

## Supporting information

### Contents

<b>1. General information</b> .....	S2
<b>2. Additional Optimization Information</b> .....	S3
<b>3. Preparation of Substrates</b> .....	S6
<b>4. General procedure</b> .....	S11
<b>5. Scale-up reaction</b> .....	S11
<b>6. References</b> .....	S12
<b>7. Spectroscopic data of products</b> .....	S13
<b>8. NMR spectra of the products</b> .....	S21

## 1. General information

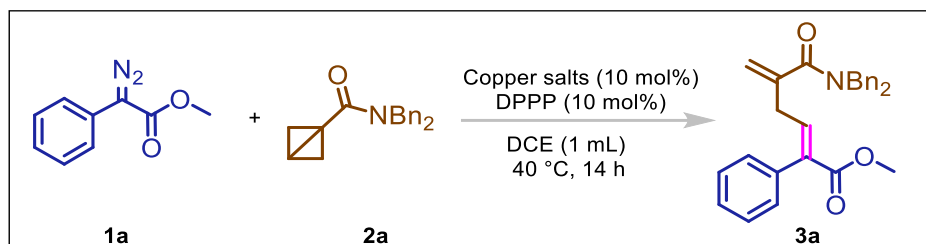
**Reagents and solvents:** Unless otherwise noted, reagents were ordered from *Sigma-Aldrich*, *TCI*, *ABCR*, *Alfa Aesar* or *BLD pharm*, and used without purification. Pure solvents were available from *Thermo Fisher*.

**Purification:** Analytical thin layer chromatography was performed using MACHEREY-NAGEL Gmbn & Co. KG silica gel plates (Silica gel 60 UV254). Visualization was by ultraviolet fluorescence ( $\lambda = 254$  nm) and/or staining with potassium permanganate ( $\text{KMnO}_4$ ). The products were isolated from the reaction mixture by column chromatography on silica gel 60, 0.063-0.2 mm, 70-230 mesh (Merck). Gradient flash chromatography was conducted eluting with PE/EA, PE refers to pentane and EA refers to ethyl acetate, they were listed as volume/volume ratios.

**Data collection:** GC analysis was performed on an Agilent HP-7890A instrument with FID detector and HP-5 capillary column (polydimethylsiloxane with 5% phenyl groups, 30 m, 0.32 mm i.d., 0.25  $\mu\text{m}$  film thickness) using argon as carrier gas. Electron impact (EI) mass spectra were recorded on AMD 402 mass spectrometer (70 eV). The data are given as mass units per charge ( $m/z$ ). NMR spectra were recorded on Bruker Avance 300 and Bruker ARX 400 spectrometers. Multiplets were assigned as s(singlet), d (doublet), t (triplet), q (quartet), dd (doublet of doublet), m (multiplet) and br. s (broad singlet). Chemical shifts (ppm) are given relative to solvent: references for  $\text{CDCl}_3$  were 7.26 ppm ( $^1\text{H}$  NMR) and 77.00 ppm ( $^{13}\text{C}$  NMR). All measurements were carried out at room temperature unless otherwise stated.

## 2. Additional Optimization Information

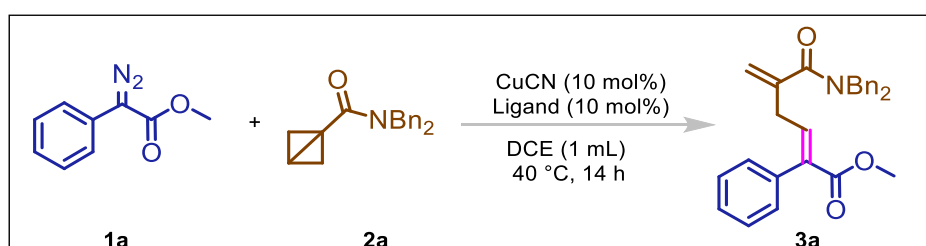
Table S1. Optimization of copper salts.



Entry	Copper salts	Yield	<i>E/Z</i>
1	CuI	12 %	> 20:1
2	CuBr(Me <sub>2</sub> S)	30 %	> 20:1
3	CuCN	60 %	> 20:1
4	CuCl <sub>2</sub>	18 %	> 20:1
5	Cu(acac) <sub>2</sub>	43 %	> 20:1
6	Cu(OTf) <sub>2</sub>	21 %	> 20:1
7	Cu(HCO <sub>3</sub> ) <sub>2</sub>	25 %	> 20:1
8	Co(PPh <sub>3</sub> )NO <sub>3</sub>	33 %	> 20:1

Reaction conditions: 1a (0.4 mmol), 2 (0.2 mmol), **Copper salts** (10 mol%), DPPP (10 mol%), DCE (1.0 mL), stirred at 40 °C for 14 h. Determined by NMR with 1,3,5-trimethoxybenzene as internal standard.

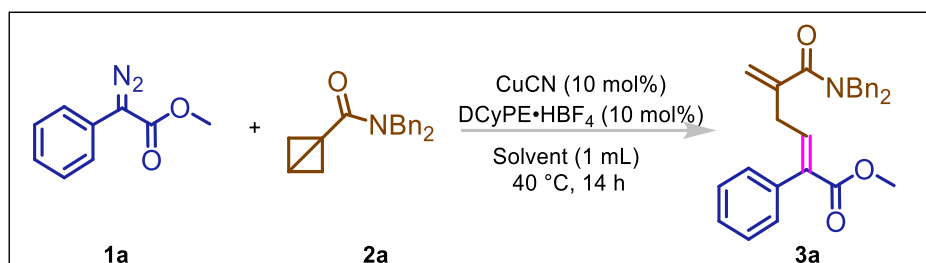
Table S2. Optimization of ligands.



Entry	Ligand	Yield	<i>E/Z</i>
1	bpy	N.R.	n/a
2	dtbbpy	N.R.	n/a
3	1,10-phen	N.R.	n/a
4	PPh <sub>3</sub>	62 %	> 20:1
5	BuPAd <sub>2</sub>	68 %	> 20:1
6	DCyPE•HBF <sub>4</sub>	77 %	> 20:1
7	Xantphos	25 %	> 20:1
8	BINAP	trace	> 20:1

Reaction conditions: 1a (0.4 mmol), 2 (0.2 mmol), CuCN (10 mol%), **Ligand** (10 mol%), DCE (1.0 mL), stirred at 40 °C for 14 h. Determined by NMR with 1,3,5-trimethoxybenzene as internal standard.

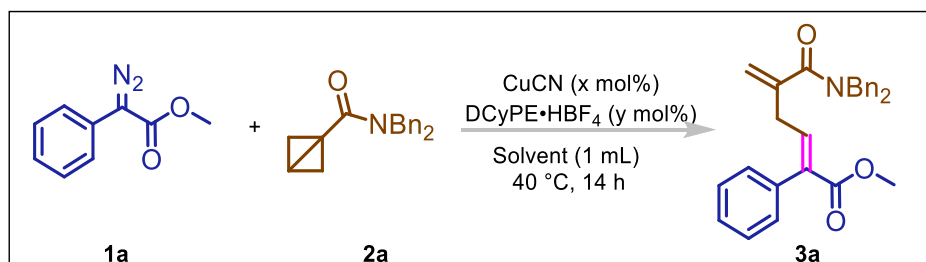
Table S3. Optimization of solvent.



Entry	Solvent	Yield	<i>E/Z</i>
1	CH <sub>3</sub> CN	trace	n/a
2	THF	12 %	> 20:1
3	1,4-Dioxane	22 %	> 20:1
4	DME	35 %	> 20:1
5	MTBE	55 %	> 20:1
6	toluene	15 %	> 20:1
7	DMF	27 %	> 20:1
8	DMSO	34 %	> 20:1

Reaction conditions: 1a (0.4 mmol), 2 (0.2 mmol), CuCN (10 mol%), DCyPE•HBF<sub>4</sub> (10 mol%), **Solvent** (1.0 mL), stirred at 40 °C for 14 h. Determined by NMR with 1,3,5-trimethoxybenzene as internal standard.

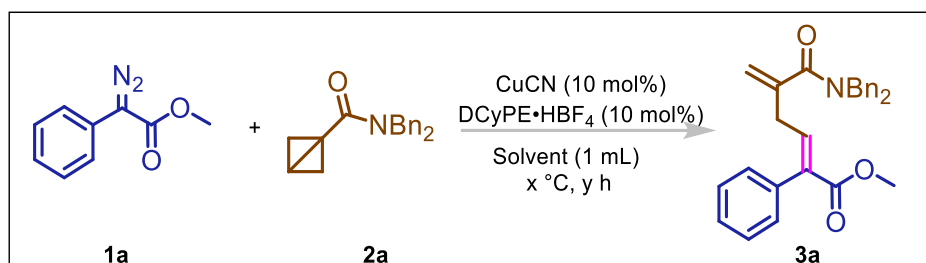
Table S4. Optimization of loading of copper and ligand.



Entry	X (mol%)	y (mol%)	Yield	<i>E/Z</i>
1	1	1	trace	n/a
2	5	5	50 %	> 20:1
3	10	20	55 %	> 20:1
4	15	15	62 %	> 20:1
5	20	20	58 %	> 20:1

Reaction conditions: 1a (0.4 mmol), 2 (0.2 mmol), CuCN (x mol%), DCyPE·HBF<sub>4</sub> (y mol%), **Solvent** (1.0 mL), stirred at 40 °C for 14 h. Determined by NMR with 1,3,5-trimethoxybenzene as internal standard.

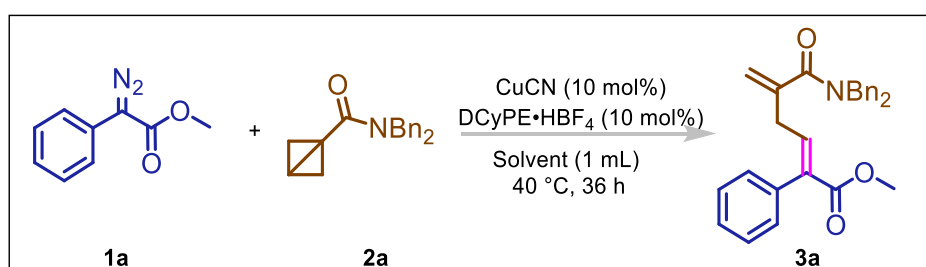
Table S5. Optimization of temperature and time.



Entry	X (°C)	y (h)	Yield	E/Z
1	25	14	trace	n/a
2	30	14	42 %	> 20:1
3	50	14	70 %	> 20:1
4	40	24	88 %	> 20:1
5	40	36	90 %	> 20:1

Reaction conditions: 1a (0.4 mmol), 2 (0.2 mmol), CuCN (10 mol%), DCyPE·HBF<sub>4</sub> (10 mol%), **Solvent** (1.0 mL), stirred at x °C for y h. Determined by NMR with 1,3,5-trimethoxybenzene as internal standard.

Table S6. Optimization of loading of 1a.



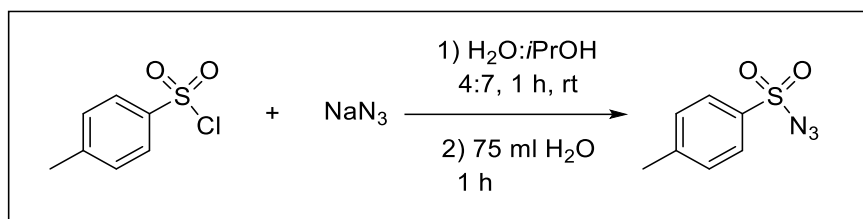
Entry	1a (mmol)	Yield	E/Z
1	0.1	54 %	n/a
2	0.15	80 %	> 20:1
3	0.2	90 %	> 20:1
4	0.25	99 % (95 %) <sup>a</sup>	> 20:1
5	0.3	99 %	> 20:1

Reaction conditions: 1a (0.4 mmol), 2 (0.2 mmol), CuCN (10 mol%), DCyPE·HBF<sub>4</sub> (10 mol%), **Solvent** (1.0 mL), stirred at 40 °C for 14 h. Determined by NMR with 1,3,5-trimethoxybenzene as internal standard. <sup>a</sup> Isolated yield.

### 3. Preparation of Substrates

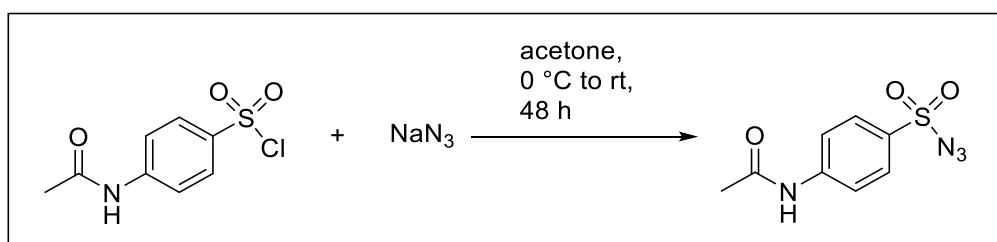
#### 3.1 Synthesis of Diazo Transfer Reagents

##### General Procedure 1 for preparation of 4-Toluenesulfonyl azide<sup>1</sup>.



A solution of NaN<sub>3</sub> (936 mg, 14.4 mmol) in H<sub>2</sub>O (4 mL) was quickly added to a suspension of *p*-toluenesulfonyl chloride (PTSCl) (2.3 g, 12 mmol) in isopropanol (7 mL). The reaction mixture was stirred for 1 h at RT, H<sub>2</sub>O (75 mL) was added and the mixture stirred for another 1 h, then extracted with CH<sub>2</sub>Cl<sub>2</sub> (4×25 mL). The combined organic extract was dried (MgSO<sub>4</sub>) and solvent was evaporated under reduced pressure to yield TosN<sub>3</sub> as a colorless oil (2.36 g, 100 %)

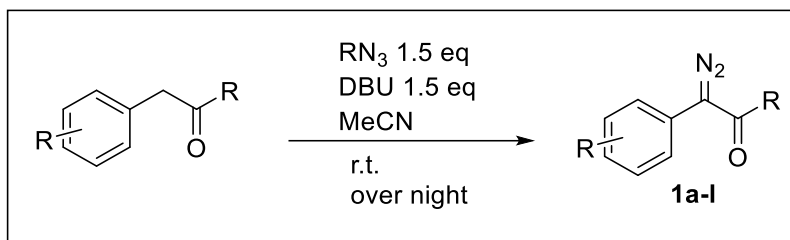
##### General Procedure 2 for Preparation of N-Acetylsulfanilylazid<sup>2</sup>.



Acetylsulfanilyl chloride (1.17 g, 5.0 mmol) was added portionwise over 2 min to a stirring mixture of sodium azide (325 mg, 5.0 mmol) in acetone (117 mL) at 0 °C. The resulting mixture was stirred at 25 °C for 48 h. The reaction mixture was then filtered and concentrated in vacuo to yield azide Sb as a white solid (1.19 g, 99%)

### 3.2 Synthesis of starting material

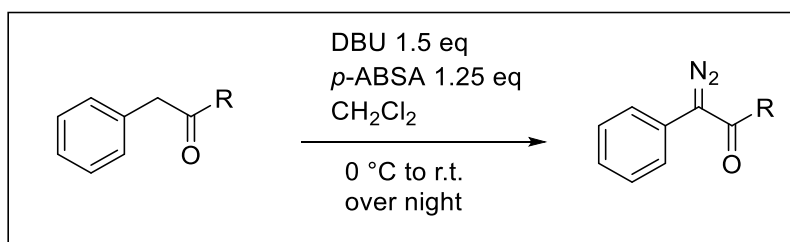
#### General Procedure 3 for preparation of alpha-diazoesters<sup>3</sup>.



To a mixture of ester (1 eq) and tosyl azide (1.5 eq) in anhydrous CH<sub>3</sub>CN (0.67 M), 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) (1.5 eq) was added. The reaction mixture was stirred at room temperature for overnight. Upon complete consumption of the starting materials, the reaction mixture was quenched with saturated aqueous solution of NH<sub>4</sub>Cl, extracted with CH<sub>2</sub>Cl<sub>2</sub> (3 × 30 mL), washed with brine (3 × 10 mL), dried over MgSO<sub>4</sub>, and concentrated under reduced pressure to give the product. The residue was purified by flash chromatography (pentane/EtOAc) to afford the α-diazoester.

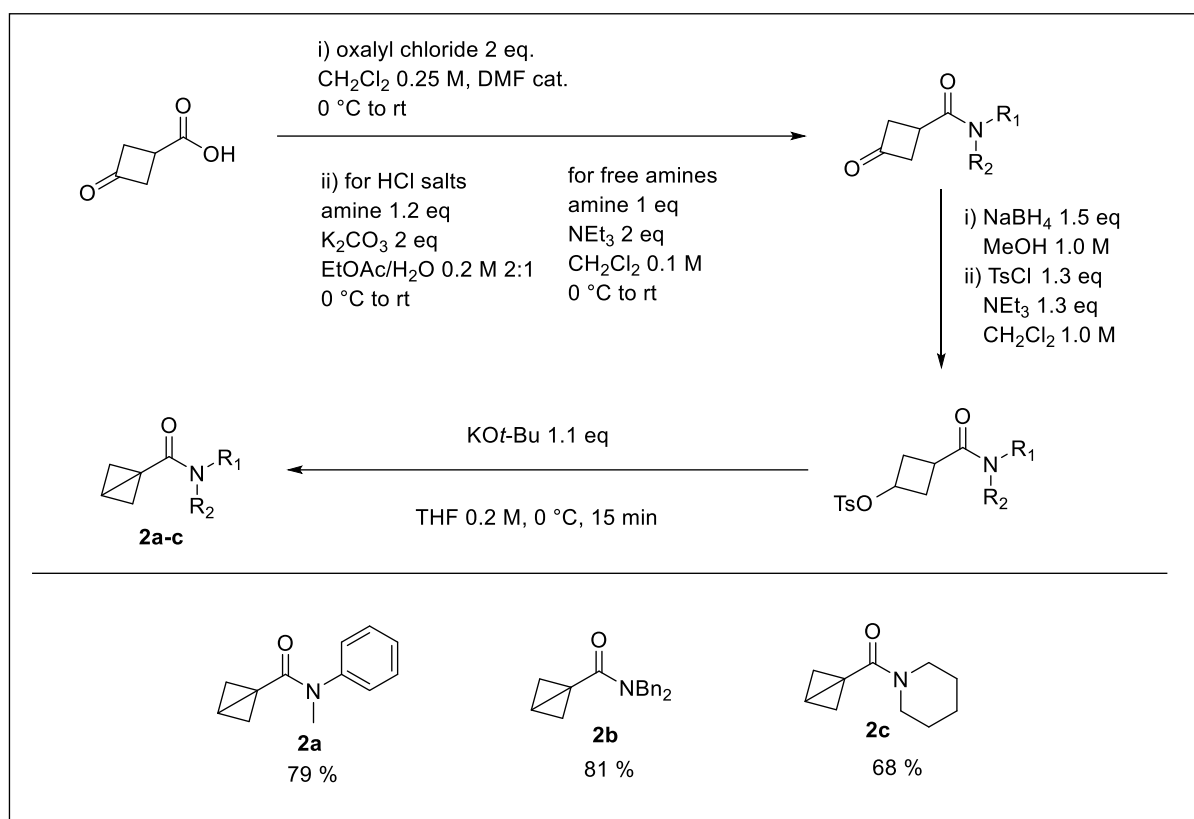
All synthesized diazoesters are known to literature.

#### General Procedure 4 for preparation of 2-Diazo-1,2-diphenylethan-1-one<sup>4</sup>.



To a 25 mL flame-dried flask under argon was added the corresponding ketone (12 mmol), *p*-acetamidobenzenesulfonyl azide (*p*-ABSA) (3.60 g, 15 mmol) and anhydrous acetonitrile (15 mL). The mixture was cooled with an ice-bath and a solution of 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) (2.35 mL, 2.40 g, 16 mmol) in anhydrous acetonitrile (5 mL) was added dropwise over 0.5 h. The mixture was stirred 1 h at 0 °C, then at room temperature until the reaction was completed. The reaction was then quenched with a solution of 10% NaOH in water. The organic phases were extracted with diethyl ether (2 × 25 mL), combined, dried over MgSO<sub>4</sub>, and evaporated under reduced pressure (temperature 30 °C).

## General Procedure 5 for Preparation of Weinreb Amide BCB<sup>5</sup>.



1 st Step: Following a literature procedure: 24 In a round-bottom flask 3-oxocyclobutane-1-carboxylic acid (1.0 equiv) was dissolved in CH<sub>2</sub>Cl<sub>2</sub> (0.20 M) and DMF was added (0.5 drops/mmol). The solution was cooled to 0 °C and subsequently oxalyl chloride (2.0 equiv) was added dropwise. The reaction was stirred for 2 h at 0 °C and was then allowed to warm up to room temperature. After stirring for 1 h at room temperature, the solvent was removed under reduced pressure to yield the crude acid chloride which was used without further purification.

