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Supporting Information

Palladium-Catalyzed Difluorocarbene Transfer Synthesis of Diaryl Ketones from Iodoarene and Arylboronic Acid

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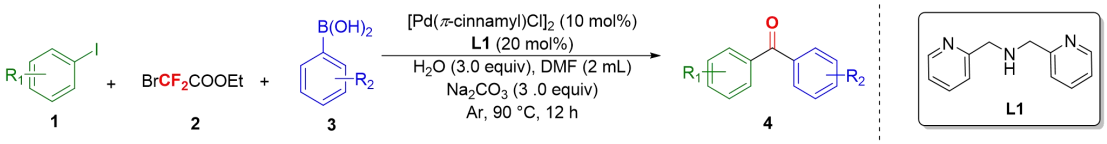
SI- § 1 General Information

Melting points were determined on an EZ-Melt (Automated melting point apparatus). ^{1}H and ^{13}C $\{^{1}H\}$ NMR spectra were recorded on a 400 MHz Varian Unity Plus or Varian Mercury plus spectrometer. The chemical shift (δ) values are reported in parts per million (ppm), and the coupling constants (J) aregiven in Hz. The spectra was recorded using $CDCl_3$ or D_2O as a solvent. ^{1}H NMR chemical shifts are referenced to tetramethylsilane (TMS) (0 ppm). Chemical shifts are reported in δ ppm referenced to an internal TMS standard for ^{1}H NMR and $CDCl_3$ (δ 77.1) for ^{13}C $\{^{1}H\}$ NMR. High-resolution mass spectrometry (HRMS) data were collected on a high-resolution massspectrometer (LCMS-IT-TOF) using electrospray ionization (EI) mass spectrometry. The product purification was done using silica gel column chromatography. Thin-layer chromatography (TLC) characterization was performed with precoated silica gel GF254 (0.2 mm), while column chromatography characterization was performed with silica gel (200-300 mesh). ^{18}O labeled water was purchased from Aladdin (^{18}O purity: 98 atom%). GC-Ms spectra were recorded on Shimadzu GCMS-QP2010SE. Oil bath was used as heating source. Unless otherwise stated, all experiments were conducted in a seal tube under Ar atmosphere.

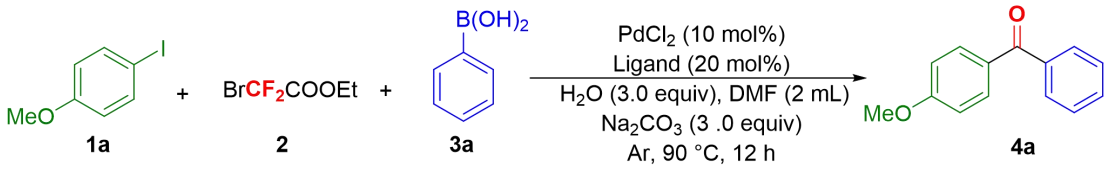
SI- § 2 General Procedures



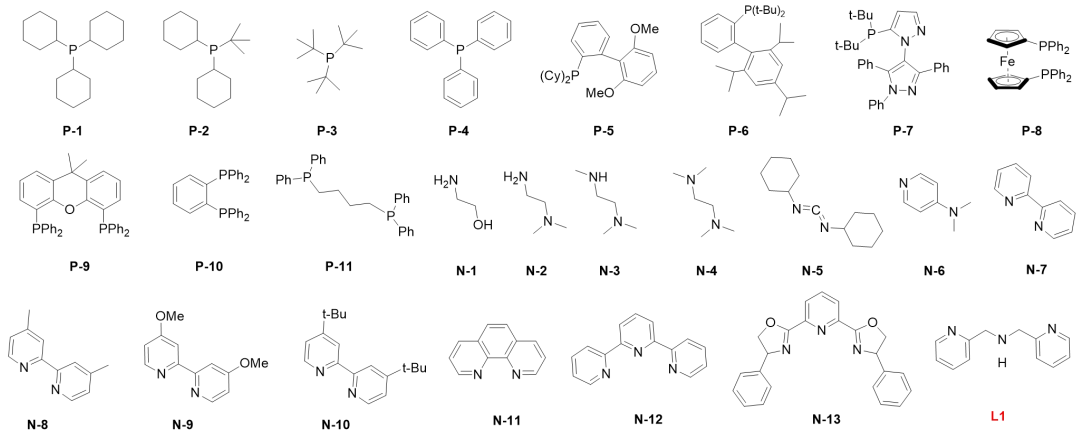
To a 25 mL schlenk tube was added **1** (0.2 mmol, 1.0 equiv) (for liquid aryl iodide, added in a 1 mL syringe after solid), **3** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), Na_2CO_3 (0.6 mmol, 3.0 equiv), the tube was evacuated and filled with argon for three cycles. And **2** (0.4 mmol, 2.0 equiv), **L1** (20 mol%), DMF (2 mL) were injected in schlenk tube. The schlenk tube was then heated up to 90 °C and kept stirring for 12 hours. After completion of the reaction, the mixture was cooled to room temperature and extracted with EtOAc (3 × 5 mL). The organic layers wer combined and dried with Na_2SO_4. After filtration and evaporation, the crude product was purified and separated by 200-300 mesh silica gel column chromatography to obtain the final product **4**.

SI- § 3 Optimization Tables

Table S1. Optimization of reaction conditions by using different ligands[a].

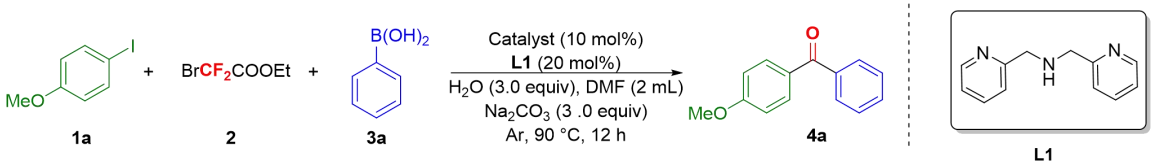


Entry	Ligand	Yield(%)[b]
1	**P-1**	36
2	**P-2**	10
3	**P-3**	10
4	**P-4**	17
5	**P-5**	10
6	**P-6**	23
7	**P-7**	20
8	**P-8**	31
9	**P-9**	ND
10	**P-10**	ND
11	**P-11**	26
12	**N-1**	10
13	**N-2**	20
14	**N-3**	20
15	**N-4**	35
16	**N-5**	20
17	**N-6**	20
18	**N-7**	36
19	**N-8**	5
20	**N-9**	10
21	**N-10**	trace
22	**N-11**	trace
23	**N-12**	34
24	**N-13**	30
25	**L1**	**63**



[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), $PdCl_2$ (10 mol%), Ligand (20 mol%), H_2O (0.6 mmol, 3.0 equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield.

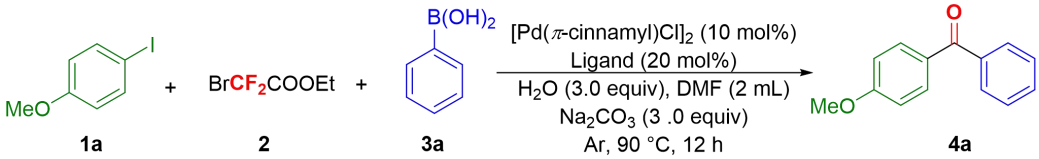
Table S2. Optimization of reaction conditions by using different catalysts[a].



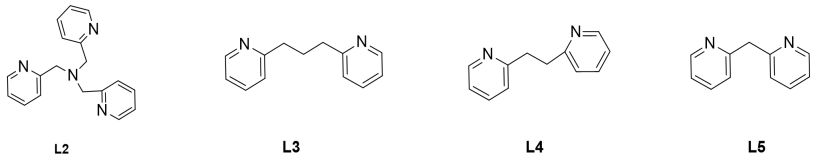
Entry	Catalyst	Yield(%)[b]
1	$Pd(PPh_3)_4$	40
2	$Pd(dba_2)$	59
3	**[Pd(*π*-cinnamyl)Cl]$_2$**	**84**
4	$DPPF{\cdot}PdCl_2$	trace
5	$Pd(TFA)_2$	40
6	$Pd(OAc)_2$	23
7	$(CH_3CN)_2PdCl_2$	50
8	$Pd(dba)_3$	36
9	$(PPh_3)_2PdCl_2$	5
10	$NiCl_2(pph_3)_2$	ND
11	$NiCl_2(dme)$	ND
12[c]	[Pd(*π*-cinnamyl)Cl]$_2$	38
13[d]	[Pd(*π*-cinnamyl)Cl]$_2$	72

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), Catalyst (10 mol%), **L1** (20 mol%), H_2O (0.6 mmol, 3.0 equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield. [c] [Pd(*π*-cinnamyl)Cl]$_2$ (5 mol%). [d] [Pd(*π*-cinnamyl)Cl]$_2$ (5 mol%), **L1**(10 mol%).

Table S3. Optimization of reaction conditions by using different ligands[a]

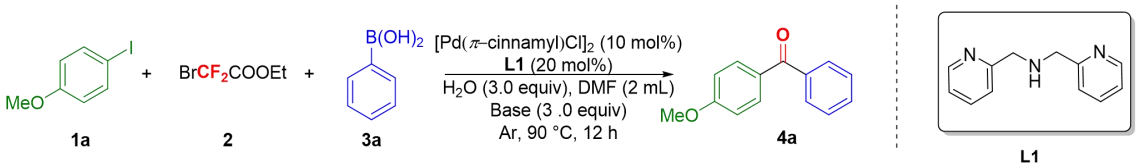


Entry	Ligand	Yield(%)[b]
1	**L2**	70
2	**L3**	74
3	**L4**	69
4	**L5**	63



[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), Ligand (20 mol%), H_2O (0.6 mmol, 3.0 equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield.

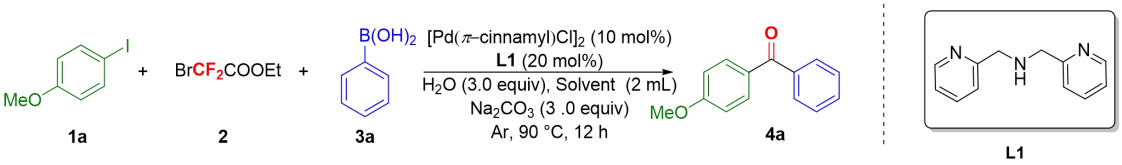
Table S4. Optimization of reaction conditions by using different bases[a]



Entry	Base	Yield(%)[b]
1	**Na_2CO_3**	**84**
2	K_2CO_3	60
3	K_3PO_4	16
4	HCOONa	trace
5	DBU	13
6	DIPEA	22
7	Et_3N	trace

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), **L1** (20 mol%), H_2O (0.6 mmol, 3.0 equiv), Base (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield.

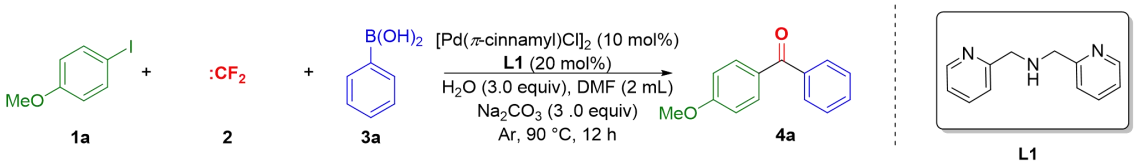
Table S5. Optimization of reaction conditions by using different solvents[a].



Entry	Solvent	Yield(%)[b]
1	**DMF**	**84**
2	DMSO	trace
3	Toluene	NR
4	1,4-Dioxane	5
5	NMP	45
6	DMAc	24
7	H_2O	ND

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), **L1** (20 mol%), H_2O (0.6 mmol, 3.0 equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in various solvent (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield.

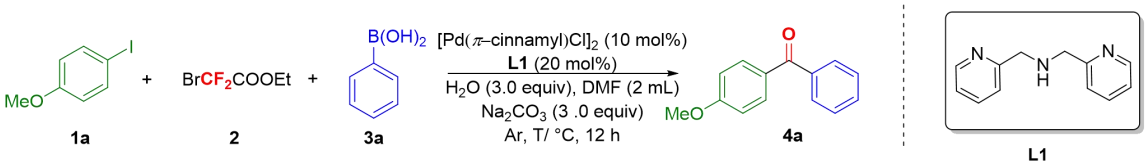
Table S6. Optimization of reaction conditions by using different difluorocarbene precursors[a]



Entry	Difluorocarbene precursor	Yield(%)[b]
1	**$BrCF_2COOEt$**	**84**
2	$ClCF_2COOEt$	59
3	$BrCF_2PO(OEt)_2$	16
4	$BrCF_2COONa$	74
5	$ClCF_2COONa$	52
6	$TMSCF_2Br$	10
7	$Ph_3P{+}CF_2CO_2{-}$	trace
8	/	ND

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), **L1** (20 mol%), H_2O (0.6 mmol, 3.0 equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield.

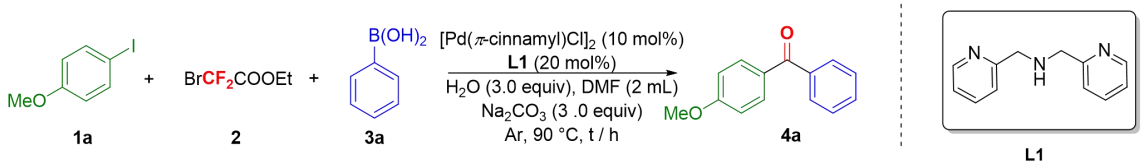
Table S7. Optimization of reaction conditions by using different temperatures[a]



Entry	Temperature(°C)	Yield(%)[b]
1	60	43
2	70	64
3	80	70
4	**90**	**84**
5	110	66

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), **L1** (20 mol%), H_2O (0.6 mmol, 3.0 equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), T / °C, 12 h, in Ar atmosphere. [b] isolated yield.

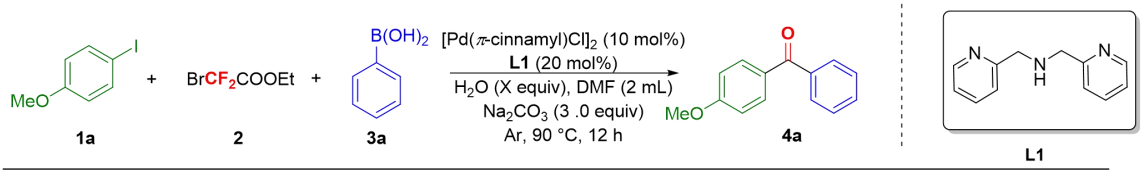
Table S8. Optimization of reaction conditions by using different times[a]



Entry	Time (h)	Yield(%)[b]
1	4	69
2	6	58
3	8	64
4	10	60
5	**12**	**84**
6	14	83

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), **L1** (20 mol%), H_2O (0.6 mmol, 3.0 equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, t / h, in Ar atmosphere. [b] isolated yield.

Table S9. Optimization of reaction conditions by using different amount of H_2O [a]

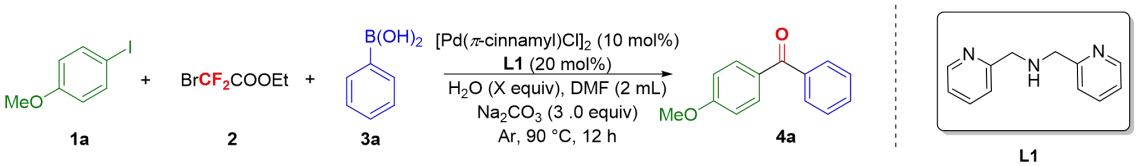


Entry	H_2O (equiv)	Yield(%)[b]
1	1	60
2	2	73
3	**3**	**84**

4	4	83
5	5	80

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), **L1** (20 mol%), H_2O (X equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield.

Table S10. Optimization of reaction conditions by using different amount of $BrCF_2COOEt$ [a]

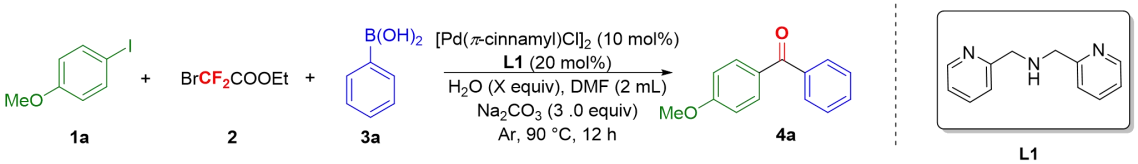


1a **2** **3a** **4a** **L1**

Entry	$BrCF_2COOEt$ (equiv)	Yield(%)[b]
1	1.8	80
2	1.9	82
3	**2**	**84**
4	2.1	84
5	2.2	84

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (X equiv), **3a** (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), **L1** (20 mol%), H_2O (X equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield.

Table S11. Optimization of reaction conditions by using different amount of phenylboronic acid [a]



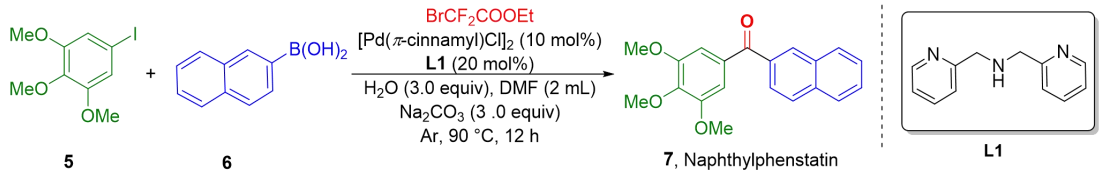
1a **2** **3a** **4a** **L1**

Entry	**3a** (equiv)	Yield(%)[b]
1	1.3	74
2	1.4	78
3	**1.5**	**84**
4	1.6	84
5	1.7	84

[a] Reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2** (0.4 mmol, 2.0 equiv), **3a** (X equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), **L1** (20 mol%), H_2O (X equiv), Na_2CO_3 (0.6 mmol, 3.0 equiv) in DMF (2 mL), 90 °C, 12 h, in Ar atmosphere. [b] isolated yield.

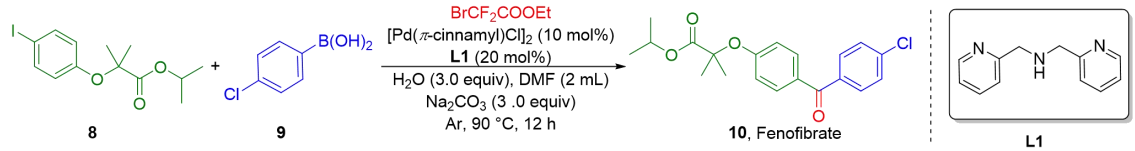
SI- § 4 Further Synthetic Transformation

§ 4a Drug synthesis



5 **6** **7**, Naphthylphenstatin **L1**

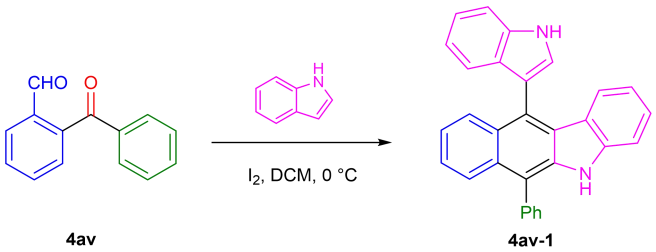
To a 25 mL schlenk tube was added 5-iodo-1,2,3-trimethoxybenzene (0.2 mmol, 1.0 equiv), naphthalen-2-ylboronic acid (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), Na_2CO_3 (0.6 mmol, 3.0 equiv), the tube was evacuated and filled with argon for three cycles. And $BrCF_2COOEt$ (0.4 mmol, 2.0 equiv), **L1** (20 mol%), DMF (2 mL) were injected in schlenk tube. The schlenk tube was then heated up to 90 °C and kept stirring for 12 hours. After completion of the reaction, the mixture was cooled to room temperature and extracted with EtOAc (3 × 5 mL). The organic layers were combined and dried with Na_2SO_4. After filtration and evaporation, the crude product was purified and separated by 200-300 mesh silica gel column chromatography to obtain the final product Naphthylphenstatin.



8 **9** **10**, Fenofibrate **L1**

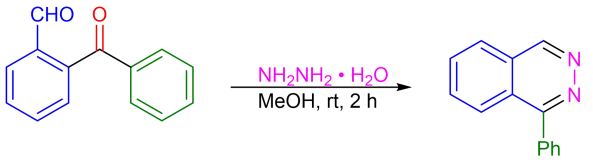
Isopropyl 2-(4-iodophenoxy)-2-methylpropanoate (0.2 mmol, 1.0 equiv), (4-chlorophenyl)boronic acid (0.3 mmol, 1.5 equiv), [Pd(π-cinnamyl)Cl]$_2$ (10 mol%), Na_2CO_3 (0.6 mmol, 3.0 equiv), the tube was evacuated and filled with argon for three cycles. And $BrCF_2COOEt$ (0.4 mmol, 2.0 equiv), **L1** (20 mol%), DMF (2 mL) were injected in schlenk tube. The schlenk tube was then heated up to 90 °C and kept stirring for 12 hours. After completion of the reaction, the mixture was cooled to room temperature and extracted with EtOAc (3 × 5 mL). The organic layers were combined and dried with Na_2SO_4. After filtration and evaporation, the crude product was purified and separated by 200-300 mesh silica gel column chromatography to obtain the final product Fenofibrate.

