Supporting Information

Bimetallic Au-Pd Nanochain Networks: Facile Synthesis and Promising Application in Biaryl Synthesis

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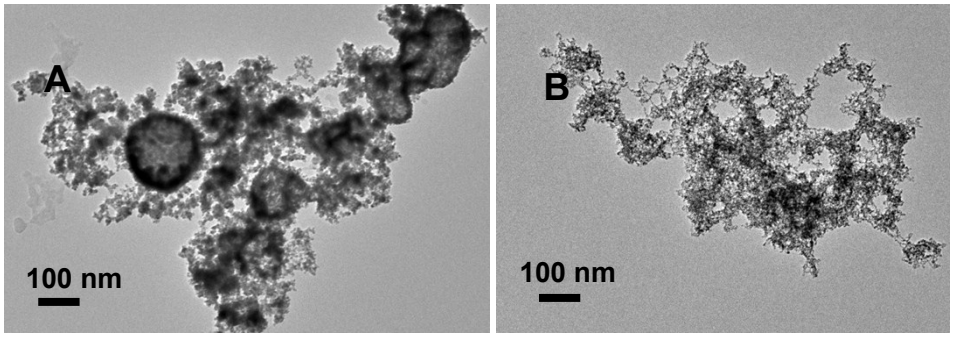

Figure S1. TEM images of the Au-Pd products obtained with 5 mM (A), 70 mM (B) of 4-AP.

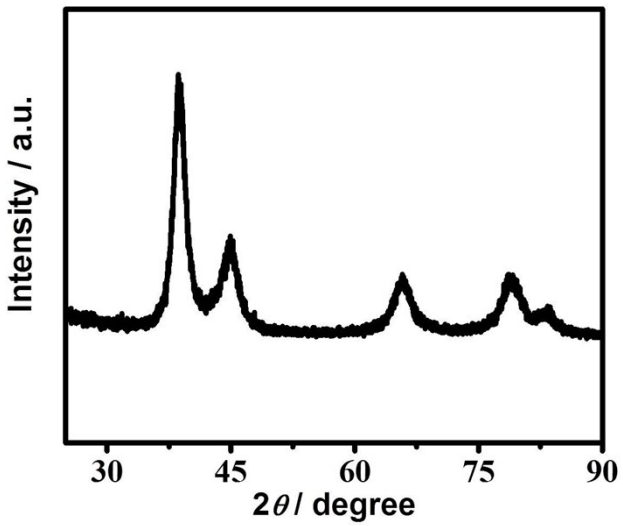

Figure S2. XRD pattern of the Au-Pd NNCs after used for 5 times.

Table S1. Elemental analysis of the Au-Pd NNCs by ICP-MS.

Element	Before reaction (mg/L)	After fifth cycle(mg/L)	Leaching (mg/L)
Pd	67.3	66.7	0.6
Au	33.4	32.2	1.2

Characterization Data of Products: 2a-n are known compounds.[1-6] And analytical data of the corresponding products are summarized as follows:

Biphenyl (2a): White solid, MP: 68-69 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.35 (t, 2 H, J = 7.4 Hz), 7.44 (t, 4 H, J = 7.6 Hz), 7.59 (d, 4 H, J = 7.6 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 127.17, 127.25, 128.75, 141.26. MS (EI): m/z 154.1.

4, 4'-Dimethylbiphenyl (2b): White solid, MP: 119-120 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 2.39 (s, 6 H), 7.24 (t, 4 H, J = 5.8 Hz), 7.47 (d, 4 H, J = 8.0 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 21.51, 124.86, 127.54, 133.31, 141.71. MS (EI): m/z 182.1.

4, 4'-Dimethoxylbiphenyl (2c): White solid, MP: 178-179 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 3.84 (s, 6 H), 6.95 (d, 4 H, J = 8.8 Hz), 7.47 (d, 4 H, J = 8.4 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 55.16, 113.98, 127.54, 133.31, 158.51. MS (EI): m/z 214.1.

3, 3'-Dimethoxylbiphenyl (2d): White solid, MP: 45-47 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 3.86 (s, 6 H), 6.88-6.91 (m, 2 H), 7.12 (s, 2H), 7.17 (d, 2 H, J = 7.8 Hz), 7.35 (t, 2 H, J =7.8 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 55.33, 112.84, 112.97, 119.73, 129.74, 142.66, 159.92. MS (EI): m/z 214.1.

2, 2'-Dimethoxylbiphenyl (2e): White solid, MP: 241-244 °C; ^{1}H NMR

(400 MHz, $CDCl_3$): δ (ppm) 3.89 (s, 6 H), 6.83 (t, 3 H, J = 7.6 Hz), 8.89 (d, 2H, J = 8.0 H z), 7.27 (t, 2 H, J = 7.4 Hz), 7.52-7.54 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 56.16, 111.70, 121.82, 128.53, 133.36, 155.86. MS (EI): m/z 214.1.

4, 4'-Dinitro-biphenyl (2f): Pale yellow solid, MP 241-244 °C; ^1H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.60 (t, 4 H, J = 4.4 Hz), 8.02 (d, 4 H, J = 8.8 Hz), ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 125.01, 129.99, 132.63, 147.03. MS (EI): m/z 244.2.

2, 2', 6, 6'-Tetramethyl-biphenyl (2g): White solid, MP: 67-70 °C; ^1H NMR (400 MHz, $CDCl_3$): δ (ppm) 2.37 (s, 12 H), 7.19(s, 4 H), 7.26 (s, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 21.40, 125.11, 128.72, 138.10, 141.47. MS (EI): m/z 210.1.

4, 4'-Di-tert-butyl-1,1'-biphenyl (2h): White solid, MP: 127-129 °C; ^1H NMR (400 MHz, $CDCl_3$): δ (ppm) 1.28 (s, 18 H), 7.24 (d, 4 H, J = 8.8 Hz), 7.39 (d, 4 H, J = 8.4 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 26.39, 29.68, 121.81, 122.35, 126.19, 145.24. MS (EI): m/z 266.1.

4, 4'-Biphenol (2i): White solid, MP: 279-282 °C; ^1H NMR (400 MHz, $CDCl_3$): δ (ppm) 5.60 (s, 2 H), 6.71 (d, 4 H, J = 8.8 Hz), 7.31 (d, 4 H, J = 8.4 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 113.01, 117.28, 132.55, 154.49. MS (EI): m/z

186.1.

4, 4'-Diacetylbiphenyl (2j): White solid, MP: 189-191 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 2.57 (s, 6 H), 7.66 (d, 4 H, J = 8.4 Hz), 7.83 (d, 4 H, J = 8.4 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 26.48, 101.10, 129.73, 136.37, 137.92, 197.34. MS (EI): m/z 238.1.

3, 3'-Dichloro-1, 1'-biphenyl (2k): White solid, MP: 28-29 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.33-7.39 (m, 4 H), 7.42 (d, 2 H, J = 7.2 Hz), 7.54 (s, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 125.28, 127.28, 127.90, 130.14, 134.84, 141.63. MS (EI): m/z 223.1.

1, 6-Diphenylhexane (2l): White solid, MP: 136-139 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 2.09-2.16 (m, 4 H), 2.72 (t, 4 H, J = 7.4 Hz), 3.16 (t, 4 H, J = 6.8 Hz), 7.20 (t, 6 H, J = 7.4 Hz), 7.28 (t, 4 H, J = 7.4 Hz). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 6.40, 34.93, 36.26, 126.22, 128.54, 128.60, 140.44. MS (EI): m/z 238.1.

1, 2-Di(naphthalen-2-yl)ethane (2m): White solid, MP: 127-129 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 4.83 (s, 4 H), 7.46-7.50 (m, 6 H), 7.79-7.84 (m, 8 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 85.49, 125.18, 125.48, 125.92, 126.21, 127.74, 127.90, 128.36, 132.96, 133.39, 138.32. MS (EI): m/z 282.1.

1, 1'-Biisoquinoline (2n): Pale yellow solid, MP: 160-162 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm): 7.36 (d, 3 H, J = 7.6 Hz), 7.49 (t, 3 H, J = 8.4 Hz), 7.58-7.63 (m, 3 H), 8.11-8.13 (M, 3 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 120.42, 123.74, 124.83, 128.68, 131.86, 141.42, 143.90, 165.51. MS (EI): m/z 256.1.

5, 5-Biindolyl (2o): White solid, MP: 197-199 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 6.49 (s, 2 H), 7.19 (s, 2 H), 7.23-7.28 (m, 4 H), 7.77 (s, 2 H), 7.18 (s, 2 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 102.33, 112.45, 113.05, 123.24, 124.87, 125.38, 129.66, 134.43. MS (EI): m/z 232.1.

4, 4'-Difluorobiphenyl (2p): White solid, MP: 94-96 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 7.10 (t, 4 H, J = 8.4 Hz), 7.45-7.484 (m, 4 H). ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 115.58, 115.80, 128.54, 128.62, 136.39, 136.42, 161.22, 163.67. ^{19}F NMR (400 MHz, $CDCl_3$): δ (ppm) -115.71. MS (EI): m/z 190.1.

6-Phenyl-6,7-dihydro-5H-dibenzo[c,e]azepine (2q): White solid, MP: 85-87 °C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 4.66 (s, 4 H), 6.56 (d, 4 H, J = 8.0 Hz), 6.72 (t, 1 H, J = 7.2 Hz), 7.13-7.19 (m, 4 H), 7.23-7.29 (m, 4 H), 7.59 (d, 2 H, J = 8.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$): δ (ppm) 55.37, 112.06, 117.17, 122.77, 127.68, 127.81, 128.57, 129.35, 133.01, 136.48, 148.03. MS (EI): m/z 271.2.

References

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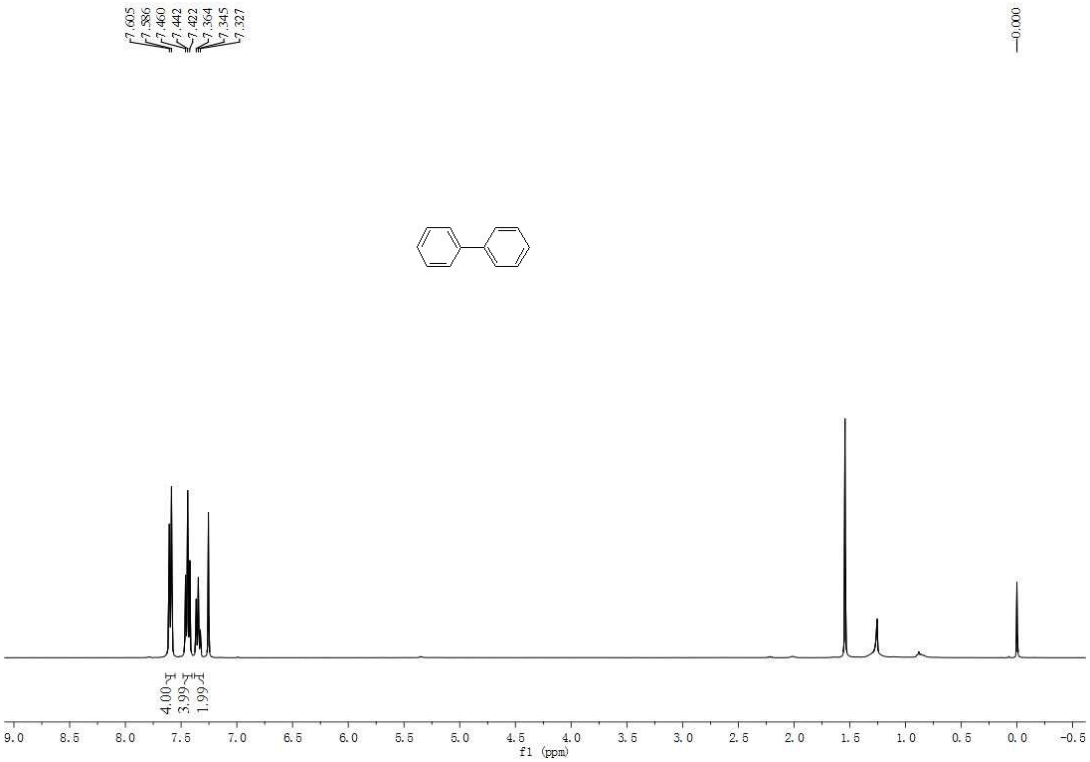
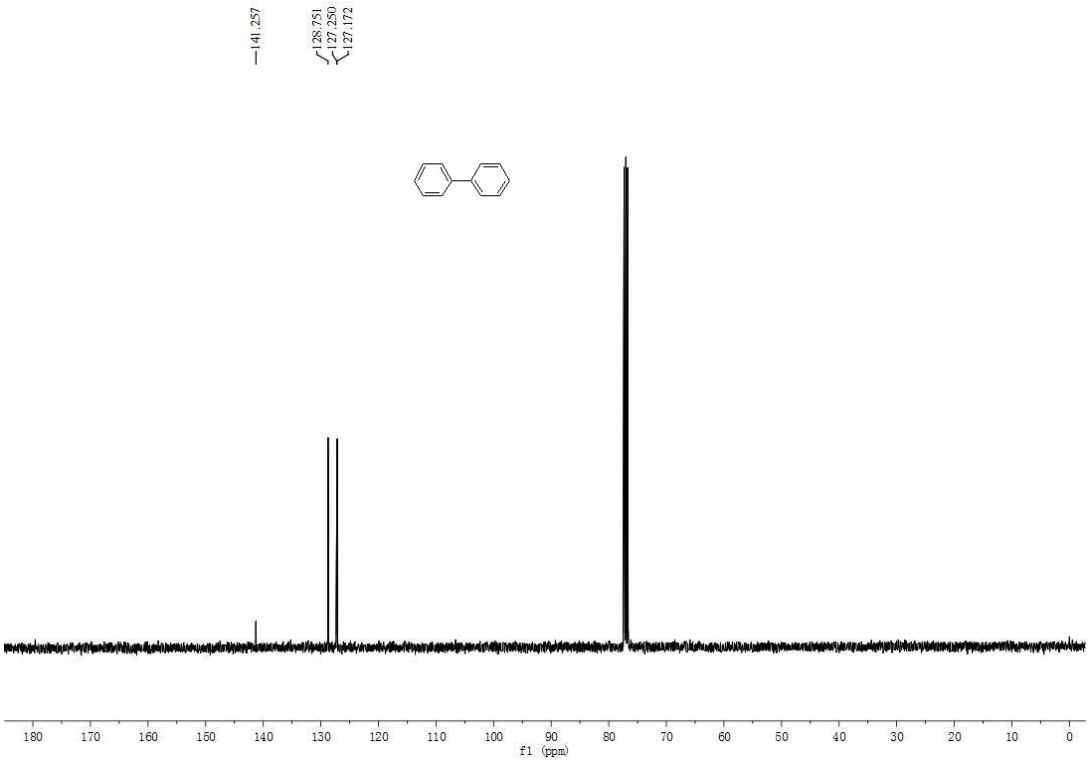
NMR spectra of all compounds



