Electronic Supplementary Material (ESI) for ChemComm.

Chiral Phosphoric acid Catalyzed Enantioselective N-Alkylation of Indoles with in situ Generated Cyclic N-Acyl Ketimines

Lvye Zhang, Binqiang Wu, Zhangtao Chen, Jinjin Hu, Xiaofei Zeng,* Guofu Zhong*

College of Materials, Chemistry and Chemical Engineering, Hangzhou Normal University, Hangzhou 310036, China

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I General information:

Analytical thin layer chromatography (TLC) was performed using Merck 60 F254 precoated silica gel plate (0.2 mm thickness). Subsequent to elution, plates were visualized using UV radiation (254 nm) on Spectroline Model ENF-24061/F 254 nm. Further visualization was possible by staining with basic solution of potassium permanganate or acidic solution of ceric molybdate.

Flash column chromatography was performed using Merck aluminium oxide90 active neutral with freshly distilled solvents. Columns were typically packed as slurry and equilibrated with the appropriate solvent system prior to use.

Proton nuclear magnetic resonance spectra (^{1}H NMR) were recorded on Bruker AMX 500 spectrophotometer ($CDCl_3$ as solvent). Chemical shifts for ^{1}H NMR spectra are reported as δ in units of parts per million (ppm) downfield from $SiMe_4$ (0.0) and relative to the signal of chloroform-d (7.26, singlet). Multiplicities were given as: s (singlet), d (doublet), t (triplet), dd (doublets of doublet) or m (multiplets). The number of protons (n) for a given resonance is indicated by nH. Coupling constants are reported as a *J* value in Hz. Carbon nuclear magnetic resonance spectra (^{13}C NMR) are reported as δ in units of parts per million (ppm) downfield from $SiMe_4$ (0.0) and relative to the signal of chloroform-d (77.0, triplet).

Enantiomeric excesses were determined by high performance liquid chromatography (HPLC) analysis on a chiral stationary phase, CHIRALCEL IC, CHIRALCEL IB or CHIRALCEL IA. Optical rotations were measured in $CHCl_3$ on a Schmidt + Haensdchpolarimeter (Polartronic MH8) with a 10 cm cell (*c* given in g/100 mL).

High resolution mass spectrometry (HRMS) was recorded on QTOF perimer for ESI^+.

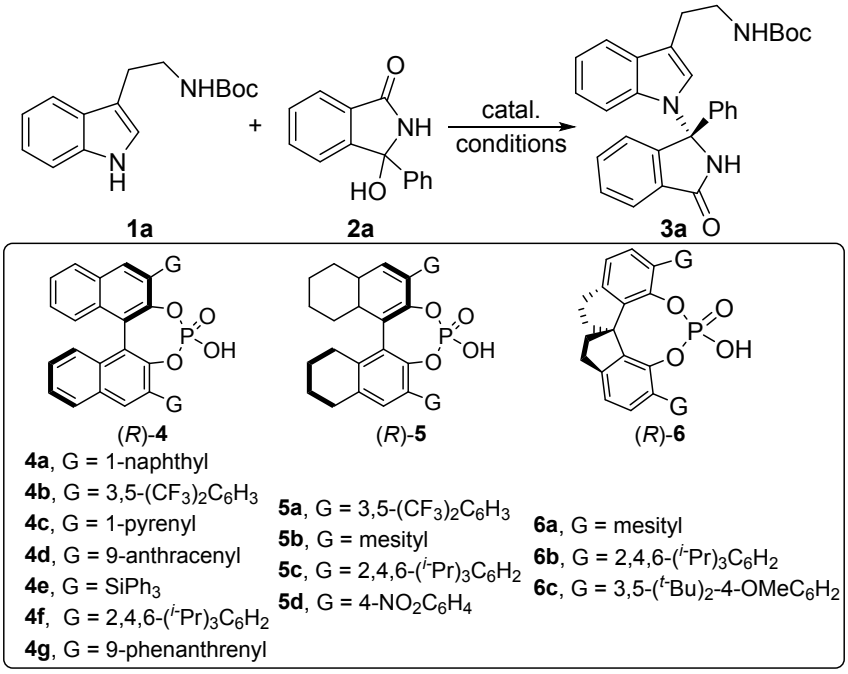
The racemic products used to determine the *ee* values were synthesized by using $(PhO)_2POOH$ as the catalyst.

The starting materials **1** and **2** were prepared according to the literatures reported.[1, 2,]

II Optimization of reaction conditions:

To an oven dried 5 mL vial was added N-Boc tryptamine (**1a**, 0.2 mmol, 1.0 equiv) and 3-hydroxy-3-phenylisoindolin-1-one (**2a**, 0.24 mmol, 1.2 equiv) in 1 mL solvent, followed by addition of the catalyst (5 mol%) and additive, the reaction was stirred at room temperature until the completion of the reaction (monitored by TLC). The reaction mixture was concentrated under reduced pressure and the resulting residue was purified by flash chromatography (EtOAc/hexane) to provide **3a**.

Table 1: Reaction condition optimization.[a]



entry	catal.	solvent	T (℃)	yield (%)[b]	*ee* (%)[c]
1	**4a**	DCM	20	44	30
2	**4b**	DCM	20	48	0
3	**4c**	DCM	20	81	3
4	**4d**	DCM	20	48	15
5	**4e**	DCM	20	23	65
6	**4f**	DCM	20	70	3
7	**4g**	DCM	20	47	19
8	**5a**	DCM	20	50	8
9	**5b**	DCM	20	32	28
10	**5c**	DCM	20	54	15
11	**5d**	DCM	20	52	0
12	**6a**	DCM	20	51	87
13	**6b**	DCM	20	trace	--
14	**6c**	DCM	20	trace	--
15	**6a**	DCE	20	55	88
16	**6a**	toluene	20	50	86

17	**6a**	CH_3CN	20	25	88
18	**6a**	THF	20	—	—
19	**6a**	$CHCl_3$	20	50	87
20	**6a**	CCl_4	20	—	—
21	**6a**	EtOAc	20	—	—
22	**6a**	Chlorobenzene	20	35	80
23	**6a**	DMF	20	—	—
24	**6a**	DCE	40	62	82
25	**6a**	DCE	0	—	—
26[d]	**6a**	DCE	20	60	92
27[e]	**6a**	**DCE**	**20**	**63**	**94**
28[f]	**6a**	**DCE**	**20**	**63**	**94**

[a]Reaction conditions: The reaction was conducted with **1a** (0.2 mmol), **2a** (0.24 mmol) in the presence of catalyst (5 mol%) and 20 mg of MS in 1 mL of solvent at different temperatures for 12 h. [b]solated yield. [c]Determined by chiral HPLC analysis. [d]20 mg 3 Å molecular sieve was added. [e]20 mg 4 Å molecular sieve was added. [f]20 mg 5 Å molecular sieve was added, DCE = $ClCH_2CH_2Cl$.

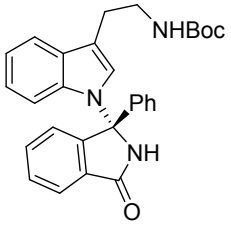
III Substrate scope of the asymmetric N-alkylation reaction

General procedure

To an oven dried 5 mL vial was added indole derivative (**1**, 0.2 mmol, 1.0 equiv) and 3-hydroxy-3-arylisoindolin-1-one (**2a**, 0.24 mmol, 1.2 equiv) in 1 mL DCE, followed by addition of the (*R*)-**6a** (5 mol%) and 4 Å MS (20 mg), the reaction mixture was stirred at room temperature until the completion of the reaction (monitored by TLC). The reaction mixture was concentrated under reduced pressure and the resulting residue was purified by flash chromatography (EtOAc/hexane) to provide **3a**.

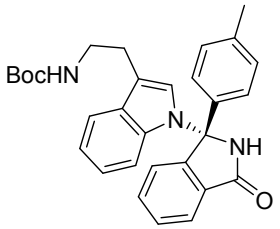
IV Characterization of products:

***tert*-butyl (*S*)-(2-(1-(3-oxo-1-phenylisoindolin-1-yl)-1*H*-indol-3-yl)ethyl)carbamate (3a)**



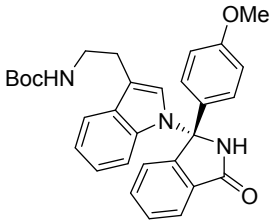
White solid, yield (63%); mp. = 125-126 °C; $[\alpha]_D^{25}$ = -2.62 (c 0.25, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 6.7 Hz, 1H), 7.61–7.46 (m, 7H), 7.40–7.35 (m, 3H), 7.08 (t, *J* = 7.4 Hz, 1H), 6.95 (t, *J* = 7.6 Hz, 1H), 6.70 (s, 1H), 6.55 (d, *J* = 8.3 Hz, 1H), 4.65 (s, 1H), 3.34 (d, *J* = 6.5 Hz, 2H), 2.84 (t, *J* = 6.9 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.3, 146.8, 139.6, 136.5, 132.9, 130.4, 130.1, 123.0, 129.4, 129.1, 125.7, 125.2, 124.8, 124.4, 122.3, 120.2, 119.6, 113.5, 112.7, 79.5, 79.2, 60.4, 28.4, 25.8. 94% *ee* as determined by HPLC (Chiralcel IC, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 22.14 min, t_r (minor) = 17.23 min. HRMS (ESI+) calcd for $C_{29}H_{29}N_3O_3$ $(M+H)^+$, m/z 468.2282, found 468.2278.

***tert*-butyl (*S*)-(2-(1-(3-oxo-1-(p-tolyl)isoindolin-1-yl)-1*H*-indol-3-yl)ethyl)carbamate (3b)**



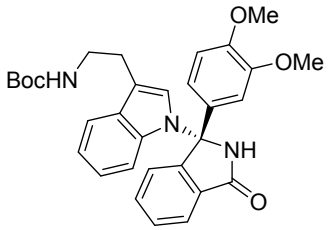
White solid, yield (63%); mp. = 110-111 °C; $[\alpha]_D^{25}$ = -3.31 (c 0.25, $CHCl_3$);^1H NMR (500 MHz, $CDCl_3$) δ 7.90 (d, *J* = 7.1 Hz, 1H), 7.56 (dd, *J* = 17.6, 10.8 Hz, 4H), 7.38 (d, *J* = 8.0 Hz, 3H), 7.17 (d, *J* = 7.9 Hz, 2H), 7.08 (t, *J* = 7.4 Hz, 1H), 6.96 (t, *J* = 7.6 Hz, 1H), 6.69 (s, 1H), 6.58 (d, *J* = 8.0 Hz, 1H), 4.63 (s, 1H), 3.34 (d, *J* = 6.2 Hz, 2H), 2.83 (t, *J* = 6.6 Hz, 2H), 2.35 (s, 3H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.3, 155.9, 146.9, 139.1, 136.6, 136.5, 132.9, 130.3, 130.1, 123.0, 129.9, 125.6, 125.3, 124.8, 124.4, 122.3, 120.2, 119.5, 113.4, 112.8, 79.4, 79.1, 40.9, 28.4, 25.7, 21.1. 92% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 18.64 min, t_r (minor) = 21.95 min. HRMS (ESI+) calcd for $C_{30}H_{31}N_3O_3$ $(M+Na)^+$, m/z 504.2258, found 504.2258.

***tert*-butyl (*S*)-(2-(1-(1-(4-methoxyphenyl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3c)**



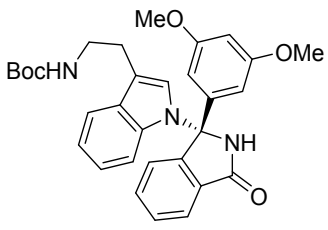
White solid, yield (57%); mp. =122-123 °C; $[\alpha]_D^{25}$ = -513.20 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.90 (d, *J* = 7.3 Hz, 1H), 7.73–7.64 (m, 1H), 7.61–7.49 (m, 4H), 7.40 (d, *J* = 8.7 Hz, 2H), 7.07 (t, *J* = 7.5 Hz, 1H), 6.95 (t, *J* = 7.6 Hz, 1H), 6.87 (d, *J* = 8.6 Hz, 2H), 6.70 (s, 1H), 6.61 (d, *J* = 7.8 Hz, 1H), 4.67 (s, 1H), 3.78 (s, 3H), 3.34 (d, *J* = 6.1 Hz, 2H), 2.83 (t, *J* = 6.7 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.5, 160.2, 155.9, 147.1, 136.5, 134.2, 132.9, 131.4, 130.3, 129.9, 127.1, 125.2, 124.7, 124.2, 123.5, 122.3, 120.2, 119.5, 114.6, 112.9, 79.4, 79.1, 55.3, 40.9, 28.4, 25.7. 88% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 25.47 min, t_r (minor) = 21.65 min. HRMS (ESI+) calcd for $C_{30}H_{31}N_3O_4$ $(M+H)^+$, m/z 520.2207, found 520.2211.

tert-buty (*S*)-(2-(1-(1-(3,4-dimethoxyphenyl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3d)



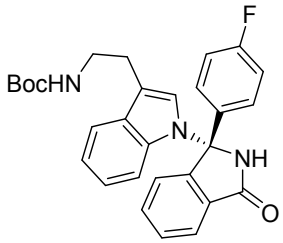
White solid, yield (63%); mp. =97-98 °C; $[\alpha]_D^{25}$ = -425.14 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.2 Hz, 1H), 7.82-7.80 (m, 1H), 7.60-7.53 (m, 4H), 7.09-7.02 (m, 3H), 6.96 (t, *J* = 7.4 Hz, 1H), 6.82 (d, *J* = 8.6 Hz, 1H), 6.68 (s, 1H), 6.63 (d, *J* = 7.2 Hz, 1H), 4.67 (s, 1H), 3.85 (d, *J* = 8.4 Hz, 3H), 3.75 (s, 3H), 3.34 (d, *J* = 6.0 Hz, 2H), 2.83 (t, *J* = 6.4 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.5, 154.9, 148.6, 148.5, 145.9, 135.6, 131.9, 130.8, 129.3, 129.0, 128.9, 124.2, 123.7, 123.1, 121.3, 119.2, 118.4, 117.4, 112.5, 111.8, 110.4, 107.8, 78.5, 78.1, 55.0, 54.9, 39.8, 27.4, 24.7. 90% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 9.51 min, t_r (minor) = 38.72 min. HRMS (ESI+) calcd for $C_{31}H_{33}N_3O_5$ $(M+Na)^+$, m/z 550.2312, found 550.2311.

tert-butyl (*S*)-(2-(1-(1-(3,5-dimethoxyphenyl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl) ethyl)carbamate (3e)



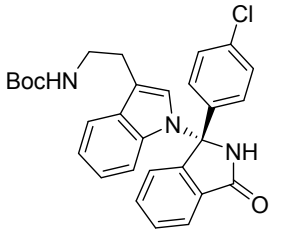
White solid, yield (61%); mp. =110-111 °C; $[\alpha]_D^{25}$ = -396.26 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.90 (d, *J* = 7.3 Hz, 1H), 7.63-7.54 (m, 4H), 7.30 (s, 1H), 7.09 (t, *J* = 7.4 Hz, 1H), 6.99 (t, *J* = 7.6 Hz, 1H), 6.68-6.66 (m, 4H), 6.45 (s, 1H), 4.63 (s, 1H), 3.71 (s, 6H), 3.34 (d, *J* = 5.7 Hz, 2H), 2.83 (t, *J* = 6.3 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.2, 160.6, 154.9, 145.4, 141.0, 135.6, 131.9, 129.3, 129.1, 128.9, 124.1, 123.7, 123.3, 121.4, 119.3, 118.5, 112.6, 111.6, 103.1, 99.4, 78.4, 78.1, 54.4, 39.8, 27.4, 24.7. 93% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 10.08 min, t_r (minor) = 16.06 min. HRMS (ESI+) calcd for $C_{31}H_{33}N_3O_5$ $(M+H)^+$, m/z 550.2312, found 550.2318.

***tert*-butyl (*S*)-(2-(1-(1-(4-fluorophenyl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3f)**



White solid, yield (61%); mp. =116-117 °C; $[\alpha]_D^{25}$ = -448.72 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.4 Hz, 2H), 7.61-7.45 (m, 6H), 7.09-7.03 (m, 3H), 6.97 (t, *J* = 7.7 Hz, 1H), 6.68 (s, 1H), 6.59 (d, *J* = 7.7 Hz, 1H), 4.67 (s, 1H), 3.33 (d, *J* = 6.5 Hz, 2H), 2.83 (d, *J* = 6.8 Hz, 2H), 1.39 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.5, 162.1 (d, *J* = 249.5 Hz), 154.9, 145.6, 135.2, 134.5 (d, *J* = 2.9 Hz), 133.1, 132.0, 129.3, 129.3, 129.2, 128.9, 126.7 (d, *J* = 8.0 Hz), 124.1, 123.9, 123.3, 122.5, 121.3, 119.3, 118.6, 115.3 (d, *J* = 21.4 Hz), 112.6, 111.7, 78.2, 78.1, 39.8, 27.4, 24.7. 91% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 11.18 min, t_r (minor) = 14.55 min. HRMS (ESI+) calcd for $C_{29}H_{28}FN_3O_3$ $(M+H)^+$, m/z 486.2187, found 486.2182.

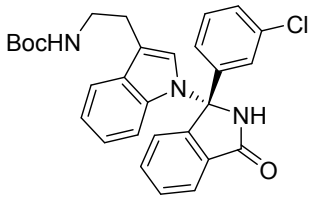
***tert*-butyl (*S*)-(2-(1-(1-(4-chlorophenyl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3g)**



White solid, yield (67%); mp. =114-115 °C; $[\alpha]_D^{25}$ = -256.56 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.92 (d, *J* = 7.7 Hz, 1H), 7.65-7.56 (m, 3H), 7.56-7.40 (m, 4H), 7.39-7.32 (m, 2H), 7.10 (t, *J* = 7.5 Hz, 1H), 6.99 (t, *J* = 7.8 Hz, 1H), 6.66 (s, 1H), 6.58 (d, *J* = 8.0 Hz, 1H), 4.62 (s, 1H), 3.34 (d, *J* = 6.4 Hz, 2H), 2.83 (t, *J* = 6.8 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.3, 154.9, 145.3, 137.3, 135.2, 134.2, 132.1, 129.4, 129.3, 128.8, 128.6, 128.4, 126.1, 124.0, 123.9, 123.5, 121.5, 119.4, 118.7, 112.7, 111.5, 78.2, 78.0, 39.8, 28.7, 27.4. 96% *ee* as determined by HPLC

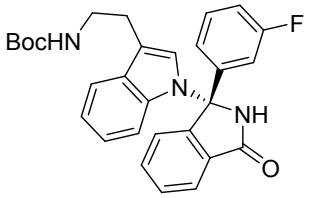
(Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 14.60 min, t_r (minor) = 13.46 min. HRMS (ESI+) calcd for $C_{29}H_{28}ClN_3O_3(M+H)^+$, m/z 524.1711, found 524.1717.

***tert*-butyl (*S*)-(2-(1-(1-(3-chlorophenyl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3h)**



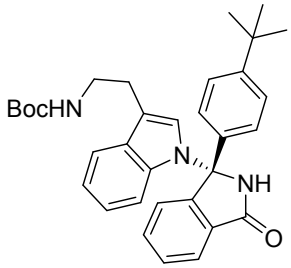
White solid, yield (62%); mp. =268-269 °C; $[\alpha]_D^{25}$ = -363.14 (c 0.25, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.3 Hz, 1H), 7.64 -7.59 (m, 3H), 7.52 (d, *J* = 8.8 Hz, 2H), 7.39-7.30 (m, 4H), 7.11 (t, *J* = 7.5 Hz, 1H), 7.00 (t, *J* = 7.7 Hz, 1H), 6.66 (s, 1H), 6.57 (d, *J* = 7.9 Hz, 1H), 4.62 (s, 1H), 3.35 (d, *J* = 6.4 Hz, 2H), 2.84 (t, *J* = 6.7 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.2, 155.9, 146.1, 141.9, 136.3, 135.5, 133.2, 130.8, 130.4, 129.8, 129.4, 125.7, 125.0, 124.4, 124.1, 122.6, 120.5, 119.8, 113.9, 112.4, 79.2, 79.0, 40.8, 28.4, 25.7. 96% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 8.16 min, t_r (minor) = 12.15 min. HRMS (ESI+) calcd for $C_{29}H_{28}ClN_3O_3(M+H)^+$, m/z 524.1711, found 524.1713.

***tert*-butyl (*S*)-(2-(1-(1-(3-fluorophenyl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3i)**



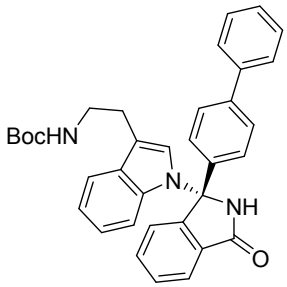
White solid, yield (67%); mp. =198-199 °C; $[\alpha]_D^{25}$ = -178.74 (c 0.25, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.91-7.90 (m, 1H), 7.67-7.52 (m, 5H), 7.35-7.21 (m,3H), 7.08 (dt, *J* = 8.1, 6.9 Hz, 2H), 6.99 (t, *J* = 7.6 Hz, 1H), 6.67 (s, 1H), 6.59 (d, *J* = 7.9 Hz, 1H), 4.66 (s, 1H), 3.33 (s, 2H), 2.83 (s, 2H), 1.39 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.3, 162.3 (d, *J* = 252 Hz), 154.9, 145.1, 141.4 (d, *J* = 6.8 Hz), 135.3, 132.1, 132.0, 130.1 (d, *J* = 8.2 Hz), 129.3, 128.9, 124.0, 123.9, 123.3, 121.4, 120.4, 119.4, 118.7, 115.2 (d, *J* = 25.2 Hz), 112.8, 112.2, 112.0, 111.5, 78.1, 78.0, 39.8, 27.4, 24.7. 96% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 9.11 min, t_r (minor) = 19.32 min. HRMS (ESI+) calcd for $C_{29}H_{28}FN_3O_3$ $(M+Na)^+$, m/z 508.2007, found 508.1999.

***tert*-butyl (*S*)-(2-(1-(1-(4-(tert-butyl)phenyl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl) ethyl)carbamate (3j)**



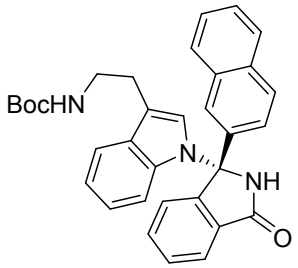
White solid, yield (61%); mp. =102-103 °C; $[\alpha]_D^{25}$ = -811.80 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.90 (d, *J* = 7.6 Hz, 1H), 7.70-7.53 (m, 5H), 7.39 (dd, *J* = 27.6, 8.3 Hz, 4H), 7.06 (t, *J* = 7.5 Hz, 1H), 6.94 (t, *J* = 7.7 Hz, 1H), 6.71 (s, 1H), 6.56 (d, *J* = 8.0 Hz, 1H), 4.69 (s, 1H), 3.34 (d, *J* = 5.9 Hz, 2H), 2.83 (t, *J* = 6.7 Hz, 2H), 1.40 (s, 9H), 1.29 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.5, 156.0, 152.1, 147.0, 136.5, 136.4, 132.9, 130.3, 130.1, 129.9, 126.3, 125.5, 125.4, 124.7, 124.4, 122.2, 120.1, 119.4, 113.4, 112.9, 79.5, 79.1, 40.9, 34.6, 31.3, 28.4, 25.7. 98% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 7.94 min, t_r (minor) = 7.33 min. HRMS (ESI+) calcd for $C_{33}H_{37}N_3O_3$ $(M+H)^+$, m/z 546.2727, found 546.2730.

tert-butyl (*S*)-(2-(1-(1-([1,1'-biphenyl]-4-yl)-3-oxoisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3k)



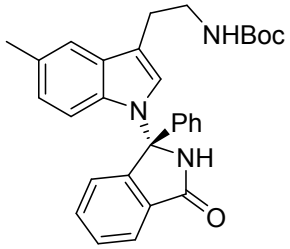
White solid, yield (62%); mp. =271-272 °C; $[\alpha]_D^{25}$ = -273.48 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, *J* = 7.3 Hz, 1H), 7.64-7.55 (m, 10H), 7.44 (t, *J* = 7.6 Hz, 2H), 7.36 (d, *J* = 7.3 Hz, 1H), 7.15-7.10 (m, 2H), 6.99 (t, *J* = 7.7 Hz, 1H), 6.72 (s, 1H), 6.63 (d, *J* = 8.3 Hz, 1H), 4.61 (s, 1H), 3.37 (d, *J* = 6.5 Hz, 2H), 2.86 (t, *J* = 6.9 Hz, 2H), 1.41 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.2, 154.9, 145.7, 141.0, 138.9, 137.4, 135.4, 132.1, 129.4, 129.2, 128.8, 127.9, 127.0, 126.8, 126.0, 125.1, 124.2, 123.8, 123.4, 121.4, 119.3, 118.7, 112.6, 111.6, 78.3, 78.2, 39.9, 27.4, 24.7. 94% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 25.68 min, t_r (minor) = 20.06 min. HRMS (ESI+) calcd for $C_{35}H_{33}N_3O_3$ $(M+Na)^+$, m/z 566.2414, found 566.2423

tert-butyl (*S*)-(2-(1-(1-(naphthalen-2-yl)-3-oxoisoindolin-1-yl)-1H-indol-3-yl)ethyl) carbamate (3l)



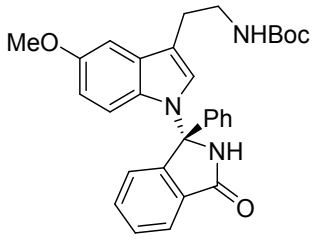
White solid, yield (52%); mp. =291-292 °C; $[\alpha]_D^{25}$ = -0.29 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 8.04 (s, 1H), 7.94 (d, *J* = 6.3 Hz, 1H), 7.85 (t, *J* = 8.1 Hz, 2H), 7.80 (d, *J* = 8.5 Hz, 1H), 7.61-7.56 (m, 5H), 7.54-7.49 (m, 2H), 7.28 (s, 1H), 7.09 (t, *J* = 7.5 Hz, 1H), 6.91 (t, *J* = 7.7 Hz, 1H), 6.74 (s, 1H), 6.57 (d, *J* = 8.3 Hz, 1H), 4.62 (s, 1H), 3.41-3.32 (m, 2H), 2.87 (t, *J* = 6.9 Hz, 2H), 1.41 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.3, 154.9, 145.7, 135.9, 135.5, 132.4, 132.2, 132.0, 129.4, 129.1, 128.8, 128.6, 127.4, 126.7, 126.0, 125.8, 124.3, 123.9, 123.5, 123.4, 122.4, 121.5, 119.3, 118.6, 112.7, 111.6, 78.6, 78.2, 39.8, 27.4, 24.7. 93% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 19.57 min, t_r (minor) = 12.66 min. HRMS (ESI+) calcd for $C_{33}H_{31}N_3O_3$ $(M+Na)^+$, m/z 540.2258, found 540.2257.

tert-butyl (*S*)-(2-(5-methyl-1-(3-oxo-1-phenylisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3n)



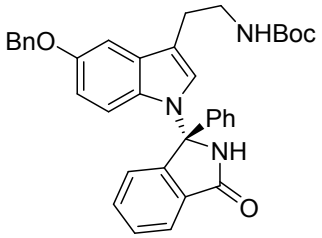
White solid, yield (55%); mp. =267-268 °C; $[\alpha]_D^{25}$ = -217.34 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.1 Hz, 1H), 7.62-7.55 (m, 2H), 7.54-7.47 (m, 3H), 7.37 (dd, *J* = 6.1, 2.4 Hz, 4H), 6.78 (d, *J* = 8.4 Hz, 1H), 6.65 (s, 1H), 6.42 (d, *J* = 8.3 Hz, 1H), 4.62 (s, 1H), 3.34 (d, *J* = 5.9 Hz, 2H), 2.81 (t, *J* = 6.6 Hz, 2H), 2.39 (s, 3H), 1.41 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.3, 145.7, 138.6, 133.8, 131.9, 129.6, 129.0, 128.9, 128.6, 128.4, 128.1, 127.5, 124.7, 124.4, 123.8, 123.4, 122.9, 118.3, 112.1, 111.3, 78.4, 78.1, 39.9, 27.4, 24.7, 20.3. 84% *ee* as determined by HPLC (Chiralcel IC, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 16.64 min, t_r (minor) = 14.25 min. HRMS (ESI+) calcd for $C_{30}H_{31}N_3O_3$ $(M+H)^+$, m/z 482.2438, found 482.2440.

tert-butyl (*S*)-(2-(5-methoxy-1-(3-oxo-1-phenylisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3o)



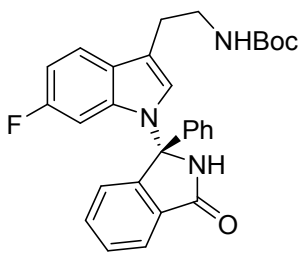
White solid, yield (77%); mp. =177-178 °C; $[\alpha]_D^{25}$ = -330.26 (c 0.25, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.90 (d, *J* = 6.9 Hz, 1H), 7.54 (ddd, *J* = 13.7, 11.9, 6.1 Hz, 6H), 7.38 (d, *J* = 2.0 Hz, 3H), 7.00 (s, 1H), 6.66 (s, 1H), 6.60 (dd, *J* = 9.0, 2.3 Hz, 1H), 6.42 (d, *J* = 8.8 Hz, 1H), 4.66 (s, 1H), 3.80 (s, 3H), 3.34 (d, *J* = 5.7 Hz, 2H), 2.80 (t, *J* = 6.7 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.3, 153.4, 145.7, 138.6, 131.9, 130.5, 130.0, 129.0, 128.9, 128.4, 128.1, 125.0, 124.7, 124.5, 123.8, 123.3, 112.4, 112.3, 111.0, 100.5, 78.5, 78.1, 54.7, 39.7, 27.4, 24.7. 88% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 5.59 min, t_r (minor) = 6.75 min. HRMS (ESI+) calcd for $C_{30}H_{31}N_3O_4$ $(M+H)^+$, m/z 498.2387, found 498.2390.

tert-butyl (*S*)-(2-(5-(benzyloxy)-1-(3-oxo-1-phenylisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3p)



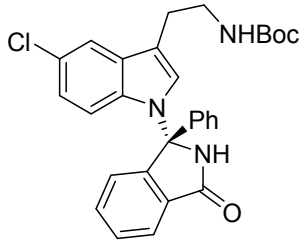
White solid, yield (55%); mp. =141-142 °C; $[\alpha]_D^{25}$ = -32.26 (c 0.25, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.90 (d, *J* = 6.9 Hz, 1H), 7.61-7.28 (m, 15H), 7.10 (s, 1H), 6.70-6.60 (m, 2H), 6.42 (d, *J* = 8.8 Hz, 1H), 5.05 (s, 2H), 4.64 (s, 1H), 3.32 (d, *J* = 6.0 Hz, 2H), 2.78 (t, *J* = 6.7 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.3, 155.9, 153.6, 146.7, 139.6, 137.4, 133.0, 131.8, 131.0, 130.1, 129.9, 129.4, 129.2, 128.5, 127.9, 127.6, 126.1, 125.7, 125.5, 124.8, 124.3, 113.4 112.6, 103.1, 79.5, 79.2, 70.8, 40.7, 29.7, 28.4, 25.8. 90% *ee* as determined by HPLC (Chiralcel IC, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 25.00 min, t_r (minor) = 11.56 min. HRMS (ESI+) calcd for $C_{36}H_{35}N_3O_4$ $(M+H)^+$, m/z 574.2700, found 574.2709.

tert-butyl (*S*)-(2-(6-fluoro-1-(3-oxo-1-phenylisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3q)



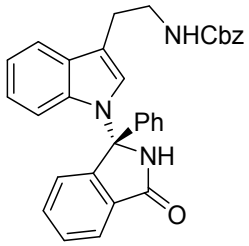
White solid, yield (58%); mp. =226-227 °C; $[\alpha]_D^{25}$ = -5.27 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.88 (t, *J* = 30.1 Hz, 2H), 7.62-7.45 (m, 6H), 7.39 (s, 3H), 6.83 (td, *J* = 9.1, 1.6 Hz, 1H), 6.68 (s, 1H), 6.23 (d, *J* = 9.6 Hz, 1H), 4.66 (s, 1H), 3.32 (d, *J* = 6.5 Hz, 2H), 2.80 (t, *J* = 6.8 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.5, 159.5 (d, *J* = 6.5 Hz), 155.9, 146.5, 139.1, 136.4 (d, *J* = 11.34 Hz), 133.0, 130.2, 130.0, 129.5, 129.4, 126.8, 125.7, 125.4, 124.9, 124.3, 120.1, 113.7, 108.9 (d, *J* = 25.2 Hz), 99.6 (d, *J* = 25.2 Hz), 79.6, 79.2, 40.8, 28.4, 25.7. 93% *ee* as determined by HPLC (Chiralcel IC, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 15.00 min, t_r (minor) = 13.15 min. HRMS (ESI+) calcd for $C_{29}H_{28}FN_3O_3$ $(M+H)^+$, m/z 486.2187, found 486.2189.

tert-butyl (*S*)-(2-(5-chloro-1-(3-oxo-1-phenylisoindolin-1-yl)-1*H*-indol-3-yl)ethyl) carbamate (3r)



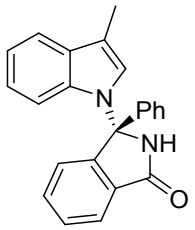
White solid, yield (50%); mp. =243-244 °C; $[\alpha]_D^{25}$ = -31.56 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.90 (d, *J* = 7.8 Hz, 2H), 7.58 (dd, *J* = 14.7, 7.4 Hz, 2H), 7.52 (d, *J* = 1.5 Hz, 2H), 7.49-7.45 (m, 2H), 7.38 (s, 3H), 6.89 (dd, *J* = 8.8, 1.7 Hz, 1H), 6.74 (s, 1H), 6.48 (d, *J* = 8.3 Hz, 1H), 4.66 (s, 1H), 3.33-3.26 (m, 2H), 2.78 (t, *J* = 6.7 Hz, 2H), 1.40 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.5, 155.9, 146.5, 139.2, 134.7, 133.0, 131.5, 130.2, 130.0, 129.5, 129.3, 126.5, 126.1, 125.7, 124.9, 124.3, 122.5, 119.0, 113.8, 113.2, 79.6, 79.3, 40.9, 28.4, 25.6. 91% *ee* as determined by HPLC (Chiralcel IC, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 23.57 min, t_r (minor) = 14.56 min. HRMS (ESI+) calcd for $C_{29}H_{28}ClN_3O_3$ $(M+H)^+$, m/z 502.1892, found 502.1891.

