Supplementary Material

Palladium-catalyzed tandem reaction toward 2,5-diarylthiazole derivatives

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Table of Contents

Experimental Details

General Information

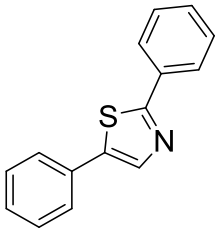
All reagents used in experiment were obtained from commercial sources and used without further purification. Solvents for chromatography were technical grade and distilled prior for using. Solvent mixtures were understood as volume/volume. Chemical yields refer to pure isolated substances. Catalysts were purchased for analytical reagent. Thin layer chromatography employed glass 0.25 mm silica gel plates with F-254 indicator, visualized by irradiation with UV light.

The NMR spectra were recorded on Bruker AVANCE III-400 spectrometry at 400 MHz and 100 MHz for ^{1}H and ^{13}C NMR in $CDCl_3$, respectively. The NMR chemical shift was reported in ppm relative to 7.26 and 77 ppm of $CDCl_3$ as the standards of ^{1}H and ^{13}C NMR, respectively. The NMR spectra were reported in delta (δ) units, parts per million (ppm) downfield from the internal standard and coupling constants were reported in Hertz (Hz). Multiplicities were indicated s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet). The mass spectra were performed on a Bruker Esquire 3000plus mass spectrometer equipped with ESI interface and ion trap analyzer. The ESI HR-MS were tested on Bruker 7-tesla FT-ICR MS equipped with an electrospray source.

General procedures for preparation of 3 , 5

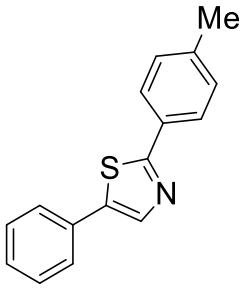
A mixture of N,N-dimethyl-2-phenylethen-1-amine **1** or **4** (10 mmol), and benzothioamides **2** (12 mmol), $Pd(OAc)_2$ (10 mol%) and Cs_2CO_3 (2 equiv, 20 mmol), in DMSO (15 mL) was stirred under an N_2 atmosphere. After the reaction mixture was stirred at 100 °C for 12 h, it was allowed to cool to ambient temperature. Then the mixture was quenched with saturated salt water (20 mL), and the solution was extracted with ethyl acetate (3×20 mL). The organic layers were combined and dried by sodium sulfate and concentrated in vacuo. The pure product 2-(phenylsulfinyl)-6,7-2,5-diphenylthiazole **3** or **5** (76-89% yield) was obtained by flash column chromatography on silica gel.

Analytical Datas



3a

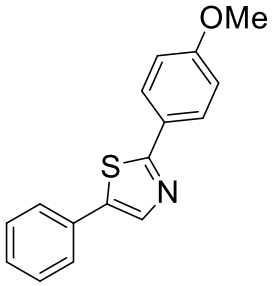
2,5-diphenylthiazole. Pale yellow solid, 2.38g, isolated yield: 87%, m.p. 116-118 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.1 (q, 2H, *J* = 4.0 Hz), 7.7 (d, 2H, *J* = 7.6 Hz), 7.4 (m, 6H), 7.3 (t, 1H, *J* = 7.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 151, 130, 129, 129, 128, 28, 127, 126, 124, 123; HRMS(ESI): m/z calcd for $C_{15}H_{11}NNaS$ $(M+Na)^+$: 260.0510, found: 260.0508.



3b

5-phenyl-2-(p-tolyl)thiazole. Pale yellow solid, 2.22g, isolated yield: 84%, m.p. 117-119 °C.

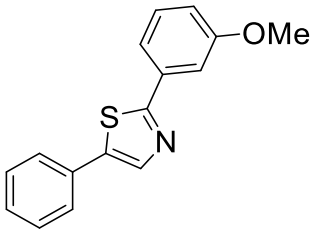
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.0 (d, 2H, *J* = 8.0 Hz), 7.7 (d, 2H, *J* = 7.6 Hz), 7.4 (t, 3H, *J* = 7.0 Hz), 7.3 (d, 1H, *J* = 7.6 Hz), 7.3 (d, 2H, *J* = 8.0 Hz), 2.41 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 151, 140, 129, 128, 128, 128, 126, 124, 124, 123, 21; HRMS(ESI): m/z calcd for $C_{16}H_{13}NNaS$ $(M+Na)^+$: 274.0666, found: 274.0664.



3c

2-(4-methoxyphenyl)-5-phenylthiazole. Pale yellow solid, 2.35g, isolated yield: 88%, m.p. 108-109 °C.

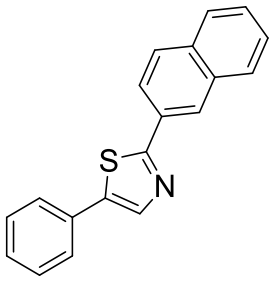
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.7 (t, 3H, *J* = 6.6 Hz), 7.6 (s, 1H), 7.4 (m, 5H), 7.00 (q, 1H, *J* = 4.2 Hz), 3.89 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 159, 151, 129, 128, 128, 128, 128, 124, 123, 118, 116, 111, 55; HRMS(ESI): m/z calcd for $C_{16}H_{13}NNaOS$ $(M+Na)^+$: 290.0616, found: 290.0614.



3d

2-(3-methoxyphenyl)-5-phenylthiazole. Pale yellow solid, 2.17g, isolated yield: 81%, m.p. 121-124 °C.

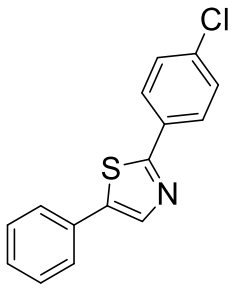
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.7 (t, 2H, *J* = 6.6 Hz), 7.6 (s, 1H), 7.4 (m, 5H), 7.00 (q, 1H, *J* = 8.4 Hz); ^{13}CNMR ($CDCl_3$, 100 MHz): δ 161, 160, 151, 130, 128, 128, 128, 128, 124, 123, 118, 116, 111, 55; HRMS(ESI): m/z calcd for $C_{16}H_{13}NNaOS$ $(M+Na)^+$: 290.0616, found: 290.0614.



3e

2-(naphthalen-2-yl)-5-phenylthiazole. Pale yellow solid, 2.18g, isolated yield: 76%, m.p. 127-129 °C.

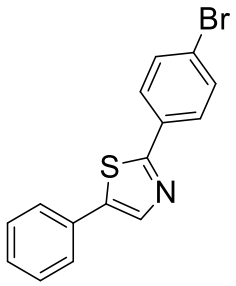
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.7 (t, 2H, *J* = 6.6 Hz), 7.6 (s, 1H), 7.3 (m, 5H), 7.0 (q, 1H, *J* = 8.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 159, 151, 130, 129, 128, 128, 128, 124, 123, 118, 116, 111, 55; HRMS(ESI): m/z calcd for $C_{19}H_{13}NNaS$ $(M+Na)^+$: 310.0666, found: 310.0664.



3f

2-(4-chlorophenyl)-5-phenylthiazole. Pale yellow solid, 2.15g, isolated yield: 79%, m.p. 123-125 °C.

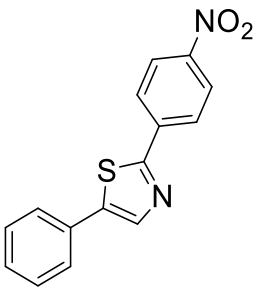
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.0 (d, 2H, *J* = 8.8 Hz), 7.7 (d, 2H, *J* = 7.6 Hz), 7.4 (m, 5H), 7.3 (t, 1H, *J* = 7.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 160, 151, 136, 129, 128, 128, 127, 127, 125, 124, 123; HRMS(ESI): m/z calcd for $C_{15}H_{10}ClNNaS$ $(M+Na)^+$: 294.0120, found: 294.0118.



3g

2-(4-bromophenyl)-5-phenylthiazole. Pale yellow solid, 2.53g, isolated yield: 80%, m.p. 120-122 °C.

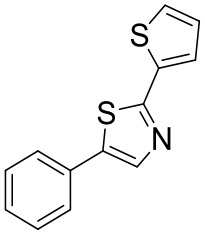
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.9 (d, 2H, *J* = 8.8 Hz), 7.7 (d, 2H, *J* = 7.6 Hz), 7.6 (d, 2H, *J* = 8.8 Hz), 7.4 (m, 3H), 7.3 (t, 1H, *J* = 7.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 171, 160, 151, 132, 128, 128, 127, 127, 126, 124, 124, 123; HRMS(ESI): m/z calcd for $C_{15}H_{10Br}NNaS$ $(M+Na)^+$: 337.9615, found: 337.9613.



3h

2-(4-nitrophenyl)-5-phenylthiazole. Pale yellow solid, 2.34g, isolated yield: 83%, m.p. 208-210 °C.

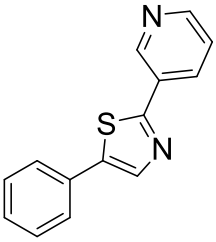
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.34\ (d, 2H, *J* = 9.2 Hz), 8.1 (m, 2H), 7.8 (d, 2H, *J* = 8.8 Hz), 7.6 (s, 1H), 7.5 (t, 3H, *J* = 3.2 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 162, 149, 147, 133, 131, 129, 126, 126, 126, 124, 124; HRMS(ESI): m/z calcd for $C_{14}H_5D_5N_2NaOS$ $(M+Na)^+$: 305.0361, found: 305.0359.



3i

5-phenyl-2-(thiophen-2-yl)thiazole. Pale yellow solid, 2.00g, isolated yield: 82%, m.p. 112-114 °C.

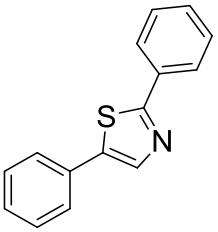
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.7 (d, 1H, *J* = 3.6 Hz), 7.7 (d, 2H, *J* = 7.6 Hz), 7.4 (m, 3H), 7.3 (s, 1H), 7.3 (t, 1H, *J* = 7.4 Hz), 7.1 (q, 1H, *J* = 4.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 157, 150, 130, 128, 128, 128, 127, 127, 127, 124, 123; HRMS(ESI): m/z calcd for $C_{13}H_9NNaS_2$ $(M+Na)^+$: 266.0074, found: 266.0072.



3j

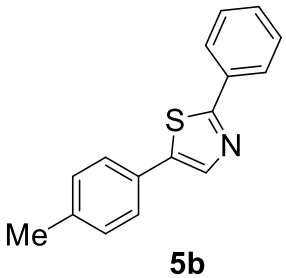
5-phenyl-2-(pyridin-3-yl)thiazole. Pale yellow solid, 1.86g, isolated yield: 78%, m.p. 137-139 °C.

^{1}H NMR ($CDCl_3$, 400 MHz): δ 9.3 (d, 1H, *J* = 1.2 Hz), 8.6 (d, 1H, *J* = 3.2 Hz), 8.3 (d, 1H, *J* = 8.0 Hz), 7.7 (d, 2H, *J* = 7.6 Hz), 7.3 (m, 5H); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 158, 152, 150, 147, 133, 129, 128, 127, 124, 123, 123; HRMS(ESI): m/z calcd for $C_{14}H_{10}N_2NaS$ $(M+Na)^+$: 261.0462, found: 261.0460.



5a

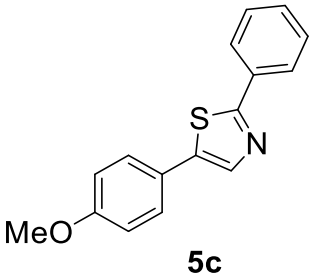
2,5-diphenylthiazole. Pale yellow solid, 2.38g, isolated yield: 87%, m.p. 116-118 °C. ^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.1 (q, 2H, *J* = 4.0 Hz), 7.7 (d, 2H, *J* = 7.6 Hz), 7.4 (m, 6H), 7.3 (t, 1H, *J* = 7.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 151, 130, 128, 128, 128, 28, 127, 126, 124, 123; HRMS(ESI): m/z calcd for $C_{15}H_{11}NNaS$ $(M+Na)^+$: 260.0510, found: 260.0508.



5b

2-phenyl-5-(p-tolyl)thiazole. Pale yellow solid, 2.19g, isolated yield: 87%, m.p. 129-131 °C.

^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.1 (d, 2H, *J* = 8.0 Hz), 7.6 (d, 2H, *J* = 8.0 Hz), 7.4 (m, 3H), 7.3 (s, 1H), 7.2 (d, 2H, *J* = 7.6 Hz), 2,39 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 160, 151, 138, 130, 129, 128, 127, 126, 125, 124, 122, 21; HRMS(ESI): m/z calcd for $C_{16}H_{13}NNaS$ $(M+Na)^+$: 274.0666, found: 274.0664.

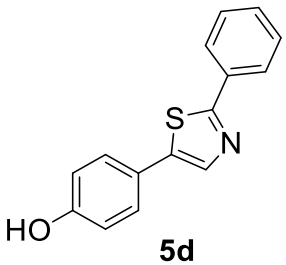


5c

5-(4-methoxyphenyl)-2-phenylthiazole. Colorless solid, 2.27g, isolated yield: 85%, m.p. 128-129 °C.

^{1}H ($CDCl_3$, 400 MHz): δ 8.1 (d, 2H, *J* = 6.4 Hz), 7.6 (d, 2H, *J* = 8.8 Hz), 7.4 (m, 3H), 7.3 (s, 1H), 6.9 (d, 2H, *J* = 8.8 Hz), 3.8 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 160, 159, 151, 130, 128, 127, 126, 125, 122, 121, 114, 55; HRMS(ESI): m/z calcd for $C_{16}H_{13}NNaOS$ $(M+Na)^+$:

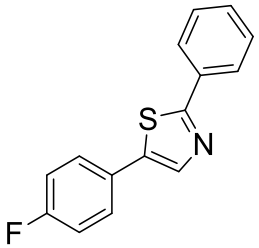
290.3358, found: 290.3356.



5d

4-(2-phenylthiazol-5-yl)phenol. Pale yellow solid, 2.13g, isolated yield: 84%, m.p.89-91 °C.

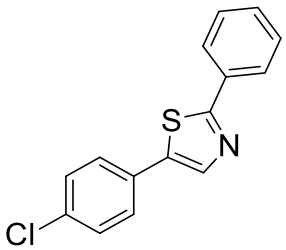
^{1}H MR (DMSO-*d*, 400 MHz): δ 9.8 (s, 1H), 8.0 (t, 2H, *J* = 6.4 Hz), 7.6 (d, 2H, *J* = 8.8 Hz), 7.5 (s, 1H), 7.4 (m, 3H), 6.8 (d, 2H, *J* = 8.4 Hz); ^{13}C NMR (DMSO-*d*, 100 MHz): δ 159, 158, 151, 130, 129, 127, 126, 126, 122, 119, 116; HRMS(ESI): m/z calcd for $C_{14}H_5D_5N_2NaOS$ $(M+Na)^+$: 276.0459, found: 276.0457.



5e

5-(4-fluorophenyl)-2-phenylthiazole. Pale yellow solid, 1.97g, isolated yield: 77%, m.p. 98-100 °C.

^{1}H MR ($CDCl_3$, 400 MHz): δ 8.0 (q, 2H, *J* = 7.2 Hz), 7.6 (m, 2H), 7.4 (m, 3H), 7.3 (s, 1H), 7.1 (d, 2H, *J* = 8.8 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 150, 130, 129, 128, 129, 127, 126, 126, 123, 116; HRMS(ESI): m/z calcd for $C_{15}H_{10}FNNaS$ $(M+Na)^+$: 278.0416, found: 278.0414.

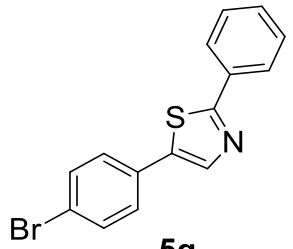


5f

5-(4-chlorophenyl)-2-phenylthiazole. Colorless solid, 2.31G, isolated yield: 85%, m.p. 110-112 °C.

^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.0 (q, 2H, *J* = 3.8 Hz), 7.6 (d, 2H, *J* = 8.4 Hz), 7.4 (m, 3H),

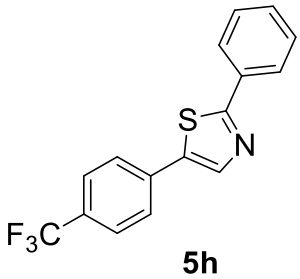
7.4 (d, 2H, *J* = 3.6 Hz), 7.3 (s, 1H); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 150, 134, 130, 129, 128, 127, 126, 126, 125, 123; HRMS(ESI): m/z calcd for $C_{15}H_{10}ClNNaS$ $(M+Na)^+$: 294.0120, found: 294.0118.



5g

5-(4-bromophenyl)-2-phenylthiazole. Pale yellow solid, 2.62g, isolated yield: 83%, m.p. 111-113 °C.

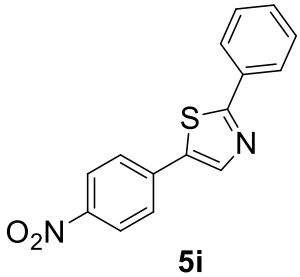
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.0 (q, 2H, *J* = 4.0 Hz), 7.5 (s, 4H), 7.4 (m, 4H); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 150, 132, 130, 128, 127, 127, 126, 125, 124, 123; HRMS(ESI): m/z calcd for $C_{15}H_{10}BrNNaS$ $(M+Na)^+$: 337.9615, found: 337.9613.



5h

2-phenyl-5-(4-(trifluoromethyl)phenyl)thiazole. Colorless solid, 2.29g, isolated yield: 75%, m.p. 203-205 °C.

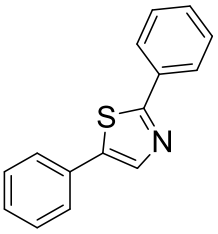
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.1 (q, 2H, *J* = 3.8 Hz), 7.8 (d, 2H, *J* = 8.0 Hz), 7.6 (d, 2H, *J* = 8.0 Hz), 7.5 (s, 1H), 7.4 (q, 3H, *J* = 2.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 162, 149, 131, 131, 130, 129, 128, 127, 126, 126, 125, 124; HRMS(ESI): m/z calcd for $C_{16}H_{10}F_3NNaS$ $(M+Na)^+$: 328.0384, found: 328.0382.



5i

5-(4-nitrophenyl)-2-phenylthiazole. Pale yellow solid, 2.51g, isolated yield: 89%, m.p. 132-135 °C.

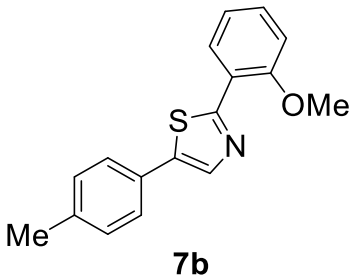
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.3 (d, 2H, *J* = 9.2 Hz), 8.1 (m, 2H), 7.8 (d, 2H, *J* = 8.8 Hz), 7.6 (s, 1H), 7.5 (d, 3H, *J* = 3.2 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 162, 149, 147, 133, 131, 129, 126, 126, 126, 124, 124; HRMS(ESI): m/z calcd for $C_{15}H_{10}N_2NaO_2S$ $(M+Na)^+$: 305.3068, found: 305.3066.



7a

2,5-diphenylthiazole. Pale yellow solid, 2.11g, isolated yield: 87%, m.p. 118-120 ^{o}C.

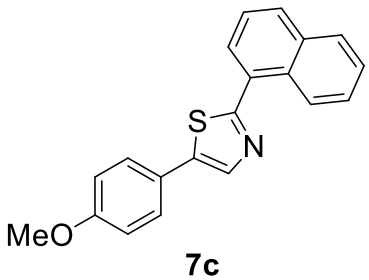
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.1 (q, 2H, *J* = 4.0 Hz), 7.7 (d, 2H, *J* = 7.6 Hz), 7.4 (m, 6H), 7.3 (t, 1H, *J* = 7.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 151, 130, 128, 128, 128, 28, 127, 126, 124, 123; HRMS(ESI): m/z calcd for $C_{15}H_{11}NNaS$ $(M+Na)^+$: 260.0510, found: 260.0508.



7b

2-(2-methoxyphenyl)-5-(p-tolyl)thiazole. Pale yellow solid, 1.80g, isolated yield: 74%, m.p. 117-119 ^{o}C.

