Electronic supplementary materials *Mendeleev Commun.*, 2025, **35**, 155–157

Novel 3-aroyl-5-arylidene-1,3-thiazolidine-2,4-diones: synthesis and antitumor activity

Xia Zhang, Pingping Fan, Shigui Wei, Yonghong Du, Jinjing Li and Chengyang Shi

Table of content

Materials and methods

The NMR spectra of the synthesized compounds were recorded using an AVANCE III NMR spectrometer from Bruker, Switzerland. Mass spectrometry was conducted on a Shimadzu Instruments (Suzhou) LCMS-IT-TOF mass spectrometer, equipped with an ESI source. Comprehensive characterization data for 15 target derivatives are included as supplementary material. All reagents and solvents utilized in the experimental procedures were procured from commercial suppliers and were of analytical grade, used without the need for additional purification or drying.

Cell lines and culture conditions: Human colon cancer cells SW620, human non-small cell lung cancer cells A549, human cervical cancer cells HeLa and human breast cancer cells MCF-7 were inoculated with 5000 cells per well in a 96-well cell culture plate, and cultured at 37 °C for 20 h in a 5 % CO_2 incubator.

Experimental

Preparation of intermediates 2a~e and 2'a~e

Intermediates **2a-e** were synthesized according to a previously reported method. Chloroacetic acid was reacted with thiourea in a cycloaddition reaction to form Compound **1**. Compound **1**[S1,S2] was coupled with 3,4,5-trimethoxybenzaldehyde, and glacial acetic acid was added under stirring at room temperature. The mixture was then refluxed with anhydrous sodium acetate added under continuous stirring and monitored by TLC until the reaction was complete. After cooling to room temperature, the mixture was filtered, and the resulting solid was recrystallized with ethyl acetate to yield the intermediates **2a~e**.[S3-S6]

Intermediates **2'a~e**[S7,S8] were prepared *via* a published method by refluxing mixtures of intermediates **2a-e** with potassium hydroxide in anhydrous ethanol, monitored by TLC. After cooling, the mixtures were filtered, and the solids were washed with ethanol and dried to yield the products.

Intermediate 2'e

Chloroacetic acid (25.00 g, 264.57 mmol) and thiourea (20.14 g, 264.57 mmol) were placed in a reaction flask. Water (50 mL) was added, and the mixture was stirred at room temperature for 15 minutes. Concentrated hydrochloric acid (10 mL) was slowly added dropwise. The reaction was carried out under reflux for about 4 hours and monitored by thin-layer chromatography (TLC) until completion. After the reaction ended, the mixture was cooled to room temperature. A solid was obtained by suction filtration. After washing with water, it was recrystallized from absolute ethanol to obtain white crystal compound 1 with a yield of 86.1%. m. p.: 124.2 ~ 125.5 °C

Compound **1** (5.00 g, 42.69 mmol) and 2,3,4-trimethoxybenzaldehyde (8.46 g, 43.12 mmol) were placed in a reaction flask. Acetic acid (20 mL) was added, and the mixture was stirred at room temperature for 5 minutes. Anhydrous sodium acetate (7.00 g, 85.38 mmol) was then added. The reaction was carried out under reflux for about 31 hours and monitored by thin-layer chromatography (TLC) until completion. After the reaction ended, the mixture was cooled to room temperature and filtered by suction. The filter cake was recrystallized from ethyl acetate to obtain yellow crystal-like intermediate **2e** with a yield of 80.3%. m. p.: 250.3 ~ 251.6 °C.

Intermediate **2e** (5.00 g, 16.93 mmol) and potassium hydroxide (0.95 g, 16.93 mmol) were placed in a reaction flask. Absolute ethanol (25 mL) was added. The reaction was carried out under reflux for about 3 hours and monitored by thin-layer chromatography (TLC) until completion. After the reaction ended, the mixture was cooled to room temperature and filtered by suction. The filter cake was washed with 95% ethanol. After drying, a white solid **2'e** was obtained with a yield of 80.8%. m. p.: 281.6~283.9 °C. IR (KBr, cm-1): 3441, 3139, 2837, 1671, 1546, 1272, 1072, 780. ^{1}H NMR （400 MHz, DMSO-d_6）δ 7.48 (s, 1H), 7.25 (d, J = 8.9 Hz, 1H), 6.92 (d, J = 8.9 Hz, 1H), 3.82 (s, 3H), 3.79 (s, 3H), 3.76 (s, 3H). ^{13}C NMR (101 MHz, DMSO-*d6*) δ183.3, 176.1, 153.6, 152.4, 142.1, 135.2, 122.8, 122.7, 116.3, 108.3, 61.6, 60.6, 56.1.

Synthesis of target compounds

(*Z*)-5-(2-Fluorobenzylidene)-3-(thiophene-2-carbonyl)-1,3-thiazolidine-2,4-dione (3a)

Compound **2'a** (3.00 g, 11.48 mmol) was dissolved in acetone (20 mL) in a reaction vial. 2-Thenoyl chloride (1.85 g, 12.63 mmol) in acetone (5 mL) was added dropwise under stirring. The mixture was stirred at room temperature for 7 hours and monitored by TLC. After completion, the reaction was diluted with water (50 mL), filtered, and the solid was recrystallized from anhydrous ethanol. The product was dried to yield 2.56 g of a white solid, with a yield of 67.0%. m. p.: 153.0~154.5 ℃. IR (KBr, cm^{-1}): 3427, 3107, 1690, 1467, 1290, 1174, 1058, 762. ^{1}H NMR （400 MHz, DMSO-d_6）δ 8.42-8.37 (m, 1H), 8.36-8.32 (m, 1H), 7.97 (s, 1H), 7.68-7.58 (m, 2H), 7.48-7.41 (m, 2H), 7.37 (t, J = 4.40Hz, 1H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 165.3 (d, J = 1.1 Hz, C-4), 163.7 (C-2), 160.6 (d, J = 252.5 Hz, C-2''), 159.7 (C=O), 141.1 (C-2'), 140.4 (C-5'), 135.1 (C-3'), 133.4 (d, J = 9.0 Hz, C-4''), 129.7 (C-4'), 129.1 (d, J = 1.3 Hz, C-5), 125.6 (d, J = 3.4 Hz, =CH), 125.4 (d, J = 6.2 Hz, C-6''), 123.9 (d, J = 1.1 Hz, C-5''), 120.6 (d, J = 12.1 Hz, C-1''), 116.4 (d, J = 21.5 Hz, C-3''). HRMS (ESI）: Calcd. $C_{15}H_8FNO_3S_2[M]^+$ *m/z*: 332.9924, found: 332.9919.

(*Z*)-5-(2-Fluorobenzylidene)-3-(4-methylbenzoyl)-1,3-thiazolidine-2,4-dione (3b)

White solid, yield 53.8 %, m. p.: 151.4~152.2 °C. IR (KBr, cm^{-1}): 3427, 1735, 1711, 1597, 1462, 1262, 1170, 750. ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.04 (d, J = 6.90Hz, 2H), 7.95 (s,1H), 7.68-7.59 (m, 2H), 7.49-7.40(m, 4H), 2.45 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 166.3 (C=O), 165.5 (d, J = 0.9 Hz, C-4), 163.9 (C-2), 160.6 (d, J = 252.6 Hz, C-2''), 147.4 (C-4'), 133.4 (d, J = 8.8 Hz, C-4''), 131.2 (C-3' C-5'), 130.0 (C-2' C-6'), 129.1 (d, J = 1.5 Hz, C-5), 127.8 (C-1'), 125.6 (d, J = 3.6 Hz, =CH), 125.2 (d, J = 6.1 Hz, C-6''), 124.1 (d, J = 1.4 Hz, C-5''), 120.7 (d, J = 12.0 Hz, C-1''), 116.4 (d, J = 21.6 Hz, C-3''), 21.5 (-CH_3). HRMS (ESI): Calcd. $C_{18}H_{13}FNO_3S$, $[M+H]^+$ *m/z*: 342.0595, found: 342.0580.

(*Z*)-5-(2-Fluorobenzylidene)-3-(2-methoxybenzoyl)-1,3-thiazolidine-2,4 - dione (3c)

White solid, yield 67.8 %, m. p.: 168.5~169.5 °C. IR (KBr, cm^{-1}): 3436, 3125, 1708, 1592, 1467, 1300, 1179, 756. ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.08 (s, 1H), 7.88 (dd, J = 8.00, 1.80 Hz, 1H), 7.74-7.71 (m, J = 8.41, 1H), 7.71-7.65 (m, 2H), 7.60-7.55 (m, 2H), 7.24 (d, J = 8.41 Hz, 1H), 7.17 (t, J = 7.50Hz, 1H), 3.84 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 165.0 (d, J = 0.9 Hz, C-4), 163.6 (C-2), 163.5 (C=O), 160.6 (d, J = 252.4 Hz, C-2''), 159.0 (C-2'), 137.1 (C-4'), 133.4 (d, J = 9.0 Hz, C-4''), 132.5 (C-6'), 129.3 (d, J = 1.1 Hz, C-5), 125.6 (d, J = 4.2 Hz, =CH), 125.4 (d, J = 6.0 Hz, C-6''), 123.2 (d, J = 1.5 Hz, C-5''), 121.3 (C-5'), 120.6 (d, J = 12.2 Hz, C-1''), 119.7 (C-1'), 116.9 (d, J = 21.1 Hz, C-3''), 113.0 (C-3'), 56.6 (OCH_3). HRMS (ESI): Calcd. $C_{18}H_{13}FNO_4S$, $[M+H]^+$ *m/z*: 358.0544, found: 358.0536.

(Z)-3-(4-Chlorobenzoyl)-5-(2-chlorobenzylidene)-1,3-thiazolidine–2,4-dione (3d)

White solid, yield 70.1 %, m. p.: 127.8~129.6 °C. IR (KBr, cm^{-1}): 3427, 3120, 1700, 1592, 1300, 1165, 826, 752. ^1H NMR (400 MHz, DMSO-d_6) δ 8.18 (d, J = 8.63 Hz, 2H), 8.06 (s, 1H), 7.71 (d, J = 8.63 Hz, 2H), 7.68-7.66 (m, 1H), 7.66-7.63 (m, 1H), 7.59-7.54 (m, 2H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 168.1, 167.5, 166.9, 138.3, 134.9, 132.3, 131.6, 130.8, 130.1, 129.4, 129.2, 128.6, 127.8, 127.2 HRMS(ESI): Calcd. $C_{17}H_9Cl_2NO_3S$, $[M]^+$ m/z: 376.9675, found: 376.9670.

(Z)-5-(2-Chlorobenzylidene)-3-(thiophene-2-carbonyl)-1,3-thiazolidine-2,4-dione (3e)

White solid, yield 46.1 %, m. p.: 132.1~132.9 °C. IR (KBr, cm^{-1}): 3427, 3116, 1690, 1416, 1290, 1165, 1053, 747. ^1H NMR (400 MHz, DMSO-d_6) δ 8.40 (dd, J = 4.98, 1.35 Hz, 1H), 8.36 (dd, J = 4.10, 1.11 Hz, 1H), 8.09 (s, 1H), 7.72-7.68 (m, 1H), 7.68-7.64 (m, 1H), 7.60-7.55 (m, 2H), 7.40-7.36 (m, 1H). ^{13}C NMR (101 MHz, DMSO-$d6$) δ 165.9, 164.2, 160.2, 141.6, 140.9, 135.6, 135.1, 132.9, 131.2, 131.0, 130.2, 129.6, 129.5, 128.8, 125.5. HRMS(ESI): Calcd. $C_{15}H_8ClNO_3S_2$, $[M]^+$ m/z: 348.9629, found: 348.9627.

(Z)-5-(2-Chlorobenzylidene)-3-(2-methoxybenzoyl)-1,3-thiazolidine-2,4-dione (3f)

White solid, yield 52.3 %, m. p.: 153.8~160.1 °C. IR (KBr, cm^{-1}): 3446, 1713, 1602, 1434, 1295, 1188, 1063, 732. ^1H NMR (400 MHz, DMSO-d_6) δ 7.13 (s, 1H), 7.04 (d, J = 7.70 Hz, 1H), 6.91 (t, J = 8.54, 7.09 Hz, 1H), 6.87-6.75 (m, 2H), 6.65-6.57 (m, 2H), 6.41 (d, J = 8.45 Hz, 1H), 6.34 (t, J = 7.60Hz, 1H), 3.0 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 165.5.0, 163.9, 163.9, 159.4, 137.6, 135.1, 133.0, 132.9, 131.2, 131.0, 129.7, 129.7, 128.7, 124.8, 121.8, 120.12, 113.47, 57.1. HRMS(ESI): Calcd. $C_{18}H_{12}ClNO_4S$, $[M]^+$ m/z: 374.0248, found: 374.0239.

(Z)-5-(2-Bromobenzylidene)-3-(4-chlorobenzoyl)-1,3-thiazolidine–2,4-dione (3g)

White solid, yield 42.9 %, m. p.: 139.3~140.8 °C. IR (KBr, cm^{-1}): 3427, 3120, 1755, 1708, 1597, 1281, 1151, 729. ^1H NMR (400 MHz, DMSO-d_6) δ 8.19 (d, J = 8.74 Hz, 2H), 8.03 (s, 1H), 7.86 (d, J = 7.74 Hz, 1H), 7.72 (d, J = 8.74 Hz, 2H), 7.65-7.61 (m, 2H）, 7.51-7.44 (m, 1H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 166.9, 166.1, 164.1, 141.5, 138.3, 134.3, 134.1, 133.2, 132.1, 131.6, 130.0, 129.6, 129.2, 126.0, 125.4. HRMS(ESI): Calcd. $C_{17}H_9BrClNO_3S$, $[M]^+$ m/z: 420.9170, found: 420.9162.

(Z)-5-(2-Bromobenzylidene)-3-(thiophene-2-carbonyl)-1,3-thiazolidine-2,4-dione (3h)

White solid, yield 78.5 %, m. p.: 131.8~132.1 °C. IR (KBr, cm^{-1}): 3423, 3092, 1694, 1418, 1281, 1146, 1053, 737 cm. ^1H NMR (400 MHz, DMSO-d_6) δ 8.40 (dd, J = 4.71, 1.10 Hz, 1H), 8.36 (dd, J = 3.93, 1.22 Hz, 1H), 8.05 (s, 1H), 7.86 (d, J = 7.88 Hz, 1H), 7.66-7.59 (m, 2H), 7.51-7.45 (m, 1H), 7.38-7.36 (m, 1H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 165.6, 163.8, 159.9, 141.3, 140.7, 135.3, 134.0, 132.7, 132.6, 132.0, 130.0, 129.3, 129.0, 125.7, 125.2. HRMS(ESI):

Calcd. $C_{15}H_9BrNO_3S_2$, $[M+H]^+$ *m/z*: 393.9201, found: 393.9193.

(*Z*)-5-(2-Bromobenzylidene)-3-(4-methylbenzoyl)-1,3-thiazolidine-2,4-dione (3i)

White solid, yield 64.9 %, m. p.: 161.4~162.7 °C. IR (KBr, cm^{-1}): 3413, 3032, 1704, 1602, 1439, 1300, 1165, 742. ^1H NMR (400 MHz, DMSO-d_6) δ 8.06 (s, 1H), 8.03 (d, J = 2.70Hz, 2H), 7.86 (d, J = 7.90Hz, 1H), 7.64 (dd, J = 7.60, 5.90 Hz, 2H), 7.50-7.42 (m, 3H), 2.45 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 166.7, 166.1, 164.3, 147.8, 134.2, 133.0, 132.1, 131.7, 130.5, 129.6, 129.3, 128.3, 126.0, 125.5, 21.9. HRMS(ESI): Calcd. $C_{18}H_{13}BrNO_3S$, $[M+H]^+$ *m/z*: 401.9794, found: 401.9782.

(*Z*)-3-(4-Chlorobenzoyl)-5-(4-methylbenzylidene)-1,3-thiazolidine-2,4-dione (3j)

White solid, yield 72.2 %, m. p.:142.2~143.6 °C. IR (KBr, cm^{-1}): 3418, 3083, 1708, 1583, 1267, 1160, 808, 701. ^1H NMR (400 MHz, DMSO-d_6) δ 8.15 (d, J = 8.53 Hz, 2H), 7.95 (s, 1H), 7.70 (d, J = 9.15 Hz, 2H), 7.58 (d, J = 9.15 Hz, 2H), 7.40 (d, J = 8.53 Hz, 2H), 2.39 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 166.5, 166.2, 164.6, 142.0, 141.4, 134.9, 133.2, 131.6, 130.9, 130.6, 130.0, 129.2, 120.2, 21.6. HRMS(ESI): Calcd. $C_{18}H_{13}ClNO_3S$, $[M+H]^+$ *m/z*: 358.0299, found: 358.0291.

(*Z*)-5-(4-Methylbenzylidene)-3-(thiophene-2-carbonyl)-1,3-thiazolidine-2,4-dione (3k)

White solid, yield 64.3 %, m. p.: 146.1~148.0 °C. IR (KBr, cm^{-1}): 3418, 3102, 1694, 1416, 1304, 1165, 1058, 752. ^1H NMR (400 MHz, DMSO-d_6) δ 8.39 (dd, J = 5.14, 1.08 Hz, 1H), 8.31 (dd, J = 4.42, 1.24 Hz, 1H), 7.98 (s, 1H), 7.59 (d, J = 8.21 Hz, 2H), 7.41 (d, J = 8.21 Hz, 2H), 7.37-7.35 (m, 1H), 2.39 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 166.1, 164.6, 160.6, 142.0, 141.4, 140.7, 135.7, 135.0, 130.9, 130.6, 130.5, 130.2, 120.2, 21.6. HRMS(ESI): Calcd. $C_{16}H_{12}NO_3S_2$, $[M+H]^+$ *m/z*: 330.0253, found: 330.0248.

(*Z*)-3-(4-Methylbenzoyl)-5-(4-methylbenzylidene)-1,3-thiazolidine-2,4-dione (3l)

white solid, yield 54.9 %, m. p.: 169.3~170.1 °C. IR (KBr, cm^{-1}): 3423, 3051, 1702, 1592, 1416, 1272, 1165, 826. ^1H NMR (400 MHz, DMSO-d_6) δ 8.02 (d, J = 8.39 Hz, 2H), 7.96 (s, 1H), 7.58 (d, J = 8.11 Hz, 2H), 7.44 (d, J = 8.39 Hz, 2H), 7.41 (d, J = 8.11 Hz, 2H), 2.44 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 167.1, 166.2, 164.8, 147.8, 142.0, 134.9, 131.6, 130.9, 130.6, 130.5, 129.80, 129.6, 128.4, 120.3, 21.9, 21.6. HRMS(ESI): Calcd. $C_{19}H_{16}NO_3S$, $[M+H]^+$ *m/z*: 338.0845, found: 338.0838.

(*Z*)-3-(4-Chlorobenzoyl)-5-(2,3,4-trimethoxybenzylidene)-1,3-thiazolidine-2,4-dione (3m)

Light yellow solid, yield 41.8 %, m. p.: 152.6~153.2 °C. IR (KBr, cm^{-1}): 3408, 3107, 1699, 1578, 1267, 1086, 803, 791. ^1H NMR (400 MHz, DMSO-d_6) δ 8.14 (d, J = 8.70Hz, 2H), 7.98 (s ，1H), 7.70 (d, J = 8.70 Hz, 2H), 7.27 （d, J = 8.94 Hz, 1H），7.06 (d, J = 8.90 Hz, 1H) 3.90 (s, 3H), 3.89 (s, 3H), 3.80 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 168.6, 168.0, 166.9, 156.3, 153.5, 142.3, 138.3, 131.6, 129.2, 126.6, 124.4, 119.9, 109.1, 62.2, 61.0, 56.6. HRMS(ESI): Calcd. $C_{20}H_{17}ClNO_6S$, $[M+H]^+$ *m/z*: 434.0460, found: 434.0444.

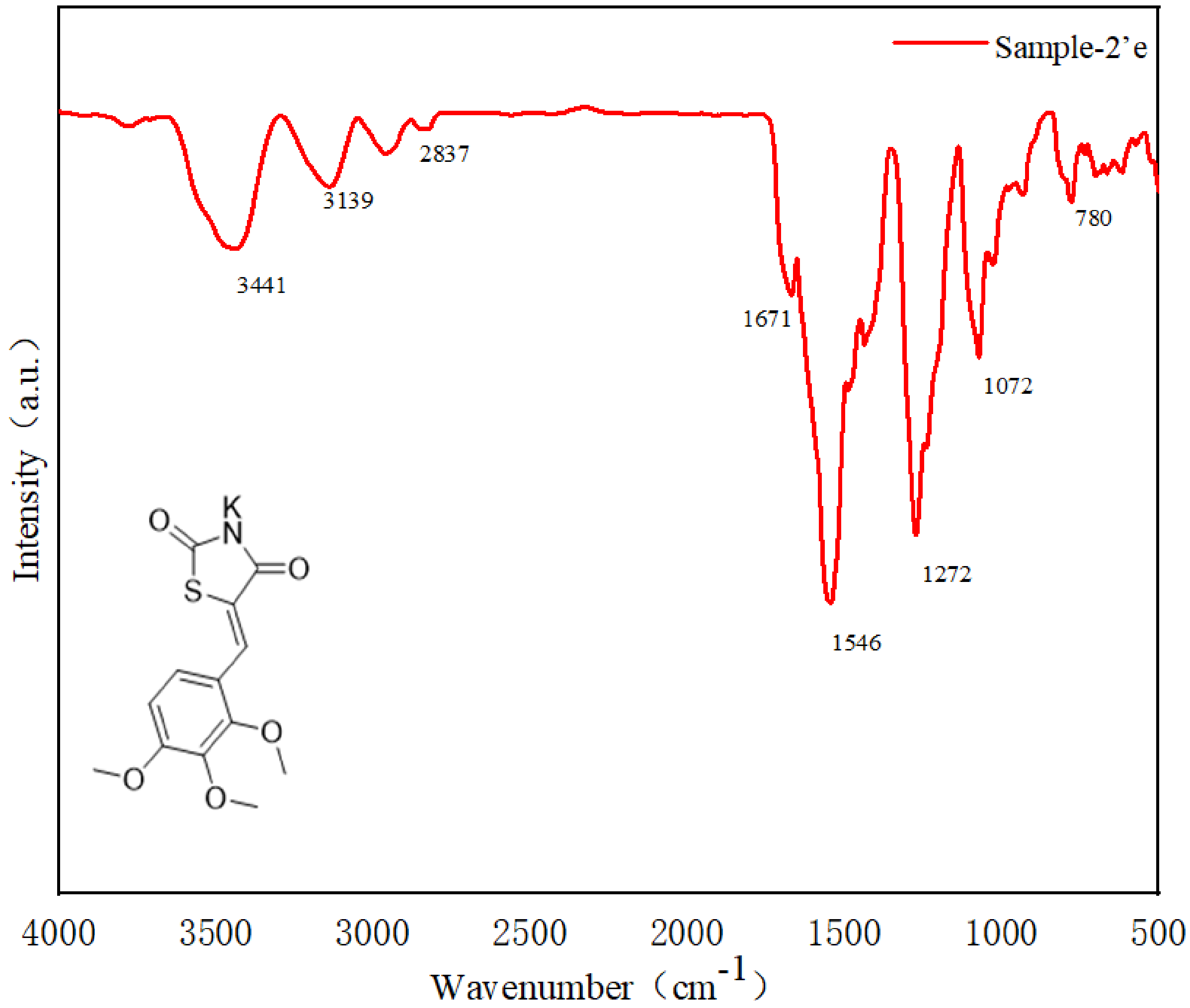
(*Z*)-3-(4-Methylbenzoyl)-5-(2,3,4-trimethoxybenzylidene)-1,3-thiazolidine-2,4-dione (3n)

Light yellow solid, yield 54.6 %, m. p.: 154.4~156.7 °C. IR (KBr, cm^{-1}): 3450, 3139, 1694, 1587, 1471, 1276, 1193, 788. ^1H NMR (400 MHz, DMSO-d_6) δ 8.02-7.98 (m, 3H), 7.44-7.42 (m, 2H), 7.28 (d, J = 8.86 Hz, 1H), 7.06 (d, J = 8.86 Hz, 1H), 3.91 (s, 3H), 3.90 (s, 3H), 3.80 (s, 3H), 2.45 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 167.2, 166.5, 164.9, 157.0, 153.6, 147.8, 142.3, 131.6, 130.5, 129.5, 128.5, 125.2, 109.22, 62.3, 61.0, 56.7, 21.9. HRMS（ESI）:Calcd. $C_{21}H_{20}NO_6S$, $[M+H]^+$ *m/z*: 414.1006, found: 414.0987.

(*Z*)-3-(2-Methoxybenzoyl)-5-(2,3,4-trimethoxybenzylidene)-1,3-thiazolidine-2,4-dione (3o)

Light yellow solid, yield 61.9 %, m. p.: 171.9~173.3 °C. IR (KBr, cm^{-1}): 3446, 2958, 1708, 1587, 1467, 1286, 1091, 770. ^1H NMR (400 MHz, DMSO-d_6) δ 8.00 (s, 1H), 7.85 (d, J = 8.06 Hz, 1H), 7.74（dd, J =11.40，4.40Hz, 1H）, 7.28 (d, J = 8.82 Hz, 1H), 7.23 (d, J = 8.64 Hz, 1H), 7.16 (t, J = 7.50Hz, 1H), 7.05 (d, J = 8.90 Hz, 1H), 3.90 (d, J = 3.9 Hz, 6H), 3.81 (d, J = 5.0 Hz, 6H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 166.0, 164.5, 164.4, 159.4, 157.0, 153.6, 142.3, 137.5, 132.9, 129.5, 125.3, 121.8, 120.4, 119.5, 118.8, 113.4, 109.2, 62.3, 61.1, 57.1, 56.7. HRMS(ESI): Calcd. $C_{21}H_{20}NO_7S$, $[M+H]^+$ *m/z*: 430.0955, found: 430.0947.

