**): yellow solid, yield 56%, 67.9 mg, m.p.: 88–90 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.69 (d, *J* = 15.8 Hz, 1H), 7.40 (s, 5H), 6.99 (d, *J* = 3.3 Hz, 1H), 6.70 (t, *J* = 2.9 Hz, 1H), 4.89 (d, *J* = 2.5 Hz, 1H), 3.87 (s, 2H), 3.3 (s, 3H), 2.87 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 167.3, 139.5, 135.4, 134.7, 131.3, 130.7, 130.2, 127.8, 127.4, 126.7, 124.2, 118.7, 101.7, 78.4, 74.5, 51.8, 36.8, 17.1 ppm; IR (KBr) *v* = 3291, 3058, 2947, 1715, 1576, 1444, 1366, 1340, 1230, 1200, 1160, 1092, 1048, 920, 769, 727, 706. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{18}NO_2^+$, $[M + H]^+$ 304.1332, found: 304.1330.

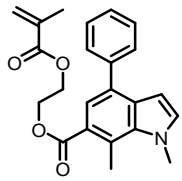


**Prop-2-yn-1-yl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6ab**): white solid, yield 20%, 24.2 mg, m.p.: 1102–104 ℃; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.66 – 7.61 (m, 3H), 7.46 (t, *J* = 7.6 Hz, 2H), 7.36 ((t, *J* = 7.4 Hz, 1H), 7.09 (d, *J* = 3.1 Hz, 1H), 6.58 (d, *J* = 3.2 Hz, 1H), 4.92 (d, *J* = 2.5 Hz, 2H), 4.13 (s, 3H), 3.91 (s, 1H), 3.03 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.1, 140.4, 136.3, 134.5, 132.0, 130.8, 128.8, 128.5, 127.1, 124.2, 123.6, 121.7, 100.6, 78.2,

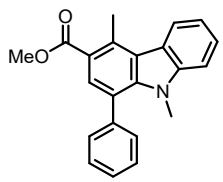
74.7, 52.1, 38.4, 15.9 ppm; IR (KBr) $v$ = 3529, 3056, 3025, 2950, 1712, 1599, 1508, 1481, 1402, 1375, 1327, 1274, 1222, 1169, 1088, 1016, 911, 866, 730, 703. HRMS (APCI, TOF): *m/z*: calcd for $C_{20}H_{18}NO_2^+$, $[M + H]^+$ 304.1332, found: 304.1330.



**2-(Methacryloyloxy)ethyl 1,4-dimethyl-7-phenyl-1*H*-indole-5-carboxylate** (**5ac**): colorless oil, yield 38%, 57.5 mg; $^1$H NMR (600 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.67 (s, 1H), 7.39 (s, 5H), 6.98 (d, $J$ = 3.2 Hz, 1H), 6.68 (d, $J$ = 3.2 Hz, 1H), 6.10 (s, 1H), 5.52 (s, 1H), 4.56 – 4.53 (m, 2H), 4.47 (dd, $J$ = 5.9, 3.8 Hz, 2H), 3.28 (s, 3H), 2.86 (s, 3H), 1.90 ppm (s, 3H); $^{13}$C NMR (151 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.1, 167.2, 139.6, 136.0, 135.3, 134.1, 131.4, 130.7, 130.2, 127.8, 127.5, 126.7, 126.1, 124.2, 119.4, 101.7, 62.7, 62.1, 36.9, 18.3, 17.20 ppm; IR (KBr) $v$ = 3057, 2954, 1888, 1717, 1636, 1576, 1447, 1368, 1341, 1323, 1232, 1158, 1092, 1068, 943, 768. HRMS (APCI, TOF): *m/z*: calcd for $C_{23}H_{24}NO_4^+$, $[M + H]^+$ 378.1700, found: 378.1700.

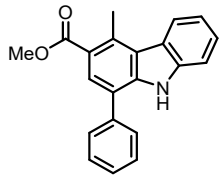


**2-(Methacryloyloxy)ethyl 1,7-dimethyl-4-phenyl-1*H*-indole-6-carboxylate** (**6ac**): colorless oil, yield 35%, 52.9 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 7.67 – 7.59 (m, 3H), 7.46 (t, $J$ = 7.6 Hz, 2H), 7.36 (t, $J$ = 7.4 Hz, 1H), 7.10 (d, $J$ = 3.2 Hz, 1H), 6.59 (d, $J$ = 3.1 Hz, 1H), 6.15 (s, 1H), 5.57 (s, 1H), 4.60 – 4.55 (m, 2H), 4.52 – 4.48 (m, 2H), 4.14 (s, 3H), 3.02 (s, 3H), 1.94 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.8, 167.2, 140.4, 136.3, 136.0, 134.3, 132.0, 130.6, 128.8, 128.5, 127.1, 126.1, 124.4, 123.7, 121.7, 100.6, 62.6, 62.4, 38.3, 18.3, 15.9 ppm; IR (KBr) $v$ = 2956, 1718, 1637, 1601, 1515, 1451, 1377, 1341, 1236, 1165, 1114, 1064, 786, 703. HRMS (APCI, TOF): *m/z*: calcd for $C_{23}H_{24}NO_4^+$, $[M + H]^+$ 378.1700, found: 378.1700.

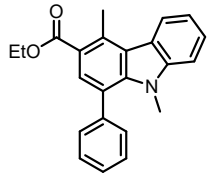


**Methyl 4, 9-dimethyl-1-phenyl-9*H*-carbazole-3-carboxylate** (**8a**): colorless oil,

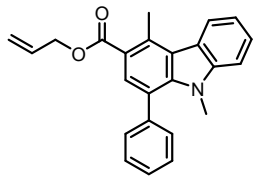
yield 64%, 84.3 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 8.06 (d, *J* = 7.8 Hz, 1H), 7.92 (d, *J* = 8.2 Hz, 1H), 7.64 (d, *J* = 8.1 Hz, 1H), 7.50 (t, *J* = 7.1 Hz, 1H), 7.48 – 7.33 (m, 2H), 7.33 – 7.14 (m, 4H), 4.12 (s, 3H), 3.94 (s, 3H), 3.01 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.5, 143.3, 140.6, 134.3, 129.7, 129.0, 128.6, 126.8, 126.4, 126.2, 122.8, 122.2, 121.2, 120.6, 119.5, 117.4, 109.1, 52.1, 33.6, 17.0 ppm; IR (KBr) *v* = 2949, 1711, 1696, 1620, 1575, 1512, 1459, 1435, 1384, 1338, 1320, 1295, 1241, 1222, 1201, 1154, 1116, 1064, 912, 788, 774, 748, 734 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{22}H_{20}NO_2^+$: 330.1489 [M + H]$^+$; found: 330.1489.




**Methyl 4-dimethyl-1-phenyl-9*H*-carbazole-3-carboxylate** (**8b**): yellow oil, yield 41%, 51.8 mg; $^1$H NMR (400 MHz, DMSO-$d_6$, 25 ℃) $\delta$ = 11.49 (s, 1H), 8.16 (d, *J* = 7.9 Hz, 1H), 7.58 – 7.55 (m, 4H), 7.41 – 7.35 (m, 5H), 3.87 (s, 3H), 2.80 ppm (s, 3H); $^{13}$C NMR (101 MHz, DMSO-$d_6$, 25 ℃) $\delta$ = 168.6, 141.4, 139.9, 133.6, 130.7, 129.7, 128.8, 127.5, 126.5, 125.7, 123.6, 123.2, 123.0, 121.9, 120.6, 119.5, 111.7, 52.2, 20.5 ppm; IR (KBr) *v* = 3379, 2967, 2874, 1696, 1620, 1574, 1514, 1459, 1436, 1383, 1342, 1229, 1233, 1203, 1154, 1119, 1059, 912, 746 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{21}H_{18}NO_2^+$: 316.1332 [M + H]$^+$; found: 316.1332.



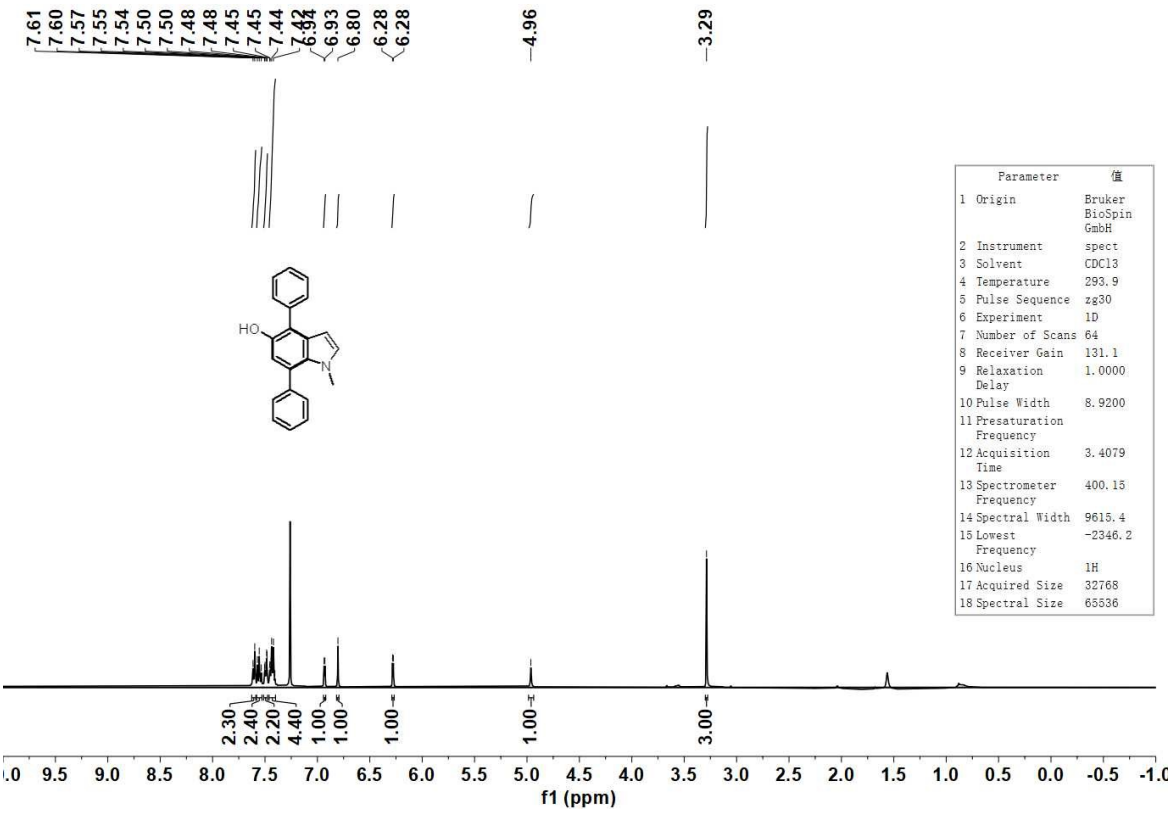

**Ethyl 4, 9-dimethyl-1-phenyl-9*H*-carbazole-3-carboxylate** (**8c**): yellow oil, yield 52%, 71.3 mg; $^1$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 8.05 (d, *J* = 7.8 Hz, 1H), 7.91 (d, *J* = 8.1 Hz, 1H), 7.63 (d, *J* = 8.3 Hz, 1H), 7.49 (t, *J* = 7.7 Hz, 1H), 7.39 – 7.32 (m, 2H), 7.26 (dt, *J* = 21.9, 8.0 Hz, 4H), 4.14 (q, *J* = 7.2 Hz, 2H), 4.10 (s, 3H), 3.00 (s, 3H), 1.43 ppm (t, *J* = 7.2 Hz, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 169.2, 143.3, 140.6, 134.3, 129.7, 129.5, 128.6, 126.7, 126.5, 126.1, 122.5, 122.3, 121.2, 120.6, 119.4, 117.4, 109.1, 61.0, 33.6, 17.0, 14.4 ppm; IR (KBr) *v* = 2980, 2937, 1692, 1620, 1576, 1513, 1459, 1386, 1367, 1321, 1295, 1240, 1221, 1196, 1062, 912, 872, 774, 747 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{23}H_{22}NO_2^+$: 344.1645 [M + H]$^+$; found: 344.1645.



**Allyl 4, 9-dimethyl-1-phenyl-9*H*-carbazole-3-carboxylate** (**8d**): yellow oil, yield 57%, 80.9 mg; $^{1}$H NMR (400 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 8.07 (d, *J* = 7.8 Hz, 1H), 7.92 (d, *J* = 8.2 Hz, 1H), 7.68 (d, *J* = 8.2 Hz, 1H), 7.67 – 7.42 (m, 2H), 7.42 – 7.27 (m, 2H), 7.27 – 7.05 (m, 3H), 6.14 – 6.04 (m, 1H), 5.45 (dd, *J* = 17.2, 1.6Hz, 1H), 5.31 (dd, *J* = 10.4, 1.4 Hz, 1H), 4.86 (d, *J* = 5.7 Hz, 2H), 4.13 (s, 3H), 3.02 ppm (s, 3H); $^{13}$C NMR (101 MHz, Chloroform-*d*, 25 ℃) $\delta$ = 168.7, 143.3, 140.6, 132.4, 129.7, 129.0, 126.8, 126.3, 125.9, 122.9, 122.2, 121.3, 120.6, 119.5, 119.1, 118.3, 117.4, 109.1, 108.6, 65.6, 33.7, 17.0 ppm; IR (KBr) *v* = 2971, 2937, 1697, 1620, 1513, 1458, 1386, 1320, 1295, 1221, 1193, 1128, 1059, 992, 913, 774, 746 cm$^{-1}$. HRMS (APCI, TOF): *m/z*: calcd for $C_{24}H_{22}NO_2^+$: 356.1645 $[M + H]^+$; found: 356.1643.

**8. $^{1}$H NMR and $^{13}$C NMR spectra**

**3a**




| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 293.9 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 64 |
| 8 Receiver Gain | 131.1 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
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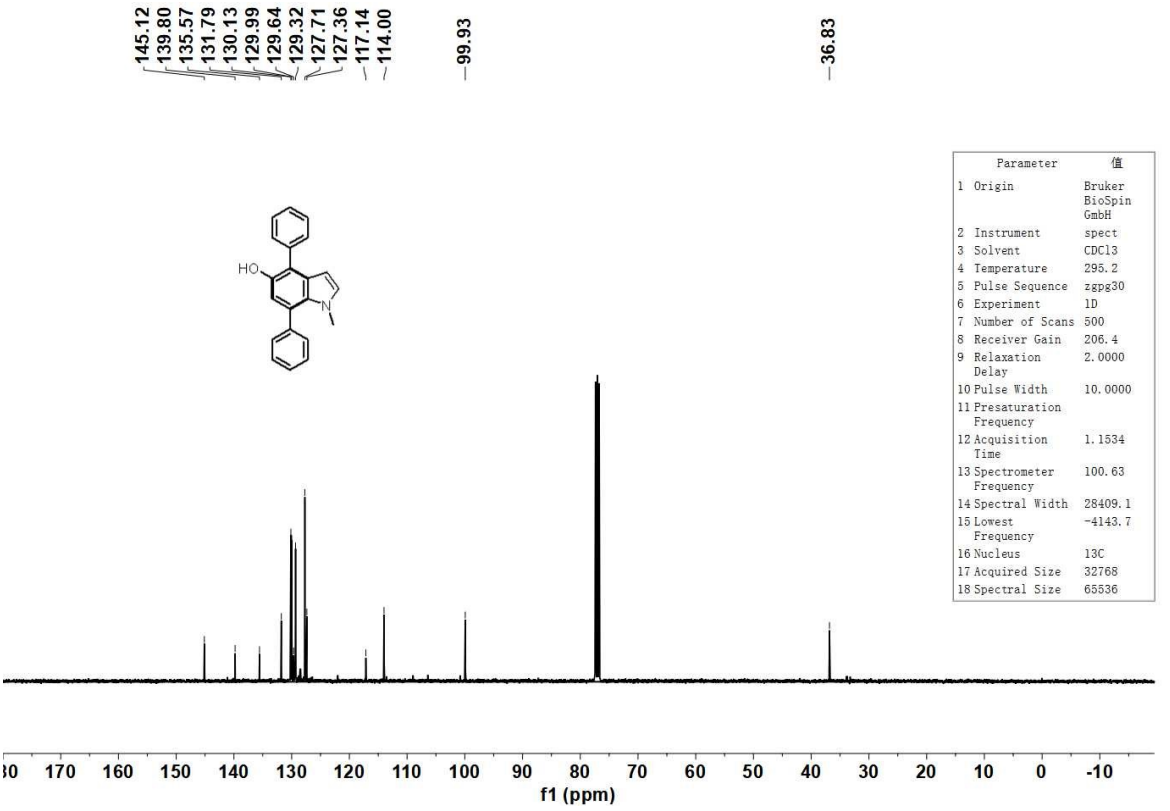
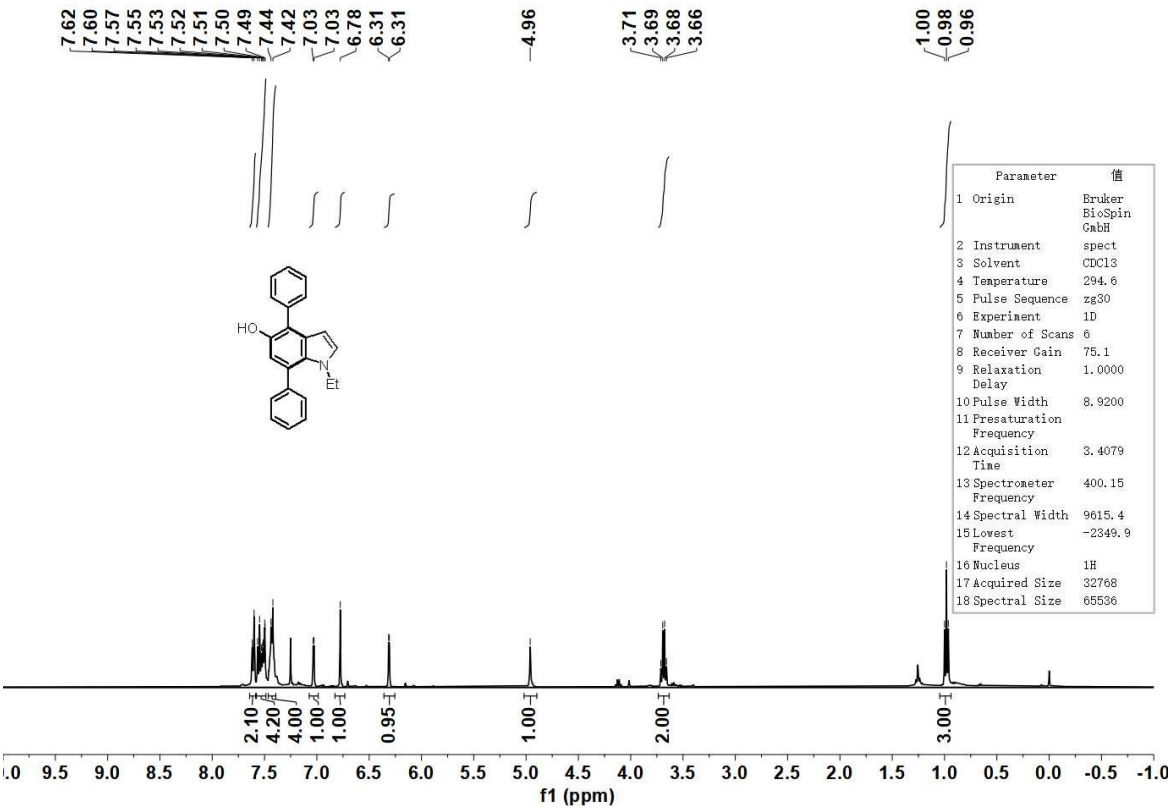
| 15 Lowest Frequency | -2346.2 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |




| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 295.2 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 500 |
| 8 Receiver Gain | 206.4 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

**3b**


7.62
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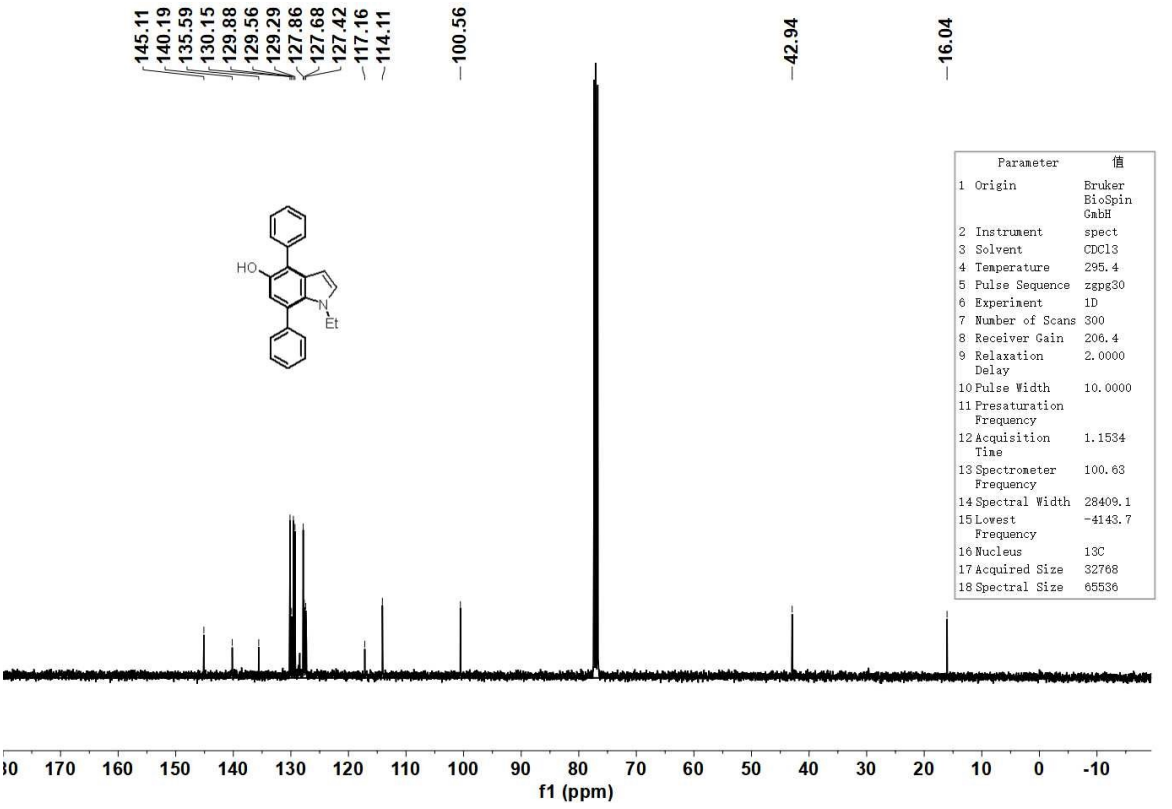
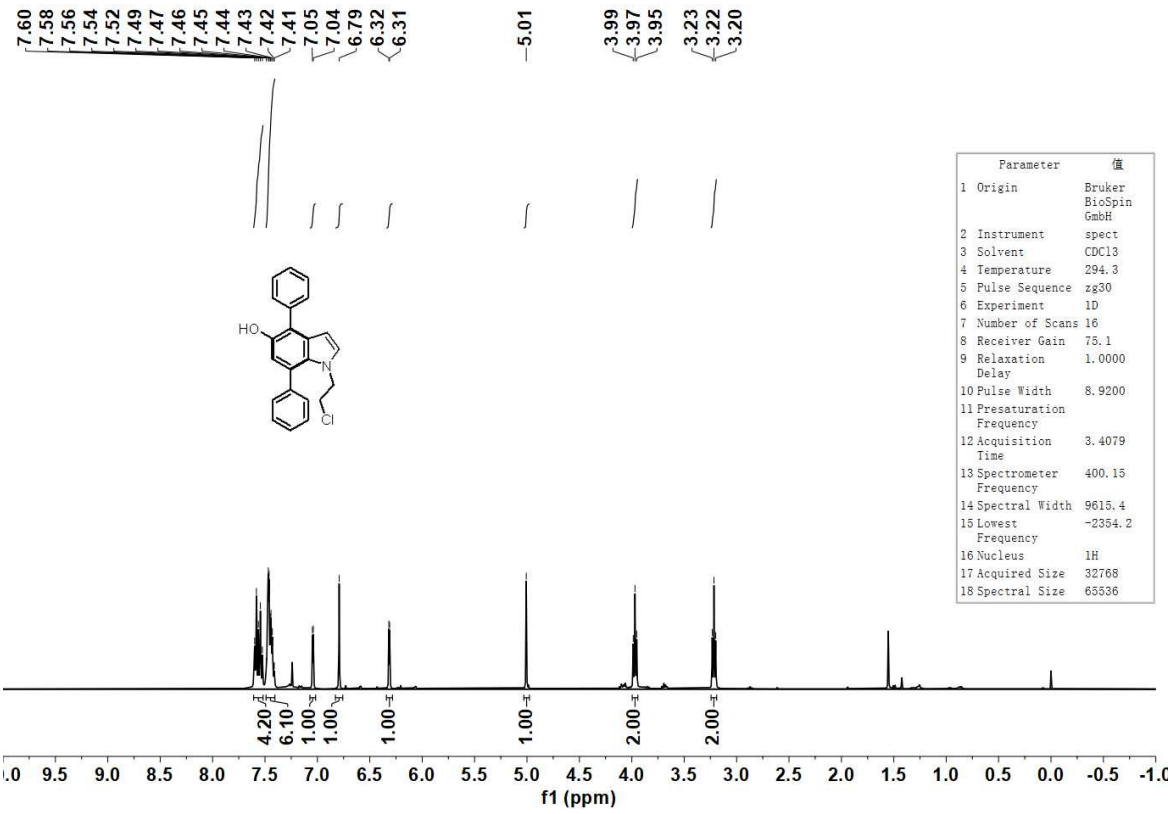
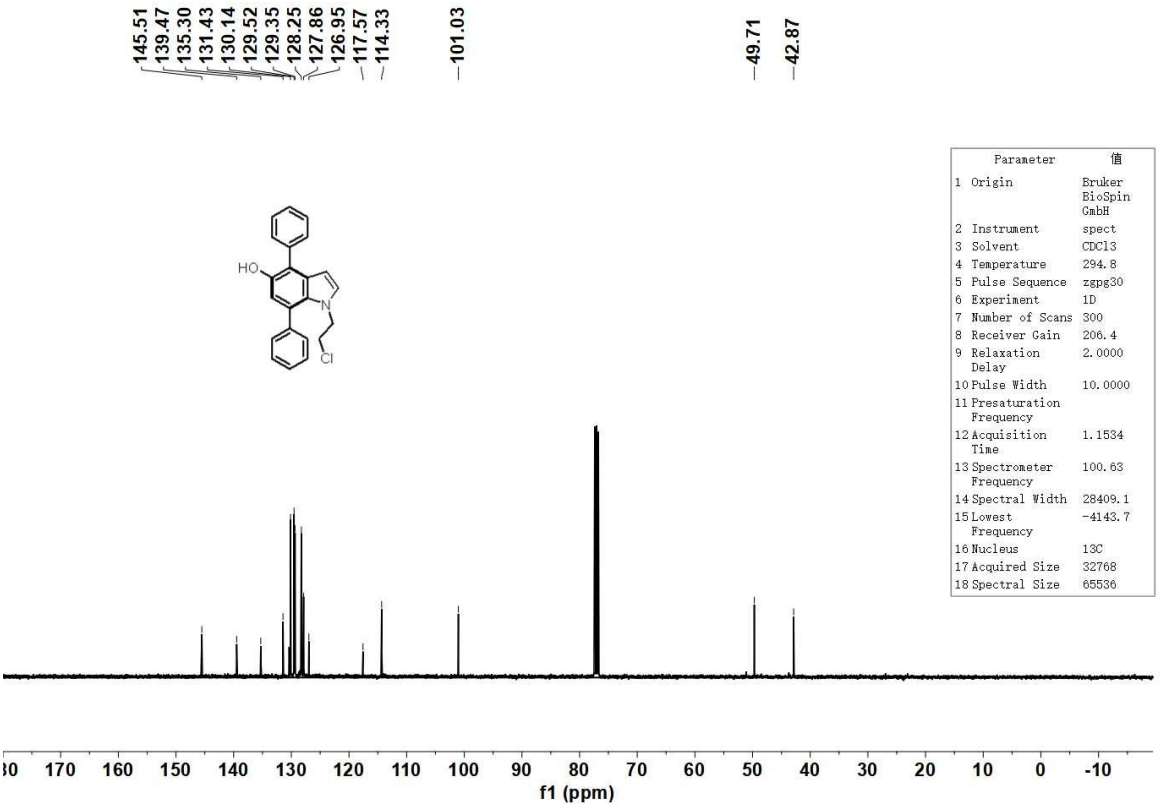
7.49
7.44
7.42
7.03
6.78
6.31
6.31
4.96
3.71
3.69
3.68
3.66
1.00
0.98
0.96
HO
N
Et
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.6
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 6
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2349.9
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
2.10
4.20
4.00
1.00
1.00
0.95
1.00
2.00
3.00
f1 (ppm)

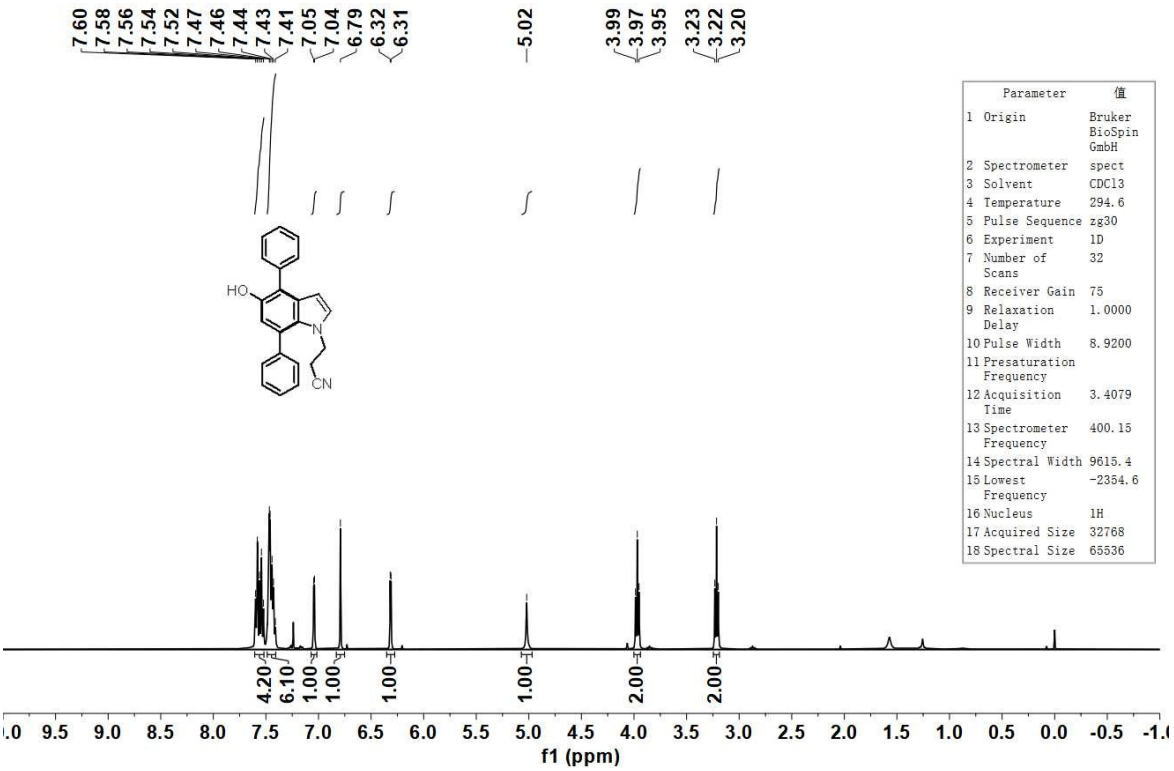

145.11
140.19
135.59
130.15
129.88
129.56
129.29
127.86
127.68
127.42
117.16
114.11
100.56
42.94
16.04
HO
N
Et
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.4
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**3c**

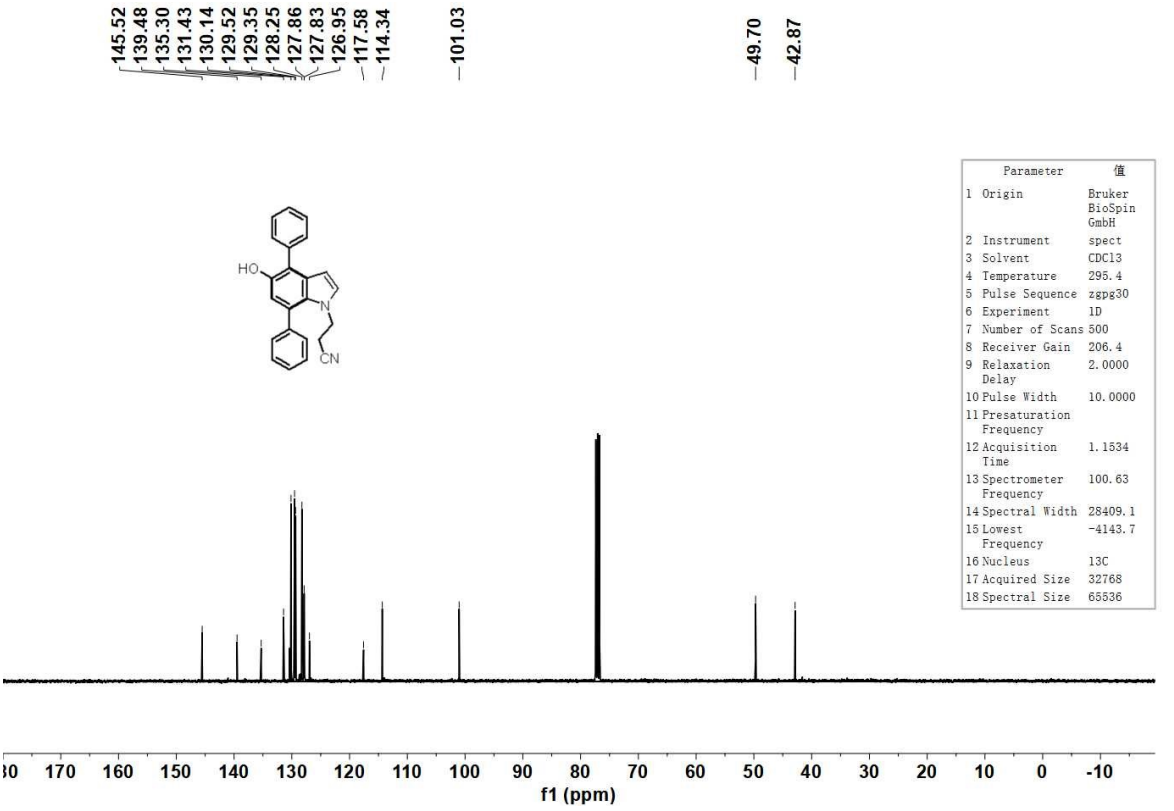

7.60
7.58
7.56
7.54
7.52
7.49
7.47
7.46
7.45
7.44
7.43
7.42
7.41
7.05
7.04
6.79
6.32
6.31
5.01
3.99
3.97
3.95
3.23
3.22
3.20
HO
N
Cl
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.3
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2354.2
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
4.20
6.10
1.00
1.00
1.00
1.00
2.00
2.00
f1 (ppm)


145.51
139.47
135.30
131.43
130.14
129.52
129.35
128.25
127.86
126.95
117.57
114.33
101.03
49.71
42.87
HO
N
Cl
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.8
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**3d**

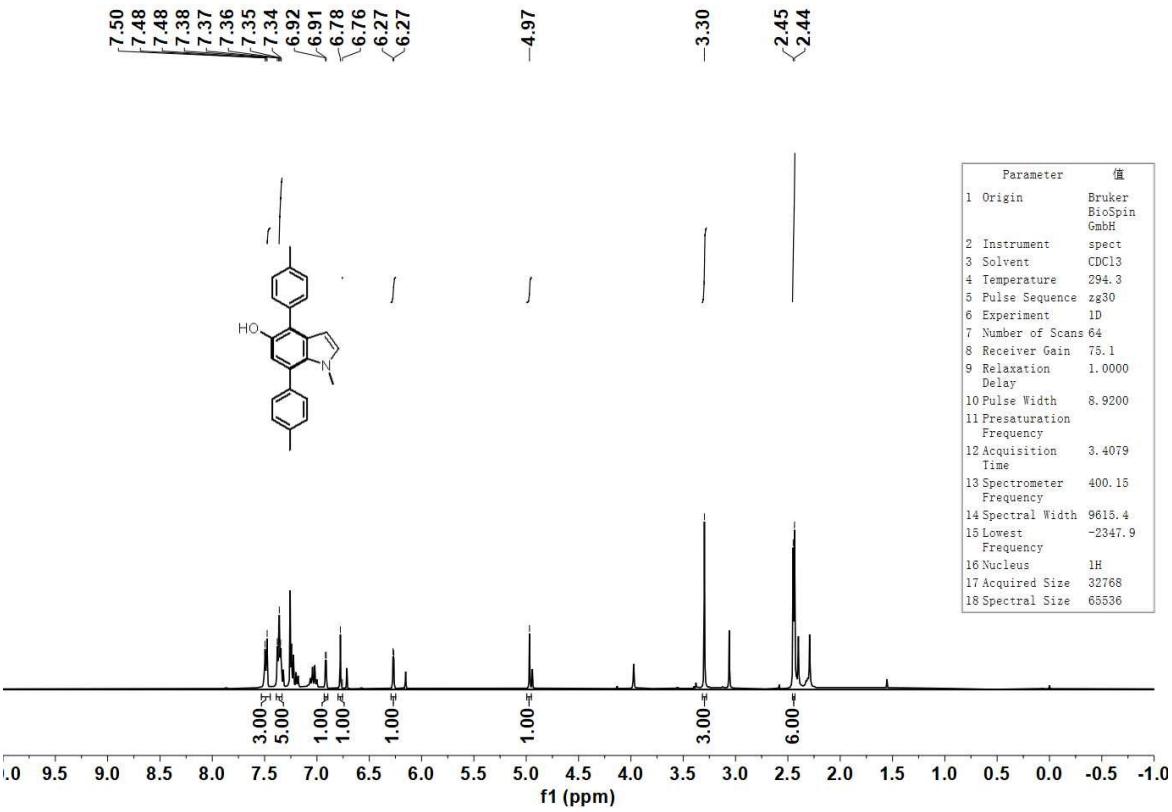


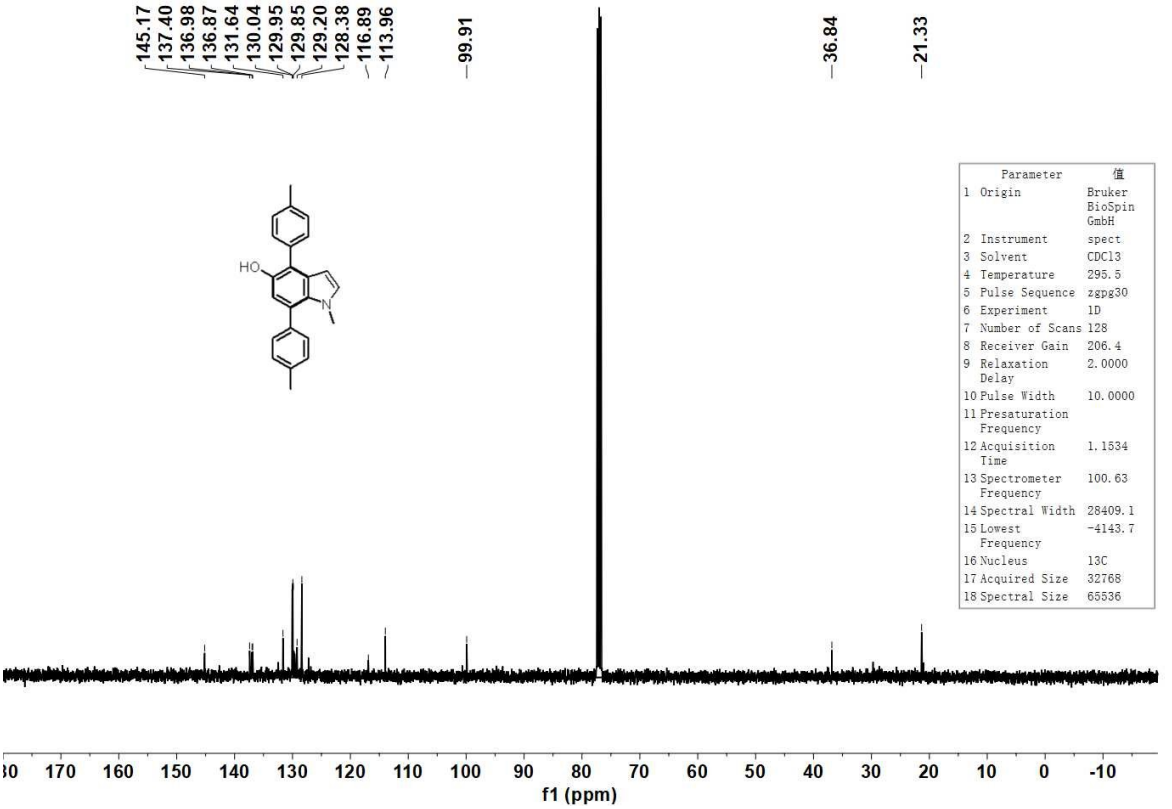

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.6 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 32 |
| 8 Receiver Gain | 75 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2354.6 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |



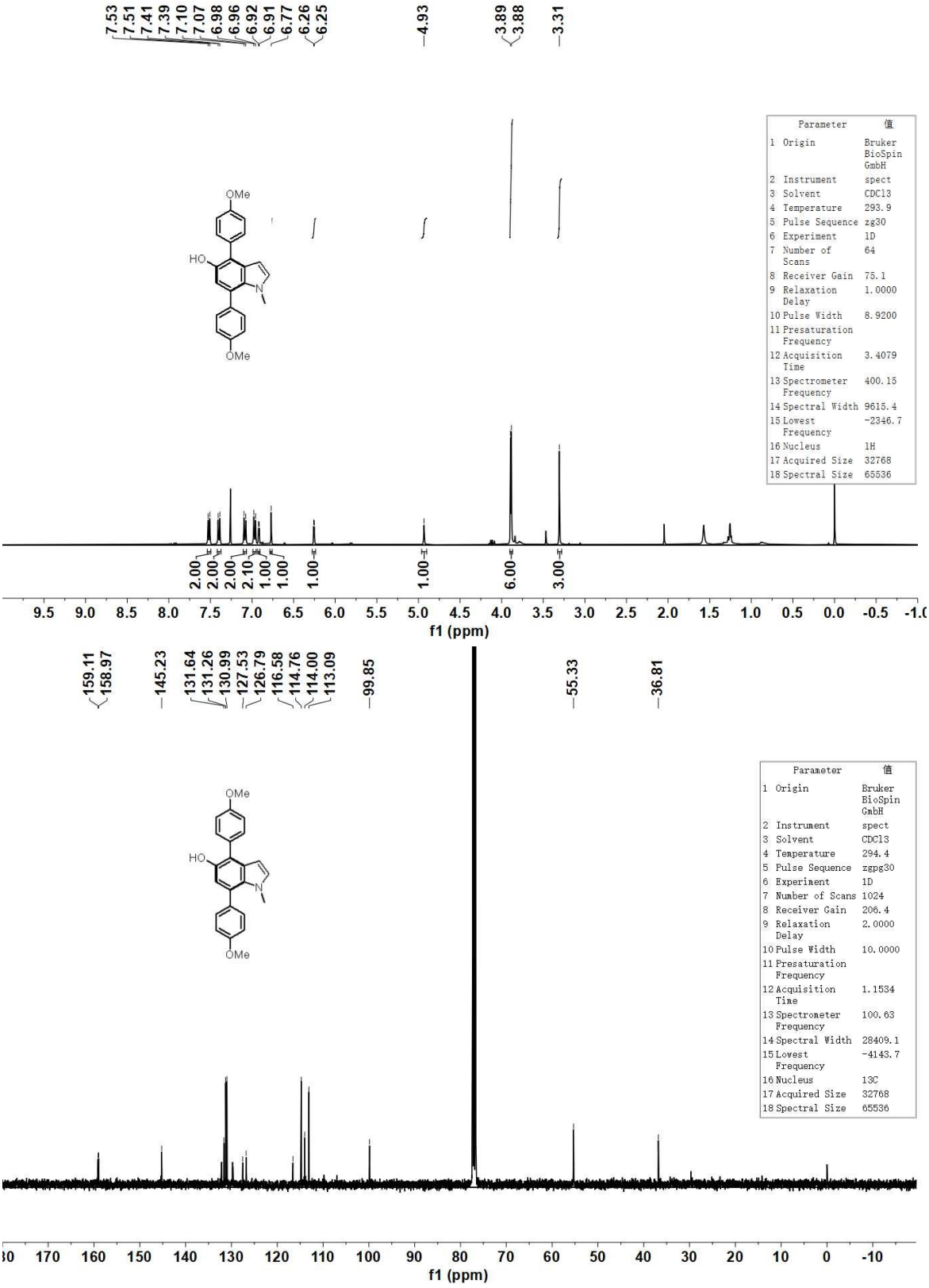

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 295.4 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 500 |
| 8 Receiver Gain | 206.4 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

**3e**

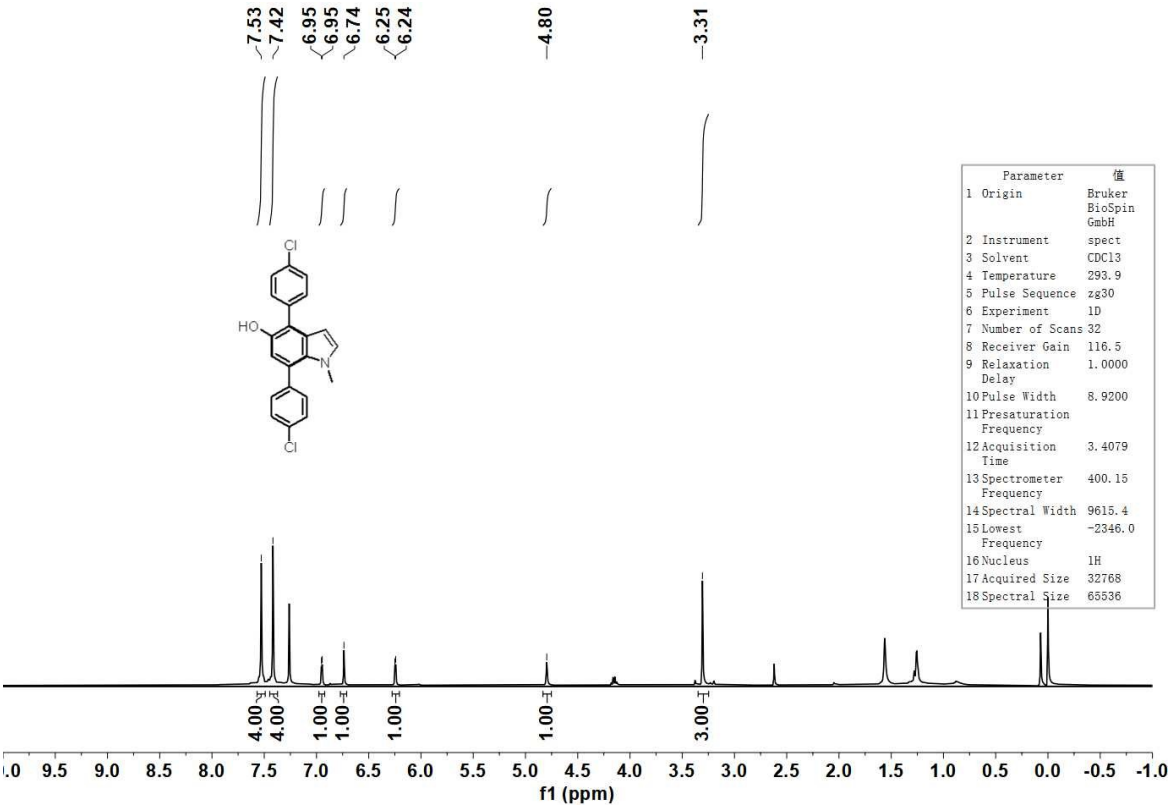

7.50
7.48
7.48
7.38
7.37
7.36
7.35
7.34
6.92
6.91
6.78
6.76
6.27
6.27
4.97
3.30
2.45
2.44
HO
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.3
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 64
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2347.9
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
3.00
5.00
1.00
1.00
1.00
1.00
3.00
6.00
f1 (ppm)

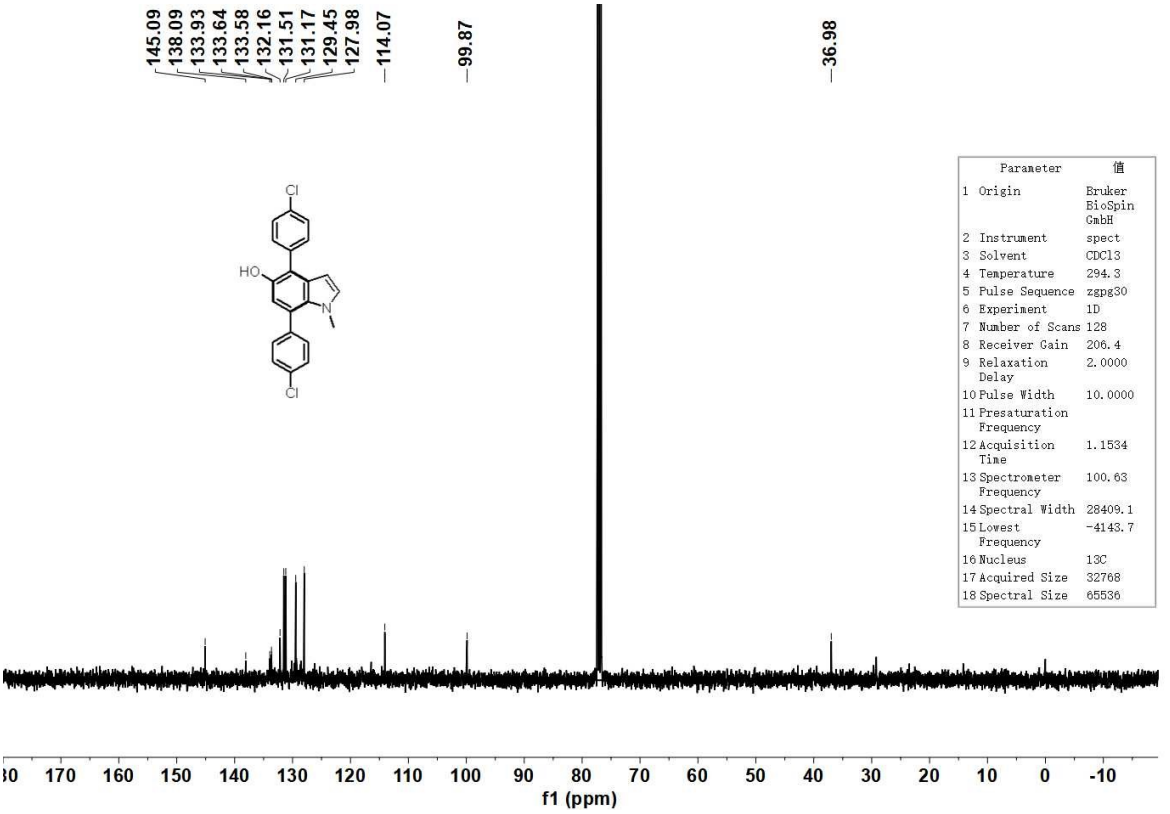

145.17
137.40
136.98
136.87
131.64
130.04
129.95
129.85
129.20
128.38
116.89
113.96
99.91
36.84
21.33
HO
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.5
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**3f**