^{1}H NMR of **2a** in $CDCl_3$



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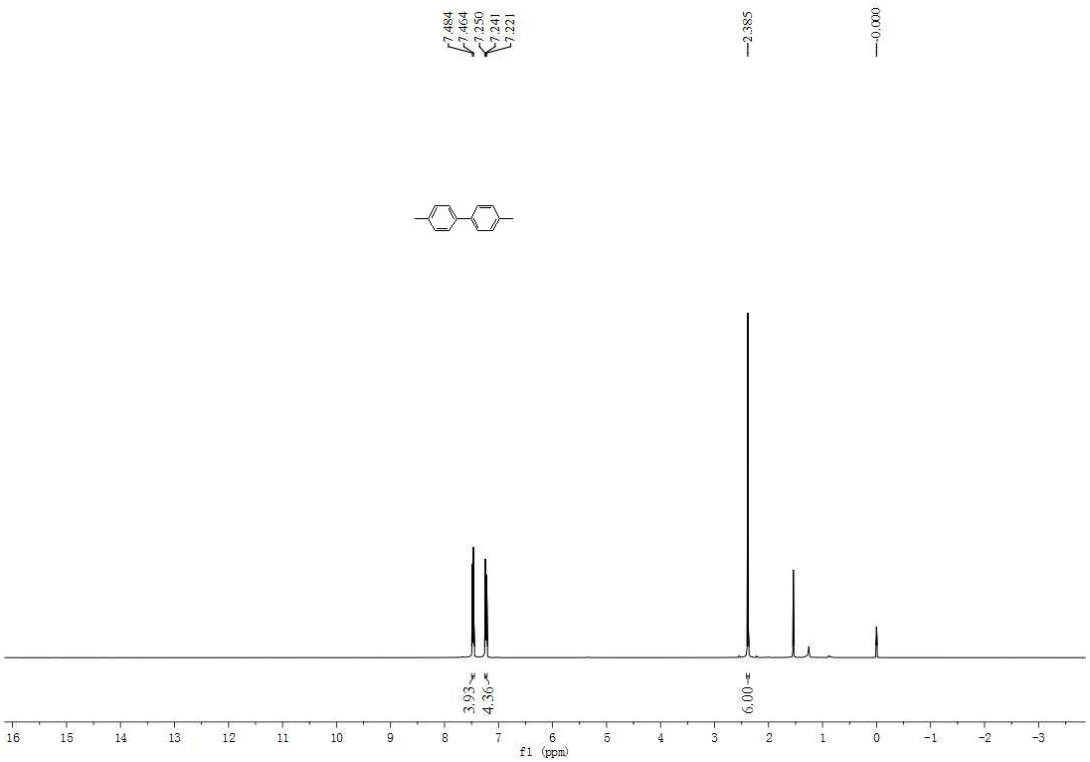

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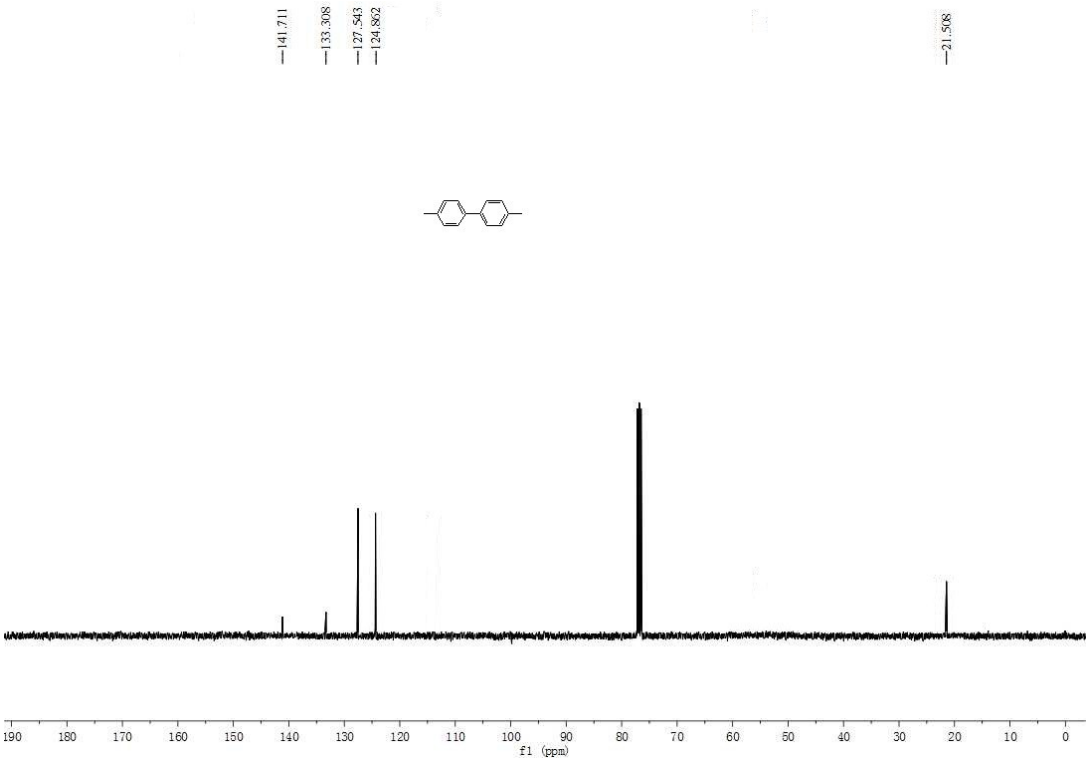

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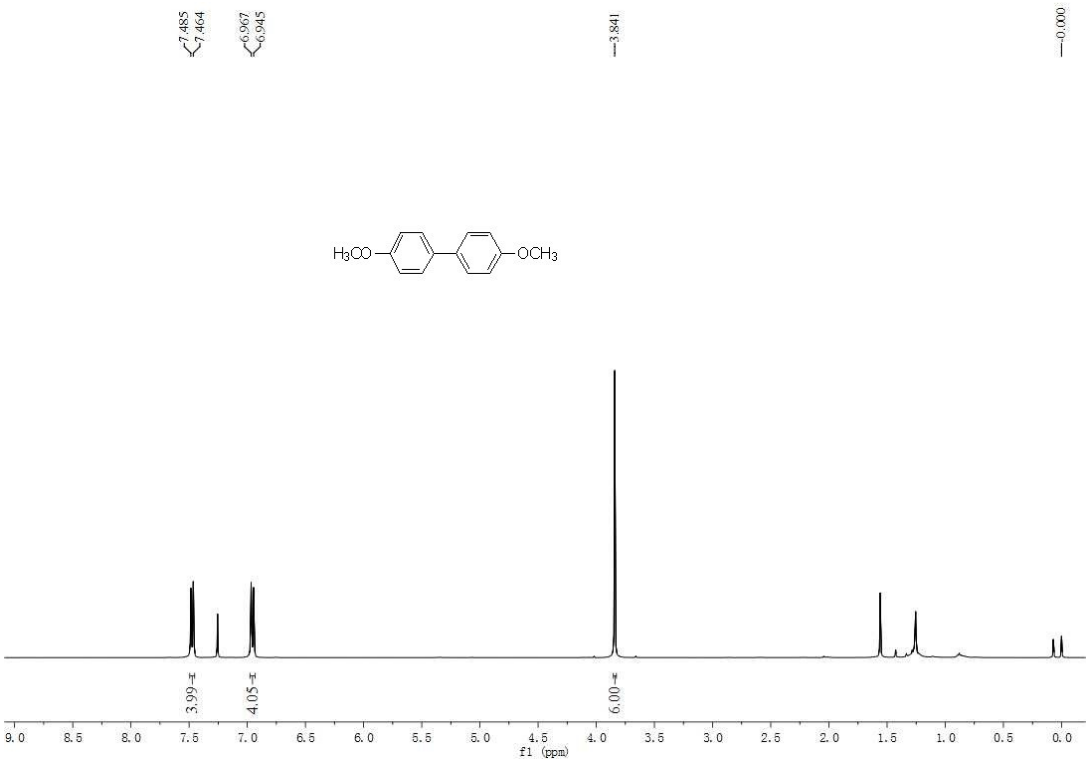

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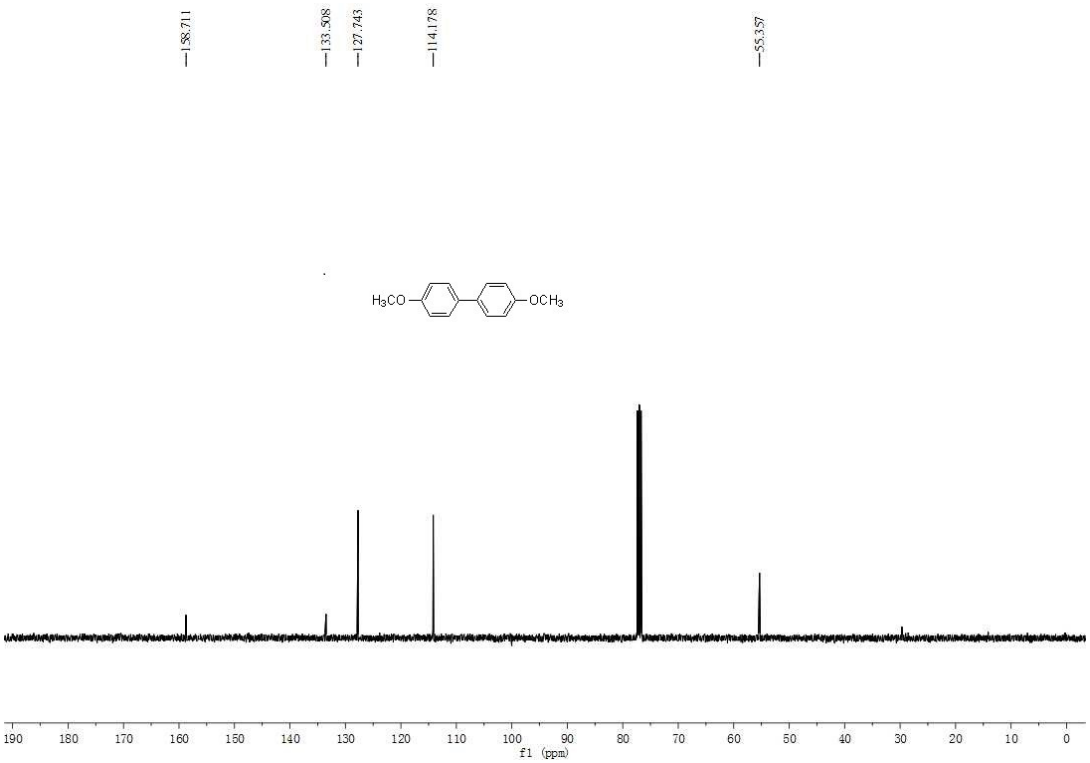