IR and NMR spectra



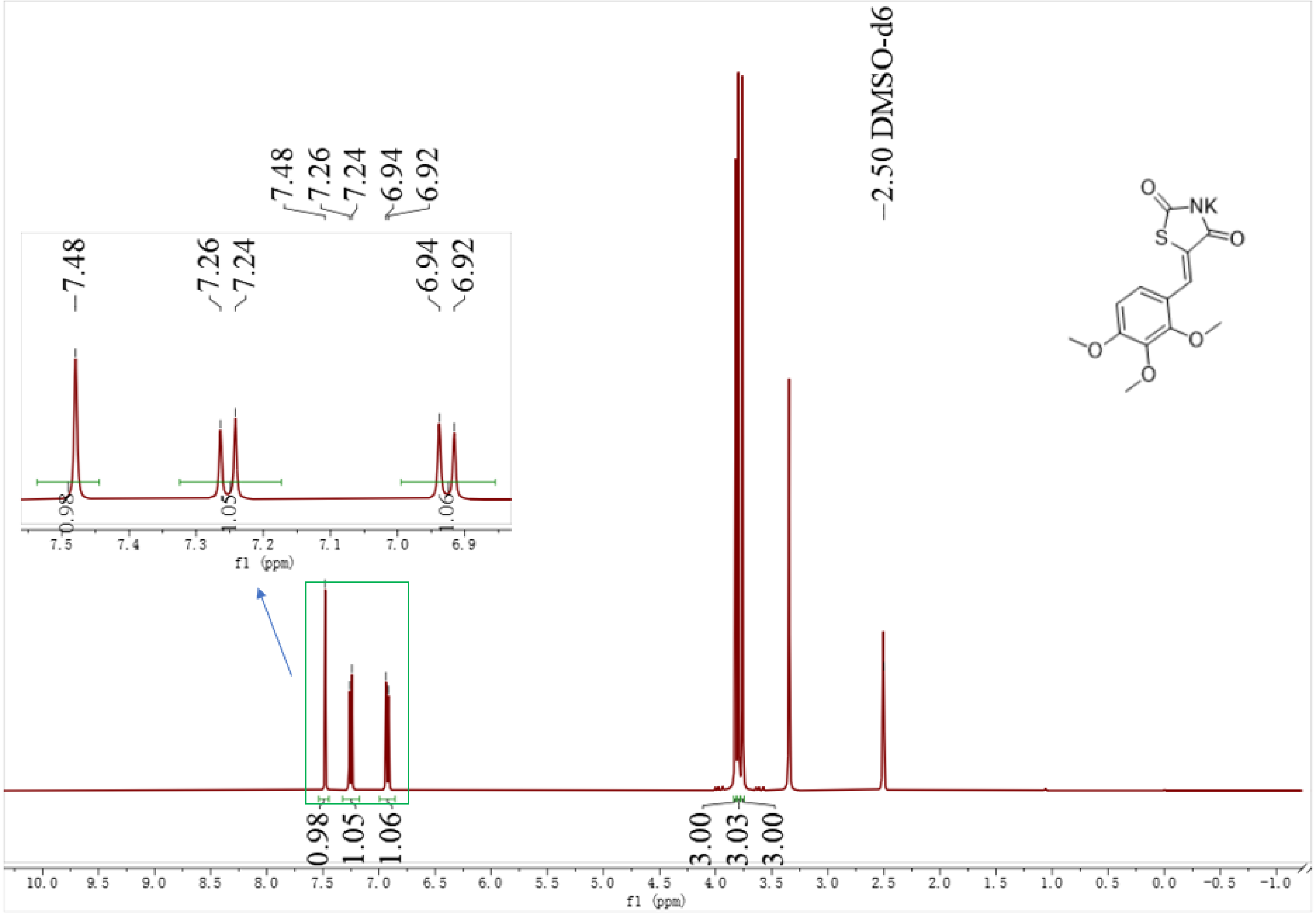


Figure S1-1 ^{1}H-NMR spectrum of intermediate **2’e**

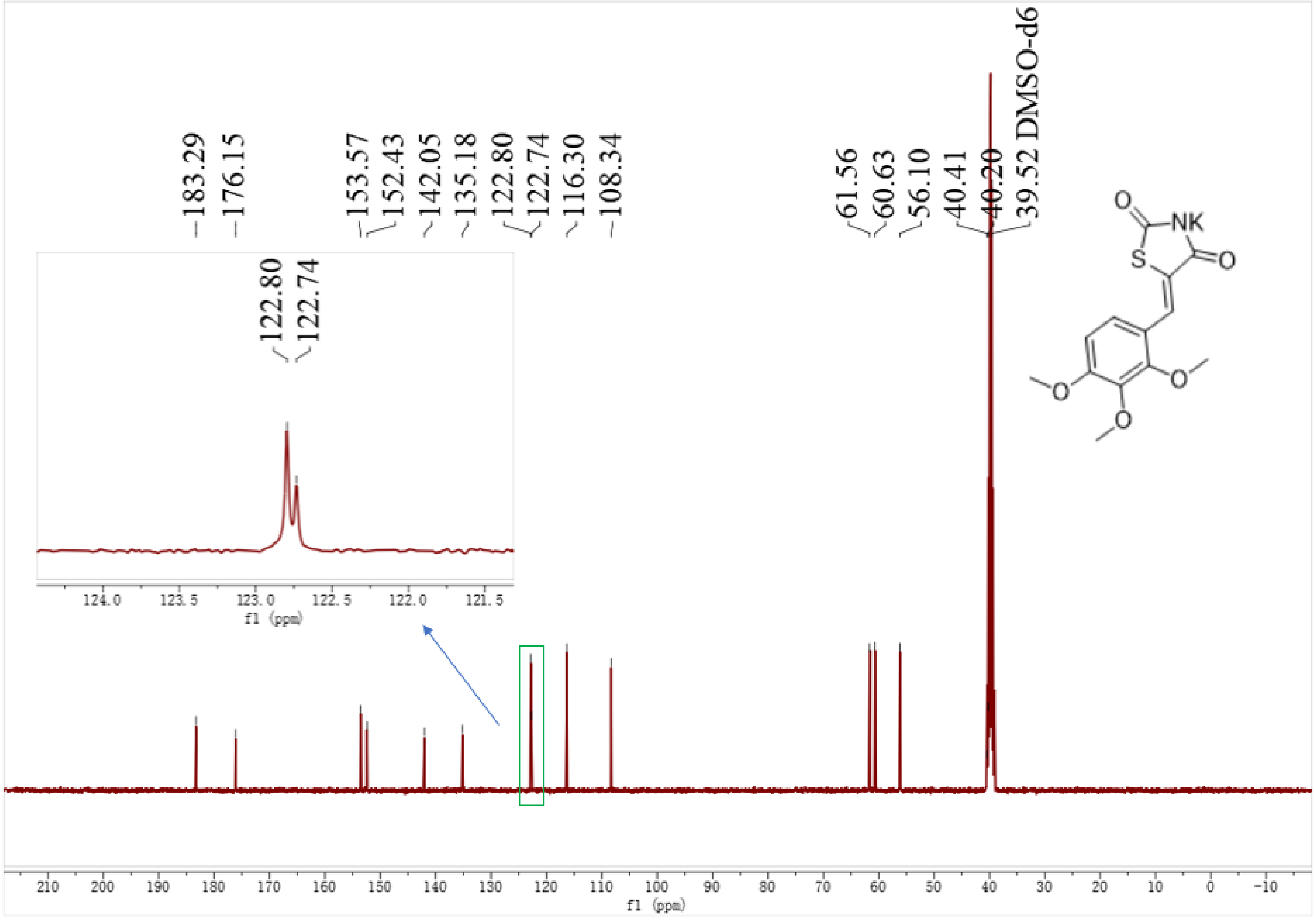
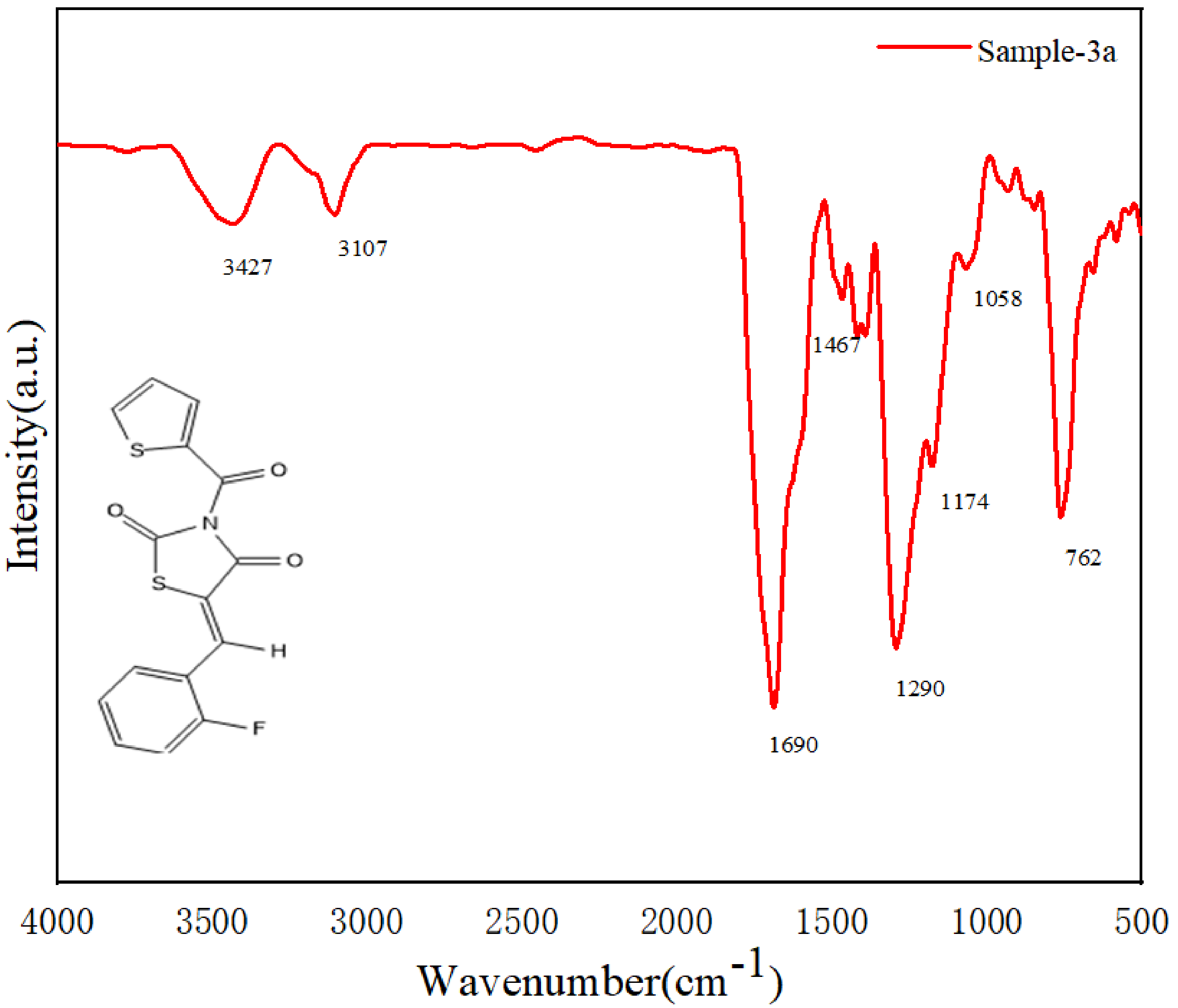


Figure S1-2 ^{13}C-NMR spectrum of compound **2'e**



Sample-3a
3427
3107
1467
1058
1174
762
1290
1690
O
O
N
O
S
S
H
F
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm^{-1})

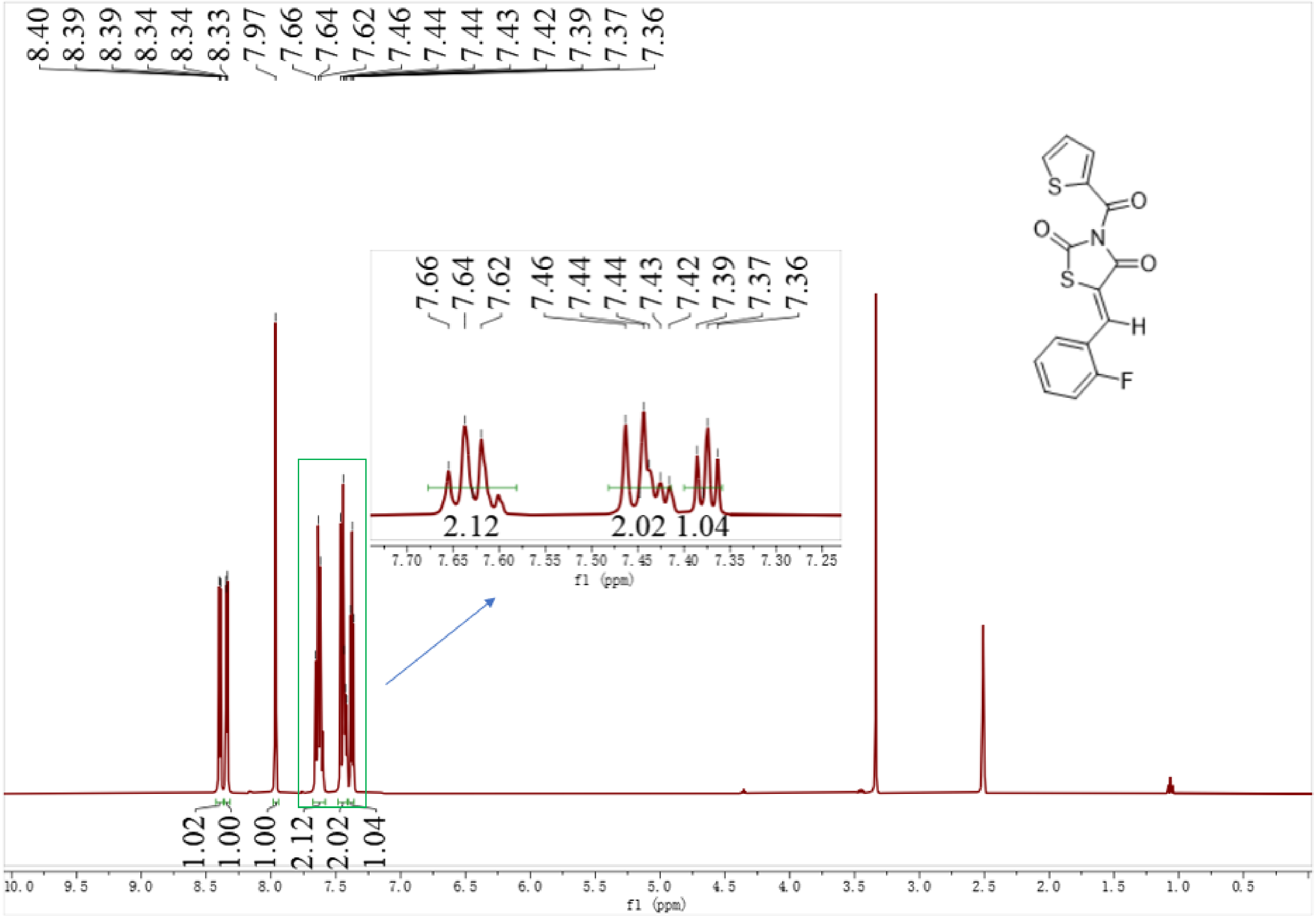


Figure S2-1 [1]H-NMR spectrum of compound **3a**

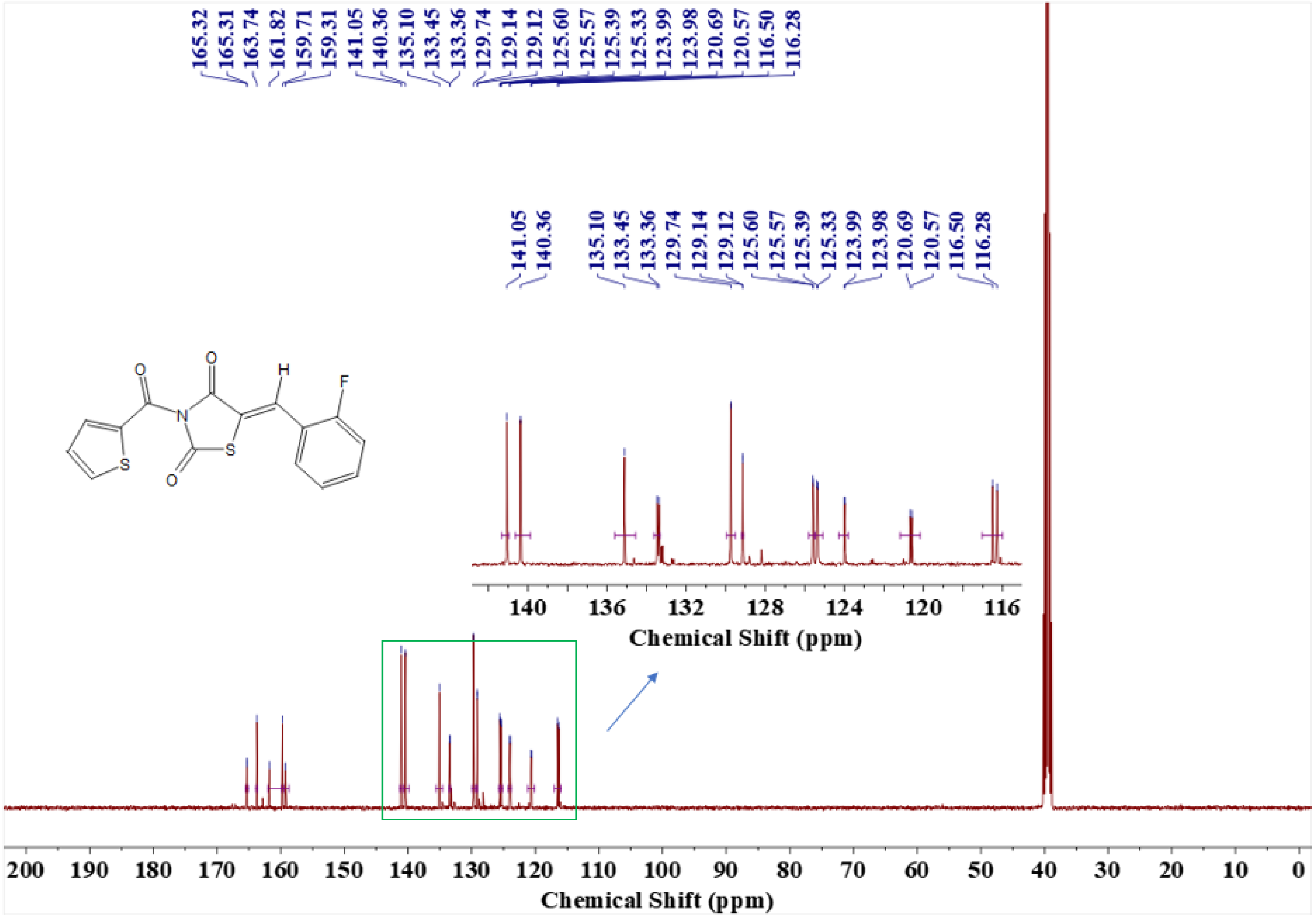
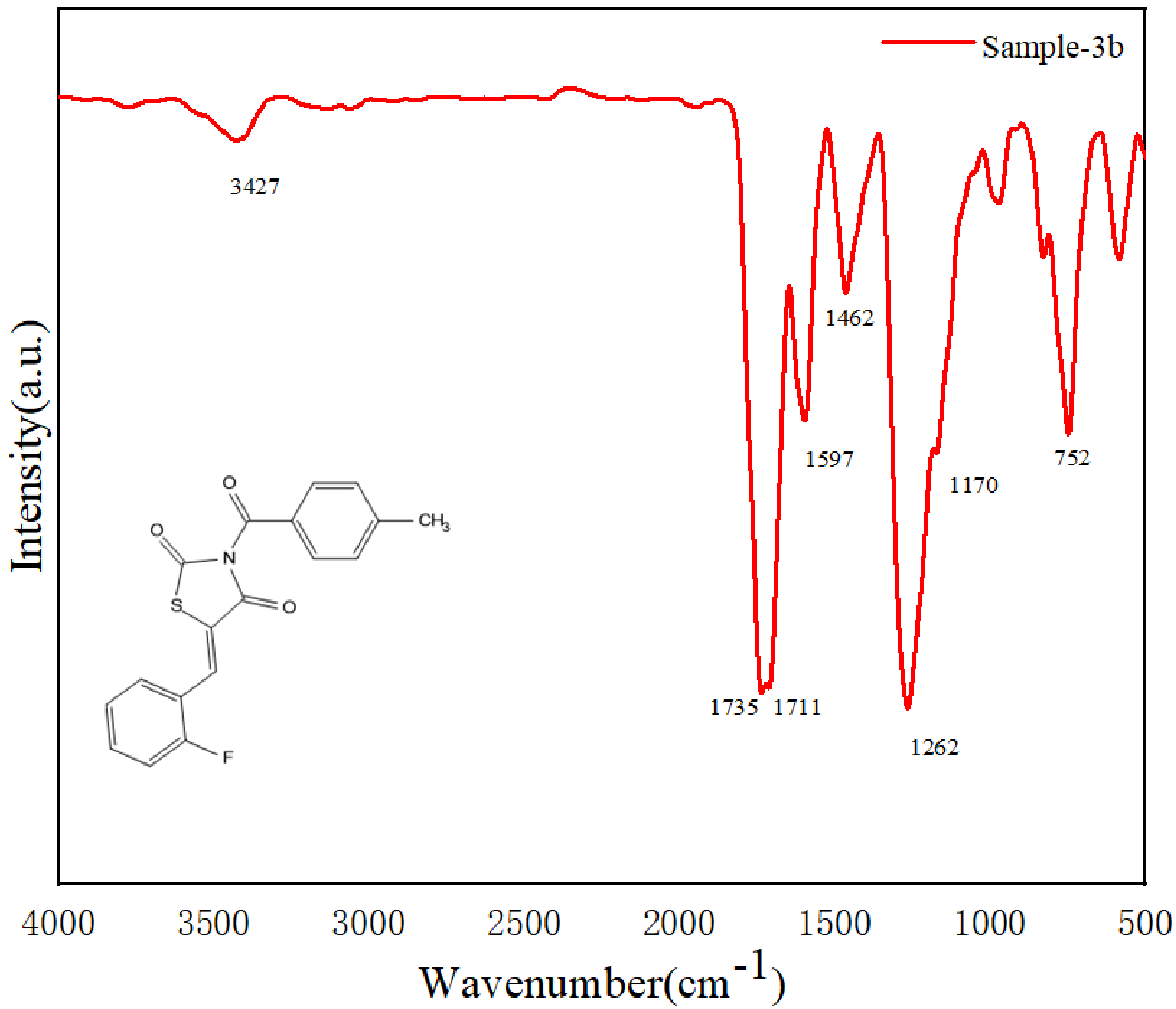


Figure S2-2 [13]C-NMR spectrum of compound **3a**


Sample-3b
3427
1462
1597
1170
752
1735
1711
1262
O
O
N
CH3
S
O
F
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm-1)
Intensity(a.u.)