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.7 (t, 2H, *J* = 6.6 Hz), 7.6 (s, 1H), 7.3 (m, 5H), 7.0 (q, 1H, *J* = 8.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 159, 151, 130, 129, 128, 128, 128, 124, 123, 118, 116, 111, 55; HRMS(ESI): m/z calcd for $C_{17}H_{15}NNaOS$ $(M+Na)^+$: 304.0772, found: 304.0770.

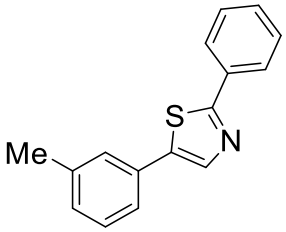


7c

5-(4-methoxyphenyl)-2-(naphthalen-1-yl)thiazole. Pale yellow solid, 2.38g, isolated

yield: 85%, m.p. 109-112 °C.

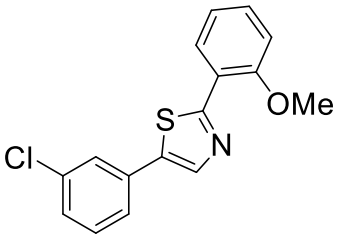
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.6 (s, 1H),8.1 (d, 1H, *J* = 8.4 Hz), 7.7 (m, 5H), 7.47 (m, 5H), 7.3 (t, 1H, *J* = 7.2 5 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 151, 134, 133, 128, 128, 128, 128, 128, 127, 127, 126, 126, 124, 124, 123, 123; HRMS(ESI): m/z calcd for $C_{20}H1_5NNaOS$ $(M+Na)^+$: 340.0772, found: 340.0770.



7d

2-phenyl-5-(m-tolyl)thiazole. Pale yellow solid, 1.81g, isolated yield: 82%, m.p. 119-121 °C.

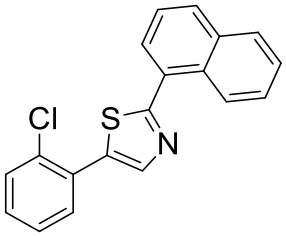
^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.1 (d, 2H, *J* = 8.0 Hz), 7.6 (d, 2H, *J* = 8.0 Hz), 7.4 (m, 3H), 7.4 (s, 1H), 7.2 (d, 2H, *J* = 7.6 Hz), 2,3 (s, 3H); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 160, 151, 138, 130, 129, 128, 127, 126, 125, 124, 122, 21; HRMS(ESI): m/z calcd for $C_{16}H_{13}NNaS$ $(M+Na)^+$: 274.0666, found: 274.0664.



7e

5-(3-chlorophenyl)-2-(2-methoxyphenyl)thiazole. Pale yellow solid, 2.39g, isolated yield: 89%, 112-114 °C.

^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.1 (m, 2H), 7.6 (s, 1H), 7.5 (d, 1H, *J* = 8.0 Hz), 7.4 (m, 4H), 7.3 (t, 1H, *J* = 8.0 Hz), 7.2 (d, 1H, *J* = 8.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 149, 135, 130, 130, 129, 128, 128, 127, 126, 124, 124, 122; HRMS(ESI): m/z calcd for $C_{16}H_{12}ClNNaOS$ $(M+Na)^+$: 324.0226, found: 324.0224.



7f

5-(2-chlorophenyl)-2-(naphthalen-1-yl)thiazole. Colorless solid, 2.00g, isolated yield: 72%, 111-112 °C.

^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.1 (q, 2H, *J* = 3.8 Hz), 7.7 (s, 1H), 7.5 (d, 1H, *J* = 8.0 Hz), 7.4 (m, 4H), 7.3 (t, 1H, *J* = 8.0 Hz), 7.3 (d, 1H, *J* = 8.4 Hz); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 161, 149, 135, 130, 130, 129, 128, 128, 127, 126, 124, 124, 122; HRMS(ESI): m/z calcd for $C_{19}H_{12}ClNNaS$ $(M+Na)^+$: 344.0277, found: 344.0275.