§ 4b Experimental procedures for derivatization of ketones



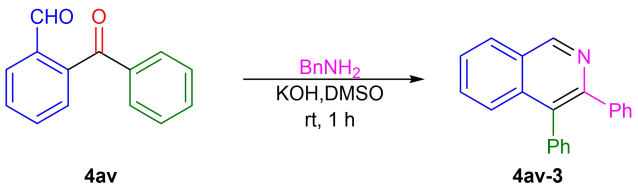
4av 4av-1

2-benzoyl benzaldehyde (0.25 mmol, 1.0 equiv), CH_2Cl_2 (2 mL) and I_2 (0.05 mmol, 20 mol%) were added to a 25 mL reaction tube. After cooling the reaction tube to 0 °C in an ice bath, indole (0.525 mmol, 2.1 equiv) and CH_2Cl_2 (3 mL) were added drip. The reaction mixture was stirred at 0 °C. Upon completion of the reaction, the reaction mixture was transferred to a separating funnel using CH_2Cl_2 (15 mL), the organic layers was extracted, and dried with sodium sulfate. The solvent was removed using a rotary evaporator at low pressure, and the crude product was purified by silica gel column chromatography using an ethyl acetate/hexane mixture as eluent.



4av 4av-2

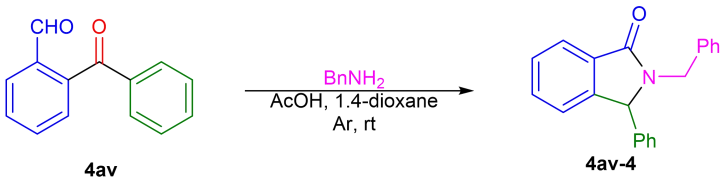
To a solution of the 2-benzoyl benzaldehyde (0.2 mmol, 1.0 equiv) in MeOH (1 mL) was added $NH_2NH_2 \cdot H_2O$ (0.4 mmol, 2.0 equiv). The reaction mixture was stirred at room temperature for 2 h. Upon completion of the reaction, the solvent was removed using a rotary evaporator at low pressure, and the final product was purified by silica gel column chromatography with 200-300 mesh.



4av 4av-3

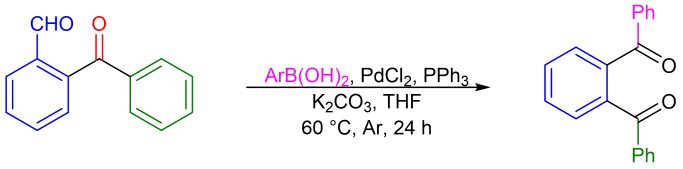
2-benzoyl benzaldehyde (0.2 mmol, 1.0 equiv), benzylamine (0.24 mmol, 1.2 equiv), KOH (0.24 mmol, 1.2 equiv) and DMSO (1 mL) were added to a 15 mL reaction tube. The resulting reaction mixture was stirred at room temperature for 1 h. Upon completion of the reaction, ethyl acetate was added to the mixture, then washed three times with water, and the organic layers were

dried over anhydrous Na_2SO_4. The crude product was filtered, concentrated under vacuum, and purified and separated by 200-300 mesh silica gel column chromatography to obtain the final product.



4av **4av-4**

A stirred solution of 2-benzoyl benzaldehyde (0.2 mmol, 1.0 equiv) and AcOH (0.46 mmol, 2.3 equiv) in 1,4-dioxane (1 mL) was treated at room temperature with benzylamine (0.4 mmol, 2.0 equiv). After 5min the reaction mixture was quenched with saturated NH_4Cl. Ethyl acetate extraction reaction mixture, the organic layers were combined with Na_2SO_4 and dried. The crude product was filtered and evaporated, and then purified and separated by 200-300 mesh silica gel column chromatography to obtain the final product.

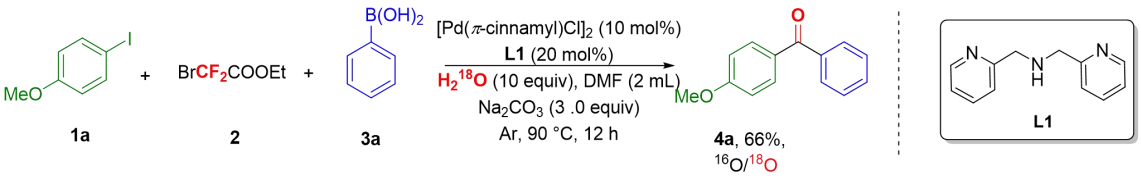


4av **4av-5**

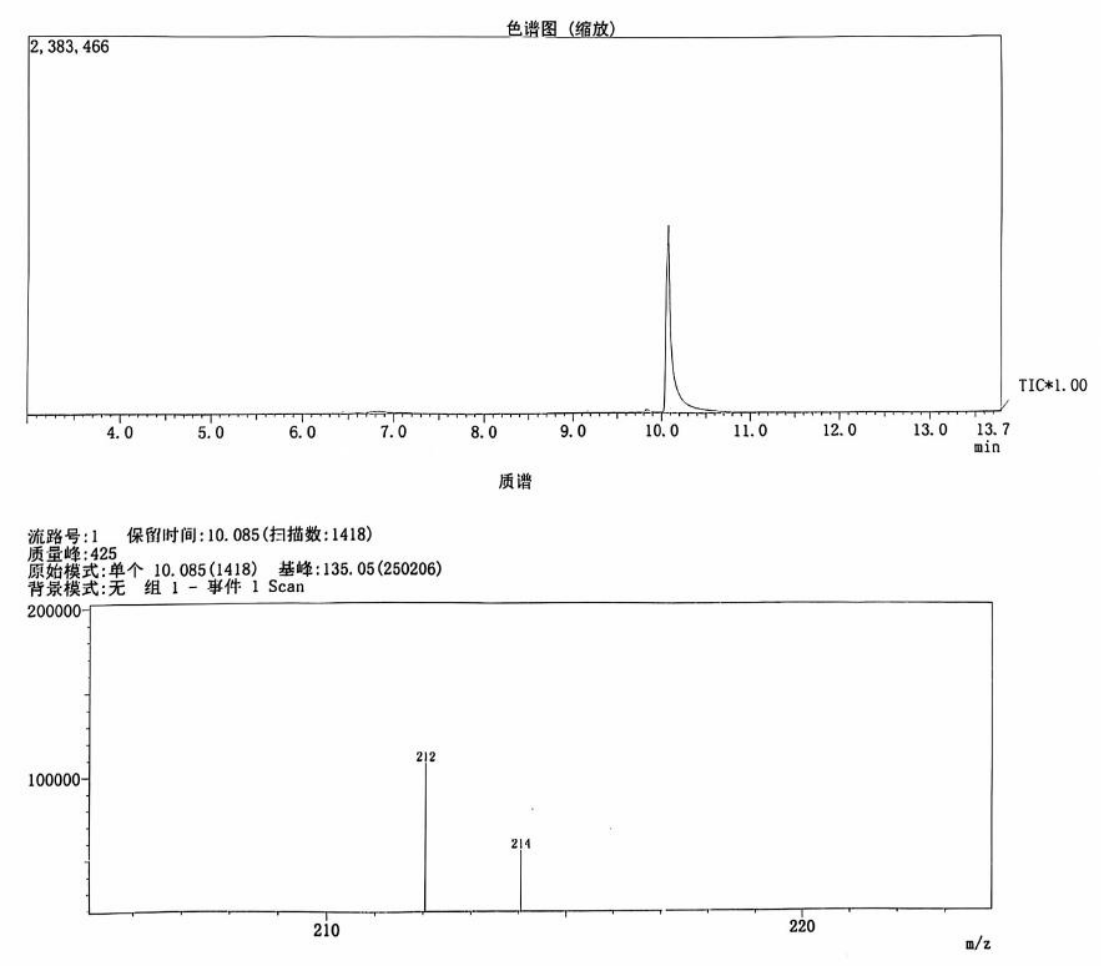
To a 25 mL schlenk tube 2-benzoylbenzaldehyde (0.25 mmol, 1.0 equiv), phenylboronic acid (0.5 mmol, 2.0 equiv), $PdCl_2$ (0.025 mmol, 10 mol%), PPh_3 (0.0125 mmol, 5 mol%), and K_2CO_3 (0.75 mmol, 3.0 equiv) were sealed with rubber stopper and then purged three times with argon. THF (2.5 mL) was added to the reaction tube with a syringe. The mixture was heated at 60 ℃ for 24 h. After completion of the reaction, the resulting mixture was cooled to room temperature and HCl (4 M, 1 mL) was slowly added. The stirring was continued for 1 h under an argon atmosphere, followed by extraction with ethyl acetate three times. The combined organic extracts were washed with a saturated solution of $NaHCO_3$, with brine and dried over Na_2SO_4. The crude product was filtered and evaporated and then purified and separated by 200-300 mesh silica gel column chromatography to obtain the final product.

SI- § 5 Mechanism Experiments

§ 5a ^{18}O-Labeling experiment

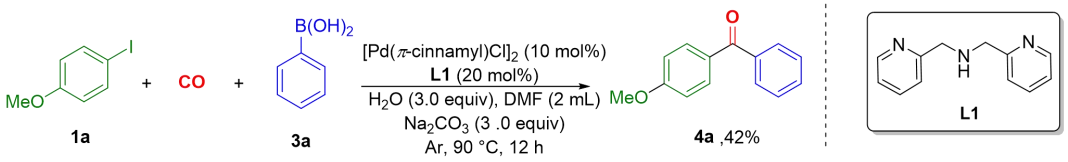


[Pd(π-cinnamyl)Cl]$_2$ (10 mol%), Na_2CO_3 (0.6 mmol, 3.0 equiv), 4-Iodoanisole (0.2 mmol, 1.0 equiv) and Phenylboronic acid (0.3 mmol, 1.5 equiv) were added into an oven-dried schlenk tube equipped with a magnetic stirred bar, then purged three times with argon. And $BrCF_2COOEt$ (0.4 mmol, 2.0 equiv), **L1** (20 mol%), $H_2{}^{18}O$(2 mmol, 10 equiv), DMF (2 mL) were injected in schlenk tube. The schlenk tube was then heated up to 90 °C and kept stirring for 12 hours. After completion of the reaction, then the mixture was detected by GC-MS.



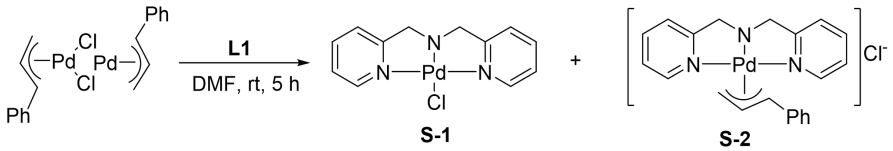
^{18}O-Labeling Experiment

§ 5b CO experiment



[Pd(π-cinnamyl)Cl]$_2$ (10 mol%), Na_2CO_3 (0.6 mmol, 3.0 equiv), 4-iodoanisole (0.2 mmol, 1.0 equiv) and Phenylboronic acid (0.3 mmol, 1.5 equiv) were added into an oven-dried schlenk tube equipped with a magnetic stirred bar, then purged three times with CO balloon. And **L1** (20 mol%), DMF (2 mL) were injected in schlenk tube. The mixture was continuously reacted at 90 °C for 12 h under CO atmosphere.

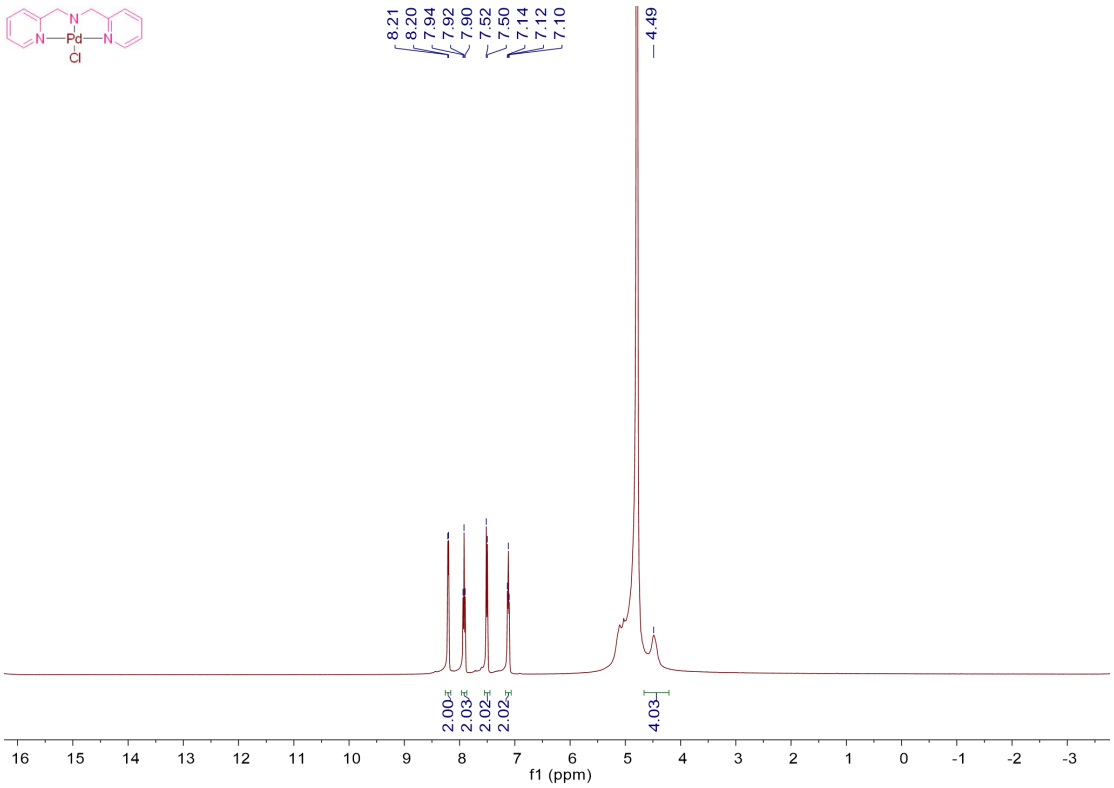
§ 5c Complexation experiments of [Pd(π-cinnamyl)Cl]$_2$ and L1



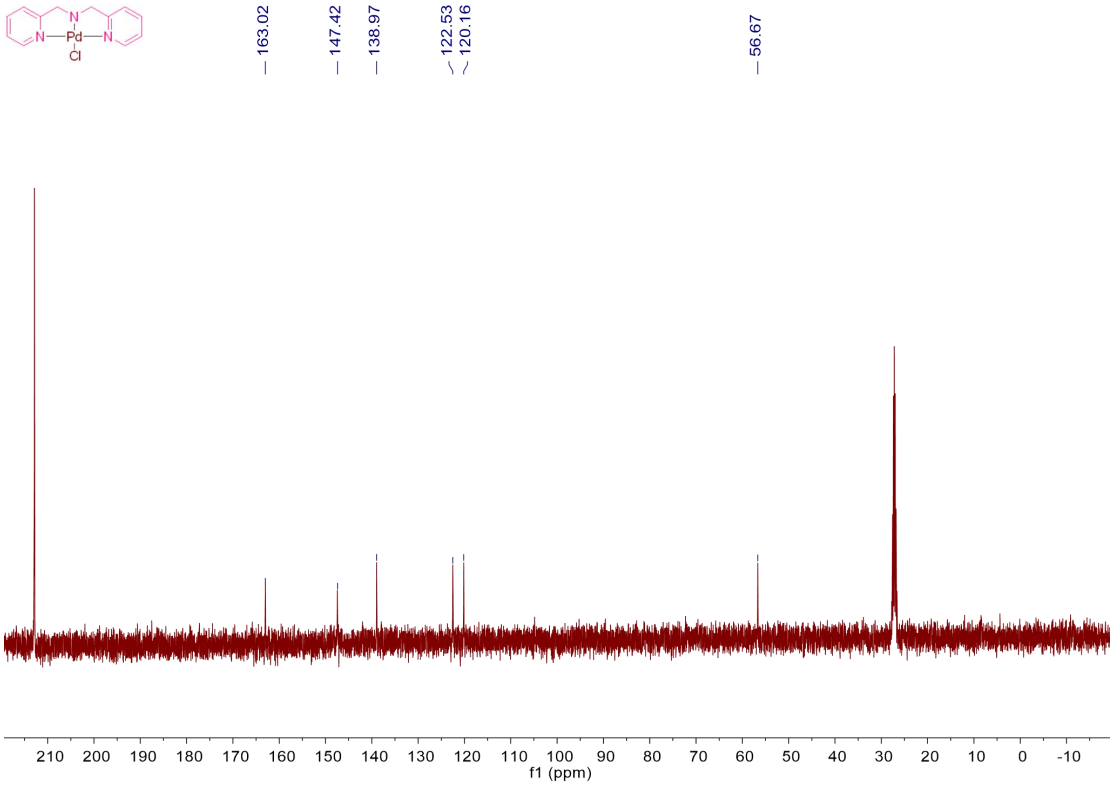
[Pd(π-cinnamyl)Cl]$_2$ (0.1 mmol, 1.0 equiv), DMF (1 mL) were added to a 10 mL reaction tube and stirred stirred at room temperature for 10 min. The supernatant was centrifuged and transferred to another reaction tube. bis(pyridin-2-ylmethyl)amine (0.2 mmol, 2.0 equiv) was added to this tube, and solid precipitation began about 10 minutes after stirring. The reaction mixture continued to react for 5 h before being filtered and concentrated under reduced pressure. Finally, the upper solid is complex **S-1** and the lower mother liquid is complex **S-2.**

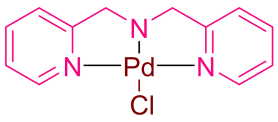
The resulting product **S-1** is a light yellow solid (26.1 mg, 77% yield). mp 286.1 °C.. ^{1}H NMR (400 MHz, Deuterium Oxide) δ 8.21 (d, J = 5.4 Hz, 2H), 7.92 (t, J = 7.7 Hz, 2H), 7.51 (d, J = 7.9 Hz, 2H), 7.12 (t, J = 6.5 Hz, 2H), 4.49 (s, 4H). ^{13}C {^{1}H} NMR (100 MHz, Acetone) δ 163.0, 147.4, 139.0, 122.5, 120.2, 56.7.

^{1}H-NMR (400 MHz, Deuterium Oxide) of **S-1**



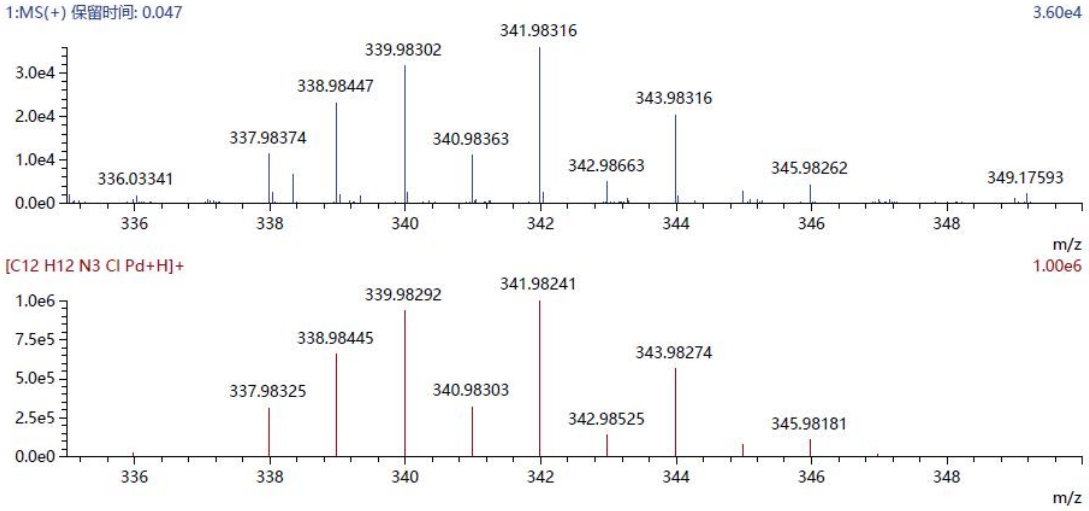
^{13}C {^{1}H} NMR (100 MHz, Acetone) of **S-1**

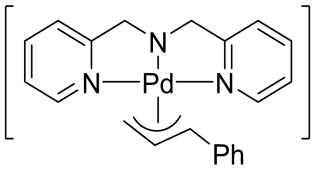




complex S-1

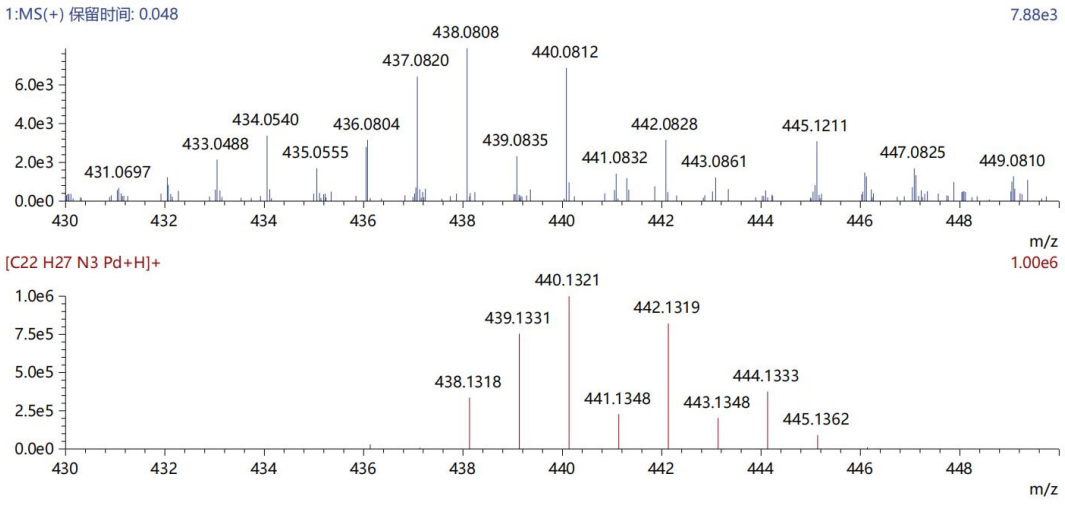
HRMS m/z calculated for $C_{12}H_{12}ClN_3Pd$ $[M+H]^+$: 339.98273, found: 339.98302.