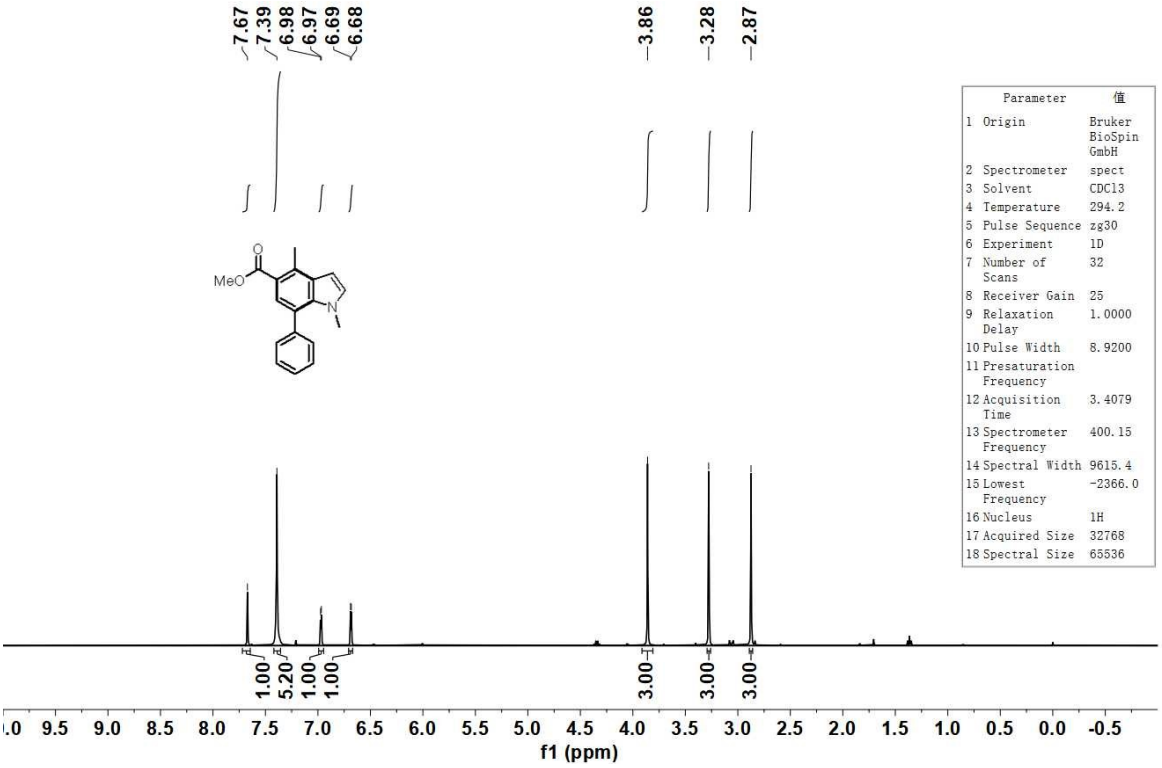

7.53
7.51
7.41
7.39
7.10
7.07
6.98
6.96
6.92
6.91
6.77
6.26
6.25
4.93
3.89
3.88
3.31
OMe
HO
N
OMe
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 293.9
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 64
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2346.7
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
2.00
2.00
2.00
2.10
1.00
1.00
1.00
1.00
6.00
3.00
f1 (ppm)
159.11
158.97
145.23
131.64
131.26
130.99
127.53
126.79
116.58
114.76
114.00
113.09
99.85
55.33
36.81
OMe
HO
N
OMe
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.4
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 1024
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

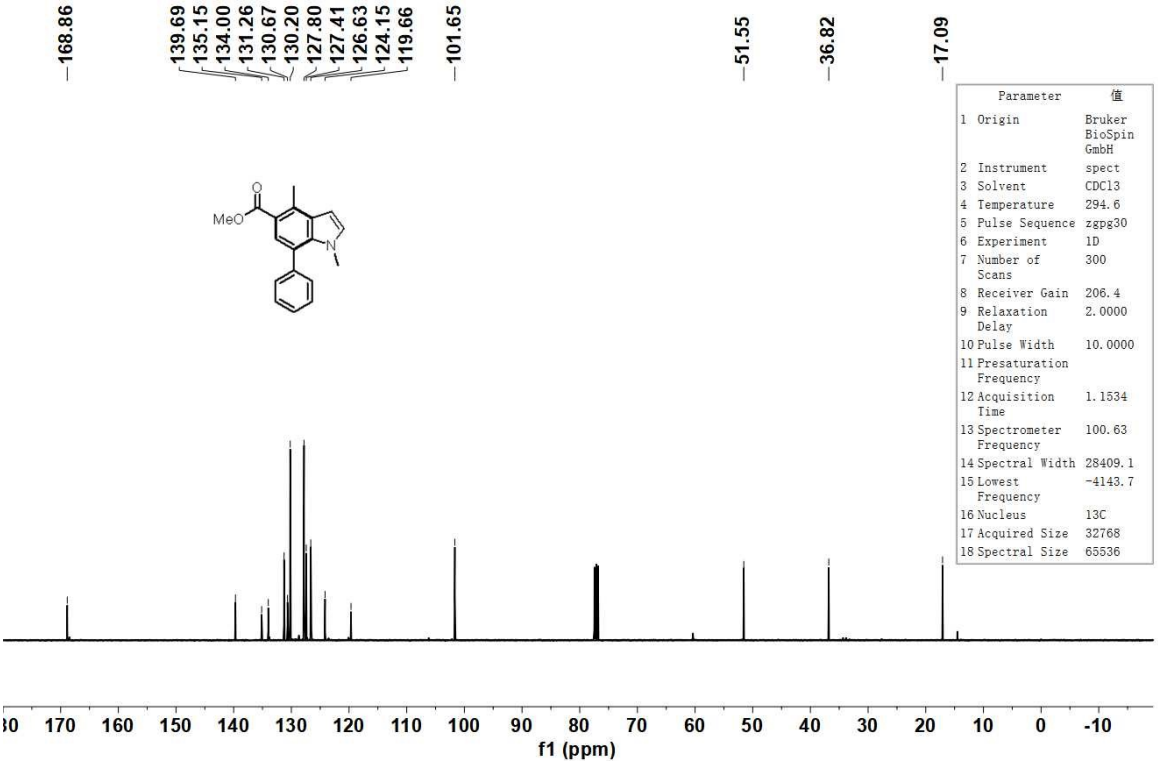
**3g**


7.53
7.42
6.95
6.95
6.74
6.25
6.24
4.80
3.31
Cl
HO
N
Cl
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 293.9
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 116.5
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2346.0
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
4.00
4.00
1.00
1.00
1.00
1.00
3.00
f1 (ppm)

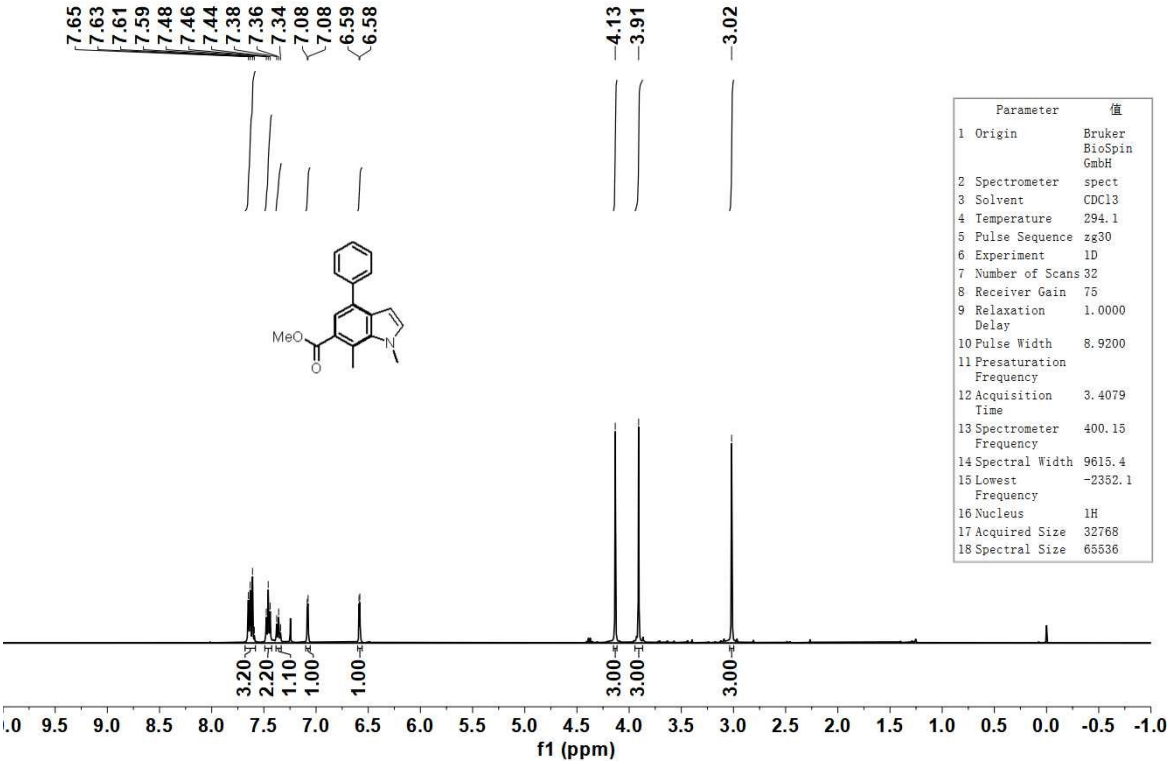

145.09
138.09
133.93
133.64
133.58
132.16
131.51
131.17
129.45
127.98
114.07
99.87
36.98
Cl
HO
N
Cl
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.3
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

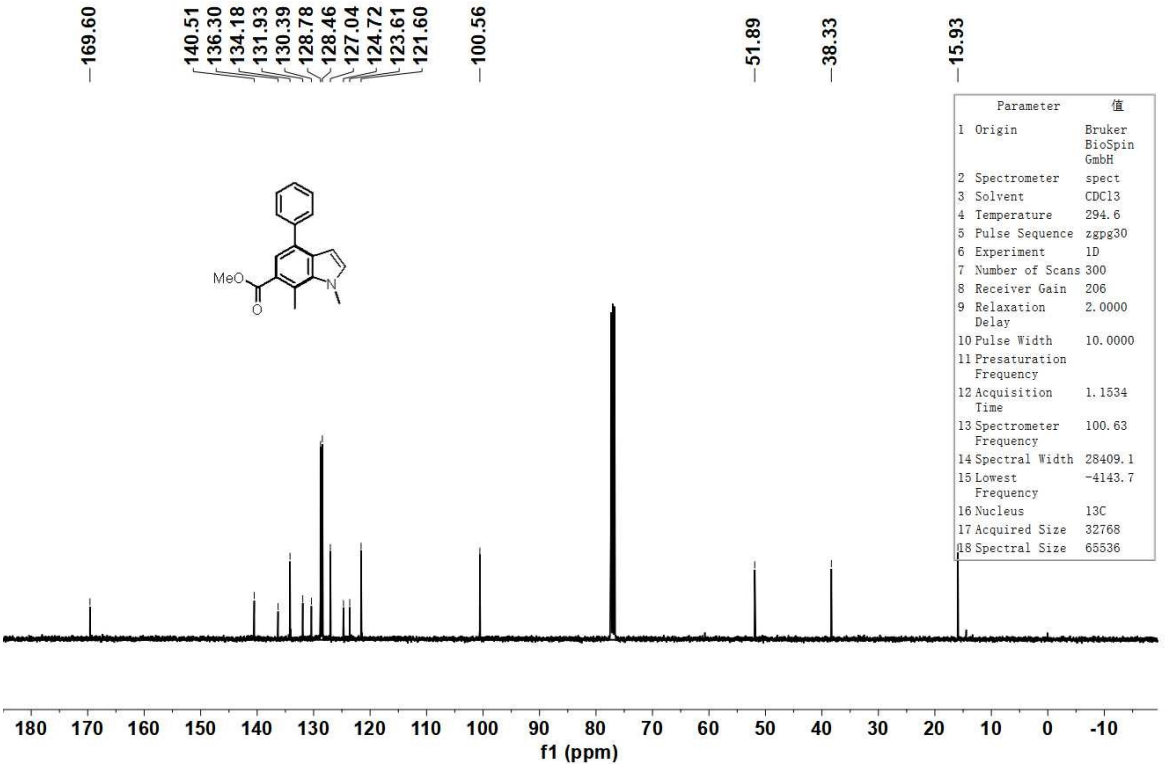
**5a**


7.67
7.39
6.98
6.97
6.69
6.68
3.86
3.28
2.87
MeO
O
N
1.00
5.20
1.00
1.00
3.00
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.2
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 25
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2366.0
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536

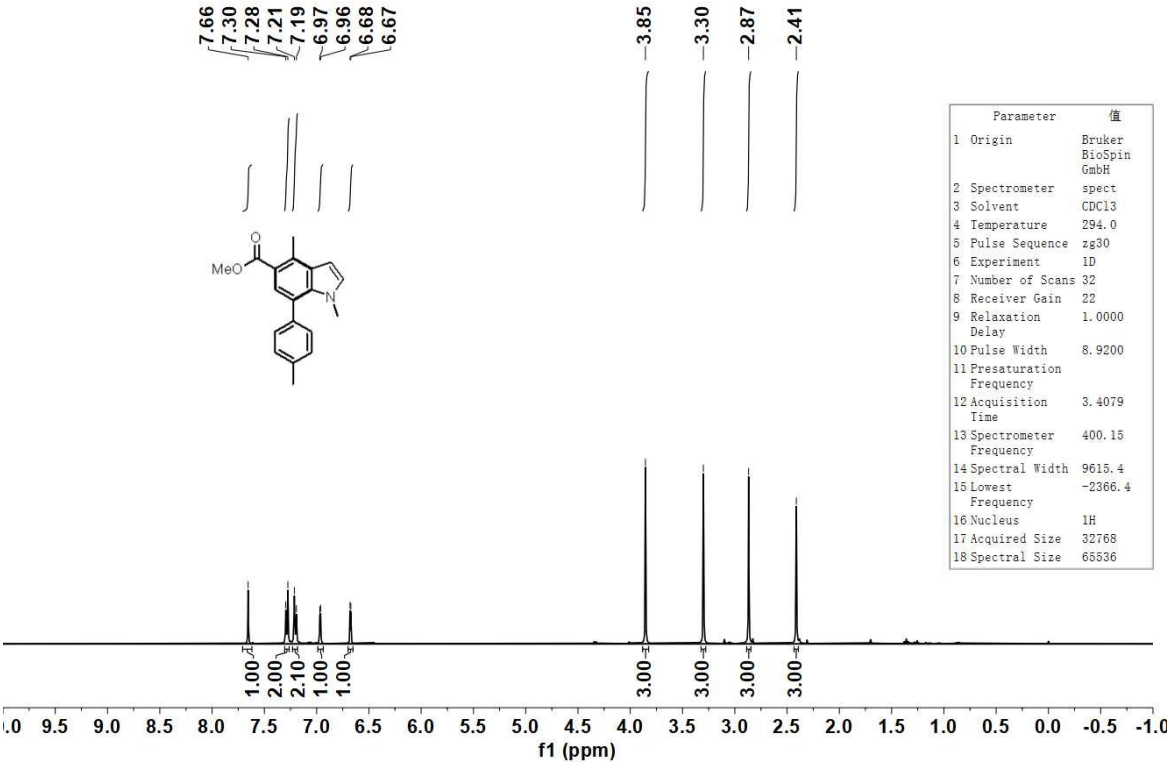

168.86
139.69
135.15
134.00
131.26
130.67
130.20
127.80
127.41
126.63
124.15
119.66
101.65
51.55
36.82
17.09
MeO
O
N
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

**6a**

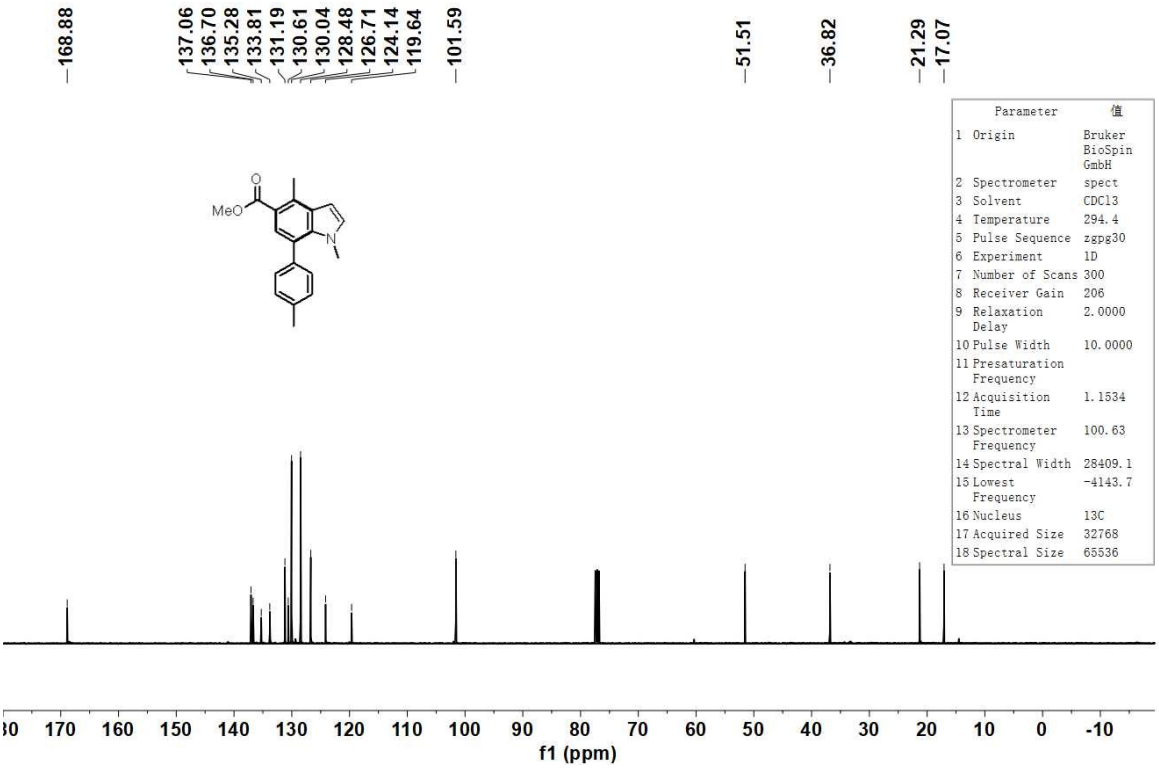

7.65
7.63
7.61
7.59
7.48
7.46
7.44
7.38
7.36
7.34
7.08
7.08
6.59
6.58
4.13
3.91
3.02
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.1
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2352.1
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
3.20
2.20
1.10
1.00
1.00
3.00
3.00
3.00
f1 (ppm)


169.60
140.51
136.30
134.18
131.93
130.39
128.78
128.46
127.04
124.72
123.61
121.60
100.56
51.89
38.33
15.93
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5b**

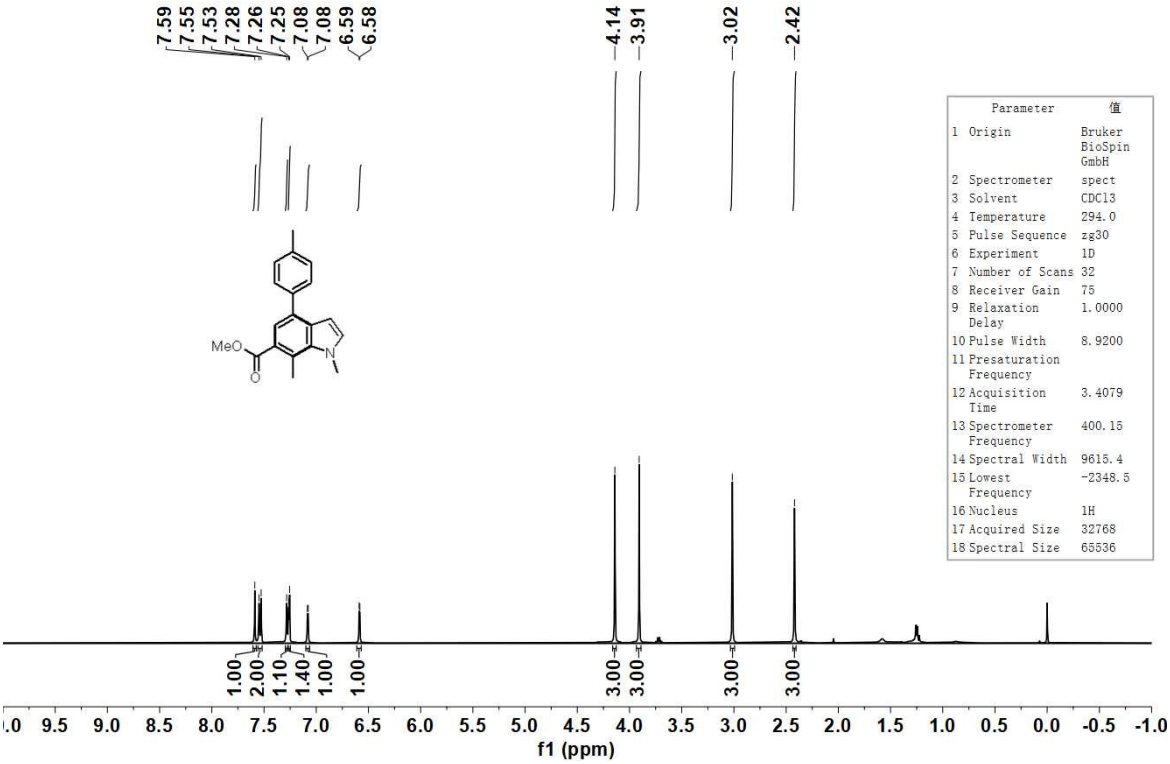


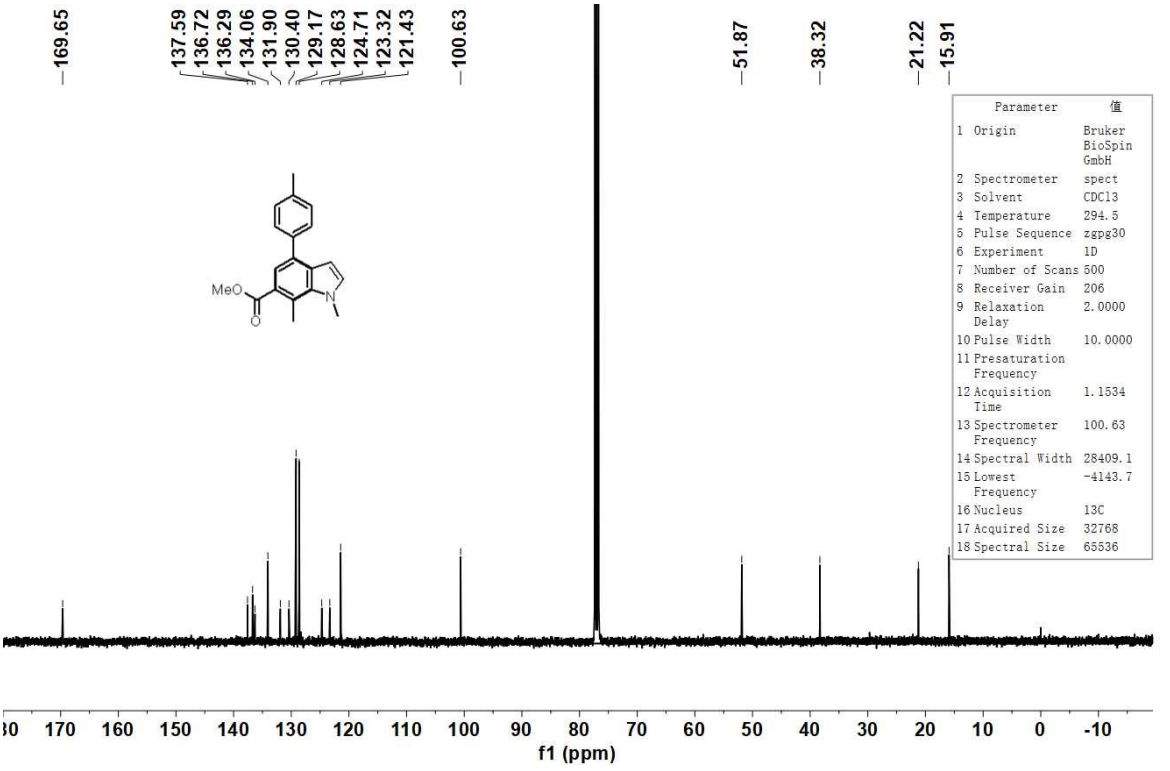

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.0 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 32 |
| 8 Receiver Gain | 22 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2366.4 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |



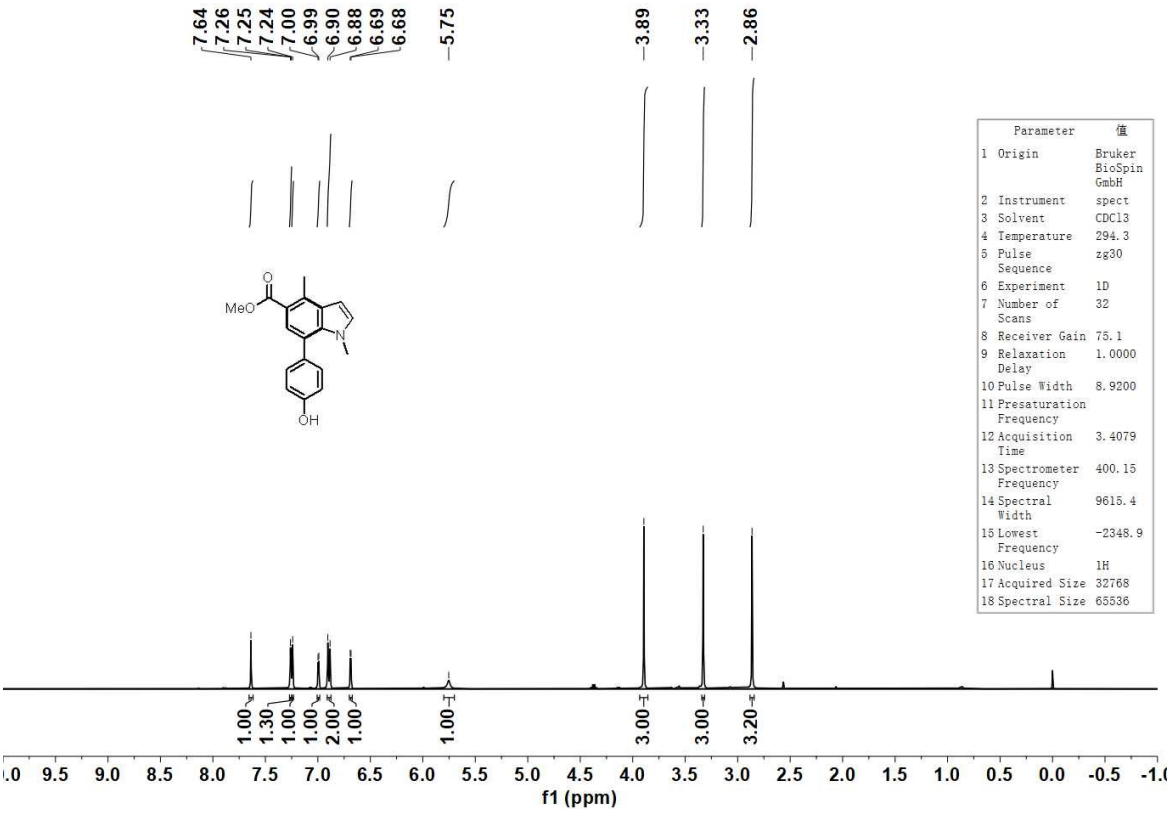

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.4 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 300 |
| 8 Receiver Gain | 206 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

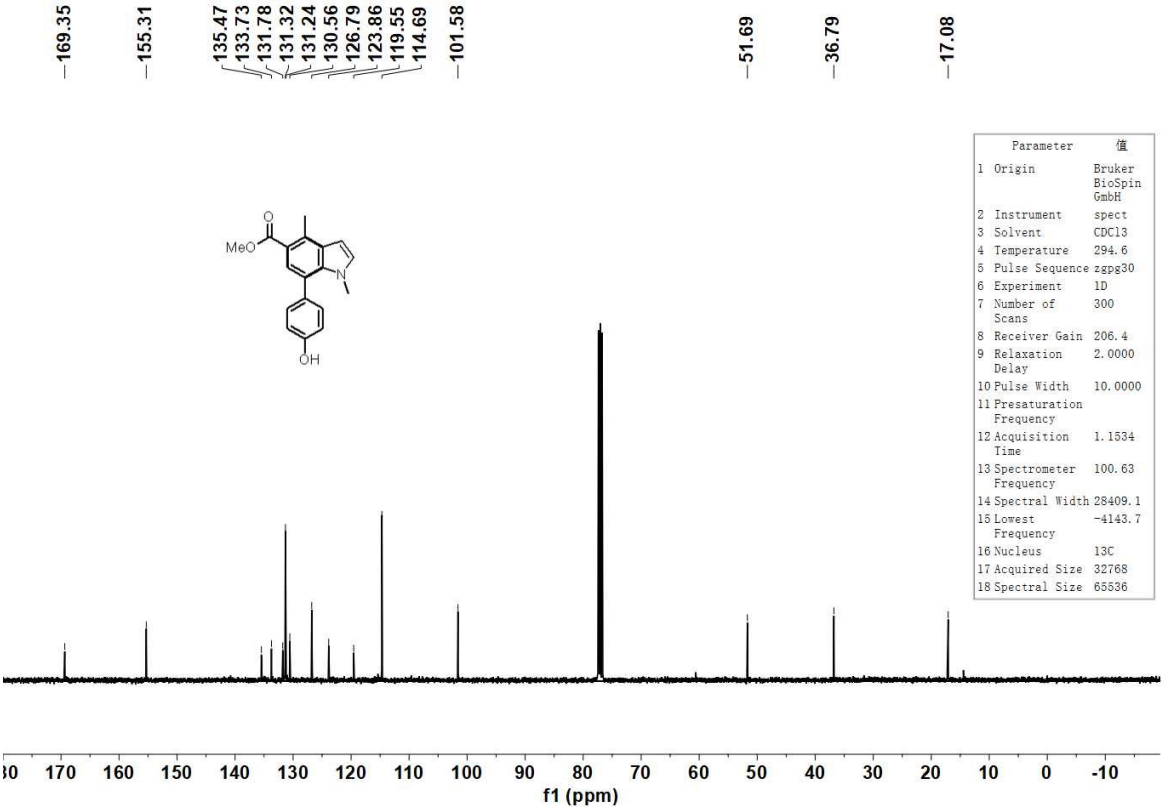
**6b**


7.59
7.55
7.53
7.28
7.26
7.25
7.08
7.08
6.59
6.58
4.14
3.91
3.02
2.42
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2348.5
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
2.00
1.10
1.40
1.00
1.00
3.00
3.00
3.00
3.00
f1 (ppm)

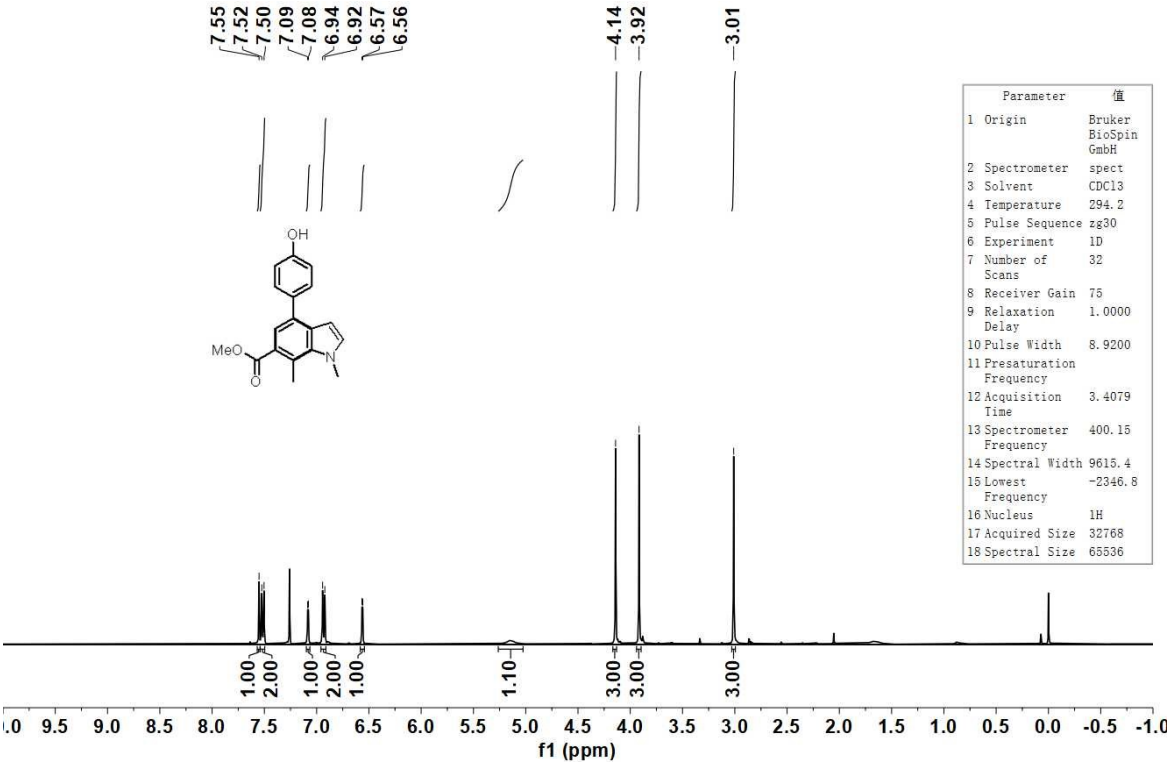

169.65
137.59
136.72
136.29
134.06
131.90
130.40
129.17
128.63
124.71
123.32
121.43
100.63
51.87
38.32
21.22
15.91
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.5
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 500
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

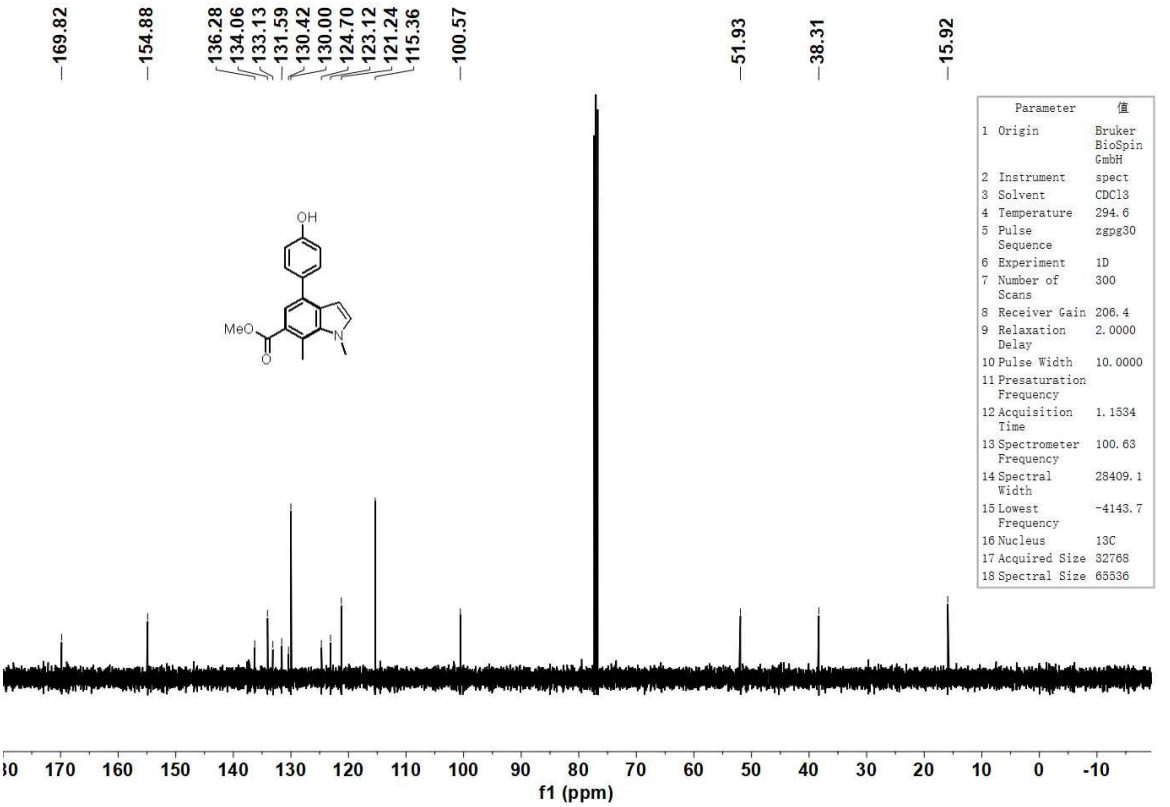
**5c**


7.64
7.26
7.25
7.24
7.00
6.99
6.90
6.88
6.69
6.68
5.75
3.89
3.33
2.86
MeO
O
N
OH
1.00
1.30
1.00
1.00
2.00
1.00
1.00
3.00
3.00
3.20
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.3
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2348.9
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536

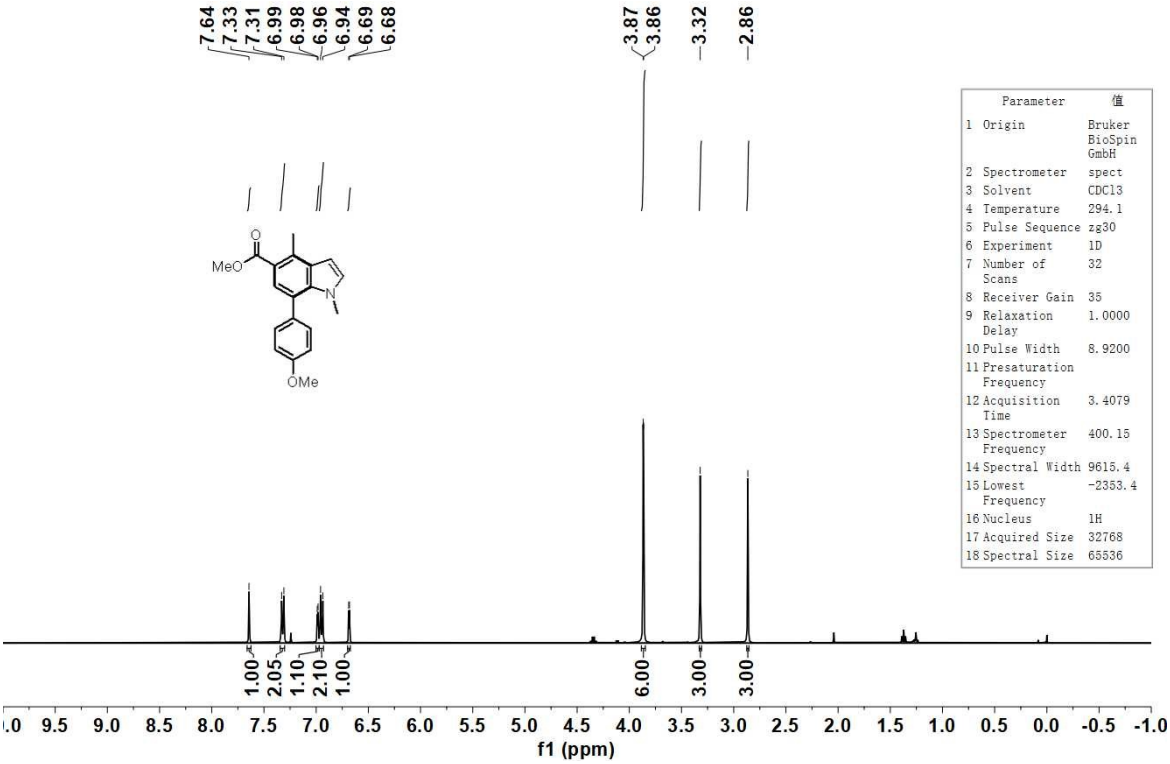

169.35
155.31
135.47
133.73
131.78
131.32
131.24
130.56
126.79
123.86
119.55
114.69
101.58
51.69
36.79
17.08
MeO
O
N
OH
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

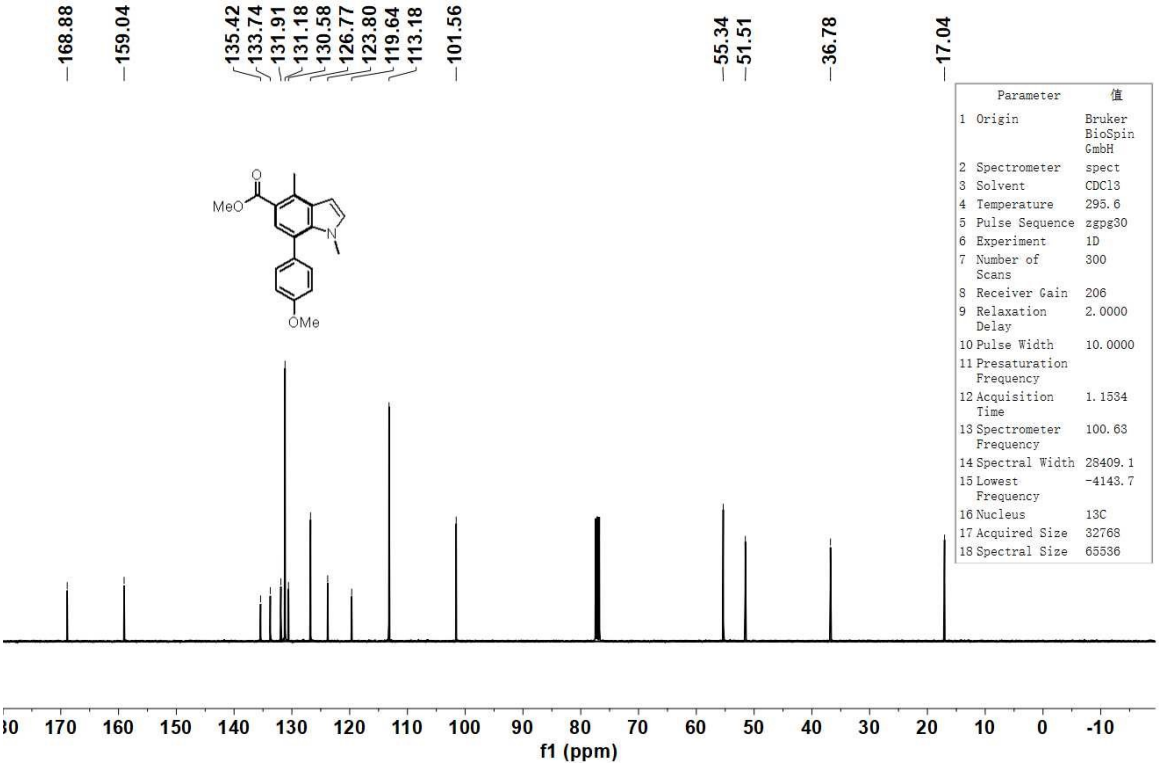
**6c**


7.55
7.52
7.50
7.09
7.08
6.94
6.92
6.57
6.56
4.14
3.92
3.01
OH
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.2
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2346.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
2.00
1.00
2.00
1.00
1.10
3.00
3.00
3.00
f1 (ppm)

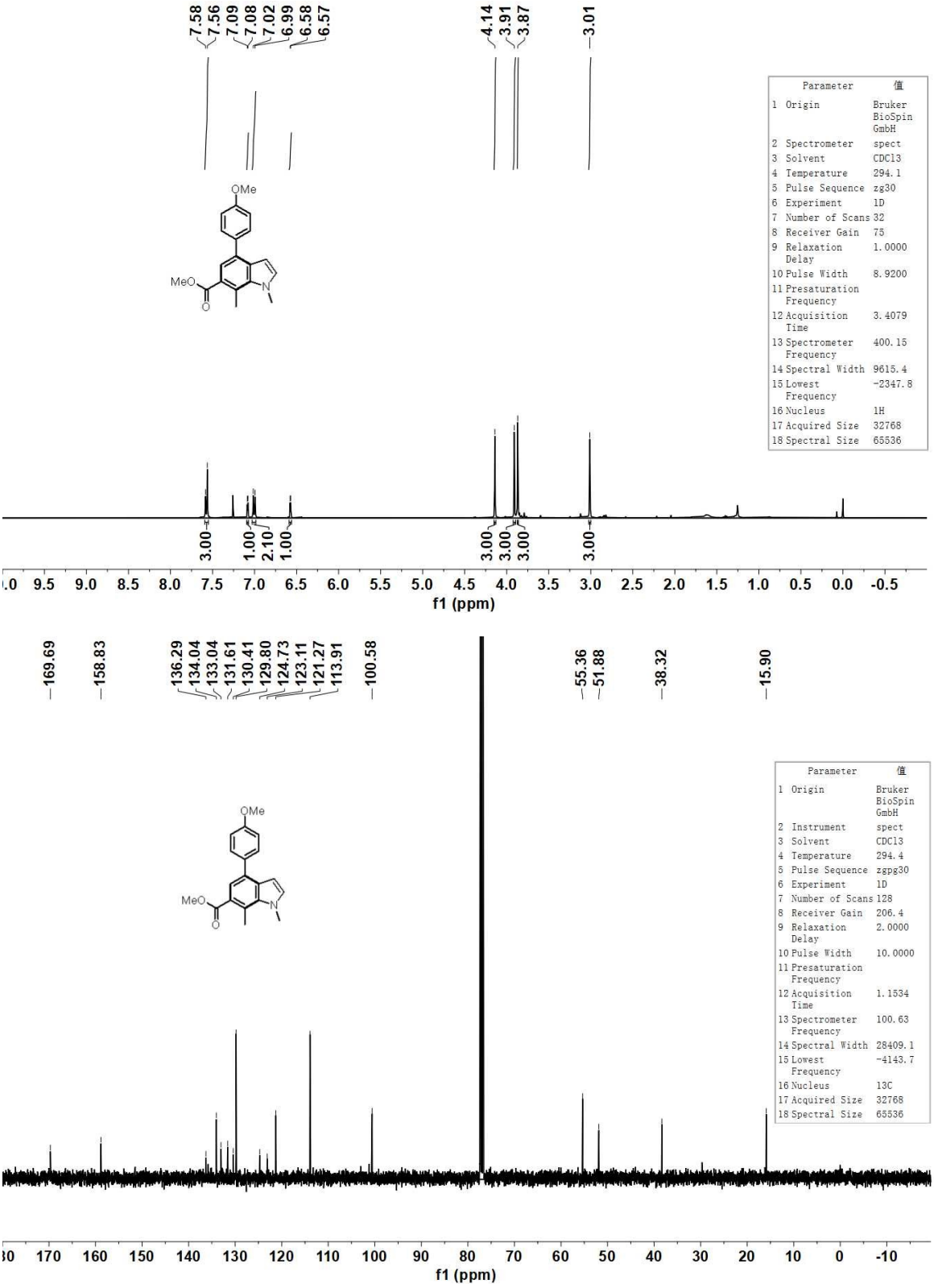

169.82
154.88
136.28
134.06
133.13
131.59
130.42
130.00
124.70
123.12
121.24
115.36
100.57
51.93
38.31
15.92
OH
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5d**


7.64
7.33
7.31
6.99
6.98
6.96
6.94
6.69
6.68
3.87
3.86
3.32
2.86
MeO
O
N
OMe
1.00
2.05
1.10
2.10
1.00
6.00
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.1
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 35
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2353.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536


168.88
159.04
135.42
133.74
131.91
131.18
130.58
126.77
123.80
119.64
113.18
101.56
55.34
51.51
36.78
17.04
MeO
O
N
OMe
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