Spectrums

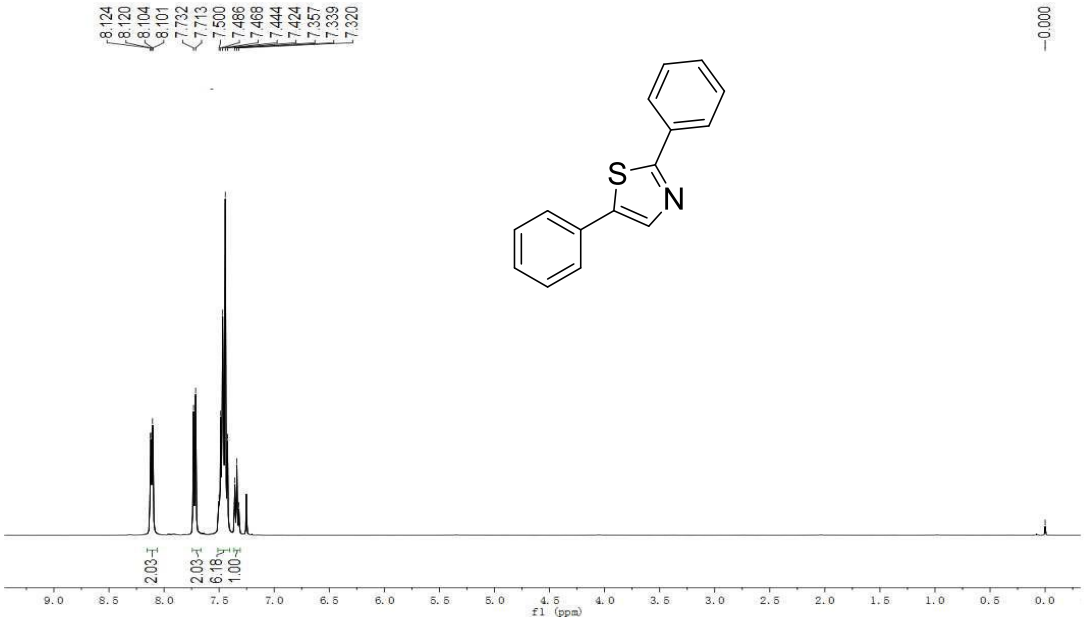


Figure 1. **3a** ^{1}H NMR

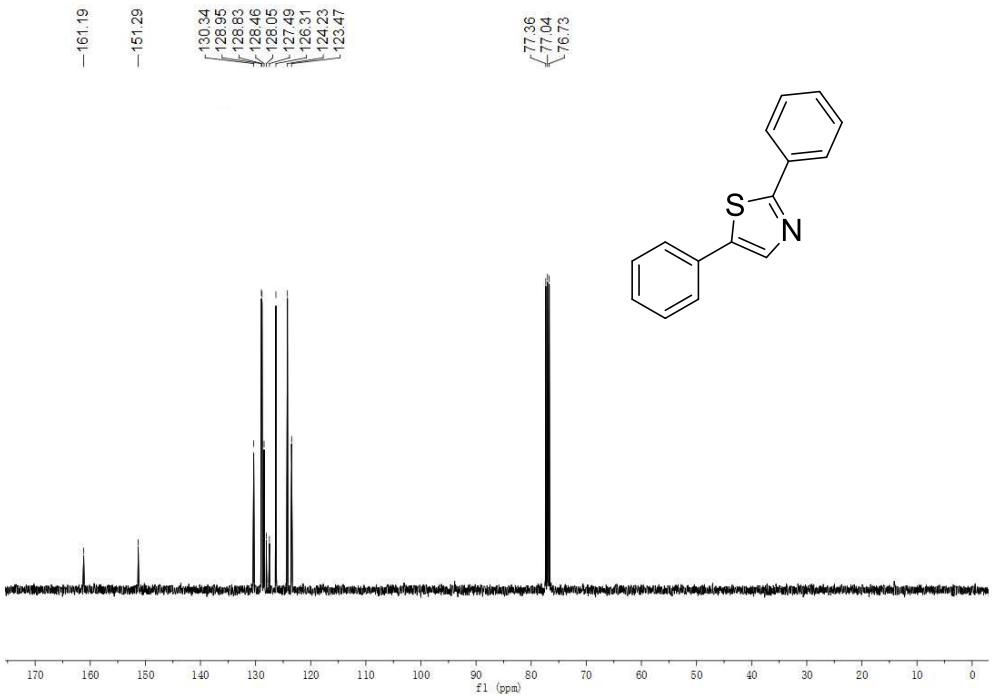


Figure 2. **3a** ^{13}C NMR

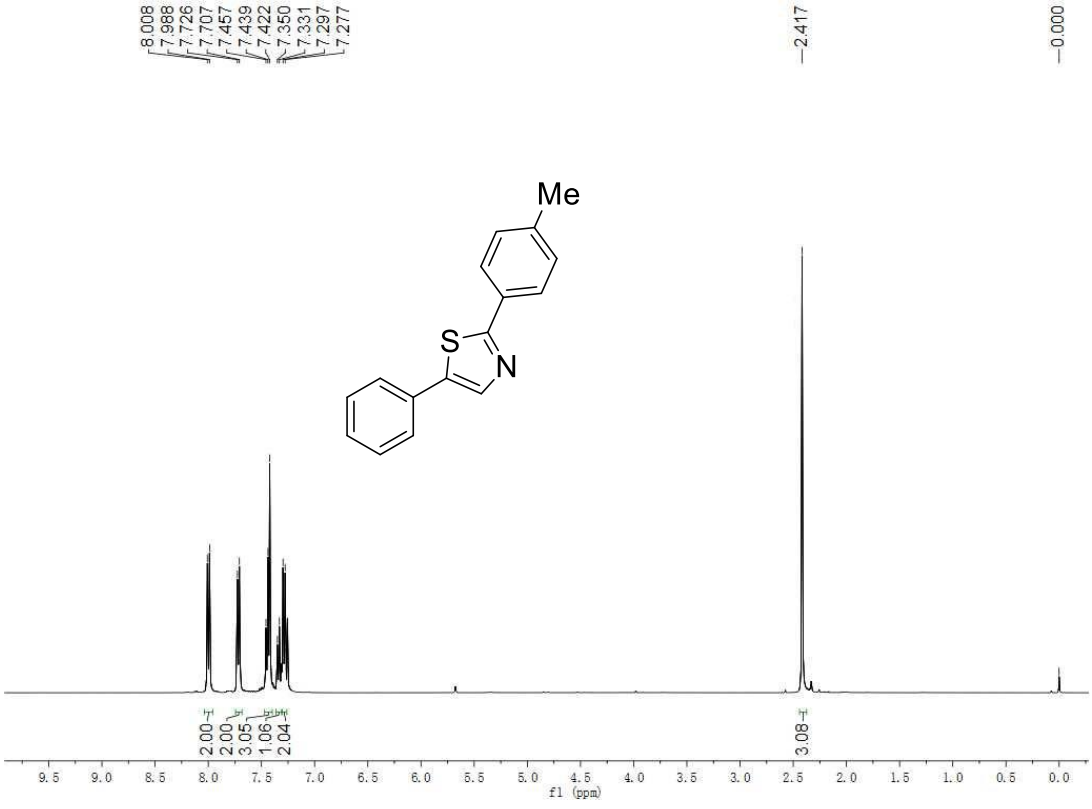


Figure 3. **3b** ^{1}H NMR

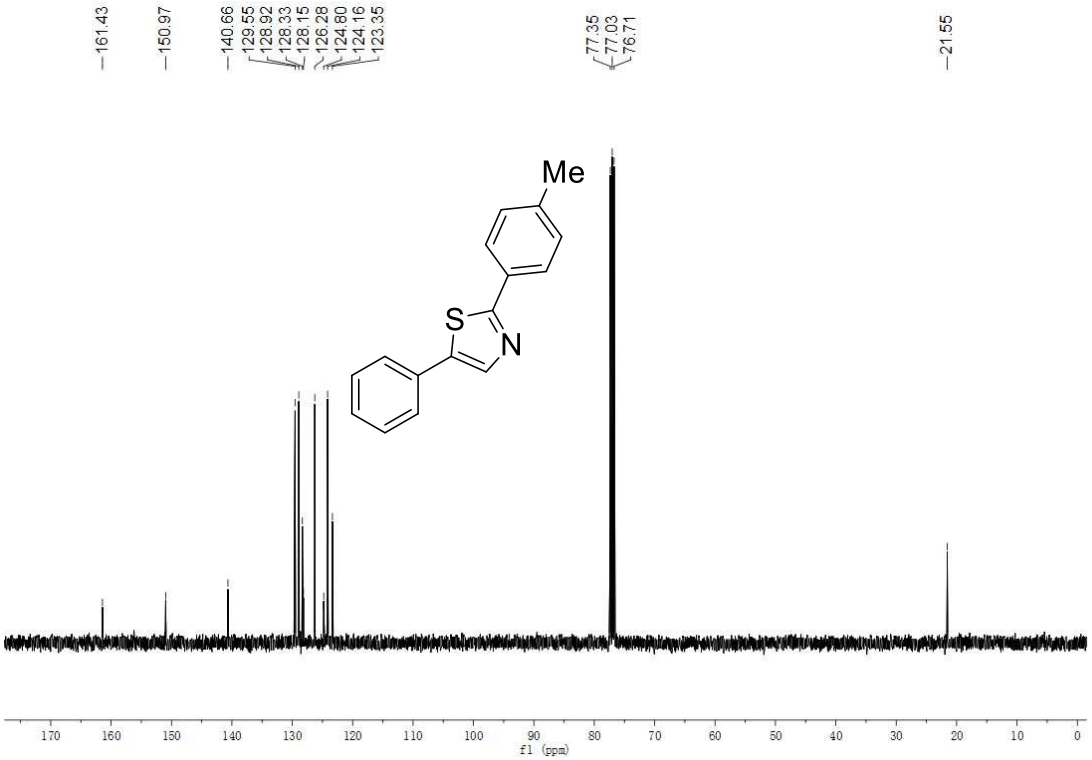


Figure 4. **3b** ^{13}C NMR

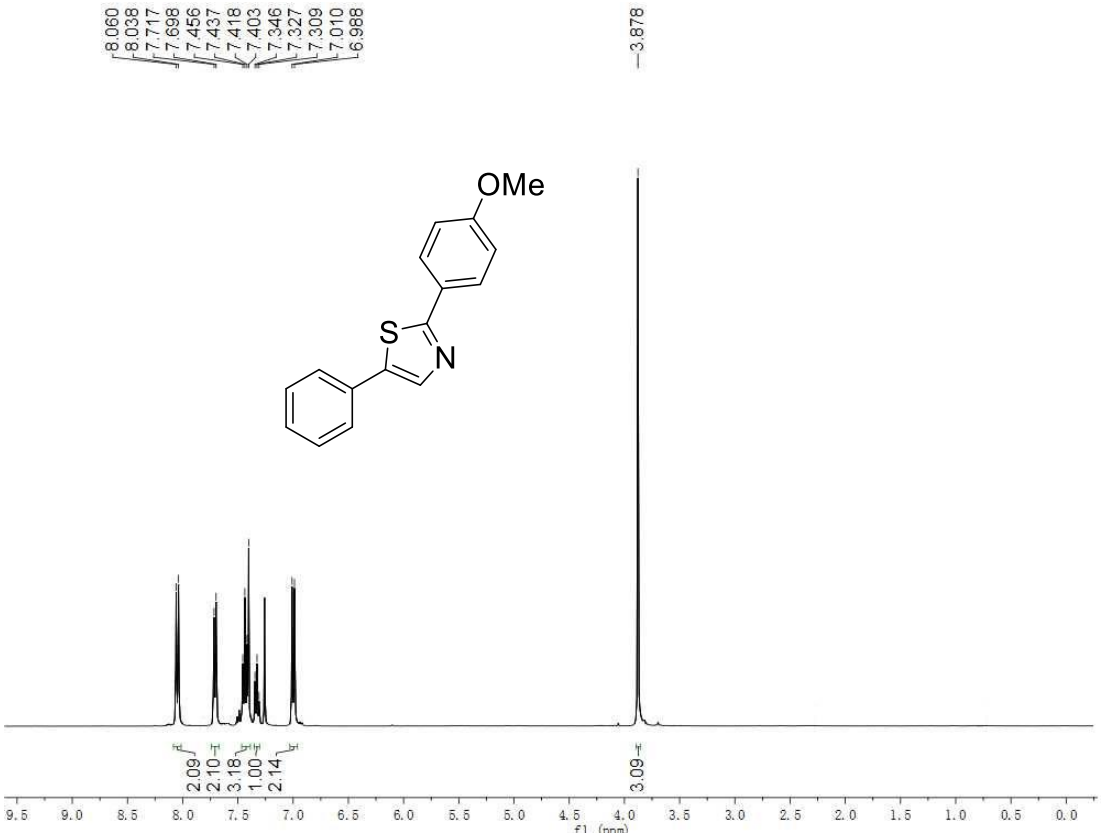


Figure 5. **3c** ^{1}H NMR

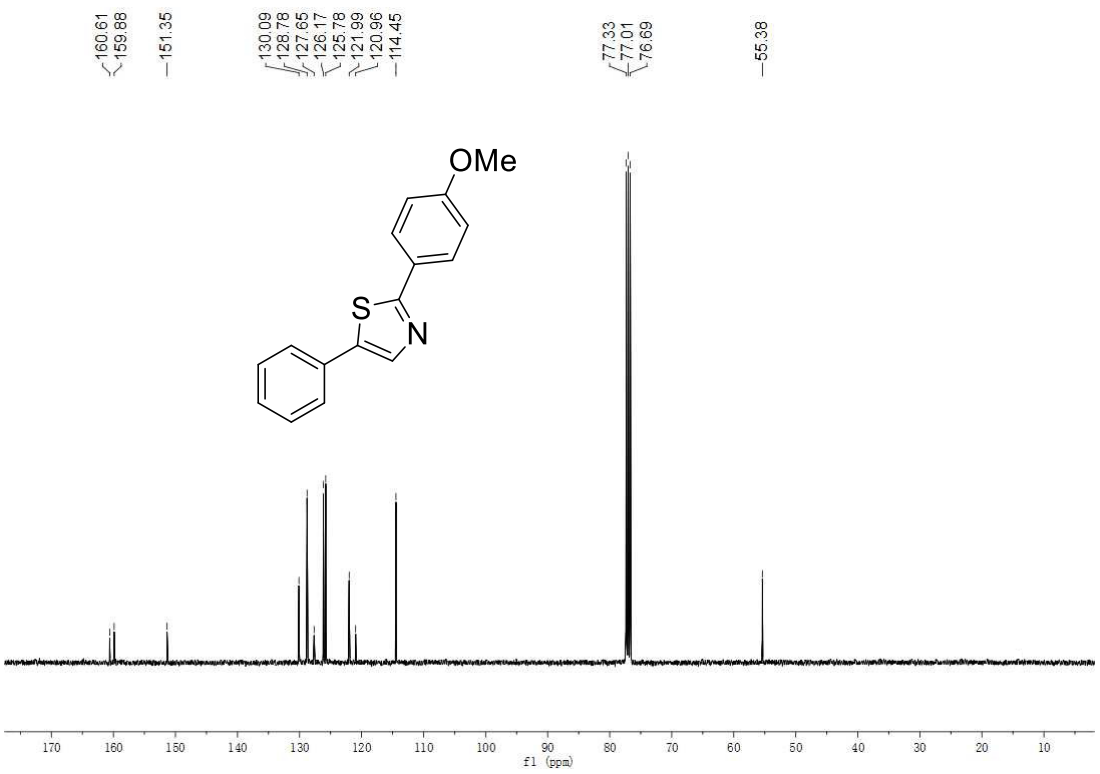


Figure 6. **3c** ^{13}C NMR

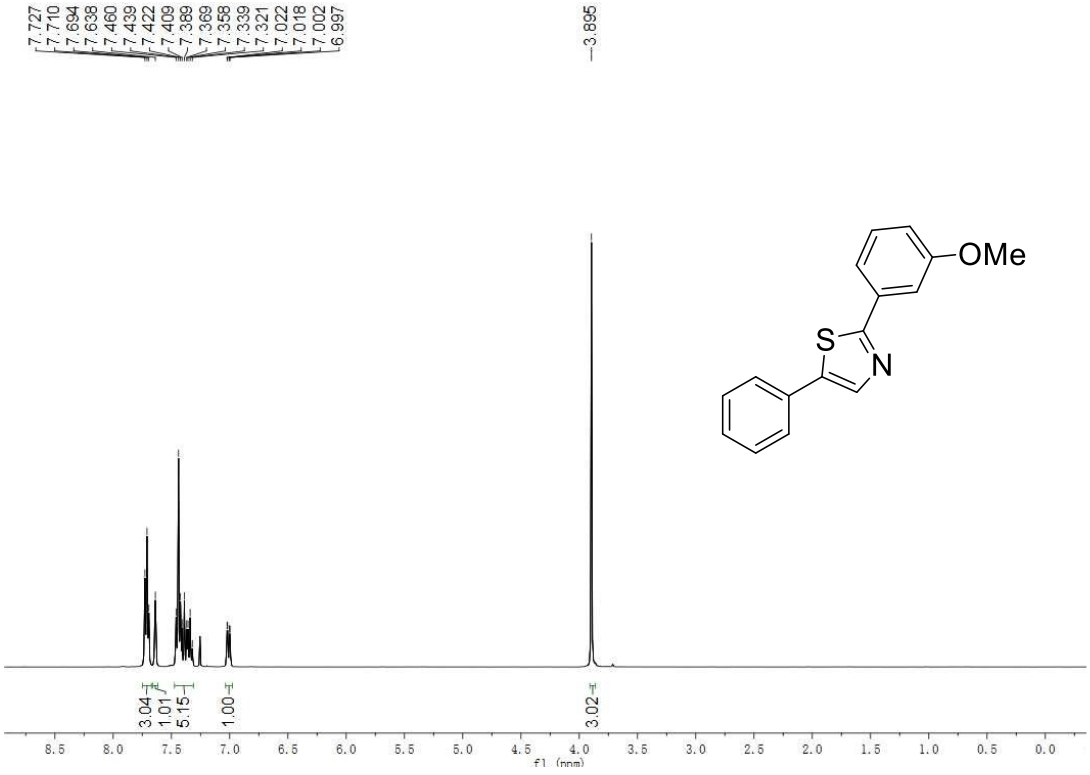


Figure 7. **3d** ^{1}H NMR

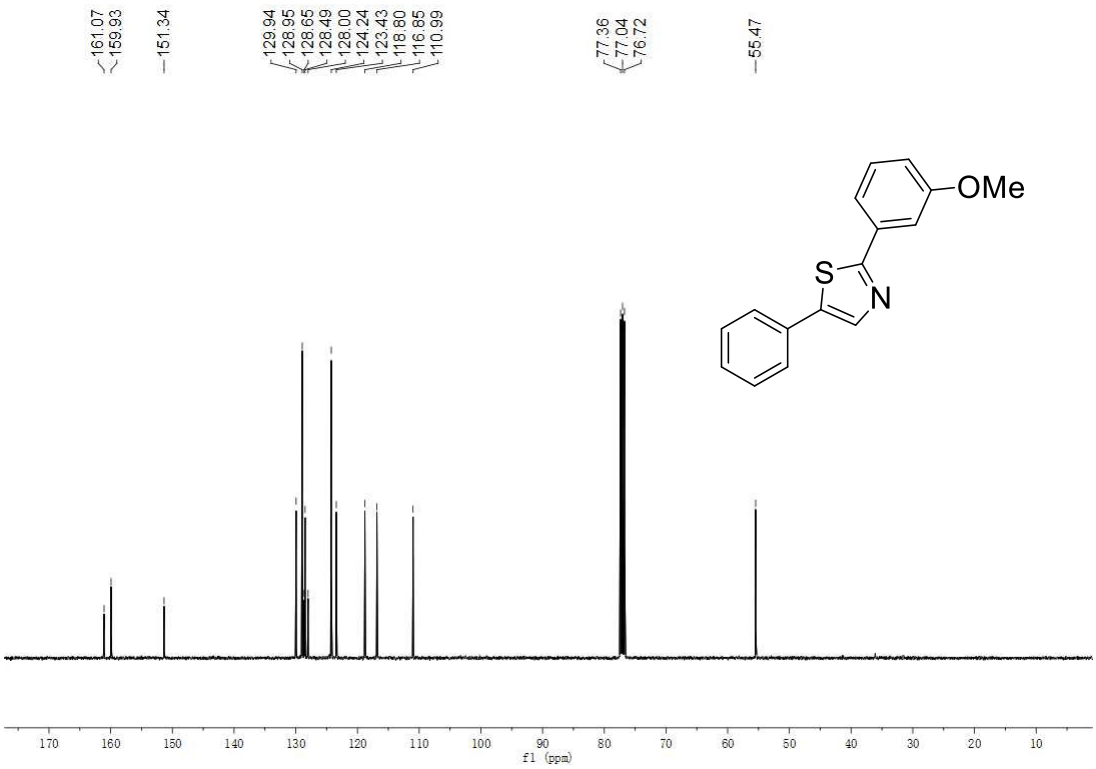


Figure 8. **3d** ^{13}C NMR

