Pd-Catalyzed Heck Cyclization and *in-situ* Hydrocarboxylation or Hydromethenylation via A Borrowing Hydrogen Strategy

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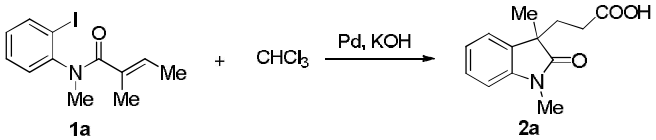
Supporting Information

General Information. All reactions were carried out under a nitrogen atmosphere unless the reaction procedure states otherwise. Tetrahydrofuran (THF) was distilled from sodium-benzophenone in a continuous still under an atmosphere of N_2. Dioxane was distilled from sodium-benzophenone under an atmosphere of N_2. Dichloromethane were distilled from calcium hydride in a still under and atmosphere of nitrogen. Room temperature reactions were carried out between 20-25 °C. Flash column chromatography was performed using 40-63 μm silica gel as the stationary phase. ^{1}H and ^{13}C NMR spectra were recorded on a Bruker AC-400 FT spectrometer using solvent $CDCl_3$ residue as an internal reference (7.26 ppm for ^{1}H NMR and 77.00 ppm for ^{13}C NMR). Electron spray ionization (ESI) mass spectrometry data were acquired using a Thermo LTQ Orbitrap XL instrument.

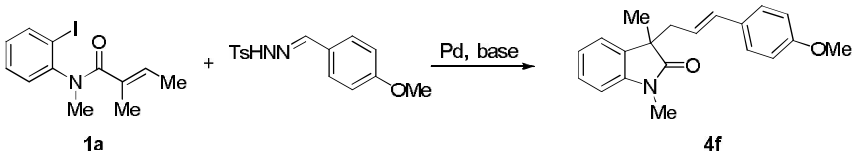
Table S1. Full Results for Reaction Condition Optimization[a]



entry	Pd	lligand	solvent	$CHCl_3$ (equiv)	T/°C	yield (%)
1	$Pd(PPh_3)_2Cl_2$	none	dioxane/H_2O	4.0	80	13
2	$Pd(OAc)_2$	TFP[b]	dioxane/H_2O	4.0	80	57
3	$Pd(OAc)_2$	TFP	dioxane/H_2O	4.0	60	67
4	$Pd(OAc)_2$	TFP	THF	4.0	60	Trace
5	$Pd(PPh_3)_2Cl_2$	none	THF/H_2O	4.0	60	<10
6	$Pd(PPh_3)_2Cl_2$	PPh_3	THF/H_2O	4.0	60	<10
7	$Pd(OAc)_2$	TFP	dioxane/H_2O	4.0	90	75
8	$Pd(OAc)_2$	PPh_3	dioxane/H_2O	4.0	90	65
9	$Pd(OAc)_2$	PPh_3	dioxane/H_2O	4.0	80	52
10	$Pd(OAc)_2$	PPh_3	dioxane/H_2O	4.0	70	68
11	$Pd(OAc)_2$	TFP	dioxane/H_2O	4.0	80	79
12	$Pd(OAc)_2$	TFP	dioxane/H_2O	8.0	80	80
13	$Pd(OAc)_2$	TFP	dioxane/H_2O	0.2 ml	80	16

[a] The reaction was carried out at 0.10 mmol scale of iodide, Pd (5 mol%), ligand (15 mol%), KOH (8.0 equiv) in 1.0 ml of solvent for 1 h; dioxane/H_2O = 1:4, THF/H_2O = 1:4. [b] TFP = tri(2-furyl)phosphine (5 mol%).

Table S2. Conditions Optimization for the Reaction with Hydrazones[a]

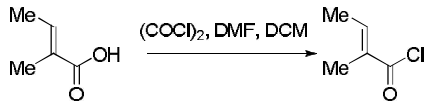


entry	Pd	ligand (mol %)	solvent	base	T/°C	yield (%)
1	$Pd(OAc)_2$	PPh_3 (10)	MeCN	^{t}BuOLi	80	<10
2	$Pd(OAc)_2$	PPh_3 (5)	MeCN	^{t}BuOLi	80	45
3	$Pd(OAc)_2$	PPh_3 (2.5)	MeCN	^{t}BuOLi	80	50
4	$Pd(OAc)_2$	PPh_3 (1)	MeCN	^{t}BuOLi	80	42
5	$Pd(OAc)_2$	PPh_3 (5)	dioxane	KOH	80	<10
6	$Pd(OAc)_2$	PPh_3 (5)	toluene	^{t}BuOLi	80	<10
7	$PdCl_2$	PPh_3 (5)	MeCN	^{t}BuOLi	80	61
8	$Pd(MeCN)_2Cl_2$	PPh_3 (5)	MeCN	^{t}BuOLi	80	49
9	$Pd(PPh_3)_2Cl_2$	none	MeCN	^{t}BuOLi	80	66
10	$Pd(PPh_3)_2Cl_2$	none	MeCN	^{t}BuOK	80	<10
11	$Pd(PPh_3)_2Cl_2$	none	MeCN	^{t}BuONa	80	42
12	$Pd(PPh_3)_2Cl_2$	none	dioxane	^{t}BuOLi	80	77
13	$Pd(PPh_3)_2Cl_2$	none	THF	^{t}BuOLi	80	92
14	$Pd(PPh_3)_2Cl_2$	none	DME	^{t}BuOLi	80	84
15	$Pd(PPh_3)_2Cl_2$	none	THF	^{t}BuOLi	70	88

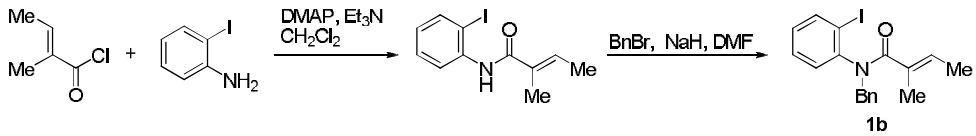
[a] The reaction was carried out at 0.10 mmol scale of iodide, Pd (5 mol%), base (3.0 equiv) in 1.5 ml of solvent at indicated temperature for 1 h.

Compounds **1a** was prepared following the literature [1] .

Preparation of 1b:



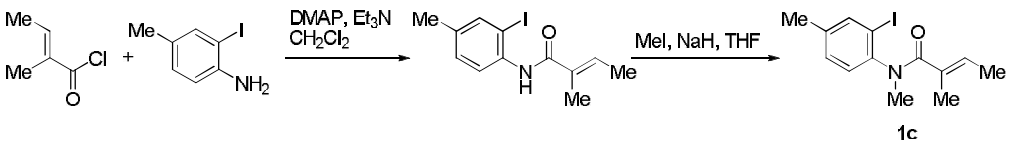
Oxalyl dichloride (0.61 ml, 7.20 mmol, 2.4 equiv) was added to a solution of (*E*)-2-methylbut-2-enoic acid (0.36 g, 3.60 mmol, 1.2 equiv) with a drop of DMF in CH_2Cl_2 (10.0 ml) at room temperature dropwise. The reaction was maintained at room temperature for 30 min and the excess oxalyl dichloride and CH_2Cl_2 was carefully removed by evaporation.



The above acid chloride in CH_2Cl_2 (10.0 ml) was added to a mixture of 2-iodoaniline (0.66 g, 2.00 mmol, 1.0 equiv), DMAP (18.3 mg, 0.15 mmol, 0.05 equiv), Et_3N (0.84 ml, 6.00 mmol, 2.0 equiv) in CH_2Cl_2 (10.0 ml) at -20 °C dropwise. After stirring at -20 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.36 g, 60% in mineral oil, 9.00 mmol, 3.0 equiv) was added to a solution of the above amide in DMF (10.0 ml) at room temperature for portions. After stirring for 20 min at room temperature BnBr (0.53 ml, 4.50 mmol, 1.5 equiv) was added dropwise and the reaction mixture was allowed to stir for additional 3 hours. The reaction was quenched by the addition of water, diluted with ethyl acetate (100 ml), washed with water. The organic layer was dried over Na_2SO_4, concentrated and purified by column chromatography on silica (hexanes: ethyl acetate = 20: 1) to afford **1b** (0.41 g, 1.04 mmol, 35% three steps). Solid, 63.1 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.86 (dd, J_1 = 8.0 Hz, J_2 = 1.6 Hz, 1H), 7.26-7.16 (m, 5H), 7.12 (td, J_1 = 7.8 Hz, J_2 = 1.2 Hz, 1H), 6.92 (td, J_1 = 7.6 Hz, J_2 = 1.6 Hz, 1H), 6.66 (d, J = 7.6 Hz, 1H), 5.76 (bs, 1H), 5.64 (bd, J = 12.8 Hz, 1H), 4.14 (bd, J = 14.0 Hz, 1H), 1.65 (s, 3H), 1.43 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.8, 144.7, 140.0, 137.0, 132.1, 131.4, 129.9, 129.3, 128.9, 128.5, 128.3, 127.4, 99.8, 51.8, 14.2, 13.3. HRMS (ESI) calcd. for $C_{18}H_{19}NOI^+$ $(M+H)^+$ 392.0506, found 392.0507.

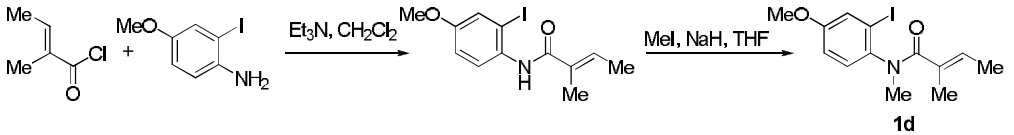
Preparation of 1c:



The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.20 g, 2.00 mmol, 1.2 equiv)] in CH_2Cl_2 (6.0 ml) was added to a mixture of 2-iodo-4-methylaniline (0.38 g, 1.60 mmol, 1.0 equiv), DMAP (9.8 mg, 0.08 mmol, 0.05 equiv), Et_3N (0.45 ml, 3.20 mmol, 2.0 equiv) in CH_2Cl_2 (6.0 ml) at -20 °C dropwise. After stirring at -20 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.19 g, 60% in mineral oil, 4.80 mmol, 3.0 equiv) was added to a solution of the above amide in THF (10.0 ml) at 0 °C for portions. After stirring at 0 °C for 20 min MeI (0.21 ml, 3.20 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at 50 °C for 2 hours. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with brine, dried over Na_2SO_4, concentrated. The crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1c** (0.26 g, 0.78 mmol, 49% three steps) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.68 (s, 1H), 7.11 (d, J = 7.2 Hz, 1H), 6.99 (d, J = 8.4 Hz, 1H), 5.80 (bs, 1H), 3.19 (s, 3H), 2.30 (s, 3H), 1.60 (bs, 3H), 1.45 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.3, 144.5 (bs), 140.4, 139.1, 132.2, 130.0, 128.9, 126.2, 98.7, 37.1 (bs), 20.4, 14.0, 13.3. HRMS (ESI) calcd. for $C_{13}H_{17}NOI^+$ $(M+H)^+$ 330.0349, found 330.0341.

Preparation of 1d:

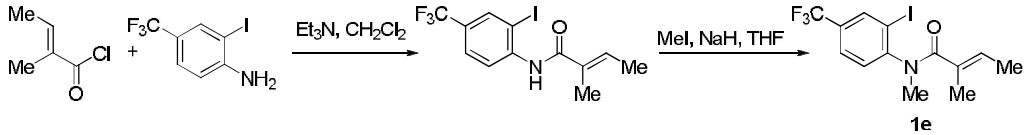


The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.60 g, 6.00 mmol, 1.2 equiv)] in CH_2Cl_2 (10.0 ml) was added to a mixture of 2-iodo-4-methoxyaniline [2] (1.25 g, 5.00 mmol, 1.0 equiv) in CH_2Cl_2 (10.0 ml) at 0 °C, followed by Et_3N (2.8 ml, 20.00 mmol, 4.0 equiv) added to the mixture dropwise. After stirring at 0 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.40 g, 60% in mineral oil, 10.00 mmol, 2.0 equiv) was added to a solution of the above amide in THF (20.0 ml) at 0 °C for portions. After stirring for 30 min at 0 °C MeI (0.62 ml, 10.00 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at room temperature overnight. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with brine, dried over Na_2SO_4, concentrated. The crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1d** (1.02 g, 3.95 mmol, 59% three steps). Solid, 107.8-112.3 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 735 (d, J = 2.0 Hz, 1H), 7.02 (d, J = 8.0 Hz, 1H), 6.85 (d, J = 7.6 Hz, 1H), 5.80 (bs, 1H), 3.79 (s, 3H), 3.18 (s, 3H), 1.60 (bs, 3H), 1.47 (bs, 3H); ^{13}C NMR

(100 MHz, $CDCl_3$): δ 173.4, 158.5, 140.0, 132.3, 129.7, 129.5, 124.5, 115.0, 99.3, 55.6, 37.2, 14.1, 13.3. HRMS (ESI) calcd. for $C_{13}H_{16}INO_2Na^+$ $(M+Na)^+$ 368.0123, found 368.0121.

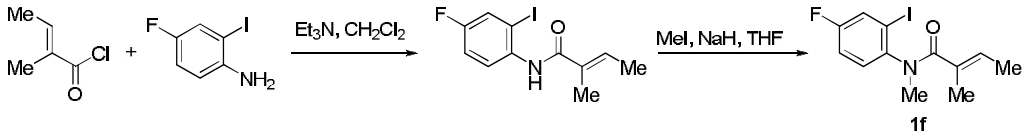
Preparation of 1e:



The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.60 g, 6.00 mmol, 1.2 equiv)] in CH_2Cl_2 (10.0 ml) was added to a mixture of 2-iodo-4-(trifluoromethyl)aniline (1.44 g, 5.00 mmol, 1.0 equiv) in CH_2Cl_2 (10.0 ml) at 0 °C, followed by Et_3N (2.8 ml, 20.00 mmol, 4.0 equiv) added to the mixture dropwise. After stirring at 0 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.40 g, 60% in mineral oil, 10.00 mmol, 2.0 equiv) was added to a solution of the above amide in THF (20.0 ml) at 0 °C for portions. After stirring for 30 min at 0 °C MeI (0.62 ml, 10.00 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at room temperature overnight. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with brine, dried over Na_2SO_4, concentrated. The crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 7: 1 to 5: 1) to afford **1e** (0.36 g, 0.93 mmol, 19% three steps). Solid, 69.8-71.5 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.12 (s, 1H), 7.61 (d, J = 7.6 Hz, 1H), 7.24 (d, J = 8.4 Hz, 1H), 5.81 (bs, 1H), 3.24 (s, 3H), 1.68 (bs, 3H), 1.51 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.9, 150.6, 137.1 (q, J = 3.6 Hz), 131.8, 131.1, 130.6 (d, J = 33.1 Hz), 129.4, 126.4 (q, J = 2.9 Hz), 122.5 (q, J = 271.0 Hz), 98.8, 37.1, 14.0, 13.4; ^{19}F NMR (376 MHz, $CDCl_3$): δ -62.6. HRMS (ESI) calcd. for $C_{13}H_{13}F_3INONa^+$ $(M+Na)^+$ 405.9892, found 405.9892.

Preparation of 1f:

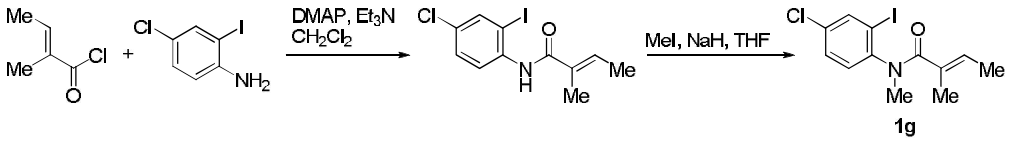


The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.60 g, 6.00 mmol, 1.2 equiv)] in CH_2Cl_2 (10.0 ml) was added to a mixture of 2-iodo-4-fluoroaniline (1.44 g, 5.00 mmol, 1.0 equiv) in CH_2Cl_2 (10.0 ml) at 0 °C, followed by Et_3N (2.8 ml, 20.00 mmol, 4.0 equiv) added to the mixture dropwise. After stirring at 0 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed

with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.40 g, 60% in mineral oil, 10.00 mmol, 2.0 equiv) was added to a solution of the above amide in THF (20.0 ml) at 0 °C for portions. After stirring for 30 min at 0 °C MeI (0.62 ml, 10.00 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at room temperature overnight. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with brine, dried over Na_2SO_4, concentrated. The crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1f** (0.42 g, 1.26 mmol, 25% three steps). Solid, 95.7-98.0 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.58 (bd, J = 5.2 Hz, 1H), 7.21-6.96 (m, 2H), 5.79 (bs, 1H), 3.20 (s, 3H), 1.63 (bs, 3H), 1.48 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.1, 160.4 (d, J = 252.0 Hz), 143.5 (bs), 131.9, 130.2, 129.8, 126.6 (d, J = 24.0 Hz), 116.2 (d, J = 22.0 Hz), 98.7, 37.0 (bs), 14.0, 13.2; ^{19}F NMR (376 MHz, $CDCl_3$) : δ -112.6. HRMS (ESI) calcd. for $C_{12}H_{14}FINO^+$ $(M+H)^+$ 334.0104, found 334.0100.

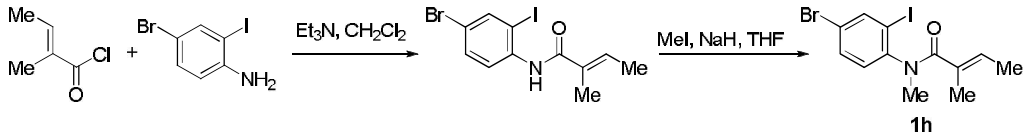
Preparation of 1g:



The crude acid chloride [prepared as above from (E)-2-methylbut-2-enoic acid (0.24 g, 2.40 mmol, 1.2 equiv)] in CH_2Cl_2 (8.0 ml) was added to a mixture of 4-chloro-2-iodoaniline (0.51 g, 2.00 mmol, 1.0 equiv), DMAP (12.2 mg, 0.10 mmol, 0.05 equiv), Et_3N (0.56 ml, 4.00 mmol, 2.0 equiv) in CH_2Cl_2 (8.0 ml) at -20 °C dropwise. After stirring at -20 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.24 g, 60% in mineral oil, 6.00 mmol, 3.0 equiv) was added to a solution of the above amide in THF (10.0 ml) at 0 °C for portions. After stirring for 20 min at 0 °C MeI (0.25 ml, 4.00 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at 50 °C for 3 hours. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with brine, dried over Na_2SO_4, concentrated. The crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1g** (0.24 g, 0.69 mmol, 34% three steps). Solid, 76.3-81.0 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.84 (d, J = 2.4 Hz, 1H), 7.30 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H), 7.05 (d, J = 8.0 Hz, 1H), 5.78 (bs, 1H), 3.18 (s, 3H), 1.64 (bs, 3H), 1.48 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.1, 145.0 (bs), 138.4, 132.5, 131.0, 129.6 (bs), 128.8, 128.5, 98.2, 36.1 (bs), 13.1, 12.4. HRMS (ESI) calcd. for $C_{12}H_{14}NOI^{35}Cl^+$ $(M+H)^+$ 349.9803, found 349.9797.

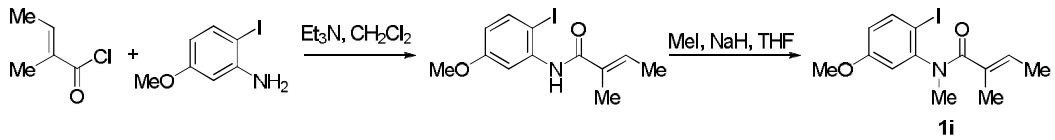
Preparation of 1h:



The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.33 g, 3.30 mmol, 1.1 equiv)] in CH_2Cl_2 (7.0 ml) was added to a mixture of 4-bromo-2-iodoaniline (0.88 g, 3.00 mmol, 1.0 equiv) in CH_2Cl_2 (7.0 ml) at 0 °C dropwise, followed by Et_3N (1.60 ml, 12.00 mmol, 4.0 equiv) added to the mixture dropwise. After stirring at -20 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.24 g, 60% in mineral oil, 6.00 mmol, 2.0 equiv) was added to a solution of the above amide in DMF (10.0 ml) at 0 °C for portions. After stirring for 30 min at room temperature MeI (0.37 ml, 6.00 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at room temperature overnight. The reaction was quenched by the addition of water, diluted with ethyl acetate, washed with water and brine, dried over Na_2SO_4, concentrated. The crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1h** (0.42 g, 1.07 mmol, 35% three steps). Solid, 95.1-97.3 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.01 (d, J = 2.0 Hz, 1H), 7.46 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H), 7.00 (d, J = 8.4 Hz, 1H), 5.80 (bs, 1H), 3.20 (s, 3H), 1.65 (bs, 3H), 1.50 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.8, 146.3 (bs), 141.9, 132.3, 131.8, 130.5, 130.1, 121.2, 99.6, 36.9 (bs), 14.0, 13.3. HRMS (ESI) calcd. for $C_{12}H_{13}{}^{81}BrINONa^+$ $(M+Na)^+$ 415.9123, found 415.9122.

Preparation of 1i:

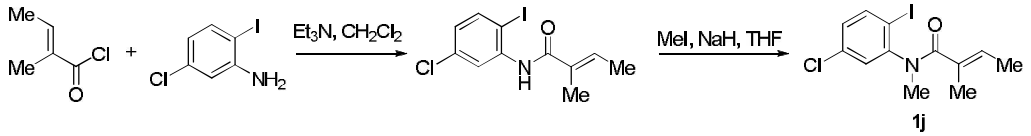


The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.44 g, 4.40 mmol, 1.5 equiv)] in CH_2Cl_2 (10.0 ml) was added to a mixture of 2-iodo-5-methoxyaniline [3] (0.72 g, 2.90 mmol, 1.0 equiv) in CH_2Cl_2 (10.0 ml) at 0 °C, followed by Et_3N (0.81 ml, 5.80 mmol, 2.0 equiv) added to the mixture dropwise. After stirring at 0 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.15 g, 60% in mineral oil, 3.80 mmol, 1.3 equiv) was added to a solution of the above amide in THF (15.0 ml) at 0 °C for portions. After stirring for 30 min at 0 °C MeI (0.36 ml, 5.80 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at room temperature overnight. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with brine,

dried over Na_2SO_4, concentrated. The crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 5: 1) to afford **1i** (0.34 g, 0.98 mmol, 34% three steps). Solid, 82.7-89.5 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.71 (d, J = 8.8 Hz, 1H), 6.70 (bs, 1H), 6.60 (d, J = 7.2 Hz, 1H), 5.84 (bs, 1H), 3.77 (s, 3H), 3.22 (bs, 3H), 1.66 (bs, 3H), 1.49 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.2, 160.6, 148.0, 140.2, 132.2, 130.2, 115.4, 115.1, 87.3, 55.6, 37.1, 14.1, 13. 4. HRMS (ESI) calcd. for $C_{13}H_{16}INO_2Na^+$ $(M+Na)^+$ 368.0123, found 368.0124.

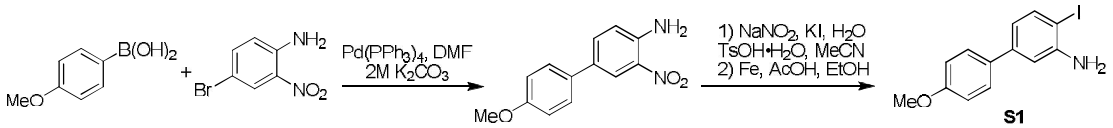
Preparation of 1j:



The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.60 g, 6.00 mmol, 1.2 equiv)] in CH_2Cl_2 (10.0 ml) was added to a mixture of 5-chloro-2-iodoaniline (1.27 g, 5.00 mmol, 1.0 equiv) in CH_2Cl_2 (10.0 ml) at 0 °C, followed by Et_3N (2.8 ml, 20.00 mmol, 4.0 equiv) added to the mixture dropwise. After stirring at 0 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was used in next step without further purification.

Sodium hydride (0.40 g, 60% in mineral oil, 10.00 mmol, 2.0 equiv) was added to a solution of the above amide in THF (20.0 ml) at 0 °C for portions. After stirring for 30 min at 0 °C MeI (0.62 ml, 10.00 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at room temperature overnight. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with brine, dried over Na_2SO_4, concentrated. The crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1j** (0.60 g, 1.72 mmol, 34% three steps). Solid, 103.3-107.8 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.78 (d, J = 8.4 Hz, 1H), 7.14 (s, 1H), 6.99 (d, J = 7.6 Hz, 1H), 5.81 (bs, 1H), 3.21 (s, 3H), 1.68 (bs, 3H), 1.51 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.9, 148.3 (bs), 140.7, 134.9, 131.8, 130.7, 129.5, 129.1, 96.3, 37.0 (bs), 14.0, 13.4. HRMS (ESI) calcd. for $C_{12}H_{13}{}^{35}ClINONa^+$ $(M+Na)^+$ 371.9628, found 371.9623.

Preparation of 1k:

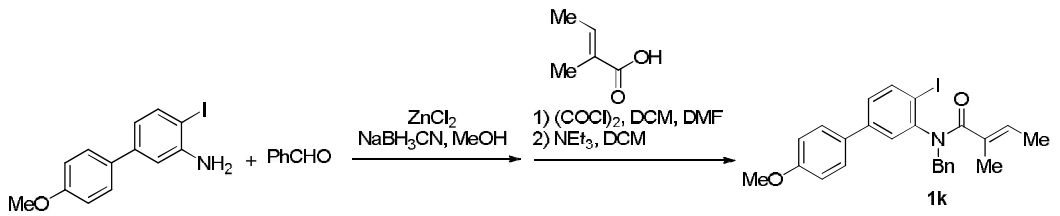


A mixture of 4-methoxyphenylboronic acid (3.65 g, 24.00 mmol. 1.2 equiv), 4-bromo-2-nitroaniline (4.34 g, 20.00 mmol. 1.0 equiv), $Pd(PPh_3)_4$ (1.15 g, 1.00 mmol, 0.05 equiv) in 2 M K_2CO_3 (aq.) (30.0 ml) and DMF (30.0 ml) was heated at 100 °C for 3 days. Then the mixture was filtered through a pad of celite and extracted with ethyl acetate (300 ml), washed with water and brine, dried over Na_2SO_4. After

filtration and concentration, the crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford 4'-methoxy-3-nitrobiphenyl-4-amine (4.59 g, 18.80 mmol, 94%).

To a solution of *p*-TsOH·H_2O (8.56 g, 45.00 mmol, 3.0 equiv) in MeCN (200 mL) was added the aromatic amine (3.66 g, 15.00 mmol, 1.0 equiv) and stirred for 2 min. After being cooled to 10-15 °C the resulting suspension was added a solution of $NaNO_2$ (2.07 g, 30.00 mmol, 2.0 equiv) and KI (6.23 g, 37.50 mmol, 2.5 equiv) in H_2O (25.0 mL) gradually. The reaction mixture was stirred for 10 min before warmed to room temperature and stirred overnight. To the reaction mixture was added H_2O, saturated $NaHCO_3$ and $Na_2S_2O_3$. After filtered through a pad of celite, extracted with ethyl acetate and dried over Na_2SO_4. After filtration and concentration, the crude iodide was obtained [4] .

Iron power (4.12 g, 75.00 mmol, 5.0 equiv) was added to a mixture of the crude iodide in AcOH (50.0 ml) and EtOH (50.0 ml) at room temperature. The mixture was stirred at 100 °C for 1.3 hours. After cooling to room temperature, AcOH and EtOH were removed by evaporation and the residue was neutralized with saturated $NaHCO_3$. Then the mixture was filtered through a pad of celite, extracted with ethyl acetate and dried over Na_2SO_4. After filtration and concentration, the residue was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **S1** [5] (3.31 g, 10.2 mmol, 68%). Solid, 160.0-162.8 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.65 (d, J = 8.4 Hz, 1H), 7.47 (d, J = 8.4 Hz, 2H), 7.00-6.87 (m, 3H), 6.68 (dd, J_1 = 8.0 Hz, J_2 = 2.0 Hz, 1H), 4.14 (bs, 2H), 3.84 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 159.3, 146.9, 142.3, 139.1, 132.8, 127.9, 118.7, 114.2, 112.9, 82.1, 55.3. HRMS (ESI) calcd. for $C_{13}H_{13}INO^+$ $(M+H)^+$ 326.0042, found 326.0034.

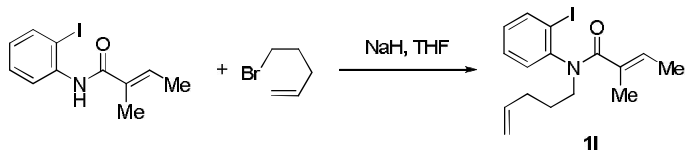


Sodium cyanoborohydride (0.23 g, 3.60 mmol. 1.2 equiv) was added to a stirred mixture of 4-iodo-4'-methoxybiphenyl-3-amine (0.98 g, 3.00 mmol, 1.0 equiv), zinc(II) chloride (0.49 g, 3.6 mmol, 1.2 equiv) and benzaldehyde (0.37 mL, 3.60 mmol, 1.2 equiv) in methanol (30.0 mL), and the reaction mixture was refluxed under nitrogen for 2 hours. After cooling to room temperature, the reaction mixture was diluted with 10% aq. NaOH (15 mL) and methanol was removed by evaporation. Then the mixture was extracted with ethyl acetate, dried over Na_2SO_4 and concentrated, the crude *N*-benzyl-4-iodo-4'-methoxybiphenyl-3-amine was used in next step without further purification. [6]

The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.36 g, 3.60 mmol, 1.2 equiv)] in CH_2Cl_2 (15.0 ml) was added to the crude *N*-benzyl-4-iodo-4'-methoxybiphenyl-3-amine in CH_2Cl_2 (15.0 ml) at 0 °C, followed by Et_3N (2.8 ml, 20.00 mmol, 4.0 equiv) added to the mixture dropwise. After stirring

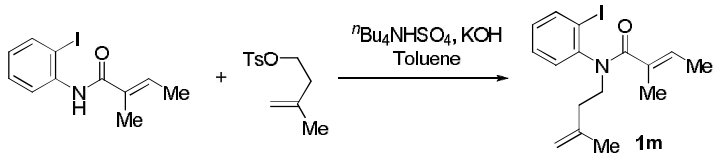
at 0 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with ethyl acetate, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1k** (0.30 g, 0.60 mmol, 20% three steps). Solid, 109.8-114.5 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.86 (d, J = 8.0 Hz, 1H), 7.32-7.20 (m, 5H), 7.20-7.13 (m, 2H), 7.10 (dd, J_1 = 8.4, J_2 = 2.0 Hz, 1H), 6.89 (d, J = 8.4 Hz, 2H), 6.76 (s, 1H), 5.83 (bs, 1H), 5.72 (d, J = 13.2 Hz, 1H), 4.14 (d, J = 13.2 Hz, 1H), 3.81 (s, 3H), 1.68 (bs, 3H), 1.44 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) rotaters : δ 174.3, 172.5, 159.3 (bs), 144.6, 141.1, 140.2, 139.8, 136.9, 135.4, 134.0, 132.0, 131.0, 129.7, 129.3, 129.2, 127.8, 127.5, 127.2, 126.8, 114.0, 97.0, 55.1, 51.5 (bs), 14.1, 13.8, 13.1, 13.0. HRMS (ESI) calcd. for $C_{25}H_{24}INO_2Na^+$ $(M+Na)^+$ 520.0749, found 520.0756.

Preparation of 1l:



Sodium hydride (0.34 g, 60% in mineral oil, 8.60 mmol, 2.0 equiv) was added to a solution of the amide [7] (1.20 g, 4.30 mmol, 1.0 equiv) in THF (20.0 ml) and DMF (3.0 ml) at 0 °C for portions. After stirring for 30 min at 0 °C 5-bromopent-1-ene (0.76 g, 5.10 mmol, 1.2 equiv) was added dropwise and the reaction mixture was allowed to stir at 65 °C for 24 hours. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with water and brine, dried over Na_2SO_4 and concentrated. The residue was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1l** (1.29 g, 3.50 mmol, 81%) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.87 (d, J = 8.0 Hz, 1H), 7.32 (t, J = 7.2 Hz, 1H), 7.09 (d, J = 7.6 Hz, 1H), 6.98 (t, J = 7.2 Hz, 1H), 5.86-5.62 (m, 2H), 5.07-4.84 (m, 2H), 4.10 (bs, 1H), 3.23 (bs, 1H), 2.16-1.95 (m, 2H), 1.85-1.53 (m, 5H), 1.42 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.7, 145.3 (bs), 140.2, 137.7, 132.3, 130.8, 129.7, 128.8, 114.9, 100.0, 48.7 (bs), 31.1, 26.3, 14.1, 13.3. HRMS (HESI) calcd. for $C_{16}H_{21}NOI^+$ $(M+H)^+$ 370.0662, found 370.0664.

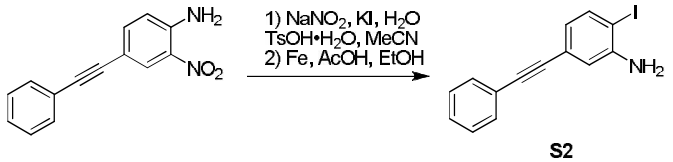
Preparation of 1m [8]:



Potassium hydroxide (0.36 g, 6.40 mmol, 2.0 equiv) and ^{n}Bu$_4$NHSO$_4$ (54.3 mg, 0.16 mmol, 0.05 equiv) was added to a solution of the amide (0.96 g, 3.20 mmol, 1.0 equiv) in toluene (20.0 ml) at room temperature successively. After stirred at room temperature for 3 hours, 3-methylbut-3-enyl 4-methylbenzenesulfonate (0.78 g, 3.20 mmol, 1.0 equiv) was added and the mixture was stirred at 80 °C for 6 hours. The

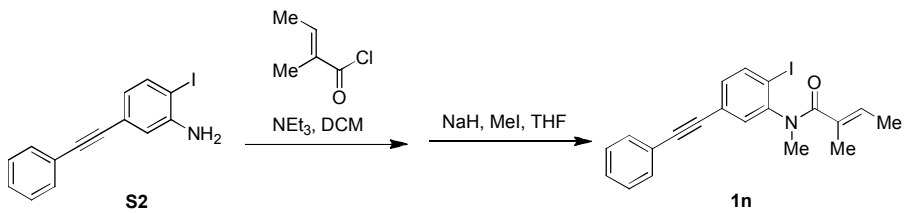
reaction was quenched by the addition of water, extracted with ethyl acetate, dried over Na_2SO_4 and concentrated. The residue was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1m** (0.68 g, 1.8 mmol, 58%). Solid, 45.7-47.9 °C (ethyl acetate/hexanes) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 (d, *J* = 6.8 Hz, 1H), 7.43-7.29 (m, 1H), 7.12 (d, *J* = 6.0 Hz, 1H), 7.06-6.92 (m, 1H), 5.72 (s, 1H), 4.76 (s, 1H), 4.71 (bs, 1H), 4.30 (bs, 1H), 3.30 (bs, 1H), 2.47-2.16 (m, 2H), 1.71 (bs, 3H), 1.62 (s, 3H), 1.43 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 172.8, 143.1, 140.2, 132.4, 131.0, 129.7, 128.85, 128.80, 128.76, 111.6, 100.0, 47.5, 35.1, 22.6, 14.1, 13.3. HRMS (ESI) calcd. for $C_{16}H_{20}INONa^+$ $(M+Na)^+$ 392.0487, found 392.0485.

Preparation of 1n:



To a solution of *p*-TsOH·H_2O (6.33 g, 33.3 mmol, 3.0 equiv) in MeCN (200 mL) was added to 2-nitro-4-(phenylethynyl)aniline [9] (2.65 g, 11.10 mmol, 1.0 equiv) and stirred for 2 min. After being cooled to 10-15 °C, the resulting suspension was added a solution of $NaNO_2$ (1.53 g, 22.20 mmol, 2.0 equiv) and KI (4.61 g, 27.80 mmol, 2.5 equiv) in H_2O (25.0 ml) gradually. The reaction mixture was stirred for 10 min before warmed to room temperature and stirred overnight and quenched by the addition of H_2O, saturated $NaHCO_3$ and $Na_2S_2O_3$. After filtered through a pad of celite, the filtrate was extracted with ethyl acetate, dried over Na_2SO_4. Filtration and concentration gave the crude iodide, which was used in next step without further purification.

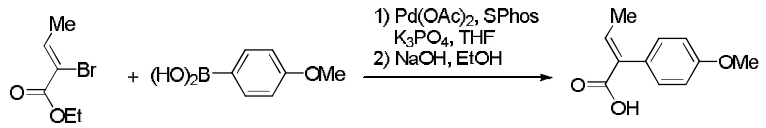
Iron power (3.10 g, 55.50 mmol, 5.0 equiv) was added to a mixture of the crude iodide in AcOH (40.0 ml) and EtOH (40.0 ml) at room temperature. The mixture was stirred at 100 °C for 1.5 hours. After cooling to room temperature AcOH and EtOH was removed by evaporation, the residue was neutralized with saturated $NaHCO_3$ and filtered through a pad of celite. The filtrate was extracted with ethyl acetate and dried over Na_2SO_4. After filtration and concentration, the residue was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **S2** (2.21 g, 6.90 mmol, 63%). Solid, 70.3 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.61 (d, *J* = 8.0 Hz, 1H), 7.56-7.45 (m, 2H), 7.41-7.29 (m, 3H), 6.91 (s, 1H), 6.65 (d, *J* = 8.0 Hz, 1H), 4.12 (bs, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 146.6, 138.9, 131.6, 128.4, 128.3, 124.2, 123.03, 123.01, 117.1, 89.8, 88.7, 84.2. HRMS (ESI) calcd. for $C_{14}H_{11}IN^+$ $(M+H)^+$ 319.9936, found 319.9934.



The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.45 g, 4.50 mmol, 1.5 equiv)] in CH_2Cl_2 (10.0 ml) was added to a mixture of **S2** (0.96 g, 3.0 mmol, 1.0 equiv) in CH_2Cl_2 (10.0 ml) at 0 °C, followed by Et_3N (0.84 ml, 6.00 mmol, 2.0 equiv) added to the mixture dropwise. After stirring at 0 °C for 30 min and room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed with brine and dried over Na_2SO_4. Filtration and concentration gave the crude amide, which was used in next step without further purification.

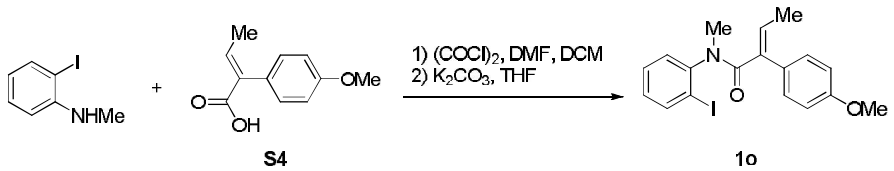
Sodium hydride (0.16 g, 60% in mineral oil, 3.90 mmol, 1.3 equiv) was added to a solution of the above amide in THF (15.0 ml) at 0 °C for portions. After stirring for 30 min at 0 °C MeI (0.37 ml, 6.00 mmol, 2.0 equiv) was added dropwise and the reaction mixture was allowed to stir at room temperature overnight. The reaction was quenched by the addition of water, extracted with ethyl acetate, washed with brine, dried over Na_2SO_4, concentrated and purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1) to afford **1n** (0.46 g, 1.10 mmol, 36% three steps). Solid, 111.6-116.0 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.84 (d, *J* = 8.0 Hz, 1H), 7.58-7.48 (m, 2H), 7.42-7.33 (m, 3H), 7.30 (s, 1H), 7.12 (d, *J* = 8.0 Hz, 1H), 5.83 (bs, 1H), 3.23 (s, 3H), 1.69 (bs, 3H), 1.50 (bs, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 173.0, 147.4 (bs), 140.1, 132.0, 131.9, 131.60, 131.56, 130.7, 128.8, 128.4, 124.7, 122.4, 99.0, 91.5, 87.4, 37.0 (bs), 14.2, 13.4. HRMS (ESI) calcd. for $C_{20}H_{18}INONa^+$ $(M+Na)^+$ 438.0331, found 438.0330.

Preparation of 1o:



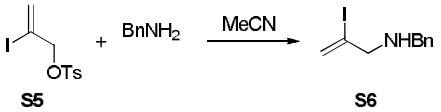
S3 **S4**

A solution of **S3** [10] (1.16 g, 6.00 mmol, 1.2 equiv), $Pd(OAc)_2$ (11.0 mg, 0.05 mmol, 1 mol %), SPhos (26.7 mg, 0.065 mmol, 1.3 mol %), 4-Methoxyphenylboronic acid (0.76 g, 5.00 mmol, 1.0 equiv), K_3PO_4 (1.38 g, 6.50 mmol, 1.3 equiv) in THF (40 ml) was stirred at 40 °C for 24 hours. The reaction mixture was diluted with water and extracted with ethyl acetate, dried over MgSO4, and concentrated in vacuo. The residue was purified by column chromatography on silica gel (hexanes: ethyl acetate = 50: 1) to afford the crude cross-coupling ester [11] (0.34 g, 31%). Then to a solution of the above crude ester (0.34 g, 1.50 mmol, 1.0 equiv) in EtOH (10 mL, 95%) was added 10% aq. NaOH (4 ml). The mixture was stirred at 55 °C for 2 hours. After being cooled to room temperature, EtOH was removed by evaporation. The residue mixture was diluted with ethyl acetate (50 ml), washed with 10% aq. NaOH (10 ml×2). The water layer was acidified with 2 M HCl, extracted with ethyl acetate. The organic layer was dried over Na_2SO_4, concentrated and the residue was used in next step without purification.

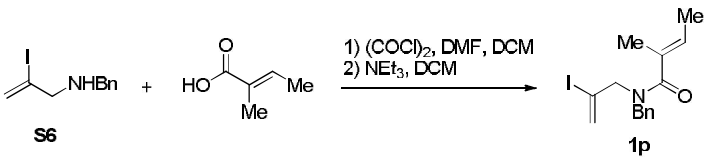


The crude acid chloride [prepared as above from **S4** (1.50 mmol, 1.0 equiv)] in THF (5.0 ml) was added to a mixture of 2-iodo-*N*-methylaniline (0.35 g, 1.50 mmol, 1.0 equiv) and K_2CO_3 (0.42 g, 3.00 mmol, 2.0 equiv) in THF (10.0 ml) at room temperature dropwise. After stirring at room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with ethyl acetate, washed with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was purified by column chromatography on silica (hexanes: ethyl acetate = 8: 1 to 10: 1) to afford **1o** (0.23 g, 0.56 mmol, 38%) as viscous oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.69 (d, J = 8.0 Hz, 1H), 7.05 (t, J = 7.6 Hz, 1H), 6.84 (td, J_1 = 8.0 Hz, J_2 = 0.8 Hz, 1H), 6.72-6.62 (m, 5H), 6.34 (q, J = 6.8 Hz, 1H), 3.76 (s, 3H), 3.19 (s, 3H), 1.57 (d, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 171.6, 158.4, 145.7, 139.6, 138.5, 131.3, 130.0, 129.7, 128.7, 128.6, 127.7, 113.3, 99.2, 55.2, 36.8, 14.3. HRMS (ESI) calcd. for $C_{18}H_{18}INO_2Na^+$ $(M+Na)^+$ 430.0280, found 430.0284.

Preparation of 1p:



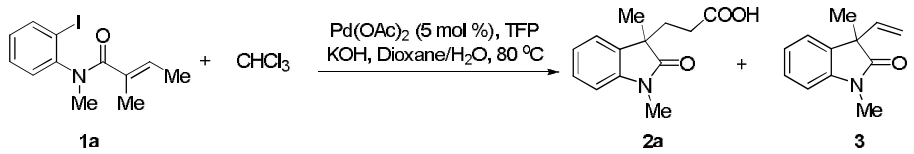
To a solution of **S5** [12] (1.57 g, 4.64 mmol, 1.0 equiv) in MeCN (10 mL) was added a solution of $BnNH_2$ (1.0 ml, 9.28 mmol, 2.0 equiv) in MeCN (5 mL) and stirred at 50 °C for overnight. After being cooled to room temperature, MeCN was removed by evaporation. The residue mixture was neutralized with 10% aq. NaOH, extracted with ethyl acetate, dried over Na_2SO_4. After filtration and concentration, the crude product was purified by column chromatography on silica (hexanes: ethyl acetate = 10: 1 to 5: 1) to afford **S6** (0.71 g, 2.60 mmol, 56%) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.39-7.30 (m, 4H), 7.29-7.23 (m, 1H), 6.27 (q, J = 1.6 Hz, 1H), 5.94-5.82 (m, 1H), 3.71 (s, 2H), 3.38 (dd, J_1 = 1.2 Hz, J_2 = 0.8 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 139.7, 128.4, 128.3, 127.1, 126.4, 113.4, 60.1, 51.3. HRMS (ESI) calcd. for $C_{10}H_{13}INNa^+$ $(M+Na)^+$ 274.0093, found 274.0086.



The crude acid chloride [prepared as above from (*E*)-2-methylbut-2-enoic acid (0.50 g, 3.90 mmol, 1.5 equiv)] in CH_2Cl_2 (5.0 ml) was added to a mixture of **S6** (0.71 g, 2.60 mmol, 1.0 equiv) and Et_3N (0.72 ml, 5.20 mmol, 2.0 equiv) in CH_2Cl_2 (10.0 ml) at 0 °C dropwise. After stirring at room temperature overnight, the mixture was quenched with the addition of saturated $NaHCO_3$, extracted with CH_2Cl_2, washed

with brine, and dried over Na_2SO_4. After filtration and concentration, the crude amide was purified by column chromatography on silica (hexanes: ethyl acetate = 15: 1 to 10: 1) to afford **1p** (0.75 g, 2.11 mmol, 81%) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37-7.24 (m, 3H), 7.23-7.12 (m, 2H), 6.15 (bs, 1H), 5.93 (s, 1H), 5.77 (bs, 1H), 4.59 (s, 2H), 4.10 (bs, 2H), 1.90 (t, J = 1.2 Hz, 3H), 1.70 (dd, J_1 = 6.8 Hz, J_2 = 1.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 174.1, 136.4, 131.5, 128.6, 127.5, 127.4, 126.1, 106.3 (bs), 58.9 (bs), 53.2 (bs), 51.1 (bs), 46.0 (bs), 14.3, 13.1. HRMS (ESI) calcd. for $C_{15}H_{19}INO^+$ $(M+H)^+$ 356.0511, found 356.0511.