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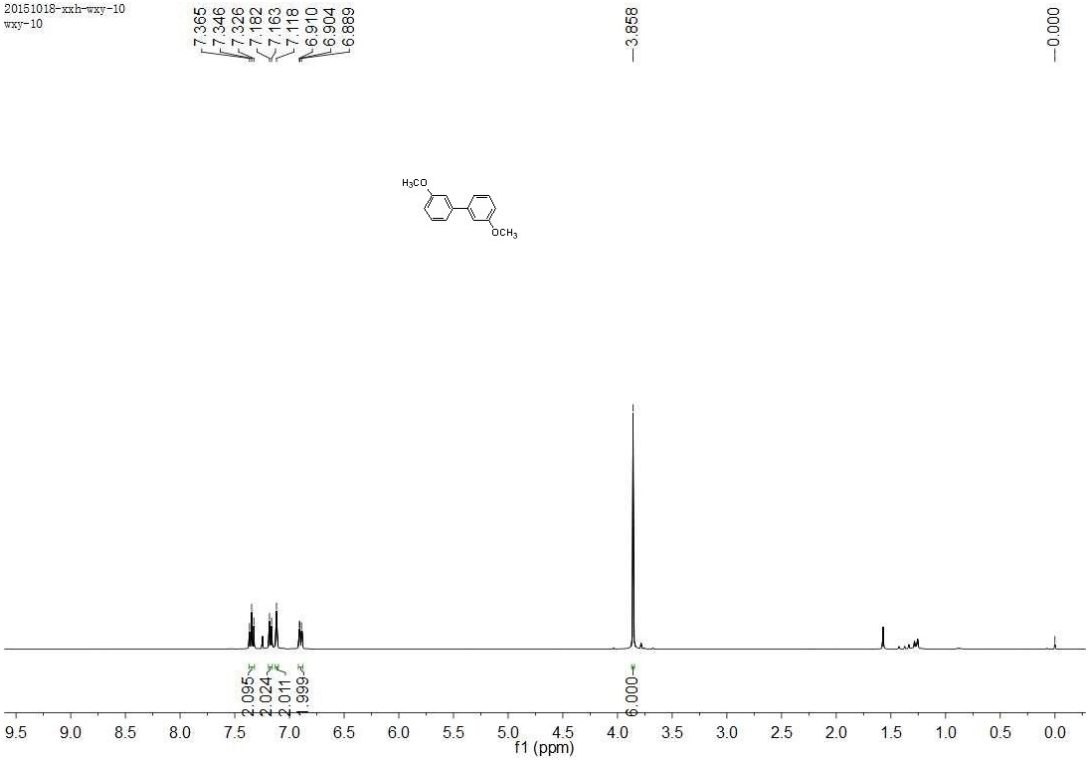

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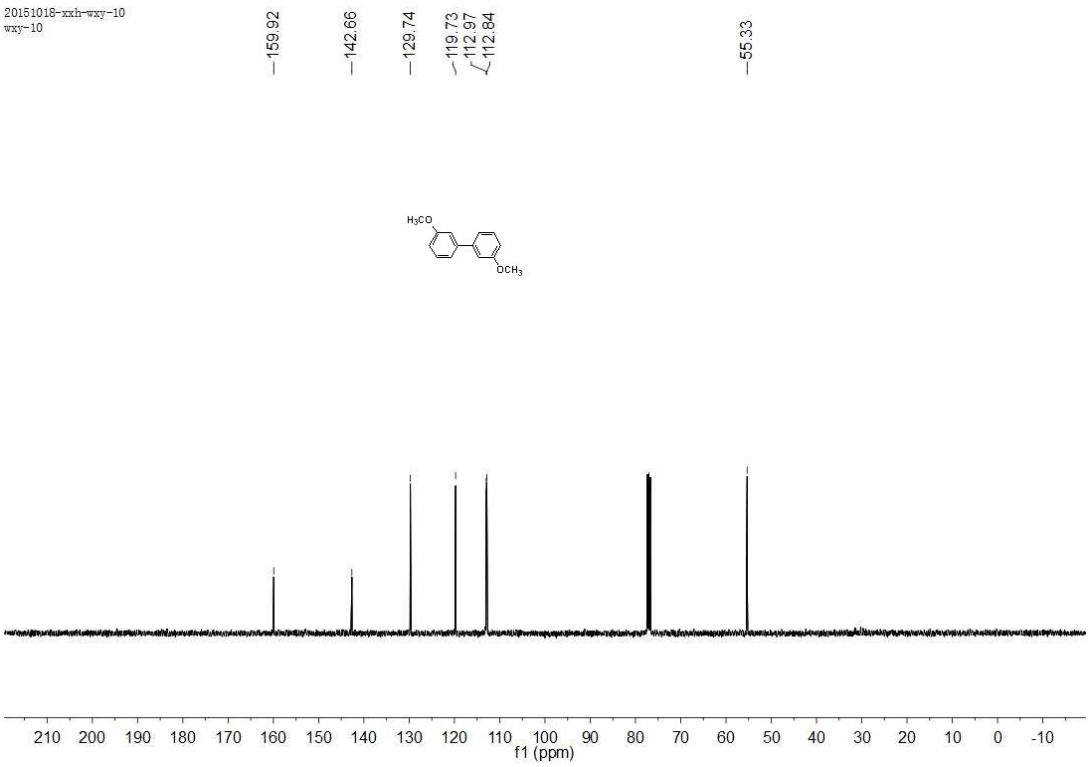

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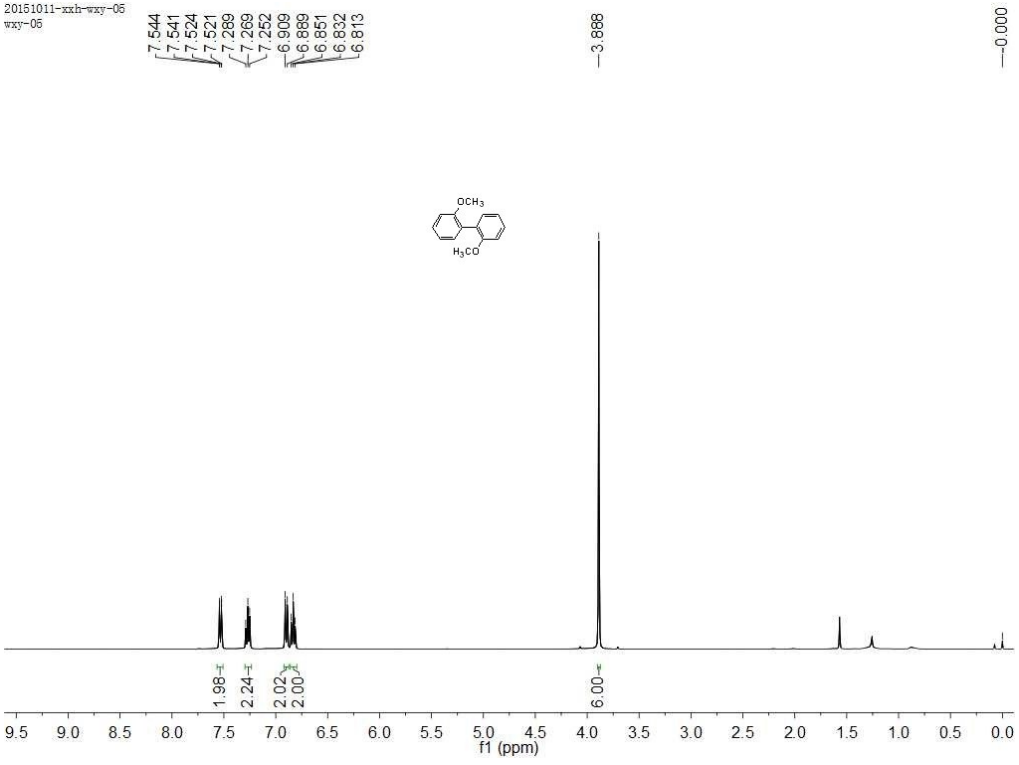

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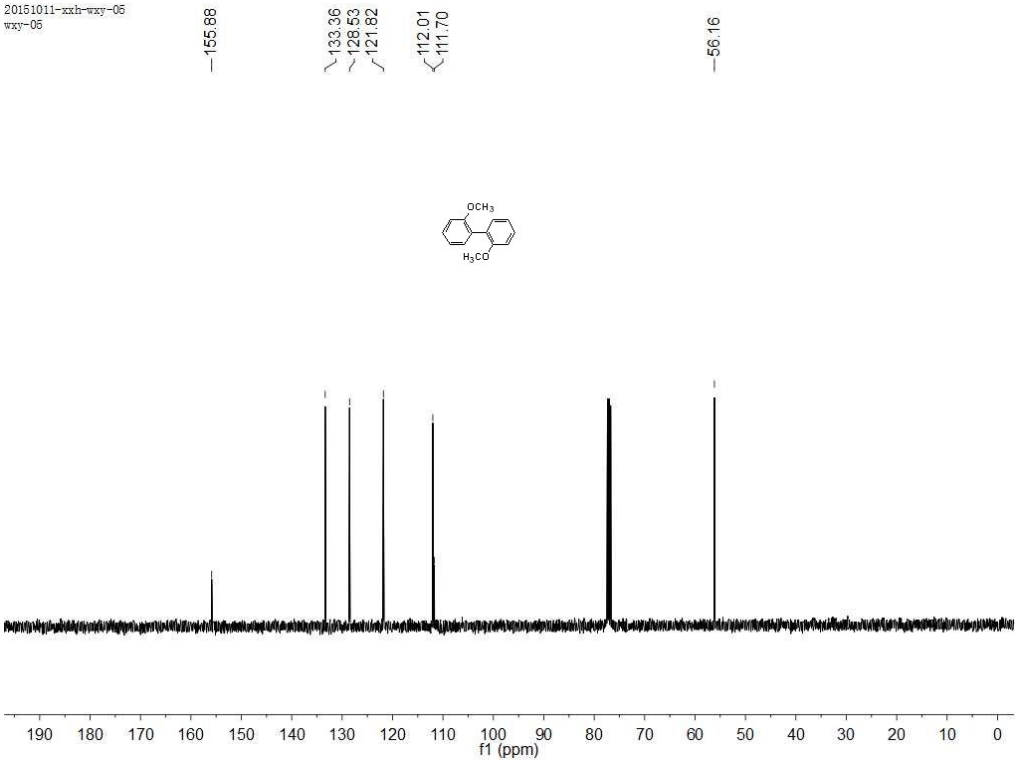

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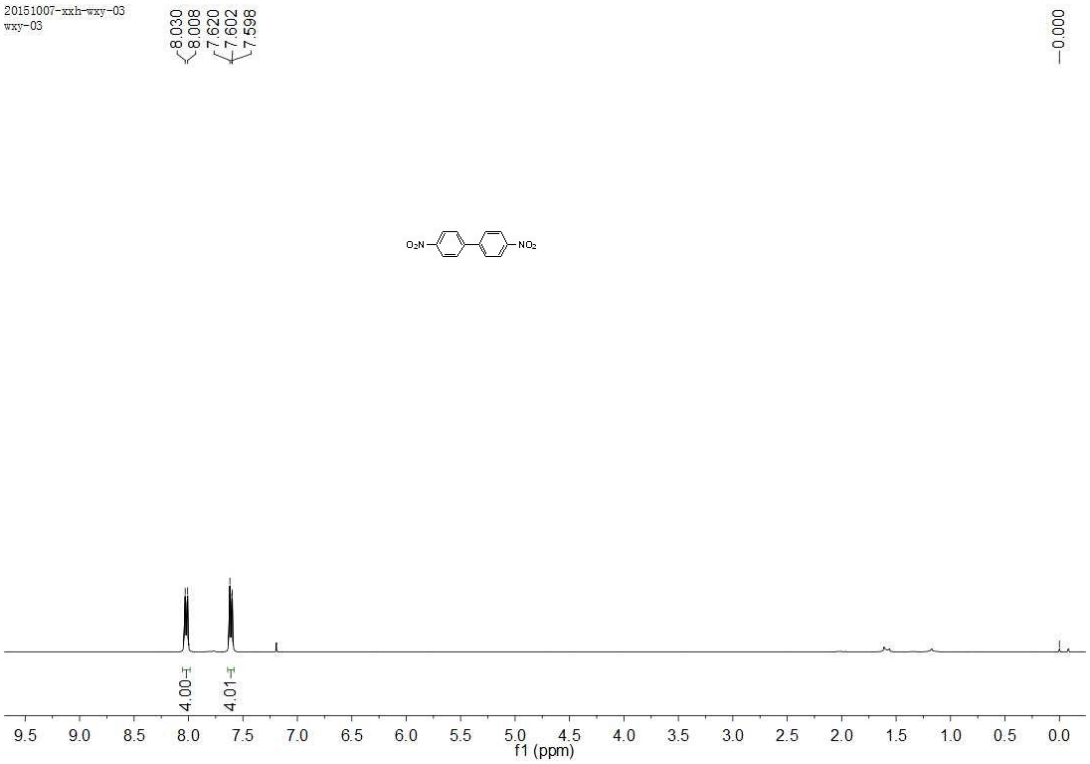