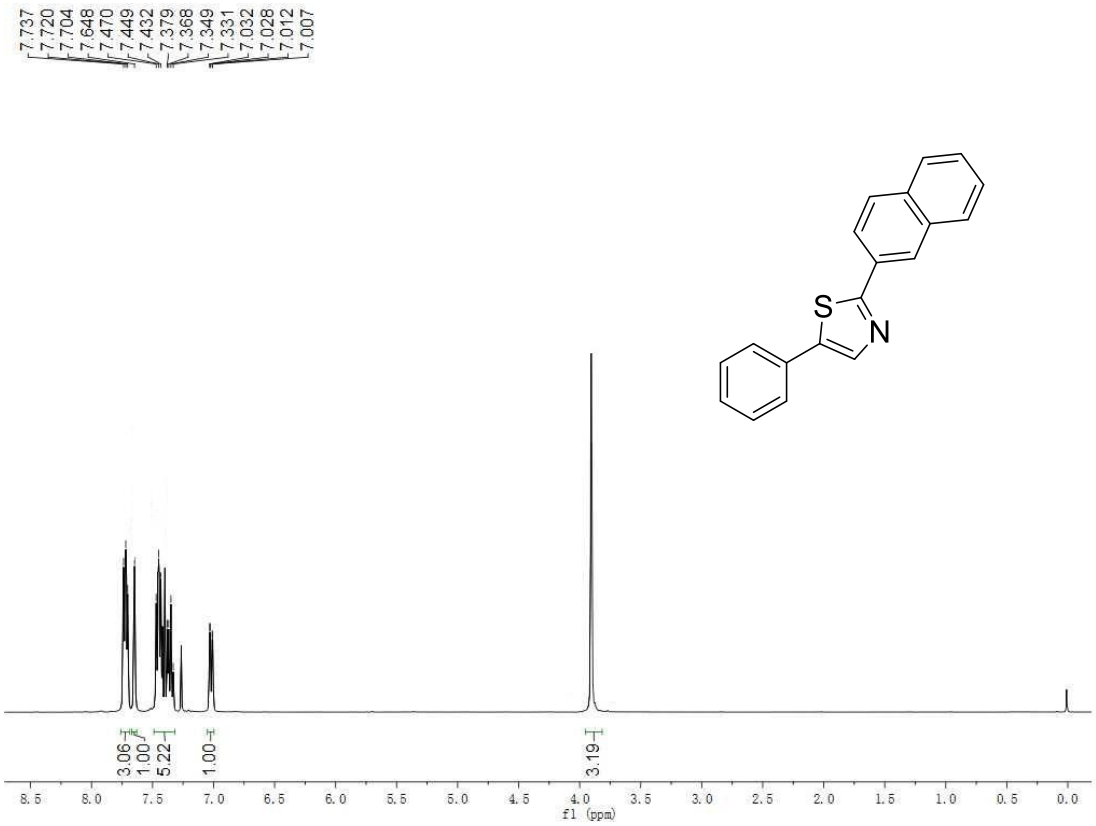


Figure 9. **3e** ^{1}H NMR

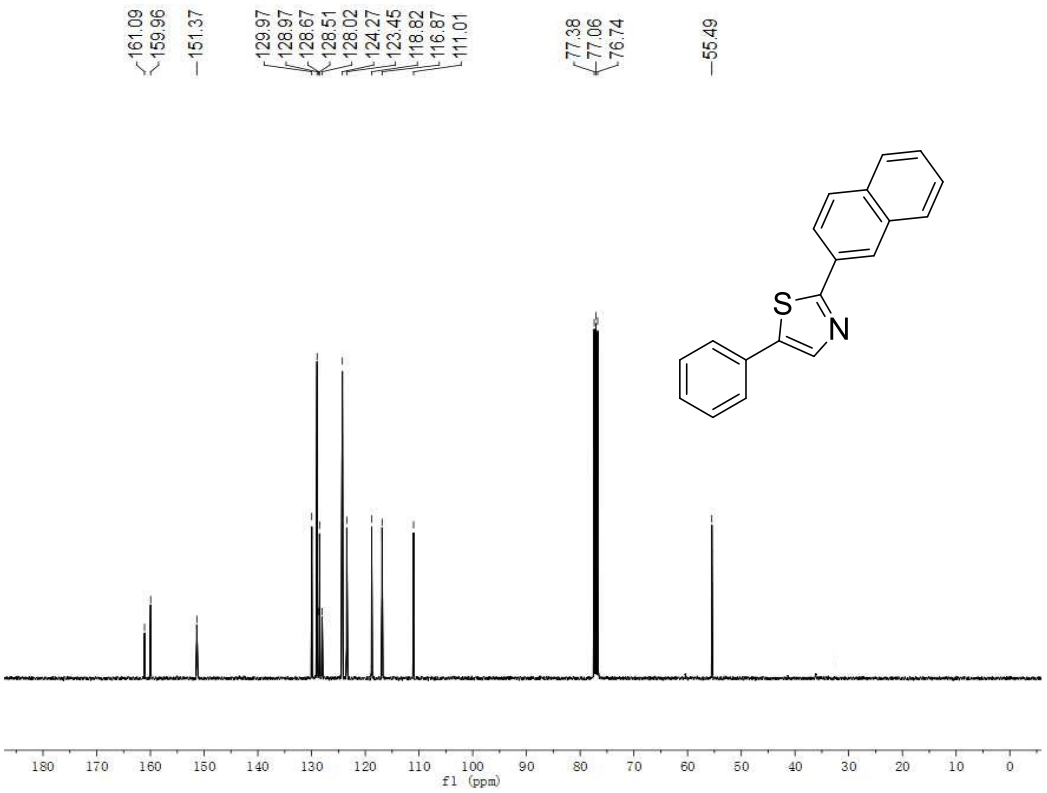


Figure 10. **3e** ^{13}C NMR

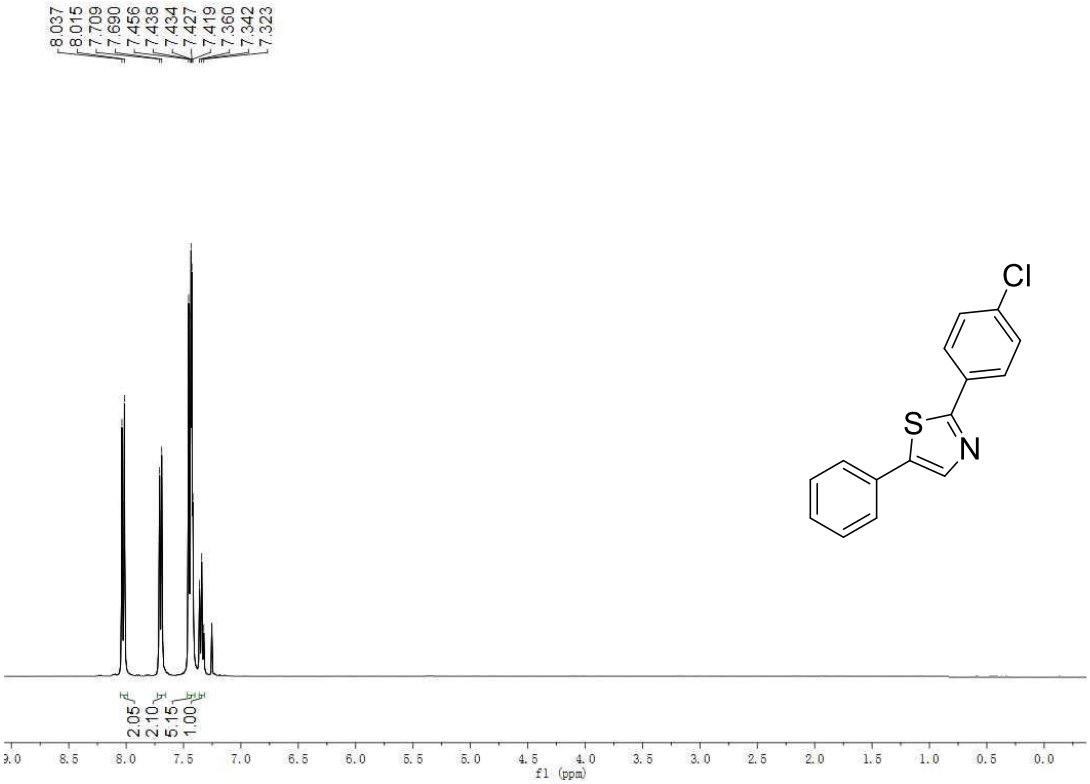


Figure 11. **3f** ^{1}H NMR

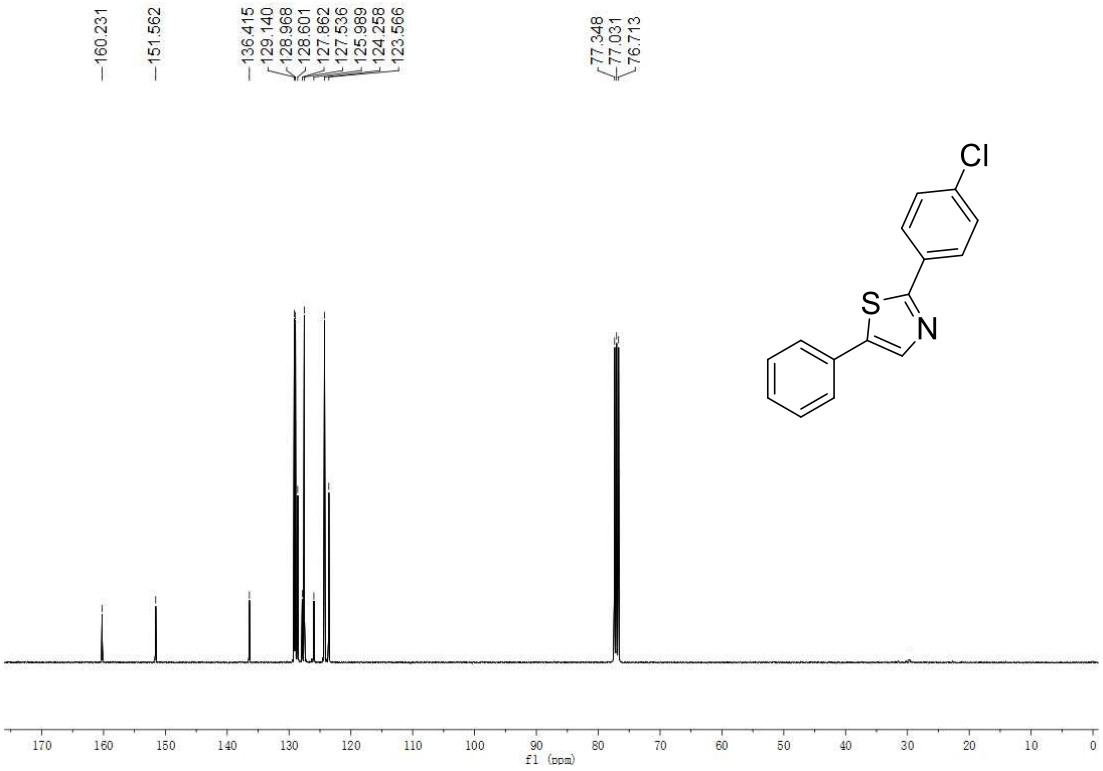


Figure 12. **3f** ^{13}C NMR

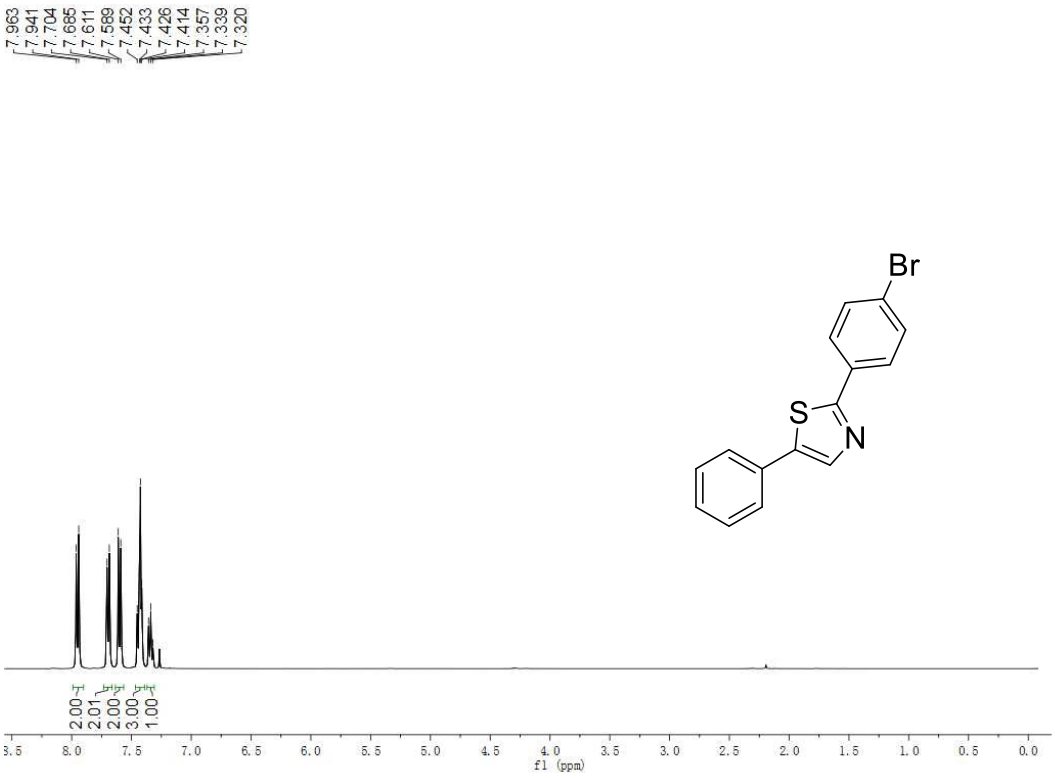


Figure 13. **3g** ^{1}H NMR

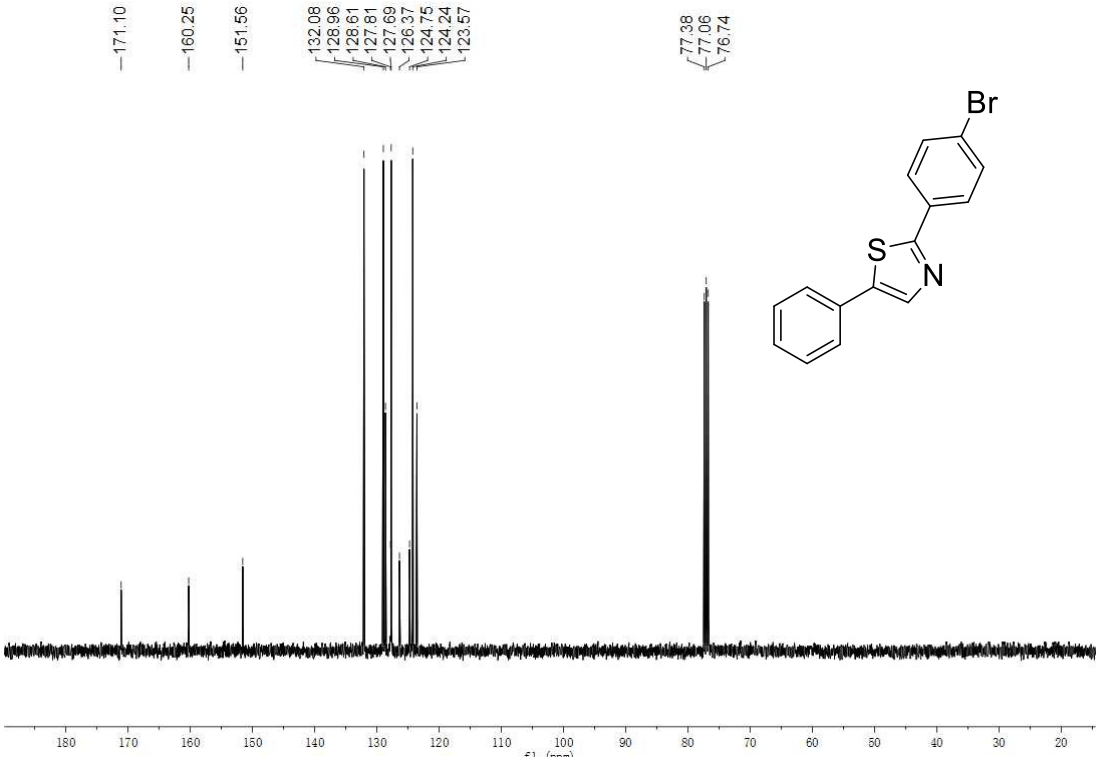


Figure 14. **3g** ^{13}C NMR

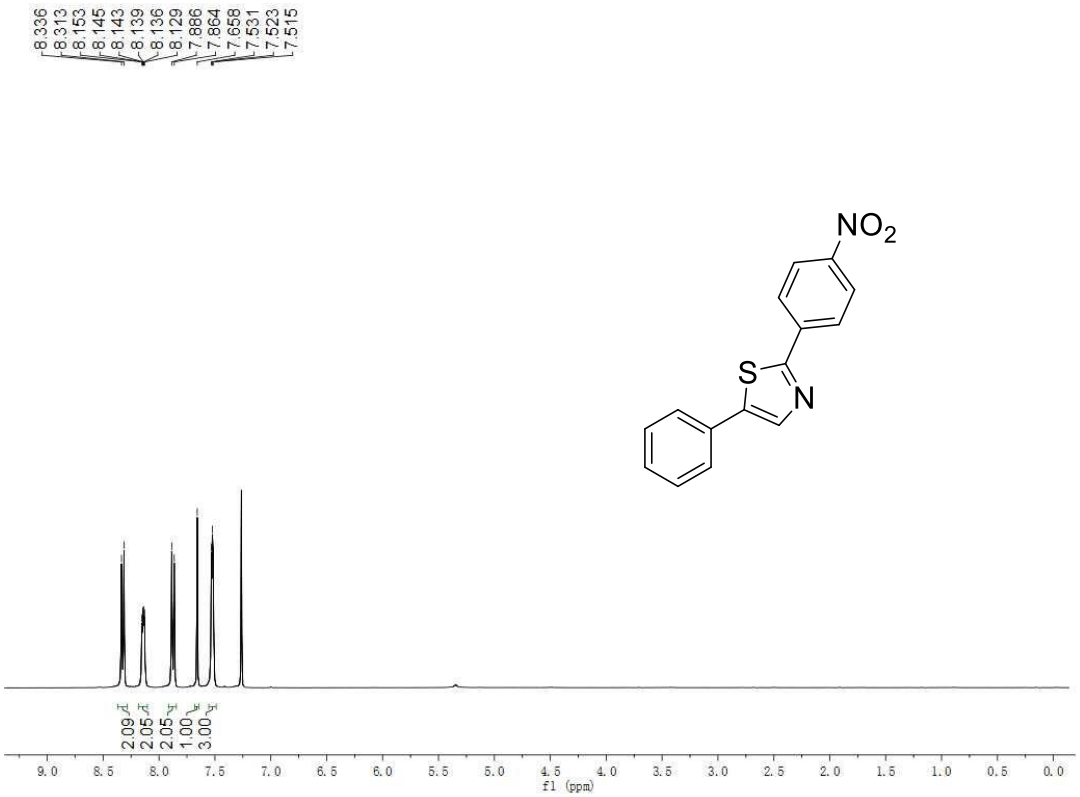


Figure 15. **3h** ^{1}H NMR

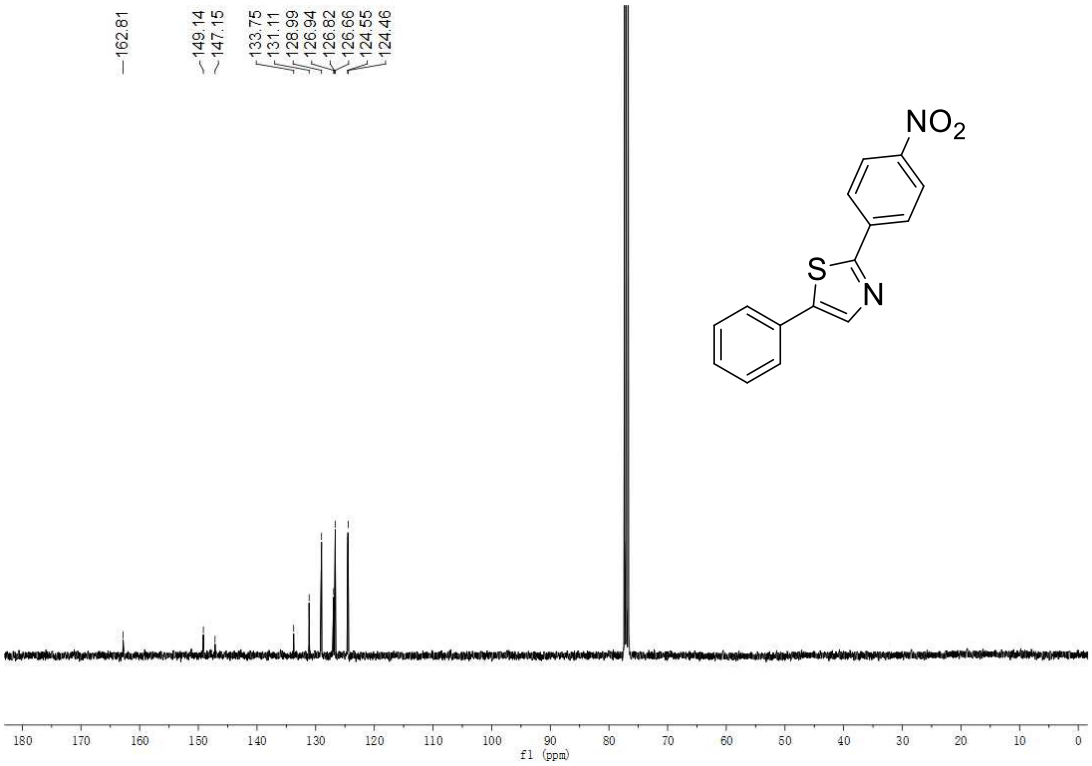


Figure 16. **3h** ^{13}C NMR

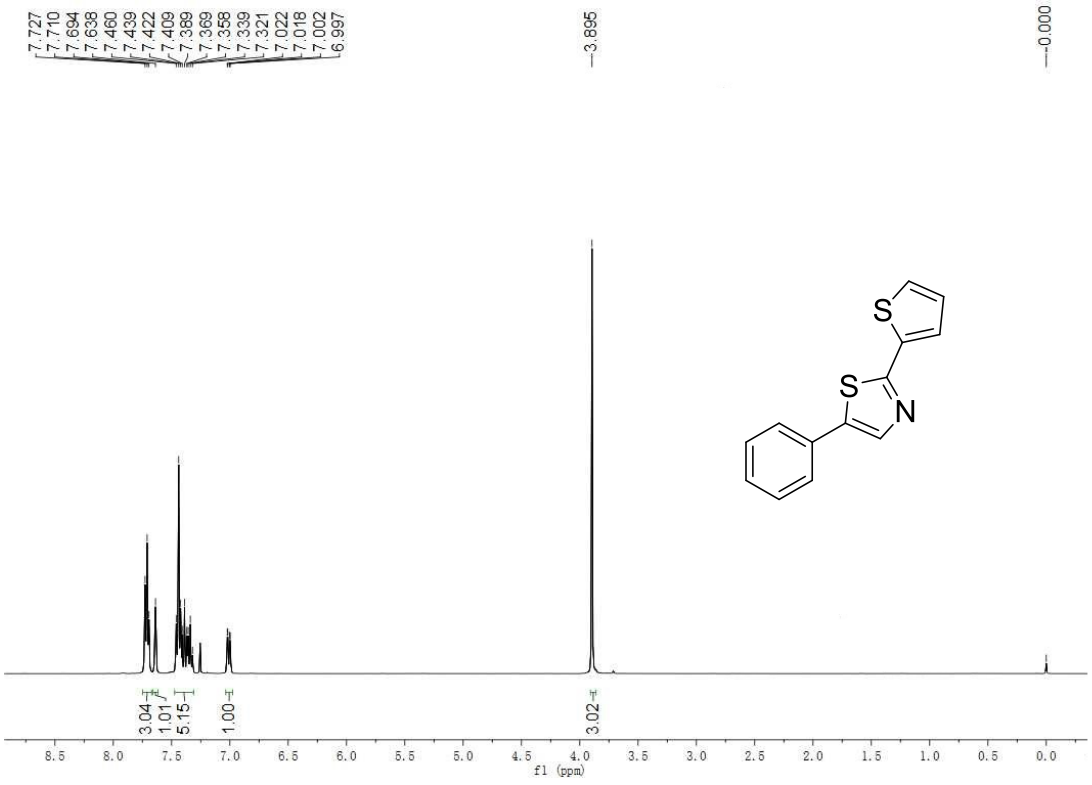