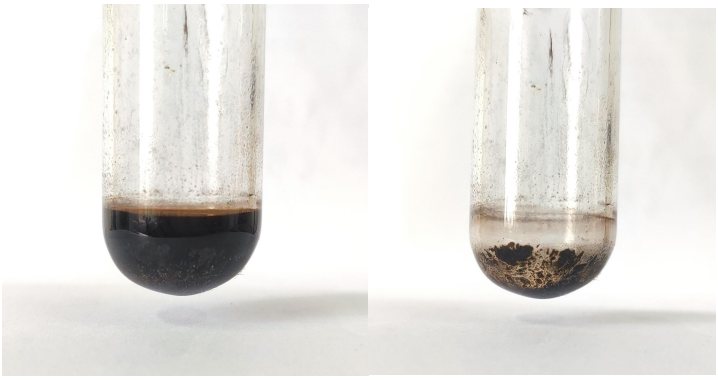
complex S-2

HRMS m/z calculated for $C_{22}H_{27}N_3Pd$ $[M+H]^+$: 440.1313, found: 440.1321.

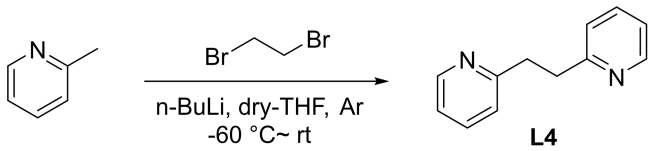


§ 5d Formation of palladium black

[Pd(π-cinnamyl)Cl]$_2$ (10 mol%), Na_2CO_3 (0.6 mmol, 3.0 equiv) were added into an oven-dried schlenk tube equipped with a magnetic stirred bar, then purged three times with argon. And $BrCF_2COOEt$ (0.4 mmol, 2.0 equiv), **L1** (20 mol%), DMF (2 mL) were injected in schlenk tube. The schlenk tube was then heated up to 90 °C and kept stirring for 12 hours.



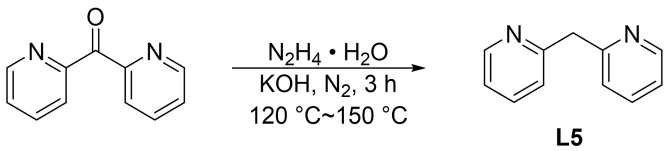
SI- § 6 Preparation of Ligands



L4

1 mL dry THF and 2.5 M n-butyl lithium (0.6 mmol, 1.2 equiv) in hexane under argon were added to a 15 mL reaction tube. After cooling in an ice bath, 2-methylpyridine (0.5 mmol, 1.0 equiv) was added by slow drops using a syringe. The resulting dark red mixture was then cooled to -60 °C and added 1,2-dibromoethane (0.25 mmol, 0.5 equiv) in 0.1 mL THF. The reaction tube was slowly heated to room temperature when the color of the mixture became lighter. A saturated aqueous solution of KOH (2.2 g KOH in 2 mL H_2O) was then added. A small amount of brown precipitate was generated, filtered, and then dried with Na_2SO_4. After filtration and concentration under reduced pressure, the target product was obtained.

1,2-di(pyridin-2-yl)ethane (L4). The residue was purified by column chromatography (Hexane/EtOAc = 1/1) on silica gel and collected as yellow solid (81.0 mg, 88% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.46 (d, J = 4.0 Hz, 2H), 7.54 – 7.39 (m, 2H), 7.10 – 6.93 (m, 4H), 3.16 (s, 4H). **^{13}C {^{1}H} NMR** (100 MHz, CDCl3) δ 161.0, 149.2, 136.3, 123.0, 121.1, 38.1.

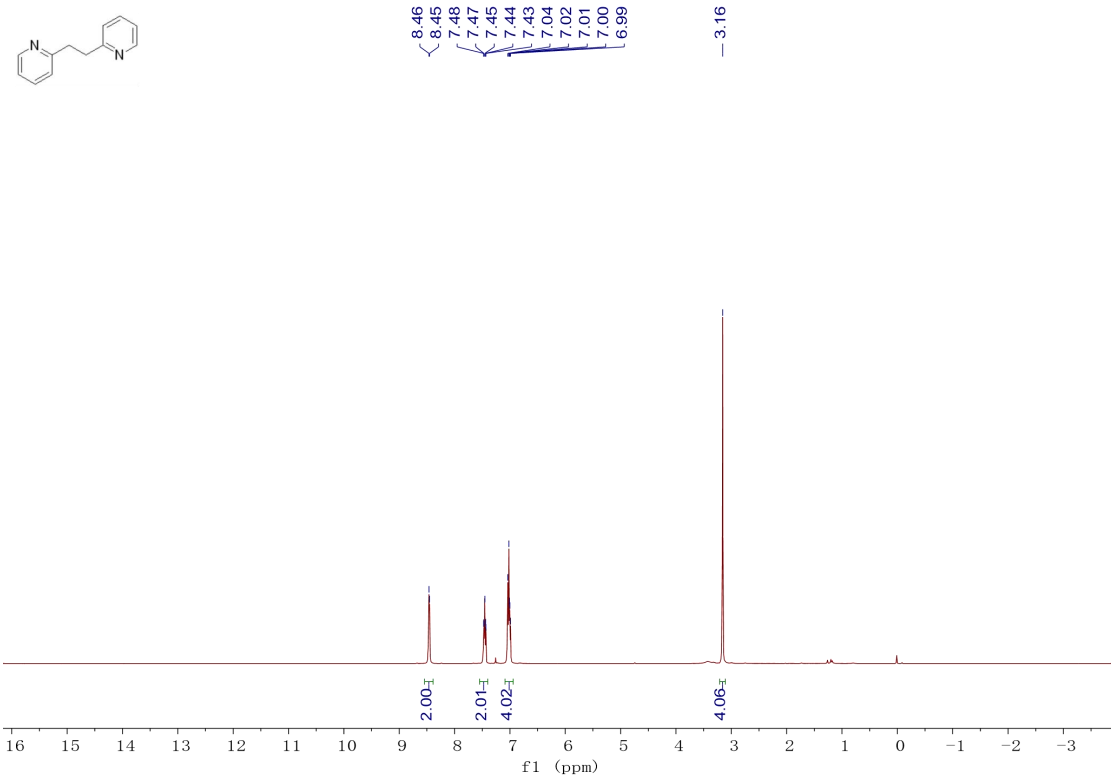


L5

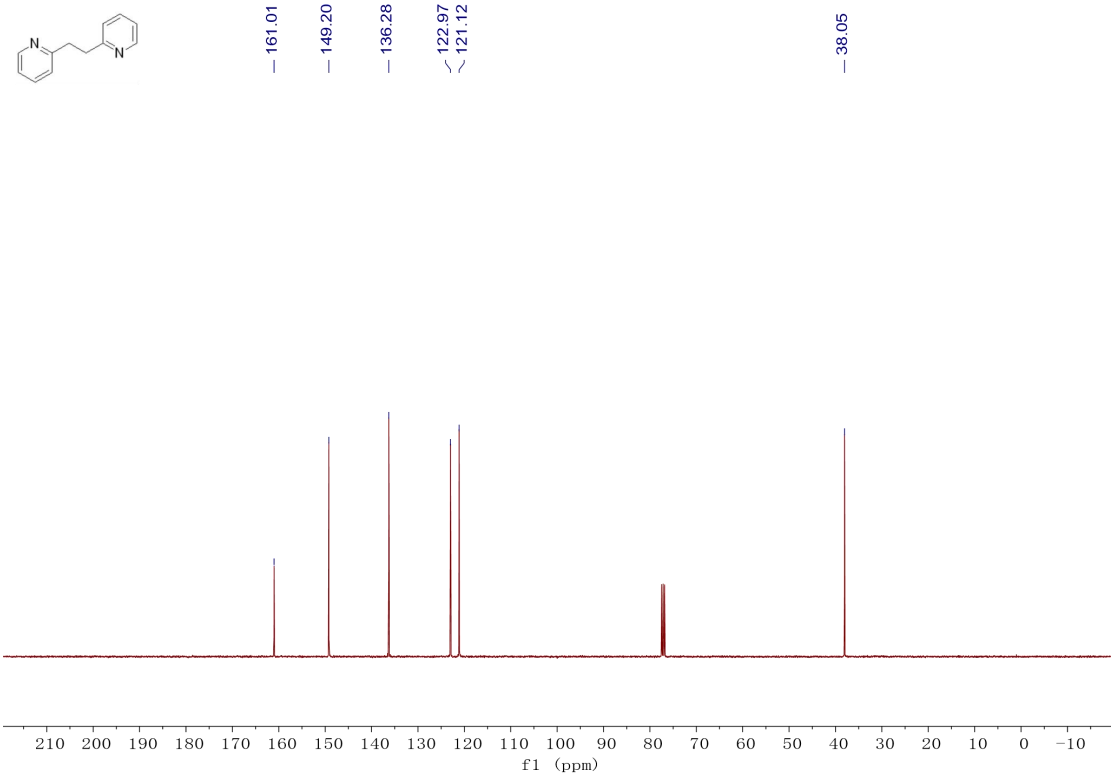
2, 2-dipyridone (1.0 mmol, 1.0 equiv), KOH (3.5 mmol, 3.5 equiv) were loaded into a 15 mL reaction tube under nitrogen, and 64% $N_2H_4 \cdot H_2O$ (37.7 mmol, 37.7 equiv) was added by syringe. While stirring, the reaction was heated to 120 °C to form a yellow solid, which subsequently dissolved during the reaction. The mixture was heated at 120 °C for 1 h and then at 150 °C for 2 h. The reaction mixture was then cooled to room temperature and diluted with CH_2Cl_2 : water =5 mL : 5 mL (v:v). The aquifer was extracted with CH_2Cl_2(3 x 5 mL). The organic layers was combined, washed with water (3x5 mL), dried with anhydrous sodium sulfate, filtered through Celite, and solvent removed under vacuum to give green oil.

di(pyridin-2-yl)methane (L5). The residue was purified by column chromatography (Hexane/EtOAc = 1/1) on silica gel and collected as yellow oil (166.6 mg, 98% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.24 (d, J = 4.6 Hz, 1H), 7.25 (td, J = 7.7, 1.5 Hz, 1H), 6.96 (d, J = 7.8 Hz, 1H), 6.83 – 6.72 (m, 1H), 4.06 (s, 1H). **^{13}C {^{1}H} NMR** (100 MHz, CDCl3) δ 159.1, 149.1, 136.3, 123.3, 121.2, 47.0.

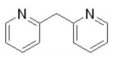
^{1}H-NMR (400 MHz, $CDCl_3$) of **L4**

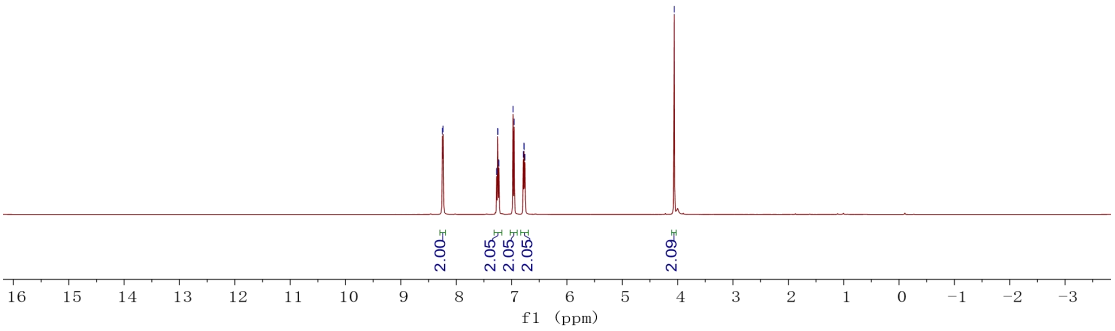


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **L4**

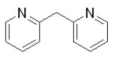


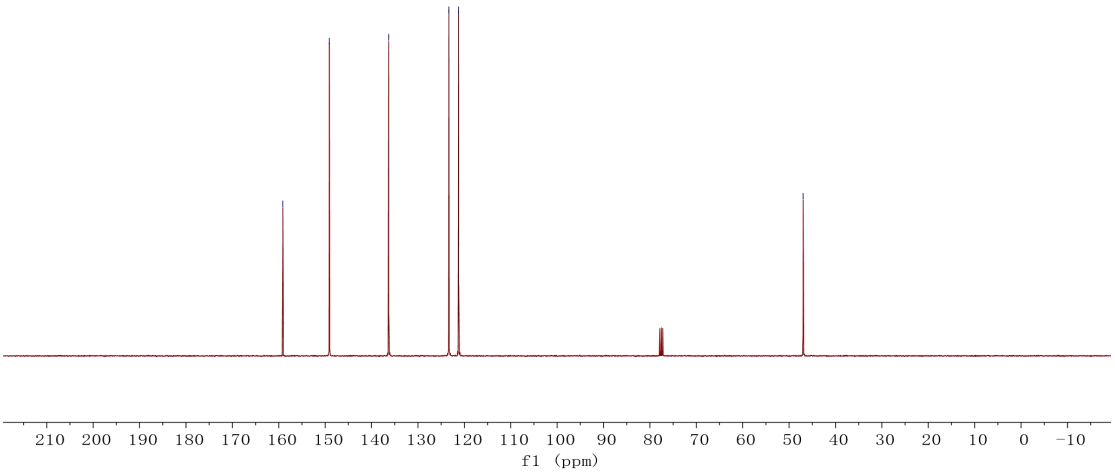
^{1}H-NMR (400 MHz, $CDCl_3$) of **L5**



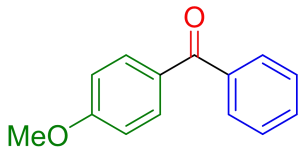


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **L5**

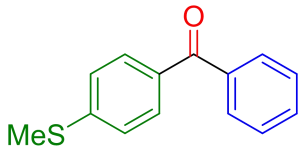




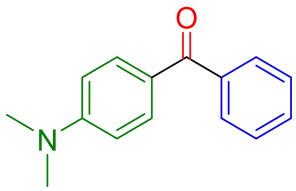
SI- § 7 Characterization Data and NMR Spectra of Products



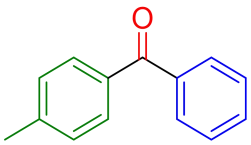
(4-methoxyphenyl)(phenyl)methanone[1] **(4a).** The residue was purified by column chromatography (Hexane/EtOAc = 40/1) on silica gel and collected as yellow oil (35.6 mg, 84% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.82 (d, J = 8.7 Hz, 2H), 7.75 (d, J = 7.1 Hz, 2H), 7.56 (t, J = 7.3 Hz, 1H), 7.46 (t, J = 7.7 Hz, 2H), 6.96 (d, J = 8.7 Hz, 2H), 3.87 (s, 3H). **^{13}C {^{1}H}** NMR (100 MHz, $CDCl_3$) δ 195.6, 163.3, 138.3, 132.6, 131.9, 130.2, 129.7, 128.2, 113.6, 55.5. HRMS m/z calculated for $C_{14}H_{12}O_2$ $[M+H]^+$: 213.0910, found: 213.0901.



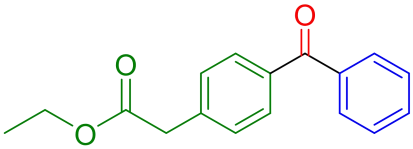
(4-(methylthio)phenyl)(phenyl)methanone[1] **(4b)**. The residue was purified by column chromatography (Hexane/EtOAc = 40/1) on silica gel and collected as yellow oil (34.7 mg, 76% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.78 – 7.72 (m, 4H), 7.62 – 7.53 (m, 1H), 7.51 – 7.42 (m, 2H), 7.28 (d, J = 8.5 Hz, 2H), 2.52 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.8, 145.3, 137.8, 133.6, 132.2, 130.7, 129.8, 128.3, 124.8, 14.8. HRMS m/z calculated for $C_{14}H_{12}OS$ $[M+H]^+$: 229.0682, found: 229.0671.



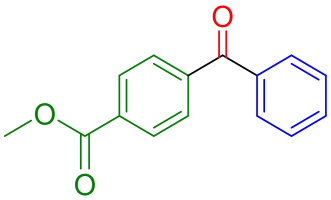
(4-(dimethylamino)phenyl)(phenyl)methanone[2] **(4c).** The residue was purified by column chromatography (Hexane/EtOAc =25/1) on silica gel and collected as yellow oil (30.2 mg, 67% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.80 (d, J = 9.0 Hz, 2H), 7.72 (d, J = 7.1 Hz, 2H), 7.52 (t, J = 7.3 Hz, 1H), 7.45 (t, J = 7.4 Hz, 2H), 6.67 (d, J = 9.0 Hz, 2H), 3.06 (s, 6H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.2, 153.3, 139.3, 132.8, 131.1, 129.5, 128.0, 124.7, 110.6, 40.1. HRMS m/z calculated for $C_{15}H_{15}NO$ $[M+H]^+$: 226.1226, found: 226.1222.



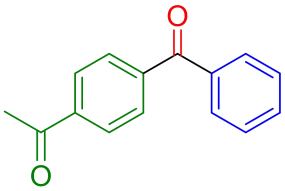
phenyl(p-tolyl)methanone[2] **(4d).** The residue was purified by column chromatography (Hexane) on silica gel and collected as pale yellow oil (28.6 mg, 73% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.81 – 7.75 (m, 1H), 7.73 (d, J = 8.2 Hz, 1H), 7.57 (tt, J = 6.8, 1.2 Hz, 1H), 7.47 (t, J = 7.5 Hz, 1H), 7.28 (d, J = 7.9 Hz, 1H), 2.44 (s, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.5, 143.3, 138.0, 134.9, 132.2, 130.3, 129.9, 129.0, 128.2, 21.7. HRMS m/z calculated for $C_{14}H_{12}O$ $[M+H]^+$: 197.0961, found: 197.0953.



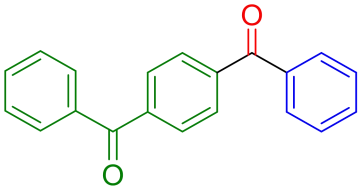
ethyl 2-(4-benzoylphenyl)acetate[3] **(4e).** The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as colorless oil (42.8 mg, 80% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.81 – 7.72 (m, 4H), 7.57 (t, J = 7.4 Hz, 1H), 7.46 (t, J = 7.7 Hz, 2H), 7.40 (d, J = 8.1 Hz, 2H), 4.17 (q, J = 7.1 Hz, 2H), 3.69 (s, 2H), 1.26 (t, J = 7.1 Hz, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.3, 170.9, 138.9, 137.6, 136.3, 132.4, 130.4, 130.0, 129.3, 128.3, 61.1, 41.3, 14.2. HRMS m/z calculated for $C_{17}H_{16}O_3$ $[M+H]^+$: 269.1172, found: 269.1167.



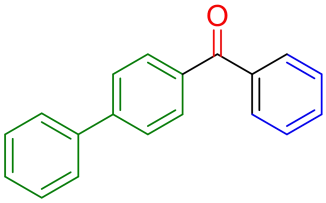
methyl 4-benzoylbenzoate[4] **(4f).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as white solid (30.2 mg, 63% yield). mp 119.7 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.17 – 8.11 (m, 2H), 7.86 – 7.77 (m, 4H), 7.65 – 7.58 (m, 1H), 7.49 (t, J = 7.6 Hz, 2H), 3.96 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.0, 166.3, 141.3, 136.9, 133.2, 133.0, 130.1, 129.8, 129.5, 128.5, 52.5. HRMS m/z calculated for $C_{15}H_{12}O_3$ $[M+H]^+$: 241.0859, found: 241.0856.



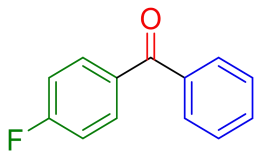
1-(4-benzoylphenyl)ethan-1-one[5] **(4g).** The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as pale yellow solid (28.7 mg, 64% yield). mp 83.3 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.04 (d, J = 8.4 Hz, 2H), 7.85 (d, J = 8.4 Hz, 2H), 7.79 (d, J = 7.1 Hz, 2H), 7.61 (t, J = 7.4 Hz, 1H), 7.49 (t, J = 7.6 Hz, 2H), 2.66 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 197.6, 196.0, 141.3, 139.5, 136.9, 133.0, 130.1, 130.0, 128.5, 128.2, 26.9. HRMS m/z calculated for $C_{15}H_{12}O_2$ $[M+H]^+$: 225.0910, found: 225.0902.



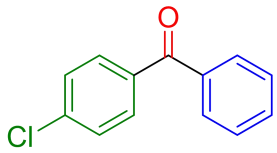
1,4-phenylenebis(phenylmethanone)[6] **(4h).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow solid (37.2 mg, 65% yield). mp 154.1 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.89 (s, 4H), 7.84 (d, J = 7.1 Hz, 4H), 7.63 (t, J = 7.4 Hz, 2H), 7.51 (t, J = 7.6 Hz, 4H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.0, 140.7, 136.9, 133.0, 130.1, 129.8, 128.5. HRMS m/z calculated for $C_{20}H_{14}O_2$ $[M+H]^+$: 287.1067, found: 287.1055.



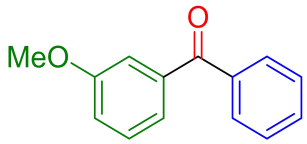
[1,1'-biphenyl]-4-yl(phenyl)methanone[7] **(4i).** The residue was purified by column chromatography (Hexane) on silica gel and collected as yellow solid (39.7 mg, 77% yield). mp 91.5 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.88 (dd, J = 22.9, 7.7 Hz, 4H), 7.69 (dd, J = 21.5, 7.7 Hz, 4H), 7.64 – 7.57 (m, 1H), 7.50 (q, J = 7.6 Hz, 4H), 7.42 (t, J = 7.2 Hz, 1H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.4, 145.3, 140.0, 137.8, 136.2, 132.4, 130.8, 130.0, 129.0, 128.3, 128.2, 127.3, 127.0. HRMS m/z calculated for $C_{19}H_{14}O$ $[M+H]^+$: 259.1117, found: 259.1114.



