Supporting Information

Copper-Catalyzed Enantioselective Radical Sulfonylation from Sodium Hydrogen Sulfite: Construction of Chiral Sulfonated Dihydrofuran-2(3*H*)-ones

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1. Supplementary Notes

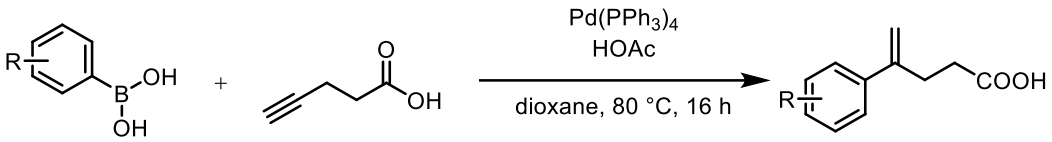
All glassware was thoroughly oven-dried. Chemicals and solvents were either purchased from commercial suppliers or purified by standard techniques. Thin-layer chromatography plates were visualized by exposure to ultraviolet light and/or I_2. Flash chromatography was carried out using silica gel (200−300 mesh). Visualization on TLC was achieved by use of UV light (254 nm). ^{1}H NMR and ^{13}C NMR spectra were recorded on a Bruker AM-400 (400 MHz). The spectra were recorded in deuterochloroform ($CDCl_3$) as solvent at room temperature, ^{1}H 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 ($CDCl_3$: δ_H = 7.26 ppm, δ_C = 77.0 ppm). Data for ^{1}H 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. The enantiomeric excess values were determined by chiral HPLC with a Shimadzu instrument and a Daicel CHIRALCEL and CHIRALPAK column.

2. Substrates involved in the reactions and their synthesis

2.1 General procedure for the preparation of enoic acid.

Enoic acid **1** are known compounds, which were prepared according to literatures. [1-2]

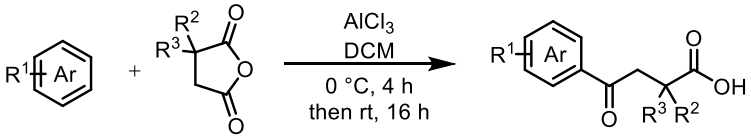
Method A[1]:



An oven dried round-bottom-flask was charged with arylboronic acid (2.49 g, 20.4 mmol, 1.0 equiv), $Pd(PPh_3)_4$ (1.178 g, 1.02 mmol, 0.05 equiv) and dry dioxane (100 mL). Next 4-pentynoic acid (2.31 mL, ρ = 0.99 g/mL, 20.4 mmol, 1.00 equiv) and acetic acid (150 μL, ρ = 1.05 g mL^{-1}, 2.04 mmol, 0.10 equiv) were added and the mixture was heated to 90°C overnight (ca. 16 h). The solvent was removed in vacuum and the crude product was filtered by silica gel column (eluent: CH_2Cl_2) to remove the catalyst and boronic acid residues. The resulting product mixture was then separated by preparative HPLC (Lux Amylose, 20 mL/min, H_2O/CH_3CN, 75:25, 45 min, R_t = 33 min product) and afforded the pure product. Compounds **1a** and **1ae** are characterized in the reference.[1]

Method B: [2]

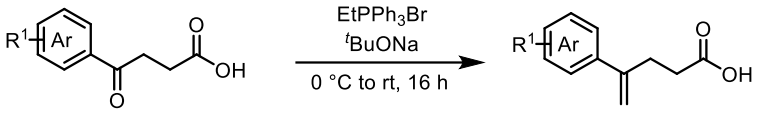
Step I. General procedure for synthesis of ketone precursors using Friedel-Craft reaction



A 100 mL, three-necked, round-bottomed flask is charged with powdered dihydrofuran-2,5-dione (1.0 equiv) and arene (1.0 equiv) under dry nitrogen. The resulting white mixture was cooled to 0 °C before anhydrous aluminum trichloride (1.2 equiv) was added in one portion. The reaction mixture was stirred over a period of 4 h before allowing it to warm to room temperature for 16 h. The reaction was poured in ice and 10 mL of concentrated hydrochloric acid was added under stirring at 0 °C. The organic layer was separated and the aqueous layer was extracted with DCM twice. The combined organic layers were washed with water, dried over $MgSO_4$ and concentrated.

The product was engaged in the next step without further purification.

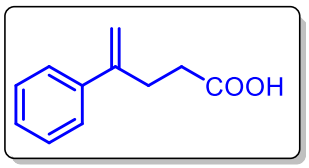
Step II. General procedure for synthesis of enoic acid using Wittig reaction.



Under nitrogen, to a solution of ^{t}BuONa (2.6 equiv) in dry THF (0.5 M) was added bromo(ethyl)triphenylphosphorane (1.3 equiv) in portions at 0 °C. The mixture was stirred at 0 °C for 30 min and a solution of ketone (1.0 equiv) in dry THF (1 M) was added dropwise and the reaction was stirred at 0 °C for 1 h and at rt overnight. The solvent was removed in vacuo and the residue diluted with DCM and aqueous NaOH (1 M). The aqueous layer was separated, washed with dichloromethane, and acidified to pH 1 with concentrated HCl. DCM was added and the organic compound was extracted twice with DCM. The organic layer was washed with water, dried over $MgSO_4$ and concentrated. The crude product was purified by SiO_2 column chromatography to give pure enoic acid. Compounds **1a**[2a], **1b**[2a], **1c**[2a], **1d**[2a], **1e**[2a], **1f**[2b], **1g**[2a], **1h**[2a], **1i**[2c], **1j**[2a], **1k**[2d], **1l**[2d], **1m**[2e], **1n**[2a], **1o**[2d] and **1p**[2f] are charactered in references.

Characterization of representative enoic acid

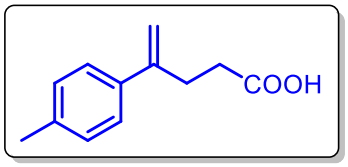
4-phenylpent-4-enoic acid (1a)



Purification by flash chromatography (PE/EA = 4/1). White solid, 88% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 11.43 (s, 1H), 7.39 (d, *J* = 7.1 Hz, 2H), 7.35 – 7.23 (m, 3H), 5.32 (s, 1H), 5.10 (s, 1H), 2.89 – 2.80 (m, 2H), 2.56 – 2.49 (m, 2H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 179.7, 146.6, 140.5, 128.5, 127.7, 126.1, 113.0, 33.0, 30.2.

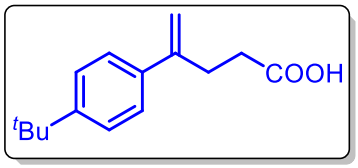
4-(p-tolyl)pent-4-enoic acid (1c)



Purification by flash chromatography (PE/EA = 4/1). White solid, 76% yield.

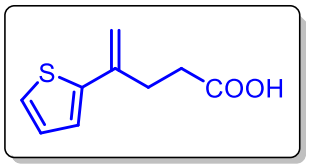
^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 11.35 (s, 1H), 7.30 (d, *J* = 8.0 Hz, 2H), 7.14 (d, *J* = 8.0 Hz, 2H), 5.29 (s, 1H), 5.06 (d, *J* = 0.6 Hz, 1H), 2.86 – 2.79 (m, 2H), 2.55 – 2.49 (m, 2H), 2.34 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 179.8, 146.3, 137.5, 137.5, 129.2, 126.0, 112.2, 33.1, 30.2, 21.1.

4-(4-(tert-butyl)phenyl)pent-4-enoic acid (1d)



Purification by flash chromatography (PE/EA = 4/1). White solid, 74% yield.
^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 7.35 (s, 4H), 5.32 (s, 1H), 5.07 (d, *J* = 1.2 Hz, 1H), 2.89 – 2.79 (m, 2H), 2.56 – 2.52 (m, 2H), 1.32 (s, 9H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 179.2, 150.7, 146.2, 137.3, 125.7, 125.4, 112.3, 34.5, 33.0, 31.3, 30.1. HRMS (ESI) for $C_{15}H_{21}O_2^+$ $[M+H]^+$ calcd. 233.1536, found: 233.1538.

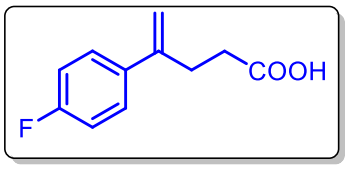
4-(thiophen-2-yl)pent-4-enoic acid (1o)



Purification by flash chromatography (PE/EA = 4/1). Yellow solid, 75% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 7.28 (dd, *J* = 5.0, 2.9 Hz, 1H), 7.25 – 7.21 (m, 2H), 5.40 (s, 1H), 5.06 (d, *J* = 0.6 Hz, 1H), 2.83 – 2.78 (m, 2H), 2.64 – 2.60 (m, 2H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 179.5, 141.8, 140.9, 125.8, 125.7, 120.5, 111.6, 33.0, 30.0.

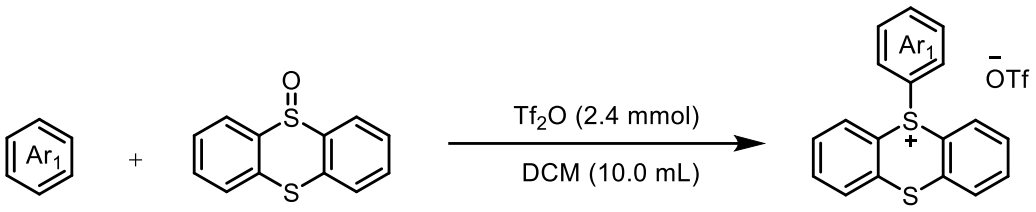
4-(4-fluorophenyl)pent-4-enoic acid (1n)



Purification by flash chromatography (PE/EA = 4/1). White solid, 71% yield.

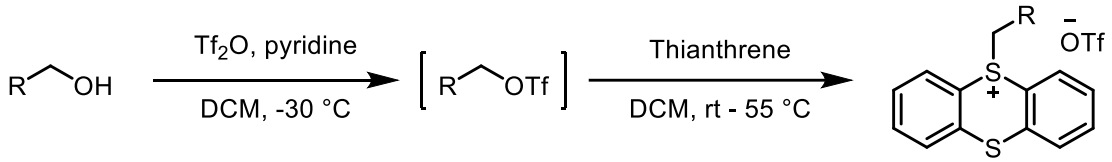
^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 11.76 (s, 1H), 7.39 – 7.32 (m, 2H), 7.01 (t, *J* = 8.7 Hz, 2H), 5.26 (s, 1H), 5.08 (s, 1H), 2.83 – 2.79 (m, 2H), 2.55 – 2.48 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ (ppm) = 179.8, 162.5 (d, *J* = 245.2 Hz), 145.6, 136.52 (d, *J* = 3.2 Hz), 127.74 (d, *J* = 7.9 Hz), 115.3 (d, *J* = 21.4 Hz), 113.0, 33.0, 30.2. **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) = –114.68 – –114.76 (m).

2.2 Preparation of aryl thianthrenium salts [3]



A 25 mL schlenk tube was charged with thianthrene S-oxide (2.0 mmol, 1.0 equiv), CH_2Cl_2 (5.0 mL) and arene (2.0 mmol, 1.0 equiv) under a nitrogen atmosphere. The reaction mixture was then cooled to -40 °C and stirred at this temperature. Tf_2O (2.4 mmol, 1.2 equiv) was added dropwisely. The reaction mixture was stirred at -40 °C for 30 min, and then allowed to stir at room temperature for 12 h, neutralized by a saturated aqueous $NaHCO_3$ solution, and extracted with CH_2Cl_2. The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated to dryness under reduced pressure. The crude product was purified by crystallization from CH_2Cl_2 / Et_2O system as a white solid. Compounds **2a**[3a], **2q**[3b], **2r**[3b], **2s**[3a], **2t**[3a], **2u**[3a], **2v**[3a], **2w**[3a], **2x**[3a], **2y**[3a], **2z**[3a] and **2aa**[3c] are charactered in references

2.3 Preparation of alkyl thianthrenium salts[4]

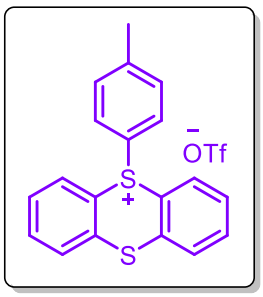


A flame-dried 100 mL flask was placed under an atmosphere of nitrogen and charged with a stir bar and alcohol (5.0 mmol, 1.0 equiv). The alcohol was dissolved in CH_2Cl_2 (20.0 mL) and cooled to -30 °C before adding pyridine (483 μL, 6.0 mmol, 1.2 equiv). While stirring, triflic anhydride (1.0 mL, 29.3 mmol, 1.20 equiv) was added dropwisely, and then the reaction mixture was stirred for 3 h while remaining at -5 °C. While the flask was still in a -5 °C bath, 0.5 M H_2SO_4 (30 mL) was added. The flask was removed from the cold bath, and the mixture was transferred to a separatory funnel and extracted with 3×20 mL of CH_2Cl_2. The organic layers were combined and washed 1× 50 mL of distilled water. The collected organic layers were then dried over $MgSO_4$, then filtered and concentrated to a 10 mL liquid under vacuum (without heating), which was used directly in the next step.

Flame-dried 25 mL Schlenk tube was added thianthrene (1.08g, 5.0 mmol), then the above liquid was added. The mixture was stirred at 55 °C for 24 h. The mixture was carefully condensed under reduced pressure at 25 ºC and purified by precipitation with Et_2O/CH_2Cl_2. Most of the unreacted dibenzothiophene was removed by repeating the precipitation procedure 2 or 3 times. If the salt still did not precipitate, it was subjected to silica gel chromatography with acetone/CH_2Cl_2. Compounds **2ab**[4], **2ac**[4] and **2ad**[4]are charactered in references.

Characterization of representative thianthrenium salts

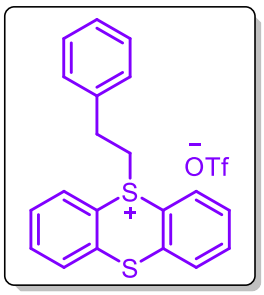
5-(p-tolyl)-5H-thianthren-5-ium triflate (2a)



Purification by flash chromatography (DCM/MeOH = 10/1). White solid, 95% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 8.51 (d, *J* = 7.9 Hz, 2H), 7.92 – 7.83 (m, 4H), 7.81 – 7.73 (m, 2H), 7.25 (d, *J* = 8.3 Hz, 2H), 7.07 (d, *J* = 8.3 Hz, 2H), 2.33 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 144.4, 136.5, 135.1, 134.8, 131.5, 130.5, 130.2, 127.9, 120.9 (q, *J* = 319.0 Hz), 120.1, 118.5, 21.3. **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) = –77.98.

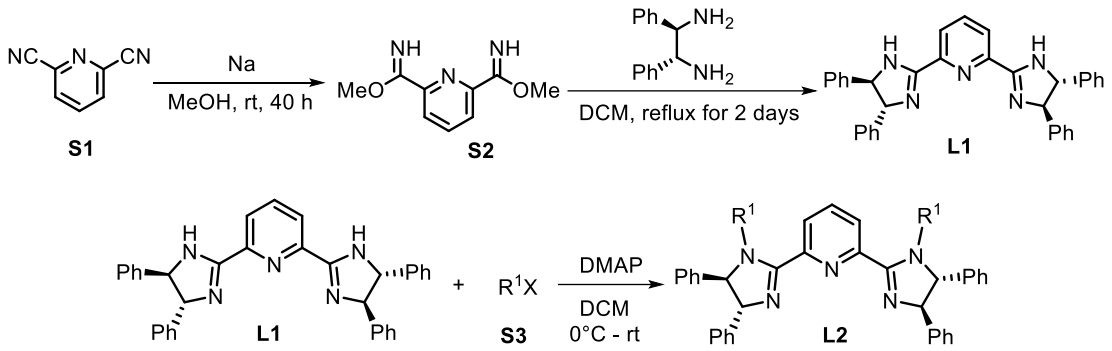
5-phenethyl-5H-thianthren-5-ium triflate (2ab)



Purification by flash chromatography (DCM/MeOH = 10/1). White solid, 90% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 8.13 (d, *J* = 7.9 Hz, 2H), 7.88 – 7.80 (m, 2H), 7.78 – 7.71 (m, 2H), 7.64 – 7.56 (m, 2H), 7.25 – 7.15 (m, 3H), 7.12 (dd, *J* = 8.2, 6.3 Hz, 2H), 4.09 – 3.97 (m, 2H), 2.99 (t, *J* = 7.7 Hz, 2H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 135.8, 135.1, 134.6, 134.4, 130.3, 129.9, 129.0, 128.7, 127.7, 120.9(q, *J* = 318.7 Hz), 117.3, 41.7, 30.6. **^{19}F NMR (376 MHz, $CDCl_3$)** δ (ppm) = –77.93.

2.4 General procedure for the synthesis of Pybim ligands[5]



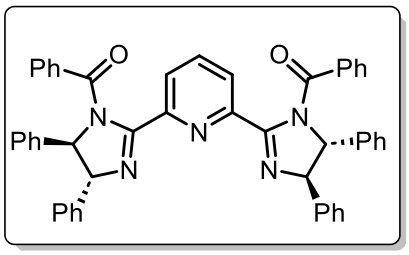
To pyridine-2,6-carbodinitrile **S1** (41.5 mmol) in anhydrous MeOH (100 mL), Na (5.2 mmol) was added. After stirring for 40 h at room temperature, acetic acid (5.25 mmol) was added and the solvent was removed under reduced pressure. Compound **S2** was obtained as a yellow powder (100 %) and was used directly for further reaction.

A 100 mL pressure tube was charged with **S2** (804 mg, 4.17 mmol), (*R*,*R*)-1,2-diphenyl ethylene diamine (8.75 mmol) and DCM (20 mL). After the resulting mixture was stirred at refluxing temperature for two days, water (20 mL) was added and the phases were separated. The aqueous phase was extracted with DCM (20 mL x 2). The combined organic layer was dried over $MgSO_4$ and the solvent was removed in vacuo to give a yellow solid, which was purified by crystallization to give **L1** as a white solid.

A 100 mL round-bottom flask was charged with **L1** (1.0 mmol), DMAP (3.0 mmol) and DCM (15 mL). The resulting mixture was cooled to 0 °C, and acyl chloride (2.5 mmol) was added neat at once. The ice bath was removed, and the reaction mixture was stirred at room temperature for 5 hours. The solvent was removed under vacuo, the residue was partitioned between saturated NH_4Cl (25 mL) and ethyl acetate (25 mL), and the aqueous phase was re-extracted with ethyl acetate (25 mL × 2). The combined organic layer was dried over $MgSO_4$, and the solvent was removed in vacuo to give **L2** as a white solid, which was purified by column chromatography on silica gel.

Characterization of representative Pybim ligands

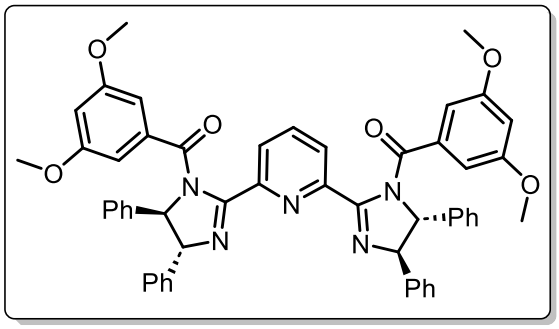
((4*R*,4'*R*,5*R*,5'*R*)-pyridine-2,6-diylbis(4,5-diphenyl-4,5-dihydro-1H-imidazole-2,1-diyl))bis(phenylmethanone)（L17）



Purification by flash chromatography (PE/EA = 2/1). White solid, 65% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 7.93 (d, *J* = 7.7 Hz, 2H), 7.78 (t, *J* = 7.8 Hz, 1H), 7.36 (m, 19H), 7.25 – 7.21 (m, 2H), 7.10 – 7.02 (m, 9H), 5.16 (m, 4H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 169.6, 160.7, 149.5, 141.6, 134.0, 137.4, 134.8, 131.6, 129.2， 129.1, 128.4, 128.2, 128.0, 127.7, 126.4, 125.2, 124.6, 79.2, 71.5.

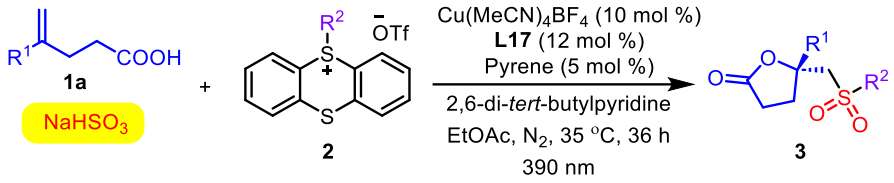
((4*R*,4'*R*,5*R*,5'*R*)-pyridine-2,6-diylbis(4,5-diphenyl-4,5-dihydro-1H-imidazole-2,1-diyl))bis((3,5-dimethoxyphenyl)methanone) (L16)



Purification by flash chromatography (PE/EA = 2/1). White solid, 60% yield.

^{1}H NMR (400 MHz, $CDCl_3$) δ (ppm) = 8.06 (s, 2H), 7.88 (s, 1H), 7.49 (s, 4H), 7.39 (m, 11H), 7.14 (s, 5H), 6.50 (s, 4H), 6.32 (s, 2H), 5.14 (s, 4H), 3.20 (s, 12H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 169.3, 160.2, 149.5, 142.1, 139.5, 137.3, 136.0, 129.4， 129.2, 128.3, 127.7, 126.3, 125.1, 124.5, 106.1, 105.2, 79.5, 71.1, 54.8.

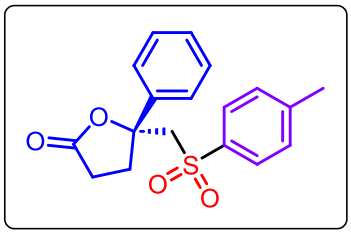
3. General procedure for the synthesis of compound 3



In a screw-capped vial, $Cu(MeCN)_4BF_4$ (3.2 mg, 10 mol %) and **L17** (8.7 mg, 12 mol %) were combined with EtOAc (2 mL) under N_2 atmosphere. The resultant solution was stirred for 30 min at room temperature. Enoic acid **1** (0.1 mmol, 1.0 equiv), thianthrenium salt **2** (0.15 mmol, 1.5 equiv), $NaHSO_3$ (15.6 mg, 0.15 mmol, 1.5 equiv), pyrene (5 mol %) and 2,6-di-*tert*-butylpyridine (0.2 mmol, 2.0 equiv) were added under N_2 atmosphere. The reaction was placed 4 cm away from a 390 nm Kessil lamp and irradiated for 36 h while stirring at 900 rpm. Then the mixture was purified directly by flash column chromatography (*n*-hexane/EtOAc (v/v): 5/1 - 2/1) to provide the desired product **3**.

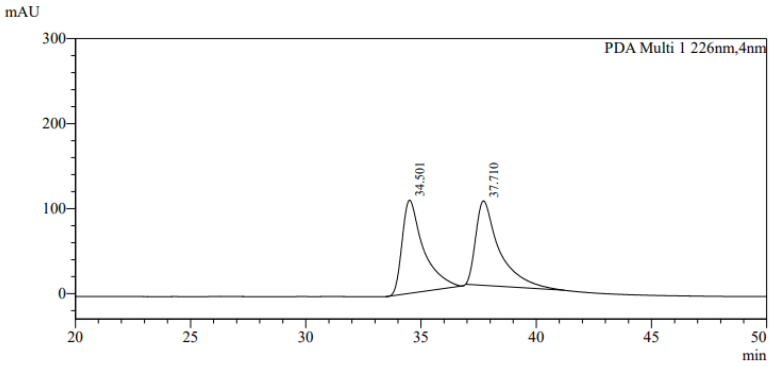
4. Characterization of all products and HPLC chromatograph

(*R*)-5-phenyl-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3a)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 80% yield, 97% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.70 (d, *J* = 8.4 Hz, 2H), 7.35 – 7.29 (m, 7H), 3.78 – 3.69 (m, 2H), 3.41 – 3.33 (m, 1H), 2.67 – 2.60 (m, 1H), 2.90 – 2.81 (m, 1H), 2.54 – 2.45 (m, 1H), 2.42 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.3, 145.0, 142.0, 137.6, 129.9, 128.9, 128.5, 127.9, 124.5, 84.7, 65.1, 32.5, 28.3, 21.7.

HPLC analysis: CHIRALPAK AD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 0.5 mL/min, wave length = 226 nm, t_R = 34.56 min (minor), t_R = 37.76 min (major).



<Peak Table>

PDA Ch1 226nm

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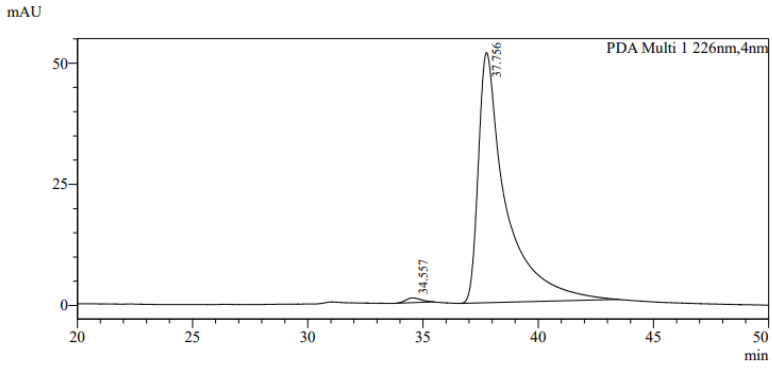
2	37.710	7076709	99389	50.044

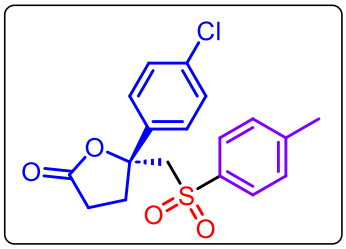


<Peak Table>

PDA Ch1 226nm

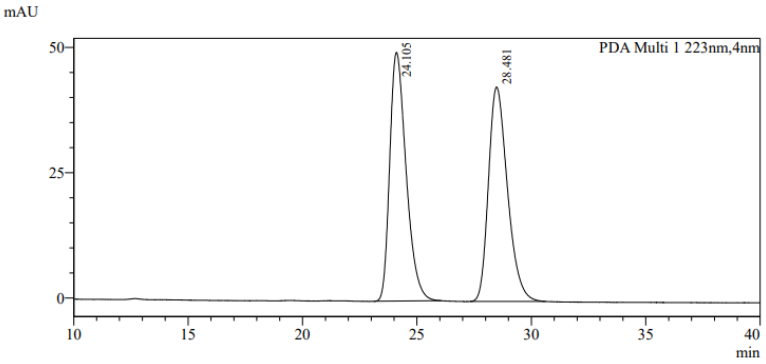
Peak#	Ret. Time	Area	Height	Aera%
1	34.557	44260	966	1.020
2	37.756	4293897	51582	98.980

(*R*)-5-(4-chlorophenyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3b)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). white solid, 76% yield, 90% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.65 (d, *J* = 8.4 Hz, 2H), 7.31 – 7.23 (m, 6H), 3.72 (t, *J* = 15.2 Hz, 2H), 3.33 – 3.26 (m, 1H), 2.89 – 2.80 (m, 1H), 2.65 – 2.58 (m, 1H), 2.54 – 2.45 (m, 1H), 2.43(s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.0, 145.2, 139.9, 137.3, 134.7, 129.9, 129.0, 127.9, 126.3, 84.3, 65.0, 32.6, 28.2, 21.7.

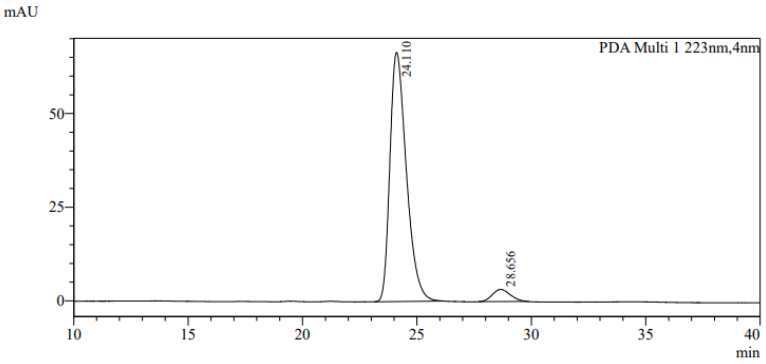
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 223 nm, t_R = 24.11 min (major), t_R = 28.66 min (minor).



<Peak Table>

PDA Ch1 223nm

Peak#	Ret. Time	Area	Height	Aera%
1	24.105	2474118	49663	50.005
2	28.481	2473659	42801	49.995

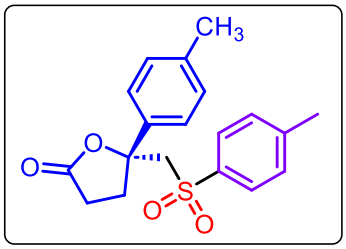


<Peak Table>

PDA Ch1 223nm

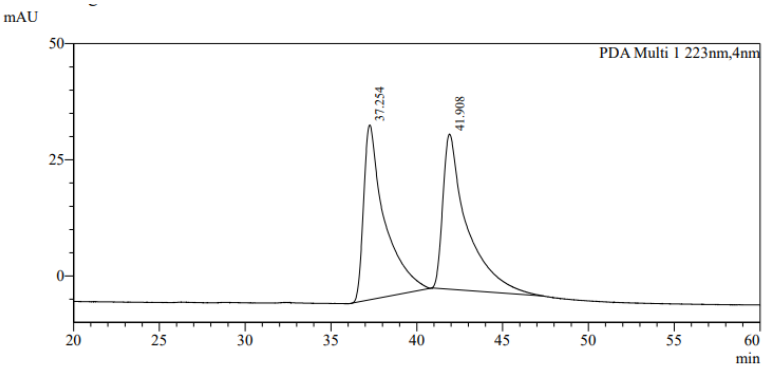
Peak#	Ret. Time	Area	Height	Aera%
1	24.110	3325496	66534	94.890
2	28.656	179088	3250	5.110

(*R*)-5-(*p*-tolyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3c)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 80% yield, 94% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.68 (d, *J* = 8.4 Hz, 2H), 7.29 (d, *J* = 8.4 Hz, 2H), 7.15 (dd, *J* = 23.6, 8.0 Hz, 4H), 3.72 (dd, *J* = 17.2, 15.2 Hz, 2H), 3.37 – 3.29 (m, 1H), 2.86 – 2.78 (m, 1H), 2.53 – 2.46 (m, 1H), 2.43 (s, 3H), 2.32 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.4, 144.9, 138.8, 138.5, 137.5, 129.8, 129.5, 127.9, 124.5, 84.8, 65.2, 32.4, 28.3, 21.7, 21.0.

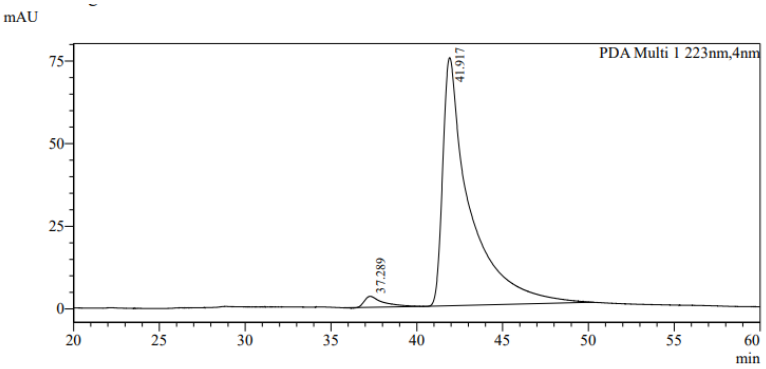
HPLC analysis: CHIRALPAK AD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 0.5 mL/min, wave length = 223 nm, t_R = 37.29 min (minor), t_R = 41.92 min (major).



<Peak Table>

PDA Ch1 223nm

Peak#	Ret. Time	Area	Height	Aera%
1	37.254	3204438	37613	49.616
2	41.908	3254002	33358	50.384

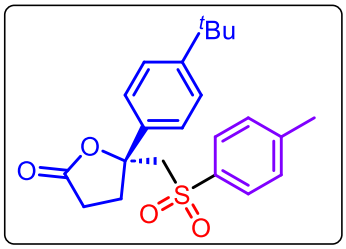


<Peak Table>

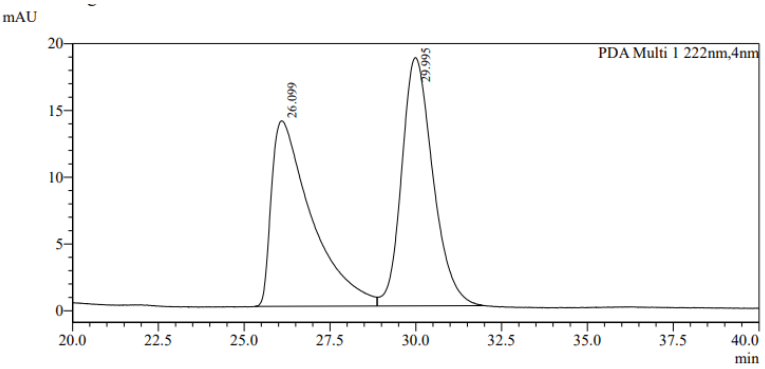
PDA Ch1 223nm

Peak#	Ret. Time	Area	Height	Aera%
1	37.289	252497	3340	2.961
2	41.917	8273619	75074	97.039

(*R*)-5-(4-(*tert*-butyl)phenyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3d)



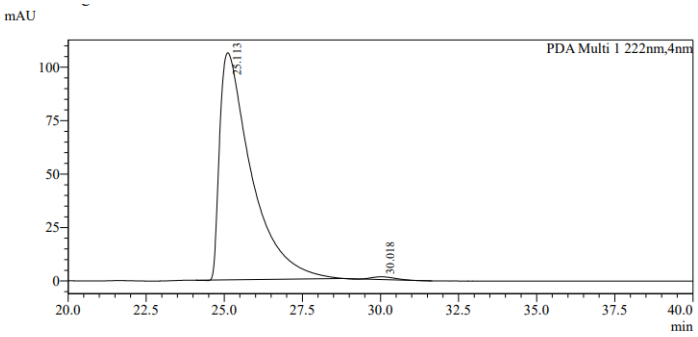
Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 99% yield, 98% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.67 (d, *J* = 8.4 Hz, 2H), 7.33 – 7.20 (m, 6H), 3.75 (dd, *J* = 16.8, 15.2 Hz, 2H), 3.39 – 3.31 (m, 1H), 2.89 – 2.80 (m, 1H), 2.68 – 2.61 (m, 1H), 2.54 – 2.45 (m, 1H), 2.41 (s, 3H), 1.28 (s, 9H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.5, 151.6, 144.8, 138.7, 137.6, 129.8, 127.9, 125.8, 124.3, 84.8, 65.1, 34.5, 32.3, 31.2, 28.3, 21.7. HRMS (ESI) for $C_{22}H_{27}O_4S^+$ $[M+H]^+$ calcd. 387.1625, found: 387.1625. HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 90:10, flow rate = 1.0 mL/min, wave length = 222 nm, t_R = 25.11 min (major), t_R = 30.02 min (minor).



<Peak Table>

PDA Ch1 222nm

Peak#	Ret. Time	Area	Height	Aera%
1	26.099	1133772	13887	49.019
2	29.995	1179136	18593	50.981

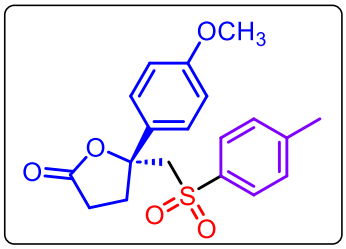


<Peak Table>

PDA Ch1 222nm

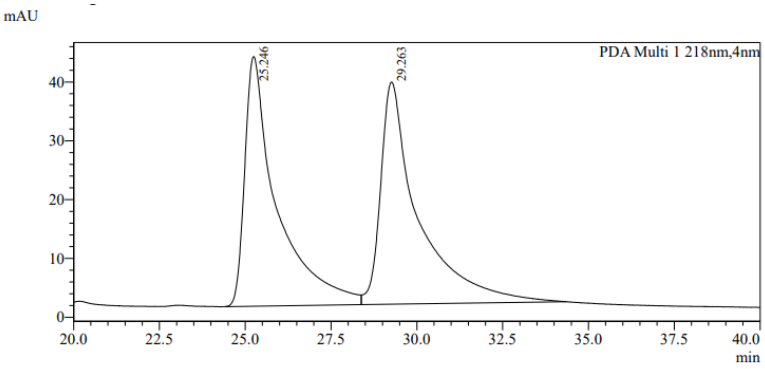
Peak#	Ret. Time	Area	Height	Aera%
1	25.113	7518330	106256	99.209
2	30.018	59911	1278	0.791

(*R*)-5-(4-methoxyphenyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3e)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 99% yield, 87% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.66 (d, *J* = 8.0 Hz, 2H), 7.30 – 7.21 (m, 4H), 6.83 – 6.81 (m, 2H), 3.78 (s, 3H), 3.72 (dd, *J* = 16.4, 15.2 Hz, 2H), 3.33 – 3.25 (m, 1H), 2.85 – 2.77 (m, 1H), 2.68 – 2.61 (m, 1H), 2.53 – 2.44 (m, 1H), 2.42 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.4, 159.6, 144.9, 137.5, 133.4, 129.8, 127.9, 126.1, 114.1, 84.7, 65.3, 55.4, 32.4, 28.4, 21.7.

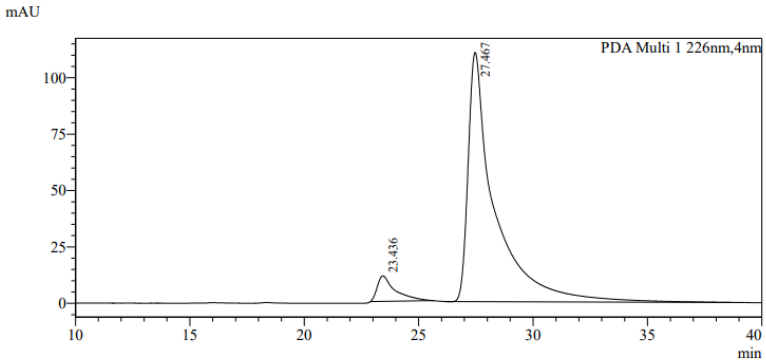
HPLC analysis: CHIRALPAK AD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 218 nm, t_R = 23.44 min (minor), t_R = 27.47 min (major)[错误!未找到引用源。].



<Peak Table>

PDA Ch1 218nm

Peak#	Ret. Time	Area	Height	Aera%
1	25.246	2765848	42453	48.916
2	29.263	2888398	37776	51.084

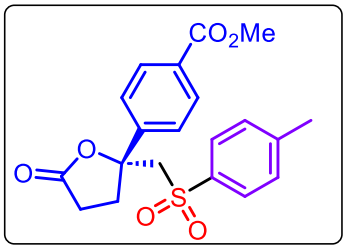


<Peak Table>

PDA Ch1 226nm

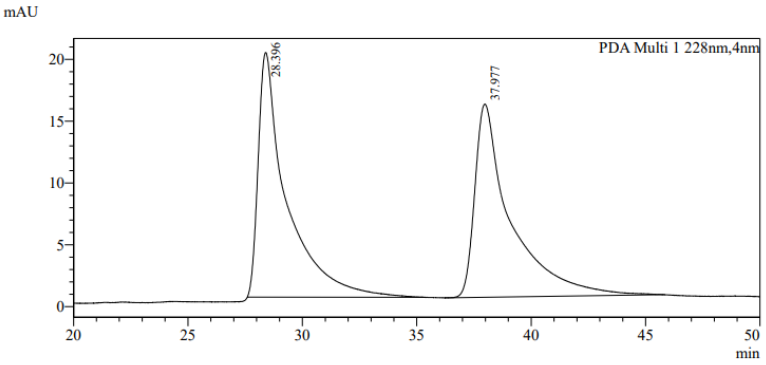
Peak#	Ret. Time	Area	Height	Aera%
1	23.436	617843	11337	6.448
2	27.467	8964389	110498	93.552

methyl (*R*)-4-(5-oxo-2-(tosylmethyl)tetrahydrofuran-2-yl)benzoate (3f)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 70% yield, 92% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.99 (d, *J* = 8.4 Hz, 2H), 7.69 (d, *J* = 8.4 Hz, 2H), 7.40 (d, *J* = 8.4 Hz, 2H), 7.30 (d, *J* = 8.4 Hz, 2H), 3.92 (s, 3H), 3.74 (s, 2H), 3.40 – 3.32 (m, 1H), 2.92 – 2.84 (m, 1H), 2.66 – 2.59 (m, 1H), 2.55 – 2.46 (m, 1H), 2.42 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 174.9, 166.2, 146.5, 145.2, 137.3, 130.3, 130.1, 129.9, 127.9, 124.7, 84.4, 64.7, 52.3, 32.7, 28.1, 21.7. HRMS (ESI) for $C_{20}H_{20}NaO_6S^+$ $[M+Na]^+$ calcd. 411.0878, found: 411.0865.

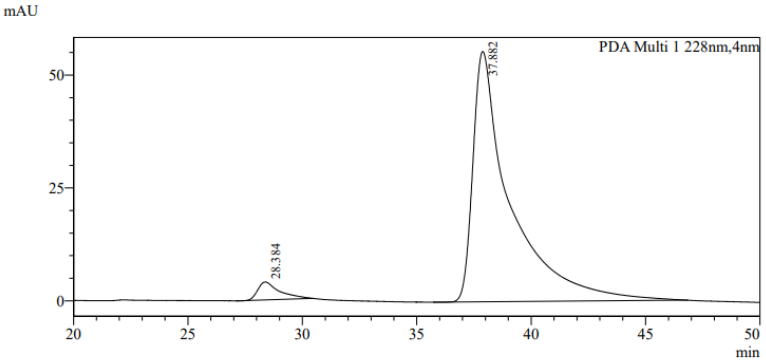
HPLC analysis: CHIRALPAK AD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 228 nm, t_R = 28.38 min (minor), t_R = 37.88 min (major).



<Peak Table>

PDA Ch1 228nm

Peak#	Ret. Time	Area	Height	Aera%
1	28.396	1712243	19793	50.083
2	37.977	1706590	15620	49.917

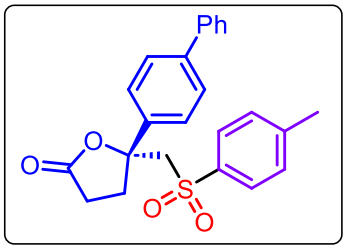


<Peak Table>

PDA Ch1 228nm

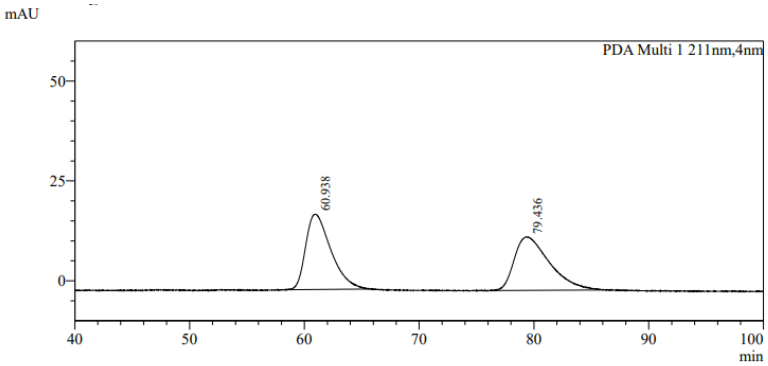
Peak#	Ret. Time	Area	Height	Aera%
1	28.384	260704	3960	3.955
2	37.882	6331152	55431	96.045

(*R*)-5-([1,1'-biphenyl]-4-yl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3g)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). white solid, 76% yield, 91% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.60 (d, *J* = 8.4 Hz, 2H), 7.46 – 7.44 (m, 4H), 7.38 – 7.34 (m, 2H), 7.30 – 7.27 (m, 3H), 7.21 – 7.18 (m, 2H), 3.72 (t, *J* = 15.2 Hz, 2H), 3.32 – 3.25 (m, 1H), 2.83 – 2.75 (m, 1H), 2.65 – 2.58 (m, 1H), 2.50 – 2.41 (m, 1H), 2.31 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.3, 145.0, 141.5, 140.5, 134.0, 137.5, 129.9, 128.9, 127.9, 127.8, 127.5, 127.1, 125.2, 84.7, 65.1, 32.5, 28.3, 21.7.

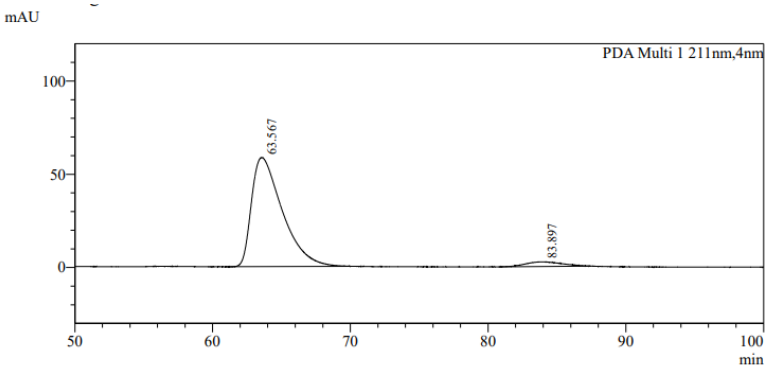
HPLC analysis: CHIRALPAK AD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length =211 nm, t_R = 63.57 min (major), t_R = 83.90 min (minor).



<Peak Table>

PDA Ch1 211nm

Peak#	Ret. Time	Area	Height	Aera%
1	60.938	2890782	18870	50.304
2	79.436	2855841	13398	49.696

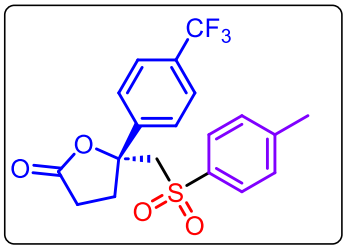


<Peak Table>

PDA Ch1 211nm

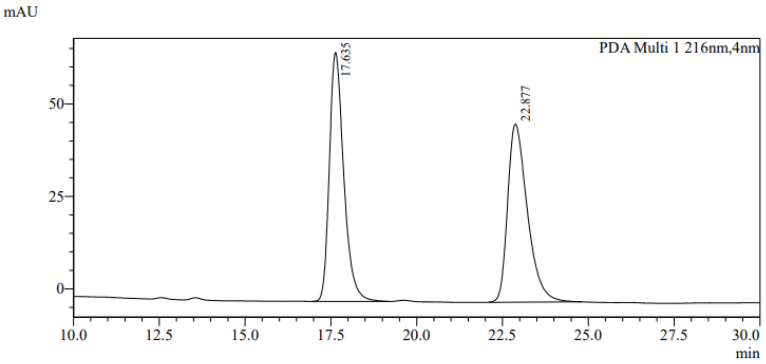
Peak#	Ret. Time	Area	Height	Aera%
1	63.567	9112161	58538	95.321
2	83.897	447303	2456	4.679

(*R*)-5-(tosylmethyl)-5-(4-(trifluoromethyl)phenyl)dihydrofuran-2(3H)-one (3h)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). white solid, 67% yield, 96% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.64 (d, *J* = 8.4 Hz, 2H), 7.57 (d, *J* = 8.4 Hz, 2H), 7.45 (d, *J* = 8.4 Hz, 2H), 7.28 (d, *J* = 8.0 Hz, 2H), 3.76 (s, 2H), 3.37 – 3.29 (m, 1H), 2.92 – 2.84 (m, 1H), 2.68 – 2.61 (m, 1H), 2.55 – 2.46 (m, 1H), 2.42 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 174.7, 145.2, 137.1, 130.8 (d, *J* = 33 Hz), 129.9, 127.9, 125.9 (q, *J* = 3.0 Hz), 125.3, 125.0, 122.3, 84.2, 64.8, 32.8, 28.0, 21.6. **^{19}F NMR (376 MHz, $CDCl_3$)** δ –62.80. HRMS (ESI) for $C_{19}H_{17}F_3NaO_4S^+$ $[M+Na]^+$ calcd. 421.0698, found: 421.0692.

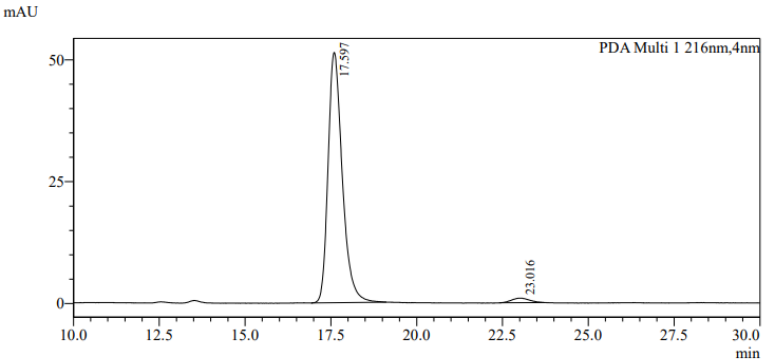
HPLC analysis: CHIRALPAK IA (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 223 nm, t_R = 17.60 min (major), t_R = 23.02 min (minor).



<Peak Table>

PDA Ch1 216nm

Peak#	Ret. Time	Area	Height	Aera%
1	17.635	1966437	67335	50.493
2	22.877	1928024	48137	49.507

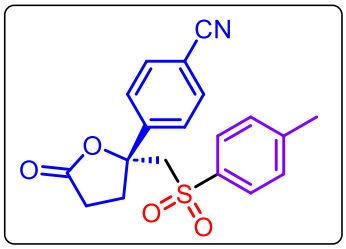


<Peak Table>

PDA Ch1 216nm

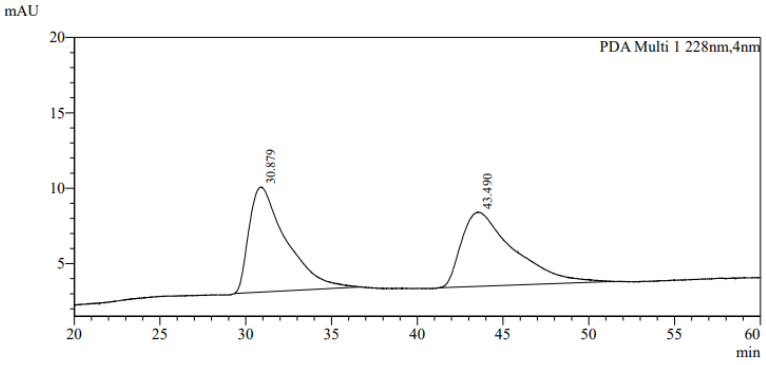
Peak#	Ret. Time	Area	Height	Aera%
1	17.597	1481144	51364	97.776
2	23.016	33687	931	2.224

(*R*)-4-(5-oxo-2-(tosylmethyl)tetrahydrofuran-2-yl)benzonitrile (3i)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). white solid, 99% yield, 90% ee. $[\alpha]_D^{20}$= -30.0 (c = 0.12, $CHCl_3$). **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.67 (dd, *J* = 13.6, 8.4 Hz, 4H), 7.48 (d, *J* = 8.4 Hz, 2H), 7.32 (d, *J* = 8.4 Hz, 2H), 3.74 – 3.67 (m, 2H), 3.39 – 3.31 (m, 1H), 2.94 – 2.85 (m, 1H), 2.64 – 2.48 (m, 2H), 2.45 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 174.5, 146.7, 145.5, 137.2, 132.7, 130.0, 127.9, 125.7, 118.0, 112.7, 84.0, 64.7, 32.7, 28.0, 21.7. HRMS (ESI) for $C_{19}H_{17}NaO_4S^+$ $[M+Na]^+$ calcd. 378.0776, found: 378.0777.

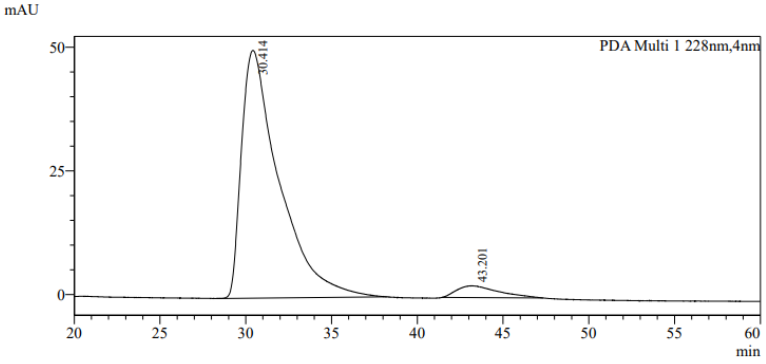
HPLC analysis: CHIRALPAK IA (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 228 nm, t_R = 30.41 min (major), t_R = 43.20 min (minor).



<Peak Table>

PDA Ch1 228nm

Peak#	Ret. Time	Area	Height	Aera%
1	30.879	1047182	6963	50.151
2	43.490	1040877	4922	49.849

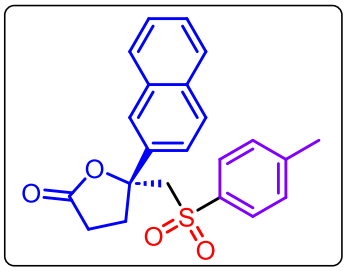


<Peak Table>

PDA Ch1 228nm

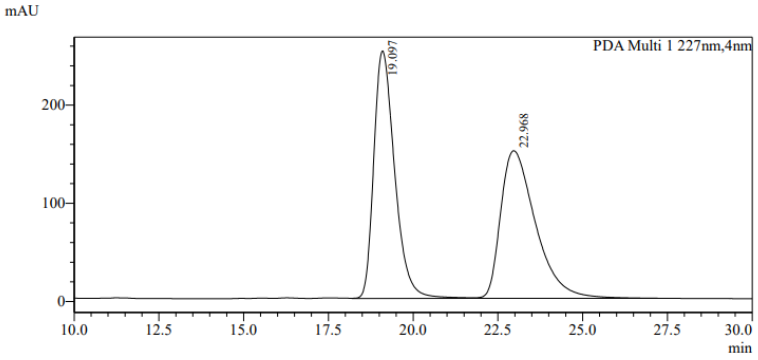
Peak#	Ret. Time	Area	Height	Aera%
1	30.414	7674329	50066	95.033
2	43.201	401116	2375	4.967

(*R*)-5-(naphthalen-2-yl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3j)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 75% yield, 90% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.81 – 7.76 (m, 4H), 7.64 (d, *J* = 8.0 Hz, 2H), 7.52 – 7.50 (m, 2H), 7.33 – 7.31 (m, 1H), 7.18 (d, *J* = 8.0 Hz, 2H), 3.88 – 3.80 (m, 2H), 3.44 – 3.37 (m, 1H), 2.92 – 2.84 (m, 1H), 2.79 – 2.72 (m, 1H), 2.58 – 2.49 (m, 1H), 2.34 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.4, 144.9, 138.4, 137.3, 132.9, 132.7, 129.7, 129.1, 128.3, 127.9, 127.6, 126.9, 123.8, 122.2, 84.8, 64.9, 32.4, 28.2, 21.6. HRMS (ESI) for $C_{22}H_{20}NaO_4S^+$ $[M+Na]^+$ calcd. 403.0975, found: 403.0973.

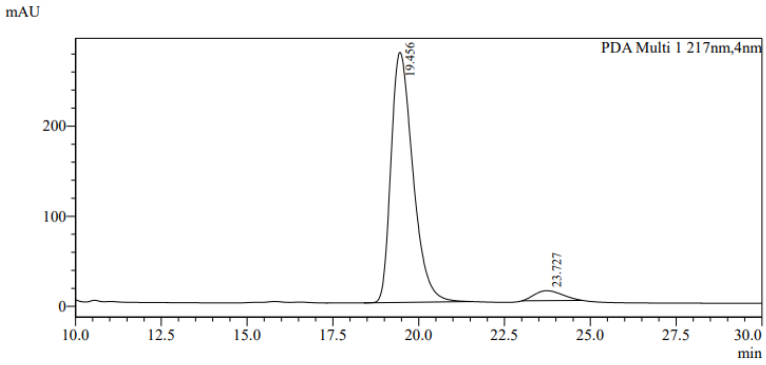
HPLC analysis: CHIRALPAK AS-H (*n*-hexane/*i*-PrOH) = 50:50, flow rate = 1.0 mL/min, wave length = 217 nm, t_R = 19.46 min (major), t_R = 23.73 min (minor).



<Peak Table>

PDA Ch1 227nm

Peak#	Ret. Time	Area	Height	Aera%
1	19.097	10824923	252063	50.059
2	22.968	10799555	150389	49.941

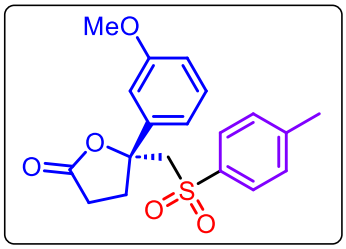


<Peak Table>

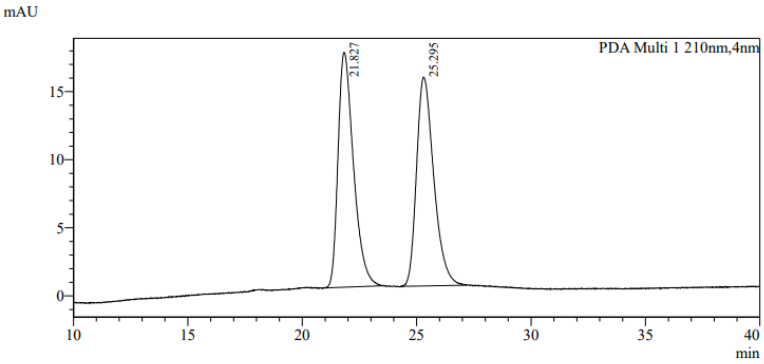
PDA Ch1 217nm

Peak#	Ret. Time	Area	Height	Aera%
1	19.456	12312895	277454	95.164
2	23.727	625767	11077	4.836

(*R*)-5-(3-methoxyphenyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3k)



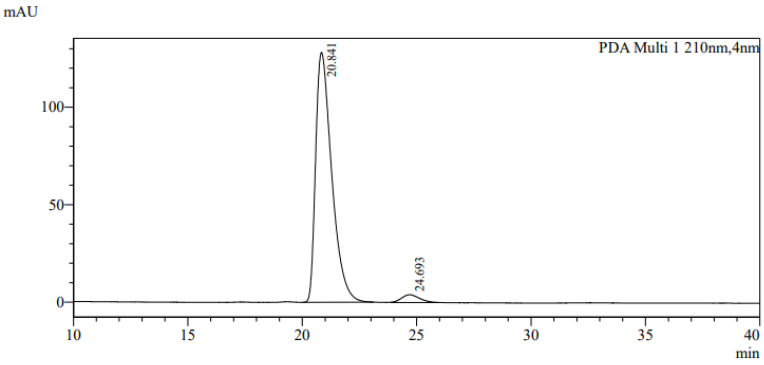
Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 78% yield, 93% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.63 (d, *J* = 8.0 Hz, 2H), 7.24 – 7.15 (m, 3H), 6.80 – 6.73 (m, 3H), 3.69 (s, 3H), 3.66 (d, *J* = 3.6 Hz, 2H), 3.32 – 3.25 (m, 1H), 2.82 – 2.74 (m, 1H), 2.57 – 2.38 (m, 2H), 2.35 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 174.3, 158.9, 144.0, 142.6, 136.5, 129.0, 128.8, 126.9, 115.6, 112.7, 109.4, 83.6, 63.9, 54.3, 31.4, 27.2, 20.6. HRMS (ESI) for $C_{19}H_{20}NaO_5S^+$ $[M+Na]^+$ calcd. 383.0924, found: 383.0920. HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 210 nm, t_R = 20.84 min (minor), t_R = 24.69 min (major).