Amide formation from HCl salts: To a round-bottom flask were added the respective amine hydrochloride (1.2 equiv), K<sub>2</sub>CO<sub>3</sub> (2.0 equiv) and a mixture of EtOAc/H<sub>2</sub>O (2:1, 0.20 M). The mixture was cooled to 0 °C, and subsequently the crude acid chloride was added dropwise (the flask containing acid chloride was rinsed with EtOAc to make sure everything was transferred). Then, the reaction was stirred at room temperature overnight. The layers were separated and the aq. layer was extracted with EtOAc (3×). The combined org. layers were dried over MgSO<sub>4</sub> and concentrated under reduced pressure. Purification by silica gel column chromatography gave the desired product. S18

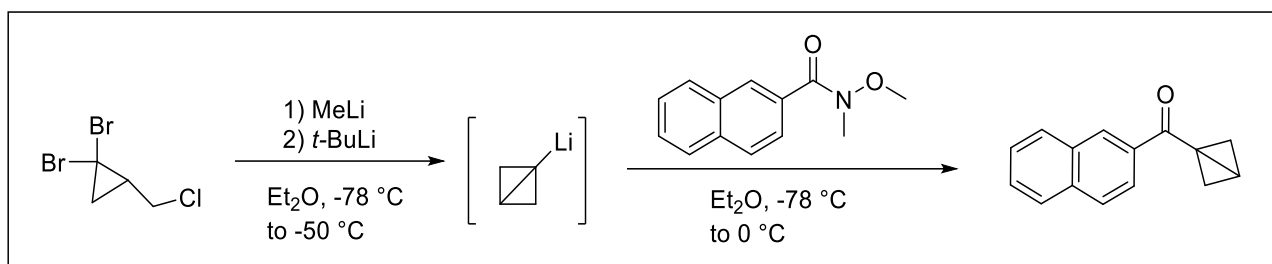
Amide formation from free amines: To a solution of amine (1.0 equiv) and NEt<sub>3</sub> (2.0 equiv) in CH<sub>2</sub>Cl<sub>2</sub> (0.10 M) at 0 °C, the crude acid chloride (1.2 equiv) was added dropwise and the resulting reaction mixture was allowed to warm to room temperature while stirring overnight. The reaction was quenched with sat. aq. NaHCO<sub>3</sub> and the layers were separated. The aq. layer was extracted with CH<sub>2</sub>Cl<sub>2</sub>, and the combined org. layers were dried over MgSO<sub>4</sub>, filtered, and concentrated under reduced pressure. The crude material was purified by silica gel column chromatography.



2<sup>nd</sup> Step: Following a literature procedure: In a round-bottom flask amide (1.0 equiv) was dissolved in MeOH (1.0 M), and the mixture was cooled to 0 °C. NaBH<sub>4</sub> (1.5 equiv) was added portionwise (attention: gas evolution!) until full conversion (by TLC) of the starting material. The reaction was quenched with water, and the aq. layer was extracted with CH<sub>2</sub>Cl<sub>2</sub>. The combined org. layers were dried over MgSO<sub>4</sub> and removing the solvent in vacuo gave the crude product which was used in the next step without further purification. To an oven-dried Schlenk flask equipped with a Teflon-coated magnetic stir bar was added the crude alcohol and the flask was evacuated and backfilled with argon three times. Subsequently, CH<sub>2</sub>Cl<sub>2</sub> (1.0 M) was added, and the solution was cooled to 0 °C. TsCl (1.3 equiv) and NEt<sub>3</sub> (1.3 equiv) were added successively, and the reaction was allowed to warm up to room temperature. Upon full conversion (monitored by TLC; if not full conversion after stirring overnight, further TsCl and NEt<sub>3</sub> were added), the reaction was quenched with water. The org. layer was separated, washed with brine, dried over MgSO<sub>4</sub>, and concentrated in vacuo. Purification by silica gel column chromatography gave the desired product. S19

3<sup>rd</sup> Step: Following a literature procedure: To an oven-dried Schlenk tube equipped with a Teflon-coated magnetic stir bar was added the protected alcohol (1.0 equiv), and the flask evacuated and backfilled with argon three times. Subsequently, dry THF (0.20 M) was added, and the solution was cooled to 0 °C. KO<sup>t</sup>Bu (1.1 equiv) was separately dissolved in dry THF (1 M, under air), and the solution was added dropwise to the reaction flask at 0 °C. After stirring for 15 min, the reaction was quenched with sat. aq. NH<sub>4</sub>Cl, and the org. layer was extracted with Et<sub>2</sub>O (3×). The combined org. layers were dried over MgSO<sub>4</sub> and concentrated under reduced pressure. Purification by silica gel column chromatography gave the desired product.

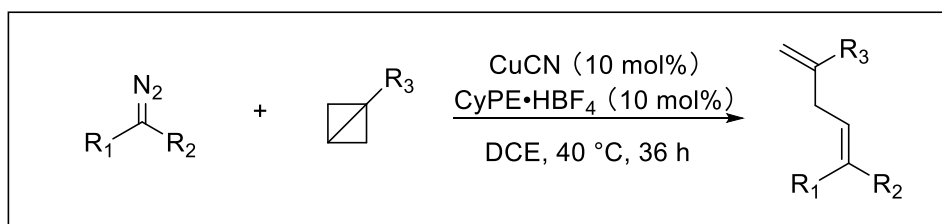
## General Procedure 6 of Preparation for bicyclobutane-1-yl(naphthalen-2-yl)methanone<sup>6</sup>.



Therefore, trihalocyclopropanes were dissolved in anhydrous diethyl ether (0.2 M). The solution was cooled to  $-78\text{ }^{\circ}\text{C}$  and methyl lithium (2.2 M-solution of the LiBr-complex in diethyl ether or 1.6 M-solution (“halide-free”) in diethyl ether) was added slowly. Stirring was continued for 30 minutes, then the mixture was warmed to  $-50\text{ }^{\circ}\text{C}$  and stirred for further 60 minutes. After cooling to  $-78\text{ }^{\circ}\text{C}$ , *t*-butyl lithium (1.7 M-solution in pentane or 1.9 M-solution in heptane) was added slowly and the solution was stirred for 20 minutes. A solution of the Weinreb-amide (1.2 equiv. – 1.5 equiv.) in anhydrous diethyl ether (1.2 M – 1.5 M) was added dropwise at  $-78\text{ }^{\circ}\text{C}$ . The mixture was stirred for 30 minutes at  $-78\text{ }^{\circ}\text{C}$  and for one hour at  $0\text{ }^{\circ}\text{C}$  and then quenched by addition of ammonium chloride solution. The phases were separated, the aqueous phase was extracted with diethyl ether (3 x), the combined organic phases were washed with brine, dried over magnesium sulfate, and concentrated under reduced pressure at room temperature. Purification by flash column chromatography (diethyl ether/pentane) afforded the bicyclo[1.1.0]butane as a solids.

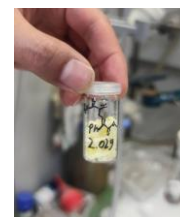
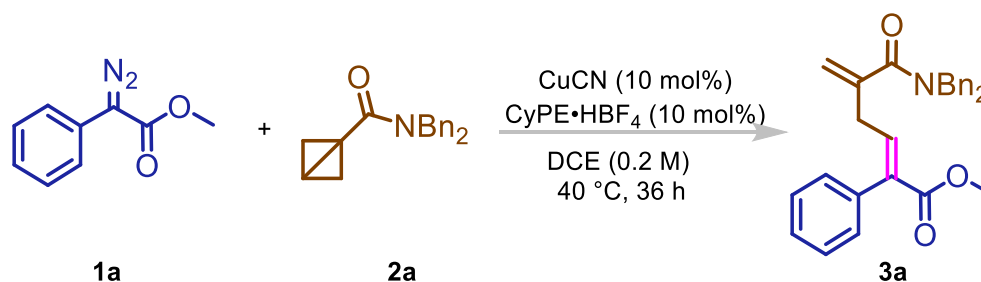
with 9 Et<sub>2</sub>O (3× 100 mL) and then the combined organic phases were dried (MgSO<sub>4</sub>), filtered, and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (SiO<sub>2</sub>; 60:40 pentane:EtOAc) to afford the BCB-sulfoxide 5 (avg. 1.30 g, avg. 52 % over 13 experiments) as a colorless oil.

## 4. General procedure



To an oven dried Schlenk Flask (15 ml), was added the diazoester (0.5 mmol, 2.5 eq), the Bicyclobutane (0.2 mmol, 1 eq), CuCN (0.02 mmol, 10 mol%) and DCyPE·HBF<sub>4</sub> (0.02 mmol, 10 mol%). The reaction flask was evacuated and backfilled with nitrogen 3 times. The DCE (2 ml) was added and stirred 36 h at 40 °C. After the reaction time, the Solvent was removed under reduced pressure and purified by column chromatography (pentane/EtOAc) to afford the penta-1,4-diene in quantitative yields.

## 5. Scale-up reaction



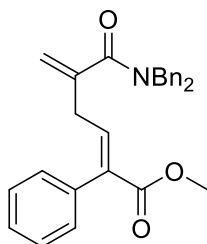
To an oven dried Schlenk Flask (100 ml), was added the methyl 2-diazo-2-phenylacetate (12.5 mmol, 2.5 eq), the *N,N*-dibenzylbicyclo[1.1.0]butane-1-carboxamide (5 mmol, 1 eq), CuCN (0.5 mmol, 10 mol%) and DCyPE·HBF<sub>4</sub> (0.5 mmol, 10 mol%). The reaction flask was evacuated and backfilled with nitrogen 3 times. The DCE (50 ml) was added and stirred 36 h at 40 °C. After the reaction time, the Solvent was removed under reduced pressure and purified by column chromatography (pentane/EtOAc) to afford the product **3a** as a yellow solid (2.02 g, 95 %).

## 6. References

- (1) Bélanger, D.; Tong, X.; Soumaré, S.; Dory, Y. L.; Zhao, Y. Cyclic Peptide–Polymer Complexes and Their Self-Assembly. *Chem. Eur. J.* **2009**, *15*, 4428-4436.
- (2) Brown, D. G.; Velthuisen, E. J.; Commerford, J. R.; Brisbois, R. G. A Convenient Synthesis of Dimethyl (Diazomethyl)phosphonate (Seyferth/Gilbert Reagent). *J. Org. Chem.* **1996**, *61*, 2540-2541.
- (3) Keipour, H.; Ollevier, T. Iron-Catalyzed Carbene Insertion Reactions of  $\alpha$ -Diazoesters into Si–H Bonds. *Org. Lett.* **2017**, *19*, 5736-5739.
- (4) Denton, J. R.; Davies, H. M. L. Enantioselective Reactions of Donor/Acceptor Carbenoids Derived from  $\alpha$ -Aryl- $\alpha$ -Diazoketones. *Org. Lett.* **2009**, *11*, 787-790.
- (5) Kleinmans, R.; Pinkert, T.; Dutta, S.; Paulisch, T. O.; Keum, H.; Daniliuc, C. G.; Glorius, F. Intermolecular  $[2\pi+2\sigma]$ -photocycloaddition enabled by triplet energy transfer. *Nature* **2022**, *605*, 477-482.
- (6) Radhoff, N.; Daniliuc, C. G.; Studer, A. Lewis acid catalyzed formal (3+ 2)-cycloaddition of bicyclo [1.1. 0] butanes with ketenes. *Angew. Chem. Int. Ed.* **2023**, *62*, e202304771.

## 7. Spectroscopic data of products

### Methyl-5-(dibenzylcarbamoyl)-2-phenylhexa-2,5-dienoate (3a)



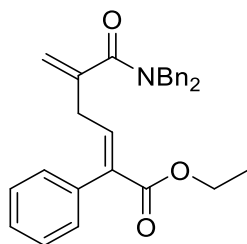
Following GP 9, the product was obtained as a yellowish solid (70.6 mg, 0.167 mmol, 83 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.44 – 7.13 (m, 9H), 7.12 – 6.74 (m, 7H), 5.11 (dt, *J* = 16.4, 1.5 Hz, 2H), 4.38 (d, *J* = 31.7 Hz, 4H), 3.61 (s, 3H), 3.04 (dt, *J* = 7.8, 1.5 Hz, 2H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.8, 167.2, 141.7, 139.5, 136.2, 134.6, 129.4, 128.8, 128.2, 127.9, 127.7, 127.0, 115.7, 52.2, 51.0, 46.6, 34.2.

**HRMS-ESI(*m/z*):** calcd for C<sub>28</sub>H<sub>27</sub>NO<sub>3</sub>Na<sup>+</sup> [*M*+Na]<sup>+</sup> 448.1883, found 448.1887.

### Methyl-2-(2-bromophenyl)-5-(dibenzylcarbamoyl)hexa-2,5-dienoate (3b)



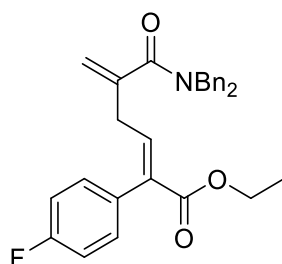
Following GP 9, the product was obtained as a yellow solid (90.2 mg, 0.174 mmol, 87 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ = 7.55 – 7.37 (m, 9H), 7.32 – 7.19 (m, 7H), 5.37 (dt, *J*=15.4, 1.5, 2H), 4.79 – 4.54 (m, 4H), 4.35 (q, *J*=7.1, 2H), 3.29 (dt, *J*=7.7, 1.5, 2H), 1.38 (t, *J*=7.1, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.9, 166.7, 141.8, 138.9, 136.5, 134.6, 129.4, 128.8, 128.3, 128.1, 127.8, 127.6, 127.0, 115.6, 61.0, 34.1, 31.5, 30.2, 14.3.

**HRMS-ESI(*m/z*):** calcd for C<sub>29</sub>H<sub>29</sub>NO<sub>3</sub>Na<sup>+</sup> [*M*+Na]<sup>+</sup> 462.2039, found 462.2048.

### Ethyl-5-(dibenzylcarbamoyl)-2-(4-fluorophenyl)hexa-2,5-dienoate (3c)



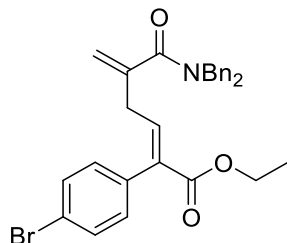
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.39 – 7.27 (m, 7H), 7.25 – 6.93 (m, 7H), 5.27 (d, *J* = 1.3 Hz, 1H), 5.21 (t, *J* = 1.7 Hz, 1H), 4.48 (dd, *J* = 26.1, 14.5 Hz, 4H), 4.21 (q, *J* = 7.1 Hz, 2H), 3.13 (dt, *J* = 7.8, 1.5 Hz, 2H), 1.26 (t, *J* = 7.1 Hz, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.8, 166.548, 163.9, 160.7, 141.6, 139.3, 135.5, 130.5, 130.4, 128.8, 128.3, 127.7, 126.9, 115.7, 61.1, 51.0, 46.6, 29.7.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)**: δ -117.2 (p, *J* = 6.5 Hz).

**HRMS-ESI(m/z)**: calcd for C<sub>29</sub>H<sub>28</sub>FNO<sub>3</sub>Na<sup>+</sup> [M+Na]<sup>+</sup> 480.1945, found 480.1948.

**Ethyl-2-(4-bromophenyl)-5-(dibenzylcarbamoyl)hexa-2,5-dienoate (3d)**

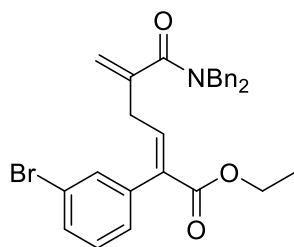


**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.46 – 7.28 (m, 8H), 7.20 – 6.96 (m, 7H), 5.30 – 5.26 (m, 1H), 5.21 (t, *J* = 1.7 Hz, 1H), 4.61 – 4.41 (m, 4H), 4.21 (q, *J* = 7.1 Hz, 2H), 3.12 (dt, *J* = 7.8, 1.5 Hz, 2H), 1.25 (t, *J* = 7.1 Hz, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.8, 166.3, 141.6, 139.6, 135.4, 133.6, 131.4, 131.2, 128.9, 128.4, 127.7, 126.9, 122.1, 115.9, 61.3, 51.1, 46.7, 14.3.

**HRMS-ESI(m/z)**: calcd for C<sub>29</sub>H<sub>28</sub>BrNO<sub>3</sub>Na<sup>+</sup> [M+Na]<sup>+</sup> 540.1144, found 540.1159.

**methyl-2-(3-bromophenyl)-5-(dibenzylcarbamoyl)hexa-2,5-dienoate (3e)**



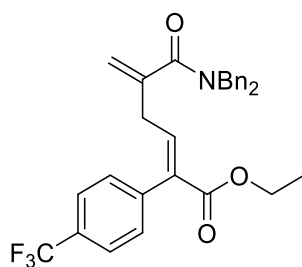
Following GP 9, the product was obtained as a yellow solid (93.3 mg, 0.18 mmol, 90 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.42 (ddd, *J* = 7.9, 2.0, 1.2 Hz, 1H), 7.38 – 7.28 (m, 7H), 7.24 – 7.02 (m, 7H), 5.28 (d, *J* = 1.3 Hz, 1H), 5.21 (t, *J* = 1.7 Hz, 1H), 4.65 – 4.40 (m, 4H), 4.22 (q, *J* = 7.1 Hz, 2H), 3.12 (dt, *J* = 7.8, 1.5 Hz, 2H), 1.26 (t, *J* = 7.1 Hz, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.8, 166.2, 141.5, 139.9, 136.7, 135.2, 132.4, 130.9, 129.7, 128.9, 128.2, 127.7, 122.2, 115.9, 61.3, 51.2, 46.7, 34.2.

**HRMS-ESI(m/z)**: calcd for C<sub>29</sub>H<sub>28</sub>BrNO<sub>3</sub>Na<sup>+</sup> [M+Na]<sup>+</sup> 540.1144, found 540.1140.

**Ethyl-5-(dibenzylcarbamoyl)-2-(4-(trifluoromethyl)phenyl)hexa-2,5-dienoate (3f)**



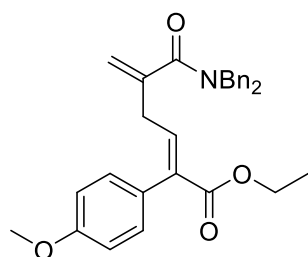
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.64 – 7.53 (m, 2H), 7.39 – 7.28 (m, 7H), 7.19 (t, *J* = 7.7 Hz, 1H), 5.25 (dt, *J* = 18.5, 1.5 Hz, 2H), 4.51 (d, *J* = 15.3 Hz, 4H), 4.22 (q, *J* = 7.1 Hz, 2H), 3.11 (dt, *J* = 7.8, 1.5 Hz, 2H), 1.26 (t, *J* = 7.1 Hz, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.6, 166.0, 141.4, 140.1, 138.4, 135.2, 130.1, 129.9, 129.7, 128.8, 127.7, 125.1 (q, *J* = 4.0), 115.9, 77.5, 77.0, 76.6, 61.3, 34.1, 14.2.

**<sup>19</sup>F NMR (282 MHz, CDCl<sub>3</sub>)** δ -62.6.

**HRMS-ESI(*m/z*):** calcd for C<sub>29</sub>H<sub>28</sub>F<sub>3</sub>NO<sub>3</sub>Na<sup>+</sup> [*M*+Na]<sup>+</sup> 530.1913, found 530.1914.

### Ethyl-5-(dibenzylcarbamoyl)-2-(4-methoxyphenyl)hexa-2,5-dienoate (3g)



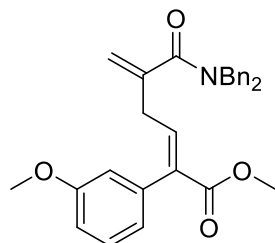
Following GP 9, the product was obtained as a yellow solid (85.4 mg, 0.182 mmol, 91 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.31 (d, *J* = 7.3 Hz, 7H), 7.10 – 7.04 (m, 3H), 6.95 – 6.90 (m, 2H), 6.86 – 6.80 (m, 2H), 5.25 (d, *J* = 1.3 Hz, 1H), 5.21 (t, *J* = 1.7 Hz, 1H), 4.48 (m, *J* = 12.9, 6.5 Hz, 3H), 4.21 (q, *J* = 7.1 Hz, 2H), 3.78 (s, 3H), 3.17 (dt, *J* = 7.7, 1.5 Hz, 2H), 1.25 (t, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.9, 166.6, 159.3, 141.8, 138.9, 129.1, 128.8, 128.4, 127.6, 127.6, 113.4, 61.1, 55.1, 51.0, 34.1.

**HRMS-ESI(*m/z*):** calcd for C<sub>30</sub>H<sub>31</sub>NO<sub>4</sub>Na<sup>+</sup> [*M*+Na]<sup>+</sup> 492.2145, found 462.2150.

### methyl-5-(dibenzylcarbamoyl)-2-(3-methoxyphenyl)hexa-2,5-dienoate (3h)

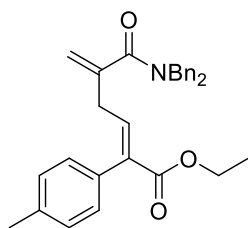


Following GP 9, the product was obtained as yellowish solid (74.7 mg, 0.164 mmol, 82 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.31 (d, *J* = 7.4 Hz, 6H), 7.22 (ddd, *J* = 8.1, 7.4, 0.6 Hz, 1H), 7.15 – 7.07 (m, 4H), 6.82 (ddd, *J* = 8.3, 2.5, 1.0 Hz, 1H), 6.76 – 6.70 (m, 2H), 5.26 (d, *J* = 1.3 Hz, 1H), 5.21 (t, *J* = 1.7 Hz, 1H), 4.50 (d, *J* = 29.9 Hz, 4H), 3.73 (s, 3H), 3.16 (dt, *J* = 7.8, 1.5 Hz, 2H), 1.26 (t, *J* = 7.1 Hz, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.9, 167.0, 162.6, 159.1, 141.9, 138.4, 130.6, 129.6, 129.5, 128.8, 127.6, 126.8, 113.6, 61.4, 60.9, 55.5.

**Ethyl-5-(dibenzylcarbamoyl)-2-(*p*-tolyl)hexa-2,5-dienoate (3i)**

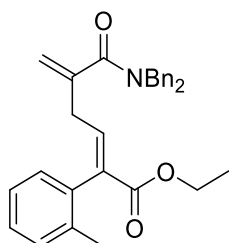


**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.38 – 7.27 (m, 7H), 7.22 – 7.01 (m, 7H), 5.23 (dt, *J* = 13.9, 1.5 Hz, 2H), 4.63 – 4.37 (m, 4H), 4.21 (q, *J* = 7.1 Hz, 2H), 3.16 (dt, *J* = 7.7, 1.5 Hz, 2H), 2.32 (d, *J* = 0.7 Hz, 3H), 1.25 (t, *J* = 7.1 Hz, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.9, 166.9, 141.9, 138.5, 137.4, 136.5, 131.6, 129.5, 129.3, 128.8, 127.6, 115.5, 77.5, 77.1, 76.6, 60.9, 51.0, 46.5, 34.0.

