Supporting Information

Electrochemical Promoted thio-Michael Addition of *N*-Substituted Maleimides with Thiols in Aqueous Medium

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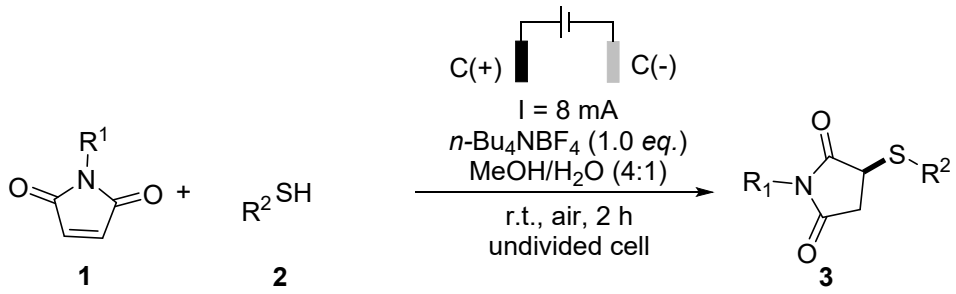
1. General methods

Unless otherwise noted, materials were obtained from commercial suppliers and used without further purified. Reactions were monitored by thin layer chromatography (TLC). Yields refer to products isolated after purified by column chromatography. ^{1}H NMR, ^{13}C NMR and ^{19}F NMR spectra were recorded on a Bruker AV 400 MHz spectrometer using $CDCl_3$ or DMSO-d_6 as the solvent with TMS as the internal standard. Chemical shifts are reported in parts per million. Multiplicity was indicated as follows: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet. Coupling constants (*J*) were reported in Hz. Electrolysis experiments were performed using MESTEK DC power supply. Cyclic voltammetry was obtained from CHI 660E (Shanghai Chenhua Instrument Factory, Shanghai, China).

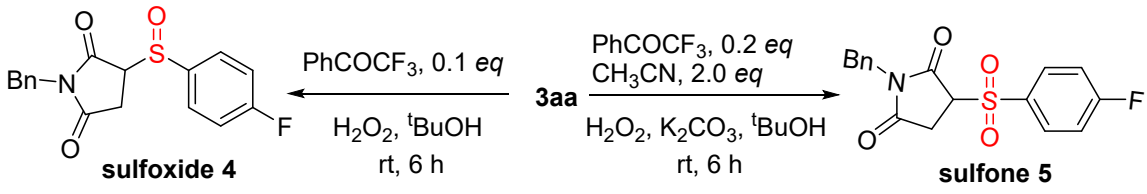
2. General procedure

General procedure for the synthesis of 3



In an oven-dried undivided three-necked bottle (25.0 mL) equipped with a stir bar, *N*-benzylmaleimide **1** (0.3 mmol, 1.0 *eq.*), 4-fluorobenzenethiol **2** (0.6 mmol, 2.0 *eq.*), *n*-Bu_4NBF_4 (0.6 mmol, 2.0 *eq.*), MeOH (8.0 mL) and H_2O (2.0 mL) were combined and added. Two graphite rod (ϕ 5 mm) were used as anode and cathode respectively (the electrodes were immersed 1 cm in the reaction solution). The reaction mixture was stirred and electrolyzed at a constant current of 8.0 mA under room temperature for 2 h. After reaction completion, the solvents were removed in vacuum, the products **3** were obtained by silica gel column chromatography.

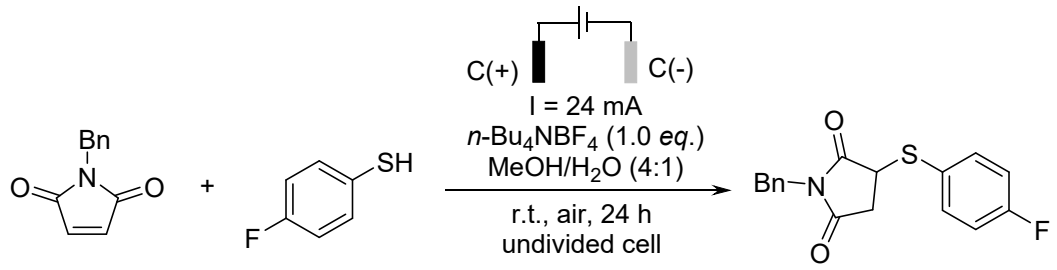
General procedure for the synthesis of 4 and 5



Sulfide **3aa** (0.3 mmol) was placed in a round-bottom flask, followed by t-BuOH (0.5 mL), 2,2,2-trifluoroacetophenone (5.2 mg, 0.03 mmol), and 30% aq H_2O_2 (0.06 mL, 0.45 mmol). The reaction mixture was stirred for 6 h. The crude residue was purified using flash column chromatography (40–60% EtOAc in PE) to afford the desired sulfoxide **4**. Sulfide **3aa** (0.3 mmol) was placed in a round-bottom flask, followed by t-

BuOH (0.5 mL), 2,2,2-trifluoroacetophenone (10.2 mg, 0.06 mmol), CH_3CN (31 uL, 2.0 eq.), K_2CO_3 (82.8 mg, 2.0 eq.) and 30% aq H_2O_2 (0.11 mL, 0.9 mmol). The reaction mixture was stirred for 6 h. The crude residue was purified using flash column chromatography (40–60% EtOAc in PE) to afford the desired sulfone **5**.

Procedure for gram scale synthesis of 3aa



1a
5 mmol, 0.94 g

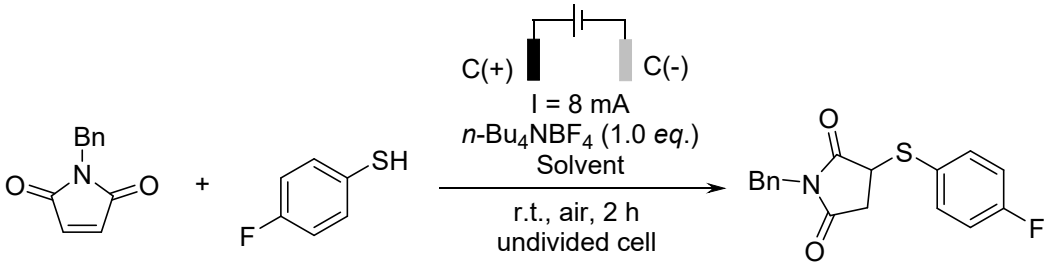
2a
10 mmol, 1.29 g

3aa
1.47g, 93%

In an oven-dried undivided three-necked bottle (50.0 mL) equipped with a stir bar, *N*-benzylmaleimide **1a** (5 mmol, 1.0 *eq.*), 4-fluorobenzenethiol **2a** (10 mmol, 2.0 *eq.*), *n*-Bu_4NBF_4 (5 mmol, 1.0 *eq.*), MeOH (16.0 mL) and H_2O (4.0 mL) were added. Two graphite rods (ϕ 10 mm) were used as anode and cathode, respectively (the electrodes were immersed 3 cm in the reaction solution). The reaction mixture was stirred and electrolyzed at a constant current of 24.0 mA under room temperature for 24 h. After reaction completion, the reaction mixture was diluted with water, and extracted with ethyl acetate. The organic layers were combined, washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure. The crude was purified by silica gel column (petroleum ether/ethyl acetate = 8:1) to obtain the product **3aa** (1.47g, 93%).

3. Optimization of reaction conditions

Table S1 Optimization of solvents[a]



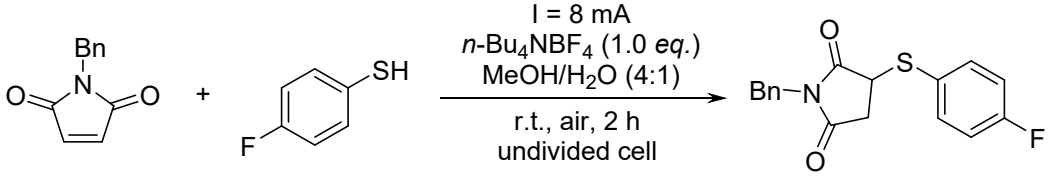
1a **2a** **3aa**

Entry	Solvent	Yield (%)[b]
1	MeCN	61
2	MeOH	91
3	THF	n.d.

4	H_2O	59
5	H_2O/Tween 20 (8:1)	62
6	H_2O/Tween 20 (10:1)	72
7	H_2O/Tween 20 (15:1)	65
8	H_2O/Tween 20 (20:1)	68
9	MeCN/H_2O (4:1, v/v)	80
10	EtOH/H_2O (2:1, v/v)	47
11	THF/H_2O (4:1, v/v)	75
12	DMSO/H_2O (4:1, v/v)	87
13	DMF/H_2O (4:1, v/v)	60
14	Diox/H_2O (4:1)	91
15	MeOH/H_2O (8:1, v/v)	92
16	MeOH/H_2O (4:1, v/v)	96
17	MeOH/H_2O (2:1, v/v)	91
18	MeOH/H_2O (1:1, v/v)	85
19	MeOH/H_2O (1:2, v/v)	90
20	MeOH/H_2O (1:4, v/v)	88
21	MeOH/H_2O (1:8, v/v)	86
22	MeOH/H_2O/Tween 20（3:6:1）	82
23	MeOH/H_2O/Tween 20（2:8:1）	86

[a]Reaction conditions: **1a** (0.3 mmol, 1.0 *eq*.), **2a** (0.6 mmol, 2.0 *eq*.), *n*-Bu_4NBF_4 (0.3 mmol, 1.0 *eq*.), solvent (10.0 mL), constant current (8.0 mA), under air, room temperature, 2 h, undivided cell. Anode: graphite rod, cathode: graphite rod. [b]Isolated yields.

Table S2 Optimization of electrode materials[a]



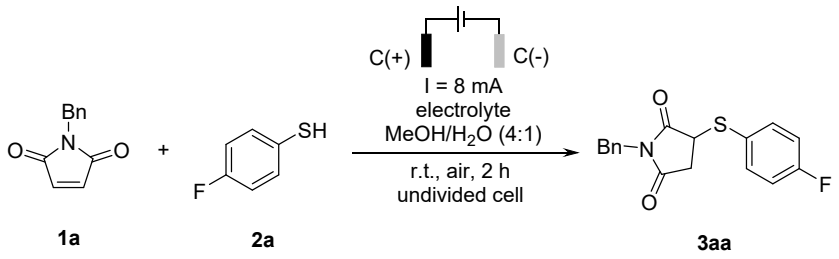
1a **2a** **3aa**

Entry	Electrode material	Yield (%)[b]

1	C(+) || C(-)	96
2	Pt(+) || Pt(-)	93
3	C(+) || Pt(-)	88
4	Pt(+) || C(-)	84
5	Pt(+) || Ni(-)	38
6	C(+) || Ni(-)	77

[a]Reaction conditions: **1a** (0.3 mmol, 1.0 *eq*.), **2a** (0.6 mmol, 1.0 *eq*.), *n*-Bu_4NBF_4 (0.3 mmol, 1.0 *eq*.), MeOH/H_2O (v/v = 4:1, 10.0 mL), constant current (8.0 mA), air, room temperature, 2 h, undivided cell. [b]Isolated yields.

Table S3 Optimization of electrolytes[a]

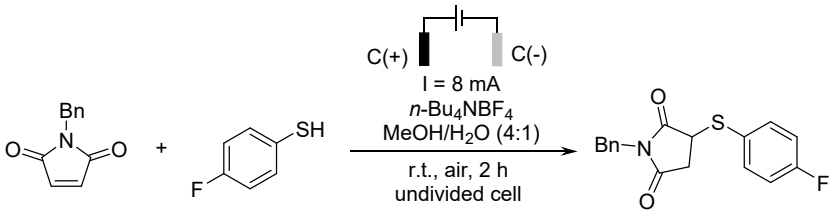


1a **2a** **3aa**

Entry	electrolyte	Yield (%)[b]
1	*n*-Bu_4NBF_4	96
2	*n*-Bu_4NPF_6	85
3	*n*-Bu_4NI	77
4	*n*-Bu_4NBr	87
5	*n*-Bu_4NF	65
6	NaI	84
7	KI	96
8	NH_4I	93
9	KBr	81
10	NaBr	86

[a]Reaction conditions: **1a** (0.3 mmol, 1.0 *eq*.), **2a** (0.6 mmol, 2.0 *eq*.), electrolyte, MeOH/H_2O (v/v = 4:1, 10.0 mL), constant current (8.0 mA), under air, room temperature, 2 h, undivided cell. Anode: graphite rod, cathode: graphite rod. [b]Isolated yields.

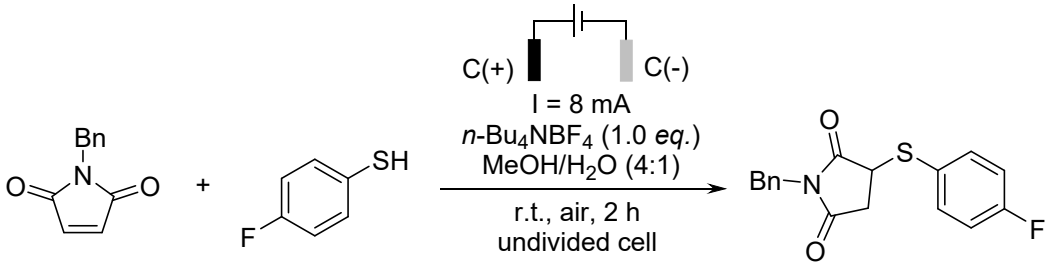
Table S4 Optimization of the amount of *n*-Bu_4NBF_4[a]



Entry	Amount of *n*-Bu_4NBF_4 (*eq*.)	Yield (%)[b]
1	1	96
2	2	85
3	3	61

[a]Reaction conditions: **1a** (0.3 mmol, 1.0 *eq*.), **2a** (0.3 mmol, 1.0 *eq*.), *n*-Bu_4NBF_4, MeOH/H_2O (v/v = 4:1, 10.0 mL), constant current (8.0 mA), air, room temperature, 2 h, undivided cell. Anode: graphite rod, cathode: graphite rod. [b]Isolated yields.

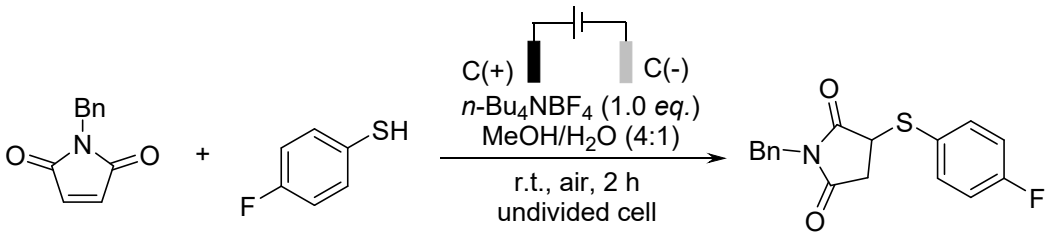
Table S5 Screening the amount ratio of substrates



Entry	ratio	Yield (%)[b]
1	1:2	96
2	1:3	89
3	1:1.5	92
4	1:1.2	64
5	1:1	62

[a]Reaction conditions: **1a** (0.3 mmol, 1.0 *eq*.), **2a**, *n*-Bu_4NBF_4 (0.3 mmol, 1.0 *eq*.), MeOH/H_2O (v/v = 4:1, 10.0 mL), constant current (8.0 mA), under air, room temperature, 2 h, undivided cell.Anode: graphite rod, cathode: graphite rod. [b]Isolated yields.

Table S6 Optimization of current[a]

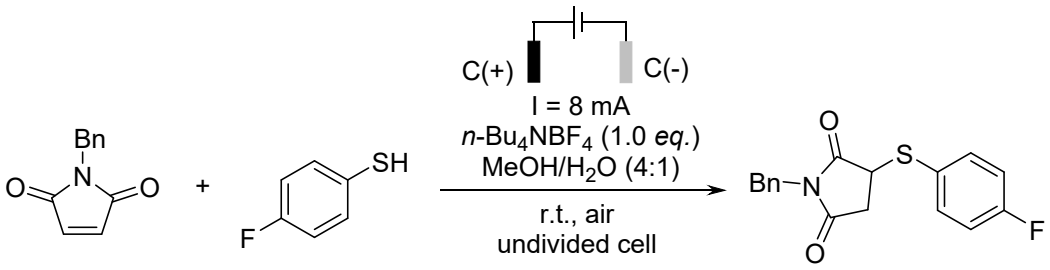


1a **2a** **3aa**

Entry	Current (mA)	Yield (%)[b]
1	8.0	96
2	4.0	85
3	6.0	87
4	10.0	85
5	12.0	86
6	0	56

[a]Reaction conditions: **1a** (0.3 mmol, 1.0 *eq*.), **2a** (0.6 mmol, 2.0 *eq*.), *n*-Bu_4NBF_4 (0.3 mmol, 1.0 *eq*.), MeOH/H_2O (v/v = 4:1, 10.0 mL), constant current electrolysis, air, room temperature, 2 h, undivided cell. Anode: graphite rod, cathode: graphite rod. [b]Isolated yields.

Table S7 Optimization of reaction time[a]

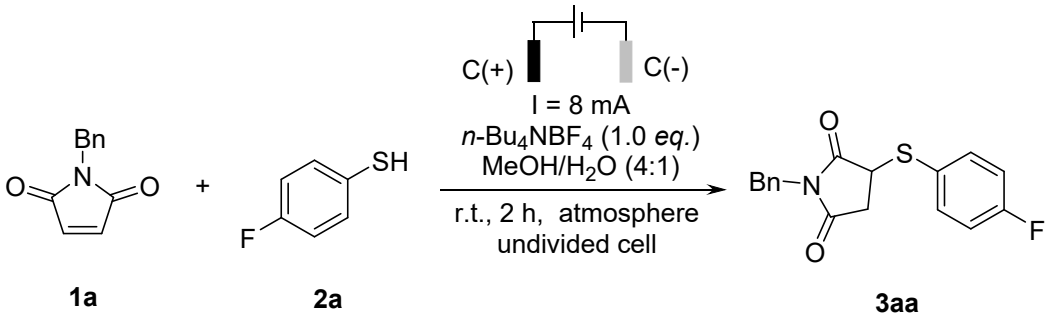


1a **2a** **3aa**

Entry	Time (h)	Yield (%)[b]
1	1	84
2	2	96
3	3	79
4	4	83
5	5	68
6	6	75

[a]Reaction conditions: **1a** (0.3 mmol, 1.0 *eq*.), **2a** (0.6 mmol, 2.0 *eq*.), *n*-Bu_4NBF_4 (0.3 mmol, 1.0 *eq*.), MeOH/H_2O (v/v = 4:1, 10.0 mL), constant current (8.0 mA), air, room temperature, undivided cell. Anode: graphite rod, cathode: graphite rod. [b]Isolated yields.

Table S8 Optimization of atmosphere[a]



1a **2a** **3aa**

Entry	Atmosphere	Yield (%)[b]
1	Air	96
2	N_2	83

[a]Reaction conditions: **1a** (0.3 mmol, 1.0 *eq*.), **2a** (0.6 mmol, 2.0 *eq*.), *n*-Bu_4NBF_4 (0.3 mmol, 1.0 *eq*.), MeOH/H_2O (v/v = 4:1, 10.0 mL), constant current (8.0 mA), room temperature, 2 h, undivided cell. Anode: graphite rod, cathode: graphite rod. [b]Isolated yields.

4. Mechanistic investigation

Cyclic voltammetry experiments

Cyclic voltammetry was performed in a 25.0 mL three-electrode cell under air at room temperature. The working electrode was a steady glassy carbon disk electrode, the counter electrode a platinum wire. The reference was an Ag/AgCl electrode submerged in saturated aqueous KCl solution. 8.0 mL of methanol and 2.0 mL of water containing 0.1 M *n*-Bu_4NBF_4 were poured into the electrochemical cell in all experiments. The scan rate is 0.1 V/s, ranging from 0 V to 3.0 V. Background (*n*Bu_4NBF_4, 0.1 M in the mixed solvent); *N*-Benzylmaleimide (**1a**, 0.1 M in the mixed solvent); 4-Fluorobenzenethiol (**2a**, 0.1 M in the mixed solvent) and the mixture of **1a**, **2a** and *n*-Bu_4NBF_4 (0.1 M in the mixed solvent).

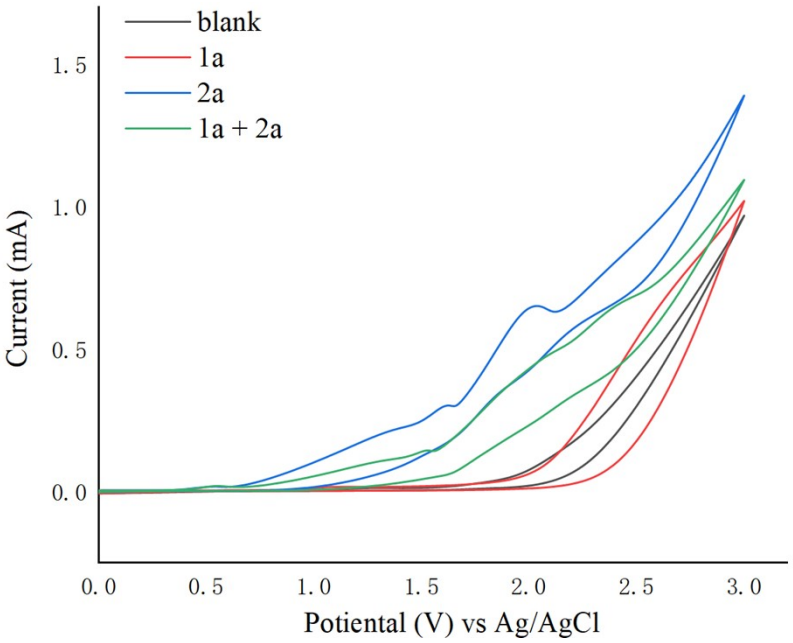
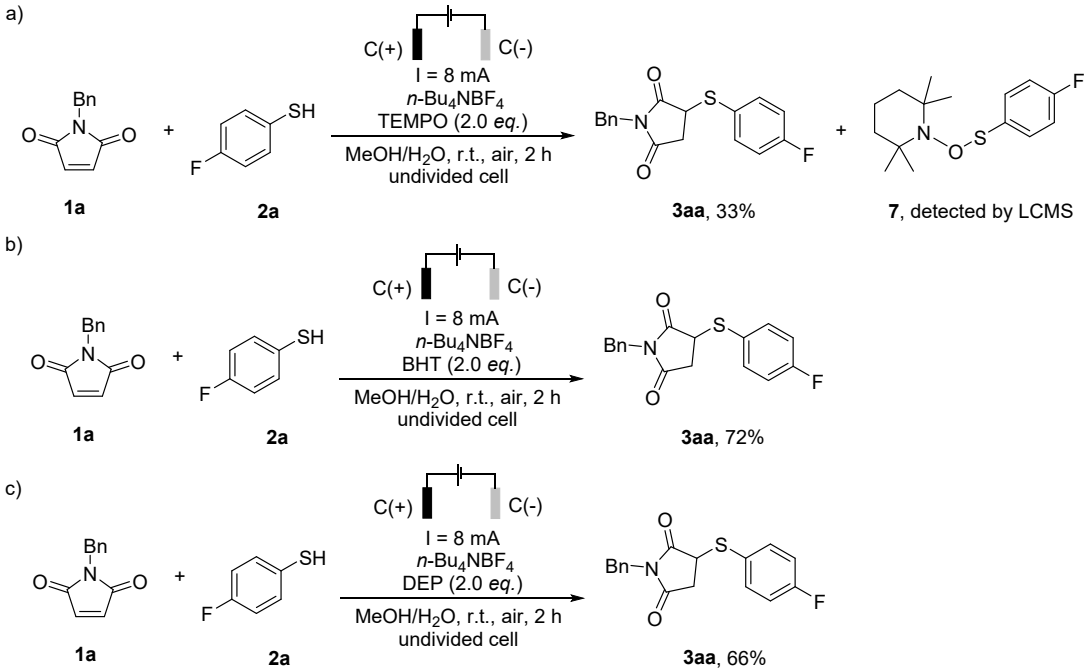


Figure S1 CV measurements. *n*-Bu_4NBF_4 was used as the electrolyte for the CV measurements.

Radical trapping experiment



In order to confirm whether the reaction undergoes a radical mechanism, commonly used radical scavengers such as 2,2,6,6-tetramethylpiperidinooxy (TEMPO), 1,1-diphenylethylene (DPE) and butylated hydroxytoluene (BHT) was used respectively in radical capture and suppression experiments. Under the standard conditions, the radical scavenger (2.0 *eq*. to **2a**) was added to the model reaction system at the beginning of the reaction. Additionally, after 2 h, a small amount of the reaction mixture added with TEMPO was used to measurement. The radical trapping product **7** can be observed by

LCMS.

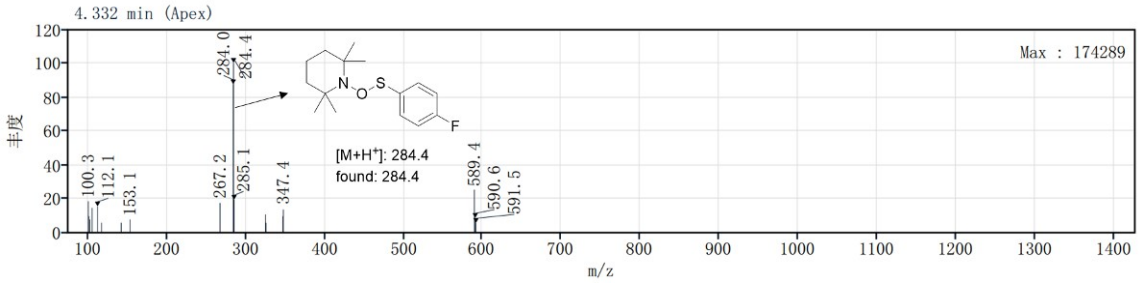
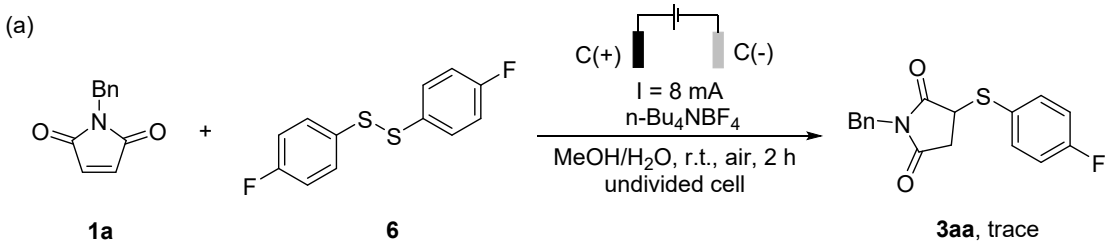
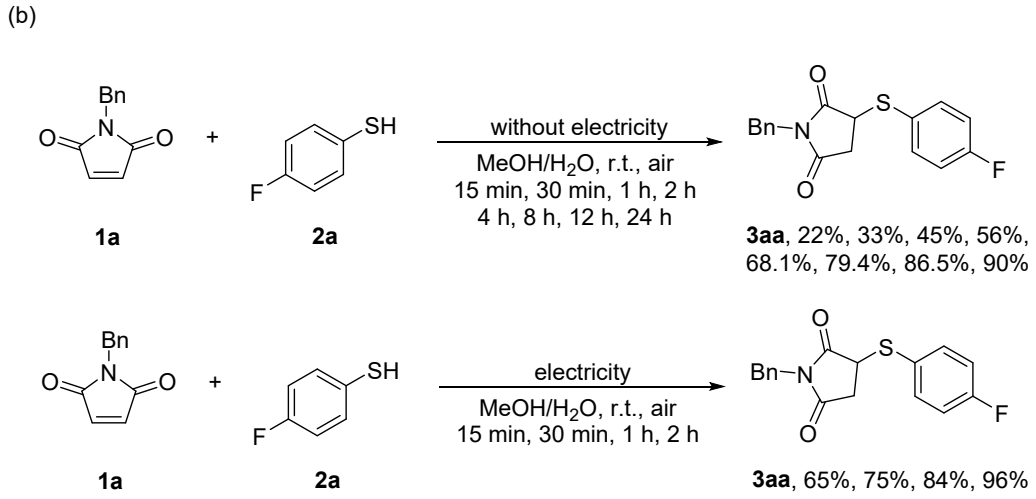


Figure S2. Mass spectrometry (LCMS) data of possible intermediate (with TEMPO).

Control experiments

In order to investigate the possible mechanism of this electrochemical vulcanization, a series of controlled experiments were carried out.





5. Characterization data of the products

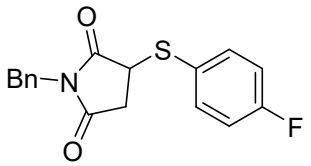


Figure S3. Structure of **3aa**

1-benzyl-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (**3aa**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3aa** as a white solid (90.8 mg, 96% yield); m.p.: 74~76 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.34 (m, 2H), 7.32 – 7.26 (m, 5H), 6.89 – 6.81 (m, 2H), 4.61 – 4.52 (d, 2H), 3.91 (dd, J = 9.3, 4.1 Hz, 1H), 3.14 (dd, J = 18.8, 9.3 Hz, 1H), 2.65 (dd, J = 18.8, 4.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.23, 174.06, 163.68 (d, $^1J_{FC}$ = 250.8 Hz), 137.40 (d, $^3J_{FC}$ = 8.5 Hz), 135.35, 129.07, 128.79, 128.22, 124.86 (d, $^4J_{FC}$ = 3.6 Hz), 116.66 (d, $^2J_{FC}$ = 21.9 Hz), 44.21, 42.88, 35.83. ^{19}F NMR (375 MHz, $CDCl_3$) δ -110.51. HRMS m/z (ESI) calcd. for $C_{17}H_{15}FNO_2S$ ([M+H]$^+$): 316.0808, Found: 316.0826.

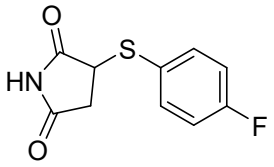


Figure S4. Structure of **3ba**

3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (**3ba**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ba** as a yellow solid (60.1 mg, 89% yield); m.p.: 90~92 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.79 (br, 1H), 7.58 – 7.49 (m, 2H), 7.09 – 6.99 (m, 2H), 3.99 (dd, J = 9.2, 4.2 Hz, 1H), 3.17 (dd, J = 18.8, 9.2 Hz, 1H), 2.69 (dd, J = 18.8, 4.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.16, 174.97, 163.75 (d, $^1J_{FC}$ = 250.8 Hz), 137.26 (d, $^3J_{FC}$ = 8.6 Hz), 125.44 (d, $^4J_{FC}$ = 3.5 Hz), 116.84 (d, $^2J_{FC}$= 22.0 Hz), 45.77, 37.08. HRMS m/z (ESI) calcd. for $C_{10}H_9FNO_2S$ ([M+H]$^+$): 226.0338, Found: 226.0345.

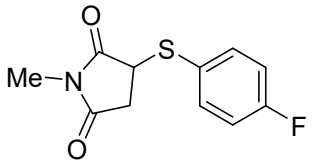


Figure S5. Structure of **3ca**

3-((4-fluorophenyl)thio)-1-methylpyrrolidine-2,5-dione (**3ca**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ca** as a white solid (55.7 mg, 78% yield); m.p.: 88~90 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 – 7.46 (m, 2H), 7.09 – 6.98 (m, 2H), 3.95 (dd, J = 9.1, 3.0 Hz, 1H), 3.14 (dd, J = 18.7, 9.1 Hz, 1H), 2.89 (s, 3H), 2.67 (dd, J = 18.7, 3.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.62, 174.43, 163.80 (d, $^1J_{FC}$ = 250.9 Hz), 137.26 (d, $^3J_{FC}$ = 8.6 Hz), 125.52 (d, $^4J_{FC}$ = 3.6 Hz), 116.74 (d, $^2J_{FC}$ = 21.9 Hz), 44.57, 36.16, 25.22. HRMS m/z (ESI) calcd. for $C_{11}H_{11}FNO_2S$ ([M+H]$^+$): 240.0495, Found: 240.0484.

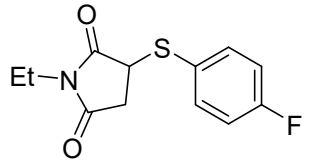


Figure S6. Structure of **3da**

1-ethyl-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (**3da**). Purified by column

chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3da** as a white solid (66.8 mg, 88% yield); m.p.: 38~40 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.45 (m, 2H), 7.12 – 6.93 (m, 2H), 3.91 (dd, J = 9.6, 4.9 Hz, 1H), 3.44 (q, J = 6.5 Hz, 2H), 3.11 (dd, J = 16.6, 8.2 Hz, 1H), 2.65 (dd, J = 18.8, 5.0 Hz, 1H), 1.02 (t, J = 6.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.28, 174.22, 163.71 (d, $^1J_{FC}$ = 250.9 Hz), 137.41 (d, $^3J_{FC}$ = 8.6 Hz), 125.28 (d, $^4J_{FC}$ = 3.5 Hz), 116.64 (d, $^2J_{FC}$ = 21.8 Hz), 44.27, 36.05, 34.13, 12.85. HRMS m/z (ESI) calcd. for $C_{12}H_{13}FNO_2S$ ([M+H]$^+$): 254.0651, Found: 254.0668.