3-(1',3'-dimethyl-2'-oxoindolin-3'-yl)propanoic acid (2a):

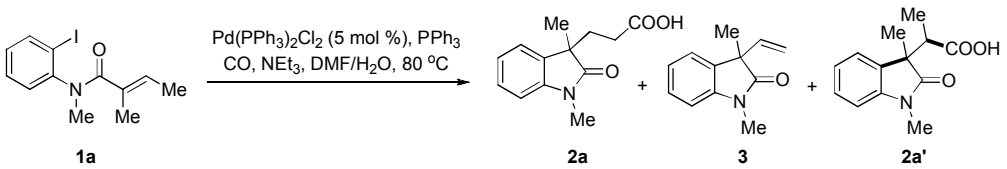


Typical Procedure: Chloroform (65 µl, 0.80 mmol, 4.0 equiv) was added to a mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) under nitrogen, followed by H_2O (1.60 ml) was added. After stirring at room temperature for 0.5 min, dioxane (0.40 ml) was added and the reaction mixture was stirred at room temperature for additional 1 min before heated to 80 °C for 1 hour. After complete consumption of starting material, the mixture was cooled to room temperature, quenched with 1 M HCl (6 ml) and extracted with EtOAc (3×20 ml). The organic layer was dried over Na_2SO_4 and concentrated. The residue was purified by column chromatography on silica (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1) to afford **2a** (36.7 mg, 79%) and **3** (6.3 mg, 17%).

2a: Solid, 119.6-121.8 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31-7.27 (m, 1H), 7.18 (d, J = 7.2 Hz, 1H), 7.07 (t, J = 7.2 Hz, 1H), 6.85 (d, J = 7.6 Hz, 1H), 3.21 (s, 3H), 2.28-2.17 (m, 1H), 2.14-2.03 (m, 2H), 2.00-1.85 (m, 1H), 1.38 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.9, 177.8, 143.2, 132.8, 128.2, 122.8, 122.7, 108.2, 47.50, 32.65, 29.20, 26.20, 23.53. The spectra were identical with the reported data. [13]

3: Oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29 (td, J_1 = 7.6 Hz, J_2 = 1.2 Hz, 1H), 7.19 (ddd, J_1 = 7.2 Hz, J_2 = 1.2 Hz, J_3 = 0.8 Hz, 1H), 7.09 (td, J_1 = 7.6 Hz, J_2 = 1.2 Hz, 1H), 6.86 (d, J = 7.6 Hz, 1H), 5.95 (dd, J_1 = 17.2 Hz, J_2 = 10.4 Hz, 1H), 5.19-5.09 (m, 2H), 3.21 (s, 3H), 1.49 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 178.7, 143.0, 138.0, 132.7, 128.0, 123.8, 122.5, 115.2, 108.2, 51.2, 26.3, 22.4. The spectra were identical with the reported data. [14]

The reaction with carbon monoxide:



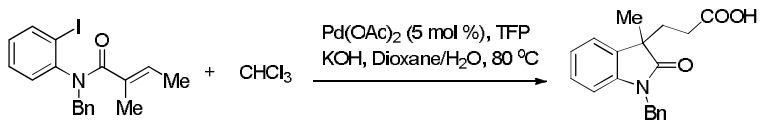
An autoclave containing $Pd(PPh_3)_2Cl_2$ (14.0 mg, 0.02 mmol, 5 mol %), PPh_3 (21.0 mg, 0.08 mmol, 20 mol %), **1a** (0.126 g, 0.40 mmol, 1.0 equiv), NEt_3 (0.22 ml, 1.60 mmol, 4.0 equiv) and DMF/H_2O (4.0 ml/0.40 ml) filled with CO at 5 atm and evacuated (this sequence was repeated three times). The autoclave was warmed up to 80 ºC and stirred for 1.5 hours. The mixture was then cooled to room temperature and diluted with ethyl acetate (100 ml). The mixture was washed with 10 % aq. NaOH (3×10 ml).

The combined aqueous phase was then extracted with ethyl acetate (1×10 ml). All of the organic layer was combined, dried over Na_2SO_4, concentrated and purified by column chromatography on silica (ethyl acetate: hexanes = 1: 10) to afford **3** (11.7 mg, 16%).

The water layer was acidified with 2 M HCl till pH ~ 1, extracted with ethyl acetate (3×30 ml). The organic layer was dried over Na_2SO_4, concentrated and the residue was purified by column chromatography on silica (dichloromethane: ethyl acetate = 20: 3) to afford **2a′** (30.2 mg, 32%) and **2a** (44.1 mg, 47%) (ethyl acetate: hexanes: AcOH = 50: 50: 1).

2a′: Viscous oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34 (td, J_1 = 7.6 Hz, J_2 = 1.6 Hz, 1H), 7.23-7.13 (m, 2H), 6.94 (d, J = 7.6 Hz, 1H), 3.30 (s, 3H), 3.10 (q, J = 7.2 Hz, 1H), 1.53 (s, 3H), 0.97 (d, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 181.7, 174.7, 142.5, 132.2, 128.7, 124.2, 122.2, 109.0, 49.6, 48.3, 26.6, 22.6, 13.3. HRMS (ESI) calcd. for $C_{13}H_{15}NO_3Na^+$ $(M+Na)^+$ 256.0950, found 256.0953.

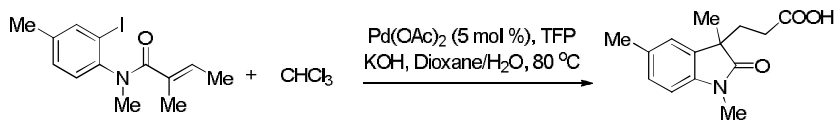
3-(*N*-benzyl-3'-methyl-2'-oxoindolin-3'-yl)propanoic acid (2b):



1b **2b**

The reaction of chloroform (65 μl, 0.80 mmol, 4.0 equiv), **1b** (78.2 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2b** (35.5 mg, 57%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1) as viscous oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36-7.22 (m, 5H), 7.21-7.11 (m, 2H), 7.03 (t, J = 7.2 Hz, 1H), 6.75 (d, J = 7.6 Hz, 1H), 4.94 (d, J = 15.6 Hz, 1H), 4.89 (d, J = 15.6 Hz, 1H), 2.37-2.22 (m, 1H), 2.21-2.06 (m, 2H), 2.02-1.87 (m, 1H), 1.44 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.0, 178.2, 142.2, 135.8, 132.7, 128.8, 128.1, 127.6, 127.2, 122.8, 122.7, 109.2, 47.5, 43.7, 32.6, 29.3, 23.9. HRMS (ESI) calcd. for $C_{19}H_{18}NO_3^-$ $(M-H)^-$ 308.1281, found 308.1286.

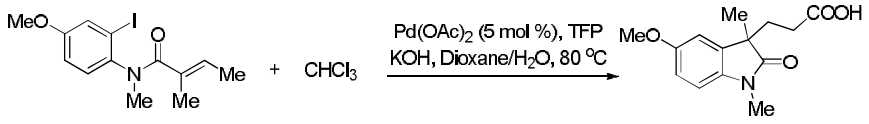
3-(1',3',5'-trimethyl-2'-oxoindolin-3'-yl)propanoic acid (2c):



1c **2c**

The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1c** (65.8 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2c** (30.7 mg, 62%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 90.8-96.7 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.06 (d, J = 7.6 Hz, 1H), 6.98 (s, 1H), 6.73 (d, J = 7.6 Hz, 1H), 3.18 (s, 3H), 2.33 (s, 3H), 2.25-2.17 (m, 1H), 2.13-2.01 (m, 2H), 1.96-1.82 (m, 1H), 1.36 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.9, 178.1, 140.7, 132.8, 132.4, 128.3, 123.5, 107.9, 47.6, 32.7, 29.3, 26.2, 23.5, 21.1. HRMS (ESI) calcd. for $C_{14}H_{16}NO_3^-$ $(M-H)^-$ 246.1125, found 246.1132.

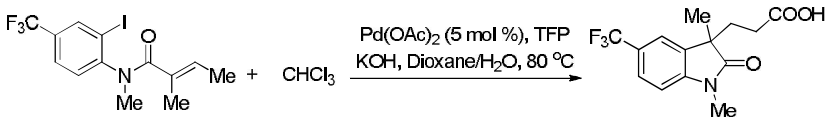
3-(5'-methoxy-1',3'-dimethyl-2'-oxoindolin-3'-yl)propanoic acid (2d):



1d 2d

The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1d** (69.0 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2d** (35.1 mg, 68%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 138.8-140.4 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.85-6.70 (m, 3H), 3.80 (s, 3H), 3.18 (s, 3H), 2.30-2.14 (m, 1H), 2.14-1.99 (m, 2H), 1.97-1.81 (m, 1H), 1.36 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.5, 178.1, 156.2, 136.6, 134.1, 112.2, 110.2, 108.5, 55.7, 48.0, 32.7, 29.3, 26.3, 23.6. HRMS (ESI) calcd. for $C_{14}H_{17}NO_4Na^+$ $(M+Na)^+$ 286.1055, found 286.1057.

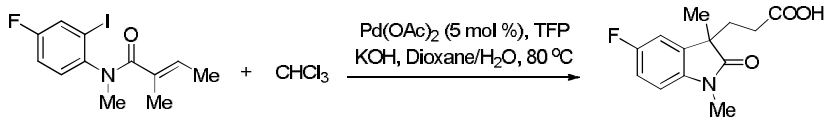
3-(1',3'-dimethyl-2'-oxo-5'-(trifluoromethyl)indolin-3'-yl)propanoic acid (2e):



1e 2e

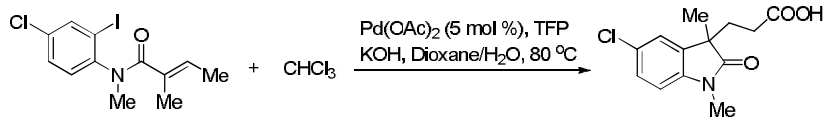
The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1e** (76.6 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2e** (38.7 mg, 64%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 139.8-143.9 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.56 (d, J = 8.4 Hz, 1H), 7.40 (s, 1H), 6.92 (d, J = 8.4 Hz, 1H), 3.24 (s, 3H), 2.33-2.18 (m, 1H), 2.18-2.03 (m, 2H), 1.98-1.83 (m, 1H), 1.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.8, 178.2, 146.2, 133.3, 126.1 (q, J = 3.8 Hz), 125.0 (q, J = 32.6 Hz), 124.3 (q, J = 270.0 Hz), 119.8 (q, J = 3.4 Hz), 108.0, 47.5, 32.4, 29.2, 26.4, 23.4. ^{19}F NMR (376 MHz, $CDCl_3$): δ -61.41. HRMS (ESI) calcd. for $C_{14}H_{14}F_3NO_3Na^+$ $(M+Na)^+$ 324.0823, found 324.0823.

3-(5'-fluoro-1',3'-dimethyl-2'-oxoindolin-3'-yl)propanoic acid (2f):



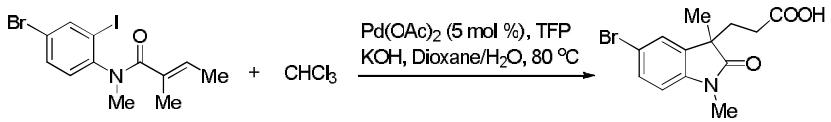
The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1f** (66.6 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2f** (33.7 mg, 67%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 146.2-150.3 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.01-6.89 (m, 2H), 6.77 (dd, J_1 = 8.4 Hz, J_2 = 4.0 Hz, 1H), 3.20 (s, 3H), 2.29-2.17 (m, 1H), 2.15-2.00 (m, 2H), 1.95-1.82 (m, 1H), 1.37 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.5, 178.1, 159.4 (d, J = 239.7 Hz), 139.0 (d, J = 1.8 Hz), 134.5 (d, J = 7.8 Hz), 114.4 (d, J = 23.3 Hz), 110.9 (d, J = 24.5 Hz), 108.7 (d, J = 8.1 Hz), 48.0 (d, J = 1.6 Hz), 32.6, 29.2, 26.3, 23.4. ^{19}F NMR (376 MHz, $CDCl_3$): δ -120.1. HRMS (ESI) calcd. for $C_{13}H_{14}FNO_3Na^+$ $(M+Na)^+$ 274.0855, found 274.0855.

3-(5'-chloro-1',3'-dimethyl-2'-oxoindolin-3'-yl)propanoic acid (2g):



The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1g** (69.9 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2g** (37.4 mg, 70%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 140.6-144.6 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.26-7.22 (m, 1H), 7.15 (d, J = 2.0 Hz, 1H), 6.77 (d, J = 8.4 Hz, 1H), 3.19 (s, 3H), 2.29-2.18 (m, 1H), 2.16-2.02 (m, 2H), 1.98-1.84 (m, 1H), 1.37 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.4, 177.9, 141.7, 134.5, 128.2, 128.1, 123.3, 109.1, 47.8, 32.6, 29.2, 26.3, 23.4. HRMS (ESI) calcd. for $C_{13}H_{13}NO_3{}^{35}Cl^-$ $(M-H)^-$ 266.0579, found 266.0586.

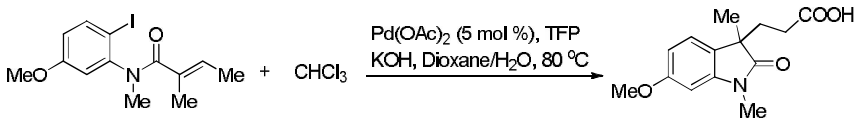
3-(5'-bromo-1',3'-dimethyl-2'-oxoindolin-3'-yl)propanoic acid (2h):



The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1h** (78.8 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2h** (35.7 mg, 58%) (dichloromethane: ethyl

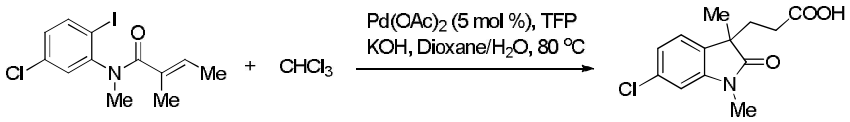
acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 134.7-138.9 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.39 (dd, J_1 = 8.4 Hz, J_2 = 2.0 Hz, 1H), 7.28 (d, J = 2.0 Hz, 1H), 6.72 (d, J = 8.0 Hz, 1H), 3.19 (s, 3H), 2.29-2.17 (m, 1H), 2.16-2.02 (m, 2H), 1.98-1.84 (m, 1H), 1.37 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.2, 178.1, 142.2, 134.8, 131.0, 126.0, 115.5, 109.6, 47.8, 32.5, 29.2, 26.3, 23.4. HRMS (ESI) calcd. for $C_{13}H_{14}{}^{79}BrNO_3Na^+$ $(M+Na)^+$ 334.0055, found 334.0054.

3-(6'-methoxy-1',3'-dimethyl-2'-oxoindolin-3'-yl)propanoic acid (2i):



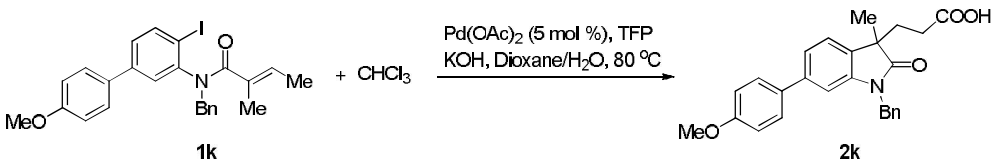
The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1i** (69.0 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1.5 hours afforded **2i** (34.1 mg, 65%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1) as viscous oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.05 (d, J = 8.4 Hz, 1H), 6.55 (d, J = 7.2 Hz, 1H), 6.43 (s, 1H), 3.81 (s, 3H), 3.18 (s, 3H), 2.27-2.13 (m, 1H), 2.13-1.98 (m, 2H), 1.97-1.80 (m, 1H), 1.35 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.5, 178.4, 160.2, 144.4, 124.6, 123.2, 106.5, 96.2, 55.5, 47.0, 32.8, 29.3, 26.2, 23.7. HRMS (ESI) calcd. for $C_{14}H_{17}NO_4Na^+$ $(M+Na)^+$ 286.1055, found 286.1057.

3-(6'-chloro-1',3'-dimethyl-2'-oxoindolin-3'-yl)propanoic acid (2j):



The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1j** (69.8 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2j** (30.9 mg, 58%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 85.5-88.6 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.08 (d, J = 7.6 Hz, 1H), 7.03 (dd, J_1 = 8.0 Hz, J_1 = 1.6 Hz, 1H), 6.84 (d, J = 1.6 Hz, 1H), 3.19 (s, 3H), 2.27-2.15 (m, 1H), 2.13-2.01 (m, 2H), 1.97-1.83 (m, 1H), 1.36 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.8, 178.2, 144.4, 133.9, 131.0, 123.6, 122.5, 108.9, 47.3, 32.5, 29.2, 26.3, 23.5. HRMS (ESI) calcd. for $C_{13}H_{14}{}^{35}ClNO_3Na^+$ $(M+Na)^+$ 290.0560, found 290.0559.

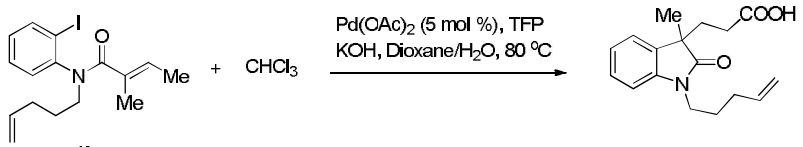
3-(*N*-benzyl-6'-(4''-methoxyphenyl)-3'-methyl-2'-oxoindolin-3'-yl)propanoic acid (2k):



The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1k** (99.5 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2k** (37.8 mg, 45%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 134.6-138.9 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.38 (d, *J* = 8.4 Hz, 2H), 7.36-7.24 (m, 5H), 7.20 (s, 2H), 6.95 (d, *J* = 8.4 Hz, 2H), 6.90 (s, 1H), 4.99 (d, *J* = 15.6 Hz, 1H), 4.93 (d, *J* = 15.6 Hz, 1H), 3.84 (s, 3H), 2.37-2.24 (m, 1H), 2.30-2.10 (m, 2H), 2.08-1.93 (m, 1H), 1.47 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.2, 178.4, 159.3, 142.8, 141.3, 135.9, 133.4, 131.0, 128.8, 128.1, 127.7, 127.2, 122.9, 121.3, 114.2, 107.7, 55.3, 47.3, 43.7, 32.6, 29.4, 23.9. HRMS (ESI) calcd. for $C_{26}H_{25}NO_4Na^+$ $(M+Na)^+$ 438.1681, found 438.1678.

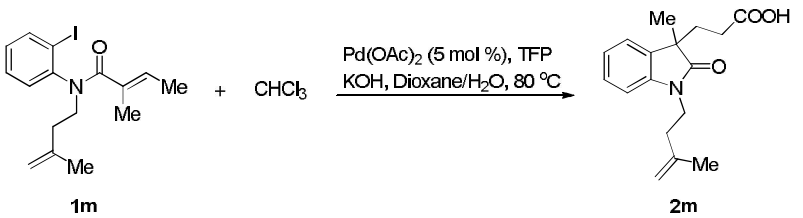
3-(3'-methyl-2'-oxo-*N*-(pent-4''-enyl)indolin-3'-yl)propanoic acid

(2l):



The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1l** (73.8 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2l** (34.5 mg, 60%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 67.3-71.8 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29-7.22 (m, 1H), 7.17 (d, *J* = 6.8 Hz, 1H), 7.05 (t, *J* = 7.2 Hz, 1H), 6.85 (d, *J* = 7.8 Hz, 1H), 5.91-5.75 (m, 1H), 5.13-4.93 (m, 2H), 3.80-3.63 (m, 2H), 2.28-2.18 (m, 1H), 2.18-2.02 (m, 4H), 1.88 (t, *J* = 11.2 Hz, 1H), 1.83-1.70 (m, 2H), 1.37 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.7, 178.2, 142.5, 137.2, 132.9, 128.1, 122.8, 122.6, 115.6, 108.4, 47.4, 39.4, 32.6, 31.0, 29.2, 26.6, 23.7. HRMS (ESI) calcd. for $C_{17}H_{21}NO_3Na^+$ $(M+Na)^+$ 310.1419, found 310.1419.

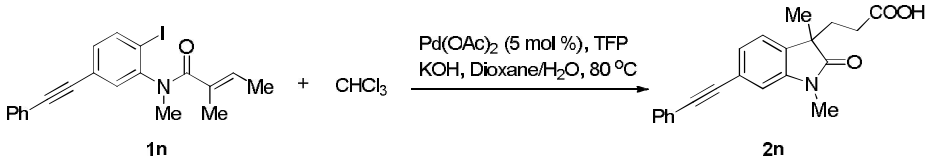
3-(3'-methyl-*N*-(3''-methylbut-3''-enyl)-2'-oxoindolin-3'-yl)propanoic acid (2m):



The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1m** (73.8 mg, 0.20

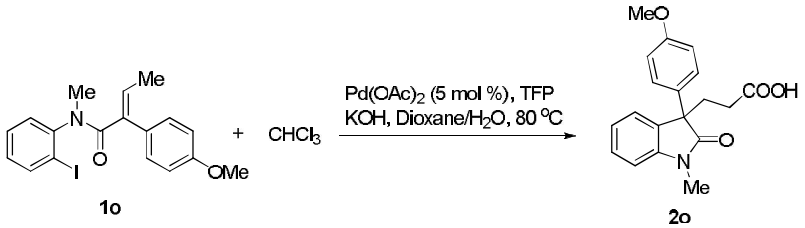
mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2m** (30.0 mg, 52%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29-7.23 (m, 1H), 7.17 (d, J = 7.2 Hz, 1H), 7.05 (t, J = 7.6 Hz, 1H), 6.87 (d, J = 8.0 Hz, 1H), 4.77 (s, 1H), 4.66 (s, 1H), 3.89 (dt, J_1 = 14.4 Hz, J_2 = 7.2 Hz, 1H), 3.79 (dt, J_1 = 14.0 Hz, J_2 = 7.2 Hz, 1H), 2.37 (t, J = 7.2 Hz, 2H), 2.25-2.16 (m, 1H), 2.15-2.01 (m, 2H), 1.92-1.83 (m, 1H), 1.82 (s, 3H), 1.36 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.7, 178.2, 142.3, 142.0, 132.9, 128.1, 122.8, 122.5, 112.8, 108.4, 47.4, 38.2, 35.3, 32.5, 29.2, 23.9, 22.1. HRMS (ESI) calcd. for $C_{17}H_{21}NO_3Na^+$ $(M+Na)^+$ 310.1419, found 310.1413.

3-(1',3'-dimethyl-2'-oxo-6'-(phenylethynyl)indolin-3'-yl)propanoic acid (2n):



The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1n** (83.0 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded **2n** (42.4 mg, 64%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). Solid, 158.5-162.4 °C (ethyl acetate/hexanes). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.58-7.49 (m, 2H), 7.41-7.32 (m, 3H), 7.29-7.23 (m, 1H), 7.14 (d, J = 7.6 Hz, 1H), 7.00 (s, 1H), 3.22 (s, 3H), 2.31-2.18 (m, 1H), 2.17-2.03 (m, 2H), 2.00-1.85 (m, 1H), 1.38 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.7, 178.1, 143.2, 133.0, 131.6, 128.4, 128.3, 126.4, 123.1, 122.9, 122.6, 110.9, 89.5, 89.0, 47.5, 32.5, 29.2, 26.2, 23.3. HRMS (ESI) calcd. for $C_{21}H_{19}NO_3Na^+$ $(M+Na)^+$ 356.1263, found 356.1266.

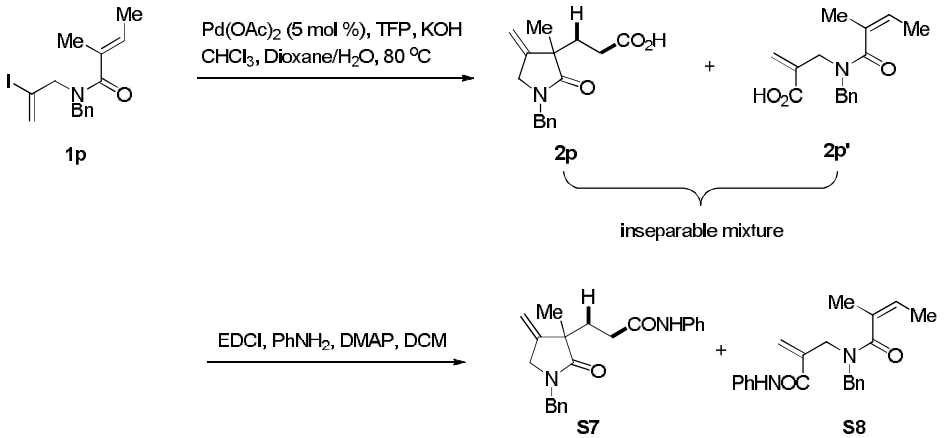
3-(3-(4-methoxyphenyl)-1-methyl-2-oxoindolin-3-yl)propanoic acid (2o):



The reaction of chloroform (32 µl, 0.40 mmol, 4.0 equiv), **1o** (40.7 mg, 0.10 mmol, 1.0 equiv), $Pd(OAc)_2$ (1.1 mg, 0.005 mmol, 5 mol %), KOH (44.9 mg, 0.80 mmol, 8.0 equiv) and TFP (3.5 mg, 0.015 mmol, 15 mol %) in H_2O (0.80 ml)/dioxane (0.20 ml) at 80 °C for 1 hour afforded **2o** (12.7 mg, 39%) as viscous oil (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37-7.20 (m, 4H), 7.11 (td, J = 7.6, 1.2 Hz, 1H), 6.91 (d, J = 8.0 Hz, 1H), 6.86-6.79 (m, 2H), 3.76 (s, 3H), 3.22 (s, 3H), 2.73-2.62 (m, 1H), 2.55-2.43 (m, 1H), 2.19-2.13 (m, 1H), 2.06-1.94 (m, 1H); ^{13}C NMR (100 MHz,

$CDCl_3$): δ 178.1, 178.0, 158.9, 143.7, 131.3 ,131.2, 128.5, 127.9, 124.7, 122.9, 114.0, 108.5, 55.2, 55.0, 32.3, 29.4, 26.4. HRMS (ESI) calcd. for $C_{19}H_{19}NO_4Na^+$ $(M+Na)^+$ 348.1212, found 342.1213.

3-(1-benzyl-3-methyl-4-methylene-2-oxopyrrolidin-3-yl)-*N*-phenylpropanamide (S7) and (Z)-*N*-benzyl-2-methyl-N-(2-(phenylcarbamoyl)allyl)but-2-enamide (S8):



The reaction of chloroform (65 µl, 0.80 mmol, 4.0 equiv), **1p** (71.0 mg, 0.20 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.01 mmol, 5 mol %), KOH (89.8 mg, 1.60 mmol, 8.0 equiv) and TFP (7.0 mg, 0.03 mmol, 15 mol %) in H_2O (1.60 ml)/dioxane (0.40 ml) at 80 °C for 1 hour afforded a mixture of acids (**2p/2p′** = 2:1, 21.2 mg, 39%) (dichloromethane: ethyl acetate = 20: 3 to ethyl acetate: hexanes: AcOH = 50: 50: 1).

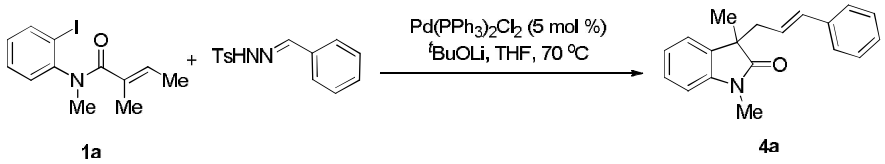
EDCI (18.0 mg, 0.094 mmol, 1.2 equiv) and $PhNH_2$ (8.5µl, 0.094 mmol, 1.2 equiv) was added to a solution of the above acids, DMAP (11.5 mg, 0.094 mmol, 1.2 equiv) in DCM (1 ml) at 0 °C subsequently. The reaction was stirred at room temperature for overnight and quenched with the addition of H_2O, extracted with ethyl acetate, and dried over Na_2SO_4. After filtration and concentration, the crude amide was purified by column chromatography on silica (hexanes: ethyl acetate = 2: 1) to afford **S7** (18.1 mg, 66%) and **S8** (7.6 mg, 28%).

S7: Viscous oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.65 (bs, 1H), 7.49 (d, J = 8.0 Hz, 2H), 7.40-7.27 (m, 5H), 7.27-7.20 (m, 2H), 7.08 (t, J = 7.2 Hz, 1H), 5.10 (s, 1H), 5.09 (s, 1H), 4.55 (d, J = 14.4 Hz, 1H), 4.50 (d, J = 14.8 Hz, 1H), 3.87 (d, J = 14.0 Hz, 1H), 3.82 (d, J = 14.4 Hz, 1H), 2.40-2.27 (m, 1H), 2.27-2.11 (m, 2H), 2.08-1.97 (m, 1H), 1.30 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 177.3, 170.8, 145.6, 138.1, 135.9, 128.88, 128.85, 128.1, 127.8, 124.0, 119.6, 108.5, 50.1, 48.1, 46.3, 34.3, 33.5, 24.7. HRMS (ESI) calcd. for $C_{22}H_{24}N_2O_2Na^+$ $(M+Na)^+$ 371.1735, found 371.1726.

S8: Viscous oil. ^{1}H NMR (400 MHz, $CDCl_3$): 9.87 (bs, 1H), 7.78 (d, J = 8.0 Hz, 2H), 7.46-1.29 (m, 5H), 7.20 (d, J = 7.2 Hz, 2H), 7.10 (t, J = 7.6 Hz, 1H), 6.53 (s, 1H), 5.83-5.63 (m, 1H), 5.42 (s, 1H), 4.60 (s, 2H), 4.40 (s, 2H), 1.82 (s, 3H), 1.66 (d, J = 6.4 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 175.4, 162.8 (bs), 138.6, 137.7(bs), 135.4(bs), 131.3, 129.9(bs), 129.1, 128.8, 127.9, 127.0, 126.4, 124.1, 120.1, 50.3, 43.9, 14.3, 13.2. HRMS (ESI) calcd. for $C_{22}H_{24}N_2O_2Na^+$ $(M+Na)^+$ 371.1735, found

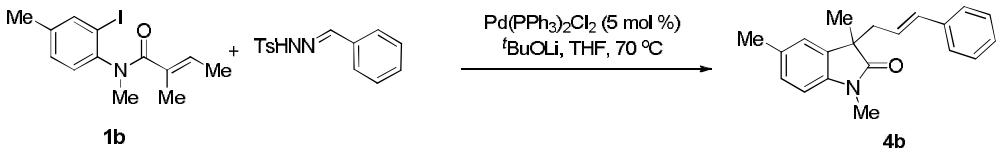
371.1740.

3-cinnamyl-1,3-dimethylindolin-2-one (4a):



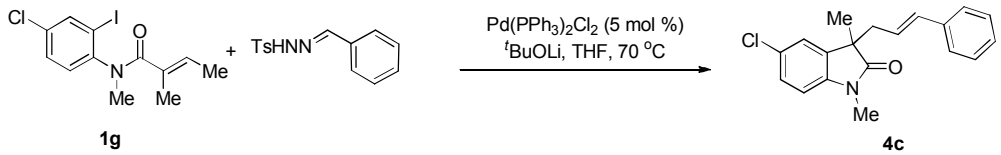
Typical Procedure: Under N_2 atmosphere a flame-dried schlenk tube was added **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N′*-benzylidene-4-methylbenzenesulfonohydrazide (0.110 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 70 °C for 1 h. After consumption of starting material, the mixture was cooled to room temperature and quenched by the addition of water, extracted with EtOAc, washed with brine. The organic layer was dried over Na_2SO_4 and concentrated, and the residue was purified by column chromatography on silica (10% ethyl acetate/hexanes) to afford **4a** (38.6 mg, 70%) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36-7.19 (m, 7H), 7.13 (dt, J_1 = 7.6 Hz, J_1 = 0.8 Hz, 1H), 6.88 (d, J = 8.0 Hz, 1H), 6.41 (d, J = 15.6 Hz, 1H), 6.01-5.88 (m, 1H), 3.24 (s, 3H), 2.78-2.64 (m, 2H), 1.48 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.2, 143.1, 137.2, 133.6, 133.5, 128.4, 127.8, 127.1, 126.1, 124.2, 122.9, 122.4, 108.0, 48.6, 41.6, 26.1, 22.5. The spectra were identical with the reported data [15] .

3-cinnamyl-1,3,5-trimethylindolin-2-one (4b):



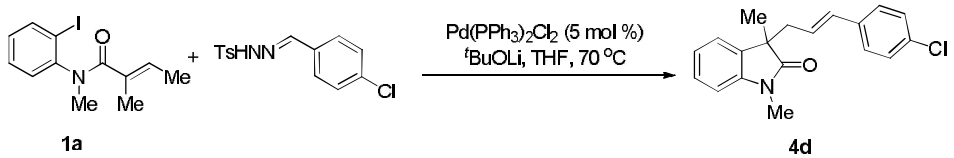
A mixture of **1b** (65.8 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N′*-benzylidene-4-methylbenzenesulfonohydrazide (0.110 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 70 °C for 1 hour afforded **4b** (38.3 mg, 66%) (hexanes: acetone = 20: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.33-7.19 (m, 5H), 7.12 (m, 2H), 6.76 (d, J = 7.6 Hz, 1H), 6.42 (d, J = 16.0 Hz, 1H), 5.92 (dt, J_1 = 15.6 Hz, J_2 = 7.6 Hz, 1H), 3.21 (s, 3H), 2.70 (dd, J_1 = 7.6 Hz, J_2 = 0.8 Hz, 2H), 2.42 (s, 3H), 1.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.1, 140.7, 137.3, 133.6, 133.5, 131.8, 128.3, 128.0, 127.1, 126.1, 124.3, 123.7, 107.7, 48.6, 41.6, 26.1, 22.6, 21.2. HRMS (ESI) calcd. for $C_{20}H_{21}NONa^+$ $(M+Na)^+$ 314.1521, found 314.1523.

5-chloro-3-cinnamyl-1,3-dimethylindolin-2-one (4c)



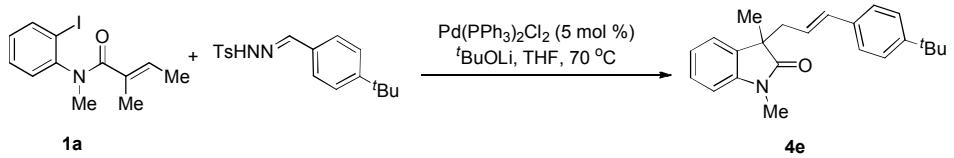
A mixture of **1g** (69.9 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N′*-benzylidene-4-methylbenzenesulfonohydrazide (0.110 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 70 °C for 1 hour afforded **4c** (37.9 mg, 61%) (hexanes: dichloromethane: ethyl acetate = 20: 20: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34-7.22 (m, 7H), 6.79 (d, J = 8.4 Hz, 1H), 6.42 (d, J = 15.6 Hz, 1H), 5.88 (dt, J_1 = 15.6 Hz, J_2 = 7.6 Hz, 1H), 3.22 (s, 3H), 2.77-2.64 (m, 2H), 1.47 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 179.6, 141.7, 137.0, 135.2, 134.0, 128.4, 127.7, 127.3, 126.1, 123.5, 123.4, 108.9, 49.0, 41.5, 26.2, 22.5. HRMS (ESI) calcd. for $C_{19}H_{18}NO^{35}ClNa^+$ $(M+Na)^+$ 334.0999, found 334.0996.

(*E*)-3-(3'-(4''-chlorophenyl)allyl)-1,3-dimethylindolin-2-one (4d)



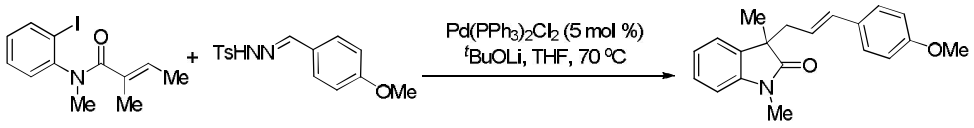
A mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N′*-(4-chlorobenzylidene)-4-methylbenzenesulfonohydrazide (0.124 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 70 °C for 1 hour afforded **4d** (58.0 mg, 87%) (hexanes: ethyl acetate = 10: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30-7.24 (m, 1H), 7.24-7.16 (m, 3H), 7.13-7.05 (m, 3H), 6.82 (d, J = 7.6 Hz, 1H), 6.29 (d, J = 16.0 Hz, 1H), 5.84 (dt, J_1 = 15.6 Hz, J_2 = 7.6 Hz, 1H), 3.18 (s, 3H), 2.64 (dd, J_1 = 7.6 Hz, J_2 = 1.2 Hz, 2H), 1.42 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.1, 143.1, 135.7, 133.4, 132.8, 132.4, 128.5, 127.9, 127.3, 124.9, 122.8, 122.4, 108.0, 48.6, 41.6, 26.1, 22.5. HRMS (HESI) calcd. for $C_{19}H_{19}NO^{35}Cl^+$ $(M+H)^+$ 312.1150, found 312.1148.

(*E*)-3-(3-(4-*tert*-butylphenyl)allyl)-1,3-dimethylindolin-2-one (4e)



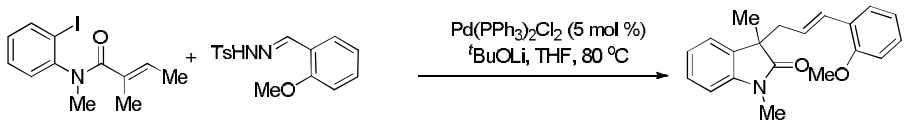
A mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N′*-(4-*tert*-butylbenzylidene)-4-methylbenzenesulfonohydrazide (0.132 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 70 °C for 1 hour afforded **4e** (59.0 mg, 88%) (hexanes: acetone = 20: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31-7.21 (m, 4H), 7.15 (d, J = 8.4 Hz, 2H), 7.06 (t, J = 7.2 Hz, 1H), 6.82 (d, J = 8.0 Hz, 1H), 6.33 (d, J = 15.6 Hz, 1H), 5.86 (dt, J_1 = 15.6 Hz, J_2 = 7.6 Hz, 1H), 3.19 (s, 3H), 2.72-2.57 (m, 2H), 1.41 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.2, 150.2, 143.1, 134.5, 133.6, 133.4, 127.8, 125.9, 125.3, 123.3, 122.9, 122.3, 107.9, 48.6, 41.6, 34.4, 31.2, 26.1, 22.6. HRMS (HESI) calcd. for $C_{23}H_{28}NO^+$ $(M+H)^+$ 334.2165, found 334.2161.

(*E*)-3-(3'-(4''-methoxyphenyl)allyl)-1,3-dimethylindolin-2-one (4f)



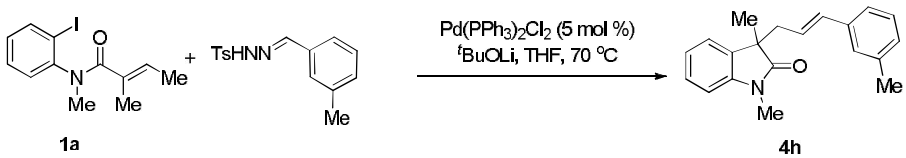
A mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N'*-(4-methoxybenzylidene)-4-methylbenzenesulfonohydrazide (0.122 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 70 °C for 1 hour afforded **4f** (56.6 mg, 92%) (hexanes: ethyl acetate = 10: 1 to 5: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29-7.20 (m, 2H), 7.16-7.11 (m, 2H), 7.07 (td, J_1 = 7.6 Hz, J_2 = 0.8 Hz, 1H), 6.86-6.74 (m, 3H), 6.29 (d, J = 15.6 Hz, 1H), 5.74 (dt, J_1 = 15.6 Hz, J_2 = 7.2 Hz, 1H), 3.77 (s, 3H), 3.18 (s, 3H), 2.69-2.56 (m, 2H), 1.41 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.3, 158.9, 143.1, 133.6, 133.0, 130.1, 127.7, 127.2, 122.9, 122.3, 121.9, 113.8, 107.9, 55.2, 48.7, 41.6, 26.1, 22.4. HRMS (HESI) calcd. for $C_{20}H_{22}NO_2^+$ $(M+H)^+$ 308.1645, found 308.1640.

(*E*)-3-(3'-(2''-methoxyphenyl)allyl)-1,3-dimethylindolin-2-one (4g):



A mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N'*-(2-methoxybenzylidene)-4-methylbenzenesulfonohydrazide (0.122 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 80 °C for 1 hour afforded **4g** (57.9 mg, 94%) (hexanes: ethyl acetate = 10: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31-7.22 (m, 2H), 7.22-7.13 (m, 2H), 7.10-7.03 (m, 1H), 6.89-6.77 (m, 3H), 6.65 (d, J = 16.0 Hz, 1H), 5.91 (dt, J_1 = 16.0 Hz, J_2 = 8.0 Hz, 1H), 3.77 (s, 3H), 3.20 (s, 3H), 2.75-2.58 (m, 2H), 1.42 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.3, 156.5, 143.1, 133.8, 128.5, 128.2, 127.7, 126.7, 126.5, 124.9, 123.1, 122.3, 120.5, 110.8, 107.8, 55.4, 48.6, 42.0, 26.1, 22.3. HRMS (HESI) calcd. for $C_{20}H_{22}NO_2^+$ $(M+H)^+$ 308.1645, found 308.1647.

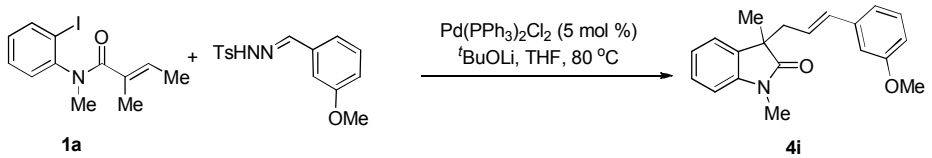
(*E*)-1,3-dimethyl-3-(3'-*m*-tolylallyl)indolin-2-one (4h):



A mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N'*-(3-methylbenzylidene)-4-methyl-benzenesulfonohydrazide (0.115 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 70 °C for 1 hour afforded **4h** (49.6 mg, 85%) (hexanes: acetone = 20: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30-7.21 (m, 2H), 7.14 (t, J = 7.6 Hz, 1H), 7.08 (td, J_1 = 7.6 Hz, J_2 = 0.8 Hz, 1H), 7.05-6.98 (m, 3H), 6.83 (d, J =8.0 Hz, 1H), 6.32 (d, J = 15.6 Hz, 1H), 5.90 (dt, J_1 = 15.6 Hz, J_2 = 7.2 Hz, 1H), 3.19 (s, 3H), 2.71-2.58 (m, 2H), 2.30 (s, 3H), 1.42 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ

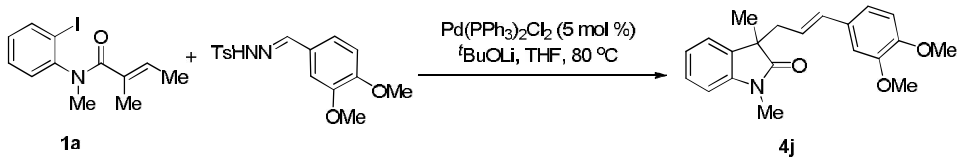
180. 2, 143.1, 137.9, 137.2, 133.8, 133.6, 128.3, 128.0, 127.8, 126.9, 123.9, 123.2, 122.9, 122.4, 108.0, 48.6, 41.6, 26.1, 22.5, 21.3. HRMS (HESI) calcd. for $C_{20}H_{22}NO^+$ $(M+H)^+$ 298.1696, found 298.1696.

(*E*)-3-(3'-(3''-methoxyphenyl)allyl)-1,3-dimethylindolin-2-one (4i):



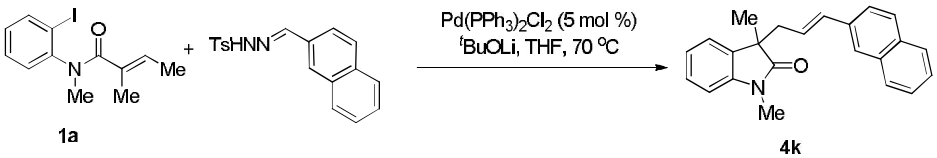
A mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N'*-(3-methoxybenzylidene)-4-methylbenzenesulfonohydrazide (0.122 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 80 °C for 1 hour afforded **4i** (41.7 mg, 68%) (hexanes: acetone = 40: 3) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30-7.20 (m, 2H), 7.19-7.13 (m, 1H), 7.07 (td, J_1 = 7.6 Hz, J_1 = 0.8 Hz, 1H), 6.85-6.77 (m, 2H), 6.76-6.70 (m, 2H), 6.32 (d, J = 15.6 Hz, 1H), 5.88 (dt, J_1 = 15.6 Hz, J_2 = 7.6 Hz, 1H), 3.77 (s, 3H), 3.18 (s, 3H), 2.70-2.59 (m, 2H), 1.42 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.1, 159.6, 143.1, 138.7, 133.53, 133.48, 129.3, 127.8, 124. 5, 122.9, 122.4, 118.8, 112.6, 111.6, 108.0, 55.1, 48.6, 41.5, 26.1, 22.5. HRMS (HESI) calcd. for $C_{20}H_{22}NO_2^+$ $(M+H)^+$ 308.1645, found 308.1642.