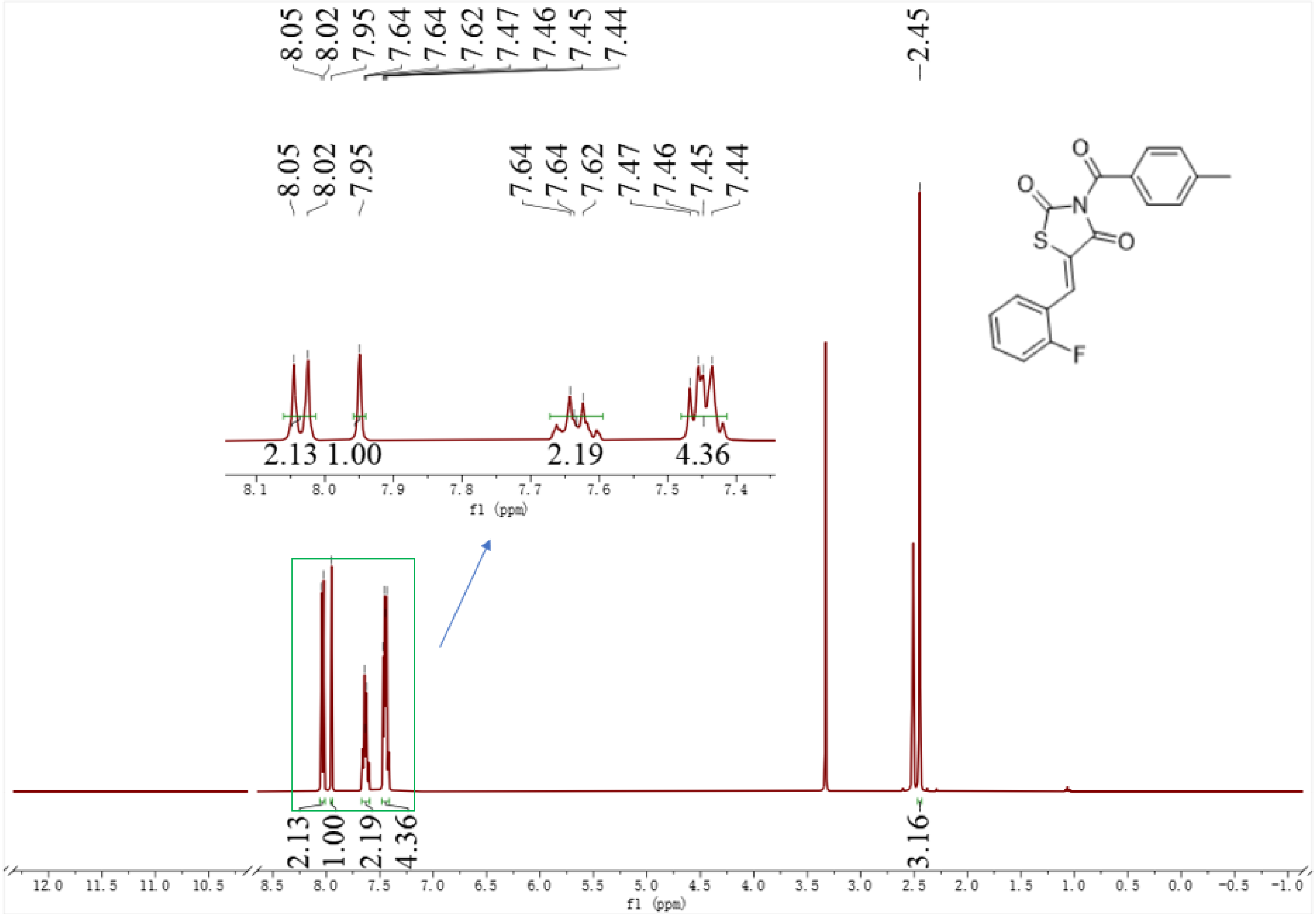


Figure S3-1 ¹H-NMR spectrum of compound **3b**

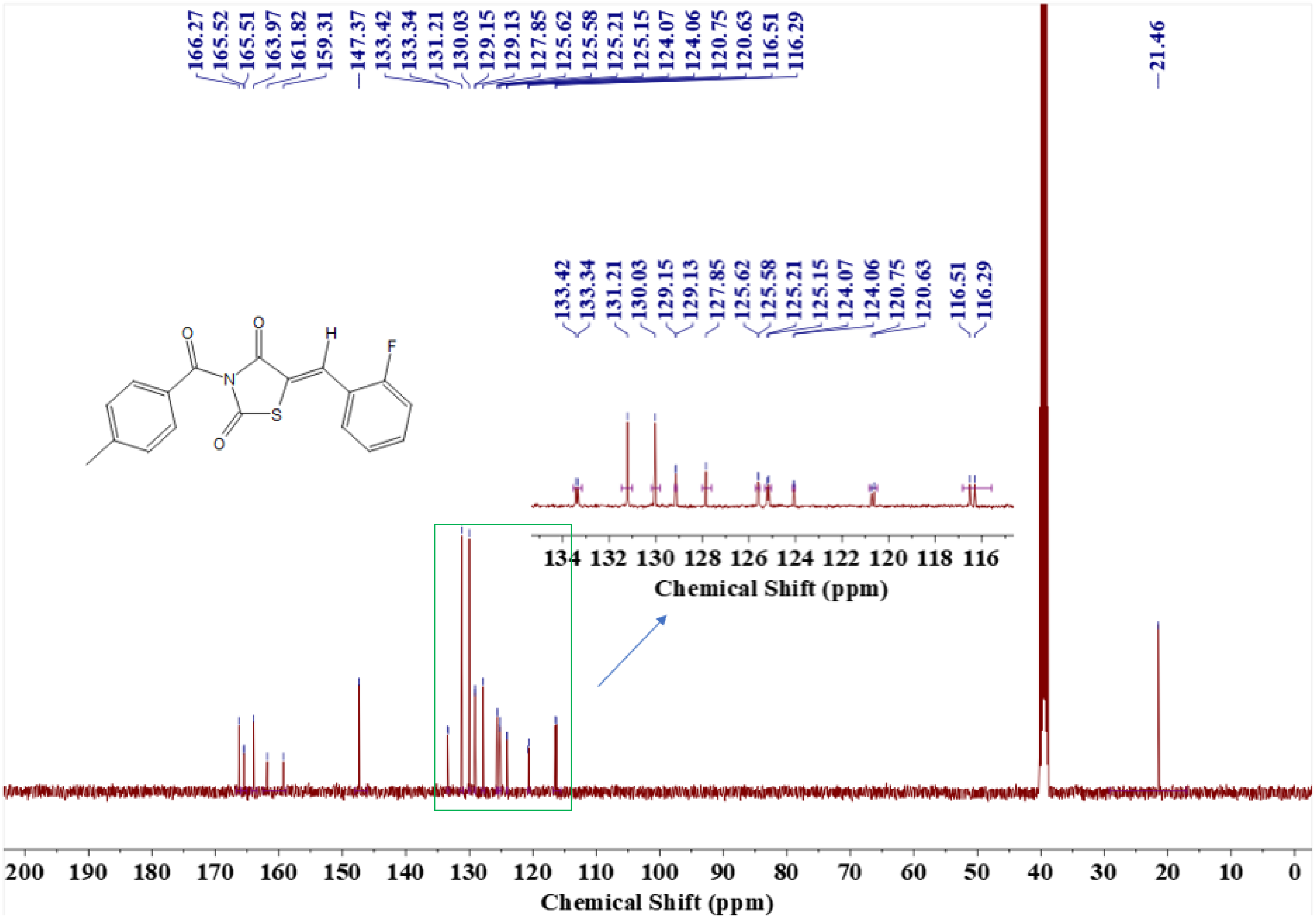
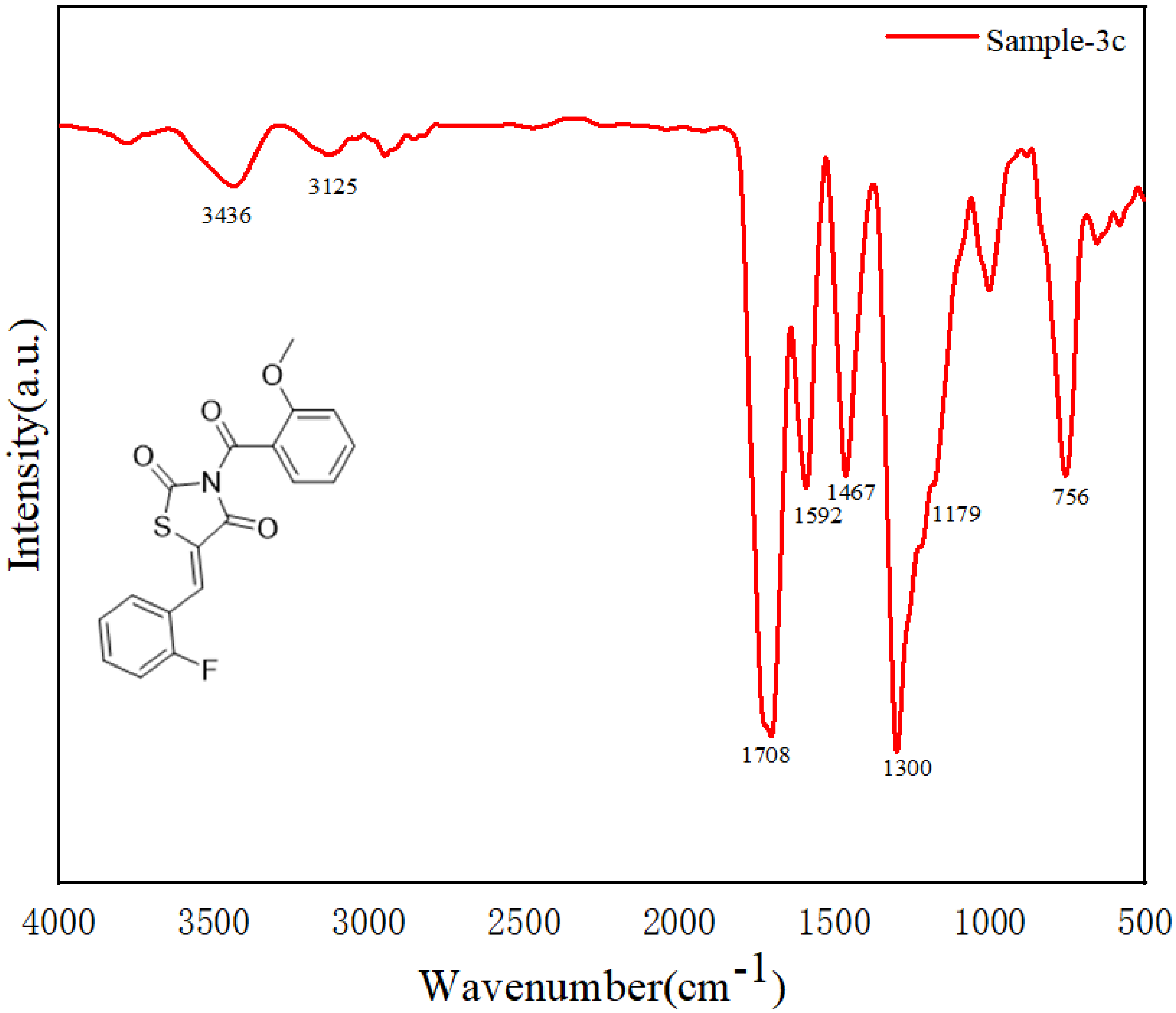


Figure S3-2 ^{13}C-NMR spectrum of compound **3b**


Sample-3c
3436
3125
1708
1592
1467
1300
1179
756
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm-1)

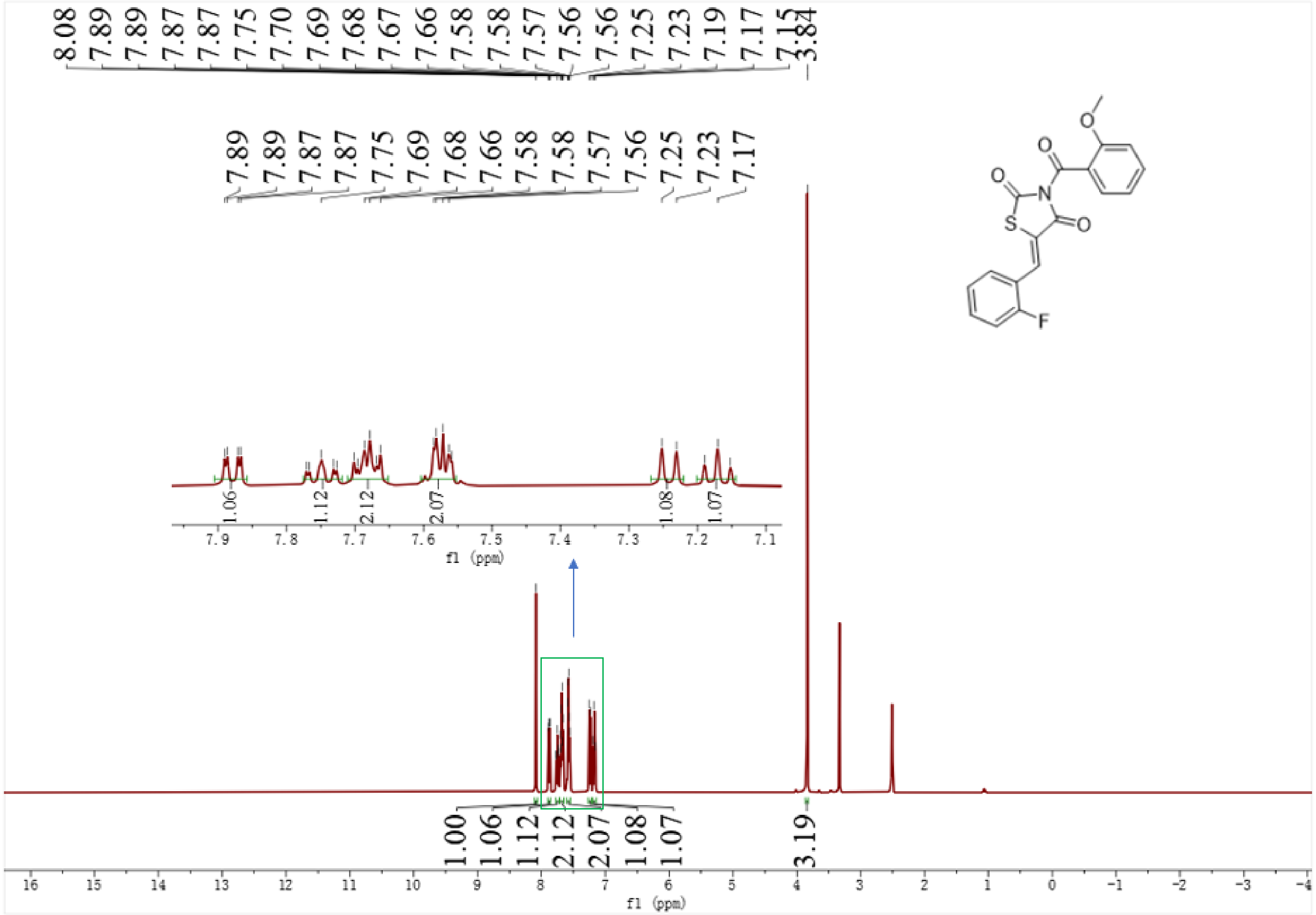


Figure S4-1 ^{1}H-NMR spectrum of compound **3c**

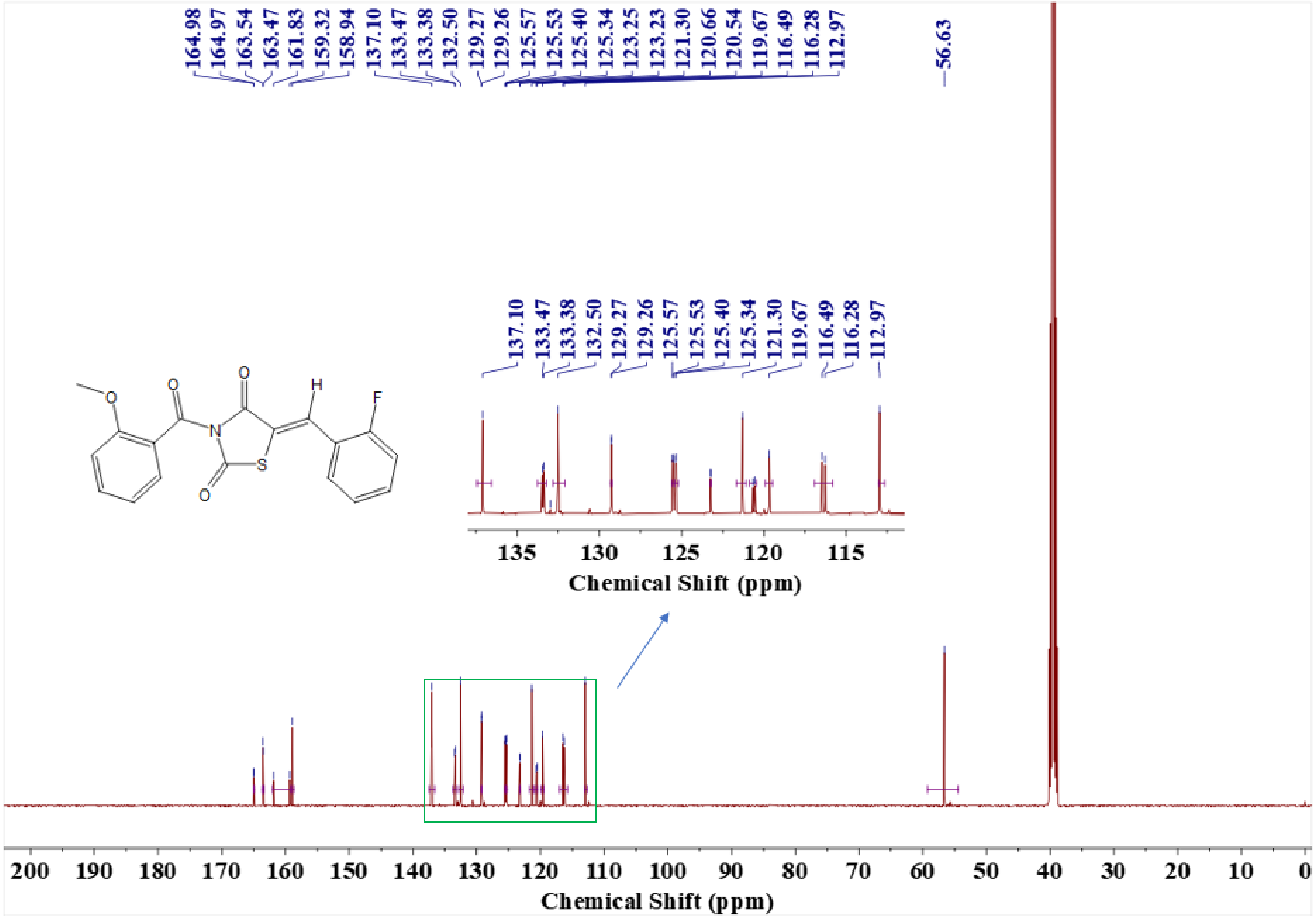
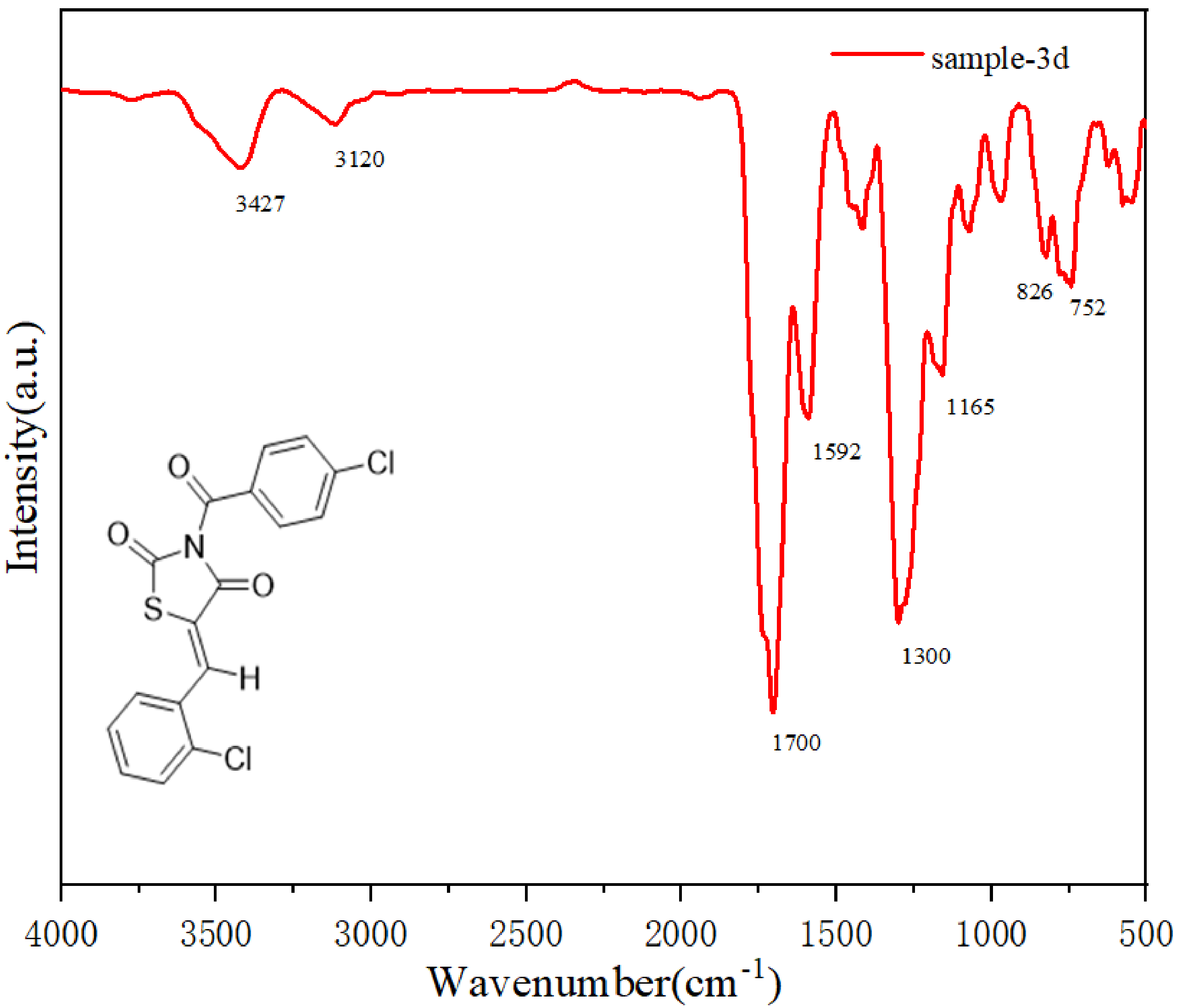


Figure S4-2 ^{13}C-NMR spectrum of compound **3c**


sample-3d
3427
3120
1700
1592
1300
1165
826
752
Intensity(a.u.)
Wavenumber(cm-1)
4000
3500
3000
2500
2000
1500
1000
500
O
Cl
O
N
O
S
H
Cl

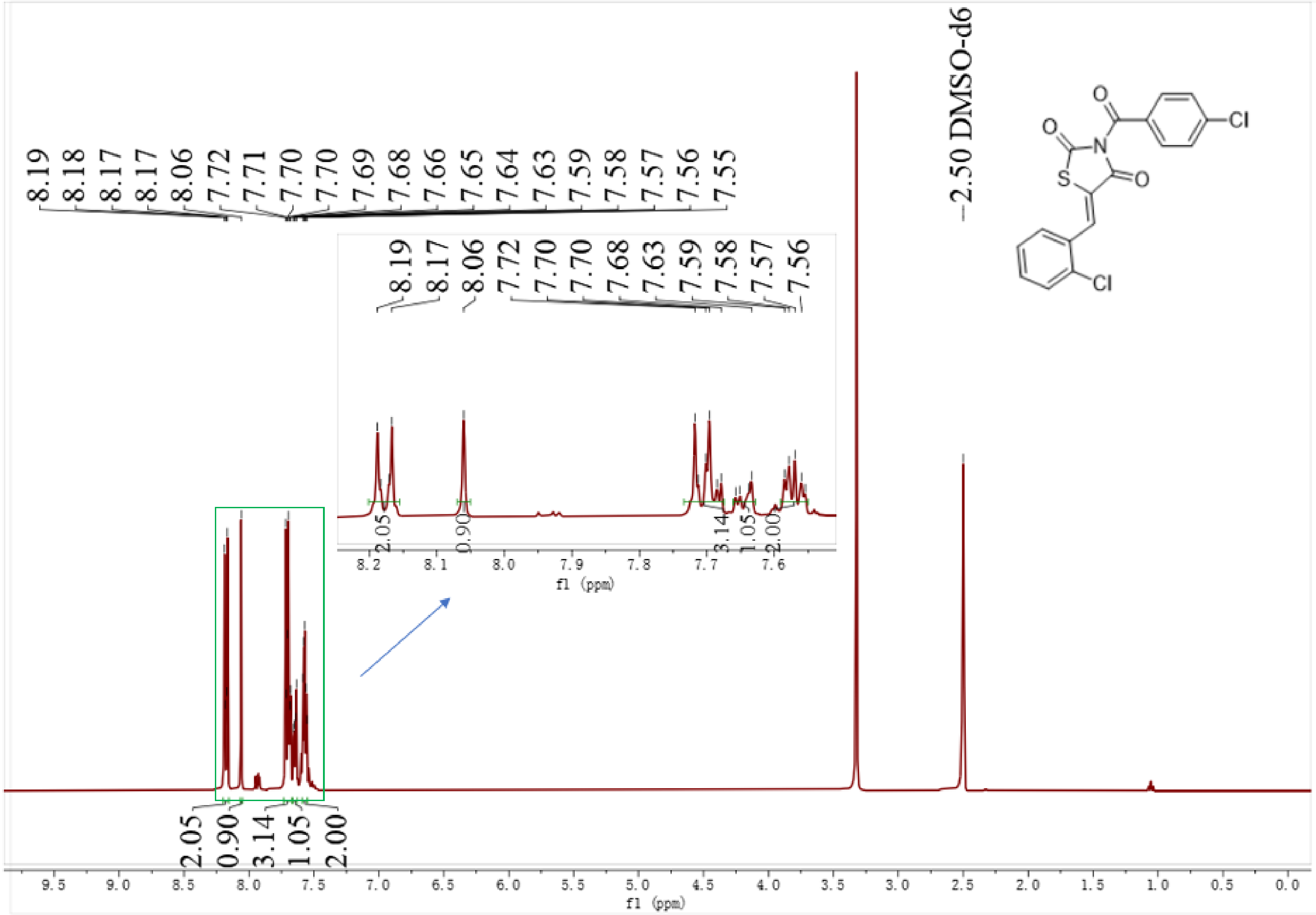


Figure S5-1 [1]H-NMR spectrum of compound **3d**

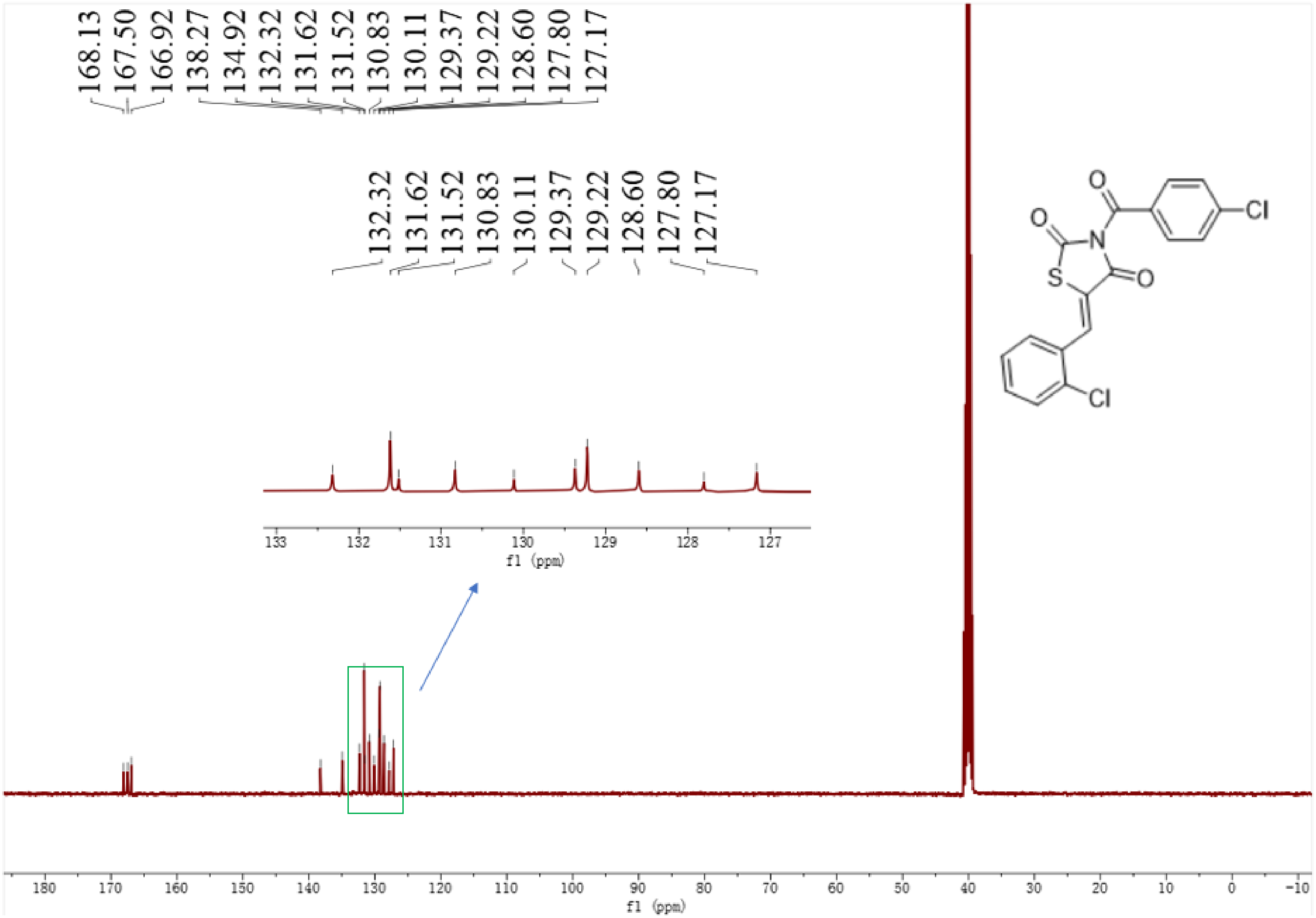
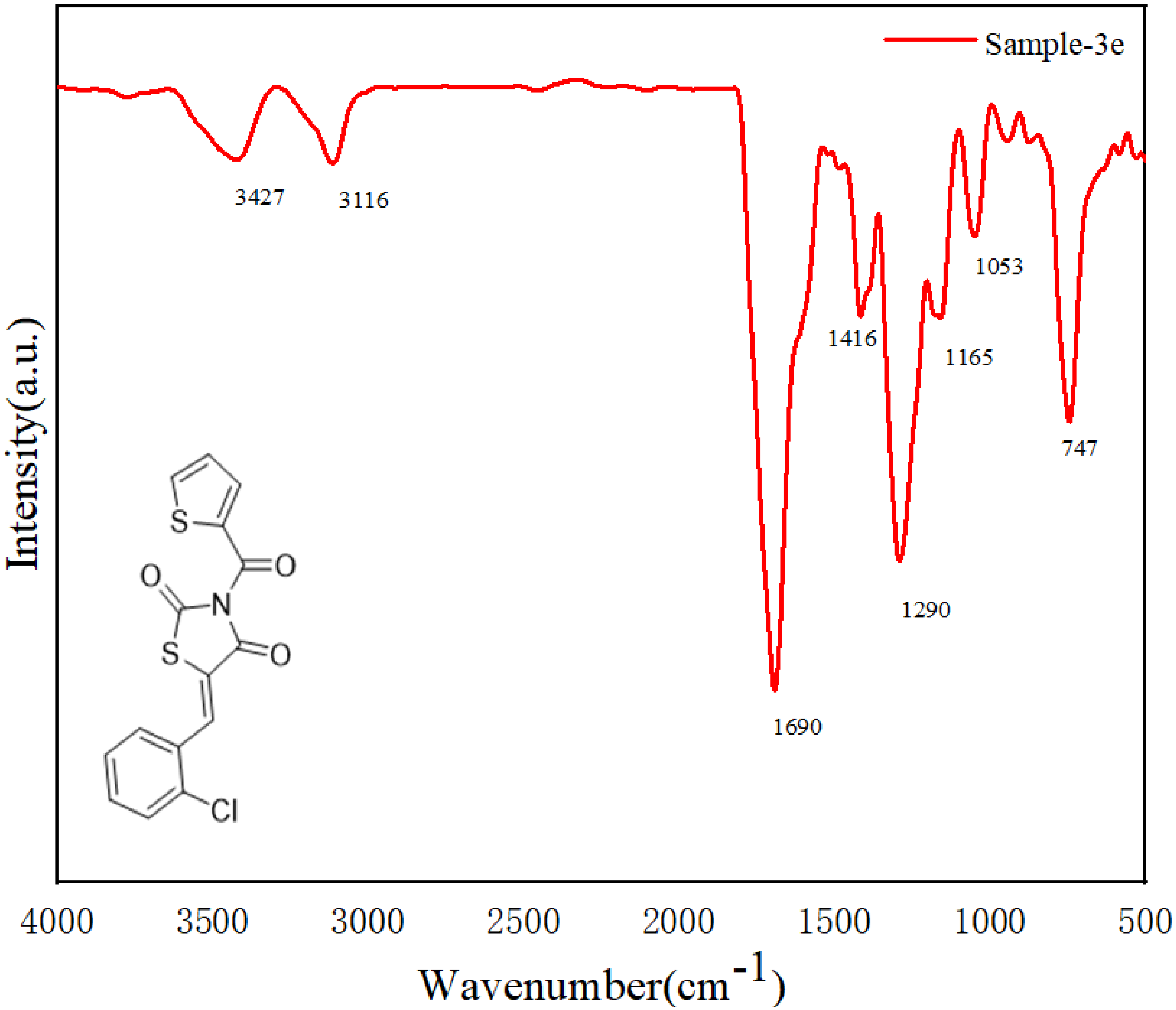