Benzyl (*S*)-(2-(1-(3-oxo-1-phenylisoindolin-1-yl)-1*H*-indol-3-yl)ethyl)carbamate (3s)



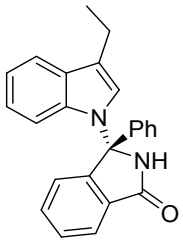
White solid, yield (60%); mp. =127-128 °C; $[\alpha]_D^{25}$ = -240.02 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.0 Hz, 1H), 7.60 -7.45 (m, 7H), 7.33 (dd, *J* = 30.3, 6.6 Hz, 8H), 7.06 (dd, *J* = 13.1, 5.2 Hz, 1H), 6.94 (t, *J* = 7.6 Hz, 1H), 6.70 (s, 1H), 6.55 (d, *J* = 8.2 Hz, 1H), 5.04 (s, 2H), 4.93 (s, 1H), 3.41 (s, 2H), 2.85 (t, *J* = 6.5 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.4, 155.4, 145.7, 138.5, 135.4, 132.0, 131.9, 129.1, 128.4, 128.1, 127.6, 127.5, 127.1, 124.7, 124.5, 124.2, 123.8, 123.3, 121.3, 119.3, 118.5, 112.2, 111.8, 78.5, 65.6, 40.2, 24.7. 88% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 23.90 min, t_r (minor) = 18.05 min. HRMS (ESI+) calcd for $C_{32}H_{27}N_3O_3$ $(M+H)^+$, m/z 502.2125, found 502.2118.

(*S*)-3-(3-methyl-1*H*-indol-1-yl)-3-phenylisoindolin-1-one (3t)



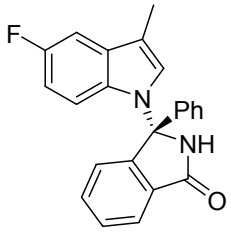
White solid, yield (67%); mp. =261-262 °C; $[\alpha]_D^{25}$ = -346.00 (c 0.25, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 7.92 -7.88 (m, 1H), 7.60-7.51 (m, 6H), 7.40-7.36 (m, 3H), 7.16 (d, *J* = 7.0 Hz, 1H), 7.11-7.06 (m, 1H), 6.97-6.93 (m, 1H), 6.61 (d, *J* = 0.7 Hz, 1H), 6.52 (d, *J* = 8.4 Hz, 1H), 2.22 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.2, 145.9, 138.6, 135.4, 131.8, 130.2, 129.0, 128.9, 128.4, 128.1, 124.7, 123.9, 123.7, 123.4, 121.1, 119.0, 118.6, 111.4, 111.0, 78.4, 8.5. 91% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 9.83 min, t_r (minor) = 9.18 min. HRMS (ESI+) calcd for $C_{23}H_{18}N_2O$ $(M+H)^+$, m/z 339.1492, found 339.1498.

(S)-3-(3-ethyl-1H-indol-1-yl)-3-phenylisoindolin-1-one (3u)



White solid, yield (72%); mp. =264-265 °C; $[\alpha]_D^{25}$ = -286.44 (c 0.25, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 7.83 (dd, *J* = 6.5, 1.1 Hz, 1H), 7.55-7.43 (m, 6H), 7.32-7.27 (m, 3H), 7.16 (d, *J* = 11.7 Hz, 1H), 7.03-6.97 (m, 1H), 6.87 (dd, *J* = 11.4, 4.1 Hz, 1H), 6.53 (s, 1H), 6.46 (d, *J* = 8.3 Hz, 1H), 2.60 (q, *J* = 7.5 Hz, 2H), 1.14 (t, *J* = 7.5 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.3, 145.9, 138.7, 135.5, 131.8, 129.4, 129.0, 128.9, 128.3, 128.1, 124.7, 123.7, 123.4, 122.7, 121.1, 118.9, 118.6, 117.9, 111.5, 78.4, 17.2, 13.2. 84% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 8.34 min, t_r (minor) = 7.55 min. HRMS (ESI+) calcd for $C_{24}H_{20}NO$ $(M+H)^+$, m/z 353.1648, found 353.1650.

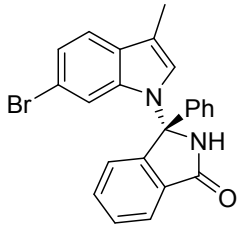
(*S*)-3-(5-fluoro-3-methyl-1*H*-indol-1-yl)-3-phenylisoindolin-1-one (3v)



White solid, yield (79%); mp. =111-112 °C; $[\alpha]_D^{25}$ = -52.24 (c 0.25, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 7.80 (dd, *J* = 7.3, 6.4 Hz, 1H), 7.57-7.40 (m, 6H), 7.36-7.28 (m, 3H), 7.07 (dd, *J* = 9.2,

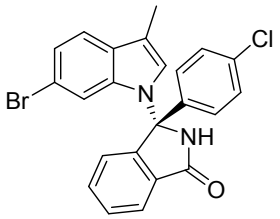
2.3 Hz, 1H), 6.66-6.55 (m, 2H), 6.41-6.33 (m, 1H), 2.08 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.4, 157.9 (d, *J* = 232.0 Hz), 146.8, 139.5, 132.9, 131.9, 131.8, 130.1, 130.0, 129.4, 129.2, 126.7, 125.8, 124.8, 124.3, 113.3 (d, *J* = 9.1 Hz), 112.1, 112.0, 110.2 (d, *J* = 26.3 Hz), 104.5 (d, *J* = 23.2 Hz), 79.5, 9.5. 92% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 6.75 min, t_r (minor) = 11.84 min. HRMS (ESI+) calcd for $C_{23}H_{18}FN_2O$ $(M+H)^+$, m/z 357.1398, found 357.1400.

(*S*)-3-(6-bromo-3-methyl-1*H*-indol-1-yl)-3-phenylisoindolin-1-one (3w)



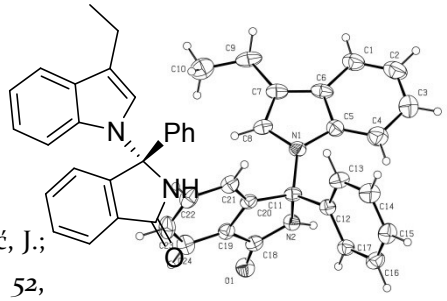
White solid, yield (61%); mp. =187-188 °C; $[\alpha]_D^{25}$ = -100.10 (c 0.25, $CHCl_3$); ^{1}H NMR (500 MHz, DMSO) δ 10.16 (s, 1H), 7.81 (d, *J* = 7.2 Hz, 1H), 7.73 (d, *J* = 7.5 Hz, 1H), 7.68 (dd, *J* = 10.7, 4.5 Hz, 2H), 7.64 (t, *J* = 7.3 Hz, 1H), 7.51 (dd, *J* = 7.6, 1.8 Hz, 2H), 7.46-7.41 (m, 3H), 7.02 (dd, *J* = 8.9, 1.9 Hz, 1H), 6.75 (s, 1H), 6.40 (d, *J* = 8.9 Hz, 1H), 2.15 (s, 3H). ^{13}C NMR (125 MHz, DMSO) δ 168.7, 146.9, 139.9, 134.9, 133.4, 132.8, 130.8, 130.7, 129.6, 129.5, 127.1, 126.4, 124.9, 124.3, 121.8, 115.4, 112.8, 110.8, 79.6, 9.6. 97% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 11.04 min, t_r (minor) = 16.53 min. HRMS (ESI+) calcd for $C_{23}H_{17}BrN_2O$ $(M+H)^+$, m/z 417.0597, found 417.0560.

(*S*)-3-(6-bromo-3-methyl-1*H*-indol-1-yl)-3-(4-chlorophenyl)isoindolin-1-one (3x)



White solid, yield (57%); mp. =158-159 °C; $[\alpha]_D^{25}$ = -128.24 (c 0.25, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.88 (d, *J* = 5.2 Hz, 2H), 7.65 (d, *J* = 1.7 Hz, 1H), 7.62 – 7.57 (m, 2H), 7.47 (d, *J* = 7.6 Hz, 1H), 7.41 (d, *J* = 8.6 Hz, 2H), 7.35 (d, *J* = 8.7 Hz, 2H), 7.05 (dd, *J* = 8.8, 1.7 Hz, 1H), 6.59 (s, 1H), 6.45 (d, *J* = 8.8 Hz, 1H), 2.15 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.4, 145.2, 136.9, 134.3, 133.7, 132.1, 131.9, 129.3, 128.8, 128.7, 126.2, 124.9, 123.9, 123.9, 123.1, 121.3, 112.9, 112.6, 110.7, 78.0, 8.4. 96% *ee* as determined by HPLC (Chiralcel IA, 80:20 hexanes/*i*-PrOH, 1 mL/min), t_r (major) = 7.82 min, t_r (minor) = 9.68 min. HRMS (ESI+) calcd for $C_{23}H_{16}BrClN_2O$ $(M+H)^+$, m/z 451.0200, found 451.0206.

V Crystal structure of 3u :



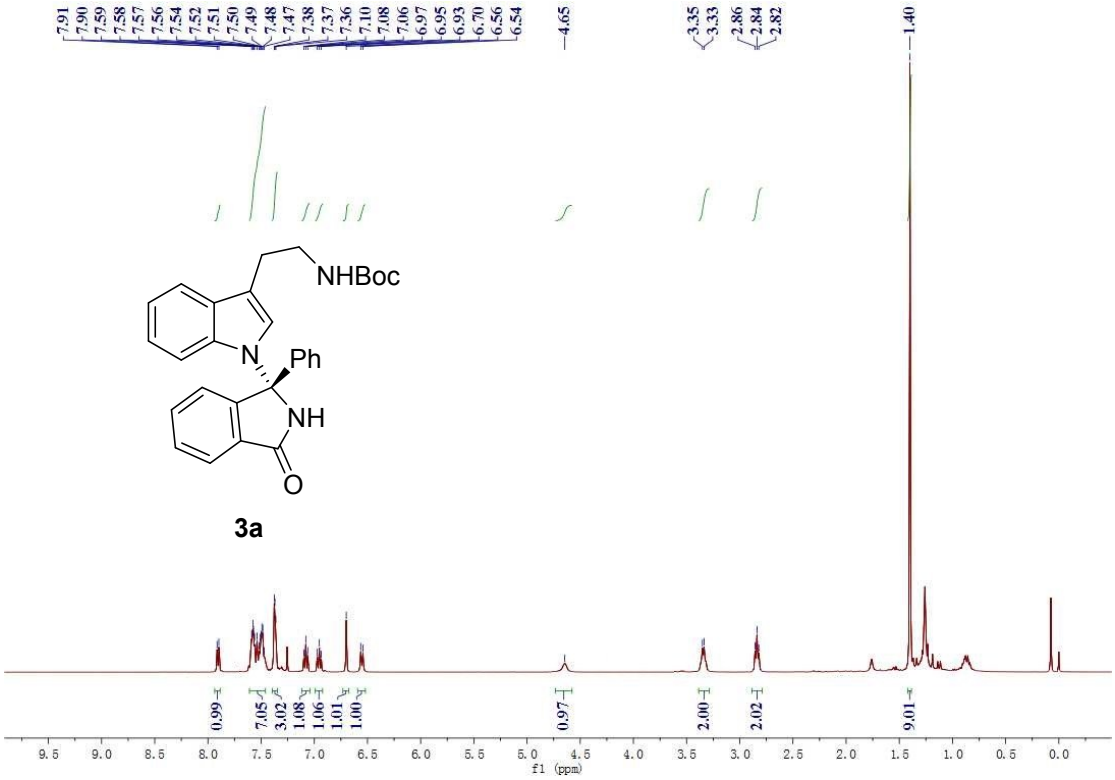
VI

References :

[1] Suć, J.; Dokli, I.; Gredičak, M. *Chem. Commun*., **2016**, *52*, 2071-2074.

[2] Tu, D. Q.; Cheng, X. Z.; Gao, Y. D.; Yang, P. P.; Ding, Y. S.; Jiang, C. *Org. Biomol. Chem*., **2016**, *14*, 7443-7446.

VII NMR and HPLC spectra:



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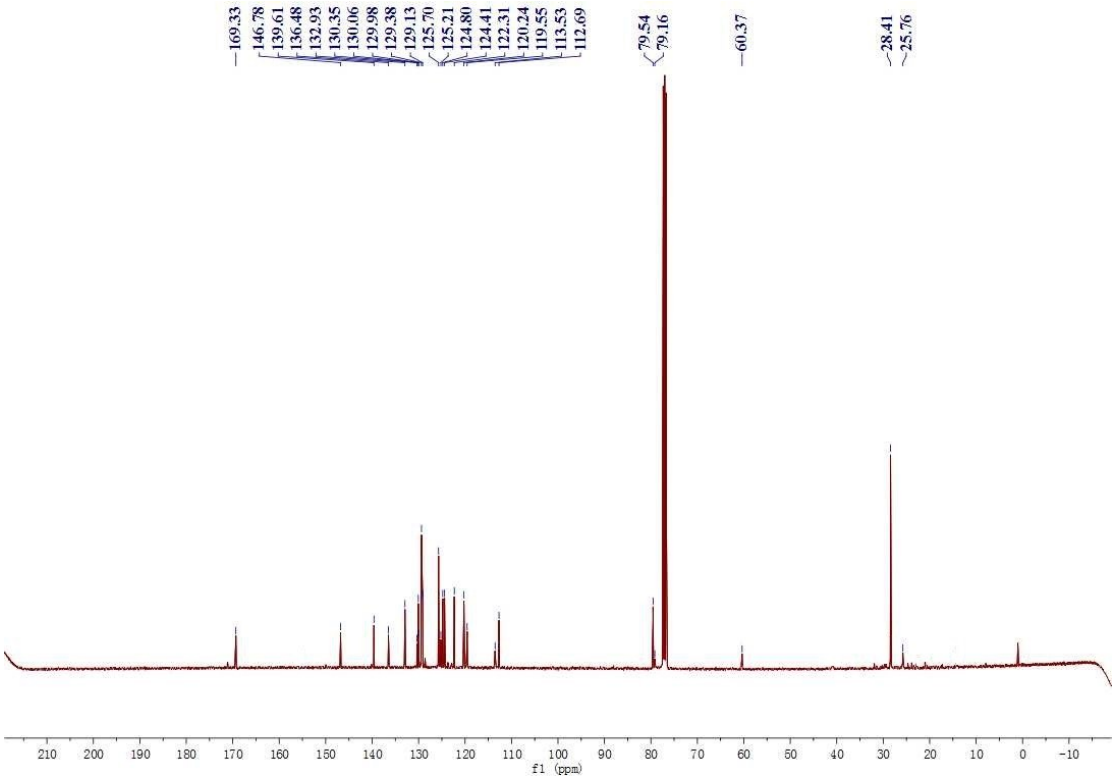

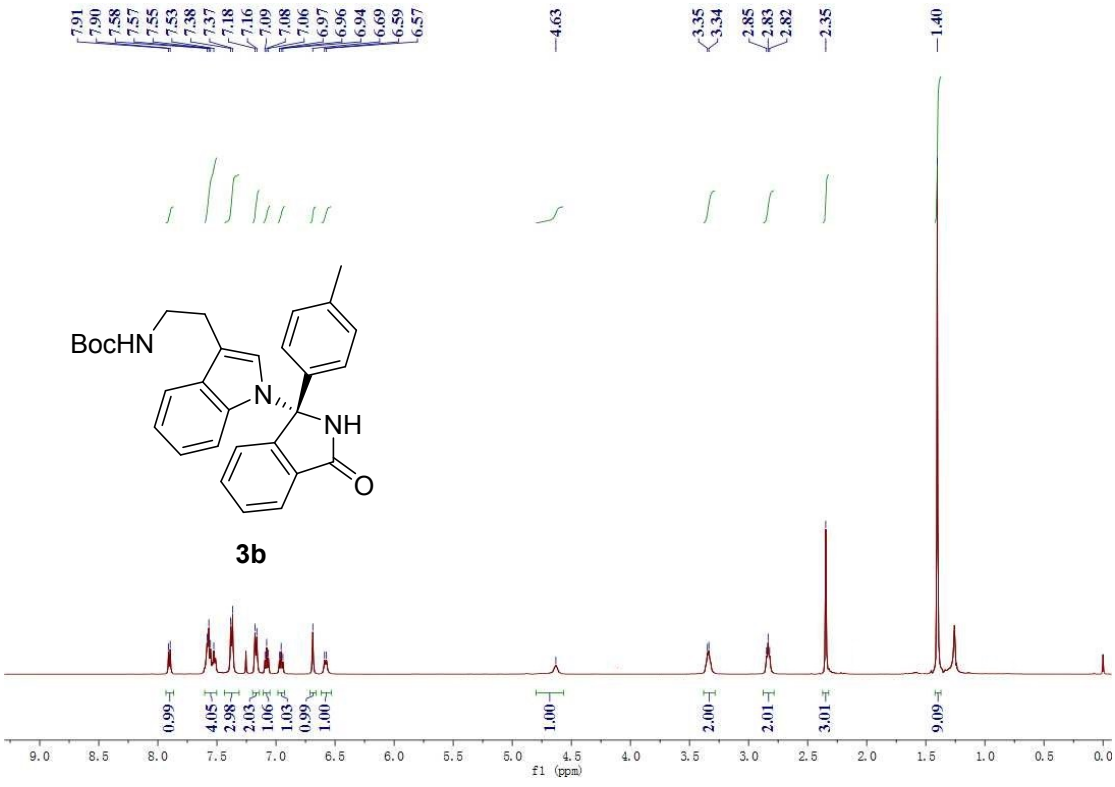
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2.82
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O
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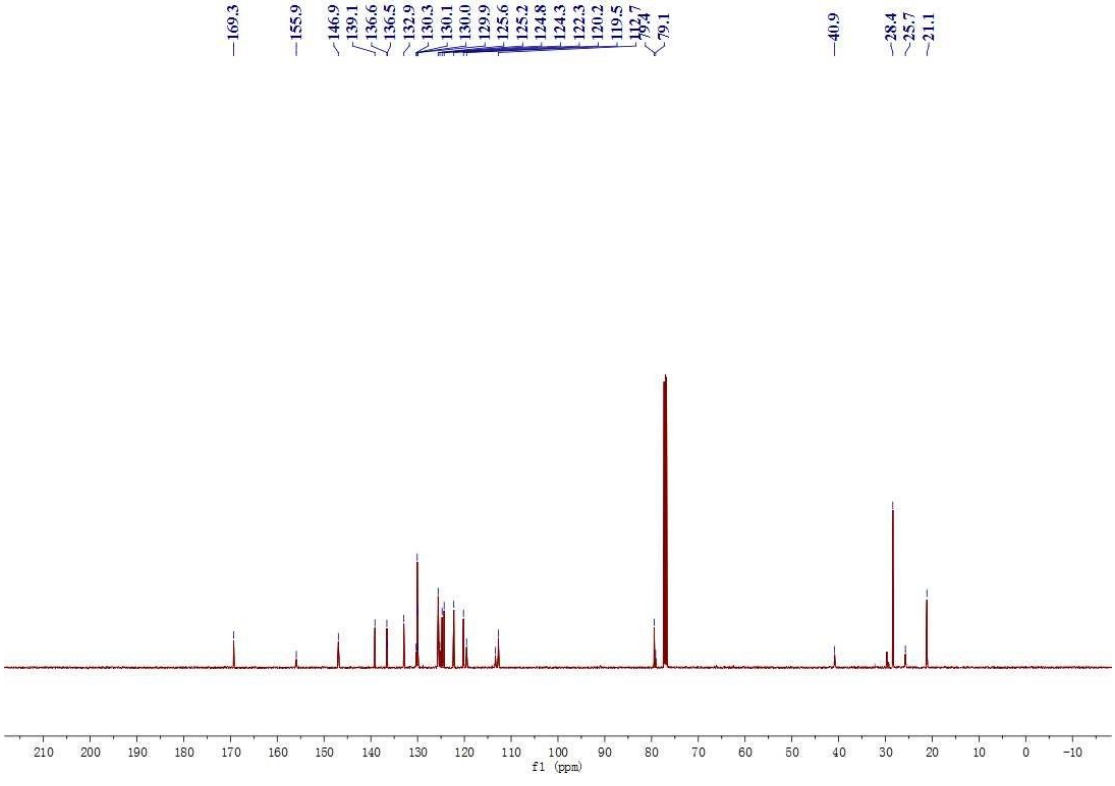
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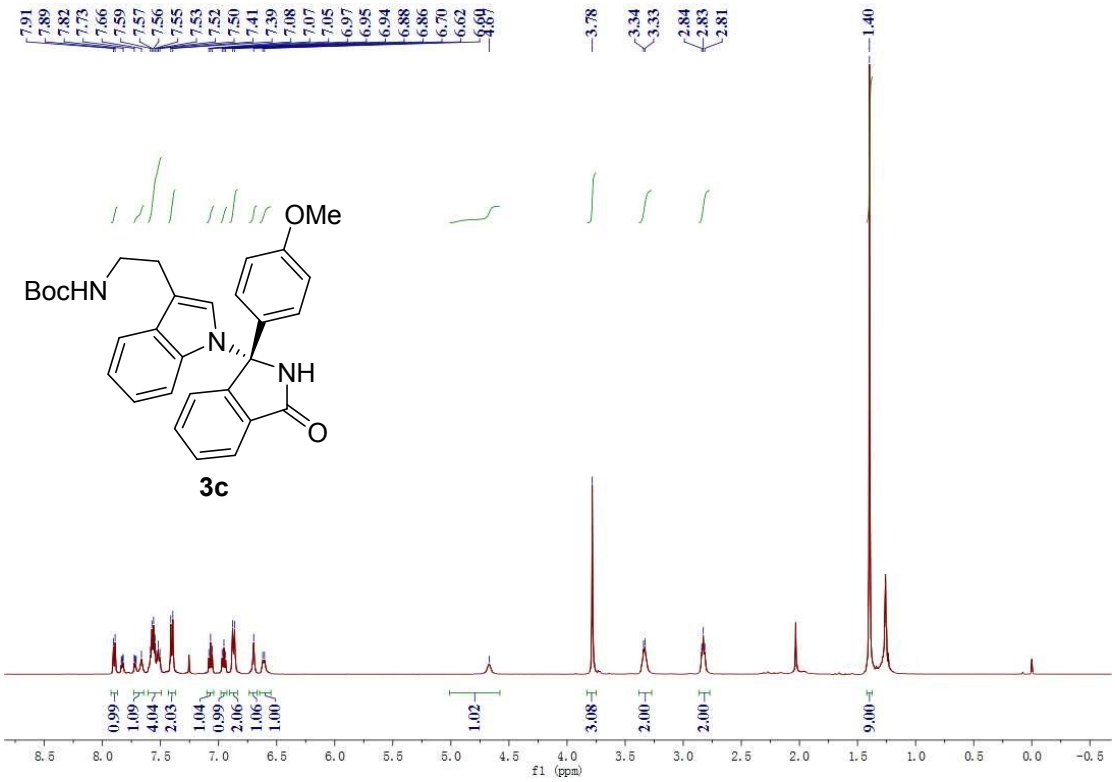
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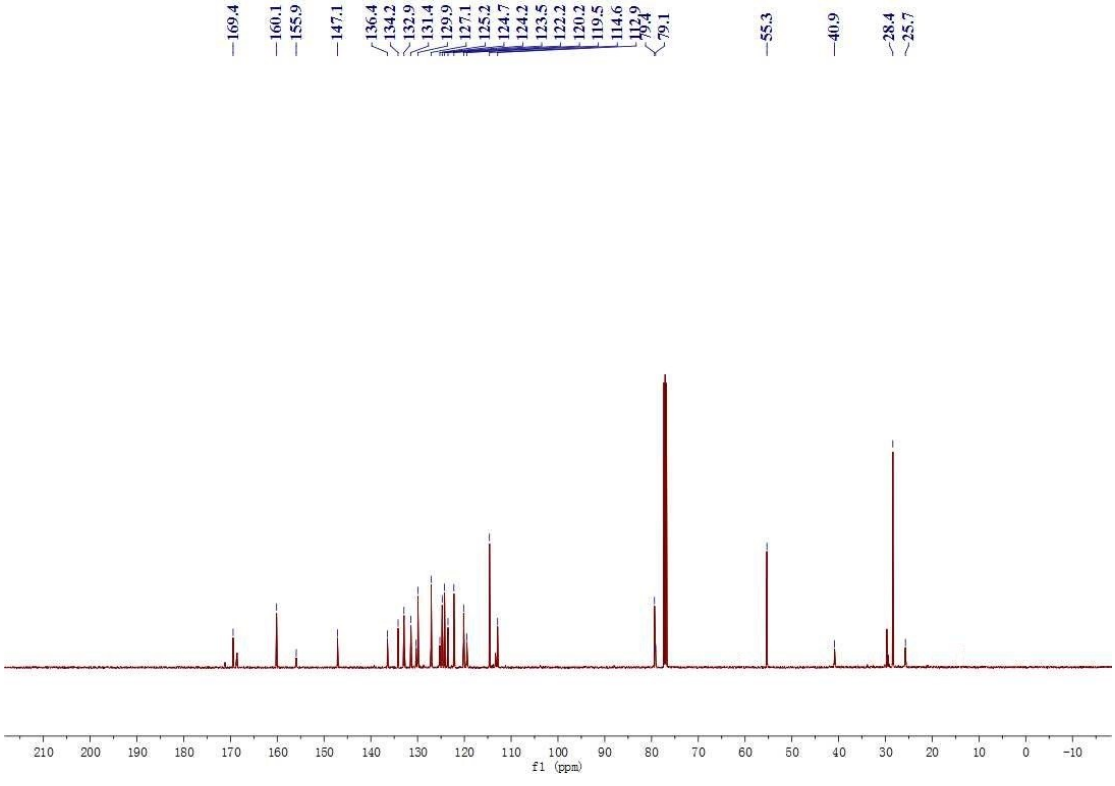
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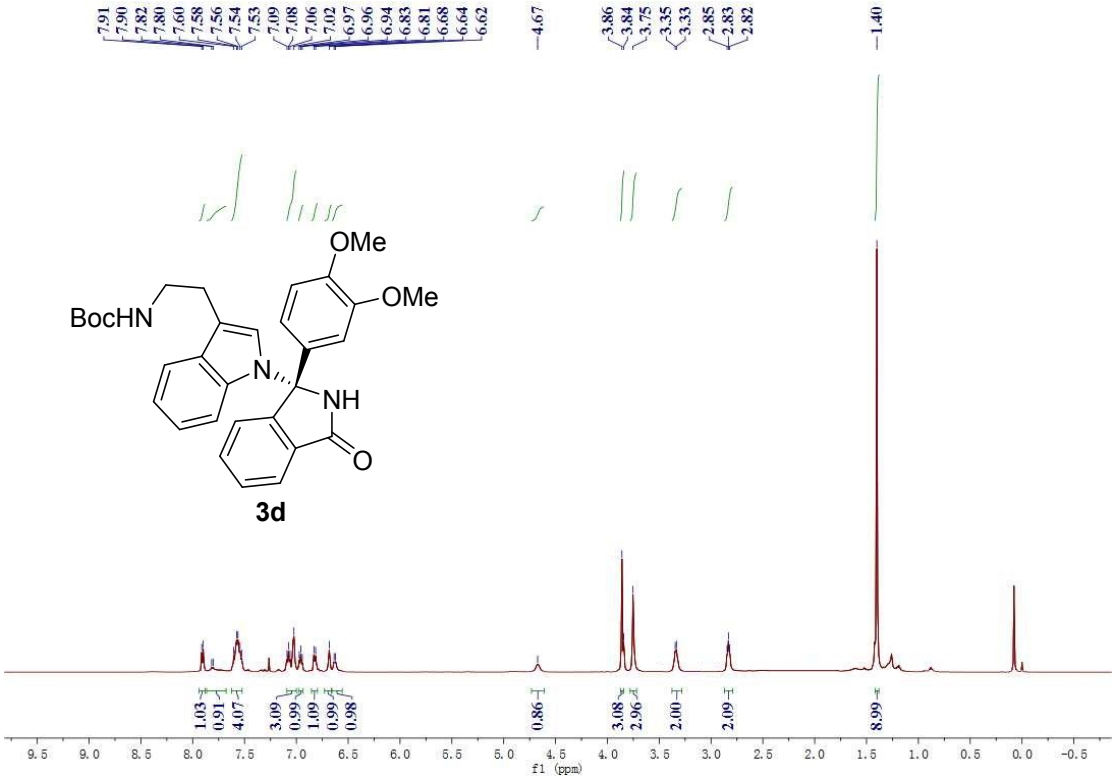
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OMe
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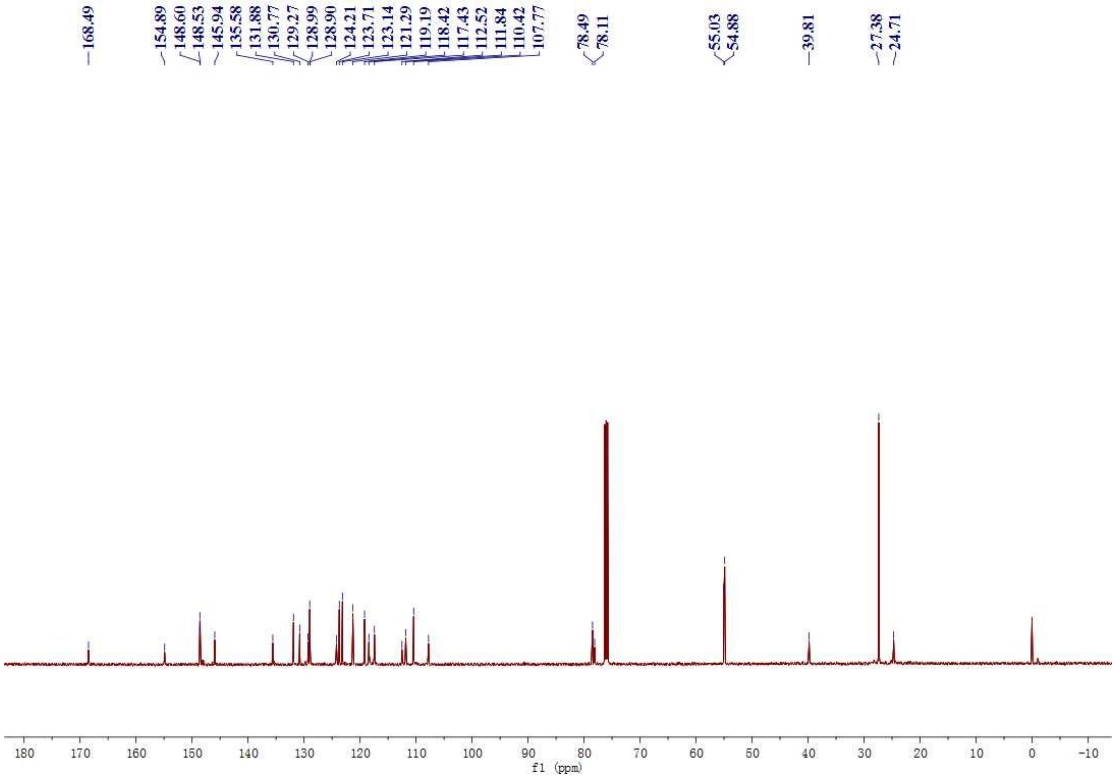
3d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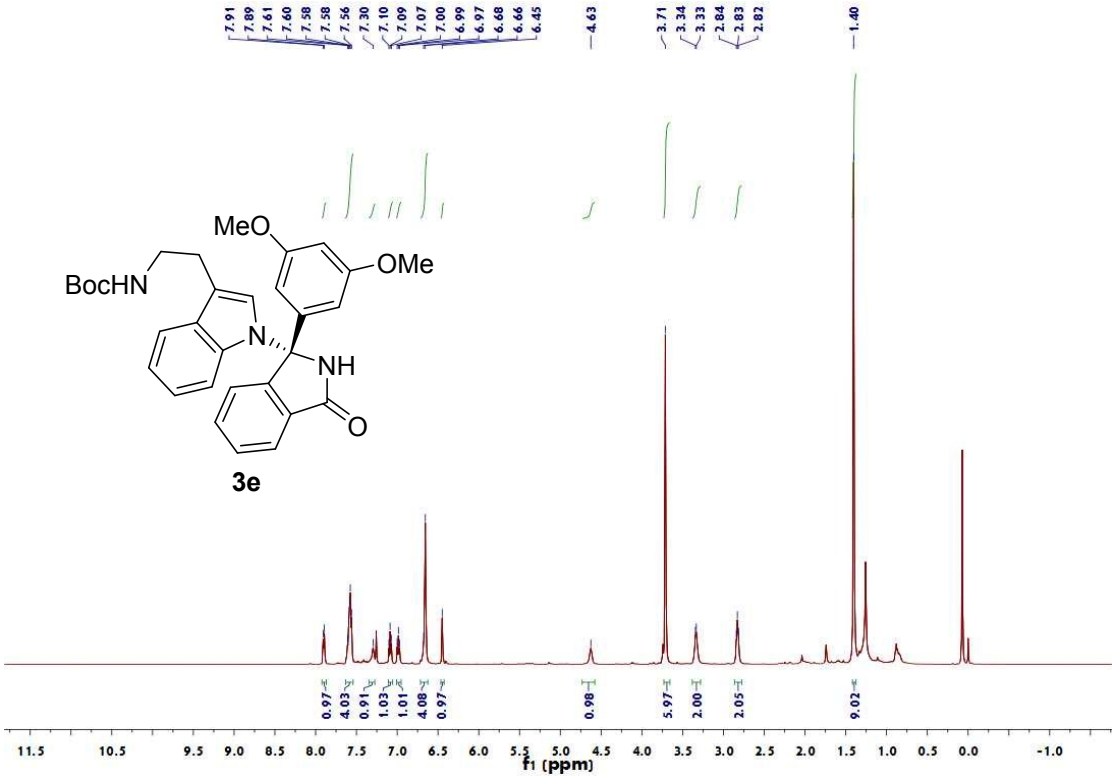
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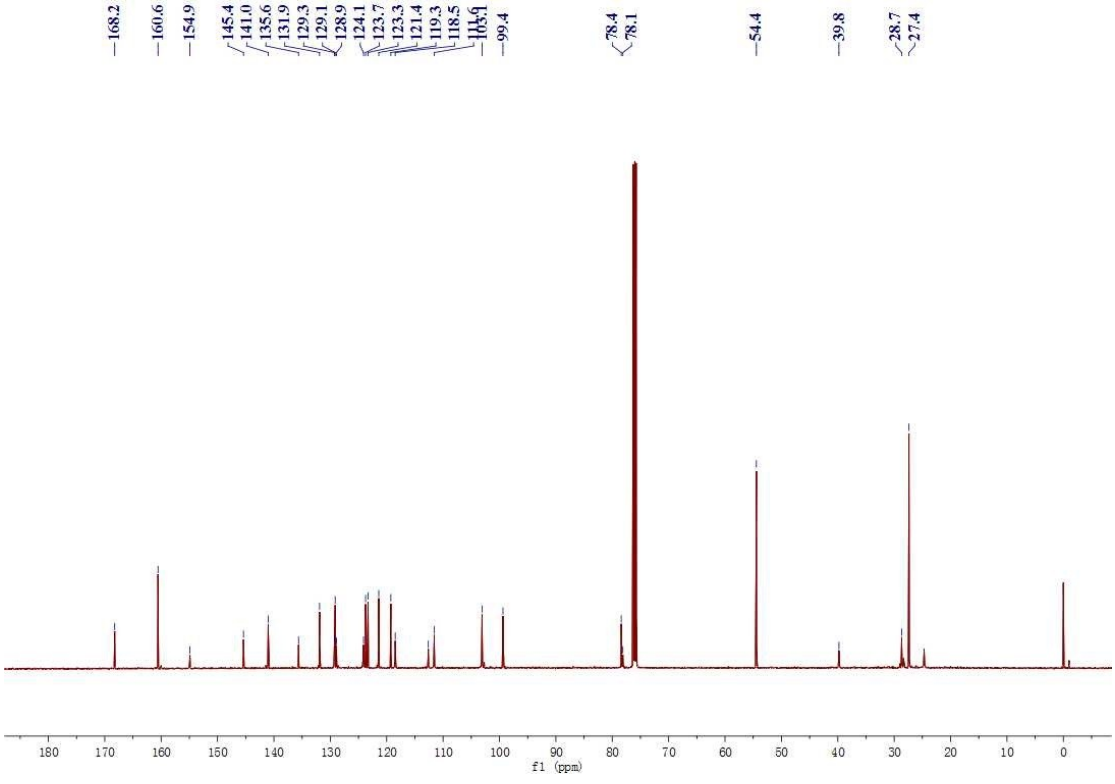
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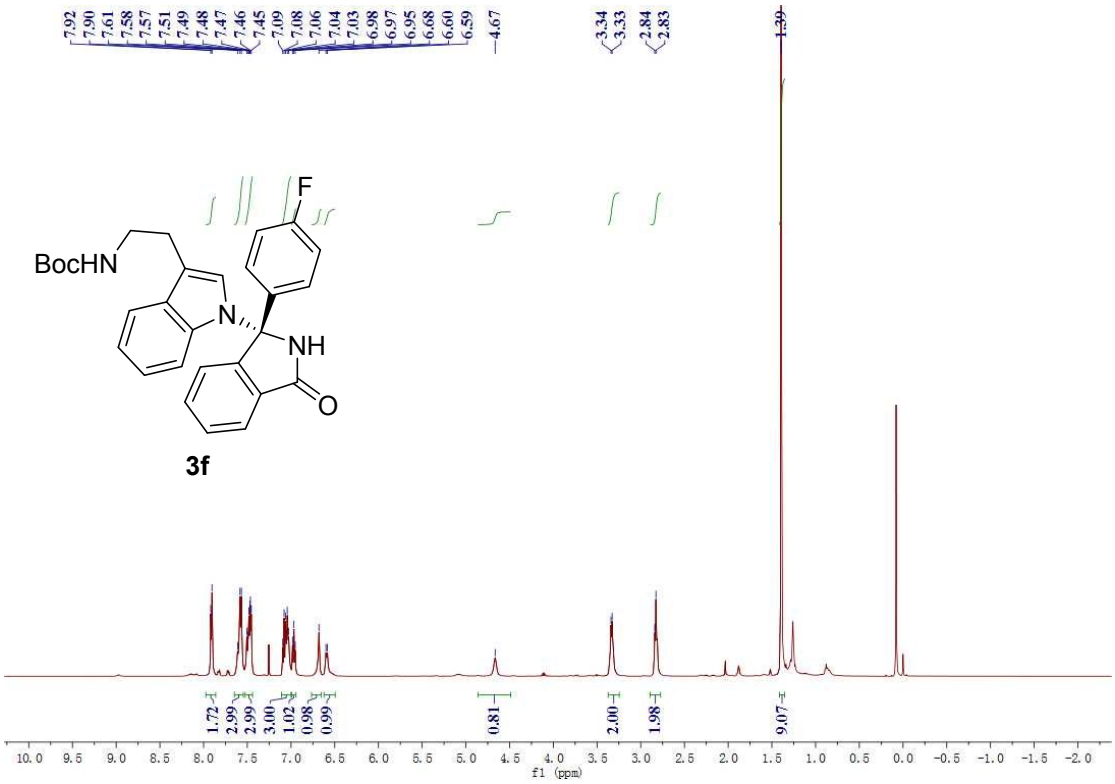