<Peak Table>

PDA Ch1 210nm

Peak#	Ret. Time	Area	Height	Aera%
1	21.827	810065	17246	50.176
2	25.295	804378	15346	49.824

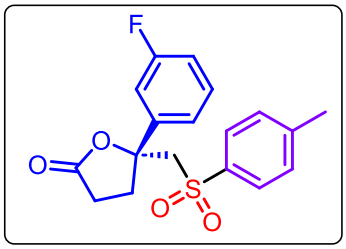


<Peak Table>

PDA Ch1 210nm

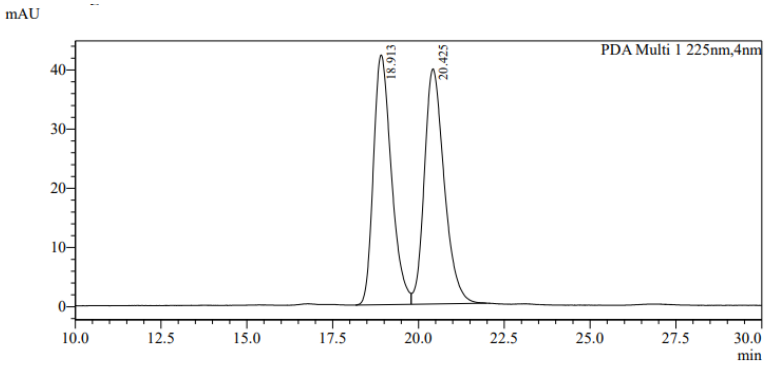
Peak#	Ret. Time	Area	Height	Aera%
1	20.841	6273265	128239	96.713
2	24.693	213179	3964	3.287

(*R*)-5-(3-fluorophenyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3l)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 86% yield, 89% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.62 (d, *J* = 8.4 Hz, 2H), 7.25 – 7.19 (m, 3H), 7.03 (d, *J* = 8.0 Hz, 1H), 6.97 – 6.89 (m, 2H), 3.69 – 3.61 (m, 2H), 3.30 – 3.21 (m, 1H), 2.83 – 2.75 (m, 1H), 2.56 – 2.39 (m, 2H), 2.36 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.0, 162.8 (d, *J* = 247 Hz), 145.2, 144.4 (d, *J* = 7.0 Hz), 137.3, 130.7 (d, *J* = 8.0 Hz), 129.9, 127.9, 120.3 (d, *J* = 3.0 Hz), 115.5 (d, *J* = 21 Hz), 112.4 (d, *J* = 24 Hz), 84.1 (d, *J* = 2.0 Hz), 64.8, 32.6, 28.1, 21.7. **^{19}F NMR (376 MHz, $CDCl_3$)** δ –110.92 – –110.98 (m). HRMS (ESI) for $C_{18}H_{17}FNaO_4S^+$ $[M+Na]^+$ calcd. 371.0725, found: 371.0721.

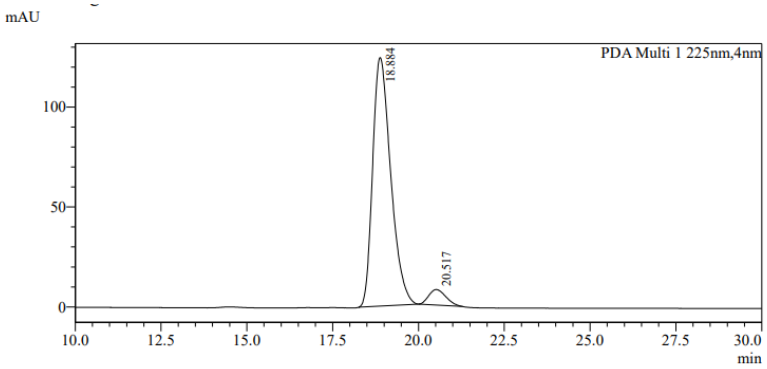
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 225 nm, t_R = 18.88 min (major), t_R = 20.52 min (minor).



<Peak Table>

PDA Ch1 225nm

Peak#	Ret. Time	Area	Height	Aera%
1	18.913	1536170	42193	49.017
2	20.425	1597797	39698	50.983

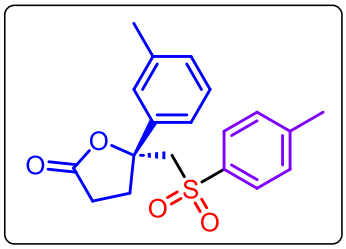


<Peak Table>

PDA Ch1 225nm

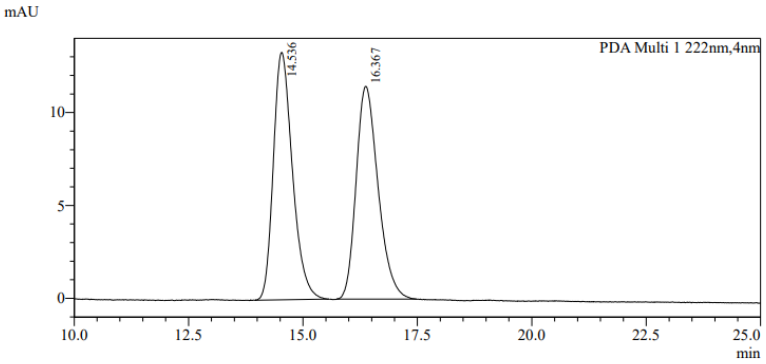
Peak#	Ret. Time	Area	Height	Aera%
1	18.884	4549081	124344	94.471
2	20.517	266258	7712	5.529

(*R*)-5-(*m*-tolyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3m)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 72% yield, 96% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.69 (d, *J* = 8.4 Hz, 2H), 7.30 (d, *J* = 8.0 Hz, 2H), 7.24 – 7.20 (m, 1H), 7.10 – 7.08 (m, 3H), 3.77 – 3.69 (m, 2H), 3.40 – 3.32 (m, 1H), 2.88 – 2.80 (m, 1H), 2.66 – 2.59 (m, 1H), 2.54 – 2.47 (m, 1H), 2.43 (s, 3H), 2.30 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.5, 144.9, 141.9, 138.7, 137.5, 129.8, 129.2, 128.8, 127.9, 125.1, 121.6, 84.8, 65.1, 32.4, 28.3, 21.7, 21.5. HRMS (ESI) for $C_{19}H_{20}NaO_4S^+$ $[M+Na]^+$ calcd. 367.0975, found: 367.0972.

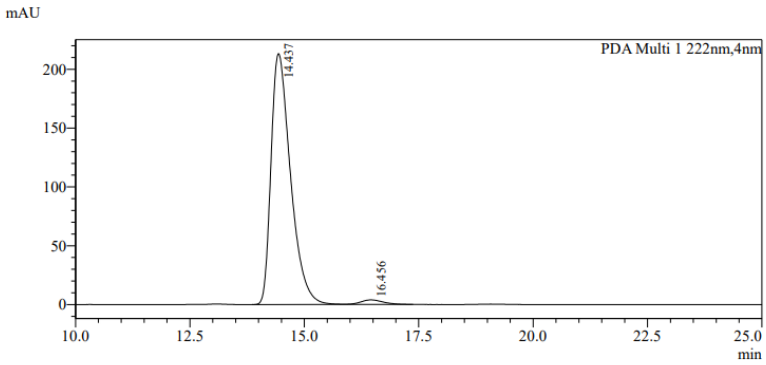
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 222 nm, t_R = 14.44 min (major), t_R = 16.46 min (minor).



<Peak Table>

PDA Ch1 222nm

Peak#	Ret. Time	Area	Height	Aera%
1	14.536	386944	13318	50.254
2	16.367	383029	11442	49.746

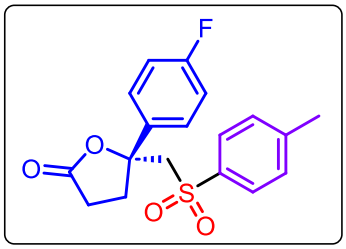


<Peak Table>

PDA Ch1 222nm

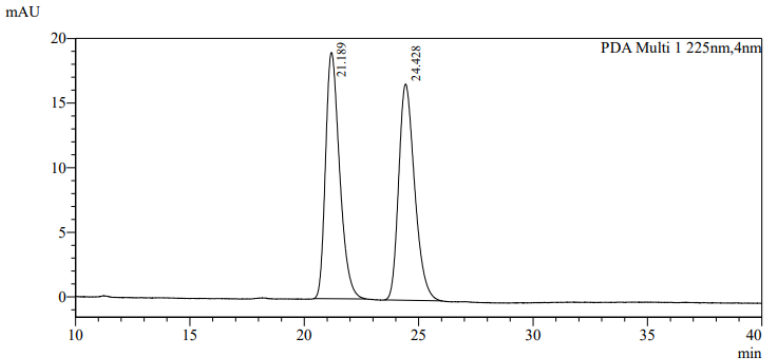
Peak#	Ret. Time	Area	Height	Aera%
1	14.437	6320132	213233	97.888
2	16.456	136390	3899	2.112

(*R*)-5-(4-fluorophenyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3n)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 86% yield, 91% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.67 (d, *J* = 8.0 Hz, 2H), 7.32 – 7.29 (m, 4H), 7.03 – 6.99 (m, 2H), 3.76 – 3.68 (m, 2H), 3.36 – 3.28 (m, 1H), 2.89 – 2.81 (m, 1H), 2.54 – 2.46 (m, 1H), 2.54 – 2.46 (m, 1H), 2.43 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.1, 163.8, 161.3, 145.1, 137.4 (t, *J* = 3.0 Hz), 129.9, 127.9, 126.7 (d, *J* = 21 Hz), 115.8 (d, *J* = 8.0 Hz), 84.4, 65.2, 32.6, 28.2, 21.7. **^{19}F NMR (376 MHz, $CDCl_3$)** δ –112.86 – –110.93 (m).

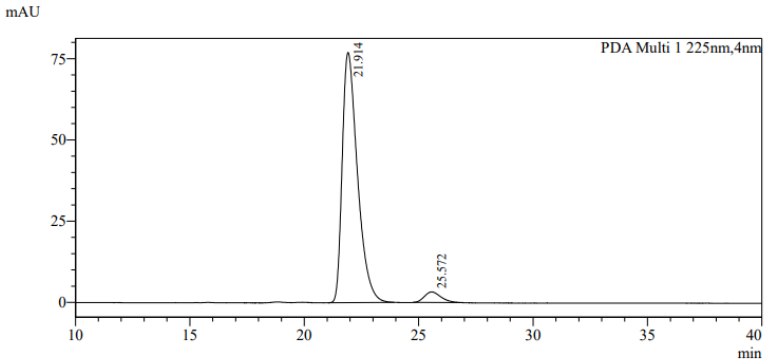
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 225 nm, t_R = 21.91 min (major), t_R = 25.57 min (minor).



<Peak Table>

PDA Ch1 225nm

Peak#	Ret. Time	Area	Height	Aera%
1	21.189	815680	19058	50.115
2	24.428	811929	16731	49.885

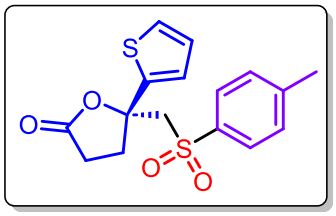


<Peak Table>

PDA Ch1 225nm

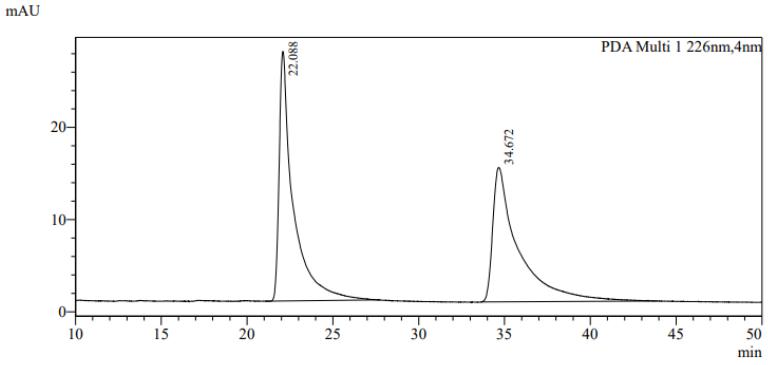
Peak#	Ret. Time	Area	Height	Aera%
1	21.914	3565883	77010	95.604
2	25.572	163952	3262	4.396

(*S*)-5-(thiophen-2-yl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3o)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 70% yield, 94% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.67 (d, *J* = 8.0 Hz, 2H), 7.31 – 7.27 (m, 3H), 7.22 – 7.21 (m, 1H), 6.93 (dd, *J* = 5.2, 1.2 Hz, 1H), 3.81 – 3.73 (m, 2H), 3.28 – 3.20 (m, 1H), 2.84 – 2.76 (m, 1H), 2.69 – 2.50 (m, 2H), 2.43 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.2, 145.0, 142.4, 137.4, 129.9, 127.9, 127.6, 124.7, 121.8, 83.3, 64.6, 32.4, 28.4, 21.7. HRMS (ESI) for $C_{16}H_{16}NaO_4S_2^+$ $[M+Na]^+$ calcd. 359.0383, found: 359.0379.

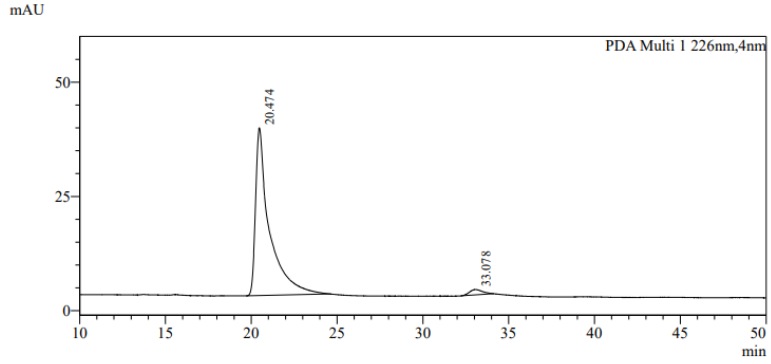
HPLC analysis: CHIRALPAK AD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 226 nm, t_R = 20.47 min (major), t_R = 33.09 min (minor).



<Peak Table>

PDA Ch1 226nm

Peak#	Ret. Time	Area	Height	Aera%
1	22.088	1552279	27076	50.592
2	34.672	1515935	14572	49.408

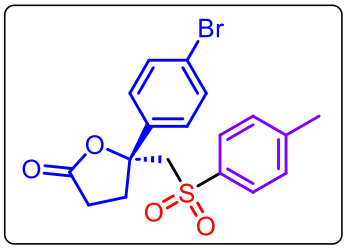


<Peak Table>

PDA Ch1 226nm

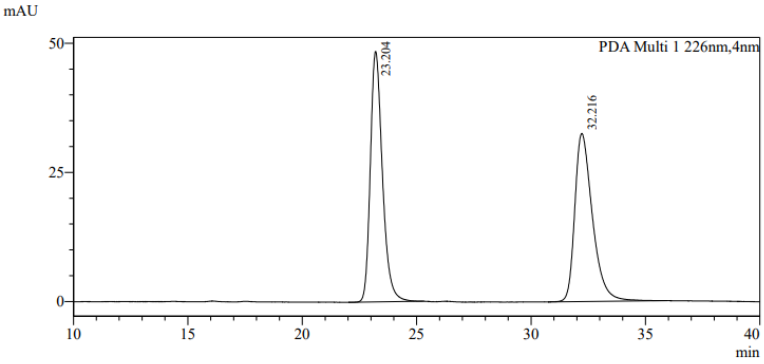
Peak#	Ret. Time	Area	Height	Aera%
1	20.474	2072736	36703	97.140
2	33.078	61021	1164	2.860

(*R*)-5-(4-bromophenyl)-5-(tosylmethyl)dihydrofuran-2(3*H*)-one (3p)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 79% yield, 94% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.64 (d, *J* = 8.4 Hz, 2H), 7.44 (d, *J* = 8.8 Hz, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 7.18 (d, *J* = 8.4 Hz, 2H), 3.75 – 3.68 (m, 2H), 3.32 – 3.25 (m, 1H), 2.88 – 2.80 (m, 1H), 2.64 – 2.57 (m, 1H), 2.53 – 2.47 (m, 1H), 2.44 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 174.9, 145.2, 140.5, 137.3, 132.0, 129.9, 127.9, 126.6, 122.8, 84.3, 64.9, 32.6, 28.1, 21.7.

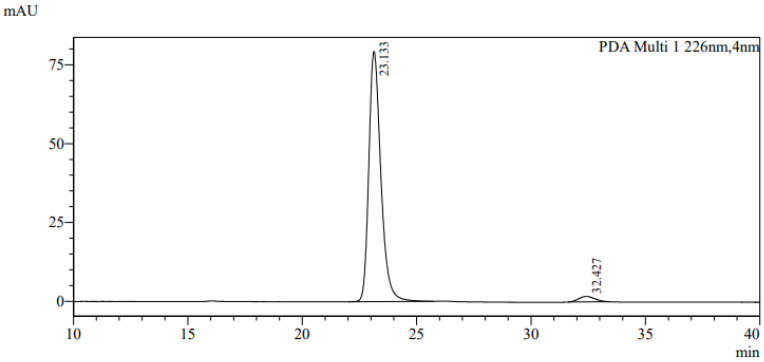
HPLC analysis: CHIRALPAK IA (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 226 nm, t_R = 23.13 min (major), t_R = 32.43 min (minor).



<Peak Table>

PDA Ch1 226nm

Peak#	Ret. Time	Area	Height	Aera%
1	23.204	1782963	48495	50.473
2	32.216	1749578	32548	49.527

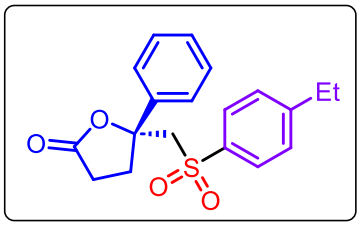


<Peak Table>

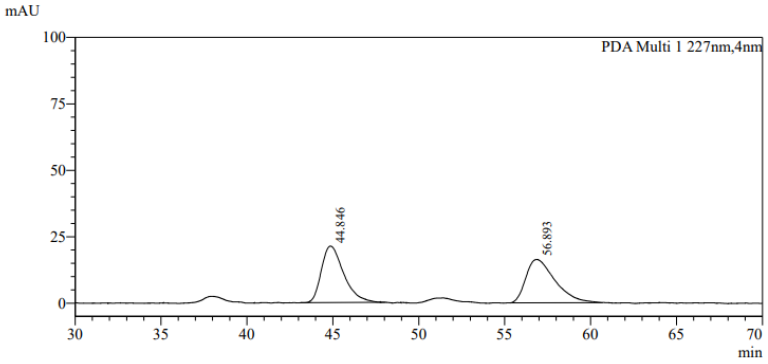
PDA Ch1 226nm

Peak#	Ret. Time	Area	Height	Aera%
1	23.133	2907813	79329	97.156
2	32.427	85113	1744	2.844

(*R*)-5-(((4-ethylphenyl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3H)-one (3q)



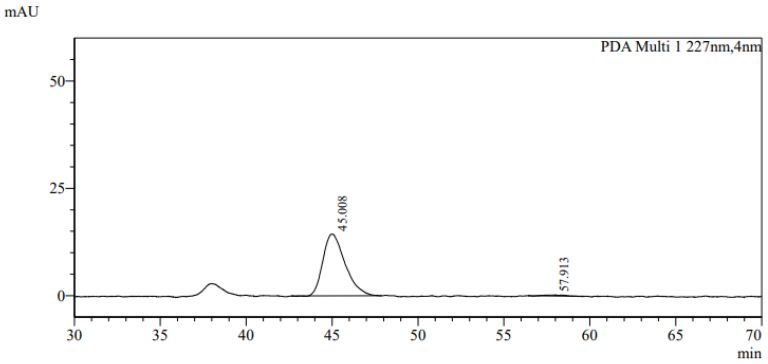
Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 90% yield, 97% ee. $[\alpha]_D^{20}$= +5.1 (c = 0.1, $CHCl_3$).**^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.72 (d, *J* = 8.4 Hz, 2H), 7.33 – 7.28 (m, 7H), 3.74 (d, *J* = 17.2, 14.8 Hz, 2H), 3.41 – 3.33 (m, 1H), 2.90 – 2.82 m, 1H), 2.74 – 2.61 (m, 3H), 2.54 – 2.45 (m, 1H), 1.24 (t, *J* = 7.6 Hz, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.4, 151.1, 141.9, 137.7, 128.9, 128.8, 128.5, 128.0, 124.6, 84.8, 65.1, 32.5, 28.9, 28.3, 15.1. HRMS (ESI) for $C_{19}H_{20}NaO_4S^+$ $[M+Na]^+$ calcd. 367.0980, found: 367.0977. HPLC analysis: CHIRALPAK IA (*n*-hexane/*i*-PrOH) = 95:5, flow rate = 1.0 mL/min, wave length = 227 nm, t_R = 45.00 min (major), t_R = 57.91 min (minor).



<Peak Table>

PDA Ch1 227nm

Peak#	Ret. Time	Area	Height	Aera%
1	44.846	1920757	21256	49.960
2	56.893	1923834	16298	50.040

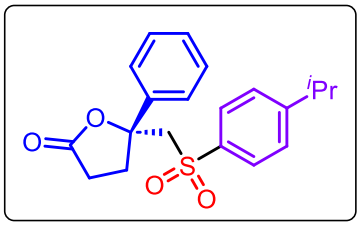


<Peak Table>

PDA Ch1 227nm

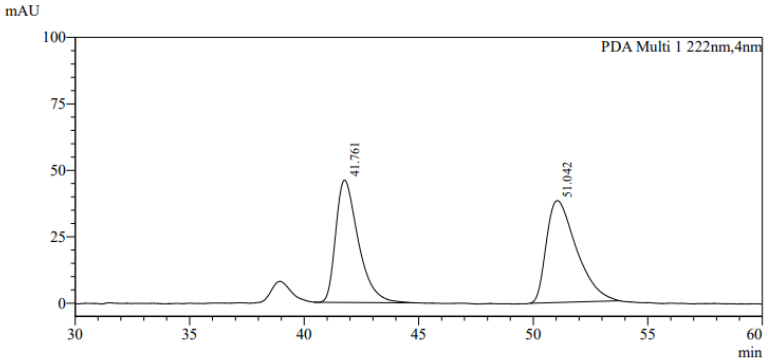
Peak#	Ret. Time	Area	Height	Aera%
1	45.008	1294333	14421	98.627
2	57.913	18023	234	1.373

(*R*)-5-(((4-isopropylphenyl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3H)-one (3r)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1); yellow solid, 85% yield, 97% ee. $[\alpha]_D^{20}$= +5.4 (c = 0.4, $CHCl_3$). **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.72 (d, *J* = 9.2 Hz, 2H), 7.35 – 7.27 (m, 7H), 3.78 – 3.70 (m, 2H), 3.40 – 3.32 (m, 1H), 3.00 – 2.83 (m, 2H), 2.69 – 2.62 (m, 1H), 2.55 – 2.46 (m, 1H), 1.26 (d, *J* = 7.2 Hz, 6H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 175.3, 155.6, 141.8, 137.7, 128.9, 128.5, 128.0, 127.4, 124.6, 84.8, 65.1, 34.3, 32.5, 28.3, 23.6, 23.6. HRMS (ESI) for $C_{20}H_{22}NaO_4S^+$ $[M+Na]^+$ calcd. 381.1137, found: 381.1128.

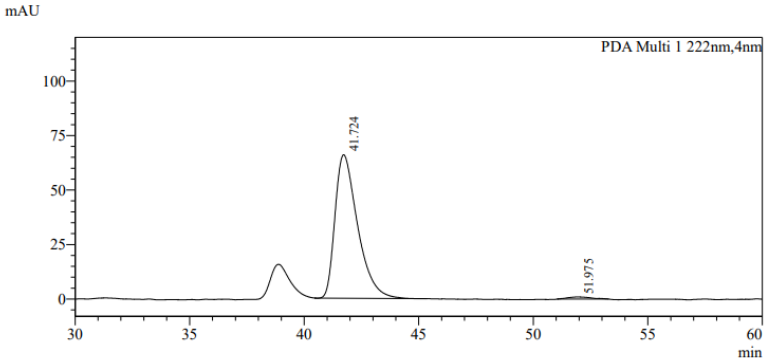
HPLC analysis: CHIRALPAK IA (*n*-hexane/*i*-PrOH) = 95:5, flow rate = 1.0 mL/min, wave length = 222 nm, t_R = 41.72 min (major), t_R = 51.98 min (minor).



<Peak Table>

PDA Ch1 222nm

Peak#	Ret. Time	Area	Height	Aera%
1	41.761	3151823	45995	47.329
2	51.042	3507545	38333	52.671

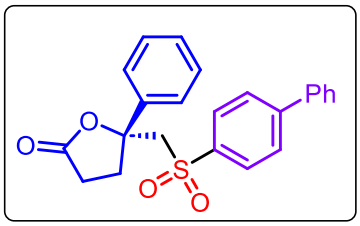


<Peak Table>

PDA Ch1 222nm

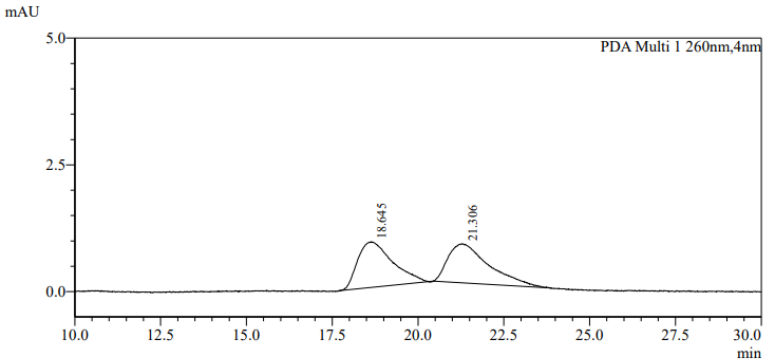
Peak#	Ret. Time	Area	Height	Aera%
1	41.724	4527678	65805	98.550
2	51.975	66607	949	1.450

(*R*)-5-(([1,1'-biphenyl]-4-ylsulfonyl)methyl)-5-phenyldihydrofuran-2(3*H*)-one（3s）



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). white solid, 38% yield, 92% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.86 (d, *J* = 8.4 Hz, 2H), 7.69 (d, *J* = 8.4 Hz, 2H), 7.58 (d, *J* = 7.2 Hz, 2H), 7.50 – 7.40 (m, 3H), 7.33 – 7.27 (m, 5H), 3.85 – 3.77 (m, 2H), 3.40 – 3.33 (m, 1H), 2.91 – 2.83 (m, 1H), 2.70 – 2.63 (m, 1H), 2.55 – 2.47 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.4, 146.8, 141.7, 139.1, 138.9, 129.1, 128.9, 128.7, 128.6, 128.5, 127.9, 127.4, 124.6, 84.7, 65.2, 32.7, 28.3. HRMS (ESI) for $C_{23}H_{20}NaO_4S^+$ $[M+Na]^+$ calcd. 415.0975, found: 415.0970.

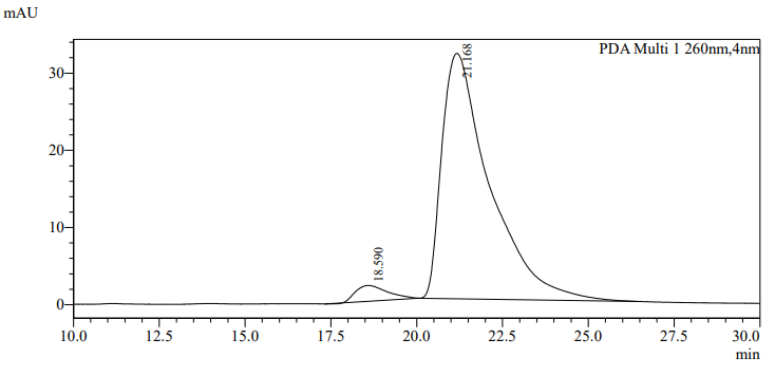
HPLC analysis: CHIRALPAK AD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 260 nm, t_R = 18.59 min (minor), t_R = 21.17 min (major).



<Peak Table>

PDA Ch1 260nm

Peak#	Ret. Time	Area	Height	Aera%
1	18.645	63158	898	49.715
2	21.306	63881	768	50.285

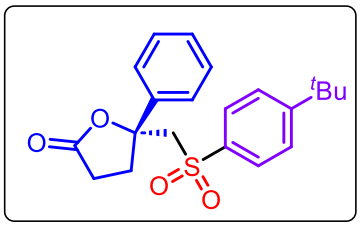


<Peak Table>

PDA Ch1 260nm

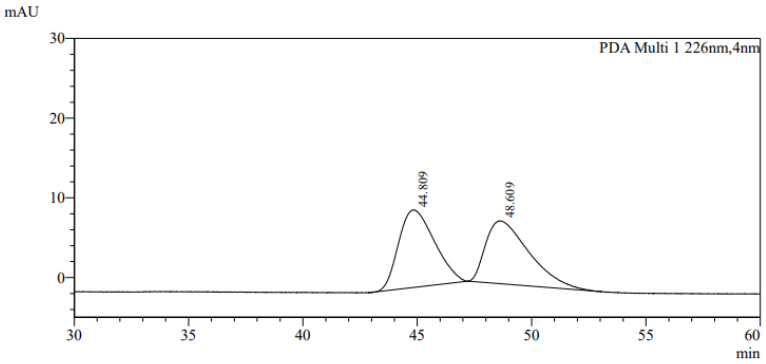
Peak#	Ret. Time	Area	Height	Aera%
1	18.590	130679	2048	4.055
2	21.168	3091650	31791	95.945

(*R*)-5-(((4-(tert-butyl)phenyl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3H)-one (3t)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 85% yield, 96% ee. $[\alpha]_D^{20}$= +24.0 (c = 0.1, $CHCl_3$). **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.72 (d, *J* = 8.4 Hz, 2H), 7.49 (d, *J* = 8.4 Hz, 2H), 7.33 – 7.27 (m, 5H), 3.75 (t, *J* = 15.6 Hz, 2H), 3.40 – 3.32 (m, 1H), 2.92 – 3.84 (m, 1H), 2.70 – 2.63 (m, 1H), 2.55 – 2.47 (m, 1H), 1.33 (s, 9H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.4, 157.8, 141.8, 137.3, 128.9, 128.5, 127.7, 126.3, 124.6, 84.8, 65.1, 35.3, 32.5, 31.0, 28.3.

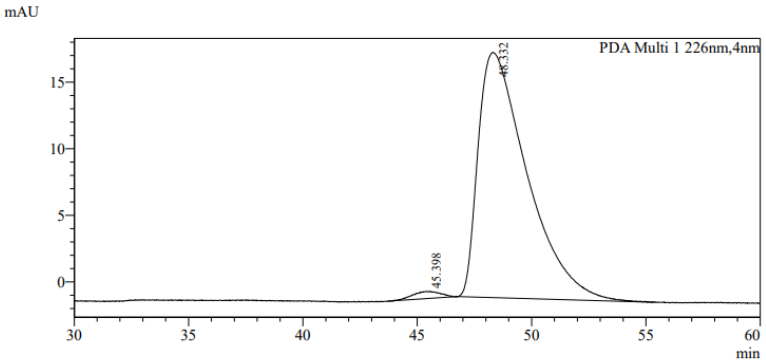
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 95:5, flow rate = 1.0 mL/min, wave length = 226 nm, t_R = 45.40 min (major), t_R = 48.33 min (minor).



<Peak Table>

PDA Ch1 226nm

Peak#	Ret. Time	Area	Height	Aera%
1	44.809	1059765	9729	50.349
2	48.609	1045064	7875	49.651

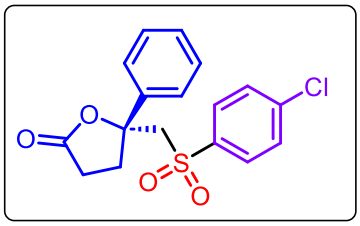


<Peak Table>

PDA Ch1 226nm

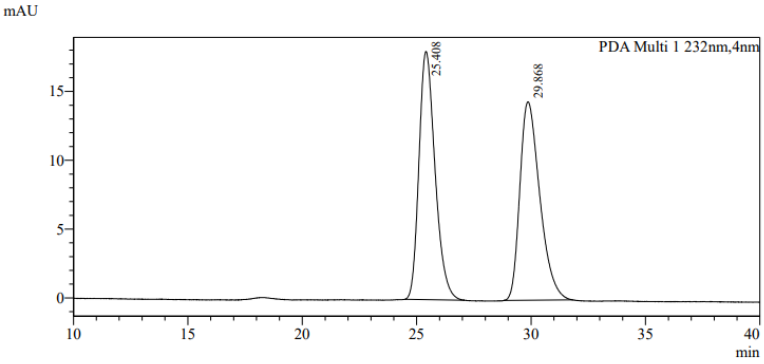
Peak#	Ret. Time	Area	Height	Aera%
1	45.398	44593	543	1.599
2	48.332	2743749	18408	98.401

(*R*)-5-(((4-chlorophenyl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3*H*)-one (3u)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 50% yield, 89% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.74 (d, *J* = 8.8 Hz, 2H), 7.47 (d, *J* = 8.8 Hz, 2H), 7.36 – 7.27 (m, 5H), 3.77 (t, *J* = 15.6 Hz, 2H), 3.35 – 3.27 (m, 1H), 2.86 – 2.78 (m, 1H), 2.68 – 2.61 (m, 1H), 2.54 – 2.45 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.1, 141.5, 140.7, 138.9, 129.6, 129.5, 129.0, 128.7, 124.5, 84.4, 65.2, 32.8, 28.1.

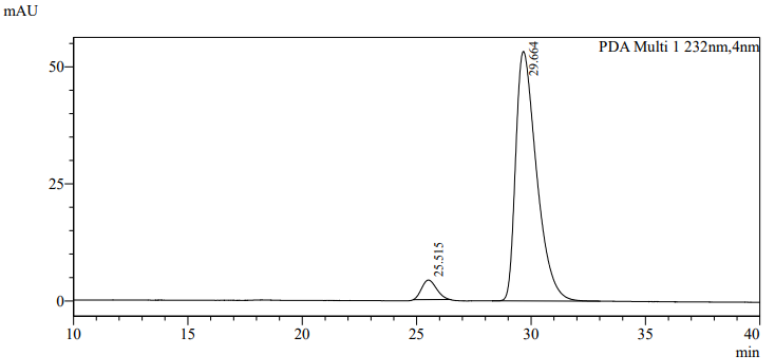
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 232 nm, t_R = 25.52 min (minor), t_R = 29.66 min (major).



<Peak Table>

PDA Ch1 232nm

Peak#	Ret. Time	Area	Height	Aera%
1	25.408	881171	18037	50.188
2	29.868	874557	14421	49.812

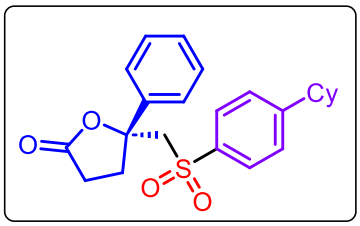


<Peak Table>

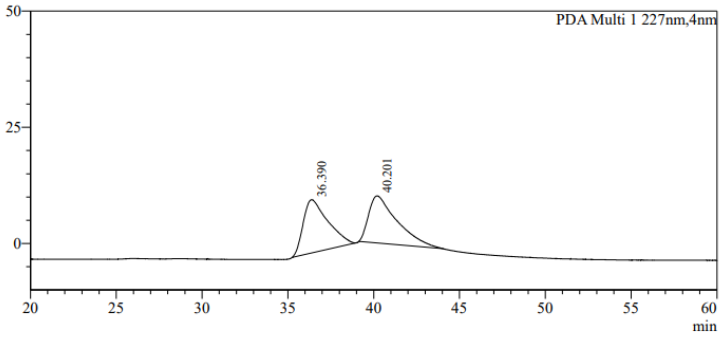
PDA Ch1 232nm

Peak#	Ret. Time	Area	Height	Aera%
1	25.515	187389	4177	5.241
2	29.664	3388277	53301	94.759

(*R*)-5-(((4-cyclohexylphenyl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3*H*)-one (3v)



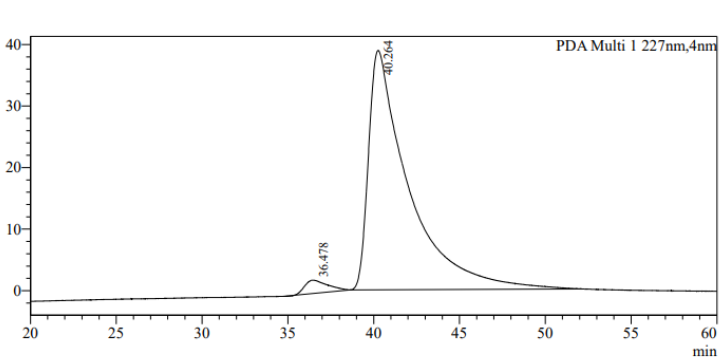
Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 80% yield, 94% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.70 (d, *J* = 8.4 Hz, 2H), 7.32 – 7.27 (m, 7H), 3.74 (dd, *J* = 16.8, 14.8 Hz, 2H), 3.40 – 3.32 (m, 1H), 2.91 – 2.82 (m, 1H), 2.69 – 2.62 (m, 1H), 2.56 – 2.46 (m, 2H), 1.87 – 1.75 (m, 5H), 1.42 – 1.34 (m, 5H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ(ppm) = 175.3, 154.7, 141.8, 137.6, 128.9, 128.5, 127.9, 127.8, 124.6, 84.8, 65.1, 44.6, 34.0, 34.0, 32.4, 28.3, 26.6, 25.9. HRMS (ESI) for $C_{23}H_{26}NaO_4S^+$ $[M+Na]^+$ calcd. 421.1450, found: 421.1443. HPLC analysis: CHIRALPAK AD-H (*n*-hexane/*i*-PrOH) = 92:8, flow rate = 0.8 mL/min, wave length = 227 nm, t_R = 36.48 min (minor), t_R = 40.26 min (major).



<Peak Table>

PDA Ch1 227nm

Peak#	Ret. Time	Area	Height	Aera%
1	36.390	1139667	11450	49.271
2	40.201	1173390	10140	50.729

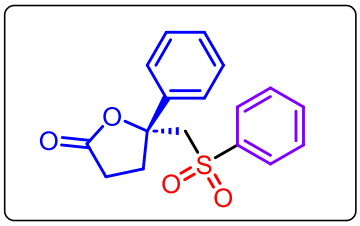


<Peak Table>

PDA Ch1 227nm

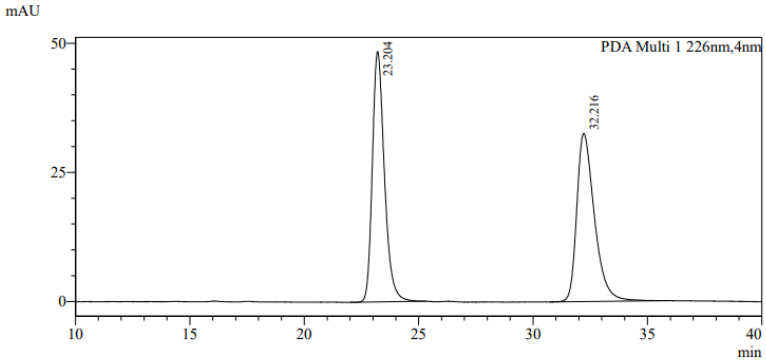
Peak#	Ret. Time	Area	Height	Aera%
1	36.478	196825	2158	3.013
2	40.264	6336269	38896	96.987

(*R*)-5-phenyl-5-((phenylsulfonyl)methyl)dihydrofuran-2(3*H*)-one (3w)[6]



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). white solid, 55% yield, 94% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.83 – 7.81 (m, 2H), 7.64 – 7.61 (m, 1H), 7.54 – 7.50 (m, 2H), 7.36 – 7.27 (m, 5H), 3.81 – 3.72 (m, 2H), 3.40 – 3.32 (m, 1H), 2.89 – 2.81 (m, 1H), 2.69 – 2.62 (m, 1H), 2.54 – 2.45 m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.3, 141.8 140.4, 133.9, 129.3 128.9, 128.6, 127.9, 124.6, 84.7, 65.0, 32.6, 28.2.

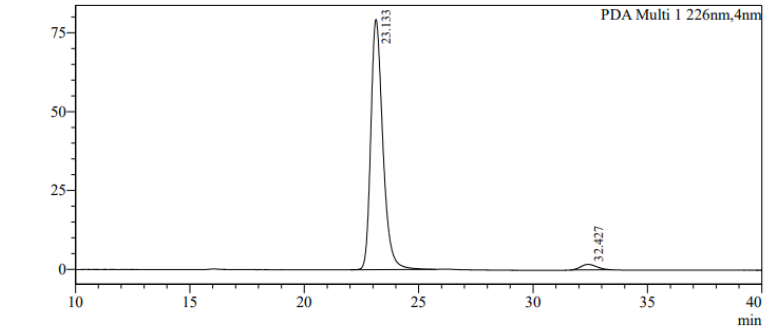
HPLC analysis: CHIRALPAK IA (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 226 nm, t_R = 23.13 min (major), t_R = 32.43 min (minor).



<Peak Table>

PDA Ch1 226nm

Peak#	Ret. Time	Area	Height	Aera%
1	23.204	1782963	48495	50.473
2	32.216	1749578	32548	49.527

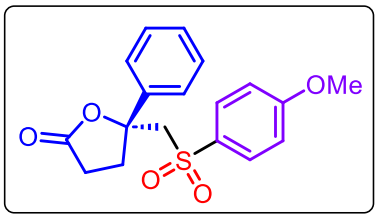


<Peak Table>

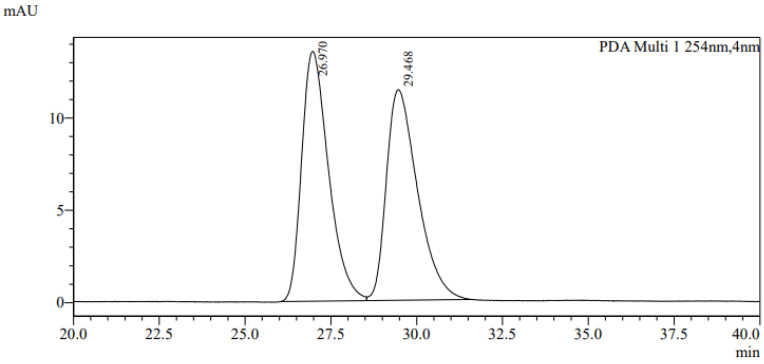
PDA Ch1 226nm

Peak#	Ret. Time	Area	Height	Aera%
1	23.133	2907813	79329	97.156
2	32.427	85113	1744	2.844

(*R*)-5-(((4-methoxyphenyl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3*H*)-one (3x)[6]



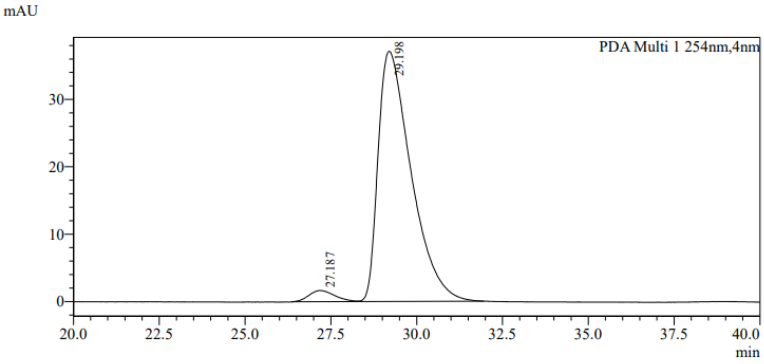
Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 73% yield, 93% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.74 (d, *J* = 8.8 Hz, 2H), 7.36 – 7.27 (m, 5H), 6.96 (d, *J* = 8.8 Hz, 2H), 3.87 (s, 3H), 3.73 (dd, *J* = 16.8, 15.2 Hz, 2H), 3.41 – 3.33 (m, 1H), 2.89 – 2.81 (m, 1H), 2.66 – 2.56 (m, 1H), 2.54 – 2.45 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.4, 163.9, 142.0, 132.0, 130.2, 128.9, 128.5, 124.5, 114.4, 84.8, 65.3, 55.7, 32.5, 28.3. HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 254 nm, t_R = 27.19 min (minor), t_R = 29.20 min (major).



<Peak Table>

PDA Ch1 254nm

Peak#	Ret. Time	Area	Height	Aera%
1	26.970	739108	13535	50.579
2	29.468	722194	11408	49.421

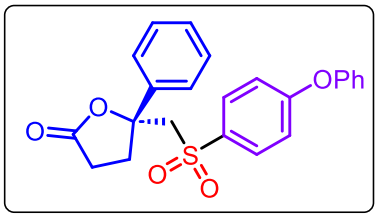


<Peak Table>

PDA Ch1 254nm

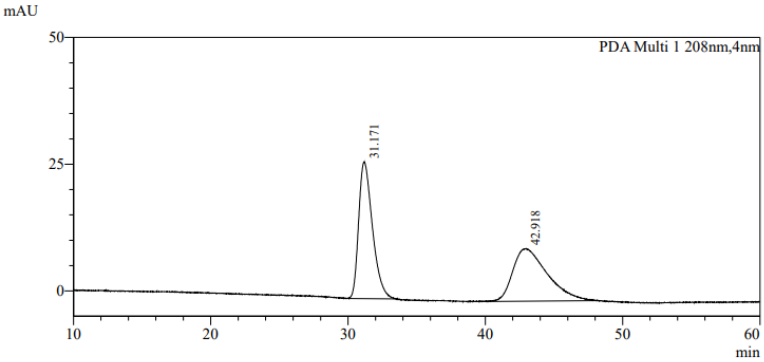
Peak#	Ret. Time	Area	Height	Aera%
1	27.187	87311	1663	3.395
2	29.198	2484195	37121	96.605

(*R*)-5-(((4-phenoxyphenyl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3*H*)-one (3y)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 71% yield, 93% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.74 (dd, *J* = 6.8, 2.0 Hz, 2H), 7.44 – 7.40 (m, 2H), 7.37 – 7.29 (m, 5H), 7.24 (t, *J* = 7.6 Hz, 1H), 7.08 – 7.06 (m, 2H), 7.00 (dd, *J* = 2.8, 2.0 Hz, 2H), 3.75 (dd, *J* = 17.6, 15.2 Hz, 2H), 3.39 – 3.31 (m, 1H), 2.88 – 2.80 (m, 1H), 2.68 – 2.61 (m, 1H), 2.54 – 2.45 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.3, 162.7, 154.8, 141.8, 133.7, 130.3, 130.3, 128.9, 128.6, 125.2, 124.6, 120.5, 117.6, 84.7, 65.3, 32.6, 28.3. HRMS (ESI) for $C_{23}H_{20}NaO_5S^+$ $[M+Na]^+$ calcd. 431.0924, found: 431.0922.

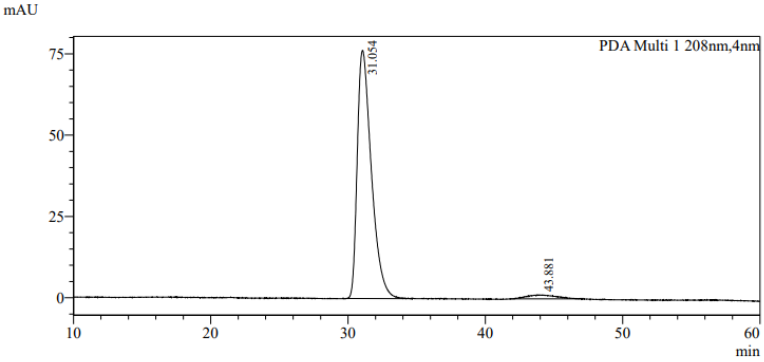
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 208 nm, t_R = 25.604 min (major), t_R = 35.861 min (minor).



<Peak Table>

PDA Ch1 208nm

Peak#	Ret. Time	Area	Height	Aera%
1	31.171	1884801	26943	50.982
2	42.918	1812177	10348	49.018

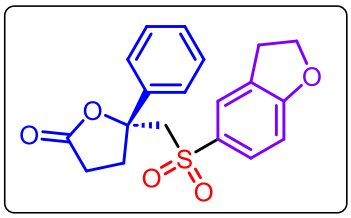


<Peak Table>

PDA Ch1 208nm

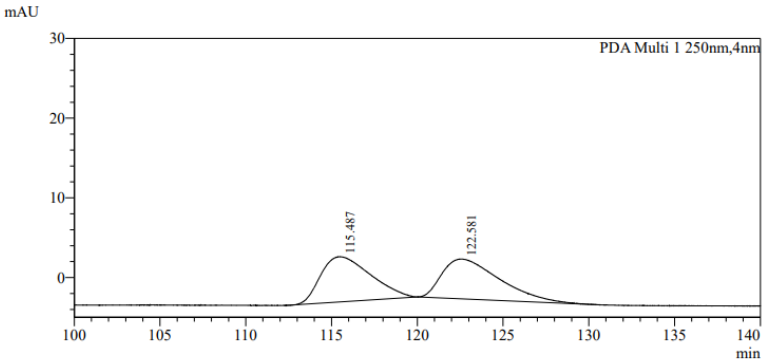
Peak#	Ret. Time	Area	Height	Aera%
1	31.054	5447499	76290	96.827
2	43.881	178497	1179	3.173

(*R*)-5-(((2,3-dihydrobenzofuran-5-yl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3H)-one (3z)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 85% yield, 98% ee. $[\alpha]_D^{20}$= +10.3 (c = 0.12, $CHCl_3$). **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.60 – 7.58 (m, 2H), 7.36 – 7.27 (m, 5H), 6.81 (d, *J* = 8.0 Hz, 1H), 4.67 (t, *J* = 9.2 Hz, 2H), 3.72 (dd, *J* = 16.8, 15.2 Hz, 2H), 3.40 – 3.19 (m, 3H), 2.89 – 2.81 (m, 1H), 2.67 – 2.60 (m, 1H), 2.54 – 2.45 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.4, 164.8, 142.0, 133.0, 129.7, 128.8, 128.6, 128.5, 125.3, 124.6, 109.7, 84.8, 72.5, 65.4, 32.4, 28.9, 28.3. HRMS (ESI) for $C_{19}H_{18}NaO_5S^+$ $[M+Na]^+$ calcd. 381.0773, found: 381.0763.

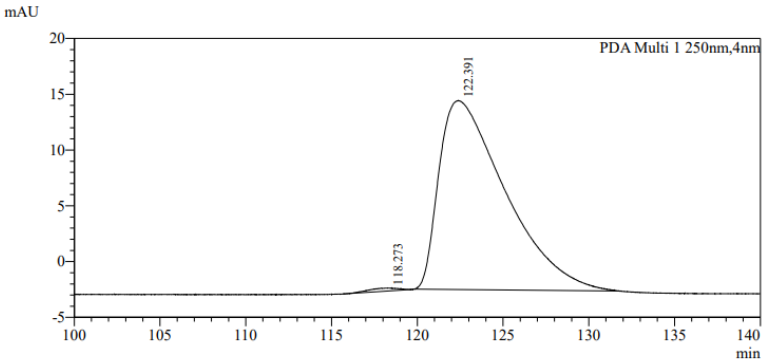
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 90:10, flow rate = 0.6 mL/min, wave length = 254 nm, t_R = 71.87 min (minor), t_R = 74.29 min (major).



<Peak Table>

PDA Ch1 250nm

Peak#	Ret. Time	Area	Height	Aera%
1	115.487	1142531	5671	49.345
2	122.581	1172844	5002	50.655

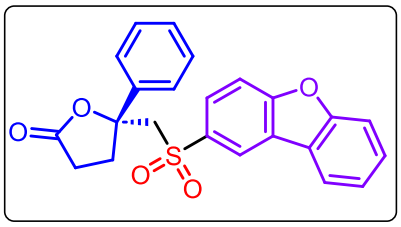


<Peak Table>

PDA Ch1 250nm

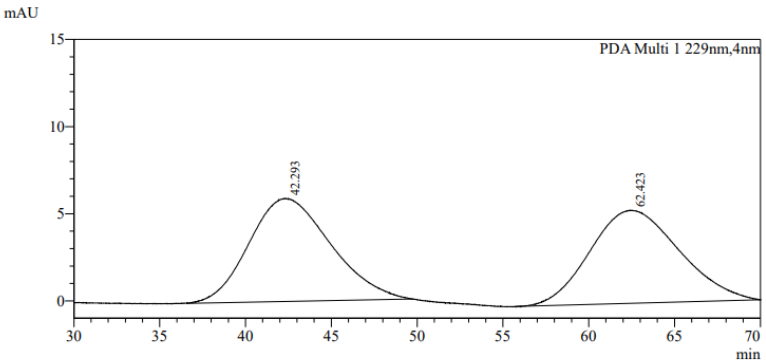
Peak#	Ret. Time	Area	Height	Aera%
1	118.273	34352	267	0.747
2	122.391	4566226	16934	99.253

(*R*)-5-((dibenzo[b,d]furan-2-ylsulfonyl)methyl)-5-phenyldihydrofuran-2(3*H*)-one (3aa)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 55% yield, 89% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 8.38 (d, *J* = 2.0 Hz, 1H), 8.07 – 7.97 (m, 1H), 7.92 – 7.80 (m, 1H), 7.65 – 7.61 (m, 2H), 7.58 – 7.53 (m, 1H), 7.45 – 7.41 (m, 1H), 7.32 – 7.25 (m, 4H), 7.24 – 7.19 (m, 1H), 3.90 – 3.81 (m, 2H), 3.41 – 3.34 (m, 1H), 2.93 – 2.84 (m, 1H), 2.72 – 2.65 (m, 1H), 2.57 – 2.48 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.3, 158.8, 157.1, 141.5, 134.9, 128.8, 128.7, 128.6, 126.9, 125.1, 124.7, 123.8, 122.9, 121.9, 121.3, 112.5, 112.1, 84.7, 65.6, 32.8, 28.3. HRMS (ESI) for $C_{23}H_{19}O_5S^+$ $[M+H]^+$ calcd. 429.0773, found: 429.0768.

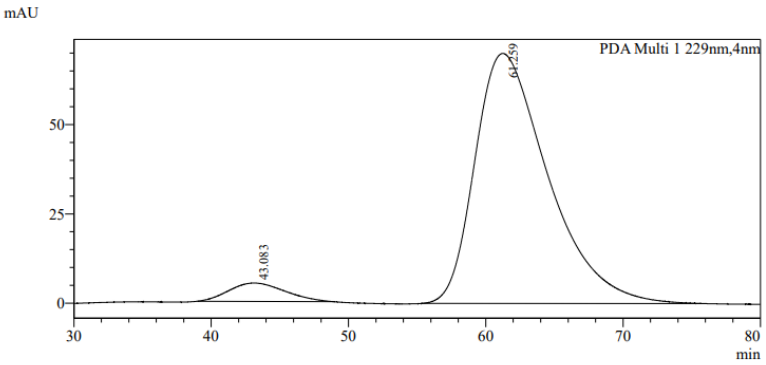
HPLC analysis: CHIRALPAK OZ-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 229 nm, t_R = 43.08 min (minor), t_R = 61.26 min (major).



<Peak Table>

PDA Ch1 229nm

Peak#	Ret. Time	Area	Height	Aera%
1	42.293	1959127	5905	50.406
2	62.423	1927576	5340	49.594

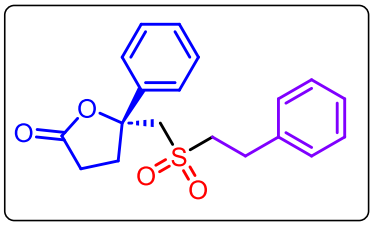


<Peak Table>

PDA Ch1 229nm

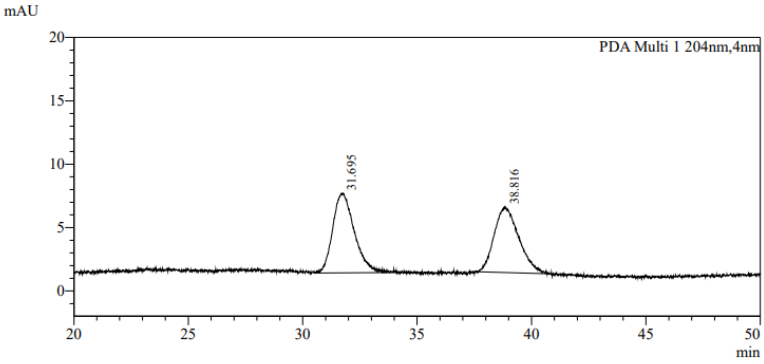
Peak#	Ret. Time	Area	Height	Aera%
1	43.083	1463099	5164	5.349
2	61.259	25891283	69998	94.651

(*R*)-5-((phenethylsulfonyl)methyl)-5-phenyldihydrofuran-2(3*H*)-one (3ab)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow oil, 68% yield, 95% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.42 – 7.28 (m, 7H), 7.24 – 7.18 (m, 3H), 3.53 – 3.44 (m, 2H), 3.26 – 3.18 (m, 3H), 3.10 – 3.05 (m, 2H), 2.78 – 2.70 (m, 1H), 2.64 – 2.58 (m, 1H), 2.52 – 2.43 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.2, 141.5, 137.2, 129.2, 128.9, 128.8, 128.6, 127.1, 124.5, 84.2, 61.9, 57.0, 32.8, 28.2, 27.9. HRMS (ESI) for $C_{19}H_{20}NaO_4S^+$ $[M+Na]^+$ calcd. 367.0980, found: 367.0972.