Figure S5-2 ^{13}C-NMR spectrum of compound **3d**



Sample-3e
3427
3116
1690
1416
1290
1165
1053
747
Intensity(a.u.)
Wavenumber(cm^{-1})
4000
3500
3000
2500
2000
1500
1000
500
S
O
N
O
S
O
Cl

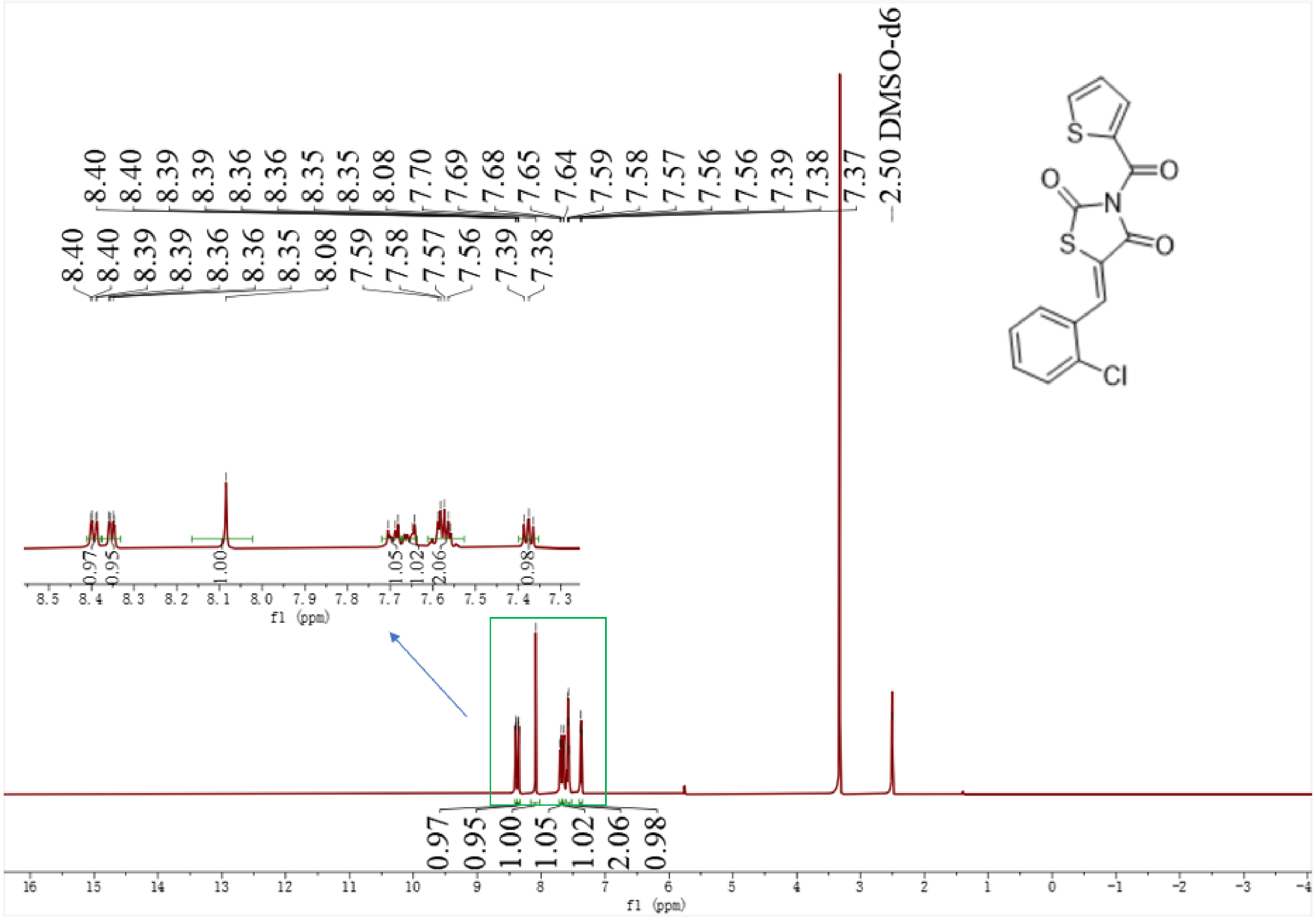


Figure S6-1 ^{1}H-NMR spectrum of compound **3e**

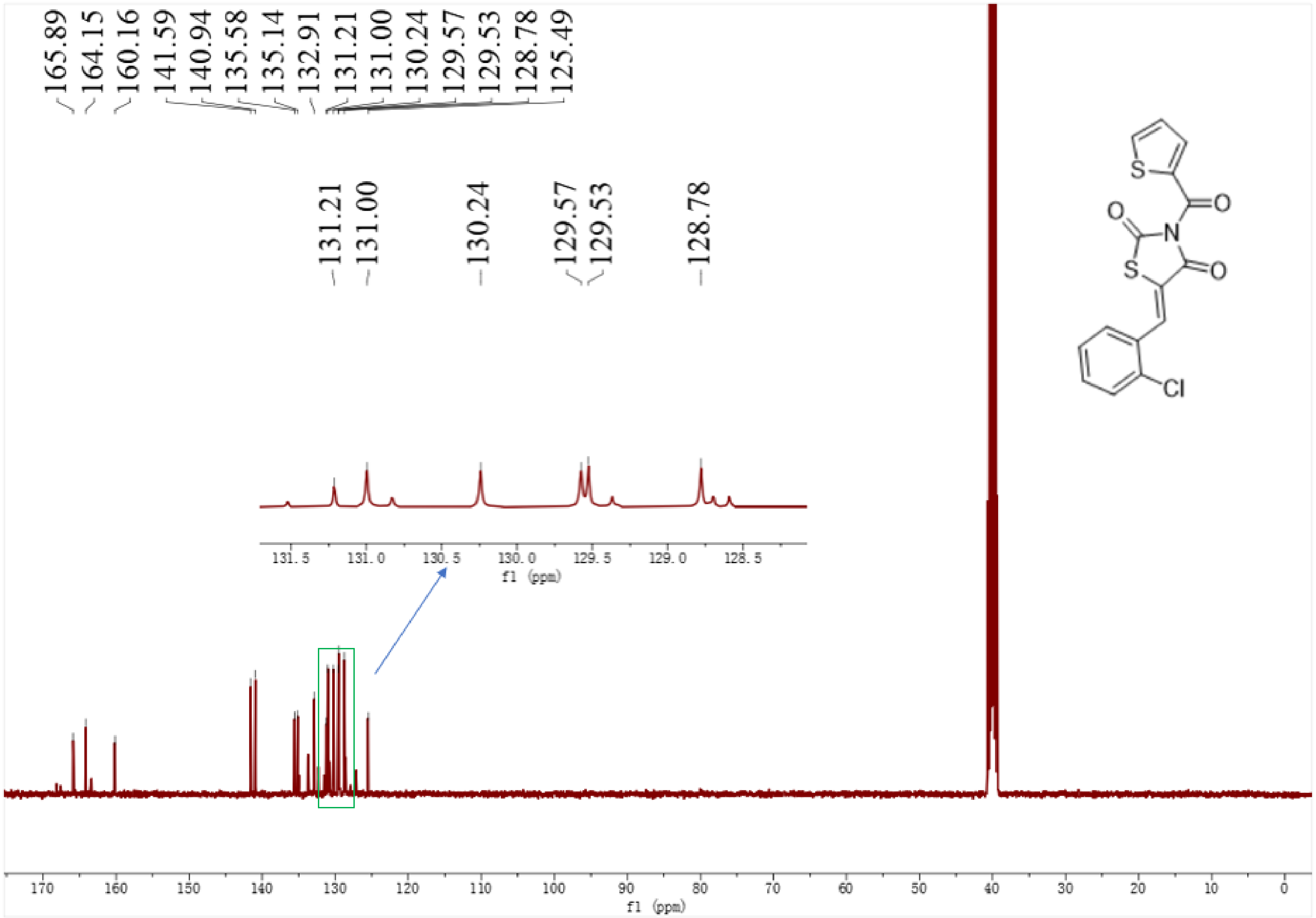
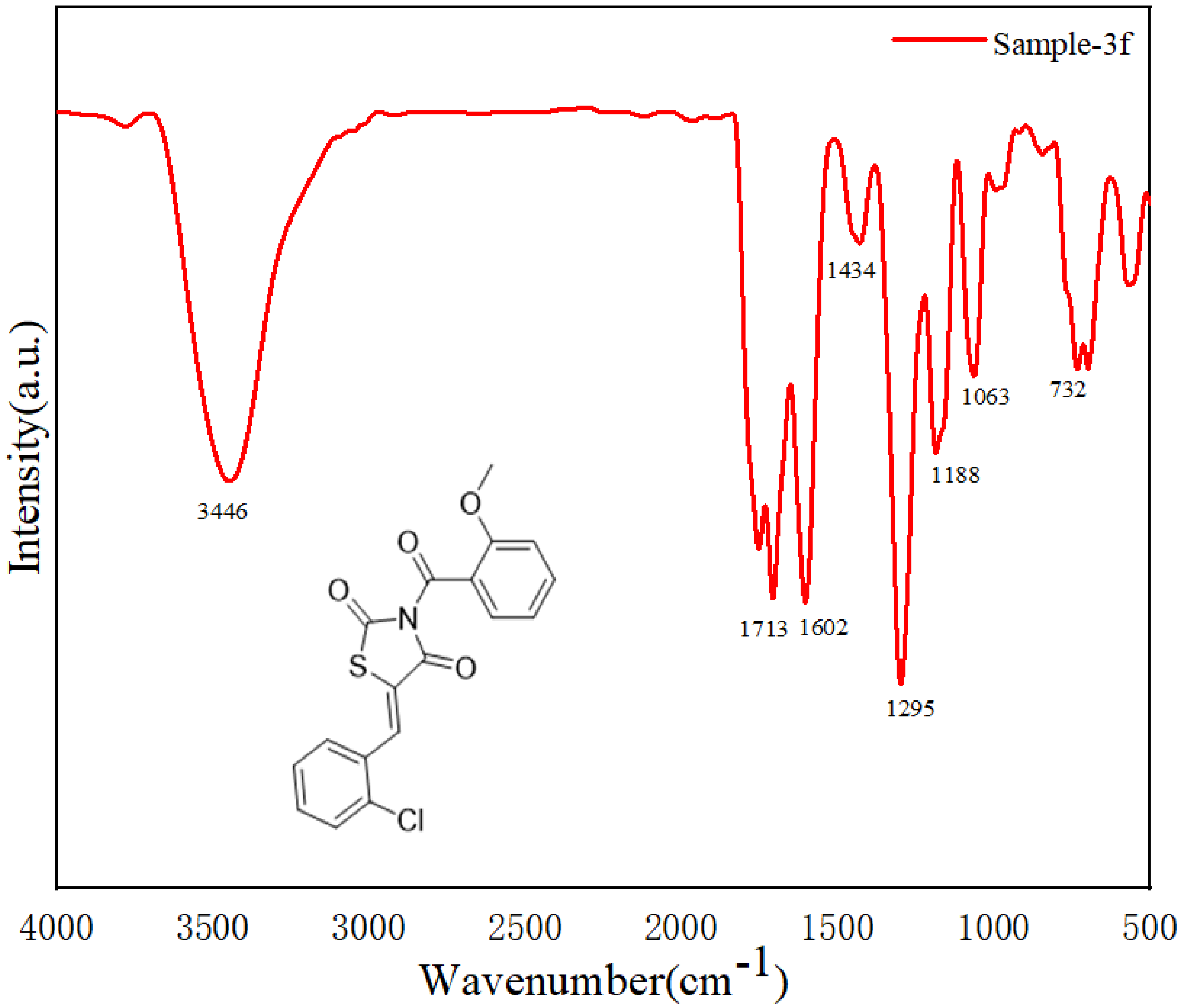


Figure S6-2 ^{13}C-NMR spectrum of compound **3e**



Sample-3f
3446
1713
1602
1434
1295
1188
1063
732
O
O
N
O
S
O
Cl
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm-1)

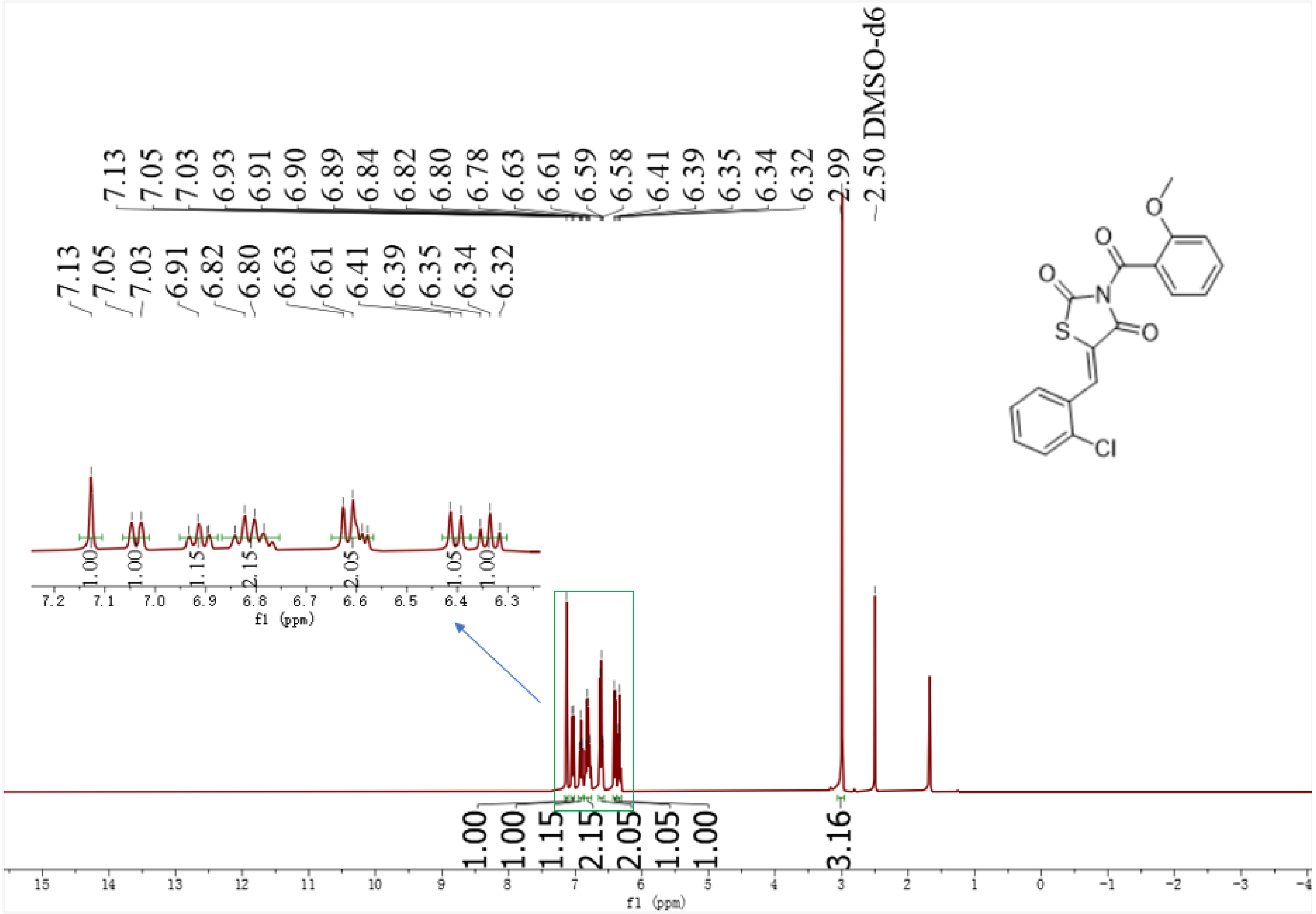


Figure S7-1 ^{1}H-NMR spectrum of compound **3f**

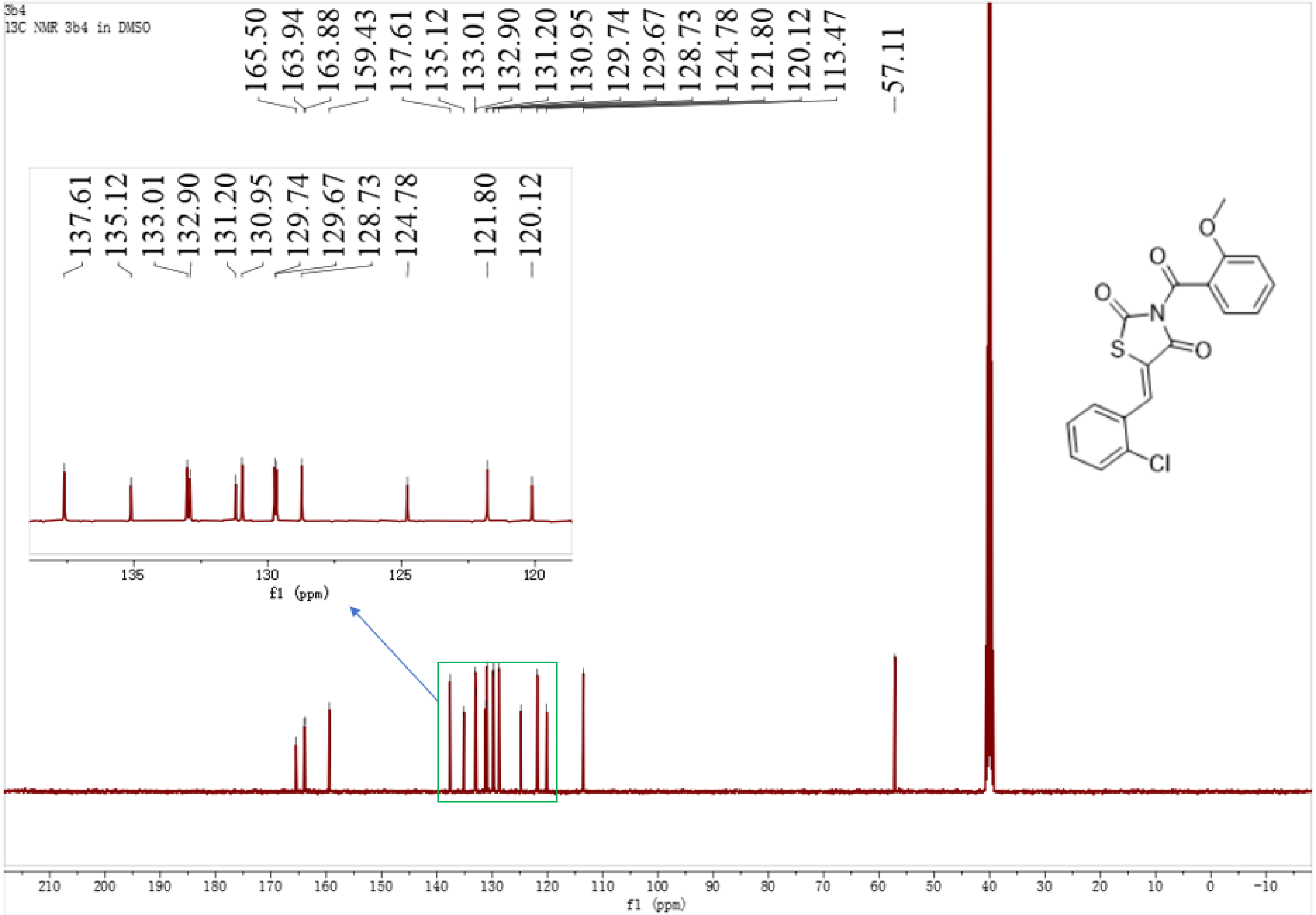
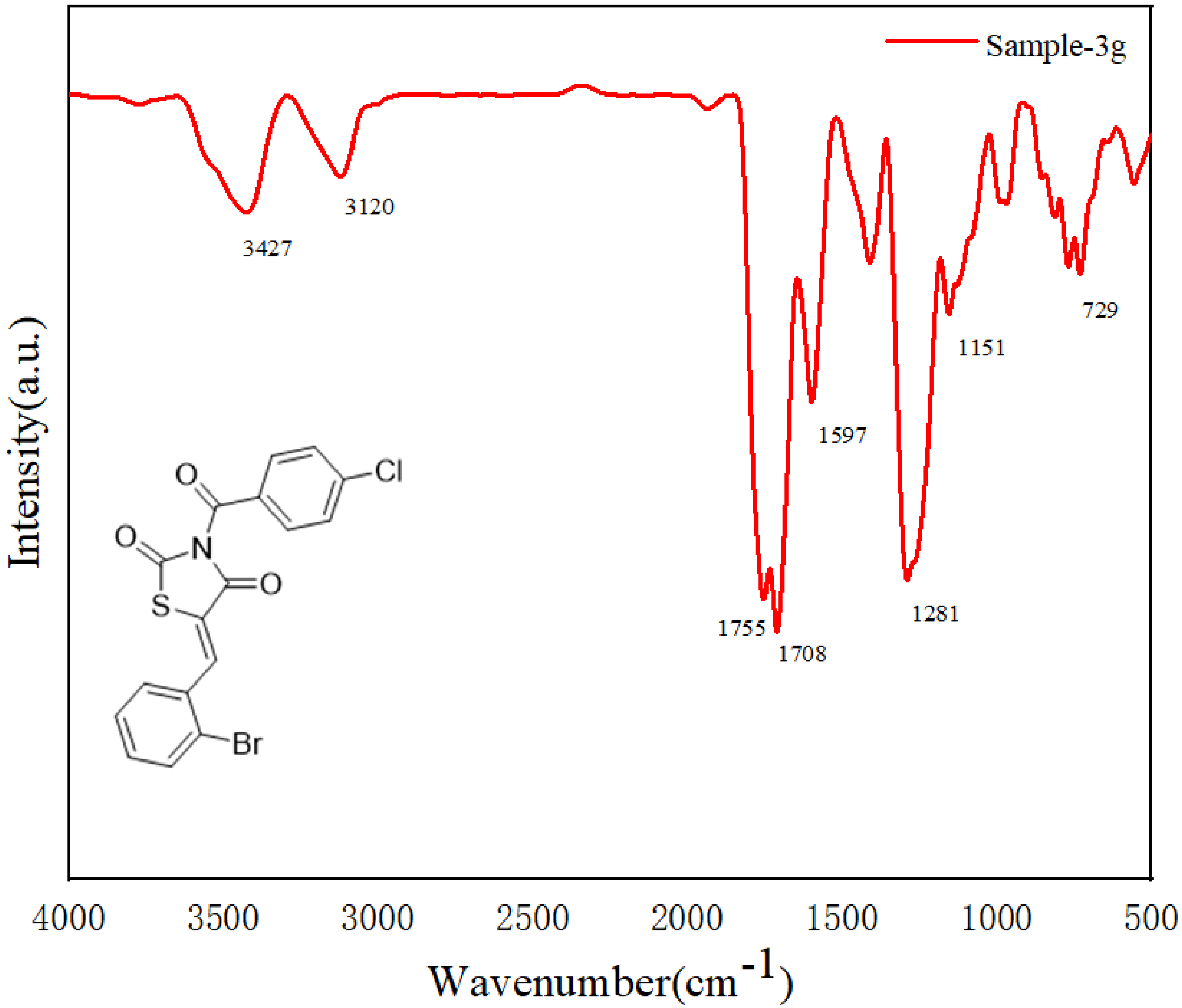


Figure S7-2 ^{13}C-NMR spectrum of compound **3f**


Sample-3g
Intensity(a.u.)
Wavenumber(cm-1)
4000
3500
3000
2500
2000
1500
1000
500
3427
3120
1755
1708
1597
1281
1151
729
O
Cl
O
N
O
S
Br