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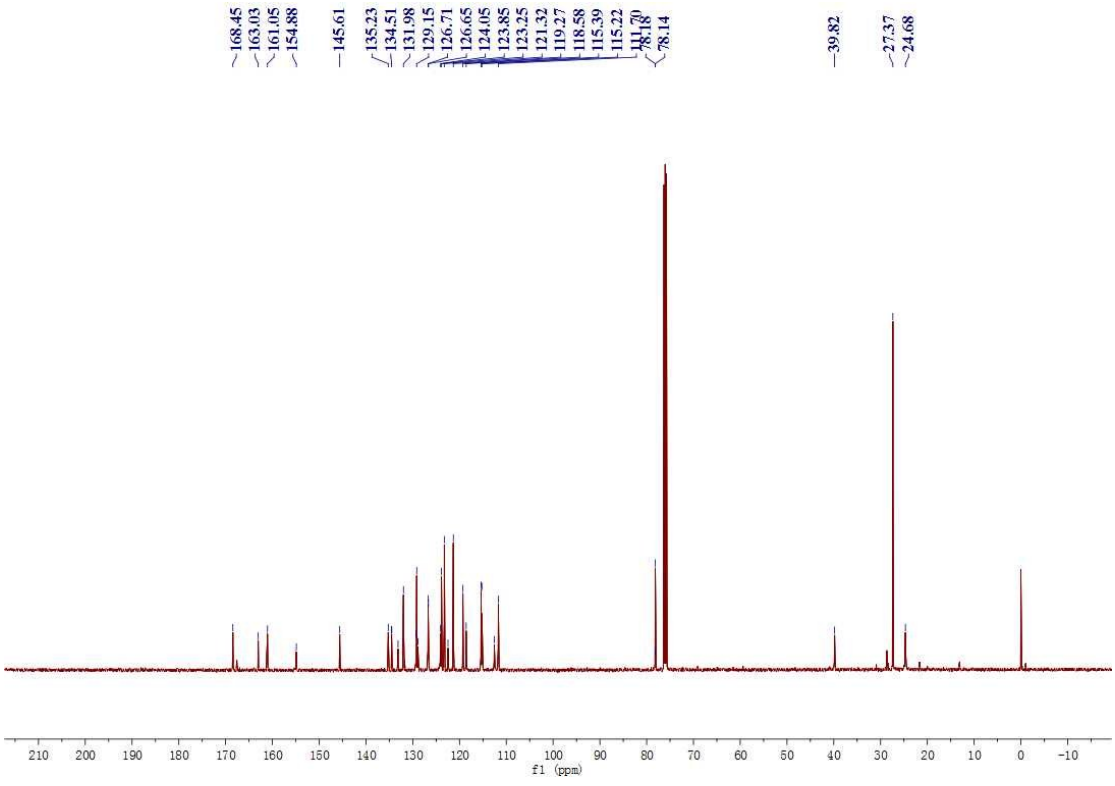

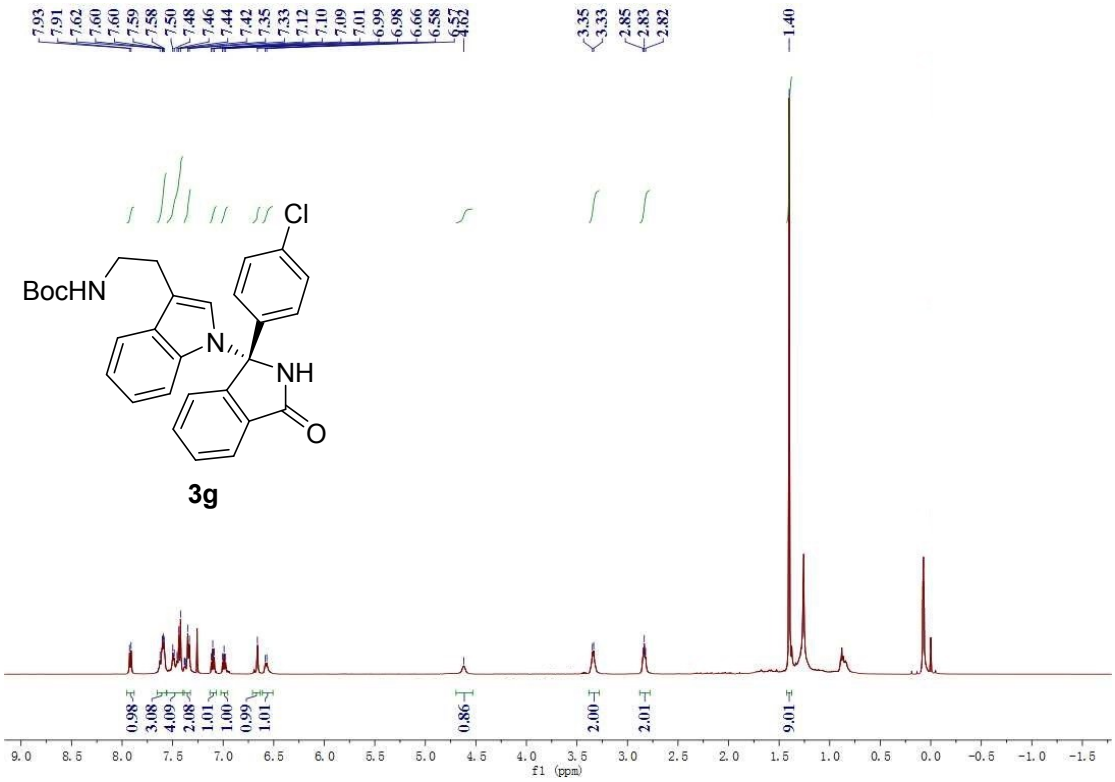
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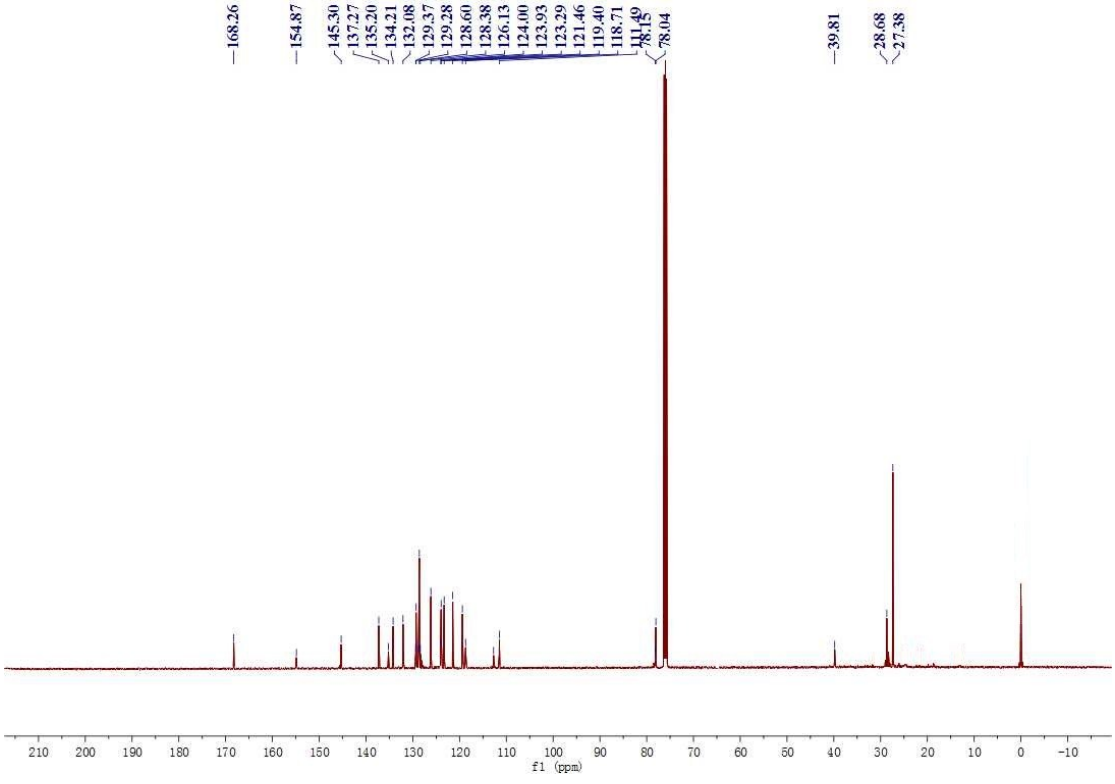
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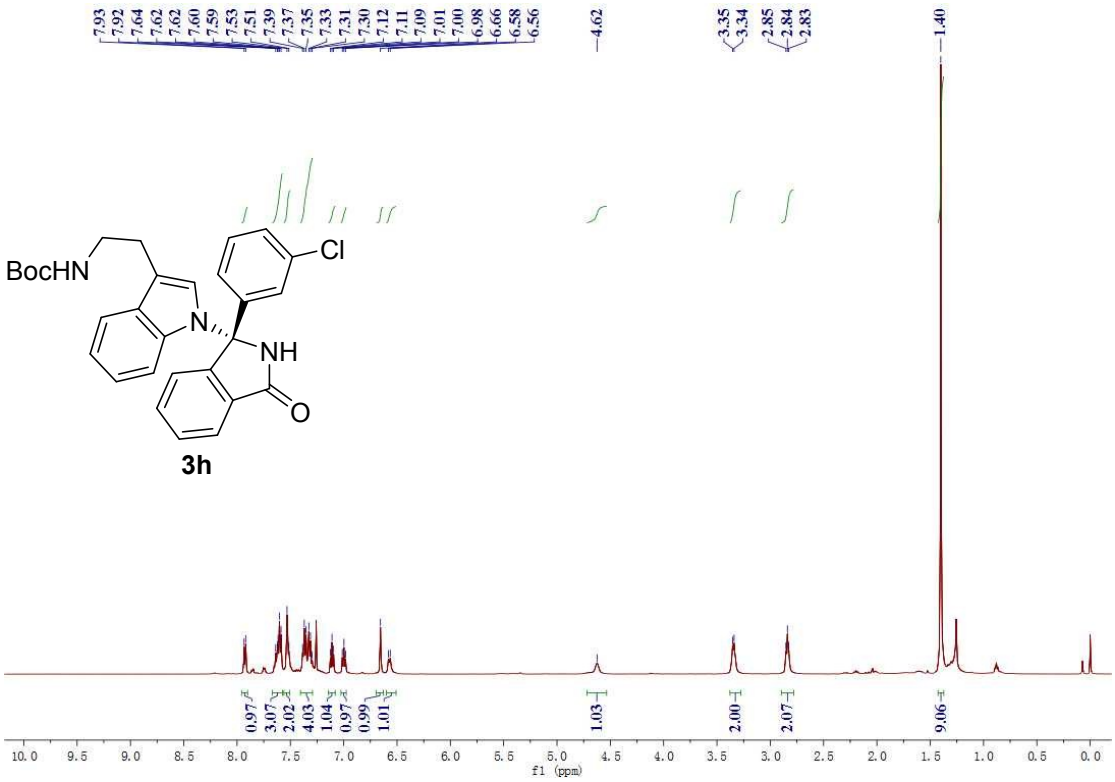
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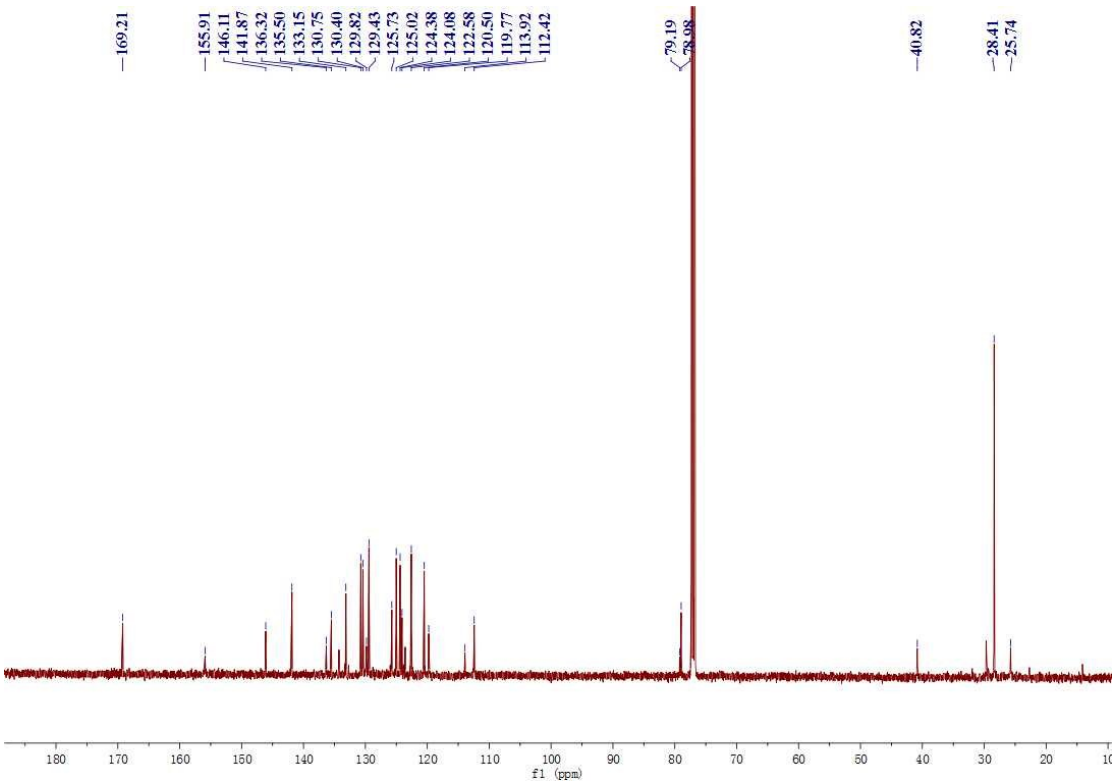
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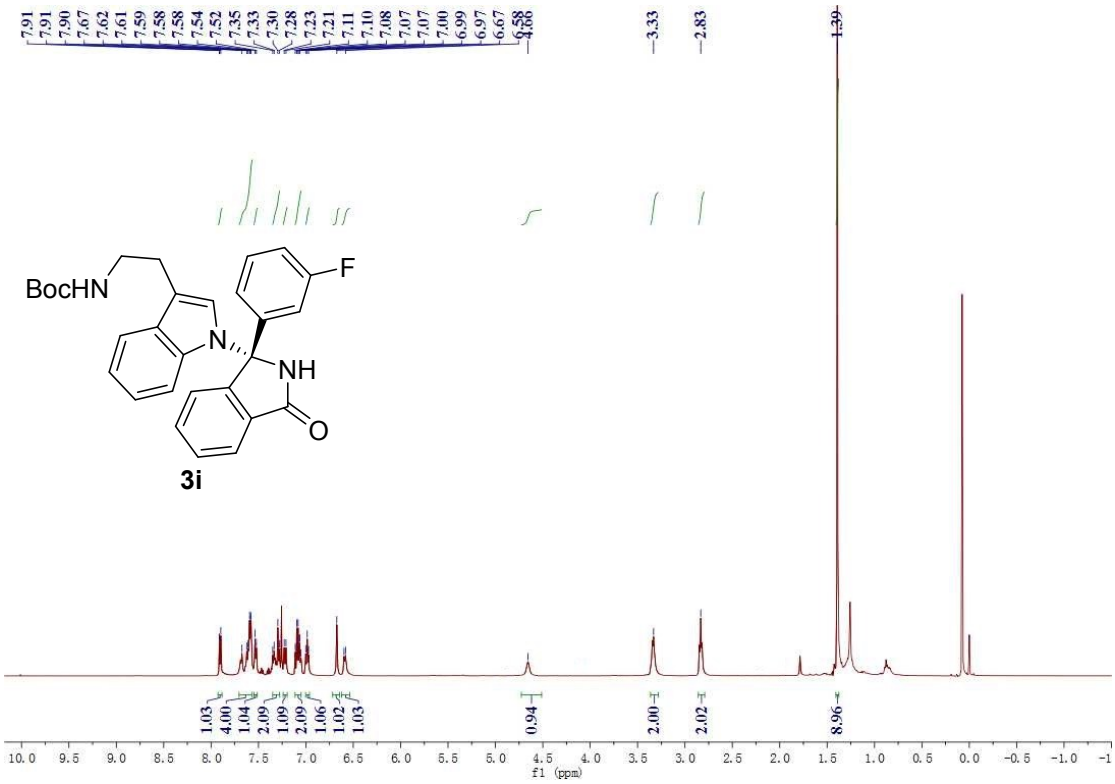
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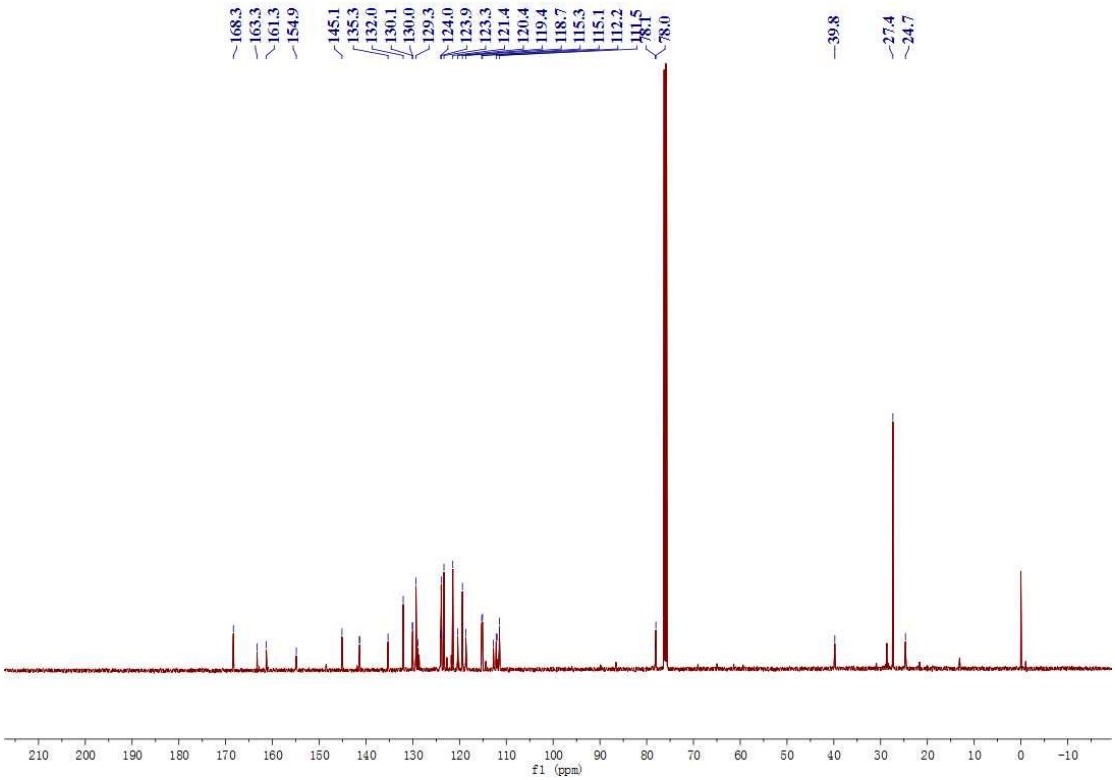
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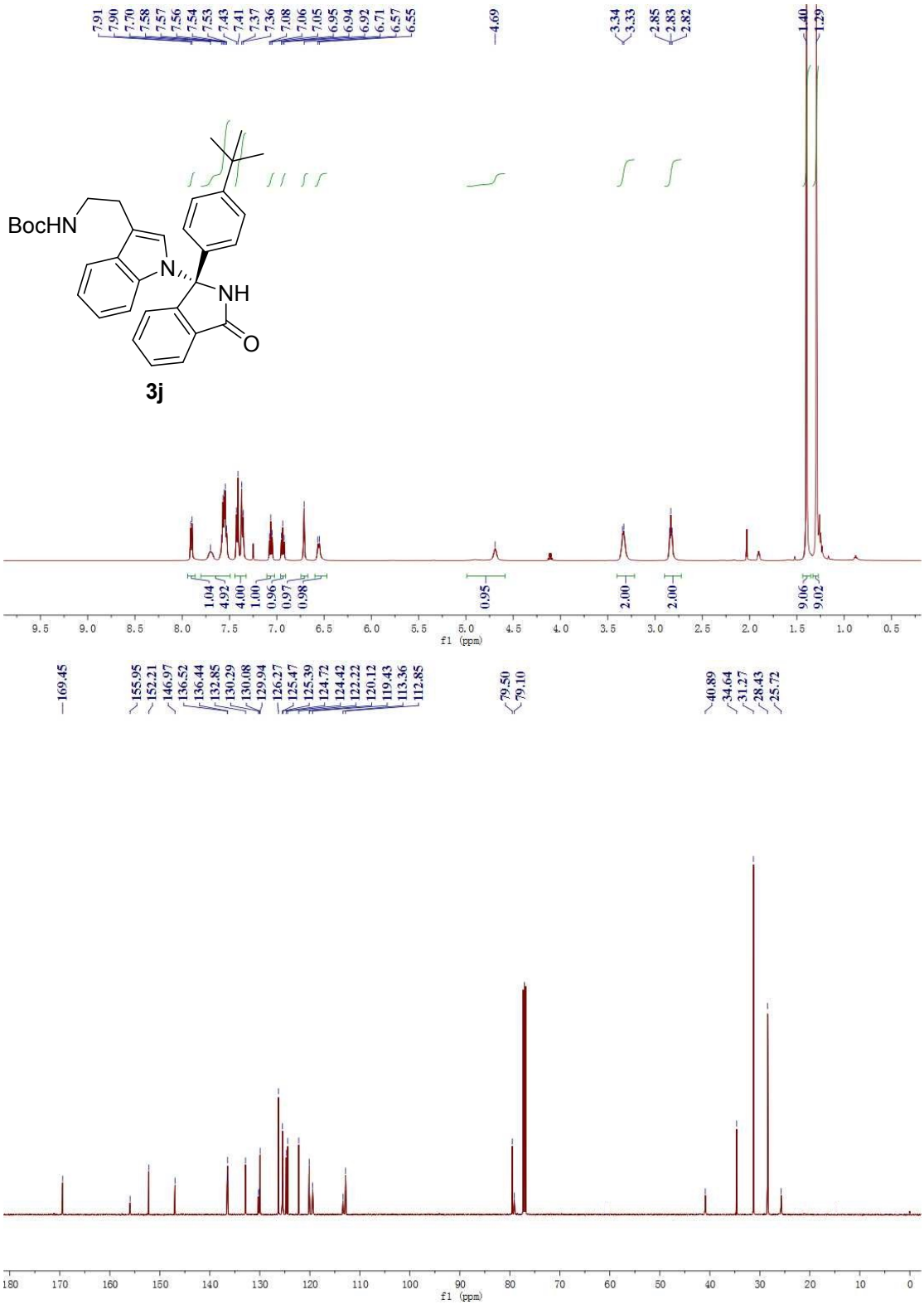
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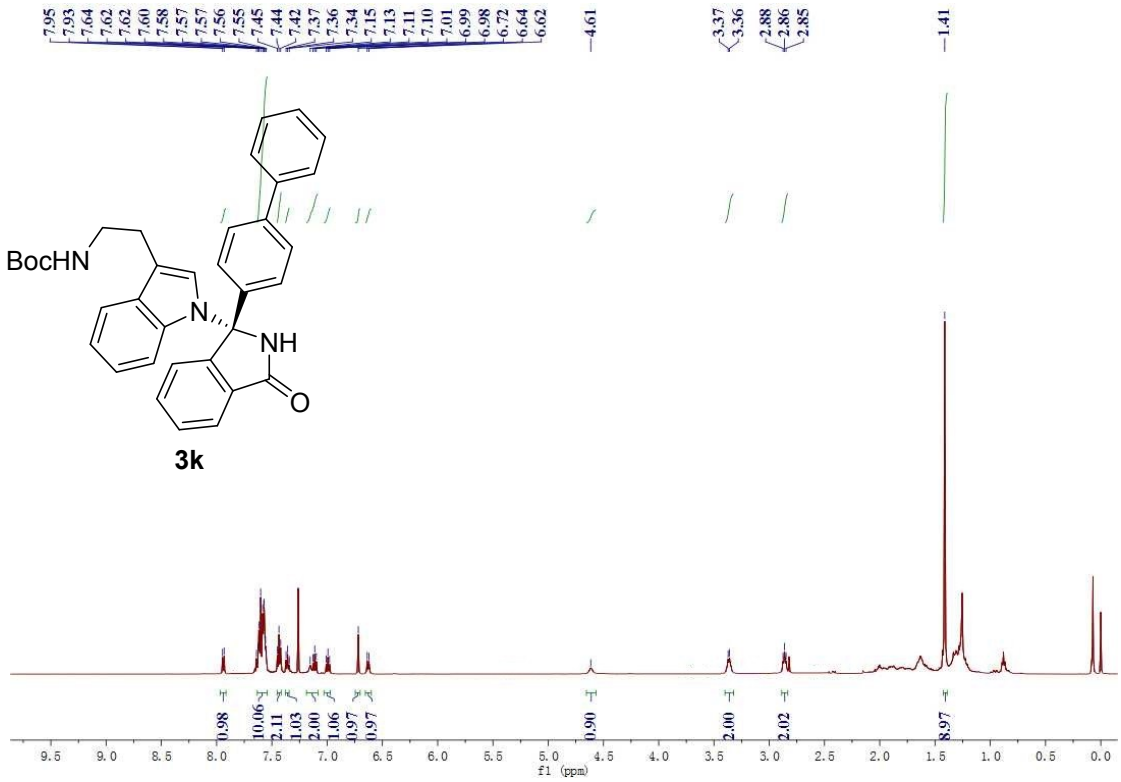
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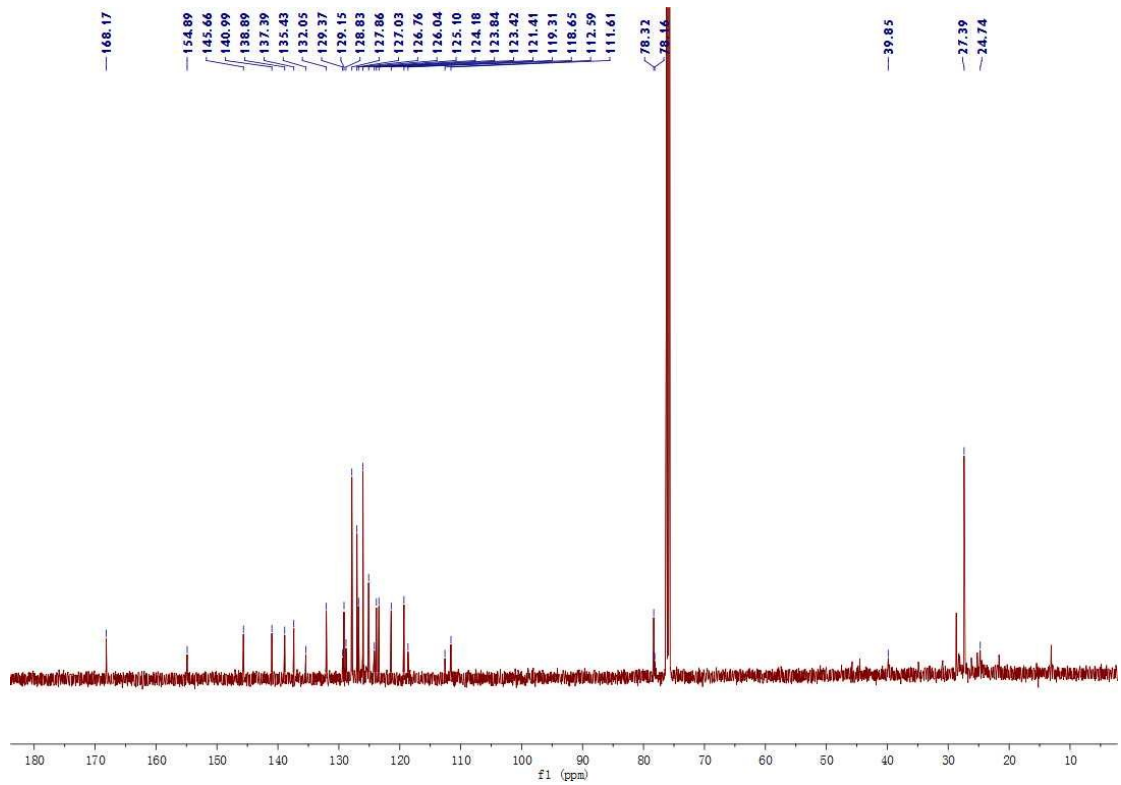
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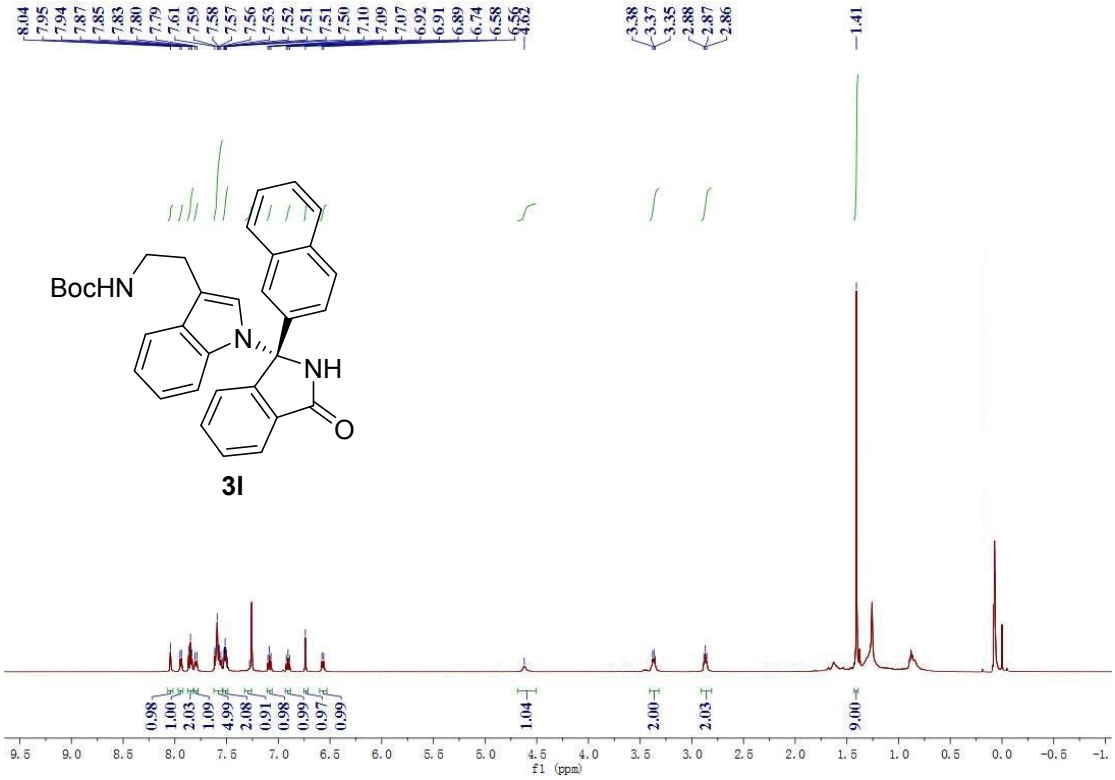