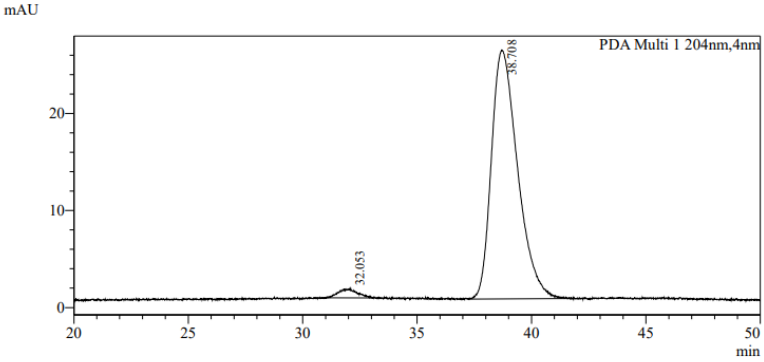
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 204 nm, t_R = 32.50 min (minor), t_R = 38.71 min (major).



<Peak Table>

PDA Ch1 204nm

Peak#	Ret. Time	Area	Height	Aera%
1	31.695	414354	6294	51.796
2	38.816	385621	5151	48.204

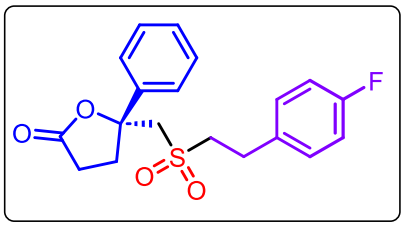


<Peak Table>

PDA Ch1 204nm

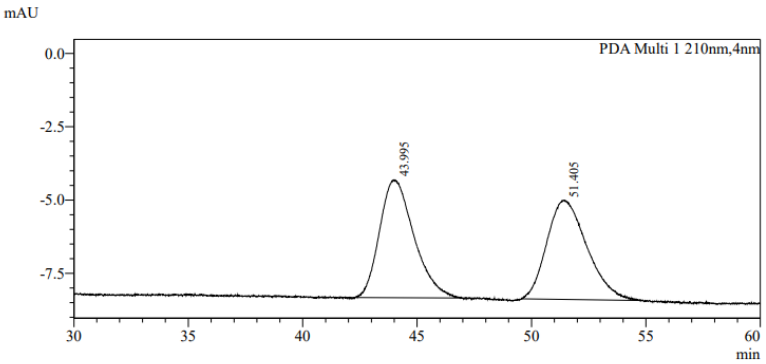
Peak#	Ret. Time	Area	Height	Aera%
1	32.053	54123	947	2.578
2	38.708	2045278	25627	97.422

(*R*)-5-(((4-fluorophenethyl)sulfonyl)methyl)-5-phenyldihydrofuran-2(3*H*)-one (3ac)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow oil, 45% yield, 90% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.45 – 7.34 (m, 5H), 7.18 – 7.14 (m, 2H), 7.01 – 6.96 (m, 2H), 3.50 (dd, *J* = 18.0, 15.6 Hz, 2H), 3.28 – 3.19 (m, 3H), 3.08 – 3.06 (m, 2H), 2.78 – 2.70 (m, 1H), 2.64 – 2.58 (m, 1H), 2.53 – 2.44 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.2, 163.1, 141.5, 132.9 (d, *J* = 2.0 Hz), 130.1 (d, *J* = 8.0 Hz), 129.2, 128.9, 124.4, 115.8 (d, *J* = 21 Hz), 84.2, 61.9, 57.0, 32.9, 27.9, 27.4. **^{19}F NMR (376 MHz, $CDCl_3$)** δ –116.78 – –116.85 (m). HRMS (ESI) for $C_{19}H_{20}FO_4S^+$ $[M+H]^+$ calcd. 385.0886, found: 385.0877.

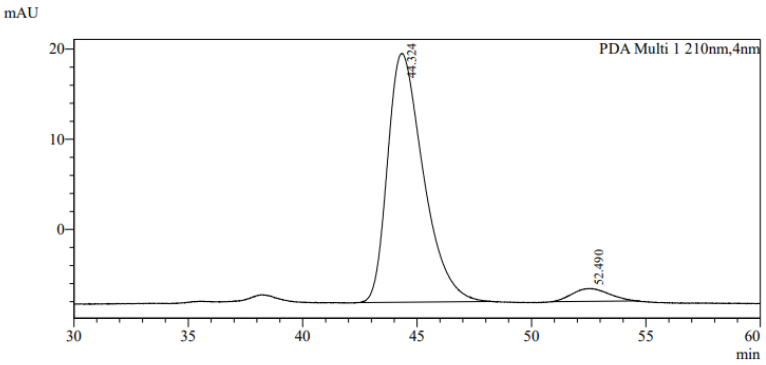
HPLC analysis: CHIRALPAK OD-H (*n*-hexane/*i*-PrOH) = 90:10, flow rate = 1.0 mL/min, wave length = 210 nm, t_R = 44.32 min (major), t_R = 52.49 min (minor).



<Peak Table>

PDA Ch1 210nm

Peak#	Ret. Time	Area	Height	Aera%
1	43.995	419852	4021	50.437
2	51.405	412573	3380	49.563

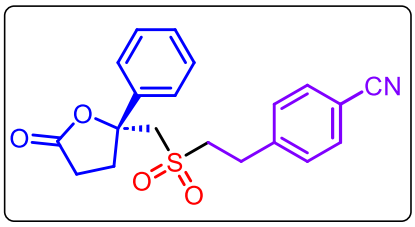


<Peak Table>

PDA Ch1 210nm

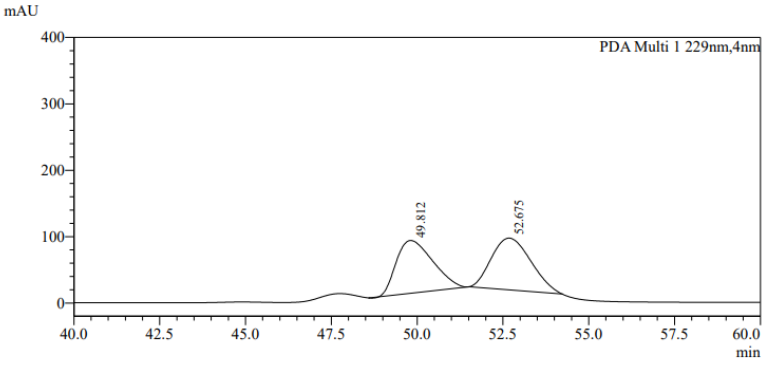
Peak#	Ret. Time	Area	Height	Aera%
1	44.324	2999390	27600	94.952
2	52.490	159464	1442	5.048

(*R*)-4-(2-(((5-oxo-2-phenyltetrahydrofuran-2-yl)methyl)sulfonyl)ethyl)benzonitrile (3ad)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow oil, 71% yield, 89% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.60 (d, *J* = 8.4 Hz, 2H), 7.46 – 7.32 (m, 7H), 3.55 (s, 2H), 3.34 – 3.13 (m, 5H), 2.78 – 2.70 (m, 1H), 2.64 – 2.45 (m, 2H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 175.2, 142.8, 141.4, 132.7, 129.5, 129.3, 129.0, 124.3, 118.6, 111.2, 84.1, 62.1, 56.2, 33.0, 28.1, 27.8. HRMS (ESI) for $C_{20}H_{19}NNaO_4S^+$ $[M+Na]^+$ calcd. 392.0933, found: 392.0934.

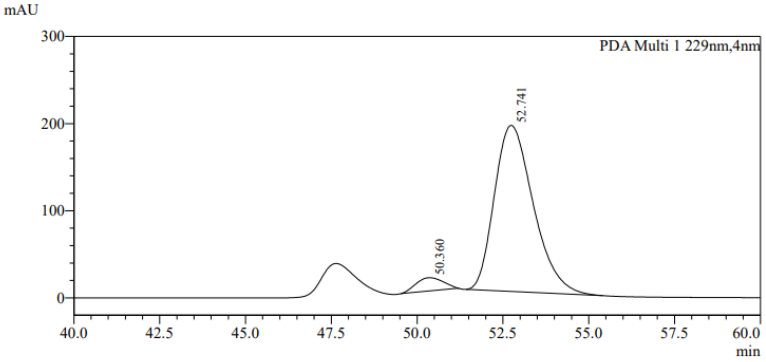
HPLC analysis: CHIRALPAK IA (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 229 nm, t_R = 50.36 min (minor), t_R = 52.74 min (major).



<Peak Table>

PDA Ch1 229nm

Peak#	Ret. Time	Area	Height	Aera%
1	49.812	5875793	79508	48.423
2	52.675	6258495	77957	51.577

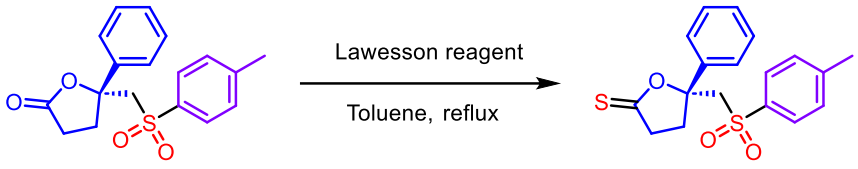


<Peak Table>

PDA Ch1 229nm

Peak#	Ret. Time	Area	Height	Aera%
1	50.360	839460	15175	5.281
2	52.741	15055701	190541	94.719

5.Transformations of 3a

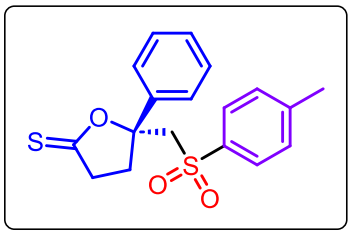


3a
97% ee

4
57% yield, 90% ee

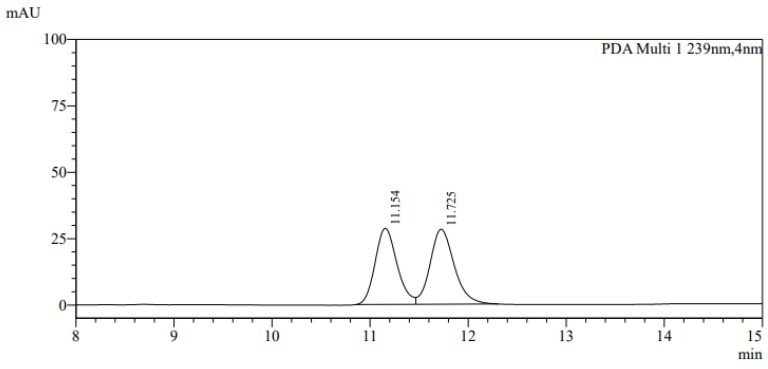
A solution of **3a** (66.1 mg, 0.2 mmol) and Lawesson reagent (181.8 mg, 0.45 mmol) in toluene (2.0 mL) was stirred and refluxed. After 12 h, the mixture was concentrated under reduced pressure. The residue was purified by flash chromatography on silica gel to afford the corresponding product **4** as a white solid in 57% yield (39.5 mg).

(*R*)-5-phenyl-5-(tosylmethyl)dihydrofuran-2(3*H*)-thione (4)



Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). yellow solid, 57% yield, 90% ee. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.69 (d, *J* = 8.0 Hz, 2H), 7.32 – 7.28 (m, 7H), 3.89 – 3.80 (m, 2H), 3.41 – 3.28 (m, 2H), 2.97 – 2.88 (m, 1H), 2.73 – 2.68 (m, 1H), 2.42 (s, 3H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 145.1, 140.4, 137.2, 129.9, 129.0, 128.8, 128.0, 124.8, 94.5, 64.3, 44.0, 33.8, 21.7. HRMS (ESI) for $C_{18}H_{18}NaO_3S_2^+$ $[M+Na]^+$ calcd. 369.0590, found: 369.0588.

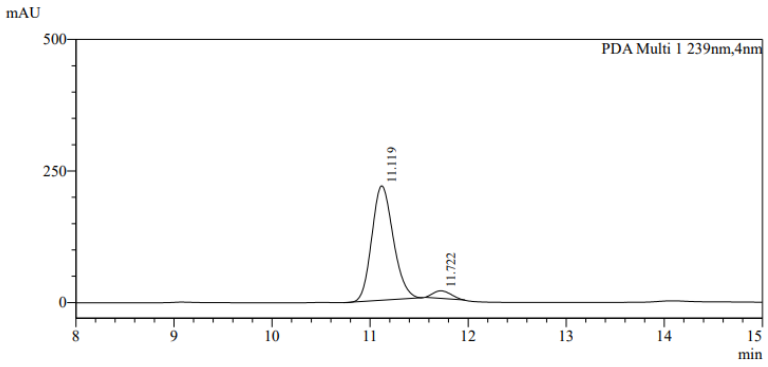
HPLC analysis: CHIRALPAK IA (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 239 nm, t_R = 30.745 min (major), t_R = 33.818 min (minor).



<Peak Table>

PDA Ch1 239nm

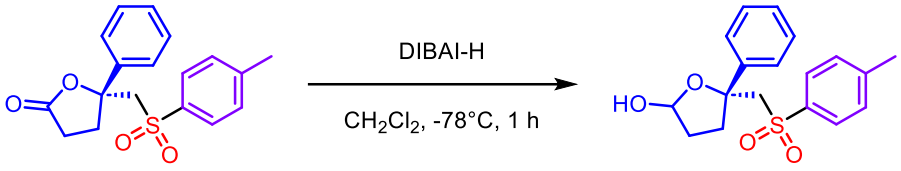
Peak#	Ret. Time	Area	Height	Acra%
1	11.154	445502	28665	48.055
2	11.725	481565	28240	51.945



<Peak Table>

PDA Ch1 239nm

Peak#	Ret. Time	Area	Height	Aera%
1	11.119	3310263	217478	94.854
2	11.722	179603	14248	5.146



3a

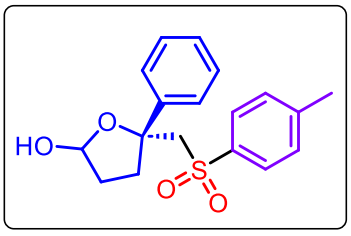
97% ee

5

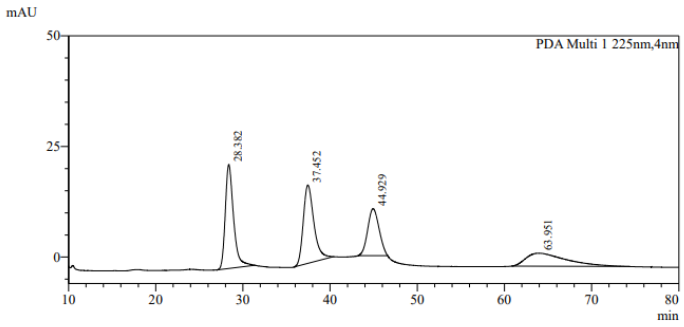
67% yield, 93% ee, 1.5:1 dr

To a solution of **3a** (66.1 mg, 0.2 mmol) in CH_2Cl_2 (1 mL) was added a solution of DIBAL-H (1M in toluene, 0.2 mL, 0.22 mmol) at -78 ºC and the mixture was stirred for 1 hour. The reaction was quenched by addition of H_2O (0.4 mL) and NaOH (0.4 mL, 2M), and then the aqueous layer was extracted with CH_2Cl_2 (3 × 20 mL). The combined organic phase was dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by flash chromatography on silica gel to afford the corresponding product **5** as a white solid in 67% yield (44.5 mg).

(5*R*)-5-phenyl-5-(tosylmethyl)tetrahydrofuran-2-ol (5a)



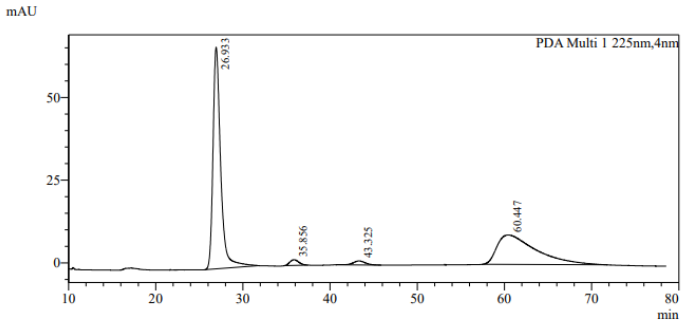
Purification by flash chromatography (*n*-hexane/ethyl acetate = 4/1). white solid, 67% yield, 93% ee, 1.5:1 dr. **^{1}H NMR (400 MHz, $CDCl_3$)** δ (ppm) = 7.69 (d, *J* = 8.0 Hz, 2H), 7.39 – 7.19 (m, 7H), 5.65 (s, 1H), 4.01 (d, *J* = 6.8 Hz, 1H), 3.79 (s, 2H), 3.03 – 2.90 (m, 1H), 2.40 (s, 3H), 2.29 – 2.24 (m, 1H), 2.04 – 1.99 (m, 1H), 1.90 – 1.84 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ (ppm) = 144.5, 144.0, 138.1, 129.6, 128.3, 128.0, 127.4, 124.9, 100.1, 84.8, 66.2, 35.4, 33.1, 21.6. HRMS (ESI) for $C_{18}H_{20}NaO_4S^+$ $[M+Na]^+$ calcd. 355.0975, found: 355.0971. HPLC analysis: CHIRALPAK OJ-H (*n*-hexane/*i*-PrOH) = 80:20, flow rate = 1.0 mL/min, wave length = 225 nm, t_{R1} = 26.93 min (major), t_{R1} = 35.86 min (minor); t_{R2} = 43.33 min (minor), t_{R2} = 60.45 min (major).



<Peak Table>

PDA Ch1 225nm

Peak#	Ret. Time	Area	Height	Aera%
1	28.382	1552352	23482	31.257
2	37.452	1501594	17705	30.235
3	44.929	965925	10636	19.449
4	63.951	946599	2940	19.060



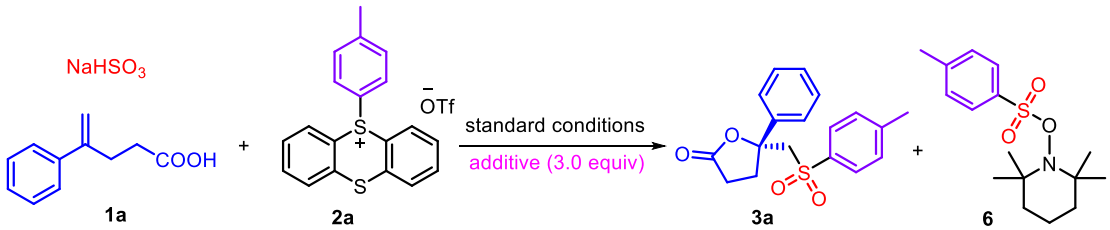
<Peak Table>

PDA Ch1 225nm

Peak#	Ret. Time	Area	Height	Aera%
1	26.933	4092302	66928	57.695
2	35.856	122282	1729	1.724
3	43.325	114978	1196	1.621
4	60.447	2763445	8880	38.960

6. Mechanistic studies

a) Radical trapping experiment with TEMPO.



No additive : 80% yield, 97% ee

3 equiv of TEMPO : 0% yield

In a screw-capped vial, $Cu(MeCN)_4BF_4$ (3.2 mg, 10 mol %) and **L17** (8.7 mg, 12 mol %) were combined with EtOAc (2 mL) under N_2 atmosphere. The resultant solution was stirred for 30 min at room temperature. Enoic acid **1** (0.1 mmol, 1.0 equiv), thianthrenium salt **2** (0.15 mmol, 1.5

equiv), $NaHSO_3$ (15.6 mg, 0.15 mmol, 1.5 equiv), TEMPO (3.0 equiv), pyrene (5 mol %) and 2,6-di-*tert*-butylpyridine (0.2 mmol, 2.0 equiv) were added under N_2 atmosphere. The reaction was placed 4 cm away from a 390 nm Kessil lamp and irradiated for 36 h while stirring at 900 rpm. TLC and HRMS analysis demonstrated that product **3a** was not founded. Compound **6** was detected by HRMS.

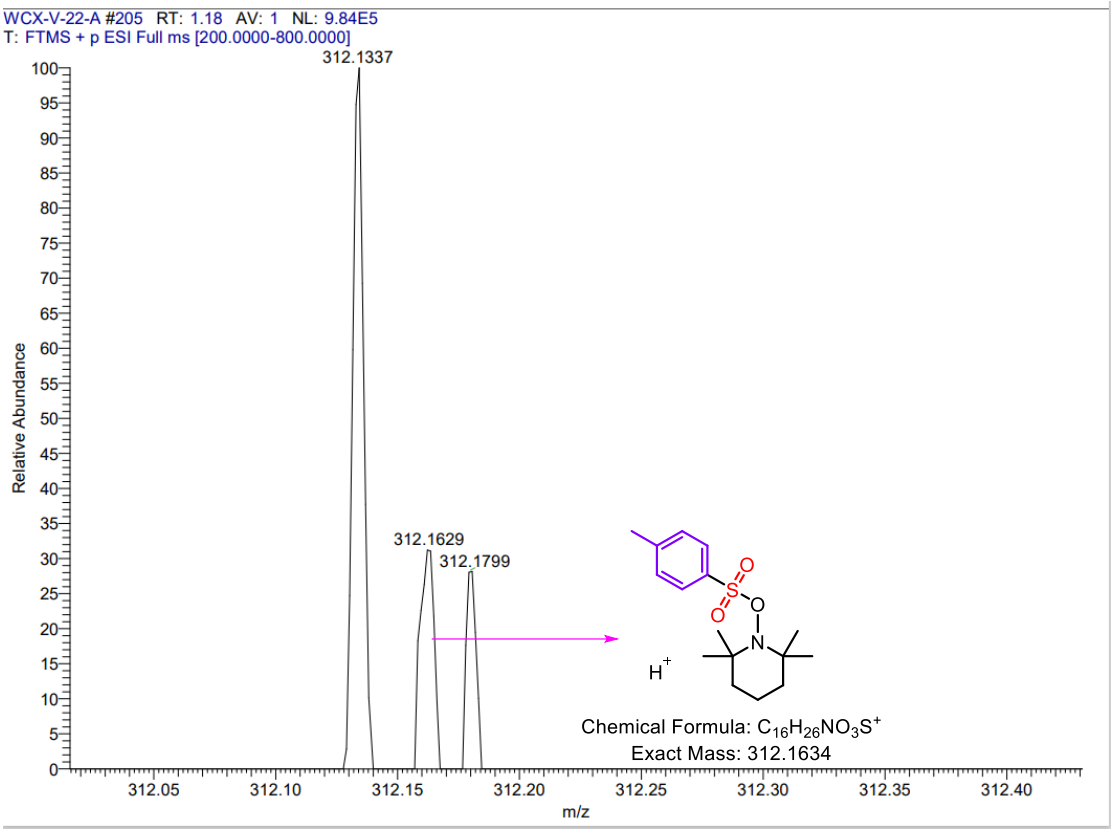
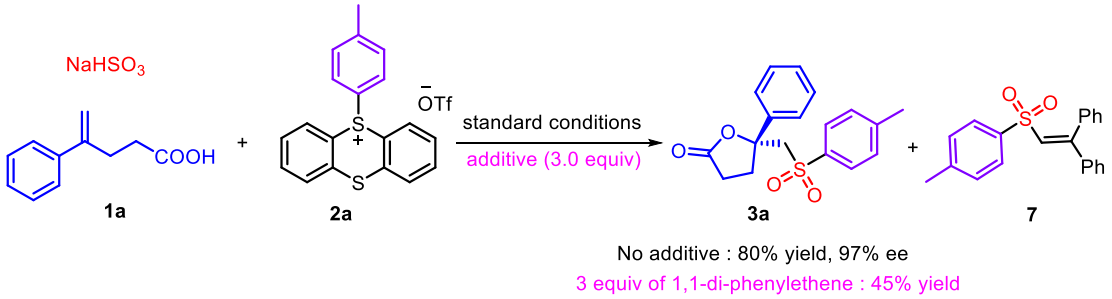


Figure S1 Radical trapping experiment with TEMPO

b) Radical trapping experiment with 1,1-diphenylethylene.



In a screw-capped vial, $Cu(MeCN)_4BF_4$ (3.2 mg, 10 mol %) and **L17** (8.7 mg, 12 mol %) were combined with EtOAc (2 mL) under N_2 atmosphere. The resultant solution was stirred for 30 min at room temperature. Enoic acid **1** (0.1 mmol, 1.0 equiv), thianthrenium salt **2** (0.15 mmol, 1.5 equiv), $NaHSO_3$ (15.6 mg, 0.15 mmol, 1.5 equiv), 1,1-di-phenylethene (0.3 mmol, 3 equiv), pyrene

(5 mol %) and 2,6-di-*tert*-butylpyridine (0.2 mmol, 2.0 equiv) were added under N_2 atmosphere. The reaction was placed 4 cm away from a 390 nm Kessil lamp and irradiated for 36 h while stirring at 900 rpm. Product **3a** was obtained in 45% yield. Compound **7** was detected by HRMS.

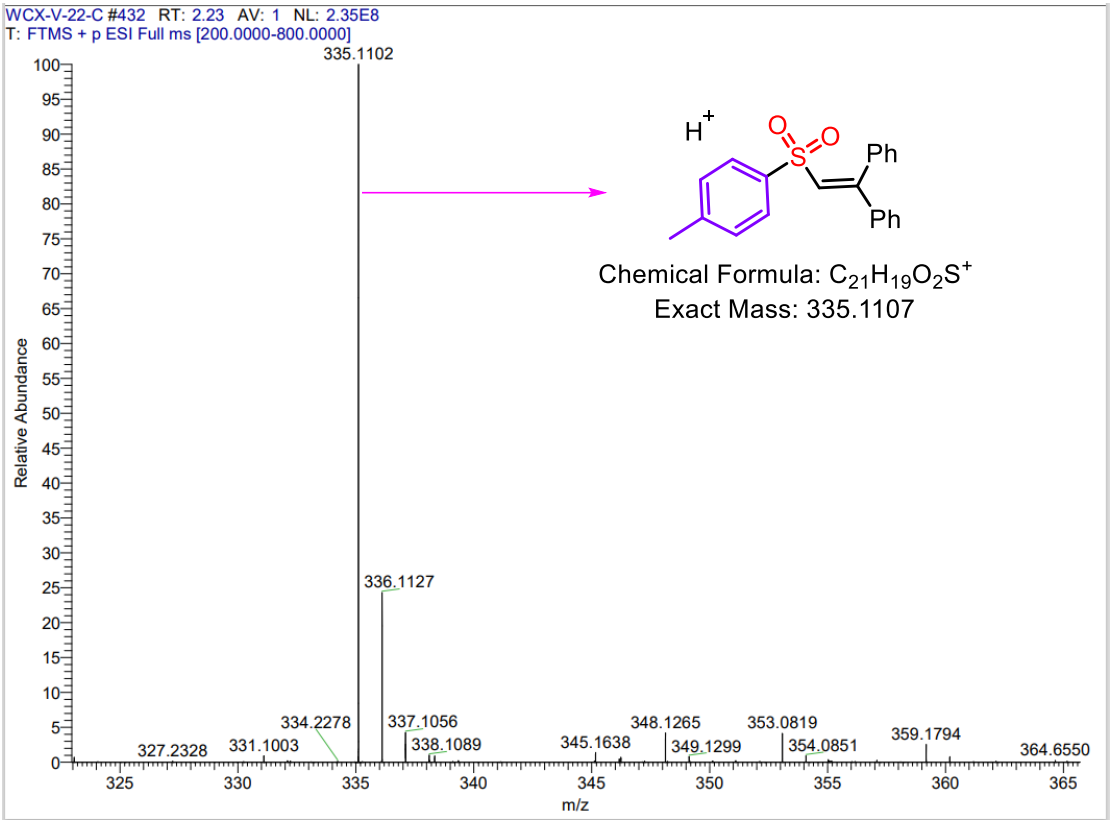


Figure S2 Radical trapping experiment with 1,1-diphenylethylene.

c) Stern-Volmer fluorescene quenching experiments.

Stern-Volmer fluorescence quenching experiments were run with freshly prepared solutions of 0.1 mM pyrene in degassed dry CH_3CN added with the appropriate amount of a quencher in a screw-top quartz cuvette at room temperature. The solutions were irradiated at 345 nm and fluorescence was measured from 360 nm to 420 nm.

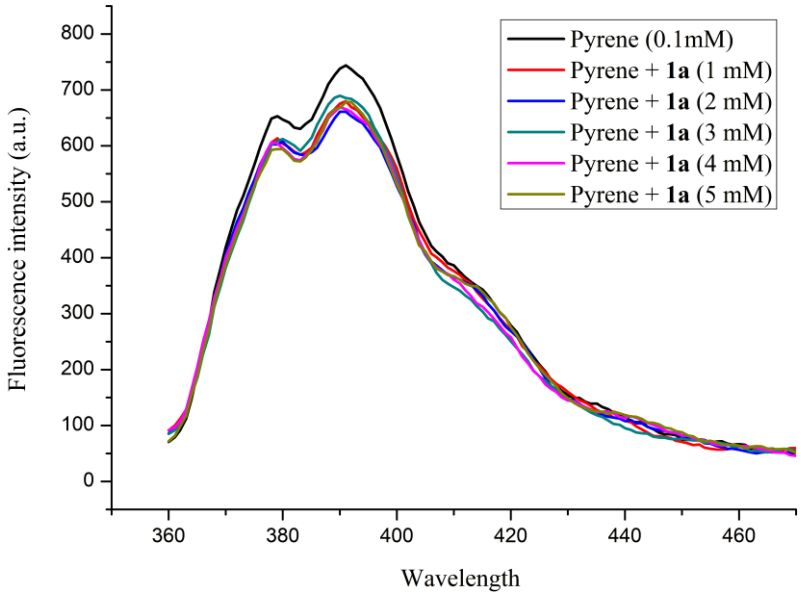


Figure S3 Fluorescence quenching experiments of pyrene and **1a**.

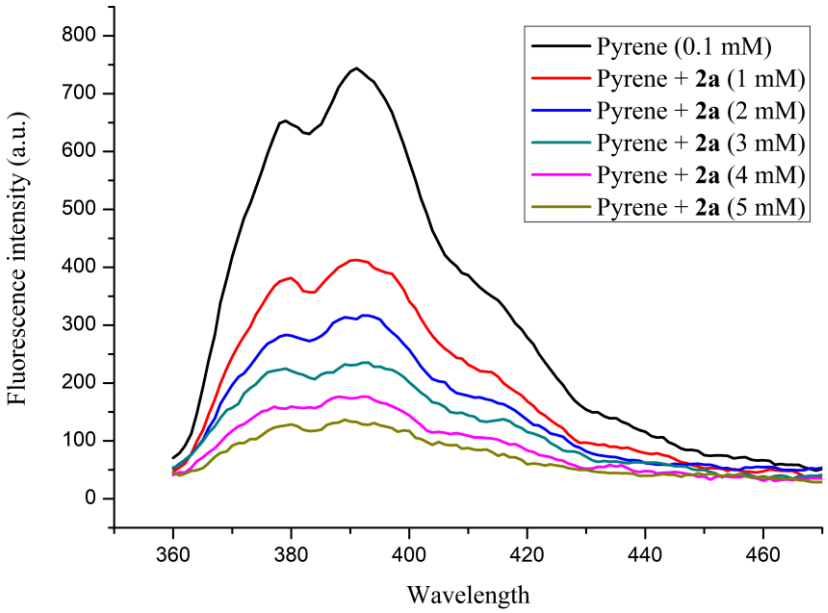


Figure S4 Fluorescence quenching experiments of pyrene and **2a**.

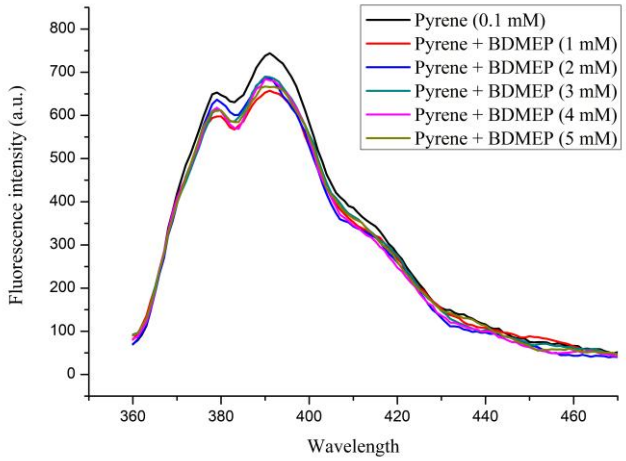


Figure S5 Fluorescence quenching experiments of pyrene and BDMEP.

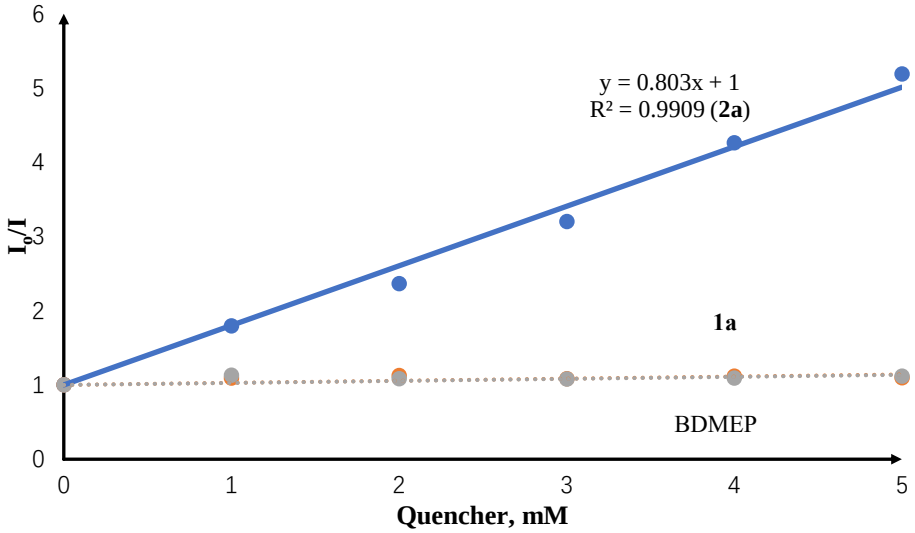
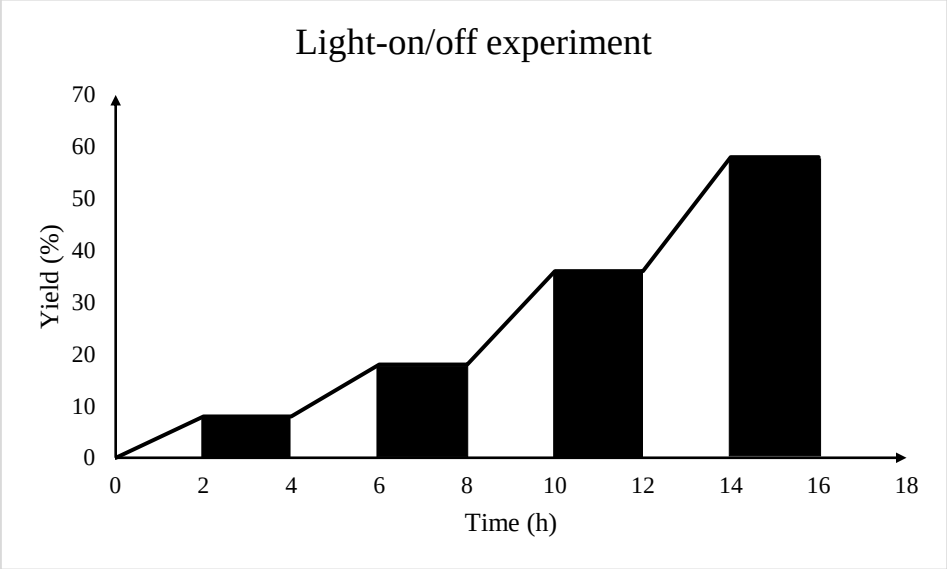


Figure S6 Stern-Volmer plots of pyrene with different quenchers.

d) light on-off experiments

To further study the necessity of continuous irradiation with visible light for the progress of the reaction, the reaction proceeding was monitored by ^{1}H NMR spectroscopy using dibromomethane as an internal standard before and after light irradiation and dark periods. The control experiments shown below with successive intervals of irradiation and dark periods resulted in total interruption of the reaction progress in the absence of light, and recuperation of reactivity upon further illumination, demonstrating that light is a necessary component for the reaction proceeding.



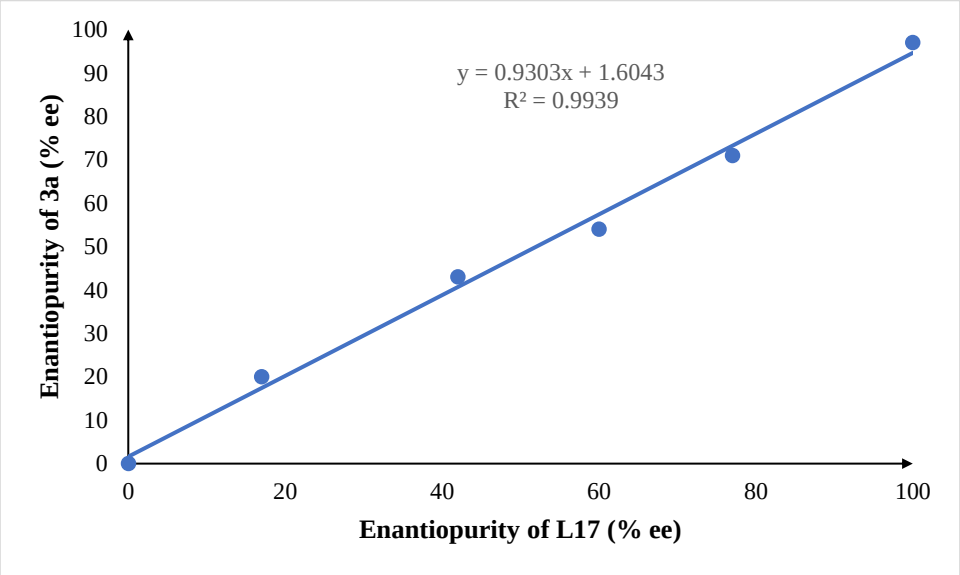
Time (h)	0	2	4	6	8	10	12	14	16
Yield (%)	0	8	8	18	18	36	36	58	58

Figure S7 Light-on/off experiment.

e) Non-linear effect studies

Investigation into non-linear effects was conducted by comparing the ee value of the chiral ligand **L17** and that of the product **3a**. 6 reactions containing **L17** of racemic, 17%, 42%, 60%, 77%, and > 99% optical purity were run in parallel. The nonlinear effect study revealed a linear relationship between the ee of the product **3a** and the enantiopurity of the ligand **L17**, indicating a single chiral ligand is likely involved in the enantiodetermining transition state.

In a screw-capped vial, $Cu(MeCN)_4BF_4$ (3.2 mg, 10 mol %) and **L17** with different ee values (8.7 mg, 12 mol %) were combined with EtOAc (2 mL) under N_2 atmosphere. The resultant solution was stirred for 30 min at room temperature. Enoic acid **1** (0.1 mmol, 1.0 equiv), thianthrenium salt **2** (0.15 mmol, 1.5 equiv), $NaHSO_3$ (15.6 mg, 0.15 mmol, 1.5 equiv), pyrene (5 mol %) and 2,6-di-*tert*-butylpyridine (0.2 mmol, 2.0 equiv) were added under N_2 atmosphere. The reaction was placed 4 cm away from a 390 nm Kessil lamp and irradiated for 36 h while stirring at 900 rpm. Then the mixture was purified directly by flash column chromatography (*n*-hexane/EtOAc (v/v): 4/1) to provide the desired product **3a**. The ee of **3a** was determined by HPLC analysis: (Chiralcel AD-H, 0.5 mL/min, *n*-hexane/*i*-PrOH = 80:20, 226 nm, t_R = 34.56 min (minor), t_R = 37.76 min (major)). A graph of ee of product vs. ee of ligand was then plotted.



Ee of **L17** (%)	17	42	60	77	100
Ee of **3a** (%)	20	43	54	71	97

Figure S8 Non-linear effects.

7. Crystal data and structural refinement for 3a

The crystal structure of compound **3a** has been deposited at the Cambridge Crystallographic Data Centre (CCDC 2401076).

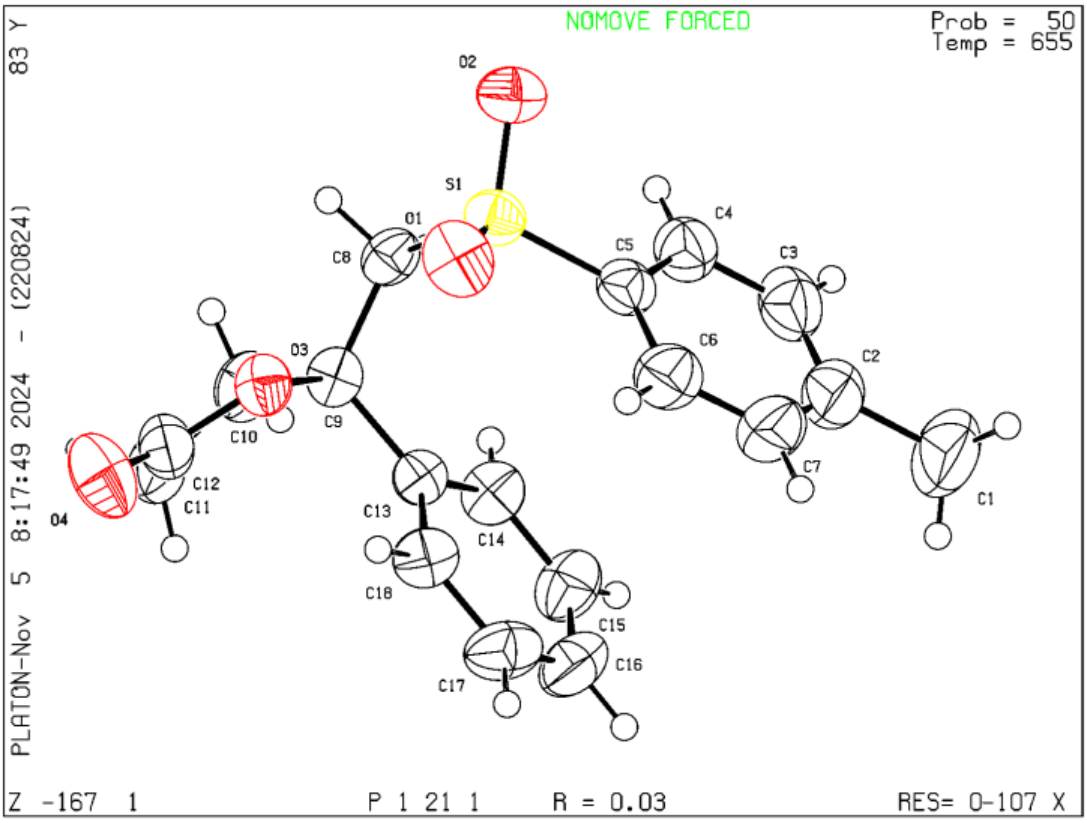


Table 1 Crystal data and structure refinement for 3a.

Identification code	**3a**
Empirical formula	$C_{18}H_{18}O_4S$
Formula weight	330.38
Temperature/K	655.0
Crystal system	monoclinic
Space group	$P2_1$
a/Å	5.8777(2)
b/Å	15.5812(5)
c/Å	9.2526(3)
α/°	90
β/°	102.9160(10)
γ/°	90
Volume/Å^3	825.93(5)
Z	2
ρ_{calc}g/cm^3	1.328
μ/mm^{-1}	1.893
F(000)	348.0
Crystal size/mm^3	0.22 × 0.21 × 0.2
Radiation	CuKα (λ = 1.54178)
2Θ range for data collection/°	15.026 to 136.96

Index ranges	$-7 \leq h \leq 6, -13 \leq k \leq 18, -11 \leq l \leq 11$
Reflections collected	6665
Independent reflections	2358 [R_{int} = 0.0300, R_{sigma} = 0.0386]
Data/restraints/parameters	2358/1/209
Goodness-of-fit on F^2	1.063
Final R indexes [I>=2σ (I)]	R_1 = 0.0309, wR_2 = 0.0816
Final R indexes [all data]	R_1 = 0.0312, wR_2 = 0.0819
Largest diff. peak/hole / e $Å^{-3}$	0.17/-0.26
Flack parameter	0.084(9)

8. Computational details

Gaussian 16 program was used for all the calculations.[7] The PBE0[8] density functional with D3BJ[9-10] dispersion correction and def2-SVP[11] basis sets were utilized for structures optimization and frequency calculations at 298.15 K and 1 atm. Frequency calculations were employed to confirm the minima (zero imaginary frequency) and transition state (only one imaginary frequency) at the same level of theory as above calculations. Intrinsic reaction coordinate (IRC) [12] calculations were performed for all the transition states. Further refining of single point energies with solvent effect was calculated at the PBE0-D3BJ and def2-TZVP[11, 13] level of theory. The solvent effects were performed with SMD[14] model in dichloromethane.

The results of DFT calculations of the reaction process without copper catalyst are outlined in Figure S9.

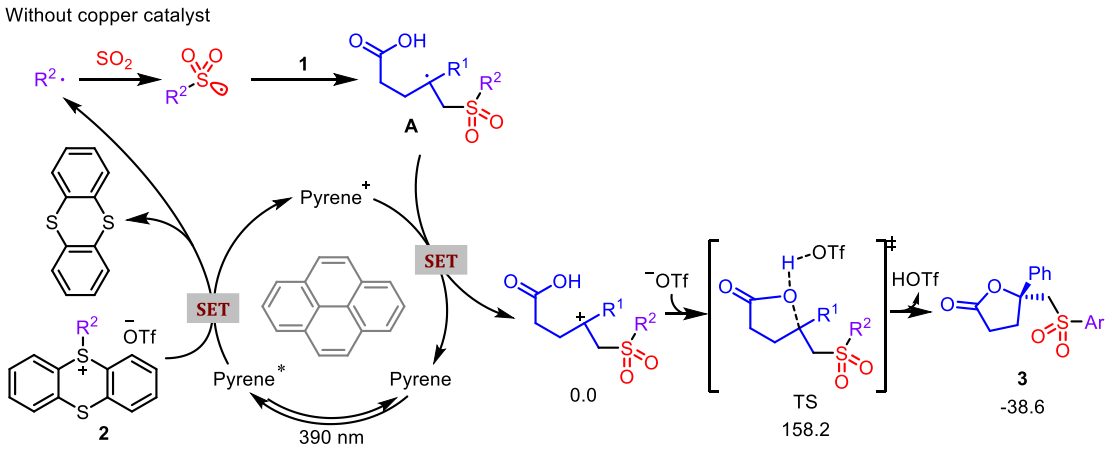


Figure S9. Computational studies of enantioselective radical sulfonylation (in kcal/mol).

Cartesian coordinates of related structures

L*Cu^{I}X

6	1.787462	2.291132	-1.56976
6	1.54574	1.21829	-0.71281
7	0.308702	0.831447	-0.39937
6	-0.74828	1.403672	-0.98303
6	-0.60262	2.483437	-1.8538
6	0.686941	2.938989	-2.1267
6	2.543749	0.240933	-0.23596
7	3.869448	0.448022	0.048506
6	4.536511	-0.87061	0.015281
6	3.309337	-1.79993	0.248596
7	2.169255	-0.9984	-0.19121
6	-1.97301	0.611571	-0.73569
7	-1.80875	-0.66042	-0.56456
6	-3.11413	-1.24758	-0.29929
6	-4.11802	-0.19946	-0.849
7	-3.28557	1.016858	-0.75424
29	0.116746	-1.24195	0.082448
6	3.159824	-2.25007	1.68431
6	2.403849	-1.52475	2.608656
6	2.327243	-1.93485	3.938409
6	3.007911	-3.07551	4.358774
6	3.761765	-3.80741	3.44133
6	3.834263	-3.3979	2.112401
6	5.264431	-1.08935	-1.28836
6	6.652371	-0.93567	-1.33803
6	7.33929	-1.11096	-2.53724
6	6.644007	-1.4343	-3.70092
6	5.257949	-1.58295	-3.6616
6	4.571389	-1.41432	-2.46174
6	-3.29852	-2.63779	-0.83847
6	-4.3341	-3.43501	-0.3364
6	-4.53739	-4.72129	-0.83307
6	-3.69925	-5.22843	-1.82731
6	-2.66301	-4.43946	-2.32645
6	-2.4675	-3.14778	-1.83899
6	-5.40621	-0.12537	-0.08153
6	-5.42115	0.296614	1.252484
6	-6.61219	0.314031	1.972163
6	-7.7996	-0.10009	1.367513
6	-7.79041	-0.52198	0.039925
6	-6.59879	-0.52868	-0.68302

1	2.805162	2.592386	-1.81819
1	-1.46579	2.946095	-2.33126
1	0.834816	3.774039	-2.81394
1	5.248021	-0.91495	0.849367
1	3.394919	-2.68911	-0.39246
1	-3.23503	-1.28999	0.79989
1	-4.33169	-0.40138	-1.91247
1	1.847395	-0.64271	2.282575
1	1.731042	-1.35946	4.6504
1	2.950935	-3.39604	5.401407
1	4.295622	-4.70464	3.762743
1	4.424922	-3.97645	1.396267
1	7.193109	-0.65702	-0.43106
1	8.424704	-0.99151	-2.56254
1	7.182949	-1.57276	-4.64094
1	4.708735	-1.83851	-4.57072
1	3.485085	-1.53848	-2.44347
1	-4.98899	-3.04189	0.446027
1	-5.35461	-5.33138	-0.44124
1	-3.85767	-6.2368	-2.21651
1	-2.00564	-4.83019	-3.10672
1	-1.65588	-2.52748	-2.22545
1	-4.49545	0.626999	1.732549
1	-6.6162	0.654552	3.010033
1	-8.73458	-0.08676	1.931985
1	-8.71848	-0.83856	-0.44102
1	-6.59436	-0.84515	-1.72885
6	-3.84658	2.286196	-0.98098
6	4.56231	1.59783	0.433008
8	-4.86289	2.380958	-1.62397
8	5.769407	1.598523	0.446581
6	-3.17302	3.44652	-0.34092
6	-2.43044	3.32677	0.840123
6	-3.35737	4.706769	-0.92193
6	-1.85771	4.455716	1.418183
1	-2.31782	2.353744	1.323301
6	-2.76568	5.829203	-0.35322
1	-3.97192	4.784294	-1.82154
6	-2.01306	5.703761	0.815887
1	-1.29666	4.36412	2.350234
1	-2.90122	6.80982	-0.81443
1	-1.55898	6.588282	1.268735
6	3.742317	2.768263	0.854
6	4.128363	4.041912	0.425551

6	2.644497	2.623068	1.709688
6	3.380126	5.155115	0.79686
1	5.014044	4.144314	-0.20559
6	1.915164	3.741584	2.100676
1	2.374033	1.635809	2.091006
6	2.269792	5.004901	1.629175
1	3.670623	6.147743	0.445975
1	1.07071	3.626194	2.783059
1	1.689137	5.881386	1.925979
7	-0.38243	-2.85873	1.072565
6	-0.85516	-3.89484	1.267256
6	-1.47246	-5.18663	1.465251
1	-1.9489	-5.23106	2.454898
1	-2.23803	-5.33707	0.687733
1	-0.71612	-5.98118	1.394756

L*$Cu^{II}X$

6	-2.73464	-3.21328	-1.81673
6	-2.33013	-2.06743	-1.13318
7	-1.04144	-1.73428	-1.09547
6	-0.07094	-2.45813	-1.6609
6	-0.39864	-3.62423	-2.34952
6	-1.74698	-3.98552	-2.42446
6	-3.1556	-0.9989	-0.50755
7	-4.44601	-1.01937	-0.11692
6	-4.89198	0.386601	0.080679
6	-3.51905	1.127561	0.170095
7	-2.57754	0.164376	-0.38911
6	1.236407	-1.75337	-1.5166
7	1.175371	-0.52927	-1.06019
6	2.522109	0.033516	-0.99428
6	3.364817	-0.95242	-1.84539
7	2.474046	-2.14623	-1.86427
29	-0.60533	0.132569	-0.55335
6	-3.1085	1.573145	1.551157
6	-2.48324	0.697124	2.444135
6	-2.12193	1.126063	3.719854
6	-2.38803	2.436078	4.116585
6	-3.01792	3.313923	3.233555
6	-3.37259	2.885452	1.955299
6	-5.77724	0.856337	-1.04266
6	-7.12798	1.114276	-0.80062
6	-7.95496	1.553313	-1.83232

6	-7.4396	1.727402	-3.11504
6	-6.09224	1.464828	-3.36631
6	-5.264	1.034502	-2.33412
6	2.588758	1.464897	-1.44619
6	3.359492	2.385196	-0.73196
6	3.424045	3.716643	-1.14236
6	2.712157	4.136795	-2.26611
6	1.947267	3.219001	-2.98785
6	1.891603	1.887513	-2.58291
6	4.730816	-1.24499	-1.29855
6	4.883741	-1.81466	-0.02856
6	6.154476	-2.07772	0.473593
6	7.282302	-1.76561	-0.2872
6	7.135114	-1.198	-1.55076
6	5.862019	-0.94399	-2.0583
1	-3.78516	-3.49381	-1.88031
1	0.362969	-4.23751	-2.82855
1	-2.03004	-4.88338	-2.9778
1	-5.43783	0.435366	1.031733
1	-3.55532	2.00762	-0.48903
1	2.861042	-0.02063	0.055087
1	3.451146	-0.58942	-2.88243
1	-2.26993	-0.33304	2.144048
1	-1.63809	0.433507	4.412136
1	-2.11396	2.770659	5.119497
1	-3.24268	4.336572	3.54588
1	-3.86918	3.575445	1.266931
1	-7.53886	0.957136	0.199289
1	-9.00944	1.755399	-1.63318
1	-8.08919	2.069263	-3.92371
1	-5.68697	1.601841	-4.37122
1	-4.20749	0.839687	-2.54452
1	3.921386	2.055323	0.146298
1	4.043619	4.426764	-0.58945
1	2.769016	5.177721	-2.59291
1	1.402986	3.541547	-3.8783
1	1.297328	1.171651	-3.1584
1	4.00609	-2.06545	0.575368
1	6.268901	-2.52838	1.461756
1	8.279935	-1.97066	0.10708
1	8.015885	-0.95918	-2.15037
1	5.746541	-0.51591	-3.057
6	2.946801	-3.33916	-2.51183
6	-5.32183	-2.087	0.224446

8	3.671467	-3.21337	-3.45965
8	-6.50017	-1.86833	0.280061
6	2.555826	-4.62684	-1.90612
6	2.127917	-4.73482	-0.57443
6	2.676051	-5.7773	-2.69969
6	1.797075	-5.98108	-0.05286
1	2.089346	-3.85114	0.066219
6	2.331579	-7.01815	-2.17641
1	3.04473	-5.6766	-3.72295
6	1.889165	-7.11955	-0.85538
1	1.485175	-6.07186	0.989749
1	2.420756	-7.91416	-2.7942
1	1.632259	-8.09788	-0.44261
6	-4.70281	-3.39416	0.553575
6	-5.38828	-4.55551	0.17597
6	-3.51426	-3.49062	1.290624
6	-4.8515	-5.80348	0.476019
1	-6.33944	-4.46423	-0.35361
6	-2.99445	-4.74152	1.609673
1	-3.01707	-2.5885	1.656656
6	-3.65322	-5.89665	1.187343
1	-5.37839	-6.70992	0.170399
1	-2.08358	-4.81862	2.207268
1	-3.24494	-6.87869	1.436783
7	-0.19073	1.937249	0.091749
6	0.048234	2.996873	0.475631
6	0.336726	4.321691	0.962786
1	-0.42488	4.610223	1.702511
1	1.332548	4.331401	1.429108
1	0.330623	5.029726	0.121174

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6	4.453429	1.141958	1.851012
6	3.716394	0.47344	0.873802
7	2.639429	1.036201	0.344624
6	2.140354	2.203212	0.752378
6	2.779271	2.900267	1.776127
6	3.958694	2.363717	2.300149
6	3.966195	-0.85661	0.26875
7	4.829523	-1.80971	0.736864
6	5.083059	-2.73814	-0.37358
6	3.834104	-2.4763	-1.2804
7	3.366073	-1.1537	-0.83549

6	0.851887	2.474167	0.055024
7	0.438767	1.556903	-0.76067
6	-0.89654	1.898657	-1.23344
6	-1.3867	2.894265	-0.15144
7	-0.07741	3.449489	0.288789
29	1.607092	-0.06959	-0.94795
6	2.748182	-3.52246	-1.20988
6	2.39557	-4.12757	0.001562
6	1.398327	-5.09766	0.043748
6	0.741731	-5.47452	-1.12722
6	1.080926	-4.87108	-2.33713
6	2.077935	-3.89936	-2.37621
6	6.384663	-2.4723	-1.08606
6	6.890665	-3.46214	-1.93529
6	8.055966	-3.23858	-2.66243
6	8.731562	-2.02387	-2.54484
6	8.236568	-1.03784	-1.69488
6	7.067657	-1.26104	-0.96853
6	-0.86463	2.476606	-2.6328
6	-2.07012	2.614674	-3.33152
6	-2.07932	3.177043	-4.60442
6	-0.88996	3.602226	-5.19755
6	0.312873	3.455061	-4.51212
6	0.324868	2.893708	-3.23511
6	-2.11502	2.283755	1.022915
6	-1.73123	1.049961	1.564305
6	-2.39799	0.532191	2.672901
6	-3.45193	1.237456	3.253699
6	-3.8418	2.462003	2.713613
6	-3.17539	2.981112	1.605939
1	5.36177	0.709799	2.269448
1	2.387594	3.844383	2.149942
1	4.490434	2.906874	3.083704
1	5.087128	-3.76259	0.021621
1	4.161149	-2.37397	-2.32483
1	-1.53537	1.006516	-1.23022
1	-1.98088	3.706971	-0.58403
1	2.905873	-3.85701	0.928679
1	1.138445	-5.56604	0.995384
1	-0.03372	-6.24348	-1.09692
1	0.57013	-5.16121	-3.25782
1	2.337658	-3.42497	-3.32562
1	6.370212	-4.4202	-2.02357
1	8.445059	-4.02097	-3.31771

