# Supporting Information

## Synthesis of Quinazolines via CuO nanoparticles Catalyzed Aerobic Oxidative Coupling of Aromatic Alcohols and Amidines

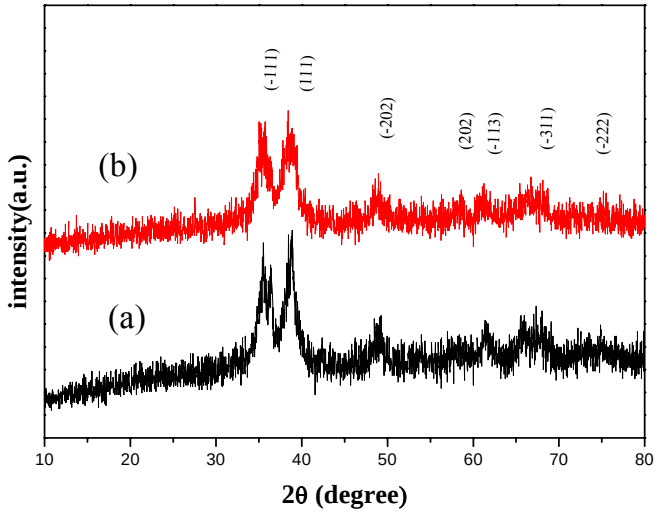
**Wu Zhang,* Fei Guo, Fei Wang, Na Zhao, Liang Liu, Jia Li, Zhenghua Wang**

Key Laboratory of Functional Molecular Solids, Ministry of Education, Anhui Laboratory of Molecule-Based Materials, College of Chemistry and Materials Science, Anhui Normal University, Wuhu 241000, China. E-mail: zhangwu@mail.ahnu.edu.cn

## Content

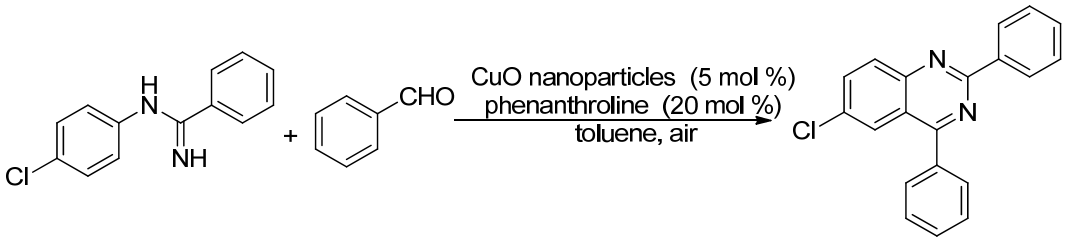
## Catalyst Characterization

The obtained CuO nanoparticles were characterized by X-ray powder diffraction analysis (XRD). Figure S1a presents a typical XRD pattern of the as-prepared products. All of the detectable diffraction peaks can be indexed to (-111), (111), (-202), (202), (-113), (-311) and (-222) reflections of the cubic phase CuO (PCPDF card NO.80-1916).




## Successive Test of Recycled Catalyst

**Table S1.**




| test | 1 | 2 | 3 |
|---|---|---|---|
| yield (%) | 88 | 83 | 79 |

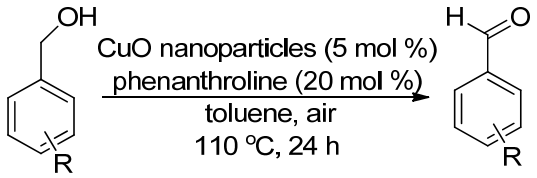
[a]Reaction condition: N-(chlorophenyl)benzimidamide (1 equiv), benzaldehyde (1.5 equiv), 5 mol % of CuO nanoparticles, 20 mol % phenanthroline, toluene (2 mL), under reflux in air for 24 h.

Recycling Procedure of the Catalysts: The separated precipitates in the above procedure were washed sufficiently with deionized water and ethanol three times each

and then dried under vacuum at 60 °C for 6 h, and then the CuO nanoparticles were recovered. The recyclability of the CuO nanoparticles was also tested as shown in Table. No significant decrease in the catalytic activity for the arylation of N-(chlorophenyl) benzimidamide with benzaldehyde was observed for the recovered CuO nanoparticles. The slight decrease in activity of the catalyst was due to the loss of catalyst during the separating process. XRD of the catalysts after the reaction demonstrated that the catalysts did not change during the reaction process.

## Aerobic Oxidation of Alcohols to Aldehydes

**Table S2 Aerobic oxidation of alcohols to aldehydes using CuO nanoparticles as catalyst.**




| entry | R | yield |
|---|---|---|
| 1 | R=H | 95% |
| 2 | R=4-Cl | 98% |
| 3 | R=4-OMe | 90% |
| 4 | R=4-$CH_3$ | 96% |
| 5 | R=4-$NO_2$ | 85% |
| 6 | R=3-$NO_2$ | 78% |
| 7 | R=2-$NO_2$ | 76% |

## Synthesis of [(phen)Cu(II)] complexes[1]

199 mg of copper acetate (1 mmol) and 360 mg of phenanthroline (2 mmol) were added into the 50 mL of ethanol, the mixture was stirred at 80 °C for 3 h. The solution was cooled to 0 °C, and a blue powder was got, which was recrystallized from ethanol to give blue crystals after 24 h. Melting point is 213 °C.

## Characterization data for the products

Compounds 3ca, 3cb, 3cg, 3cf, 3cd, 3da, 3ja, 3fa, 3ga (from Table 3) provided spectral data that are agreement with the corresponding products from Table 2.

### 6-chloro- 2,4-diphenylquinazoline[2] (3aa)

White solid; yield 88%; m.p.191-193°C; Lit.m.p:185-186°C, $^1$H NMR (300 MHz,

$CDCl_3$) δ 8.64-8.61 (m, 2H ), 8.12-8.03 (m, 2H), 7.81-7.75 (m, 3H), 7.57-7.45 (m, 6H); $^{13}C$ NMR (75 MHz, $CDCl_3$) δ 167.6, 160.4, 150.4, 137.7, 137.1, 134.6, 132.7, 130.8, 130.8, 130.3, 130.1, 128.8, 128.7, 128.6, 125.8, 122.2.

**6-fluoro-2,4-diphenylquinazoline[3] (3ba)**

White solid; yield 86%; m.p.179-180°C; Lit.m.p:172-173°C, $^1H$ NMR (500 MHz, $CDCl_3$) δ 8.69-8.67 (m, 2H ), 8.21-8.19 (m, 1H), 7.89-7.87 (m, 2H), 7.77-7.75 (m, 1H), 7.70-7.61 (m, 4H ), 7.56-7.50 (m, 3H) ; $^{13}C$ NMR (125 MHz, $CDCl_3$) δ 167.9 (d, *J* = 5.4 Hz), 161.4, 159.8 (d, *J* = 2.1 Hz), 159.4, 149.0, 137.8, 137.3, 131.7 (d, *J* = 8.5 Hz), 130.7, 130.2, 130.0, 128.7, 128.6, 124.0 (d, *J* = 25.5 Hz), 122.1 (d, *J* = 8.9 Hz), 110.4 (d, *J* = 23.1Hz).

**2,4-diphenylquinazoline[4] (3ca)**

Yellow solid; yield 84%; m.p.116 °C; Lit.m.p:118-120°C, $^1H$ NMR (300 MHz, $CDCl_3$) δ 8.75-8.73 (m, 2H) , 8.32-8.31 (m, 1H), 8.16 (d, *J* = 8.1 Hz, 1H), 7.96-7.90 (m , 3H), 7.63-7.54 (m , 7H); $^{13}C$ NMR (75 MHz, $CDCl_3$) δ 168.3, 160.2, 152.0, 138.2, 137.7, 133.5, 130.5, 130.2, 129.9, 129.2, 128.7, 128.5, 127.0, 121.7.

**6-methyl-2,4-diphenylquinazoline[5] (3da)**

White solid; yield 98%; m.p.178-180 °C; Lit.m.p:226-227°C, $^1H$ NMR (300 MHz, $CDCl_3$) δ 8.68 (d , *J* = 6.3 Hz , 2H), 8.11 (d , *J* = 7.6 Hz, 1H), 7.88-7.87 (m, 3H), 7.74 (d, *J* = 7.9 Hz, 1H), 7.62-7.51 (m, 6H), 2.52(s, 3H); $^{13}C$ NMR (75 MHz, $CDCl_3$) δ 167.6, 159.5, 150.4, 138.2, 137.8, 137.2, 135.9, 130.4, 130.1, 129.8, 128.8, 128.6, 128.5, 125.6, 121.6, 21.9.

**8-methyl-2,4-diphenylquinazoline (3ea)**

Red solid; yield 94%; m.p.119-120 °C; $^1H$ NMR (300 MHz, $CDCl_3$) δ 8.73-8.66 (m, 2H), 7.88 (d, *J* = 8.3 Hz, 1H), 7.81-7.78 (m, 2H), 7.66 (d, *J* = 7.2 Hz, 1H), 7.52-7.33 (m, 7H), 2.85(s, 3H); $^{13}C$NMR (75 MHz, $CDCl_3$) δ 168.4, 159.0, 151.0, 138.6, 138.1, 137.5, 133.3, 130.4, 130.2, 129.7, 129.0, 128.6, 128.4, 126.4, 124.7, 121.6, 17.6. HRMS (ESI) calcd for $C_{21}H_{17}N_2$ ($[M+H]^+$) 297.1392, found 297.1386.

**6-methoxy-2,4-diphenylquinazoline[6] (3fa)**

Yellow solid; yield 87%; m.p.140-142 °C; $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.58 (d, *J* = 6.6Hz, 2H), 8.01 (d, *J* = 9.3 Hz, 1H), 7.84-7.83 (m, 2H), 7.54-7.43 (m, 7H), 7.33-7.32 (m, 1H), 3.79 (s, 3H); $^{13}$C NMR (75MHz, $CDCl_3$) δ 166.7, 158.6, 158.1, 148.0, 138.2, 138.0, 130.6, 130.2, 129.9, 129.8, 128.6, 128.5, 128.3, 126.3, 122.4, 104.4, 55.6.

**4-phenyl-2-(p-tolyl)quinazoline[6](3ga)**

White solid; yield 98%; m.p.162-163 °C; Lit.m.p:166-168°C, $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.52 (d, *J* = 7.8 Hz, 2H), 8.06-8.02 (m, 2H), 7.81-7.77(m, 3H), 7.52-7.42(m, 4H), 7.26 (d, *J* = 7.8 Hz, 2H), 2.37 (s, 3H); $^{13}$C NMR (75MHz, $CDCl_3$) δ167.2, 159.2, 150.9, 139.8, 136.7, 134.3, 132.5, 129.2, 128.9, 128.3, 128.0, 127.6, 127.5, 126.0, 125.8, 120.6, 20.5.

**4-phenyl-2-(m-tolyl)quinazoline[6](3ha)**

White solid; yield 95%; m.p.106 °C; Lit.m.p:115-117°C, $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.42 (d, *J* = 6.9 Hz, 2H), 8.11-8.04 (m, 2H), 7.84-7.80 (m, 3H), 7.54-7.45 (m, 4H), 7.38-7.33 (m, 1H), 7.25 (d, *J* = 7.5 Hz, 1H) 2.42(s, 3H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ168.3, 160.4, 152.0, 138.2, 138.1, 137.7, 133.6, 131.4, 130.2, 129.9, 129.2, 129.1, 128.6, 128.5, 127.0, 126.9, 125.9, 121.7, 21.6.

**4-phenyl-2-(o-tolyl)quinazoline[6](3ia)**

White solid; yield 92%; m.p.67-69 °C; Lit.m.p:72-74°C, $^{1}$H NMR (300MHz, $CDCl_3$) δ 8.22-8.16 (m, 2H), 7.99-7.85 (m, 4H), 7.63-7.58 (m, 4H), 7.36-7.31 (m, 3H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 168.1, 163.4, 151.6, 138.7, 137.4, 133.7, 131.3, 130.8, 130.2, 130.0, 129.3, 129.0, 128.6, 127.4, 127.0, 126.0, 121.0, 21.3.

**2-(4-chlorophenyl)-4-phenylquinazoline[6](3ja)**

Yellow solid; yield 93%; m.p.187 °C; Lit.m.p:190-192°C, $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.58 (d, *J* = 8.5 Hz, 2H), 8.08 (t, *J* = 9.3 Hz, 2H), 7.85-7.79 (m, 3H), 7.54-7.40 (m, 6H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 167.4, 158.1, 150.8, 136.5, 135.7, 135.6, 132.7, 129.1, 129.0, 128.9, 128.0, 127.7, 127.5, 126.2, 126.0, 120.7.

**2-(2-chlorophenyl)-4-phenylquinazoline (3ka)**

Yellow solid; yield 89%; m.p.53-54°C; $^{1}$H NMR (300 MHz,$CDCl_3$) δ 8.11 (d, *J* = 9.1

Hz, 2H), 7.87-7.78 (m, 4H), 7.57-7.44 (m, 5H),7.35-7.27 (m, 2H). $^{13}$C NMR(75 MHz, $CDCl_3$) δ 168.3, 161.3, 151.6, 138.5, 137.2, 133.9, 133.1, 131.8, 130.6, 130.2, 130.2, 130.1, 129.1, 128.7, 127.8, 127.1, 126.9, 121.4. HRMS(ESI) calcd for $C_{20}H_{14}N_2Cl$ ($[M+H]^+$) 317.0845, found 317.0840.

**2-(4-chlorophenyl)-6-methyl-4-phenylquinazoline (3la)**

Yellow solid; yield 92%; m.p.179-180 °C; $^1$H NMR (300 MHz, $CDCl_3$) δ 8.62 (d, *J* = 8.6 Hz, 2H), 8.04 (d, *J* = 8.6 Hz, 1H), 7.87-7.85(m, 3H), 7.75-7.71(m, 1H), 7.6-7.60 (m, 3H), 7.48(d, *J* = 8.6 Hz, 2H), 2.52 (s, 3H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ167.7, 158.5, 150.4, 137.7, 137.4, 136.5, 136.0, 130.1, 129.9, 128.8, 128.7, 128.6, 125.7, 121.7, 21.9. HRMS (ESI) calcd for $C_{21}H_{16}N_2Cl$ ($[M+H]^+$) 331.1002, found 331.0997.

**6-chloro-4-phenyl-2-(p-tolyl)quinazoline[2](3ma)**

White solid; yield 90%; m.p.197-199 °C; Lit.m.p.216-218°C, $^1$H NMR (300 MHz, $CDCl_3$) δ 8.50 (d, *J* = 8.2 Hz, 2H), 8.04-8.00 (m, 2H), 7.81-7.72 (m, 3H), 7.56-7.54 (m, 3H), 7.26(d, *J* = 8.1 Hz, 2H), 2.37 (s, 3H); $^{13}$C NMR (75MHz, $CDCl_3$) δ167.5, 160.5, 150.4, 141.1, 137.1, 135.0, 134.4, 132.3, 130.7, 130.2, 130.1, 129.4, 128.7, 128.6, 125.8, 122.1, 21.6.

**2-(4-chlorophenyl)-7-methyl-4-phenylquinazoline (3na)**

White solid; yield 91%; m.p.202-203 °C; $^1$H NMR (300 MHz, $CDCl_3$) δ 8.66 (d, *J* = 8.4 Hz, 2H), 8.03 (d, *J* = 8.4 Hz, 2H), 7.89-7.86(m, 2H), 7.61-7.39(m, 6H), 2.62(s, 3H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 167.9, 159.3, 152.2, 144.7, 137.7, 136.8, 136.6, 130.1, 129.9, 129.5, 128.7, 128.5, 128.0, 126.7, 119.9, 22.1. HRMS (ESI) calcd for $C_{21}H_{16}N_2Cl$ ($[M+H]^+$) 331.1002, found 331.1002.

**4-(4-chlorophenyl)-2-phenylquinazoline (3cb)**

White solid; yield 95%; m.p.143-145 °C; $^1$H NMR (300 MHz, $CDCl_3$) δ 8.66-8.63(m, 2H), 8.25 (d, *J* = 7.8 Hz, 2H), 8.05-8.02(m, 1H), 7.89-7.78(m, 4H), 7.56-7.47(m, 6H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ167.1, 160.2, 152.0, 137.9, 136.3, 136.1, 133.7, 131.5, 130.7, 129.3, 128.9, 128.7, 128.6, 127.2, 126.6, 121.5. HRMS (ESI) calcd for $C_{20}H_{14}N_2Cl$ ($[M+H]^+$) 317.0845, found 317.0840.

**4-(2-phenylquinazolin-4-yl)benzonitrile (3cc)**

White solid; yield 91%; m.p.129-130 °C; $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.67(br, 2H), 8.24 (d, *J* = 8.4 Hz, 1H), 8.02-7.89 (m, 6H), 7.63-7.53 (m, 4H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 166.3, 160.2, 152.0, 141.9, 137.6, 134.1, 132.3, 130.9, 130.8, 129.5, 128.7, 127.6, 126.1, 121.2, 118.4, 113.6. HRMS (ESI) calcd for $C_{21}H_{14}N_3$([M+H]$^+$) 308.1188, found 308.1182.

**4-(4-nitrophenyl)-2-phenylquinazoline (3cd)**

Yellow solid; yield 83%; m.p.179-180 °C; $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.61-8.59 (m, 2H), 8.40 (d, *J* = 8.1 Hz, 2H), 8.15 (d, *J* = 8.1 Hz, 1H), 8.00-7.85 (m, 4H), 7.56-7.46 (m, 4H); $^{13}$C NMR (75MHz, $CDCl_3$) δ165.9, 160.3, 152.1, 148.7, 143.7, 137.6, 134.1, 131.1, 130.9, 129.5, 128.6, 127.7, 126.0, 123.8, 121.3. HRMS (ESI) calcd for $C_{20}H_{14}N_3O_2$ ([M+H]$^+$) 328.1086, found 328.1081.