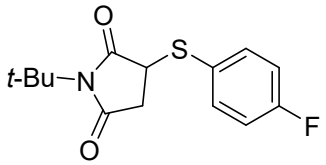


Figure S7. Structure of **3ea**

1-(tert-butyl)-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (**3ea**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ea** as a white solid (71.2 mg, 85% yield); m.p.: 48~50 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 – 7.48 (m, 2H), 7.08 – 6.99 (m, 2H), 3.78 (dd, J = 9.5, 4.2 Hz, 1H), 3.01 (dd, J = 18.6, 9.5 Hz, 1H), 2.56 (dd, J = 18.6, 4.2 Hz, 1H), 1.46 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.37, 175.44, 163.70 (d, $^1J_{FC}$ = 250.6 Hz), 137.42 (d, $^3J_{FC}$ = 8.5 Hz), 125.68 (d, $^4J_{FC}$ = 3.5 Hz), 116.62 (d, $^2J_{FC}$ = 21.9 Hz), 59.06, 44.40, 36.33, 28.31. HRMS m/z (ESI) calcd. for $C_{14}H_{17}FNO_2S$ ([M+H]$^+$): 282.0964, Found: 282.0980.

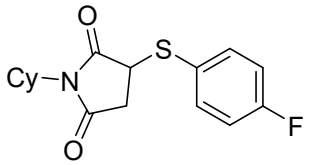


Figure S8. Structure of **3fa**

1-cyclohexyl-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (**3fa**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3fa** as a white solid (77.3 mg, 84% yield); m.p.: 70~72 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 (dd, J = 8.6, 5.3 Hz, 2H), 7.02 (t, J = 8.6 Hz, 2H), 3.87 (ddd, J = 17.0, 8.5, 3.9 Hz, 2H), 3.08 (dd, J = 18.8, 9.3 Hz, 1H), 2.60 (dd, J = 18.8, 4.0 Hz, 1H), 2.01 (p, J = 11.5, 10.9 Hz, 2H), 1.77 (d, J = 11.3 Hz, 2H), 1.62 (d, J = 11.0 Hz, 1H), 1.39 (d, J = 11.4 Hz, 2H), 1.21 (dq, J = 22.6, 12.7 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.52, 174.49, 163.72 (d, $^1J_{FC}$ = 250.8 Hz), 137.48 (d, $^3J_{FC}$ = 8.5 Hz), 125.34 (d, $^4J_{FC}$ = 3.4 Hz), 116.62 (d, $^2J_{FC}$ = 21.9 Hz), 52.18, 43.97, 35.78, 28.56, 25.83, 24.99. HRMS m/z (ESI) calcd. for $C_{16}H_{19}FNO_2S$ ([M+H]$^+$): 308.1121, Found: 308.1138.

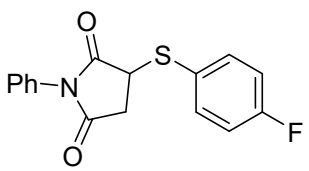


Figure S9. Structure of **3ga**

3-((4-fluorophenyl)thio)-1-phenylpyrrolidine-2,5-dione (**3ga**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ga** as a white solid (74.9 mg, 89% yield); m.p.: 130~132 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 – 7.56 (m, 2H), 7.47 – 7.35 (m, 3H), 7.12 – 7.03 (m, 4H), 4.08 (dd, J = 9.3, 3.9 Hz, 1H), 3.33 (dd, J = 18.9, 9.4 Hz, 1H), 2.87 (dd, J = 18.9, 3.9 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.51, 173.43, 163.96 (d, $^1J_{FC}$ = 251.3 Hz), 137.80 (d, $^3J_{FC}$ = 8.5 Hz), 131.56, 129.32, 128.99, 126.37, 125.10 (d, $^4J_{FC}$ = 3.3 Hz), 116.85 (d, $^2J_{FC}$ = 22.0 Hz), 44.52, 36.29. HRMS m/z (ESI) calcd. for $C_{16}H_{13}FNO_2S$ ([M+H]$^+$): 302.0651, Found: 302.0662.

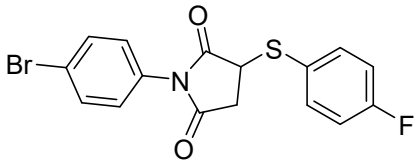


Figure S10. Structure of **3ha**

1-(4-bromophenyl)-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (**3ha**)[1]. Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ha** as a white solid (94.7 mg, 83% yield); m.p.: 157~159 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 – 7.52 (m, 4H), 7.09 – 7.02 (m, 2H), 6.99 – 6.94 (m, 2H), 4.07 (dd, J = 9.3, 3.8 Hz, 1H), 3.31 (dd, J = 19.0, 9.3 Hz, 1H), 2.84 (dd, J = 19.0, 3.8 Hz, 1H). HRMS m/z (ESI) calcd. for $C_{16}H_{12}BrFNO_2S$ ([M+H]$^+$): 378.9678 Found: 378.9687.

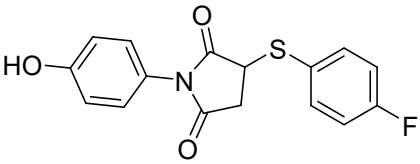


Figure S11. Structure of **3ia**

3-((4-fluorophenyl)thio)-1-(4-hydroxyphenyl)pyrrolidine-2,5-dione (**3ia**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ia** as a white solid (82.8 mg, 87% yield); m.p.: 145~147 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 – 7.55 (m, 2H), 7.11 – 7.03 (m, 2H), 6.94 – 6.82 (m, 4H), 5.19 (s, 1H), 4.08 (dd, J = 9.3, 3.9 Hz, 1H), 3.32 (dd, J = 18.9, 9.3 Hz, 1H), 2.86 (dd, J = 18.9, 3.9 Hz, 1H). HRMS m/z (ESI) calcd. for $C_{16}H_{13}FNO_3S$ ([M+H]$^+$): 318.0600, Found: 318.0613.

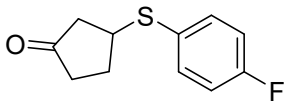


Figure S12. Structure of **3ja**

3-((4-fluorophenyl)thio)cyclopentan-1-one (**3ja**)[2]. Purified by column chromatography on silica gel (10:1 petroleum ether/ethyl acetate) afforded **3ja** as a yellow liquid (39.7 mg, 63% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 – 7.38 (m, 2H), 7.07 – 6.99 (m, 2H), 3.80 (p, J = 6.1 Hz, 1H), 2.61 – 2.40 (m, 2H), 2.37 – 2.15 (m, 3H), 2.05 – 1.92 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 216.36, 162.77 (d, $^1J_{FC}$ = 248.4 Hz), 135.26 (d, $^3J_{FC}$ = 8.2 Hz), 129.07 (d, $^4J_{FC}$ = 3.6 Hz), 116.42 (d, $^2J_{FC}$ = 21.9 Hz), 45.23, 44.48, 36.87, 29.41. HRMS m/z (ESI) calcd. for $C_{11}H_{12}FOS$ ([M+H]$^+$): 211.0593, Found:

211.0589.

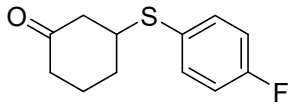


Figure S13. Structure of **3ka**

3-((4-fluorophenyl)thio)cyclohexan-1-one(**3ka**). Purified by column chromatography on silica gel (10:1 petroleum ether/ethyl acetate) afforded **3ja** as a yellow liquid (43.7 mg, 65% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 – 7.35 (m, 2H), 7.07 – 6.95 (m, 2H), 3.31 (dtd, J = 10.4, 5.1, 4.5, 3.2 Hz, 1H), 2.70 – 2.60 (m, 1H), 2.39 – 2.27 (m, 3H), 2.16 – 2.08 (m, 2H), 1.74 – 1.65 (m, 2H). HRMS m/z (ESI) calcd. for $C_{12}H_{14}FOS$ ($[M+H]^+$): 225.0746, Found: 225.0758.

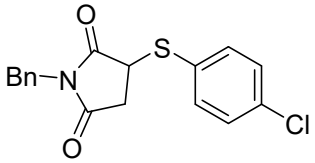


Figure S14. Structure of **3ab**

1-benzyl-3-((4-chlorophenyl)thio)pyrrolidine-2,5-dione (**3ab**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ab** as a white solid (93.8 mg, 95% yield); m.p.: 76~78 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 – 7.27 (m, 8H), 7.15 – 7.09 (m, 2H), 4.58 (s, 2H), 3.96 (dd, J = 9.3, 4.1 Hz, 1H), 3.15 (dd, J = 18.8, 9.3 Hz, 1H), 2.64 (dd, J = 18.8, 4.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.17, 173.99, 135.91, 135.29, 129.65, 129.04, 128.81, 128.43, 128.25, 43.93, 42.92, 35.84. HRMS m/z (ESI) calcd. for $C_{17}H_{15}ClNO_2S$ ($[M+H]^+$): 332.0512, Found: 332.0505.

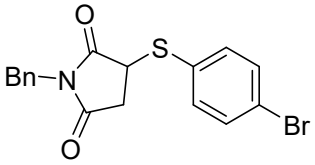


Figure S15. Structure of **3ac**

1-benzyl-3-((4-bromophenyl)thio)pyrrolidine-2,5-dione (**3ac**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ac** as a white solid (97.1 mg, 90% yield); m.p.: 68~70 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 – 7.28 (m, 5H), 7.28 – 7.26 (m, 2H), 7.26 – 7.22 (m, 2H), 4.58 (d, J = 1.3 Hz, 2H), 3.97 (dd, J = 9.3, 4.2 Hz, 1H), 3.15 (dd, J = 18.8, 9.3 Hz, 1H), 2.64 (dd, J = 18.8, 4.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.14, 173.96, 135.99, 135.28, 132.60, 129.16, 129.03, 128.82, 128.25, 124.06, 43.81, 42.93, 35.84. HRMS m/z (ESI) calcd. for $C_{17}H_{15}BrNO_2S$ ($[M+H]^+$): 376.0007, Found: 376.0010.

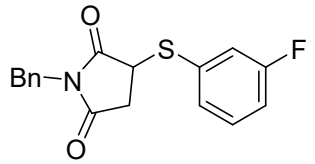


Figure S16. Structure of **3ad**

1-benzyl-3-((3-fluorophenyl)thio)pyrrolidine-2,5-dione (**3ad**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ad** as a white solid (83.3 mg, 88% yield); m.p.: 66~68 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 – 7.27 (m, 5H), 7.21 – 7.15 (m, 3H), 7.03 – 6.95 (m, 1H), 4.61 (s, 2H), 4.05 (dd, J = 9.2, 4.3 Hz, 1H), 3.17 (dd, J = 18.8, 9.2 Hz, 1H), δ 2.66 (dd, J = 18.8, 4.3 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.11, 173.94, 162.64 (d, $^{1}J_{FC}$ = 250.3 Hz), 132.95 (d, $^{3}J_{FC}$ = 7.7 Hz), 130.74 (d, $^{3}J_{FC}$ = 8.4 Hz), 129.26 (d, $^{4}J_{FC}$ = 3.0 Hz), 129.00, 128.84, 128.25, 120.56 (d, $^{2}J_{FC}$ = 22.3 Hz), 116.26 (d, $^{2}J_{FC}$ = 21.0 Hz), 43.83, 42.99, 36.01. HRMS m/z (ESI) calcd. for $C_{17}H_{15}FNO_2S$ ([M+H]$^+$): 316.0808, Found: 316.0821.

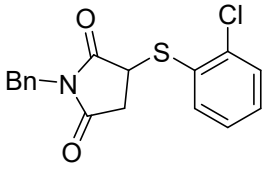


Figure S17. Structure of **3ae**

1-benzyl-3-((2-chlorophenyl)thio)pyrrolidine-2,5-dione (**3ae**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ae** as a colorless liquid (83.6 mg, 83% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (dd, J = 7.8, 1.6 Hz, 1H), 7.41 (dd, J = 8.0, 1.3 Hz, 1H), 7.37 – 7.32 (m, 2H), 7.32 – 7.26 (m, 3H), 7.24 (td, J = 7.7, 1.6 Hz, 1H), 7.12 (td, J = 7.6, 1.4 Hz, 1H), 4.63 (s, 2H), 4.20 (dd, J = 9.1, 4.0 Hz, 1H), 3.12 (dd, J = 18.8, 9.1 Hz, 1H), 2.65 (dd, J = 18.8, 4.0 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.00, 174.02, 137.28, 135.39, 134.93, 130.83, 130.27, 130.06, 128.98, 128.77, 128.17, 127.56, 42.87, 42.38, 35.71. HRMS m/z (ESI) calcd. for $C_{17}H_{15}ClNO_2S$ ([M+H]$^+$): 332.0512, Found: 332.0534.

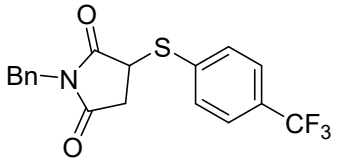


Figure S18. Structure of **3af**

1-benzyl-3-((4-(trifluoromethyl)phenyl)thio)pyrrolidine-2,5-dione (**3af**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3af** as a white solid (72.3 mg, 66% yield); m.p.: 110~112 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (d, J = 8.2 Hz, 2H), 7.43 (d, J = 8.2 Hz, 2H), 7.36 – 7.28 (m, 5H), 4.63 (s, 2H), 4.10 (dd, J = 9.3, 4.3 Hz, 1H), 3.21 (dd, J = 18.8, 9.3 Hz, 1H), 2.65 (dd, J = 18.8, 4.3 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.08, 173.73, 136.13, 135.27, 132.89, 129.14, 128.89, 128.37, 126.22 (q, $^{3}J_{FC}$ = 3.7 Hz), 123.83 (q, $^{1}J_{FC}$ = 272.0 Hz), 43.26, 43.07, 35.94. HRMS m/z (ESI) calcd. for $C_{18}H_{15}F_3NO_2S$ ([M+H]$^+$): 366.0776, Found: 366.0796.

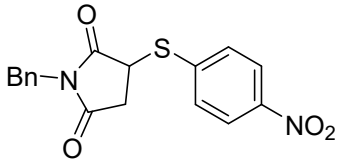


Figure S19. Structure of **3ag**

1-benzyl-3-((4-nitrophenyl)thio)pyrrolidine-2,5-dione (**3ag**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ag** as a yellow liquid (79.5 mg, 82% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 – 8.01 (m, 2H), 7.55 – 7.49 (m, 2H), 7.38 – 7.33 (m, 2H), 7.33 – 7.28 (m, 3H), 4.65 (s, 2H), 4.22 (dd, J = 9.4, 4.3 Hz, 1H), 3.28 (dd, J = 18.8, 9.4 Hz, 1H), 2.67 (dd, J = 18.8, 4.3 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.74, 173.42, 147.17, 141.31, 135.14, 131.24, 129.15, 128.88, 128.45, 124.23, 43.15, 42.58, 35.92. HRMS m/z (ESI) calcd. for $C_{17}H_{15}N_2O_4S$ ([M+H]$^+$): 343.0753, Found: 343.0738.

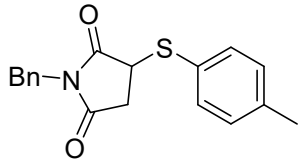


Figure S20. Structure of **3ah**

1-benzyl-3-(p-tolylthio)pyrrolidine-2,5-dione (**3ah**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ah** as a white solid (73.1 mg, 82% yield); m.p.: 74~76 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 – 7.25 (m, 7H), 6.98 (d, J = 7.9 Hz, 2H), 4.56 (s, 2H), 3.93 (dd, J = 9.2, 4.1 Hz, 1H), 3.10 (dd, J = 18.8, 9.2 Hz, 1H), 2.66 (dd, J = 18.8, 4.1 Hz, 1H), 2.30 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.51, 174.36, 139.81, 135.39, 135.09, 130.23, 129.01, 128.69, 128.05, 126.03, 44.14, 42.80, 35.77, 21.33. HRMS m/z (ESI) calcd. for $C_{18}H_{18}NO_2S$ ([M+H]$^+$): 312.1058, Found: 312.1052.

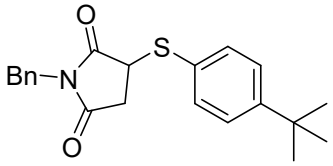


Figure S21. Structure of **3ai**

1-benzyl-3-((4-(tert-butyl)phenyl)thio)pyrrolidine-2,5-dione (**3ai**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ai** as a white solid (98.7 mg, 93% yield); m.p.: 104~106 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 – 7.25 (m, 7H), 7.19 (t, J = 8.0 Hz, 2H), 4.56 (s, 2H), 3.95 (dd, J = 9.1, 4.3 Hz, 1H), 3.08 (dd, J = 18.7, 9.1 Hz, 1H), 2.63 (dd, J = 18.7, 4.3 Hz, 1H), 1.26 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.67, 174.34, 152.79, 135.43, 134.52, 129.10, 128.76, 128.13, 126.51, 126.46, 44.12, 42.85, 35.78, 34.79, 31.27. HRMS m/z (ESI) calcd. for $C_{21}H_{24}NO_2S$ ([M+H]$^+$): 354.1528, Found: 354.1505.

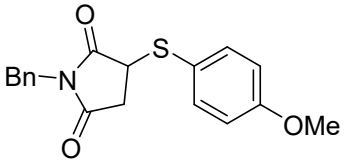


Figure S22. Structure of **3aj**

1-benzyl-3-((4-methoxyphenyl)thio)pyrrolidine-2,5-dione (**3aj**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3aj** as a white solid (82.7 mg, 88% yield); m.p.: 84~86 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 – 7.29 (m, 2H), 7.29 – 7.24 (m, 5H), 6.72 – 6.65 (m, 2H), 4.55 (s, 2H), 3.86 (dd, J = 9.2, 4.1 Hz, 1H), 3.77 (s, 3H), 3.09 (dd, J = 18.8, 9.2 Hz, 1H), 2.67 (dd, J = 18.8, 4.0 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.57, 174.39, 161.02, 137.44, 135.44, 129.01, 128.72, 128.06, 119.73, 115.01, 55.42, 44.47, 42.81, 35.69. HRMS m/z (ESI) calcd. for $C_{18}H_{18}NO_3S$ ([M+H]$^+$): 328.1007, Found: 328.1021.

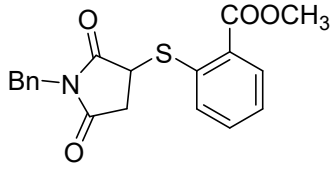


Figure S23. Structure of **3ak**

methyl 2-((1-benzyl-2,5-dioxopyrrolidin-3-yl)thio)benzoate (**3ak**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ak** as a colorless liquid (76.7 mg, 80% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, J = 5.5 Hz, 1H), 7.58 (d, J = 8.1 Hz, 1H), 7.46 – 7.33 (m, 3H), 7.33 – 7.21 (m, 4H), 4.73 – 4.59 (d, 2H), 4.34 (dd, J = 9.2, 3.9 Hz, 1H), 3.89 (s, 3H), 3.23 (dd, J = 18.8, 9.2 Hz, 1H), 2.70 (dd, J = 18.8, 3.8 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.51, 174.08, 166.89, 136.97, 135.40, 132.59, 131.19, 130.00, 129.53, 128.98, 128.79, 128.16, 126.38, 52.45, 42.95, 41.88, 36.16. HRMS m/z (ESI) calcd. for $C_{19}H_{18}NO_4S$ ([M+H]$^+$): 356.0957, Found: 356.0946.

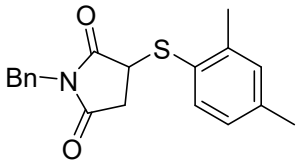


Figure S24. Structure of **3al**

1-benzyl-3-((2,4-dimethylphenyl)thio)pyrrolidine-2,5-dione (**3al**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3al** as a white solid (86.4 mg, 89% yield); m.p.: 94~96 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 – 7.25 (m, 5H), 7.22 (d, J = 7.9 Hz, 1H), 7.00 (s, 1H), 6.80 (d, J = 7.8 Hz, 1H), 4.58 (s, 2H), 3.93 (dd, J = 9.0, 3.9 Hz, 1H), 2.58 (dd, J = 18.7, 3.9 Hz, 1H), 2.35 (s, 3H), 2.26 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.47, 174.42, 141.69, 139.57, 135.42, 135.25, 131.73, 128.92, 128.67, 128.03, 127.68, 126.42, 43.47, 42.73, 35.68, 21.18, 20.90. HRMS m/z (ESI) calcd. for $C_{19}H_{20}NO_2S$ ([M+H]$^+$): 326.1215, Found: 326.1208.

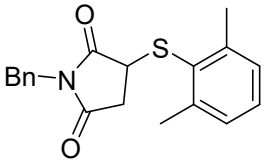


Figure S25. Structure of **3am**

1-benzyl-3-((2,6-dimethylphenyl)thio)pyrrolidine-2,5-dione (**3am**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3am** as a white solid (71.5 mg, 74% yield); m.p.: 56~58 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.34 (m, 2H), 7.33 – 7.27 (m, 3H), δ 7.22 – 7.14 (m, 1H), 7.11 (d, J = 7.5 Hz, 2H), 4.65 (s, 2H), 3.87 (dd, J = 8.9, 3.5 Hz, 1H), 3.03 (dd, J = 18.7, 8.9 Hz, 1H), 2.57 (dd, J = 18.7, 3.5 Hz, 1H), 2.45 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.29, 174.53, 143.91, 135.47, 130.04, 129.81, 128.99, 128.79, 128.59, 128.17, 42.81, 42.43, 35.79, 22.18. HRMS m/z (ESI) calcd. for $C_{19}H_{20}NO_2S$ ($[M+H]^+$): 326.1215, Found: 326.1222.

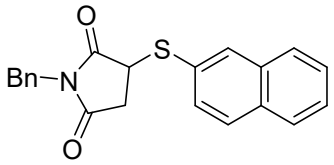


Figure S26. Structure of **3an**

1-benzyl-3-(naphthalen-2-ylthio)pyrrolidine-2,5-dione (**3an**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3an** as a white solid (84.3 mg, 81% yield); m.p.: 100~102 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (s, 1H), 7.82 – 7.77 (m, 1H), 7.75 – 7.70 (m, 1H), 7.64 (d, J = 8.5 Hz, 1H), 7.54 – 7.47 (m, 2H), 7.41 (dd, J = 8.5, 1.7 Hz, 1H), 7.25 – 7.18 (m, 5H), 4.58 (s, 2H), 4.11 (dd, J = 9.2, 4.3 Hz, 1H), 3.16 (dd, J = 18.8, 9.2 Hz, 1H), 2.75 (dd, J = 18.8, 4.3 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.39, 174.23, 135.31, 134.30, 133.24, 130.63, 129.24, 128.89, 128.76, 128.13, 127.98, 127.89, 127.59, 127.27, 126.98, 44.14, 42.93, 36.02. HRMS m/z (ESI) calcd. for $C_{21}H_{18}NO_2S$ ($[M+H]^+$): 348.1058, Found: 348.1076.

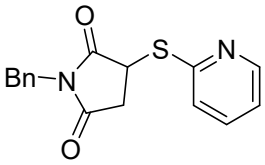


Figure S27. Structure of **3ao**

1-benzyl-3-(pyridin-2-ylthio)pyrrolidine-2,5-dione (**3ao**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ao** as a yellow solid (68.4 mg, 77% yield); m.p.: 60~62 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 – 7.46 (m, 3H), 7.46 – 7.40 (m, 1H), 7.35 – 7.28 (m, 3H), 7.12 (d, J = 8.1 Hz, 1H), 6.83 (dd, J = 6.9, 5.4 Hz, 1H), 4.80 – 4.69 (d, 2H), 4.15 (dd, J = 9.4, 5.6 Hz, 1H), 3.19 (dd, J = 18.3, 9.4 Hz, 1H), 2.94 (dd, J = 18.3, 5.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.83, 175.19, 155.56, 149.11, 136.55, 135.78, 129.71, 128.73, 128.03, 122.00, 120.10, 43.19, 40.95, 36.53. HRMS m/z (ESI) calcd. for $C_{16}H_{15}N_2O_2S$ ($[M+H]^+$): 299.0854, Found: 299.0876.

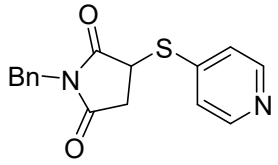


Figure S28. Structure of **3ap**

1-benzyl-3-(pyridin-4-ylthio)pyrrolidine-2,5-dione (**3ap**). Purified by column chromatography on silica gel (2:1 petroleum ether/ethyl acetate) afforded **3ap** as a yellow liquid (67.5 mg, 76% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.42 – 8.36 (m, 2H), 7.39 – 7.27 (m, 5H), 7.24 – 7.19 (m, 2H), 4.70 – 4.60 (d, 2H), 4.25 (dd, J = 9.4, 4.6 Hz, 1H), 3.25 (dd, J = 18.8, 9.4 Hz, 1H), 2.64 (dd, J = 18.8, 4.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.71, 173.42, 149.84, 144.61, 135.09, 129.00, 128.84, 128.32, 123.12, 43.09, 41.22, 35.97. HRMS m/z (ESI) calcd. for $C_{15}H_{14}F_2NO_2S$ ($[M+H]^+$): 299.0854, Found: 299.0870.

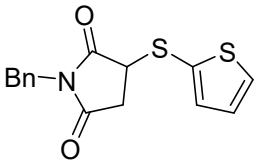


Figure S29. Structure of **3aq**

1-benzyl-3-(thiophen-2-ylthio)pyrrolidine-2,5-dione (**3aq**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3aq** as a yellow solid (68.6 mg, 76% yield); m.p.: 60~62 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (dd, J = 5.4, 1.3 Hz, 1H), 7.30 – 7.22 (m, 5H), 7.07 (dd, J = 3.7, 1.2 Hz, 1H), 6.87 (dd, J = 5.4, 3.6 Hz, 1H), 4.58 – 4.49 (d, 2H), 3.82 (dd, J = 9.2, 4.1 Hz, 1H), 3.13 (dd, J = 18.8, 9.2 Hz, 1H), 2.79 (dd, J = 18.9, 4.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.86, 174.10, 137.89, 135.34, 132.51, 129.04, 128.70, 128.25, 128.06, 126.52, 45.47, 42.91, 35.70. HRMS m/z (ESI) calcd. for $C_{15}H_{14}NO_2S_2$ ($[M+H]^+$): 304.0466, Found: 304.0472.

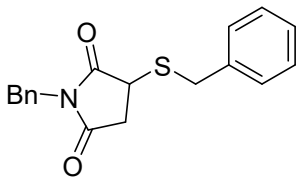


Figure S30. Structure of **3ar**

1-benzyl-3-(benzylthio)pyrrolidine-2,5-dione (**3ar**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3ar** as a colorless liquid (70.7 mg, 76% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.27 (m, 10H), 4.72 – 4.60 (d, 2H), 4.20 (d, J = 13.5 Hz, 1H), 3.84 (d, J = 13.5 Hz, 1H), 3.51 (dd, J = 9.2, 3.7 Hz, 1H), 2.97 (dd, J = 18.8, 9.2 Hz, 1H), 2.41 (dd, J = 18.8, 3.7 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.52, 174.41, 136.85, 135.50, 129.24, 128.77, 128.10, 127.60, 42.63, 37.47, 35.91, 35.54. HRMS m/z (ESI) calcd. for $C_{18}H_{18}NO_2S$ ($[M+H]^+$): 312.1058, Found: 312.1069.

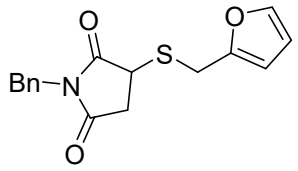


Figure S31. Structure of **3as**

1-benzyl-3-((furan-2-ylmethyl)thio)pyrrolidine-2,5-dione (**3as**). Purified by column chromatography on silica gel (8:1 petroleum ether/ethyl acetate) afforded **3as** as a yellow liquid (79.4 mg, 88% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 – 7.35 (m, 3H), 7.35 – 7.27 (m, 3H), 6.30 (t, J = 2.6 Hz, 1H), 6.21 (d, J = 3.2 Hz, 1H), 4.72 – 4.61 (d, 2H), 4.29 (d, J = 14.9 Hz, 1H), 3.81 (d, J = 14.9 Hz, 1H), 3.67 (dd, J = 9.2, 3.9 Hz, 1H), 3.03 (dd, J = 18.8, 9.2 Hz, 1H), 2.41 (dd, J = 18.8, 3.9 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.37, 174.39, 150.00, 142.80, 135.51, 128.89, 128.83, 128.20, 110.67, 108.85, 42.78, 38.08, 35.60, 28.27. HRMS m/z (ESI) calcd. for $C_{16}H_{16}NO_3S$ ([M+H]$^+$): 302.0851, Found: 302.0876.

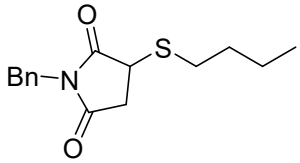


Figure S32. Structure of **3at**

1-benzyl-3-(butylthio)pyrrolidine-2,5-dione (**3at**). Purified by column chromatography on silica gel (20:1 petroleum ether/ethyl acetate) afforded **3at** as a colorless liquid (66.2 mg, 80% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.33 (m, 2H), 7.33 – 7.25 (m, 3H), 4.71 – 4.61 (d, 2H), 3.70 (dd, J = 9.1, 3.6 Hz, 1H), 3.12 (dd, J = 18.7, 9.1 Hz, 1H), 2.85 – 2.65 (m, 2H), 2.52 (dd, J = 18.7, 3.6 Hz, 1H), 1.64 – 1.48 (m, 2H), 1.38 (h, J = 6.9 Hz, 2H), 0.90 (t, J = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.44, 174.54, 135.57, 128.77, 128.75, 128.09, 42.66, 39.18, 36.26, 31.31, 31.10, 21.95, 13.66. HRMS m/z (ESI) calcd. for $C_{15}H_{20}NO_2S$ ([M+H]$^+$): 278.1215, Found: 278.1226.

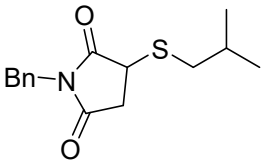


Figure S33. Structure of **3au**

1-Benzyl-3-(isobutylthio)pyrrolidine-2,5-dione (**3au**). Purified by column chromatography on silica gel (20:1 petroleum ether/ethyl acetate) afforded **3au** as a colorless liquid (69.1 mg, 83% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.34 (m, 2H), 7.34 – 7.24 (m, 3H), 4.74 – 4.59 (d, 2H), 3.68 (dd, J = 9.0, 3.6 Hz, 1H), 3.12 (dd, J = 18.7, 9.1 Hz, 1H), 2.70 (dd, J = 12.4, 6.4 Hz, 1H), 2.61 – 2.47 (m, 2H), 1.81 (dt, J = 13.5, 6.7 Hz, 1H), 0.97 (dd, J = 6.6, 1.1 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.47, 174.54, 135.63, 128.83, 128.80, 128.14, 42.71, 40.44, 39.57, 36.38, 28.39, 22.18, 21.89. HRMS m/z (ESI) calcd. for $C_{15}H_{19}NO_2S$ ([M+H]$^+$): 277.1136, Found: 277.3820.

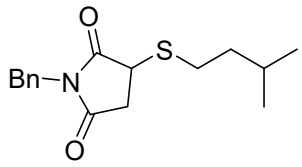


Figure S34. Structure of **3av**

1-Benzyl-3-(isopentylthio)pyrrolidine-2,5-dione (**3av**). Purified by column chromatography on silica gel (20:1 petroleum ether/ethyl acetate) afforded **3av** as a colorless liquid (65.6 mg, 75% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.35 (m, 2H), 7.33 – 7.24 (m, 3H), 4.73 – 4.59 (d, 2H), 3.70 (dd, J = 9.1, 3.6 Hz, 1H), 3.12 (dd, J = 18.7, 9.1 Hz, 1H), 2.89 – 2.65 (m, 2H), 2.53 (dd, J = 18.7, 3.6 Hz, 1H), 1.73 – 1.56 (m, 1H), 1.47 (dtd, J = 8.8, 6.6, 5.0 Hz, 2H), 0.88 (dd, J = 6.6, 1.9 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.43, 174.53, 135.62, 128.80, 128.13, 42.72, 39.26, 37.97, 36.29, 29.74, 27.52, 22.40, 22.21.HRMS m/z (ESI) calcd. for $C_{16}H_{21}NO_2S$ ([M+H]$^+$): 291.1293, Found: 291.4090.

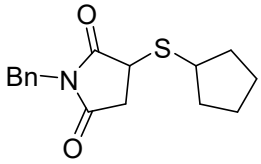


Figure S35. Structure of **3aw**

1-Benzyl-3-(cyclopentylthio)pyrrolidine-2,5-dione (**3aw**). Purified by column chromatography on silica gel (20:1 petroleum ether/ethyl acetate) afforded **3aw** as a colorless liquid (63.5 mg, 73% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 (dd, J = 7.9, 1.5 Hz, 2H), 7.35 – 7.24 (m, 3H), 4.76 – 4.59 (d, 2H), 3.76 (dd, J = 9.1, 3.7 Hz, 1H), 3.54 – 3.43 (m, 1H), 3.13 (dd, J = 18.7, 9.1 Hz, 1H), 2.56 (dd, J = 18.7, 3.7 Hz, 1H), 2.14 – 1.87 (m, 2H), 1.82 – 1.65 (m, 2H), 1.63 – 1.49 (m, 4H), 1.45 (dt, J = 13.7, 6.6 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.49, 174.58, 135.59, 128.83, 128.74, 128.08, 43.82, 42.71, 39.75, 36.57, 34.24, 33.30, 24.91, 24.79.HRMS m/z (ESI) calcd. for $C_{16}H_{19}NO_2S$ ([M+H]$^+$): 289.1136, Found: 289.3930.