**HRMS-ESI(*m/z*):** calcd for C<sub>30</sub>H<sub>31</sub>NO<sub>3</sub>Na<sup>+</sup> [*M*+Na]<sup>+</sup> 476.2196, found 476.2202.

**Ethyl-5-(dibenzylcarbamoyl)-2-(*o*-tolyl)hexa-2,5-dienoate (3j)**

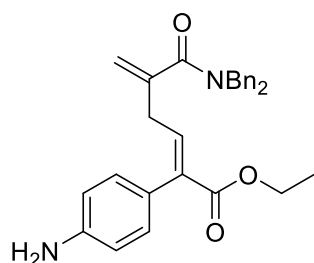


**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.38 – 7.27 (m, 7H), 7.24 – 6.94 (m, 7H), 5.22 (dt, *J* = 15.1, 1.5 Hz, 2H), 4.48 (d, *J* = 36.4 Hz, 4H), 3.09 – 2.97 (m, 2H), 2.12 (d, *J* = 0.7 Hz, 3H), 1.23 (t, *J* = 7.1 Hz, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.9, 166.5, 141.7, 139.5, 136.6, 136.3, 130.01, 129.5, 128.8, 128.4, 128.1, 127.7, 127.1, 115.7, 77.6, 77.2, 76.7, 61.0, 46.5, 51.1, 34.0.

**HRMS-ESI(*m/z*):** calcd for C<sub>30</sub>H<sub>31</sub>NO<sub>3</sub>Na<sup>+</sup> [*M*+Na]<sup>+</sup> 476.2196, found 476.2204.

**Methyl-2-(4-aminophenyl)-5-(dibenzylcarbamoyl)hexa-2,5-dienoate (3k)**



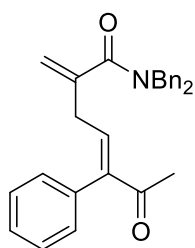
Following GP 9, this Product was obtained as a yellow solid (72.7 mg, 0.16 mmol, 78 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.43 – 7.23 (m, 8H), 7.22 – 7.03 (m, 4H), 6.98 – 6.91 (m, 2H), 5.23 (dt, *J* = 16.5, 1.5 Hz, 2H), 4.63 – 4.40 (m, 4H), 4.21 (q, *J* = 7.1 Hz, 2H), 3.14 (dt, *J* = 7.8, 1.5 Hz, 2H), 1.32 – 1.14 (m, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.8, 166.5, 141.7, 139.5, 139.2, 135.6, 131.2, 130.9, 128.8, 127.6, 118.8, 115.7, 61.1, 34.1, 14.2.



### Ethyl-2-(benzo[1,3-dioxol-5-yl]-5-(dibenzylcarbamoyl)hexa-2,5-dienoate (3l)

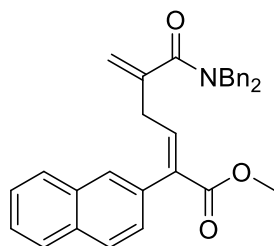


Following GP 9, this Product was obtained as a yellow solid (70.4 mg, 0.172 mmol, 86 % yield).

**<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 7.82 (ddt, *J* = 12.6, 8.3, 0.9 Hz, 2H), 7.63 (ddt, *J* = 8.1, 1.6, 0.8 Hz, 1H), 7.48 – 7.35 (m, 5H), 7.34 – 7.27 (m, 4H), 7.23 (dd, *J* = 7.0, 1.3 Hz, 1H), 7.15 – 6.88 (m, 5H), 5.20 (t, *J* = 1.2 Hz, 1H), 5.15 (t, *J* = 1.7 Hz, 1H), 4.56 – 4.24 (m, 6H), 3.69 (s, 3H), 2.96 (ddt, *J* = 7.4, 2.8, 1.5 Hz, 2H).

**<sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)** 171.7, 167.3, 141.5, 134.5, 133.5, 132.3, 131.9, 128.7, 128.5, 127.5, 127.1, 126.3, 125.9, 125.2, 125.0, 115.7, 52.2, 34.2.

### Methyl-5-(dibenzylcarbamoyl)-2-(naphthalen-2-yl)hexa-2,5-dienoate (3m)

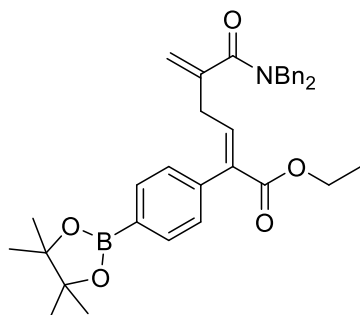


Following GP 9, the product was obtained as yellow solid (85,6 mg, 0.18 mmol, 90 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.90 – 6.85 (m, 9H), 5.17 (dt, *J* = 14.2, 1.5 Hz, 2H), 4.60 – 4.17 (m, 4H), 3.68 (s, 3H), 2.96 (dq, *J* = 7.5, 1.6 Hz, 2H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.7, 167.3, 141.5, 141.5, 134.5, 133.5, 132.3, 128.5, 127.5, 127.2, 127.1, 115.7, 77.5, 77.1, 76.6, 52.2, 50.8, 46.5, 38.1.

### Methyl-5-(dibenzylcarbamoyl)-2-(4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)phenyl)hexa-2,5-dienoate (3n)



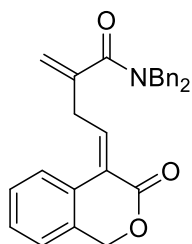
Following GP 9, the product was obtained as a yellowish solid (102.8 mg, 0.182 mmol, 91 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.37 – 7.27 (m, 1H), 7.19 – 7.10 (m, 1H), 5.21 (dt, *J* = 16.1, 1.5 Hz, 0H), 4.48 (d, *J* = 36.0 Hz, 1H), 4.20 (q, *J* = 7.1 Hz, 0H), 3.13 (dt, *J* = 7.8, 1.5 Hz, 0H), 1.35 (s, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.8, 141.7, 139.1, 137.6, 136.4, 134.5, 128.8, 127.6, 115.7, 83.8, 61.0, 34.0, 29.7, 24.9, 14.2.

**HRMS-ESI(m/z):** calcd for C<sub>35</sub>H<sub>40</sub>BNO<sub>5</sub>Na<sup>+</sup> [M+Na]<sup>+</sup> 588.2891, found 588.2905.

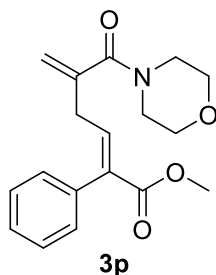
***N,N*-dibenzyl-2-methylene-4-(3-oxoisochroman-4-ylidene)butanamide (3o)**



**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.51 – 7.43 (m, 1H), 7.41 – 7.22 (m, 10H), 7.17 (d, *J* = 6.6 Hz, 4H), 7.06 (t, *J* = 7.9 Hz, 1H), 5.35 (q, *J* = 1.5 Hz, 2H), 5.19 (s, 2H), 4.60 (s, 4H), 3.58 (dt, *J* = 7.9, 1.5 Hz, 2H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 171.7, 168.4, 141.1, 137.3, 136.5, 132.1, 130.1, 128.9, 128.8, 128.7, 128.5, 127.7, 127.0, 124.9, 116.3, 69.2, 51.1, 46.9, 33.7.

**Methyl 5-(morpholine-4-carbonyl)-2-phenylhexa-2,5-dienoate (3p)**



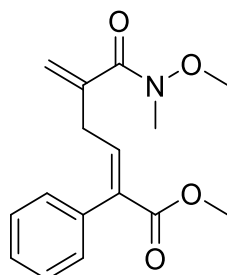
Following GP 9, this Product was obtained as a yellow oil (53.6 mg, 0.17 mmol, 85 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ = 7.41 – 7.31 (m, 3H), 7.19 – 7.13 (m, 2H), 7.09 (t, *J* = 7.7, 1H), 5.25 – 5.19 (m, 1H), 5.14 – 5.10 (m, 1H), 3.75 (s, 3H), 3.67 – 3.35 (m, 8H), 3.05 (dt, *J* = 7.8, 1.5, 2H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 169.9, 167.2, 141.2, 139.2, 136.2, 134.5, 129.4, 128.2, 127.9, 116.0, 66.8, 52.2, 33.7.

**HRMS-ESI(m/z):** calcd for C<sub>18</sub>H<sub>21</sub>NO<sub>4</sub>Na<sup>+</sup> [M+Na]<sup>+</sup> 338.1363, found 338.1364.

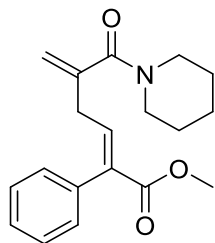
**Methyl-5-(methoxy(methyl)carbamoyl)-2-phenylhexa-2,5-dienoate (3q)**



**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.40 – 7.27 (m, 3H), 7.21 – 7.15 (m, 2H), 7.10 (t, *J* = 7.7 Hz, 1H), 5.44 (td, *J* = 1.2, 0.6 Hz, 1H), 5.26 (td, *J* = 1.7, 0.7 Hz, 1H), 3.74 (s, 3H), 3.57 (s, 3H), 3.20 (s, 3H), 3.09 (ddd, *J* = 7.7, 1.7, 1.3 Hz, 2H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 170.2, 167.4, 141.5, 139.9, 135.8, 134.7, 129.5, 128.1, 127.8, 117.9, 61.2, 52.2, 33.1.

**methyl-2-phenyl-5-(piperidine-1-carbonyl)hexa-2,5-dienoate (3r)**



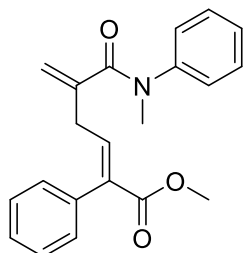
Following GP 9, the product was obtained as yellow solid (50.8 mg, 0.162 mmol, 81 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.52 – 7.39 (m, 4H), 7.31 – 7.17 (m, 3H), 5.21 (dtd, *J* = 14.0, 1.5, 0.7 Hz, 2H), 3.83 (s, 3H), 3.73 – 3.28 (m, 6H), 3.13 (dt, *J* = 7.8, 1.5 Hz, 2H), 2.71 – 2.45 (m, 1H), 1.97 – 1.31 (m, 4H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 169.9, 167.4, 142.2, 139.8, 135.9, 134.7, 123.0, 129.6, 128.2, 128.0, 127.9, 114.9, 73.6, 52.3, 46.3, 43.1, 33.9, 33.3, 30.6, 26.5, 25.6, 24.6, 24.6, 21.7.

**HRMS-ESI(*m/z*):** calcd for C<sub>19</sub>H<sub>23</sub>NO<sub>3</sub>Na<sup>+</sup> [*M*+Na]<sup>+</sup> 336.1570, found 336.1574.

**methyl (E)-5-(methyl(phenyl)carbamoyl)-2-phenylhexa-2,5-dienoate (3s)**

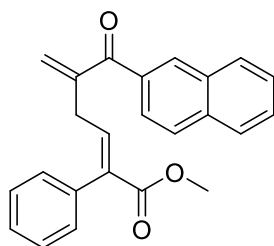


Following GP 9, the product was obtained as yellowish solid (58.4 mg, 0.174 mmol, 87 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.32 – 7.10 (m, 6H), 7.03 – 6.87 (m, 5H), 4.98 (dd, *J* = 1.4, 0.5 Hz, 2H), 3.65 (s, 3H), 3.24 (s, 3H), 2.82 (d, *J* = 7.7 Hz, 2H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 170.7, 167.4, 144.3, 141.9, 140.1, 135.6, 134.7, 129.5, 129.4, 129.2, 128.4, 127.7, 126.9, 126.8, 119.9, 52.2, 37.9, 33.6.

**methyl (E)-5-(2-naphthoyl)-2-phenylhexa-2,5-dienoate (3t)**



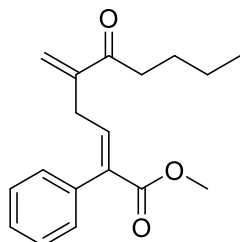
Following GP 9, the product was obtained as a yellow solid (39.2 mg, 0.11 mmol, 55 % yield).

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 8.20 (dt, *J* = 1.2, 0.7 Hz, 1H), 7.90 – 7.78 (m, 3H), 7.64 – 7.52 (m, 2H), 7.42 – 7.37 (m, 2H), 7.28 – 7.22 (m, 3H), 7.22 – 7.17 (m, 2H), 5.91 (td, *J* = 1.5, 0.5 Hz, 1H), 5.80 (q, *J* = 1.0 Hz, 1H), 3.76 (s, 3H).

**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 145.3, 140.7, 132.2, 131.1, 129.7, 129.6, 129.4, 128.4, 128.2, 127.8, 127.5, 126.8, 125.4, 52.8, 52.2, 32.1.

**HRMS-ESI(m/z):** calcd for C<sub>24</sub>H<sub>20</sub>O<sub>3</sub>Na<sup>+</sup> [M+Na]<sup>+</sup> 379.1304, found 379.1312.

**methyl (E)-5-methylene-6-oxo-2-phenyldec-2-enoate (3u)**



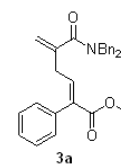
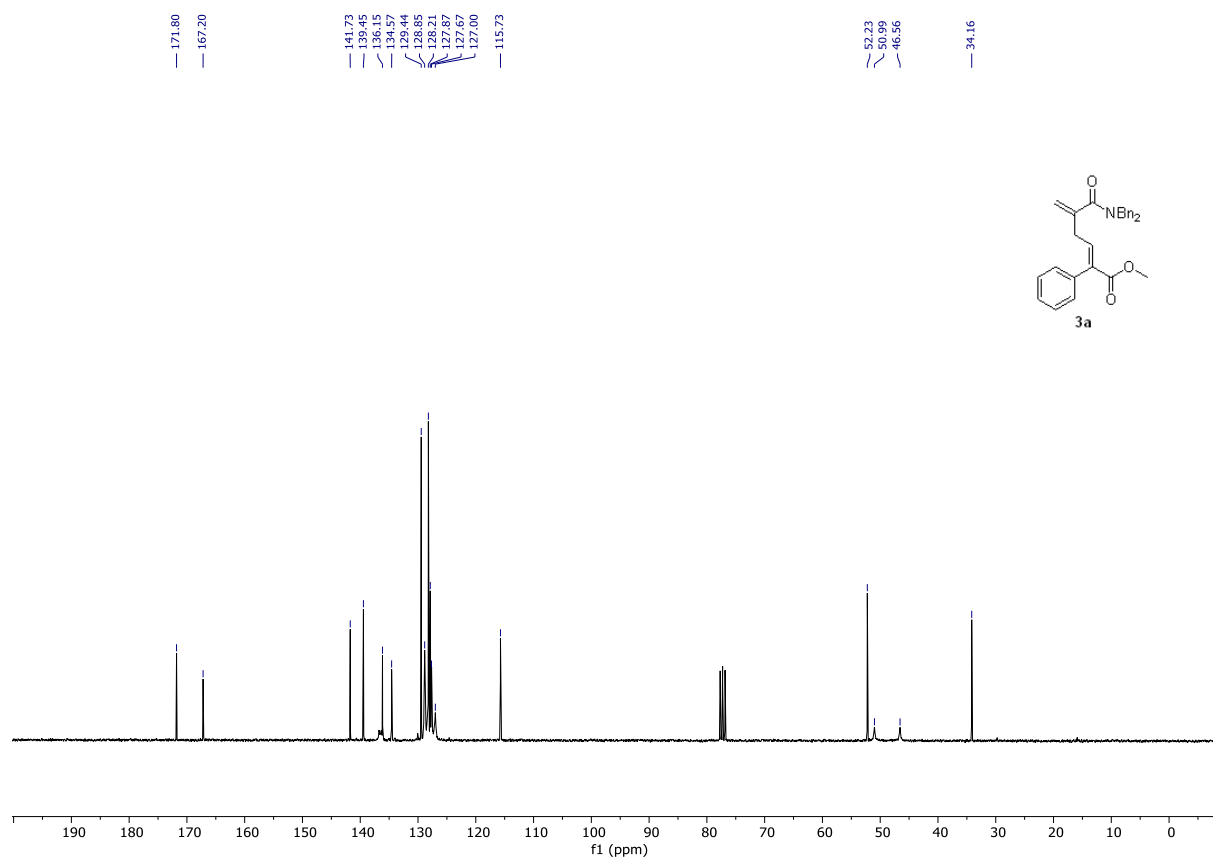
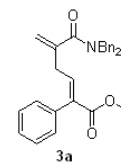
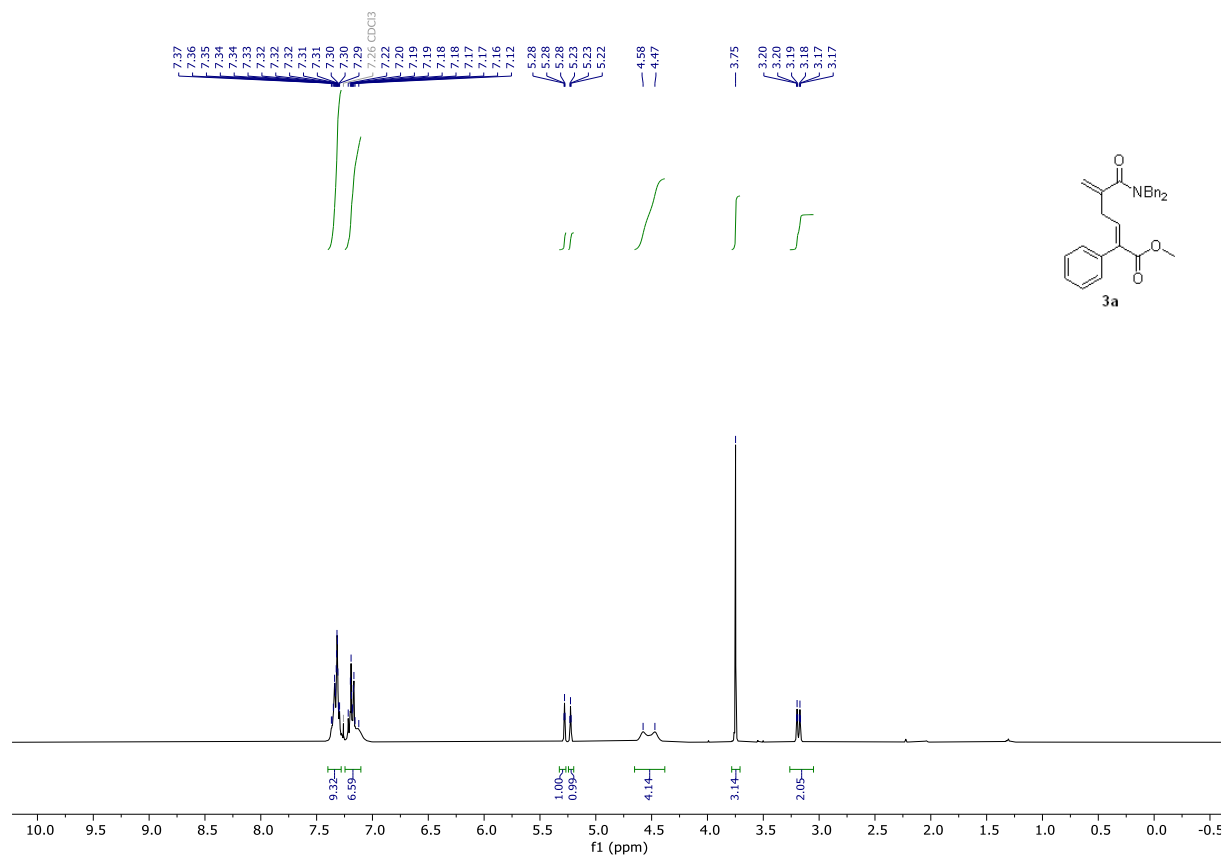
Following GP 9, the product was obtained as yellowish solid (23.5 mg, 0.082 mmol, 41 % yield).