(*E*)-3-(3'-(3'',4''-dimethoxyphenyl)allyl)-1,3-dimethylindolin-2-one (4j):



A mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %), *N'*-(3,4-dimethoxybenzylidene)-4-methylbenzenesulfonohydrazide (0.134 g, 0.40 mmol, 2.0 equiv), LiO^{t}Bu (48.0 mg, 0.60 mmol, 3.0 equiv) and in 3.0 mL of THF was stirred at 80 °C for 1 hour afforded **4j** (47.5 mg, 70%) (hexanes: ethyl acetate = 5: 1 to 3: 1) as oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32-7.22 (m, 2H), 7.09 (td, J_1 = 7.6 Hz, J_2 = 1.2 Hz, 1H), 6.84 (d, J = 8.0 Hz, 1H), 6.78-6.71 (m, 3H), 6.29 (d, J = 15.6 Hz, 1H), 5.77 (dt, J_1 = 15.2 Hz, J_2 = 7.6 Hz, 1H), 3.86 (s, 3H), 3.85 (s, 3H), 3.20 (s, 3H), 2.71-2.59 (m, 2H), 1.44 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.2, 148.7, 148.4, 143.0, 133.6, 133.2, 130.3, 127.7, 122.9, 122.3, 122.2, 118.9, 110.9, 108.8, 107.9, 55.8, 55.7, 48.6, 41.5, 26.1, 22.4. HRMS (ESI) calcd. for $C_{21}H_{23}NO_3Na^+$ $(M+Na)^+$ 360.1576, found 360.1581.

(*E*)-1,3-dimethyl-3-(3'-(naphthalen-2''-yl)allyl)indolin-2-one (4k):



A mixture of **1a** (63.0 mg, 0.20 mmol, 1.0 equiv), LiO^{t}Bu(48.0 mg, 0.60 mmol, 3.0 quiv), *N′*-(naphthalen-2-ylmethylene)-4-methylbenzenesulfonohydrazide (0.130 g, 0.40 mmol, 2.0 equiv), $Pd(PPh_3)_2Cl_2$ (7.0 mg, 0.01 mmol, 5 mol %) in 3.0 mL of THF was stirred at 70 °C for 1 hour afforded **4k** (42.0 mg, 64%) (hexanes: ethyl acetate = 10: 1) as viscous oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.80-7.68 (m, 3H), 7.57 (s, 1H), 7.47-7.37 (m, 3H), 7.31-7.23 (m, 2H), 7.10 (t, J = 7.6 Hz, 1H), 6.83 (d, J = 7.6 Hz, 1H), 6.51 (d, J = 16.0 Hz, 1H), 6.03 (dt, J_1 = 15.6 Hz, J_2 = 7.6 Hz, 1H), 3.19 (s, 3H), 2.72 (d, J = 7.6 Hz, 2H), 1.46 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 180.2, 143.1, 134.6, 133.8, 133.6, 133.5, 132.8, 128.0, 127.8, 127.5, 126.1, 125.8, 125.6, 124.6, 123.5, 122.9, 122.4, 108.0, 48.7, 41.8, 26.1, 22.5. HRMS (HESI) calcd. for $C_{23}H_{22}NO^+$ $(M+H)^+$ 328.1696, found 328.1692.

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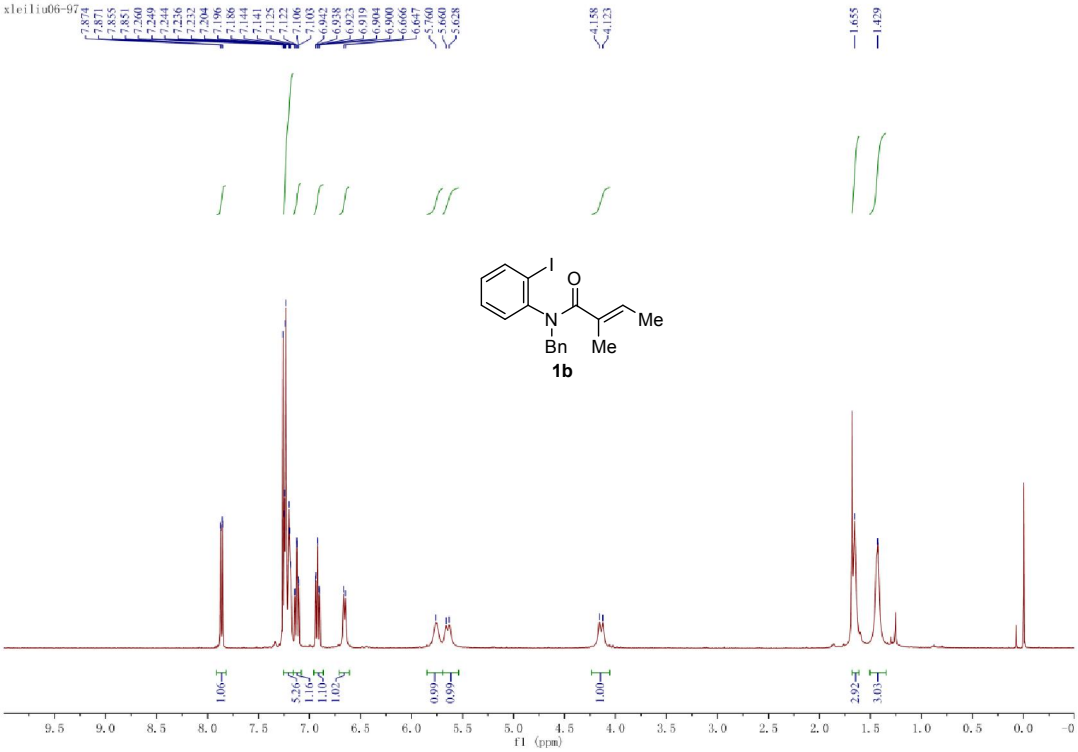
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7.851
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7.236
7.232
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7.196
7.186
7.144
7.141
7.125
7.122
7.106
7.103
6.942
6.938
6.923
6.919
6.904
6.900
6.666
6.657
5.760
5.660
5.628
4.158
4.123
1.655
1.429
I
O
N
Bn
Me
Me
1b
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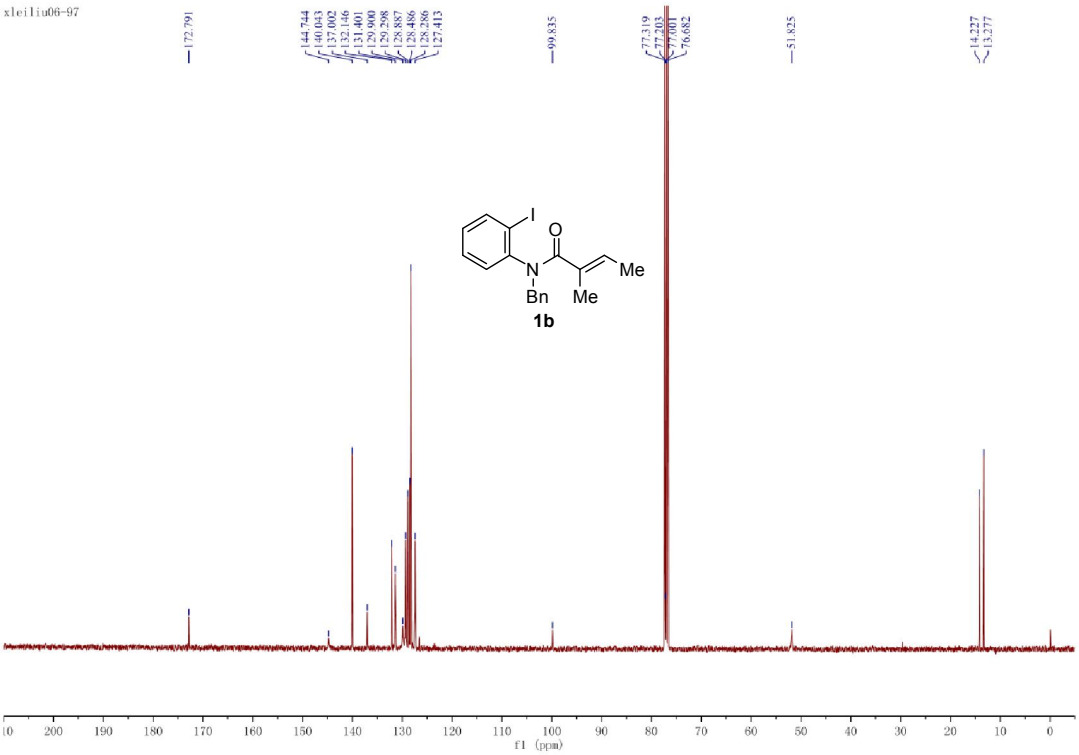
1.16
1.10
1.02
0.99
0.99
1.00
2.92
3.03
f1 (ppm)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99.835
77.319
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76.682
51.825
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13.277
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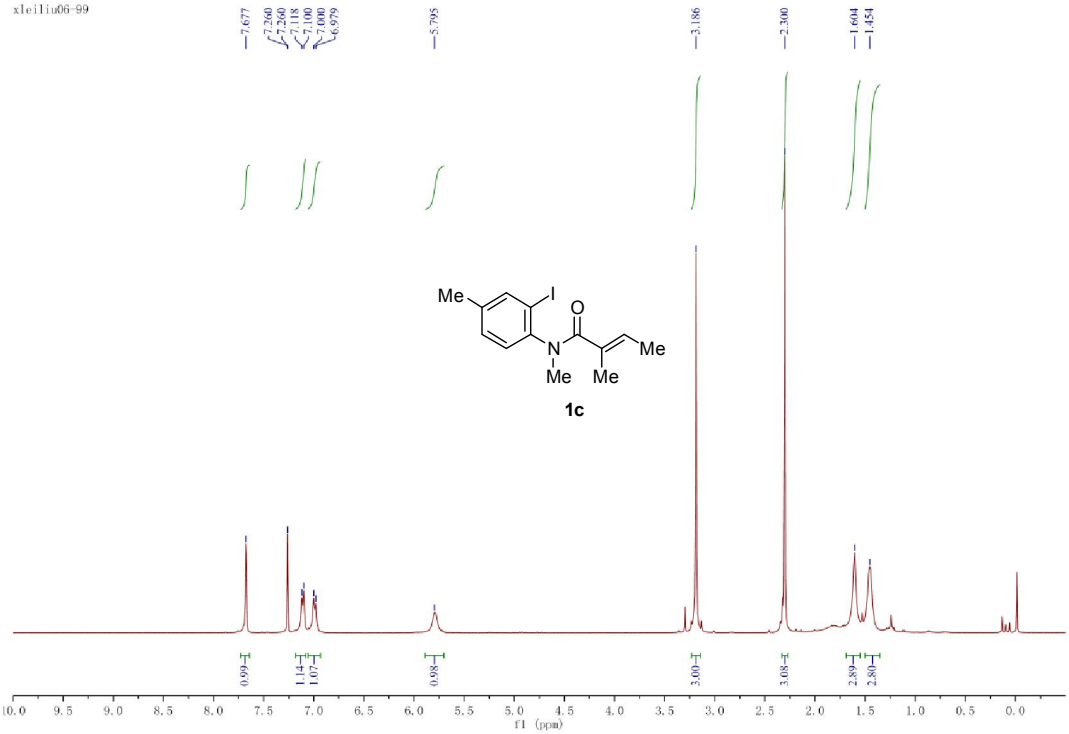
O
N
Bn
Me
Me
1b
f1 (ppm)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1.604
1.454
Me
I
O
N
Me
Me
Me
1c
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3.08
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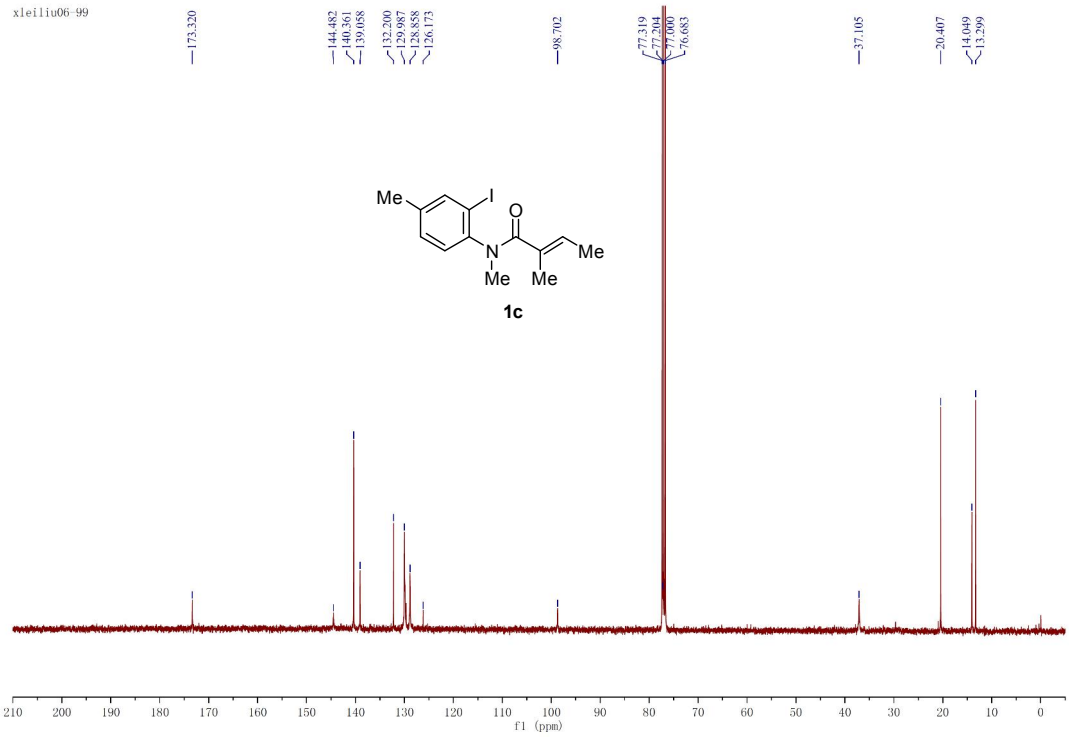
f1 (ppm)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77.204
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20.407
14.049
13.299
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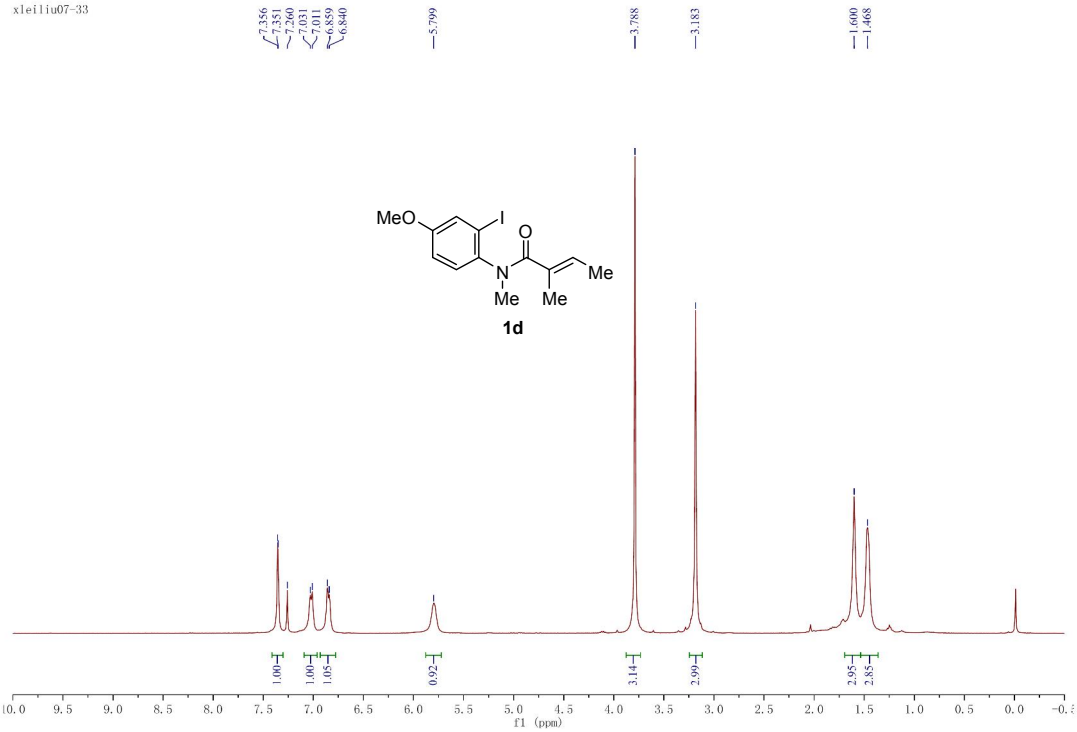
O
N
Me
Me
Me
1c
f1 (ppm)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1.600
1.468
MeO
I
O
N
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Me
Me
1d
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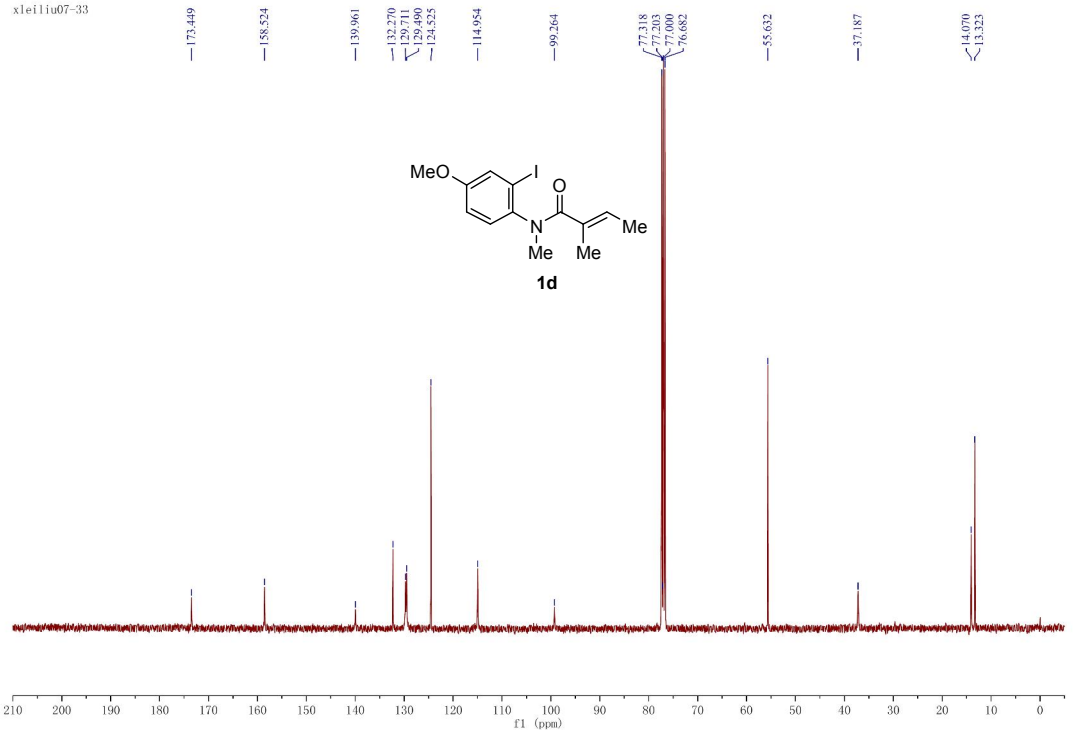
f1 (ppm)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N
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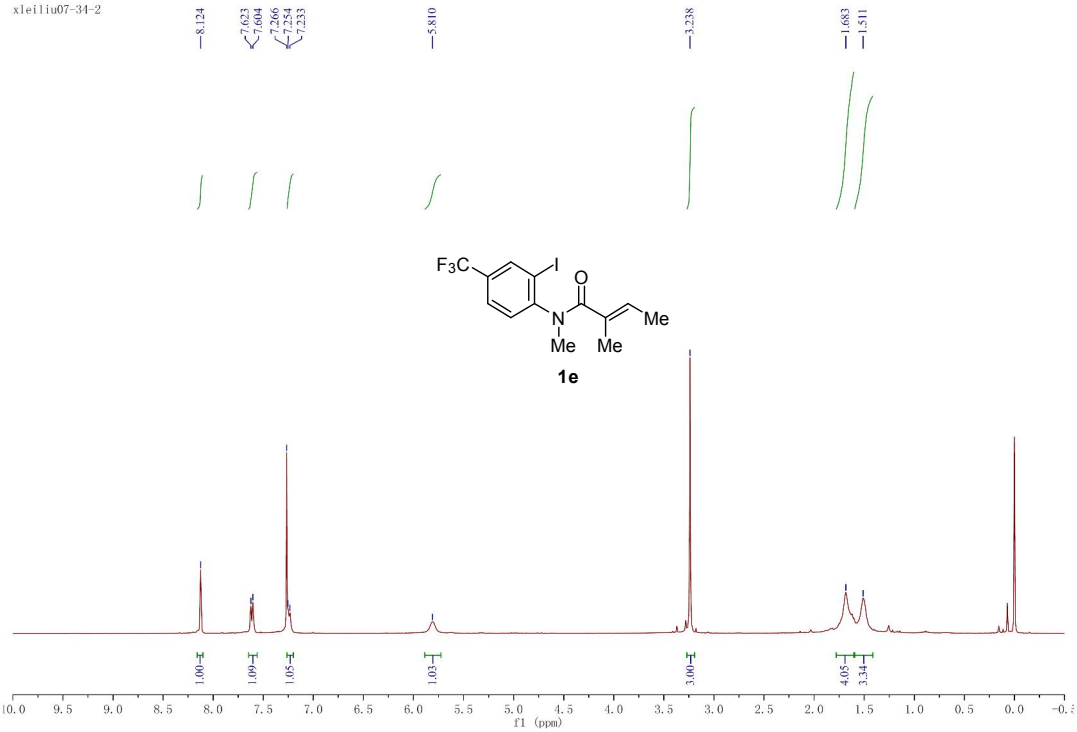
1d
f1 (ppm)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F3C
I
O
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Me
1e
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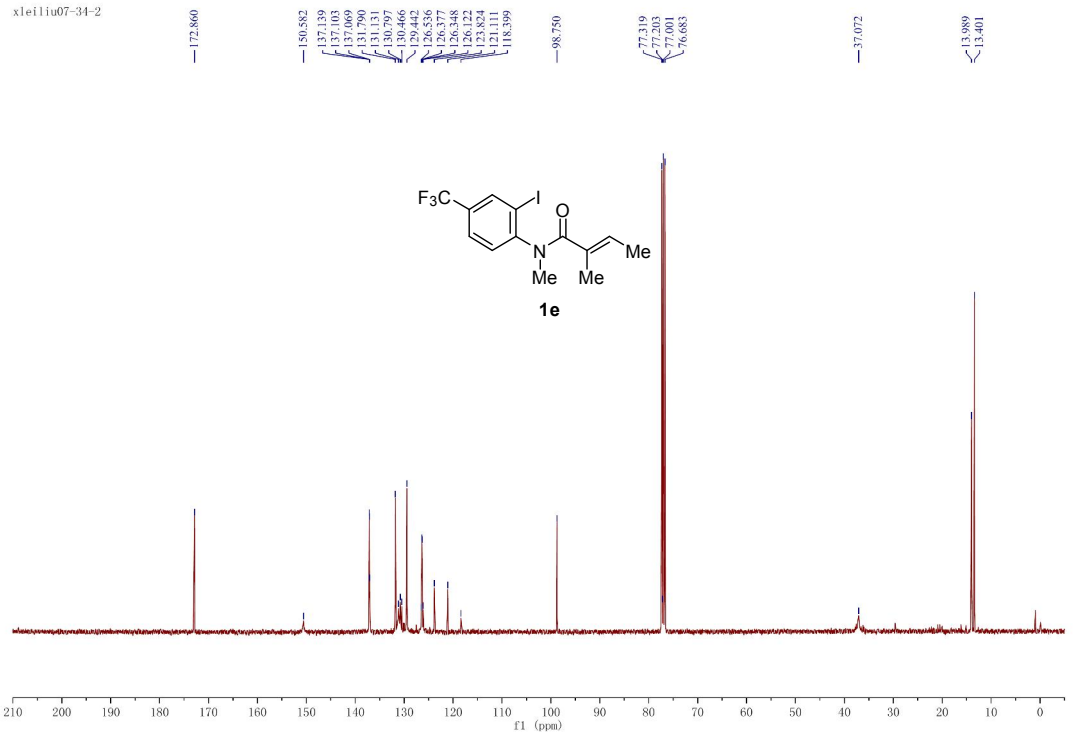
f1 (ppm)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126.122
123.824
121.111
118.399
98.750
77.319
77.203
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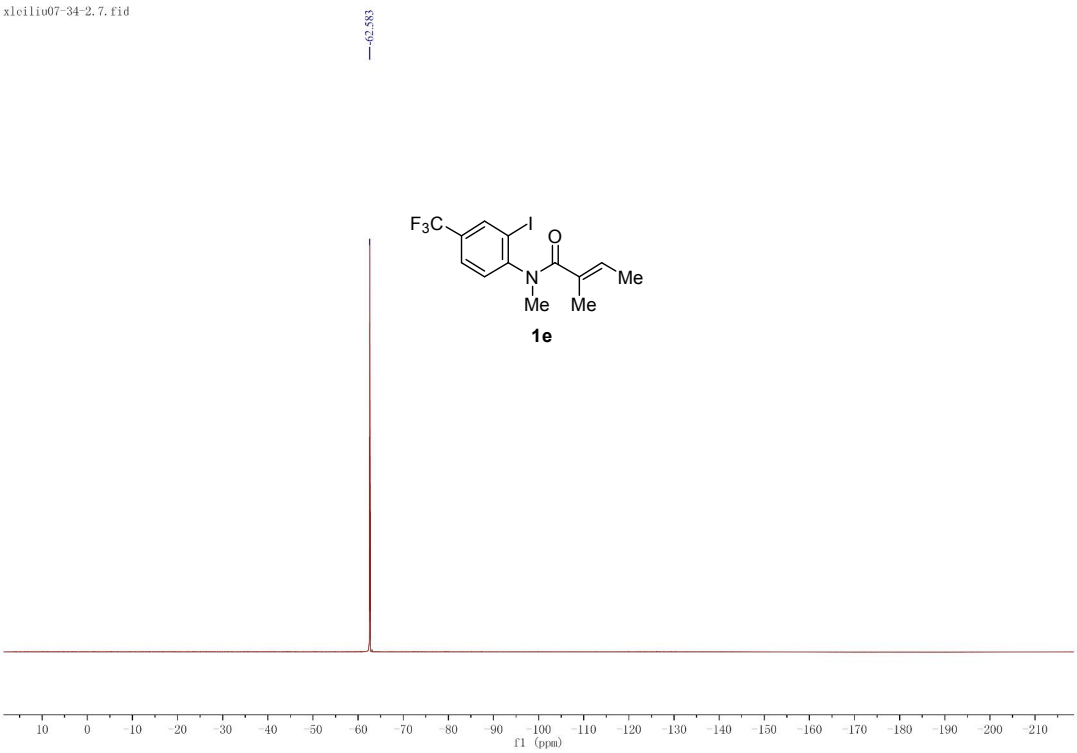
I
O
N
Me
Me
Me
1e
f1 (ppm)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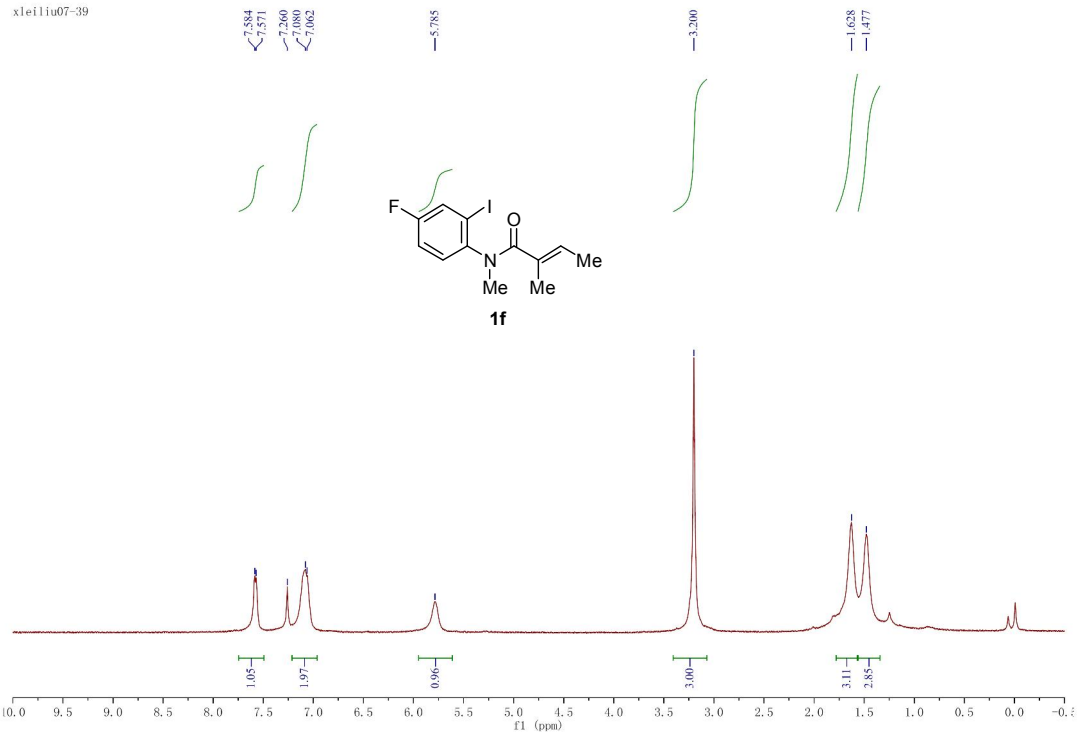
O
N
Me
Me
Me
1e
f1 (ppm)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Me
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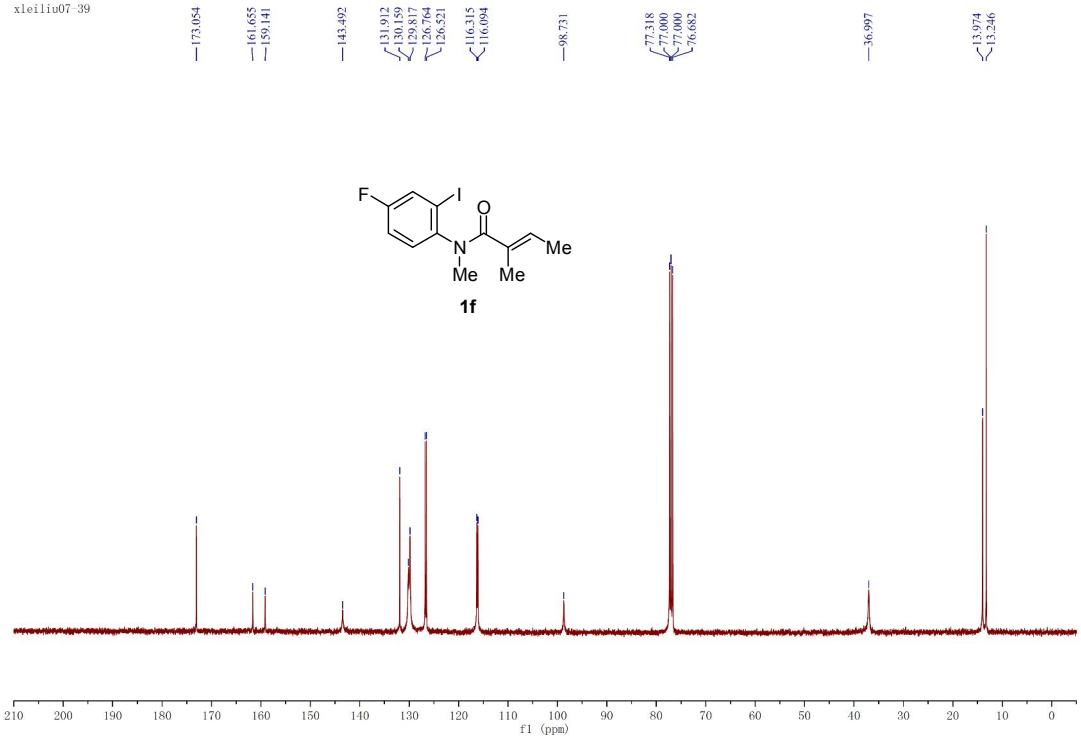
f1 (ppm)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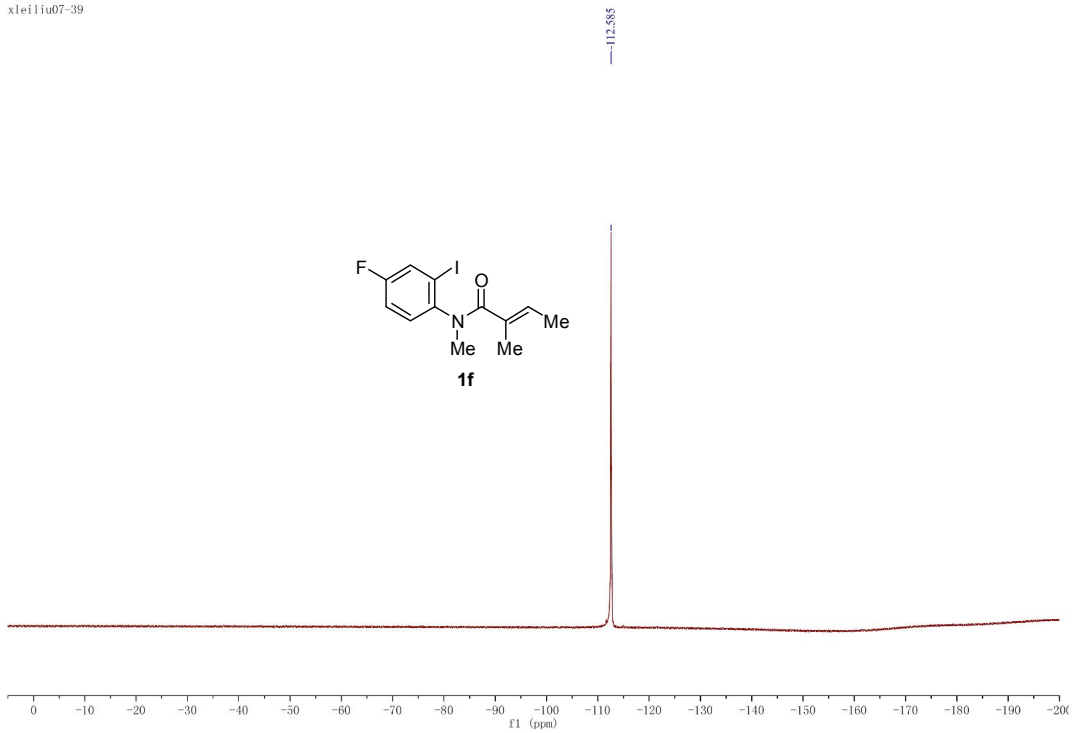
f1 (ppm)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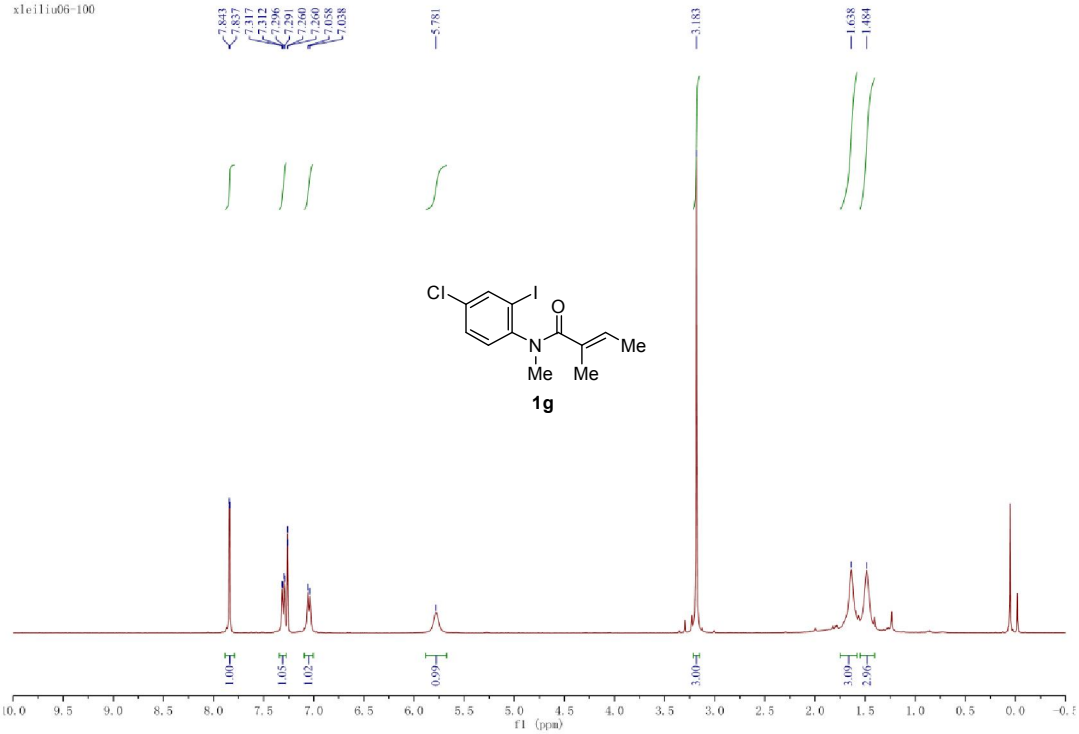
f1 (ppm)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Cl
I
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Me
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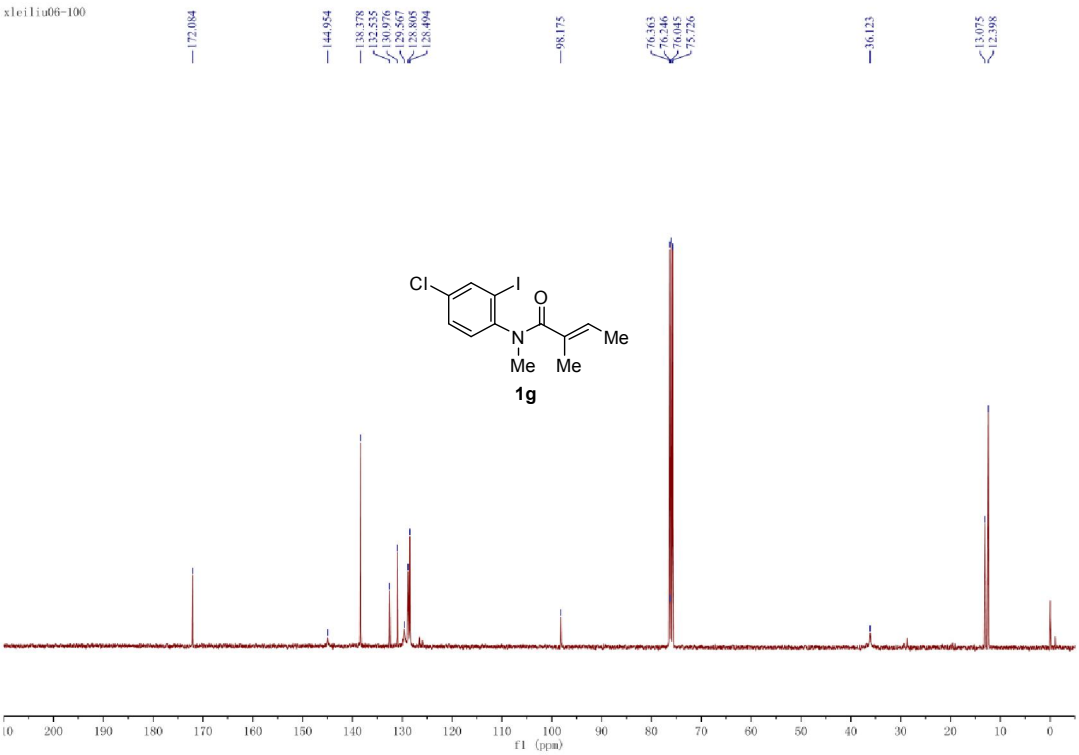
f1 (ppm)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O
N
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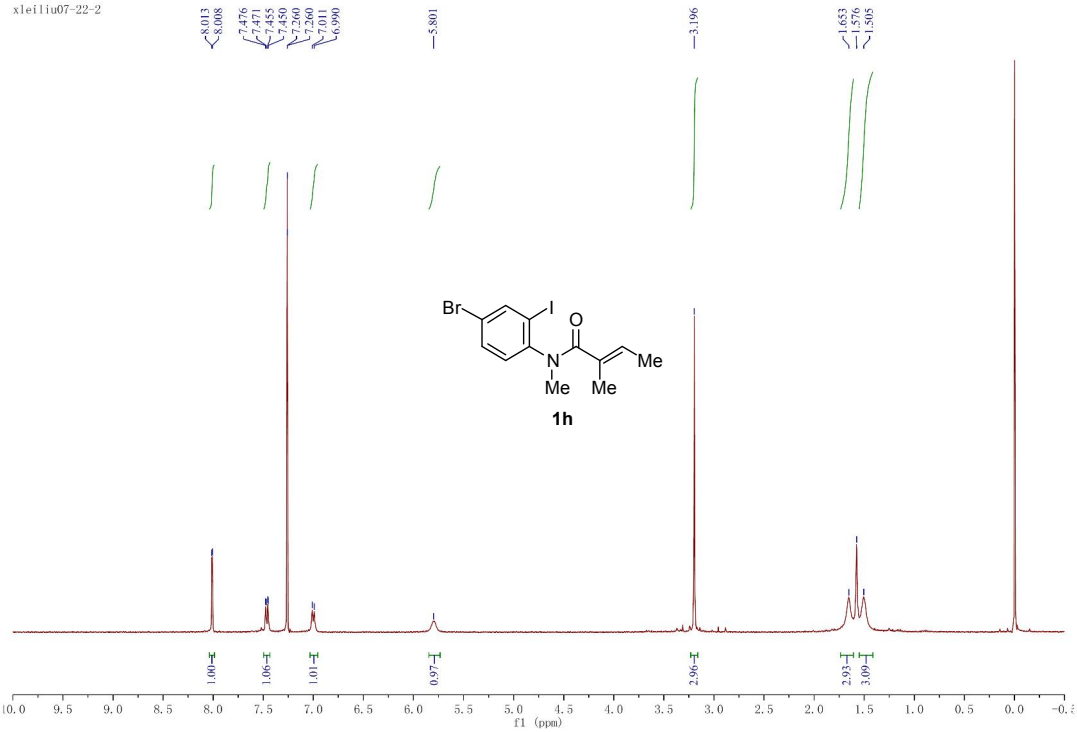
Me
Me
1g
f1 (ppm)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Br
I
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Me
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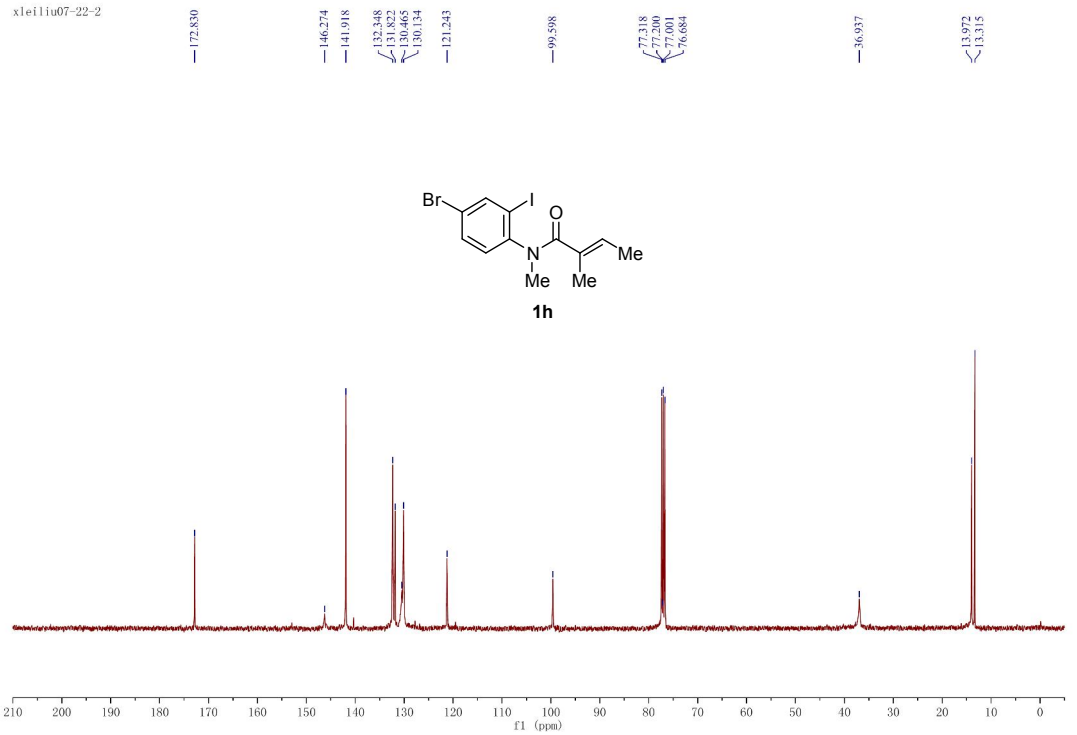
f1 (ppm)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Me
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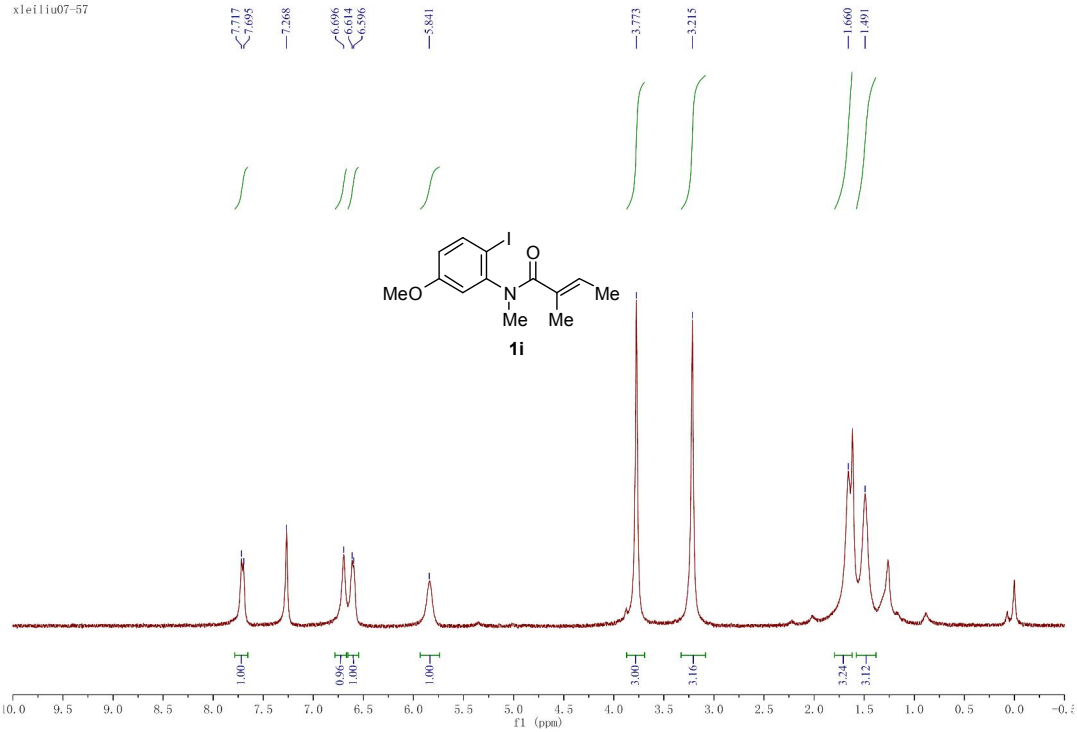
f1 (ppm)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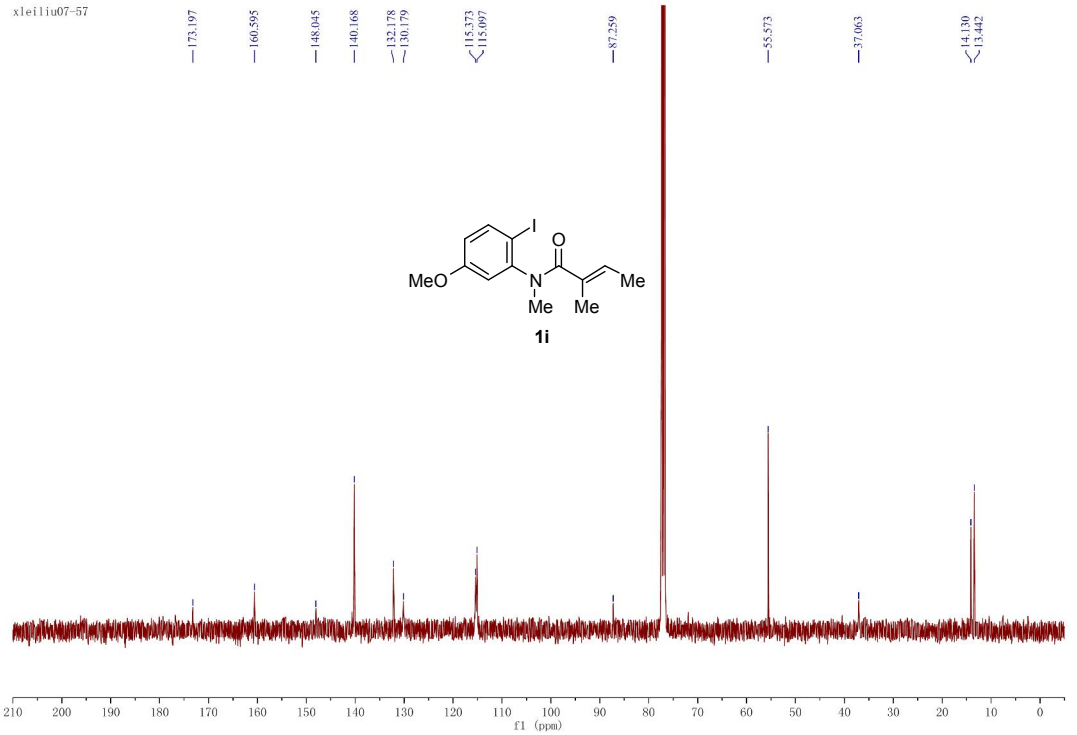
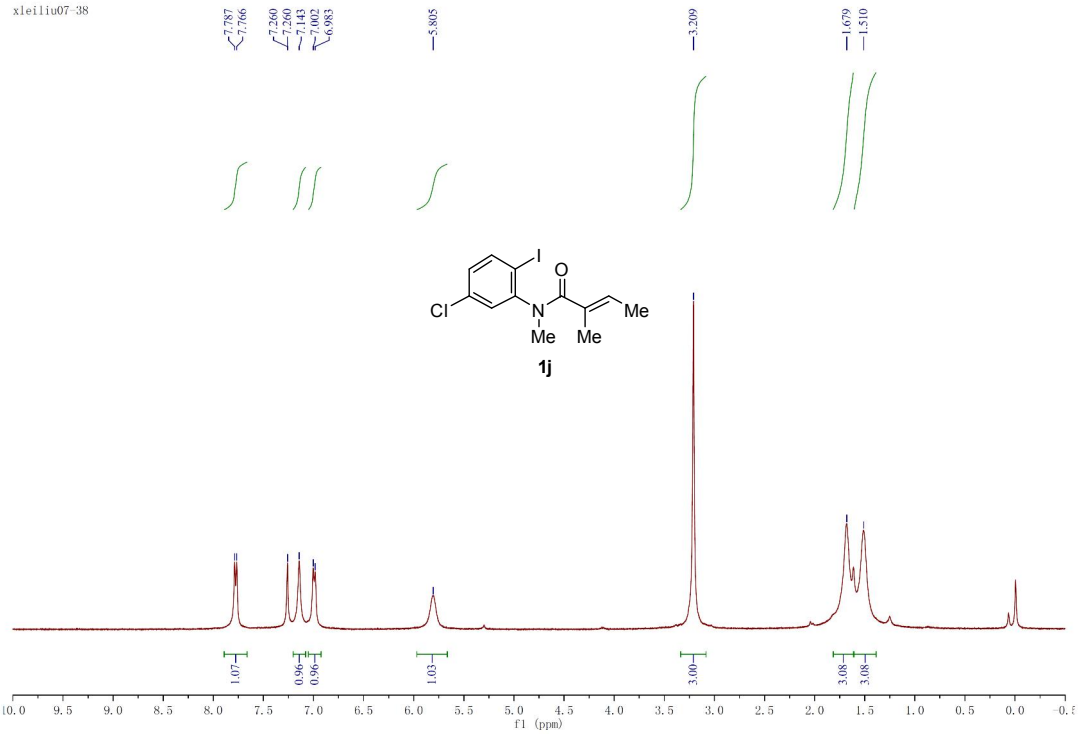
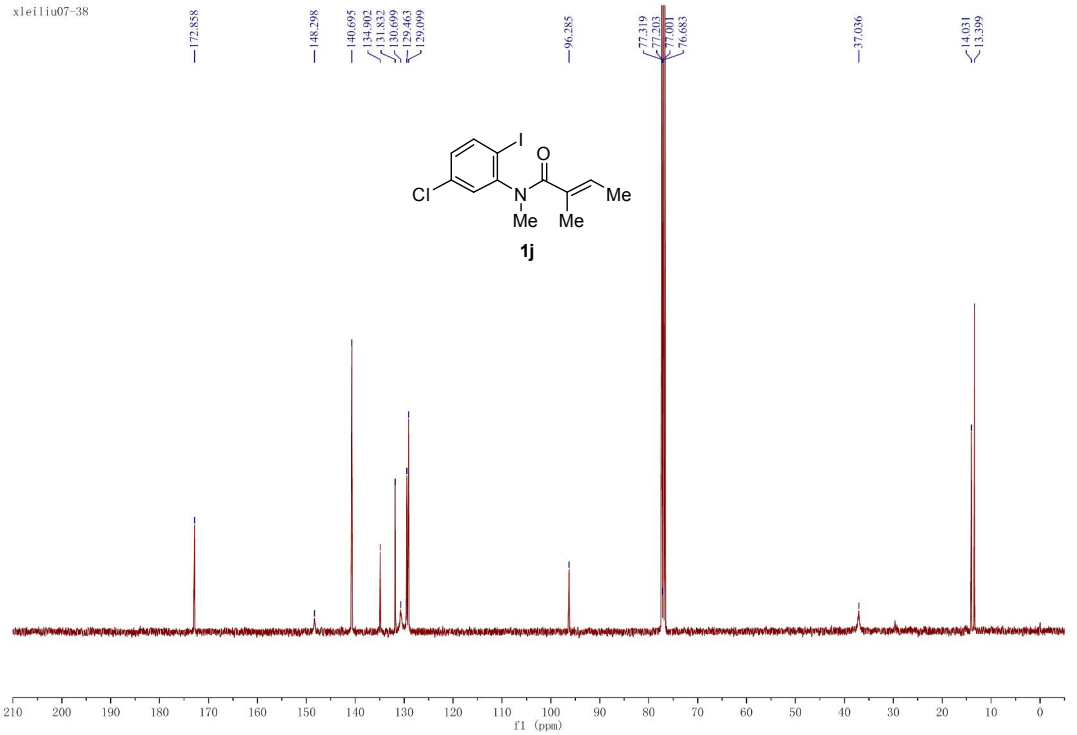
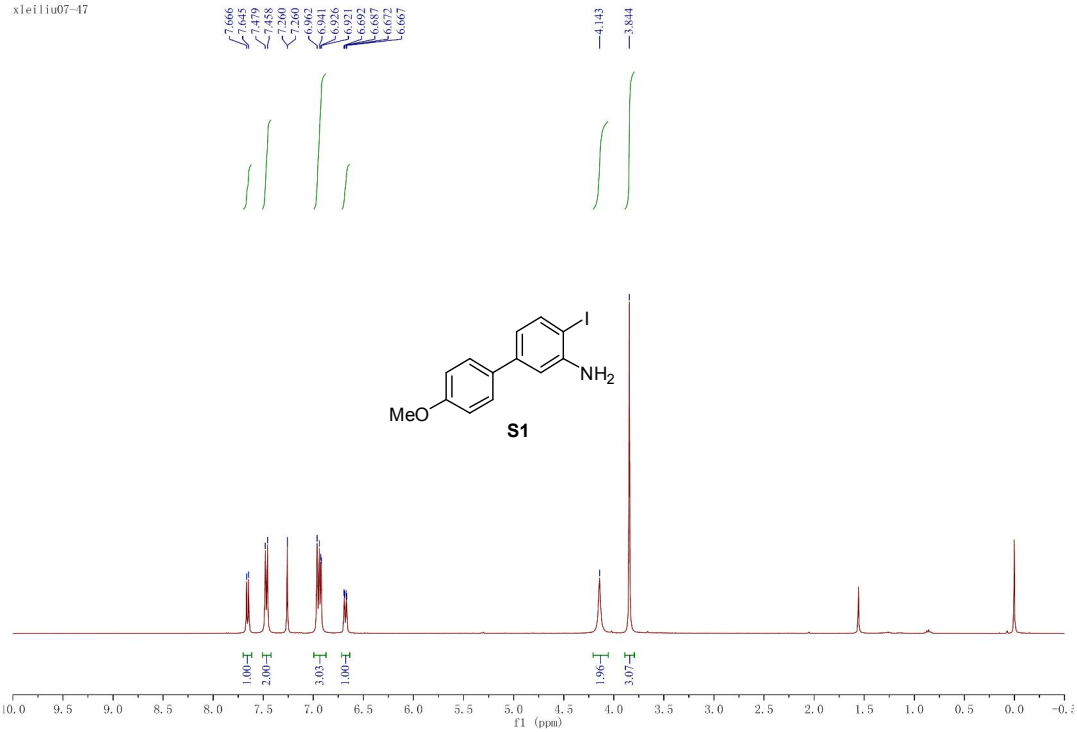
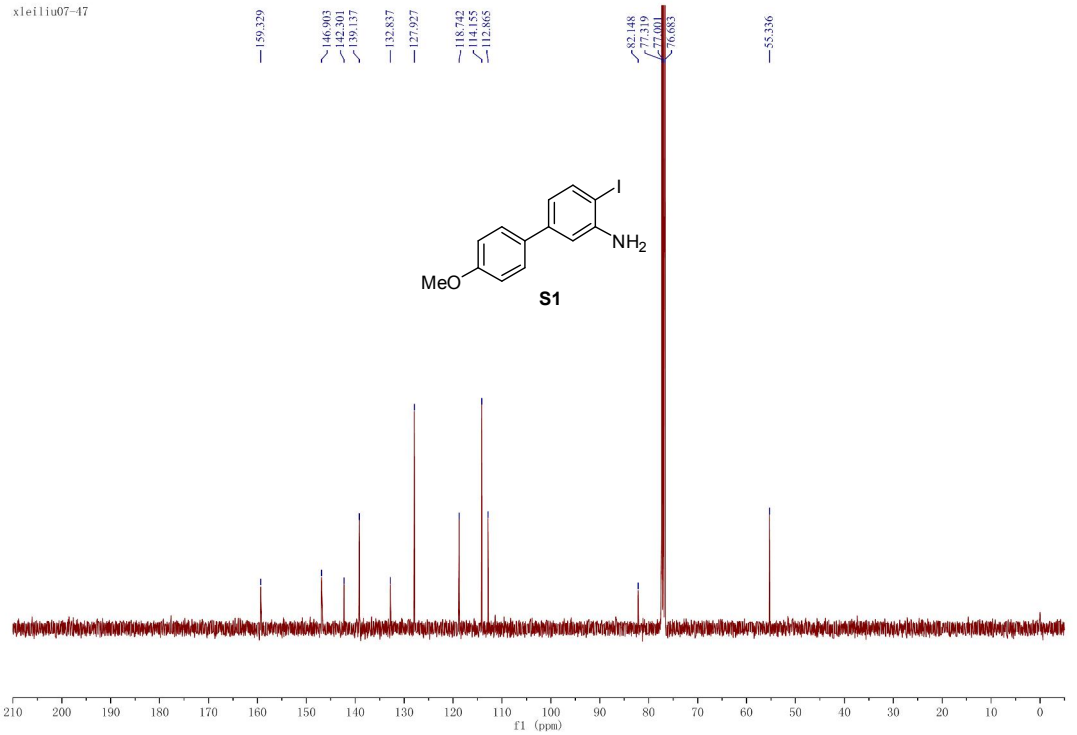
N
Me
Me
Me
1i
1.00
0.96
1.00
1.00
3.00
3.16
3.24
3.12
f1 (ppm)

