Electronic Supplementary Information

Enhanced catalytic performance of Pd–Pt nanodendrites for ligand-free Suzuki cross-coupling reactions

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General protocol for Suzuki cross-coupling reaction: Aryl halides (0.5 mmol, 1 equiv), phenylboronic acids (0.6 mmol, 1.2 equiv), Cs_2CO_3 (0.6 mmol, 1.2 equiv), and Pd-Pt NDs (4 mg) were put into 2 mL ethanol/water (v/v = 1/1). The solution was stirred for desired time at 80 ˚C under air atmosphere. The reaction was monitored by thin layer chromatography (TLC). Afterward, the reaction mixture was cooled to room temperature and the catalyst was recovered by simple filtration and thoroughly washed with ethyl acetate and water. The combined organic layer was dried by Na_2SO_4, and the filtered residue was purified by flash column chromatography on silica gel.

^{1}H NMR, ^{13}C NMR, and mass spectral data of products from the Suzuki cross-coupling reactions： 2a-2k are known compounds,[1-7] and analytical data of the isolated product are summarized as follows:

Biphenyl (2a): White solid, M. p.: 68-70 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 7.52 (d, 2H, J = 7.6 Hz), 7.36 (t, 4H, J = 7.6Hz), 7.27 (t, 4H, J = 7.4 Hz). ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 141.27, 128.80, 127.30, 127.21. MS(EI): m/z 154.1.

2-Methoxybiphenyl (2b): White solid, M. p.: 31-33 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 7.45 (d, 2H, J = 7.2 Hz), 7.33 (t, 2H, J = 7.2 Hz), 7.24 (d, 3H, J = 4.0Hz), 6.90-6.98 (m, 2H), 3.74 (s, 3H); ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 156.47, 138.55, 130.91, 129.56, 128.63, 128.0, 126.93, 120.84, 114.21, 111.23, 55.57. MS(EI): m/z 184.1.

3-Methoxybiphenyl (2c): White solid, M. p.: 49-50 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 7.58 (d, 2H, J = 7.6 Hz), 7.43 (t, 2H, J= 7.6 Hz), 7.37-7.7.33 (m, 2H), 7.17 (t, 3H, J = 12.4 Hz), 6.90-6.8 (d-d, 1H, J = 8.0 Hz, 2.4 Hz), 3.84 (s, 3H) ; ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 159.97, 142.82, 141.14, 129.81, 128.80, 127.47, 127.25, 119.73, 112.94, 112.71., 55.34. MS(EI): m/z 184.1.

4-Methoxybiphenyl (2d): White solid, M. p.: 85-86 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 7.46 (t, 4H, J = 9.0 Hz), 7.34 (t, 2H, J = 7.6 Hz), 7.23 (d, 1H, J = 7.2 Hz), 6.90 (d, 2H, J = 8.4 Hz), 3.77 (s, 3H); ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 159.16, 140.85, 133.80, 128.75, 128.18, 126.77, 114.22, 55.37. MS(EI): m/z 184.1.

4-Nitrobiphenyl 2e: Yellow solid, M. p.: 111-113 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 8.30 (d, 2H, J = 8.8Hz), 7.75-7.72 (m, 2H), 7.64-7.61 (m, 2H), 7.52-7.43 (m, 3H); ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 147.65, 147.10, 138.79, 129.18, 128.94, 127.82, 127.41, 124.13. MS(EI): m/z 199.1.

2-Methylbiphenyl (2f): Colourless liquid; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm), 7.34 (t, 2H, J = 7.2 Hz), 7.28-7.24 (m, 3H), 7.20-7.17 (m, 4H), 2.20 (S, 3H); ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 141.96, 135.36, 130.32, 129.81, 129.21, 128.08, 127.26, 126.77, 125.77. MS(EI): m/z 168.1.

4-Formylbiphenyl (2g): Yellow solid, M. p.: 58-60 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 9.65 (t, 1H, J = 8.6 Hz), 7.60-7.55 (m, 2H), 7.49 (t, 2H, J = 7.4 Hz), 7.40-7.33 (m, 3H), 6.73-6.61 (m, 1H); ^{13}C NMR (400MHz, $CDCl_3$): 193.48, 151.22, 132.44, 129.83, 129.08, 128.45, 127.76, 127.11, 125.95, 125.74. MS(EI): m/z 182.1.

4-Methylbiphenyl (2h): White solid, M. p.: 46–48 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 7.48 (d, 2H, J = 7.6 Hz), 7.40 (d, 2H, J = 8.0 Hz), 7.32 (t, 2H, J = 7.6 Hz), 7.22 (t, 1H, J = 7.4 Hz), 7.15 (d, 2H, J = 8.0 Hz), 2.30 (s, 3H); ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 141.23, 138.42, 137.09, 129.56, 128.80, 127.07, 127.05. MS(EI): m/z 168.1.

3-Methylbiphenyl (2i): Colourless liquid; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 7.51 (d, 2H, J = 7.6 Hz), 7.38-7.32 (m, 4H), 7.26 (t, 2H, J = 7.4 Hz), 7.09 (d, 1H, J = 7.6 Hz), 2.35 (s, 3H); ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 140.31, 140.19, 137.30, 127.66, 127.63, 126.96, 126.15, 123.24, 20.53. MS(EI): m/z 168.1.

4-Fluorobiphenyl (2j): White solid, M. p.: 73–76 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 7.48-7.45 (m, 4H), 7.36 (t, 2H, J = 7.6 Hz), 7.27 (t, 1H, J = 7.4 Hz), 7.05 (t, 3H, J= 10.0 Hz); ^{13}C NMR (400MHz, CDCl3): δ (ppm) 160.19, 139.21, 127.78, 127.69, 127.61, 126.22, 125.98, 114.68; ^{19}F NMR (400MHz, $CDCl_3$): 115.83. MS(EI): m/z 172.1.

4-Chlorobiphenyl (2k): White solid, M. p.: 78–79 ˚C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 7.48-7.42 (m, 4H) 7.38-7.33 (m, 3H), 7.31-7.26 (m, 2H); ^{13}C NMR (400MHz,

$CDCl_3$): δ (ppm) 140.01, 139.68, 133.40, 128.94, 128.92, 128.43, 127.62, 127.02. MS(EI): m/z 188.1.

2,6-dimethyl-1,1'-biphenyl (2l): White solid, M. p.: 119–121 °C; ^{1}H NMR (400MHz, $CDCl_3$): δ (ppm) 6.86 (d, 4H, J = 8.8 Hz), 6.77 (d, 4H, J = 8.8 Hz), 3.70 (s, 6H) ; ^{13}C NMR (400MHz, $CDCl_3$): δ (ppm) 137.30, 132.44, 129.21, 128.08, 125.77, 122.40, 115.12, 113.58, 28.68. MS(EI): m/z 182.2.

References

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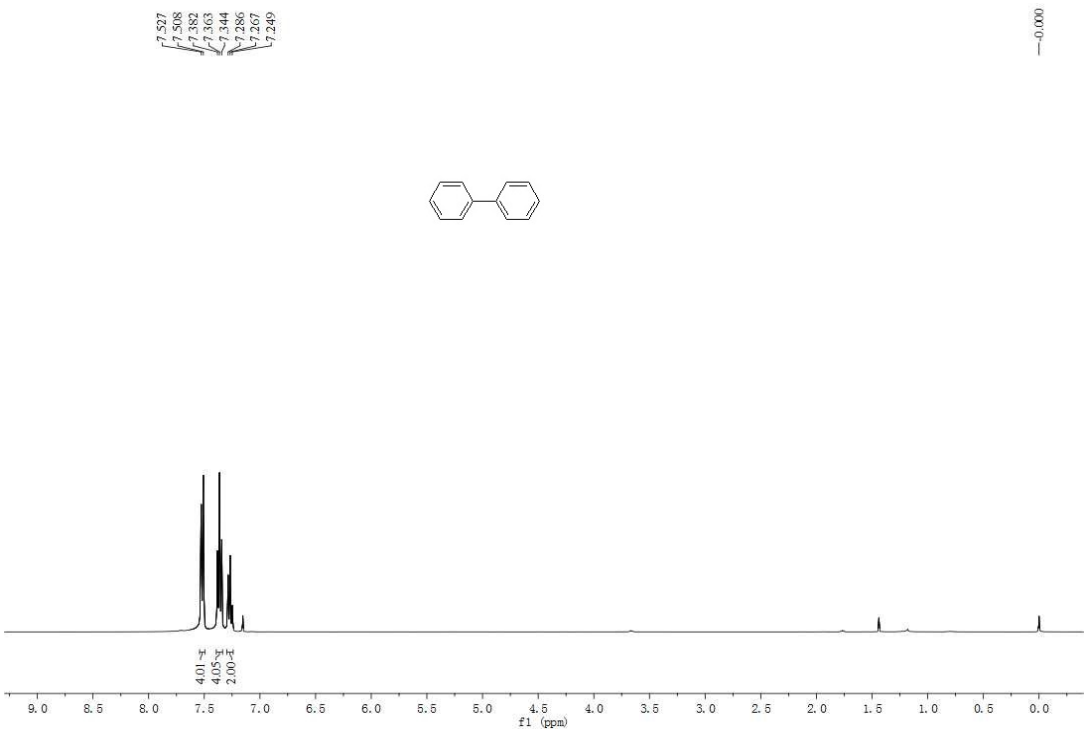
^{1}H NMR, ^{13}C NMR spectra of all compounds



