

Supporting Information

Enantioselective synthesis of chiral sulfones by hydrogen-bonding/organophotoredox co-catalyzed asymmetric sulfonylation

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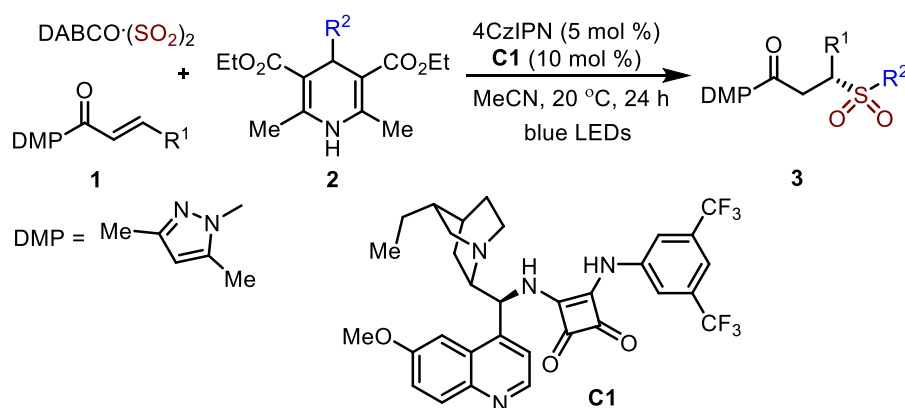
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1. General information

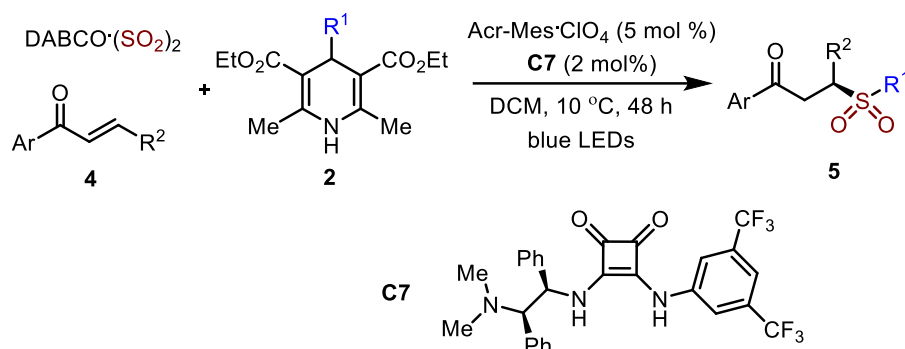
All glassware was thoroughly oven-dried. Chemicals and solvents were either purchased from commercial suppliers or purified by standard techniques. Thin-layer chromatography plates were visualized by exposure to ultraviolet light and/or staining with phosphomolybdic acid followed by heating on a hot plate. Flash chromatography was carried out using silica gel (200–300 mesh). ^1H NMR and ^{13}C NMR spectra were recorded on a Bruker AM-400 (400 MHz). The spectra were recorded in deuteriochloroform (CDCl_3) as solvent at room temperature, ^1H and ^{13}C NMR chemical shifts are reported in ppm relative to the residual solvent peak. The residual solvent signals were used as references and the chemical shifts were converted to the TMS scale (CDCl_3 : $\delta_{\text{H}} = 7.26$ ppm, $\delta_{\text{C}} = 77.0$ ppm). Data for ^1H NMR are reported as follows: chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet, dd = doublet, br = broad), integration, coupling constant (Hz) and assignment. Data for ^{13}C NMR are reported as chemical shift. Electrospray-ionisation HRMS data were acquired on a Q-TOF mass spectrometer (Waters SYNAPT G2-Si) LC-MS TOF.

2. General experimental procedure

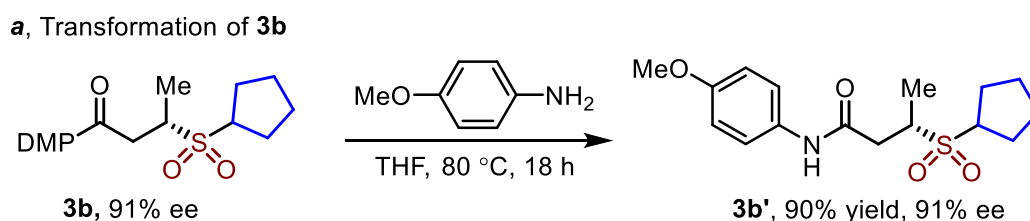


To an oven-dried flask was charged with (E)- α,β -unsaturated N -acylpyrazole **1** (0.1 mmol), DABCO \cdot (SO $_2$) $_2$ (0.12 mmol), 4-substituted Hantzsch esters **2** (0.12 mmol), 4CzIPN (5 mol %), and **C1** (10 mol %) under nitrogen atmosphere. Then anhydrous CH_3CN (2 mL) was added to the flask. The mixture was placed around a 36

W blue LEDs and stirred under blue light irradiation for 24 hours at 20 °C. After completion of reaction as as monitored by TLC analysis, the solvent was evaporated and the residue was purified directly by flash column chromatography on silica gel (petroleum ether /ethyl acetate/dichloromethane = 6:1:1) to give the corresponding product **3**.



To an oven-dried flask was charged with **4** (0.1 mmol), DABCO·(SO₂)₂ (0.12 mmol), 4-substituted Hantzsch esters **2** (0.15 mmol), Acr-Mes·ClO₄ (5 mol %), and **C7** (2 mol %) under nitrogen atmosphere. Then anhydrous CH₃Cl₂ (2 mL) was added to the flask. The mixture was placed around a 36 W blue LEDs and stirred under blue light irradiation for 48 hours at 10 °C. After completion of reaction as as monitored by TLC analysis, the solvent was evaporated and the residue was purified directly by flash column chromatography on silica gel (petroleum ether /ethyl acetate / dichloromethane = 6:1:1) to give the corresponding product **5**.



To a solution of **3b** (91% ee, 0.2 mmol) in THF (2.0 mL) was added *p*-anisidine (1.0 mmol). The reaction mixture was stirred at 80 °C for 18 h, then cooled down to room temperature and concentrated to dryness. The residue was purified by flash silica gel column chromatography (n-hexane/EtOAc (v/v): 2/1) to afford **3b'** (90% yield, 91% ee).

3. Substrate scopes with limitations

Table S1 Substrate scope of Hantzsch esters

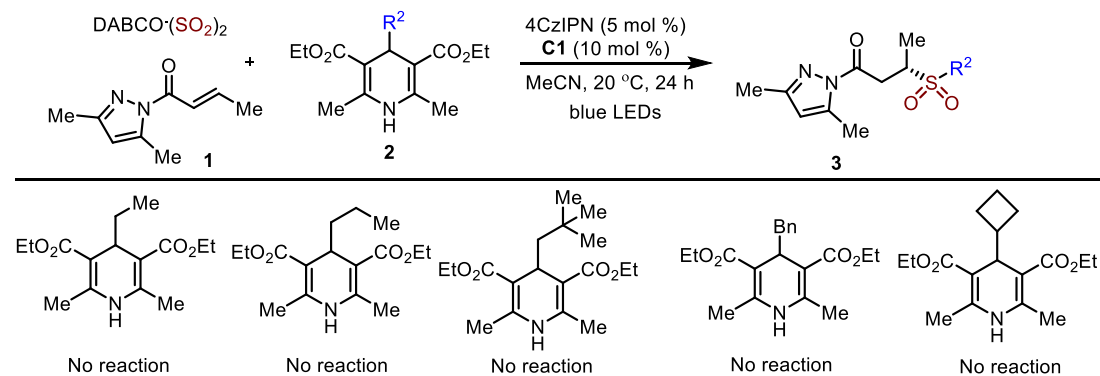


Table S2 Substrate scope of α,β -unsaturated carbonyl compounds

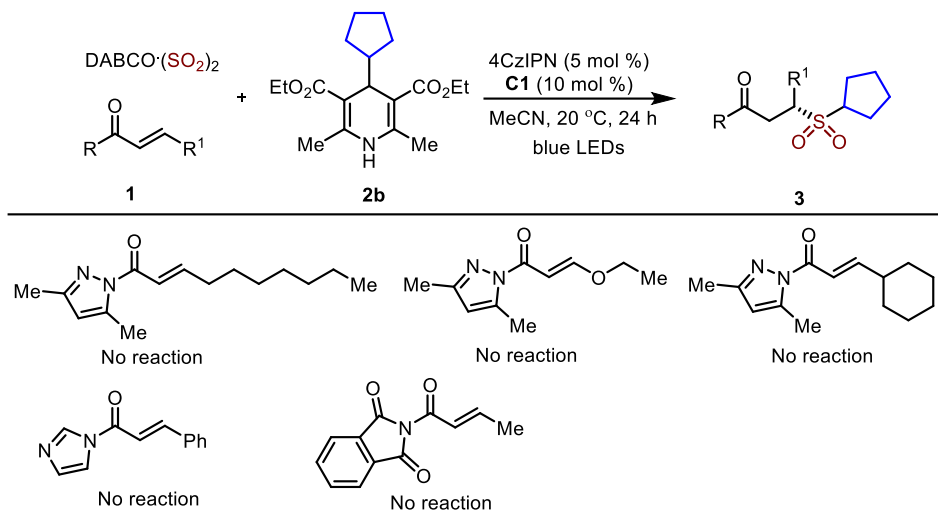
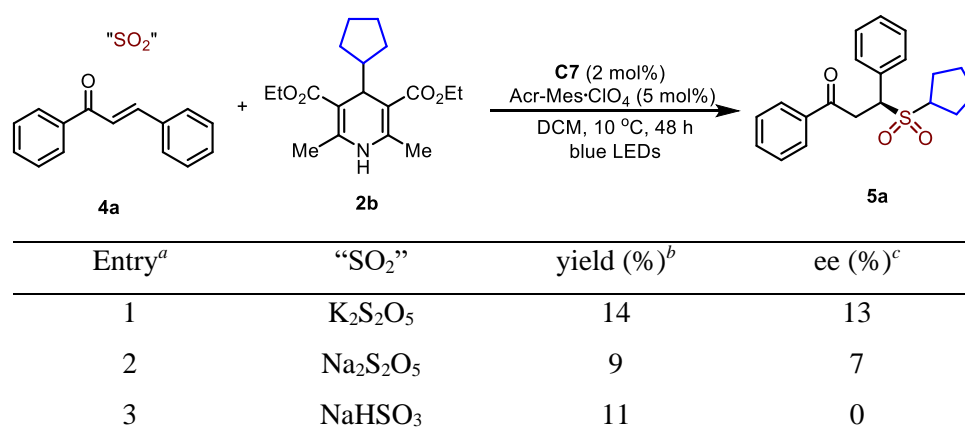


Table S3 Substrate scope of "SO₂"



^a Reaction conditions: chalcone **4a** (0.1 mmol), 4-cyclopentyl substituted Hantzsch ester **2b** (0.15 mmol), "SO₂" (0.12 mmol), Acr-Mes-ClO₄ (5 mol %), **C7** (2 mol %), DCM (2.0 mL), blue LEDs, 10 °C, 48 h, N₂ atmosphere, ^b Isolated yields. ^c Determined by HPLC analysis on a chiral stationary phase.

4. Devices for the photocatalytic reactions

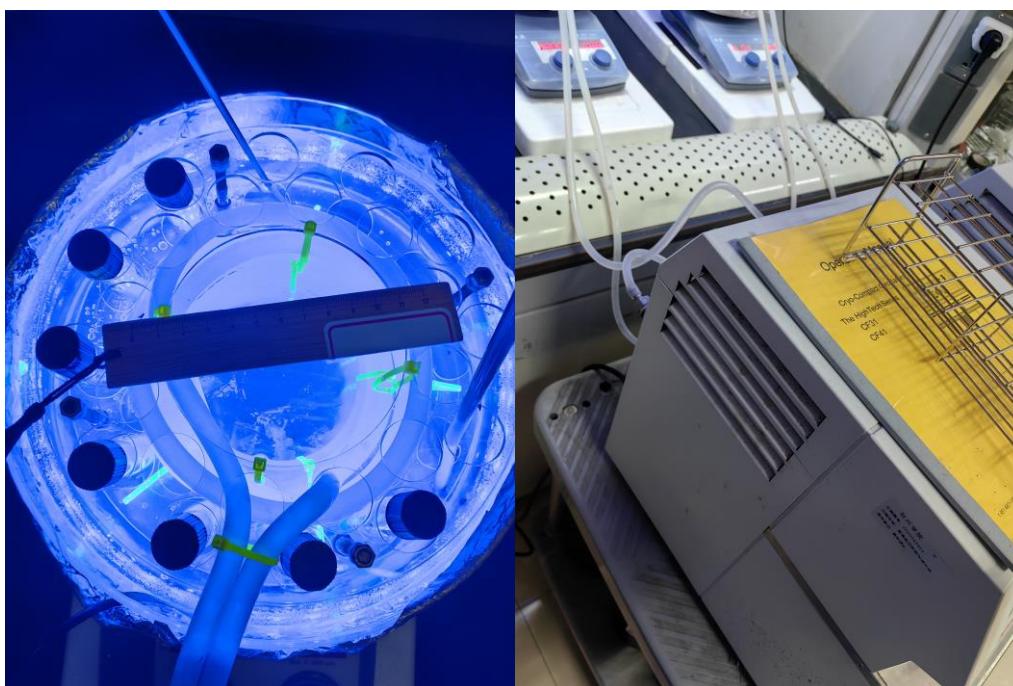


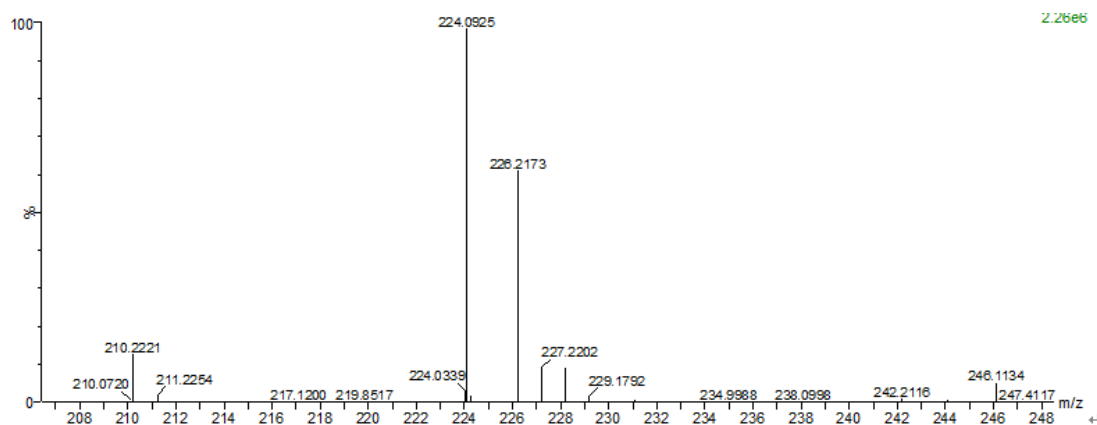
Figure S1 Devices for the photocatalytic reactions

5. Mechanistic study



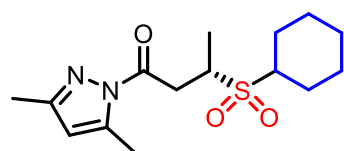
An oven-dried flask was charged with (*E*)-chalcone **4a** (0.1 mmol, 1.0 equiv.), DABCO·(SO₂)₂ (0.12 mmol, 1.2 equiv.), 4-substituted Hantzsch esters **2b** (0.15 mmol, 1.5 equiv.), Acr-Mes·ClO₄ (5 mol %), **C7** (2 mol %) and TEMPO (0.3 mmol, 3.0 equiv.) under nitrogen atmosphere. Then a mixture of anhydrous CH₂Cl₂ (2 mL) was added to the flask. The mixture was stirred under 36 W blue light irradiation for 48 hours at 10 °C. As a result, significant inhibition of the reactivity was observed, and the corresponding trapping product **3** was detected by HRMS.

HRMS (ESI) calcd for C₁₄H₂₈NO⁺ (M+H⁺): 226.2171, found: 226.2173.

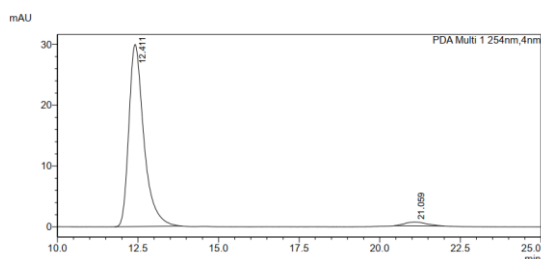


6. Characterization of new substrates and all products

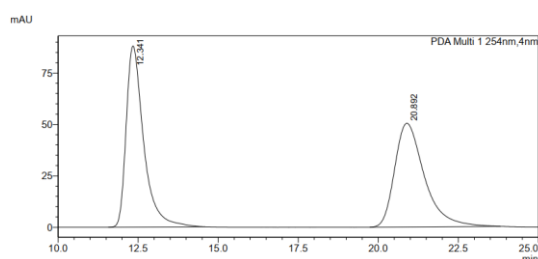
(S)-3-(cyclohexylsulfonyl)-1-(3,5-dimethyl-1H-pyrazol-1-yl)butan-1-one (**3a**)



$[\alpha]_D^{20} = 30.1^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.99 (s, 1H), 3.94–3.65 (m, 2H), 3.29 (dd, $J = 16.8, 8.8$ Hz, 1H), 3.07 (tt, $J = 12.1, 3.3$ Hz, 1H), 2.53 (s, 3H), 2.27–2.11 (m, 5H), 1.95 (d, $J = 12.7$ Hz, 2H), 1.74 (d, $J = 10.6$ Hz, 1H), 1.68–1.55 (m, 2H), 1.46 (d, $J = 6.9$ Hz, 3H), 1.30 (dd, $J = 20.8, 10.8$ Hz, 3H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 170.3, 152.7, 144.2, 111.6, 58.2, 49.8, 35.6, 25.1, 24.9, 24.6, 14.4, 13.8, 13.6. HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 12.411$ min (major), $t_R = 21.059$ min (minor).