1	9.649624	-1.85038	-3.11034
1	8.767492	-0.08894	-1.59035
1	6.697664	-0.48856	-0.29051
1	-2.99936	2.265946	-2.87611
1	-3.02638	3.27548	-5.13974
1	-0.90124	4.041245	-6.19764
1	1.250161	3.773844	-4.9741
1	1.276849	2.760897	-2.71544
1	-0.92466	0.461242	1.120395
1	-2.09672	-0.43759	3.07746
1	-3.97366	0.829095	4.122657
1	-4.67186	3.01763	3.155396
1	-3.47252	3.947105	1.192957
6	-3.95863	-2.19675	-0.748
6	-2.58087	-1.82551	-0.30306
6	-4.40158	-1.54849	-2.00741
6	-1.44405	-2.52867	-1.06431
6	-0.1817	-1.73558	-0.86815
8	0.355087	-1.20131	-1.90147
8	0.274496	-1.51513	0.273309
6	-4.8381	-3.01305	0.029264
6	-6.1888	-3.24314	-0.34994
6	-7.05006	-3.9801	0.446118
6	-6.60617	-4.53777	1.648811
6	-5.27555	-4.35058	2.034836
6	-4.40973	-3.60827	1.24735
1	-2.48758	-0.73886	-0.45517
1	-2.43529	-1.98082	0.772222
1	-3.57878	-1.41547	-2.73
1	-5.23405	-2.04053	-2.52596
1	-1.65401	-2.59344	-2.14053
1	-1.29876	-3.54973	-0.68304
1	-6.57787	-2.81851	-1.27514
1	-8.08477	-4.12297	0.125941
1	-7.28691	-5.11969	2.273725
1	-4.911	-4.79271	2.965165
1	-3.37747	-3.48216	1.576214
6	-6.23577	0.074656	-0.58286
6	-5.88994	0.043111	0.767009
6	-6.88758	-0.18872	1.704209
6	-8.22033	-0.38314	1.313411
6	-8.53867	-0.30308	-0.04905
6	-7.55348	-0.07898	-1.00526
1	-4.85406	0.199538	1.072232

1	-6.62618	-0.22596	2.764807
1	-9.57773	-0.42264	-0.3659
1	-7.79261	-0.02056	-2.06946
6	-9.27226	-0.69556	2.33355
1	-9.13806	-0.09882	3.247464
1	-9.21258	-1.75705	2.62651
1	-10.2837	-0.51335	1.945637
16	-4.95471	0.185121	-1.79115
8	-3.82973	0.927279	-1.19198
8	-5.50499	0.628508	-3.07085
6	0.016935	4.770964	0.745068
6	5.013866	-2.21265	2.076926
8	-0.96982	5.33489	1.14793
8	5.874875	-3.00749	2.348723
6	1.343603	5.432982	0.637254
6	1.696666	6.361589	1.62397
6	2.200448	5.202129	-0.44608
6	2.928984	7.003783	1.560964
1	0.993465	6.563466	2.435049
6	3.423657	5.863794	-0.51559
1	1.89468	4.535772	-1.25636
6	3.795219	6.750045	0.495101
1	3.212341	7.716828	2.33823
1	4.084575	5.69806	-1.36908
1	4.757689	7.264086	0.441747
6	4.057173	-1.64688	3.071109
6	4.550221	-1.30768	4.335927
6	2.691034	-1.48723	2.78801
6	3.701417	-0.74582	5.284685
1	5.606081	-1.4801	4.557151
6	1.843796	-0.93897	3.747397
1	2.252981	-1.79417	1.833499
6	2.350489	-0.55192	4.987736
1	4.092132	-0.46423	6.265008
1	0.782959	-0.81977	3.515939
1	1.686231	-0.11248	5.735569

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6	3.187134	3.25759	0.497338
6	2.212156	2.383021	0.021975
7	2.535105	1.113283	-0.22797
6	3.727969	0.595192	0.029905
6	4.776084	1.417286	0.441826

6	4.484159	2.761148	0.664611
6	0.742314	2.549869	-0.15889
7	-0.10492	3.40355	0.501265
6	-1.36686	2.62326	0.678812
6	-1.3329	1.844061	-0.63435
7	0.114772	1.586799	-0.75299
6	3.698343	-0.87619	-0.16402
7	2.742557	-1.37061	-0.88182
6	2.904497	-2.83056	-0.95891
6	4.344035	-3.0621	-0.41096
7	4.576088	-1.79401	0.330343
29	1.155868	-0.10859	-1.00932
6	-1.80717	2.590872	-1.86759
6	-1.46394	2.076756	-3.12601
6	-1.89566	2.71097	-4.28779
6	-2.66804	3.870209	-4.21142
6	-3.00504	4.389541	-2.96445
6	-2.57822	3.753548	-1.79867
6	-1.24828	1.766599	1.923605
6	-1.33419	2.391021	3.174252
6	-1.16345	1.65484	4.34388
6	-0.90105	0.284864	4.281012
6	-0.81771	-0.34406	3.040264
6	-0.99289	0.390723	1.866727
6	1.783805	-3.52052	-0.22028
6	0.775513	-4.17433	-0.932
6	-0.31443	-4.7316	-0.26593
6	-0.40522	-4.64655	1.123031
6	0.612359	-4.02029	1.842847
6	1.699751	-3.46212	1.175427
6	5.40529	-3.2758	-1.46012
6	5.359054	-2.60922	-2.69073
6	6.372439	-2.7926	-3.62813
6	7.439201	-3.64531	-3.3462
6	7.491967	-4.30949	-2.12202
6	6.481602	-4.12268	-1.1817
1	2.955734	4.29908	0.716222
1	5.775035	1.017959	0.612816
1	5.274232	3.434829	1.001929
1	-2.20425	3.321702	0.77481
1	-1.86142	0.885288	-0.55409
1	2.858949	-3.11976	-2.01788
1	4.374262	-3.88362	0.315865
1	-0.85612	1.170959	-3.20251

1	-1.62555	2.293243	-5.26039
1	-3.00612	4.367618	-5.12323
1	-3.60898	5.296799	-2.89182
1	-2.87653	4.173982	-0.83717
1	-1.52319	3.466595	3.219945
1	-1.24218	2.153191	5.312889
1	-0.77298	-0.29212	5.199957
1	-0.62418	-1.41778	2.972262
1	-0.94327	-0.1383	0.912831
1	0.834538	-4.22821	-2.02271
1	-1.11409	-5.22198	-0.82708
1	-1.2841	-5.05065	1.628847
1	0.562068	-3.9731	2.933449
1	2.494234	-2.98879	1.757826
1	4.526235	-1.94205	-2.93069
1	6.32475	-2.27315	-4.5878
1	8.229689	-3.79486	-4.08505
1	8.324926	-4.9791	-1.89695
1	6.532186	-4.62654	-0.21386
6	-3.40553	-1.12963	-0.82765
6	-3.1209	-1.36526	-2.28478
6	-2.97562	-2.15093	0.157608
6	-1.8433	-2.13529	-2.63756
6	-0.60454	-1.39492	-2.21342
8	-0.40812	-1.27123	-0.94855
8	0.184084	-0.87221	-3.0163
6	-4.20982	-0.01037	-0.41748
6	-4.46241	0.28042	0.951449
6	-5.21127	1.38158	1.335909
6	-5.75642	2.243046	0.378886
6	-5.53585	1.97659	-0.97459
6	-4.78139	0.880919	-1.36659
1	-3.96364	-1.929	-2.72734
1	-3.09632	-0.40119	-2.81443
1	-1.96857	-2.54341	-0.04499
1	-2.99111	-1.81021	1.198864
1	-1.80073	-2.28183	-3.72414
1	-1.86755	-3.12674	-2.16292
1	-4.05764	-0.36081	1.733566
1	-5.37533	1.56999	2.39949
1	-6.35042	3.106977	0.684979
1	-5.95674	2.634659	-1.73827
1	-4.63697	0.708383	-2.43278
6	-5.62561	-2.99977	0.468506

6	-6.4051	-2.56389	-0.6005
6	-7.59565	-1.89849	-0.33562
6	-8.019	-1.6669	0.98066
6	-7.23166	-2.15366	2.032638
6	-6.03392	-2.81643	1.787075
1	-6.07556	-2.75223	-1.62402
1	-8.21106	-1.54708	-1.1676
1	-7.56396	-2.00768	3.063571
1	-5.41416	-3.19594	2.602381
6	-9.27391	-0.89379	1.251098
1	-10.0616	-1.13517	0.522964
1	-9.07779	0.188692	1.173011
1	-9.66273	-1.08914	2.259892
16	-4.00825	-3.64738	0.156404
8	-3.96417	-4.20751	-1.1988
8	-3.59073	-4.45601	1.30576
6	5.26376	-1.78983	1.558342
6	-0.00942	4.760759	0.81744
8	6.096943	-2.63014	1.780691
8	-0.74313	5.24497	1.645759
6	4.849019	-0.76	2.555522
6	5.840576	-0.16279	3.340632
6	3.502864	-0.42221	2.762524
6	5.494731	0.812118	4.272133
1	6.881018	-0.46615	3.203471
6	3.157049	0.537231	3.709741
1	2.706822	-0.91664	2.20065
6	4.15627	1.167713	4.451797
1	6.27246	1.290329	4.871642
1	2.104	0.78257	3.870615
1	3.889274	1.927172	5.190324
6	0.982328	5.541577	0.035199
6	1.640041	6.603939	0.667741
6	1.220568	5.272326	-1.31981
6	2.580065	7.350643	-0.03479
1	1.405804	6.825078	1.711388
6	2.149098	6.036369	-2.02222
1	0.652419	4.495488	-1.83983
6	2.839181	7.06246	-1.37705
1	3.106473	8.169626	0.460173
1	2.324923	5.838478	-3.08166
1	3.571204	7.656489	-1.92906

C

6	-3.31946	2.360399	1.050929
6	-2.59172	1.254902	0.621084
7	-1.25165	1.260331	0.593602
6	-0.58651	2.381091	0.858239
6	-1.24799	3.567515	1.192258
6	-2.62917	3.537212	1.330661
6	-3.17577	-0.0423	0.197458
7	-4.46085	-0.29793	-0.22852
6	-4.65532	-1.76401	-0.17857
6	-3.18215	-2.25342	-0.15981
7	-2.42637	-1.08833	0.273238
6	0.892861	2.290589	0.943679
7	1.430044	1.422061	1.721115
6	2.84689	1.782358	1.883922
6	3.113948	2.890309	0.825615
7	1.747149	3.205993	0.382342
29	-0.34073	-0.63823	0.228505
6	-2.6431	-2.78898	-1.46375
6	-2.16771	-1.9298	-2.46026
6	-1.65005	-2.44206	-3.64877
6	-1.60676	-3.82095	-3.85295
6	-2.08522	-4.68498	-2.86774
6	-2.59852	-4.17052	-1.67846
6	-5.44706	-2.18178	1.03587
6	-6.73382	-2.70238	0.890607
6	-7.46588	-3.09683	2.009217
6	-6.92158	-2.96366	3.28484
6	-5.63987	-2.43456	3.439327
6	-4.90524	-2.04953	2.321267
6	3.090884	2.186696	3.317217
6	3.799312	1.332681	4.166022
6	4.006745	1.683833	5.499804
6	3.508241	2.888037	5.992311
6	2.799829	3.744429	5.148012
6	2.591131	3.394201	3.817252
6	3.974157	2.393404	-0.31274
6	3.429714	1.618062	-1.34257
6	4.235394	1.120836	-2.36518
6	5.606372	1.378717	-2.35497
6	6.160267	2.135249	-1.32224
6	5.347782	2.645368	-0.31003
1	-4.4029	2.315873	1.142238
1	-0.67898	4.477539	1.388386

1	-3.17375	4.428334	1.648039
1	-5.18449	-2.07142	-1.08879
1	-3.08131	-3.03973	0.600453
1	3.487219	0.91216	1.674913
1	3.570488	3.781064	1.277471
1	-2.16418	-0.84949	-2.29991
1	-1.25574	-1.75893	-4.40366
1	-1.19819	-4.22316	-4.78272
1	-2.05611	-5.76562	-3.02495
1	-2.96834	-4.84944	-0.90456
1	-7.17093	-2.78184	-0.10714
1	-8.47131	-3.50432	1.882772
1	-7.49759	-3.26903	4.161245
1	-5.2123	-2.32163	4.438714
1	-3.89895	-1.64202	2.453526
1	4.192972	0.390934	3.772509
1	4.567497	1.013853	6.155644
1	3.675918	3.165131	7.03562
1	2.413265	4.692369	5.529449
1	2.03918	4.073871	3.160855
1	2.360262	1.410202	-1.36498
1	3.775649	0.547098	-3.17406
1	6.242443	1.005297	-3.16127
1	7.231759	2.347491	-1.31302
1	5.785602	3.253391	0.485947
6	1.084446	-2.08632	0.331685
6	1.029823	-2.89842	-0.92577
6	2.300192	-1.28209	0.5992
6	1.565629	-2.18255	-2.15088
6	0.958767	-0.81159	-2.42715
8	0.425879	-0.16307	-1.43058
8	1.037844	-0.32481	-3.53828
6	0.254258	-2.4285	1.471148
6	0.097331	-1.48896	2.530488
6	-0.81397	-1.73965	3.557584
6	-1.53643	-2.92436	3.574714
6	-1.37157	-3.87241	2.549445
6	-0.51399	-3.62255	1.499891
1	1.626661	-3.81329	-0.74206
1	-0.00049	-3.23531	-1.11014
1	2.706704	-0.75991	-0.27405
1	2.138984	-0.54614	1.391819
1	1.410873	-2.7966	-3.0476
1	2.657264	-2.03575	-2.08206

1	0.67027	-0.5549	2.554517
1	-0.93299	-1.00523	4.356377
1	-2.23206	-3.13105	4.391341
1	-1.93017	-4.81007	2.585913
1	-0.3962	-4.35957	0.705283
6	4.516705	-2.89582	-0.11925
6	5.27895	-2.01032	-0.88288
6	5.8944	-2.4854	-2.03292
6	5.777701	-3.83011	-2.42024
6	5.024069	-4.69519	-1.6158
6	4.390156	-4.23888	-0.46366
1	5.388332	-0.96504	-0.5845
1	6.485691	-1.79743	-2.64228
1	4.936189	-5.74798	-1.89522
1	3.812427	-4.9094	0.176316
6	6.474196	-4.32866	-3.64895
1	6.067665	-5.292	-3.98495
1	7.548642	-4.47275	-3.44858
1	6.393365	-3.60828	-4.47588
16	3.669266	-2.27924	1.302428
8	4.521685	-1.29273	1.966066
8	3.07719	-3.39546	2.035185
6	-5.49845	0.476651	-0.77367
6	1.523621	4.31007	-0.46791
8	-6.58908	-0.02797	-0.89348
8	2.211383	5.292963	-0.32562
6	-5.21639	1.866218	-1.21567
6	-6.20778	2.823904	-0.96771
6	-4.05063	2.229232	-1.89899
6	-6.00372	4.148532	-1.33884
1	-7.13063	2.51261	-0.47359
6	-3.85929	3.552144	-2.28613
1	-3.28777	1.484086	-2.13963
6	-4.82502	4.513491	-1.99137
1	-6.77009	4.897583	-1.12794
1	-2.94695	3.8328	-2.8126
1	-4.66318	5.552643	-2.28719
6	0.558277	4.174007	-1.59216
6	0.170705	5.352833	-2.24593
6	0.227253	2.934167	-2.15302
6	-0.52373	5.288786	-3.44792
1	0.464581	6.312262	-1.81549
6	-0.43425	2.872043	-3.37651
1	0.513862	1.988953	-1.69141

6	-0.80601	4.047832	-4.02717
1	-0.81437	6.209914	-3.95797
1	-0.60501	1.891288	-3.82627
1	-1.30874	4.00147	-4.9965

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6	-2.93779	2.865872	-1.86257
6	-1.99839	2.25442	-1.02537
7	-2.03535	0.908992	-0.86753
6	-2.97292	0.127947	-1.43574
6	-3.92706	0.680071	-2.27165
6	-3.89007	2.071677	-2.48983
6	-0.8669	2.805881	-0.3051
7	-0.50667	4.114866	-0.08491
6	0.91449	4.132703	0.290264
6	1.104665	2.669871	0.798963
7	0.022796	1.949911	0.154678
6	-2.70692	-1.28287	-1.08712
7	-1.50964	-1.54349	-0.64267
6	-1.38581	-2.95321	-0.33455
6	-2.69472	-3.58639	-0.89649
7	-3.50789	-2.37731	-1.17425
29	-0.53006	0.054724	0.019063
6	1.096947	2.529121	2.305002
6	0.041641	1.926876	2.990292
6	0.090851	1.772312	4.376288
6	1.192356	2.232401	5.093419
6	2.24326	2.856585	4.417952
6	2.195552	3.001031	3.034394
6	1.831397	4.480588	-0.8541
6	2.906631	5.343282	-0.63254
6	3.812496	5.625574	-1.65371
6	3.647682	5.047992	-2.91157
6	2.57093	4.190891	-3.14249
6	1.669088	3.907891	-2.11999
6	-0.13419	-3.57915	-0.88669
6	0.373782	-4.73645	-0.28681
6	1.503919	-5.36275	-0.80541
6	2.137226	-4.83761	-1.93173
6	1.638903	-3.68238	-2.53268
6	0.505875	-3.0548	-2.01256
6	-3.37981	-4.52422	0.059443
6	-3.64789	-4.1217	1.37399

6	-4.29397	-4.98524	2.25375
6	-4.67172	-6.25995	1.829976
6	-4.40536	-6.66546	0.524092
6	-3.76661	-5.79758	-0.35977
1	-2.92206	3.94261	-2.02579
1	-4.6841	0.065761	-2.75556
1	-4.6196	2.529996	-3.15894
1	1.049728	4.862985	1.097942
1	2.063544	2.29003	0.421935
1	-1.37387	-3.05456	0.763128
1	-2.49858	-4.10144	-1.84963
1	-0.8193	1.544326	2.439527
1	-0.73871	1.282459	4.891067
1	1.232261	2.112908	6.178381
1	3.105932	3.230153	4.974606
1	3.024246	3.483127	2.508972
1	3.026743	5.812774	0.347559
1	4.641557	6.312801	-1.46993
1	4.348655	5.277694	-3.71734
1	2.42858	3.746674	-4.13059
1	0.82937	3.236191	-2.31572
1	-0.12272	-5.14762	0.596888
1	1.909477	-6.25227	-0.32063
1	3.024153	-5.33338	-2.33162
1	2.130634	-3.26794	-3.41646
1	0.112612	-2.15012	-2.48293
1	-3.34268	-3.12989	1.722692
1	-4.49964	-4.66428	3.2773
1	-5.17575	-6.9387	2.521656
1	-4.70284	-7.66095	0.18756
1	-3.57516	-6.10591	-1.39019
6	2.888671	-1.17097	1.421998
6	2.664783	-1.08246	2.896549
6	2.890193	-2.52436	0.822734
6	1.300307	-1.66553	3.258371
6	0.268032	-1.18358	2.261865
8	0.804329	-0.79962	1.135409
8	-0.93375	-1.15596	2.467817
6	3.462821	-0.07931	0.669464
6	3.316825	-0.02289	-0.73563
6	3.853833	1.029059	-1.46137
6	4.573397	2.036473	-0.81318
6	4.749936	1.981211	0.570966
6	4.188303	0.948107	1.309208

1	3.477708	-1.63521	3.401028
1	2.700708	-0.03382	3.220956
1	2.275596	-3.24943	1.371635
1	2.603148	-2.5617	-0.23559
1	0.986044	-1.3785	4.27049
1	1.298007	-2.76821	3.238641
1	2.747886	-0.79749	-1.25289
1	3.708228	1.075063	-2.54225
1	4.981605	2.871008	-1.38688
1	5.325027	2.759374	1.077835
1	4.336296	0.916342	2.388864
6	5.510335	-2.42508	-0.28257
6	6.357363	-1.40242	0.13949
6	7.036705	-0.65934	-0.81654
6	6.885156	-0.92509	-2.18541
6	6.050077	-1.98053	-2.57415
6	5.363234	-2.73814	-1.63114
1	6.470165	-1.20237	1.206199
1	7.698756	0.148914	-0.49565
1	5.942563	-2.21641	-3.63584
1	4.718172	-3.56546	-1.93147
6	7.610136	-0.09385	-3.19954
1	8.699879	-0.15675	-3.05459
1	7.33383	0.968213	-3.1031
1	7.385827	-0.41418	-4.22572
16	4.552473	-3.30522	0.91721
8	5.081252	-3.00652	2.248738
8	4.364648	-4.68023	0.466615
6	-1.25964	5.288718	0.026553
6	-4.86878	-2.51088	-1.53265
8	-0.69786	6.357344	0.000877
8	-5.21858	-3.47766	-2.16086
6	-2.72563	5.149163	0.245149
6	-3.57358	6.090169	-0.34849
6	-3.25729	4.162165	1.084464
6	-4.94931	6.00497	-0.1561
1	-3.13756	6.88173	-0.962
6	-4.63164	4.093892	1.291491
1	-2.59584	3.458525	1.595724
6	-5.47912	5.003125	0.658273
1	-5.61196	6.730155	-0.63339
1	-5.04337	3.33193	1.956887
1	-6.5586	4.942688	0.814837
6	-5.8029	-1.47524	-1.02557

6	-6.99372	-1.26594	-1.7315
6	-5.55645	-0.76341	0.155629
6	-7.90569	-0.31441	-1.28814
1	-7.18429	-1.85903	-2.62863
6	-6.48028	0.174535	0.605285
1	-4.65305	-0.95641	0.738462
6	-7.6467	0.409599	-0.12278
1	-8.8285	-0.14185	-1.84608
1	-6.29348	0.719264	1.533231
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6	-2.04848	3.431429	-1.61426
6	-1.3133	2.488776	-0.88308
7	-1.79898	1.224975	-0.75842
6	-2.98778	0.849986	-1.26654
6	-3.74784	1.736712	-2.00514
6	-3.25356	3.046506	-2.18298
6	-0.01788	2.583455	-0.25755
7	0.807015	3.673694	-0.07103
6	2.163572	3.168252	0.147348
6	1.862029	1.729407	0.663927
7	0.546364	1.453375	0.126294
6	-3.21512	-0.5798	-0.9803
7	-2.16615	-1.27742	-0.639
6	-2.53096	-2.67788	-0.48126
6	-4.06572	-2.72239	-0.75038
7	-4.36332	-1.29899	-1.04692
29	-0.61655	-0.14067	-0.04096
6	1.965908	1.533324	2.161052
6	0.891086	1.081879	2.927073
6	1.064787	0.776718	4.277647
6	2.314596	0.91996	4.87518
6	3.391751	1.386424	4.120372
6	3.214365	1.694917	2.775448
6	3.014445	3.147561	-1.10115
6	4.402483	3.036638	-0.96651
6	5.221182	2.953344	-2.08998
6	4.65946	2.979942	-3.36714
6	3.277036	3.087884	-3.50824
6	2.459484	3.170283	-2.38173
6	-1.73911	-3.58667	-1.38526
6	-1.24519	-4.79668	-0.89082

6	-0.55938	-5.67763	-1.72723
6	-0.37148	-5.35783	-3.07137
6	-0.86983	-4.15443	-3.57308
6	-1.54185	-3.27004	-2.73298
6	-4.88399	-3.20076	0.421803
6	-4.58243	-2.76883	1.720675
6	-5.37126	-3.17631	2.793063
6	-6.46299	-4.01831	2.579733
6	-6.76433	-4.4523	1.290545
6	-5.97922	-4.04187	0.214738
1	-1.67827	4.448236	-1.74011
1	-4.69966	1.443011	-2.44313
1	-3.82819	3.762886	-2.77157
1	2.650098	3.787706	0.912239
1	2.574843	1.045497	0.18533
1	-2.33903	-2.97085	0.559535
1	-4.29771	-3.3224	-1.64193
1	-0.08553	0.93572	2.462206
1	0.21509	0.411915	4.859319
1	2.45447	0.666087	5.927972
1	4.376523	1.49238	4.579374
1	4.069006	2.040877	2.185796
1	4.852377	3.034893	0.030603
1	6.304784	2.885578	-1.96915
1	5.300185	2.930545	-4.25056
1	2.830005	3.119164	-4.5045
1	1.378849	3.270609	-2.50426
1	-1.41076	-5.05511	0.158856
1	-0.17946	-6.62178	-1.3302
1	0.156296	-6.05061	-3.73056
1	-0.7368	-3.906	-4.62886
1	-1.91849	-2.32297	-3.12844
1	-3.71307	-2.1306	1.909446
1	-5.12612	-2.84099	3.803267
1	-7.07853	-4.33982	3.422958
1	-7.61778	-5.11189	1.119058
1	-6.22501	-4.36535	-0.79939
6	2.394388	-2.34538	0.618145
6	1.778498	-3.64184	1.038069
6	3.095925	-1.62033	1.70763
6	0.733544	-3.40616	2.125376
6	-0.09394	-2.18456	1.771613
8	0.493163	-1.44349	0.869563
8	-1.17635	-1.92469	2.260134

6	2.61316	-1.98213	-0.76278
6	3.438715	-0.88737	-1.11212
6	3.58785	-0.48321	-2.4287
6	2.917239	-1.16474	-3.44547
6	2.096785	-2.24966	-3.12853
6	1.938696	-2.65201	-1.81062
1	2.601166	-4.2776	1.413416
1	1.320693	-4.15489	0.184852
1	2.573497	-1.70855	2.669832
1	3.251427	-0.55337	1.530691
1	0.06592	-4.26907	2.254659
1	1.184827	-3.23588	3.116506
1	3.999575	-0.35113	-0.34877
1	4.222893	0.374355	-2.65801
1	3.030066	-0.84658	-4.48442
1	1.563104	-2.78476	-3.91544
1	1.266035	-3.48275	-1.59745
6	5.823545	-1.67082	0.911601
6	6.104278	-2.4634	-0.19767
6	6.848639	-1.91675	-1.23766
6	7.30616	-0.59311	-1.18557
6	7.037032	0.164783	-0.03556
6	6.302772	-0.3657	1.018445
1	5.735359	-3.48999	-0.23801
1	7.07338	-2.52871	-2.11459
1	7.423245	1.184635	0.038125
1	6.103426	0.21144	1.924077
6	8.045756	0.00775	-2.34173
1	8.718793	0.814026	-2.01832
1	8.639531	-0.74505	-2.87861
1	7.334254	0.4405	-3.06546
16	4.747359	-2.27968	2.175128
8	4.68805	-3.73814	2.08732
8	5.062583	-1.5996	3.426177
6	-5.70702	-0.90387	-1.25424
6	0.530035	5.027972	0.140763
8	-6.4446	-1.63794	-1.86185
8	1.424721	5.835702	0.061389
6	-6.14895	0.361275	-0.61826
6	-7.23051	1.042288	-1.18944
6	-5.5654	0.839512	0.561778
6	-7.68812	2.223124	-0.61527
1	-7.69717	0.630954	-2.08719
6	-6.03954	2.010649	1.143633

1	-4.75841	0.281718	1.04193
6	-7.08914	2.710297	0.548025
1	-8.52244	2.762616	-1.0686
1	-5.59417	2.37535	2.071697
1	-7.45518	3.633992	1.002303
6	-0.86229	5.394512	0.5192
6	-1.37709	6.604659	0.042234
6	-1.6242	4.607704	1.392006
6	-2.66839	6.994288	0.385136
1	-0.75105	7.228488	-0.59961
6	-2.90711	5.011468	1.748924
1	-1.20807	3.688708	1.811983
6	-3.43596	6.194746	1.23297
1	-3.07512	7.931642	-0.00052
1	-3.49519	4.403664	2.440017
1	-4.44657	6.505677	1.507666

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6	-3.54311	2.078096	1.152106
6	-2.74387	1.041608	0.680734
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6	-0.84601	2.362435	0.75805
6	-1.5939	3.483185	1.135287
6	-2.95175	3.320275	1.373512
6	-3.22228	-0.32246	0.327331
7	-4.48764	-0.73566	-0.03423
6	-4.50696	-2.21622	0.04008
6	-2.98829	-2.53711	0.030969
7	-2.3629	-1.28067	0.395288
6	0.640587	2.440199	0.726056
7	1.332511	1.782656	1.58306
6	2.68922	2.353993	1.590846
6	2.756097	3.253395	0.326784
7	1.338612	3.344284	-0.04287
29	-0.40742	-0.67644	0.283805
6	-2.40319	-3.06959	-1.25529
6	-1.9827	-2.21089	-2.27618
6	-1.4183	-2.72158	-3.44502
6	-1.26842	-4.09878	-3.60248
6	-1.68669	-4.96332	-2.58998
6	-2.24829	-4.44995	-1.42275
6	-5.21023	-2.70101	1.284616
6	-6.43925	-3.35552	1.188614

6	-7.08711	-3.81164	2.335161
6	-6.51686	-3.60703	3.589862
6	-5.29328	-2.94522	3.695451
6	-4.6414	-2.49852	2.549253
6	2.917212	3.059133	2.905204
6	3.732967	2.463733	3.870411
6	3.934876	3.086373	5.101503
6	3.323822	4.308455	5.374776
6	2.510473	4.909406	4.413075
6	2.30743	4.286838	3.184717
6	3.611952	2.621719	-0.7523
6	3.080615	2.035991	-1.90248
6	3.910247	1.397595	-2.82621
6	5.285162	1.339638	-2.6079
6	5.825139	1.926578	-1.46116
6	4.994874	2.561325	-0.54207
1	-4.60803	1.931764	1.322647
1	-1.10346	4.446463	1.284848
1	-3.55689	4.158003	1.72485
1	-5.02312	-2.59679	-0.84979
1	-2.78026	-3.27188	0.821583
1	3.440263	1.554819	1.518121
1	3.136105	4.257924	0.560399
1	-2.06932	-1.12825	-2.156
1	-1.07657	-2.03404	-4.22123
1	-0.82662	-4.50001	-4.51749
1	-1.57472	-6.0434	-2.71008
1	-2.57025	-5.1289	-0.62776
1	-6.89911	-3.49104	0.207396
1	-8.04758	-4.32421	2.247155
1	-7.02717	-3.96127	4.488335
1	-4.8449	-2.77821	4.677795
1	-3.67887	-1.98676	2.644324
1	4.217307	1.508965	3.645993
1	4.578786	2.616539	5.848515
1	3.486059	4.799341	6.337081
1	2.037498	5.871978	4.621039
1	1.67643	4.770615	2.43298
1	2.010753	2.067013	-2.0968
1	3.464759	0.958676	-3.72245
1	5.938472	0.853561	-3.33673
1	6.902544	1.89615	-1.28281
1	5.427218	3.009493	0.356631
6	1.661255	-1.80869	0.005092

6	1.795091	-2.71046	-1.1794
6	2.72196	-0.80867	0.262926
6	2.044926	-1.93927	-2.45875
6	1.084391	-0.76276	-2.52046
8	0.703615	-0.34342	-1.34752
8	0.760985	-0.23129	-3.56248
6	0.826559	-2.20898	1.131785
6	0.620869	-1.32486	2.234195
6	-0.18328	-1.71579	3.307595
6	-0.76612	-2.97443	3.32623
6	-0.55889	-3.86279	2.258618
6	0.201294	-3.48716	1.170764
1	2.625462	-3.40739	-0.9559
1	0.885123	-3.31341	-1.29603
1	3.196572	-0.4153	-0.64307
1	2.326966	0.041437	0.833506
1	1.918318	-2.57105	-3.347
1	3.069002	-1.53185	-2.50718
1	1.098863	-0.34167	2.276981
1	-0.32943	-1.0228	4.138137
1	-1.38151	-3.28264	4.17455
1	-1.00525	-4.85907	2.286965
1	0.339288	-4.19035	0.350605
6	4.987943	-2.49181	0.258772
6	5.734331	-1.94193	-0.78412
6	6.407702	-2.79979	-1.64423
6	6.362892	-4.19198	-1.46743
6	5.617502	-4.70718	-0.39814
6	4.927675	-3.86693	0.471194
1	5.786771	-0.85803	-0.91558
1	6.992085	-2.3815	-2.46777
1	5.582223	-5.78795	-0.23995
1	4.350886	-4.25899	1.311648
6	7.127248	-5.09991	-2.38122
1	6.724668	-6.12187	-2.3695
1	8.182623	-5.15714	-2.06716
1	7.117273	-4.73158	-3.41699
16	4.082519	-1.41411	1.32671
8	4.882889	-0.21987	1.594282
8	3.510836	-2.19901	2.417171
6	-5.64561	-0.10324	-0.51353
6	0.9021	4.323947	-0.95579
8	-6.65934	-0.75428	-0.60233
8	1.486747	5.380728	-0.99811

6	-5.59265	1.324906	-0.91802
6	-6.67933	2.126629	-0.54625
6	-4.55482	1.866174	-1.6834
6	-6.69339	3.476971	-0.87831
1	-7.50255	1.675399	0.011721
6	-4.58363	3.213555	-2.03124
1	-3.72106	1.242782	-2.01699
6	-5.64055	4.02174	-1.61515
1	-7.53269	4.104824	-0.5713
1	-3.77031	3.632977	-2.6236
1	-5.65107	5.081228	-1.88146
6	-0.16931	3.97352	-1.92943
6	-0.75256	5.034268	-2.63743
6	-0.43207	2.654401	-2.32198
6	-1.57698	4.778885	-3.72638
1	-0.50775	6.056657	-2.34287
6	-1.23464	2.402535	-3.43172
1	0.028019	1.800557	-1.82084
6	-1.80463	3.461727	-4.13612
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1	-1.35426	1.370486	-3.7668
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6	0.590807	3.846663	1.497099
6	0.088247	2.645973	0.987018
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6	2.796331	2.914769	1.328878
6	1.964249	3.983108	1.656624
6	-1.32573	2.480146	0.575229
7	-2.12173	3.52257	0.113624
6	-3.51943	3.042673	0.18878
6	-3.26829	1.522953	0.094416
7	-1.92243	1.346846	0.650181
6	2.947225	0.442056	0.849618
7	2.413645	-0.62706	1.341178
6	3.406322	-1.69204	1.287817
6	4.626615	-1.09749	0.508315
7	4.206231	0.321112	0.371262
29	0.350076	-0.47559	0.829239
6	-3.34524	0.989233	-1.32332
6	-2.20868	0.815181	-2.11845

6	-2.31691	0.287938	-3.40639
6	-3.56813	-0.05091	-3.91819
6	-4.70933	0.132689	-3.13454
6	-4.59693	0.639793	-1.84244
6	-4.19734	3.507691	1.456518
6	-4.95727	4.682047	1.43526
6	-5.57198	5.147013	2.595246
6	-5.43153	4.446502	3.792179
6	-4.67431	3.276714	3.823517
6	-4.06267	2.808587	2.662728
6	3.780589	-2.19034	2.661977
6	4.239598	-3.50227	2.813141
6	4.603346	-3.98414	4.0691
6	4.511429	-3.15563	5.187761
6	4.064013	-1.84288	5.040514
6	3.701199	-1.36235	3.783462
6	4.861757	-1.71765	-0.84569
6	3.779839	-2.02296	-1.6812
6	3.990714	-2.50621	-2.96839
6	5.292847	-2.71116	-3.42578
6	6.375677	-2.42332	-2.59679
6	6.161608	-1.92087	-1.31377
1	-0.08622	4.666774	1.732061
1	3.881605	2.988658	1.416422
1	2.385213	4.921484	2.021809
1	-4.05843	3.430437	-0.68371
1	-3.99741	0.967265	0.702623
1	2.99504	-2.54278	0.722312
1	5.543962	-1.14364	1.111785
1	-1.21707	1.027553	-1.71426
1	-1.41312	0.122037	-3.99644
1	-3.65478	-0.45966	-4.92761
1	-5.69429	-0.12879	-3.52913
1	-5.48792	0.745629	-1.21876
1	-5.04687	5.240805	0.501611
1	-6.1669	6.062576	2.562888
1	-5.91769	4.809099	4.700748
1	-4.56778	2.718334	4.756439
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1	4.794437	-3.53201	6.173321
1	3.996892	-1.18816	5.912784
1	3.327496	-0.34218	3.672021

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1	3.13097	-2.6994	-3.61374
1	5.464231	-3.09161	-4.43535
1	7.395841	-2.58163	-2.95341
1	7.011621	-1.67135	-0.67356
6	-1.86205	4.751334	-0.49789
6	4.898714	1.183507	-0.53526
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8	6.068166	1.399966	-0.34795
6	-0.4673	5.068024	-0.91002
6	0.00312	6.357123	-0.63666
6	0.354149	4.151172	-1.57462
6	1.312834	6.702166	-0.95499
1	-0.66827	7.074521	-0.15961
6	1.657052	4.506769	-1.90933
1	-0.02134	3.159376	-1.83834
6	2.143091	5.772354	-1.58233
1	1.684338	7.702837	-0.72293
1	2.29516	3.795182	-2.43053
1	3.171113	6.039773	-1.83783
6	4.164901	1.631898	-1.7462
6	4.830289	2.526727	-2.59898
6	2.958273	1.051648	-2.1645
6	4.303831	2.82213	-3.85037
1	5.781946	2.949601	-2.27116
6	2.445787	1.327814	-3.42905
1	2.411241	0.340085	-1.54617
6	3.119297	2.210162	-4.27273
1	4.829082	3.513479	-4.51287
1	1.541117	0.805092	-3.74672
1	2.723681	2.421275	-5.269
6	-0.97541	-2.43307	0.319404
6	-0.54127	-3.56766	-0.54683
6	-2.22576	-1.73792	-0.04868
6	-0.50846	-3.18451	-2.01412
6	0.192981	-1.8391	-2.17211
8	0.281395	-1.15762	-1.07625
8	0.611907	-1.4588	-3.24955
6	-0.50332	-2.29718	1.684667
6	-0.95178	-1.21134	2.500752
6	-0.49709	-1.08482	3.816159
6	0.383546	-2.01561	4.344236
6	0.827011	-3.09365	3.561532
6	0.409277	-3.22724	2.255577

1	-1.25887	-4.39054	-0.36042
1	0.445923	-3.93024	-0.23594
1	-2.4054	-1.69015	-1.12666
1	-2.25371	-0.71349	0.338438
1	0.01213	-3.93932	-2.6184
1	-1.51787	-3.09821	-2.44894
1	-1.71427	-0.51619	2.147352
1	-0.85879	-0.2551	4.42622
1	0.735223	-1.91833	5.373252
1	1.522267	-3.81989	3.986253
1	0.771766	-4.06983	1.667872
6	-4.11528	-3.79291	-0.46047
6	-4.58736	-3.45106	-1.72901
6	-4.86618	-4.46883	-2.63134
6	-4.69979	-5.81898	-2.28166
6	-4.24047	-6.12458	-0.99403
6	-3.94631	-5.12032	-0.07565
1	-4.73646	-2.40285	-2.00202
1	-5.23162	-4.2135	-3.62924
1	-4.11556	-7.17035	-0.70258
1	-3.59781	-5.35017	0.933604
6	-5.04015	-6.90343	-3.25715
1	-4.72577	-6.64011	-4.27738
1	-4.57221	-7.8586	-2.98334
1	-6.1305	-7.0642	-3.28522
16	-3.72281	-2.50572	0.686173
8	-4.73878	-1.45995	0.610704
8	-3.35265	-3.10939	1.963642

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6	-2.1422	-3.4443	-1.76559
6	-1.75956	-2.37717	-0.93619
7	-0.44172	-2.01092	-0.91686
6	0.522315	-2.69709	-1.57373
6	0.188286	-3.74803	-2.40069
6	-1.17765	-4.10593	-2.50712
6	-2.51804	-1.50663	-0.09719
7	-3.85227	-1.53898	0.258971
6	-4.23195	-0.19827	0.705826
6	-2.84425	0.385148	1.122025
7	-1.89937	-0.42742	0.382418
6	1.824783	-2.08992	-1.2816
7	1.80963	-0.88992	-0.75177
6	3.173758	-0.46512	-0.48464

6	4.052053	-1.5005	-1.24506
7	3.077273	-2.58532	-1.47231
29	0.02531	-0.38666	-0.00155
6	-2.59331	0.384582	2.61209
6	-1.75013	-0.54772	3.218765
6	-1.51892	-0.50672	4.595009
6	-2.13369	0.466583	5.379384
6	-2.99005	1.394649	4.7822
6	-3.21617	1.353127	3.409408
6	-4.9068	0.622169	-0.36404
6	-5.87958	1.554871	0.003552
6	-6.47612	2.373488	-0.95327
6	-6.10469	2.265855	-2.29297
6	-5.13683	1.333892	-2.66765
6	-4.54089	0.517232	-1.70894
6	3.484676	0.941762	-0.90715
6	4.459087	1.668549	-0.21638
6	4.826562	2.941744	-0.64574
6	4.229588	3.494152	-1.77781
6	3.258893	2.772851	-2.47362
6	2.884139	1.502151	-2.03849
6	5.267921	-1.9441	-0.48201
6	5.135793	-2.54217	0.776757
6	6.263996	-2.94142	1.486895
6	7.535336	-2.7378	0.948746
6	7.672299	-2.14045	-0.30219
6	6.541349	-1.75047	-1.01746
1	-3.18715	-3.74593	-1.82843
1	0.944541	-4.29598	-2.95929
1	-1.46884	-4.92164	-3.16976
1	-4.90629	-0.29431	1.566494
1	-2.79331	1.421933	0.767844
1	3.357386	-0.56346	0.598694
1	4.357877	-1.09245	-2.22173
1	-1.2564	-1.30405	2.605059
1	-0.8544	-1.24324	5.053165
1	-1.9554	0.499492	6.456521
1	-3.48188	2.15572	5.392422
1	-3.8798	2.086905	2.943711
1	-6.18822	1.627661	1.050211
1	-7.24776	3.086468	-0.65367
1	-6.5815	2.895866	-3.04741
1	-4.85297	1.233346	-3.71803
1	-3.79418	-0.2188	-2.01709

1	4.936038	1.227851	0.663751
1	5.572519	3.513976	-0.09134
1	4.521347	4.492993	-2.1091
1	2.790625	3.199221	-3.36412
1	2.127753	0.932427	-2.58493
1	4.143032	-2.70134	1.208306
1	6.152514	-3.41306	2.465753
1	8.42124	-3.04953	1.50649
1	8.665209	-1.98482	-0.72956
1	6.646307	-1.2991	-2.0069
6	0.443011	2.644122	1.500433
6	0.361396	2.697854	3.028485
6	1.684693	3.336559	0.946624
6	1.304413	1.591269	3.474731
6	1.184231	0.578161	2.380437
8	0.668512	1.190035	1.269158
8	1.435033	-0.59101	2.342086
6	-0.79541	3.035741	0.740214
6	-0.87487	2.737349	-0.6263
6	-2.01042	3.072031	-1.35605
6	-3.07146	3.728034	-0.7321
6	-2.98116	4.061817	0.616854
6	-1.84706	3.719762	1.352016
1	0.620813	3.697985	3.396062
1	-0.65958	2.447052	3.347755
1	2.589367	3.080927	1.517575
1	1.870207	3.061381	-0.10074
1	1.047451	1.13136	4.436988
1	2.358601	1.91146	3.533025
1	-0.03886	2.240555	-1.12871
1	-2.07388	2.816502	-2.41529
1	-3.97241	3.968759	-1.29923
1	-3.80411	4.588742	1.104765
1	-1.78454	3.993476	2.405503
6	0.70455	5.728029	-0.31868
6	-0.51464	6.338881	-0.03829
6	-1.29053	6.803094	-1.09293
6	-0.86596	6.66978	-2.42207
6	0.381434	6.080786	-2.66809
6	1.176144	5.620464	-1.6246
1	-0.83436	6.447547	0.998783
1	-2.24959	7.282622	-0.88074
1	0.74197	5.997328	-3.69646
1	2.158095	5.187571	-1.81456

6	-1.73273	7.151266	-3.5457
1	-2.04196	8.195815	-3.38919
1	-2.65368	6.549478	-3.61229
1	-1.21782	7.088729	-4.5137
16	1.712326	5.147969	1.018358
8	1.076262	5.553164	2.275335
8	3.102345	5.49036	0.732112
6	-4.75259	-2.59114	0.4277
6	3.528448	-3.83452	-1.96569
8	-5.93087	-2.35	0.55141
8	4.478788	-3.85861	-2.70578
6	-4.20476	-3.97384	0.515357
6	-4.94711	-5.01205	-0.05683
6	-3.0303	-4.2639	1.219728
6	-4.48567	-6.32293	0.020907
1	-5.88553	-4.77349	-0.56221
6	-2.58332	-5.57823	1.313639
1	-2.47255	-3.46327	1.710508
6	-3.30049	-6.60575	0.700545
1	-5.05851	-7.13025	-0.44053
1	-1.67323	-5.80391	1.873817
1	-2.94296	-7.63589	0.767236
6	2.854997	-5.05195	-1.45143
6	2.960073	-6.22256	-2.2124
6	2.186044	-5.07779	-0.22088
6	2.361758	-7.39661	-1.76842
1	3.515093	-6.18937	-3.15235
6	1.602838	-6.25812	0.227177
1	2.131386	-4.17902	0.396784
6	1.679203	-7.41361	-0.55096
1	2.43404	-8.30618	-2.36843
1	1.09028	-6.2794	1.191255
1	1.214689	-8.33814	-0.20028

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6	-1.89668	-3.84665	-0.96253
6	-1.83467	-2.52479	-0.5209
7	-0.67102	-1.90512	-0.3465
6	0.47778	-2.49944	-0.64855
6	0.520203	-3.82986	-1.06704
6	-0.69266	-4.50423	-1.2103
6	-2.95645	-1.57022	-0.37663
7	-4.27413	-1.8351	-0.09311
6	-5.05596	-0.64798	-0.50267

6	-3.94424	0.432529	-0.45657
7	-2.71049	-0.32723	-0.65176
6	1.579539	-1.51091	-0.71564
7	1.273416	-0.32231	-1.13037
6	2.499717	0.453817	-1.23492
6	3.657789	-0.57697	-1.03643
7	2.912505	-1.73022	-0.5127
29	-0.70516	0.220025	-0.67845
6	-3.90835	1.213682	0.83862
6	-3.26878	0.708162	1.975946
6	-3.31543	1.407711	3.181392
6	-3.98105	2.630233	3.255722
6	-4.59348	3.155876	2.118241
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6	-7.05093	-1.14385	-1.94859
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6	-6.89356	-1.23929	-4.35674
6	-5.53334	-0.94245	-4.27641
6	-4.93466	-0.74062	-3.03533
6	2.634495	1.22413	-2.51966
6	3.554235	2.276422	-2.58954
6	3.763725	2.950317	-3.7901
6	3.049421	2.582728	-4.93088
6	2.124664	1.542359	-4.86196
6	1.919583	0.863178	-3.66211
6	4.737695	-0.08479	-0.11356
6	4.492469	0.061141	1.257051
6	5.478398	0.577344	2.094319
6	6.713017	0.962675	1.569967
6	6.960454	0.817937	0.206718
6	5.978167	0.290287	-0.63055
1	-2.85142	-4.34642	-1.12348
1	1.463147	-4.32112	-1.30767
1	-0.70085	-5.53933	-1.55687
1	-5.83347	-0.4718	0.250691
1	-4.08302	1.135065	-1.2908
1	2.526224	1.171262	-0.3965
1	4.099066	-0.84676	-2.00898
1	-2.70603	-0.22585	1.916209
1	-2.8167	0.999549	4.063655
1	-3.99974	3.193223	4.190818
1	-5.07128	4.135735	2.159516
1	-5.02852	2.875132	0.027418

1	-7.6375	-1.24641	-1.03329
1	-8.71586	-1.57266	-3.24754
1	-7.36426	-1.39141	-5.33067
1	-4.93582	-0.8622	-5.18748
1	-3.8676	-0.5058	-2.98727
1	4.121118	2.560705	-1.69794
1	4.4903	3.764883	-3.83722
1	3.215122	3.108147	-5.87422
1	1.559078	1.254303	-5.75117
1	1.193124	0.050019	-3.60347
1	3.528905	-0.23943	1.677585
1	5.2859	0.670162	3.166033
1	7.486736	1.364835	2.227785
1	7.929356	1.10504	-0.2078
1	6.1785	0.162016	-1.69721
6	-4.91106	-2.91169	0.530721
6	3.586865	-2.87663	-0.05426
8	-6.11479	-2.99875	0.481309
8	4.689514	-3.12331	-0.477
6	-4.0643	-3.89	1.266256
6	-4.39673	-5.24535	1.166811
6	-3.00446	-3.49144	2.088158
6	-3.632	-6.19882	1.831562
1	-5.25494	-5.53646	0.557112
6	-2.25747	-4.44615	2.77113
1	-2.77195	-2.43175	2.212079
6	-2.55776	-5.8	2.628536
1	-3.8806	-7.25814	1.737433
1	-1.43608	-4.13184	3.416517
1	-1.96096	-6.54892	3.154202
6	2.910383	-3.6798	0.997227
6	3.231103	-5.03964	1.087285
6	2.049653	-3.09886	1.937811
6	2.66087	-5.82457	2.083082
1	3.935252	-5.46296	0.367562
6	1.506367	-3.88484	2.950343
1	1.815226	-2.03247	1.907068
6	1.79815	-5.2466	3.016726
1	2.901824	-6.88802	2.14453
1	0.862917	-3.42164	3.701559
1	1.365863	-5.86034	3.810845
6	0.049073	3.095472	0.618489
6	1.442265	3.524019	1.096116
6	-1.07166	3.634997	1.510504

6	1.756894	2.530838	2.20499
6	0.993827	1.296543	1.799131
8	0.051349	1.648151	0.893212
8	1.131881	0.159438	2.14588
6	-0.22618	3.226097	-0.86055
6	-1.39666	2.63977	-1.36311
6	-1.68426	2.682646	-2.72501
6	-0.81548	3.335453	-3.59753
6	0.333194	3.945347	-3.10123
6	0.633672	3.881058	-1.74146
1	1.463839	4.575953	1.408414
1	2.167339	3.401313	0.280368
1	-0.75515	3.694646	2.561081
1	-1.93712	2.958333	1.467445
1	2.823185	2.295621	2.322459
1	1.384311	2.848686	3.193014
1	-2.12743	2.227899	-0.66625
1	-2.6032	2.227438	-3.10188
1	-1.03983	3.378603	-4.66539
1	1.017537	4.458869	-3.77833
1	1.542185	4.363441	-1.38077
6	-0.49812	6.369971	0.926329
6	0.160692	6.881464	2.045384
6	1.230954	7.747228	1.85628
6	1.637144	8.127984	0.567222
6	0.934055	7.619481	-0.53279
6	-0.13623	6.745528	-0.36414
1	-0.17915	6.61332	3.048351
1	1.754441	8.153257	2.725712
1	1.224847	7.922169	-1.54206
1	-0.69751	6.354122	-1.21422
6	2.766506	9.094834	0.379695
1	3.55868	8.941167	1.126397
1	3.209834	9.012518	-0.62215
1	2.406974	10.13058	0.496639
16	-1.83731	5.234928	1.158089
8	-2.5243	5.58454	2.4003
8	-2.57148	5.122454	-0.10028

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6	-4.07541	-2.17166	1.012324
6	-2.83691	-1.57603	1.199406
6	-2.51583	-0.32866	0.599018

6	-3.51596	0.266175	-0.21492
6	-4.75107	-0.33637	-0.39511
6	-5.04616	-1.55678	0.218102
1	-4.2889	-3.12964	1.492756
1	-2.10362	-2.08418	1.826163
1	-3.30393	1.190813	-0.74931
1	-5.49339	0.148289	-1.03352
1	-6.02071	-2.02791	0.072231
6	-1.23881	0.290167	0.816895
6	-0.92961	1.614922	0.230774
1	-1.79482	2.29586	0.195508
1	-0.11221	2.140566	0.740368
6	-0.22054	-0.43223	1.657673
1	-0.67918	-0.67264	2.634702
1	0.000158	-1.41136	1.198408
6	1.10225	0.27982	1.909891
1	0.973962	1.220979	2.46138
1	1.595049	0.514811	0.952679
6	2.086508	-0.5416	2.695484
8	2.715777	-0.15623	3.643896
8	2.225772	-1.78751	2.206029
1	2.876697	-2.22687	2.774999
6	0.782127	-0.84227	-1.55209
6	1.871546	-1.69118	-1.40177
6	3.171379	-1.18472	-1.25499
6	3.360585	0.202292	-1.30125
6	2.279876	1.069899	-1.43643
6	0.998806	0.535115	-1.53681
1	-0.23235	-1.22931	-1.67047
1	1.712894	-2.77253	-1.39094
1	4.371164	0.610137	-1.21701
1	2.409789	2.154179	-1.45519
6	4.322631	-2.1139	-1.01718
1	4.321922	-2.44505	0.034481
1	4.251554	-3.01522	-1.64338
1	5.287697	-1.62768	-1.21503
16	-0.39792	1.629099	-1.53103
8	0.071549	2.98846	-1.79953
8	-1.45434	1.023871	-2.34142

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16	-0.87148	0.063778	1.074017
8	-0.46957	-0.72743	-0.06601

8	-2.06997	0.852616	1.135043
6	-0.87678	-1.07325	2.53976
9	0.325386	-1.61274	2.666608
9	-1.76752	-2.02119	2.336679
9	-1.17651	-0.40298	3.63104
8	0.35221	1.015499	1.506241
1	1.171684	0.652975	1.131595

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16	2.867289	-6.89324	3.983835
8	3.100156	-7.82508	2.870806
8	1.625952	-6.10915	3.908853
8	4.051522	-6.1666	4.464418
6	2.516269	-8.04953	5.39674
9	3.545887	-8.87121	5.637283
9	1.448767	-8.82157	5.156835
9	2.271226	-7.3876	6.534696

3

6	-1.0904	7.723408	2.502848
6	-1.01258	8.302369	3.925513
6	0.278152	7.658123	1.805649
6	-0.56067	7.109831	4.747259
6	-1.10734	5.927427	3.973296
8	-1.4312	6.338397	2.723953
8	-1.25234	4.800591	4.334463
6	-2.15202	8.330637	1.61442
6	-2.59208	7.616356	0.495943
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6	-4.0514	9.438045	-0.11968
6	-3.62478	10.15082	0.997177
6	-2.68336	9.596727	1.863221
1	-0.35683	9.178936	3.994603
1	-2.02225	8.605441	4.236381
1	1.060855	7.301291	2.491217
1	0.223031	6.946294	0.967301
1	-0.93105	7.088983	5.780045
1	0.536284	7.008702	4.796725
1	-2.19717	6.616082	0.306882
1	-3.8727	7.596008	-1.23367
1	-4.78915	9.871471	-0.79883
1	-4.02916	11.14515	1.201055
1	-2.35977	10.16887	2.734493

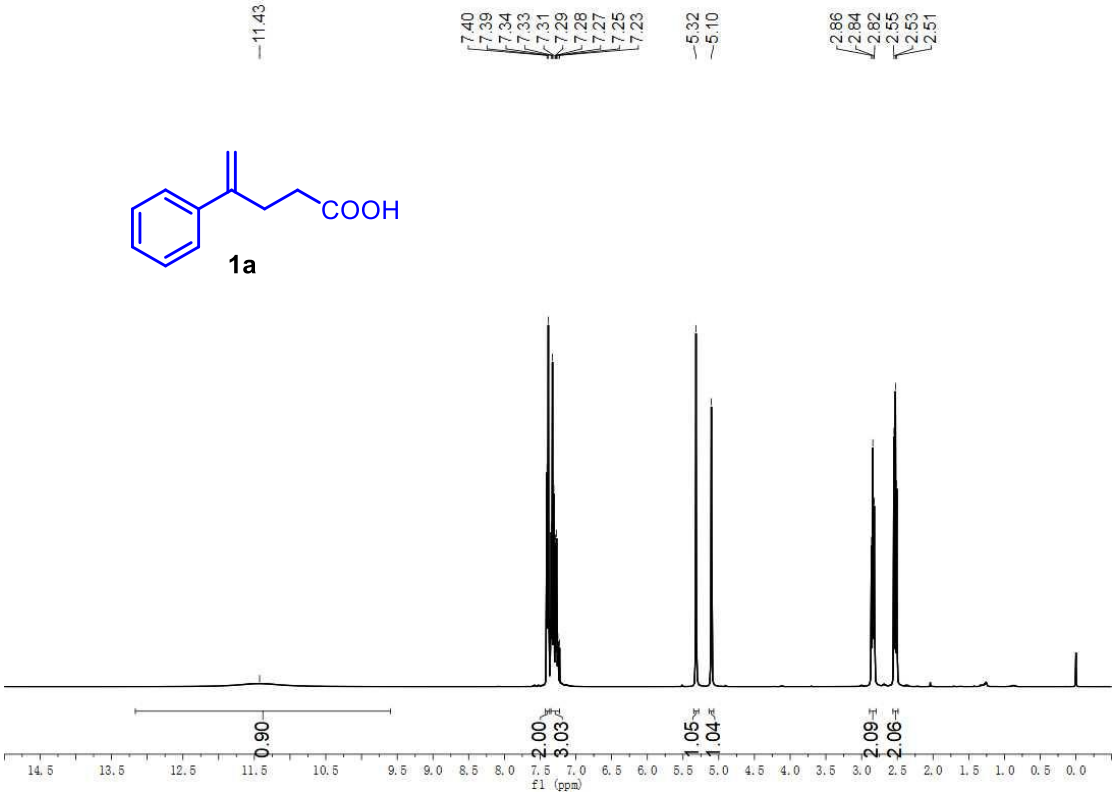
6	1.069757	10.37572	2.224269
6	2.041194	10.30786	3.222802
6	2.067804	11.29238	4.203086
6	1.153854	12.35745	4.185581
6	0.2141	12.41497	3.148778
6	0.167208	11.43252	2.163033
1	2.770811	9.494866	3.218125
1	2.820367	11.24379	4.994587
1	-0.4924	13.24836	3.110829
1	-0.55481	11.46762	1.344943
6	1.214894	13.43006	5.23159
1	0.264469	13.97617	5.307562
1	1.99988	14.16461	4.986527
1	1.456716	13.01487	6.220782
16	0.996277	9.100123	0.989539
8	2.366976	8.68788	0.691539
8	0.097648	9.548494	-0.06941