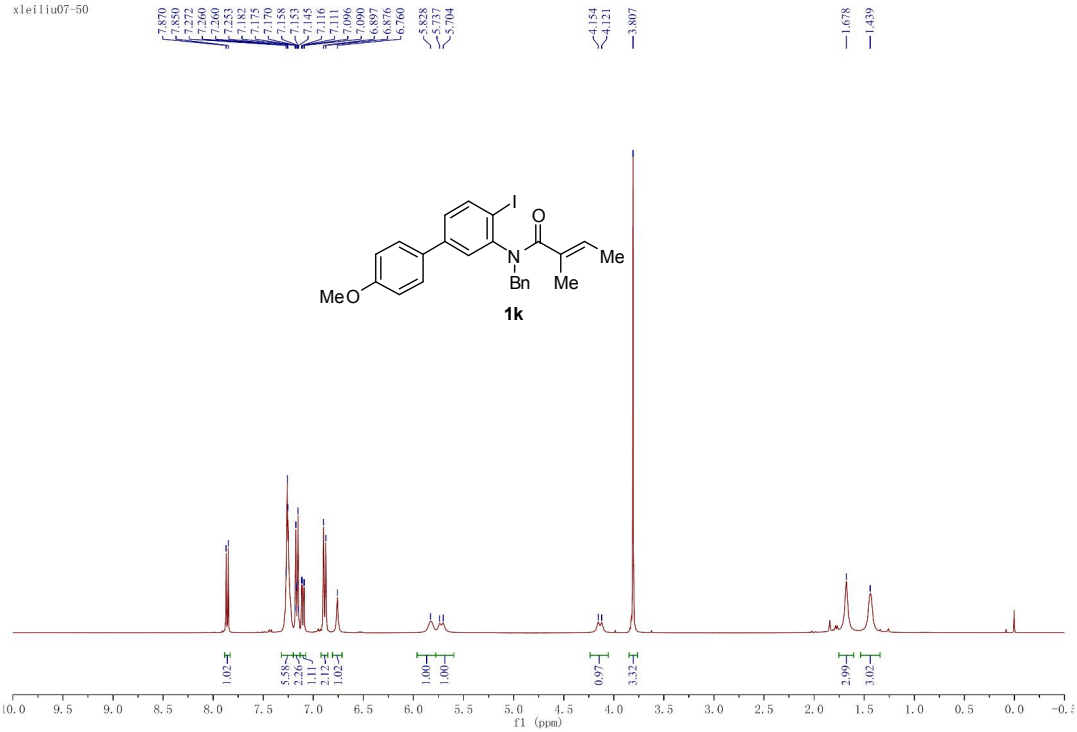

xleiliu07-57
173.197
160.595
148.045
140.168
132.178
130.179
115.373
115.097
87.259
55.573
37.063
14.130
13.442
I
O
MeO
N
Me
Me
Me
1i
f1 (ppm)

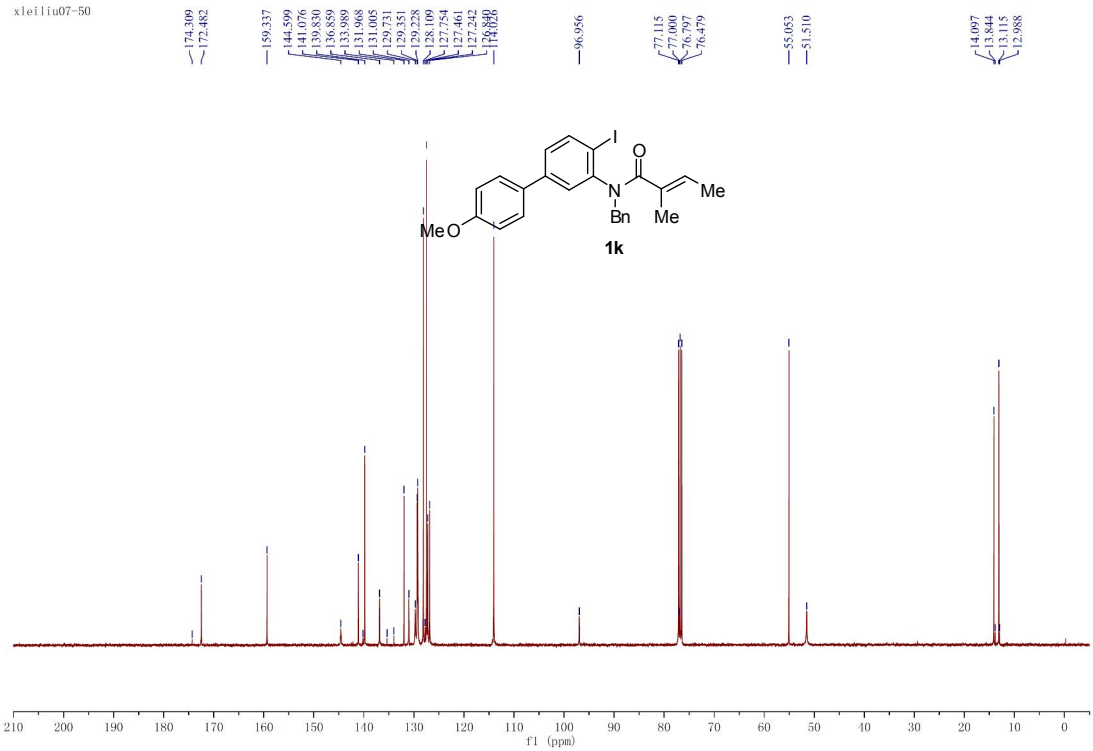

xleiliu07-38
7.787
7.766
7.260
7.260
7.143
7.002
6.983
5.805
3.209
1.679
1.510
1.07
0.96
0.96
1.03
3.00
3.08
3.08
f1 (ppm)

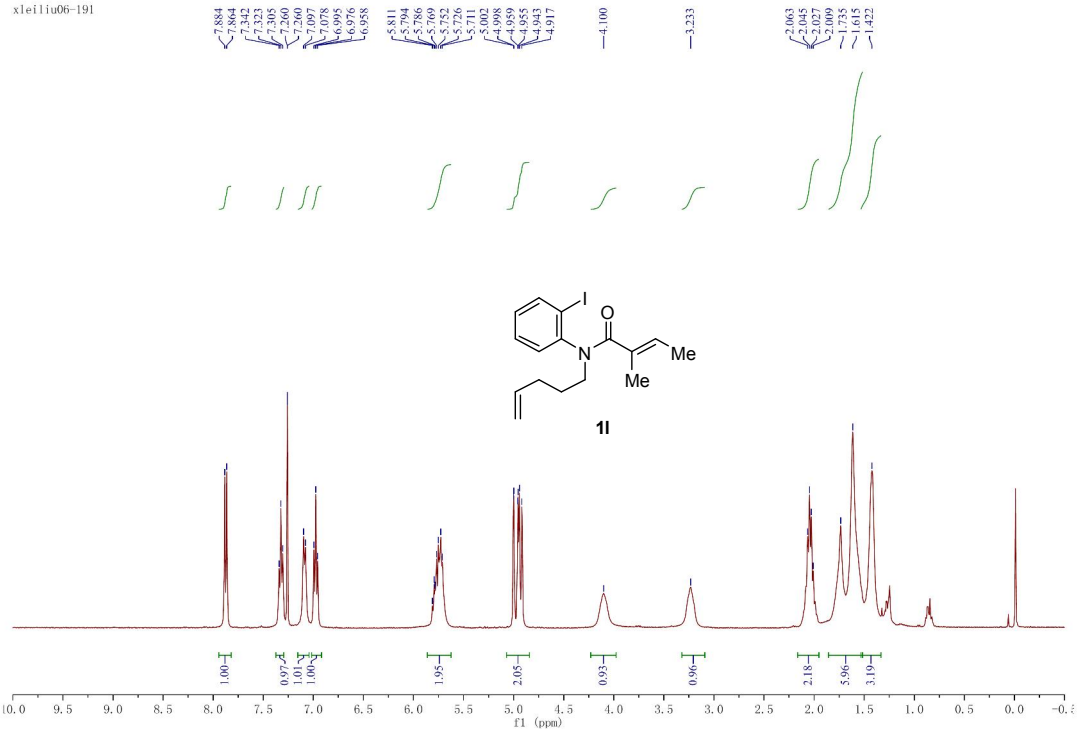

xleiliu07-38
172.858
148.298
140.695
134.902
131.832
130.699
129.463
129.099
96.285
77.319
77.203
77.001
76.683
37.036
14.031
13.399
f1 (ppm)

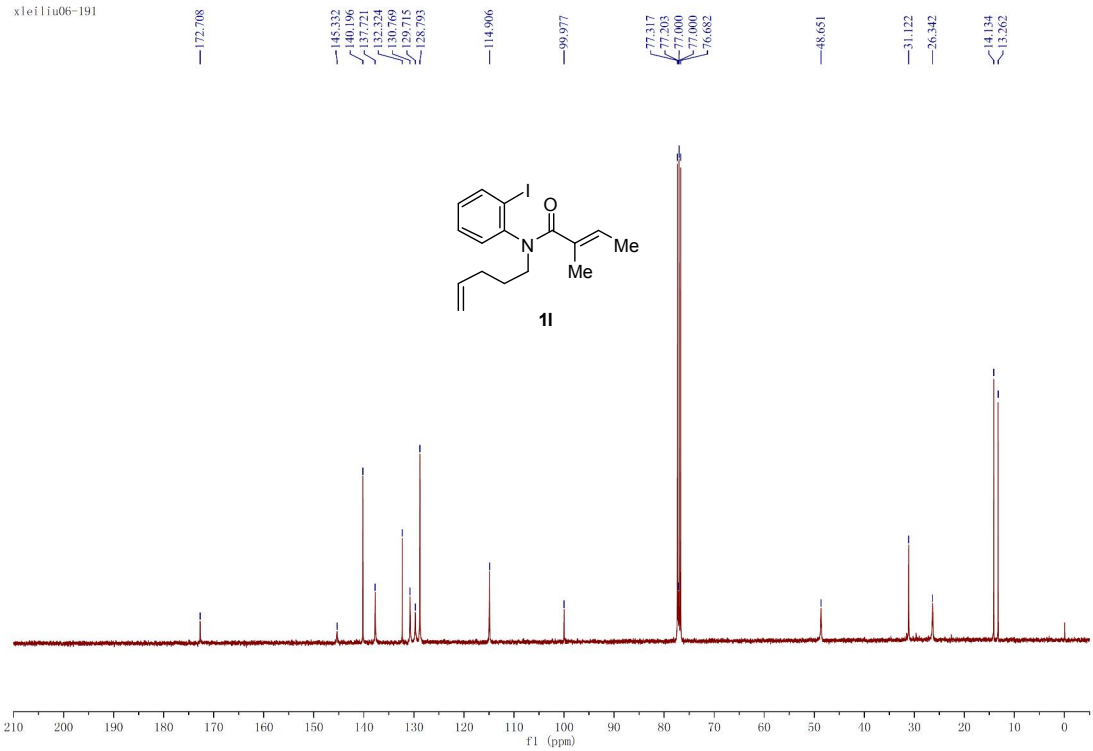

xleiliu07-47
7.666
7.645
7.479
7.458
7.260
7.260
6.962
6.941
6.926
6.921
6.692
6.657
6.672
6.667
4.143
3.844
I
NH2
MeO
S1
1.00
2.00
3.03
1.00
1.96
3.07
f1 (ppm)

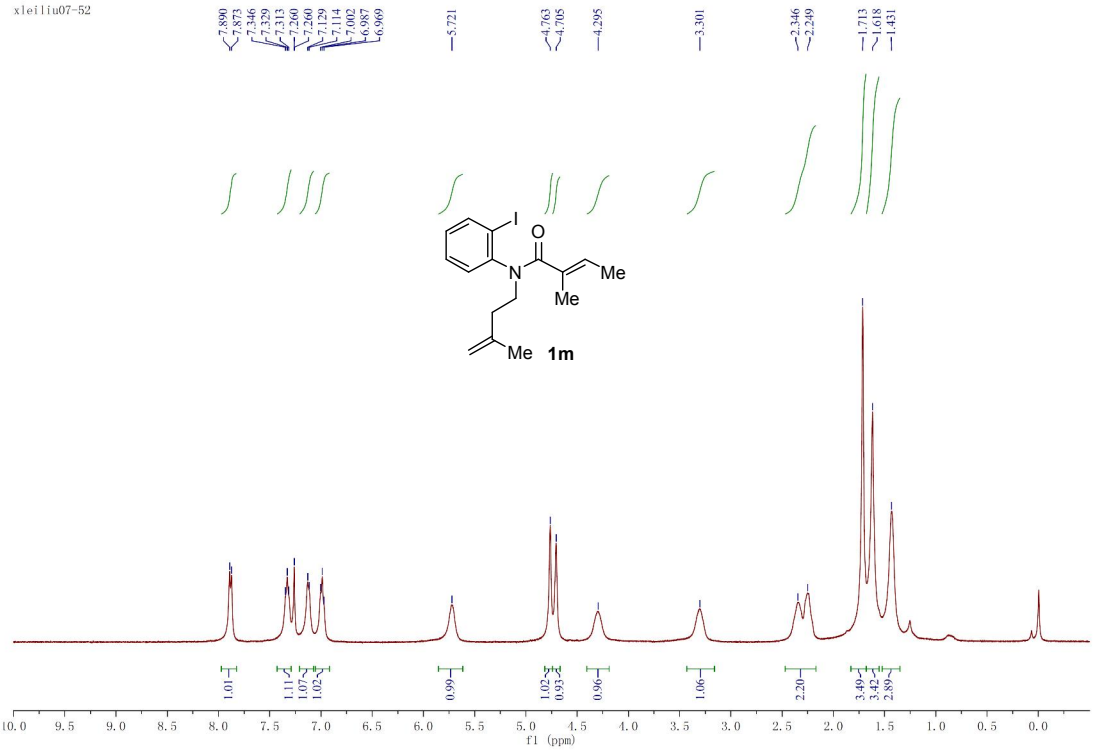

xleiliu07-47
159.329
146.903
142.301
139.137
132.837
127.927
118.742
114.155
112.865
82.148
77.319
77.001
76.683
55.336
I
NH2
MeO
S1
f1 (ppm)

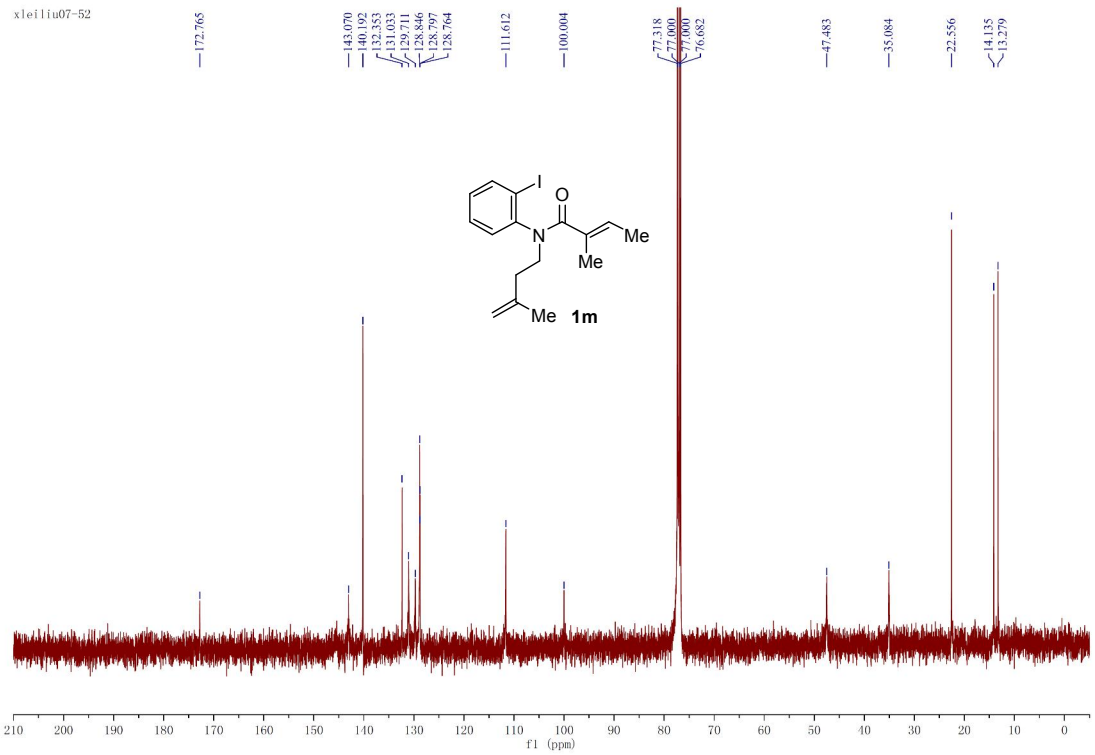

xleiliu07-50
7.870
7.850
7.272
7.260
7.260
7.253
7.182
7.175
7.170
7.158
7.153
7.145
7.116
7.111
7.096
7.090
6.897
6.876
6.760
5.828
5.737
5.704
4.154
4.121
3.807
1.678
1.439
I
O
N
Bn
Me
Me
MeO
1k
1.02
5.58
2.26
1.11
2.12
1.02
1.00
1.00
0.97
3.32
2.99
3.02
f1 (ppm)

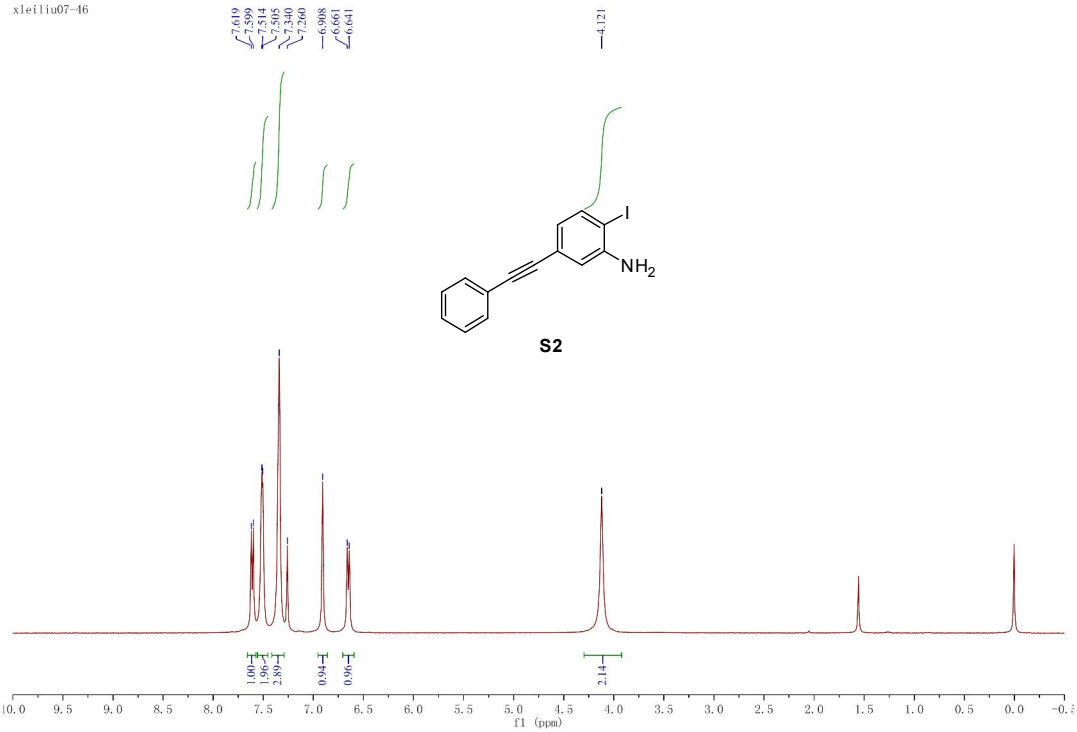

xleiliu07-50
174.309
172.482
159.337
144.599
141.076
139.830
136.859
133.989
131.968
131.005
129.731
129.351
129.228
128.109
127.754
127.461
127.242
96.956
77.115
77.000
76.797
76.479
55.053
51.510
14.097
13.844
13.115
12.988
I
O
N
Bn
Me
Me
MeO
1k
f1 (ppm)

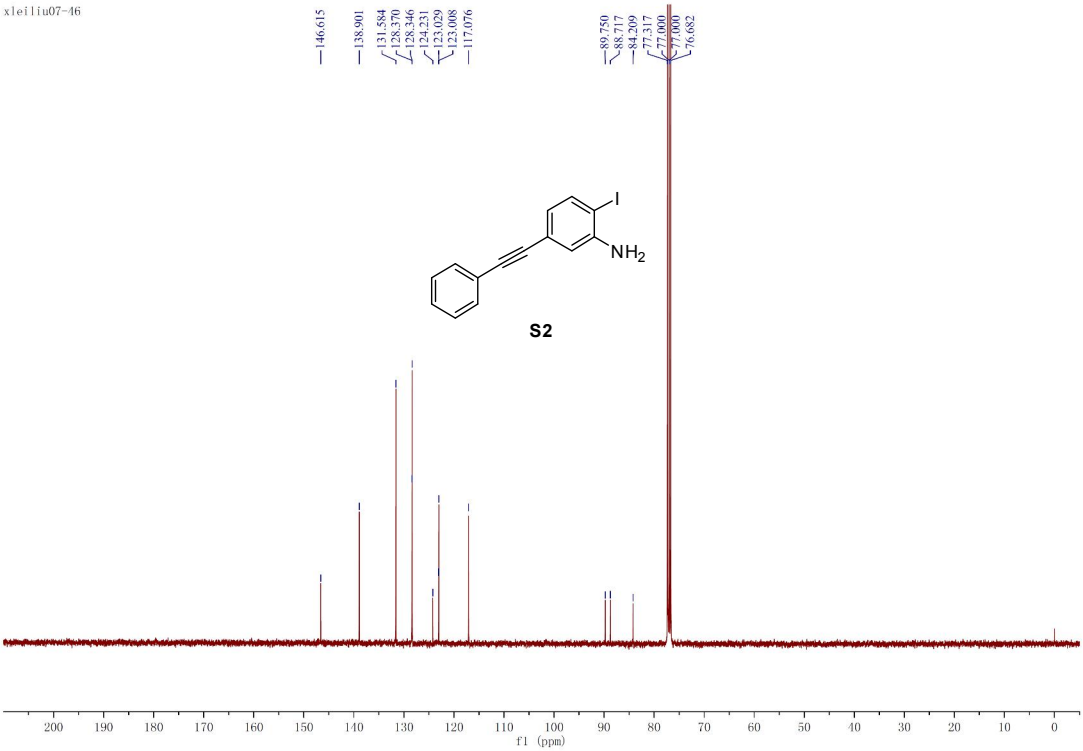

xleiliu06-191
7.884
7.864
7.342
7.323
7.305
7.260
7.260
7.097
7.078
6.995
6.976
6.958
5.811
5.794
5.786
5.769
5.752
5.726
5.711
5.002
4.998
4.959
4.955
4.943
4.917
4.100
3.233
2.063
2.045
2.027
2.009
1.735
1.615
1.422
I
O
N
Me
Me
1l
1.00
0.97
1.01
1.00
1.95
2.05
0.93
0.96
2.18
5.96
3.19
f1 (ppm)

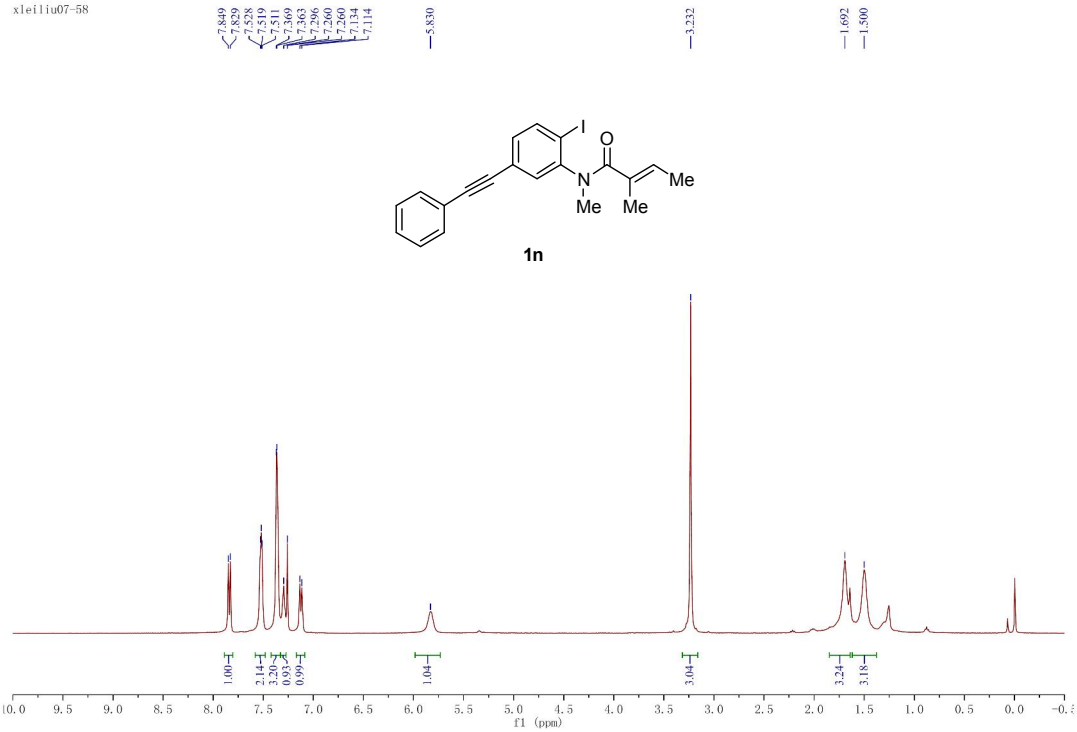

xleiliu06-191
172.708
145.332
140.196
137.721
132.324
130.769
129.715
128.793
114.906
99.977
77.317
77.203
77.000
77.000
76.682
48.651
31.122
26.342
14.134
13.262
I
O
N
Me
Me
1l
f1 (ppm)

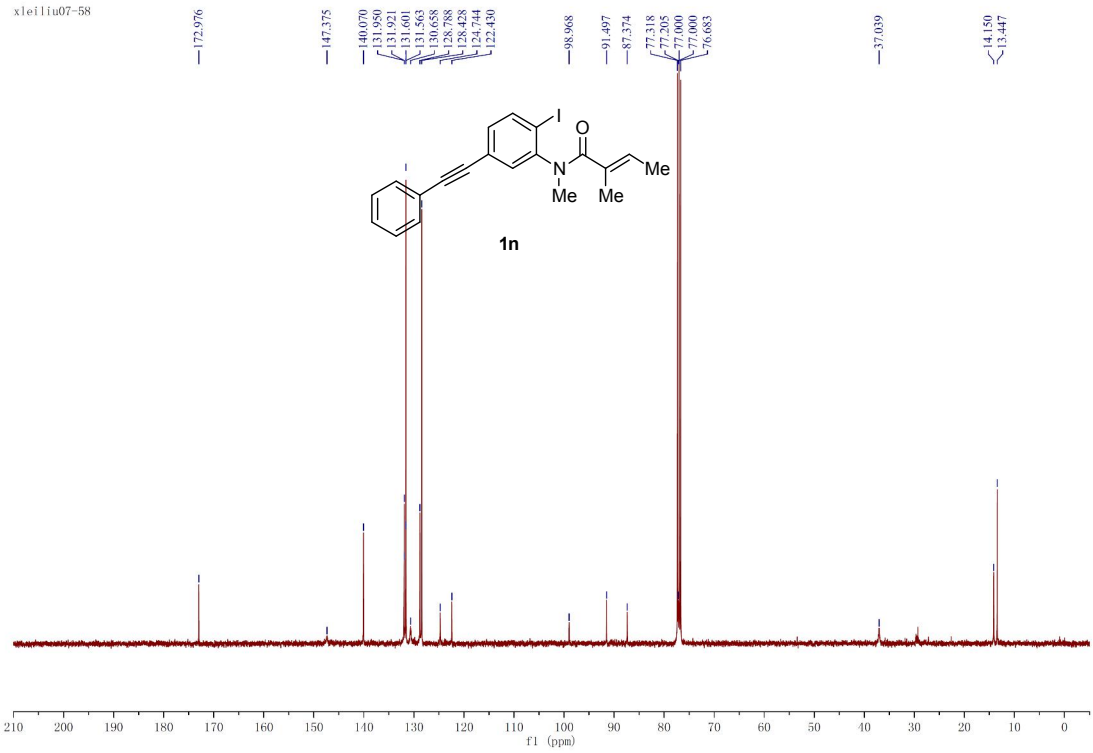

xleiliu07-52
7.890
7.873
7.346
7.329
7.313
7.260
7.260
7.129
7.114
7.002
6.987
6.969
5.721
4.763
4.705
4.295
3.301
2.346
2.249
1.713
1.618
1.431
I
O
N
Me
Me
Me
1m
1.01
1.11
1.07
1.02
0.99
1.02
0.93
0.96
1.06
2.20
3.49
3.42
2.89
f1 (ppm)

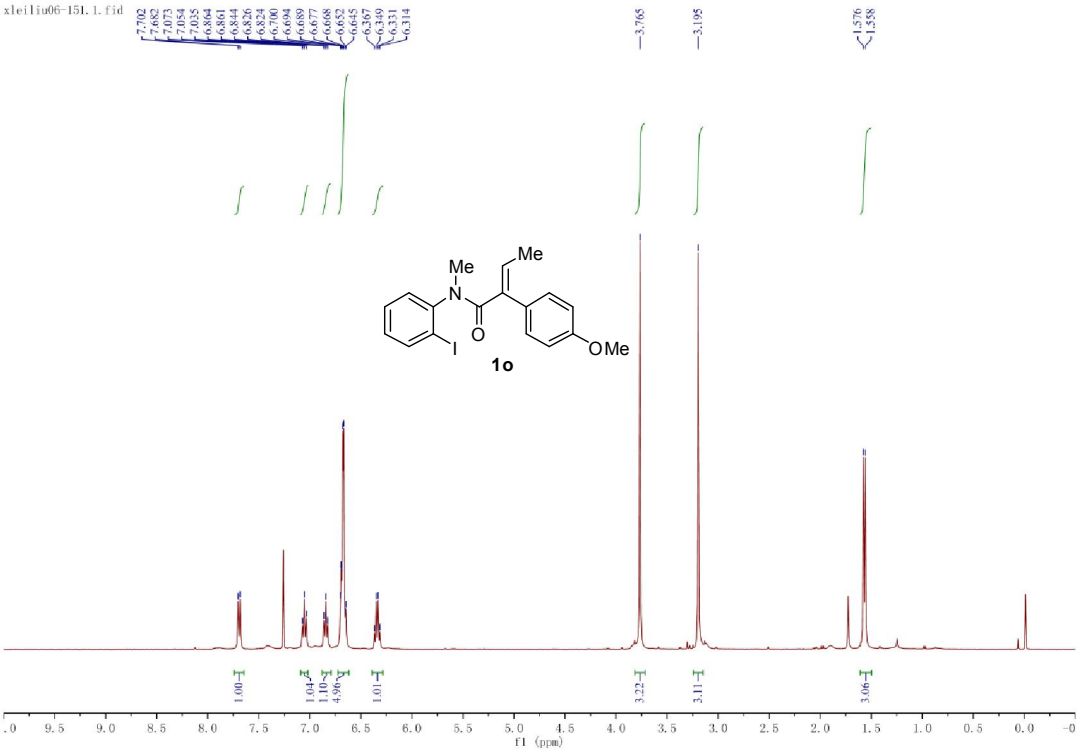

xleiliu07-52
172.765
143.070
140.192
132.353
131.033
129.711
128.846
128.797
128.764
111.612
100.004
77.318
77.000
76.682
47.483
35.084
22.556
14.135
13.279
I
O
N
Me
Me
Me
1m
f1 (ppm)