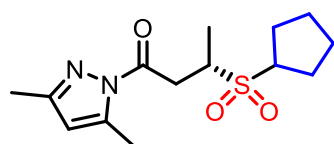


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	12.411	969789	29907	97.066
2	21.059	29309	631	2.934



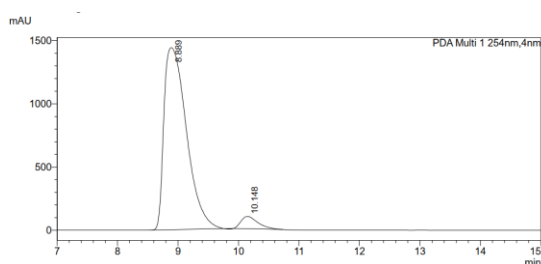
PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	12.341	3346020	88065	50.699
2	20.892	3253792	50368	49.301

(S)-3-(cyclopentylsulfonyl)-1-(3,5-dimethyl-1H-pyrazol-1-yl)butan-1-one (**3b**)

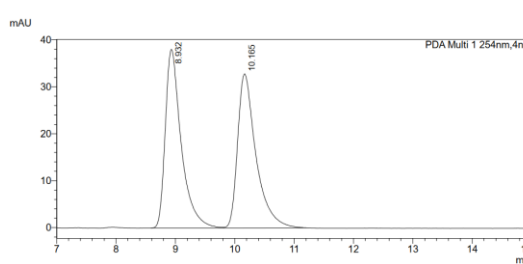


$[\alpha]_D^{20} = -7.9^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.98 (s, 1H), 3.93 – 3.69 (m, 2H), 3.63 – 3.47

(m, 1H), 3.32 (dd, $J = 17.2, 8.8$ Hz, 1H), 2.54 (s, 3H), 2.23 (s, 3H), 2.18 – 1.99 (m, 4H), 1.89 – 1.78 (m, 2H), 1.75 – 1.62 (m, 2H), 1.48 (d, $J = 6.9$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.4, 152.7, 144.2, 111.6, 58.5, 52.1, 35.6, 27.0, 26.7, 26.1, 26.0, 14.4, 14.0, 13.8. HPLC analysis: CHIRALPAK AD-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 8.889$ min (major), $t_R = 10.148$ min (minor).

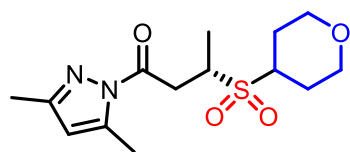


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	8.889	37247489	1439837	95.114
2	10.148	1913502	97656	4.886

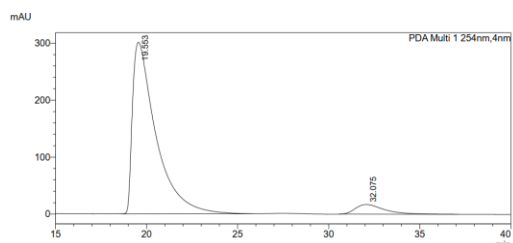


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	8.932	708962	38062	50.141
2	10.165	704968	32856	49.859

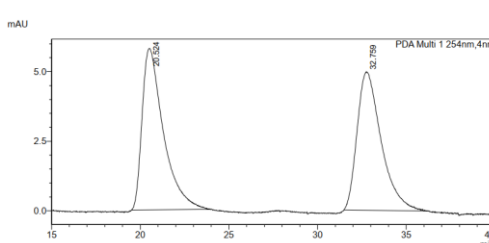
***(S)*-1-(3,5-dimethyl-1H-pyrazol-1-yl)-3-((tetrahydro-2H-pyran-4-yl)sulfonyl)butan-1-one (3c)**



$[\alpha]_D^{20} = -6.6^\circ$ ($c = 0.10$, CHCl_3); ^1H NMR (400 MHz, CDCl_3) δ 6.00 (s, 1H), 4.14 (d, $J = 11.1$ Hz, 2H), 3.84 (dd, $J = 17.1, 3.2$ Hz, 2H), 3.51 – 3.38 (m, 2H), 3.37 – 3.19 (m, 2H), 2.53 (s, 3H), 2.22 (s, 3H), 2.11 – 1.93 (m, 4H), 1.48 (d, $J = 6.8$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.2, 152.8, 144.2, 111.7, 66.5, 55.5, 50.0, 35.8, 24.9, 14.4, 13.8, 13.6; HRMS (ESI) m/z Calcd for $\text{C}_{14}\text{H}_{22}\text{N}_2\text{O}_4\text{NaS}$ $[\text{M}+\text{Na}]^+$: 337.1198, Found: 337.1190; HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 19.553$ min (major), $t_R = 32.075$ min (minor).

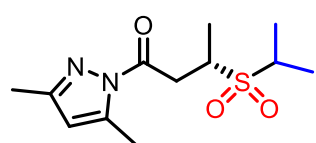


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	19.553	27041663	301448	93.565
2	32.075	1859742	16949	6.435

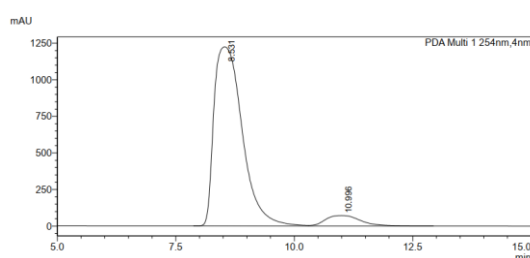


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	20.524	484736	5801	50.753
2	32.759	470348	4977	49.247

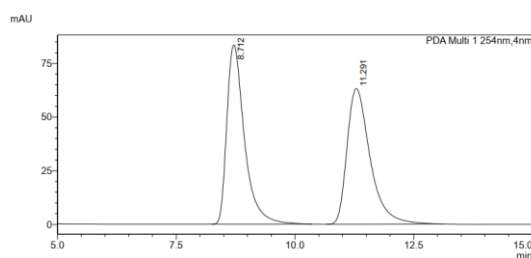
(S)-1-(3,5-dimethyl-1H-pyrazol-1-yl)-3-(isopropylsulfonyl)butan-1-one (3d)



$[\alpha]_D^{20} = -3.8^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.99 (s, 1H), 3.96 – 3.71 (m, 2H), 3.44 – 3.23 (m, 2H), 2.54 (s, 3H), 2.23 (s, 3H), 1.56 – 1.32 (m, 9H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 170.3, 152.7, 144.2, 111.6, 50.1, 49.9, 35.7, 15.3, 15.0, 14.4, 13.8, 13.8. HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 8.531$ min (major), $t_R = 10.996$ min (minor).

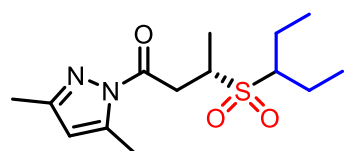


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	8.531	50872425	1223173	93.322
2	10.996	3640551	71287	6.678

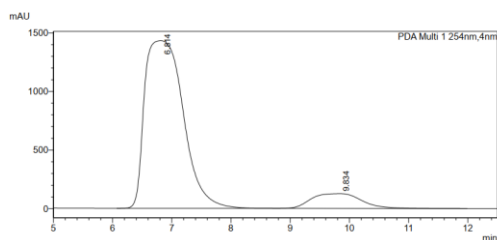


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	8.712	2154287	83464	50.236
2	11.291	2134035	63124	49.764

(S)-1-(3,5-dimethyl-1H-pyrazol-1-yl)-3-(pentan-3-ylsulfonyl)butan-1-one (3e)

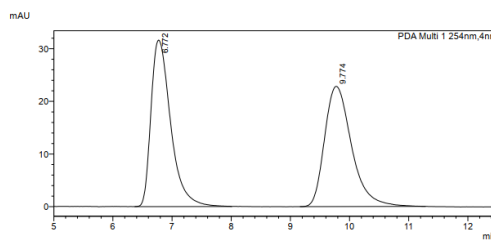


$[\alpha]_D^{20} = +5.6^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.99 (s, 1H), 3.93–3.75 (m, 2H), 3.28 (dd, $J = 17.0, 8.7$ Hz, 1H), 3.01–2.81 (m, 1H), 2.54 (s, 3H), 2.23 (s, 3H), 2.07–1.94 (m, 2H), 1.88–1.83 (m, 2H), 1.46 (d, $J = 6.8$ Hz, 3H), 1.10 (t, $J = 7.5$ Hz, 6H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 170.4, 152.7, 144.2, 111.6, 61.4, 51.0, 35.7, 19.9, 19.6, 14.4, 13.9, 13.8, 11.1, 11.0; HRMS (ESI) m/z Calcd for $\text{C}_{14}\text{H}_{24}\text{N}_2\text{O}_3\text{NaS}$ $[\text{M}+\text{Na}]^+$: 323.1405, Found: 323.1400; HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 240 nm, 30 °C, $t_R = 13.040$ min (major), $t_R = 16.959$ min (minor).



PDA Ch1 254nm

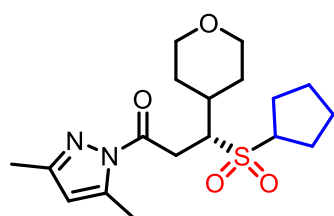
Peak#	Ret. Time	Area	Height	Aera%
1	6.814	64935084	1430495	89.793
2	9.834	7381049	126090	10.207



PDA Ch1 254nm

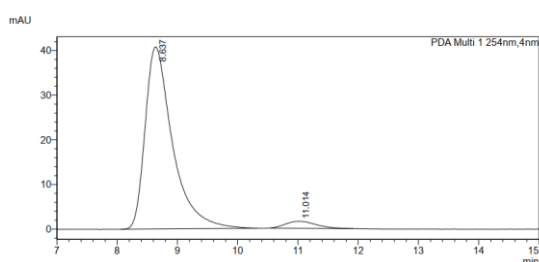
Peak#	Ret. Time	Area	Height	Aera%
1	6.772	730802	31652	50.144
2	9.774	726595	22863	49.856

***(R)*-3-(cyclopentylsulfonyl)-1-(3,5-dimethyl-1H-pyrazol-1-yl)-3-(tetrahydro-2H-pyran-4-yl)propan-1-one (3f)**



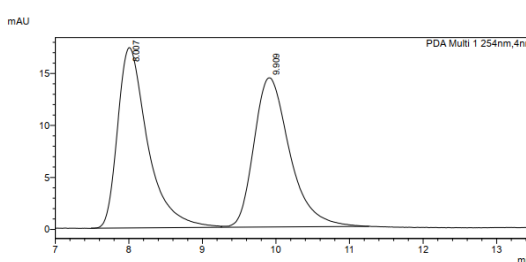
$[\alpha]_D^{20} = +9.9^\circ$ (c = 0.10, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 6.00 (s, 1H), 3.99 (dd, *J* = 11.0, 3.3 Hz, 2H), 3.88 (dd, *J* = 18.9, 6.9 Hz, 1H), 3.77 (dt, *J* = 7.0, 3.7 Hz, 1H), 3.57 – 3.39 (m, 4H), 2.65–2.56 (m, 1H), 2.53 (s, 3H),

2.24 (s, 3H), 2.16 (dd, *J* = 13.5, 7.1 Hz, 1H), 2.12 – 2.02 (m, 2H), 1.95 (d, *J* = 13.6 Hz, 2H), 1.88–1.76 (m, 2H), 1.72–1.60 (m, 3H), 1.55 (dd, *J* = 9.4, 3.8 Hz, 2H); ¹³C NMR (100 MHz, CDCl₃) δ 171.0, 152.8, 144.2, 111.7, 67.9, 67.6, 60.9, 59.5, 34.6, 31.2, 30.9, 28.3, 27.5, 26.2, 26.1, 26.1, 14.5, 13.8. HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, *t*_R = 8.637 min (major), *t*_R = 11.014 min (minor).



PDA Ch1 254nm

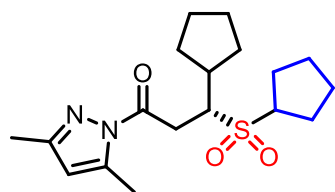
Peak#	Ret. Time	Area	Height	Aera%
1	8.637	1290502	40772	95.782
2	11.014	56835	1599	4.218



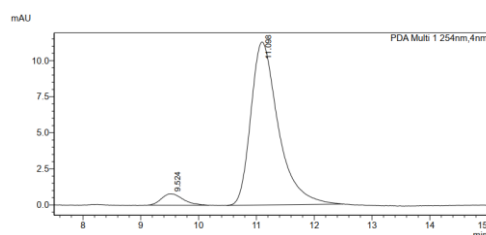
PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Aera%
1	8.007	492445	17349	50.335
2	9.909	485894	14356	49.665

***(R)*-3-cyclopentyl-3-(cyclopentylsulfonyl)-1-(3,5-dimethyl-1H-pyrazol-1-yl)propan-1-one (3g)**

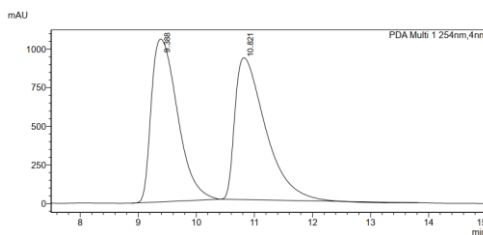


$[\alpha]_D^{20} = +4.8^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 5.98 (s, 1H), 4.09–3.77 (m, 2H), 3.62–3.40 (m, 1H), 3.28 (dd, $J = 21.2, 6.4$ Hz, 1H), 2.66–2.41 (m, 4H), 2.23 (s, 3H), 2.13 (dd, $J = 13.7, 6.9$ Hz, 2H), 2.06–1.89 (m, 4H), 1.87–1.74 (m, 2H), 1.70–1.58 (m, 6H), 1.40 (dd, $J = 14.7, 7.4$ Hz, 2H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 171.2, 152.6, 144.2, 111.6, 60.5, 59.4, 38.9, 32.1, 31.5, 28.9, 27.0, 26.8, 26.1, 25.0, 24.9, 14.5, 13.8; HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 9.524$ min (minor), $t_R = 11.098$ min (major).



PDA Ch1 254nm

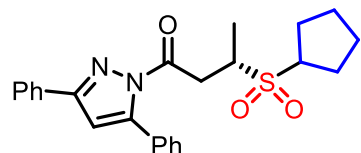
Peak#	Ret. Time	Area	Height	Aera%
1	9.524	20454	797	5.191
2	11.098	373600	11292	94.809



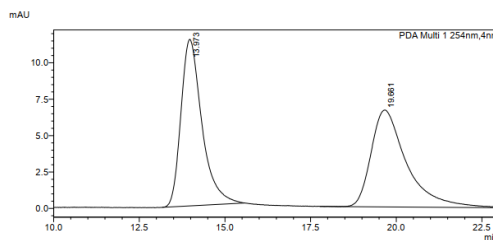
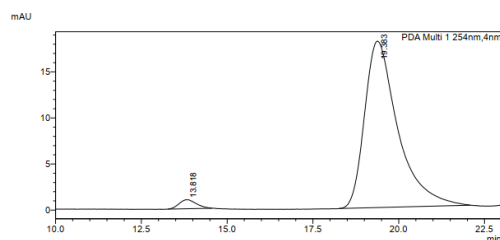
PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Aera%
1	9.388	33188887	1054372	49.611
2	10.821	33709432	919312	50.389

(S)-3-(cyclopentylsulfonyl)-1-(3,5-diphenyl-1H-pyrazol-1-yl)butan-1-one (3h)



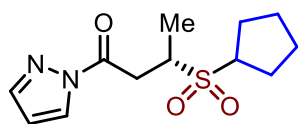
$[\alpha]_D^{20} = +5.0^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.90 (d, $J = 7.0$ Hz, 2H), 7.44 (dd, $J = 10.0, 7.0$ Hz, 8H), 6.75 (s, 1H), 4.04 (dd, $J = 17.7, 3.8$ Hz, 1H), 3.76 (ddd, $J = 10.6, 6.8, 3.9$ Hz, 1H), 3.66–3.40 (m, 2H), 2.24–1.92 (m, 4H), 1.83 (d, $J = 2.1$ Hz, 2H), 1.67 (dd, $J = 12.3, 5.9$ Hz, 2H), 1.49 (d, $J = 6.8$ Hz, 3H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 169.8, 154.1, 147.6, 131.3, 130.7, 129.5, 129.1, 129.0, 128.9, 128.0, 126.4, 110.3, 58.5, 52.1, 35.6, 27.2, 26.4, 26.1, 26.0, 14.3; HRMS (ESI) calcd for $\text{C}_{24}\text{H}_{26}\text{N}_2\text{O}_3\text{NaS}$ $[\text{M}+\text{Na}]^+$: 445.1562, found: 445.1555. HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 13.818$ min (minor), $t_R = 19.383$ min (major).



PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	13.818	34239	979	2.737
2	19.383	1216569	18062	97.263

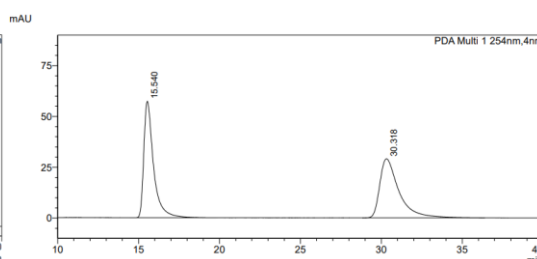
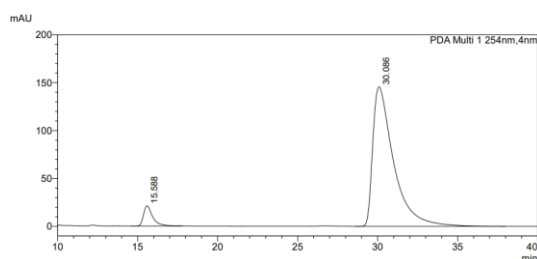
PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	13.973	486596	11432	50.323
2	19.661	480346	6647	49.677

***(S)*-3-(cyclopentylsulfonyl)-1-(1H-pyrazol-1-yl)butan-1-one (3i)**



$[\alpha]_D^{20} = -4.5^\circ$ ($c = 0.35$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.25 (d, $J = 2.8$ Hz, 1H), 7.74 (d, $J = 0.8$ Hz, 1H), 6.48 (dd, $J = 2.8, 0.8$ Hz, 1H), 3.91 (dd, $J = 17.4, 4.5$ Hz,

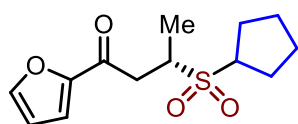
1H), 3.85–3.75 (m, 1H), 3.62–3.51 (m, 1H), 3.35 (dd, $J = 17.4, 8.7$ Hz, 1H), 2.20–1.98 (m, 4H), 1.90–1.78 (m, 2H), 1.73–1.62 (m, 2H), 1.50 (d, $J = 6.9$ Hz, 3H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 169.0, 144.5, 128.4, 110.2, 58.6, 52.0, 34.3, 27.1, 26.5, 26.0, 26.0, 14.1; HRMS (ESI) calcd for $\text{C}_{12}\text{H}_{18}\text{N}_2\text{O}_3\text{NaS}$ $[\text{M}+\text{Na}]^+$: 293.0936, found: 293.0938. HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 70:30, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 15.588$ min (minor), $t_R = 30.086$ min (major).



PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	15.588	840598	21125	5.977
2	30.086	13223378	145567	94.023

PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	15.540	2396632	57232	50.119
2	30.318	2385230	29023	49.881

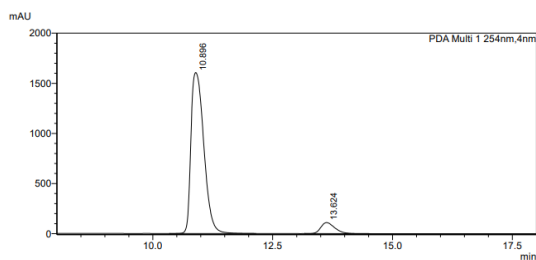
***(S)*-3-(cyclopentylsulfonyl)-1-(furan-2-yl)butan-1-one (3j)**



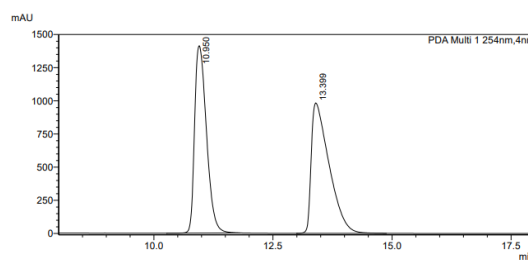
$[\alpha]_D^{20} = -21.1^\circ$ ($c = 0.2$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.63 (d, $J = 1.0$ Hz, 1H), 7.28 (d, $J = 3.4$ Hz, 1H), 6.58 (dd, $J = 3.6, 1.0$ Hz, 1H), 3.85–3.75 (m, 1H), 3.62–3.47

(m, 2H), 3.07 (dd, $J = 17.6, 9.0$ Hz, 1H), 2.24–2.12 (m, 1H), 2.21–1.96 (m, 3H), 1.91–1.77 (m, 2H), 1.71–1.59 (m, 2H), 1.44 (d, $J = 6.8$ Hz, 3H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 184.9, 152.0, 147.0, 118.1, 112.5, 58.4, 51.2, 37.2, 27.3, 26.2, 26.0, 25.9, 14.3; HRMS (ESI) calcd for $\text{C}_{13}\text{H}_{18}\text{O}_4\text{NaS}$ $[\text{M}+\text{Na}]^+$: 293.0823, found: 293.0825.

HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, t_R = 10.896 min (major), t_R = 13.624 min (minor).

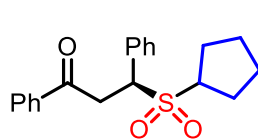


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	10.896	30037868	1604958	93.056
2	13.624	2241544	110050	6.944



PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	10.950	24474997	1411339	48.877
2	13.399	25599707	982935	51.123

(S)-3-(cyclopentylsulfonyl)-1,3-diphenylpropan-1-one (5a)



$[\alpha]_D^{20} = -47.9^\circ$ (c = 0.10, CHCl₃); ¹H NMR (400 MHz, CDCl₃)

δ 7.99–7.89 (m, 2H), 7.60–7.51 (m, 3H), 7.44 (t, *J* = 7.7 Hz, 2H), 7.41–7.31 (m, 3H), 4.96 (dd, *J* = 9.6, 3.3 Hz, 1H), 4.08

(dd, *J* = 18.0, 3.3 Hz, 1H), 3.83 (dd, *J* = 18.0, 9.7 Hz, 1H), 3.15–2.96 (m, 1H), 2.19–

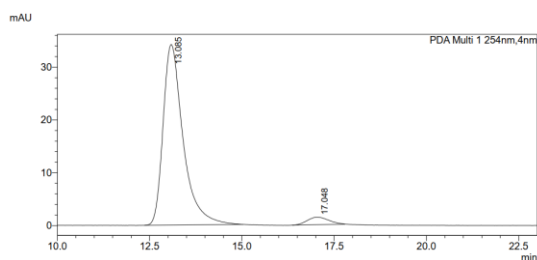
1.90 (m, 3H), 1.85–1.65 (m, 3H), 1.63 – 1.42 (m, 2H); ¹³C NMR (100 MHz, CDCl₃)

δ 195.2, 136.2, 133.7, 133.6, 129.6, 129.1, 129.0, 128.7, 128.2, 77.4, 77.1, 76.8, 62.1,

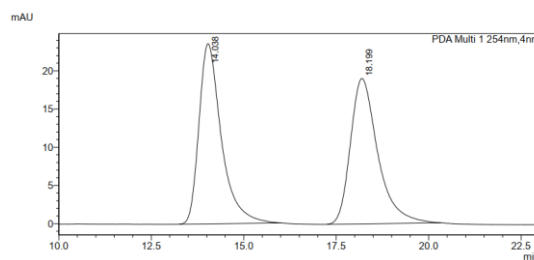
58.5, 37.1, 28.0, 26.1, 26.1, 25.6; HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-

PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, t_R = 13.085

min (major), t_R = 17.048 min (minor).

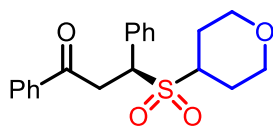


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	13.085	1290436	34154	95.766
2	17.048	57052	1422	4.234

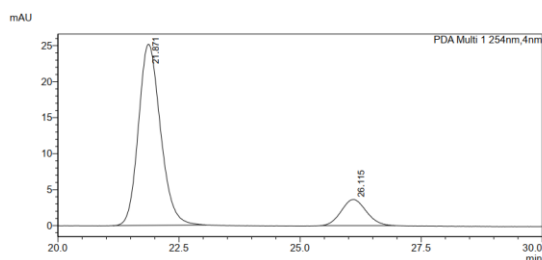


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	14.038	992575	23590	50.344
2	18.199	978993	19044	49.656

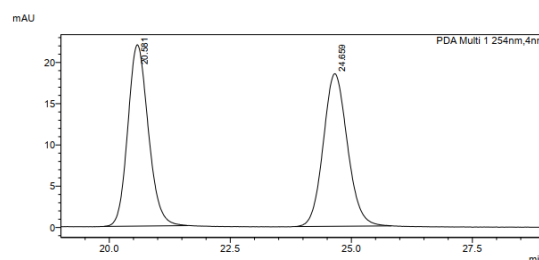
(S)-3-(cyclohexylsulfonyl)-1,3-diphenylpropan-1-one (5b)



$[\alpha]_D^{20} = -3.3^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.94 (d, $J = 7.4$ Hz, 2H), 7.59–7.53 (m, 3H), 7.46 (t, $J = 7.7$ Hz, 2H), 7.38 (d, $J = 7.5$ Hz, 3H), 5.02 (dd, $J = 9.5, 3.2$ Hz, 1H), 4.13–3.97 (m, 3H), 3.83 (dd, $J = 18.0, 9.5$ Hz, 1H), 3.22 (dt, $J = 7.3, 5.7$ Hz, 2H), 2.90–2.85 (m, 1H), 2.02–1.85 (m, 3H), 1.76 (dd, $J = 13.1, 1.9$ Hz, 1H).; $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 195.0, 136.0, 133.8, 133.2, 129.5, 129.3, 129.2, 128.8, 128.2, 66.6, 66.0, 60.6, 55.4, 37.3, 26.3, 23.5; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 21.871$ min (major), $t_R = 26.115$ min (minor).

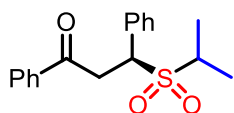


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	21.871	797664	25182	85.886
2	26.115	131081	3634	14.114

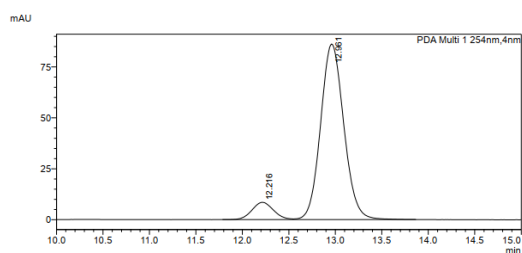


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	20.581	646956	21957	50.183
2	24.659	642239	18489	49.817

(S)-3-(isopropylsulfonyl)-1,3-diphenylpropan-1-one (5c)

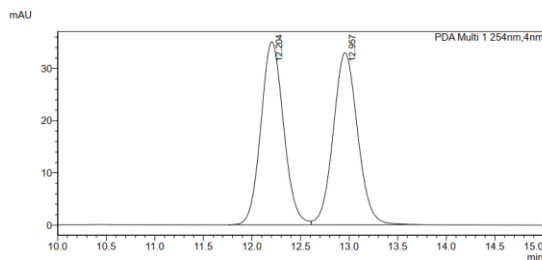


$[\alpha]_D^{20} = -28.1^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.94 (d, $J = 7.5$ Hz, 2H), 7.57 (t, $J = 8.0$ Hz, 3H), 7.45 (t, $J = 7.7$ Hz, 2H), 7.41–7.31 (m, 3H), 5.07 (dd, $J = 9.7, 3.1$ Hz, 1H), 4.07 (dd, $J = 17.9, 3.1$ Hz, 1H), 3.84 (dd, $J = 17.9, 9.7$ Hz, 1H), 2.87 (dt, $J = 13.7, 6.8$ Hz, 1H), 1.37 (d, $J = 6.7$ Hz, 3H), 1.27 (d, $J = 7.0$ Hz, 3H).; $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 195.2, 136.1, 133.7, 133.5, 129.5, 129.1, 129.0, 128.7, 128.2, 60.3, 50.1, 37.4, 16.6, 13.7; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 12.216$ min (minor), $t_R = 12.961$ min (major).



PDA Ch1 254nm

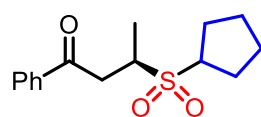
Peak#	Ret. Time	Area	Height	Aera%
1	12.216	136755	8469	8.374
2	12.961	1496369	86182	91.626



PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Aera%
1	12.204	569400	35041	49.756
2	12.957	574989	32922	50.244

(R)-3-(cyclopentylsulfonyl)-1-phenylbutan-1-one (5d)

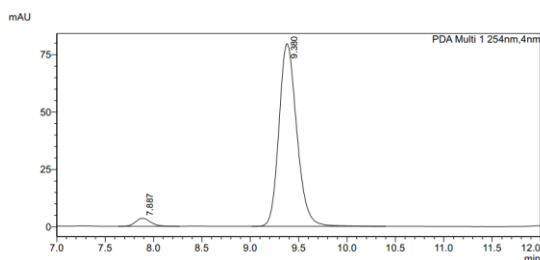


$[\alpha]_D^{20} = +11.9^\circ$ (c = 0.10, CHCl₃); ¹H NMR (400 MHz, CDCl₃)

δ 8.02 – 7.96 (m, 2H), 7.61 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.7 Hz, 2H), 3.89–3.82 (m, 1H), 3.76 (dd, *J* = 17.9, 3.4 Hz, 1H),

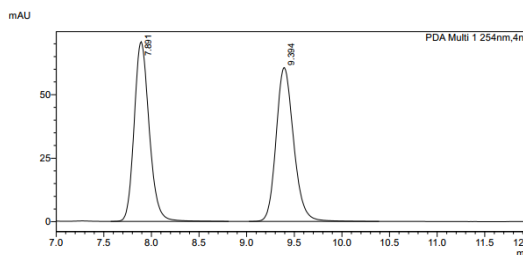
3.59–3.48 (m, 1H), 3.20 (dd, *J* = 17.9, 9.1 Hz, 1H), 2.20 (dd, *J* = 13.4, 7.8 Hz, 1H), 2.10–1.97 (m, 3H), 1.88–1.78 (m, 2H), 1.73–1.62 (m, 2H), 1.46 (d, *J* = 6.8 Hz, 3H);

¹³C NMR (100 MHz, CDCl₃) δ 196.1, 136.2, 133.8, 128.8, 128.2, 58.4, 51.7, 37.4, 27.4, 26.2, 26.1, 26.0, 14.6; HRMS (ESI) calcd for C₁₅H₂₀O₃NaS [M+Na]⁺: 303.1031, found: 303.1032; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, *t*_R = 7.887 min (minor), *t*_R = 9.380 min (major).



PDA Ch1 254nm

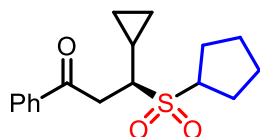
Peak#	Ret. Time	Area	Height	Aera%
1	7.887	37983	3517	3.583
2	9.380	1022090	79585	96.417



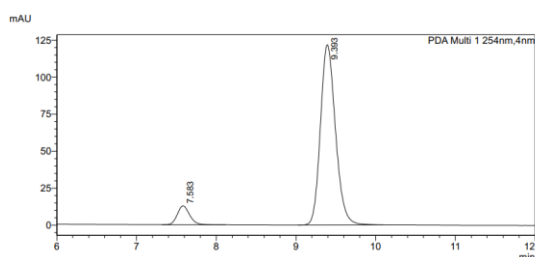
PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Aera%
1	7.891	776223	70695	50.008
2	9.394	775970	60498	49.992

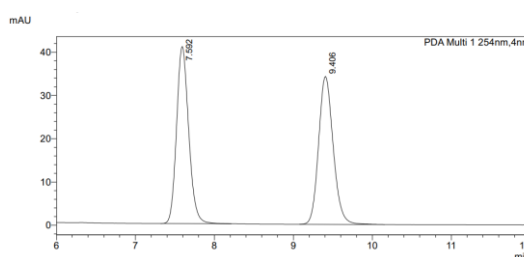
(S)-3-(cyclopentylsulfonyl)-3-cyclopropyl-1-phenylpropan-1-one (5e)



$[\alpha]_D^{20} = +9.8^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.06 – 7.93 (m, 2H), 7.60 (t, $J = 7.4$ Hz, 1H), 7.49 (t, $J = 7.6$ Hz, 2H), 3.93–3.81 (m, 1H), 3.80–3.67 (m, 1H), 3.35–3.22 (m, 2H), 2.25 (td, $J = 14.2, 7.1$ Hz, 1H), 2.14–2.00 (m, 2H), 2.01–1.90 (m, 1H), 1.91–1.75 (m, 2H), 1.74–1.56 (m, 2H), 1.21 (ddd, $J = 10.3, 6.7, 4.2$ Hz, 1H), 0.90–0.79 (m, 1H), 0.68 – 0.51 (m, 2H), 0.47 – 0.39 (m, 1H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 196.3, 136.4, 133.6, 128.8, 128.3, 60.7, 59.2, 36.7, 28.0, 26.2, 26.2, 25.9, 12.0, 6.5, 3.7; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 7.583$ min (minor), $t_R = 9.393$ min (major).

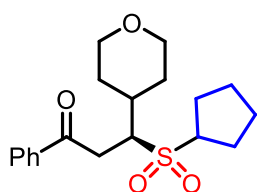


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	7.583	137049	12808	7.880
2	9.393	1602170	121683	92.120

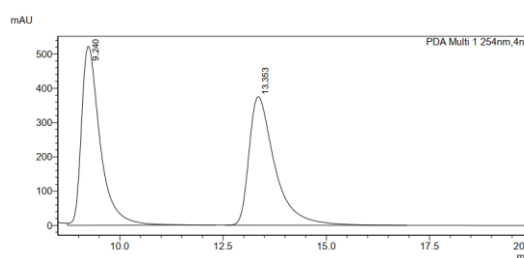
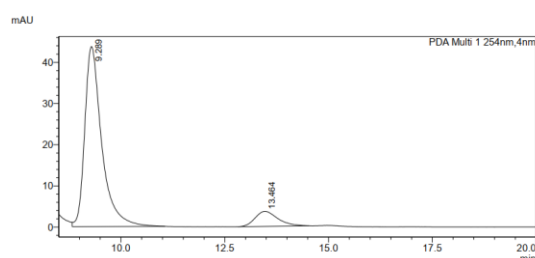


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	7.592	437220	40928	49.873
2	9.406	439450	34173	50.127

(S)-3-(cyclopentylsulfonyl)-1-phenyl-3-(tetrahydro-2H-pyran-4-yl)propan-1-one (5f)



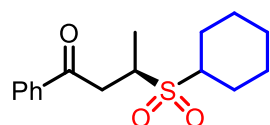
$[\alpha]_D^{20} = -9.4^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.02 (d, $J = 7.5$ Hz, 2H), 7.63 (t, $J = 7.4$ Hz, 1H), 7.51 (t, $J = 7.7$ Hz, 2H), 3.98 (dd, $J = 6.7, 3.4$ Hz, 3H), 3.77 (dd, $J = 19.0, 6.7$ Hz, 1H), 3.50–3.36 (m, 3H), 3.25 (dd, $J = 19.0, 3.9$ Hz, 1H), 2.64–2.58 (m, 1H), 2.17–2.04 (m, 3H), 1.94 (t, $J = 10.7$ Hz, 2H), 1.86–1.74 (m, 2H), 1.70–1.40 (m, 5H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 196.4, 135.9, 133.9, 128.9, 128.3, 67.9, 67.6, 61.1, 58.7, 34.4, 33.8, 30.9, 28.4, 27.5, 26.2, 26.1, 26.0; HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 9.289$ min (major), $t_R = 13.464$ min (minor).



PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	9.289	1244536	43717	89.944
2	13.464	139146	3649	10.056

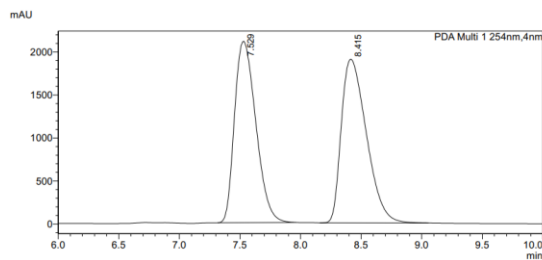
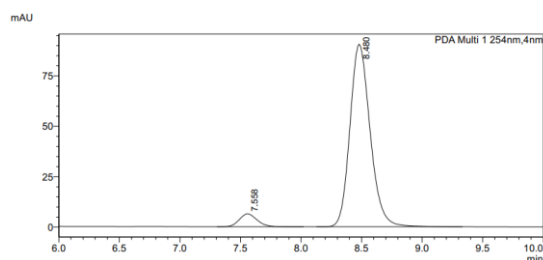
PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	9.240	16408297	522227	50.208
2	13.353	16272071	374383	49.792

(R)-3-(cyclohexylsulfonyl)-1-phenylbutan-1-one (5g)



$[\alpha]_D^{20} = +7.3^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3)

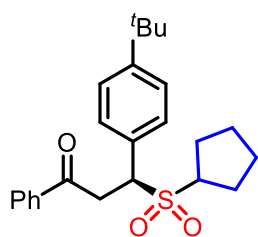
δ 8.07–7.92 (m, 2H), 7.61 (t, $J = 7.4$ Hz, 1H), 7.49 (t, $J = 7.7$ Hz, 2H), 3.95–3.90 (m, 1H), 3.72 (dd, $J = 18.0, 3.2$ Hz, 1H), 3.22 (dd, $J = 18.0, 9.2$ Hz, 1H), 3.03 (tt, $J = 12.1, 3.4$ Hz, 1H), 2.17 (dd, $J = 39.1, 12.8$ Hz, 2H), 1.96 (dd, $J = 15.4, 7.4$ Hz, 2H), 1.77–1.55 (m, 3H), 1.43 (d, $J = 6.8$ Hz, 3H), 1.36–1.22 (m, 3H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 196.1, 136.2, 133.8, 128.8, 128.2, 58.2, 49.5, 37.2, 25.6, 25.1, 25.1, 25.1, 23.9, 14.5; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{22}\text{O}_3\text{NaS}$ $[\text{M}+\text{Na}]^+$: 317.1187, found: 317.1192. HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 7.558$ min (minor), $t_R = 8.480$ min (major).



PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	7.558	65459	6359	5.844
2	8.480	1054689	90507	94.156

PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	7.529	25922092	2110443	48.538
2	8.415	27483541	1905274	51.462

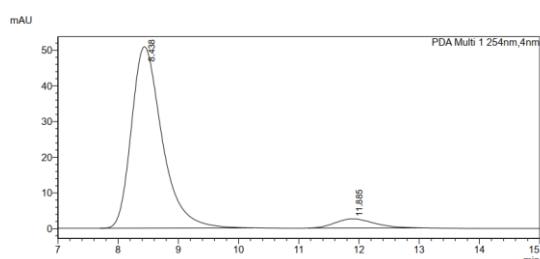
(S)-3-(4-(tert-butyl)phenyl)-3-(cyclopentylsulfonyl)-1-phenylpropan-1-one (5h)



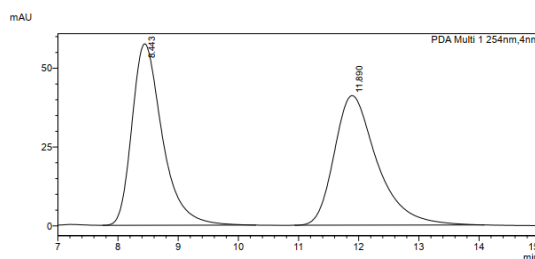
$[\alpha]_D^{20} = -65.9^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3)

δ 7.95 (d, $J = 7.5$ Hz, 2H), 7.55 (t, $J = 7.4$ Hz, 1H), 7.49–7.41 (m, 4H), 7.37 (d, $J = 8.3$ Hz, 2H), 4.96 (dd, $J = 9.4, 3.3$ Hz, 1H), 4.07 (dd, $J = 18.0, 3.3$ Hz, 1H), 3.81 (dd, $J = 18.0, 9.5$ Hz, 1H), 3.10 (dd, $J = 11.4, 4.2$ Hz, 1H), 2.20–1.90 (m, 3H), 1.88–1.67 (m, 3H), 1.66–1.48 (m, 2H), 1.29 (s, 9H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 195.3, 152.0, 136.2, 133.6, 130.4, 129.1, 128.7, 128.2, 126.0, 61.5, 58.2, 37.0, 34.6, 31.2,

28.0, 26.2, 26.1, 25.5; HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, t_R = 8.438 min (major), t_R = 11.885 min (minor).

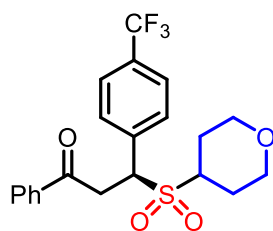


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	8.438	1803285	50836	93.834
2	11.885	118507	2583	6.166

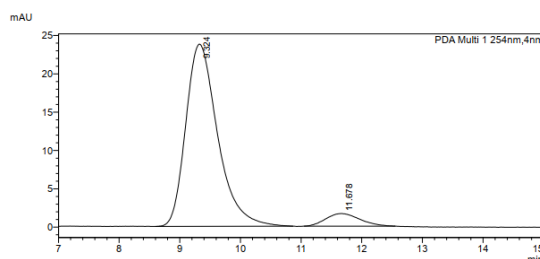


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	8.443	2017230	57513	49.733
2	11.890	2038927	41069	50.267

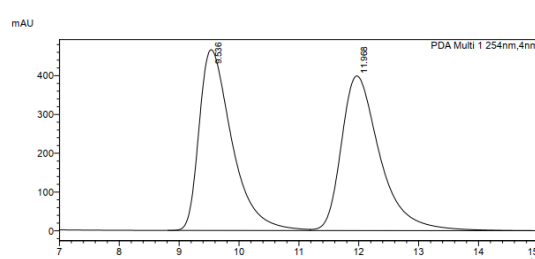
(S)-3-(cyclopentylsulfonyl)-1-phenyl-3-(4-(trifluoromethyl)phenyl)propan-1-one (5i)



$[\alpha]_D^{20}$ = -10.3° (c = 0.10, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.94 (d, *J* = 7.4 Hz, 2H), 7.71 (d, *J* = 8.2 Hz, 2H), 7.64 (d, *J* = 8.3 Hz, 2H), 7.59 (t, *J* = 7.4 Hz, 1H), 7.46 (t, *J* = 7.7 Hz, 2H), 5.01 (dd, *J* = 9.9, 3.2 Hz, 1H), 4.12 (dd, *J* = 18.1, 3.2 Hz, 1H), 3.83 (dd, *J* = 18.1, 9.9 Hz, 1H), 3.06 (t, *J* = 7.9 Hz, 1H), 2.10 (dt, *J* = 19.8, 6.4 Hz, 2H), 1.96 (d, *J* = 8.3 Hz, 1H), 1.88–1.71 (m, 3H), 1.67–1.46 (m, 2H); ¹³C NMR (100 MHz, CDCl₃) δ 194.9, 137.7, 135.9, 133.9, 131.3, 131.0, 130.1, 128.8, 128.2, 126.0, 126.0, 125.1, 122.4, 61.6, 58.8, 37.2, 28.0, 26.1, 26.0, 25.6; HPLC analysis: CHIRALPAK AS-H (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, t_R = 9.324 min (major), t_R = 11.678 min (minor).

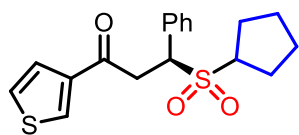


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	9.324	869132	23774	93.127
2	11.678	64145	1648	6.873

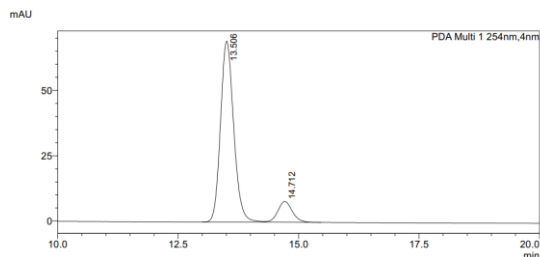


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	9.536	17715041	465887	49.816
2	11.968	17845892	398496	50.184

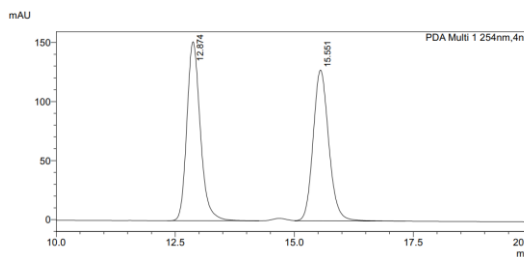
(S)-3-(cyclopentylsulfonyl)-3-phenyl-1-(thiophen-3-yl)propan-1-one (5j)



$[\alpha]_D^{20} = -45.1^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.96 (d, $J = 7.6$ Hz, 2H), 7.58 (t, $J = 7.4$ Hz, 1H), 7.46 (t, $J = 7.7$ Hz, 2H), 7.32 (d, $J = 5.1$ Hz, 1H), 7.00 (dd, $J = 4.8, 3.9$ Hz, 1H), 5.26 (dd, $J = 9.7, 3.2$ Hz, 1H), 4.05 (dd, $J = 17.8, 3.3$ Hz, 1H), 3.82 (dd, $J = 17.8, 9.7$ Hz, 1H), 3.27 (t, $J = 7.8$ Hz, 1H), 2.17–1.97 (m, 3H), 1.89–1.72 (m, 3H), 1.69–1.52 (m, 2H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 194.9, 136.1, 135.3, 133.8, 128.8, 128.2, 127.3, 127.1, 58.1, 57.6, 38.0, 28.2, 26.1, 26.1, 25.5; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 13.506$ min (major), $t_R = 14.712$ min (minor).

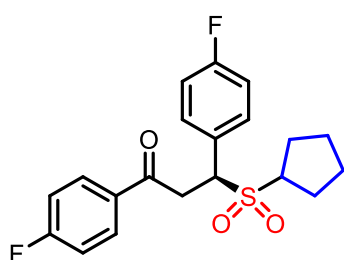


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	13.506	1319279	69238	88.735
2	14.712	167488	7950	11.265



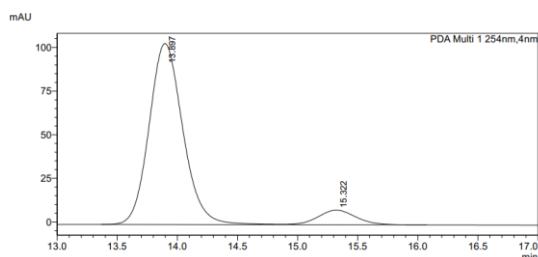
PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	12.874	2976074	151565	50.443
2	15.551	2923850	127887	49.557

(S)-3-(cyclopentylsulfonyl)-1,3-bis(4-fluorophenyl)propan-1-one (5k)

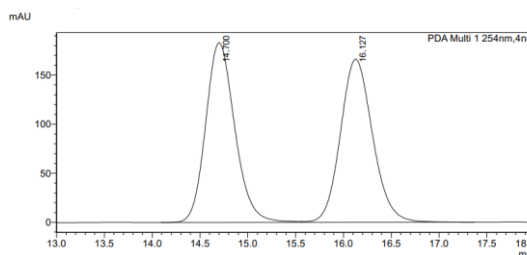


$[\alpha]_D^{20} = -39.8^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.03 – 7.91 (m, 2H), 7.54 (dd, $J = 8.6, 5.3$ Hz, 2H), 7.10 (dt, $J = 21.3, 8.6$ Hz, 4H), 4.93 (dd, $J = 9.7, 3.3$ Hz, 1H), 4.05 (dd, $J = 17.9, 3.3$ Hz, 1H), 3.73 (dd, $J = 17.9, 9.7$ Hz, 1H), 3.08 (dd, $J = 11.5, 4.2$ Hz, 1H), 2.15–1.99 (m, 2H), 1.98–1.93 (m, 1H), 1.86–1.68 (m, 3H), 1.64–1.52 (m, 2H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 193.6, 167.4, 164.8, 164.3, 161.8, 132.5, 132.5, 131.4, 131.3, 130.9, 130.8, 129.4, 129.3, 116.3, 116.1, 115.8, 61.2, 58.5, 37.1, 27.9, 26.1, 26.0, 25.6; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate =

1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 13.897$ min (major), $t_R = 15.322$ min (minor).

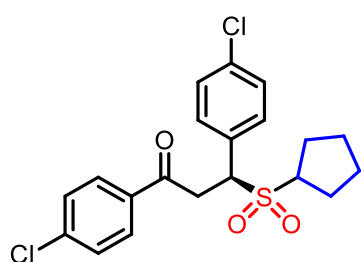


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	13.897	2025819	103785	91.678
2	15.322	183900	8344	8.322

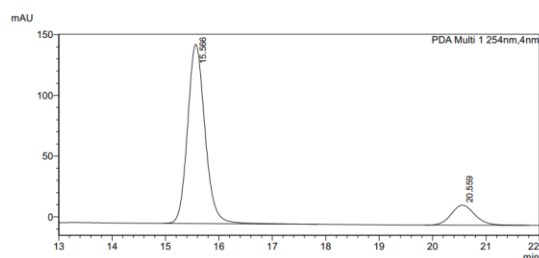


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	14.700	3884146	183079	49.913
2	16.127	3897634	166206	50.087

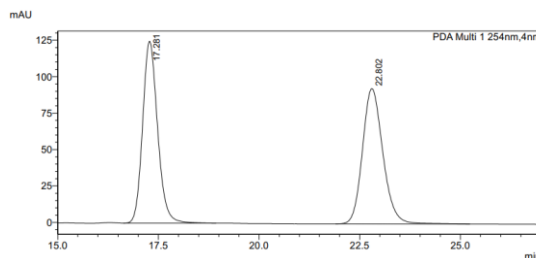
***(S)*-1,3-bis(4-chlorophenyl)-3-(cyclopentylsulfonyl)propan-1-one (5l)**



$[\alpha]_D^{20} = -69.3^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.88 (d, $J = 8.4$ Hz, 2H), 7.49 (d, $J = 8.4$ Hz, 2H), 7.43 (d, $J = 8.4$ Hz, 2H), 7.36 (d, $J = 8.3$ Hz, 2H), 4.89 (dd, $J = 9.7, 3.0$ Hz, 1H), 4.04 (dd, $J = 18.0, 3.1$ Hz, 1H), 3.72 (dd, $J = 18.0, 9.8$ Hz, 1H), 3.15 – 3.00 (m, 1H), 2.07 (dd, $J = 14.9, 7.6$ Hz, 2H), 1.94 (dd, $J = 13.4, 5.4$ Hz, 1H), 1.77 (dd, $J = 8.0, 3.9$ Hz, 3H), 1.66–1.49 (m, 2H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 193.9, 140.4, 135.2, 134.3, 132.0, 130.8, 129.6, 129.4, 129.1, 61.3, 58.6, 37.1, 27.9, 26.1, 26.0, 25.6; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 15.566$ min (major), $t_R = 20.559$ min (minor).

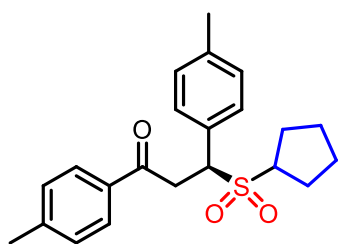


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	15.566	3354521	147690	86.913
2	20.559	505115	16412	13.087

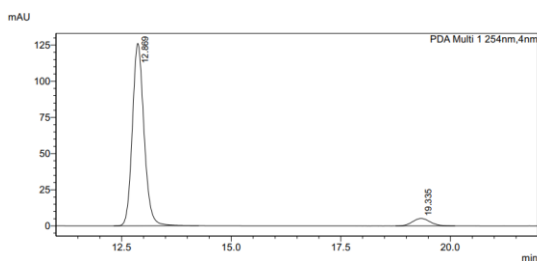


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	17.281	3238864	124831	49.699
2	22.802	3278042	92849	50.301

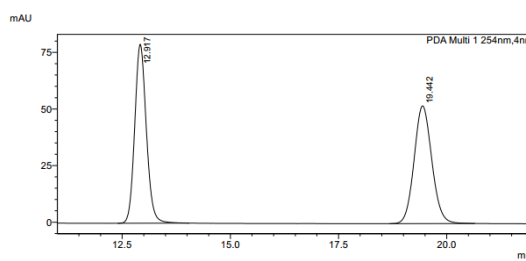
***(S)*-3-(cyclopentylsulfonyl)-1,3-di-*p*-tolylpropan-1-one (5m)**



$[\alpha]_D^{20} = -54.9^\circ$ ($c = 0.10$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 7.84 (d, $J = 8.2$ Hz, 2H), 7.42 (d, $J = 8.0$ Hz, 2H), 7.27–7.20 (m, 2H), 7.16 (d, $J = 7.9$ Hz, 2H), 4.91 (dd, $J = 9.8, 3.2$ Hz, 1H), 4.01 (dd, $J = 17.8, 3.3$ Hz, 1H), 3.79 (dd, $J = 17.8, 9.8$ Hz, 1H), 3.14–3.00 (m, 1H), 2.39 (s, 3H), 2.32 (s, 3H), 2.16–2.02 (m, 2H), 1.99–1.90 (m, 1H), 1.85–1.68 (m, 3H), 1.61–1.47 (m, 2H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 194.9, 144.5, 138.9, 133.8, 130.5, 129.7, 129.4, 128.3, 61.8, 58.3, 36.8, 28.0, 26.1, 26.1, 25.5, 21.7, 21.2; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{26}\text{O}_3\text{NaS}$ $[\text{M}+\text{Na}]^+$: 393.1500, found: 393.1497; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 12.869$ min (major), $t_R = 19.335$ min (minor).

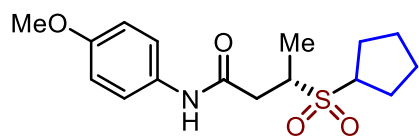


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	12.869	2340525	125959	94.162
2	19.335	145101	5204	5.838

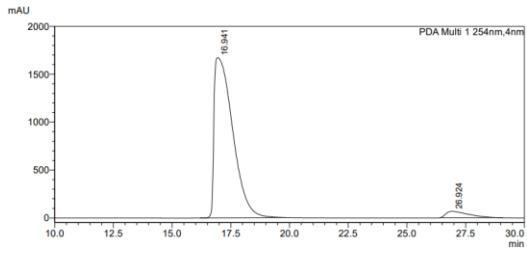


PDA Ch1 254nm				
Peak#	Ret. Time	Area	Height	Aera%
1	12.917	1479776	79007	49.966
2	19.442	1481816	51997	50.034

(S)-3-(cyclopentylsulfonyl)-*N*-(4-methoxyphenyl)butanamide (*3b'*)

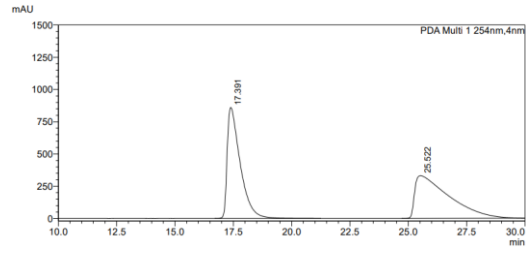


$[\alpha]_D^{20} = -2.4^\circ$ ($c = 0.24$, CHCl_3); $^1\text{H NMR}$ (400 MHz, CDCl_3) δ 8.1 (s, 1H), 7.43 (d, $J = 8.9$ Hz, 2H), 6.84 (d, $J = 8.9$ Hz, 2H), 3.82–3.70 (m, 4H), 3.58–3.49 (m, 1H), 3.12 (dd, $J = 15.4, 4.3$ Hz, 1H), 2.56 (dd, $J = 15.4, 9.1$ Hz, 1H), 2.21–1.94 (m, 4H), 1.89–1.75 (m, 2H), 1.72–1.61 (m, 2H), 1.46 (d, $J = 6.8$ Hz, 3H); $^{13}\text{C NMR}$ (100 MHz, CDCl_3) δ 167.2, 156.5, 130.9, 121.7, 114.1, 58.6, 55.4, 52.7, 36.1, 27.2, 26.3, 26.0, 26.0, 14.2; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{23}\text{NO}_4\text{NaS}$ $[\text{M}+\text{Na}]^+$: 348.1245, found: 348.1254; HPLC analysis: CHIRALPAK IA (Hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, 30 °C, $t_R = 16.941$ min (major), $t_R = 26.924$ min (minor).