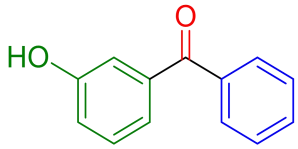
(4-fluorophenyl)(phenyl)methanone[2] **(4j).** The residue was purified by column chromatography (Hexane) on silica gel and collected as white solid (38.8 mg, 97% yield). mp 48.5 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.89 – 7.81 (m, 2H), 7.80 – 7.74 (m, 2H), 7.59 (t, J = 7.4 Hz, 1H), 7.48 (t, J = 7.5 Hz, 2H), 7.21 – 7.12 (m, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.2, 166.7, 164.1, 137.5, 133.8, 132.7, 132.6, 132.5, 129.9, 128.4, 115.6, 115.3. ^{19}F NMR (377 MHz, $CDCl_3$) δ -105.92 (s) ppm. HRMS m/z calculated for $C_{13}H_9FO$ $[M+H]^+$: 201.0710, found: 201.0701.



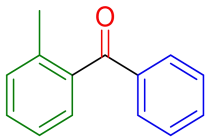
(4-chlorophenyl)(phenyl)methanone[7] **(4k).** The residue was purified by column chromatography (Hexane) on silica gel and collected as white solid (29.4 mg, 68% yield). mp 70.8 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.76 (t, J = 7.3 Hz, 4H), 7.60 (t, J = 7.1 Hz, 1H), 7.53 – 7.42 (m, 4H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.5, 138.9, 137.2, 135.9, 132.7, 131.5, 129.9, 128.6, 128.4. HRMS m/z calculated for $C_{13}H_9ClO$ $[M+H]^+$: 217.0415, found: 217.0423.



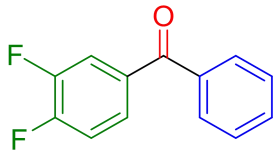
(3-methoxyphenyl)(phenyl)methanone[2] **(4l).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as yellow oil (34.3 mg, 81% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.83 – 7.78 (m, 2H), 7.58 (t, J = 7.4 Hz, 1H), 7.47 (t, J = 7.6 Hz, 2H), 7.40 – 7.31 (m, 3H), 7.16 – 7.10 (m, 1H), 3.85 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.5, 159.6, 138.9, 137.6, 132.5, 130.0, 129.2, 128.3, 122.9, 118.9, 114.3, 55.5. HRMS m/z calculated for $C_{14}H_{12}O_2$ $[M+H]^+$: 213.0910, found: 213.0905.



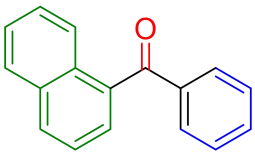
(3-hydroxyphenyl)(phenyl)methanone[8] **(4m).** The residue was purified by column chromatography (Hexane/EtOAc =8/1) on silica gel and collected as yellow oil (17.4 mg, 44% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.80 (d, J = 7.6 Hz, 2H), 7.59 (t, J = 7.4 Hz, 1H), 7.47 (t, J = 7.6 Hz, 2H), 7.40 (s, 1H), 7.36 – 7.27 (m, 2H), 7.11 (d, J = 7.3 Hz, 1H), 6.60 (s, 1H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 197.3, 156.2, 138.8, 137.4, 132.7, 130.2, 129.5, 128.3, 122.8, 120.1, 116.6. HRMS m/z calculated for $C_{13}H_{10}O_2$ $[M+H]^+$: 199.0754, found: 199.0754.



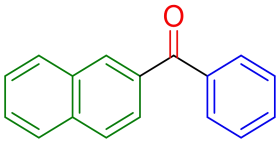
phenyl(o-tolyl)methanone[7] **(4n).** The residue was purified by column chromatography (Hexane) on silica gel and collected as yellow oil (20.4 mg, 52% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.80 (d, J = 7.3 Hz, 2H), 7.58 (t, J = 7.4 Hz, 1H), 7.45 (t, J = 7.6 Hz, 2H), 7.39 (t, J = 7.3 Hz, 1H), 7.30 (t, J = 8.5 Hz, 2H), 7.25 (t, J = 7.4 Hz, 1H), 2.33 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 198.7, 138.6, 137.7, 136.8, 133.2, 131.0, 130.3, 130.1, 128.5, 128.5, 125.2, 20.0. HRMS m/z calculated for $C_{14}H_{12}O$ $[M+H]^+$: 197.0961, found: 197.0959.



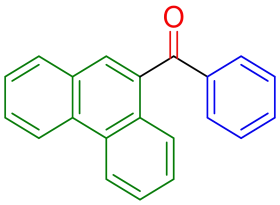
(3,4-difluorophenyl)(phenyl)methanone[9] **(4o).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow oil (27.1 mg, 62% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.85 – 7.76 (m, 2H), 7.75 – 7.67 (m, 1H), 7.67 – 7.58 (m, 2H), 7.53 (t, J = 7.7 Hz, 2H), 7.34 – 7.25 (m, 1H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 194.1, 154.6, 154.4, 152.0, 151.9, 151.5, 151.3, 149.0, 148.8, 137.6, 136.9, 134.5, 134.4, 134.4, 132.8, 132.4, 130.1, 129.8, 128.5, 128.3, 127.2, 127.1, 127.1, 127.1, 119.4, 119.4, 119.3, 119.3, 119.2, 119.2, 119.1, 119.1, 117.6, 117.5, 117.4, 117.2. ^{19}F NMR (377 MHz, $CDCl_3$) δ -130.54 (s), 136.14 (s) ppm. HRMS m/z calculated for $C_{13}H_8F_2O$ $[M+H]^+$: 219.0616, found: 219.0621.



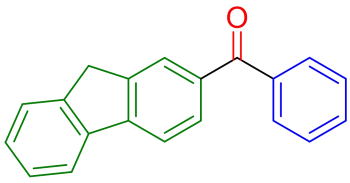
naphthalen-1-yl(phenyl)methanone[10] **(4p).** The residue was purified by column chromatography (Hexane/EtOAc =100/1) on silica gel and collected as colorless oil (35.3 mg, 76% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.15 (d, J = 8.1 Hz, 1H), 8.05 (d, J = 8.1 Hz, 1H), 7.97 (d, J = 7.8 Hz, 1H), 7.92 (d, J = 8.0 Hz, 2H), 7.63 (q, J = 7.9 Hz, 2H), 7.60 – 7.46 (m, 5H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 198.1, 138.4, 136.5, 133.8, 133.3, 131.4, 131.1, 130.5, 128.5, 127.9, 127.4, 126.7, 126.6, 125.8, 124.4. HRMS m/z calculated for $C_{17}H_{12}O$ $[M+H]^+$: 233.0961, found: 233.0959.



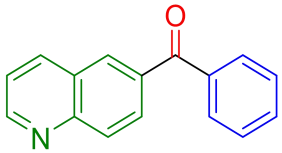
naphthalen-2-yl(phenyl)methanone[2] **(4q).** The residue was purified by column chromatography (Hexane/EtOAc =100/1) on silica gel and collected as white solid (44.1 mg, 95% yield). mp 74.8 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.27 (s, 1H), 7.97 – 7.89 (m, 4H), 7.87 (d, J = 7.3 Hz, 2H), 7.66 – 7.59 (m, 2H), 7.58 – 7.48 (m, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.8, 137.9, 135.3, 134.8, 132.4, 132.3, 131.9, 130.1, 129.4, 128.4, 128.3, 127.8, 126.8, 125.8. HRMS m/z calculated for $C_{17}H_{12}O$ $[M+H]^+$: 233.0961, found: 233.0966.



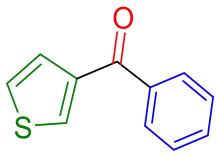
phenanthren-9-yl(phenyl)methanone[11] **(4r).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow oil (34.4 mg, 61% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.76 (dd, J = 15.0, 8.3 Hz, 2H), 8.14 (d, J = 8.1 Hz, 1H), 7.96 (d, J = 7.1 Hz, 2H), 7.92 – 7.84 (m, 2H), 7.81 – 7.68 (m, 2H), 7.67 – 7.56 (m, 3H), 7.48 (t, J = 7.7 Hz, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 198.0, 138.2, 135.4, 133.4, 131.3, 130.7, 130.5, 130.1, 129.6, 129.4, 129.2, 128.6, 128.4, 127.3, 127.2, 127.2, 126.7, 123.0, 122.8. HRMS m/z calculated for $C_{21}H_{14}O$ $[M+H]^+$: 283.1117, found: 283.1127.



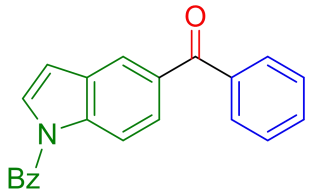
(9H-fluoren-2-yl)(phenyl)methanone[12] **(4s).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow solid (43.8 mg, 81% yield). mp 117.9 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.03 (s, 1H), 7.89 – 7.81 (m, 5H), 7.61 (t, J = 7.4 Hz, 2H), 7.51 (t, J = 7.5 Hz, 2H), 7.46 – 7.36 (m, 2H), 3.97 (s, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.8, 146.0, 144.4, 143.1, 140.6, 138.2, 135.9, 132.2, 130.0, 129.7, 128.3, 128.0, 127.1, 126.9, 125.3, 120.9, 119.4, 36.9. HRMS m/z calculated for $C_{20}H_{14}O$ $[M+H]^+$: 271.1117, found: 271.1123.



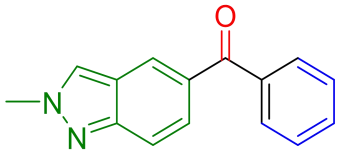
phenyl(quinolin-6-yl)methanone[13] **(4t).** The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as yellow solid (36.4 mg, 78% yield). mp 56.9 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.03 (dd, J = 4.1, 1.3 Hz, 1H), 8.29 – 8.12 (m, 4H), 7.90 – 7.81 (m, 2H), 7.64 (t, J = 7.4 Hz, 1H), 7.57 – 7.46 (m, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.1, 152.5, 149.8, 137.4, 135.5, 132.8, 131.4, 130.1, 129.9, 129.5, 128.5, 127.3, 122.1. HRMS m/z calculated for $C_{16}H_{11}NO$ $[M+H]^+$: 234.0913, found: 234.0916.



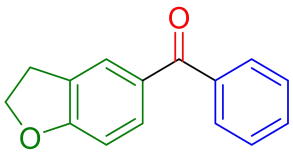
phenyl(thiophen-3-yl)methanone[12] **(4u).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as yellow oil (24.8 mg, 66% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.93 (d, J = 2.5 Hz, 1H), 7.84 (d, J = 7.8 Hz, 2H), 7.63 – 7.54 (m, 2H), 7.48 (t, J = 7.6 Hz, 2H), 7.38 (dd, J = 4.8, 3.0 Hz, 1H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 190.0, 141.3, 138.6, 134.0, 132.3, 129.4, 128.6, 128.4, 126.2. HRMS m/z calculated for $C_{11}H_8OS$ $[M+H]^+$: 189.0369, found: 189.0365.



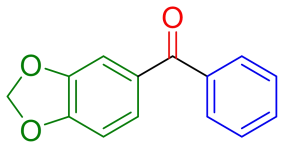
(1H-indole-1,5-diyl)bis(phenylmethanone) (4v). The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as yellow solid (38.4 mg, 59% yield). mp 129.4 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.46 (d, J = 8.6 Hz, 1H), 8.10 (s, 1H), 7.88 (d, J = 8.7 Hz, 1H), 7.80 (dd, J = 27.3, 7.5 Hz, 4H), 7.70 – 7.46 (m, 6H), 7.41 (d, J = 3.7 Hz, 1H), 6.70 (d, J = 3.7 Hz, 1H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.7, 168.7, 138.4, 138.2, 134.0, 133.4, 132.4, 132.2, 130.4, 130.1, 129.3, 129.0, 128.8, 128.3, 127.0, 123.9, 116.0, 108.9. HRMS m/z calculated for $C_{22}H_{15}NO_2$ $[M+H]^+$: 326.1176, found: 326.1179.



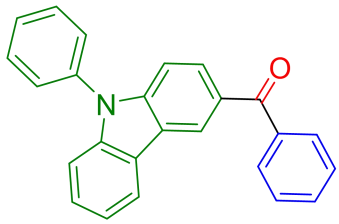
(2-methyl-2H-indazol-5-yl)(phenyl)methanone (4w). The residue was purified by column chromatography (Hexane/EtOAc =3/1) on silica gel and collected as yellow solid (30.2 mg, 64% yield). mp 98.6 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.13 (s, 1H), 8.03 (s, 1H), 7.87 – 7.71 (m, 4H), 7.61 – 7.53 (m, 1H), 7.48 (t, J = 7.5 Hz, 2H), 4.24 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.6, 150.1, 138.4, 132.0, 131.4, 129.8, 128.2, 126.5, 126.4, 126.1, 121.1, 117.4, 40.7. HRMS m/z calculated for $C_{15}H_{12}N_2O$ $[M+H]^+$: 237.1022, found: 237.1034.



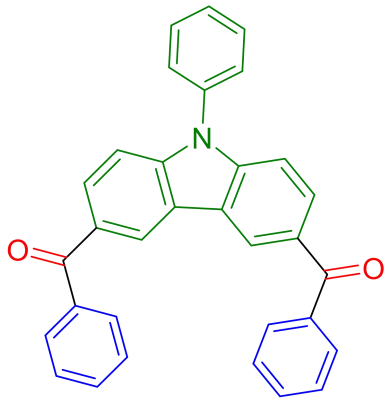
(2,3-dihydrobenzofuran-5-yl)(phenyl)methanone[13] **(4x).** The residue was purified by column chromatography (Hexane/EtOAc =8/1) on silica gel and collected as colorless oil (34.1 mg, 76% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.79 – 7.70 (m, 3H), 7.68 – 7.60 (m, 1H), 7.55 (t, J = 7.4 Hz, 1H), 7.46 (t, J = 7.5 Hz, 2H), 6.81 (d, J = 8.4 Hz, 1H), 4.66 (t, J = 8.8 Hz, 2H), 3.25 (t, J = 8.7 Hz, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.6, 164.2, 138.6, 132.5, 131.8, 130.4, 129.7, 128.2, 127.6, 127.5, 108.8, 72.2, 29.1. HRMS m/z calculated for $C_{15}H_{12}O_2$ $[M+H]^+$: 225.0910, found: 225.0912.



benzo[d][1,3]dioxol-5-yl(phenyl)methanone[2] **(4y).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow oil (42.9 mg, 95% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.73 (d, J = 7.9 Hz, 2H), 7.55 (t, J = 7.0 Hz, 1H), 7.45 (t, J = 7.6 Hz, 2H), 7.36 (d, J = 7.5 Hz, 2H), 6.84 (d, J = 8.0 Hz, 1H), 6.04 (s, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.1, 151.5, 147.9, 138.1, 132.0, 131.9, 129.7, 128.2, 126.9, 109.9, 107.7, 101.9. HRMS m/z calculated for $C_{14}H_{10}O_3$ $[M+H]^+$: 227.0703, found: 227.0702.

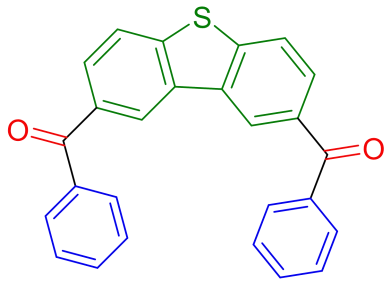


phenyl(9-phenyl-9H-carbazol-3-yl)methanone (4z). The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as white solid (62.5 mg, 90% yield). mp 161.3 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.68 (s, 1H), 8.17 (d, J = 7.7 Hz, 1H), 7.97 (dd, J = 8.6, 1.6 Hz, 1H), 7.87 (d, J = 7.1 Hz, 2H), 7.69 – 7.56 (m, 5H), 7.53 (t, J = 7.5 Hz, 3H), 7.49 – 7.39 (m, 3H), 7.38 – 7.30 (m, 1H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.6, 143.4, 141.8, 138.9, 137.0, 131.8, 130.1, 130.0, 129.6, 128.7, 128.2, 128.1, 127.2, 126.8, 123.9, 123.4, 123.0, 120.9, 120.7, 110.3, 109.4. HRMS m/z calculated for $C_{25}H_{17}NO$ $[M+H]^+$: 348.1383, found: 348.1397.

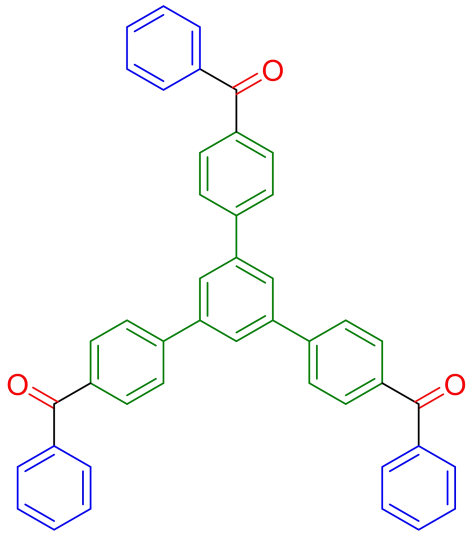


(9-phenyl-9H-carbazole-3,6-diyl)bis(phenylmethanone) (4aa). The residue was purified by column chromatography (Hexane/EtOAc =25/1) on silica gel and collected as yellow solid (48.8

mg, 54% yield). mp 191.0 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.64 (s, 1H), 8.01 (dd, J = 8.6, 1.6 Hz, 2H), 7.85 (d, J = 7.1 Hz, 4H), 7.72 – 7.65 (m, 2H), 7.65 – 7.57 (m, 5H), 7.52 (t, J = 7.5 Hz, 4H), 7.46 (d, J = 8.6 Hz, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.4, 144.2, 138.5, 136.3, 132.1, 130.5, 130.3, 130.0, 129.3, 128.7, 128.3, 127.1, 124.0, 123.0, 110.0. HRMS m/z calculated for $C_{32}H_{21}O_2N$ $[M+H]^+$: 452.1645, found: 452.1657.

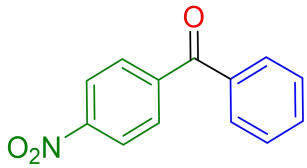


dibenzo[b,d]thiophene-2,8-diylbis(phenylmethanone) (4ab). The residue was purified by column chromatography (Hexane/EtOAc =25/1) on silica gel and collected as pale yellow solid (40 mg, 51% yield). mp 187.4 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.62 (s, 2H), 7.97 (q, J = 8.4 Hz, 4H), 7.85 (d, J = 7.4 Hz, 4H), 7.63 (t, J = 7.4 Hz, 2H), 7.52 (t, J = 7.6 Hz, 4H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.3, 144.2, 137.7, 135.1, 134.6, 132.6, 130.1, 128.8, 128.5, 123.9, 122.8. HRMS m/z calculated for $C_{26}H_{16}OS$ $[M+H]^+$: 393.0944, found: 393.0953.

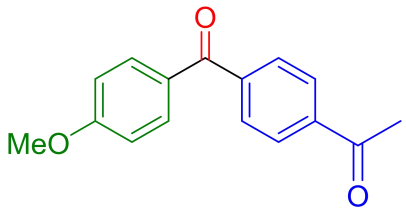


1,3,5-Tris(4-benzoylphenyl)benzene[23] **(4ac).** The residue was purified by column chromatography (Hexane/EtOAc =6/1) on silica gel and collected as yellow solid (51.9 mg, 42% yield). mp 186.1 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.99 – 7.92 (m, 9H), 7.85 (t, J = 8.8 Hz, 12H), 7.63 (t, J = 7.4 Hz, 3H), 7.52 (t, J = 7.6 Hz, 6H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.2, 144.5, 141.7, 137.6, 136.9, 132.6, 130.9, 130.1, 128.4, 127.2, 126.2. HRMS m/z calculated for

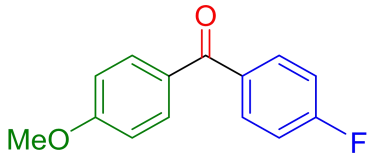
$C_{45}H_{30}O_3$ $[M+H]^+$: 619.2268, found: 619.2247.



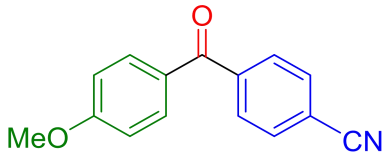
(4-nitrophenyl)(phenyl)methanone[5] **(4ad).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as yellow solid (15.0 mg, 33% yield). mp 136 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.32 (d, J = 7.5 Hz, 2H), 7.92 (d, J = 7.5 Hz, 2H), 7.79 (d, J = 6.5 Hz, 2H), 7.69 – 7.60 (m, 1H), 7.58 – 7.46 (m, 2H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 194.8, 149.8, 142.9, 136.3, 133.5, 130.7, 130.1, 128.7, 123.6.



