Electronic Supplementary Information

Copper(II)-Catalyzed Cross Dehydrogenative Coupling Reaction of *N*-Hydroxyphthalimide with Alkanes and Ethers Via Unactivated C(sp^3)-H Activation at Room Temperature

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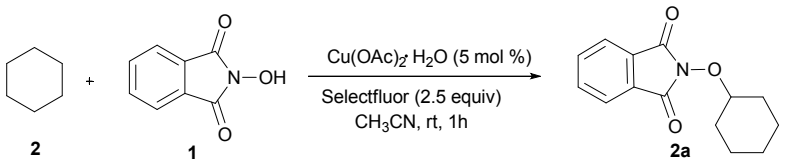
General Experimental Details

General Information:

Unless otherwise stated, all reagents were purchased from commercial suppliers and used without purifications. Melting points are uncorrected. ^{1}H (400 MHz) NMR and ^{13}C (101 MHz) NMR spectra were recorded on a Varian spectrometer in $CDCl_3$ using tetramethylsilane (TMS) as internal standards. Chemical shifts (δ) are expressed in ppm and coupling constants J are given in Hz. Mass spectra were measured with a HRMS-APCI instrument or a low-resolution MS instrument using ESI or EI ionization.

Typical experimental procedure for the synthesis of 2-(cyclohexyloxy)isoindoline-1,3-dione 2a



A flame-dried flask was charged with NHPI (1 mmol, 1 equiv, 0.163 g), cyclohexane (2 mL), F-TEDA-BF_4 (2.5 mmol, 2.5 equiv, 0.885 g), $Cu(OAc)_2 \cdot H_2O$ (5 mol %, 0.01 g), CH_3CN (10 mL) were added and the resulting mixture being stirred at room temperature for 1h. Then aqueous $NaHCO_3$ solution (10 mL) was added to the reaction mixture, the mixture was extracted with dichloromethane (3 x 10 mL), and the combined organic extracts were successively washed with water (20 mL). The mixture was dried over Na_2SO_4, and the solvent was removed under vacuum. The crude product was purified by column chromatography on silica gel (petroleum ether/ ethyl acetate 20/1) to afford the corresponding product .

Experimental characterization data for compounds

2-(cyclohexyloxy)isoindoline-1,3-dione (Table 2, 2a).

60%, 147 mg, white solid, mp 117-118 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.83-7.79 (m, 2H), 7.75-7.71 (m, 2H), 4.26-4.19 (m, 1H), 2.04-2.01 (m, 2H), 1.88-1.83 (m, 2H), 1.64-1.52 (m, 3H), 1.34-1.26 (m, 3H).

^{13}C NMR (101MHz, $CDCl_3$): δ 163.6, 133.8, 128.6, 123.0, 85.6, 31.1, 25.7, 24.1.

HRMS (ESI) m/z: calcd for $C_{14}H_{15}NNaO_3^+$: M + Na = 268.0944; found: 268.0941.

2-(cyclooctyloxy)isoindoline-1,3-dione (Table 2, 2b).

58%, 158 mg, white solid, mp 105-108 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.82-7.79 (m, 2H), 7.75-7.71 (m, 2H), 4.43-4.37 (m, 1H), 2.04-1.88 (m, 4H), 1.85-1.77 (m, 2H), 1.63-1.43 (m, 8H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 164.2, 134.2, 128.9, 123.2, 88.7, 30.1, 27.2, 25.4, 23.0.

HRMS (ESI) m/z: calcd for $C_{16}H_{19}NNaO_3^+$: M + Na = 296.1257; found: 296.1266.

2-(cyclopentyloxy)isoindoline-1,3-dione (Table 2, 2c).

42%, 97 mg, white solid, mp 81-85 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.83-7.81 (m, 2H), 7.75-7.72 (m, 2H), 4.93–4.91 (m, 1H), 2.00-1.90 (m, 4H), 1.81-1.72 (m, 2H), 1.68-1.58 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 164.0, 134.2, 128.9, 123.2, 90.3, 31.6, 23.6.

HRMS (ESI) m/z: calcd for $C_{13}H_{13}NNaO_3^+$: M + Na = 254.0788; found: 254.0799.

2-(cyclododecyloxy)isoindoline-1,3-dione (Table 2, 2d).

50%, 165 mg, white solid, mp 111-112 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.81-7.75 (m, 2H), 7.70-7.66 (m, 2H), 4.40–4.34 (m, 1H), 1.87-1.79 (m, 2H), 1.70-1.59 (m, 4H), 1.46-1.25 (m, 16H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.6, 133.8, 128.6, 122.9, 86.3, 28.9, 24.7, 24.1, 23.9, 23.8, 21.6.

HRMS (ESI) m/z: calcd for $C_{20}H_{27}NNaO_3^+$: M + Na =352.1883; found: 352.1889.

2-((1r,3r,5r,7r)-adamantan-2-yloxy)isoindoline-1,3-dione (Table 2, 2e).

37%, 110 mg, white solid, mp 175-177 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.81-7.78 (m, 2H),7.74-7.70 (m, 2H), 4.33 (s, 1H), 2.44 (d, J = 12.8 Hz, 2H), 2.23 (d, J = 1.6 Hz, 2H), 1.91-1.84 (m, 4H), 1.75 (s, 2H), 1.67 (d, J = 12.8 Hz, 2H), 1.61-1.57 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.5, 133.8, 128.6, 122.9, 90.2, 37.6, 36.9, 31.9, 31.7, 27.7, 27.6.

HRMS (ESI) m/z: calcd for $C_{18}H_{19}NNaO_3^+$: M + Na =320.1257; found: 320.1249.

2-((tetrahydrofuran-2-yl)oxy)isoindoline-1,3-dione (Table 2, 2f).

89%, 207 mg, white solid, mp 133–134 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.82-7.78 (m, 2H), 7.73-7.69 (m, 2H), 5.77 (d, J = 4.8 Hz, 1H), 4.37-4.31 (m, 1H), 4.03-4.00 (m, 1H), 2.34-2.20 (m, 2H), 2.15-2.10 (m, 1H), 2.00-1.90 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.6, 134.1, 128.9, 123.2, 108.7, 69.1, 30.9, 22.6.

HRMS (ESI) m/z: calcd for $C_{12}H_{11}NNaO_4^+$: M + Na =256.0580; found: 256.0581.

2-((5-methyltetrahydrofuran-2-yl)oxy)isoindoline-1,3-dione (Table 2, 2g).

70%, 173 mg, white solid, mp 125-126 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.81-7.79 (m, 2H), 7.72-7.70 (m, 2H), 5.75 (d, J = 12.4 Hz, 1H), 4.74-4.66 (m, 1H), 2.29-2.22 (m, 3H), 1.55-1.47 (m, 1H), 1.25 (d, J = 6.4 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.4, 134.0, 129.0, 123.2, 108.8, 76.5, 30.7, 30.3, 20.6.

HRMS (ESI) m/z: calcd for $C_{13}H_{13}NNaO_4^+$: M + Na =270.0737; found: 270.0736.

2-((tetrahydro-2H-pyran-2-yl)oxy)isoindoline-1,3-dione (Table 2, 2h).

71%, 175 mg, white solid, mp 122-124 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.81-7.80 (m, 2H), 7.72-7.71 (m, 2H), 5.41 (s, 1H), 4.54-4.48 (m, 1H), 3.65 (d, J = 10.4 Hz, 1H), 2.11 (d, J = 13.6 Hz, 1H), 2.01-1.91 (m, 1H), 1.87-1.69 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.5, 134.1, 129.0, 123.2, 102.9, 62.24, 27.8, 24.9, 17.7.

HRMS (ESI) m/z: calcd for $C_{13}H_{13}NNaO_4^+$: M + Na =270.0737; found: 270.0749.

2-((1,4-dioxan-2-yl)oxy)isoindoline-1,3-dione (Table 2, 2i).

78%, 194 mg, white solid, mp 186-188 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.84-7.80 (m, 2H), 7.77-7.73 (m, 2H), 5.23 (d, J = 1.2 Hz, 1H), 4.87-4.41 (m, 1H), 4.15 (d, J = 10.4 Hz, 1H), 3.91-3.87(m, 1H), 3.83-3.79 (m, 2H), 3.54 (dd, J_1 = 2Hz, J_2 = 11.6 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.2, 134.3, 128.9, 123.4, 99.4, 66.1, 65.9, 60.9.

HRMS (ESI) m/z: calcd for $C_{12}H_{11}NNaO_5^+$: M + Na =272.0529; found: 272.0538.

2-(1-ethoxyethoxy)isoindoline-1,3-dione (Table 2, 2j).

58%, 136 mg, white oil, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.78-7.74 (m, 2H), 7.72-7.68 (m, 2H), 5.26 (q, J = 5.2 Hz, 1H), 4.18-4.11 (m, 1H), 3.84-3.76 (m, 1H), 1.52 (d, J = 5.2 Hz, 3H), 1.23 (t, J = 7.2Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.2, 133.7, 128.5, 122.7, 106.0, 63.5, 19.3, 15.3.

HRMS (ESI) m/z: calcd for $C_{12}H_{13}NNaO_4^+$: M + Na =258.0737; found: 258.0749.

2-(2-chloro-1-(2-chloroethoxy)ethoxy)isoindoline-1,3-dione (Table 2, 2k).

70%, 212 mg, white solid, mp 84-85 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.85-7.83 (m, 2H), 7.79-7.76 (m, 2H), 5.23 (dd, J_1 = 3.2 Hz, J_2 = 8 Hz, 1H), 4.49-4.32 (m, 1H), 4.16-4.10 (m, 1H), 3.92(dd, J_1 = 2.8 Hz, J_2 = 11.6 Hz, 1H), 3.72 (t, J = 6.0 Hz, 2H), 3.66 (dd, J_1 = 7.6 Hz, J_2 = 11.6 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.2, 134.1, 128.4, 123.3, 107.8, 70.1, 42.8, 42.6.

HRMS (ESI) m/z: calcd for $C_{12}H_{11}Cl_2NNaO_4^+$: M + Na =325.9957; found: 325.9950.

2-(2-bromo-1-(2-bromoethoxy)ethoxy)isoindoline-1,3-dione (Table 2, 2l).

76%, 296 mg, white solid, mp 110-112 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.86-7.82 (m, 2H), 7.80-7.76 (m, 2H), 5.26 (dd, J_1 = 2.8 Hz, J_2 = 8.0 Hz, 1H), 4.55-4.49 (m, 1H), 4.21-4.15 (m, J = 10.4 Hz, 1H), 3.75 (dd, J_1 = 2.8 Hz, J_2 = 10.8 Hz, 1H), 3.59-3.53 (m, 2H), 3.50 (dd, J_1 = 8.4 Hz, J_2 = 11.2 Hz, 1H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.2, 134.1, 128.4, 123.3, 107.8, 70.0, 29.9, 29.8.

HRMS (ESI) m/z: calcd for $C_{12}H_{11}Br_2NNaO_4^+$: M + Na =413.8947; found: 413.8927.

2-(1-butoxybutoxy)isoindoline-1,3-dione (Table 2, 2m).

45%, 131 mg, white oil , ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.82-7.78 (m, 2H), 7.77-7.73 (m, 2H), 5.10 (dd, J_1 = 4.4 Hz, J_2 = 7.2 Hz, 1H), 4.55-4.49 (m, 1H), 4.09-4.03 (m, 1H), 3.78-3.73 (m, 1H), 1.95-1.87 (m, 1H), 1.77-1.71 (m, 1H), 1.62-1.47 (m, 4H), 1.43-1.34 (m, 1H), 0.99-0.90 (m, 6H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 162.9, 133.5, 128.4, 122.5, 109.4, 68.0, 34.8, 31.8, 19.3, 18.1, 14.0.

HRMS (ESI) m/z: calcd for $C_{16}H_{21}NNaO_4^+$: M + Na =314.1363; found: 314.1372.

2-((cyclopentyloxy)methoxy)isoindoline-1,3-dione (Table 2, 2n).

40%, 104 mg, white solid, mp 72-73 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.83-7.79 (m, 2H), 7.75-

7.70 (m, 2H), 5.16 (s, 2H), 4.78-4.70 (m, 1H), 1.88-1.81 (m, 2H), 1.73-1.65 (m, 4H), 1.62-1.54 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 162.8, 133.8, 128.6, 123.0, 97.6, 80.2 , 32.5, 23.8.

HRMS (ESI) m/z: calcd for $C_{14}H_{15}NNaO_4^+$: M + Na =284.0893, found: 284.0881.

2-(tert-butoxymethoxy)isoindoline-1,3-dione (Table 2, 2o).

61%, 152 mg, white solid, mp 95-96 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.83-7.79 (m, 2H), 7.74-7.70 (m, 2H), 5.25 (s, 2H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 162.9, 133.7, 128.6, 122.9, 94.8, 77.1, 28.7.

HRMS (ESI) m/z: calcd for $C_{13}H_{15}NNaO_4^+$: M + Na =272.0893; found: 272.0898.

2-(1-(tert-butoxy)ethoxy)isoindoline-1,3-dione (Table 2, 2p).

30%, 79 mg, white solid, mp 68-70 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.83-7.81 (m, 2H), 7.46-7.34 (m, 2H), 5.54 (d, J = 5.2 Hz, 1H), 1.46 (d, J = 4.8 Hz, 3H), 1.31 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 164.2, 134.2, 129.0, 123.2, 101.0, 76.3, 28.4, 21.1.

HRMS (ESI) m/z: calcd for $C_{14}H_{17}NNaO_4^+$: M + Na =286.1050; found: 286.1057.

2-((2-methoxyethoxy)methoxy)isoindoline-1,3-dione (Table 2, 2q).

29%, 72 mg, white solid, mp 80-82 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.78-7.76 (m, 2H), 7.70-7.68 (m, 2H), 5.17 (s, 2H), 4.10 (t, J = 4.4 Hz, 2H), 3.59 (t, J = 4.4 Hz, 2H), 3.36 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 162.7, 133.8, 128.6, 123.0, 99.8, 71.5, 69.1, 59.1.

HRMS (ESI) m/z: calcd for $C_{12}H_{13}NNaO_5^+$: M + Na =274.0686; found: 274.0697.

2-(1,2-dimethoxyethoxy)isoindoline-1,3-dione (Table 2, 2r).

31%, 78 mg, white solid, mp 65-66 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.79-7.61 (m, 2H), 7.72-7.69 (m, 2H), 5.10 (dd, J_1 = 4.0 Hz, J_2 = 6.0 Hz, 1H), 3.77 (dd, J_1 = 4.0 Hz, J_2 = 10.8 Hz, 1H), 3.74 (s, 3H), 3.58 (dd, J_1 = 6.0 Hz, J_2 = 10.8 Hz, 1H), 3.39 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.1, 133.9, 128.6, 123.1, 108.1, 71.8, 59.6, 57.2.

HRMS (ESI) m/z: calcd for $C_{12}H_{13}NNaO_5^+$: M + Na =274.0686; found: 274.0684.

2-((tetrahydrothiophen-2-yl)oxy)isoindoline-1,3-dione (Table 2, 2s).

88%, 219 mg, white solid, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.84-7.80 (m, 2H), 7.75-7.71 (m, 2H), 6.10 (d, J = 4 Hz, 1H), 3.17-3.12 (m, 1H), 2.92-2.85 (m, 1H), 2.59 (dd, J_1 = 5.6 Hz, J_2 = 13.6 Hz,1H), 2.41-2.35 (m, 1H), 2.27-2.20 (m, 1H), 2.04-1.94 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 163.1, 133.9, 128.4, 123.1, 97.1, 37.4, 32.9, 27.6.

HRMS (ESI) m/z: calcd for $C_{12}H_{11}NNaO_3S^+$: M + Na =272.0352; found: 272.0344.