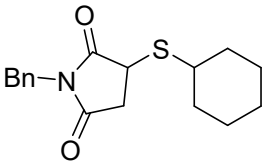


Figure S36. Structure of **3ax**

1-benzyl-3-(cyclohexylthio)pyrrolidine-2,5-dione (**3ax**). Purified by column chromatography on silica gel (20:1 petroleum ether/ethyl acetate) afforded **3ax** as a colorless liquid (62.8 mg, 70% yield); m.p.: 84~86 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.34 (m, 2H), 7.34 – 7.24 (m, 3H), 4.72 – 4.59 (d, 2H), 3.79 (dd, J = 9.1, 3.8 Hz, 1H), 3.20 – 3.06 (m, 2H), 2.52 (dd, J = 18.7, 3.7 Hz, 1H), 2.12 – 2.02 (m, 1H), 1.95 – 1.84 (m, 1H), 1.80 – 1.69 (m, 2H), 1.65 – 1.56 (m, 1H), 1.41 – 1.20 (m, 5H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 176.65, 174.61, 135.56, 128.79, 128.75, 128.07, 43.84, 42.69, 37.87, 36.64, 33.62, 33.08, 25.72. HRMS m/z (ESI) calcd. for $C_{17}H_{22}NO_2S$ ([M+H]$^+$):

304.1371, Found: 304.1352.

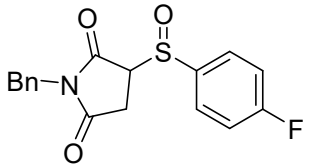


Figure S37. Structure of **4**

1-benzyl-3-((4-fluorophenyl)sulfinyl)pyrrolidine-2,5-dione (**4**). Purified by column chromatography on silica gel (4:1 petroleum ether/ethyl acetate) afforded **4** as a yellow solid (88.5 mg, 88% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 – 7.31 (m, 2H), 7.23 – 7.15 (m, 5H), 6.85 (t, J = 8.5 Hz, 2H), 4.60 (d, J = 1.1 Hz, 2H), 4.41 (dd, J = 9.0, 3.1 Hz, 1H), 2.77 (dd, J = 19.5, 9.0 Hz, 1H), 2.35 (dd, J = 18.5, 9.1 Hz, 1H).

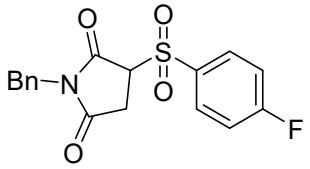


Figure S38. Structure of **5**

1-benzyl-3-((4-fluorophenyl)sulfonyl)pyrrolidine-2,5-dione (**5**)[3]. Purified by column chromatography on silica gel (4:1 petroleum ether/ethyl acetate) afforded **5** as a yellow solid (95.8 mg, 92% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 – 7.80 (m, 2H), 7.38 – 7.24 (m, 5H), 7.23 –7.11 (m, 2H), 4.61 (d, J = 3.4 Hz, 2H), 4.32 (dd, J = 9.6, 3.8 Hz, 1H), 3.34 (dd, J = 19.1, 3.8 Hz, 1H), 3.09 (dd, J = 19.1, 9.6 Hz, 1H).

references

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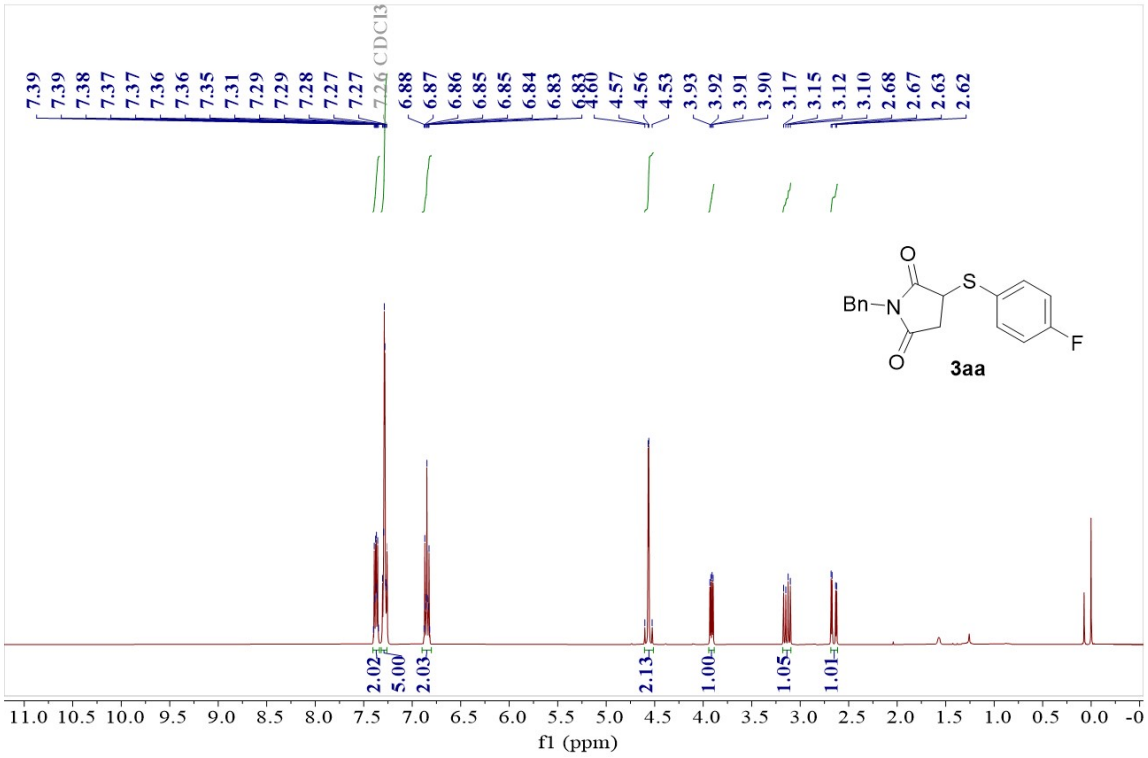
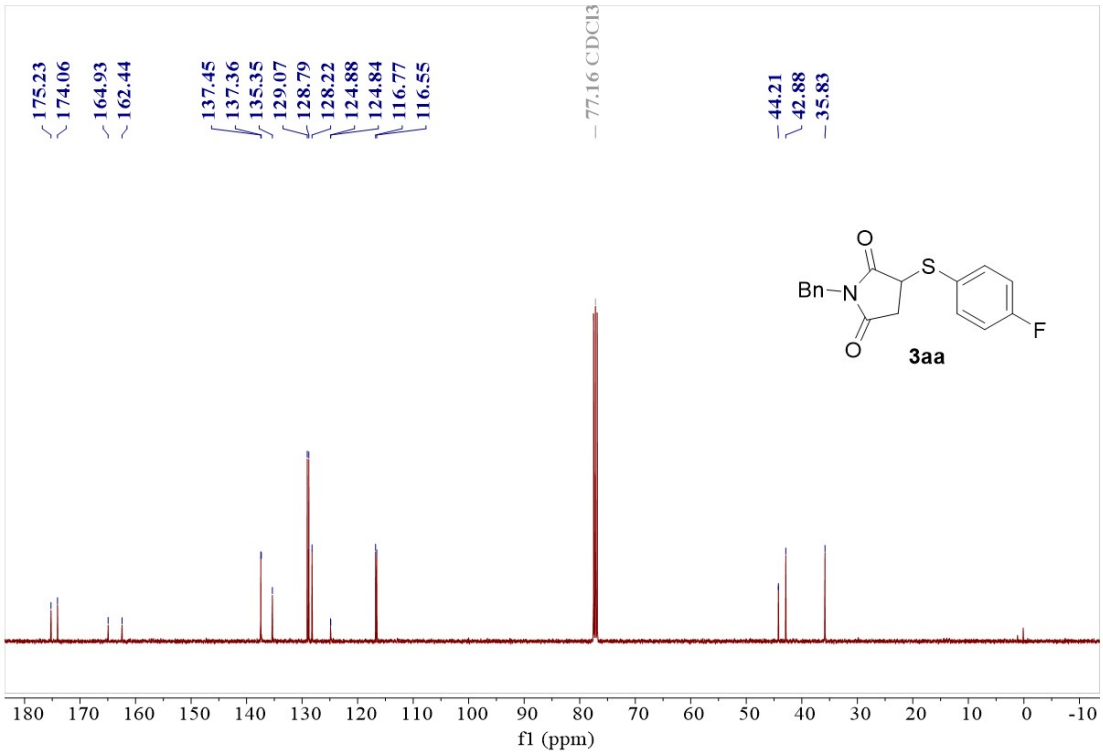
3. Sandrine M. Hell, Claudio F. Meyer, Antonio Misale, Jeroen B. I. Sap, Kirsten E. Christensen, Michael C. Willis, Andres A. Trabanco, and Veronique Gouverneur, Angewandte Chemie International Edition 2020, **59**, 11620-11626

6. NMR Spectra of Products

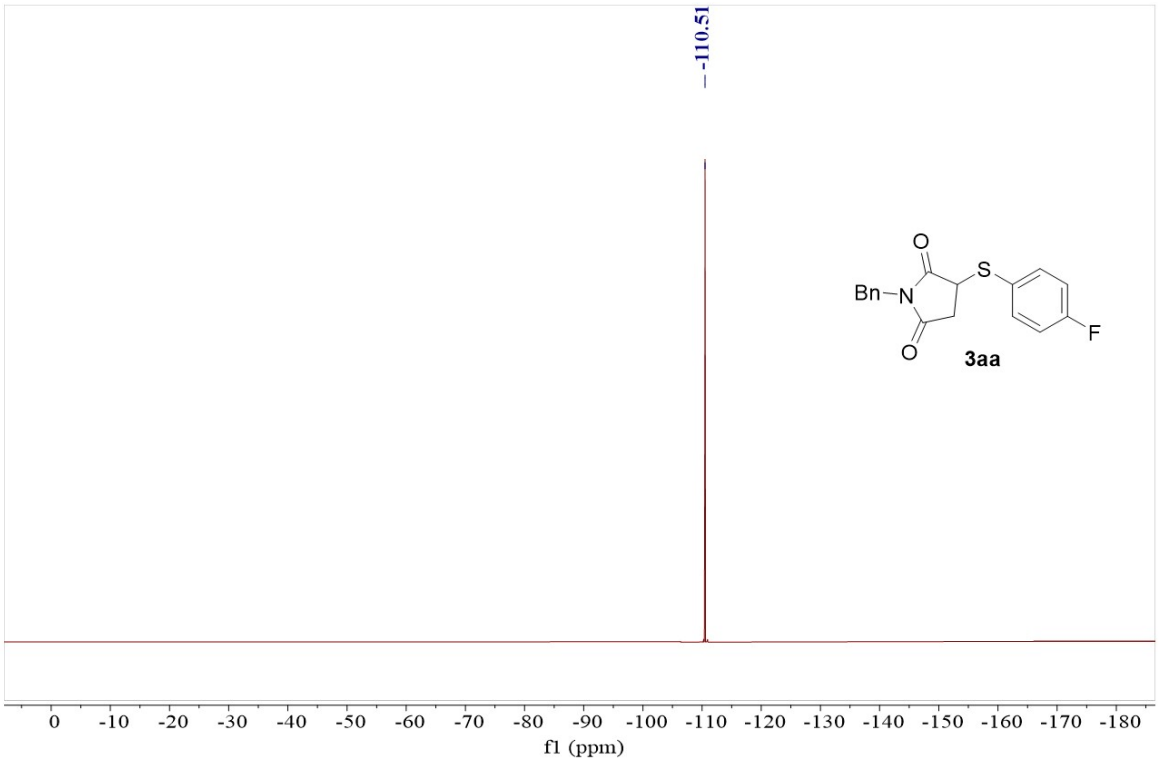
1-benzyl-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (3aa)



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3aa

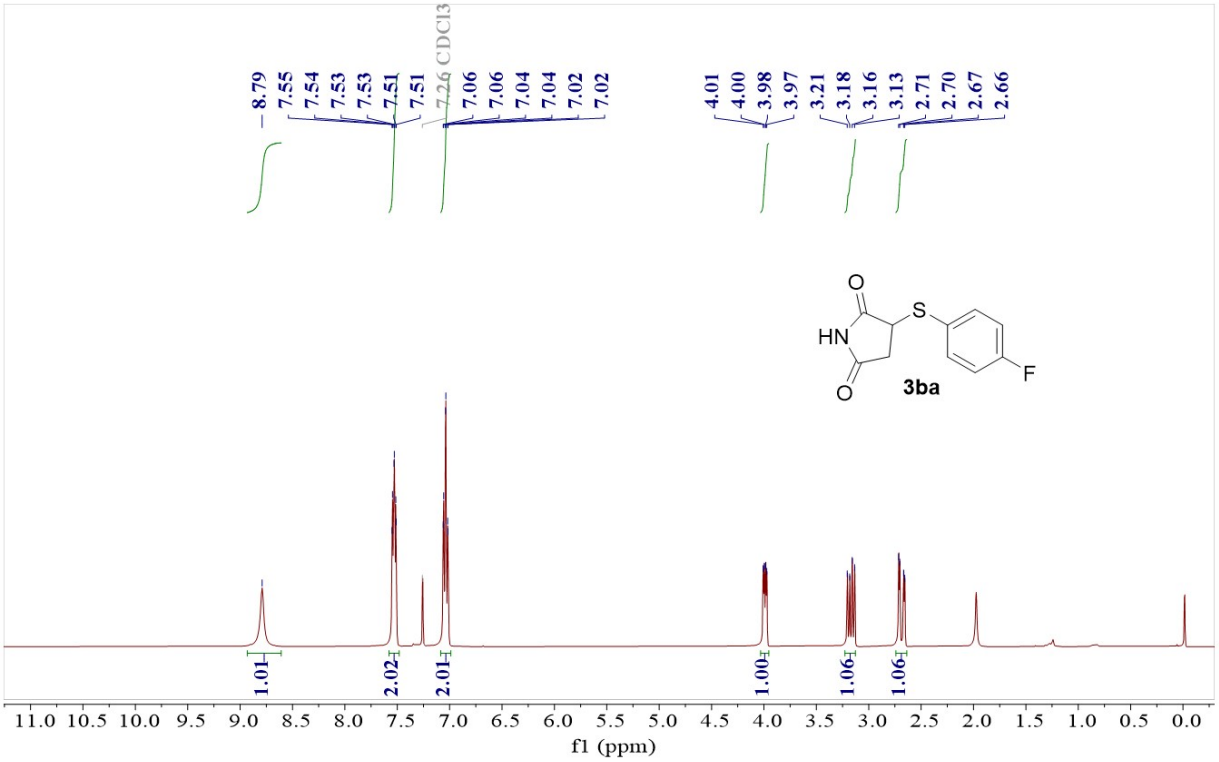


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3aa

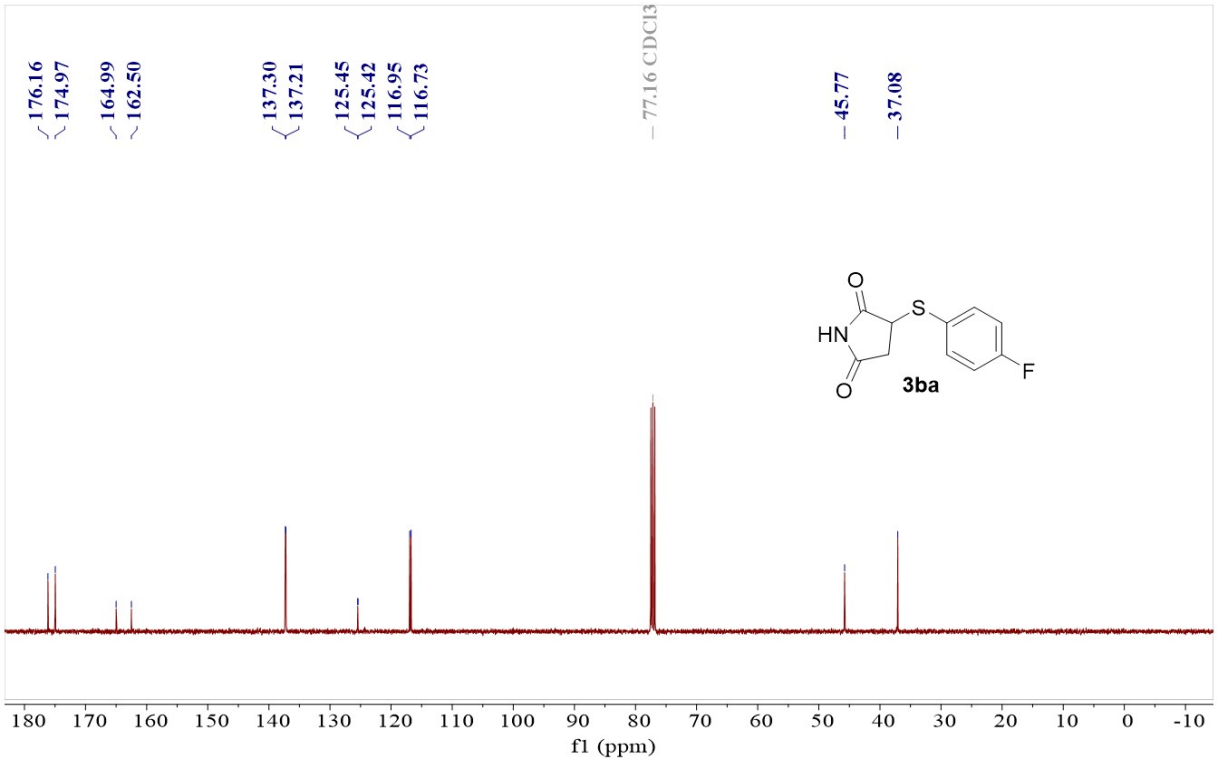


^{19}F NMR (375 MHz, $CDCl_3$) spectrum of 3aa

3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (3ba)

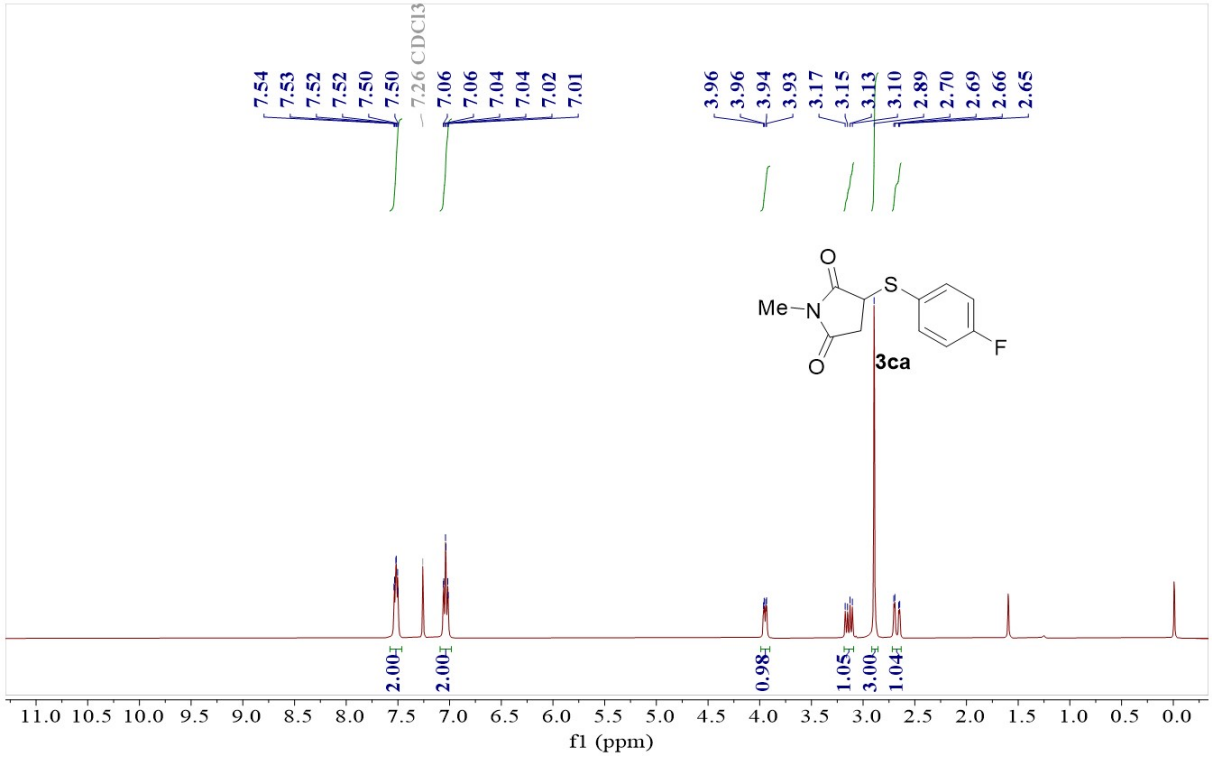


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ba

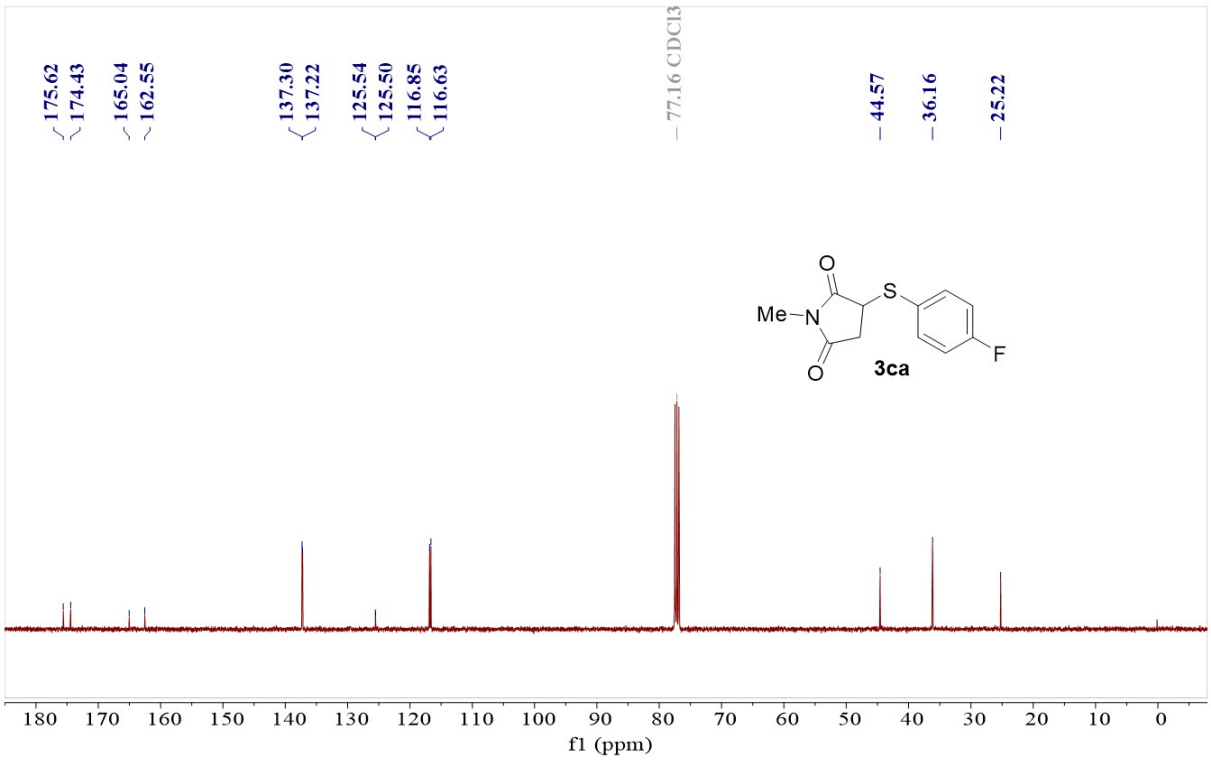


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ba

3-((4-fluorophenyl)thio)-1-methylpyrrolidine-2,5-dione (3ca)

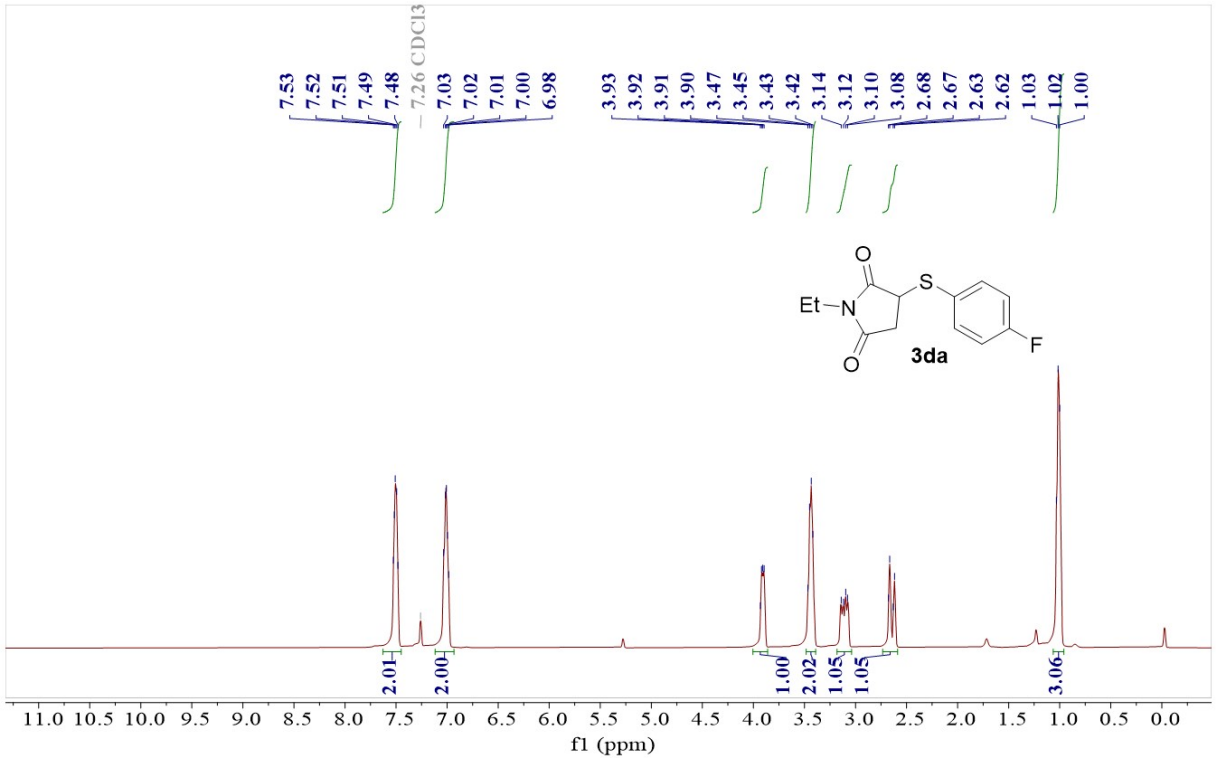


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ca

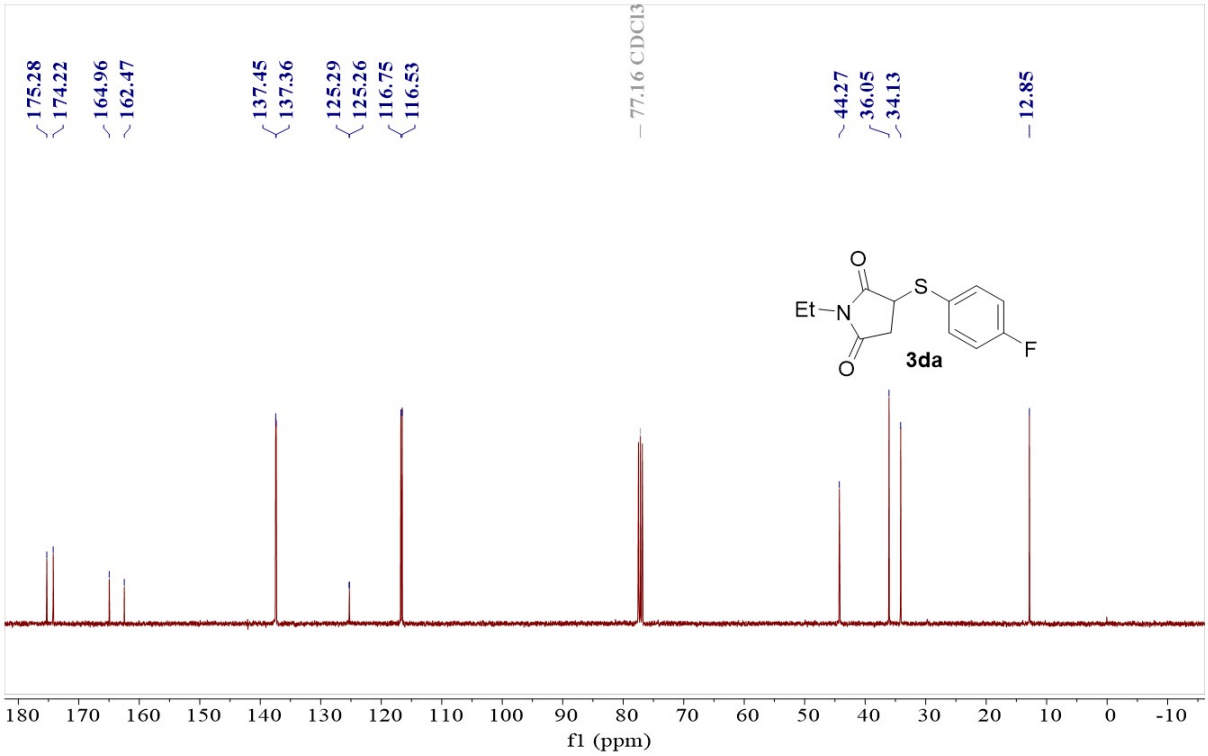


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ca

1-ethyl-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (3da)

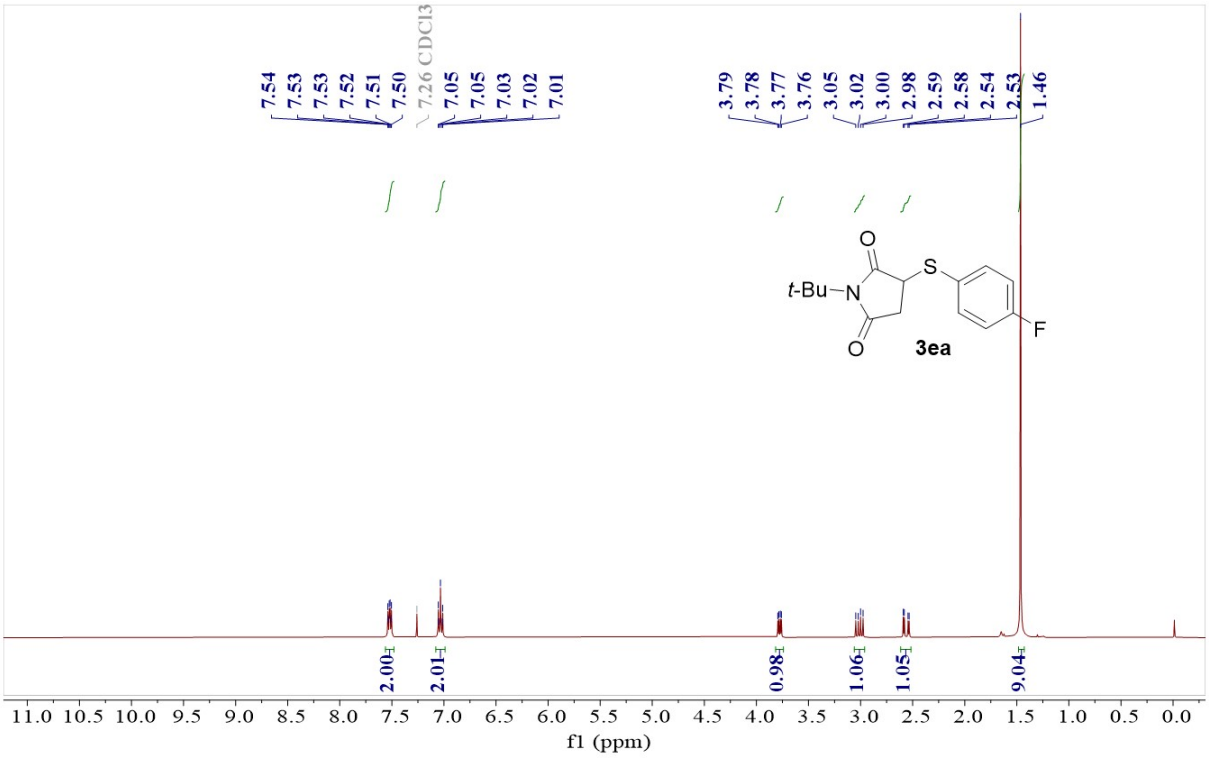


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3da

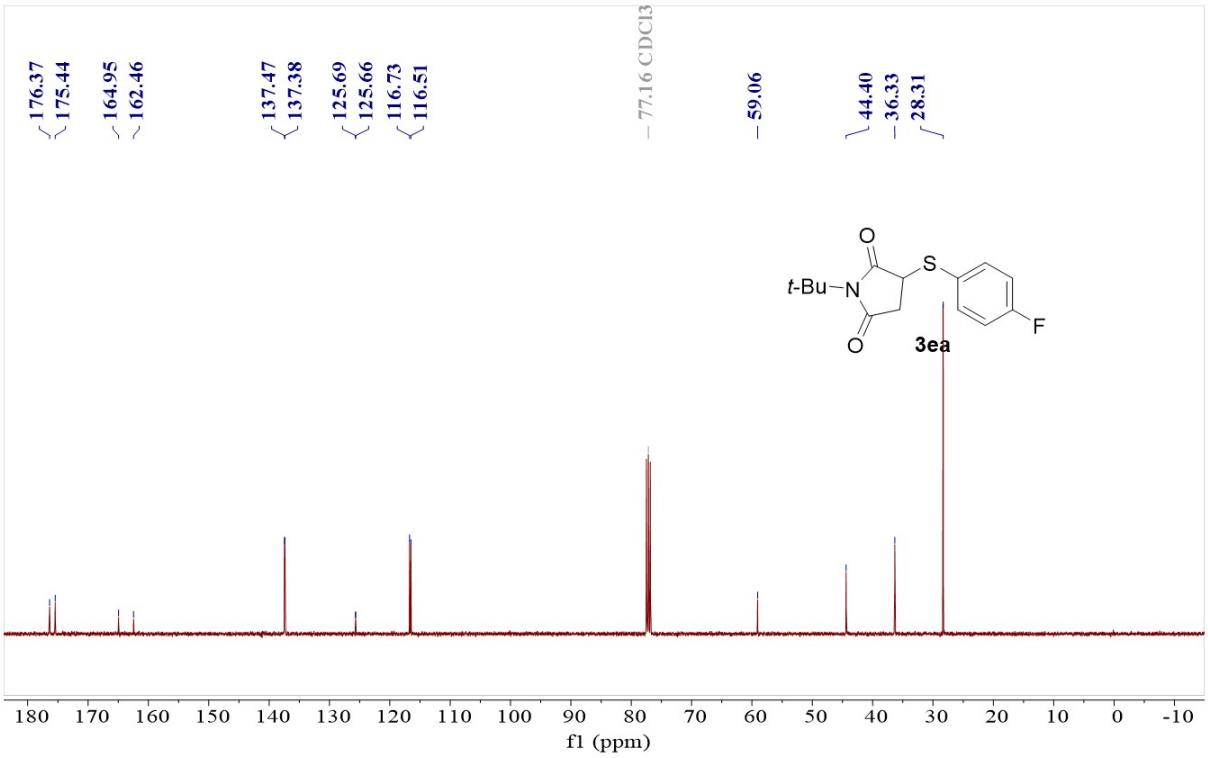


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3da

1-(tert-butyl)-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (3ea)