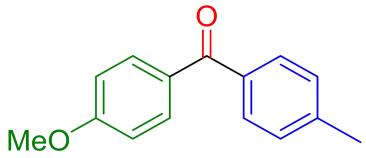
1-(4-(4-methoxybenzoyl)phenyl)ethan-1-one[14] **(4ae).** The residue was purified by column chromatography (Hexane/EtOAc =25/1) on silica gel and collected as pale yellow solid (41.2 mg, 81% yield). mp 105.2 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.02 (d, J = 8.2 Hz, 2H), 7.79 (dd, J = 8.3, 3.2 Hz, 4H), 6.95 (d, J = 8.7 Hz, 2H), 3.87 (s, 3H), 2.64 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 197.6, 194.7, 163.6, 142.1, 139.1, 132.6, 129.7, 129.5, 128.1, 113.8, 55.6, 26.9. HRMS m/z calculated for $C_{16}H_{14}O_3$ $[M+H]^+$: 255.1016, found: 255.1012.



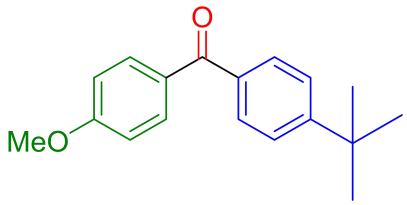
(4-fluorophenyl)(4-methoxyphenyl)methanone[2] **(4af).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow solid (39.6 mg, 86% yield). mp 91.8 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.78 (dt, J = 8.7, 2.4 Hz, 4H), 7.13 (t, J = 8.6 Hz, 2H), 6.95 (d, J = 8.7 Hz, 2H), 3.87 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 194.1, 166.3, 163.8, 163.3, 134.4, 134.4, 132.4, 132.3, 132.2, 130.0, 115.4, 115.2, 113.6, 55.5. ^{19}F NMR (377 MHz, $CDCl_3$) δ -106.90 (s) ppm. HRMS m/z calculated for $C_{14}H_{11}FO_2$ $[M+H]^+$: 231.0816, found: 231.0810.



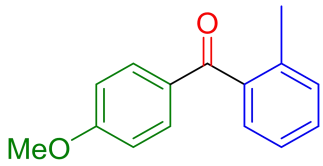
4-(4-methoxybenzoyl)benzonitrile[1] **(4ag).** The residue was purified by column chromatography (Hexane/EtOAc =25/1) on silica gel and collected as pale yellow solid (28 mg, 59% yield). mp 123.5 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.79 (q, J = 8.2 Hz, 6H), 6.97 (d, J = 8.8 Hz, 2H), 3.89 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 193.7, 163.9, 142.1, 132.6, 132.1, 129.9, 128.9, 118.1, 115.1, 113.9, 55.6. HRMS m/z calculated for $C_{15}H_{11}NO_2$ $[M+H]^+$: 238.0863, found: 238.0865.



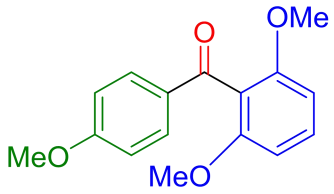
(4-methoxyphenyl)(p-tolyl)methanone[1] **(4ah).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow solid (36.2 mg, 80% yield). mp 88.6 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.85 – 7.75 (m, 2H), 7.66 (d, J = 8.1 Hz, 2H), 7.25 (d, J = 7.9 Hz, 2H), 7.00 – 6.90 (m, 2H), 3.87 (s, 3H), 2.42 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.4, 163.0, 142.6, 135.5, 132.4, 130.5, 130.0, 128.9, 113.5, 55.5, 21.6. HRMS m/z calculated for $C_{15}H_{14}O_2$ $[M+H]^+$: 227.1067, found: 227.1070.



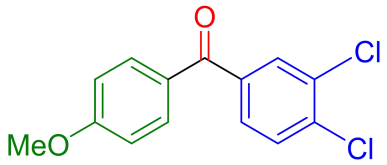
(4-(tert-butyl)phenyl)(4-methoxyphenyl)methanone[2] **(4ai).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as yellow oil (32.2 mg, 60% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.87 – 7.81 (m, 2H), 7.72 (d, J = 8.4 Hz, 2H), 7.49 (d, J = 8.4 Hz, 2H), 6.99 – 6.92 (m, 2H), 3.88 (s, 3H), 1.36 (s, 9H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.3, 163.1, 155.6, 135.5, 132.5, 130.4, 129.8, 125.2, 113.5, 55.5, 35.1, 31.2. HRMS m/z calculated for $C_{18}H_{20}O_2$ $[M+H]^+$: 269.1536, found: 269.1543.



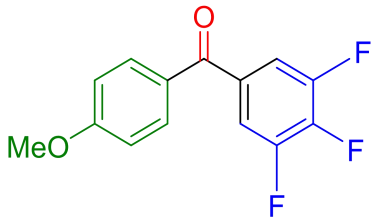
(4-methoxyphenyl)(o-tolyl)methanone[1] **(4aj).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow oil (33.0 mg, 73% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.77 (d, J = 8.8 Hz, 2H), 7.34 (t, J = 7.3 Hz, 1H), 7.29 – 7.18 (m, 3H), 6.91 (d, J = 8.8 Hz, 2H), 3.84 (s, 3H), 2.28 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 197.4, 163.7, 139.2, 136.2, 132.5, 130.8, 130.5, 129.8, 127.9, 125.2, 113.7, 55.5, 19.8. HRMS m/z calculated for $C_{15}H_{14}O_2$ $[M+H]^+$: 227.1067, found: 227.1066.



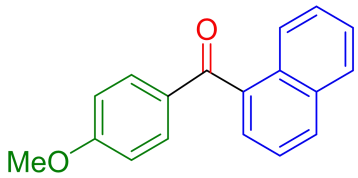
(2,6-dimethoxyphenyl)(4-methoxyphenyl)methanone[15] **(4ak).** The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as yellow oil (42.5 mg, 78% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.81 (dd, J = 8.7, 1.7 Hz, 2H), 7.32 (td, J = 8.4, 1.7 Hz, 1H), 6.95 – 6.85 (m, 2H), 6.60 (dd, J = 8.4, 1.6 Hz, 2H), 3.83 (s, 3H), 3.69 (s, 6H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 193.9, 163.7, 157.5, 131.8, 130.9, 130.6, 118.1, 113.7, 104.0, 55.9, 55.5. HRMS m/z calculated for $C_{16}H_{16}O_4$ $[M+H]^+$: 273.1121, found: 273.1128.



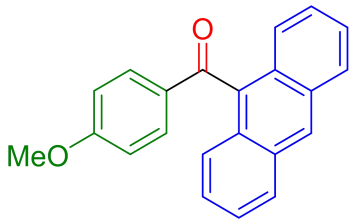
(3,4-dichlorophenyl)(4-methoxyphenyl)methanone[16] **(4al).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as white solid (52.6 mg, 92% yield). mp 88.4 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.89 – 7.73 (m, 3H), 7.57 (q, J = 8.6 Hz, 2H), 6.98 (d, J = 8.6 Hz, 2H), 3.89 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 192.9, 163.7, 137.9, 136.4, 132.8, 132.5, 131.6, 130.4, 129.2, 128.8, 113.8, 55.6. HRMS m/z calculated for $C_{14}H_{10}Cl_2O_2$ $[M+H]^+$: 281.0131, found: 281.0137.



(4-methoxyphenyl)(3,4,5-trifluorophenyl)methanone (4am). The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as white solid (52.6 mg, 92% yield). mp 99.8 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.82 – 7.73 (m, 2H), 7.46 – 7.36 (m, 2H), 7.03 – 6.92 (m, 2H), 3.90 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 191.6, 163.8, 152.2, 152.2, 152.1, 152.1, 149.7, 149.7, 149.6, 149.5, 143.8, 143.6, 143.5, 141.2, 141.1, 140.9, 133.8, 133.7, 132.4, 128.7, 114.4, 114.3, 114.2, 114.1, 113.9, 55.6. ^{19}F NMR (377 MHz, $CDCl_3$) δ -132.55 (s), -154.18 (s) ppm. HRMS m/z calculated for $C_{14}H_9F_3O_2$ $[M+H]^+$: 267.0627, found: 267.0629.

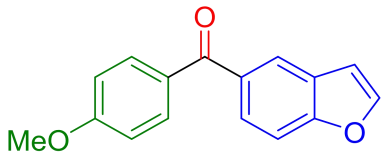


(4-methoxyphenyl)(naphthalen-1-yl)methanone[1] **(4an).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as pale yellow oil (28.8 mg, 55% yield). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.00 (t, J = 9.2 Hz, 2H), 7.91 (d, J = 7.9 Hz, 1H), 7.86 (d, J = 8.8 Hz, 2H), 7.60 – 7.43 (m, 4H), 6.93 (d, J = 8.8 Hz, 2H), 3.87 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.8, 163.9, 137.1, 133.7, 132.8, 131.1, 130.9, 130.7, 128.4, 127.1, 126.9, 126.4, 125.8, 124.5, 113.8, 55.6. HRMS m/z calculated for $C_{18}H_{14}O_2$ $[M+H]^+$: 263.1067, found: 263.1070.

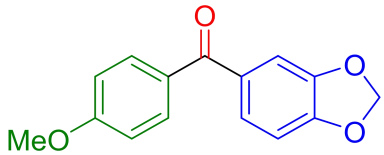


anthracen-9-yl(4-methoxyphenyl)methanone[17] **(4ao).** The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as yellow solid (29.4 mg, 47% yield). mp 186.6 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.55 (s, 1H), 8.06 (d, J = 8.5 Hz, 2H), 7.87 –

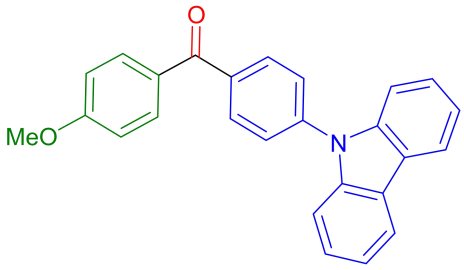
7.70 (m, 4H), 7.50 – 7.35 (m, 4H), 6.87 (d, J = 8.9 Hz, 2H), 3.82 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 198.6, 164.3, 134.5, 132.6, 131.5, 131.1, 128.6, 128.6, 128.1, 126.4, 125.5, 125.4, 114.1, 55.5. HRMS m/z calculated for $C_{22}H_{16}O_2$ $[M+H]^+$: 313.1223, found: 313.1218.



benzofuran-5-yl(4-methoxyphenyl)methanone (4ap). The residue was purified by column chromatography (Hexane/EtOAc =6/1) on silica gel and collected as pale yellow solid (36.8 mg, 73% yield). mp 126.7 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.04 (d, J = 1.5 Hz, 1H), 7.87 – 7.81 (m, 2H), 7.78 (dd, J = 8.6, 1.7 Hz, 1H), 7.71 (d, J = 2.2 Hz, 1H), 7.57 (d, J = 8.6 Hz, 1H), 7.02 – 6.94 (m, 2H), 6.85 (d, J = 1.5 Hz, 1H), 3.89 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.4, 163.0, 156.9, 146.3, 133.4, 132.5, 130.7, 127.2, 126.6, 124.0, 113.5, 111.2, 107.2, 55.5. HRMS m/z calculated for $C_{16}H_{12}O_3$ $[M+H]^+$: 253.0859, found: 253.0863.

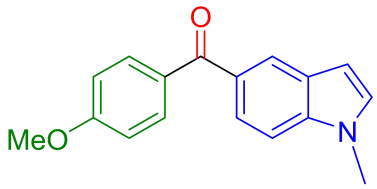


benzo[d][1,3]dioxol-5-yl(4-methoxyphenyl)methanone[18] **(4aq).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as white solid (42.5 mg, 83% yield). mp 96.2 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.77 (d, J = 8.8 Hz, 2H), 7.36 – 7.27 (m, 2H), 6.94 (d, J = 8.8 Hz, 2H), 6.85 (d, J = 8.0 Hz, 1H), 6.04 (s, 2H), 3.87 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 194.0, 162.9, 151.1, 147.8, 132.4, 132.2, 130.5, 126.2, 113.5, 109.9, 107.6, 101.8, 55.5. HRMS m/z calculated for $C_{15}H_{12}O_4$ $[M+H]^+$: 257.0808, found: 257.0814.

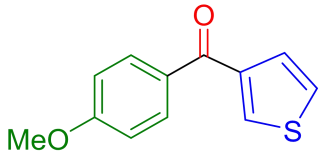


(4-(9H-carbazol-9-yl)phenyl)(4-methoxyphenyl)methanone (4ar). The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as yellow solid (59.6 mg, 79% yield). mp 167.4 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.17 (d, J = 7.7 Hz, 2H), 8.03 (d, J = 8.4 Hz, 2H), 7.94 (d, J = 8.8 Hz, 2H), 7.72 (d, J = 8.4 Hz, 2H), 7.53 (d, J = 8.2 Hz, 2H), 7.50 –

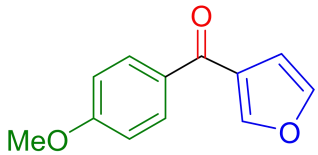
7.41 (m, 2H), 7.37 – 7.30 (m, 2H), 7.04 (d, J = 8.8 Hz, 2H), 3.92 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 194.5, 163.4, 141.2, 140.3, 136.8, 132.6, 131.6, 130.0, 126.3, 126.2, 123.8, 120.5, 120.5, 113.8, 109.8, 55.6. HRMS m/z calculated for $C_{26}H_{19}NO_2$ $[M+H]^+$: 378.1489, found: 378.1507.



(4-methoxyphenyl)(1-methyl-1H-indol-5-yl)methanone (4as). The residue was purified by column chromatography (Hexane/EtOAc =6/1) on silica gel and collected as pale yellow solid (39.2 mg, 74% yield). mp 96.4 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.09 (d, J = 1.2 Hz, 1H), 7.87 – 7.81 (m, 2H), 7.77 (dd, J = 8.6, 1.6 Hz, 1H), 7.38 (d, J = 8.6 Hz, 1H), 7.13 (d, J = 3.1 Hz, 1H), 7.01 – 6.94 (m, 2H), 6.58 (d, J = 3.1 Hz, 1H), 3.89 (s, 3H), 3.84 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.2, 162.6, 138.8, 132.4, 131.5, 130.3, 129.7, 127.6, 124.9, 123.7, 113.3, 109.0, 102.8, 55.5, 33.1. HRMS m/z calculated for $C_{17}H_{15}NO_2$ $[M+H]^+$: 266.1176, found: 266.1176.

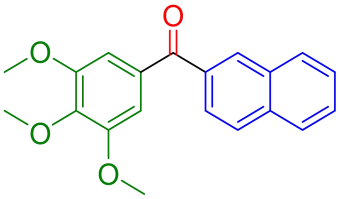


(4-methoxyphenyl)(thiophen-3-yl)methanone[19] **(4at).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as yellow solid (25.7 mg, 59% yield). mp 66.0 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.87 (d, J = 8.8 Hz, 3H), 7.55 (d, J = 5.0 Hz, 1H), 7.37 (dd, J = 5.0, 2.9 Hz, 1H), 6.97 (d, J = 8.8 Hz, 2H), 3.88 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 188.9, 163.2, 141.5, 132.8, 131.9, 131.2, 128.7, 126.0, 113.7, 55.5. HRMS m/z calculated for $C_{12}H_{10}O_2S$ $[M+H]^+$: 219.0474, found: 219.0465.

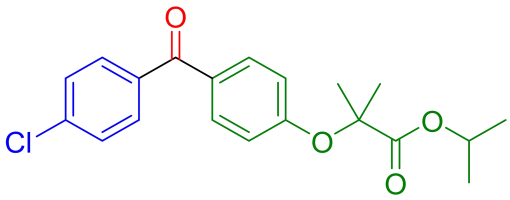


furan-3-yl(4-methoxyphenyl)methanone[20] **(4au).** The residue was purified by column chromatography (Hexane/EtOAc =40/1) on silica gel and collected as white solid (26.7 mg, 66% yield). mp 73.6 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.97 – 7.83 (m, 3H), 7.49 (s, 1H), 6.96 (d, J = 8.6 Hz, 2H), 6.87 (s, 1H), 3.87 (s, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 188.0, 163.3, 147.7,

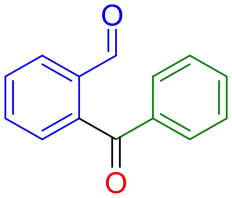
143.7, 131.4, 131.2, 126.5, 113.8, 110.4, 55.5. HRMS m/z calculated for $C_{12}H_{10}O_3$ $[M+H]^+$: 203.0703, found: 203.0699.



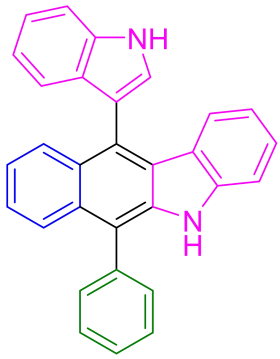
Naphthylphenstatin[21] **(7).** The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as yellow solid (54.1 mg, 84% yield). mp 106.1 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.29 (s, 1H), 7.94 (q, J = 8.2 Hz, 4H), 7.66 – 7.52 (m, 2H), 7.13 (s, 2H), 3.96 (s, 3H), 3.87 (s, 6H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 195.8, 152.9, 142.0, 135.2, 135.0, 132.9, 132.3, 131.5, 129.3, 128.3, 128.3, 127.8, 126.9, 125.8, 107.8, 61.0, 56.3. HRMS m/z calculated for $C_{20}H_{18}O_4$ $[M+H]^+$: 323.1278, found: 323.1275.



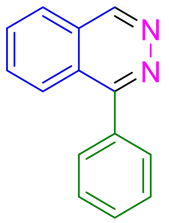
Fenofibrate[22] **(10).** The residue was purified by column chromatography (Hexane/EtOAc =25/1) on silica gel and collected as yellow solid (30.3 mg, 42% yield). mp 79.3 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.79 – 7.63 (m, 4H), 7.50 – 7.38 (m, 2H), 6.90 – 6.80 (m, 2H), 5.16 – 4.99 (m, 1H), 1.66 (s, 6H), 1.20 (d, J = 6.3 Hz, 6H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 194.3, 173.1, 159.7, 138.4, 136.4, 132.0, 131.2, 130.2, 128.5, 117.2, 79.4, 69.4, 25.4, 21.5. HRMS m/z calculated for $C_{20}H_{21}ClO_4$ $[M+H]^+$: 361.1201, found: 361.124.



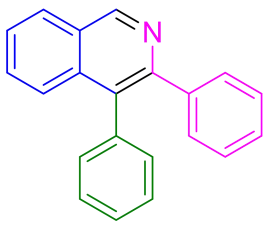
2-benzoylbenzaldehyde[29] **(4av).** The residue was purified by column chromatography (Hexane/EtOAc = 15/1) on silica gel and collected as yellow solid (28.1 mg, 67% yield). mp 66 °C. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.98 (s, 1H), 8.02 – 7.93 (m, 1H), 7.76 (d, J = 7.3 Hz, 2H), 7.69 – 7.61 (m, 2H), 7.55 (t, J = 7.4 Hz, 1H), 7.49 – 7.37 (m, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.5, 190.7, 141.3, 137.1, 135.4, 133.7, 133.4, 130.7, 130.2, 130.0, 128.9, 128.7.



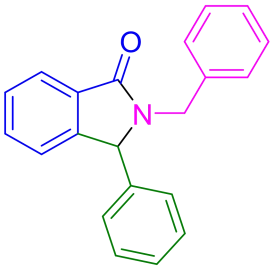
11-(1H-indol-3-yl)-6-phenyl-5H-benzo[b]carbazole[24] **(4av-1).** The residue was purified by column chromatography (Hexane/EtOAc =8/1) on silica gel and collected as yellow solid (75 mg,92% yield). mp 136 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.35 (s, 1H), 8.13 (d, J = 8.6 Hz, 1H), 8.04 (d, J = 8.6 Hz, 1H), 7.95 (s, 1H), 7.86 – 7.71 (m, 4H), 7.68 – 7.62 (m, 1H), 7.59 (d, J = 8.4 Hz, 1H), 7.55 – 7.48 (m, 1H), 7.43 – 7.32 (m, 5H), 7.27 (d, J = 6.8 Hz, 1H), 7.21 – 7.12 (m, 2H), 6.89 (t, J = 7.5 Hz, 1H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 142.3, 137.7, 137.3, 136.4, 131.2, 131.0, 129.6, 129.5, 128.2, 128.1, 127.3, 127.1, 126.3, 125.3, 124.9, 124.7, 124.2, 123.9, 123.6, 122.7, 120.7, 120.4, 119.3, 117.9, 113.9, 111.6, 110.0. HRMS m/z calculated for $C_{30}H_{20}N$ $[M+H]^+$: 409.1699, found: 409.1675.



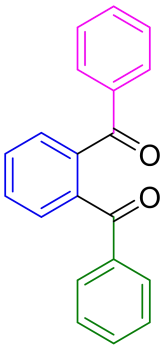
1-phenylphthalazine[25] **(4av-2).** The residue was purified by column chromatography (Hexane/EtOAc =1/1) on silica gel and collected as white solid (41.2 mg, 100% yield). mp 123 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.51 (d, J = 4.7 Hz, 1H), 8.03 (dt, J = 20.7, 6.0 Hz, 2H), 7.95 – 7.79 (m, 2H), 7.74 (s, 2H), 7.55 (t, J = 5.3 Hz, 3H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 159.9, 150.5, 136.1, 132.6, 132.3, 130.0, 129.4, 128.6, 127.1, 126.7, 126.2, 125.4. HRMS m/z calculated for $C_{14}H_{10}N_2$ $[M+H]^+$: 207.0917, found: 207.0918.



3,4-diphenylisoquinoline[26] **(4av-3).** The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as white solid (45.0 mg, 100% yield). mp 156.6 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.27 (s, 1H), 8.00 – 7.90 (m, 1H), 7.62 – 7.45 (m, 3H), 7.36 – 7.19 (m, 5H), 7.20 – 7.03 (m, 5H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 151.8, 150.6, 140.7, 137.2, 136.0, 131.2, 130.7, 130.6, 130.3, 128.3, 127.7, 127.6, 127.4, 127.4, 127.1, 126.9, 125.6. HRMS m/z calculated for $C_{21}H_{15}N$ $[M+H]^+$: 282.1277, found: 282.1287.