**4-(furan-2-yl)-2-phenylquinazoline (3ce)**

Yellow solid; yield 78%; m.p.72-74 °C; $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.83 (d, *J* = 8.4, 1H), 8.60-8.58 (m, 1H), 8.01(d, *J* = 8.4 Hz, 1H), 7.78-7.71 (m, 2H), 7.63-7.44 (m, 5H), 6.61(s, 1H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 160.0, 155.2, 154.1, 152.6, 145.8, 138.1, 133.5, 130.5, 129.1, 128.5, 127.3, 126.7, 119.6, 118.5, 116.0, 112.4. HRMS (ESI) calcd for $C_{18}H_{13}N_2O$ ([M+H]$^+$) 273.1028, found 273.1022.

**4-(4- methylphenyl)-2-phenylquinazoline[6] (3cf)**

Yellow solid; yield 96%; m.p.112-113 °C; Lit.m.p:128-130°C, $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.71-8.68 (m, 2H), 8.16-8.13 (m, 2H), 7.91-7.79 (m, 3H), 7.53-7.40 (m, 6H), 2.50 (s, 3H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 168.3, 160.2, 151.9, 140.2, 138.3, 134.9, 133.5, 130.5, 130.2, 129.3, 129.1, 128.7, 128.5, 127.1, 126.9, 121.7, 21.5.

**4-(4-methoxyphenyl)-2-phenylquinazoline (3cg)**

White solid; yield 85%; m.p.129-130 °C; $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.71 (d, *J* = 6.3 Hz, 2H ), 8.18 (d, *J* = 8.1 Hz, 2H), 7.92-7.86 (m, 3H), 7.58-7.52 (m, 4H), 7.13 (d, *J* = 8.4 Hz, 2H), 3.94(s, 3H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 167.8, 161.3, 160.1, 151.9, 138.2, 133.5, 131.9,130.5, 130.1, 129.0, 128.7,128.5, 127.1, 126.9, 121.6, 114.0, 55.5. HRMS (ESI) calcd for $C_{21}H_{17}N_2O$([M+H]$^+$)313.1341, found 313.1335.

**4-(2-ethoxyphenyl)-2-phenylquinazoline (3ch)**

White solid; yield 73%; m.p.125-126 °C; $^{1}$H NMR(300MHz, $CDCl_3$) δ 8.61-8.57(m, 2H), 8.06-8.03 (m, 1H), 7.78-7.65 (m, 2H), 7.48-7.35 (m, 6H),7.10-6.97 (m, 2H), 3.93 (q, *J* = 6.9 Hz, 2H), 0.98 (t, *J* = 6.9 Hz, 3H). $^{13}$C NMR(75MHz, $CDCl_3$) δ 166.8, 159.5, 155.4, 149.9, 137.4, 132.3, 130.3, 129.9, 129.3, 127.7, 127.6, 127.4, 126.8, 126.2, 125.3, 121.8, 119.9, 111.3, 63.0, 13.5. HRMS(ESI) calcd for $C_{22}H_{19}N_2O$ ($[M+H]^+$) 327.1497, found 327.1492.

**6-chloro-4-(4-chlorophenyl)-2-phenylquinazoline (3ab)**

White solid; yield 92%; m.p.186-188 °C; $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.63-8.61 (m, 2H), 8.15 (d, *J* = 9.0 Hz, 1H), 7.99-7.98 ( m, 1H), 7.81-7.75(m, 3H), 7.56-7.47(m, 5H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 165.3, 159.4, 149.5, 136.5, 135.7, 134.5, 133.7, 131.9, 130.4, 129.9, 129.9, 128.1, 127.7, 127.6, 124.3, 121.0. HRMS (ESI) calcd for $C_{20}H_{13}Cl_2N_2$ ($[M+H]^+$) 351.0456, found 351.0450.

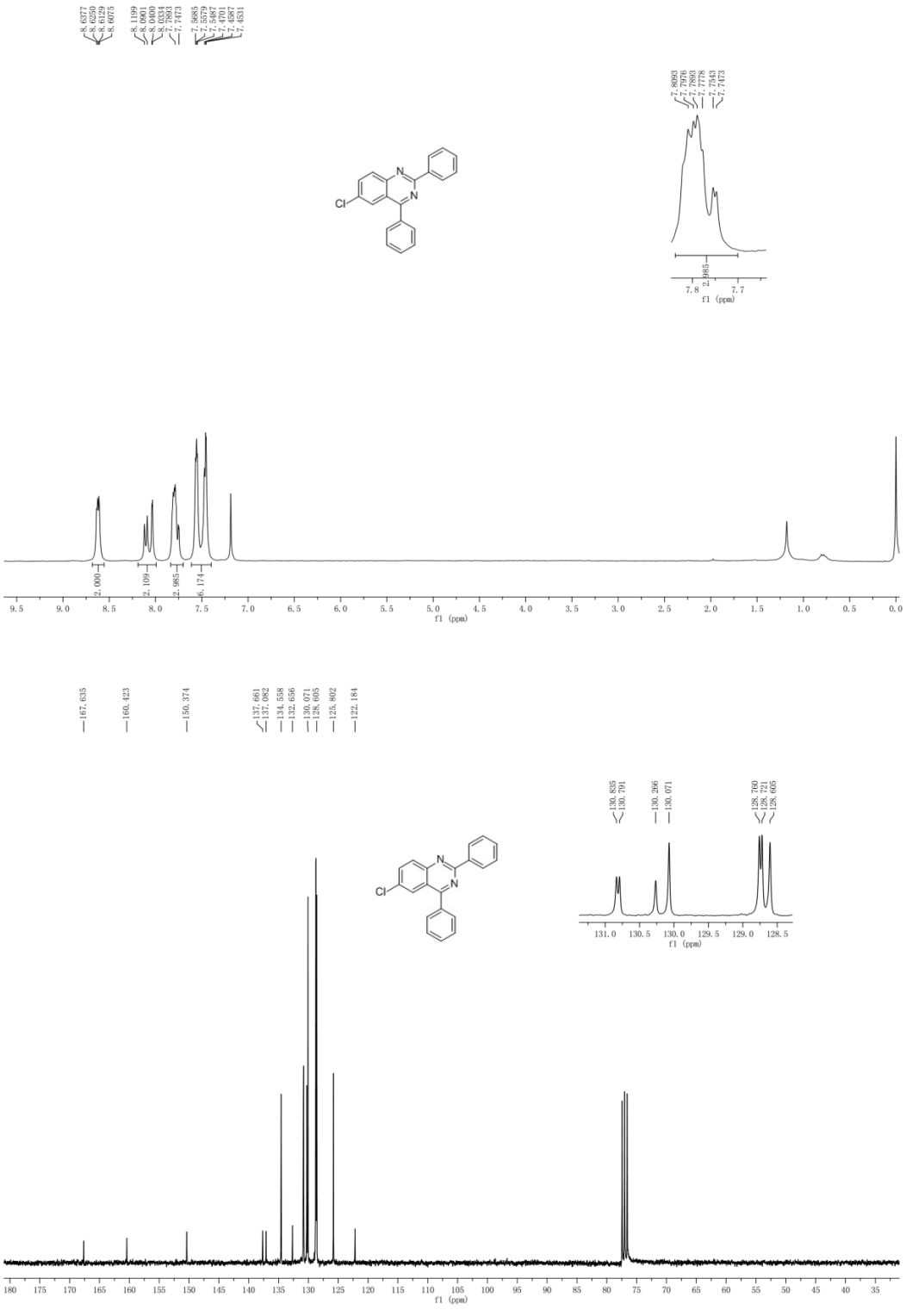
**4-(3-nitrophenyl)-2-phenylquinazoline (3cj)**

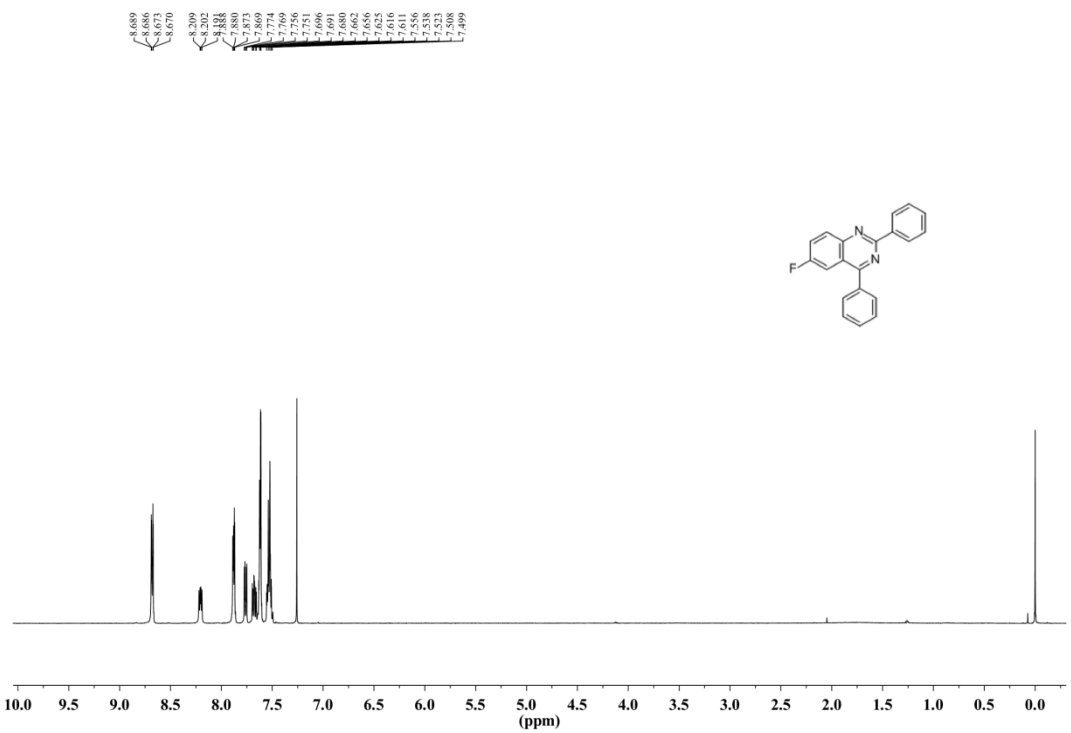
White solid; yield 76%; m.p.188-189 °C; $^{1}$H NMR (300 MHz,$CDCl_3$) δ 8.69-8.59 (m, 3H), 8.39-8.36 (m, 1H), 8.16-8.12 (m, 2H), 7.96-7.93 (m, 1H),7.89-7.84 (m, 1H), 7.74-7.69 (m, 1H),7.56-7.45 (m, 4H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 168.6, 162.3, 161.5, 151.3, 136.2, 136.0, 129.5, 129.3, 129.3, 128.8, 128.3,127.6, 124.6, 124.1, 114.3. HRMS(ESI) calcd for $C_{20}H_{14}N_3O_2$ ($[M+H]^+$) 328.1086, found 328.1081.

**4-(2-nitrophenyl)-2-phenylquinazoline (3ck)**

White solid; yield 73%; m.p.162-163 °C; $^{1}$H NMR (300 MHz, $CDCl_3$) δ 8.60-8.57 (m, 2H), 8.28-8.12 (m, 2H), 7.93-7.63 (m, 5H), 7.54-7.49 (m, 4H); $^{13}$C NMR (75 MHz, $CDCl_3$) δ 166.7, 160.7, 151.7, 138.1, 134.4, 133.6, 133.4, 132.3, 131.0, 130.7, 129.7, 129.1, 129.0, 127.9, 125.8, 125.3, 122.2. HRMS (ESI) calcd for $C_{20}H_{14}N_3O_2$ ($[M+H]^+$) 328.1086, found 328.1081.

**$^{1}$H and $^{13}$C NMR spectra of the products.**

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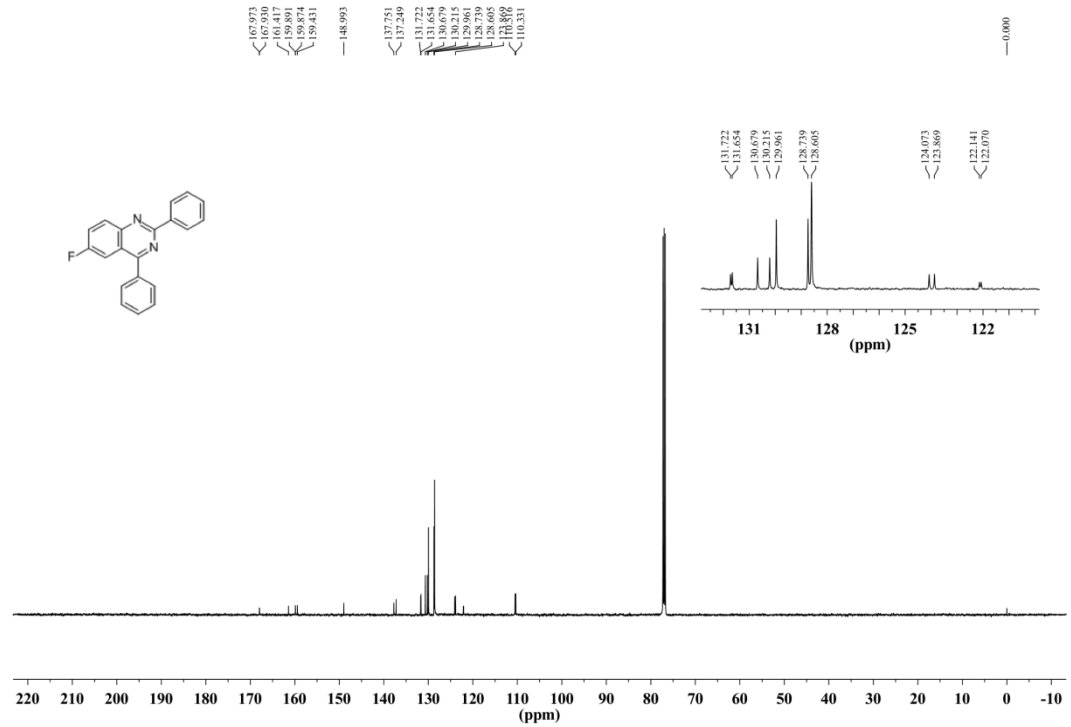
(ppm)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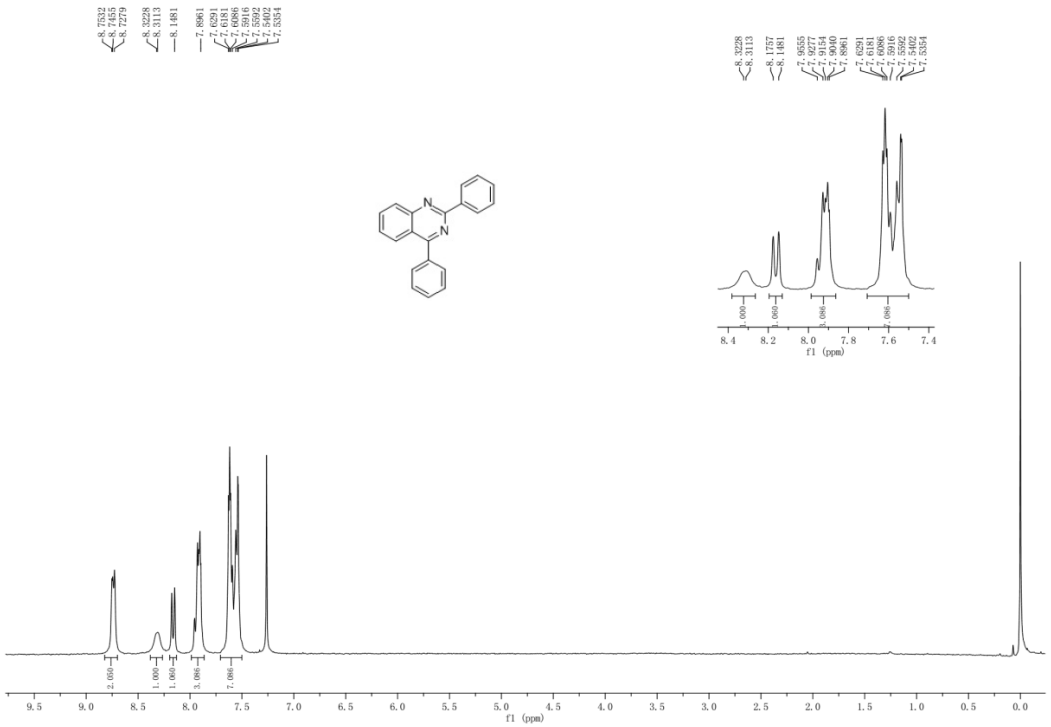
(ppm)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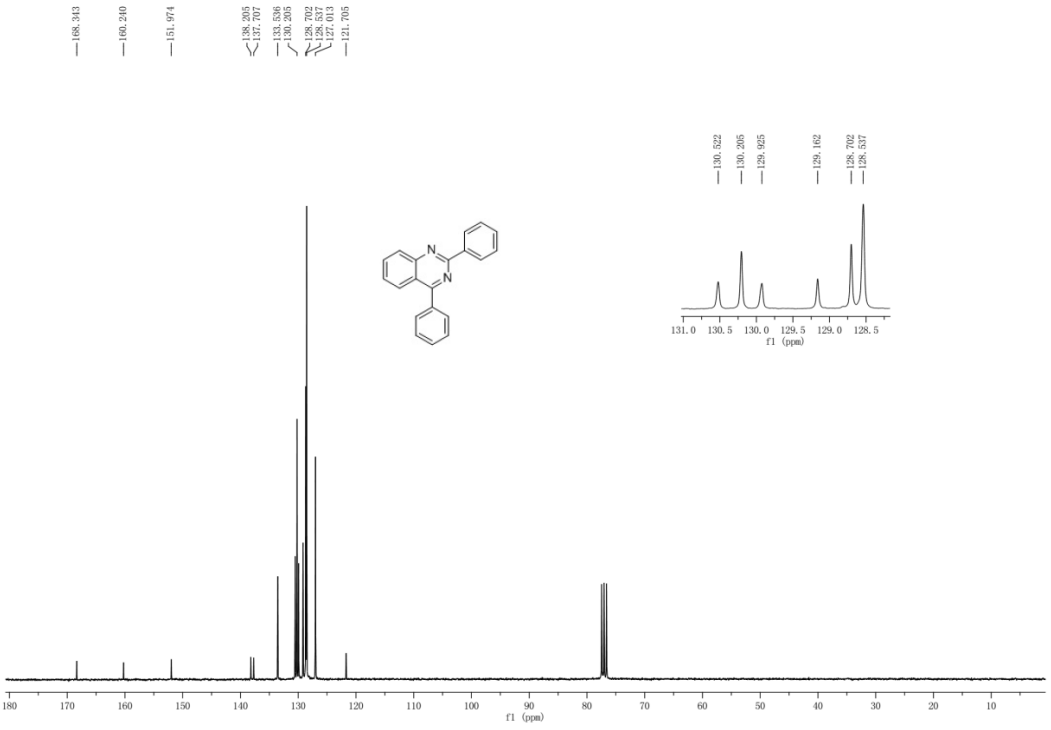
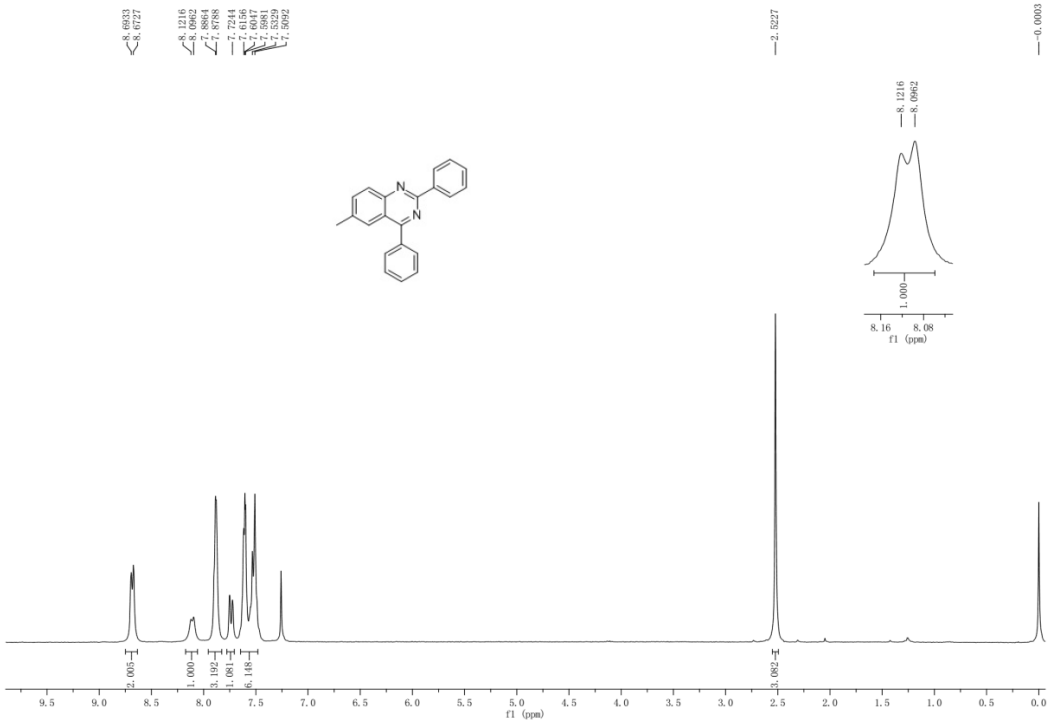
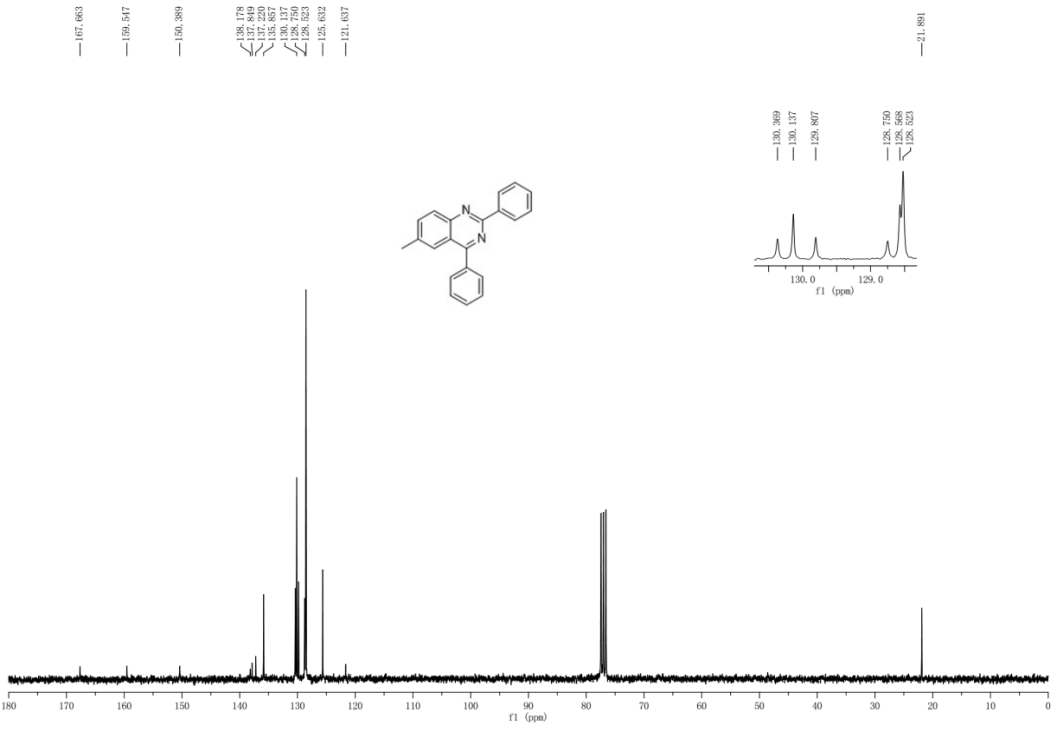
3.086
7.088
f1 (ppm)

