Supporting Information

Four-Component Assembly of Polysubstituted Pyrimidines *via* Dual C(sp³)–H Functionalization of Primary Aliphatic Amines

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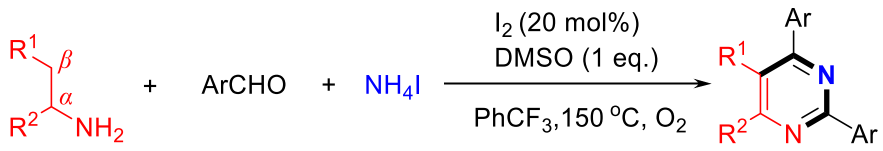
1. General information

All reagents were obtained commercially and used without further purification. All solvents were dried and distilled according to standard procedures. Column chromatography was performed on silica gel (200-300 mesh). ^{1}H NMR and ^{13}C NMR spectrawere recorded on Bruker-AV (500 and 125 MHz, respectively) instrument internally referenced to tetramethylsilane (TMS) or chloroform. The chemical shifts (δ) were expressed in ppm and coupling constants (J) were in Hz. The following abbreviations are used for the multiplicities: s: singlet, d: doublet, t: triplet, q: quartet, m: multiplet. Analytical thin layer chromatography was performed on Polygram SIL G/UV254 plates. Visualization was accomplished with short wave UV light. The reaction temperature was detected by the magnetic stirrer of probe.

2. General procedure for the synthesis of pyrimidines

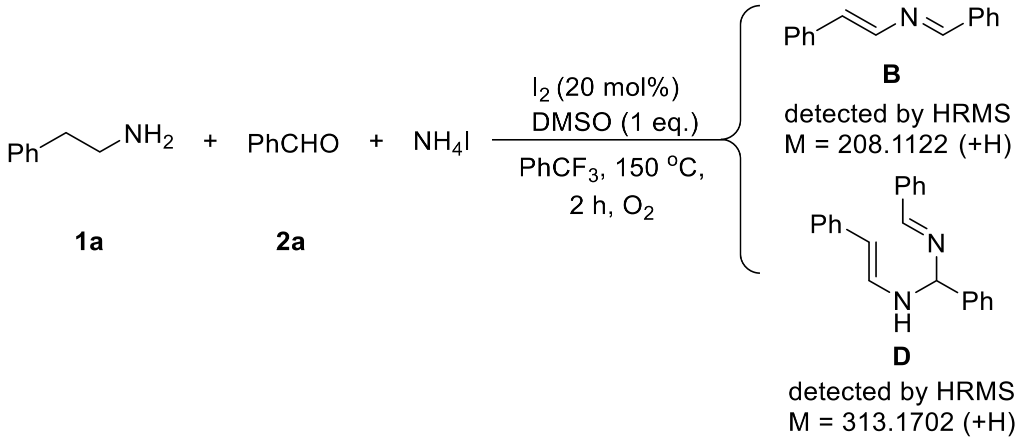


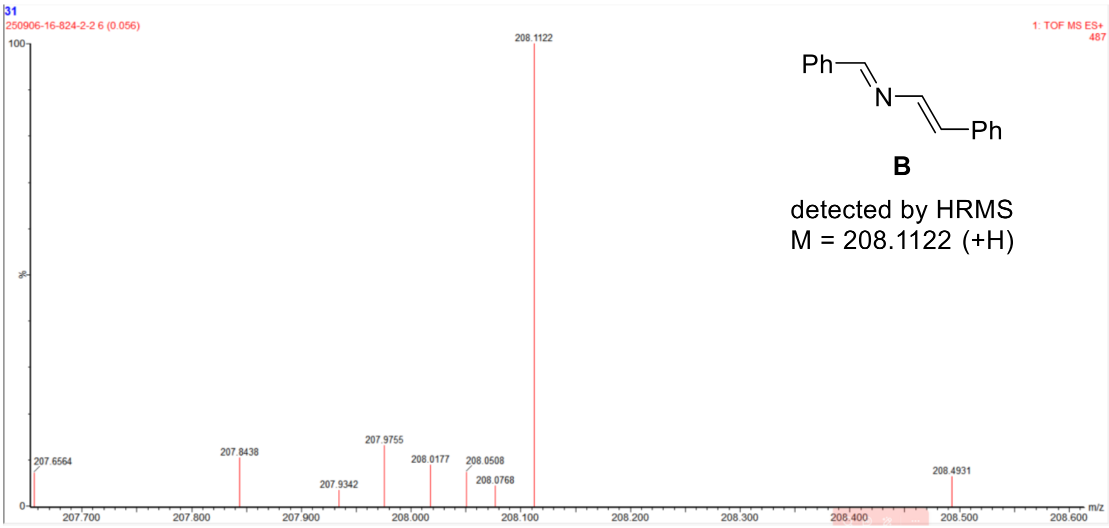
1 **2** **3**

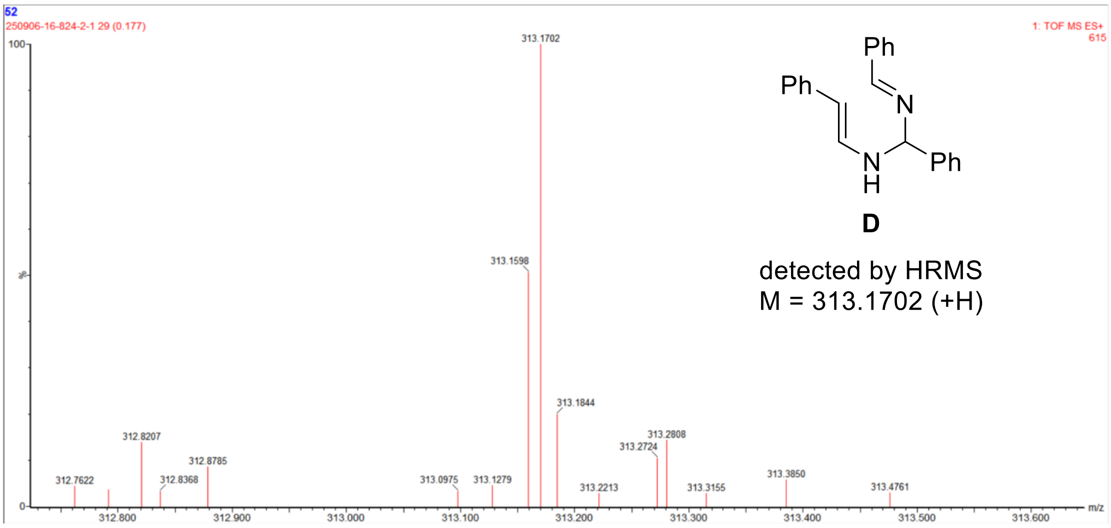
A 15 mL pressure-resistant tube was charged with phenylethylamine (0.2 mmol), aromatic aldehyde (0.6 mmol), ammonium iodide (0.3 mmol), iodine (0.04 mmol), freshly activated 4 Å molecular sieves (100 mg), DMSO (0.2 mmol) and trifluorotoluene (1 mL). The reaction vessel was purged with oxygen for three times and stirred at 150 °C for 11 h. After cooling to room temperature, the reaction mixture was diluted with EtOAc and filtered. The filtrate was then concentrated in vacuo, and the resulting residue was purified by column chromatography to afford the corresponding product.

3. The control experiments

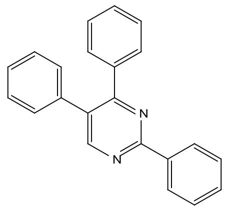
A 15 mL pressure-resistant tube was charged with phenylethylamine (0.2 mmol), aromatic aldehyde (0.6 mmol), ammonium iodide (0.3 mmol), iodine (0.04 mmol), freshly activated 4 Å molecular sieves (100 mg), DMSO (0.2 mmol) and trifluorotoluene (1 mL). The reaction vessel was purged with oxygen for three times and stirred at 150 °C for 2 h. The mixture was tested by high-resolution mass spectrometry (HRMS) and the molecular mass of intermediate **B** and intermediate **D** were detected successfully.



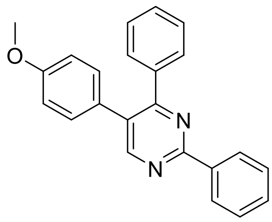




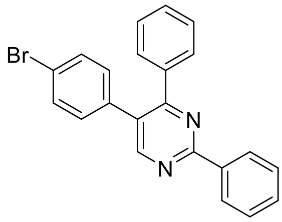
4. Characterization data of products



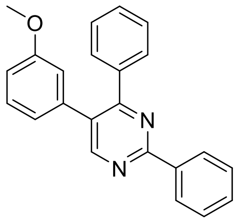
2,4,5-triphenylpyrimidine (3a)[1]: White solid (45.0 mg, 73 % yield); R_f = 0.4 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.79 (s, 1H), 8.58 (d, J = 9.7 Hz, 2H), 7.56 (d, J = 7.1 Hz, 2H), 7.54-7.47 (m, 3H), 7.37-7.32 (m, 4H), 7.30 (t, J = 7.3 Hz, 2H), 7.25 (dd, J = 6.7, 3.1 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 163.3, 163.1, 158.7, 137.8, 137.5, 136.6, 130.8, 130.7, 130.0, 129.34, 129.30, 128.7, 128.5, 128.2, 128.1, 127.9



5-**(4-methoxyphenyl)-2,4-diphenylpyrimidine (3b)[2]:** Yello w solid (35.9 mg, 53% yield); R_f = 0.3 (PE:EA = 20:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.78 (s, 1H), 8.58 (d, J = 9.8 Hz, 2H), 7.59 (d, J = 6.8 Hz, 2H), 7.55-7.49 (m, 3H), 7.39-7.31 (m, 3H), 7.18 (d, J = 8.7 Hz, 2H), 6.89 (d, J = 8.7 Hz, 2H), 3.83 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 163.2, 162.9, 159.4, 1 58.6, 138.1, 137.6, 130.53, 130.48, 130.4, 129.9, 129.2, 128.7, 128.5, 128.2, 12 8.1, 114.3, 55.3.

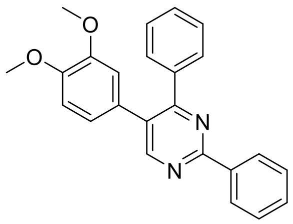


5-(4-bromophenyl)-2,4-diphenylpyrimidine (3c) (CAS: 1 622876-38-3): White solid (52.7 mg, 68% yield); R_f = 0. 3 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.76 (s, 1H), 8.59 (d, J = 9.6 Hz, 2H), 7.57-7.47 (m, 7 H), 7.39 (t, J = 7.2 Hz, 1H), 7.34 (t, J = 7.3 Hz, 2H), 7.13 (d, J = 8.5 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 163.5, 163.4, 158.4, 137.6, 137.3, 135.6, 132.0, 130.9, 130.8, 129.9, 129.6, 129.5, 128.6, 128.3, 128.2, 122.3.

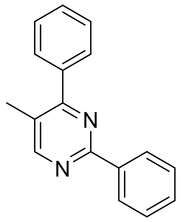


5-(3-methoxyphenyl)-2,4-diphenylpyrimidine (3d)[2]： White solid (39.9 mg, 59% yield); R_f = 0.3 (PE:EA = 50:1); Yellowish solid; yield: 26.6 mg (39 %). ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.74 (s, 1H), 8.51 (d, J = 9.5 Hz, 2H), 7.51 (d, J = 6.9 Hz, 2H), 7.44 (dd, J = 5.2, 2.0 Hz, 3H), 7.30 (t, J = 7.2 Hz, 1H), 7.25 (t, J = 7.3 Hz, 2H), 7.20 (t, J = 7.9 Hz, 1H), 7.19 (s, 2H), 6.82 (dd, J = 8.2, 1.9 Hz, 1H), 6.77 (d, J = 7.6 Hz, 1H), 6.70

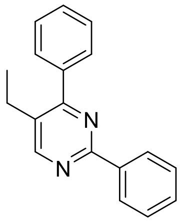
(t, J = 2.1 Hz, 1H), 3.63 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 163.5, 163.2, 159.7, 158.4, 137.8, 137.4, 130.72, 130.69, 129.9, 129.8, 129.4, 128.6, 128.3, 128.1, 121.8, 114.8, 113.7, 55.2.



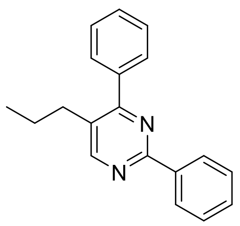
5-(3,4-dimethoxyphenyl)-2,4-diphenylpyrimidine (3e)[2]: Yellow solid (32.4 mg, 44% yield); R_f = 0.3 (PE:EA = 10:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.82 (s, 1H), 8.57 (d, J = 9.8 Hz, 2H), 7.57 (d, J = 6.6 Hz, 2H), 7.54 – 7.49 (m, 3H), 7.38 – 7.30 (m, 3H), 6.90 (d, J = 2.3 Hz, 2H), 6.63 (s, 1H), 3.91 (s, 3H), 3.62 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 163.4, 163.0, 158.4, 148.92, 148.88, 138.1, 137.5, 130.6, 130.5, 129.8, 129.2, 128.9, 128.54, 128.2, 128.1, 121.6, 112.8, 111.4, 55.9, 55.7.



5-methyl-2,4-diphenylpyrimidine (3f)[3]: White solid (29.0 mg, 59% yield); R_f = 0.5 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.68 (s, 1H), 8.51 (d, J = 7.9 Hz, 2H), 7.74 (d, J = 6.4 Hz, 2H), 7.59 – 7.40 (m, 6H), 2.43 (s, 3H).^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 164.9, 162.5, 159.2, 138.4, 137.7, 130.3, 129.3, 129.1, 128.5, 128.3, 128.0, 125.6, 17.0.

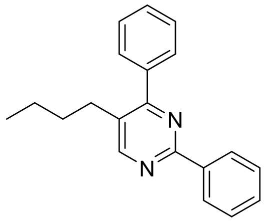


5-ethyl-2,4-diphenylpyrimidine (3g)[3]: White solid (30.2 mg, 58% yield); R_f = 0.4 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.74 (s, 1H), 8.50 (d, J = 8.0 Hz, 2H), 7.66 (d, J = 6.1 Hz, 2H), 7.56 – 7.42 (m, 6H), 2.79 (q, J = 7.6 Hz, 2H), 1.22 (t, J = 7.5 Hz, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 165.1, 162.2, 158.2, 138.5, 137.7, 131.6, 130.3, 129.1, 128.8, 128.43, 128.34, 128.0, 23.0, 14.9.

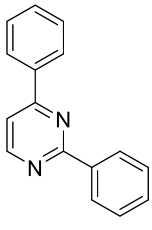


2,4-diphenyl-5-propylpyrimidine (3h)[3]: White solid (27.9 mg, 51% yield); R_f = 0.4 (PE: EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$,ppm) δ 8.71 (s, 1H), 8.50 (d, J = 8.0 Hz, 2H), 7.65 (d, J = 6.1 Hz, 2H), 7.54 – 7.45 (m, 6H), 2.73 (q, 2H), 1.65 – 1.53 (m, 2H), 0.91 (t, J = 7.3 Hz, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 165.4, 162.2, 158.5, 138.7, 137.7, 130.3, 130.2, 129.0, 128.8, 128.4, 128.3, 128.0, 31.8, 23.7, 13.8.

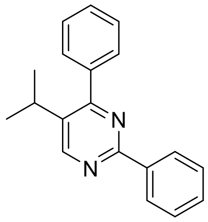
5-**butyl-2,4-diphenylpyrimidine (3i)[3]:** White solid (32.3 mg, 56% yield); R_f = 0.5



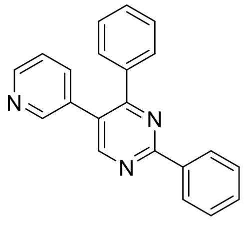
(PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.71 (s, 1H), 8.50 (d, J = 9.7 Hz, 2H), 7.65 (dd, J = 7.8, 1.8 Hz, 2H), 7.56 – 7.42 (m, 6H), 2.75 (q, 2H), 1.59 – 1.49 (m, 2H), 1.36 – 1.25 (m, 2H), 0.86 (q, J = 7.3 Hz, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 165.3, 162.1, 158.5, 138.6, 137.7, 130.4, 130.3, 129.0, 128.8, 128.4, 128.3, 128.0, 32.7, 29.4, 22.3, 13.7.



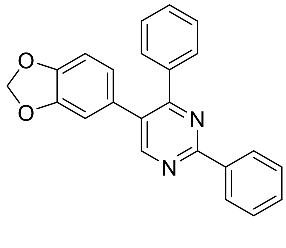
2,4-diphenylpyrimidine (3j) [3]: White solid (17.7 mg, 38% yield); R_f = 0.5 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.85 (d, J = 5.3 Hz, 1H), 8.59 (d, J = 9.8 Hz, 2H), 8.24 (d, J = 9.7 Hz, 2H), 7.62 (d, J = 5.2 Hz, 1H), 7.57 – 7.50 (m, 6H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 164.6, 163.9, 157.8, 137.8, 136.9, 131.0, 130.7, 128.9, 128.5, 128.6, 127.2, 114.5.



5-isopropyl-2,4-diphenylpyrimidine (3k)[3]: White solid (28.0 mg, 51% yield); R_f = 0.5 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.84 (s, 1H), 8.48 (d, J = 9.8 Hz, 2H), 7.64 – 7.58 (m, 2H), 7.54 – 7.45 (m, 6H), 3.30 – 3.21 (m, 1H), 1.30 (s, 3H), 1.29 (s, 3H).^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 164.7, 161.8, 156.3, 138.5, 137.7, 136.2, 130.3, 128.93, 128.88, 128.5, 128.3, 128.0, 27.4, 23.8.

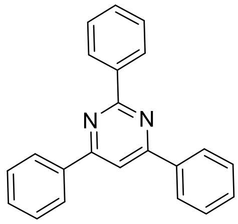


2,4-diphenyl-5-(pyridin-3-yl)pyrimidine (3l)[4]: White solid (34.0 mg, 55% yield); R_f = 0.3 (PE:EA = 10:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.80 (s, 1H), 8.60 (d, J = 3.5 Hz, 2H), 8.57 (dd, J = 10.8, 2.4 Hz, 2H), 7.56 – 7.49 (m, 6H), 7.39 (t, J = 7.3 Hz, 1H), 7.33 (t, J = 7.4 Hz, 2H), 7.29 – 7.26 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 164.0, 158.5, 149.6, 149.0, 137.2, 137.1, 136.7, 132.6, 131.0, 129.9, 129.7, 128.6, 128.4, 127.3, 123.4.

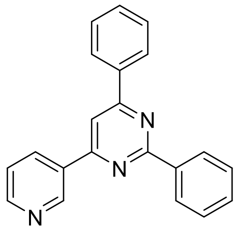


5-(benzo[d][1,3]dioxol-5-yl)-2,4-diphenylpyrimidine (3m): White solid (32.4 mg, 46% yield); R_f = 0.5 (PE:EA = 2 0:1); ^{1}H NMR (500 MHz, $CDCl_3$，ppm) δ 8.76 (s, 1H), 8.57 (d, J = 7.9 Hz, 2H), 7.61 (d, J = 6.9 Hz, 2H), 7. 54 – 7.49 (m, 3H), 7.40 – 7.32 (m, 3H), 6.81 (d, J = 7.9 Hz, 1H), 6.74 (dd, J = 8.0, 1.7 Hz, 1H), 6.68 (d, J = 1.8 Hz, 1H), 5.99 (s, 2H). ^{13}C NMR (125

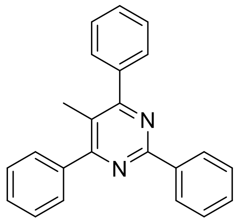
MHz, $CDCl_3$，ppm) δ 163.2, 163.1, 158.6, 148.0, 147.5, 137.9, 137.5, 130.6, 130.5, 130.3, 129.9, 129.4, 128.5, 128.24, 128.15, 123.1, 109.7, 108.7, 101.3. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{23}H_{17}N_2O_2^+$: 353.1285, found: 353.1292.



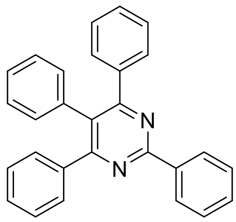
2,4,6-triphenylpyrimidine (3n)[5]: White solid (38.8 mg, 63% yield); R_f = 0.1 (Pure PE); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.74 (dd, J = 7.9, 1.8 Hz, 2H), 8.30 (dd, J = 7.8, 1.8 Hz, 4H), 8.03 (s, 1H), 7.60 – 7.50 (m, 9H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 164.8, 164.5, 138.1, 137.5, 130.8, 130.6, 128.9, 128.5, 127.3, 110.3.



2,4-diphenyl-6-(pyridin-3-yl)pyrimidine (3o)[2]: White solid (34.6 mg, 56% yield); R_f = 0.4 (PE:EA = 5:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 9.47 (d, J = 2.2 Hz, 1H), 8.78 (dd, J = 4.8, 1.7 Hz, 1H), 8.72 (d, J = 9.7 Hz, 2H), 8.61 (d, J = 8.0 Hz, 1H), 8.30 (d, J = 9.7 Hz, 2H), 8.04 (s, 1H), 7.60 – 7.53 (m, 6H), 7.51 (dd, J = 7.9, 4.8 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 165.2, 164.8, 162.5, 151.5, 148.6, 137.8, 137.2, 134.7, 133.2, 131.1, 130.9, 129.0, 128.53, 128.49, 127.3, 123.7, 110.3.

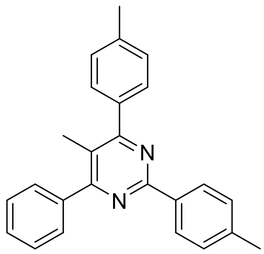


5-methyl-2,4,6-triphenylpyrimidine (3p)[6]: White solid (52.2 mg, 81% yield); R_f = 0.5 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.61 (d, J = 8.0 Hz, 2H), 7.77 (d, J = 6.6 Hz, 4H), 7.57 – 7.47 (m, 9H), 2.41 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 166.9, 161.4, 139.2, 137.8, 130.2, 129.3, 129.1, 128.3, 128.2, 128.1, 123.1, 17.7.

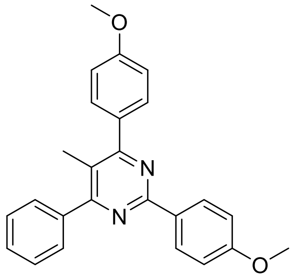


2,4,5,6-tetraphenylpyrimidine (3q): White solid (48.8 mg, 63% yield); R_f = 0.5 (PE:EA = 100:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.68 – 8.63 (m, 2H), 7.50 (dd, J = 5.2, 2.1 Hz, 3H), 7.43 – 7.39 (m, 4H), 7.29 (t, J = 7.3 Hz, 2H), 7.26 – 7.22 (m, 4H), 7.20 – 7.14 (m, 3H), 7.02 – 6.97 (m, 2H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 165.3, 162.8, 138.8, 137.7, 136.6, 131.1, 130.6, 129.9, 129.0, 128.6, 128.4, 128.3, 127.7, 127.3. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{28}H_{21}N_2^+$: 385.1699, found: 385.1708

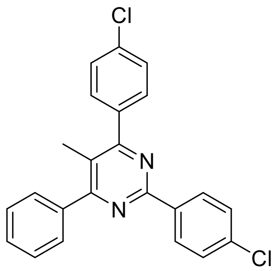
5-methyl-4-phenyl-2,6-di-p-tolylpyrimidine (3r): White solid (47.1 mg, 67% yield);



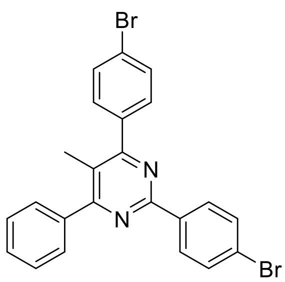
R_f = 0.5 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.46 (d, J = 8.2 Hz, 2H), 7.73 (d, J = 6.6 Hz, 2H), 7.65 (d, J = 8.0 Hz, 2H), 7.54 – 7.45 (m, 3H), 7.32 (d, J = 7.8 Hz, 2H), 7.26 (d, J = 8.0 Hz, 2H), 2.44 (s, 3H), 2.40 (s, 3H), 2.37 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 166.74, 166.69, 161.4, 140.2, 139.3, 139.1, 136.4, 135.2, 129.4, 129.3, 129.1, 129.0, 128.9, 128.2, 128.1, 122.7, 21.5, 21.4, 17.8. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{25}H_{23}N_2^+$: 351.1856, found: 351.1864



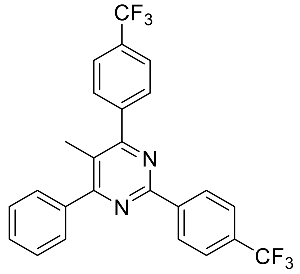
2,4-bis(4-methoxyphenyl)-5-methyl-6-phenylpyrimidine (3s): White solid (59.0 mg, 77 % yield); R_f = 0.3 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.54 (d, J = 8.9 Hz, 2H), 7.79 – 7.71 (m, 4H), 7.55 – 7.46 (m, 3H), 7.05 (d, J = 8.7 Hz, 2H), 6.98 (d, J = 8.9 Hz, 2H), 3.90 (s, 3H), 3.87 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 166.7, 166.2, 161.4, 161.1, 160.3, 139.4, 131.7, 131.0, 130.7, 129.7, 129.3, 129.0, 128.2, 122.0, 113.6, 55.4, 55.3, 17.9. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{25}H_{23}N_2O_2^+$:383.1754, found: 383.1761



2,4-bis(4-chlorophenyl)-5-methyl-6-phenylpyrimidine(3t): White solid (42.7 mg, 56% yield); R_f = 0.2 (Pure PE); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.51 (d, J = 8.6 Hz, 2H), 7.75 – 7.67 (m, 4H), 7.56 – 7.49 (m, 5H), 7.43 (d, J = 8.6 Hz, 2H), 2.38 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.2, 165.7, 160.5, 138.8, 137.3, 136.5, 136.1, 135.4, 130.7, 129.5, 129.29, 129.26, 128.6, 128.3, 123.3, 17.7. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{23}H_{17}Cl_2N_2^+$: 391.0763, found: 391.0769

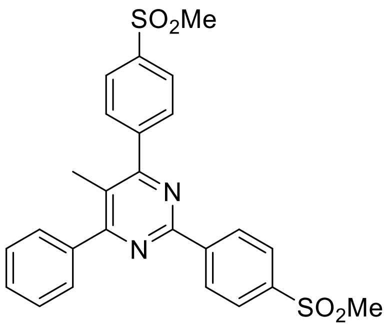


2,4-bis(4-bromophenyl)-5-methyl-6-phenylpyrimidine (3u): White solid (76.2 mg, 79% yield); R_f = 0.2 (Pure PE); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.41 (d, J = 8.6 Hz, 2H), 7.70 (d, J = 6.1 Hz, 2H), 7.65 (d, J = 8.5 Hz, 2H), 7.59 (dd, J = 15.0, 8.5 Hz, 4H), 7.51 (q, J = 8.7, 7.5 Hz, 3H), 2.36 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.2, 165.8, 160.6, 138.7, 137.8, 136.6, 131.5, 131.0, 129.7, 129.30, 129.26, 128.3, 125.0, 123.7, 123.4, 17.7. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{23}H_{17}Br_2N_2^+$: 478.9753, found: 478.9758

