Electronic Supplementary Information

Chiral *N*,*N*'-Dioxide-Sc(NTf$_2$)$_3$-Complex-Catalyzed Asymmetric Bromoamination of Chalones with *N*-Bromosuccinimide as Both Bromine and Amide Sources

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Contents:

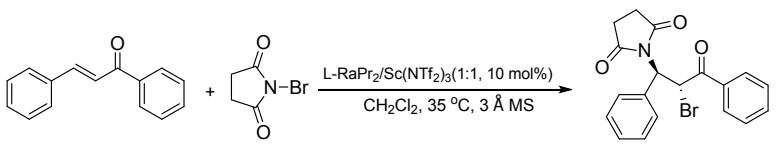
1. General method

^{1}H NMR spectra were recorded on commercial instruments (400 MHz). Chemical shifts were reported in ppm from tetramethylsilane with the solvent resonance as the internal standard ($CDCl_3$, δ = 7.26). Spectra were reported as follows: chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz), integration and assignment. ^{13}C NMR spectra were collected on commercial instruments (100 MHz) with complete proton decoupling. Chemical shifts are reported in ppm from the tetramethylsilane with the solvent resonance as internal standard ($CDCl_3$, δ = 77.0). Reactions were carried out using commercial available reagents in over-dried apparatus. CH_2Cl_2 was dried over powdered CaH_2 and distilled under nitrogen just before use. Enantiomeric excesses (*ee*) were determined by HPLC analysis using the corresponding commercial chiral column as stated in the experimental procedures at 25 ^{0}C with UV detector at 254 nm. Diastereoselectivity (dr) was determined by ^{1}H NMR spectra. HRMS was recorded on a commercial apparatus (ESI Source) and $^{78.9183}$Br and $^{80.9163}$Br were chosen as references to calculate the exact mass. Chiral *N*,*N*′-dioxide ligand were prepared using literature method[1]. Optical rotations were reported at indicated wavelength as follows: $[\alpha]^{T}_{D}$ = (c g/100mL, in solvent). NBS and NCS were recrystallized from acetone and petroleum ether.

2. General procedure of the catalytic reactions

L-RaPr$_2$ (7.0 mg, 0.01 mmol), $Sc(NTf_2)_3$ (8.8 mg, 0.01 mmol), 3 Å molecular sieve (40 mg) and chalone analogs (0.10 mmol) were added to an over-dried reaction tube under nitrogen atmosphere. 0.3 mL Anhydrous CH_2Cl_2 was added and the solution was stirred at 35 °C for 30 minutes. Subsequently, NBS **2** (0.12 mmol) was added and the reaction mixture continued stirring for 36-48 hours. The products were purified by a flash chromatography on silica gel (petroleum ether/ethyl acetate = 4:1-2:1).

3. Gram scale experiment



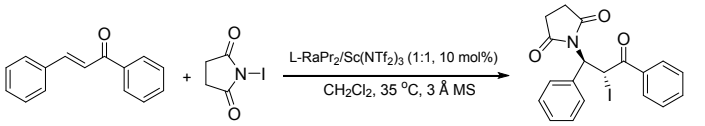
3 mmol
0.62g
1a

3.6 mmol
0.65g
2

1.04g
90% yield, 91:9 dr, 90% ee
3a

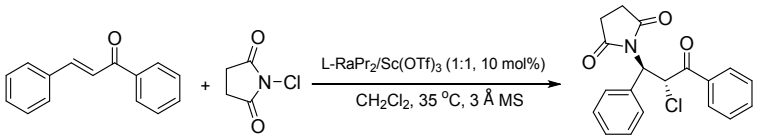
To a dry round-bottom flask, **L-RaPr$_2$** (210 mg, 0.30 mmol), Sc(NTf$_2$)$_3$ (264 mg, 0.30 mmol), 3 Å molecular sieve (600 mg) and chalone (624 mg, 3.0 mmol) were added under nitrogen atmosphere. 6.0 mL Anhydrous CH_2Cl_2 was added and the solution was stirred at 35 °C for 30 minutes. Next, NBS **2** (650 mg, 3.6 mmol) was added and the reaction mixture continued stirring for 40 hours at 35 °C. The residue was purified by a flash chromatography on silica gel (petroleum ether/ethyl acetate = 4:1-2:1) to afford the product **3a** in 1.04 g with 90% yield, 90% ee, and 91:9 dr.

4. The asymmetric haloaminaton of chalone with *N*-iodosuccinimide and *N*-chlorosuccinimide as both halogen and amide sources



1a — 75% yield, 96:4 dr, 73% ee — **4a**

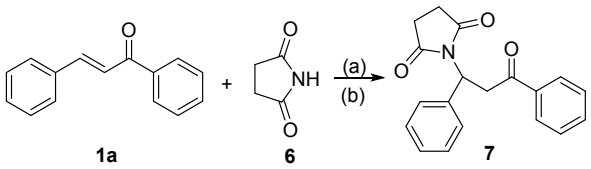
L-RaPr$_2$ (7.0 mg, 0.01 mmol), Sc(NTf$_2$)$_3$ (8.8 mg, 0.01 mmol), 3 Å molecular sieve (40 mg) and chalone **1a** (20.8 mg, 0.10 mmol) were added to an over-dried reaction tube under nitrogen atmosphere. 0.3 mL Anhydrous CH_2Cl_2 was added and the solution was stirred at 35 °C for 30 minutes. Then, NIS (26.9 mg, 0.12 mmol) was added and the reaction mixture continued stirring for 36 hours at 35 °C. The residue was purified by a flash chromatography on silica gel (petroleum ether/ethyl acetate = 4:1-2:1) to afford the product **4a** in 32.5 mg with 75% yield, 96:4 dr and 73% ee.



1a — 68% yield, 85:15 dr, 69% ee — **5a**

L-RaPr$_2$ (7.0 mg, 0.01 mmol), Sc(OTf)$_3$ (4.9 mg, 0.01 mmol), 3 Å molecular sieve (40 mg) and chalone **1a** (20.8 mg, 0.10 mmol) were added to an over-dried reaction tube under nitrogen atmosphere. 0.3 mL Anhydrous CH_2Cl_2 was added and the solution was stirred at 35 °C for 30 minutes. Then, NCS (16.0 mg, 0.12 mmol) was added and the reaction mixture continued stirring for 36 hours at 35 °C. The residue was purified by a flash chromatography on silica gel (petroleum ether/ethyl acetate = 4:1-2:1) to afford the product **5a** in 23.2 mg with 68% yield, 85:15 dr and 69% ee.

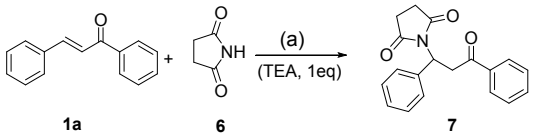
5. Control experiments



1a 6 7

(a) L-RaPr$_2$/Sc(NTf$_2$)$_3$(1:1, 10 mol%),CH_2Cl_2, 35 ^oC, 3 Å MS
(b)The additional base
(1) without base: trace
(2) base: TEA yield: 21%, ee: 75%
(3) base: DIPA yield: 15%, ee: 33%

L-RaPr$_2$ (7.0 mg, 0.01 mmol), Sc(NTf$_2$)$_3$ (8.8 mg, 0.01 mmol), 3 Å molecular sieve (40 mg) and chalone (20.8 mg, 0.10 mmol) were added to an over-dried reaction tube under nitrogen atmosphere. 0.3 mL Anhydrous CH_2Cl_2 was added and the solution was stirred at 35 °C for 30 minutes. Then, succinimide **6** (11.9 mg, 0.12 mmol) and the corresponding base (0.10 mmol) were added under these conditions. The reaction mixture continued stirring for 24 hours. The residue was purified by a flash chromatography on silica gel (petroleum ether/ethyl acetate = 3:1-2:1) to afford the product **7**.



(a) L-RaPr$_2$/Sc(NTf$_2$)$_3$(1:1,10 mol%)
CH_2Cl_2, 35 ^oC, 3 Å MS

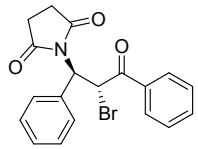
1a 6 7

100%	50%	15% yield, 80% ee
100%	20%	7% yield, 86% ee
100%	10%	4% yield, 90% ee

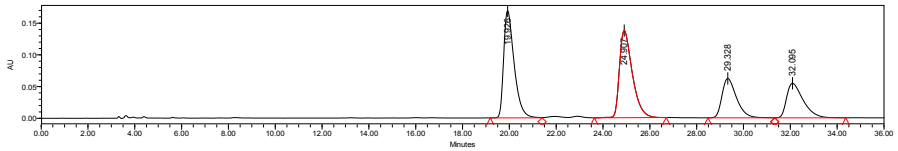
L-RaPr$_2$ (7.0 mg, 0.01 mmol), Sc(NTf$_2$)$_3$ (8.8 mg, 0.01 mmol), 3 Å molecular sieve (40 mg) and chalone (20.8 mg, 0.10 mmol) were added to an over-dried reaction tube under nitrogen atmosphere. 0.3 mL Anhydrous CH_2Cl_2 was added and the solution was stirred at 35 °C for 30 minutes. Then, succinimide **6** (11.9 mg, 0.12 mmol) and the corresponding base TEA (0.10 mmol) were added under these conditions. The reaction mixture continued stirring for 24 hours. The residue was purified by a flash chromatography on silica gel (petroleum ether/ethyl acetate = 3:1-2:1) to afford the product **7**.

6. Product characterization data

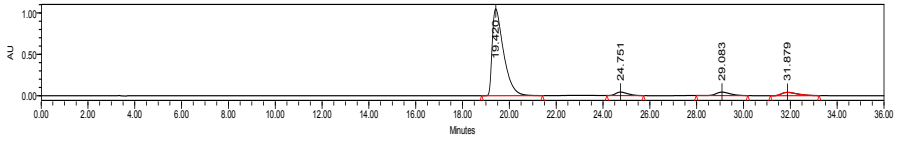
1-((1*R*,2*R*)-2-Bromo-3-oxo-1,3-diphenylpropyl)pyrrolidine-2,5-dione 3a



Yield: 33.6 mg (87%), white amorphous solid, 91:9 dr [determined by the ratio of area at δ 6.02 (d, *J* = 11.6 Hz, 0.09H) and δ 5.81 (d, *J* = 11.2 Hz, 0.91H) in ^{1}H NMR]; 91% ee; $[\alpha]^{24.9}_{D}$ = 64.0 (c = 0.73, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/ *i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 19.93 min, $t_{R(minor)}$ = 24.91 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.04 (d, *J* = 7.2 Hz, 1.82H), 7.94 (d, *J* = 7.6 Hz, 0.18H), 7.67 – 7.48 (m, 5H), 7.39 (d, 2.74H), 7.24 (d, 0.26H), 6.83 (d, *J* = 11.2 Hz, 0.09H), 6.63 (d, *J* = 11.2 Hz, 0.91H), 6.02 (d, *J* = 11.6 Hz, 0.09H), 5.81 (d, *J* = 11.2 Hz, 0.91H), 2.73 – 2.49 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.0, 176.6, 136.7, 134.0, 133.8, 129.0, 128.9, 57.4, 44.5, 28.0. ESI-HRMS: calcd for $[C_{19}H_{16}{}^{78.9183}BrNO_3+Na^+]$ 408.0206, found 408.0212; ESI-HRMS: calcd for $[C_{19}H_{16}{}^{80.9163}BrNO_3+Na^+]$ 410.0186, found 410.0196.

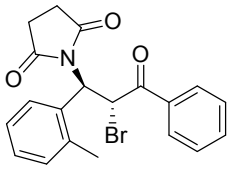


	Retention Time	% Area
1	19.926	33.22
2	24.907	33.06
3	29.328	16.86
4	32.095	16.86

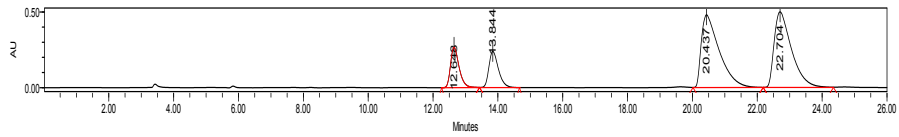


	Retention Time	% Area
1	19.420	87.37
2	24.751	3.75
3	29.083	4.22
4	31.879	4.66

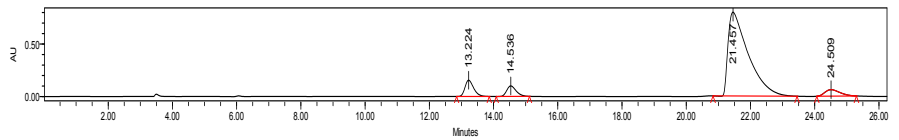
1-((1*R*,2*R*)-2-Bromo-3-oxo-3-phenyl-1-(o-tolyl)propyl)pyrrolidine-2,5-dione 3b



Yield: 32.7 mg (82%), white amorphous solid, 89:11 dr [determined by the ratio of area at δ 6.25 (d, J = 11.2 Hz, 0.11 H) and δ 6.11 (d, J = 11.2 Hz, 0.89 H) in ^{1}H NMR], 90% ee; $[\alpha]^{24.9}_D$ = 99.0 (c = 0.63, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 20.45 min, $t_{R(minor)}$ = 22.70 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.04 (d, J = 7.6 Hz, 1.78 H), δ 7.91 (d, J = 7.6 Hz, 0.22 H), 7.82 − 7.80 (m, 1 H), 7.62 − 7.59 (m, 1H), 7.56 − 7.41 (m, 2 H), 7.26 − 7.02 (m, 3H), 6.88 (d, J =11.2 Hz, 0.11 H), 6.61 (d, J = 11.2 Hz, 0.89 H), 6.25 (d, J = 11.2 Hz, 0.11 H), 6.11 (d, J = 11.2 Hz, 0.89 H), 2.67 (s, 3H), 2.66 − 2.51 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.1, 177.3, 138.2, 136.4, 134.0, 133.7, 130.8, 128.9, 128.8, 127.5, 126.8, 53.2, 46.7, 28.0, 20.2. ESI-HRMS calcd for $[C_{20}H_{18}{}^{78.9183}BrNO_3+Na^+]$ 422.0363, found 422.0369; ESI-HRMS: calcd for $[C_{20}H_{118}{}^{80.9163}BrNO_3+Na^+]$ 424.0342, found 424.0346.

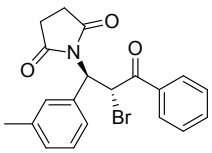


	Retention Time	% Area
1	12.648	10.48
2	13.844	10.41
3	20.437	39.46
4	22.704	39.65

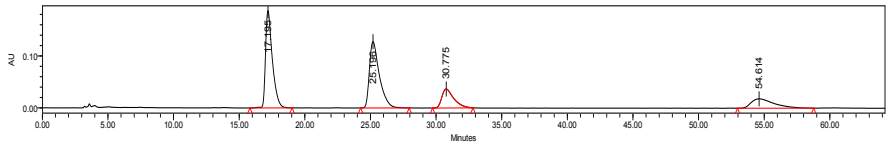


	Retention Time	% Area
1	13.224	6.91
2	14.536	4.88
3	21.457	83.41
4	24.509	4.80

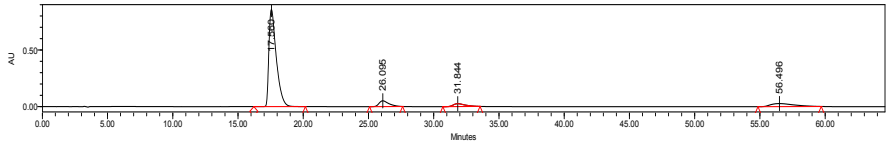
1-((1*R*,2*R*)-2-Bromo-3-oxo-3-phenyl-1-(m-tolyl)propyl)pyrrolidine-2,5-dione 3c



Yield: 35.9 mg (90%), white amorphous solid, 88:12 dr [determined by the ratio of area at δ 5.98 (d, *J* = 11.2 Hz , 0.12H) and δ 5.76 (d, *J* = 10.8 Hz, 0.88H) in ^{1}H NMR], 86% ee; $[\alpha]^{24.9}_{D}$ = 74.9 (c = 0.85, CH_2Cl_2); HPLC (Daicel chiralcel ID, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 17.20 min, $t_{R(minor)}$ = 25.20 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.06 – 7.94 (m, 2H), 7.63 – 7.58 (m, 1H), 7.53 – 7.27 (m, 5H), 7.19 – 7.03 (m, 1H), 6.81 (d, *J*= 11.2 Hz, 0.12H), 6.62 (d, *J*= 11.2 Hz , 0.88H), 5.98 (d, *J*= 11.2 Hz , 0.12H), 5.76 (d, *J*= 10.8 Hz, 0.88H), 2.74 – 2.52 (m, 4H), 2.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.0, 176.7, 138.6, 136.6, 134.0, 133.9, 129.8, 129.6, 128.9, 128.7, 126.0, 57.4, 28.0, 21.5. ESI-HRMS calcd for [$C_{20}H_{18}{}^{78.9183}BrNO_3$+Na$^+$] 422.0363, found 422.0374; ESI-HRMS: calcd for [$C_{20}H_{118}{}^{80.9163}BrNO_3$+Na$^+$] 424.0342, found 424.0359.

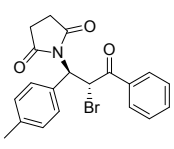


	Retention Time	% Area
1	17.195	37.59
2	25.196	37.44
3	30.775	12.81
4	54.614	12.15



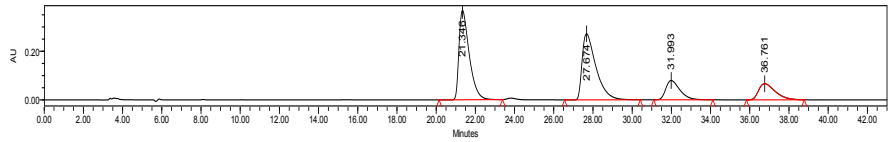
	Retention Time	% Area
1	17.560	81.52
2	26.095	6.46
3	31.844	3.88
4	56.496	8.14

1-((1*R*,2*R*)-2-Bromo-3-oxo-3-phenyl-1-(p-tolyl)propyl)pyrrolidine-2,5-dione 3d

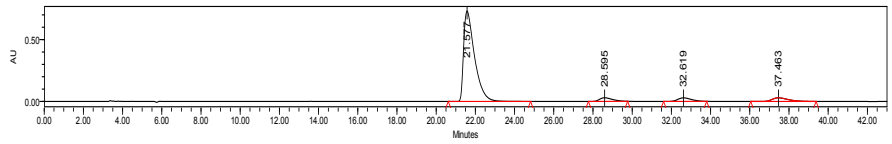


Yield: 35.5 mg (89%), white amorphous solid, 90:10 dr [determined by the ratio of area at δ 6.00 (d, *J* = 11.6 Hz, 0.10H) and δ 5.79 (d, *J* = 11.2 Hz, 0.90H) in

^{1}H NMR], 91% ee; $[\alpha]^{28.0}_D$ = 83.7 (c = 0.10, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 21.35 min, $t_{R(minor)}$ = 27.67 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.04 (d, *J* = 7.6 Hz, 1.80H), 8.04 (d, *J* = 7.6 Hz, 0.20H), 7.63 − 7.43 (m, 5H), 7.21 (d, *J* = 7.6 Hz, 1.80H), 7.21 (d, *J* = 7.6 Hz, 0.20H), 6.80 (d, *J* = 11.6 Hz, 0.10H), 6.62 (d, *J* = 10.8 Hz, 0.90H), 6.00 (d, *J* = 11.6 Hz, 0.10H), 5.79 (d, *J* = 11.2 Hz, 0.90H), 2.74 − 2.54 (m, 4H), 2.37 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.1, 176.1, 138.9, 133.8, 129.5, 128.9, 57.1, 44.6, 28.0, 21.3. ESI-HRMS: calcd for $[C_{20}H_{18}{}^{78.9183}BrNO_3+Na^+]$ 422.0363, found 422.0362; ESI-HRMS: calcd for $[C_{20}H_{118}{}^{80.9163}BrNO_3+Na^+]$ 424.0342, found 424.0344.

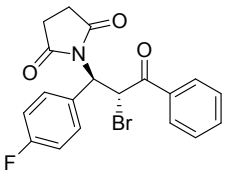


	Retention Time	% Area
1	21.346	38.67
2	27.674	38.57
3	31.993	11.44
4	36.761	11.33



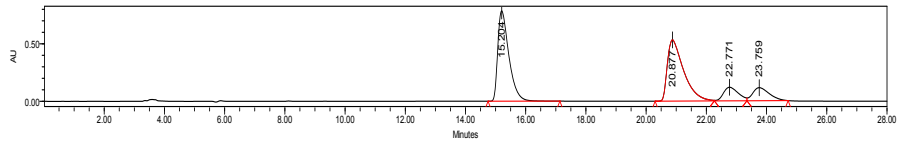
	Retention Time	% Area
1	21.577	86.61
2	28.595	4.06
3	32.619	4.19
4	37.463	5.14

1-((*1R,2R*)-2-Bromo-1-(4-fluorophenyl)-3-oxo-3-phenylpropyl)pyrrolidine-2,5-dione 3e

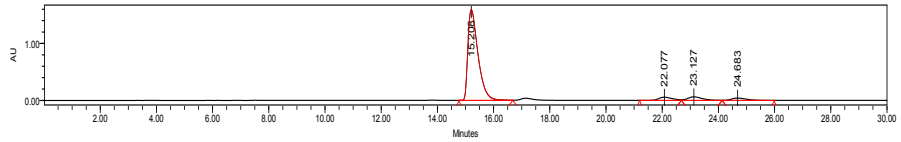


Yield: 33.8 mg (84%), white amorphous solid, 90:10 dr [determined by the ratio of area at δ 6.00 (d, *J* = 11.6 Hz, 0.10H) and δ 5.81 (d, *J* = 11.2 Hz, 0.90H) in ^{1}H NMR], 91% ee; $[\alpha]^{28.0}_D$ = 129.2 (c = 0.13, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 15.20 min, $t_{R(minor)}$ =

20.88 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.03 (d, *J* = 8.0 Hz, 1.80H), 7.94 (d, *J* = 8.0 Hz, 0.20H), 7.65 – 7.49 (m, 5H), 7.08 (t, *J* = 8.8 Hz, 1.80H), 6.92 (t, *J* = 8.4 Hz, 0.20H), 6.76 (d, *J* = 11.2 Hz, 0.10H), 6.58 (d, *J* = 10.8 Hz, 0.90H), 6.00 (d, *J* = 11.6 Hz, 0.10H), 5.81 (d, *J* = 11.2 Hz, 0.90H), 2.76 – 2.51 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.8, 176.7, 164.1, 161.7, 134.1, 132.6, 130.9, 130.8, 128.9, 128.9, 115.9, 115.7, 56.7, 44.4, 28.0. ESI-HRMS: calcd for [$C_{19}H_{15}{}^{78.9183}BrFNO_3$+Na$^+$] 426.0112, found 426.0121; ESI-HRMS: calcd for [$C_{19}H_{15}{}^{80.9163}BrClNO_3$+Na$^+$] 428.0092, found 428.0103.

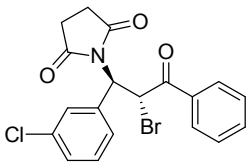


	Retention Time	% Area
1	15.204	41.58
2	20.877	41.05
3	22.771	8.38
4	23.759	9.00



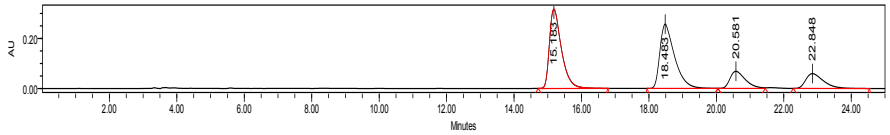
	Retention Time	% Area
1	15.208	87.67
2	22.077	4.19
3	23.127	4.91
4	24.683	3.24

1-((1*R*,2*R*)-2-Bromo-1-(3-chlorophenyl)-3-oxo-3-phenylpropyl)pyrrolidine-2,5-dione 3f

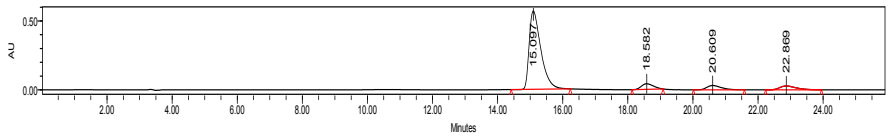


Yield: 38.4 mg (92%), white amorphous solid, 89:11 dr [determined by the ratio of area of δ 5.98 (d, *J* = 10.8 Hz, 0.11H) and 5.78 (d, *J* = 11.2 Hz, 0.89H) in ^{1}H NMR], 86% ee; $[\alpha]^{24.9}_D$ = 123.4 (c = 0.09, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 15.18 min, $t_{R(minor)}$ = 18.48 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.04 (d, *J* = 7.6 Hz, 1.78H), 7.96 (d, *J* = 7.6

Hz, 0.22H), 7.67 – 6.47 (m, 5H), 7.35 – 7.31 (m, 1.78H), 7.21 – 7.15 (m, 0.22H), 6.76 (d, *J* = 11.2 Hz 0.11H) , 6.57 (d, *J* = 11.2 Hz 0.89H), 5.98 (d, *J* = 10.8 Hz, 0.11H), 5.78 (d, *J* = 11.2 Hz, 0.89H), 2.17 – 2.58 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.7, 176.6, 138.6, 134.7, 134.1, 133.6, 130.1, 129.3, 128.9, 127.5, 56.9, 44.1, 28.0. ESI-HRMS: calcd for [$C_{19}H_{15}{}^{78.9183}BrClNO_3$+$Na^+$] 441.9817, found 441.9825; ESI-HRMS: calcd for [$C_{19}H_{15}{}^{80.9163}BrClNO_3$+$Na^+$] 443.9796, found 443.9799.

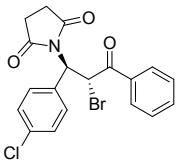


	Retention Time	% Area
1	15.183	39.20
2	18.483	38.93
3	20.581	10.97
4	22.848	10.89



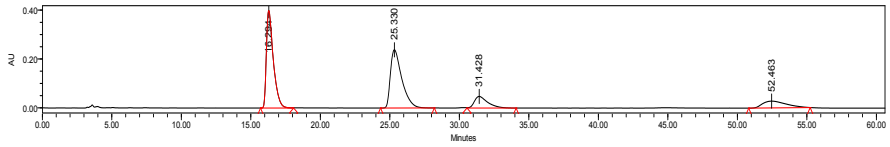
	Retention Time	% Area
1	15.097	82.55
2	18.582	6.10
3	20.609	5.57
4	22.869	5.78

1-((1*R*,2*R*)-2-Bromo-1-(4-chlorophenyl)-3-oxo-3-phenylpropyl)pyrrolidine-2,5-dione 3g

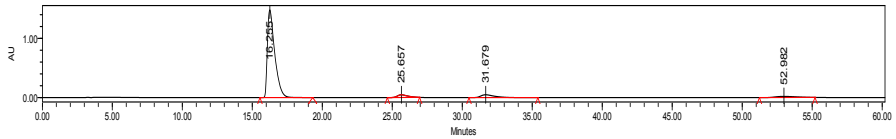


Yield: 35.5 mg (85%), white amorphous solid, 91:9 dr [determined by the ratio of area at δ 5.99 (d, *J* = 11.2 Hz, 0.09H) and δ 5.78 (d, *J* = 10.8 Hz, 0.91H) in ^{1}H NMR], 92% ee; $[\alpha]^{24.9}_D$ = 54.8 (c = 0.75, CH_2Cl_2); HPLC (Daicel chiralcel ID, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 16.29 min, $t_{R(minor)}$ = 25.33 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.03 (d, *J*= 7.2 Hz, 1.82H), 7.94 (d, *J*= 7.6 Hz, 0.18H), 7.64 – 7.44 (m, 5H), 7.37 (d, *J*= 8.4 Hz, 1.82H), 7.20 (d, *J*= 8.4 Hz, 0.18H), 6.75 (d, *J*= 11.6 Hz,

0.09H), 6.58 (d, *J*= 10.8 Hz, 0.91H), 5.99 (d, *J*= 11.2 Hz, 0.09H), 5.78 (d, *J*= 10.8 Hz, 0.91H), 2.76 – 2.50 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.7, 176.6, 135.2, 134.9, 134.1, 133.7, 130.4, 129.1, 129.0, 128.9, 56.7, 44.1, 28.0. ESI-HRMS: calcd for [$C_{19}H_{15}{}^{78.9183}BrClNO_3$+$Na^+$] 441.9817, found 441.9824; ESI-HRMS: calcd for [$C_{19}H_{15}{}^{80.9163}BrClNO_3$+$Na^+$] 443.9796, found 443.9795.

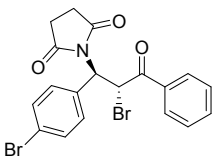


	Retention Time	% Area
1	16.294	40.76
2	25.330	40.21
3	31.428	9.32
4	52.463	9.71



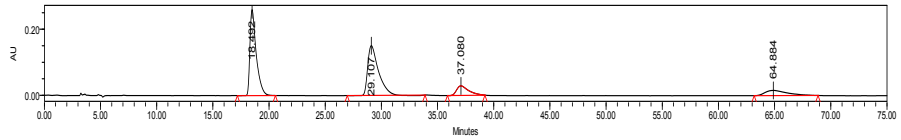
	Retention Time	% Area
1	16.255	87.67
2	25.657	4.09
3	31.679	4.71
4	52.982	3.53

1-((1*R*,2*R*)-2-Bromo-1-(4-bromophenyl)-3-oxo-3-phenylpropyl)pyrrolidine-2,5-dione 3h

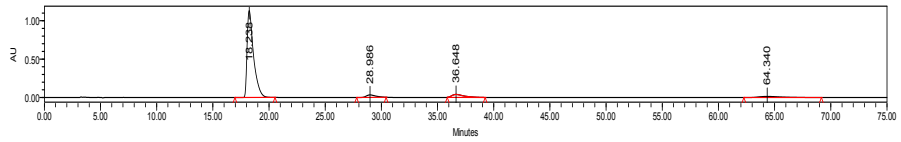


Yield: 38.8 mg (84%), white amorphous solid, 90:10 dr [determined by the ratio of area at δ 5.97 (d, *J* = 11.2 Hz, 0.10H) and δ 5.78 (d, *J* = 11.6 Hz, 0.90H) in ^{1}H NMR], 92% ee; $[\alpha]^{28.0}_D$ = 59.6 (c = 0.10, CH_2Cl_2); HPLC (Daicel chiralcel ID, *n*-hexane/ *i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 18.49 min, $t_{R(minor)}$ = 29.11 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.03 (d, *J* = 7.6 Hz, 1.80H), 7.94(d, *J* = 7.6 Hz, 0.20H), 7.64 – 7.35 (m, 7H), 6.75 (d, *J* = 11.6 Hz, 0.10H), 6.58 (d, *J* = 10.8 Hz, 0.90H), 5.97 (d, *J* = 11.2 Hz, 0.10H), 5.78 (d, *J* = 11.6 Hz, 0.90H), 2.76 – 2.51 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$)

δ = 191.7, 176.6, 135.7, 134.1, 133.7, 132.1, 130.7, 129.0, 128.9, 123.2, 56.8, 44.0, 28.0. ESI-HRMS calcd for $[C_{19}H_{15}{}^{78.9183}Br_2NO_3+Na^+]$ 485.9311, found 485.9317; ESI-HRMS: calcd for $[C_{19}H_{15}{}^{78.9183}Br^{80.9163}BrNO_3+Na^+]$ 487.9291, found 487.9288; ESI-HRMS: calcd for $[C_{19}H_{15}{}^{80.9163}Br_2NO_3+Na^+]$ 489.9270, found 489.9274.

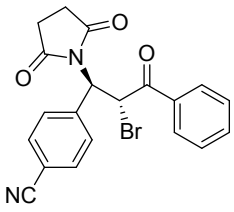


	Retention Time	% Area
1	18.492	41.36
2	29.107	41.16
3	37.080	8.77
4	64.884	8.71



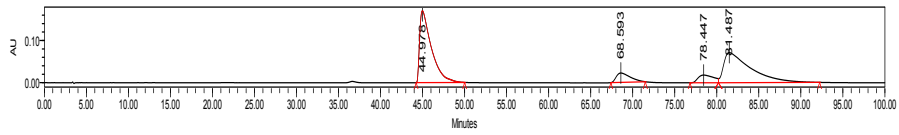
	Retention Time	% Area
1	18.238	87.01
2	28.986	3.61
3	36.648	5.59
4	64.340	3.79

4-((1*R*,2*R*)-2-Bromo-1-(2,5-dioxopyrrolidin-1-yl)-3-oxo-3-phenylpropyl)benzonitrile 3i

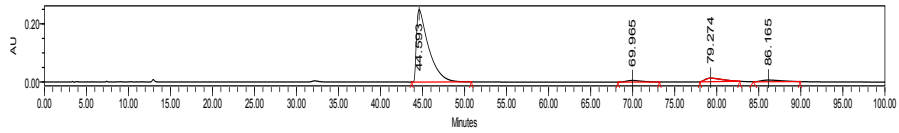


Yield: 29.9 mg (73%), white amorphous solid, 91:9 dr [determined by the ratio of area at δ 6.04 (d, *J* = 11.6 Hz, 0.09H) and δ 5.86 (d, *J* = 10.8 Hz, 0.91H) in ^{1}H NMR], 94% ee; $[\alpha]^{24.9}{}_D$ = 50.4 (c = 0.71, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 44.98 min, $t_{R(minor)}$ = 81.49 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.03 (d, *J*= 7.2 Hz, 1.82H), 7.95 (d, *J*= 7.6 Hz, 0.18H), 7.79 (d, 2H), 7.71 – 7.62 (m, 3H), 7.54 – 7.46 (m, 2H), 6.77 (d, *J* = 11.6 Hz, 0.09H), 6.60 (d, *J*= 10.8 Hz, 0.91H), 6.04 (d, *J* = 11.6 Hz, 0.09H), 5.86 (d, *J* = 10.8 Hz, 0.91H), 2.79 – 2.55 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.4, 176.6, 141.6, 133.5, 129.9,

128.9, 118.3, 113.0, 55.9, 43.3, 28.0. ESI-HRMS: calcd for [$C_{20}H_{15}{}^{78.9183}BrN_2O_3$+$Na^+$] 433.0159, found 433.0165; ESI-HRMS: calcd for [$C_{20}H_{15}{}^{80.9163}BrN_2O_3$+$Na^+$] 435.0138, found 435.0147.