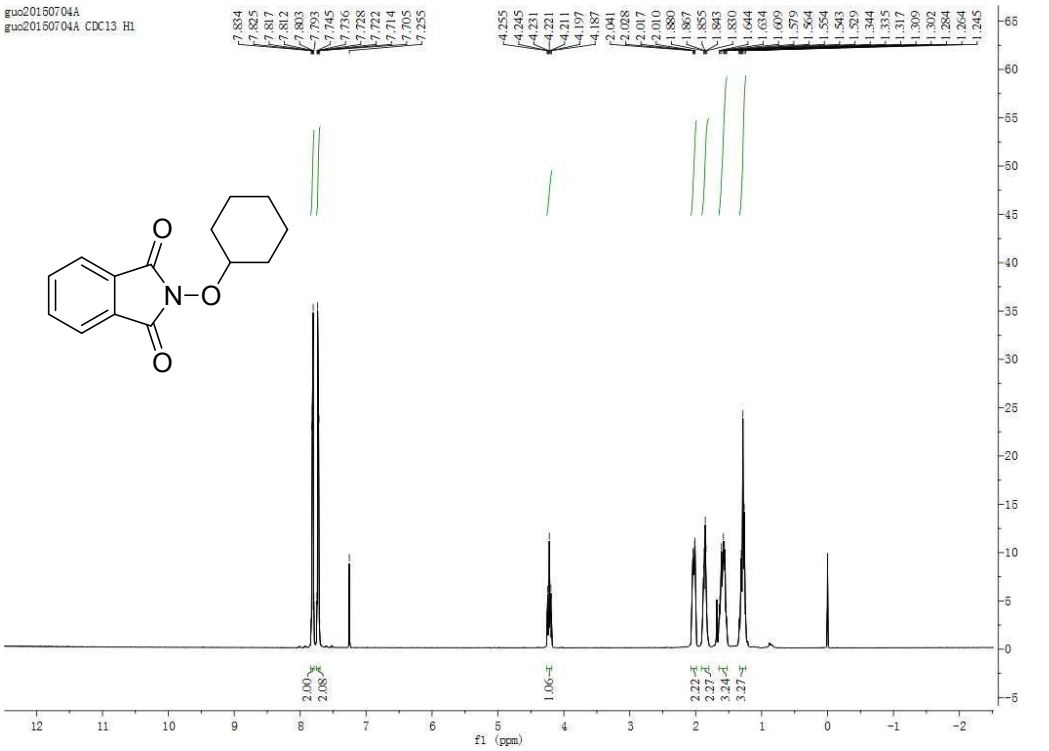
2-(1-(butylthio)butoxy)isoindoline-1,3-dione (Table 2, 2t).

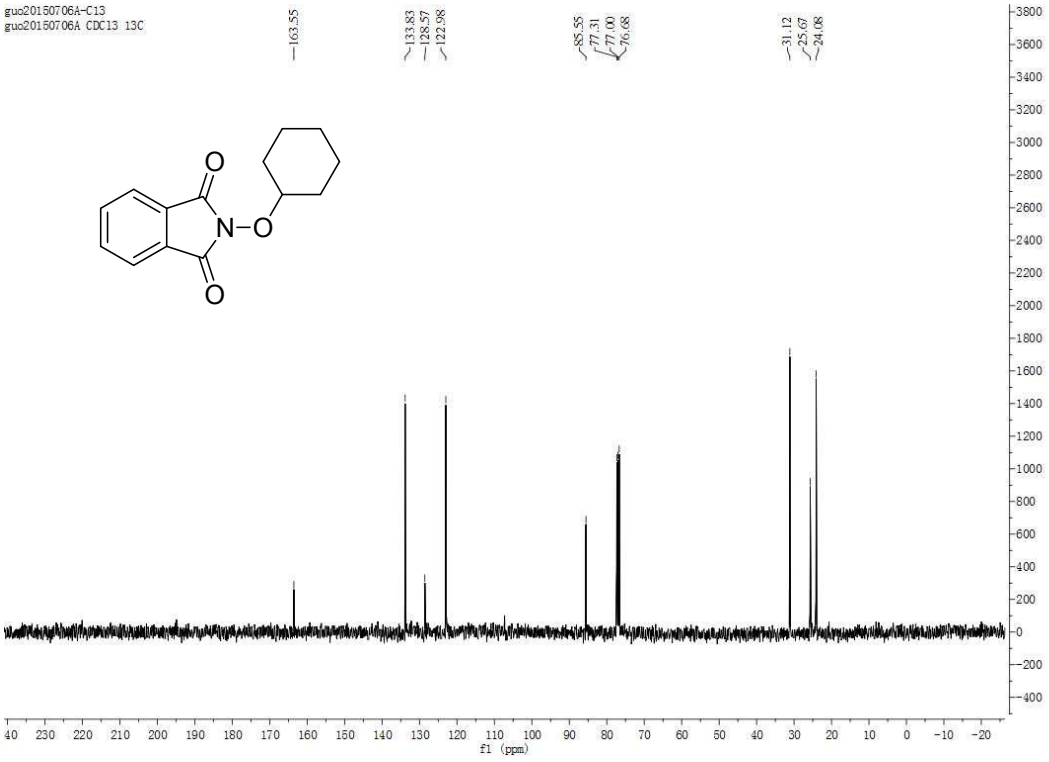
70%, 215 mg, white solid, mp 31-32 ºC, ^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.83-7.81 (m, 2H), 7.75-7.23 (m, 2H), 5.36 (t, J = 6.4 Hz, 1H), 2.92-2.86 (m, 1H), 2.78-2.71 (m, 1H), 2.14-2.05 (m, 1H), 1.94-1.85 (m, 1H), 1.68-1.51 (m, 4H), 1.45-1.36 (m, 2H), 1.00 (t, J = 7.2 Hz, 3H), 0.91 (t, J = 7.2 Hz, 3H).

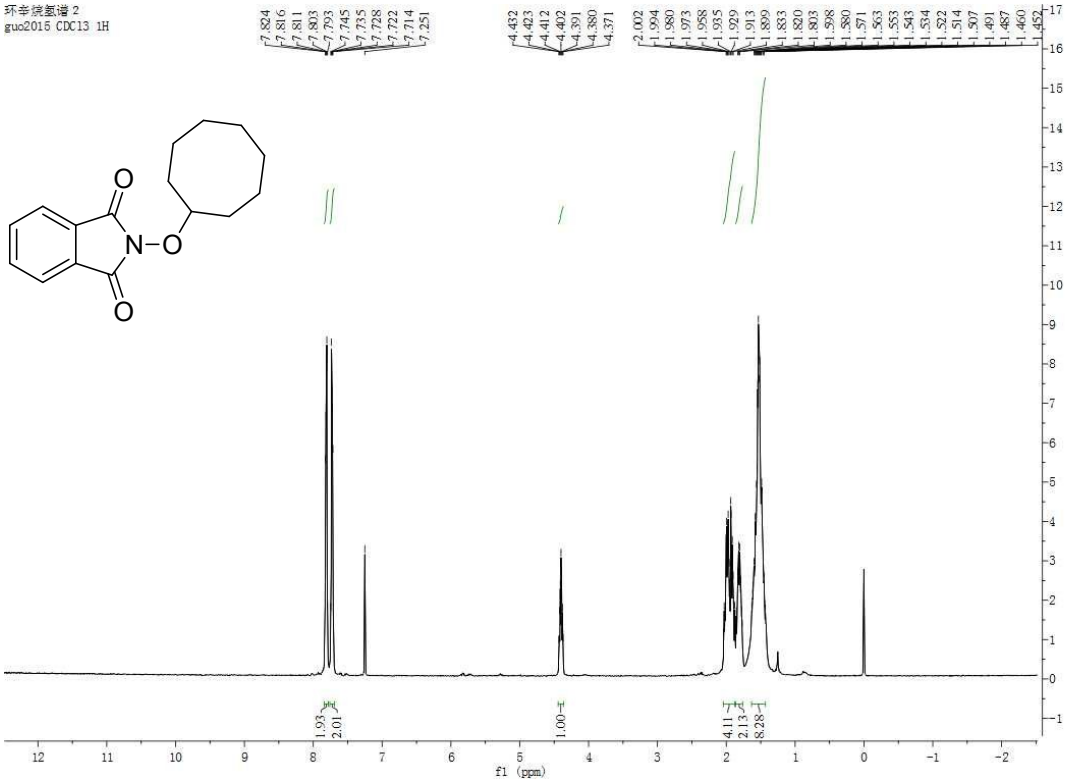
^{13}C NMR (101 MHz, $CDCl_3$): δ 162.6, 133.5, 128.2, 122.5, 93.2, 35.6, 31.7, 28.6, 22.2, 19.6, 13.8.

HRMS (ESI) m/z: calcd for $C_{16}H_{21}NNaO_3S^+$: M + Na =330.1134; found: 330.1119.