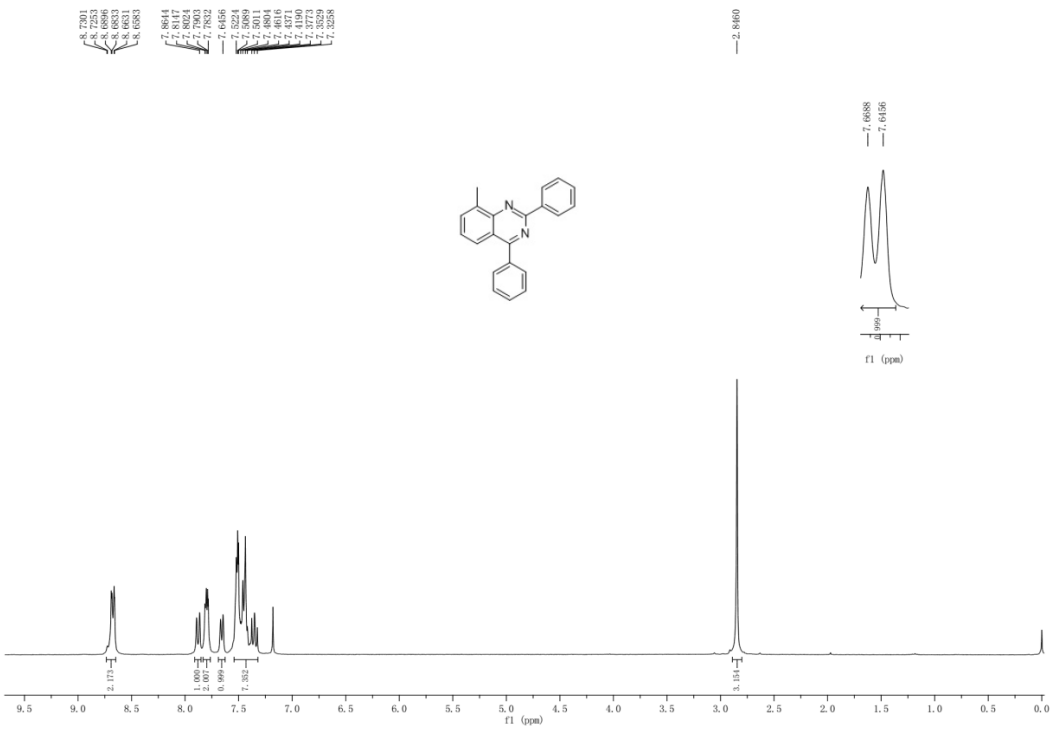

8.3228
8.3113
8.1757
8.1481
7.9555
7.9277
7.9154
7.9040
7.8861
7.8291
7.8181
7.6086
7.5916
7.5592
7.5402
7.5354
1.000
1.060
3.086
7.088
f1 (ppm)

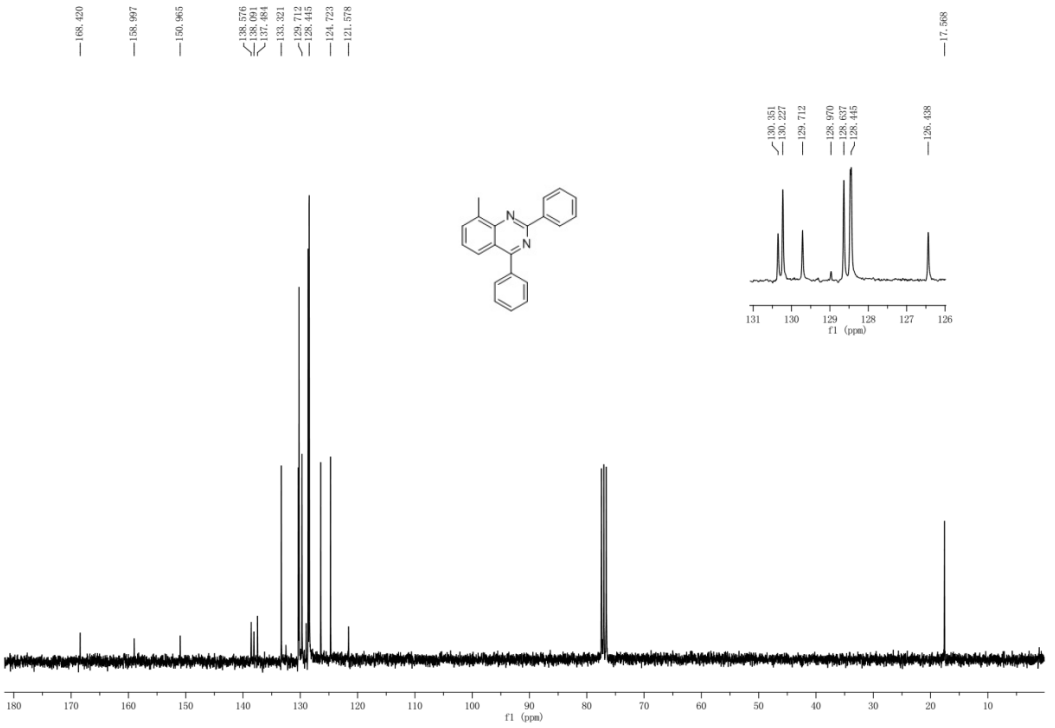

168.343
160.240
151.974
138.205
137.707
133.536
130.205
128.702
128.537
127.013
121.705
f1 (ppm)

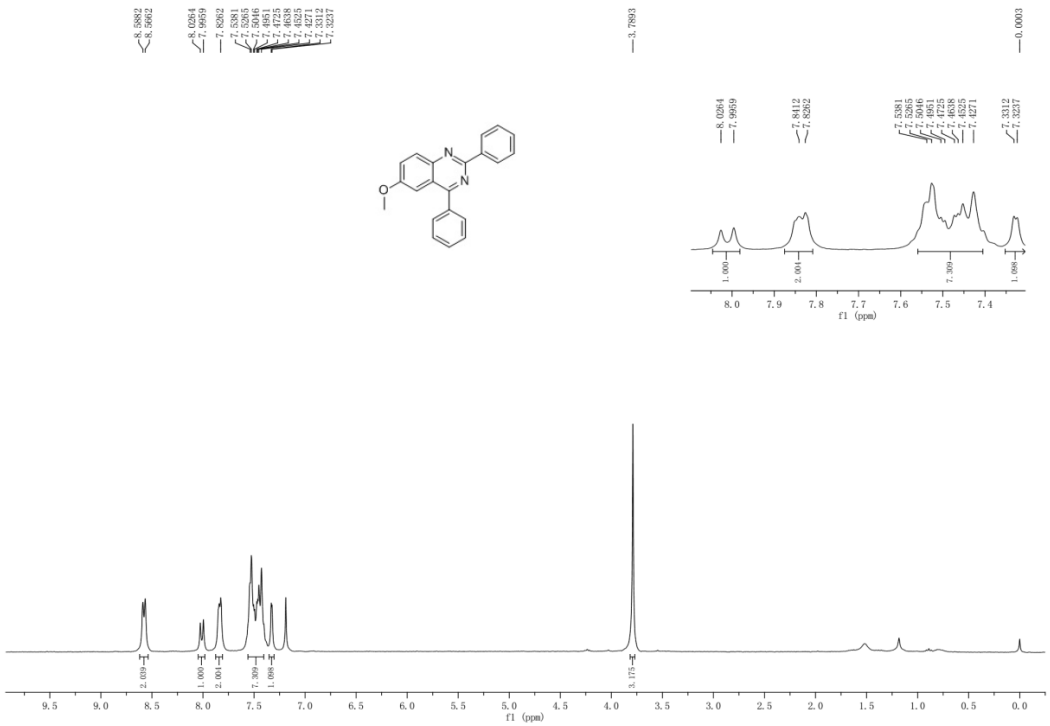

130.522
130.205
129.925
129.162
128.702
128.537
f1 (ppm)

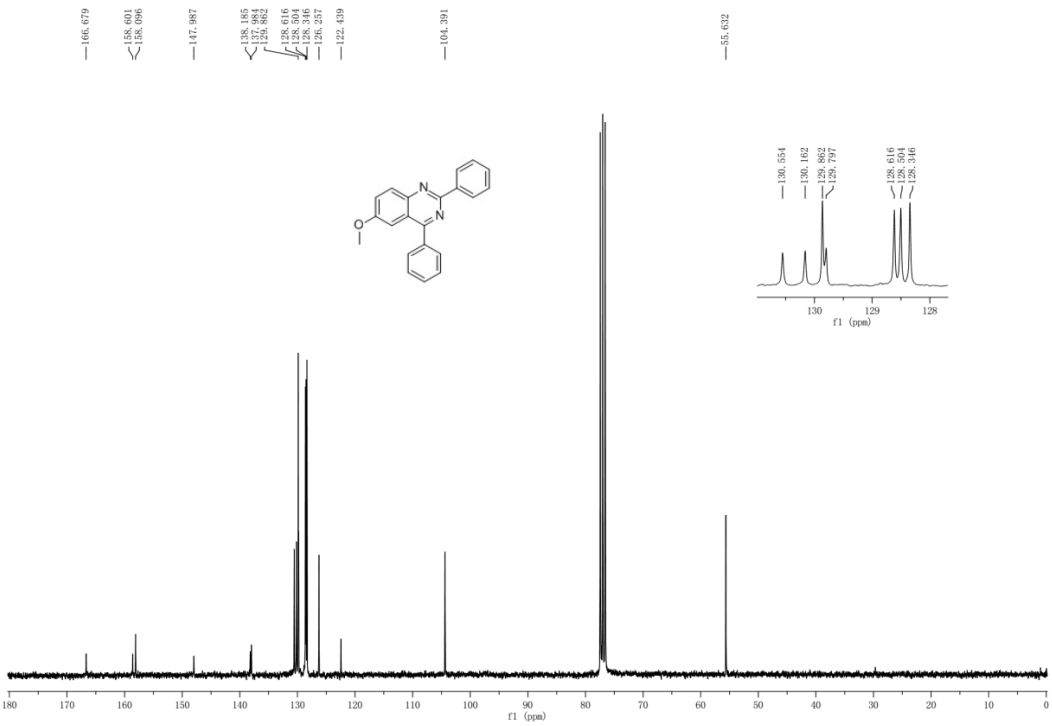

8.6933
8.6727
8.1216
8.0962
7.8864
7.8788
7.7244
7.6456
7.6047
7.5981
7.5329
7.5092
2.5227
-0.0003
8.1216
8.0962
1.000
8.16
8.08
f1 (ppm)
2.005
1.000
3.192
1.081
6.148
3.062
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

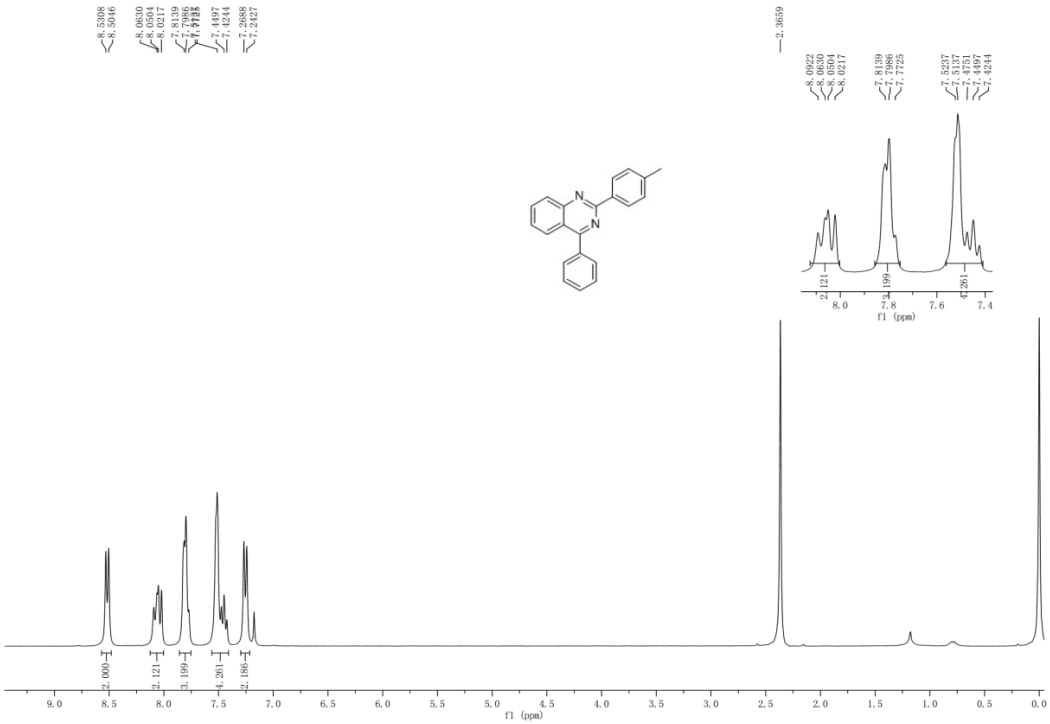

167.663
159.547
150.389
138.178
137.849
137.220
135.557
130.137
128.750
128.523
125.632
121.637
21.891
130.369
130.137
129.807
128.750
128.568
128.523
130.0
129.0
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