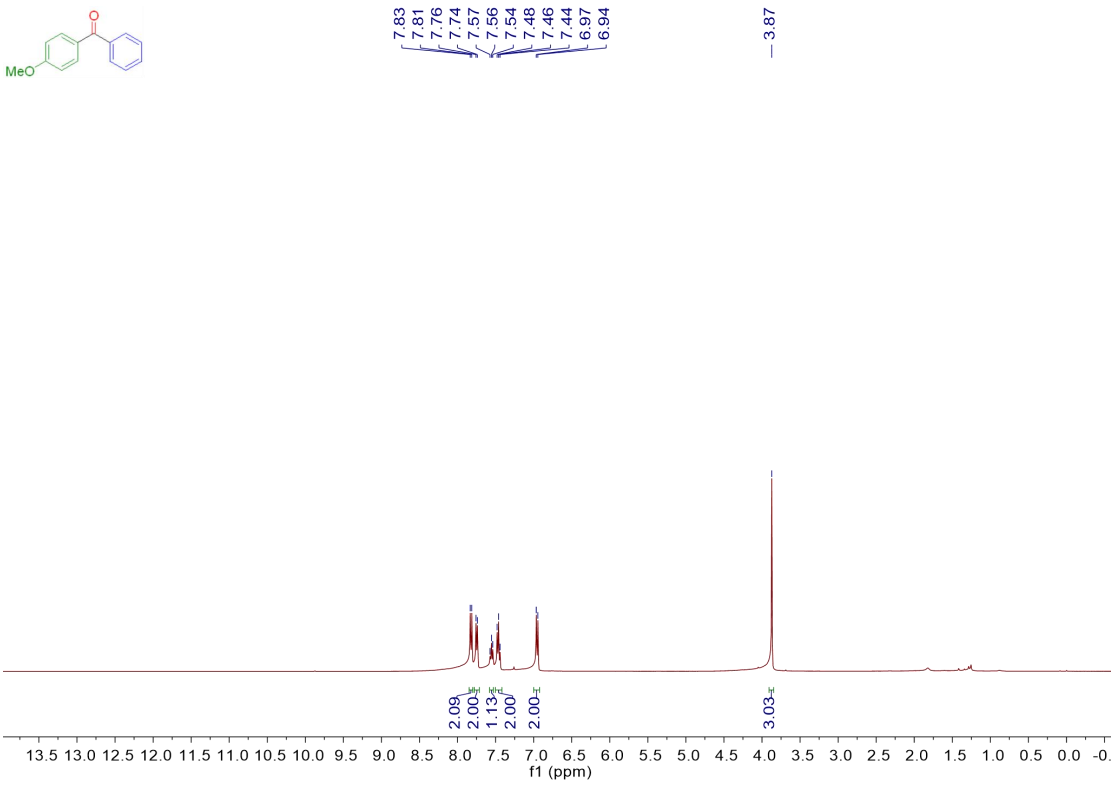
2-benzyl-3-phenylisoindolin-1-one[27] **(4av-4).** The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as white solid (55.0 mg, 92% yield). mp 135 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.85 (d, J = 7.2 Hz, 1H), 7.40 – 7.32 (m, 2H), 7.30 – 7.23 (m, 3H), 7.18 (q, J = 9.0, 7.5 Hz, 3H), 7.09 (d, J = 7.2 Hz, 2H), 7.05 – 6.93 (m, 3H), 5.31 (d, J = 14.8 Hz, 1H), 5.14 (s, 1H), 3.63 (d, J = 14.9 Hz, 1H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 168.5, 146.4, 137.1, 136.8, 131.9, 131.4, 129.2, 128.7, 128.5, 128.3, 127.8, 127.6, 123.8, 123.2, 63.6, 43.9. HRMS m/z calculated for $C_{21}H_{17}NO$ $[M+H]^+$: 300.1383, found: 300.1389.



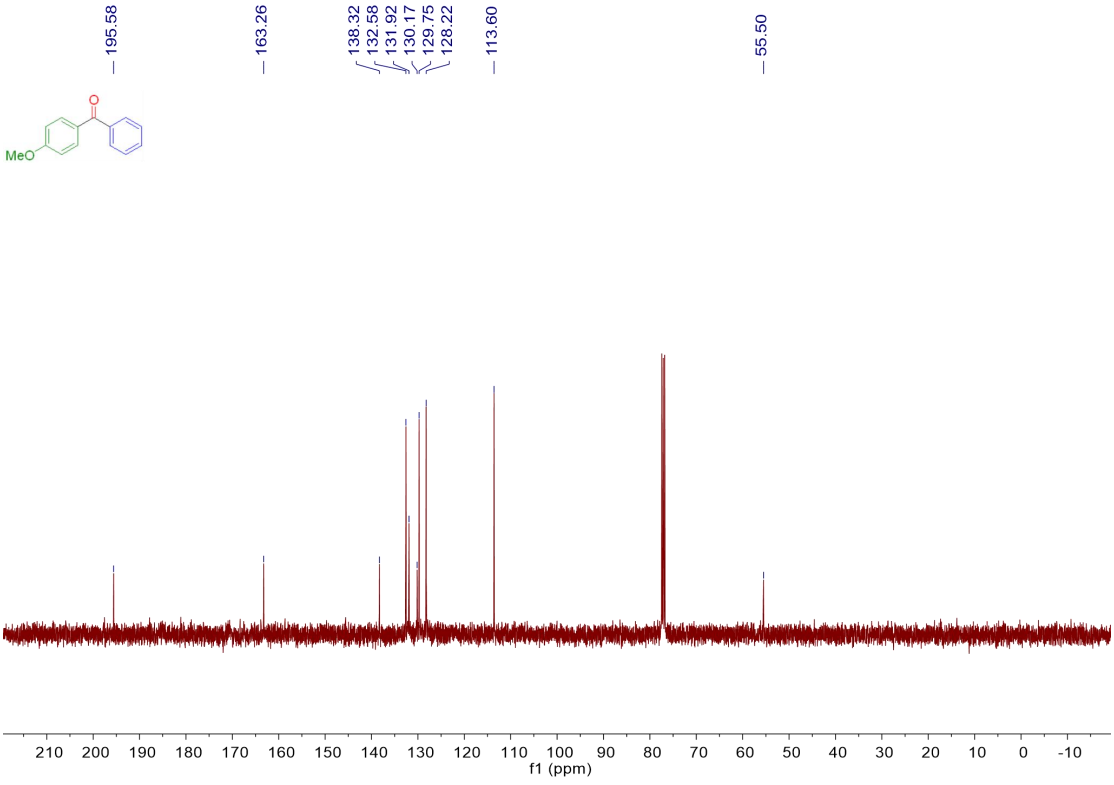
1,3-diphenylisobenzofuran (4av-5). The residue was purified by column chromatography (Hexane/EtOAc =15/1) on silica gel and collected as yellow solid (48.6 mg, 90% yield). mp 140 ℃. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.76 (d, J = 7.6 Hz, 4H), 7.66 (s, 4H), 7.56 (t, J = 7.3 Hz, 2H), 7.42 (t, J = 7.7 Hz, 4H). **^{13}C {^{1}H} NMR** (100 MHz, $CDCl_3$) δ 196.7, 140.1, 137.3, 133.1, 130.5, 129.9, 129.8, 128.5. HRMS m/z calculated for $C_{20}H_{14}O_2$ $[M+H]^+$: 287.1067, found: 287.1069.

^{1}H NMR and ^{13}C {^{1}H} NMR Spectra of Products

(4-methoxyphenyl)(phenyl)methanone (**4a**)

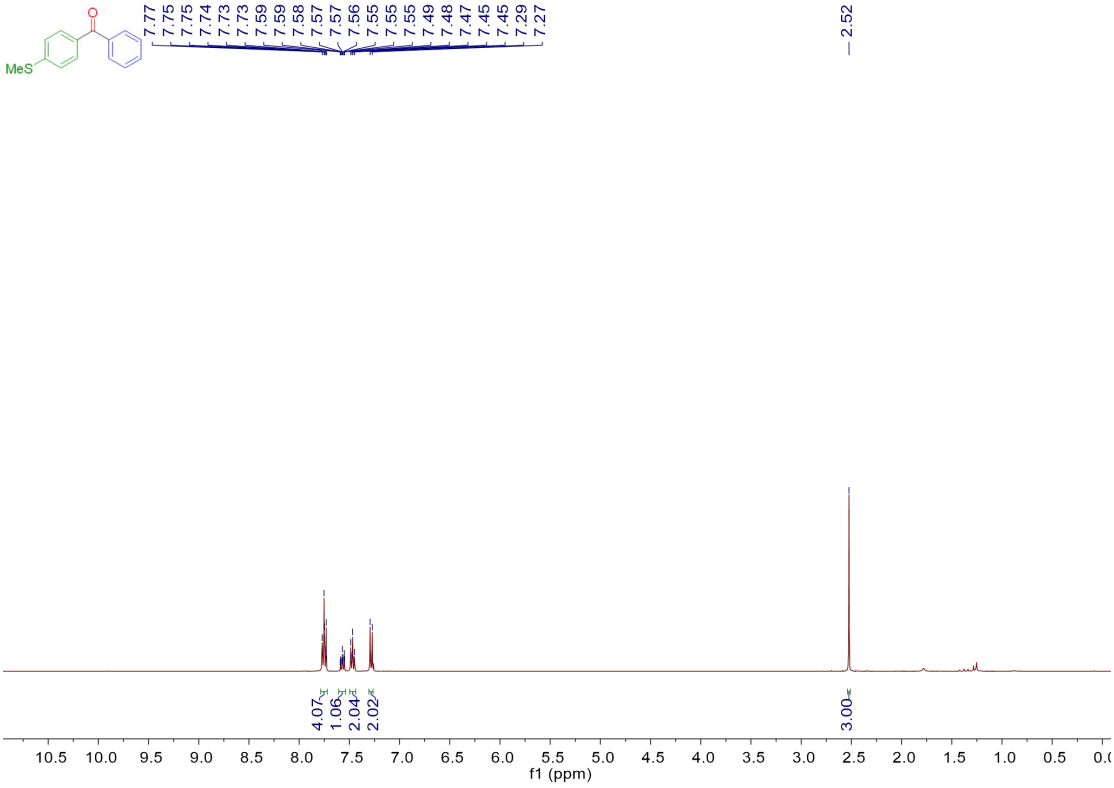


^{1}H-NMR (400 MHz, $CDCl_3$) of **4a**

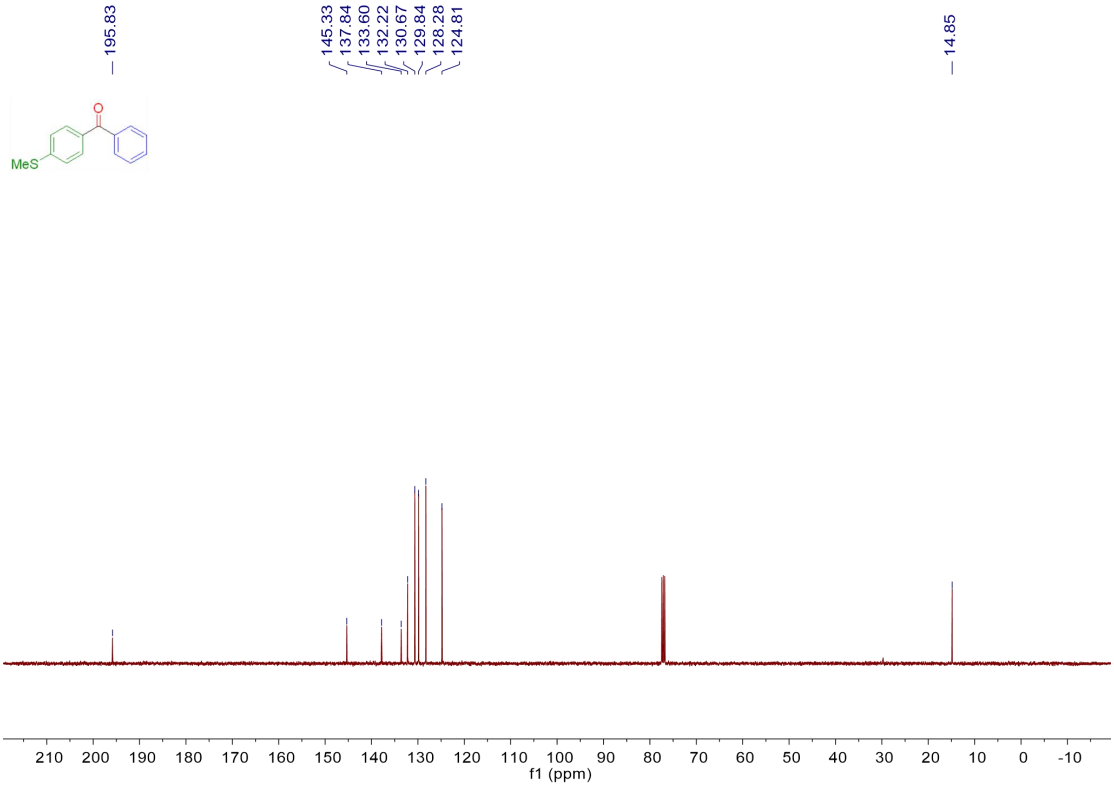


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4a**

(4-(methylthio)phenyl)(phenyl)methanone (**4b**)

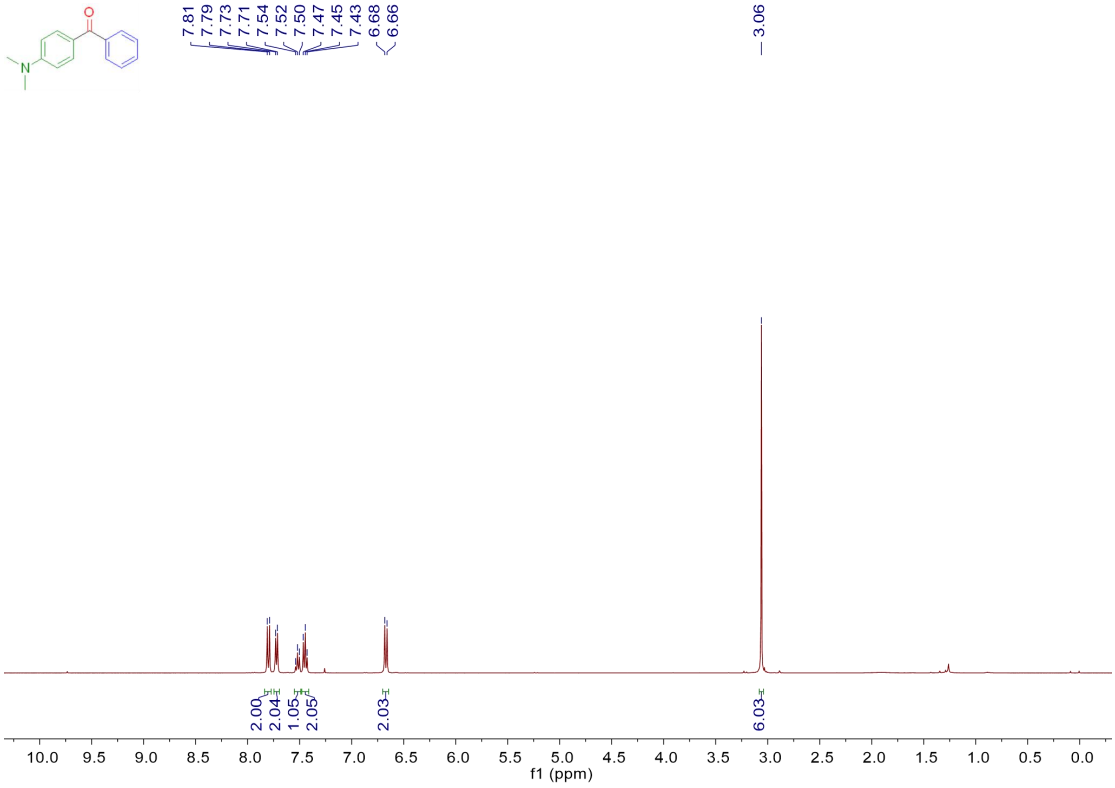


^{1}H-NMR (400 MHz, $CDCl_3$) of **4b**

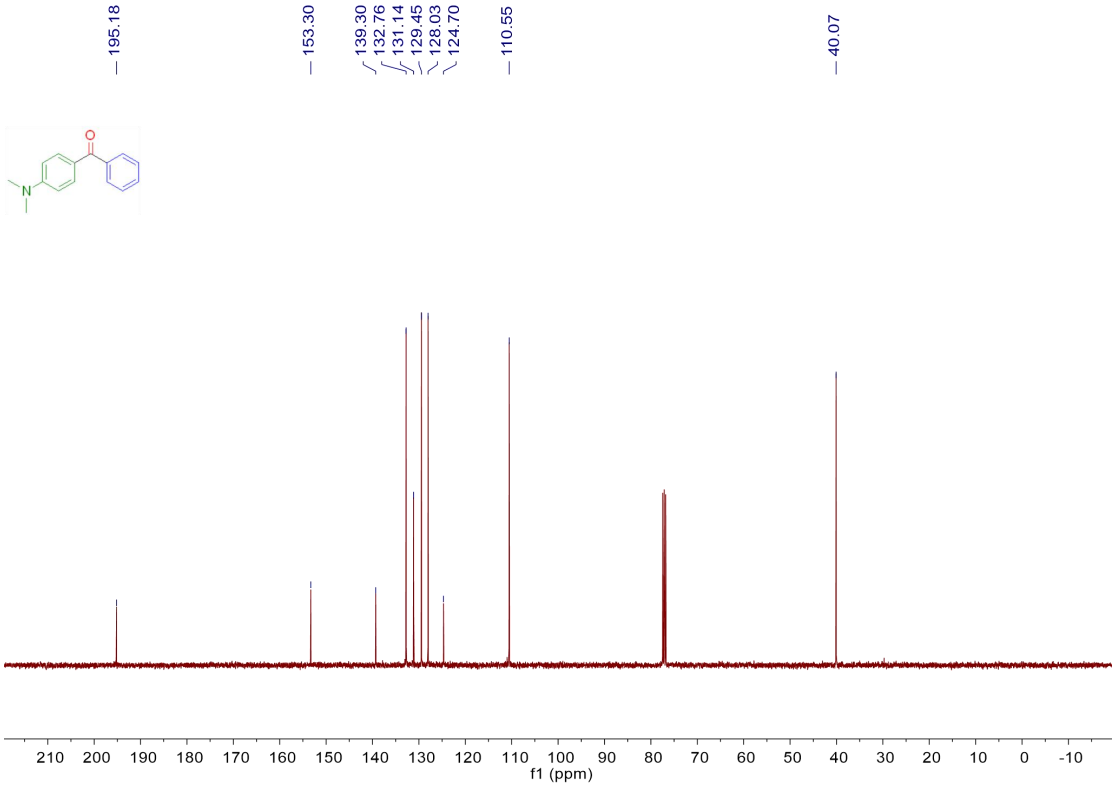


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4b**

(4-(dimethylamino)phenyl)(phenyl)methanone (**4c**)