NMR spectra of product



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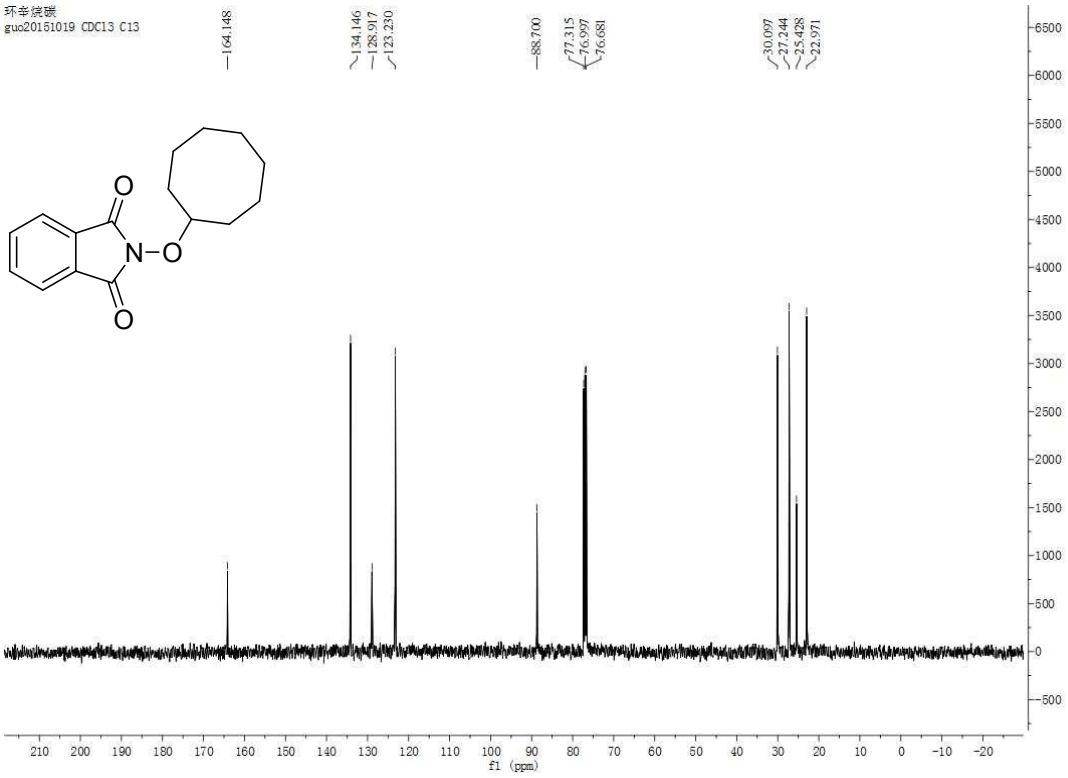
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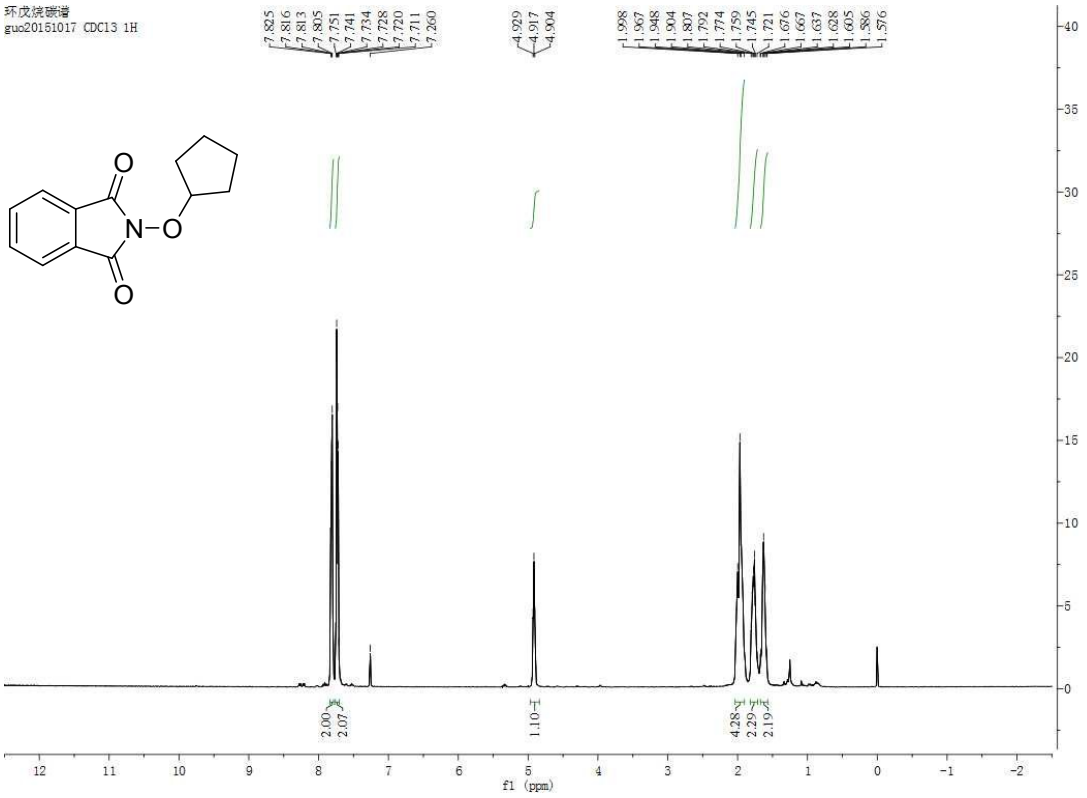
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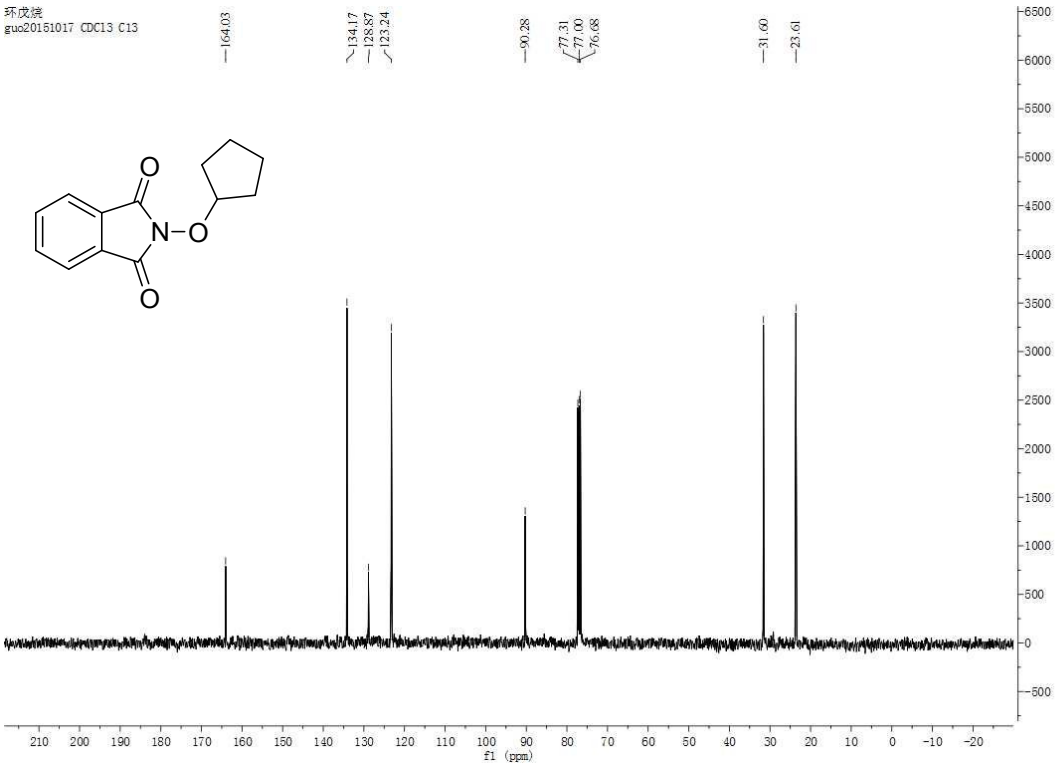
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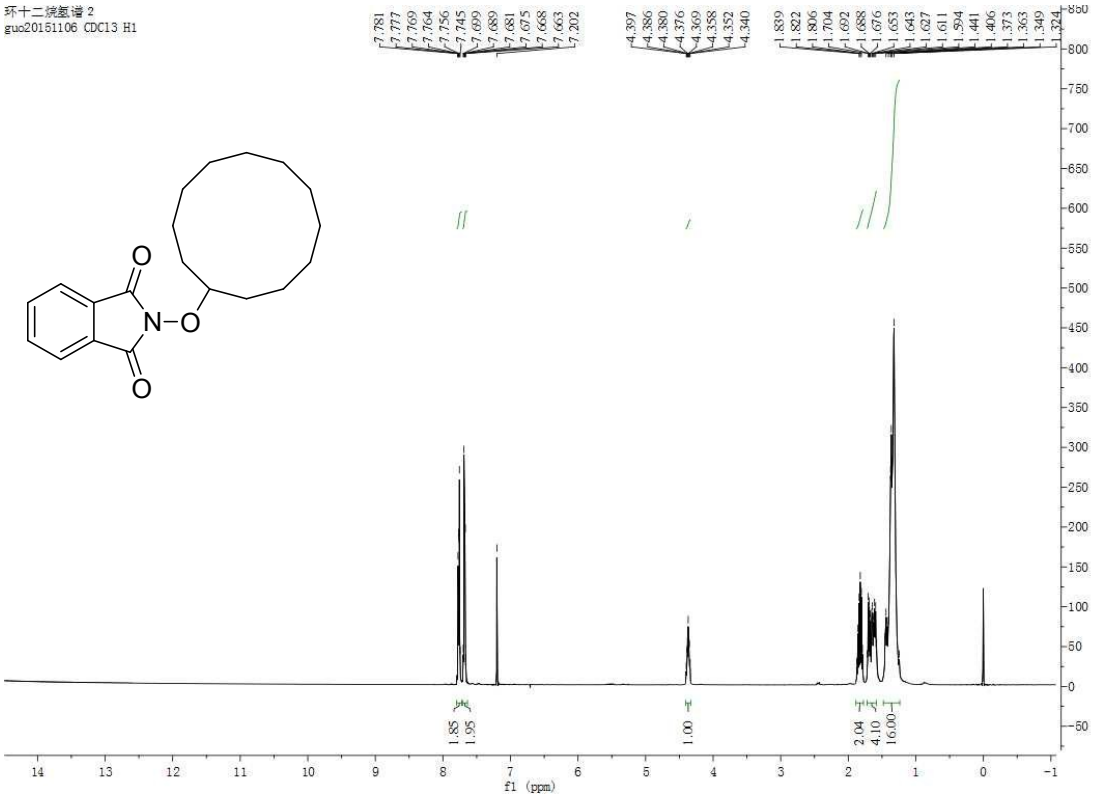
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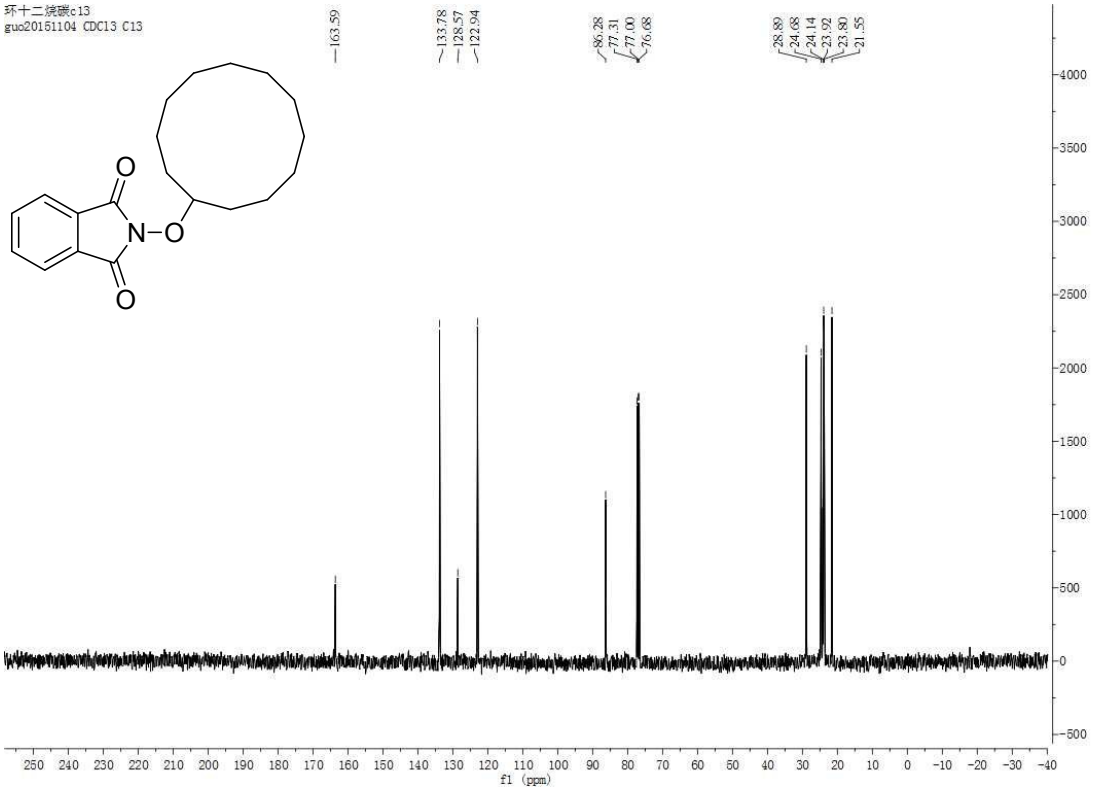
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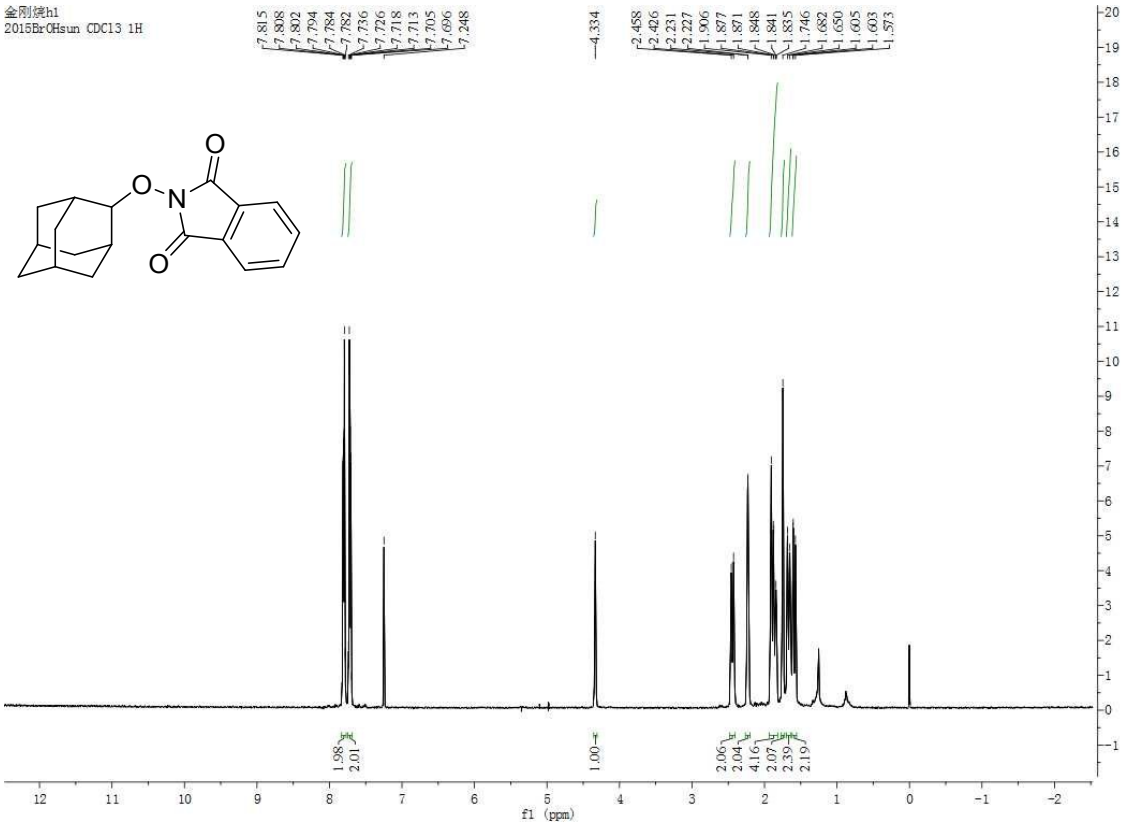
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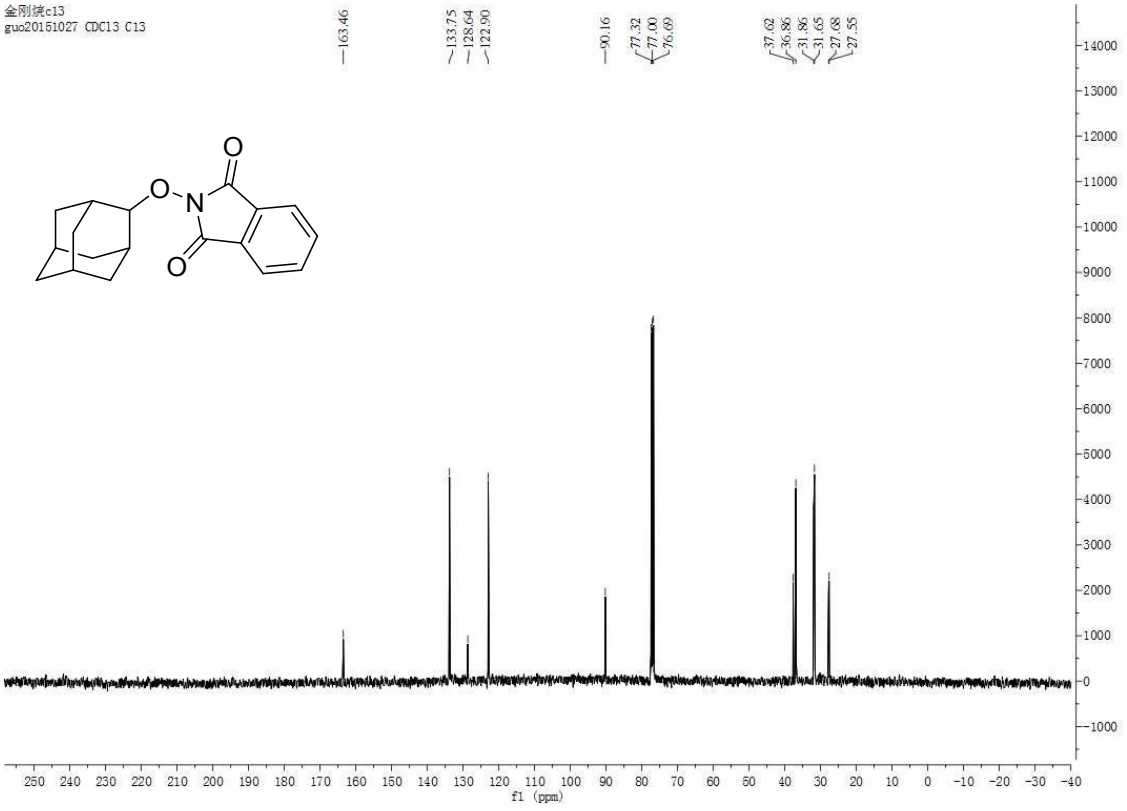
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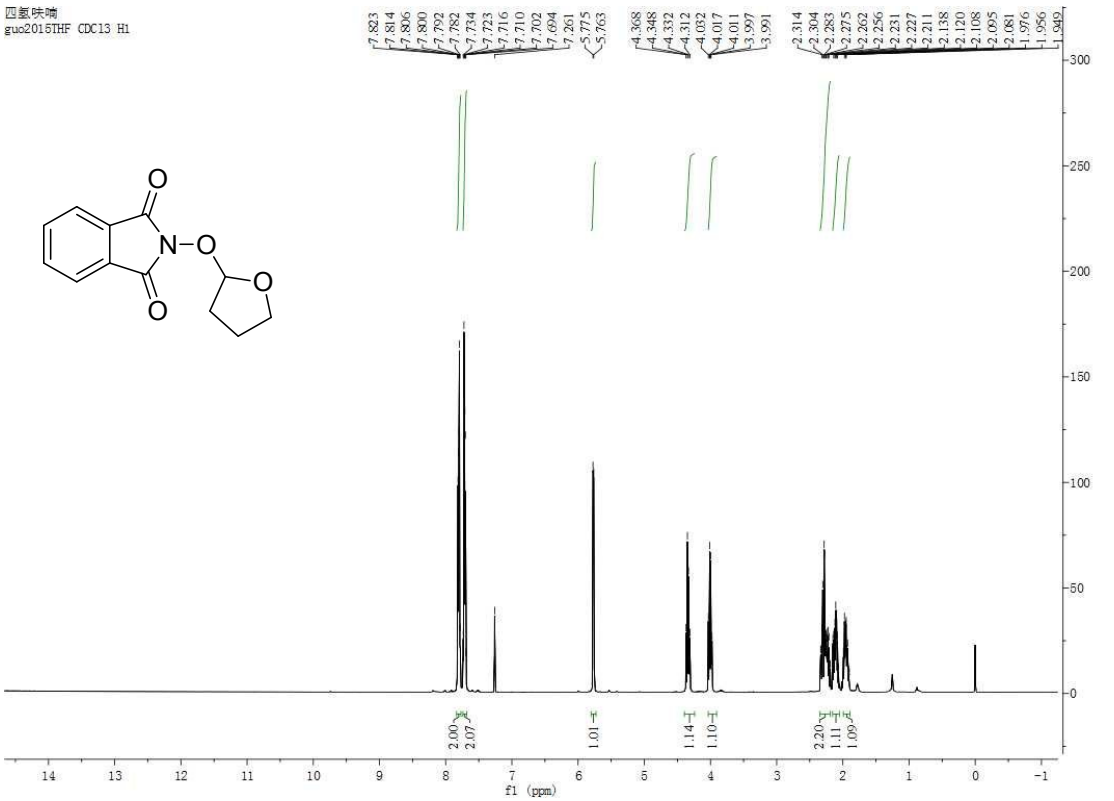
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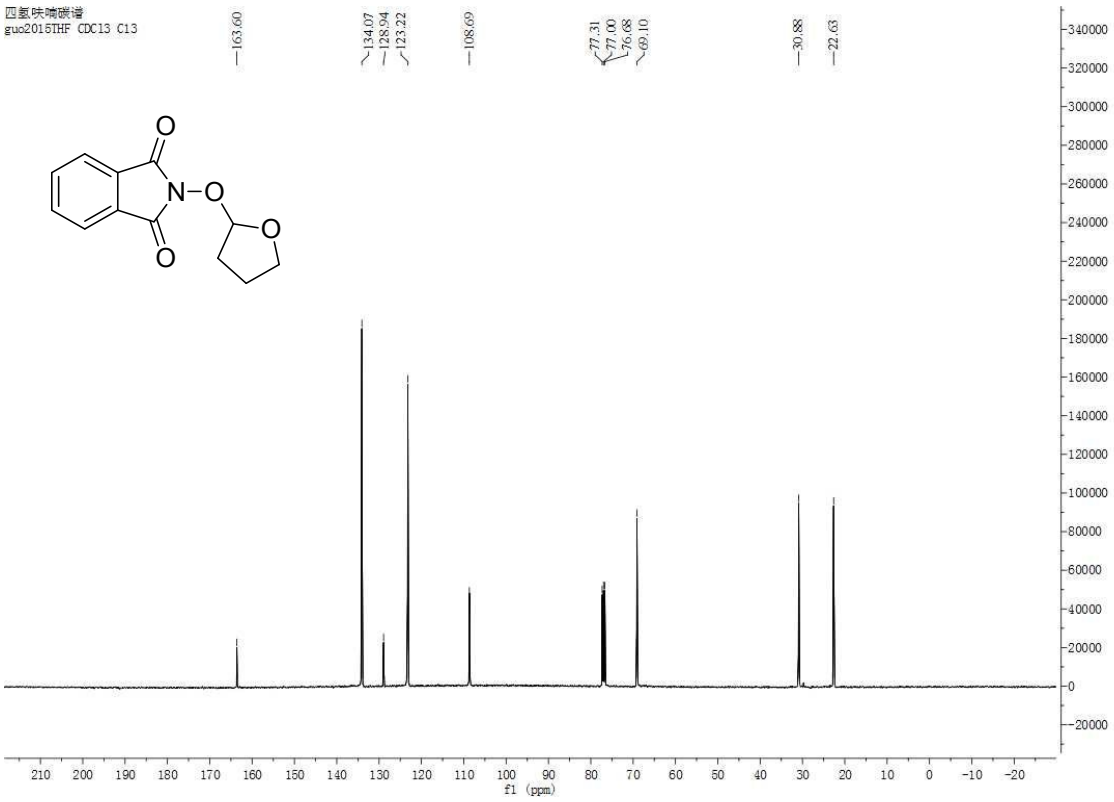
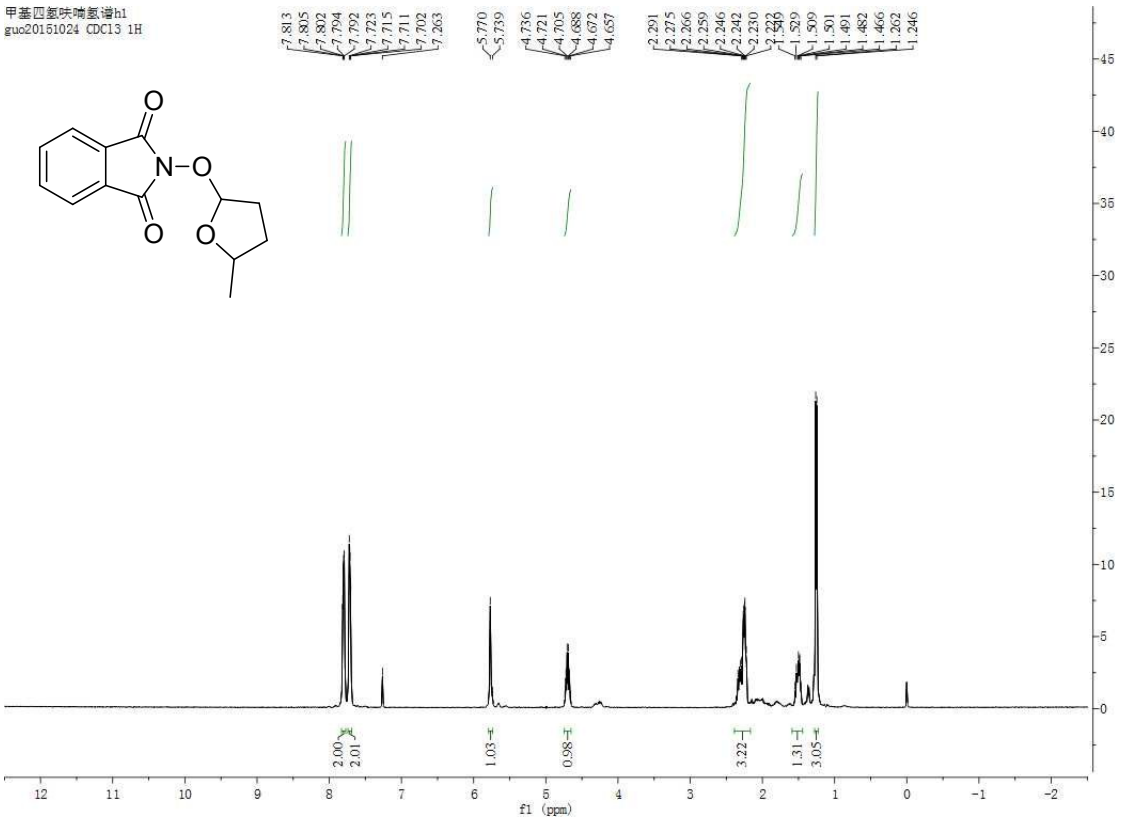
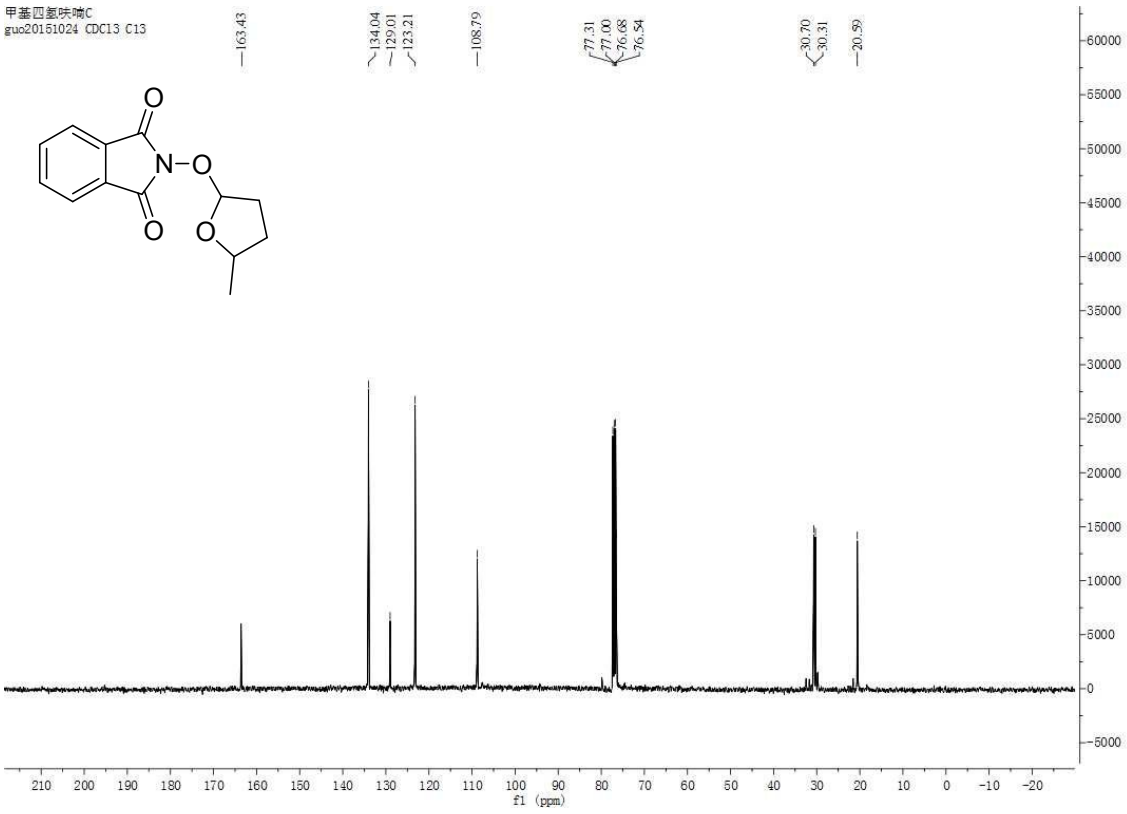
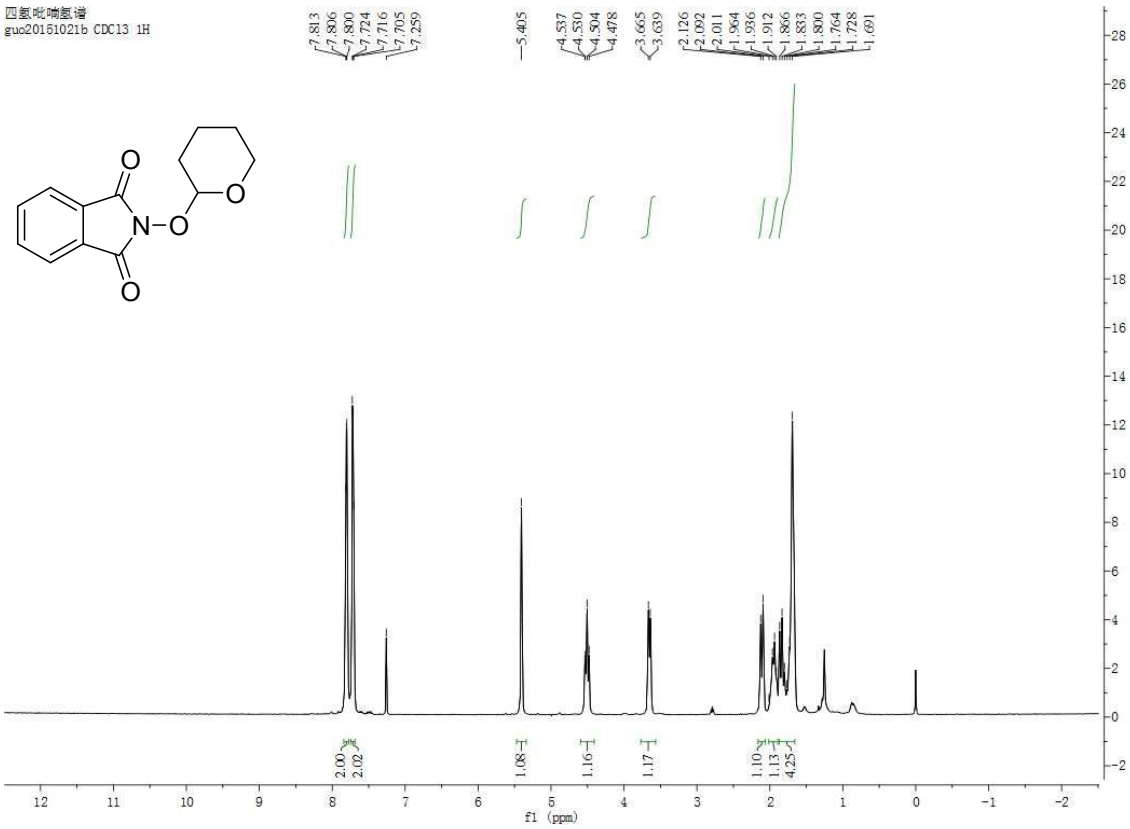
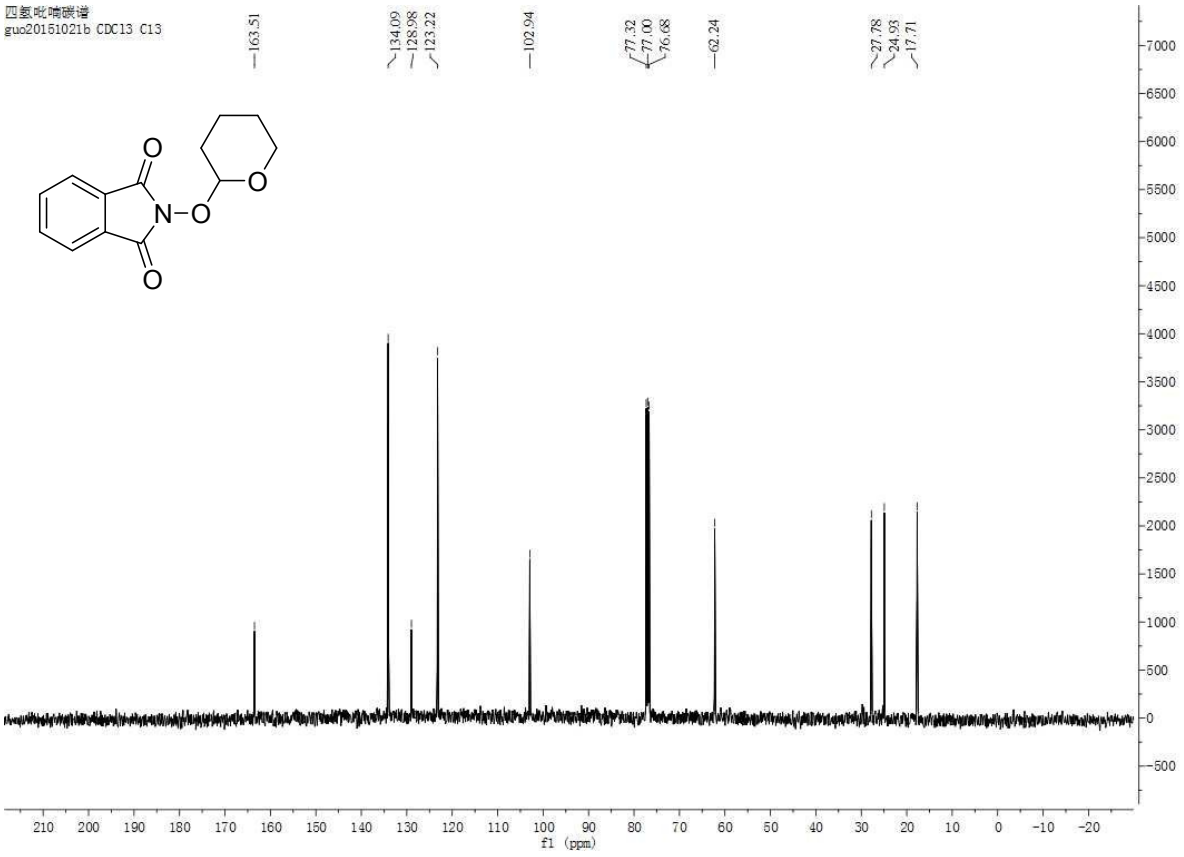
4.011
3.997
3.991
2.314
2.304
2.283
2.275
2.262
2.256
2.231
2.227
2.211
2.138
2.120
2.108
2.095
2.081
1.976
1.956
1.949
2.00
2.07
1.01
1.14
1.10
2.20
1.11
1.09
f1 (ppm)