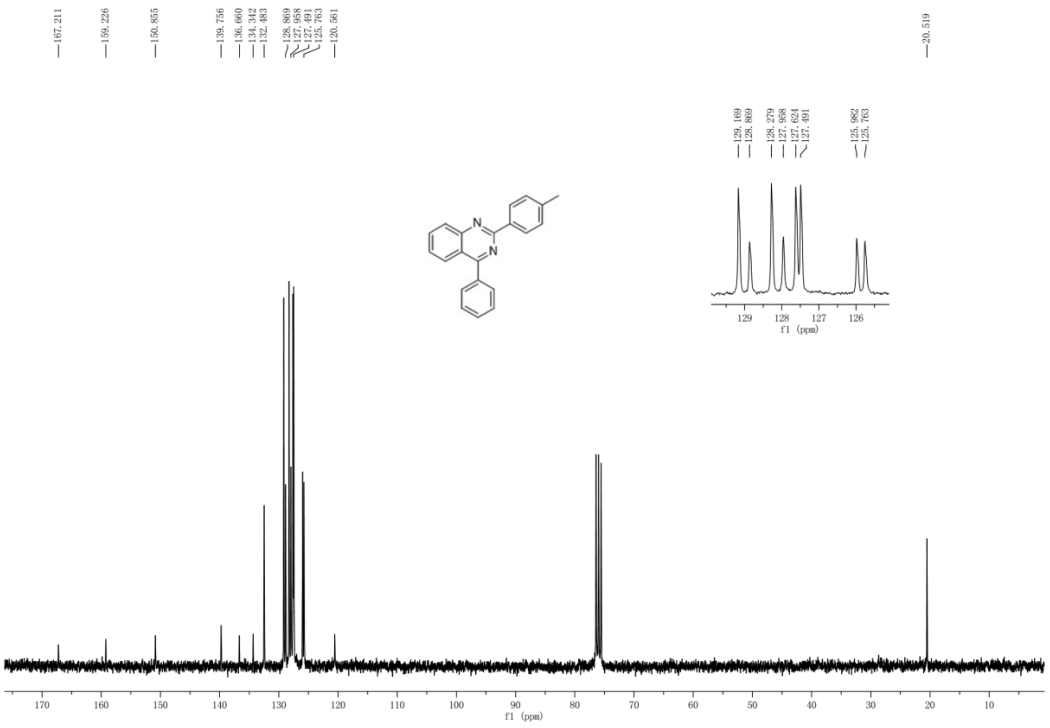

8.7201
8.7253
8.6896
8.6853
8.6631
8.6583
7.8844
7.8147
7.8024
7.7961
7.7832
7.6456
7.5224
7.5069
7.4911
7.4804
7.4616
7.4371
7.4190
7.3773
7.3529
7.3258
2.8460
7.6688
7.6456
999
f1 (ppm)
2.173
1.000
2.007
0.999
7.352
3.154
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

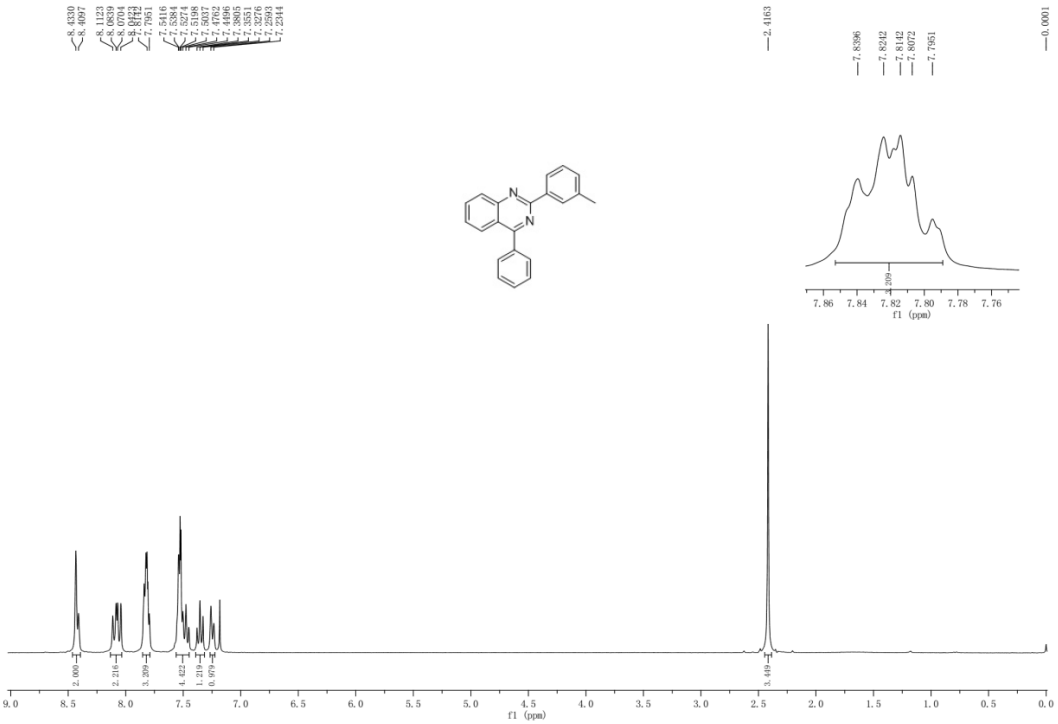

168.420
158.997
150.965
138.576
138.301
137.484
133.321
129.712
128.445
124.723
121.578
17.568
130.351
130.227
129.712
128.670
128.577
128.445
126.438
131 130 129 128 127 126
f1 (ppm)
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

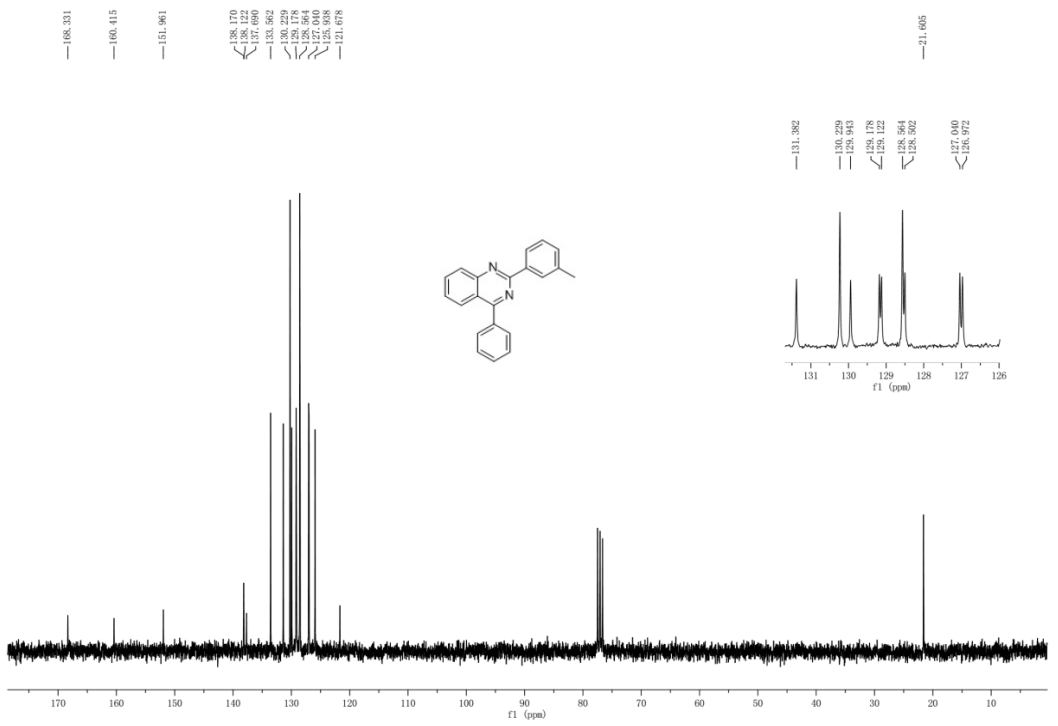


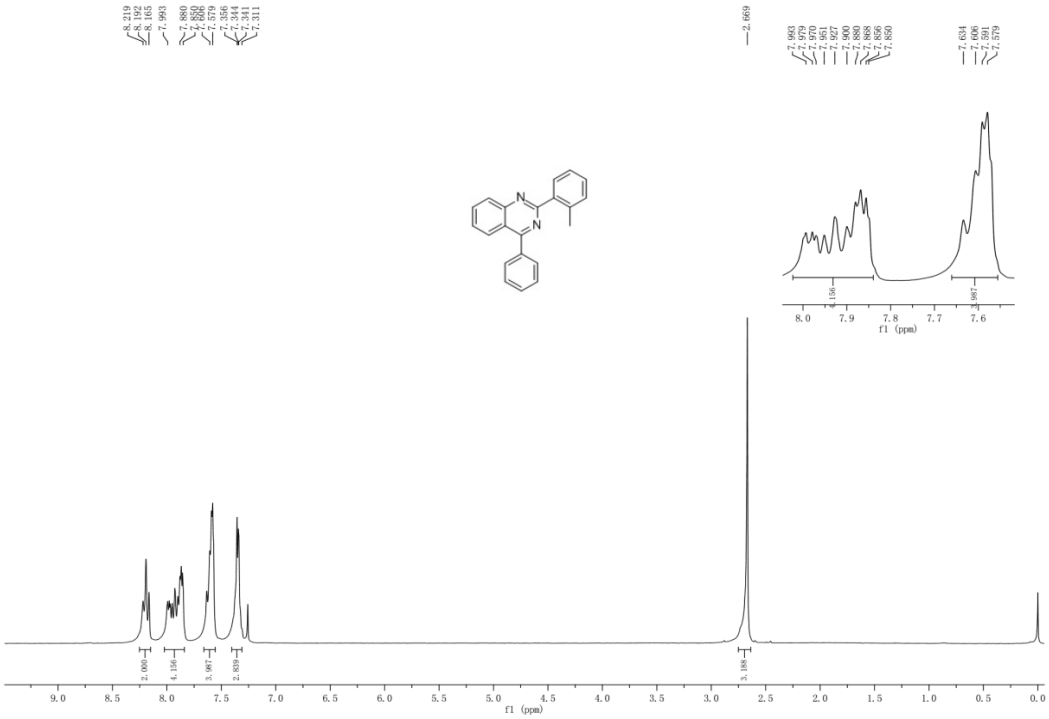


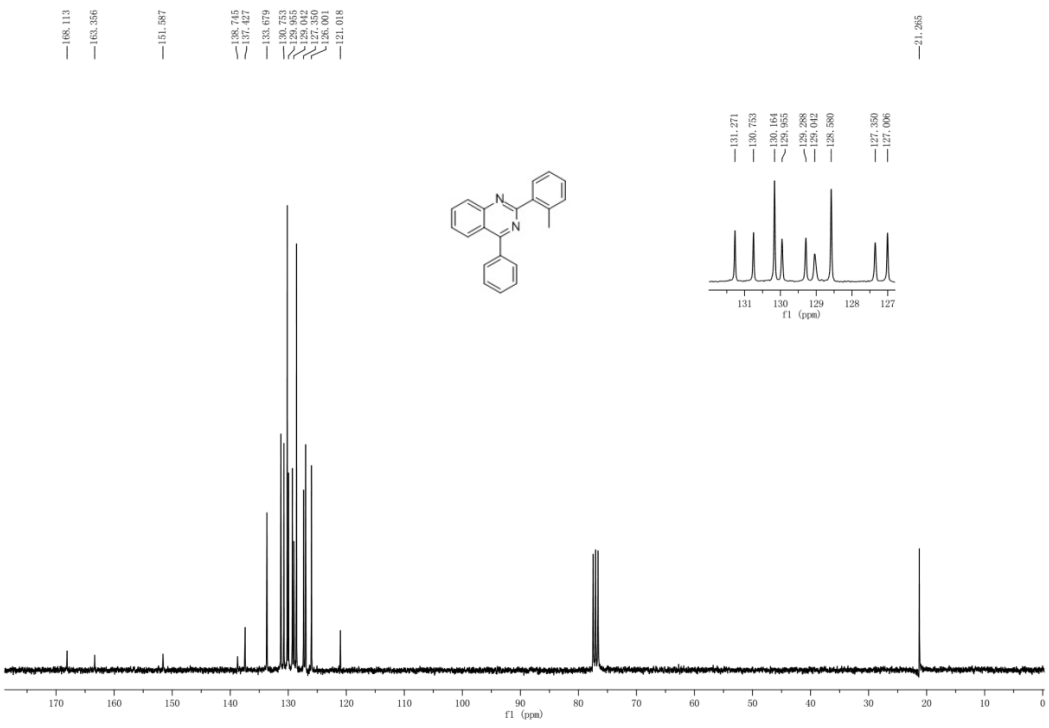

8.5308
8.5046
8.0630
8.0504
8.0217
7.8139
7.7986
7.7725
7.5237
7.5137
7.4931
7.4497
7.4244
7.2888
7.2467
2.3659
2.000
2.121
3.199
4.261
2.186
f1 (ppm)

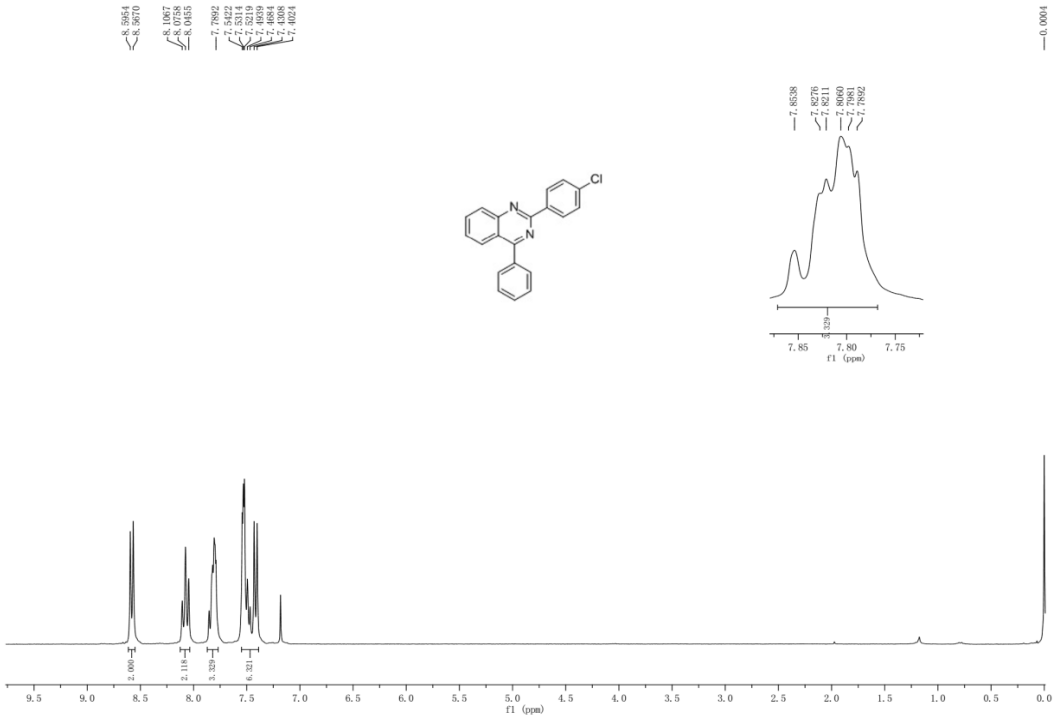

167.211
159.226
150.855
139.756
136.660
134.342
132.483
128.869
127.958
127.491
125.763
120.961
20.519
129.169
128.869
128.279
127.958
127.624
127.491
125.982
125.763
f1 (ppm)

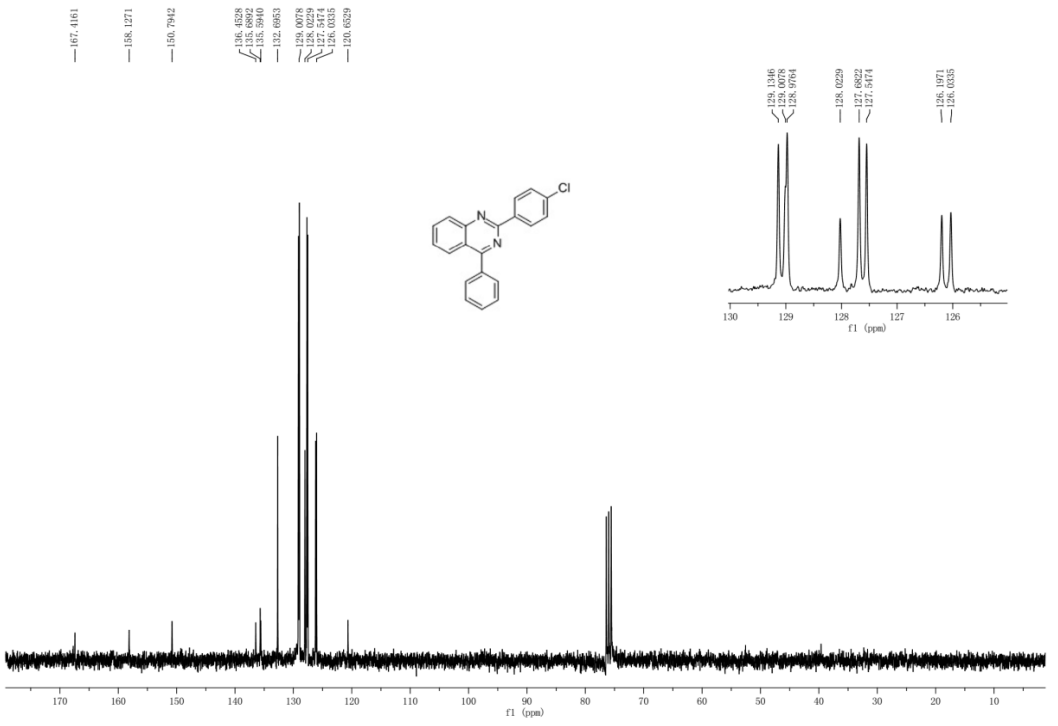

8.4330
8.4097
8.1123
8.0839
8.0704
8.0472
7.7951
7.5416
7.5274
7.5198
7.4937
7.4496
7.3805
7.3551
7.2576
7.2593
7.2344
2.4163
7.8396
7.8242
7.8142
7.8072
7.7951
0.0001
f1 (ppm)