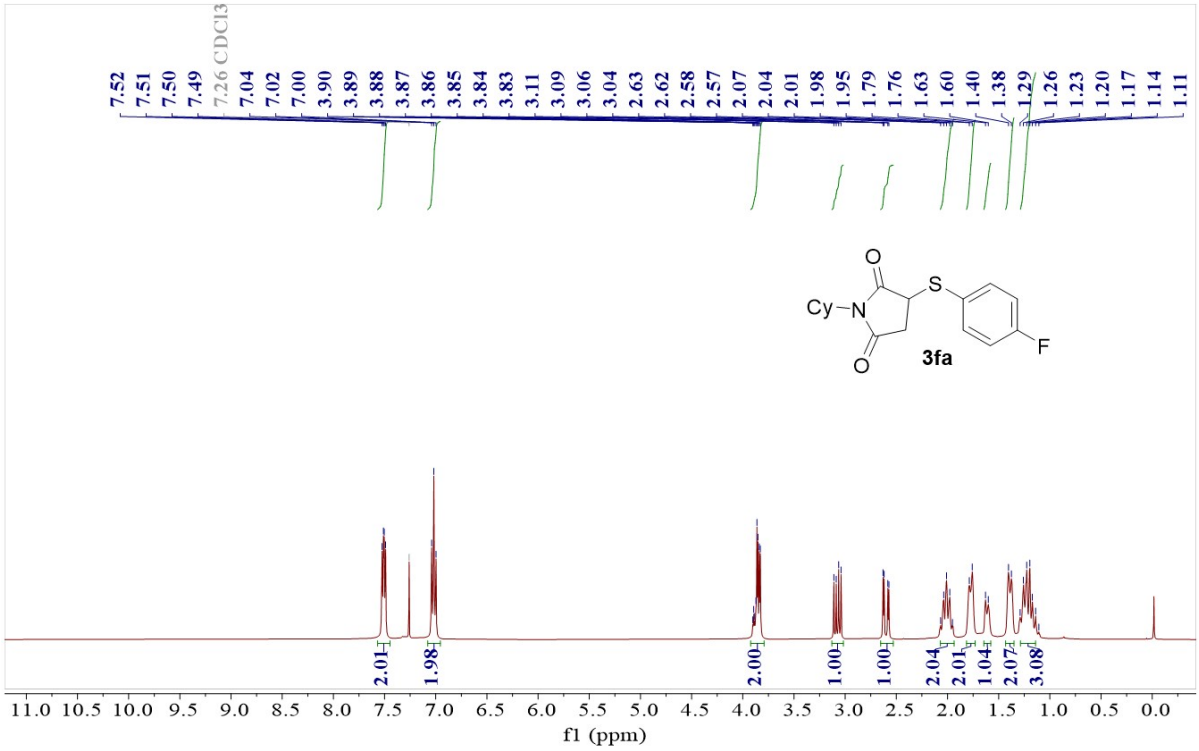


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ea

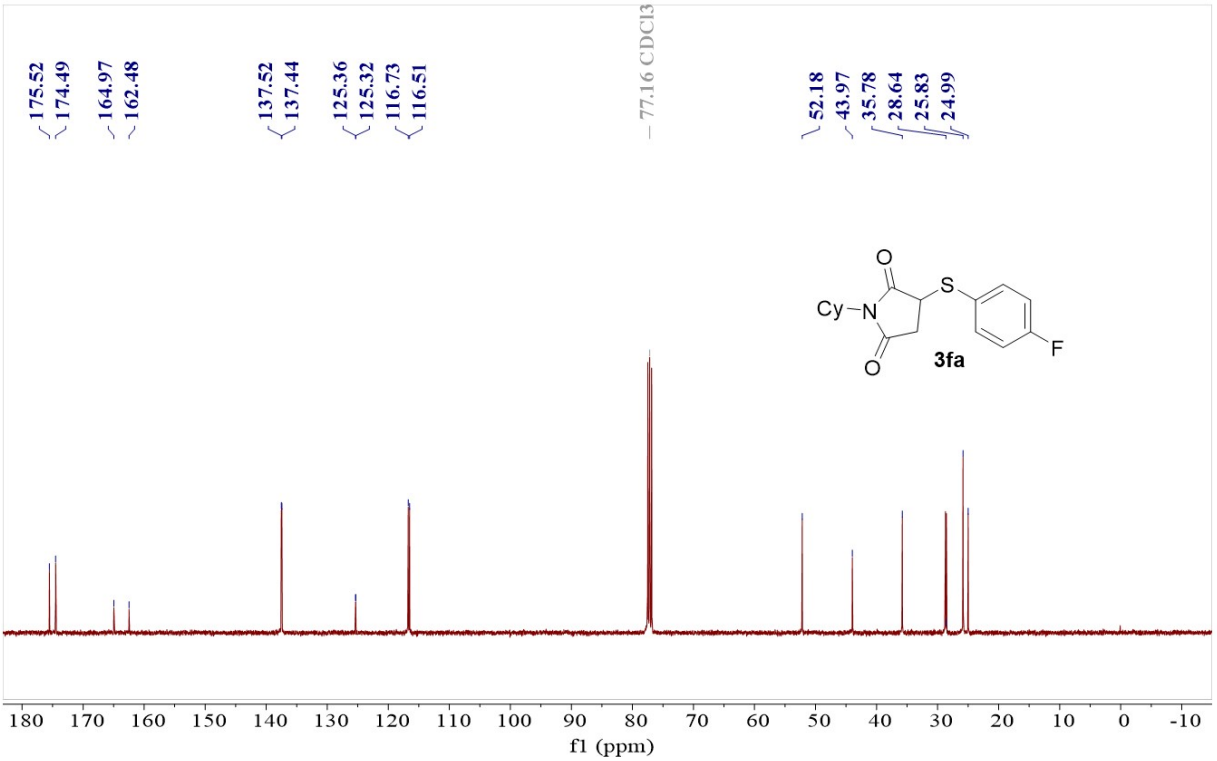


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ea

1-cyclohexyl-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (3fa)

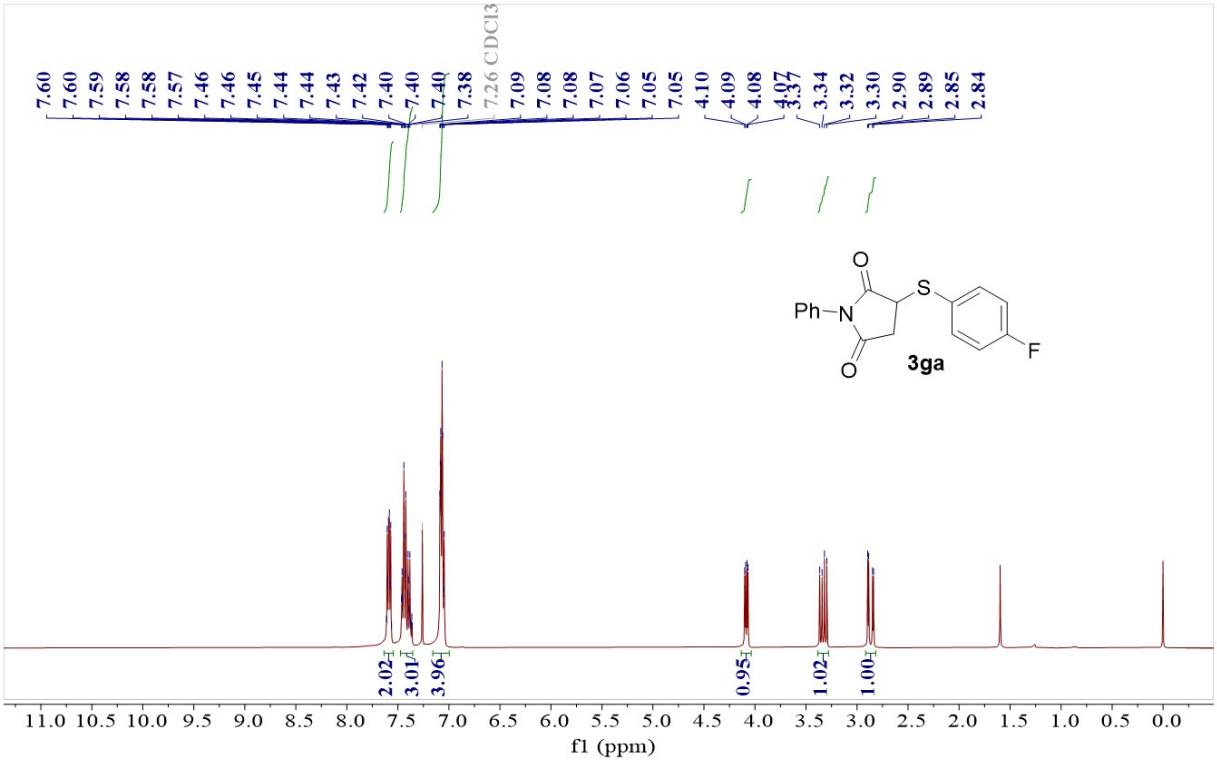


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3fa

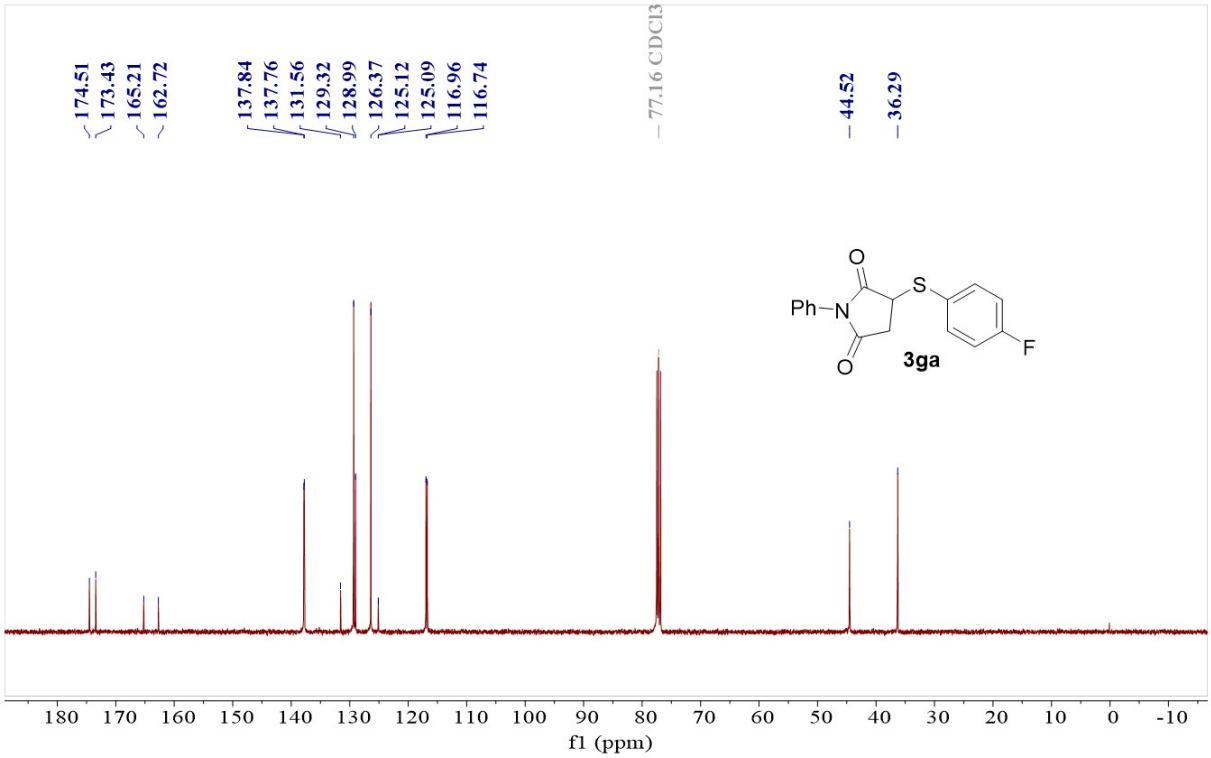


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3fa

3-((4-fluorophenyl)thio)-1-phenylpyrrolidine-2,5-dione (3ga)

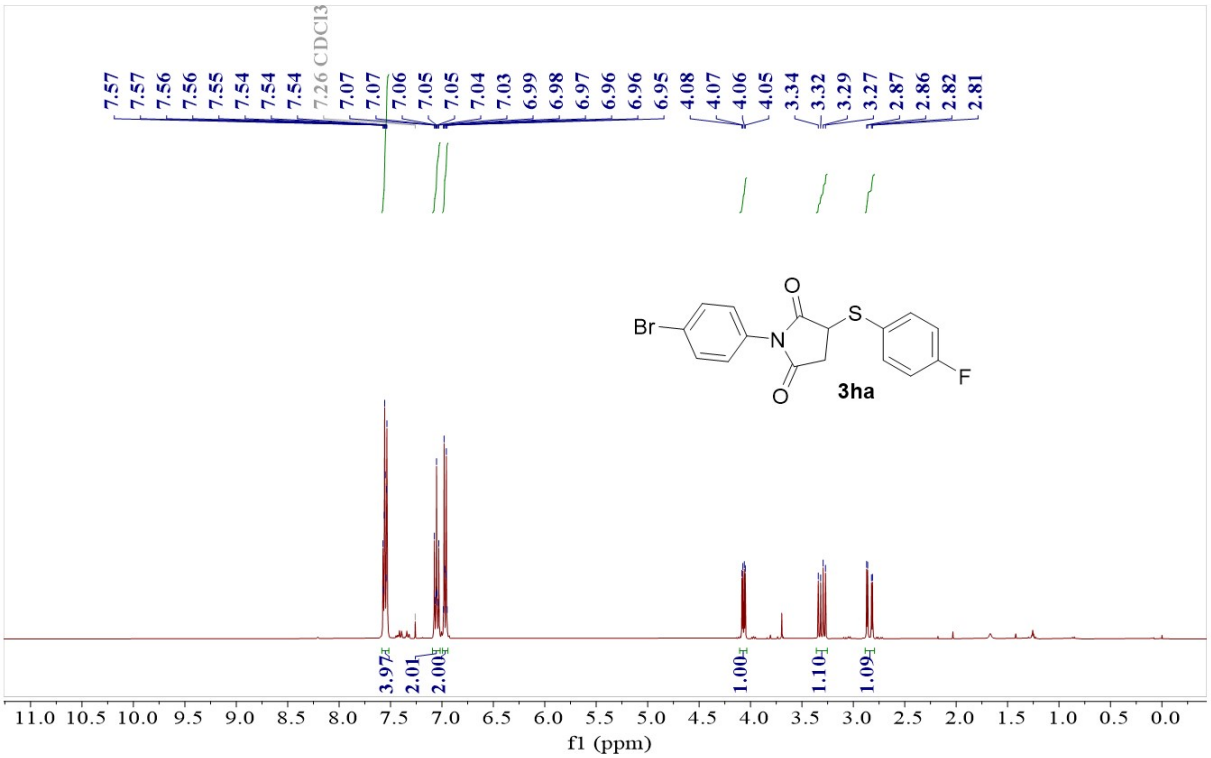


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ga



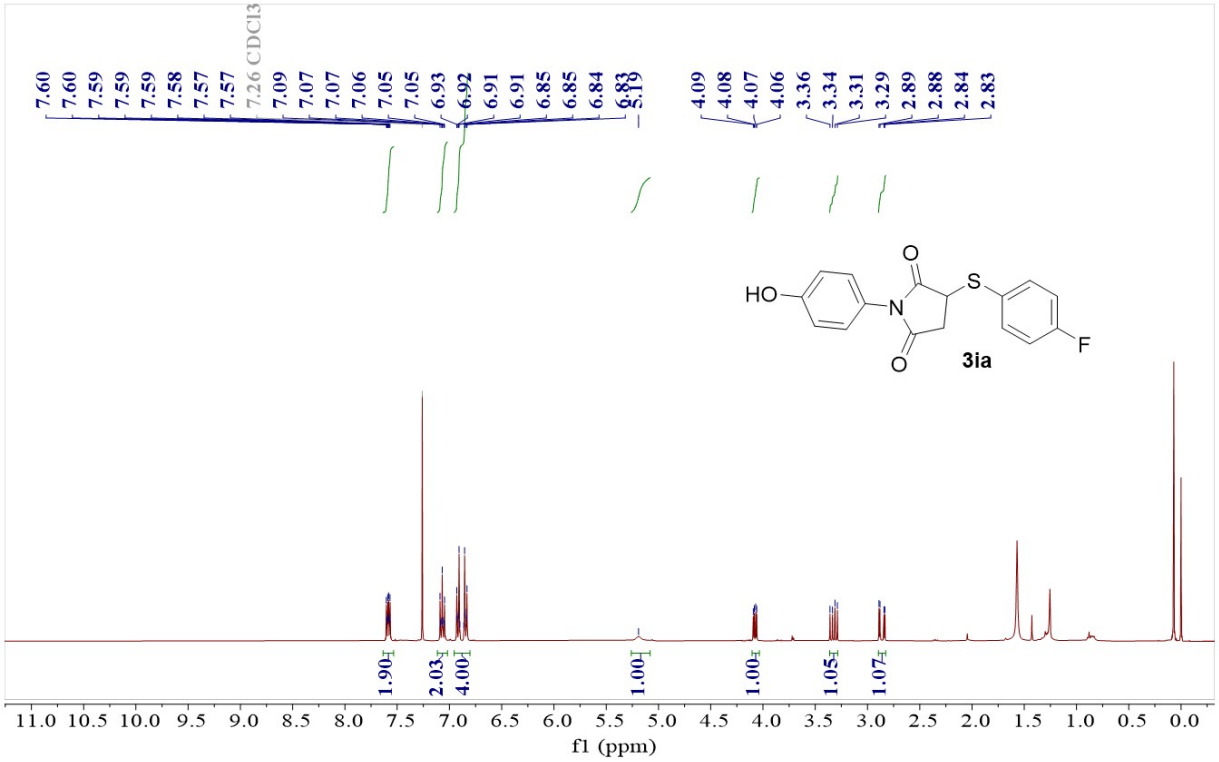
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ga

1-(4-bromophenyl)-3-((4-fluorophenyl)thio)pyrrolidine-2,5-dione (3ha)



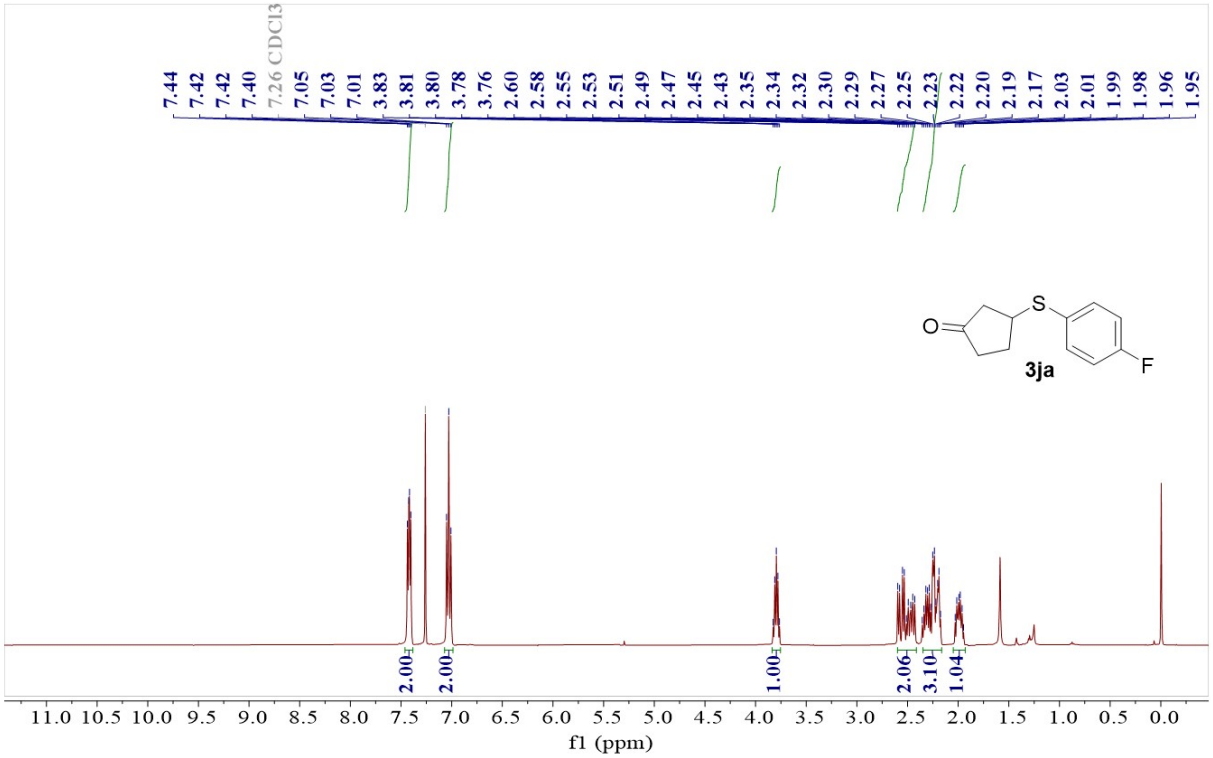
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ha

3-((4-fluorophenyl)thio)-1-(4-hydroxyphenyl)pyrrolidine-2,5-dione (3ia)

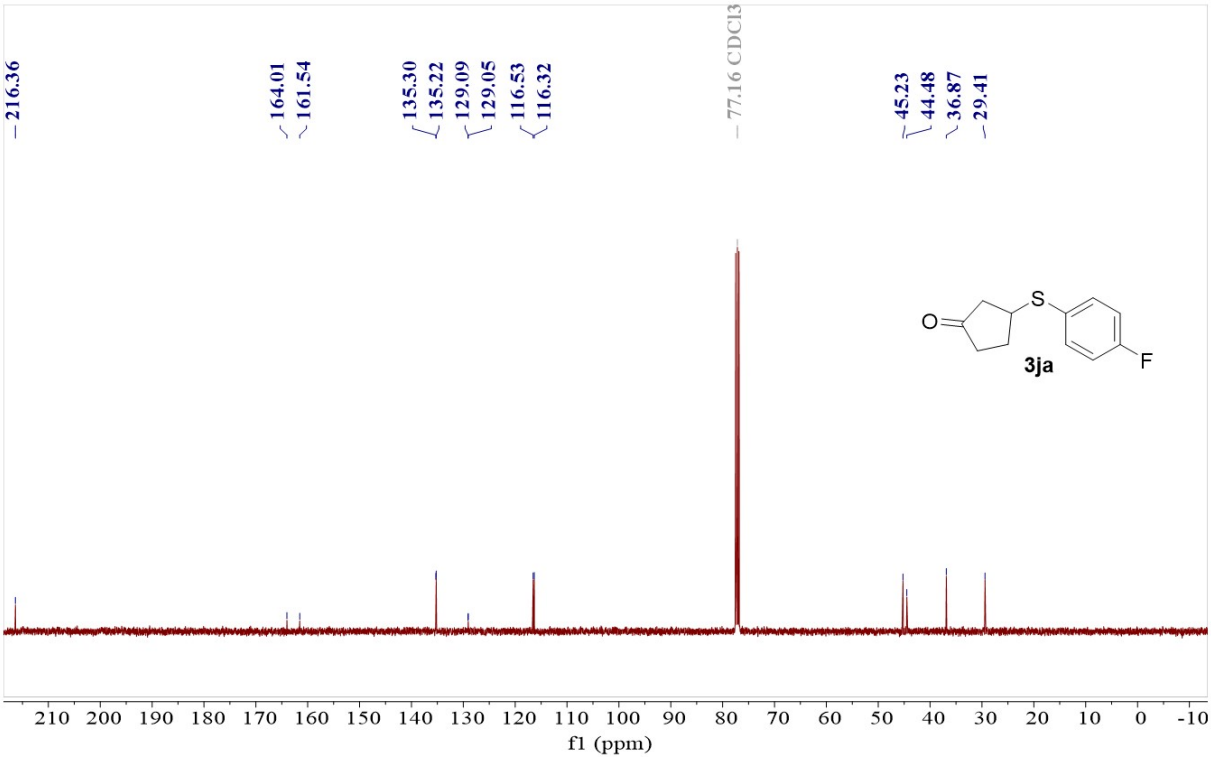


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ia

3-((4-fluorophenyl)thio)cyclopentan-1-one (3ja)

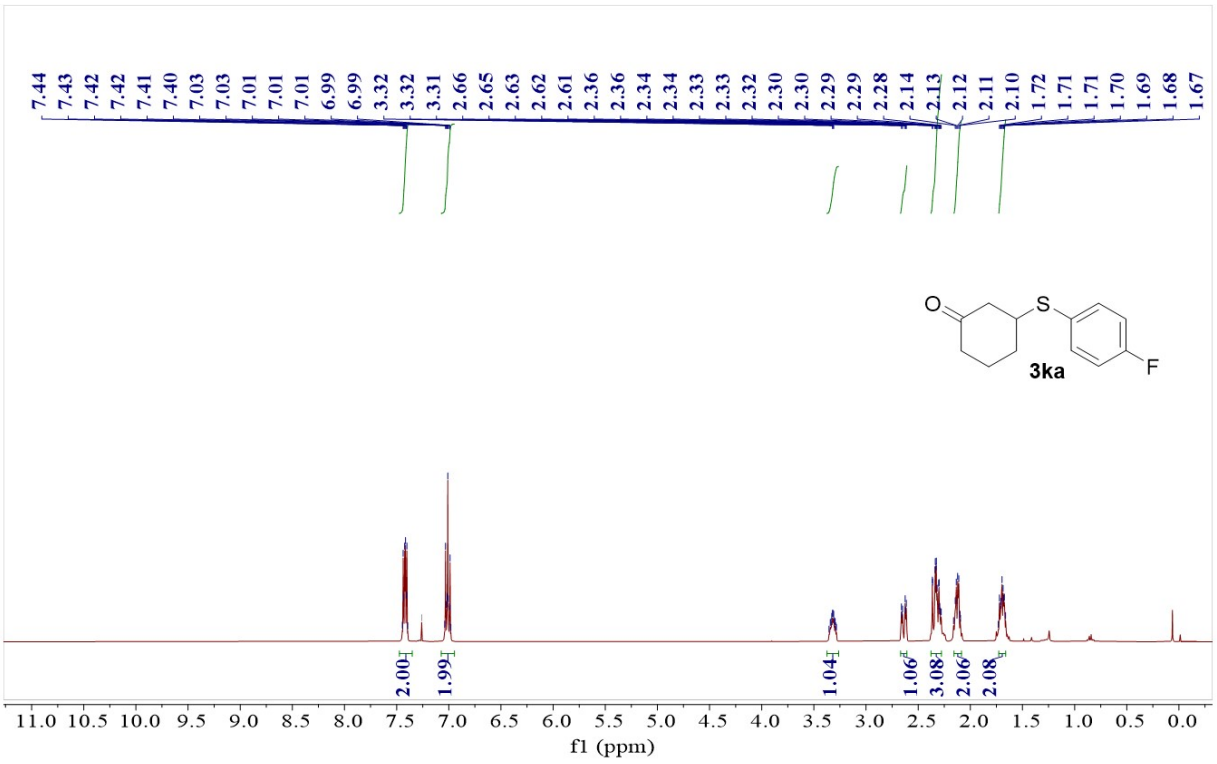


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ja



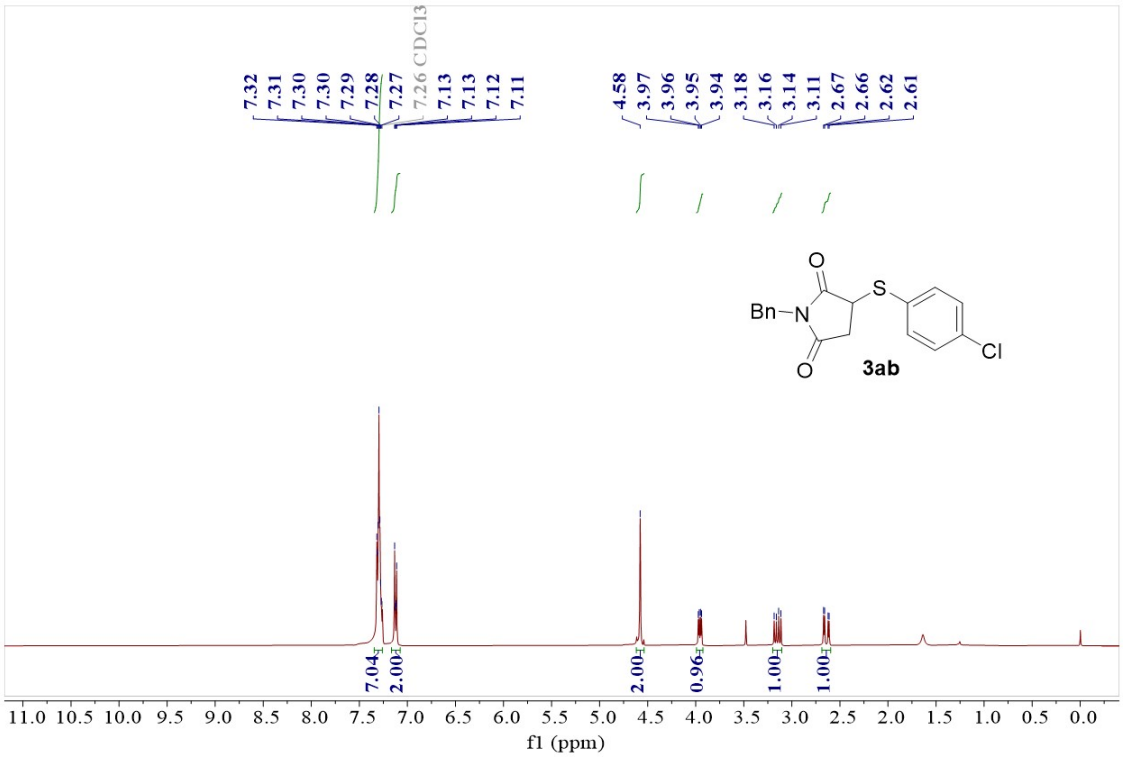
^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ja

3-((4-fluorophenyl)thio)cyclohexan-1-one (3ka)

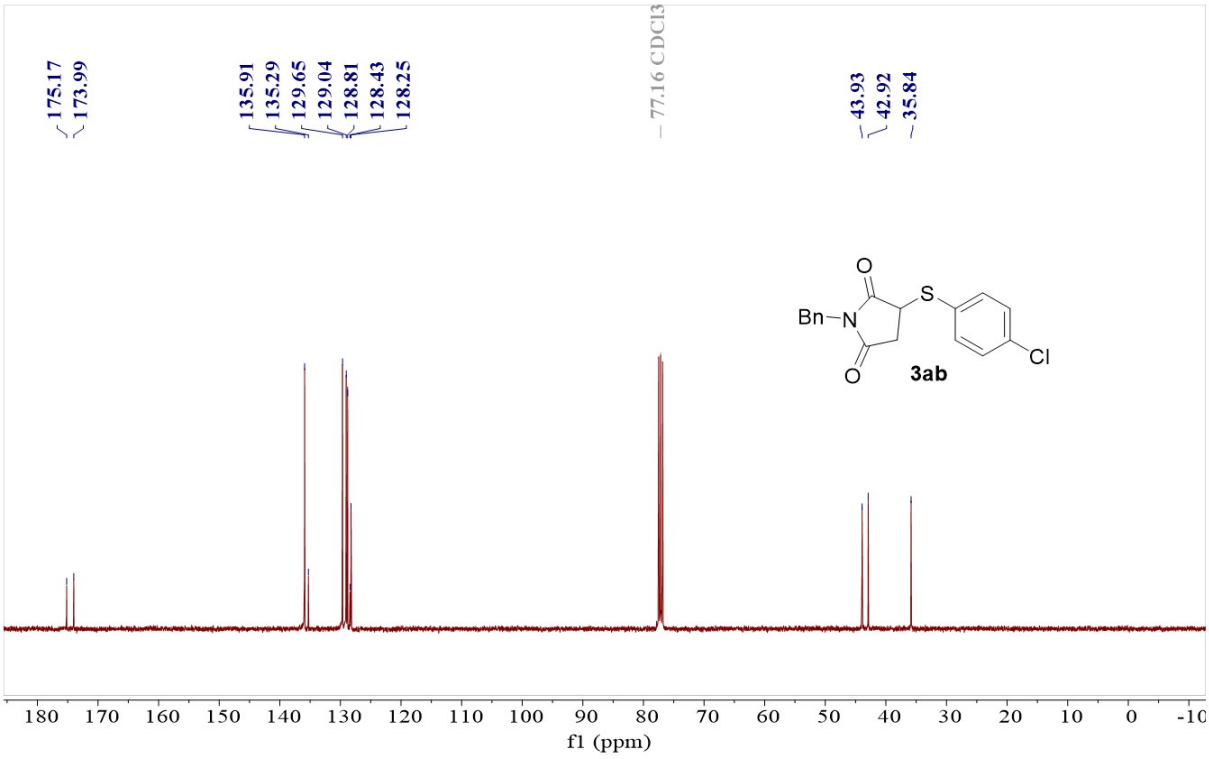


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ka

1-benzyl-3-((4-chlorophenyl)thio)pyrrolidine-2,5-dione (3ab)