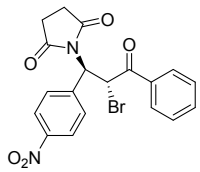


	Retention Time	% Area
1	44.978	44.37
2	68.593	6.83
3	78.447	6.22
4	81.487	42.58

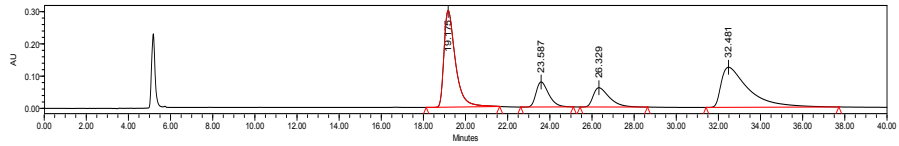


	Retention Time	% Area
1	44.593	88.33
2	69.965	2.26
3	79.274	6.08
4	86.165	3.34

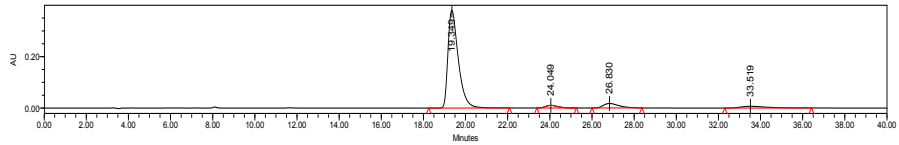
1-((1*R*,2*R*)-2-Bromo-1-(4-nitrophenyl)-3-oxo-3-phenylpropyl)pyrrolidine-2,5-dione 3j



Yield: 32.3 mg (75%), white amorphous solid, 91:9 dr [determined by the ratio of area at δ = 6.10 (d, *J* = 11.2 Hz, 0.09H) and δ 5.93 (d, *J* = 10.8 Hz, 0.91H) in ^{1}H NMR], 92% ee; $[\alpha]^{28.0}_D$ = 58.4 (c = 0.65, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 80/20, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 19.18 min, $t_{R(minor)}$ = 32.48 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 (d, 2H), 8.04 (d, *J* = 7.6 Hz, 1.82H), 7.95 (d, *J* = 7.6 Hz, 0.18H), 7.85 (d, *J* = 8.4 Hz, 1.82H), 7.75 (d, *J* = 8.8 Hz, 0.18H), 7.66 – 7.45 (m, 3H), 6.80 (d, *J* = 11.6 Hz, 0.09H), 6.63 (d, *J* = 10.8 Hz, 0.91H), 6.10 (d, *J* = 11.2 Hz, 0.09H), 5.93 (d, *J* = 10.8 Hz, 0.91H), 2.81 – 2.58 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.3, 176.6, 148.1, 143.4, 130.2, 129.0, 129.0, 124.1, 56.6, 43.3, 28.0. ESI-HRMS: calcd for [$C_{19}H_{15}{}^{78.9183}BrN_2O_5$+$Na^+$] 453.0057, found 453.0060; ESI-HRMS: calcd for [$C_{19}H_{15}{}^{80.9163}BrN_2O_5$+$Na^+$] 455.0037, found 455.0052.

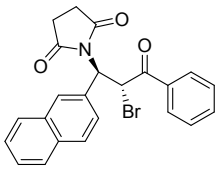


	Retention Time	% Area
1	19.175	38.87
2	23.587	11.19
3	26.329	11.05
4	32.481	38.89

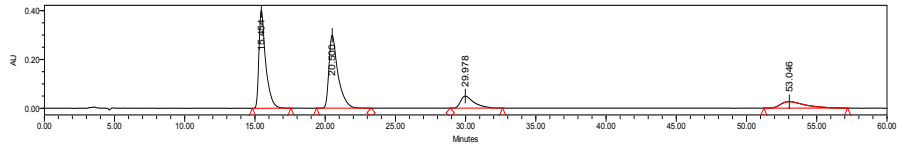


	Retention Time	% Area
1	19.349	87.22
2	24.049	2.78
3	26.830	6.09
4	33.519	3.90

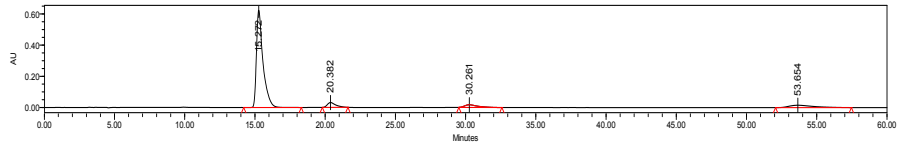
1-((1*R*,2*R*)-2-Bromo-1-(naphthalen-2-yl)-3-oxo-3-phenylpropyl)pyrrolidine-2,5-dione 3k



Yield: 34.4 mg (79%), white amorphous solid, 88:12 dr [determined by the ratio of area at δ 6.20 (d, J = 11.6 Hz, 0.12H) and δ 5.99 (d, J = 11.2 Hz, 0.88H) in ^{1}H NMR], 88% ee; HPLC (Daicel chiralcel ID, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 15.45 min, $t_{R(minor)}$ = 20.50 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.12 – 7.94 (m, 3H), 7.90 – 7.60 (m, 5H), 7.54 – 7.40 (m, 4H), 6.95 (d, J = 11.6 Hz, 0.12 H), 6.76 (d, J = 11.2 Hz, 0.88 H), 6.20 (d, J = 11.6 Hz, 0.12H), 5.99 (d, J = 11.2 Hz, 0.88H), 2.73 – 2.48 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.0, 176.8, 134.1, 134.0, 133.8, 133.4, 133.1, 128.9, 128.8, 128.5, 128.3, 127.7, 128.5, 128.3, 127.7, 127.5, 126.7, 126.5, 125.9, 57.6, 44.4, 28.0. ESI-HRMS: calcd for [$C_{23}H_{18}{}^{78.9183}BrNO_3$+$Na^+$] 458.0363, found 458.0365; ESI-HRMS: calcd for [$C_{23}H_{18}{}^{80.9163}BrNO_3$+$Na^+$] 460.0342, found 460.0348.

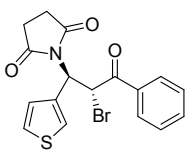


	Retention Time	% Area
1	15.454	40.30
2	20.500	40.09
3	29.978	9.85
4	53.046	9.76

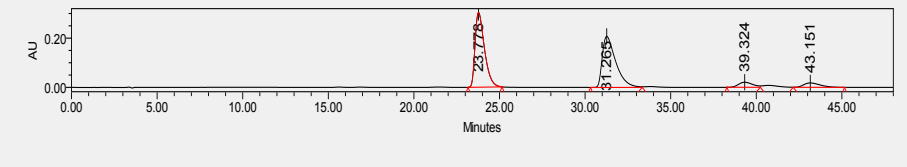


	Retention Time	% Area
1	15.272	82.74
2	20.382	5.34
3	30.261	4.46
4	53.654	7.45

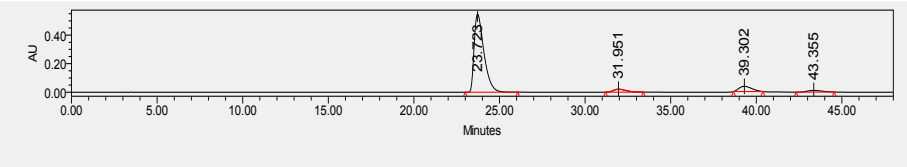
1-((*1R,2R*)-2-Bromo-3-oxo-3-phenyl-1-(thiophen-3-yl)propyl)pyrrolidine-2,5-dione 3l



Yield: 34.1 mg (87%), white amorphous solid, 90:10 dr [determined by the ratio of area at δ 6.15 (d, J = 11.2 Hz, 0.10H) and δ 5.96 (d, J = 11.2 Hz, 0.90H) in ^{1}H NMR], 92% ee; HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 23.05 min, $t_{R(minor)}$ = 30.24 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.03 – 7.93 (m, 2H), 7.64 – 7.46 (m, 4H), 7.37 – 7.33 (m, 1.76H), 7.21 – 7.16 (m, 0.23H), 6.65 (d, J = 11.2 Hz, 0.10 H), 6.57 (d, J = 11.2 Hz, 0.90 H), 6.15 (d, J = 11.2 Hz, 0.10H), 5.96 (d, J = 11.2 Hz, 0.90H), 2.77 – 2.53 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.0, 176.4, 136.7, 134.1, 133.8, 128.9, 128.8, 127.5, 126.4, 125.8, 52.2, 44.4, 27.9. ESI-HRMS: calcd for [$C_{17}H_{14}{}^{78.9183}BrNO_3S$+$Na^+$] 413.9770, found 413.9771; ESI-HRMS: calcd for [$C_{17}H_{148}{}^{80.9163}BrNO_3S$+$Na^+$] 415.9750, found 415.9752.

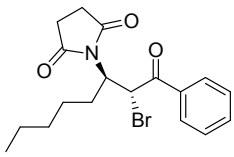


	Retention Time	% Area
1	23.778	45.61
2	31.265	44.90
3	39.324	4.75
4	43.151	4.73

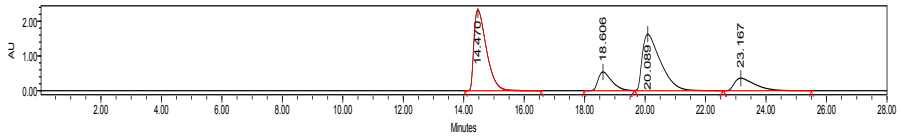


	Retention Time	% Area
1	23.723	85.44
2	31.951	4.21
3	39.302	7.56
4	43.355	2.79

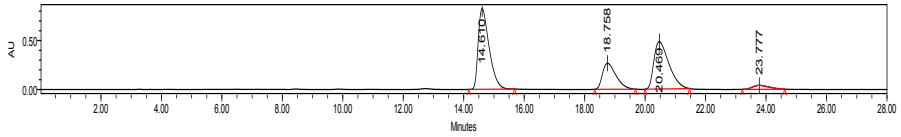
1-((2*R*,3*R*)-2-Bromo-1-oxo-1-phenyloctan-3-yl)pyrrolidine-2,5-dione **3m**



Yield: 34.2 mg (90%), white amorphous solid, 80:20 dr [determined by the ratio of area at δ 4.95 (td, *J* = 3.2 Hz, 10.8 Hz, 0.2H) and δ 4.79 (td, *J* = 3.2 Hz, 10.8 Hz, 0.8H) in ^{1}H NMR], 11% ee; HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 14.47 min, $t_{R(minor)}$ = 20.09 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.05 – 7.92 (m, 2H), 7.63 – 7.45 (m, 3H), 6.02 (d, 1H), 4.95 (td, *J* = 3.2 Hz, 10.8 Hz, 0.2H), 4.79 (td, *J* = 3.2 Hz, 10.8 Hz, 0.8H), 2.80 – 2.58 (m, 4H), 2.24 – 2.04 (m, 2H), 1.36 – 1,20 (m, 6H), 0.90 – 0.81 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.3, 176.8, 133.9, 128.9, 128.9, 53.2, 45.2, 31.3, 29.1, 27.9, 25.6, 22.5, 14.0. ESI-HRMS: calcd for [$C_{18}H_{22}{}^{78.9183}BrNO_3$+$Na^+$] 402.0676, found 402.0677; ESI-HRMS: calcd for [$C_{18}H_{22}{}^{80.9163}BrNO_3$+$Na^+$] 404.0655, found 404.0663.

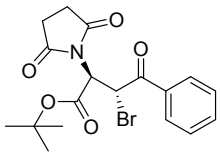


	Retention Time	% Area
1	14.470	39.50
2	18.606	10.07
3	20.089	40.39
4	23.167	10.04

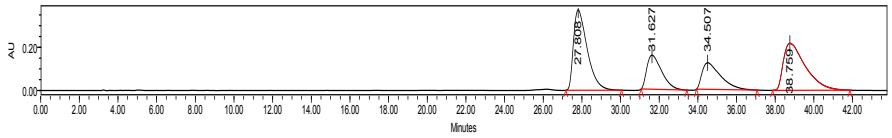


	Retention Time	% Area
1	14.610	43.86
2	18.758	17.46
3	20.469	35.42
4	23.777	3.26

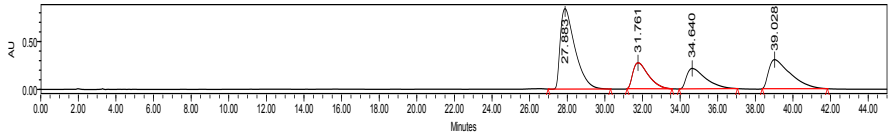
(2*R*,3*R*)-Tert-butyl 3-bromo-2-(2,5-dioxopyrrolidin-1-yl)-4-oxo-4-phenylbutanoate 3n



Yield: 26.2 mg (64%), white amorphous solid, 70:30 dr [determined by the ratio of area at δ 5.72 (d, *J* = 10.8 Hz, 0.3H) and δ 5.32 (d, *J* = 10.4 Hz, 0.7H) in ^{1}H NMR], 30% ee; HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 27.81 min, $t_{R(minor)}$ = 38.76 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.07 – 7.96 (m, 2H), 7.63 – 7.47 (m, 3H), 6.30 (d, *J* = 10.0 Hz, 0.7H), 5.99 (d, *J* = 10.8 Hz, 0.3H), 5.72 (d, *J* = 10.8 Hz, 0.3H), 5.32 (d, *J* = 10.4 Hz, 0.7H), 2.86 – 2.61 (m, 4H), 1.51 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.0, 190.7, 175.8, 165.8, 164.6, 134.1, 134.0, 133.6, 129.0, 128.9, 84.7, 84.0, 55.7, 53.8, 41.5, 40.4, 28.0, 27.9, 27.6. ESI-HRMS: calcd for [$C_{18}H_{20}{}^{78.9183}BrNO_5$+$Na^+$] 432.0418, found 432.0418; ESI-HRMS: calcd for [$C_{18}H_{22}{}^{80.9163}BrNO_3$+$Na^+$] 434.0397, found 434.0394.

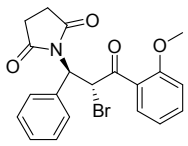


	Retention Time	% Area
1	27.808	35.18
2	31.627	16.13
3	34.507	15.71
4	38.759	32.98

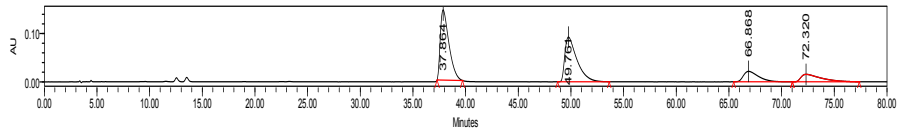


	Retention Time	% Area
1	27.883	45.39
2	31.761	15.44
3	34.640	15.03
4	39.028	24.14

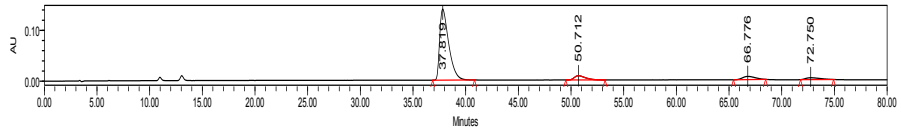
1-((1*R*,2*R*)-2-Bromo-3-(2-methoxyphenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3o



Yield: 30.3 mg (72%), white amorphous solid, 90:10 dr [determined by the ratio of area at δ 5.97 (d, J = 11.6 Hz, 0.10H) and δ 5.82 (d, J = 11.2 Hz, 0.90H) in ^{1}H NMR], 88% ee; $[\alpha]^{28.0}_D$ = 125.7 (c = 0.35, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 37.86 min, $t_{R(minor)}$ = 49.76 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.84 – 7.81 (m, 1H), 7.66 – 7.58 (m, 2H), 7.54 – 7.49 (m ,1H), 7.41 – 7.33(m, 2.8H), 7.19 – 7.16 (m, 0.20H), 7.05 – 6.96 (m, 2H), 6.94 – 6.84 (m, 1H), δ 5.97 (d, J = 11.6 Hz, 0.10H), δ 5.82 (d, J = 11.2 Hz, 0.90H), 4.01 (s, 3H), 2.56 – 2.52 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 193.0, 176.5, 158.9, 136.9, 134.8, 131.5, 129.3, 128.7, 128.6, 124.7, 120.9, 112.2, 57.2, 56.0, 49.4, 27.9. ESI-HRMS: calcd for $[C_{20}H_{18}{}^{78.9183}BrNO_4+Na^+]$ 438.0312, found 438.0321; ESI-HRMS: calcd for $[C_{20}H_{18}{}^{80.9163}BrNO_4+Na^+]$ 440.0291, found 440.0301.

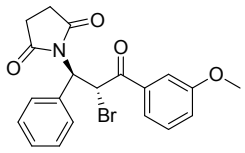


	Retention Time	% Area
1	37.864	41.72
2	49.761	37.14
3	66.868	10.90
4	72.320	10.24

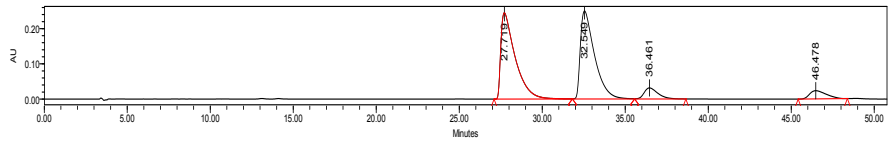


	Retention Time	% Area
1	37.819	84.98
2	50.712	6.18
3	66.776	5.33
4	72.750	3.51

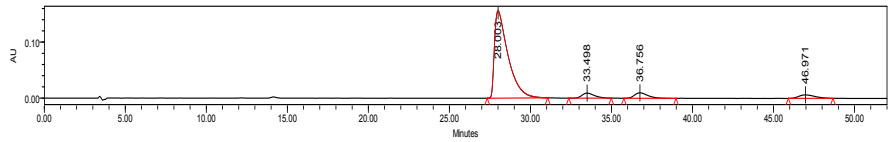
1-((1*R*,2*R*)-2-Bromo-3-(3-methoxyphenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3p



Yield: 34.5 mg (83%), white amorphous solid, 91:9 dr [determined by the ratio of area at δ 6.01 (d, J = 11.6 Hz, 0.09H) and δ 5.80 (d, J = 11.2 Hz, 0.91H) in ^{1}H NMR], 90% ee; $[\alpha]^{28.0}_D$ = 73.0 (c = 0.53, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/ *i*-PrOH 80/20, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 27.72 min, $t_{R(minor)}$ = 32.55 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.80 – 7.57 (m, 4H), 7.44 – 7.35 (m, 4H), 7.17 – 7.13 (m, 1H), 6.80 (d, J = 11.2 Hz, 0.09H), 6.60 (d, J = 11.2 Hz, 0.91H), 6.01 (d, J = 11.6 Hz, 0.09H), 5.80 (d, J = 11.2 Hz, 0.91H), 3.87 (s, 3H), 2.75 – 2.51 (m, 4H), ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.9, 160.0, 136.7, 135.1, 128.9, 120.6, 113.2, 57.4, 55.5, 44.6, 28.0. ESI-HRMS: calcd for $[C_{20}H_{18}{}^{78.9183}BrNO_4+Na^+]$ 38.0312, found 438.0316; ESI-HRMS: calcd for $[C_{20}H_{18}{}^{80.9163}BrNO_4+Na^+]$ 440.0291, found 440.0294.

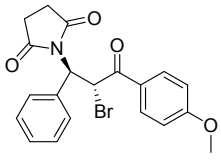


	Retention Time	% Area
1	27.719	44.61
2	32.549	44.99
3	36.461	5.49
4	46.478	4.92

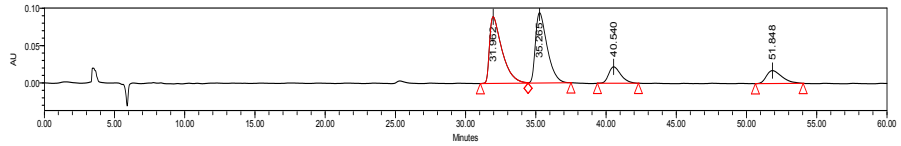


	Retention Time	% Area
1	28.003	86.09
2	33.498	4.50
3	36.756	5.29
4	46.971	4.12

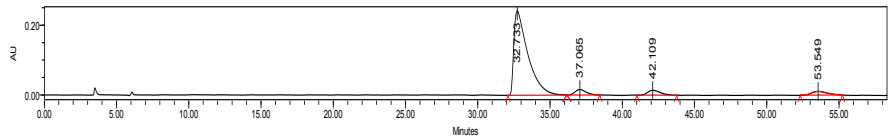
1-((1*R*,2*R*)-2-Bromo-3-(4-methoxyphenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3q



Yield: 36.1 mg (87%), white amorphous solid, 92:8 dr [determined by the ratio of area at δ 6.02 (d, J = 11.2 Hz, 0.08H) and δ 5.82 (d, J = 11.2 Hz, 0.92H) in ^{1}H NMR], 91% ee; $[\alpha]^{24.9}_D$ = 40.6 (c = 0.66, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/ *i*-PrOH 80/20, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 31.96 min, $t_{R(minor)}$ = 35.27 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, J = 8.8 Hz 1.84H), 7.94 (d, J = 8.8 Hz 0.16H), 7.67 – 7.53 (m, 2H), 7.42 – 7.35 (m, 2.76H), 7.23 – 7.21 (m, 0.24H), 6.97 (d, J = 9.2 Hz, 1.84H), 6.92 (d, J = 8.8 Hz, 0.16H), 6.79 (d, J =13.2 Hz, 0.08H), 6.61 (d, J =11.2 Hz, 0.92H), 6.02 (d, J = 11.2 Hz, 0.08H), 5.82 (d, J= 11.2 Hz, 0.92H), 3.89 (s, 3H), 2.74-2.45 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 190.5, 176.7, 164.3, 136.8, 131.4, 129.1, 128.9, 128.8, 126.6, 114.2, 57.5, 55.6, 44.3, 28.0. ESI-HRMS: calcd for [$C_{20}H_{18}{}^{78.9183}BrNO_4$+$Na^+$] 438.0312, found 438.0304 ; ESI-HRMS: calcd for [$C_{20}H_{18}{}^{80.9163}BrNO_4$+$Na^+$] 440.0291, found 440.0284.

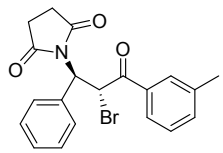


	Retention Time	% Area
1	31.962	40.49
2	35.265	39.98
3	40.540	9.70
4	51.848	9.83

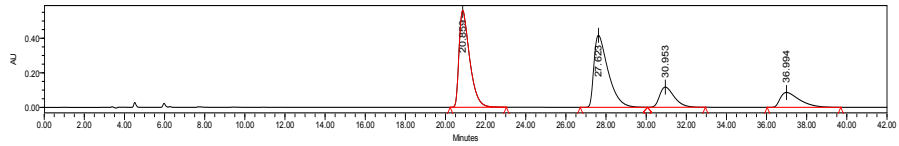


	Retention Time	% Area
1	32.733	86.71
2	37.065	4.49
3	42.109	4.50
4	53.549	4.30

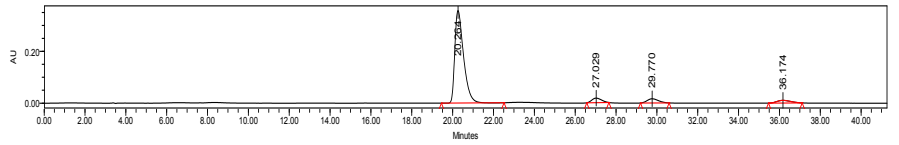
1-((1*R*,2*R*)-2-Bromo-3-oxo-1-phenyl-3-(m-tolyl)propyl)pyrrolidine-2,5-dione 3r



Yield: 33.9 mg (85%), white amorphous solid, 90/10 dr [determined by ratio of area at δ 6.02 (d, J = 11.6 Hz, 0.10H) and δ 5.81 (d, J = 11.2 Hz, 0.90H) in ^{1}H NMR], 91% ee; $[\alpha]^{28.0}_{D}$ = 187.5 (c = 0.10, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 20.86 min, $t_{R(minor)}$ = 27.62 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.85 – 7.74 (m, 2H), 7.67 – 7.54 (m, 2H), 7.43 – 7.35 (m, 4.70H), 7.24 – 7.21 (m, 0.30H), 6.81 (d, J = 11.2 Hz, 0.10H), 6.61 (d, J = 10.8 Hz, 0.90H), 6.02 (d, J = 11.6 Hz, 0.10H), 5.81 (d, J = 11.2 Hz, 0.90H), 2.74 – 2.49 (m, 4H), 2.43(s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.2, 138.8, 136.7, 134.9, 133.8, 129.0, 128.8, 1126.2, 100.0, 57.4, 44.6, 28.0, 21.2. ESI-HRMS: calcd for $[C_{20}H_{18}{}^{78.9183}BrNO_3+Na^+]$ 422.0363, found 422.0368; ESI-HRMS: calcd for $[C_{20}H_{118}{}^{80.9163}BrNO_3+Na^+]$ 424.0342, found 424.0358.

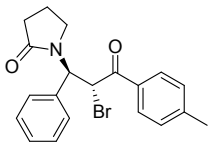


	Retention Time	% Area
1	20.859	38.97
2	27.623	38.88
3	30.953	11.23
4	36.994	10.92

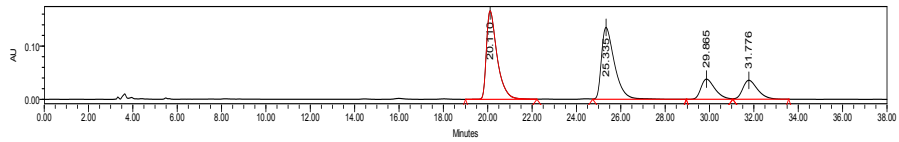


	Retention Time	% Area
1	20.264	86.45
2	27.029	4.66
3	29.770	5.00
4	36.174	3.89

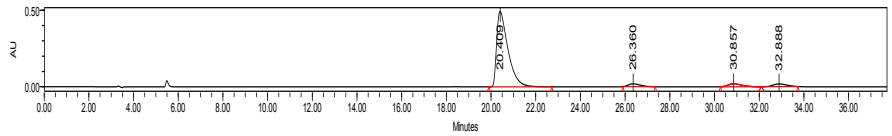
1-((1*R*,2*R*)-2-Bromo-3-oxo-1-phenyl-3-(p-tolyl)propyl)pyrrolidine-2,5-dione 3s



Yield: 34.2 mg (86%), white amorphous solid, 90:10 dr [determined by ratio of area at δ 6.01 (d, J = 11.6 Hz, 0.10H) and δ 5.81 (d, J = 11.2 Hz, 0.90H) in ^{1}H NMR], 91% ee; $[\alpha]^{24.9}_D$ = 53.8 (c = 0.60, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 20.11 min, $t_{R(minor)}$ = 25.34 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.94 (d, J = 8.0 Hz, 1.80H), 7.84 (d, J = 8.4 Hz, 0.20H), 7.67 – 7.65 (m, 2H), 7.39 – 7.29 (m, 4.6H), 7.23 – 7.20 (t, 0.4H), 6.80 (d, J = 11.2 Hz, 0.10H), 6.61 (d, J = 11.2 Hz, 0.90H), 6.01 (d, J = 11.6 Hz, 0.10H), 5.81 (d, J = 11.2 Hz, 0.90H), 2.58 – 2.49 (m, 4H), 2.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.6, 176.7, 145.1, 136.8, 131.3, 129.6, 129.1, 128.9, 128.8, 57.4, 44.5, 28.0, 21.8. ESI-HRMS: calcd for $[C_{20}H_{18}{}^{78.9183}BrNO_3+Na^+]$ 422.0363, found 422.0371; ESI-HRMS: calcd for $[C_{20}H_{118}{}^{80.9163}BrNO_3+Na^+]$ 424.0342, found 424.0352.

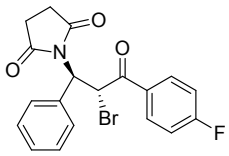


	Retention Time	% Area
1	20.110	38.57
2	25.335	38.34
3	29.865	11.55
4	31.776	11.54

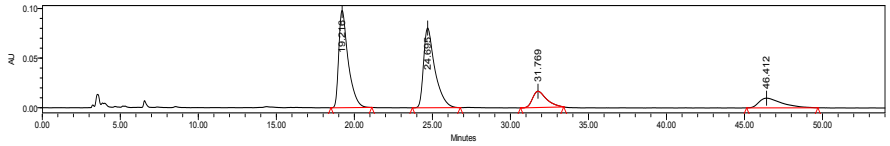


	Retention Time	% Area
1	20.409	88.42
2	26.360	3.60
3	30.857	4.18
4	32.888	3.80

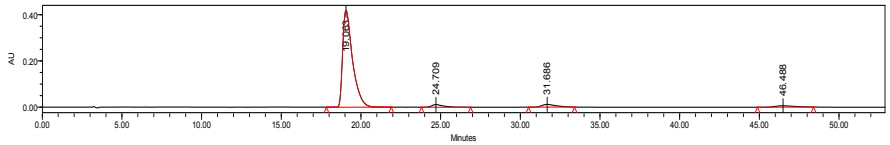
1-((1*R*,2*R*)-2-Bromo-3-(4-fluorophenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3t



Yield: 32.6 mg (81%), white amorphous solid, 92:8 dr [determined by the ratio of area of δ 6.00 (d, *J* = 11.6 Hz, 0.08H) and δ 5.79 (d, *J*= 11.2 Hz, 0.92H) in ^{1}H NMR], 93% ee; $[\alpha]^{24.9}_{D}$ = 43.8 (c = 0.27, CH_2Cl_2); HPLC (Daicel chiralcel ID, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 19.22 min, $t_{R(minor)}$ = 24.71 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.09 – 7.96(m, 2H), 7.65 – 7.39 (m, 5H), 7.23 – 7.10 (m, 2H), 6.78 (d, *J* = 11.6 Hz, 0.08H), 6.58 (d, *J* = 10.8 Hz, 0.92H), 6.00 (d, *J* = 11.6 Hz, 0.08H), 5.79 (d, *J* = 11.2 Hz, 0.92H), 2.75 – 2.49 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 190.5, 167.5, 165.0, 136.7, 131.8, 128.9, 116.3, 116.0, 57.5, 44.5, 28.0. ESI-HRMS: calcd for $[C_{19}H_{15}{}^{78.9183}BrFNO_3+Na^+]$ 426.0112, found 426.0116; ESI-HRMS: calcd for $[C_{19}H_{15}{}^{80.9163}BrClNO_3+Na^+]$ 428.0092, found 428.0096.

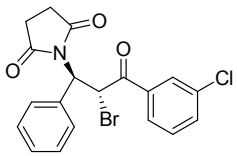


	Retention Time	% Area
1	19.216	40.36
2	24.695	39.88
3	31.769	9.99
4	46.412	9.78

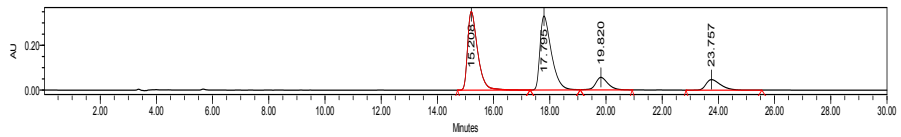


	Retention Time	% Area
1	19.063	91.09
2	24.709	2.87
3	31.686	3.61
4	46.488	2.43

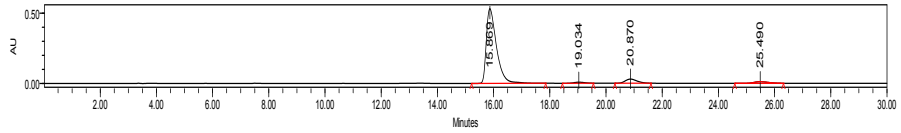
1-((1*R*,2*R*)-2-Bromo-3-(3-chlorophenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3u



Yield: 33.4 mg (80%), white amorphous solid, 92:8 dr [determined by the ratio of area at δ 6.00 (d, *J* = 11.2 Hz, 0.08H) and δ 5.77 (d, *J* = 11.2 Hz, 0.92H) in ^{1}H NMR], 97% ee; $[\alpha]^{24.9}_{D}$ = 80.7 (c = 0.27, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 15.21 min, $t_{R(minor)}$ = 17.80 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.00 (s, 1H), 7.93 – 7. 08 (m, 4H), 7.48 – 7.24 (m, 4H), 6.75 (d, *J* = 11.6 Hz, 0.08H), 6.55 (d, *J* = 10.8 Hz, 0.92H), 6.00 (d, *J* = 11.2 Hz, 0.08H), 5.77 (d, *J* = 11.2 Hz, 0.92H), 2.76 – 2.56 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 190.7, 176.7, 136.5, 135.4, 135.3, 133.9, 130.2, 129.1, 128.9, 127.0, 57.5, 44.7, 28.0. ESI-HRMS: calcd for $[C_{19}H_{15}{}^{78.9183}BrClNO_3+Na^+]$ 441.9817, found 441.9818; ESI-HRMS: calcd for $[C_{19}H_{15}{}^{80.9163}BrClNO_3+Na^+]$ 443.9796, found 443.9792.