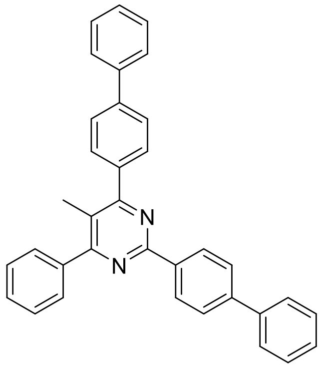


5-methyl-4-phenyl-2,6-bis(4-(trifluoromethyl)phenyl)pyrimidine(3v): White solid (66.7 mg, 72% yield); R_f = 0.2 (Pure PE); ^1H NMR (500 MHz, $CDCl_3$, ppm) δ 8.67 (d, J = 8.1 Hz, 2H), 7.89 – 7.79 (m, 4H), 7.77 – 7.70 (m, 4H), 7.60 – 7.50 (m, 3H), 2.41 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.6, 165.8, 160.3, 142.4, 140.8, 138.5, 132.0 (d, J = 32.3 Hz), 131.2 (d, J = 32.4 Hz), 129.7, 129.5, 129.3, 128.4, 128.4, 125.4 (d, J = 3.6 Hz), 125.3 (d, J = 3.4 Hz), 124.2 (d, J = 270.4 Hz), 124.2, 124.0 (d, J = 270.9 Hz), 17.6. ^{19}F NMR (471 MHz, $CDCl_3$, ppm) δ -62.63, -62.68. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{25}H_{17}F_6N_2^+$: 459.1290, found: 459.1299

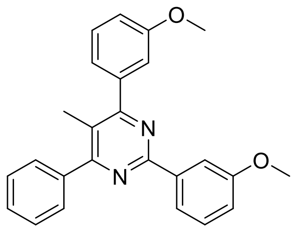
5-methyl-2,4-bis(4-(methylsulfonyl)phenyl)-6-phenylpyrimidine(3w): White solid



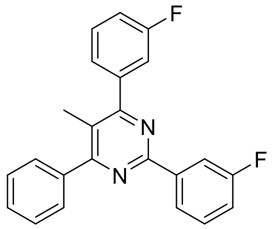
(41.7 mg, 44% yield); R_f = 0.2 (PE:EA = 2:1); ^1H NMR (500 MHz, $CDCl_3$, ppm) δ 8.74 (d, J = 8.5 Hz, 2H), 8.14 (d, J = 8.4 Hz, 2H), 8.04 (d, J = 8.6 Hz, 2H), 7.94 (d, J = 8.4 Hz, 2H), 7.74 (dd, J = 7.8, 1.8 Hz, 2H), 7.56 (d, J = 7.6 Hz, 3H), 3.15 (s, 3H), 3.10 (s, 3H), 2.42 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.9, 165.3, 159.9, 144.0, 142.5, 141.8, 141.2, 138.2, 130.3, 129.7, 129.2, 129.0, 128.5, 127.6, 127.5, 124.8, 44.50, 44.49, 17.7. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{25}H_{23}N_2O_4S_2^+$: 479.1094, found: 479.1100



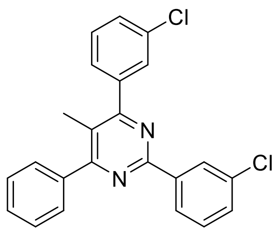
2,4-di([1,1'-biphenyl]-4-yl)-5-methyl-6-phenylpyrimidine (3x): White solid (57.5 mg, 61% yield); R_f = 0.3 (PE:EA = 50:1); ^1H NMR (500 MHz, $CDCl_3$, ppm) δ 8.68 (d, J = 8.5 Hz, 2H), 7.88 (d, J = 8.3 Hz, 2H), 7.78 (t, 4H), 7.73 (d, J = 8.5 Hz, 2H), 7.72 – 7.67 (m, 4H), 7.58 – 7.46 (m, 7H), 7.44 – 7.36 (m, 2H), 2.47 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.0, 166.5, 161.3, 142.8, 142.0, 140.7, 140.5, 139.2, 138.1, 136.9, 129.9, 129.4, 129.1, 128.9, 128.8, 128.6, 128.3, 127.7, 127.5, 127.2, 127.14, 127.07, 127.0, 123.2, 17.9. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{35}H_{27}N_2^+$: 475.2169, found: 475.2172



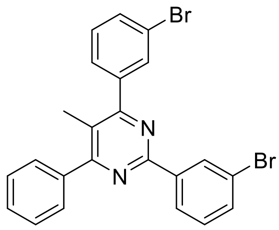
2,4-bis(3-methoxyphenyl)-5-methyl-6-phenylpyrimidine (3y): White solid (45.7 mg, 60% yield); R_f = 0.4 (PE:EA = 30:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.19 (d, J = 7.8 Hz, 1H), 8.14 (dd, J = 2.7, 1.5 Hz, 1H), 7.75 (dd, J = 8.1, 1.6 Hz, 2H), 7.56 – 7.48 (m, 3H), 7.44 (t, J = 7.9 Hz, 1H), 7.39 (t, J = 7.9 Hz, 1H), 7.33 – 7.28 (m, 2H), 7.07 – 7.01 (m, 2H), 3.90 (d, J = 2.4 Hz, 6H), 2.40 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 166.8, 166.7, 161.2, 159.8, 159.5, 140.5, 139.4, 139.1, 129.4, 129.34, 129.28, 129.1, 128.2, 123.3, 121.7, 120.8, 116.3, 114.9, 114.7, 113.1, 55.4, 14.3. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{25}H_{23}N_2O_2^+$: 383.1754, found: 383.1761.



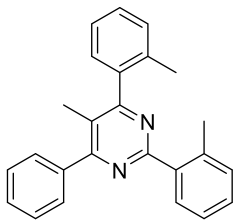
2,4-bis(3-fluorophenyl)-5-methyl-6-phenylpyrimidine(3z): White solid (41.7 mg, 58 % yield); R_f = 0.2 (Pure PE); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.35 (d, J = 7.8 Hz, 1H), 8.28 – 8.23 (m, 1H), 7.74 (dd, J = 8.0, 1.6 Hz, 2 H), 7.57 – 7.49 (m, 5H), 7.49 – 7.40 (m, 2H), 7.23 – 7.18 (m, 1H), 7.16 (td, J = 9.2, 8.8, 2.7 Hz, 1H), 2.41 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.3, 165.6 (d, J = 2.4 Hz), 163.2 (d, J = 243.4 Hz), 162.6 (d, J = 245.0 Hz), 160.4 (d, J = 3.2 Hz), 141.0 (d, J = 7.7 Hz), 140.1 (d, J = 7.7 Hz), 138.7, 129.92 (d, J = 7.9 Hz), 129.86 (d, J = 7.6 Hz), 129.4, 129.3, 128.4, 125.1 (d, J = 3.1 Hz), 123.8 (d, J = 2.8 Hz), 123.7, 117.2 (d, J = 21.3 Hz), 116.5 (d, J = 22.4 Hz), 116.2 (d, J = 21.1 Hz), 115.0 (d, J = 23.4 Hz), 17.7. ^{19}F NMR (471 MHz, $CDCl_3$, ppm) δ -112.57, -113.46. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{23}H_{17}F_2N_2^+$: 359.1354, found:359.1361



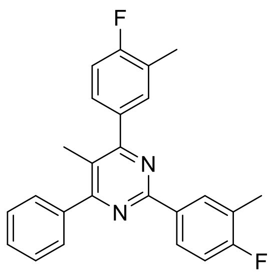
2,4-bis(3-chlorophenyl)-5-methyl-6-phenylpyrimidine(3aa): White solid (46.5 mg, 59% yield);R_f = 0.2 (Pure PE); ^{1}H NMR (500 MHz, $CDCl_3$, ppm)) δ 8.55 (s, 1H), 8.45 (dt, J = 7.4, 1.6 Hz, 1H), 7.75 – 7.72 (m, 3H), 7.63 – 7.59 (m, 1H), 7.57 – 7.52 (m, 3H), 7.50 – 7.47 (m, 2H), 7.45 – 7.39 (m, 2H), 2.40 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.3, 165.6, 160.3, 140.6, 139.5, 138.7, 134.6, 134.4, 130.4, 129.7, 129.6, 129.40, 129.38, 129.32, 129.29, 128.4, 128.2, 127.5, 126.3, 123.8, 17.7. HRMS (ESI-TOF): m/z $[M + H]^+$ cal cd for $C_{23}H_{17}Cl_2N_2^+$: 391.0763, found: 391.0769.



2,4-bis(3-bromophenyl)-5-methyl-6-phenylpyrimidine (3ab): White solid (47.4 mg, 49% yield); R_f = 0.2 (Pure PE); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 8.70 (s, 1H), 8.50 (d, J = 7.9 Hz, 1H), 7.88 (s, 1H), 7.73 (dd, J = 7.9, 1.7 Hz, 2H), 7.65 (t, 2H), 7.59 (d, J = 8.9 Hz, 1H), 7.57 – 7.51 (m, 3H), 7.41 (t, J = 7.8 Hz, 1H), 7.35 (t, J = 7.8 Hz, 1H), 2.39 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.3, 165.5, 160.2, 140.8, 139.7, 138.6, 133.3, 132.2, 131.0, 129.95, 129.88, 129.4, 129.3, 128.4, 127.9, 126.8, 123.8, 122.7, 122.5, 17.7. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{23}H_{17}Br_2N_2^+$: 478.9753, found: 478.9758.

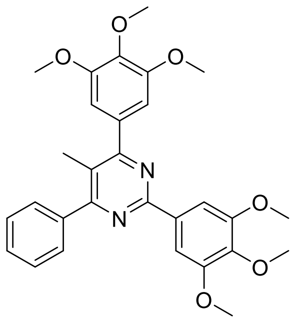


5-**methyl-4-phenyl-2,6-di-o-tolylpyrimidine (3ac):** White solid (40.5 mg, 58% yield); R_f = 0.4 (PE:EA = 50:1); ^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 7.87 (d, J = 7.2 Hz, 1H), 7.71 (d, J = 6.6 Hz, 2H), 7.52 – 7.44 (m, 3H), 7.36 – 7.27 (m, 6H), 7.25 (d, 1H), 2.61 (s, 3H), 2.25 (s, 3H), 2.18 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 168.3, 165.9, 164.5, 138.82, 138.79, 138.4, 137.1, 135.1, 131.1, 130.5, 130.4, 129.2, 129.1, 129.0, 128.5, 128.3, 128.2, 125.9, 125.8, 123.5, 21.3, 19.6, 16.3. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{25}H_{23}N_2^+$: 351.1856, found: 351.1864.

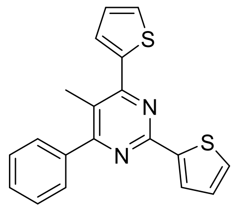


2,4-bis(4-fluoro-3-methylphenyl)-5-methyl-6-phenylpyrimi dine (3ad): White solid (55.1 mg, 71% yield); R_f = 0.5 (PE:EA = 50:1); ^{1}H NMR (500 MHz, 125 MHz, $CDCl_3$, ppm) δ 8.44 – 8.34 (m, 2H), 7.73 (d, J = 6.5 Hz, 2H), 7.58 (dd, J = 7.6, 2.3 Hz, 1H), 7.56 – 7.47 (m, 4H), 7.1 5 (t, J = 8.9 Hz, 1H), 7.08 (t, J = 8.9 Hz, 1H), 2.40 (d, J = 1.9 Hz, 3H), 2. 38 – 2.33 (m, 6H). ^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.0, 166.2, 163.0 (d, J = 246.8 Hz), 161.8 (d, J = 246.3 Hz), 160.8, 139.1, 134.9 (d, J = 3.8 Hz), 133.6 (d, J = 3.1 Hz), 132.6 (d, J = 5.75 Hz), 131.4 (d, J = 5.9 Hz), 1

29.3, 129.2, 128.5 (d, J = 8.4 Hz), 128.3, 127.6 (d, J = 8.6 Hz), 125.0 (d, J = 17.5 Hz), 124.7 (d, J = 17.5 Hz), 122.8, 115.0 (d, J = 5.4 Hz), 114.8 (d, J = 5.5 Hz), 17.7, 14.7 (d, J = 3.3 Hz),14.6 (d, J = 3.4 Hz). ^{19}F NMR (471 MHz, $CDCl_3$, ppm) δ -115.39, -116.26. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{23}H_{17}Cl_2N_2^+$: 387.1667, found: 387.1675



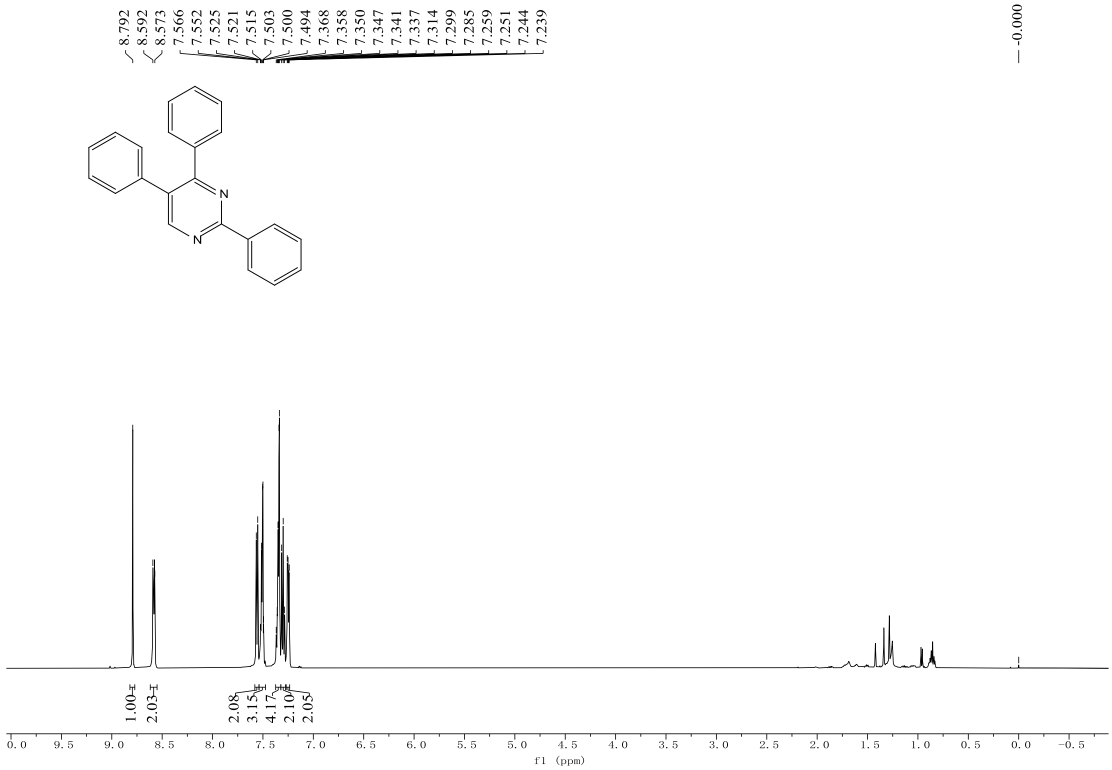
5-**methyl-4-phenyl-2,6-bis(3,4,5-trimethoxyphenyl)pyrimidine (3ae):** White solid (43.2 mg, 43% yield); R_f = 0.4 (PE:EA = 3:1);^{1}H NMR (500 MHz, $CDCl_3$, ppm) δ 7.86 (s, 2H), 7.74 (dd, J = 8.1, 1.7 Hz, 2H), 7.56 – 7.49 (m, 3H), 6.96 (s, 2H), 3.96 (s, 6H), 3.95 (s, 3H), 3.94 (s, 6H), 3.91 (s, 3H), 2.40 (s, 3H).^{13}C NMR (125 MHz, $CDCl_3$, ppm) δ 167.0, 166.6, 160.9, 153.2, 153.0, 140.2, 139.1, 138.8, 134.6, 133.3, 129.3, 129.1, 128.3, 122.8, 106.7, 105.4, 61.0, 60.9, 56.3, 56.2, 17.9. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{29}H_{31}N_2O_6^+$: 503.2177, found: 503.2184



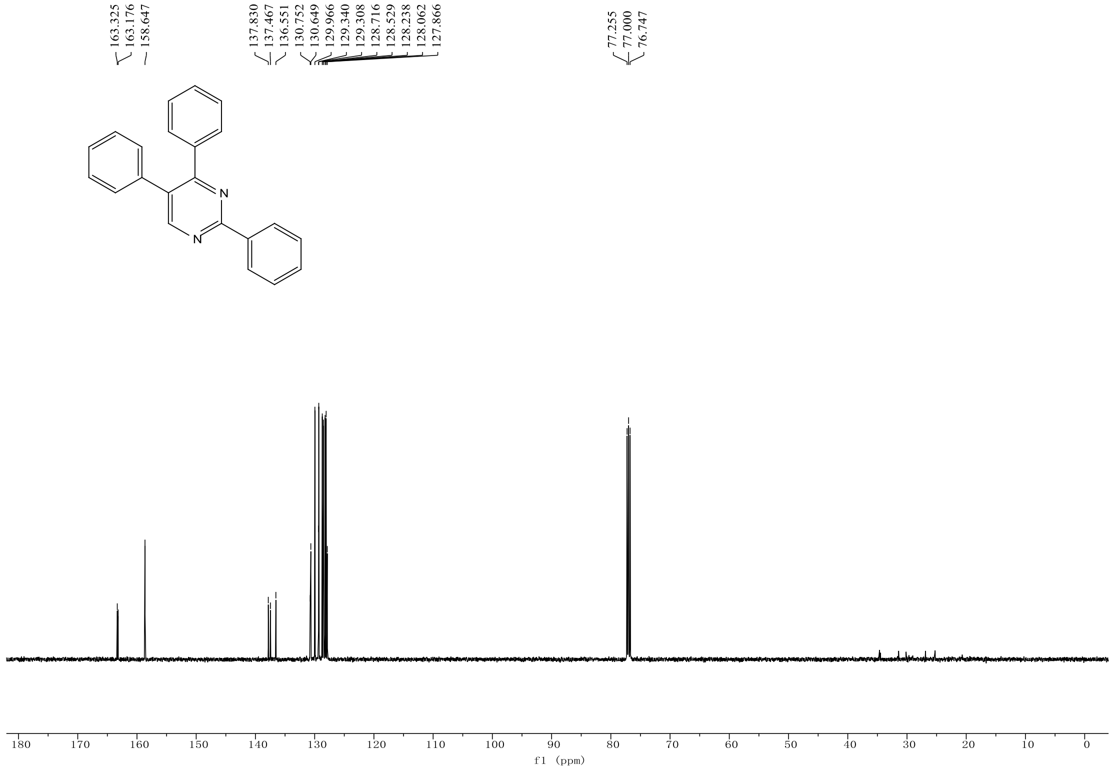
5-methyl-4-phenyl-2,6-di(thiophen-2-yl)pyrimidine(3af): White solid (32.7 mg, 49 % yield); R_f = 0.3 (Pure PE); ^{1}H NMR (500 MHz, Chloroform-d) δ 8.08 (dd, J = 3.7, 1.3 Hz, 1H), 7.75 (dd, J = 3.8, 1.0 Hz, 1H), 7.68 (dd, J = 7.9, 1.7 Hz, 2H), 7.57 (dd, J = 5.1, 1.0 Hz, 1H), 7.55 – 7.48 (m, 3H), 7.45 (dd, J = 5.0, 1.3 Hz, 1H), 7.21 (dd, J = 5.1, 3.8 Hz, 1H), 7.15 (dd, J = 5.0, 3.6 Hz, 1H), 2.57 (s, 3H).^{13}C NMR (125 MHz, $CDCl_3$) δ 167.6, 158.7, 158.1, 143.6, 143.5, 138.8, 130.1, 129.9, 129.4, 129.2, 128.5, 128.2, 128.0, 120.6, 18.0. HRMS (ESI-TOF): m/z $[M + H]^+$ calcd for $C_{19}H_{15}N_2S_2^+$: 335.0671, found: 335.0679.

5. ^{1}H NMR and ^{13}C NMR spectra of all products

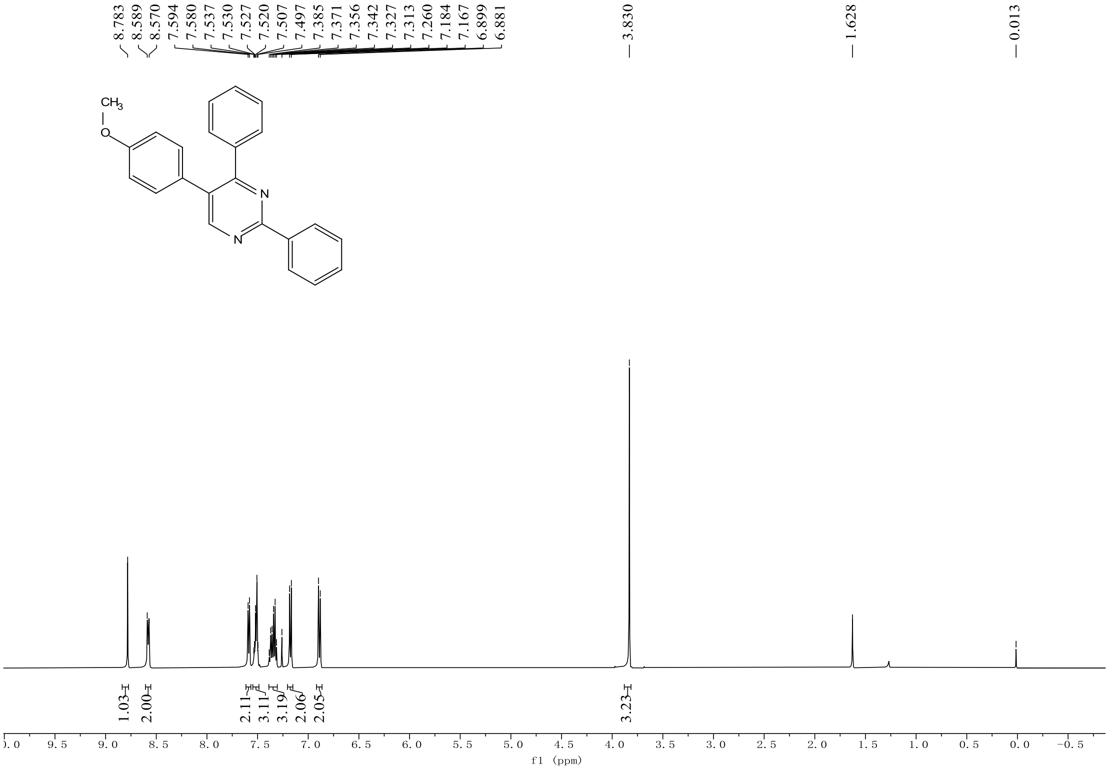
^{1}H NMR of **3a** (500 MHz, $CDCl_3$)



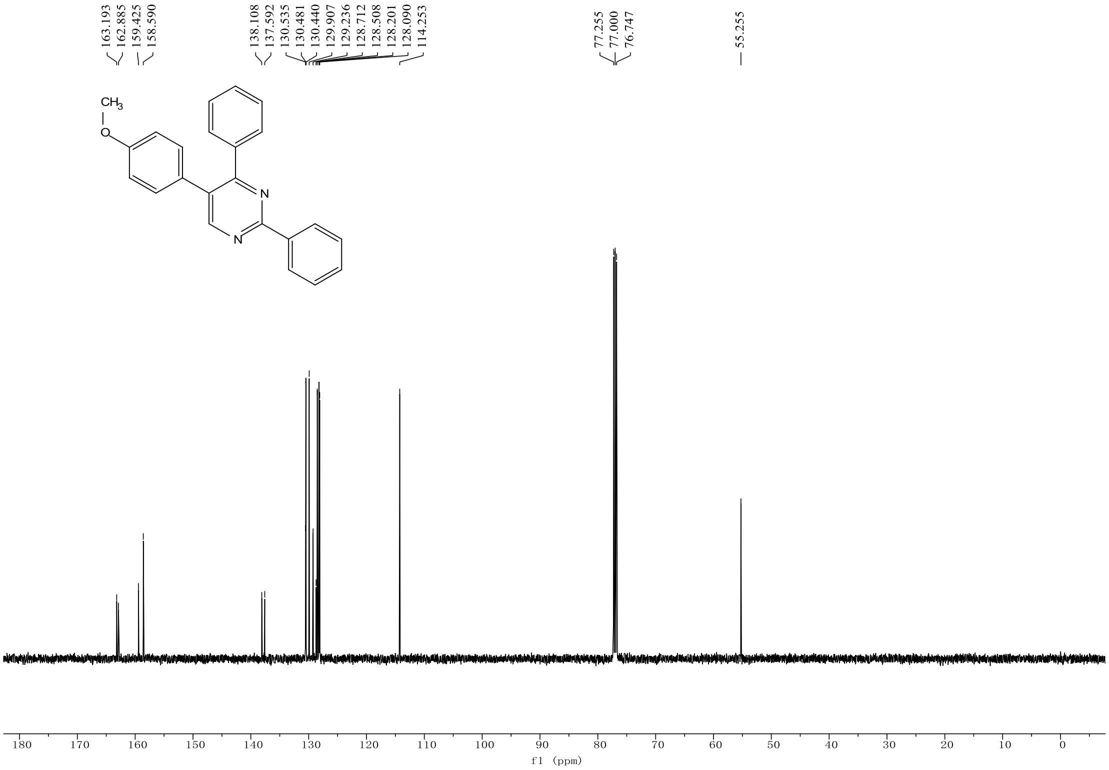
^{13}C NMR of **3a** (125 MHz, $CDCl_3$)



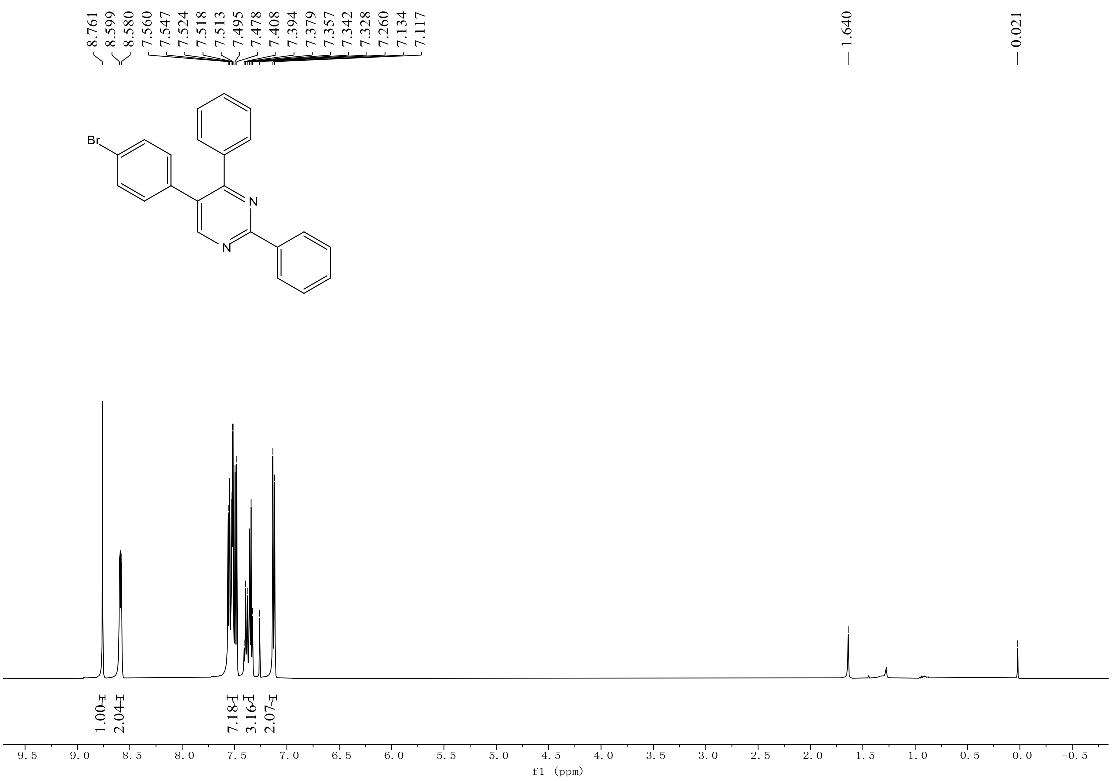
^{1}H NMR of **3b** (500 MHz, $CDCl_3$)