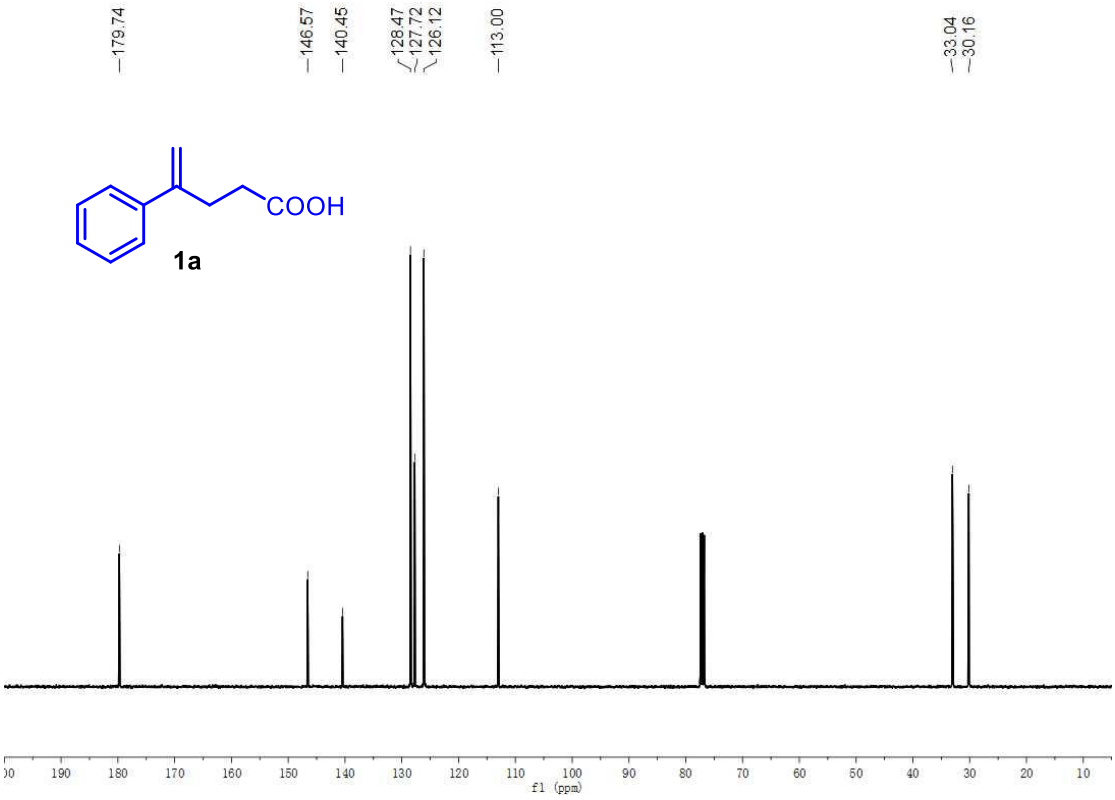
3'

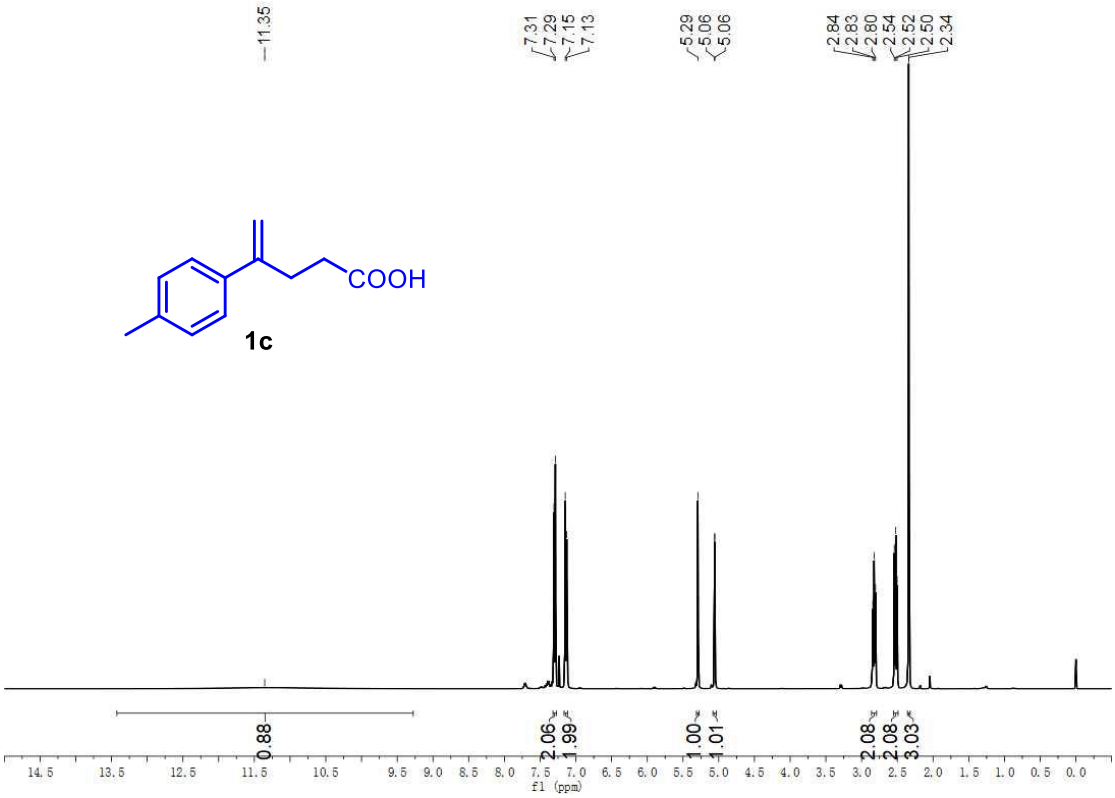
6	-1.20255	7.713778	2.557012
6	-0.939	8.436048	3.898605
6	-2.23529	8.475138	1.737958
6	-0.65398	7.272765	4.828046
6	-1.47857	6.150154	4.234838
8	-1.80168	6.478091	2.957757
8	-1.82115	5.122822	4.732712
6	0.101888	7.438257	1.824493
6	0.845965	8.499829	1.299084
6	2.054622	8.265357	0.653919
6	2.540072	6.963432	0.527292
6	1.804789	5.902478	1.047137
6	0.589404	6.137153	1.690934
1	-0.12439	9.166253	3.815621
1	-1.85143	8.96645	4.21462
1	-3.20439	8.449011	2.254643
1	-1.93908	9.526833	1.604395
1	-0.92128	7.428905	5.880639
1	0.403073	6.962221	4.790461
1	0.472822	9.52396	1.374628
1	2.617752	9.104082	0.238865
1	3.489424	6.779062	0.019204
1	2.172797	4.878414	0.949036
1	0.003472	5.298784	2.069794

6	-2.69536	6.207524	0.036578
6	-3.83002	5.594131	0.565809
6	-3.89582	4.208522	0.582836
6	-2.85213	3.427028	0.063006
6	-1.74301	4.074786	-0.49167
6	-1.65495	5.464306	-0.50833
1	-4.65014	6.201856	0.952999
1	-4.77612	3.716884	1.004905
1	-0.93055	3.480447	-0.91778
1	-0.79334	5.982044	-0.93296
6	-2.93037	1.930572	0.115343
1	-2.13424	1.461809	-0.47912
1	-3.89929	1.567834	-0.26004
1	-2.8311	1.573216	1.153253
16	-2.58218	7.975243	0.030497
8	-3.90808	8.529597	-0.23918
8	-1.43393	8.356065	-0.79097

9. NMR spectra of compounds 1, 2 and 3



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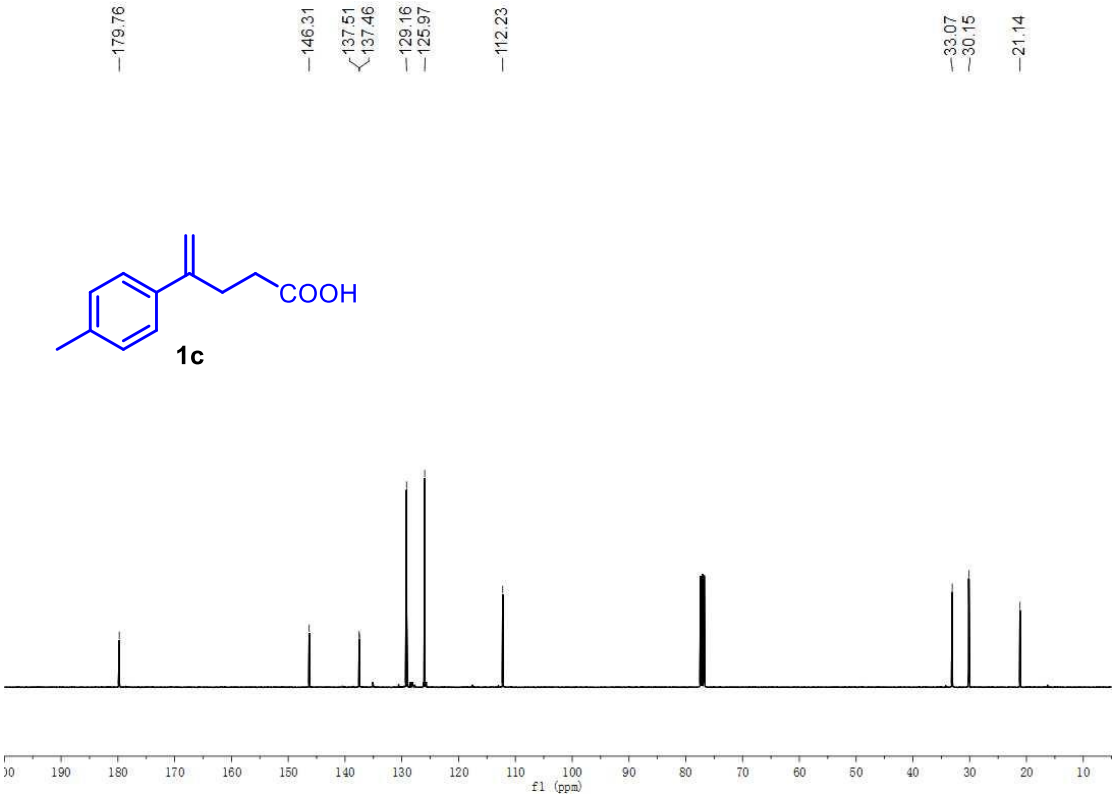
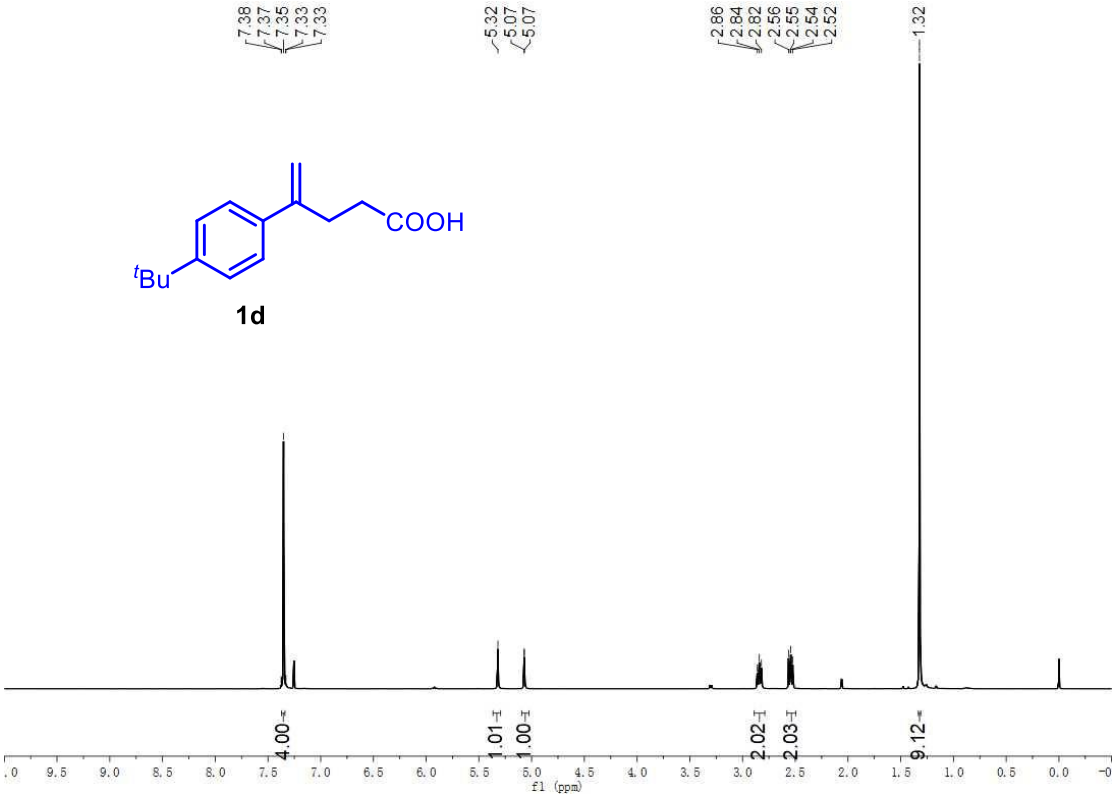
7.31
7.29
7.15
7.13
5.29
5.06
5.06
2.84
2.83
2.80
2.54
2.52
2.50
2.34
COOH
1c
0.88
2.06
1.99
1.00
1.01
2.08
2.08
3.03
f1 (ppm)


179.76
146.31
137.51
137.46
129.16
125.97
112.23
33.07
30.15
21.14
COOH
1c
f1 (ppm)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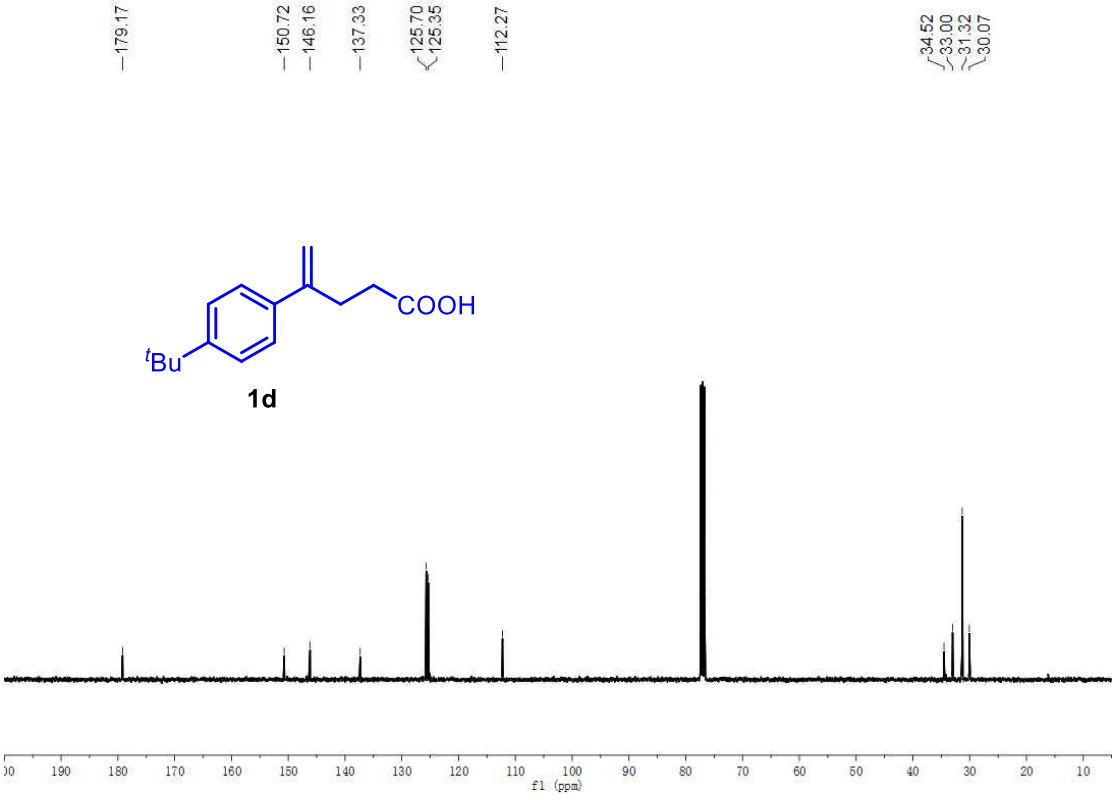
7.37
7.35
7.33
7.33
5.32
5.07
5.07
2.86
2.84
2.82
2.56
2.55
2.54
2.52
1.32
COOH
tBu
1d
4.00
1.01
1.00
2.02
2.03
9.12
f1 (ppm)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150.72
146.16
137.33
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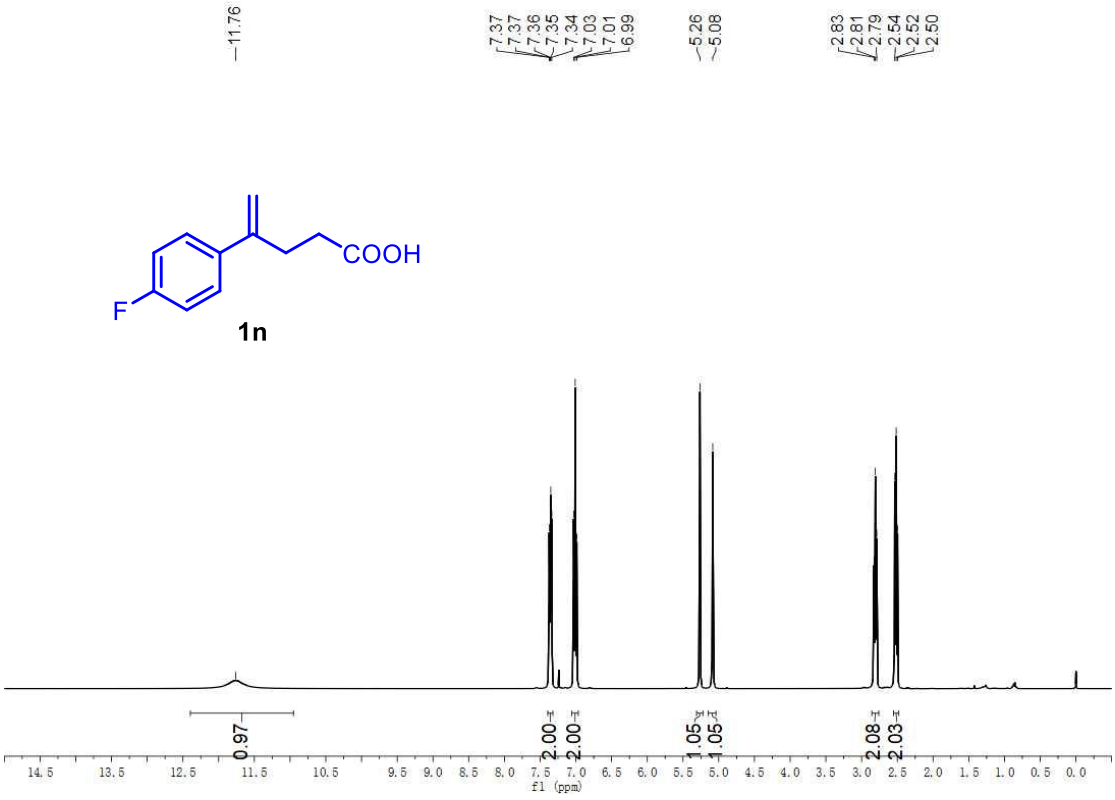
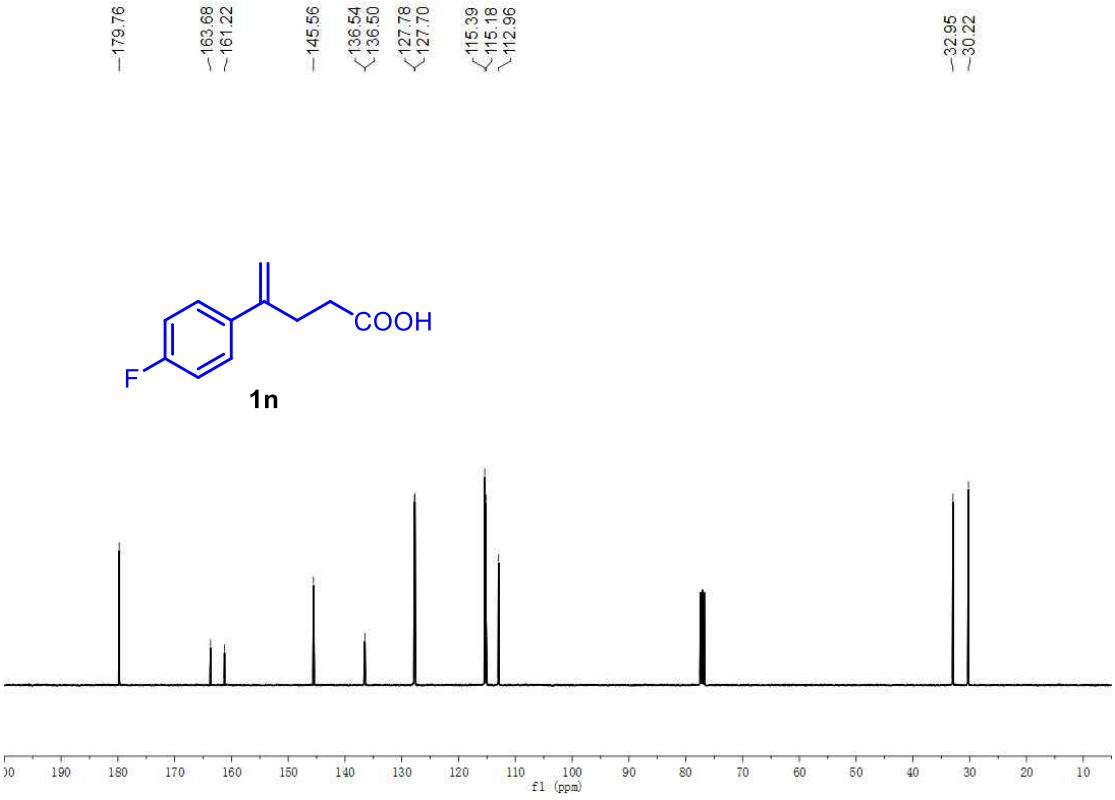
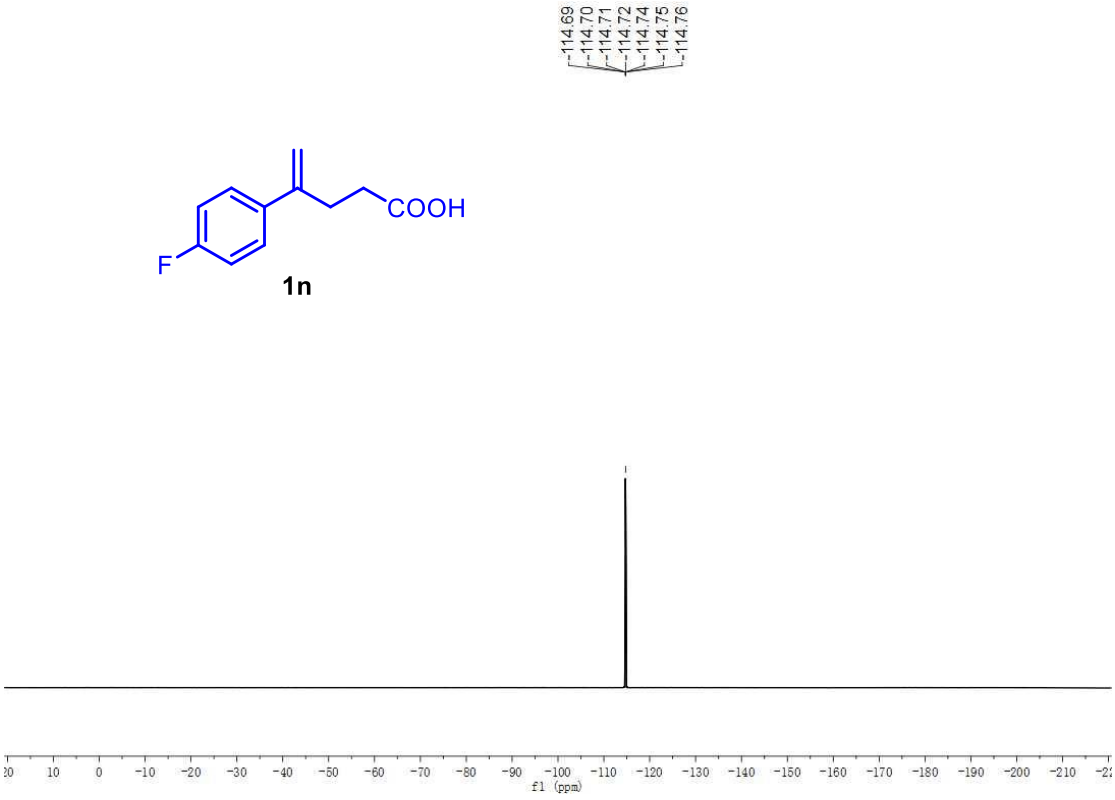
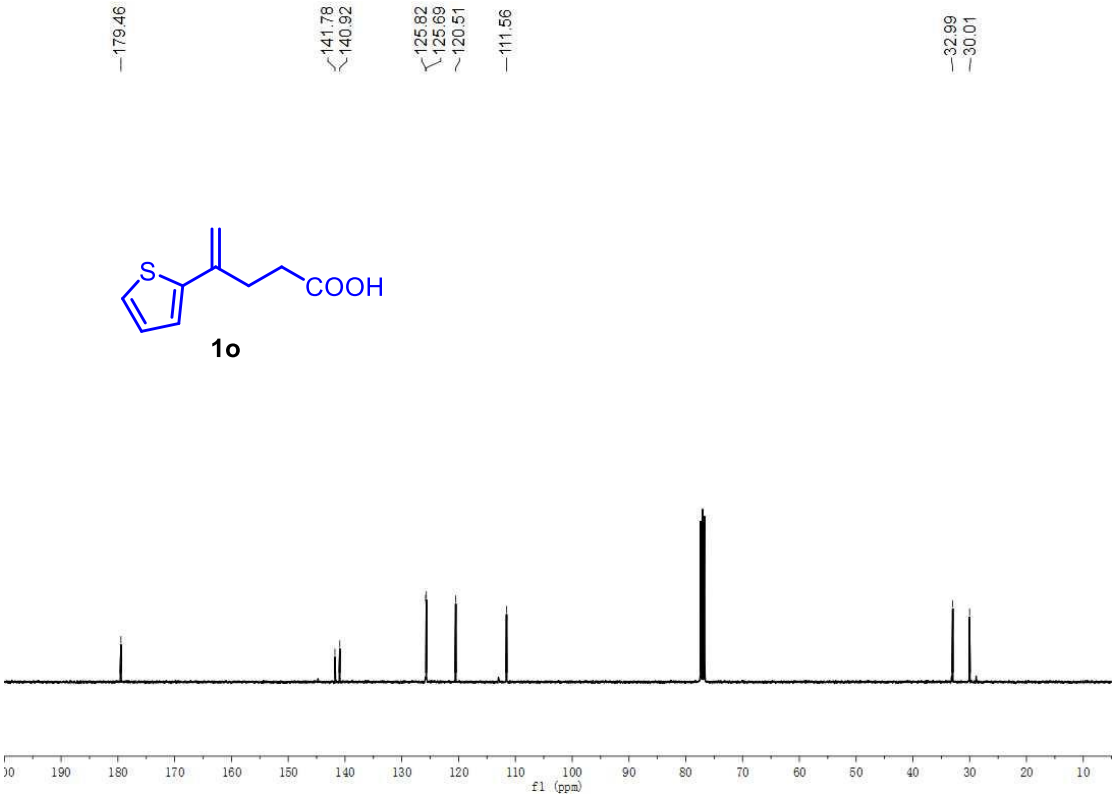
125.35
112.27
34.52
33.00
31.32
30.07
COOH
tBu
1d
f1 (ppm)

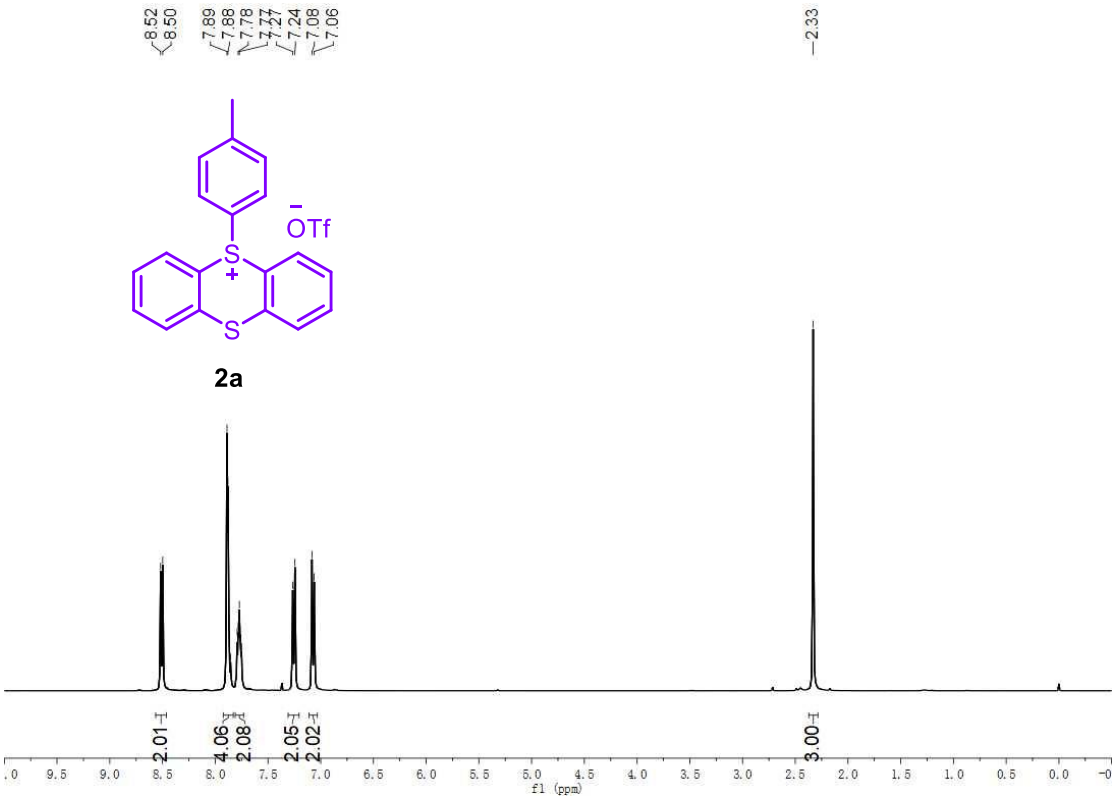

11.76
7.37
7.37
7.36
7.35
7.34
7.03
7.01
6.99
5.26
5.08
2.83
2.81
2.79
2.54
2.52
2.50
COOH
F
1n
0.97
2.00
2.00
1.05
1.05
2.08
2.03
f1 (ppm)


179.76
163.68
161.22
145.56
136.54
136.50
127.78
127.70
115.39
115.18
112.96
32.95
30.22
COOH
F
1n
f1 (ppm)

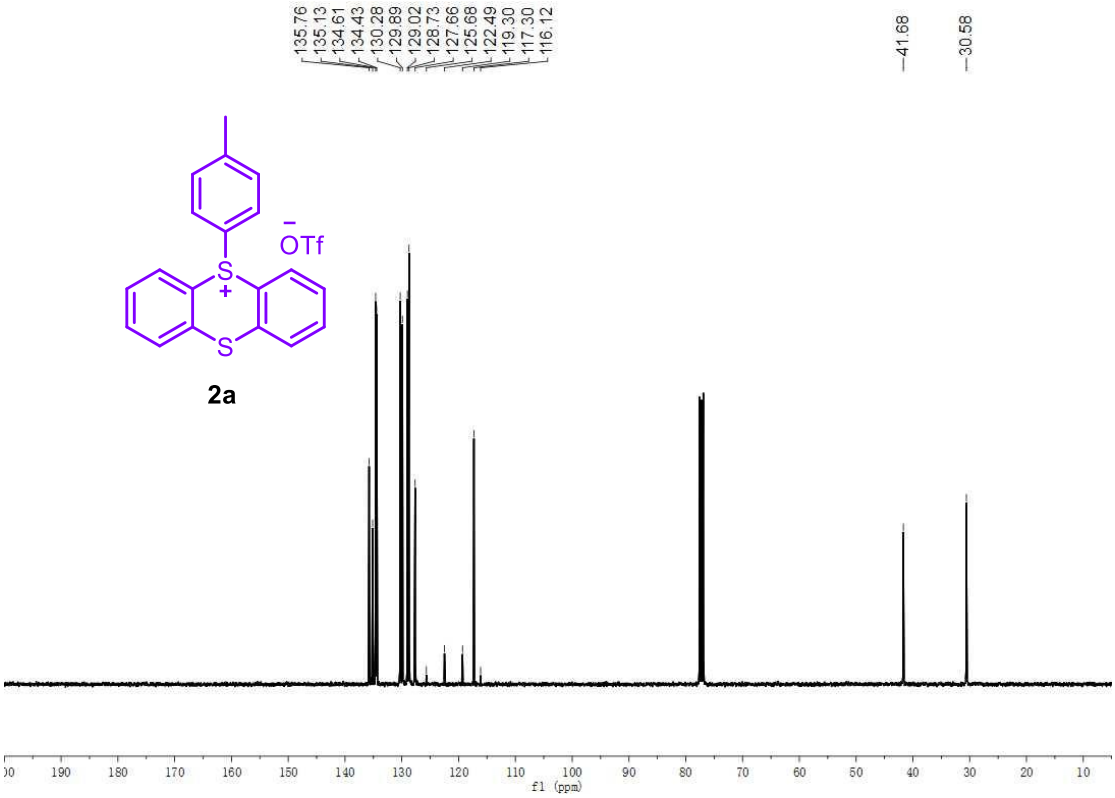

114.69
114.70
114.71
114.72
114.74
114.75
114.76
COOH
F
1n
f1 (ppm)
7.29
7.29
7.28
7.27
7.24
7.24
7.23
7.23
7.22
5.40
5.06
5.06
2.82
2.80
2.78
2.64
2.62
2.62
2.60
S
COOH
1o
1.00
2.00
1.04
1.11
2.04
2.06
f1 (ppm)

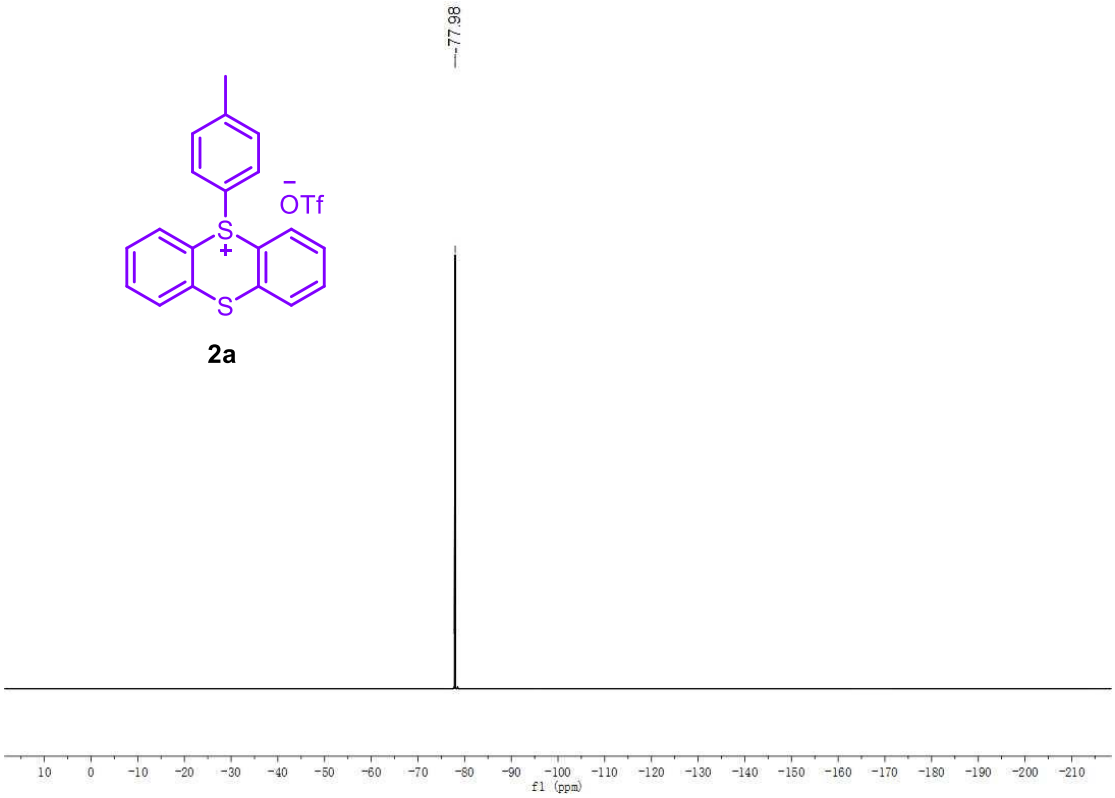

179.46
141.78
140.92
125.82
125.69
120.51
111.56
32.99
30.01
S
COOH
f1 (ppm)

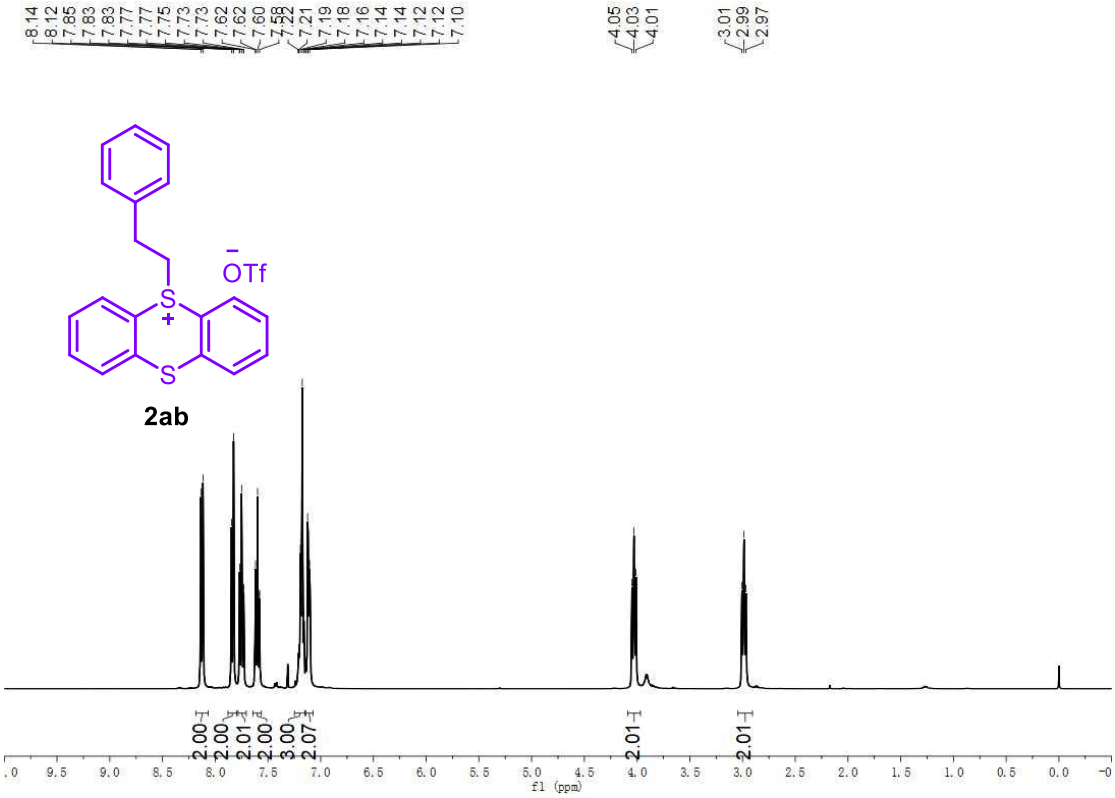
1o

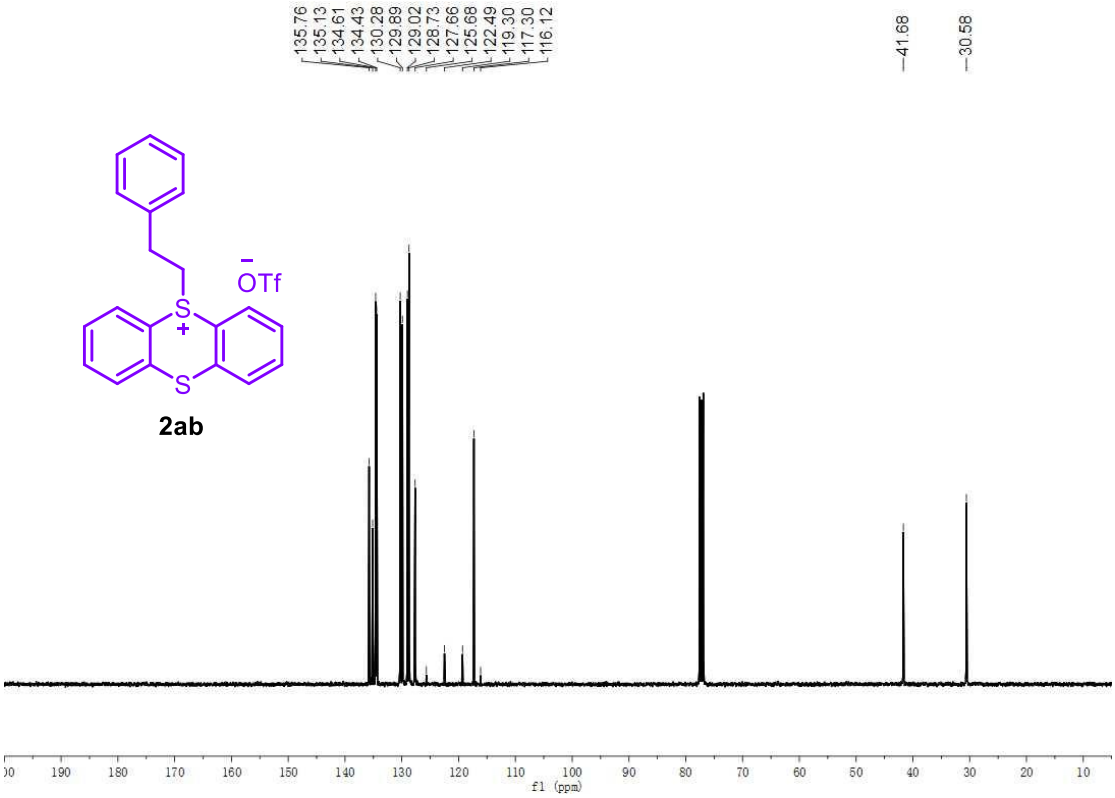

8.52
8.50
7.89
7.88
7.78
7.77
7.27
7.24
7.08
7.06
2.33
OTf
S
S
2.01
4.06
2.08
2.05
2.02
3.00
f1 (ppm)

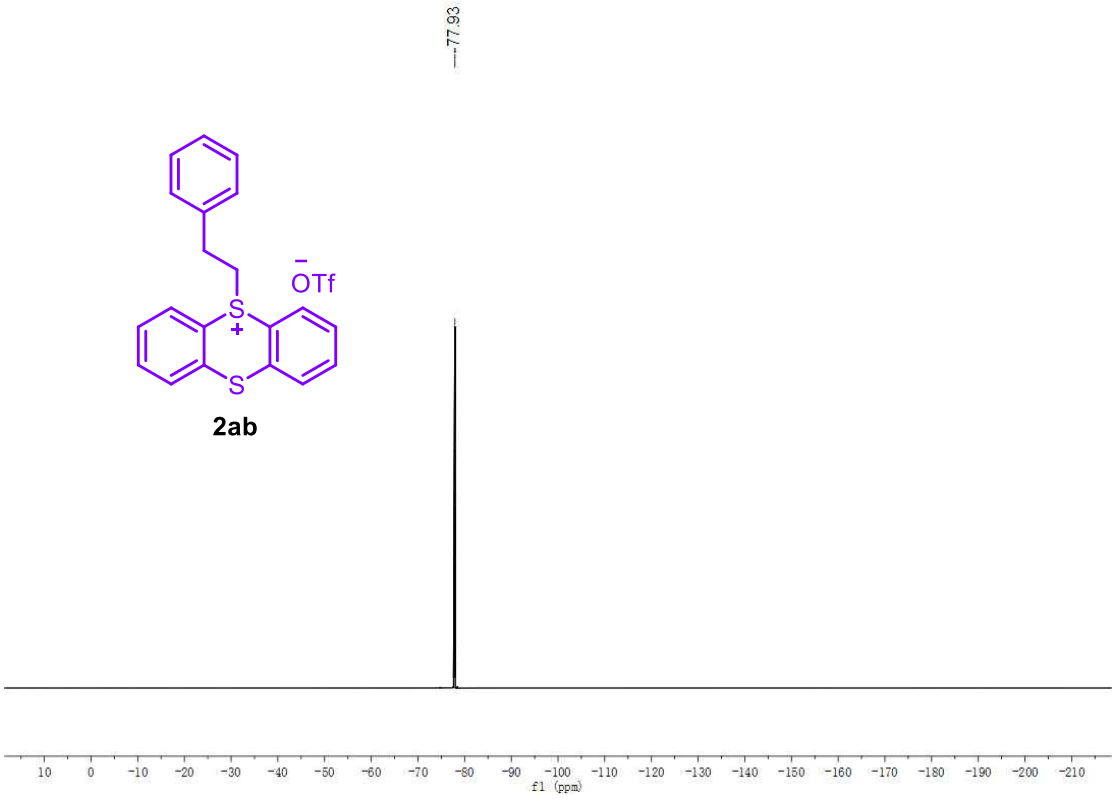
2a


135.76
135.13
134.61
134.43
130.28
129.89
129.02
128.73
127.66
125.68
122.49
119.30
117.30
116.12
41.68
30.58
OTf
S
+
S
2a
f1 (ppm)


77.98
OTf
S
+
S
2a
f1 (ppm)


8.14
8.12
7.85
7.83
7.83
7.77
7.77
7.75
7.73
7.73
7.62
7.62
7.60
7.58
7.22
7.21
7.19
7.18
7.16
7.14
7.14
7.12
7.12
7.10
4.05
4.03
4.01
3.01
2.99
2.97
OTf
S
+
S
2ab
2.00
2.00
2.01
2.00
3.00
2.07
2.01
2.01
f1 (ppm)


135.76
135.13
134.61
134.43
130.28
129.89
129.02
128.73
127.66
125.68
122.49
119.30
117.30
116.12
41.68
30.58
OTf
S
+
S
2ab
f1 (ppm)


77.93
OTf
S
S
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
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-110
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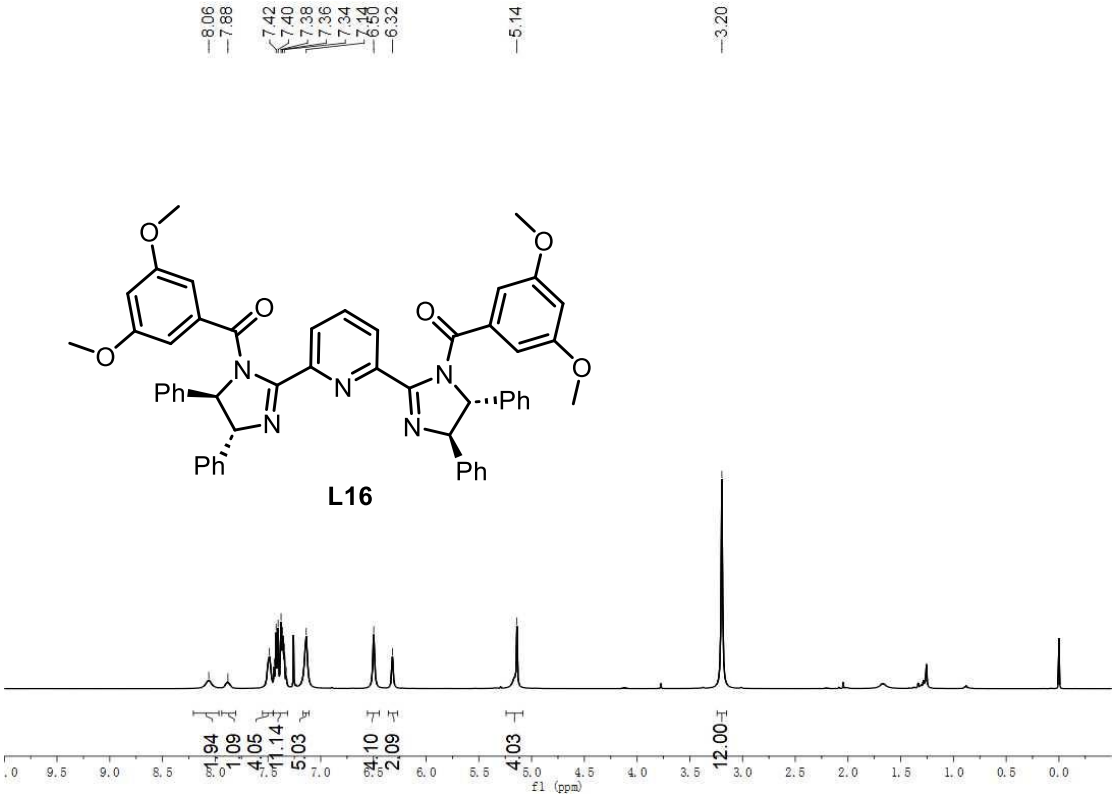
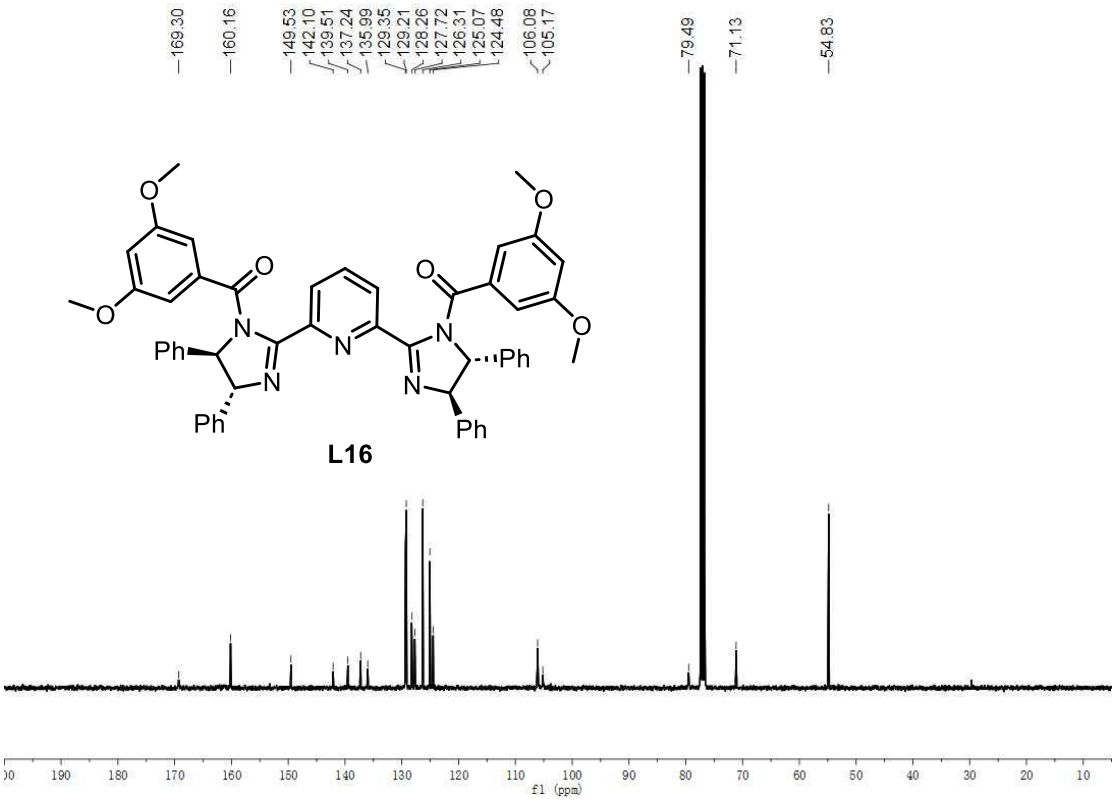
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

2ab


8.06
7.88
7.42
7.40
7.38
7.36
7.34
7.14
6.50
6.32
5.14
3.20
L16
1.94
1.09
4.05
11.14
5.03
4.10
2.09
4.03
12.00
f1 (ppm)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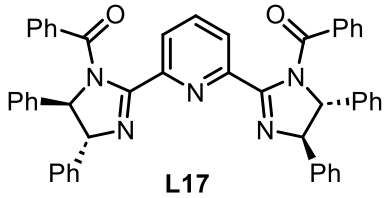
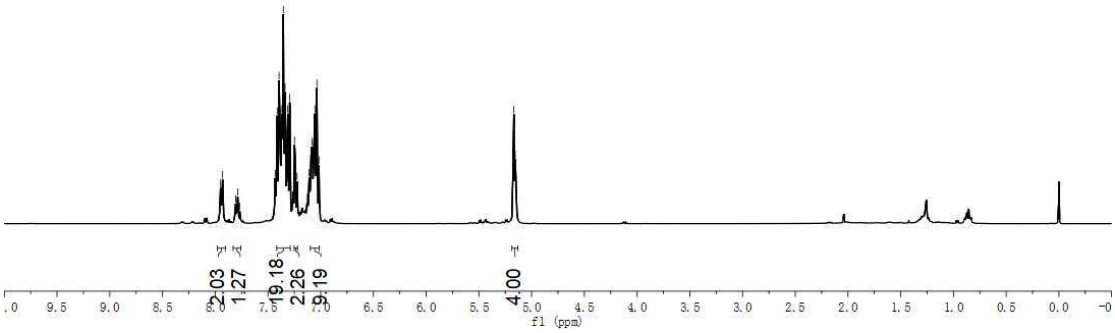
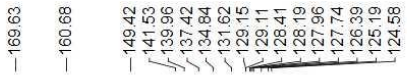
160.16
149.53
142.10
139.51
137.24
135.99
129.35
129.21
128.26
127.72
126.31
125.07
124.48
106.08
105.17
79.49
71.13
54.83
L16
f1 (ppm)


7.95
7.93
7.81
7.79
7.77
7.43
7.41
7.39
7.39
7.37
7.35
7.34
7.31
7.29
7.25
7.24
7.22
7.13
7.11
7.09
7.08
7.06
7.06
7.04
7.02
5.17
5.17
5.16


Ph
O
N
Ph
N
N
Ph
O
Ph
N
Ph
N
Ph

L17


2.03
1.27
19.18
2.26
9.19
4.00
f1 (ppm)


169.63
160.68
149.42
141.53
139.96
137.42
134.84
131.62
129.15
129.11
128.41
128.19
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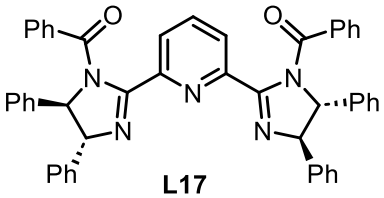
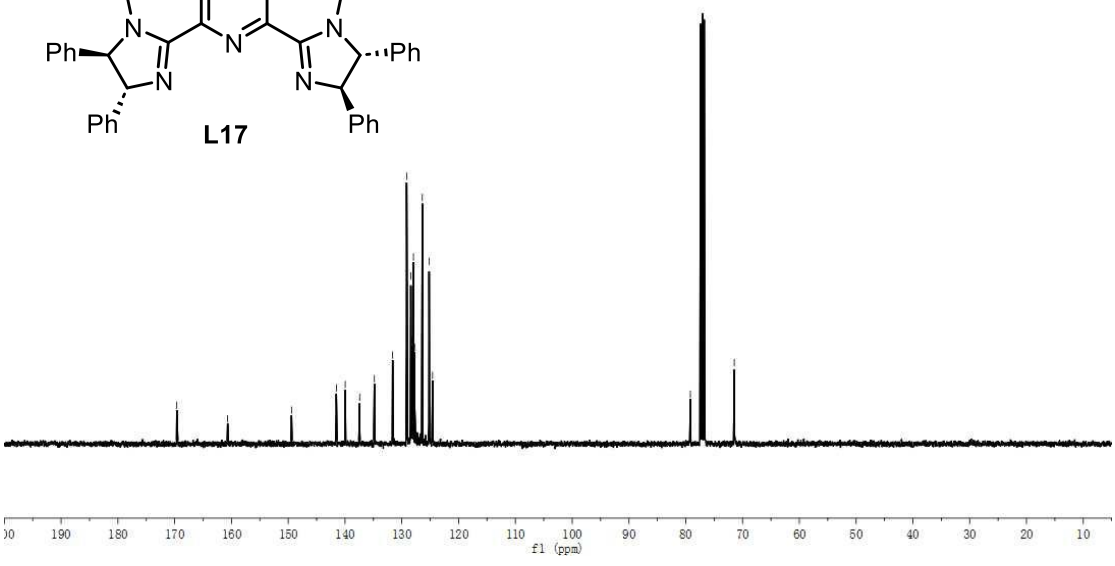
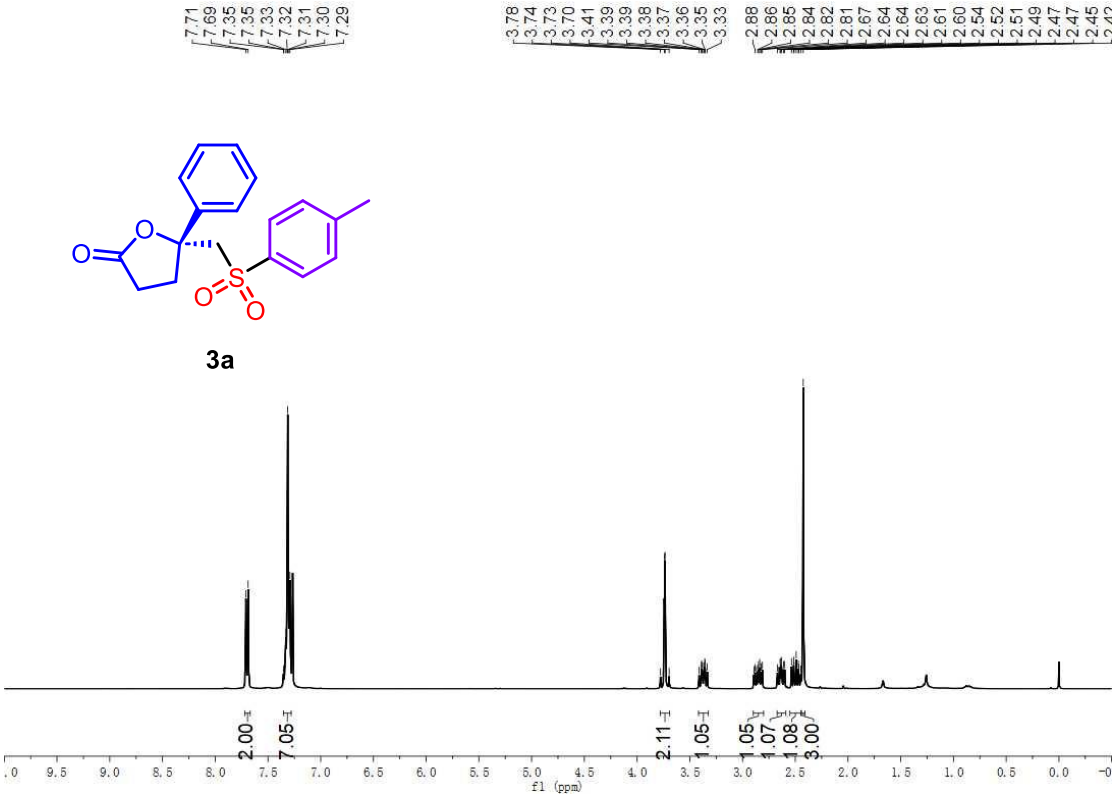
127.74
126.39
125.19
124.58
79.19
71.45