PDA Ch1 254nm

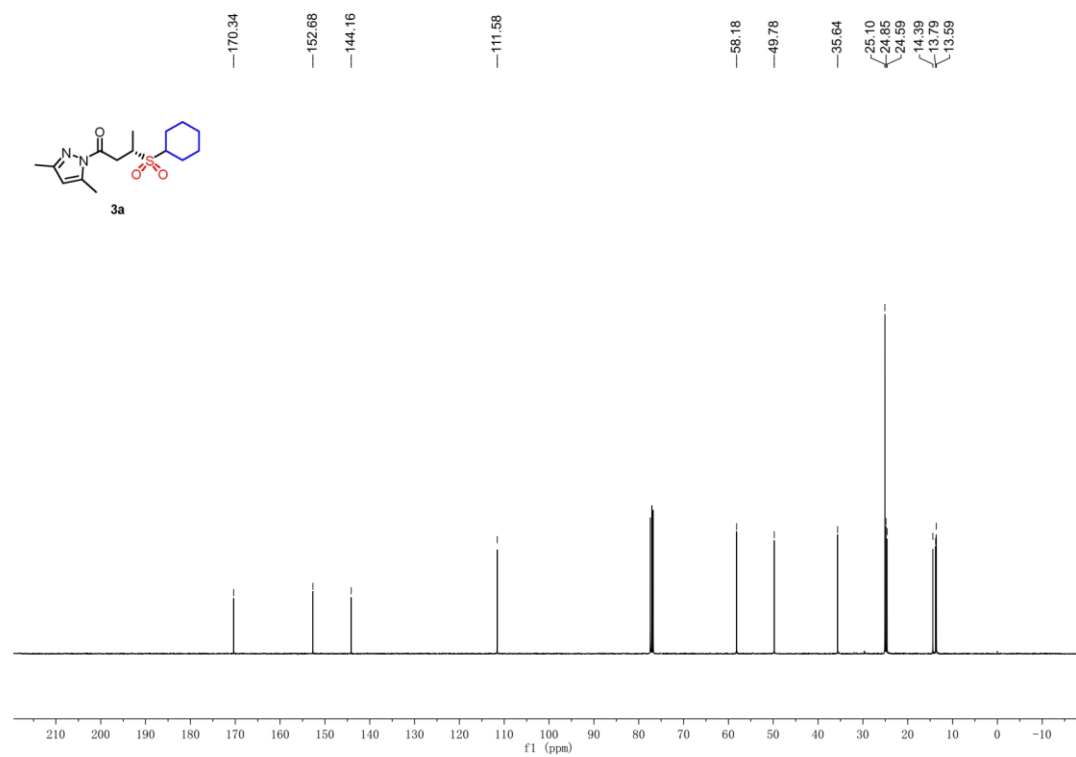
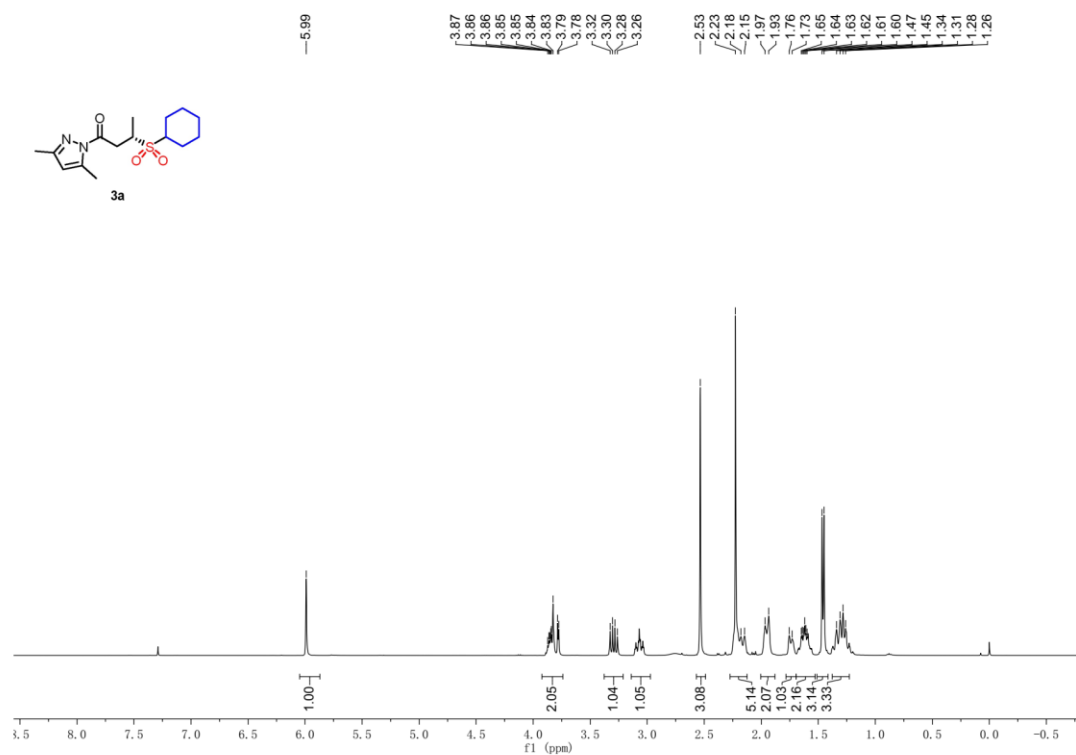
Peak#	Ret. Time	Area	Height	Aera%
1	16.941	92473846	1672700	95.381
2	26.924	4477926	66711	4.619

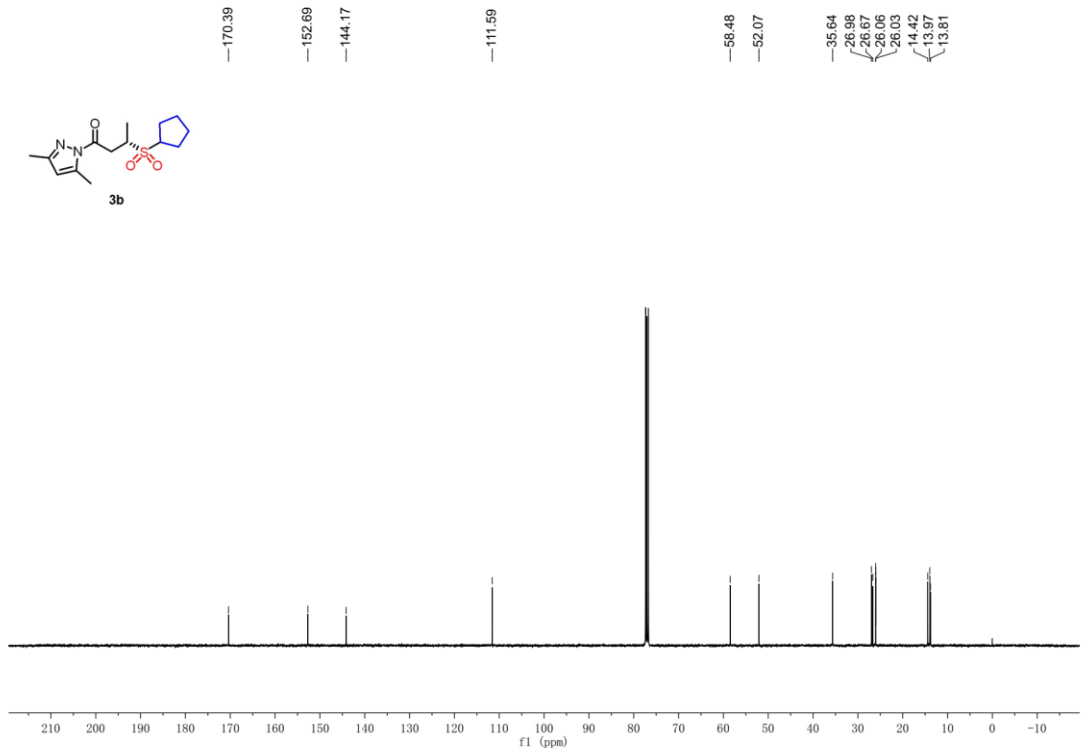
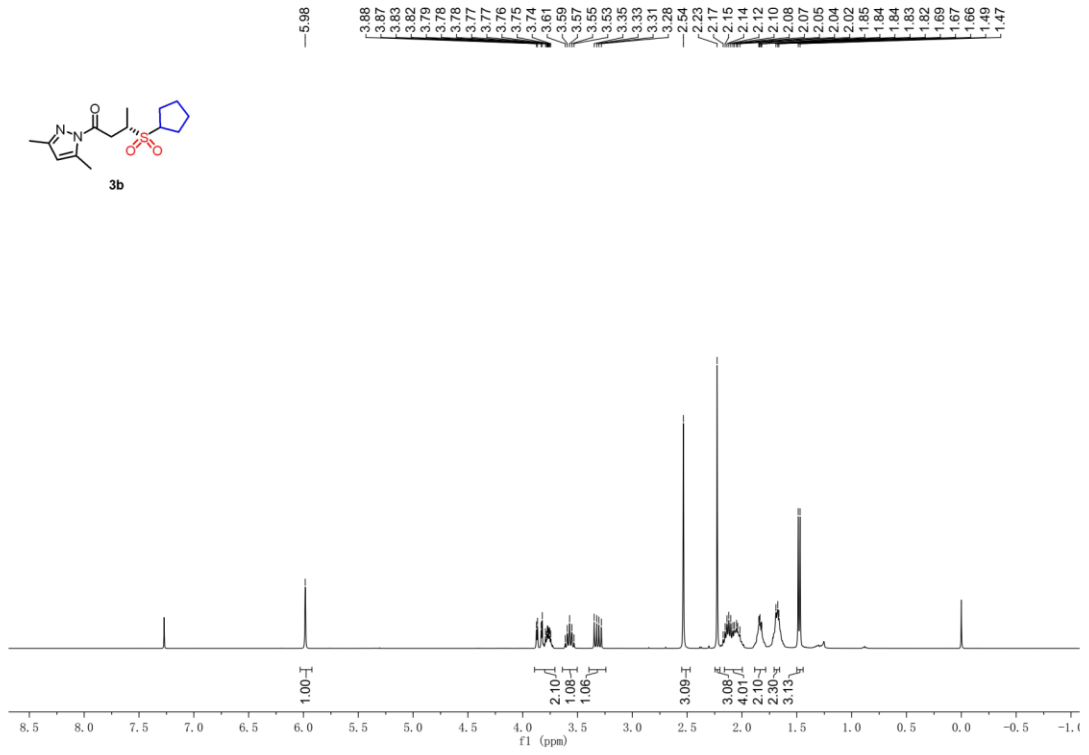


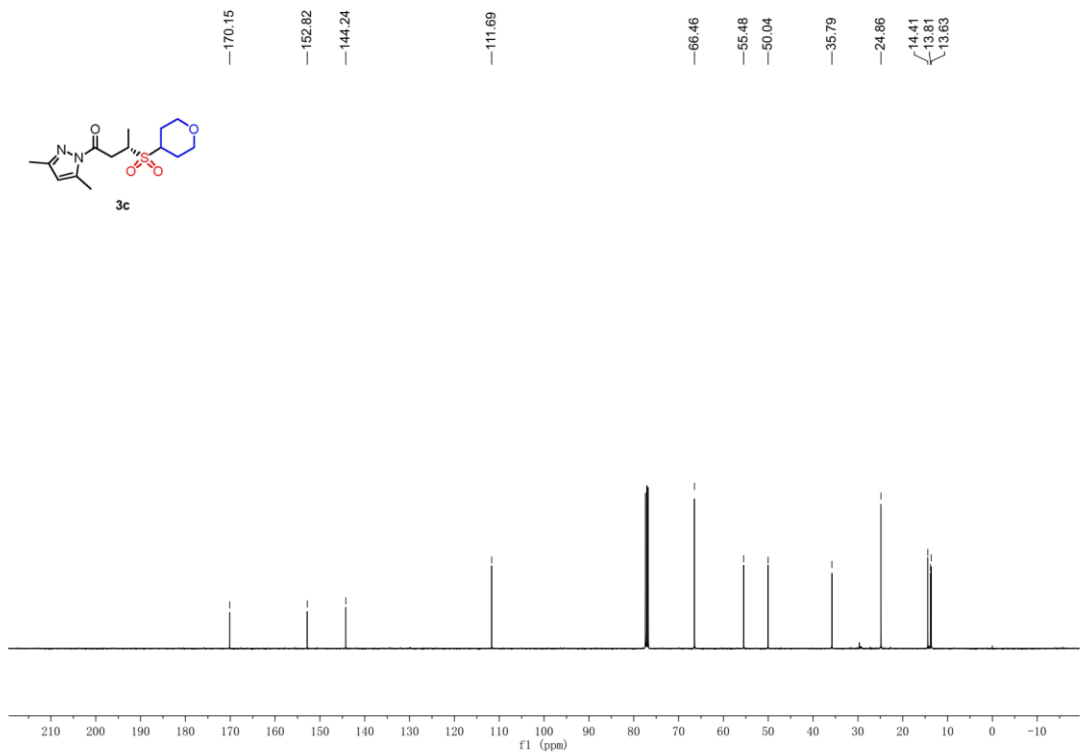
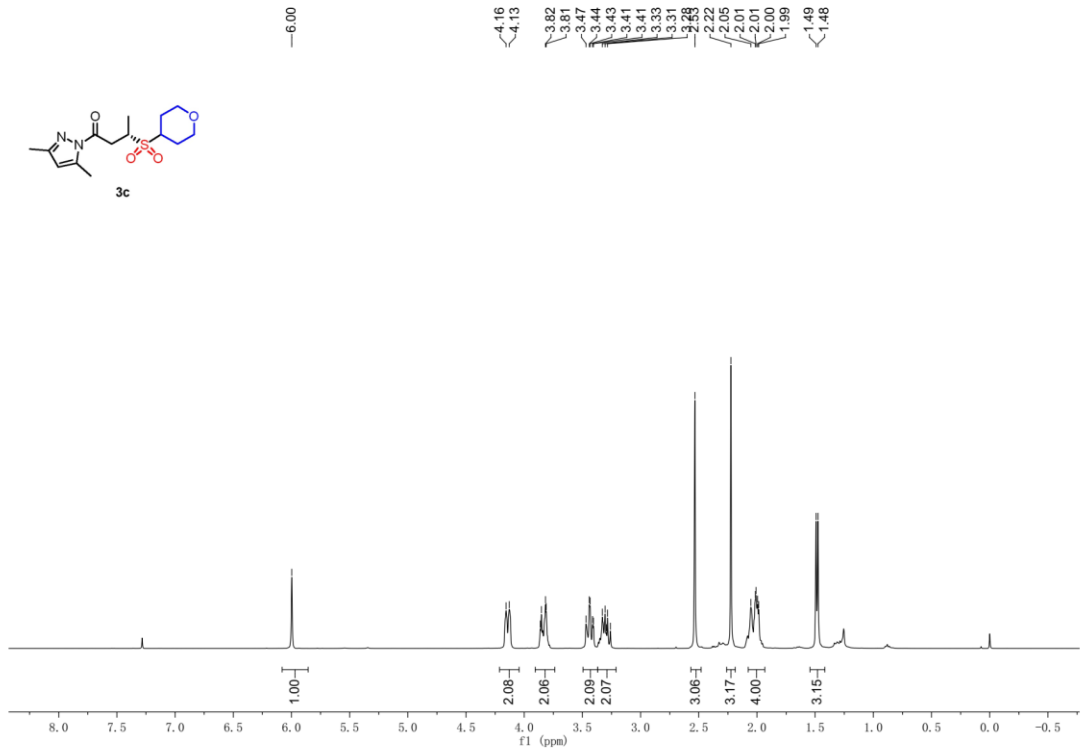
PDA Ch1 254nm