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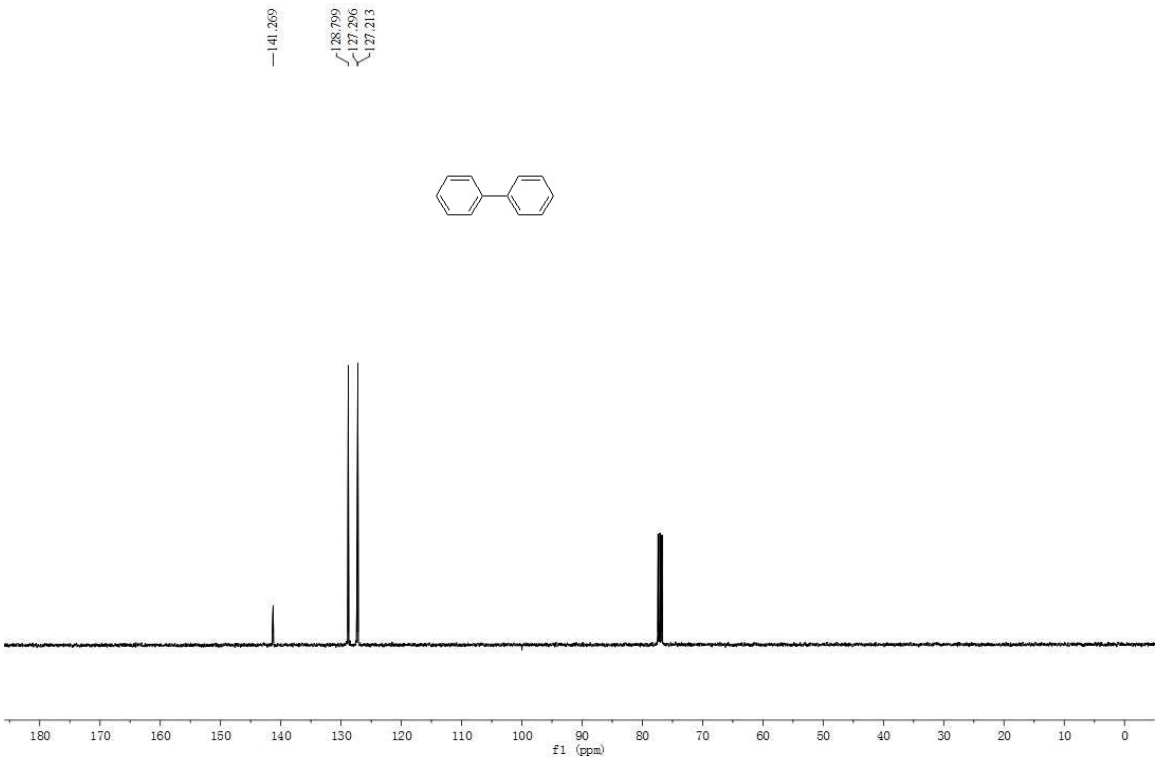

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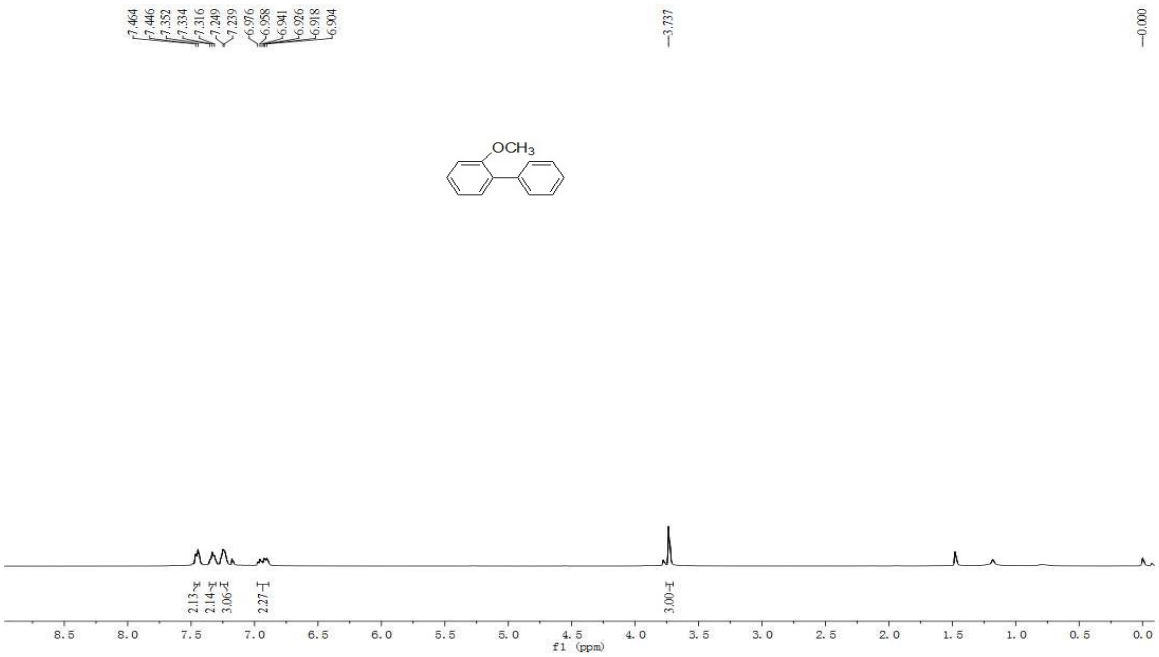

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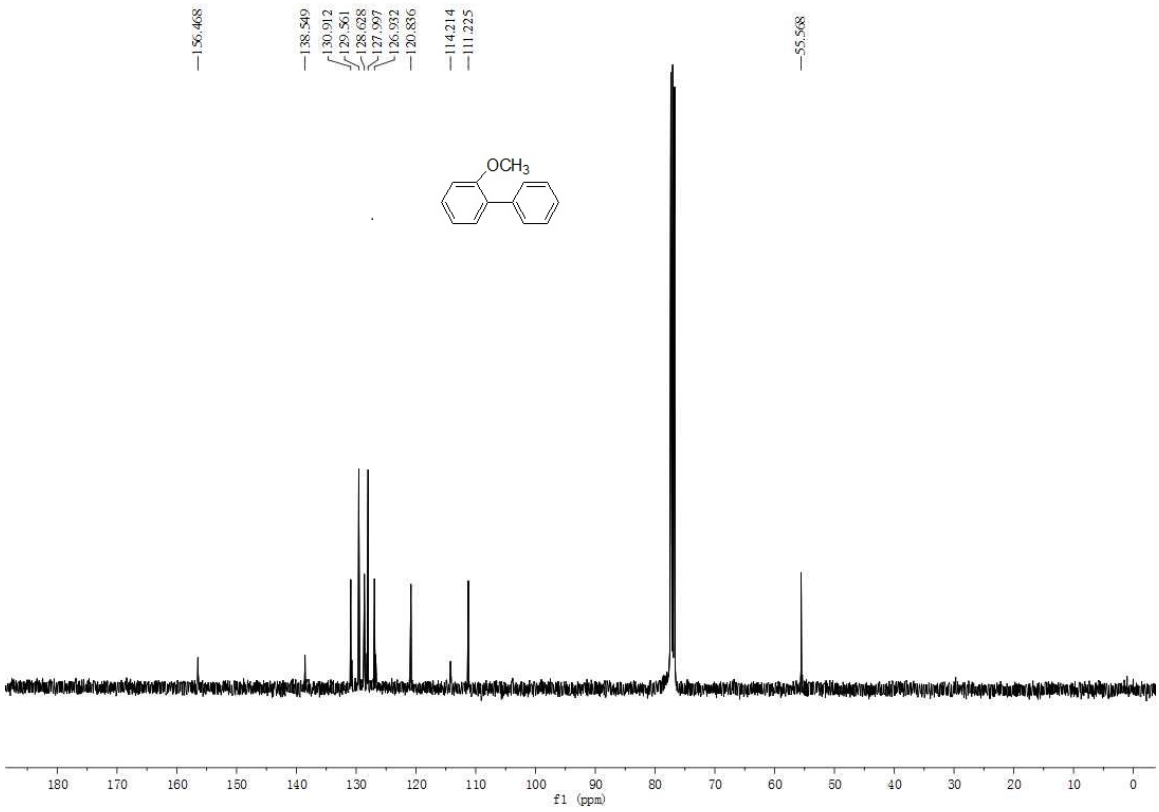

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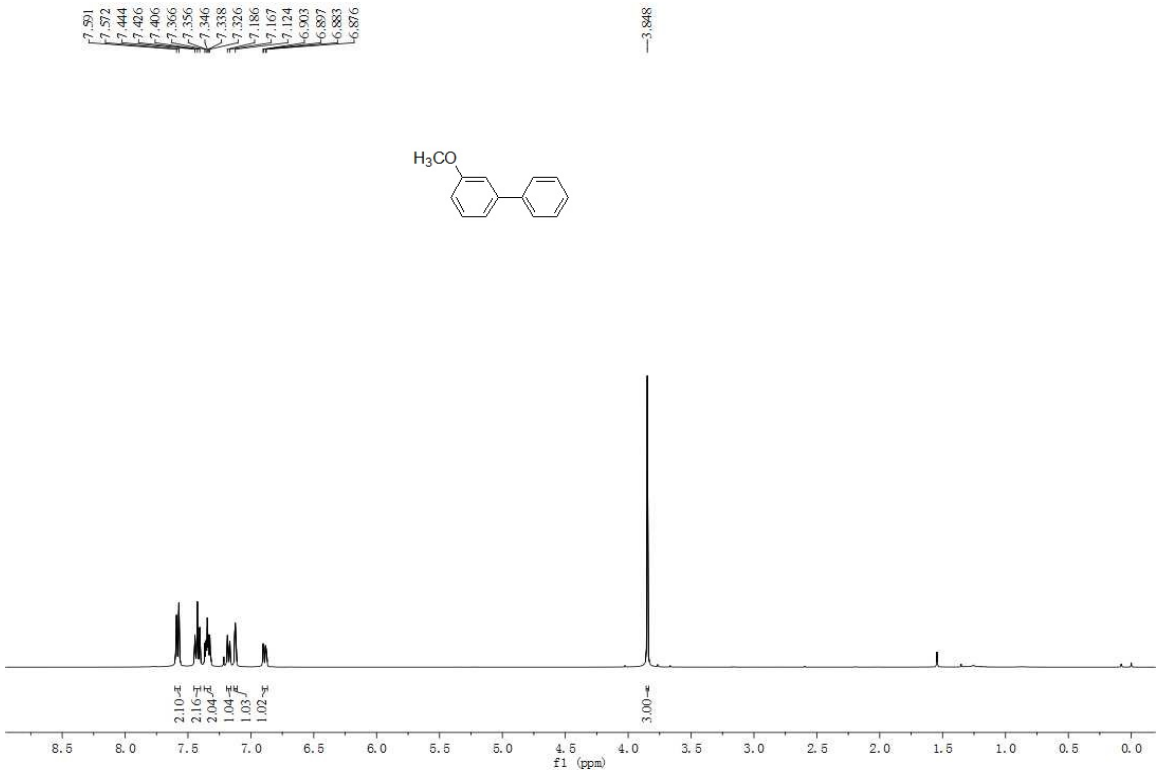