Ph
O
N
Ph
N
N
Ph
O
Ph
N
Ph
N
Ph

L17


f1 (ppm)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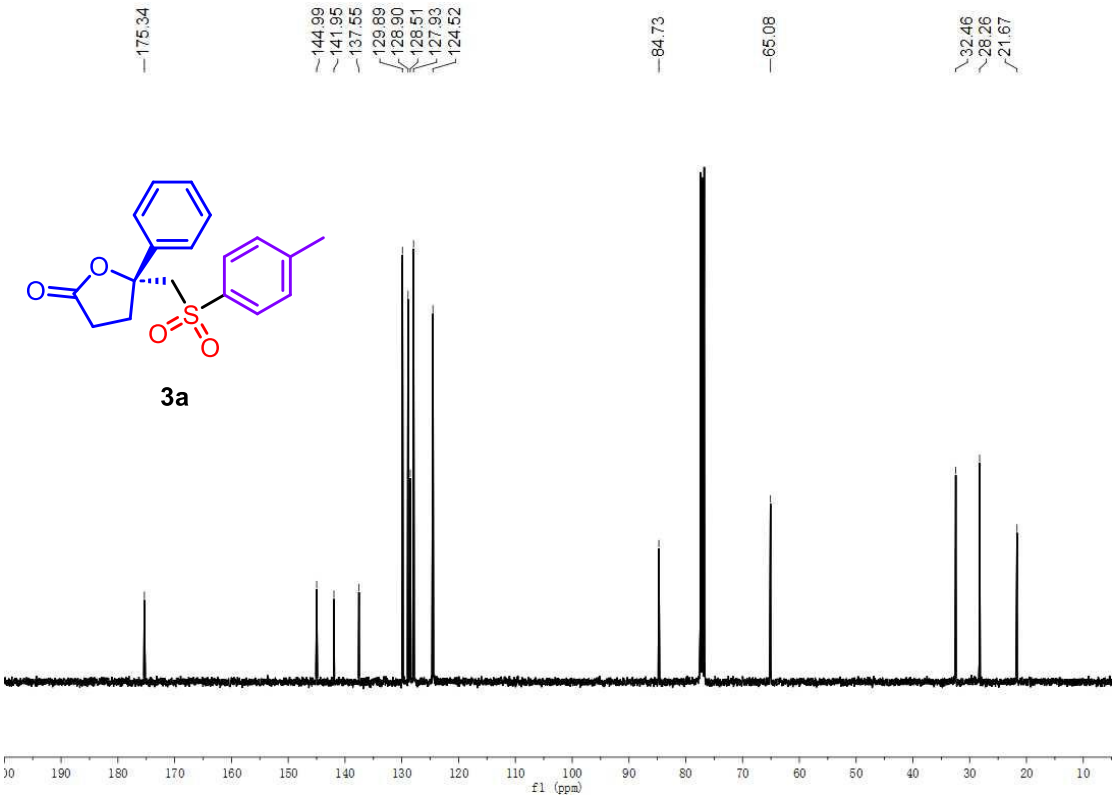
3.70
3.41
3.39
3.39
3.38
3.37
3.36
3.35
3.33
2.88
2.86
2.85
2.84
2.82
2.81
2.67
2.64
2.64
2.63
2.61
2.60
2.54
2.52
2.51
2.49
2.47
2.47
2.45
O
O
S
O
O
3a
2.00
7.05
2.11
1.05
1.05
1.07
1.08
3.00
f1 (ppm)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141.95
137.55
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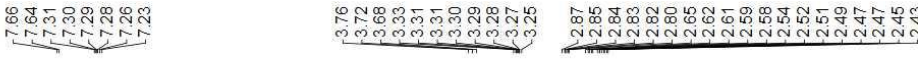
128.90
128.51
127.93
124.52
84.73
65.08
32.46
28.26
21.67
O
O
S
O
O
3a
f1 (ppm)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7.64
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7.28
7.26
7.23
3.76
3.72
3.68
3.33
3.31
3.31
3.30
3.29
3.28
3.27
3.25
2.87
2.85
2.84
2.83
2.82
2.80
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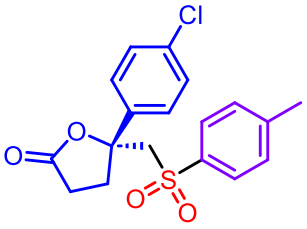
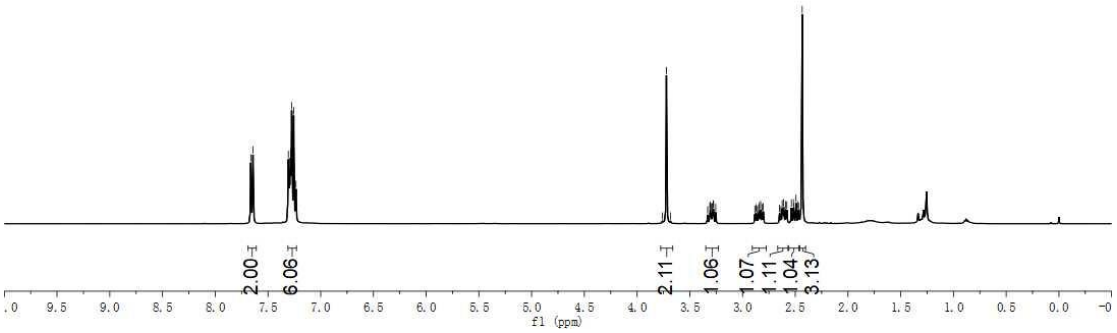
2.51
2.49
2.47
2.47
2.45


Cl
O
O
O
S
O

3b


2.00
6.06
2.11
1.06
1.07
1.11
1.04
3.13
f1 (ppm)


174.96
145.15
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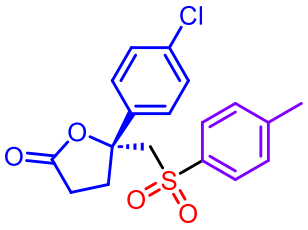
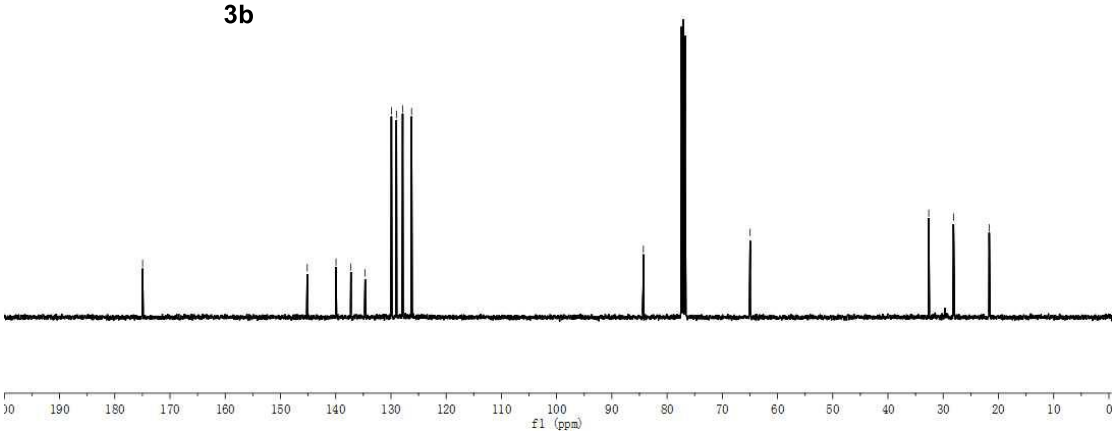
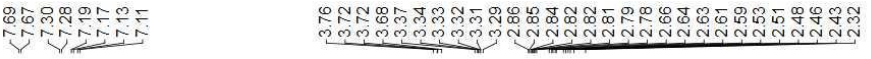
129.91
129.00
127.87
126.26
84.29
64.96
32.62
28.14
21.67


Cl
O
O
O
S
O

3b


f1 (ppm)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7.19
7.17
7.13
7.11
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3.72
3.72
3.68
3.37
3.34
3.33
3.32
3.31
3.29
2.86
2.85
2.84
2.82
2.82
2.81
2.79
2.78
2.66
2.64
2.63
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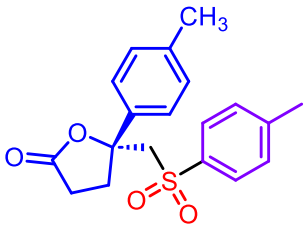
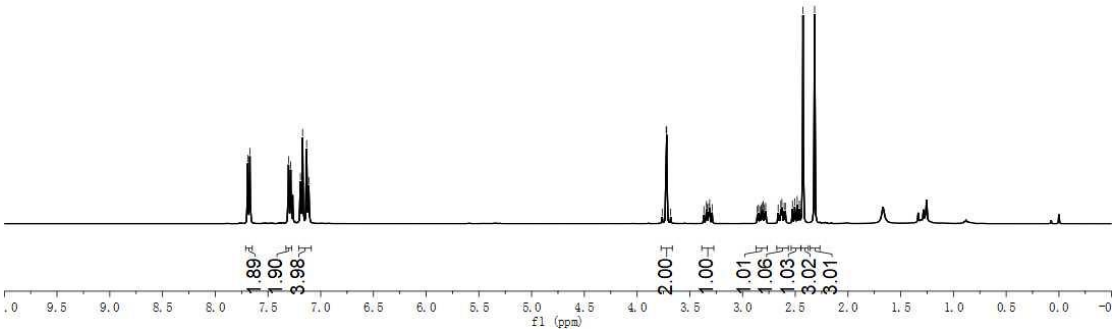
2.53
2.51
2.48
2.46
2.43
2.32


CH3
O
O
O=S=O

3c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1.01
1.06
1.03
3.02
3.01
f1 (ppm)


175.41
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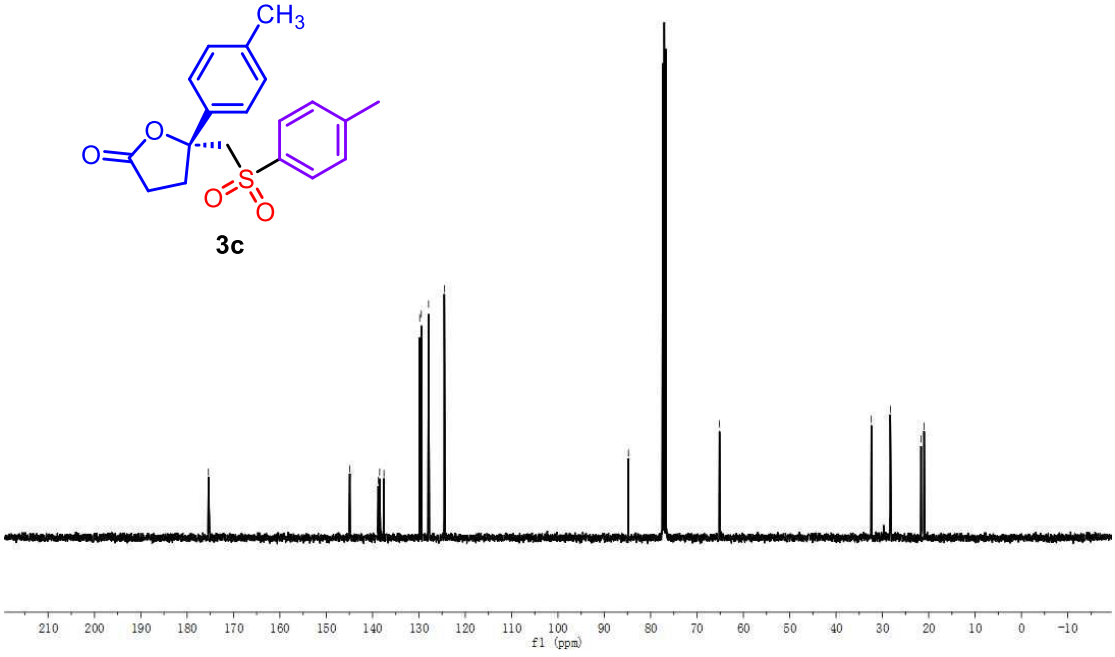
138.77
138.47
137.53
129.83
129.49
127.92
124.51
84.79
65.15
32.39
28.29
21.66
21.00

CH3
O
O
O=S=O

3c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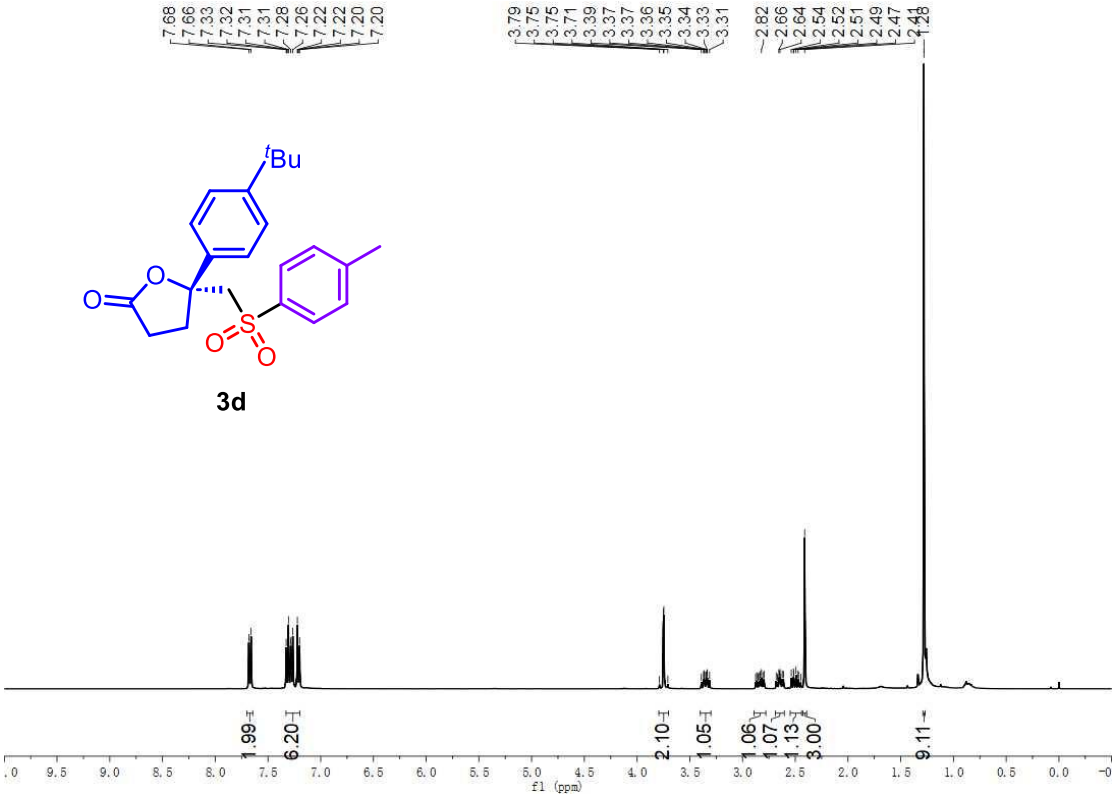
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7.31
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7.26
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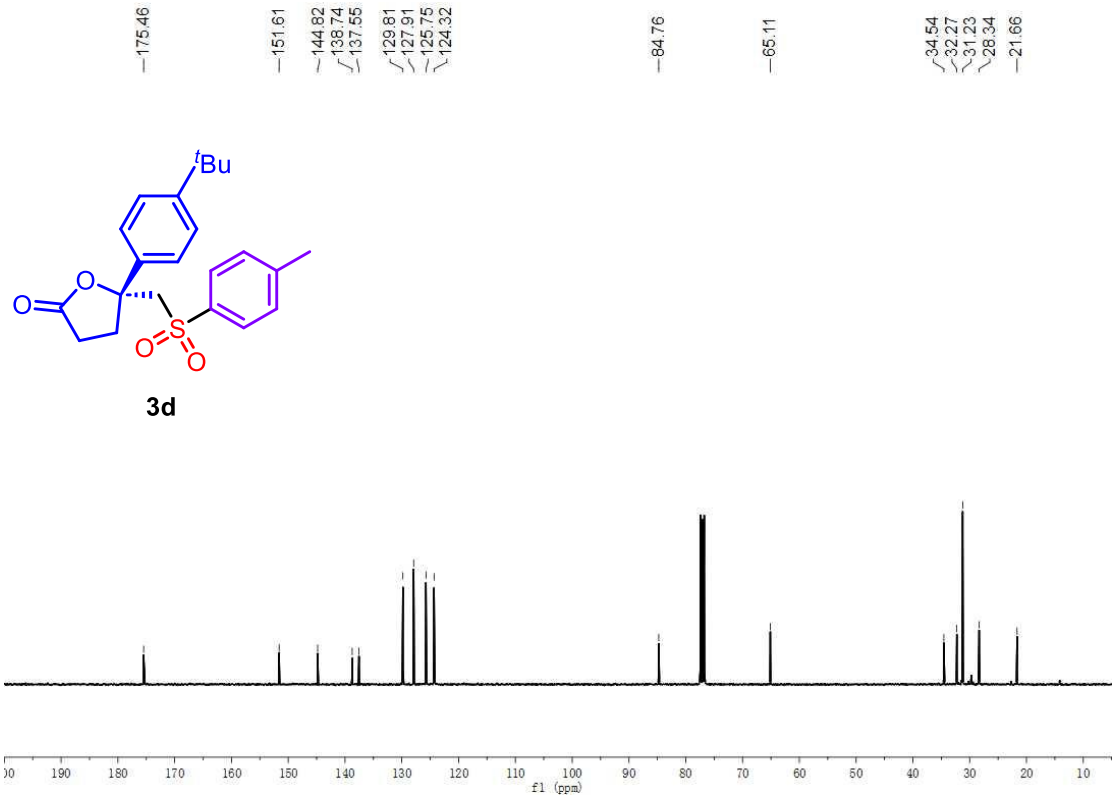
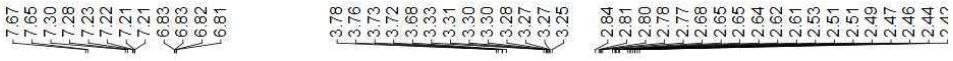
7.22
7.20
7.20
3.79
3.75
3.75
3.71
3.39
3.37
3.37
3.36
3.35
3.34
3.33
3.31
2.82
2.66
2.64
2.54
2.52
2.51
2.49
2.47
2.41
1.28
tBu
O
O
O
S
O
1.99
6.20
2.10
1.05
1.06
1.07
1.13
3.00
9.11
f1 (ppm)

3d


175.46
151.61
144.82
138.74
137.55
129.81
127.91
125.75
124.32
84.76
65.11
34.54
32.27
31.23
28.34
21.66
tBu
O
O
O
S
O
f1 (ppm)

3d


7.67
7.65
7.30
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7.22
7.21
7.21
6.83
6.83
6.82
6.81
3.78
3.76
3.73
3.72
3.68
3.33
3.31
3.30
3.30
3.28
3.27
3.27
3.25
2.84
2.81
2.80
2.78
2.77
2.68
2.65
2.65
2.64
2.62
2.61
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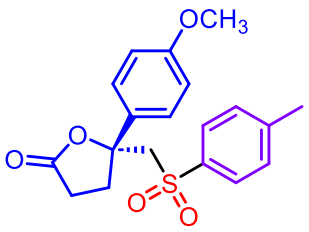
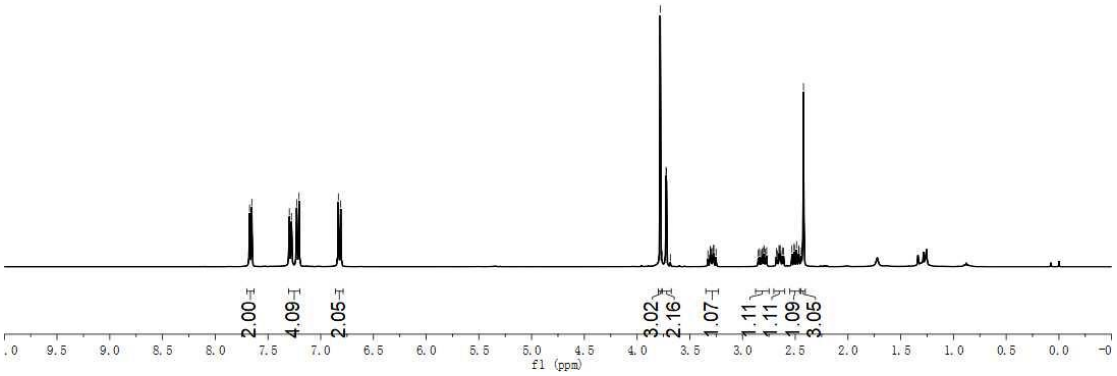
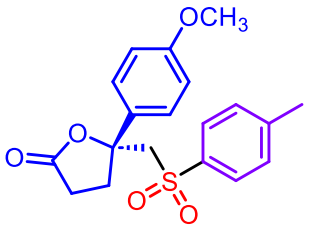
2.51
2.51
2.49
2.47
2.46
2.44


OCH3
O
O
S
O
O

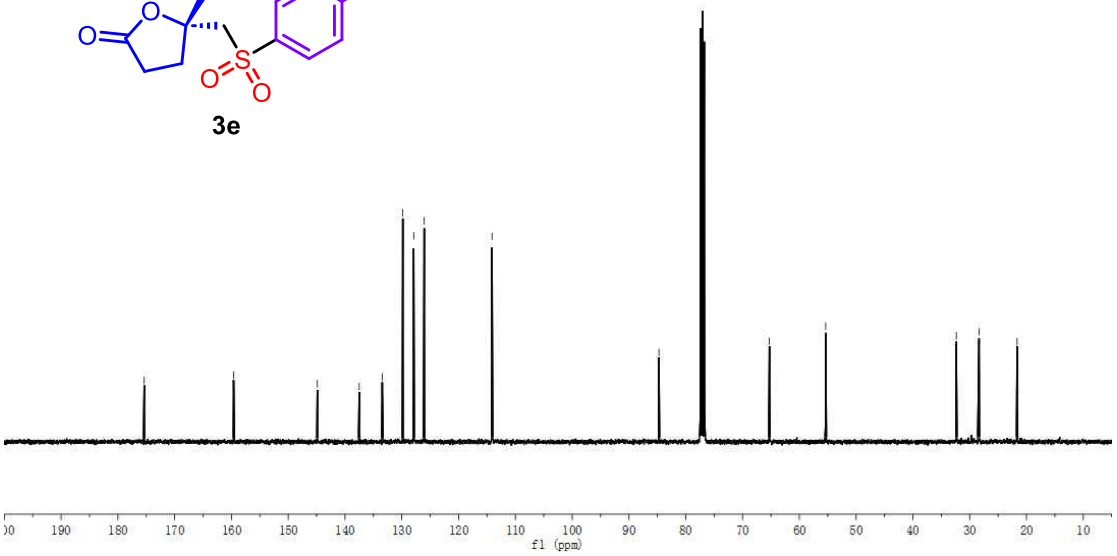
3e

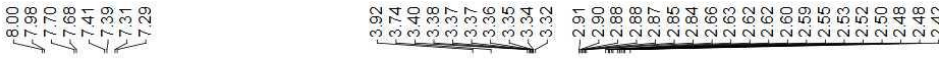

2.00
4.09
2.05
3.02
2.16
1.07
1.11
1.11
1.09
3.05
f1 (ppm)


175.37
159.62
144.88
137.51
133.44
129.83
127.90
126.06
114.11
84.72
65.27
55.35
32.35
28.35
21.65


OCH3
O
O
S
O
O

3e


f1 (ppm)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7.98
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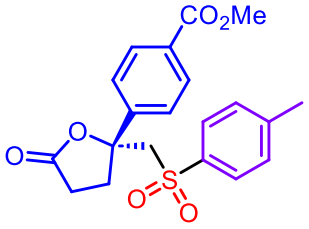
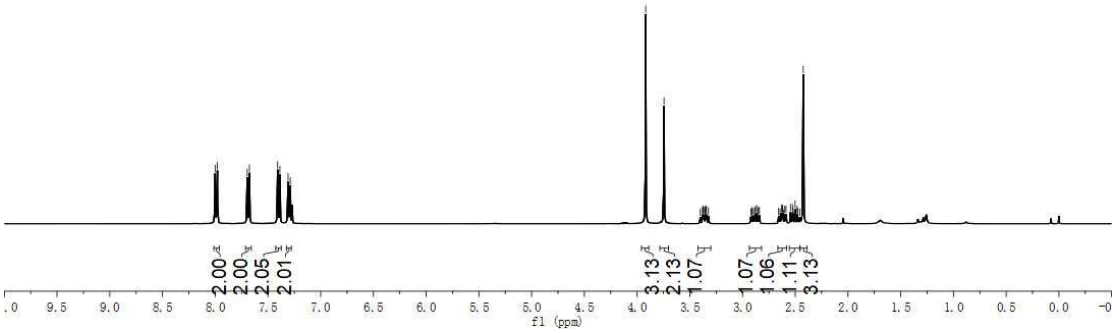
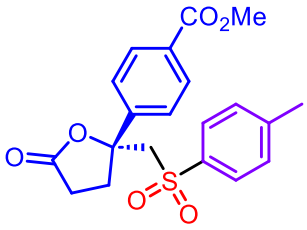
7.68
7.41
7.39
7.31
7.29
3.92
3.74
3.40
3.38
3.37
3.37
3.36
3.35
3.34
3.32
2.91
2.90
2.88
2.88
2.87
2.85
2.84
2.66
2.63
2.62
2.62
2.60
2.59
2.55
2.53
2.52
2.50
2.48
2.48


CO2Me
O
O
O=S
O

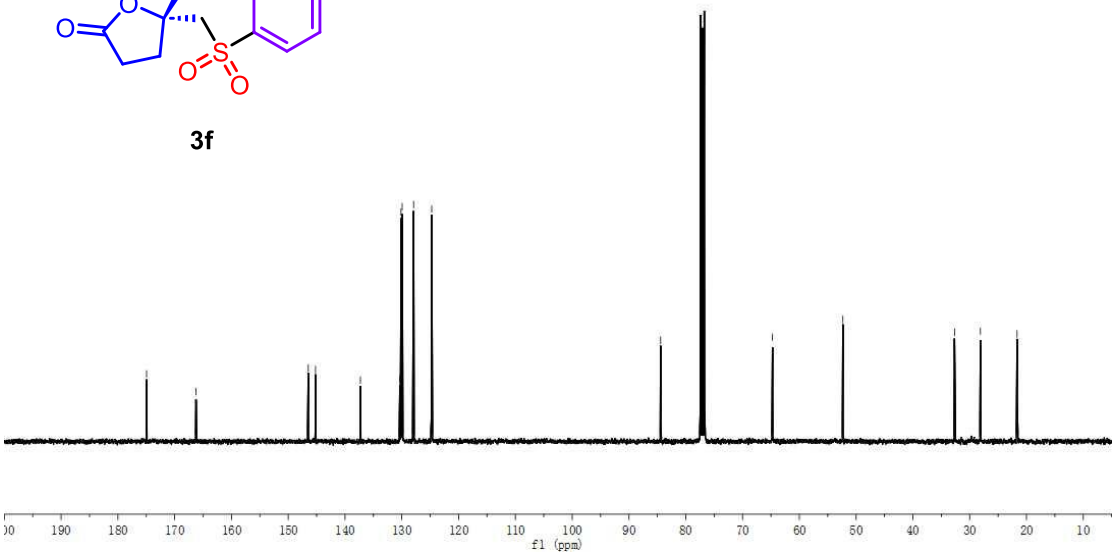
3f

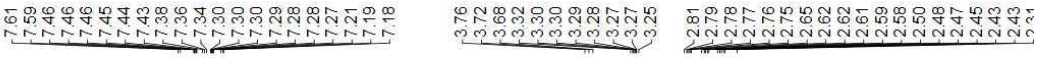

2.00
2.00
2.05
2.01
3.13
2.13
1.07
1.07
1.06
1.11
3.13
f1 (ppm)

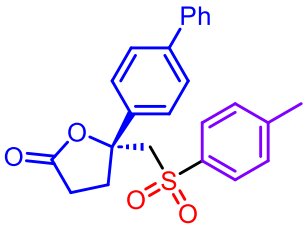

174.94
166.24
146.47
145.20
137.30
130.34
130.14
129.93
127.92
124.74
84.42
64.73
52.33
32.67
28.11
21.65


CO2Me
O
O
O=S
O

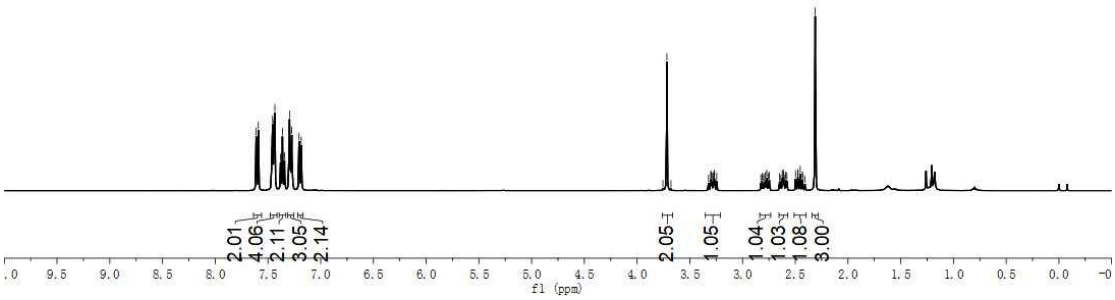
3f

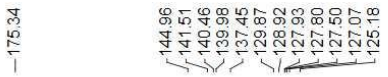

f1 (ppm)

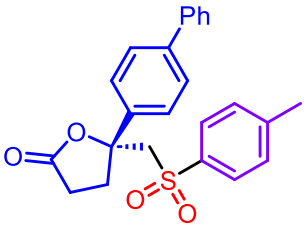

7.61
7.59
7.46
7.46
7.46
7.45
7.44
7.43
7.38
7.36
7.34
7.30
7.30
7.30
7.29
7.28
7.28
7.27
7.21
7.19
7.18
3.76
3.72
3.68
3.32
3.30
3.30
3.29
3.28
3.27
3.27
3.25
2.81
2.79
2.78
2.77
2.76
2.75
2.65
2.62
2.62
2.61
2.59
2.58
2.50
2.48
2.47
2.45
2.43
2.43


Ph
O
O
O=S
O

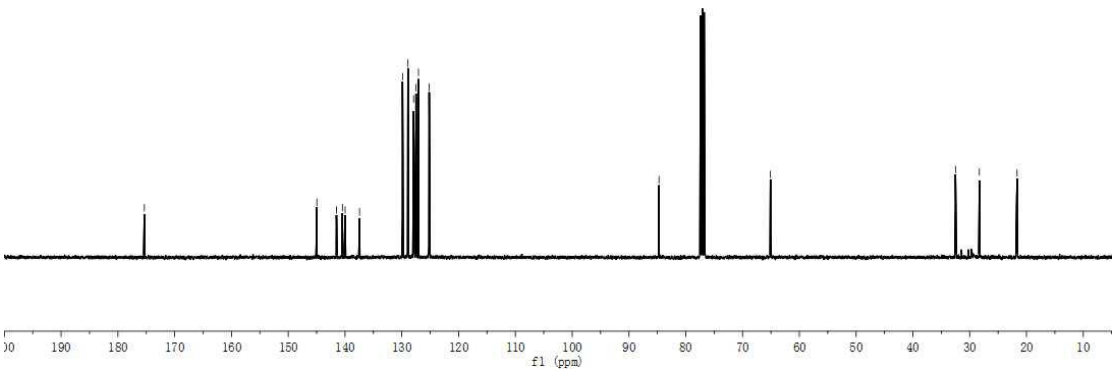
3g

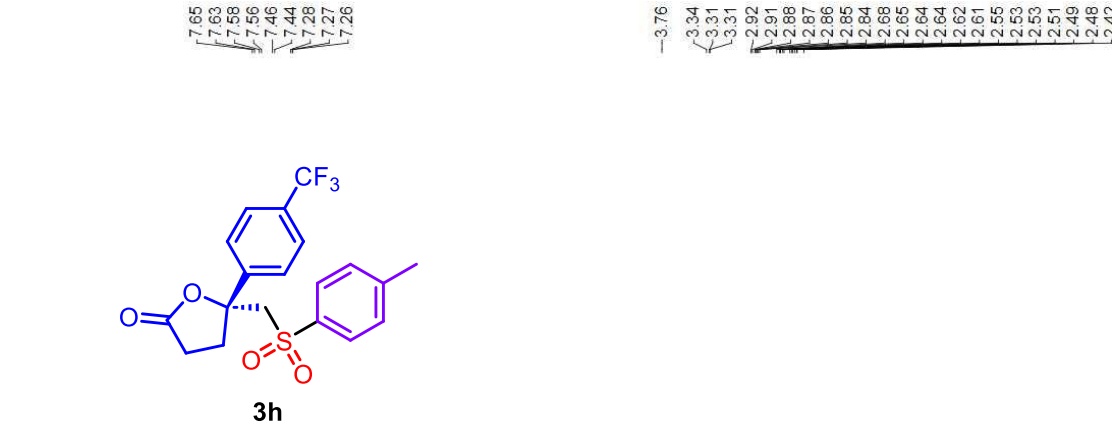

2.01
4.06
2.11
3.05
2.14
2.05
1.05
1.04
1.03
1.08
3.00
f1 (ppm)

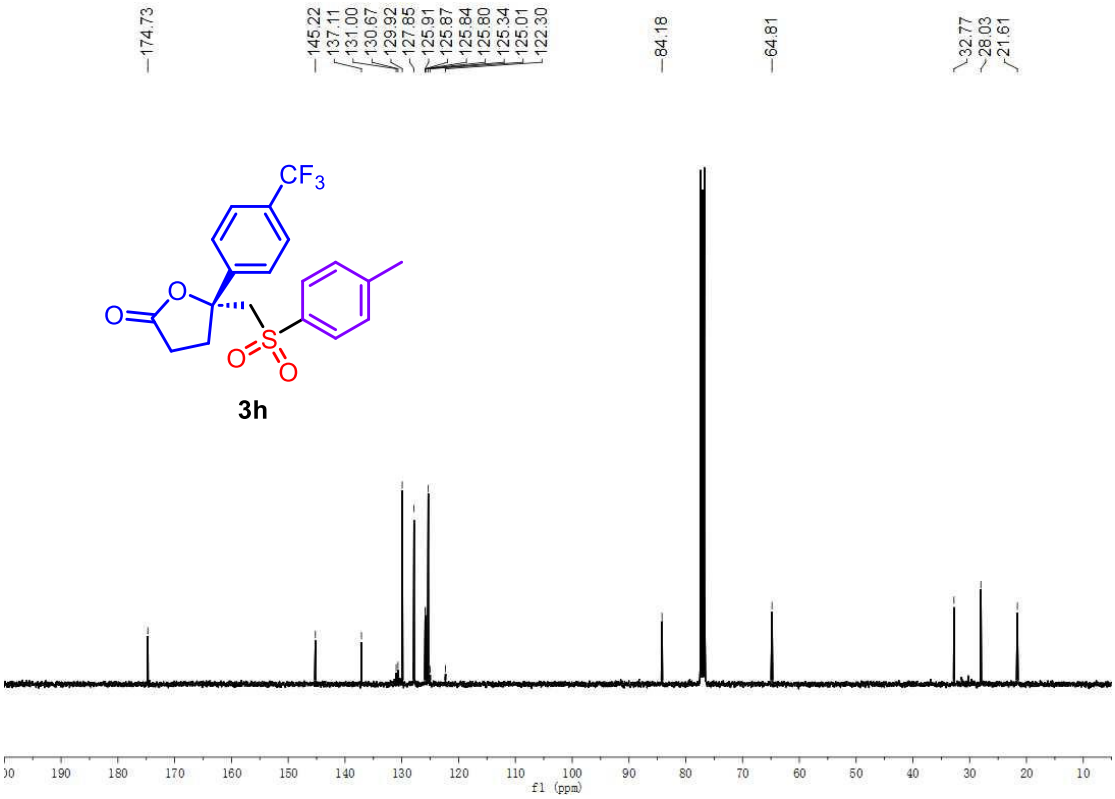

175.34
144.96
141.51
140.46
139.98
137.45
129.87
128.92
127.93
127.80
127.50
127.07
125.18
84.71
65.09
32.50
28.30
21.66

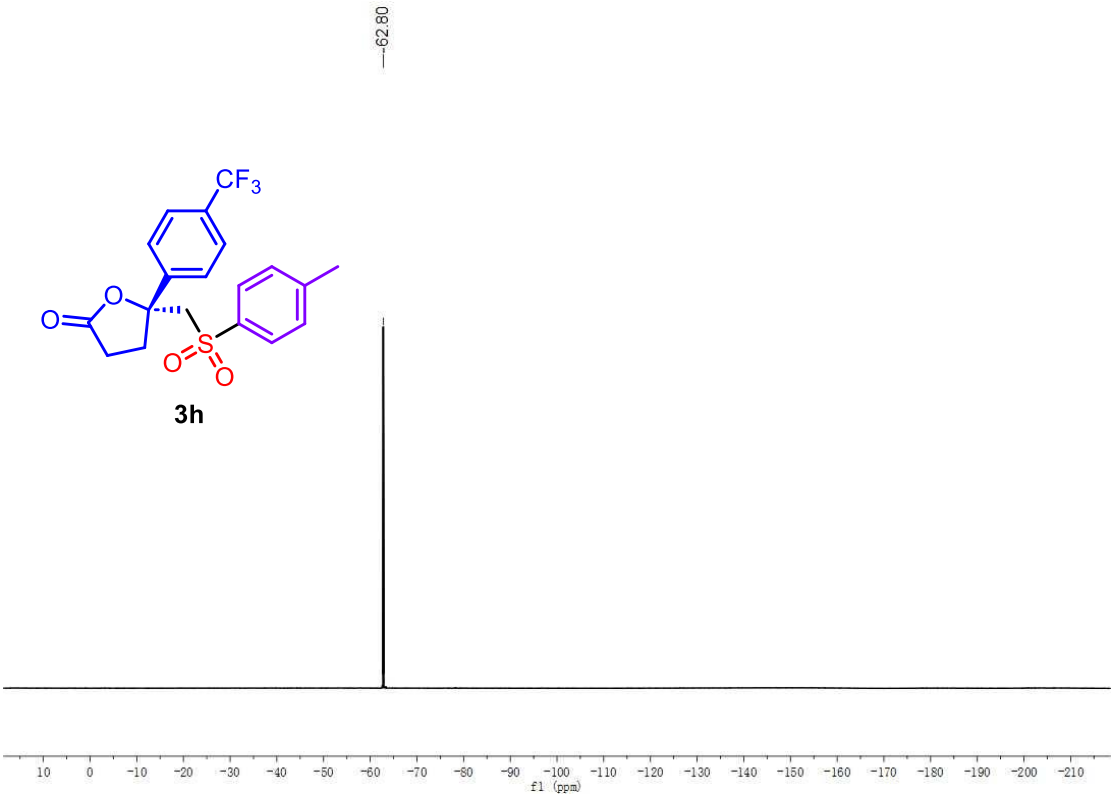

Ph
O
O
O=S
O

3g


f1 (ppm)


7.65
7.63
7.58
7.56
7.46
7.44
7.28
7.27
7.26
3.76
3.34
3.31
3.31
2.92
2.91
2.88
2.87
2.86
2.85
2.84
2.68
2.65
2.64
2.64
2.62
2.61
2.55
2.53
2.53
2.51
2.49
2.48
CF3
O
O
O
S
O
3h
1.97
1.99
2.01
2.21
1.99
1.04
1.05
1.07
1.15
3.00
f1 (ppm)


174.73
145.22
137.11
131.00
130.67
129.92
127.85
125.91
125.87
125.84
125.80
125.34
125.01
122.30
84.18
64.81
32.77
28.03
21.61
CF3
O
O
O
S
O
3h
f1 (ppm)


-62.80
CF3
O
O
O
S
O
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)
7.70
7.68
7.66
7.64
7.49
7.47
7.33
7.31
3.74
3.71
3.67
3.39
3.37
3.36
3.35
3.34
3.33
3.33
3.31
2.93
2.92
2.91
2.90
2.89
2.88
2.87
2.65
2.64
2.62
2.60
2.59
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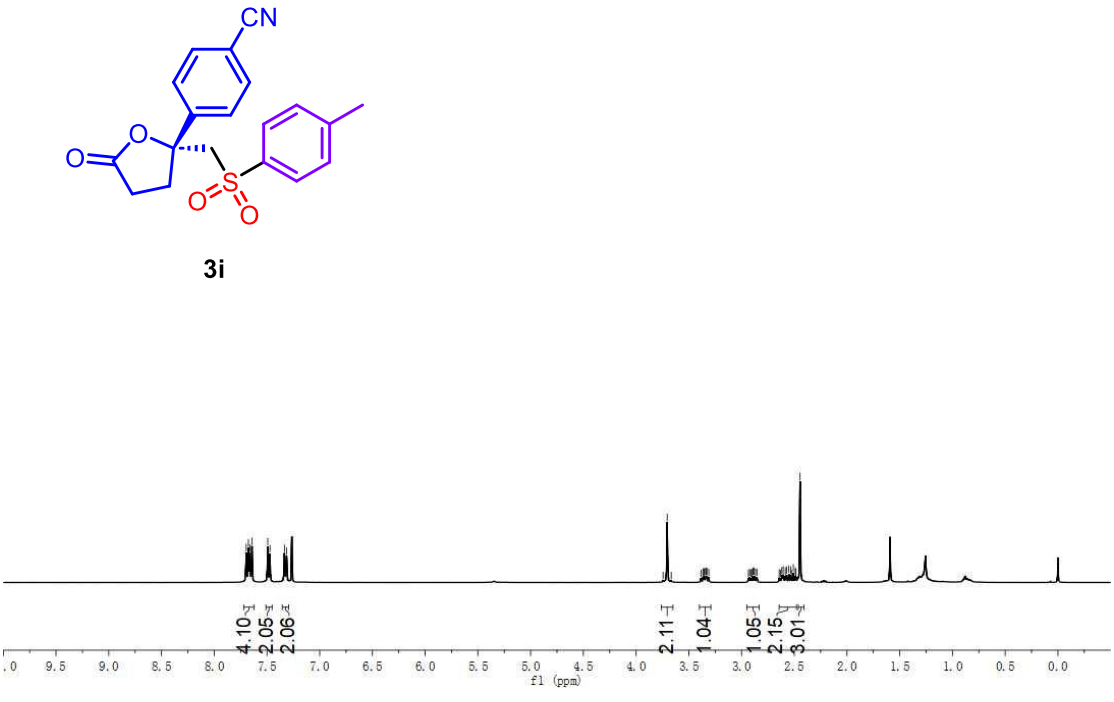
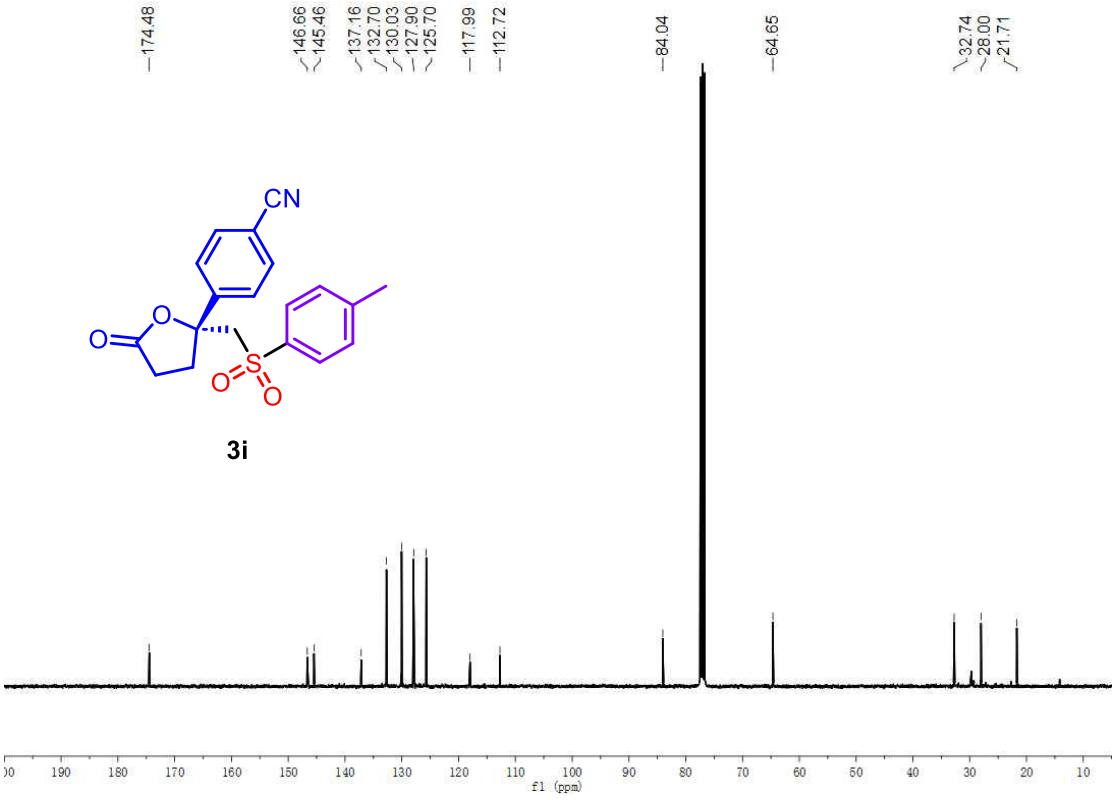
2.53
2.53
2.51
2.49
2.48

3h


CN
O
O
O
S
O
4.10
2.05
2.06
2.11
1.04
1.05
2.15
3.01
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

3i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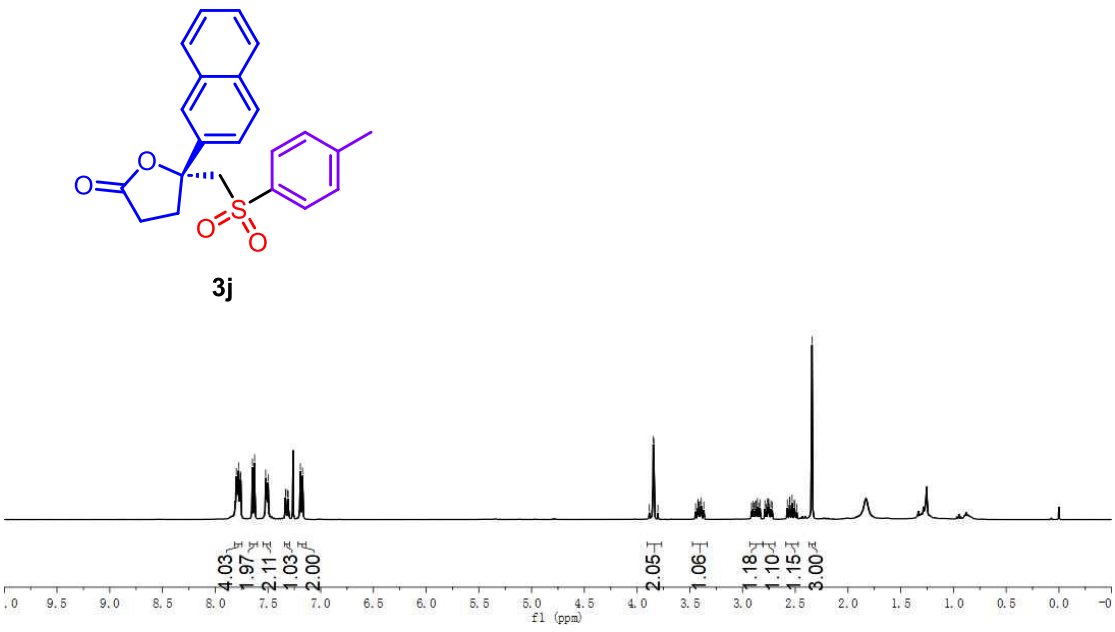
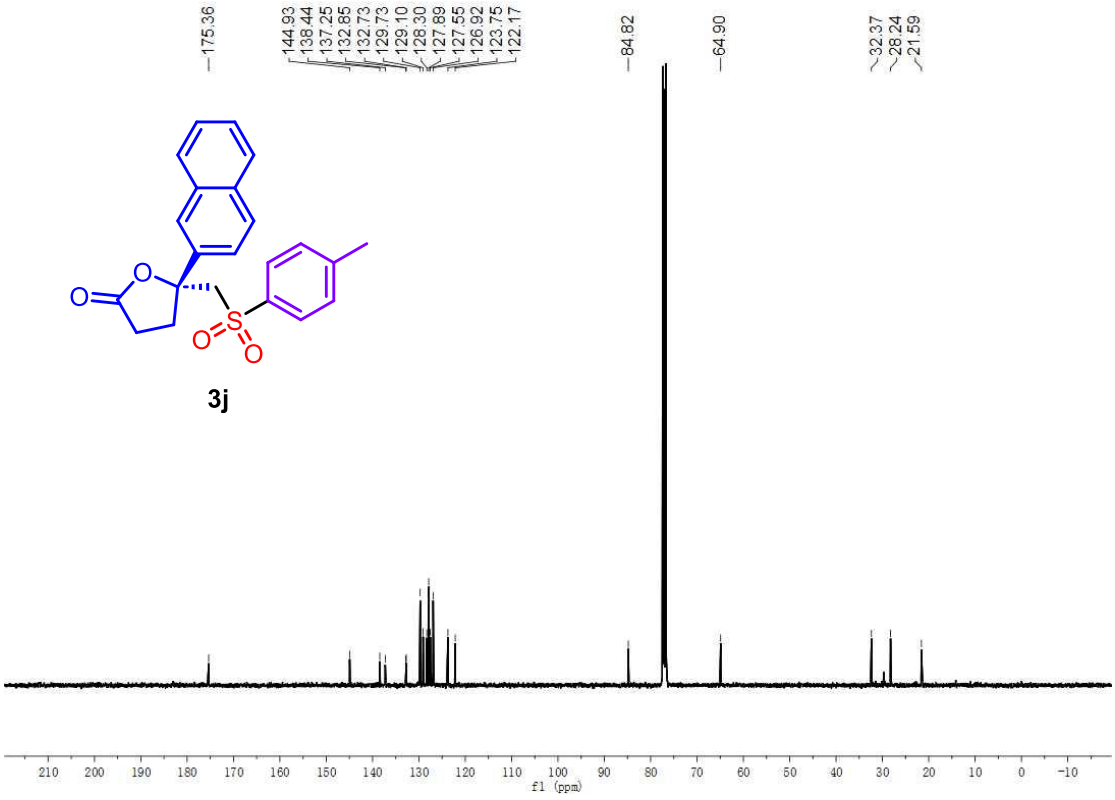
146.66
145.46
137.16
132.70
130.03
127.90
125.70
117.99
112.72
84.04
64.65
32.74
28.00
21.71
CN
O
O
S
O
O
f1 (ppm)

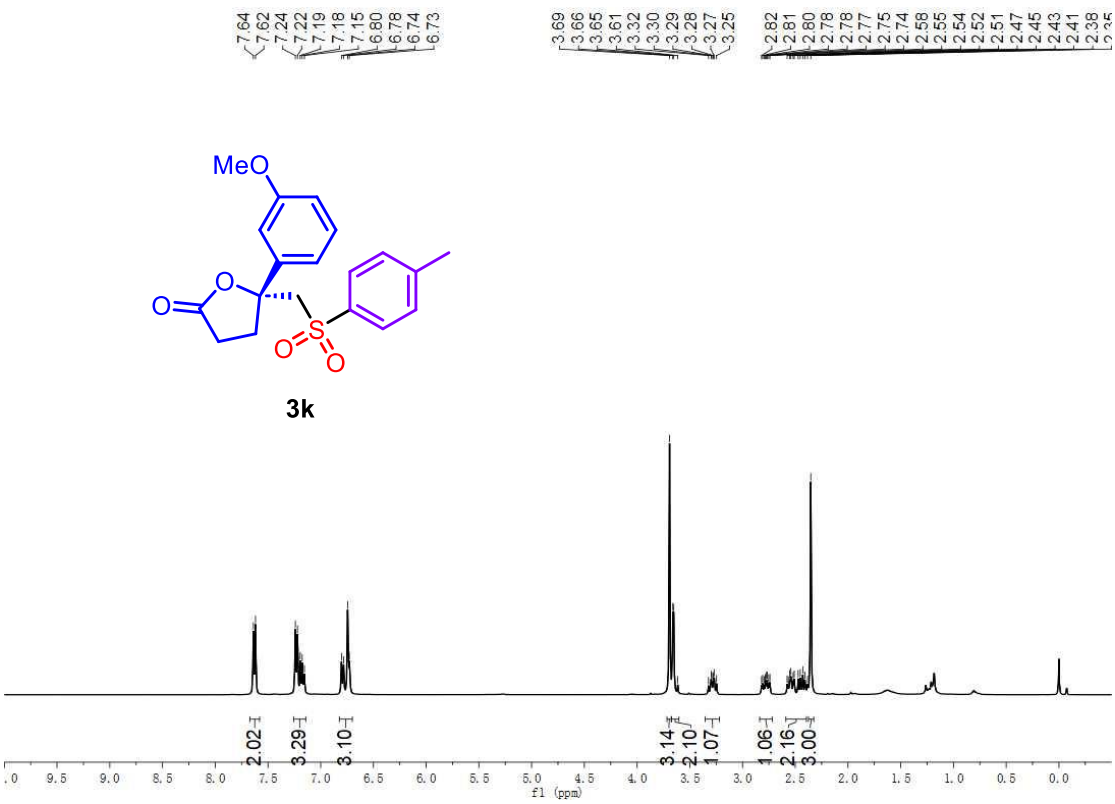
3i


O
O
S
O
O
4.03
1.97
2.11
1.03
2.00
2.05
1.06
1.18
1.10
1.15
3.00
f1 (ppm)

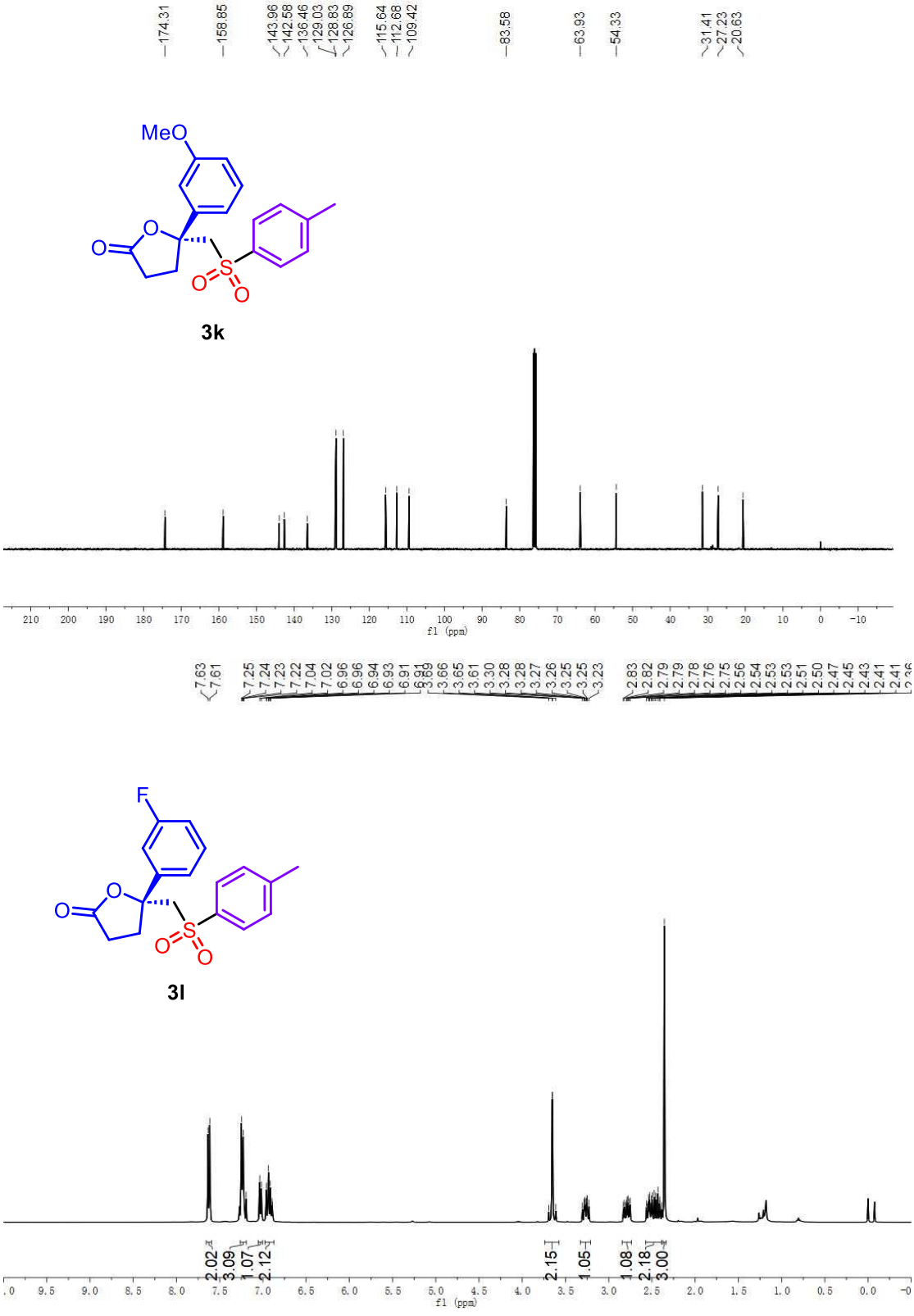
3j


175.36
144.93
138.44
137.25
132.85
132.73
129.73
129.10
128.30
127.89
127.55
126.92
123.75
122.17
84.82
64.90
32.37
28.24
21.59
f1 (ppm)