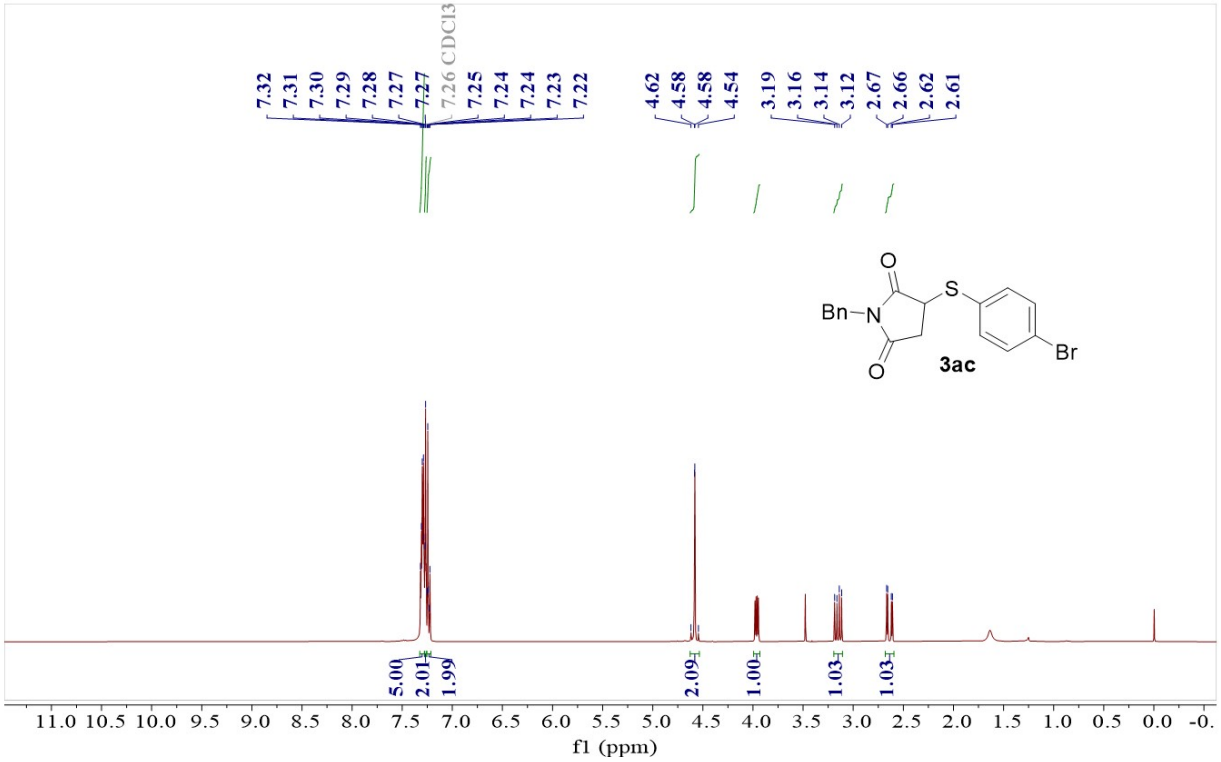


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ab

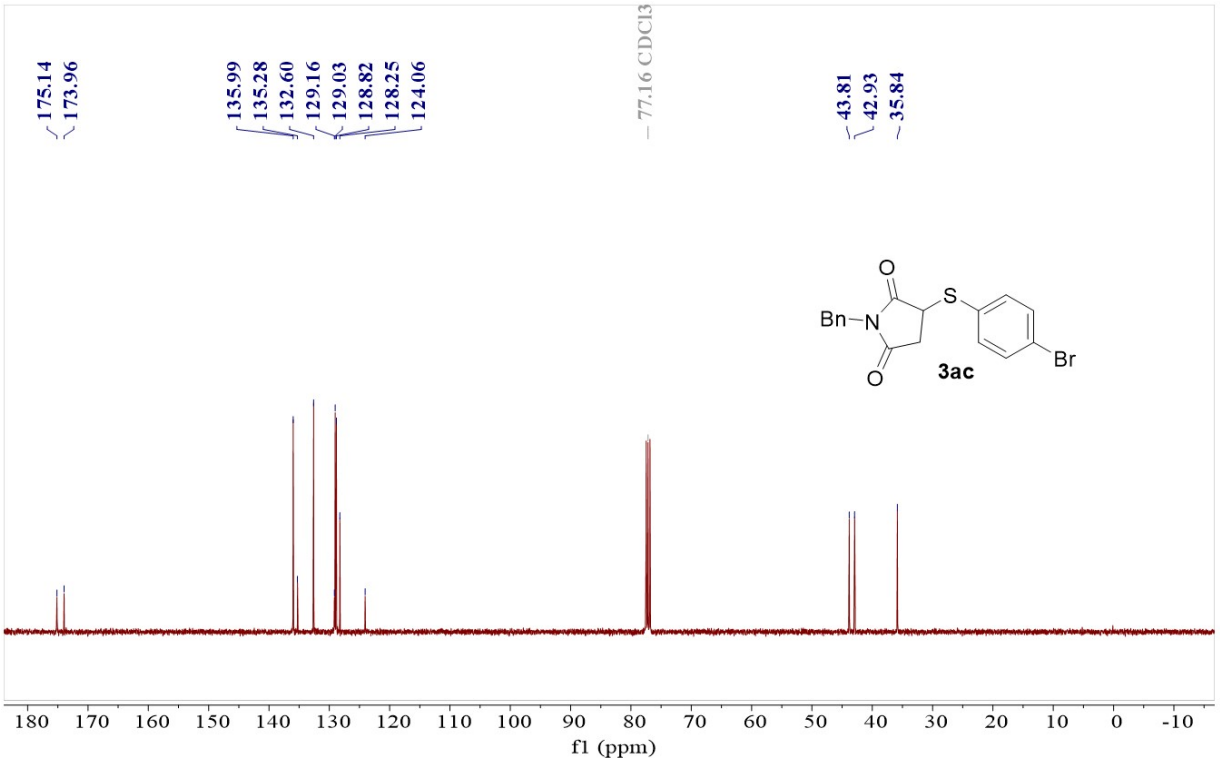


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ab

1-benzyl-3-((4-bromophenyl)thio)pyrrolidine-2,5-dione (3ac)

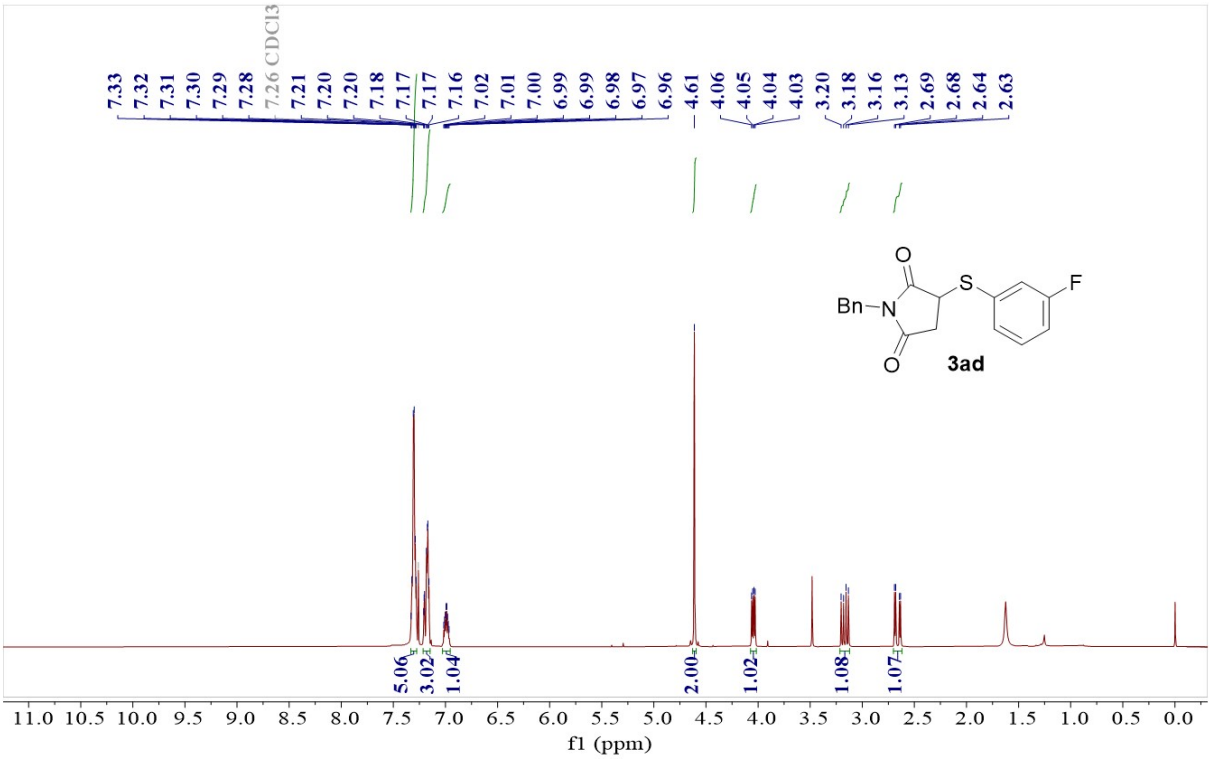


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ac

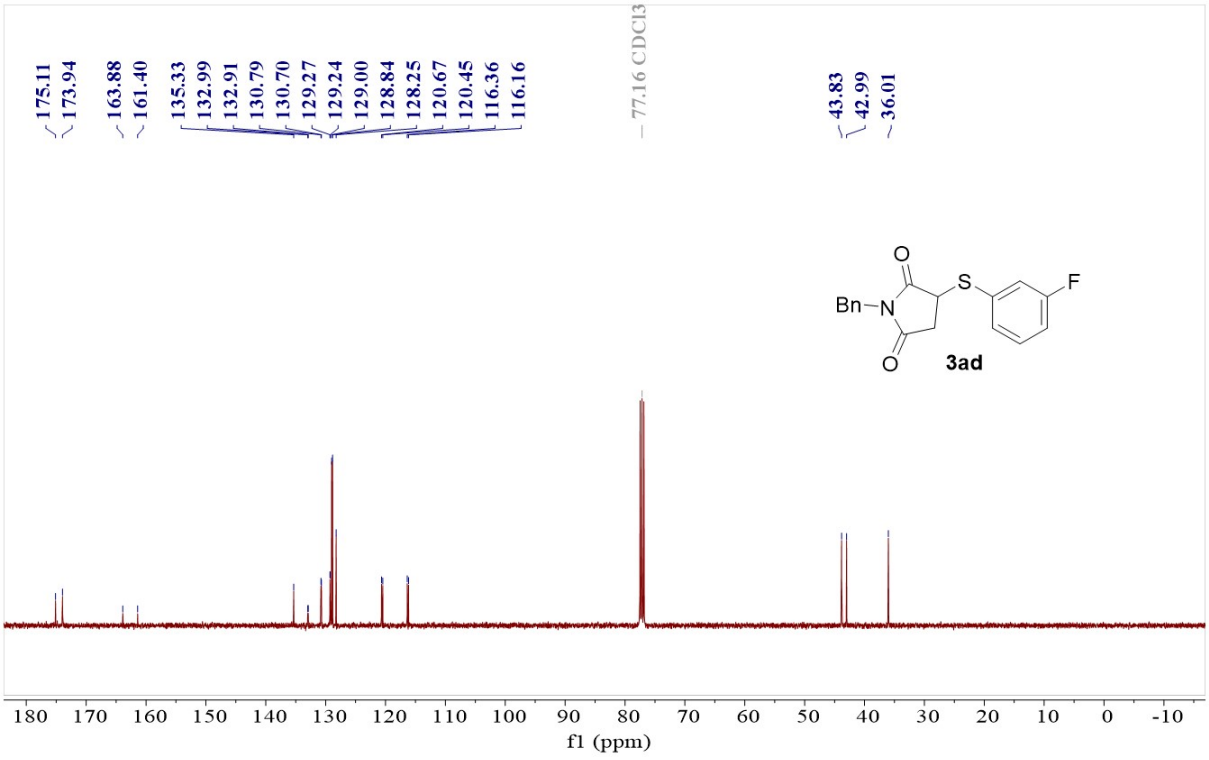


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ac

1-benzyl-3-((3-fluorophenyl)thio)pyrrolidine-2,5-dione (3ad)

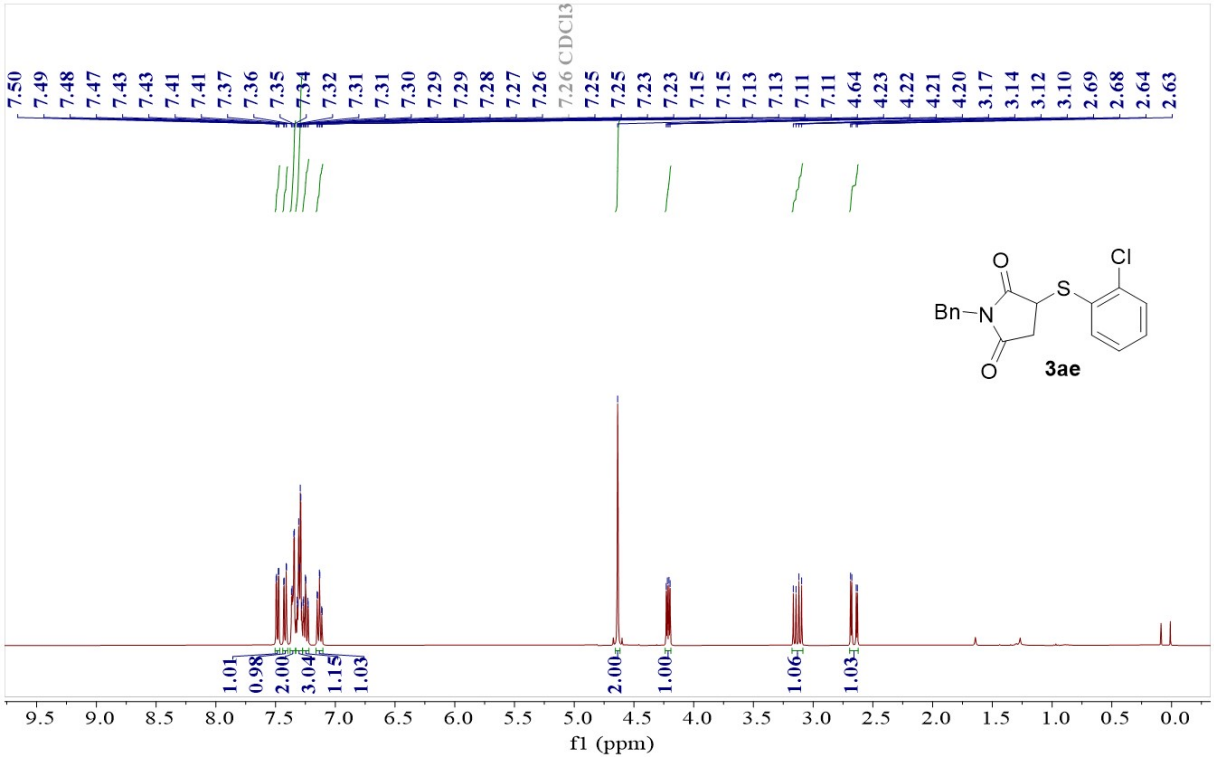


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ad

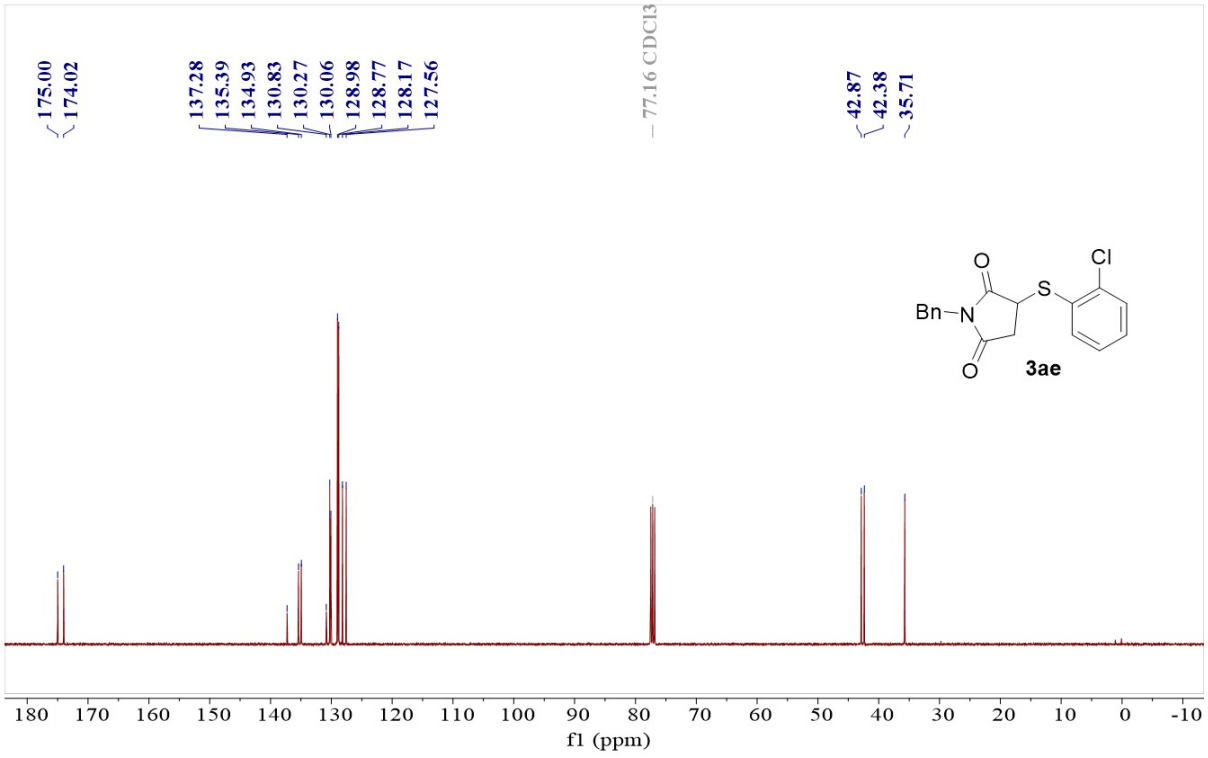


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ad

1-benzyl-3-((2-chlorophenyl)thio)pyrrolidine-2,5-dione (3ae)



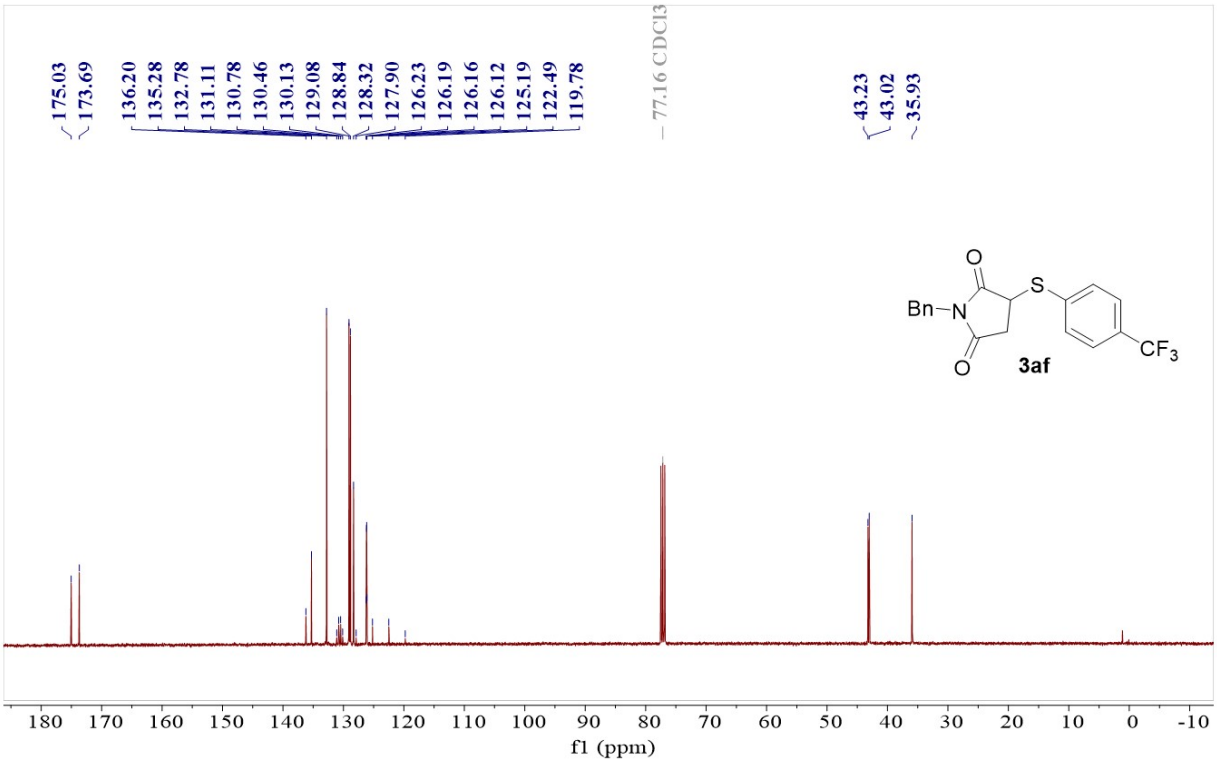
^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ae



^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ae

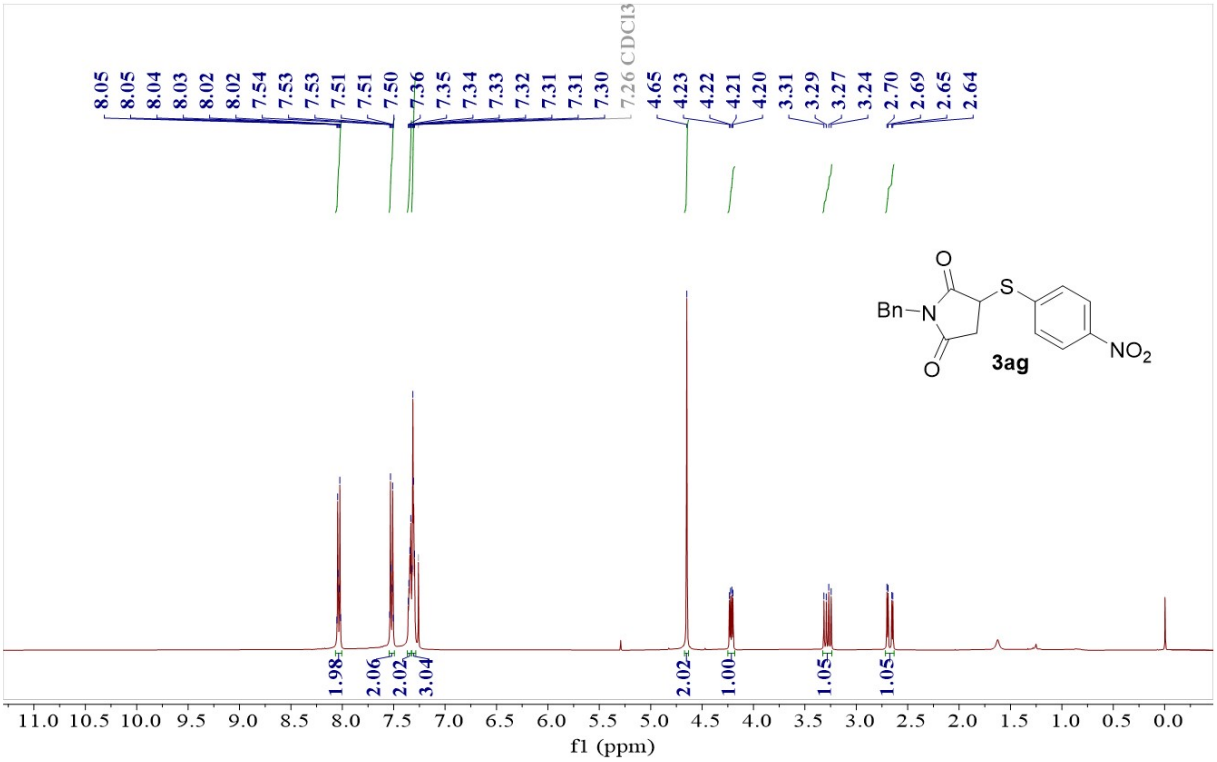
1-benzyl-3-((4-(trifluoromethyl)phenyl)thio)pyrrolidine-2,5-dione (3af)

^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3af

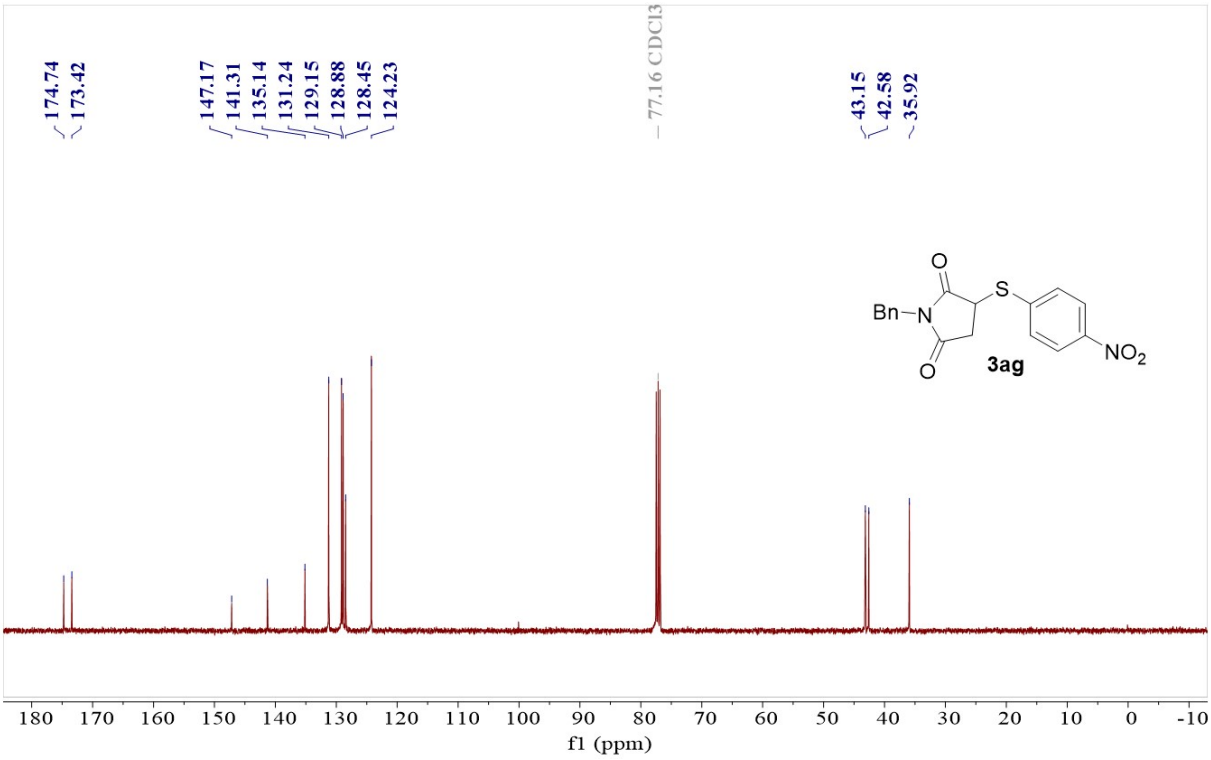


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3af

1-benzyl-3-((4-nitrophenyl)thio)pyrrolidine-2,5-dione (3ag)

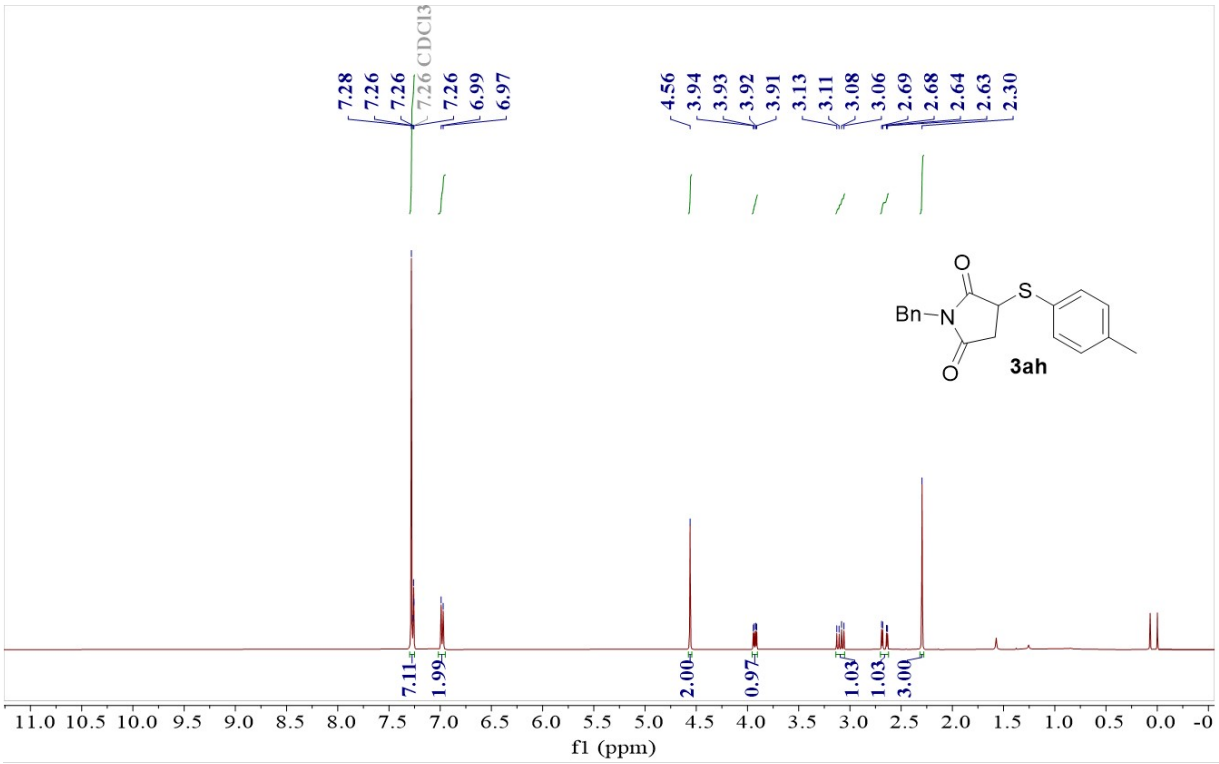


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ag

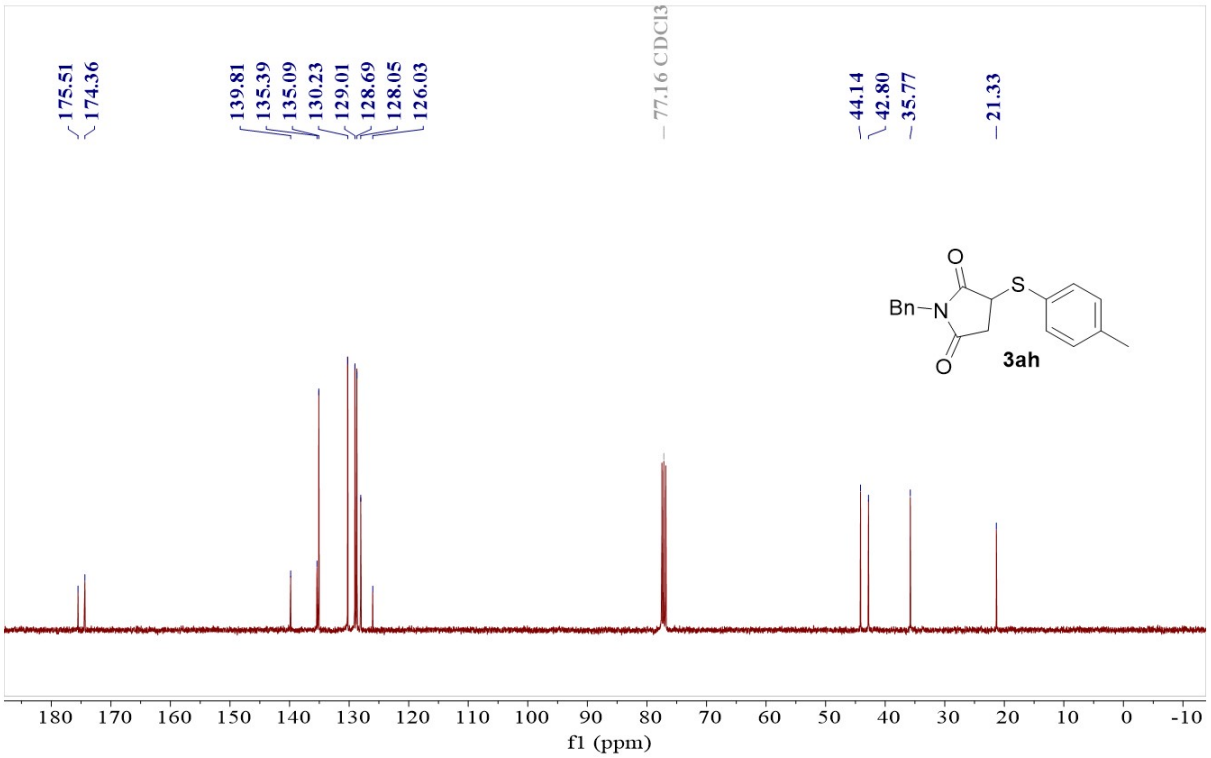


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ag

1-benzyl-3-(p-tolylthio)pyrrolidine-2,5-dione (3ah)