**6d**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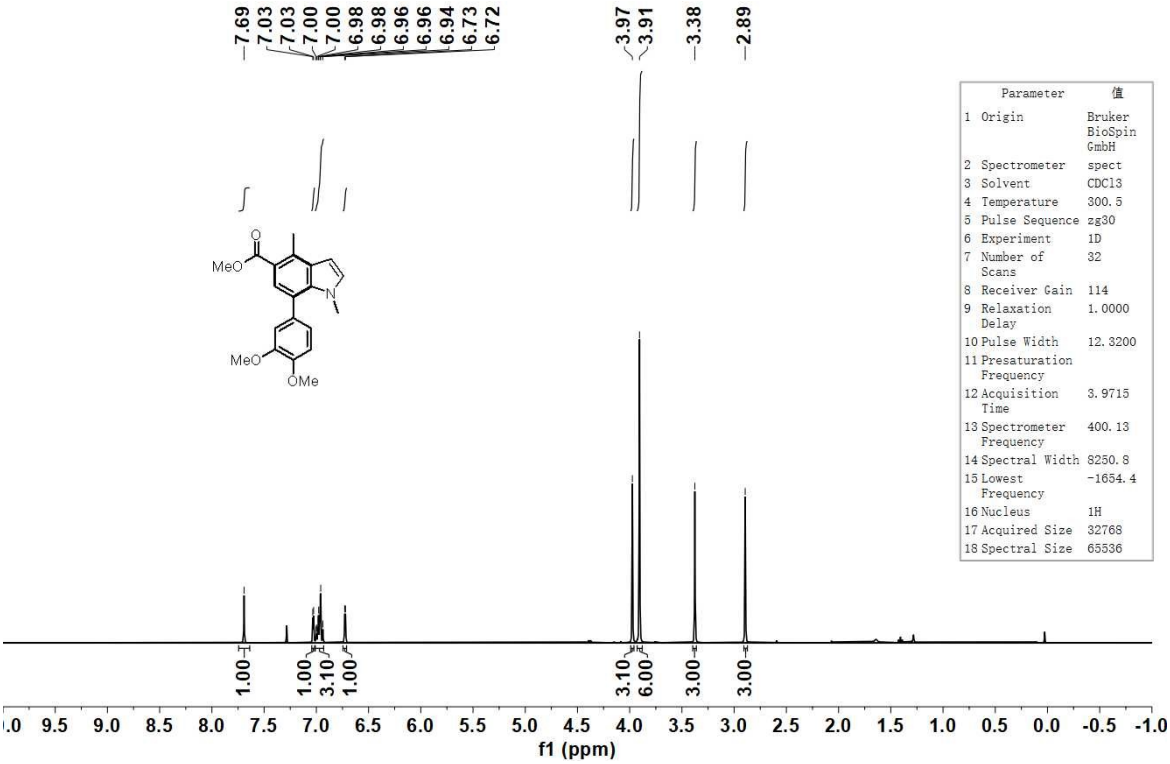
7.56
7.09
7.08
7.02
6.99
6.58
6.57
4.14
3.91
3.87
3.01
OMe
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.1
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2347.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
3.00
1.00
2.10
1.00
3.00
3.00
3.00
3.00
f1 (ppm)
169.69
158.83
136.29
134.04
133.04
131.61
130.41
129.80
124.73
123.11
121.27
113.91
100.58
55.36
51.88
38.32
15.90
OMe
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.4
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5e**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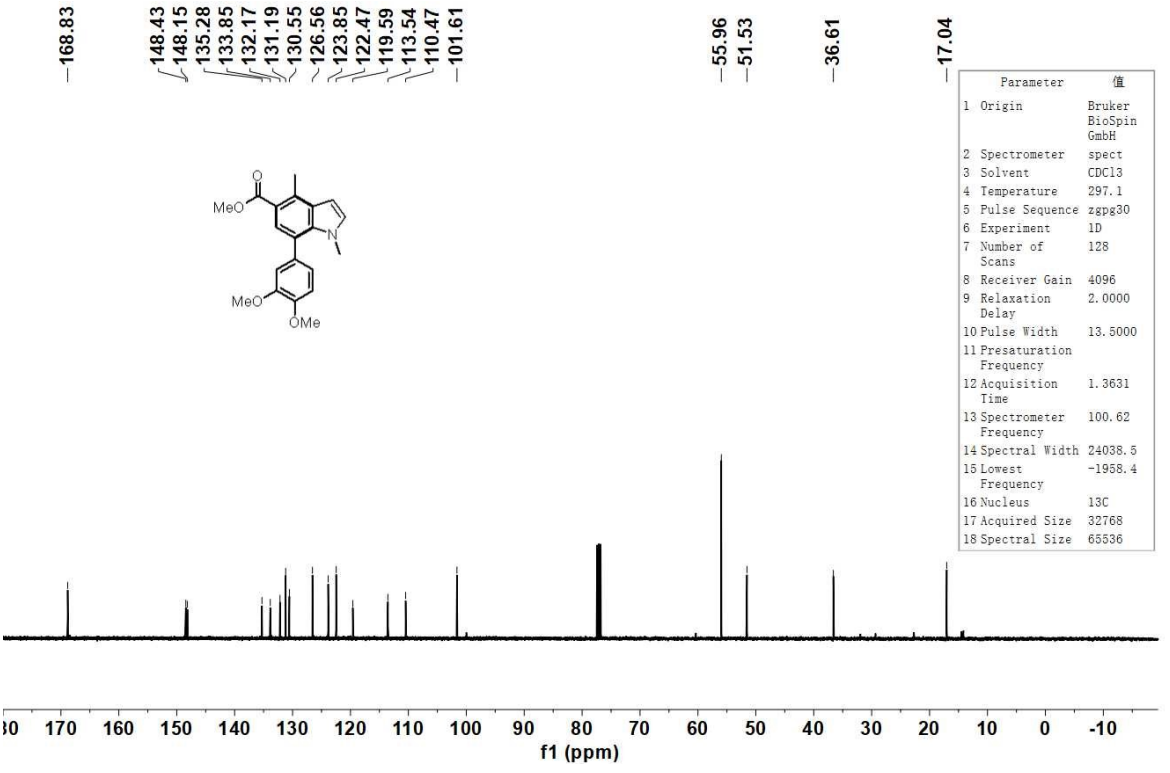
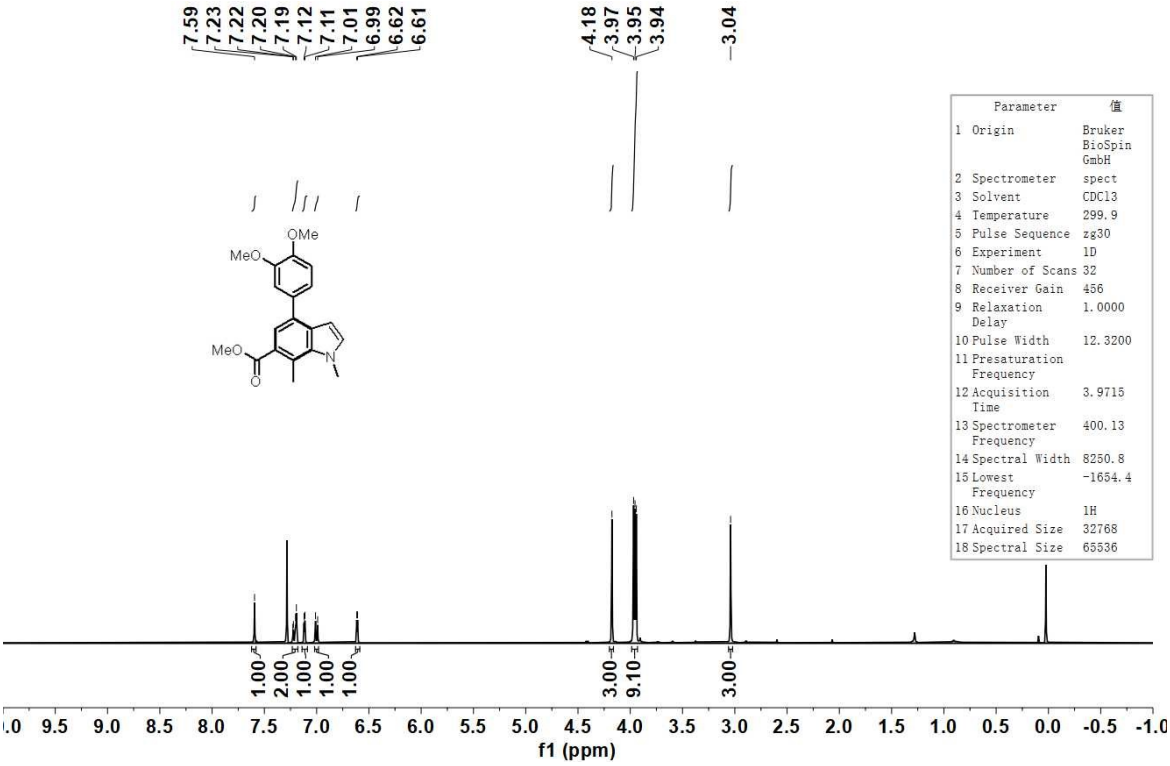
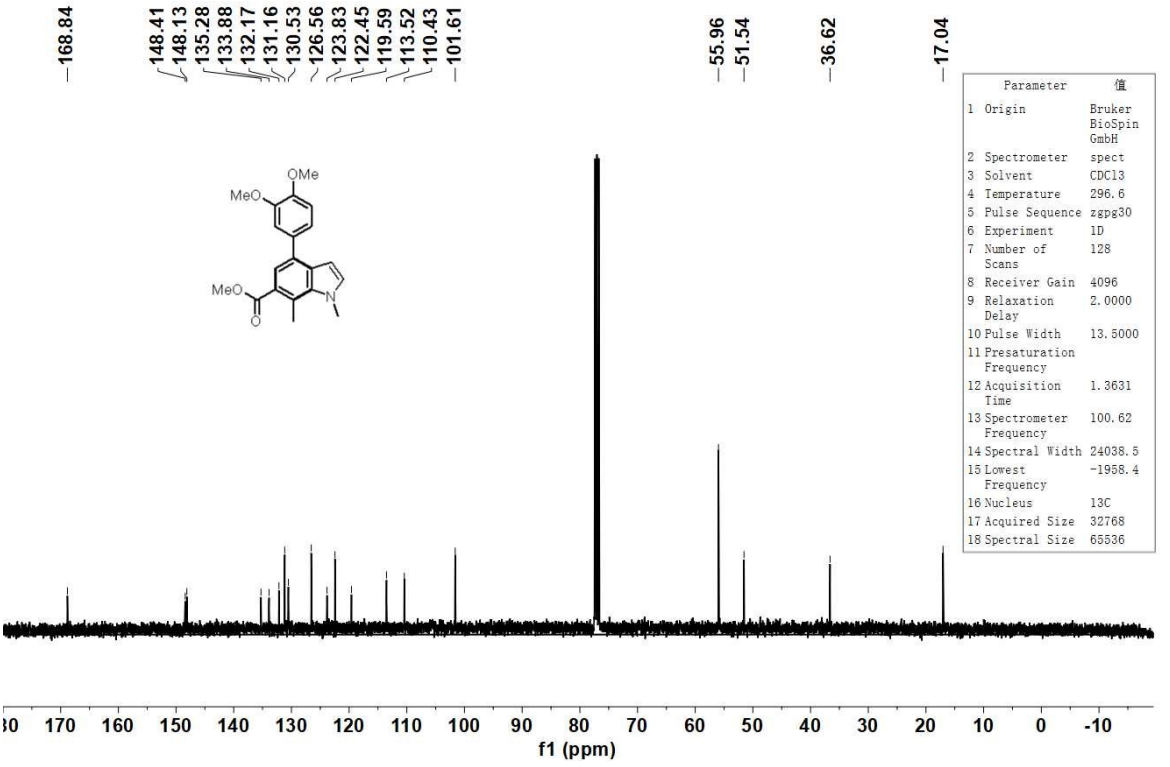
7.03
7.03
7.00
7.00
6.98
6.98
6.96
6.96
6.94
6.73
6.72
3.97
3.91
3.38
2.89
MeO
MeO
OMe
1.00
1.00
3.10
1.00
3.10
6.00
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 300.5
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 114
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536

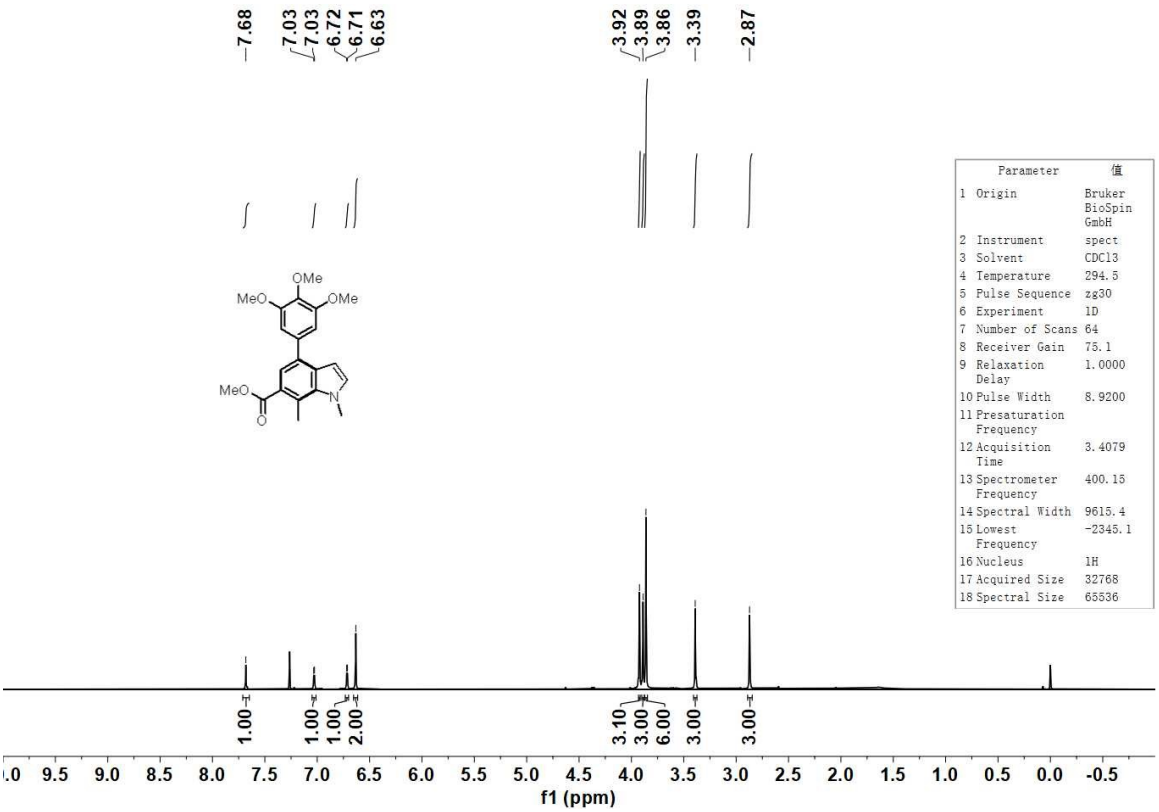

168.83
148.43
148.15
135.28
133.85
132.17
131.19
130.55
126.56
123.85
122.47
119.59
113.54
110.47
101.61
55.96
51.53
36.61
17.04
MeO
MeO
OMe
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 297.1
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 4096
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

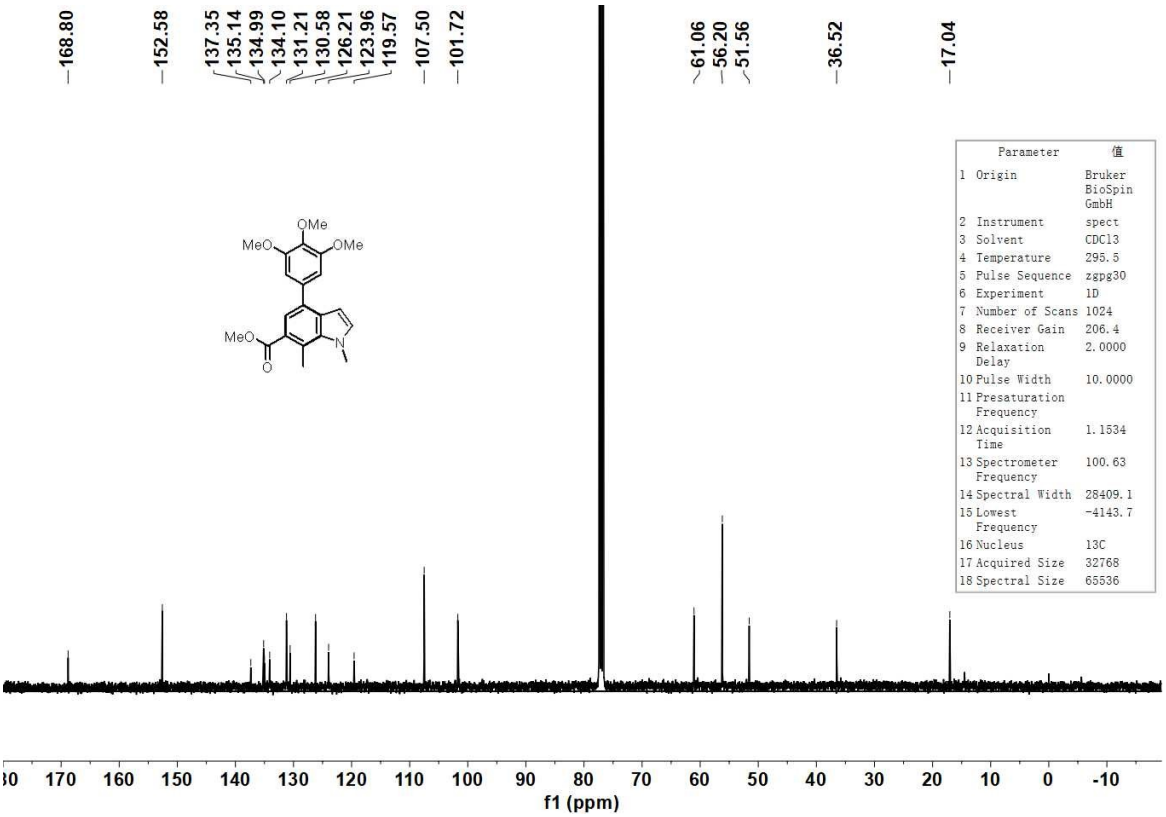
**6e**


7.59
7.23
7.22
7.20
7.19
7.12
7.11
7.01
6.99
6.62
6.61
4.18
3.97
3.95
3.94
3.04
OMe
MeO
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 299.9
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 456
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
2.00
1.00
1.00
1.00
3.00
9.10
3.00
f1 (ppm)

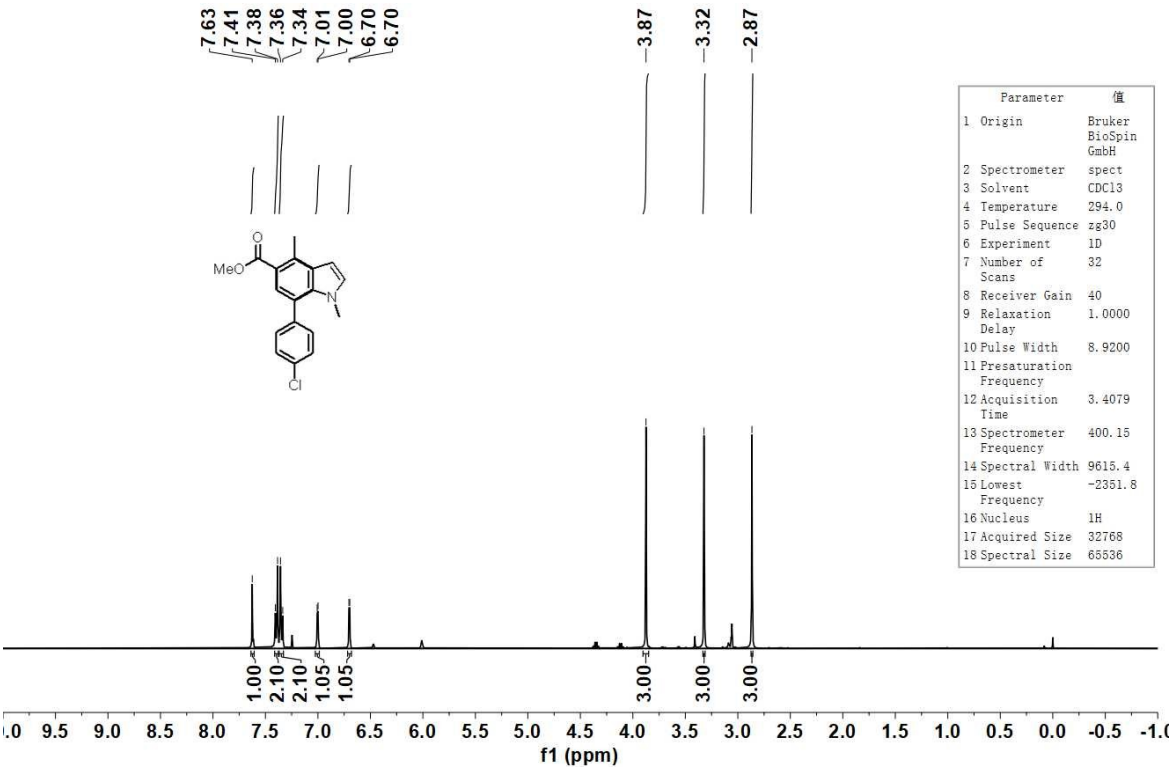

168.84
148.41
148.13
135.28
133.88
132.17
131.16
130.53
126.56
123.83
122.45
119.59
113.52
110.43
101.61
55.96
51.54
36.62
17.04
OMe
MeO
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 4096
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5f**


7.68
7.03
7.03
6.72
6.71
6.63
3.92
3.89
3.86
3.39
2.87
OMe
MeO
OMe
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.5
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 64
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2345.1
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
1.00
1.00
2.00
3.10
3.00
6.00
3.00
3.00
f1 (ppm)


168.80
152.58
137.35
135.14
134.99
134.10
131.21
130.58
126.21
123.96
119.57
107.50
101.72
61.06
56.20
51.56
36.52
17.04
OMe
MeO
OMe
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.5
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 1024
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5g**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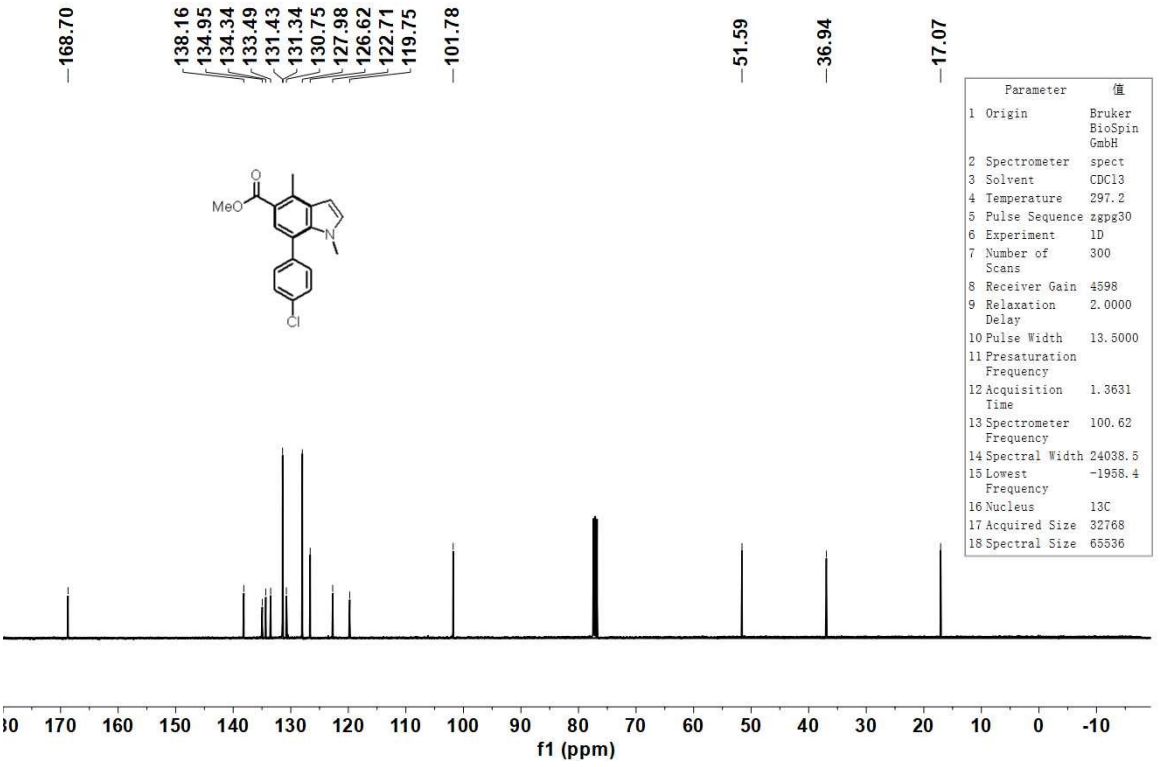
7.41
7.38
7.36
7.34
7.01
7.00
6.70
6.70
3.87
3.32
2.87
MeO
O
N
Cl
1.00
2.10
2.10
1.05
1.05
3.00
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 40
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2351.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536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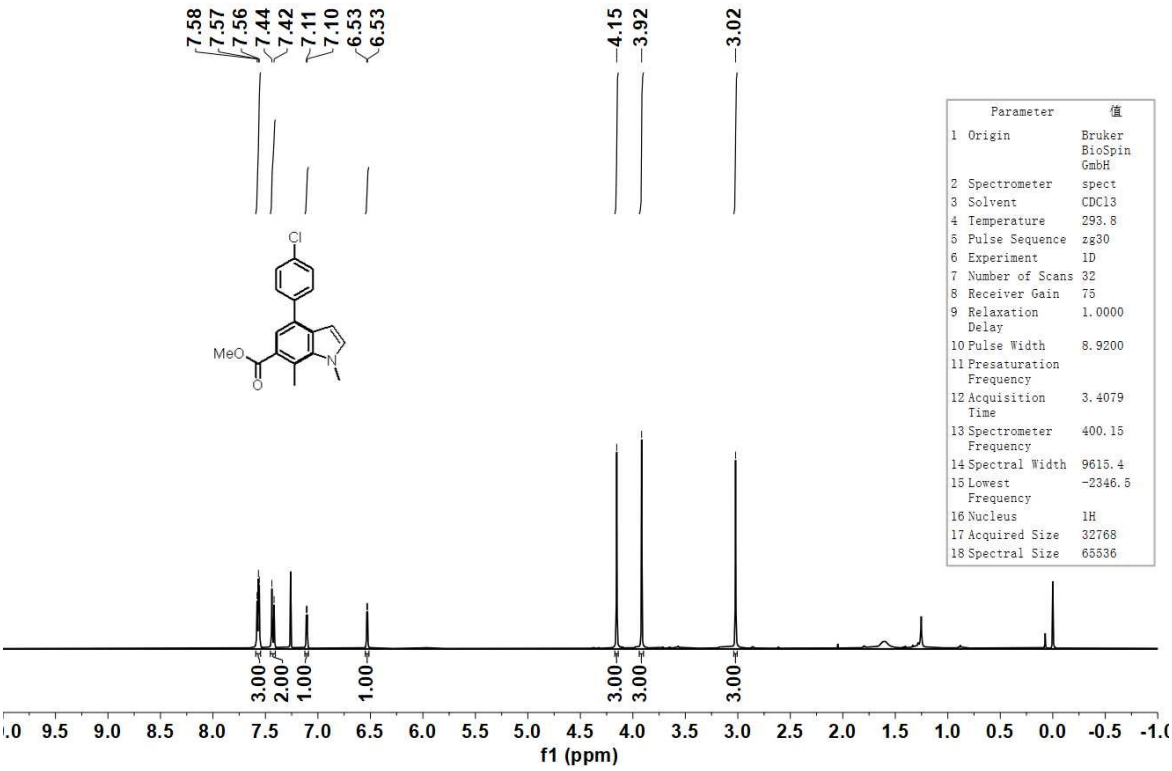
134.34
133.49
131.43
131.34
130.75
127.98
126.62
122.71
119.75
101.78
51.59
36.94
17.07
MeO
O
N
Cl
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 297.2
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 4598
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

**6g**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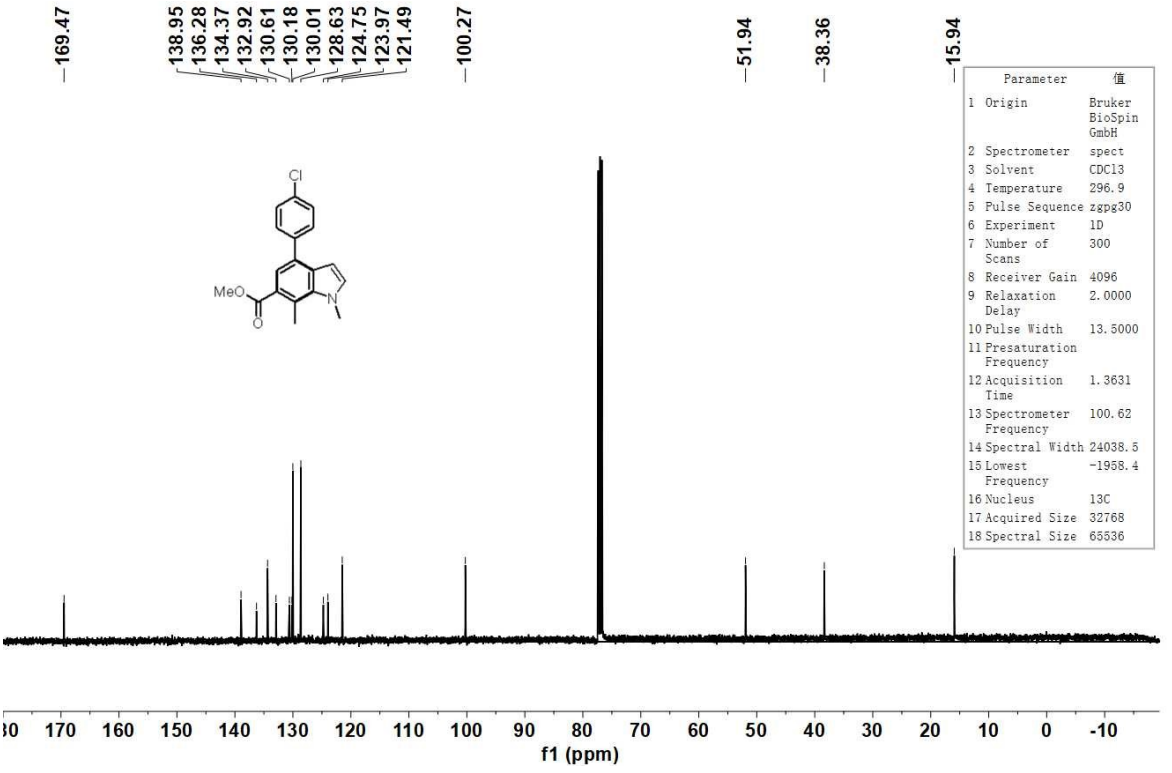
7.57
7.56
7.44
7.42
7.11
7.10
6.53
6.53
4.15
3.92
3.02
Cl
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 293.8
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2346.5
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
3.00
2.00
1.00
1.00
3.00
3.00
3.00
f1 (ppm)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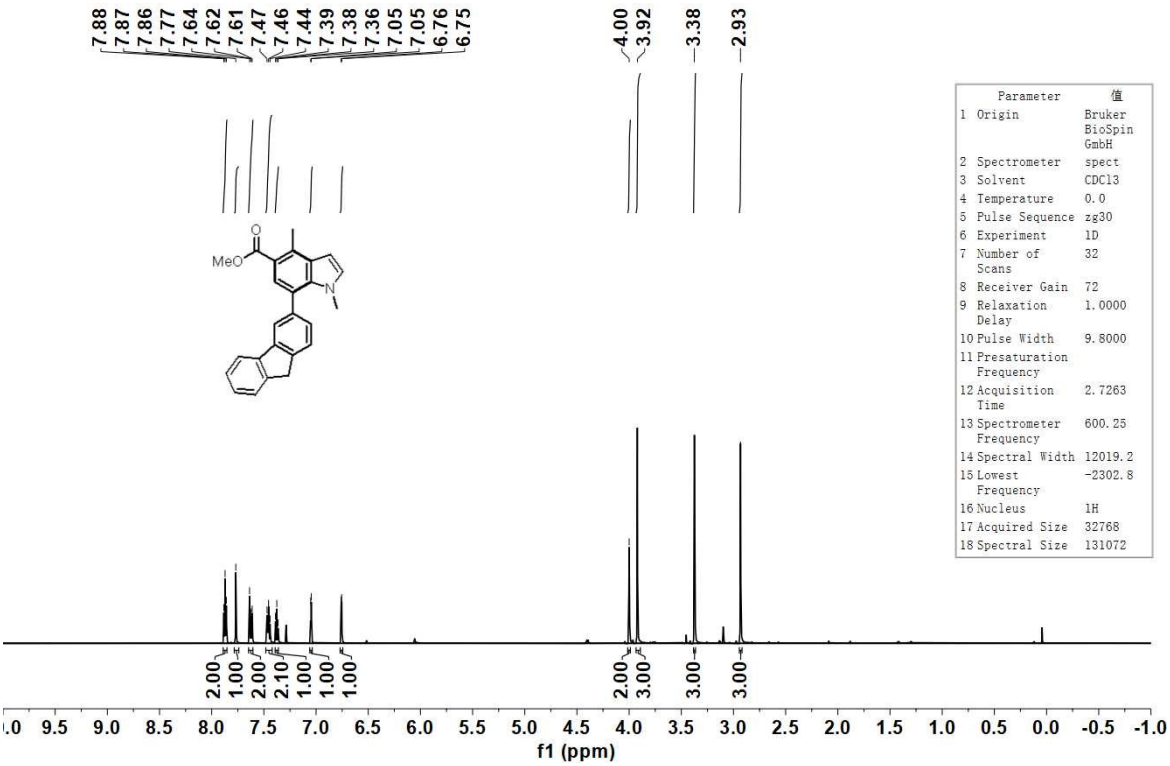
138.95
136.28
134.37
132.92
130.61
130.18
130.01
128.63
124.75
123.97
121.49
100.27
51.94
38.36
15.94
Cl
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.9
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 4096
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5h**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7.87
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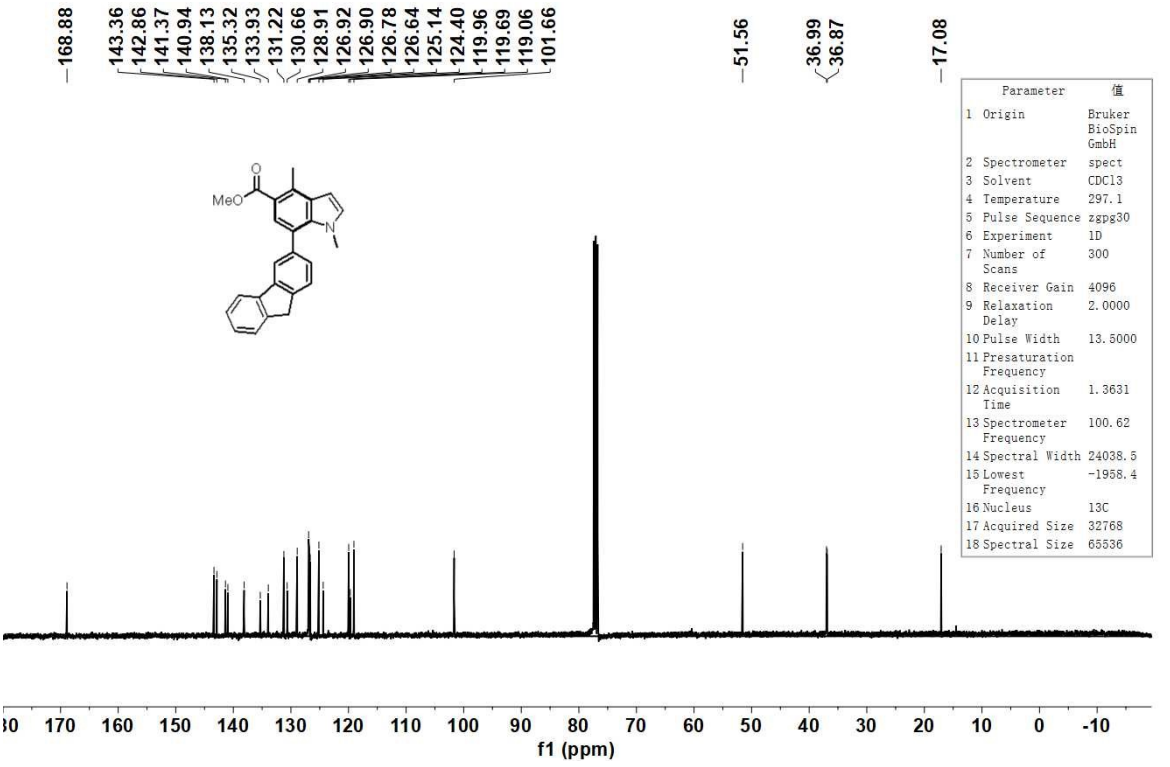
7.61
7.47
7.46
7.44
7.39
7.38
7.36
7.05
7.05
6.76
6.75
4.00
3.92
3.38
2.93
MeO
O
N
2.00
1.00
2.00
2.10
1.00
1.00
1.00
2.00
3.00
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 0.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 72
9 Relaxation Delay 1.0000
10 Pulse Width 9.8000
11 Presaturation Frequency
12 Acquisition Time 2.7263
13 Spectrometer Frequency 600.25
14 Spectral Width 12019.2
15 Lowest Frequency -2302.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 131072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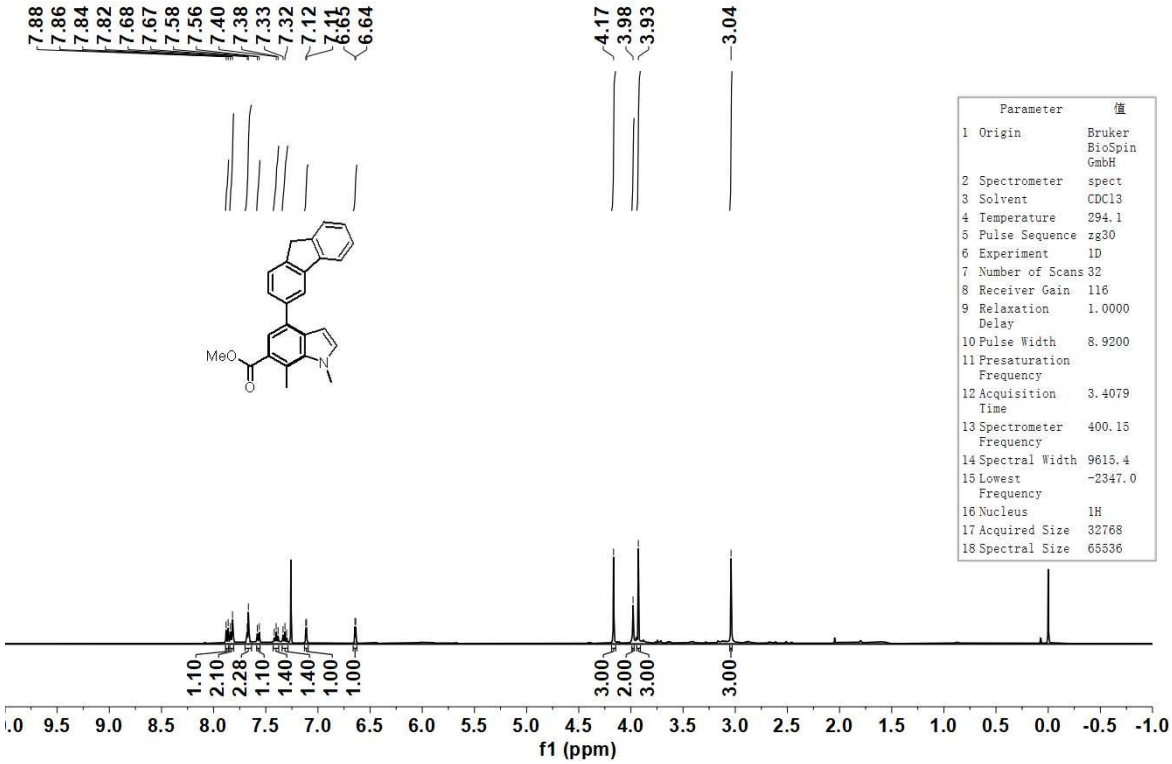
143.36
142.86
141.37
140.94
138.13
135.32
133.93
131.22
130.66
128.91
126.92
126.90
126.78
126.64
125.14
124.40
119.96
119.69
119.06
101.66
51.56
36.99
36.87
17.08
MeO
O
N
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 297.1
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 4096
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

**6h**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7.86
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7.82
7.68
7.67
7.58
7.56
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7.38
7.33
7.32
7.12
7.11
6.65
6.64
4.17
3.98
3.93
3.04
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.1
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 116
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2347.0
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.10
2.10
2.28
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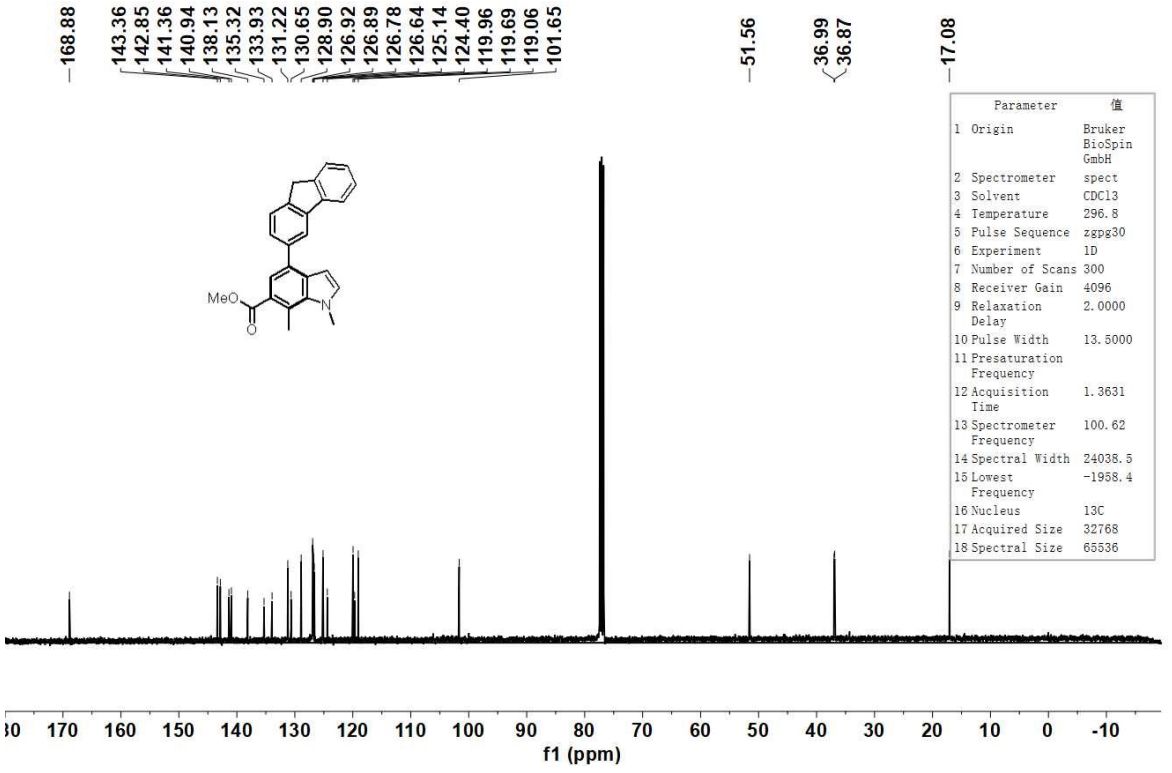
1.00
3.00
2.00
3.00
3.00
f1 (ppm)