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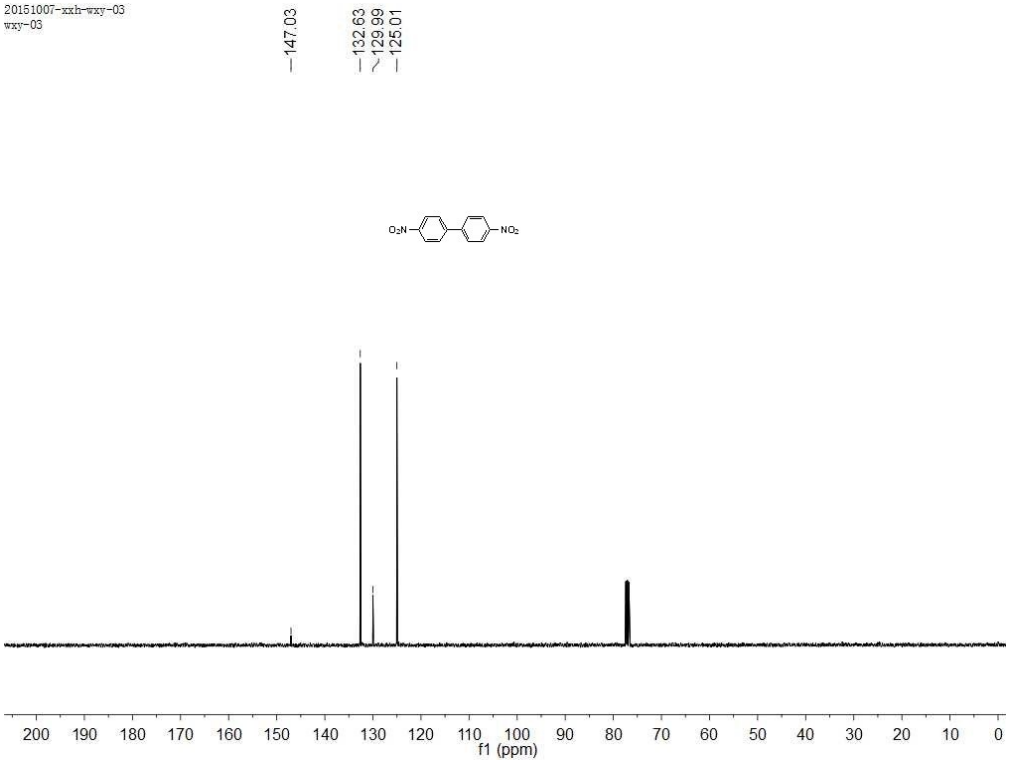

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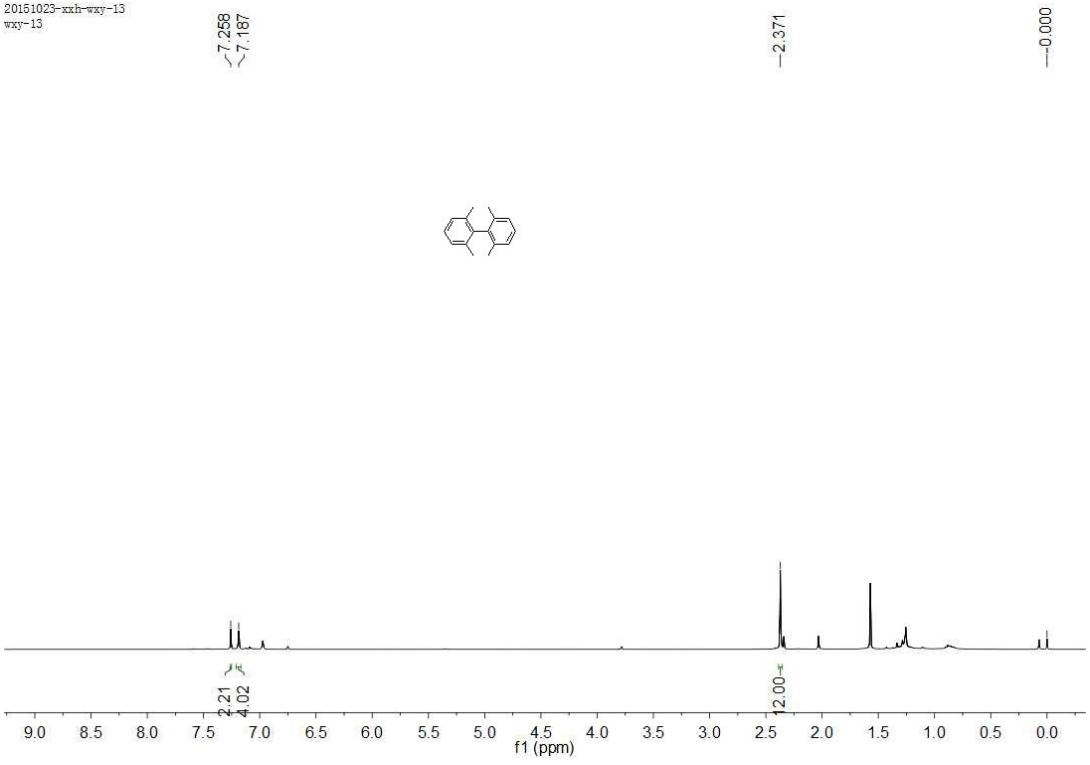

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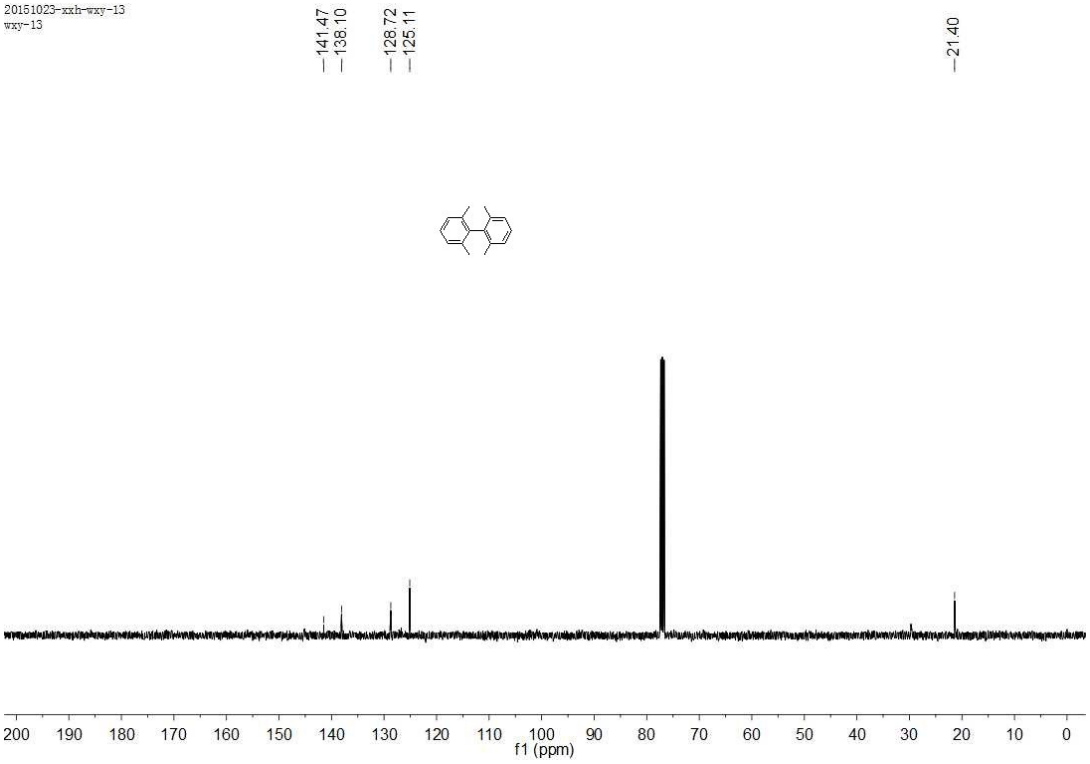

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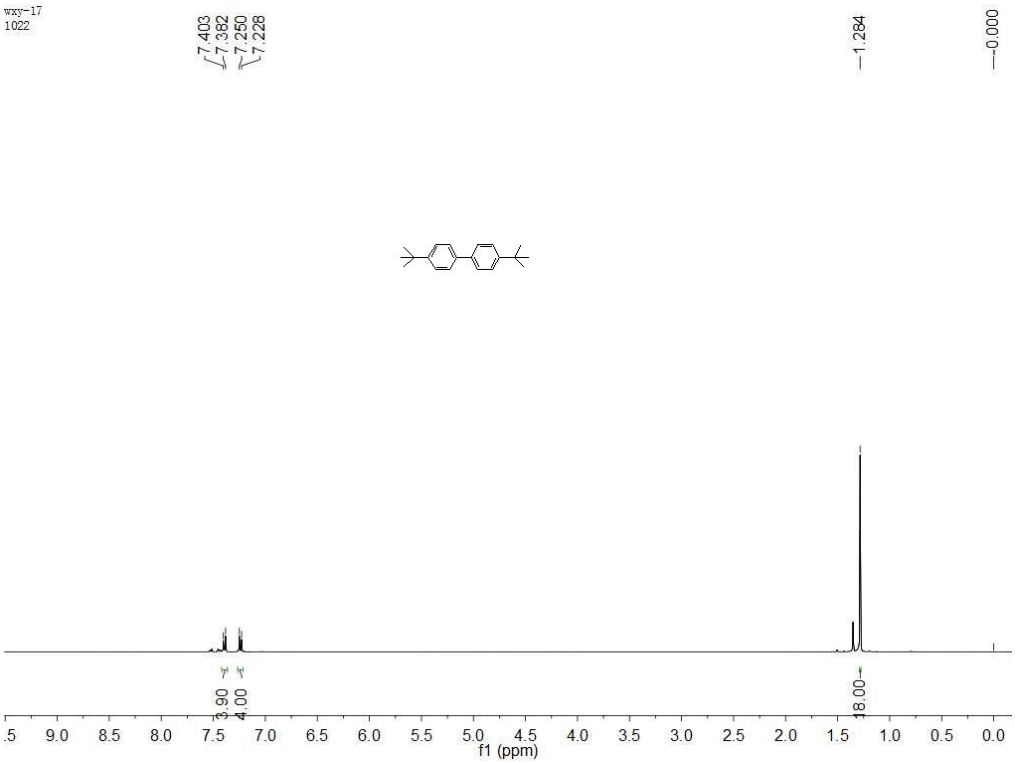

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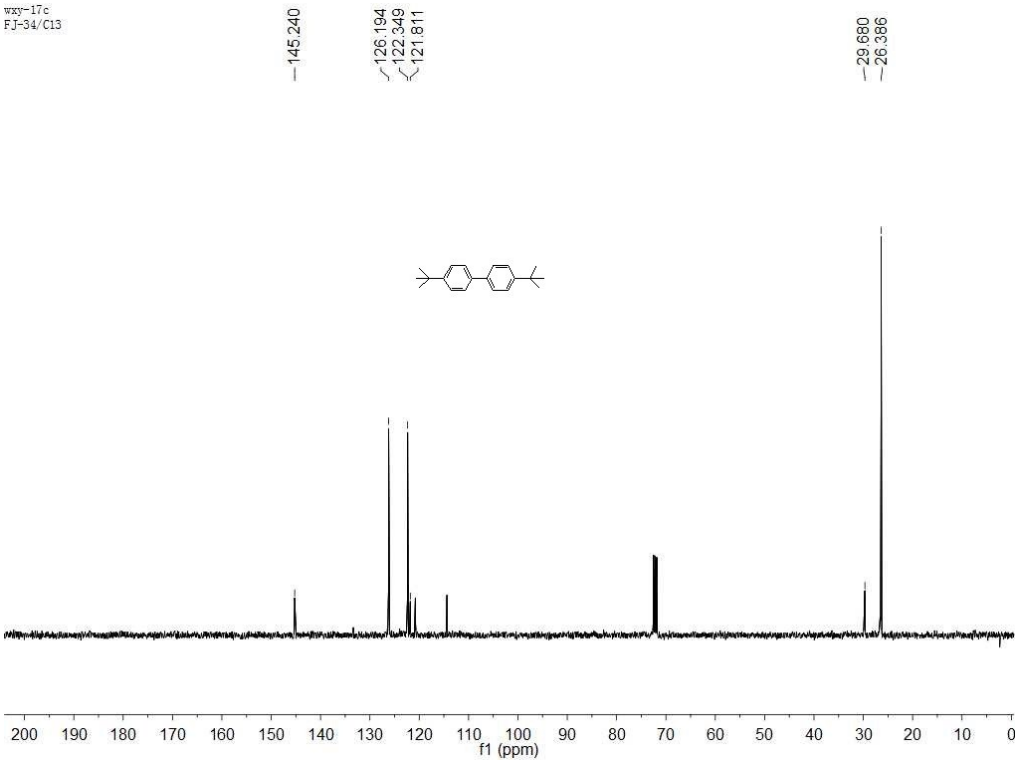