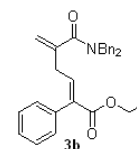
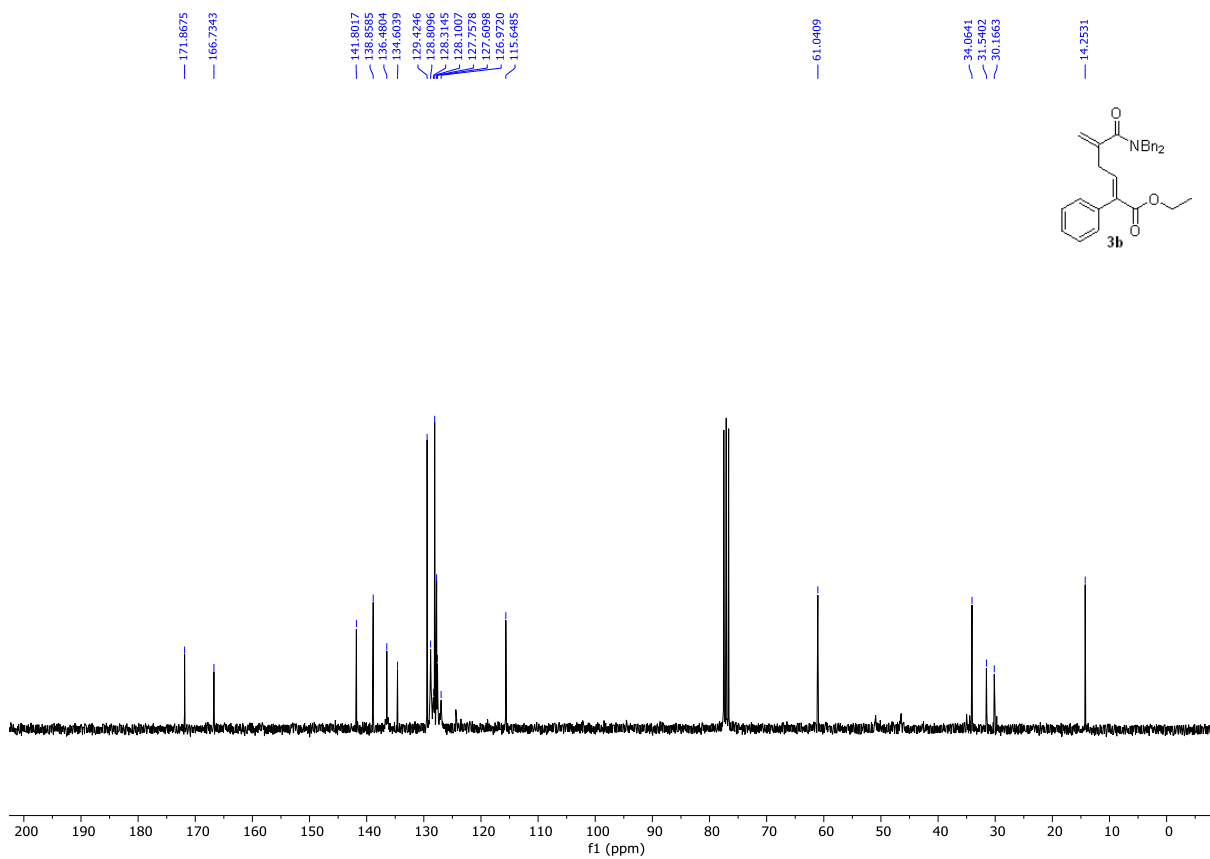
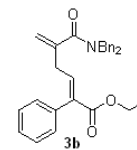
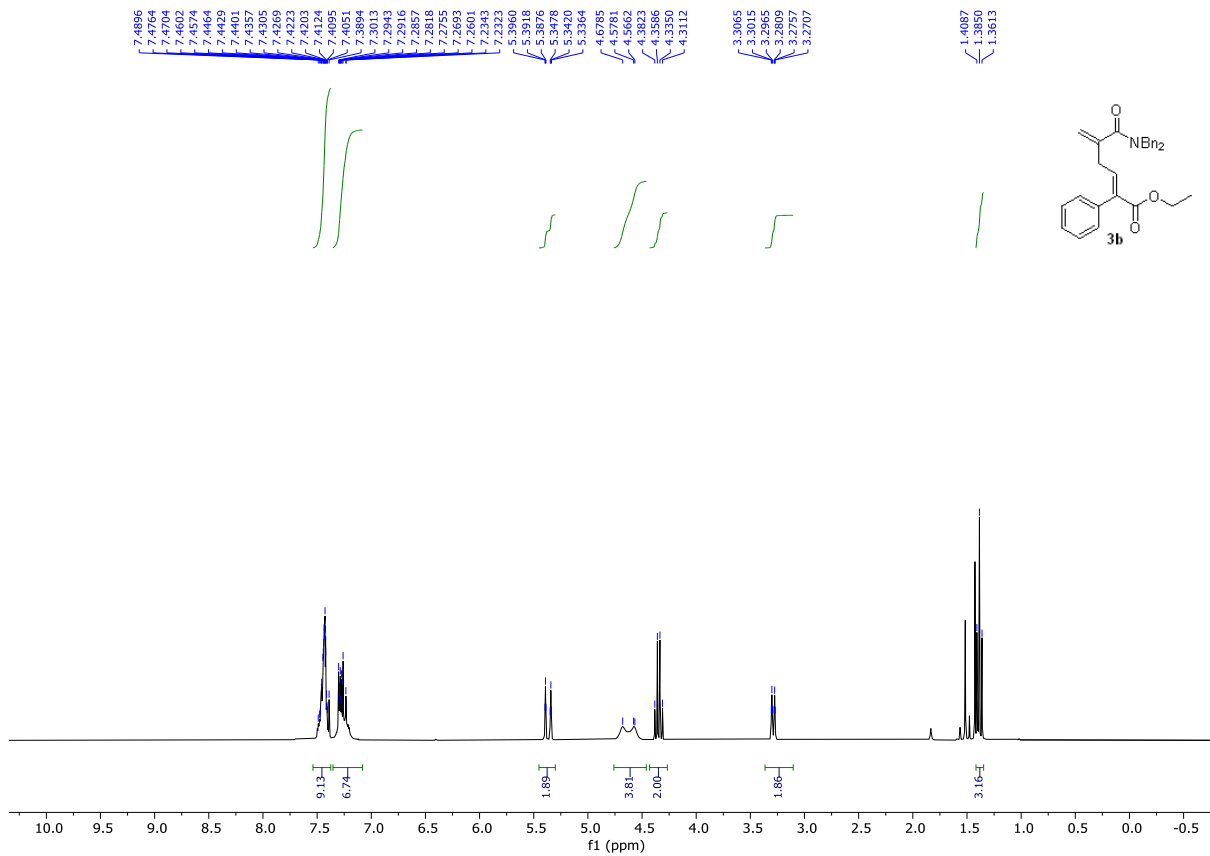
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** 7.40 – 7.31 (m, 3H), 7.20 – 7.14 (m, 2H), 7.05 (t, *J*=7.6, 1H), 6.06 (t, *J*=1.0, 1H), 5.71 (t, *J*=1.5, 1H), 3.74 (s, 3H), 3.05 (ddd, *J*=7.6, 1.5, 0.9, 1H), 2.66 (t, *J*=7.6, 2H), 1.63 – 1.51 (m, 2H), 1.37 – 1.24 (m, 2H), 0.91 (t, *J*=7.3, 3H).

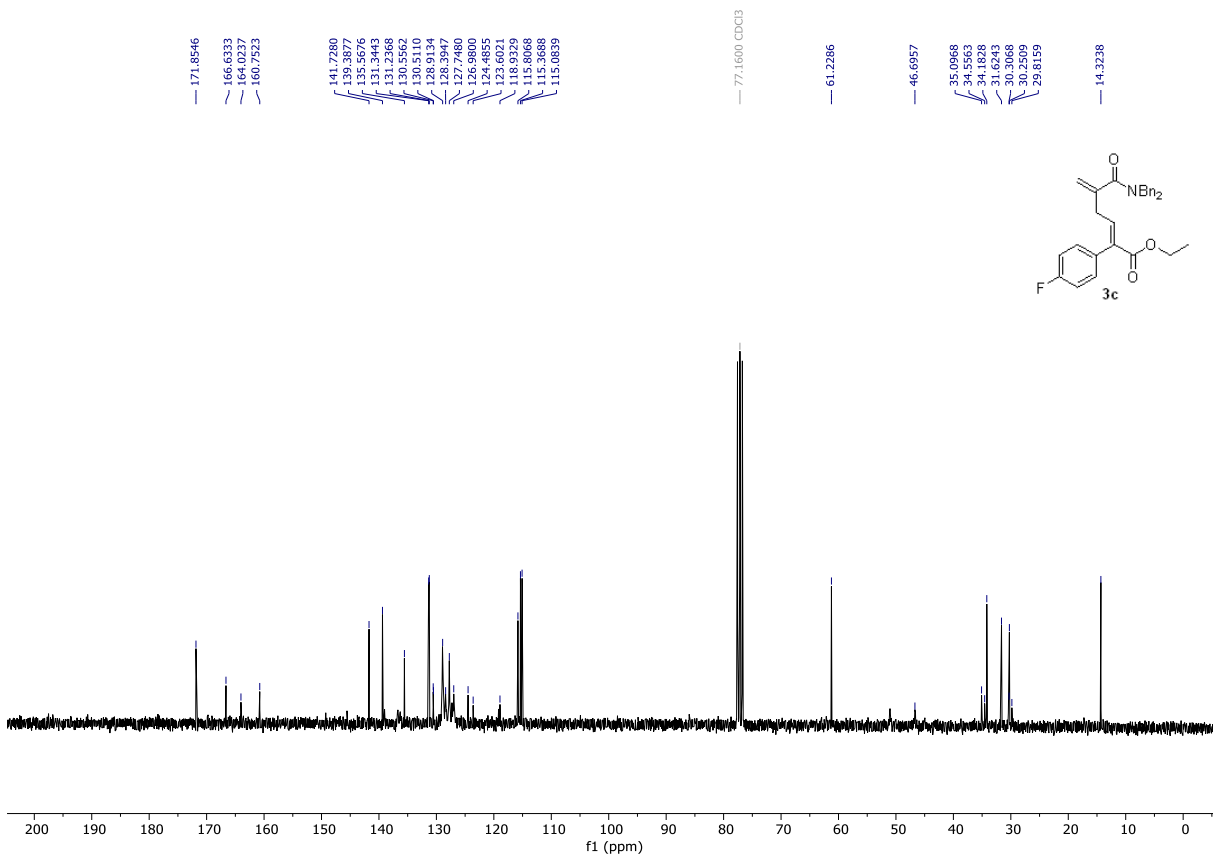
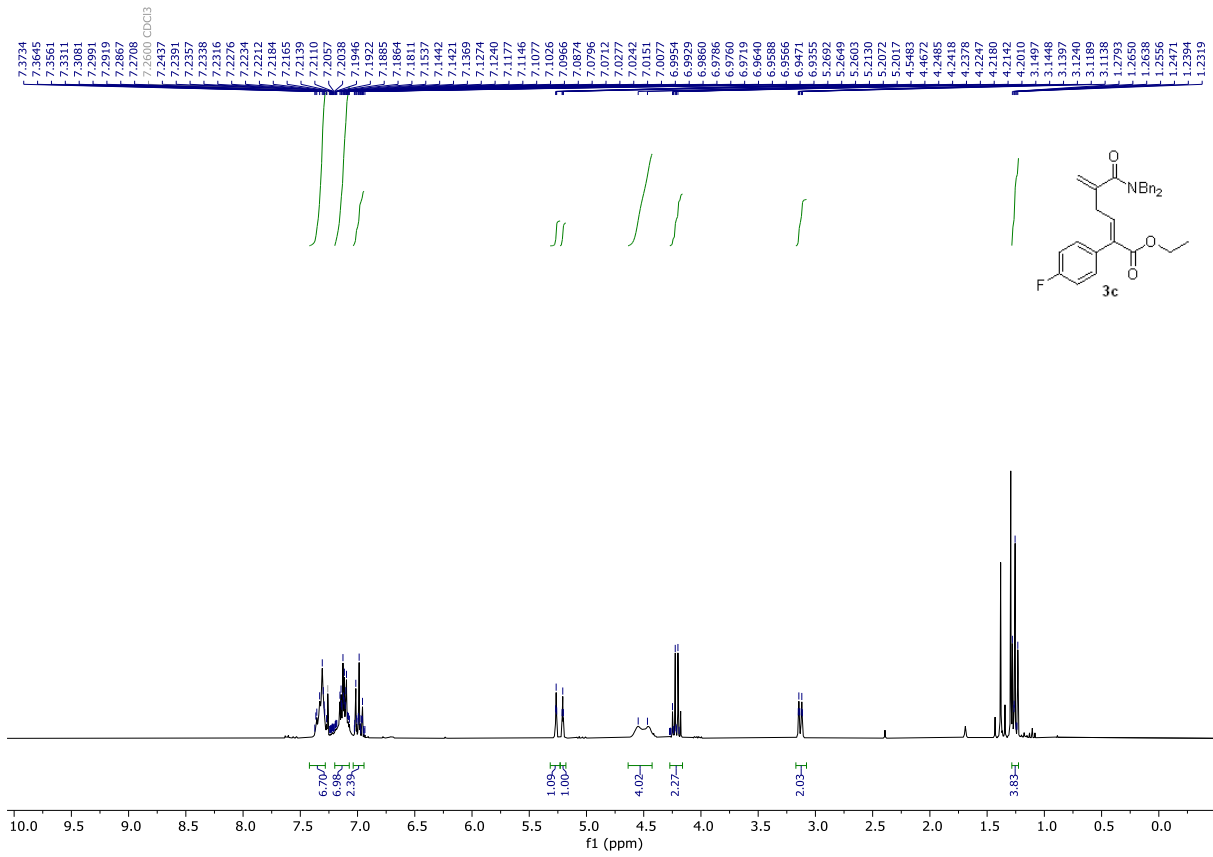
**<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 201.1, 167.5, 146.0, 141.4, 135.2, 134.8, 129.5, 128.1, 127.7, 125.2, 52.1, 37.2, 30.8, 26.6, 22.4, 13.9.

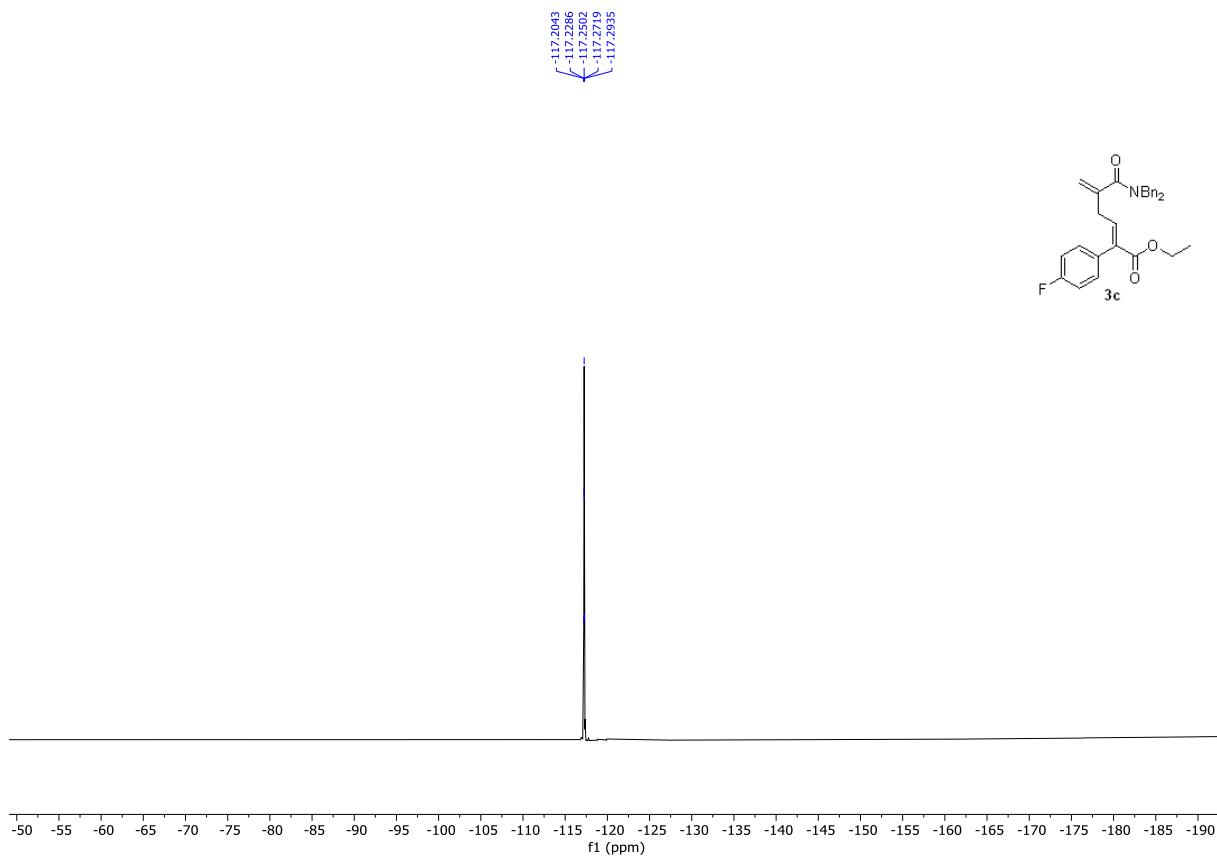
**HRMS-ESI(m/z):** calcd for C<sub>24</sub>H<sub>20</sub>O<sub>3</sub>Na<sup>+</sup> [M+Na]<sup>+</sup> 309.1461, found 309.1461.

## 8. NMR spectra of the products

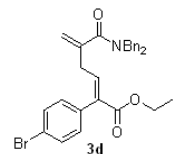
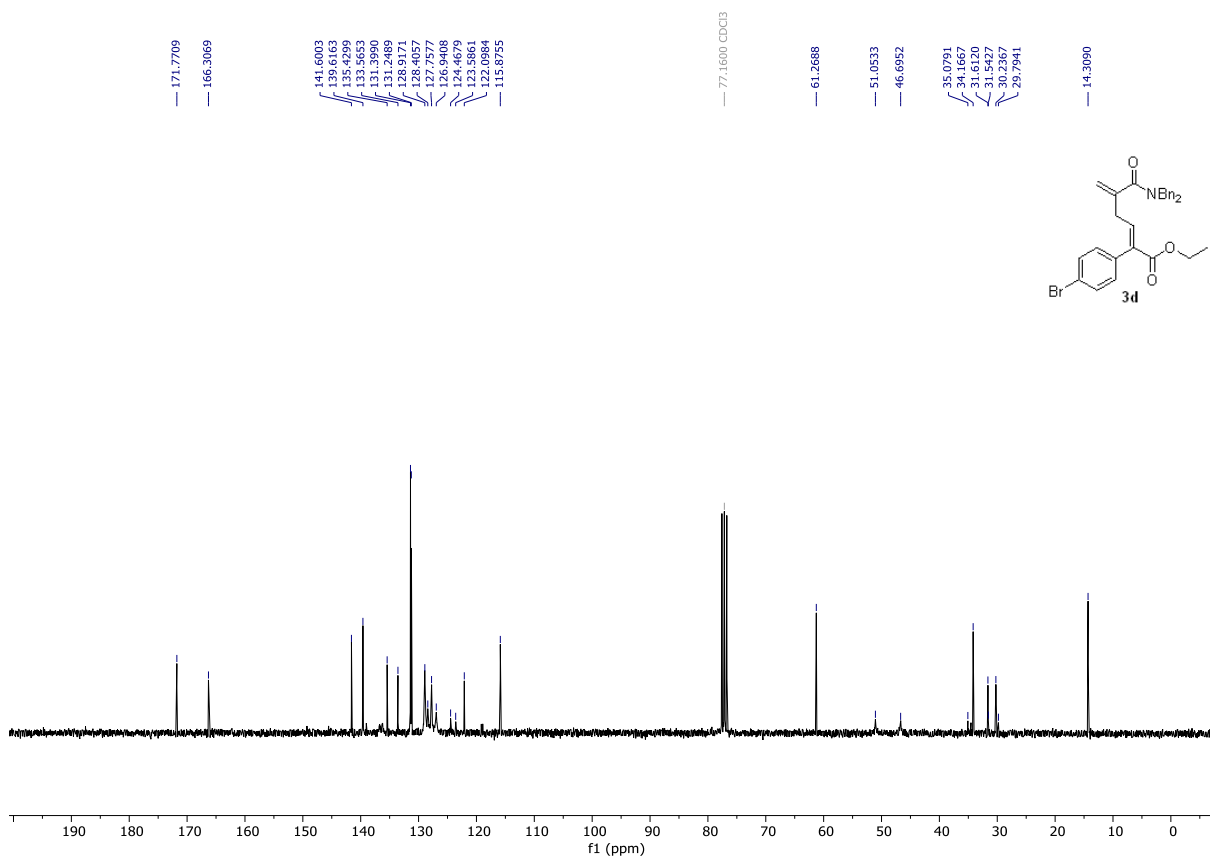
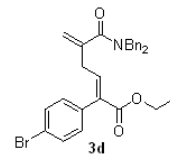
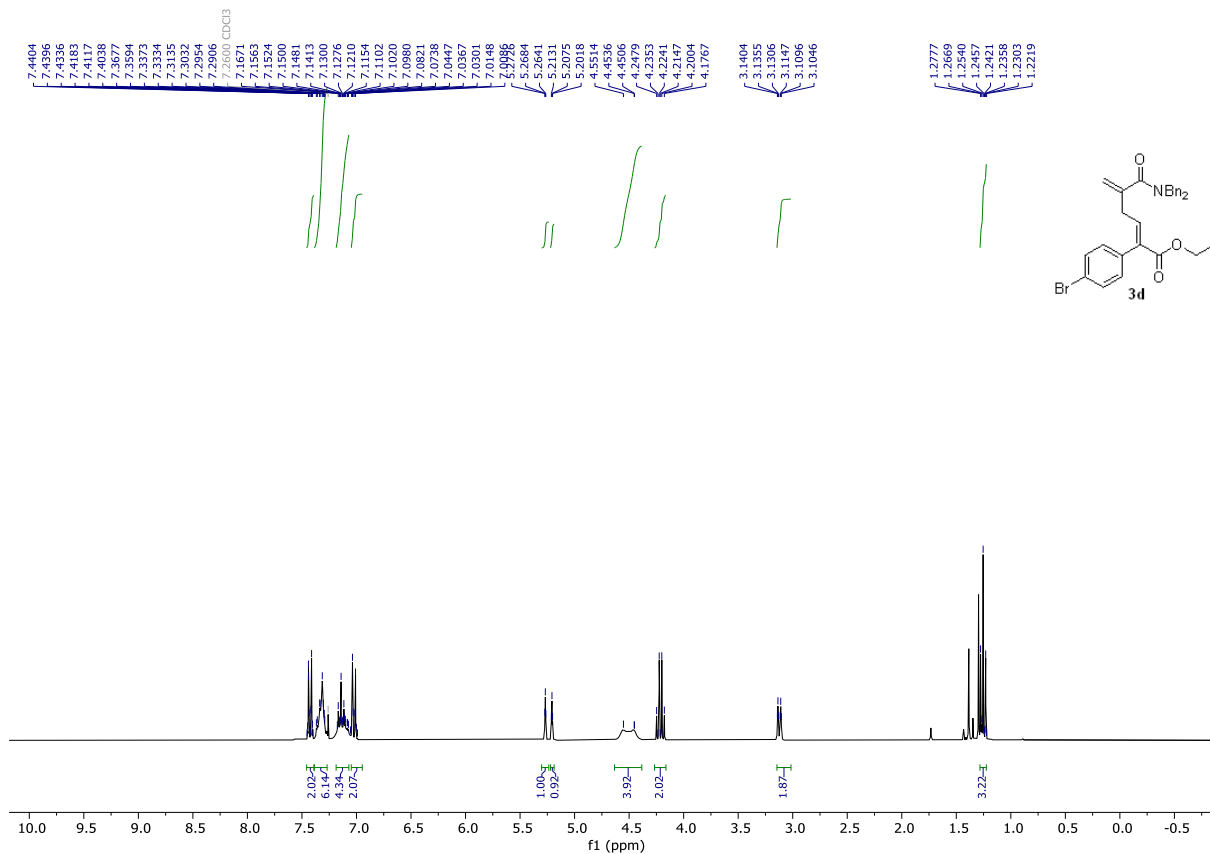