168.88
143.36
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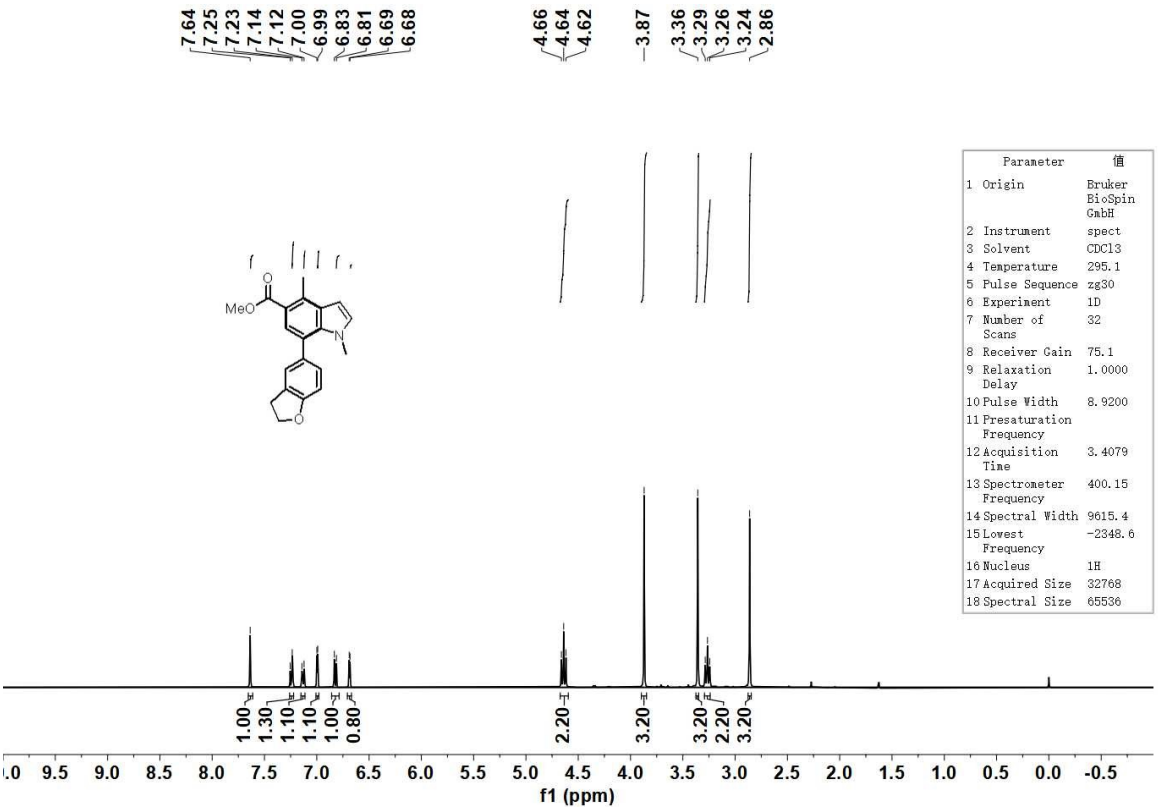
141.36
140.94
138.13
135.32
133.93
131.22
130.65
128.90
126.92
126.89
126.78
126.64
125.14
124.40
119.96
119.69
119.06
101.65
51.56
36.99
36.87
17.08
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.8
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 4096
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5i**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7.23
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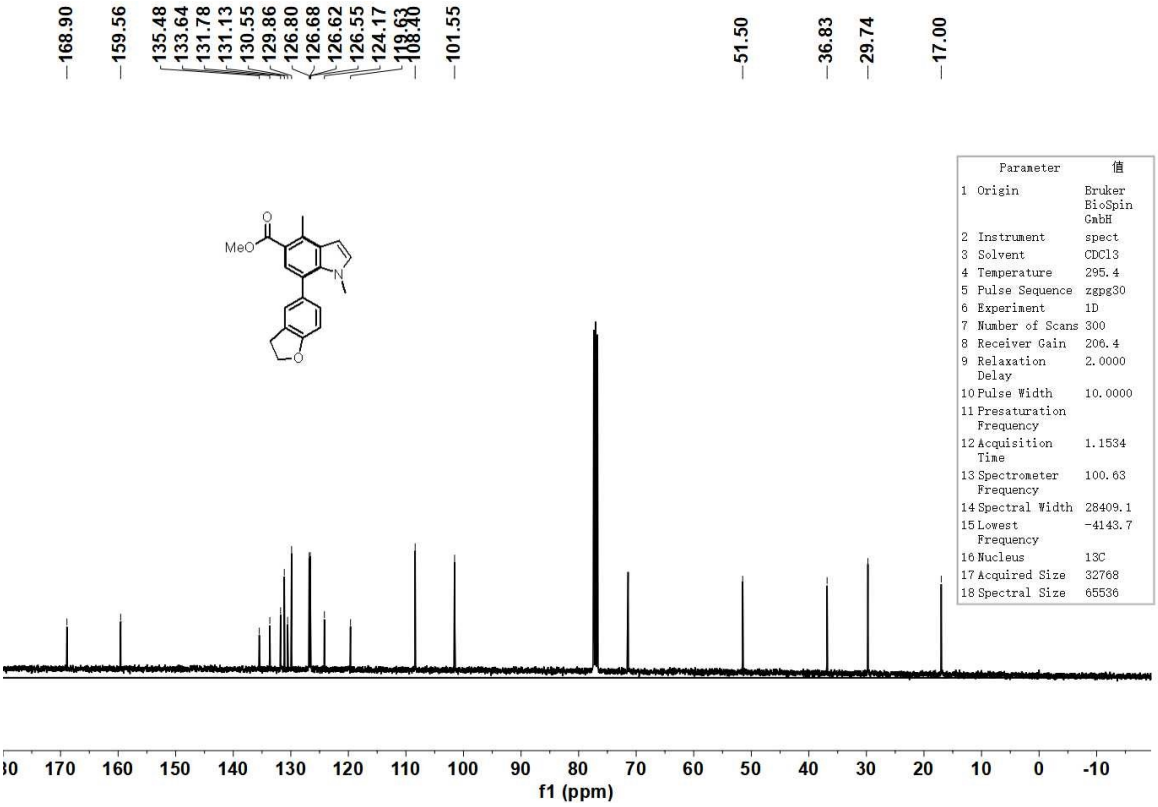
7.00
6.99
6.83
6.81
6.69
6.68
4.66
4.64
4.62
3.87
3.36
3.29
3.26
3.24
2.86
MeO
O
N
O
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.1
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2348.6
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
1.30
1.10
1.10
1.00
0.80
2.20
3.20
3.20
2.20
3.20
f1 (ppm)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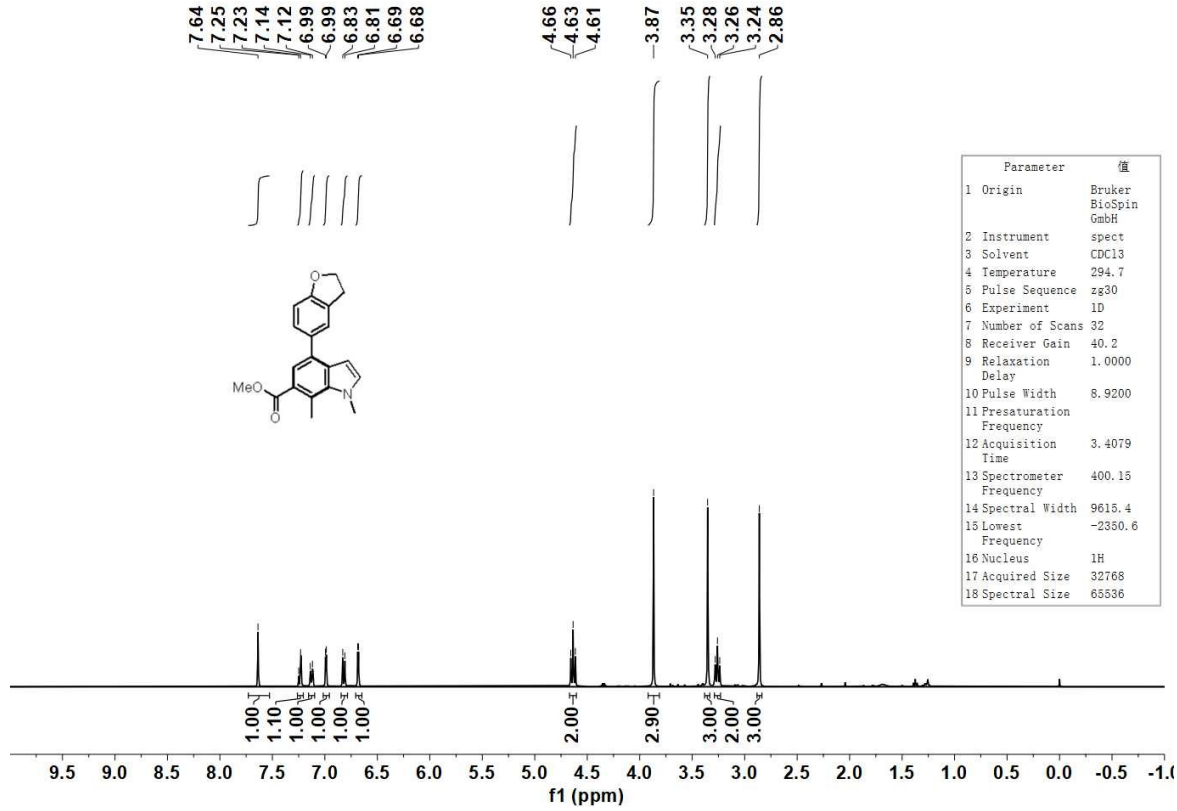
159.56
135.48
133.64
131.78
131.13
130.55
129.86
126.80
126.68
126.62
126.55
124.17
119.63
108.40
101.55
51.50
36.83
29.74
17.00
MeO
O
N
O
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.4
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**6i**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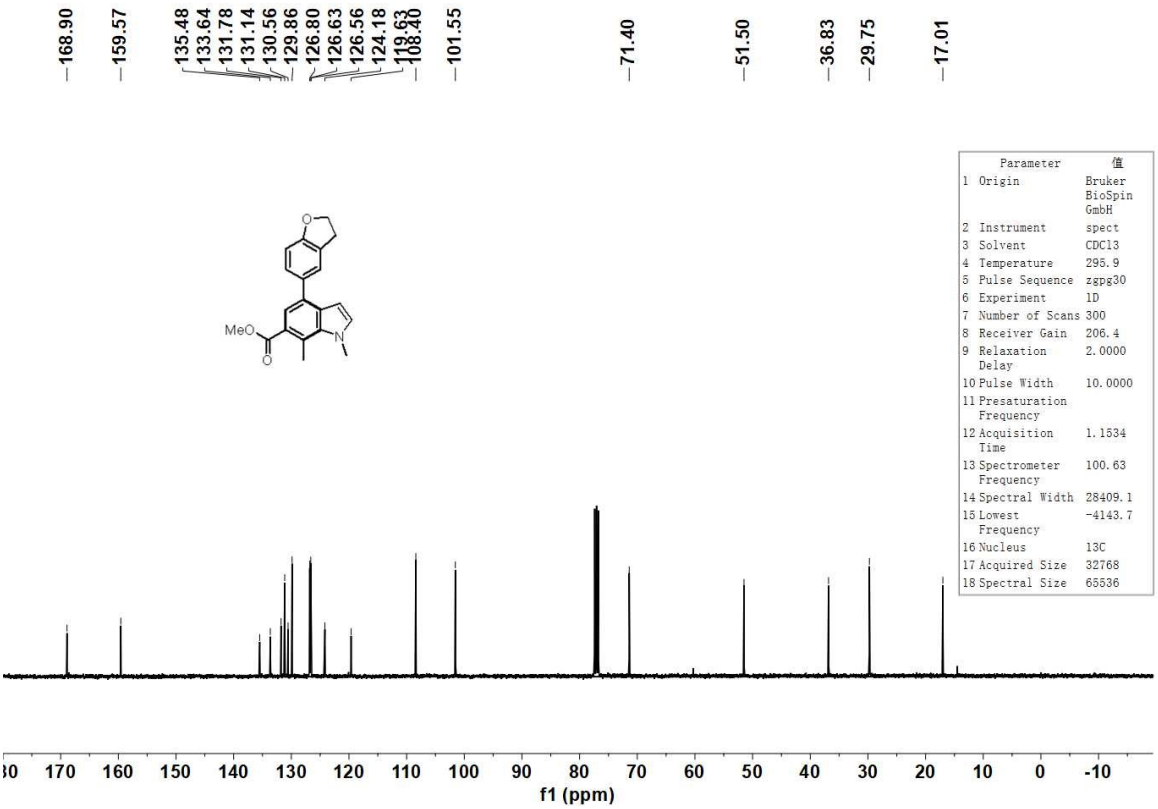
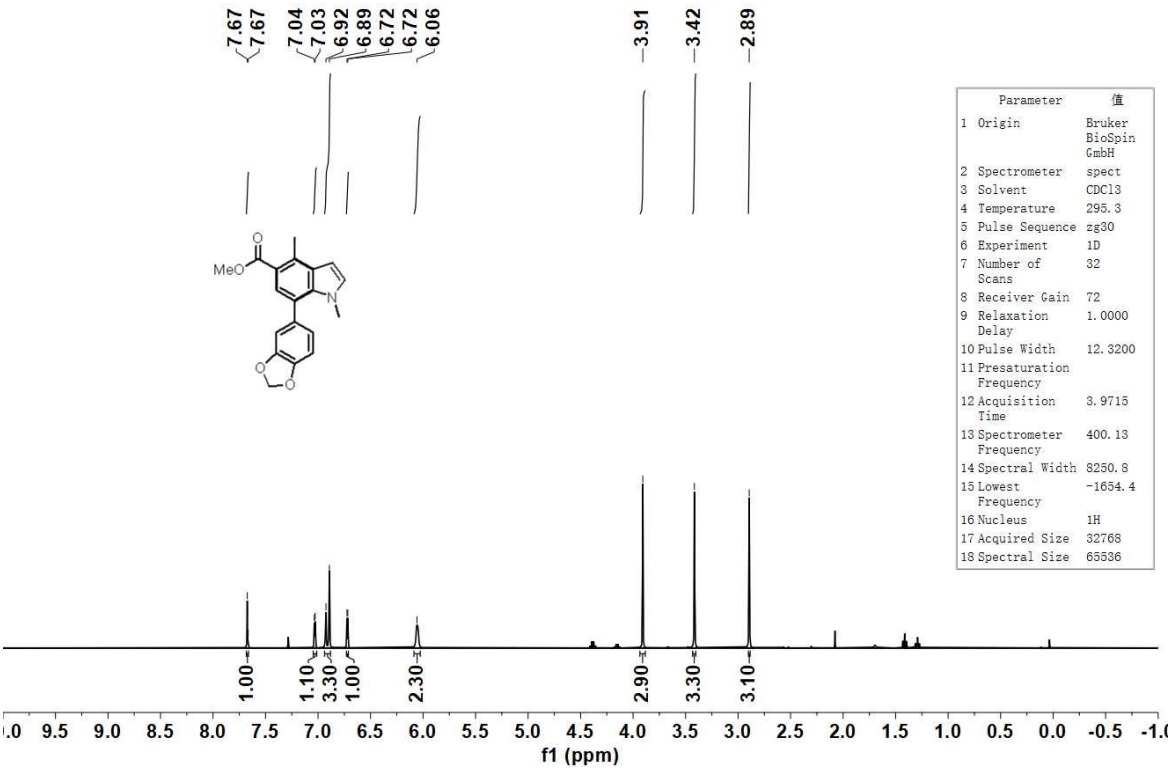
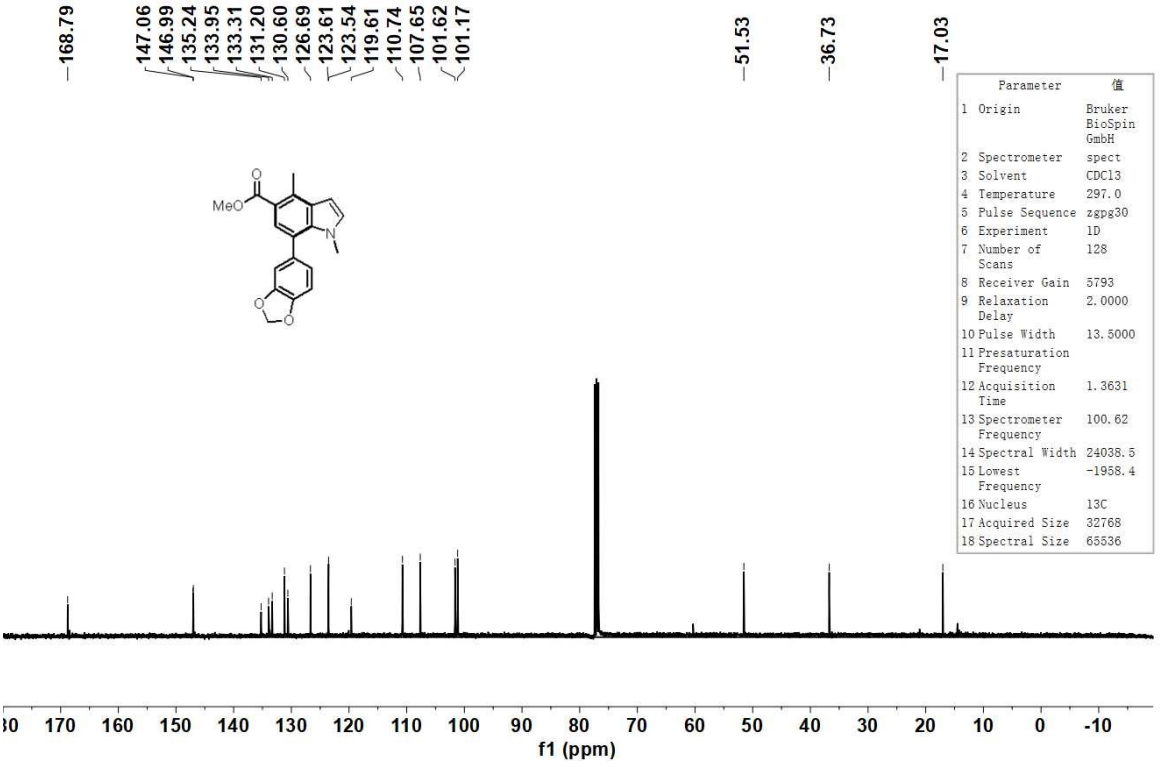
7.25
7.23
7.14
7.12
6.99
6.99
6.83
6.81
6.69
6.68
4.66
4.63
4.61
3.87
3.35
3.28
3.26
3.24
2.86
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.7
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 40.2
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2350.6
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
1.10
1.00
1.00
1.00
1.00
2.00
2.90
3.00
2.00
3.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

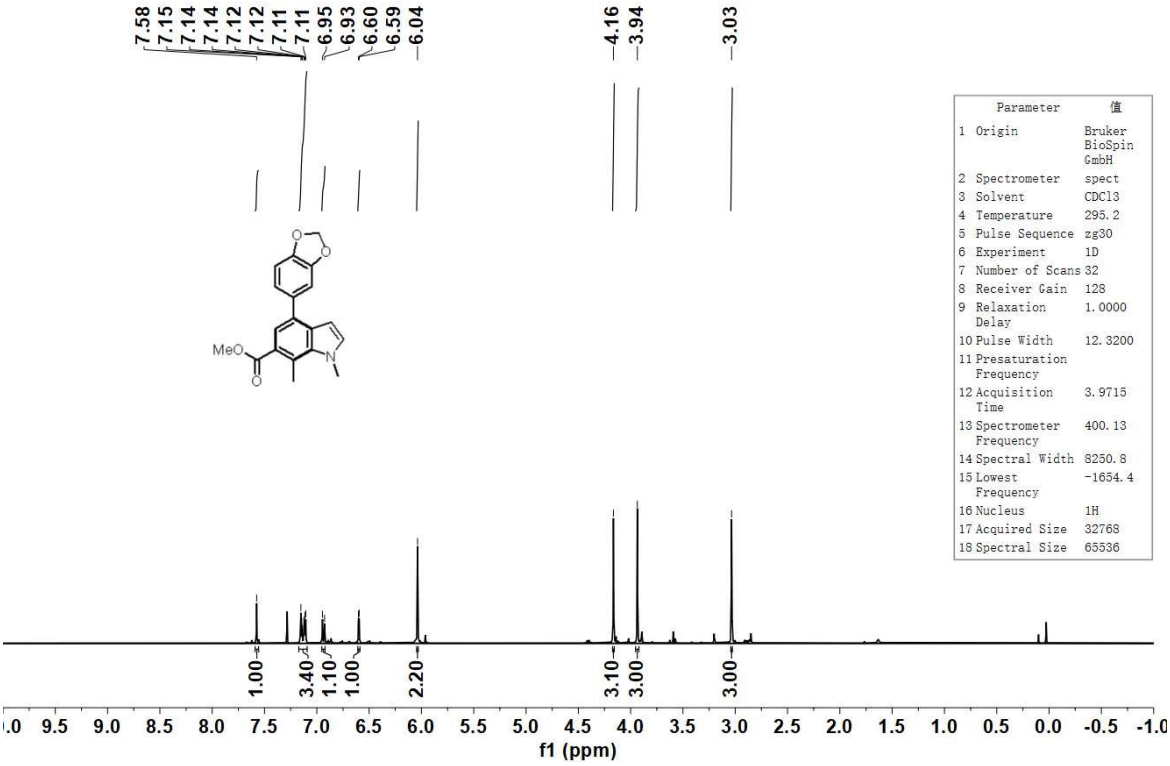

168.90
159.57
135.48
133.64
131.78
131.14
130.56
129.86
126.80
126.63
126.56
124.18
119.63
108.40
101.55
71.40
51.50
36.83
29.75
17.01
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.9
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

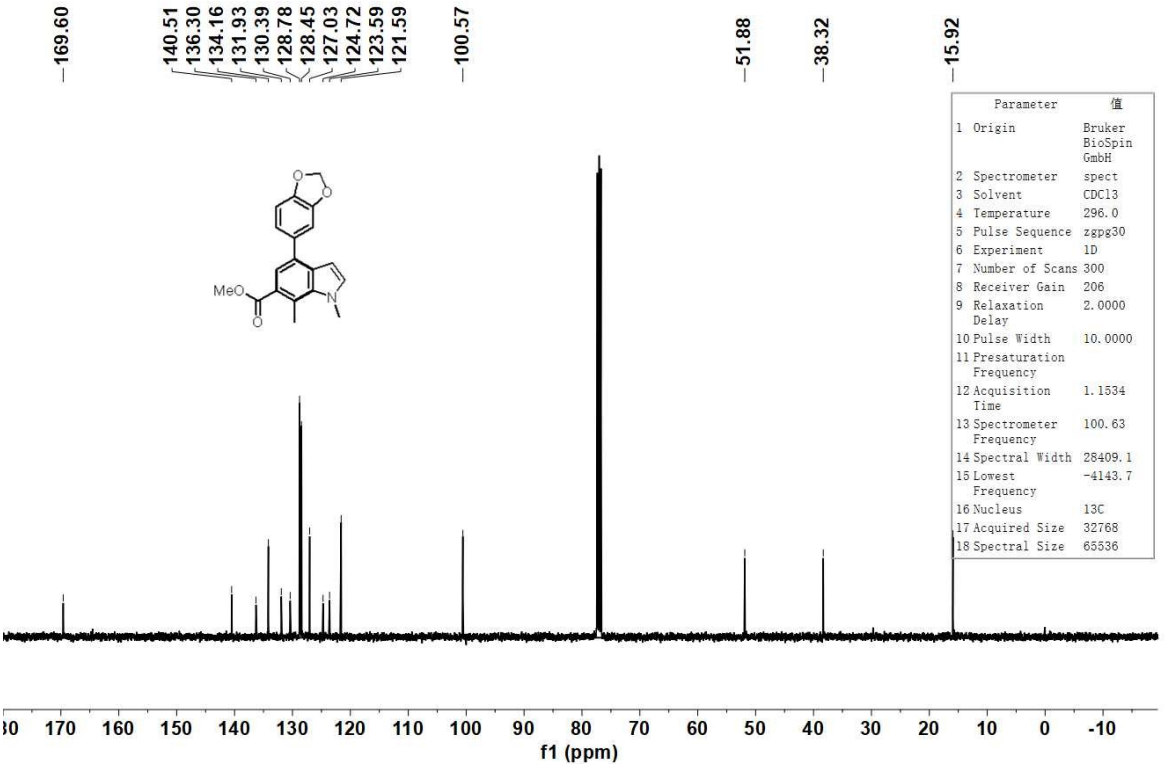
**5j**


7.67
7.67
7.04
7.03
6.92
6.89
6.72
6.72
6.06
3.91
3.42
2.89
MeO
O
O
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.3
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 72
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
1.10
3.30
1.00
2.30
2.90
3.30
3.10
f1 (ppm)

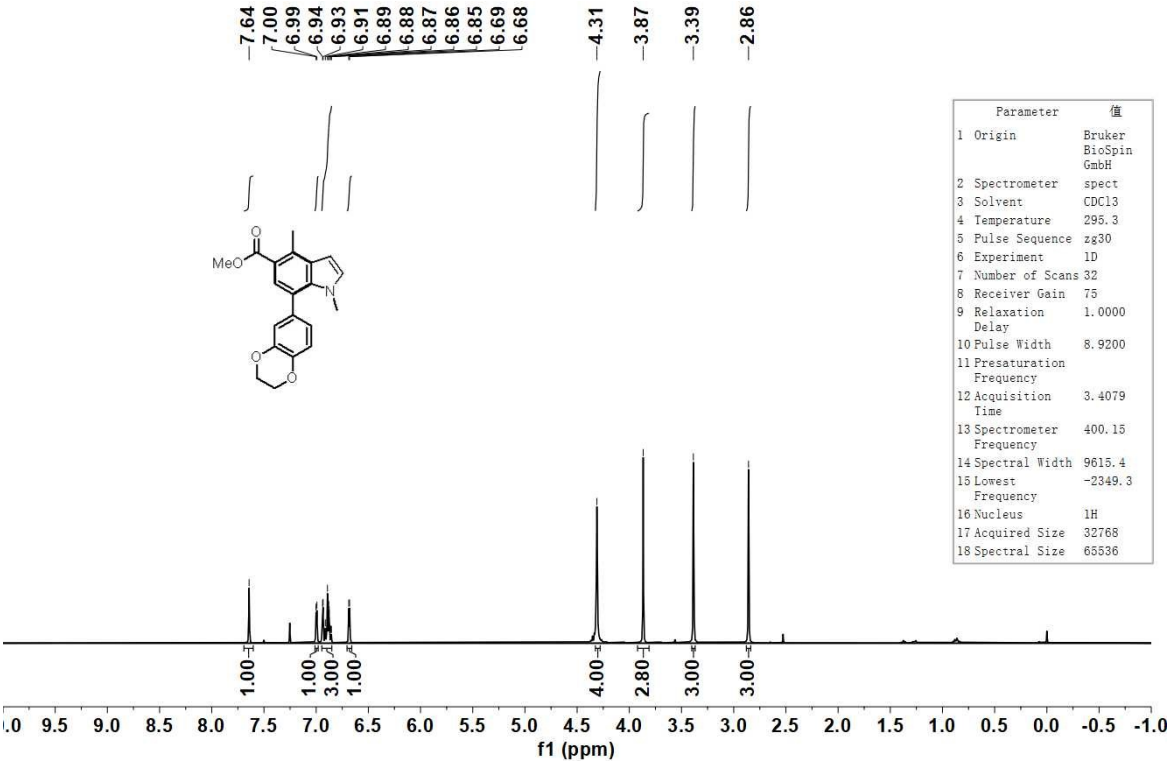

168.79
147.06
146.99
135.24
133.95
133.31
131.20
130.60
126.69
123.61
123.54
119.61
110.74
107.65
101.62
101.17
51.53
36.73
17.03
MeO
O
O
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 297.0
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 5793
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

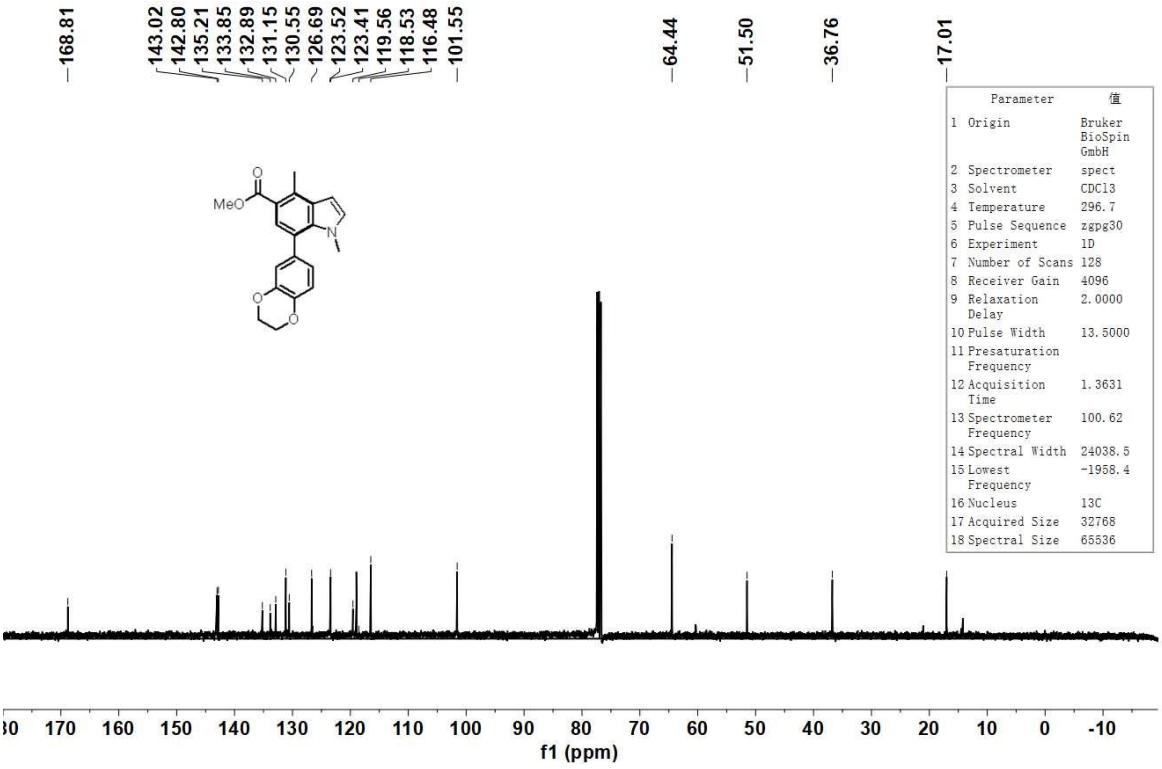
**6j**


7.58
7.15
7.14
7.14
7.12
7.12
7.11
7.11
6.95
6.93
6.60
6.59
6.04
4.16
3.94
3.03
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.2
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 128
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
3.40
1.10
1.00
2.20
3.10
3.00
3.00
f1 (ppm)

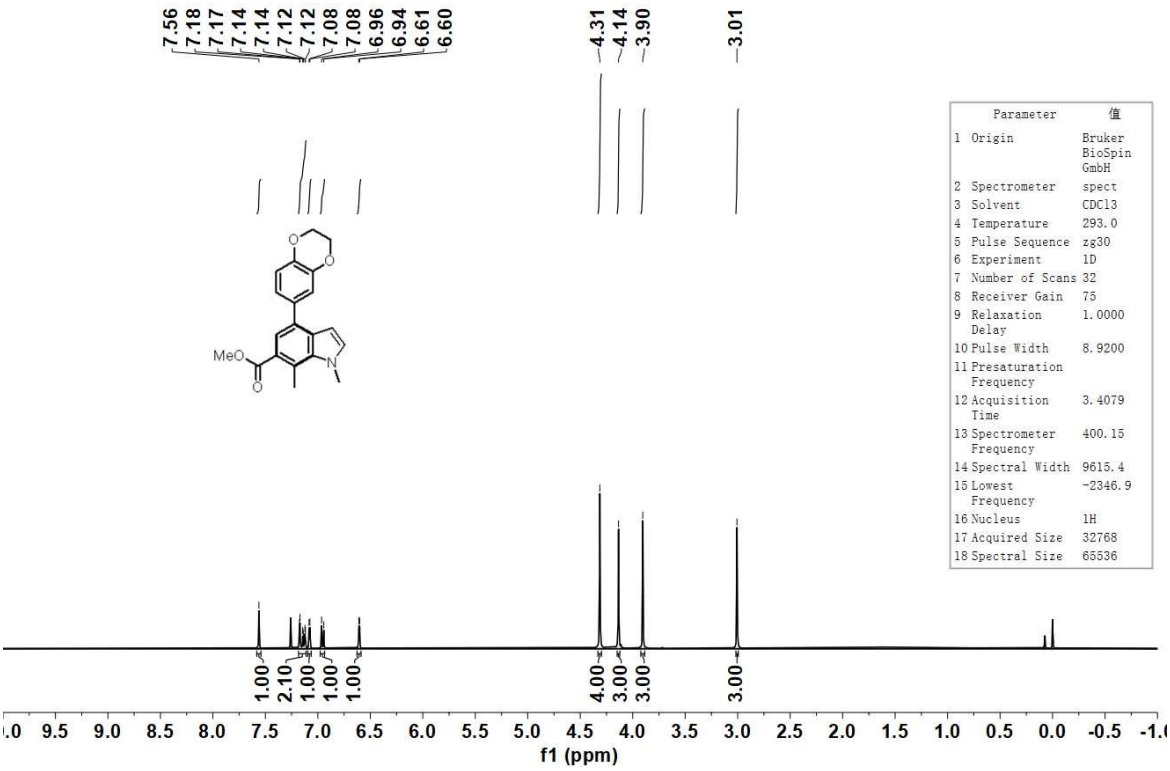

169.60
140.51
136.30
134.16
131.93
130.39
128.78
128.45
127.03
124.72
123.59
121.59
100.57
51.88
38.32
15.92
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.0
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5k**


7.64
7.00
6.99
6.94
6.93
6.91
6.89
6.88
6.87
6.86
6.85
6.69
6.68
4.31
3.87
3.39
2.86
MeO
O
N
O
O
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.3
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2349.3
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
1.00
3.00
1.00
4.00
2.80
3.00
3.00
f1 (ppm)


168.81
143.02
142.80
135.21
133.85
132.89
131.15
130.55
126.69
123.52
123.41
119.56
118.53
116.48
101.55
64.44
51.50
36.76
17.01
MeO
O
N
O
O
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.7
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 4096
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**6k**


7.56
7.18
7.17
7.14
7.14
7.12
7.12
7.08
7.08
6.96
6.94
6.61
6.60
4.31
4.14
3.90
3.01
MeO
O
O
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 293.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2346.9
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
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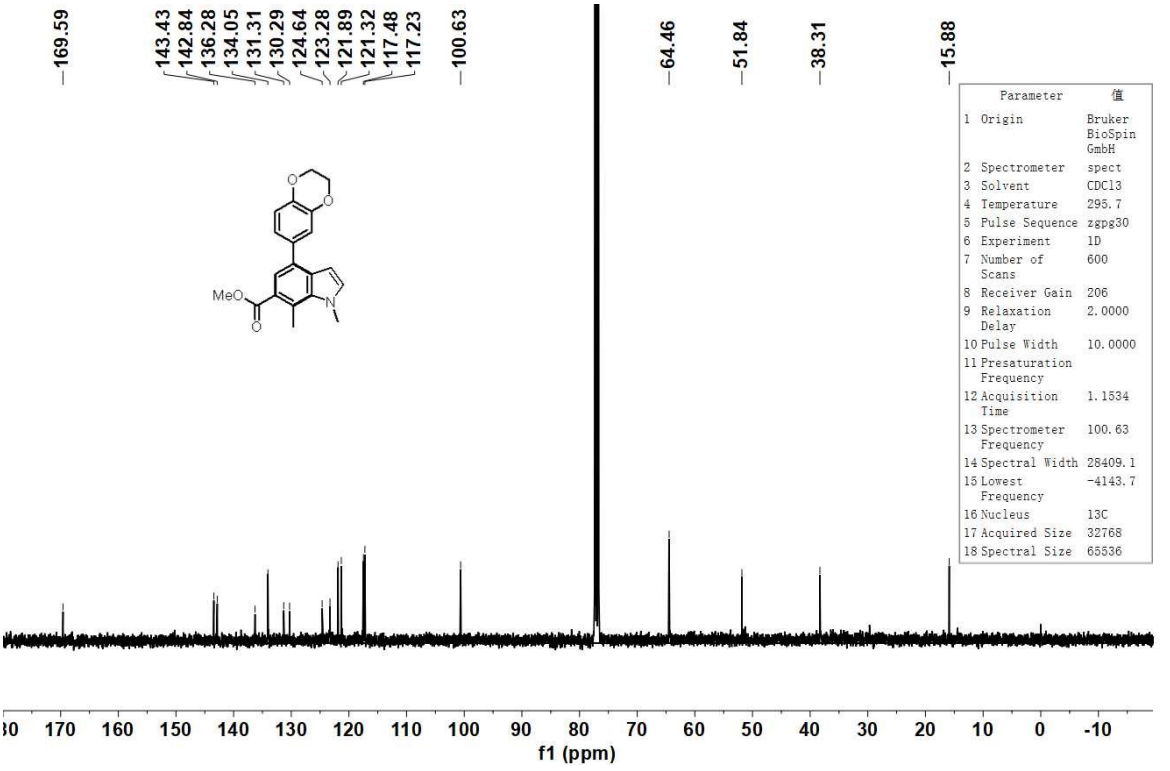
2.10
1.00
1.00
1.00
4.00
3.00
3.00
3.00
f1 (ppm)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143.43
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136.28
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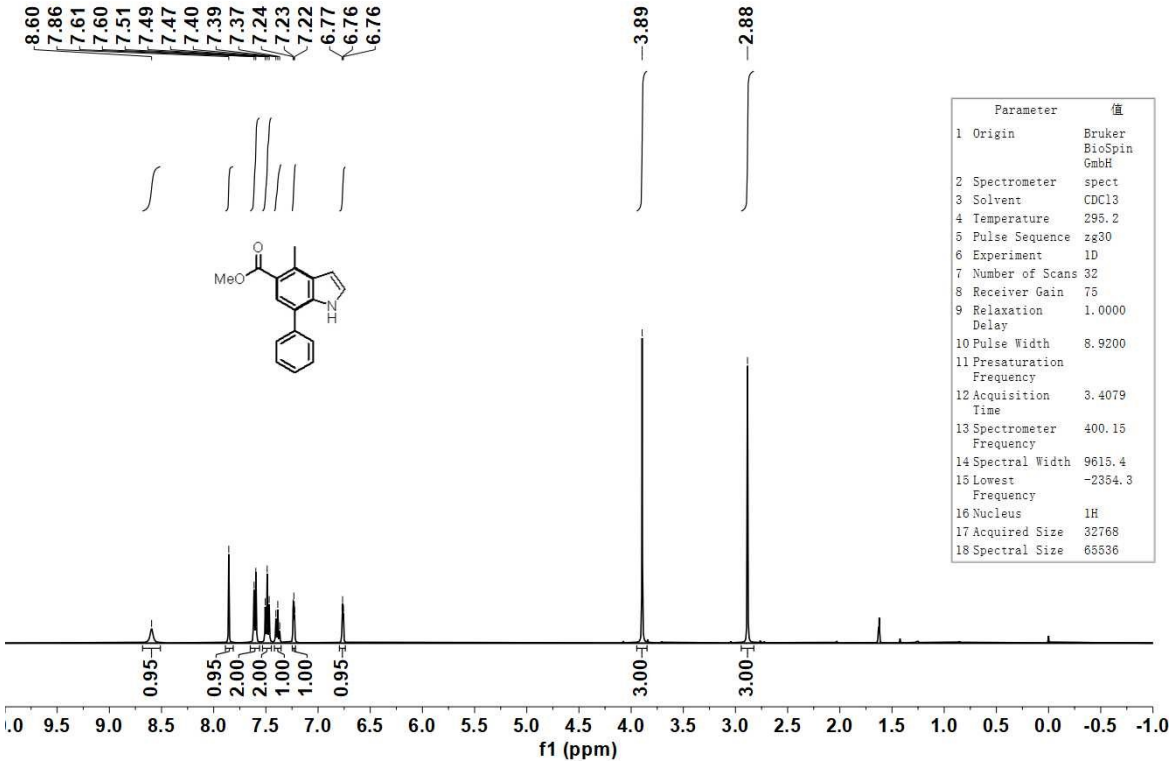
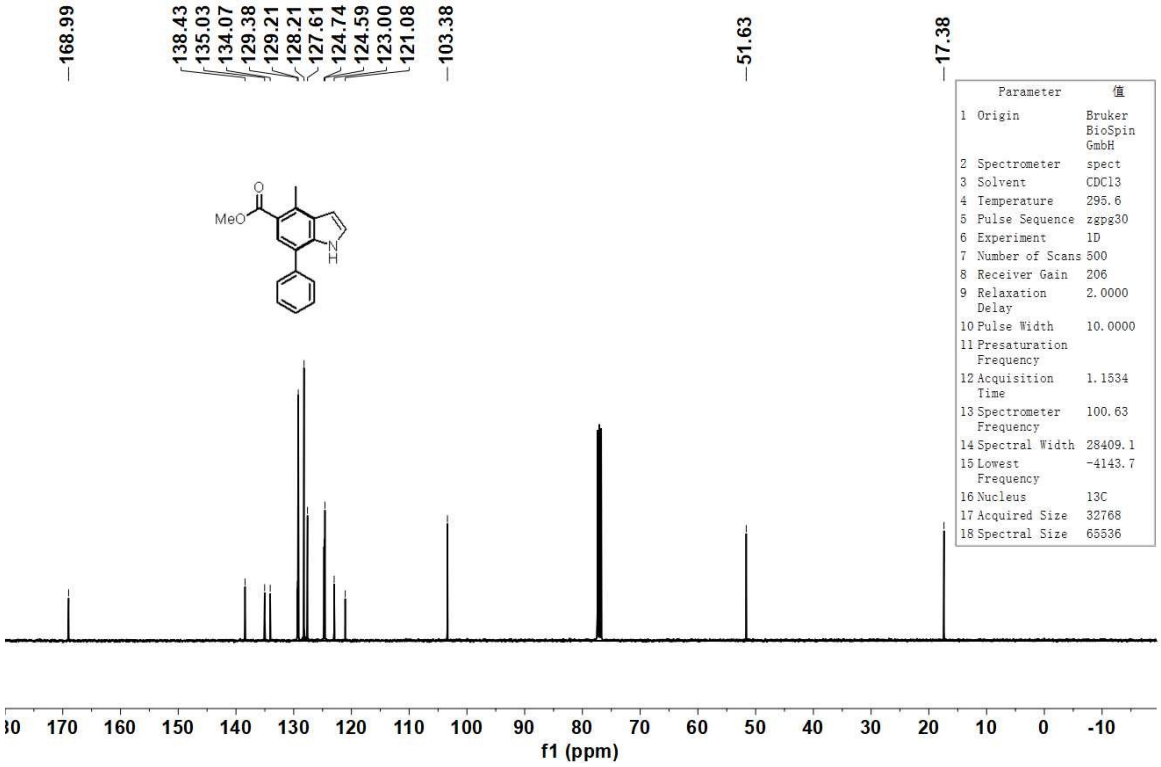
131.31
130.29
124.64
123.28
121.89
121.32
117.48
117.23
100.63
64.46
51.84
38.31
15.88
MeO
O
O
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.7
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 600
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5l**


8.60
7.86
7.61
7.60
7.51
7.49
7.47
7.40
7.39
7.37
7.24
7.23
7.22
6.77
6.76
6.76
3.89
2.88
MeO
O
N
H
0.95
0.95
2.00
2.00
1.00
1.00
0.95
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.2
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2354.3
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536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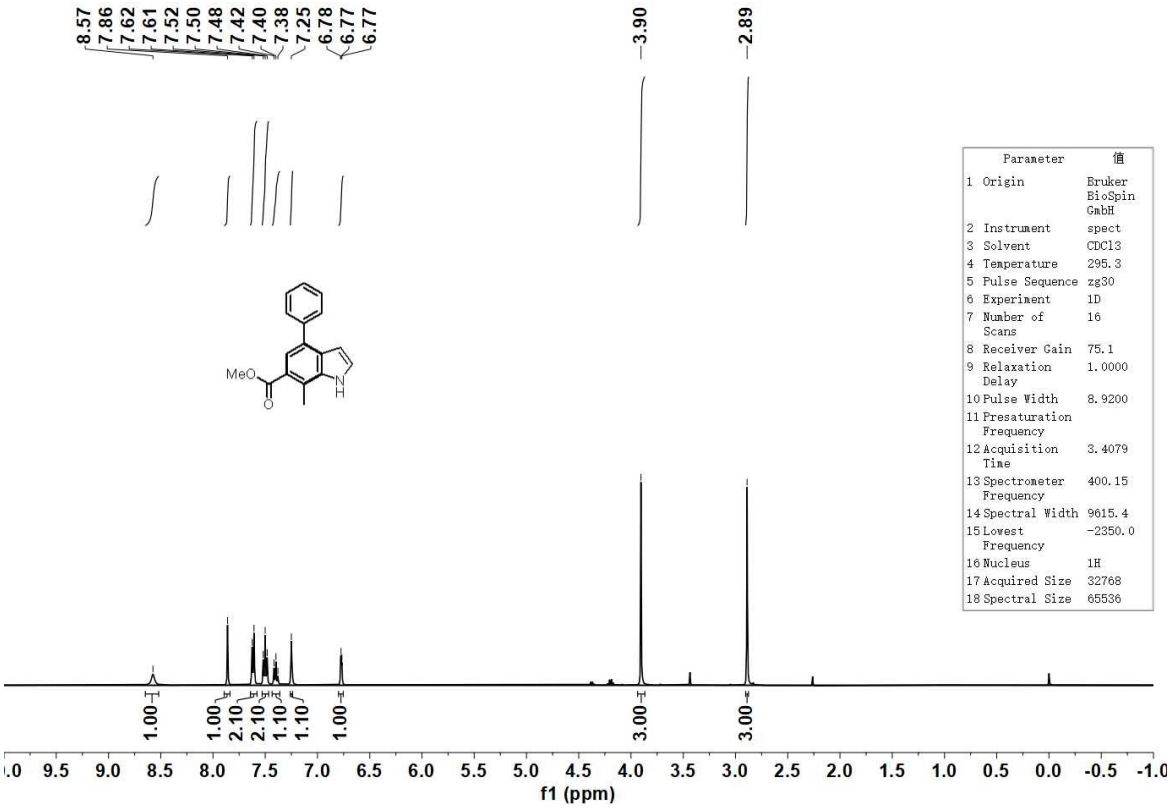
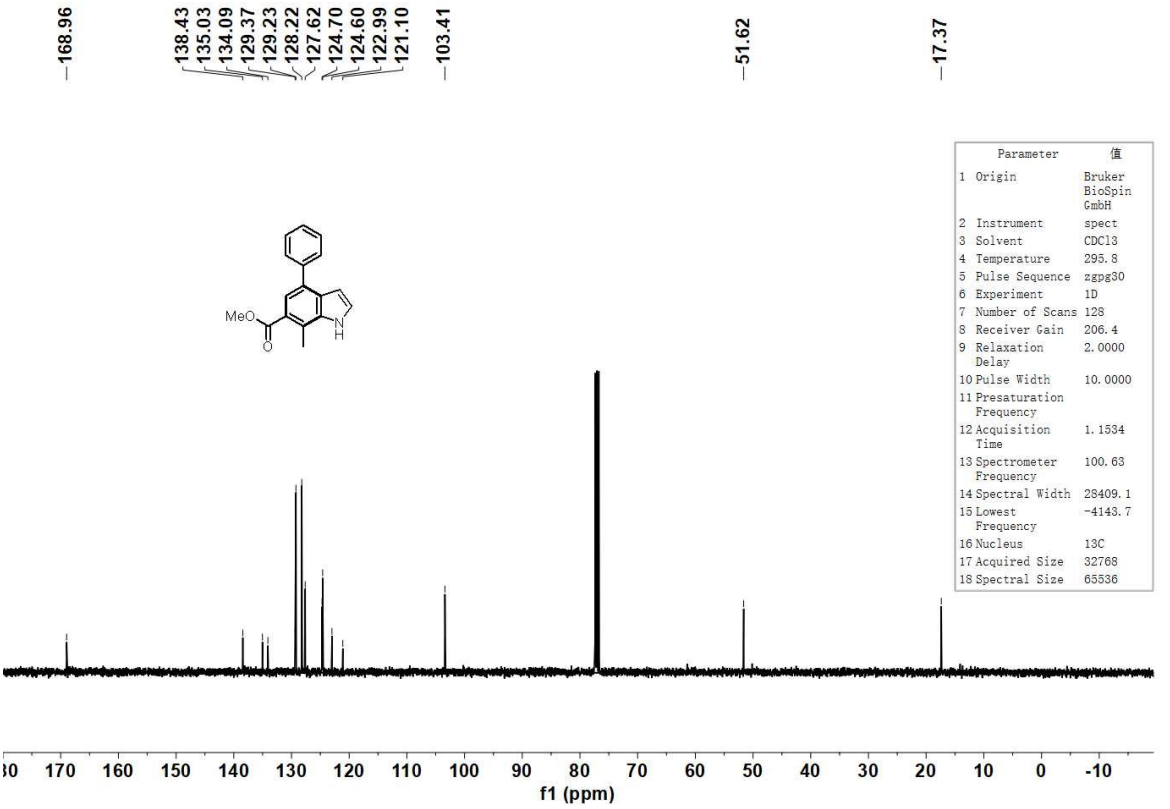
129.38
129.21
128.21
127.61
124.74
124.59
123.00
121.08
103.38
51.63
17.38
MeO
O
N
H
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 500
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

**6l**


8.57
7.86
7.62
7.61
7.52
7.50
7.48
7.42
7.40
7.38
7.25
6.78
6.77
6.77
3.90
2.89
MeO
O
N
H
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.3
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2350.0
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
1.00
2.10
2.10
1.10
1.10
1.00
3.00
3.00
f1 (ppm)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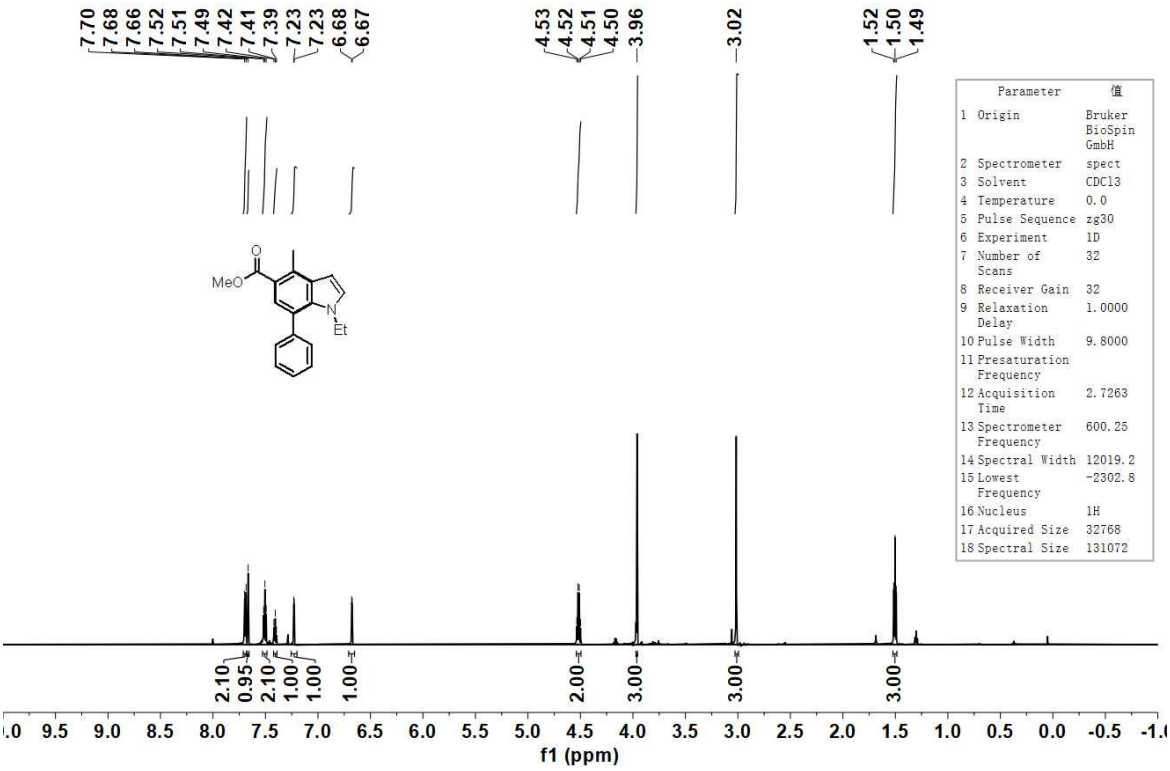
138.43
135.03
134.09
129.37
129.23
128.22
127.62
124.70
124.60
122.99
121.10
103.41
51.62
17.37
MeO
O
N
H
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.8
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5m**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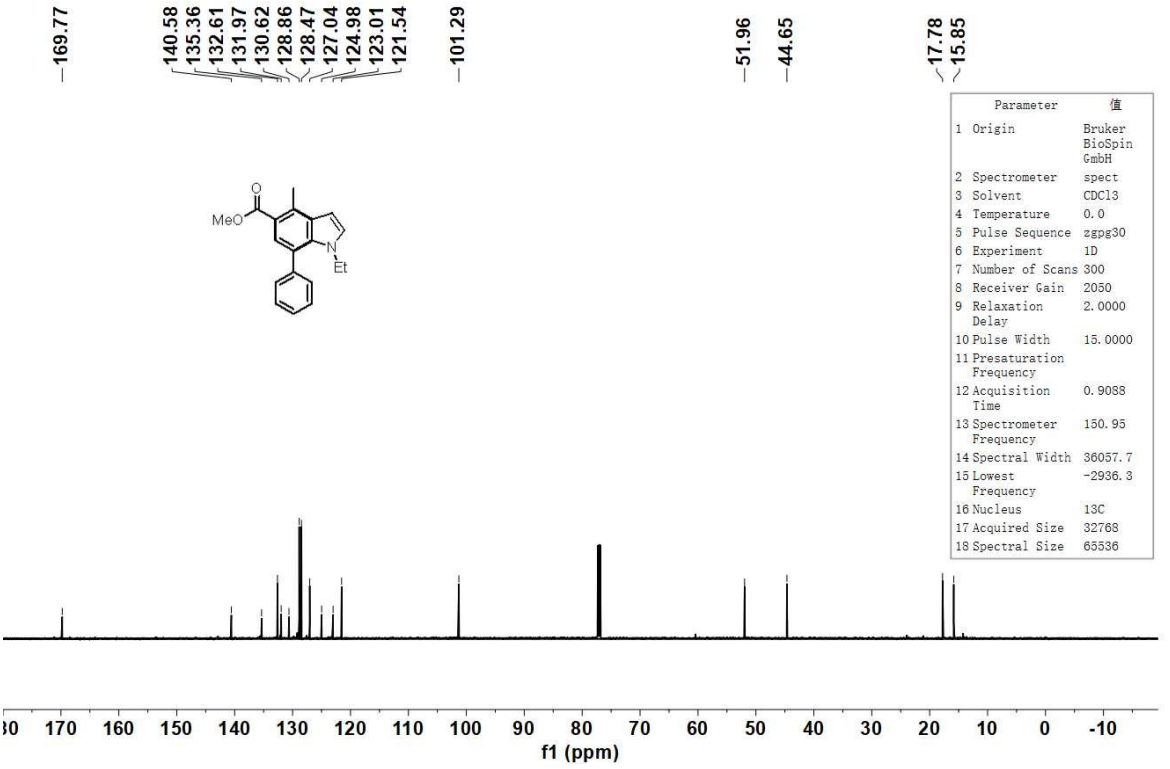
7.68
7.66
7.52
7.51
7.49
7.42
7.41
7.39
7.23
7.23
6.68
6.67
4.53
4.52
4.51
4.50
3.96
3.02
1.52
1.50
1.49
MeO
O
N
Et
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 0.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 32
9 Relaxation Delay 1.0000
10 Pulse Width 9.8000
11 Presaturation Frequency
12 Acquisition Time 2.7263
13 Spectrometer Frequency 600.25
14 Spectral Width 12019.2
15 Lowest Frequency -2302.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 131072
2.10
0.95
2.10
1.00
1.00
1.00
2.00
3.00
3.00
3.00
f1 (ppm)


169.77
140.58
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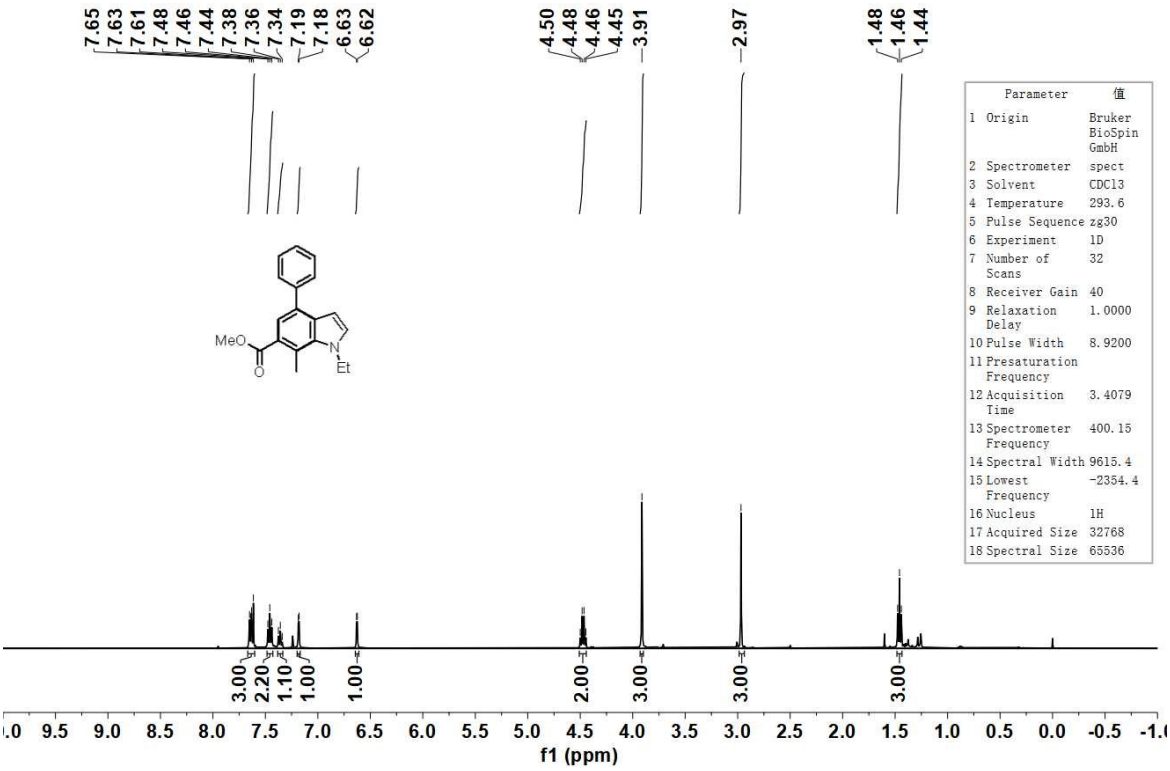
132.61
131.97
130.62
128.86
128.47
127.04
124.98
123.01
121.54
101.29
51.96
44.65
17.78
15.85
MeO
O
N
Et
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 0.0
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 2050
9 Relaxation Delay 2.0000
10 Pulse Width 15.0000
11 Presaturation Frequency
12 Acquisition Time 0.9088
13 Spectrometer Frequency 150.95
14 Spectral Width 36057.7
15 Lowest Frequency -2936.3
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**6m**