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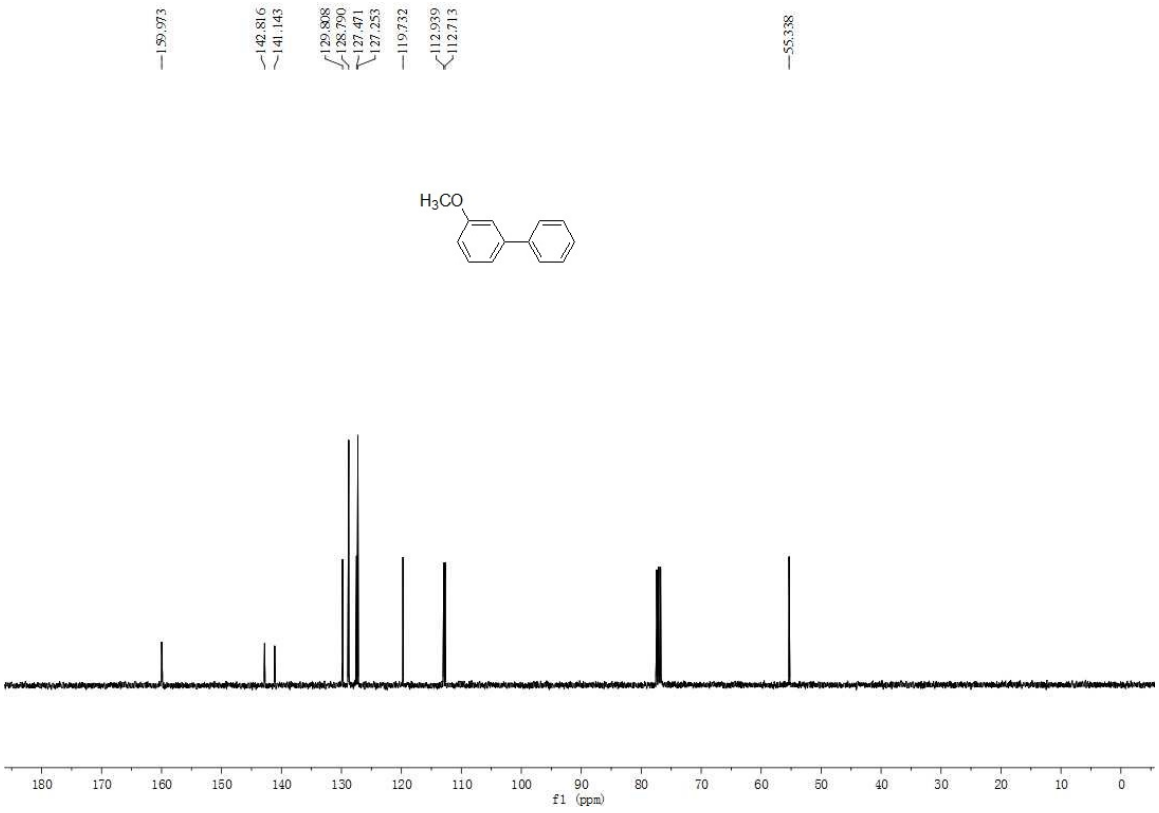

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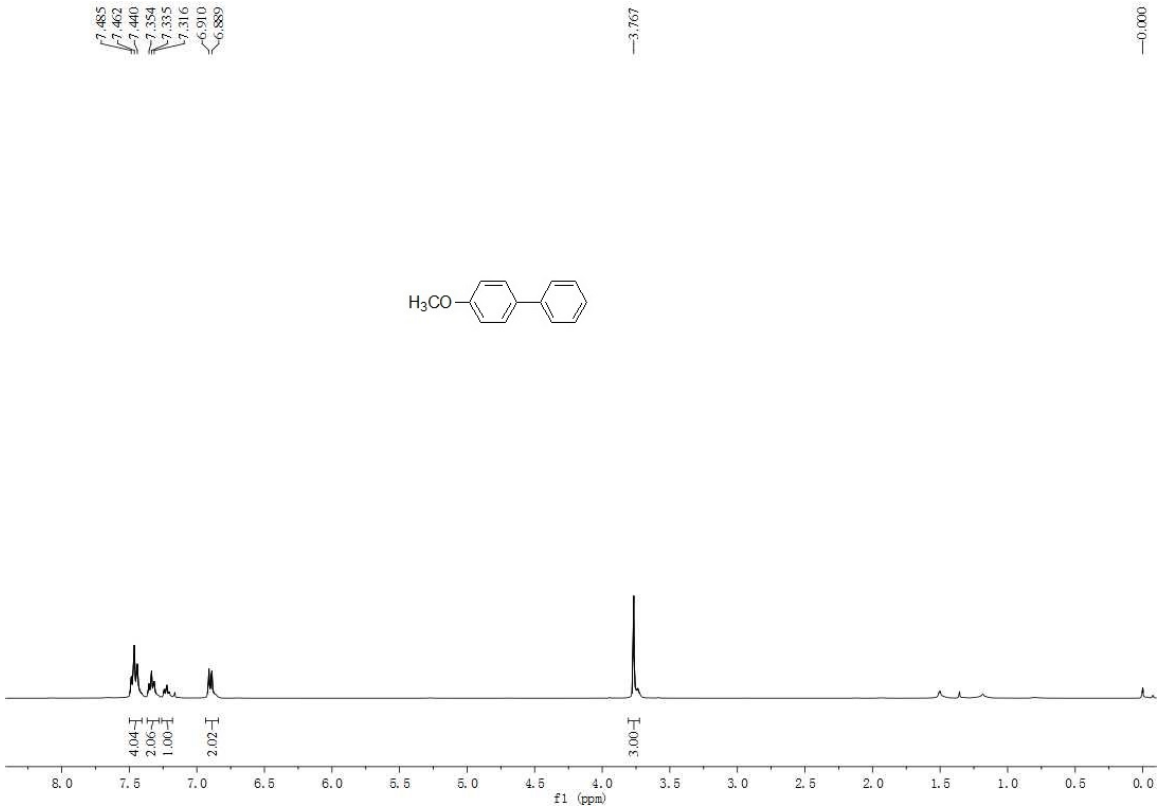

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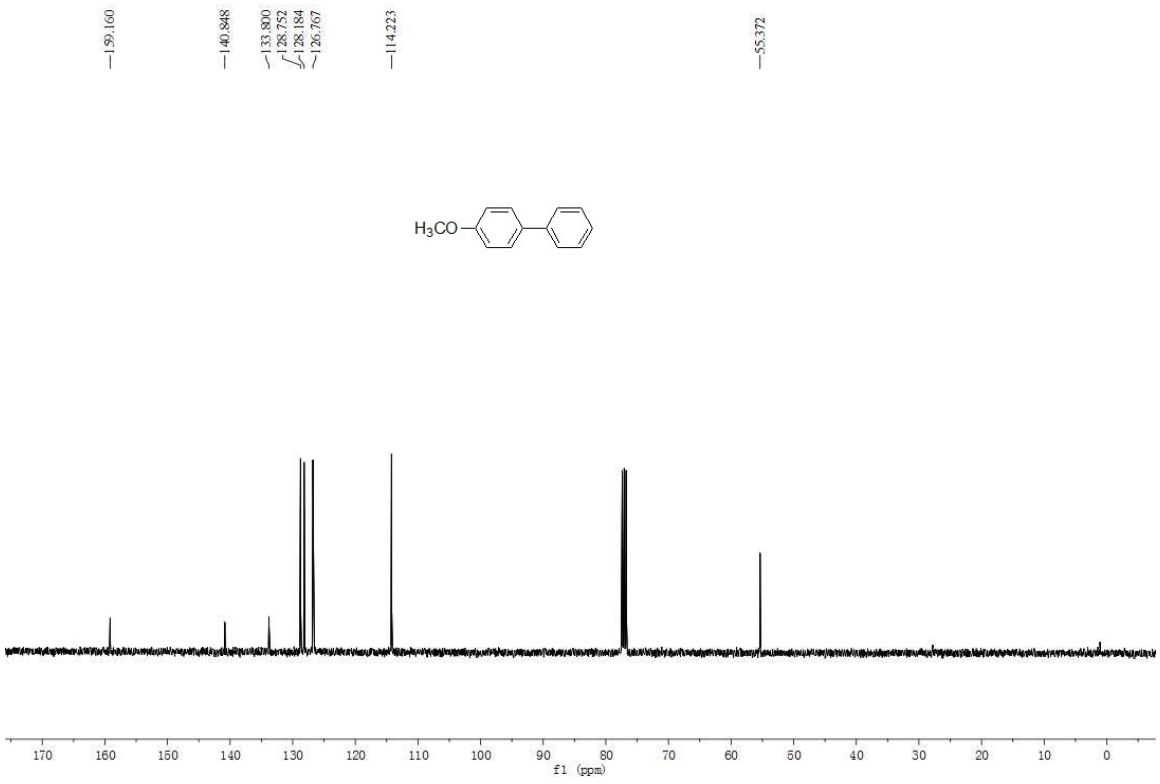