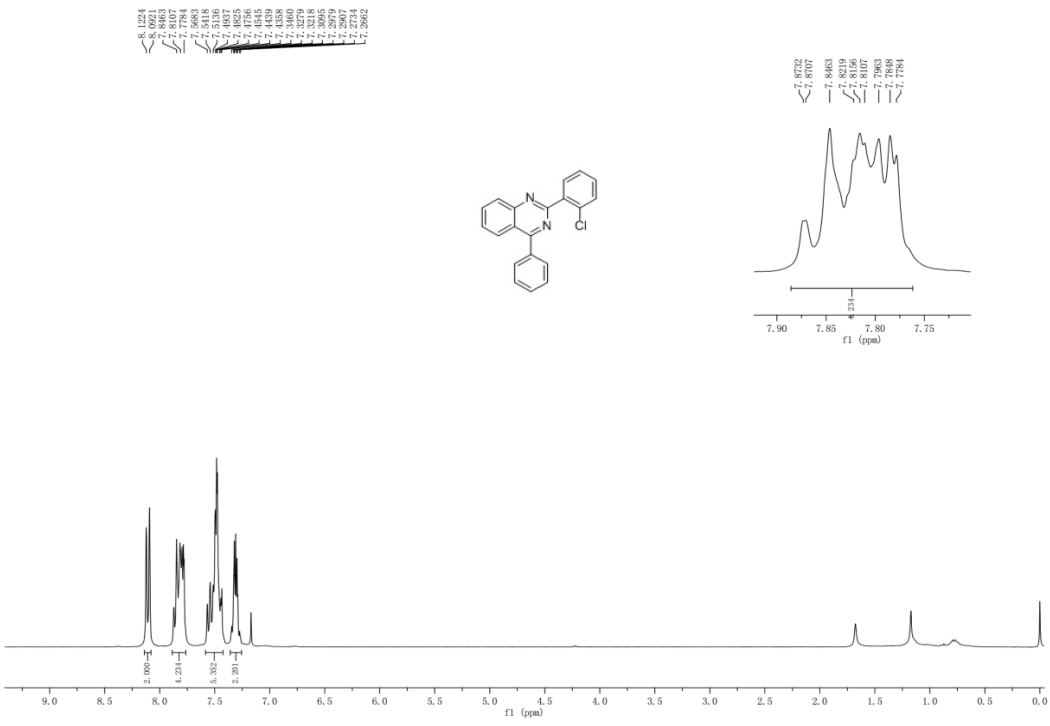

168.331
160.415
151.961
138.170
136.372
137.040
133.562
130.229
129.178
128.564
127.040
126.958
121.678
21.605
131.382
130.229
129.943
129.178
129.122
128.564
128.502
127.040
126.972
f1 (ppm)

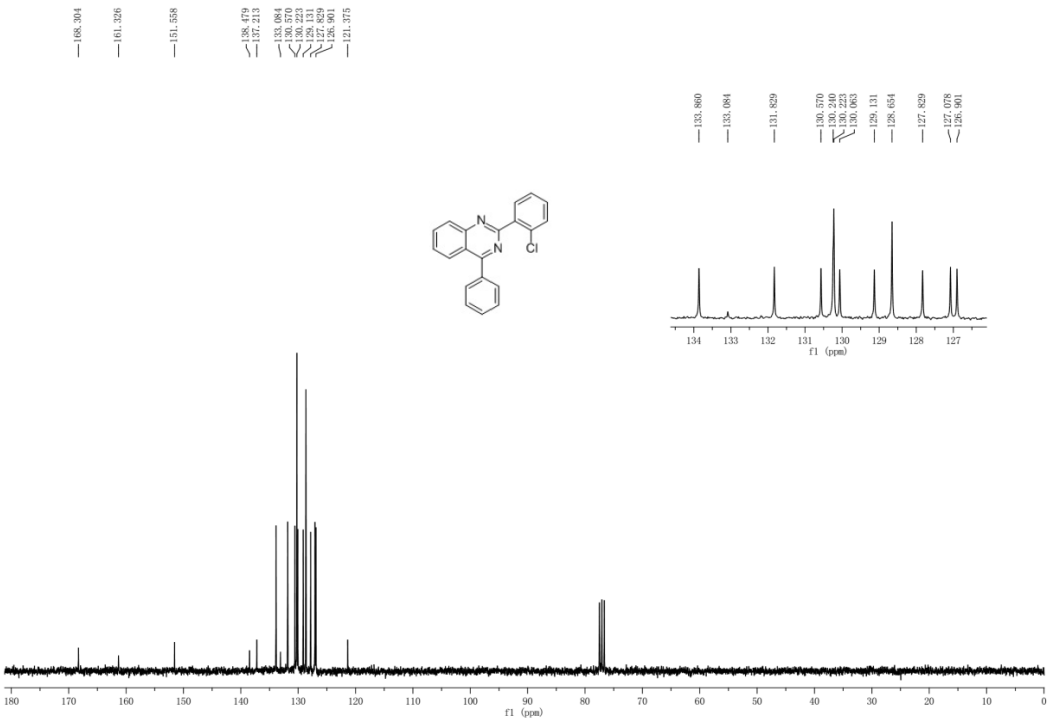


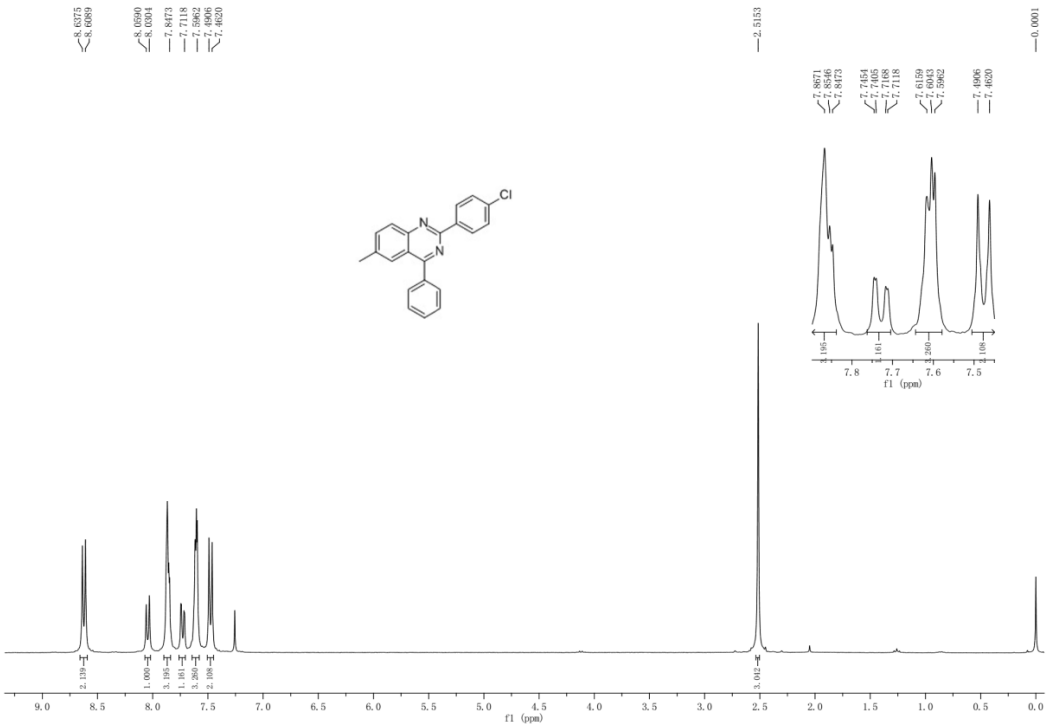


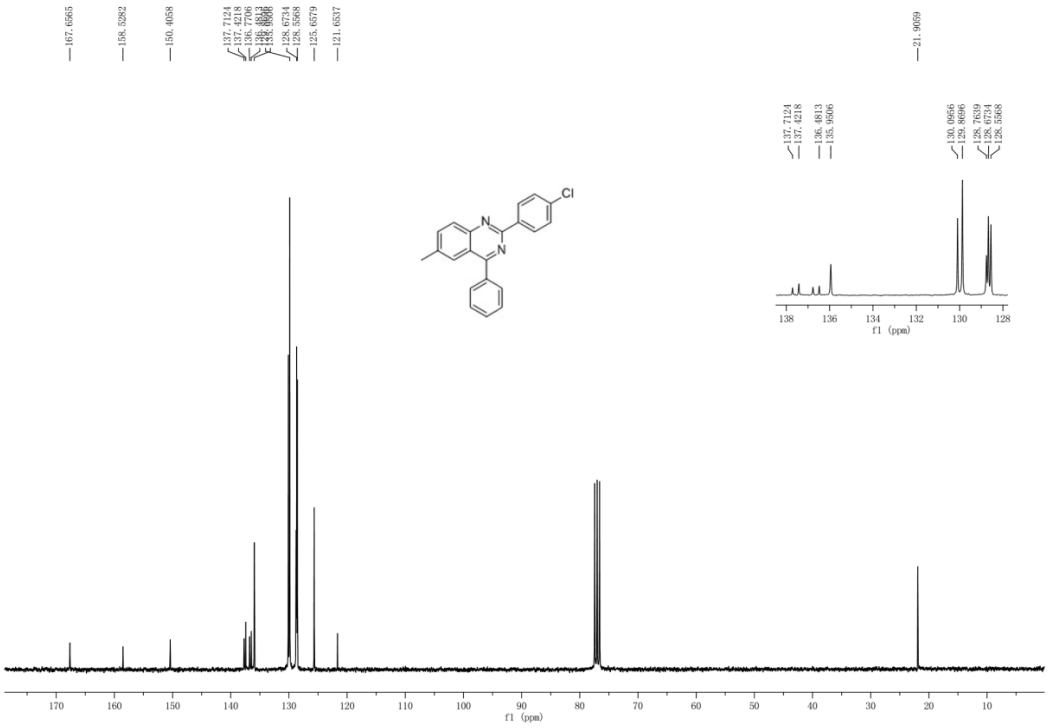

8.5954
8.5670
8.1067
8.0758
8.0455
7.7892
7.5472
7.5314
7.5219
7.4939
7.4684
7.4496
7.4024
0.0004
7.8538
7.8276
7.8211
7.8060
7.7981
7.7892
Cl
N
N
3.329
7.85
7.80
7.75
f1 (ppm)
2.000
2.118
3.329
6.321
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

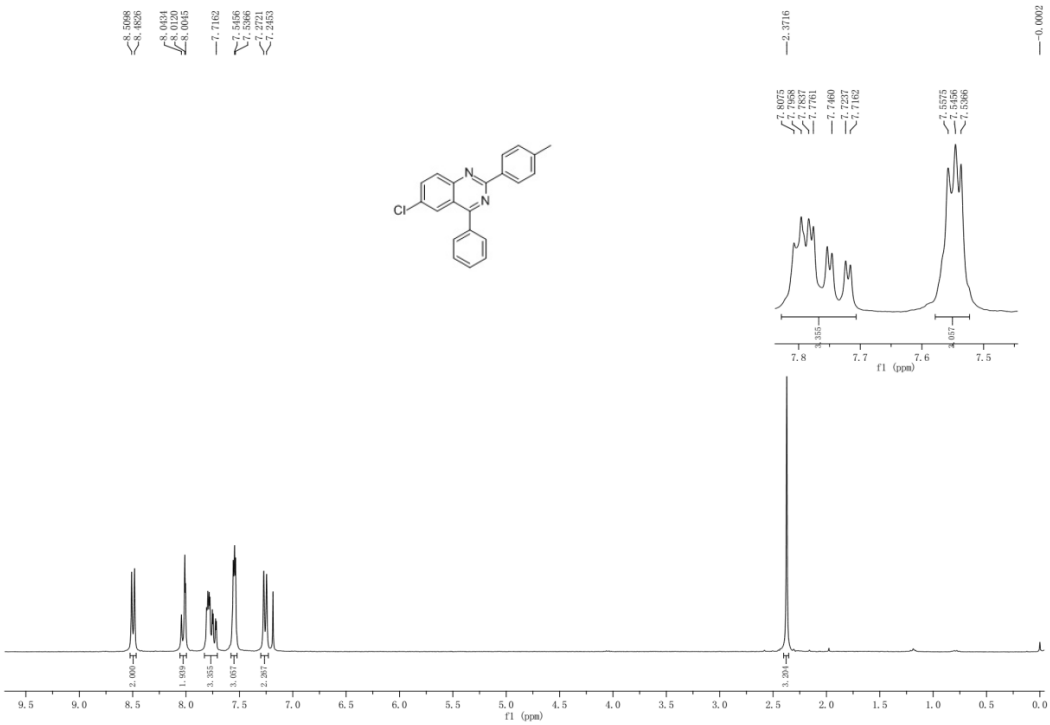

167.4161
158.1271
150.7942
136.4528
135.6892
135.5940
132.6953
129.0078
128.9764
128.0229
127.5474
126.0335
120.6529
129.1346
129.0078
128.9764
128.0229
127.6822
127.5474
126.1971
126.0335
Cl
N
N
130
129
128
127
126
f1 (ppm)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