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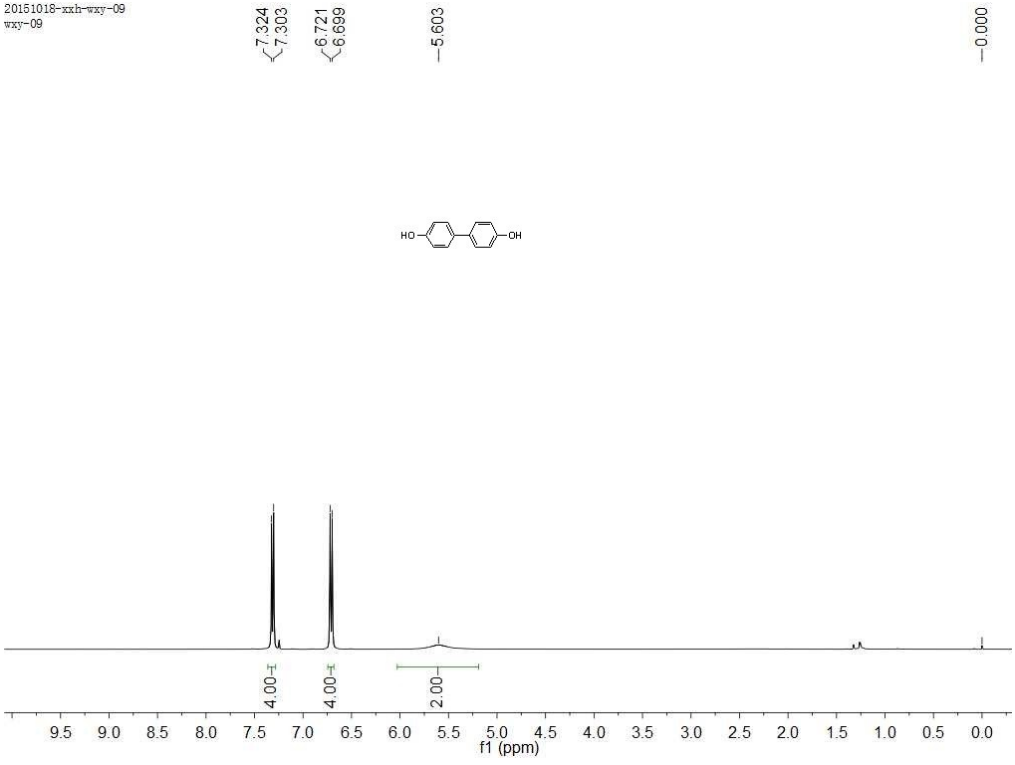

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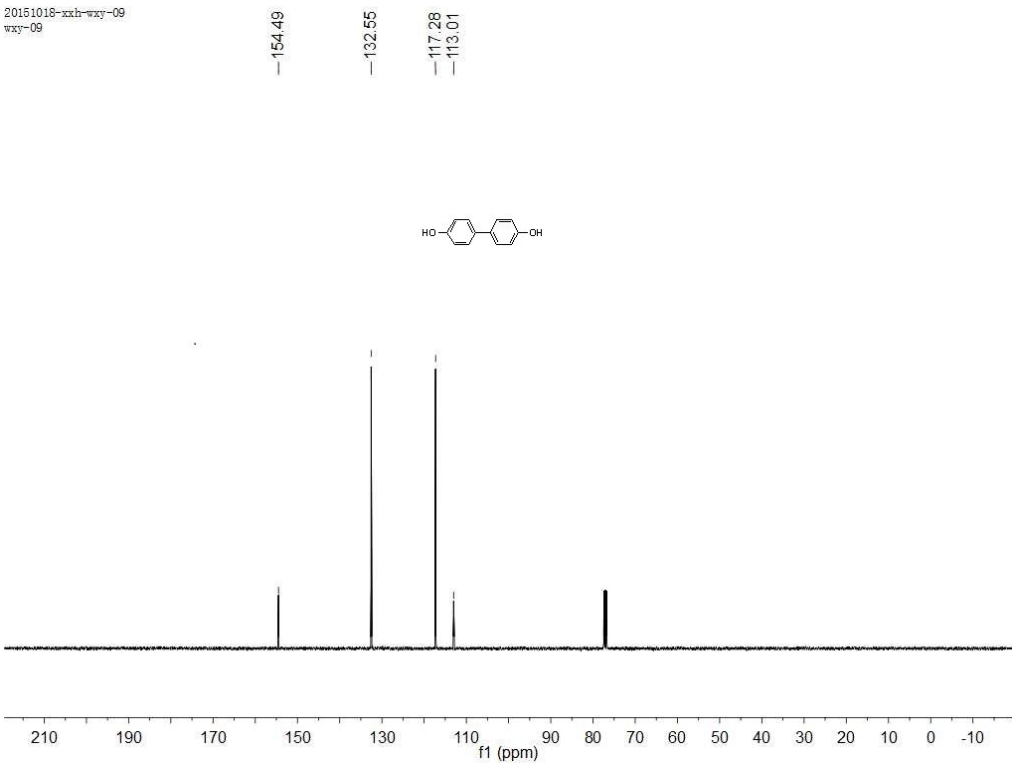

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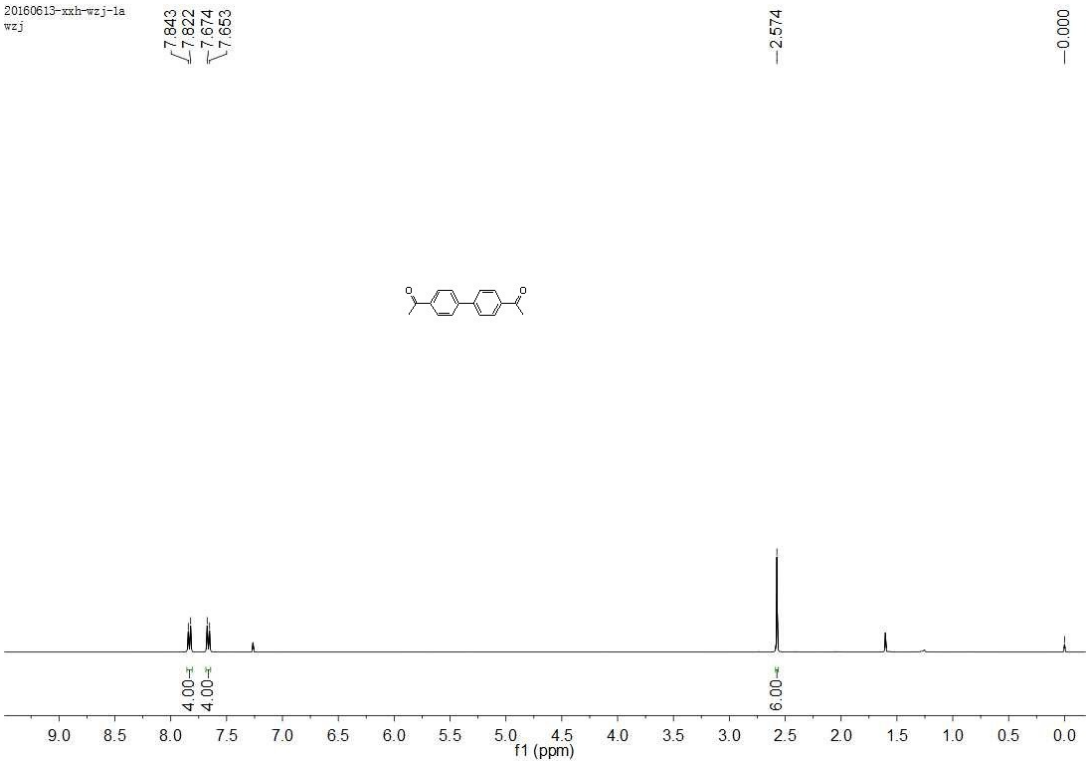

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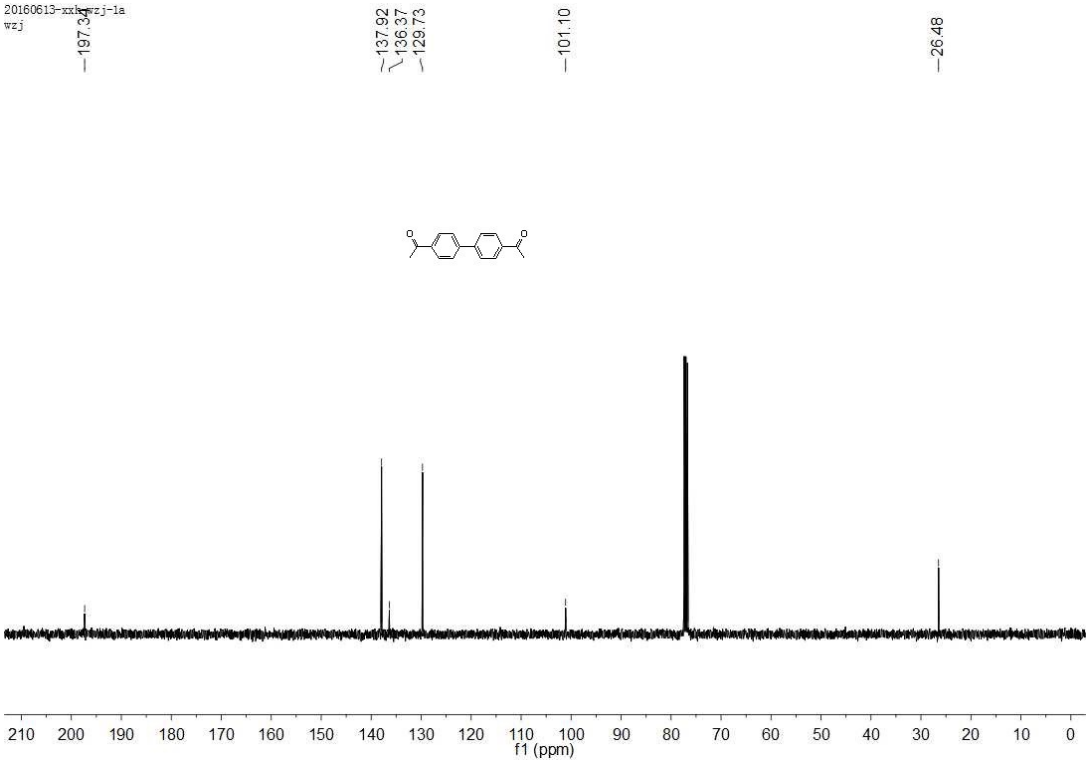

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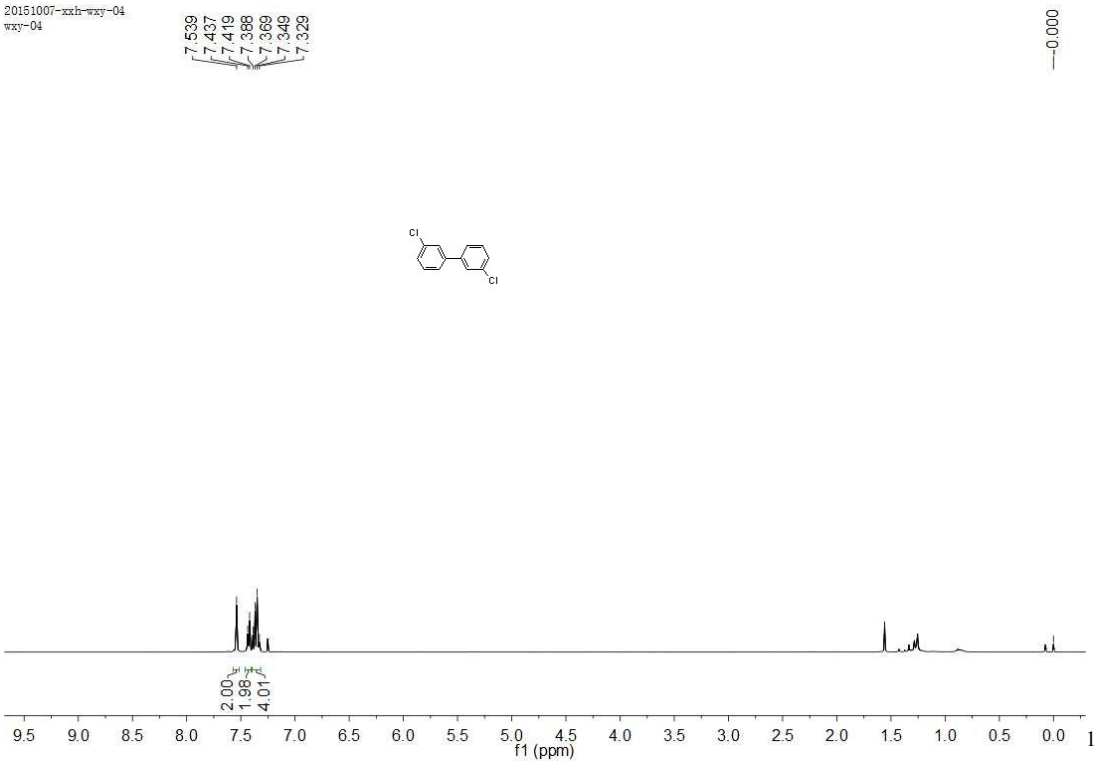