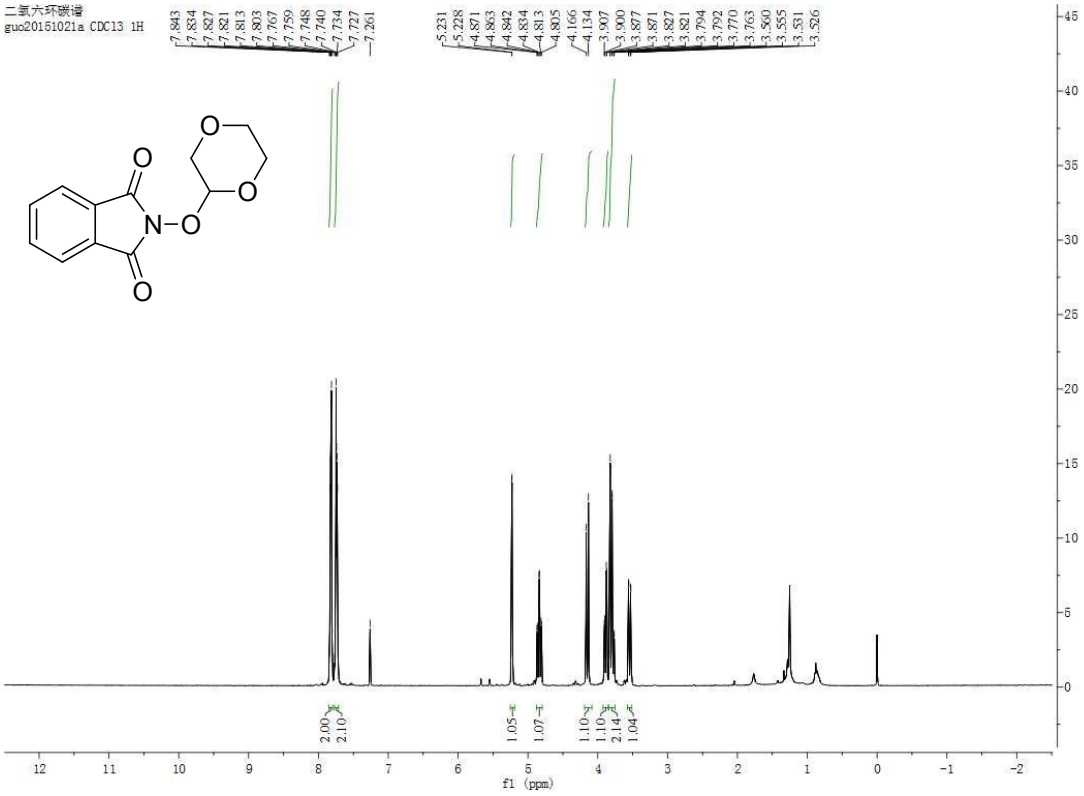

四氢呋喃碳谱
guo2015THF CDC13 C13
163.60
134.07
128.94
123.22
108.69
77.31
77.00
76.68
69.10
30.88
22.63
f1 (ppm)