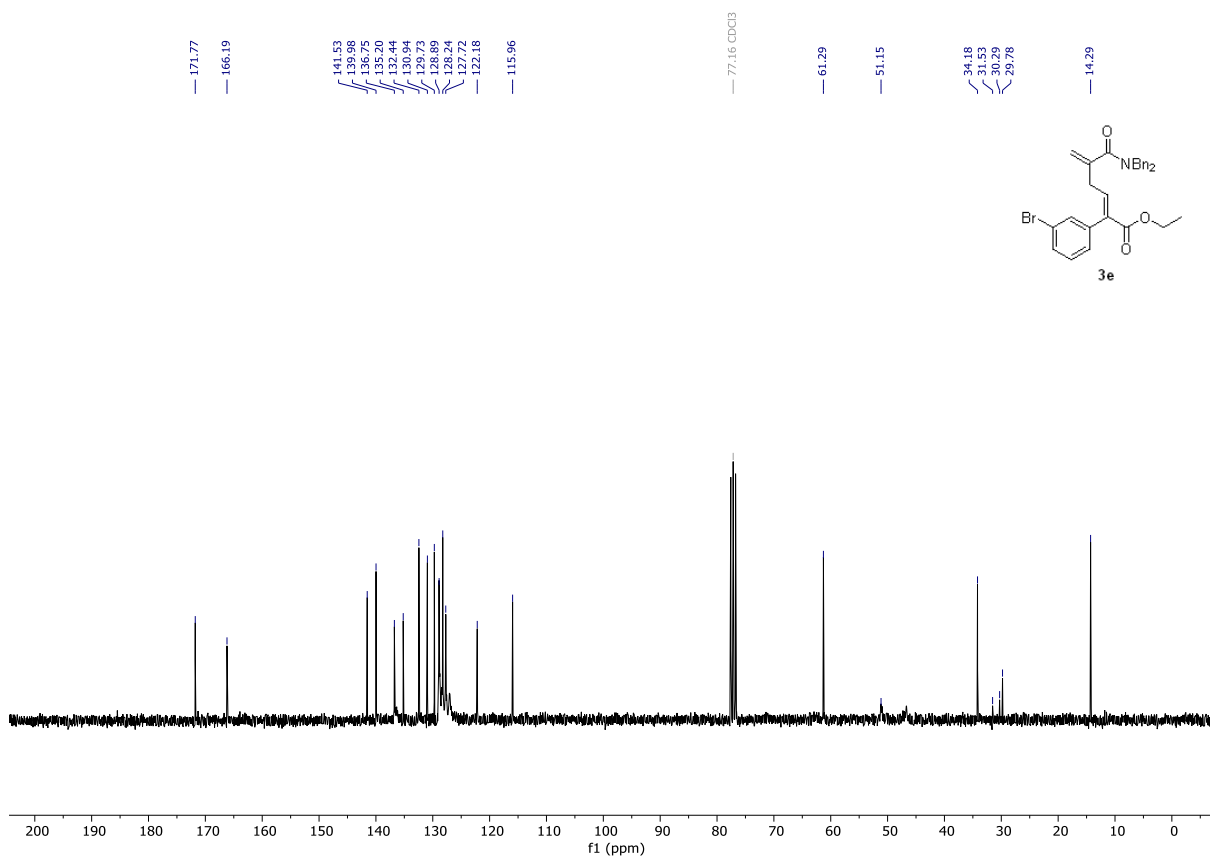
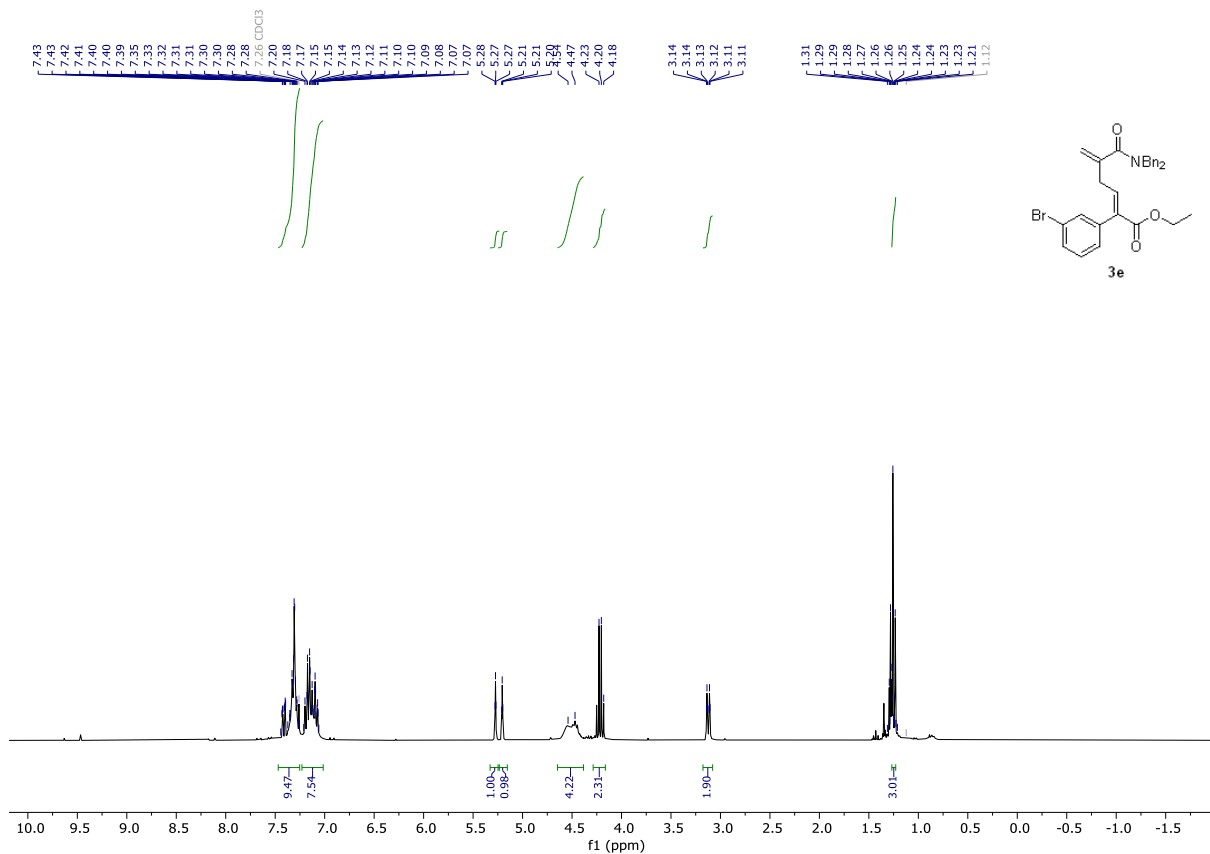


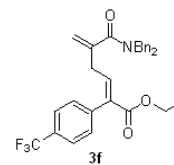
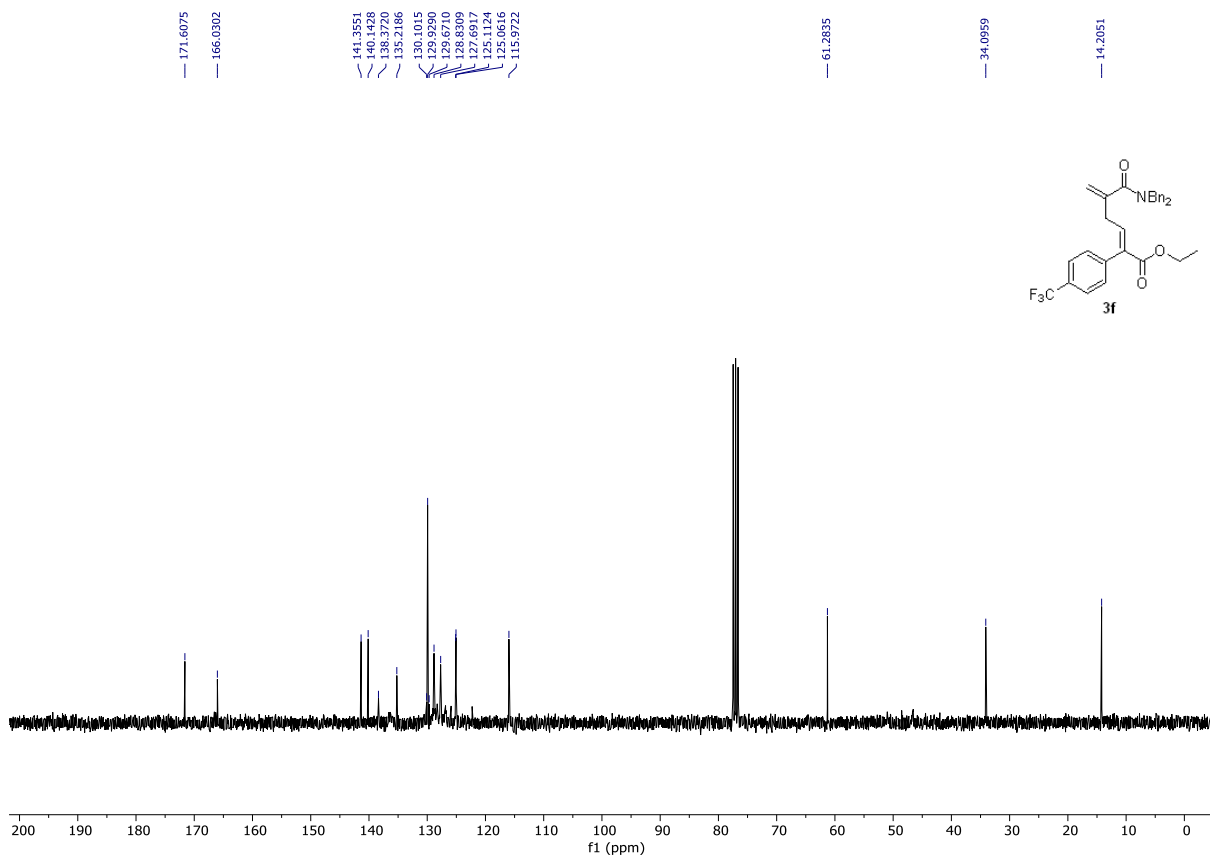
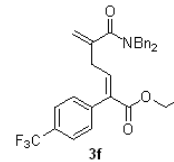
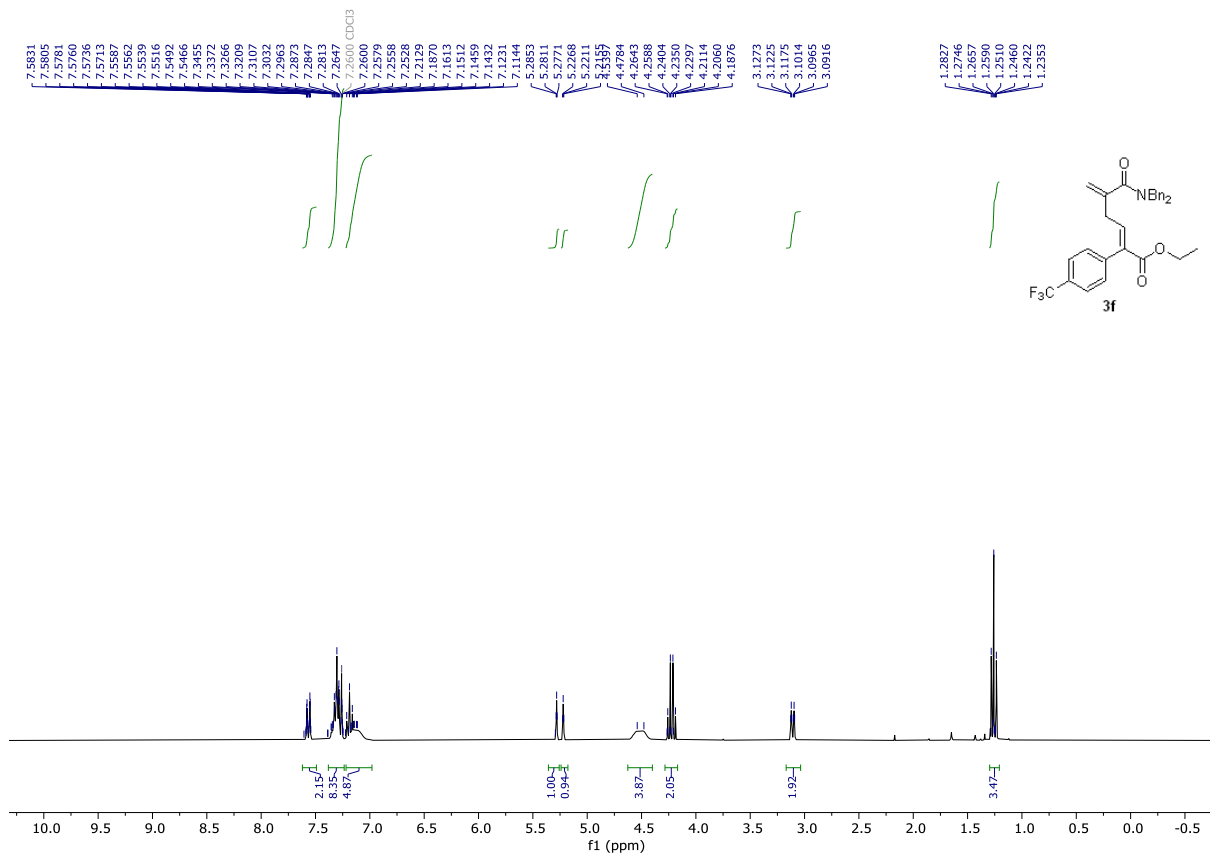


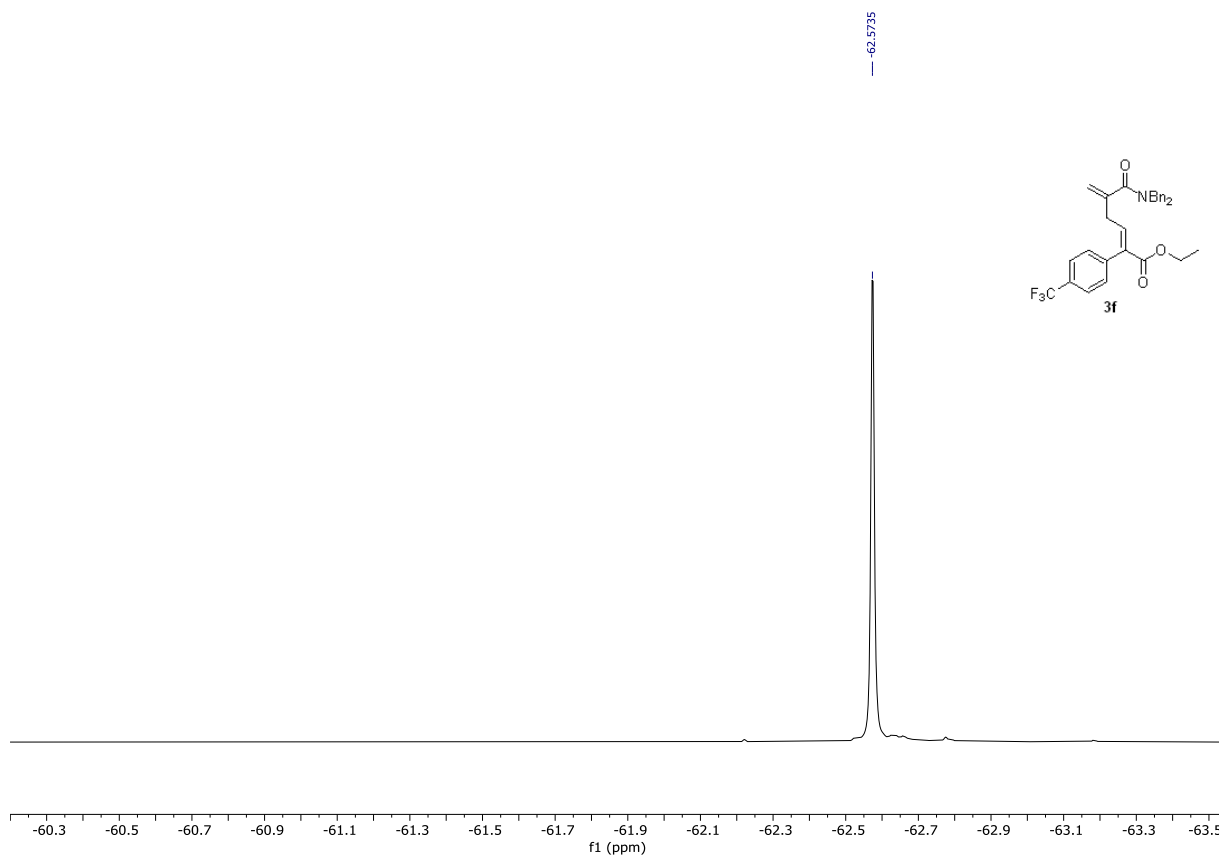


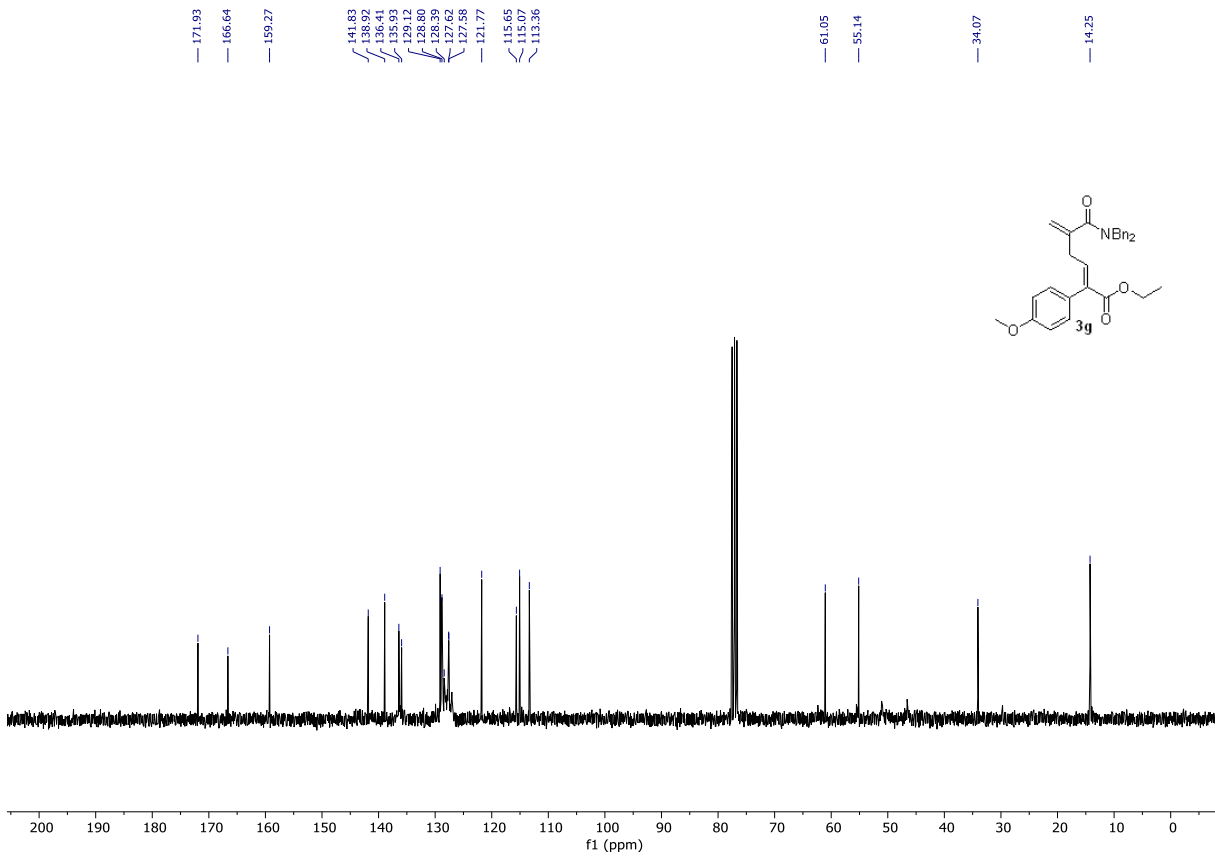
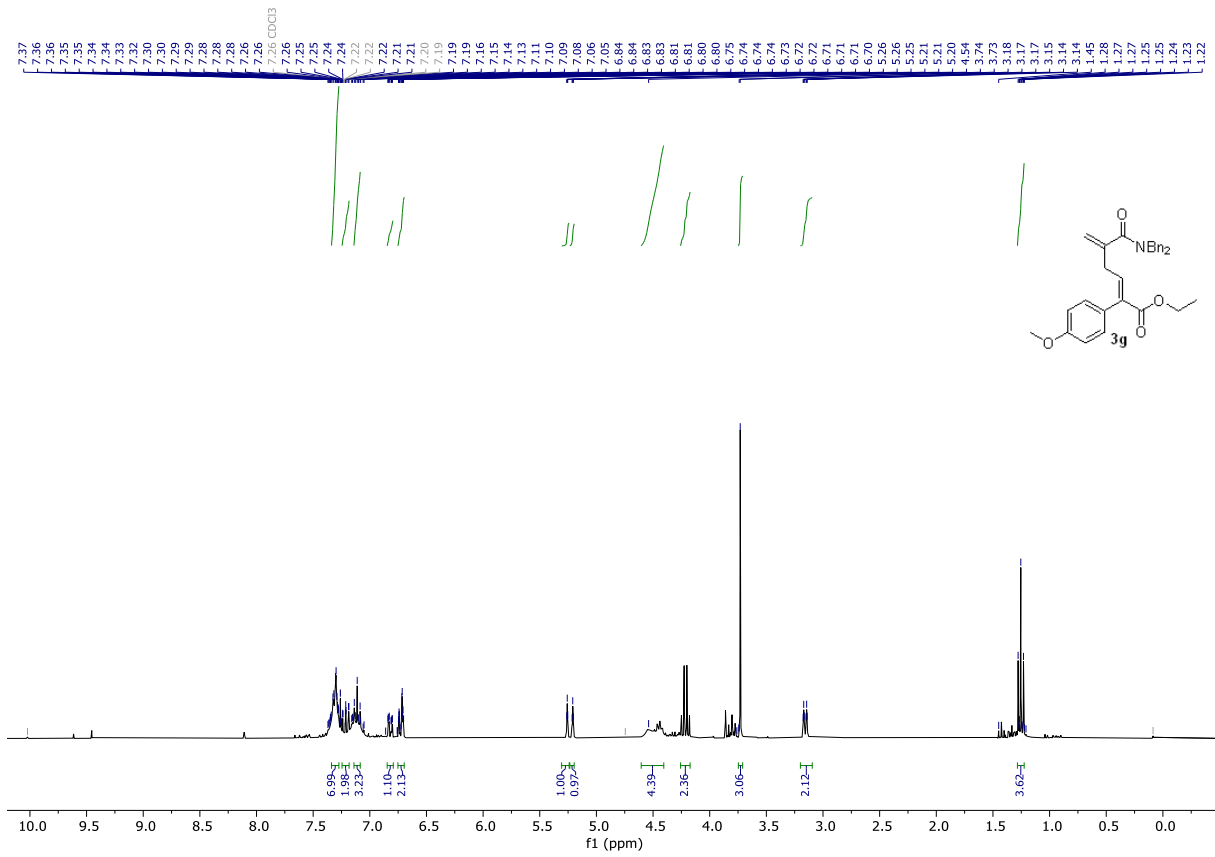