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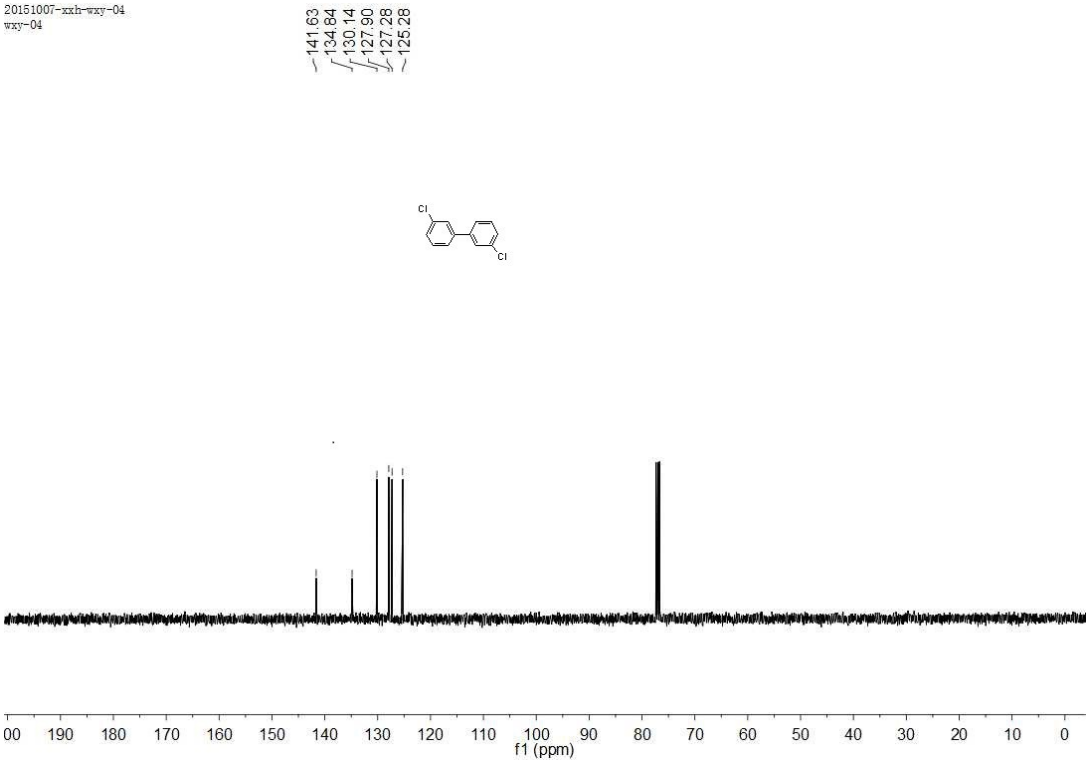

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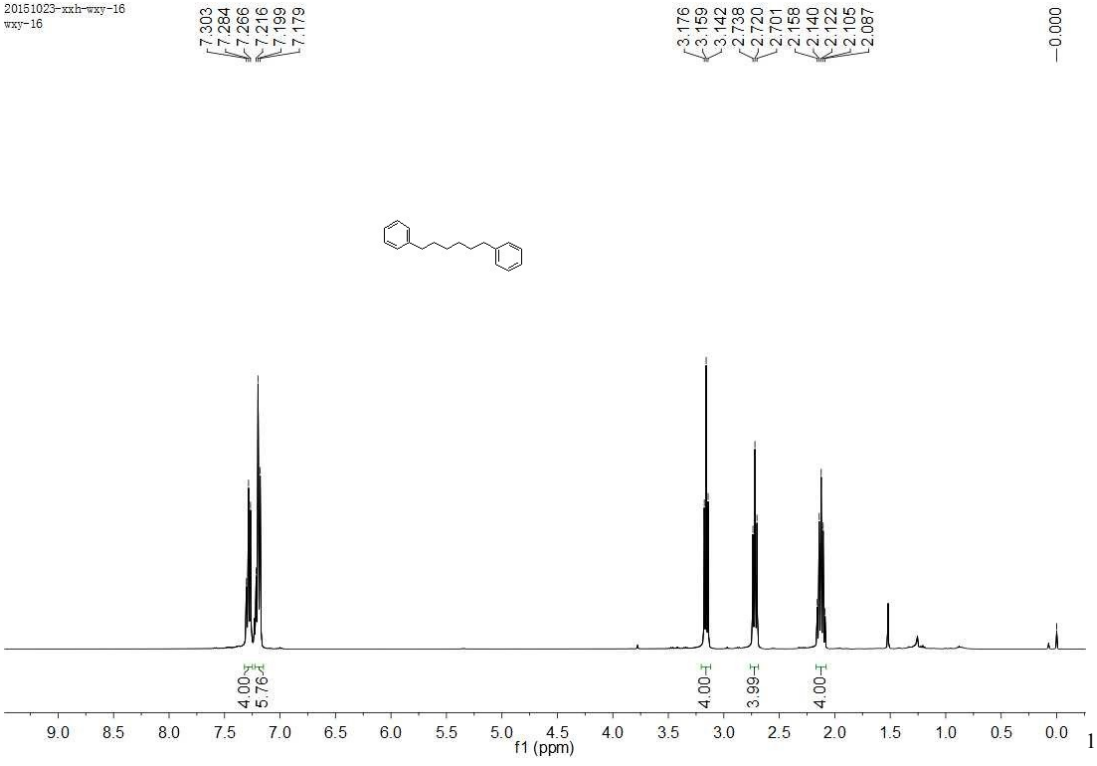

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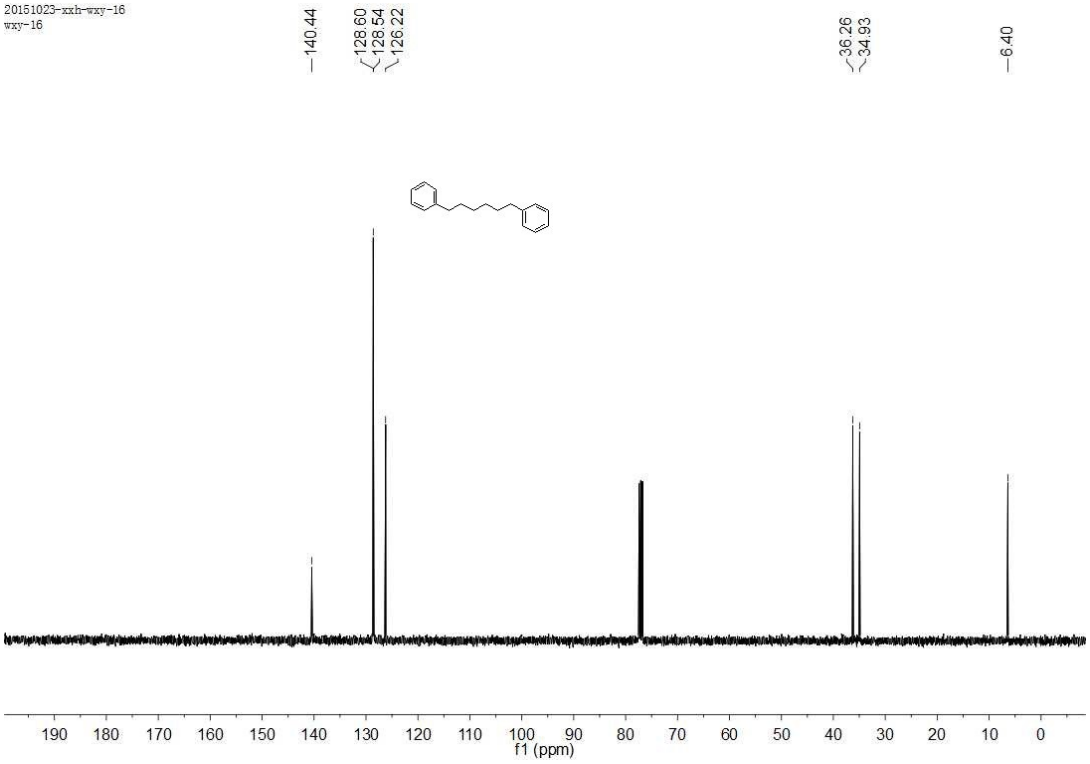

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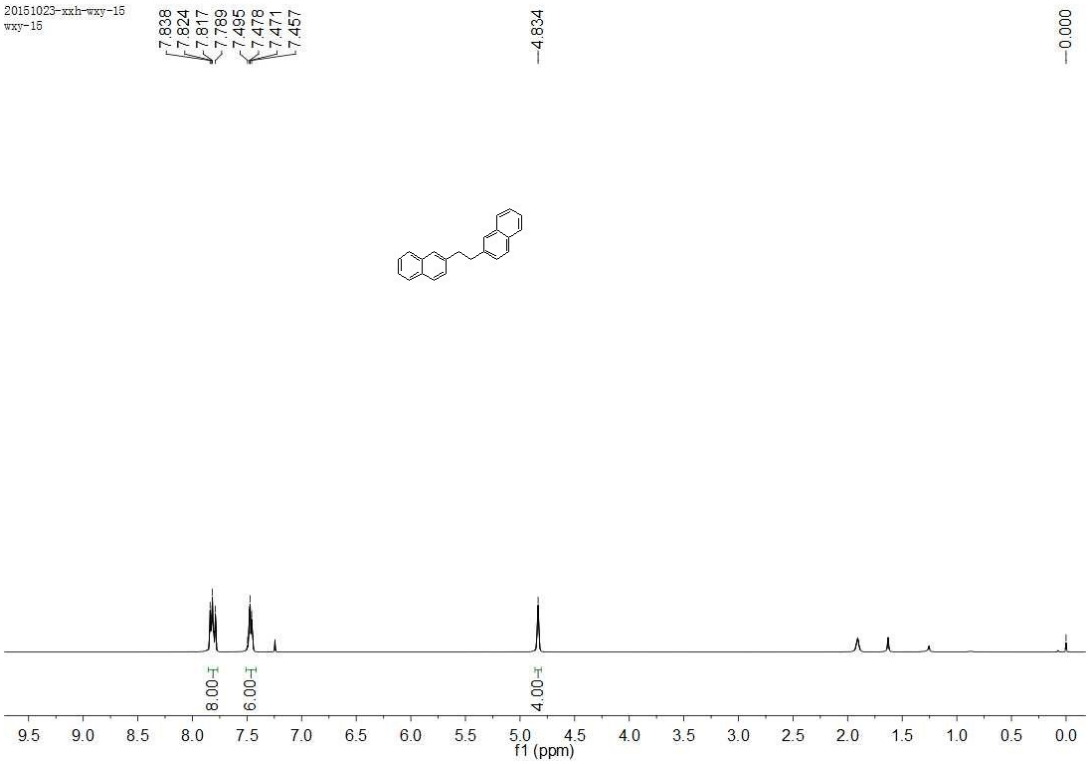

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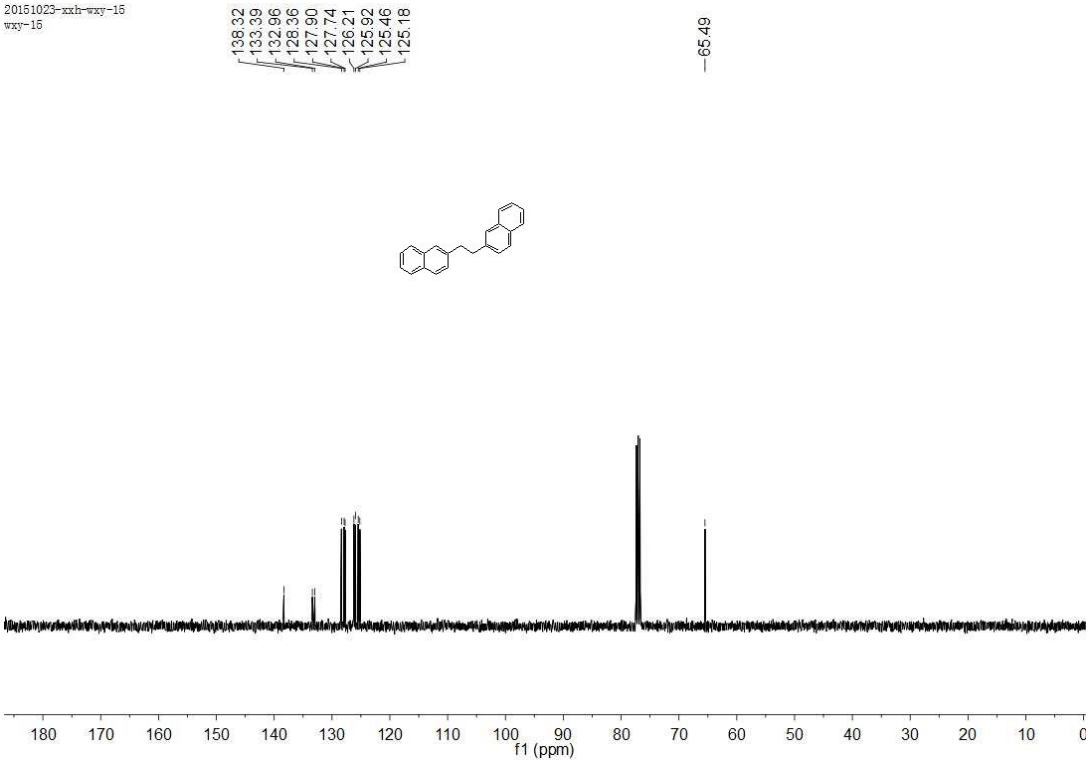