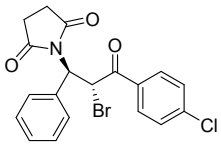


	Retention Time	% Area
1	15.208	40.69
2	17.795	43.42
3	19.820	7.97
4	23.757	7.92

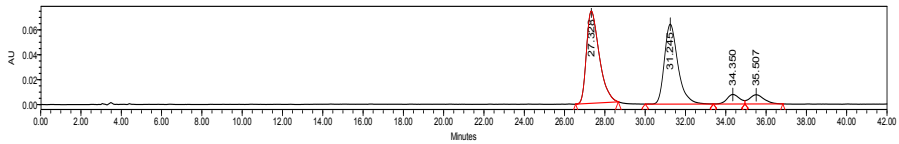


	Retention Time	% Area
1	15.869	90.22
2	19.034	1.22
3	20.870	5.77
4	25.490	2.79

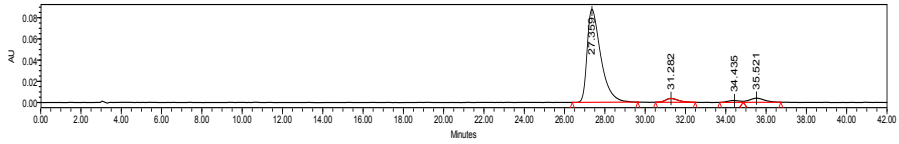
1-((1*R*,2*R*)-2-Bromo-3-(4-chlorophenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3v



Yield: 34.7 mg (83%), white amorphous solid, 91/9 dr [determined by the ratio of area at δ 5.99 (d, *J* = 11.2 Hz, 0.09H) and 5.78 (d, *J* =11.2 Hz, 0.91H) in ^{1}H NMR], 92% ee; $[\alpha]^{24.9}_{D}$ = 51.1 (c = 0.57, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 27.33 min, $t_{R(minor)}$ = 31.25 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.98 (d, *J* = 8.4 Hz, 1.82H), 7.88 (d, *J* = 8.4 Hz, 0.18H), 7.65 − 7.46 (m, 4H), 7.41 − 7.38 (m, 2.73H), 7.23 (d, 0.27H), 6.76 (d, *J* = 11.6 Hz, 0.09H), 6.56 (d, *J* = 11.2 Hz, 0.91H), 5.99 (d, *J* = 11.2 Hz, 0.09H) , 5.78 (d, *J* = 11.2 Hz, 0.91H), 2.74 − 2.48 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 190.8, 176.7, 140.5, 136.6, 132.1, 130.3, 129.3, 129.0, 128.9, 57.5, 44.5, 28.0. ESI-HRMS: calcd for $[C_{19}H_{15}{}^{78.9183}BrClNO_3+Na^+]$ 441.9817, found 441.9822; ESI-HRMS: calcd for $[C_{19}H_{15}{}^{80.9163}BrClNO_3+Na^+]$ 443.9796, found 443.9801.

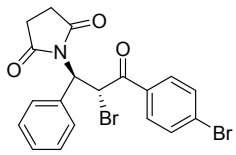


	Retention Time	% Area
1	27.328	46.87
2	31.245	42.87
3	34.350	4.84
4	35.507	5.42

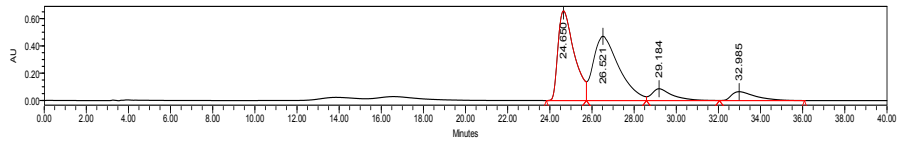


	Retention Time	% Area
1	27.359	90.42
2	31.282	3.49
3	34.435	1.62
4	35.521	4.46

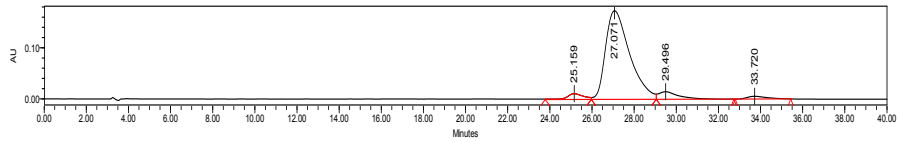
1-((1*R*,2*R*)-2-Bromo-3-(4-bromophenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3w



Yield: 36.5 mg (79%), white amorphous solid, 91/9 dr [determined by the ratio of area at δ 5.99 (d, *J*= 11.6 Hz, 0.09H) and 5.77 (d, *J*= 11.2 Hz, 0.91H) in ^{1}H NMR], 90% ee; $[\alpha]^{24.6}_{D}$ = 57.3 (c = 0.45, CH_2Cl_2); HPLC (Daicel chiralcel ID, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 26.52 min, $t_{R(minor)}$ = 24.65 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.90 (d, *J* = 8.8 Hz, 1.82H), 7.79 (d, *J* = 8.4 Hz, 0.18H), 7.65 − 7.52 (m, 4H), 7.41 − 7.38 (m, 2.73H), 7.23 (d, 0.23H), 6.76 (d, *J* = 11.6 Hz, 0.09H), 6.56 (d, *J* = 11.2 Hz, 0.91H), 5.99 (d, *J* = 11.6 Hz, 0.09H), 5.77 (d, *J* = 11.2 Hz, 0.91H), 2.74 − 2.47 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.0, 176.8, 136.6, 132.5, 132.3, 130.4, 129.4, 129.1, 129.0, 128.9, 57.5, 44.6, 28.0. ESI-HRMS: calcd for $[C_{19}H_{15}{}^{78.9183}Br_2NO_3+Na^+]$ 485.9311, found 485.9313; ESI-HRMS: calcd for $[C_{19}H_{15}{}^{78.9183}Br^{80.9163}BrNO_3+Na^+]$ 487.9291, found 487.9291; ESI-HRMS: calcd for $[C_{19}H_{15}{}^{80.9163}Br_2NO_3+Na^+]$ 489.9270, found 489.9275.

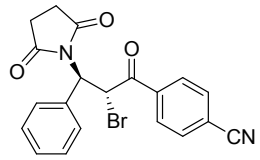


	Retention Time	% Area
1	24.650	40.76
2	26.521	46.43
3	29.184	6.86
4	32.985	5.96

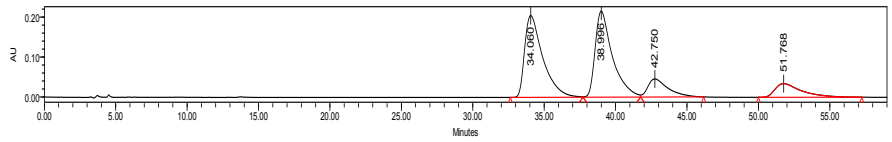


	Retention Time	% Area
1	25.159	3.63
2	27.071	88.23
3	29.496	5.89
4	33.720	2.25

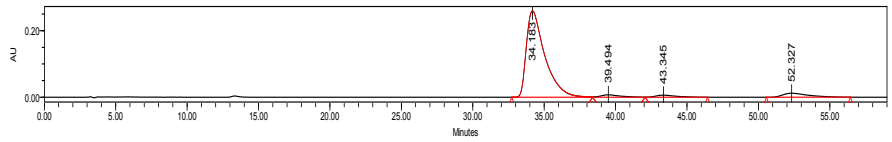
4-((2*R*,3*R*)-2-Bromo-3-(2,5-dioxopyrrolidin-1-yl)-3-phenylpropanoyl)benzonitrile 3x



Yield: 29.5 mg (72%), white amorphous solid, 92:8 dr [determined by the ratio of area at δ 5.98 (d, J = 11.2 Hz, 0.08H) and δ 5.76 (d, J = 11.2 Hz, 0.92H) in ^{1}H NMR], 94% ee; $[\alpha]^{24.9}_D$ = 103.7 (c = 0.38, CH_2Cl_2); HPLC (Daicel chiralcel ID, *n*-hexane /*i*-PrOH 85/15, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 34.06 min, $t_{R(minor)}$ = 39.00 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.13 (d, J = 8.4 Hz, 1.84H), 8.02 (d, J = 8.4 Hz, 0.16H), 7.81 (d, J = 8.4 Hz, 1.84H), 7.75 (d, J = 8.4 Hz, 0.16H), 7.63 – 7.61 (m, 2H), 7.42 – 7.38 (m, 2.76H), 7.25 – 7.24 (m, 0.24H), 6.78 (d, J = 11.6 Hz, 0.08H), 6.57 (d, J = 10.8 Hz, 0.92H), 5.98 (d, J = 11.2 Hz, 0.08H), 5.76 (d, J = 11.2 Hz, 0.92H), 2.76 – 2.53 (m, 4H), ^{13}C NMR (100 MHz, $CDCl_3$) δ = 190.7, 176.9, 137.1, 136.4, 132.7, 129.3, 129.2, 129.0, 128.8, 117.8, 111.7, 57.6, 45.0, 28.0. ESI-HRMS: calcd for $[C_{20}H_{15}{}^{78.9183}BrN_2O_3+Na^+]$ 433.0159, found 433.0162; ESI-HRMS: calcd for $[C_{20}H_{15}{}^{80.9163}BrN_2O_3+Na^+]$ 435.0138, found 435.0138.

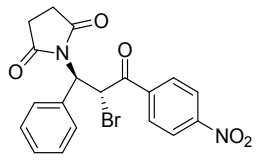


	Retention Time	% Area
1	34.060	40.19
2	38.996	40.13
3	42.750	9.84
4	51.768	9.83

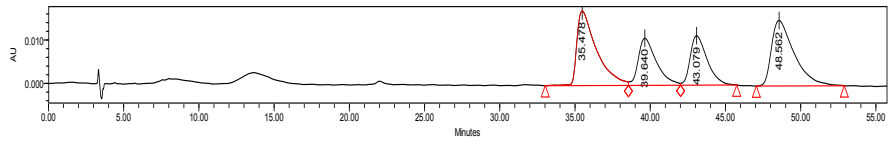


	Retention Time	% Area
1	34.183	89.26
2	39.494	2.61
3	43.345	2.32
4	52.327	5.81

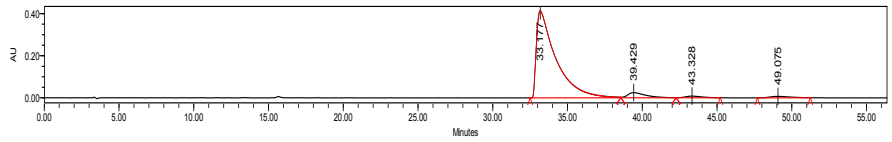
1-((1*R*,2*R*)-2-Bromo-3-(4-nitrophenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3y



Yield: 32.2mg (75%), white amorphous solid, 91/9 dr [determined by ratio of area at δ 5.99 (d, *J* = 11.6 Hz, 0.09H) and δ 5.76 (d, *J* = 11.2 Hz, 0.91H) in ^{1}H NMR] , 92% ee; $[\alpha]^{28.0}_{D}$ = 63.2 (c = 0.74, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 80/20, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 35.49min, $t_{R(minor)}$ = 48.56 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.37 – 8.28 (m, 2H), 8.22 – 8.08 (m, 2H), 7.64 – 7.54 (m, 2H), 7.44 – 7.37 (m, 2.79H), 7.25 (d, 0.21H), 6.81 (d, *J* =11.6 Hz 0.09H), 6.59 (d, *J* = 11.2 Hz, 0.91H), 5.99 (d, *J* = 11.6 Hz, 0.09H) , 5.76 (d, *J* =11.2 Hz, 0.91H), 2.78 – 2.55 (m, 4H), ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.3, 176.6, 148.2, 143.4, 133.5, 130.0, 129.0, 124.1, 56.6, 43.3, 28.0. ESI-HRMS calcd for $[C_{19}H_{15}{}^{78.9183}BrN_2O_5+Na^+]$ 453.0057, found 453.0067; ESI-HRMS: calcd for $[C_{19}H_{15}{}^{80.9163}BrN_2O_5+Na^+]$ 455.0037, found 455.0045.

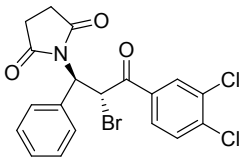


	Retention Time	% Area
1	35.478	31.57
2	39.640	18.41
3	43.079	18.00
4	48.562	32.02

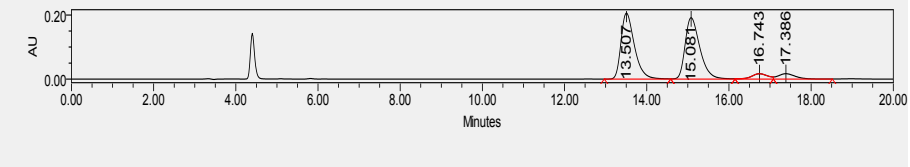


	Retention Time	% Area
1	33.177	91.89
2	39.429	5.11
3	43.328	1.45
4	49.075	1.55

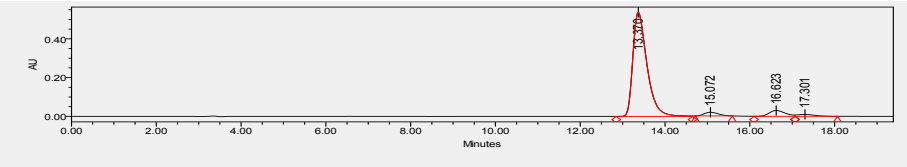
1-((1*R*,2*R*)-2-Bromo-3-(3,4-dichlorophenyl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3z



Yield: 34.5 mg (76%), white amorphous solid, 93:7 dr [determined by the ratio of area at δ 5.98 (d, *J* = 11.2 Hz, 0.07H)) and δ 5.75 (d, *J* = 11.2 Hz, 0.93H) in ^{1}H NMR], 92% ee; $[\alpha]^{24.6}_{D}$ = 74.0 (c = 0.48, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 13.51 min, $t_{R(minor)}$ = 15.08 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.11 (d, *J*= 2.0 Hz, 0.93H), 8.00 (d, *J*= 2.4 Hz, 0.07H), 7.88 – 7.75 (m, 1H), 7.64 – 7.37 (m, 5.79H), 7.25 – 7.24 (t, 0.21H), 6.72 (d, *J*= 11.6 Hz, 0.07H), 6.50 (d, *J*= 11.2 Hz, 0.93H), 5.98 (d, *J*= 11.2 Hz, 0.07H), 5.75 (d, *J*= 11.2 Hz, 0.93H) 2.76 – 2.52 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ= 189.8, 176.8, 138.7, 136.5, 133.7, 133.3, 131.0, 130.8, 129.1, 129.0, 128.9, 127.9, 57.5, 44.7, 28.0. ESI-HRMS: calcd for $[C_{19}H_{14}{}^{78.9183}BrCl_2NO_3+Na^+]$ 475.9427, found 475.9424; ESI-HRMS: calcd for $[C_{19}H_{14}{}^{80.9163}BrCl_2NO_3+Na^+]$ 477.9406, found 477.9389.

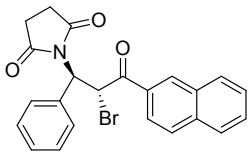


	Retention Time	% Area
1	13.507	45.02
2	15.081	45.87
3	16.743	4.38
4	17.386	4.72

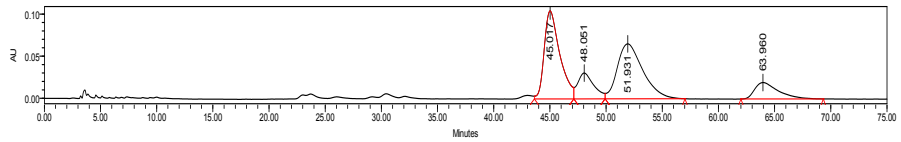


	Retention Time	% Area
1	13.370	89.07
2	15.072	3.16
3	16.623	5.78
4	17.301	1.98

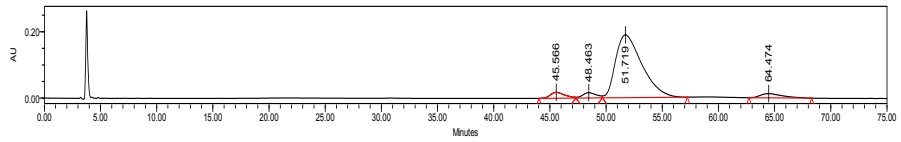
1-((1*R*,2*R*)-2-Bromo-3-(naphthalen-2-yl)-3-oxo-1-phenylpropyl)pyrrolidine-2,5-dione 3aa



Yield: 35.7 mg (82%), white amorphous solid, 91:9 dr [determined by the ratio of area at δ 6.10 (d, *J* = 11.6 Hz, 0.09H) and δ 5.88 (d, *J* =_11.2 Hz, 0.91H) in ^{1}H NMR], 91% ee; $[\alpha]^{24.9}_{D}$ = 9.6 (c = 0.36, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/*i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 48.05 min, $t_{R(minor)}$ = 45.02 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.60 (s, 1H), 8.06 – 7.70 (m, 6H), 7.62 – 7.50 (m, 2H), 7.43 – 7.36 (m, 2.73H), 7.24 – 7.19 (m, 0.26H), 7.00 (d, *J*=11.6 Hz, 0.09H), 6.81 (d, *J* =11.2 Hz, 0.91H), 6.10 (d, *J*= 11.6 Hz, 0.09H), 5.88 (d, *J*= 11.2 Hz, 0.91H), 2.73 – 2.47 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 192.0, 176.8, 136.8, 136.0, 132.5, 131.1, 130.9, 129.9, 129.0, 128.9, 127.8, 127.0, 124.2, 57.5, 44.6, 28.0. ESI-HRMS: calcd for $[C_{23}H_{18}{}^{78.9183}BrNO_3+Na^+]$ 458.0363, found 458.0371 ; ESI-HRMS: calcd for $[C_{23}H_{18}{}^{80.9163}BrNO_3+Na^+]$ 460.0342, found 460.0343.

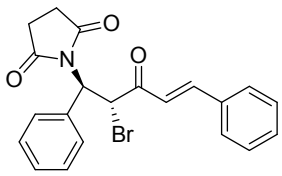


	Retention Time	% Area
1	45.017	38.28
2	48.051	11.69
3	51.931	39.16
4	63.960	10.87

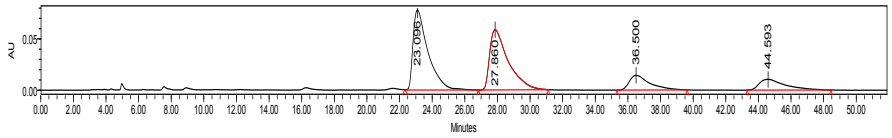


	Retention Time	% Area
1	45.566	4.46
2	48.463	3.82
3	51.719	86.87
4	64.474	4.85

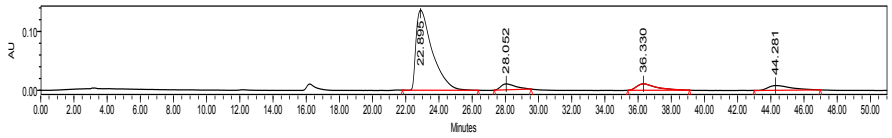
1-((1*R*,2*R*,*E*)-2-Bromo-3-oxo-1,5-diphenylpent-4-en-1-yl)pyrrolidine-2,5-dione 3ab



Yield: 34.5 mg (84%), white amorphous solid, 85/15 dr [determined by ratio of area at δ 5.87 (d, *J* = 12.0 Hz, 0.15H) and δ 5.72 (d, *J* = 11.2 Hz, 0.85H) in ^{1}H NMR], 86% ee; $[\alpha]^{24.6}_{D}$ = 56.4 (c = 0.57, CH_2Cl_2); HPLC (Daicel chiralcel ID, *n*-hexane/*i*-PrOH 85/15, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 23.10 min, $t_{R(minor)}$ = 27.86 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, 1H), 7.61 – 7.36 (m, 10H), 6.92 (d, *J* =16.0 Hz, 0.85H), 6.82 (d, *J* = 16.0 Hz, 0.15H), 6.21 (d, *J* = 11.6 Hz, 0.15H), 6.01 (d, *J* = 11.6 Hz, 0.85H), 5.87 (d, *J* = 12.0 Hz, 0.15H), 5.72 (d, *J* = 11.2 Hz, 0.85H), 2.74 – 2.55 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.0, 176.6, 145.5, 131.2, 128.9, 128.8, 122.4, 57.2, 48.4, 28.0. ESI-HRMS: calcd for $[C_{21}H_{18}{}^{78.9183}BrNO_3+Na^+]$ 434.0363, found 434.0371; ESI-HRMS: calcd for $[C_{21}H_{18}{}^{80.9163}BrNO_3+Na^+]$ 436.0342, found 436.0354.

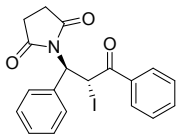


	Retention Time	% Area
1	23.096	41.42
2	27.860	38.53
3	36.500	10.38
4	44.593	9.67

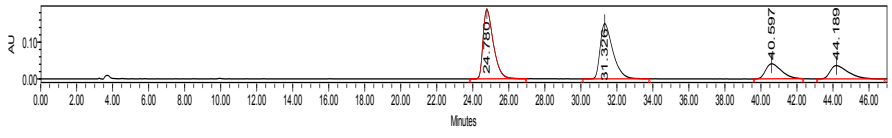


	Retention Time	% Area
1	22.895	80.02
2	28.052	5.40
3	36.330	7.89
4	44.281	6.68

1-((1*R*,2*R*)-2-Iodo-3-oxo-1,3-diphenylpropyl)pyrrolidine-2,5-dione **4a**

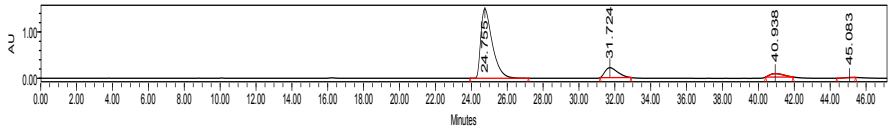


Yield: 32.5 mg (75%), white amorphous solid, 96/4 dr [determined by ratio of area at δ 6.01 (d, J = 11.6 Hz, 0.04H) and δ 5.88 (d, J = 11.6 Hz, 0.96H) in ^{1}H NMR], 73% ee; HPLC (Daicel chiralcel IE, *n*-hexane/ *i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 24.78 min, $t_{R(minor)}$ = 31.33 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 – 7.92 (m, 2H), 7.68 – 7.37 (m, 8H), 7.10 (d, J = 11.6 Hz, 0.04H), 6.85 (d, J = 11.6 Hz, 0.96H), 6.01 (d, J = 11.6 Hz, 0.04H), 5.88 (d, J = 11.6 Hz, 0.96H), 2.76 – 2.49 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 193.6, 176.6, 137.5, 133.8, 133.6, 129.1, 129.0, 128.9, 128.7, 58.7, 27.9, 25.1. ESI-HRMS: calcd for [$C_{19}H_{16}INO_3$+Na^+] 456.0068, found 456.0081.



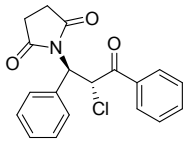
	Retention Time	% Area

1	24.780	37.81
2	31.326	36.90
3	40.597	12.63
4	44.189	12.67

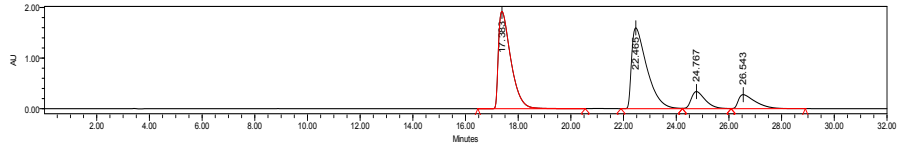


	Retention Time	% Area
1	24.755	82.07
2	31.724	12.87
3	40.938	4.83
4	45.083	0.23

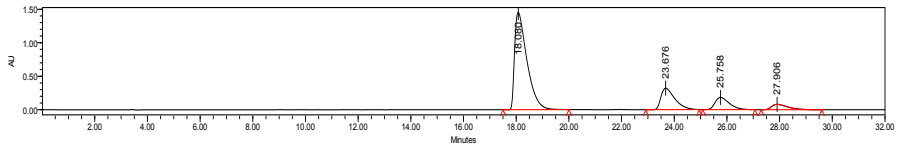
1-((1*R*,2*R*)-2-Chloro-3-oxo-1,3-diphenylpropyl)pyrrolidine-2,5-dione **5a**



Yield: 23.2 mg (68%), white amorphous solid, 85/15 dr [determined by ratio of area at δ 5.96 (d, J = 11.2 Hz, 0.15H) and δ 5.71 (d, J = 10.8 Hz, 0.85H) in ^{1}H NMR], 69% ee; $[\alpha]^{28.0}_D$ = 55.1 (c = 0.65, CH_2Cl_2); HPLC (Daicel chiralcel IE, *n*-hexane/ *i*-PrOH 90/10, 1.0 mL/min, 254 nm) $t_{R(major)}$ = 17.38 min, $t_{R(minor)}$ = 22.47 min; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 – 8.04 (m, 2H), 7.67 – 7.45 (m, 5H), 7.40 – 7.37 (m, 2.70H), 7.23 – 7.21 (m, 0.30H), 6.72 (d, J = 11.6 Hz, 0.15H), 6.60 (d, J = 11.2 Hz, 0.85H), 5.96 (d, J = 11.2 Hz, 0.15H), 5.71 (d, J = 10.8 Hz, 0.85H), 2.75 – 2.50 (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 191.9, 176.8, 136.3, 134.1, 133.8, 129.1, 129.0, 128.8, 122.4, 57.3, 53.7, 28.0. ESI-HRMS: calcd for [$C_{19}H_{16}ClNO_3$+Na^+] 364.0711, found 364.0712.

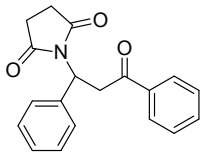


	Retention Time	% Area
1	17.383	41.24
2	22.465	42.40
3	24.767	8.23
4	26.543	8.13

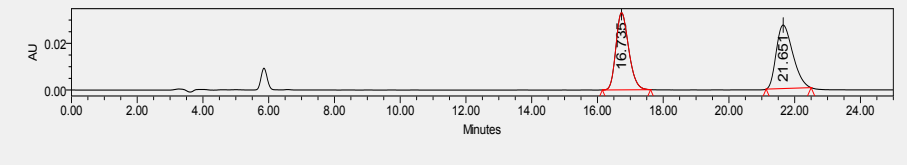


	Retention Time	% Area
1	18.080	68.28
2	23.676	16.96
3	25.758	9.91
4	27.906	4.85

1-(3-oxo-1,3-Diphenylpropyl)pyrrolidine-2,5-dione **7**

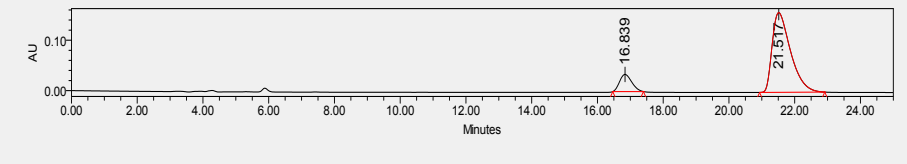


(1) without base, yield: trace; (2) base Et_3N, yield: 6.45 mg (21%), ee: 75%; (3) base DIPA, yield: 4.6 mg (15%), ee: 33%, white amorphous solid,^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, 2H), 7.67 – 7.56 (d, 3H), 7.45 (t, 2H), 7.36 – 7.29 (m, 3H), 5.90 – 5.86 (d, 1H), 4.62 – 4.55 (d, 1H), 3.70 – 3.64 (d, 1H), 2.62 (s, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 197.0, 177.4, 138.8, 136.4, 133.5, 128.8, 128.7, 128.3, 128.1, 128.0, 51.2, 39.2, 28.0. ESI-HRMS: calcd for [$C_{19}H_{16}ClNO_3$+Na^+] 330.1101, found 330.1108.