7.65
7.63
7.61
7.48
7.46
7.44
7.38
7.36
7.34
7.19
7.18
6.63
6.62
4.50
4.48
4.46
4.45
3.91
2.97
1.48
1.46
1.44
MeO
O
N
Et
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 293.6
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 40
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2354.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
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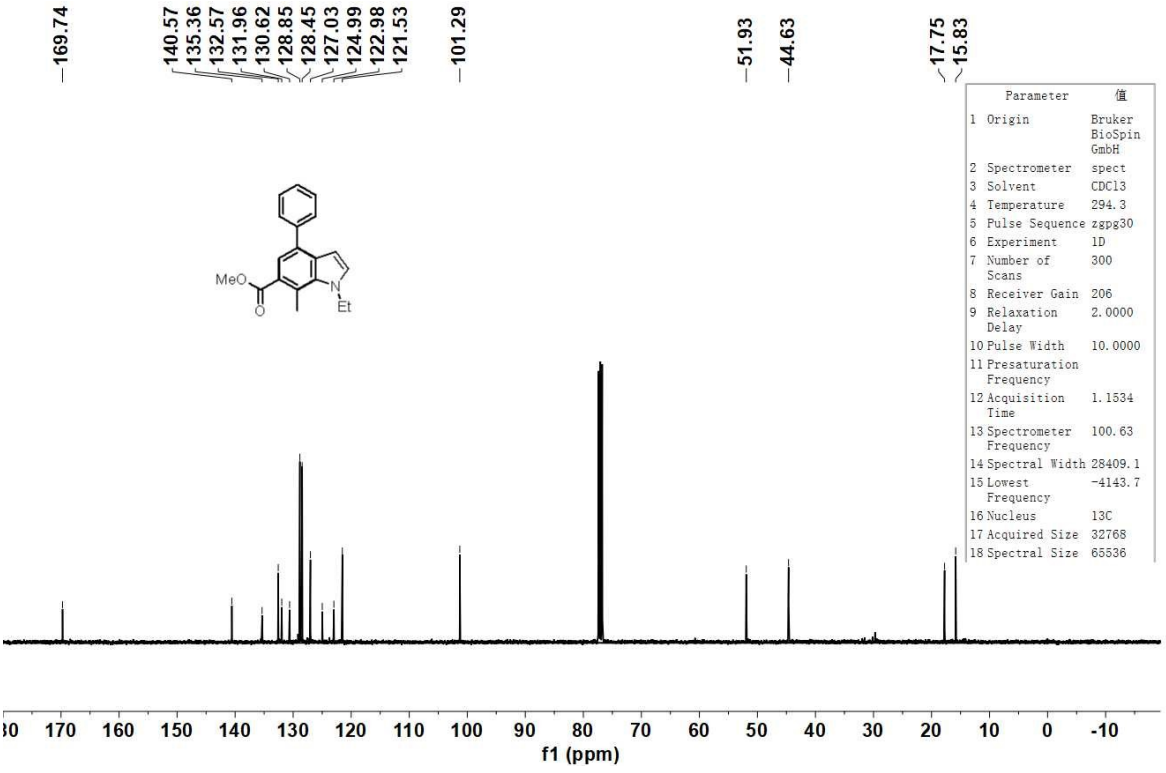
2.20
1.10
1.00
1.00
2.00
3.00
3.00
3.00
f1 (ppm)


169.74
140.57
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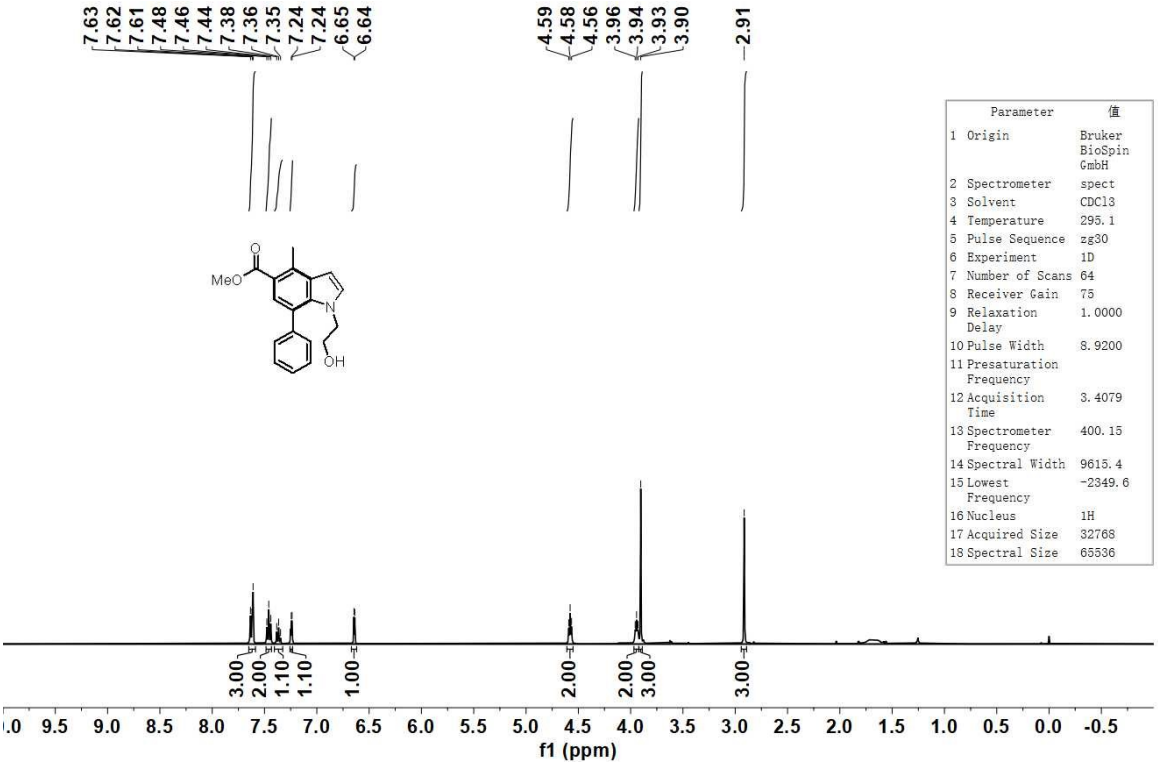
131.96
130.62
128.85
128.45
127.03
124.99
122.98
121.53
101.29
51.93
44.63
17.75
15.83
MeO
O
N
Et
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.3
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5n**


7.63
7.62
7.61
7.48
7.46
7.44
7.38
7.36
7.35
7.24
7.24
6.65
6.64
4.59
4.58
4.56
3.96
3.94
3.93
3.90
2.91
MeO
O
N
OH
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.1
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 64
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2349.6
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
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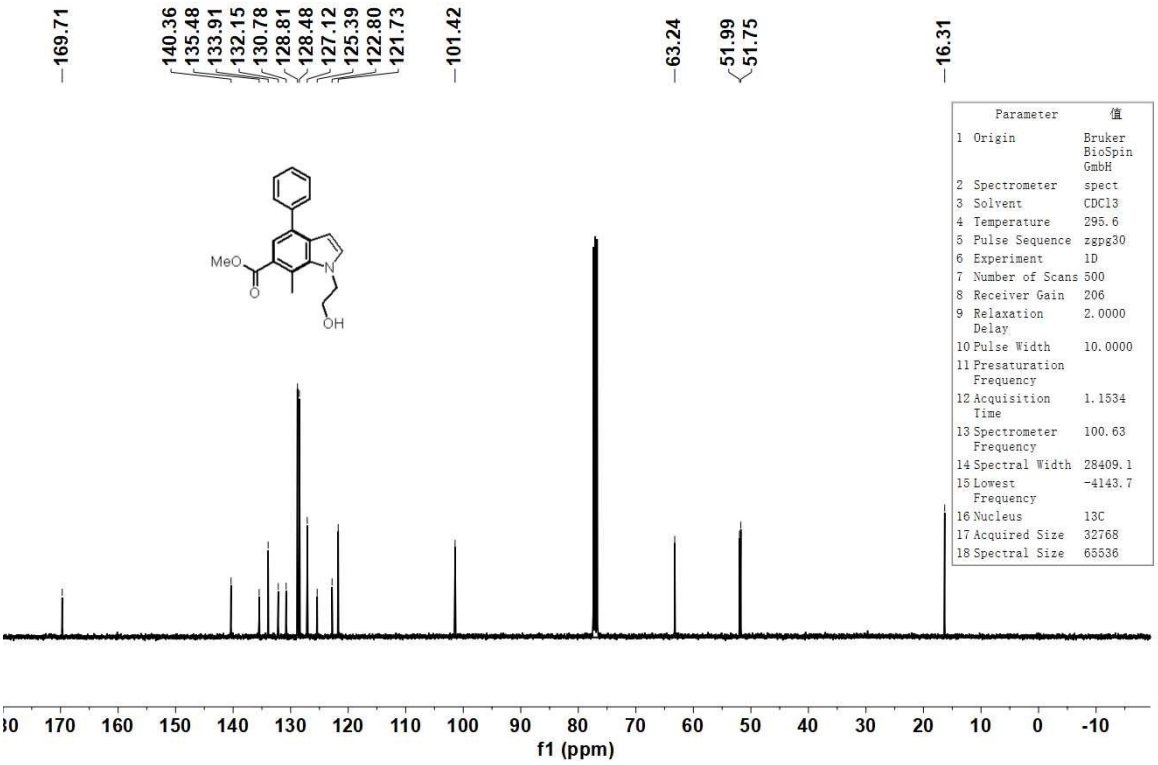
2.00
1.10
1.10
1.00
2.00
2.00
3.00
3.00
f1 (ppm)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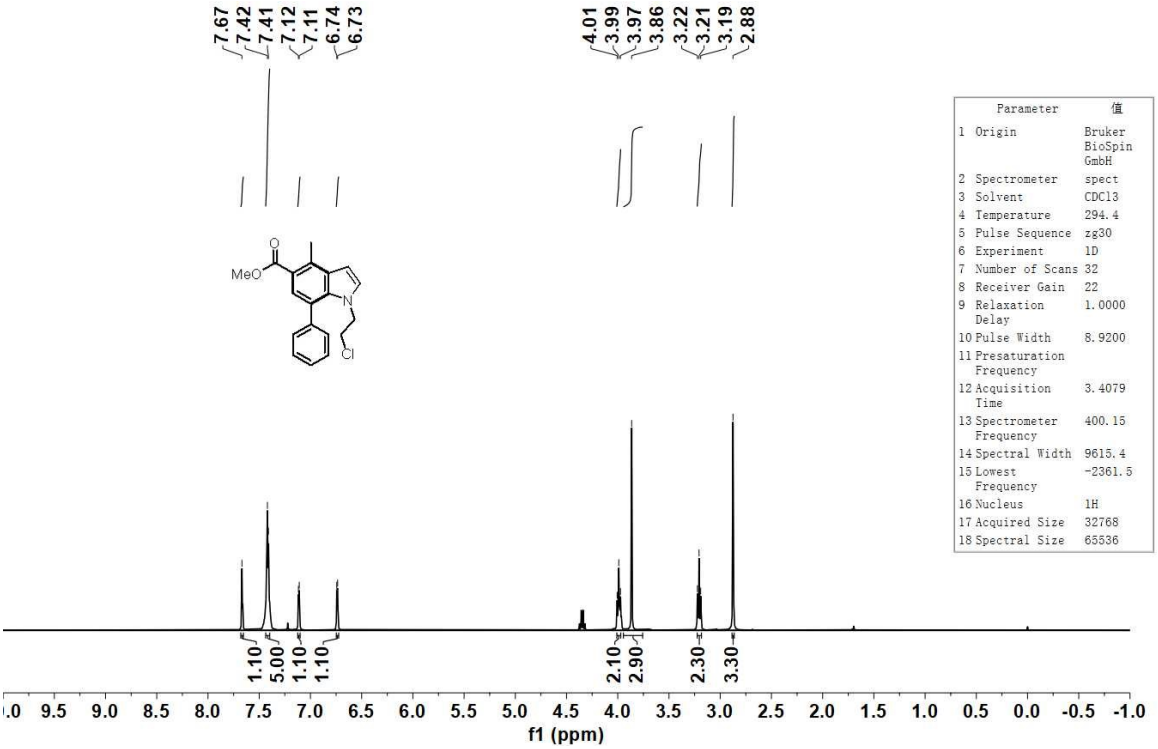
140.36
135.48
133.91
132.15
130.78
128.81
128.48
127.12
125.39
122.80
121.73
101.42
63.24
51.99
51.75
16.31
MeO
O
N
OH
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 500
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5o**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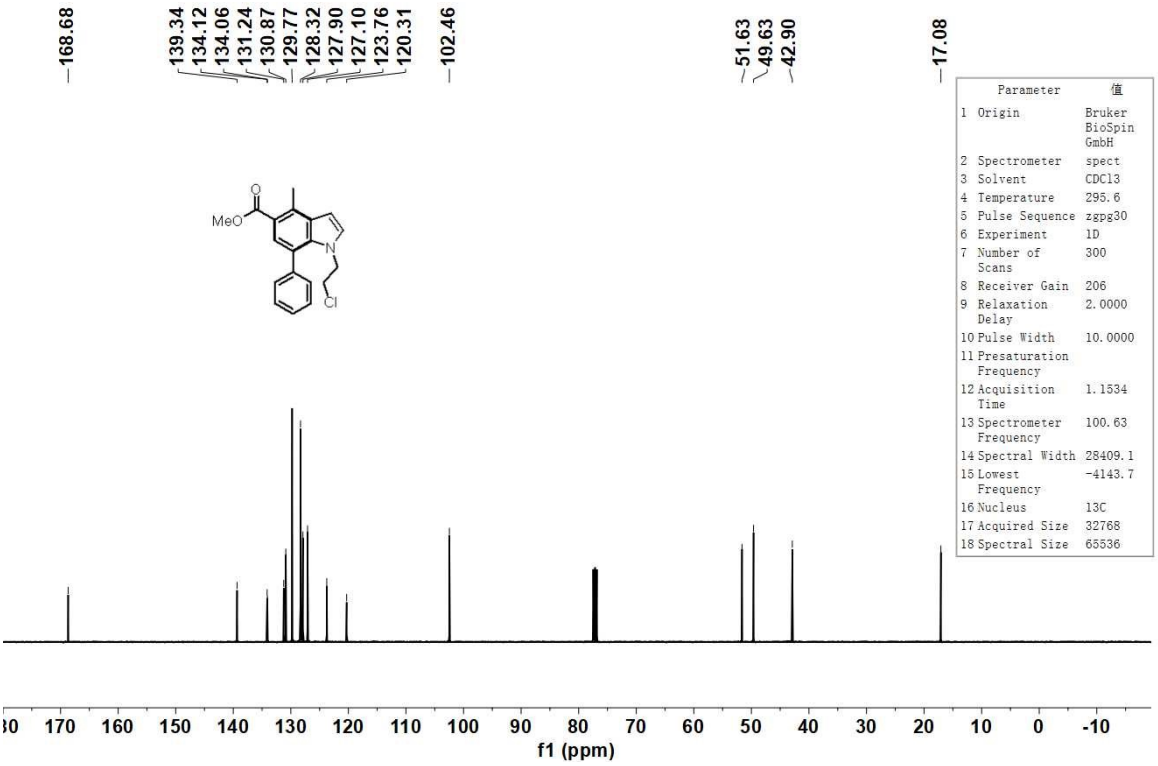
7.42
7.41
7.12
7.11
6.74
6.73
4.01
3.99
3.97
3.86
3.22
3.21
3.19
2.88
MeO
O
N
Cl
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.4
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 22
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2361.5
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.10
5.00
1.10
1.10
2.10
2.90
2.30
3.30
f1 (ppm)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139.34
134.12
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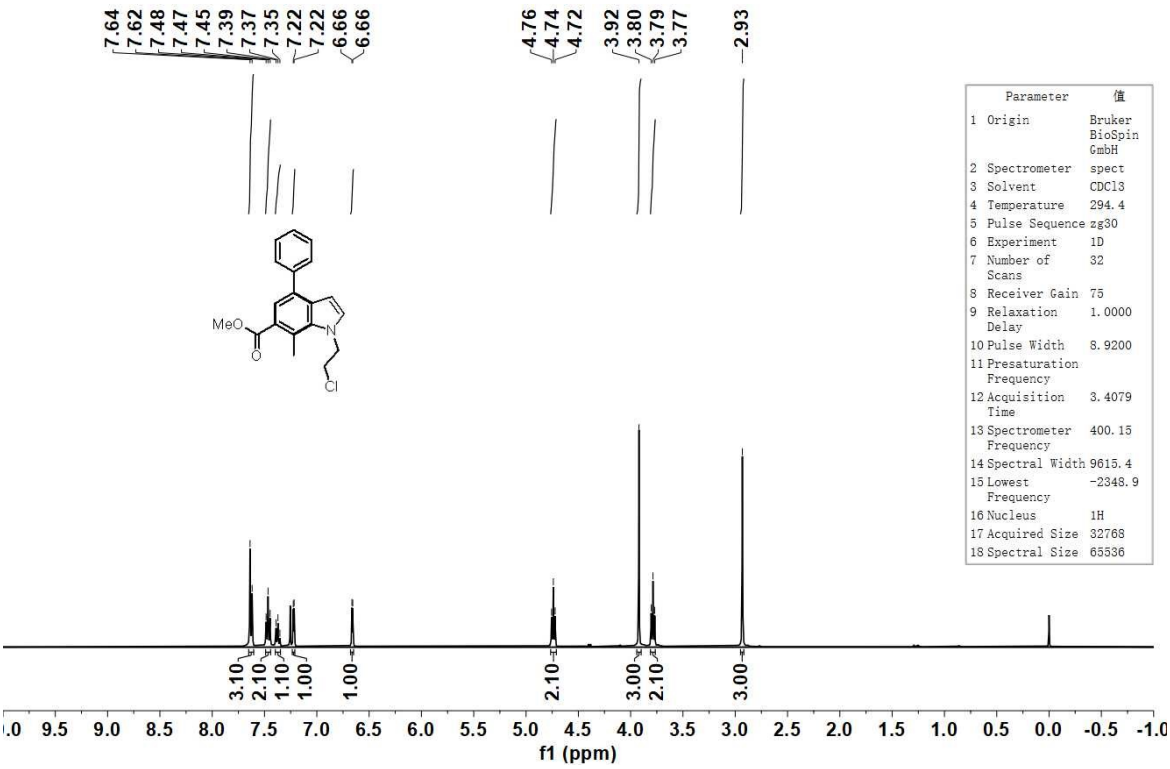
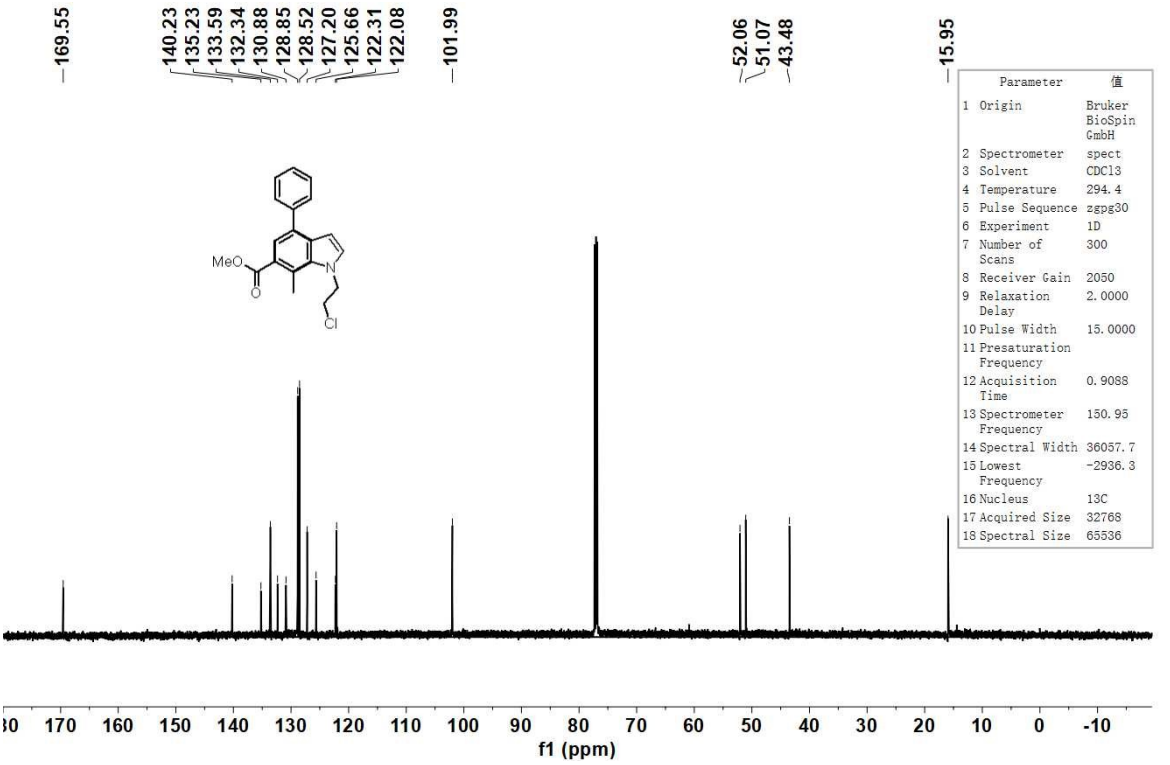
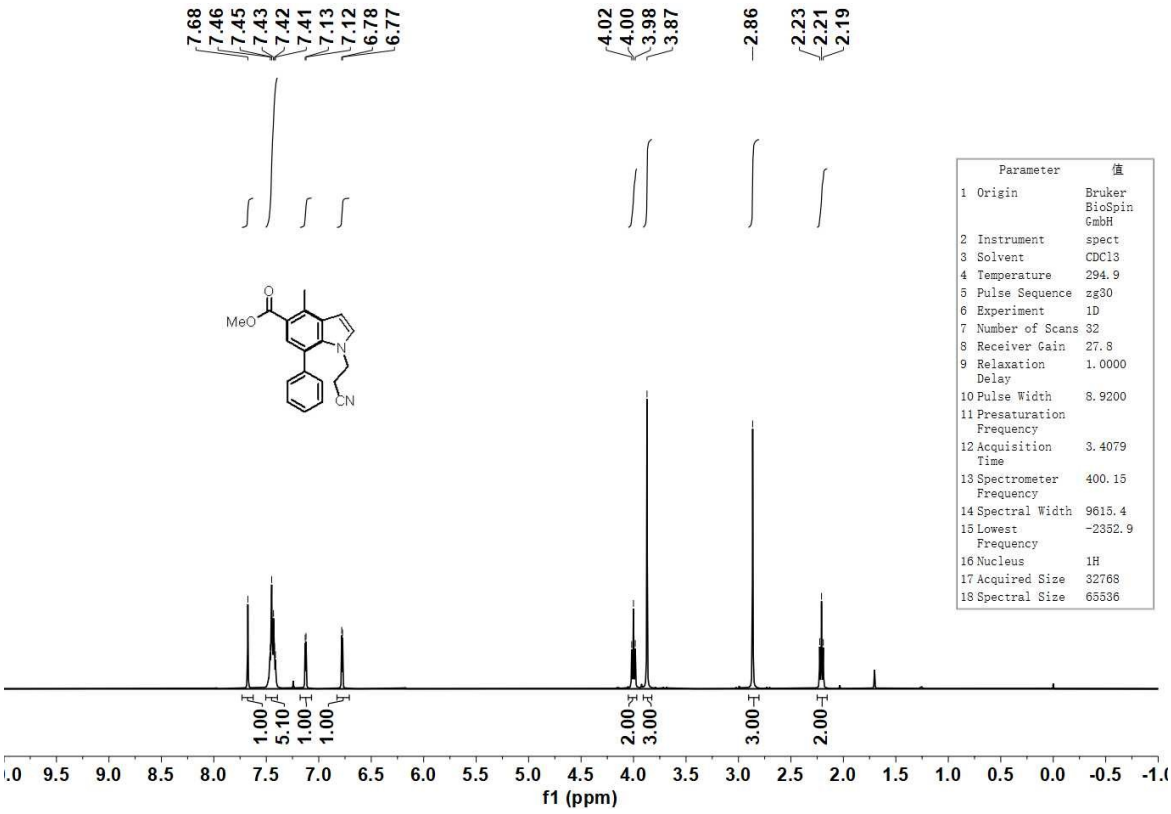
131.24
130.87
129.77
128.32
127.90
127.10
123.76
120.31
102.46
51.63
49.63
42.90
17.08
MeO
O
N
Cl
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**6o**

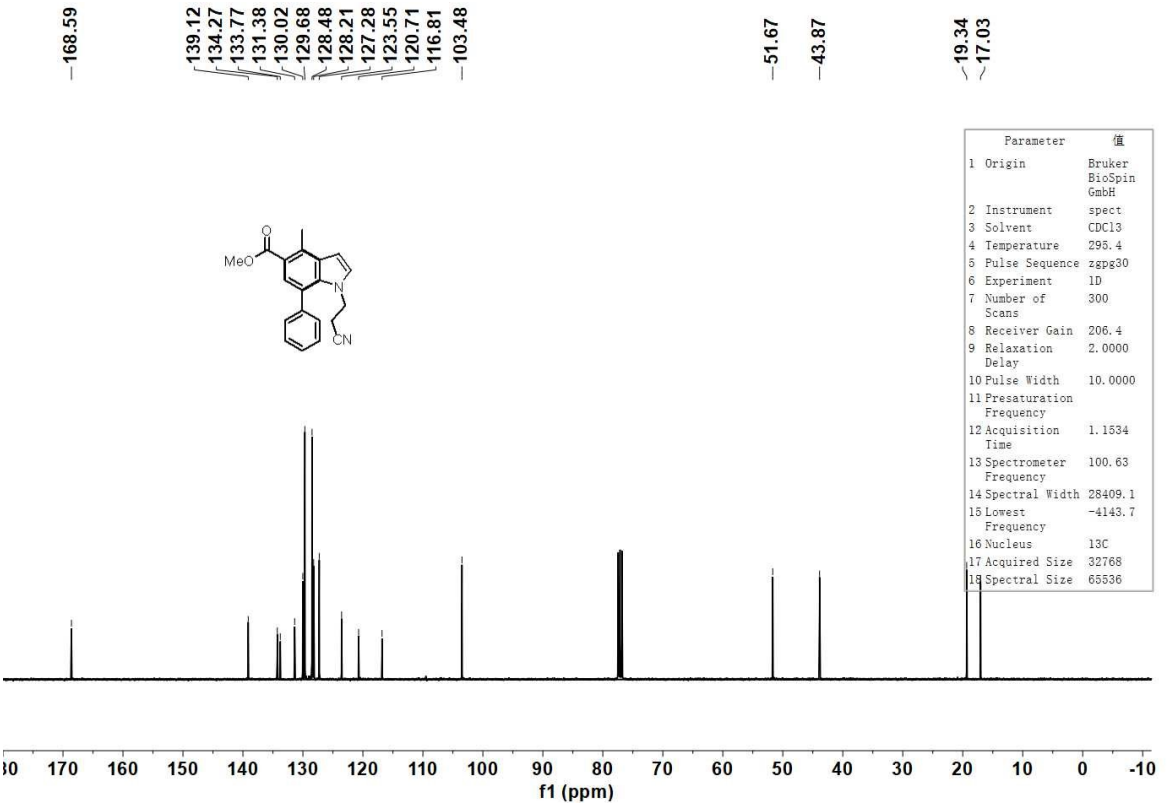

7.64
7.62
7.48
7.47
7.45
7.39
7.37
7.35
7.22
7.22
6.66
6.66
4.76
4.74
4.72
3.92
3.80
3.79
3.77
2.93
MeO
O
N
Cl
3.10
2.10
1.10
1.00
1.00
2.10
3.00
2.10
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.4
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2348.9
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536


169.55
140.23
135.23
133.59
132.34
130.88
128.85
128.52
127.20
125.66
122.31
122.08
101.99
52.06
51.07
43.48
15.95
MeO
O
N
Cl
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.4
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 2050
9 Relaxation Delay 2.0000
10 Pulse Width 15.0000
11 Presaturation Frequency
12 Acquisition Time 0.9088
13 Spectrometer Frequency 150.95
14 Spectral Width 36057.7
15 Lowest Frequency -2936.3
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

**5p**

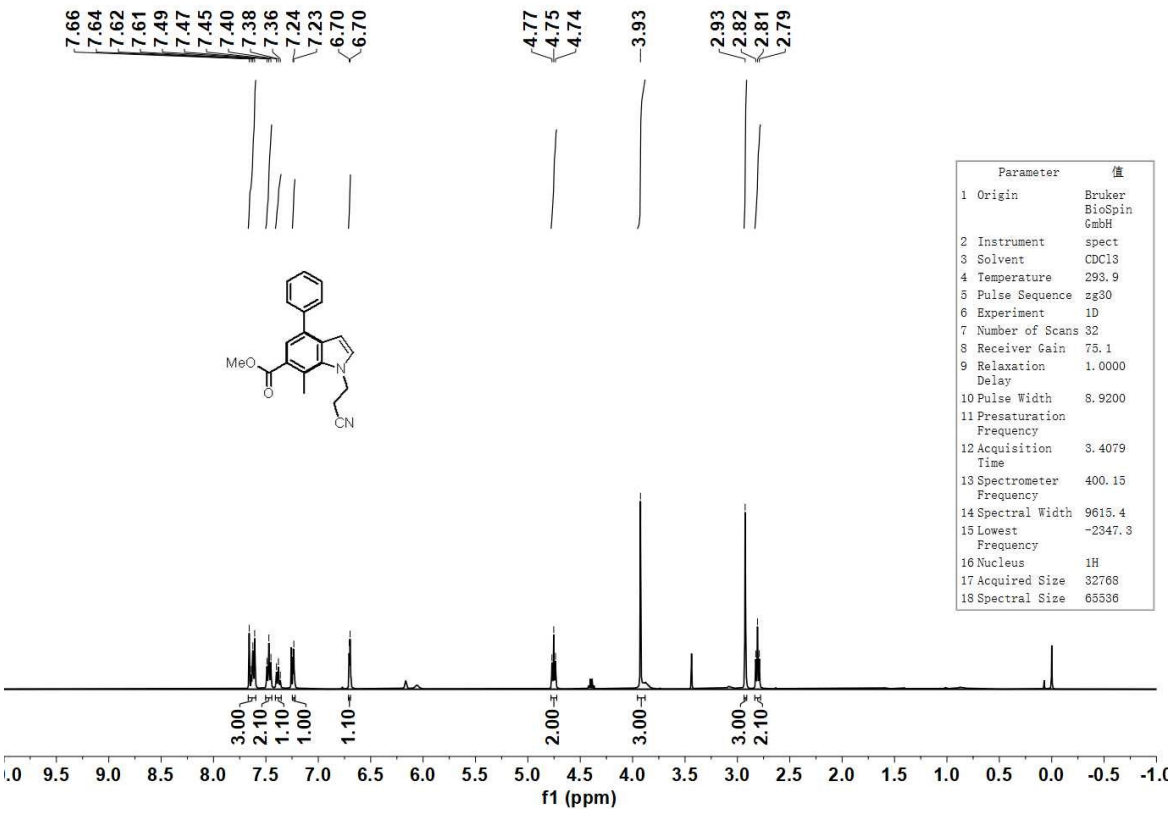


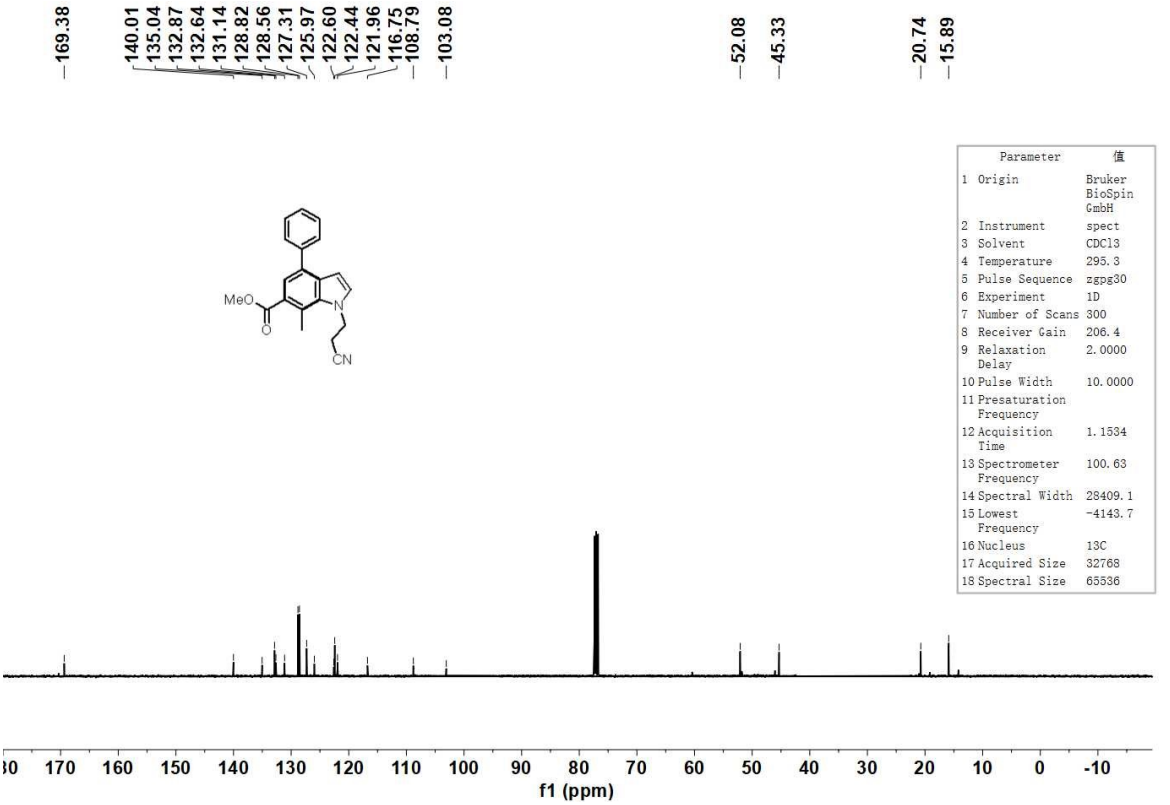

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.9 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 32 |
| 8 Receiver Gain | 27.8 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2352.9 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |



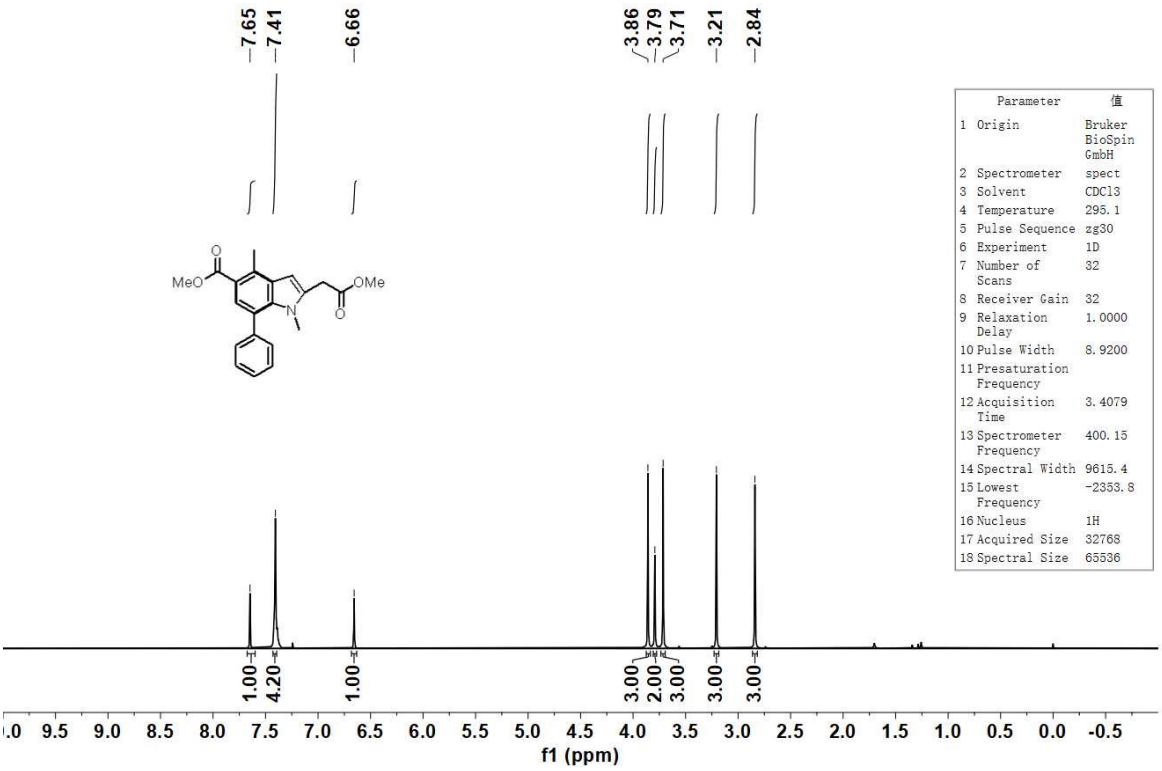

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 295.4 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 300 |
| 8 Receiver Gain | 206.4 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

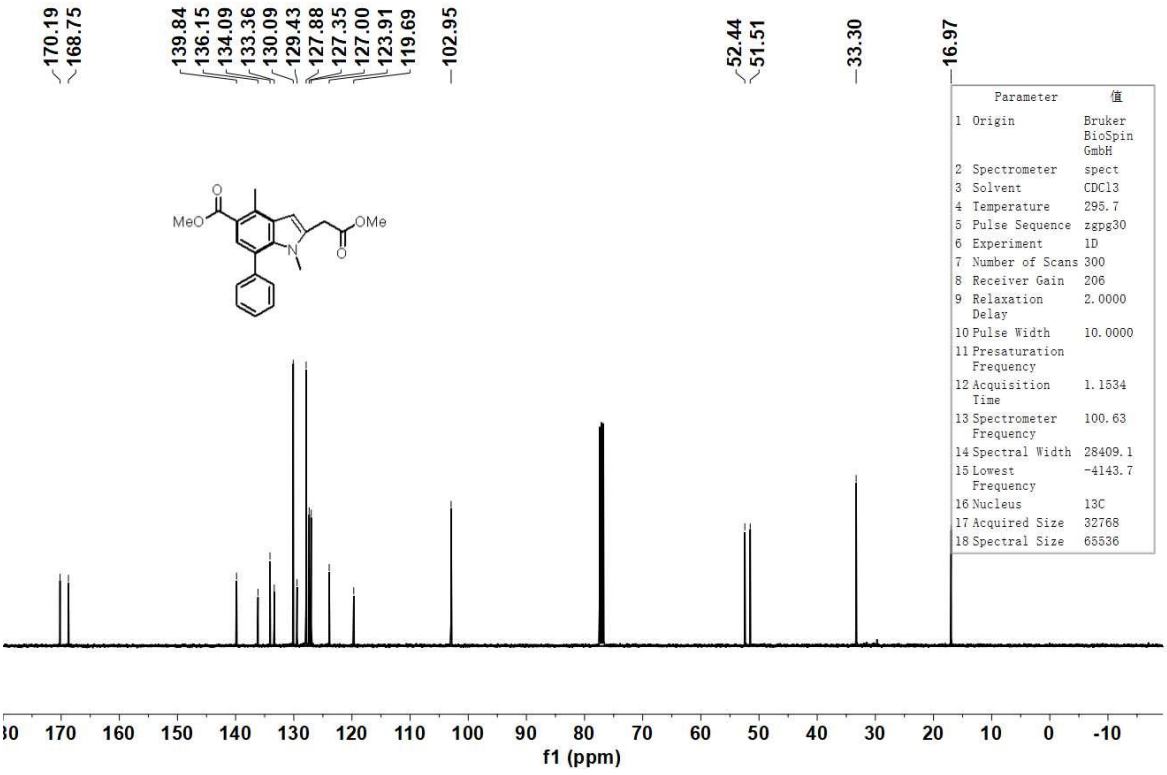
**6p**


7.66
7.64
7.62
7.61
7.49
7.47
7.45
7.40
7.38
7.36
7.24
7.23
6.70
6.70
4.77
4.75
4.74
3.93
2.93
2.82
2.81
2.79
MeO
O
N
CN
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 293.9
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2347.3
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
3.00
2.10
1.10
1.00
1.10
2.00
3.00
3.00
2.10
f1 (ppm)

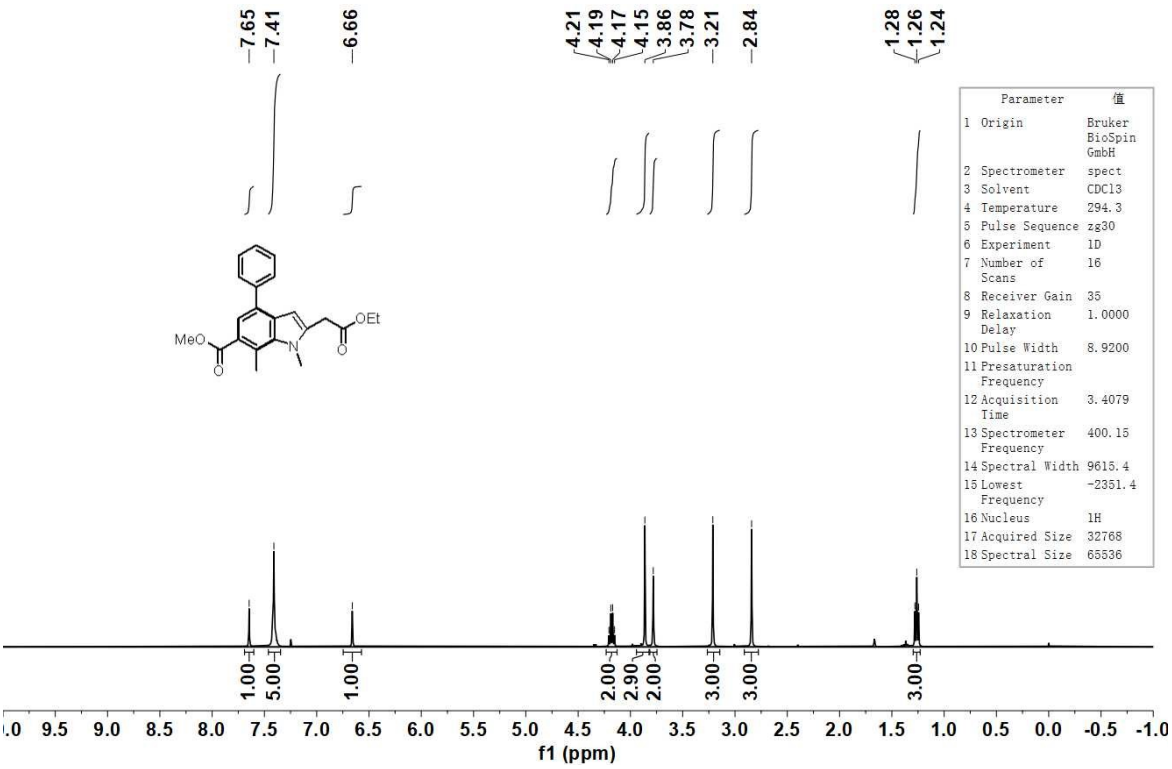

169.38
140.01
135.04
132.87
132.64
131.14
128.82
128.56
127.31
125.97
122.60
122.44
121.96
116.75
108.79
103.08
52.08
45.33
20.74
15.89
MeO
O
N
CN
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 295.3
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5q**

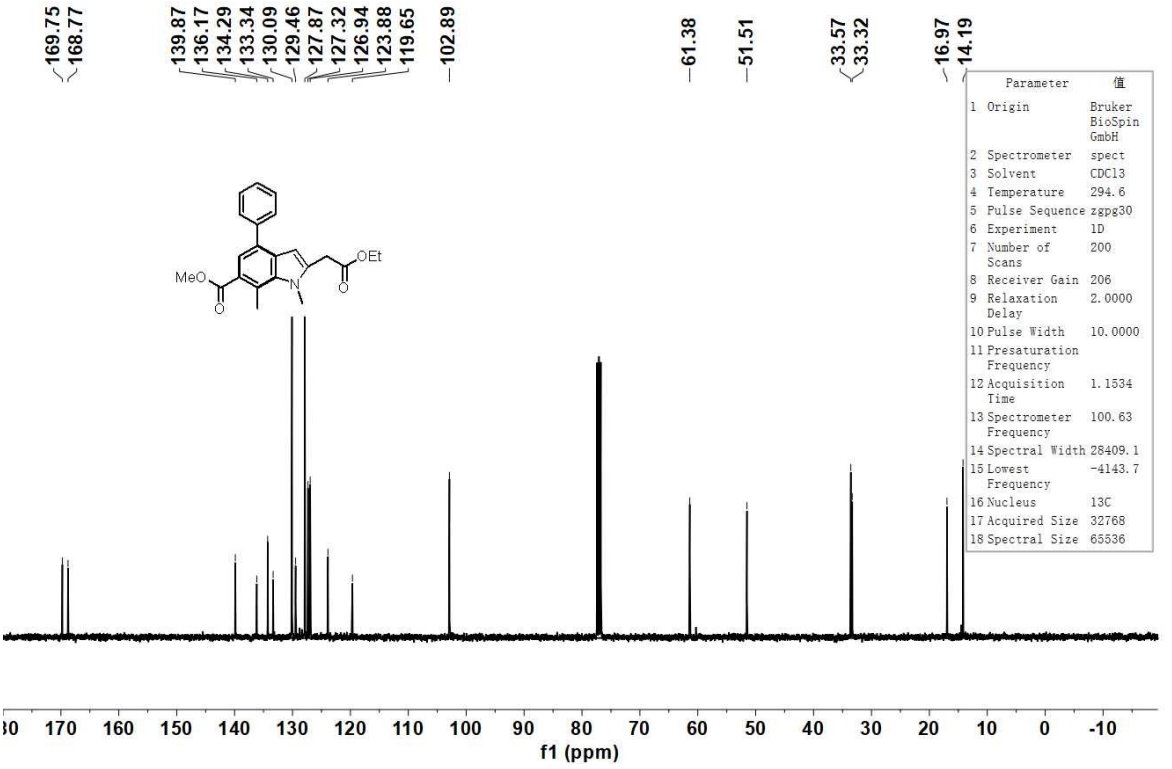

7.65
7.41
6.66
3.86
3.79
3.71
3.21
2.84
MeO
OMe
O
O
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.1
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 32
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2353.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
4.20
1.00
3.00
2.00
3.00
3.00
3.00
f1 (ppm)


170.19
168.75
139.84
136.15
134.09
133.36
130.09
129.43
127.88
127.35
127.00
123.91
119.69
102.95
52.44
51.51
33.30
16.97
MeO
OMe
O
O
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.7
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5r**

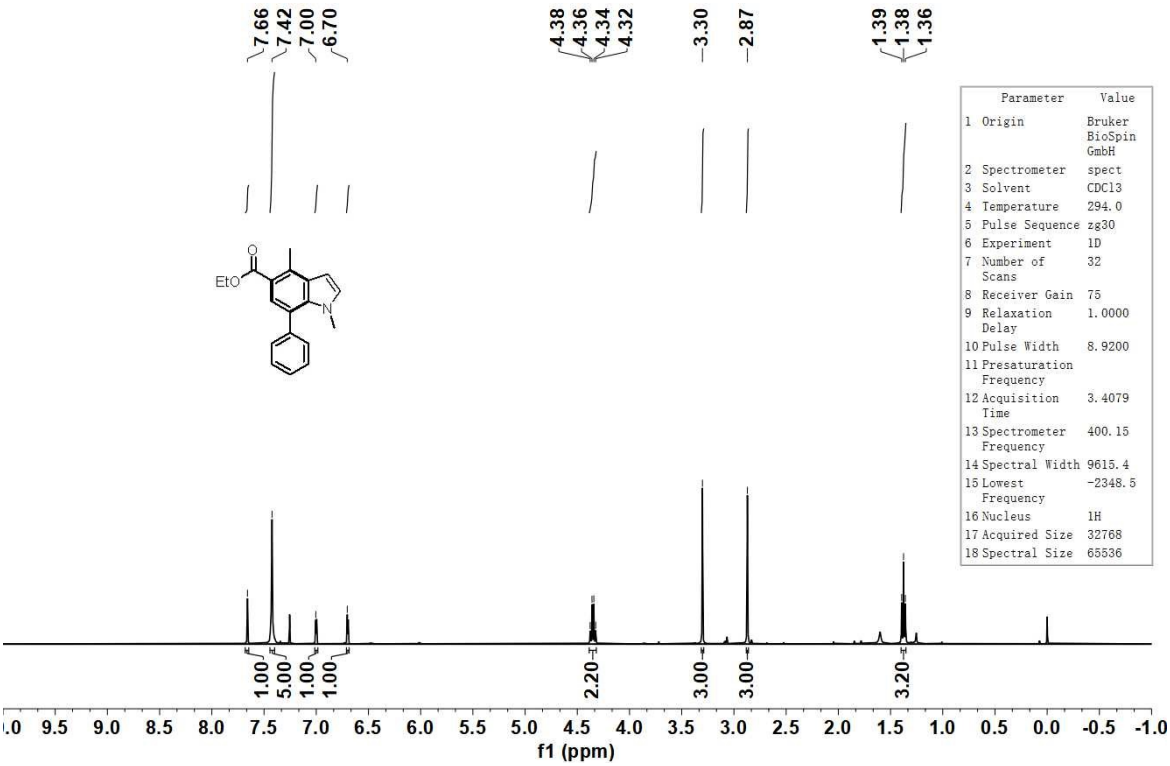



| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.3 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 16 |
| 8 Receiver Gain | 35 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2351.4 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |




| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.6 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 200 |
| 8 Receiver Gain | 206 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