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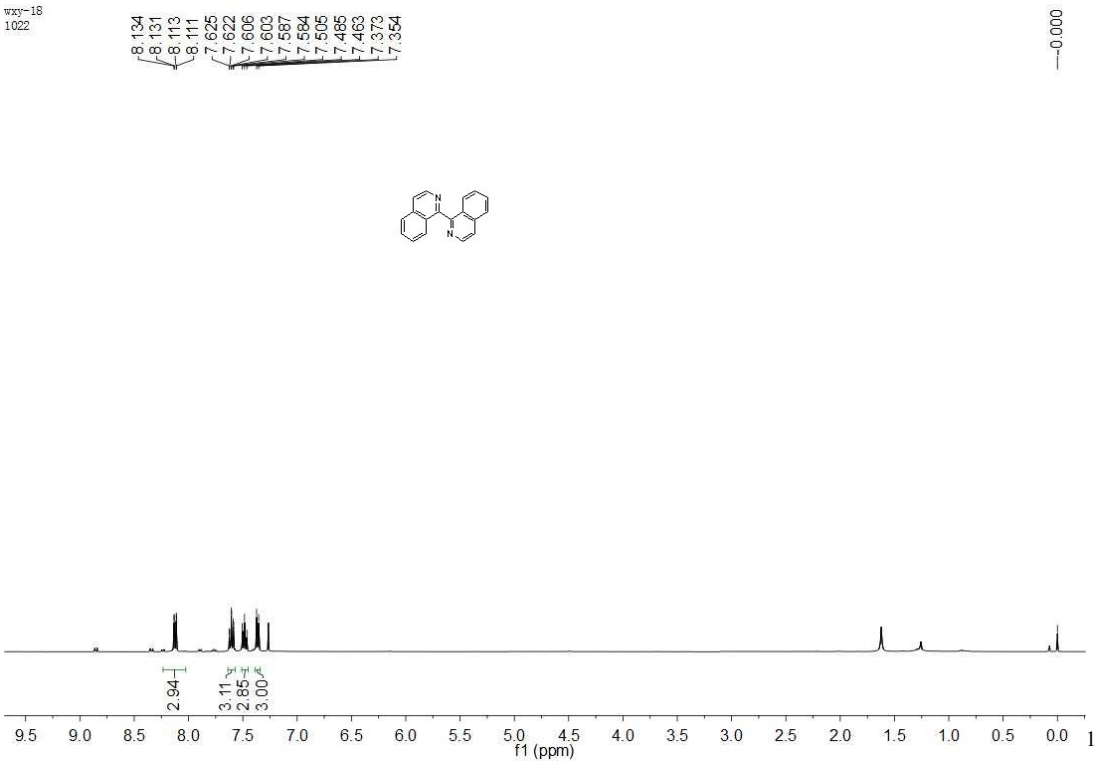

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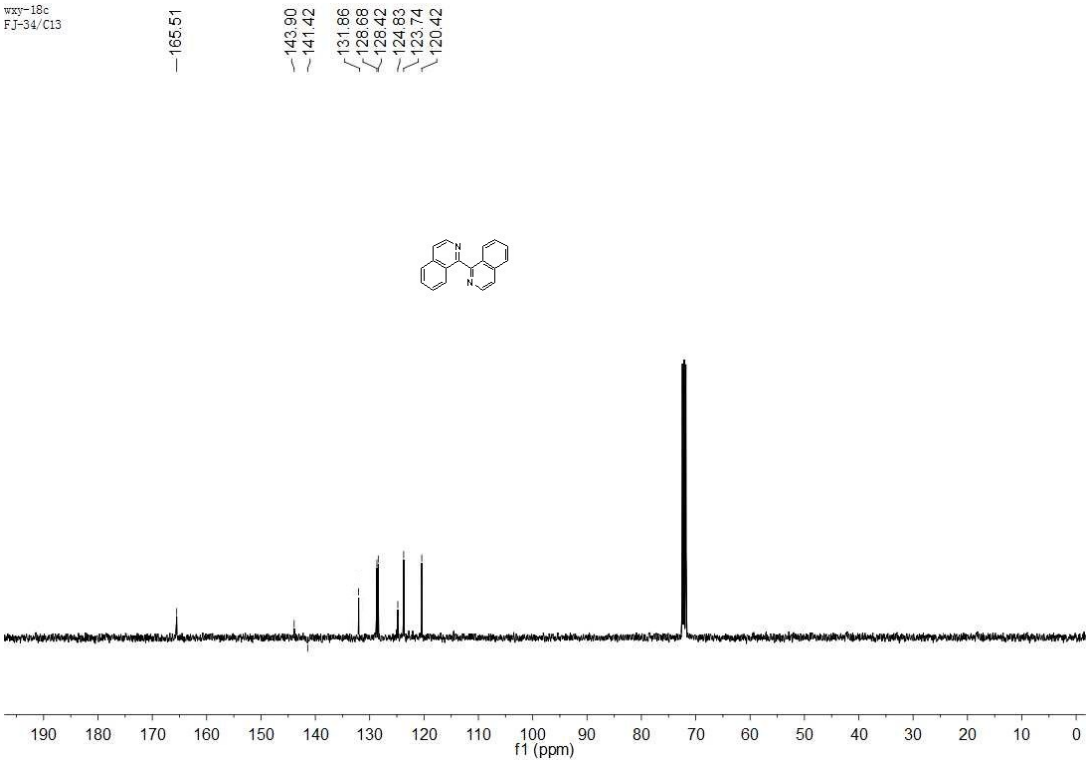

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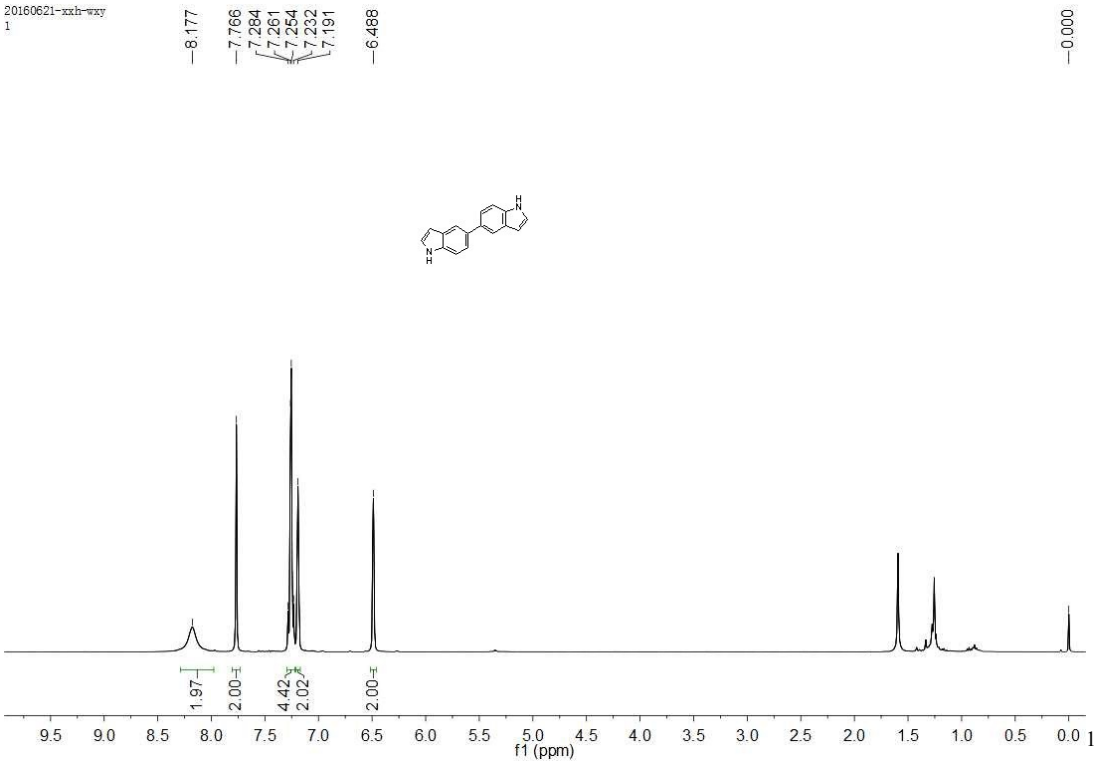

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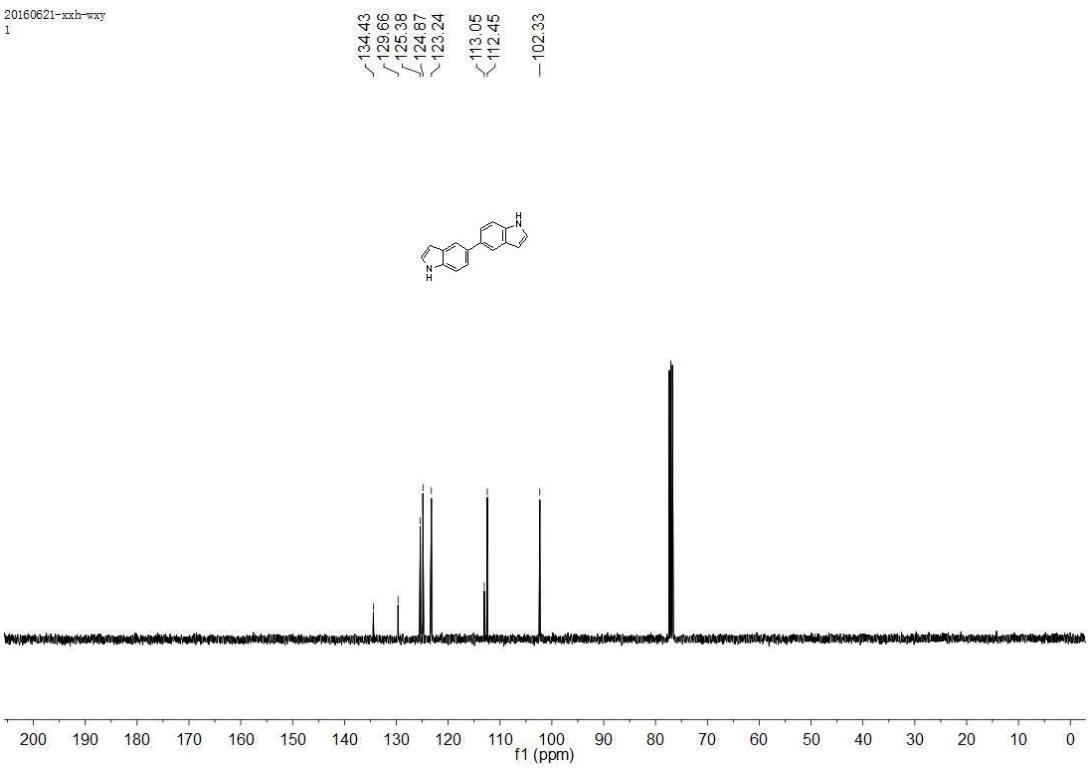