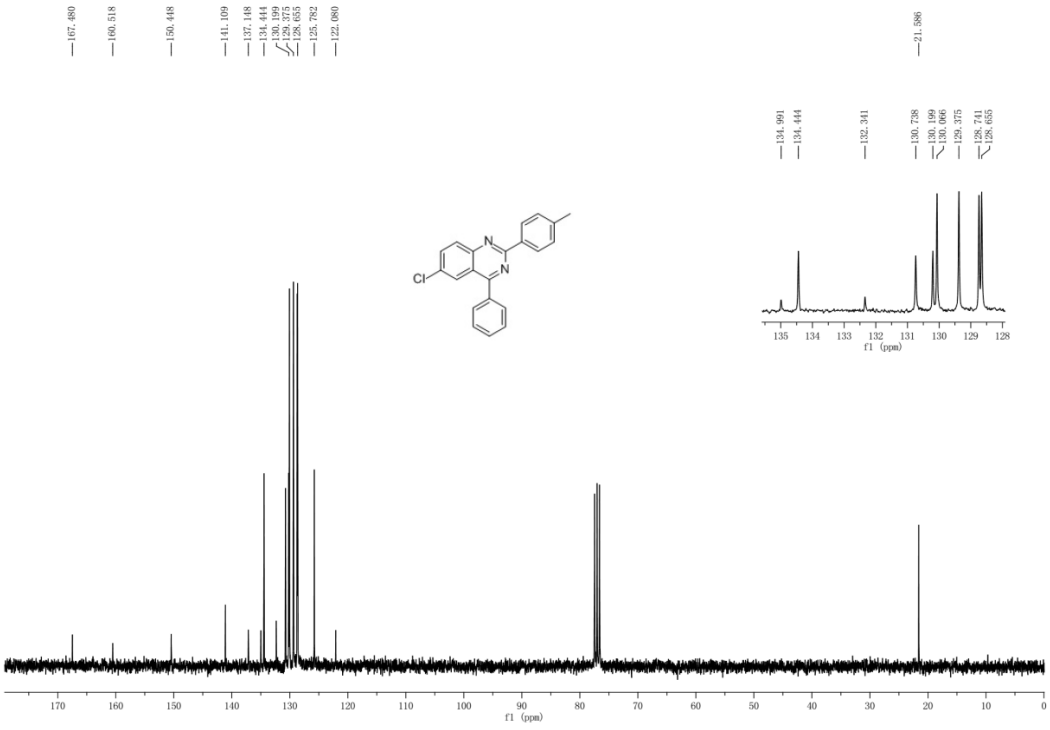


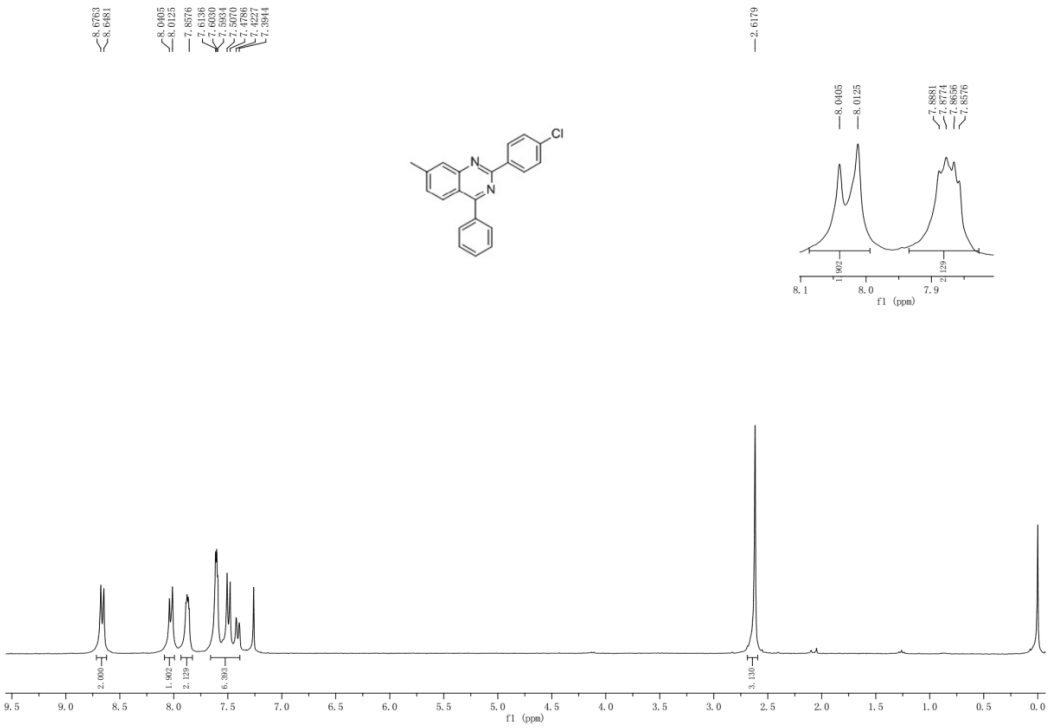


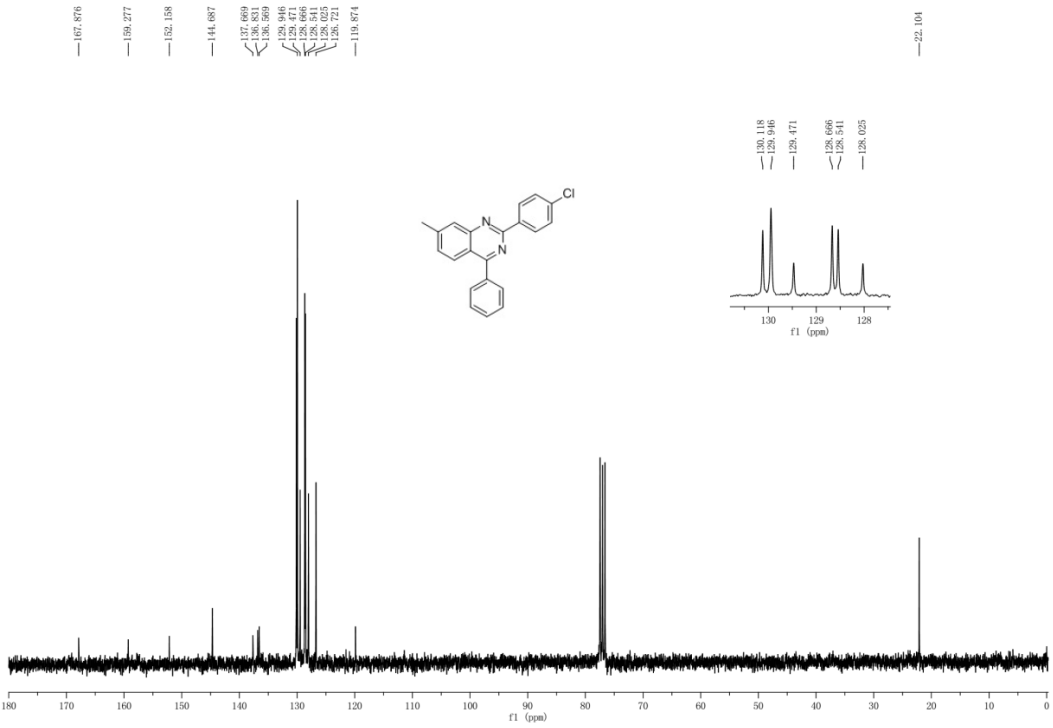

8.6375
8.6089
8.0590
8.0304
7.8473
7.7118
7.5962
7.4906
7.4620
2.5153
0.0001
7.8871
7.8586
7.8473
7.7454
7.7405
7.7198
7.7118
7.6159
7.6043
7.5962
7.4906
7.4620
Cl
N
N
2.139
1.000
3.195
1.161
3.260
2.108
3.042
f1 (ppm)

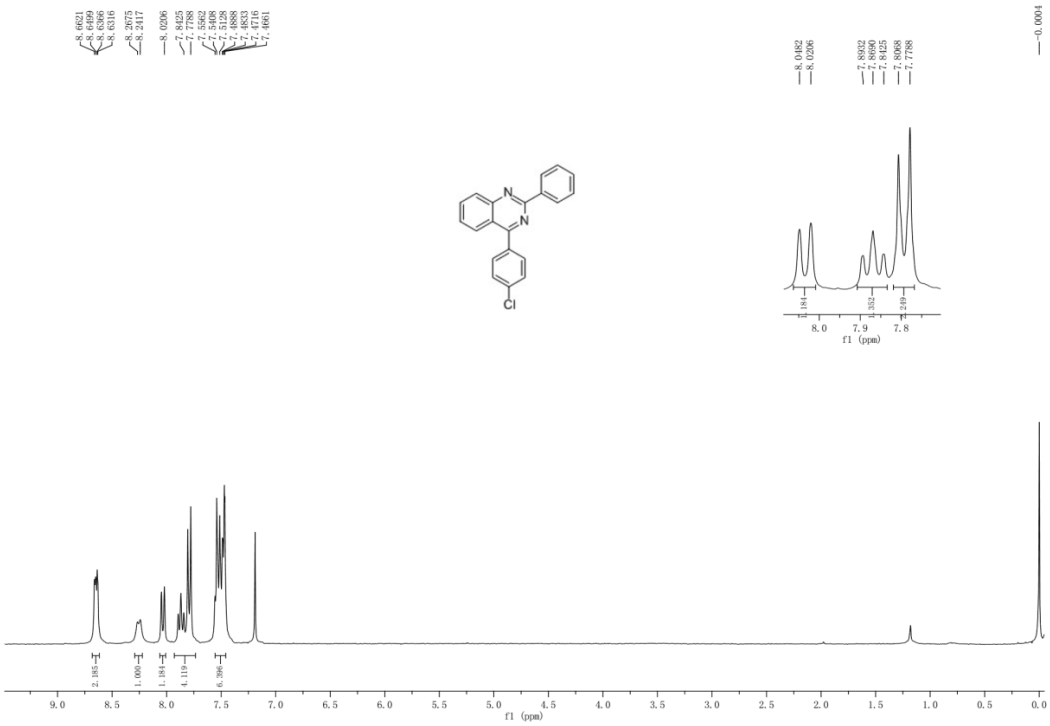

167.6565
158.5282
150.4058
137.7124
137.4218
136.7706
136.4813
135.9506
130.0956
129.8696
128.7639
128.6734
128.5968
125.6579
121.6537
21.9069
Cl
N
N
f1 (ppm)

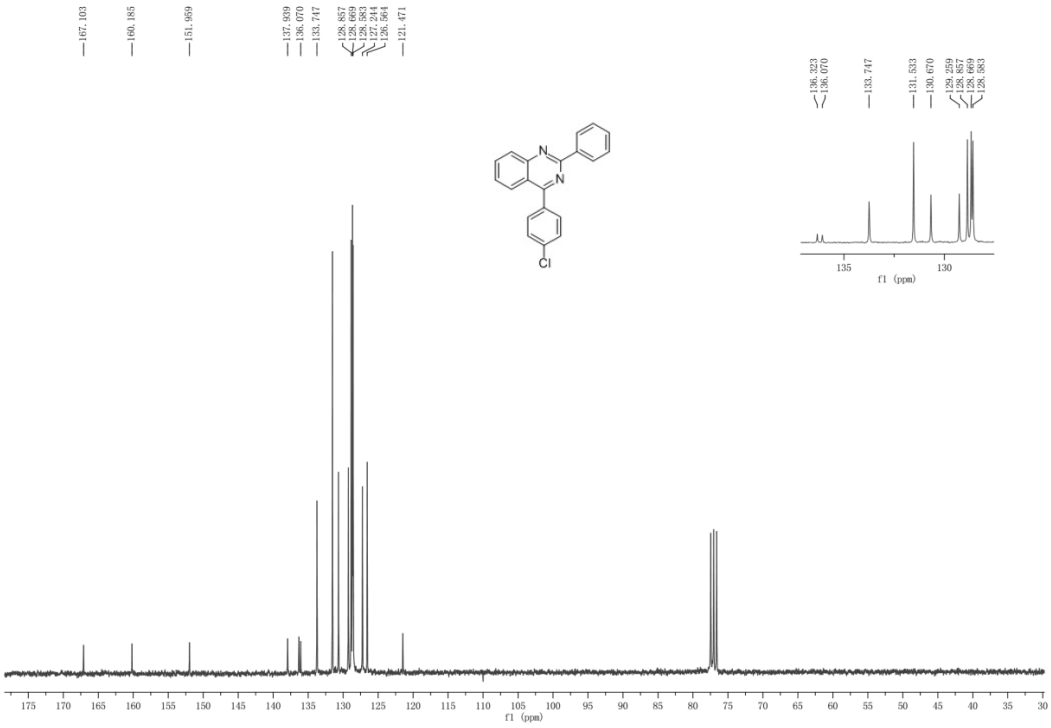

8.5098
8.4826
8.0434
8.0120
8.0045
7.7162
7.5456
7.5366
7.2721
7.2483
2.3716
0.0002
7.8075
7.7968
7.7857
7.7701
7.7460
7.7257
7.7162
7.5575
7.5456
7.5366
Cl
N
N
2.008
1.939
3.355
3.057
2.267
3.204
f1 (ppm)

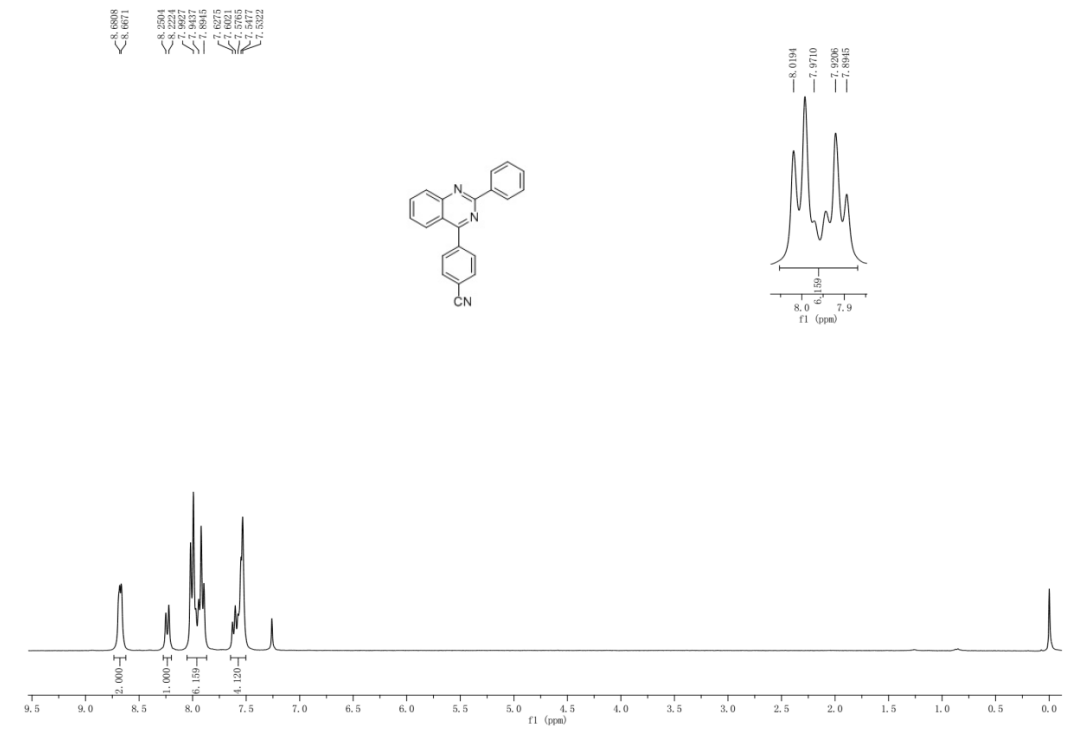

167.480
160.518
150.448
141.109
137.148
134.444
130.199
129.375
128.655
125.782
122.080
21.586
134.991
134.444
132.341
130.738
130.199
130.066
129.375
128.741
128.655
Cl
N
N
f1 (ppm)

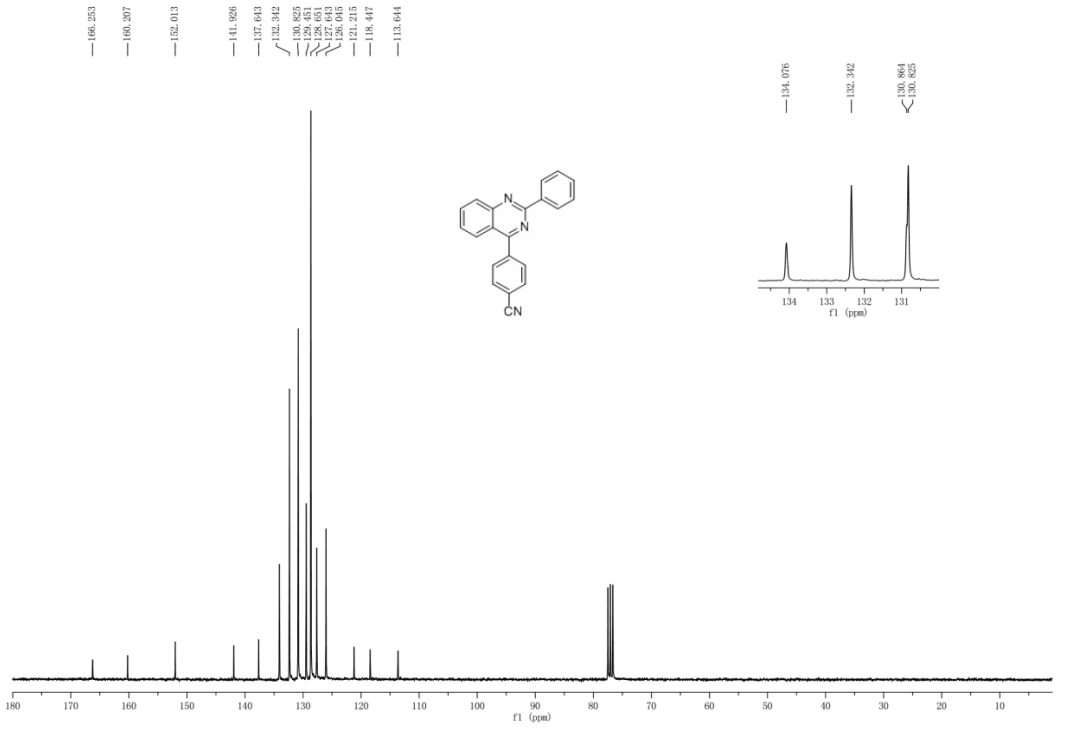

8.6763
8.6681
8.0405
8.0125
7.8876
7.6136
7.5980
7.5934
7.5070
7.4736
7.4577
7.3944
2.6179
Cl
N
N
8.0405
8.0125
7.8881
7.8774
7.8674
7.8576
1.902
2.129
8.1
8.0
7.9
f1 (ppm)
2.000
1.902
2.129
6.393
3.138
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


167.876
159.277
152.158
144.687
137.669
136.831
136.569
129.946
129.471
128.666
128.541
128.025
126.721
119.874
22.104
Cl
N
N
130.118
129.946
129.471
128.666
128.541
128.025
130
129
128
f1 (ppm)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.6621
8.6499
8.6366
8.6316
8.3675
8.2417
8.0206
7.8425
7.7788
7.5962
7.5498
7.5128
7.4888
7.4833
7.4770
7.4661
8.0482
8.0206
7.8932
7.8699
7.8455
7.8068
7.7788
0.0004
Cl
2.185
1.000
1.184
4.119
6.386
f1 (ppm)
1.184
3.352
2.249
f1 (ppm)


167.103
160.185
151.959
137.939
136.070
133.747
128.857
128.669
128.383
127.244
126.564
121.471
Cl
136.323
136.070
133.747
131.533
130.670
129.259
128.857
128.669
128.383
f1 (ppm)
f1 (ppm)


8.6808
8.6671
8.2504
8.2224
7.9827
7.9497
7.8945
7.6275
7.6021
7.5765
7.5577
7.5322
8.0194
7.9710
7.9306
7.8945
6.159
8.0
7.9
f1 (ppm)
CN
2.000
1.000
6.159
4.120
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