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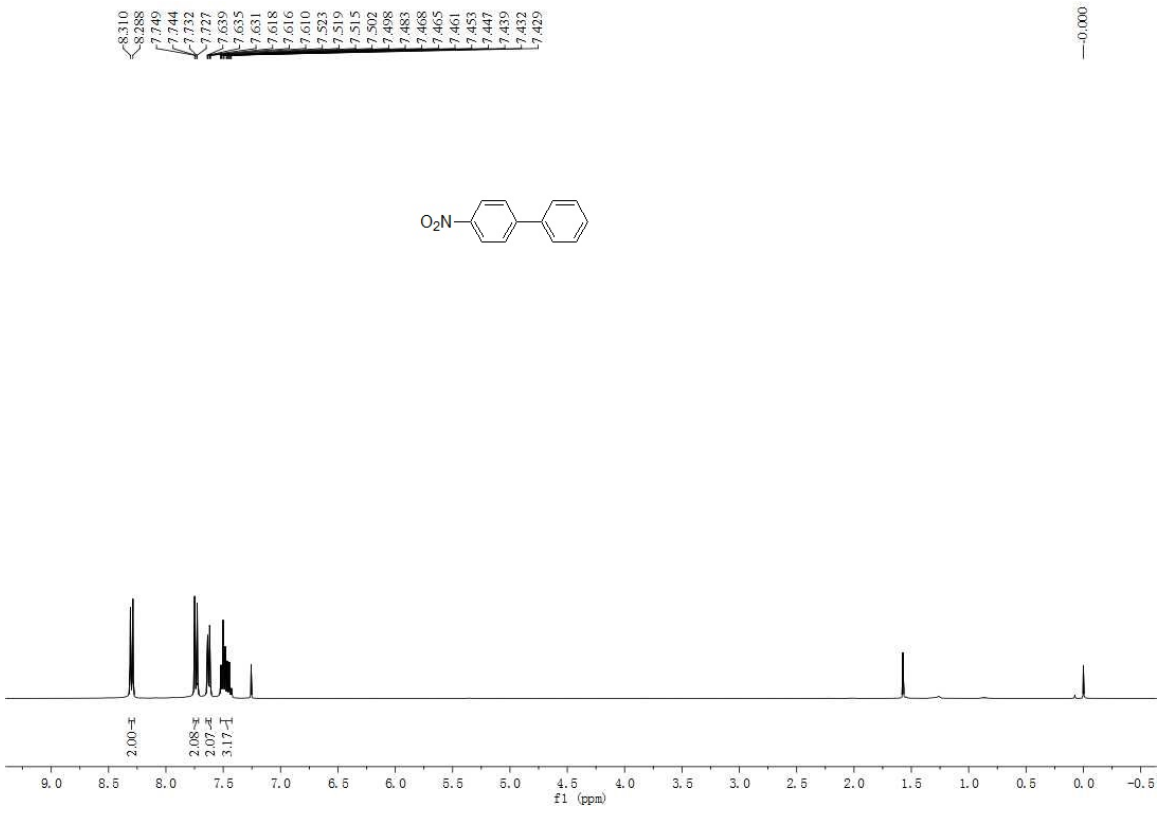

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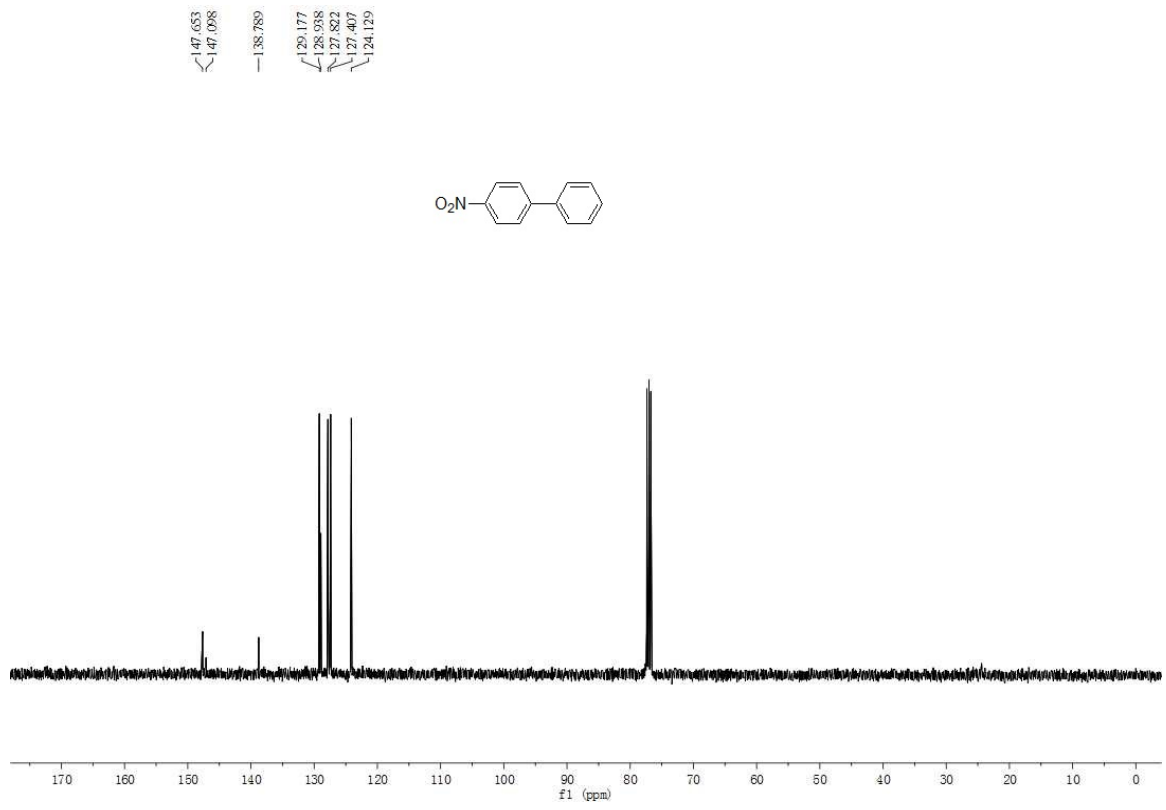

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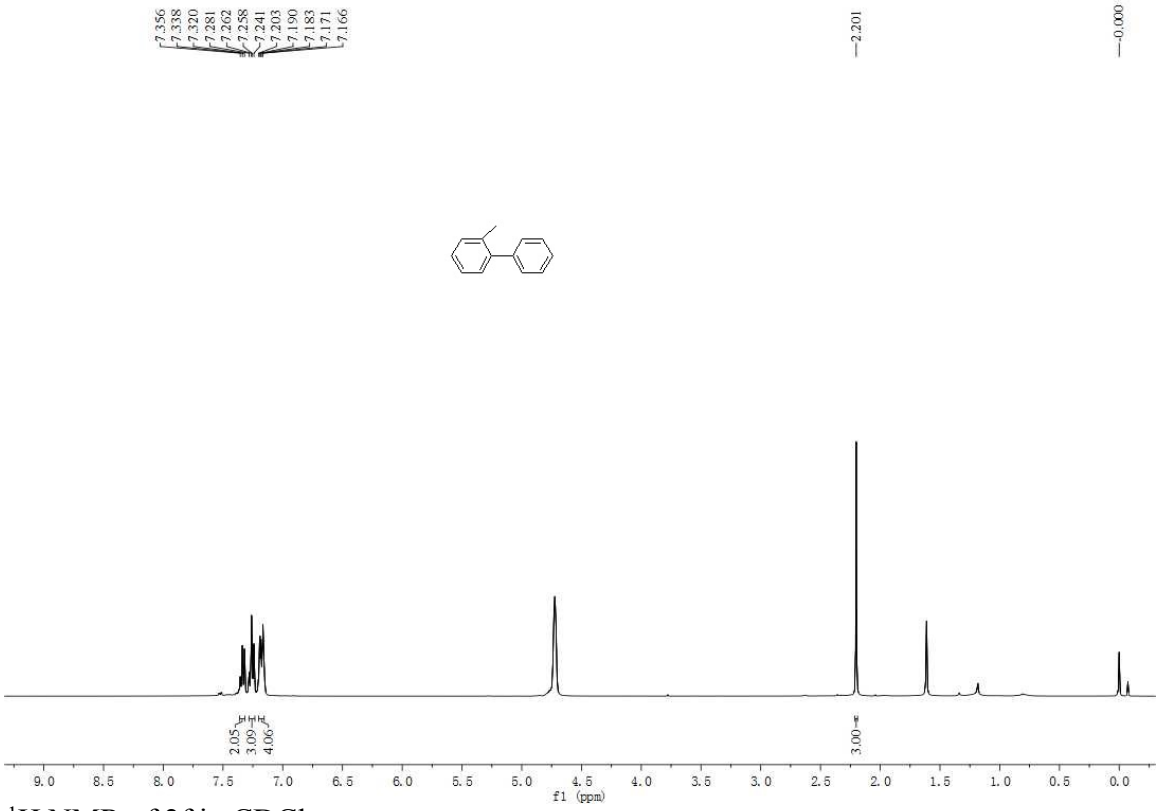