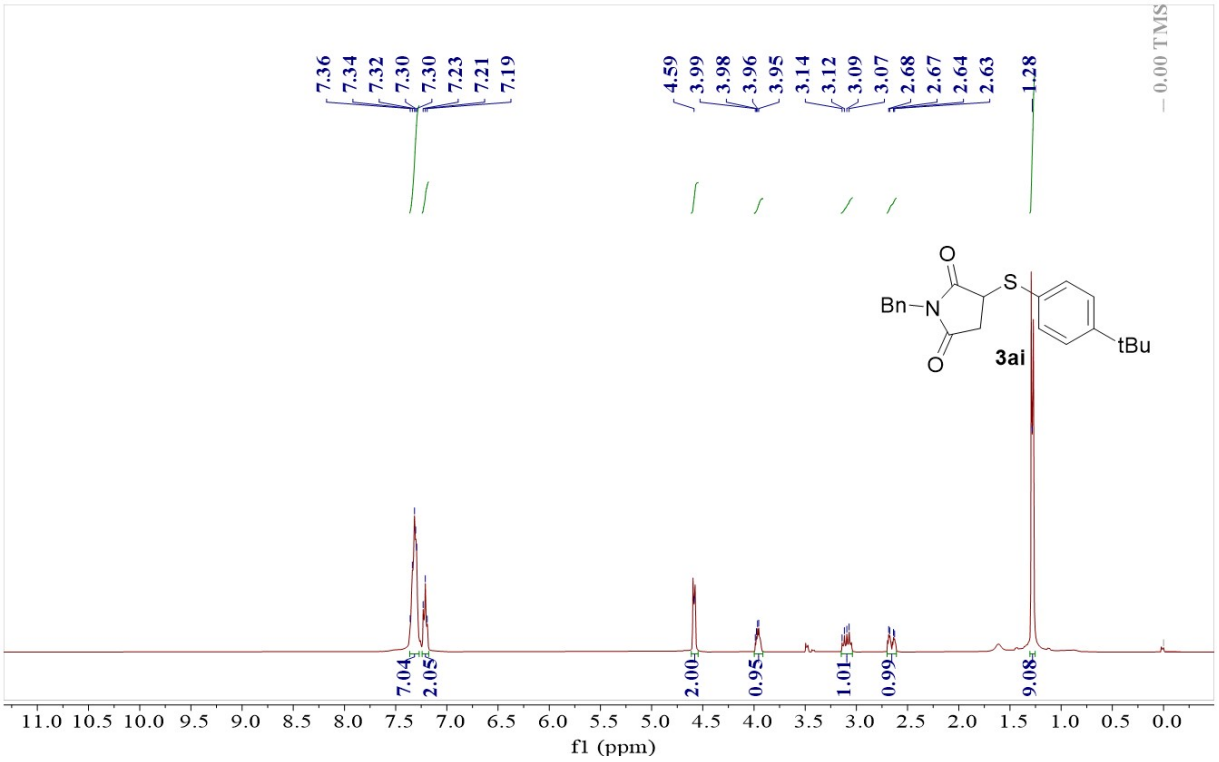


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ah

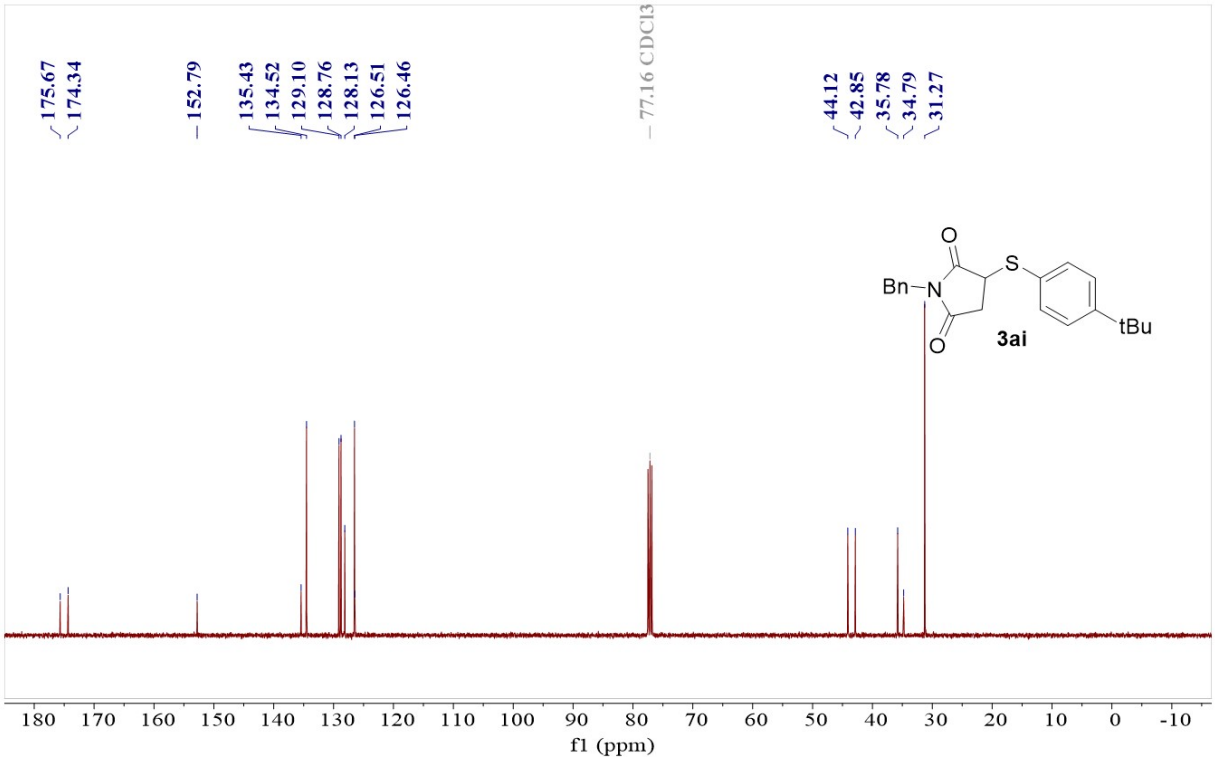


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ah

1-benzyl-3-((4-(tert-butyl)phenyl)thio)pyrrolidine-2,5-dione (3ai)

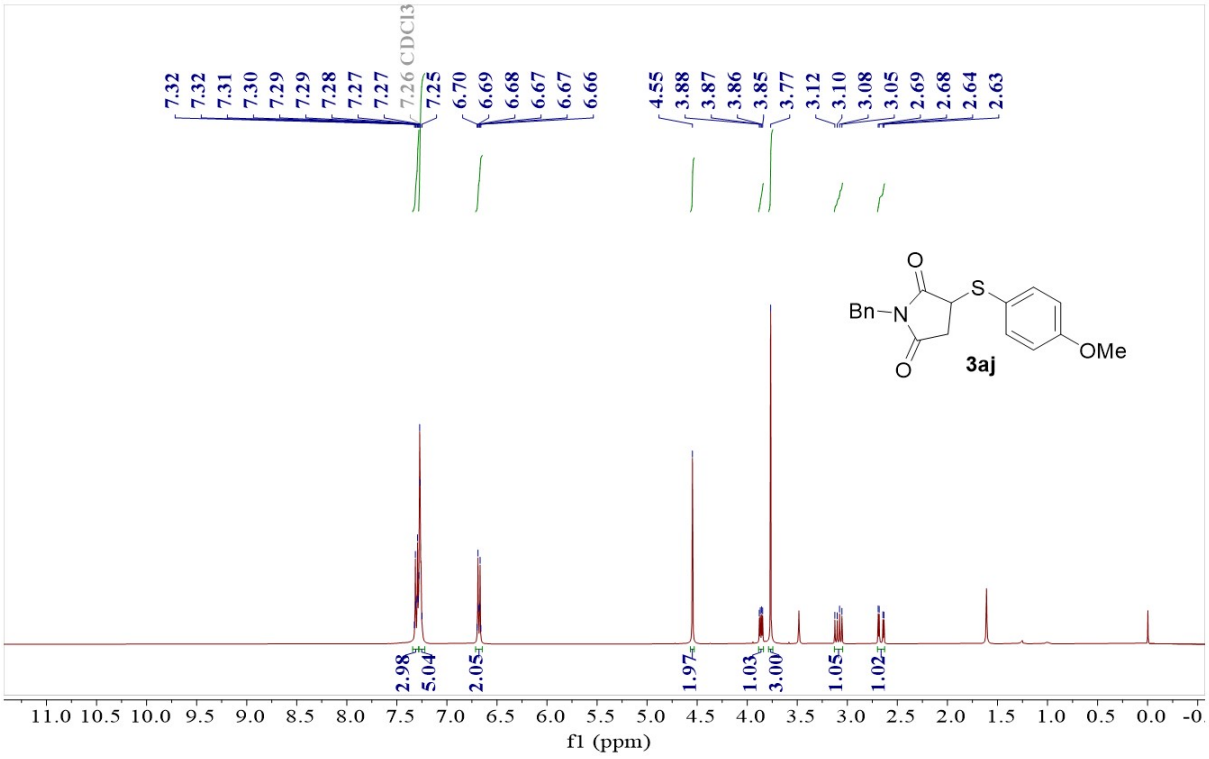


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ai

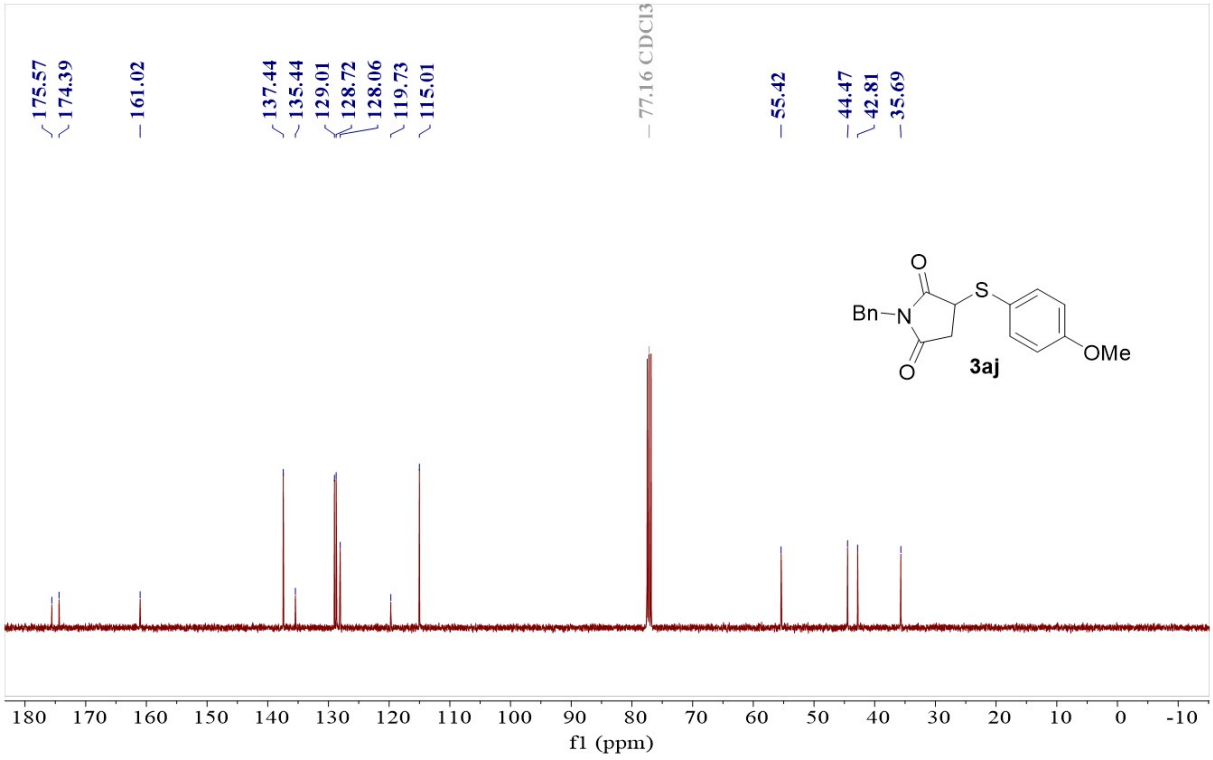


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ai

1-benzyl-3-((4-methoxyphenyl)thio)pyrrolidine-2,5-dione (3aj)

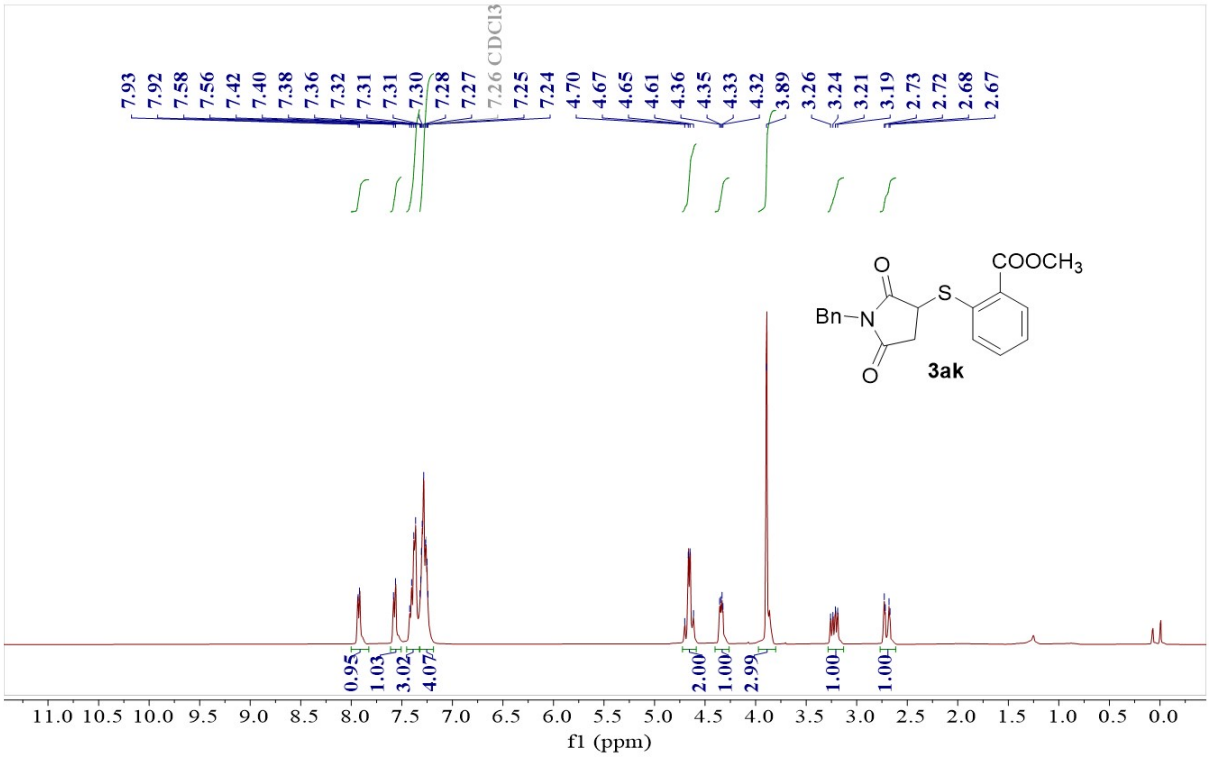


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3aj

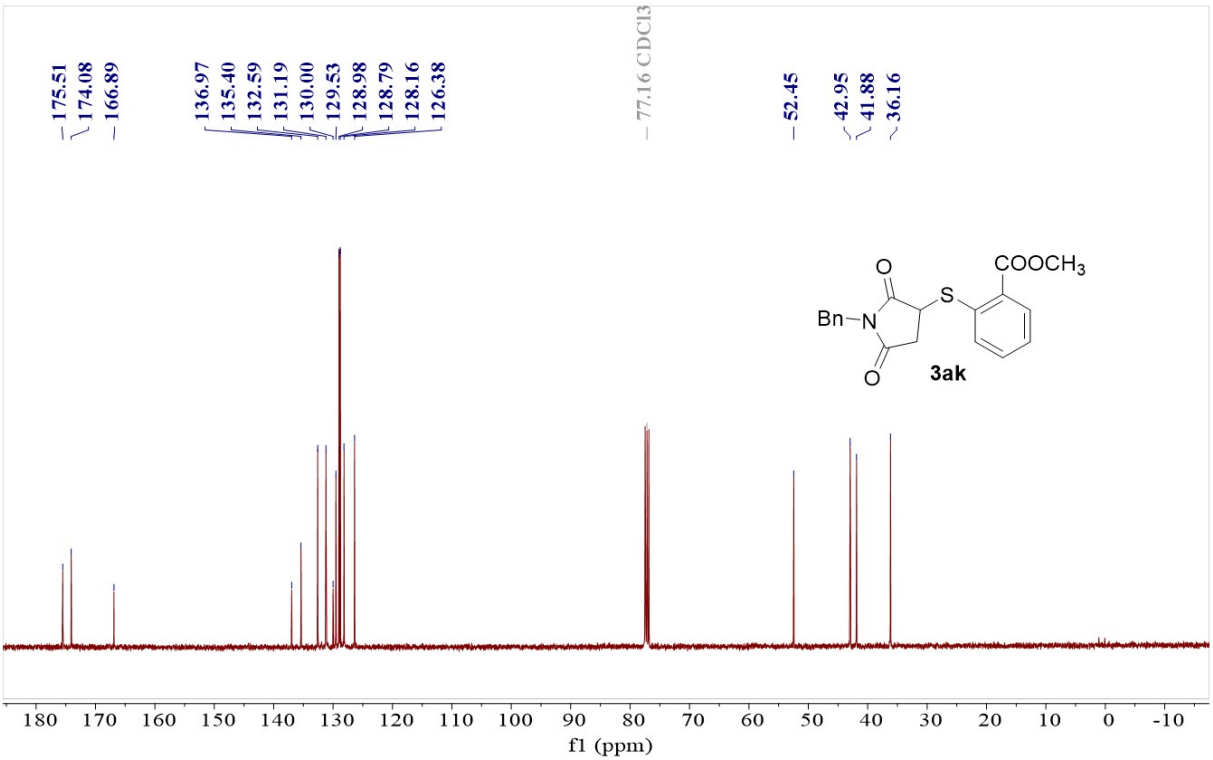


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3aj

methyl 2-((1-benzyl-2,5-dioxopyrrolidin-3-yl)thio)benzoate (3ak)

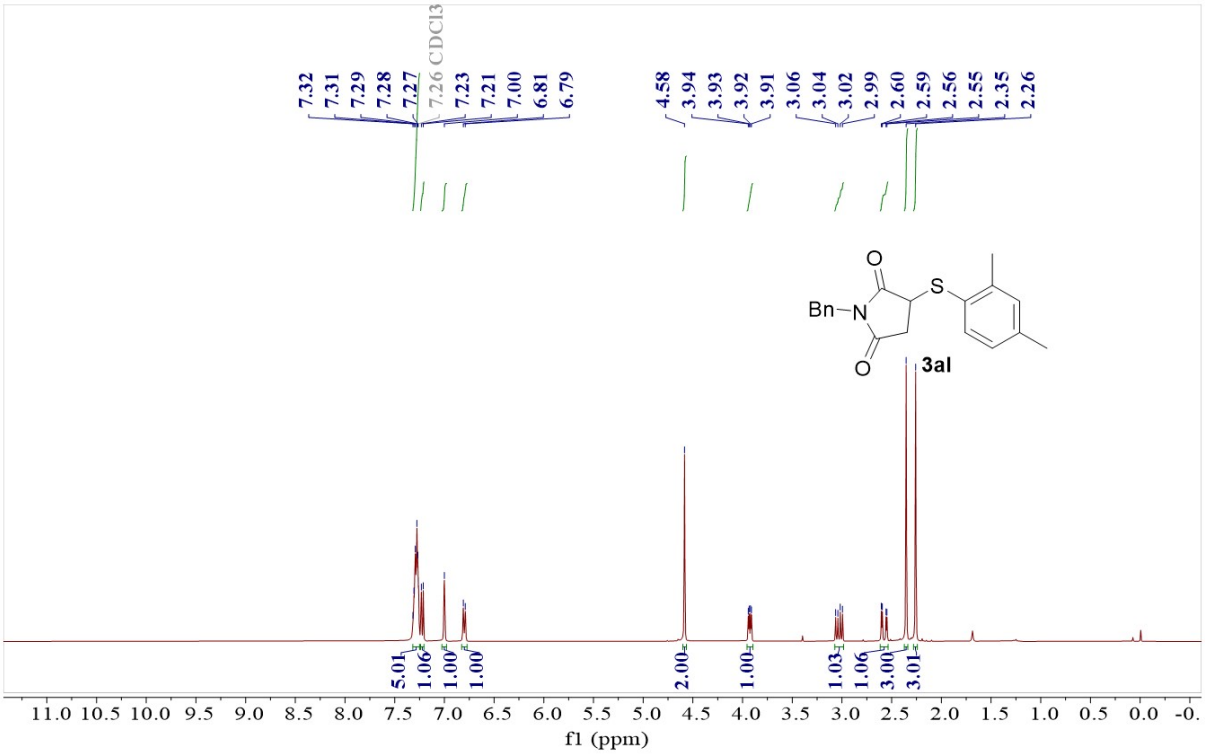


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ak

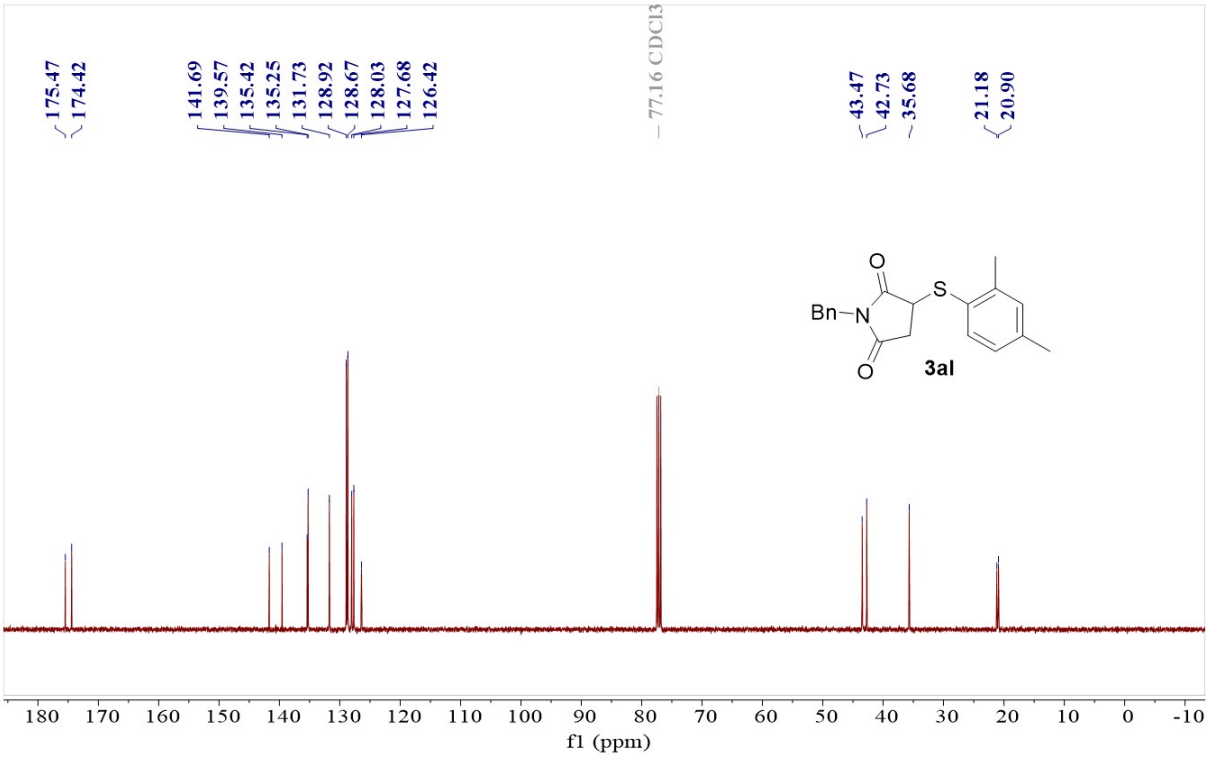


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ak

1-benzyl-3-((2,4-dimethylphenyl)thio)pyrrolidine-2,5-dione (3al)

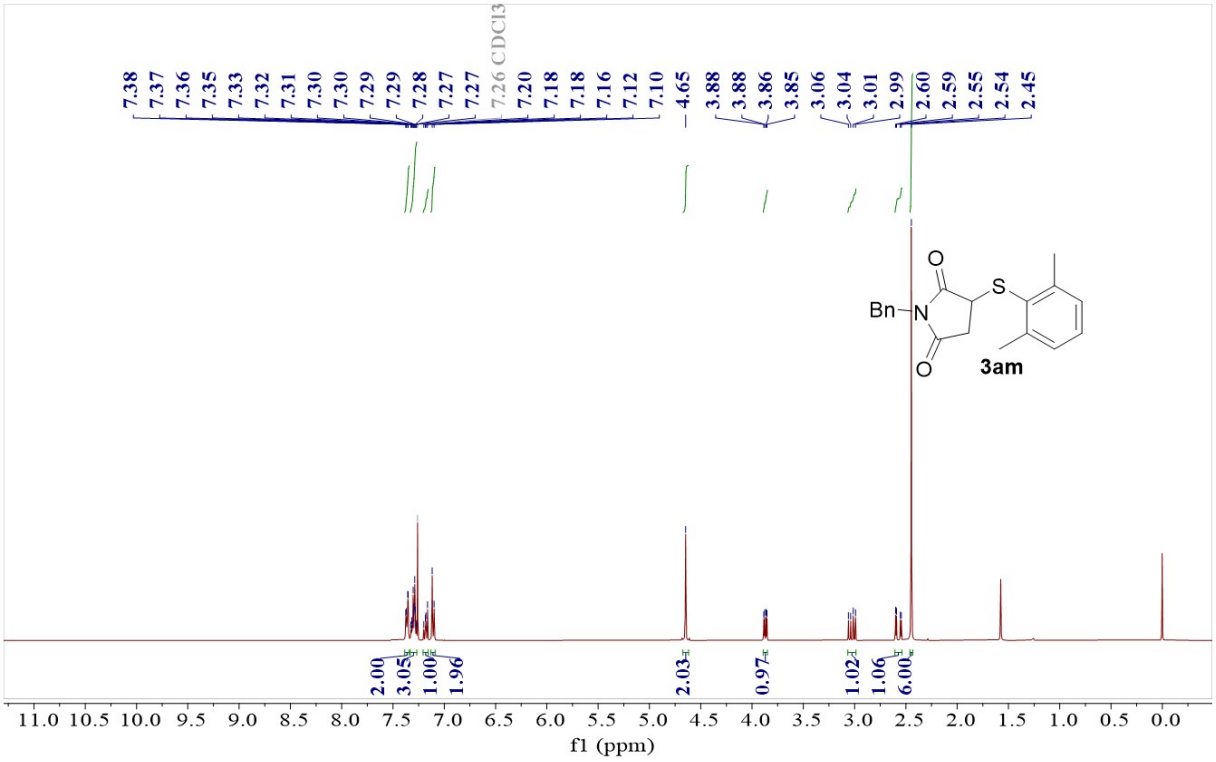


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3al

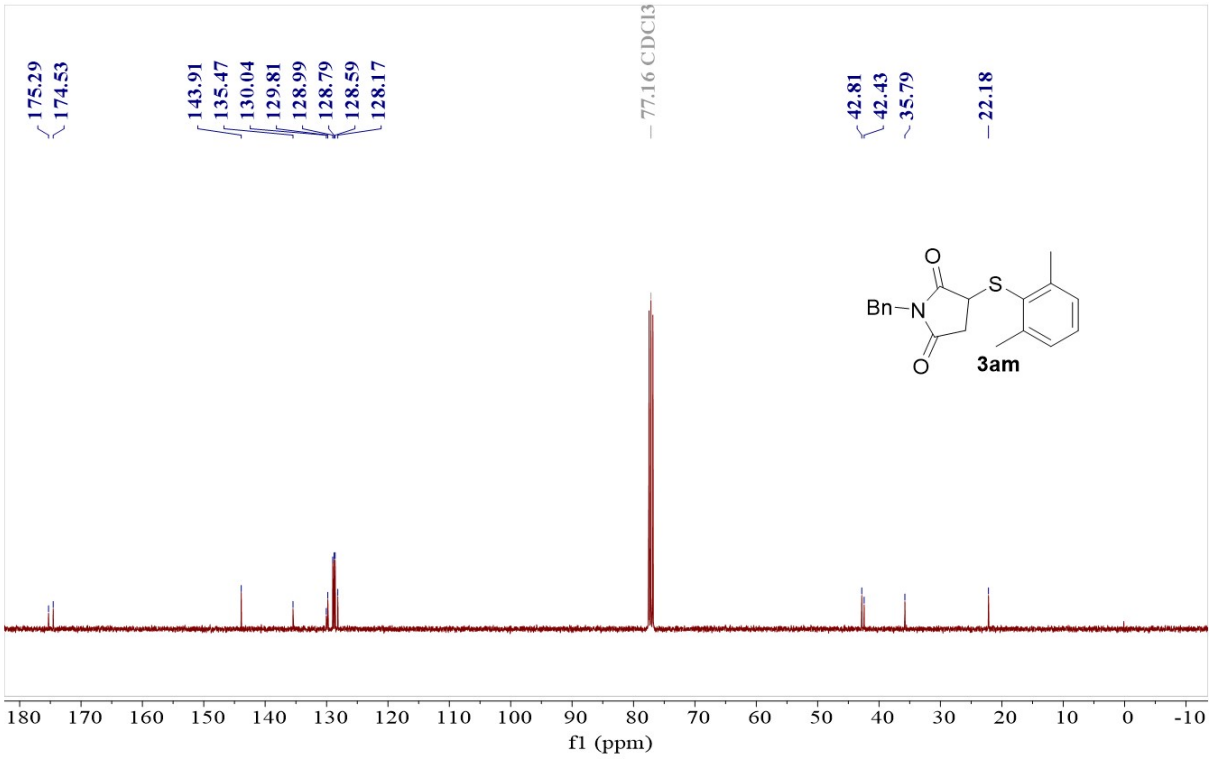


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3al

1-benzyl-3-((2,6-dimethylphenyl)thio)pyrrolidine-2,5-dione (3am)