	Retention Time	% Area
1	16.735	48.40
2	21.651	51.60

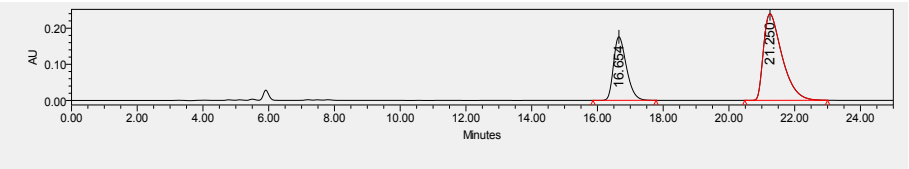
(2) base: TEA



	Retention Time	% Area
1	16.839	12.39

2	21.517	87.61

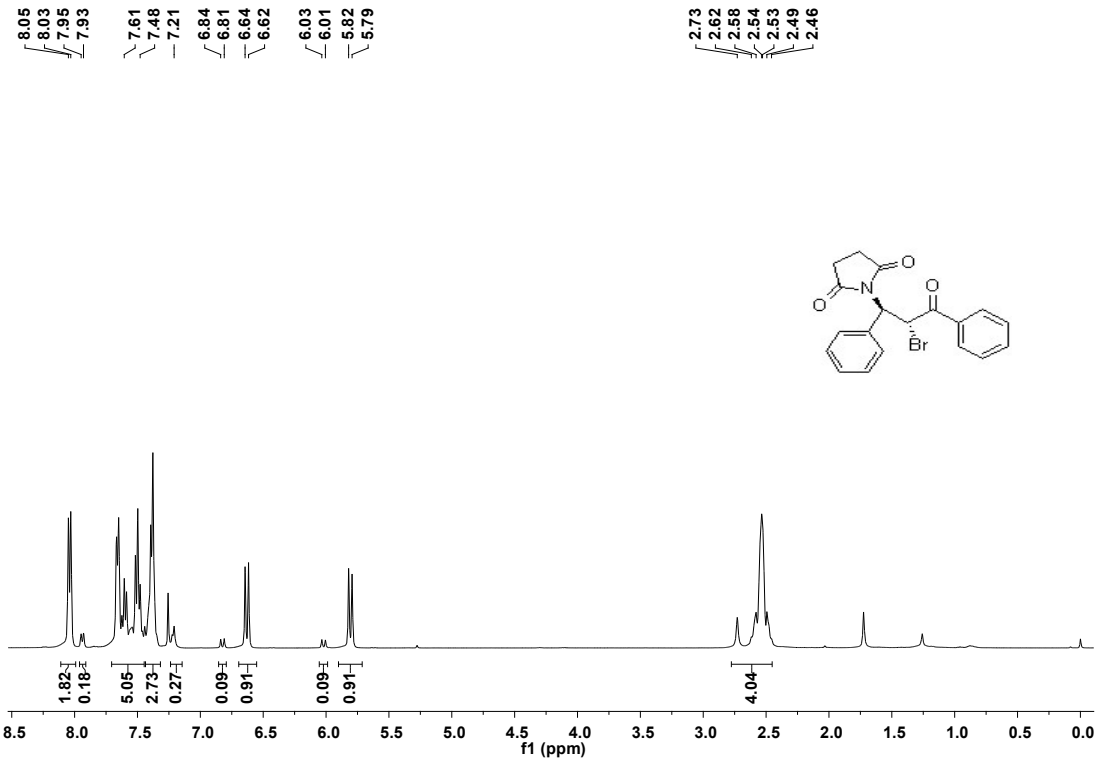
(3) base: DIPA

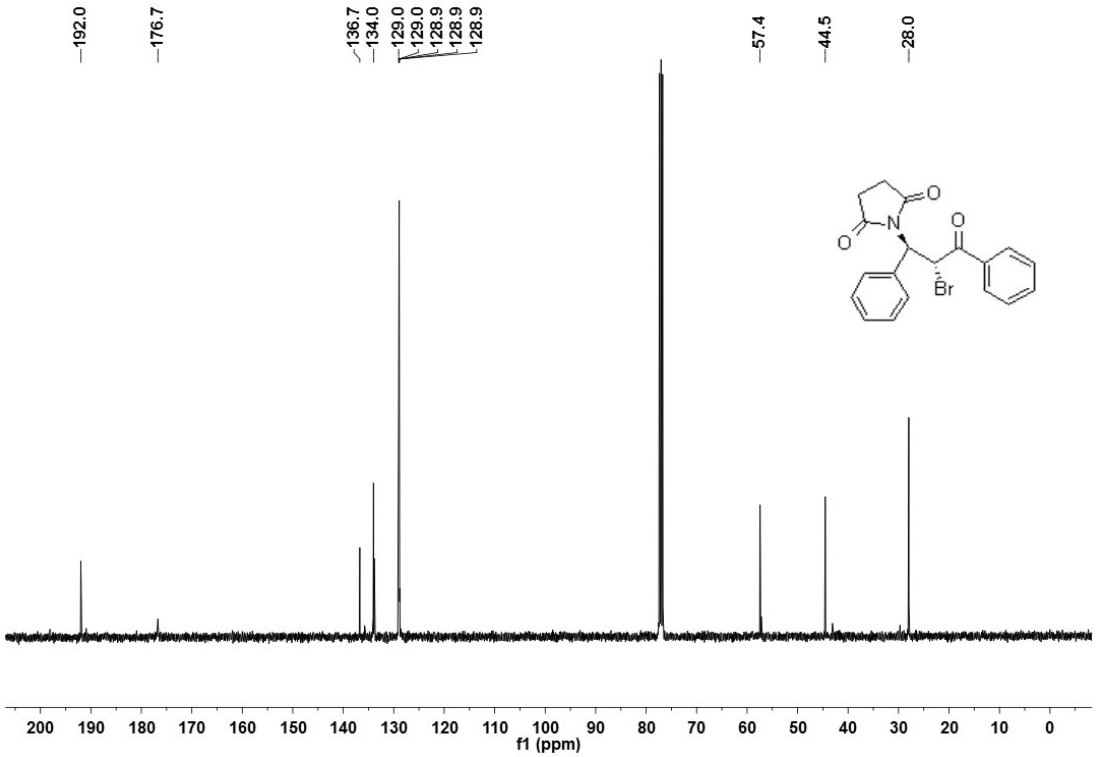


	Retention Time	% Area
1	16.654	33.78
2	21.250	66.22

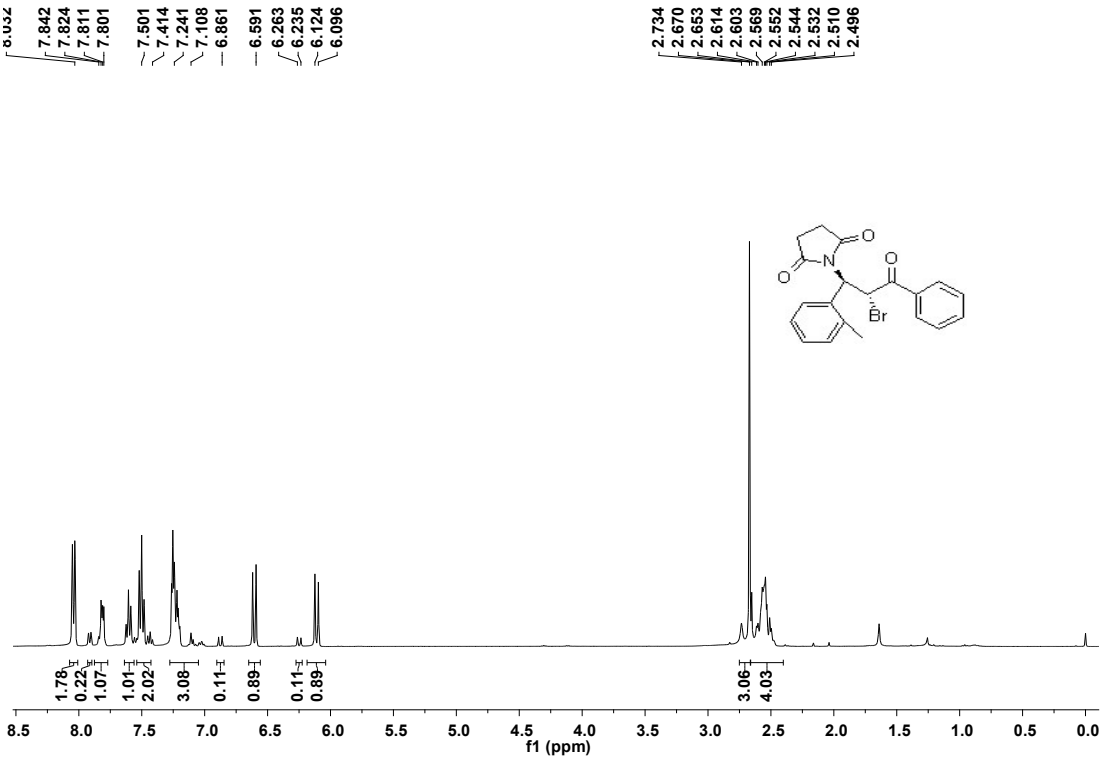
7. Copies of ^{1}H NMR and ^{13}C NMR Spectra for Product

3a





3b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7.811
7.801
7.501
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7.241
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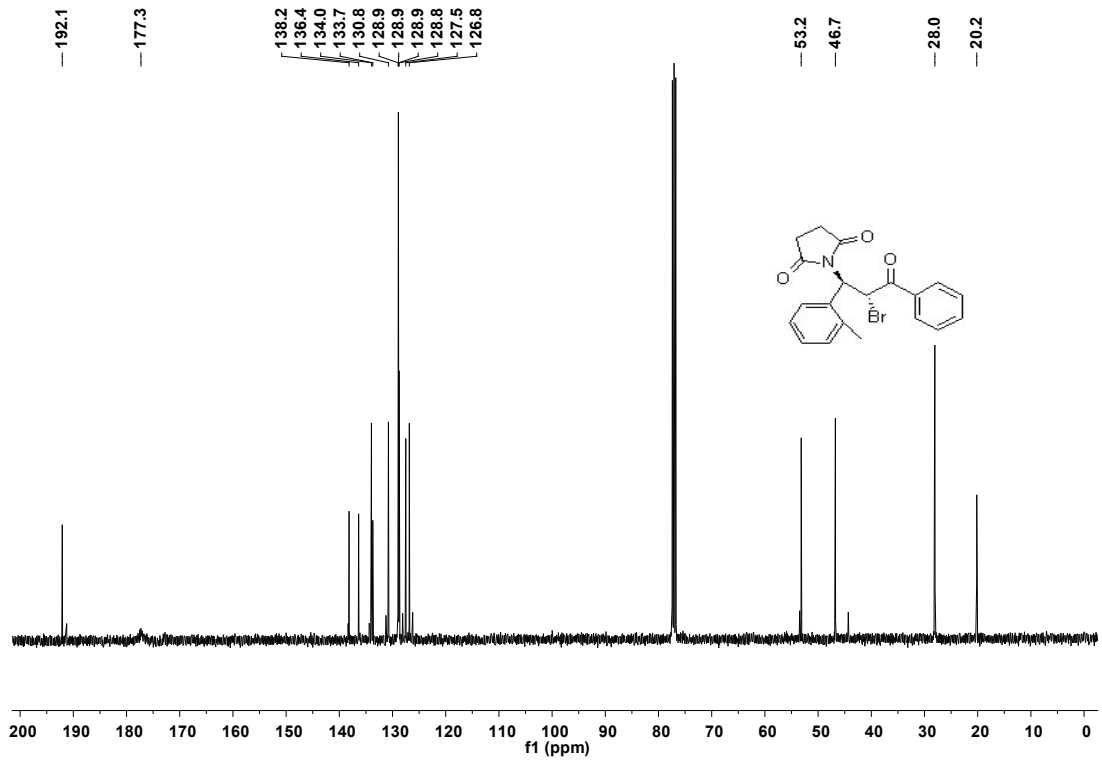
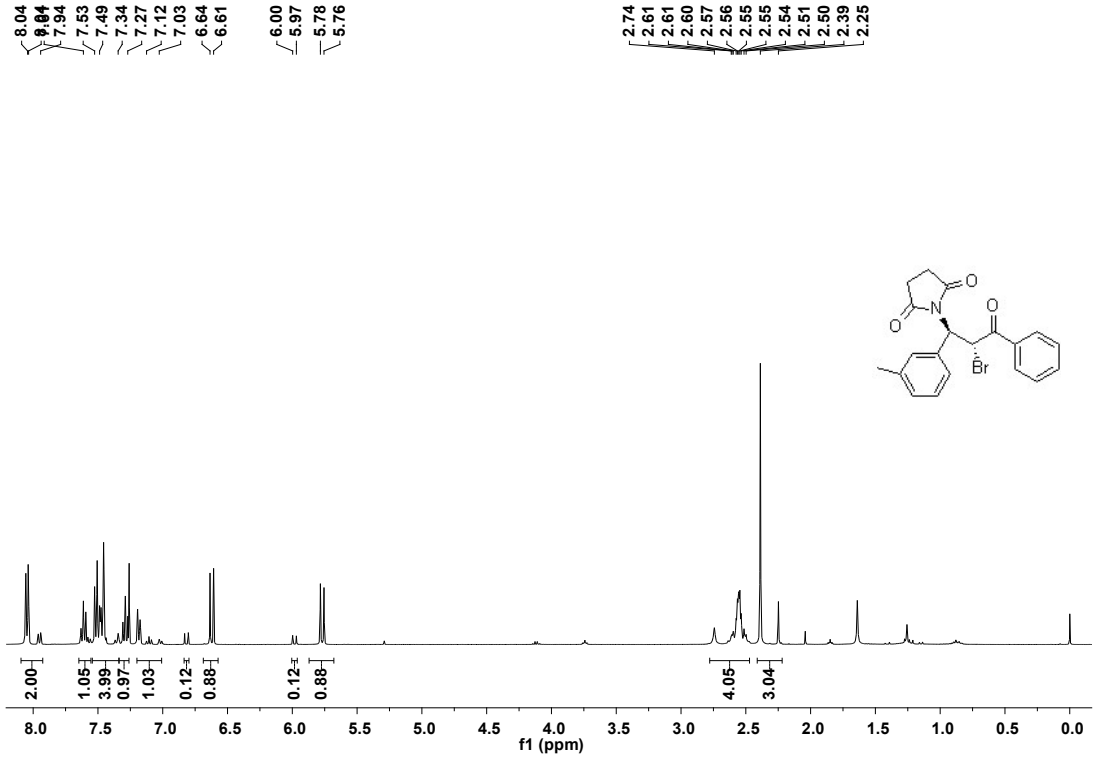
6.861
6.591
6.263
6.235
6.124
6.096
2.734
2.670
2.653
2.614
2.603
2.569
2.552
2.544
2.532
2.510
2.496
1.78
0.22
1.07
1.01
2.02
3.08
0.11
0.89
0.11
0.89
3.06
4.03
f1 (ppm)


192.1
177.3
138.2
136.4
134.0
133.7
130.8
128.9
128.9
128.9
128.8
127.5
126.8
53.2
46.7
28.0
20.2
f1 (ppm)

3c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7.94
7.53
7.49
7.34
7.27
7.12
7.03
6.64
6.61
6.00
5.97
5.78
5.76
2.74
2.61
2.61
2.60
2.57
2.56
2.55
2.55
2.54
2.51
2.50
2.39
2.25
O
O
N
O
Br
2.00
1.05
3.99
0.97
1.03
0.12
0.88
0.12
0.88
4.05
3.04
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
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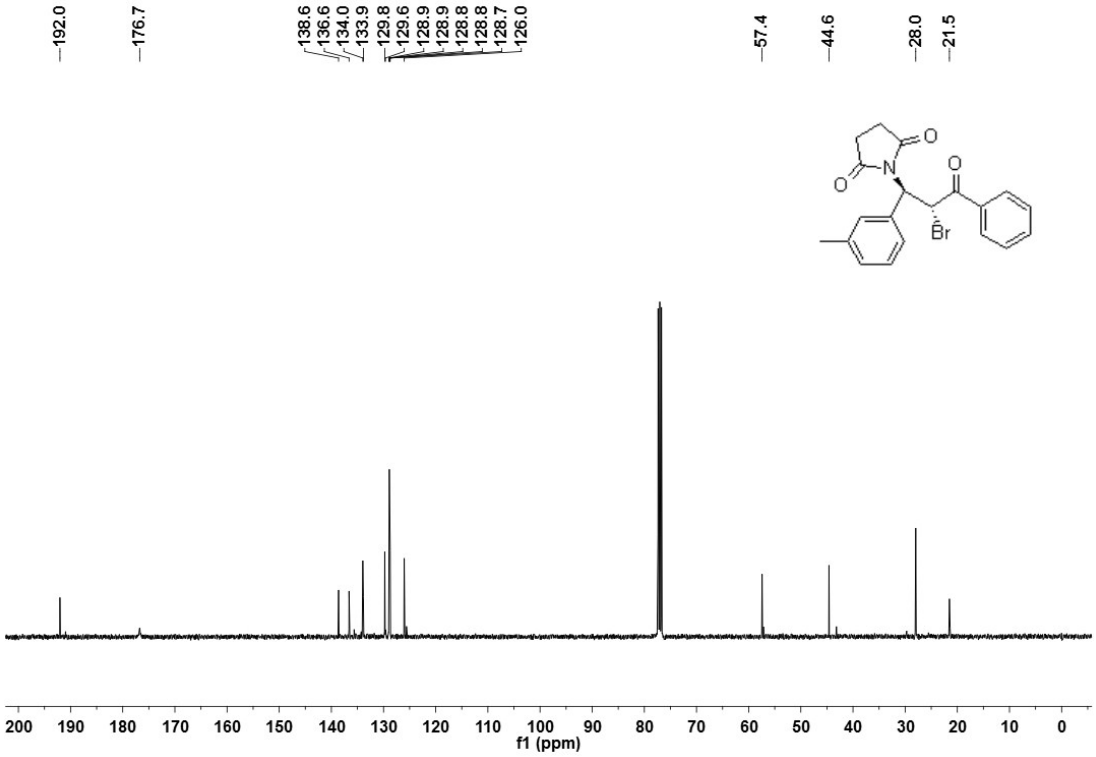
1.5
1.0
0.5
0.0
f1 (ppm)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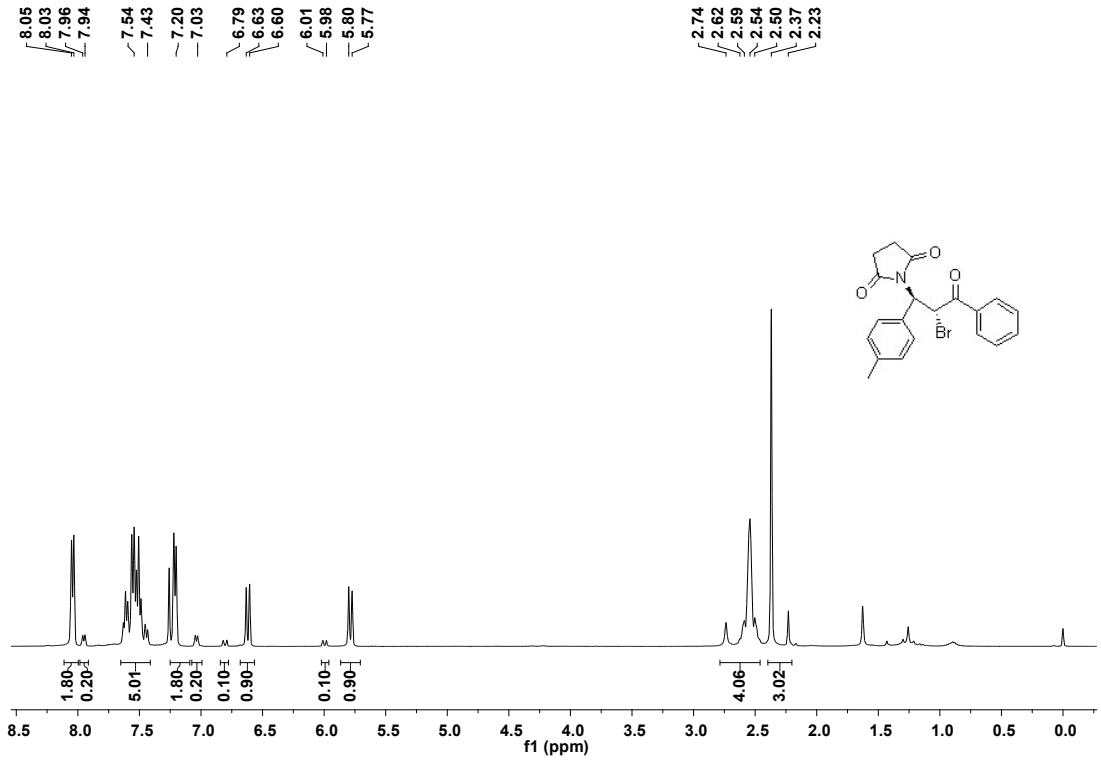
176.7
138.6
136.6
134.0
133.9
129.8
129.6
128.9
128.9
128.8
128.8
128.7
126.0
57.4
44.6
28.0
21.5
O
O
N
O
Br
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3d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8.03
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7.94
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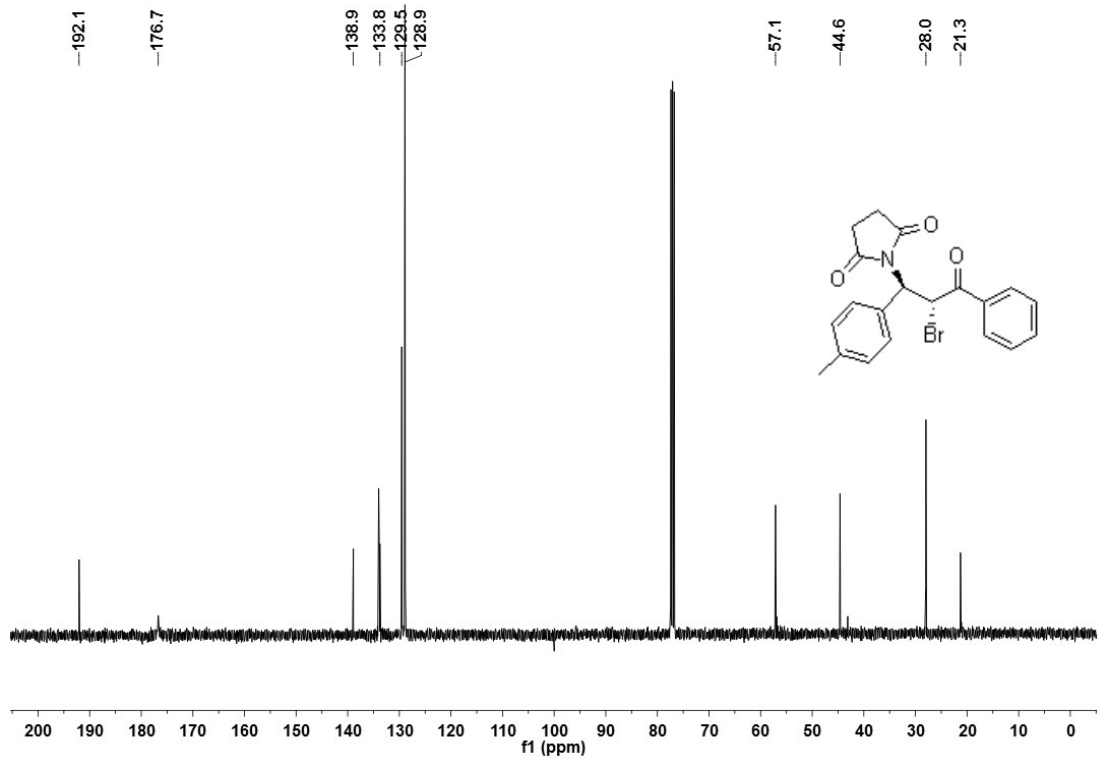
7.43
7.20
7.03
6.79
6.63
6.60
6.01
5.98
5.80
5.77
2.74
2.62
2.59
2.54
2.50
2.37
2.23
O
O
N
O
Br
1.80
0.20
5.01
1.80
0.20
0.10
0.90
0.10
0.90
4.06
3.02
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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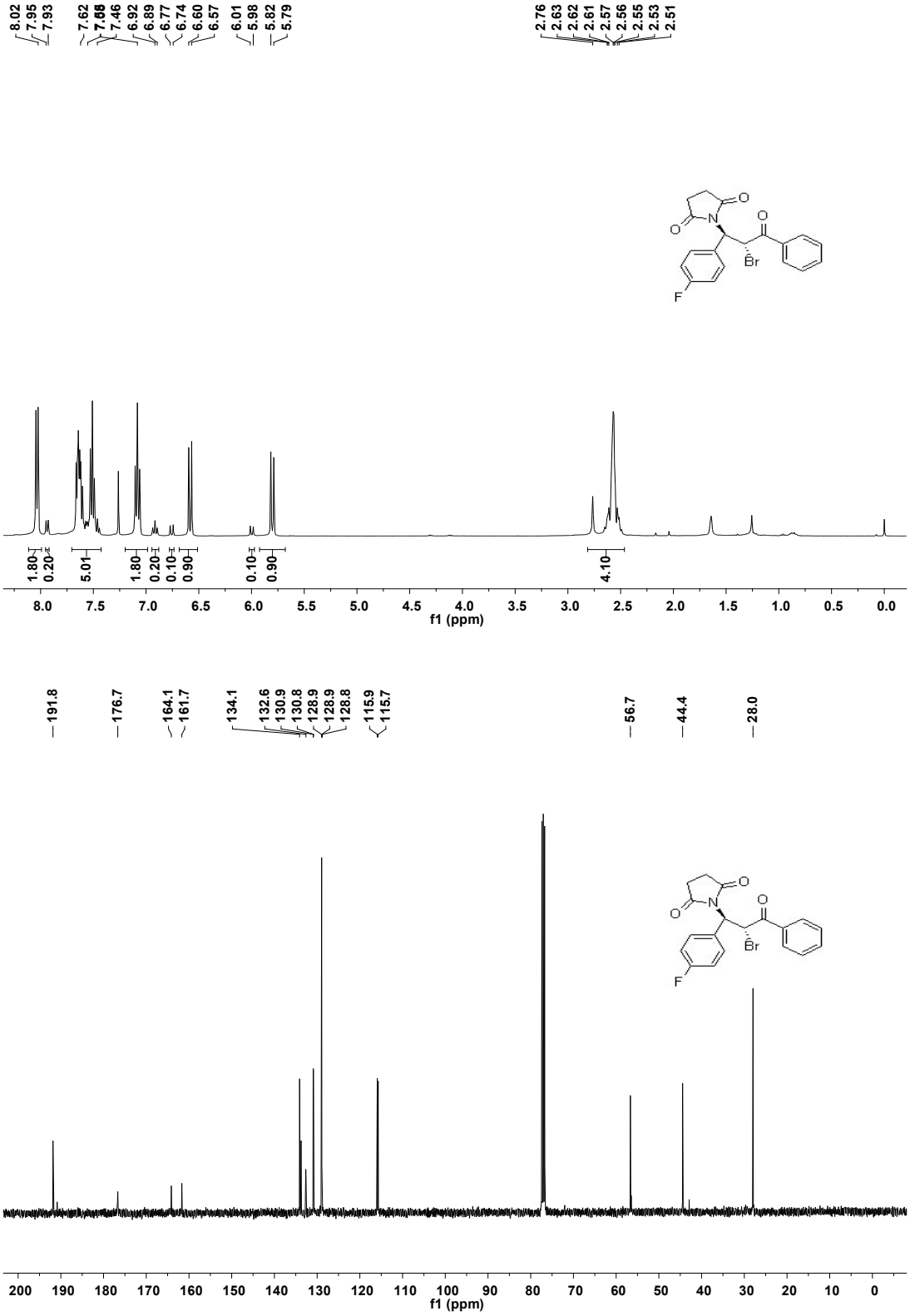
176.7
138.9
133.8
129.5
128.9
57.1
44.6
28.0
21.3
O
O
N
O
Br
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3e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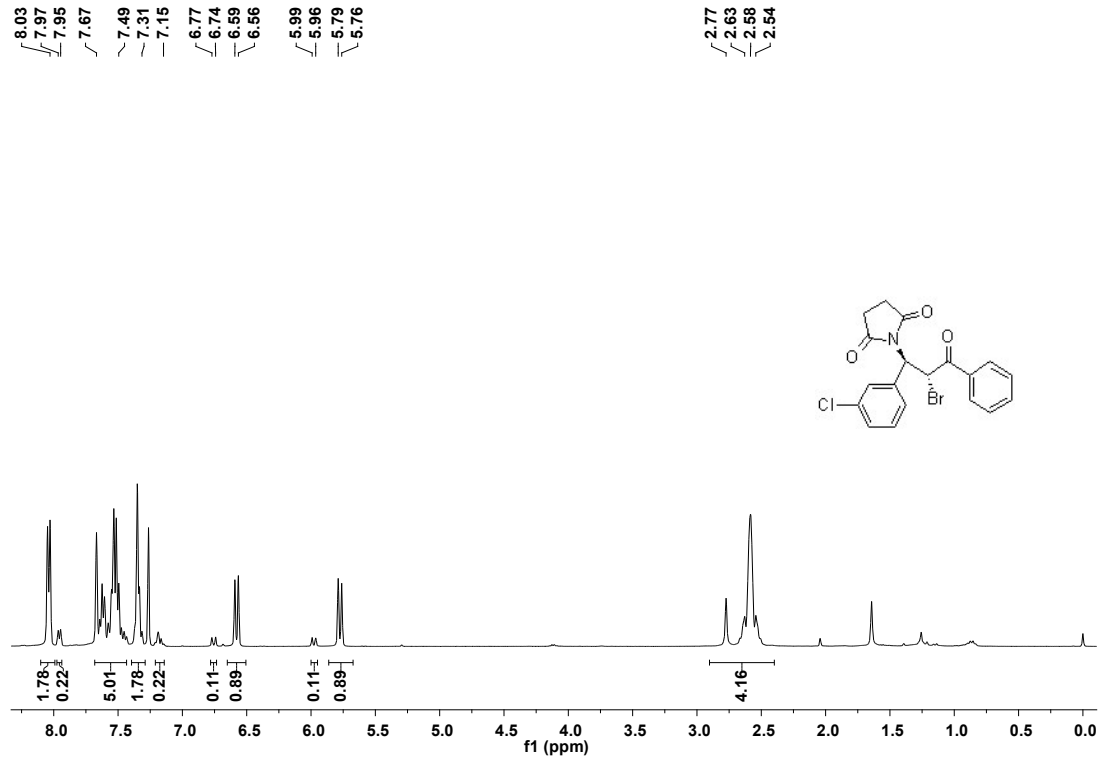
7.62
7.46
6.92
6.89
6.77
6.74
6.60
6.57
6.01
5.98
5.82
5.79
2.76
2.63
2.62
2.61
2.57
2.56
2.55
2.53
2.51
O
O
N
O
Br
F
1.80
0.20
5.01
1.80
0.20
0.10
0.90
0.10
0.90
4.10
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
191.8
176.7
164.1
161.7
134.1
132.6
130.9
130.8
128.9
128.9
128.8
115.9
115.7
56.7
44.4
28.0
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3f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7.15
6.77
6.74
6.59
6.56
5.99
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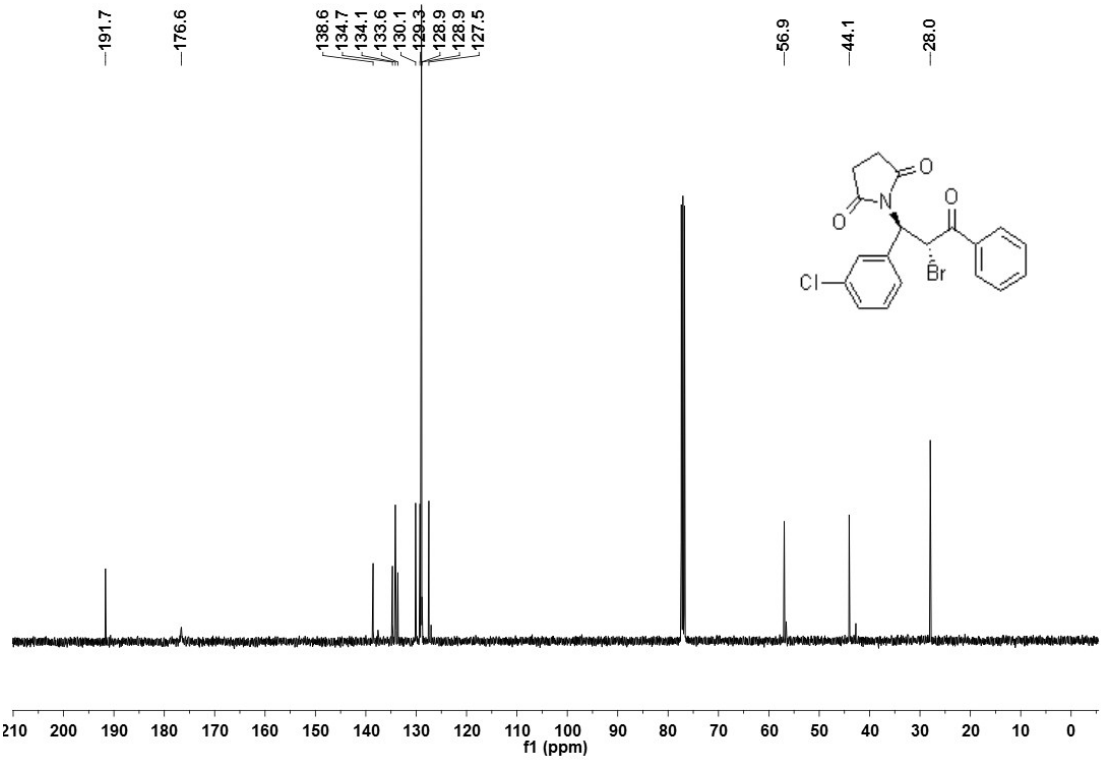
2.58
2.54
O
O
N
O
Cl
Br
1.78
0.22
5.01
1.78
0.22
0.11
0.89
0.11
0.89
4.16
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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176.6
138.6
134.7
134.1
133.6
130.1
129.3
128.9
128.9
127.5
56.9
44.1
28.0
O
O
N
O
Cl
Br
210
200
190
180
170
160
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140
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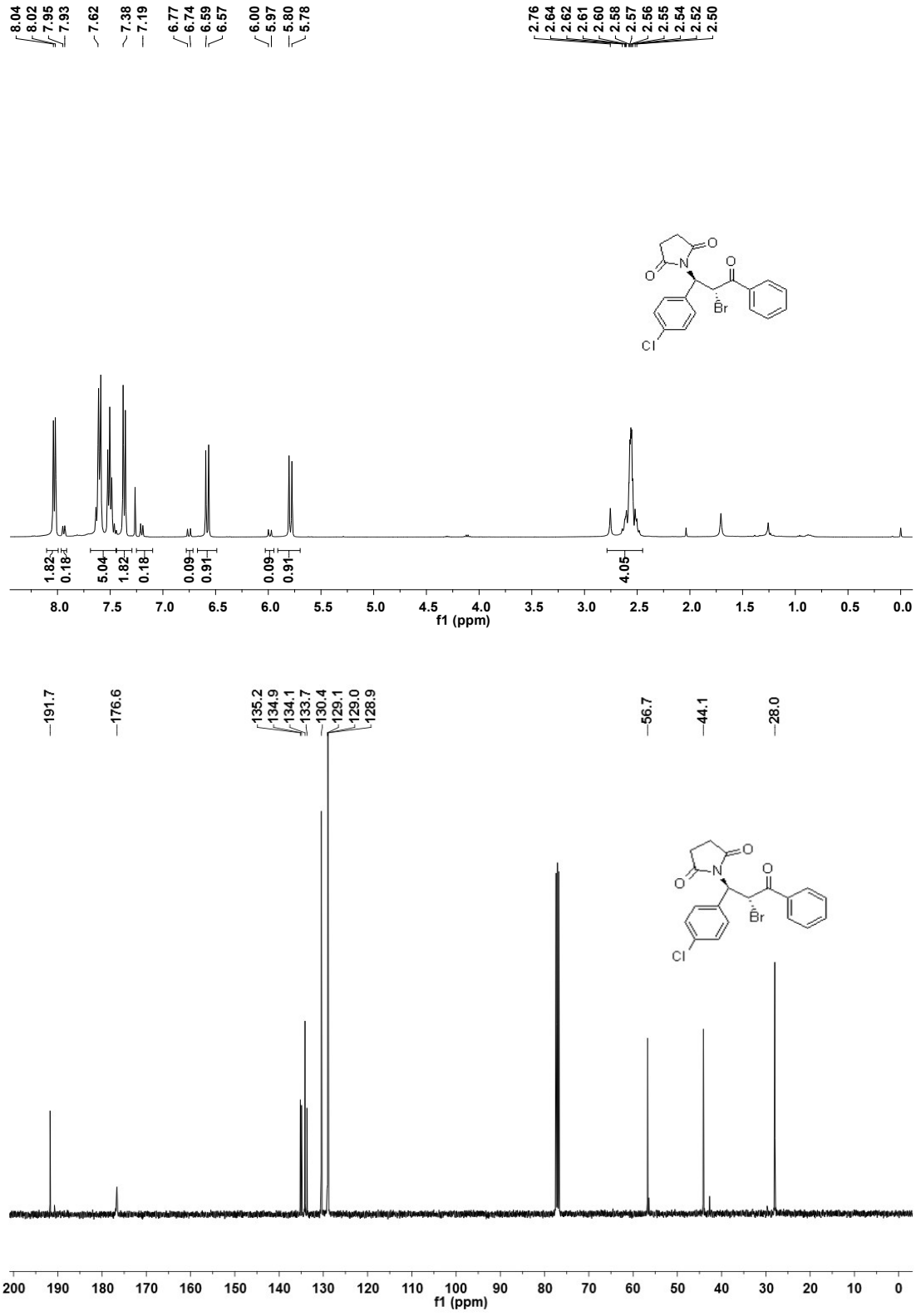
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3g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6.57
6.00
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O
O
N
O
Br
Cl
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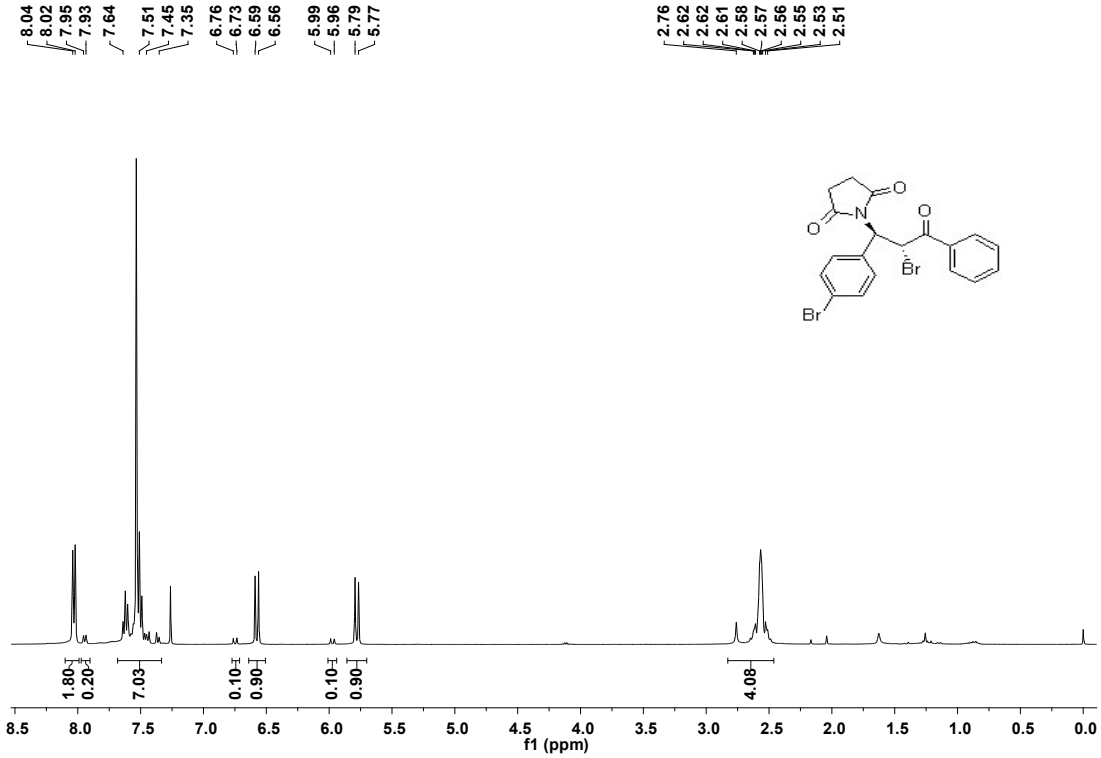
0.18
5.04
1.82
0.18
0.09
0.91
0.09
0.91
4.05
f1 (ppm)
191.7
176.6
135.2
134.9
134.1
133.7
130.4
129.1
129.0
128.9
56.7
44.1
28.0
f1 (ppm)