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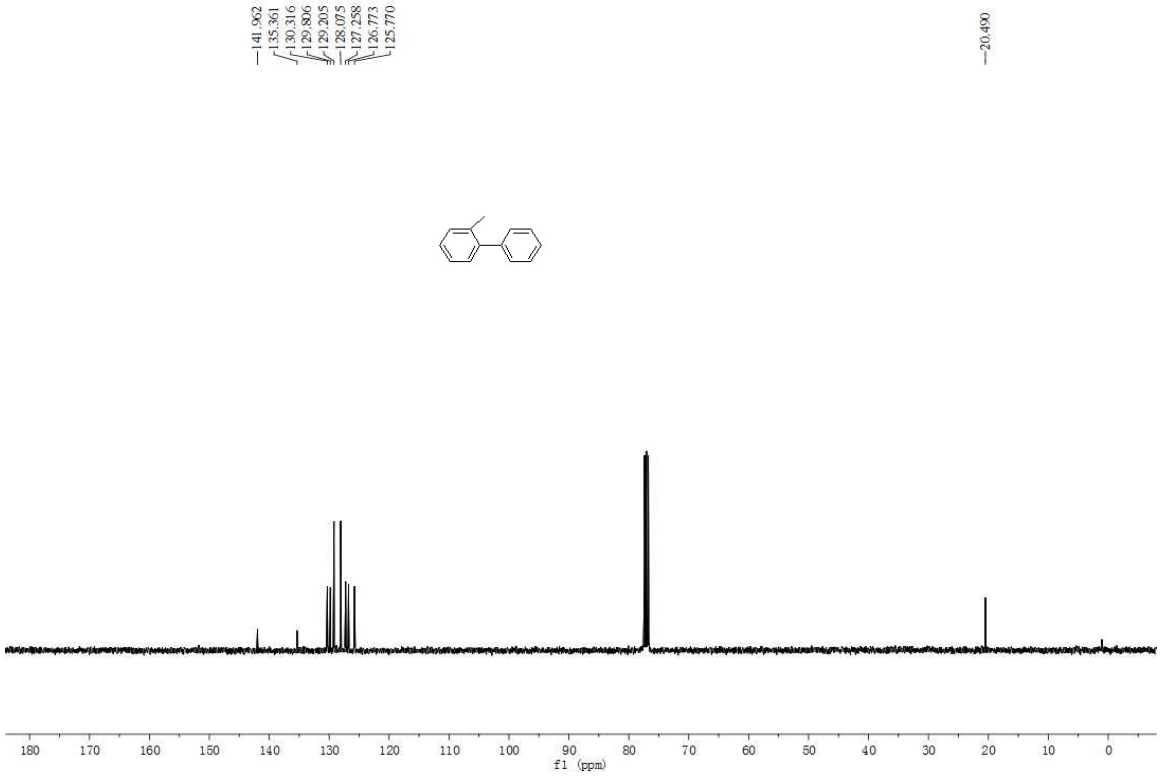

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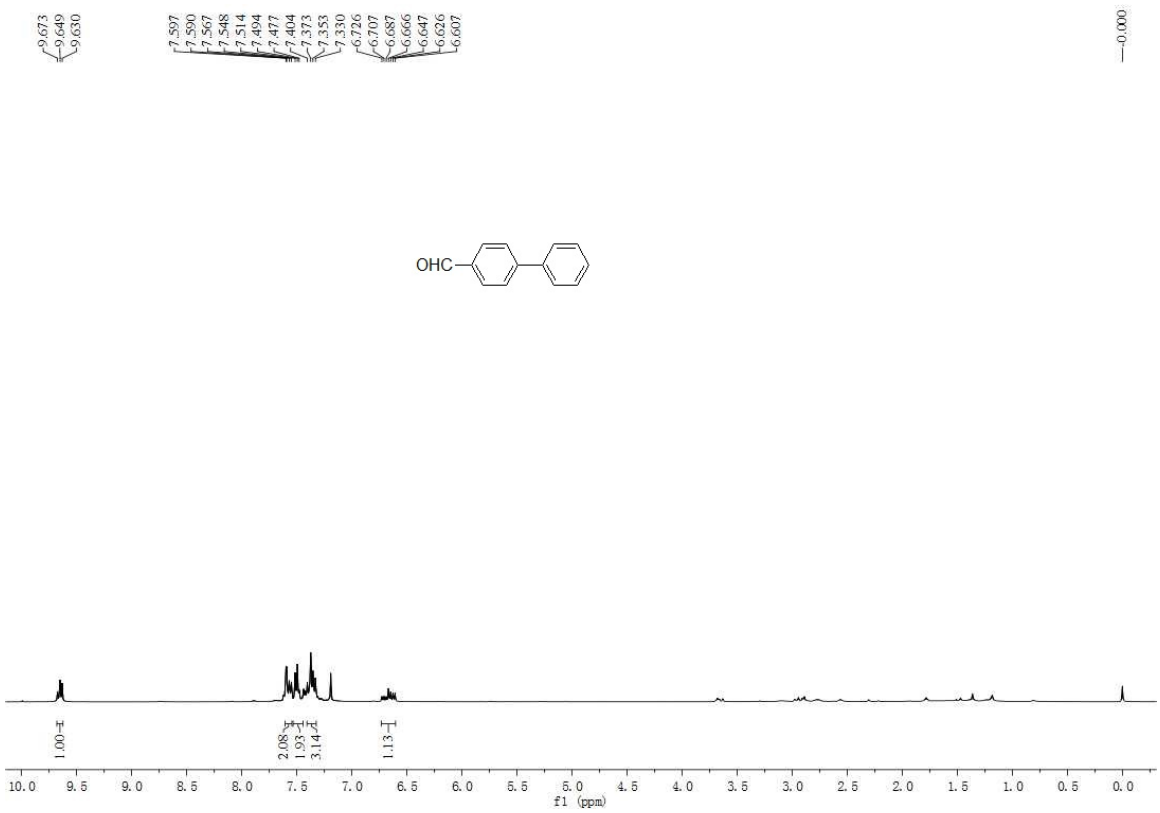

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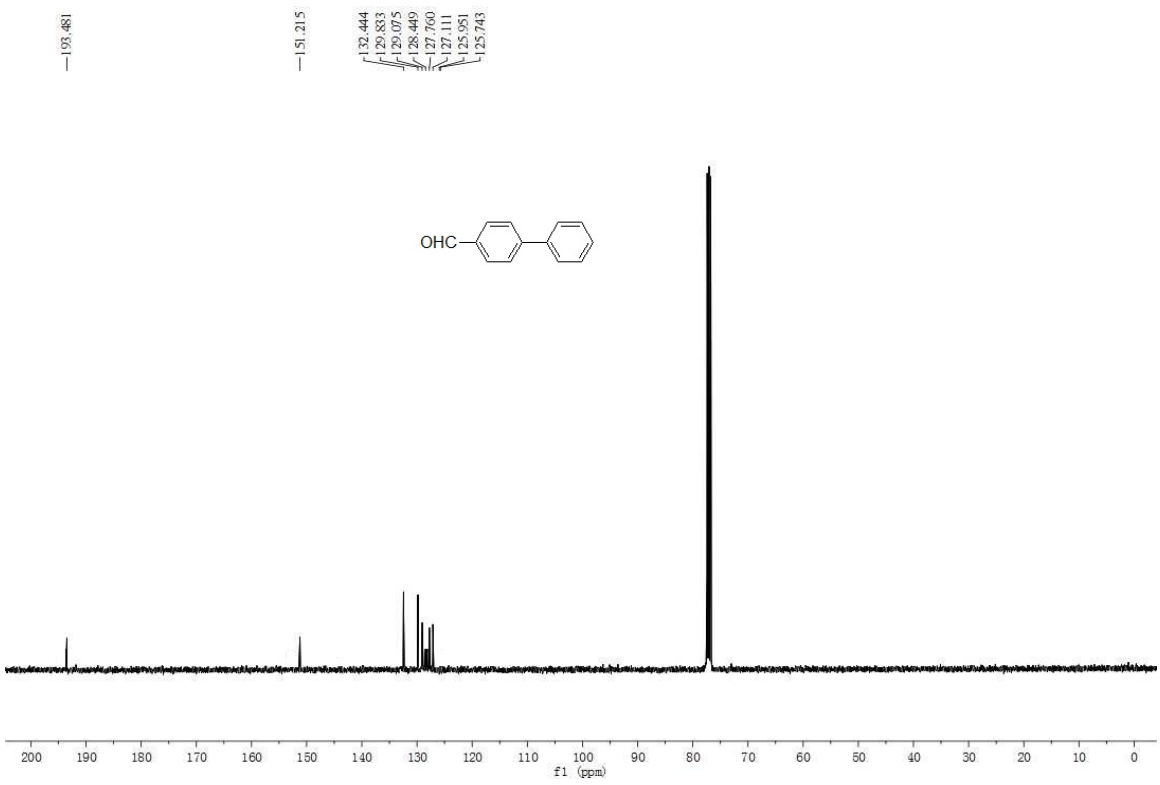