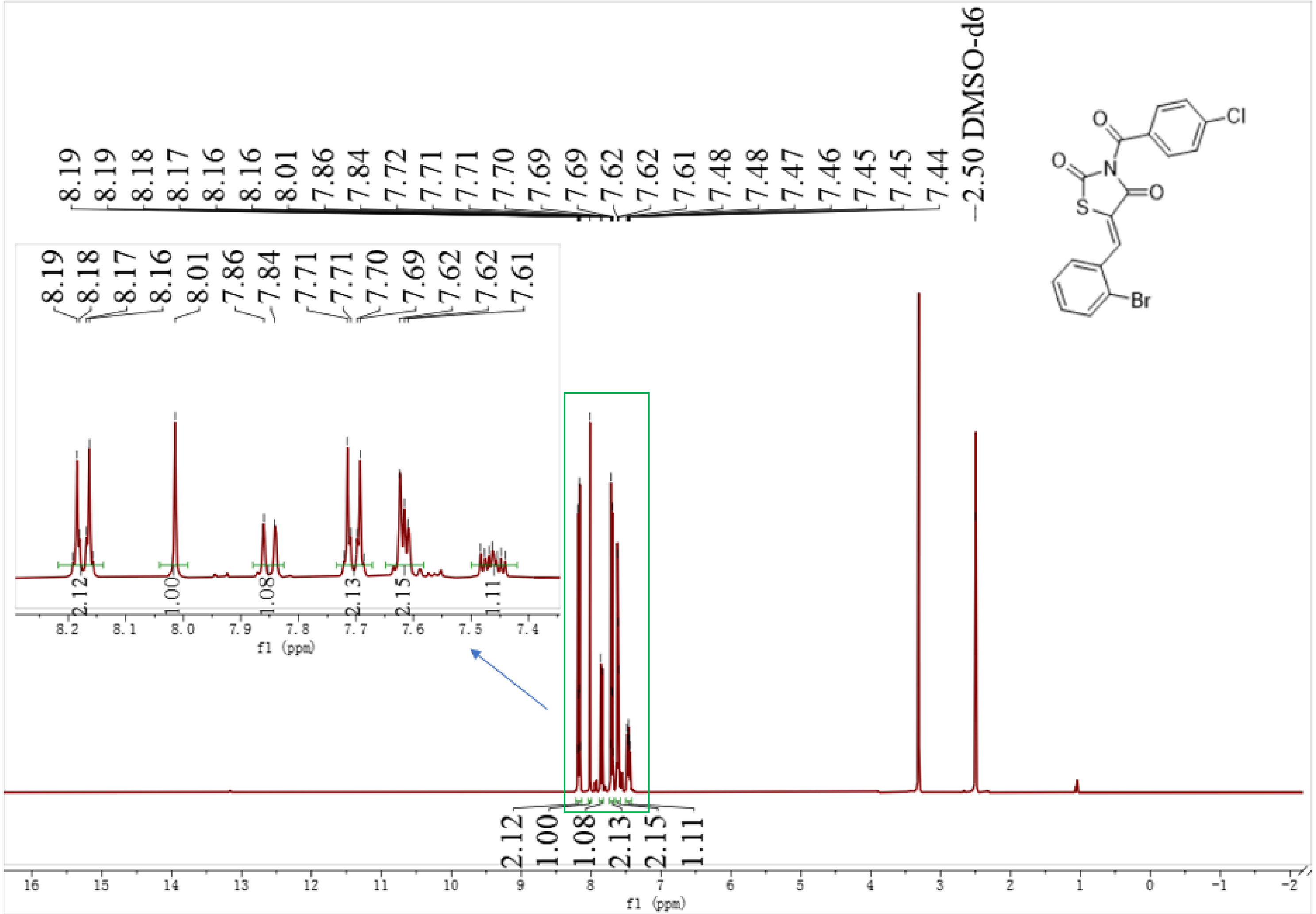


Figure S8-1 ^{1}H-NMR spectrum of compound **3g**

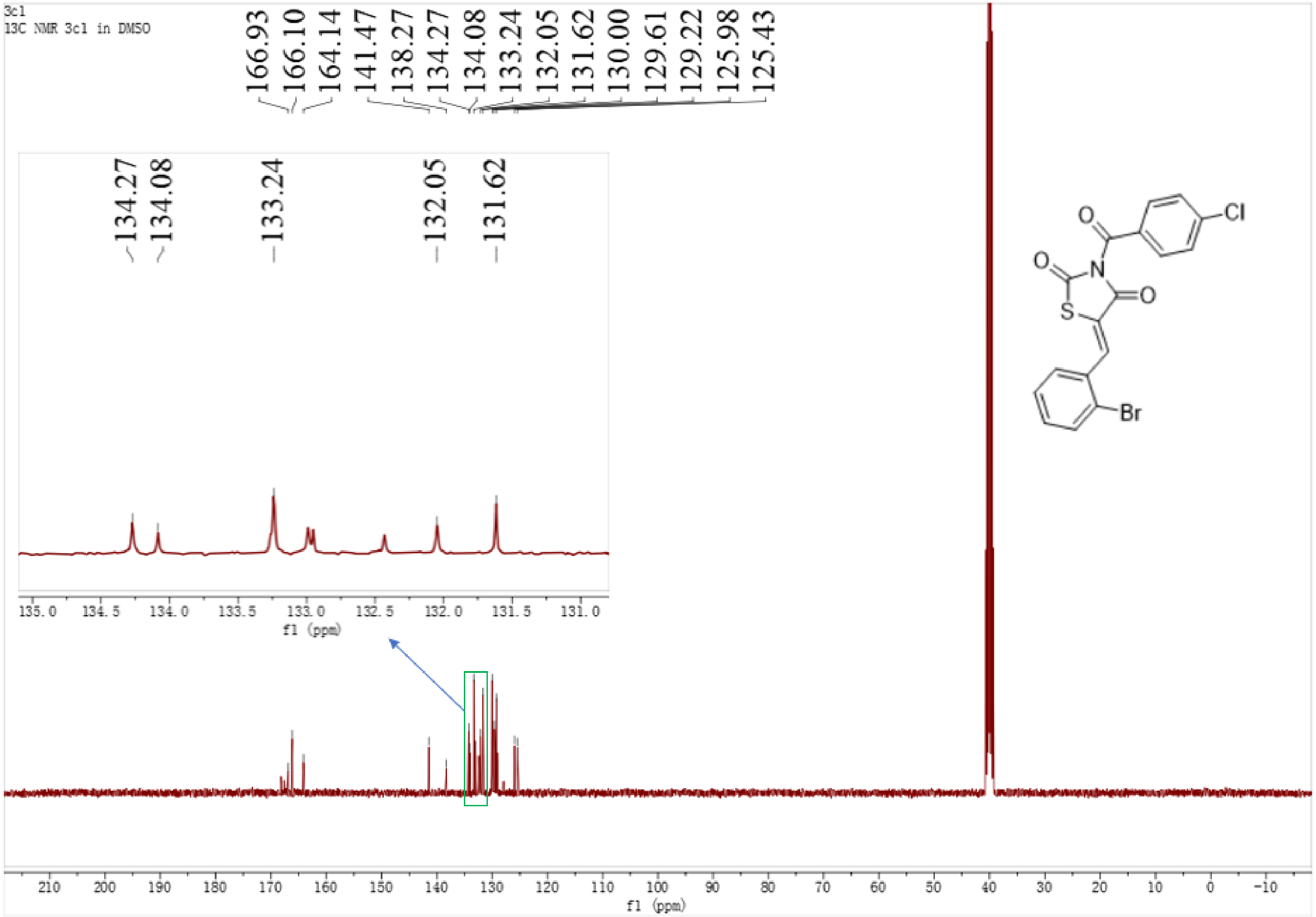
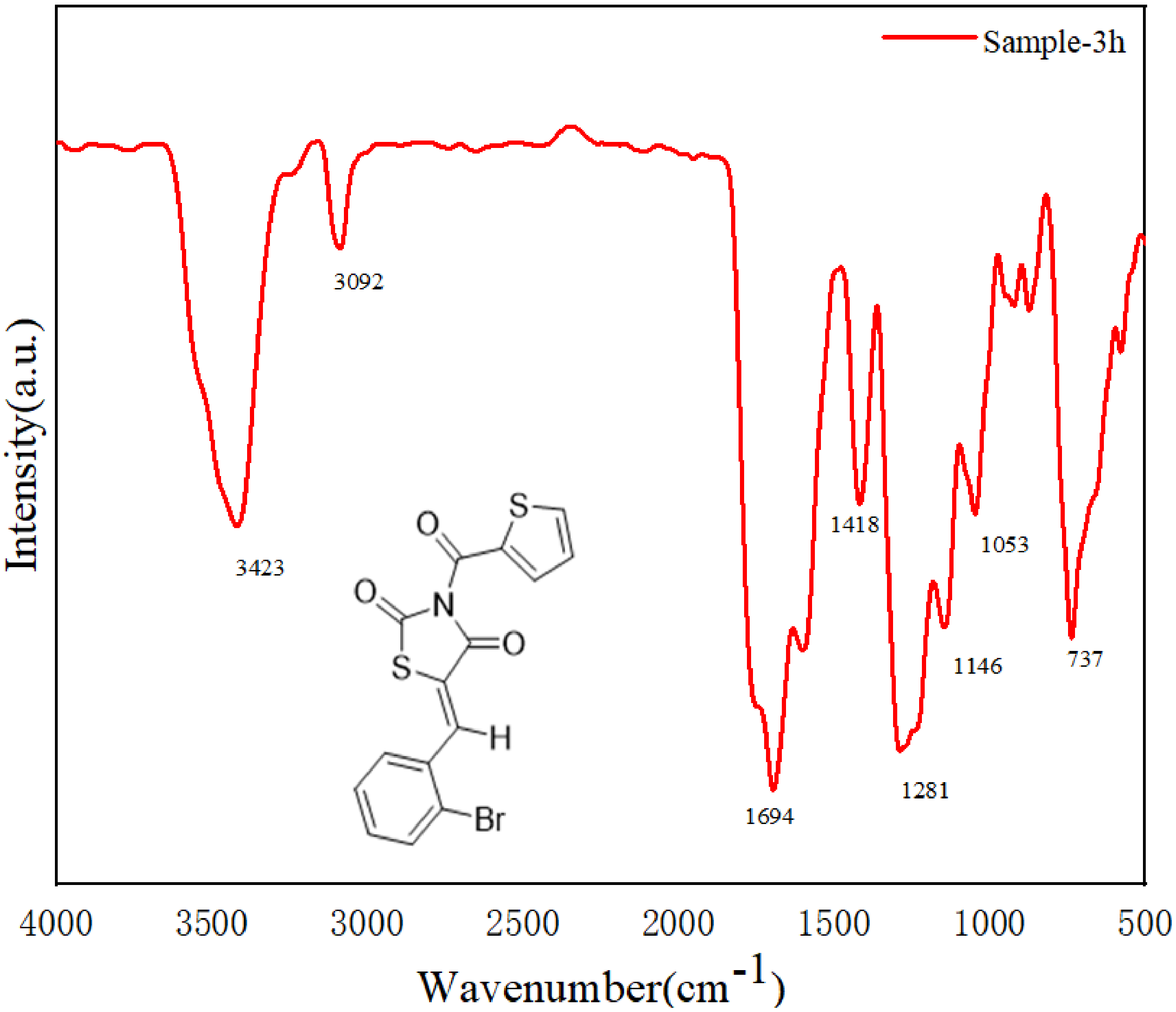


Figure S8-2 ^{13}C-NMR spectrum of compound **3g**



Sample-3h
Intensity(a.u.)
3423
3092
1694
1418
1281
1146
1053
737
O
S
O
N
O
S
H
Br
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm^{-1})

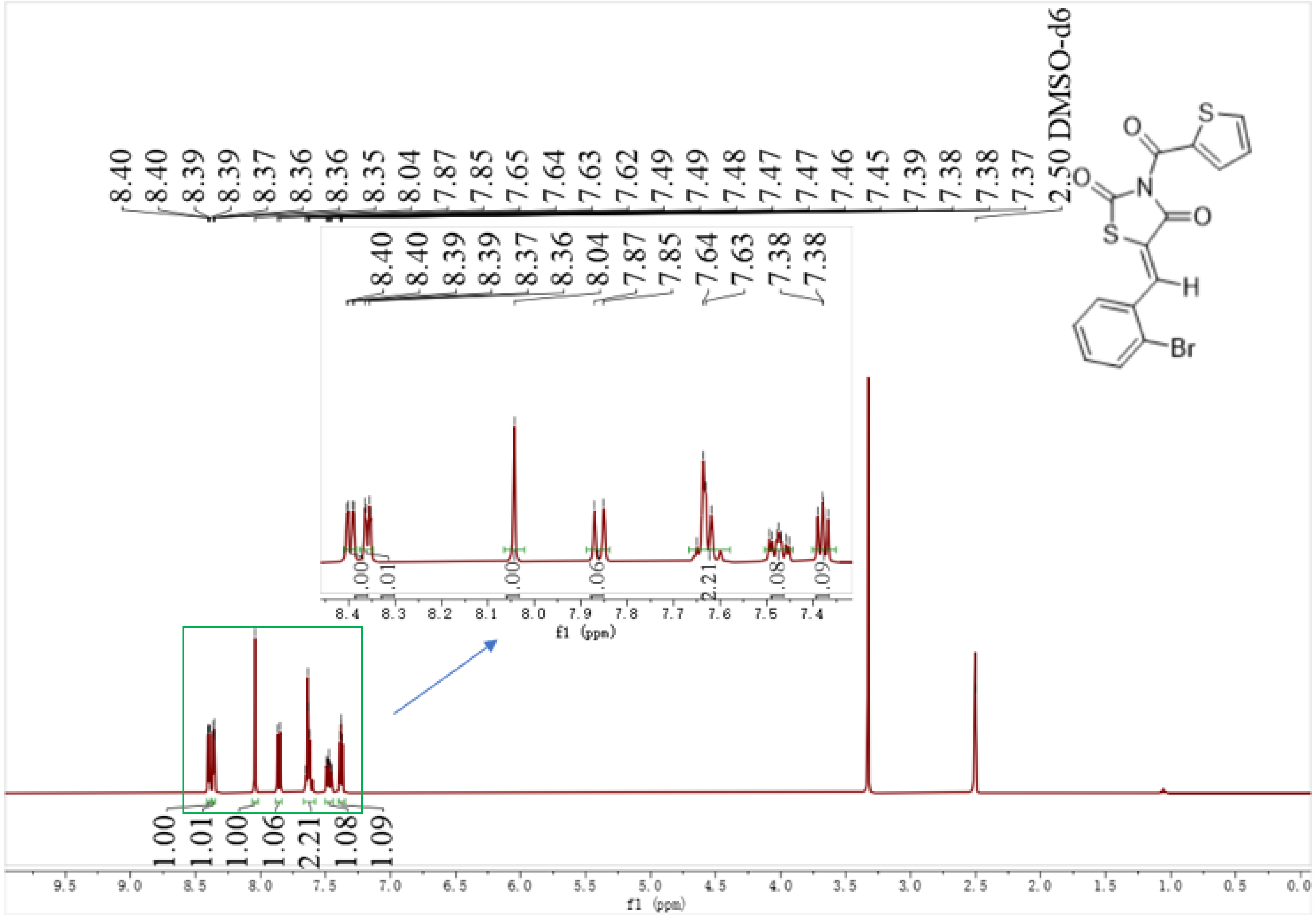


Figure S9-1 [1]H-NMR spectrum of compound **3h**

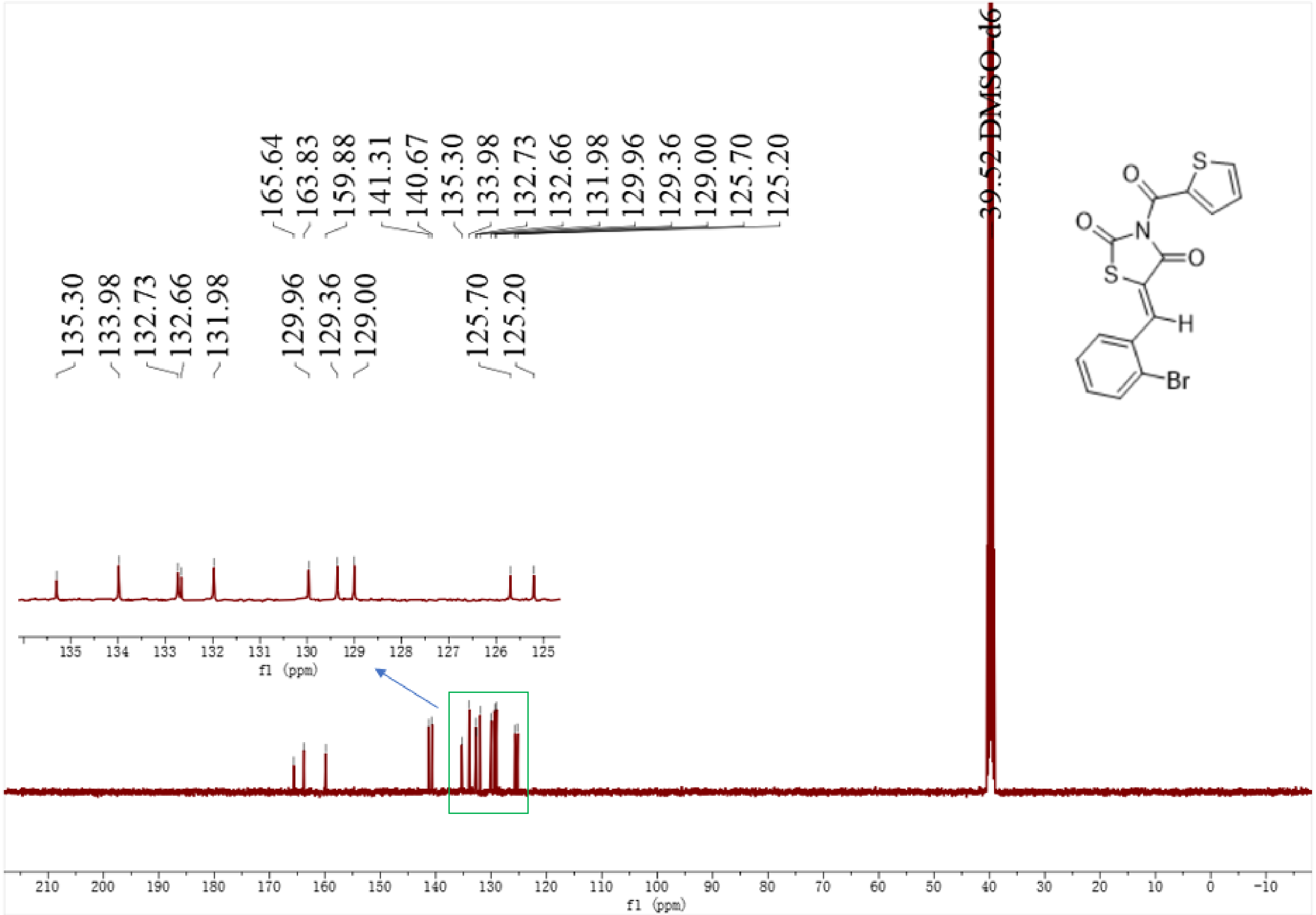
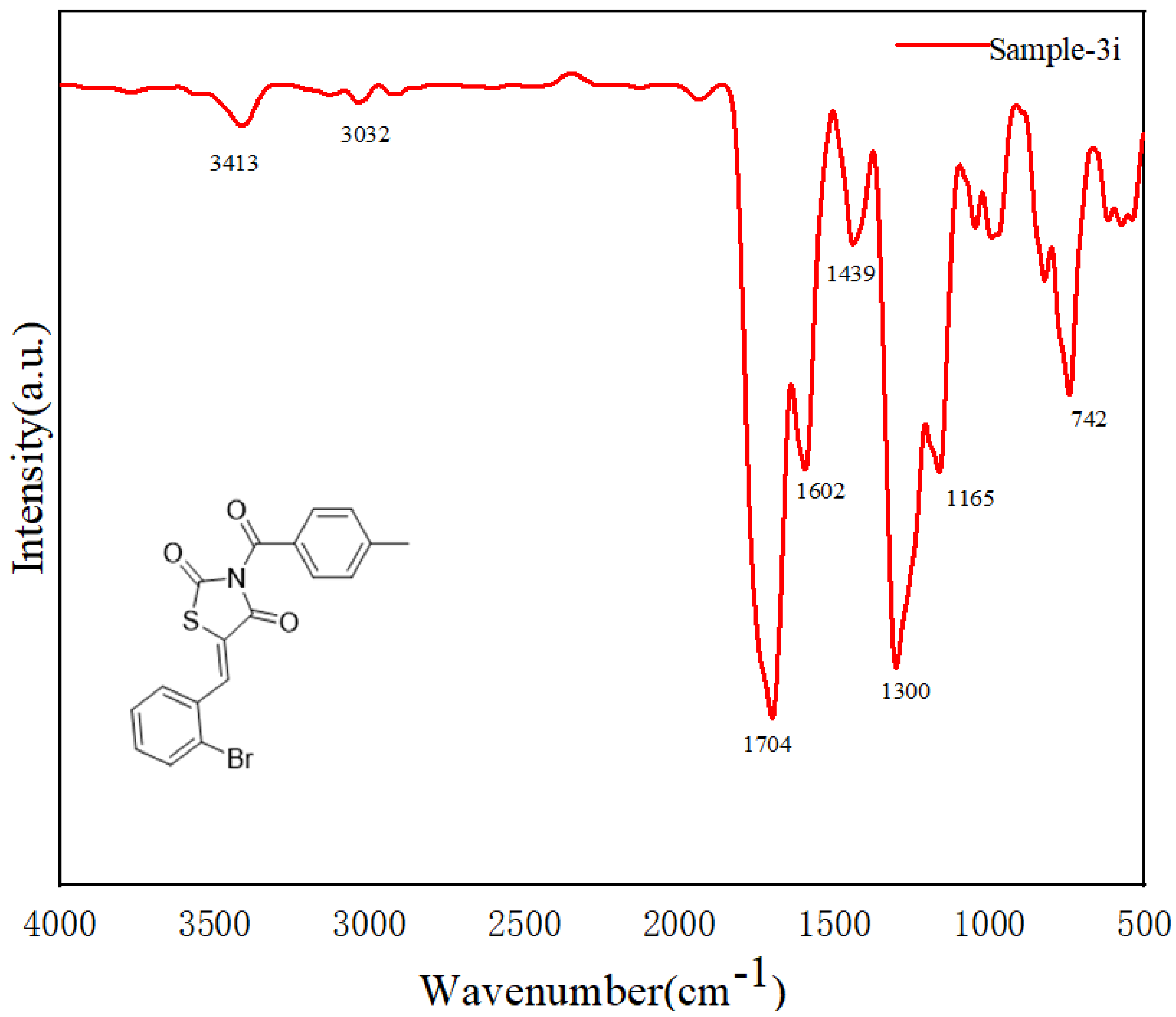


Figure S9-2 ^{13}C-NMR spectrum of compound **3h**



Sample-3i
3413
3032
1439
1602
1165
742
1300
1704
O
O
N
S
O
Br
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm-1)