**5s**


7.66
7.42
7.00
6.70
4.38
4.36
4.34
4.32
3.30
2.87
1.39
1.38
1.36
EtO
O
N
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2348.5
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
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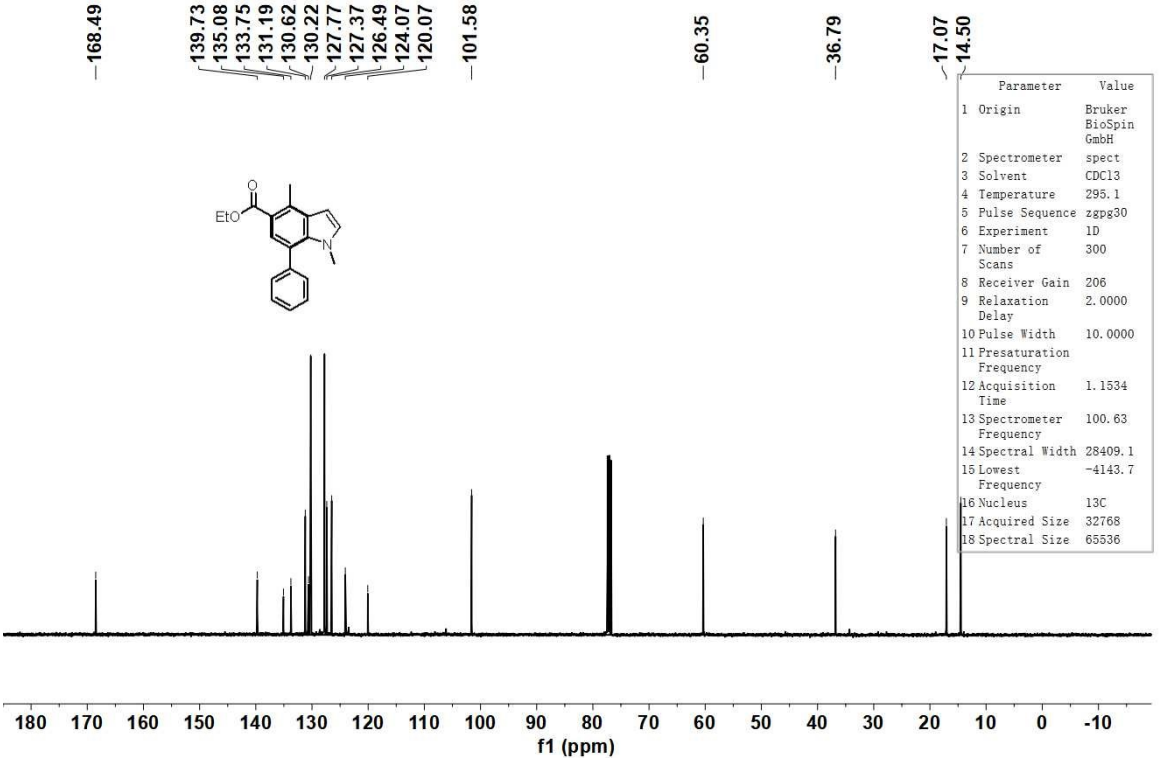
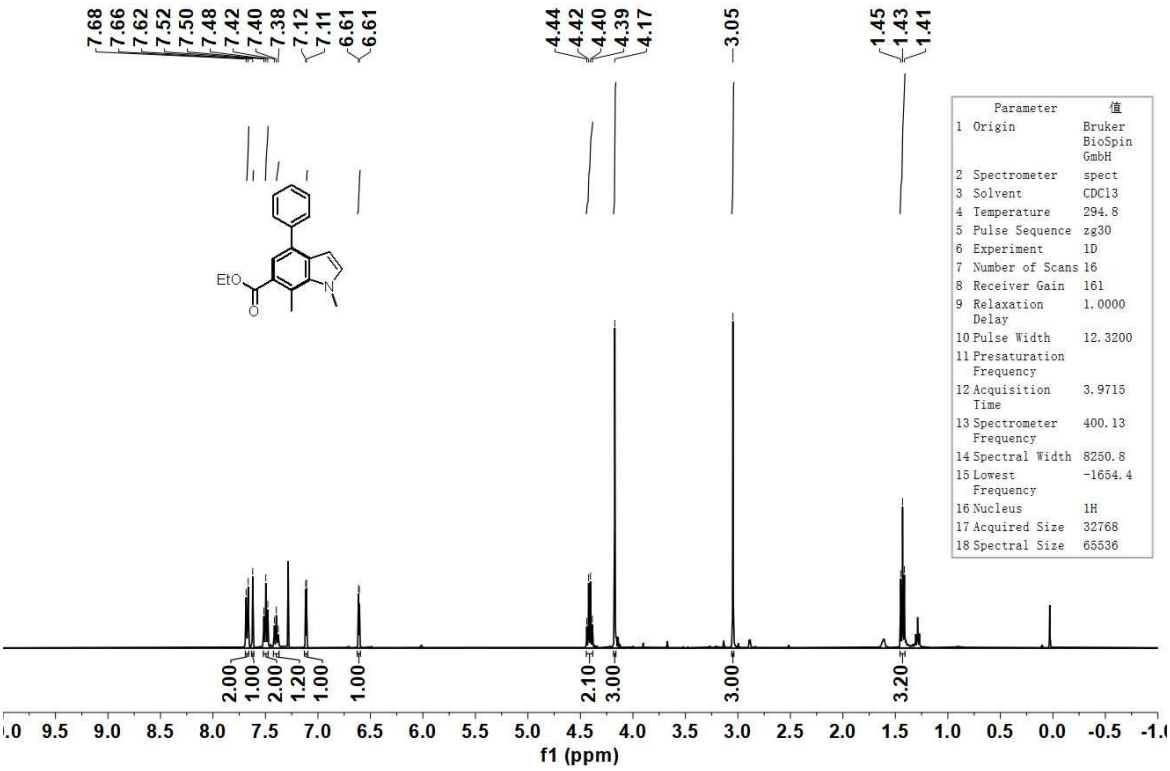
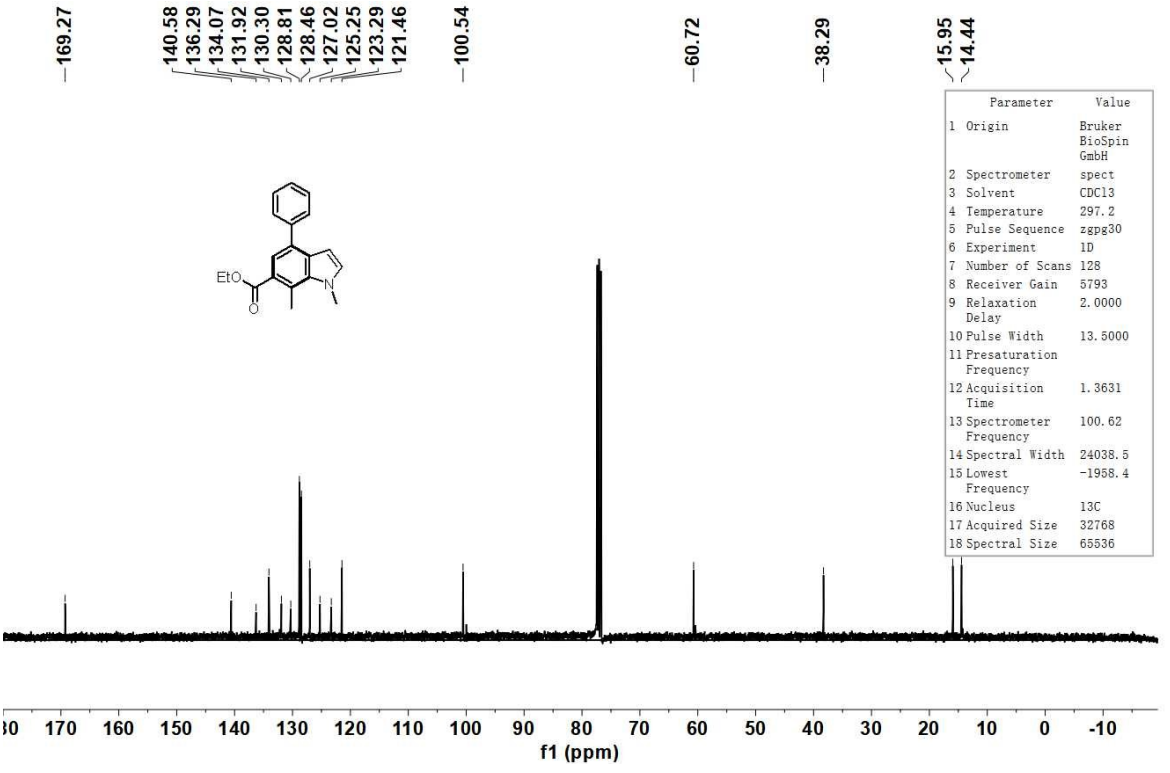
5.00
1.00
1.00
2.20
3.00
3.00
3.20
f1 (ppm)


168.49
139.73
135.08
133.75
131.19
130.62
130.22
127.77
127.37
126.49
124.07
120.07
101.58
60.35
36.79
17.07
14.50
EtO
O
N
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.1
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**6s**


7.68
7.66
7.62
7.52
7.50
7.48
7.42
7.40
7.38
7.12
7.11
6.61
6.61
4.44
4.42
4.40
4.39
4.17
3.05
1.45
1.43
1.41
EtO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.8
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 161
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
2.00
1.00
2.00
1.20
1.00
1.00
2.10
3.00
3.00
3.20
f1 (ppm)


169.27
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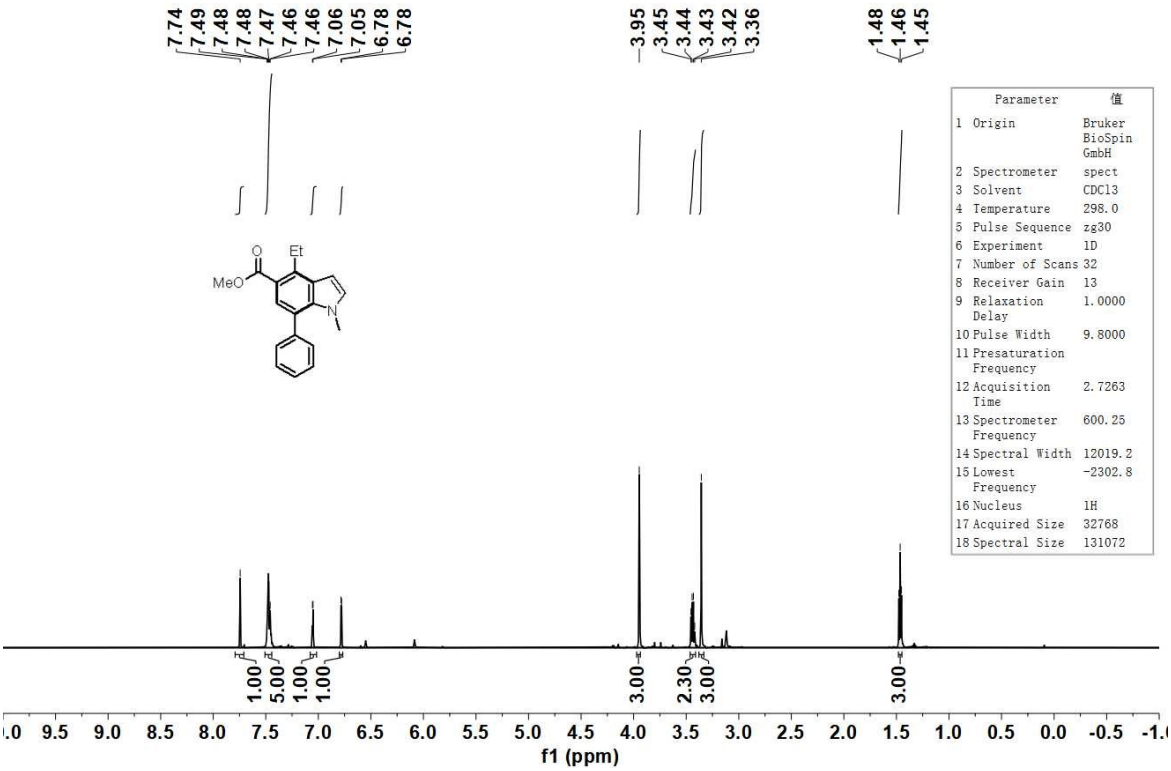
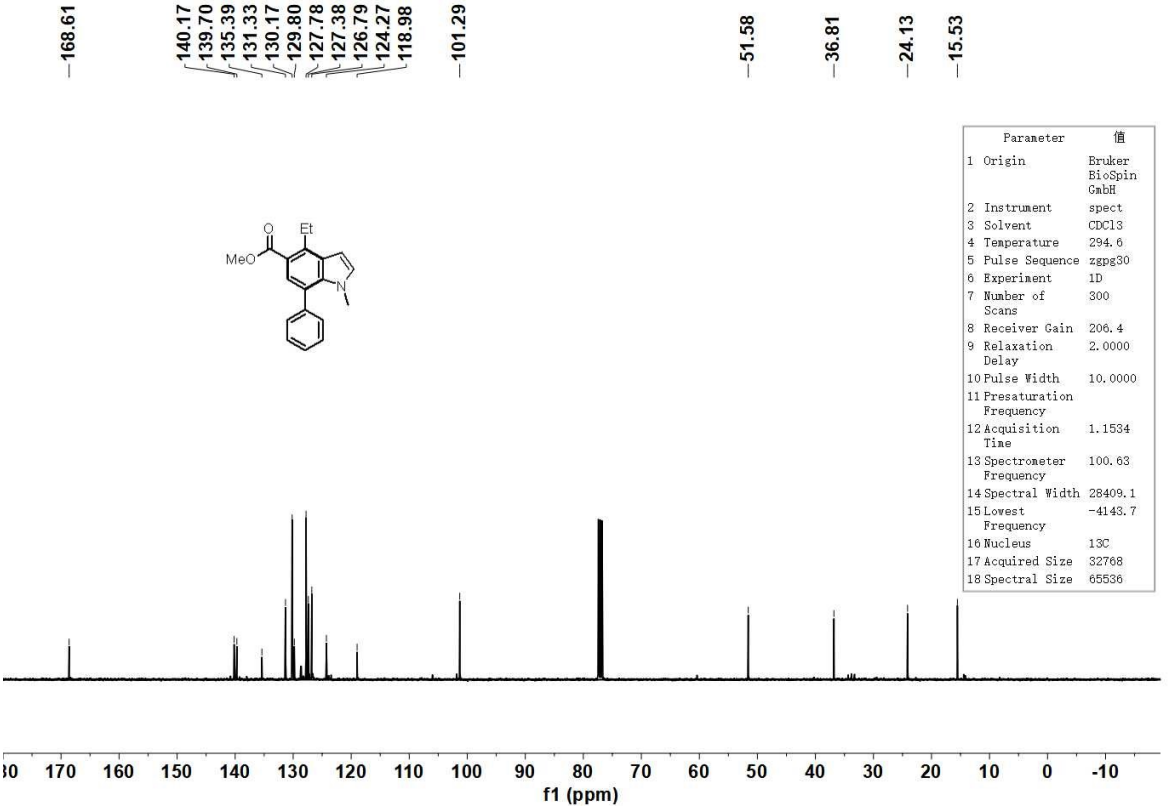
136.29
134.07
131.92
130.30
128.81
128.46
127.02
125.25
123.29
121.46
100.54
60.72
38.29
15.95
14.44
EtO
O
N
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 297.2
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 5793
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5t**


7.74
7.49
7.48
7.48
7.47
7.46
7.46
7.06
7.05
6.78
6.78
3.95
3.45
3.44
3.43
3.42
3.36
1.48
1.46
1.45
Et
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 298.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 13
9 Relaxation Delay 1.0000
10 Pulse Width 9.8000
11 Presaturation Frequency
12 Acquisition Time 2.7263
13 Spectrometer Frequency 600.25
14 Spectral Width 12019.2
15 Lowest Frequency -2302.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 131072
1.00
5.00
1.00
1.00
3.00
2.30
3.00
3.00
f1 (ppm)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140.17
139.70
135.39
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130.17
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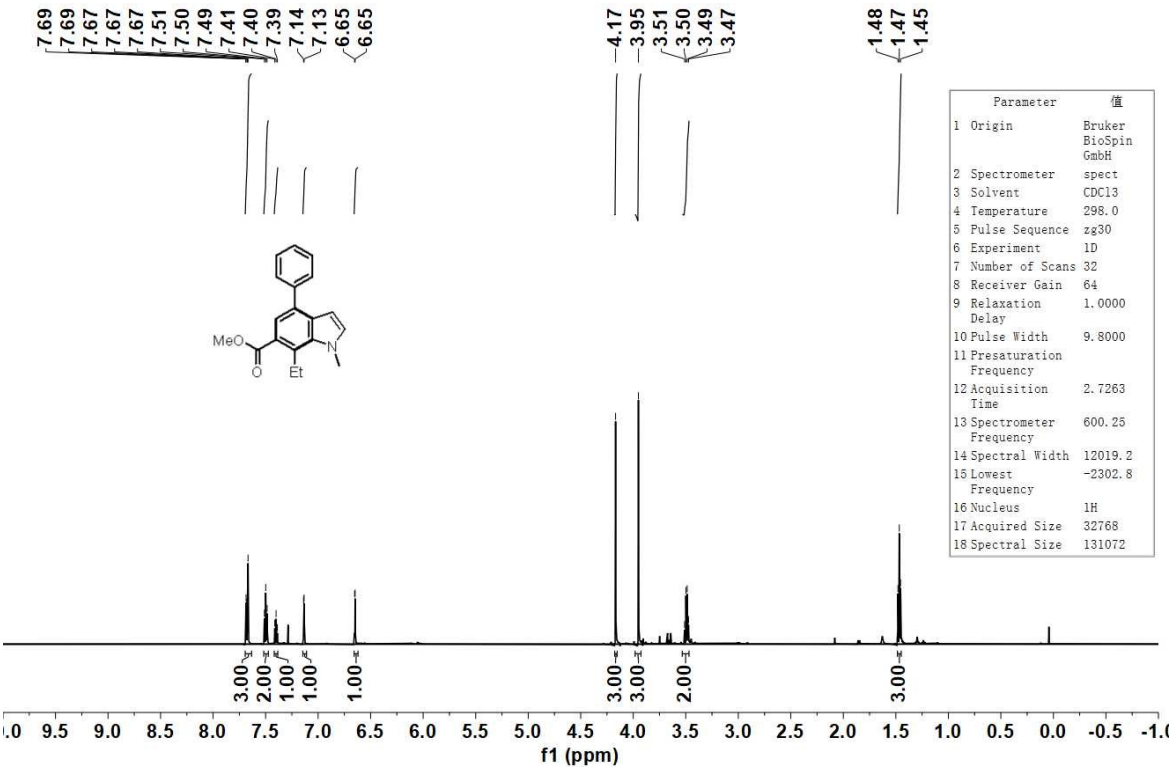
127.78
127.38
126.79
124.27
118.98
101.29
51.58
36.81
24.13
15.53
Et
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**6t**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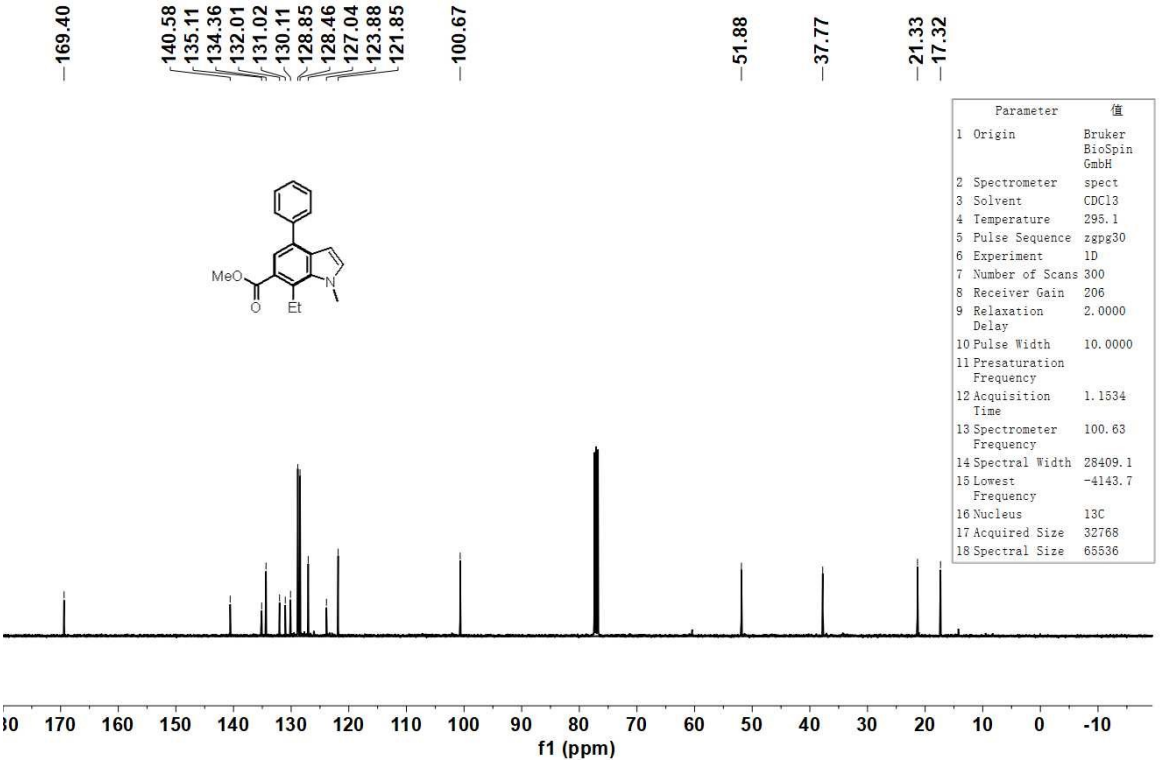
7.69
7.67
7.67
7.67
7.51
7.50
7.49
7.41
7.40
7.39
7.14
7.13
6.65
6.65
4.17
3.95
3.51
3.50
3.49
3.47
1.48
1.47
1.45
MeO
O
Et
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 298.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 64
9 Relaxation Delay 1.0000
10 Pulse Width 9.8000
11 Presaturation Frequency
12 Acquisition Time 2.7263
13 Spectrometer Frequency 600.25
14 Spectral Width 12019.2
15 Lowest Frequency -2302.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 131072
3.00
2.00
1.00
1.00
1.00
3.00
3.00
2.00
3.00
f1 (ppm)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140.58
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134.36
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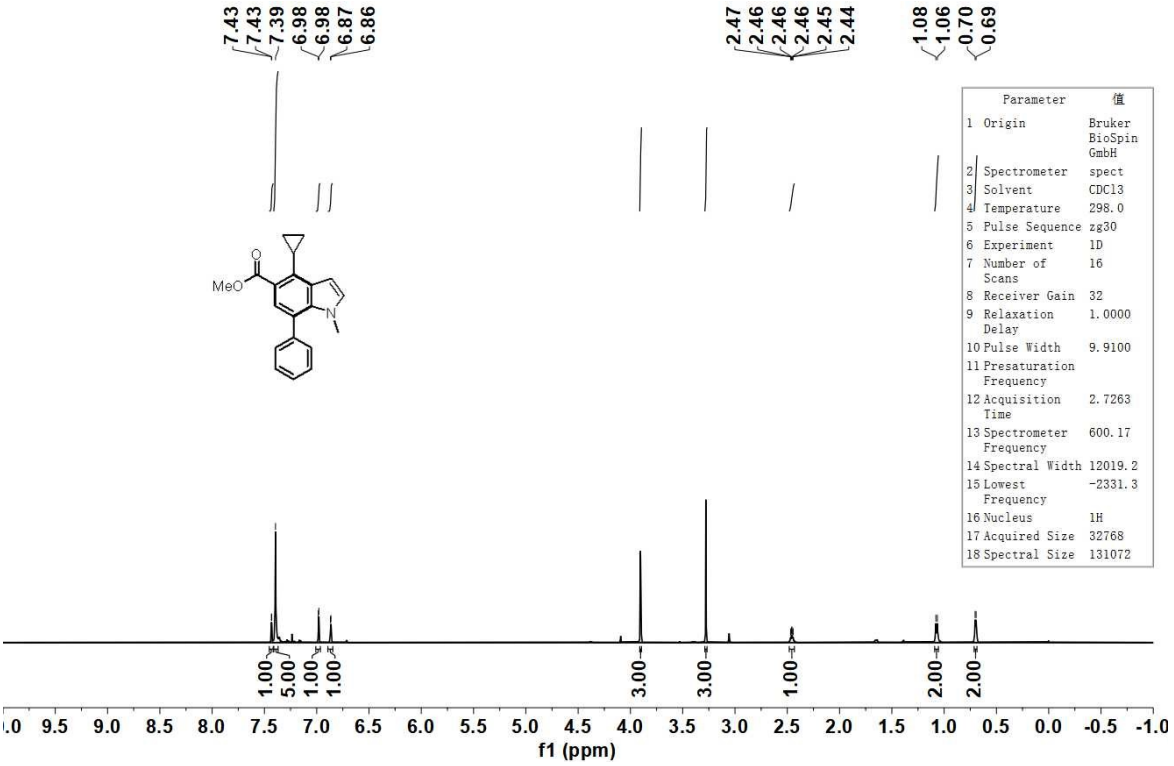
131.02
130.11
128.85
128.46
127.04
123.88
121.85
100.67
51.88
37.77
21.33
17.32
MeO
O
Et
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.1
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5u**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7.43
7.39
6.98
6.98
6.87
6.86
2.47
2.46
2.46
2.46
2.45
2.44
1.08
1.06
0.70
0.69
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 298.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 32
9 Relaxation Delay 1.0000
10 Pulse Width 9.9100
11 Presaturation Frequency
12 Acquisition Time 2.7263
13 Spectrometer Frequency 600.17
14 Spectral Width 12019.2
15 Lowest Frequency -2331.3
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 131072
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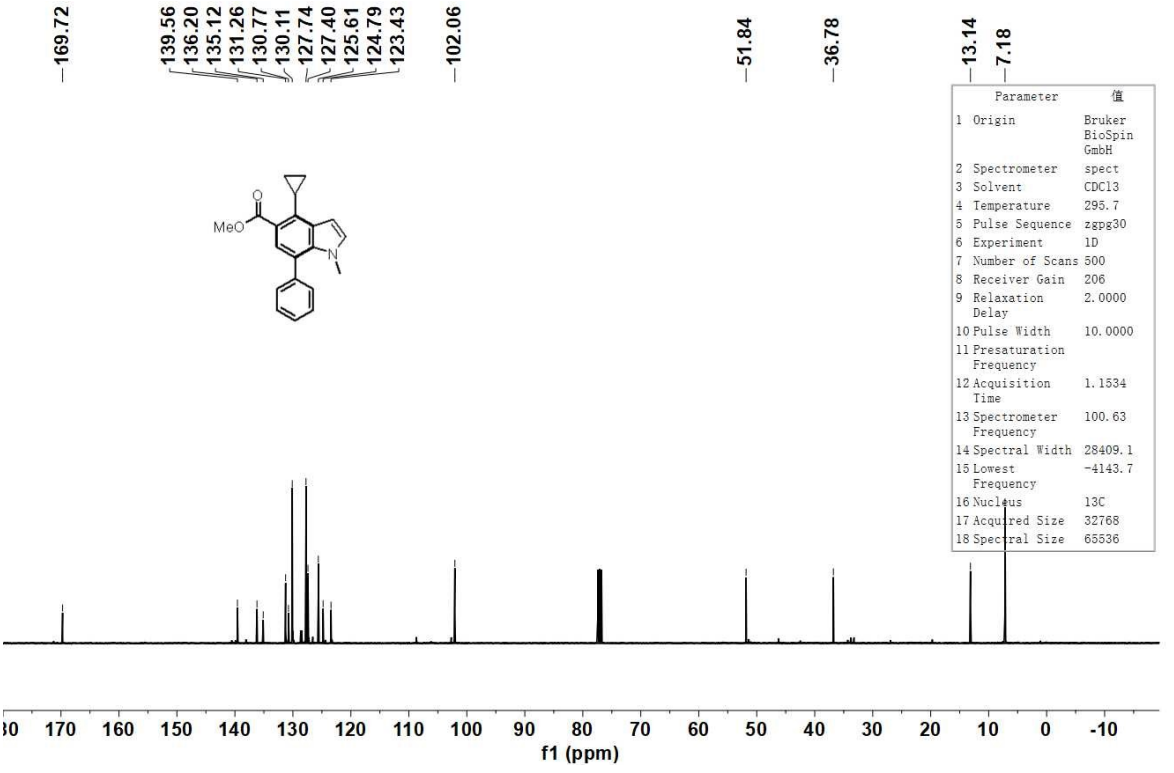
5.00
1.00
1.00
3.00
3.00
1.00
2.00
2.00
f1 (ppm)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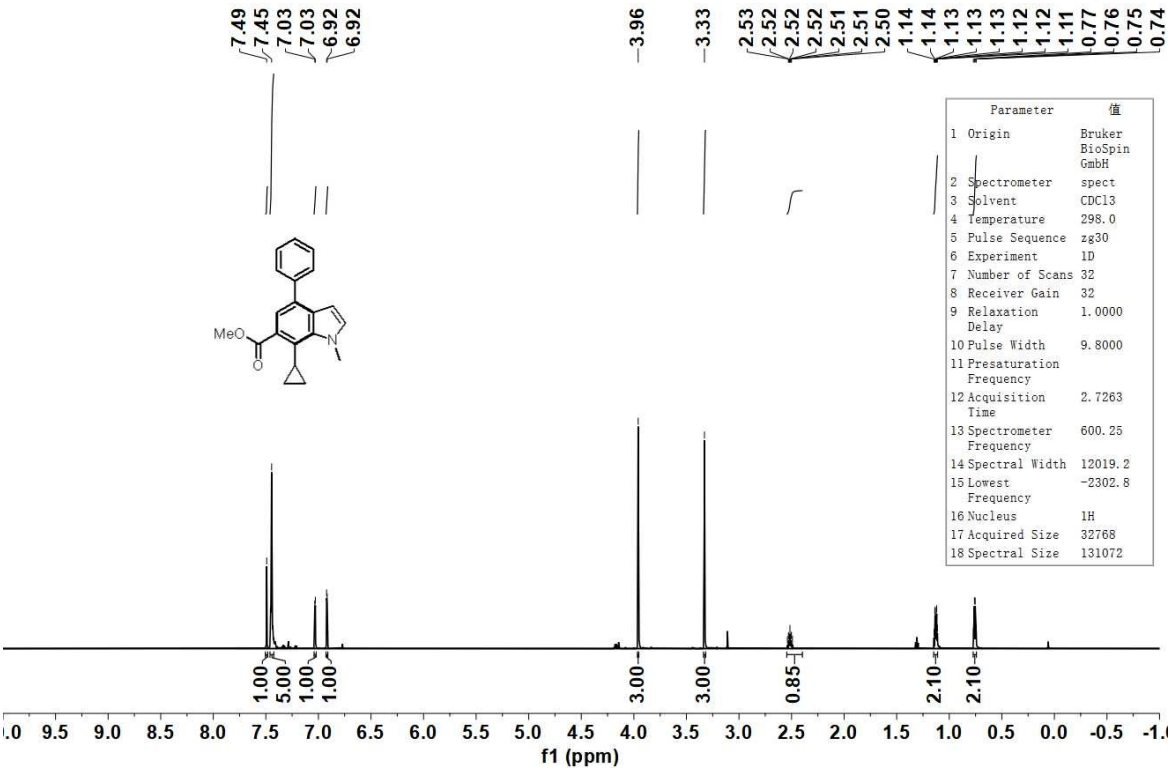
139.56
136.20
135.12
131.26
130.77
130.11
127.74
127.40
125.61
124.79
123.43
102.06
51.84
36.78
13.14
7.18
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.7
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 500
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**6u**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7.45
7.03
7.03
6.92
6.92
3.96
3.33
2.53
2.52
2.52
2.52
2.51
2.51
2.50
1.14
1.14
1.13
1.13
1.12
1.12
1.11
0.77
0.76
0.75
0.74
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 298.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 32
9 Relaxation Delay 1.0000
10 Pulse Width 9.8000
11 Presaturation Frequency
12 Acquisition Time 2.7263
13 Spectrometer Frequency 600.25
14 Spectral Width 12019.2
15 Lowest Frequency -2302.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 131072
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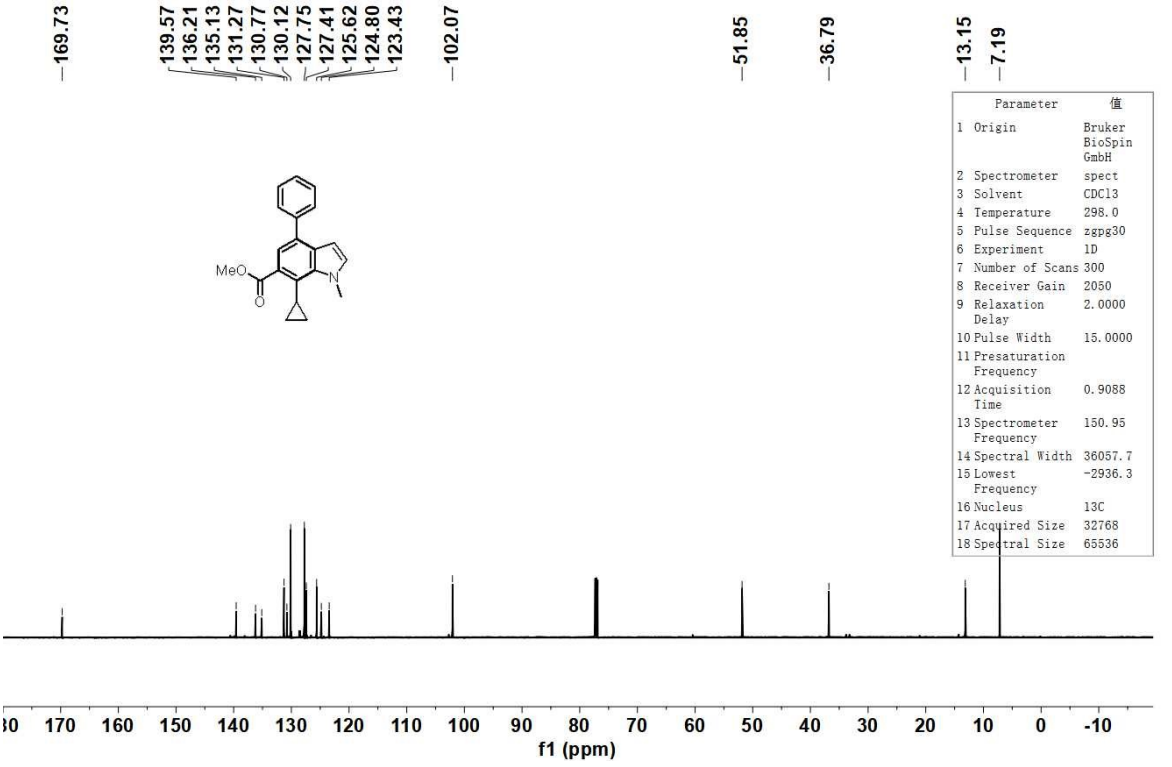
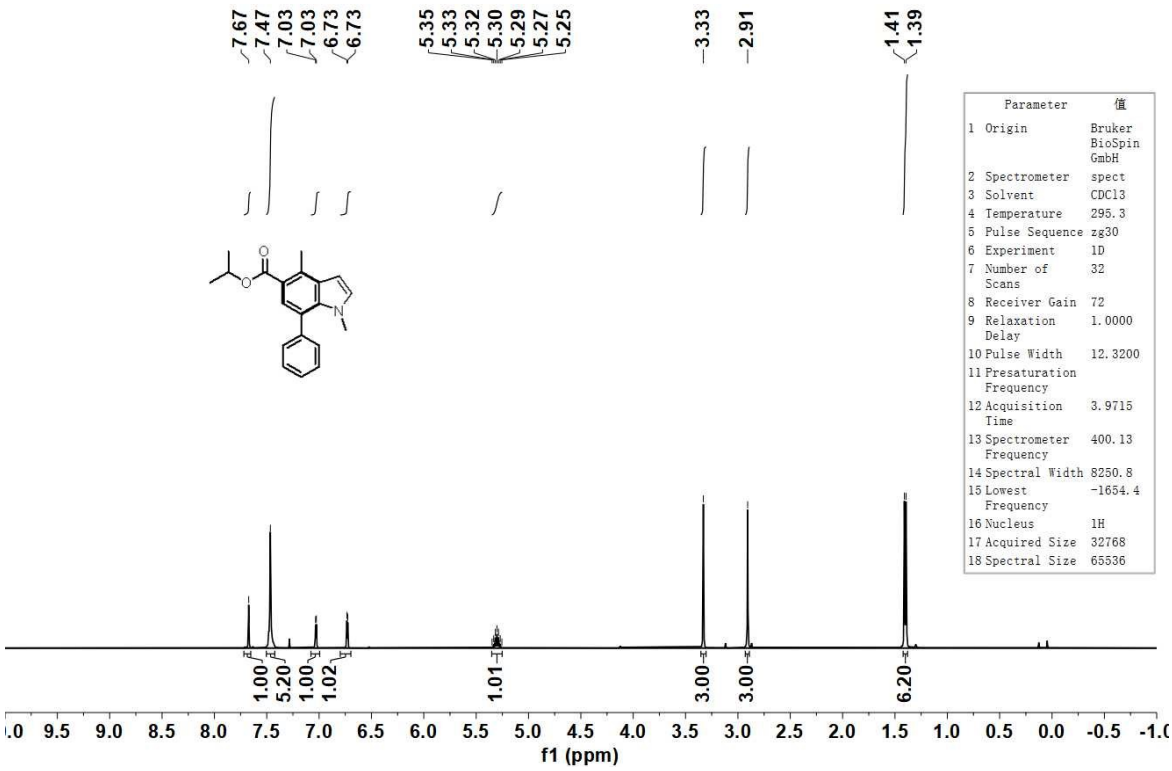
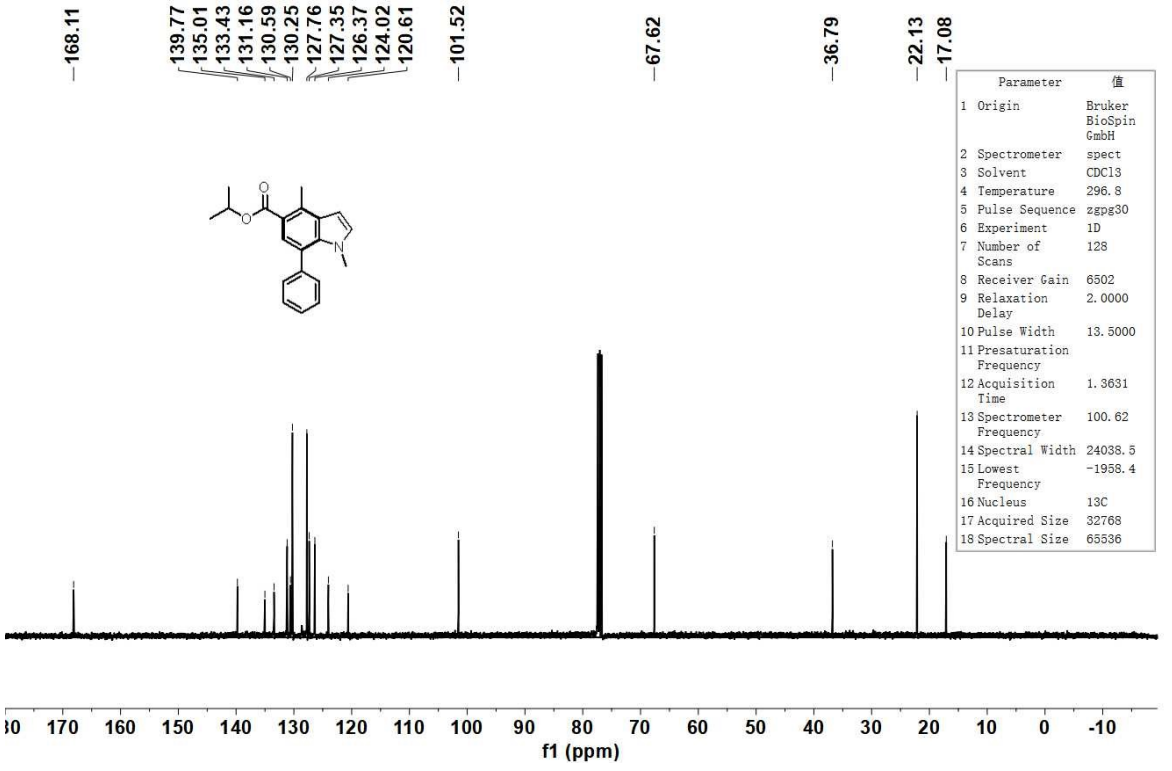
5.00
1.00
1.00
3.00
3.00
0.85
2.10
2.10
f1 (ppm)

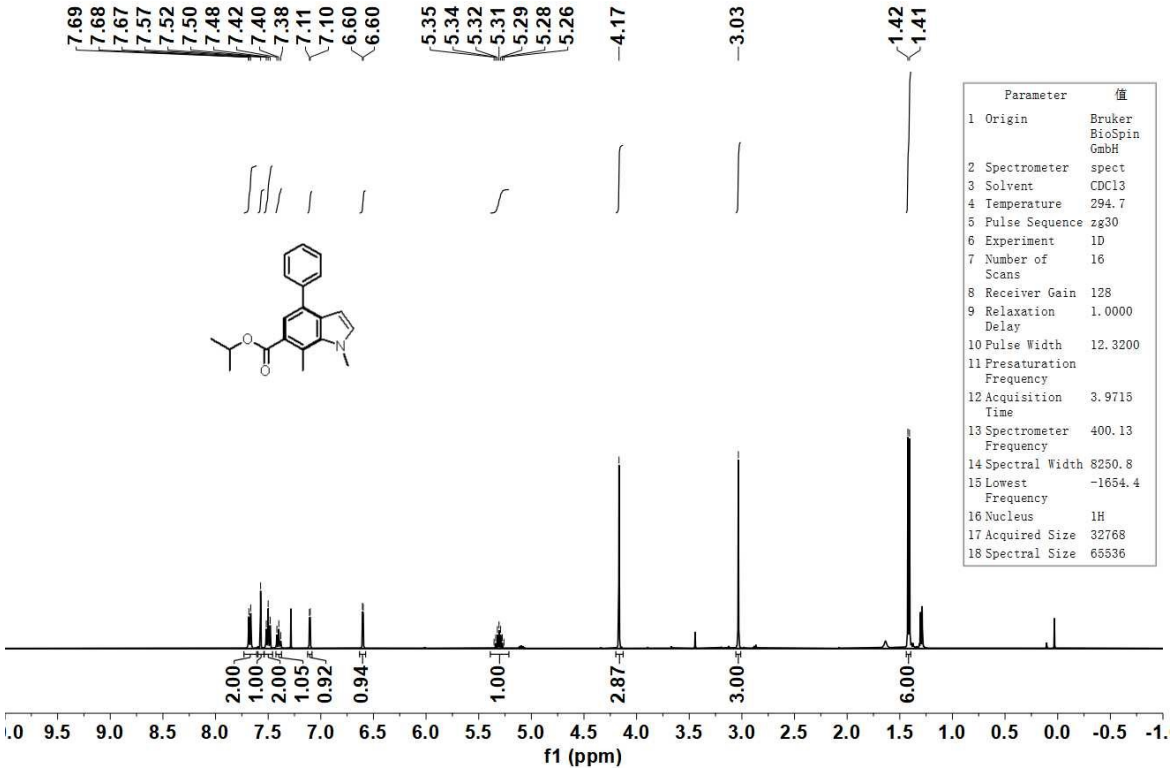

169.73
139.57
136.21
135.13
131.27
130.77
130.12
127.75
127.41
125.62
124.80
123.43
102.07
51.85
36.79
13.15
7.19
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 298.0
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 2050
9 Relaxation Delay 2.0000
10 Pulse Width 15.0000
11 Presaturation Frequency
12 Acquisition Time 0.9088
13 Spectrometer Frequency 150.95
14 Spectral Width 36057.7
15 Lowest Frequency -2936.3
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5v**


7.67
7.47
7.03
7.03
6.73
6.73
5.35
5.33
5.32
5.30
5.29
5.27
5.25
3.33
2.91
1.41
1.39
1.00
5.20
1.00
1.02
1.01
3.00
3.00
6.20
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.3
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 72
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536


168.11
139.77
135.01
133.43
131.16
130.59
130.25
127.76
127.35
126.37
124.02
120.61
101.52
67.62
36.79
22.13
17.08
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.8
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 6502
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

**6v**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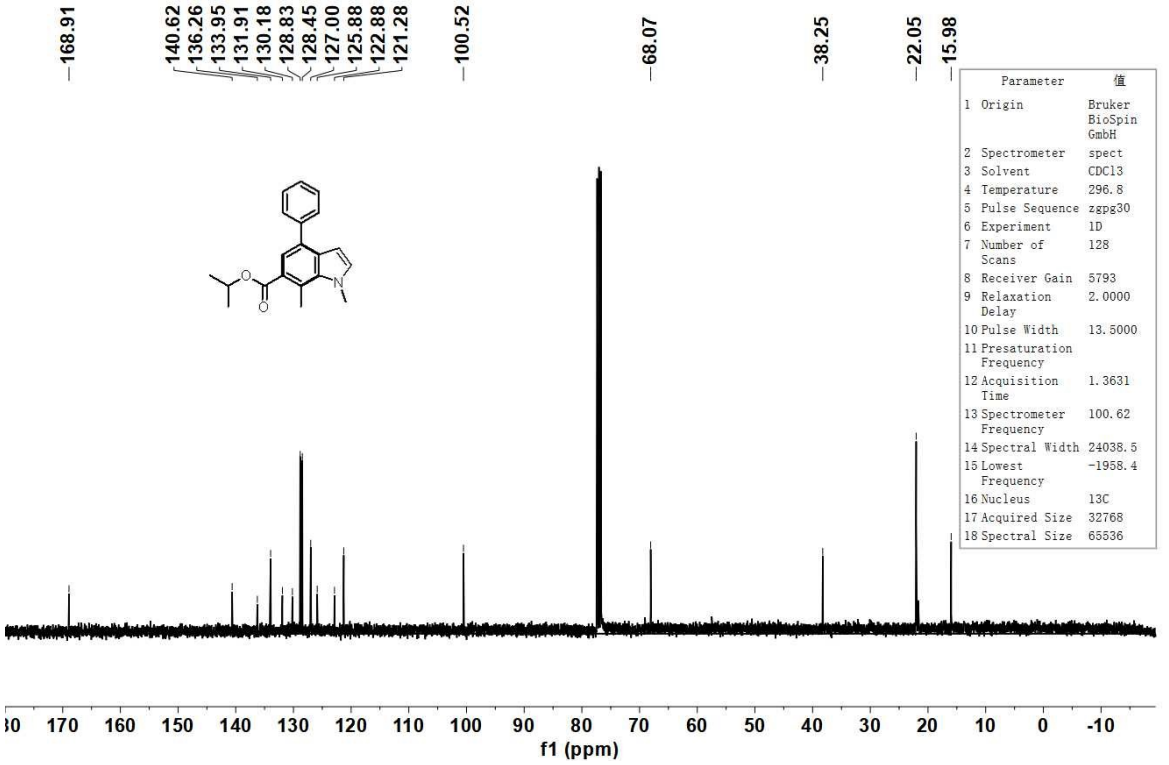
7.50
7.48
7.42
7.40
7.38
7.11
7.10
6.60
6.60
5.35
5.34
5.32
5.31
5.29
5.28
5.26
4.17
3.03
1.42
1.41
2.00
1.00
2.00
1.05
0.92
0.94
1.00
2.87
3.00
6.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.7
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 128
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536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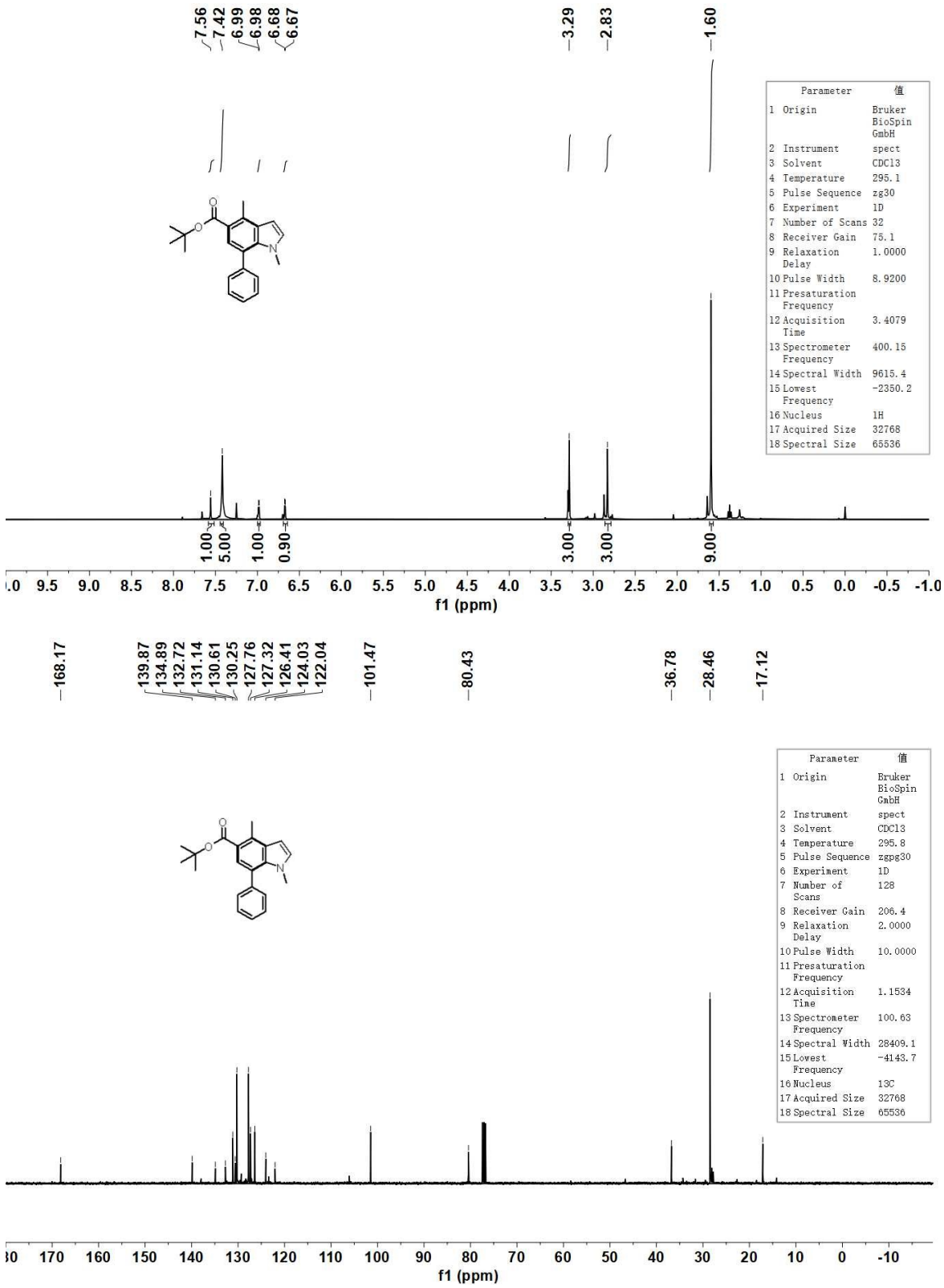
136.26
133.95
131.91
130.18
128.83
128.45
127.00
125.88
122.88
121.28
100.52
68.07
38.25
22.05
15.98
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.8
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 5793
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