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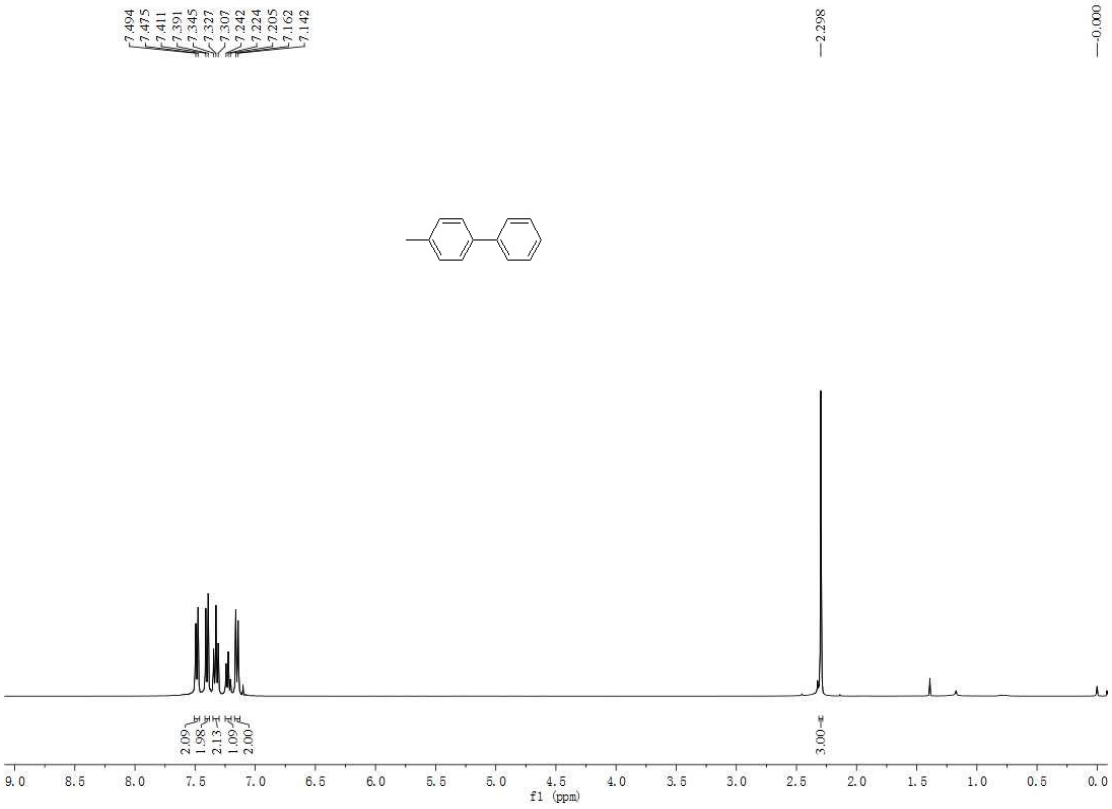
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2.09
1.98
2.13
1.09
2.00
3.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
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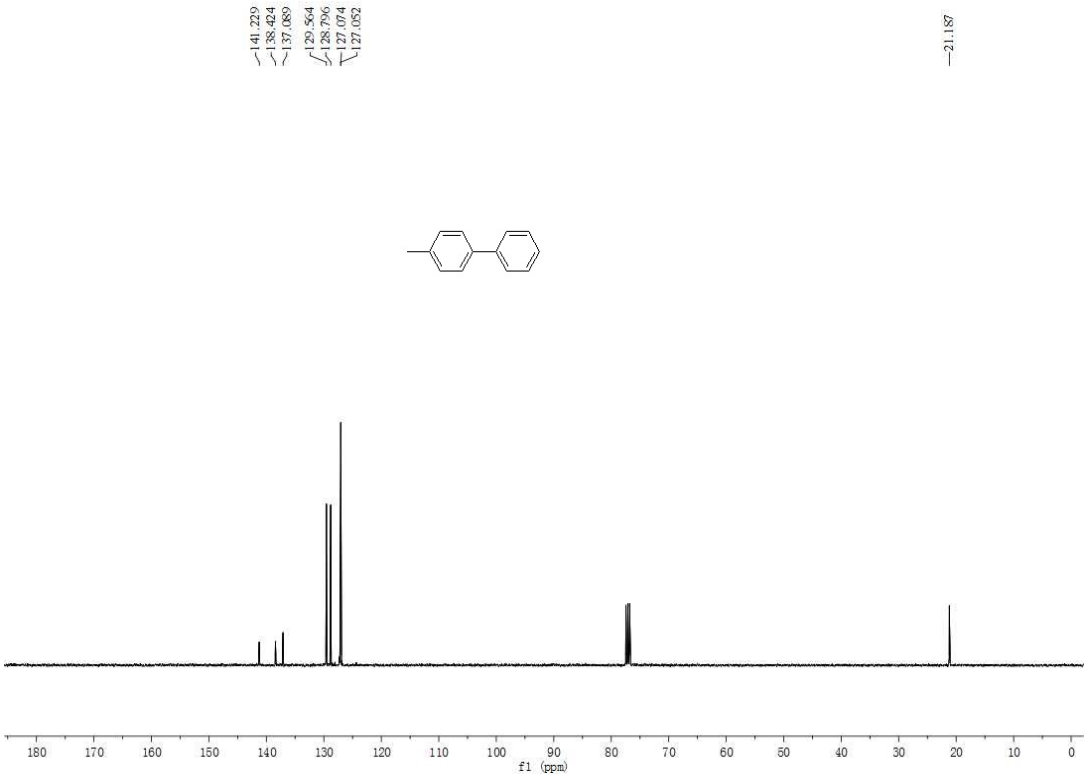
f1 (ppm)

^{1}H NMR of 2h in $CDCl_3$



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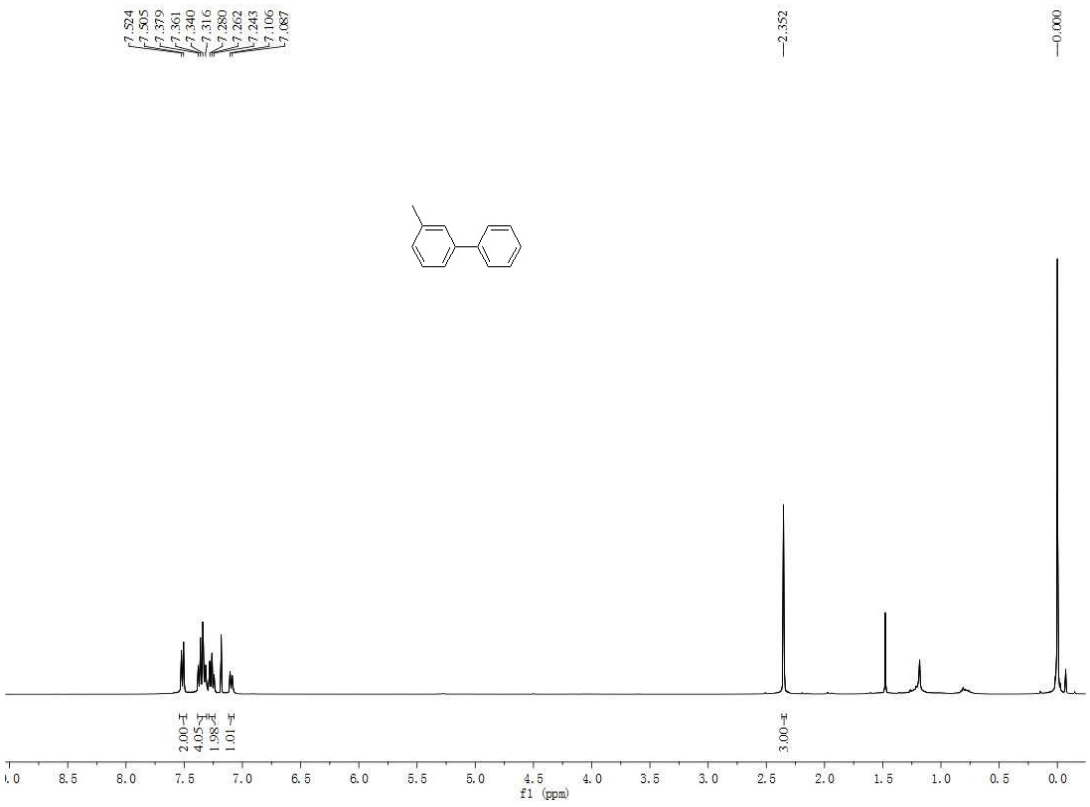

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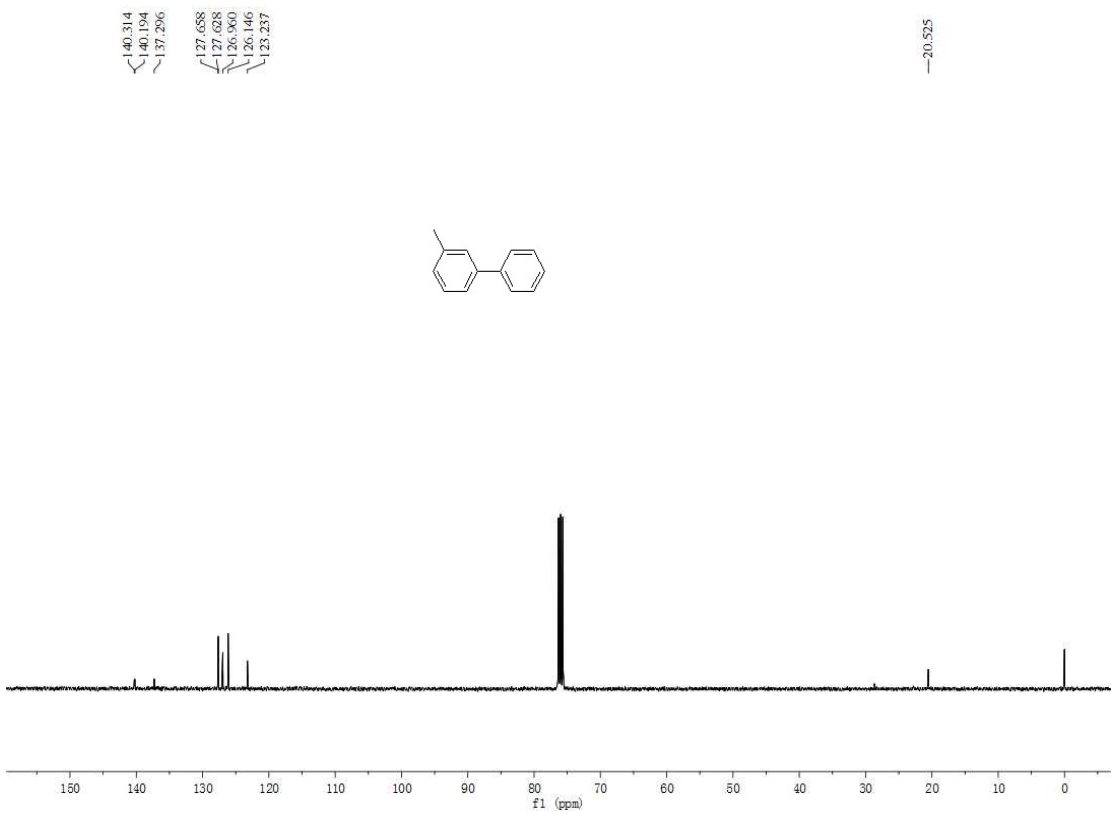
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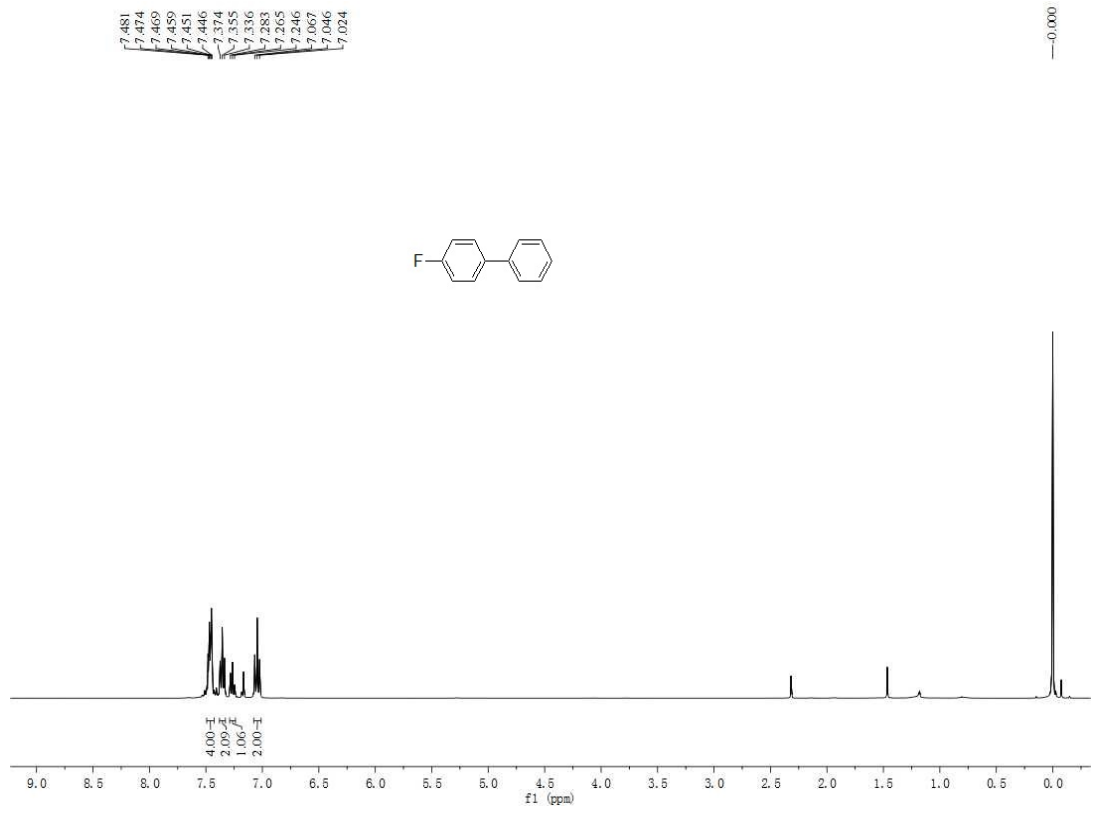
f1 (ppm)