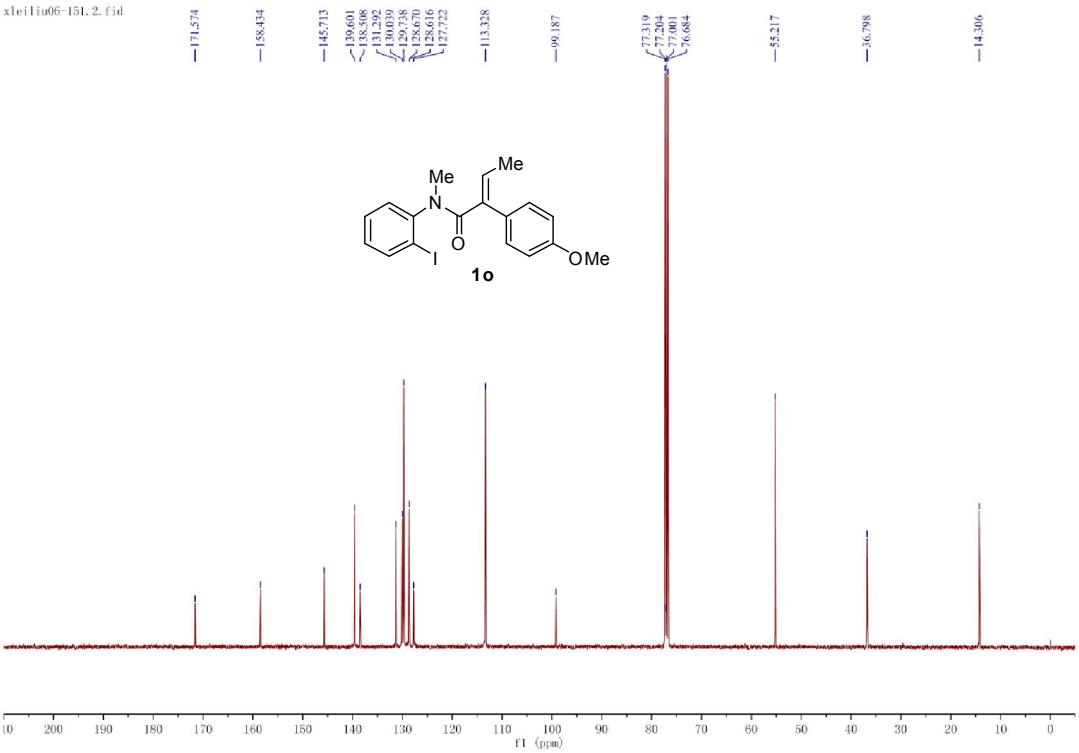

xleiliu07-46
7.619
7.599
7.514
7.505
7.340
7.260
6.908
6.661
6.641
4.121
I
NH2
S2
1.00
1.96
2.89
0.94
0.96
2.14
f1 (ppm)

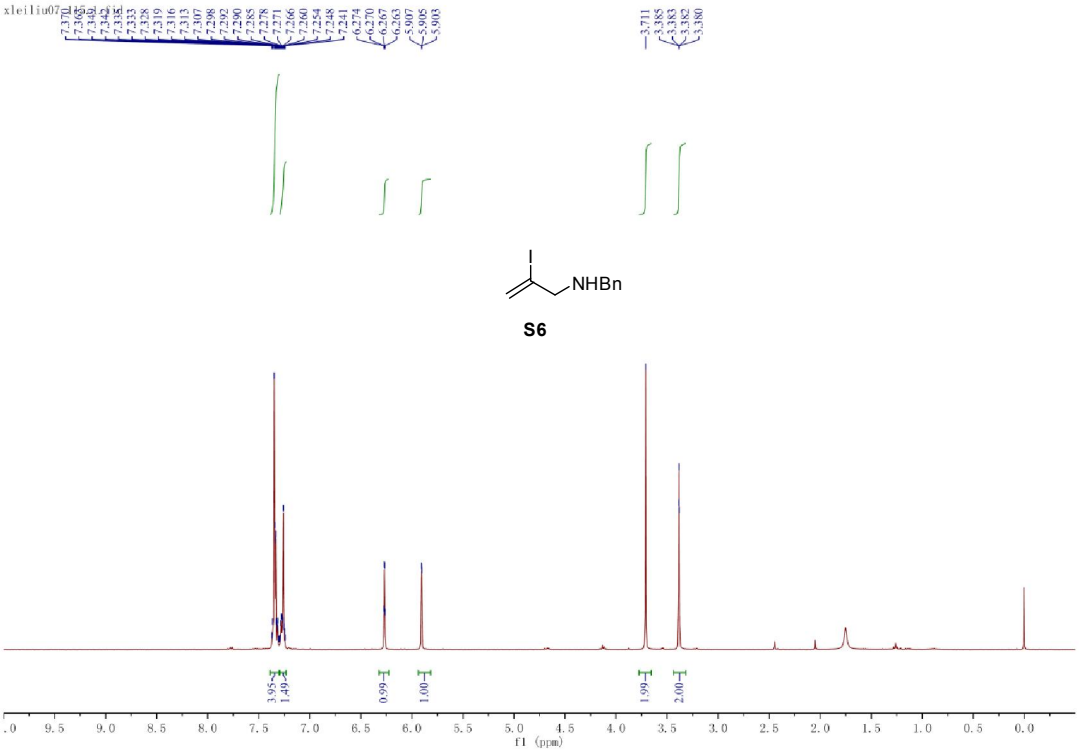

xleiliu07-46
146.615
138.901
131.584
128.370
128.346
124.231
123.029
123.008
117.076
89.750
88.717
84.209
77.317
77.000
76.682
I
NH2
S2
f1 (ppm)

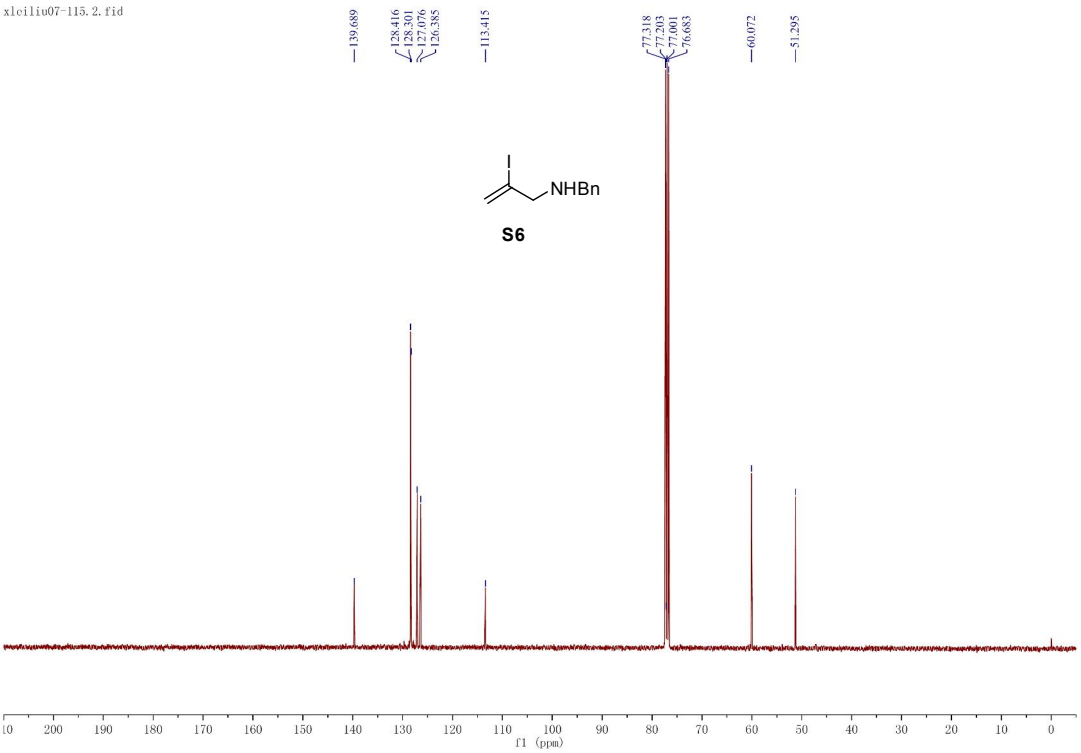

xleiliu07-58
7.849
7.829
7.528
7.519
7.511
7.369
7.363
7.296
7.260
7.260
7.134
7.114
5.830
3.232
1.692
1.500
I
O
N
Me
Me
Me
1n
1.00
2.14
3.20
0.93
0.99
1.04
3.04
3.24
3.18
f1 (ppm)

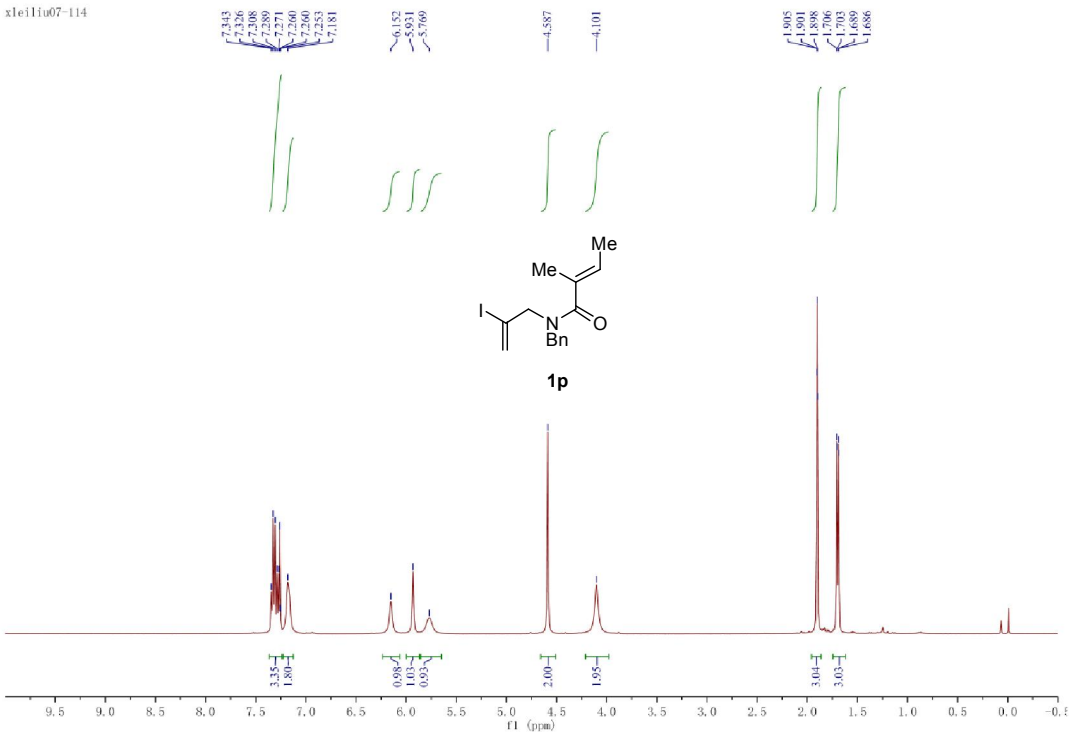

xleiliu07-58
172.976
147.375
140.070
131.950
131.921
131.601
131.563
130.658
128.788
128.428
124.744
122.430
98.968
91.497
87.374
77.318
77.205
77.000
77.000
76.683
37.039
14.150
13.447
I
O
N
Me
Me
Me
1n
f1 (ppm)

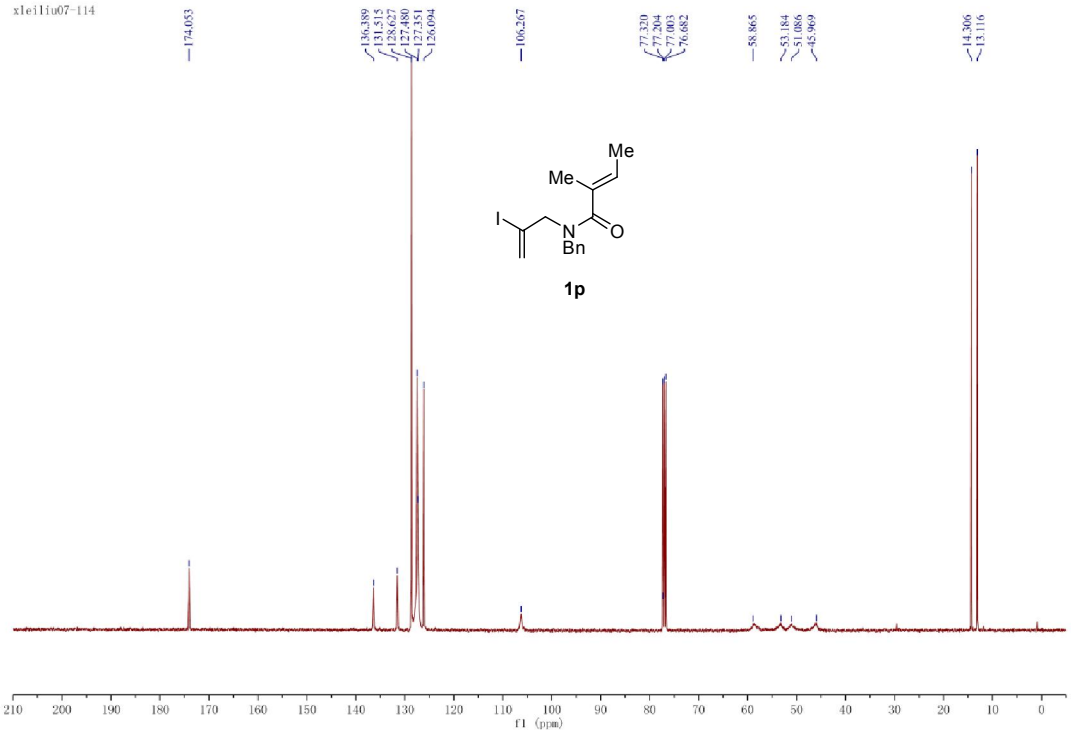

xleiliu06-151.1.fid
7.702
7.682
7.073
7.054
7.035
6.864
6.844
6.826
6.824
6.700
6.694
6.689
6.677
6.668
6.652
6.645
6.367
6.349
6.331
6.314
3.765
3.195
1.576
1.558
Me
Me
N
O
I
OMe
1o
1.00
1.04
1.10
4.96
1.01
3.22
3.11
3.06
f1 (ppm)

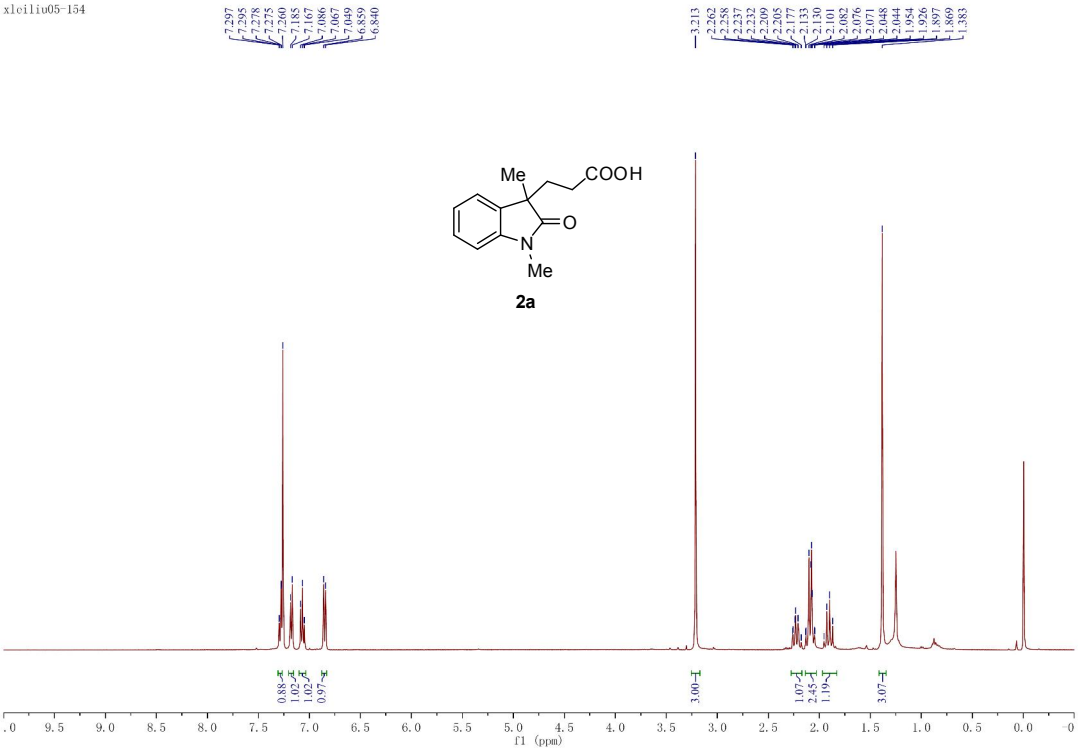

xleiliu06-151.2.fid
171.574
158.434
145.713
139.601
138.508
131.292
130.039
129.758
129.670
128.616
127.722
113.328
99.187
77.319
77.204
77.001
76.684
55.217
36.798
14.306
Me
Me
N
O
I
OMe
1o
f1 (ppm)

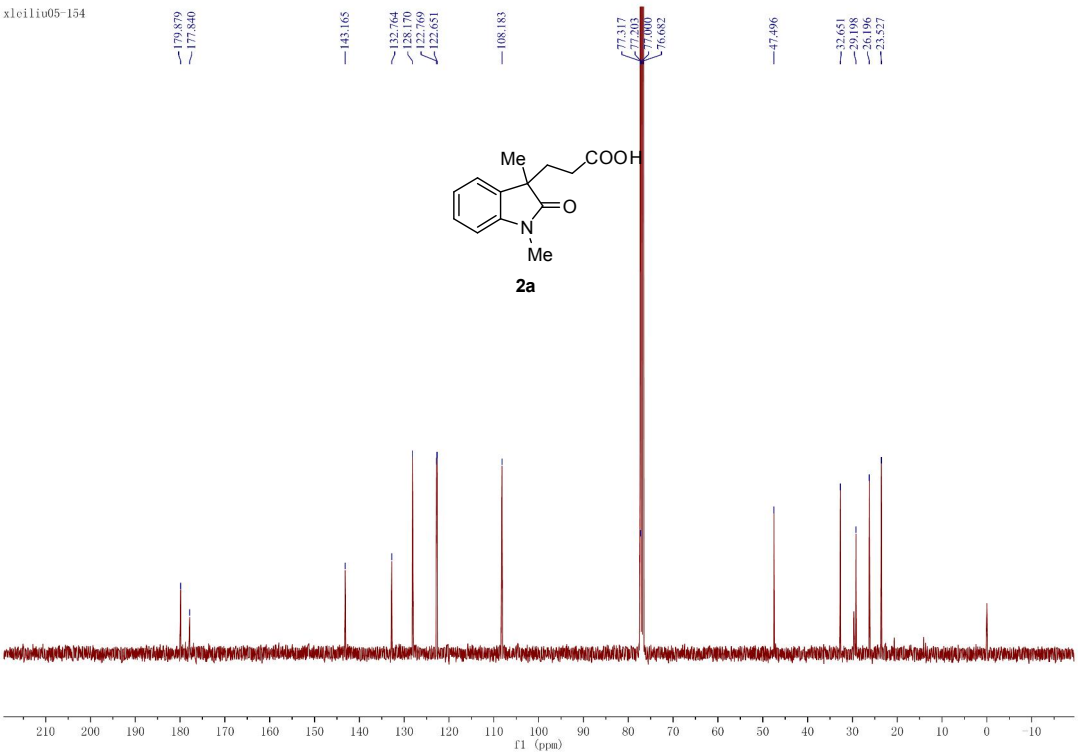

xleiliu07
7.371
7.365
7.349
7.342
7.335
7.333
7.328
7.319
7.316
7.313
7.307
7.298
7.292
7.290
7.285
7.278
7.271
7.266
7.264
7.254
7.248
7.241
6.274
6.270
6.267
6.263
5.907
5.905
5.903
3.711
3.385
3.383
3.382
3.380
I
NHBn
S6
3.95
1.49
0.99
1.00
1.99
2.00
f1 (ppm)

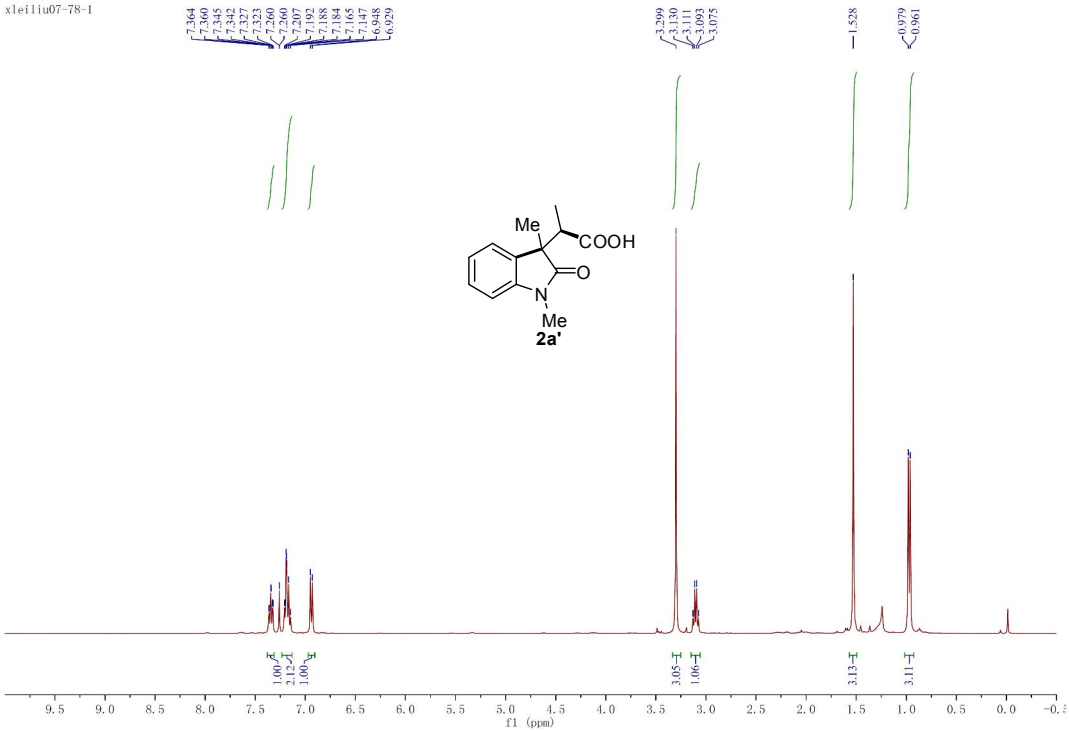

xleiliu07-115.2.fid
139.689
128.416
128.301
127.076
126.385
113.415
77.318
77.203
77.001
76.683
60.072
51.295
I
NHBn
S6
f1 (ppm)

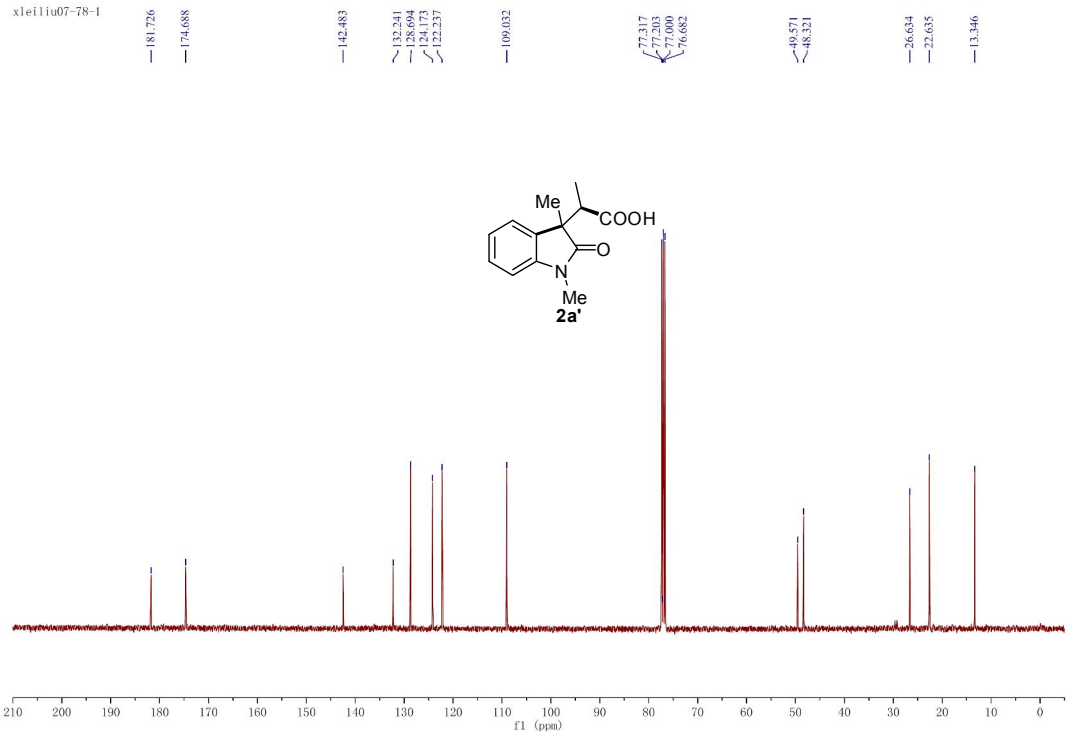

xleiliu07-114
7.343
7.326
7.308
7.289
7.271
7.260
7.260
7.253
7.181
6.152
5.931
5.769
4.587
4.101
1.905
1.901
1.898
1.706
1.703
1.689
1.686
Me
Me
I
N
Bn
O
1p
3.35
1.80
0.98
1.03
0.93
2.00
1.95
3.04
3.03
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

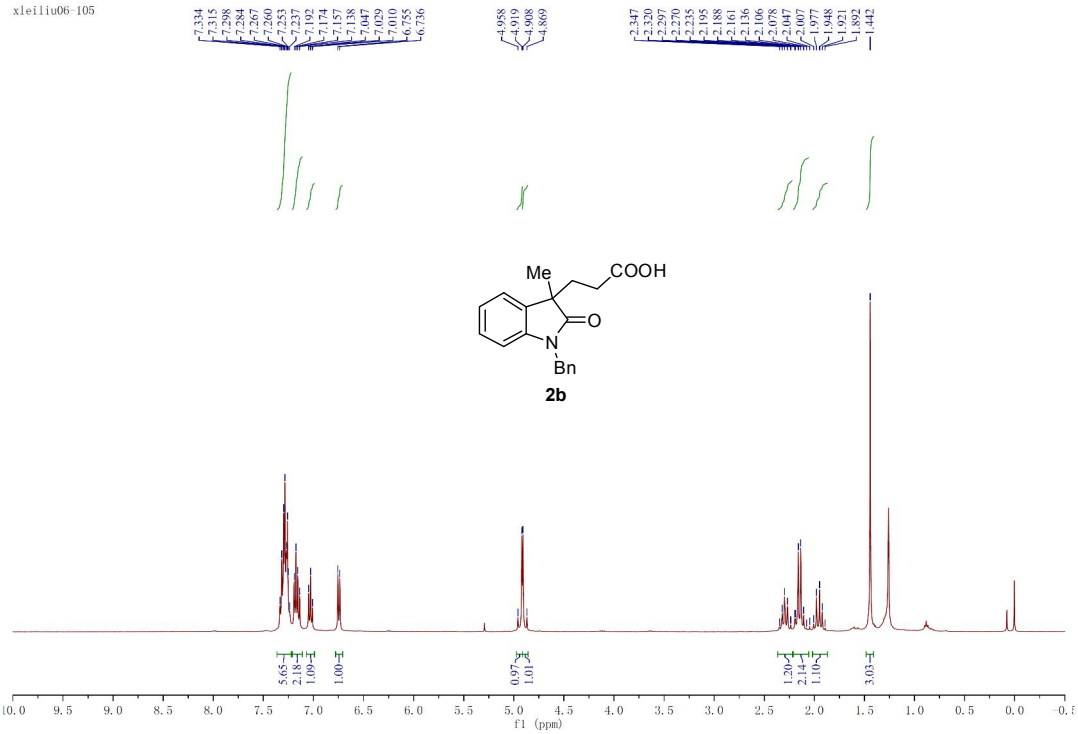

xleiliu07-114
174.053
136.389
131.515
128.627
127.480
127.351
126.094
106.267
77.320
77.204
77.003
76.682
58.865
53.184
51.086
45.969
14.306
13.116
Me
Me
I
N
Bn
O
1p
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

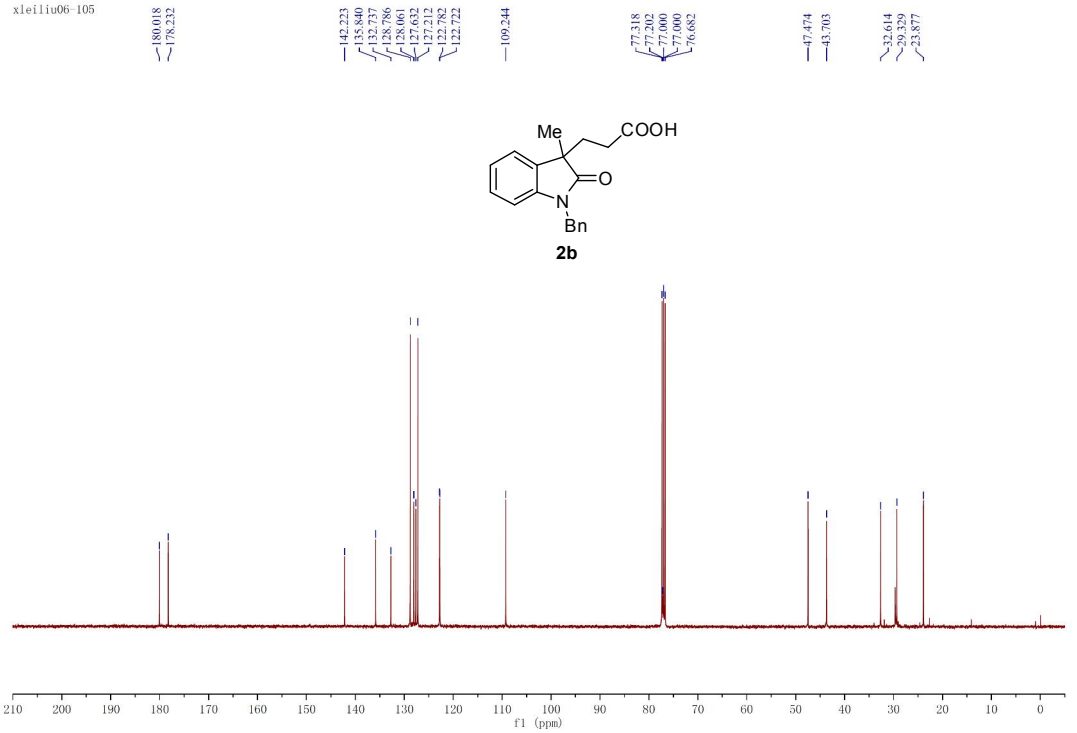

xleiliu05-154
7.297
7.295
7.278
7.275
7.260
7.185
7.167
7.086
7.067
7.049
6.859
6.840
3.213
2.262
2.258
2.237
2.232
2.209
2.205
2.177
2.133
2.130
2.101
2.082
2.076
2.071
2.048
2.044
1.954
1.926
1.897
1.869
1.383
Me
COOH
O
N
Me
2a
0.88
1.02
1.02
0.97
3.00
1.07
2.45
1.19
3.07
f1 (ppm)

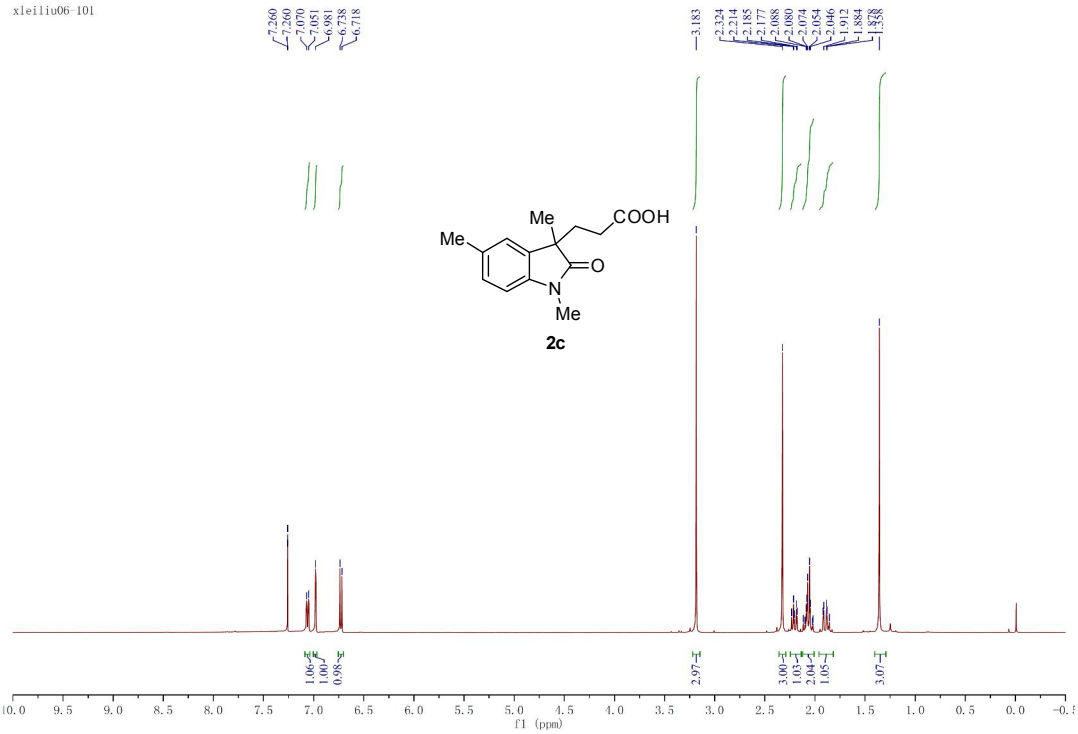

xleiliu05-154
179.879
177.840
143.165
132.764
128.170
122.769
122.651
108.183
77.317
77.203
77.000
76.682
47.496
32.651
29.198
26.196
23.527
Me
COOH
O
N
Me
2a
f1 (ppm)

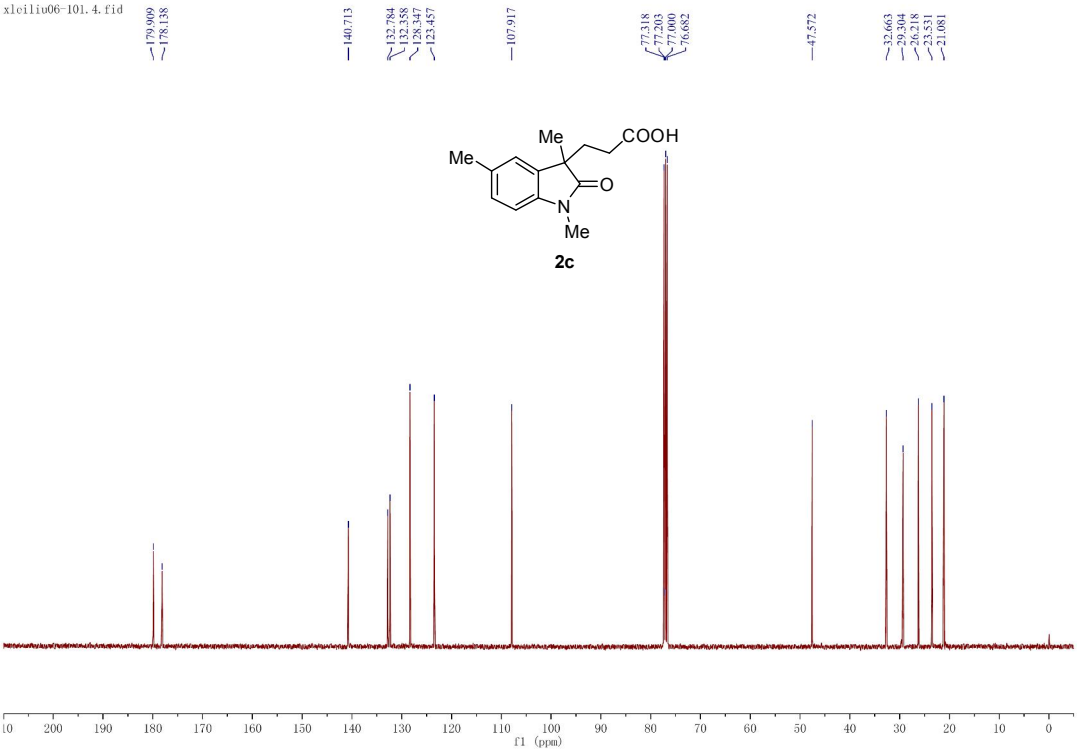

xleiliu07-78-1
7.364
7.360
7.345
7.342
7.327
7.323
7.260
7.260
7.207
7.197
7.192
7.188
7.184
7.165
7.147
6.948
6.929
3.299
3.130
3.111
3.093
3.075
1.528
0.979
0.961
Me
COOH
O
N
Me
2a'
1.00
2.12
1.00
3.05
1.06
3.13
3.11
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

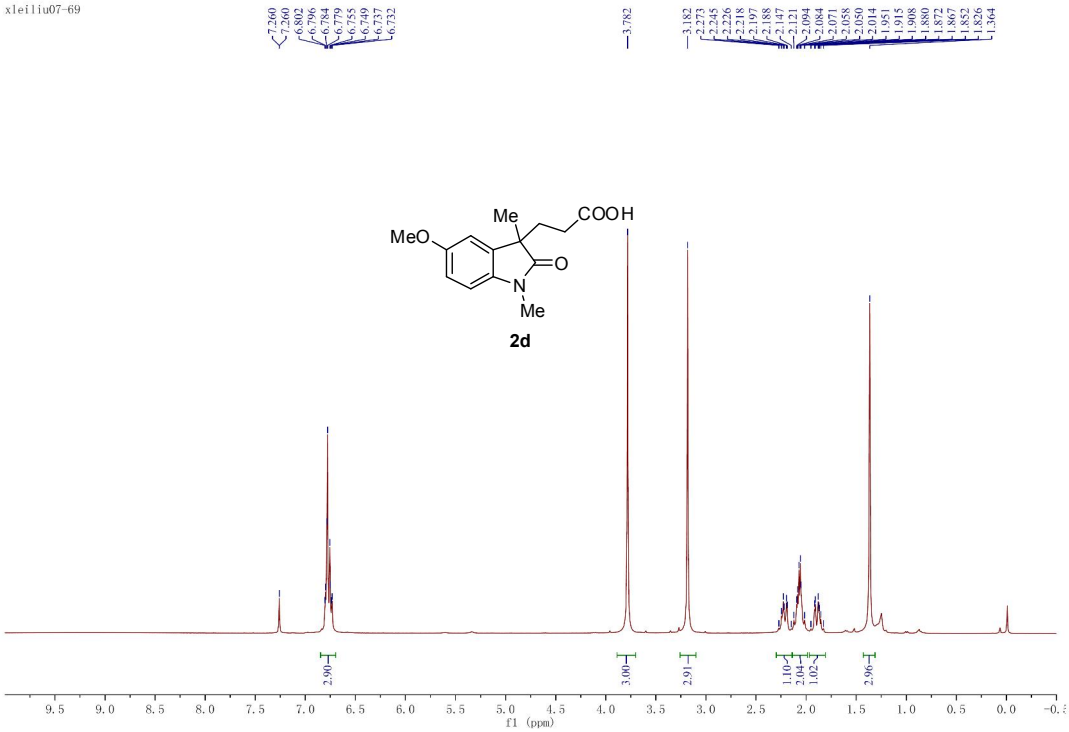

xleiliu07-78-1
181.726
174.688
142.483
132.241
128.694
124.173
122.237
109.032
77.317
77.203
77.000
76.682
49.571
48.321
26.634
22.635
13.346
Me
COOH
O
N
Me
2a'
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

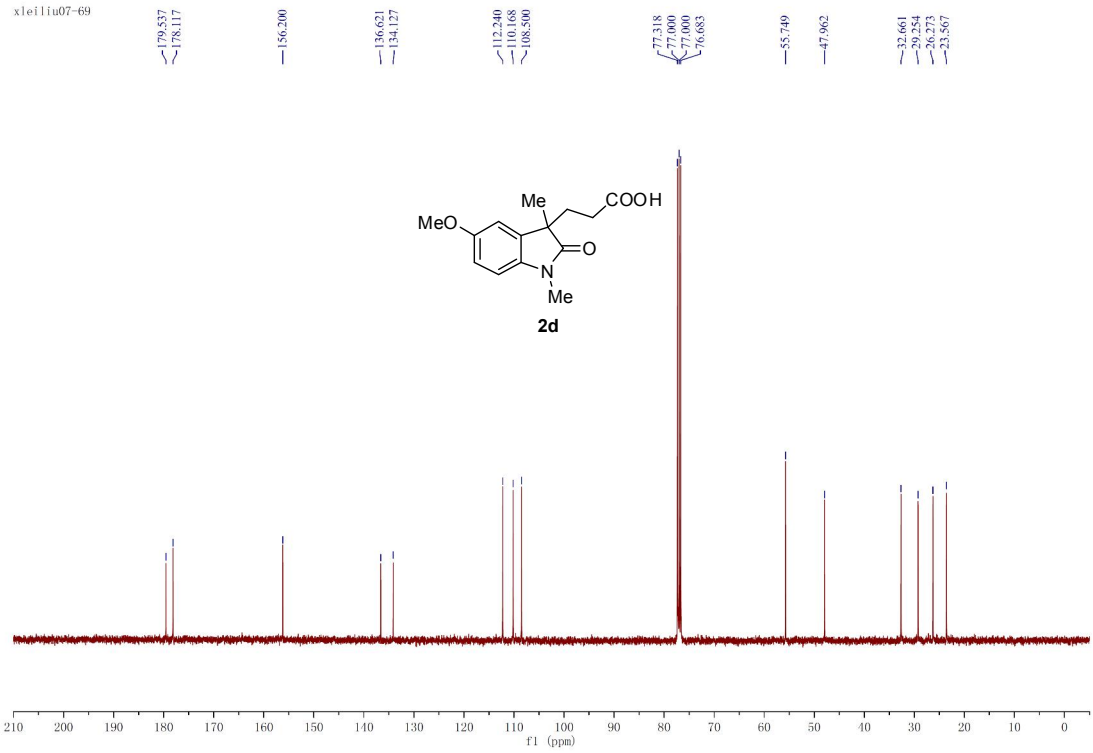

xleiliu06-105
7.334
7.315
7.298
7.284
7.267
7.260
7.253
7.237
7.192
7.174
7.157
7.138
7.047
7.029
7.010
6.755
6.736
4.958
4.919
4.908
4.869
2.347
2.320
2.297
2.270
2.235
2.195
2.188
2.161
2.136
2.106
2.078
2.047
2.007
1.977
1.948
1.921
1.892
1.442
Me
COOH
O
N
Bn
2b
5.65
2.18
1.09
1.00
0.97
1.01
1.20
2.14
1.10
3.03
f1 (ppm)

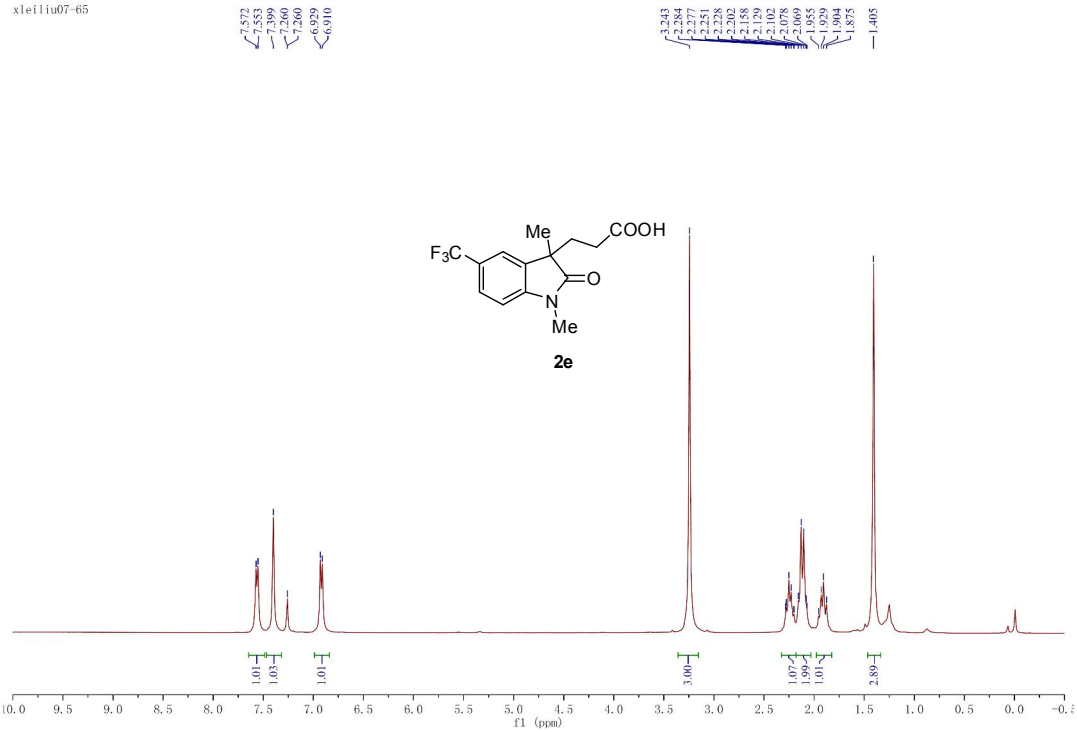

xleiliu06-105
180.018
178.232
142.223
135.840
132.737
128.786
128.060
127.632
127.212
122.782
122.722
109.244
77.318
77.202
77.000
77.000
76.682
47.474
43.703
32.614
29.329
23.877
Me
COOH
O
N
Bn
2b
f1 (ppm)