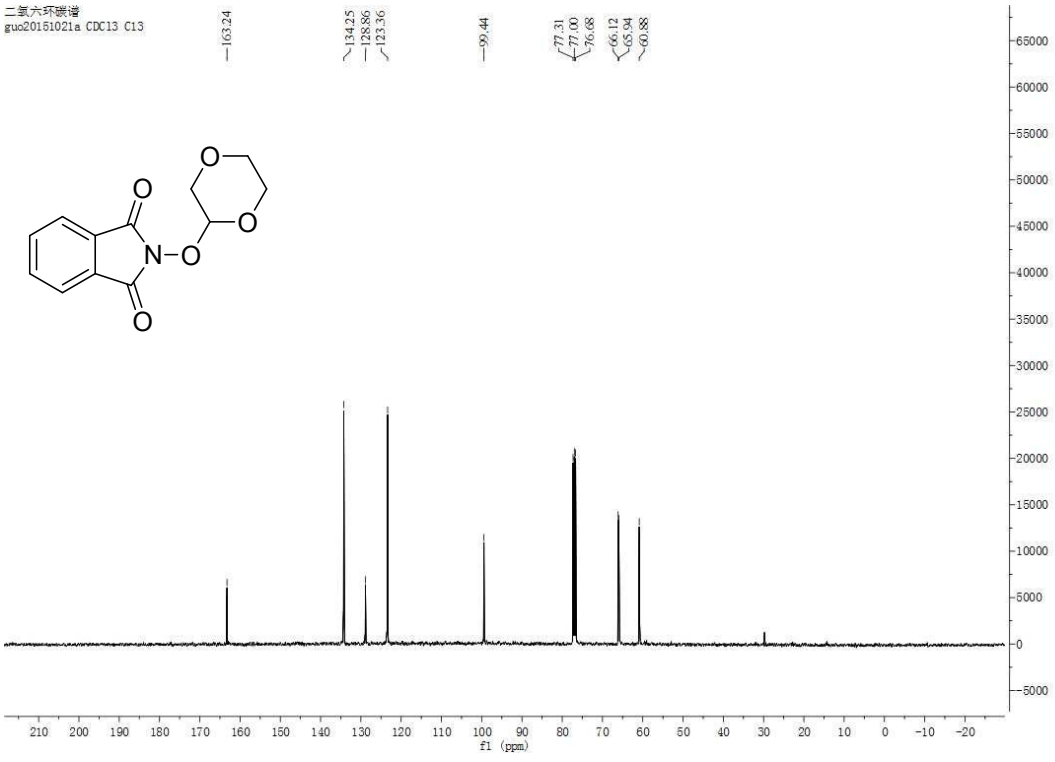

甲基四氢呋喃氢谱h1
guo20151024 CDCl3 1H
7.813
7.805
7.802
7.794
7.792
7.723
7.715
7.711
7.702
7.263
5.770
5.739
4.736
4.721
4.705
4.688
4.672
4.657
2.291
2.275
2.266
2.259
2.246
2.242
2.230
2.222
1.529
1.509
1.501
1.491
1.482
1.466
1.262
1.246
2.00
2.01
1.03
0.98
3.22
1.31
3.05
f1 (ppm)

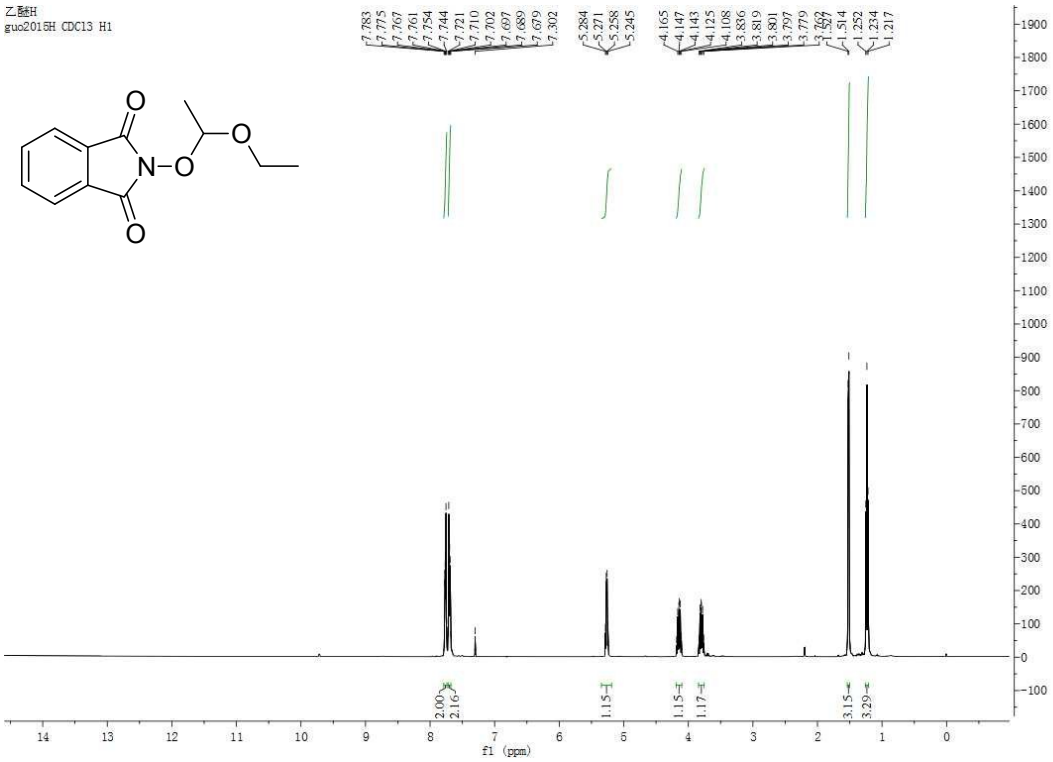

甲基四氢呋喃C
guo20151024 CDCl3 C13
163.43
134.04
129.01
123.21
108.79
77.31
77.00
76.68
76.54
30.70
30.31
20.59
f1 (ppm)

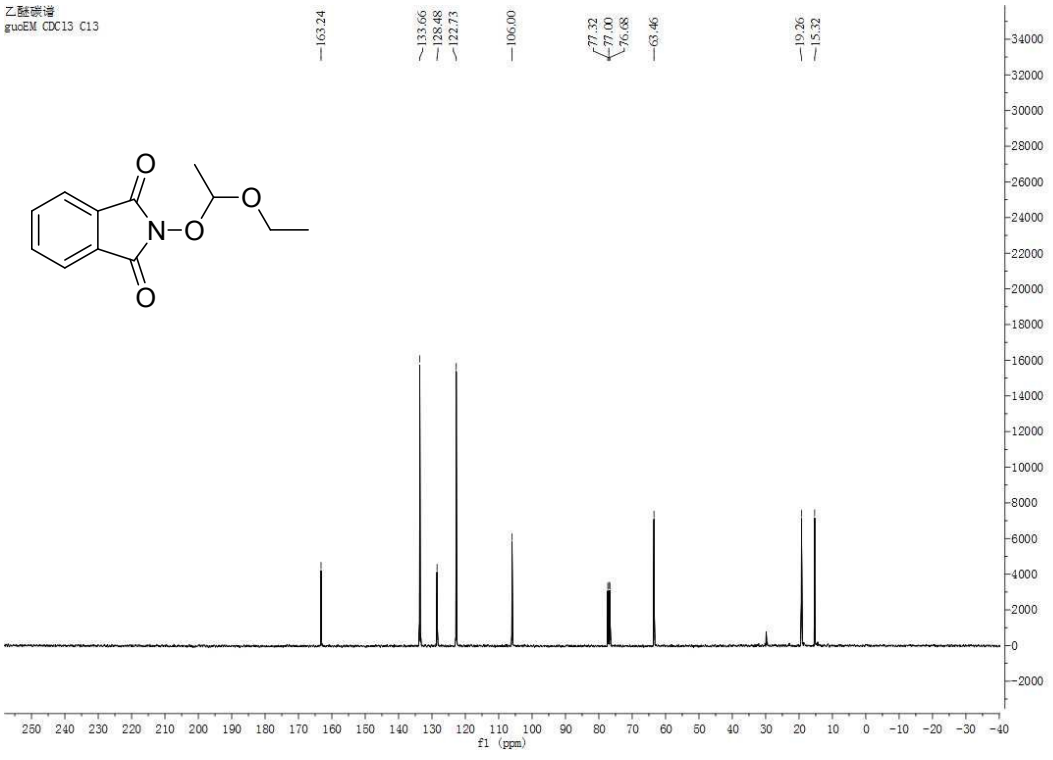

四氢吡喃氢谱
guo20151021b CDC13 1H
7.813
7.806
7.800
7.724
7.716
7.705
7.259
5.405
4.537
4.530
4.504
4.478
3.665
3.639
2.126
2.092
2.011
1.964
1.936
1.912
1.866
1.833
1.800
1.764
1.728
1.691
2.00
2.02
1.08
1.16
1.17
1.10
1.13
4.25
f1 (ppm)

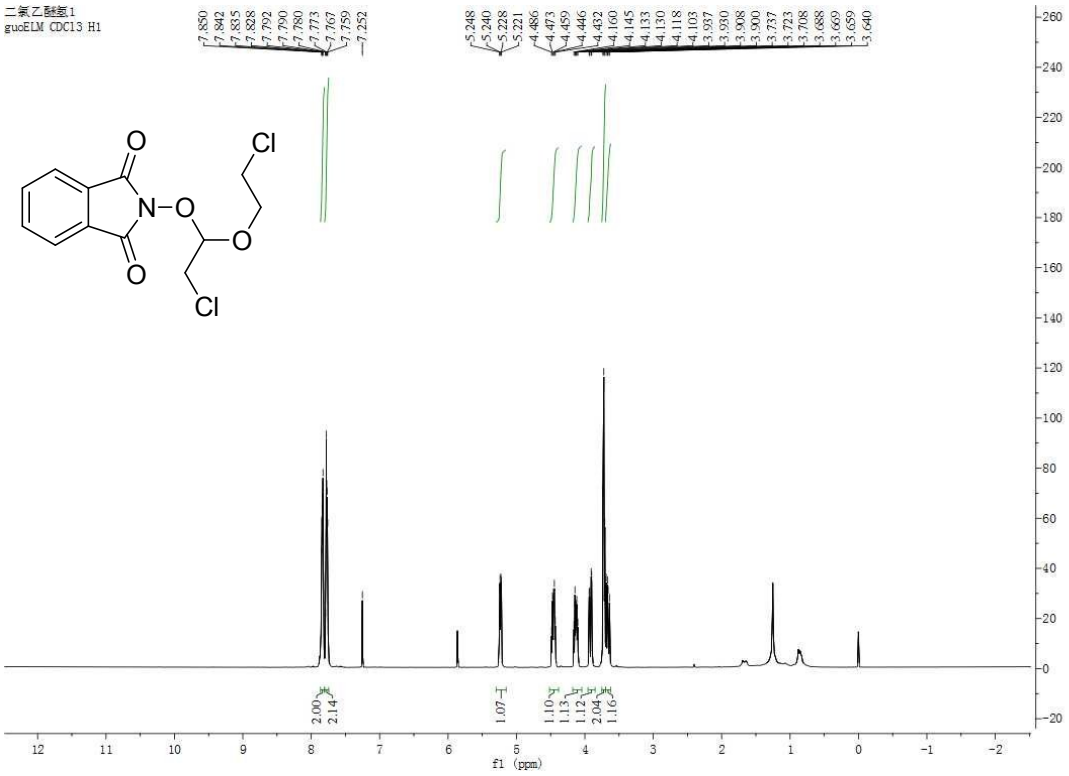

四氢吡喃碳谱
guo20151021b CDC13 C13
163.51
134.09
128.98
123.22
102.94
77.32
77.00
76.68
62.24
27.78
24.93
17.71
f1 (ppm)

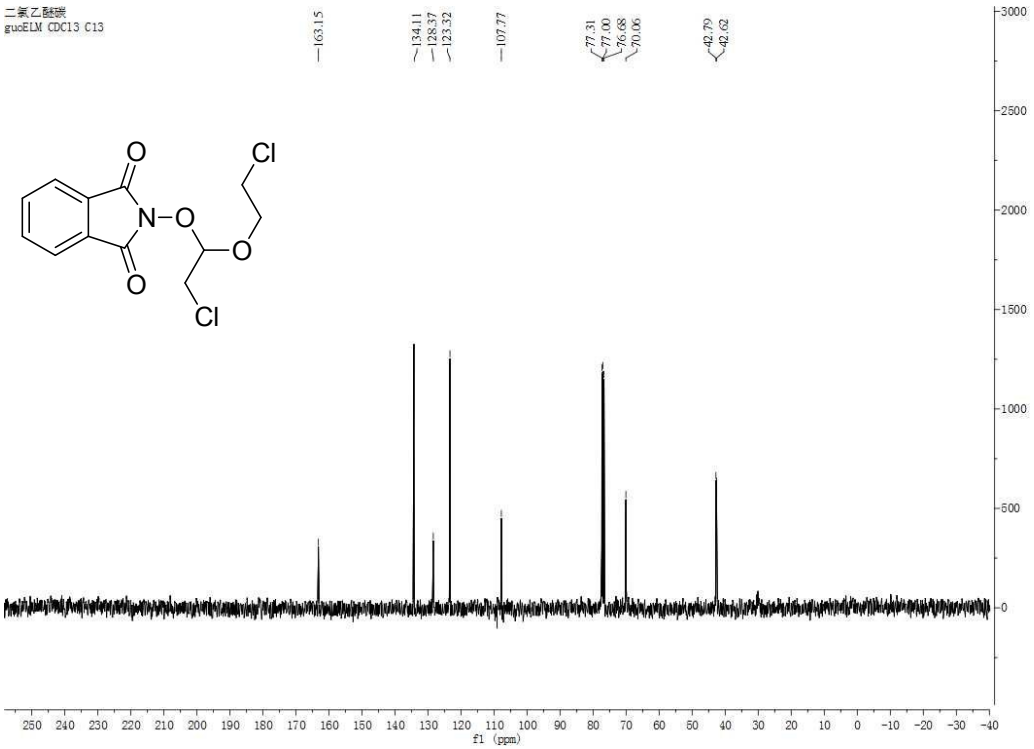

二氢六环碳谱
guo20151021a CDC13 1H
7.843
7.834
7.827
7.821
7.813
7.803
7.767
7.759
7.748
7.740
7.734
7.727
7.261
5.231
5.228
4.871
4.863
4.842
4.834
4.813
4.805
4.166
4.134
3.907
3.900
3.877
3.871
3.827
3.821
3.794
3.792
3.770
3.763
3.560
3.555
3.531
3.526
2.00
2.10
1.05
1.07
1.10
1.10
2.14
1.04
f1 (ppm)

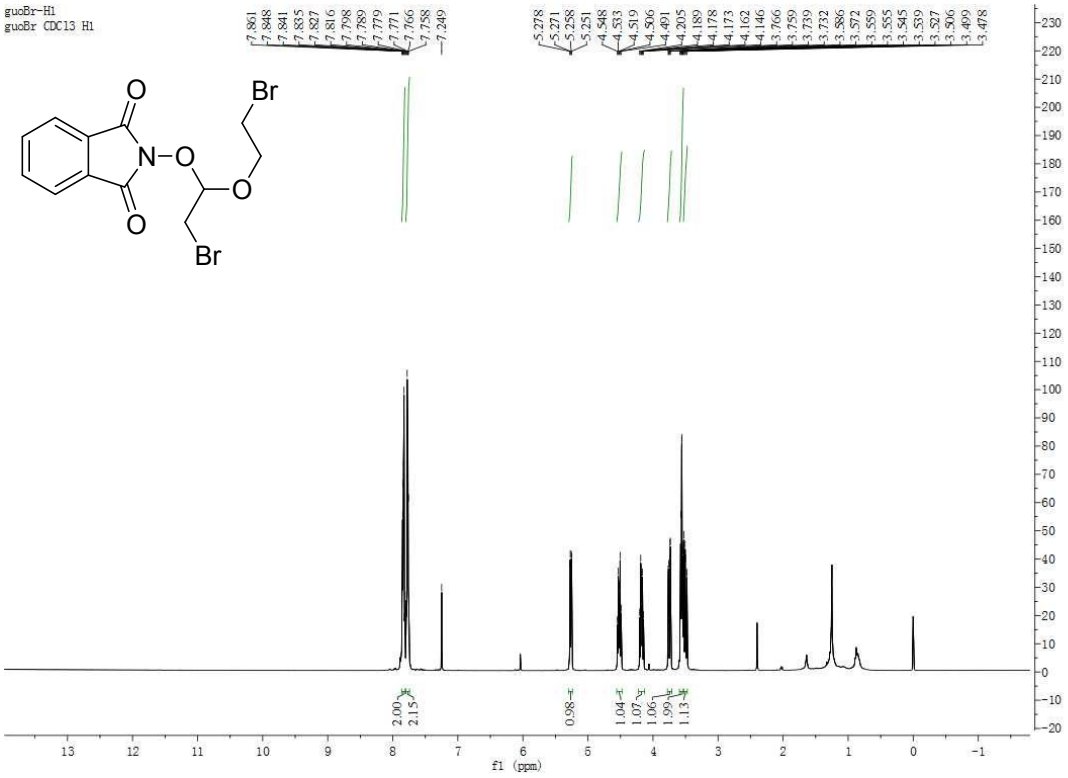

二氢六环碳谱
guo20151021a CDC13 C13
163.24
134.25
128.86
123.36
99.44
77.31
77.00
76.68
66.12
65.94
60.88
f1 (ppm)