^{13}C NMR of 2i in $CDCl_3$



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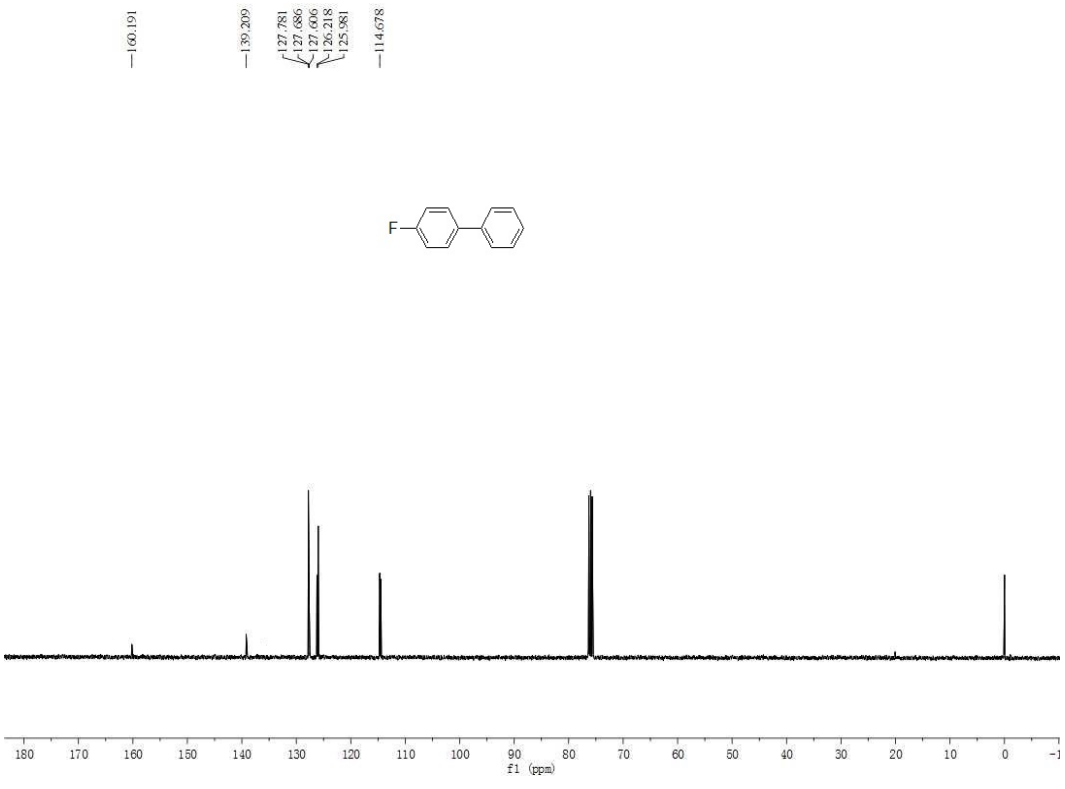

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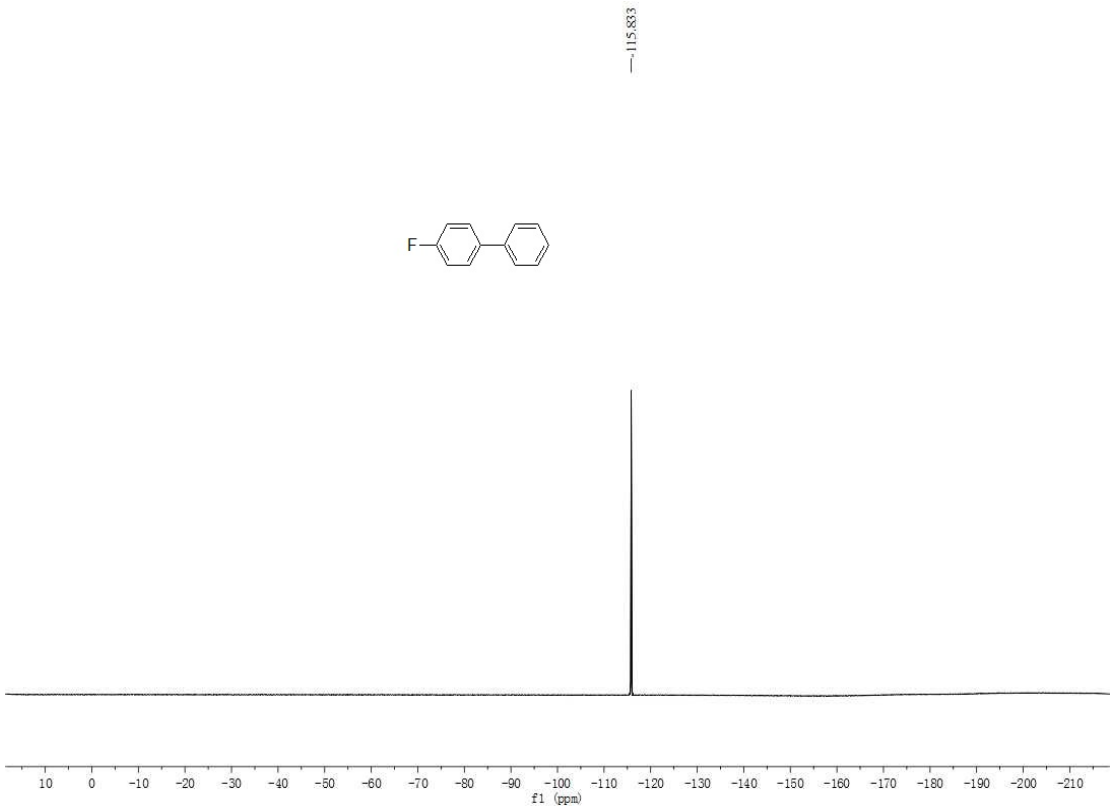

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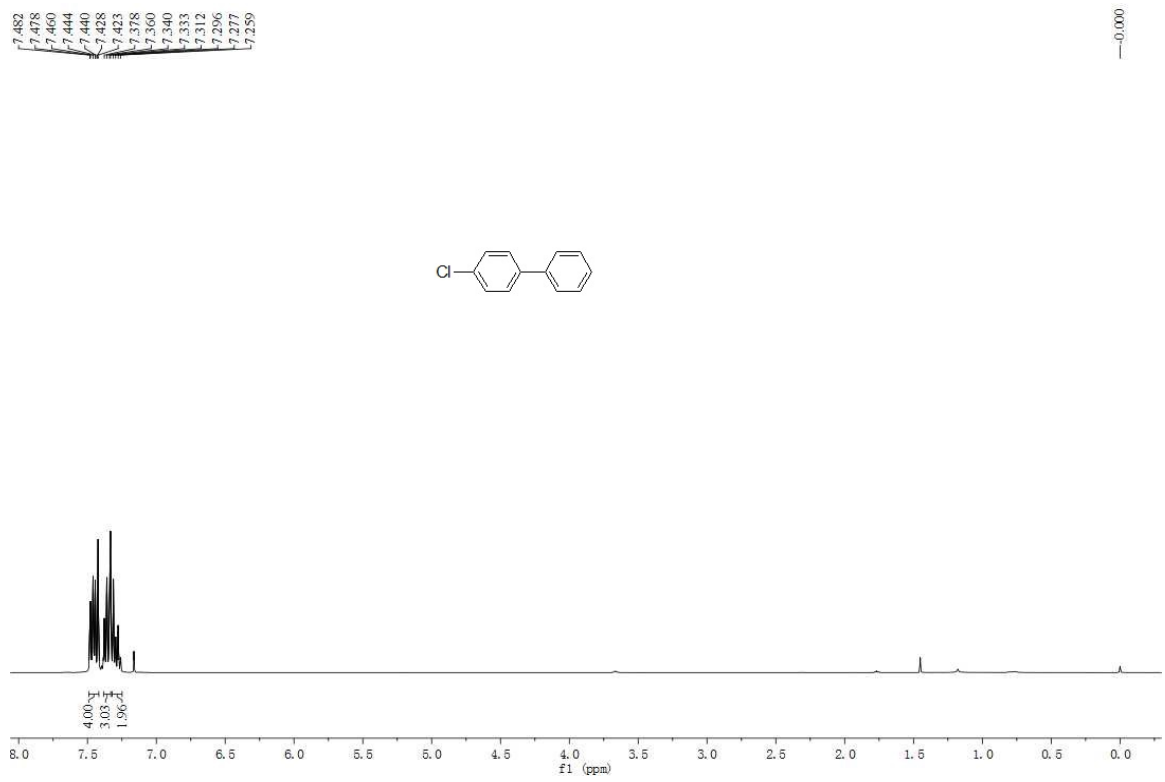