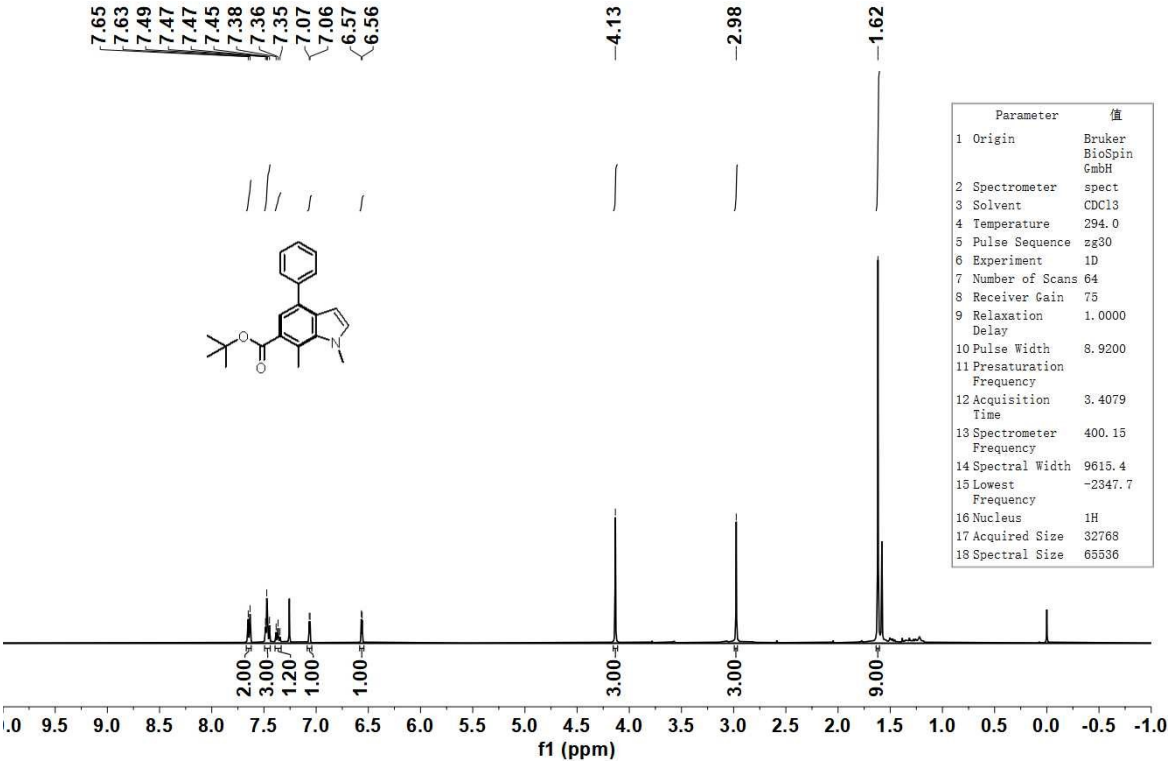
**5w**



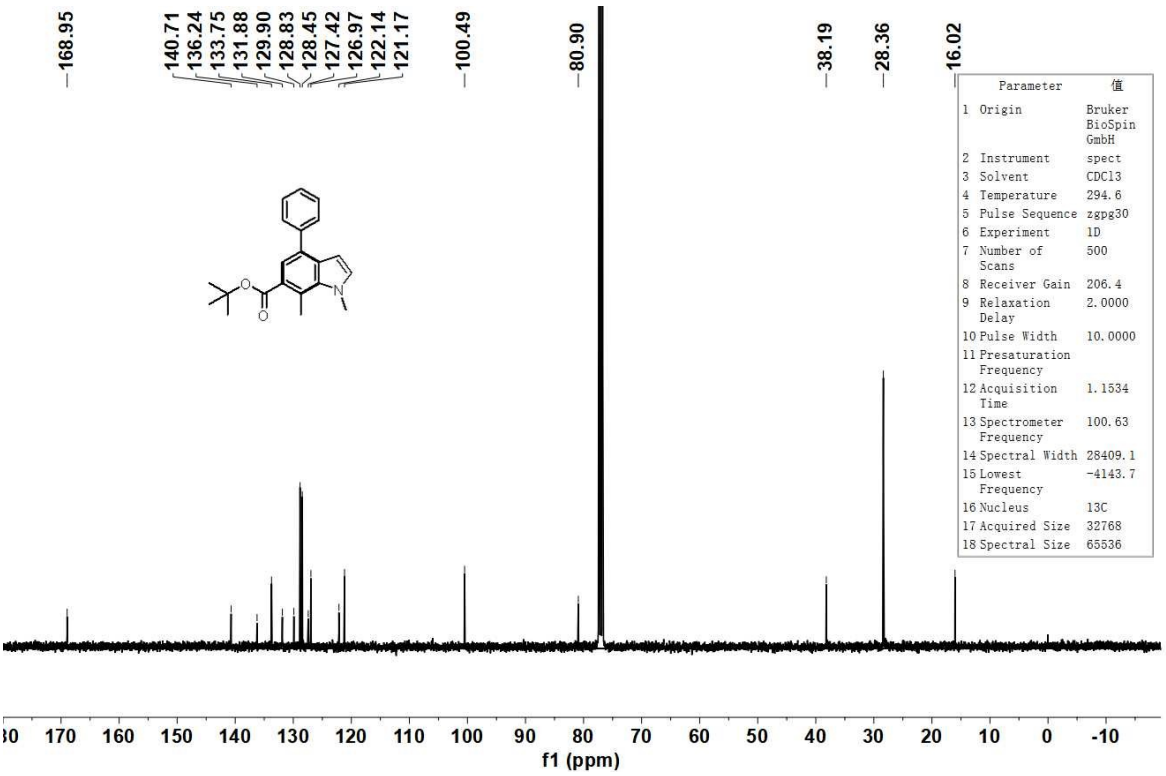

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 295.1 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 32 |
| 8 Receiver Gain | 75.1 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2350.2 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 295.8 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 128 |
| 8 Receiver Gain | 206.4 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

**6w**

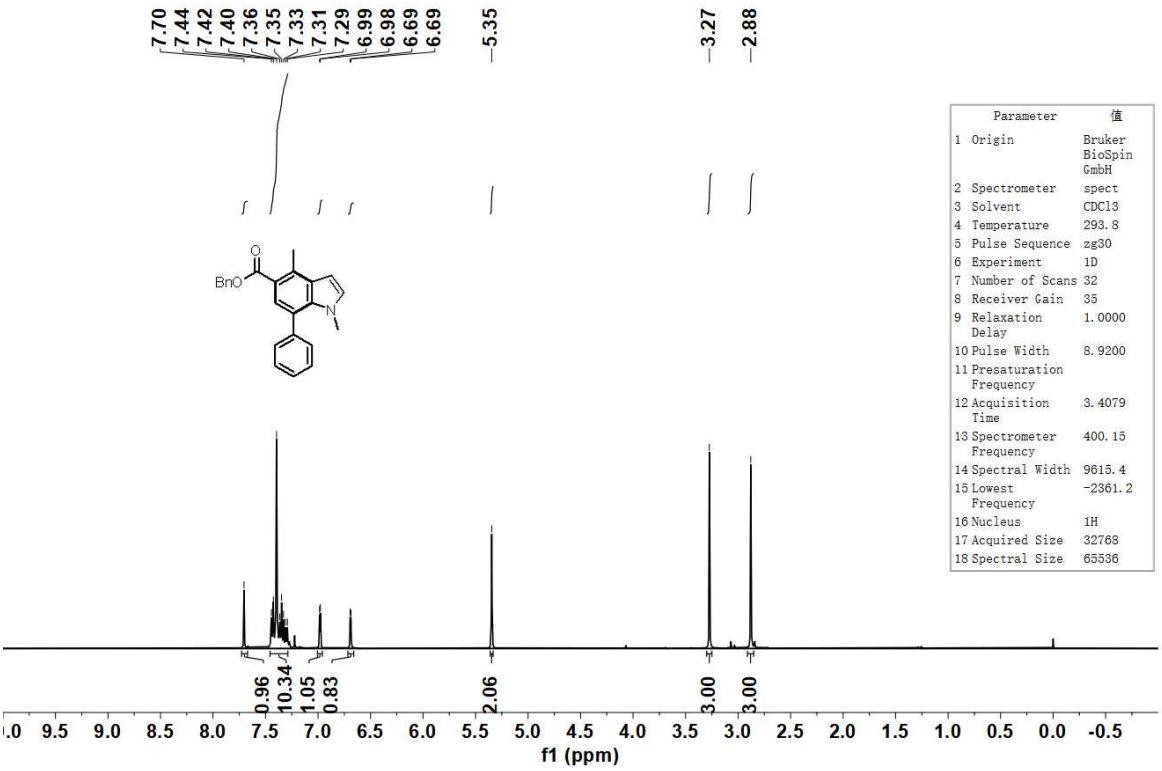


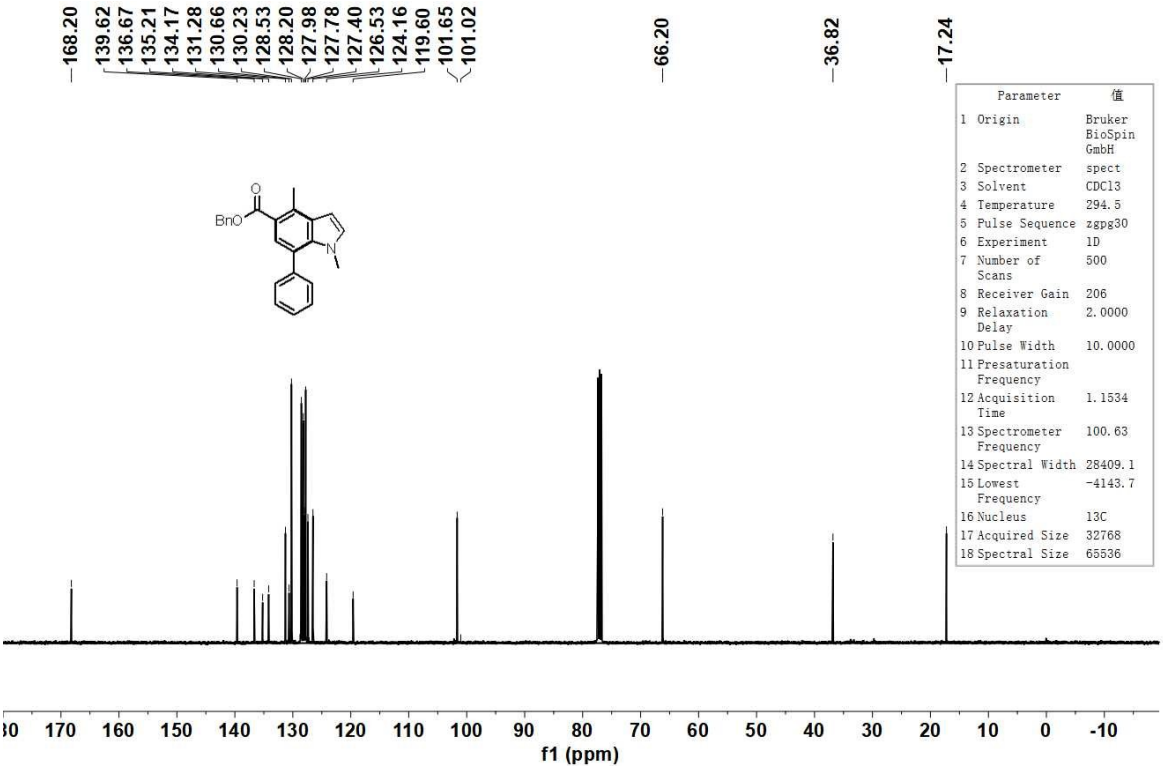

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.0 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 64 |
| 8 Receiver Gain | 75 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2347.7 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |




| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.6 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 500 |
| 8 Receiver Gain | 206.4 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

**5x**


7.70
7.44
7.42
7.40
7.36
7.35
7.33
7.31
7.29
6.99
6.98
6.69
6.69
5.35
3.27
2.88
BnO
O
N
0.96
10.34
1.05
0.83
2.06
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 293.8
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 35
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2361.2
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536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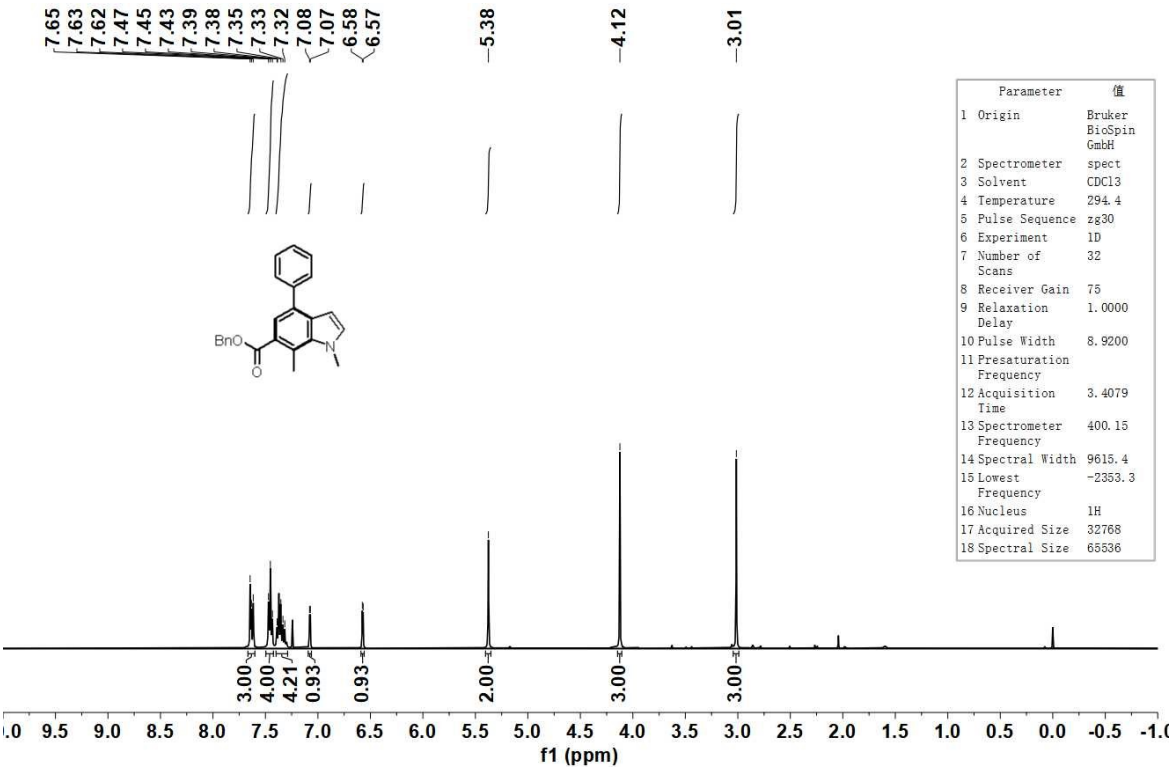
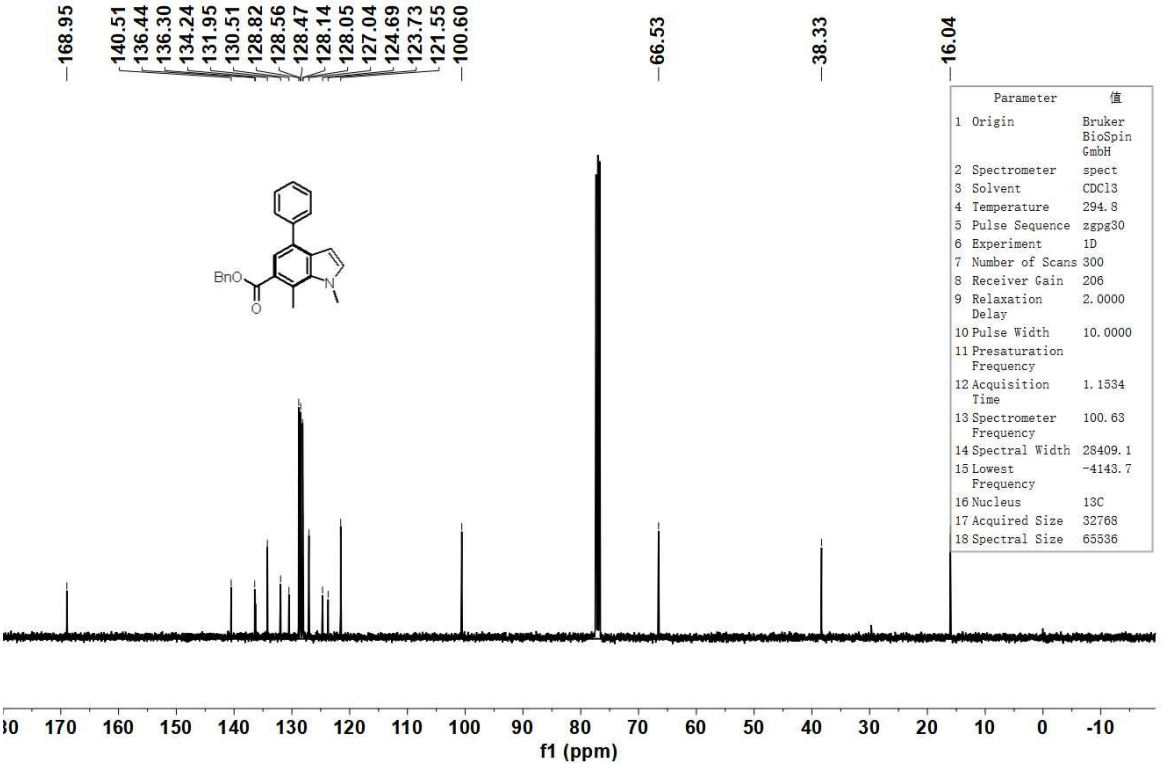
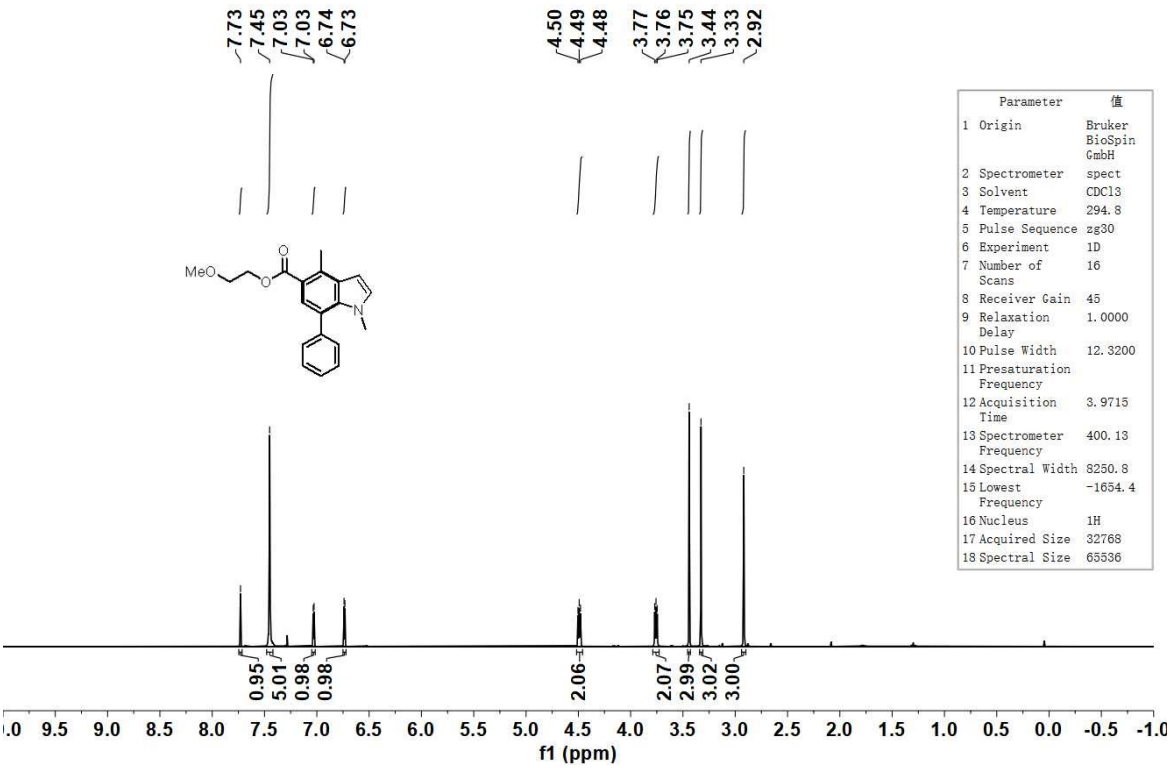
139.62
136.67
135.21
134.17
131.28
130.66
130.23
128.53
128.20
127.98
127.78
127.40
126.53
124.16
119.60
101.65
101.02
66.20
36.82
17.24
BnO
O
N
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.5
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 500
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

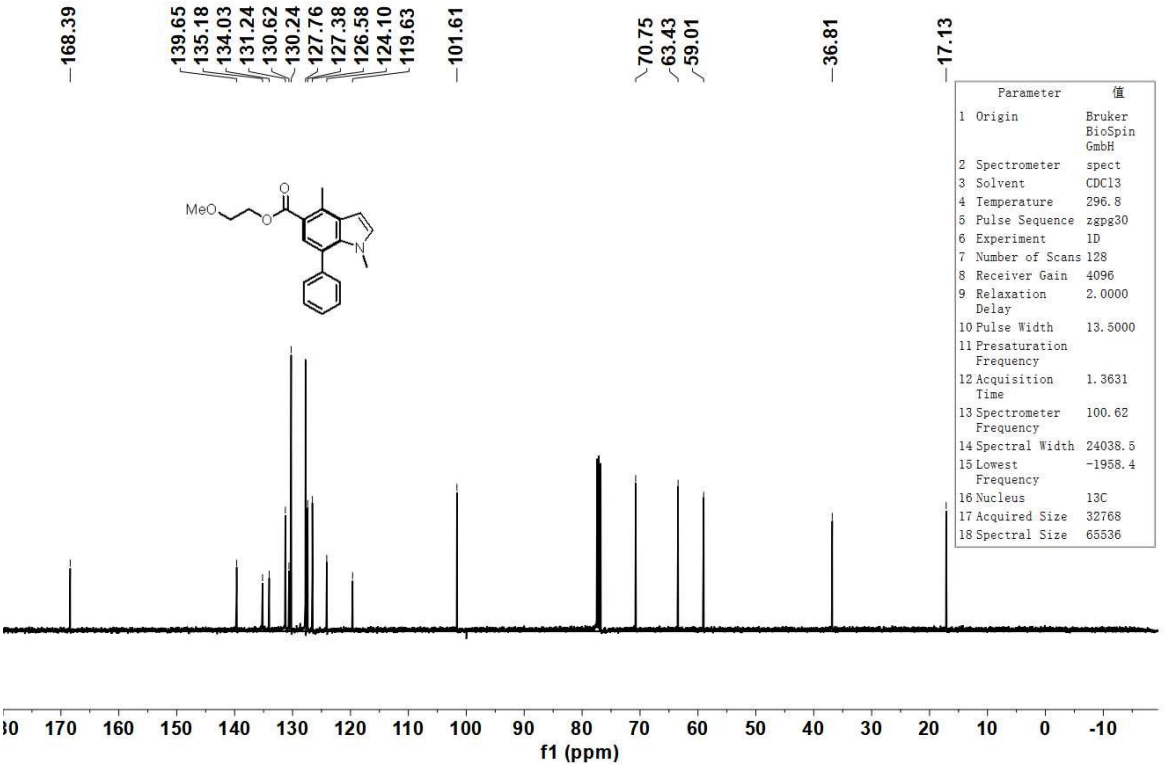
**6x**


7.65
7.63
7.62
7.47
7.45
7.43
7.39
7.38
7.35
7.33
7.32
7.08
7.07
6.58
6.57
5.38
4.12
3.01
BnO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.4
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2353.3
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
3.00
4.00
4.21
0.93
0.93
2.00
3.00
3.00
f1 (ppm)

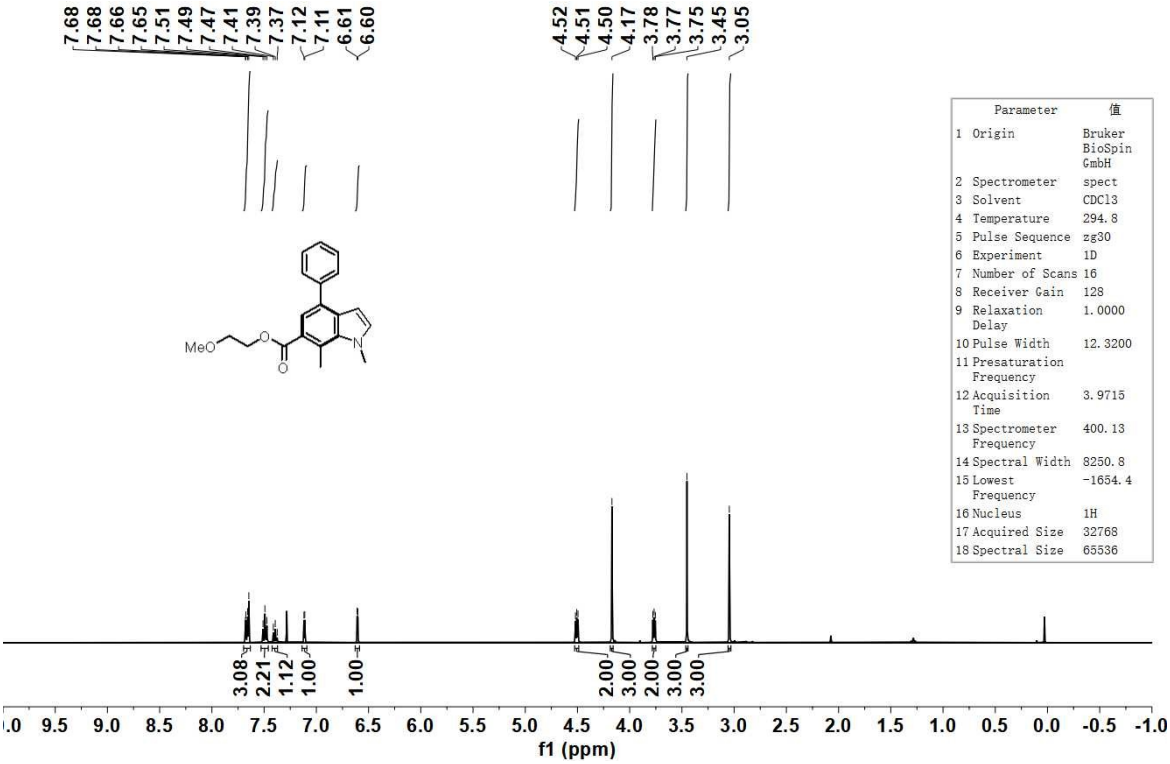

168.95
140.51
136.44
136.30
134.24
131.95
130.51
128.82
128.56
128.47
128.14
128.05
127.04
124.69
123.73
121.55
100.60
66.53
38.33
16.04
BnO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.8
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

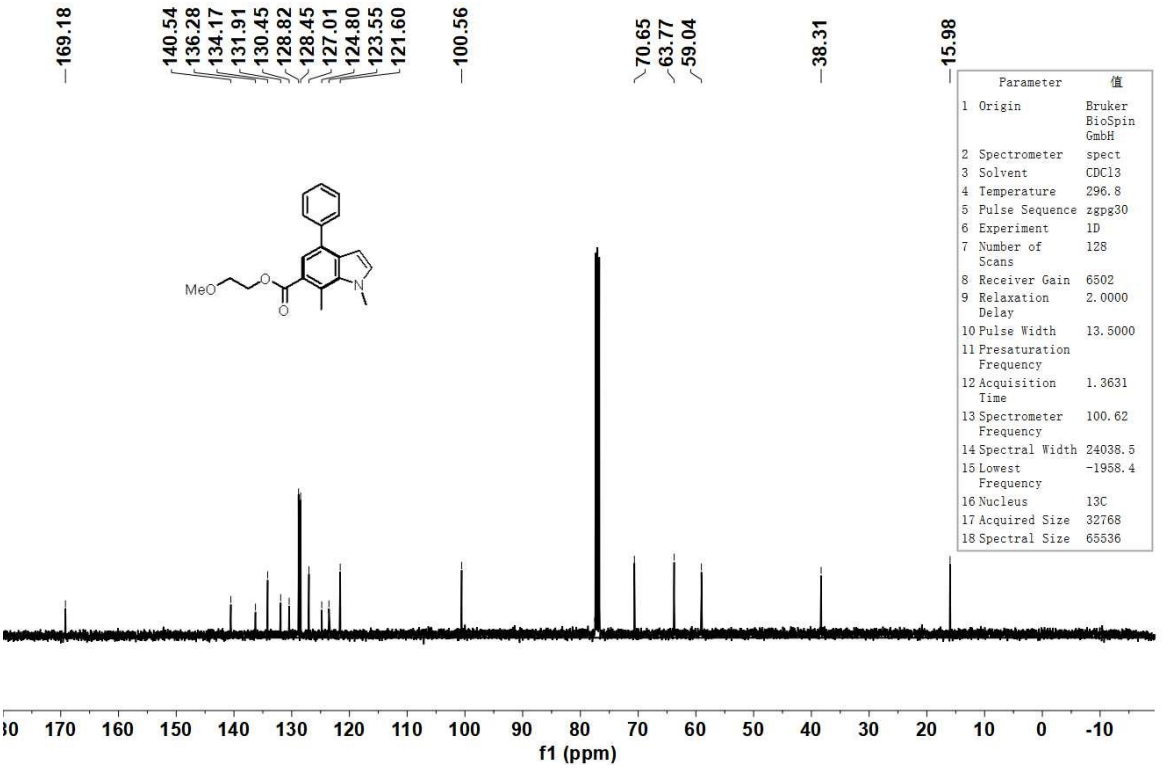
**5y**


7.73
7.45
7.03
7.03
6.74
6.73
4.50
4.49
4.48
3.77
3.76
3.75
3.44
3.33
2.92
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.8
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 45
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
0.95
5.01
0.98
0.98
2.06
2.07
2.99
3.02
3.00
f1 (ppm)

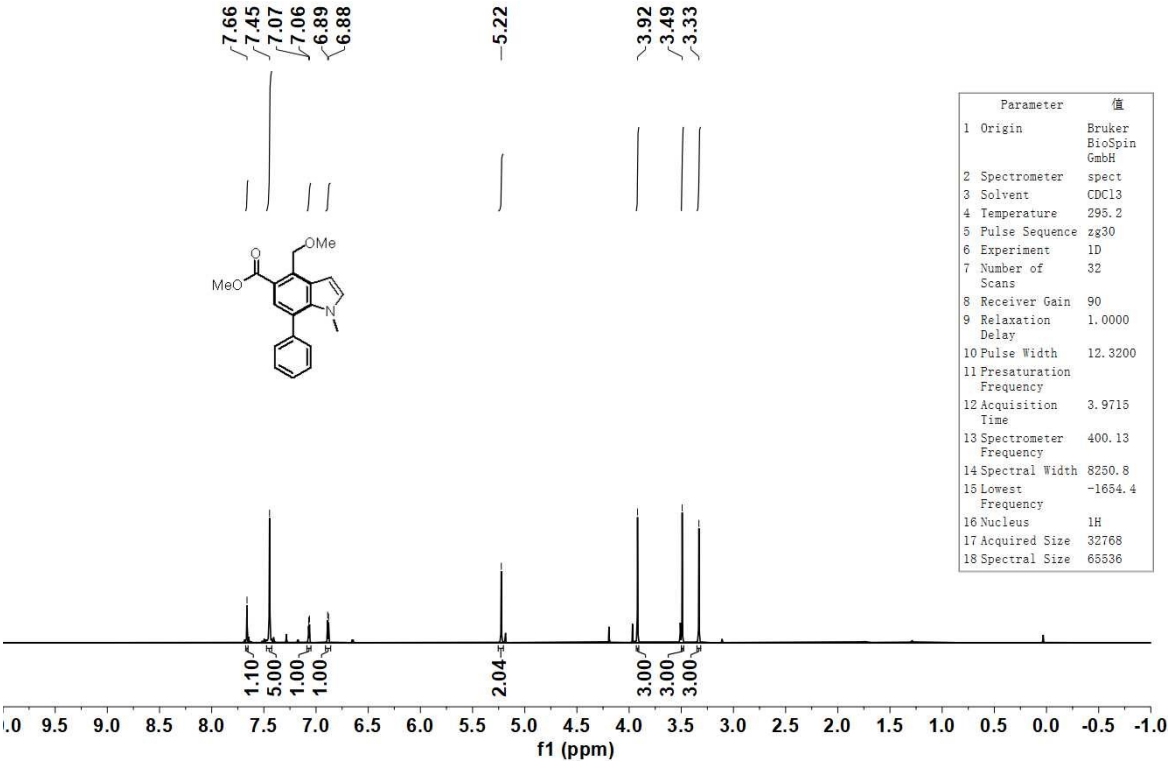

168.39
139.65
135.18
134.03
131.24
130.62
130.24
127.76
127.38
126.58
124.10
119.63
101.61
70.75
63.43
59.01
36.81
17.13
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.8
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 4096
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

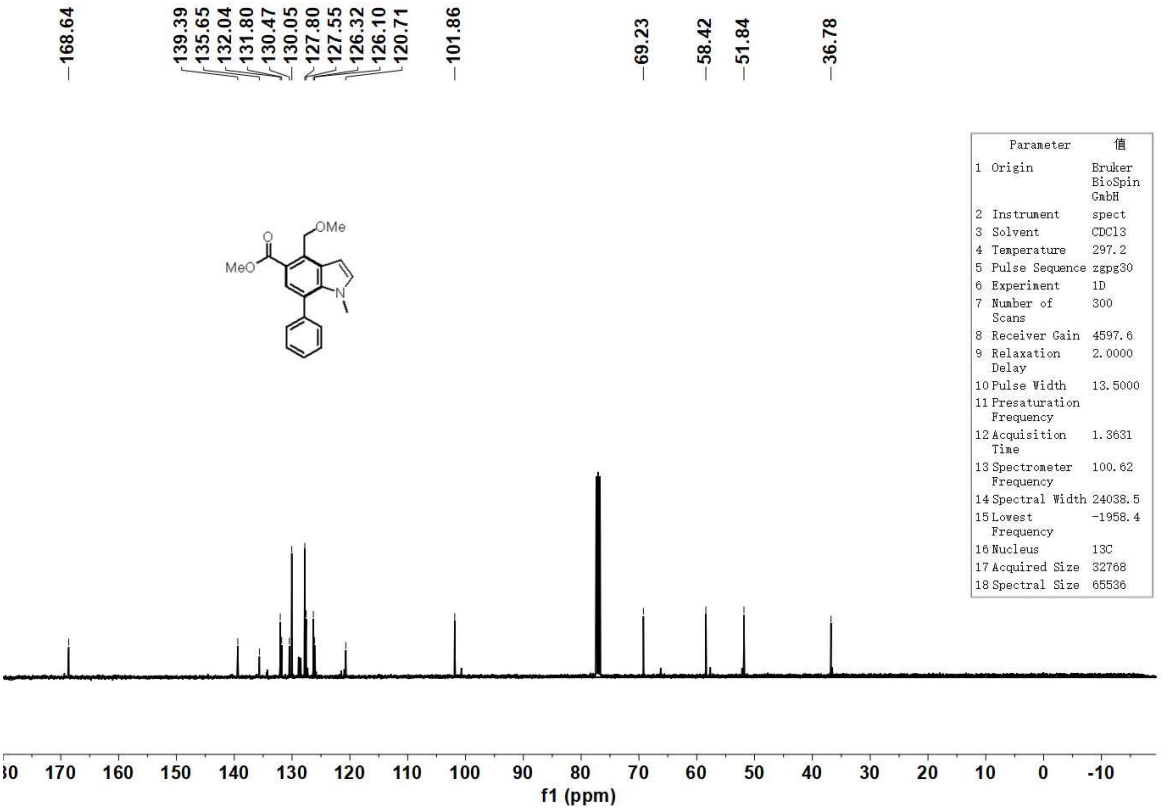
**6y**


7.68
7.68
7.66
7.65
7.51
7.49
7.47
7.41
7.39
7.37
7.12
7.11
6.61
6.60
4.52
4.51
4.50
4.17
3.78
3.77
3.75
3.45
3.05
MeO
O
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.8
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 128
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
3.08
2.21
1.12
1.00
1.00
2.00
3.00
2.00
3.00
3.00
f1 (ppm)

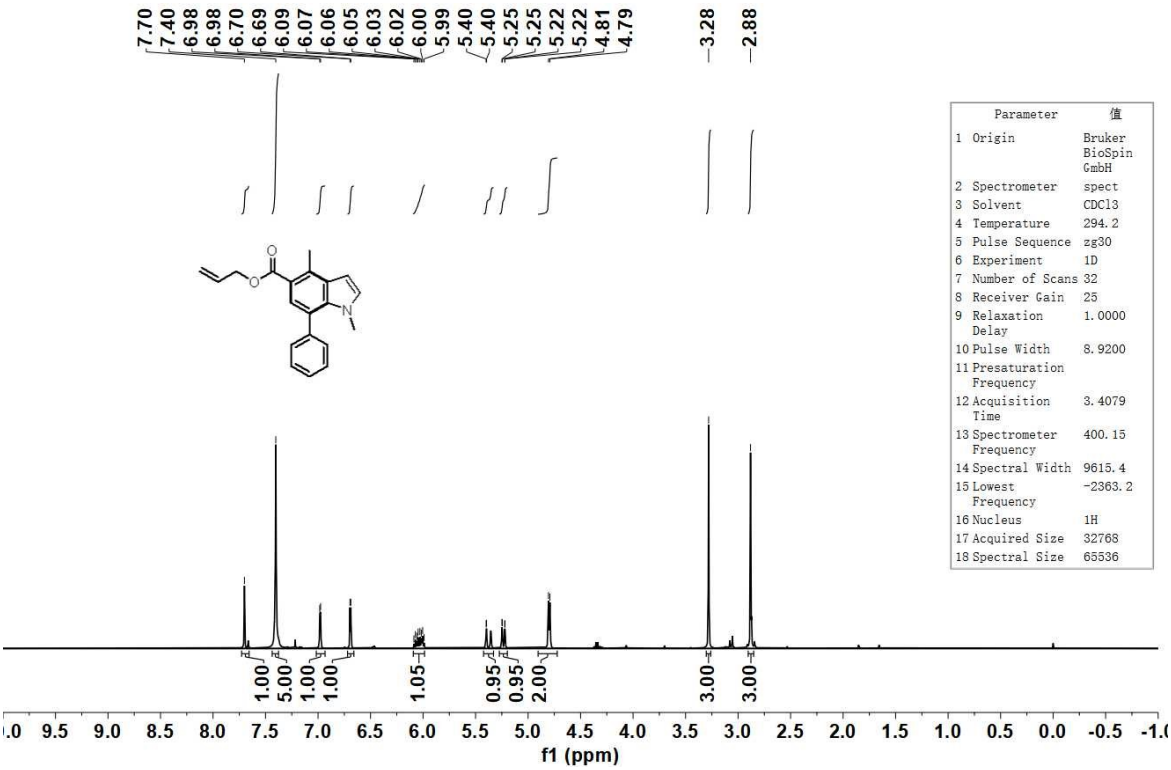

169.18
140.54
136.28
134.17
131.91
130.45
128.82
128.45
127.01
124.80
123.55
121.60
100.56
70.65
63.77
59.04
38.31
15.98
MeO
O
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 296.8
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 128
8 Receiver Gain 6502
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5z**

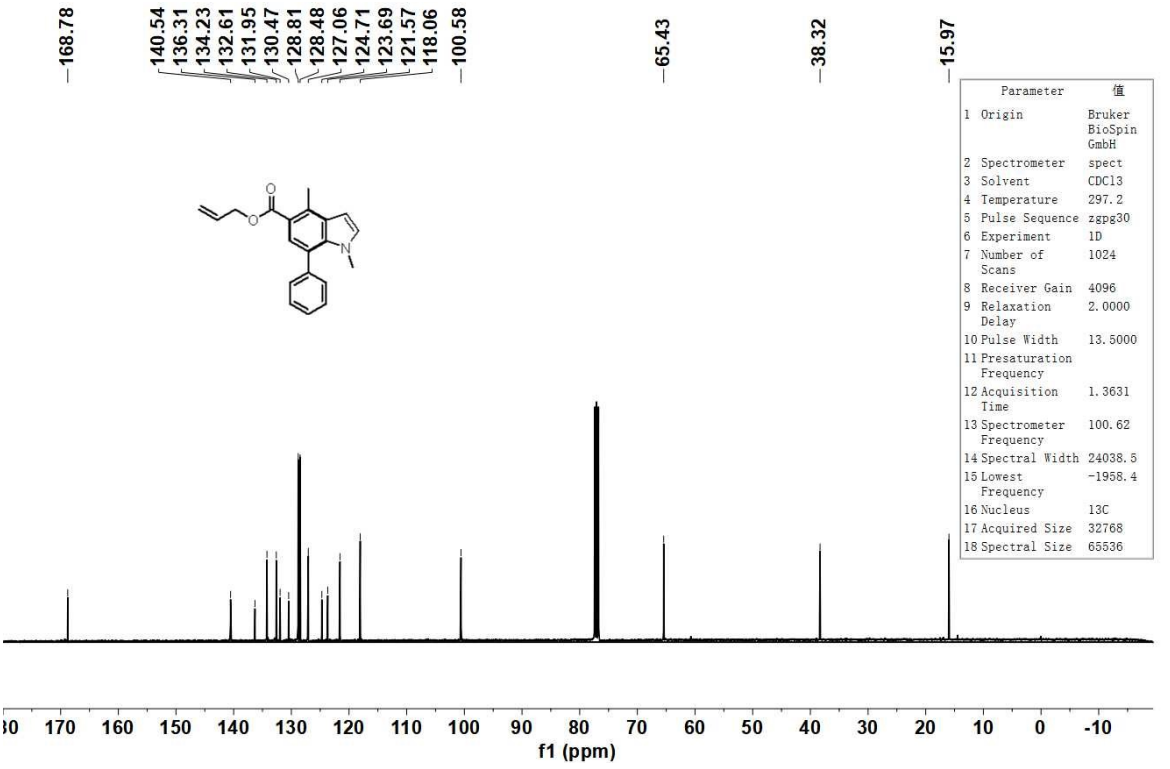

7.66
7.45
7.07
7.06
6.89
6.88
5.22
3.92
3.49
3.33
OMe
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.2
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 90
9 Relaxation Delay 1.0000
10 Pulse Width 12.3200
11 Presaturation Frequency
12 Acquisition Time 3.9715
13 Spectrometer Frequency 400.13
14 Spectral Width 8250.8
15 Lowest Frequency -1654.4
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.10
5.00
1.00
1.00
2.04
3.00
3.00
3.00
f1 (ppm)


168.64
139.39
135.65
132.04
131.80
130.47
130.05
127.80
127.55
126.32
126.10
120.71
101.86
69.23
58.42
51.84
36.78
OMe
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 297.2
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 4597.6
9 Relaxation Delay 2.0000
10 Pulse Width 13.5000
11 Presaturation Frequency
12 Acquisition Time 1.3631
13 Spectrometer Frequency 100.62
14 Spectral Width 24038.5
15 Lowest Frequency -1958.4
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5aa**

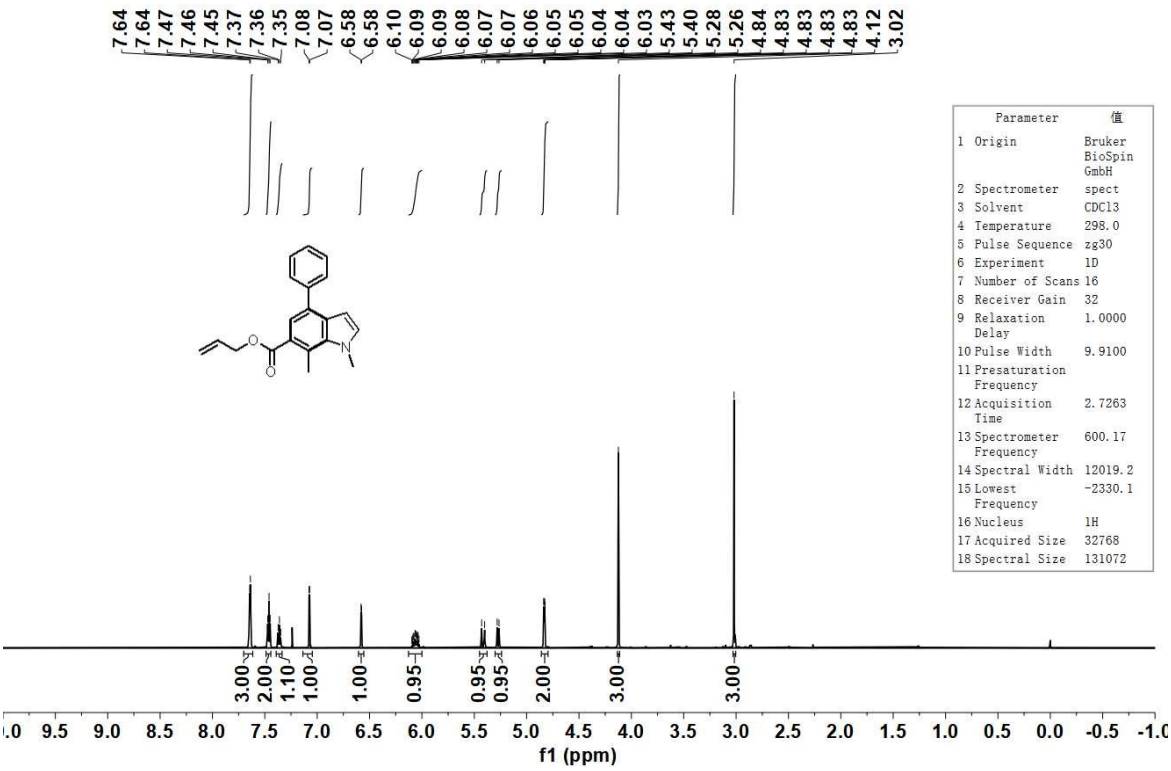


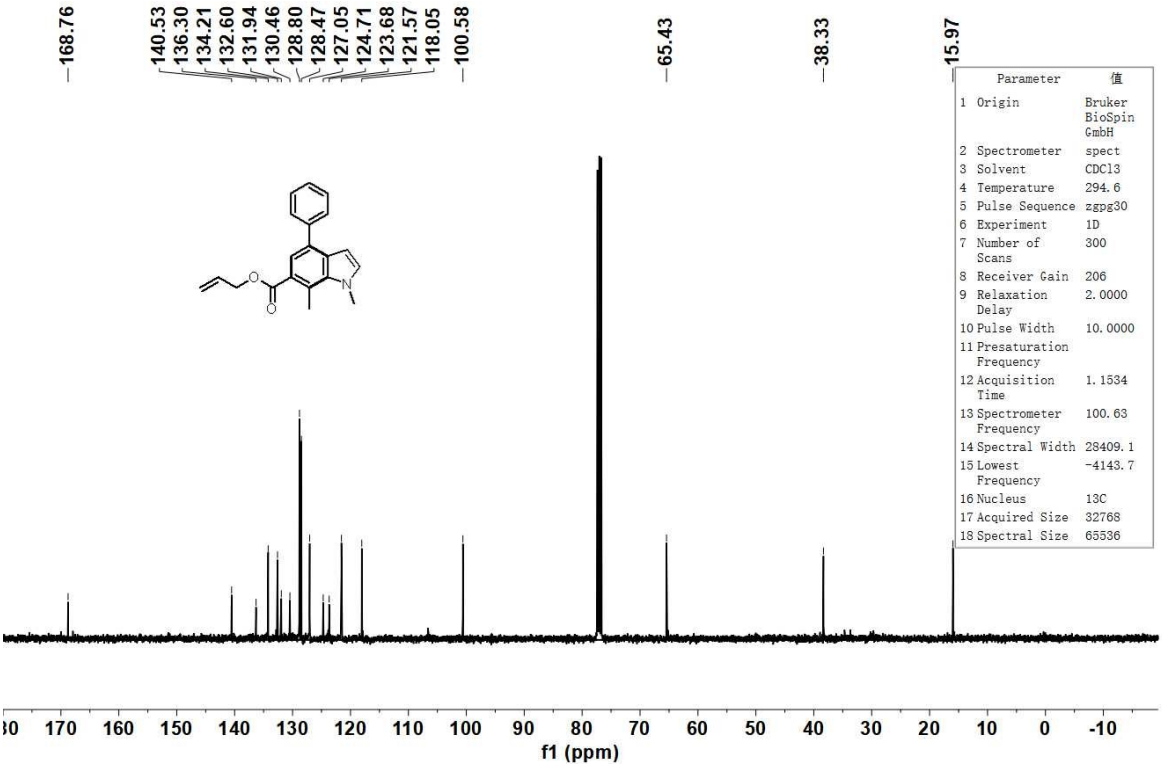

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.2 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 32 |
| 8 Receiver Gain | 25 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2363.2 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |



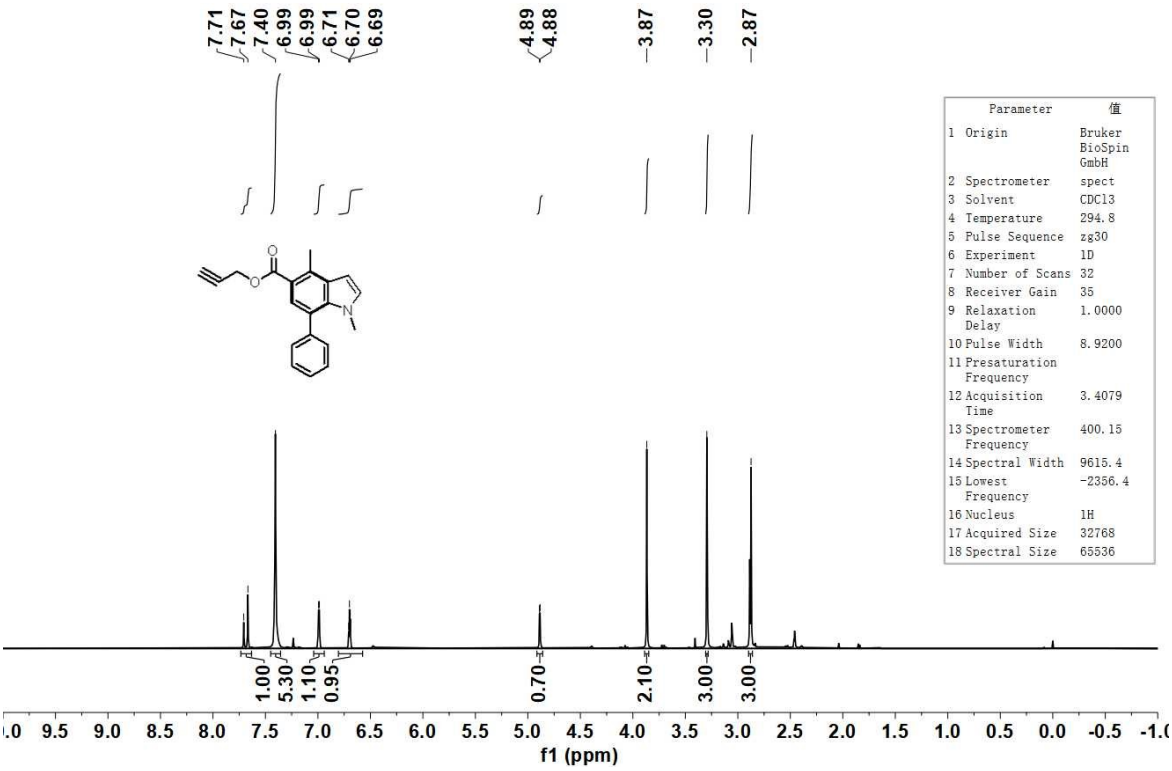

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 297.2 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 1024 |
| 8 Receiver Gain | 4096 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 13.5000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.3631 |
| 13 Spectrometer Frequency | 100.62 |
| 14 Spectral Width | 24038.5 |
| 15 Lowest Frequency | -1958.4 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