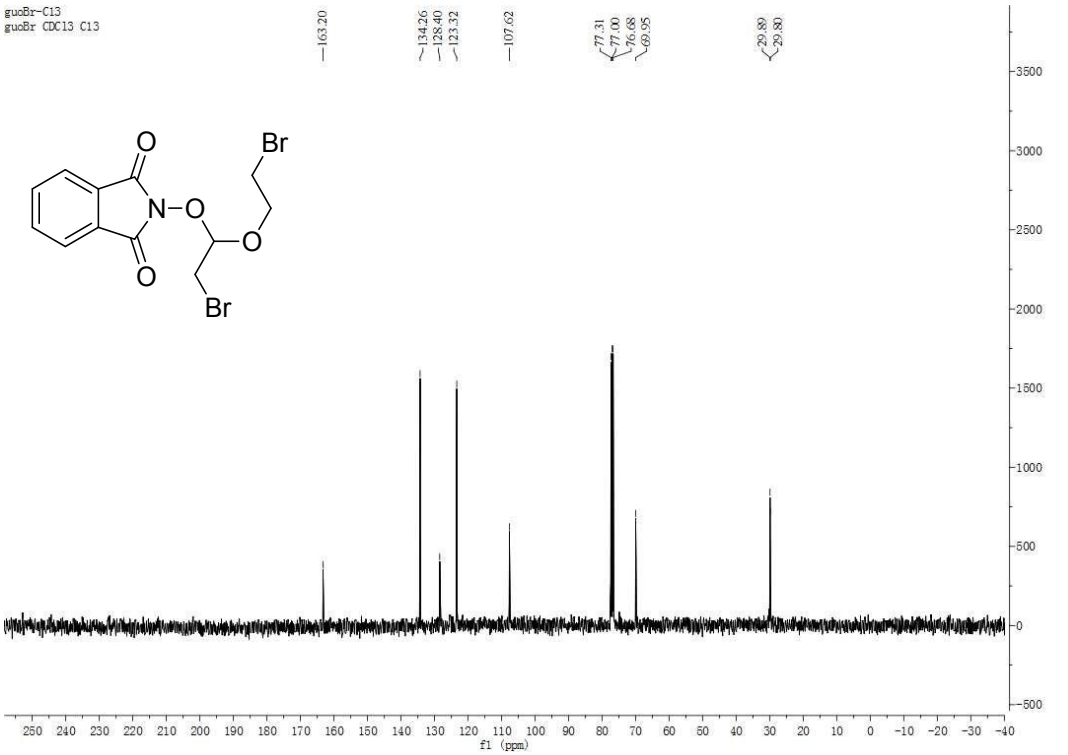

乙酰H
guo2016H CDC13 H1
7.783
7.775
7.767
7.761
7.754
7.744
7.721
7.710
7.702
7.697
7.689
7.679
7.302
5.284
5.271
5.258
5.245
4.165
4.147
4.143
4.125
4.108
3.836
3.819
3.801
3.797
3.779
1.514
1.252
1.234
1.217
2.00
2.16
1.15
1.15
1.17
3.15
3.29
f1 (ppm)

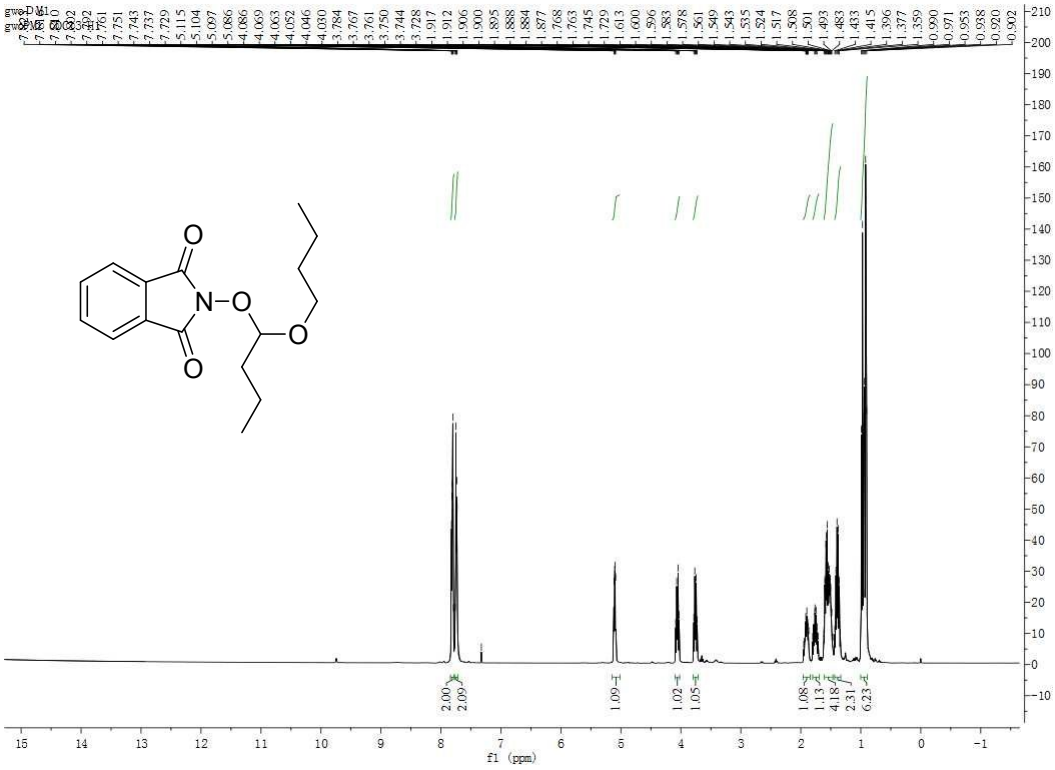

乙酰碳谱
guoEM CDC13 C13
163.24
133.66
128.48
122.73
106.00
77.32
77.00
76.68
63.46
19.26
15.32
f1 (ppm)

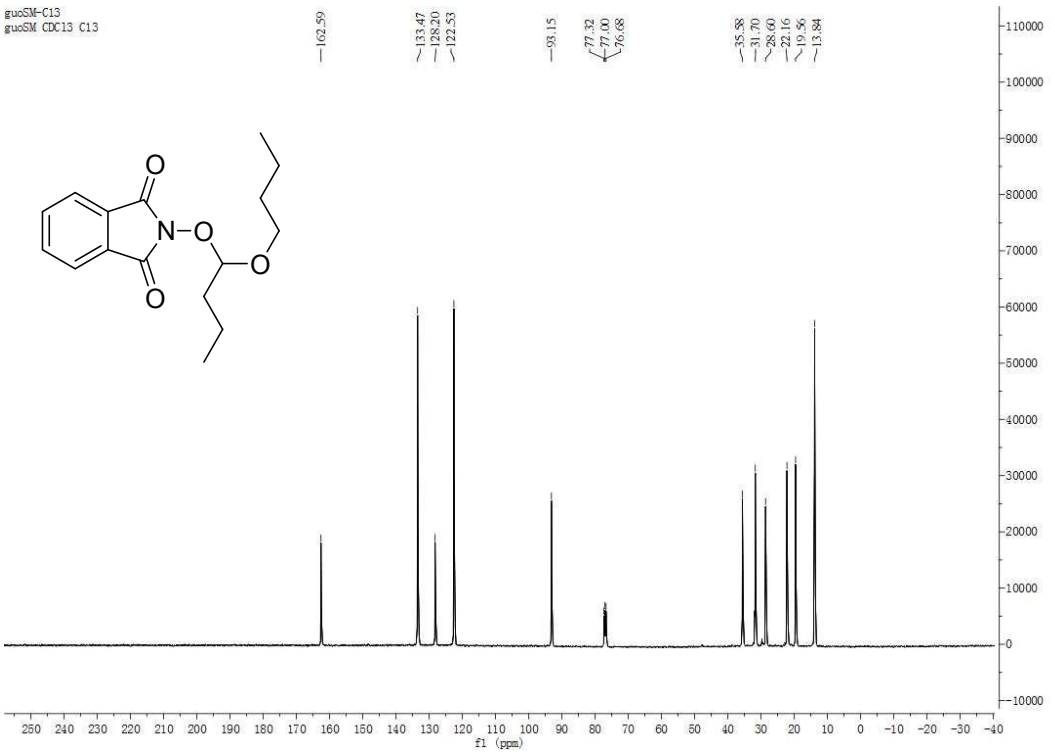

二氯乙醚胺1
guoELM CDCl3 H1
7.850
7.842
7.835
7.828
7.792
7.790
7.780
7.773
7.767
7.759
7.252
5.248
5.240
5.228
5.221
4.486
4.473
4.459
4.446
4.432
4.160
4.145
4.133
4.130
4.118
4.103
3.937
3.930
3.908
3.900
3.737
3.723
3.708
3.688
3.669
3.659
3.640
O
Cl
N−O
O
O
Cl
2.00
2.14
1.07
1.10
1.13
1.12
2.04
1.16
f1 (ppm)

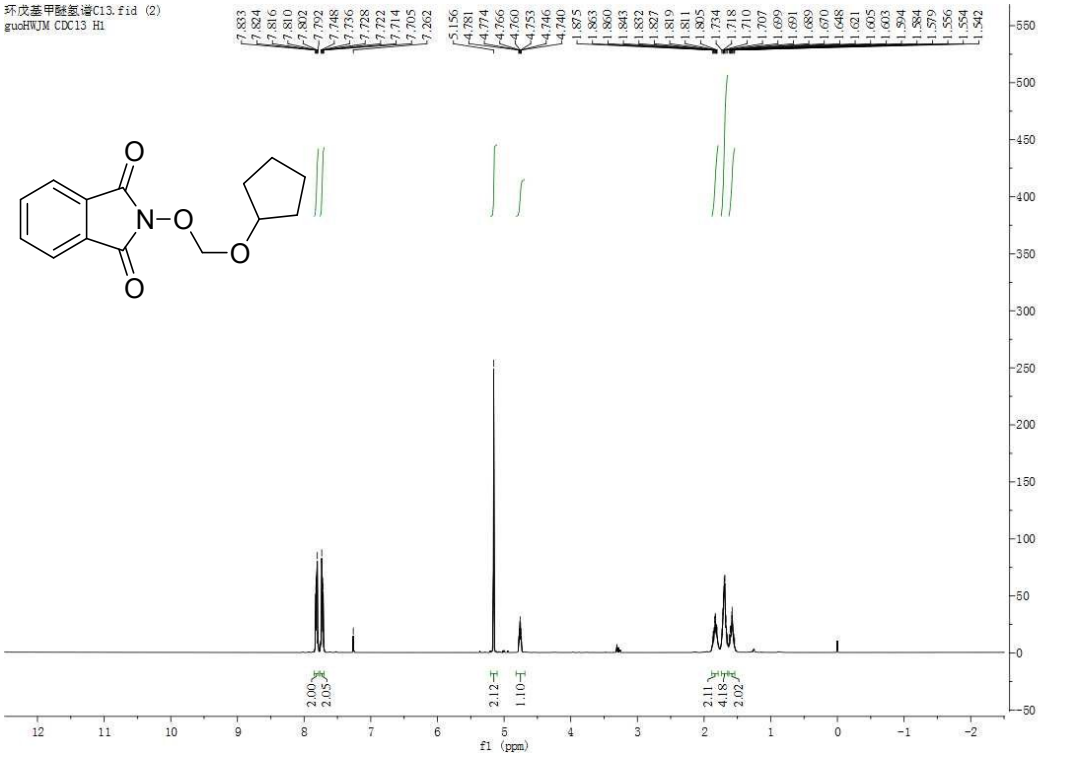

二氯乙醚碳
guoELM CDCl3 C13
163.15
134.11
128.37
123.32
107.77
77.31
77.00
76.68
70.06
42.79
42.62
O
Cl
N−O
O
O
Cl
f1 (ppm)

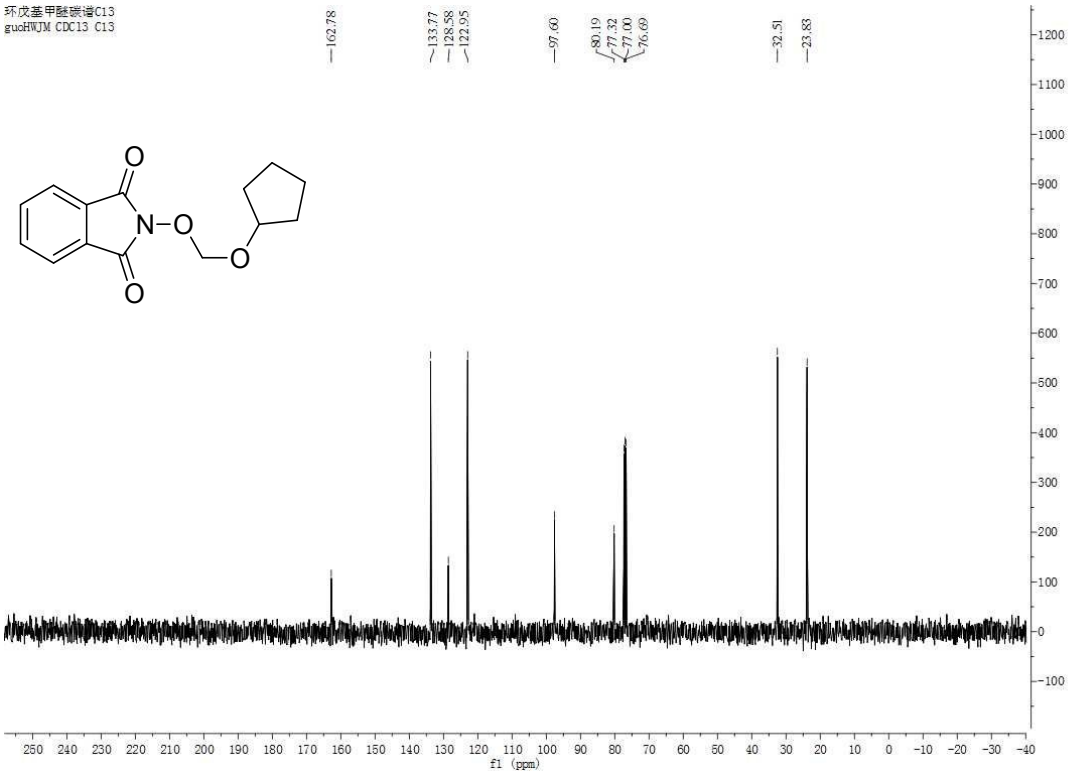

guoBr-H1
guoBr CDCl3 H1
7.861
7.848
7.841
7.835
7.827
7.816
7.798
7.789
7.779
7.771
7.766
7.758
7.249
5.278
5.271
5.258
5.251
4.548
4.533
4.519
4.506
4.491
4.205
4.189
4.178
4.173
4.162
4.146
3.766
3.759
3.739
3.732
3.586
3.572
3.559
3.555
3.545
3.539
3.527
3.506
3.499
3.478
O
N
O
O
O
Br
Br
2.00
2.15
0.98
1.04
1.07
1.06
1.99
1.13
f1 (ppm)

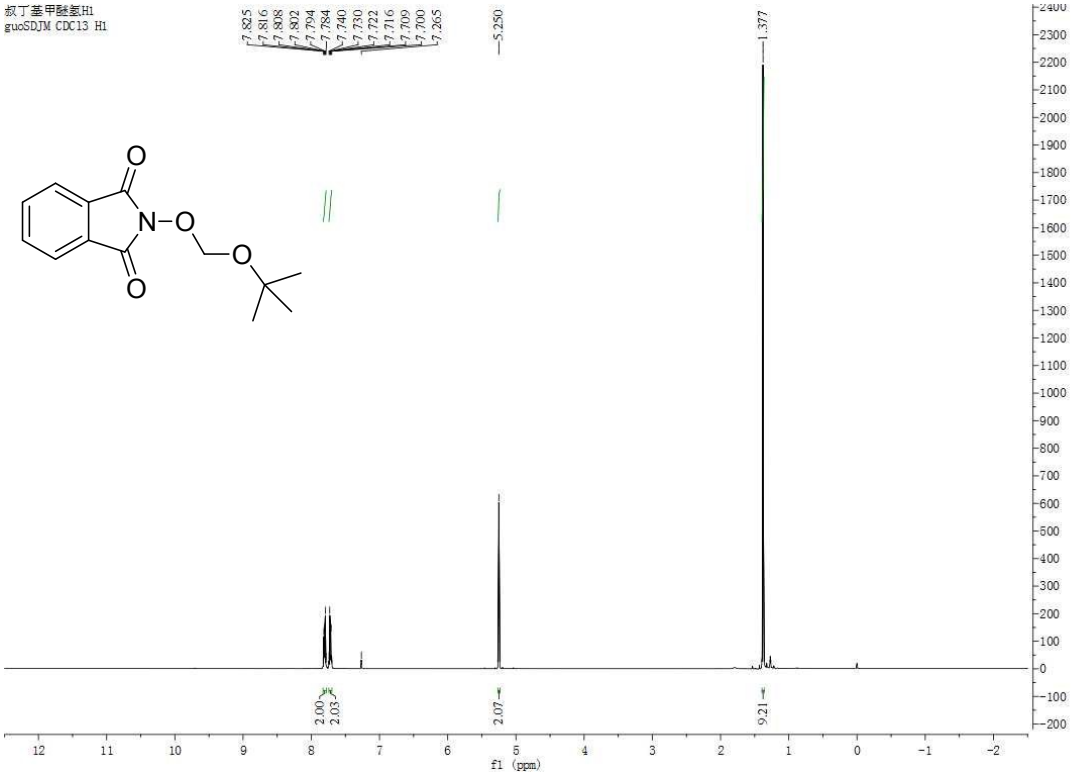

guoBr-C13
guoBr CDCl3 C13
163.20
134.26
128.40
123.32
107.62
77.31
77.00
76.68
69.95
29.89
29.80
O
N
O
O
O
Br
Br
f1 (ppm)