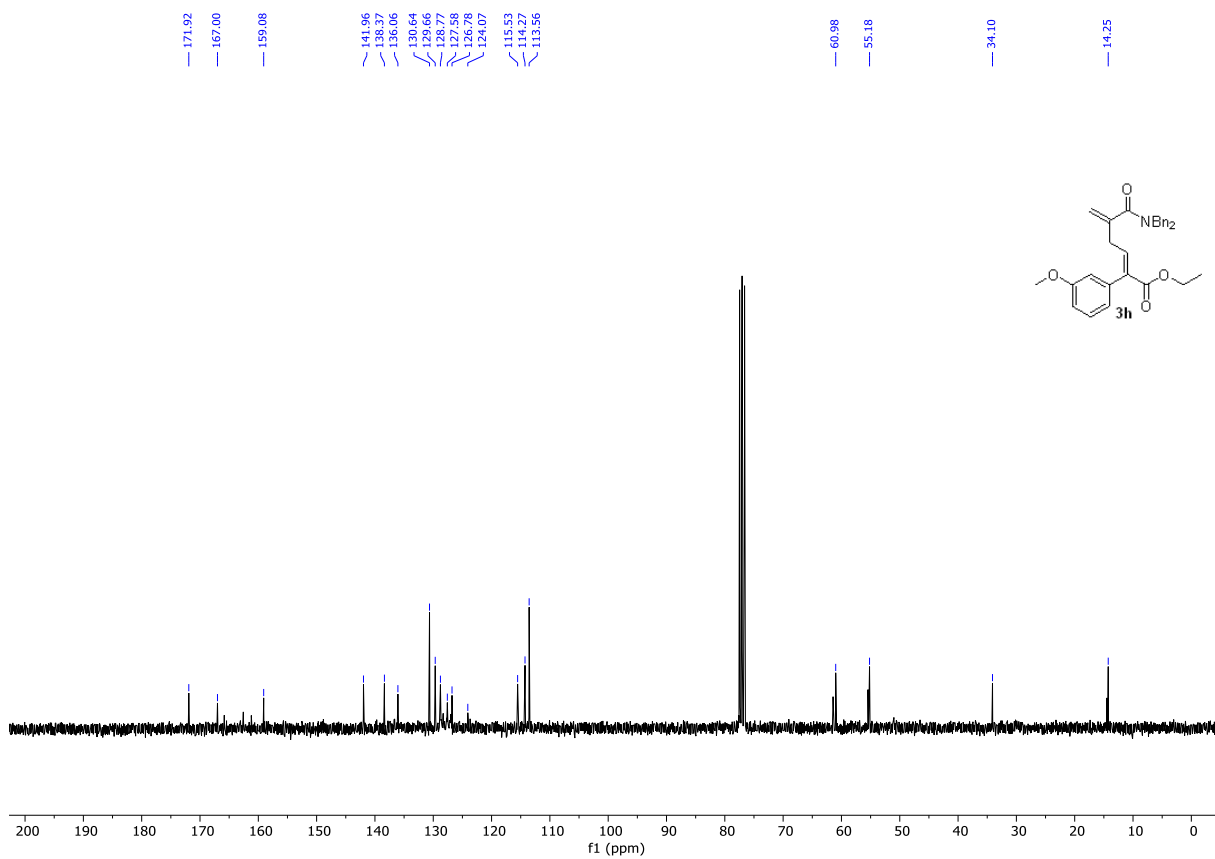
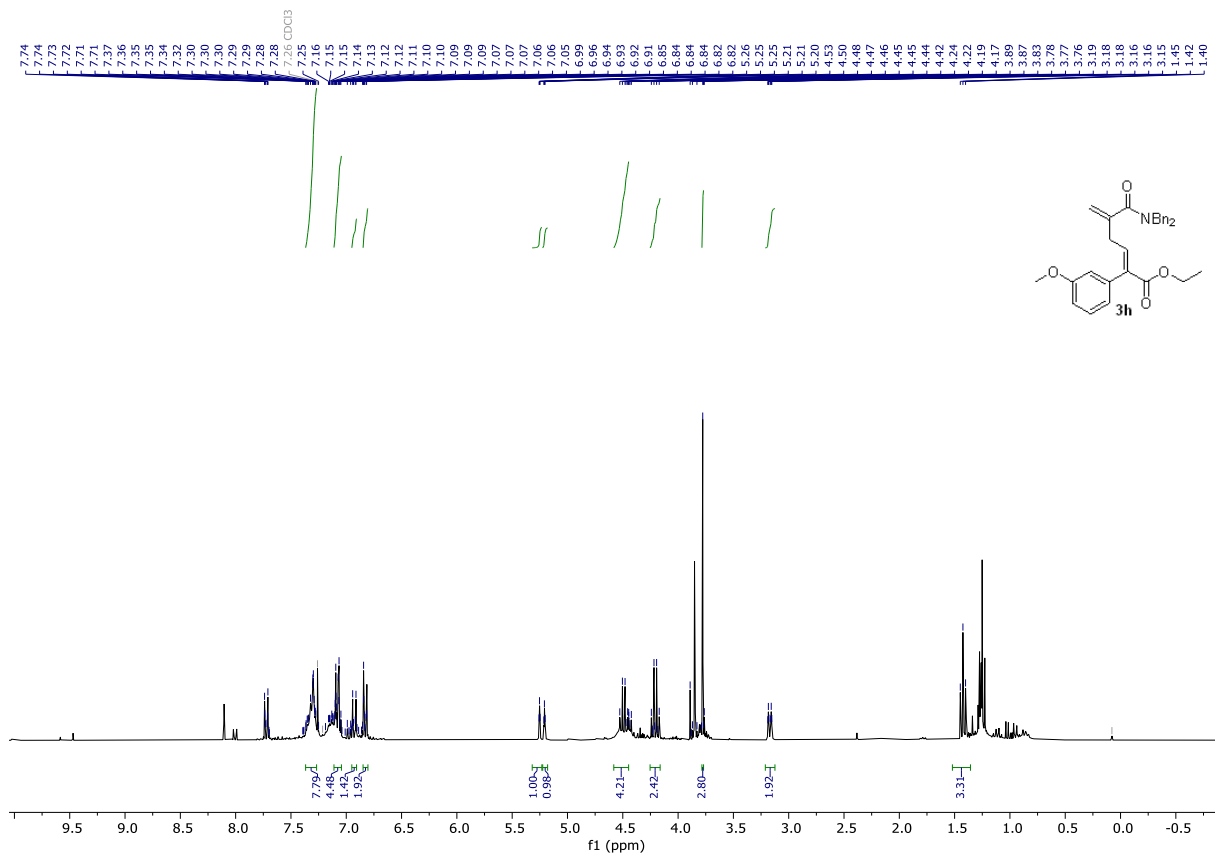


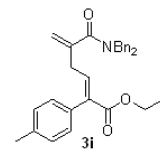
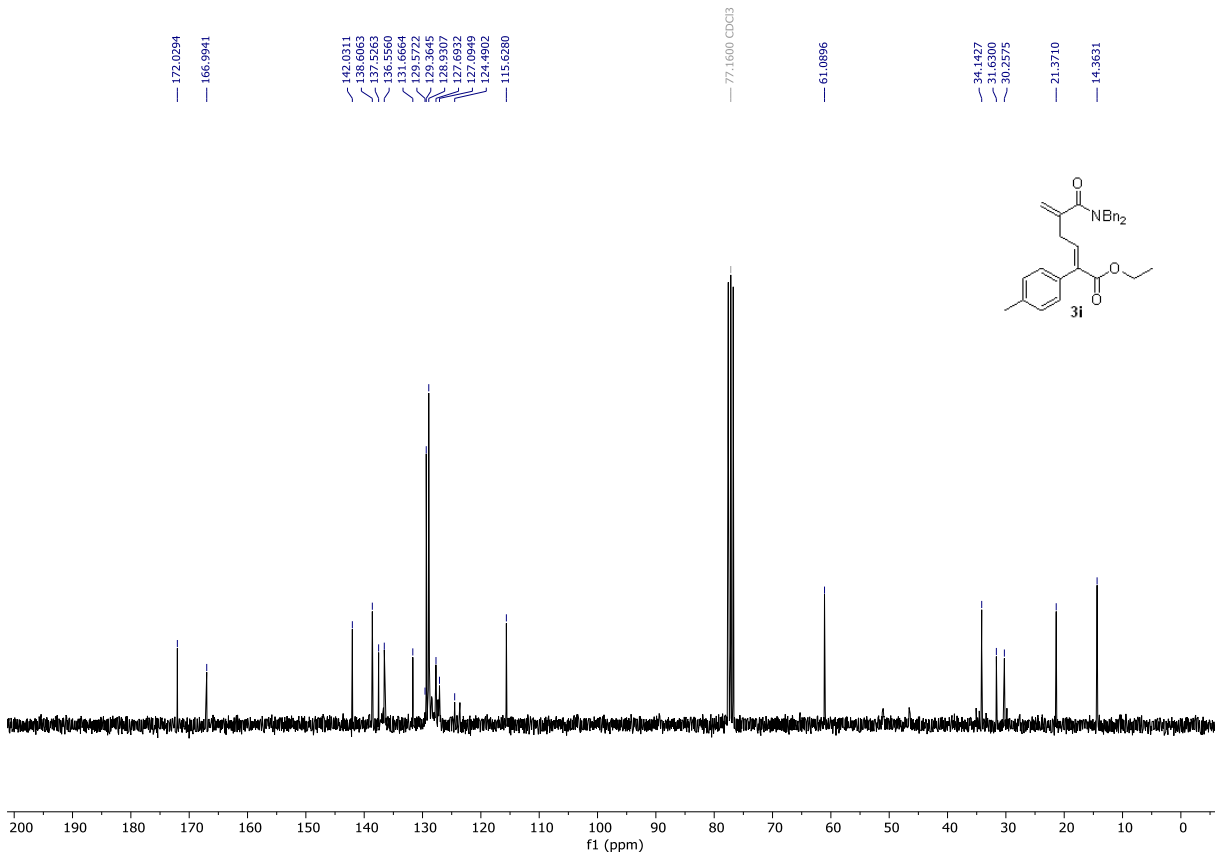
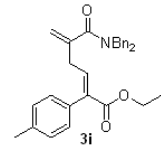
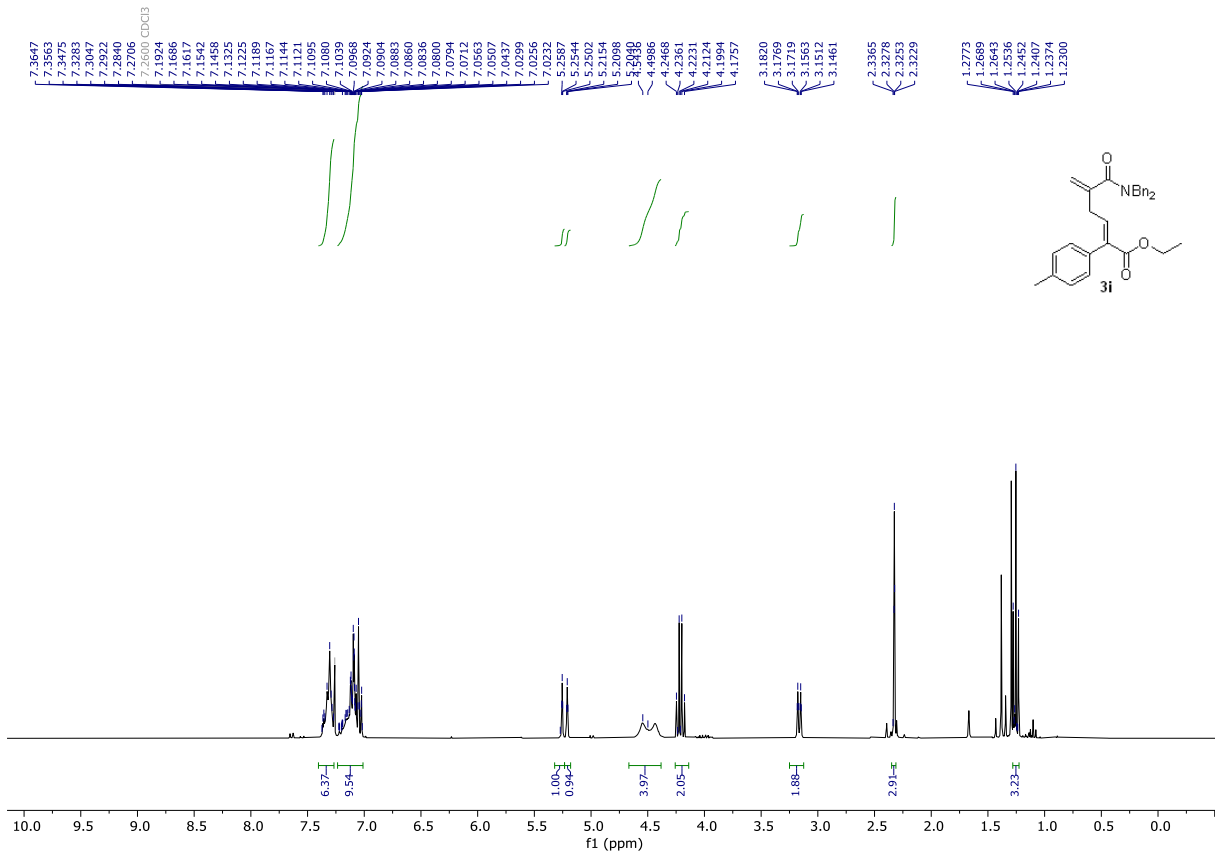


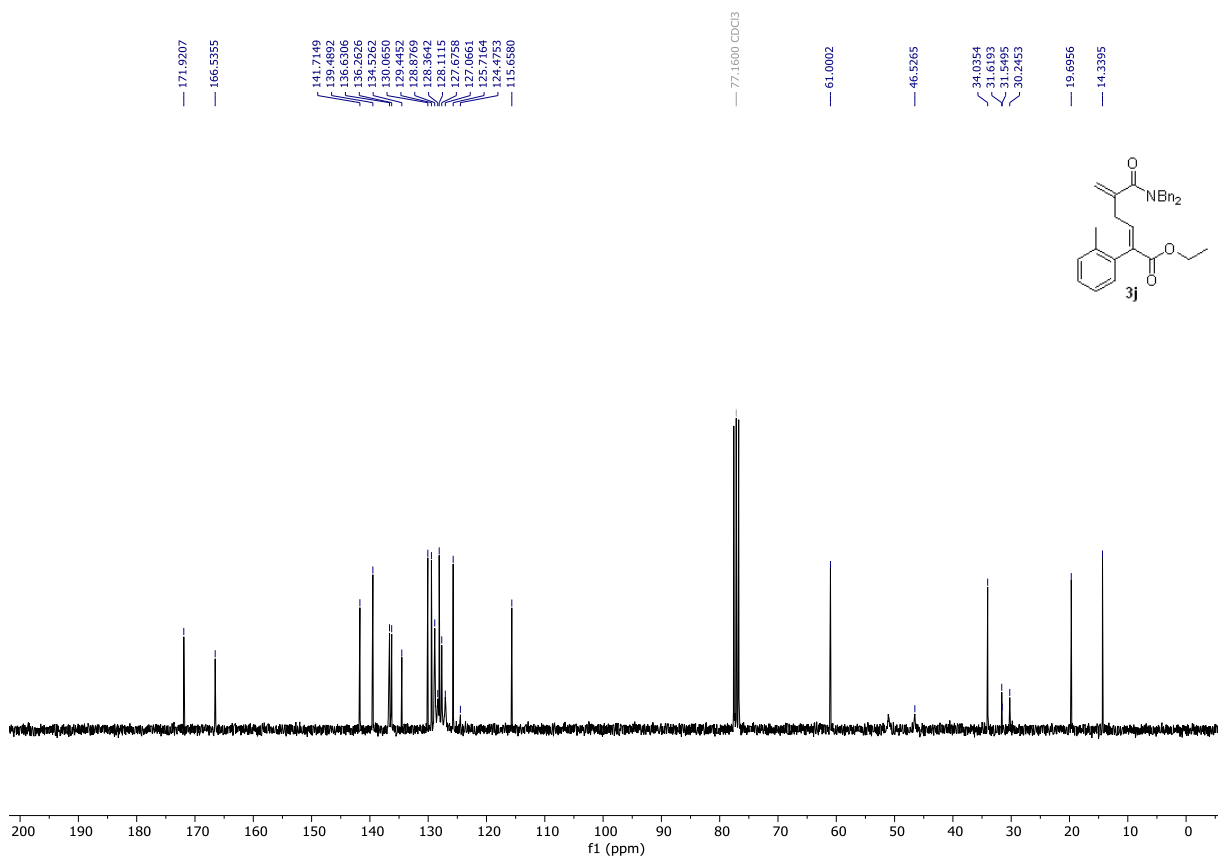
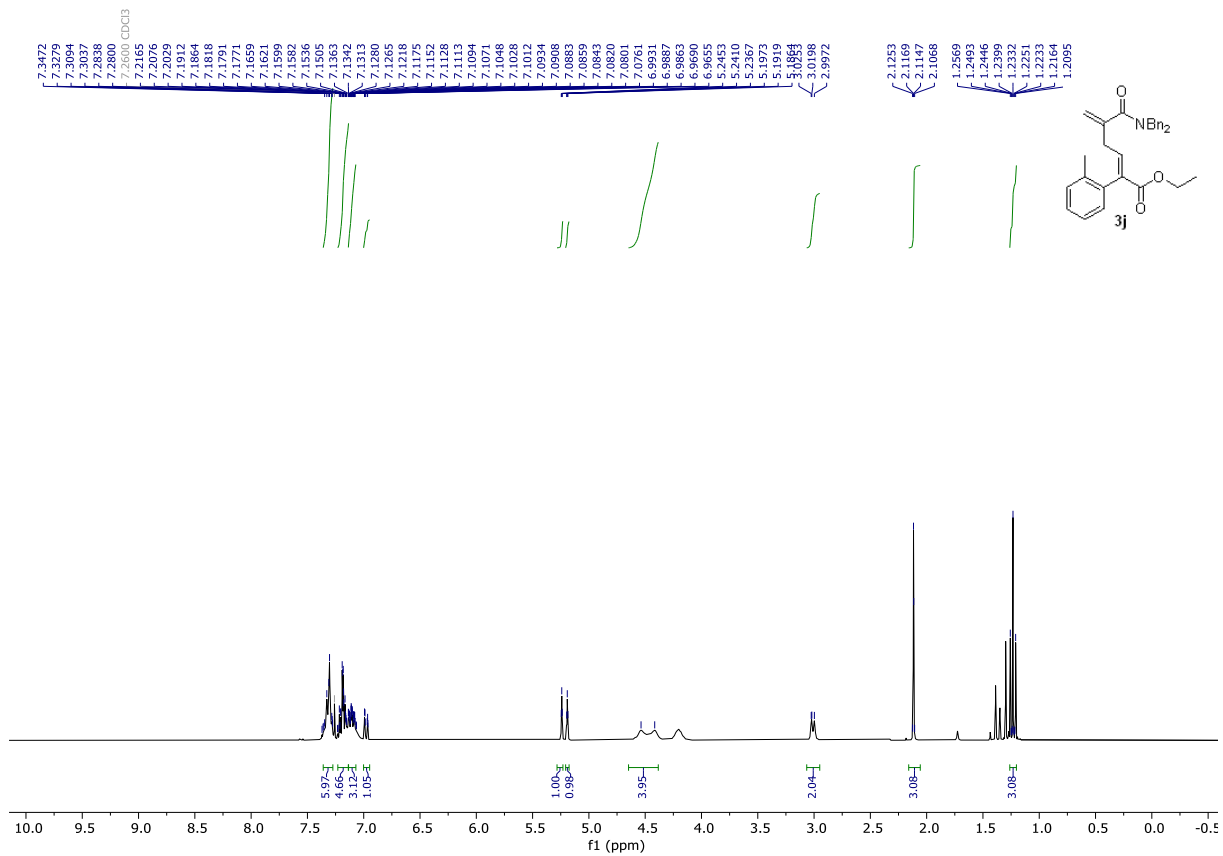