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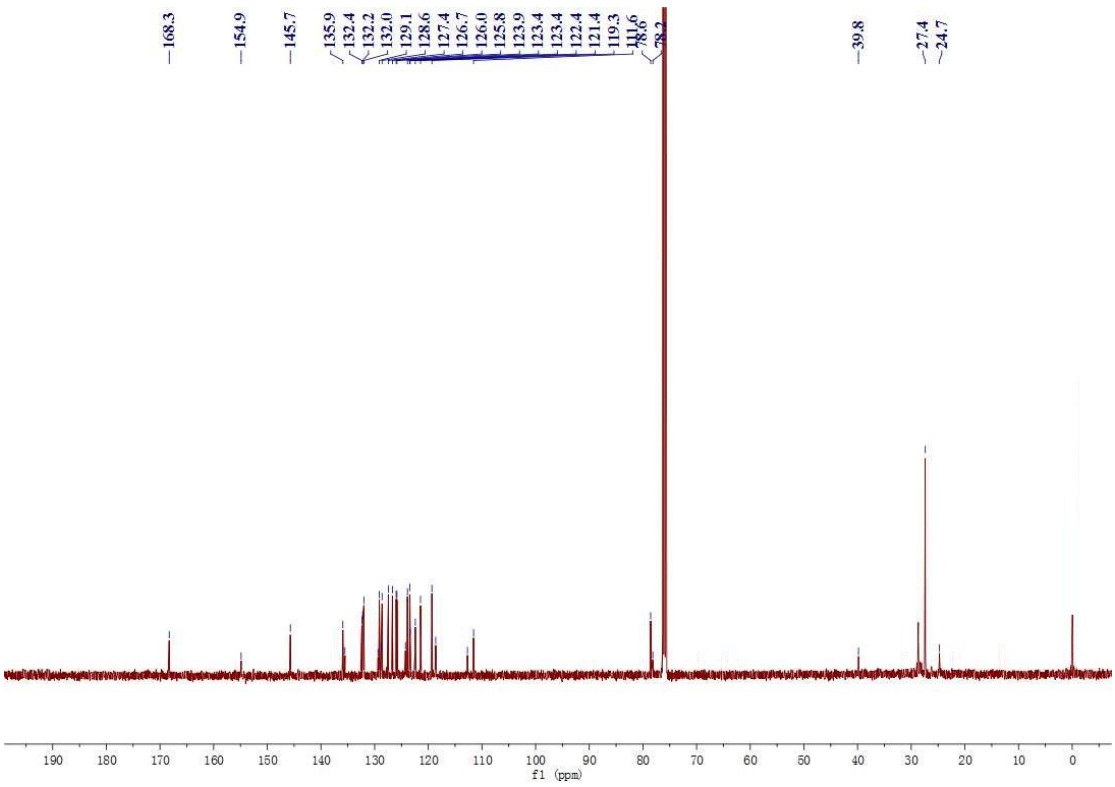

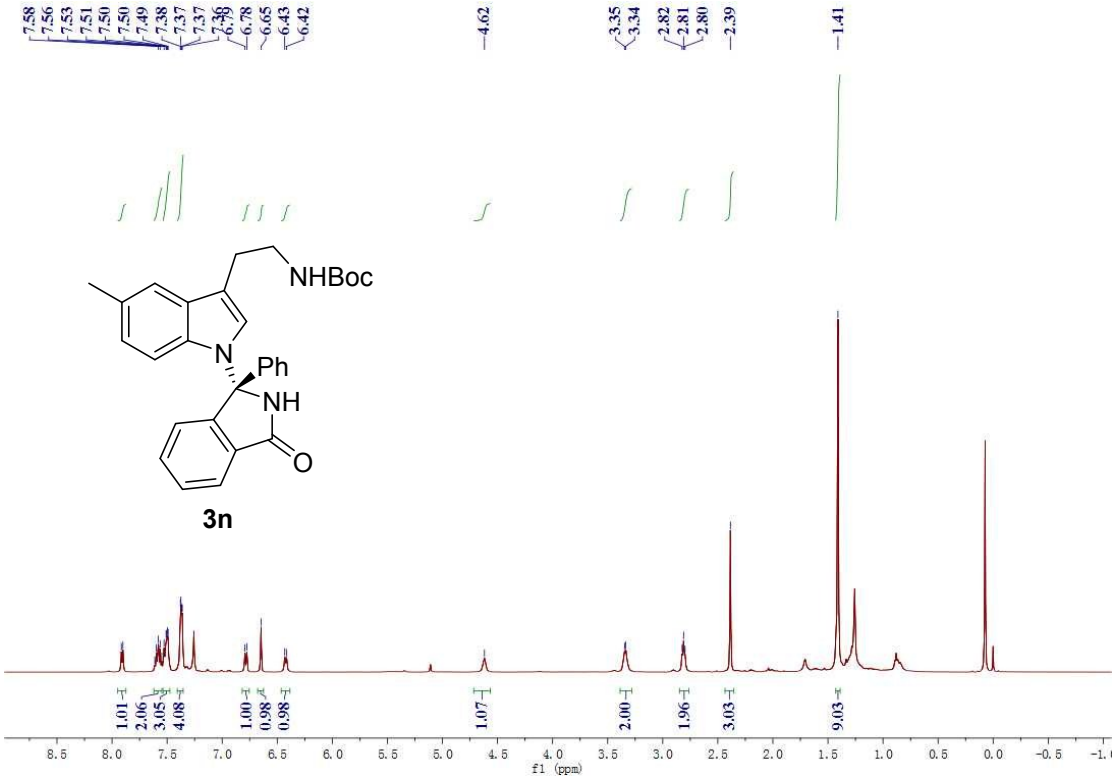
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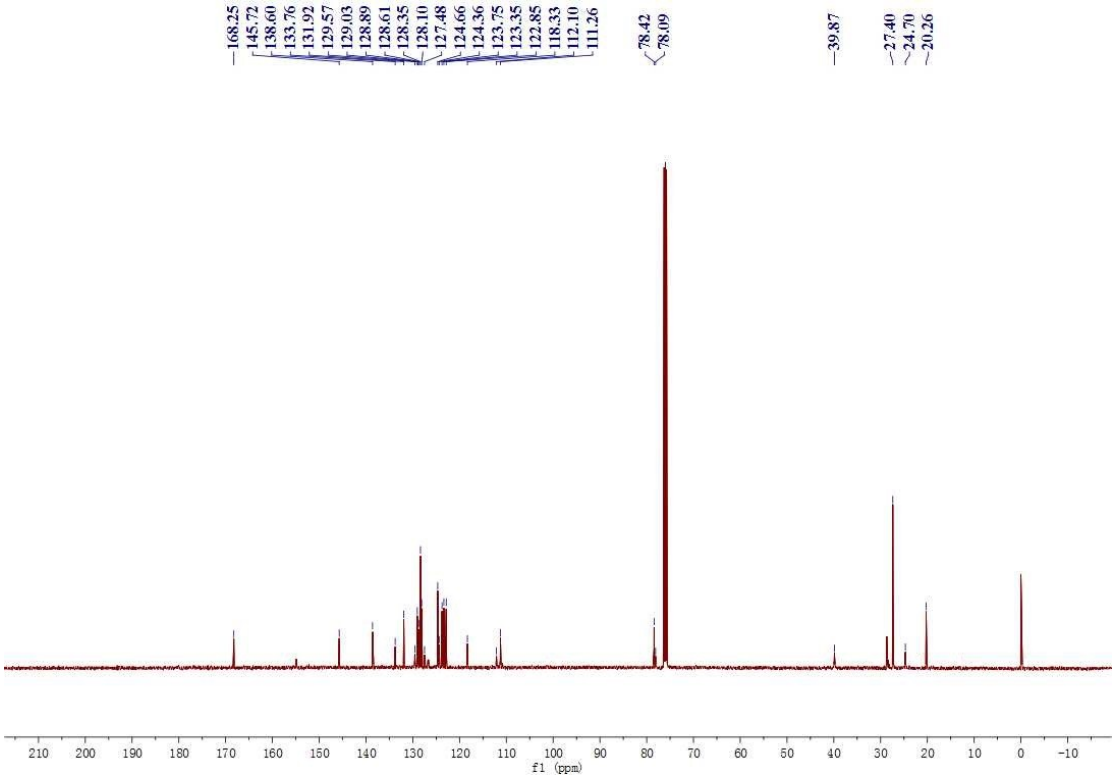
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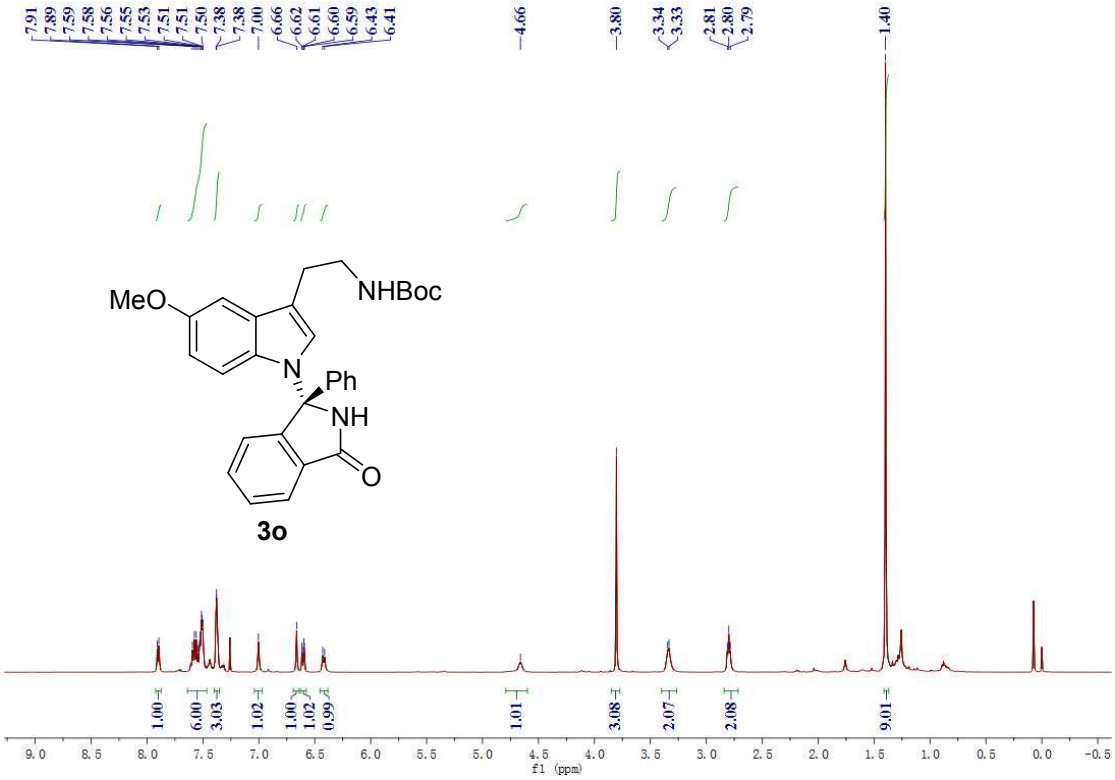
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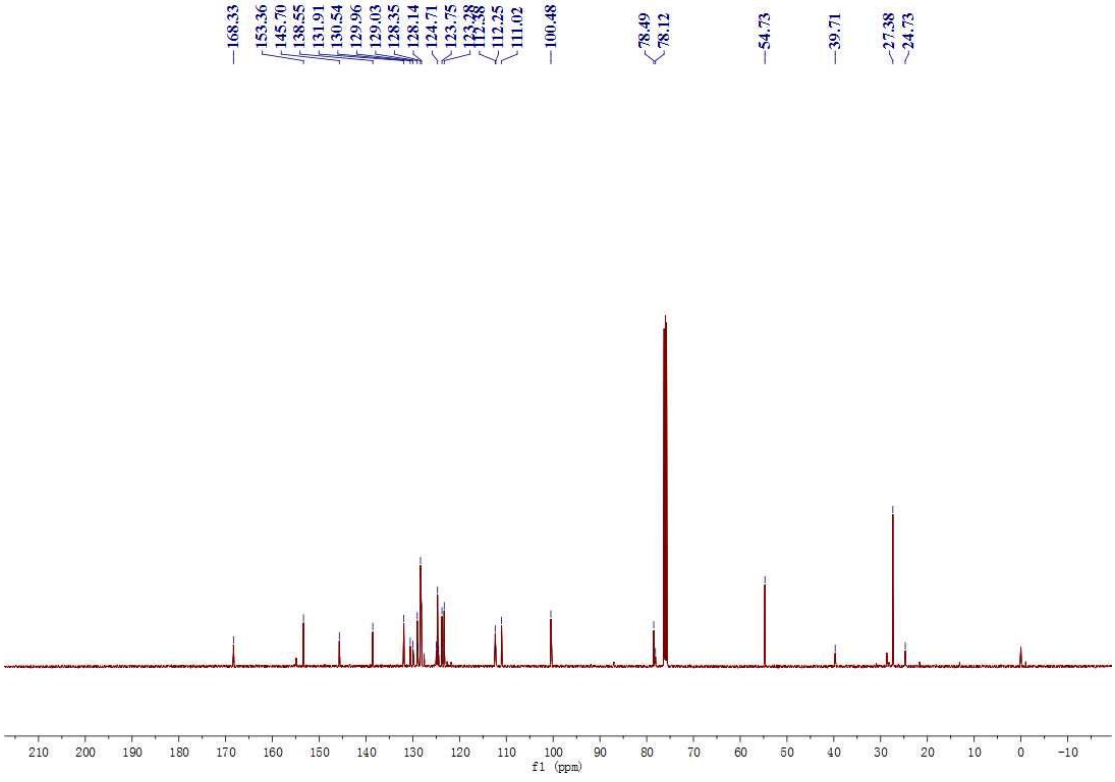
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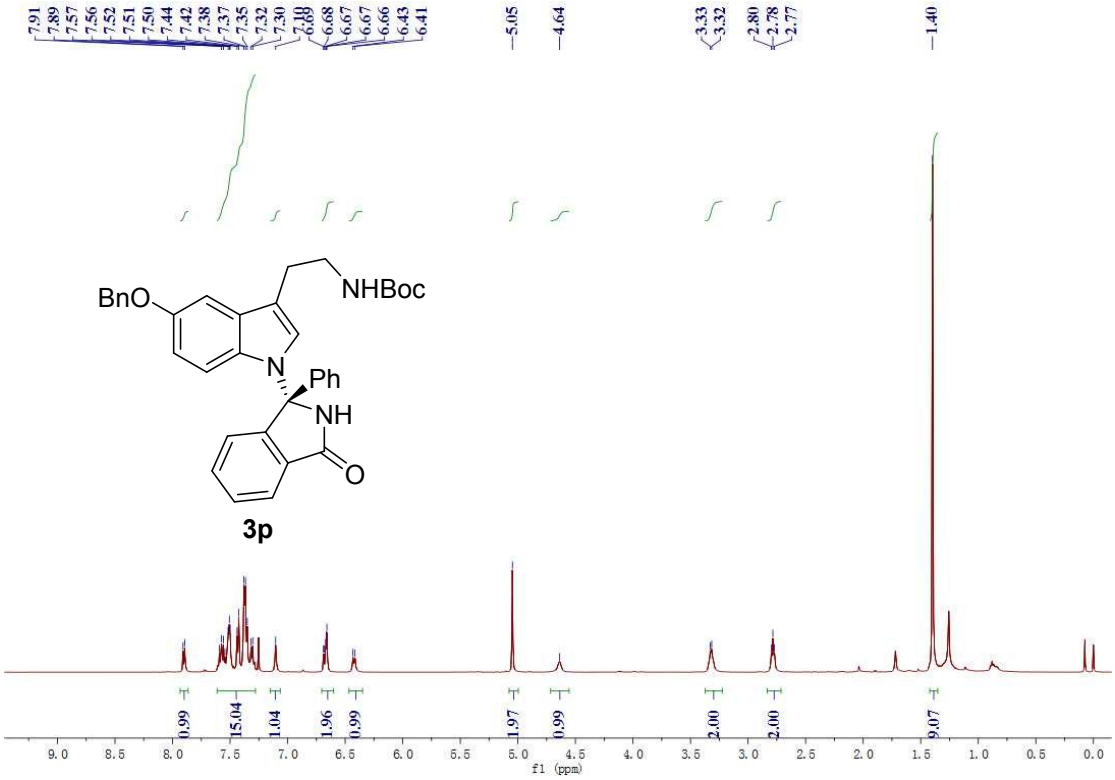
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2.80
2.78
2.77
1.40
BnO
NHBoc
N
Ph
NH
O
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1.04
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0.99
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0.99
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2.00
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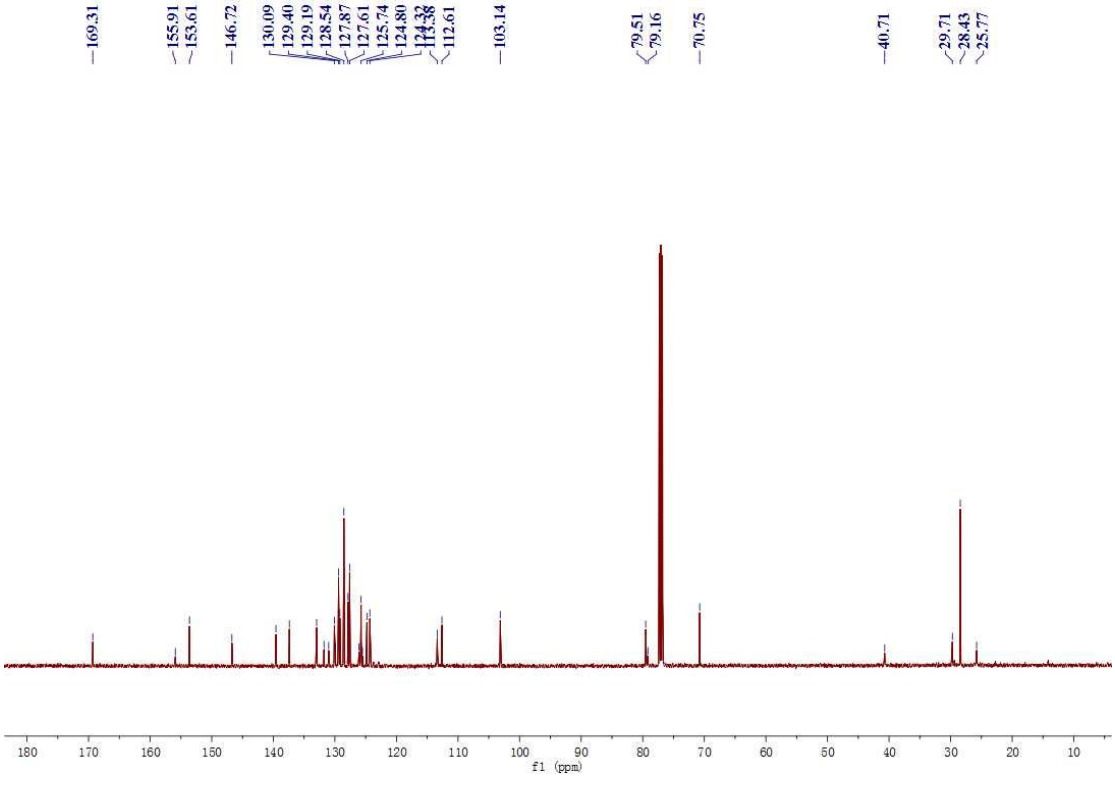
f1 (ppm)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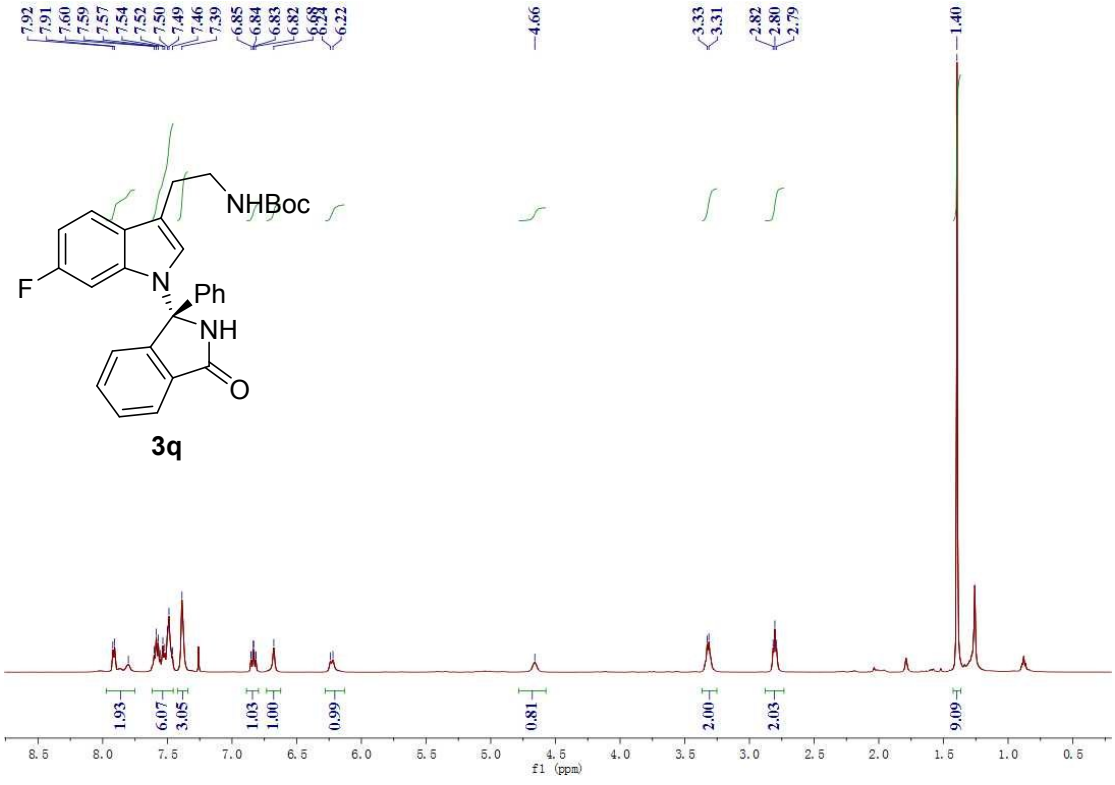
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6.83
6.82
6.22
4.66
3.33
3.31
2.82
2.80
2.79
1.40
NHBoc
F
N
Ph
NH
O
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1.00
0.99
0.81
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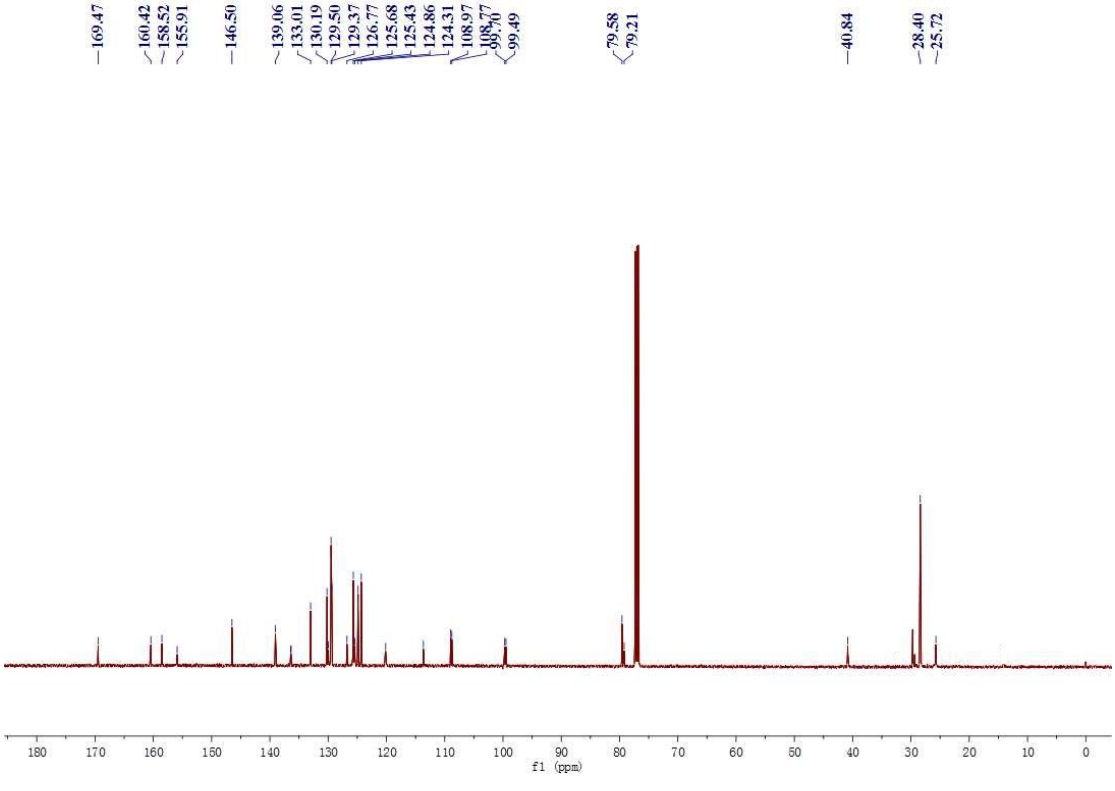
9.09
f1 (ppm)