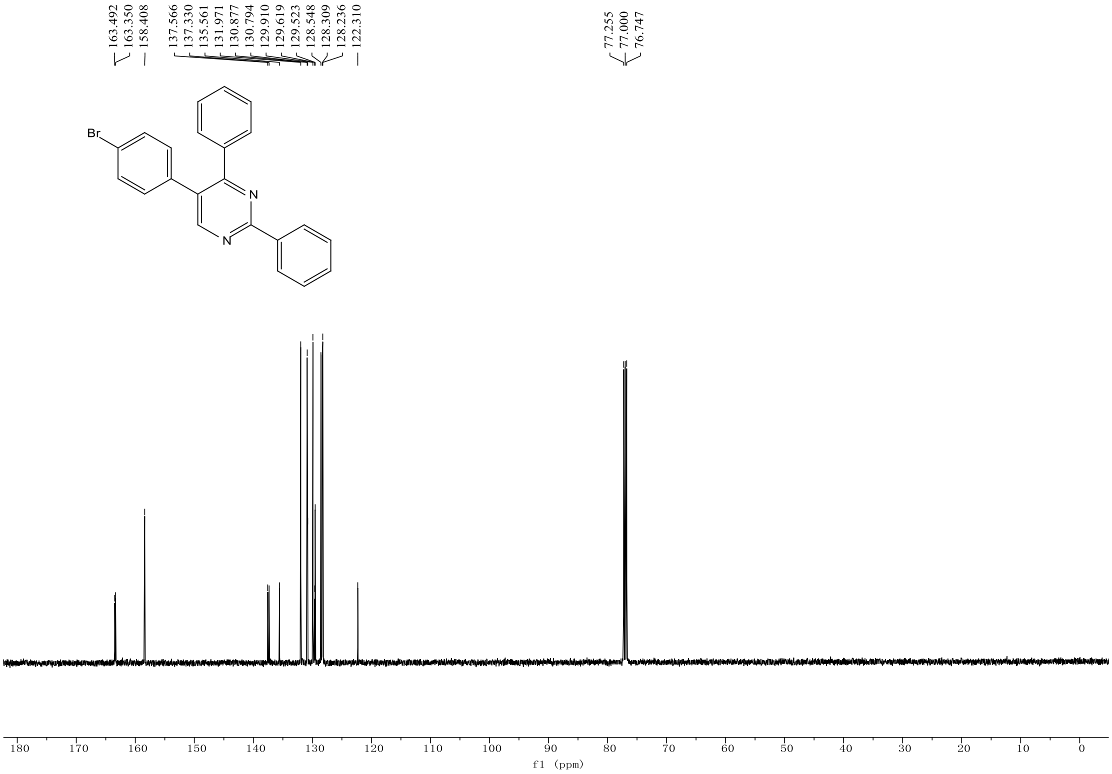
^{13}C NMR of **3b** (125 MHz, $CDCl_3$)



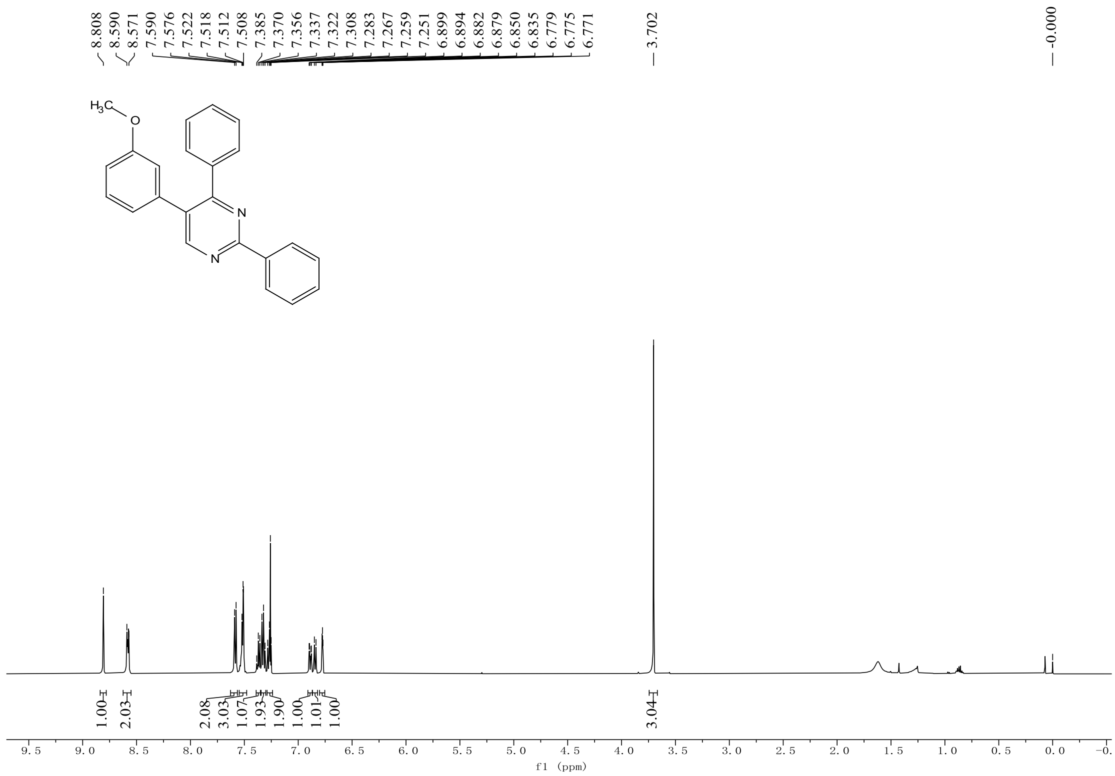
^{1}H NMR of **3c** (500 MHz, $CDCl_3$)



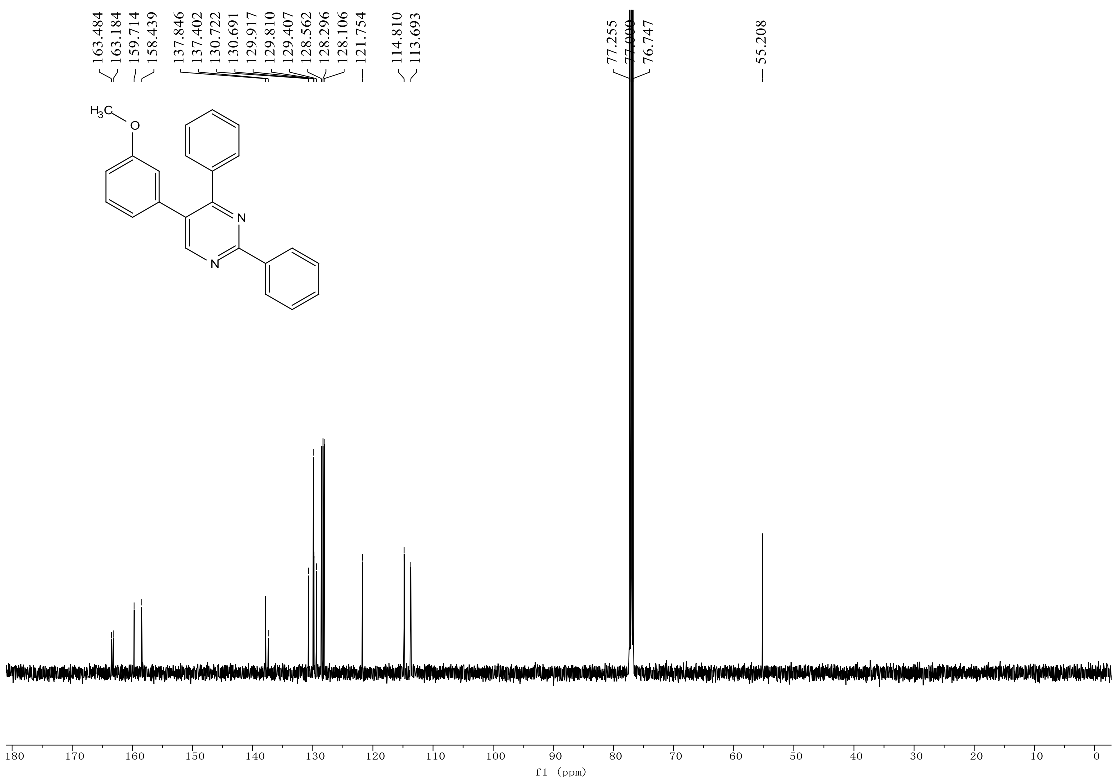
^{13}C NMR of **3c** (125 MHz, $CDCl_3$)



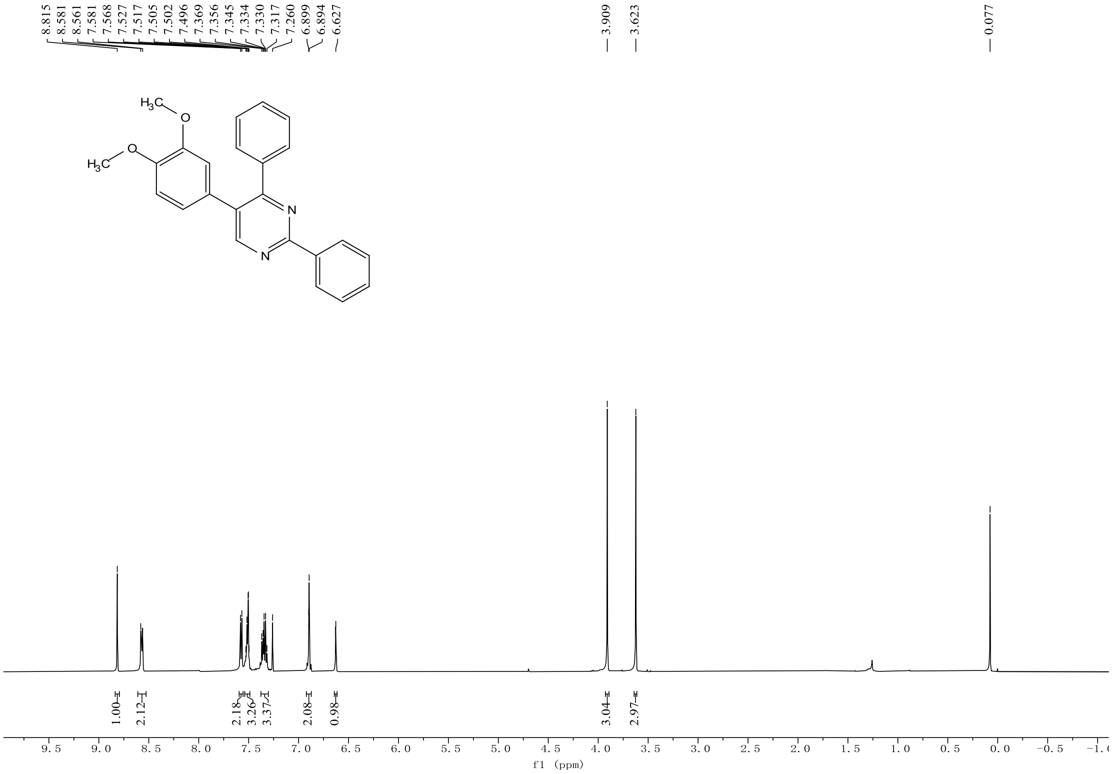
^{1}H NMR of **3d** (500 MHz, $CDCl_3$)



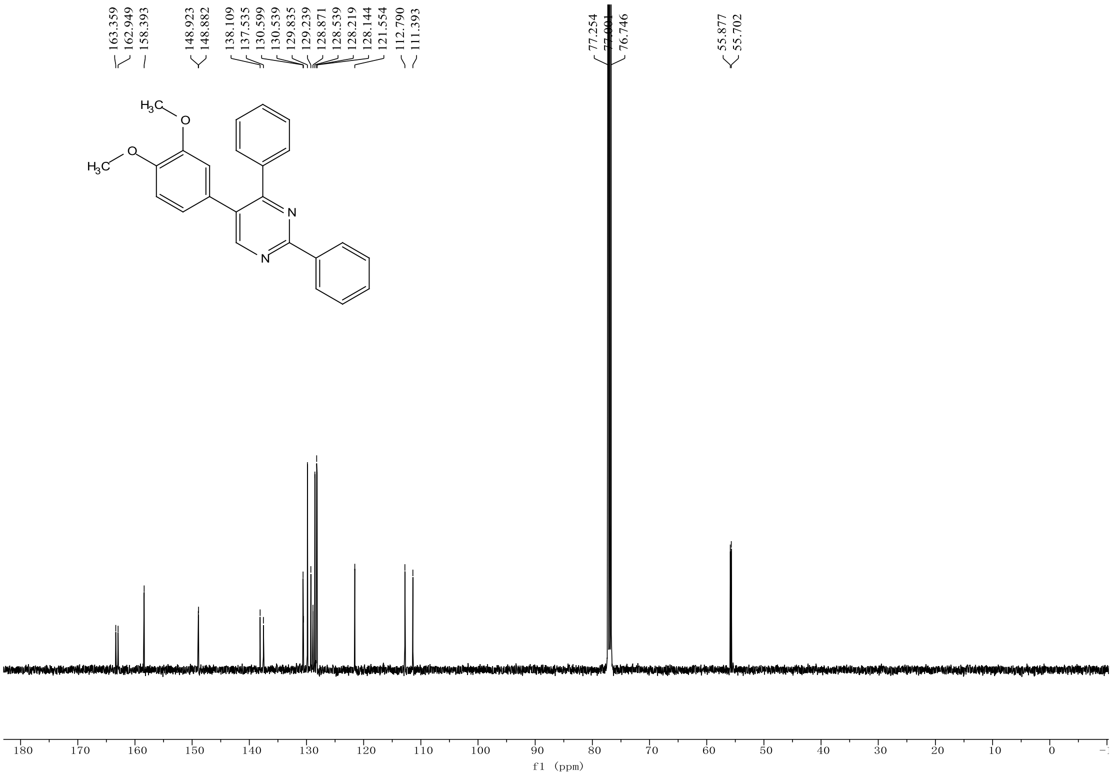
^{13}C NMR of **3d** (125 MHz, $CDCl_3$)



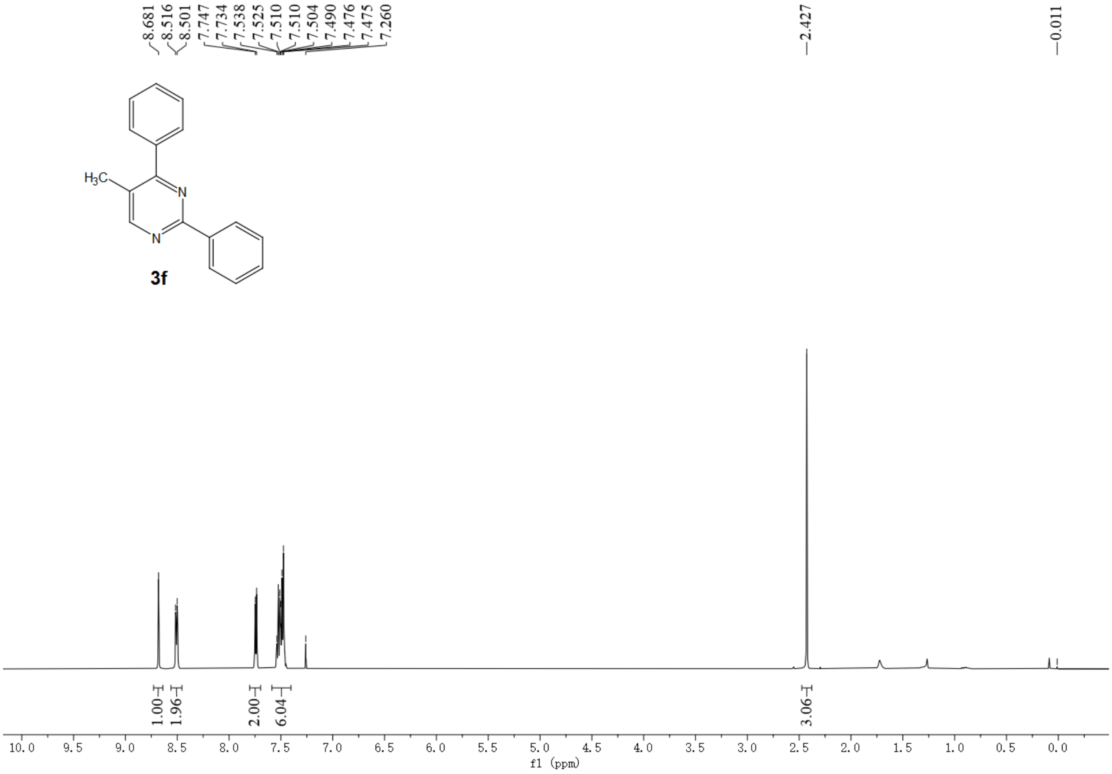
^{1}H NMR of **3e** (500 MHz, $CDCl_3$)



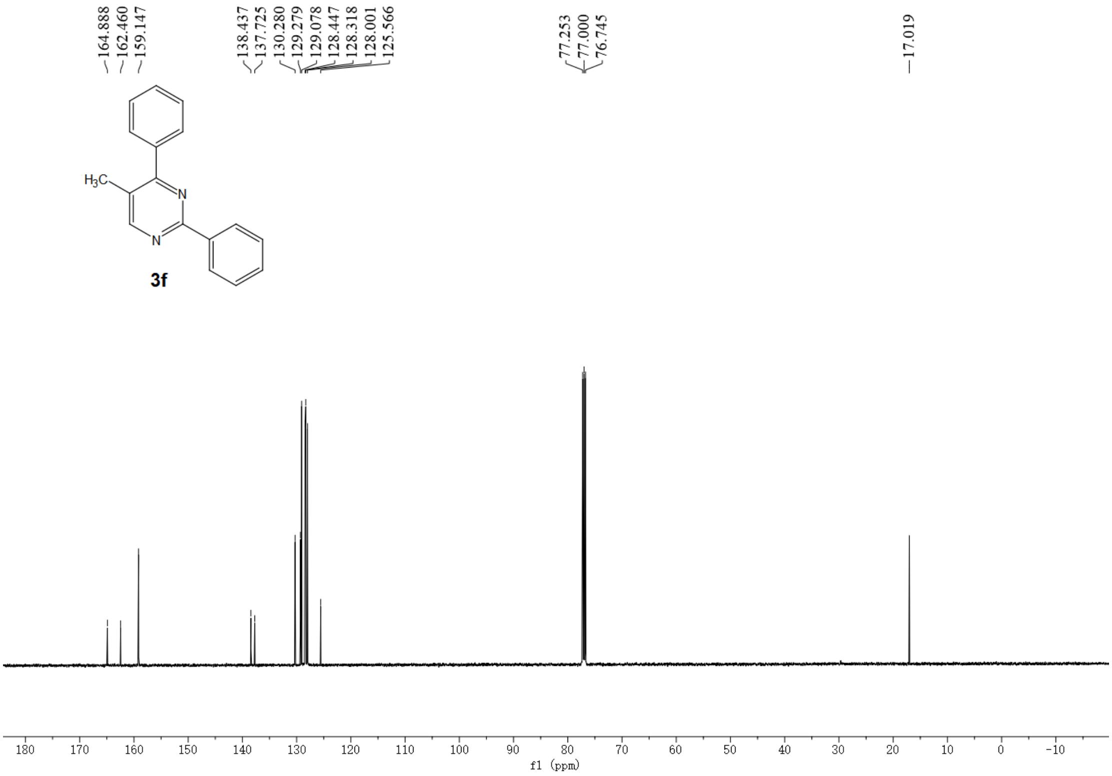
^{13}C NMR of **3e** (125 MHz, $CDCl_3$)



[1]H NMR of **3f** (500 MHz, $CDCl_3$)

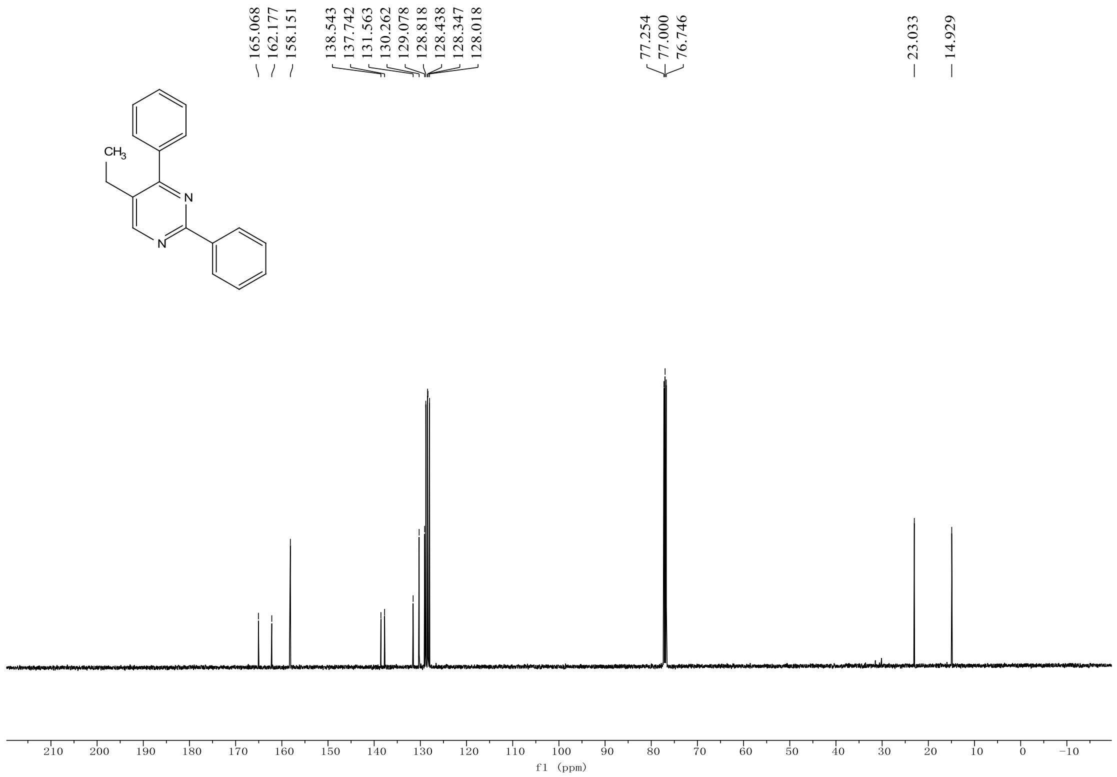


[13]C NMR of **3f** (125 MHz, $CDCl_3$)

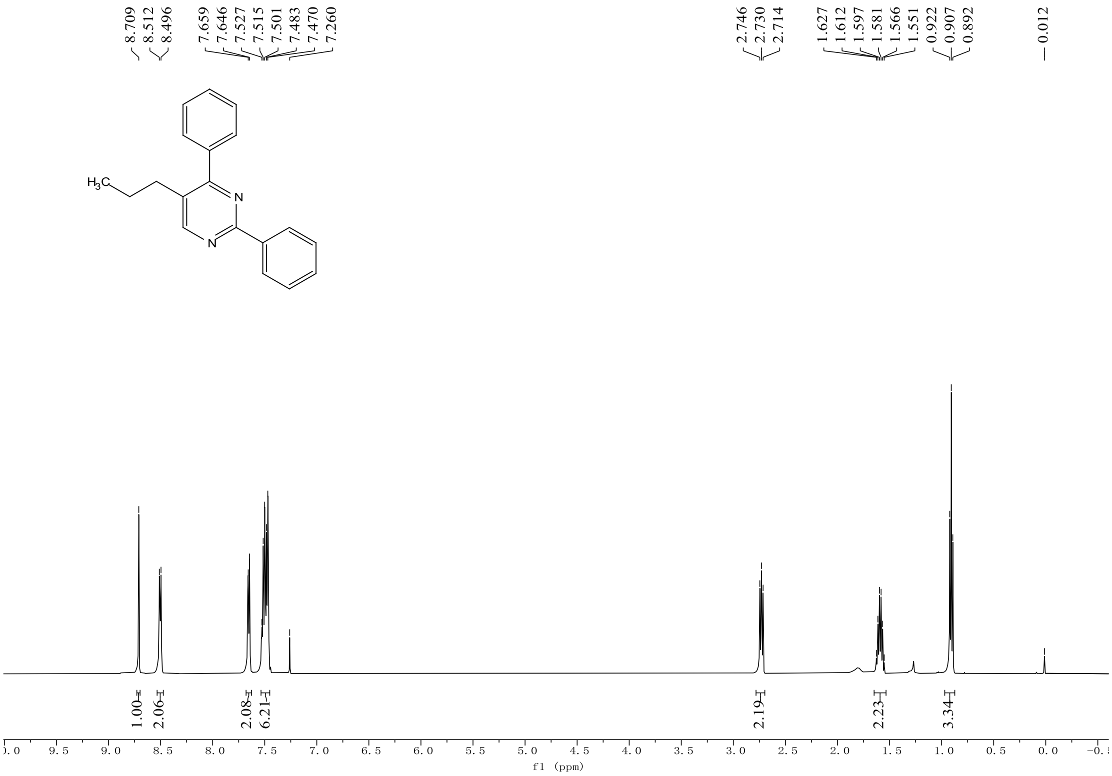


[1]H NMR of **3g** (500 MHz, $CDCl_3$)

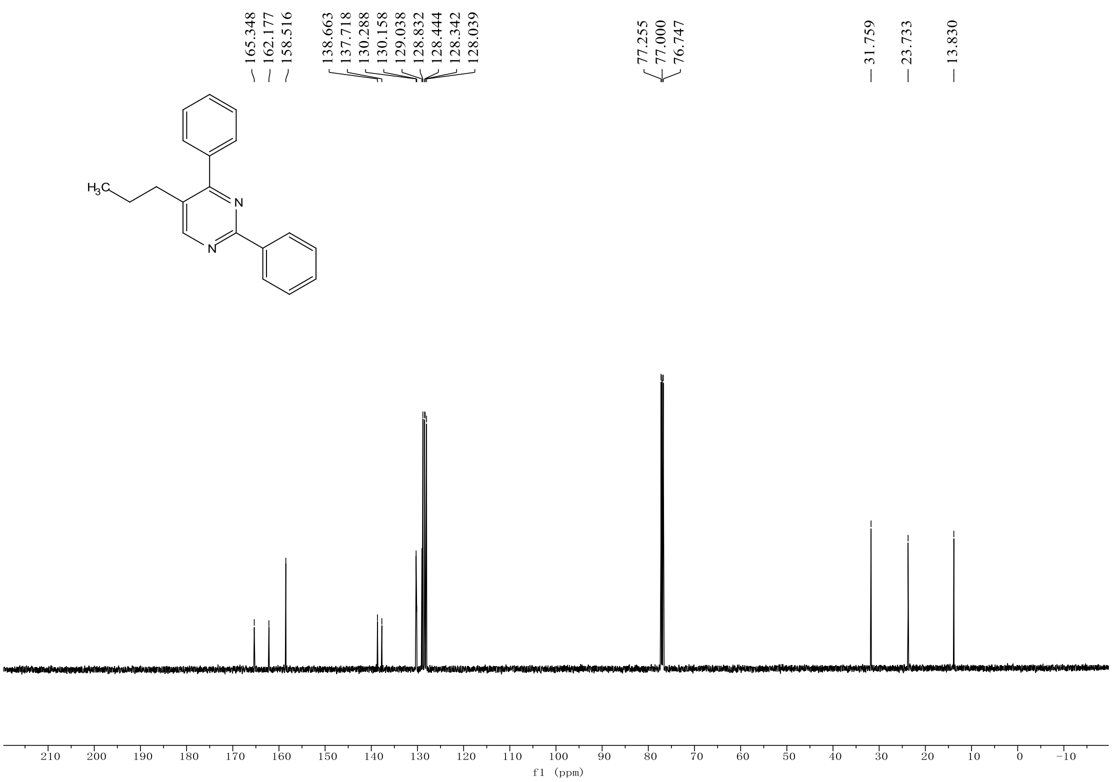
[13]C NMR of **3g** (125 MHz, $CDCl_3$)