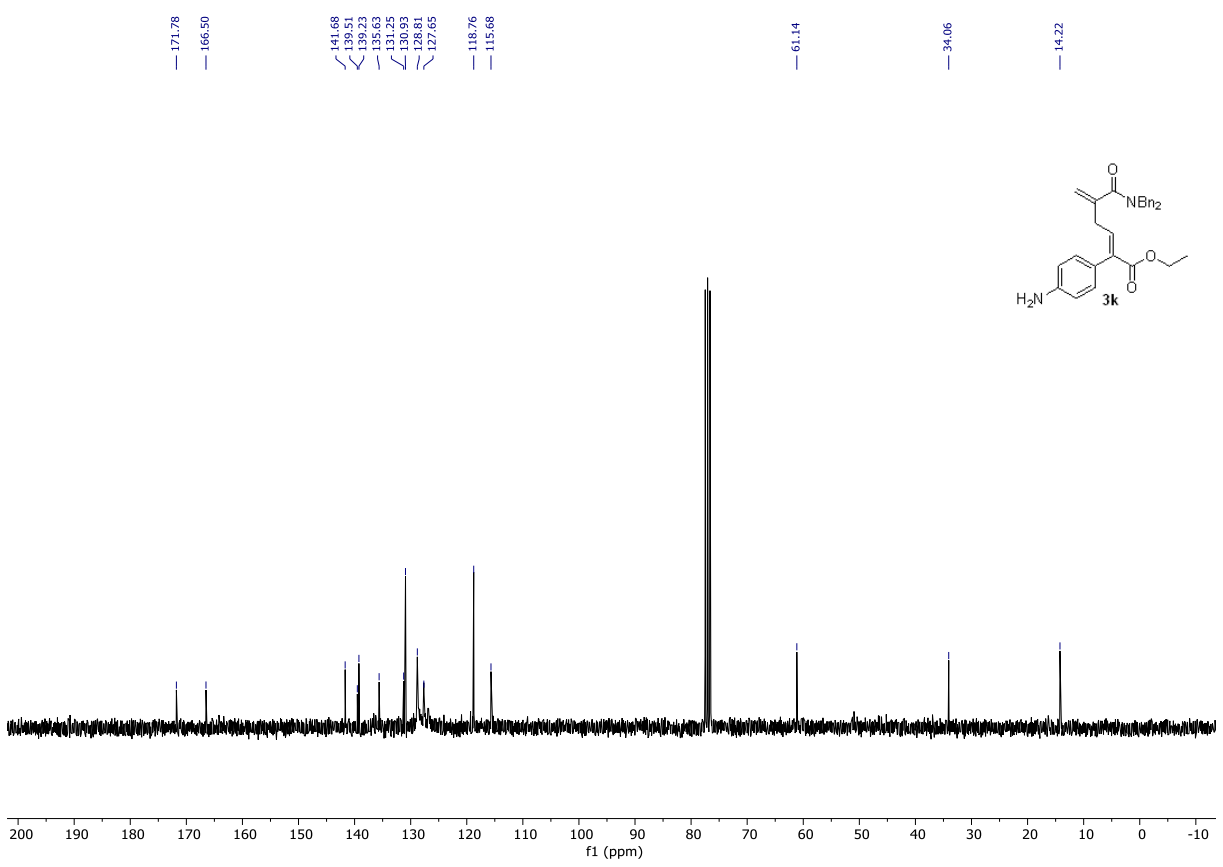
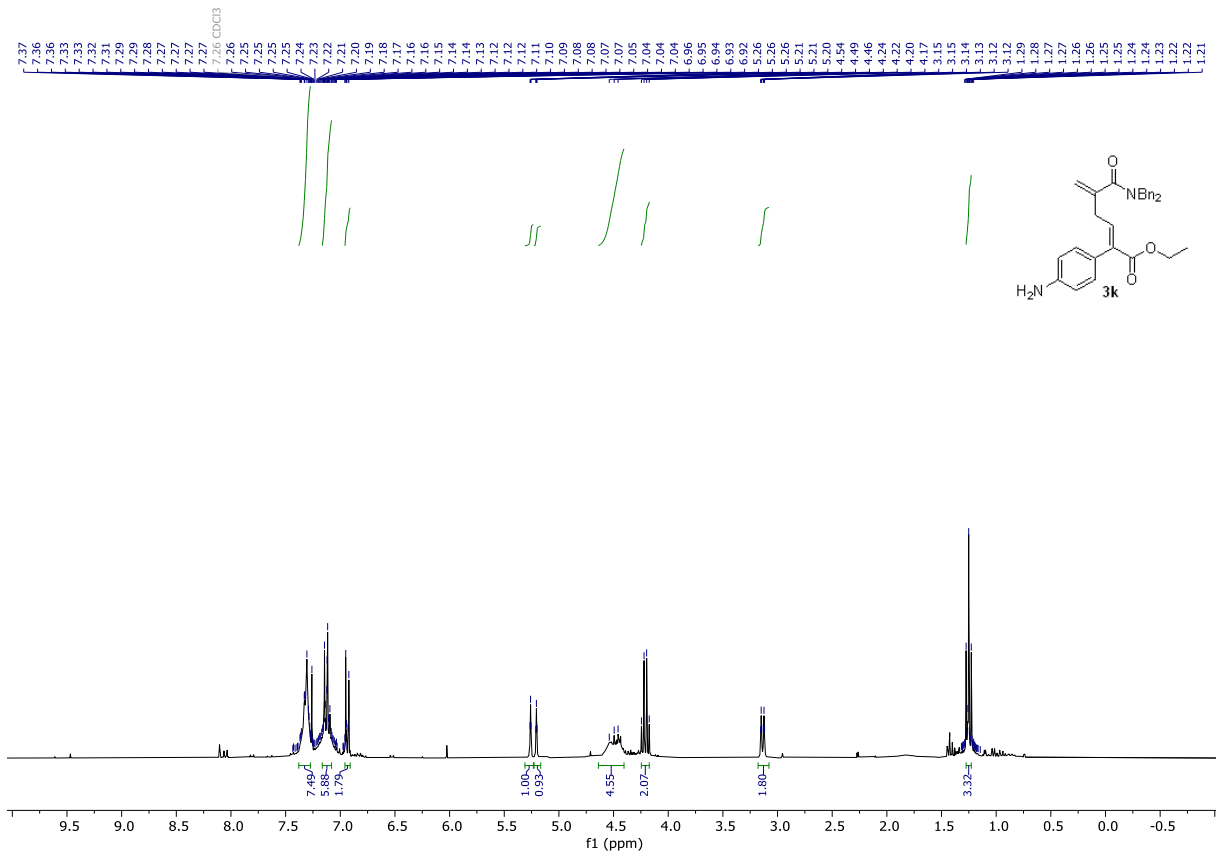


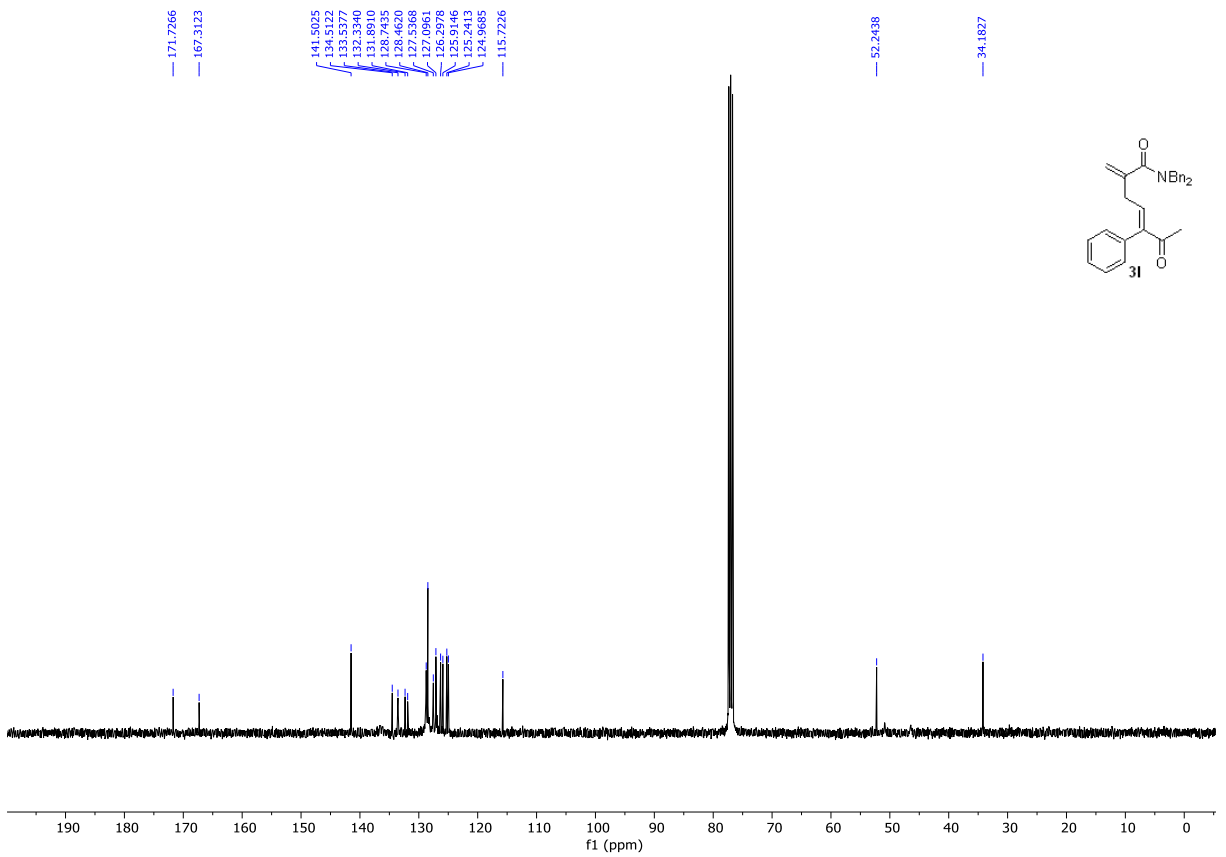
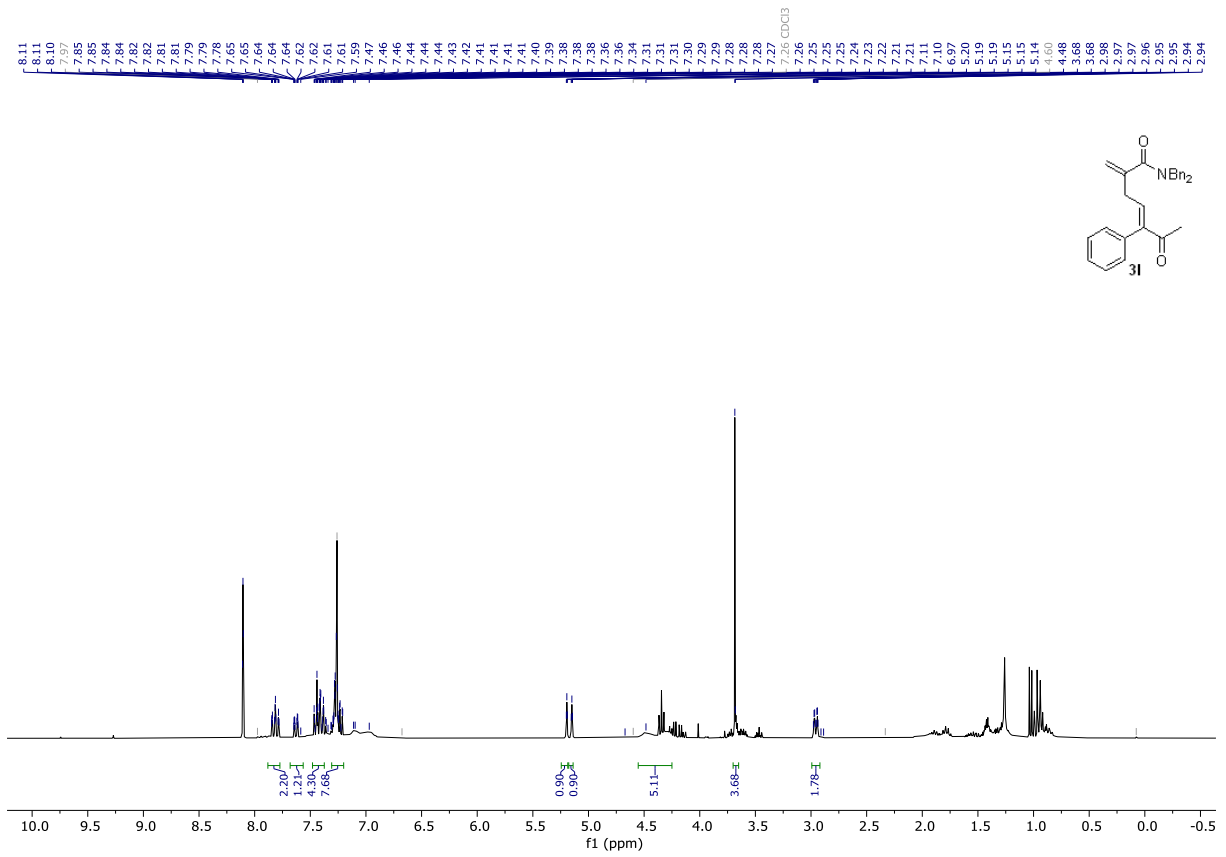


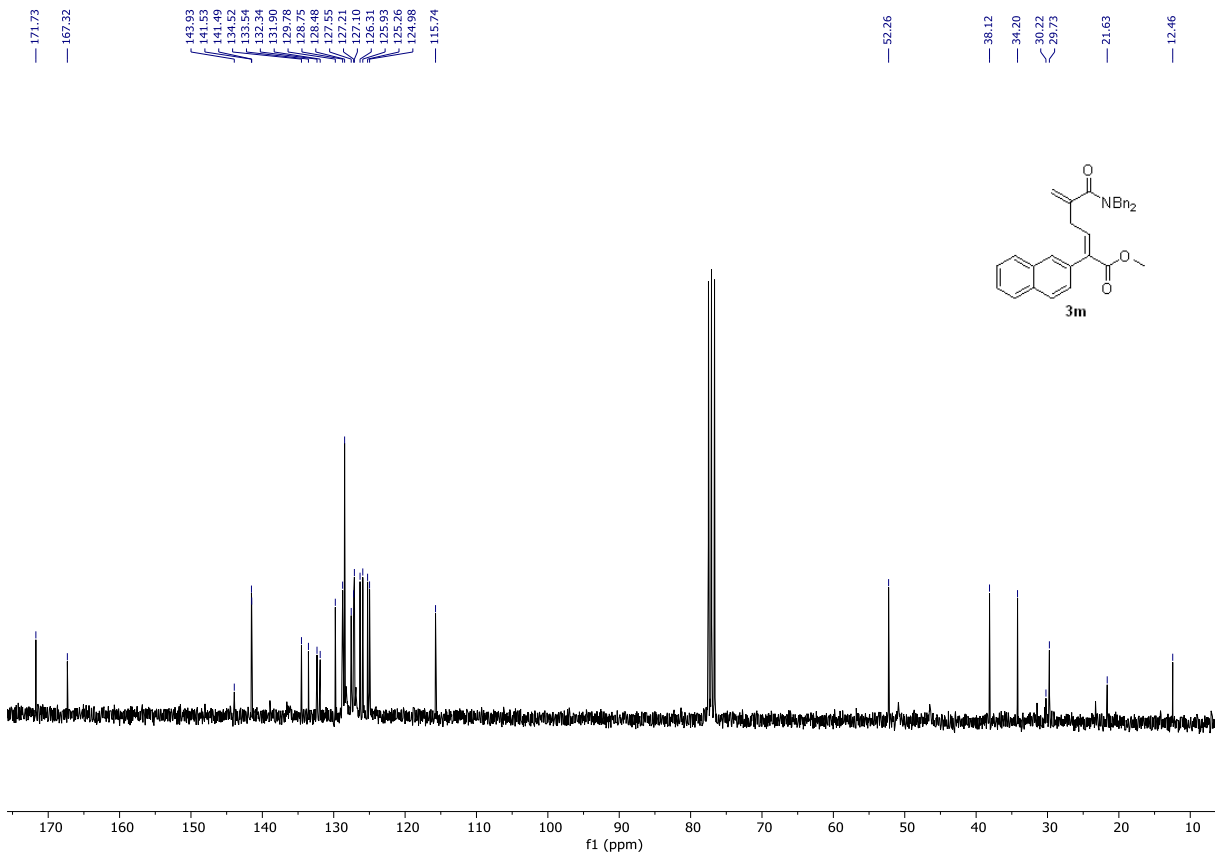
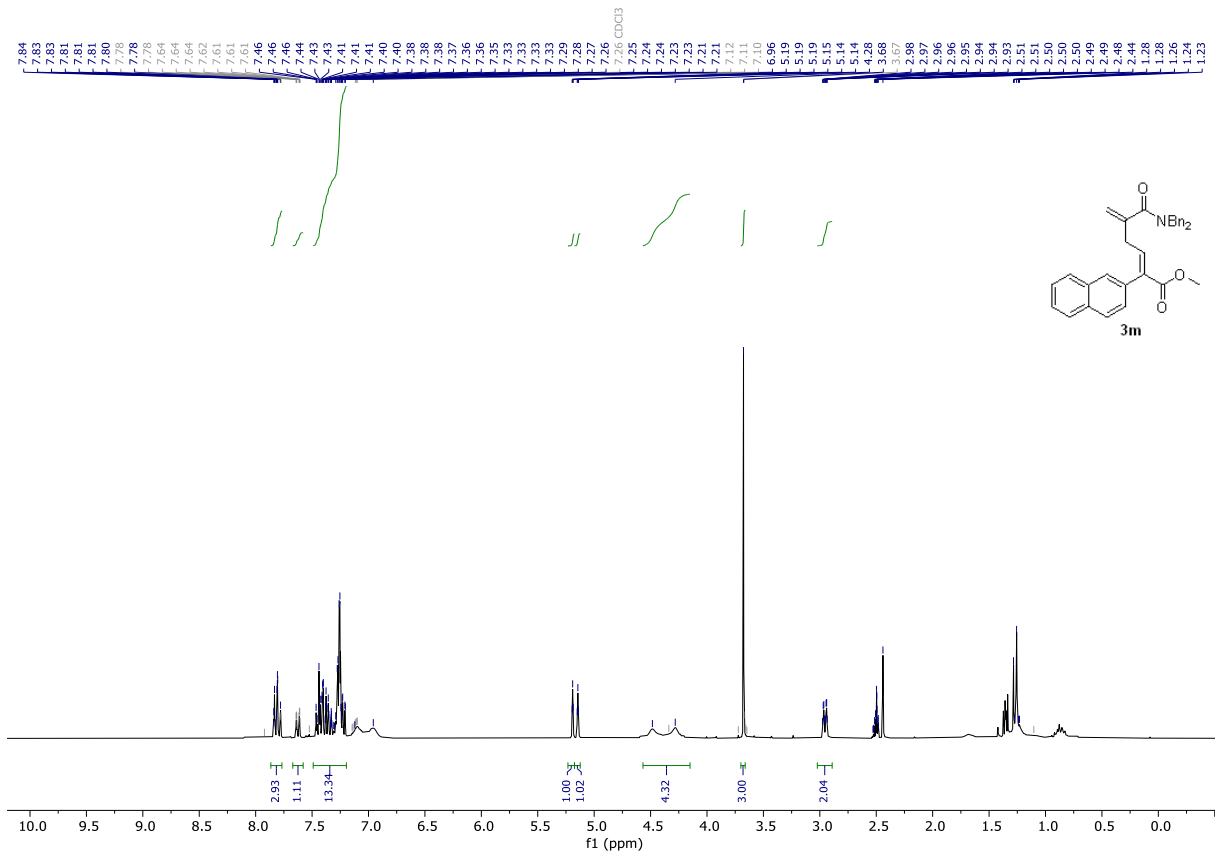