3h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7.93
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7.51
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6.73
6.59
6.56
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5.79
5.77
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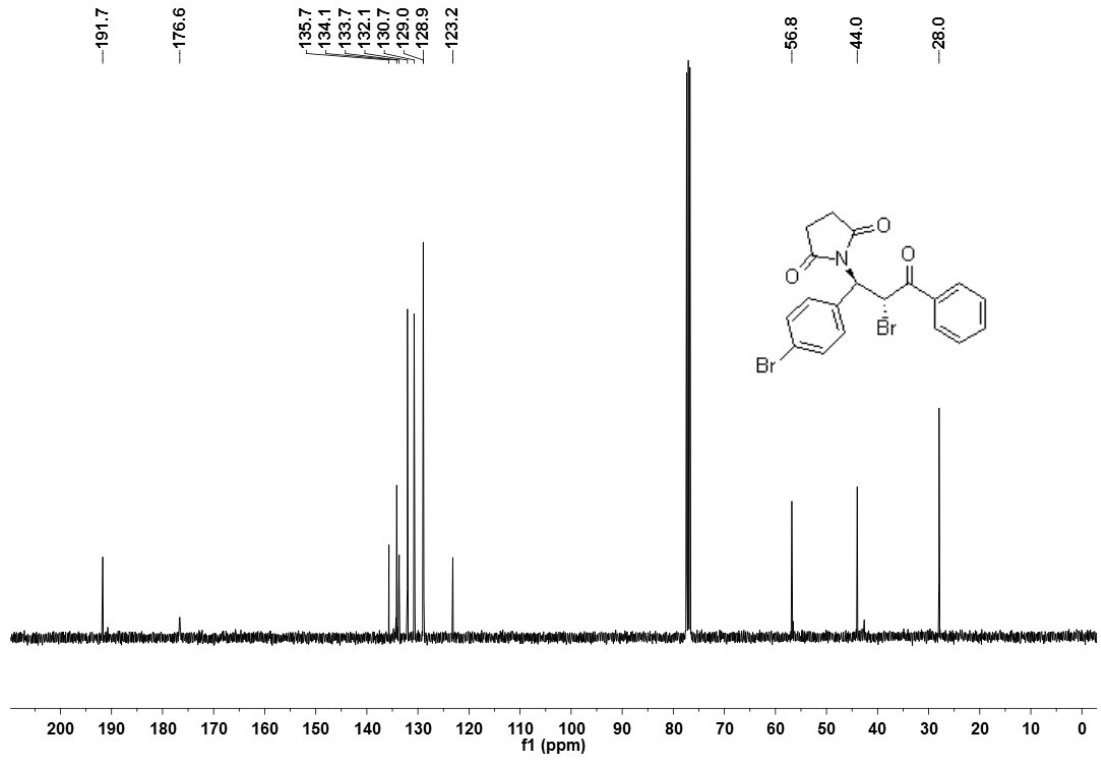
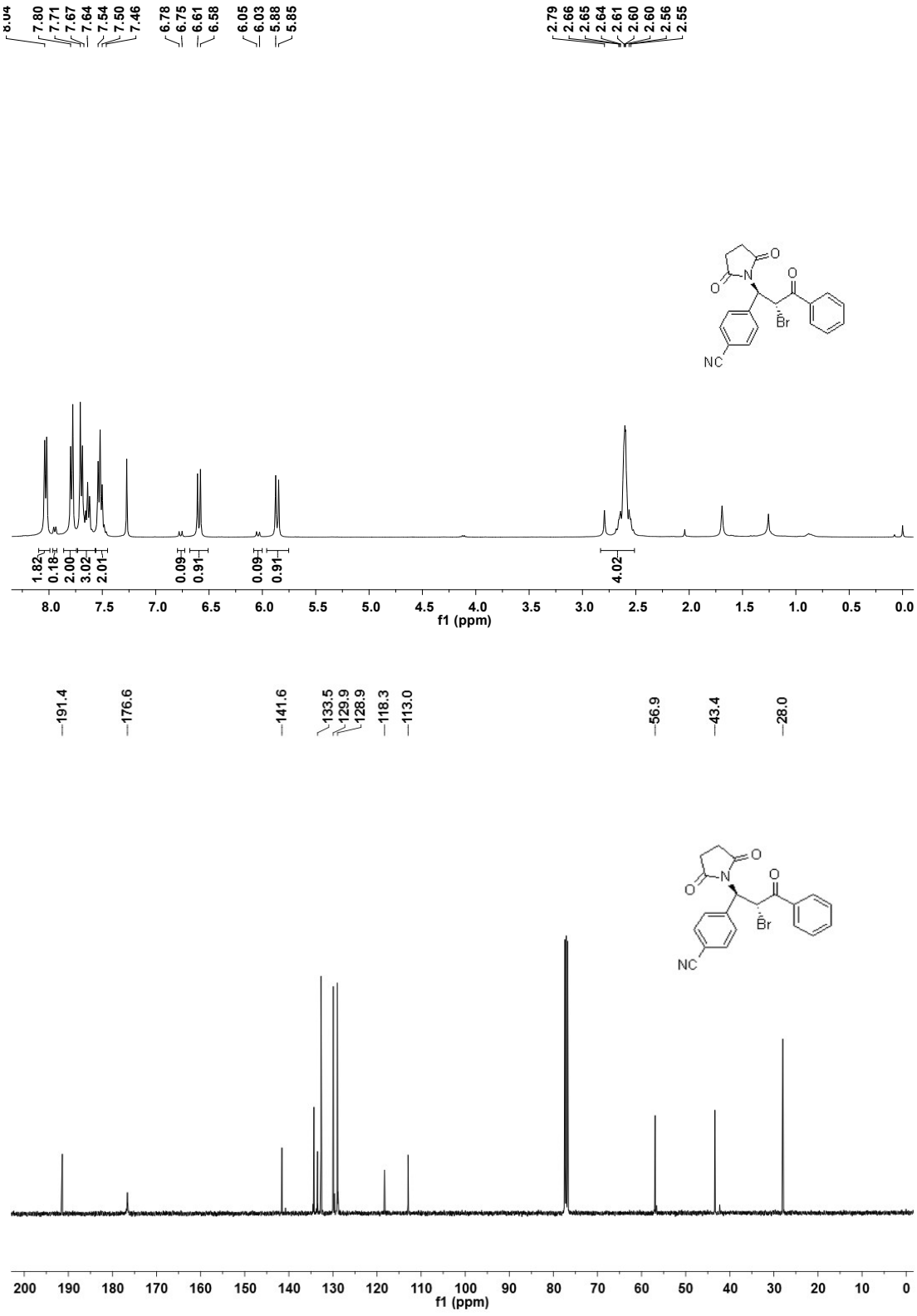
2.61
2.58
2.57
2.56
2.55
2.53
2.51
O
O
N
O
Br
Br
1.80
0.20
7.03
0.10
0.90
0.10
0.90
4.08
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


191.7
176.6
135.7
134.1
133.7
132.1
130.7
129.0
128.9
123.2
56.8
44.0
28.0
O
O
N
O
Br
Br
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3i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7.46
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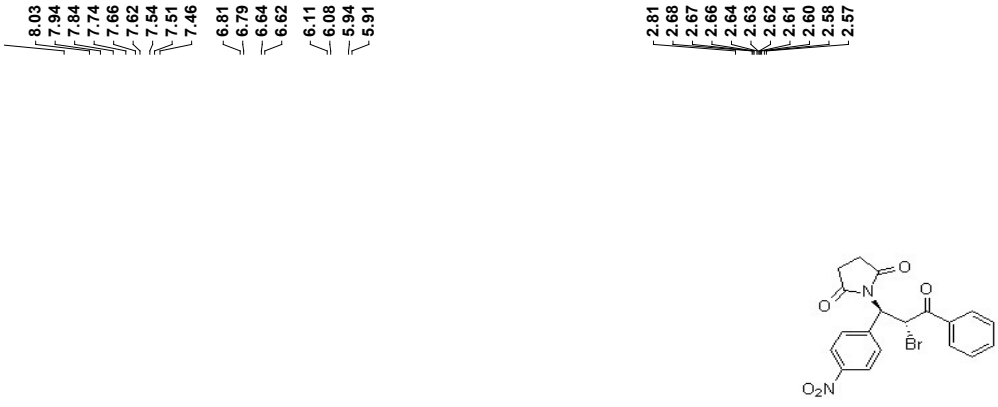
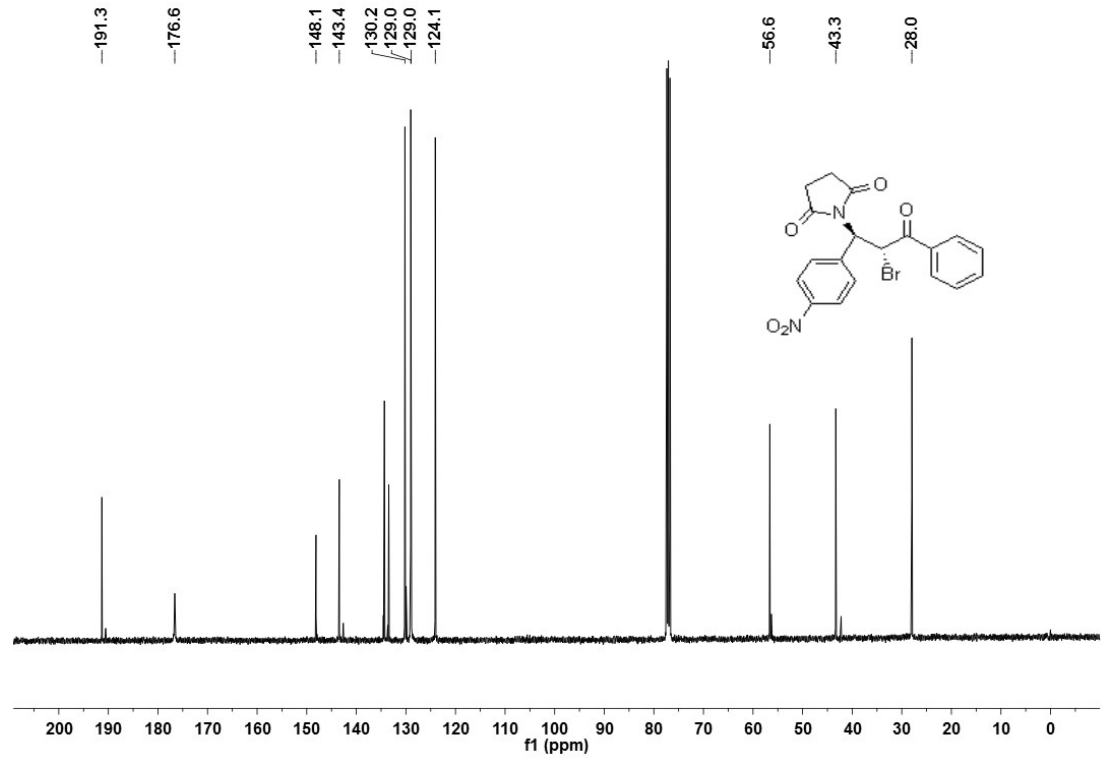
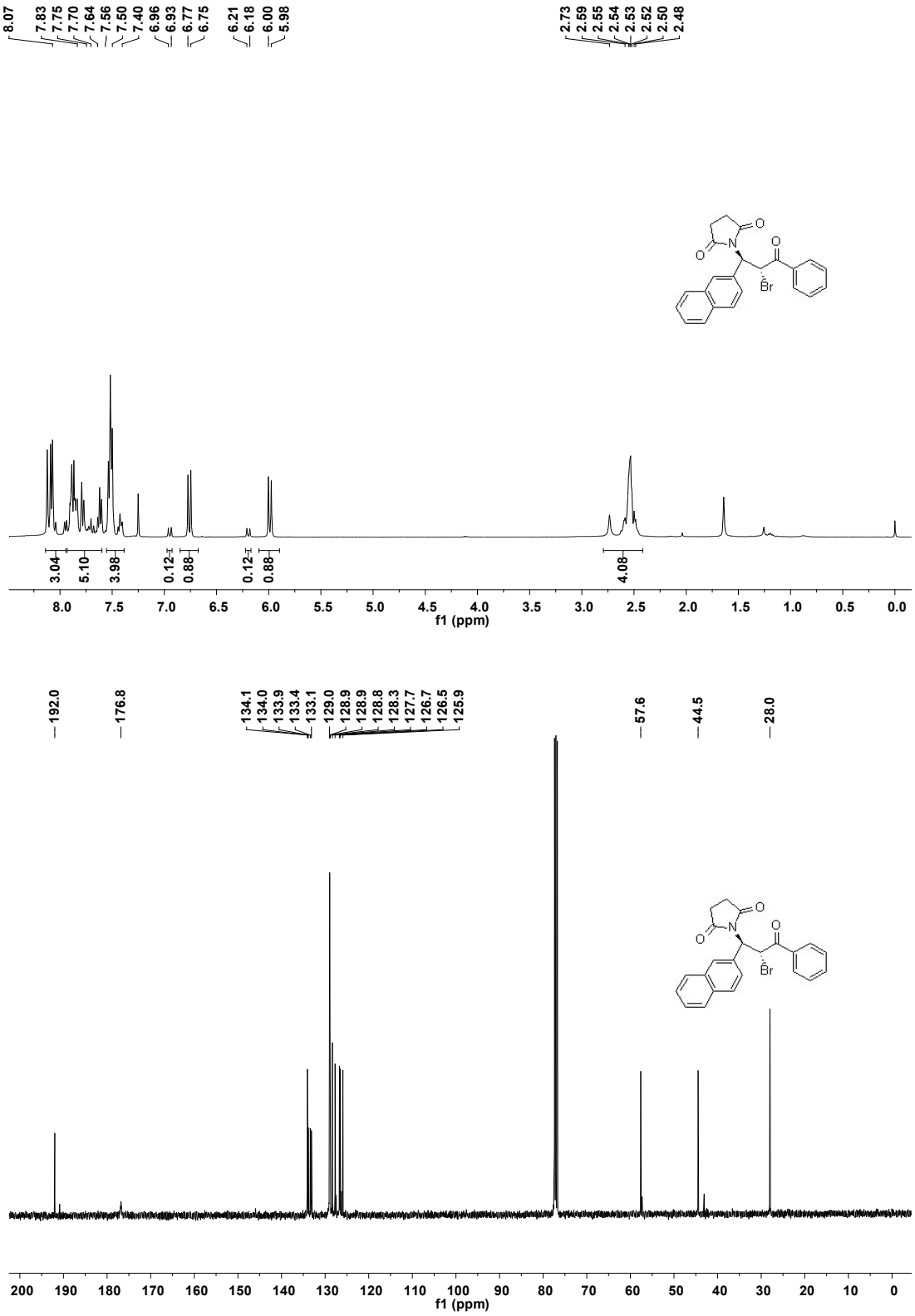
6.75
6.61
6.58
6.05
6.03
5.88
5.85
2.79
2.66
2.65
2.64
2.61
2.60
2.60
2.56
2.55
O
O
N
O
Br
NC
1.82
0.18
2.00
3.02
2.01
0.09
0.91
0.09
0.91
4.02
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
191.4
176.6
141.6
133.5
129.9
128.9
118.3
113.0
56.9
43.4
28.0
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3j

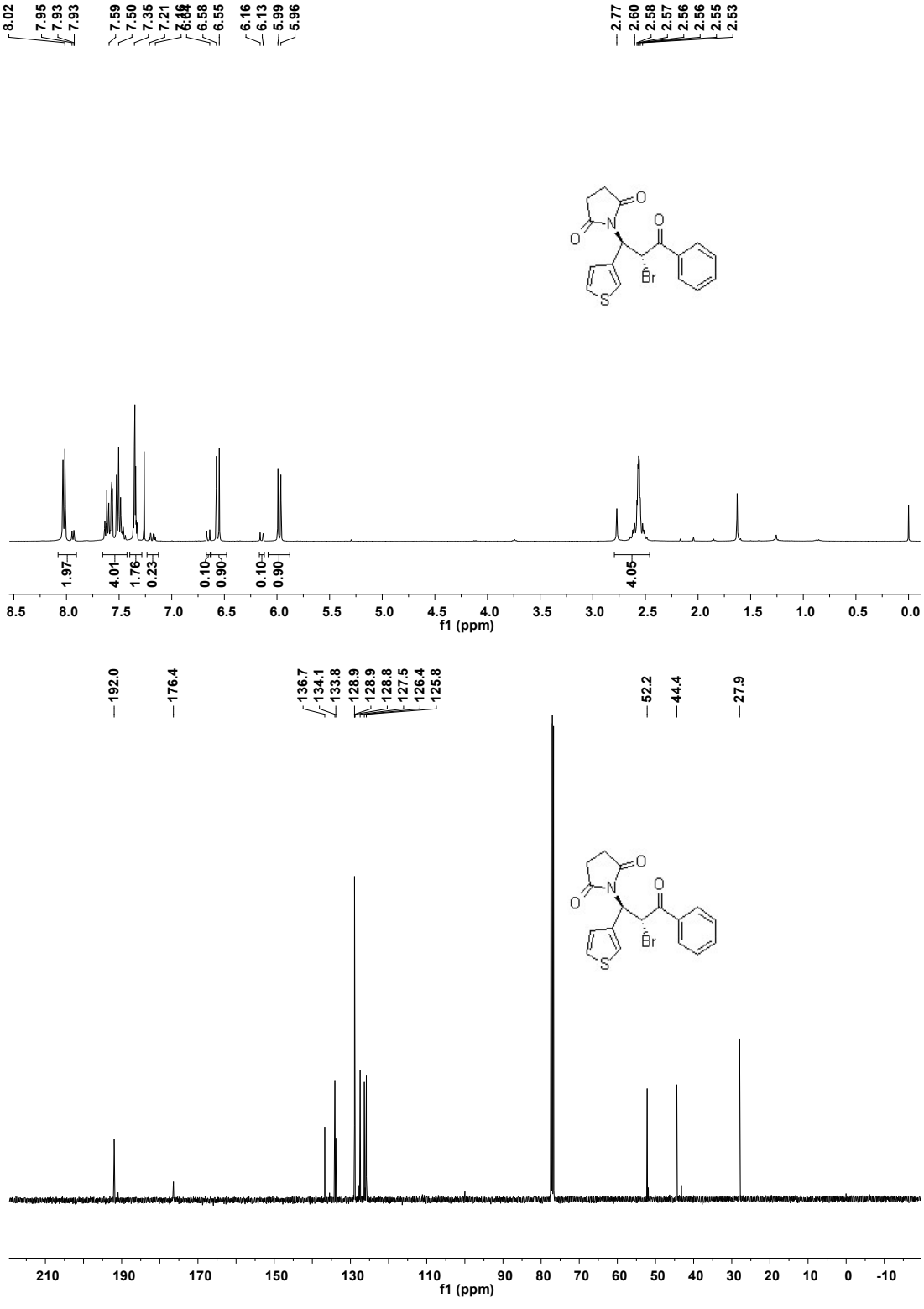

8.03
7.94
7.84
7.74
7.66
7.62
7.54
7.51
7.46
6.81
6.79
6.64
6.62
6.11
6.08
5.94
5.91
2.81
2.68
2.67
2.66
2.64
2.63
2.62
2.61
2.60
2.58
2.57
O
O
N
O
Br
O2N
2.02
2.01
1.82
0.18
3.00
0.09
0.91
0.09
0.91
4.09
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


191.3
176.6
148.1
143.4
130.2
129.0
129.0
124.1
56.6
43.3
28.0
O
O
N
O
Br
O2N
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

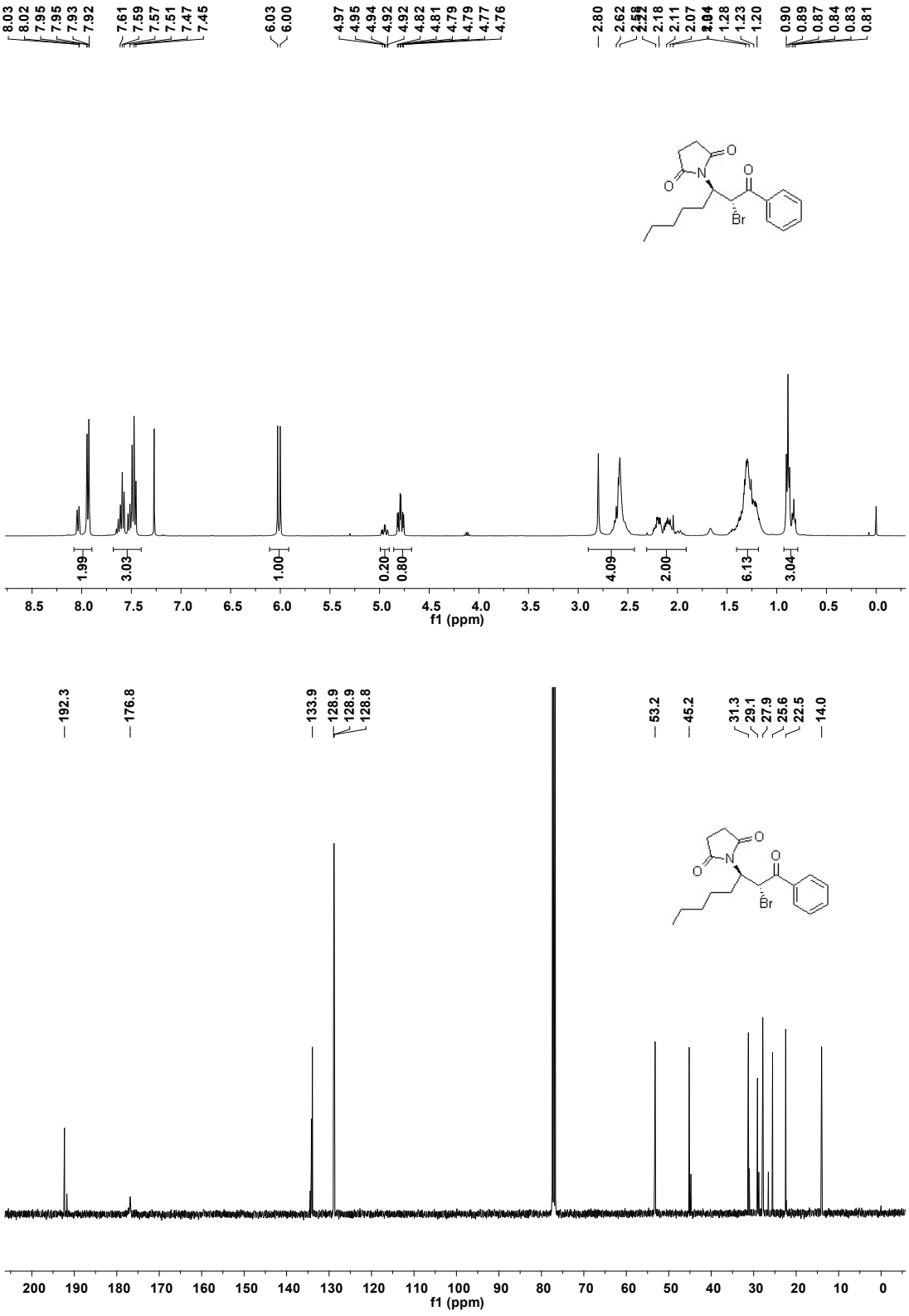
3k


8.07
7.83
7.75
7.70
7.64
7.56
7.50
7.40
6.96
6.93
6.77
6.75
6.21
6.18
6.00
5.98
2.73
2.59
2.55
2.54
2.53
2.52
2.50
2.48
O
O
N
O
Br
3.04
5.10
3.98
0.12
0.88
0.12
0.88
4.08
f1 (ppm)
192.0
176.8
134.1
134.0
133.9
133.4
133.1
129.0
128.9
128.9
128.8
128.3
127.7
126.7
126.5
125.9
57.6
44.5
28.0
f1 (ppm)

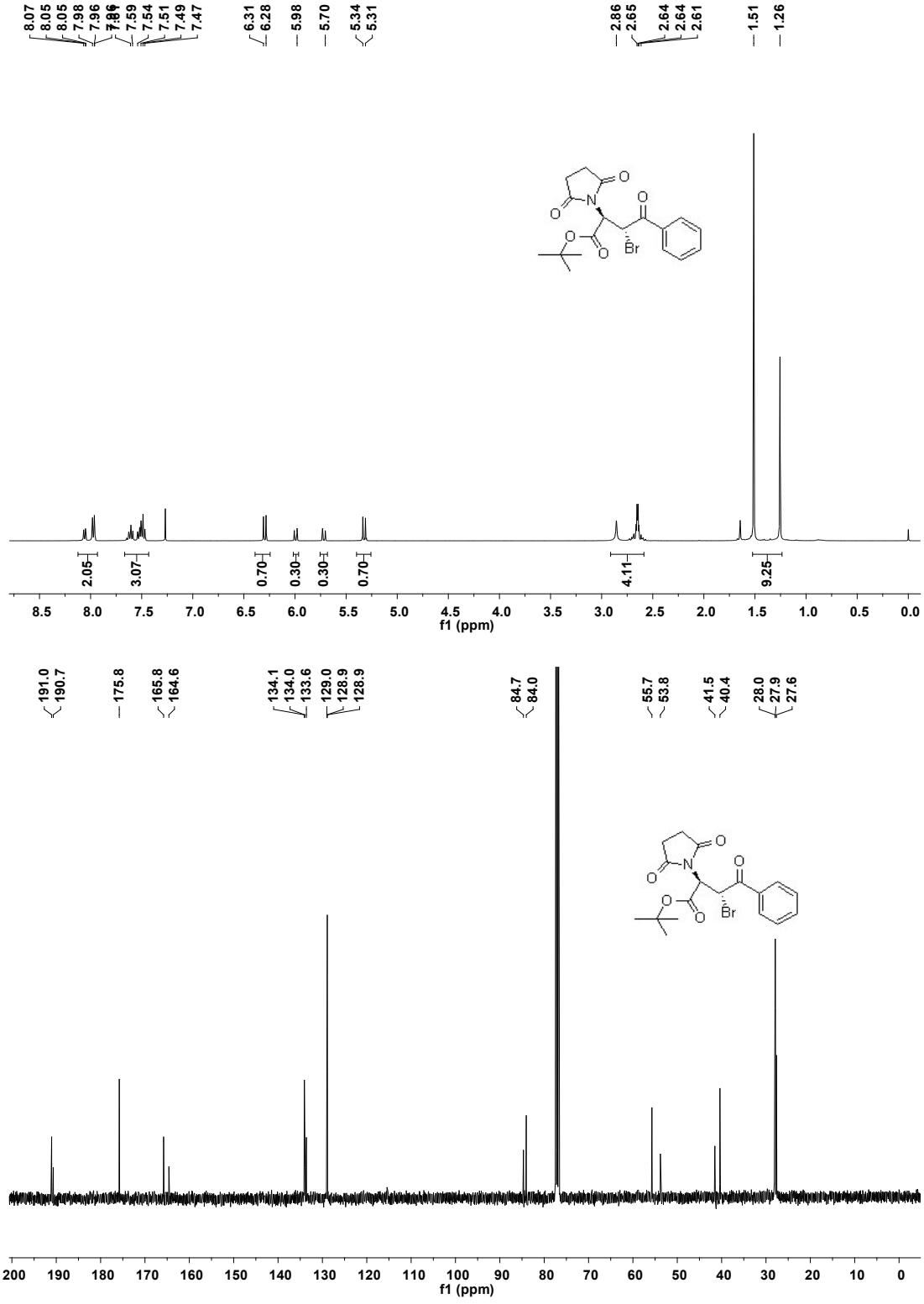
3l


8.02
7.95
7.93
7.93
7.59
7.50
7.35
7.21
6.58
6.55
6.16
6.13
5.99
5.96
2.77
2.60
2.58
2.57
2.56
2.56
2.55
2.53
O
O
N
O
Br
S
1.97
4.01
1.76
0.23
0.10
0.90
0.10
0.90
4.05
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)
192.0
176.4
136.7
134.1
133.8
128.9
128.9
128.8
127.5
126.4
125.8
52.2
44.4
27.9
O
O
N
O
Br
S
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