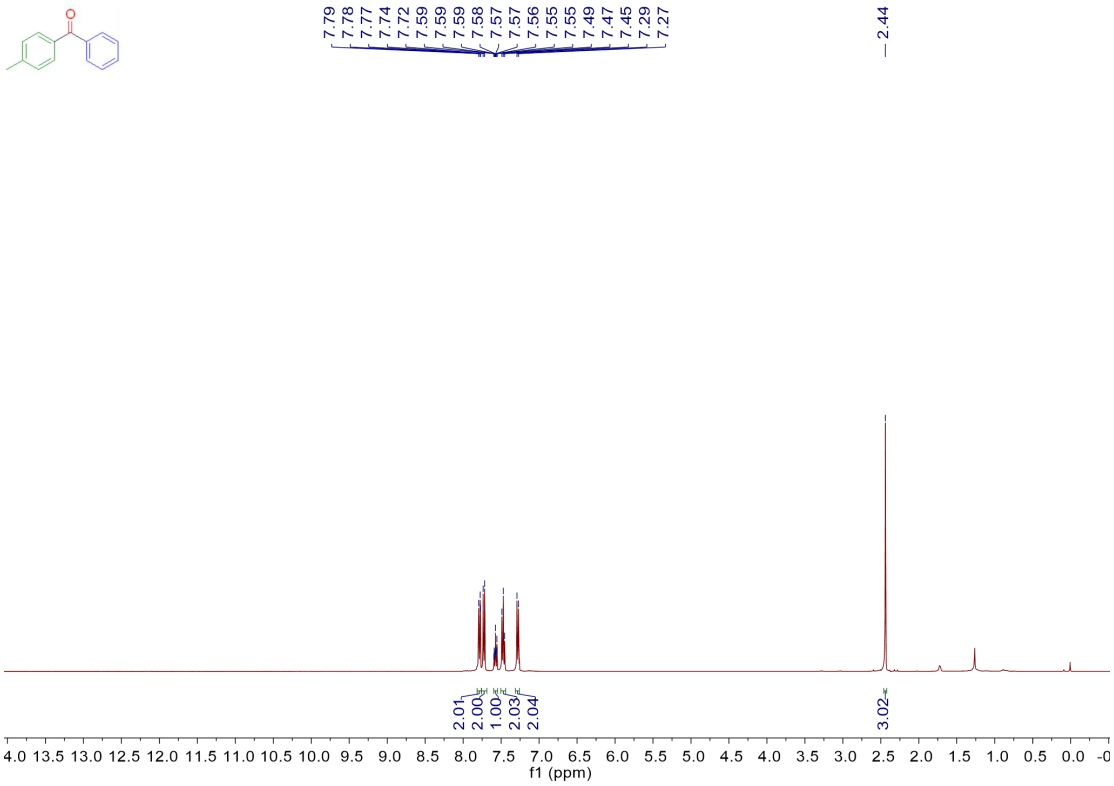


^{1}H-NMR (400 MHz, $CDCl_3$) of **4c**

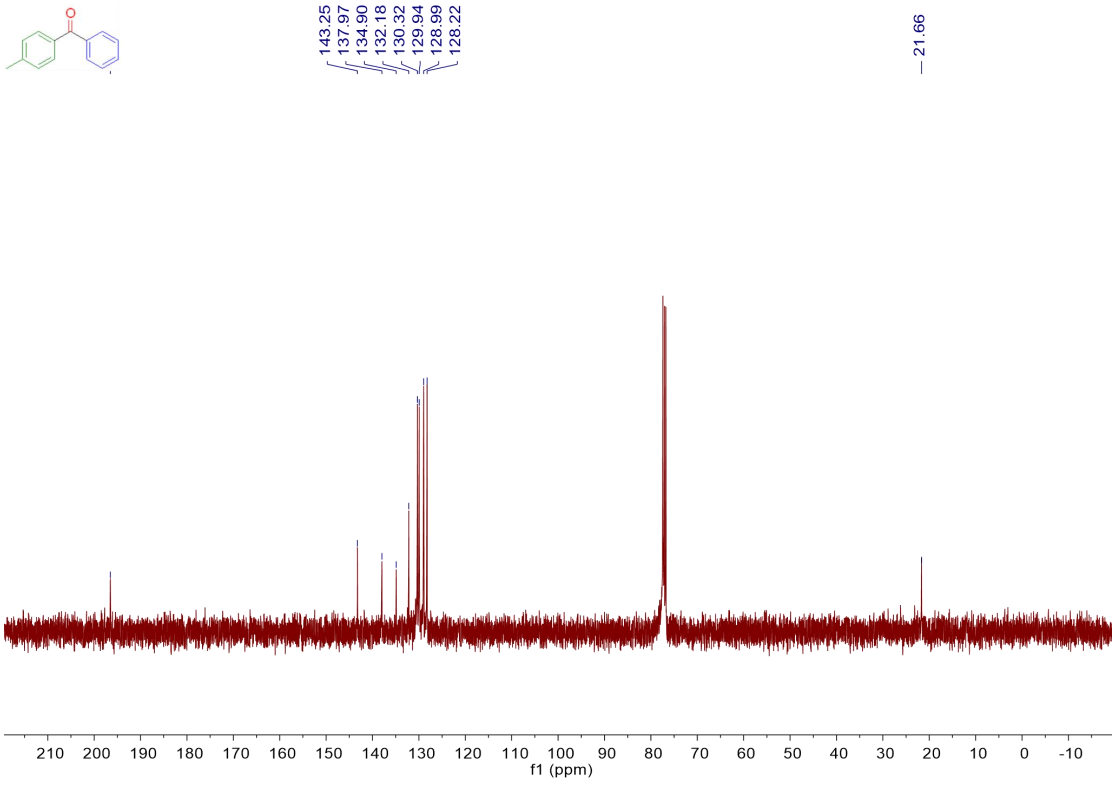


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4c**

phenyl(p-tolyl)methanone (**4d**)

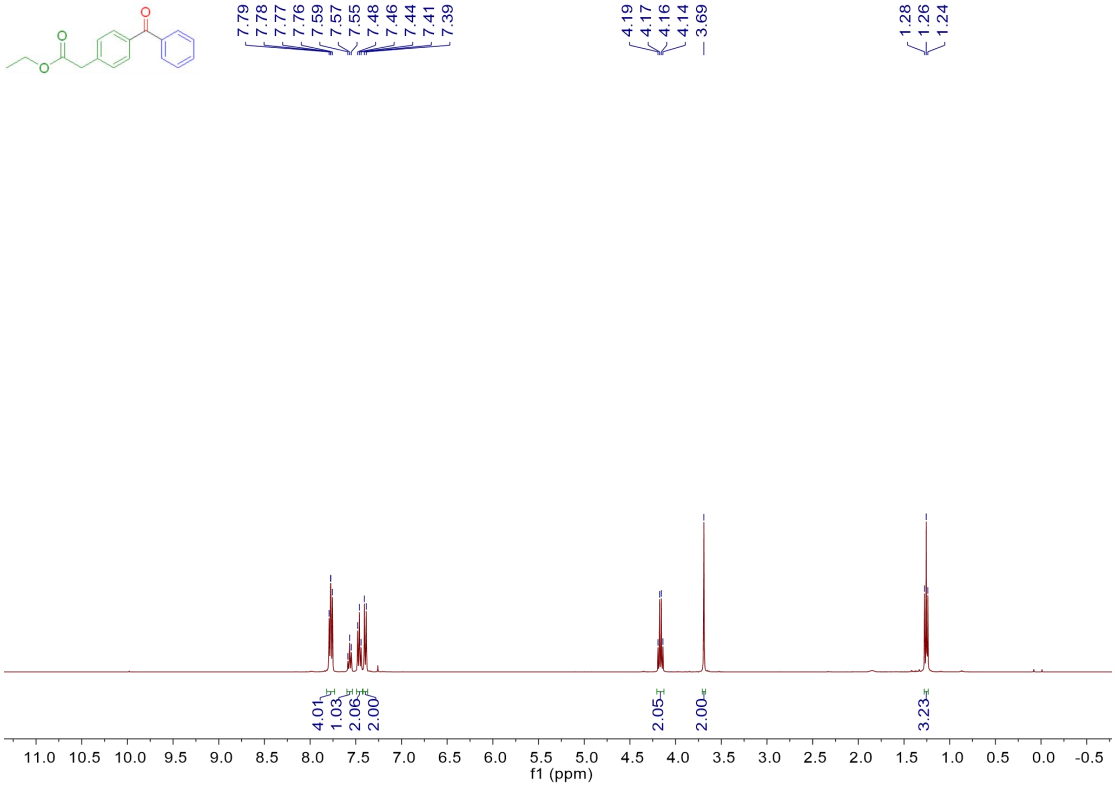


^{1}H-NMR (400 MHz, $CDCl_3$) of **4d**

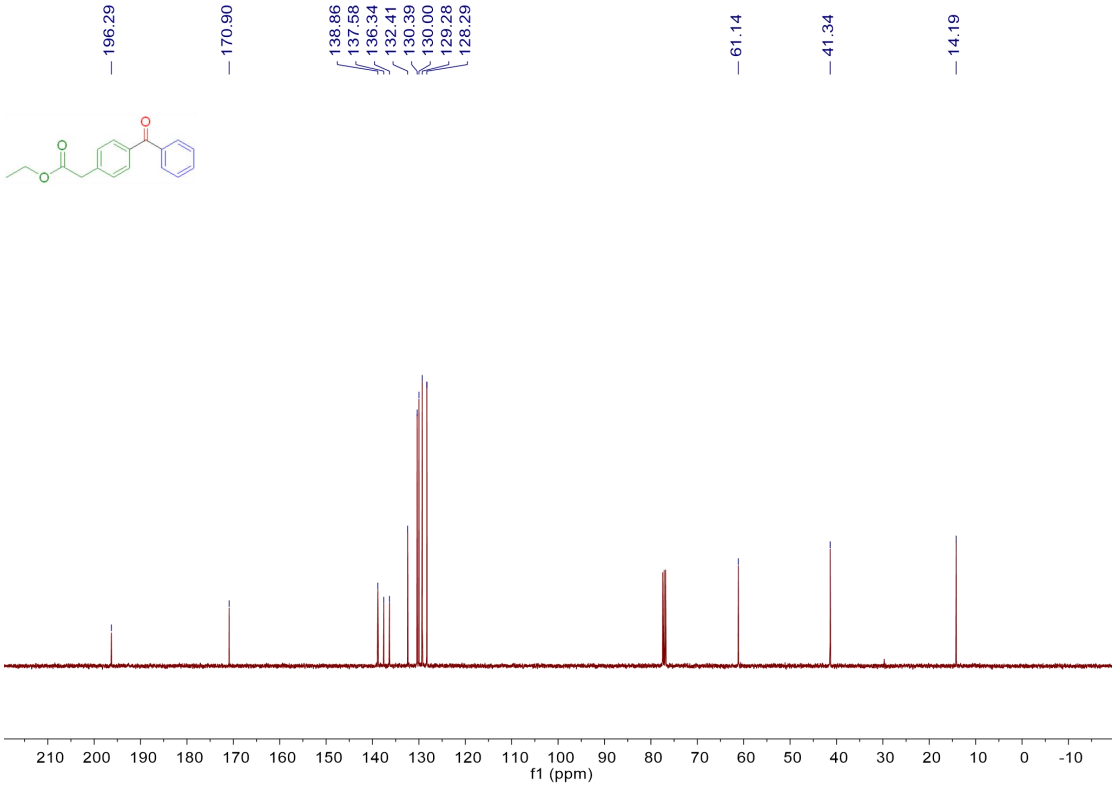


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4d**

ethyl 2-(4-benzoylphenyl)acetate (**4e**)

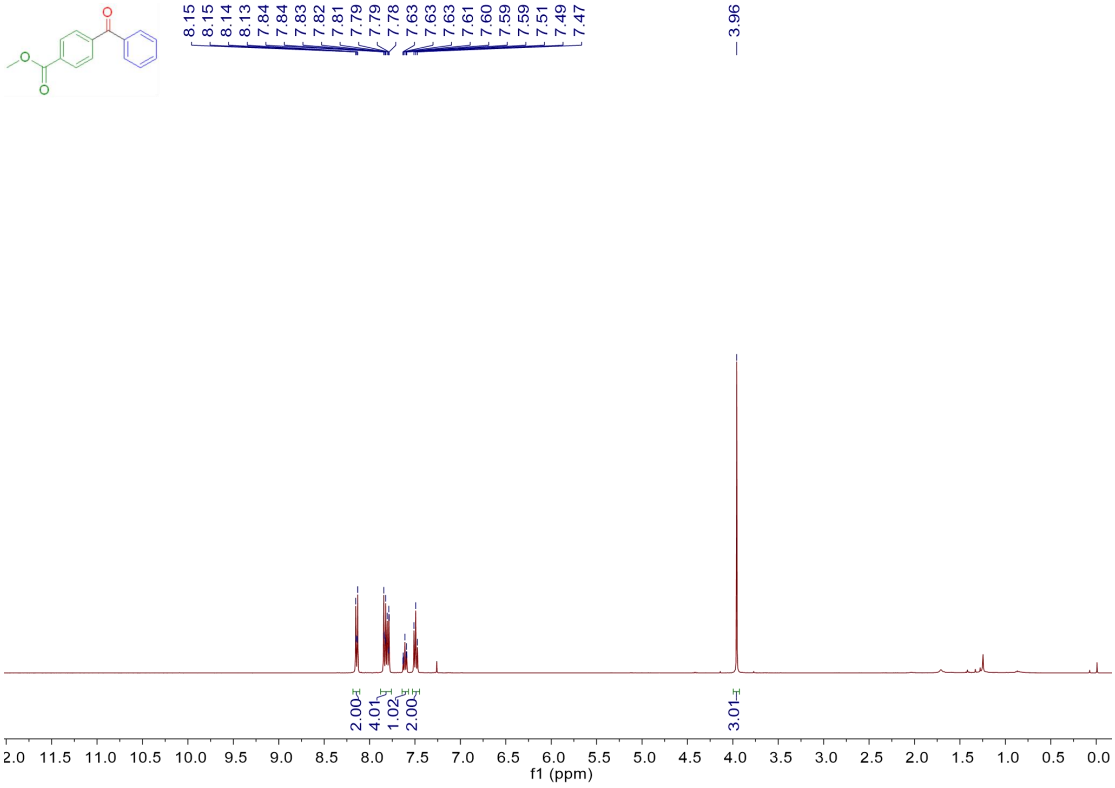


^{1}H-NMR (400 MHz, $CDCl_3$) of **4e**

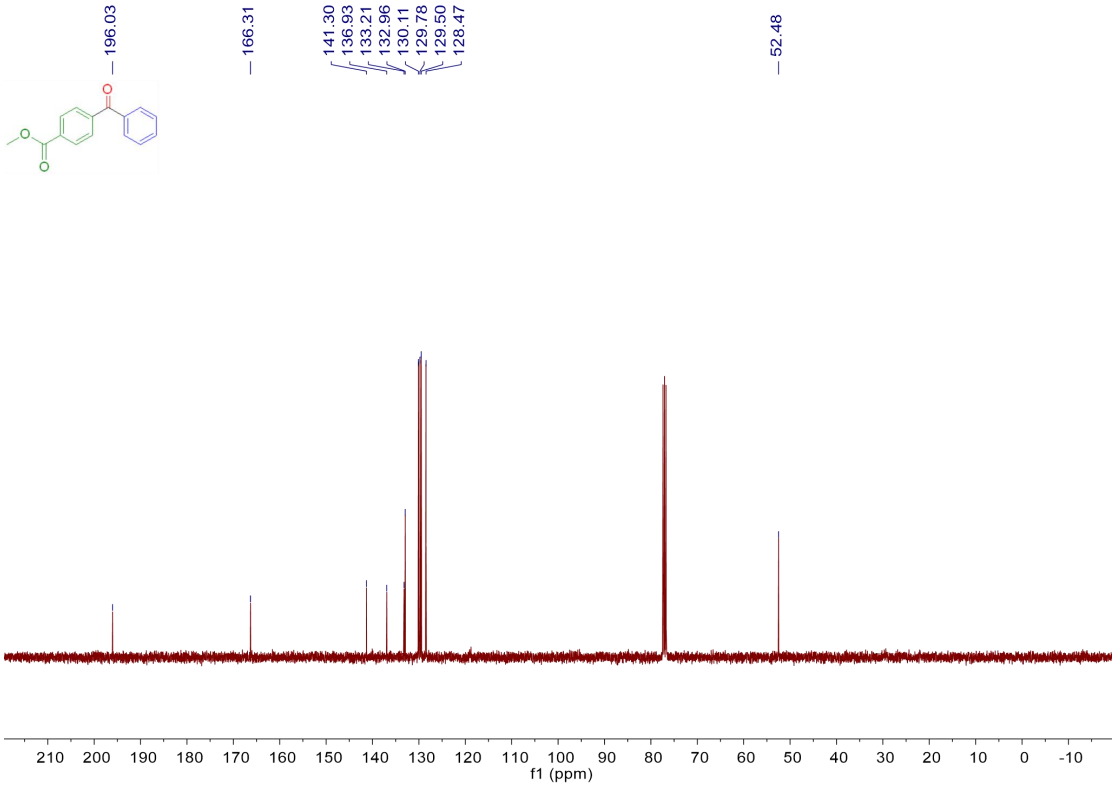


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4e**

methyl 4-benzoylbenzoate (**4f**)

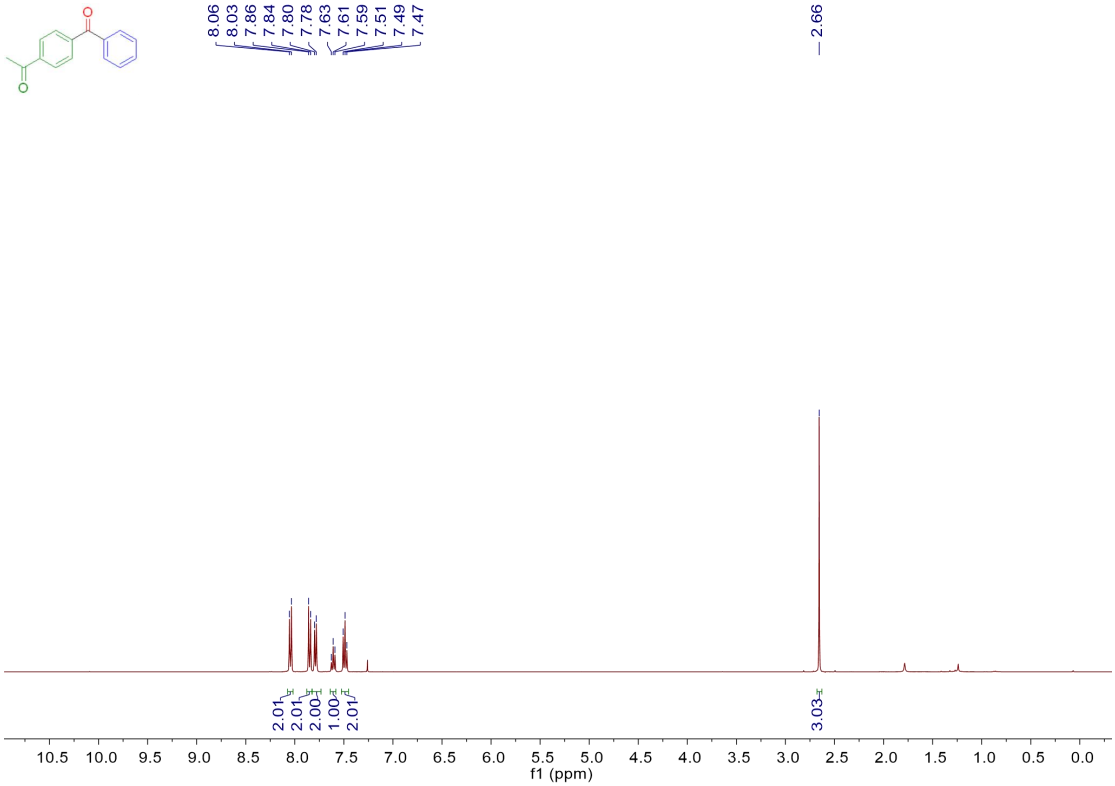


^{1}H-NMR (400 MHz, $CDCl_3$) of **4f**

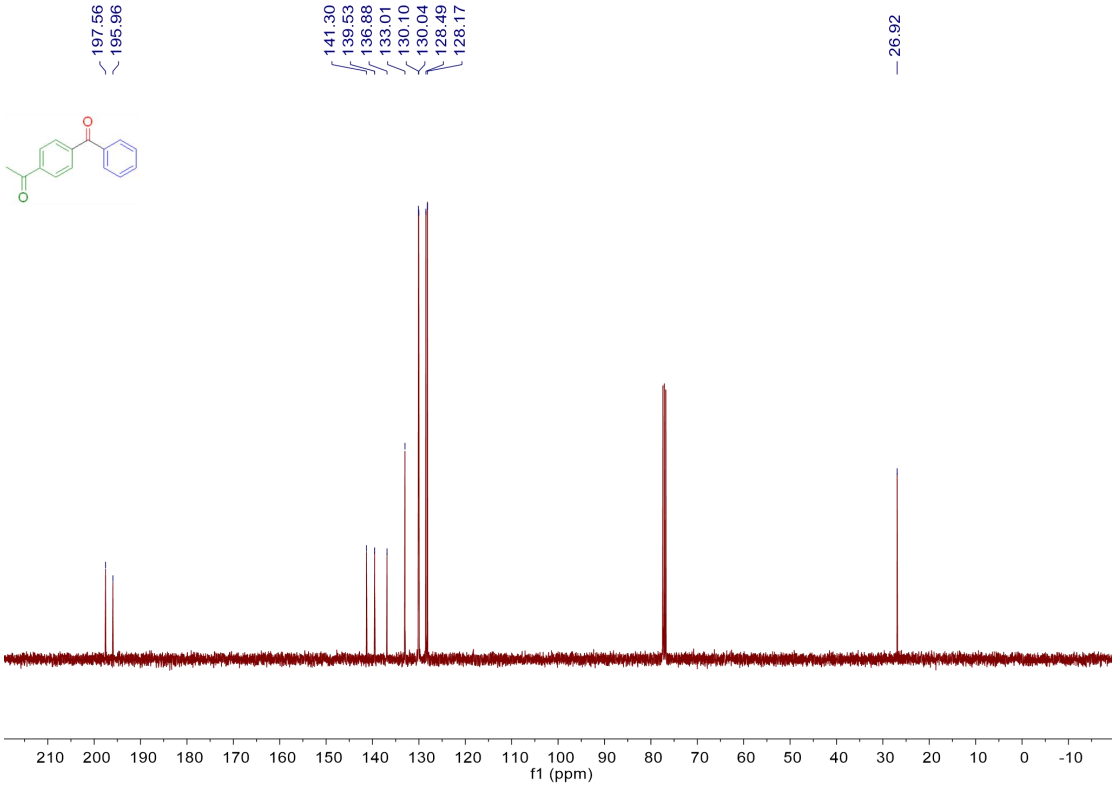


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4f**

1-(4-benzoylphenyl)ethan-1-one (**4g**)