Figure 17. **3i** ^{1}H NMR

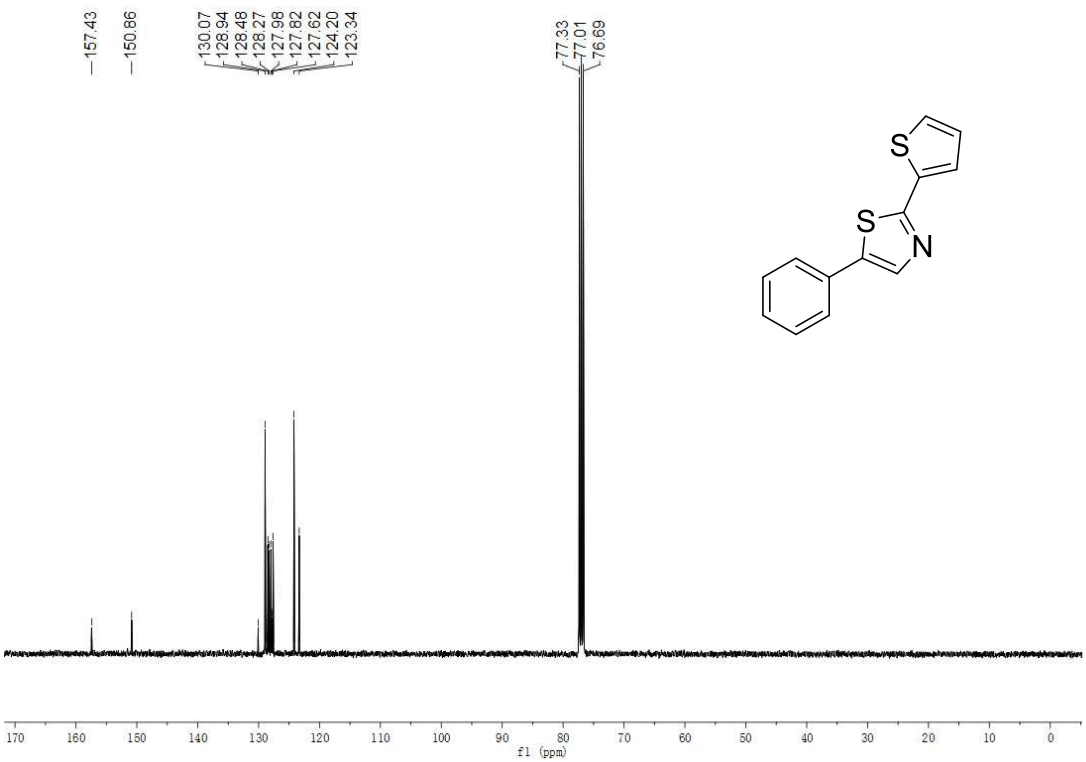


Figure 18. **3i** ^{13}C NMR

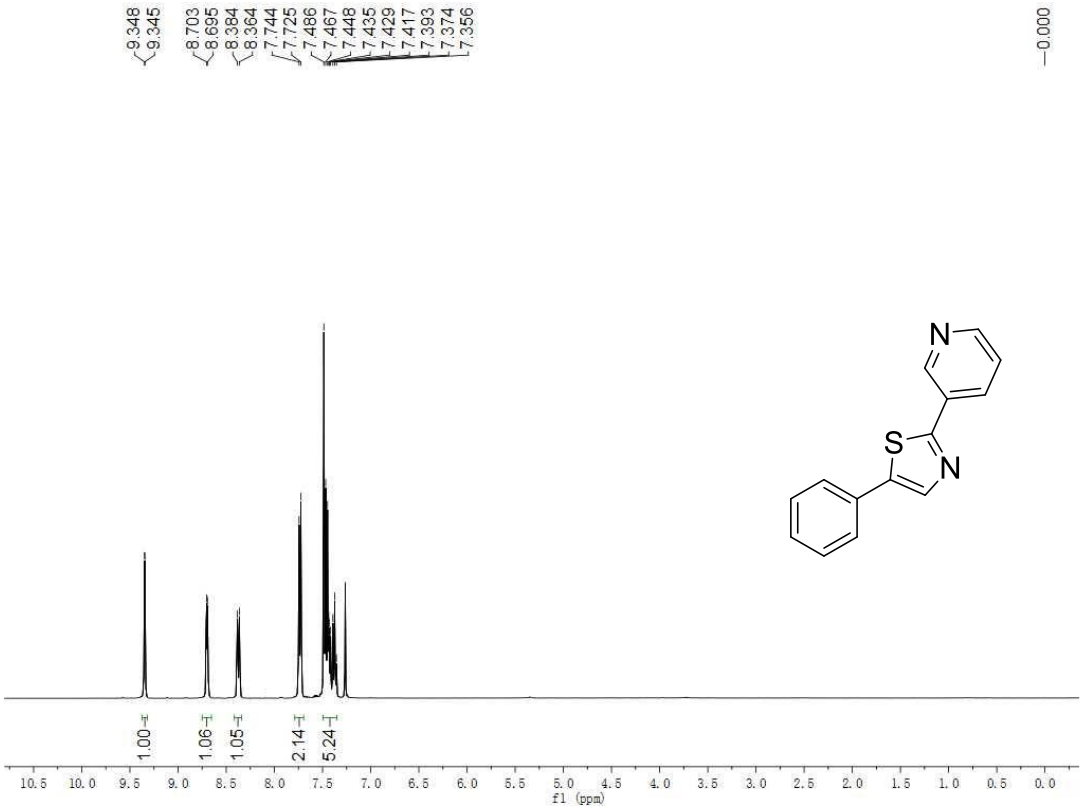


Figure 19. **3j** ^{1}H NMR

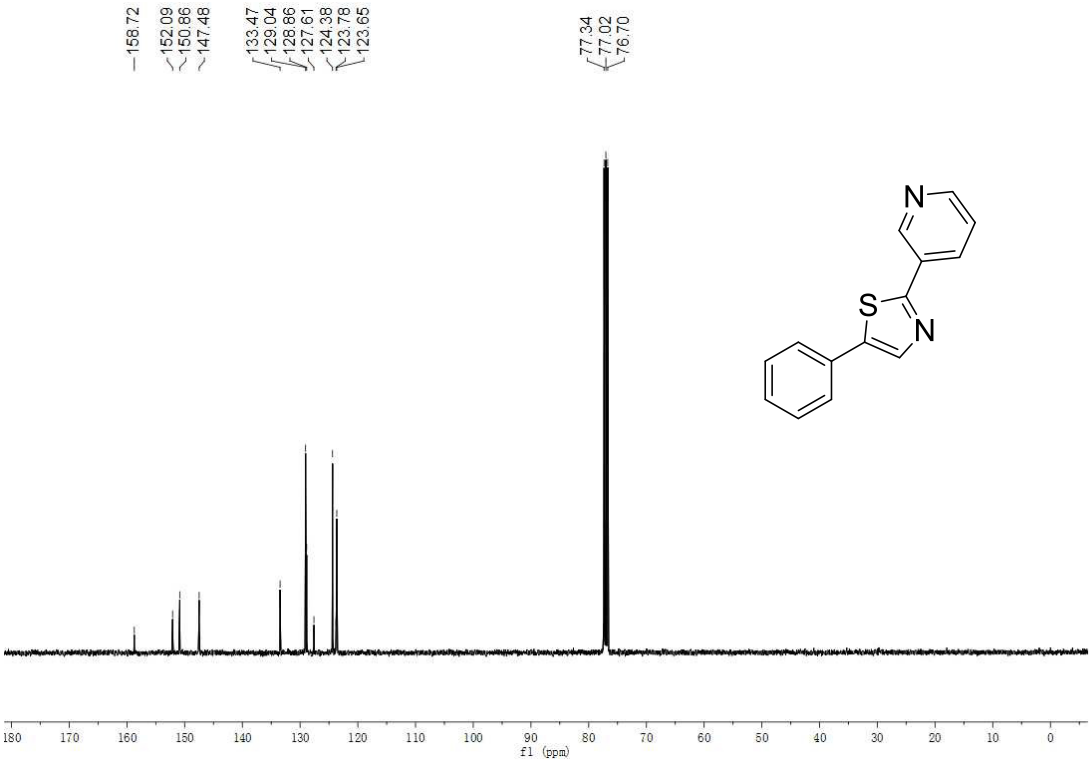


Figure 20. **3j** ^{13}C NMR

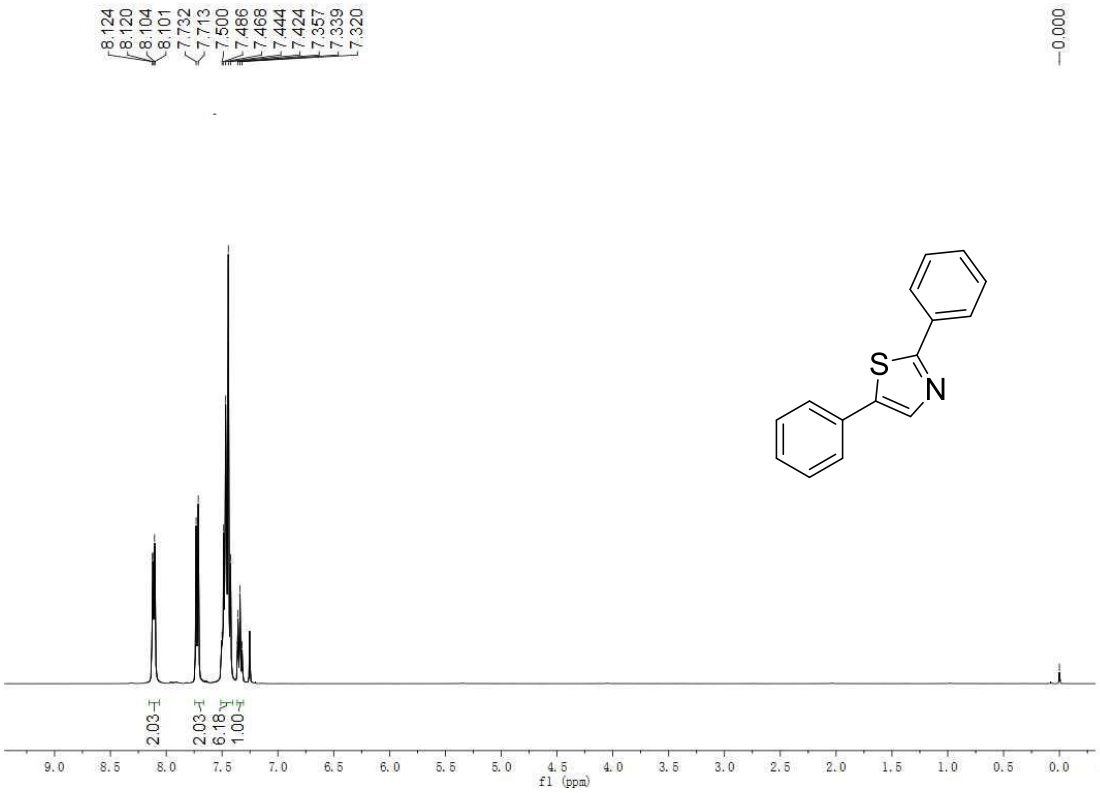


Figure 21. **5a** ^{1}H NMR

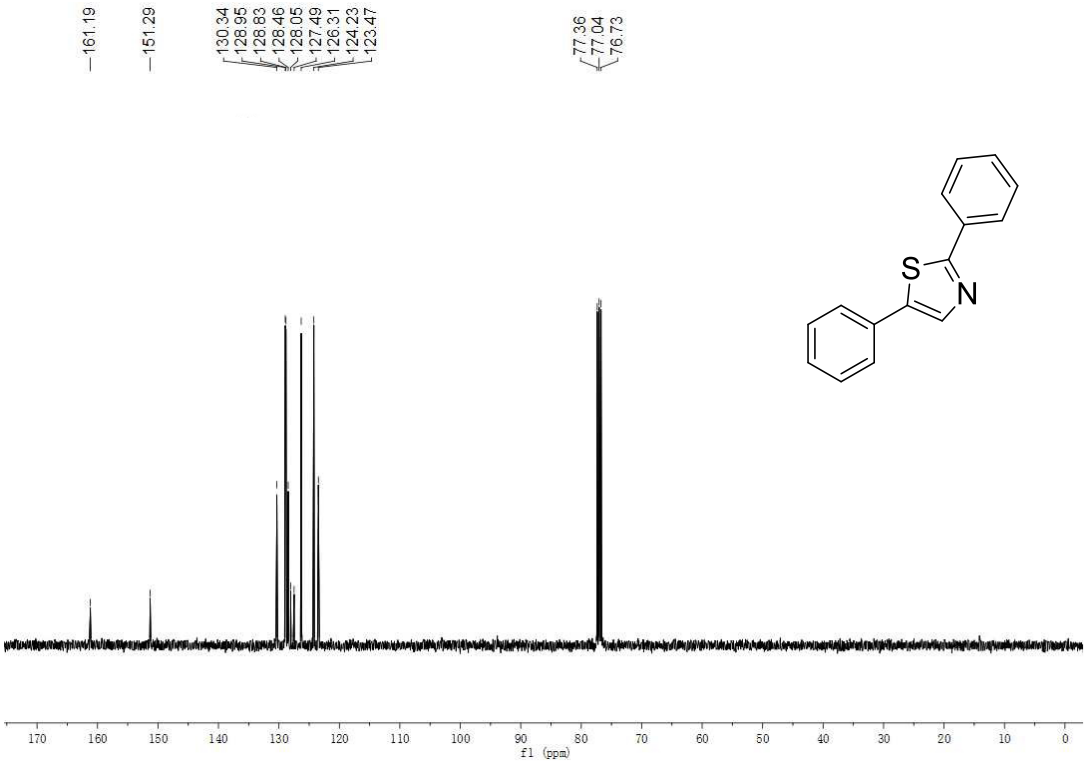


Figure 22. **5a** ^{13}C NMR

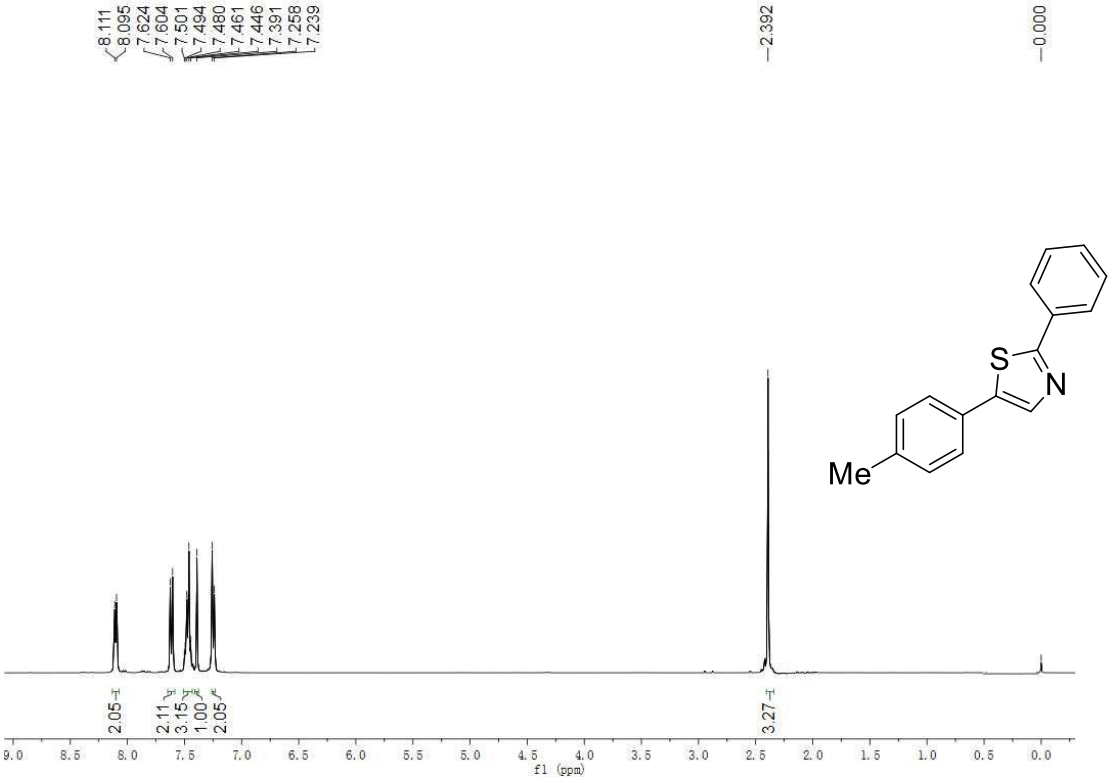


Figure 23. **5b** ^{1}H NMR

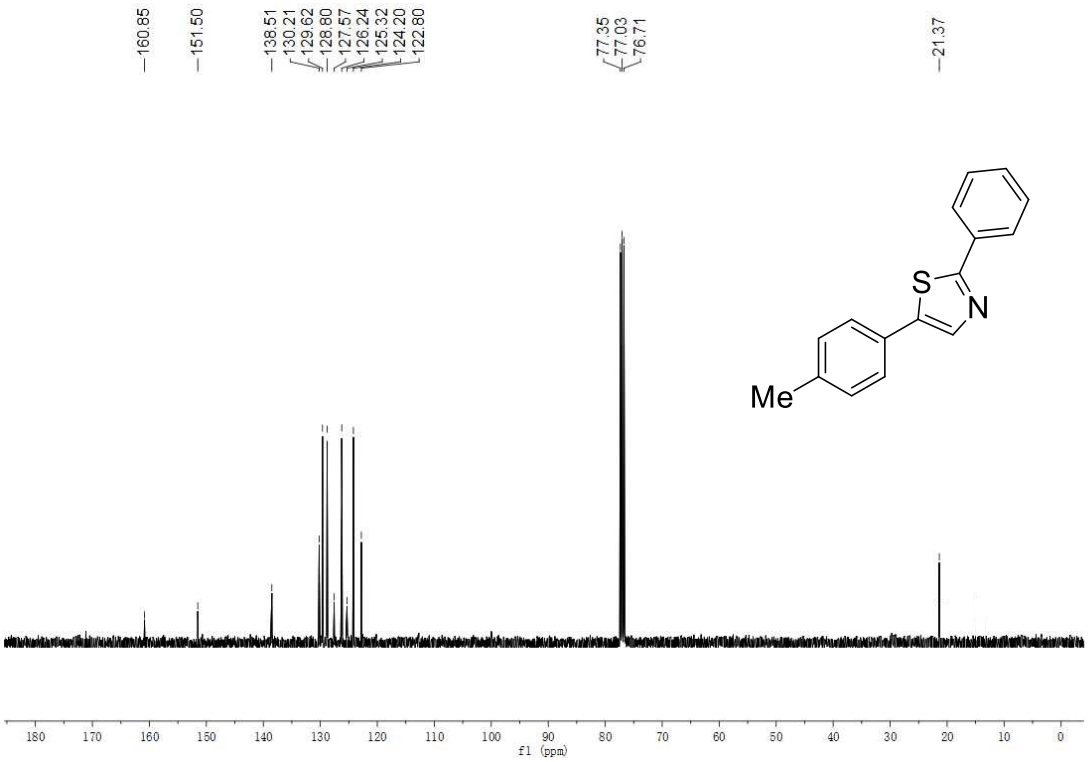


Figure 24. **5b**^{13}C NMR

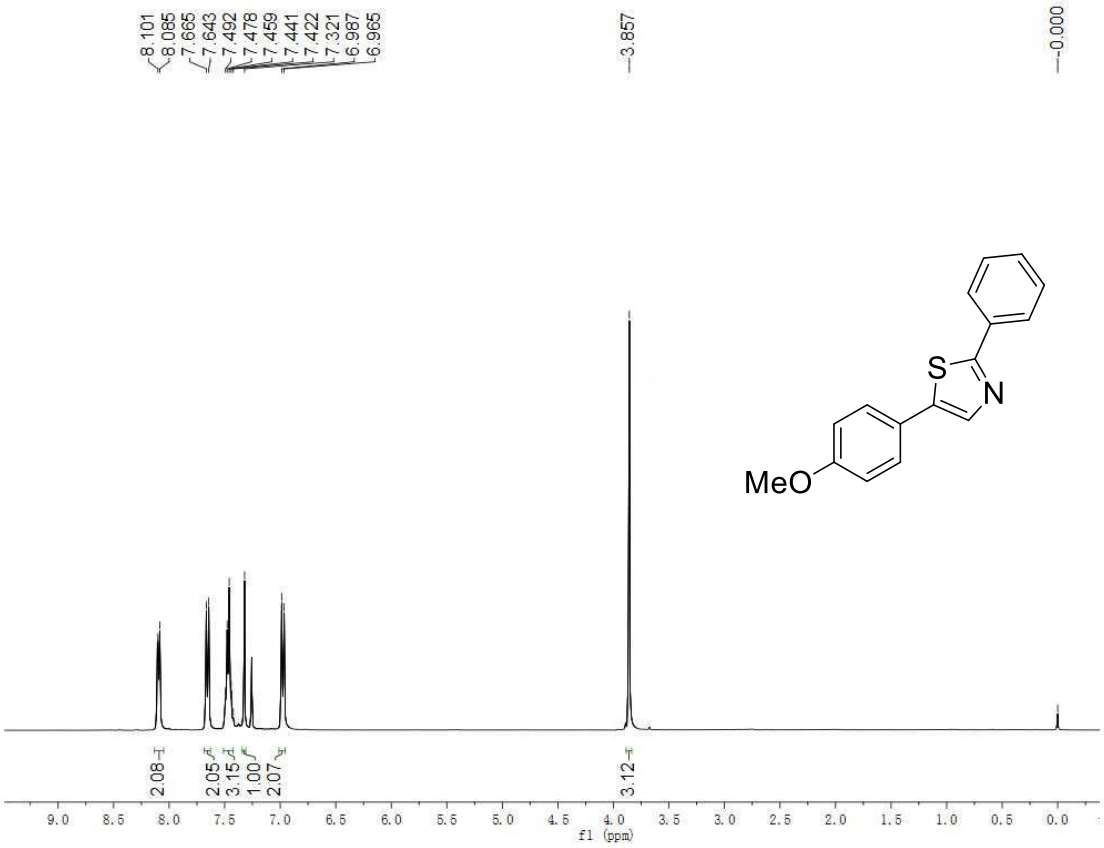


Figure 25. **5c** ^{1}H NMR