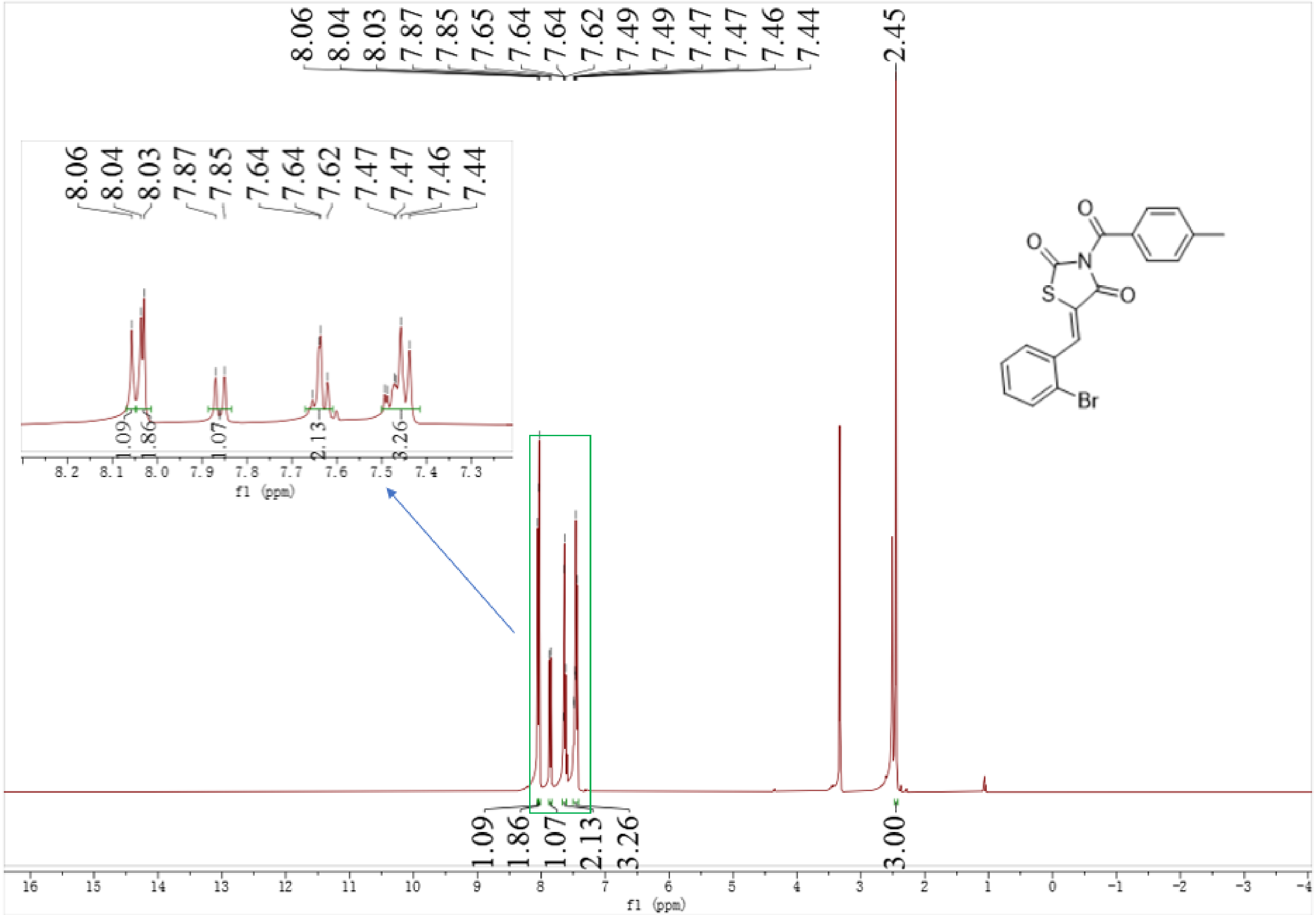


Figure S10-1 ^{1}H-NMR spectrum of compound **3i**

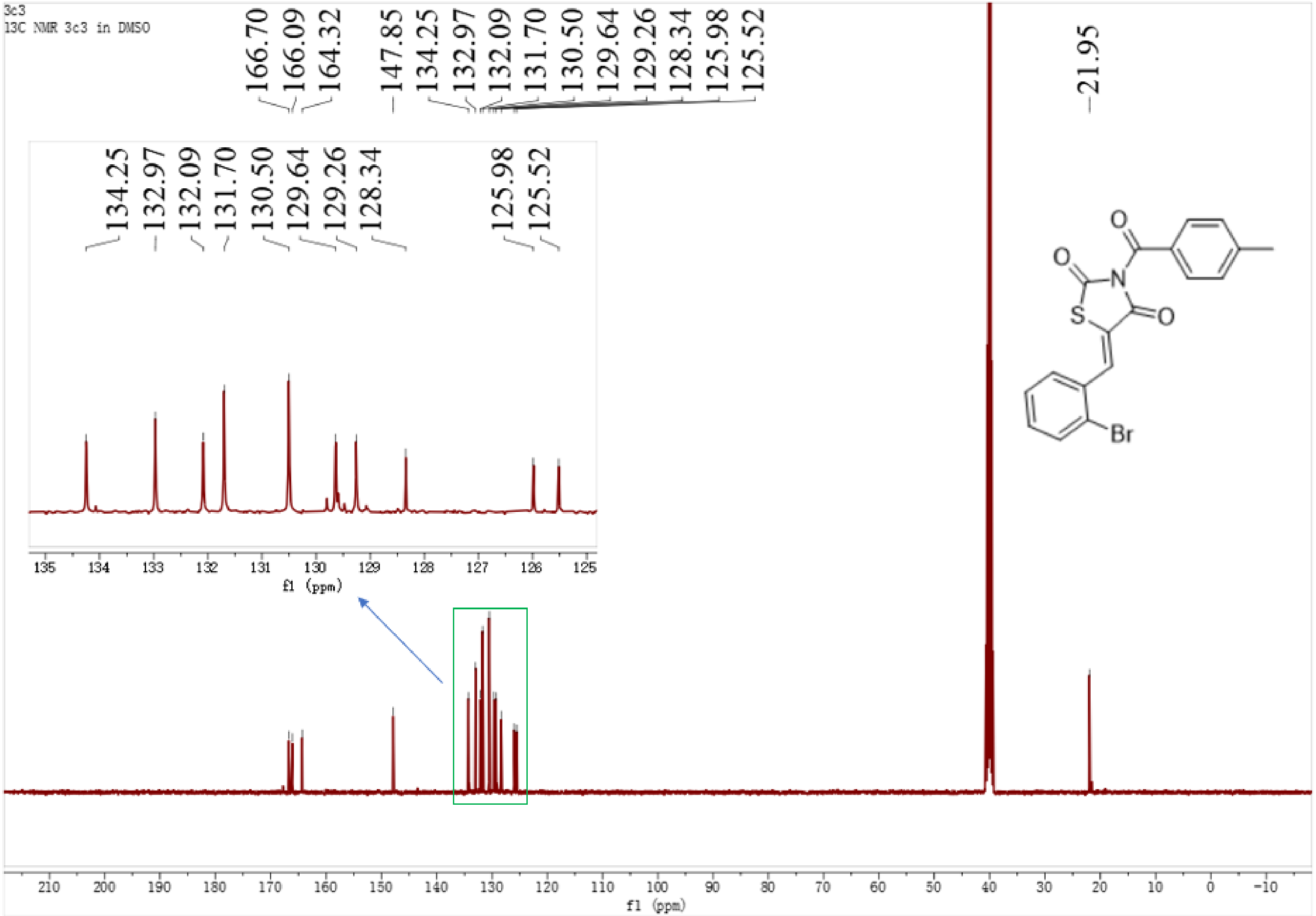
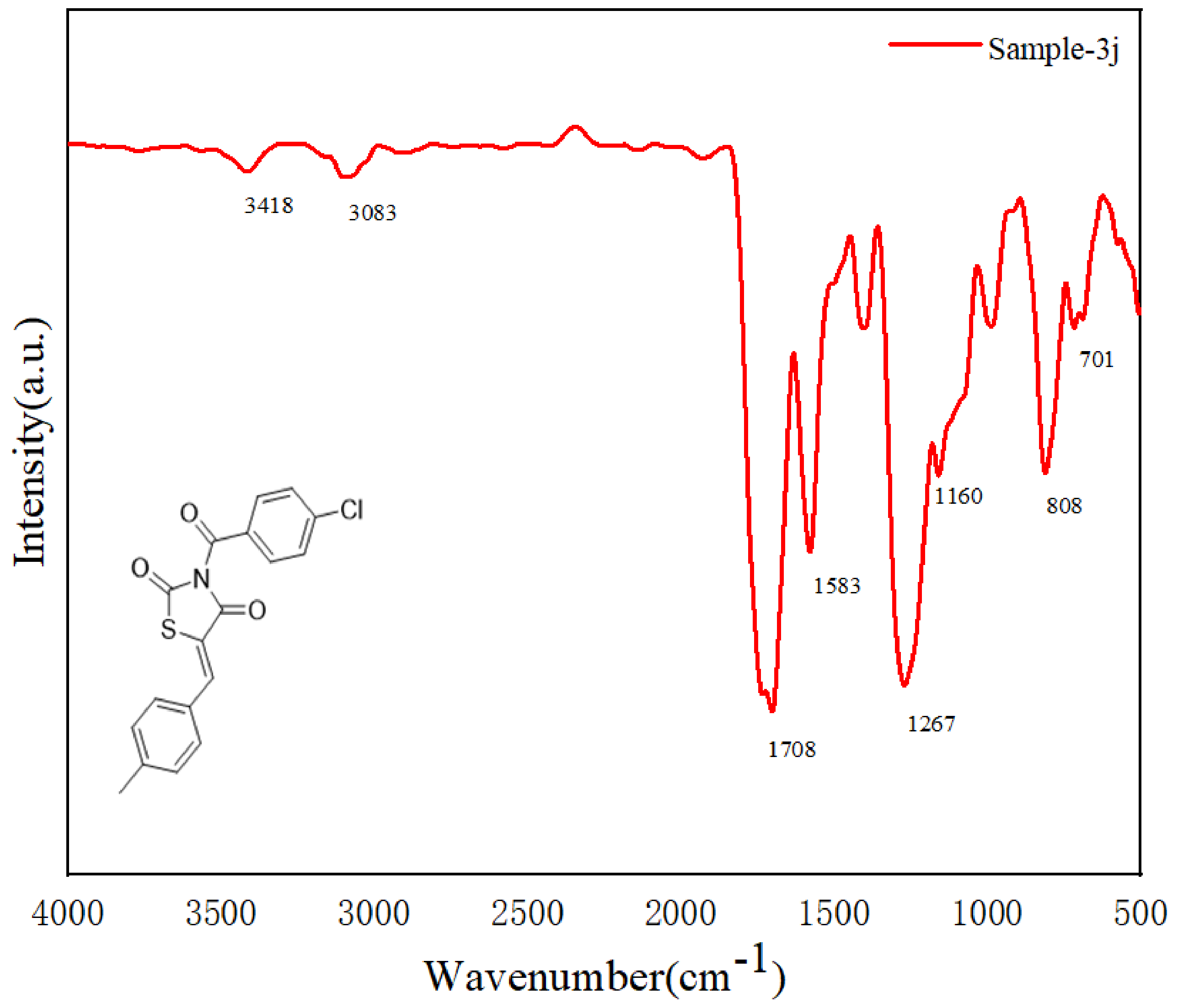


Figure S10-2 ^{13}C-NMR spectrum of compound **3i**



Sample-3j
3418
3083
1708
1583
1267
1160
808
701
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm^{-1})
O
O
N
O
S
Cl

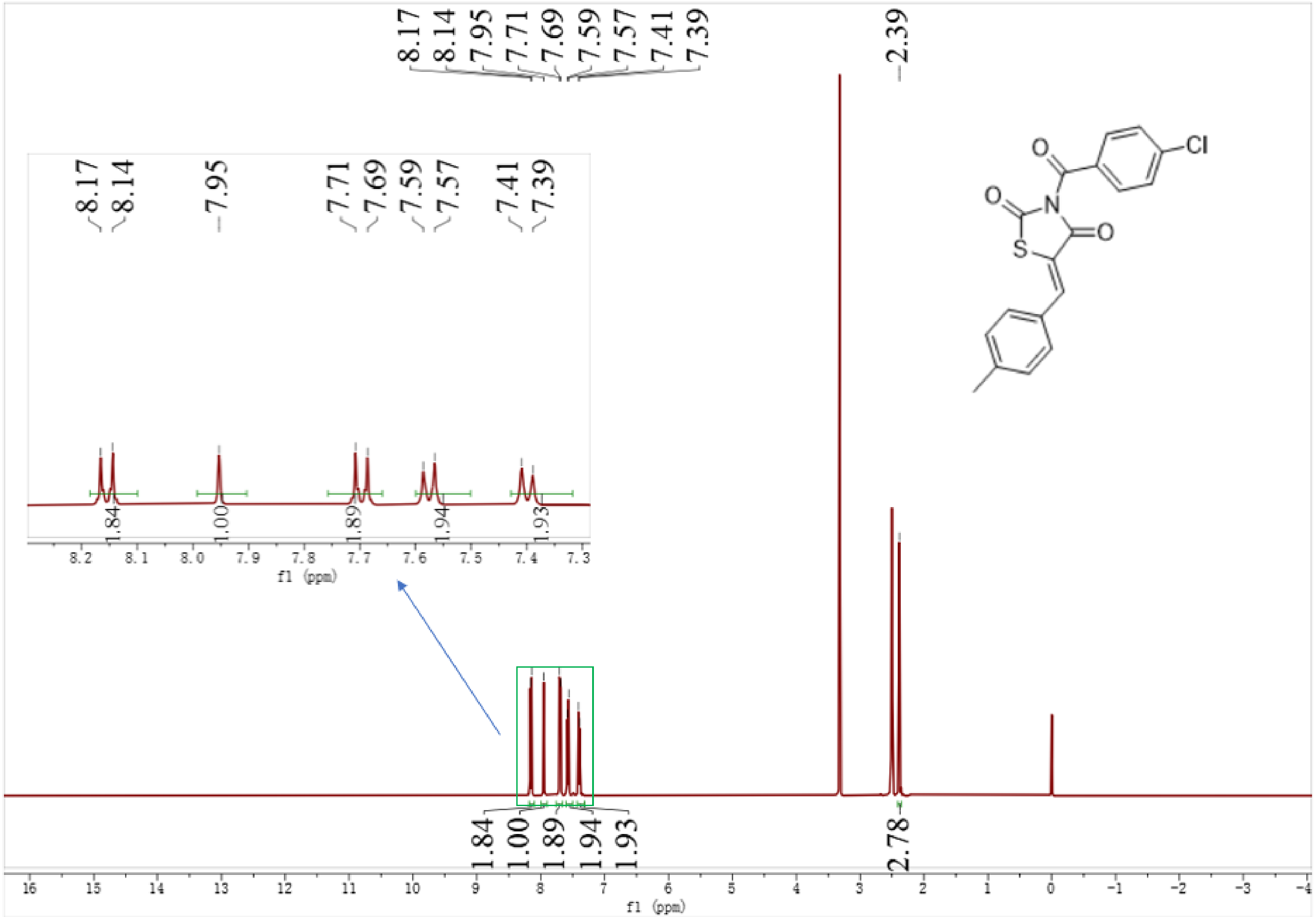


Figure S11-1 [1]H-NMR spectrum of compound **3j**

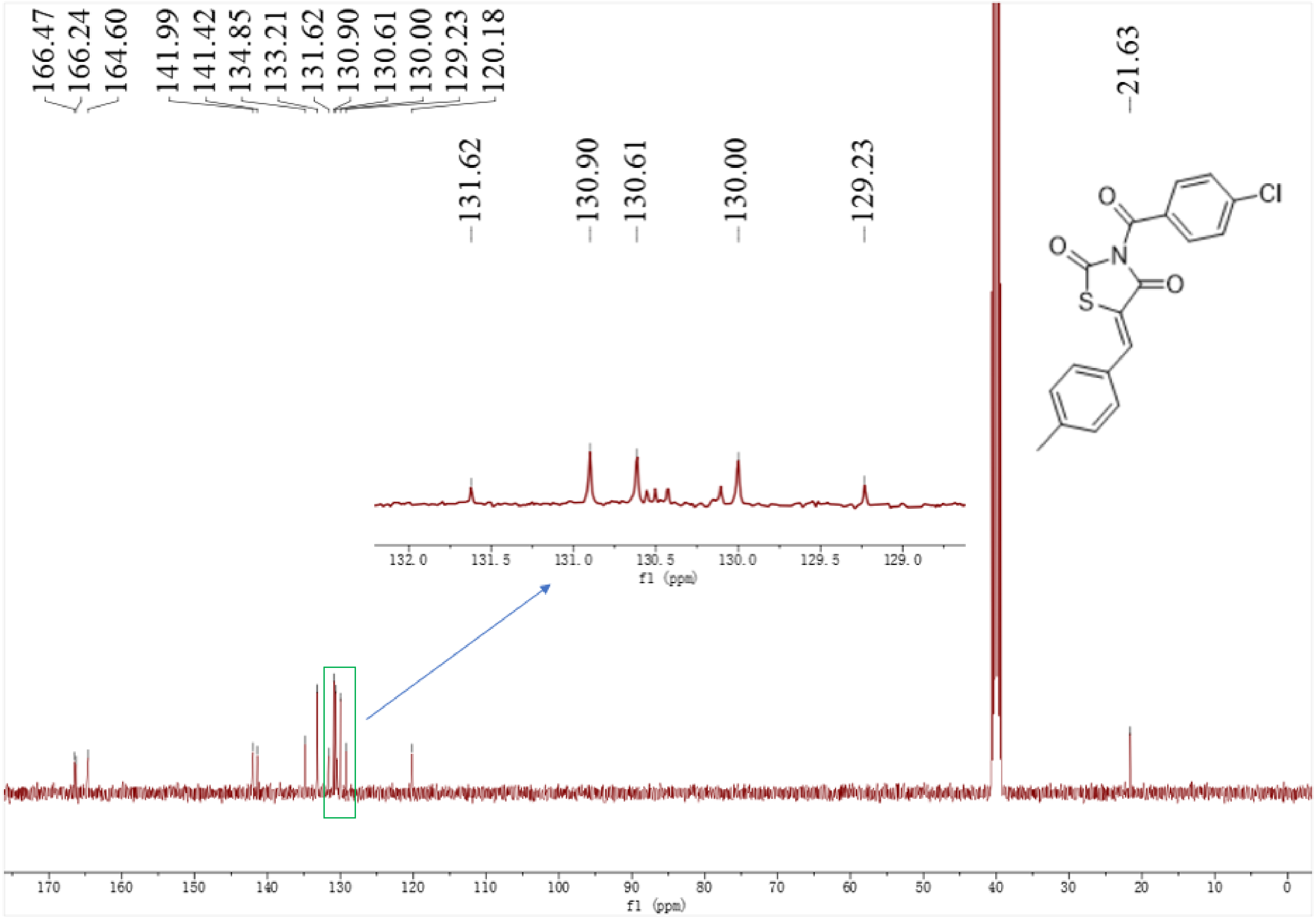
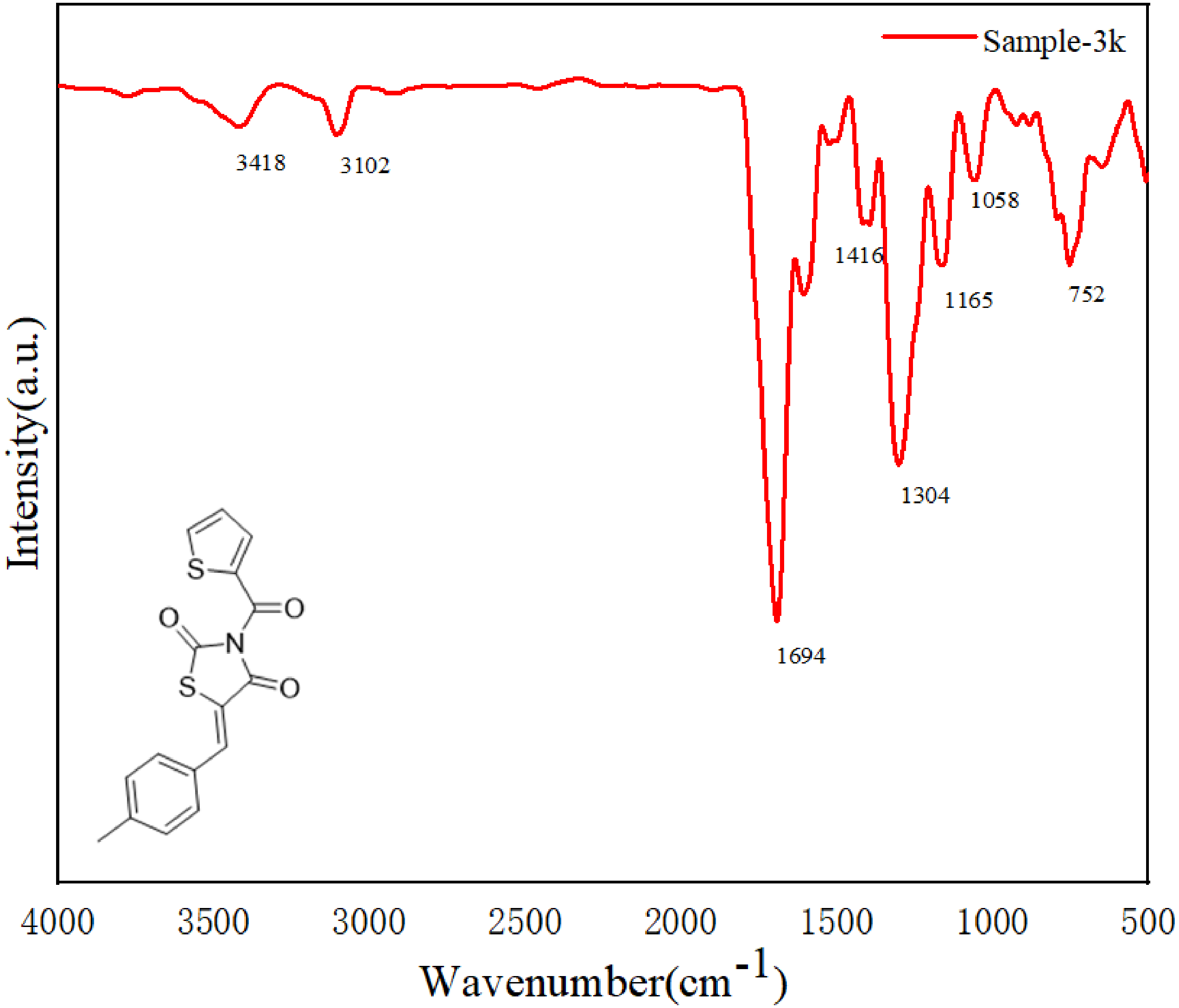


Figure S11-2 ^{13}C-NMR spectrum of compound **3j**



Sample-3k
3418
3102
1694
1416
1304
1165
1058
752
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm-1)
O
N
O
S
O
S

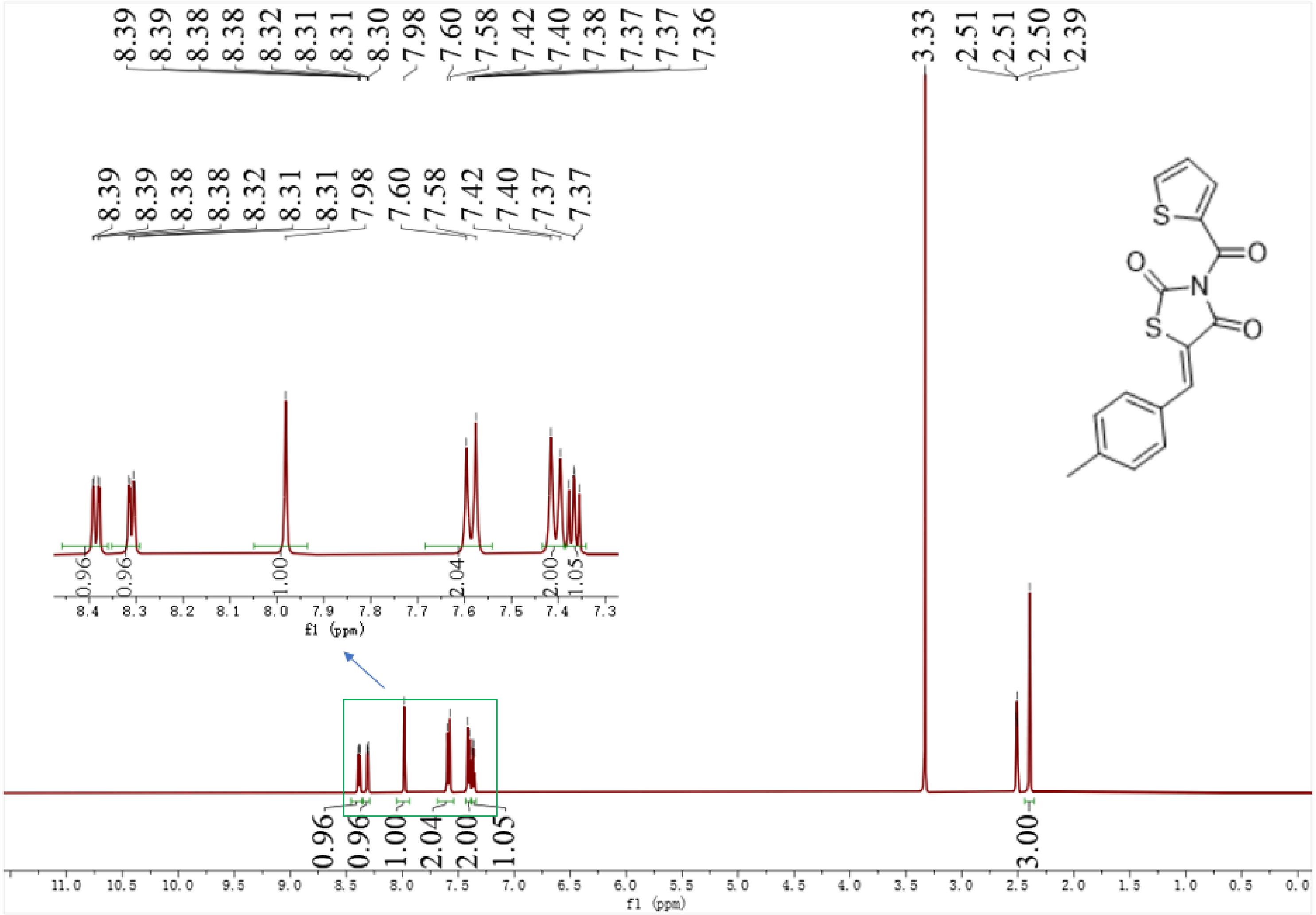


Figure S12-1 [1]H-NMR spectrum of compound **3k**

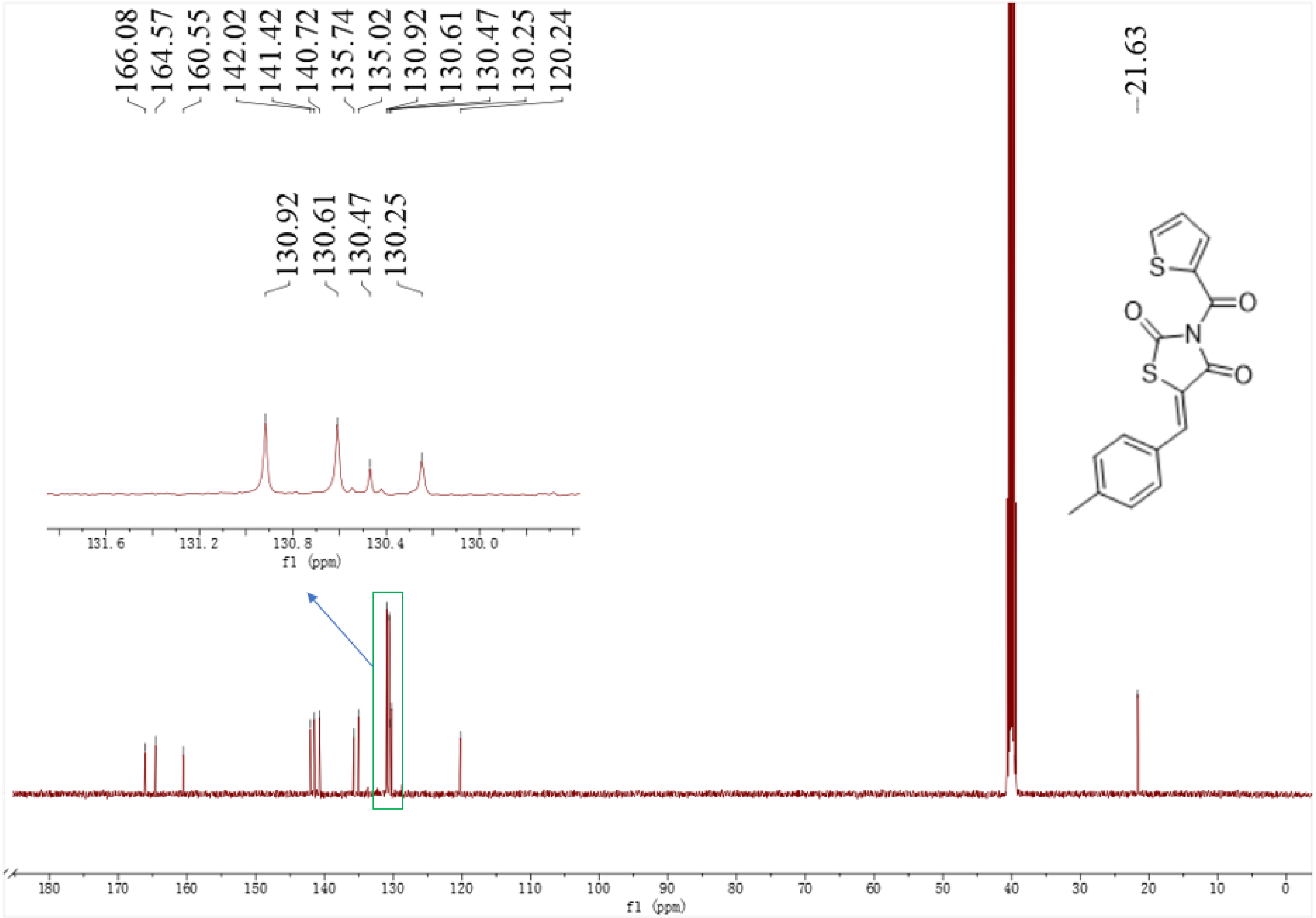
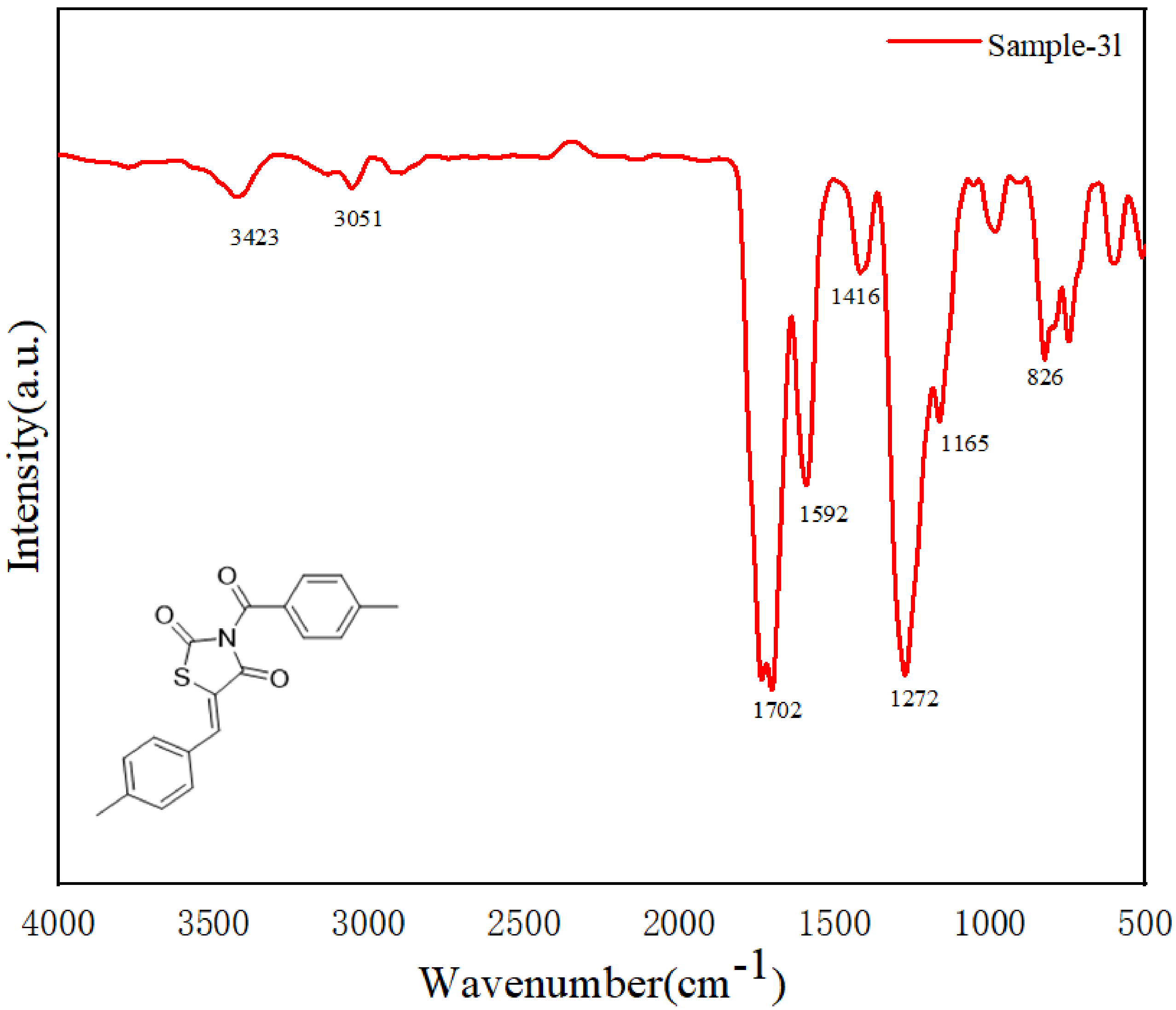