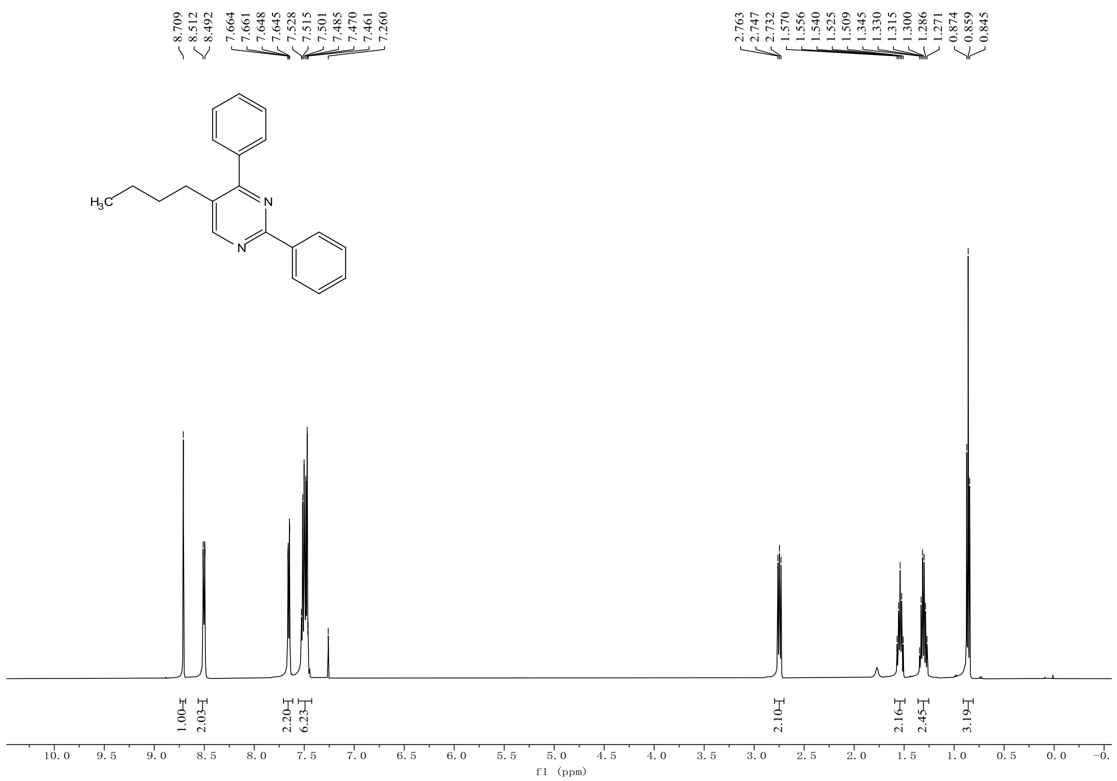
^{1}H NMR of **3h** (500 MHz, $CDCl_3$)



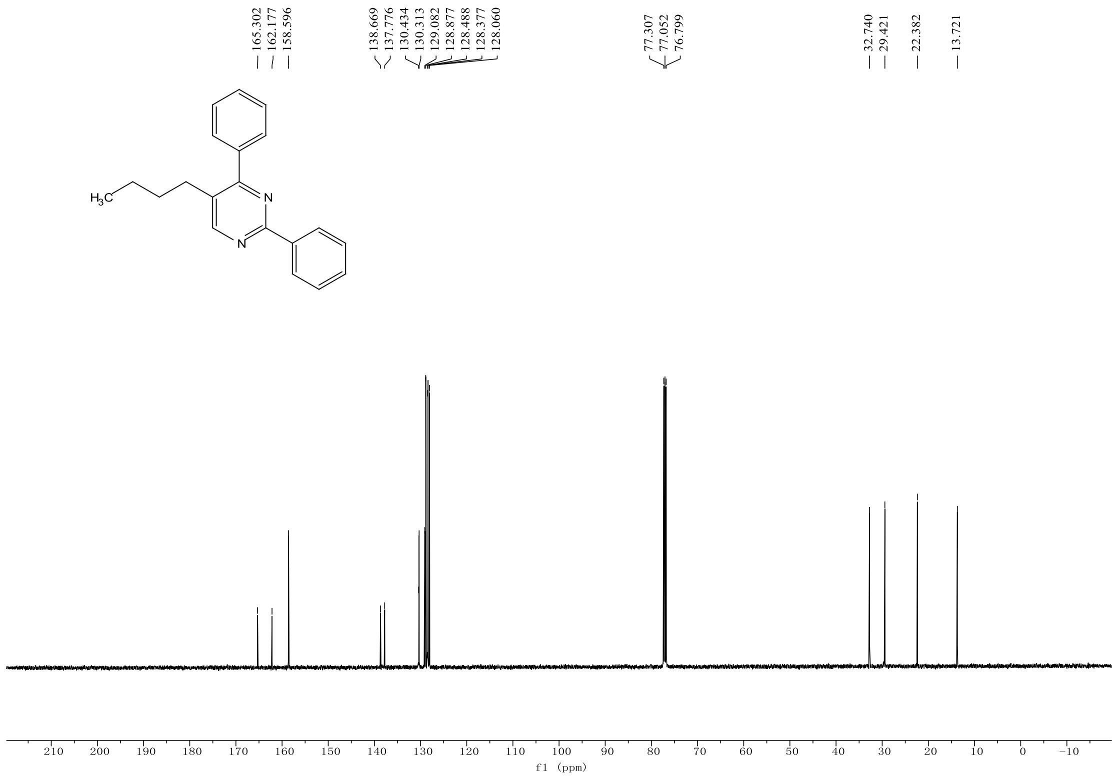
^{13}C NMR of **3h** (125 MHz, $CDCl_3$)



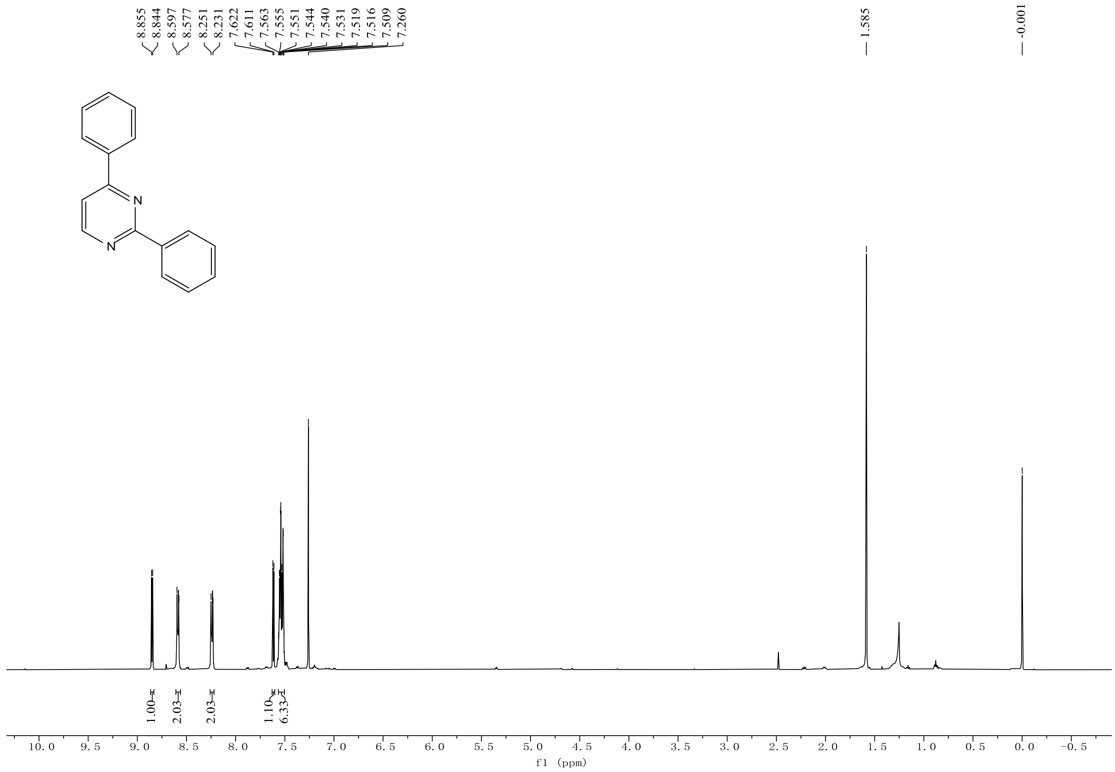
^{1}H NMR of **3i** (500 MHz, $CDCl_3$)



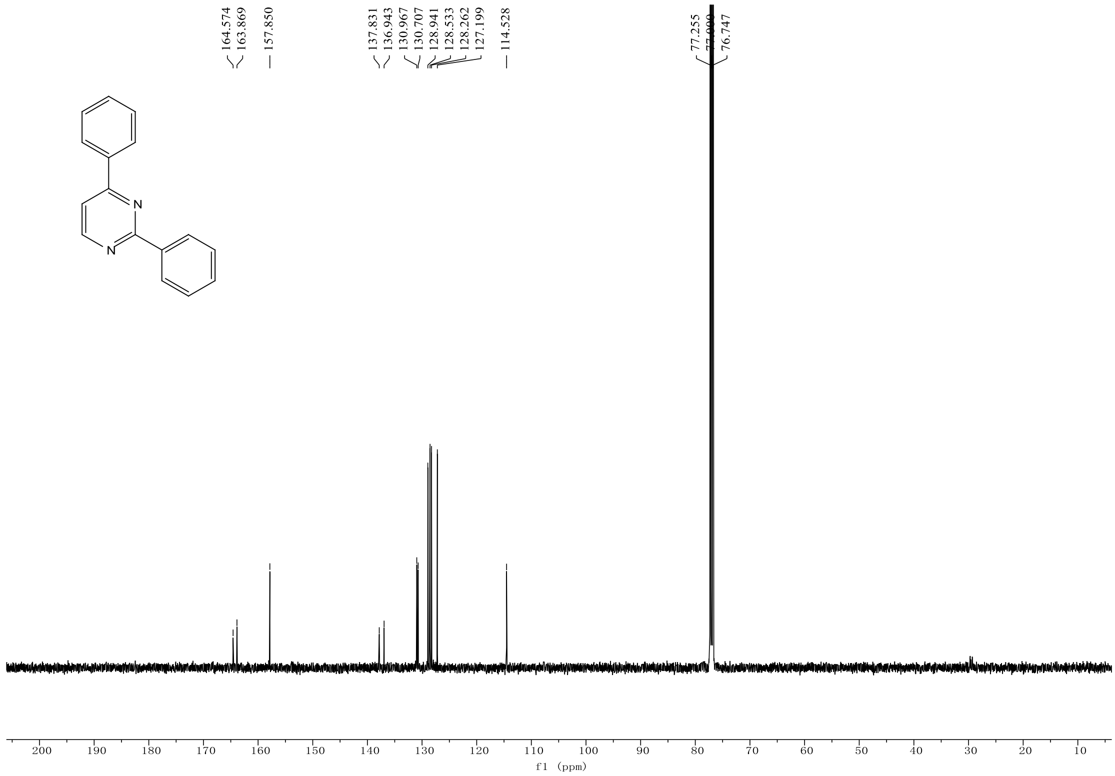
^{13}C NMR of **3i** (125 MHz, $CDCl_3$)



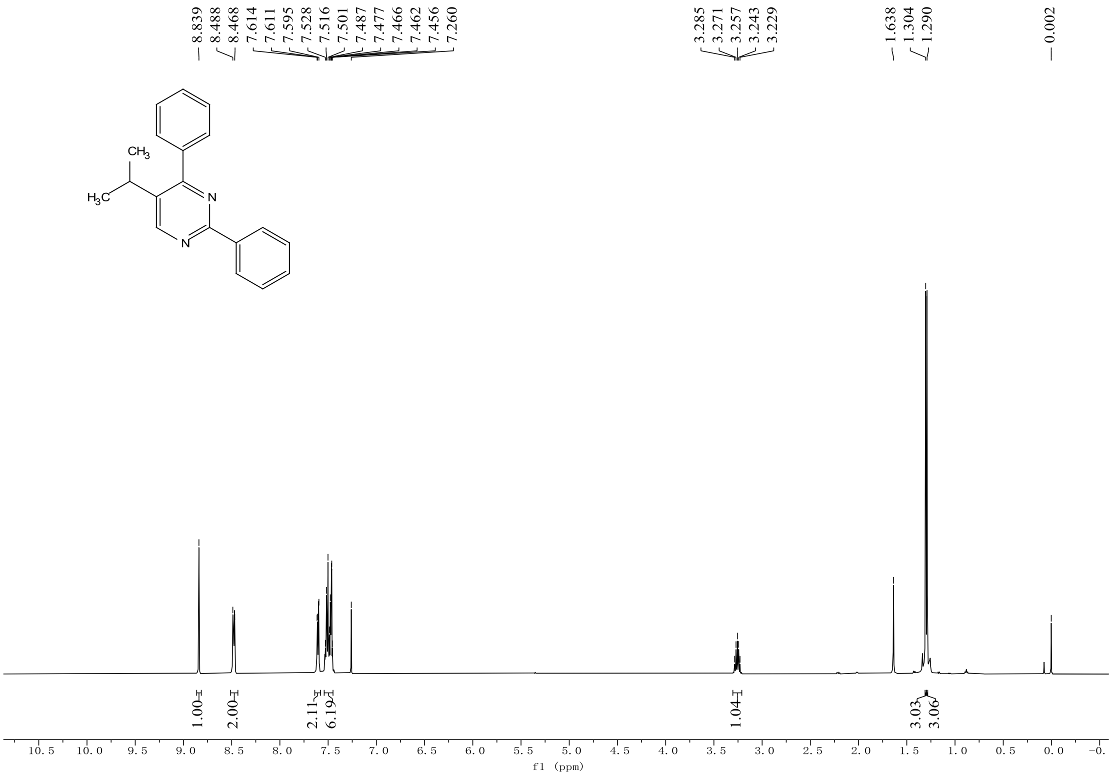
[1]H NMR of **3j** (500 MHz, $CDCl_3$)



[13]C NMR of **3j** (125 MHz, $CDCl_3$)

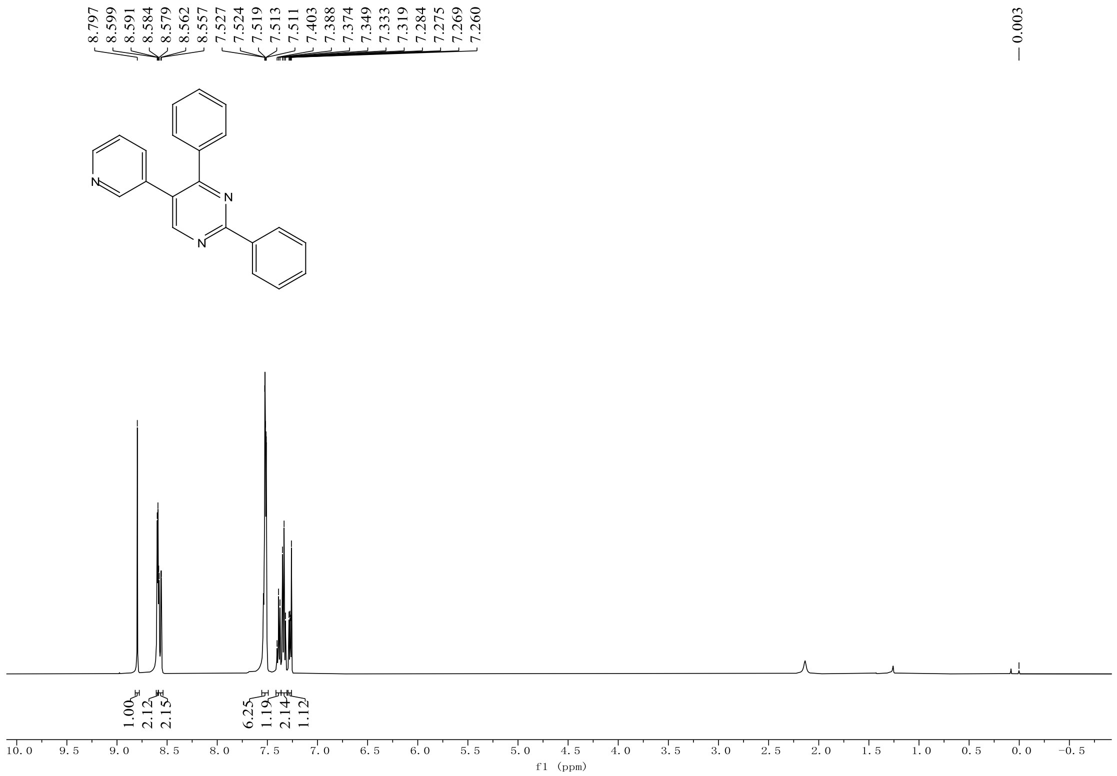


^{1}H NMR of **3k** (500 MHz, $CDCl_3$)

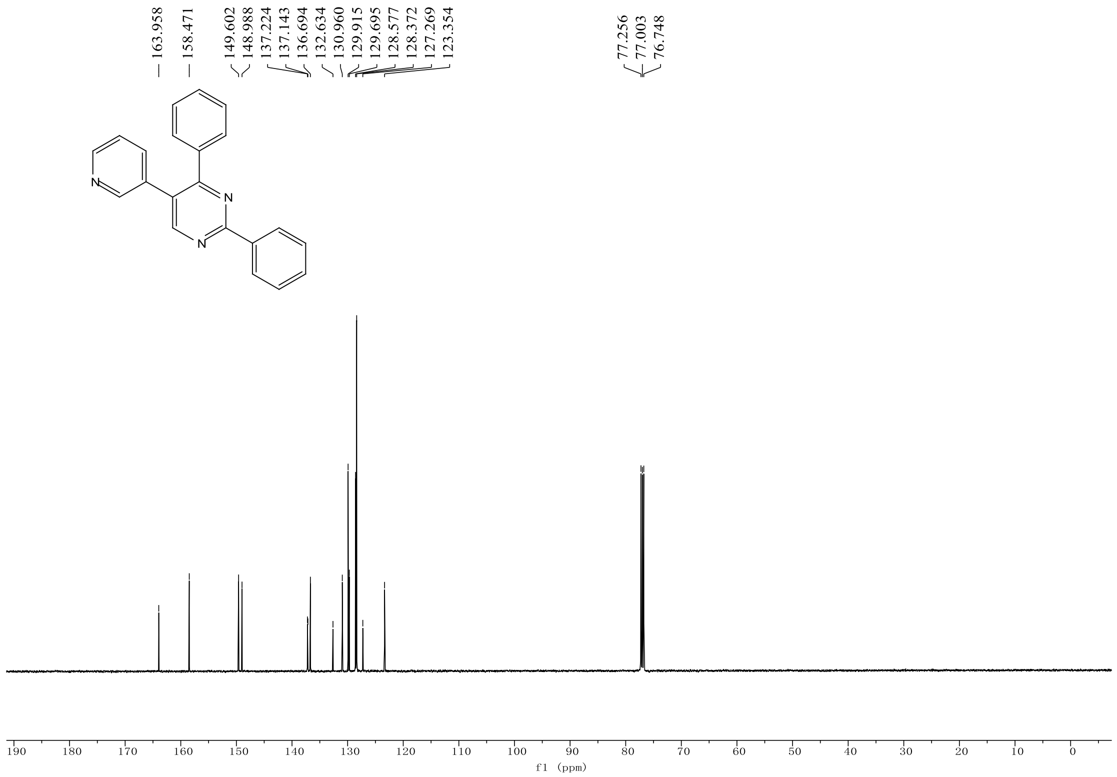


^{13}C NMR of **3k** (125 MHz, $CDCl_3$)

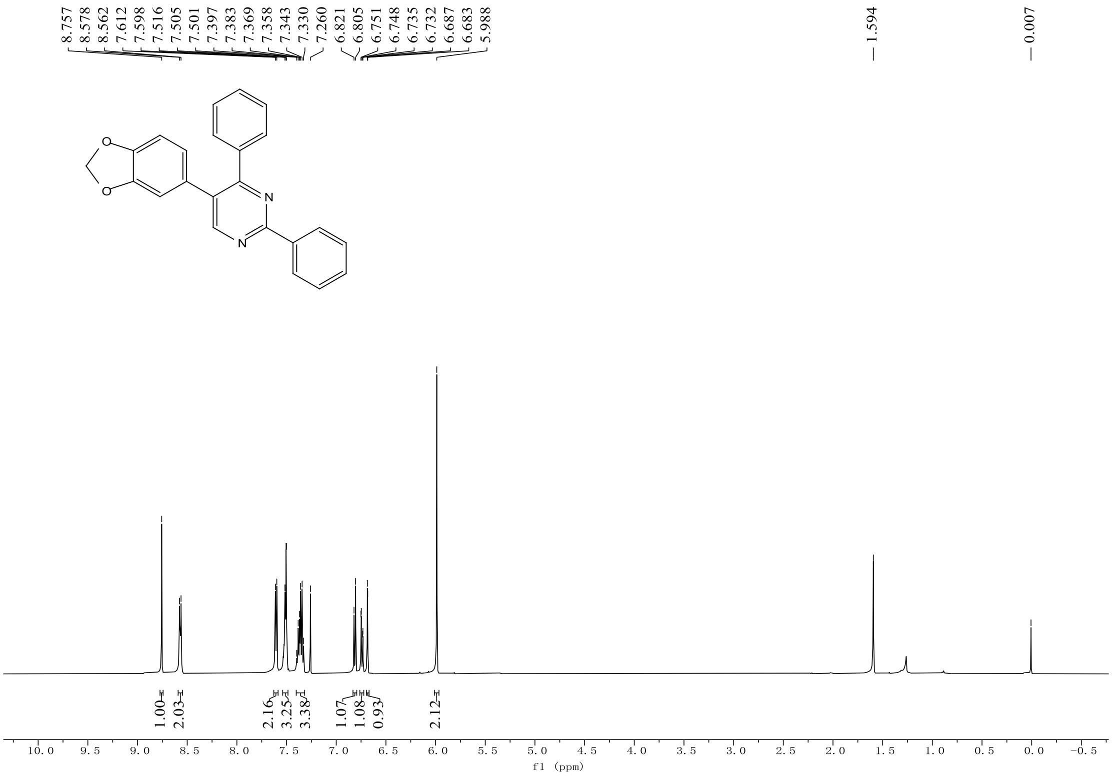
^{1}H NMR of **3l** (500 MHz, $CDCl_3$)



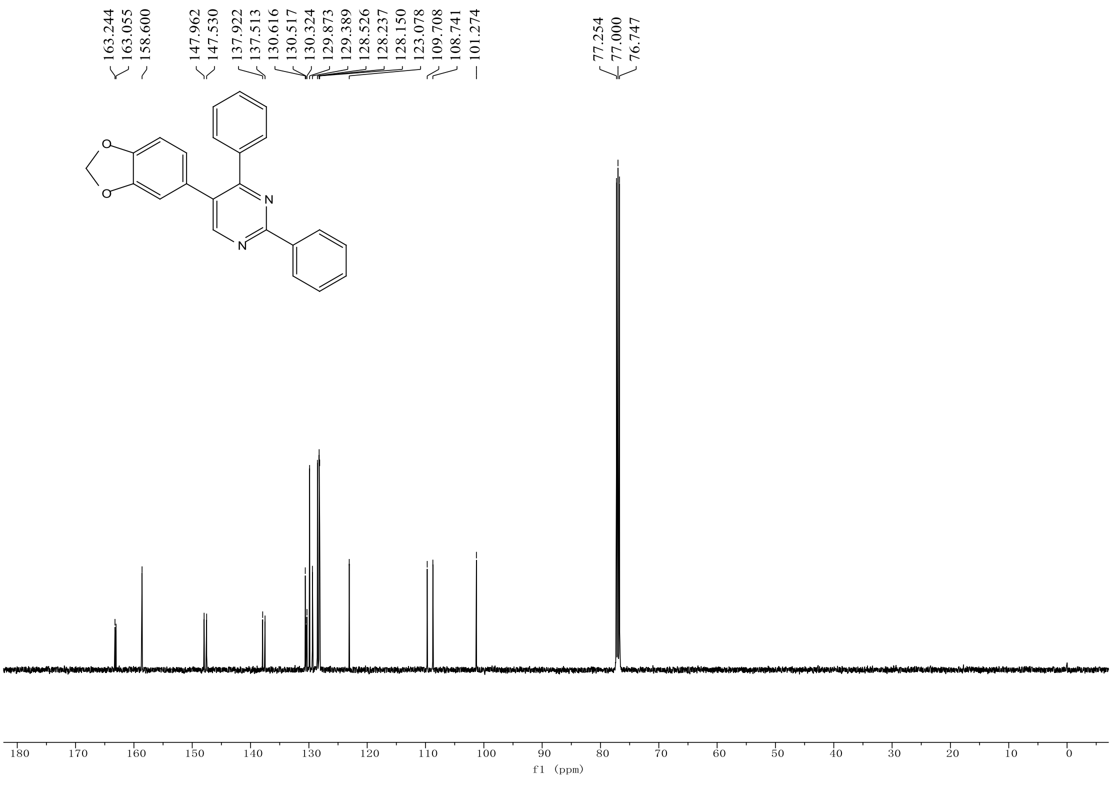
^{13}C NMR of **3l** (125 MHz, $CDCl_3$)