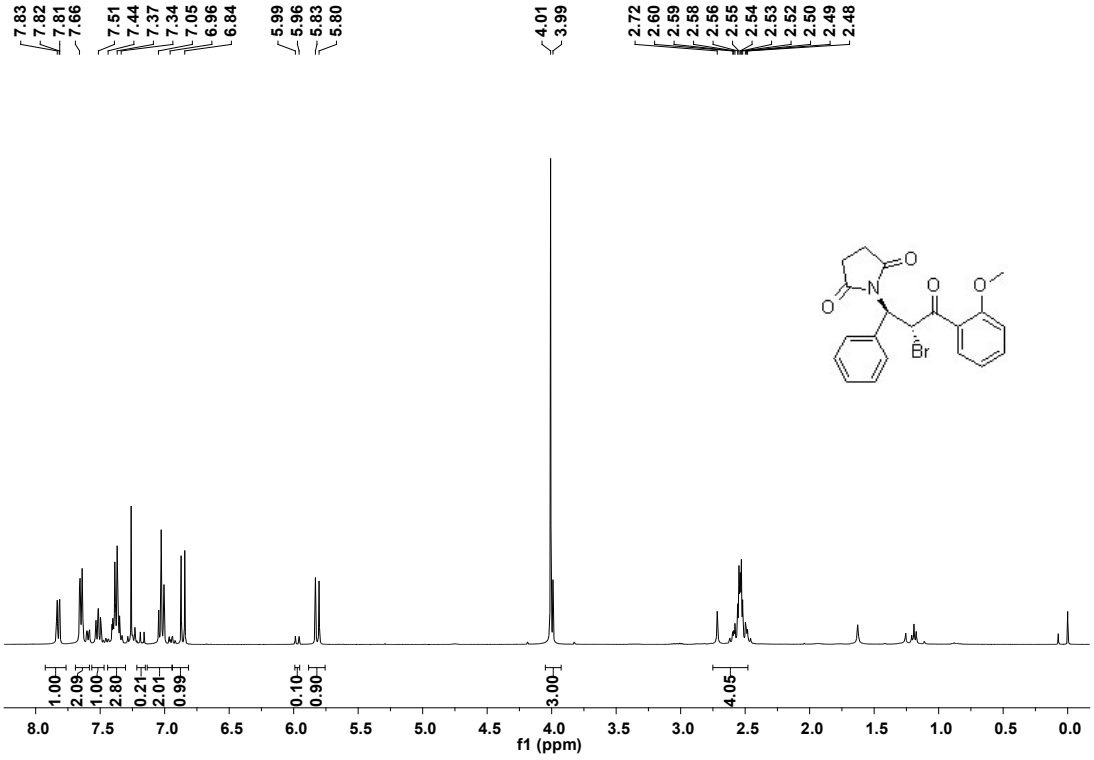
3m

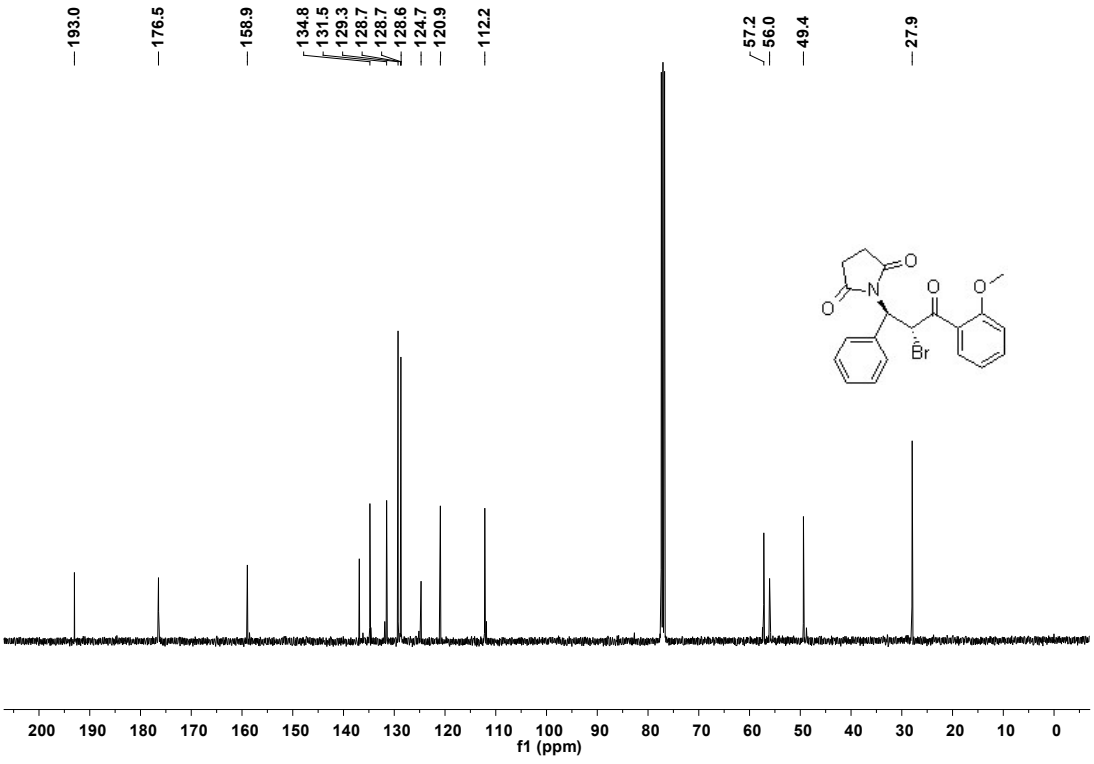

8.03
8.02
7.95
7.95
7.93
7.92
7.61
7.59
7.57
7.51
7.47
7.45
6.03
6.00
4.97
4.95
4.94
4.92
4.92
4.82
4.81
4.79
4.79
4.77
4.76
2.80
2.62
2.18
2.11
2.07
1.28
1.23
1.20
0.90
0.89
0.87
0.84
0.83
0.81
O
O
N
O
Br
1.99
3.03
1.00
0.20
0.80
4.09
2.00
6.13
3.04
f1 (ppm)
192.3
176.8
133.9
128.9
128.9
128.8
53.2
45.2
31.3
29.1
27.9
25.6
22.5
14.0
f1 (ppm)

3n

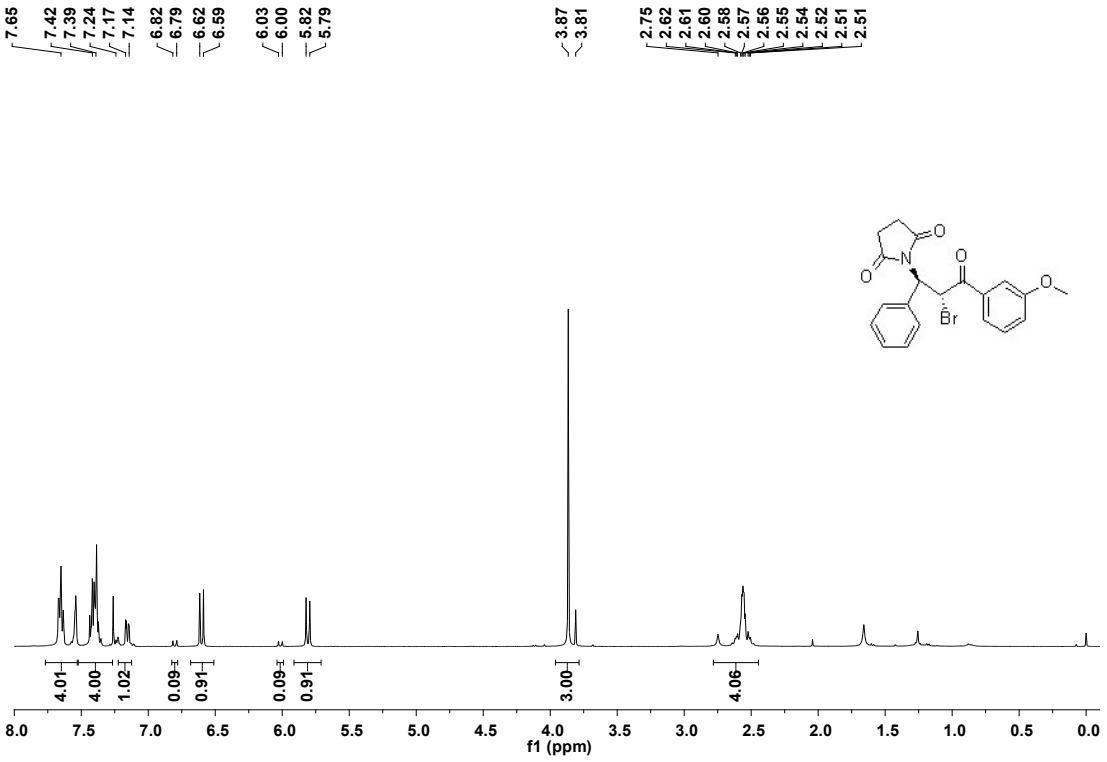

8.07
8.05
8.05
7.98
7.96
7.59
7.54
7.51
7.49
7.47
6.31
6.28
5.98
5.70
5.34
5.31
2.86
2.65
2.64
2.64
2.61
1.51
1.26
Br
2.05
3.07
0.70
0.30
0.30
0.70
4.11
9.25
f1 (ppm)
191.0
190.7
175.8
165.8
164.6
134.1
134.0
133.6
129.0
128.9
128.9
84.7
84.0
55.7
53.8
41.5
40.4
28.0
27.9
27.6
Br
f1 (ppm)

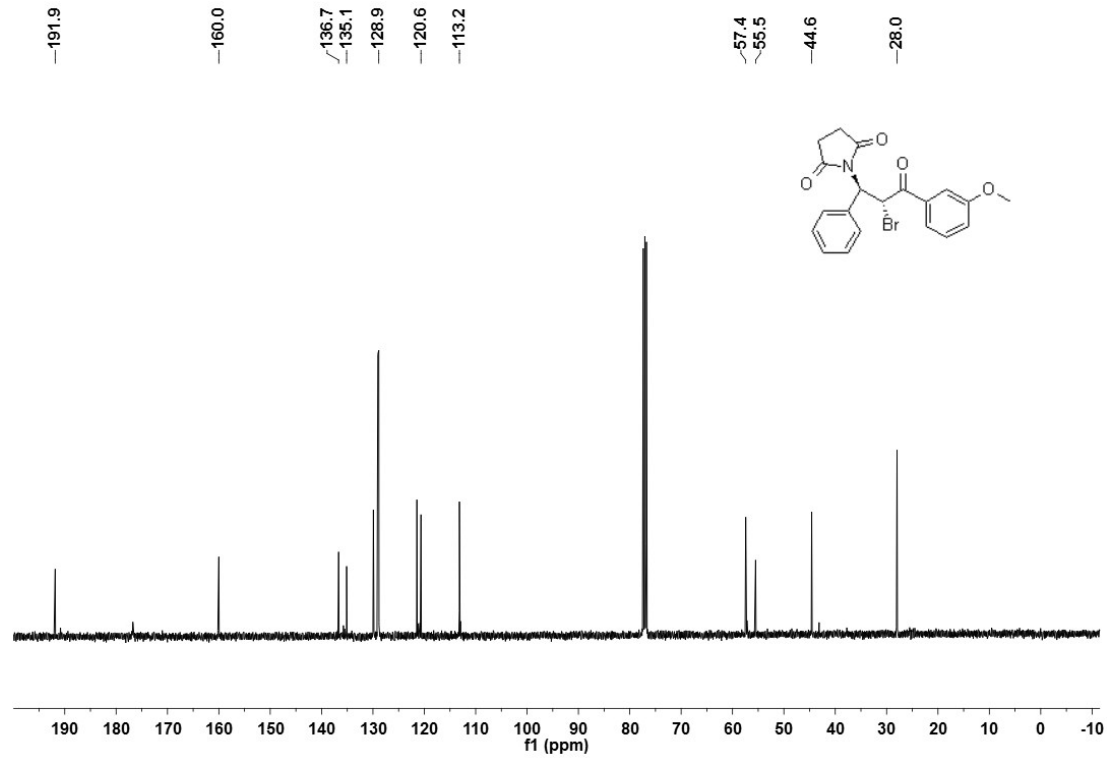
3o


7.83
7.82
7.81
7.66
7.51
7.44
7.37
7.34
7.05
6.96
6.84
5.99
5.96
5.83
5.80
4.01
3.99
2.72
2.60
2.59
2.58
2.56
2.55
2.54
2.53
2.52
2.50
2.49
2.48
O
O
N
O
O
O
Br
1.00
2.09
1.00
2.80
0.21
2.01
0.99
0.10
0.90
3.00
4.05
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)

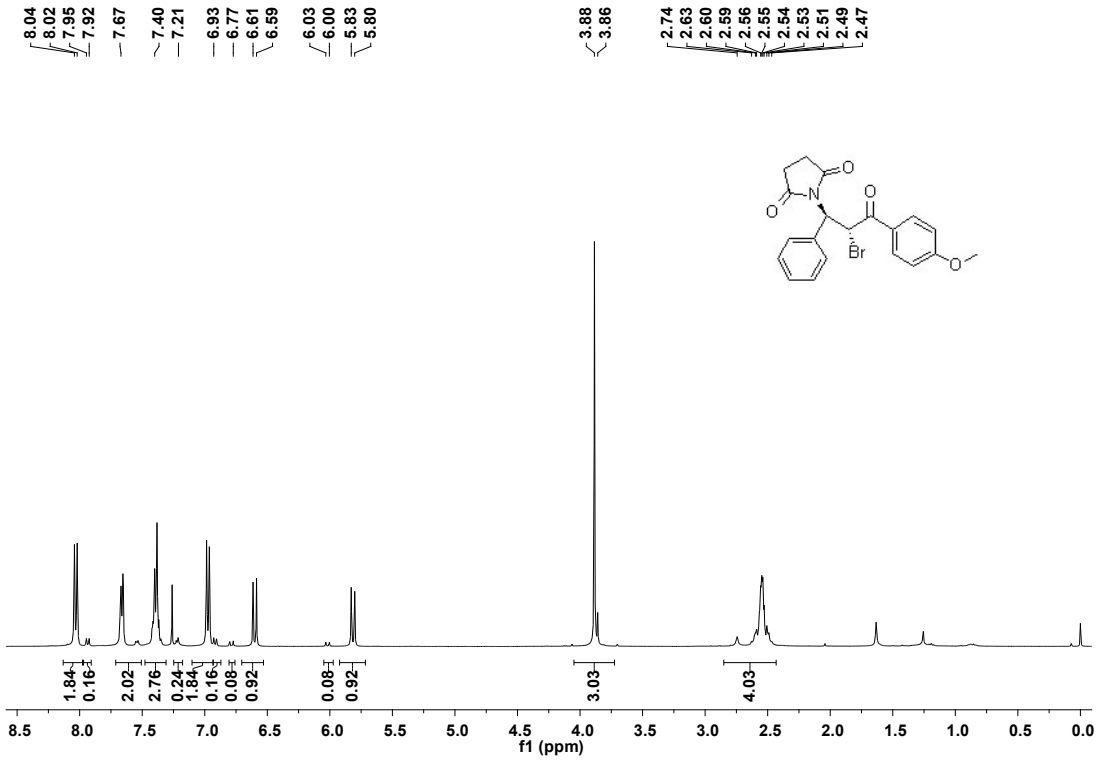

193.0
176.5
158.9
134.8
131.5
129.3
128.7
128.7
128.6
124.7
120.9
112.2
57.2
56.0
49.4
27.9
O
O
N
O
O
O
Br
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

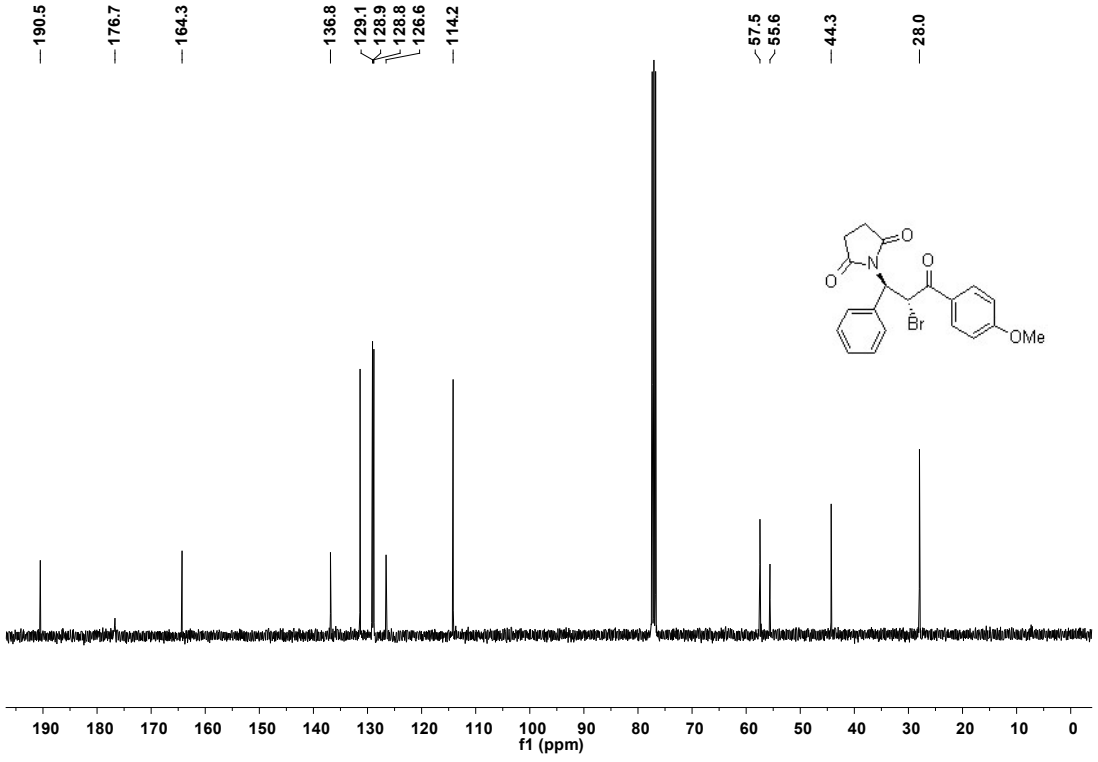
3p


7.65
7.42
7.39
7.24
7.17
7.14
6.82
6.79
6.62
6.59
6.03
6.00
5.82
5.79
3.87
3.81
2.75
2.62
2.61
2.60
2.58
2.57
2.56
2.55
2.54
2.52
2.51
2.51
O
O
N
O
O
Br
4.01
4.00
1.02
0.09
0.91
0.09
0.91
3.00
4.06
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)

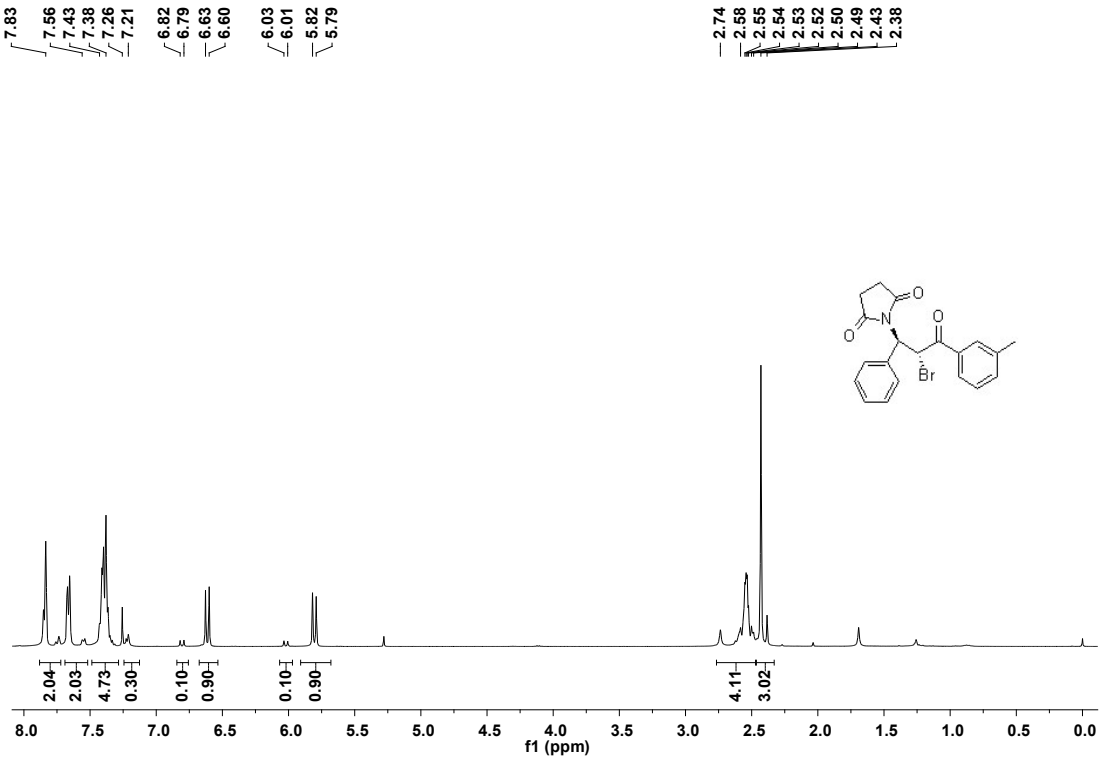

191.9
160.0
136.7
135.1
128.9
120.6
113.2
57.4
55.5
44.6
28.0
O
O
N
O
O
Br
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

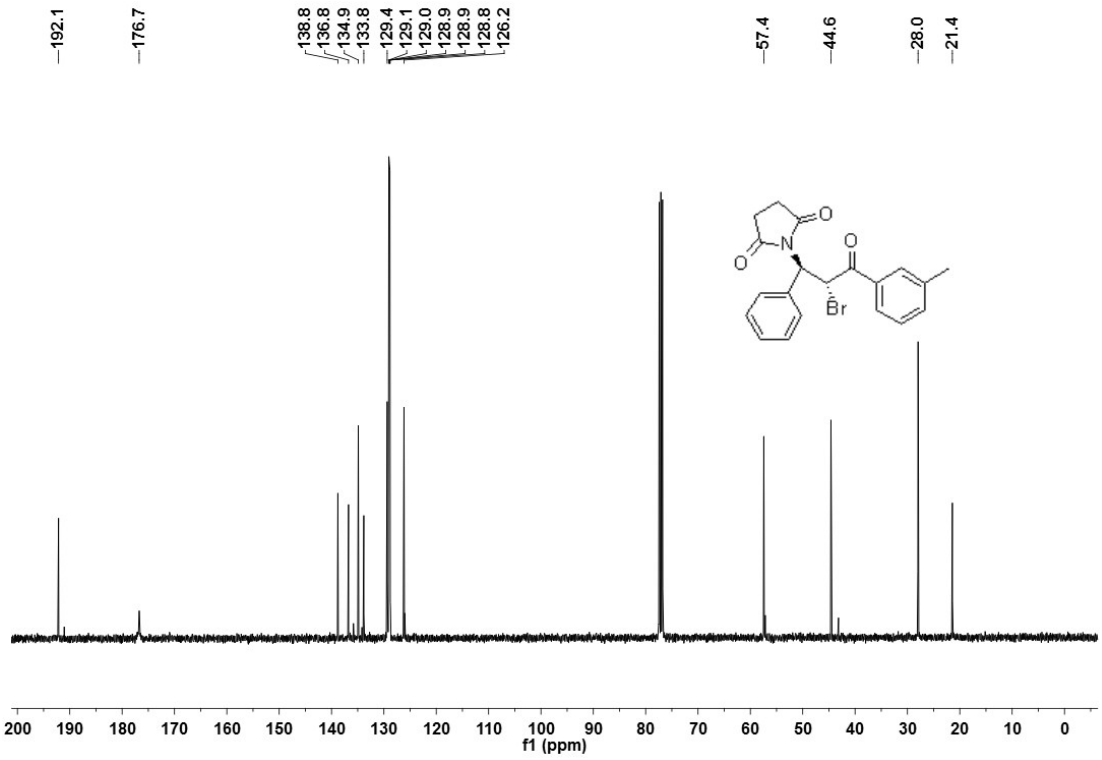
3q


8.04
8.02
7.95
7.92
7.67
7.40
7.21
6.93
6.77
6.61
6.59
6.03
6.00
5.83
5.80
3.88
3.86
2.74
2.63
2.60
2.59
2.56
2.55
2.54
2.53
2.51
2.49
2.47
O
O
N
O
Br
O
1.84
0.16
2.02
2.76
0.24
1.84
0.16
0.08
0.92
0.08
0.92
3.03
4.03
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)

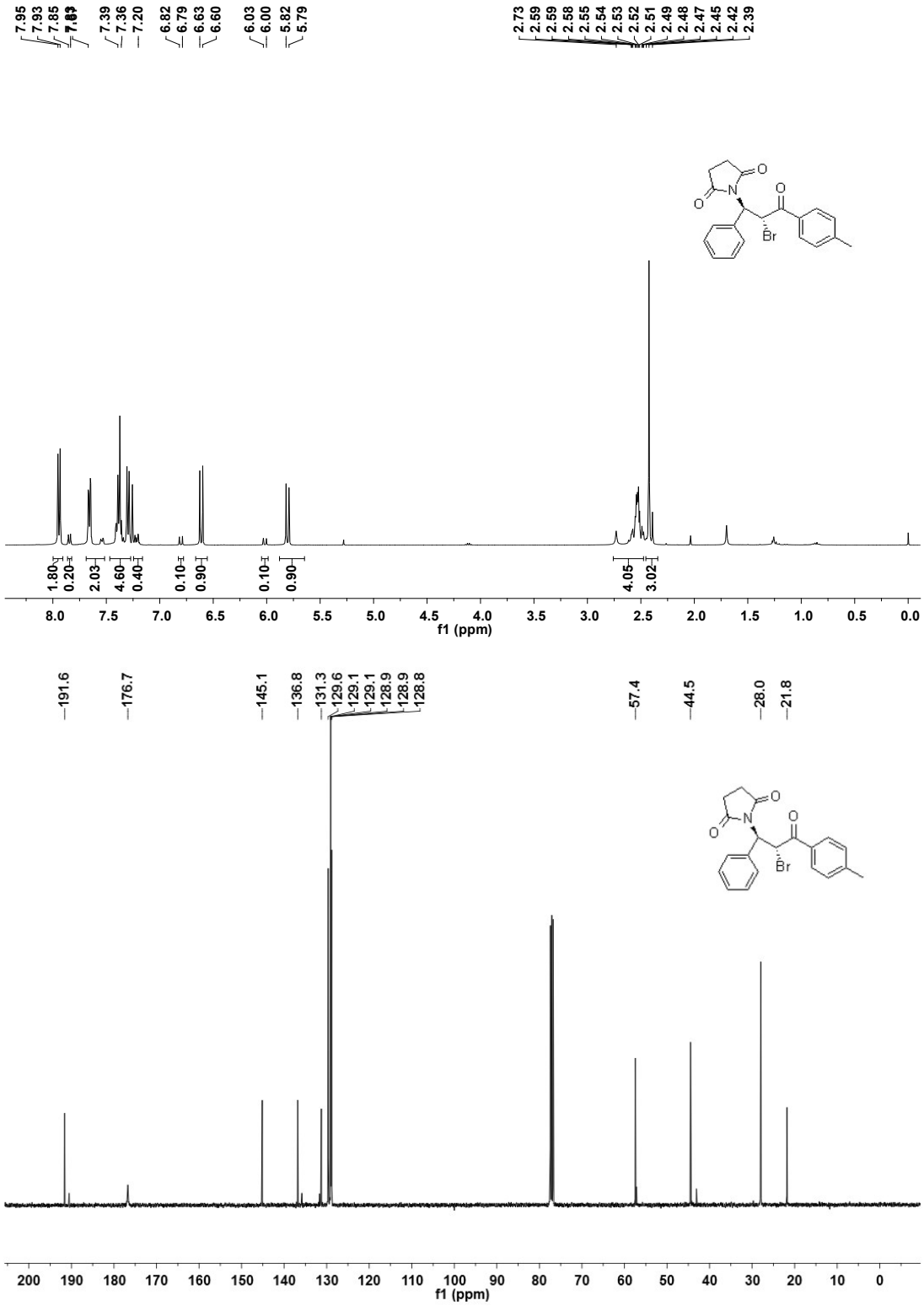

190.5
176.7
164.3
136.8
129.1
128.9
128.8
126.6
114.2
57.5
55.6
44.3
28.0
O
O
N
O
Br
OMe
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3r

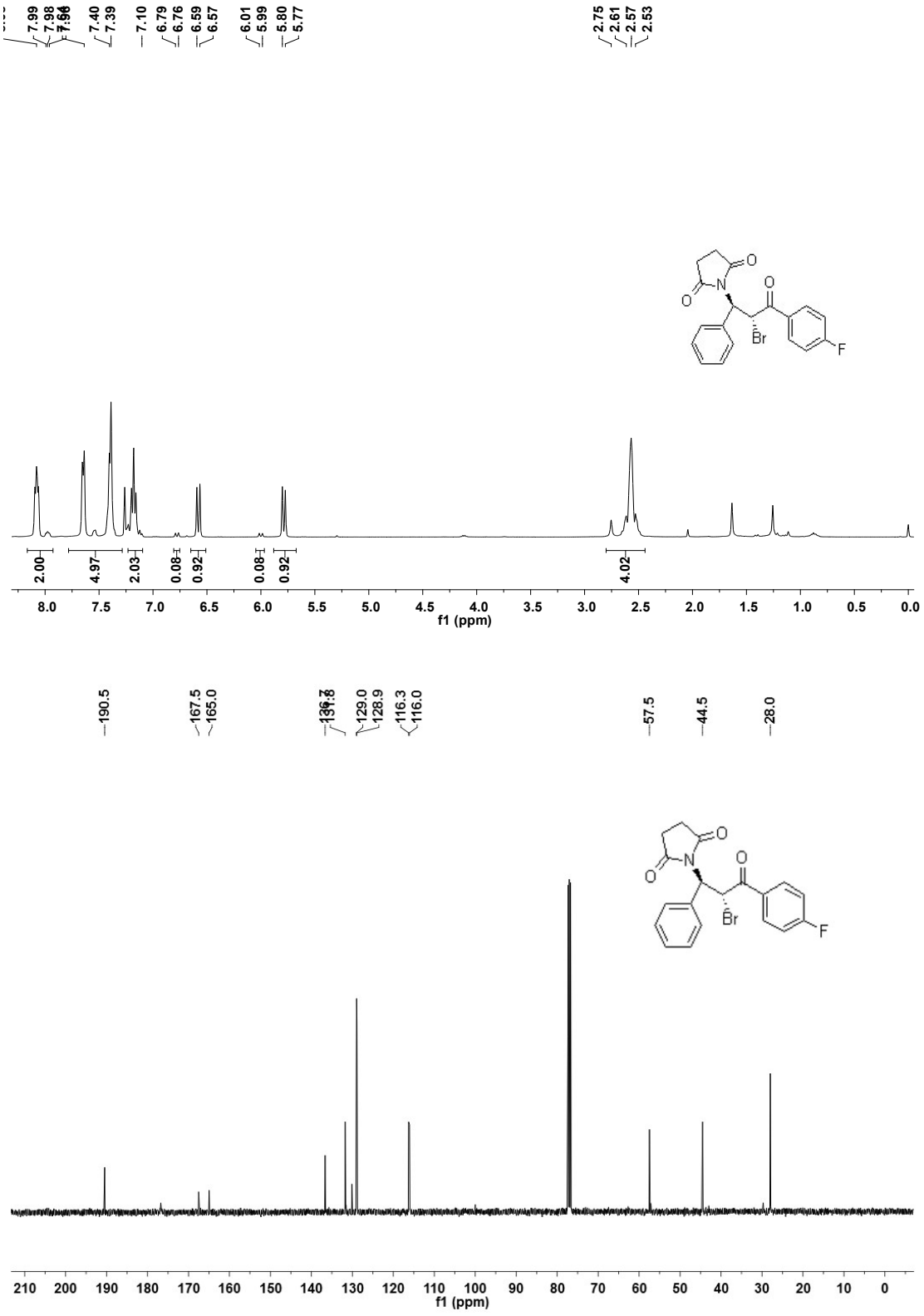

7.83
7.56
7.43
7.38
7.26
7.21
6.82
6.79
6.63
6.60
6.03
6.01
5.82
5.79
2.74
2.58
2.55
2.54
2.53
2.52
2.50
2.49
2.43
2.38
O
O
N
O
Br
2.04
2.03
4.73
0.30
0.10
0.90
0.10
0.90
4.11
3.02
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


192.1
176.7
138.8
136.8
134.9
133.8
129.4
129.1
129.0
128.9
128.9
128.8
126.2
57.4
44.6
28.0
21.4
O
O
N
O
Br
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

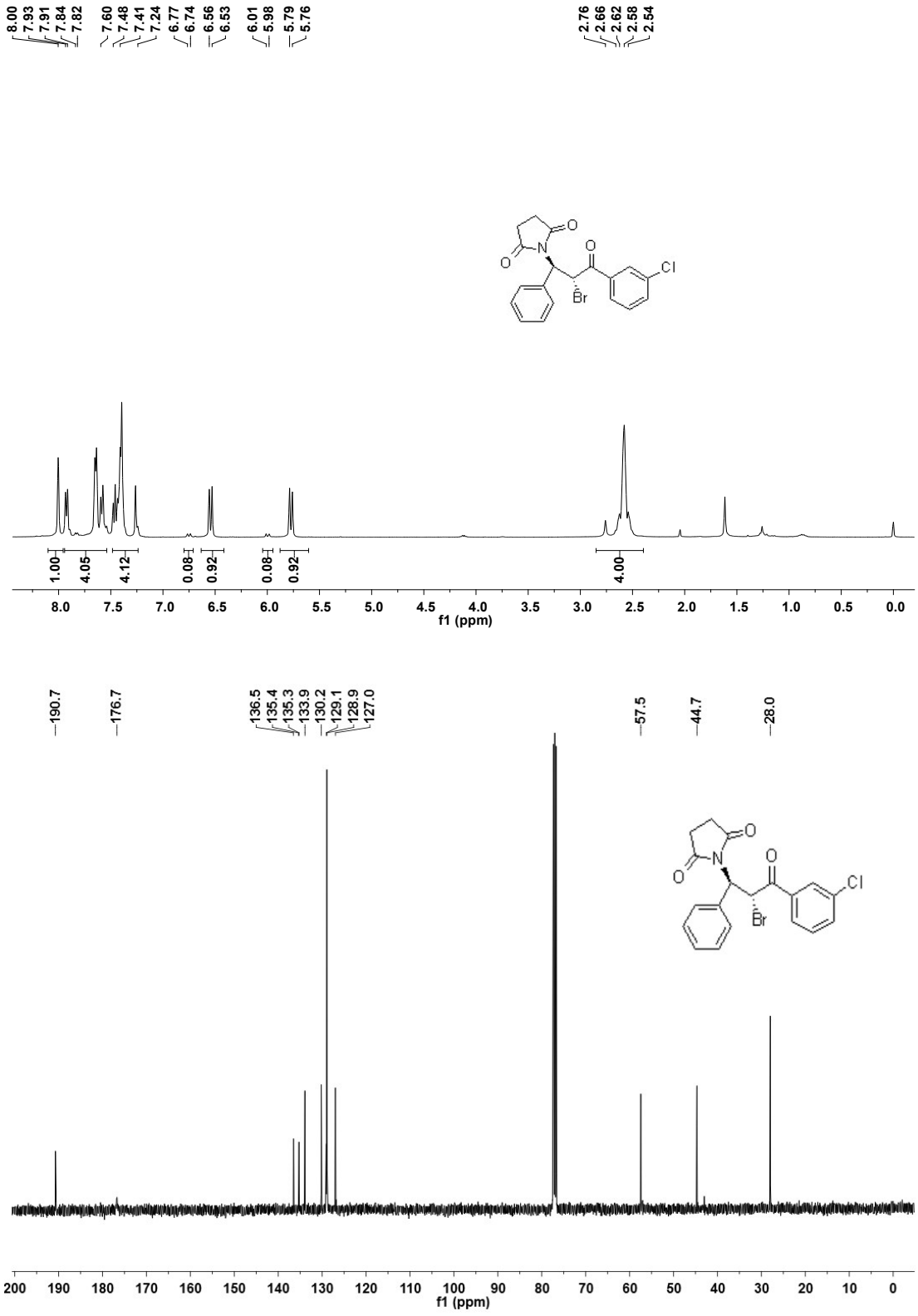
3s


7.95
7.93
7.85
7.39
7.36
7.20
6.82
6.79
6.63
6.60
6.03
6.00
5.82
5.79
2.73
2.59
2.59
2.58
2.55
2.54
2.53
2.52
2.51
2.49
2.48
2.47
2.45
2.42
2.39
Br
1.80
0.20
2.03
4.60
0.40
0.10
0.90
0.10
0.90
4.05
3.02
f1 (ppm)
191.6
176.7
145.1
136.8
131.3
129.6
129.1
129.1
128.9
128.9
128.8
57.4
44.5
28.0
21.8
Br
f1 (ppm)