166.253
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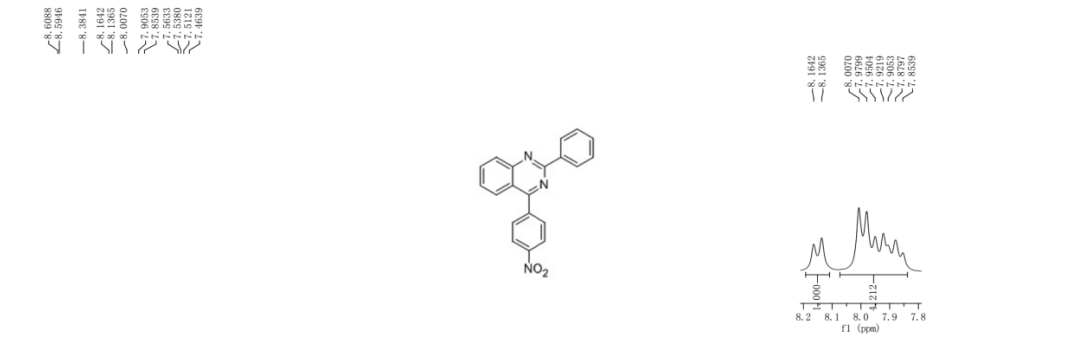
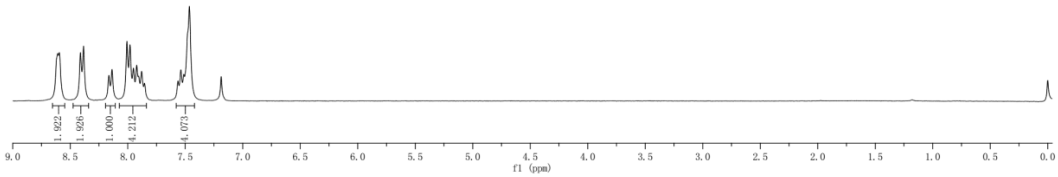
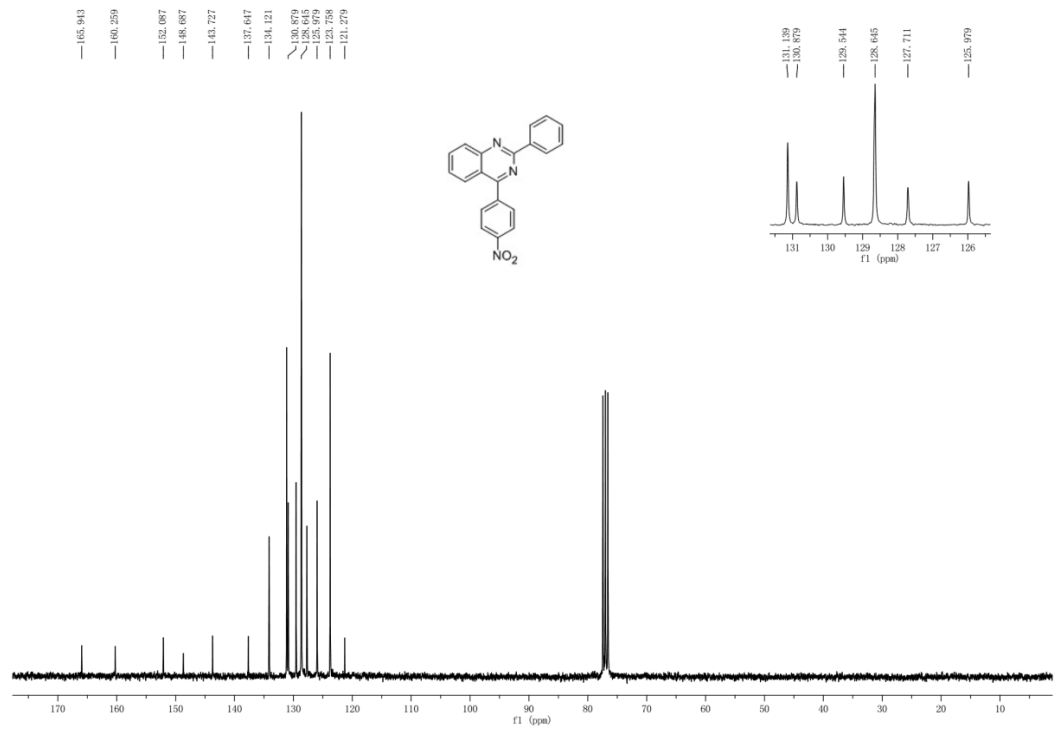
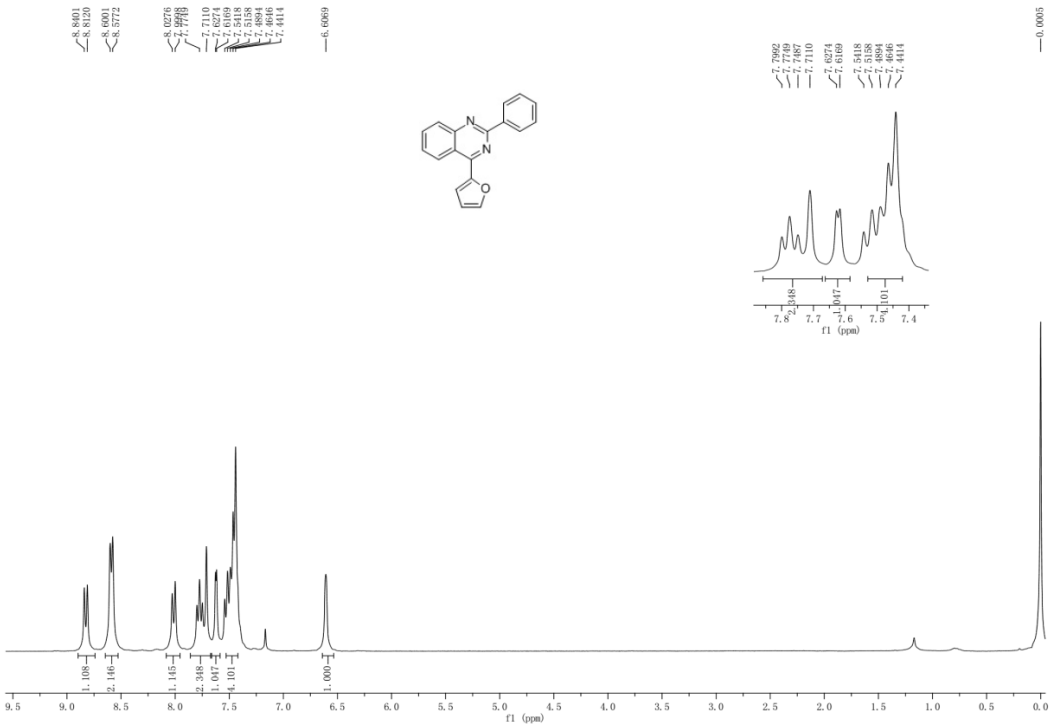
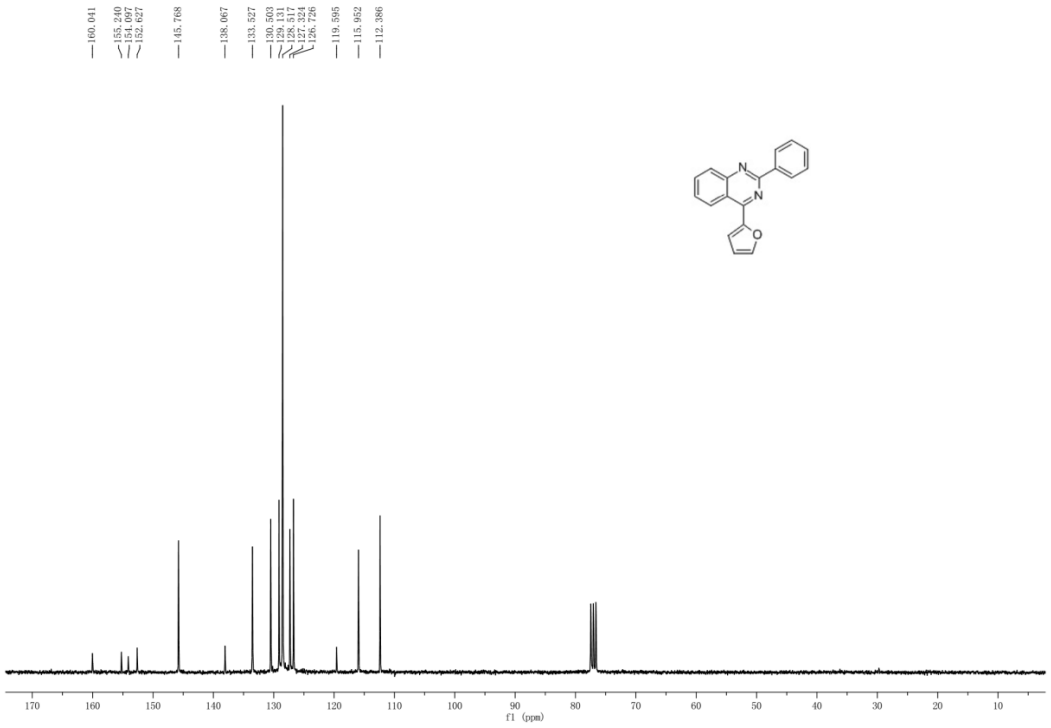
152.013
141.926
137.643
132.342
130.825
129.451
128.865
127.643
126.045
121.215
118.447
113.644
134.076
132.342
130.864
130.825
134
133
132
131
f1 (ppm)
CN
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

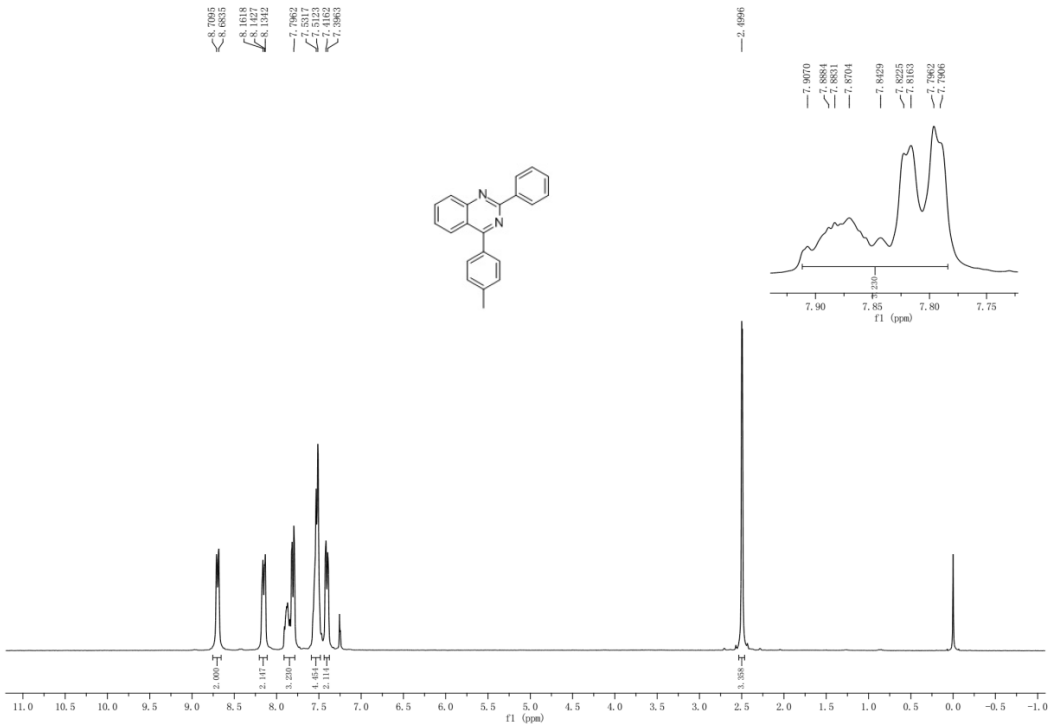

8.6088
8.5946
8.3841
8.1642
8.1365
8.0070
7.9053
7.8539
7.5833
7.5590
7.5121
7.4639
8.1642
8.1365
8.0070
7.9799
7.9504
7.9219
7.9053
7.8797
7.8539
NO2
1.000
4.212
8.2 8.1 8.0 7.9 7.8
f1 (ppm)

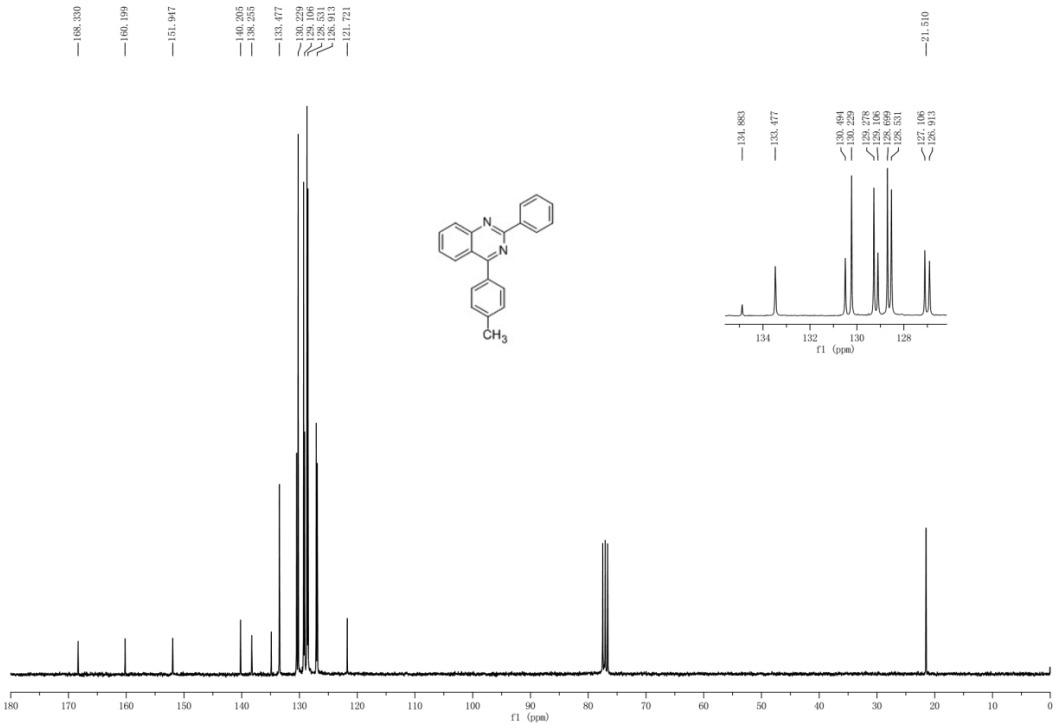

1.922
1.926
1.000
4.212
4.073
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

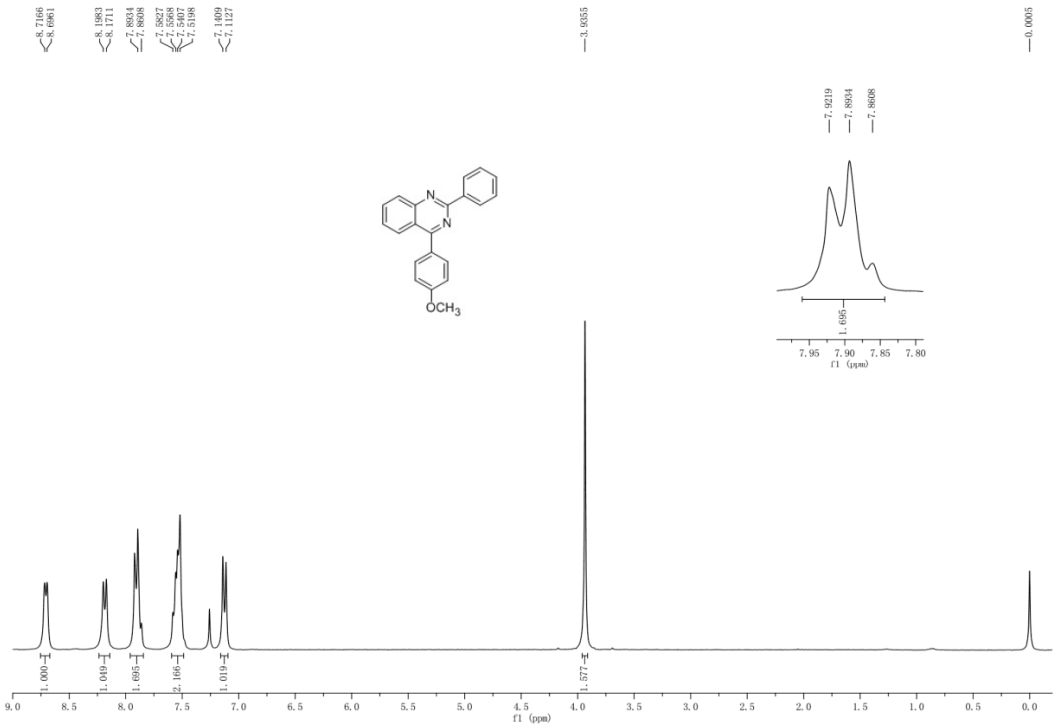

165.943
160.259
152.087
148.687
143.727
137.647
134.121
130.879
128.645
125.979
123.758
121.279
131.139
130.879
129.544
128.645
127.711
125.979
NO2
131 130 129 128 127 126
f1 (ppm)
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

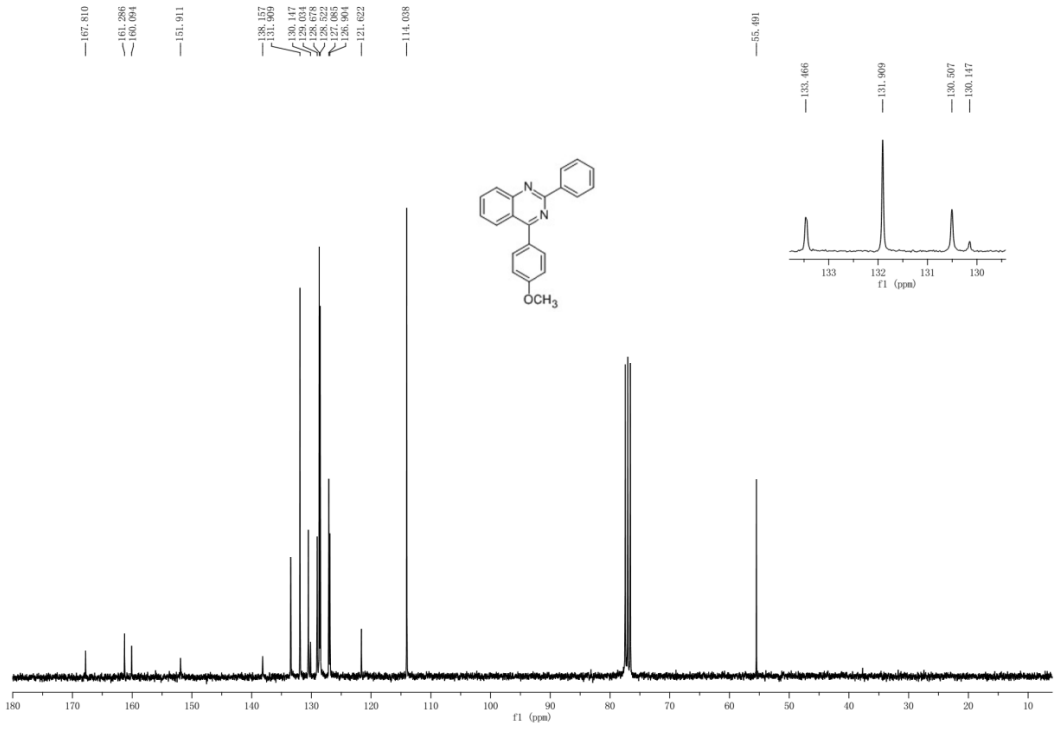

8.8491
8.8120
8.6001
8.5772
8.0276
7.9998
7.7719
7.7110
7.6274
7.6169
7.5418
7.5158
7.4894
7.4666
7.4414
6.6069
0.0005
1.108
2.146
1.145
2.348
1.047
4.101
1.000
f1 (ppm)