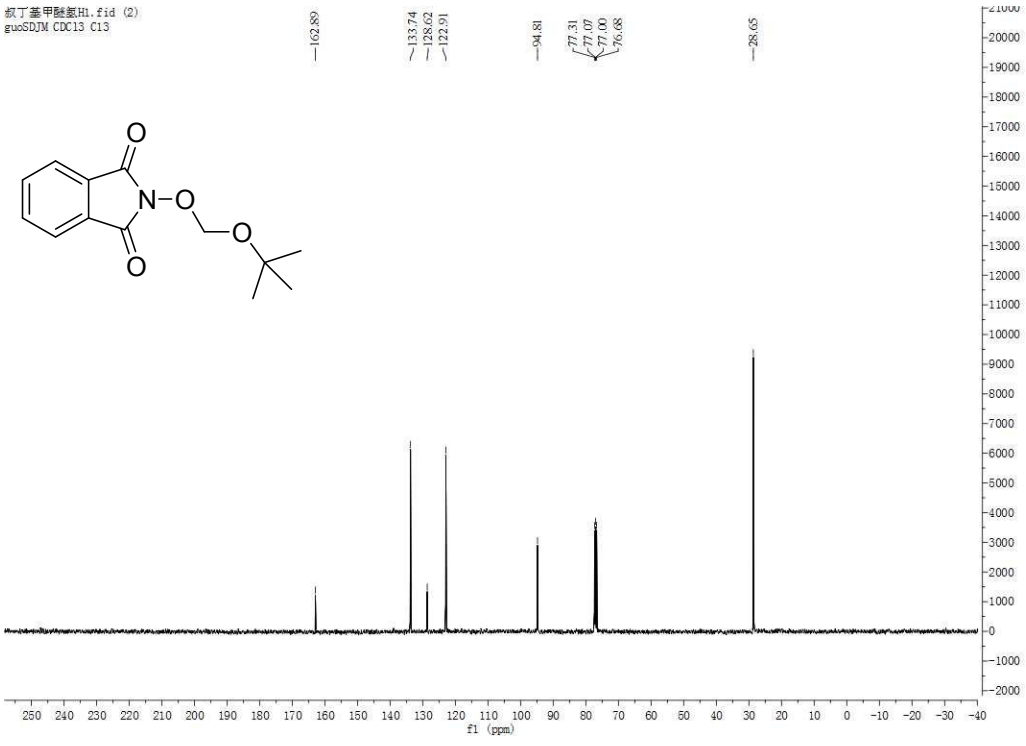

O
N–O
O
O
f1 (ppm)

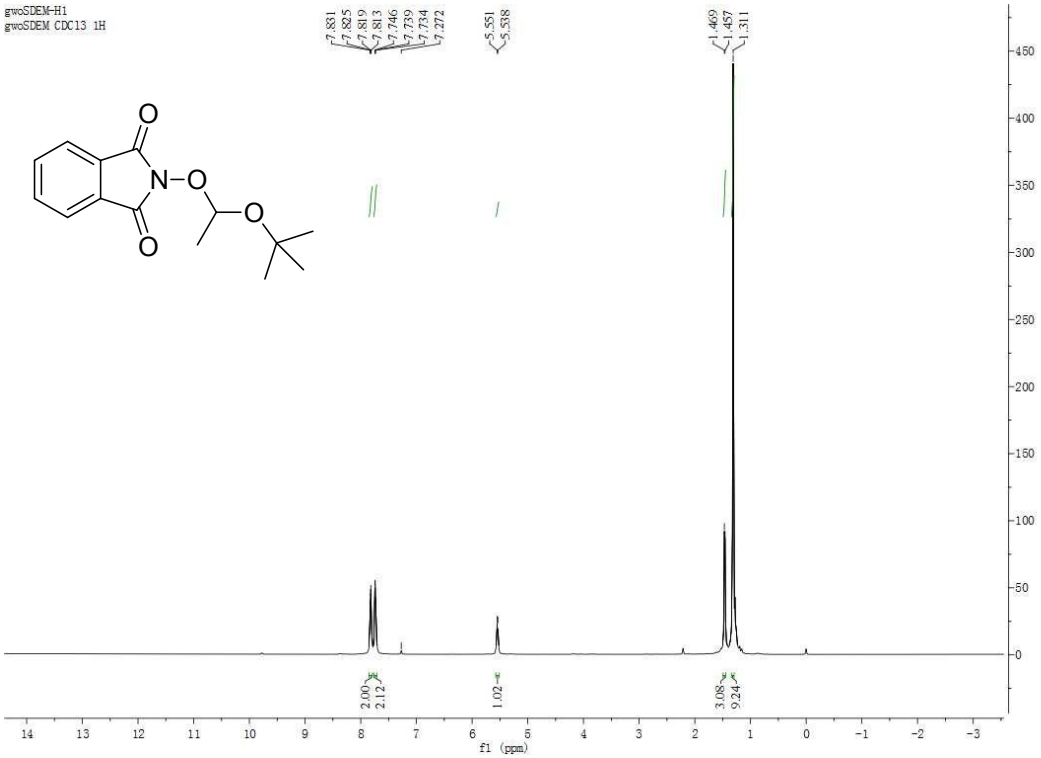

guoSM-C13
guoSM CDCl3 C13
162.59
133.47
128.20
122.53
93.15
77.32
77.00
76.68
35.58
31.70
28.60
22.16
19.56
13.84
O
N–O
O
O
f1 (ppm)

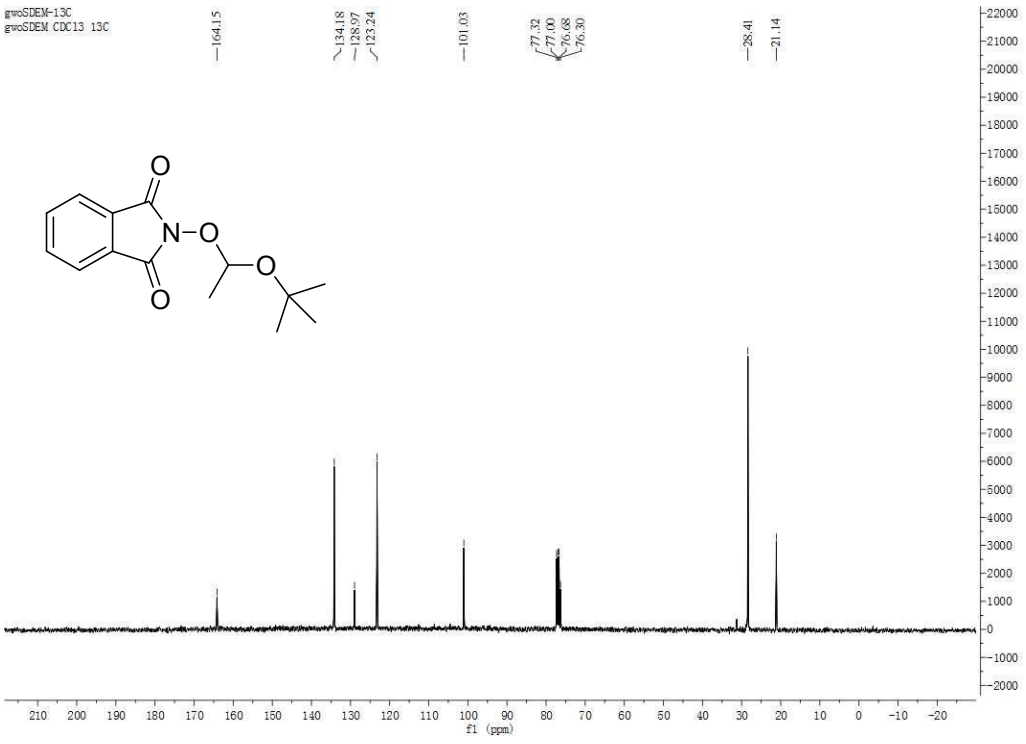

环戊基甲醚氢谱C13.fid (2)
guoHWJM CDCl3 H1
f1 (ppm)

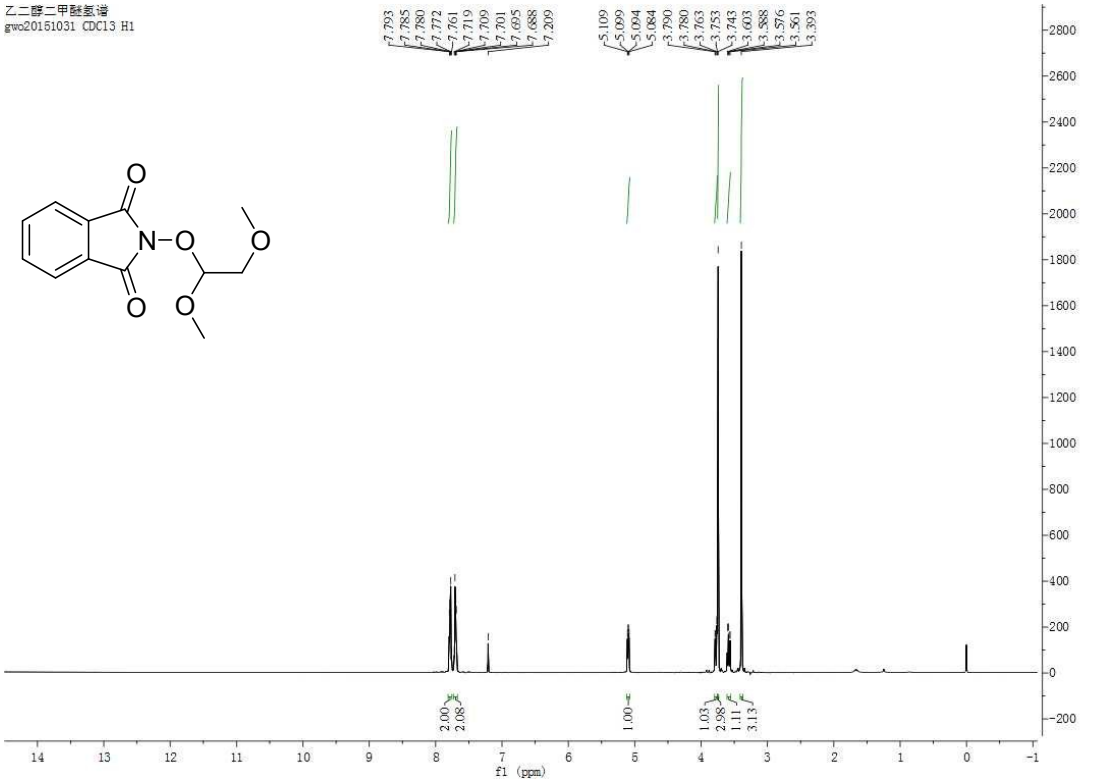

环戊基甲醚碳谱C13
guoHWJM CDCl3 C13
f1 (ppm)

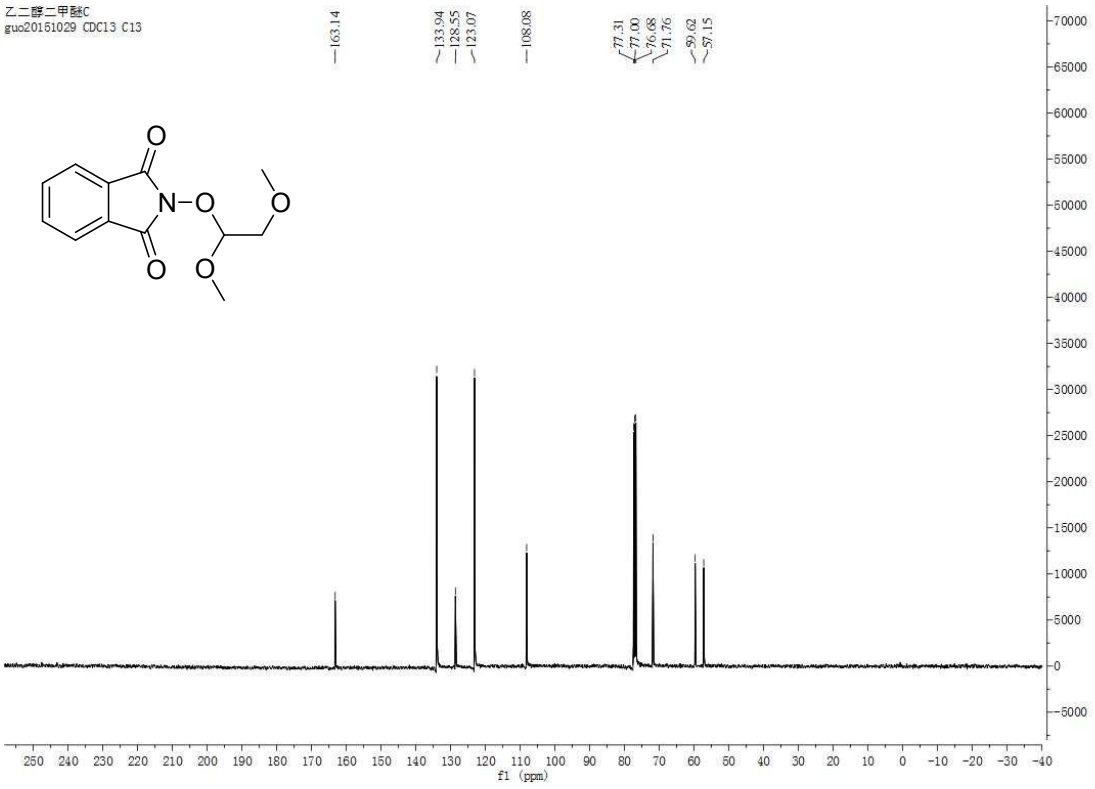

叔丁基甲醚氨H1
guoSDJM CDC13 H1
7.825
7.816
7.808
7.802
7.794
7.784
7.740
7.730
7.722
7.716
7.709
7.700
7.265
5.250
1.377
2.00
2.03
2.07
9.21
f1 (ppm)

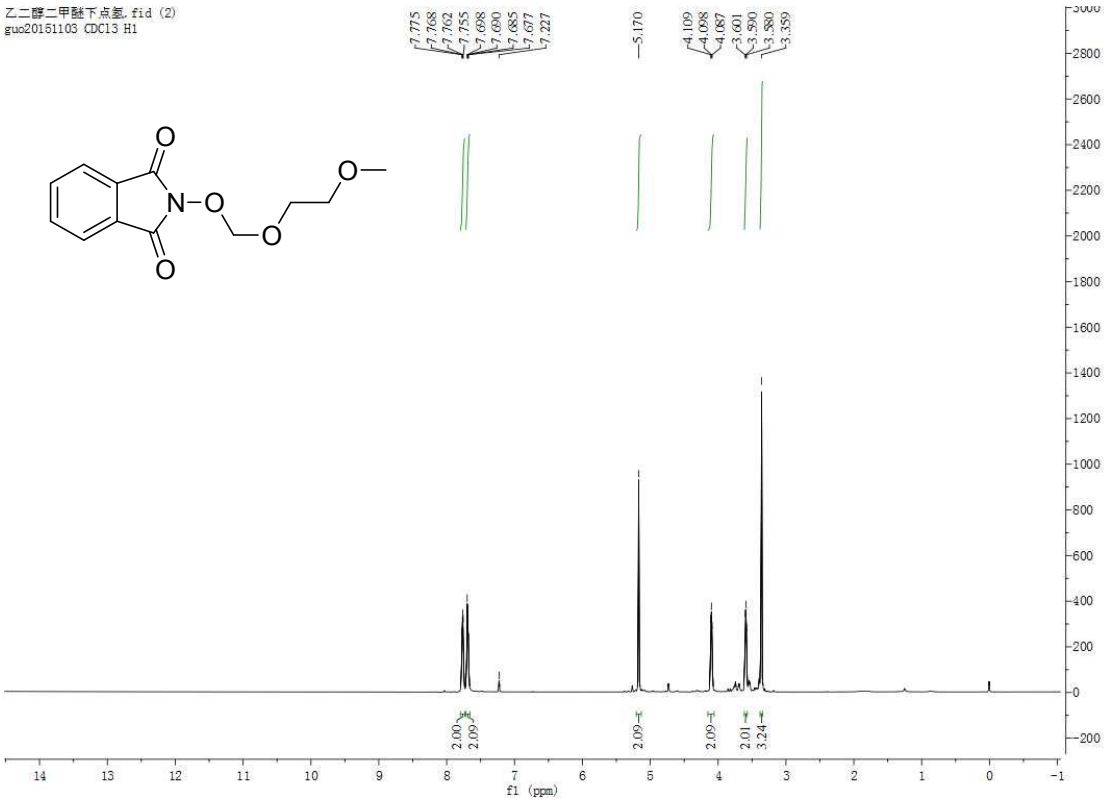

叔丁基甲醚氨H1.fid (2)
guoSDJM CDC13 C13
162.89
133.74
128.62
122.91
94.81
77.31
77.07
77.00
76.68
28.65
f1 (ppm)