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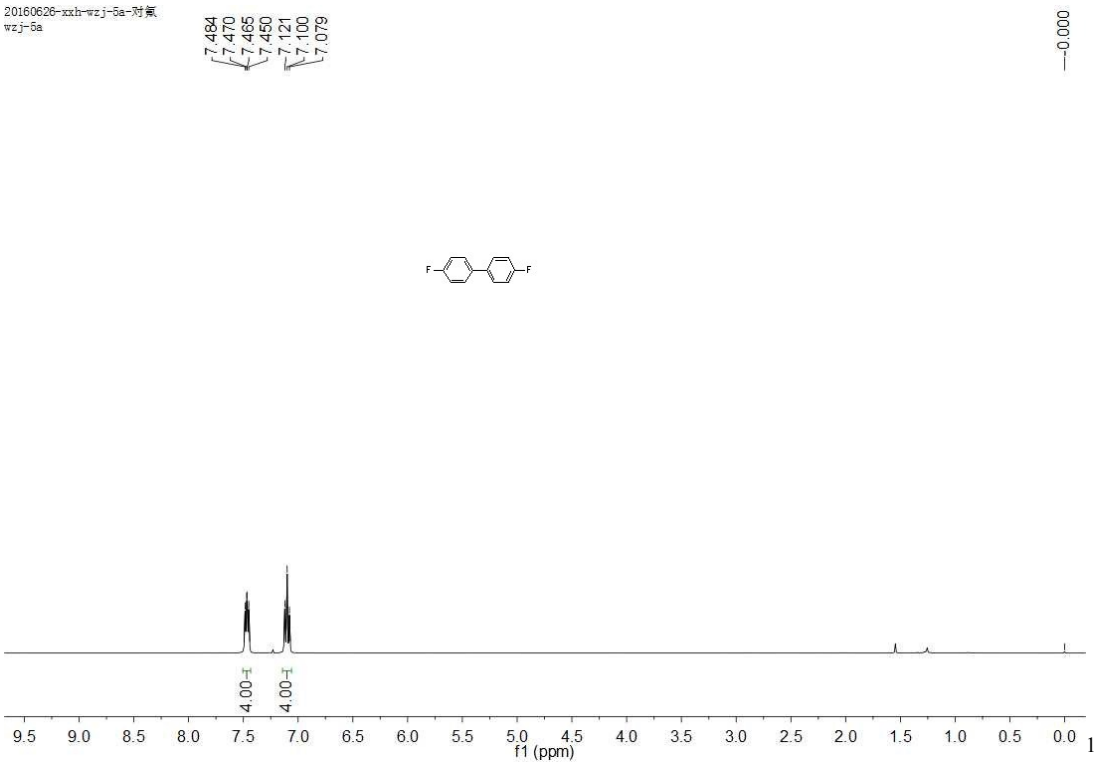
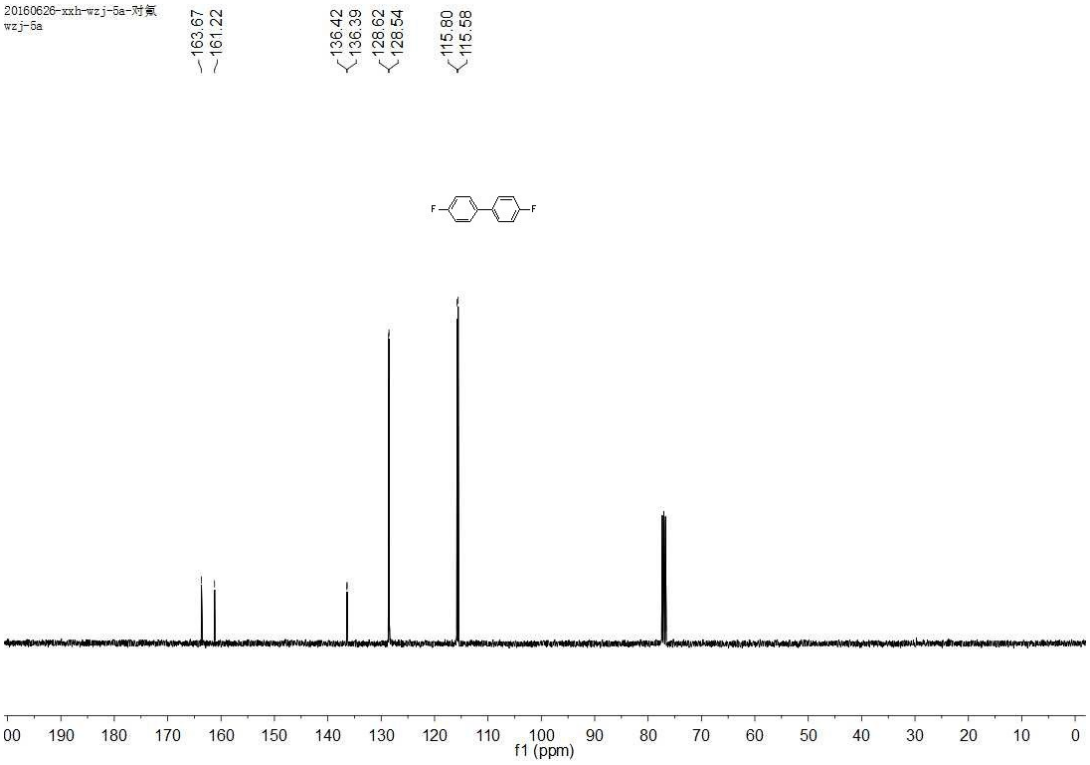
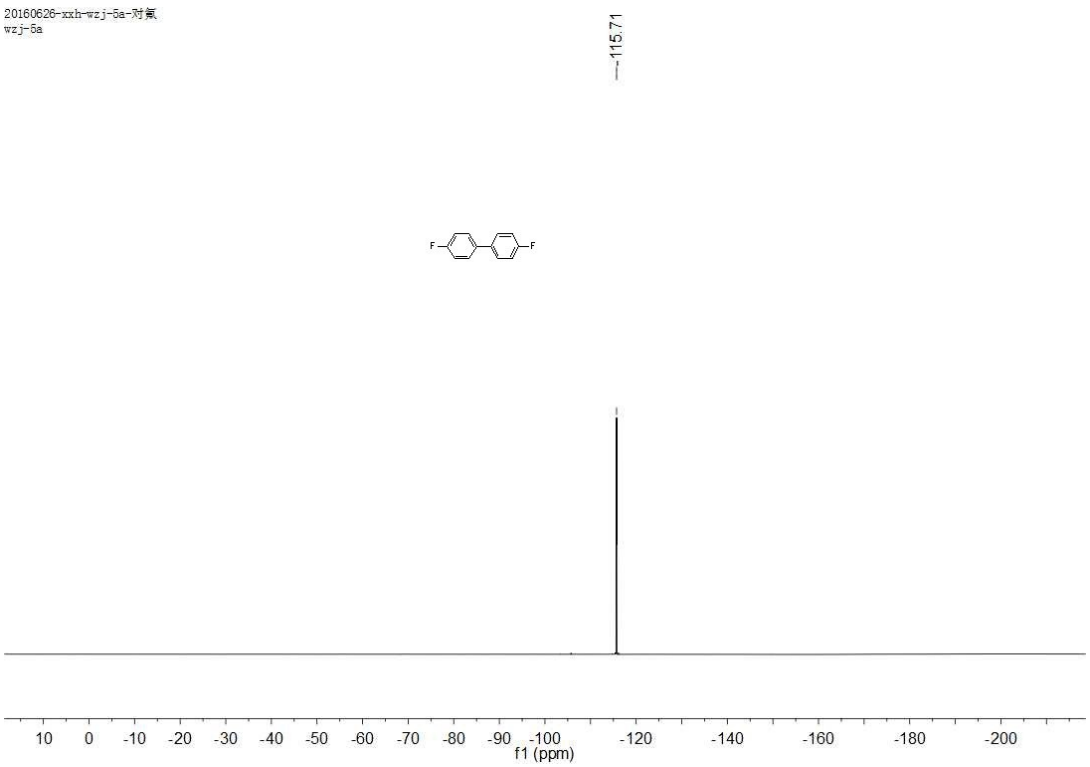


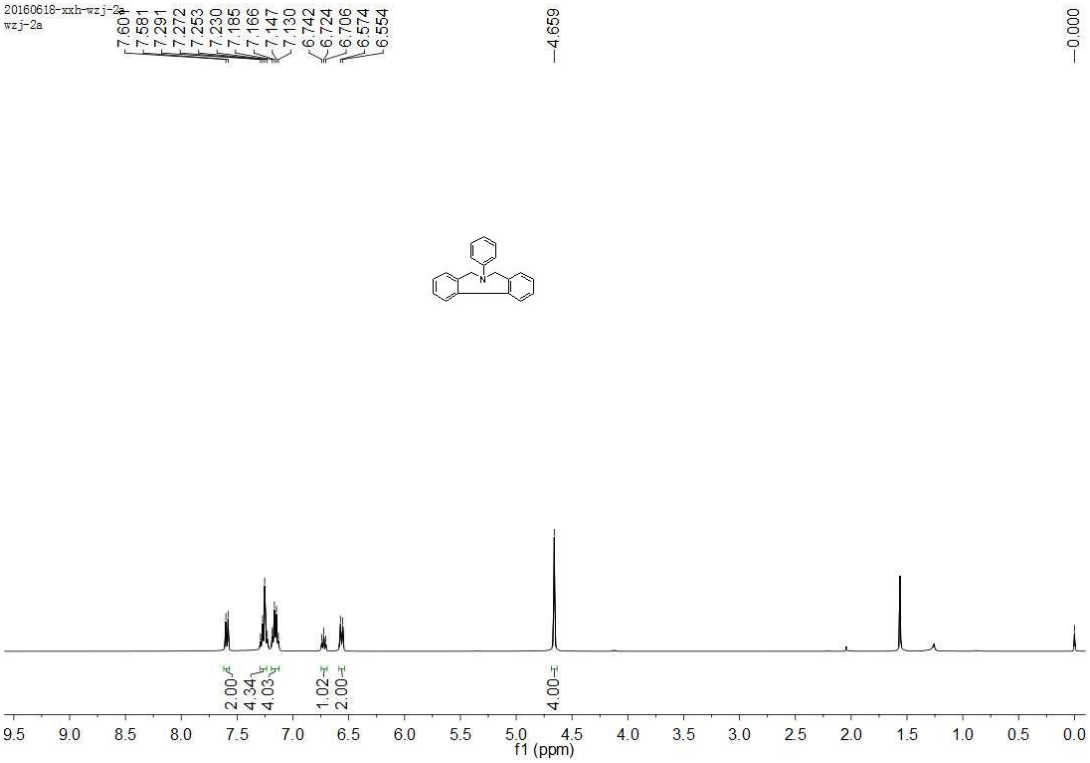
H NMR of **2p** in $CDCl_3$



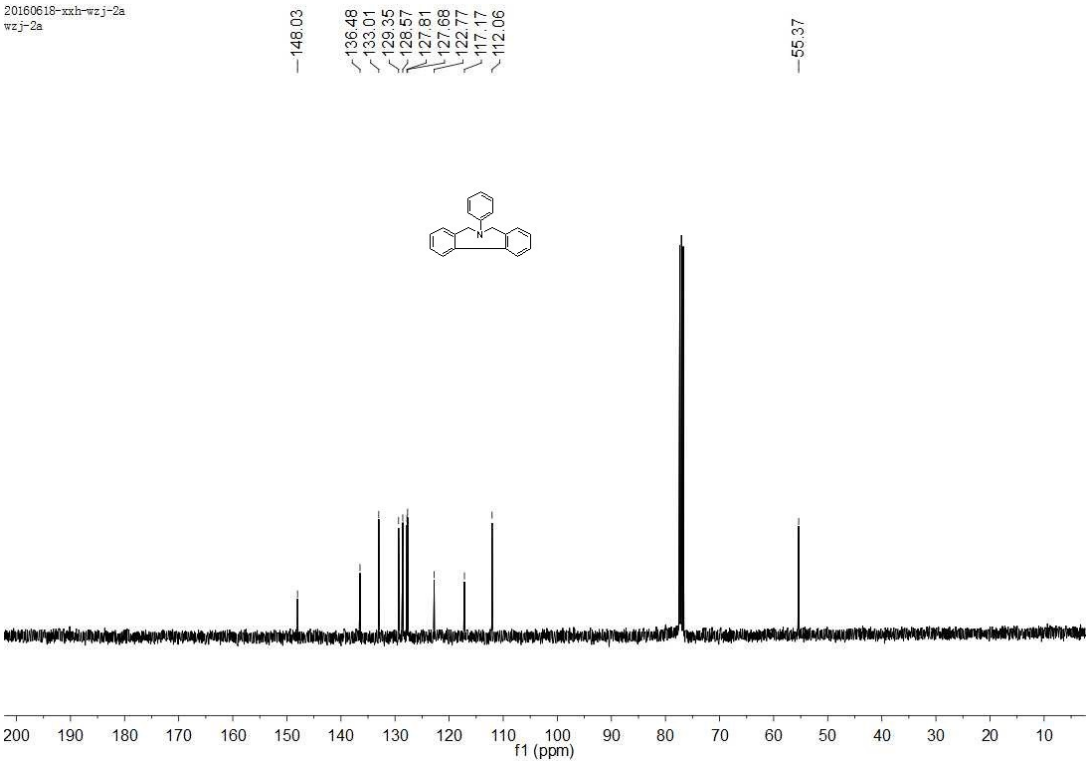
^{13}C NMR of **2p** in $CDCl_3$



^{19}F NMR of **2p** in $CDCl_3$



^{1}H NMR of **2q** in $CDCl_3$



^{13}C NMR of **2q** in $CDCl_3$