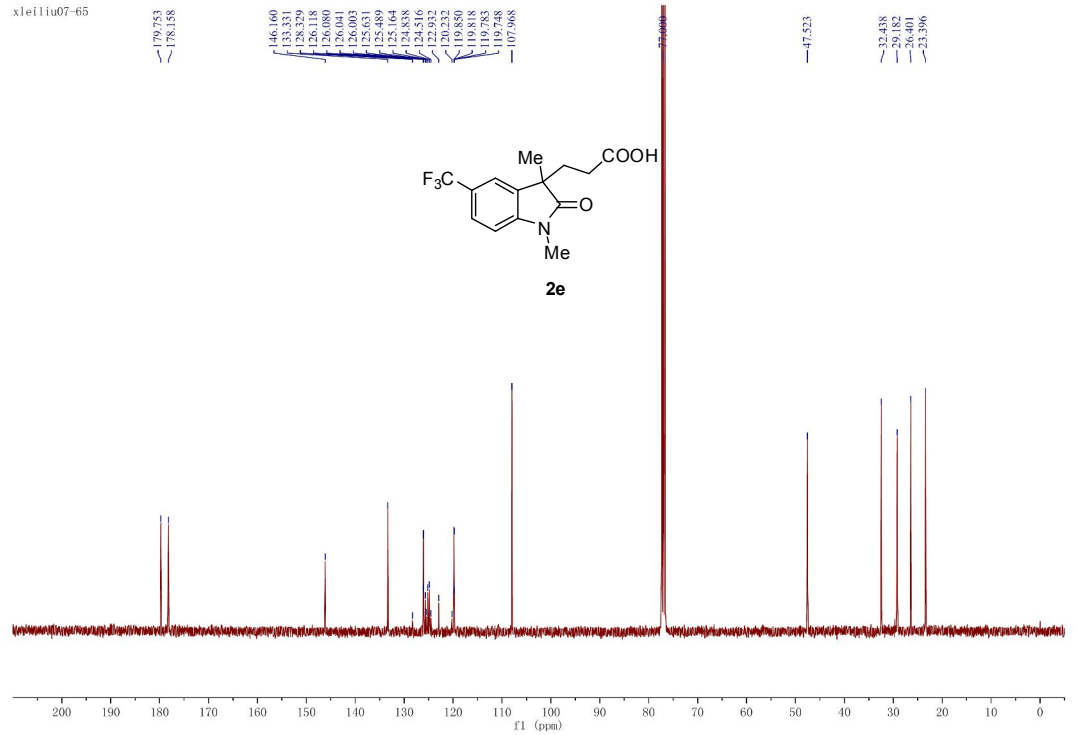

xleiliu06-101
7.260
7.260
7.070
7.051
6.981
6.738
6.718
3.183
2.324
2.214
2.185
2.177
2.088
2.080
2.074
2.054
2.046
1.912
1.884
1.838
1.538
Me
COOH
Me
O
N
Me
2c
1.06
1.00
0.98
2.97
3.00
1.03
2.04
1.05
3.07
f1 (ppm)


xleiliu06-101.4.fid
179.909
178.138
140.713
132.784
132.338
128.347
123.457
107.917
77.318
77.203
77.000
76.682
47.572
32.663
29.304
26.218
23.531
21.081
Me
COOH
Me
O
N
Me
2c
f1 (ppm)

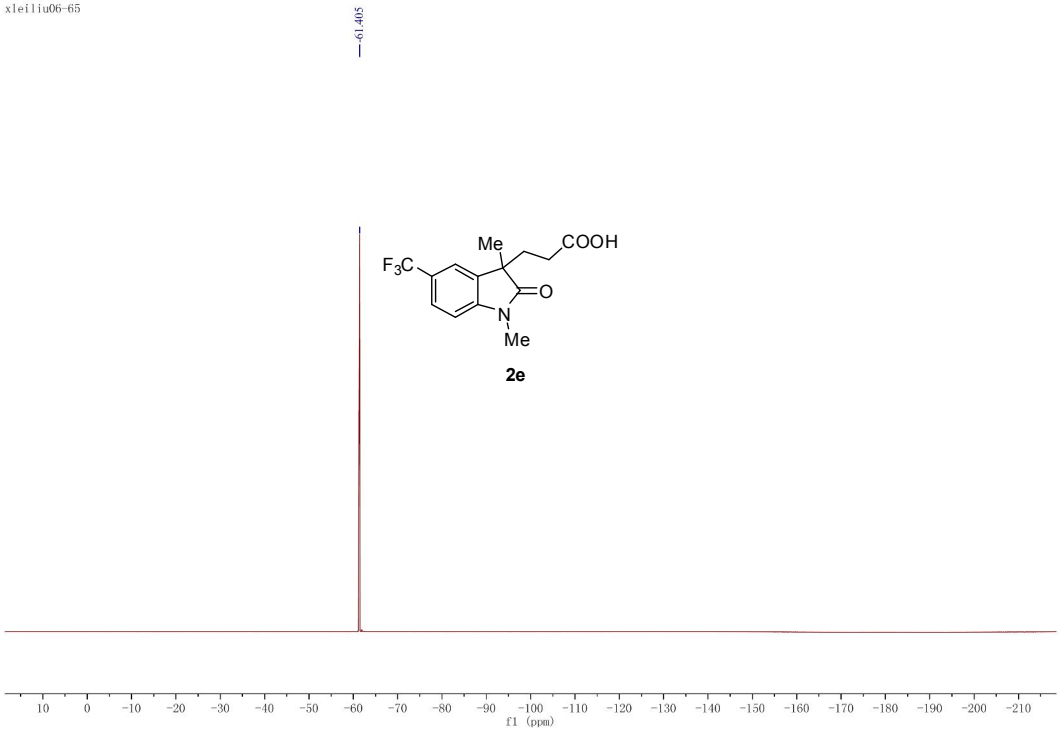

xleiliu07-69
7.260
7.260
6.802
6.796
6.784
6.779
6.755
6.749
6.737
6.732
3.782
3.182
2.273
2.245
2.226
2.218
2.197
2.188
2.147
2.121
2.094
2.084
2.071
2.058
2.050
2.014
1.951
1.915
1.908
1.880
1.872
1.867
1.852
1.826
1.364
Me
COOH
MeO
O
N
Me
2d
2.90
3.00
2.91
1.10
2.04
1.02
2.96
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


xleiliu07-69
179.537
178.117
156.200
136.621
134.127
112.240
110.168
108.500
77.318
77.000
77.000
76.683
55.749
47.962
32.661
29.254
26.273
23.567
Me
COOH
MeO
O
N
Me
2d
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

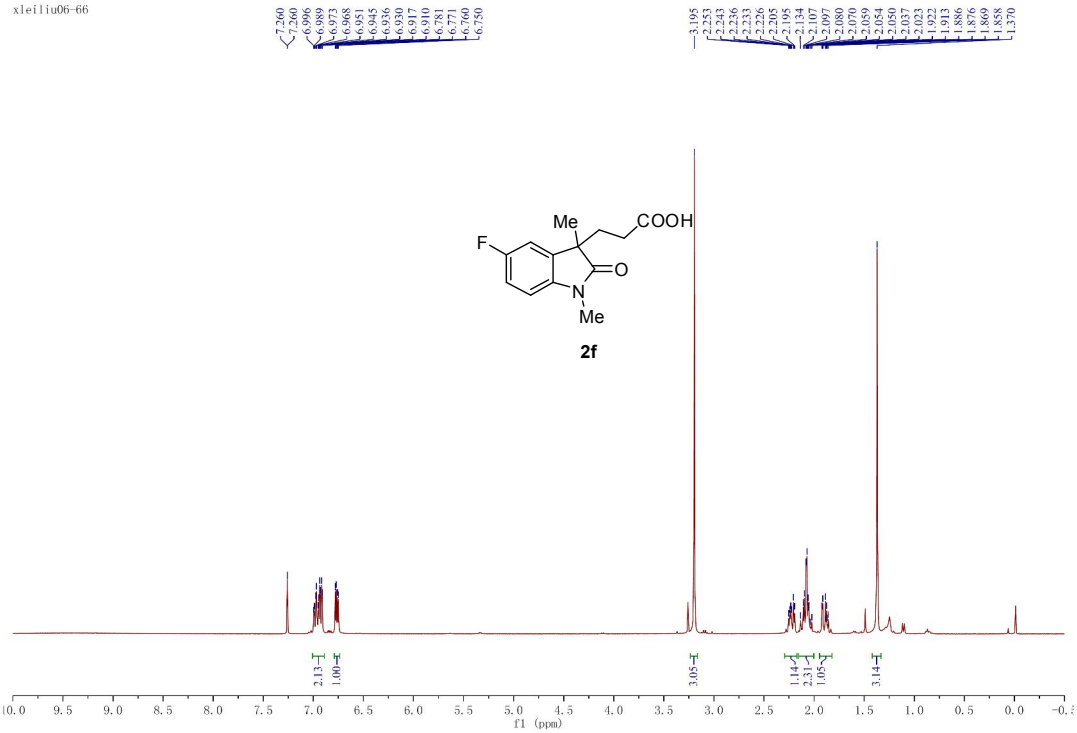

xleiliu07-65
7.572
7.553
7.399
7.260
7.260
6.929
6.910
3.243
2.284
2.277
2.251
2.228
2.202
2.158
2.129
2.102
2.078
2.069
1.955
1.929
1.904
1.875
1.405
Me
COOH
F3C
O
N
Me
2e
1.01
1.03
1.01
3.00
1.07
1.99
1.01
2.89
f1 (ppm)

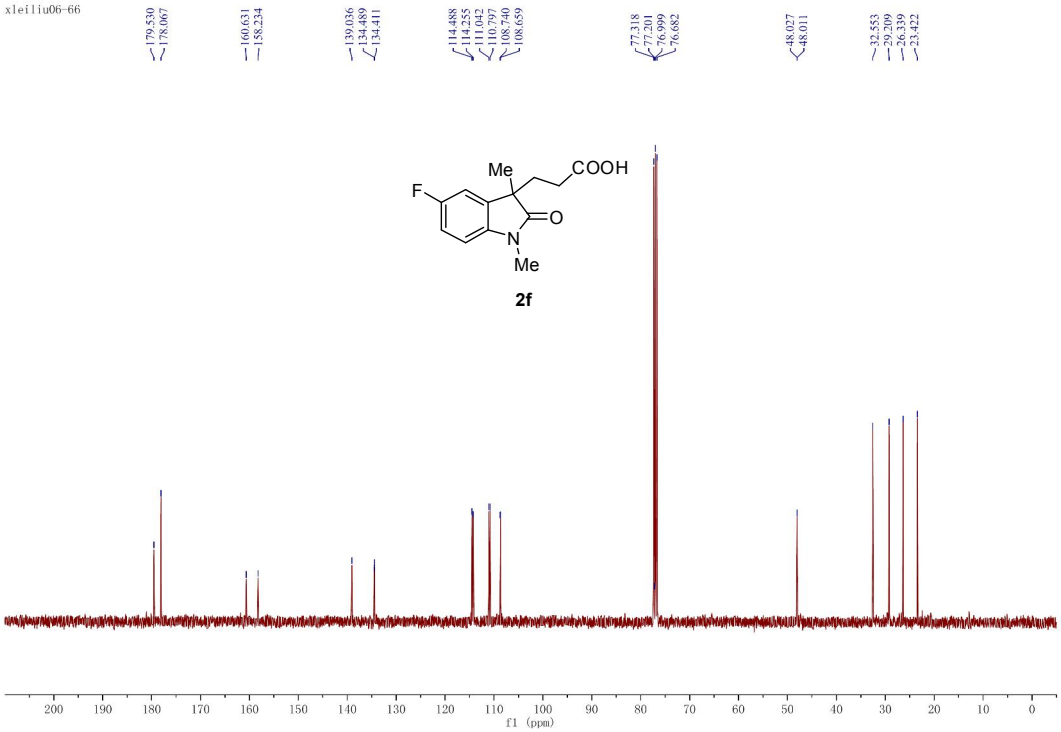

xleiliu07-65
179.753
178.158
146.160
133.331
128.329
126.118
126.080
126.041
126.003
125.631
125.489
125.164
124.838
124.516
122.932
120.232
119.880
119.818
119.783
119.748
107.968
77.000
47.523
32.438
29.182
26.401
23.396
Me
COOH
F3C
O
N
Me
2e
f1 (ppm)

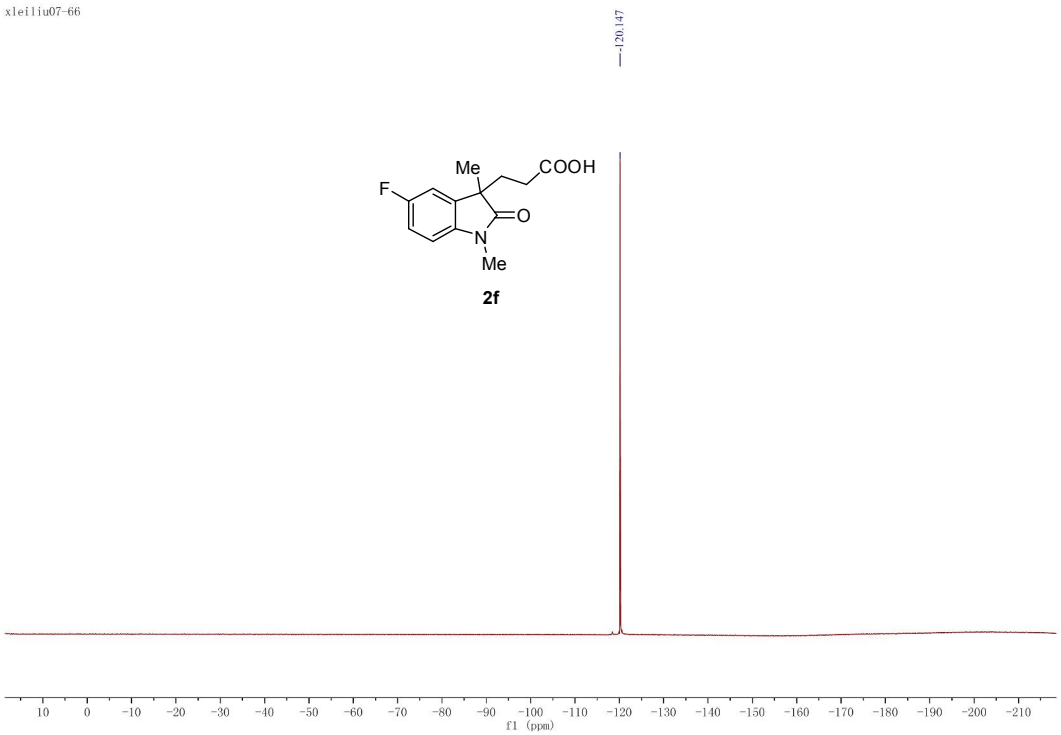
xleiliu06-65

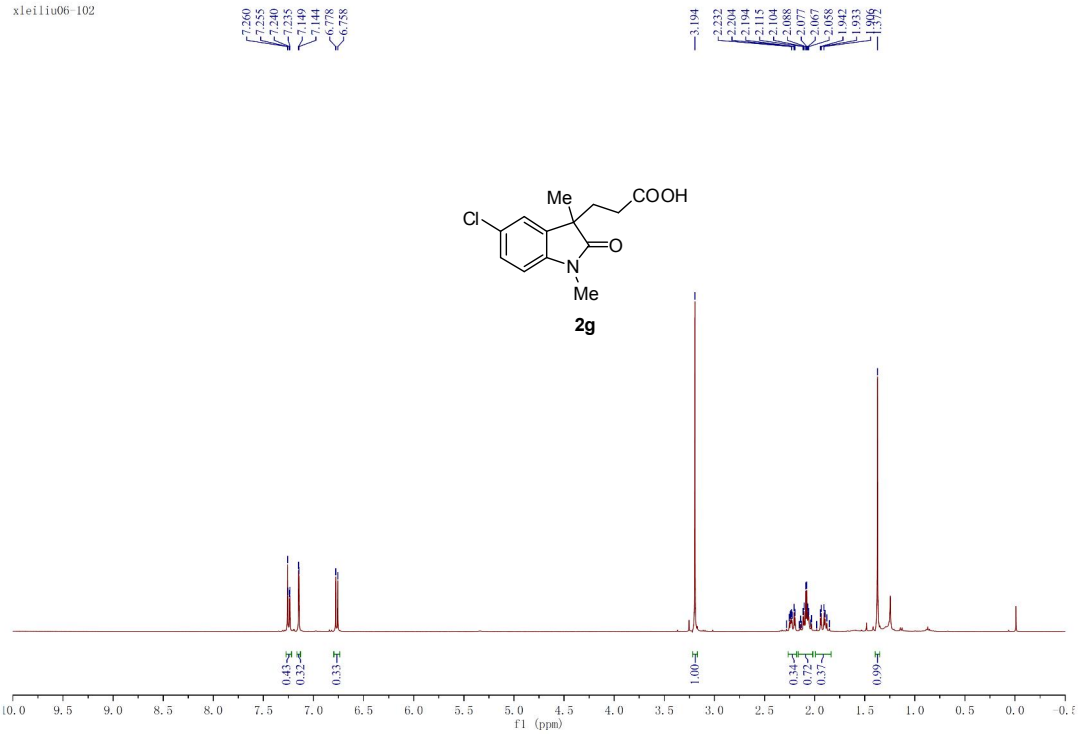


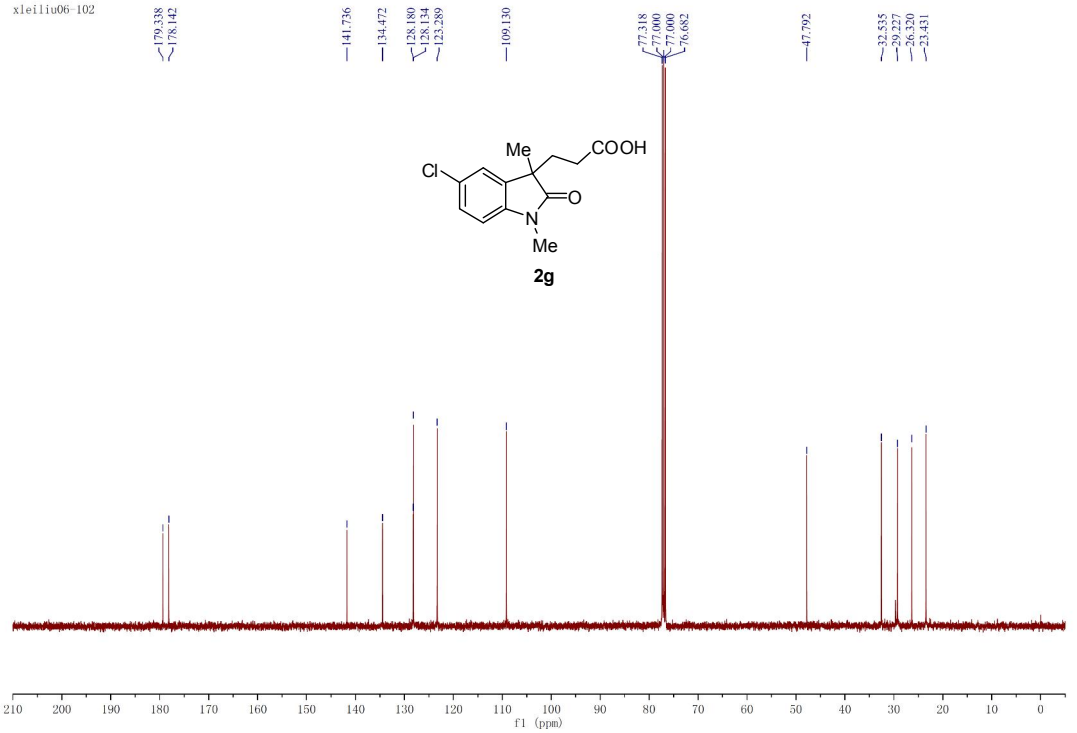
xleiliu06-66

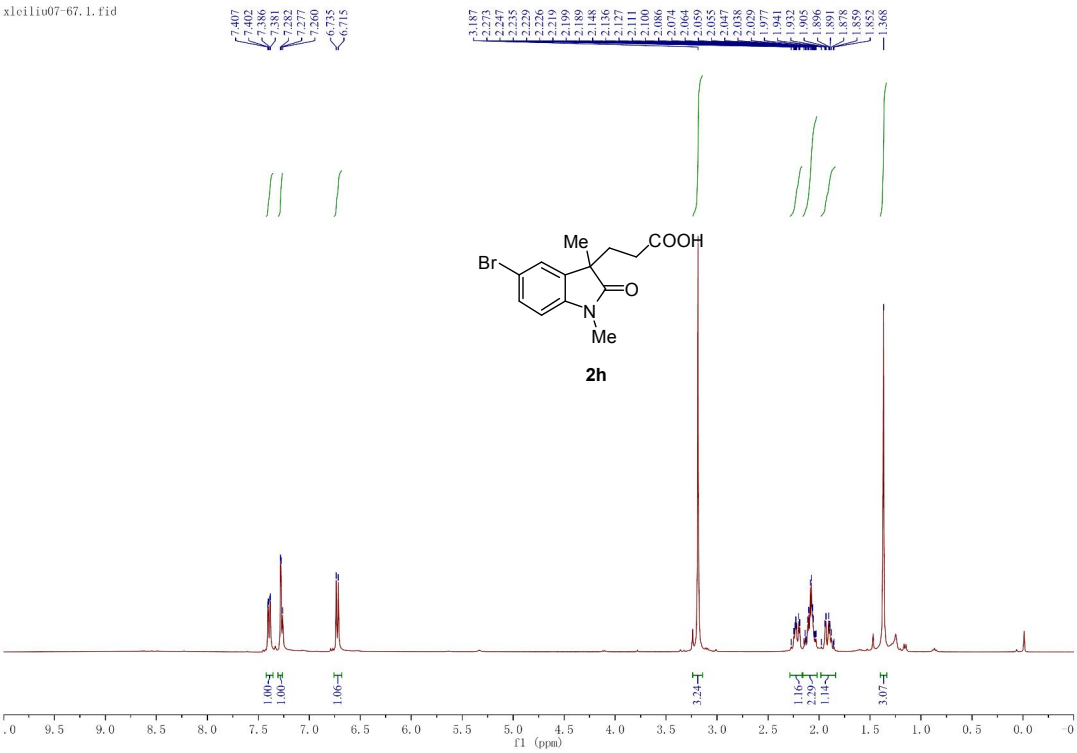


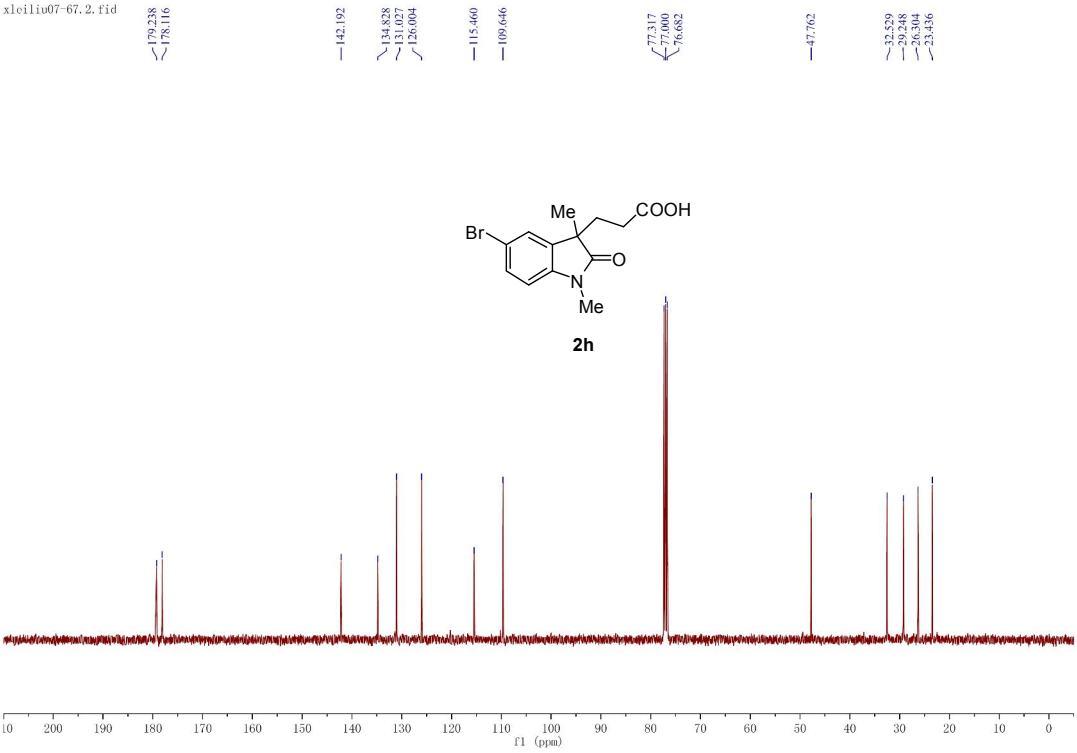

xleiliu06-66
179.530
178.067
160.631
158.234
139.036
134.489
134.411
114.488
114.255
111.042
110.797
108.740
108.659
77.318
77.201
76.999
76.682
48.027
48.011
32.553
29.209
26.339
23.422
Me
COOH
F
O
N
Me
2f
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

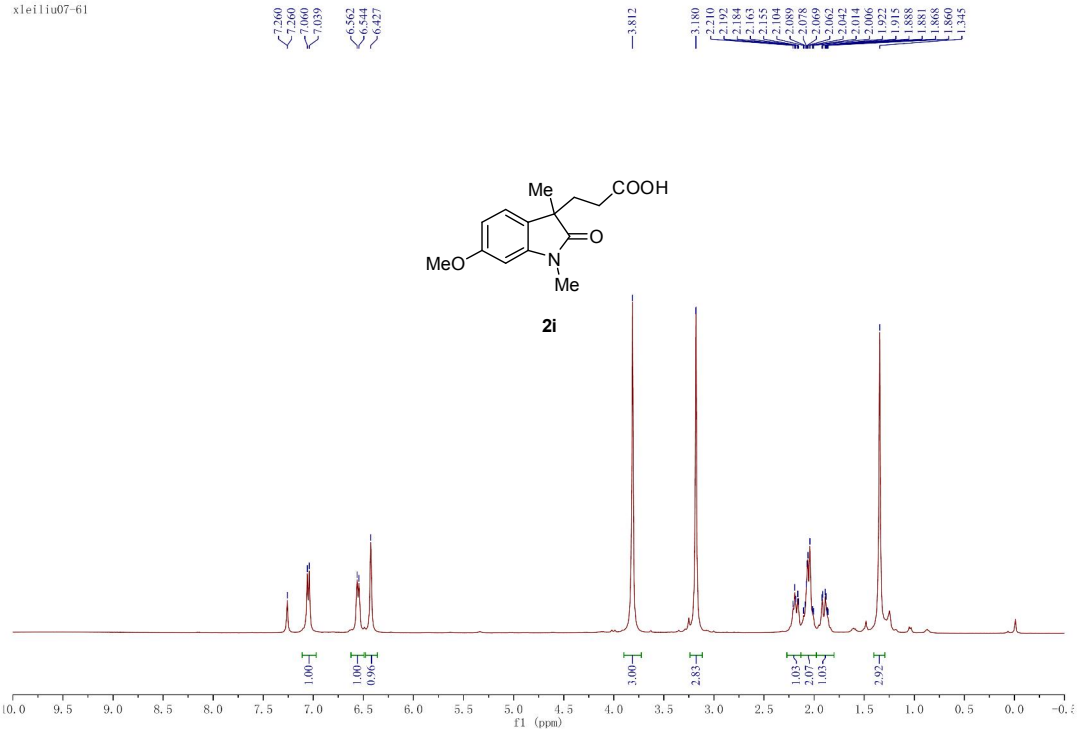

xleiliu07-66
-120.147
Me
COOH
F
O
N
Me
2f
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

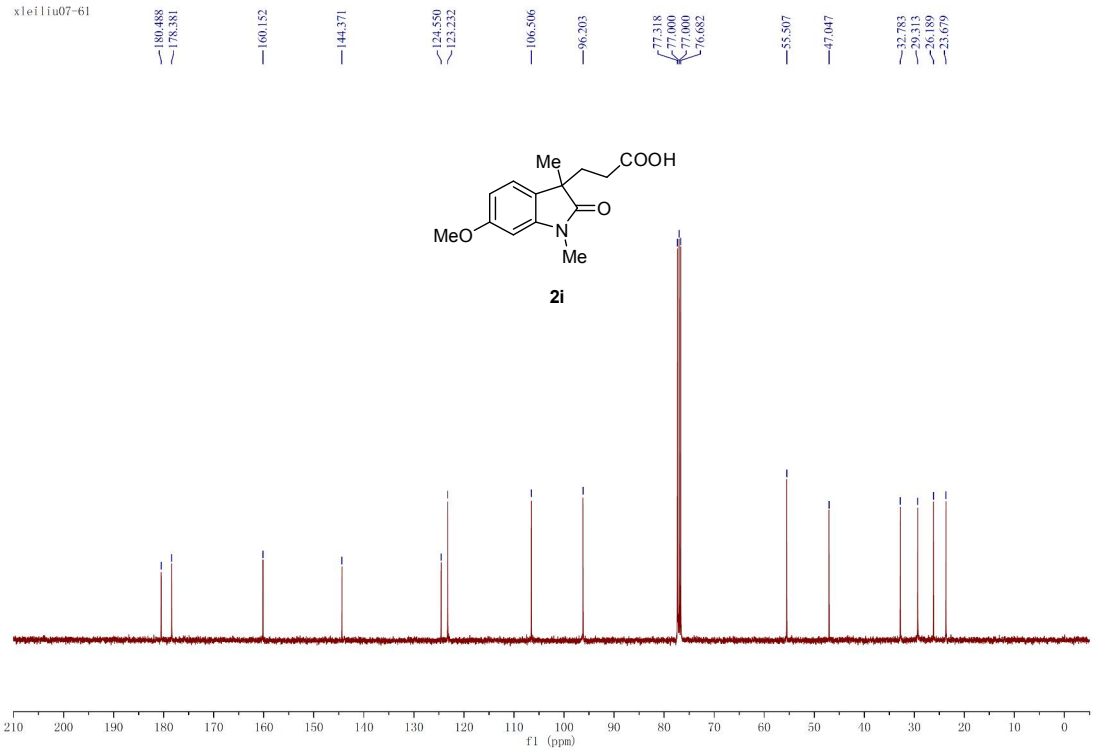

xleiliu06-102
7.260
7.255
7.240
7.235
7.149
7.144
6.778
6.758
3.194
2.232
2.204
2.194
2.115
2.104
2.088
2.077
2.067
2.058
1.942
1.933
1.906
1.372
Me
COOH
Cl
O
N
Me
2g
0.43
0.32
0.33
1.00
0.34
0.72
0.37
0.99
f1 (ppm)

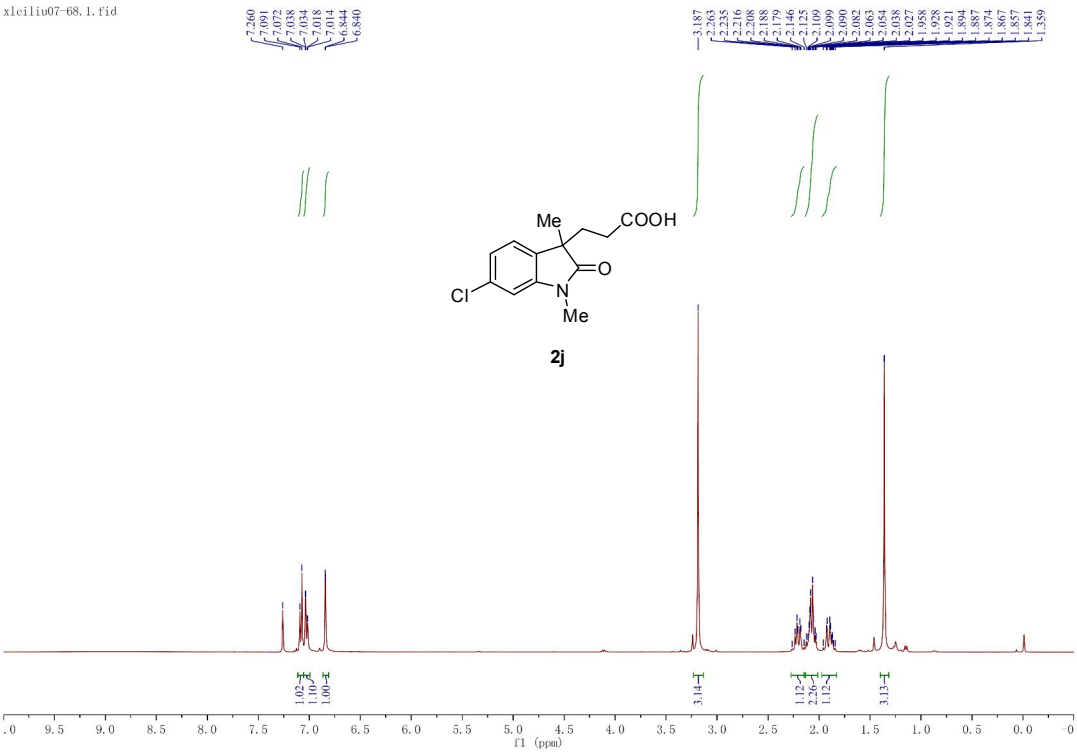

xleiliu06-102
179.338
178.142
141.736
134.472
128.180
128.134
123.289
109.130
77.318
77.000
77.000
76.682
47.792
32.535
29.227
26.320
23.431
Me
COOH
Cl
O
N
Me
2g
f1 (ppm)

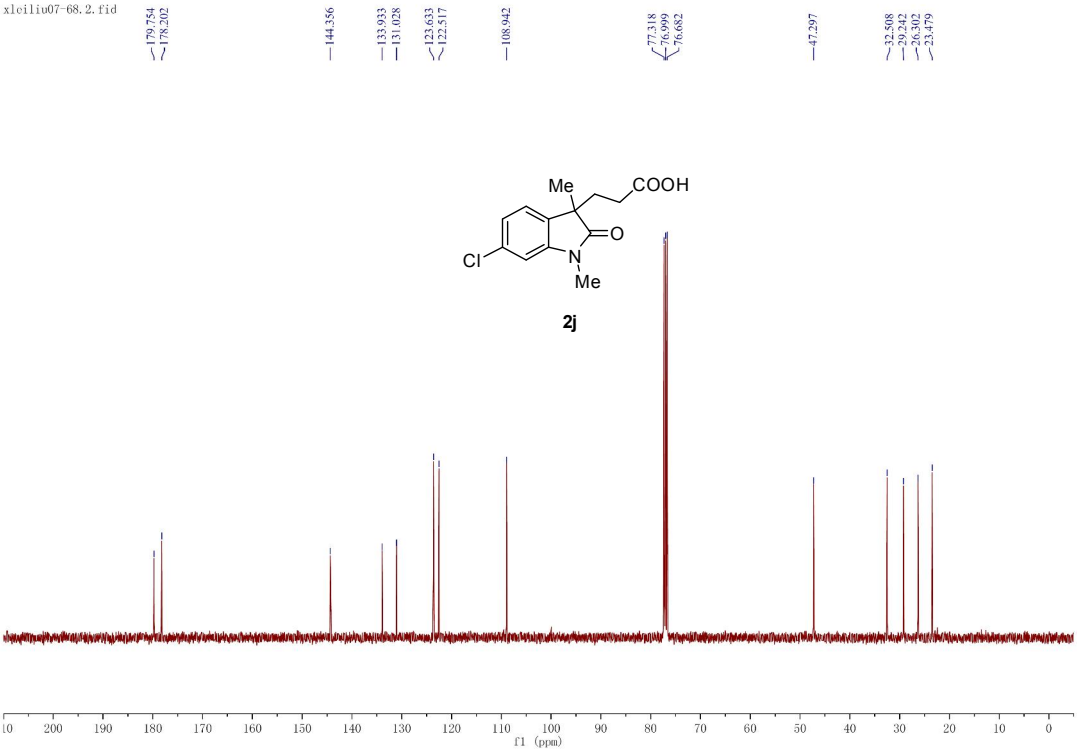

xleiliu07-67.1.fid
Br
Me
COOH
O
N
Me
2h
f1 (ppm)

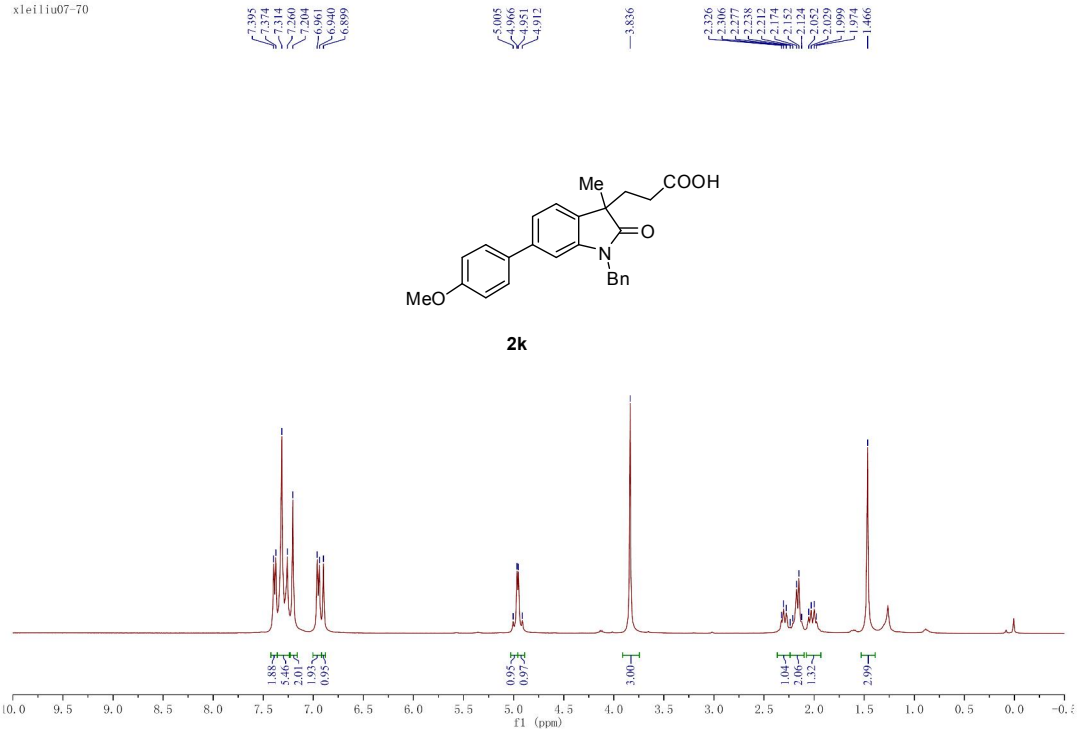

xleiliu07-67.2.fid
Br
Me
COOH
O
N
Me
2h
f1 (ppm)

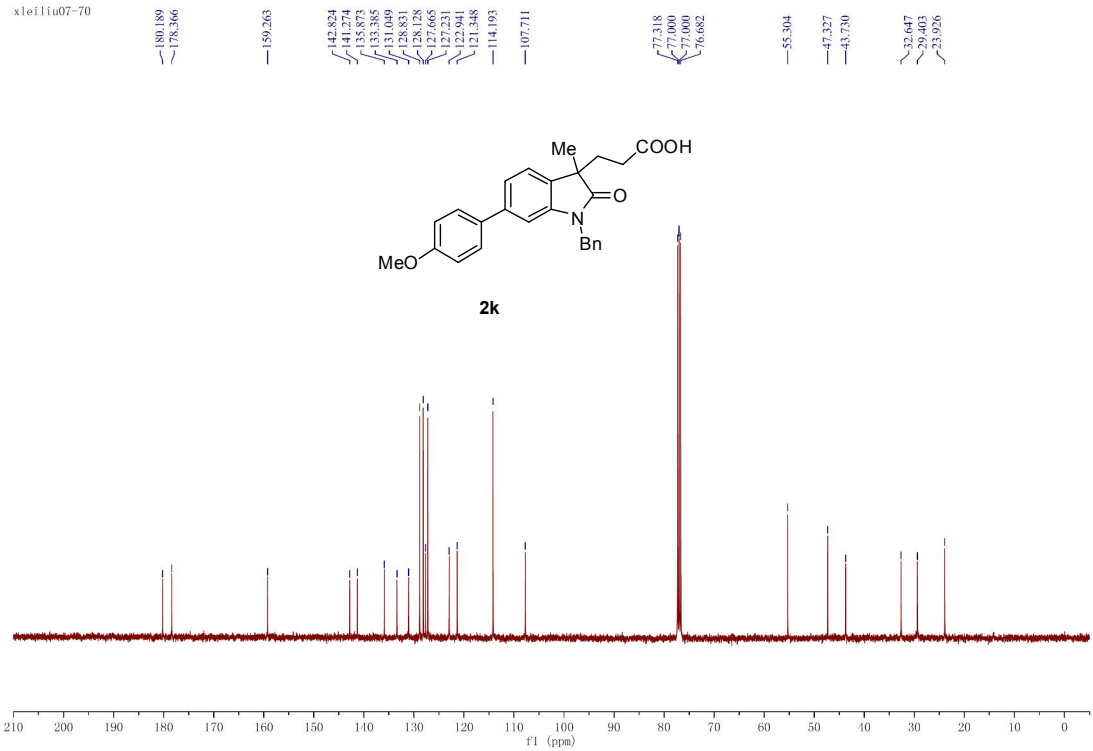

xleiliu07-61
7.260
7.060
7.060
7.039
6.562
6.544
6.427
3.812
3.180
2.210
2.192
2.184
2.163
2.155
2.104
2.089
2.078
2.069
2.062
2.042
2.014
2.006
1.922
1.915
1.888
1.881
1.868
1.860
1.345
Me
COOH
O
MeO
N
Me
2i
1.00
1.00
0.96
3.00
2.83
1.03
2.07
1.03
2.92
f1 (ppm)

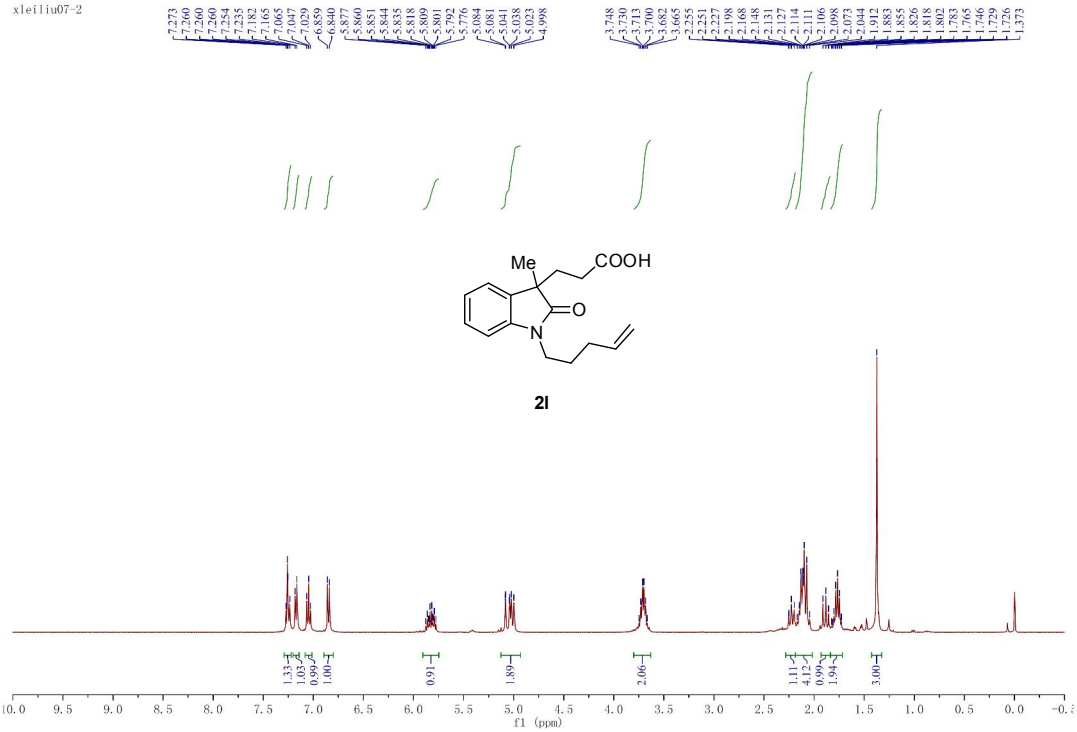

xleiliu07-61
180.488
178.381
160.152
144.371
124.550
123.232
106.506
96.203
77.318
77.000
77.000
76.682
55.507
47.047
32.783
29.313
26.189
23.679
Me
COOH
O
MeO
N
Me
2i
f1 (ppm)

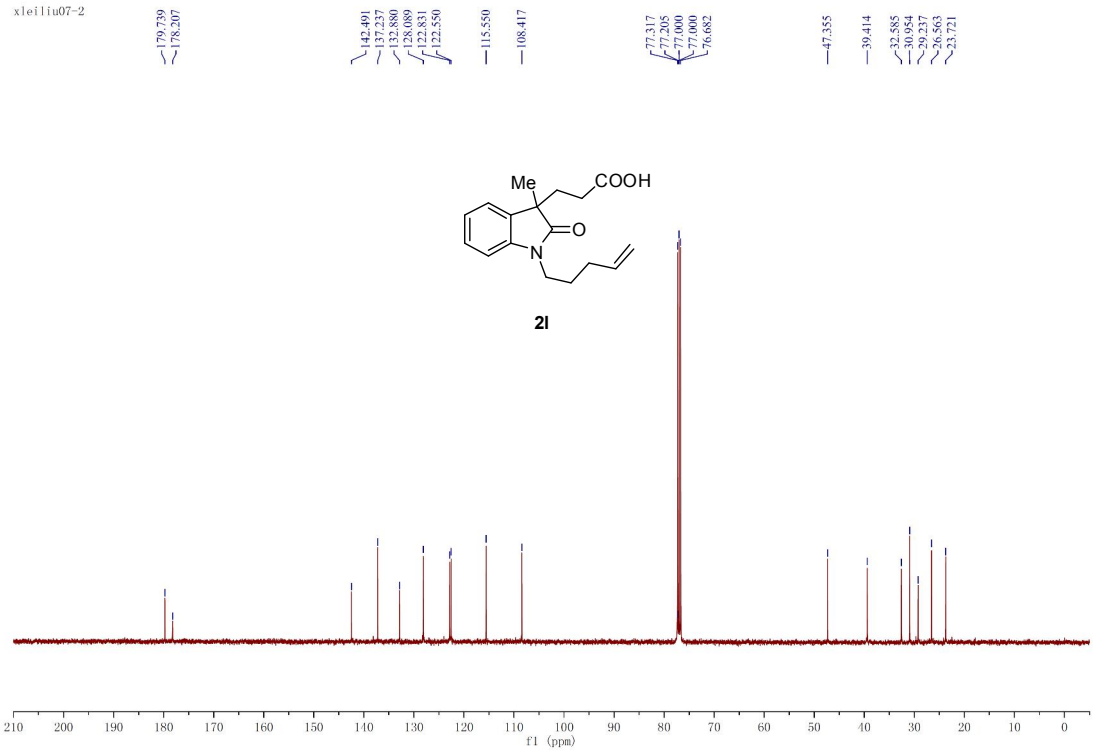

xleiliu07-68.1.fid
7.260
7.091
7.072
7.038
7.034
7.018
7.014
6.844
6.840
3.187
2.263
2.235
2.216
2.208
2.188
2.179
2.146
2.125
2.109
2.099
2.090
2.082
2.063
2.054
2.038
2.027
1.958
1.928
1.921
1.894
1.887
1.874
1.867
1.857
1.841
1.359
Me
COOH
O
Cl
N
Me
2j
1.02
1.10
1.00
3.14
1.12
2.26
1.12
3.13
f1 (ppm)