3q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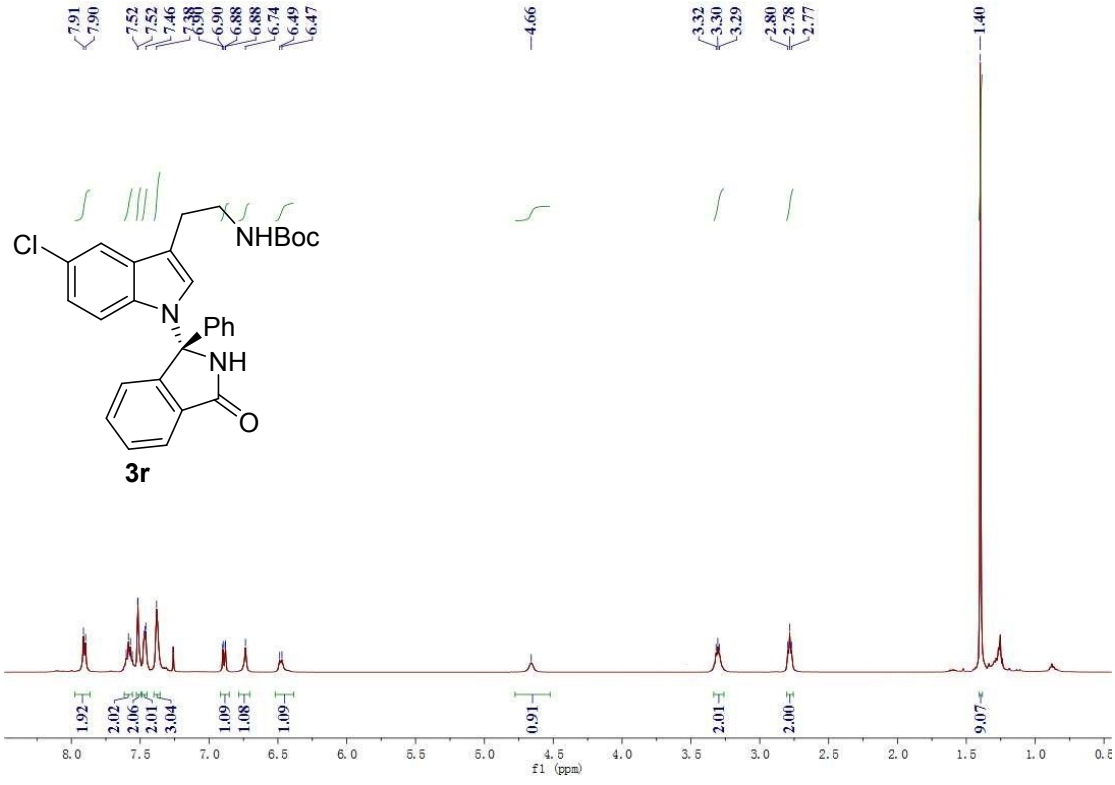
f1 (ppm)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3.30
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2.78
2.77
1.40
Cl
NHBoc
N
Ph
NH
O
3r
1.92
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1.08
1.09
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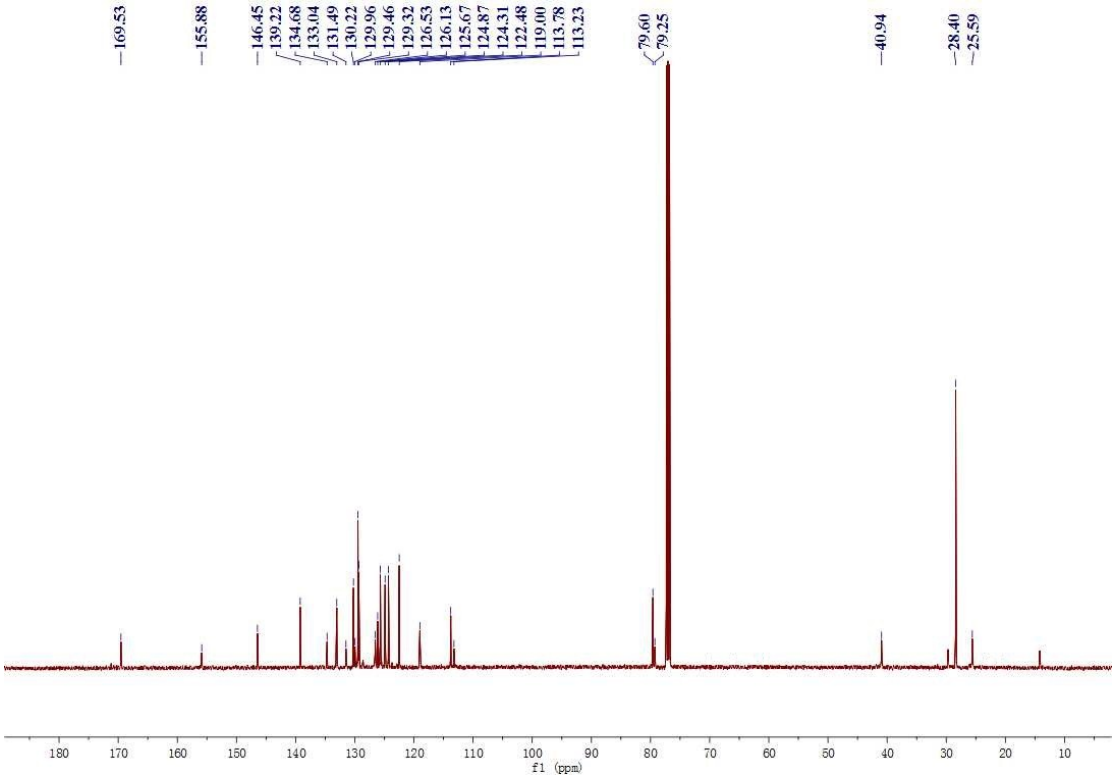
2.01
2.00
9.07
f1 (ppm)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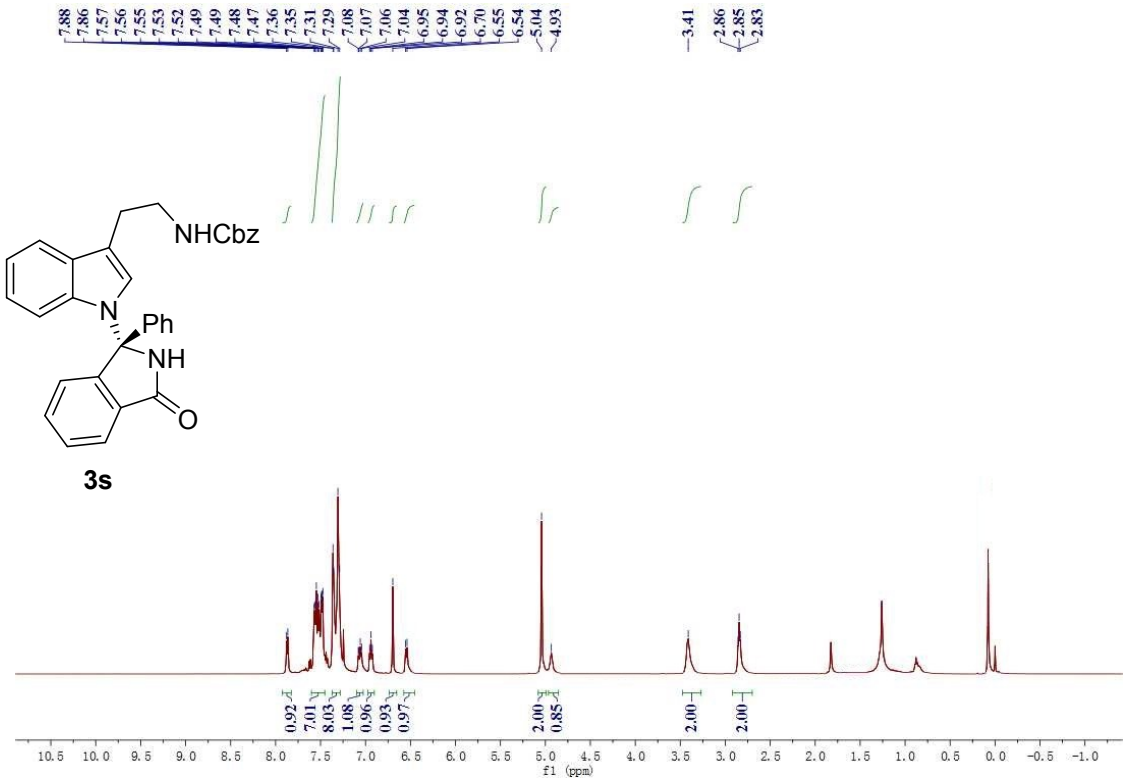
f1 (ppm)



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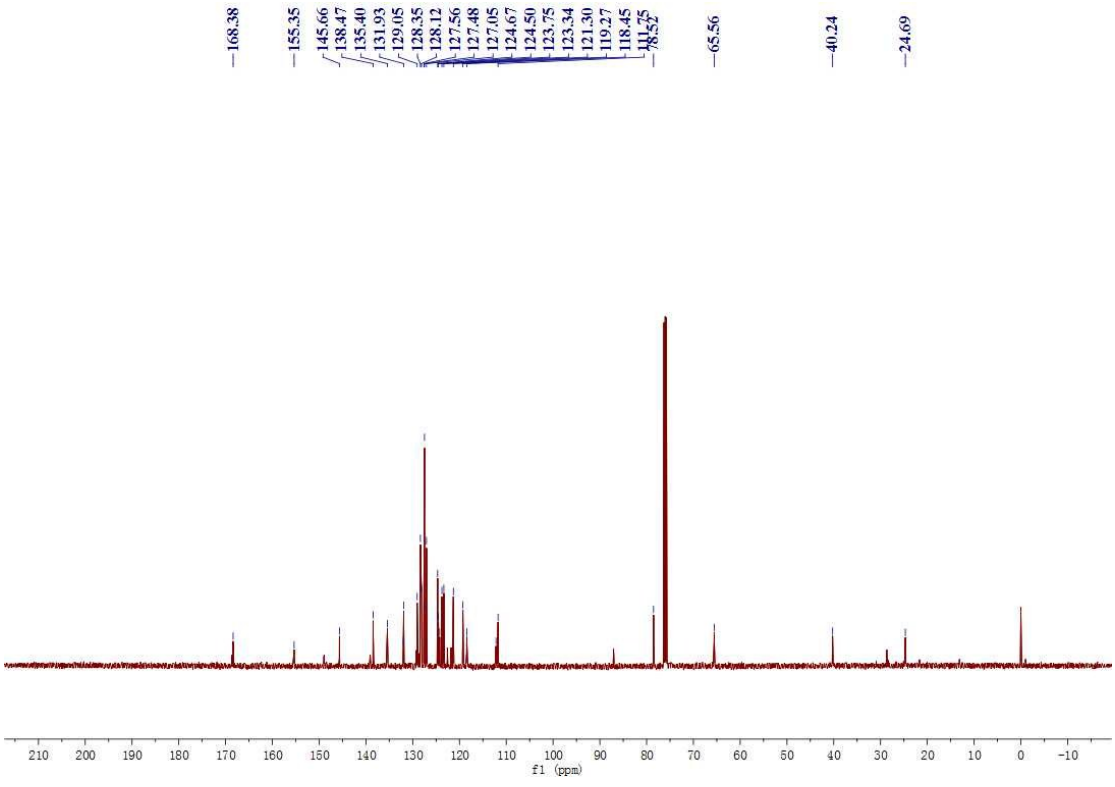

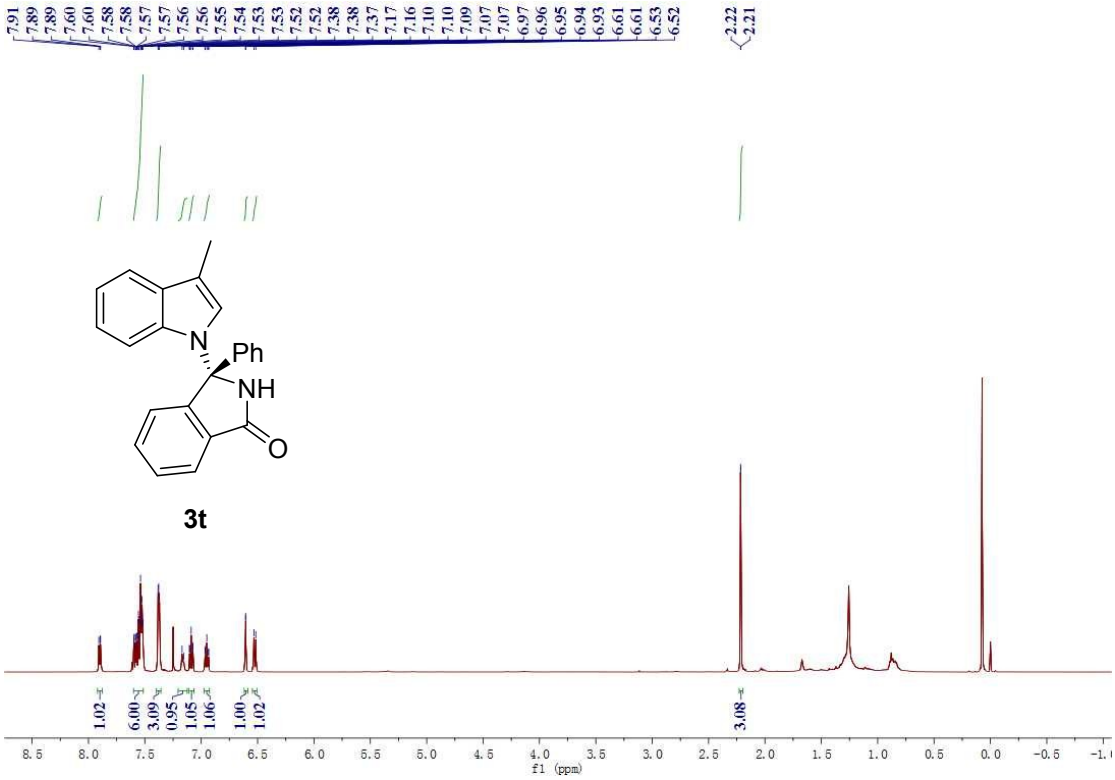
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6.61
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6.52
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2.21
N
Ph
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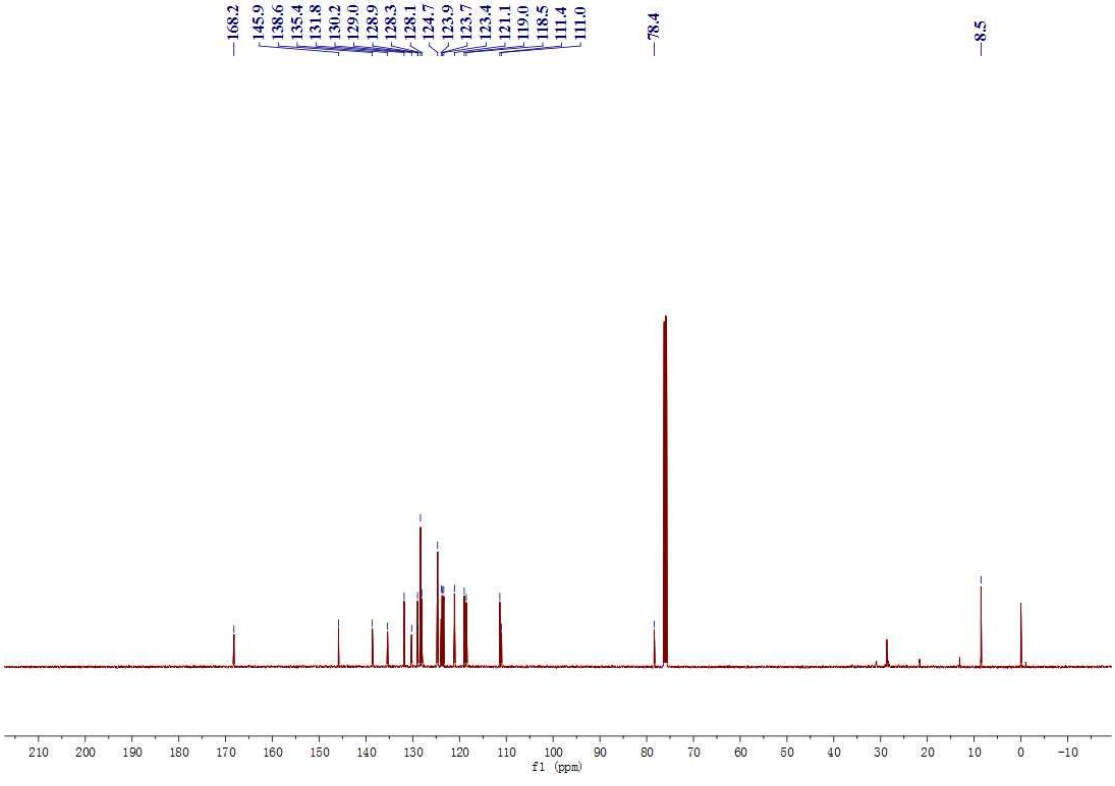
f1 (ppm)

3t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128.1
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121.1
119.0
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111.4
111.0
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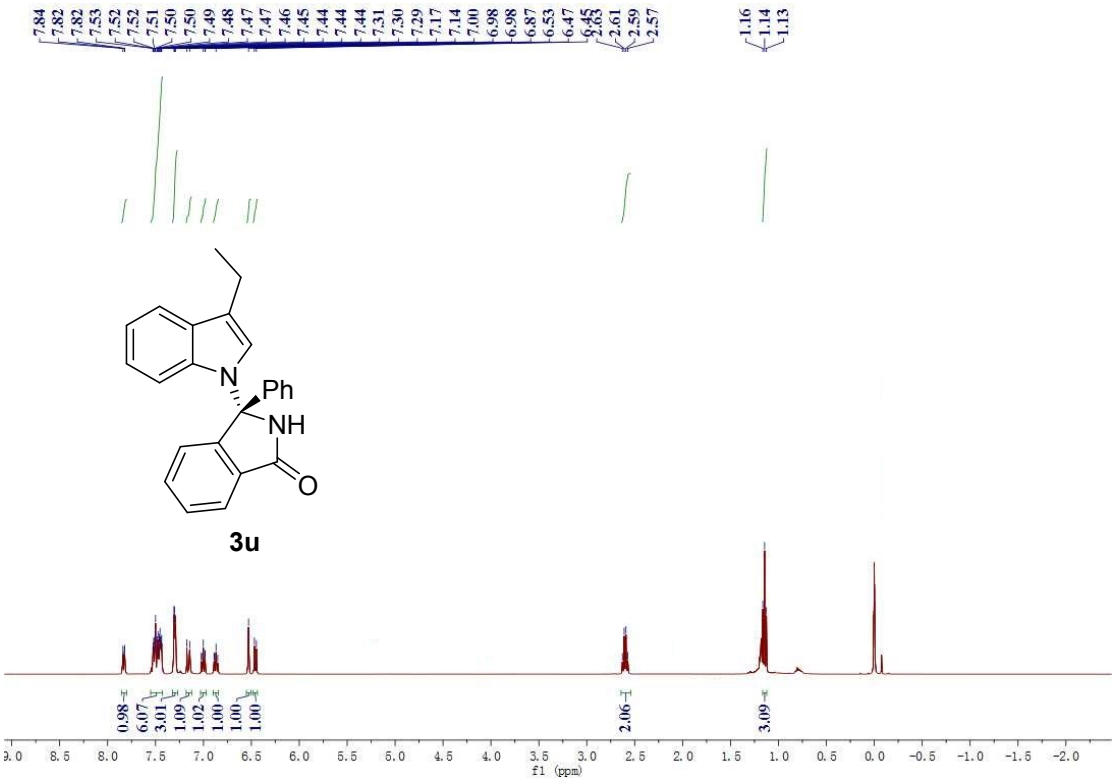
8.5
f1 (ppm)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6.53
6.47
6.45
2.63
2.61
2.59
2.57
1.16
1.14
1.13
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Ph
NH
O
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1.00
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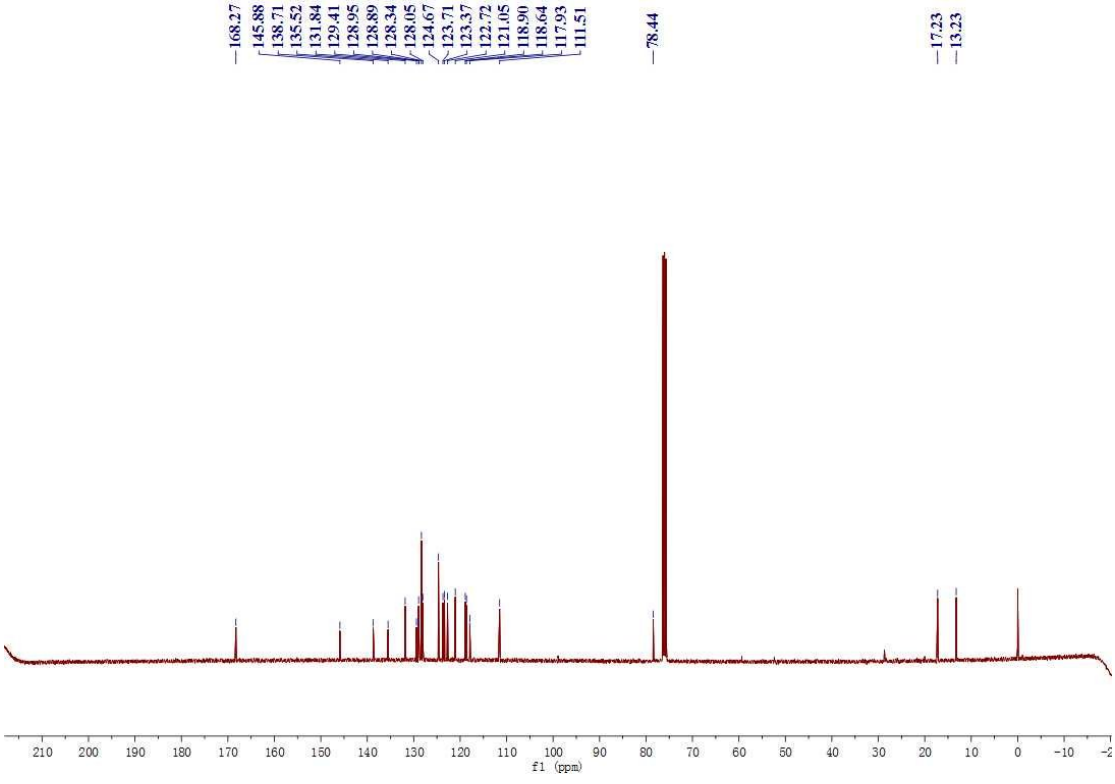
3.09
f1 (ppm)

3u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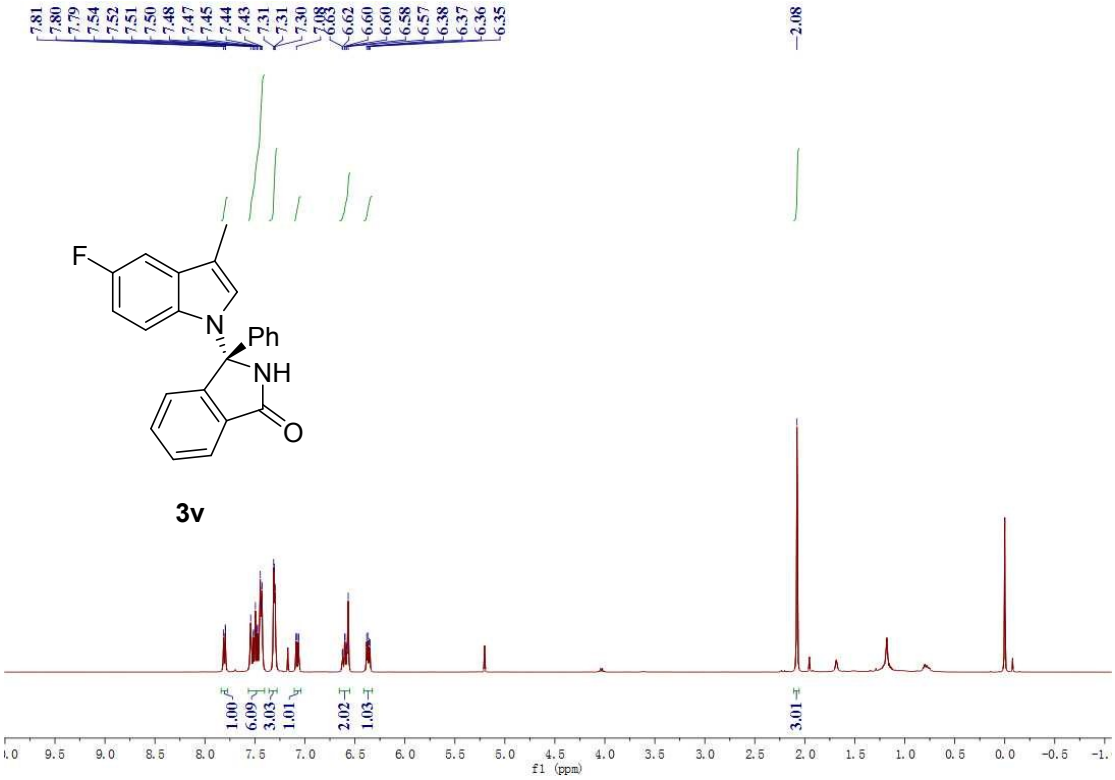
13.23
f1 (ppm)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6.62
6.60
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6.57
6.38
6.37
6.36
6.35
2.08
F
N
Ph
NH
O
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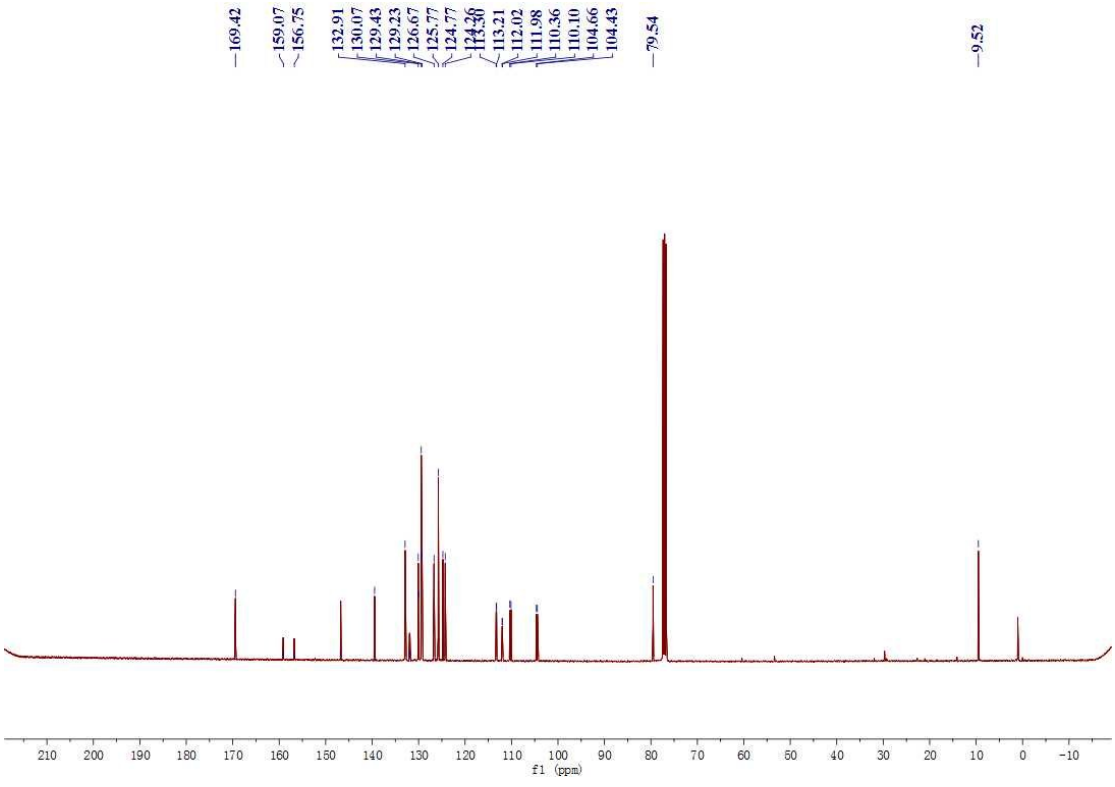
1.01
2.02
1.03
3.01
f1 (ppm)