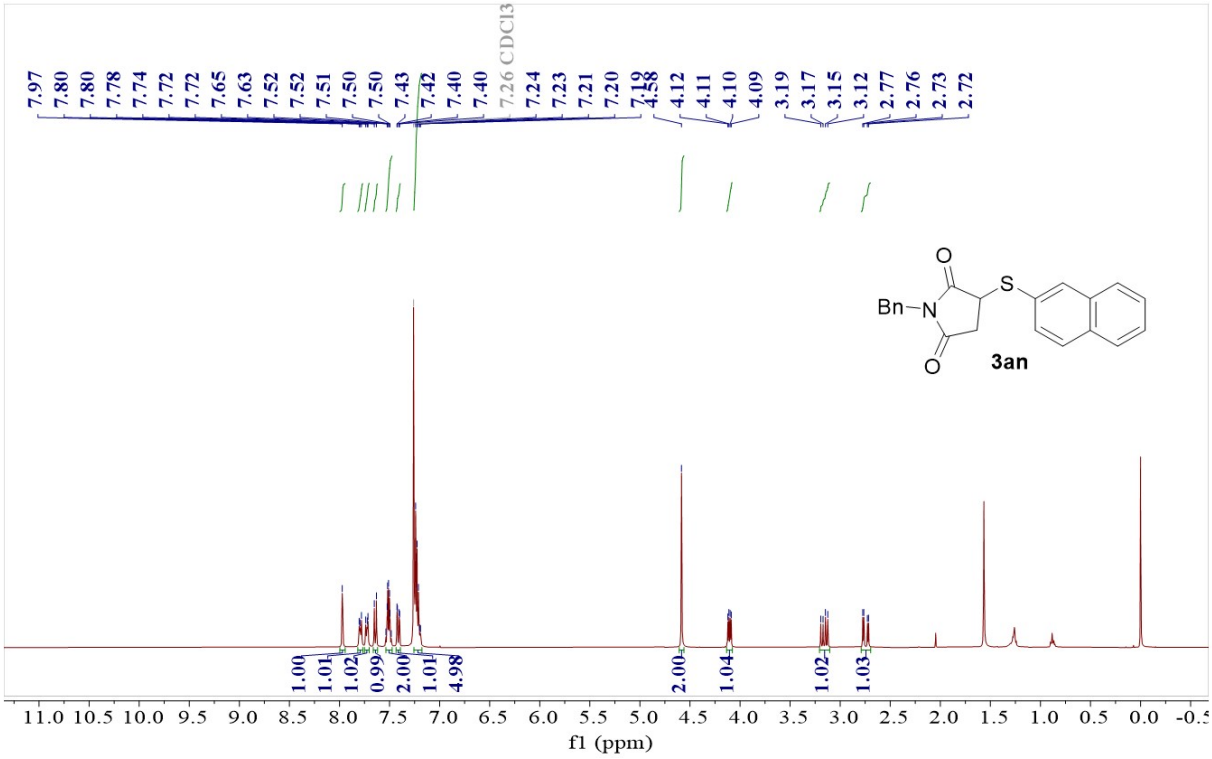


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3am

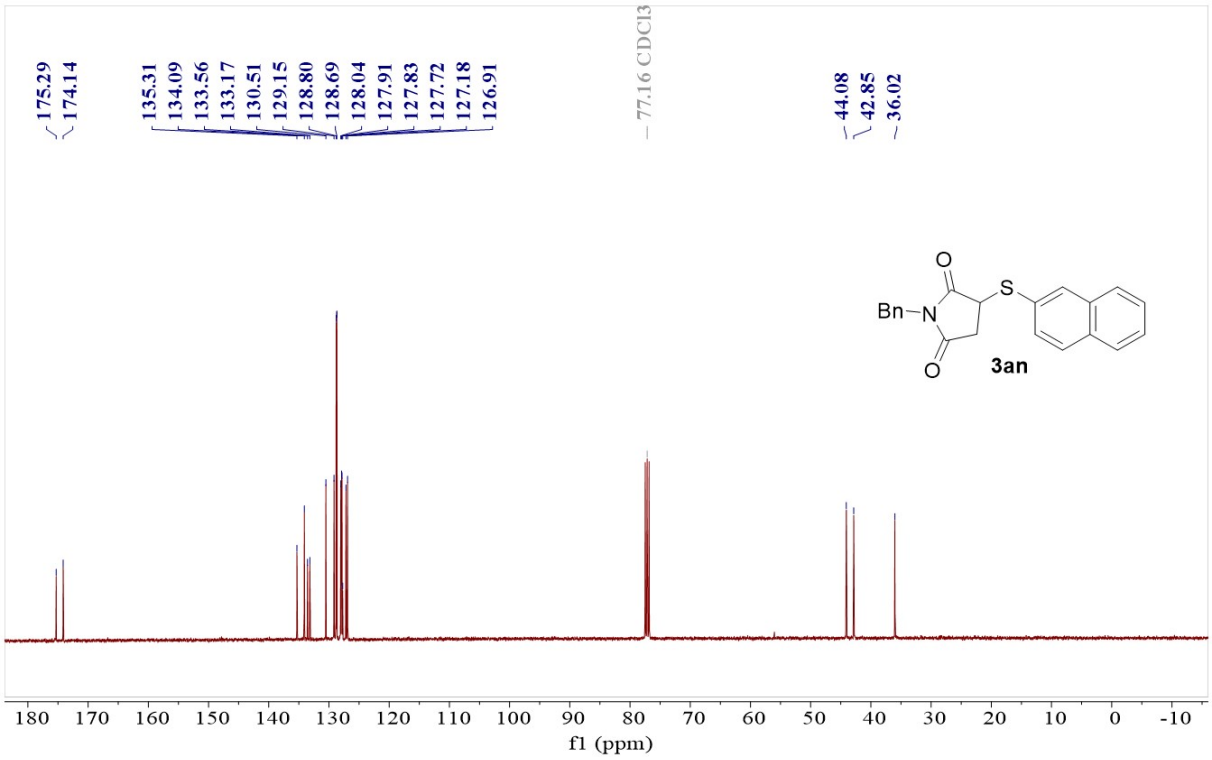


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3am

1-benzyl-3-(naphthalen-2-ylthio)pyrrolidine-2,5-dione (3an)

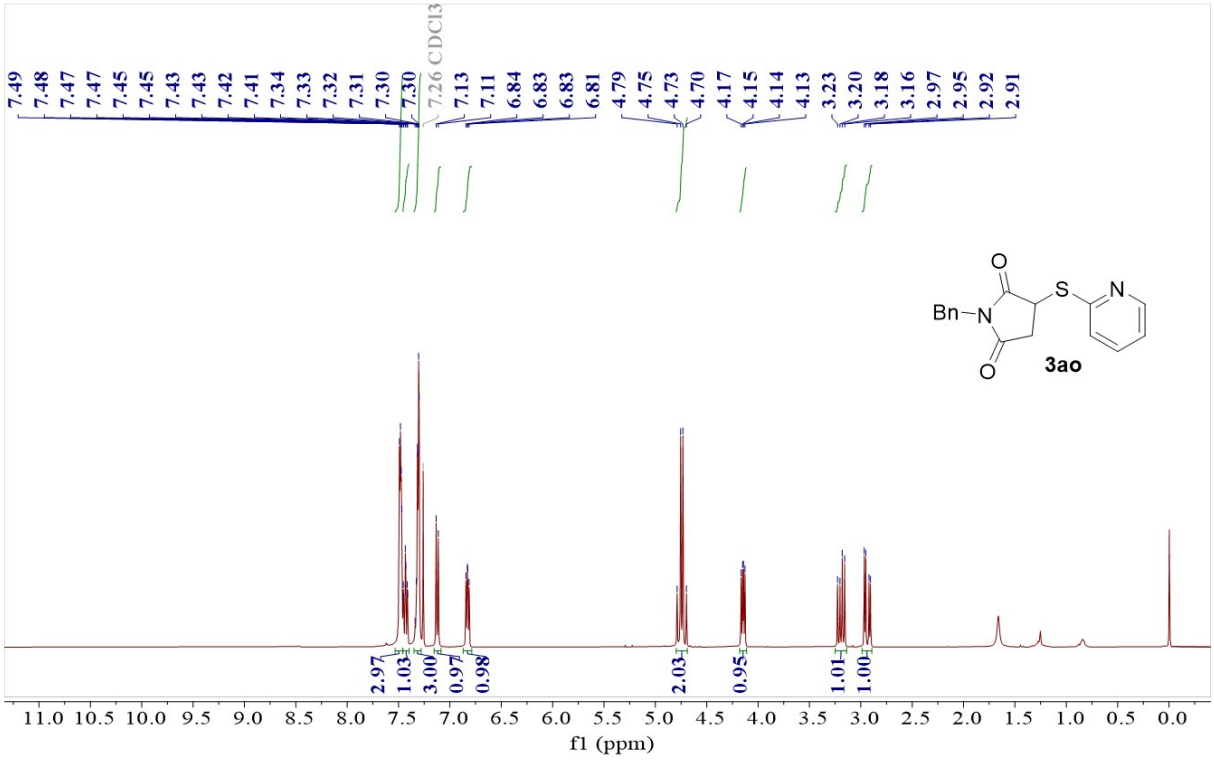


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3an

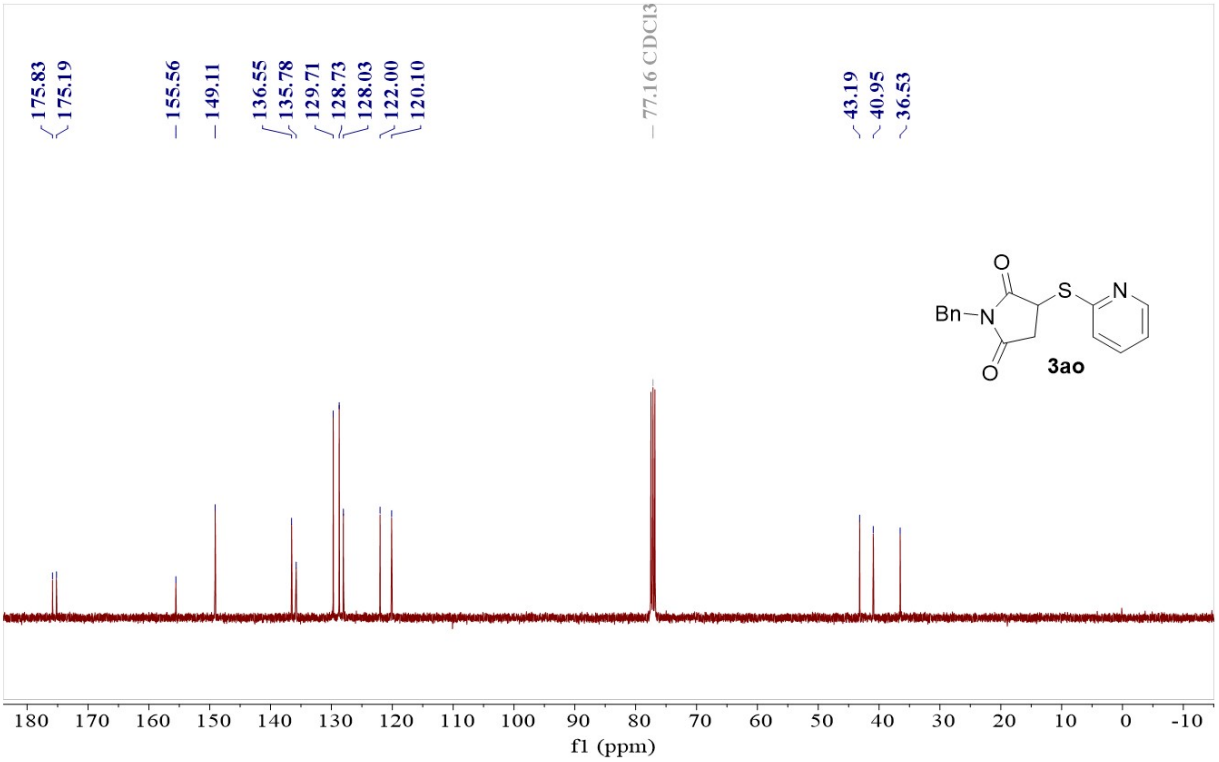


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3an

1-benzyl-3-(pyridin-2-ylthio)pyrrolidine-2,5-dione (3ao)

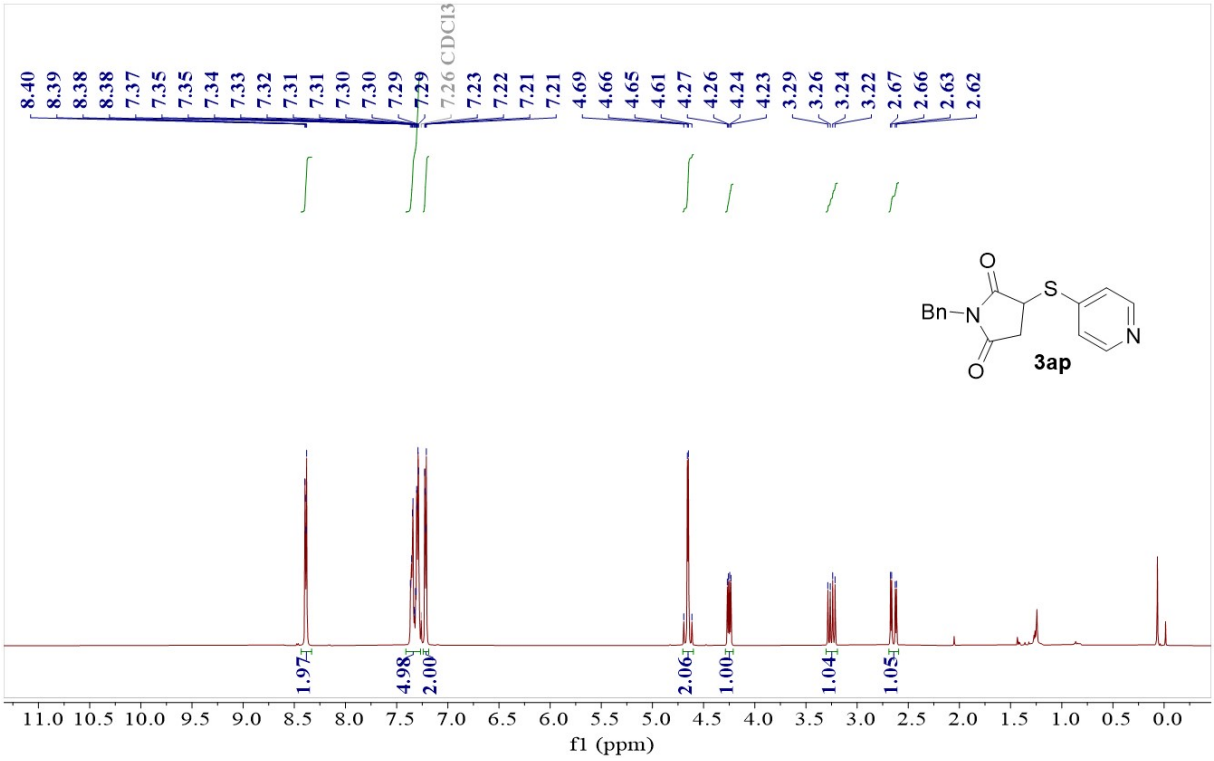


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ao

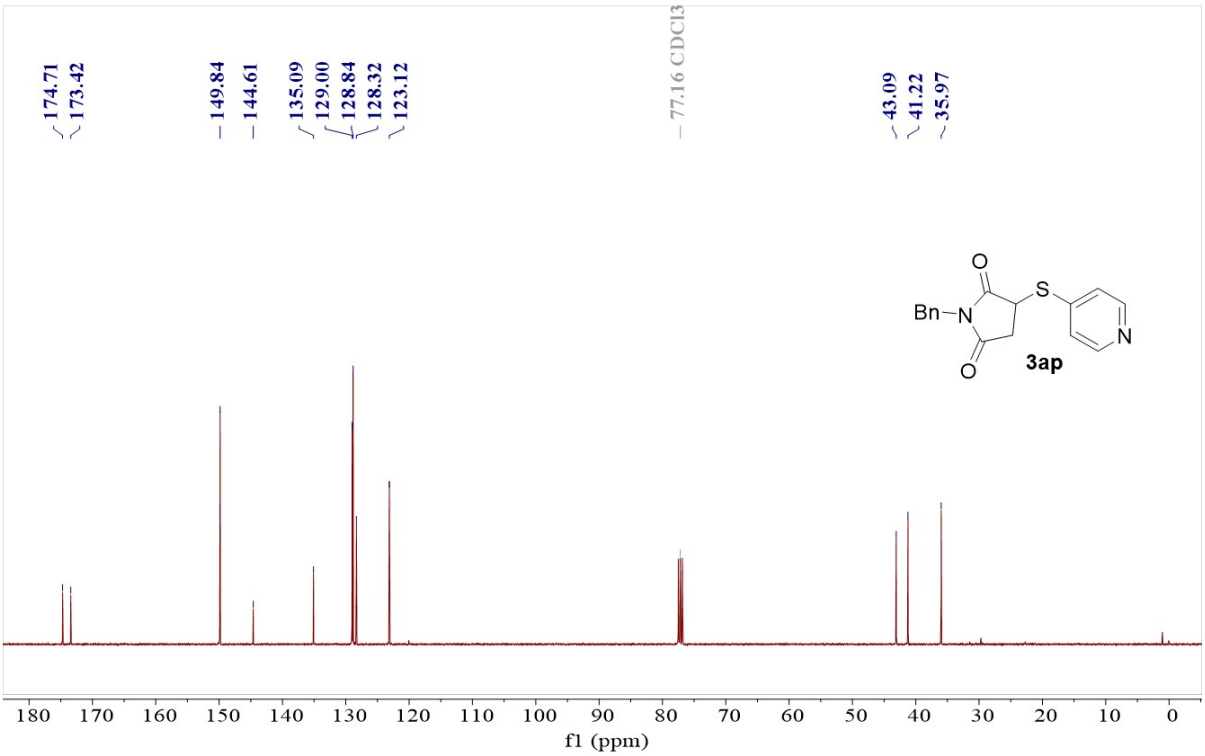


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ao

1-benzyl-3-(pyridin-4-ylthio)pyrrolidine-2,5-dione (3ap)

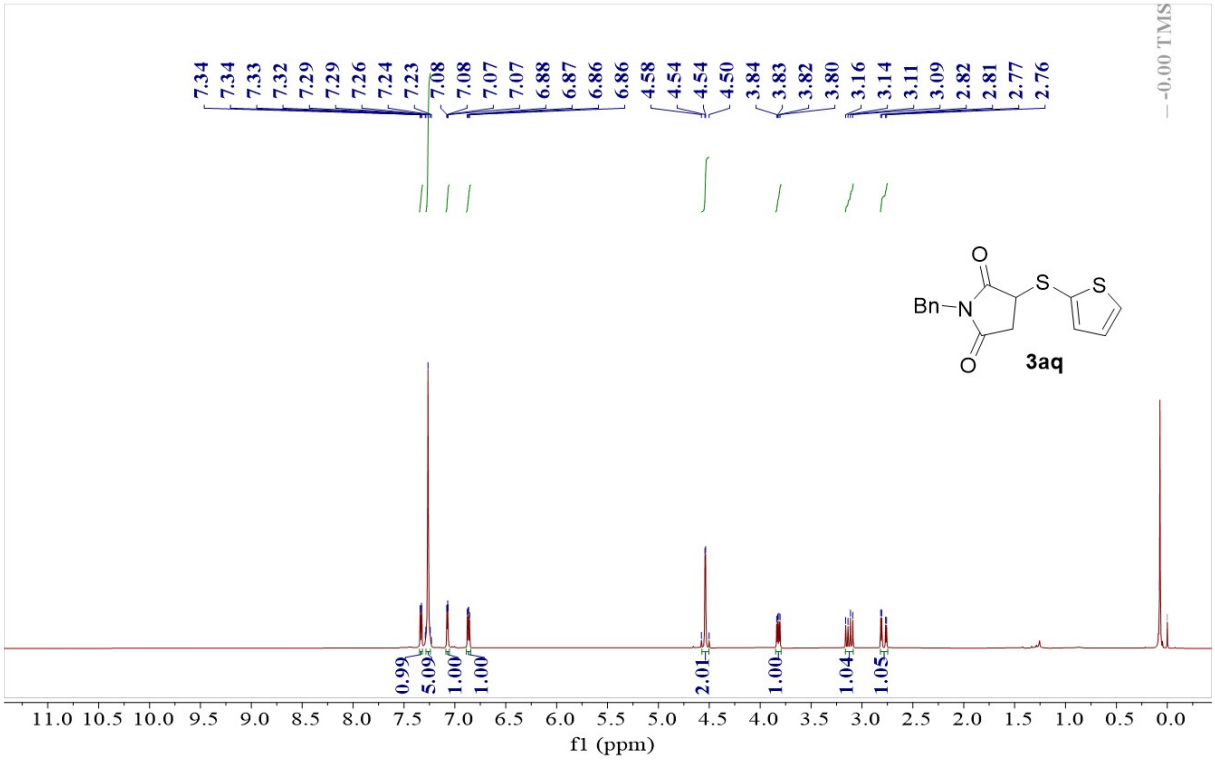


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ap

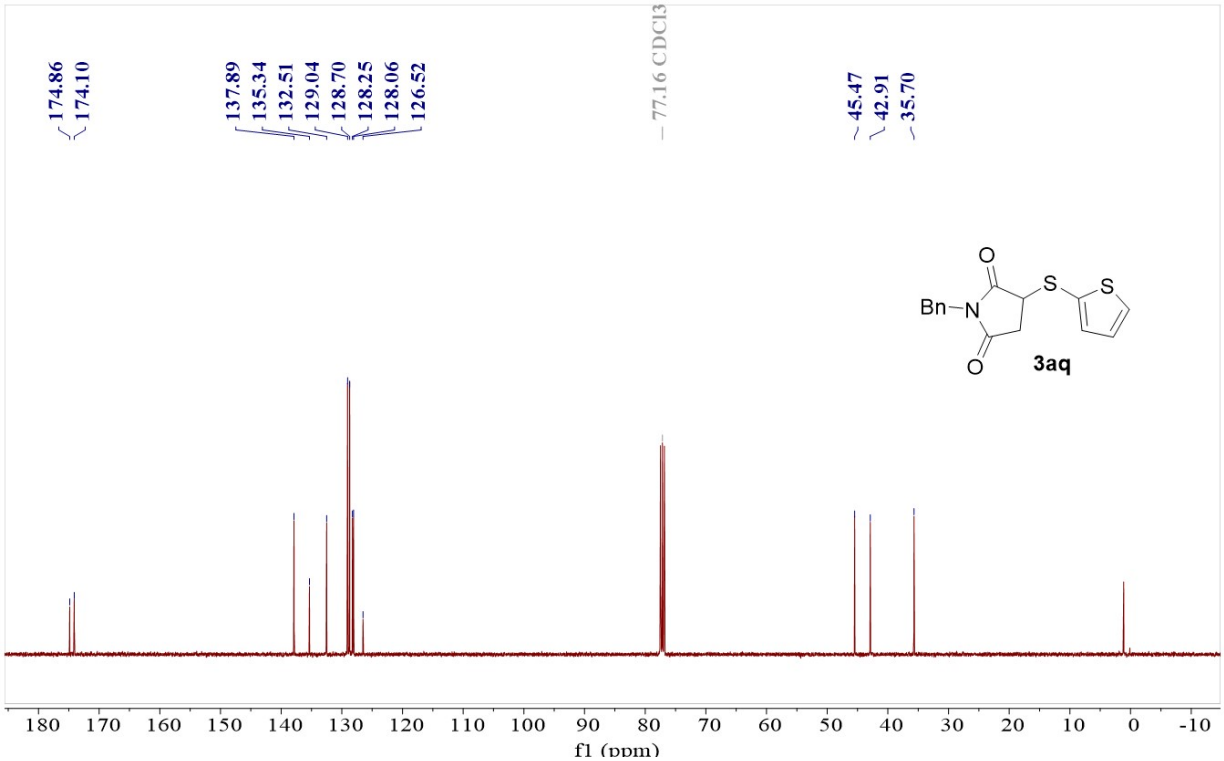


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ap

1-benzyl-3-(thiophen-2-ylthio)pyrrolidine-2,5-dione (3aq)

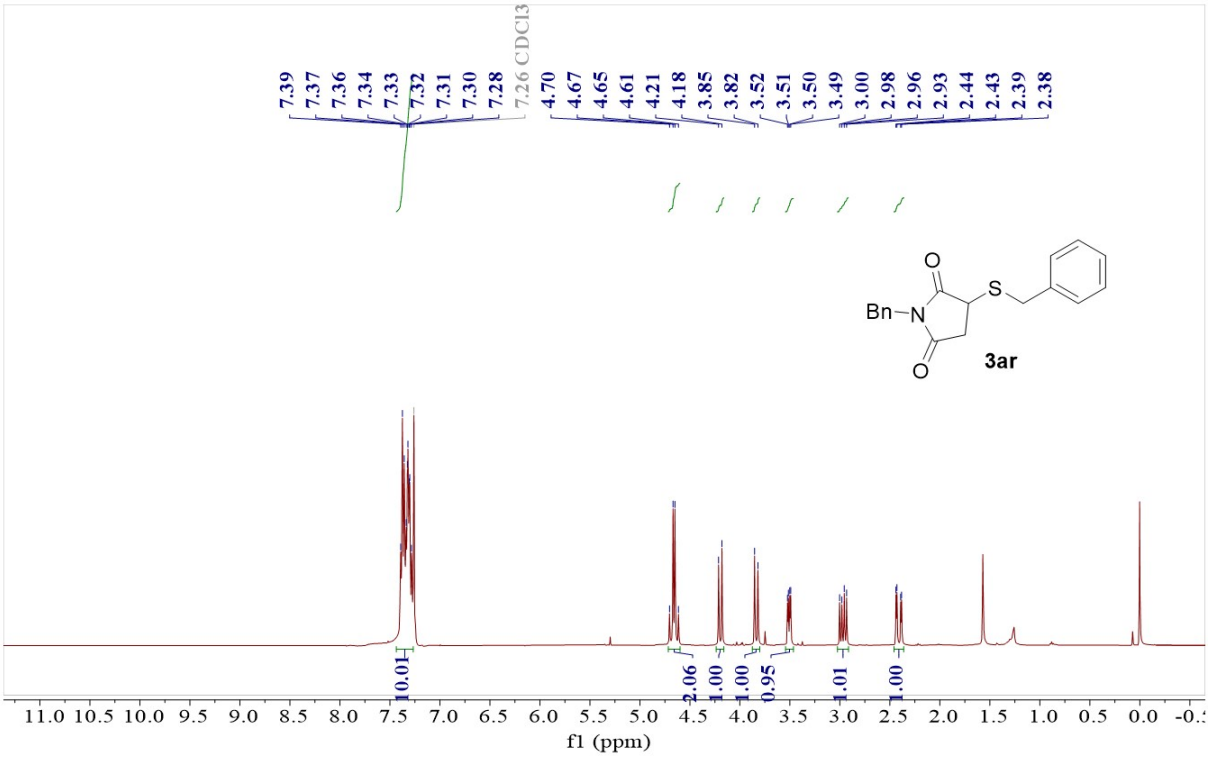


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3aq

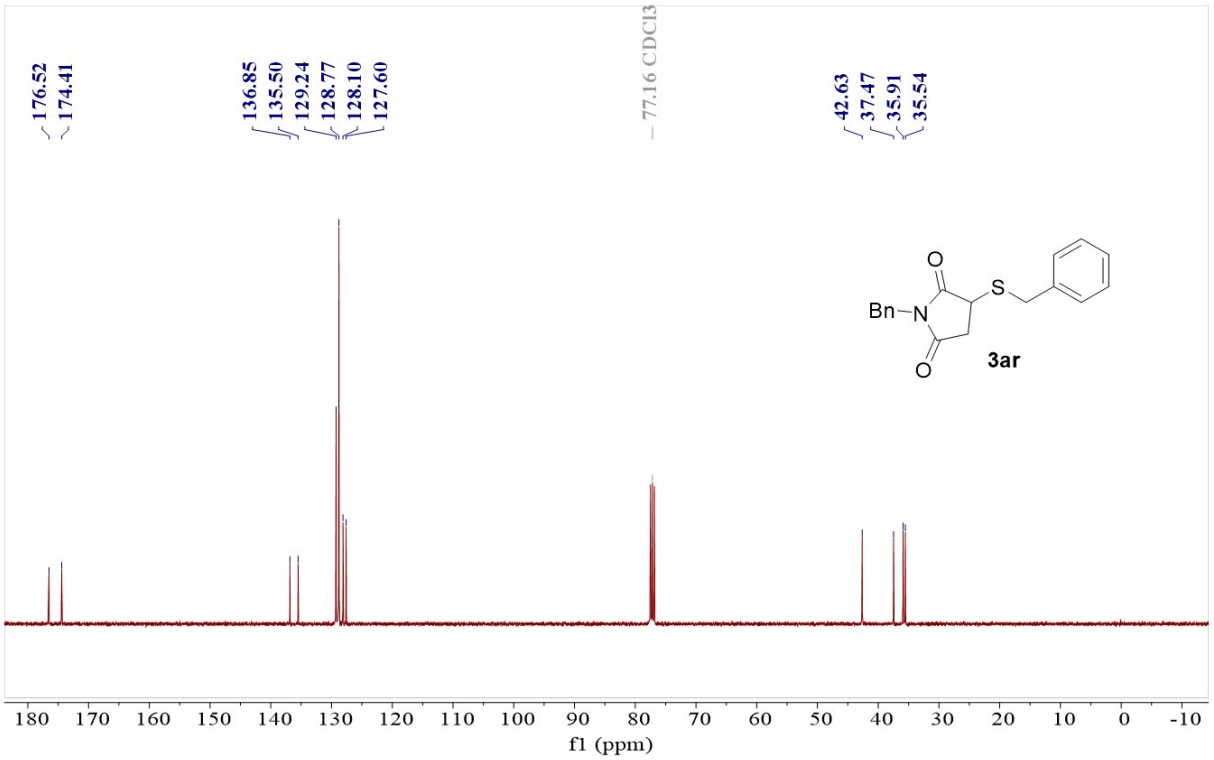


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3aq

1-benzyl-3-(benzylthio)pyrrolidine-2,5-dione (3ar)

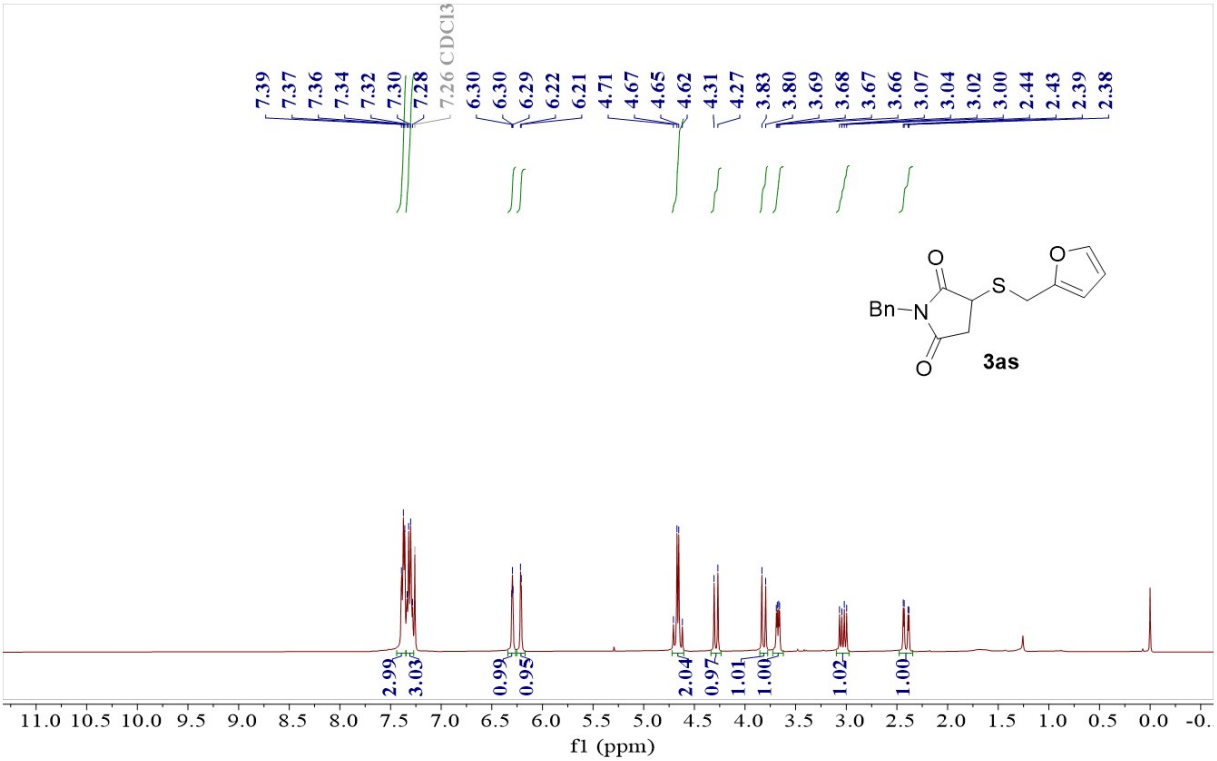


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ar

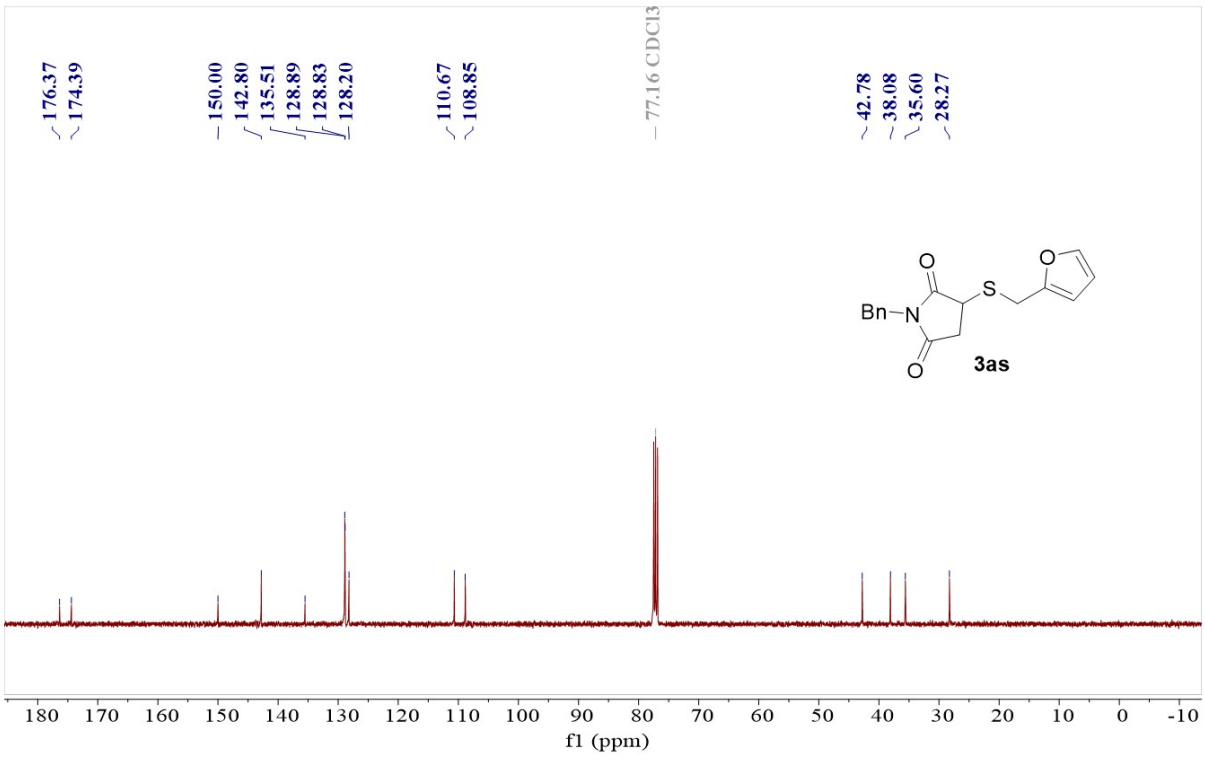


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ar

1-benzyl-3-((furan-2-ylmethyl)thio)pyrrolidine-2,5-dione (3as)