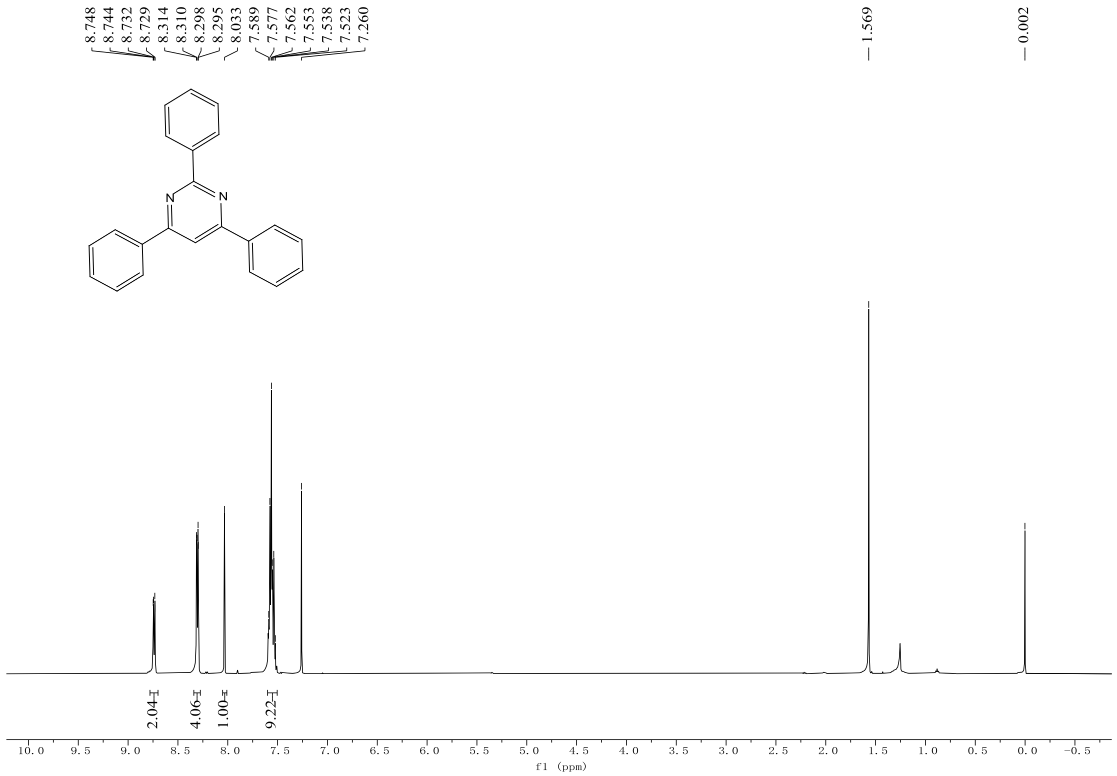
^{1}H NMR of **3m** (500 MHz, $CDCl_3$)



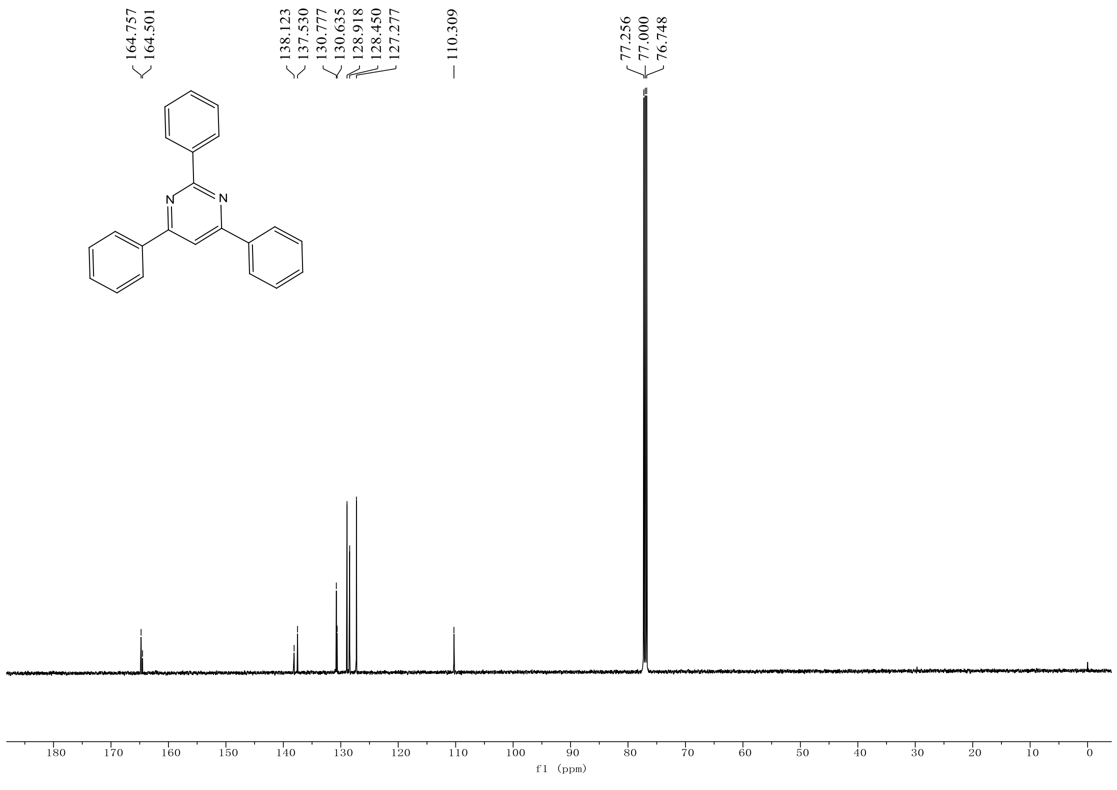
^{13}C NMR of **3m** (125 MHz, $CDCl_3$)



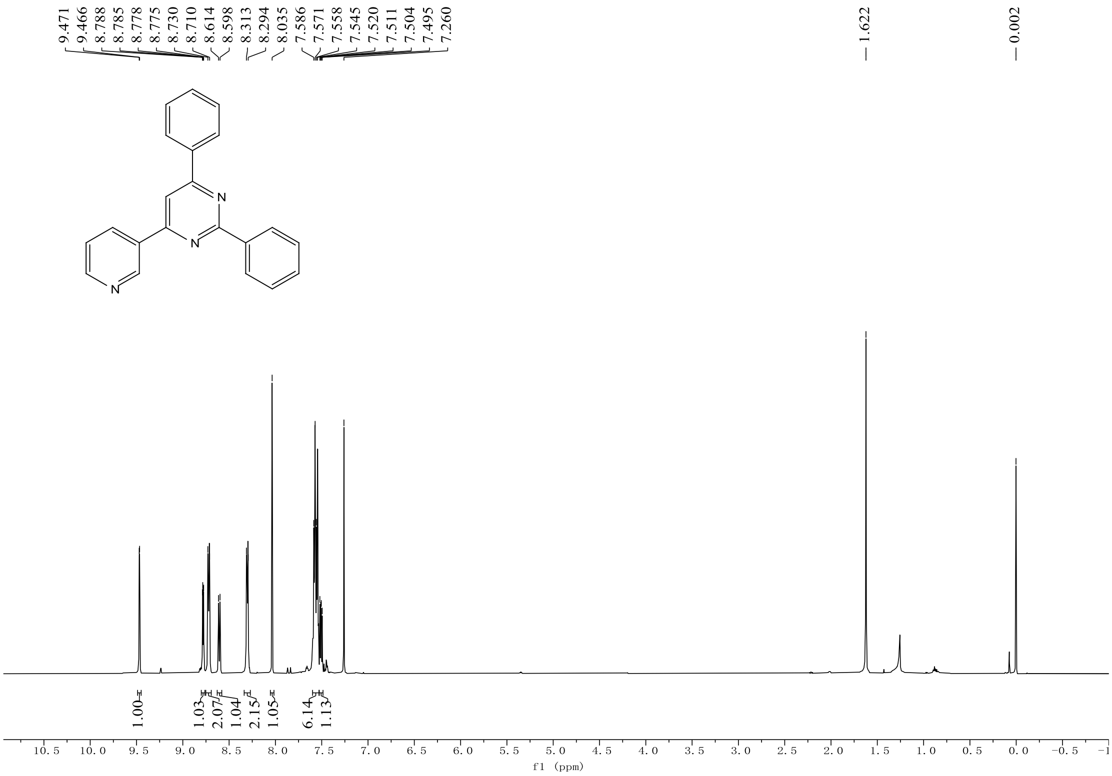
^{1}H NMR of **3n** (500 MHz, $CDCl_3$)



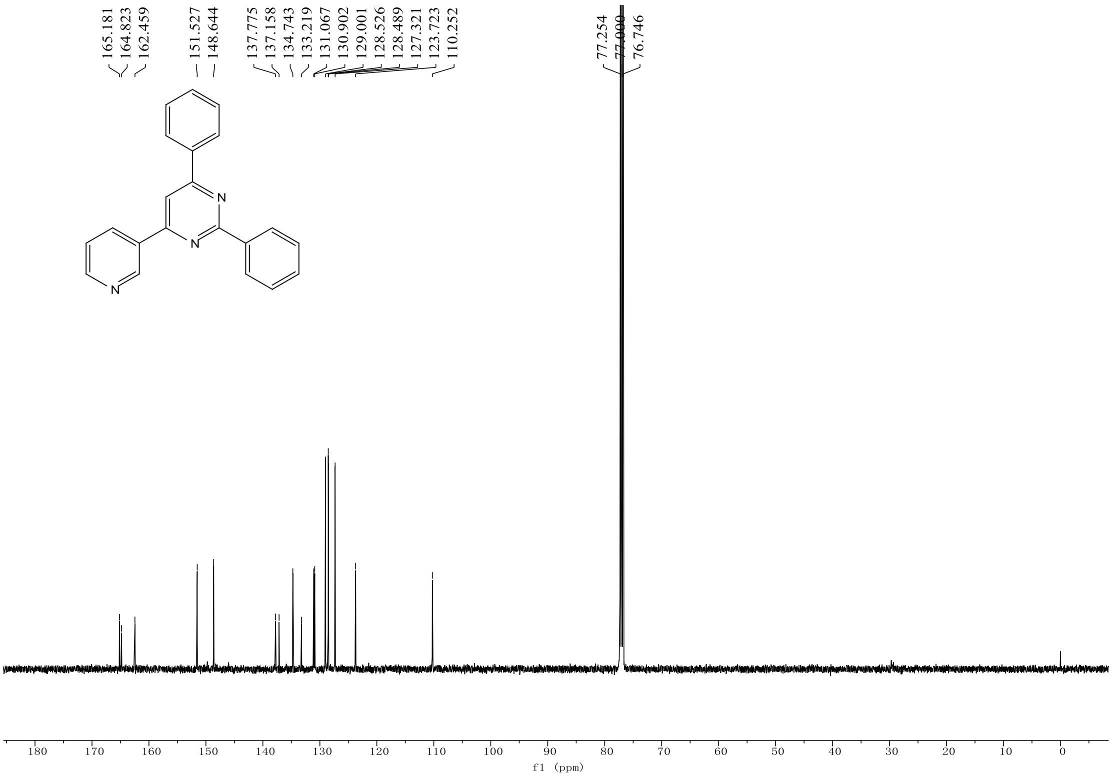
^{13}C NMR of **3n** (125 MHz, $CDCl_3$)



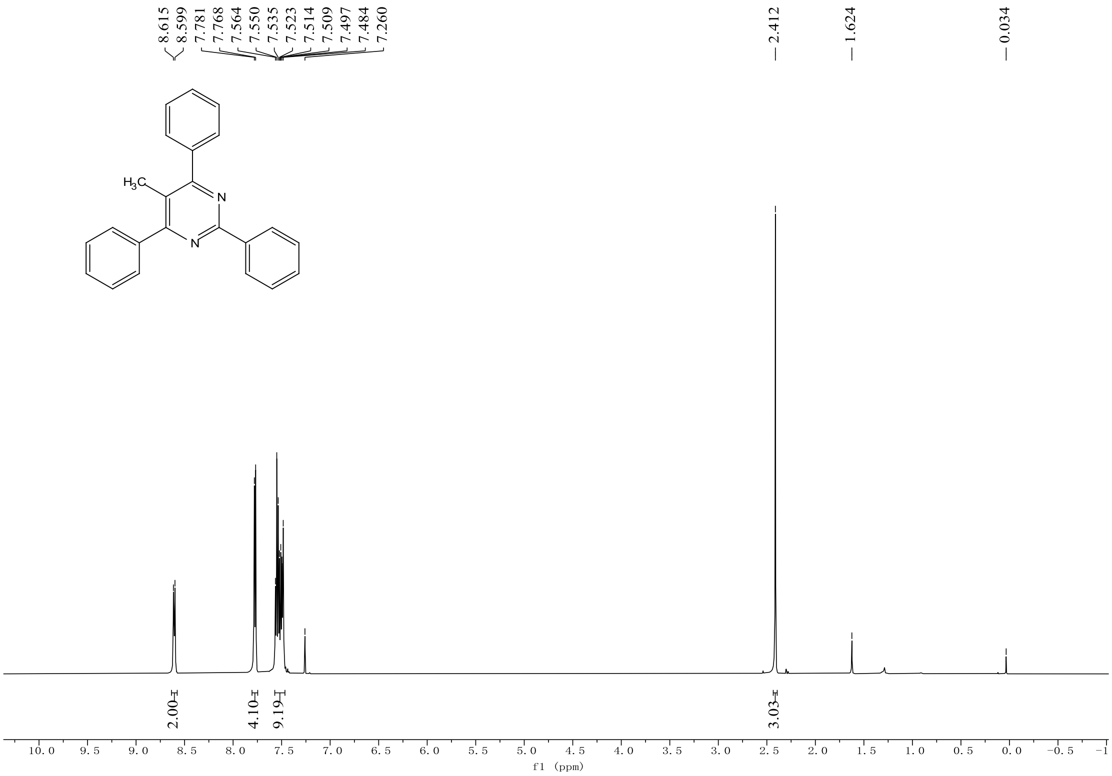
[1]H NMR of **3o** (500 MHz, $CDCl_3$)



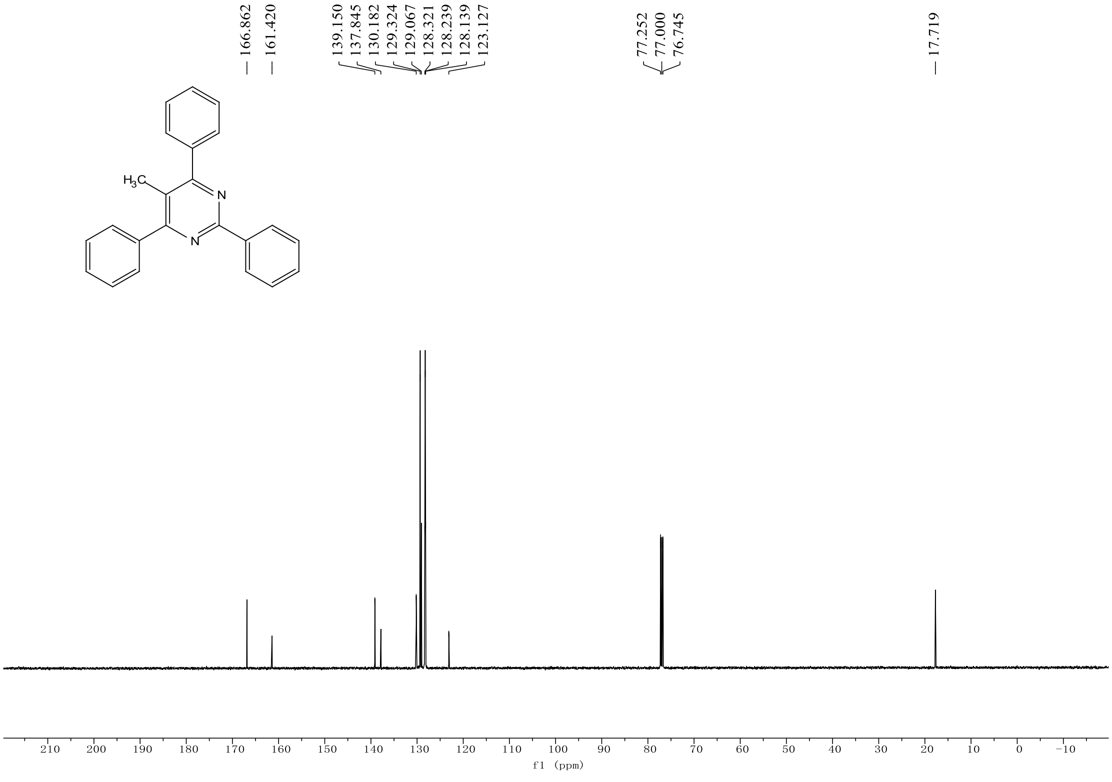
[13]C NMR of **3o** (125 MHz, $CDCl_3$)



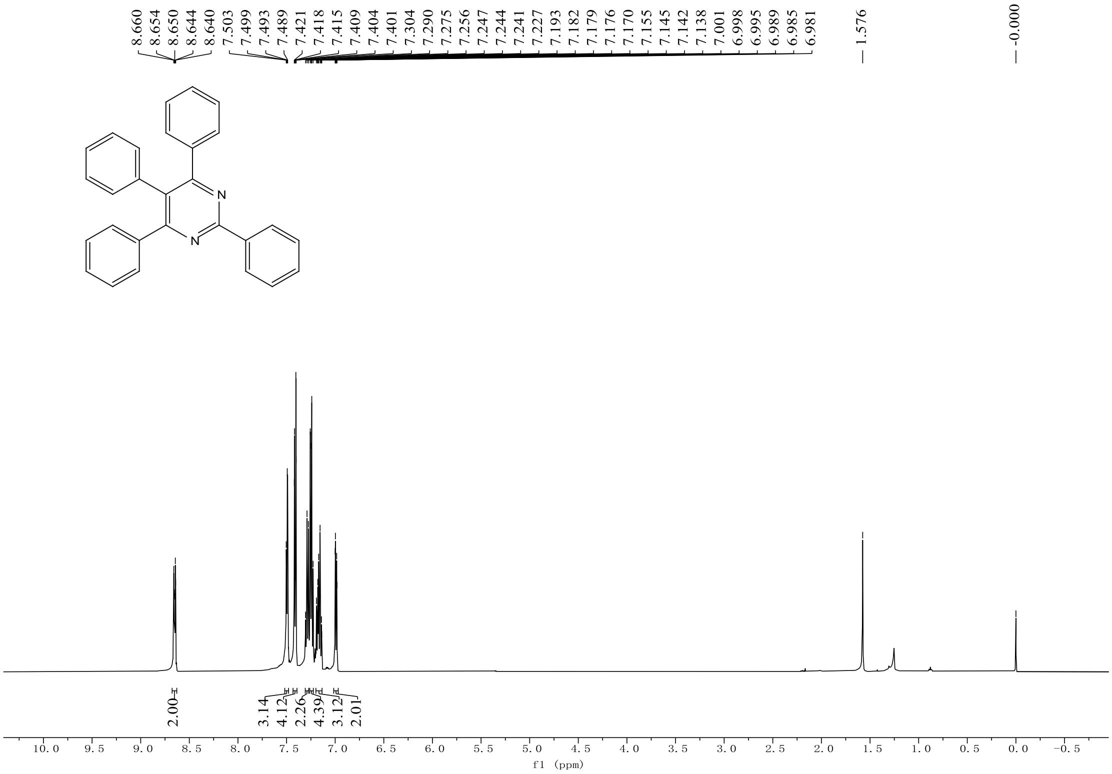
^{1}H NMR of **3p** (500 MHz, $CDCl_3$)



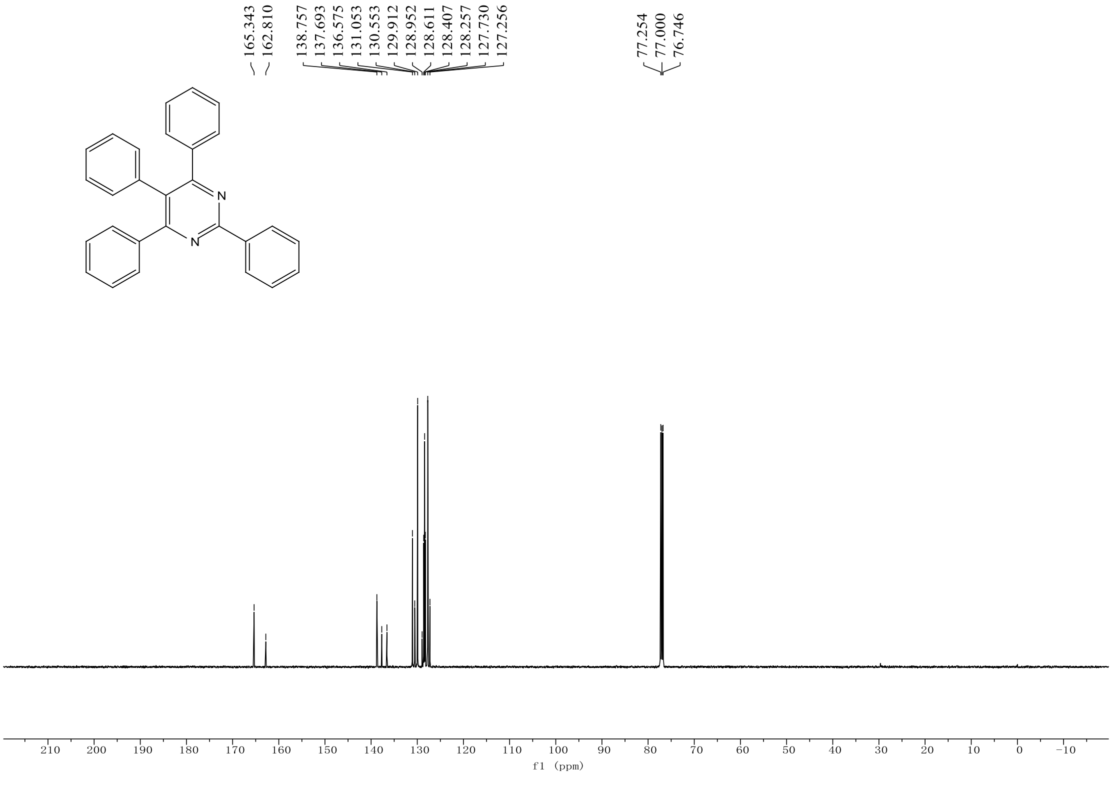
^{13}C NMR of **3p** (125 MHz, $CDCl_3$)



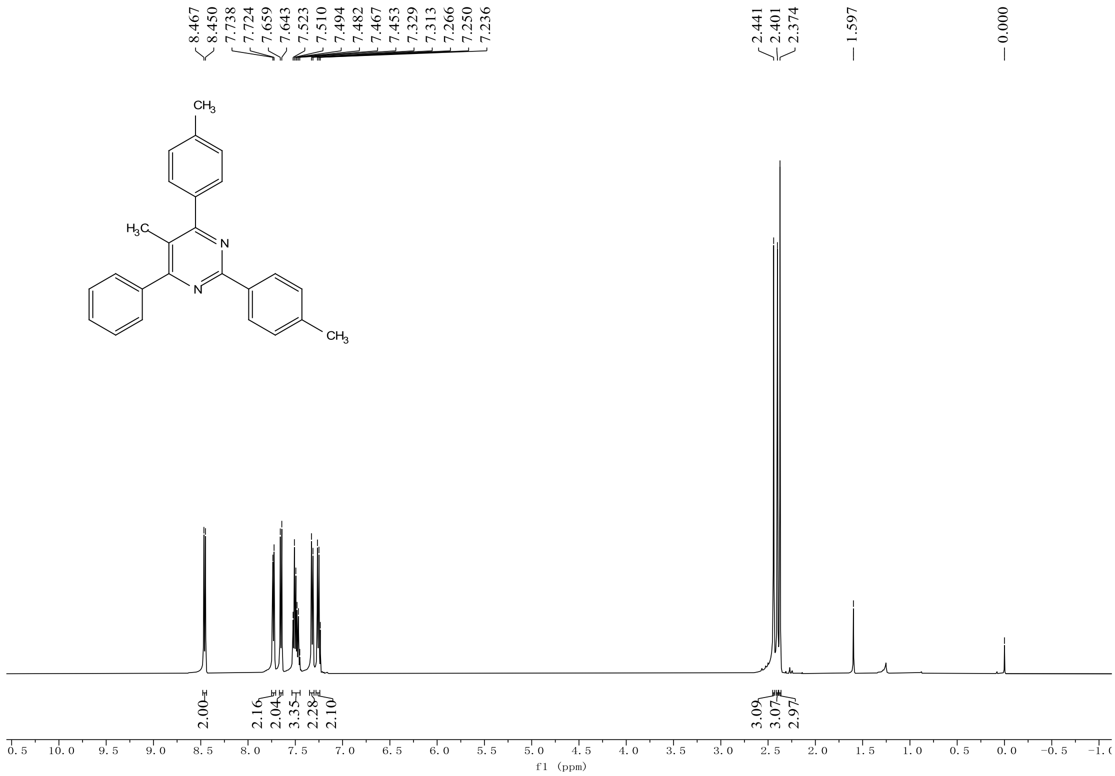
^{1}H NMR of **3q** (500 MHz, $CDCl_3$)



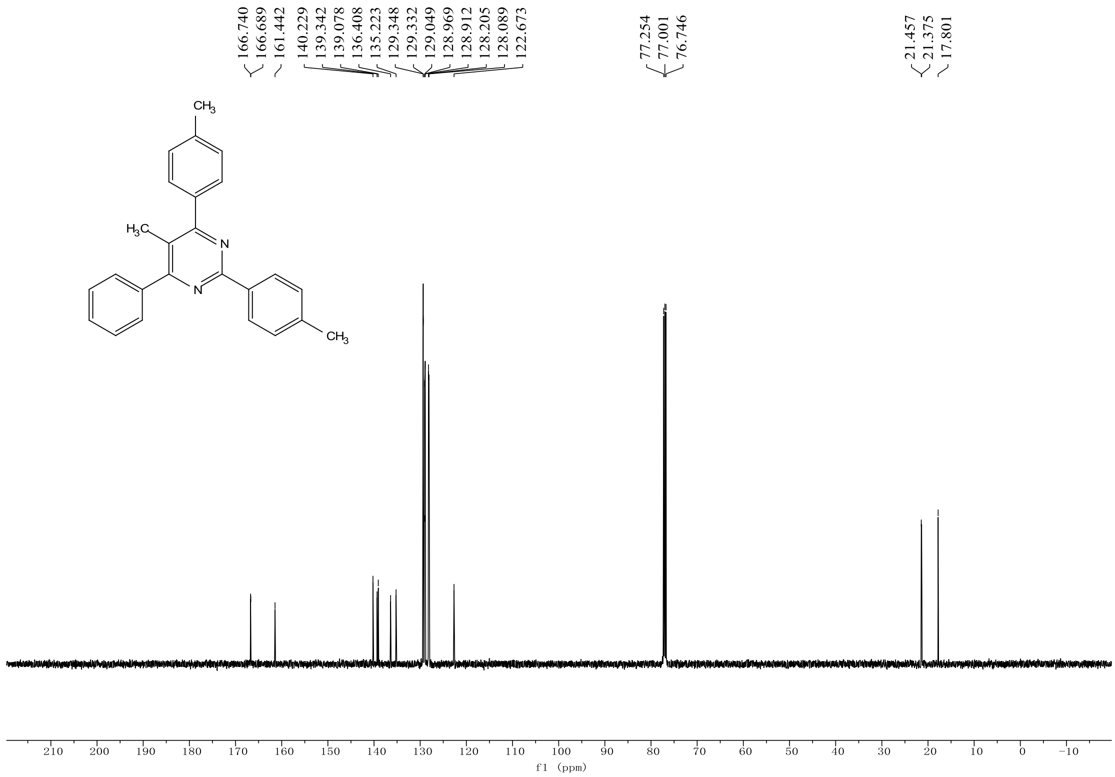
^{13}C NMR of **3q** (125 MHz, $CDCl_3$)