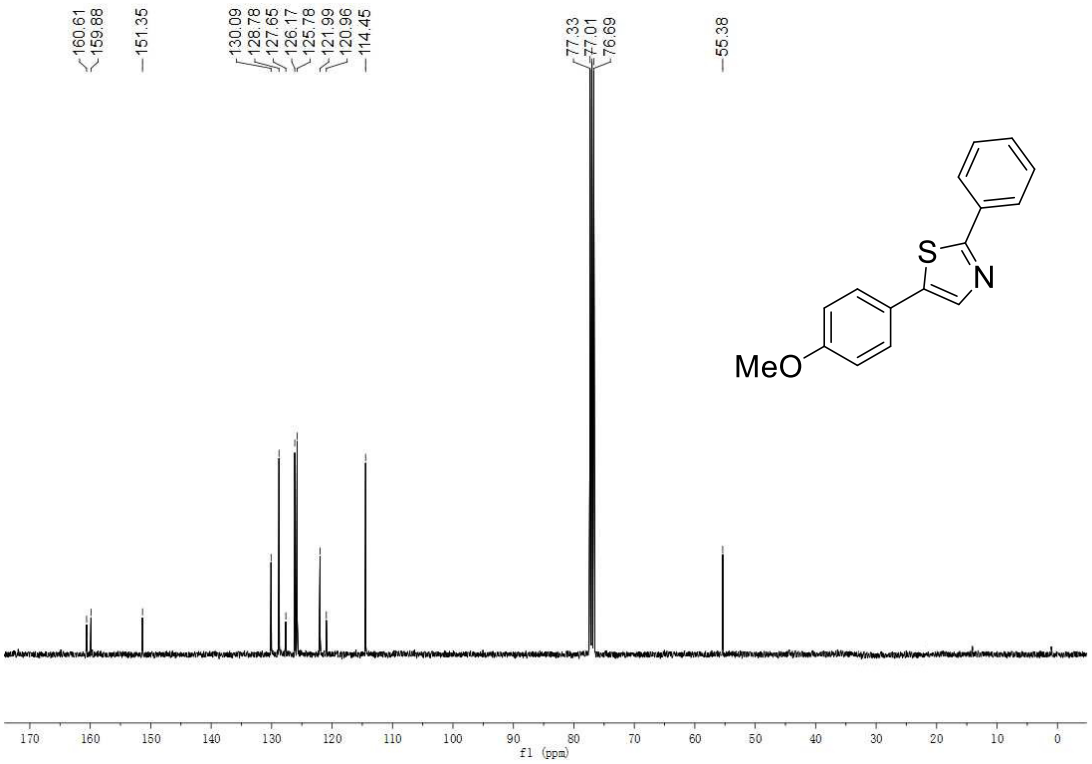


Figure 26. **5c** ^{13}C NMR

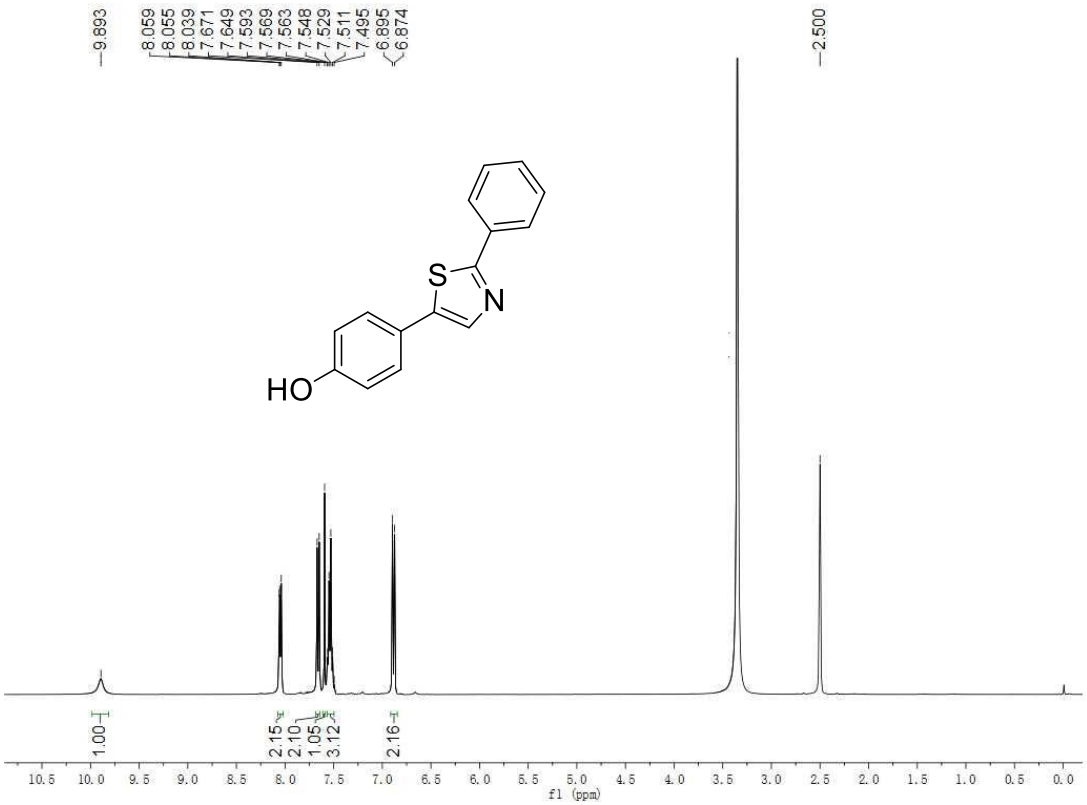


Figure 27. **5d** ^{1}H NMR

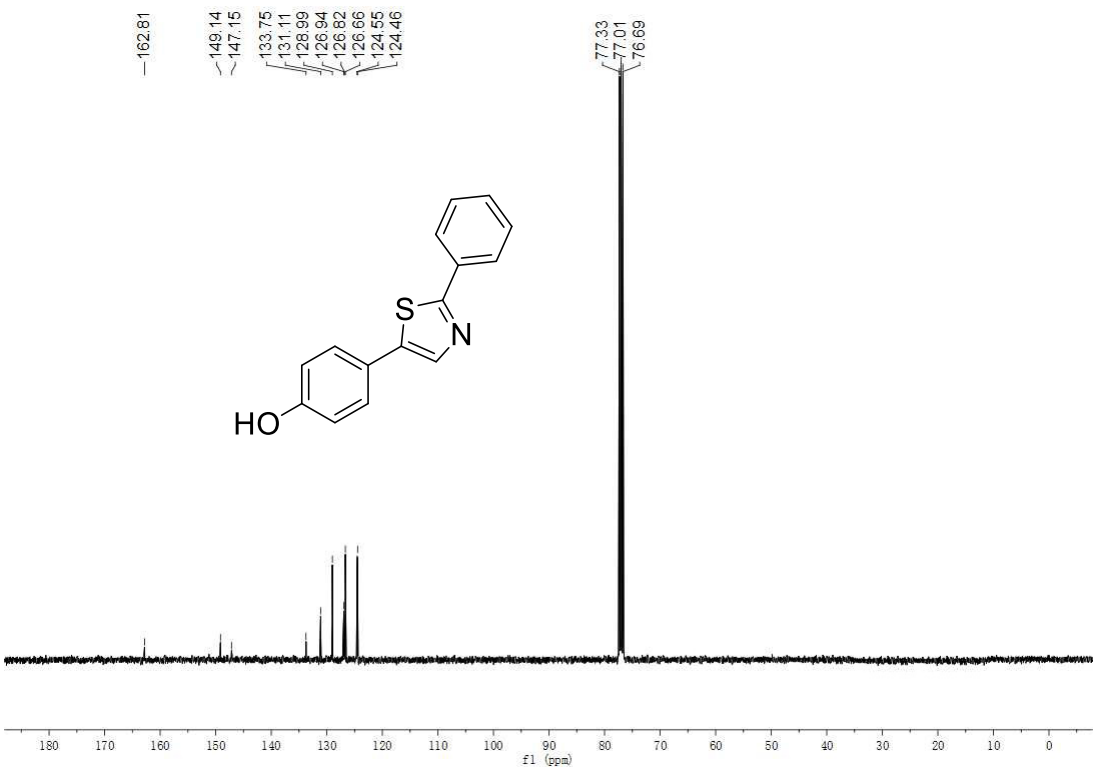


Figure 28. **5d** ^{13}C NMR

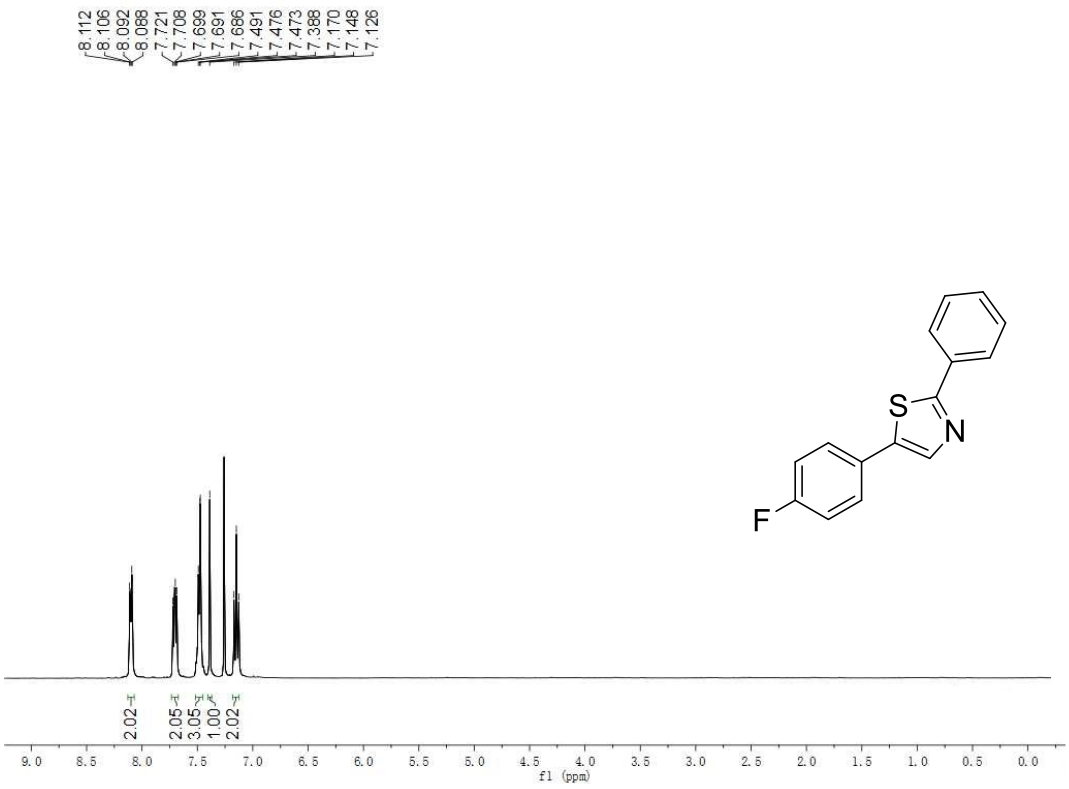


Figure 29. **5e** ^{1}H NMR

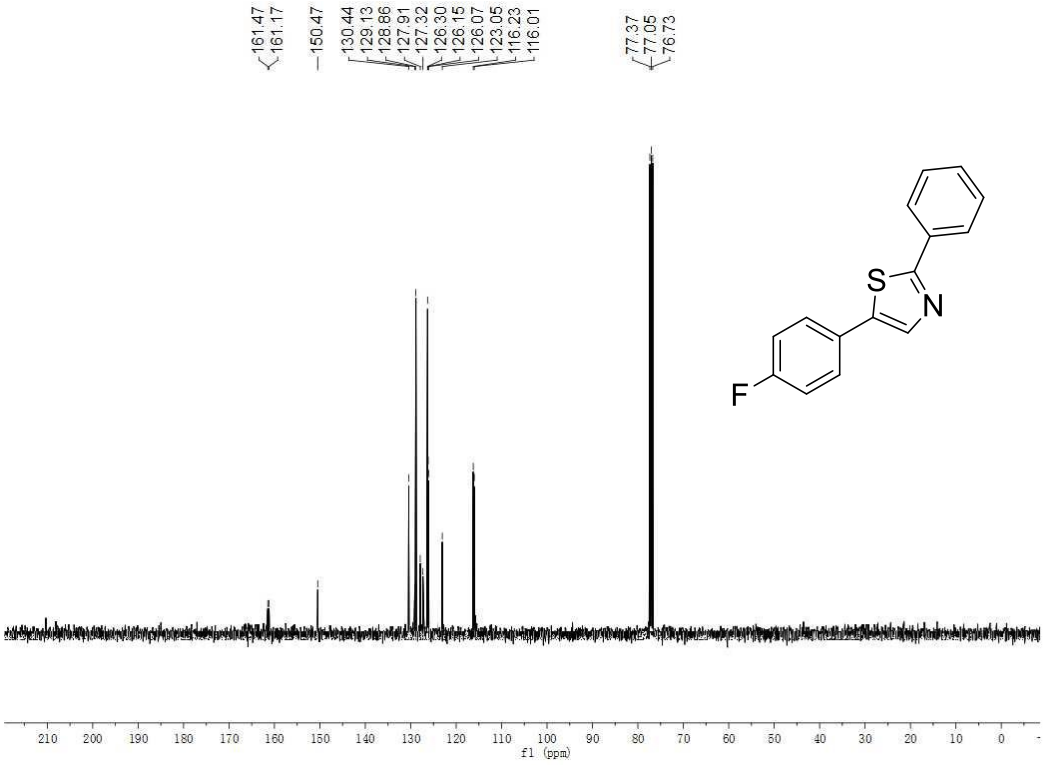


Figure 30. **5e** ^{13}C NMR

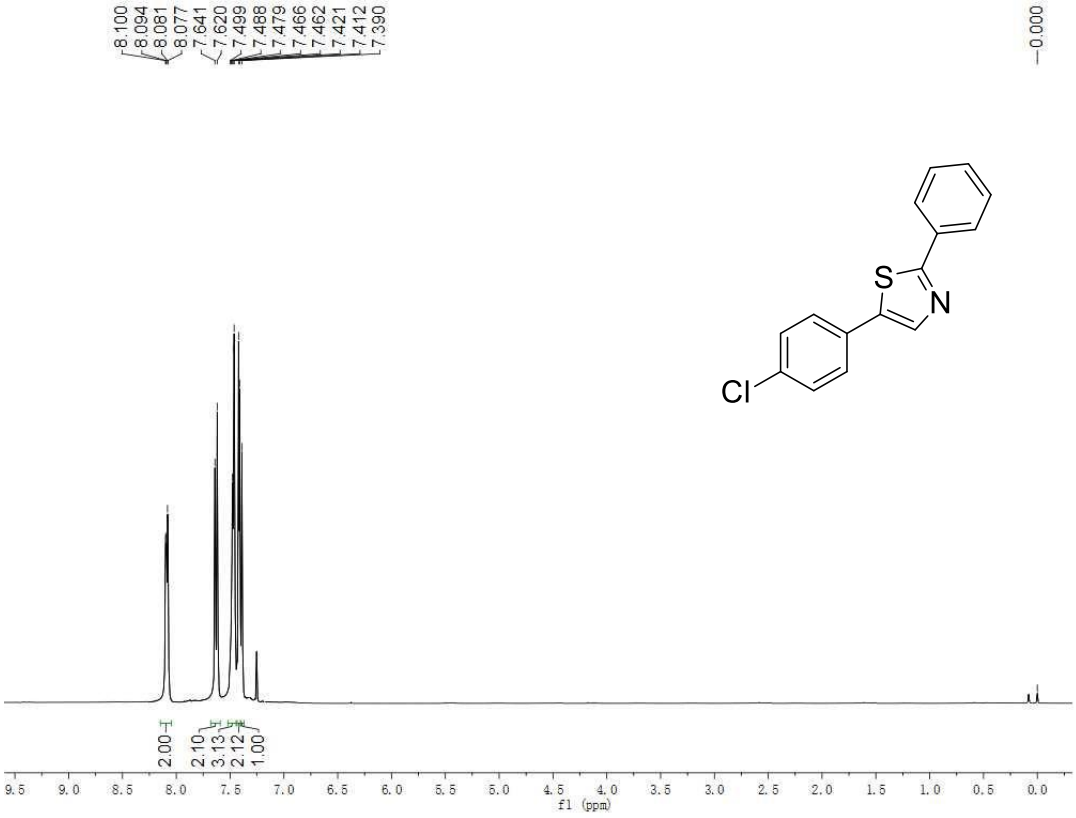


Figure 31. **5f** ^{1}H NMR

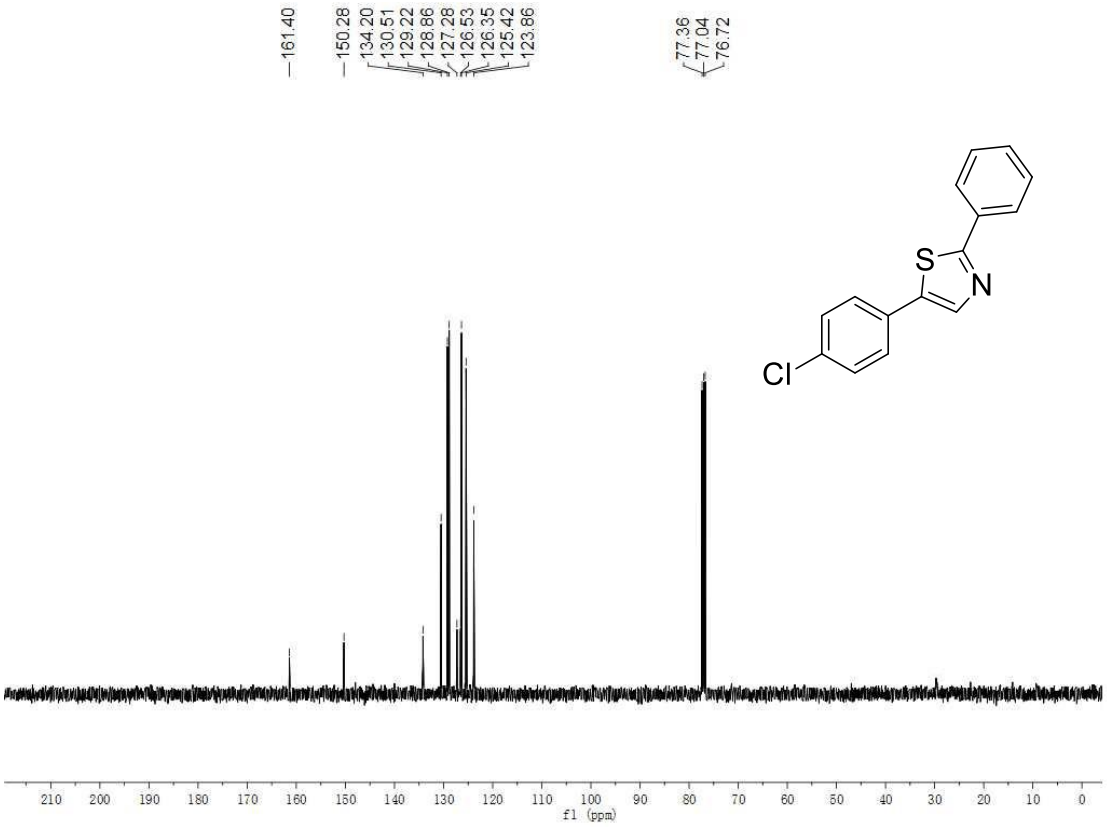


Figure 32. **5f** ^{13}C NMR

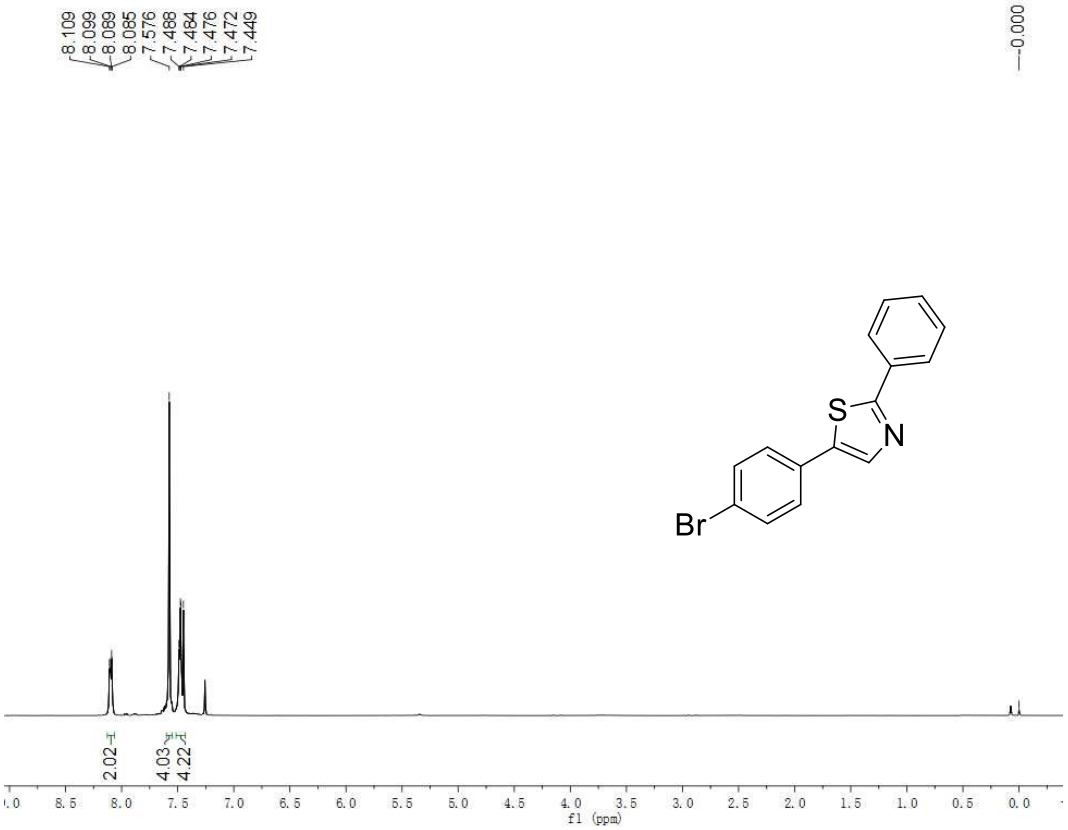


Figure 33. **5g** ^{1}H NMR

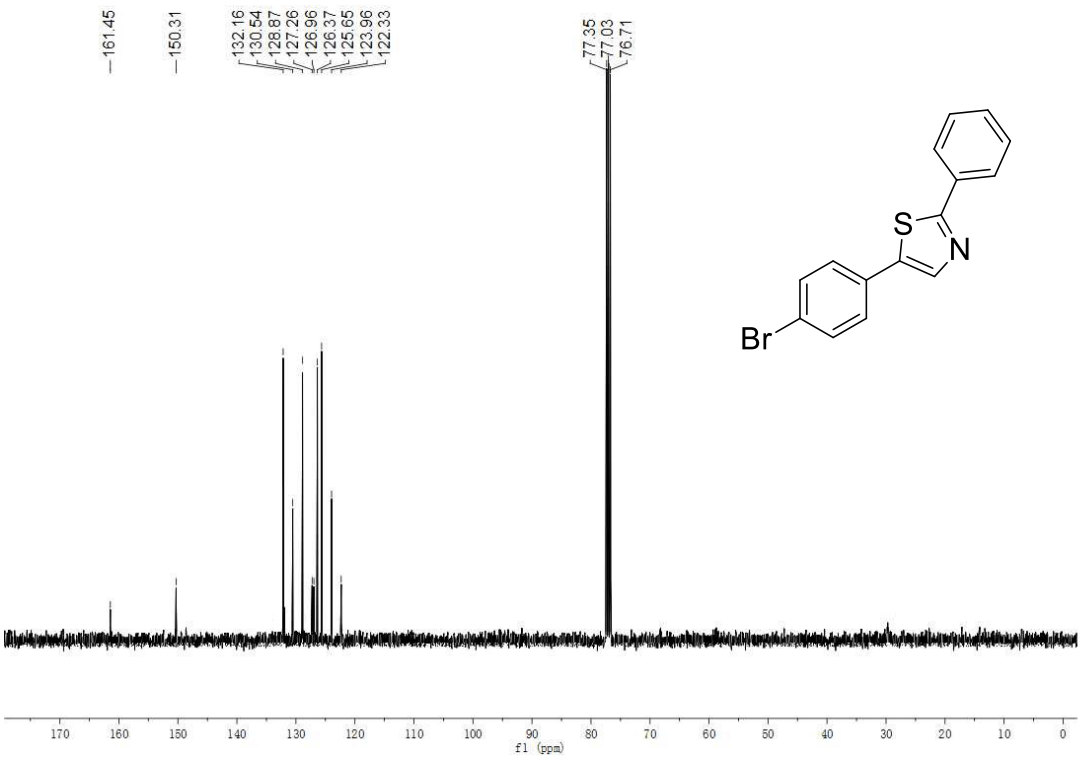