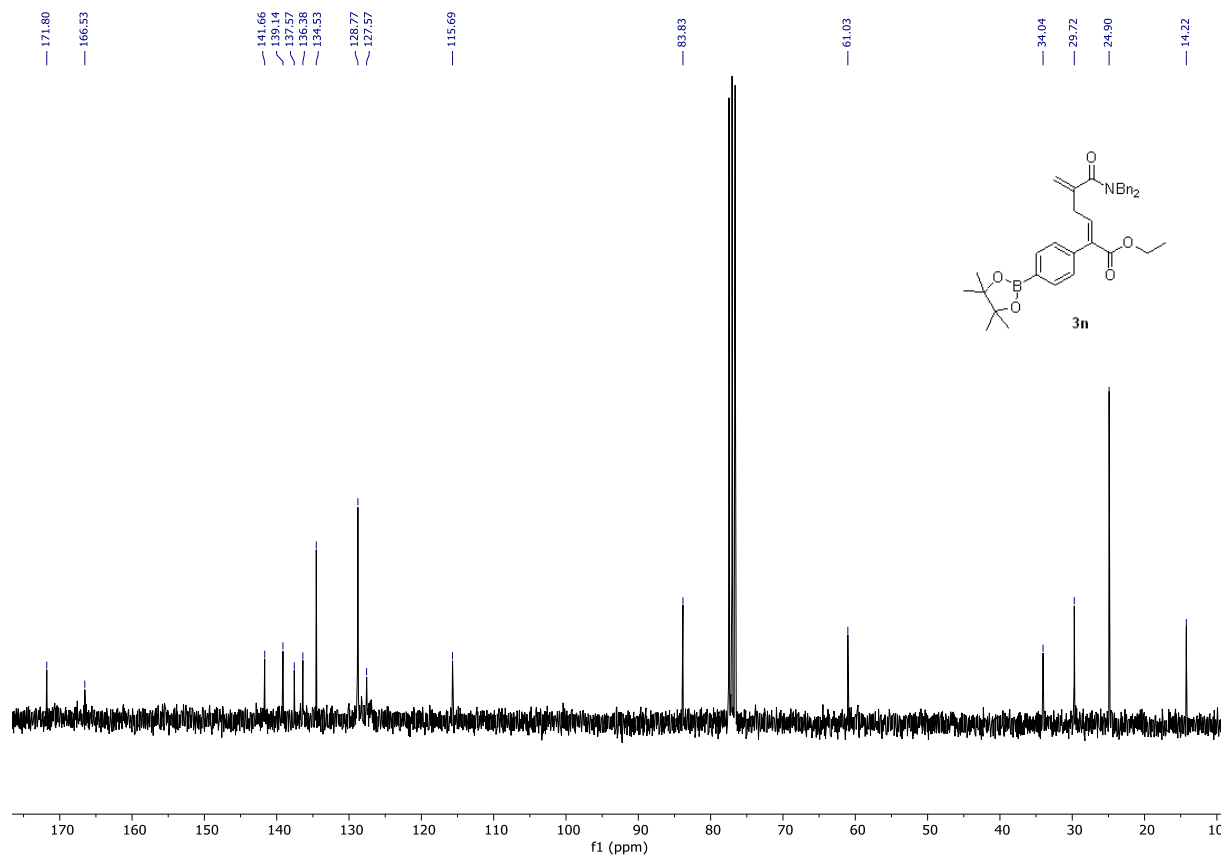
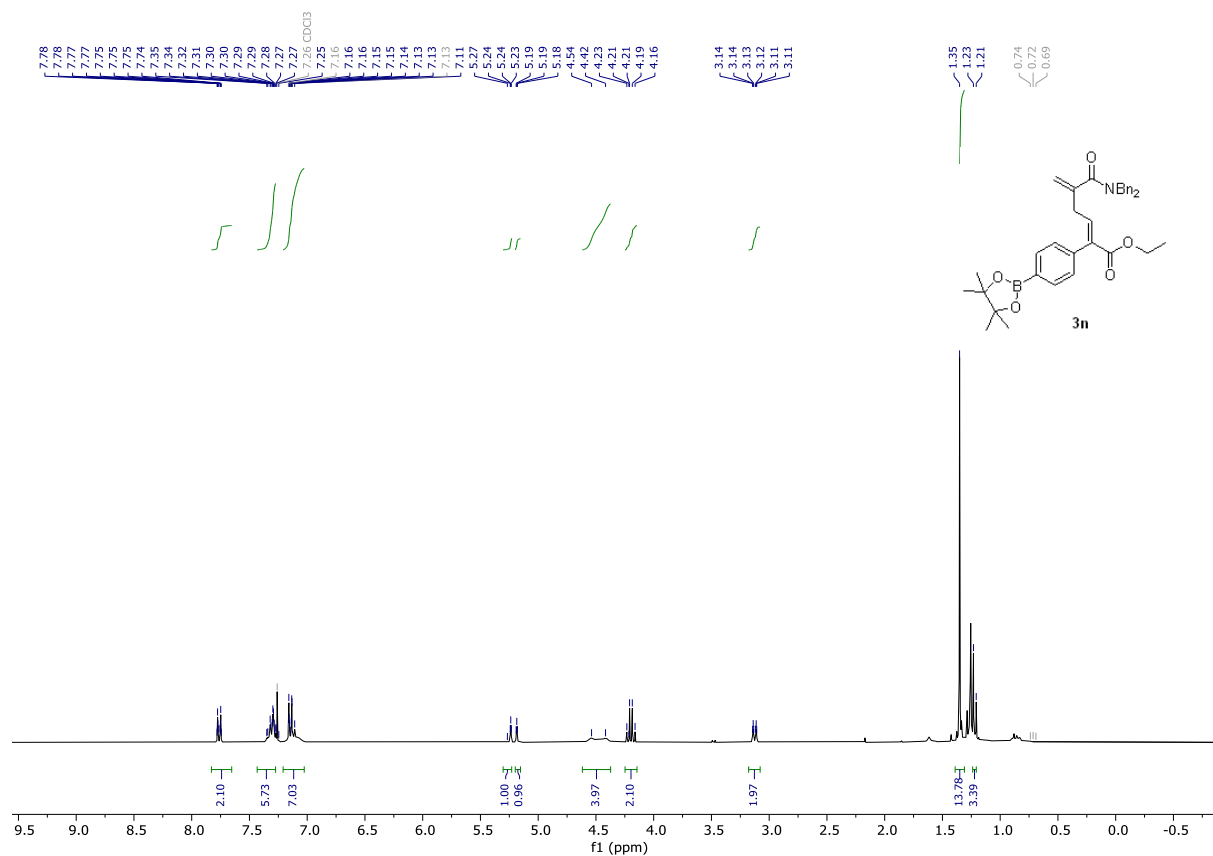


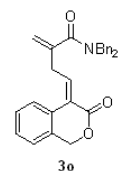
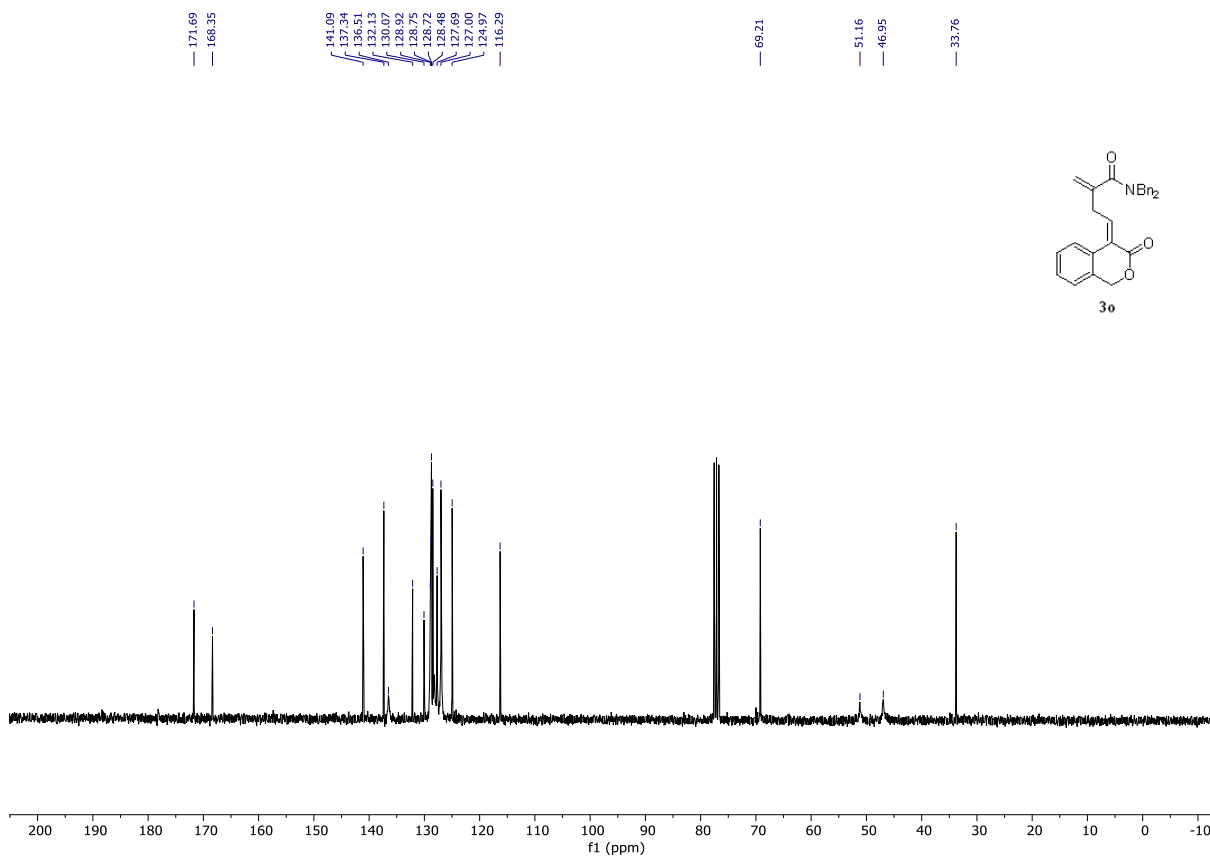
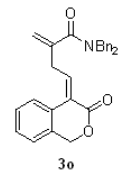
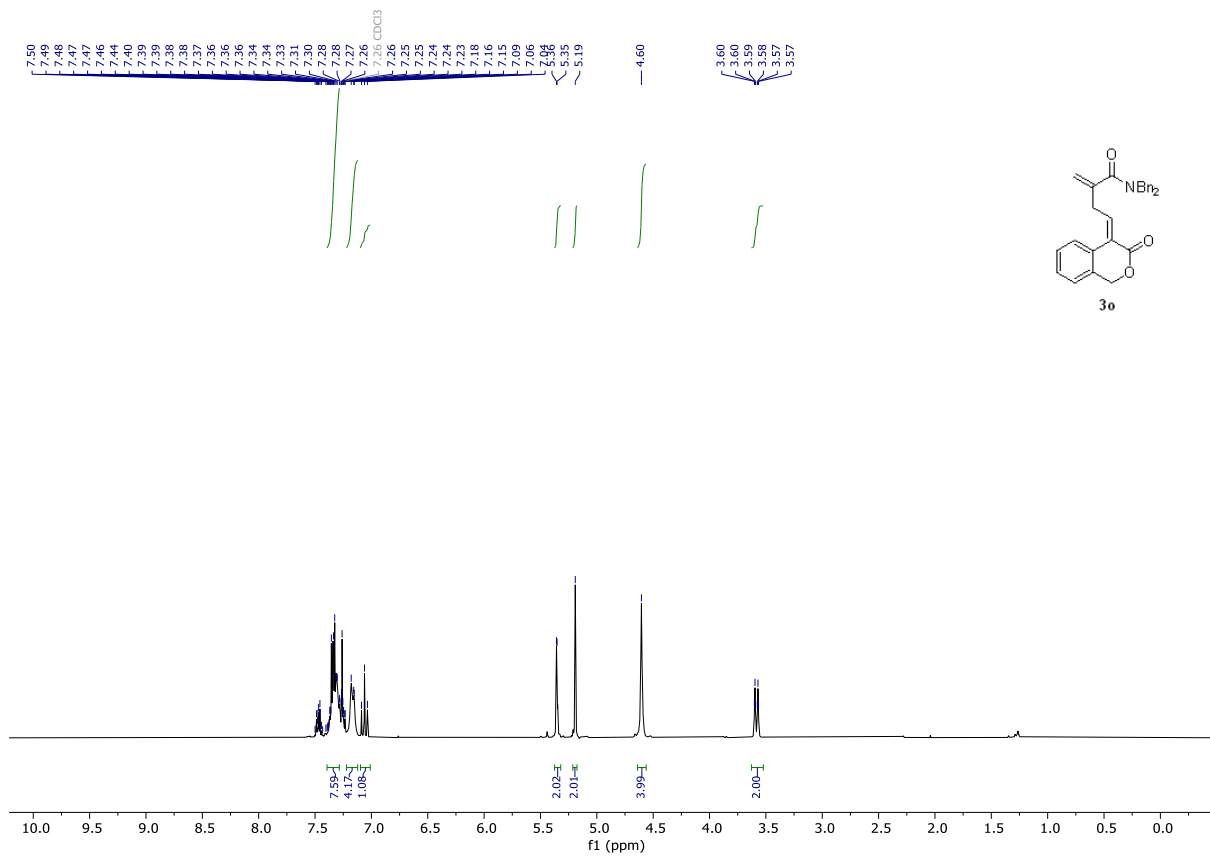




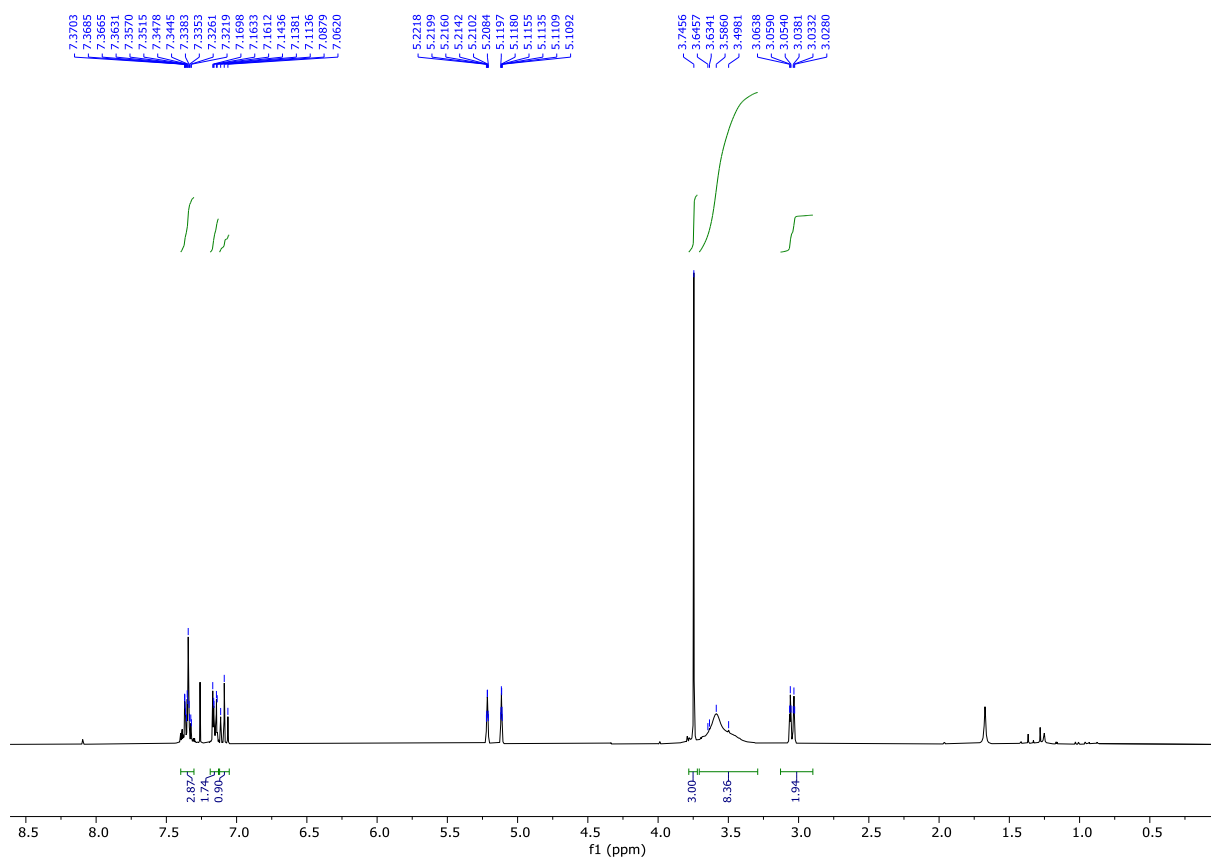




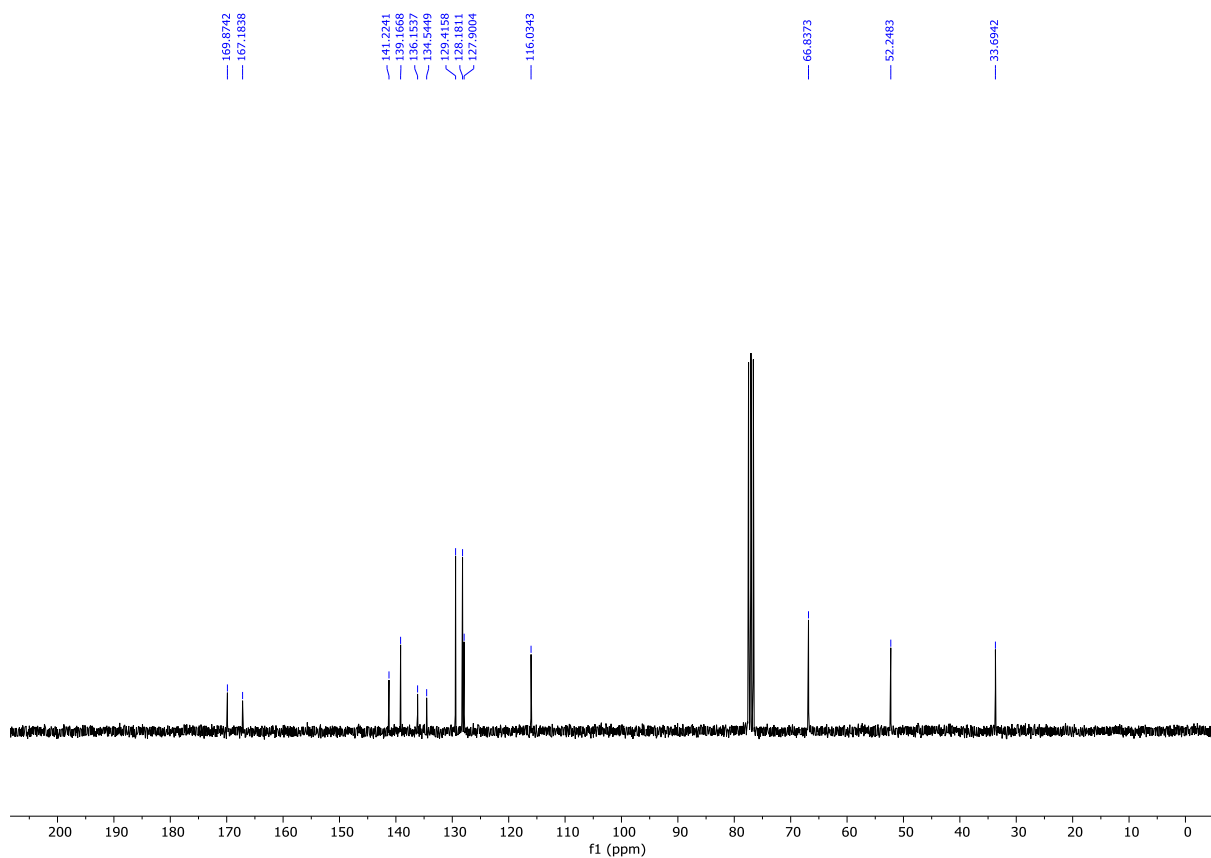


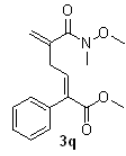
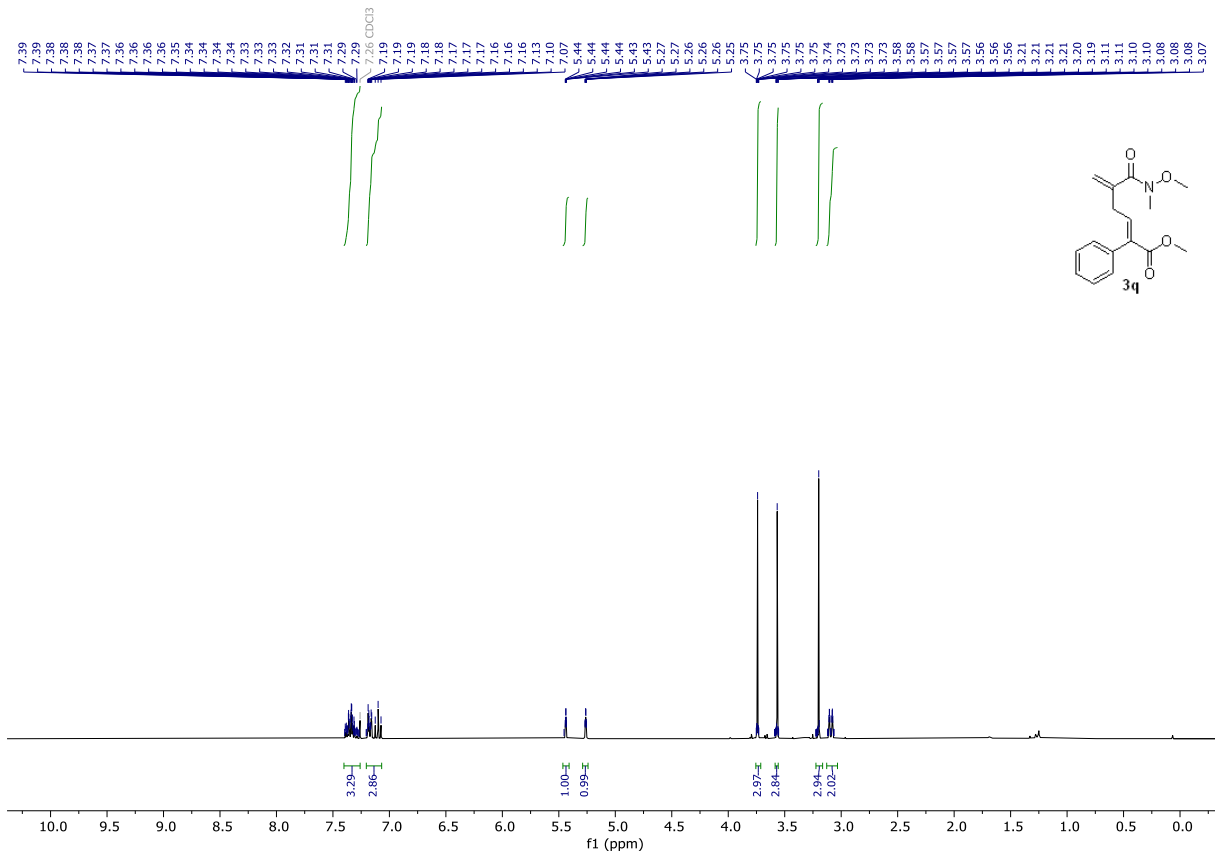


# <sup>1</sup>H NMR for 3p



# <sup>13</sup>C NMR for 3p





- 170.21
- 167.37
- 141.49
- 135.76
- 134.66
- 129.17
- 128.10
- 127.78
- 117.88
- 61.24
- 52.20
- 33.14