3v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124.77
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112.02
111.98
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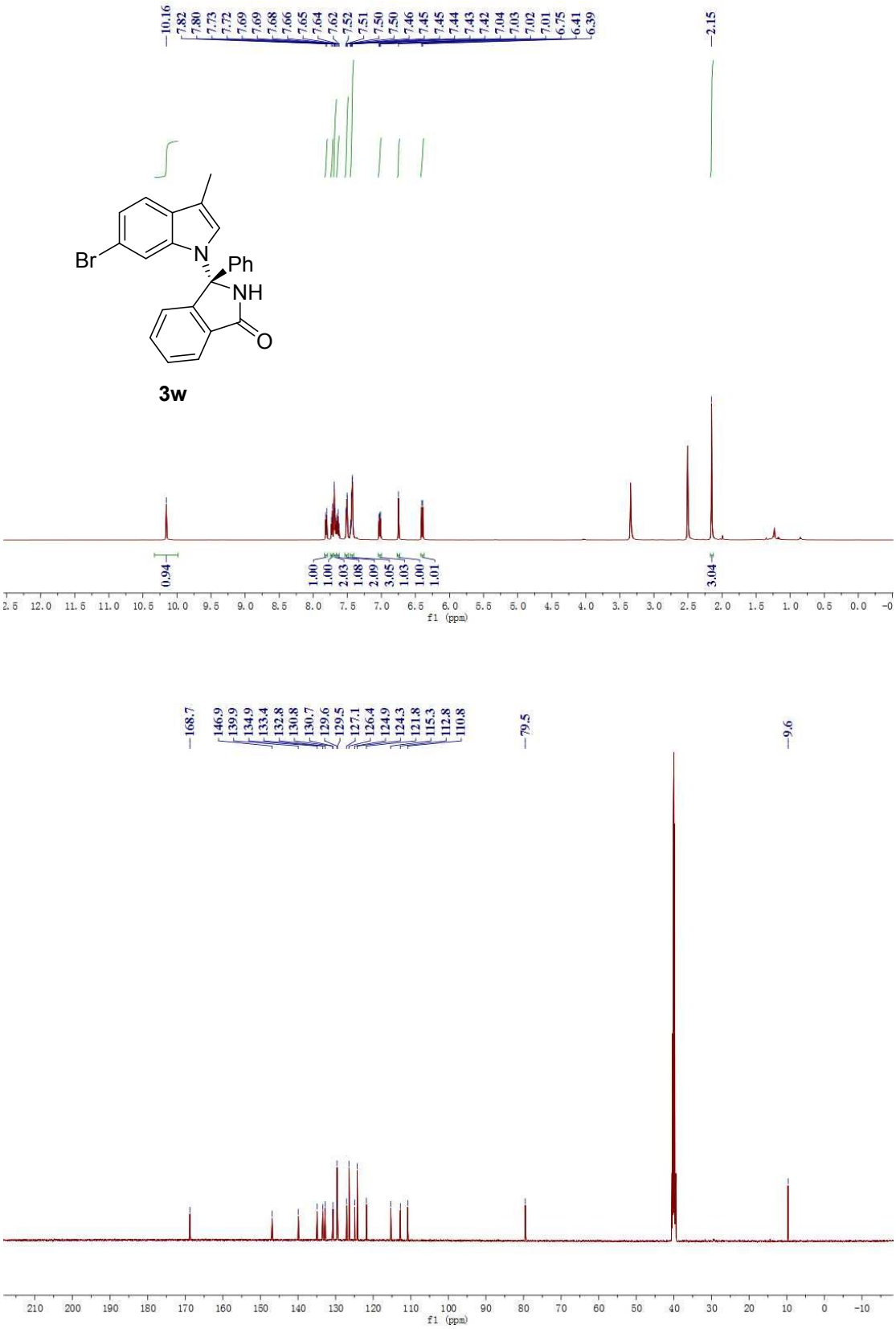
110.10
104.66
104.43
79.54
9.52
f1 (ppm)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7.44
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7.01
6.75
6.41
6.39
2.15
Br
N
Ph
NH
O
3w
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1.00
1.00
2.03
1.08
2.09
3.05
1.03
1.00
1.01
3.04
f1 (ppm)
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146.9
139.9
134.9
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129.6
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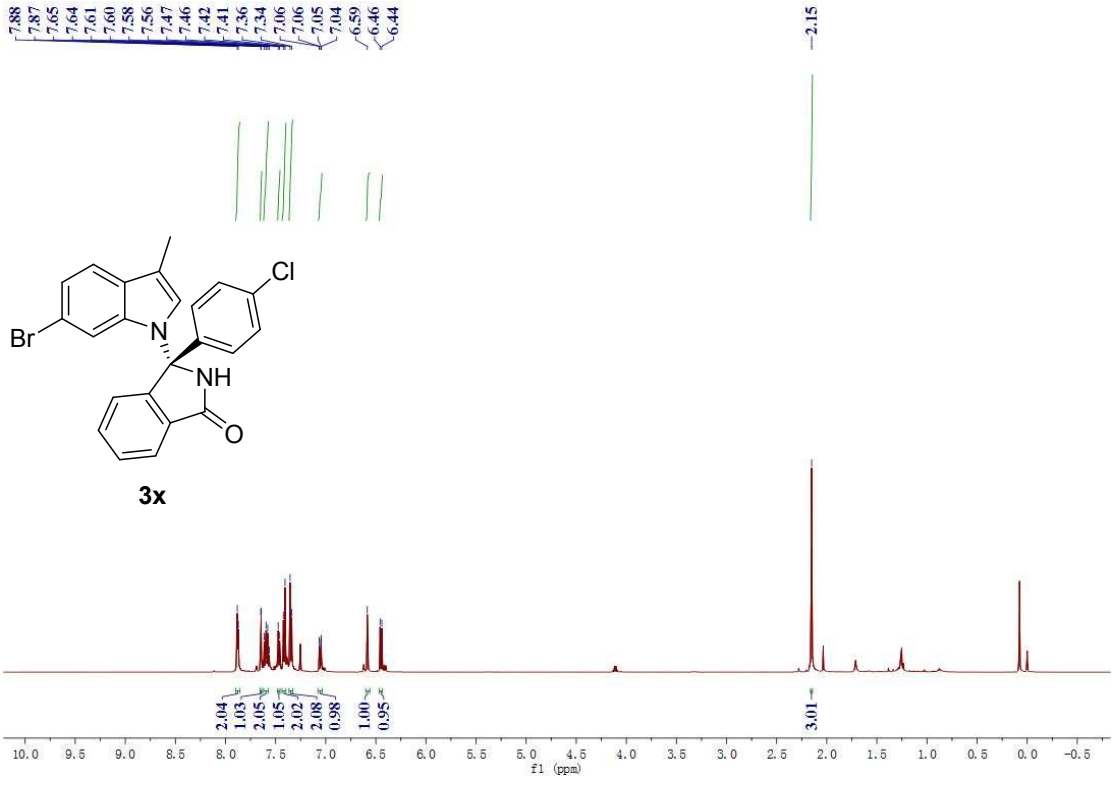
79.5
9.6
f1 (ppm)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6.46
6.44
2.15
Cl
Br
N
NH
O
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1.05
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2.08
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1.00
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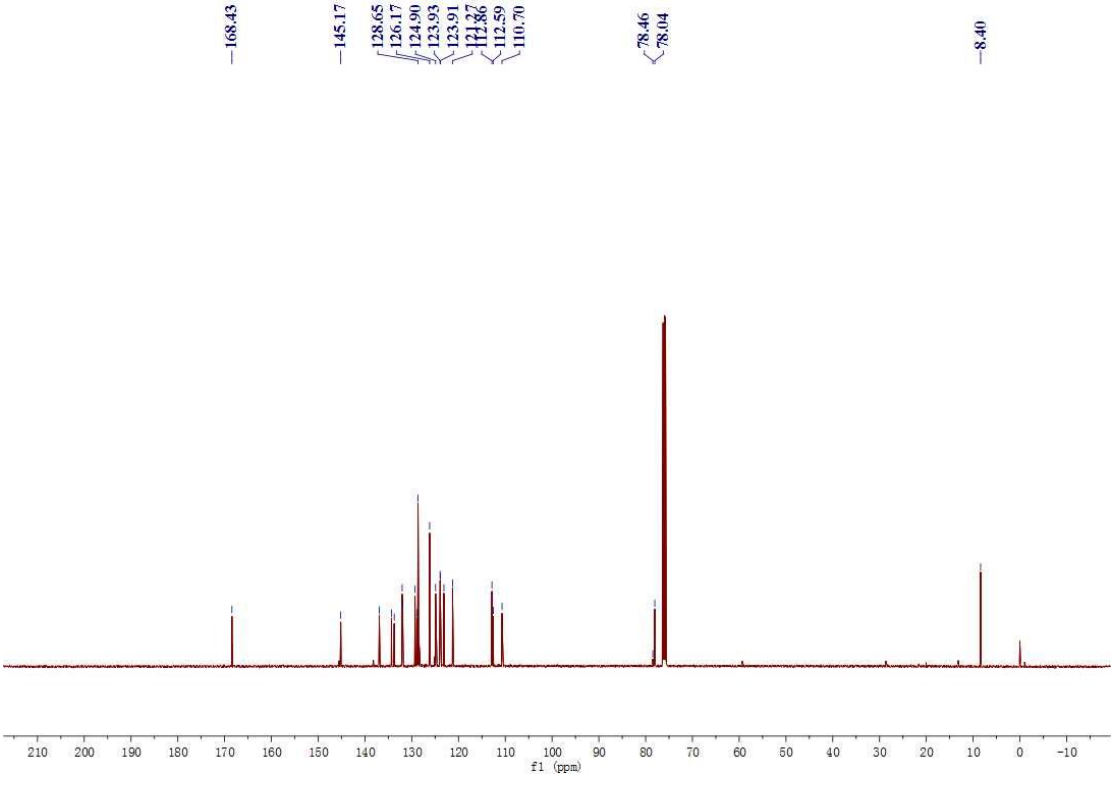
3.01
f1 (ppm)

3x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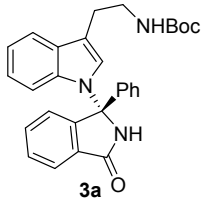
8.40
f1 (ppm)



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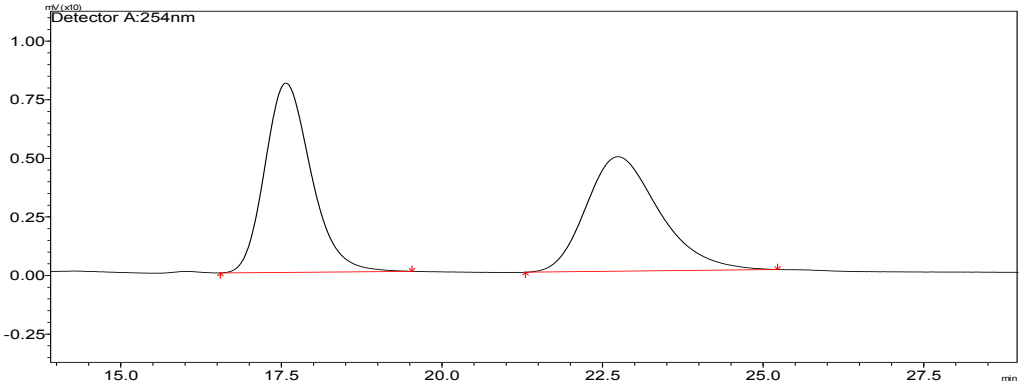
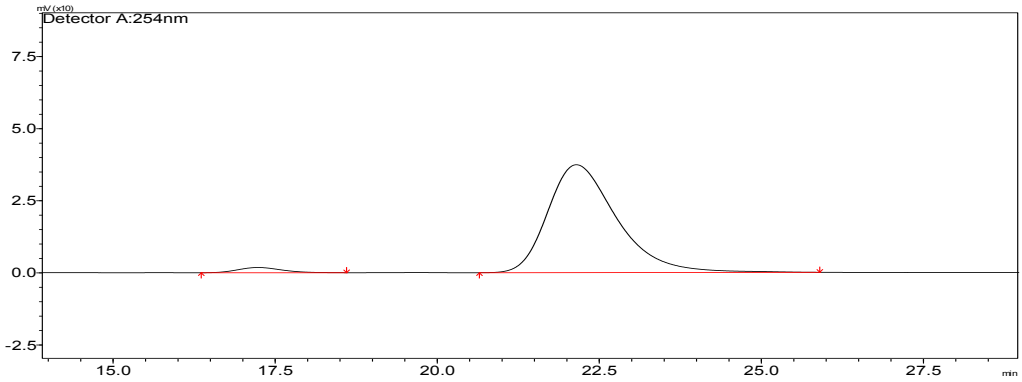
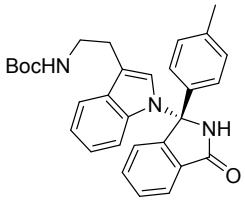


Peak	Ret. Time	Area	Height	Area%	Height%
1	17.564	405029	8076	51.055	62.302
2	22.734	388293	4887	48.945	37.698
Total		793322	12963	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	17.233	86082	1822	3.010	4.643
2	22.143	2773669	37416	96.990	95.357
Total		2859751	39237	100.000	100.000



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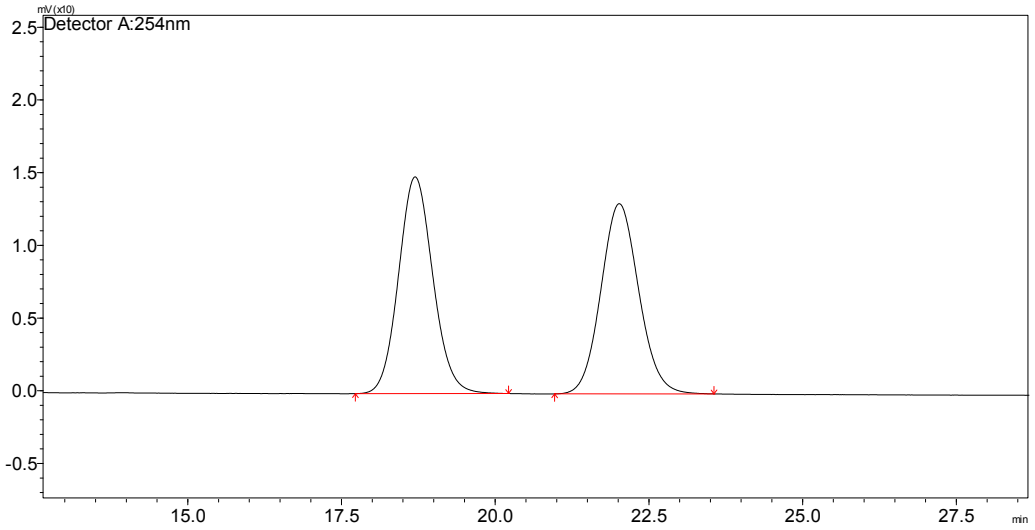
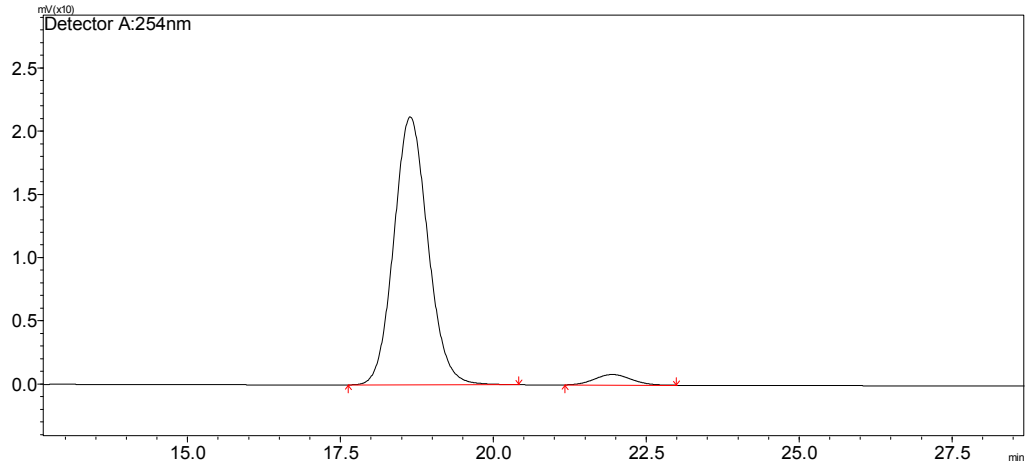
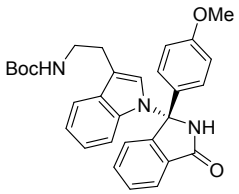


Peak	Ret. Time	Area	Height	Area%	Height%
1	18.693	579721	14906	50.814	53.262
2	22.013	561155	13080	49.186	46.738
Total		1140875	27987	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	18.636	820821	21191	95.930	96.204
2	21.947	34829	836	4.070	3.796
Total		855650	22027	100.000	100.000



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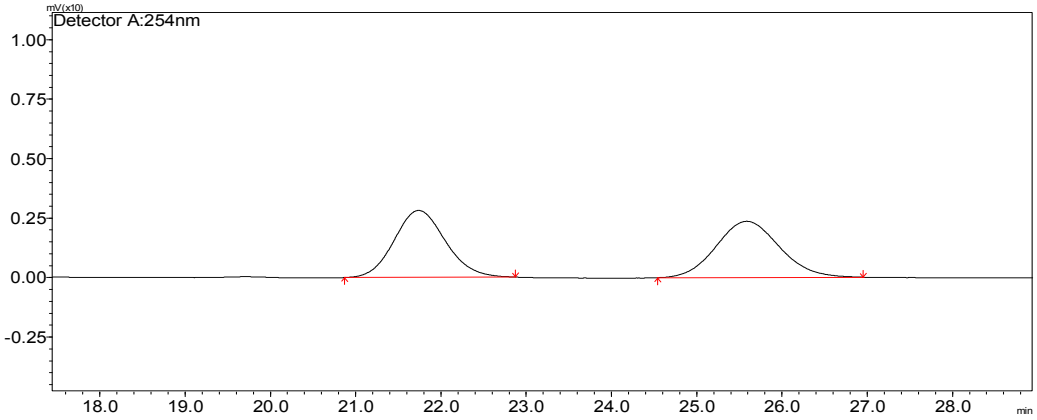
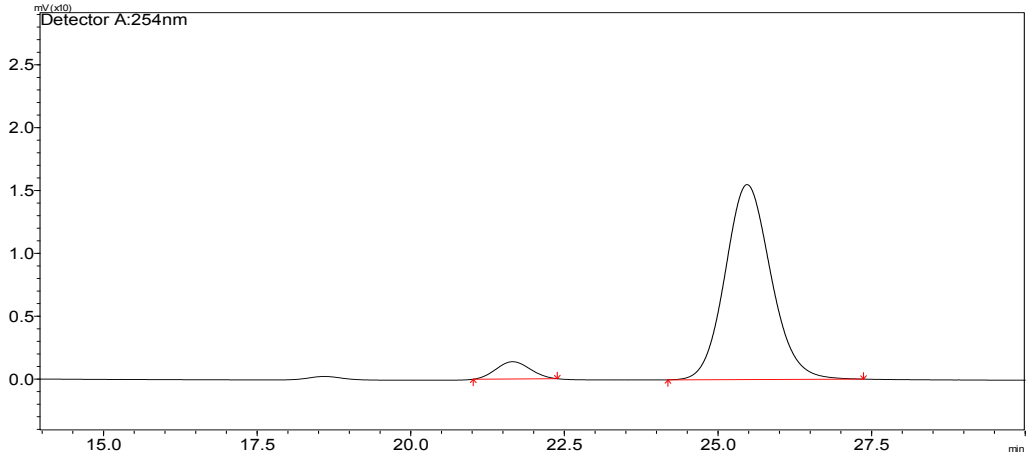
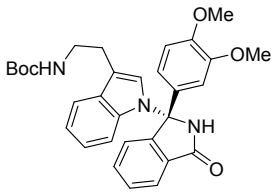


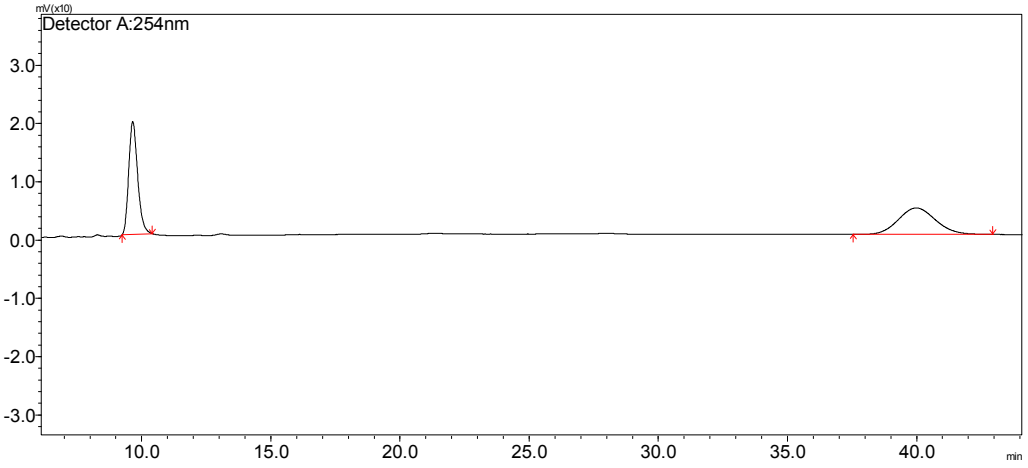
Peak	Ret. Time	Area	Height	Area%	Height%
1	21.733	118180	2818	49.193	54.396
2	25.586	122058	2363	50.807	45.604
Total		240238	5181	100.000	100.000



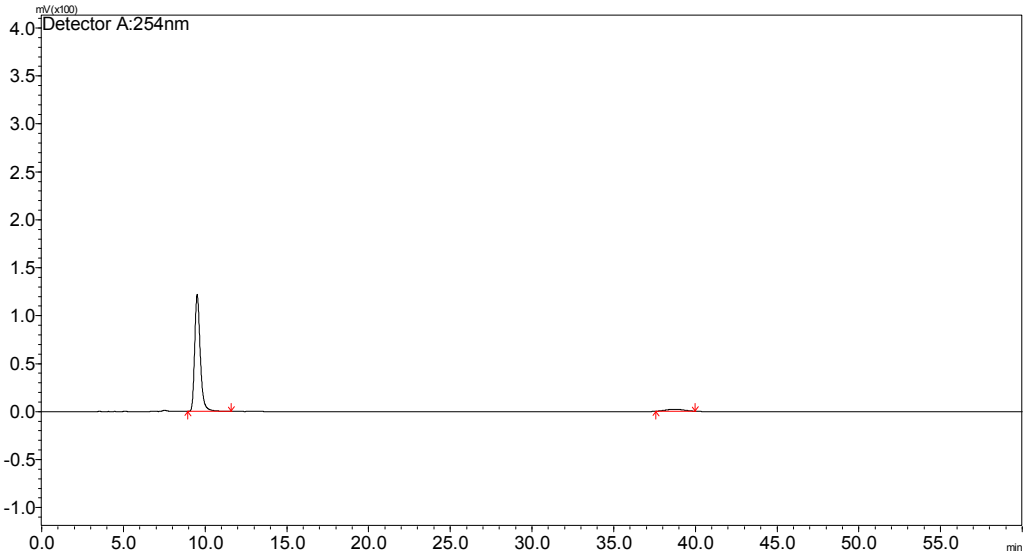
Peak	Ret. Time	Area	Height	Area%	Height%
1	21.653	52961	1374	6.176	8.139
2	25.469	804571	15512	93.824	91.861
Total		857532	16886	100.000	100.000



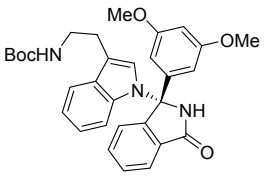
3d



Peak	Ret. Time	Area	Height	Area%	Height%
1	9.649	463958	19304	50.361	80.950
2	39.984	457305	4543	49.639	19.050
Total		921263	23847	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	9.507	2903704	122077	94.805	98.366
2	38.722	159106	2028	5.195	1.634
Total		3062810	124105	100.000	100.000



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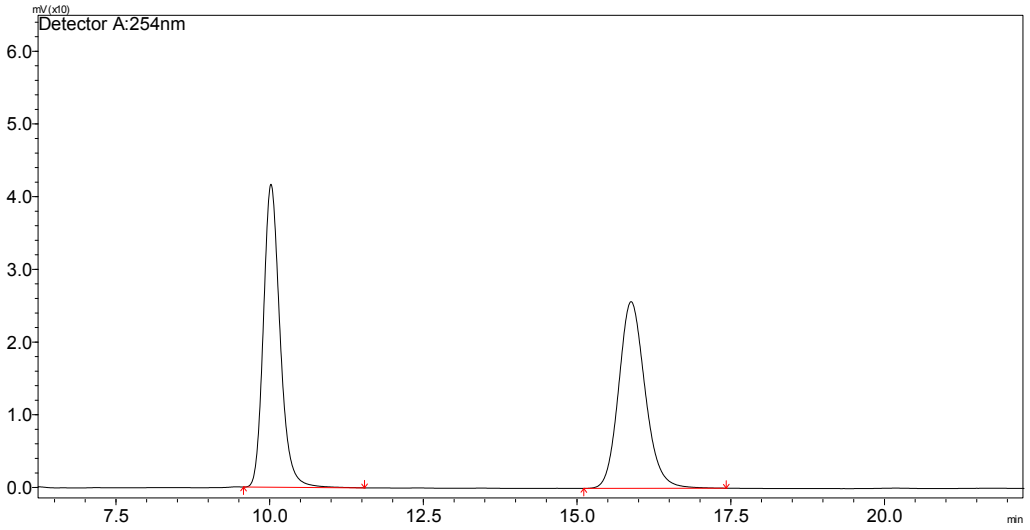
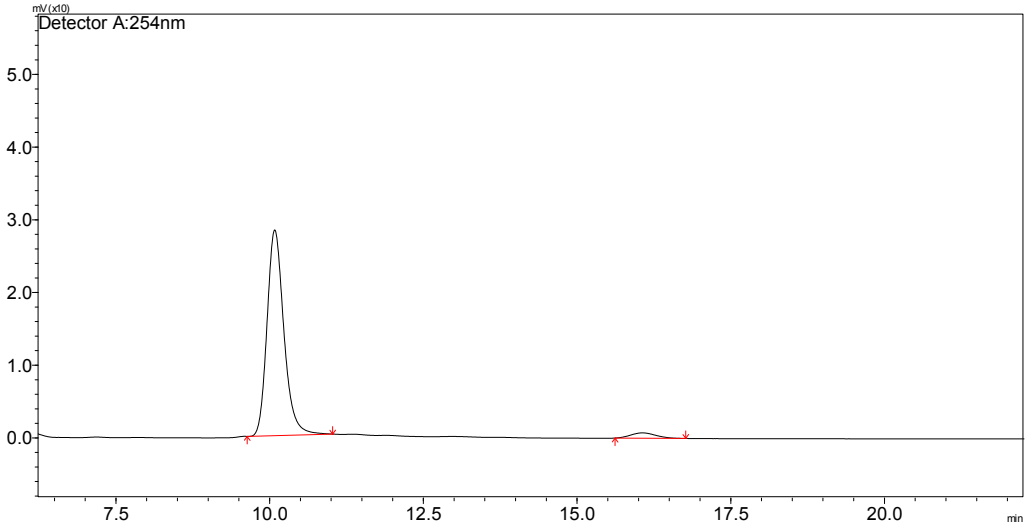
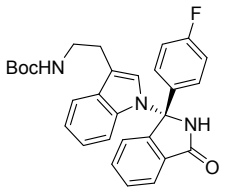


Peak	Ret. Time	Area	Height	Area%	Height%
1	10.017	784255	41669	50.517	61.871
2	15.875	768203	25679	49.483	38.129
Total		1552458	67348	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	10.078	538892	28311	96.256	97.472
2	16.056	20958	734	3.744	2.528
Total		559850	29045	100.000	100.000



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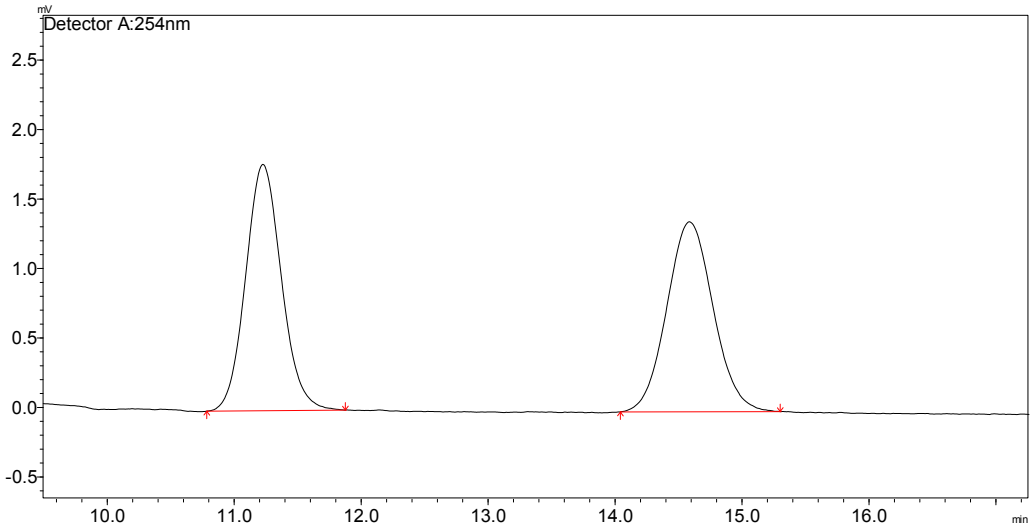
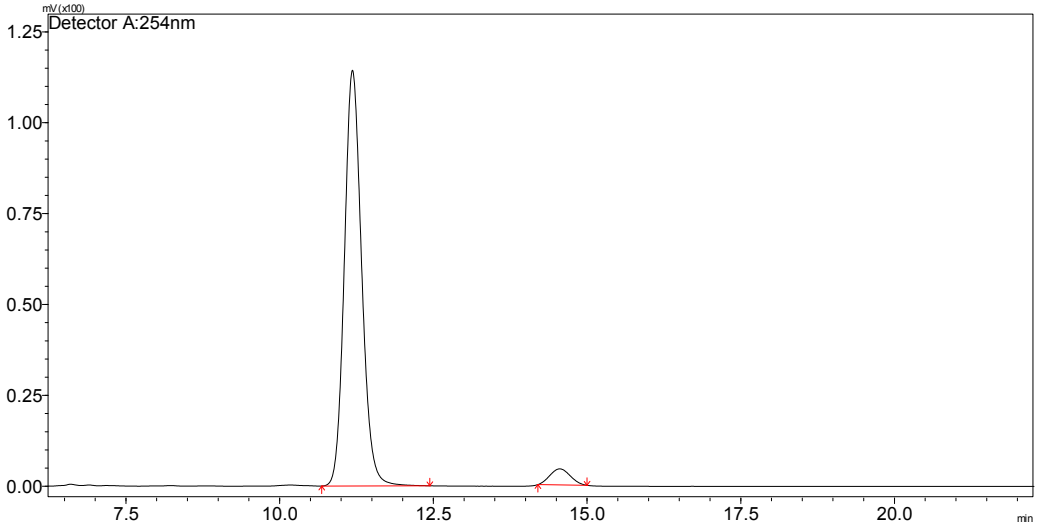
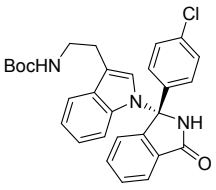