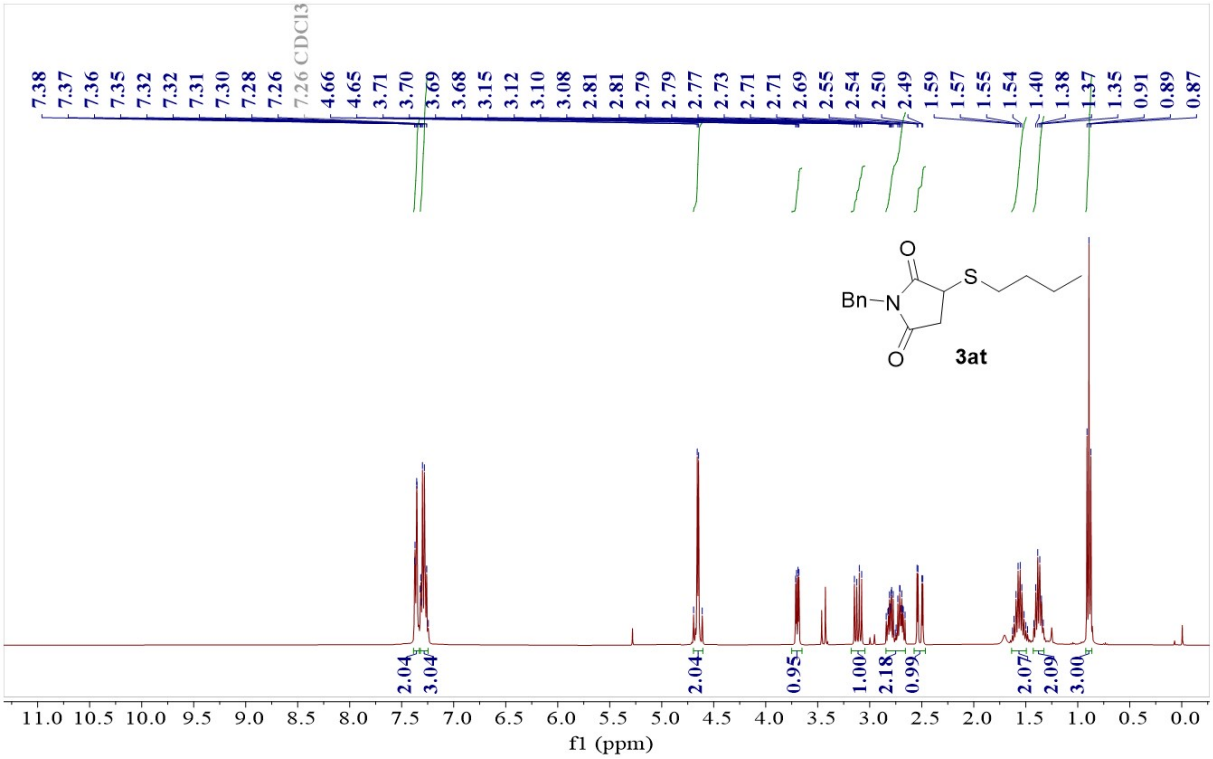


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3as

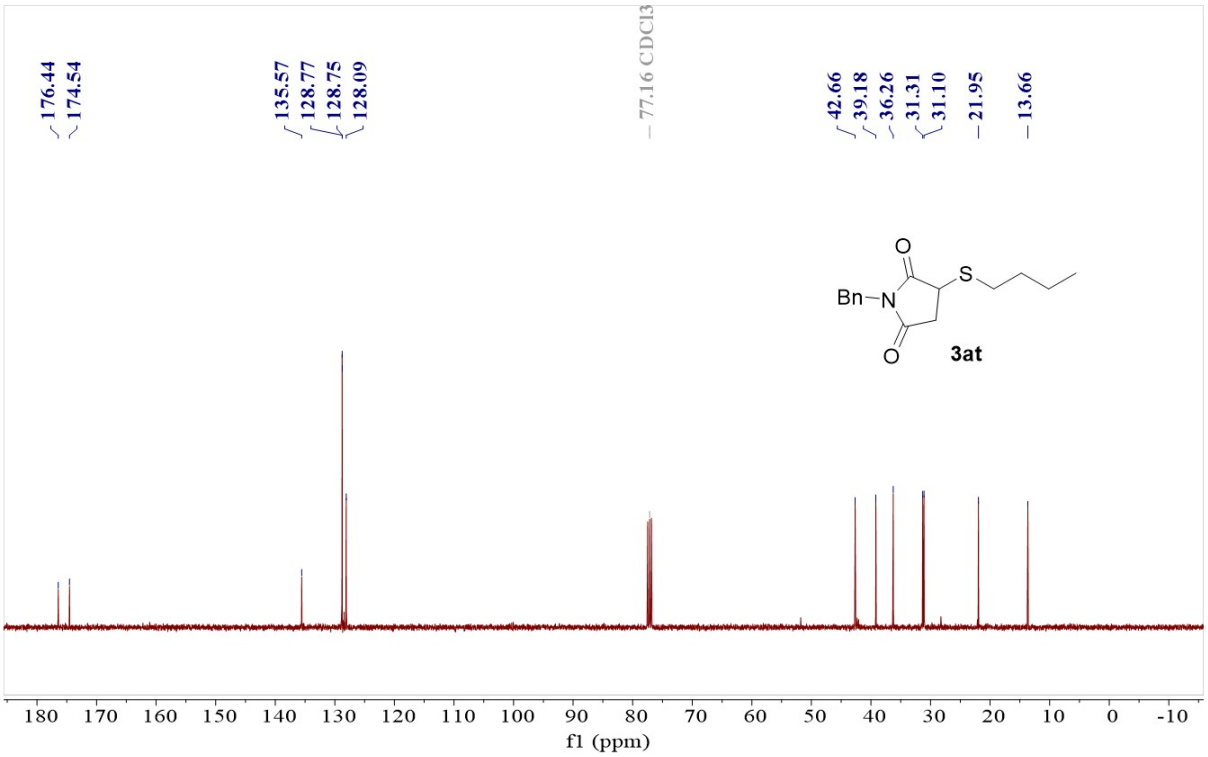


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3as

1-benzyl-3-(butylthio)pyrrolidine-2,5-dione (3at)

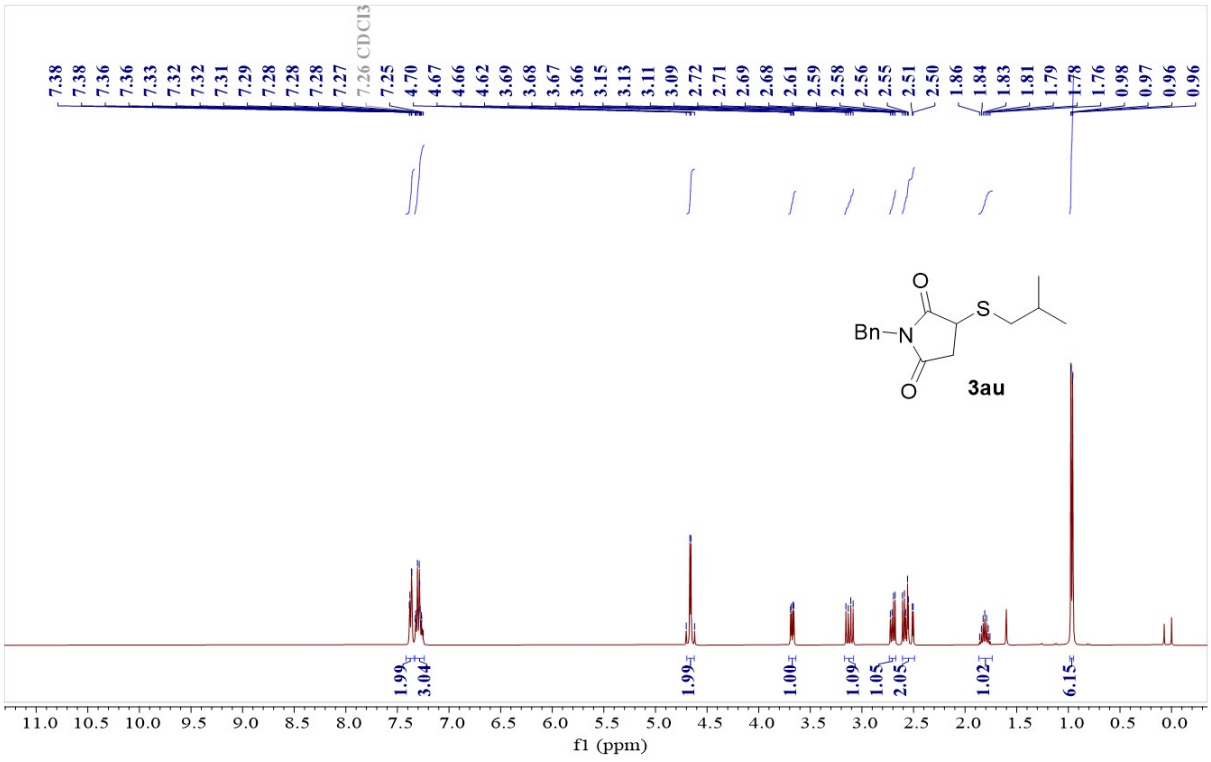


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3at

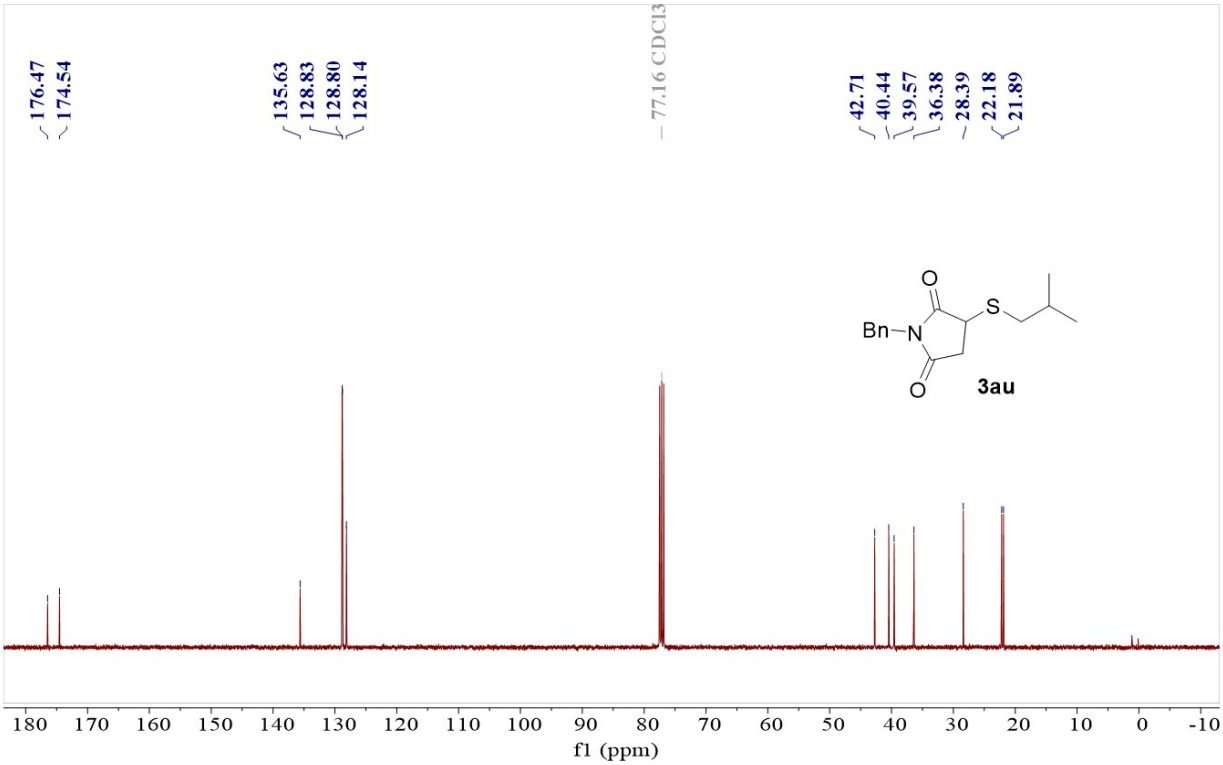


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3at

1-Benzyl-3-(isobutylthio)pyrrolidine-2,5-dione (3au)

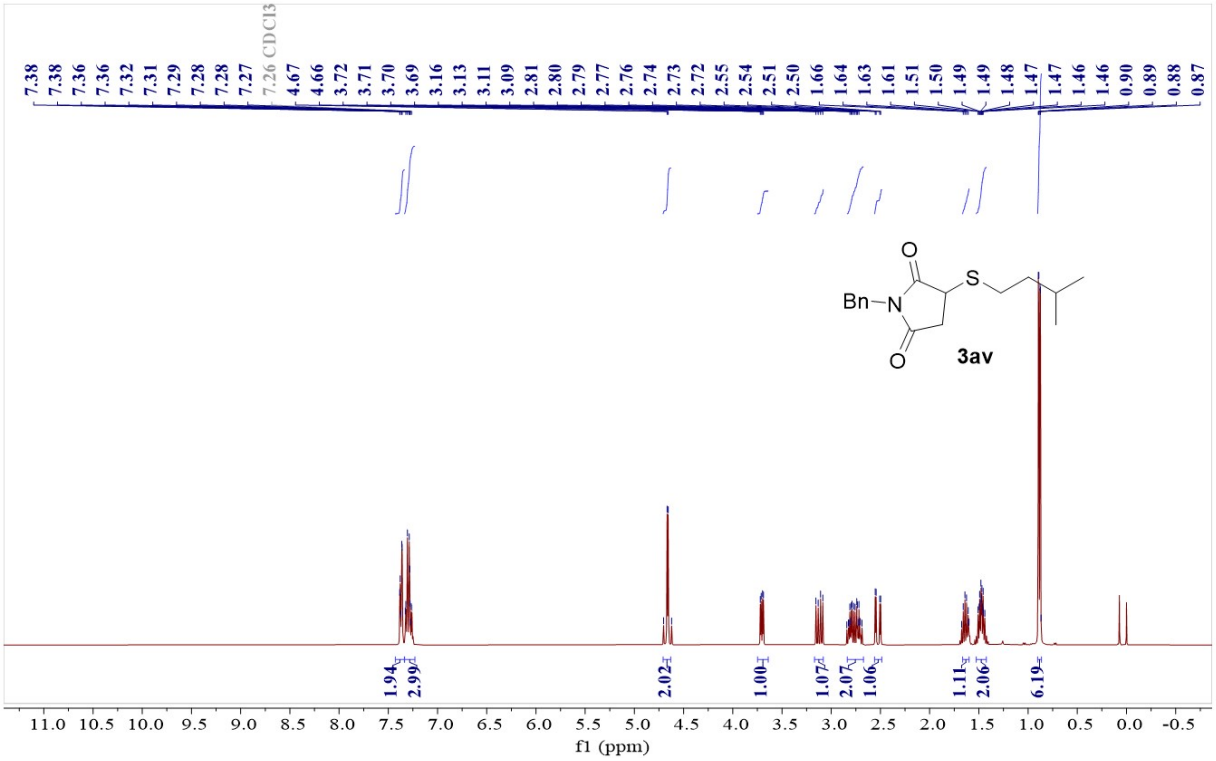


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3au

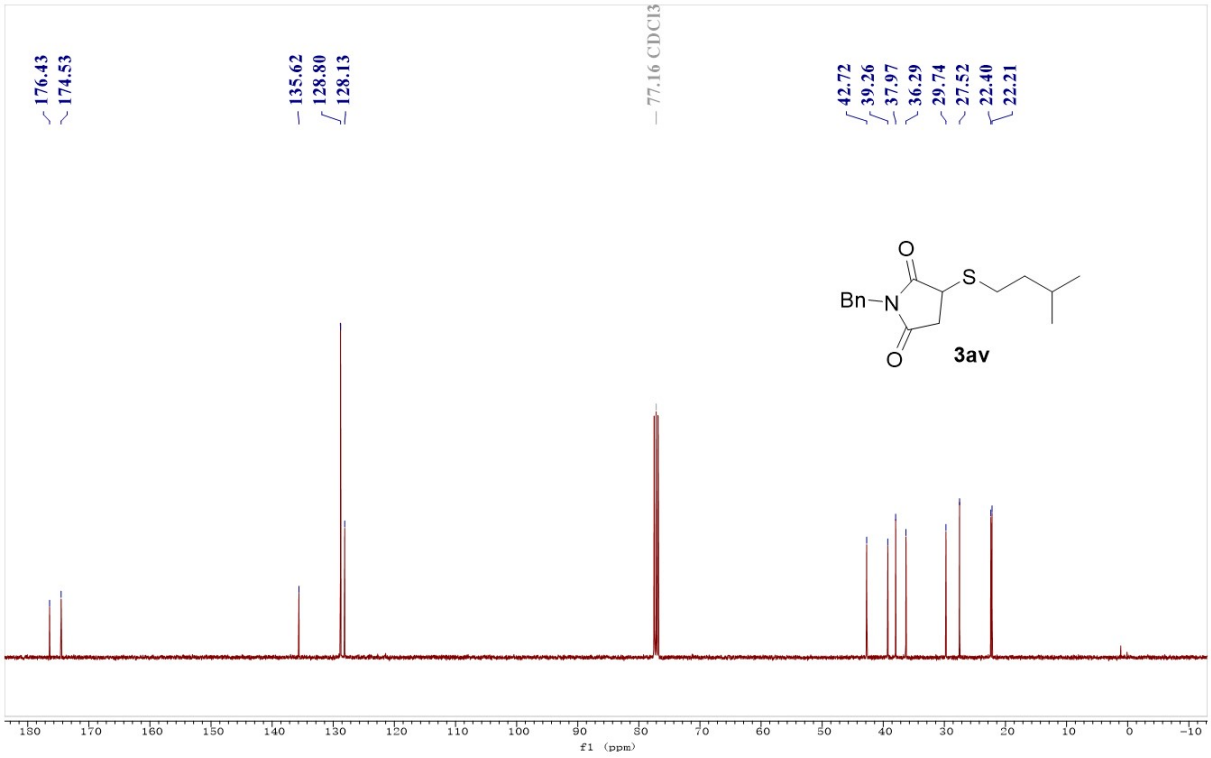


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3au

1-Benzyl-3-(isopentylthio)pyrrolidine-2,5-dione (3av)

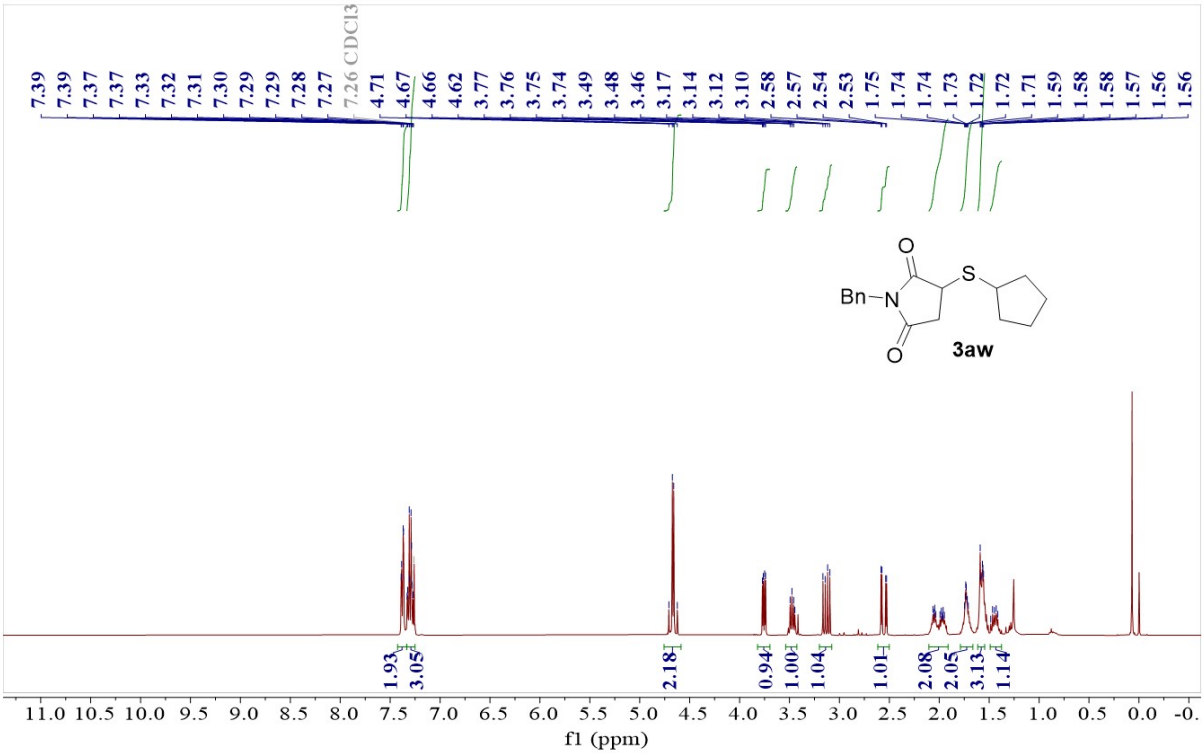


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3av

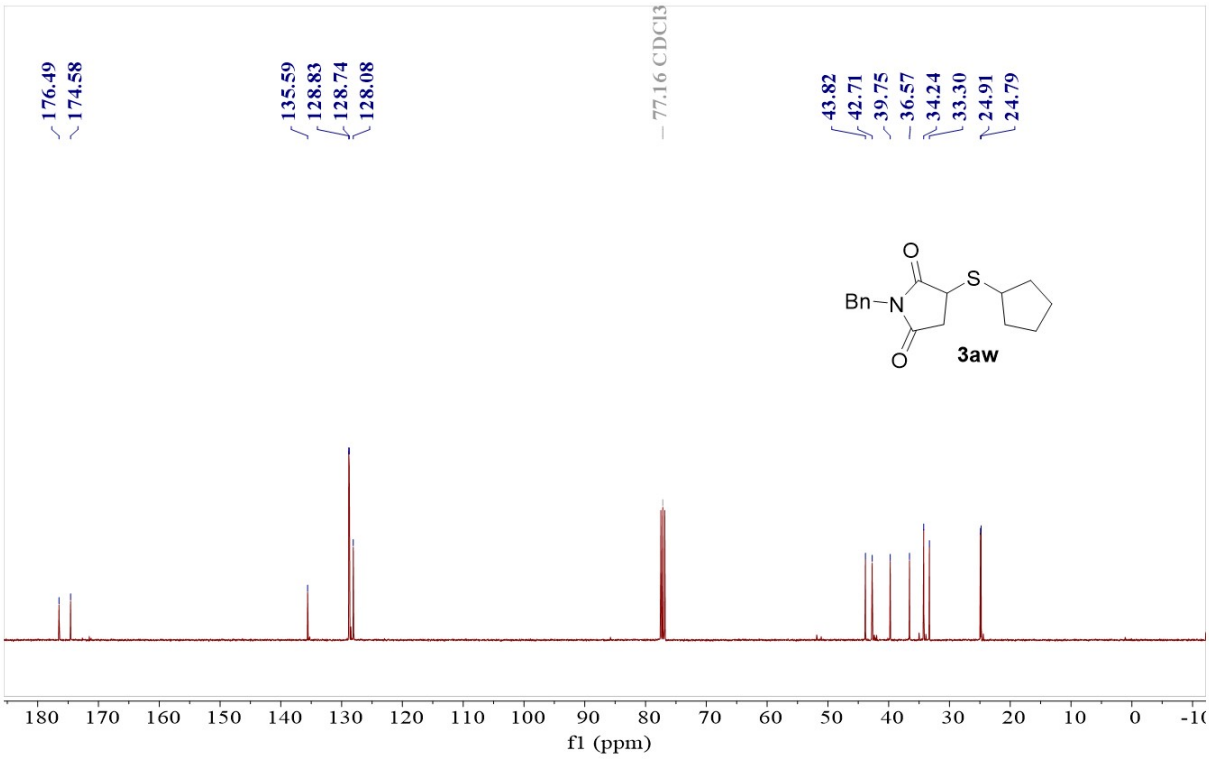


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3av

1-Benzyl-3-(cyclopentylthio)pyrrolidine-2,5-dione (3aw)

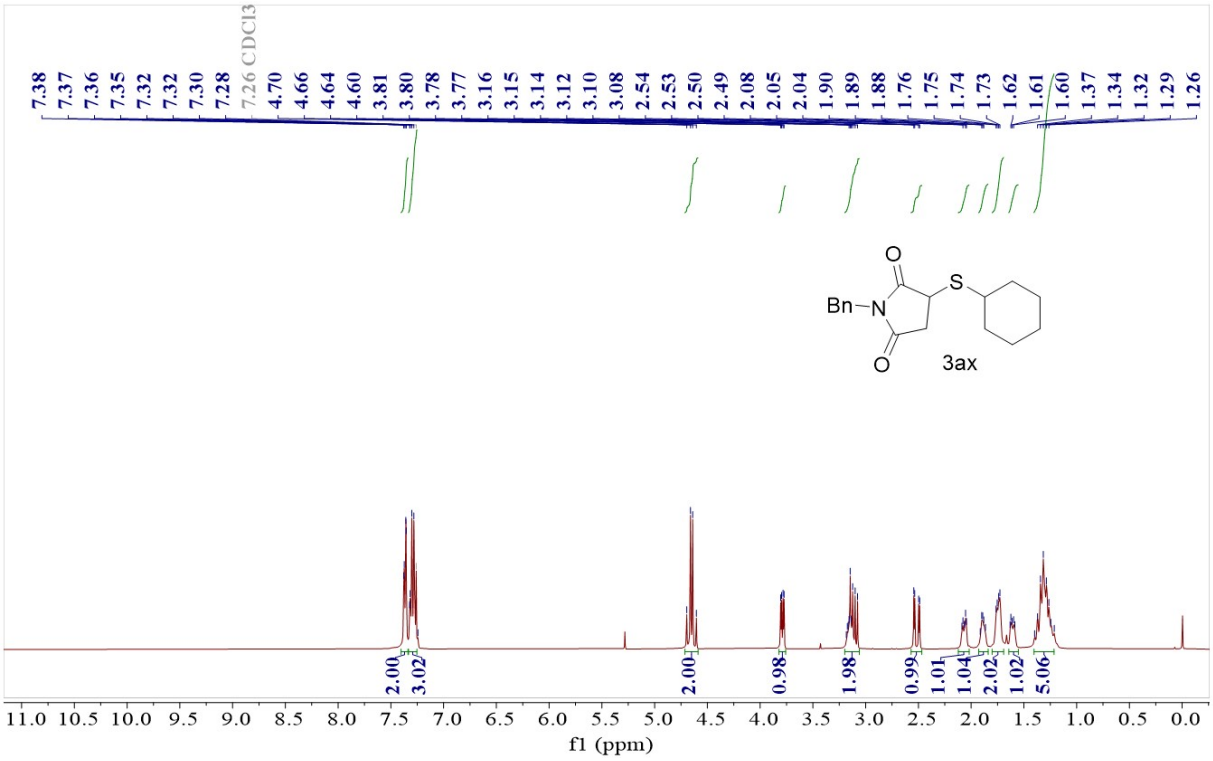


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3aw

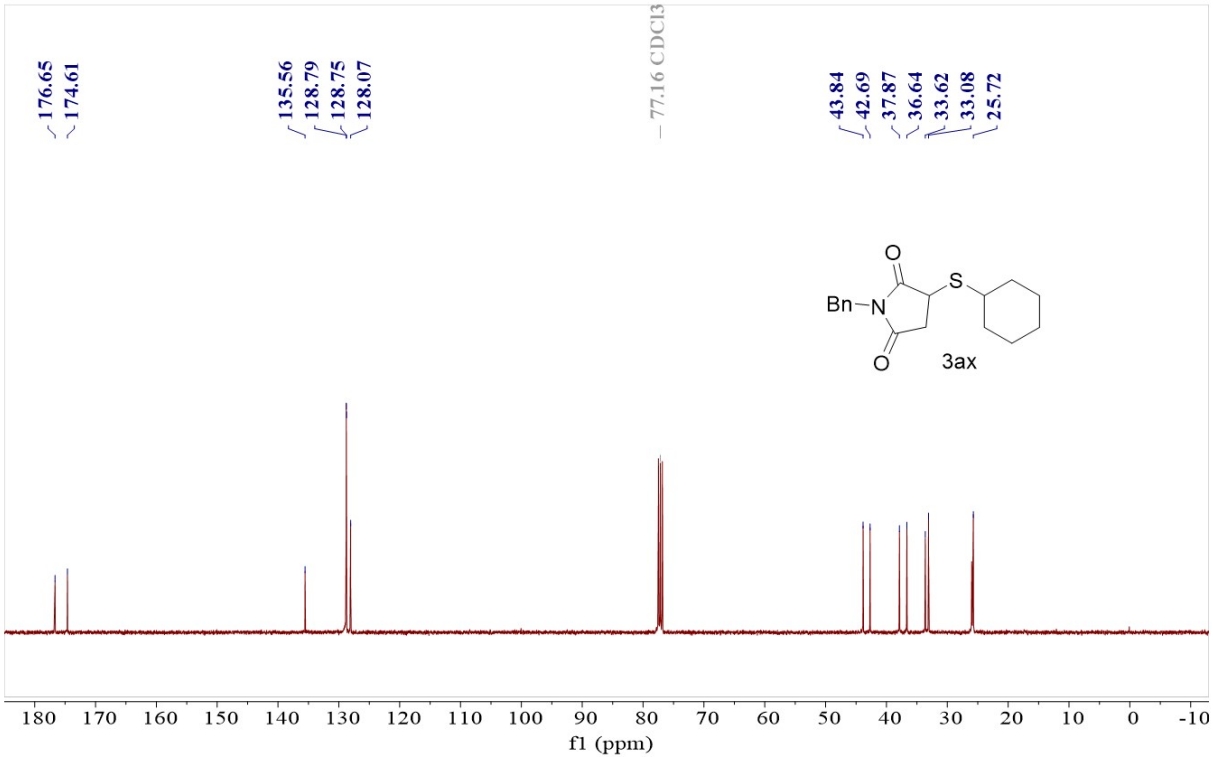


^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3aw

1-benzyl-3-(cyclohexylthio)pyrrolidine-2,5-dione (3ax)

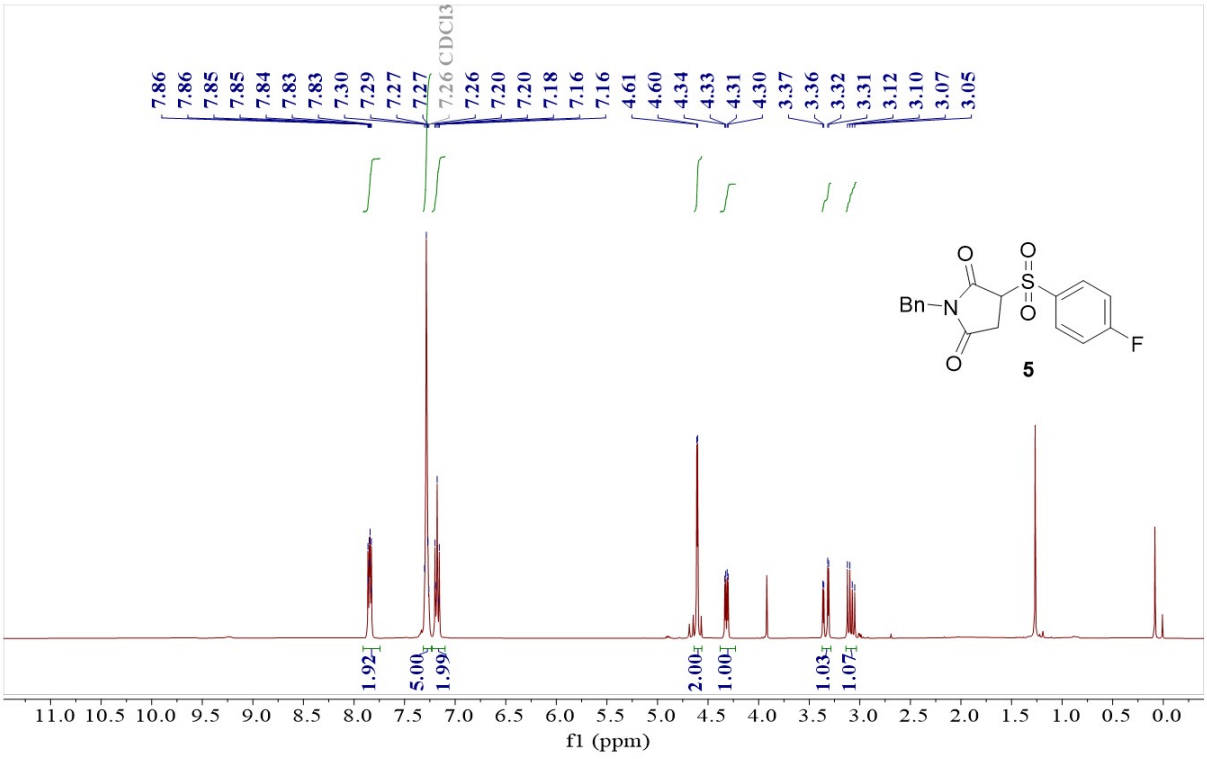


^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 3ax



^{13}C NMR (100 MHz, $CDCl_3$) spectrum of 3ax

1-benzyl-3-((4-fluorophenyl)sulfonyl)pyrrolidine-2,5-dione (5)



^{1}H NMR (400 MHz, $CDCl_3$) spectrum of 5