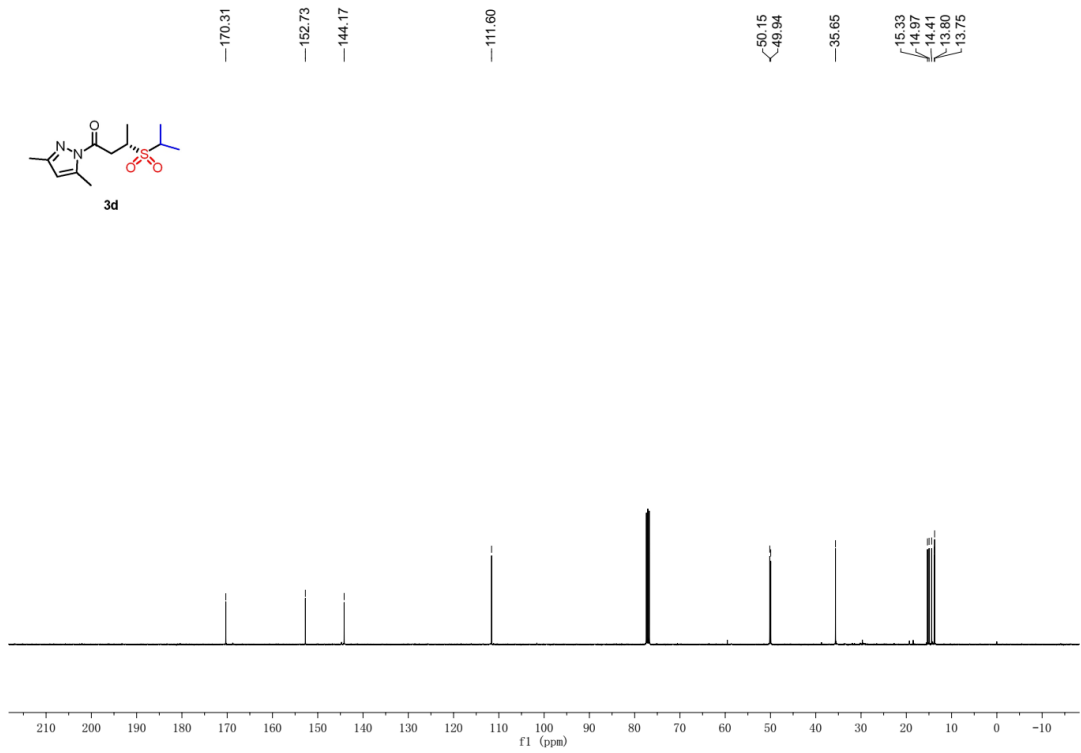
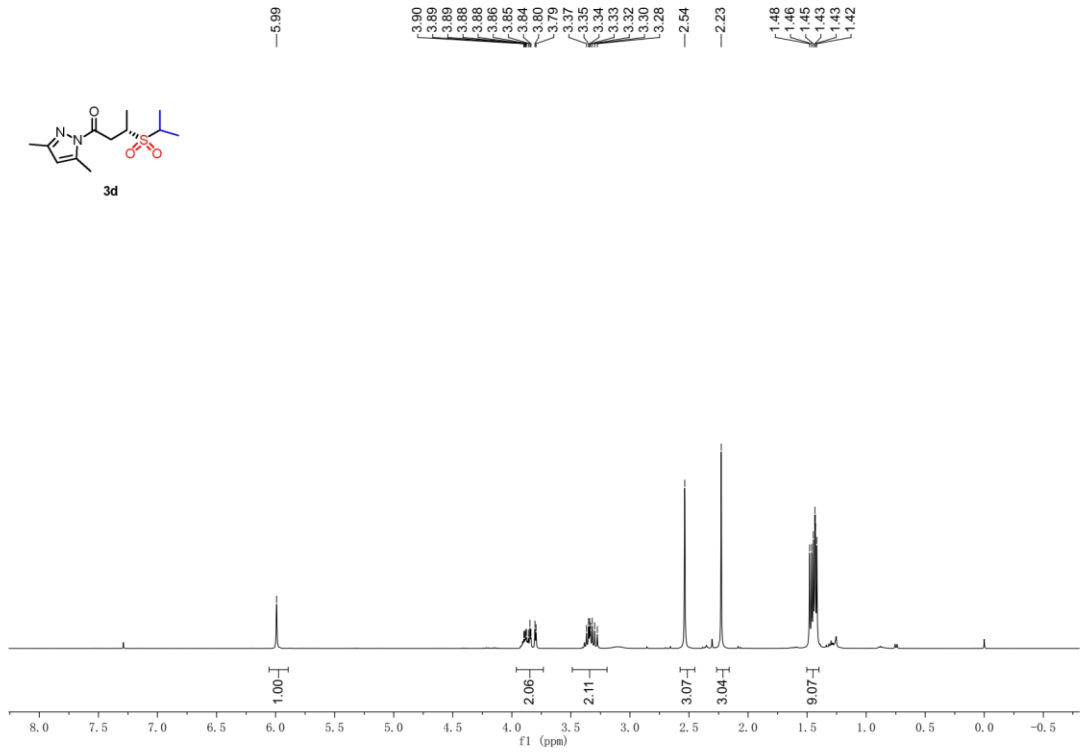
Peak#	Ret. Time	Area	Height	Aera%
1	17.391	33461197	860723	49.719
2	25.522	33839386	331255	50.281

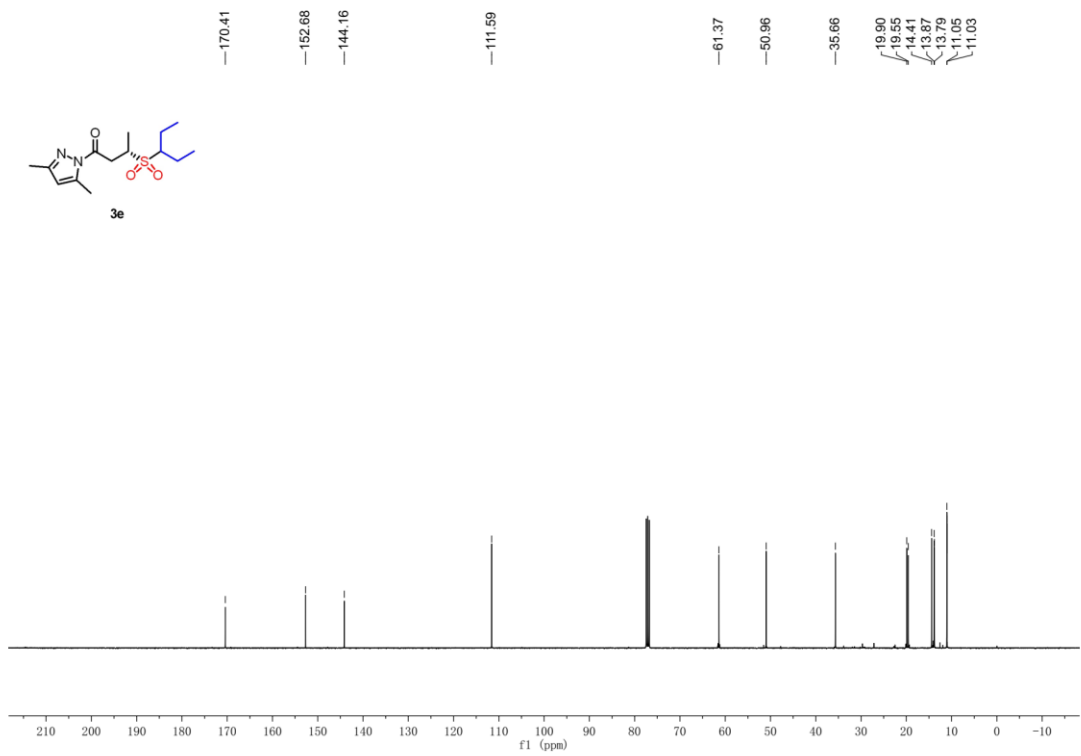
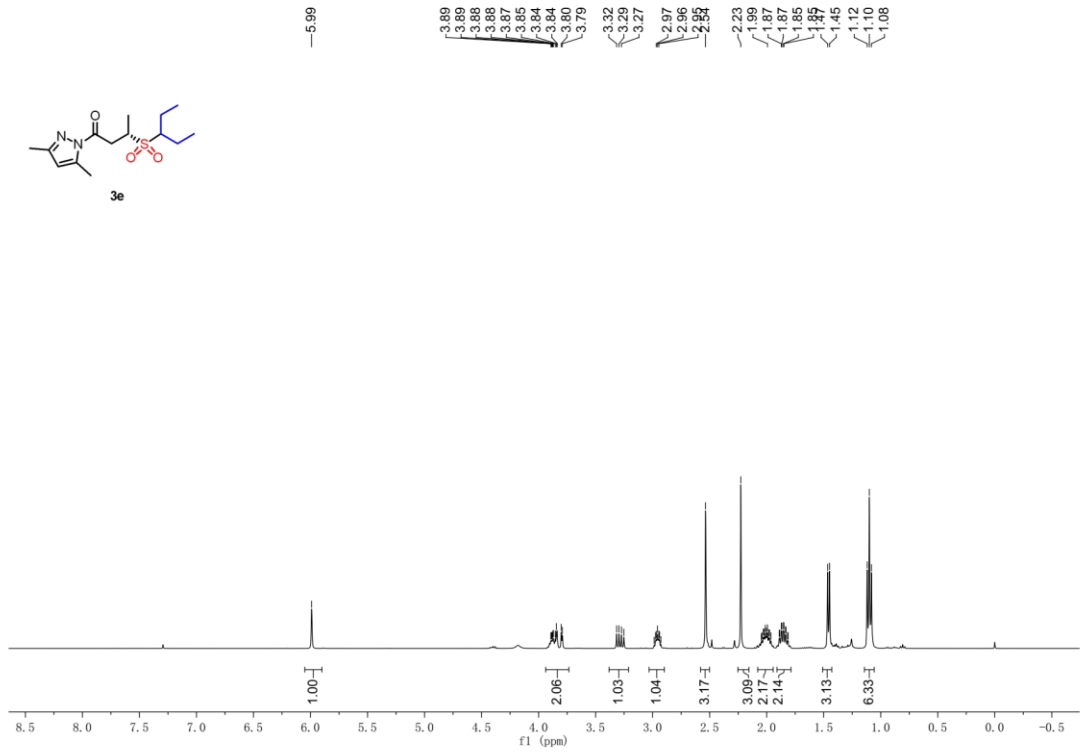
7. NMR spectra of compounds

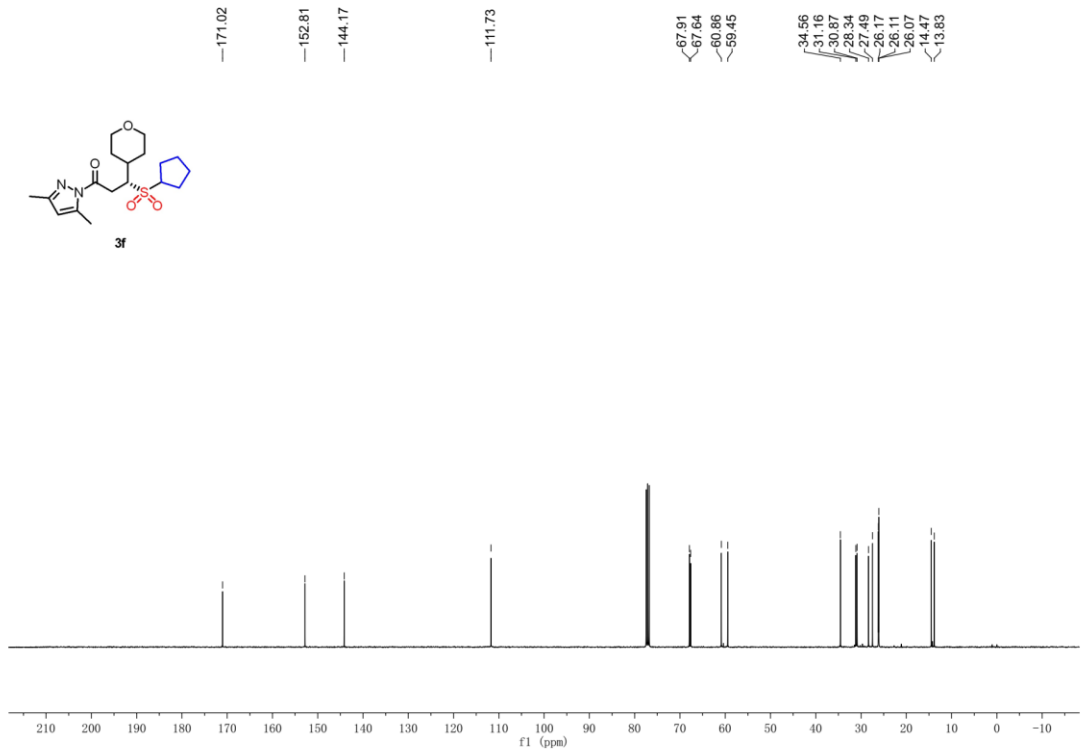
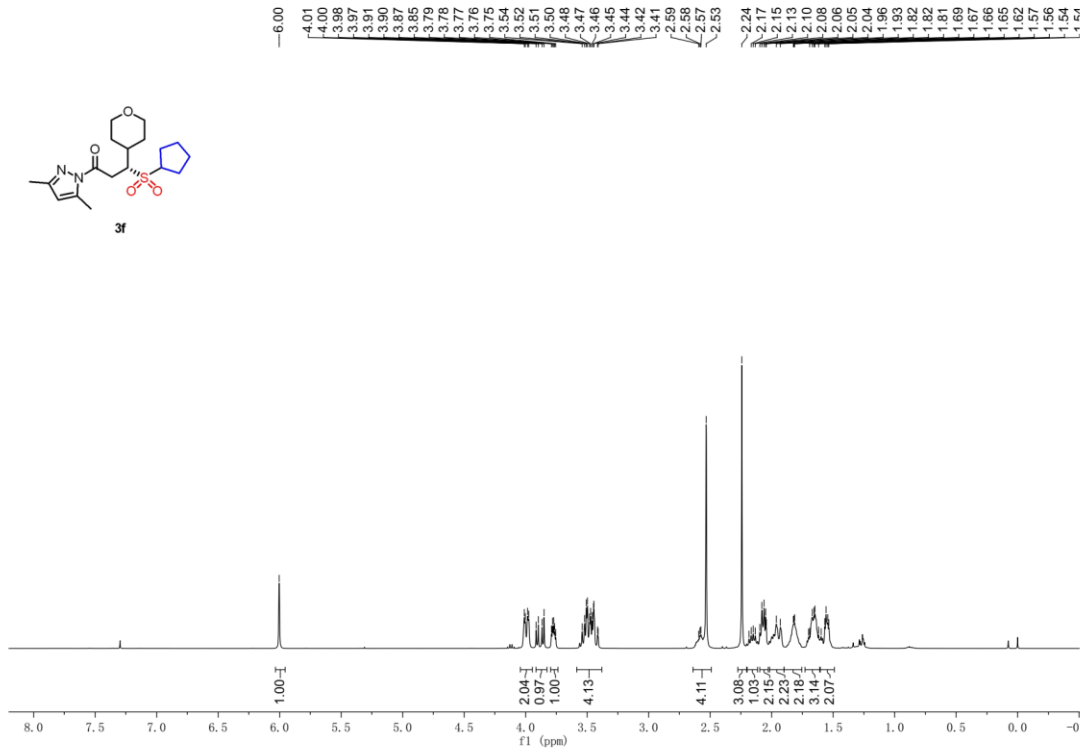


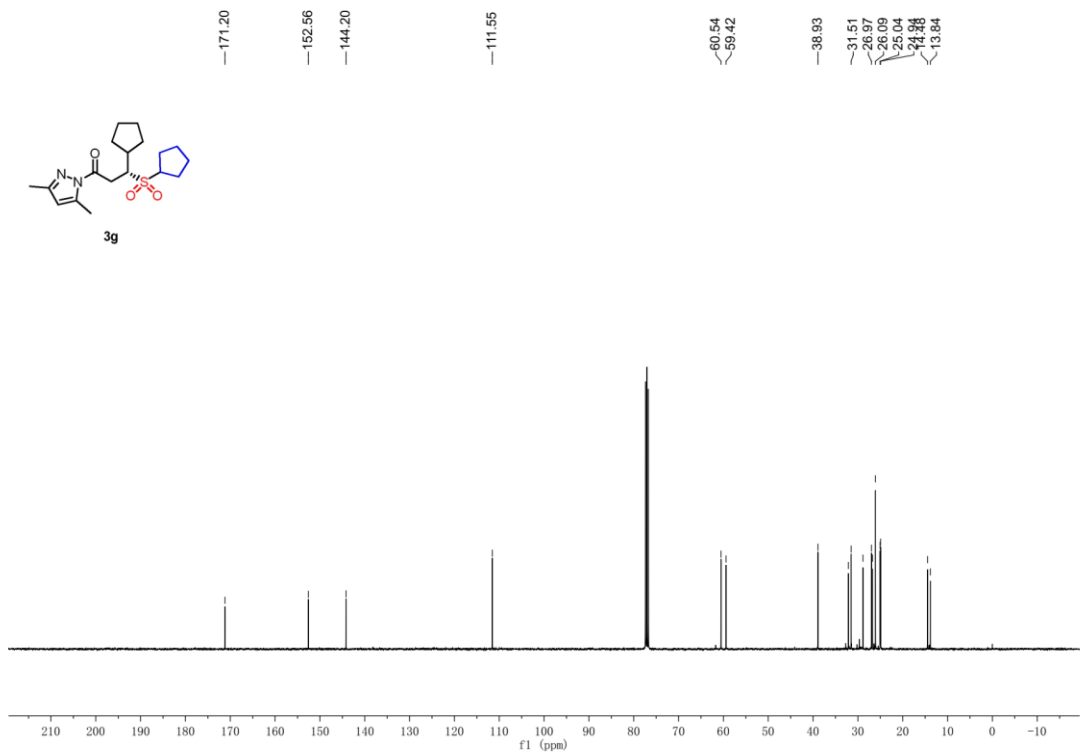
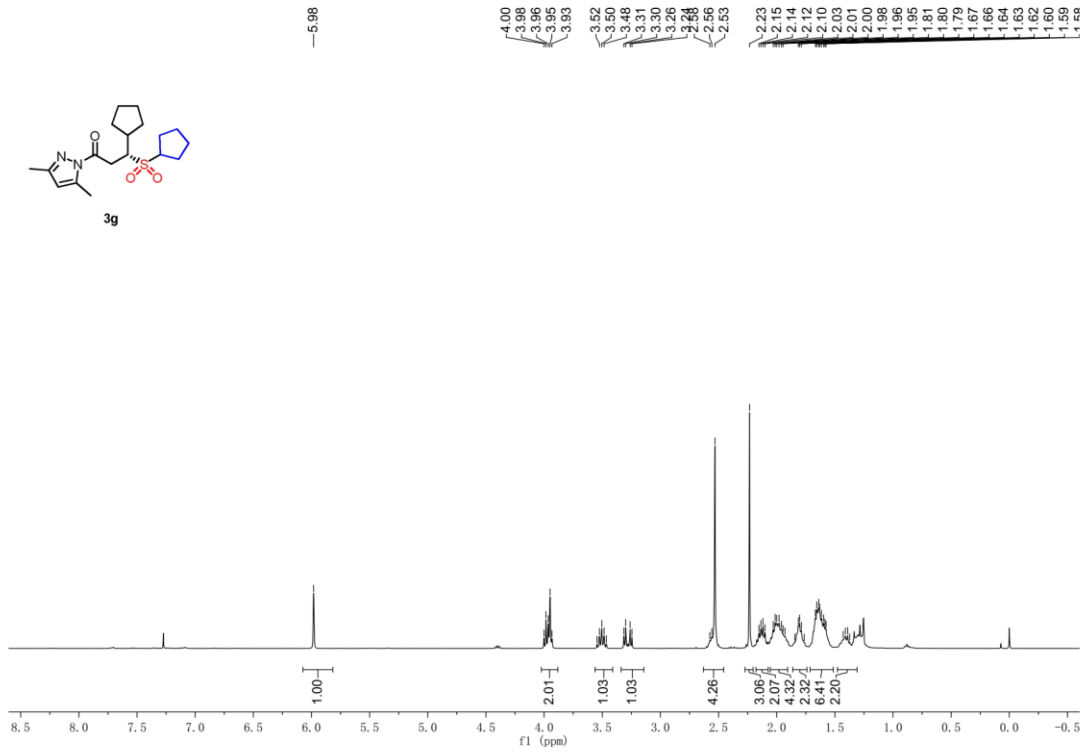