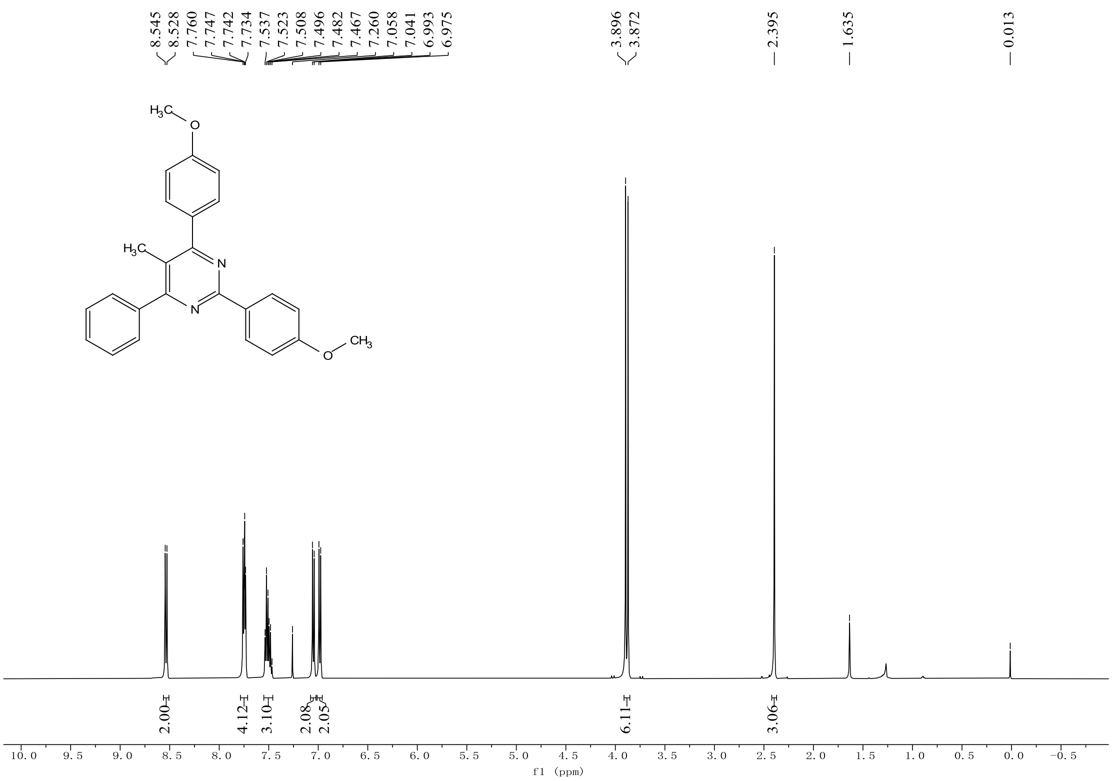
[1]H NMR of **3r** (500 MHz, $CDCl_3$)



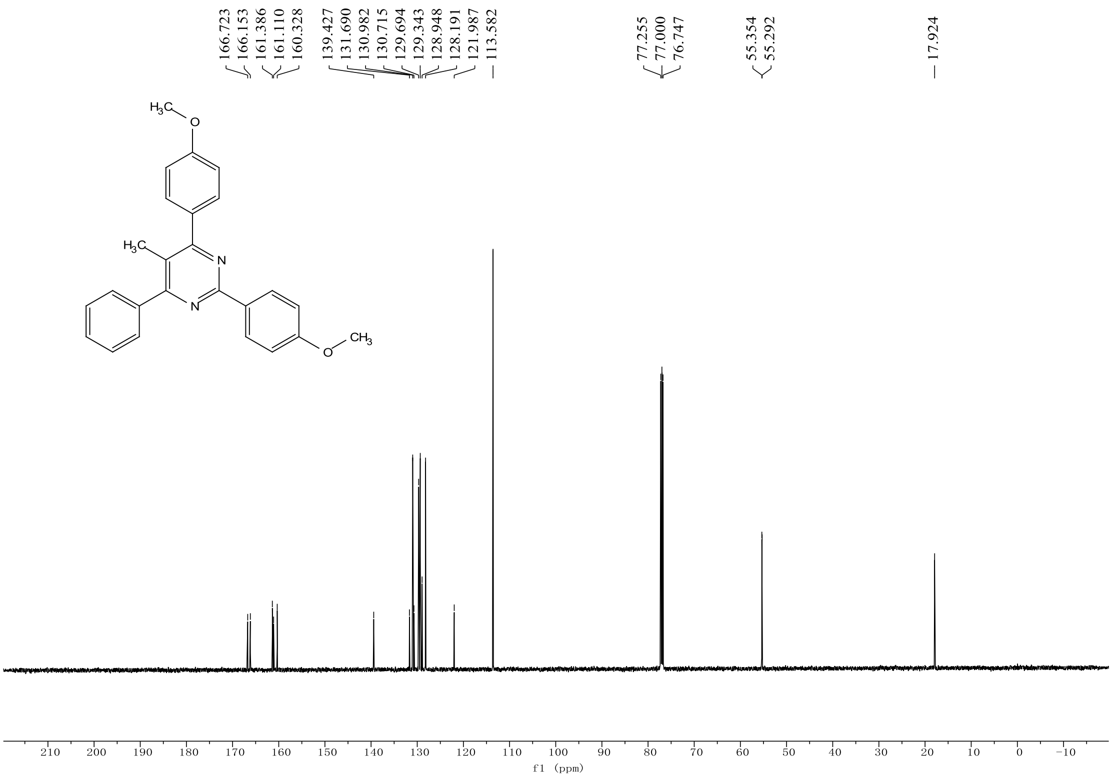
[13]C NMR of **3r** (125 MHz, $CDCl_3$)



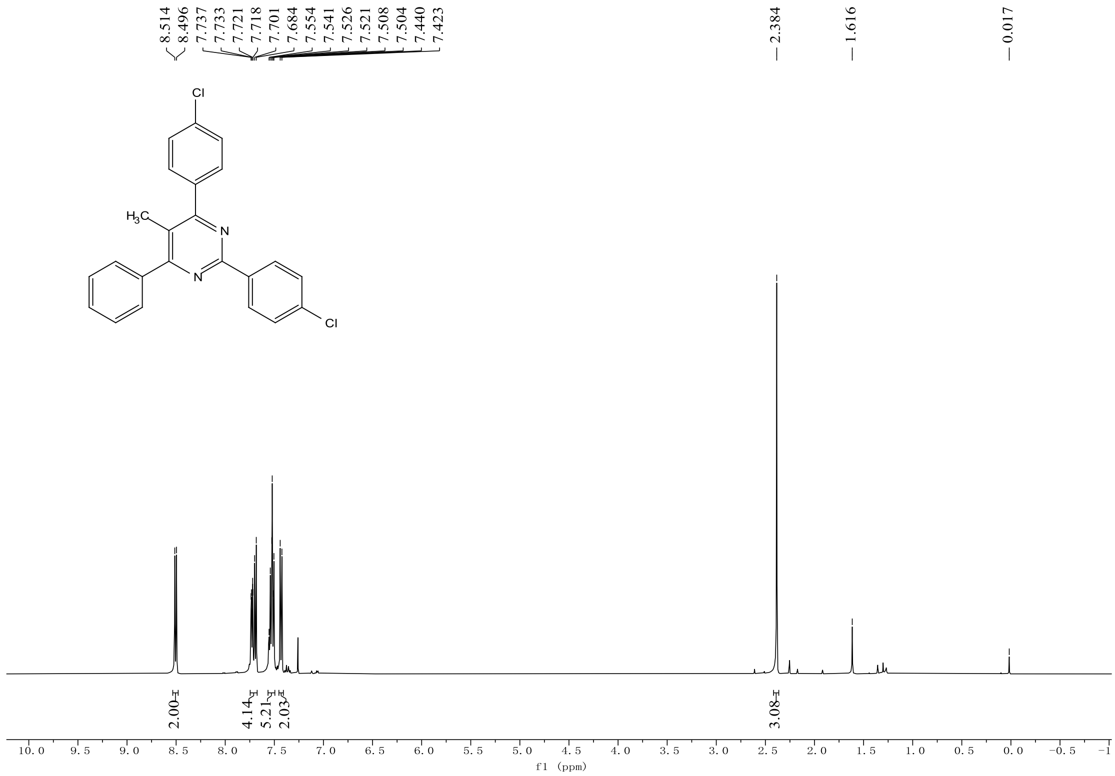
[1]H NMR of **3s** (500 MHz, $CDCl_3$)



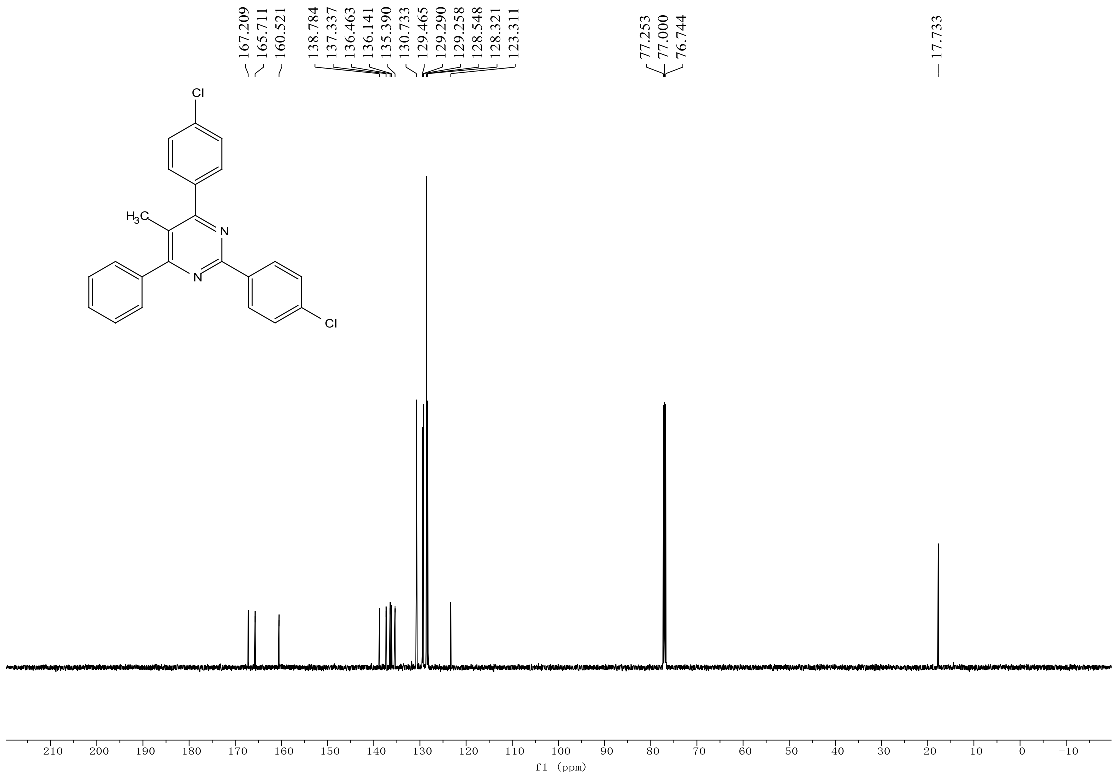
[13]C NMR of **3s** (125 MHz, $CDCl_3$)



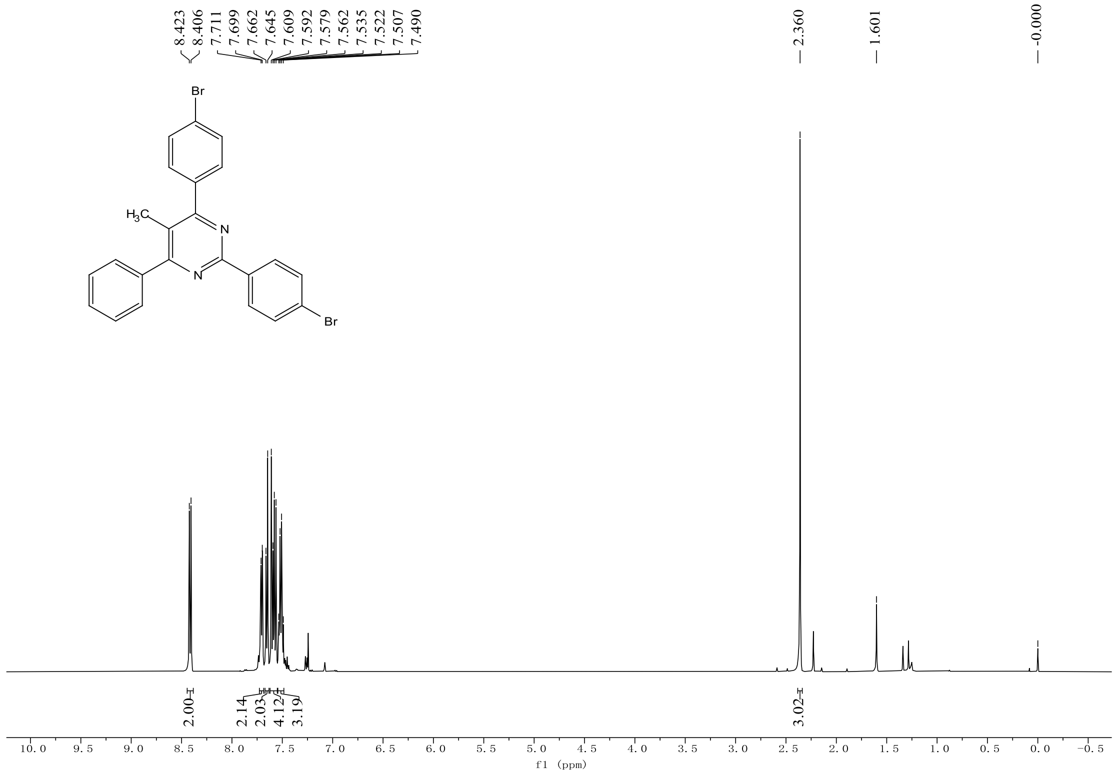
^{1}H NMR of **3t** (500 MHz, $CDCl_3$)



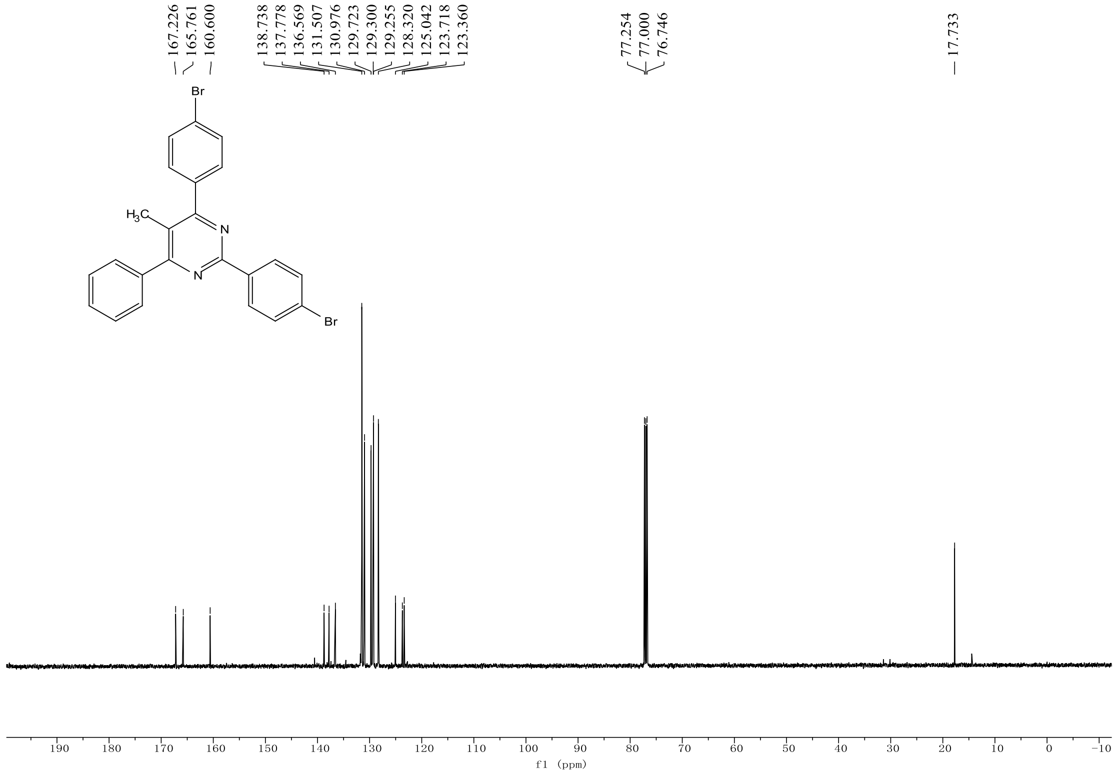
^{13}C NMR of **3t** (125 MHz, $CDCl_3$)



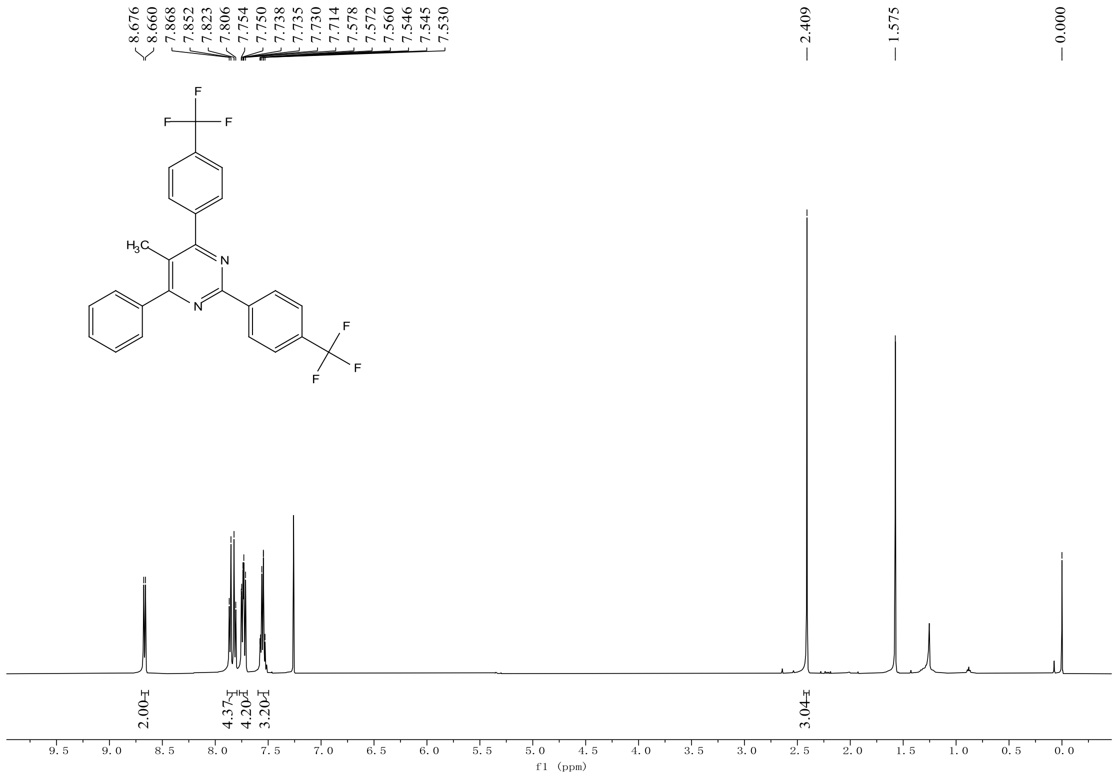
^{1}H NMR of **3u** (500 MHz, $CDCl_3$)



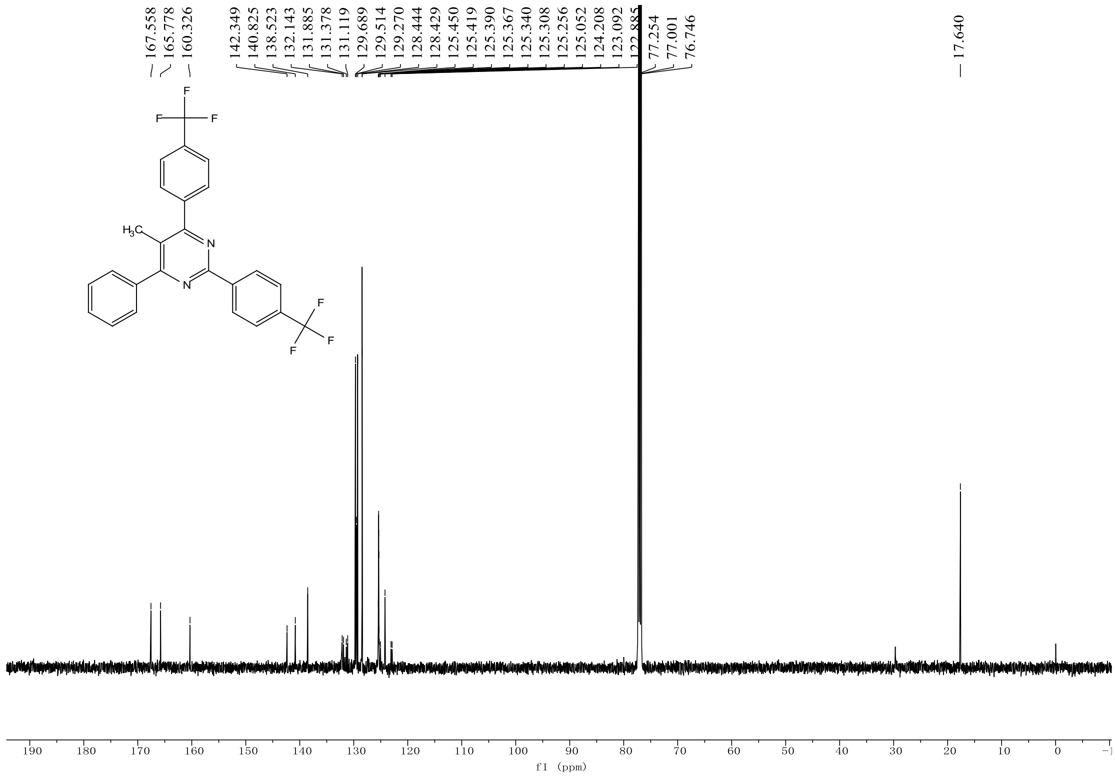
^{13}C NMR of **3u** (125 MHz, $CDCl_3$)



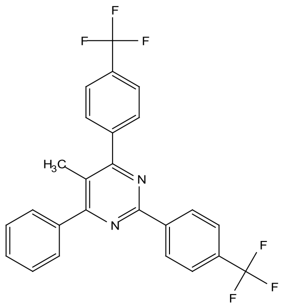
^{1}H NMR of **3v** (500 MHz, $CDCl_3$)

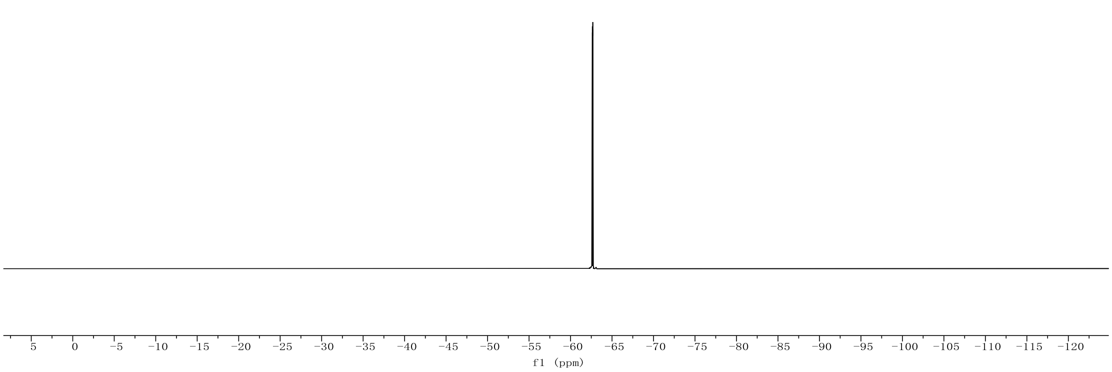


^{13}C NMR of **3v** (125 MHz, $CDCl_3$)

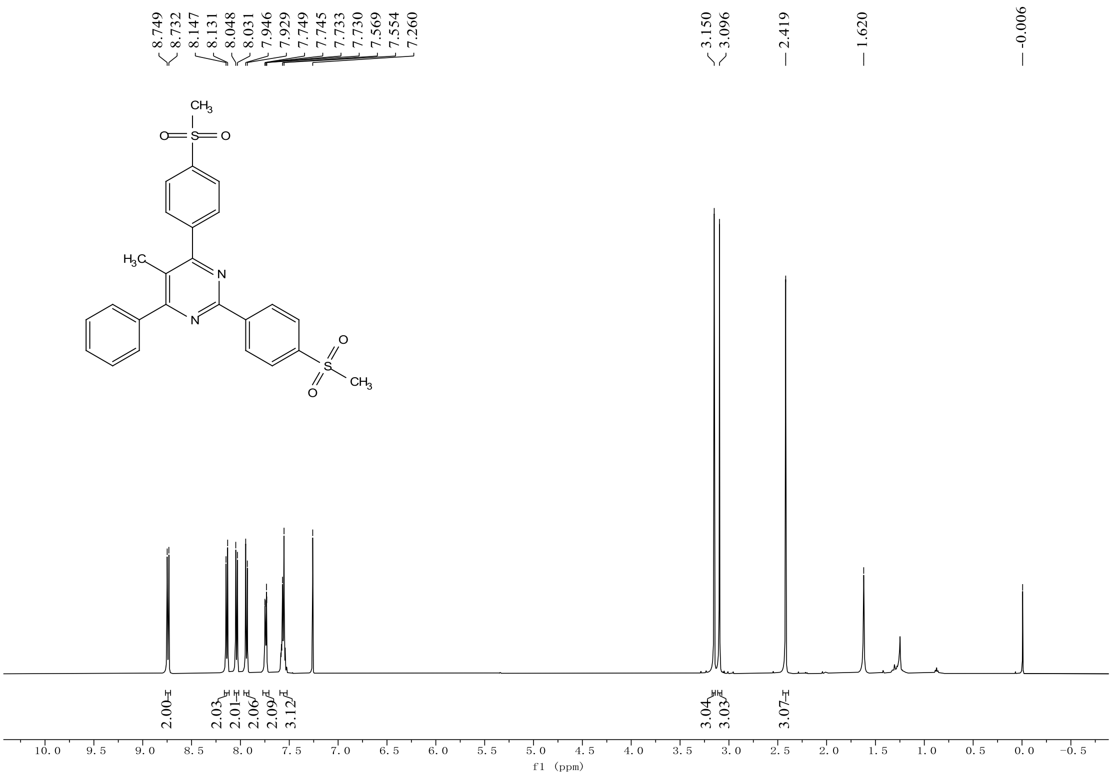


^{19}F NMR of **3v** (471 MHz, $CDCl_3$)