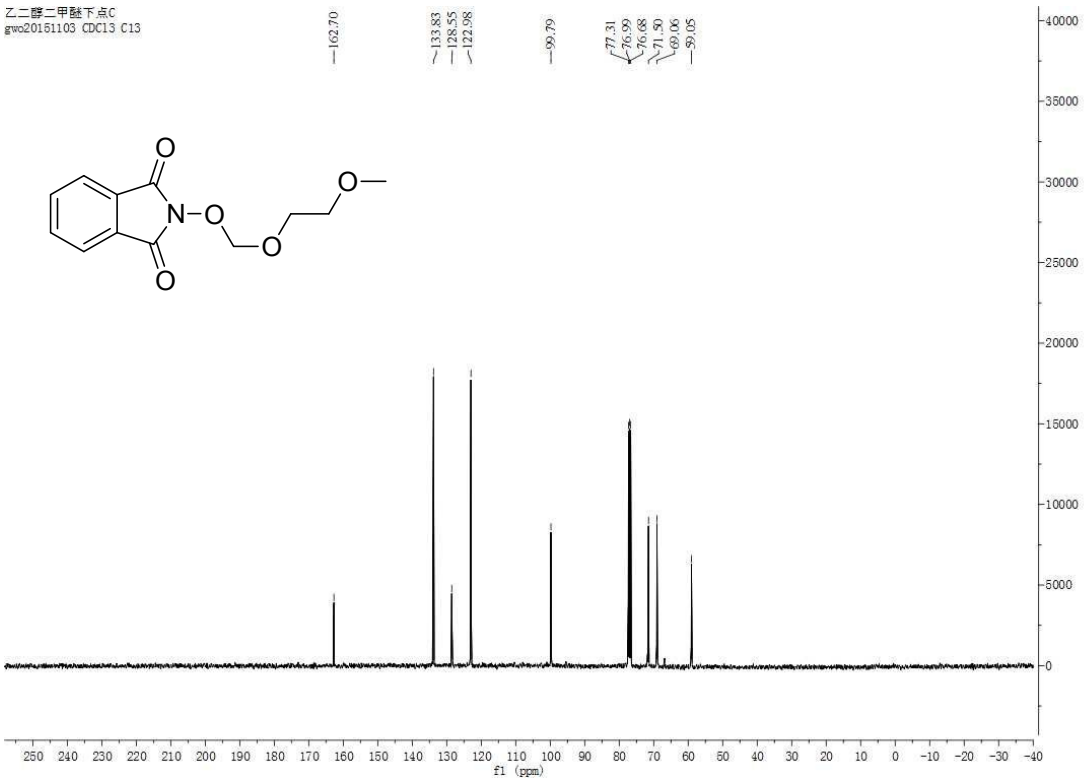

gwoSDEM-H1
gwoSDEM CDC13 1H
7.881
7.825
7.819
7.813
7.746
7.739
7.734
7.272
5.551
5.538
1.469
1.457
1.311
2.00
2.12
1.02
3.08
9.24
f1 (ppm)

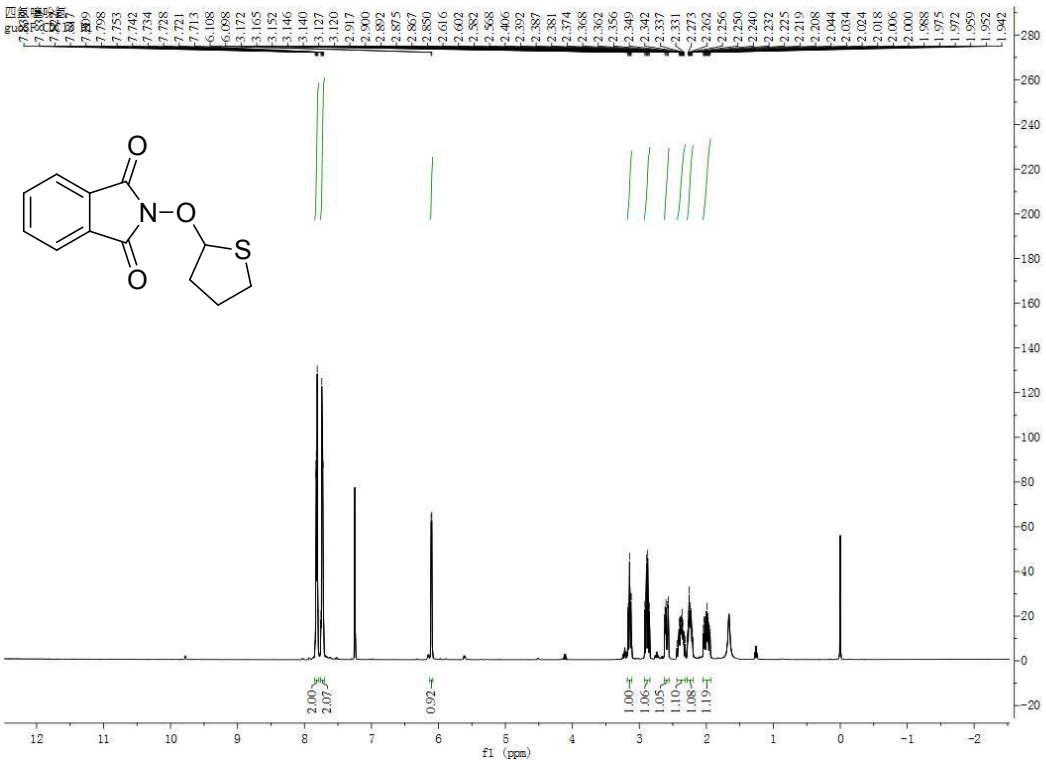

gwoSDEM-13C
gwoSDEM CDC13 13C
164.15
134.18
128.97
123.24
101.03
77.32
77.00
76.68
76.30
28.41
21.14
f1 (ppm)

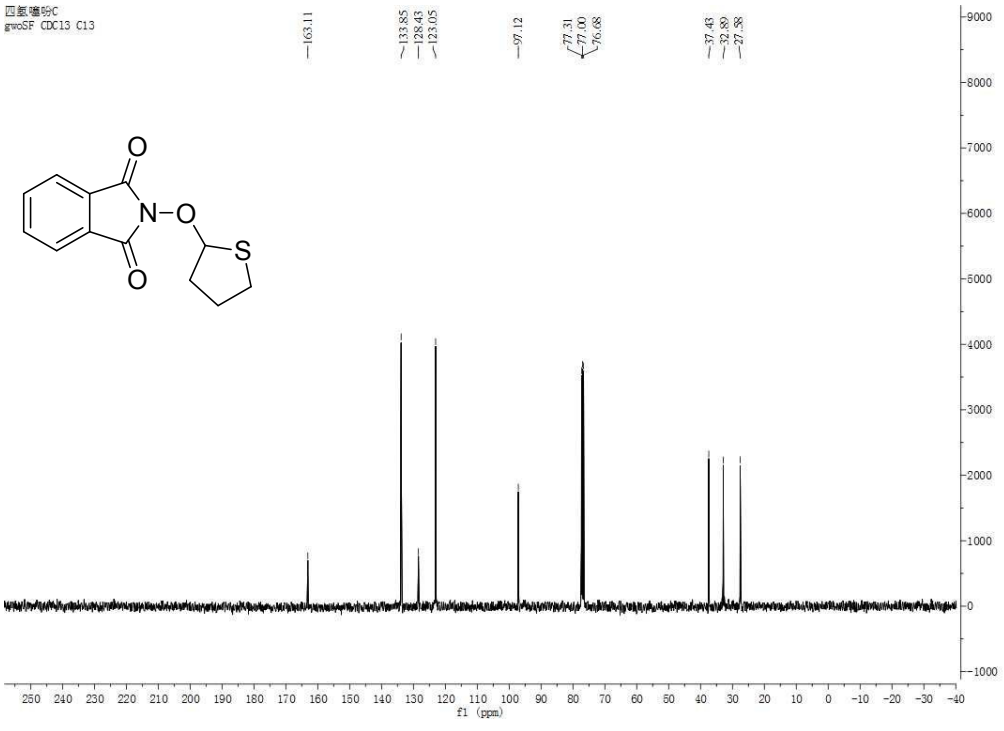

乙二醇二甲醚氢谱
gwo20151031 CDC13 H1
7.793
7.785
7.780
7.772
7.761
7.719
7.709
7.701
7.695
7.688
7.209
5.109
5.099
5.094
5.084
3.790
3.780
3.763
3.753
3.743
3.603
3.588
3.576
3.561
3.393
2.00
2.08
1.00
1.03
2.98
1.11
3.13
f1 (ppm)

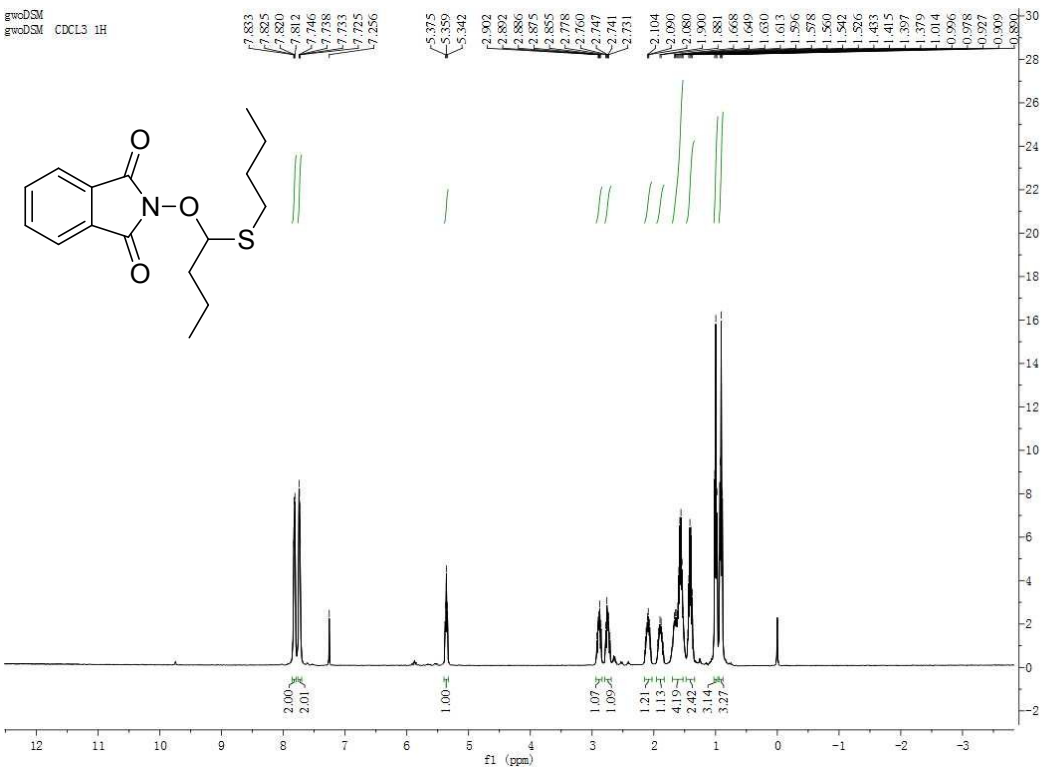

乙二醇二甲醚C
guo20151029 CDC13 C13
163.14
133.94
128.55
123.07
108.08
77.31
77.00
76.68
71.76
59.62
57.15
f1 (ppm)

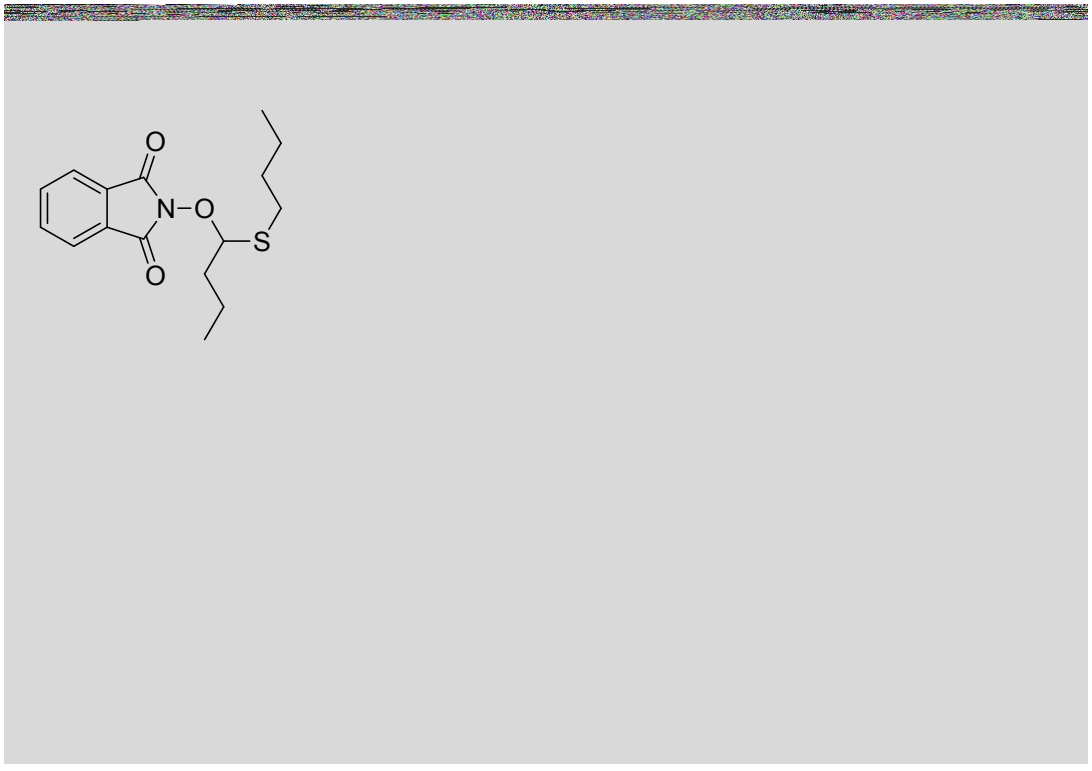

乙二醇二甲醚下点氢.fid (2)
guo20151103 CDCl3 H1
7.775
7.768
7.762
7.755
7.698
7.690
7.685
7.677
7.227
5.170
4.109
4.098
4.087
3.601
3.590
3.580
3.359
2.00
2.09
2.09
2.09
2.01
3.24
f1 (ppm)


乙二醇二甲醚下点C
gwo20151103 CDCl3 C13
162.70
133.83
128.55
122.98
99.79
77.31
76.99
76.68
71.50
69.06
59.05
f1 (ppm)

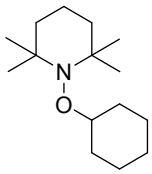

O
N–O
S
O
f1 (ppm)


四氢噻吩C
gwoSF CDCl3 C13
163.11
133.85
128.43
123.05
97.12
77.31
77.00
76.68
37.43
32.89
27.38
O
N–O
S
O
f1 (ppm)


gwoDSM
gwoDSM CDCL3 1H
f1 (ppm)



Electrospray ionization (ESI) spectra of 1-(cyclohexyloxy)-2,2,6,6-tetramethylpiperidine



1-(cyclohexyloxy)-2,2,6,6-tetramethylpiperidine
Chemical Formula: $C_{15}H_{29}NO$
Exact Mass: 239.22
(ESI) m/z: M + H =240.3