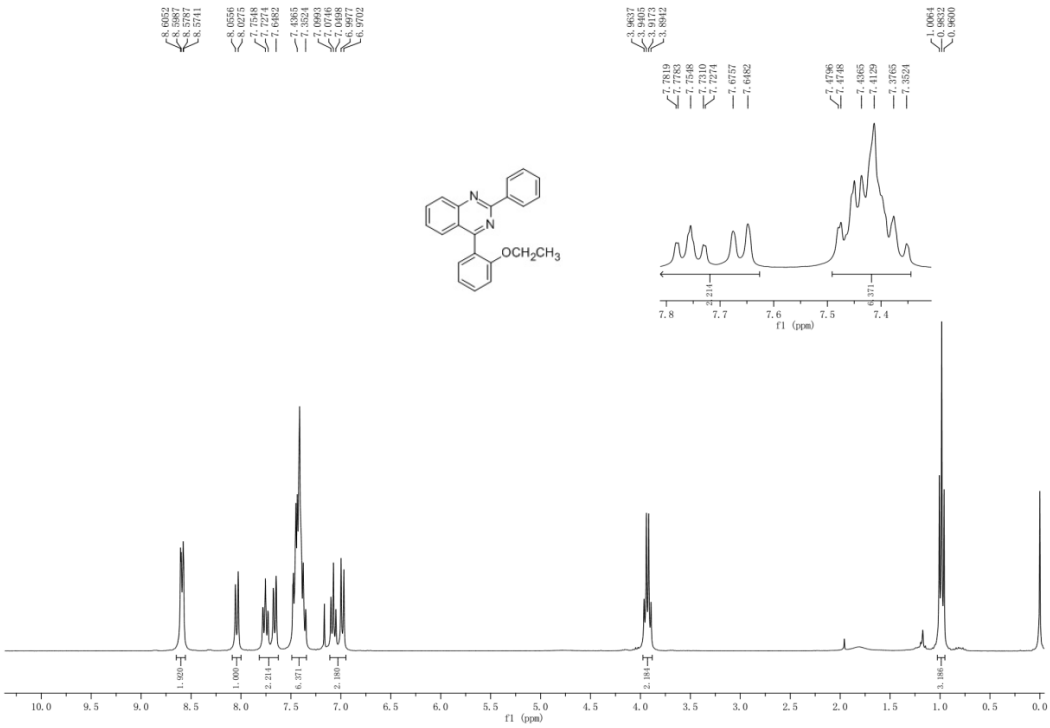

160.041
155.240
151.047
152.627
145.768
138.067
133.527
130.502
129.131
128.517
127.324
126.726
119.595
115.952
112.386
f1 (ppm)

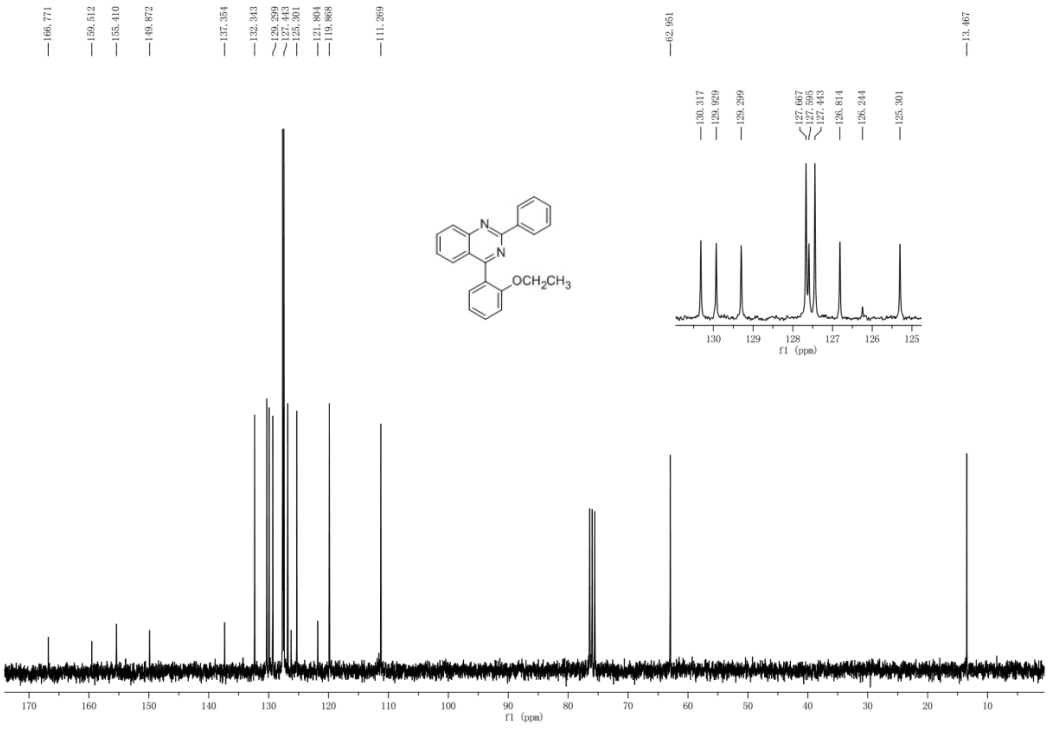

8.7095
8.6835
8.1618
8.1427
8.1342
7.7962
7.5317
7.5123
7.4642
7.3963
2.4996
7.9070
7.8884
7.8831
7.8704
7.8429
7.8225
7.8163
7.7962
7.7906
2.000
2.147
3.220
4.484
2.114
3.358
f1 (ppm)

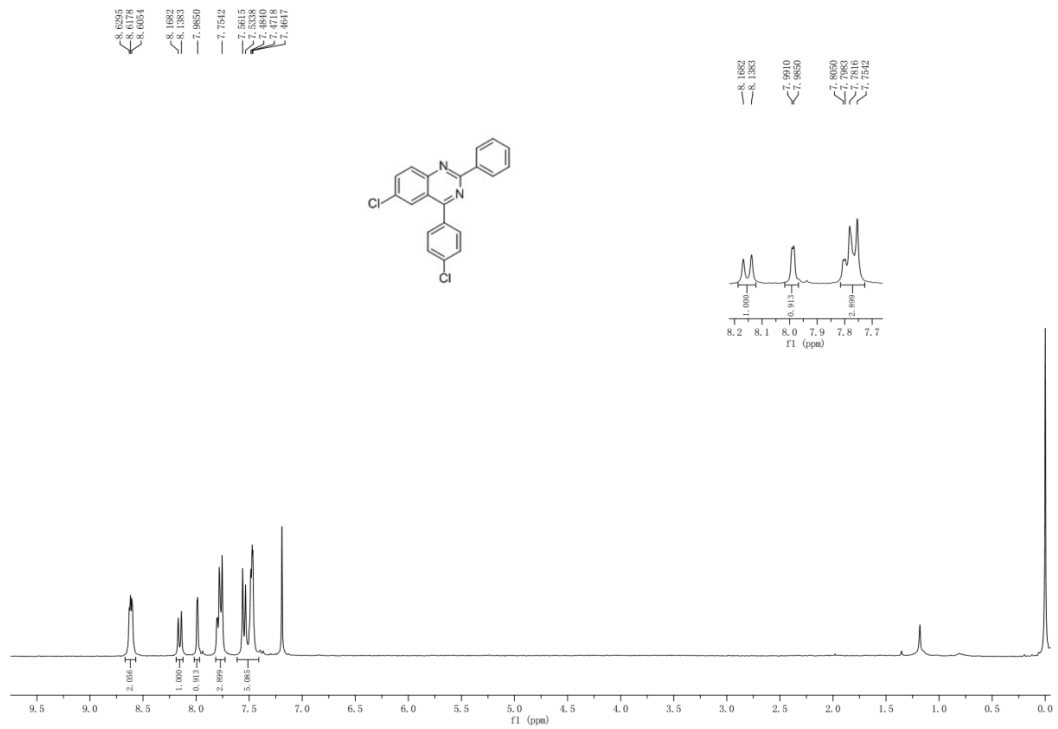

168.330
160.199
151.947
140.205
138.255
133.477
130.229
129.106
128.531
126.913
121.721
21.510
134.883
133.477
130.494
130.229
129.278
129.106
128.699
128.531
127.106
126.913
CH3
f1 (ppm)

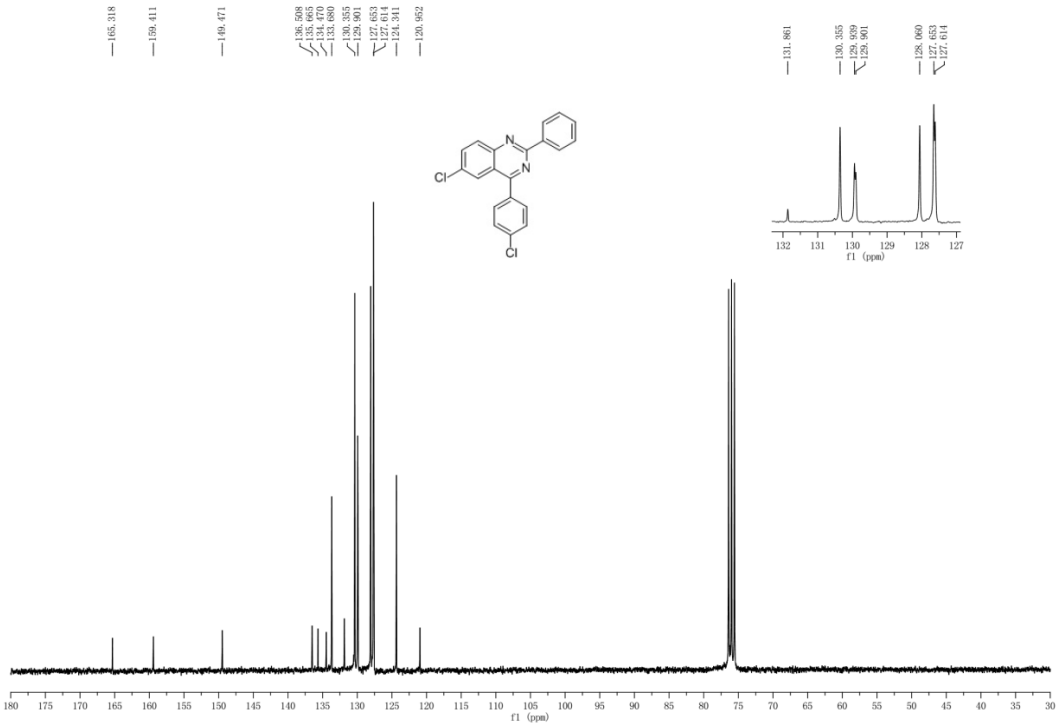

8.7166
8.6861
8.1983
8.1711
7.8934
7.8808
7.5827
7.5568
7.5407
7.5198
7.1409
7.1127
3.9355
0.0005
7.9219
7.8934
7.8608
1.695
7.95
7.90
7.85
7.80
f1 (ppm)
OCH3
1.000
1.049
1.695
2.166
1.019
1.577
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

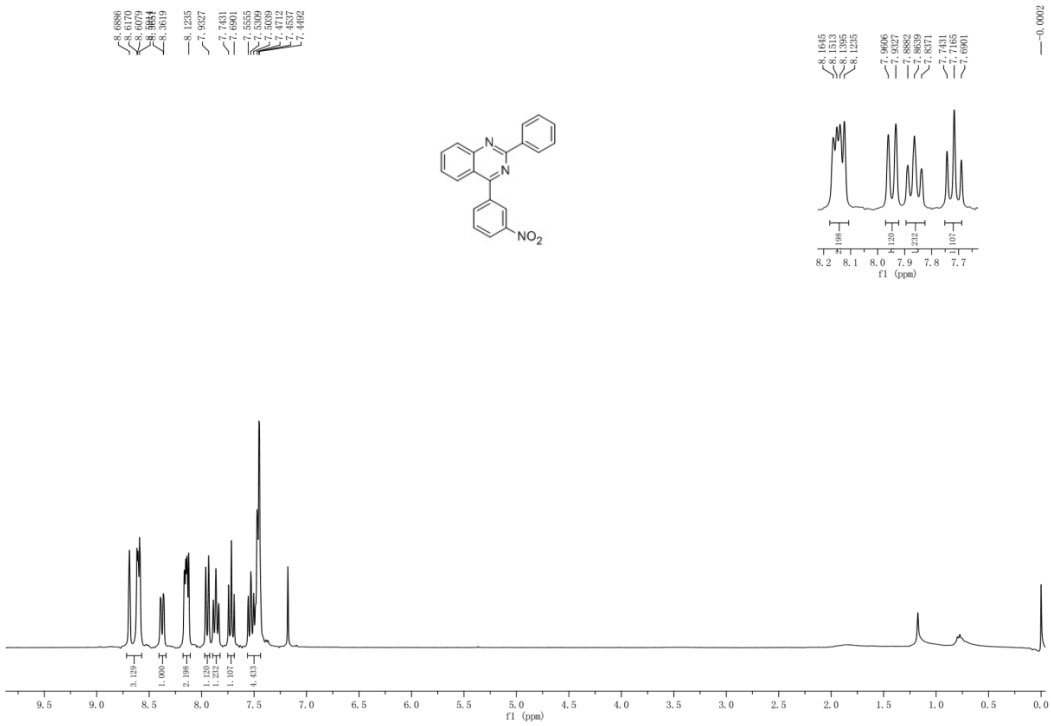

167.810
161.286
160.094
151.911
138.157
131.909
130.147
129.034
128.678
128.522
127.085
126.464
121.622
114.038
55.491
133.466
131.909
130.507
130.147
133
132
131
130
f1 (ppm)
OCH3
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

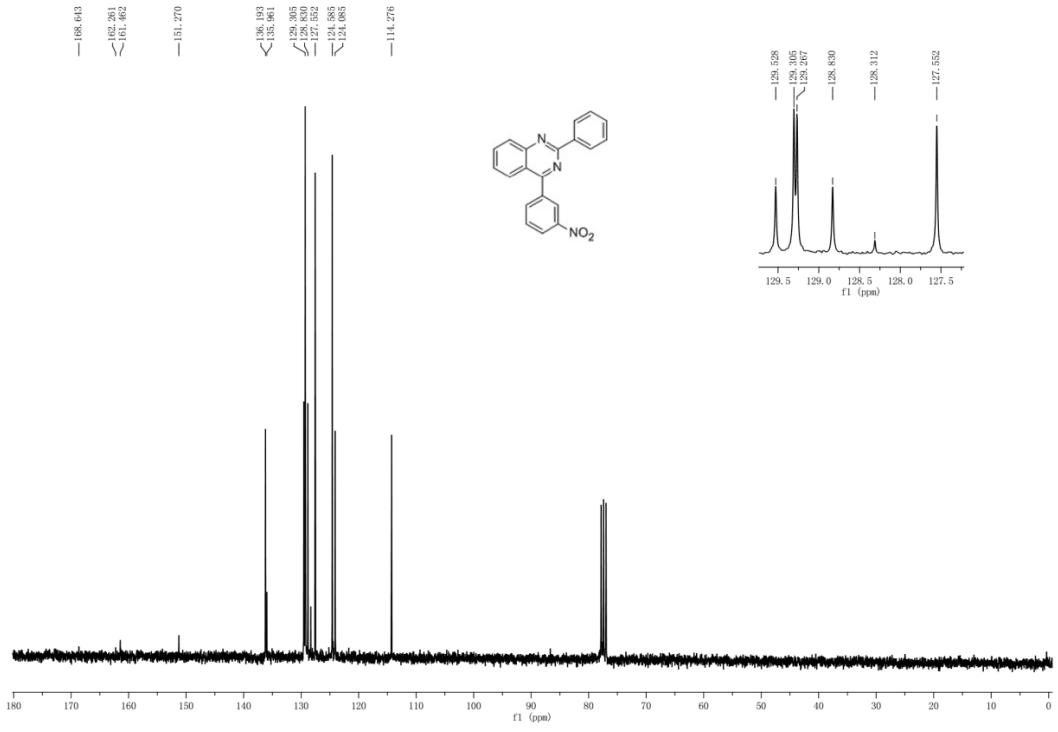

8.6052
8.5987
8.5767
8.5741
8.0356
8.0215
7.7848
7.7224
7.6482
7.4365
7.3524
7.0993
7.0746
7.0498
6.9977
6.9702
3.9637
3.9405
3.9173
3.8942
1.0064
0.9852
0.9609
OCH2CH3
f1 (ppm)

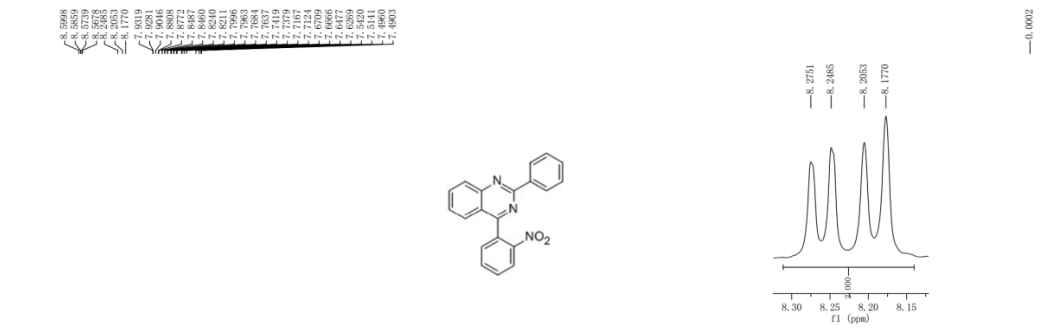

166.771
159.612
155.410
149.872
137.354
132.343
129.299
127.443
125.301
121.804
119.868
111.269
62.961
13.467
130.317
129.929
129.299
127.667
127.595
127.443
126.814
126.244
125.301
OCH2CH3
f1 (ppm)


8.6295
8.6178
8.6054
8.1682
8.1383
7.9850
7.7542
7.5615
7.5338
7.4910
7.4758
7.4647
8.1682
8.1383
7.9910
7.9850
7.8650
7.7983
7.7816
7.7542
Cl
N
N
Cl
1.000
0.913
2.899
8.2 8.1 8.0 7.9 7.8 7.7
f1 (ppm)
2.098
1.000
0.913
2.899
5.065
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


165.318
159.411
149.471
136.508
135.665
134.470
133.989
130.355
129.961
127.653
127.614
124.341
120.952
131.861
130.355
129.959
129.901
128.069
127.653
127.614
N
N
Cl
Cl
132 131 130 129 128 127
f1 (ppm)
180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30
f1 (ppm)


8.6886
8.6770
8.6079
8.3684
8.3619
8.1235
7.9327
7.7431
7.6901
7.5555
7.5389
7.5090
7.4712
7.4537
7.4492
8.1645
8.1513
8.1395
8.1235
7.9606
7.9327
7.8882
7.8839
7.8571
7.7431
7.7151
7.7045
7.6901
0.0002
NO2
3.129
1.000
2.198
1.120
1.232
1.107
4.433
f1 (ppm)


168.643
162.291
161.862
151.270
136.193
135.961
129.905
129.859
127.552
124.585
124.085
114.276
129.528
129.305
129.267
128.830
128.312
127.552
NO2
f1 (ppm)



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