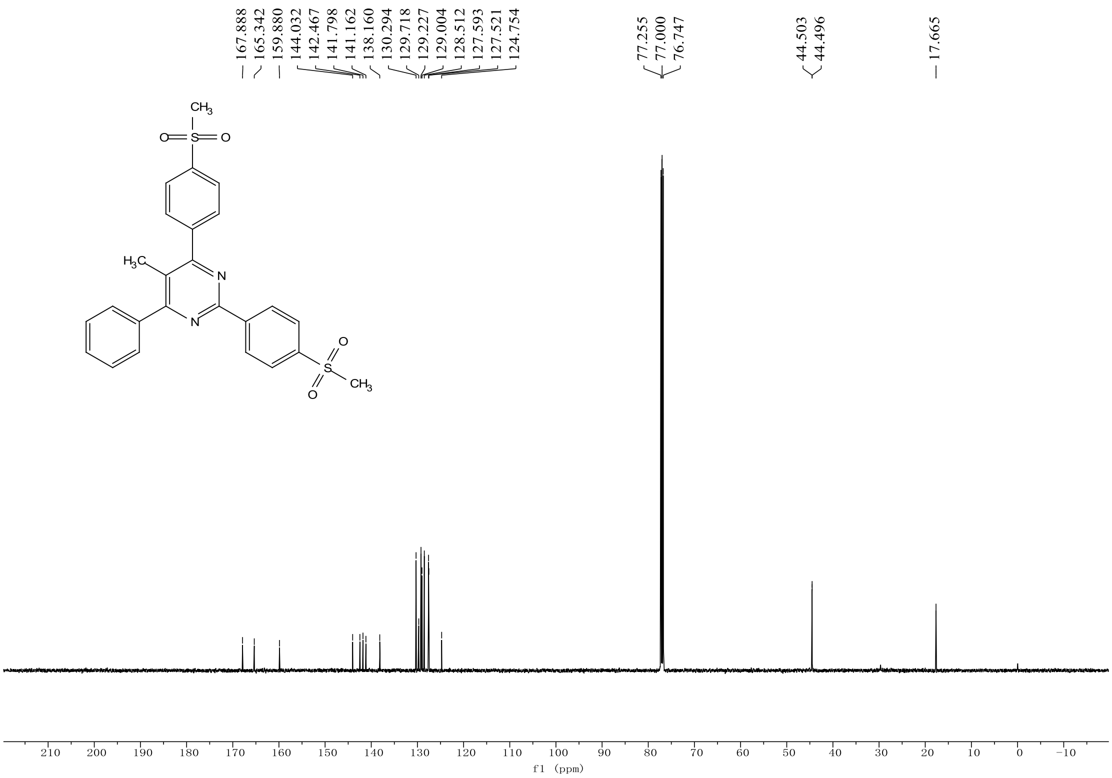




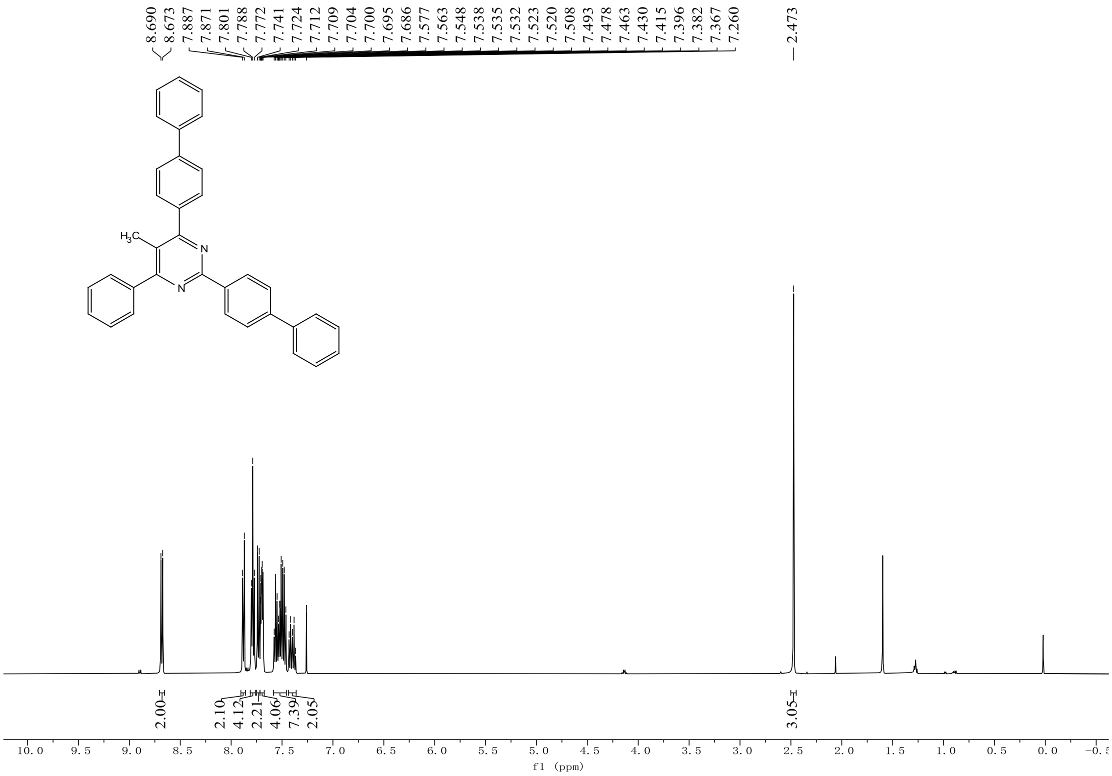
^{1}H NMR of **3w** (500 MHz, $CDCl_3$)



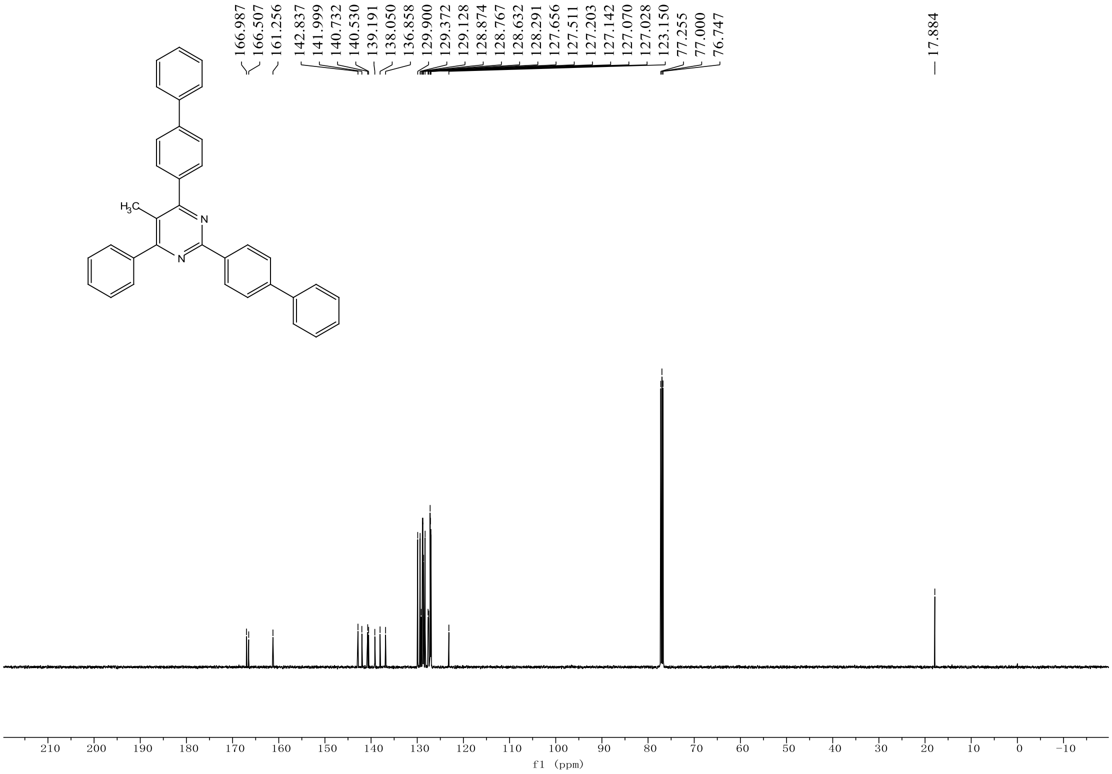
^{13}C NMR of **3w**(125 MHz, $CDCl_3$)



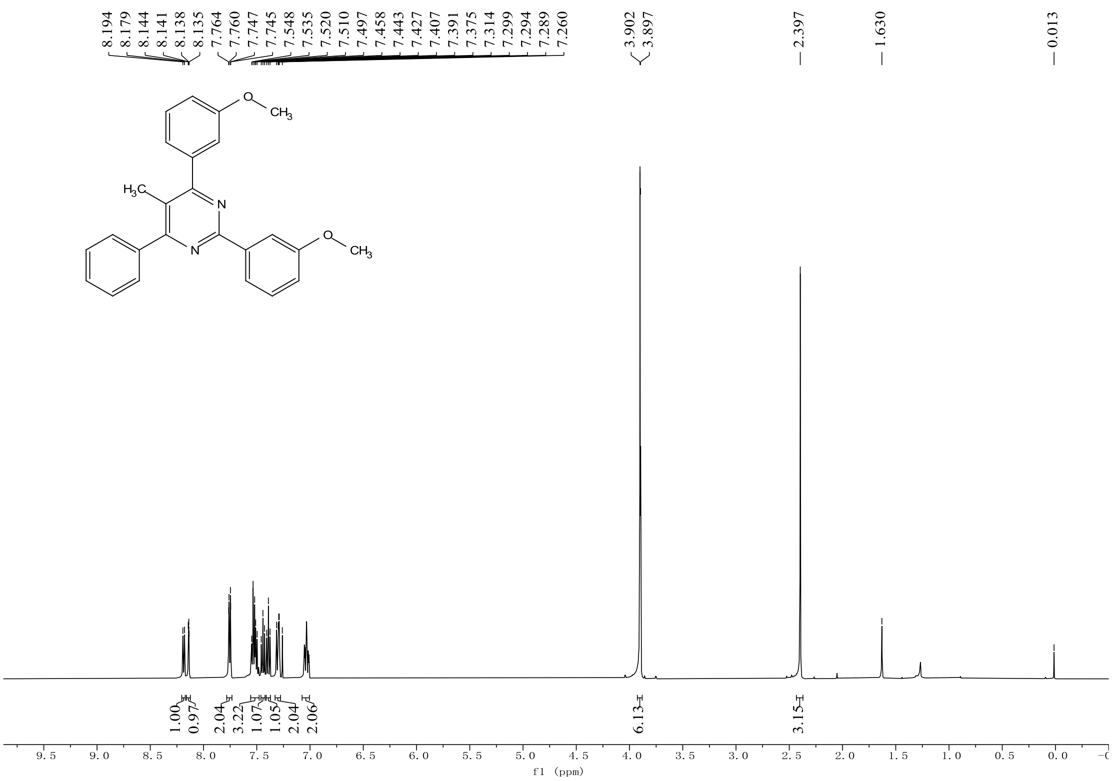
^{1}H NMR of **3x** (500 MHz, $CDCl_3$)



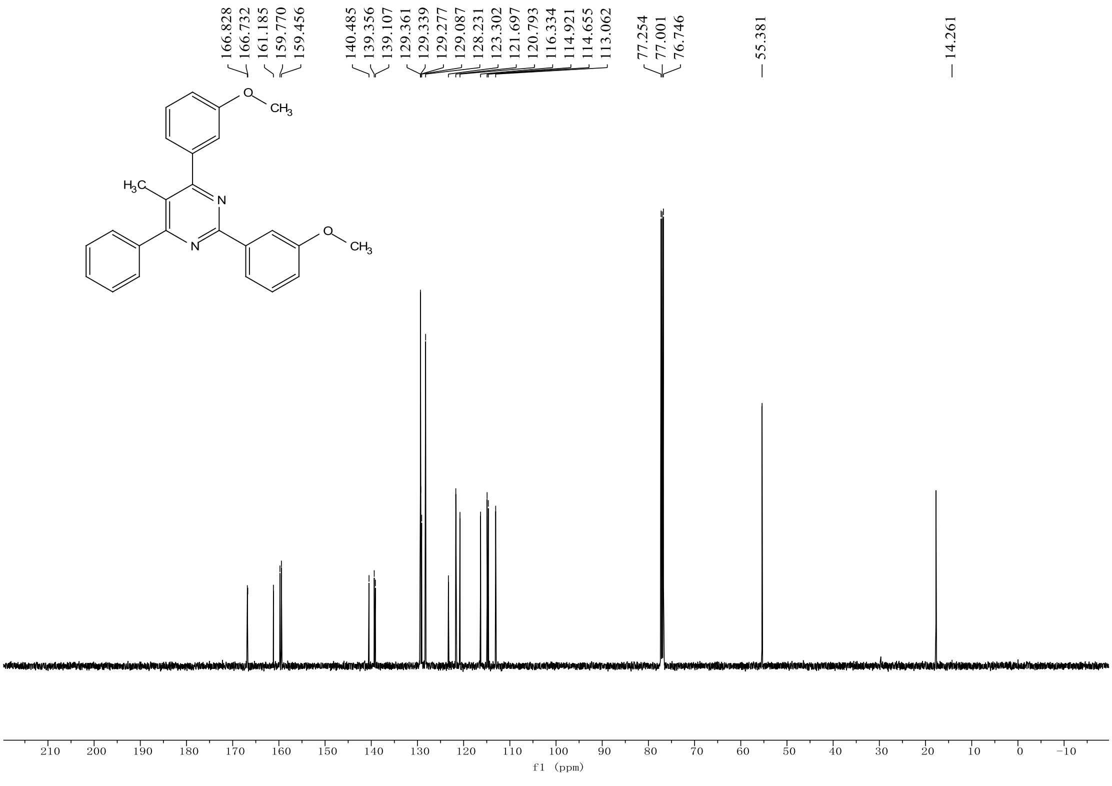
^{13}C NMR of **3x** (125 MHz, $CDCl_3$)



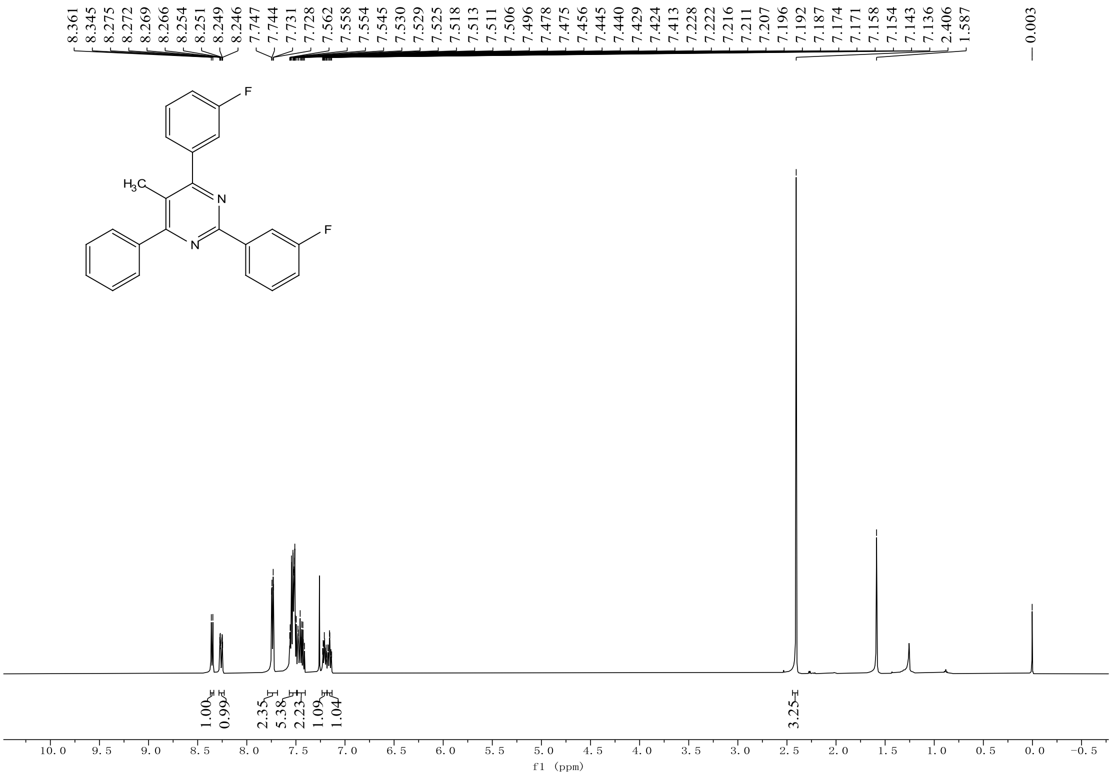
^1H NMR of **3y** (500 MHz, $CDCl_3$)



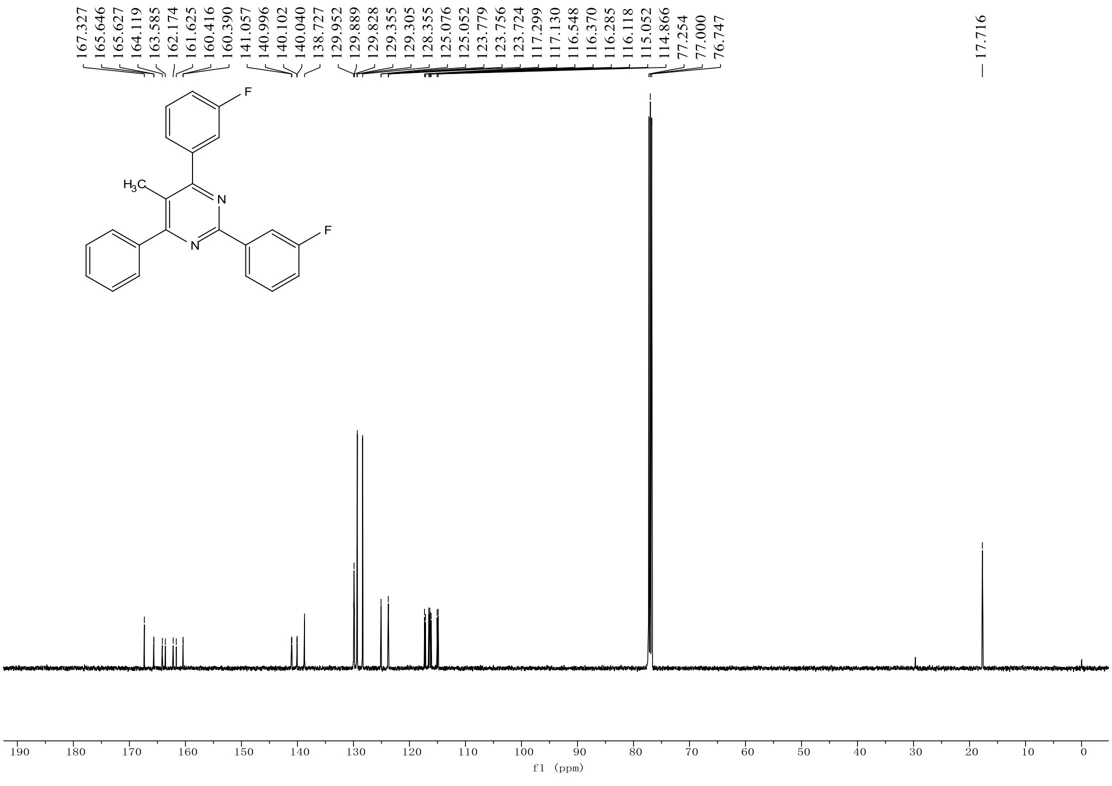
^{13}C NMR of **3y** (125 MHz, $CDCl_3$)



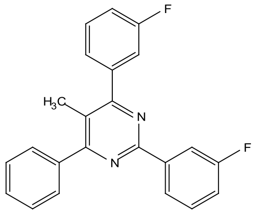
^{1}H NMR of **3z** (500 MHz, $CDCl_3$)

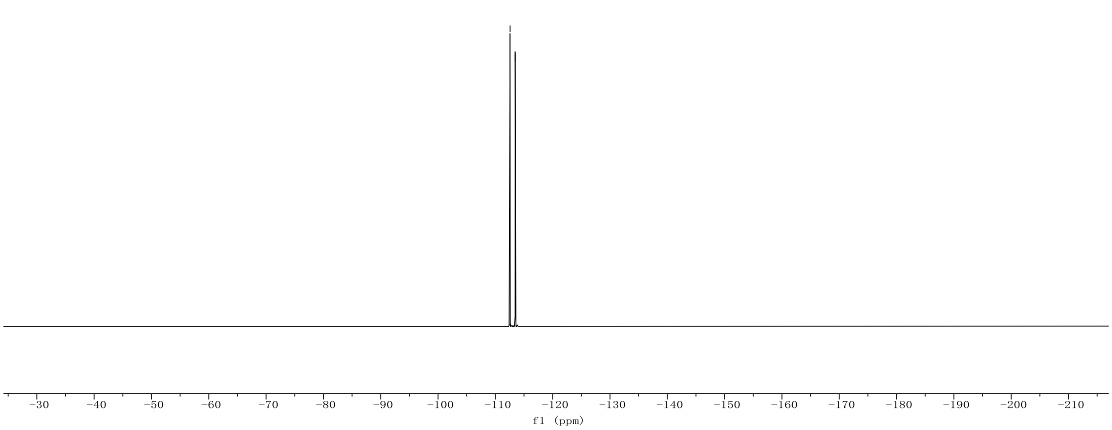


^{13}C NMR of **3z** (125 MHz, $CDCl_3$)

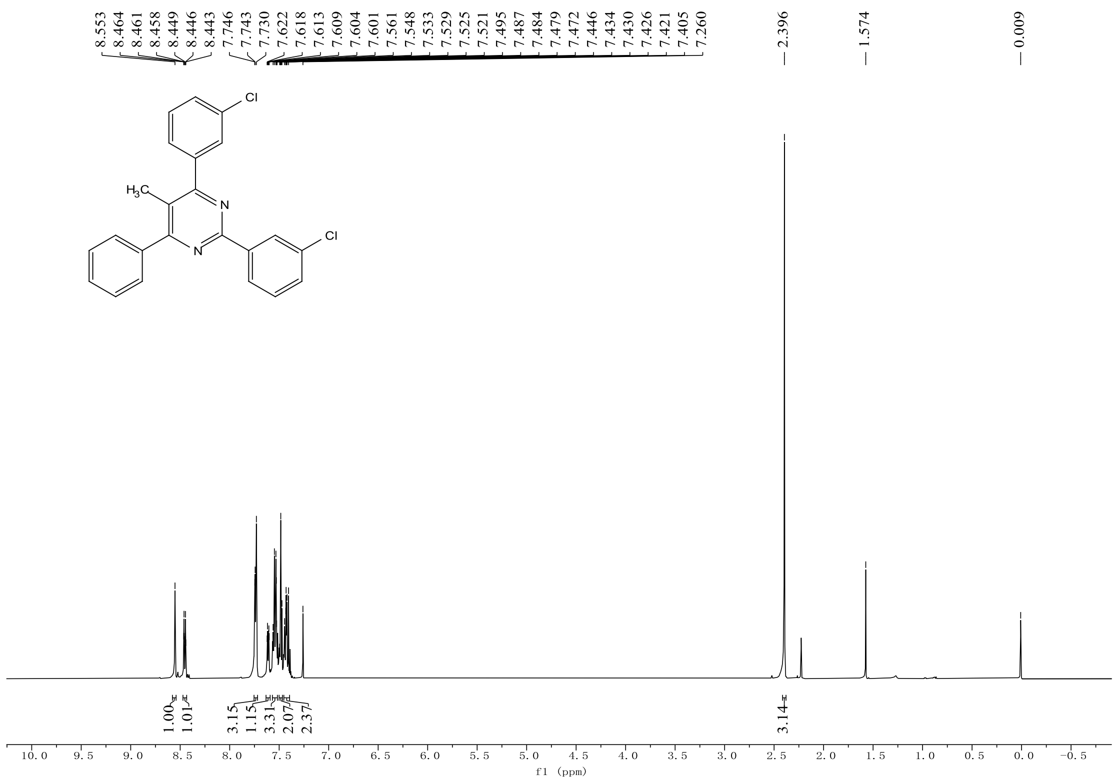


^{19}F NMR of **3z** (471 MHz, $CDCl_3$)

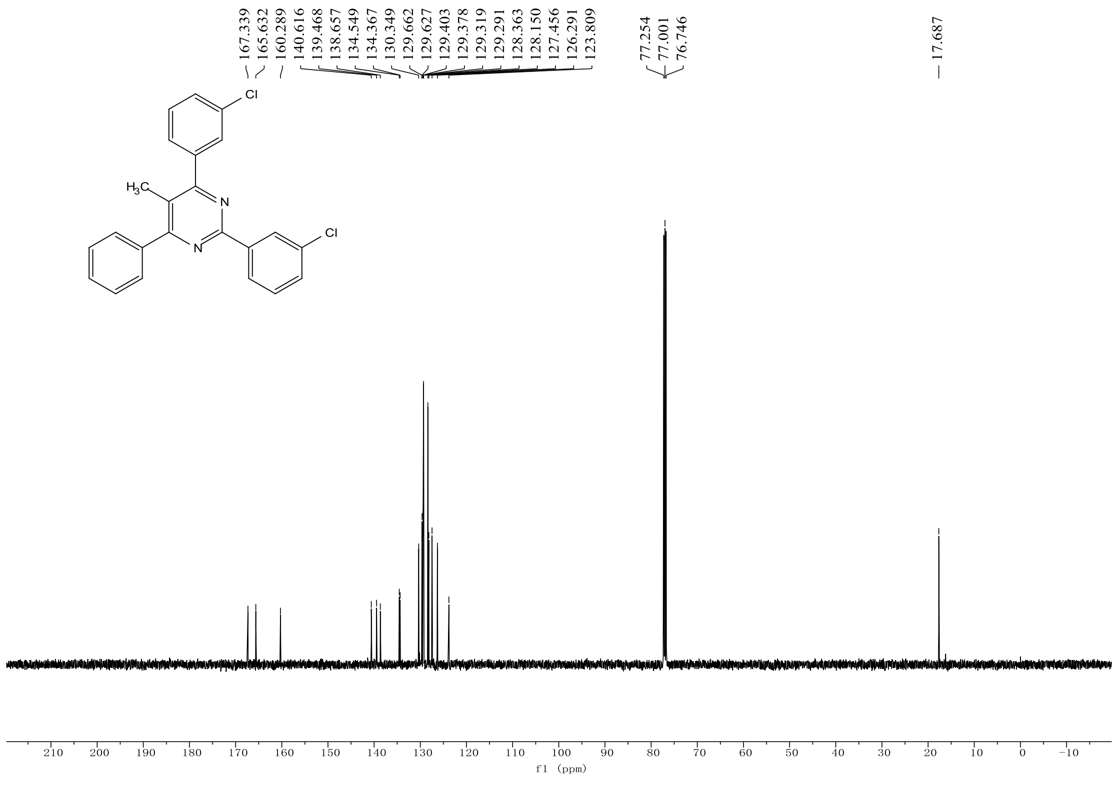




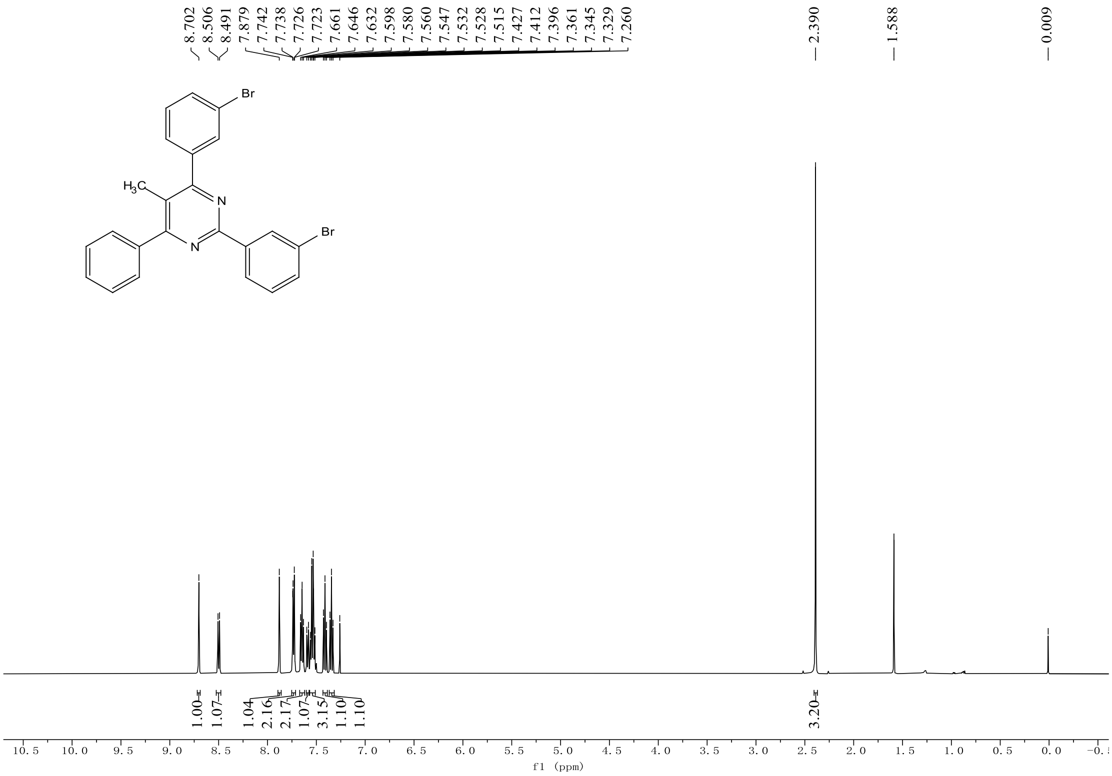
[1]H NMR of **3aa** (500 MHz, $CDCl_3$)