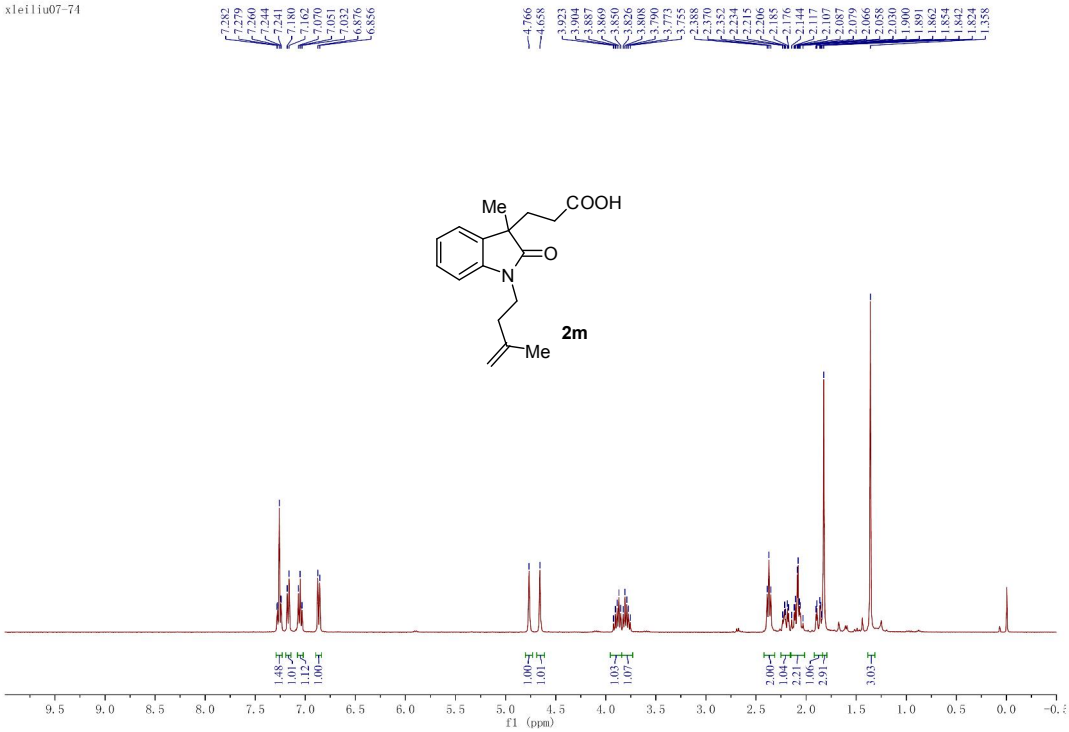

xleiliu07-68.2.fid
179.754
178.202
144.356
133.933
131.028
123.633
122.517
108.942
77.318
76.999
76.682
47.297
32.508
29.242
26.302
23.479
Me
COOH
O
Cl
N
Me
2j
f1 (ppm)

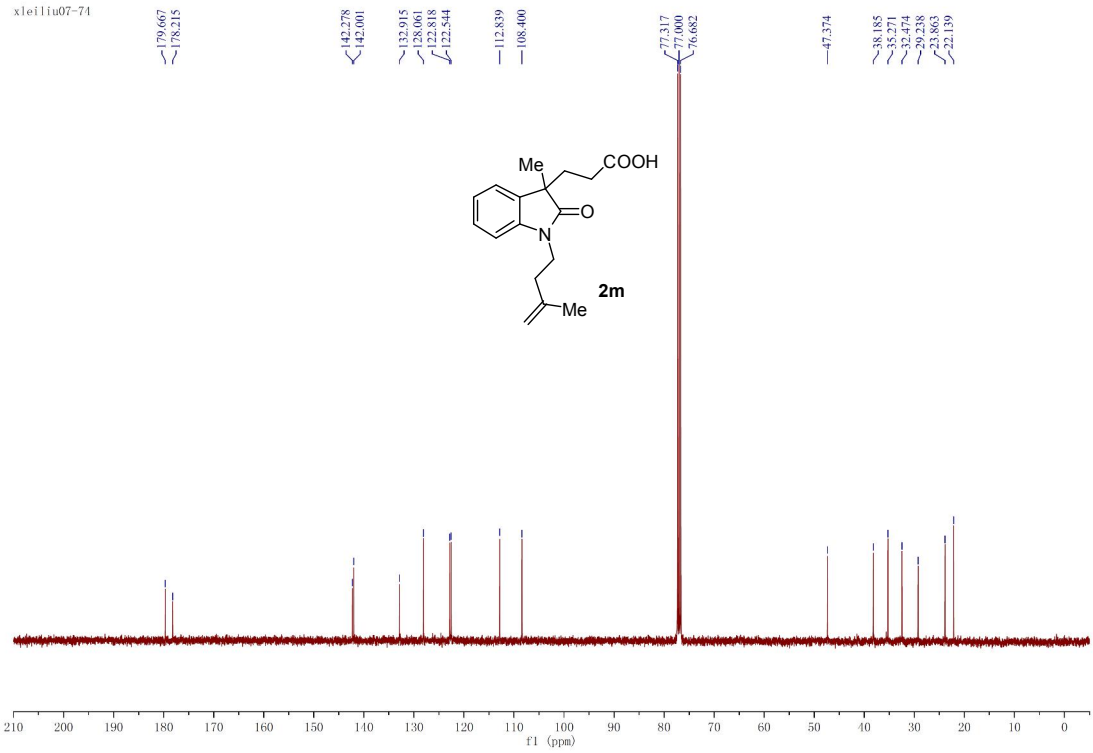

xleiliu07-70
7.395
7.374
7.314
7.260
7.204
6.961
6.940
6.899
5.005
4.966
4.951
4.912
3.836
2.326
2.306
2.277
2.238
2.212
2.174
2.152
2.124
2.052
2.029
1.999
1.974
1.466
Me
COOH
O
N
Bn
MeO
2k
1.88
5.46
2.01
1.93
0.95
0.95
0.97
3.00
1.04
2.06
1.32
2.99
f1 (ppm)

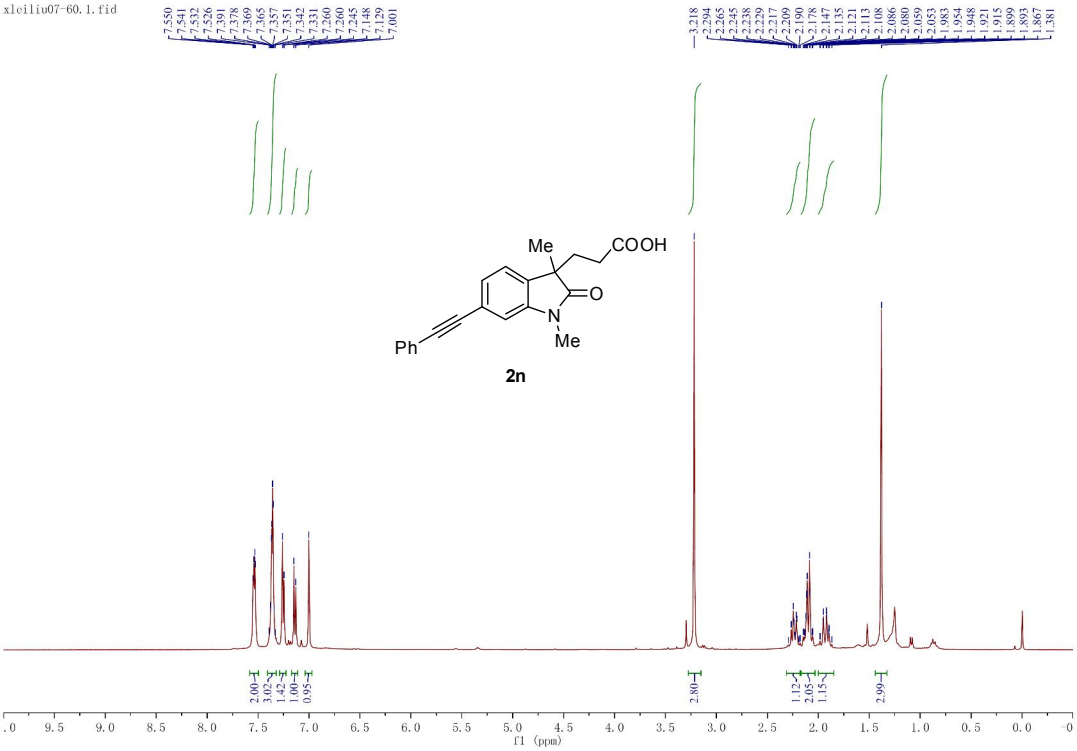

xleiliu07-70
180.189
178.366
159.263
142.824
141.274
135.873
133.385
131.049
128.831
128.128
127.665
127.231
122.941
121.348
114.193
107.711
77.318
77.000
77.000
76.682
55.304
47.327
43.730
32.647
29.403
23.926
Me
COOH
O
N
Bn
MeO
2k
f1 (ppm)

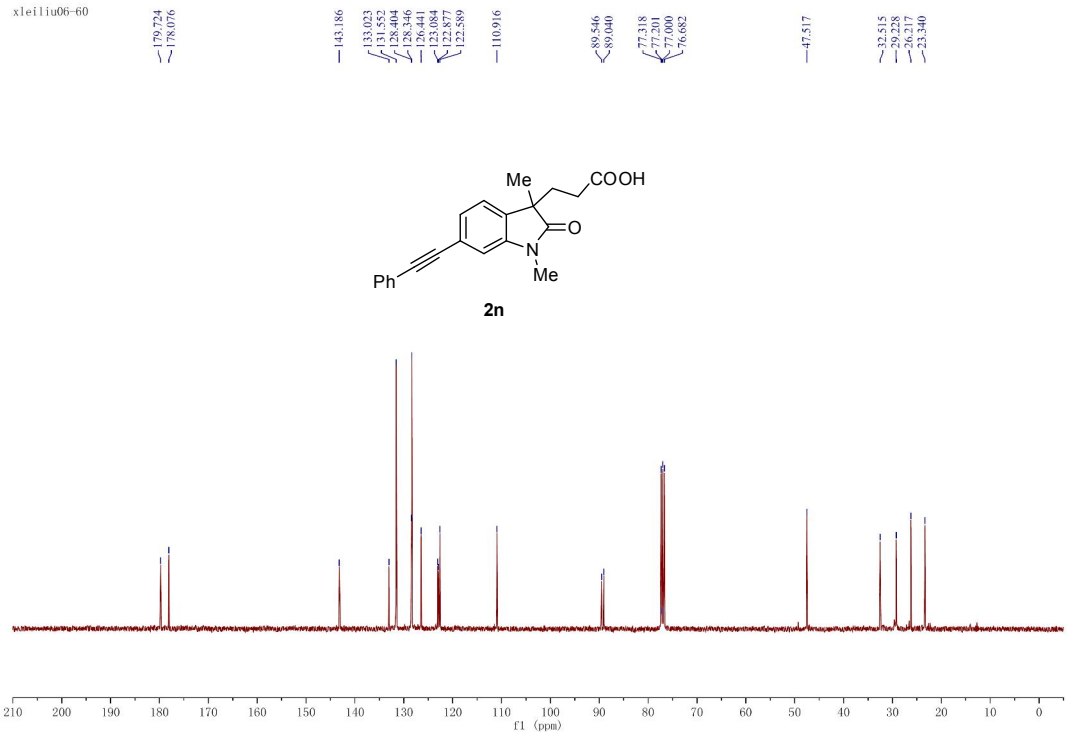

xleiliu07-2
Me
COOH
O
N
2l
f1 (ppm)

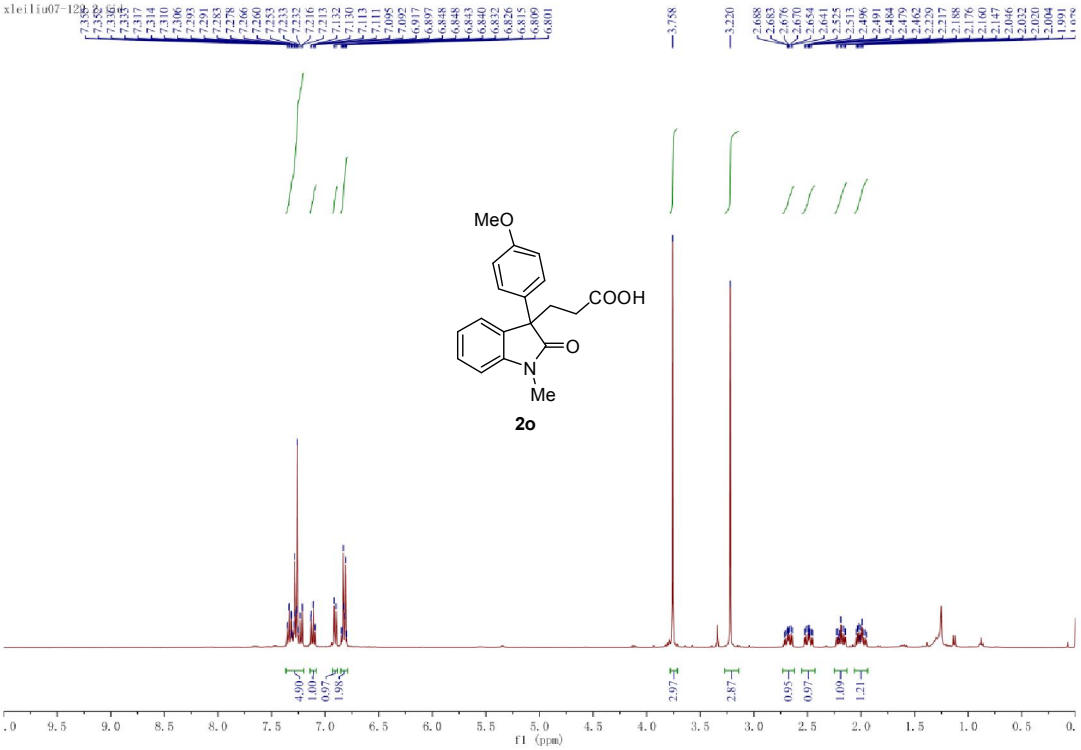

xleiliu07-2
Me
COOH
O
N
2l
f1 (ppm)

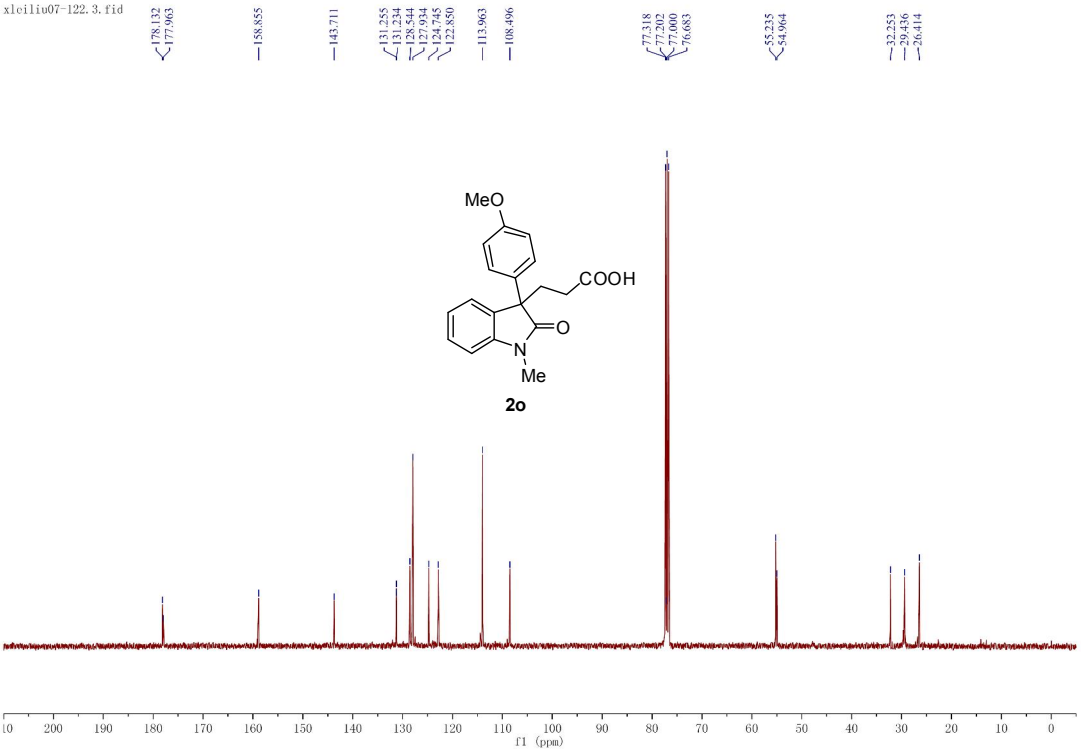

xleiliu07-74
7.282
7.279
7.260
7.244
7.241
7.180
7.162
7.070
7.051
7.032
6.876
6.856
4.766
4.658
3.923
3.904
3.887
3.869
3.850
3.826
3.808
3.790
3.773
3.755
2.388
2.370
2.352
2.234
2.215
2.206
2.185
2.176
2.144
2.117
2.107
2.087
2.079
2.066
2.058
2.030
1.900
1.891
1.862
1.854
1.842
1.824
1.358
Me
COOH
O
N
Me
2m
1.48
1.01
1.12
1.00
1.00
1.01
1.03
1.07
2.00
1.04
2.21
1.06
2.91
3.03
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

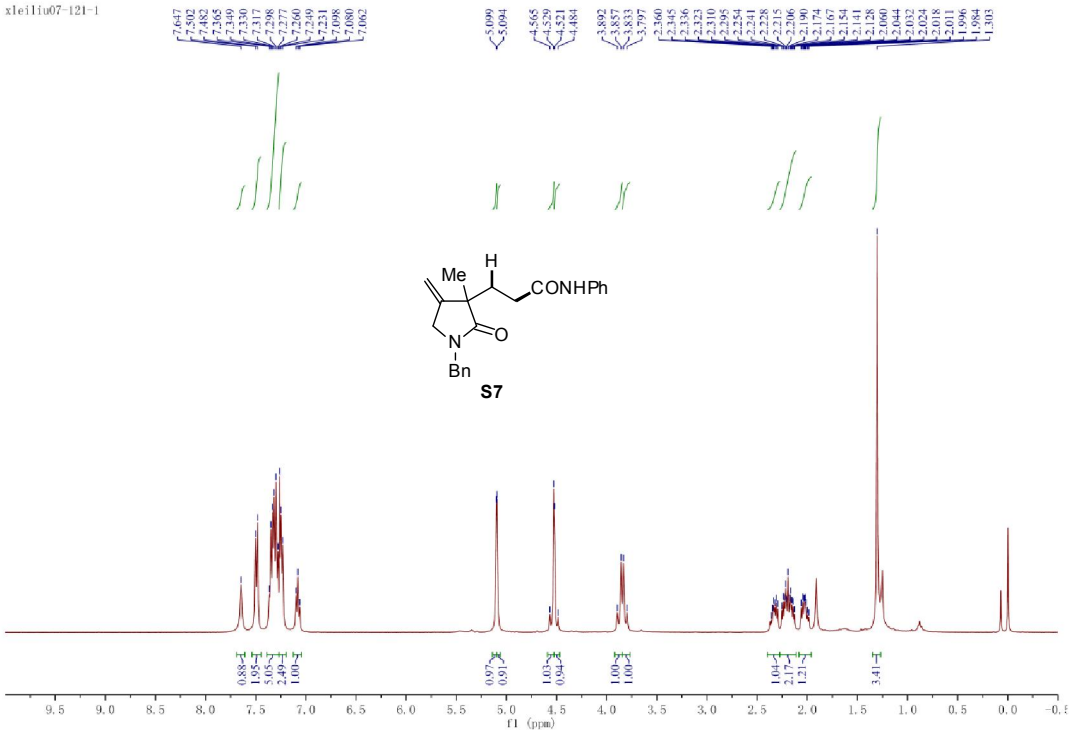

xleiliu07-74
179.667
178.215
142.278
142.001
132.915
128.061
122.818
122.544
112.839
108.400
77.317
77.000
76.682
47.374
38.185
35.271
32.474
29.238
23.863
22.139
Me
COOH
O
N
Me
2m
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

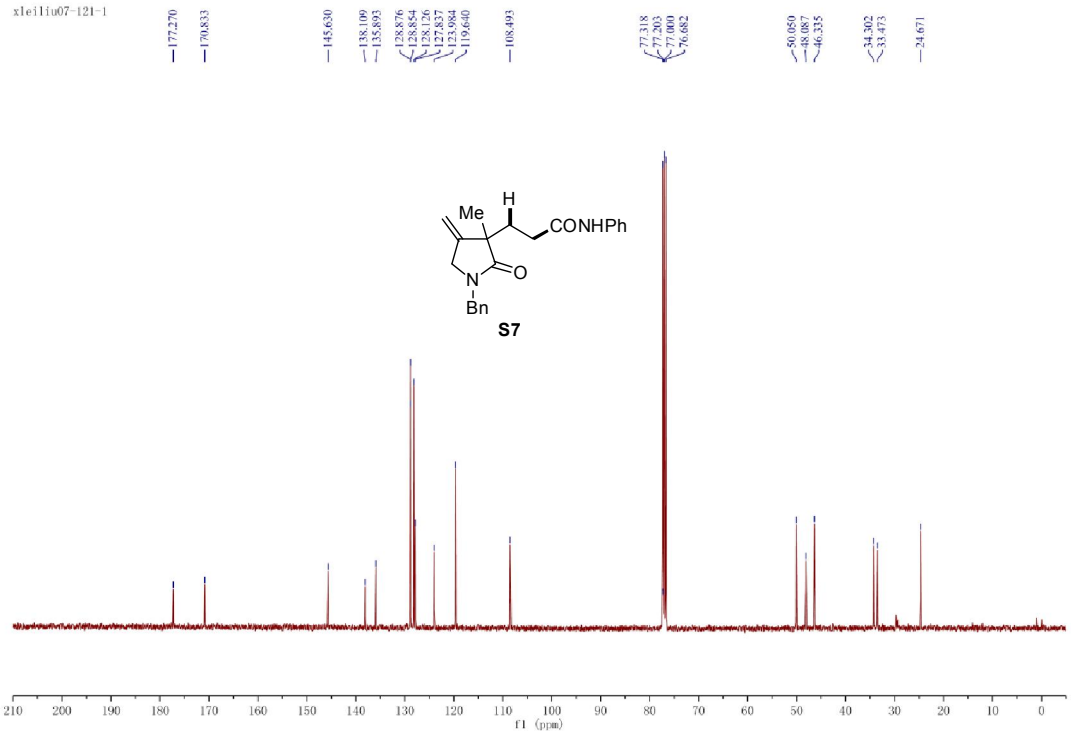

xleiliu07-60.1.fid
Me
COOH
O
N
Me
Ph
2n
f1 (ppm)

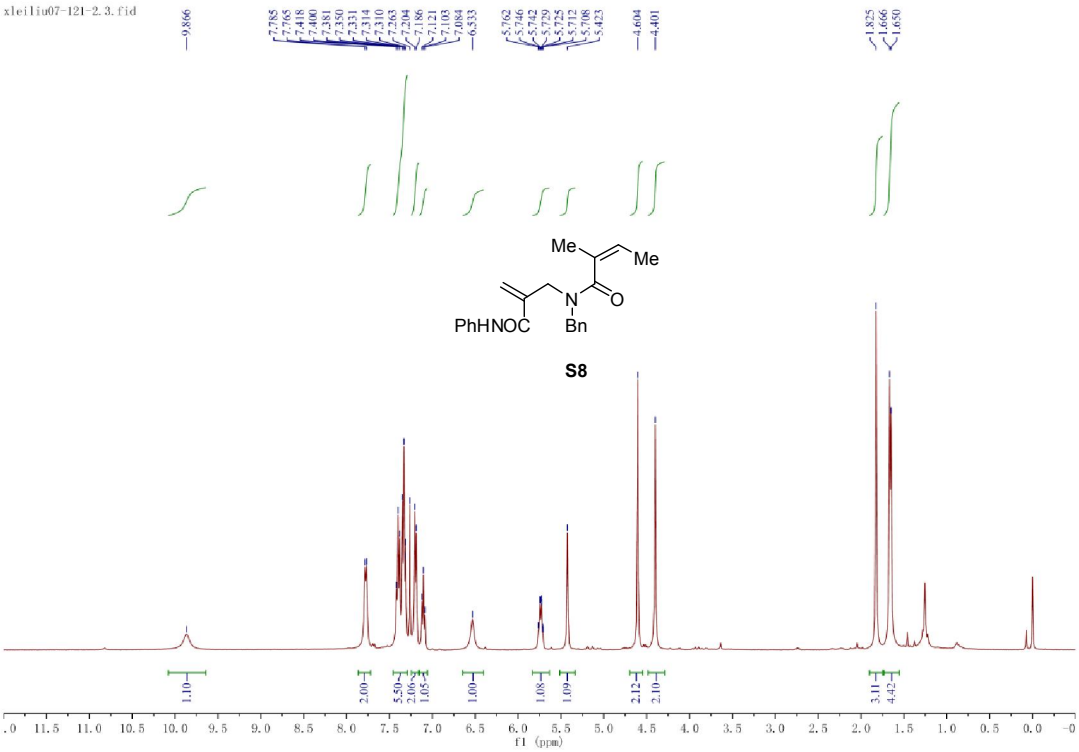

xleiliu06-60
Me
COOH
O
N
Me
Ph
2n
f1 (ppm)

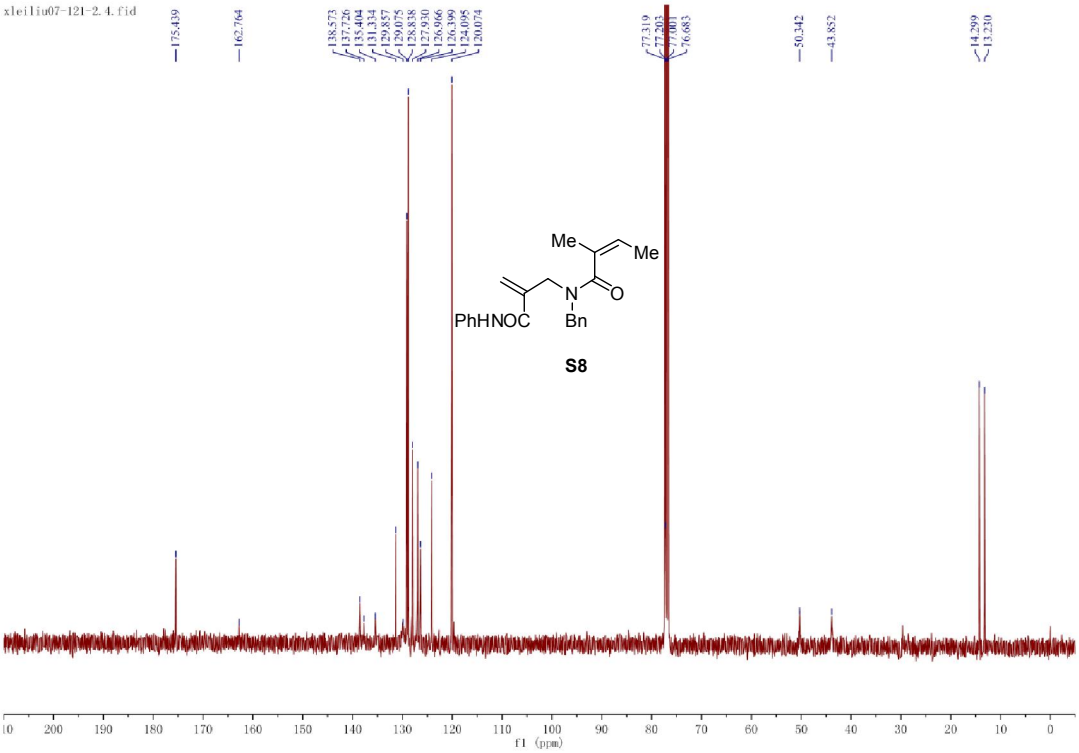

MeO
COOH
O
N
Me
2o
f1 (ppm)

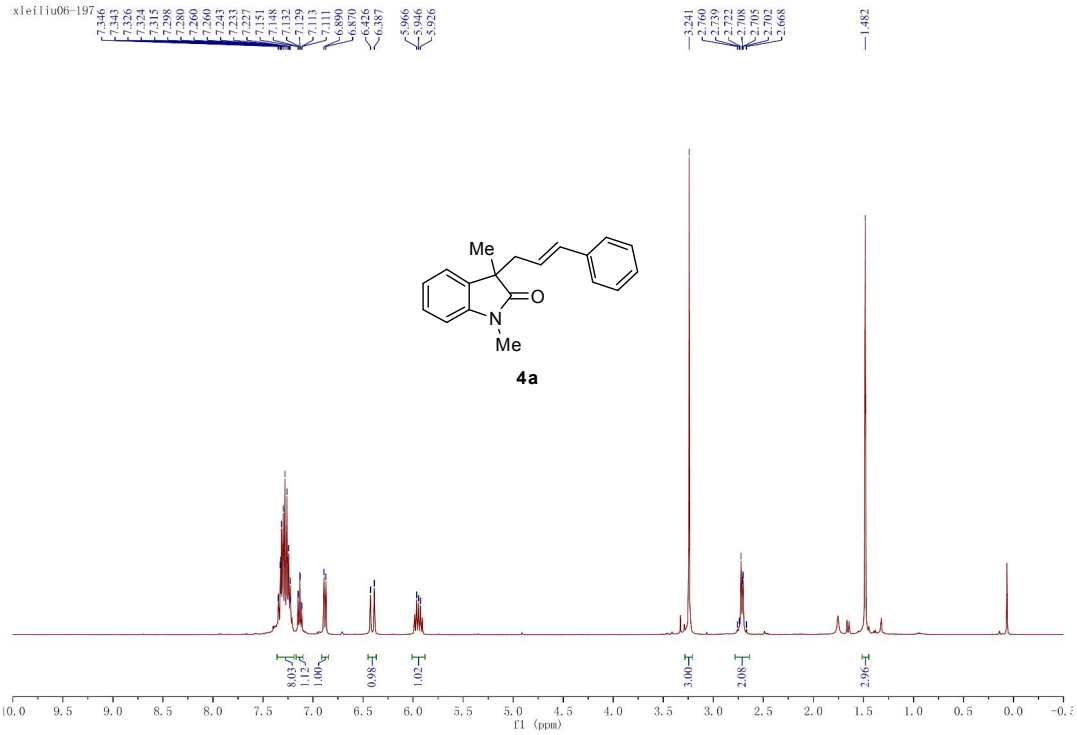

xleiliu07-122.3.fid
MeO
COOH
O
N
Me
2o
f1 (ppm)

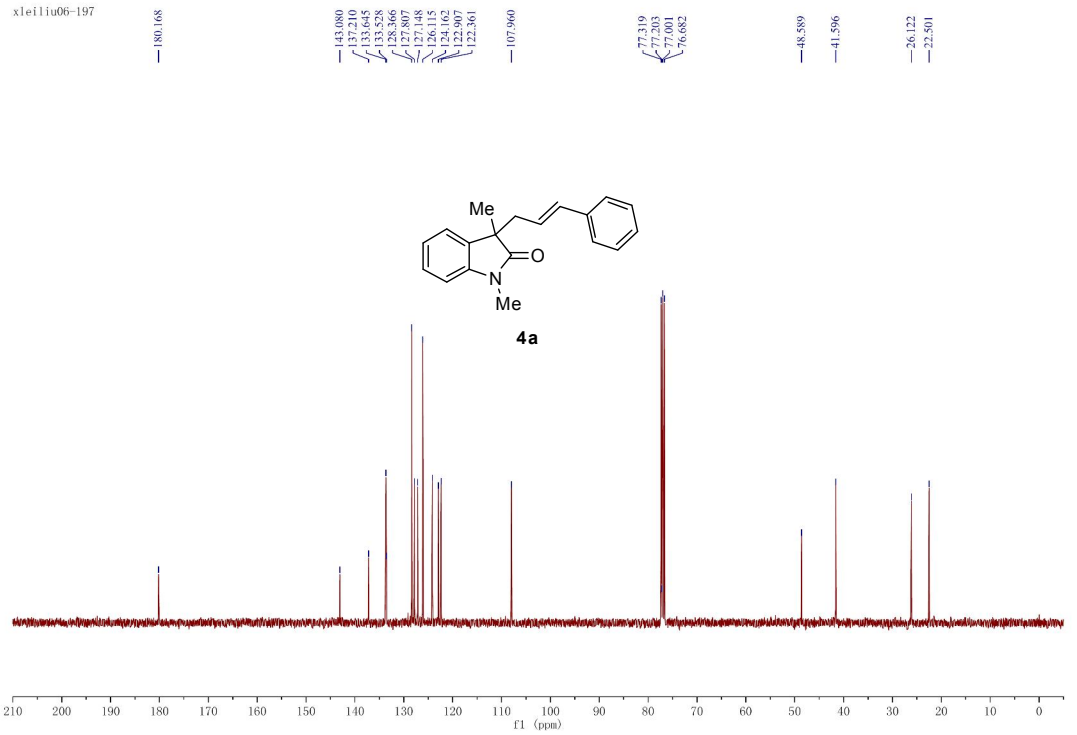

xleiliu07-121-1
Me
H
CONHPh
N
O
Bn
S7
f1 (ppm)

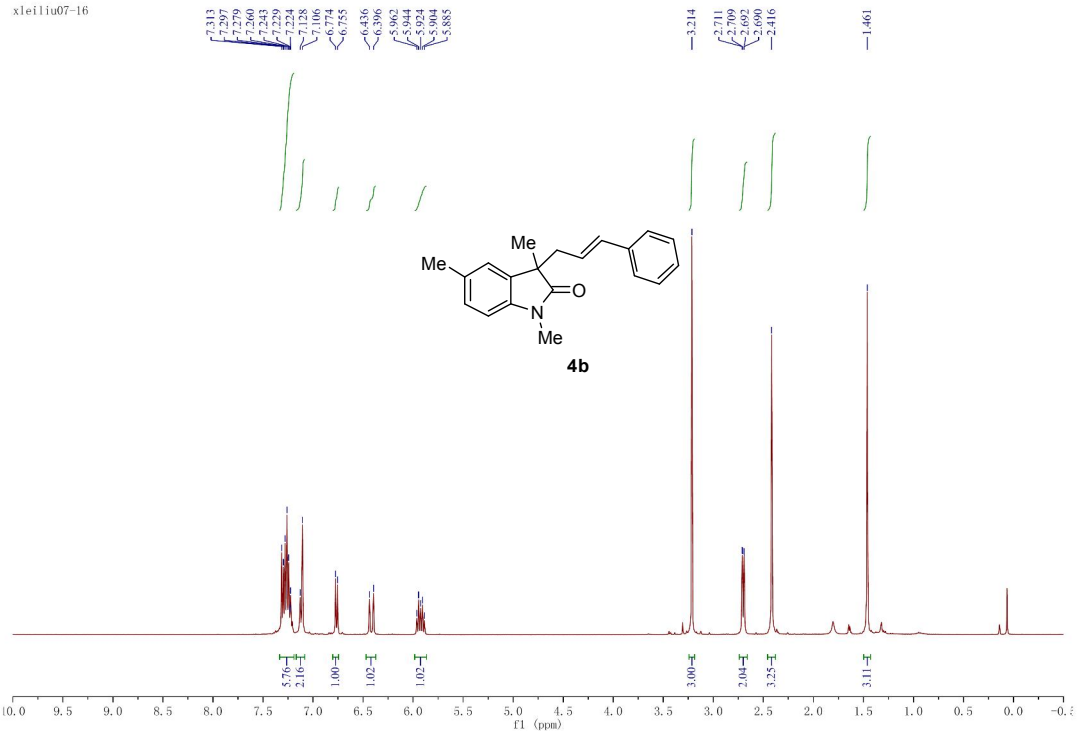

xleiliu07-121-1
Me
H
CONHPh
N
O
Bn
S7
f1 (ppm)

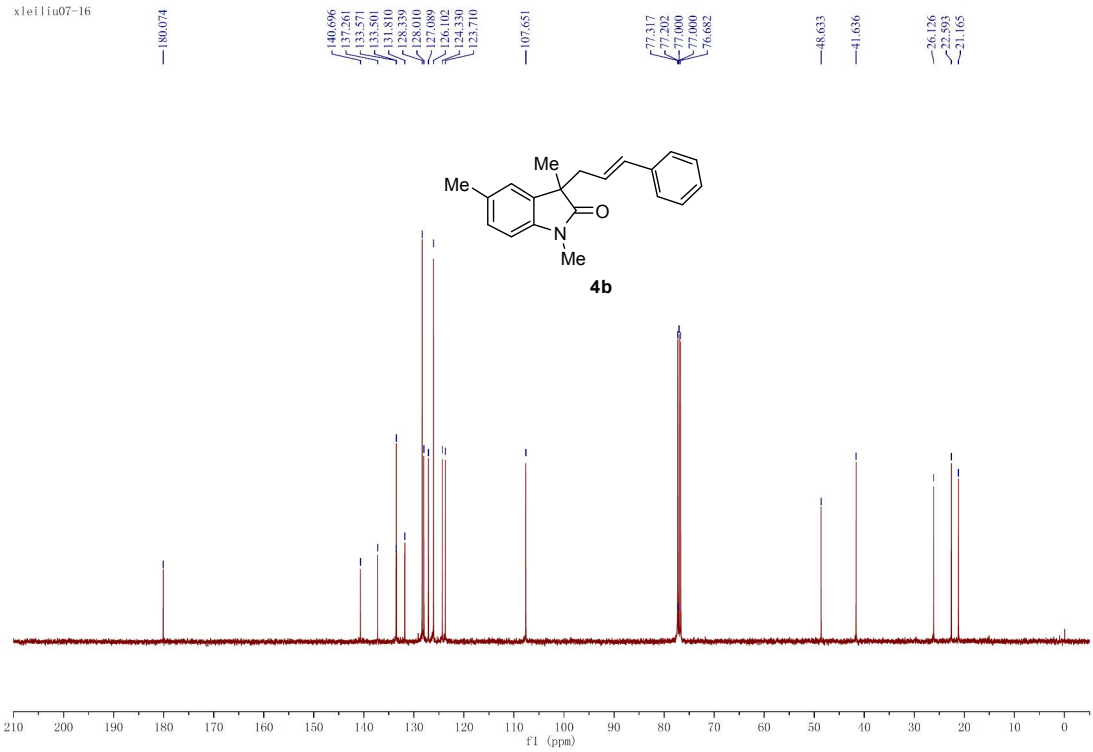

xleiliu07-121-2.3.fid
9.866
7.785
7.765
7.418
7.400
7.381
7.350
7.331
7.314
7.310
7.263
7.204
7.186
7.121
7.103
7.094
6.533
5.762
5.746
5.742
5.729
5.725
5.712
5.708
5.423
4.604
4.401
1.825
1.666
1.650
Me
Me
N
O
PhHNOC
Bn
S8
1.10
2.00
5.50
2.06
1.05
1.00
1.08
1.09
2.12
2.10
3.11
4.42
f1 (ppm)

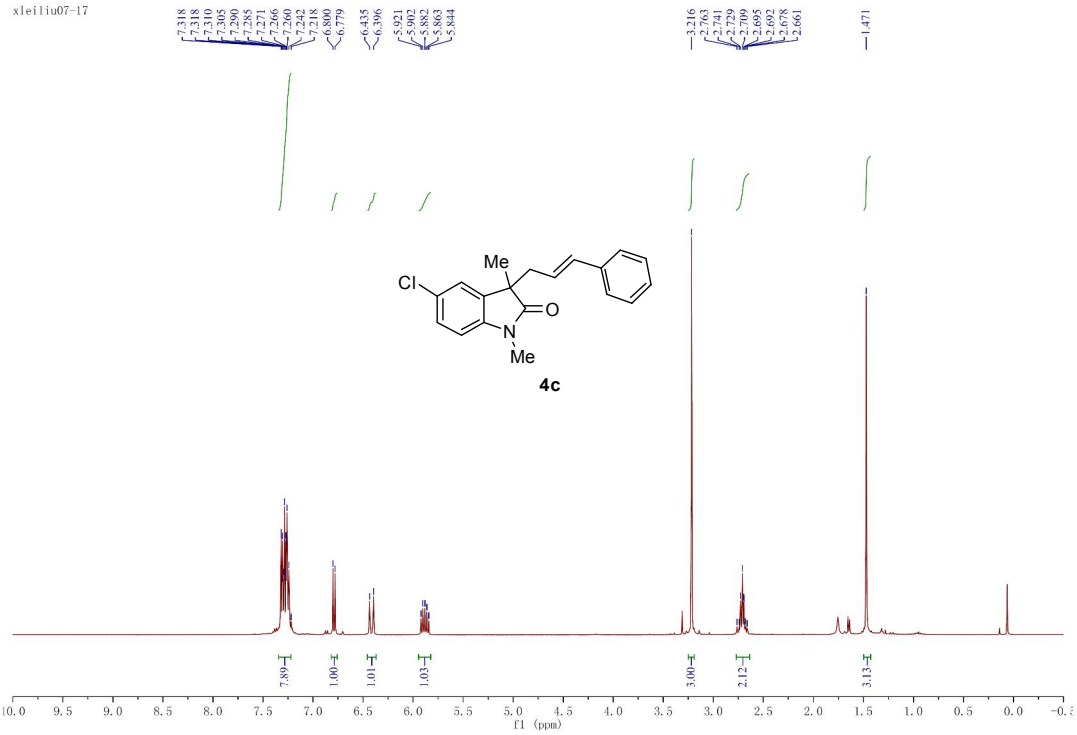

xleiliu07-121-2.4.fid
175.439
162.764
138.573
137.726
135.404
131.334
129.857
129.075
128.838
127.930
126.966
126.399
124.095
120.074
77.319
77.205
77.001
76.683
50.342
43.852
14.299
13.230
Me
Me
N
O
PhHNOC
Bn
S8
f1 (ppm)

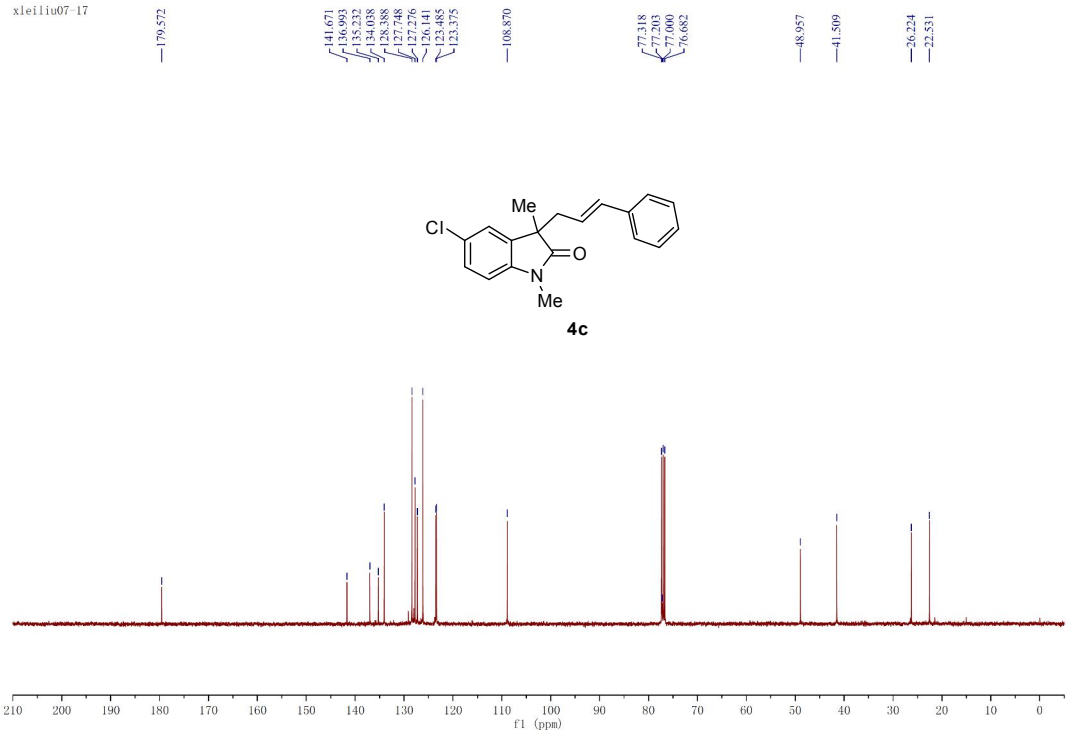

xleiliu06-197
7.346
7.343
7.326
7.324
7.315
7.298
7.280
7.260
7.249
7.245
7.233
7.227
7.151
7.148
7.132
7.129
7.113
7.111
6.890
6.870
6.426
6.387
5.966
5.946
5.926
3.241
2.760
2.739
2.722
2.708
2.705
2.702
2.668
1.482
Me
O
N
Me
4a
8.03
1.12
1.08
0.98
1.02
3.00
2.08
2.96
f1 (ppm)