3j


7.64
7.62
7.24
7.22
7.19
7.18
7.15
6.80
6.78
6.74
6.73
3.69
3.66
3.65
3.61
3.32
3.30
3.29
3.28
3.27
3.25
2.82
2.81
2.80
2.78
2.78
2.77
2.75
2.74
2.58
2.55
2.54
2.52
2.51
2.47
2.45
2.43
2.41
2.38
MeO
2.02
3.29
3.10
3.14
2.10
1.07
1.06
2.16
3.00
f1 (ppm)

3k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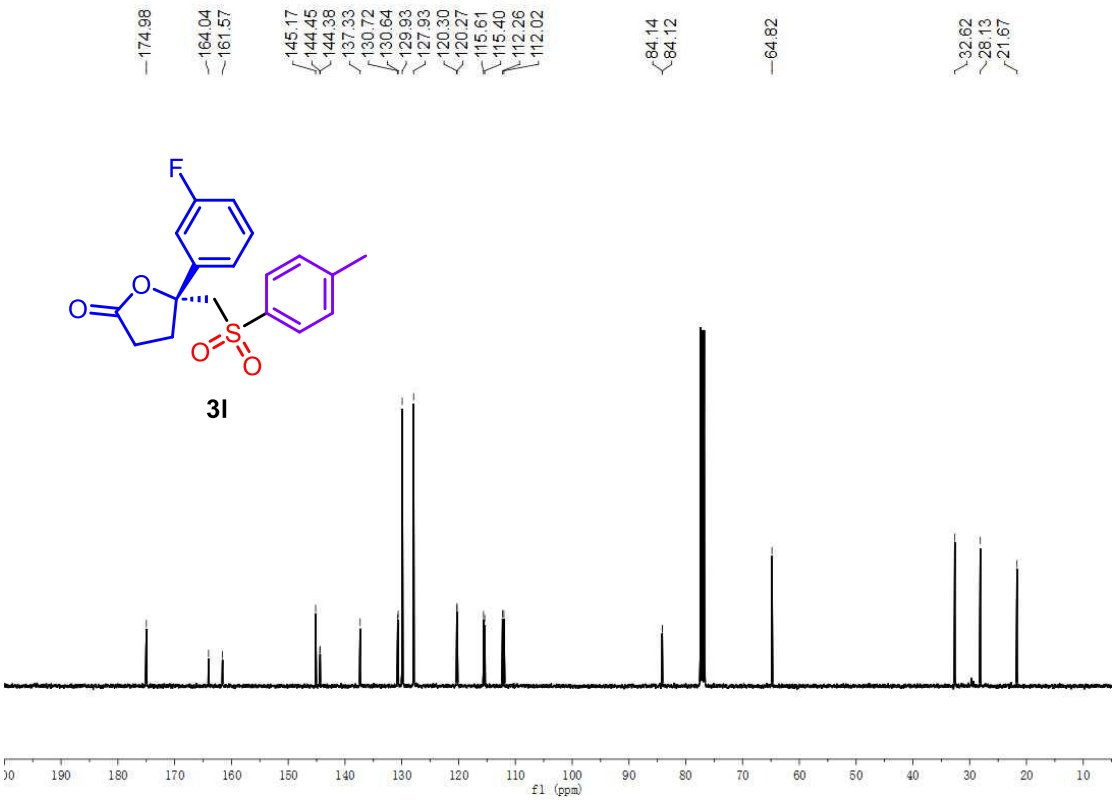
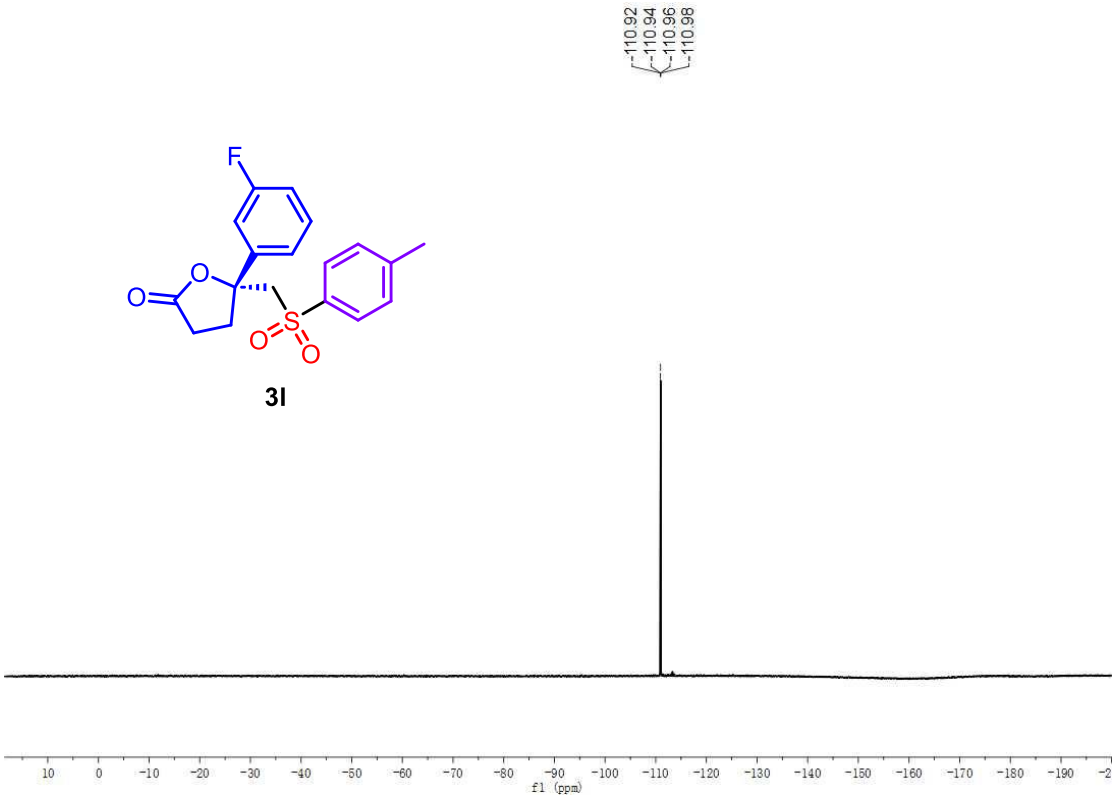
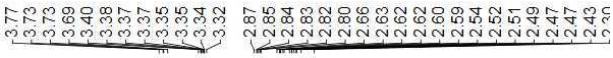
158.85
143.96
142.58
136.46
129.03
128.83
126.89
115.64
112.68
109.42
83.58
63.93
54.33
31.41
27.23
20.63
MeO
O
O
O
S
O
3k
f1 (ppm)
7.63
7.61
7.25
7.24
7.23
7.22
7.04
7.02
6.96
6.96
6.94
6.93
6.91
3.69
3.66
3.65
3.61
3.30
3.28
3.28
3.27
3.26
3.25
3.25
3.23
2.83
2.82
2.79
2.79
2.78
2.76
2.75
2.56
2.54
2.53
2.53
2.51
2.50
2.47
2.45
2.43
2.41
2.41
F
O
O
O
S
O
3l
2.02
3.09
1.07
2.12
2.15
1.05
1.08
2.18
3.00
f1 (ppm)


174.98
164.04
161.57
145.17
144.45
144.38
137.33
130.72
130.64
129.93
127.93
120.30
120.27
115.61
115.40
112.26
112.02
84.14
84.12
64.82
32.62
28.13
21.67
F
O
O
S
O
O
3l
f1 (ppm)


-110.92
-110.94
-110.96
-110.98
F
O
O
S
O
O
3l
f1 (ppm)


7.70
7.68
7.31
7.29
7.24
7.23
7.21
7.20
7.20
7.10
7.08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3.73
3.73
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3.40
3.38
3.37
3.37
3.35
3.35
3.34
3.32
2.87
2.85
2.84
2.83
2.82
2.80
2.66
2.63
2.62
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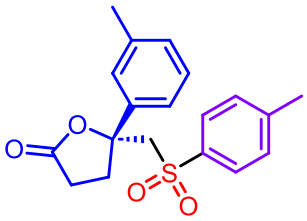
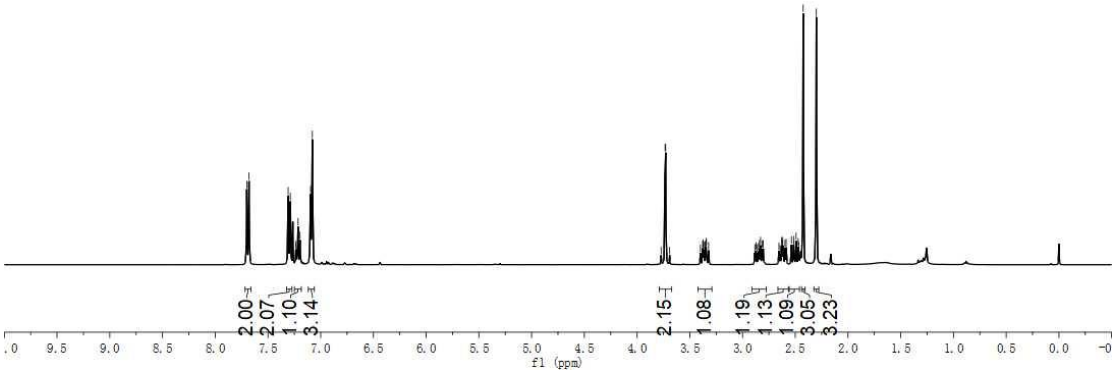
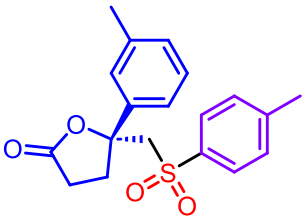
2.60
2.59
2.54
2.52
2.51
2.49
2.47
2.47
2.43



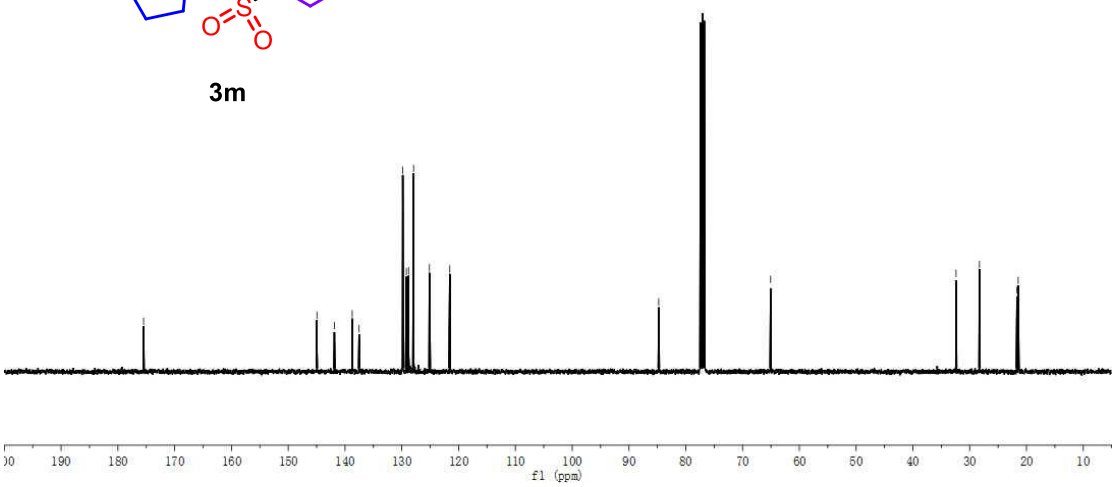
3m

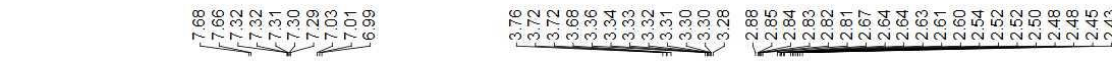

2.00
2.07
1.10
3.14
2.15
1.08
1.19
1.13
1.09
3.05
3.23
f1 (ppm)

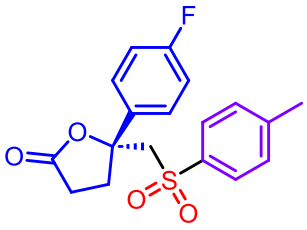

175.47
144.94
141.86
138.74
137.53
129.84
129.20
128.81
127.93
125.14
121.56
84.76
65.06
32.40
28.28
21.67
21.46



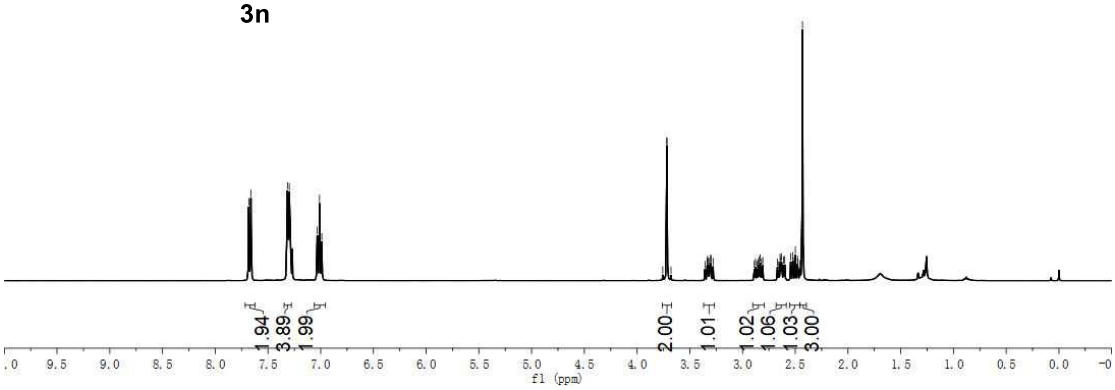
3m

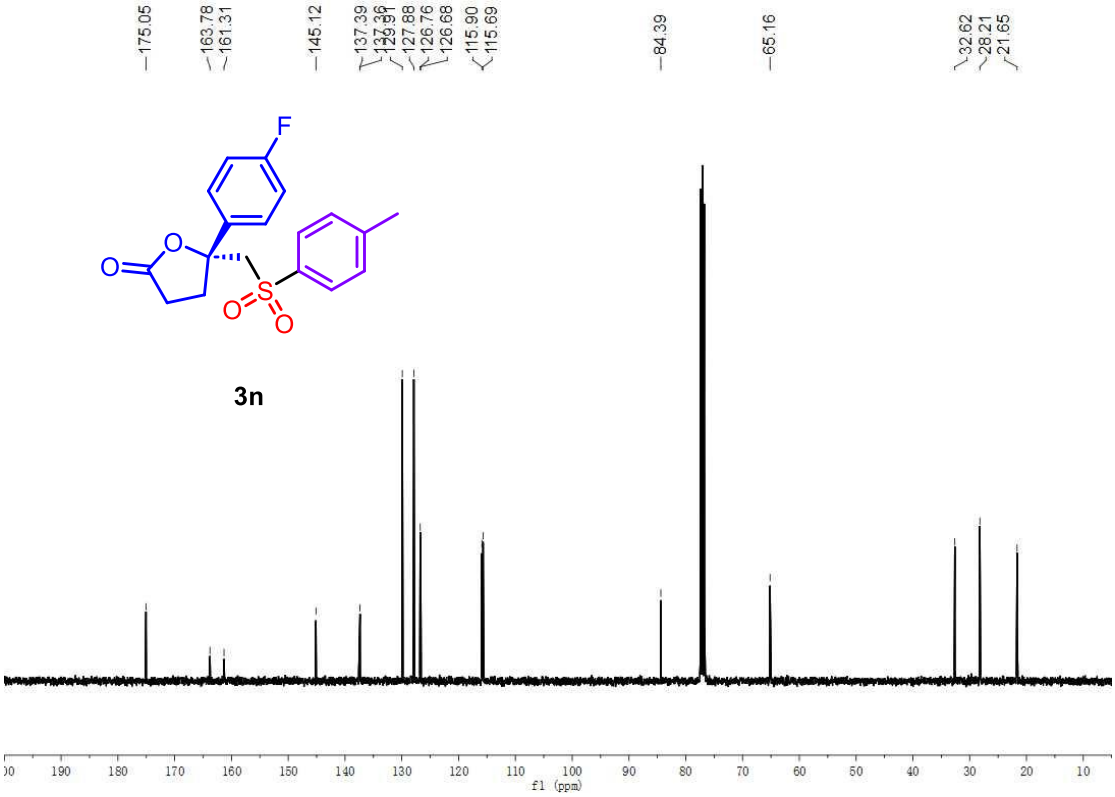

f1 (ppm)


7.68
7.66
7.32
7.32
7.31
7.30
7.29
7.03
7.01
6.99
3.76
3.72
3.72
3.68
3.36
3.34
3.33
3.32
3.31
3.30
3.30
3.28
2.88
2.85
2.84
2.83
2.82
2.81
2.67
2.64
2.64
2.63
2.61
2.60
2.54
2.52
2.52
2.50
2.48
2.48
2.45


F
O
O
O
S
O

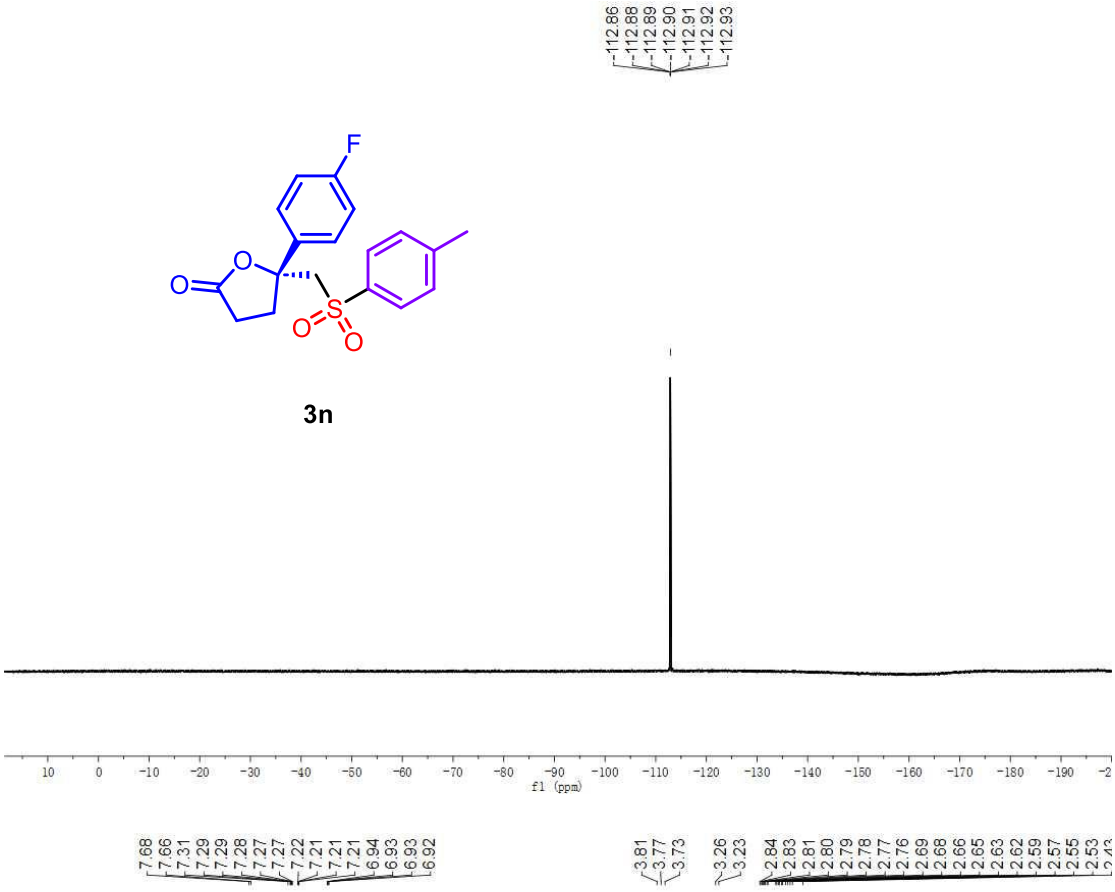
3n


1.94
3.89
1.99
2.00
1.01
1.02
1.06
1.03
3.00
f1 (ppm)

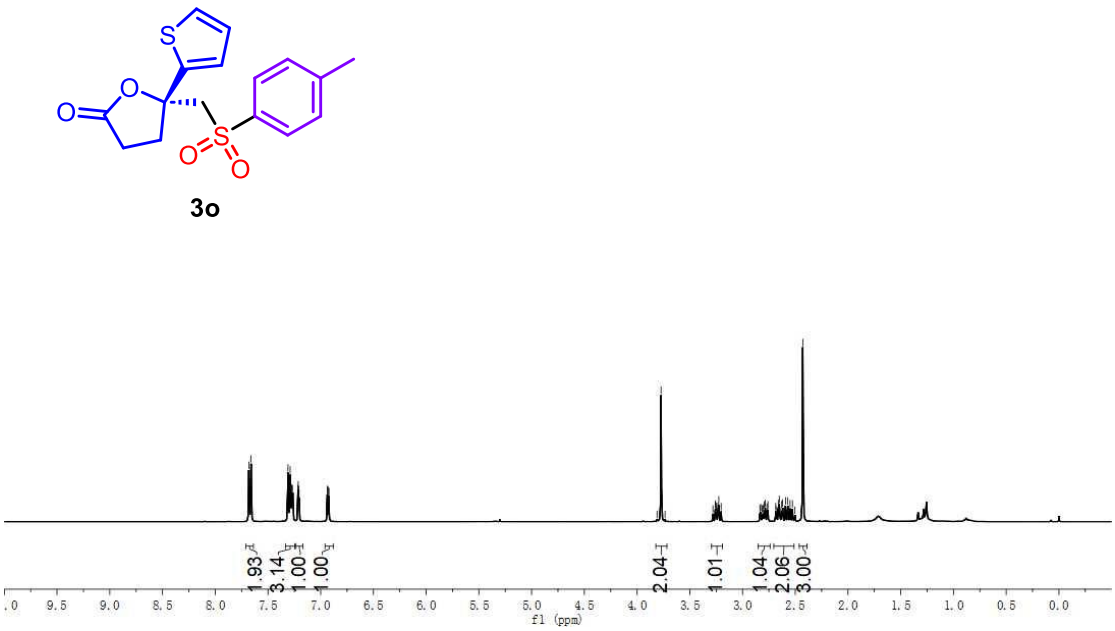

175.05
163.78
161.31
145.12
137.39
137.36
129.91
127.88
126.76
126.68
115.90
115.69
84.39
65.16
32.62
28.21
21.65
f1 (ppm)

F
O
O
O
S
O

3n

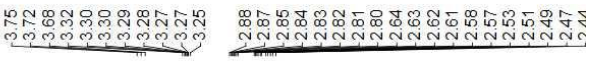

-112.86
-112.88
-112.89
-112.90
-112.91
-112.92
-112.93
F
O
O
S
O
O
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -2
f1 (ppm)
7.68
7.66
7.31
7.29
7.29
7.28
7.27
7.27
7.22
7.21
7.21
7.21
6.94
6.93
6.93
6.92
3.81
3.77
3.73
3.26
3.23
2.84
2.83
2.81
2.80
2.79
2.78
2.77
2.76
2.69
2.68
2.66
2.65
2.63
2.62
2.59
2.57
2.55
2.53

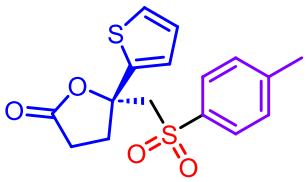
3n


S
O
O
S
O
O
1.93
3.14
1.00
1.00
2.04
1.01
1.04
2.06
3.00
.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

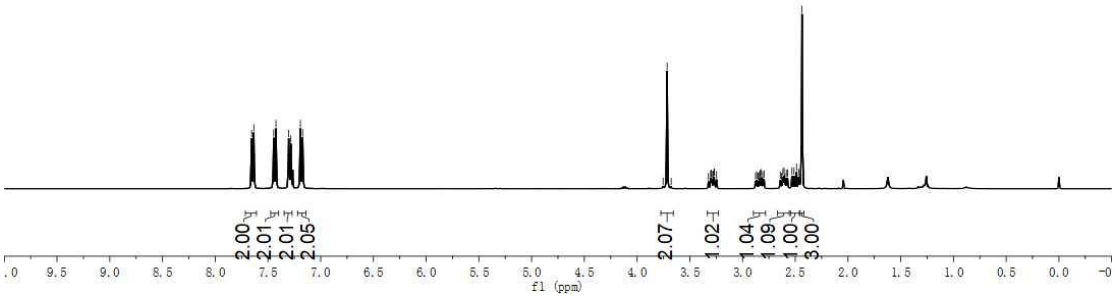
3o


7.65
7.63
7.45
7.42
7.30
7.28
7.19
7.17

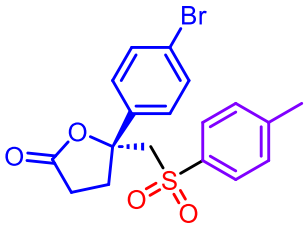

3.75
3.72
3.68
3.32
3.30
3.30
3.29
3.28
3.27
3.27
3.25
2.88
2.87
2.85
2.84
2.83
2.82
2.81
2.80
2.64
2.63
2.62
2.61
2.58
2.57
2.53
2.51
2.49
2.47


S
O
O
O=S=O

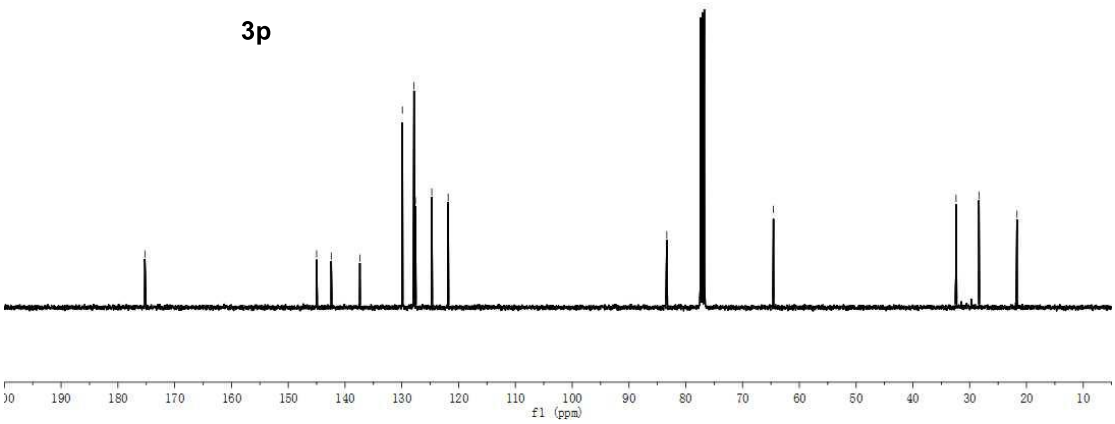
3o

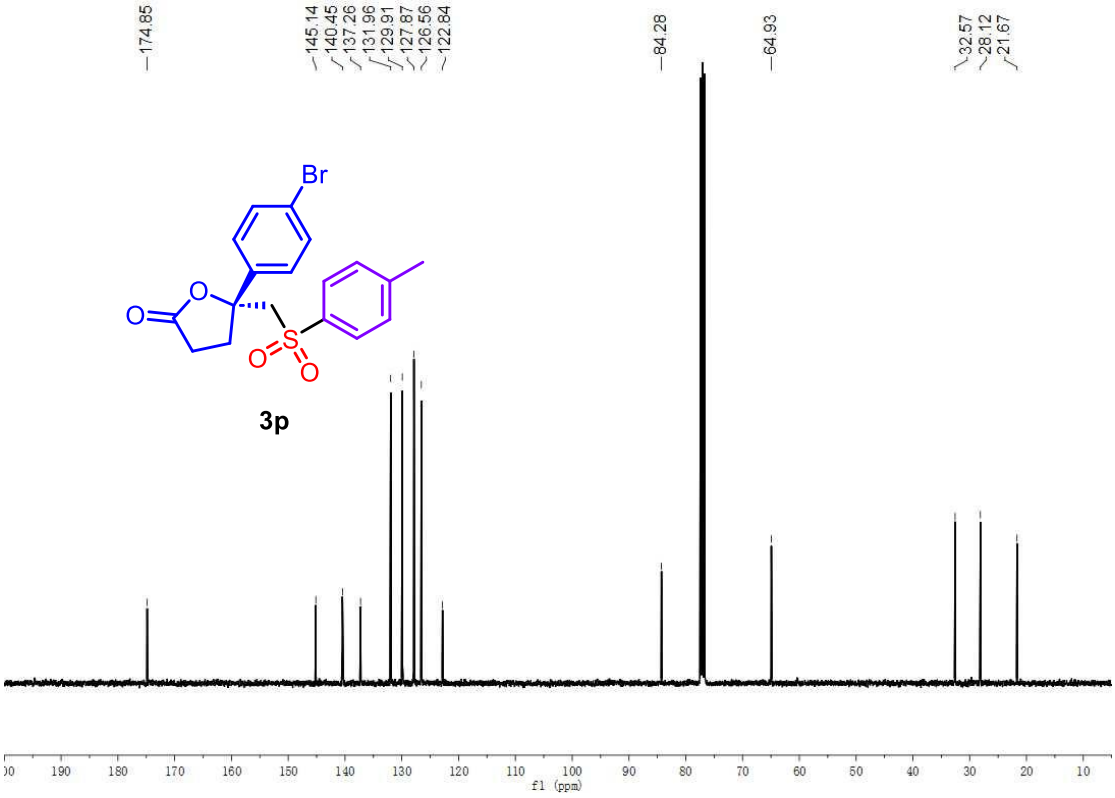

2.00
2.01
2.01
2.05
2.07
1.02
1.04
1.09
1.00
3.00
f1 (ppm)


175.24
145.00
142.43
137.38
129.89
127.86
127.60
124.72
121.84
83.34
64.56
32.40
28.37
21.67

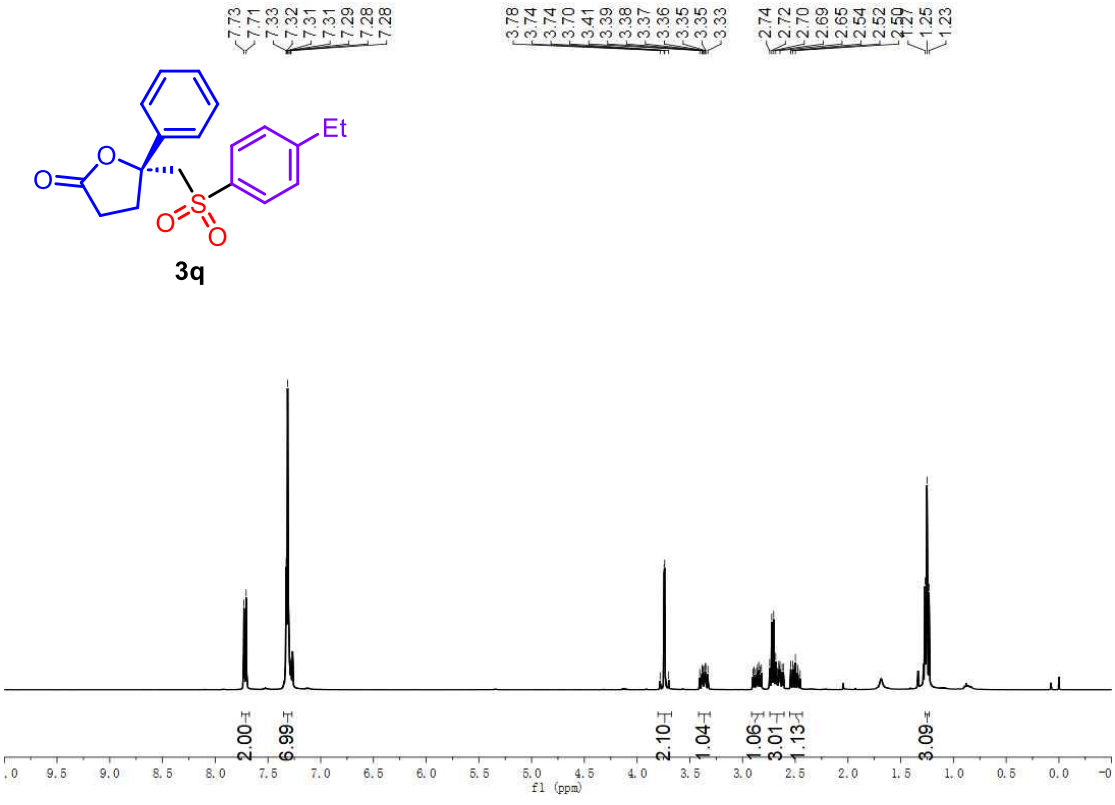

Br
O
O
O=S=O

3p

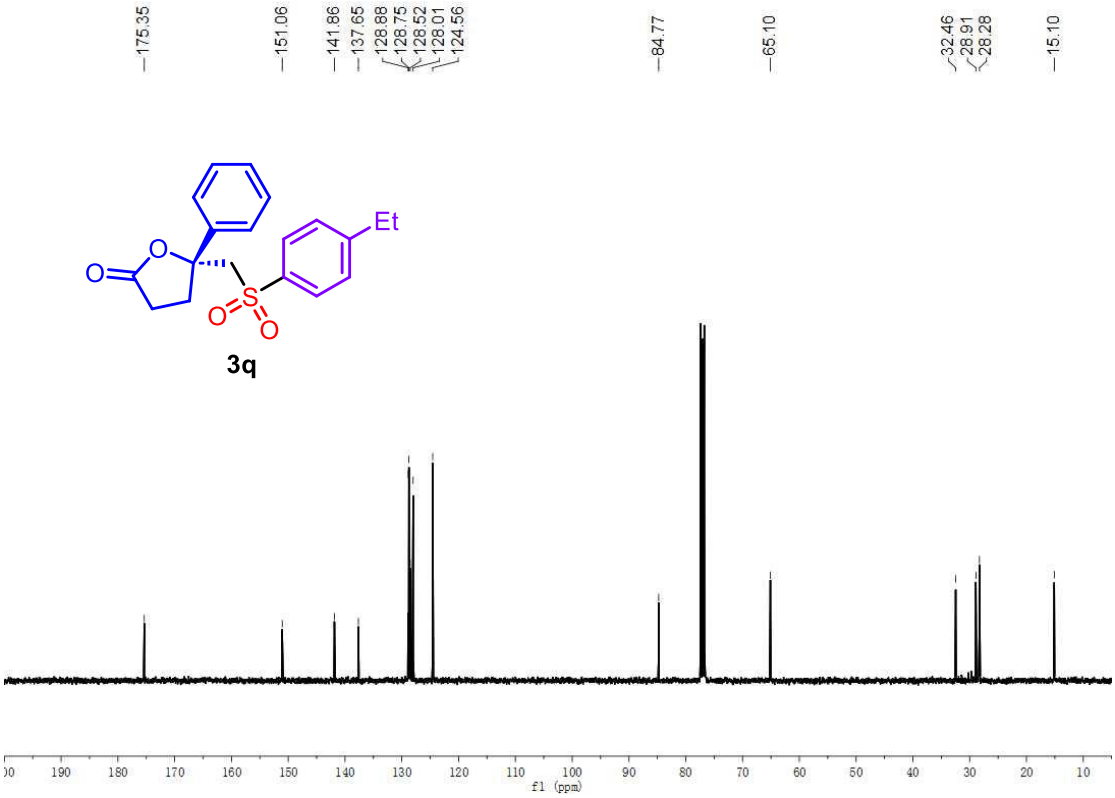

f1 (ppm)


174.85
145.14
140.45
137.26
131.96
129.91
127.87
126.56
122.84
84.28
64.93
32.57
28.12
21.67
Br
O
O
O
S
O
f1 (ppm)

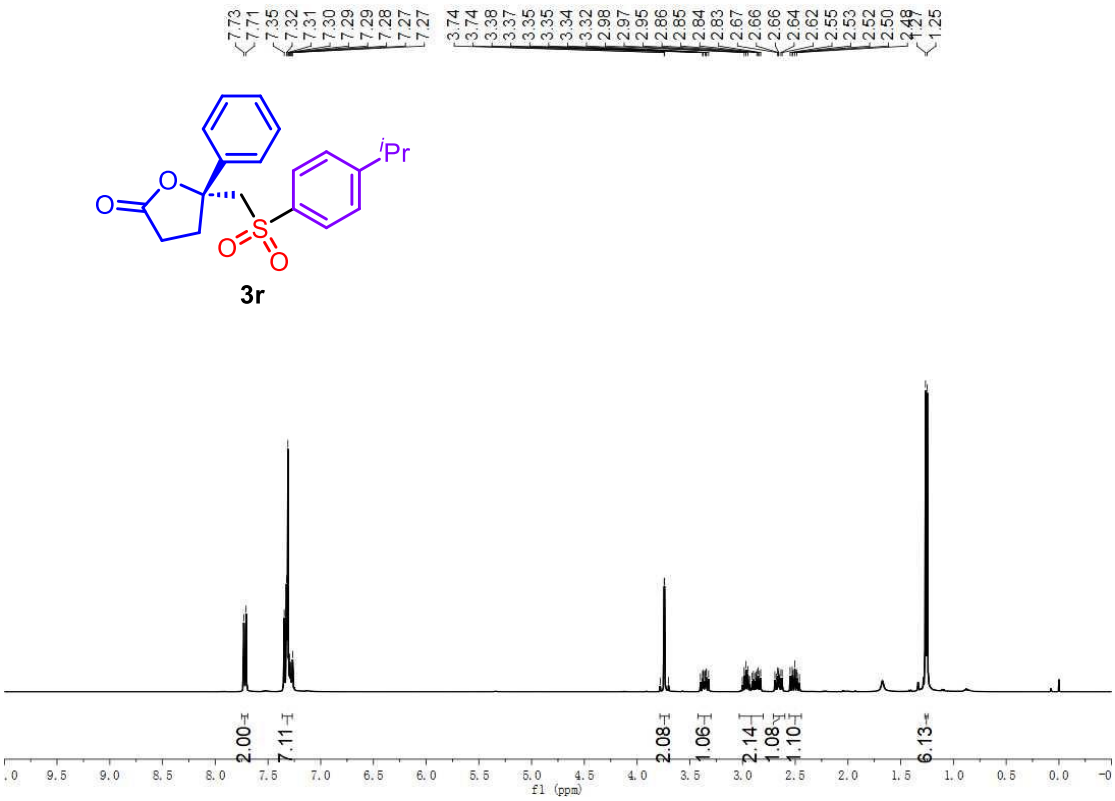
3p


7.73
7.71
7.33
7.32
7.31
7.31
7.29
7.28
7.28
3.78
3.74
3.74
3.70
3.41
3.39
3.38
3.37
3.36
3.35
3.35
3.33
2.74
2.72
2.70
2.69
2.65
2.54
2.52
2.50
1.25
1.23
Et
O
O
O
S
O
2.00
6.99
2.10
1.04
1.06
3.01
1.13
3.09
f1 (ppm)

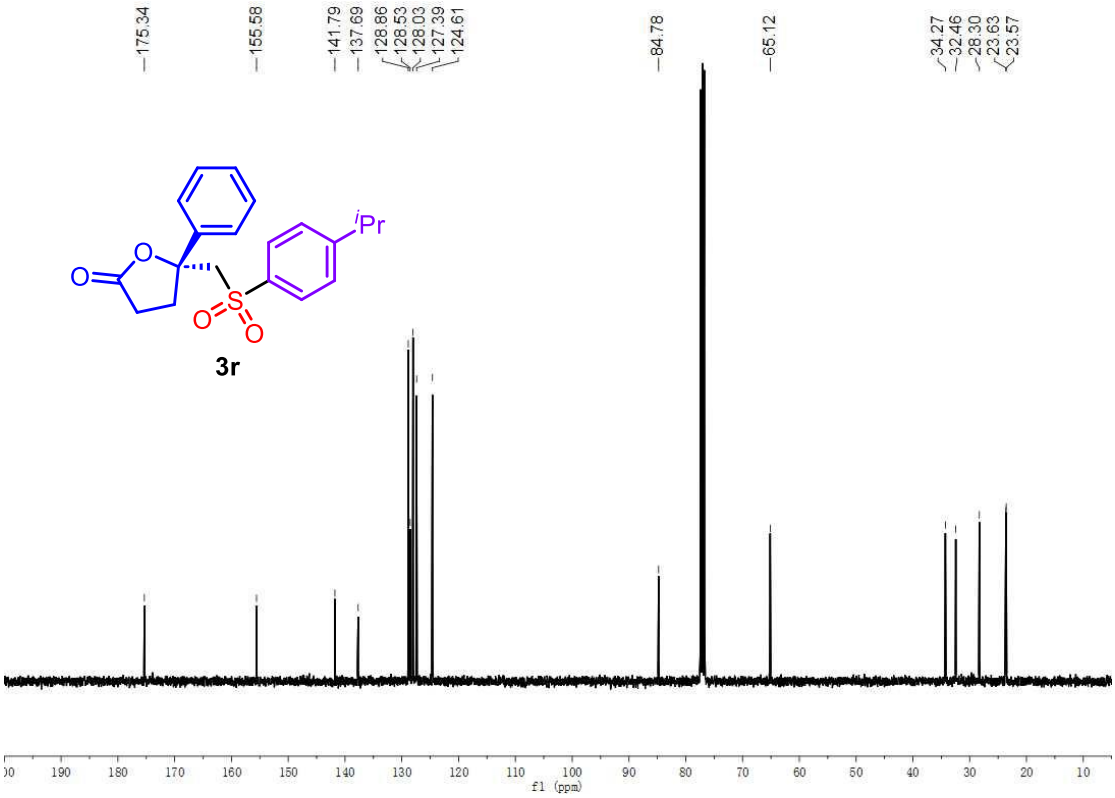
3q


175.35
151.06
141.86
137.65
128.88
128.75
128.52
128.01
124.56
84.77
65.10
32.46
28.91
28.28
15.10
Et
O
O
O
S
O
f1 (ppm)

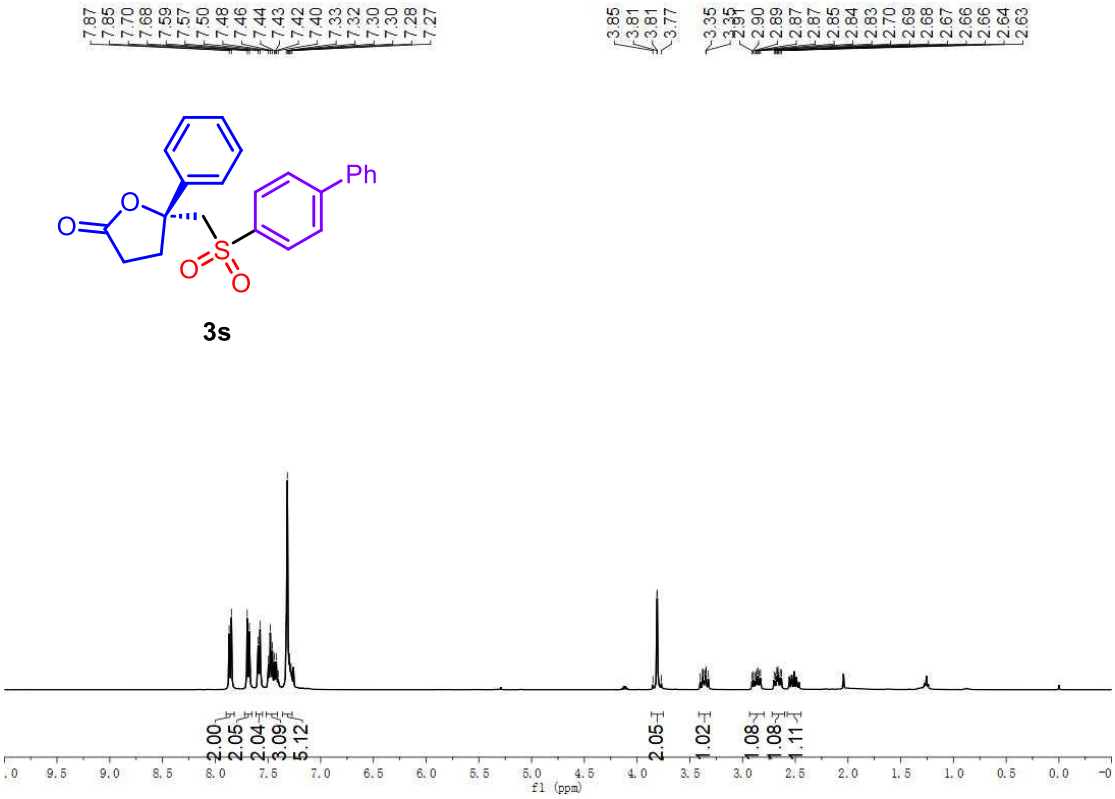
3q


7.73
7.71
7.35
7.32
7.31
7.30
7.29
7.29
7.28
7.27
7.27
3.74
3.74
3.38
3.37
3.35
3.35
3.34
3.32
2.98
2.97
2.95
2.86
2.85
2.84
2.83
2.67
2.66
2.66
2.64
2.62
2.55
2.53
2.52
2.50
1.27
1.25
iPr
O
O
O
S
O
2.00
7.11
2.08
1.06
2.14
1.08
1.10
6.13
f1 (ppm)

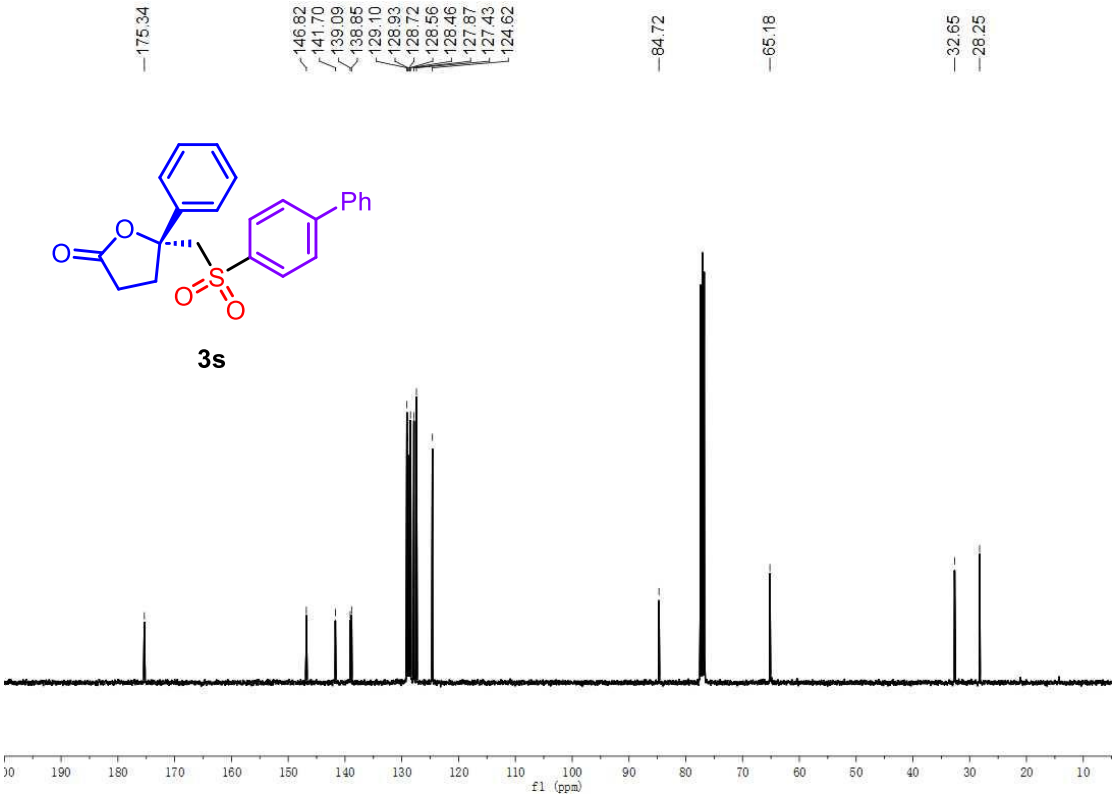
3r


175.34
155.58
141.79
137.69
128.86
128.53
128.03
127.39
124.61
84.78
65.12
34.27
32.46
28.30
23.63
23.57
iPr
O
O
O
S
O
f1 (ppm)

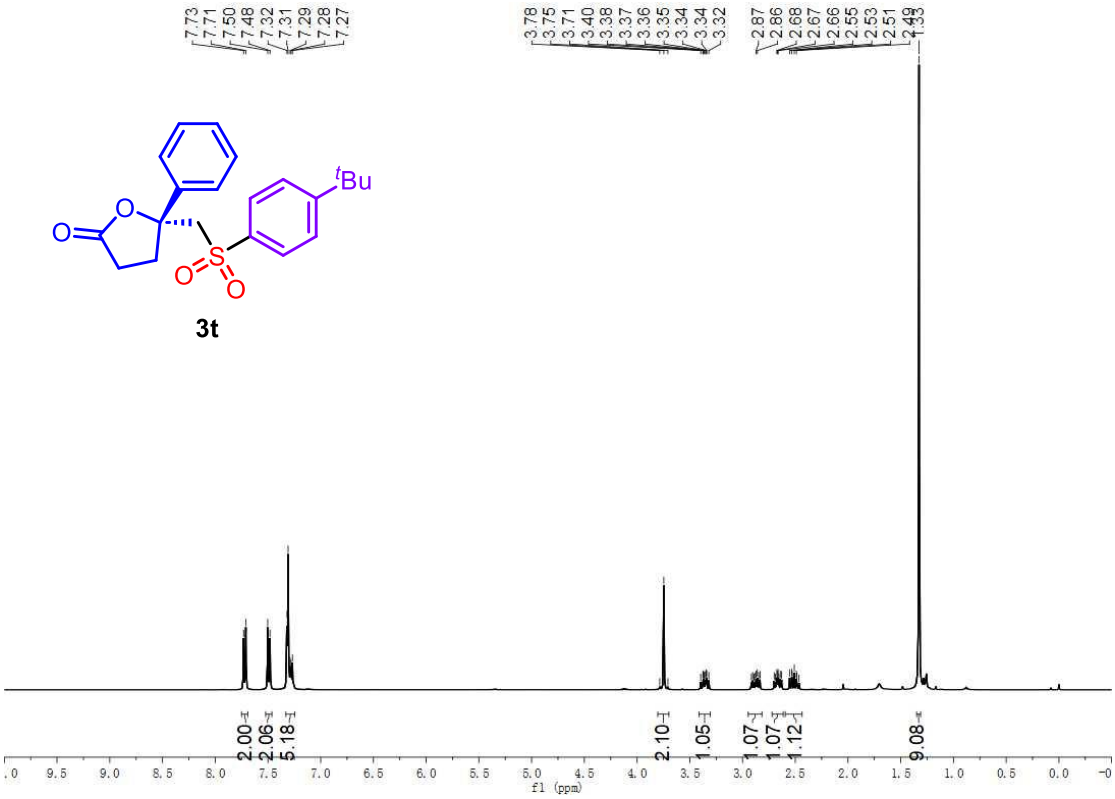
3r


7.87
7.85
7.70
7.68
7.59
7.57
7.50
7.48
7.46
7.44
7.43
7.42
7.40
7.33
7.32
7.30
7.30
7.28
7.27
3.85
3.81
3.81
3.77
3.35
3.35
2.91
2.90
2.89
2.87
2.87
2.85
2.84
2.83
2.70
2.69
2.68
2.67
2.66
2.66
2.64
2.63
Ph
O
O
O
S
O
2.00
2.05
2.04
3.09
5.12
2.05
1.02
1.08
1.08
1.11
f1 (ppm)

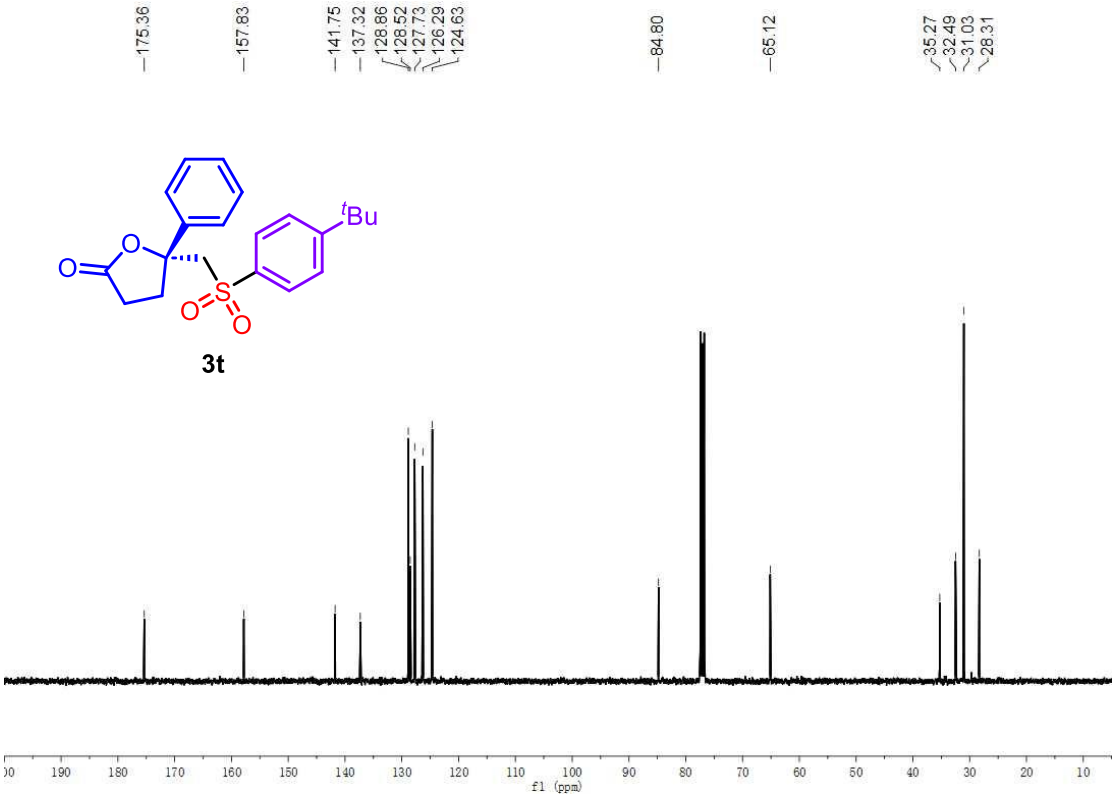
3s


175.34
146.82
141.70
139.09
138.85
129.10
128.93
128.72
128.56
128.46
127.87
127.43
124.62
84.72
65.18
32.65
28.25
Ph
O
O
O
S
O
f1 (ppm)

3s


7.73
7.71
7.50
7.48
7.32
7.31
7.29
7.28
7.27
3.78
3.75
3.71
3.40
3.38
3.37
3.36
3.35
3.34
3.34
3.32
2.87
2.86
2.68
2.67
2.66
2.55
2.53
2.51
1.33
tBu
O
O
O
S
O
2.00
2.06
5.18
2.10
1.05
1.07
1.07
1.12
9.08
f1 (ppm)

3t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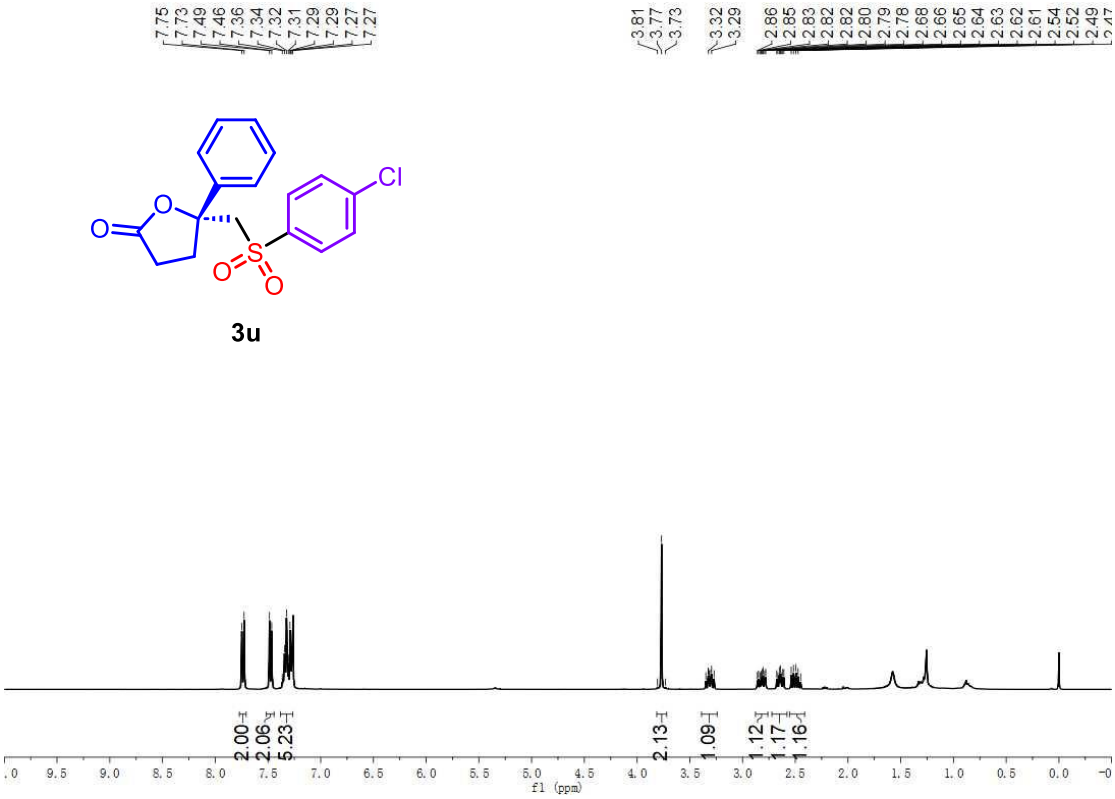
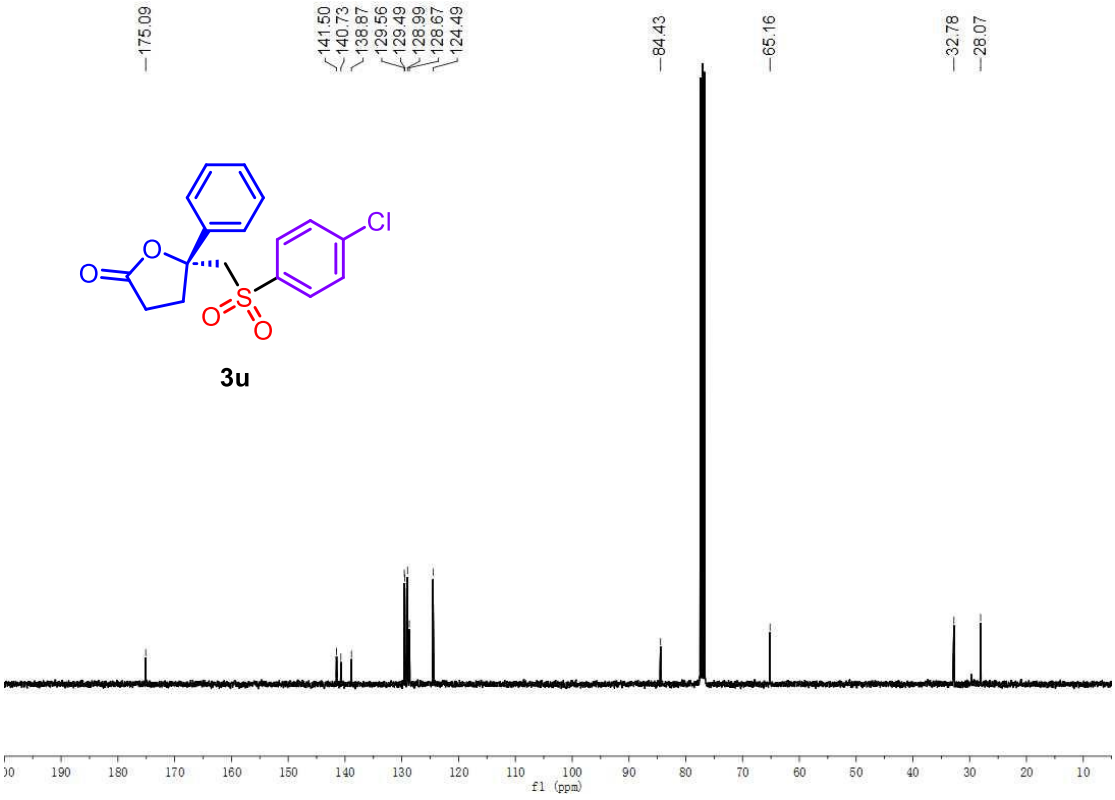
157.83
141.75
137.32
128.86
128.52
127.73
126.29
124.63
84.80
65.12
35.27
32.49
31.03
28.31
tBu
O
O
O
S
O
f1 (ppm)