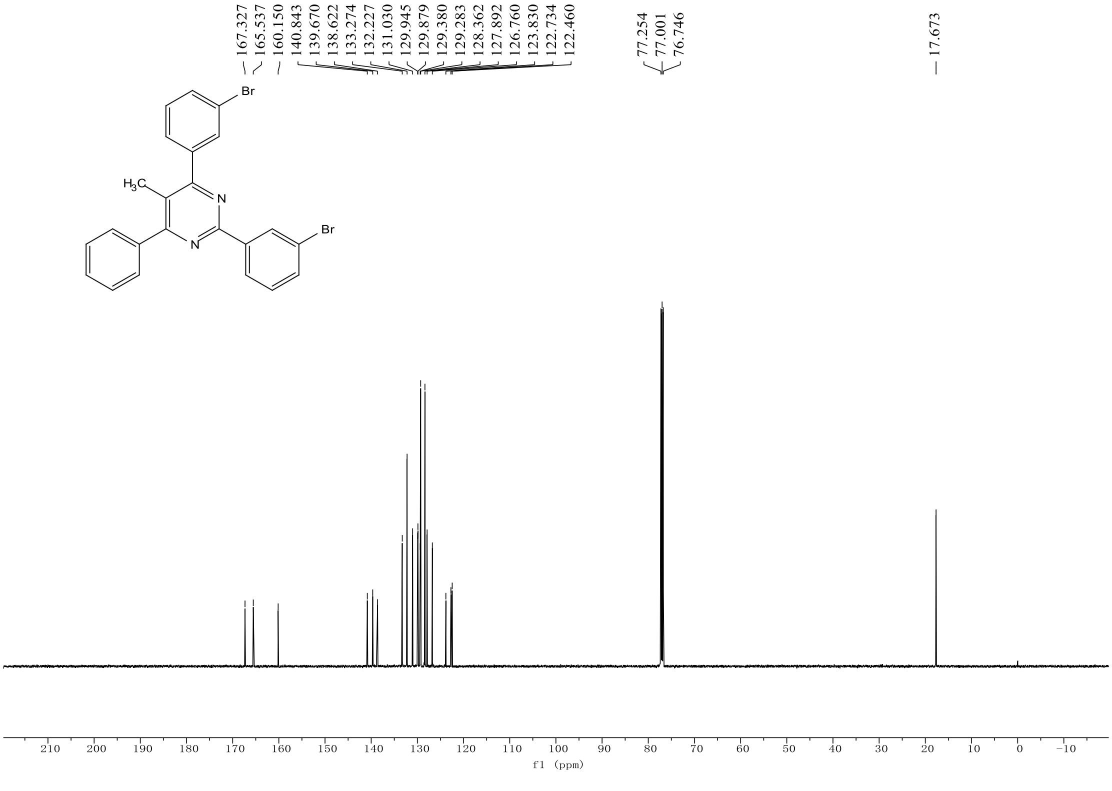
[13]C NMR of **3aa** (125 MHz, $CDCl_3$)



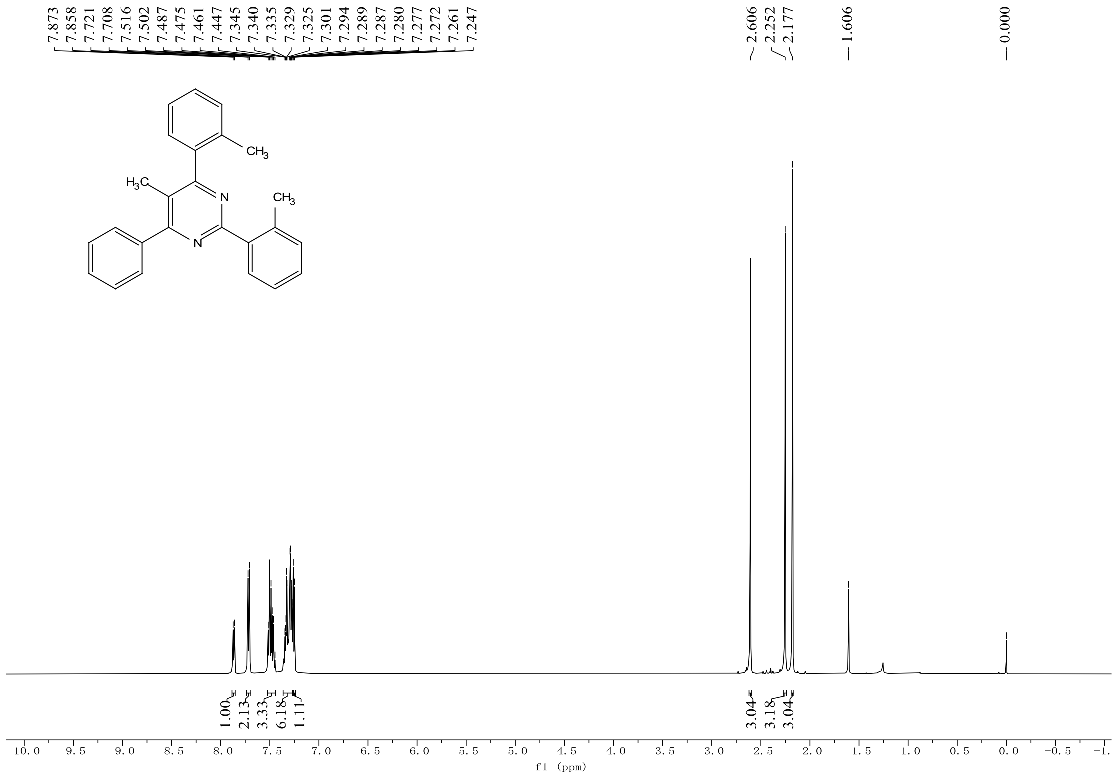
^{1}H NMR of **3ab** (500 MHz, $CDCl_3$)



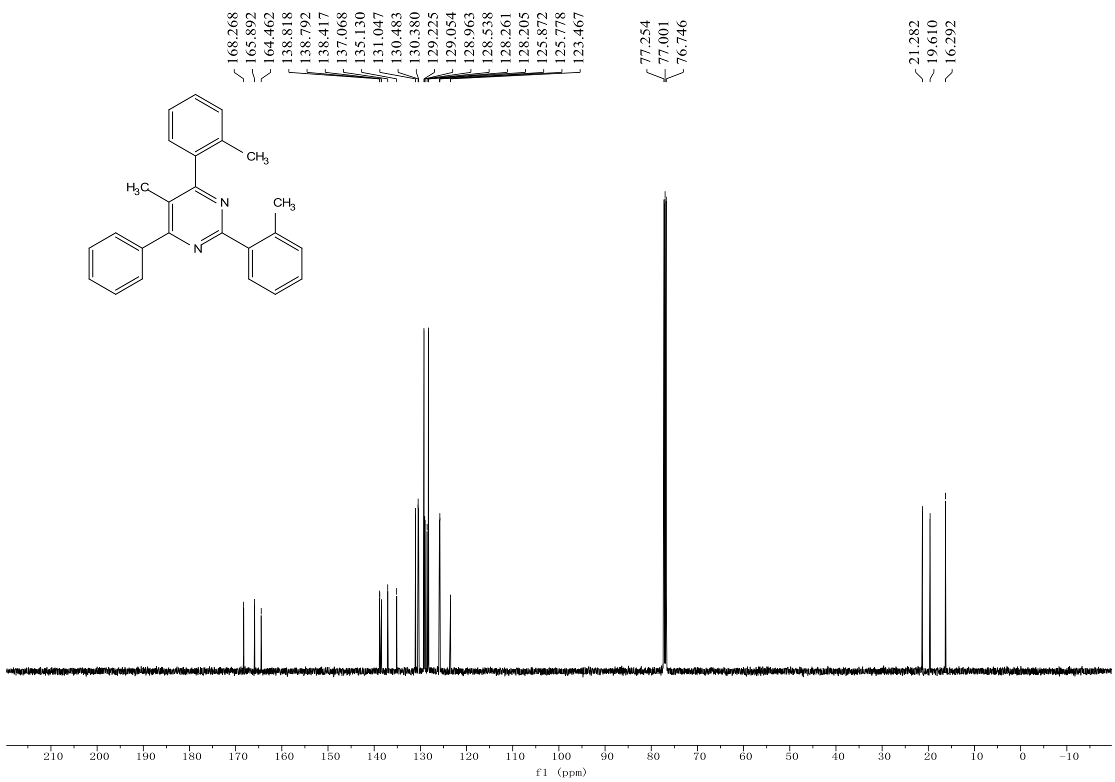
^{13}C NMR of **3ab** (125 MHz, $CDCl_3$)



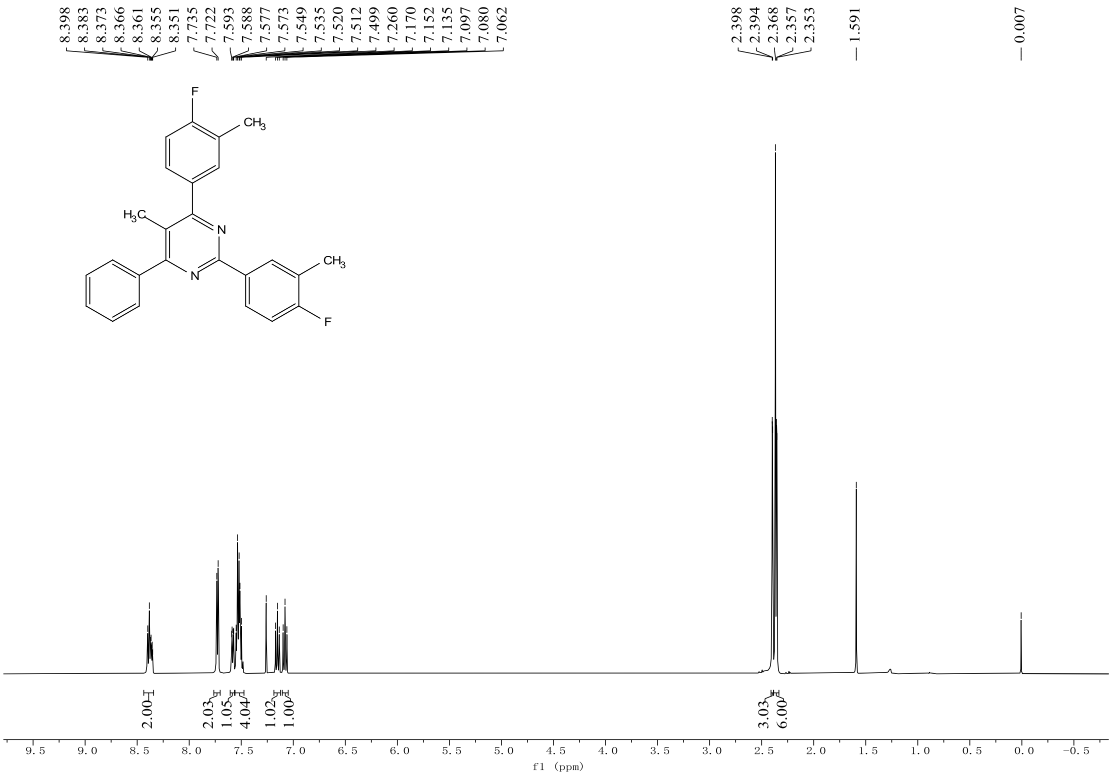
^1H NMR of **3ac** (500 MHz, $CDCl_3$)



^{13}C NMR of **3ac** (125 MHz, $CDCl_3$)

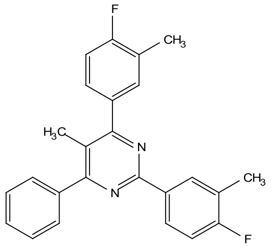


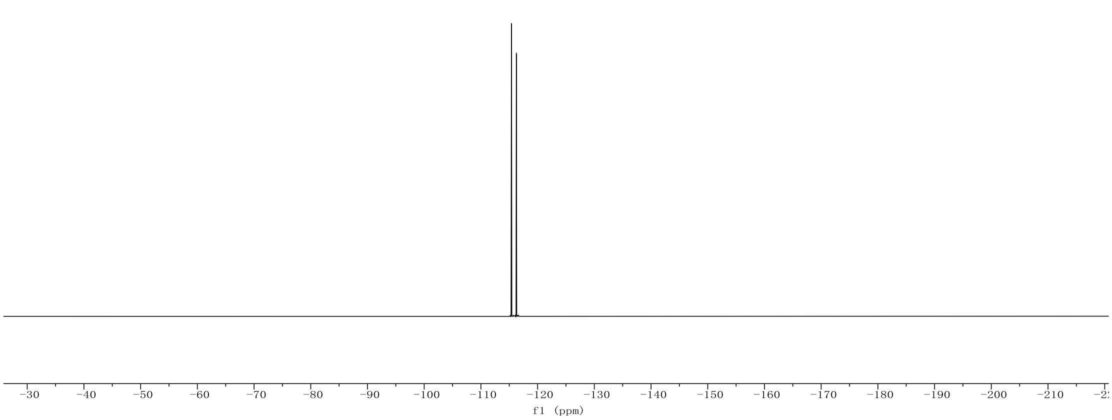
^{1}H NMR of **3ad** (500 MHz, $CDCl_3$)



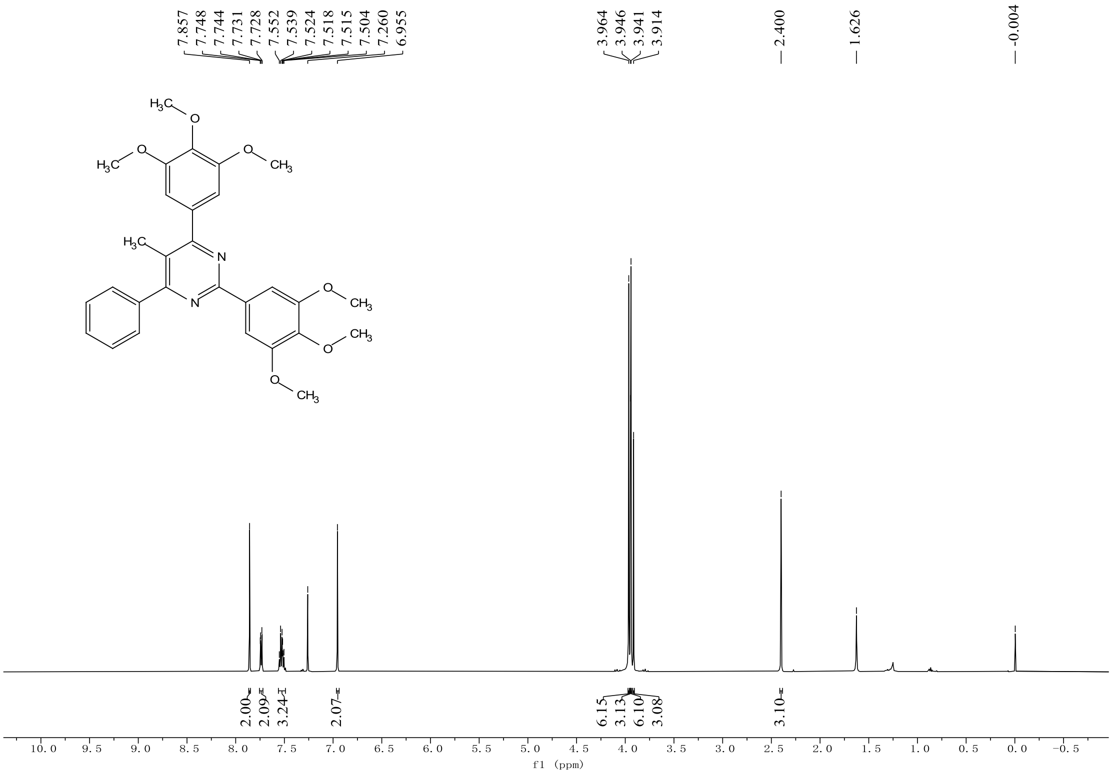
^{13}C NMR of **3ad** (125 MHz, $CDCl_3$)

^{19}F NMR of **3ad** (471 MHz, $CDCl_3$)

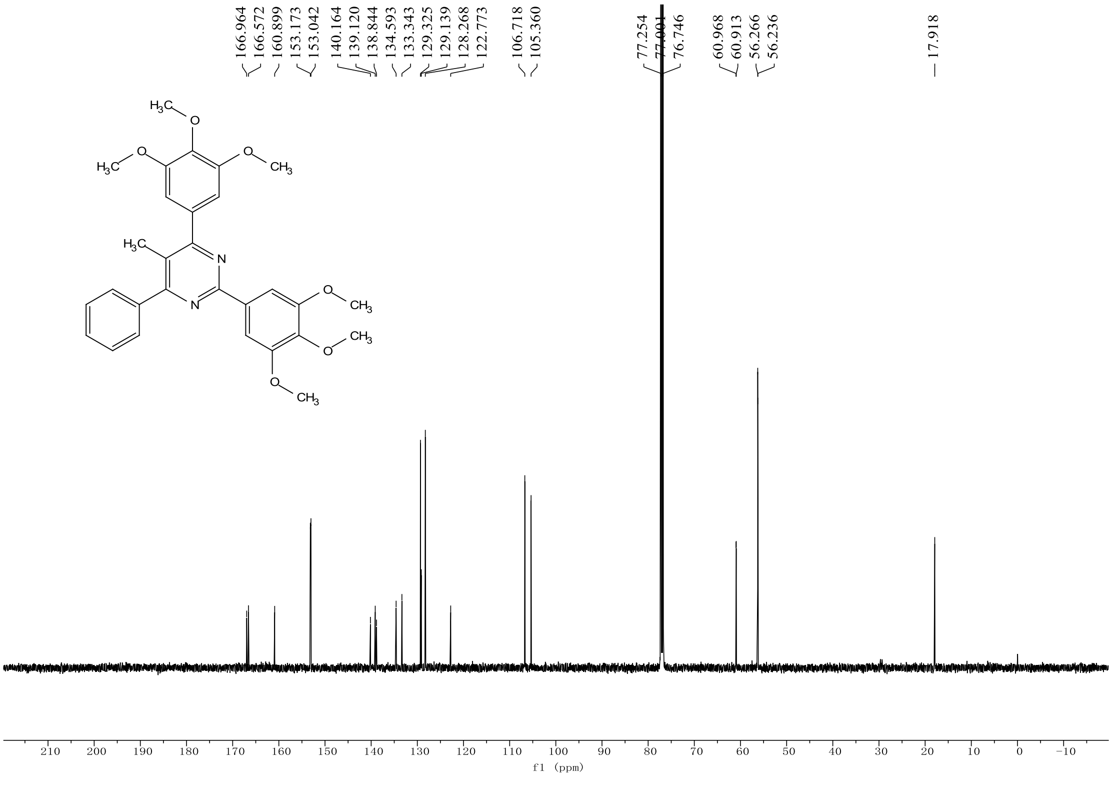




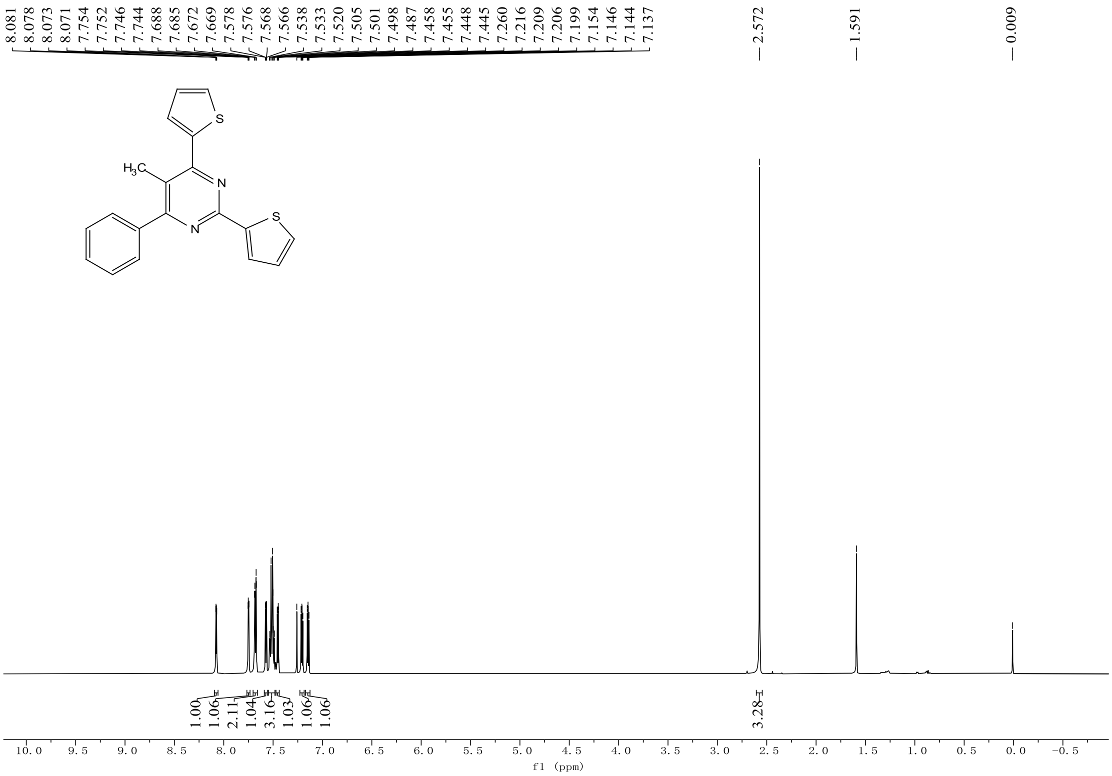
^{1}H NMR of **3ae** (500 MHz, $CDCl_3$)



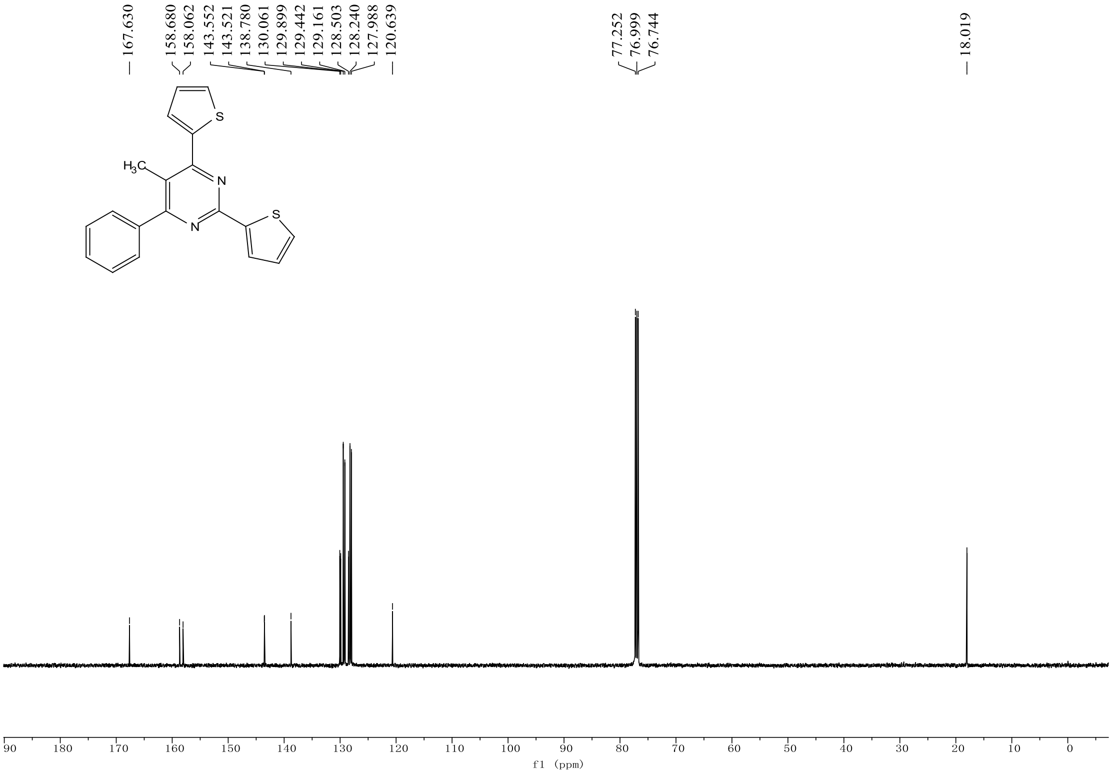
^{13}C NMR of **3ae** (125 MHz, $CDCl_3$)



^{1}H NMR of **3af** (500 MHz, $CDCl_3$)



^{13}C NMR of **3af** (125 MHz, $CDCl_3$)



6. References

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[2] Nicklas Deibl; Kevin Ament; Rhett Kempe.A Sustainable Multi-Component Pyrimidine Synthesis. *J. Am. Chem. Soc.* **2015**, 137, 40, 12804–12807.

[3] Qinghe Gao, Manman Wu, Ke Zhang, Ning Yang, Mengting Liu, Juan Li, Lizhen Fang, Suping Bai, and Yongtao Xu. I_2-Catalyzed Aerobic α,β-Dehydrogenation and Deamination of Tertiary Alkylamines: Highly Selective Synthesis of Polysubstituted Pyrimidines via Hidden Acyclic Enamines. *Org. Lett*. **2020**, 22, 14, 5645–5649.

[4] Jake D. Selingo, Jacob W. Greenwood, Mary Katherine Andrews, Chirag Patel, Andrew J. Neel, Barbara Pio, Michael Shevlin, Eric M. Phillips, Matthew L. Maddess and Andrew McNally. A General Strategy for N-(Hetero)arylpiperidine Synthesis Using Zincke Imine Intermediates. *J. Am. Chem. Soc.* **2024**, 146, 1, 936–945

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[6] Tianchao Shi, Feng Qin, Qian Li and Wu Zhang. Copper-catalyzed three-component synthesis of pyrimidines from amidines and alcohols. *Org. Biomol. Chem.*, **2018**, 16, 9487–9491.