**6aa**

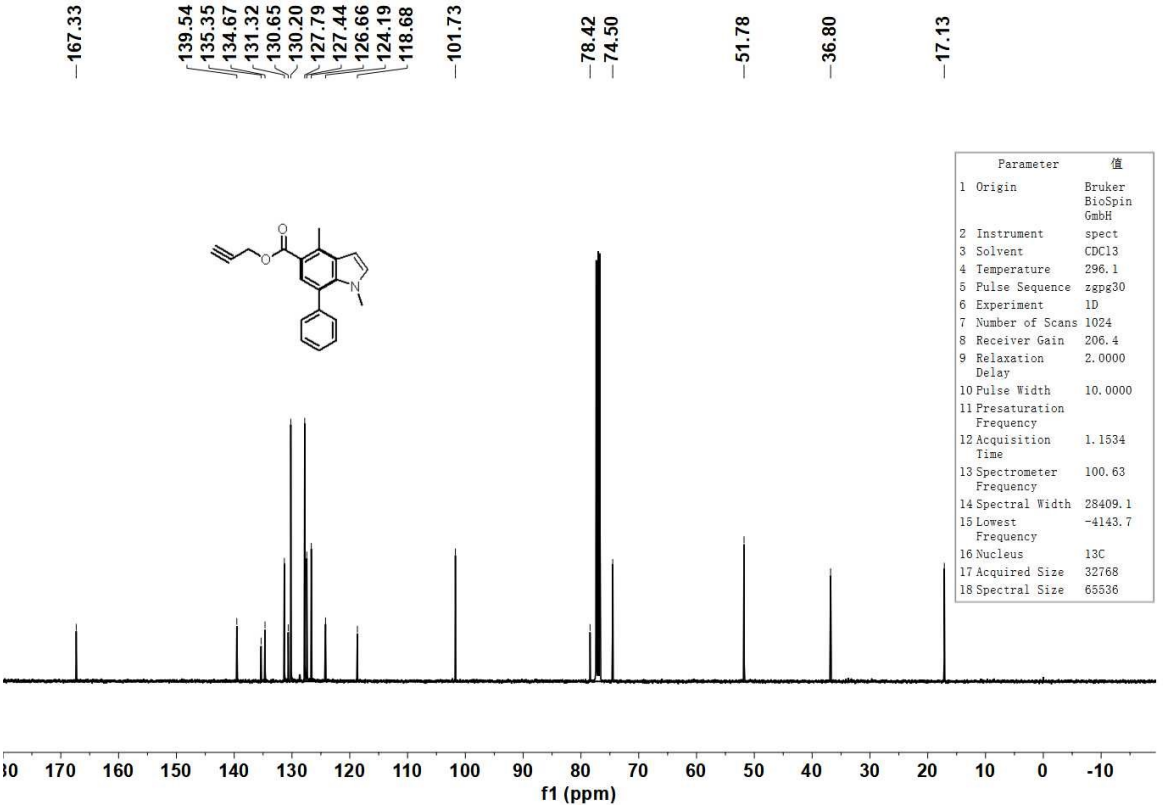

7.64 7.64 7.47 7.46 7.45 7.37 7.36 7.35 7.08 7.07 6.58 6.58 6.10 6.09 6.09 6.08 6.07 6.07 6.06 6.05 6.05 6.04 6.04 6.03 5.43 5.40 5.28 5.26 4.84 4.83 4.83 4.83 4.12 3.02
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 298.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 32
9 Relaxation Delay 1.0000
10 Pulse Width 9.9100
11 Presaturation Frequency
12 Acquisition Time 2.7263
13 Spectrometer Frequency 600.17
14 Spectral Width 12019.2
15 Lowest Frequency -2330.1
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 131072
3.00 2.00 1.10 1.00 1.00 0.95 0.95 0.95 2.00 3.00 3.00
f1 (ppm)


168.76 140.53 136.30 134.21 132.60 131.94 130.46 128.80 128.47 127.05 124.71 123.68 121.57 118.05 100.58 65.43 38.33 15.97
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.6
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**5ab**

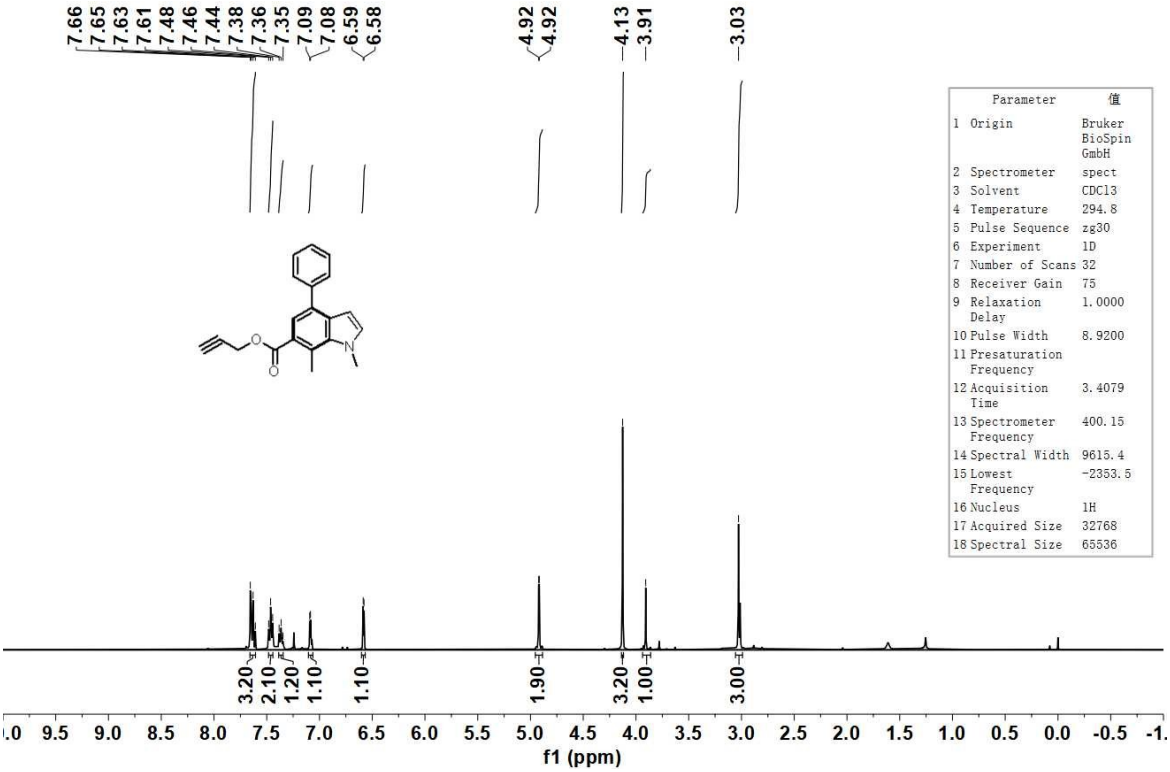



| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.8 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 32 |
| 8 Receiver Gain | 35 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2356.4 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

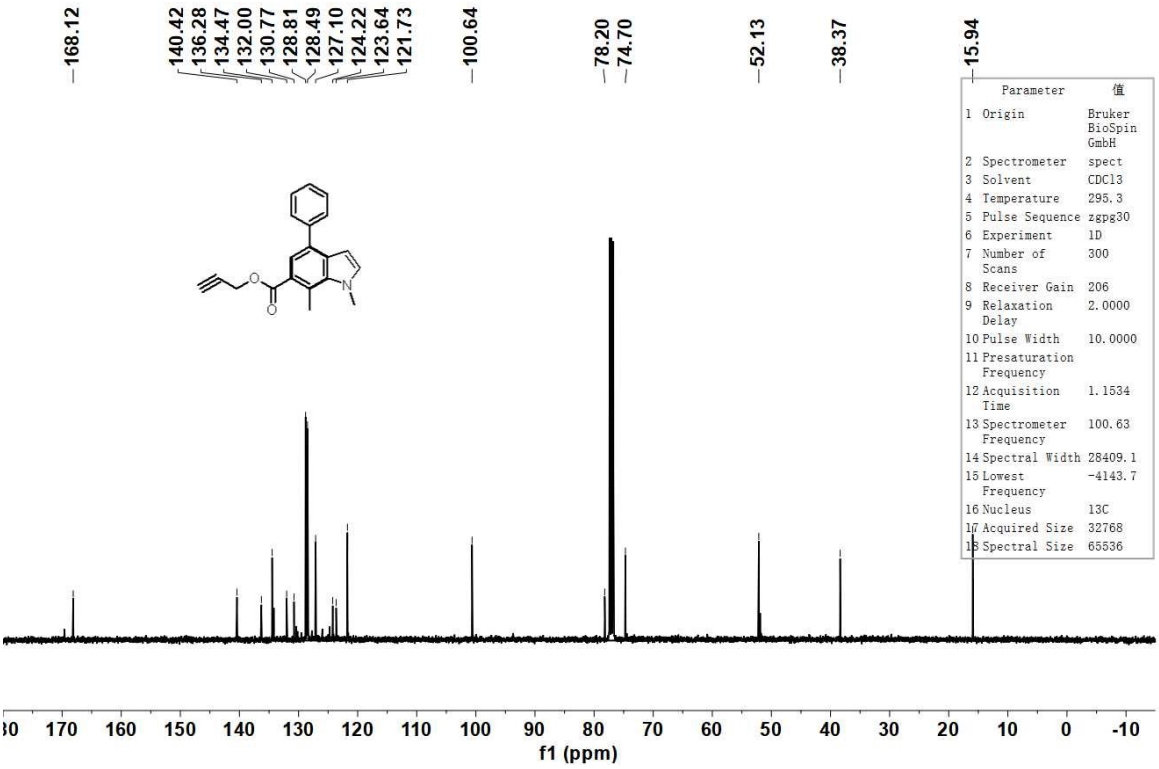



| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Instrument | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 296.1 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 1024 |
| 8 Receiver Gain | 206.4 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

**6ab**

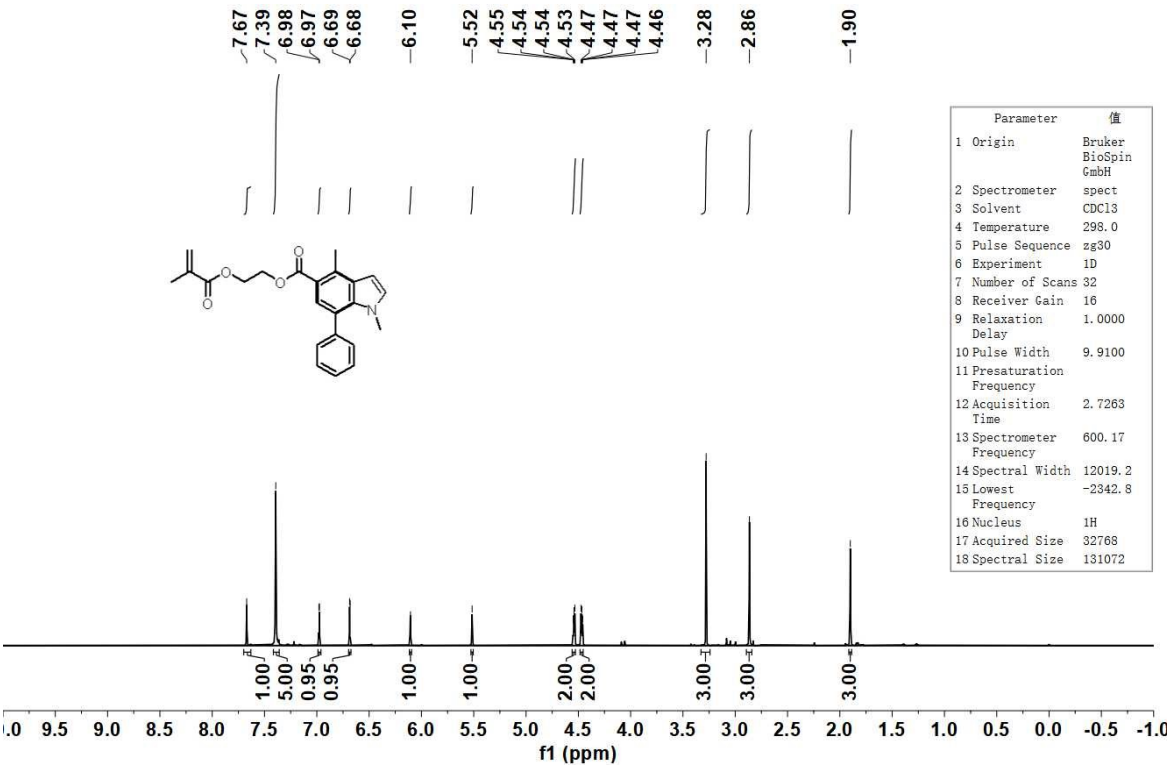


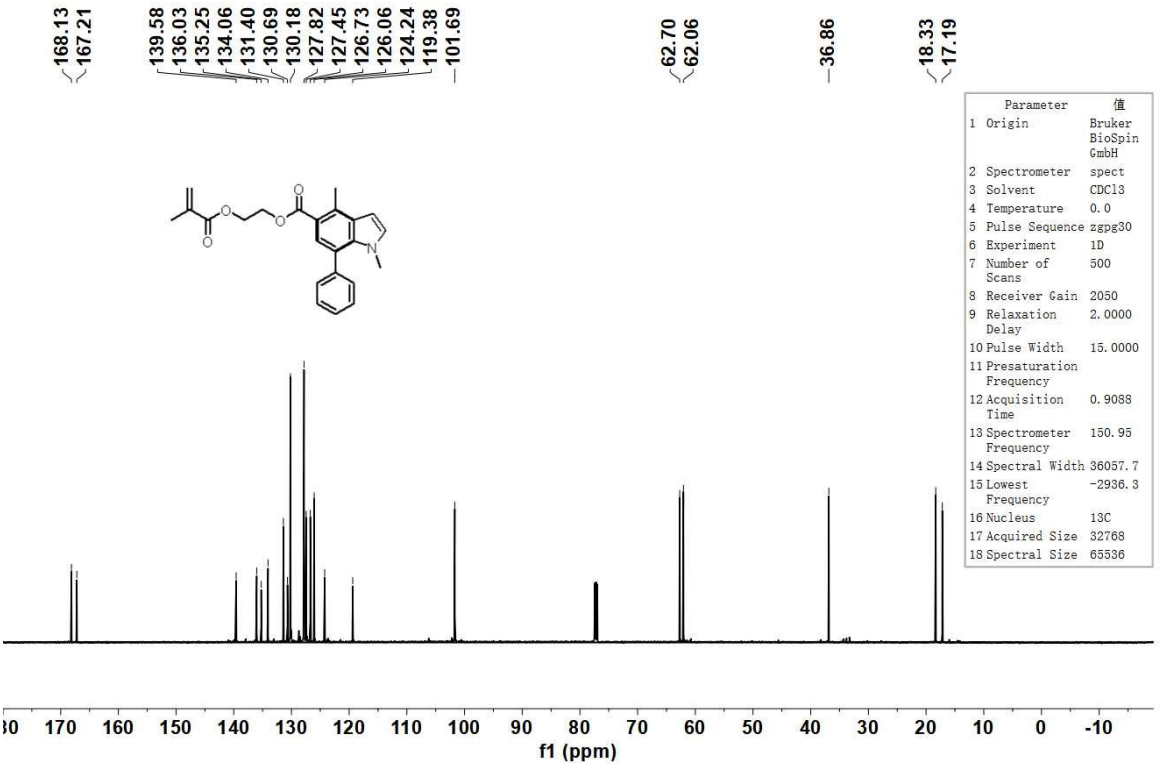

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 294.8 |
| 5 Pulse Sequence | zg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 32 |
| 8 Receiver Gain | 75 |
| 9 Relaxation Delay | 1.0000 |
| 10 Pulse Width | 8.9200 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 3.4079 |
| 13 Spectrometer Frequency | 400.15 |
| 14 Spectral Width | 9615.4 |
| 15 Lowest Frequency | -2353.5 |
| 16 Nucleus | 1H |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |



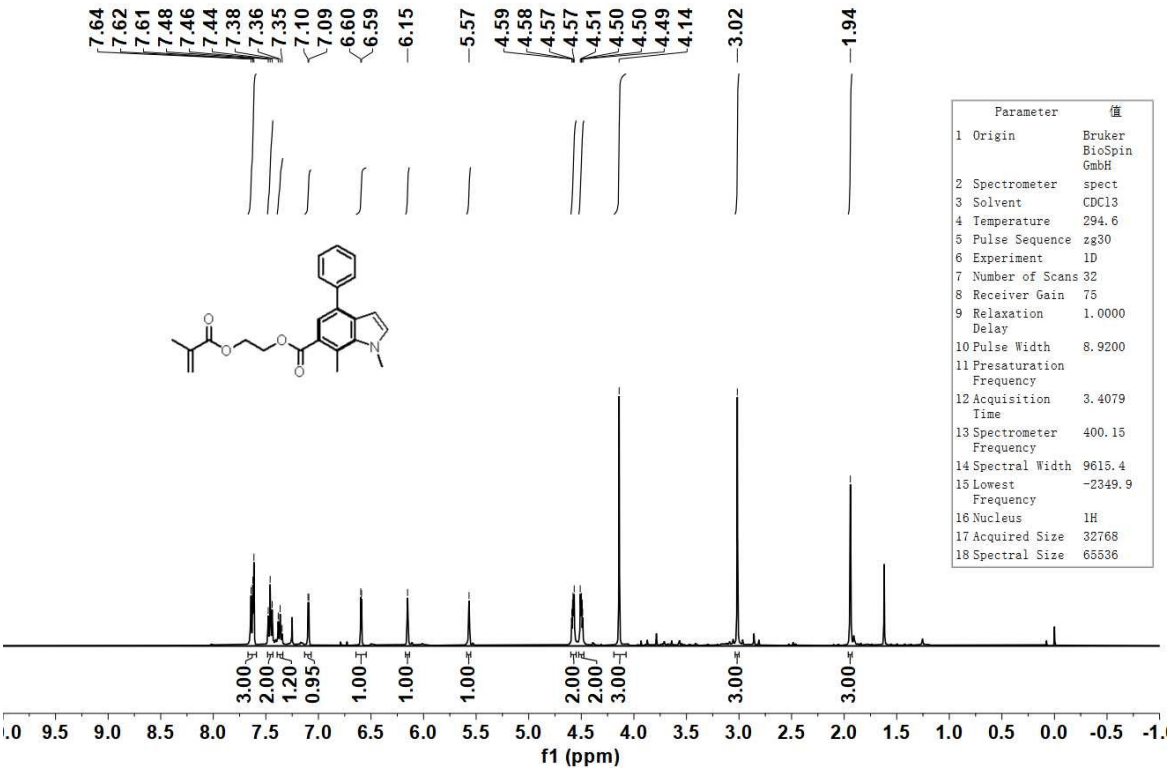

| Parameter | 值 |
|---|---|
| 1 Origin | Bruker BioSpin GmbH |
| 2 Spectrometer | spect |
| 3 Solvent | CDCl3 |
| 4 Temperature | 295.3 |
| 5 Pulse Sequence | zgpg30 |
| 6 Experiment | 1D |
| 7 Number of Scans | 300 |
| 8 Receiver Gain | 206 |
| 9 Relaxation Delay | 2.0000 |
| 10 Pulse Width | 10.0000 |
| 11 Presaturation Frequency | |
| 12 Acquisition Time | 1.1534 |
| 13 Spectrometer Frequency | 100.63 |
| 14 Spectral Width | 28409.1 |
| 15 Lowest Frequency | -4143.7 |
| 16 Nucleus | 13C |
| 17 Acquired Size | 32768 |
| 18 Spectral Size | 65536 |

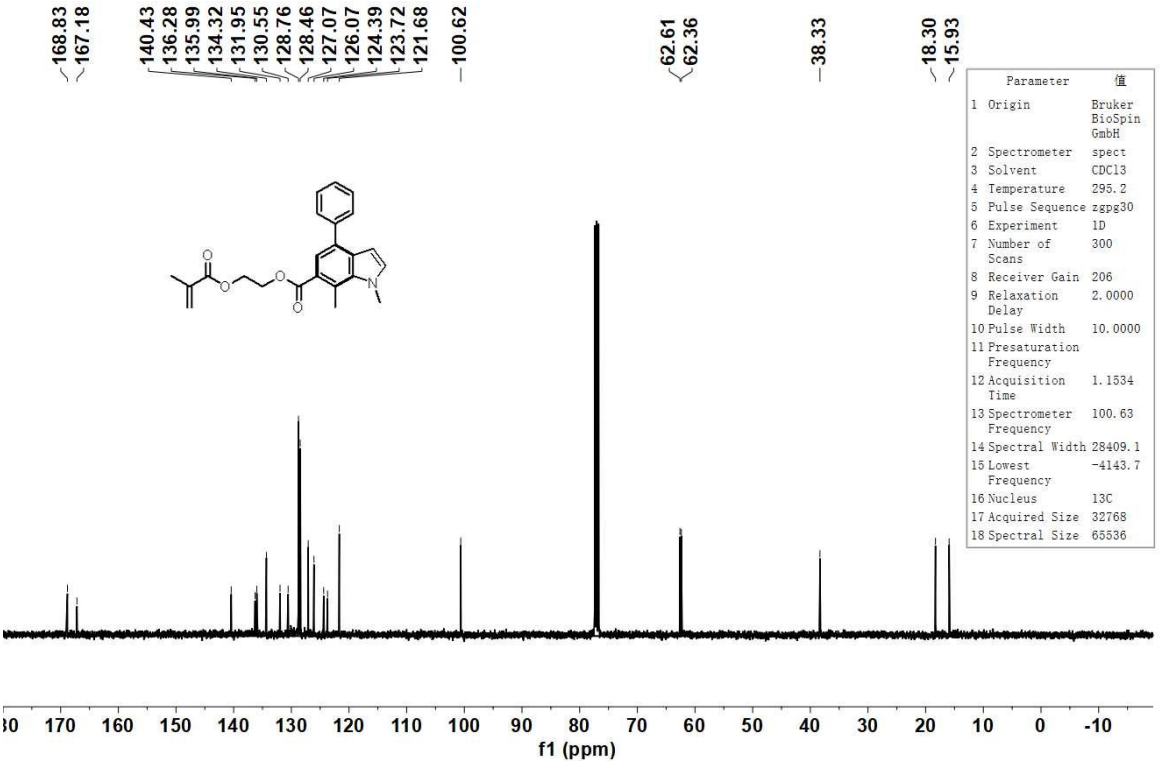
**5ac**


7.67
7.39
6.98
6.97
6.69
6.68
6.10
5.52
4.55
4.54
4.54
4.53
4.47
4.47
4.47
4.46
3.28
2.86
1.90
1.00
5.00
0.95
0.95
1.00
1.00
2.00
2.00
3.00
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 298.0
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 16
9 Relaxation Delay 1.0000
10 Pulse Width 9.9100
11 Presaturation Frequency
12 Acquisition Time 2.7263
13 Spectrometer Frequency 600.17
14 Spectral Width 12019.2
15 Lowest Frequency -2342.8
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 131072

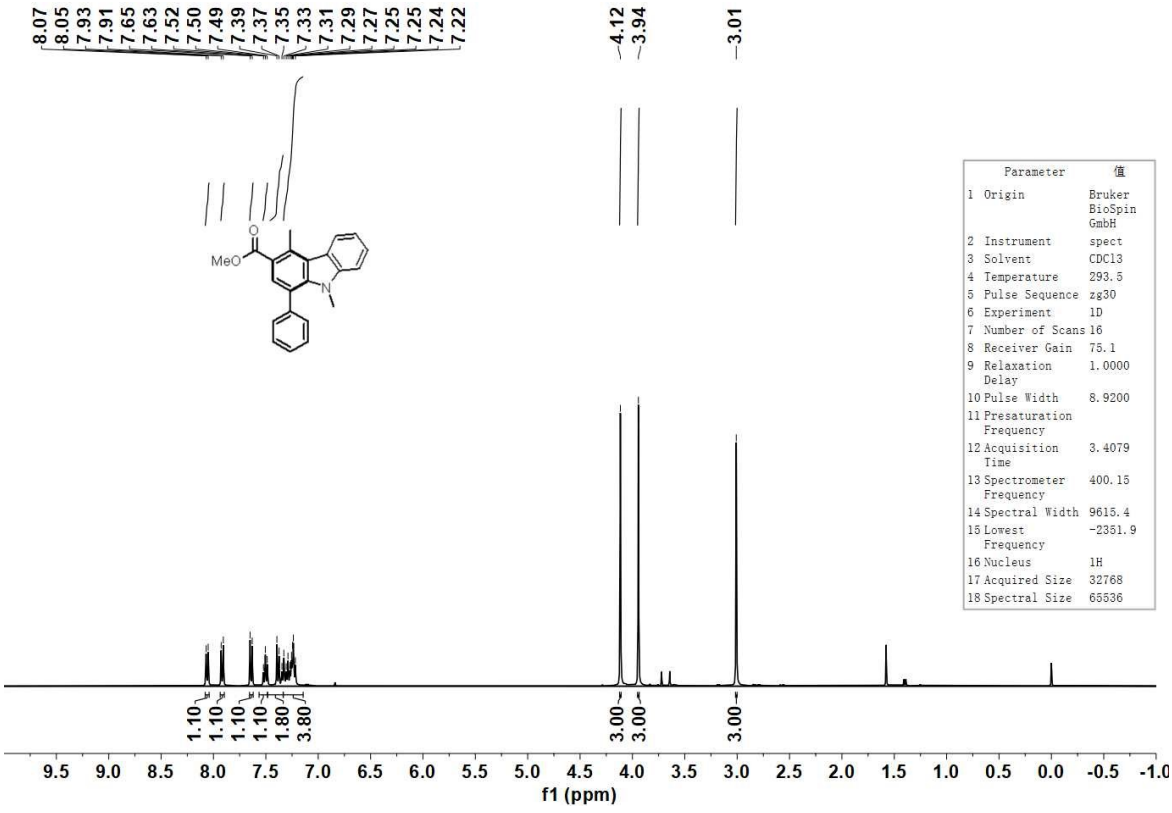

168.13
167.21
139.58
136.03
135.25
134.06
131.40
130.69
130.18
127.82
127.45
126.73
126.06
124.24
119.38
101.69
62.70
62.06
36.86
18.33
17.19
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 0.0
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 500
8 Receiver Gain 2050
9 Relaxation Delay 2.0000
10 Pulse Width 15.0000
11 Presaturation Frequency
12 Acquisition Time 0.9088
13 Spectrometer Frequency 150.95
14 Spectral Width 36057.7
15 Lowest Frequency -2936.3
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

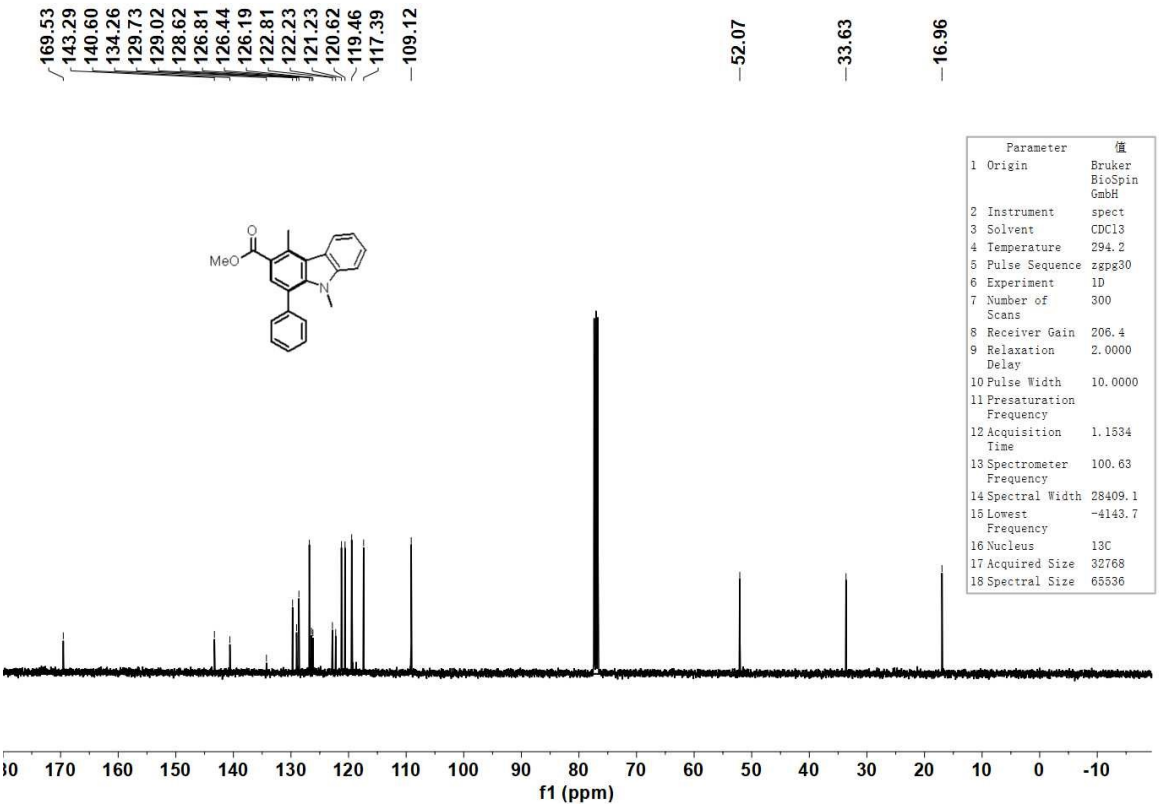
**6ac**


7.64
7.62
7.61
7.48
7.46
7.44
7.38
7.36
7.35
7.10
7.09
6.60
6.59
6.15
5.57
4.59
4.58
4.57
4.57
4.51
4.50
4.50
4.49
4.14
3.02
1.94
3.00
2.00
1.20
0.95
1.00
1.00
1.00
2.00
2.00
3.00
3.00
3.00
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 294.6
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 32
8 Receiver Gain 75
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2349.9
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536

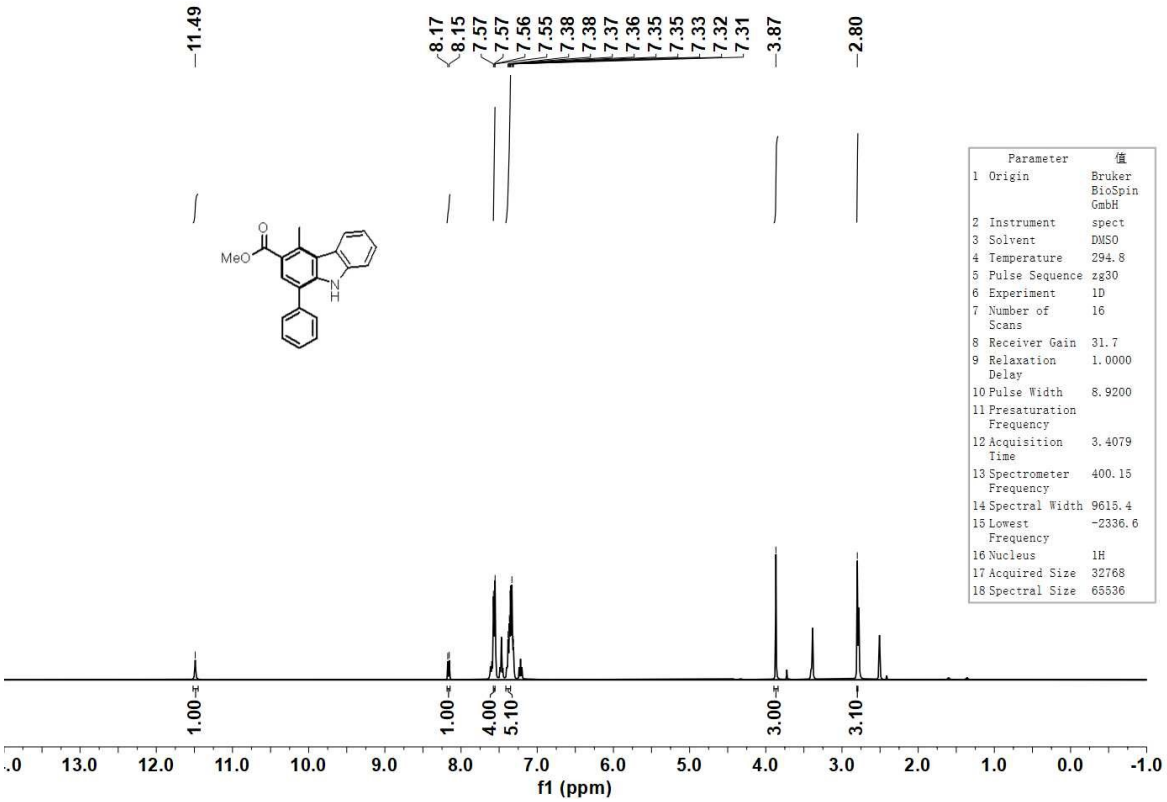

168.83
167.18
140.43
136.28
135.99
134.32
131.95
130.55
128.76
128.46
127.07
126.07
124.39
123.72
121.68
100.62
62.61
62.36
38.33
18.30
15.93
f1 (ppm)
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Spectrometer spect
3 Solvent CDCl3
4 Temperature 295.2
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536

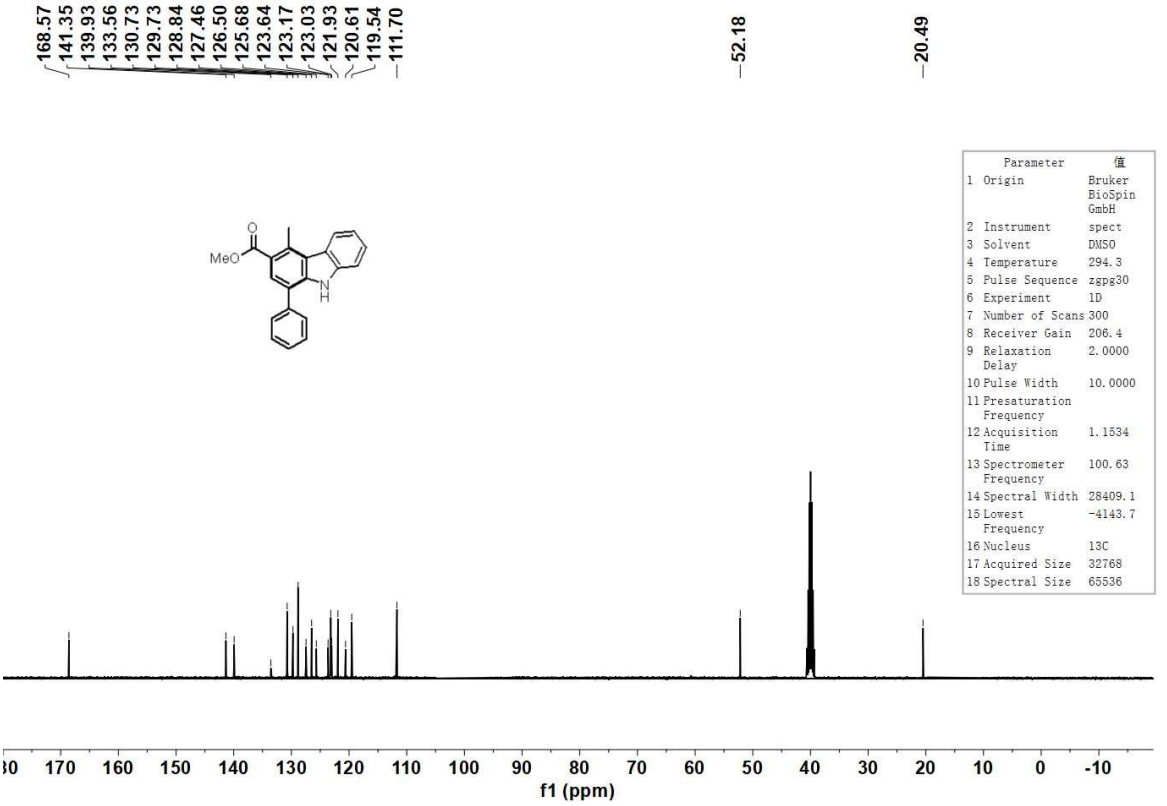
**8a**


8.07
8.05
7.93
7.91
7.65
7.63
7.52
7.50
7.49
7.39
7.37
7.35
7.33
7.31
7.29
7.27
7.25
7.24
7.22
4.12
3.94
3.01
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 293.5
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2351.9
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.10
1.10
1.10
1.10
1.80
3.80
3.00
3.00
3.00
f1 (ppm)

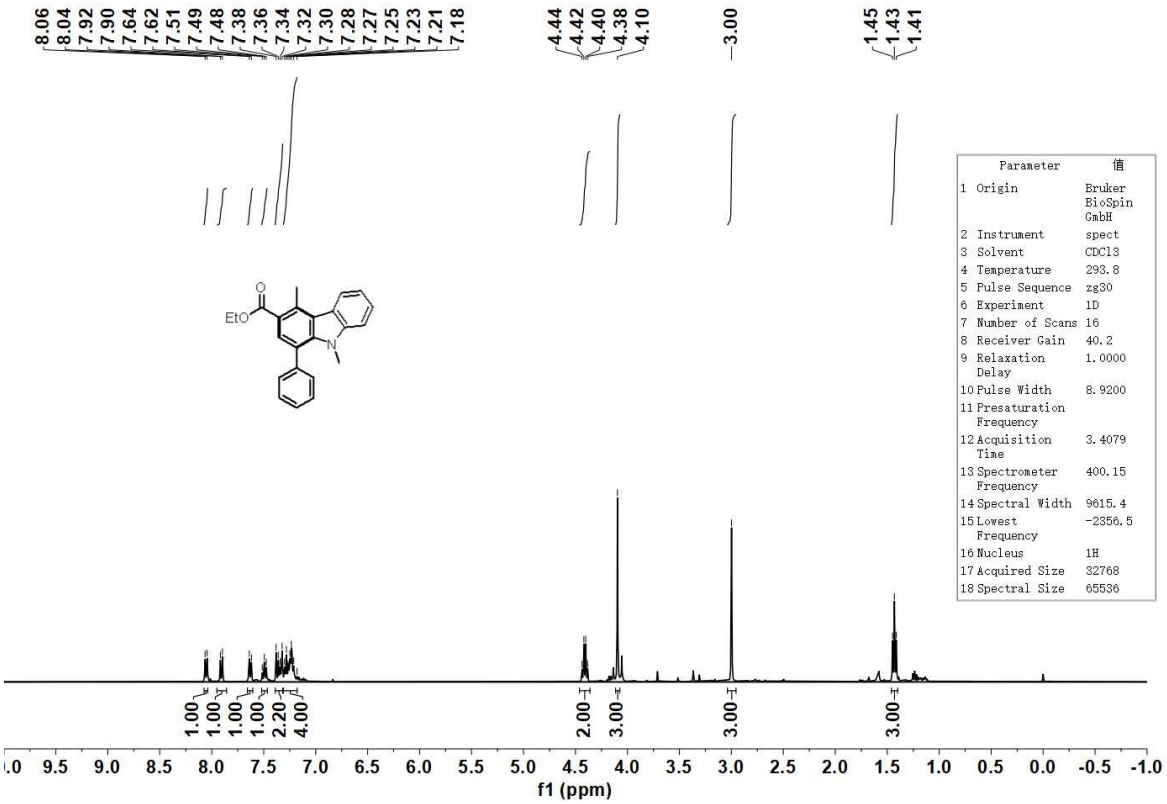

169.53
143.29
140.60
134.26
129.73
129.02
128.62
126.81
126.44
126.19
122.81
122.23
121.23
120.62
119.46
117.39
109.12
52.07
33.63
16.96
MeO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.2
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

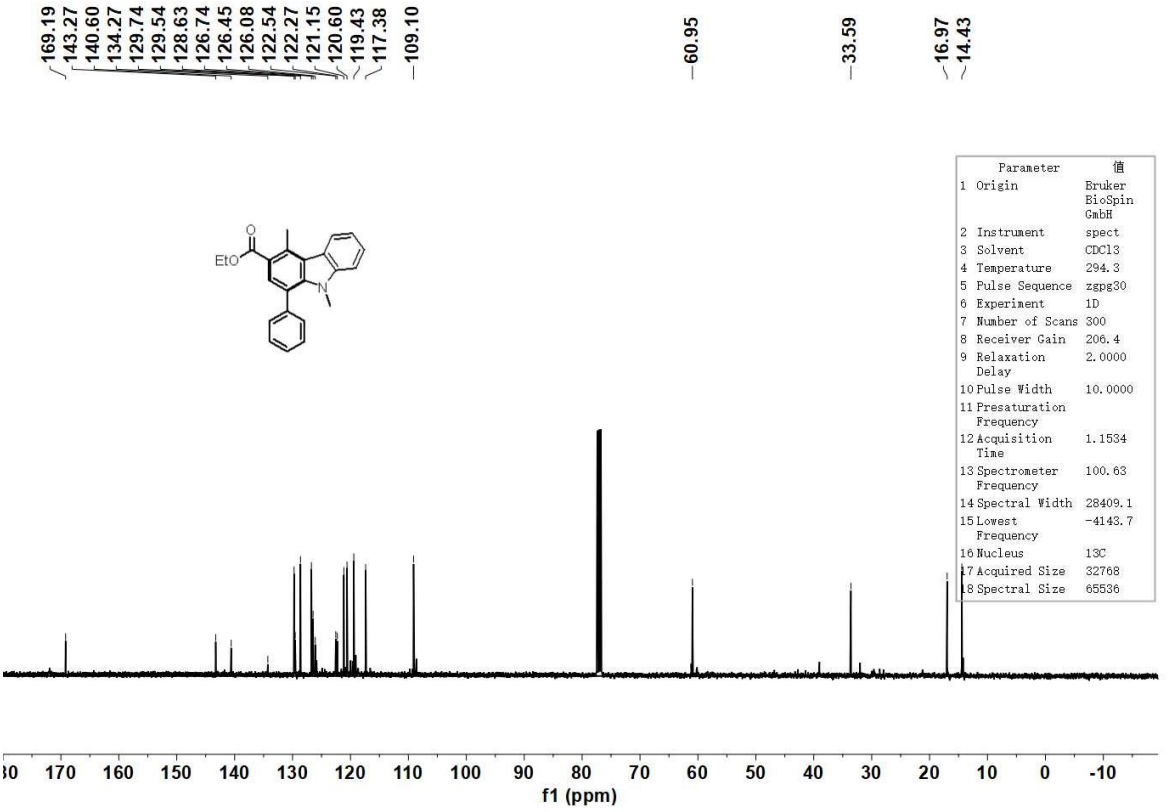
**8b**


11.49
8.17
8.15
7.57
7.57
7.56
7.55
7.38
7.38
7.37
7.36
7.35
7.35
7.33
7.32
7.31
3.87
2.80
MeO
O
N
H
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent DMSO
4 Temperature 294.8
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 31.7
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2336.6
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
1.00
4.00
5.10
3.00
3.10
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

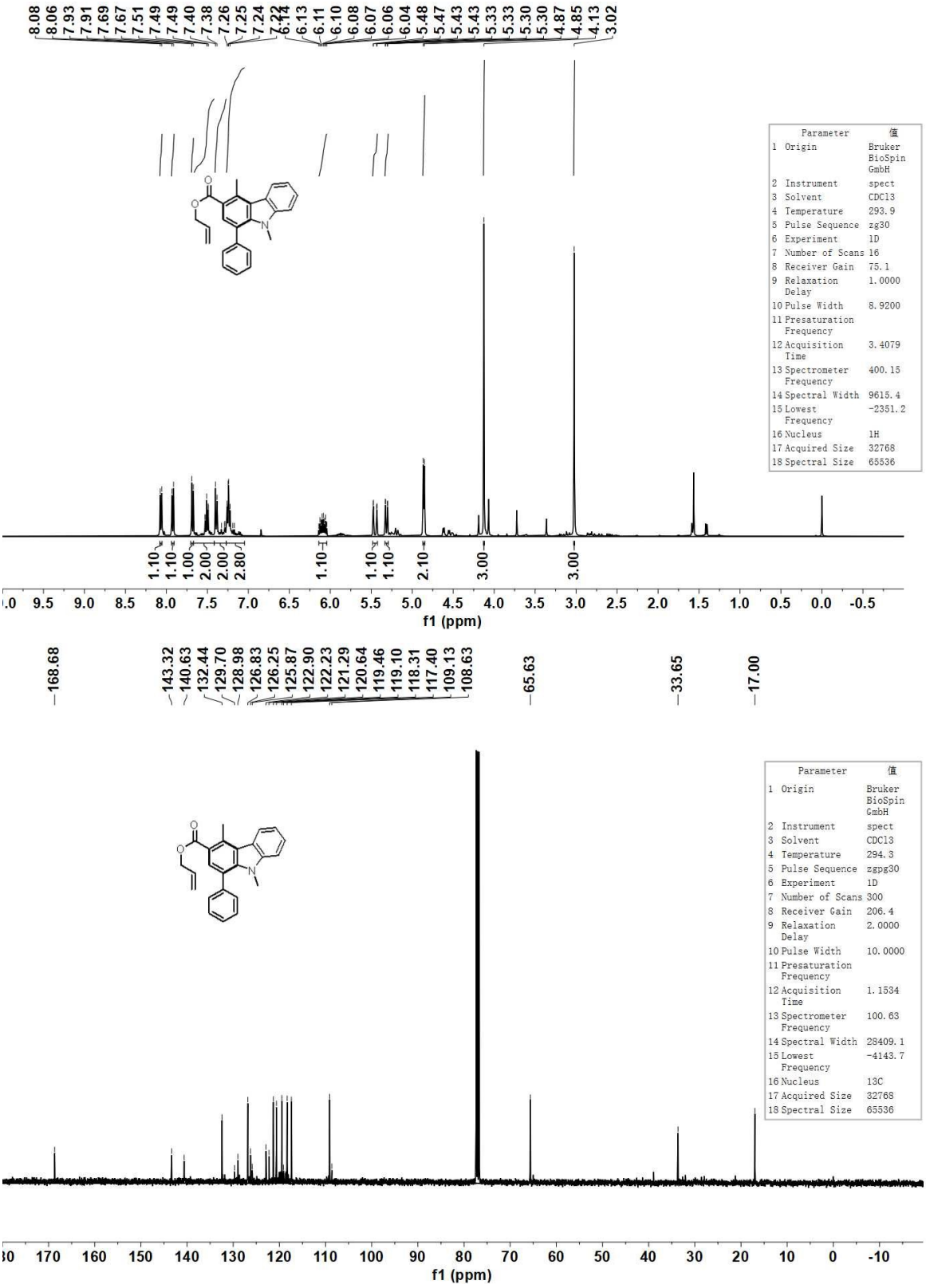

168.57
141.35
139.93
133.56
130.73
129.73
128.84
127.46
126.50
125.68
123.64
123.17
123.03
121.93
120.61
119.54
111.70
52.18
20.49
MeO
O
N
H
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent DMSO
4 Temperature 294.3
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

**8c**


8.06
8.04
7.92
7.90
7.64
7.62
7.51
7.49
7.48
7.38
7.36
7.34
7.32
7.30
7.28
7.27
7.25
7.23
7.21
7.18
4.44
4.42
4.40
4.38
4.10
3.00
1.45
1.43
1.41
EtO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 293.8
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 40.2
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2356.5
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.00
1.00
1.00
1.00
2.20
4.00
2.00
3.00
3.00
3.00
f1 (ppm)


169.19
143.27
140.60
134.27
129.74
129.54
128.63
126.74
126.45
126.08
122.54
122.27
121.15
120.60
119.43
117.38
109.10
60.95
33.59
16.97
14.43
EtO
O
N
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.3
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**8d**


8.08
8.06
7.93
7.91
7.69
7.67
7.51
7.49
7.49
7.40
7.38
7.26
7.25
7.24
6.13
6.11
6.10
6.08
6.07
6.06
6.04
5.48
5.47
5.43
5.43
5.33
5.33
5.30
5.30
4.87
4.85
4.13
3.02
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 293.9
5 Pulse Sequence zg30
6 Experiment 1D
7 Number of Scans 16
8 Receiver Gain 75.1
9 Relaxation Delay 1.0000
10 Pulse Width 8.9200
11 Presaturation Frequency
12 Acquisition Time 3.4079
13 Spectrometer Frequency 400.15
14 Spectral Width 9615.4
15 Lowest Frequency -2351.2
16 Nucleus 1H
17 Acquired Size 32768
18 Spectral Size 65536
1.10
1.10
1.00
2.00
2.00
2.80
1.10
1.10
1.10
2.10
3.00
3.00
f1 (ppm)
168.68
143.32
140.63
132.44
129.70
128.98
126.83
126.25
125.87
122.90
122.23
121.29
120.64
119.46
119.10
118.31
117.40
109.13
108.63
65.63
33.65
17.00
Parameter 值
1 Origin Bruker BioSpin GmbH
2 Instrument spect
3 Solvent CDCl3
4 Temperature 294.3
5 Pulse Sequence zgpg30
6 Experiment 1D
7 Number of Scans 300
8 Receiver Gain 206.4
9 Relaxation Delay 2.0000
10 Pulse Width 10.0000
11 Presaturation Frequency
12 Acquisition Time 1.1534
13 Spectrometer Frequency 100.63
14 Spectral Width 28409.1
15 Lowest Frequency -4143.7
16 Nucleus 13C
17 Acquired Size 32768
18 Spectral Size 65536
f1 (ppm)

**9. References**

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