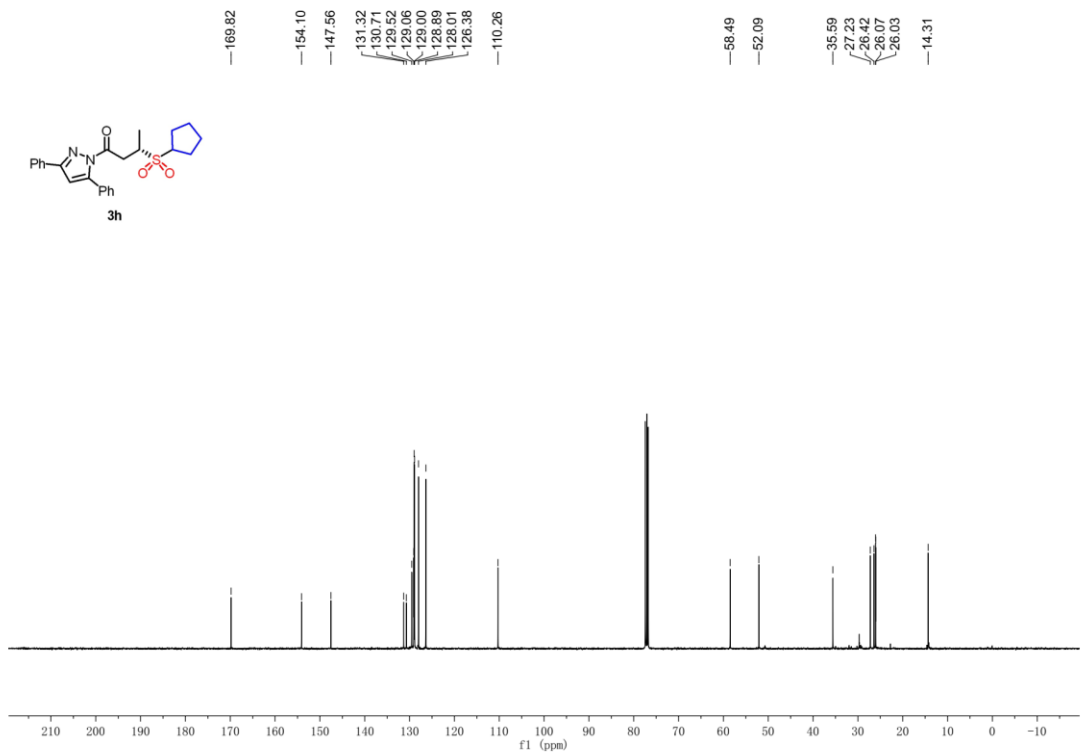
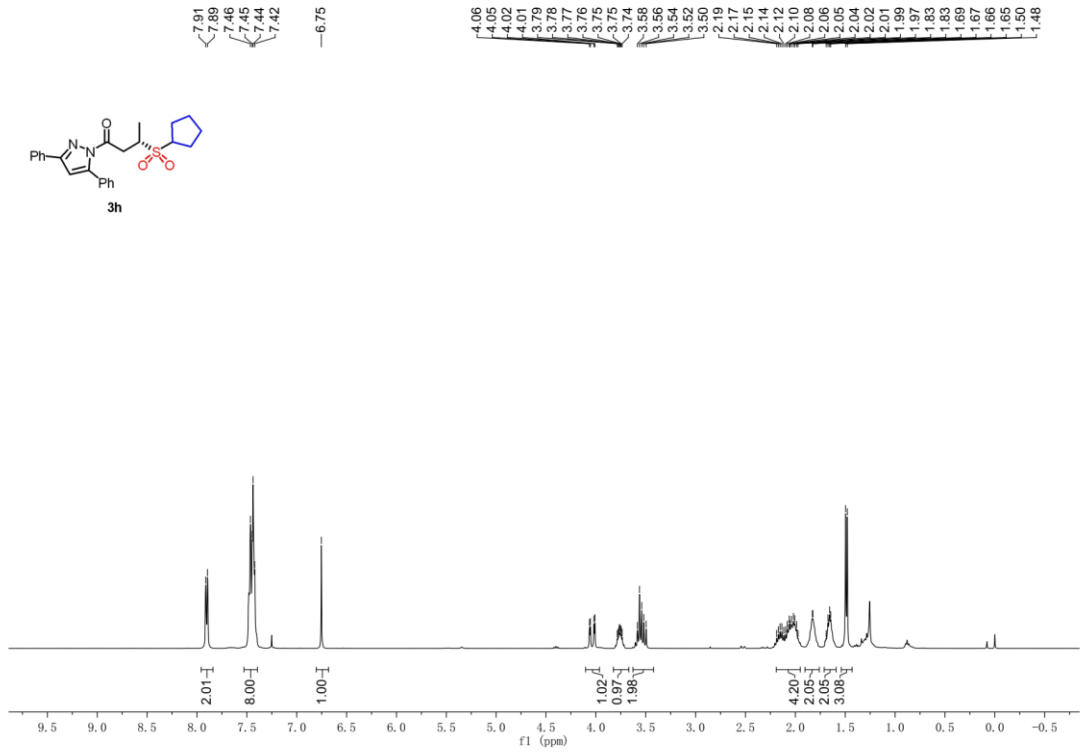


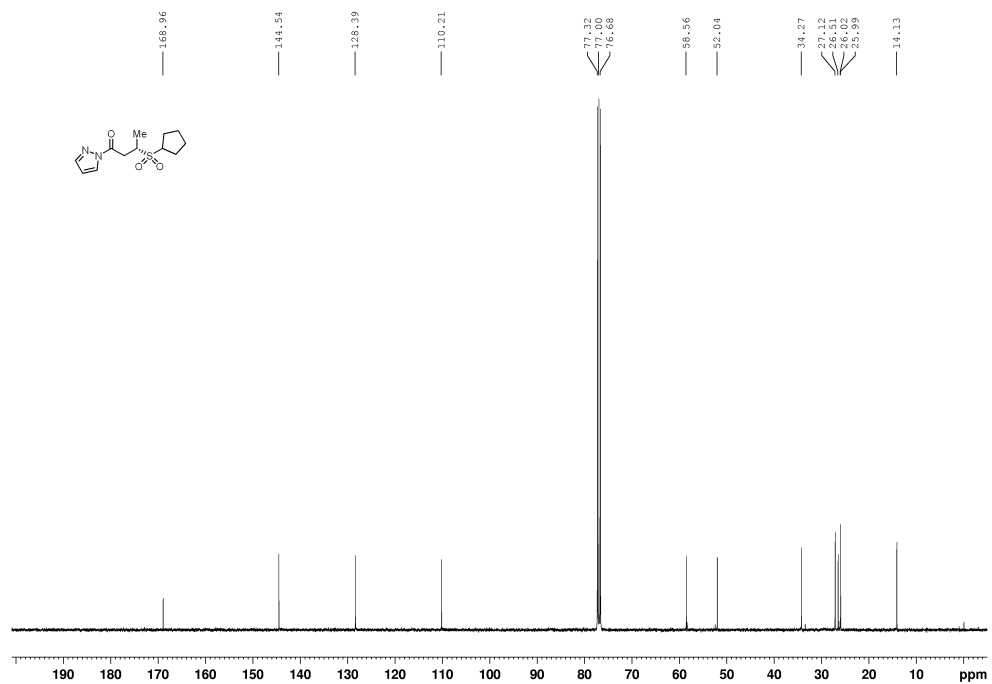
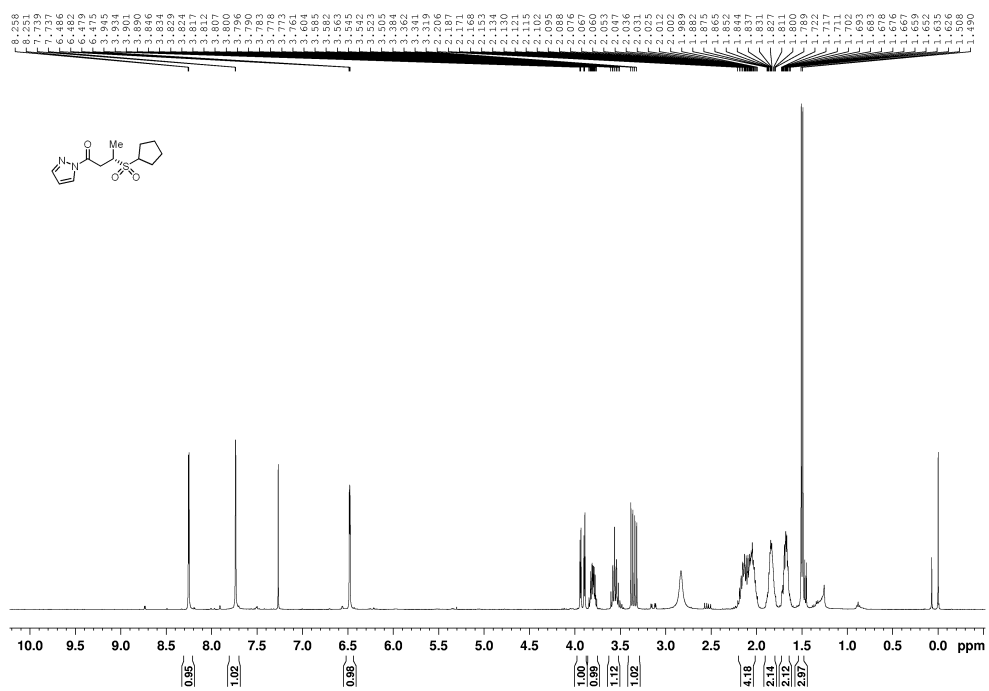


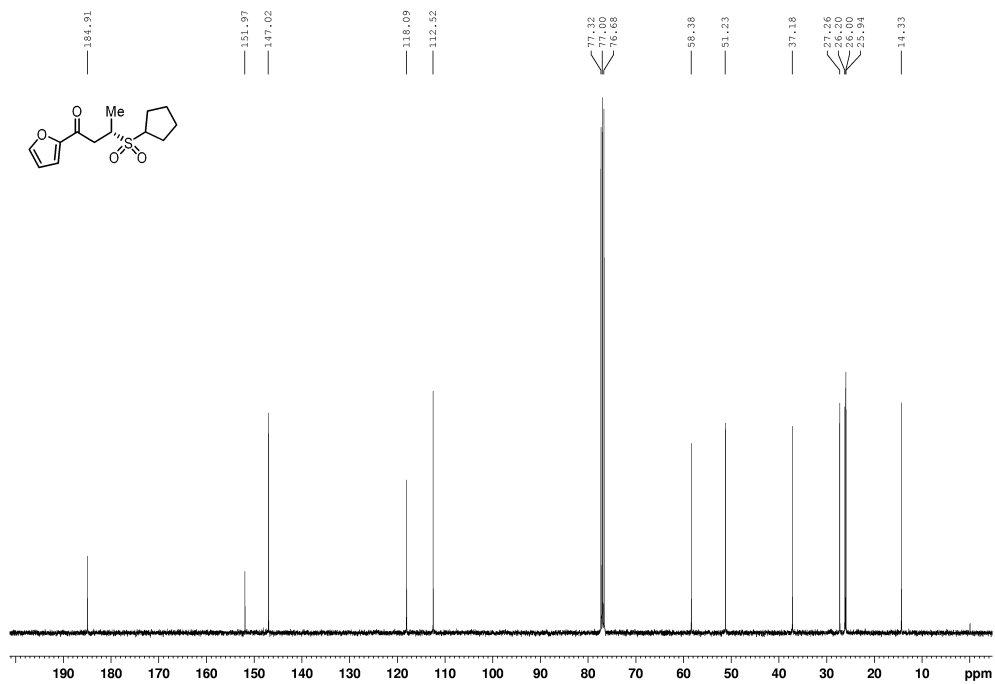
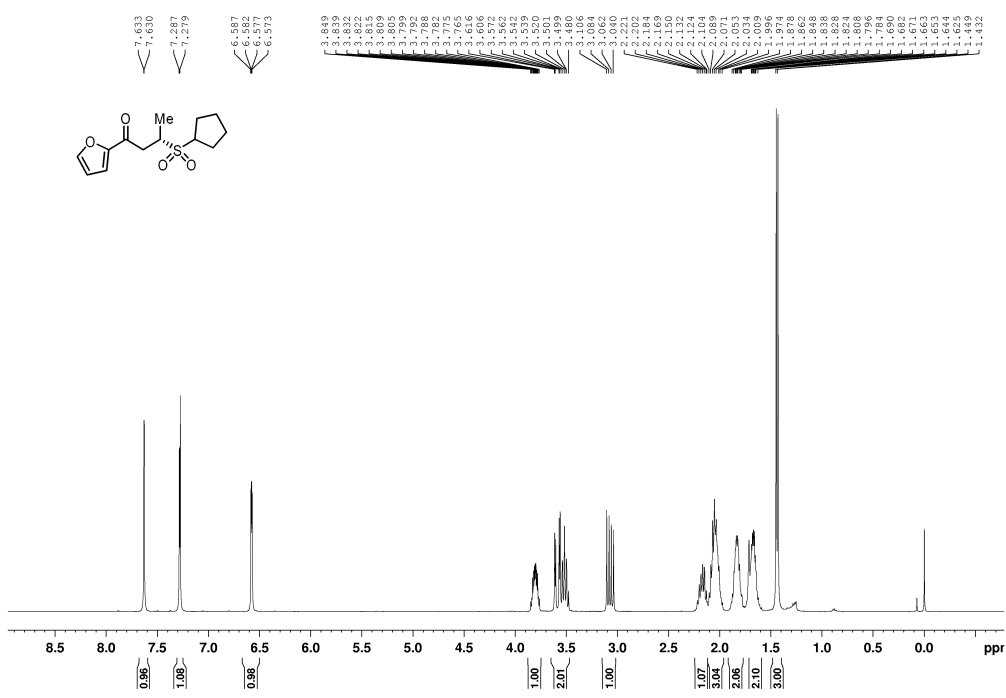


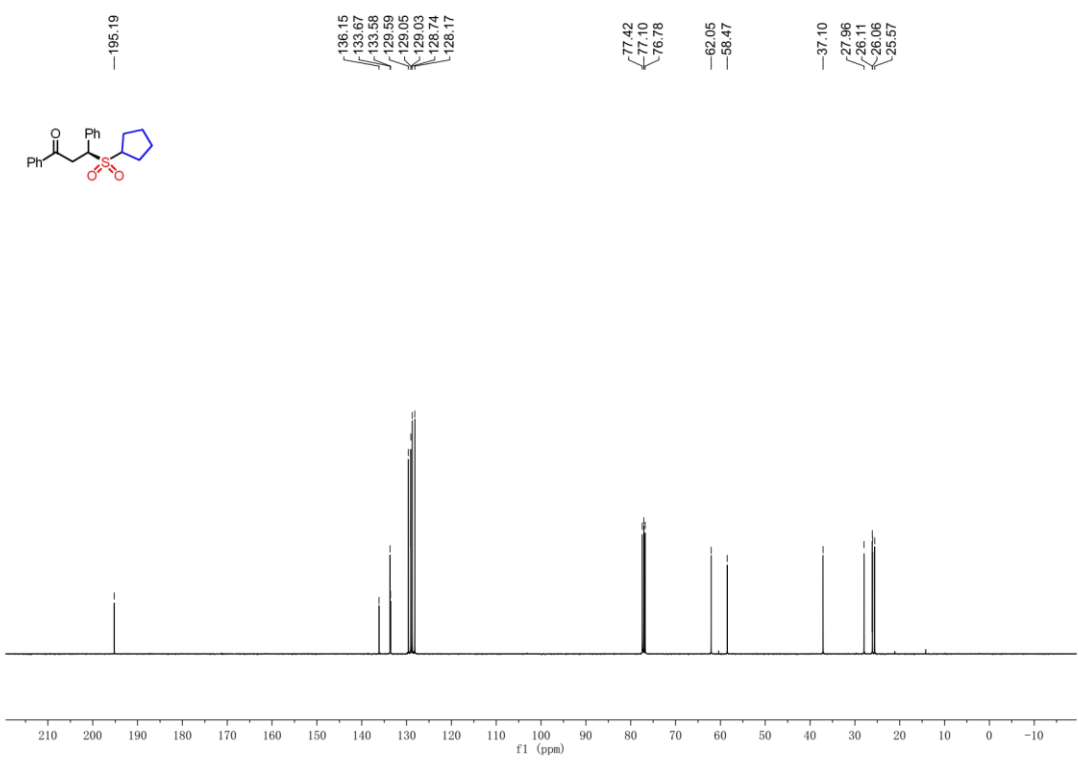
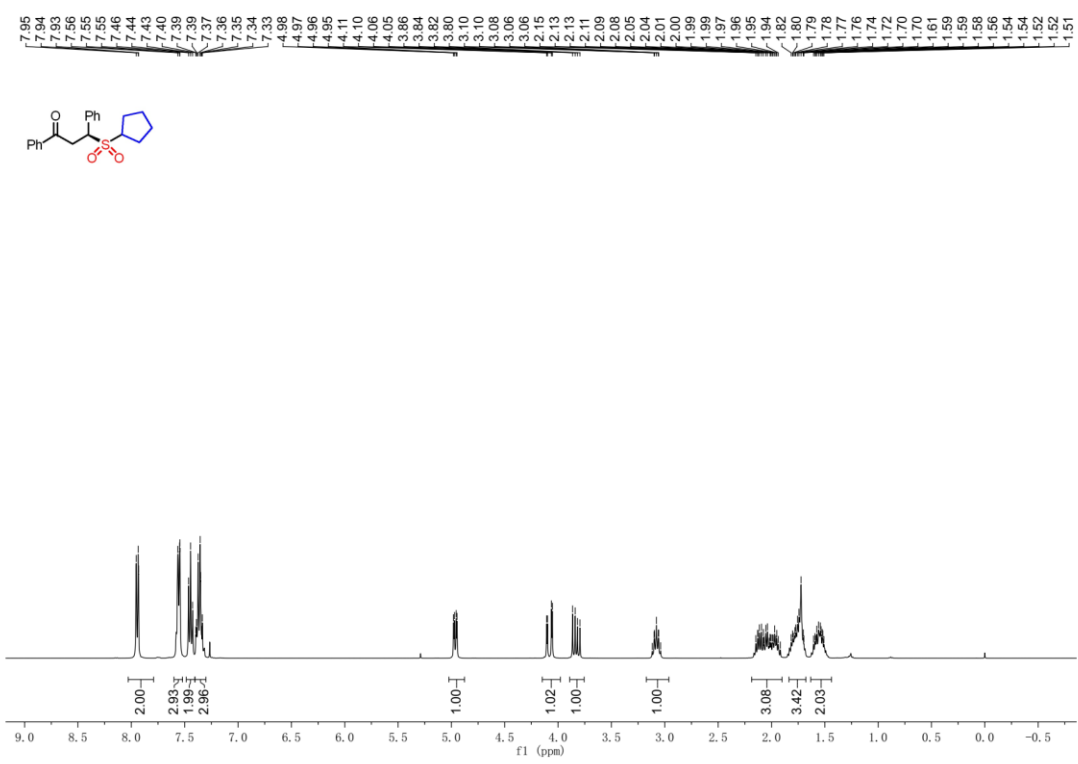