Figure S12-2 ^{13}C-NMR spectrum of compound **3k**


Sample-31
3423
3051
1416
826
1165
1592
1702
1272
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm-1)

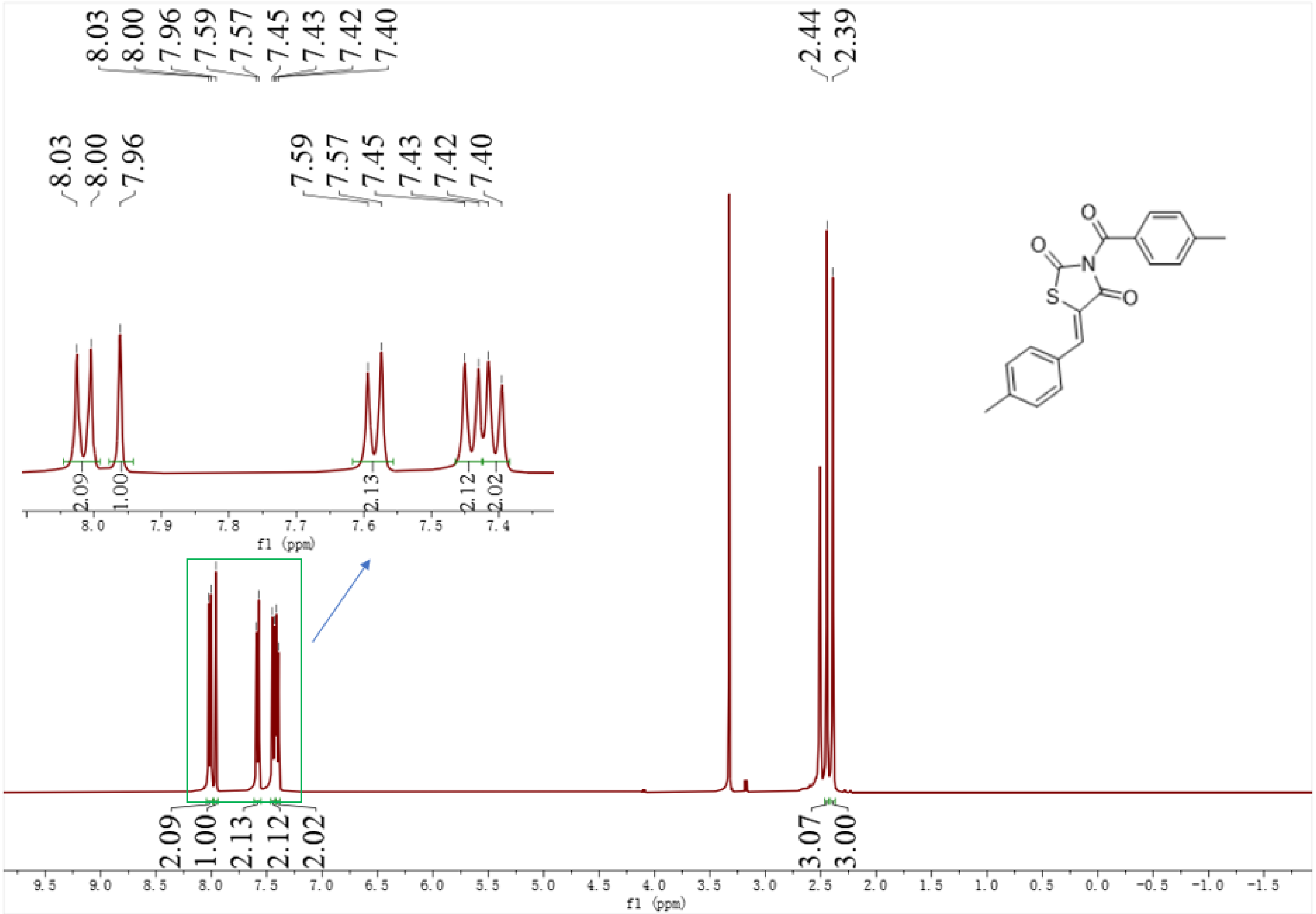


Figure S13-1 [1]H-NMR spectrum of compound **3l**

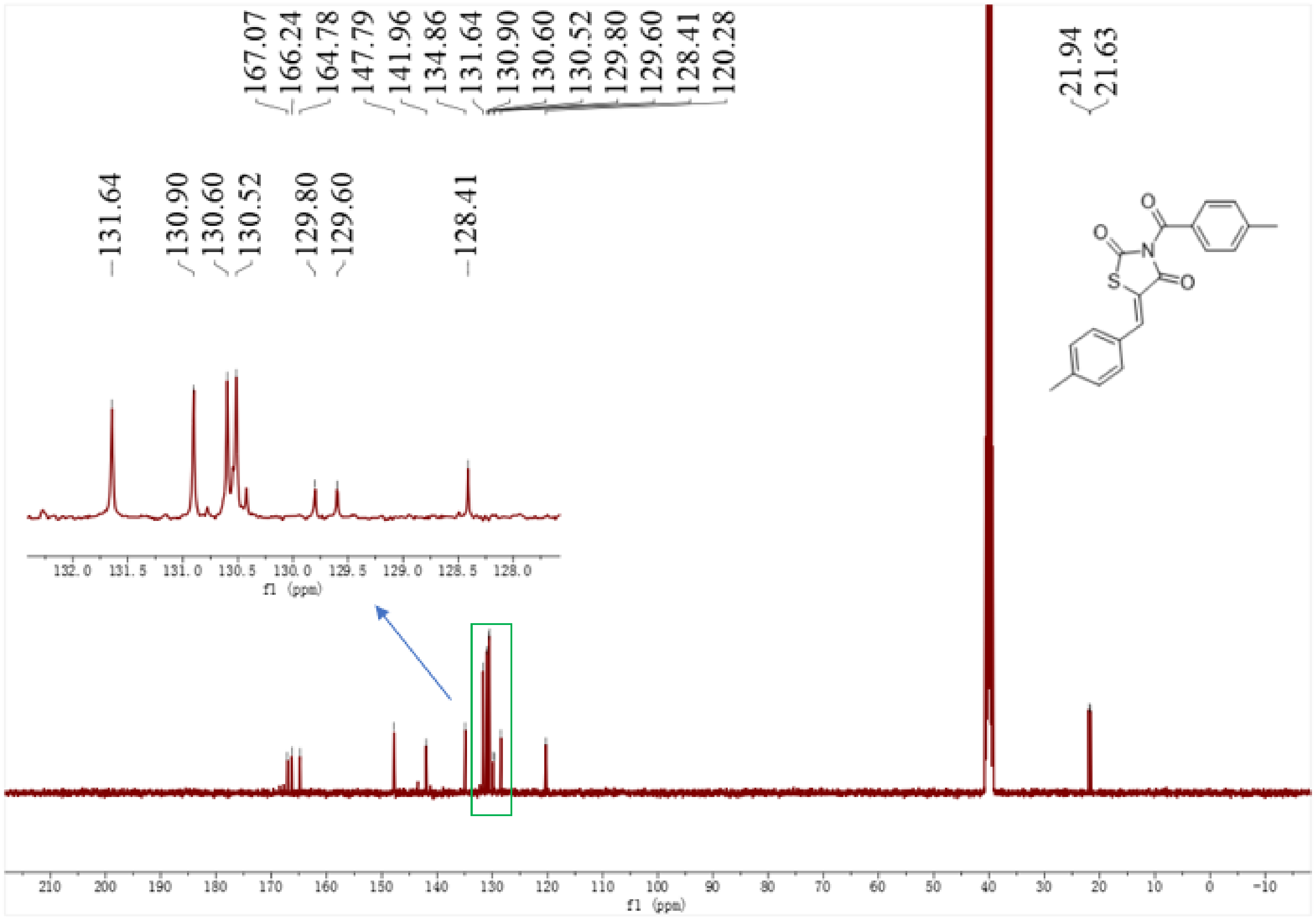
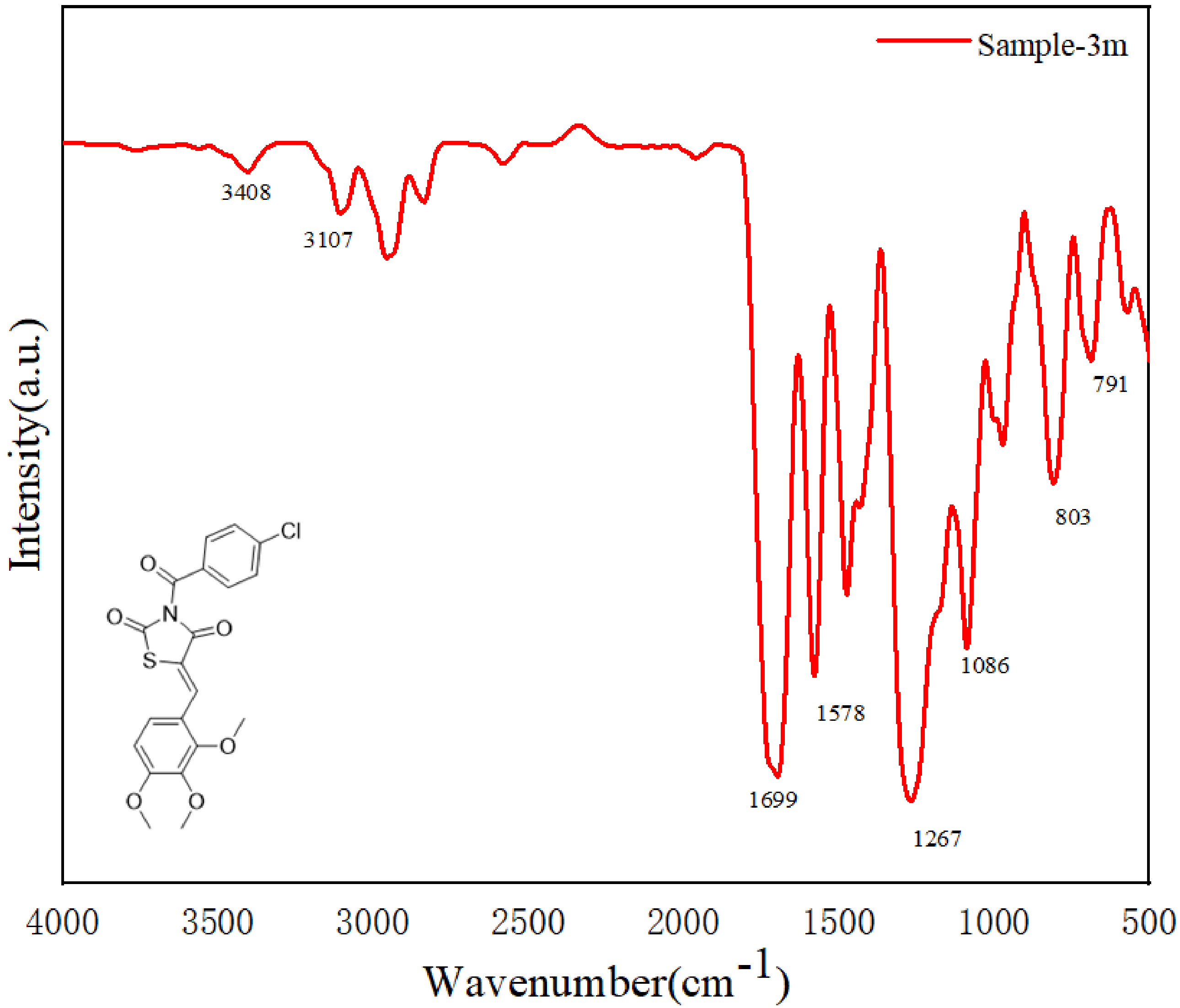


Figure S13-2 [13]C-NMR spectrum of compound **3l**


Sample-3m
3408
3107
1699
1578
1267
1086
803
791
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm-1)
Cl
O
N
O
O
S
O
O
O

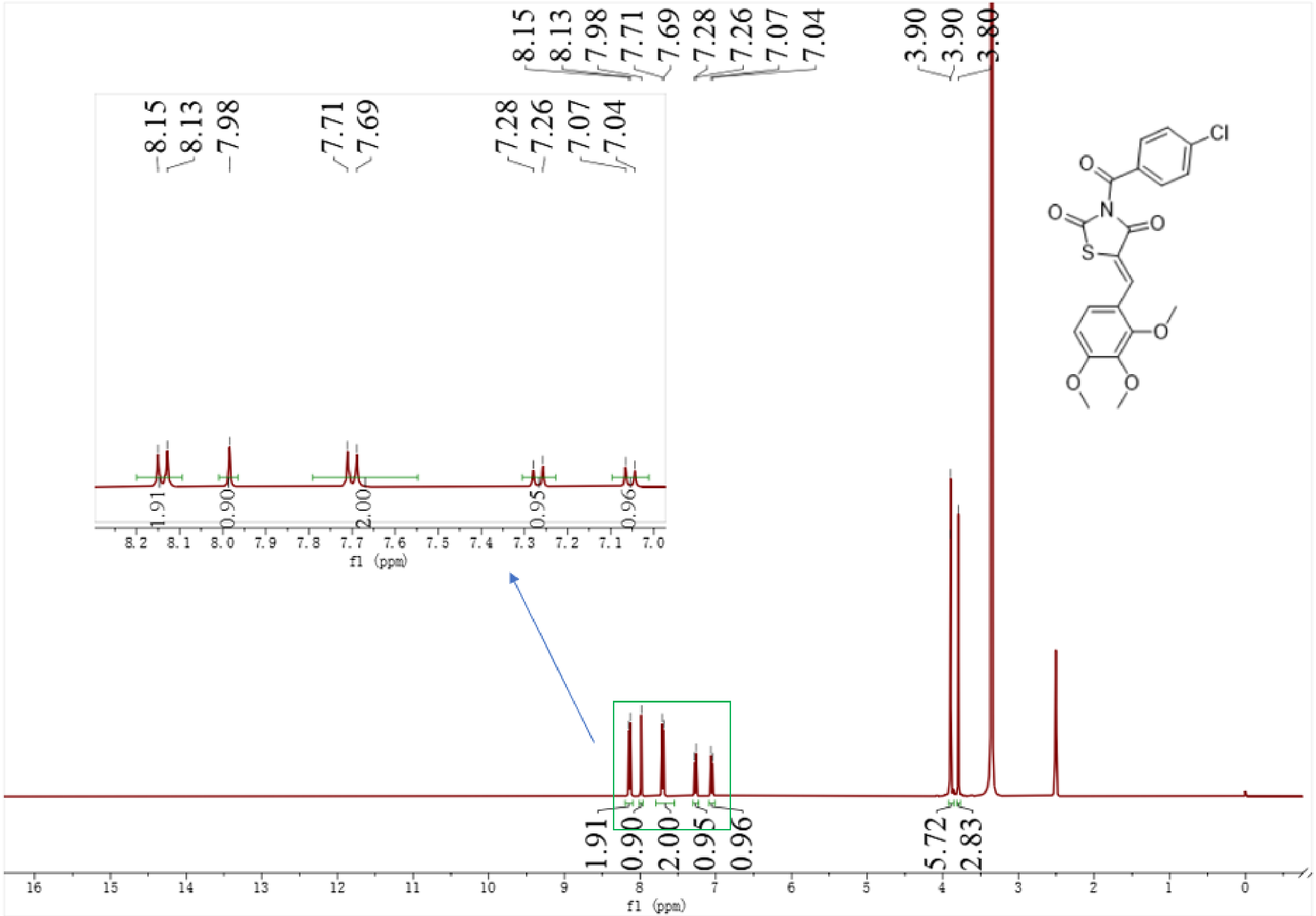


Figure S14-1 ^{1}H-NMR spectrum of compound **3m**

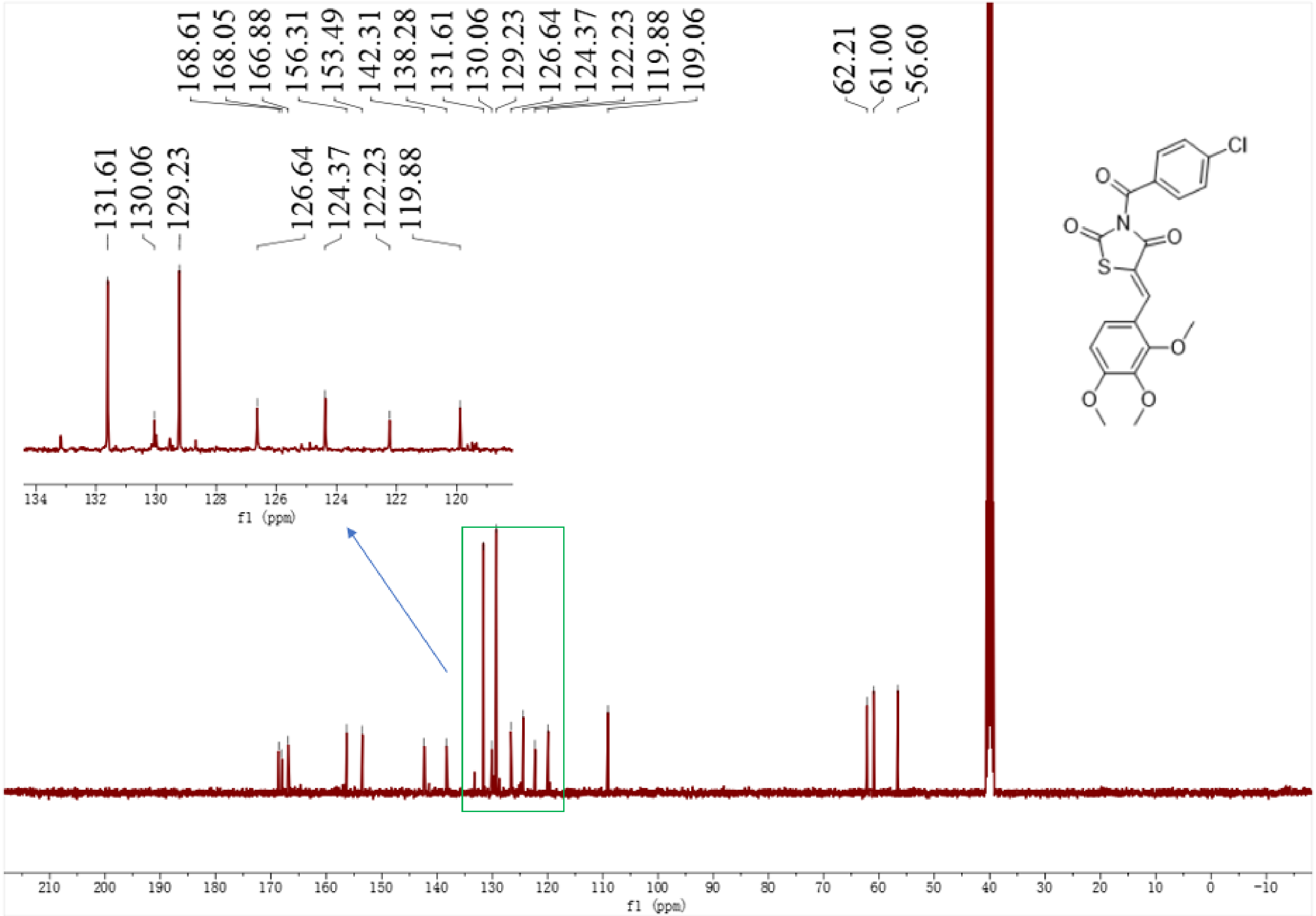
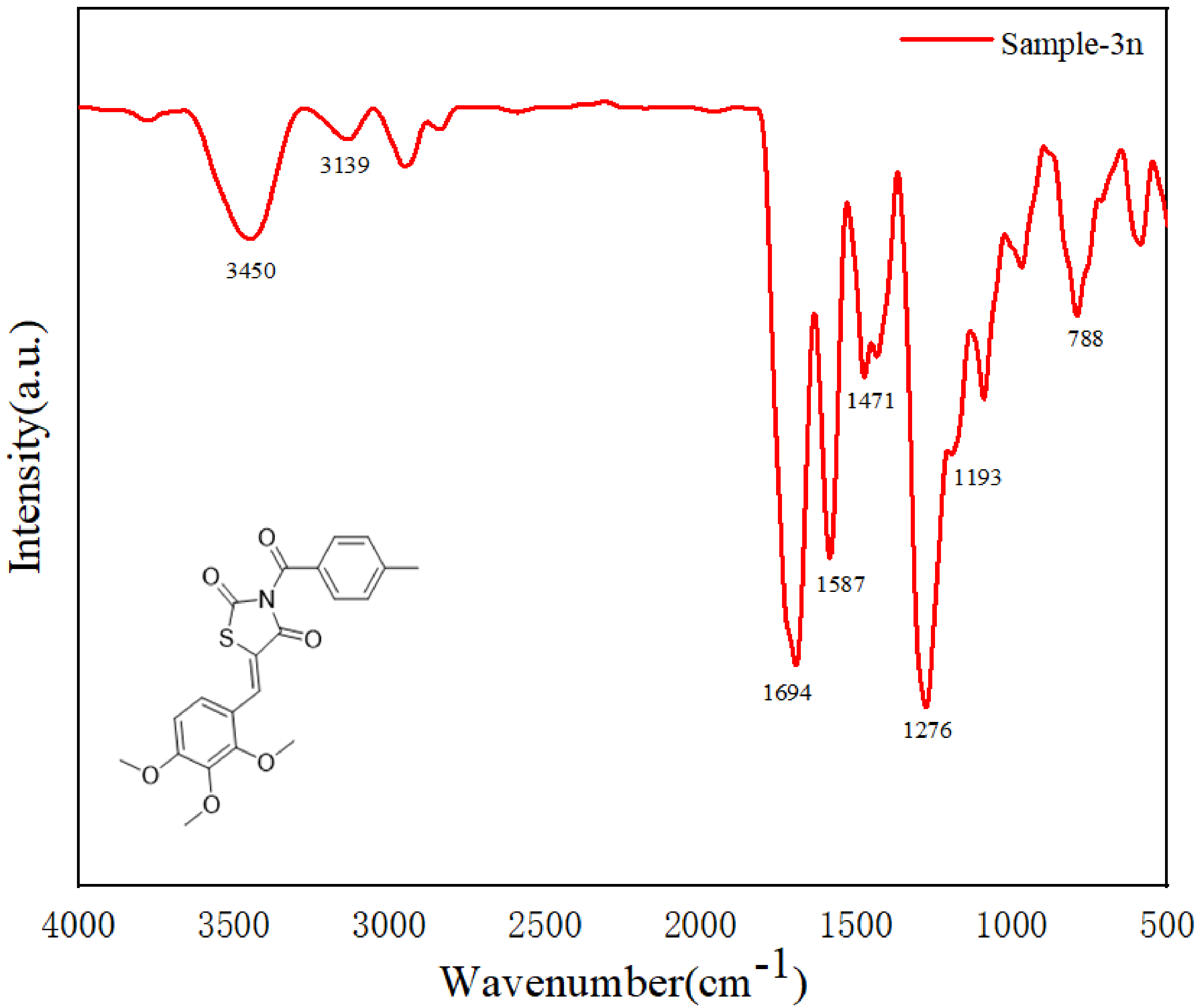