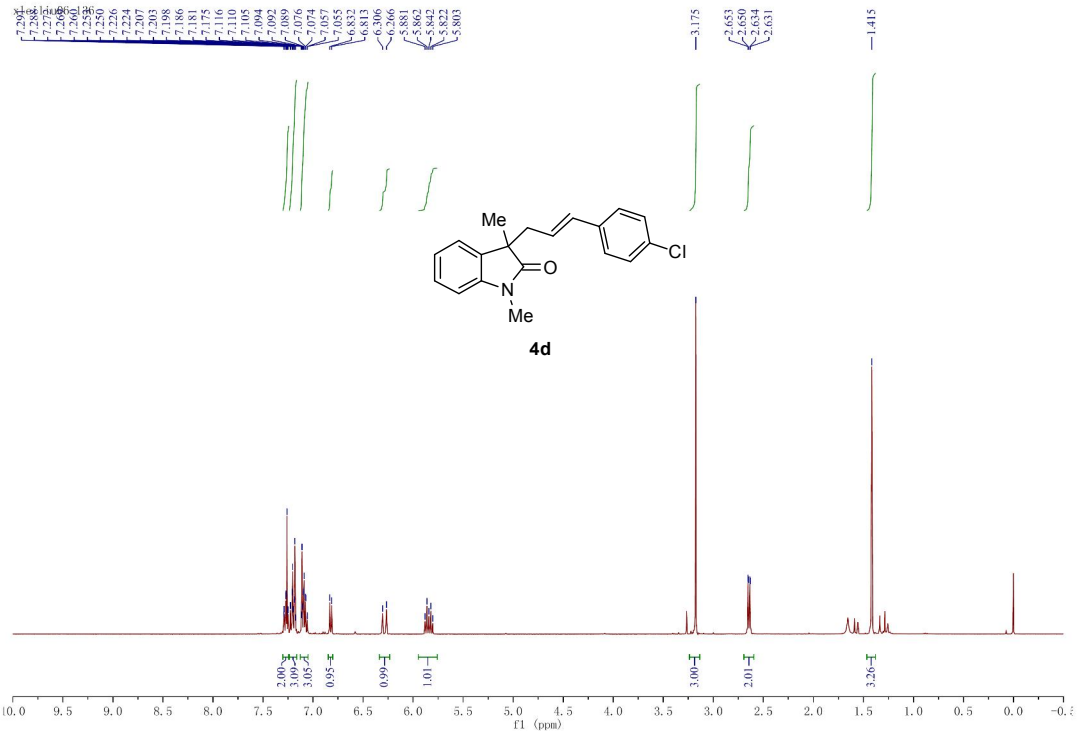

xleiliu06-197
180.168
143.080
137.210
133.645
133.528
128.366
127.807
127.148
126.115
124.062
124.007
122.361
107.960
77.319
77.203
77.001
76.682
48.589
41.596
26.122
22.501
Me
O
N
Me
4a
f1 (ppm)

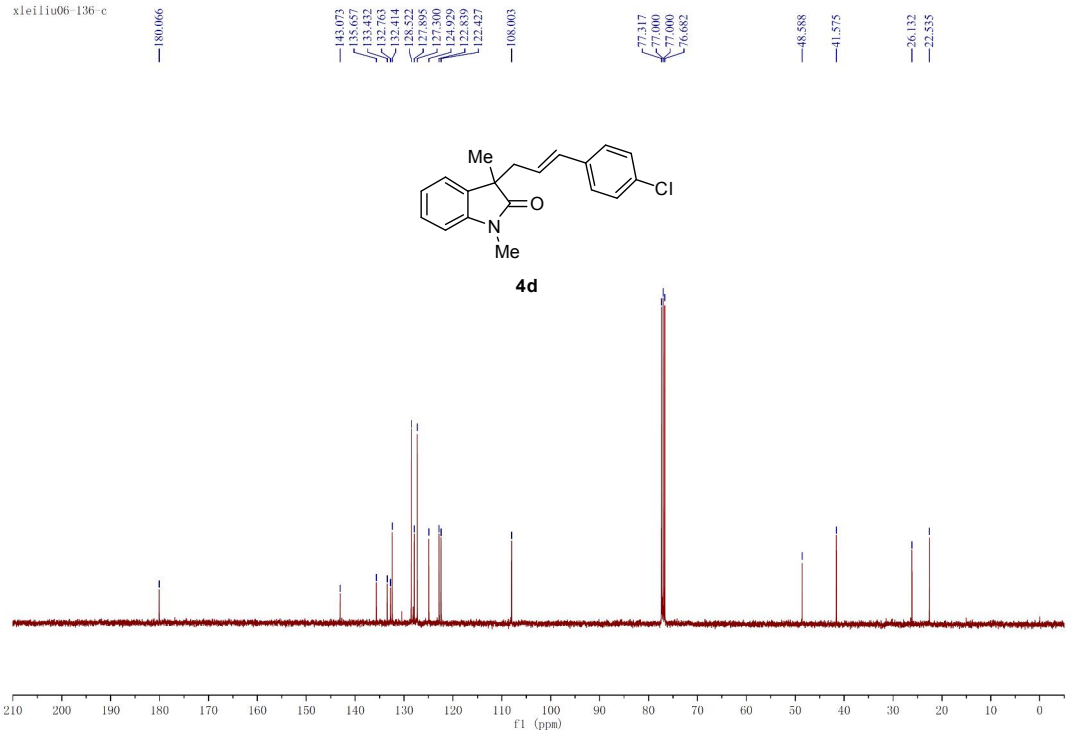

xleiliu07-16
7.313
7.297
7.279
7.260
7.243
7.229
7.224
7.128
7.106
6.774
6.755
6.436
6.396
5.962
5.944
5.924
5.904
5.885
3.214
2.711
2.709
2.692
2.690
2.416
1.461
Me
Me
O
N
Me
4b
5.76
2.16
1.00
1.02
1.02
3.00
2.04
3.25
3.11
f1 (ppm)

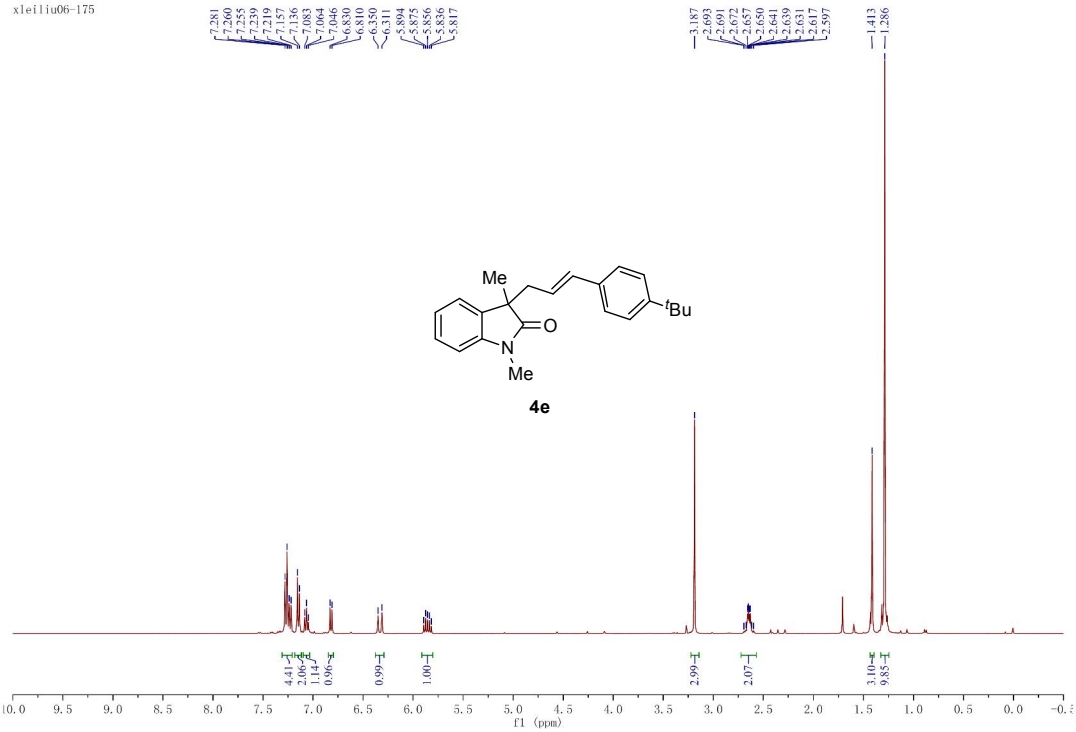

xleiliu07-16
180.074
140.696
137.261
133.571
133.501
131.810
128.339
128.010
127.089
126.102
124.330
123.710
107.651
77.317
77.202
77.000
77.000
76.682
48.633
41.636
26.126
22.593
21.165
Me
Me
O
N
Me
4b
f1 (ppm)

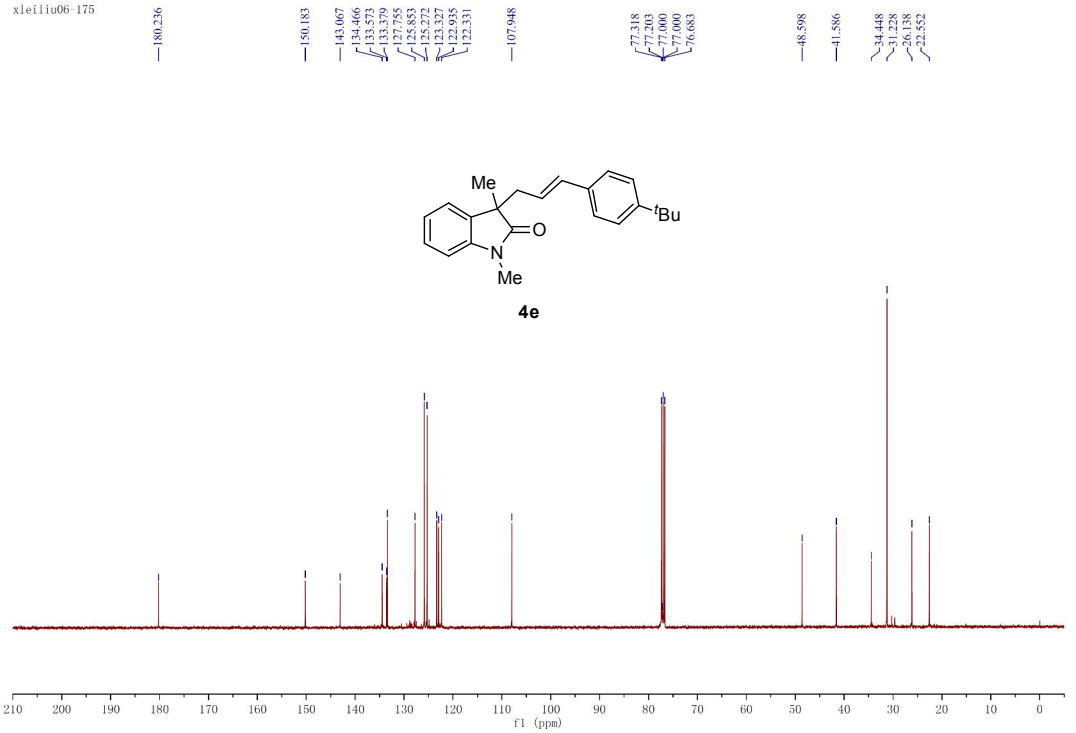

xleiliu07-17
7.318
7.318
7.310
7.305
7.299
7.285
7.271
7.266
7.260
7.242
7.218
6.800
6.779
6.435
6.396
5.921
5.902
5.882
5.863
5.844
3.216
2.763
2.741
2.729
2.709
2.695
2.692
2.678
2.661
1.471
Me
Cl
O
N
Me
4c
7.89
1.00
1.01
1.03
3.00
2.12
3.13
f1 (ppm)

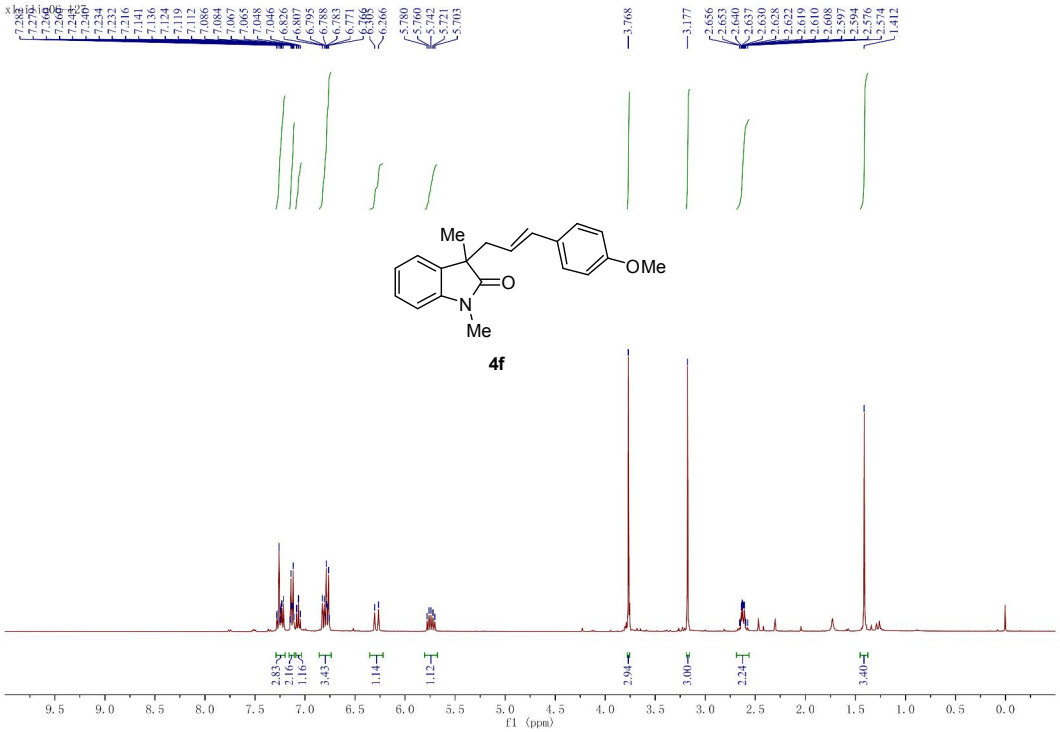

xleiliu07-17
179.572
141.671
136.993
135.232
134.038
128.388
127.748
127.276
126.141
123.485
123.375
108.870
77.318
77.203
77.000
76.682
48.957
41.509
26.224
22.531
Me
Cl
O
N
Me
4c
f1 (ppm)

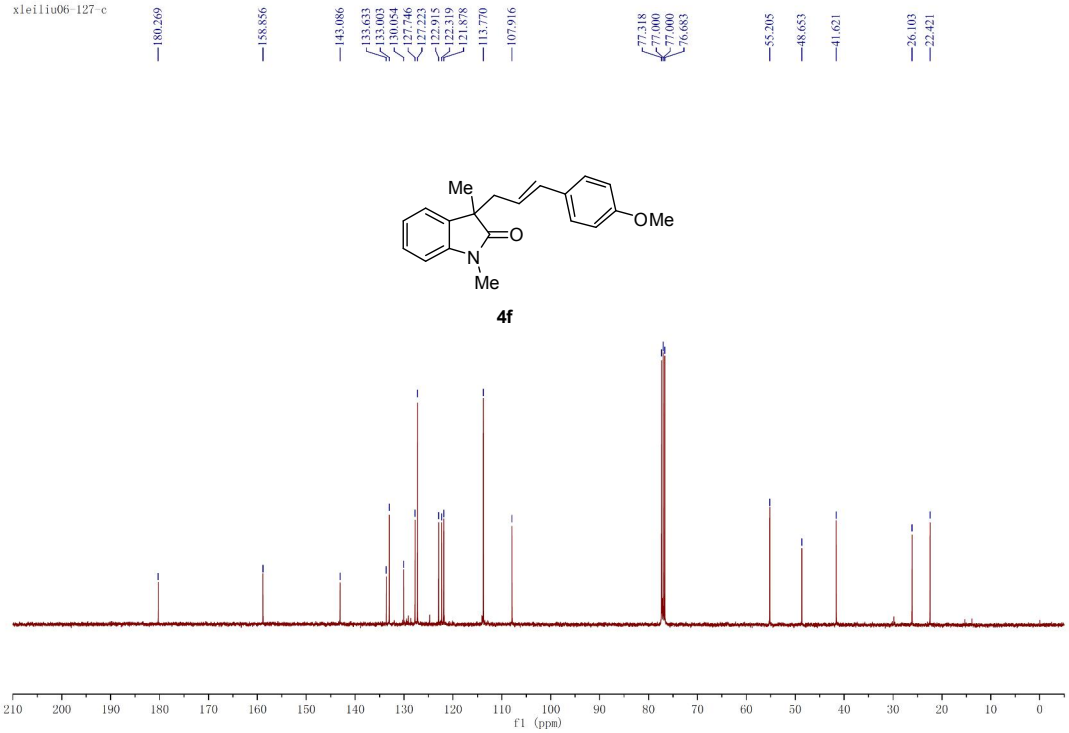

Me
Cl
O
N
Me
4d
f1 (ppm)

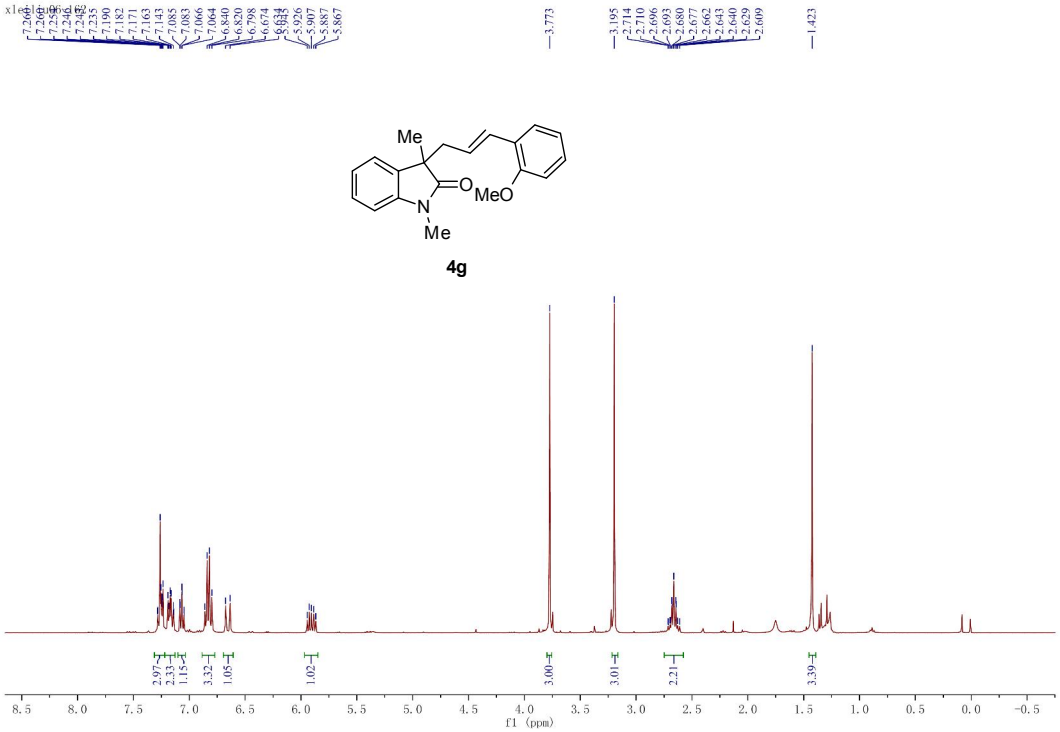

xleiliu06-136-c
Me
Cl
O
N
Me
4d
f1 (ppm)

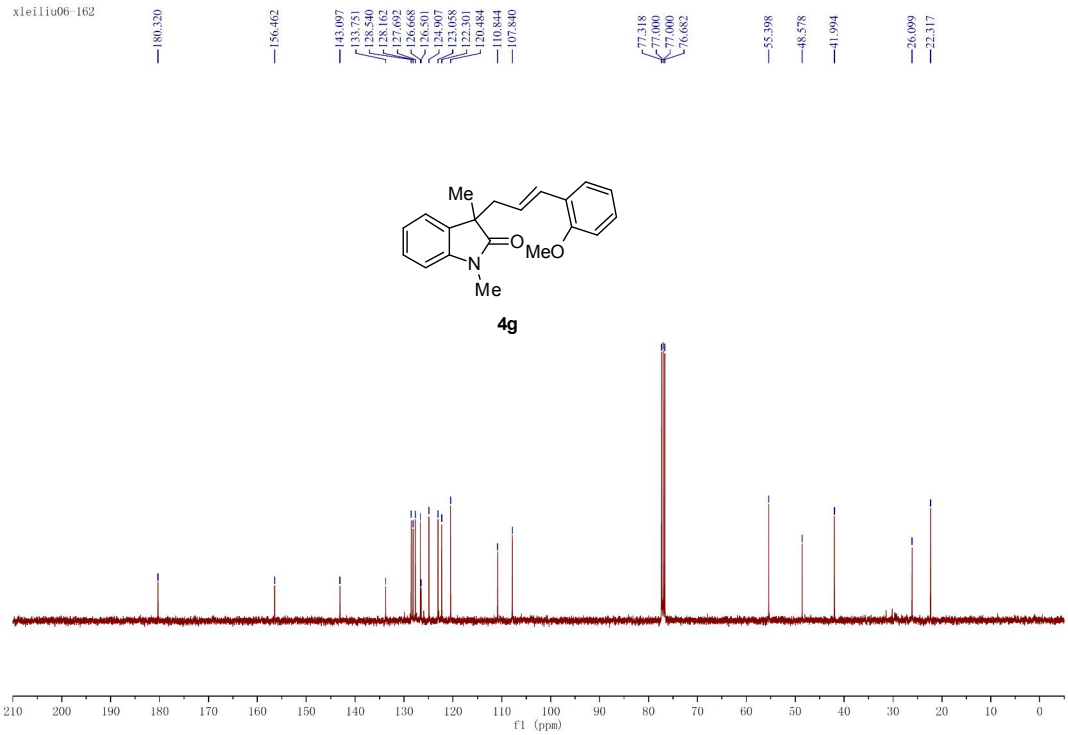

xleiliu06-175
7.281
7.260
7.255
7.239
7.219
7.157
7.136
7.083
7.064
7.046
6.830
6.810
6.350
6.311
5.894
5.875
5.856
5.836
5.817
3.187
2.693
2.691
2.672
2.657
2.650
2.641
2.639
2.631
2.617
2.597
1.413
1.286
Me
tBu
O
N
Me
4e
4.41
2.06
1.14
0.96
0.99
1.00
2.99
2.07
3.10
9.85
f1 (ppm)

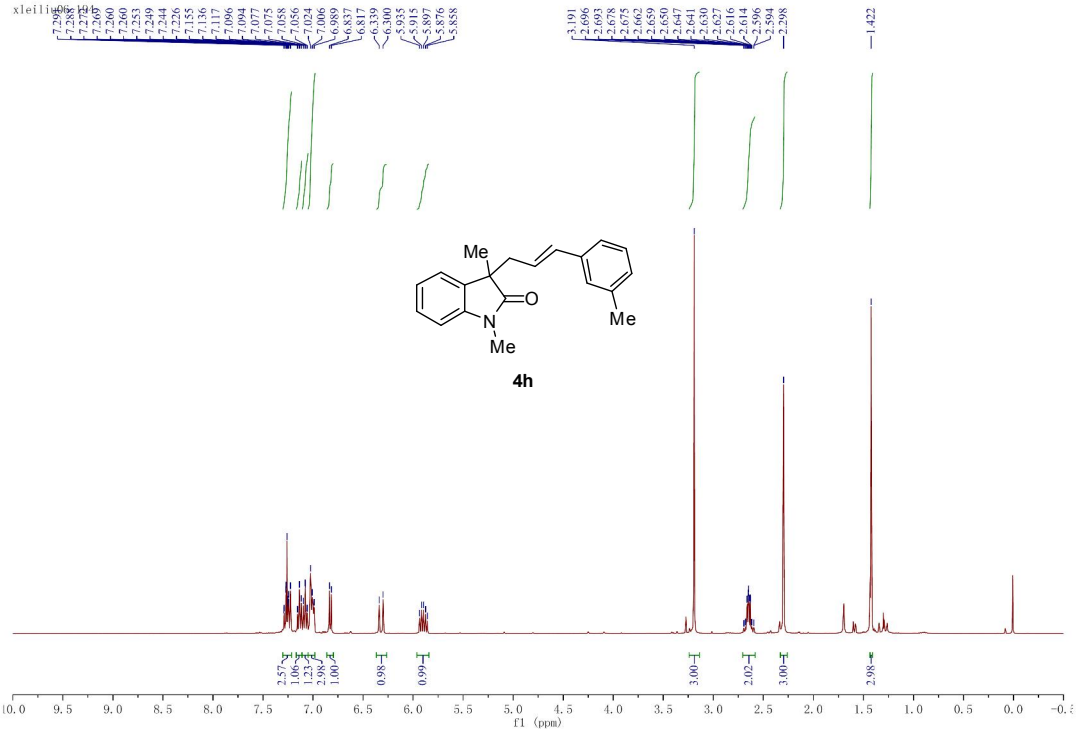

xleiliu06-175
180.236
150.183
143.067
134.466
133.573
133.379
127.755
125.853
125.272
123.327
122.935
122.331
107.948
77.318
77.203
77.000
77.000
76.683
48.598
41.586
34.448
31.228
26.138
22.552
Me
tBu
O
N
Me
4e
f1 (ppm)

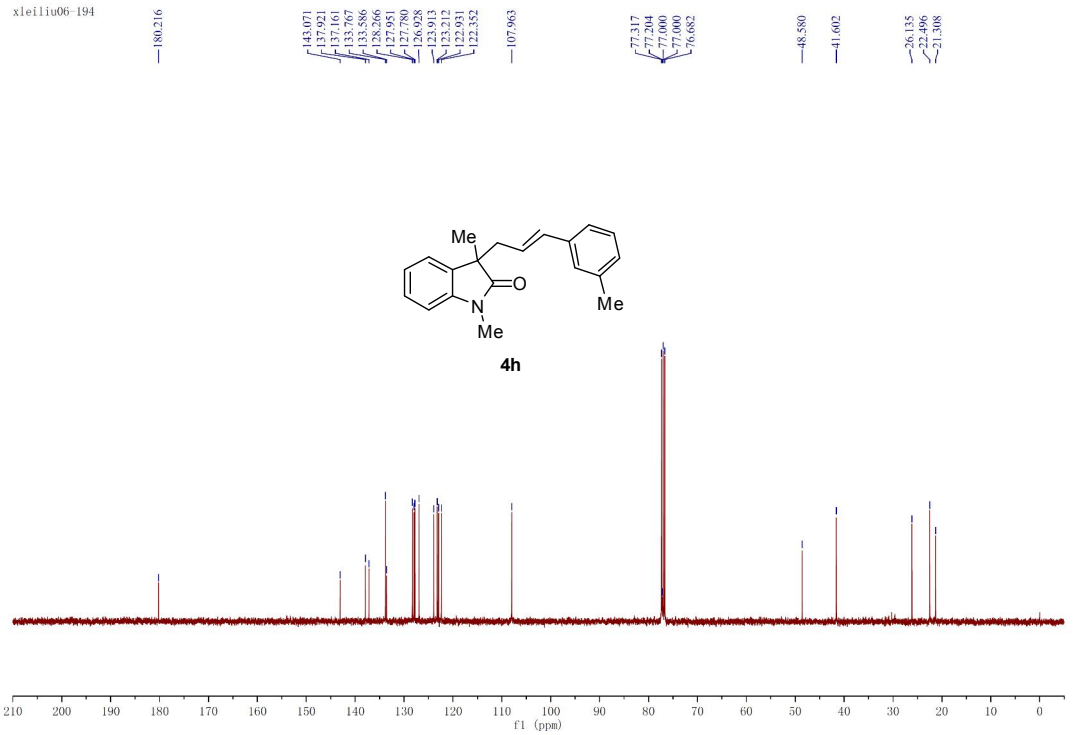

Me
OMe
O
N
Me
4f
f1 (ppm)

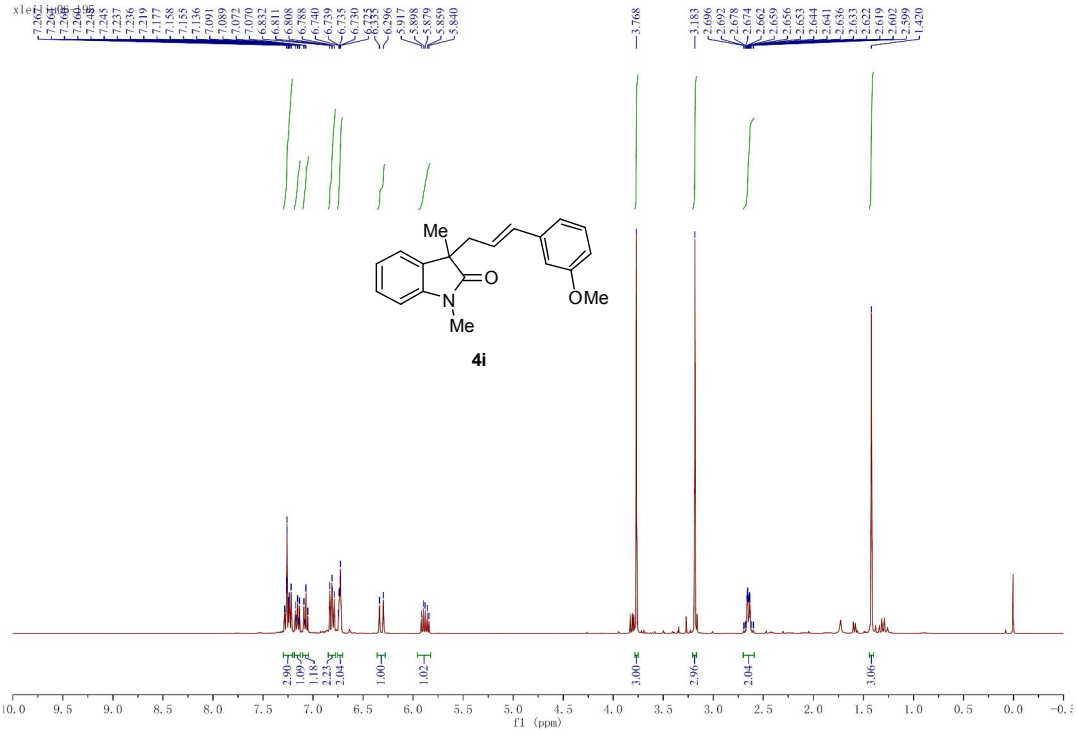

xleiliu06-127-c
Me
OMe
O
N
Me
4f
f1 (ppm)

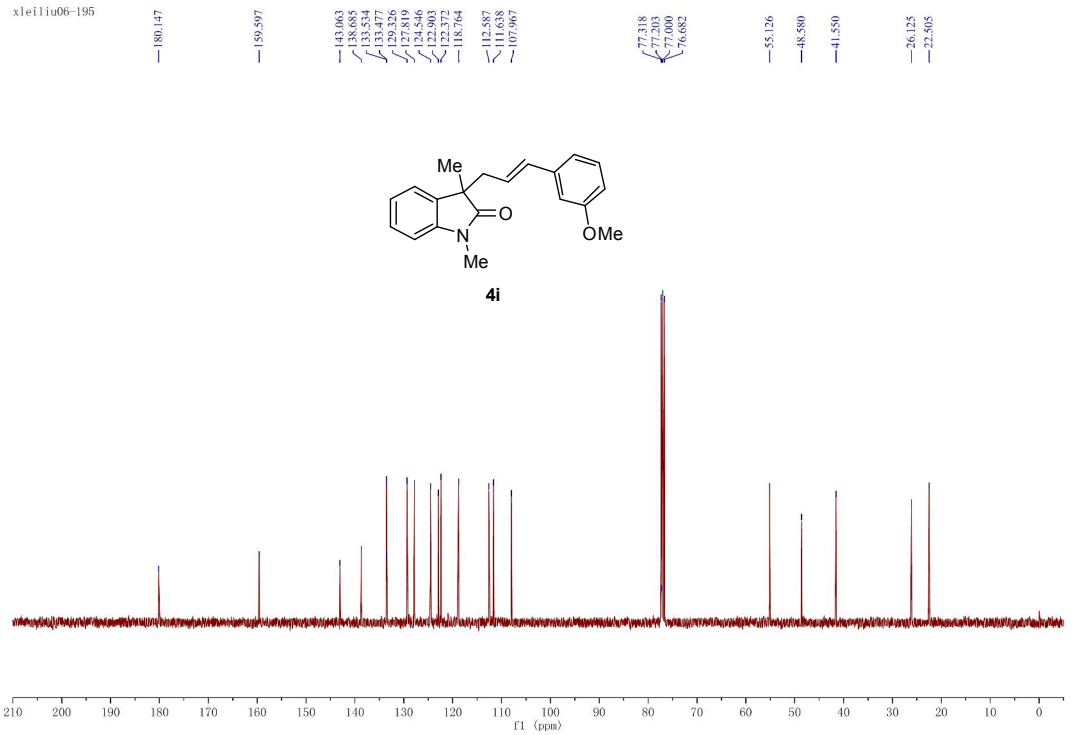

xleiliu06
7.264
7.261
7.256
7.252
7.246
7.242
7.235
7.190
7.182
7.171
7.163
7.143
7.085
7.083
7.066
7.064
6.840
6.820
6.798
6.674
6.634
5.926
5.907
5.897
5.867
3.773
3.195
2.714
2.710
2.696
2.693
2.680
2.677
2.662
2.643
2.640
2.629
2.609
1.423
Me
O
MeO
N
Me
4g
2.97
2.33
1.15
3.32
1.05
1.02
3.00
3.01
2.21
3.39
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 -0.5
f1 (ppm)

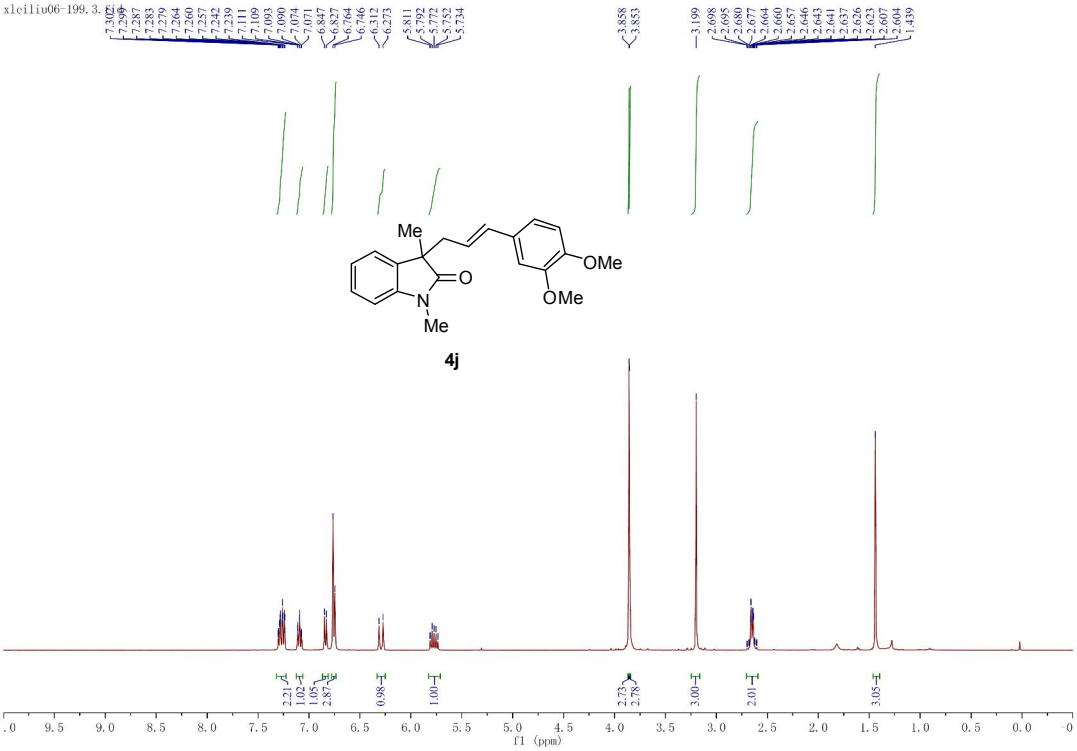

xleiliu06-162
180.320
156.462
143.097
133.751
128.540
128.162
127.692
126.668
126.501
124.907
123.058
122.301
120.484
110.844
107.840
77.318
77.000
77.000
76.682
55.398
48.578
41.994
26.099
22.317
Me
O
MeO
N
Me
4g
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

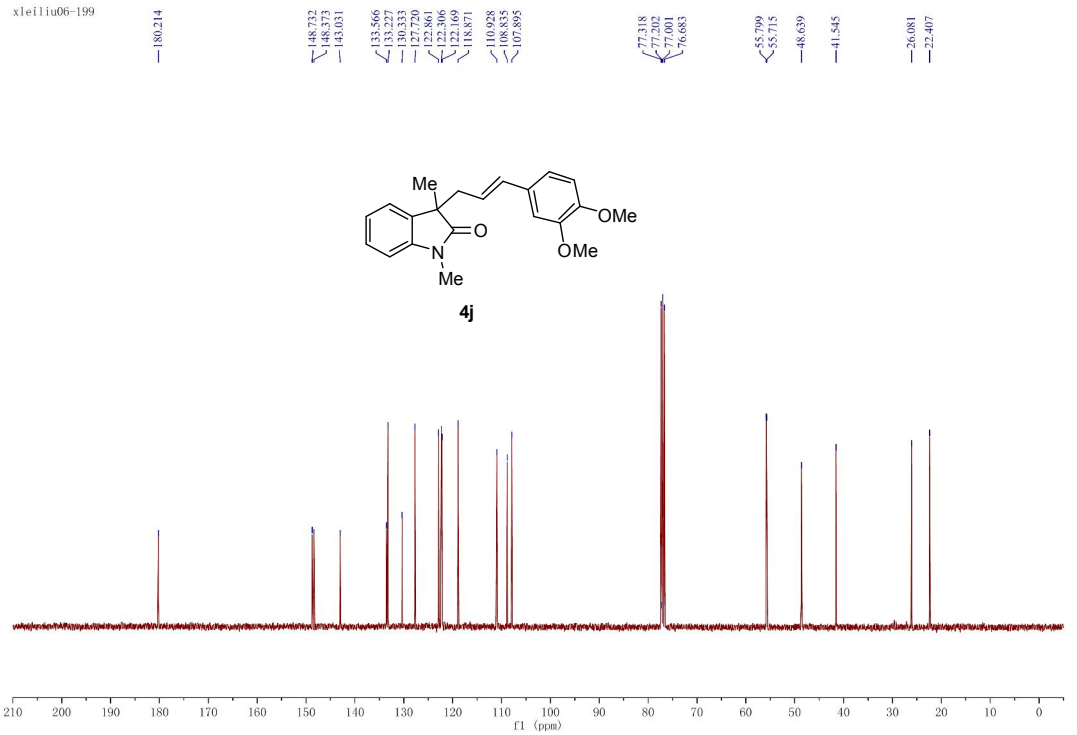

xleiliu06-194
7.298
7.288
7.274
7.269
7.260
7.260
7.255
7.249
7.244
7.226
7.155
7.136
7.117
7.096
7.094
7.077
7.075
7.058
7.056
7.024
7.006
6.989
6.837
6.817
6.339
6.300
5.935
5.915
5.897
5.876
5.858
3.191
2.696
2.695
2.678
2.675
2.662
2.659
2.650
2.647
2.641
2.630
2.627
2.616
2.614
2.596
2.594
2.298
1.422
Me
O
N
Me
Me
4h
2.57
1.06
1.23
2.98
1.00
0.98
0.99
3.00
2.02
3.00
2.98
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

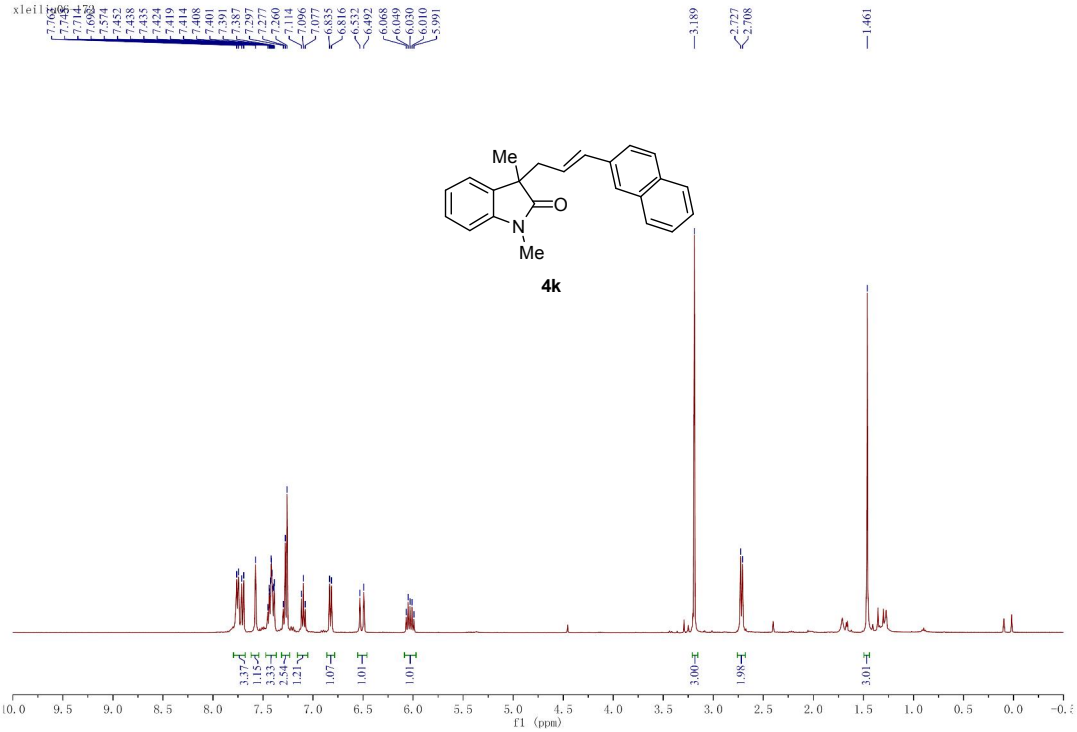

xleiliu06-194
180.216
143.071
137.921
137.161
133.767
133.586
128.266
127.951
127.780
126.928
123.913
123.212
122.931
122.352
107.963
77.317
77.204
77.000
77.000
76.682
48.580
41.602
26.135
22.496
21.308
Me
O
N
Me
Me
4h
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

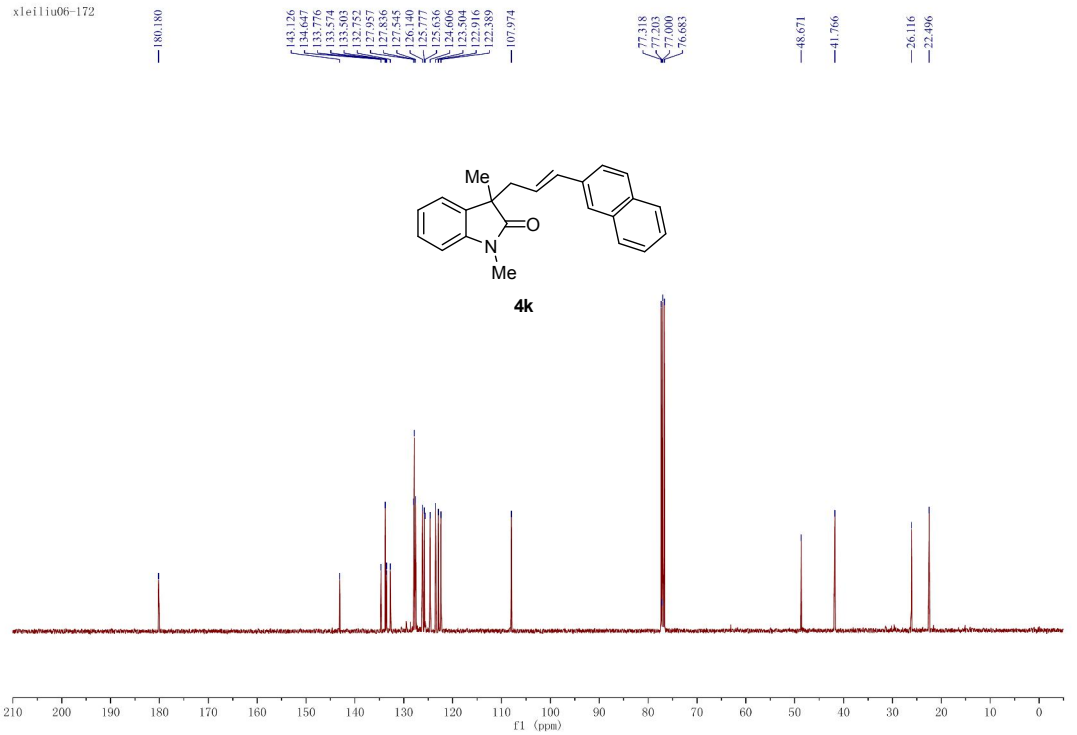

Me
O
N
Me
OMe
4i
f1 (ppm)


xleiliu06-195
Me
O
N
Me
OMe
4i
f1 (ppm)


xleiliu06-199.3.fid
Me
OMe
OMe
O
N
Me
4j
f1 (ppm)


xleiliu06-199
Me
OMe
OMe
O
N
Me
4j
f1 (ppm)


xleiliu06
7.760
7.746
7.714
7.692
7.574
7.452
7.438
7.435
7.424
7.419
7.414
7.408
7.401
7.391
7.387
7.277
7.260
7.114
7.096
7.077
6.835
6.816
6.532
6.492
6.068
6.049
6.030
6.010
5.991
3.189
2.727
2.708
1.461
Me
O
N
Me
4k
3.37
1.15
3.33
2.54
1.21
1.07
1.01
1.01
3.00
1.98
3.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


xleiliu06-172
180.180
143.126
134.647
133.776
133.574
133.503
132.752
127.957
127.836
127.545
126.140
125.777
125.636
124.606
123.504
122.916
122.389
107.974
77.318
77.203
77.000
76.683
48.671
41.766
26.116
22.496
Me
O
N
Me
4k
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)