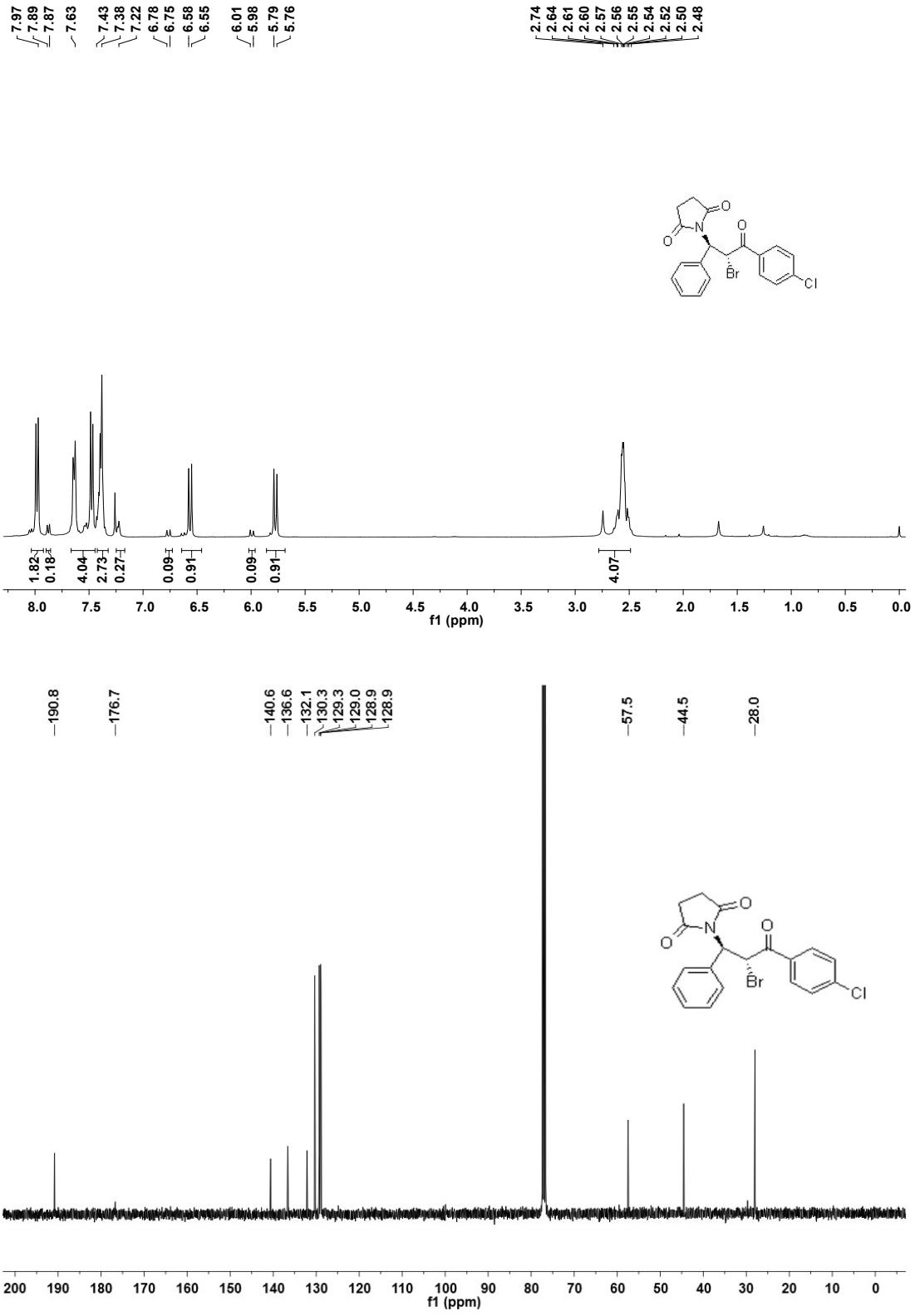
3t


7.99
7.98
7.40
7.39
7.10
6.79
6.76
6.59
6.57
6.01
5.99
5.80
5.77
2.75
2.61
2.57
2.53
O
O
N
O
Br
F
2.00
4.97
2.03
0.08
0.92
0.08
0.92
4.02
f1 (ppm)
190.5
167.5
165.0
136.7
131.8
129.0
128.9
116.3
116.0
57.5
44.5
28.0
f1 (ppm)

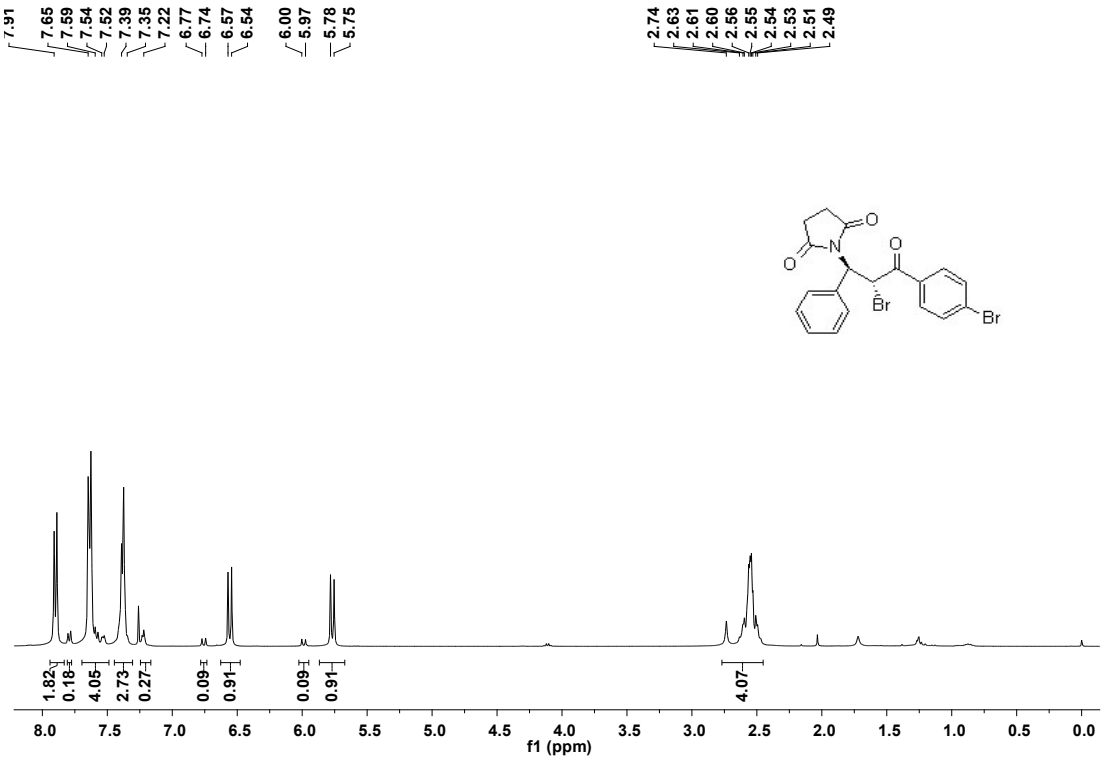
3u

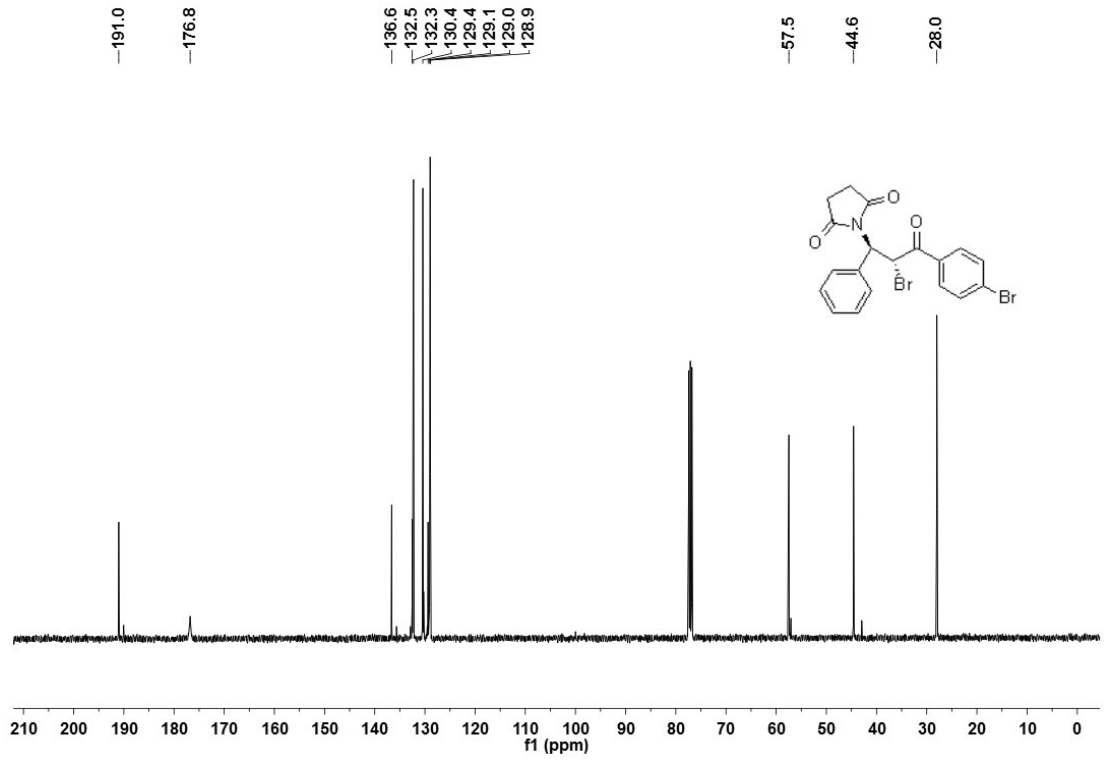

8.00
7.93
7.91
7.84
7.82
7.60
7.48
7.41
7.24
6.77
6.74
6.56
6.53
6.01
5.98
5.79
5.76
2.76
2.66
2.62
2.58
2.54
O
O
N
O
Br
Cl
1.00
4.05
4.12
0.08
0.92
0.08
0.92
4.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
190.7
176.7
136.5
135.4
135.3
133.9
130.2
129.1
128.9
127.0
57.5
44.7
28.0
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3v

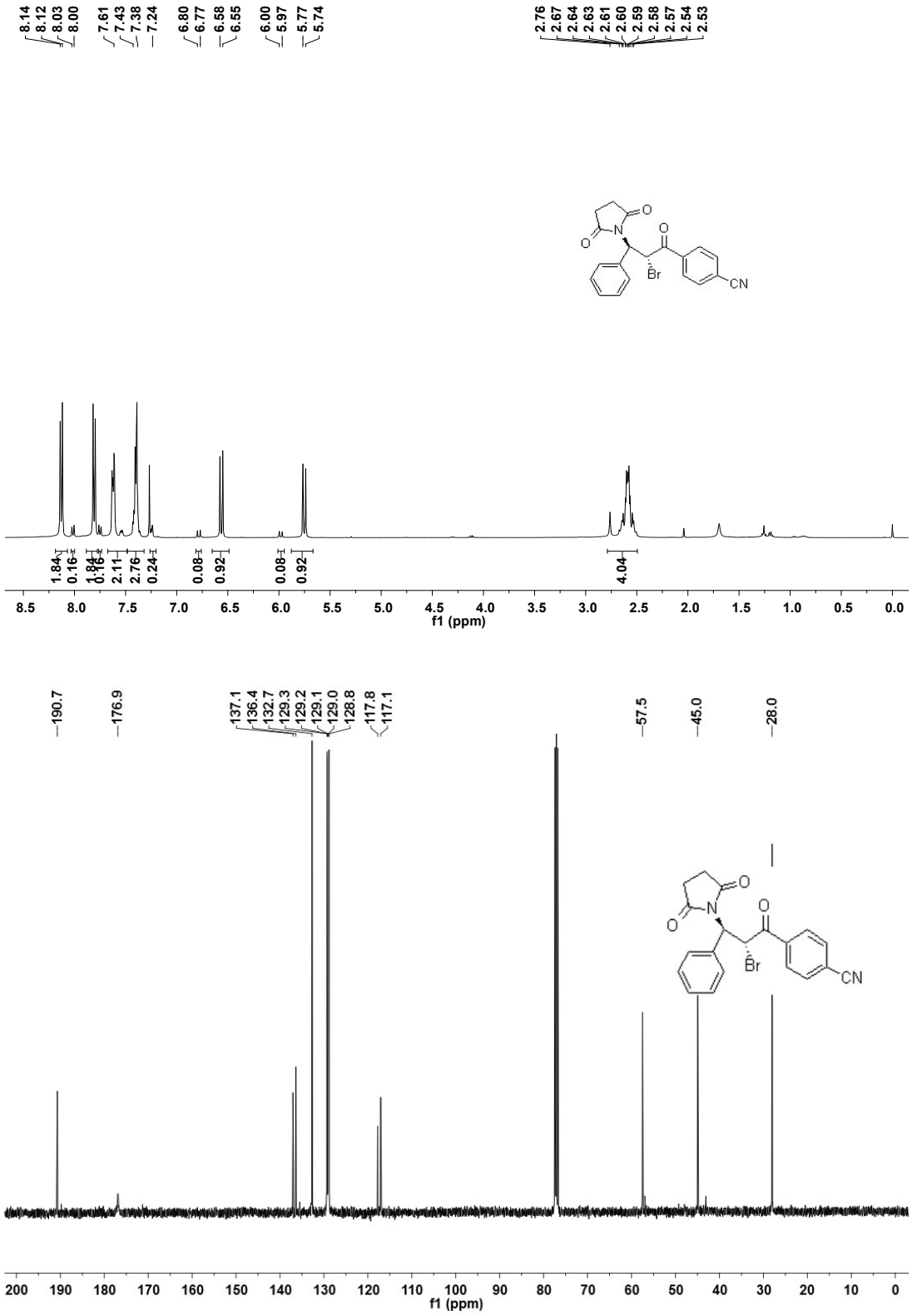

7.97
7.89
7.87
7.63
7.43
7.38
7.22
6.78
6.75
6.58
6.55
6.01
5.98
5.79
5.76
2.74
2.64
2.61
2.60
2.57
2.56
2.55
2.54
2.52
2.50
2.48
O
O
N
O
Br
Cl
1.82
0.18
4.04
2.73
0.27
0.09
0.91
0.09
0.91
4.07
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
190.8
176.7
140.6
136.6
132.1
130.3
129.3
129.0
128.9
128.9
57.5
44.5
28.0
O
O
N
O
Br
Cl
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3w

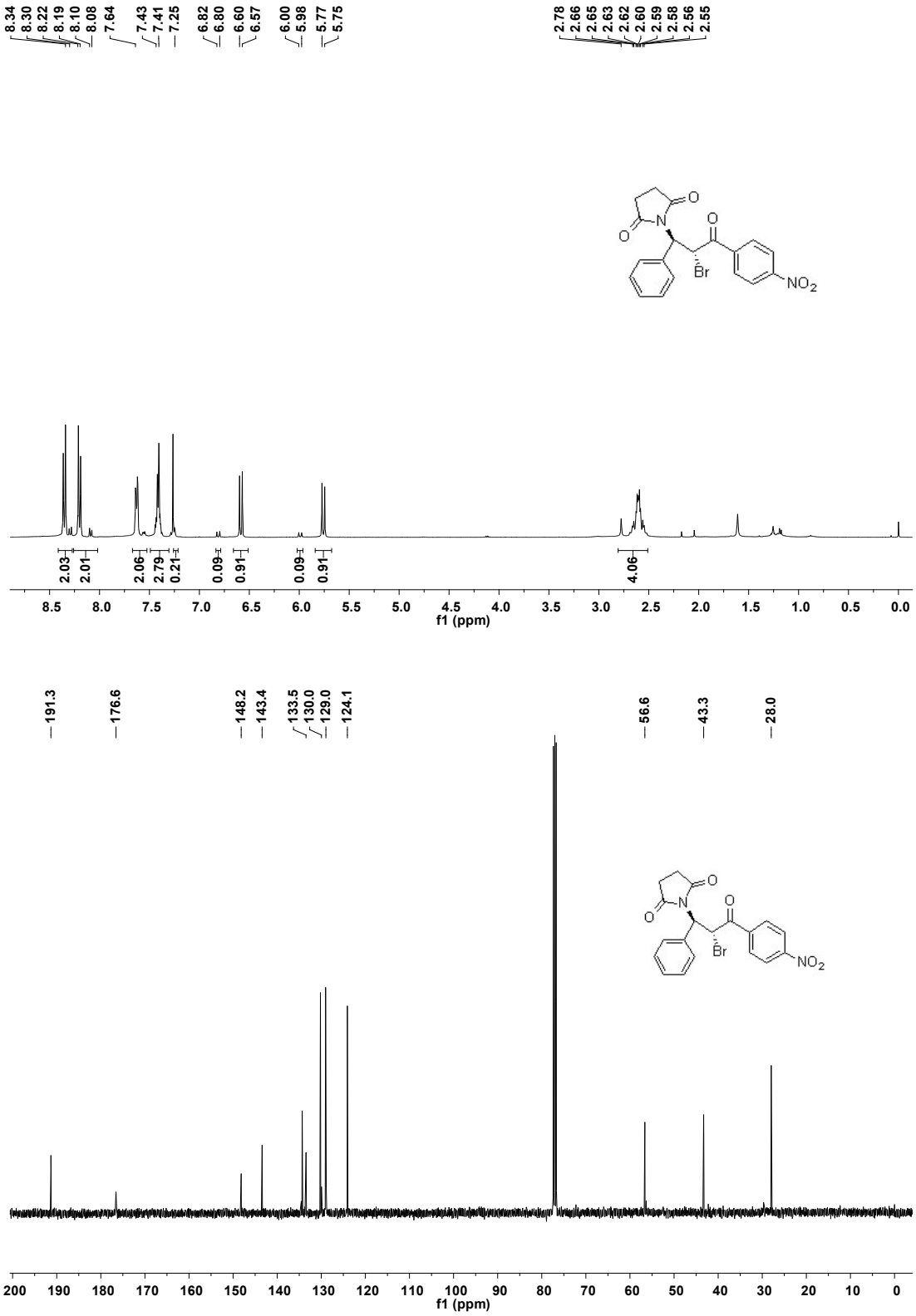

7.91
7.65
7.59
7.54
7.52
7.39
7.35
7.22
6.77
6.74
6.57
6.54
6.00
5.97
5.78
5.75
2.74
2.63
2.61
2.60
2.56
2.55
2.54
2.53
2.51
2.49
O
O
N
O
Br
Br
1.82
0.18
4.05
2.73
0.27
0.09
0.91
0.09
0.91
4.07
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


191.0
176.8
136.6
132.5
132.3
130.4
129.4
129.1
129.0
128.9
57.5
44.6
28.0
O
O
N
O
Br
Br
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3x


8.14
8.12
8.03
8.00
7.61
7.43
7.38
7.24
6.80
6.77
6.58
6.55
6.00
5.97
5.77
5.74
2.76
2.67
2.64
2.63
2.61
2.60
2.59
2.58
2.57
2.54
2.53
O
N
O
O
Br
CN
1.84
0.16
1.84
0.16
2.11
2.76
0.24
0.08
0.92
0.08
0.92
4.04
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)
190.7
176.9
137.1
136.4
132.7
129.3
129.2
129.1
129.0
128.8
117.8
117.1
57.5
45.0
28.0
I
O
N
O
O
Br
CN
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3y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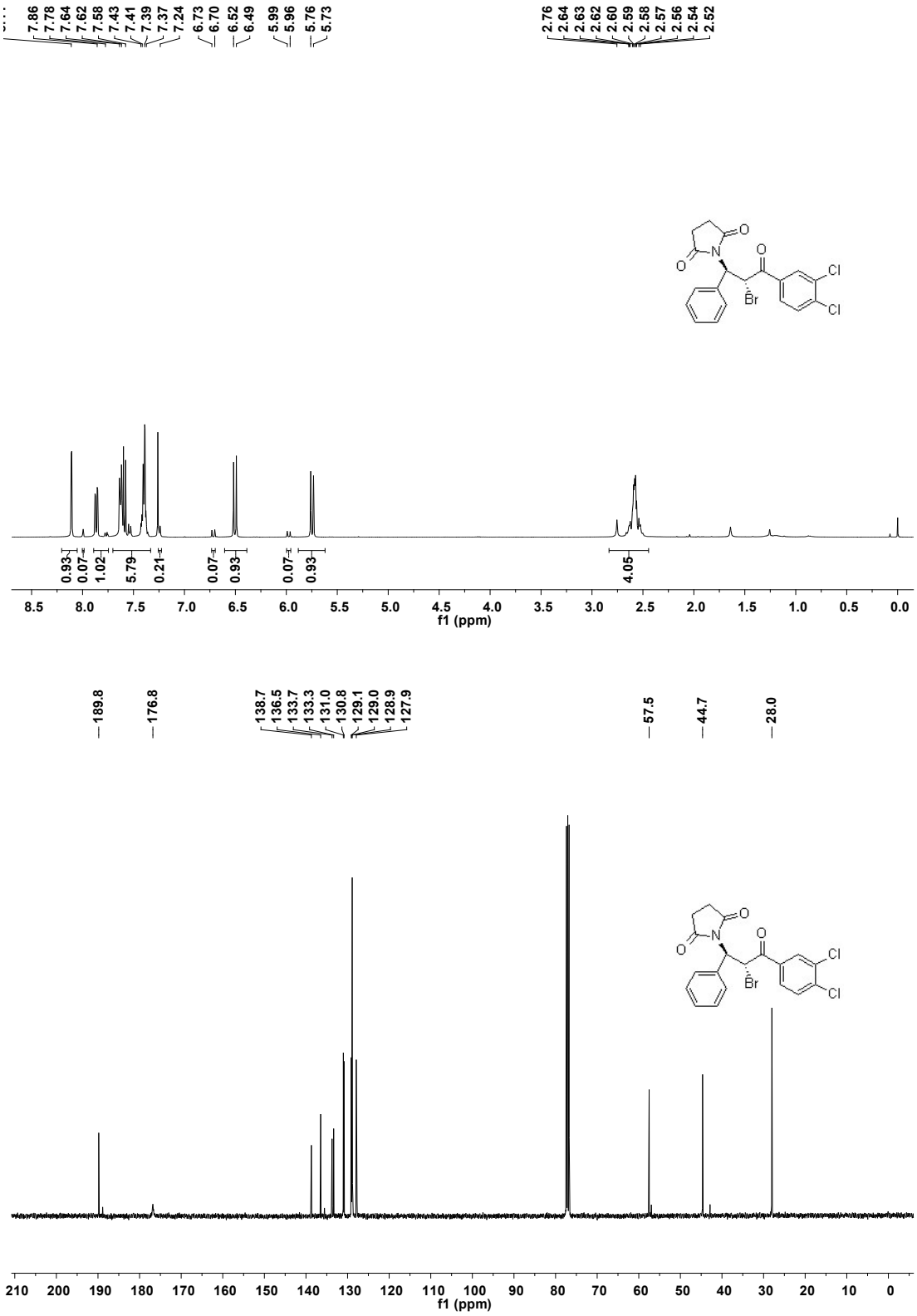
8.30
8.22
8.19
8.10
8.08
7.64
7.43
7.41
7.25
6.82
6.80
6.60
6.57
6.00
5.98
5.77
5.75
2.78
2.66
2.65
2.63
2.62
2.60
2.59
2.58
2.56
2.55
O
O
N
O
Br
NO2
2.03
2.01
2.06
2.79
0.21
0.09
0.91
0.09
0.91
4.06
f1 (ppm)
191.3
176.6
148.2
143.4
133.5
130.0
129.0
124.1
56.6
43.3
28.0
f1 (ppm)

3z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7.62
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7.43
7.41
7.39
7.37
7.24
6.73
6.70
6.52
6.49
5.99
5.96
5.76
5.73
2.76
2.64
2.63
2.62
2.60
2.59
2.58
2.57
2.56
2.54
2.52
O
O
N
O
Br
Cl
Cl
0.93
0.07
1.02
5.79
0.21
0.07
0.93
0.07
0.93
4.05
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)
189.8
176.8
138.7
136.5
133.7
133.3
131.0
130.8
129.1
129.0
128.9
127.9
57.5
44.7
28.0
210
200
190
180
170
160
150
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120
110
100
90
80
70
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50
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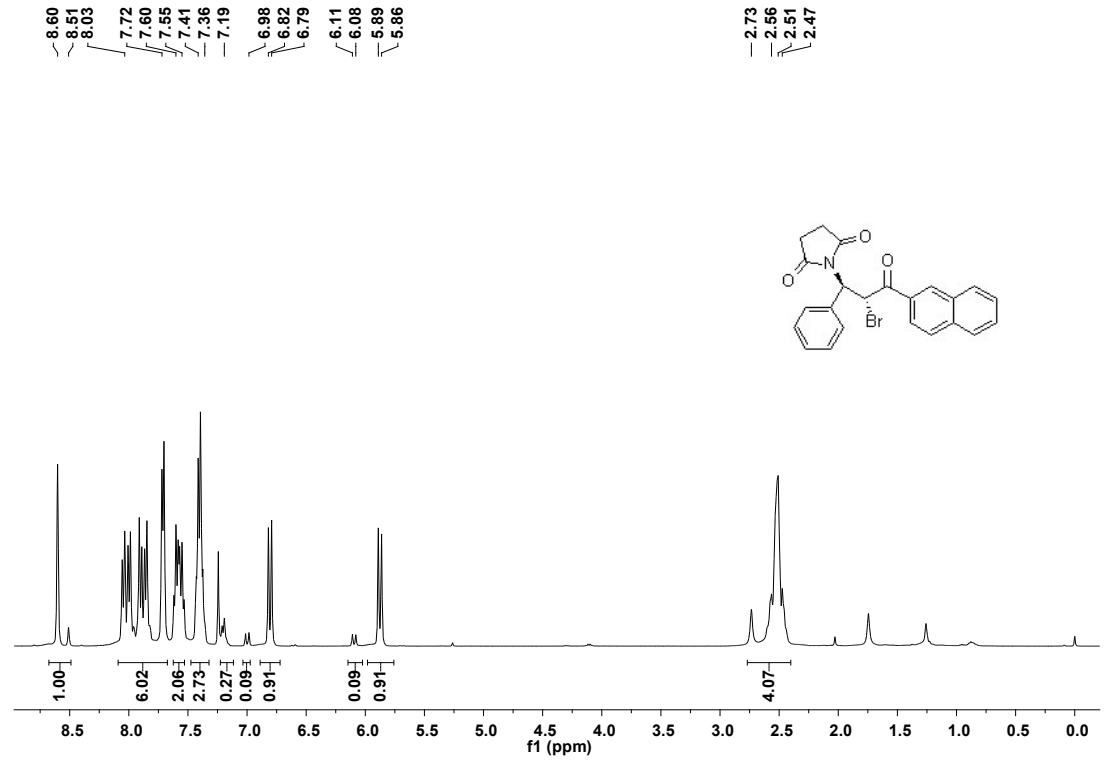
30
20
10
0
f1 (ppm)