Figure S14-2 ^{13}C-NMR spectrum of compound **3m**


Sample-3n
3450
3139
1694
1587
1471
1276
1193
788
Intensity(a.u.)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm^{-1})

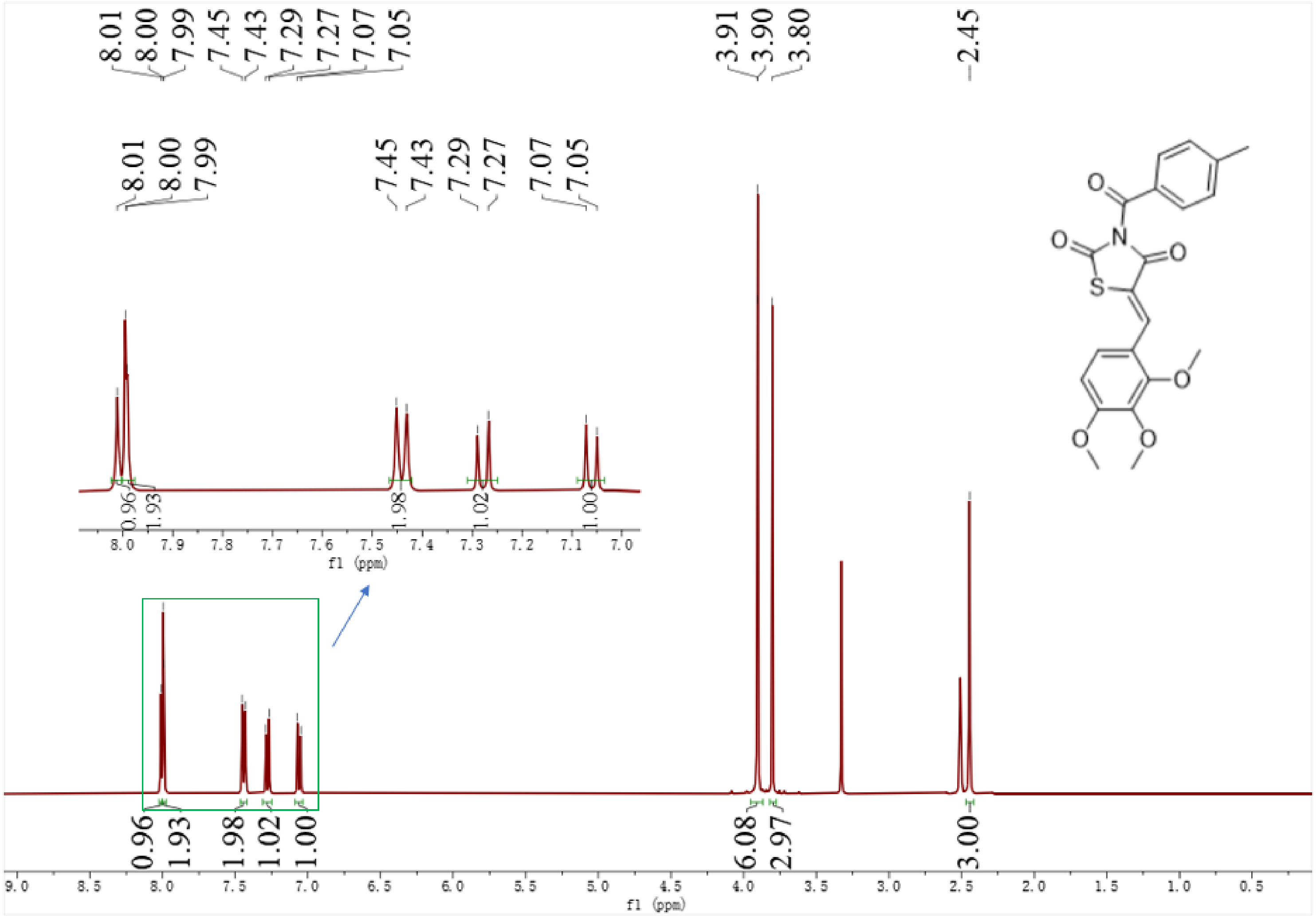


Figure S15-1 [1]H-NMR spectrum of compound **3n**

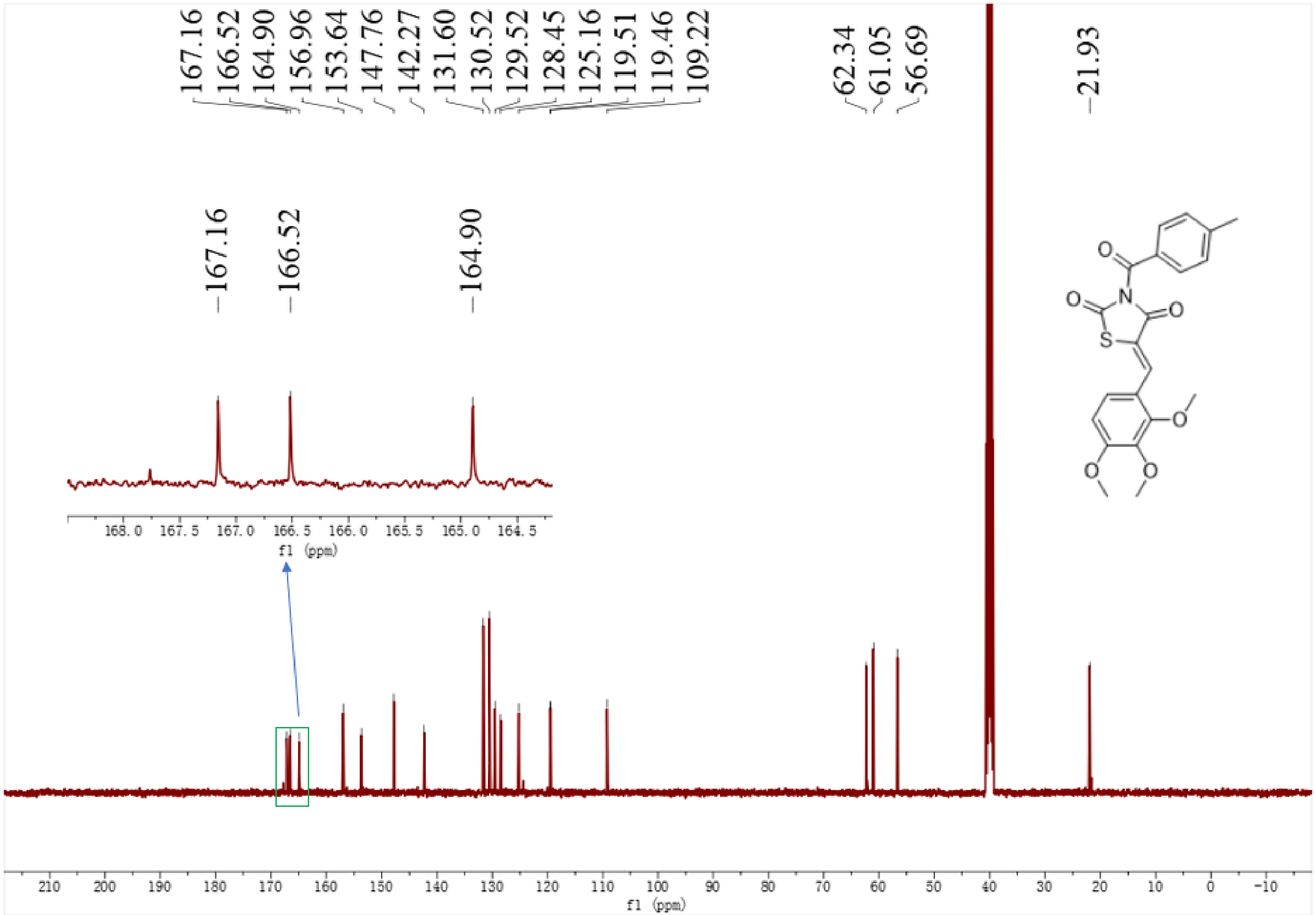
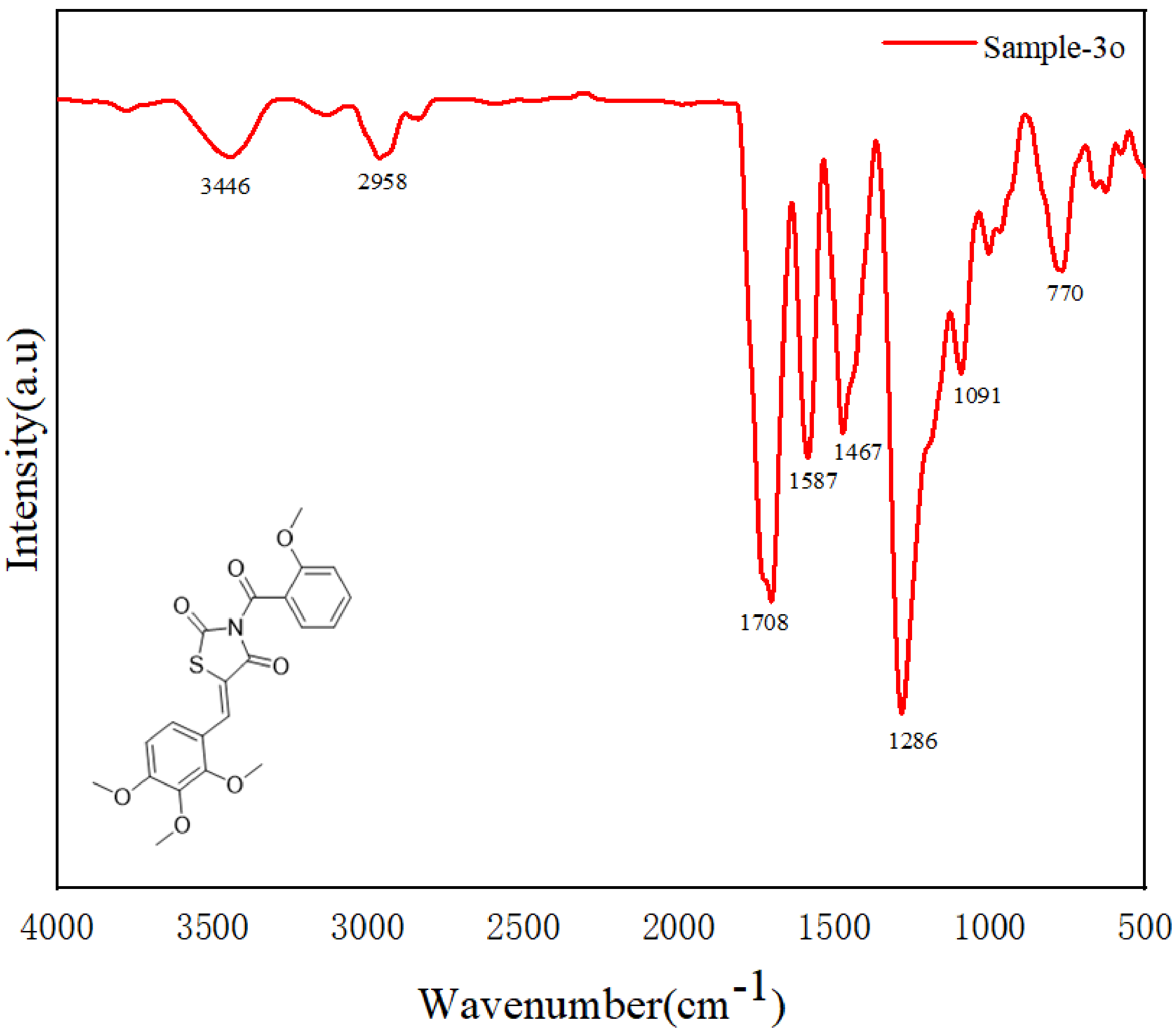


Figure S15-2 [13]C-NMR spectrum of compound **3n**



Sample-3o
3446
2958
1708
1587
1467
1286
1091
770
Intensity(a.u)
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber(cm-1)

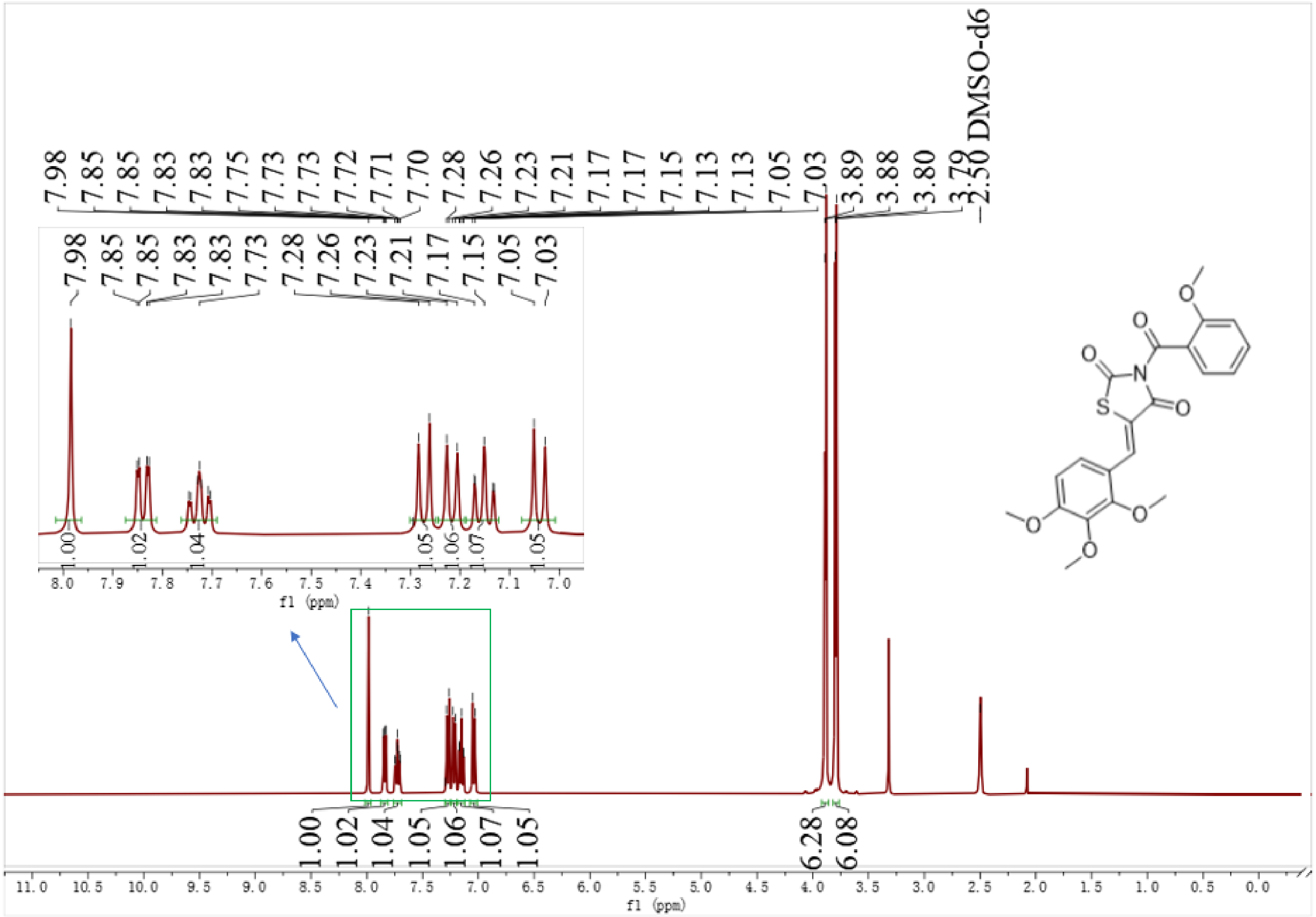


Figure S16-1 ^{1}H-NMR spectrum of compound **3o**

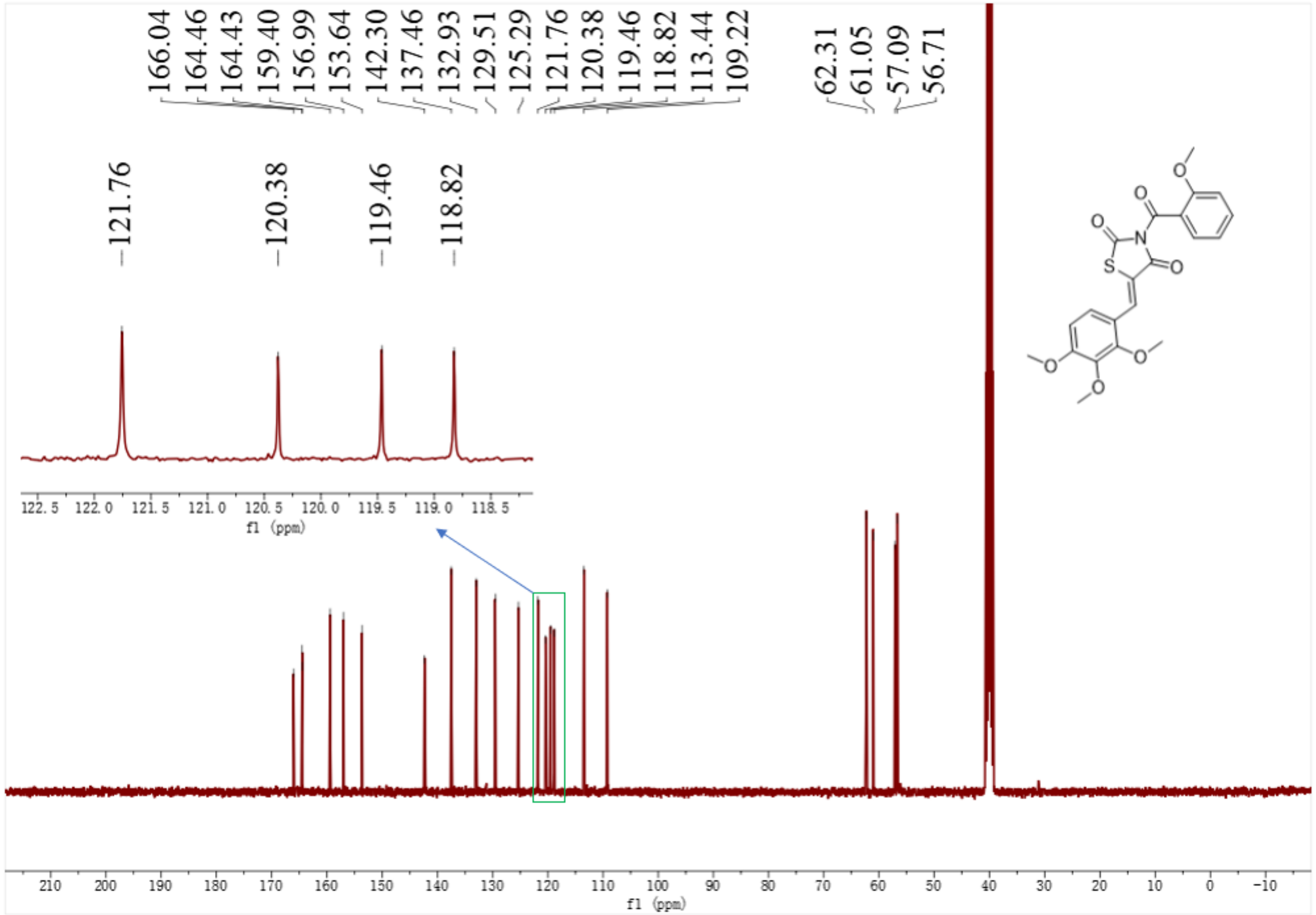


Figure S16-2 ^{13}C-NMR spectrum of compound **3o**

MTT test

SW620, Hela, A549 and MCF-7 cells in logarithmic growth phase were inoculated into 96-well plates at a density of 5×10^3 cells/well, and incubated at 37 °C in a 5 % CO_2 incubator for 20 h. After the cells had completed wall adherence, the culture solution was aspirated from the original wells, and 100 μL of the solution to be tested was added to each well, and five replicate wells were set up for each concentration. No drug was added to the blank control group, the same volume of 0.1% DMSO was added to the DMSO group in parallel with the drug, and 100 μL of cisplatin was added to the positive control group. After 48 h of incubation, 20 μL of 5 mg-mL-1 MTT was added to each well, and the incubation was continued for 4 h. The supernatant was removed by the buckling method, and 100 μL of DMSO was added to each well with 10 min of oscillation until the blue crystals were completely dissolved, then the cells were analyzed by a multifunctional enzyme assay. The absorbance value (OD value) of each well at 490 nm was measured by multifunctional enzyme labeling instrument, and finally the cell proliferation inhibition rate (IC_{50}) was calculated as follows:

$$Growth\ inhibition\ \%=(1-\frac{OD\ (experimental\ group)-OD(\ blank\ control\ group)}{OD(normal\ control\ group)-OD(blank\ control\ group)})\times 100\%$$

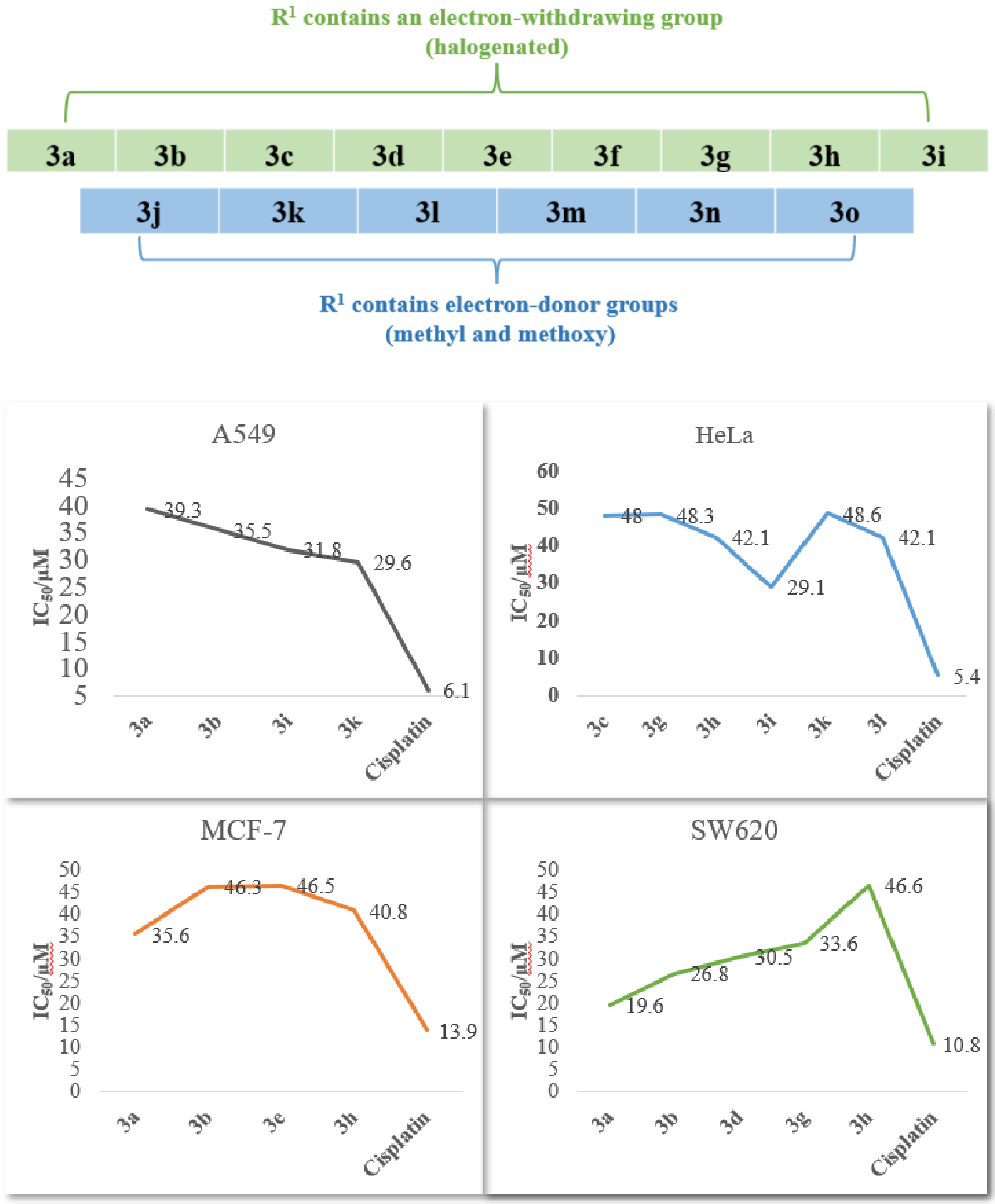


Figure S17 Comparison of growth inhibition of novel 1,3-thiazolidine-2,4-diones on various tumor cell lines

References

S1 M. E. Lugovoi, A.N. Izmest'ev, N. G. Kolotyrkina, E. S. Izmalkova, A. N. Kravchenko and G. A. Gazieva, *Mendeleev Commun*., 2024, **34**, 558; https://doi.org/10.1016/j.mencom.2024.06.029.

S2 A. A. Streltsov, A.N. Izmest'ev, Yu. A. Strelenko, A. N. Kravchenko and G. A. Gazieva, *Mendeleev Commun*., 2024, **34**, 563; https://doi.org/10.1016/j.mencom.2024.06.031.

S3 L. Lu, C. Hu, X. F. Min and Z. Liu, *Molecules*., 2023, **28**, 7470; https://doi.org/10.3390/molecules28227470.

S4 M. Akhavan, N. Foroughifar, H. Pasdar, A. Khajeh-Amiri and A. Bekhradnia, *Transition Met. Chem.*, 2017, **42**, 543; https://doi.org/10.1007/s11243-017-0159-3.

S5 S. C. Wu, Y. Q. Zhang, X. M. He, X. Y. Che, S. Z. Wang, Y. Liu, Y. Jiang, N. Liu, G. Q. Dong, J. Z. Yao, Z. Y. Miao, Y. Wang, W. N. Zhang and C. Q. Sheng, *ChemMedChem*, 2014, **9**, 2639; https://doi.org/10.1002/cmdc.201402320.

S6 H. Xu, L. Y Pan, X. M. Fang, B. Y. Liu, W. K. Zhang, M. H. Lu, Y. Q. Xu, T. Ding and H. B. Chang, *Tetrahedron Lett*., 2017, **58**, 2360; https://doi.org/10.1016/j.tetlet.2017.05.006.

S7 A. M. Ali, G. E. Saber, N. M. Mahfouz, M. A. El-Gendy, A. A. Radwa and M. A. E. Hamid, *Arch. Pharmacal Res*., 2007, **30**, 1186; https://doi.org/10.1007/BF02980259.

S8 S. G. Alegaon, V. U, K. R. Alagawadi, D. Kumar, R. S. Kavalapure and S. D. Ranade, *J. Biomol. Struct. Dyn*., 2022, **40**, 6211; https://doi.org/10.1080/07391102.2021.1880479.