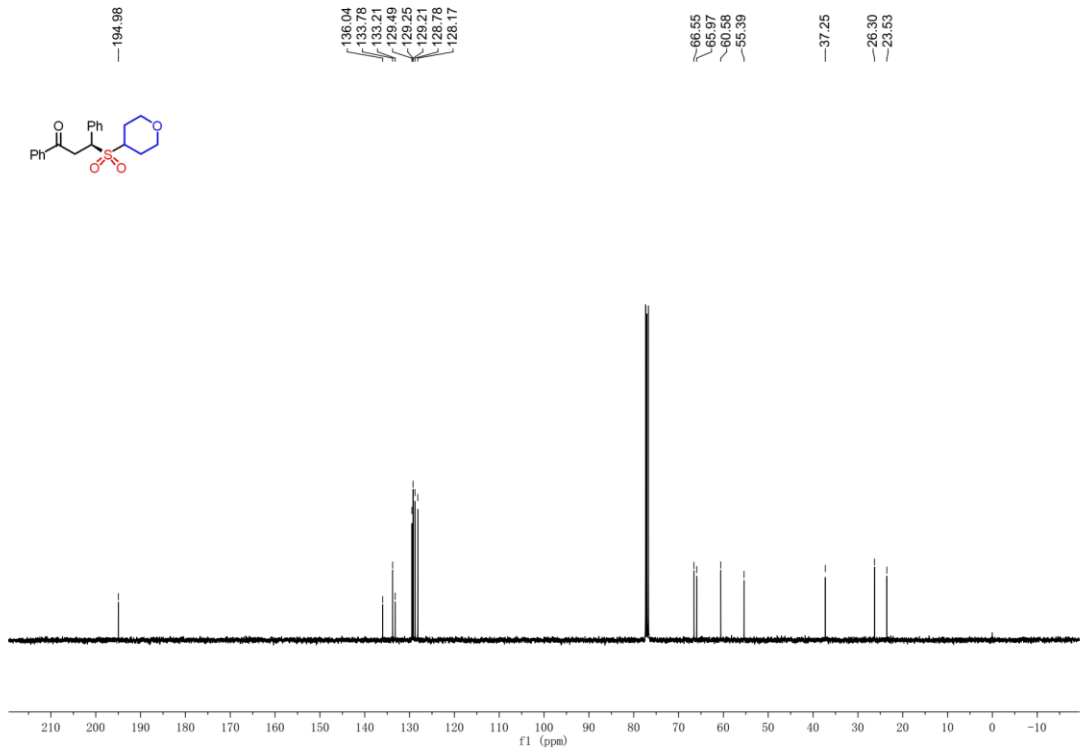
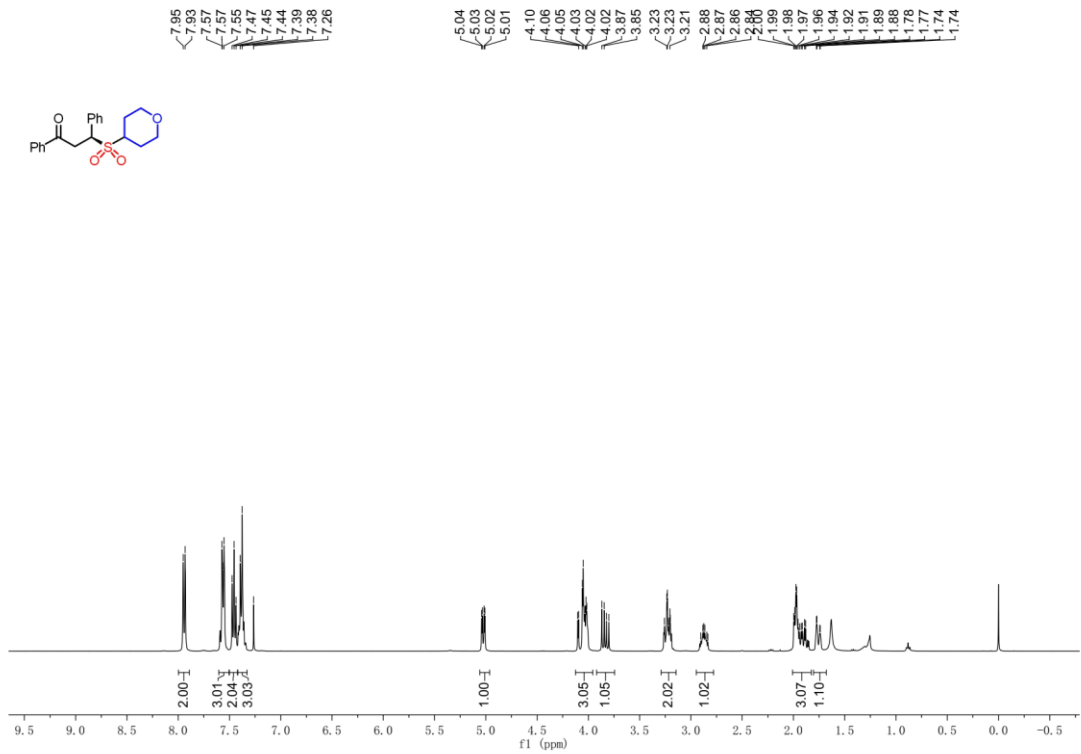


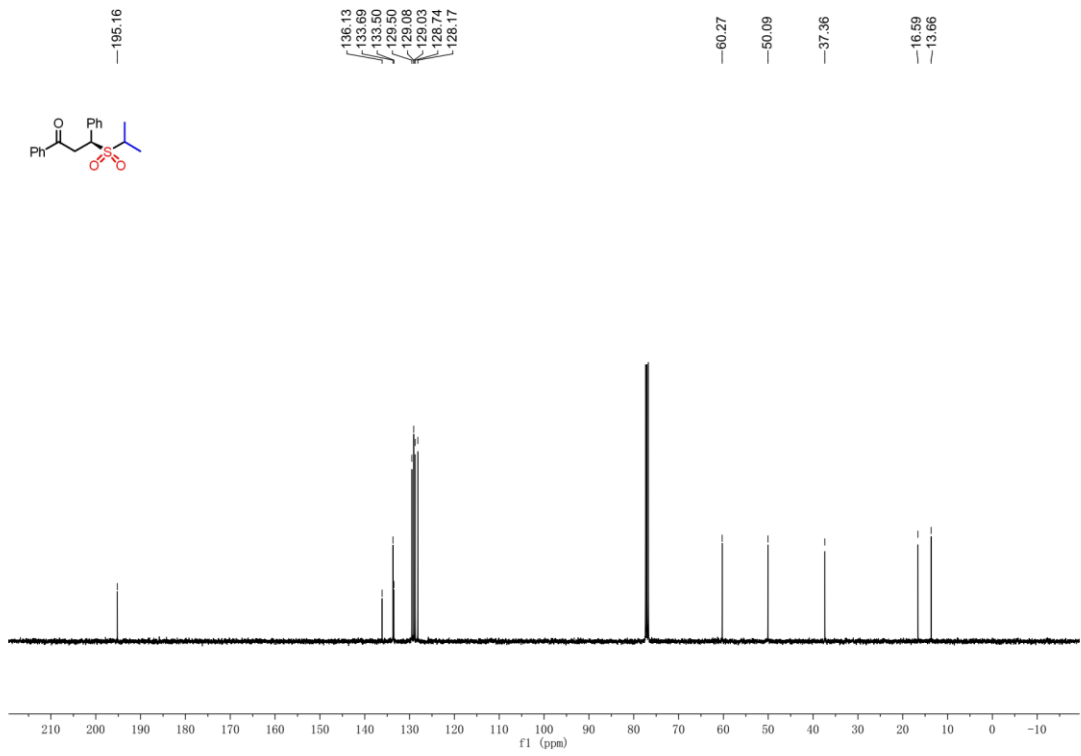
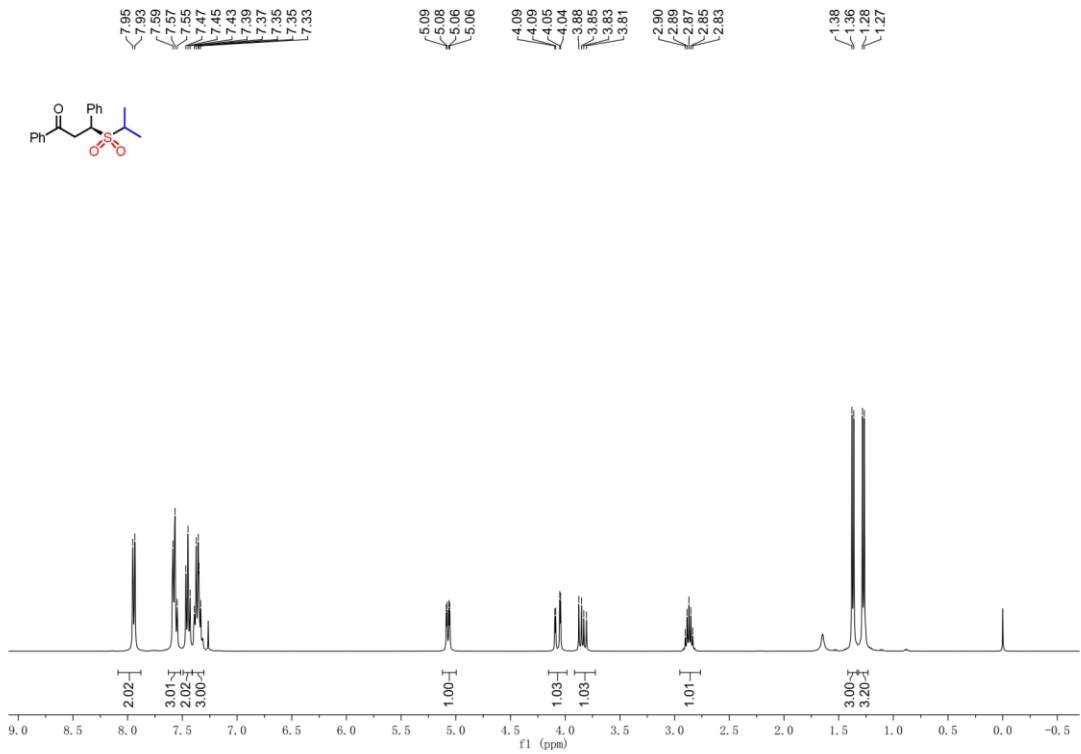


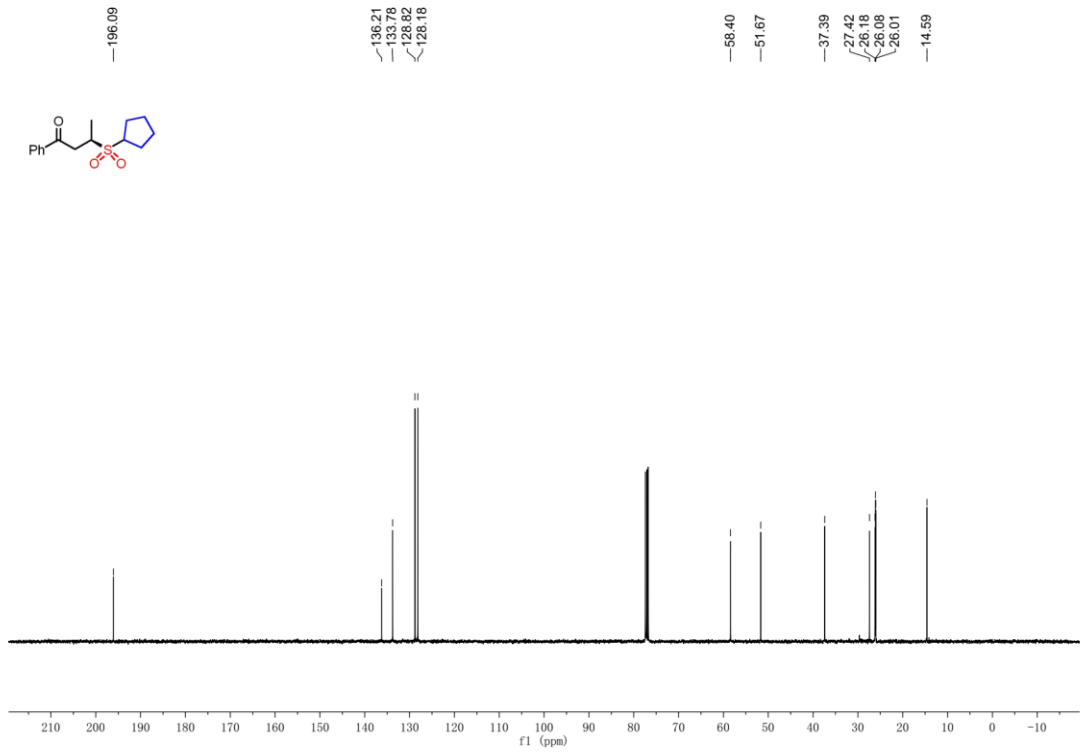
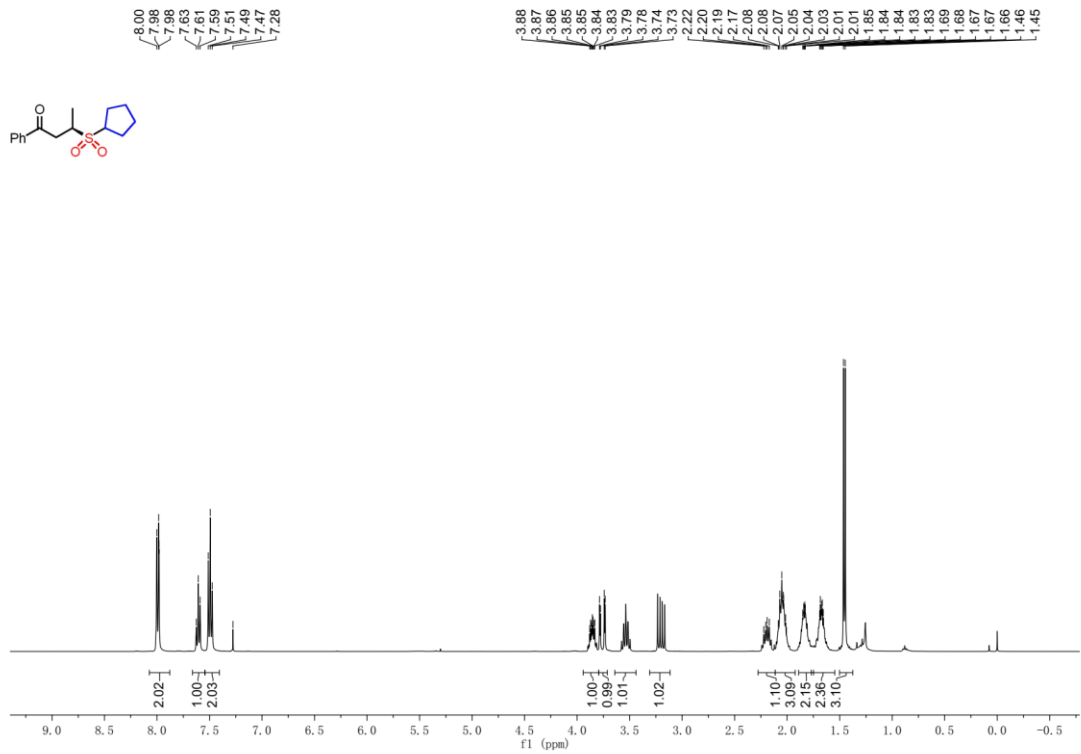




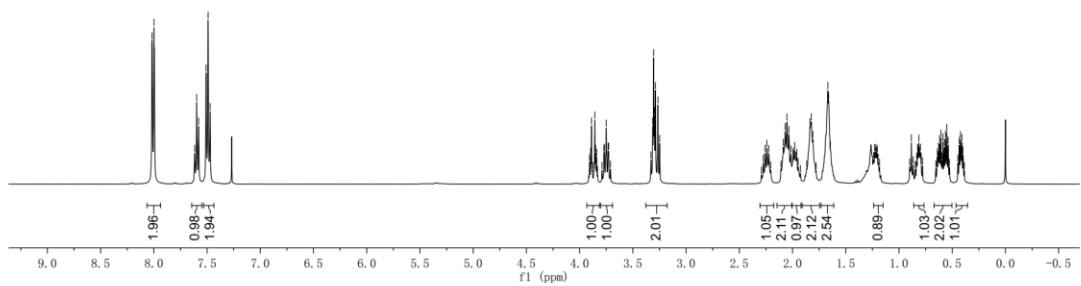
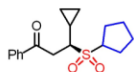








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8.00
8.00
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7.47
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3.85
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3.77
3.77
3.75
3.73
3.73
3.33
3.31
3.30
3.30
3.29
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3.25
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2.24
2.22
2.09
2.07
2.05
2.03
2.02
2.00
1.99
1.98
1.97
1.96
1.84
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1.67
1.66
1.64
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1.22
1.22
1.21
1.20
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0.85
0.81
0.81
0.80
0.64
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0.62
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0.59
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0.42
0.41
0.40



196.32

136.37
133.60
128.77
128.32

60.73
59.18

36.70
28.01
26.23
25.20
25.85

11.96
6.48
3.68