Figure 34. **5g** ^{13}C NMR

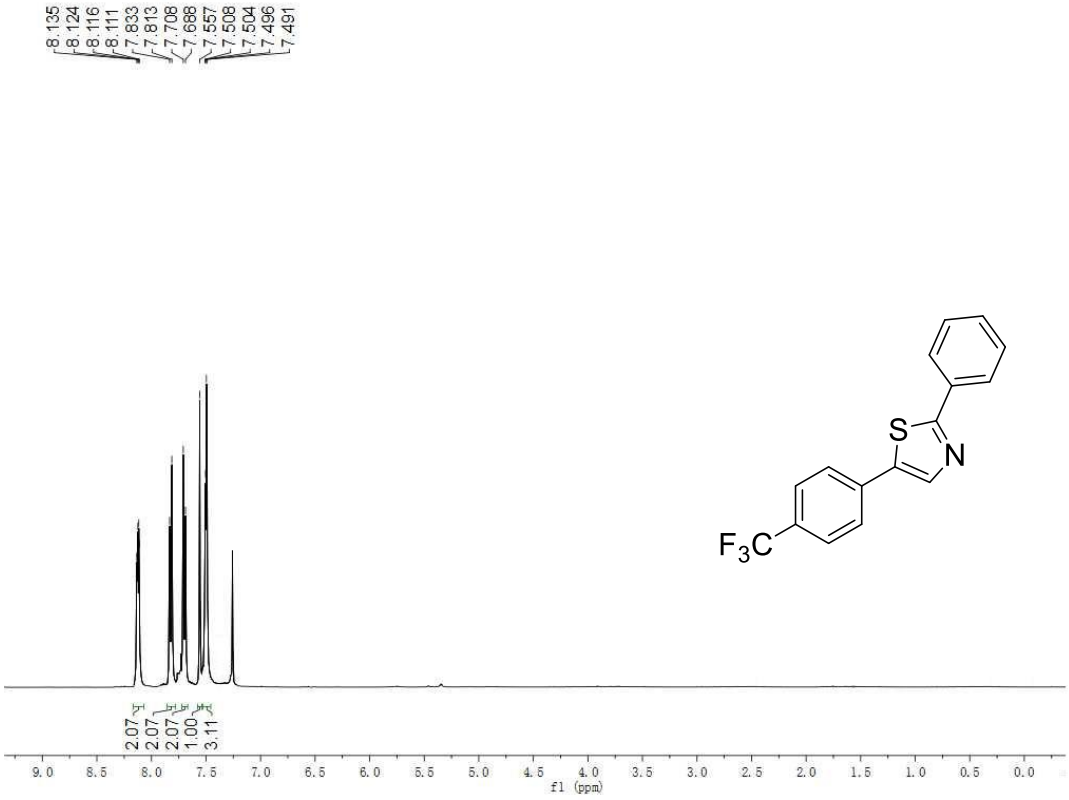


Figure 35. **5h** ^{1}H NMR

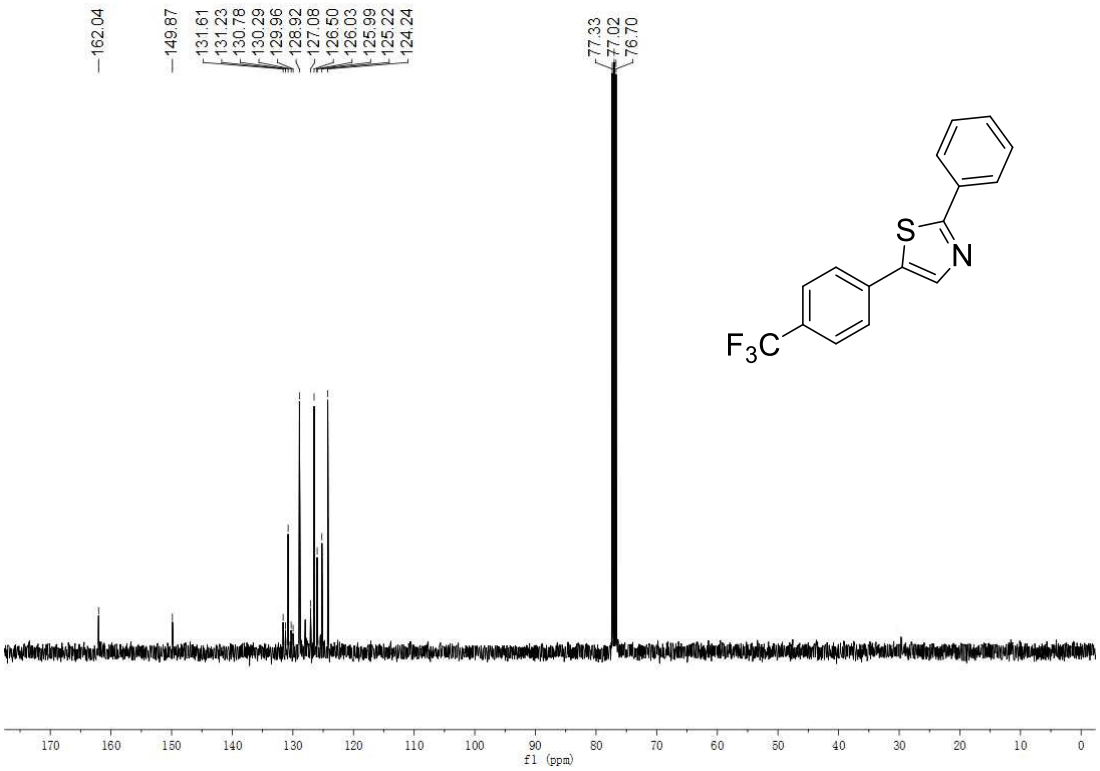


Figure 36. **5h** ^{13}C NMR

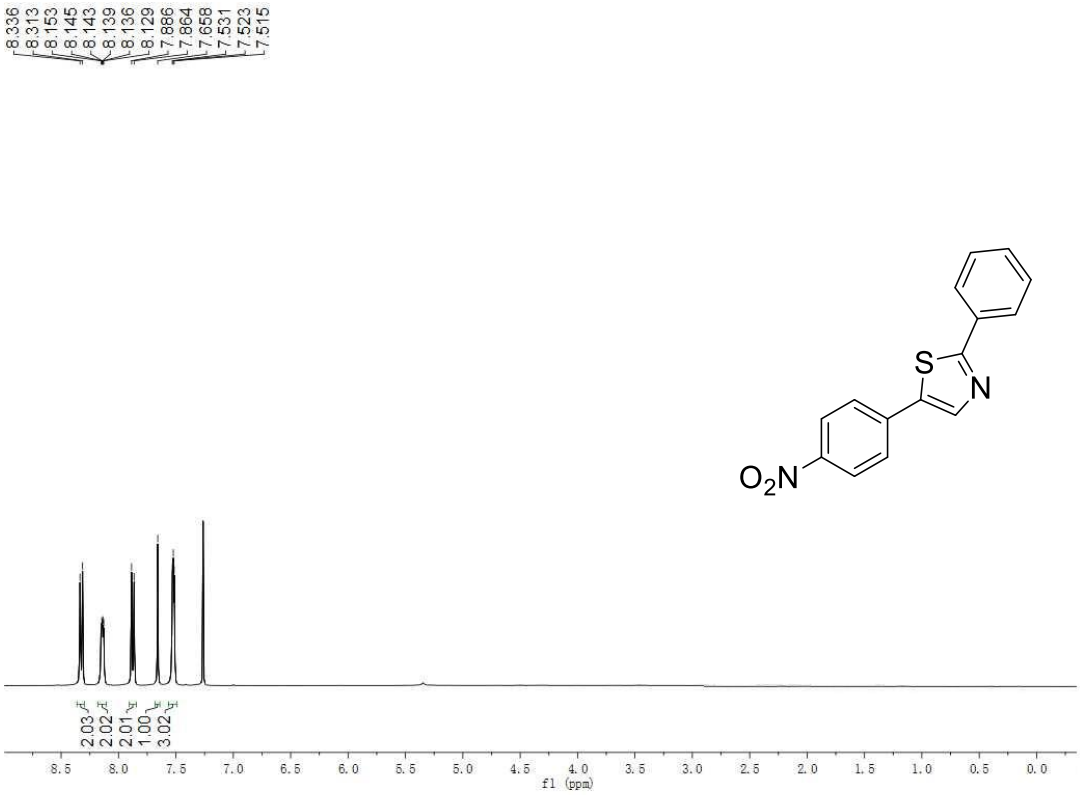


Figure 37. **5i** ^{1}H NMR

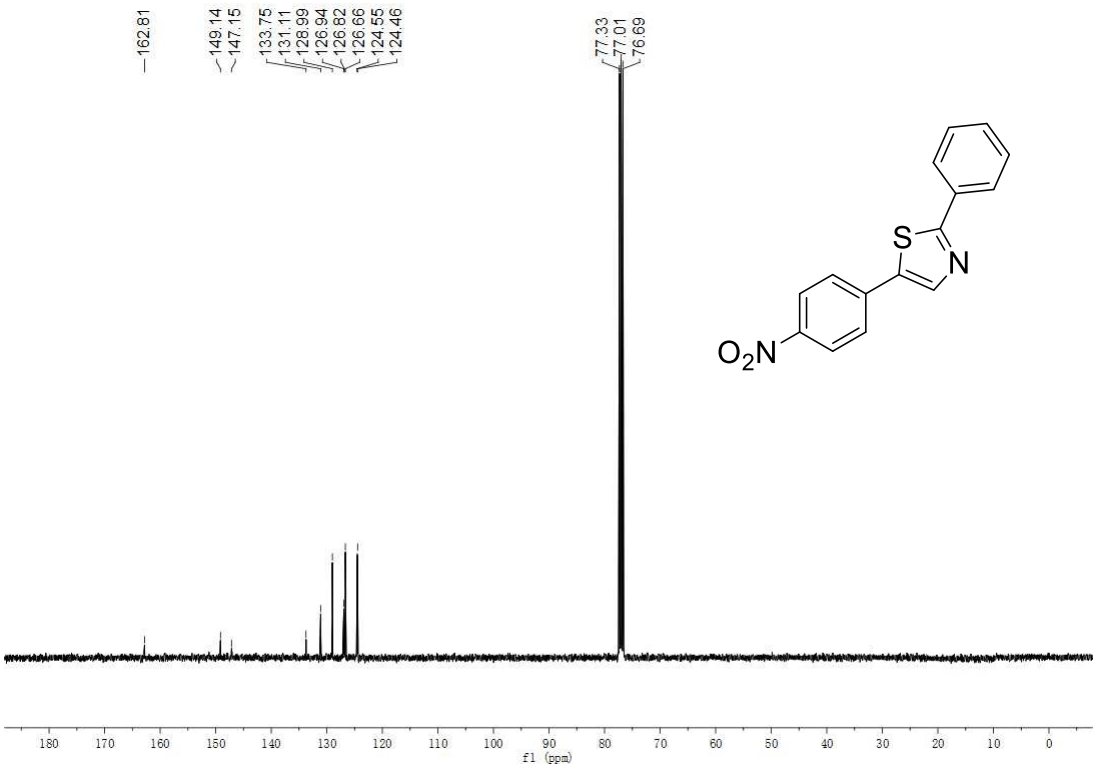


Figure 38. **5i** ^{13}C NMR

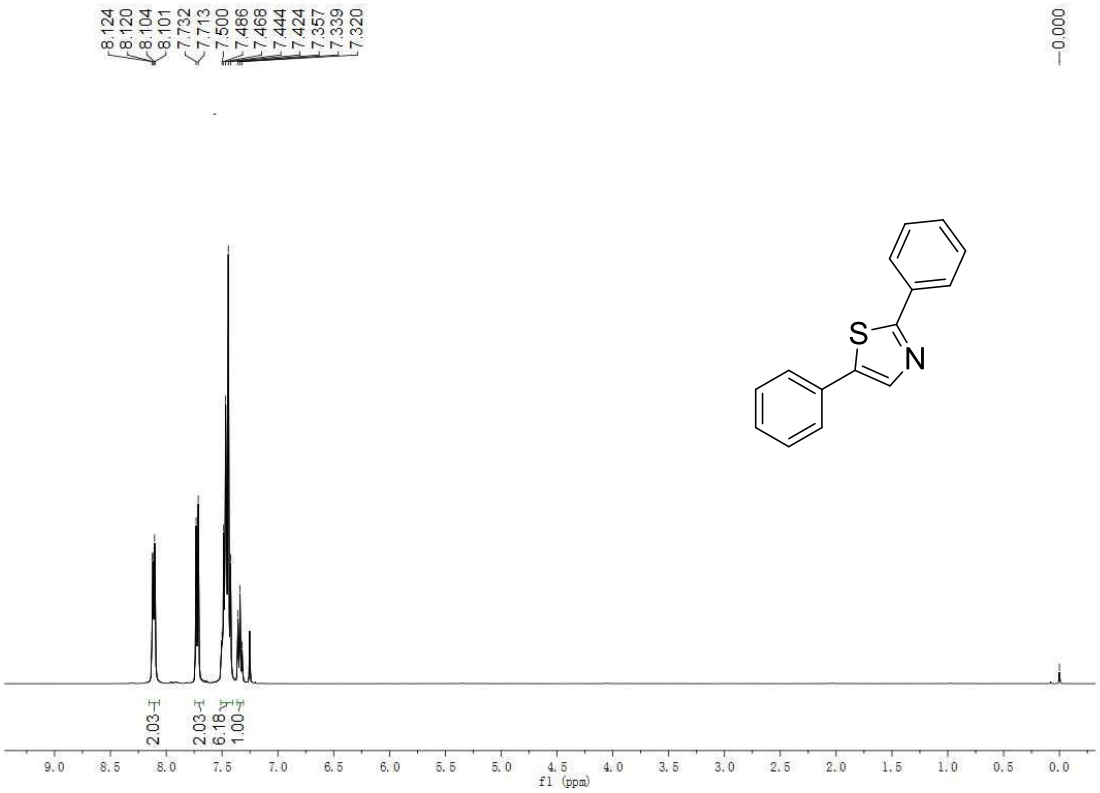


Figure 39. **7a** ^{1}H NMR

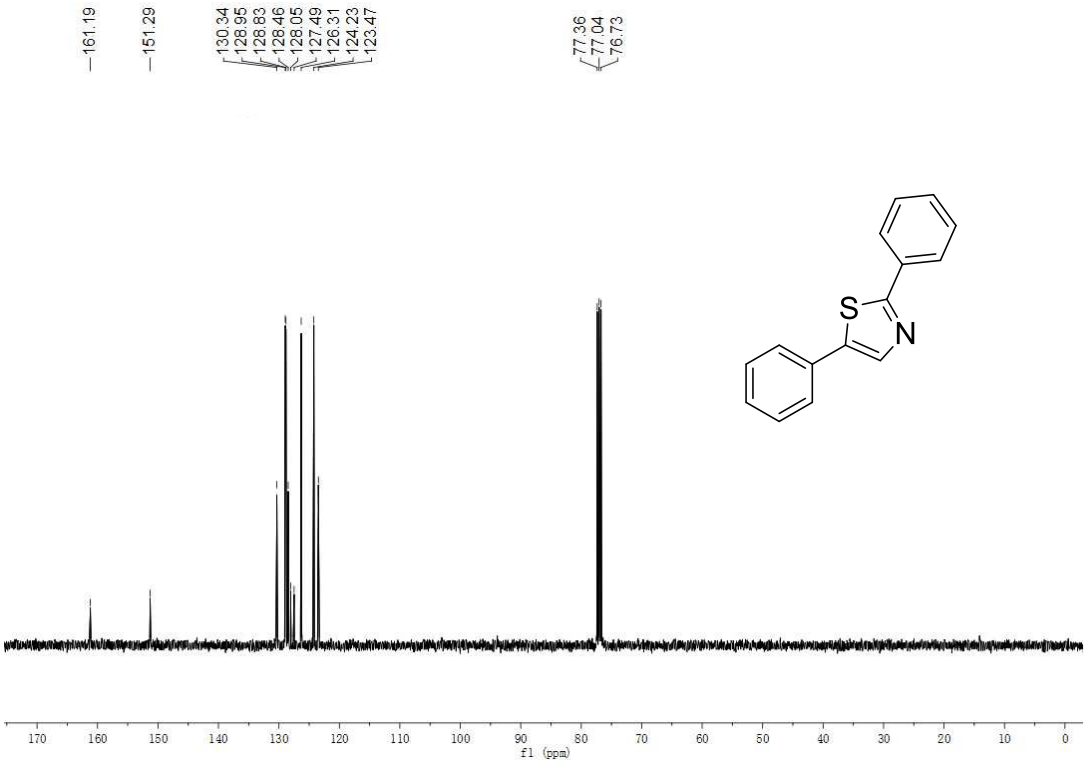


Figure 40. **7a** ^{13}C NMR

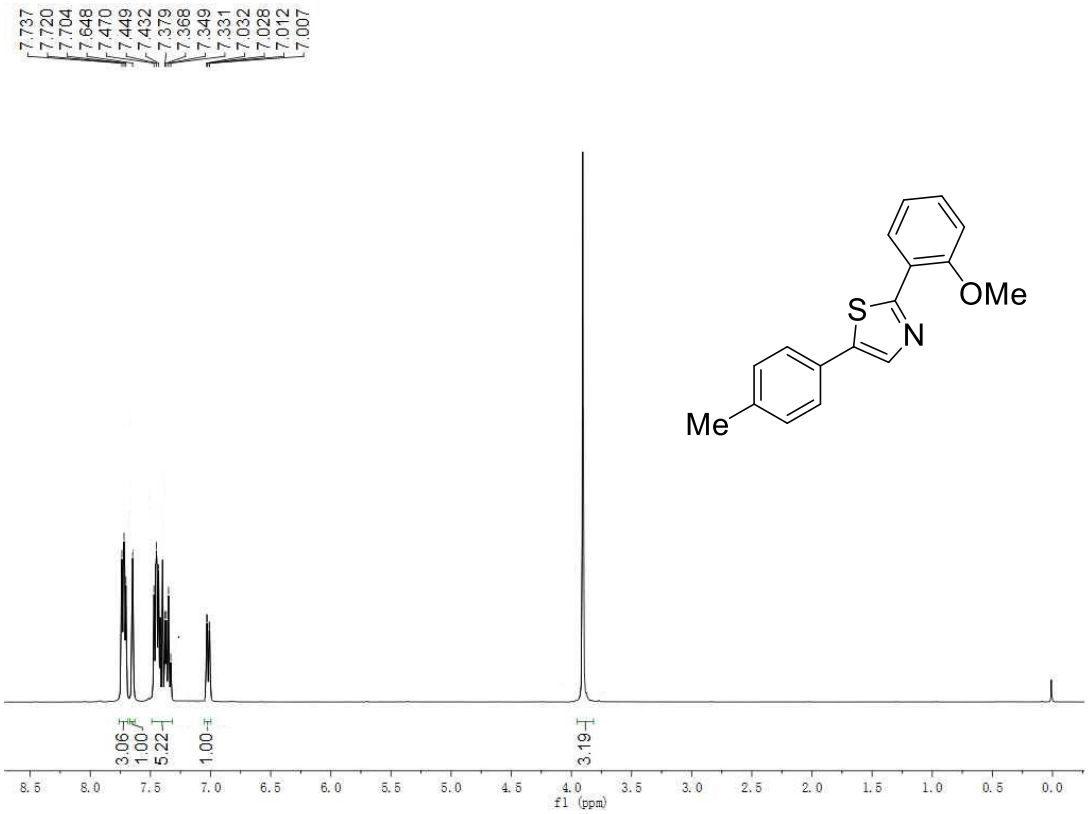


Figure 41. **7b** ^{1}H NMR

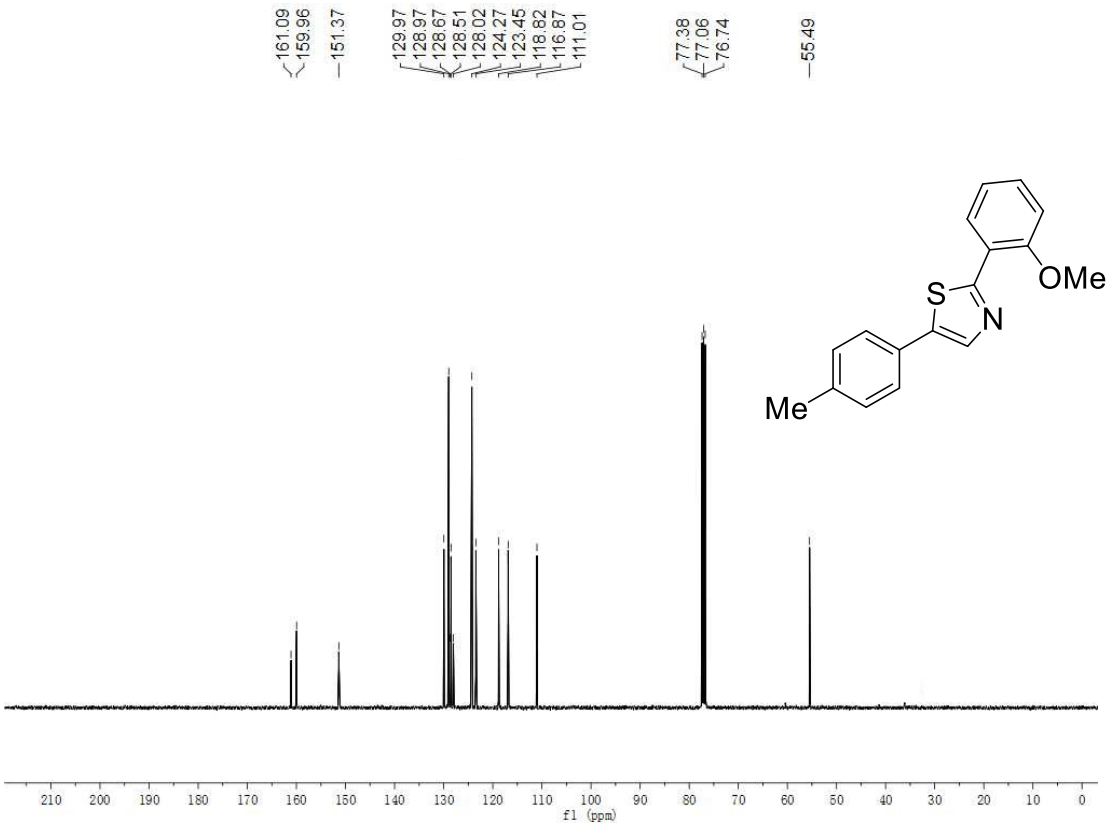