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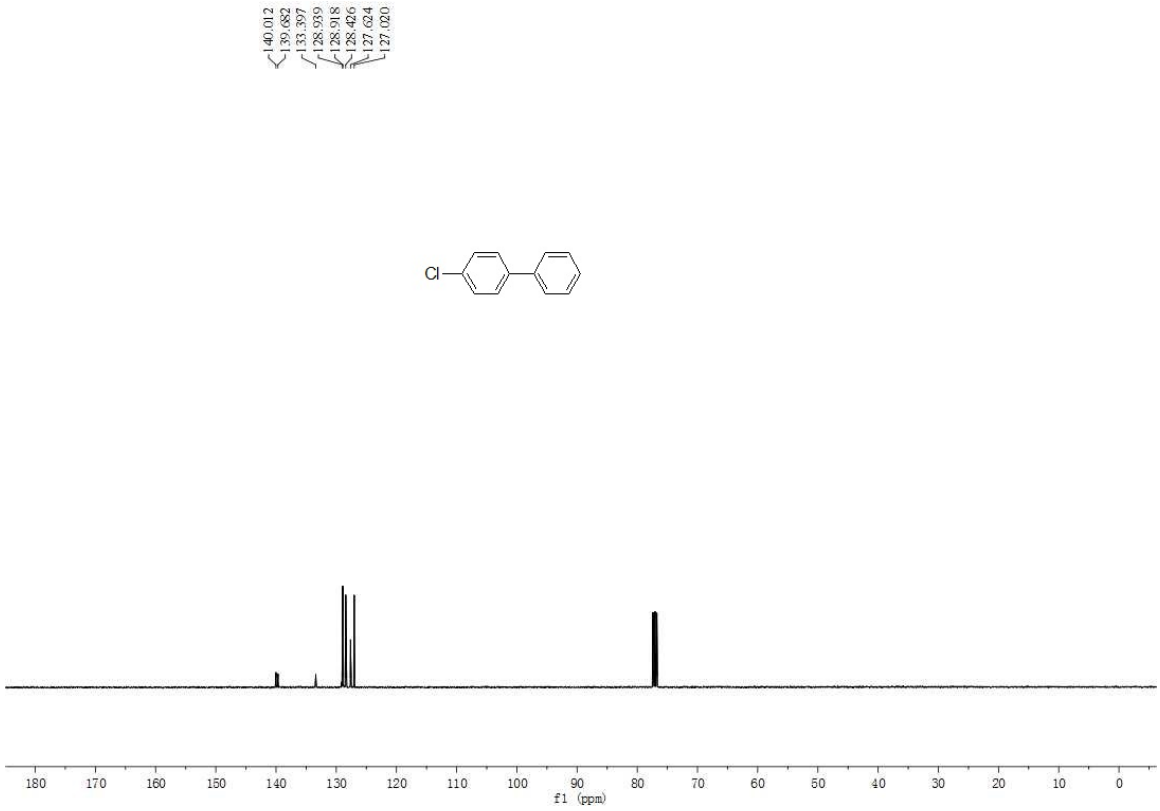

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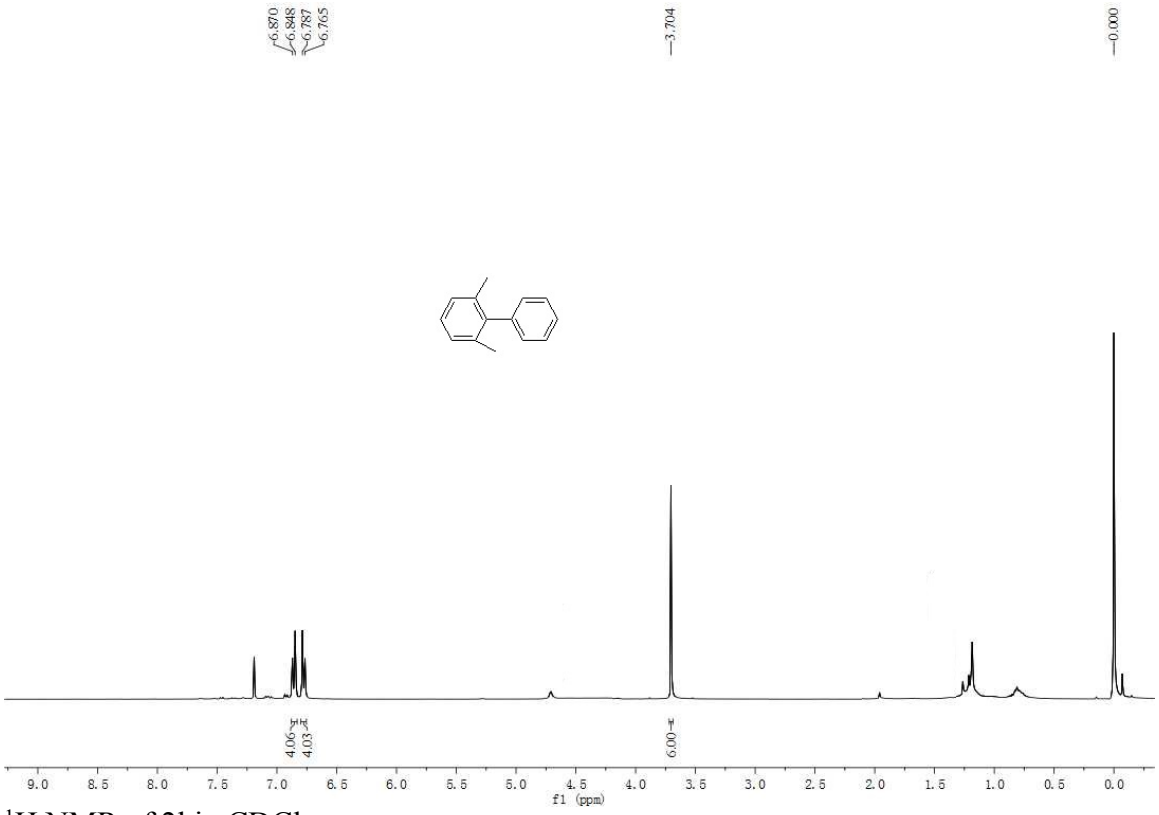

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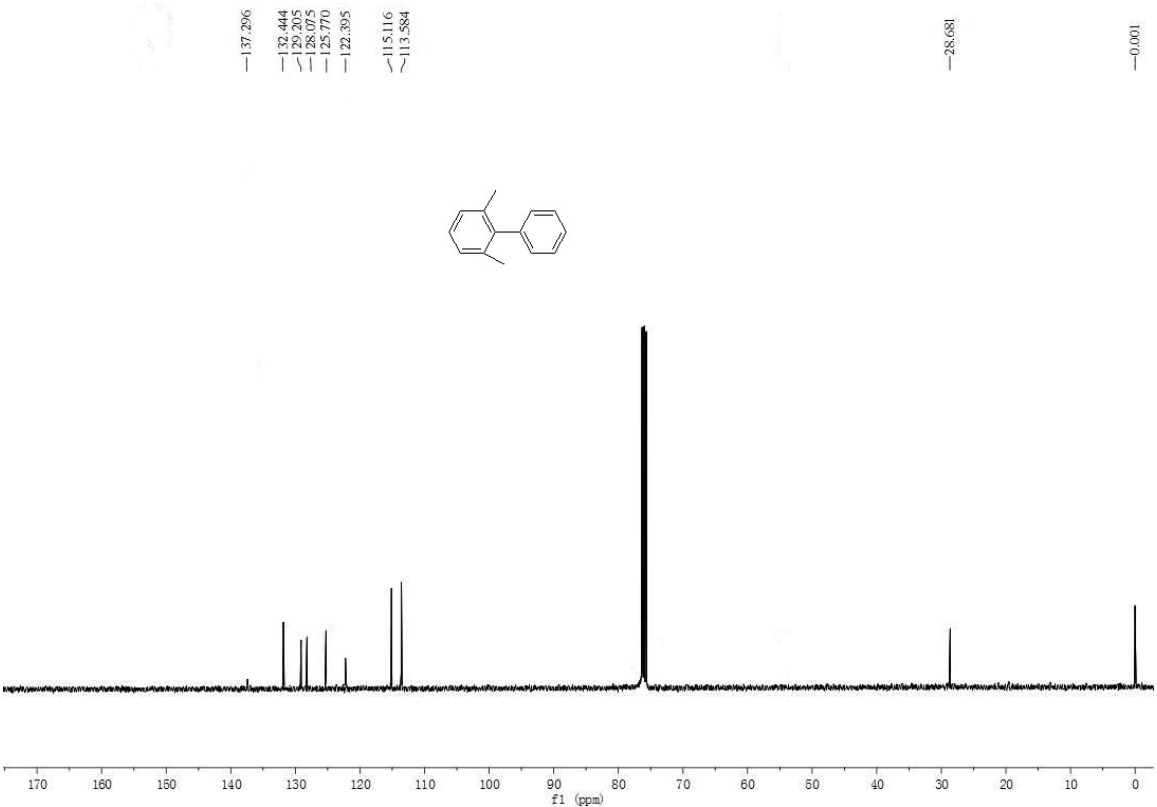

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