3aa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8.51
8.03
7.72
7.60
7.55
7.41
7.36
7.19
6.98
6.82
6.79
6.11
6.08
5.89
5.86
2.73
2.56
2.51
2.47
O
O
N
O
Br
1.00
6.02
2.06
2.73
0.27
0.09
0.91
0.09
0.91
4.07
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
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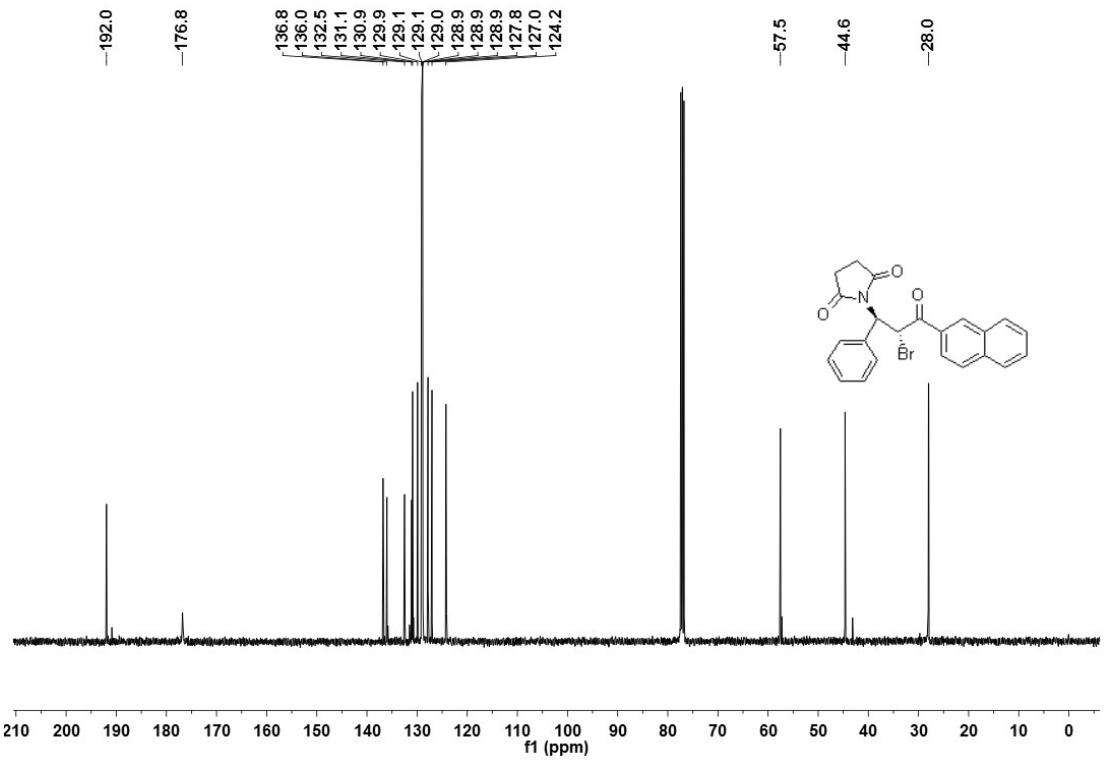
0.0
f1 (ppm)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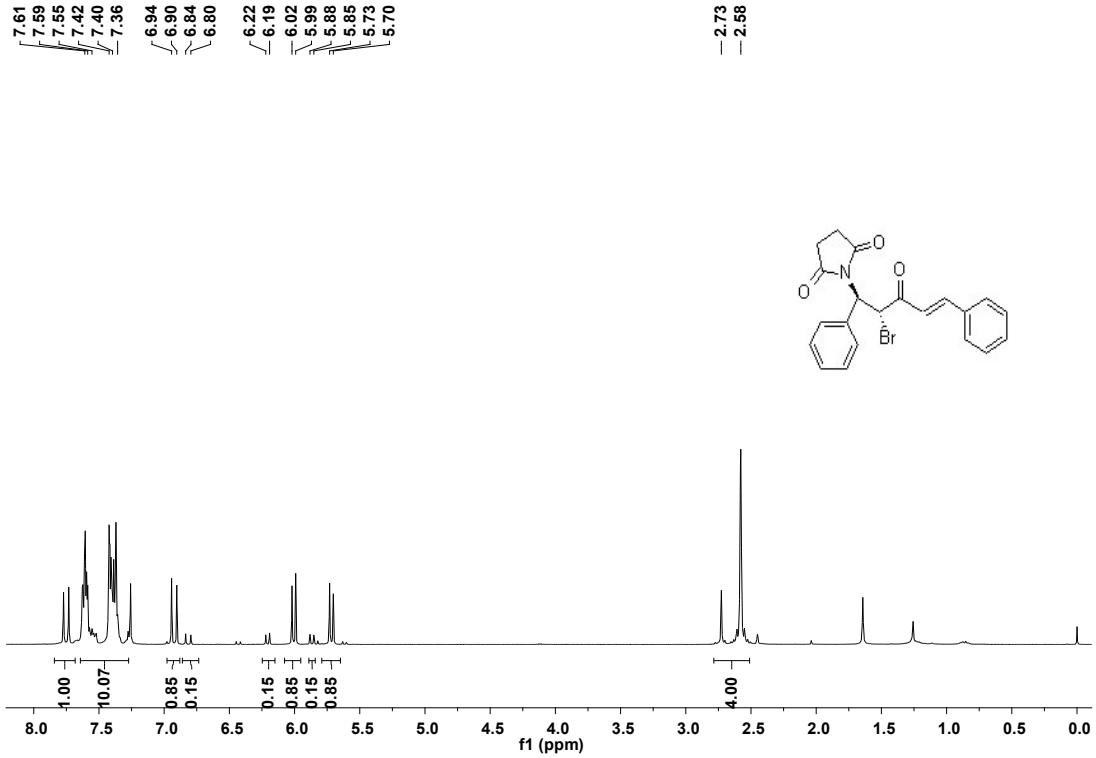
176.8
136.8
136.0
132.5
131.1
130.9
129.9
129.1
129.1
129.0
128.9
128.9
128.9
127.8
127.0
124.2
57.5
44.6
28.0
O
O
N
O
Br
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3ab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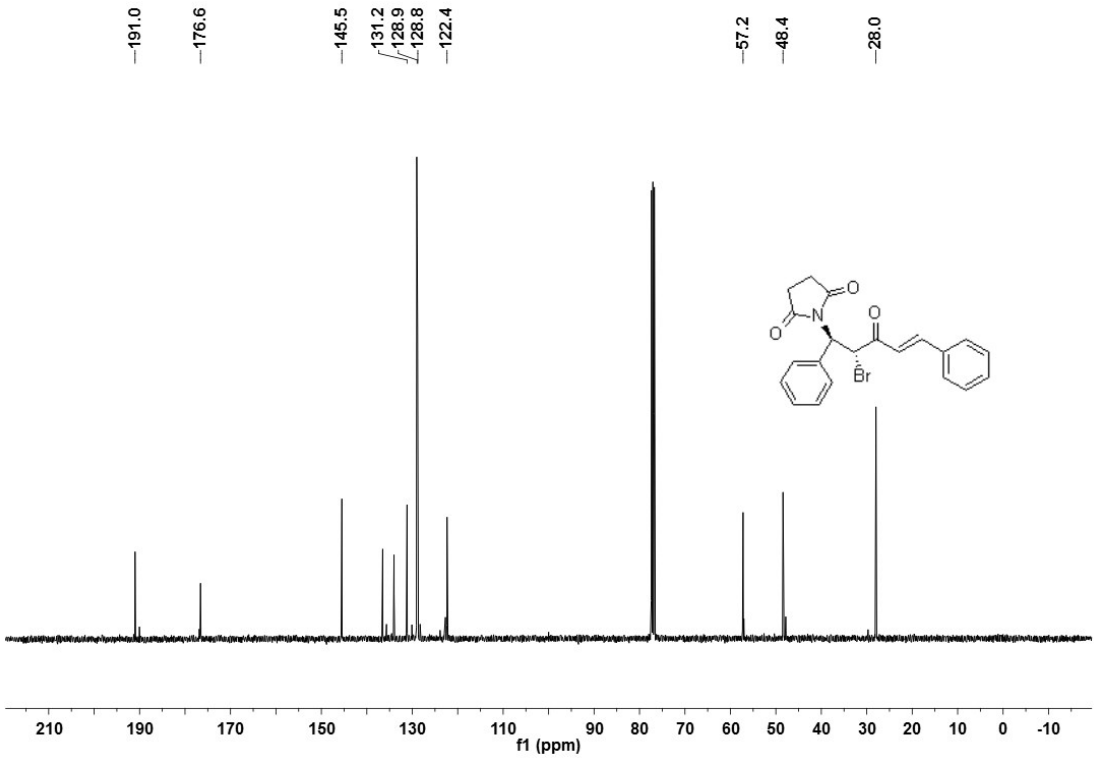
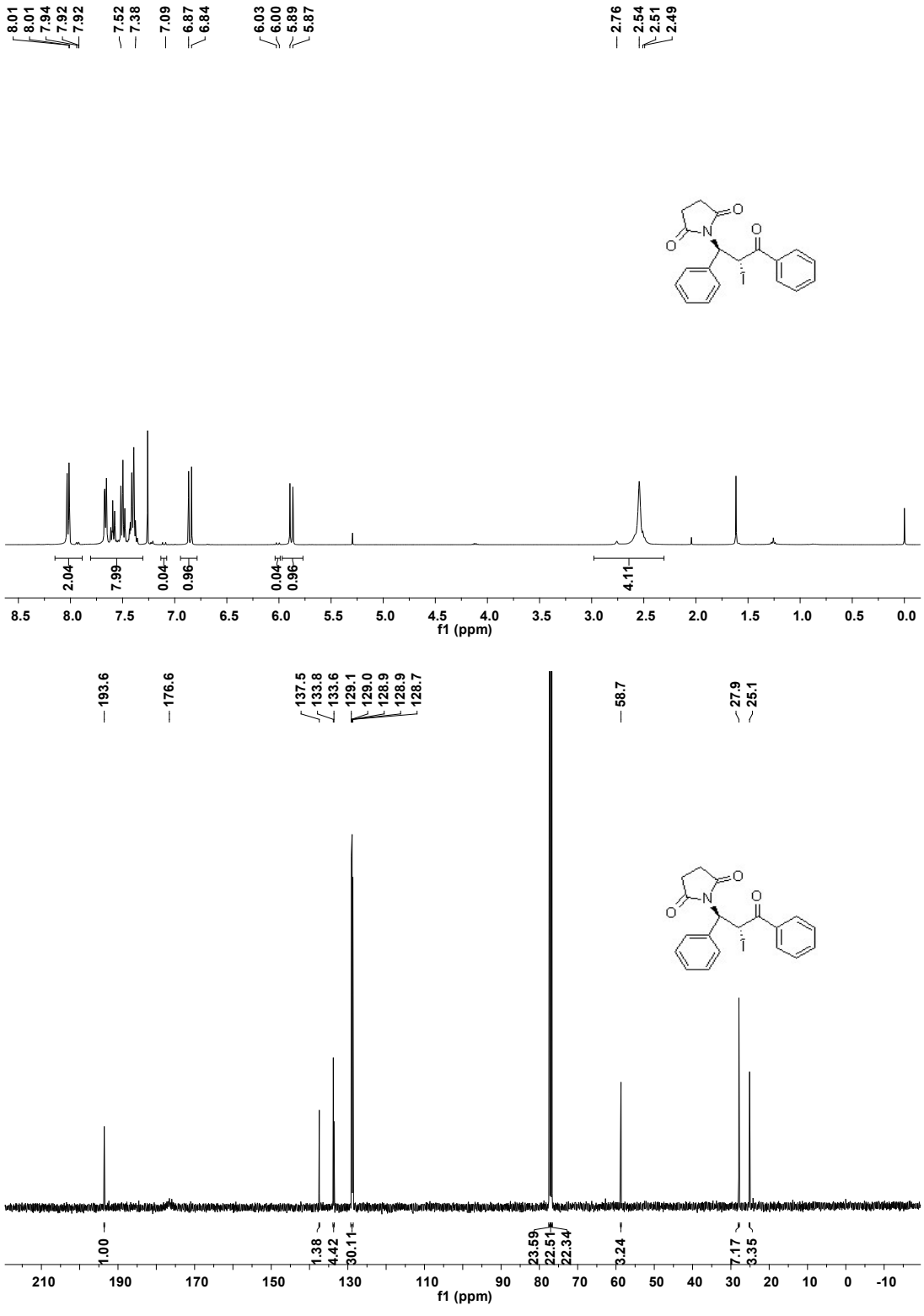
7.36
6.94
6.90
6.84
6.80
6.22
6.19
6.02
5.99
5.88
5.85
5.73
5.70
2.73
2.58
O
O
N
O
Br
1.00
10.07
0.85
0.15
0.15
0.85
0.15
0.85
4.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


191.0
176.6
145.5
131.2
128.9
128.8
122.4
57.2
48.4
28.0
O
O
N
O
Br
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

4a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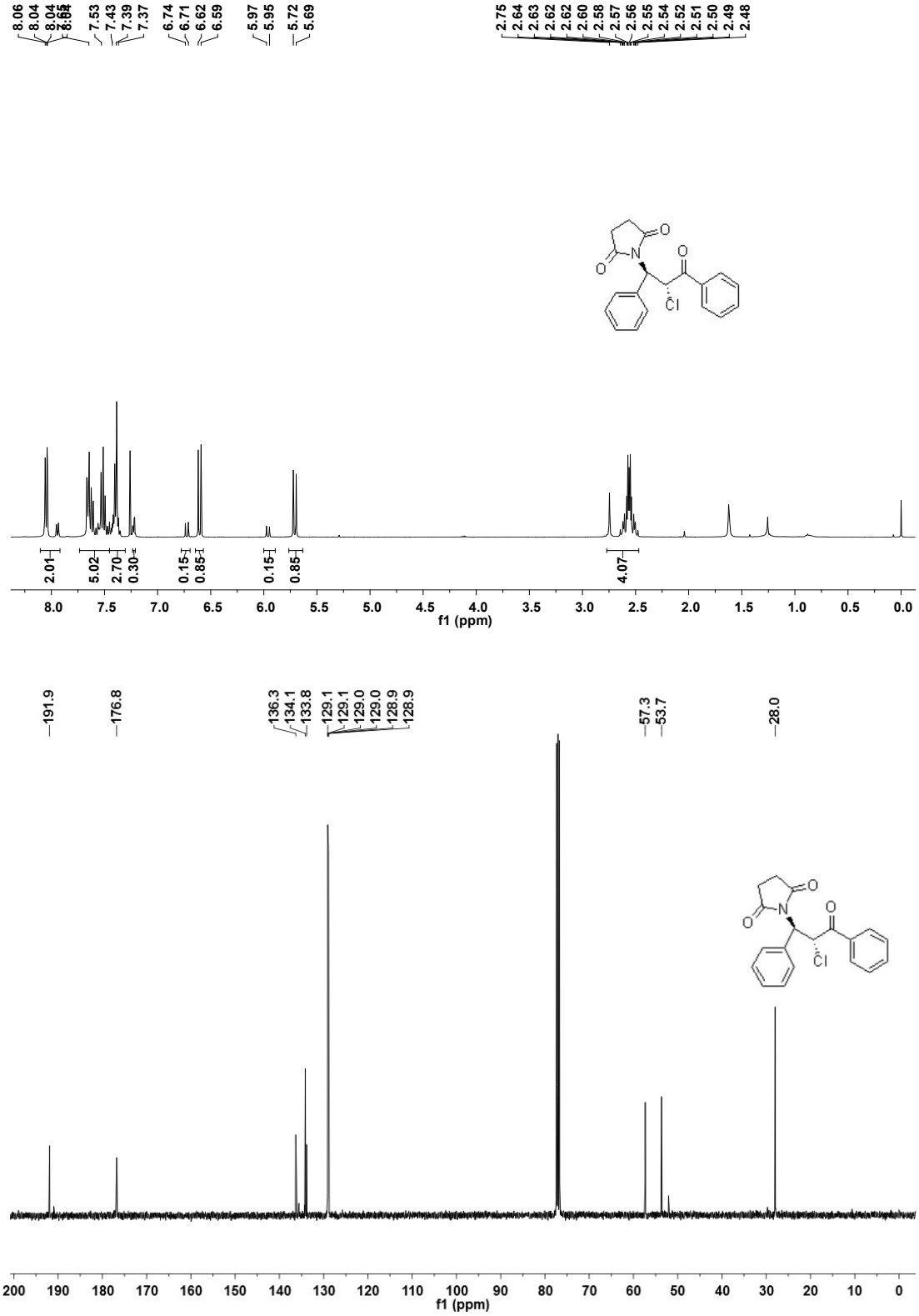
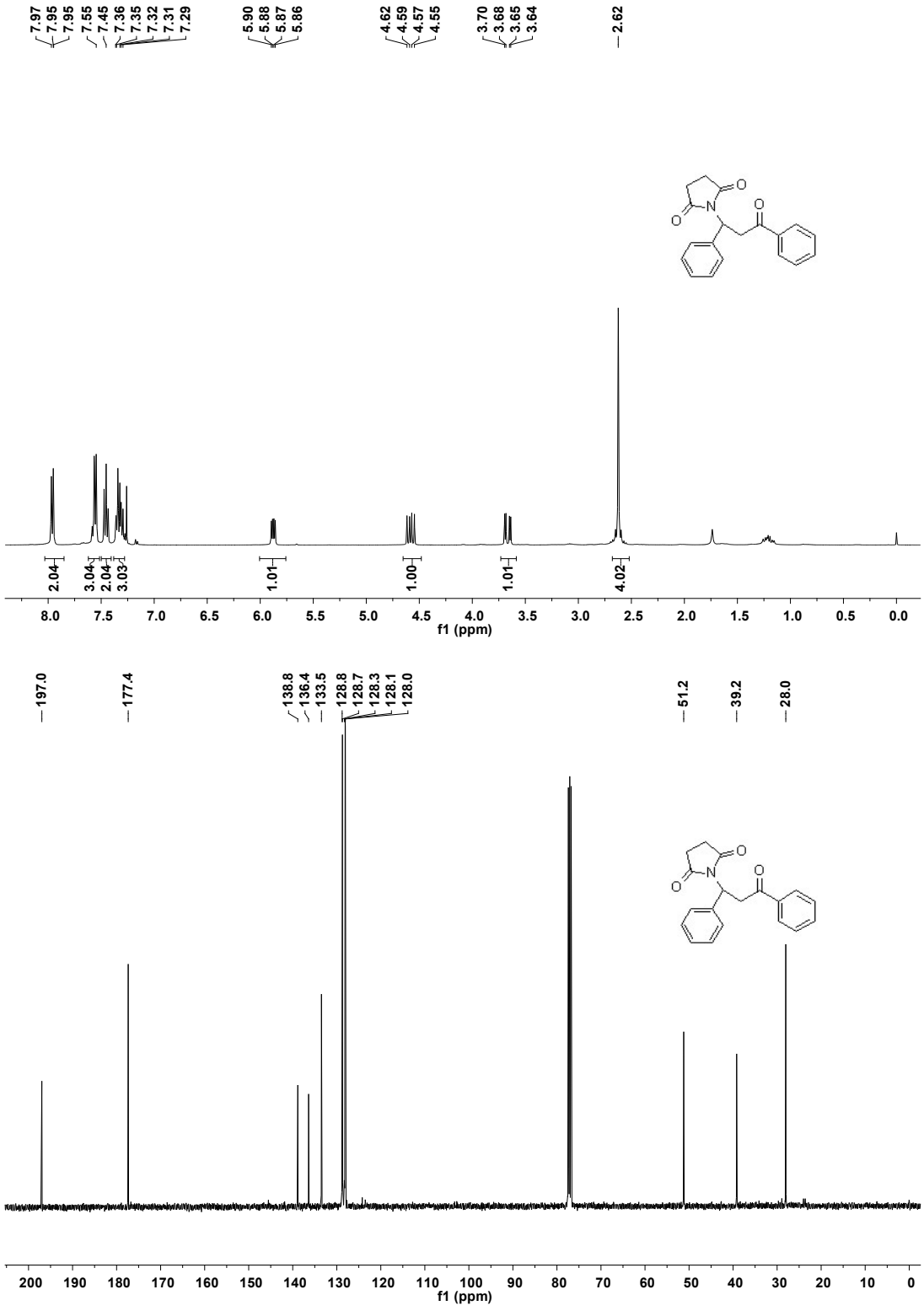
8.01
7.94
7.92
7.92
7.52
7.38
7.09
6.87
6.84
6.03
6.00
5.89
5.87
2.76
2.54
2.51
2.49
2.04
7.99
0.04
0.96
0.04
0.96
4.11
f1 (ppm)
193.6
176.6
137.5
133.8
133.6
129.1
129.0
128.9
128.9
128.7
58.7
27.9
25.1
1.00
1.38
4.42
30.11
23.59
22.51
22.34
3.24
7.17
3.35
f1 (ppm)

5a


8.06
8.04
7.53
7.43
7.39
7.37
6.74
6.71
6.62
6.59
5.97
5.95
5.72
5.69
2.75
2.64
2.63
2.62
2.62
2.60
2.58
2.57
2.56
2.55
2.54
2.52
2.51
2.50
2.49
2.48
O
O
N
O
Cl
2.01
5.02
2.70
0.30
0.15
0.85
0.15
0.85
4.07
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)
191.9
176.8
136.3
134.1
133.8
129.1
129.1
129.0
129.0
128.9
128.9
57.3
53.7
28.0
O
O
N
O
Cl
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

7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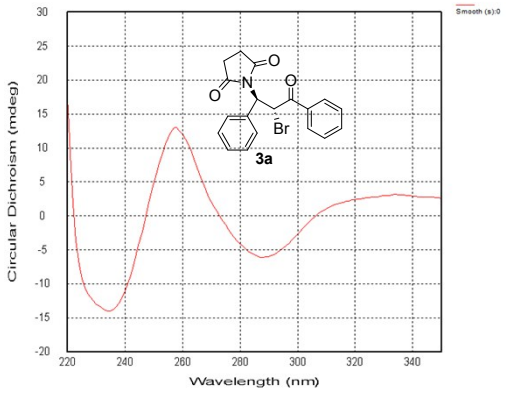
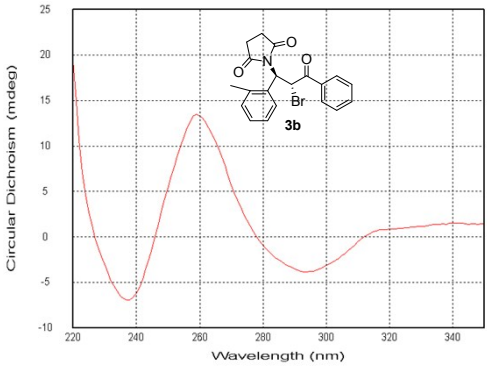
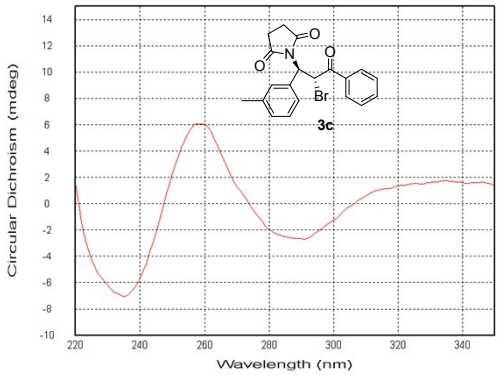
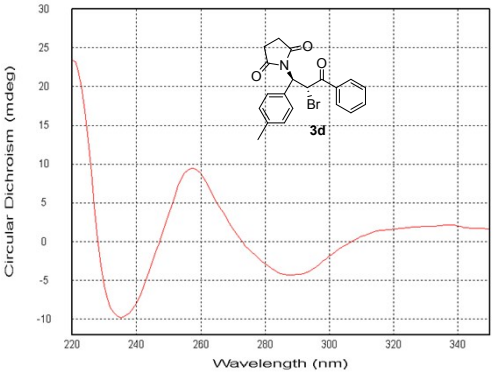
7.95
7.95
7.55
7.45
7.36
7.35
7.32
7.31
7.29
5.90
5.88
5.87
5.86
4.62
4.59
4.57
4.55
3.70
3.68
3.65
3.64
2.62
2.04
3.04
2.04
3.03
1.01
1.00
1.01
4.02
f1 (ppm)
197.0
177.4
138.8
136.4
133.5
128.8
128.7
128.3
128.1
128.0
51.2
39.2
28.0
f1 (ppm)

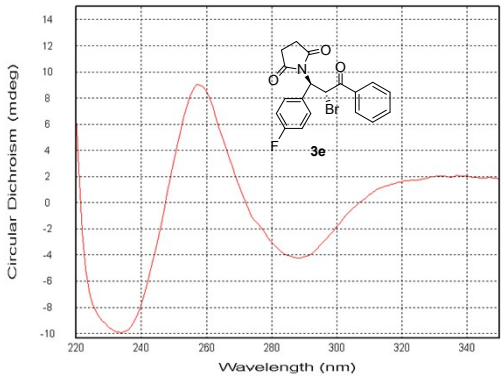
8. Copies of CD spectra in methanol

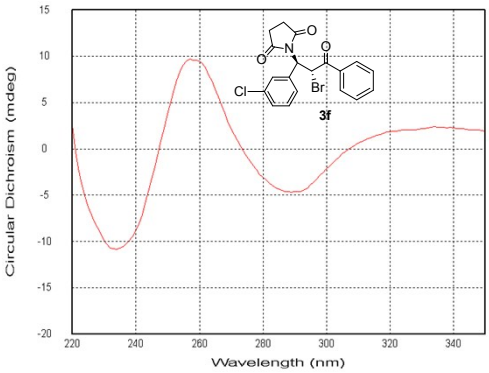


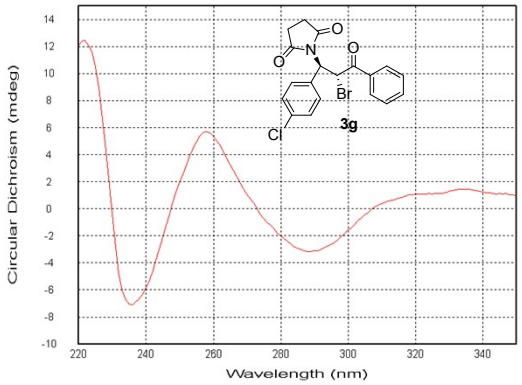


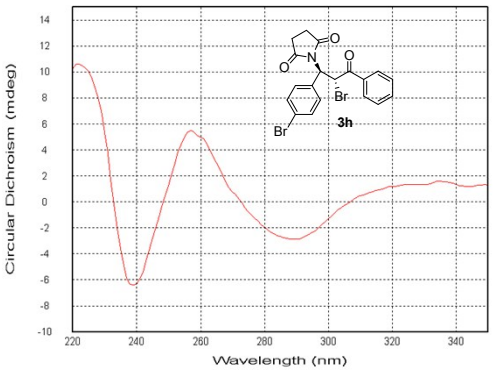


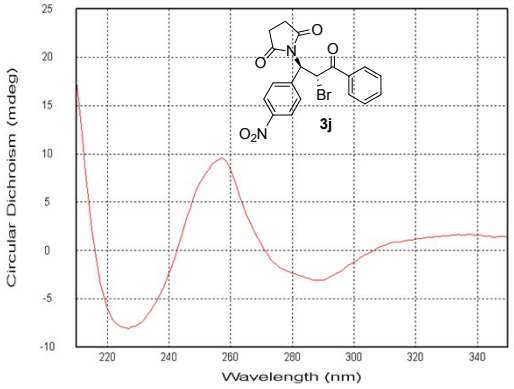


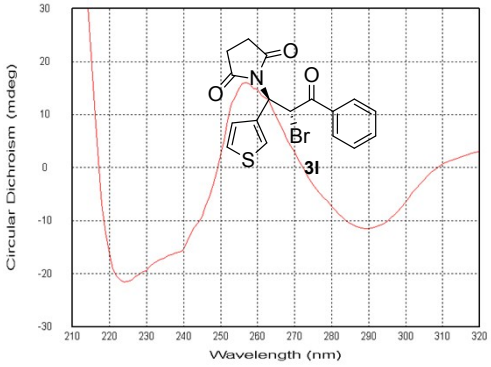


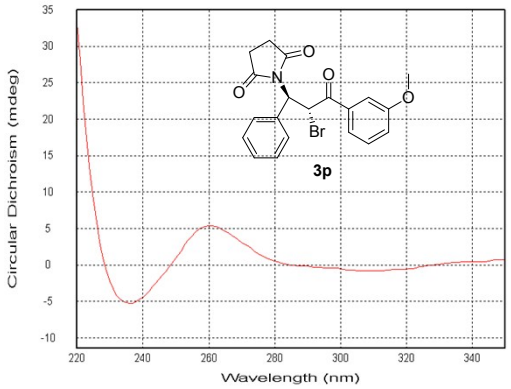


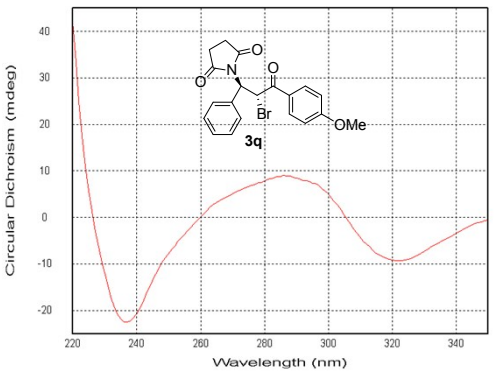


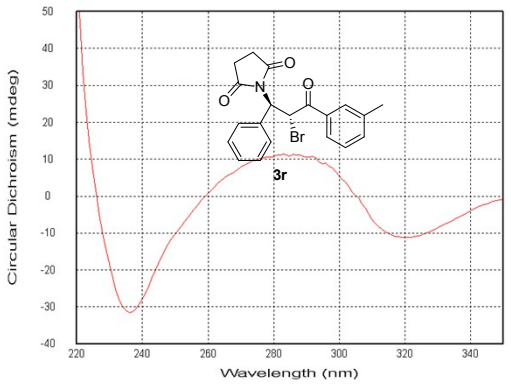


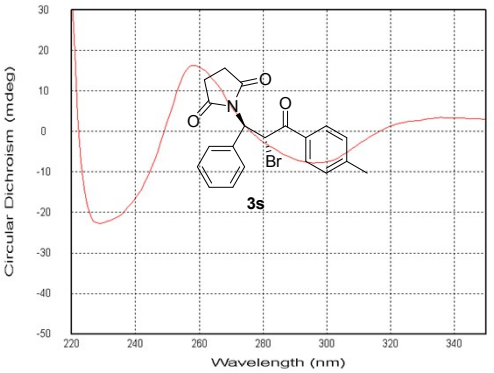

Circular Dichroism (mdeg)
Wavelength (nm)
3j

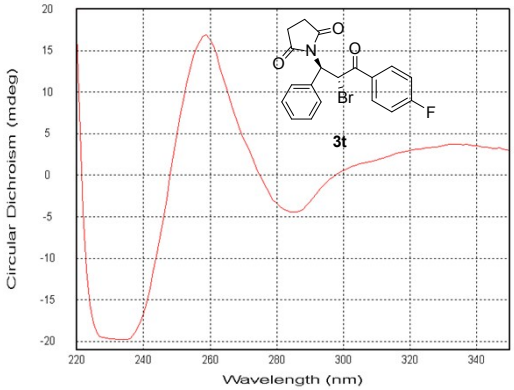

Circular Dichroism (mdeg)
Wavelength (nm)
3l

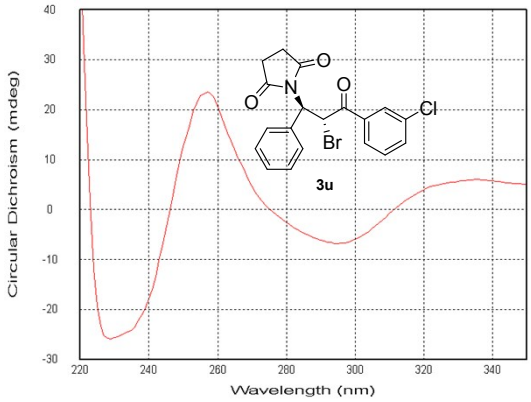

Circular Dichroism (mdeg)
Wavelength (nm)
3p

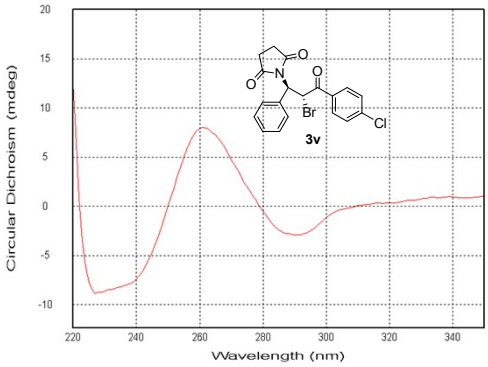

Circular Dichroism (mdeg)
Wavelength (nm)
3q

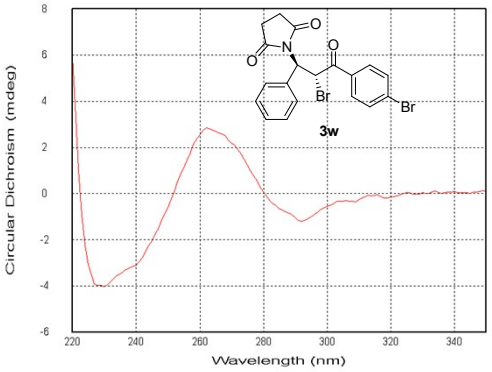

Circular Dichroism (mdeg)
Wavelength (nm)
3r

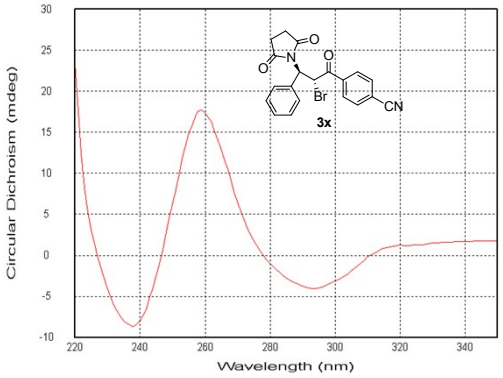

Circular Dichroism (mdeg)
Wavelength (nm)
3s

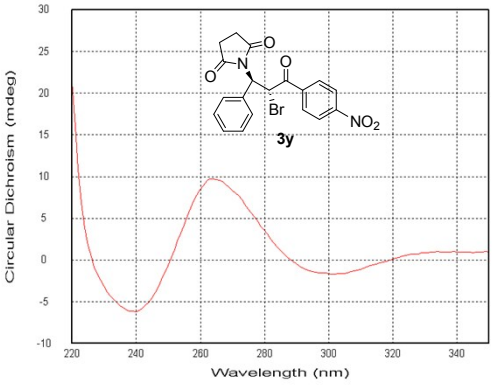

Circular Dichroism (mdeg)
Wavelength (nm)
3t

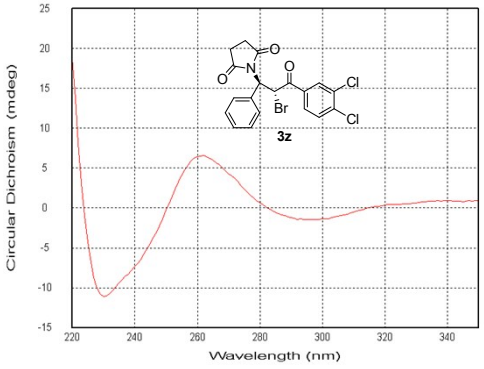

Circular Dichroism (mdeg)
Wavelength (nm)
3u

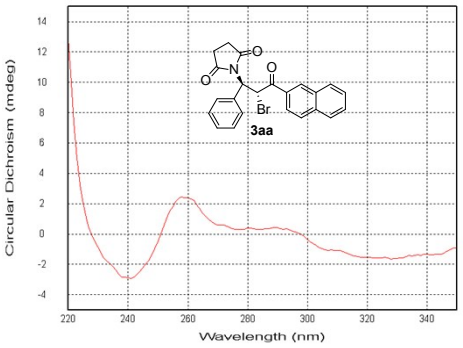

Circular Dichroism (mdeg)
Wavelength (nm)
3v

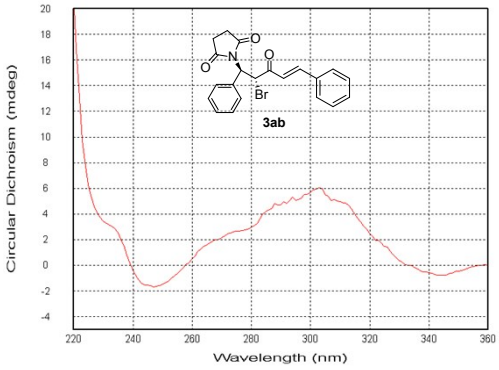

Circular Dichroism (mdeg)
Wavelength (nm)
3w


Circular Dichroism (mdeg)
Wavelength (nm)
3x


Circular Dichroism (mdeg)
Wavelength (nm)
3y


Circular Dichroism (mdeg)
Wavelength (nm)
3z


Circular Dichroism (mdeg)
Wavelength (nm)
3aa


Circular Dichroism (mdeg)
Wavelength (nm)
3ab

9. References

1. (a) Y. H. Wen, X. Huang, J. L. Huang, Y. Xiong, B. Qin and X. M. Feng, *Synlett,* 2005, 2445; (b) Z. P. Yu, X. H. Liu, Z. H. Dong, M. S. Xie and X. M. Feng, *Angew. Chem., Int. Ed.*, 2008, **47**, 1308; (c) K. Zheng, B. Qin, X. H. Liu and X. M. Feng, *J. Org. Chem.*, 2007, **72**, 8478; (d) X. Zhang, D. H. Chen, X. H. Liu and X. M. Feng, *J. Org. Chem.*, 2007, **72**, 5227; (e) X. Zhou, D. J. Shang, Q. Zhang, L. L. Lin, X. H. Liu and X. M. Feng, *Org. Lett.*, 2009, **11**, 1401.