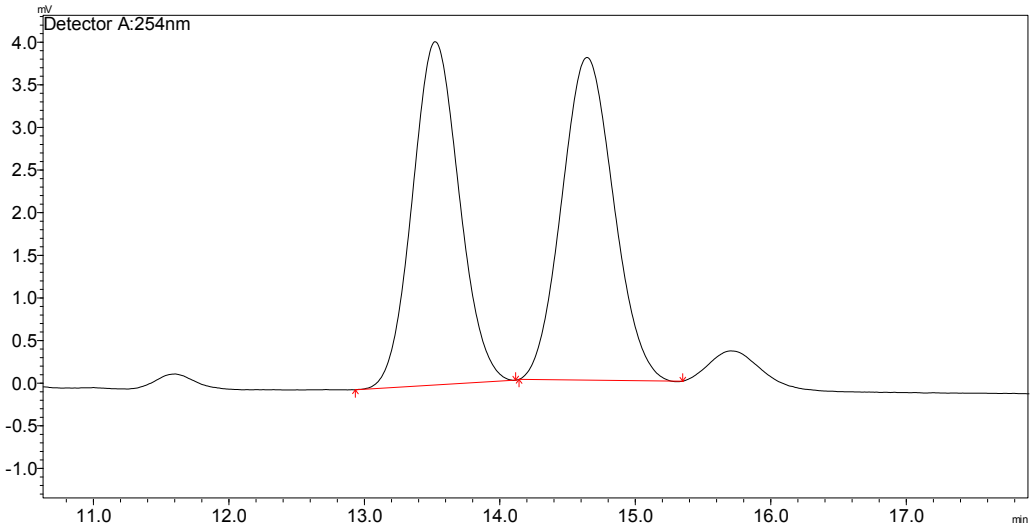
Peak	Ret. Time	Area	Height	Area%	Height%
1	11.222	34789	1773	50.023	56.444
2	14.580	34756	1368	49.977	43.556
Total		69545	3142	100.000	100.000



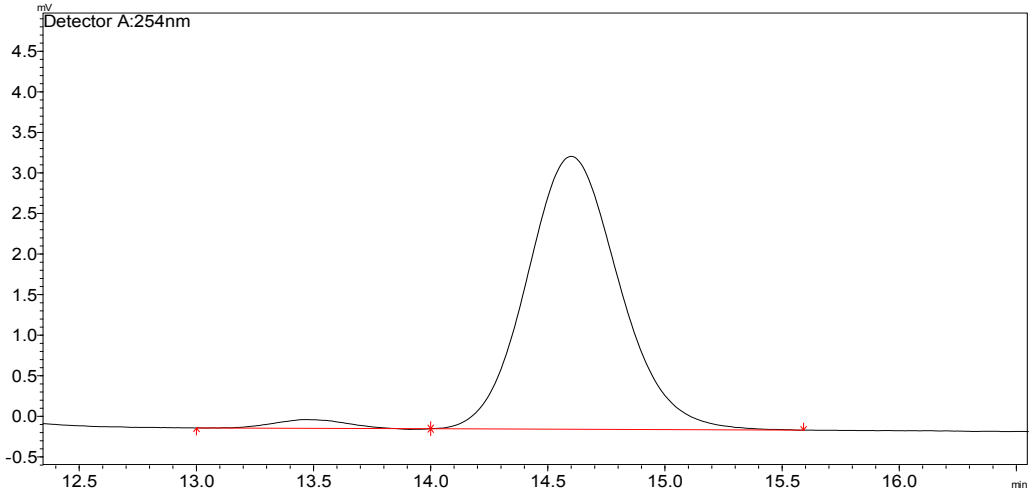
Peak	Ret. Time	Area	Height	Area%	Height%
1	11.180	2234626	114381	95.660	96.282
2	14.551	101393	4416	4.340	3.718
Total		2336018	118797	100.000	100.000



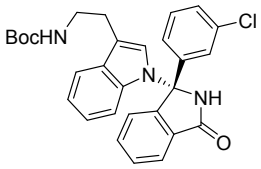
3g



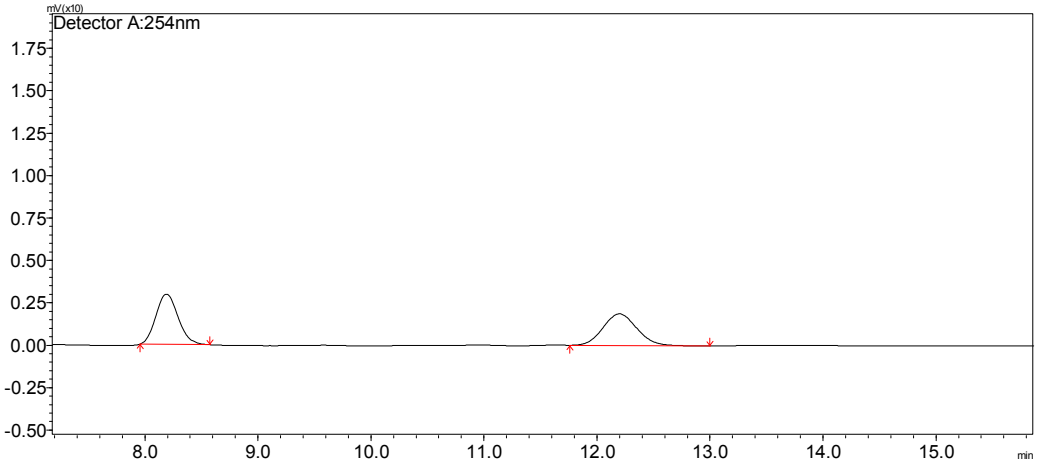
Peak	Ret. Time	Area	Height	Area%	Height%
1	13.518	96879	4026	49.017	51.547
2	14.639	100766	3785	50.983	48.453
Total		197645	7811	100.000	100.000



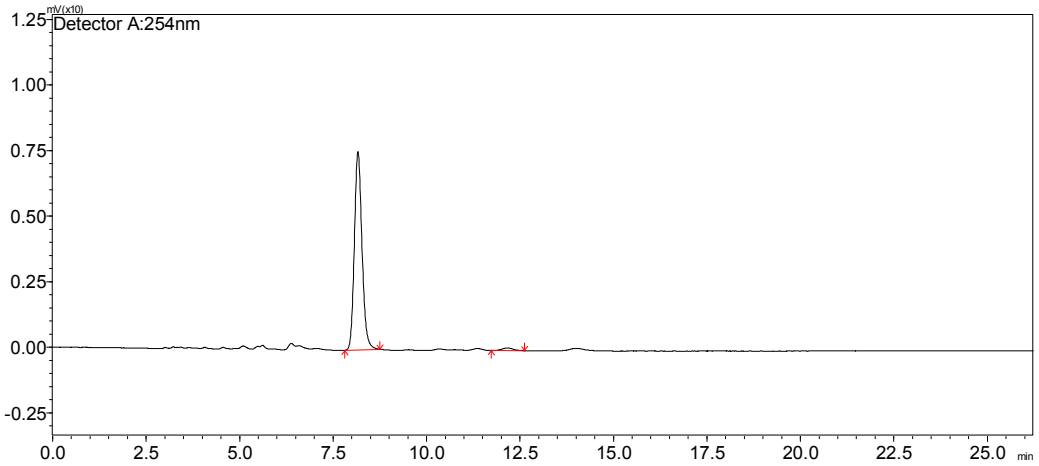
Peak	Ret. Time	Area	Height	Area%	Height%
1	13.463	2266	107	2.399	3.095
2	14.595	92160	3364	97.601	96.905
Total		94426	3471	100.000	100.000



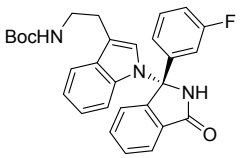
3h



Peak	Ret. Time	Area	Height	Area%	Height%
1	8.186	40248	2951	50.881	61.272
2	12.193	38855	1865	49.119	38.728
Total		79103	4816	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	8.162	107950	7560	98.063	98.719
2	12.150	2133	98	1.937	1.281
Total		110083	7658	100.000	100.000



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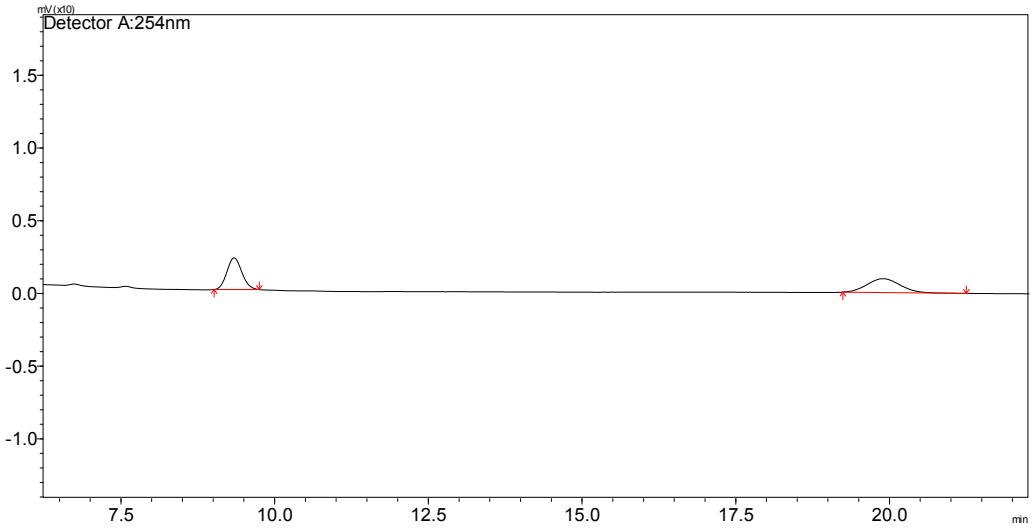
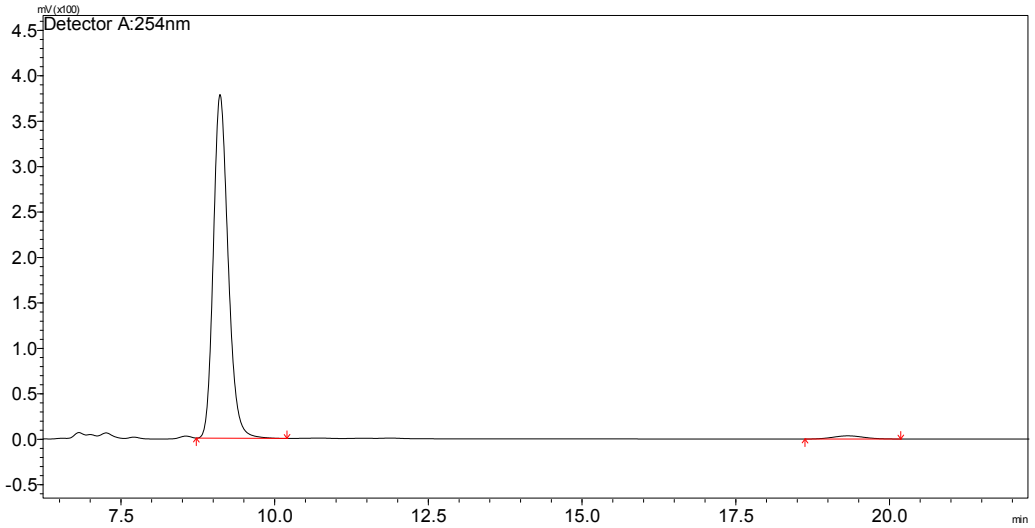
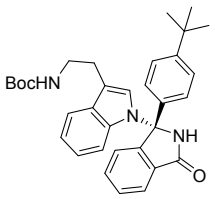


Peak	Ret. Time	Area	Height	Area%	Height%
1	9.336	36916	2183	50.887	69.638
2	19.881	35629	952	49.113	30.362
Total		72545	3134	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	9.107	6313564	378125	98.094	99.082
2	19.321	122662	3504	1.906	0.918
Total		6436226	381629	100.000	100.000



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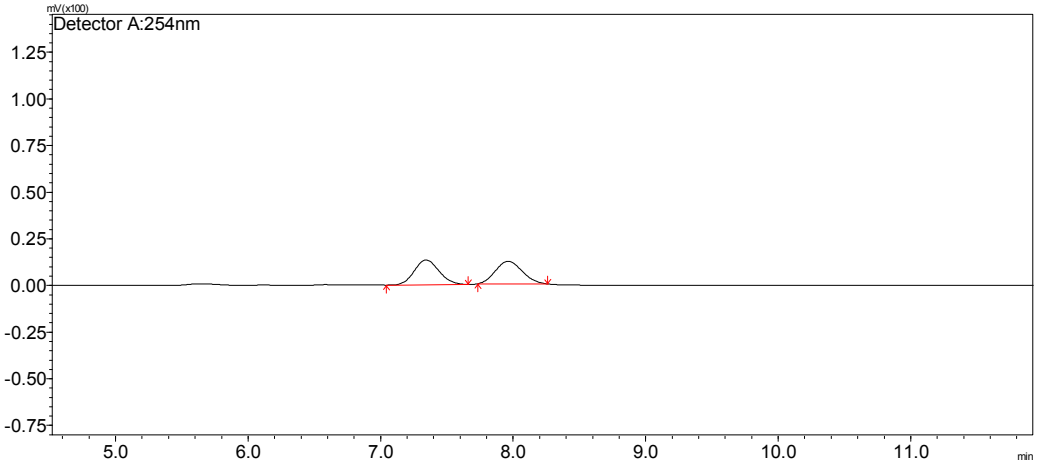
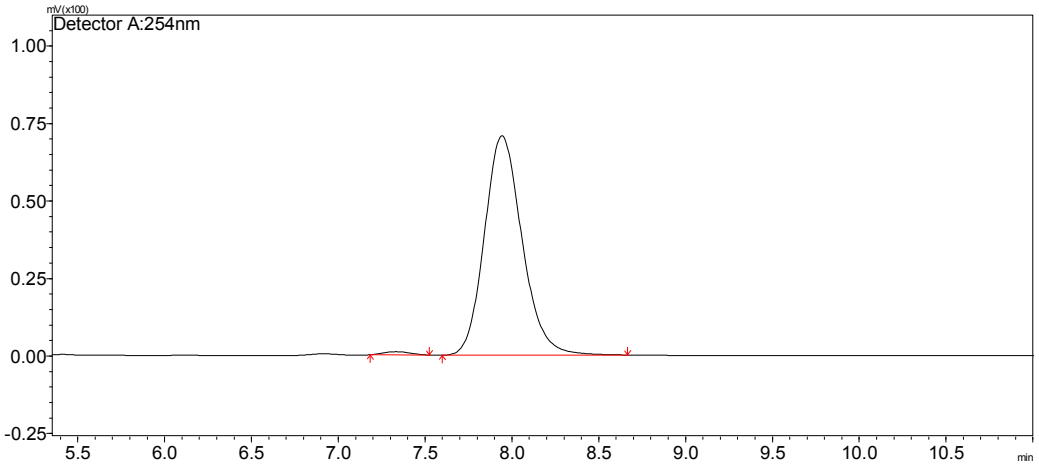
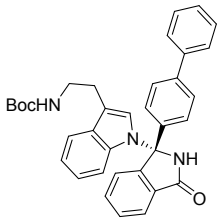


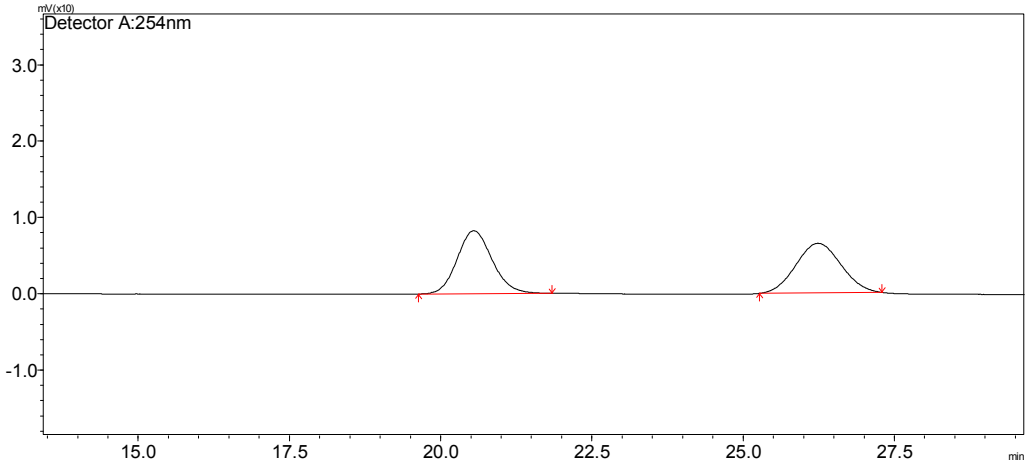
Peak	Ret. Time	Area	Height	Area%	Height%
1	7.339	173632	13345	50.516	52.506
2	7.958	170083	12072	49.484	47.494
Total		343716	25417	100.000	100.000



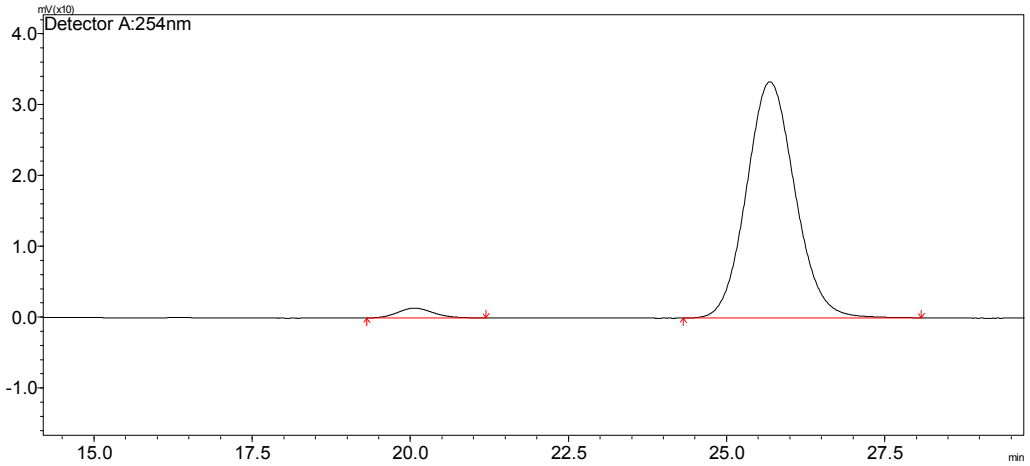
Peak	Ret. Time	Area	Height	Area%	Height%
1	7.329	11305	1050	1.046	1.461
2	7.938	1069764	70812	98.954	98.539
Total		1081069	71862	100.000	100.000



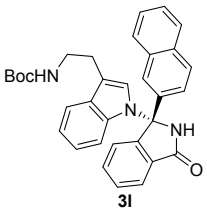
3k



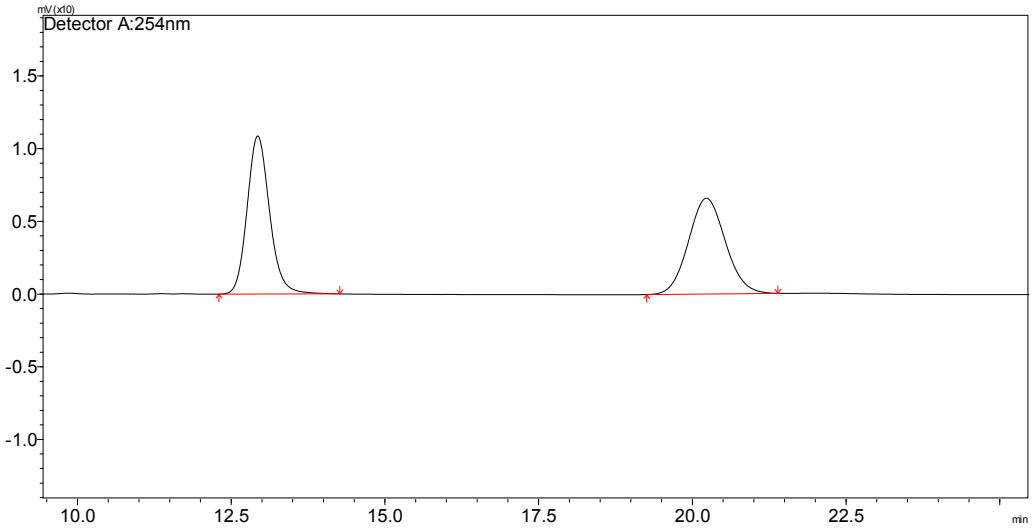
Peak	Ret. Time	Area	Height	Area%	Height%
1	20.543	333031	8257	49.627	55.943
2	26.232	338036	6502	50.373	44.057
Total		671067	14759	100.000	100.000



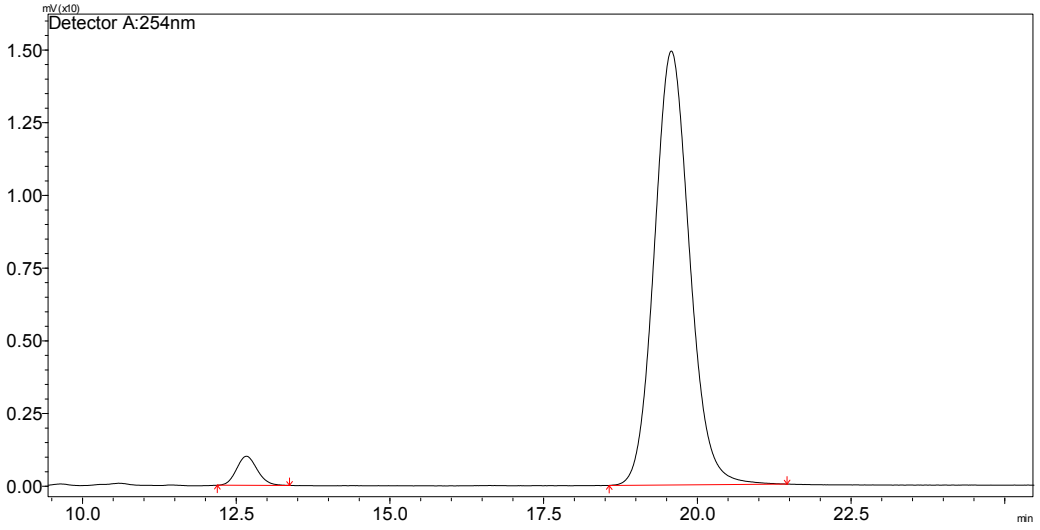
Peak	Ret. Time	Area	Height	Area%	Height%
1	20.062	54674	1390	2.983	3.999
2	25.680	1778142	33354	97.017	96.001
Total		1832816	34744	100.000	100.000



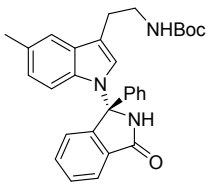
3l



Peak	Ret. Time	Area	Height	Area%	Height%
1	12.926	276721	10874	50.119	62.274
2	20.225	275402	6587	49.881	37.726
Total		552123	17461	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	12.663	23466	1001	3.791	6.287
2	19.572	595588	14922	96.209	93.713
Total		619054	15923	100.000	100.000



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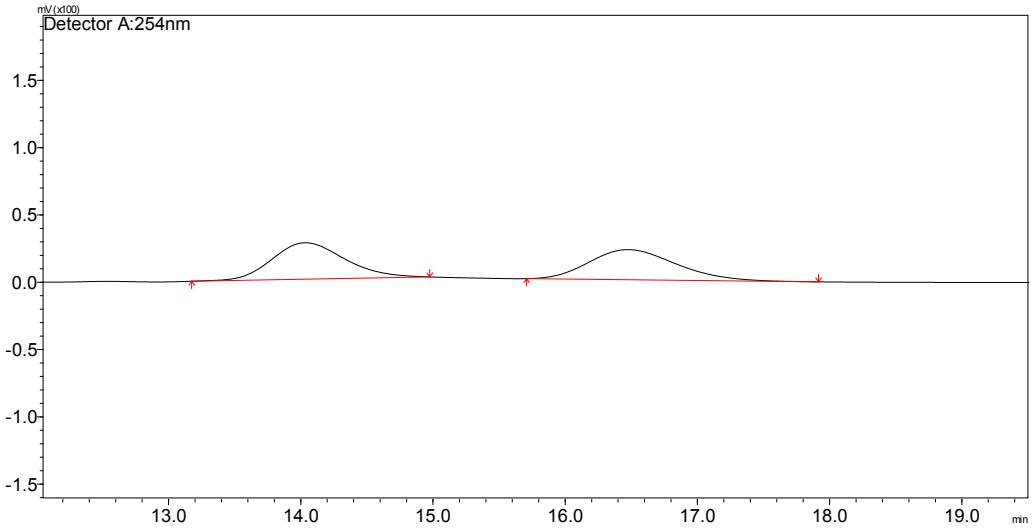
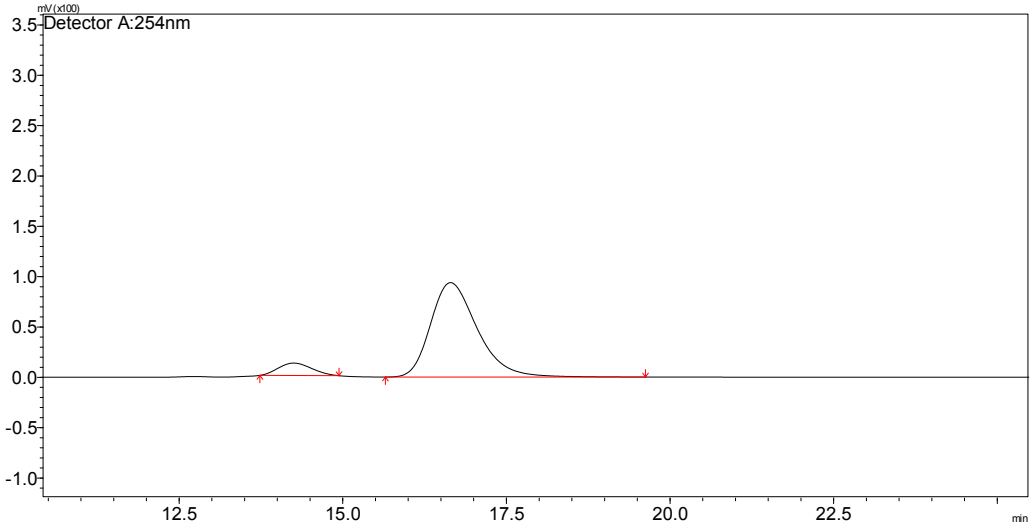
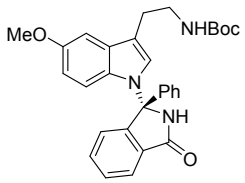


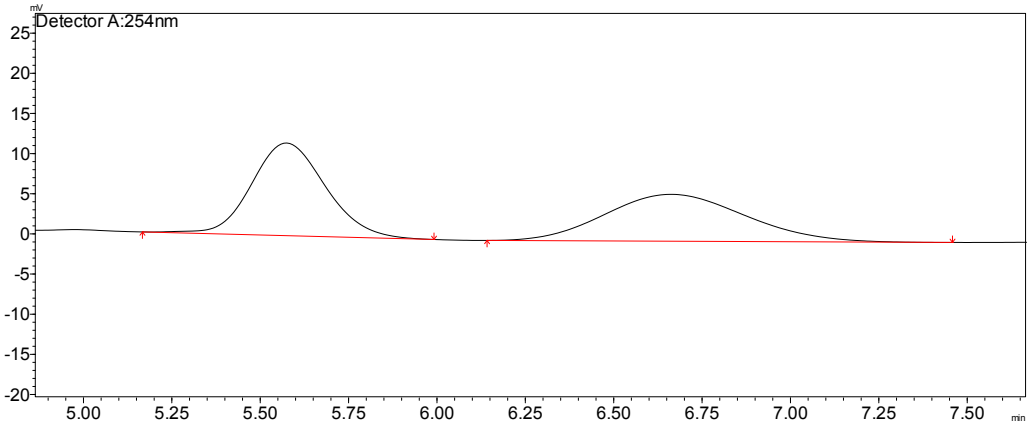
Peak	Ret. Time	Area	Height	Area%	Height%
1	14.031	1039004	27076	50.290	54.735
2	16.470	1027037	22391	49.710	45.265
Total		2066041	49467	100.000	100.000



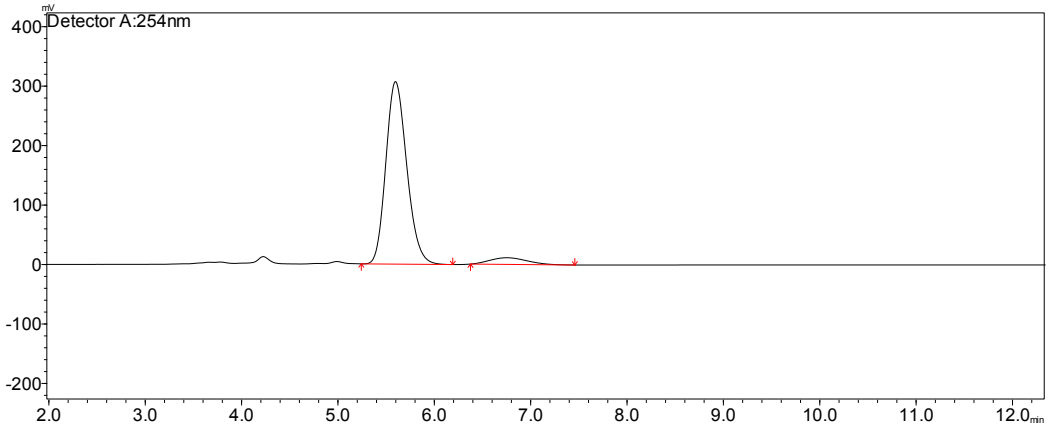
Peak	Ret. Time	Area	Height	Area%	Height%
1	14.245	438462	12346	8.607	11.635
2	16.642	4655687	93767	91.393	88.365
Total		5094149	106113	100.000	100.000



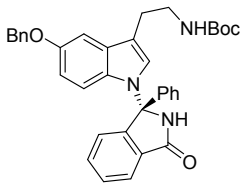
3o



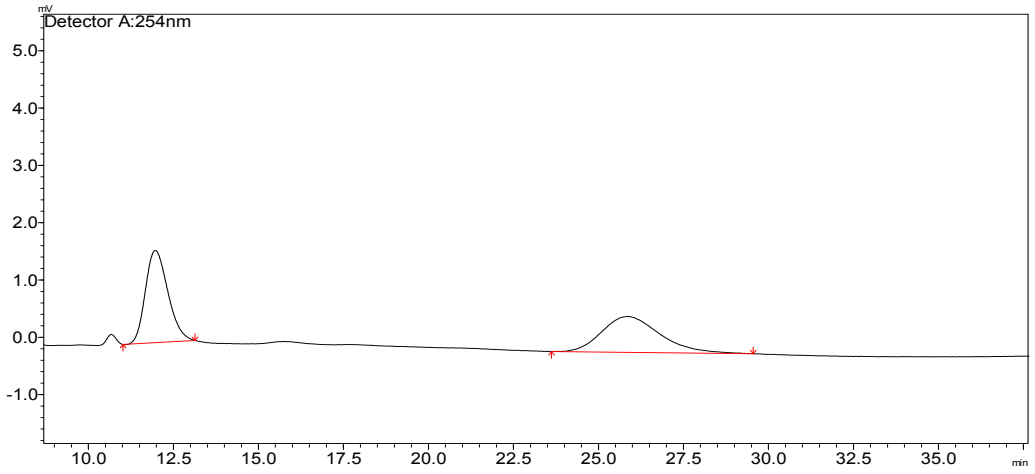
Peak	Ret. Time	Area	Height	Area%	Height%
1	5.569	167455	11532	51.001	66.395
2	6.658	160883	5837	48.999	33.605
Total		328337	17369	100.000	100.000