Figure 42. **7b** ^{13}C NMR

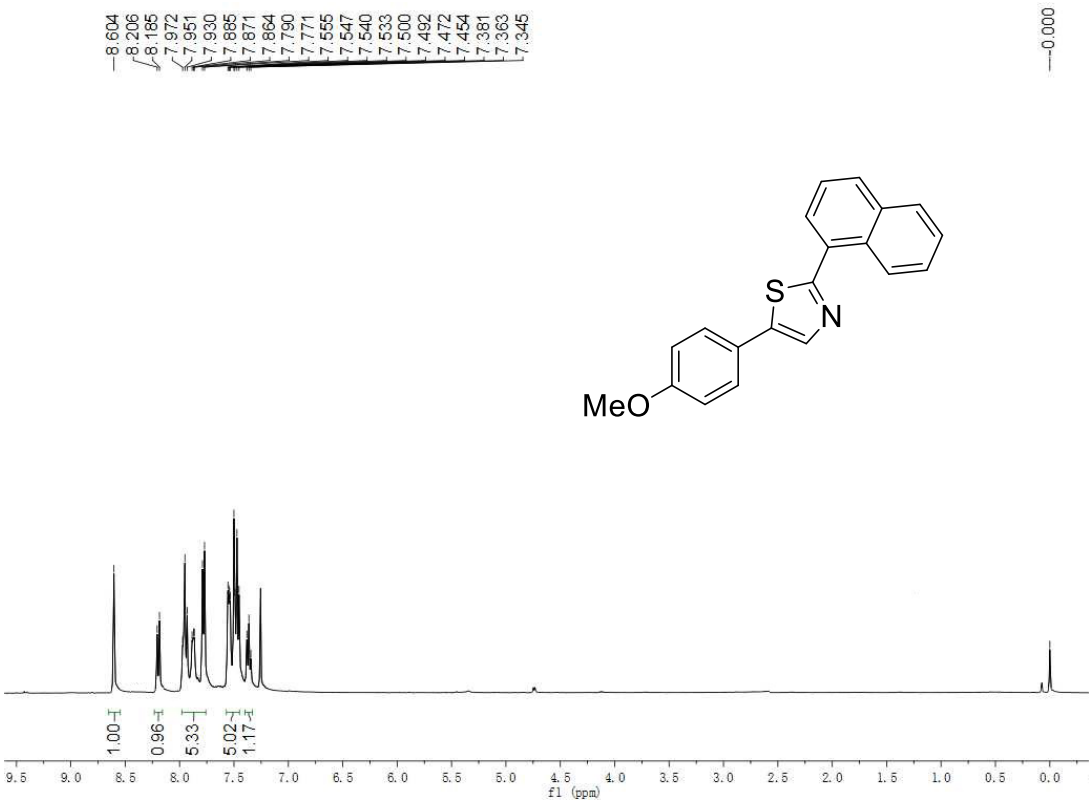


Figure 43. **7c** ^{1}H NMR

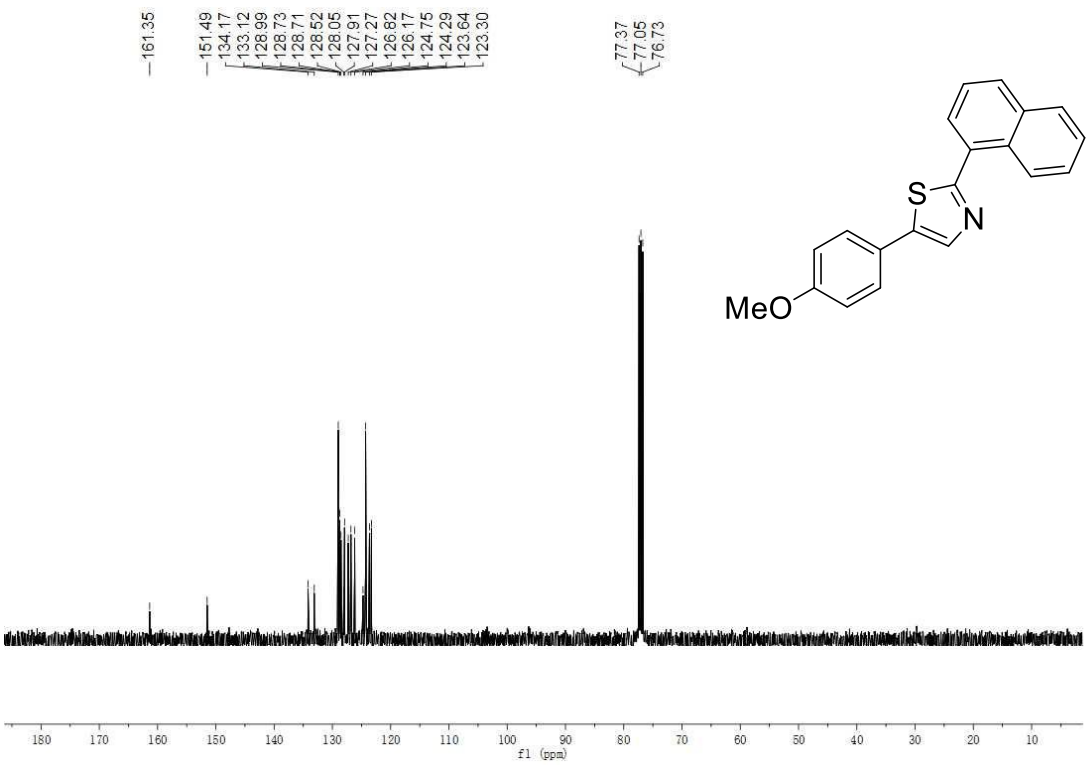


Figure 44. **7c**^{13}C NMR

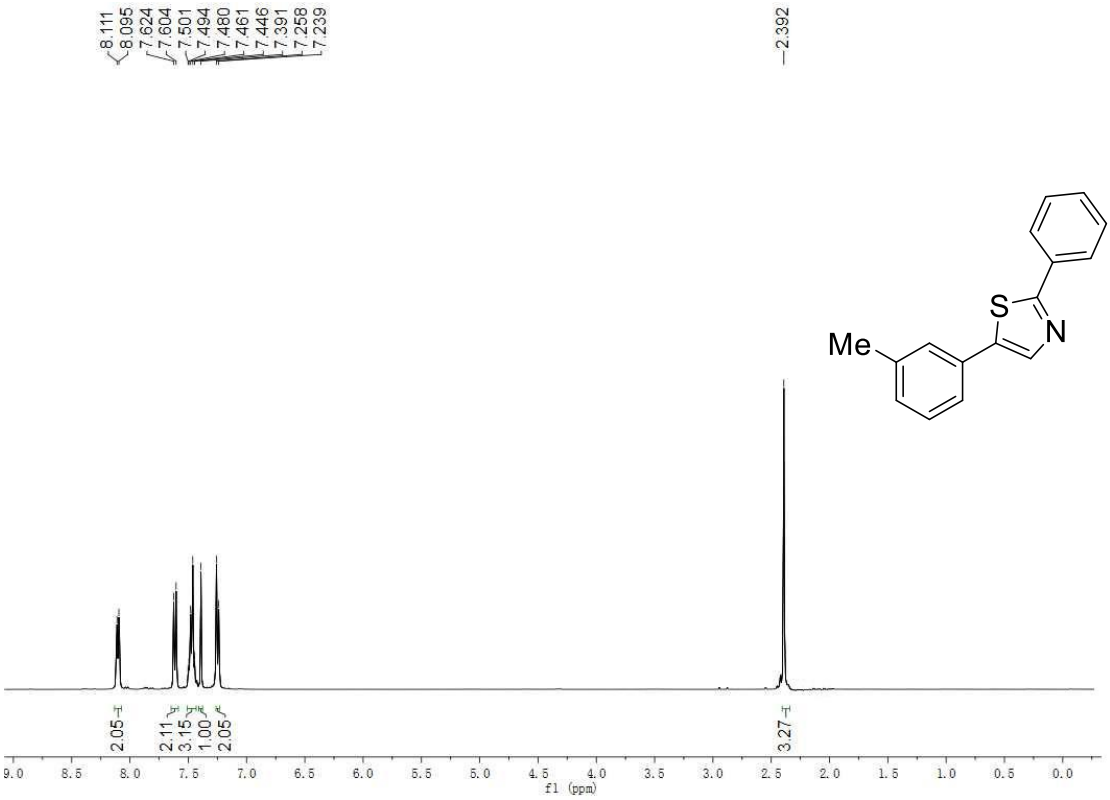


Figure 45. **7d** ^{1}H NMR

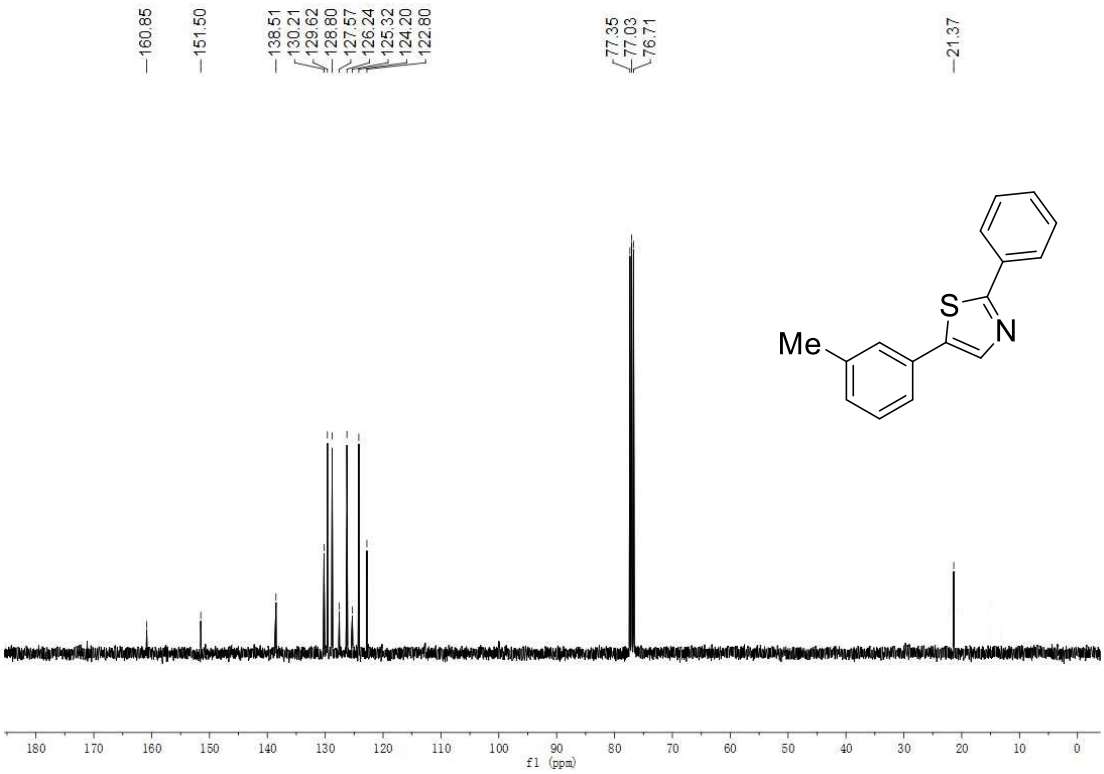


Figure 46. **7d** ^{13}C NMR

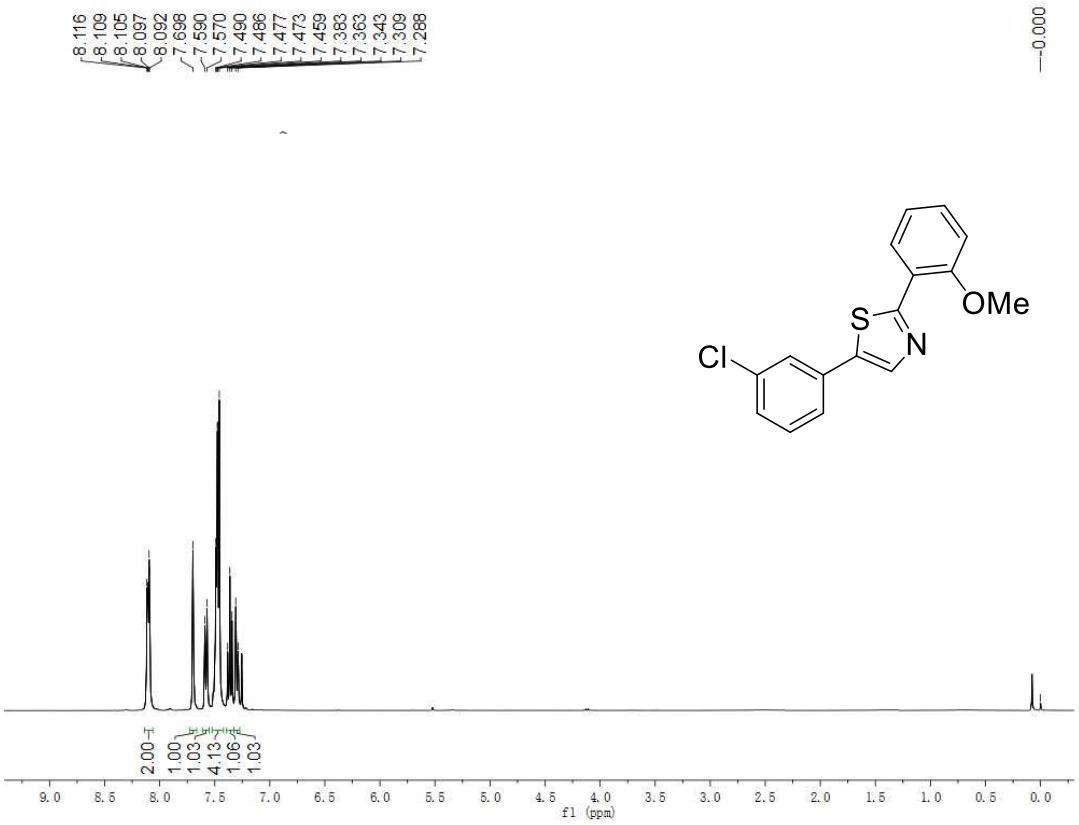


Figure 47. **7e** ^{1}H NMR

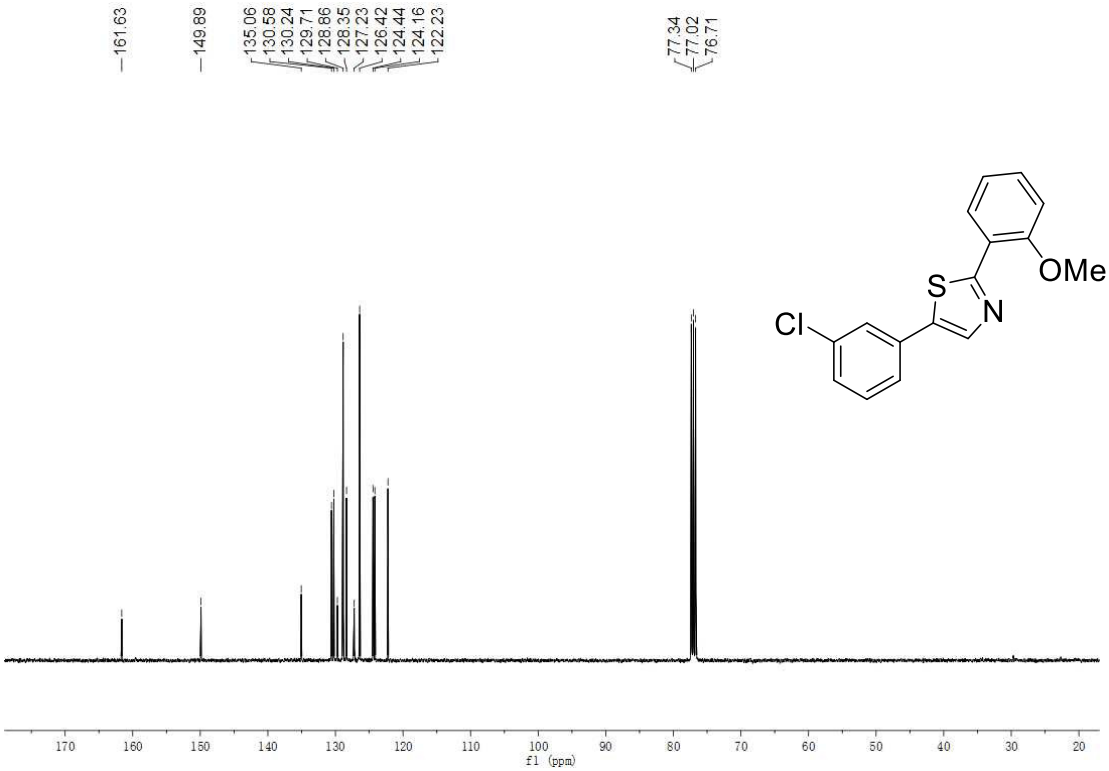


Figure 48. **7e** ^{13}C NMR

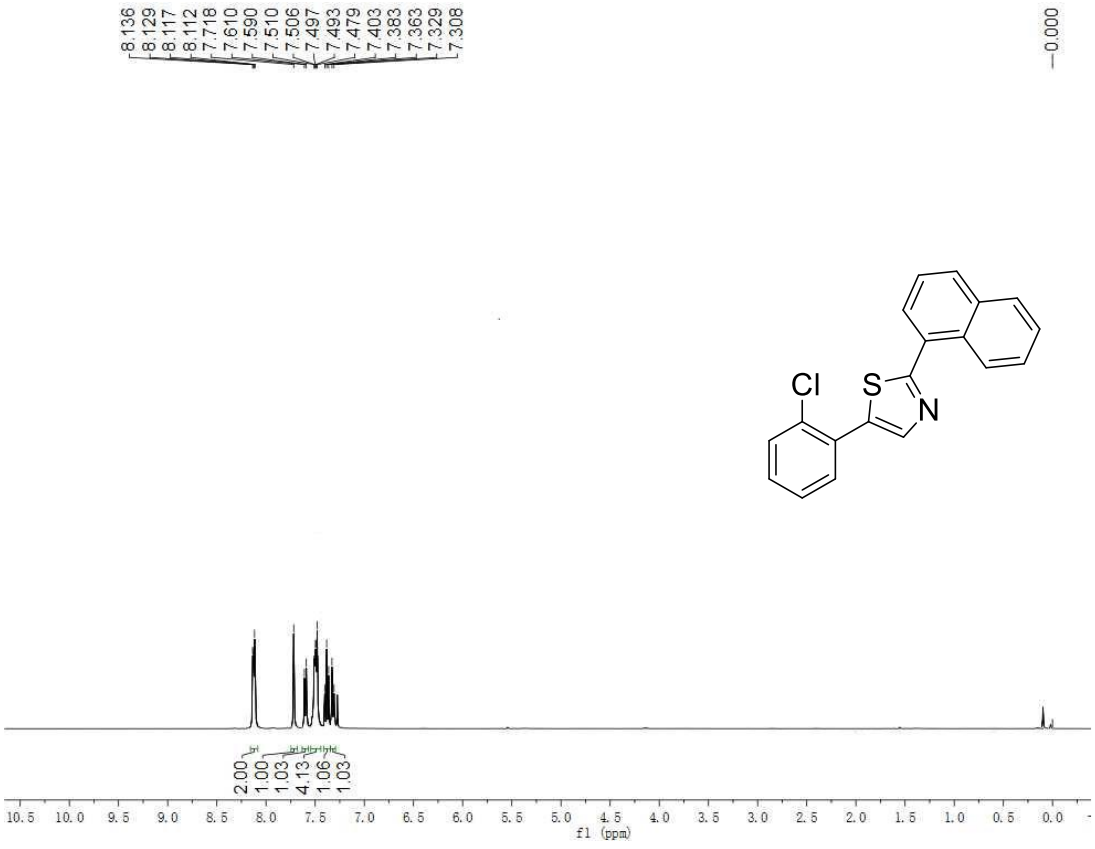


Figure 49. **7f** ^{1}H NMR

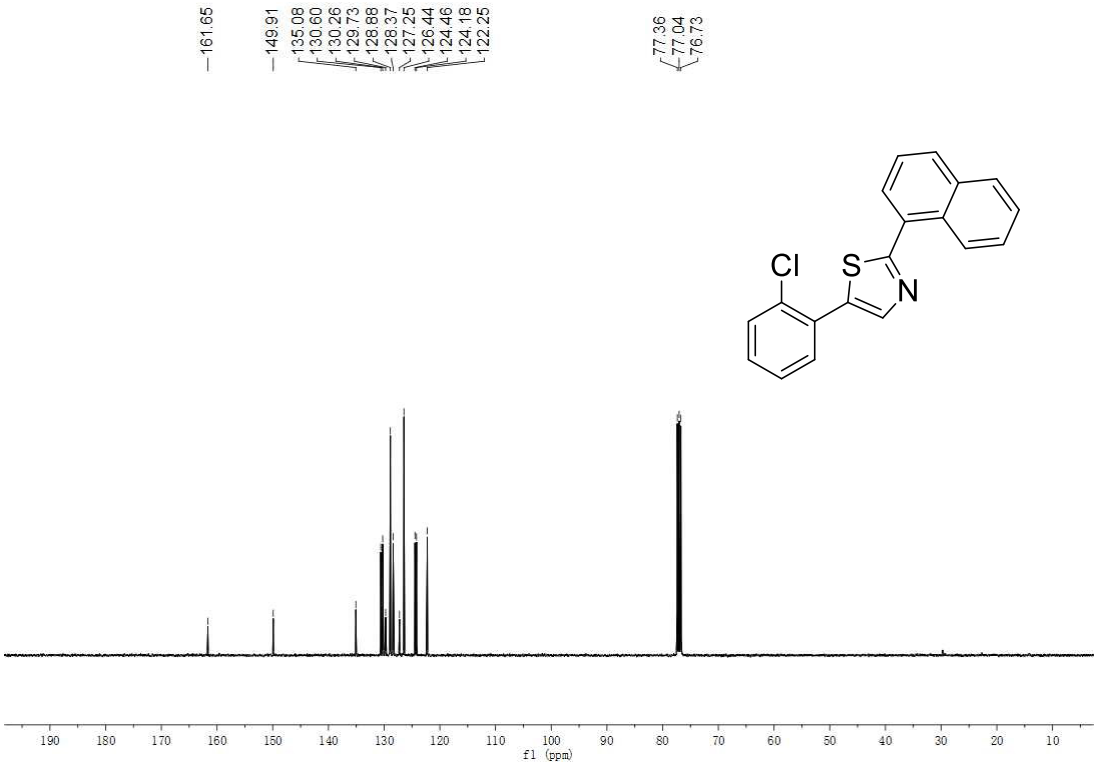


Figure 50. **7f** ^{13}C NMR