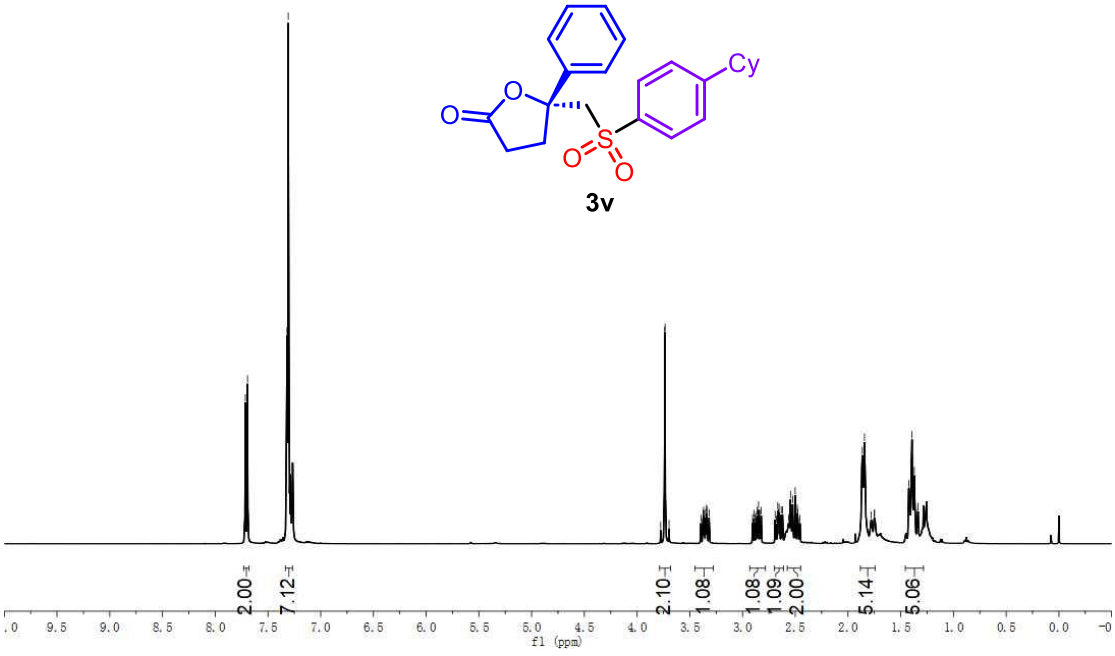
3t


7.75
7.73
7.49
7.46
7.36
7.34
7.32
7.31
7.29
7.29
7.27
7.27
3.81
3.77
3.73
3.32
3.29
2.86
2.85
2.83
2.82
2.82
2.80
2.79
2.78
2.68
2.66
2.65
2.64
2.63
2.62
2.61
2.54
2.52
2.49
Cl
O
O
O
S
O
2.00
2.06
5.23
2.13
1.09
1.12
1.17
1.16
f1 (ppm)

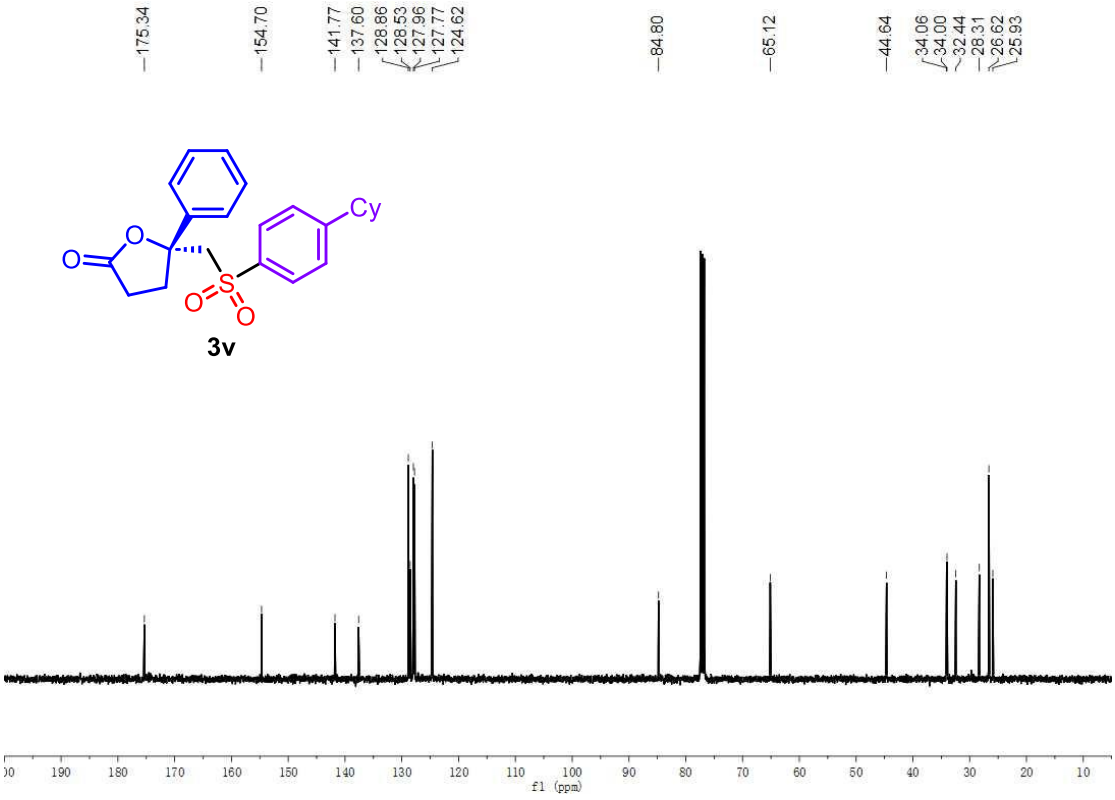
3u


175.09
141.50
140.73
138.87
129.56
129.49
128.99
128.67
124.49
84.43
65.16
32.78
28.07
Cl
O
O
O
S
O
f1 (ppm)

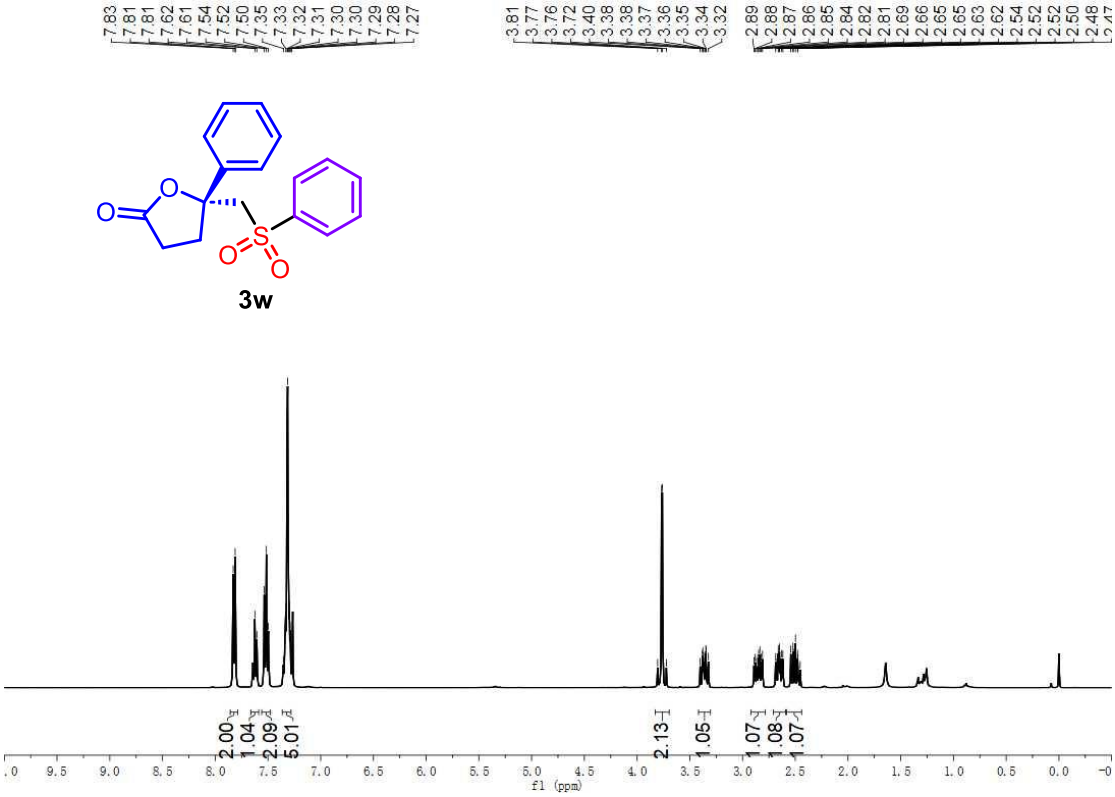
3u


Cy
O
O
O
S
O
2.00
7.12
2.10
1.08
1.08
1.09
2.00
5.14
5.06
f1 (ppm)

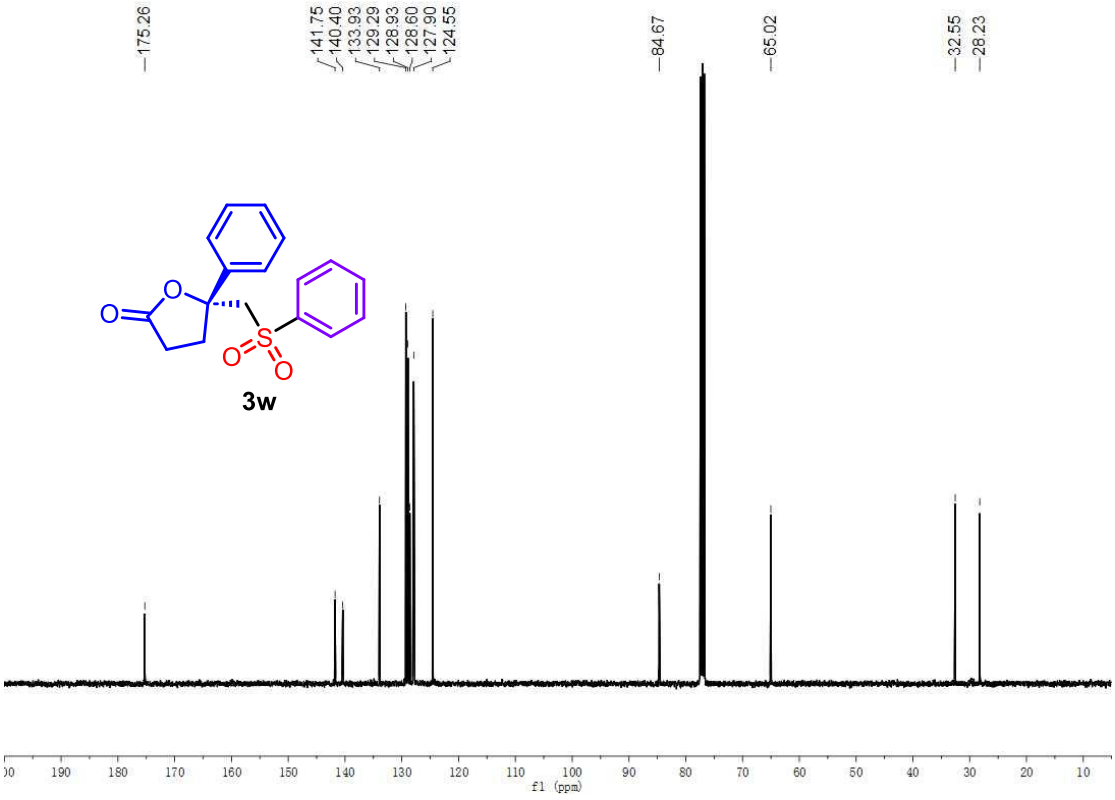
3v


175.34
154.70
141.77
137.60
128.86
128.53
127.96
127.77
124.62
84.80
65.12
44.64
34.06
34.00
32.44
28.31
26.62
25.93
Cy
O
O
O
S
O
f1 (ppm)

3v


7.83
7.81
7.81
7.62
7.61
7.54
7.52
7.50
7.35
7.33
7.32
7.31
7.30
7.30
7.29
7.28
7.27
3.81
3.77
3.76
3.72
3.40
3.38
3.38
3.37
3.36
3.35
3.34
3.32
2.89
2.88
2.87
2.86
2.85
2.84
2.82
2.81
2.69
2.66
2.65
2.65
2.63
2.62
2.54
2.52
2.52
2.50
2.48
O
O
O
S
O
2.00
1.04
2.09
5.01
2.13
1.05
1.07
1.08
1.07
f1 (ppm)

3w


175.26
141.75
140.40
133.93
129.29
128.93
128.60
127.90
124.55
84.67
65.02
32.55
28.23
f1 (ppm)

3w


7.75
7.73
7.36
7.34
7.34
7.32
7.31
7.30
7.30
7.29
7.28
7.27
6.97
6.95
3.87
3.77
3.73
3.72
3.69
3.40
3.38
3.38
3.37
3.36
3.35
3.33
2.89
2.88
2.86
2.85
2.85
2.83
2.82
2.81
2.66
2.65
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2.63
2.62
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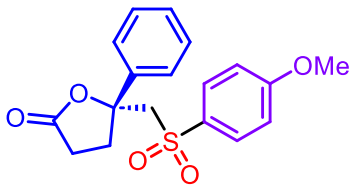
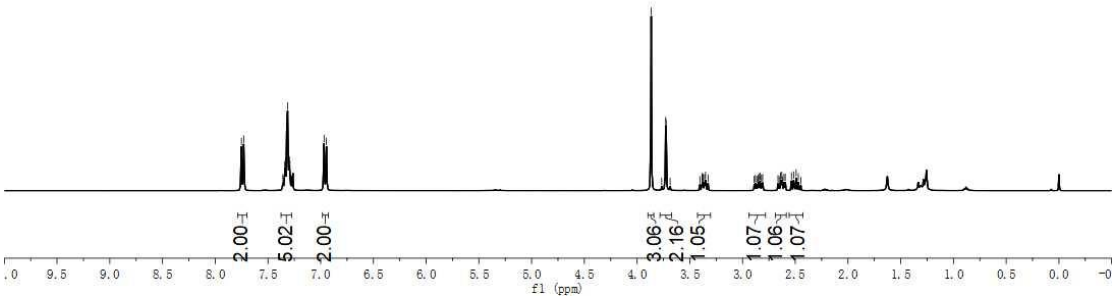
2.60
2.54
2.52
2.49
2.47
2.45


OMe

3x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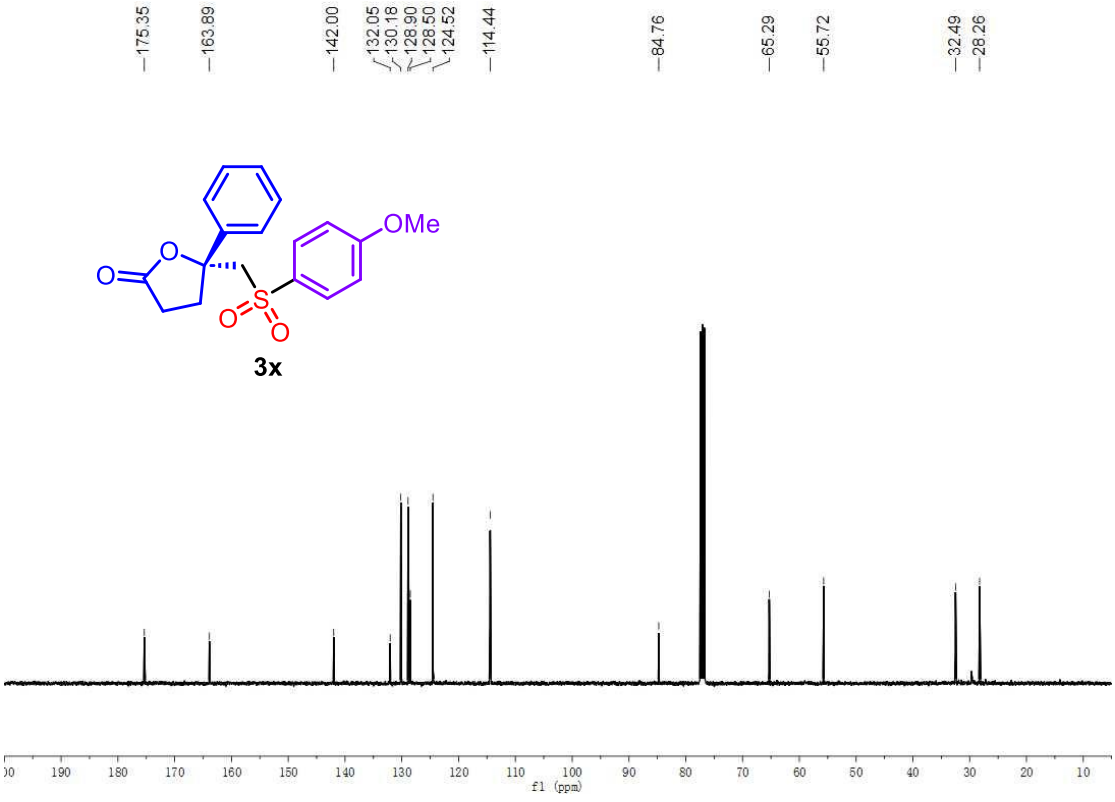
5.02
2.00
3.06
2.16
1.05
1.07
1.06
1.07
f1 (ppm)

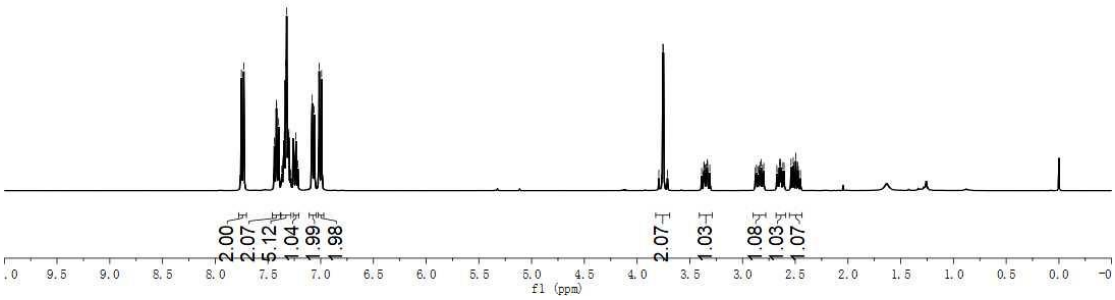

175.35
163.89
142.00
132.05
130.18
128.90
128.50
124.52
114.44
84.76
65.29
55.72
32.49
28.26
OMe
O
O
O
S
O
f1 (ppm)

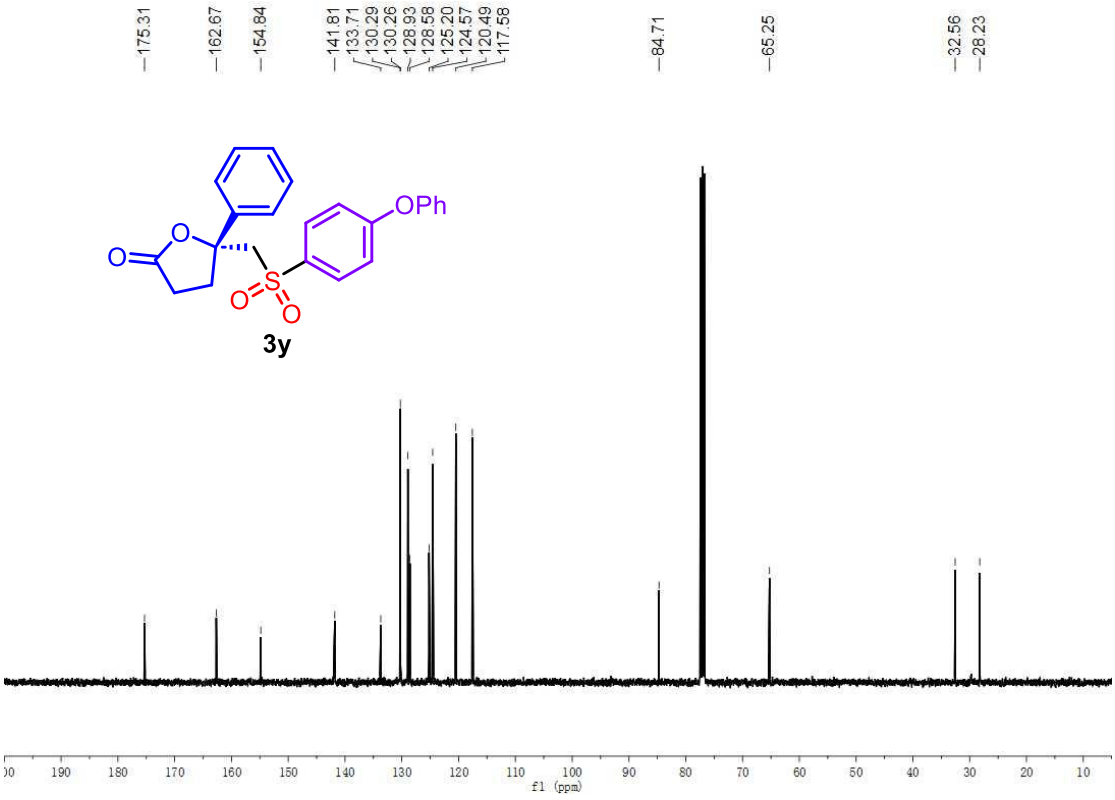
3x

7.75
7.73
7.44
7.43
7.42
7.40
7.37
7.35
7.33
7.32
7.31
7.30
7.25
7.24
7.22
7.08
7.06
7.01
7.00
6.99
3.76
3.75
3.37
3.36
3.34
3.33
3.31
2.88
2.87
2.85
2.84
2.83
2.82
2.81
2.80
2.67
2.65
2.64
2.62
2.61
2.54
2.52
2.50
2.48
2.47

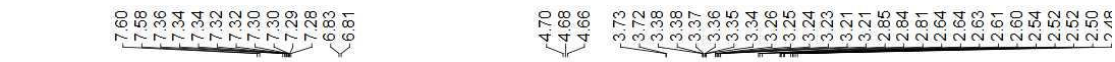

OPh
O
O
O
S
O

3y


2.00
2.07
5.12
1.04
1.99
1.98
2.07
1.03
1.08
1.03
1.07
f1 (ppm)


175.31
162.67
154.84
141.81
133.71
130.29
130.26
128.93
128.58
125.20
124.57
120.49
117.58
84.71
65.25
32.56
28.23
OPh
O
O
O
S
O
f1 (ppm)

3y


7.60
7.58
7.36
7.34
7.34
7.32
7.32
7.30
7.30
7.29
7.28
6.83
6.81
4.70
4.68
4.66
3.73
3.72
3.38
3.38
3.37
3.36
3.35
3.34
3.26
3.25
3.24
3.23
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3.21
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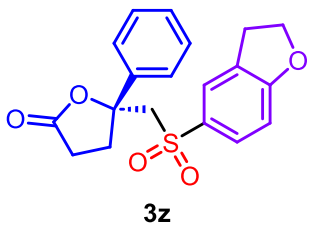
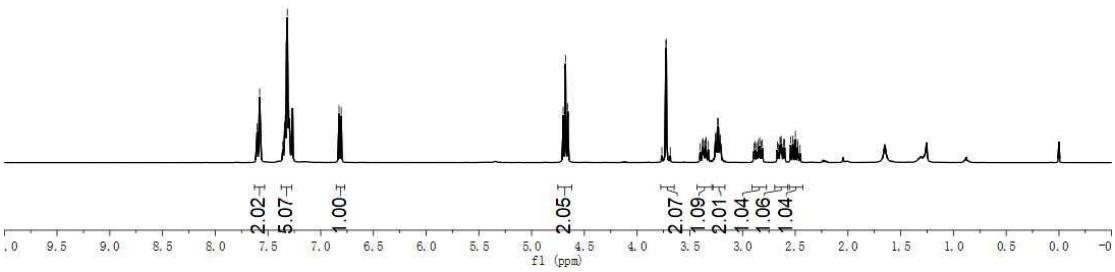
2.52
2.52
2.50


O
O
O
S
O

3z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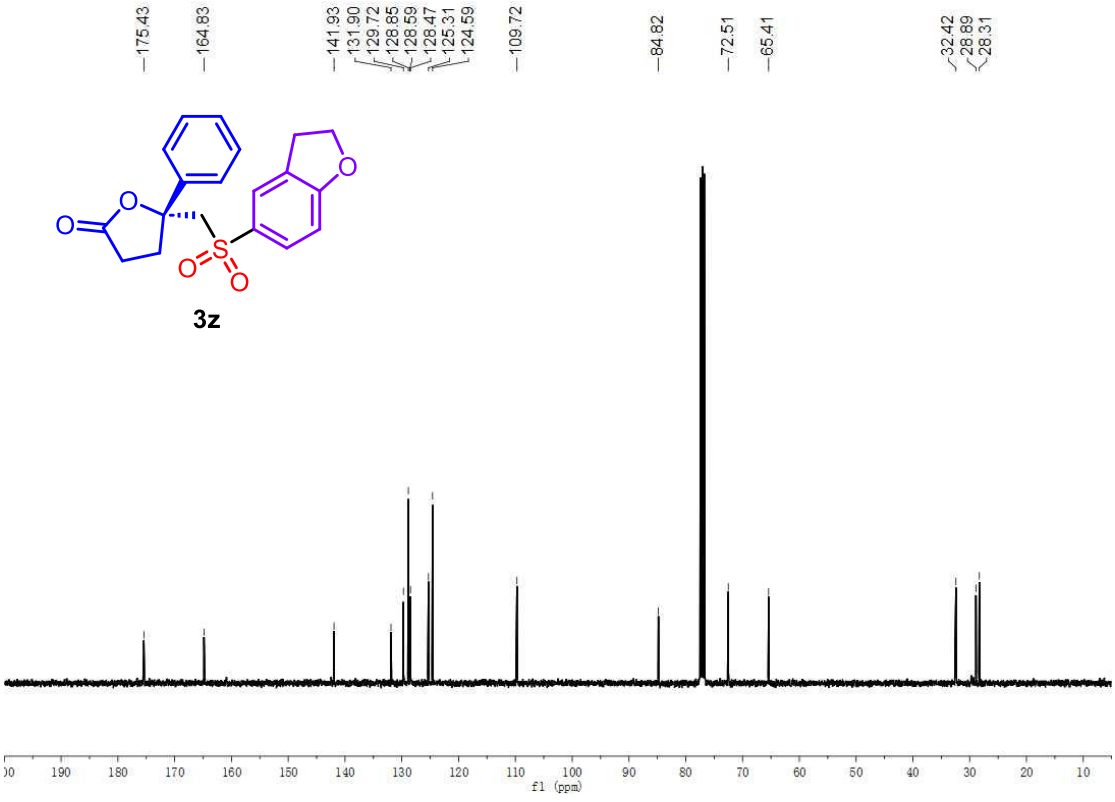
2.07
1.09
2.01
1.04
1.06
1.04
f1 (ppm)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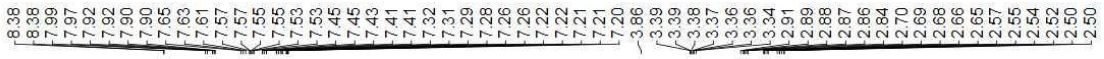
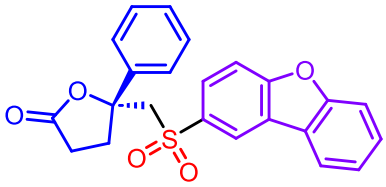
141.93
131.90
129.72
128.85
128.59
128.47
125.31
124.59
109.72
84.82
72.51
65.41
32.42
28.89
28.31
f1 (ppm)

3z





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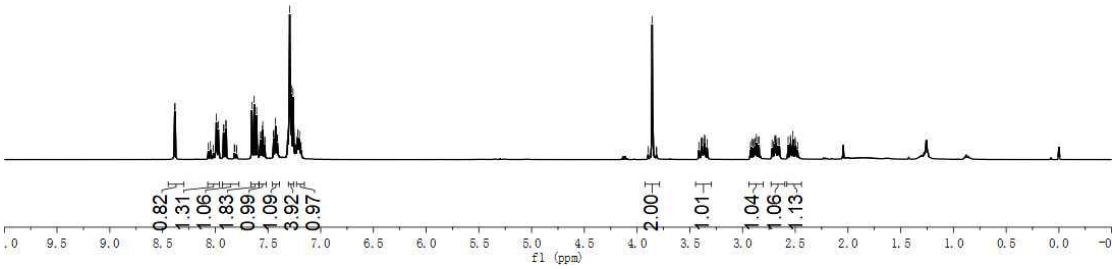
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1.09
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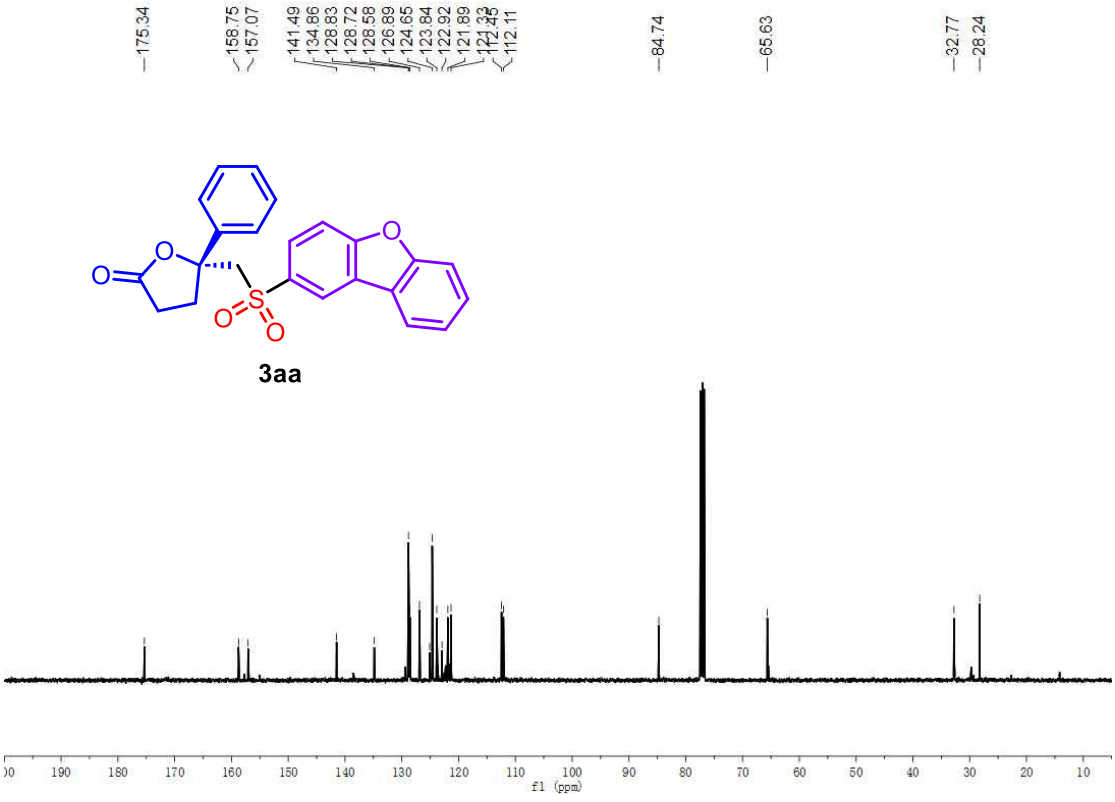
0.97
2.00
1.01
1.04
1.06
1.13
f1 (ppm)


175.34
158.75
157.07
141.49
134.86
128.83
128.72
128.58
126.89
124.65
123.84
122.92
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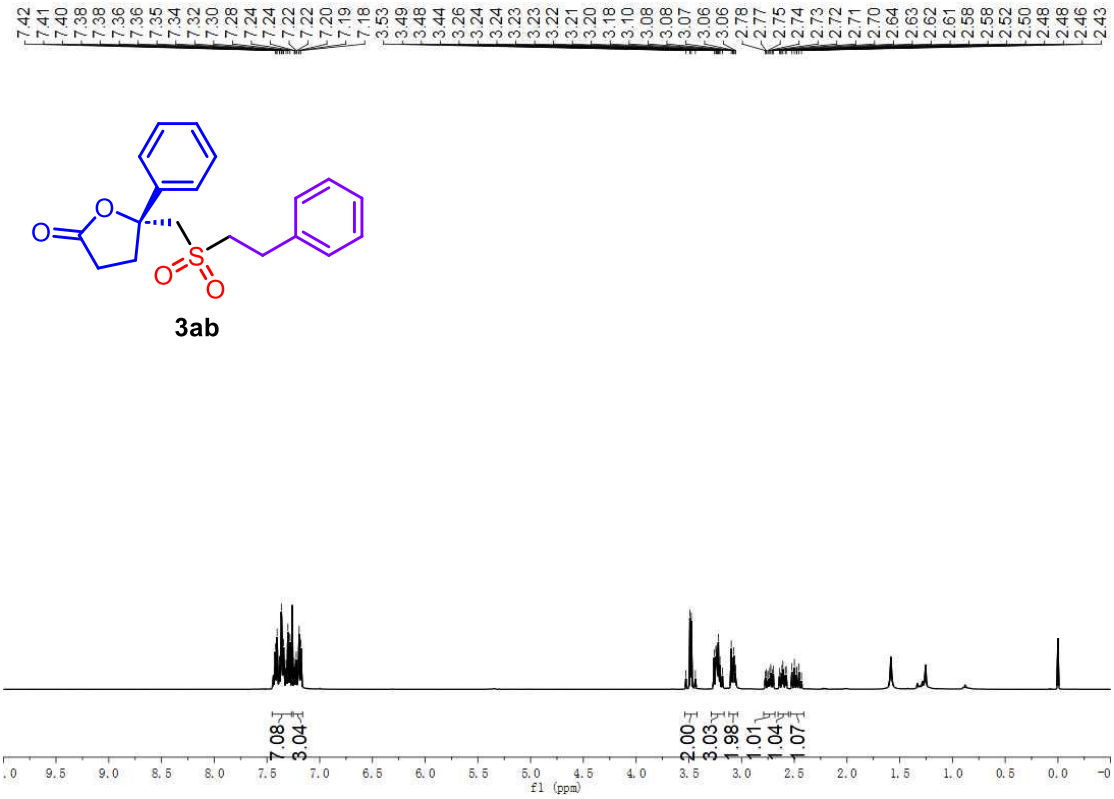
65.63
32.77
28.24
3aa
f1 (ppm)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7.38
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7.35
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7.30
7.28
7.24
7.24
7.22
7.22
7.20
7.19
7.18
3.53
3.49
3.48
3.44
3.26
3.24
3.24
3.23
3.23
3.22
3.21
3.20
3.18
3.10
3.08
3.08
3.07
3.06
3.06
2.78
2.77
2.75
2.74
2.73
2.72
2.71
2.70
2.64
2.63
2.62
2.61
2.58
2.58
2.52
2.50
2.48
2.48
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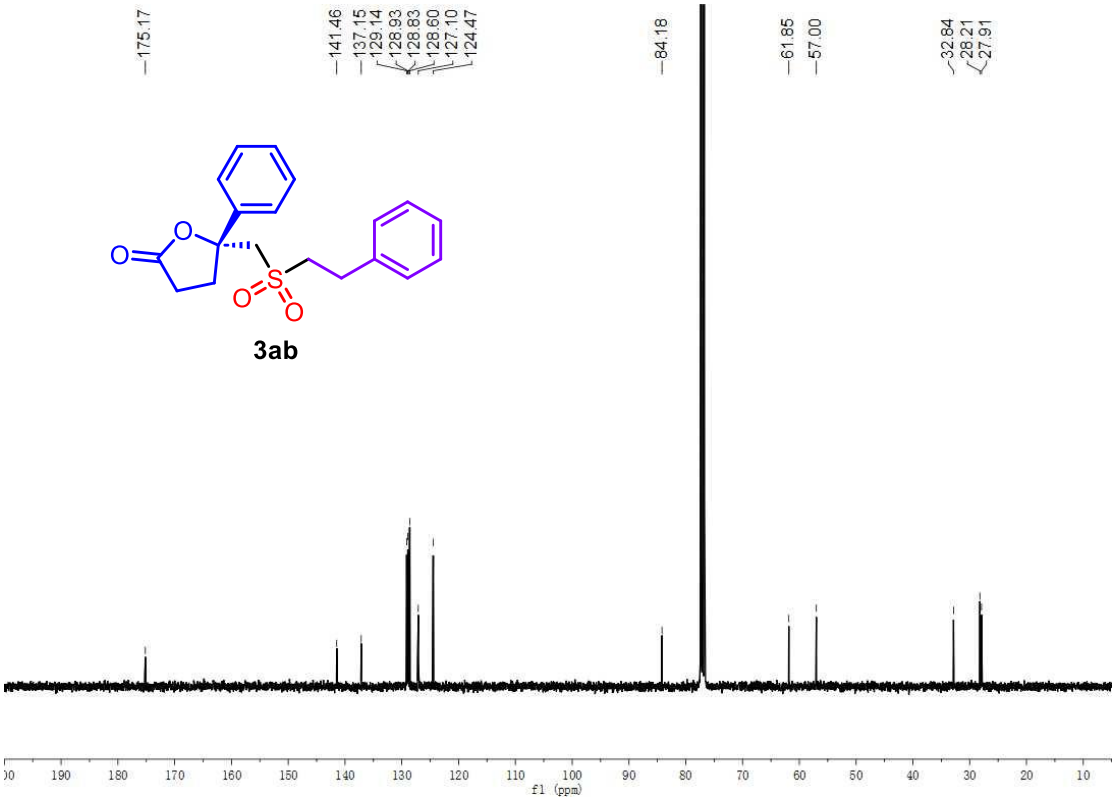
2.43
3ab
7.08
3.04
2.00
3.03
1.98
1.01
1.04
1.07
f1 (ppm)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137.15
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127.10
124.47
84.18
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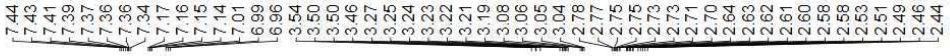
32.84
28.21
27.91
f1 (ppm)

3ab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7.34
7.17
7.16
7.15
7.14
7.01
6.99
6.96
3.54
3.50
3.50
3.46
3.27
3.25
3.24
3.23
3.22
3.21
3.19
3.08
3.06
3.05
3.04
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2.77
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2.75
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2.73
2.71
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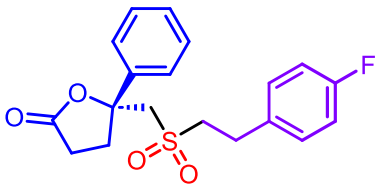
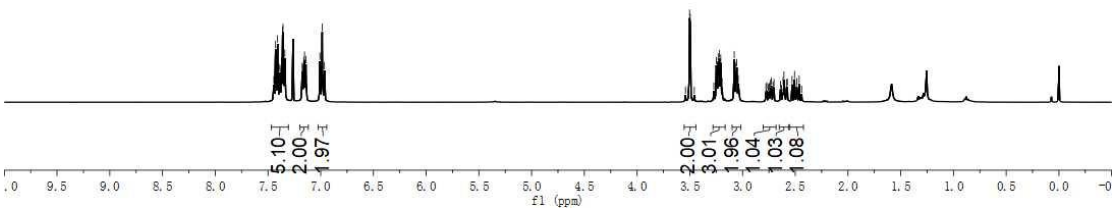
2.49
2.46
2.44


F

3ac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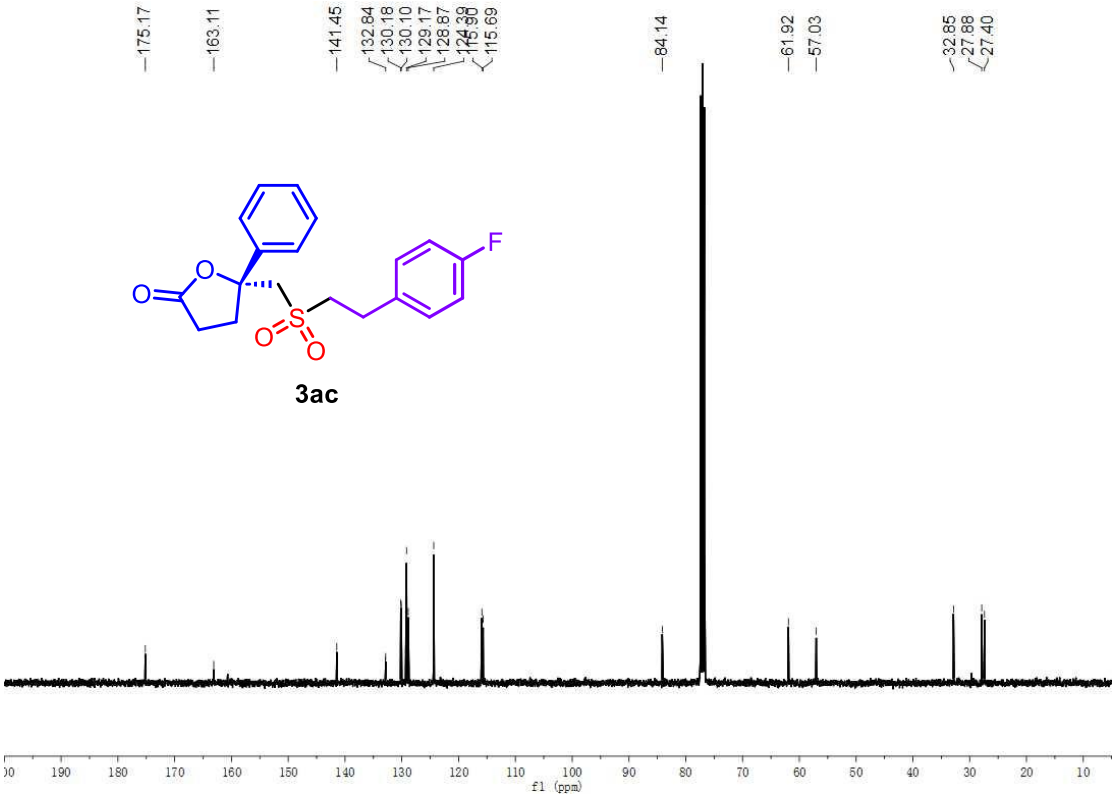
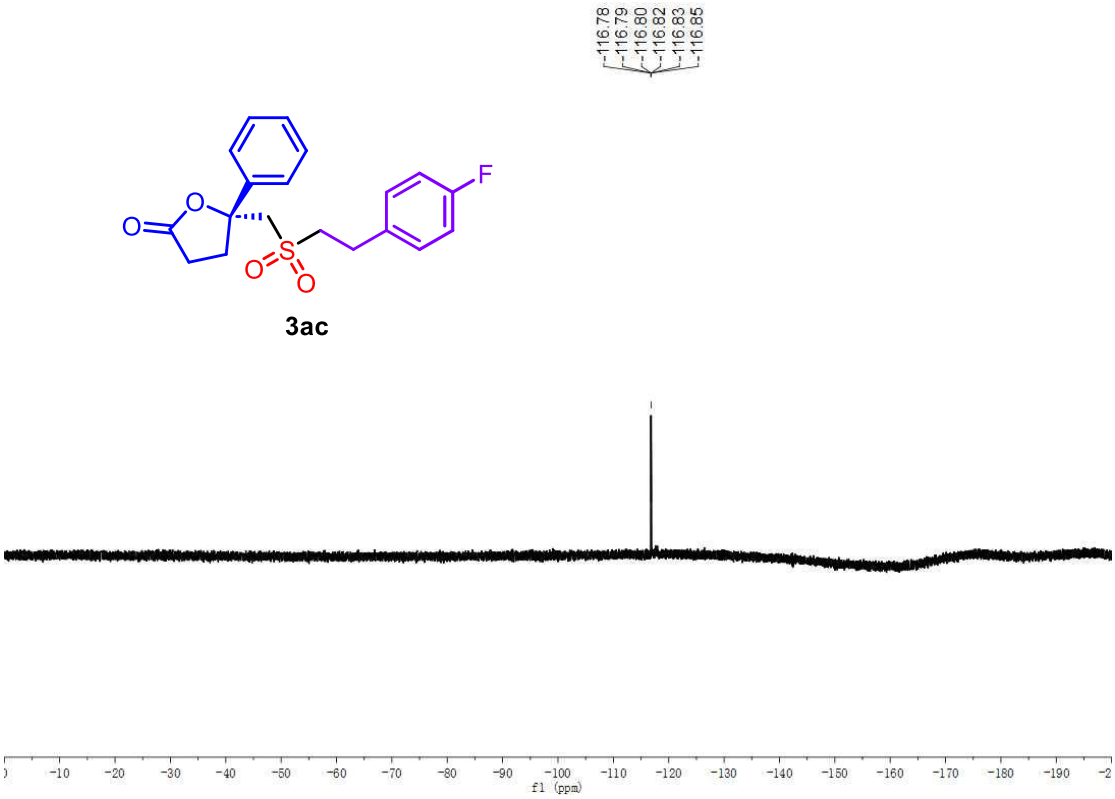
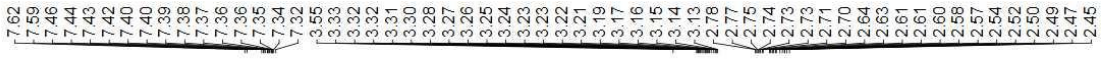
2.00
1.97
2.00
3.01
1.96
1.04
1.03
1.08
f1 (ppm)


175.17
163.11
141.45
132.84
130.18
130.10
129.17
128.87
124.39
115.90
115.69
84.14
61.92
57.03
32.85
27.88
27.40
F
O
O
O
S
O
f1 (ppm)

3ac


116.78
116.79
116.80
116.82
116.83
116.85
F
O
O
O
S
O
f1 (ppm)

3ac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7.39
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3.13
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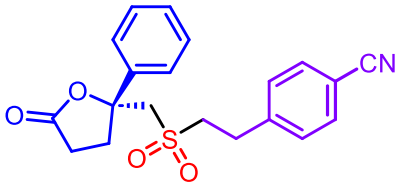
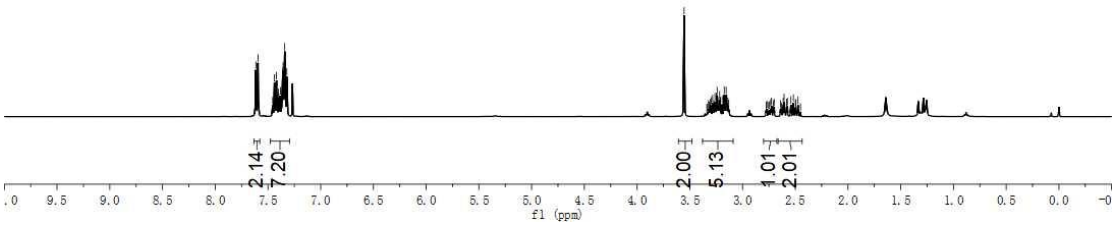
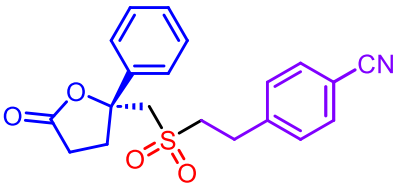
2.45


O
O
O
S
O
CN

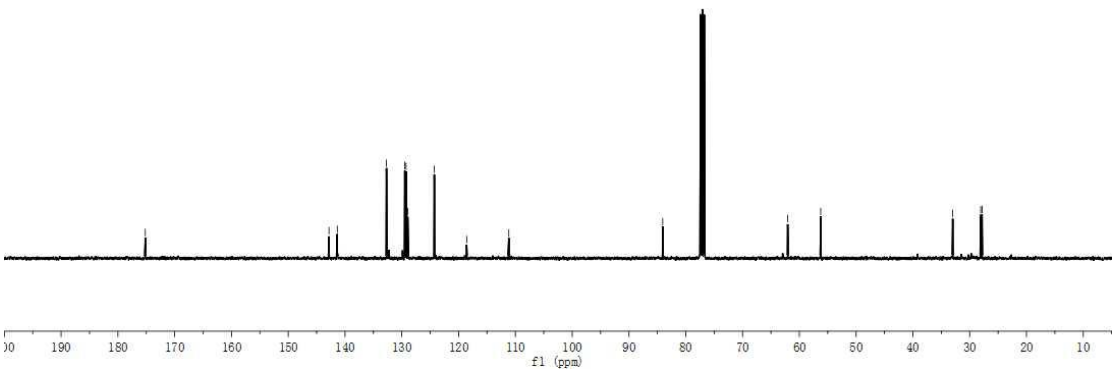
3ad

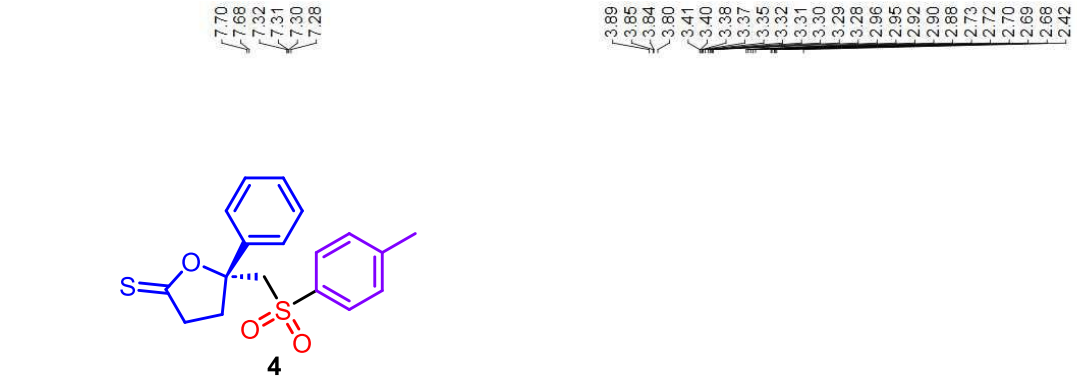

2.14
7.20
2.00
5.13
1.01
2.01
f1 (ppm)


175.17
142.82
141.36
132.71
129.48
129.25
128.96
124.28
118.57
111.16
84.06
62.06
56.23
33.00
28.06
27.82


O
O
O
S
O
CN

3ad


f1 (ppm)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7.28
3.89
3.85
3.84
3.80
3.41
3.40
3.38
3.37
3.35
3.32
3.31
3.30
3.29
3.28
2.96
2.95
2.92
2.90
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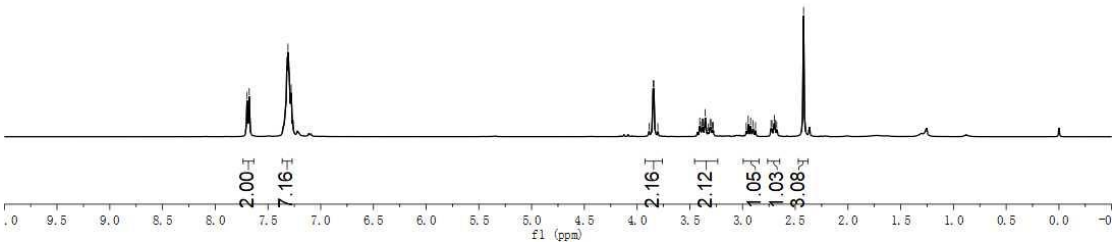
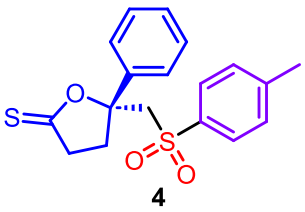
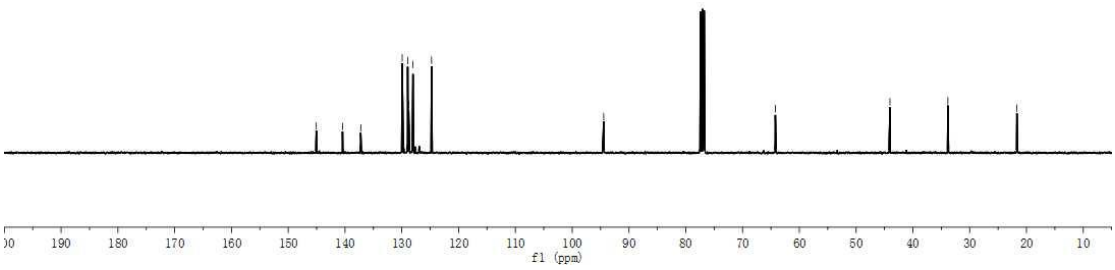
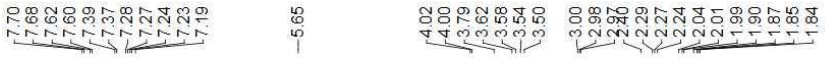
2.73
2.72
2.70
2.69
2.68
2.42
S
O
O
S
O
4


2.00
7.16
2.16
2.12
1.05
1.03
3.08
f1 (ppm)


145.06
140.44
137.22
129.93
128.96
128.79
128.04
124.76
94.45
64.22
44.04
33.84
21.70


S
O
O
S
O
4


f1 (ppm)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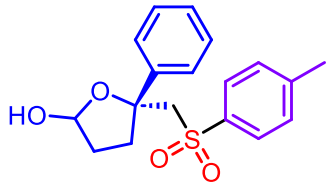
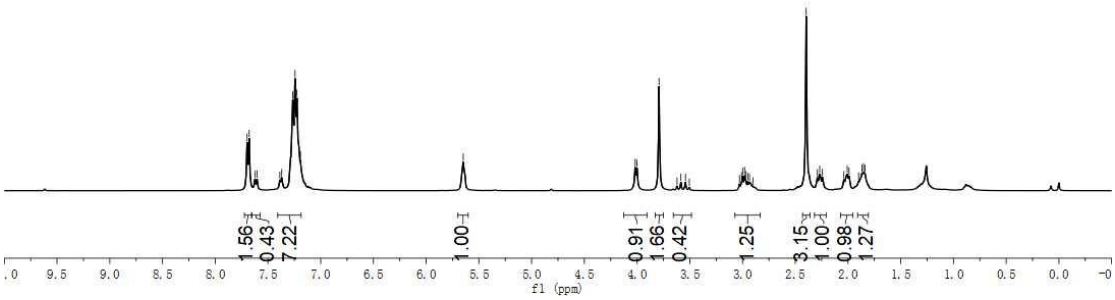
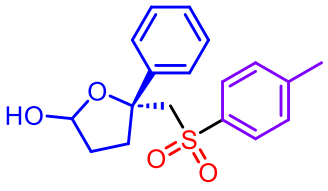
7.68
7.62
7.60
7.39
7.37
7.28
7.27
7.24
7.23
7.19
5.65
4.02
4.00
3.79
3.62
3.58
3.54
3.50
3.00
2.98
2.97
2.40
2.29
2.27
2.24
2.04
2.01
1.99
1.90
1.87
1.85
1.84


HO
O
S
O
O

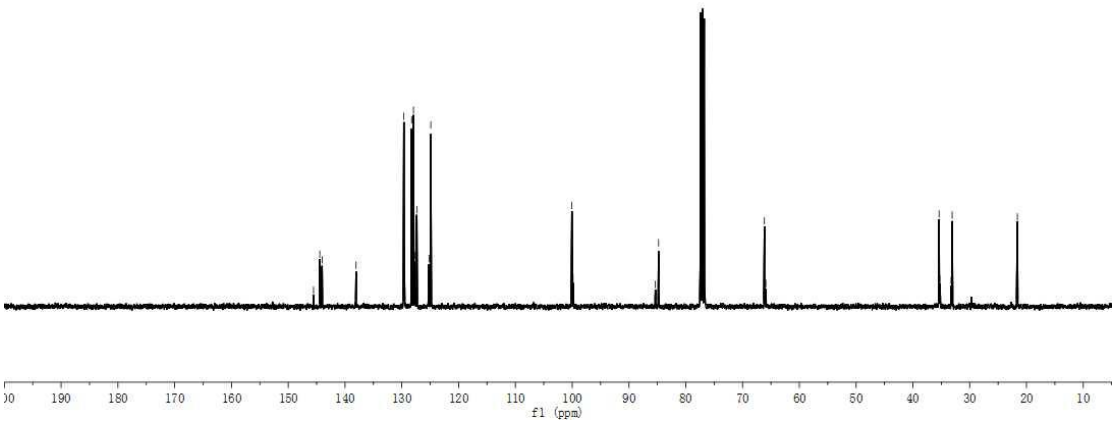
5


1.56
0.43
7.22
1.00
0.91
1.66
0.42
1.25
3.15
1.00
0.98
1.27
f1 (ppm)


145.55
144.45
144.04
138.06
129.64
129.56
128.28
128.23
127.95
127.73
127.36
125.22
124.90
100.05
99.84
85.35
84.78
66.15
65.89
35.39
35.25
33.28
33.09
21.60


HO
O
S
O
O

5


f1 (ppm)

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