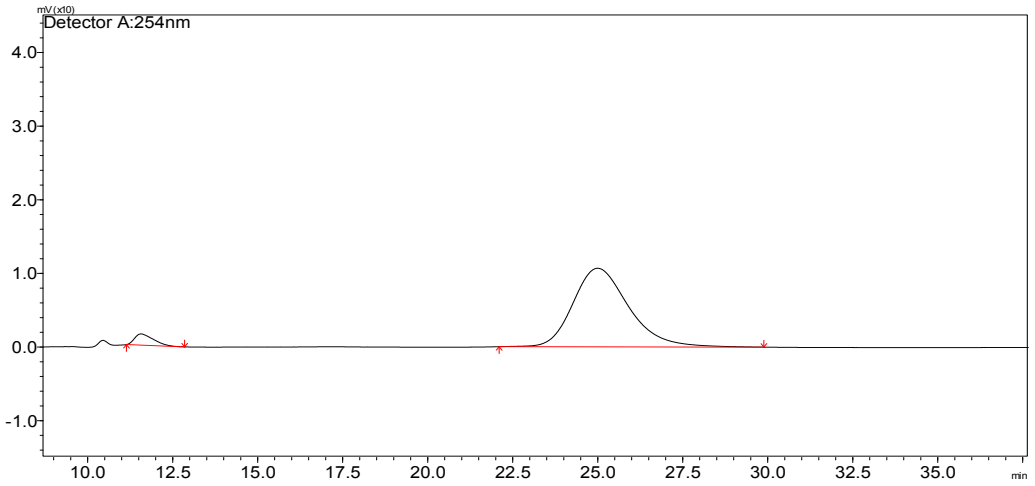
Peak	Ret. Time	Area	Height	Area%	Height%
1	5.593	4638573	306969	93.966	96.493
2	6.749	297885	11157	6.034	3.507
Total		4936458	318125	100.000	100.000



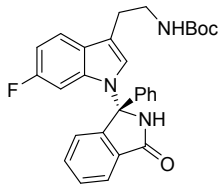
3p



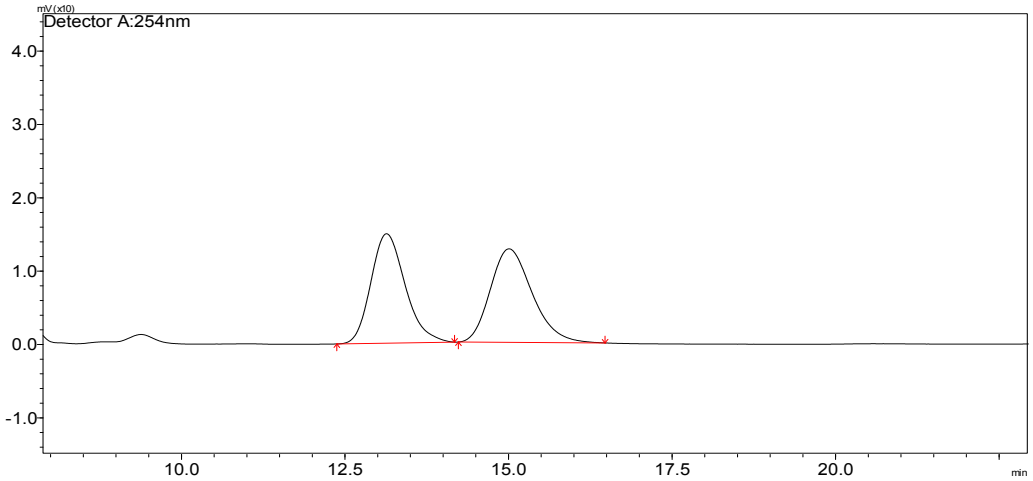
Peak	Ret. Time	Area	Height	Area%	Height%
1	11.963	74132	1610	49.903	71.969
2	25.861	74420	627	50.097	28.031
Total		148553	2237	100.000	100.000



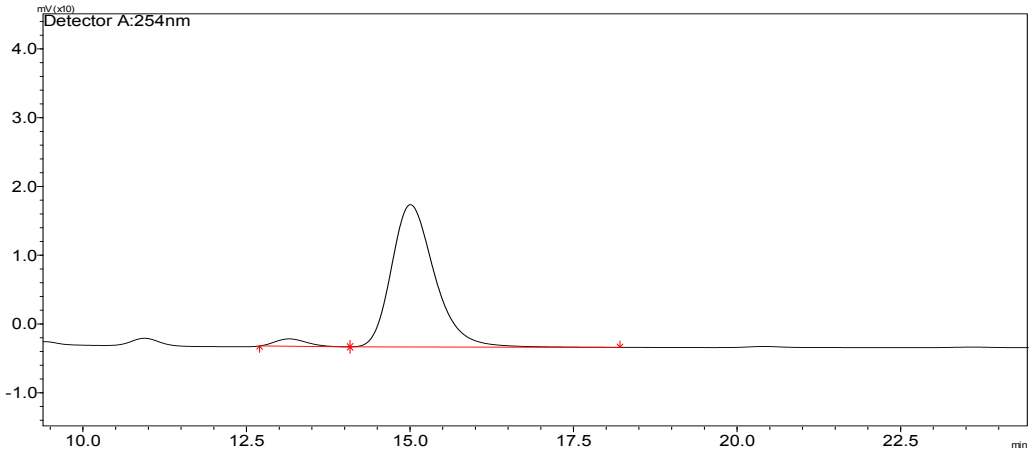
Peak	Ret. Time	Area	Height	Area%	Height%
1	11.563	58590	1526	4.595	12.505
2	24.993	1216507	10676	95.405	87.495
Total		1275097	12202	100.000	100.000



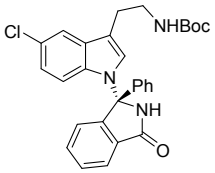
3q



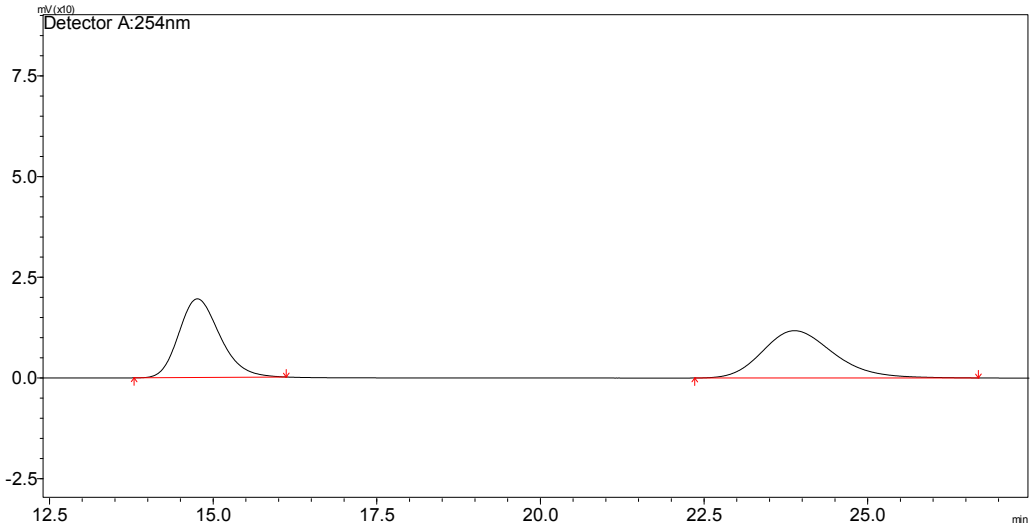
Peak	Ret. Time	Area	Height	Area%	Height%
1	13.131	543962	14925	48.927	53.923
2	15.003	567818	12753	51.073	46.077
Total		111780	27677	100.000	100.000



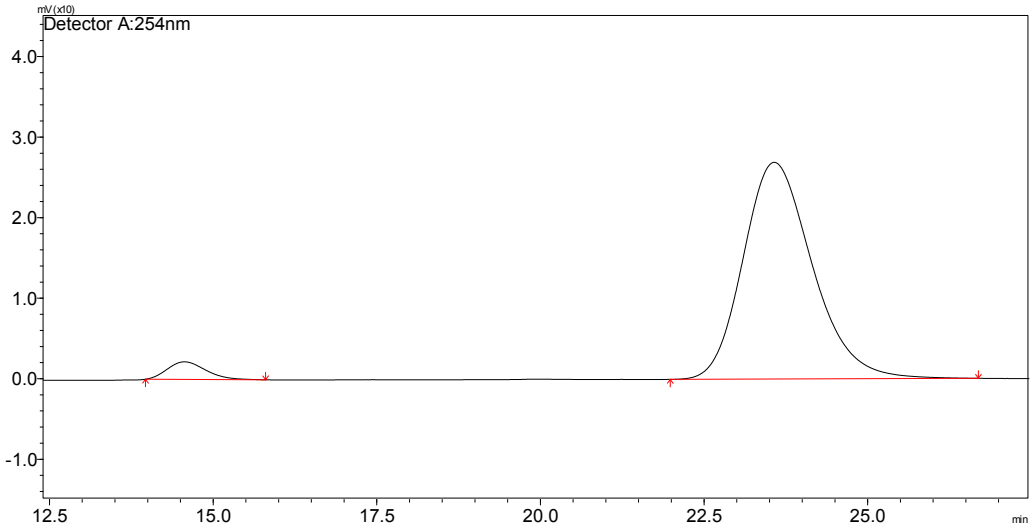
Peak	Ret. Time	Area	Height	Area%	Height%
1	13.149	35832	1077	3.644	4.944
2	15.002	947474	20700	96.356	95.056
Total		983306	21776	100.000	100.000



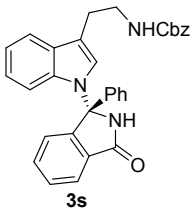
3r



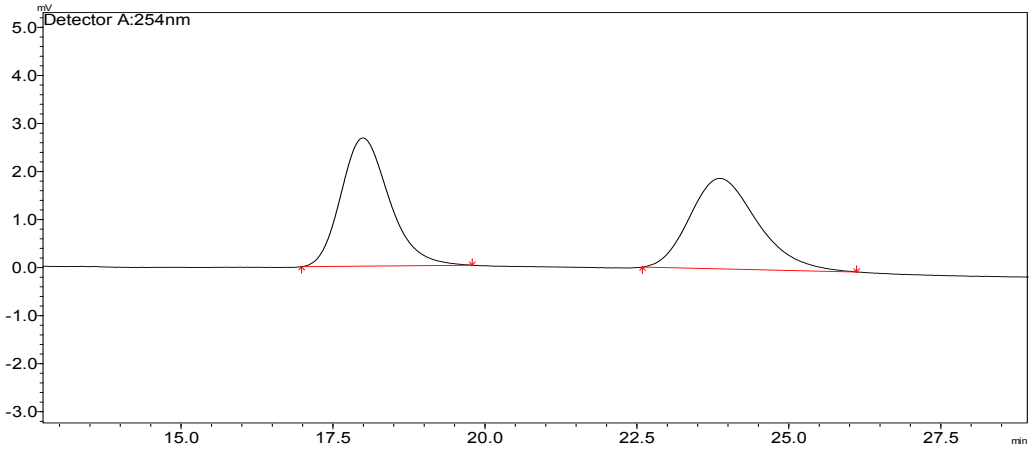
Peak	Ret. Time	Area	Height	Area%	Height%
1	14.755	855849	19540	49.033	62.468
2	23.878	889621	11740	50.967	37.532
Total		1745470	31280	100.000	100.000



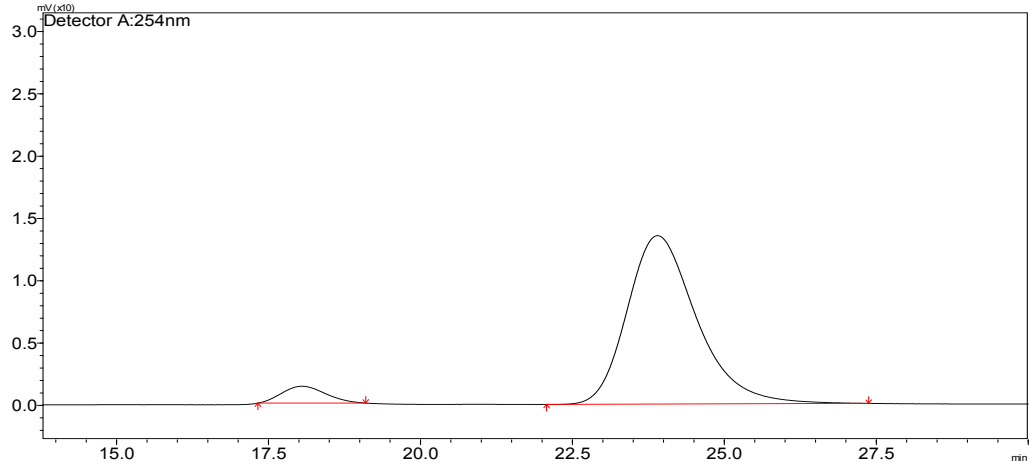
Peak	Ret. Time	Area	Height	Area%	Height%
1	14.557	89249	2185	4.318	7.512
2	23.568	1977713	26907	95.682	92.488
Total		2066962	29092	100.000	100.000



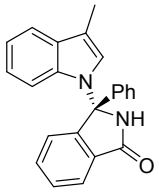
3s



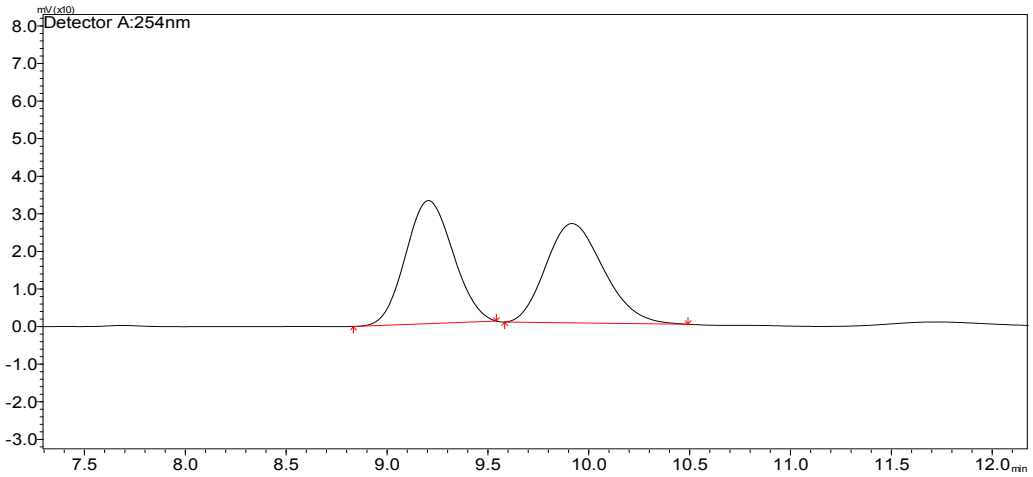
Peak	Ret. Time	Area	Height	Area%	Height%
1	17.987	147767	2668	50.257	58.637
2	23.850	146257	1882	49.743	41.363
Total		294024	4550	100.000	100.000



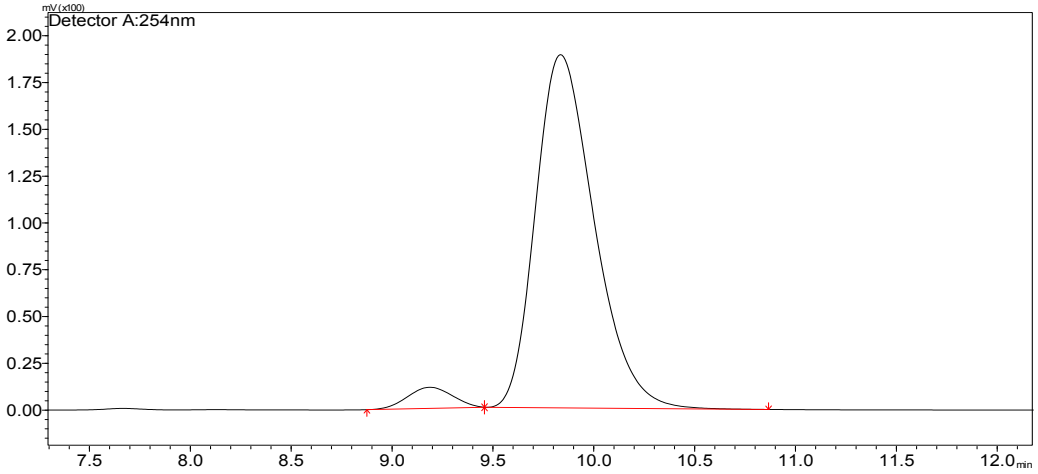
Peak	Ret. Time	Area	Height	Area%	Height%
1	18.046	67729	1354	5.928	9.106
2	23.897	1074811	13518	94.072	90.894
Total		1142540	14872	100.000	100.000



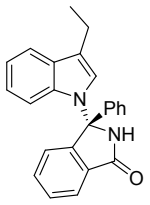
3t



Peak	Ret. Time	Area	Height	Area%	Height%
1	9.201	537808	32764	50.523	55.347
2	9.912	526679	26434	49.477	44.653
Total		1064487	59197	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	9.184	174690	11301	4.378	5.650
2	9.831	3815384	188703	95.622	94.350
Total		3990074	200004	100.000	100.000



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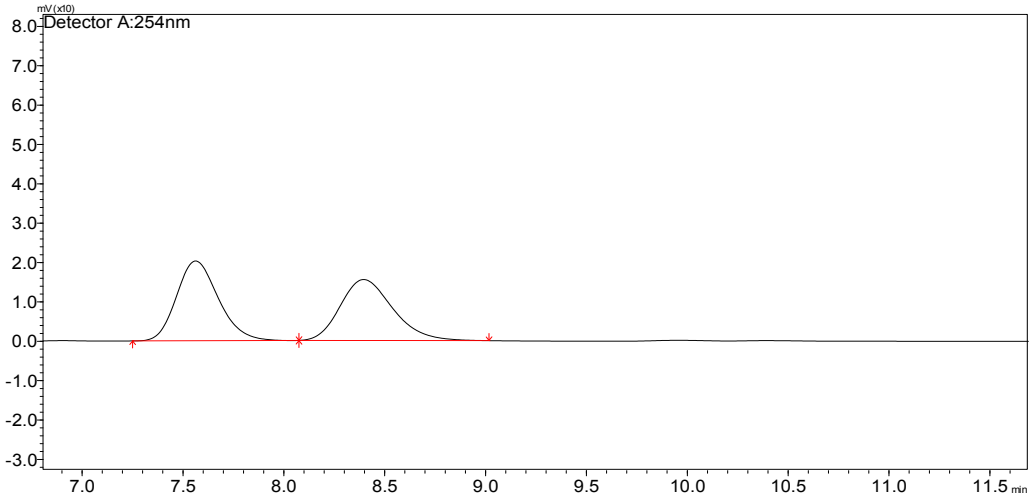
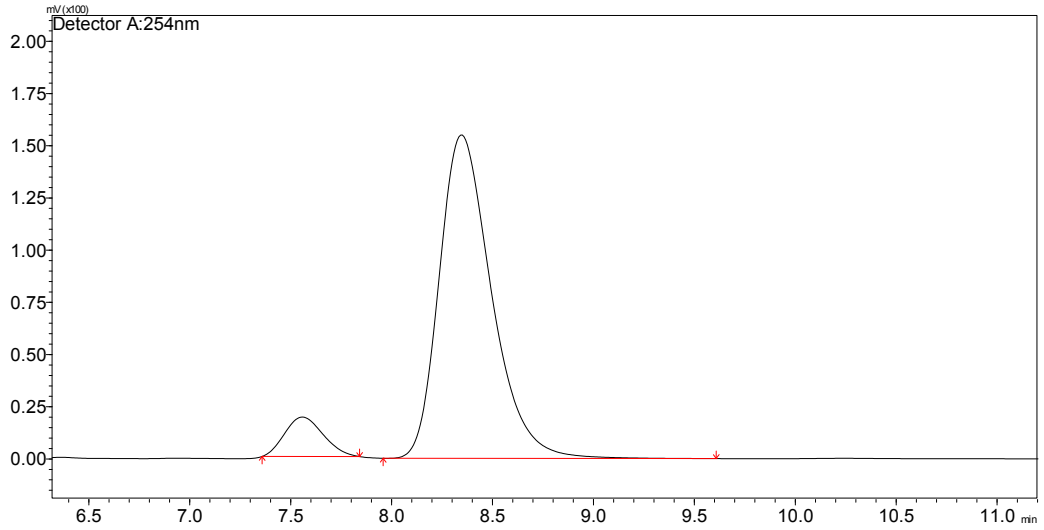
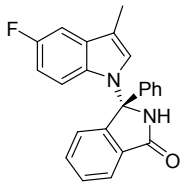


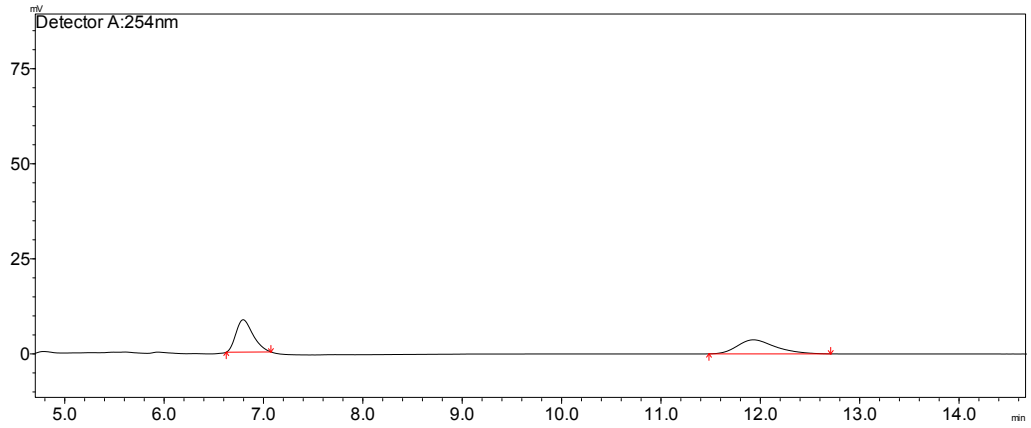
Peak	Ret. Time	Area	Height	Area%	Height%
1	7.558	291870	20246	50.982	56.650
2	8.391	280625	15493	49.018	43.350
Total		572495	35739	100.000	100.000



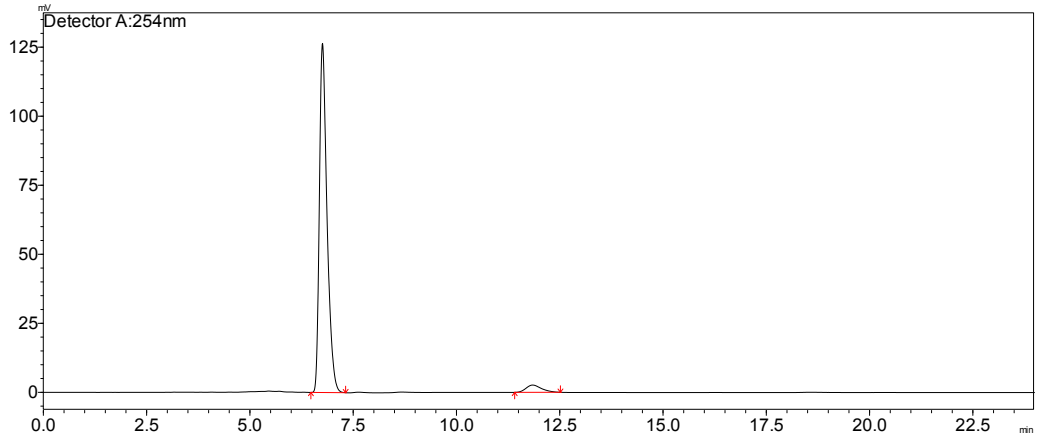
Peak	Ret. Time	Area	Height	Area%	Height%
1	7.553	250743	18898	8.261	10.878
2	8.342	2784562	154832	91.739	89.122
Total		3035305	173730	100.000	100.000



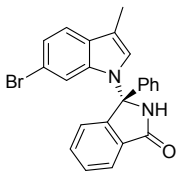
3v



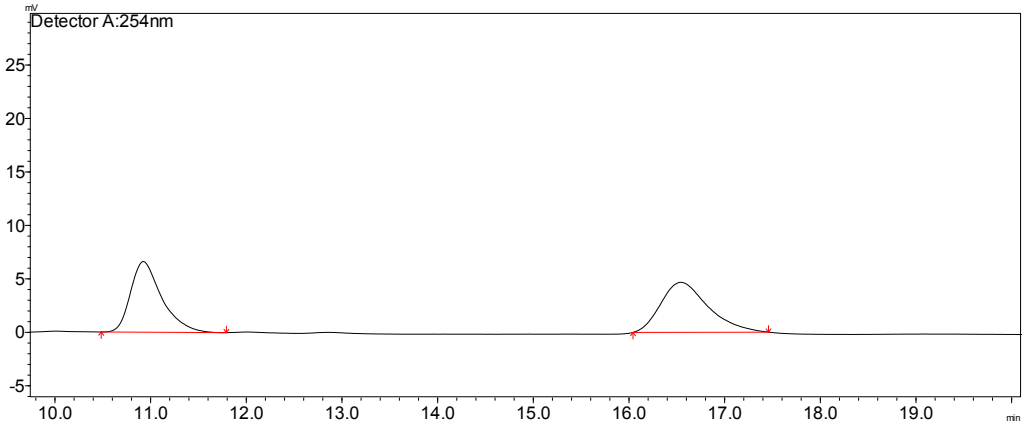
Peak	Ret. Time	Area	Height	Area%	Height%
1	6.791	101758	8516	50.877	69.743
2	11.927	98252	3695	49.123	30.257
Total		200010	12211	100.000	100.000



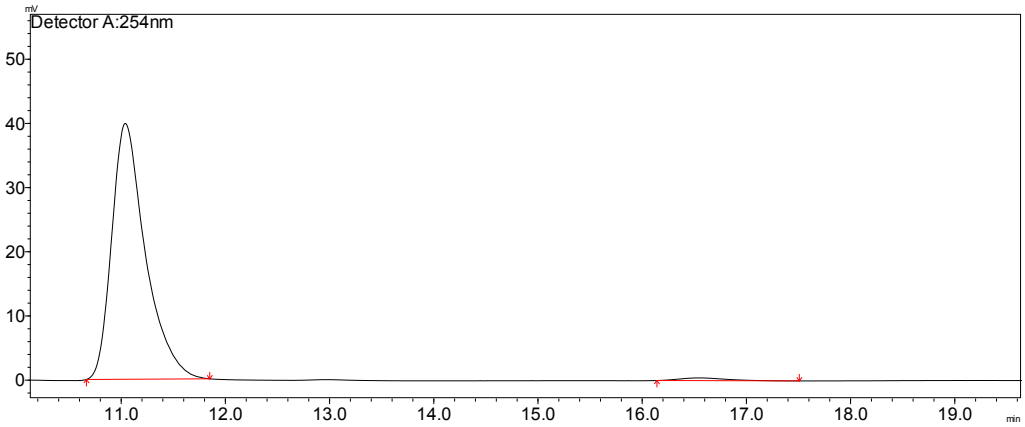
Peak	Ret. Time	Area	Height	Area%	Height%
1	6.752	1627814	126433	95.927	97.951
2	11.839	69124	2645	4.073	2.049
Total		1696938	129078	100.000	100.000



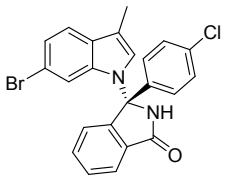
3w



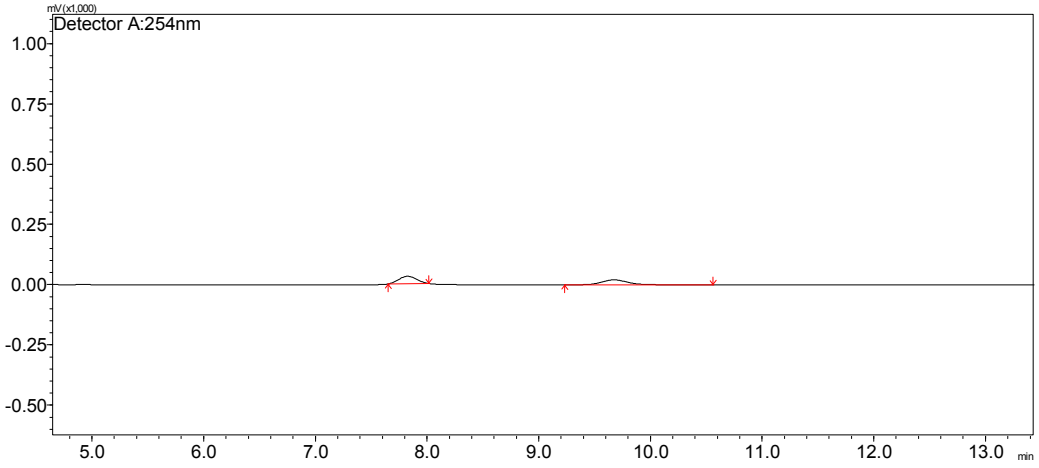
Peak	Ret. Time	Area	Height	Area%	Height%
1	10.919	149548	6608	48.122	58.535
2	16.536	161218	4681	51.878	41.465
Total		310766	11290	100.000	100.000



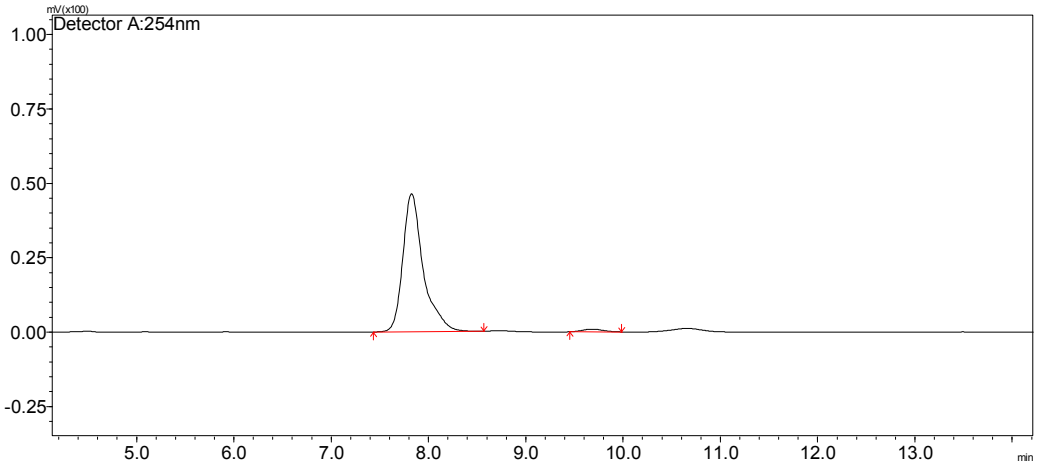
Peak	Ret. Time	Area	Height	Area%	Height%
1	11.035	894913	39863	98.555	98.954
2	16.529	13123	421	1.445	1.046
Total		908036	40285	100.000	100.000



3x



Peak	Ret. Time	Area	Height	Area%	Height%
1	7.820	342790	30907	50.981	60.074
2	9.670	329593	20541	49.019	39.926
Total		672383	51449	100.000	100.000



Peak	Ret. Time	Area	Height	Area%	Height%
1	7.821	679108	46419	98.070	98.063
2	9.675	13367	917	1.930	1.937
Total		692476	47336	100.000	100.000