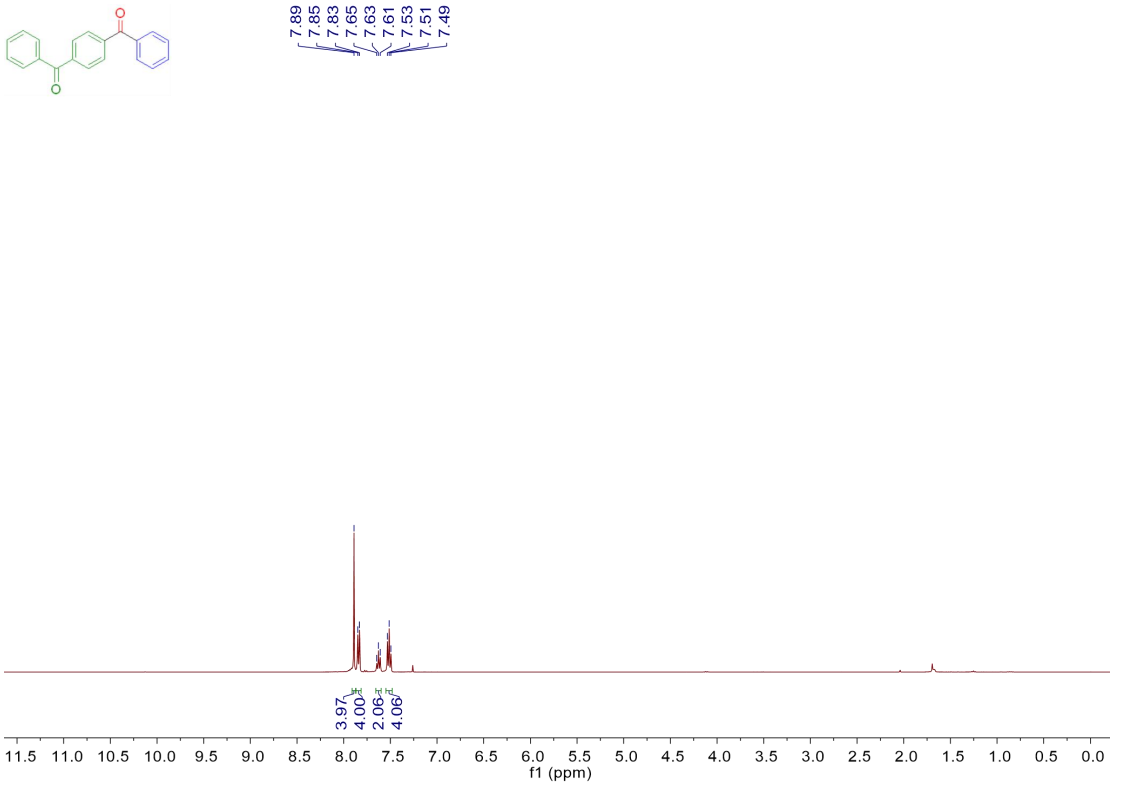


^{1}H-NMR (400 MHz, $CDCl_3$) of **4g**

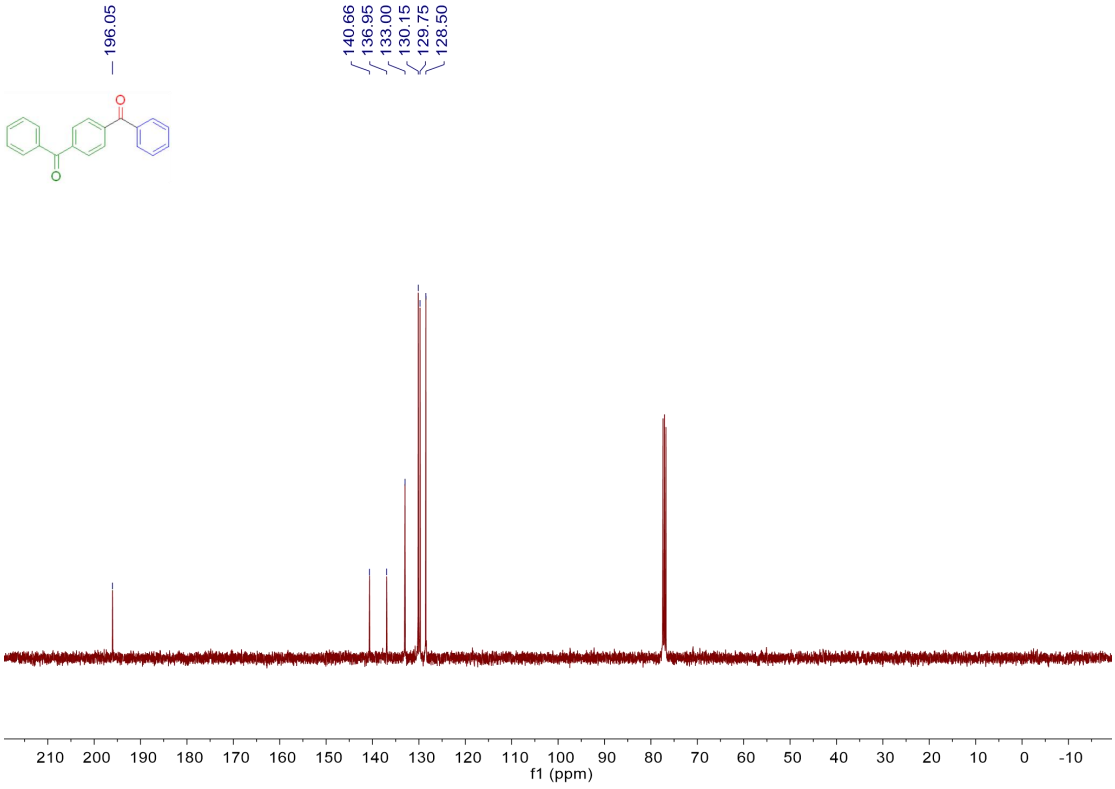


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4g**

1,4-phenylenebis(phenylmethanone) (**4h**)

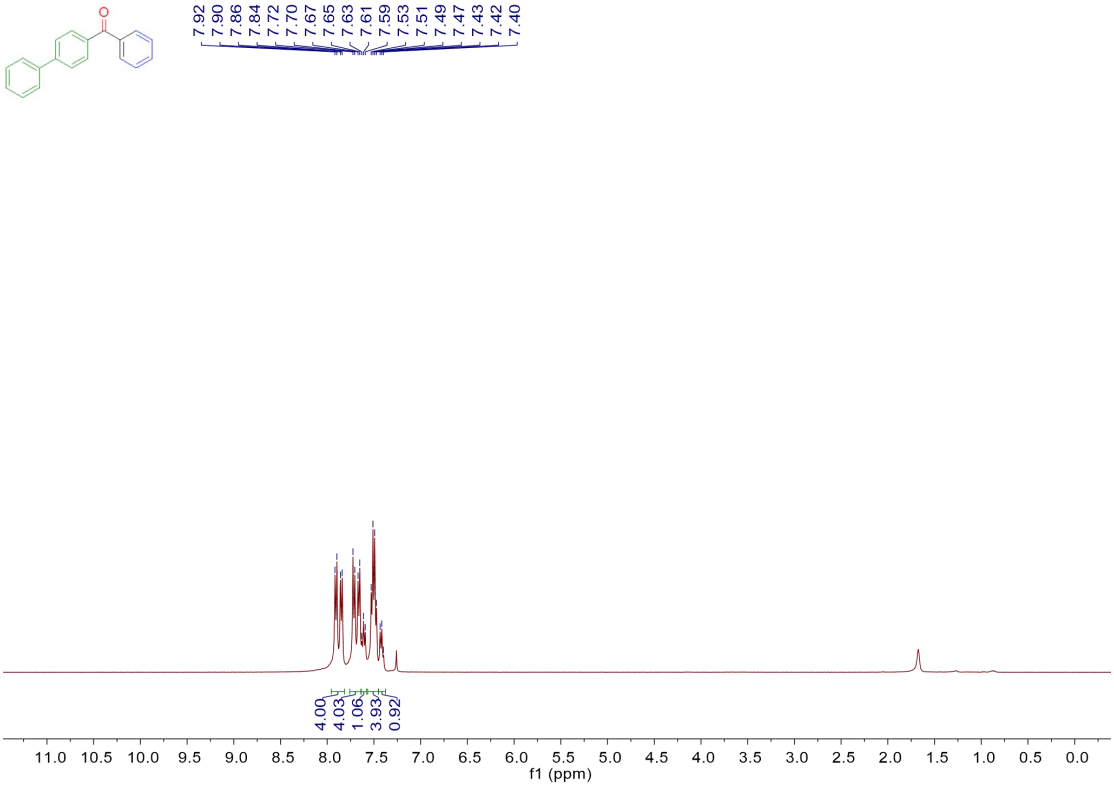


^{1}H-NMR (400 MHz, $CDCl_3$) of **4h**

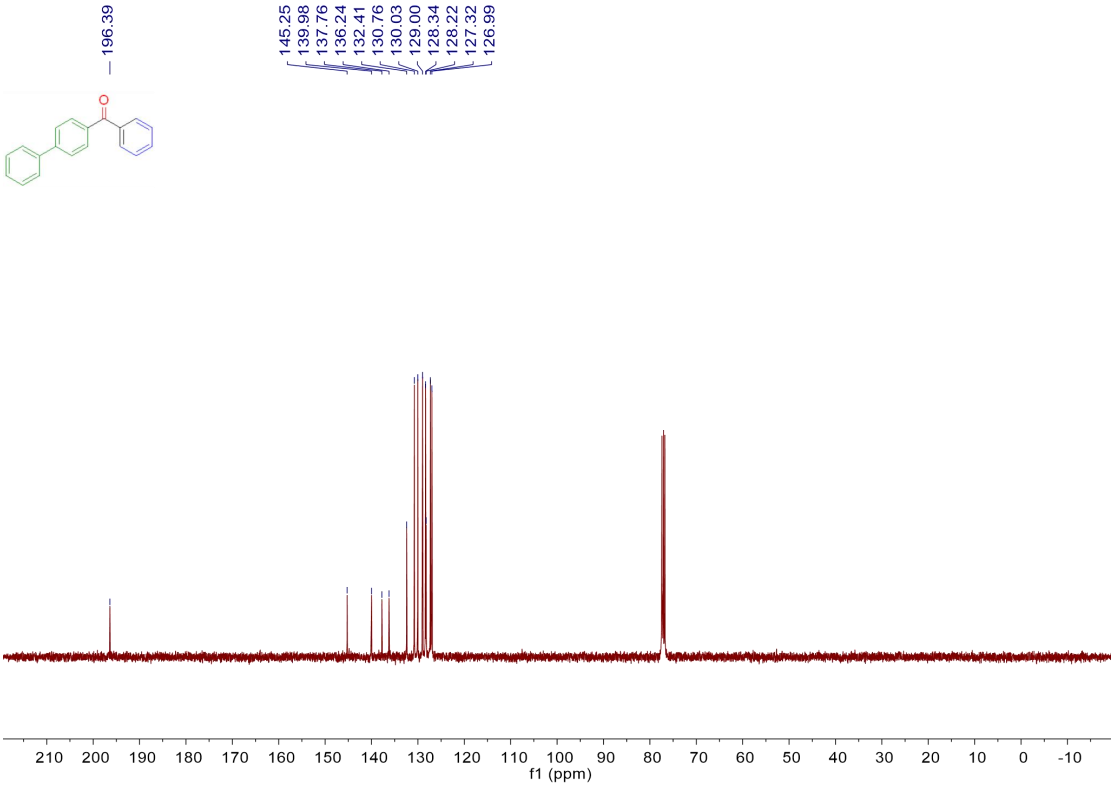


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4h**

[1,1'-biphenyl]-4-yl(phenyl)methanone (**4i**)

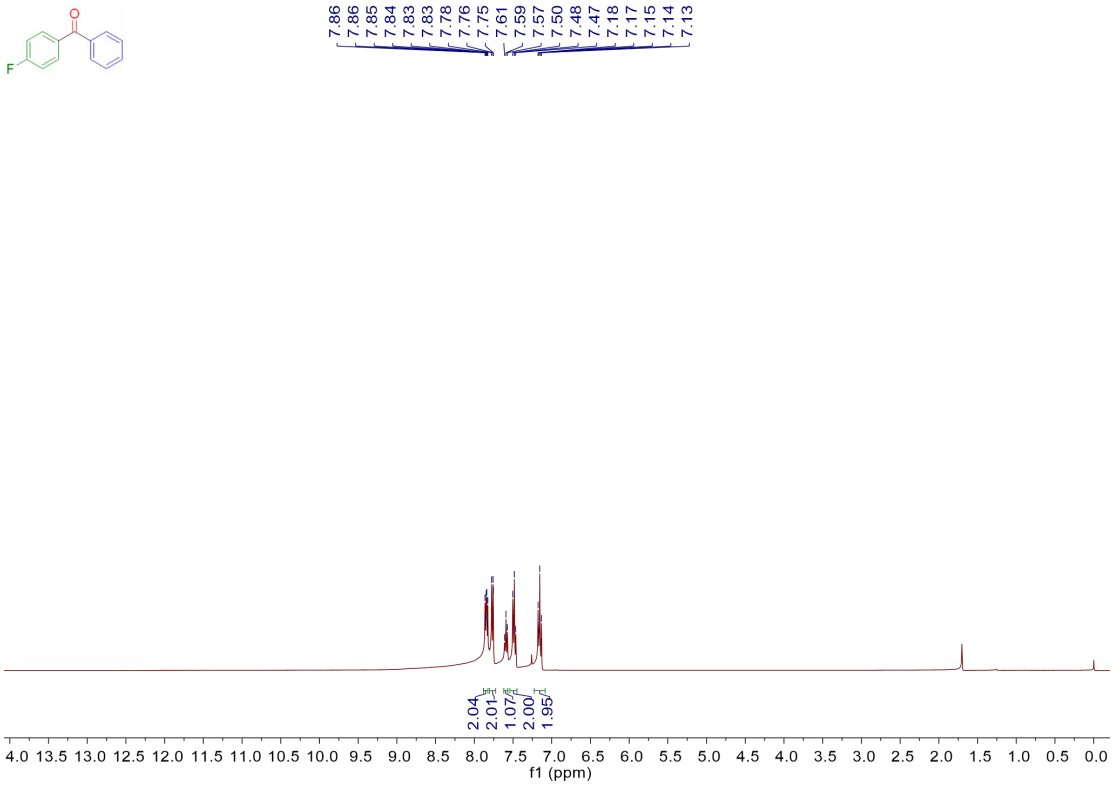


^{1}H-NMR (400 MHz, $CDCl_3$) of **4i**

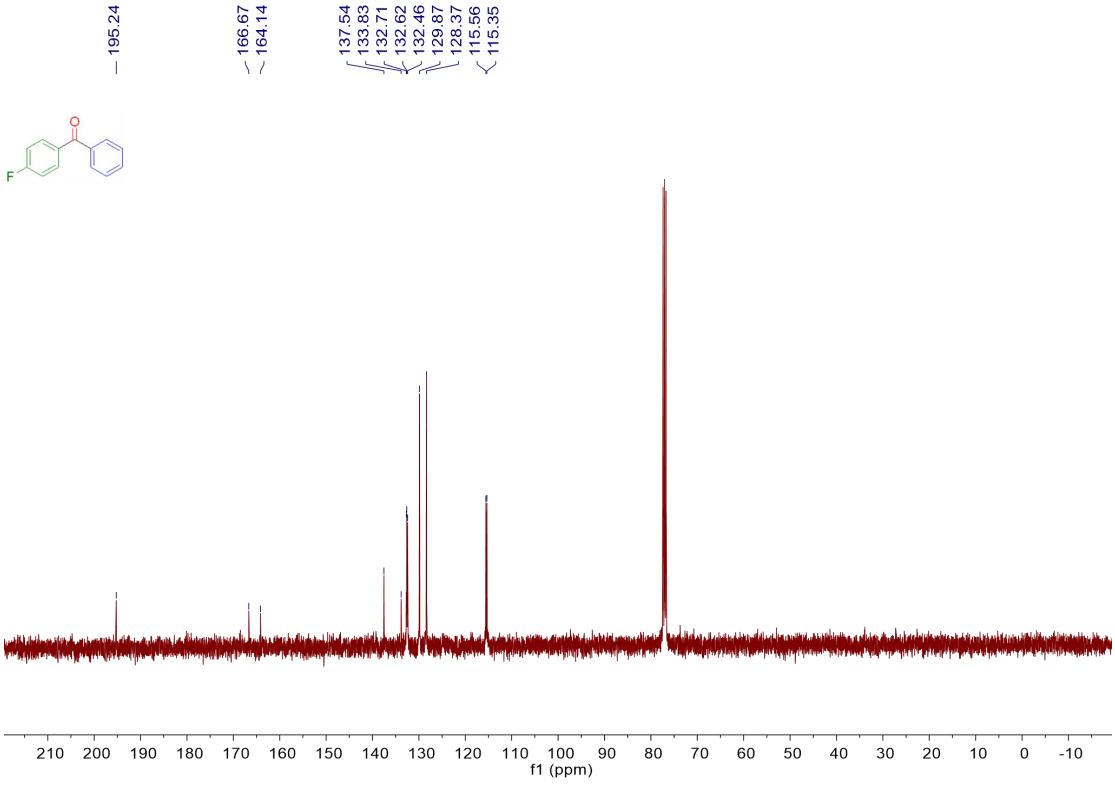


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4i**

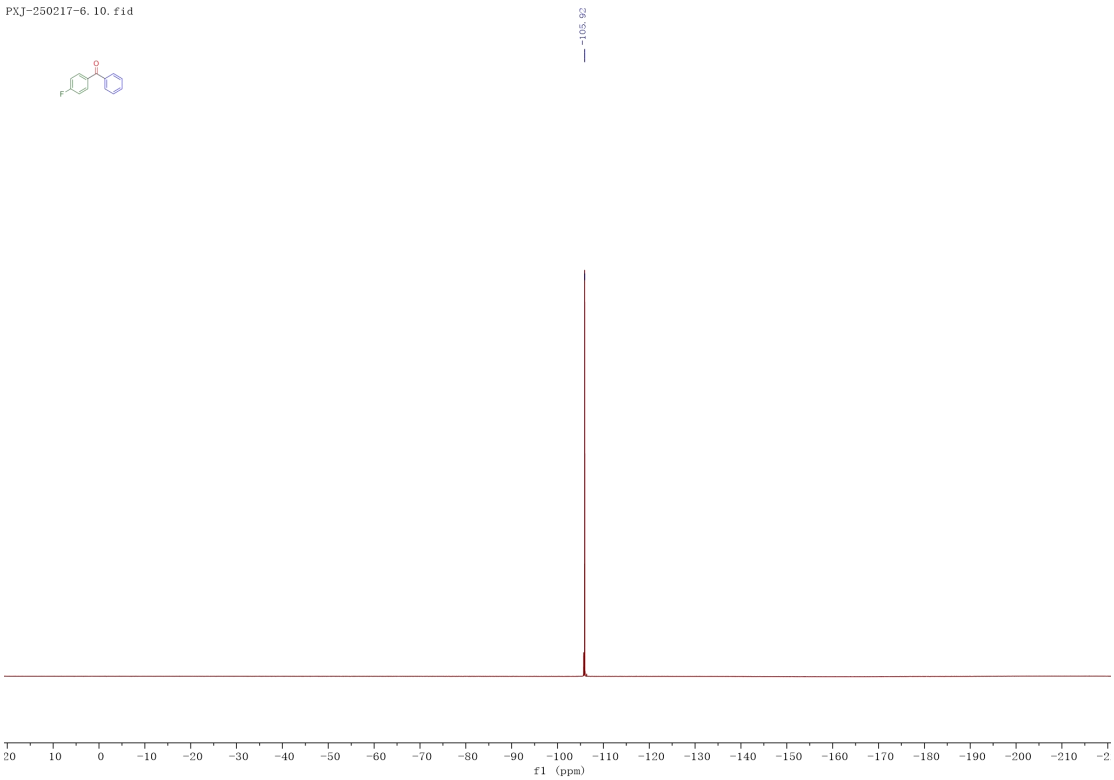
(4-fluorophenyl)(phenyl)methanone (**4j**)



^{1}H-NMR (400 MHz, $CDCl_3$) of **4j**

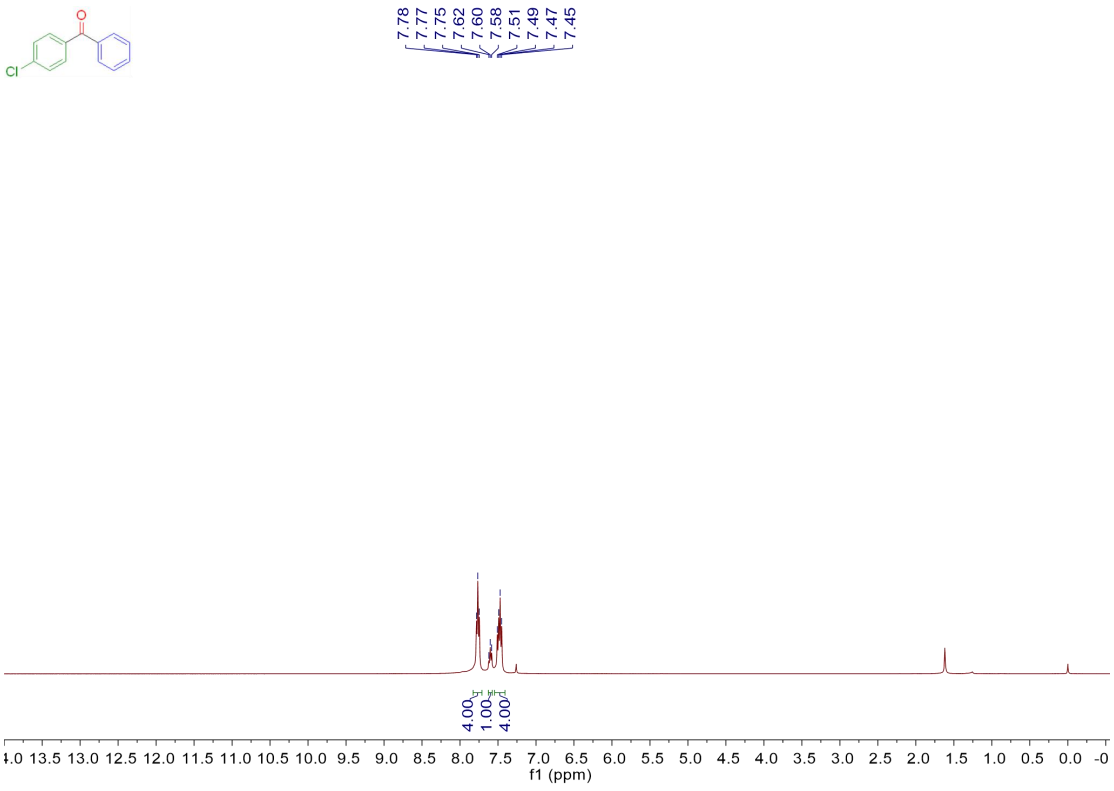


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4j**

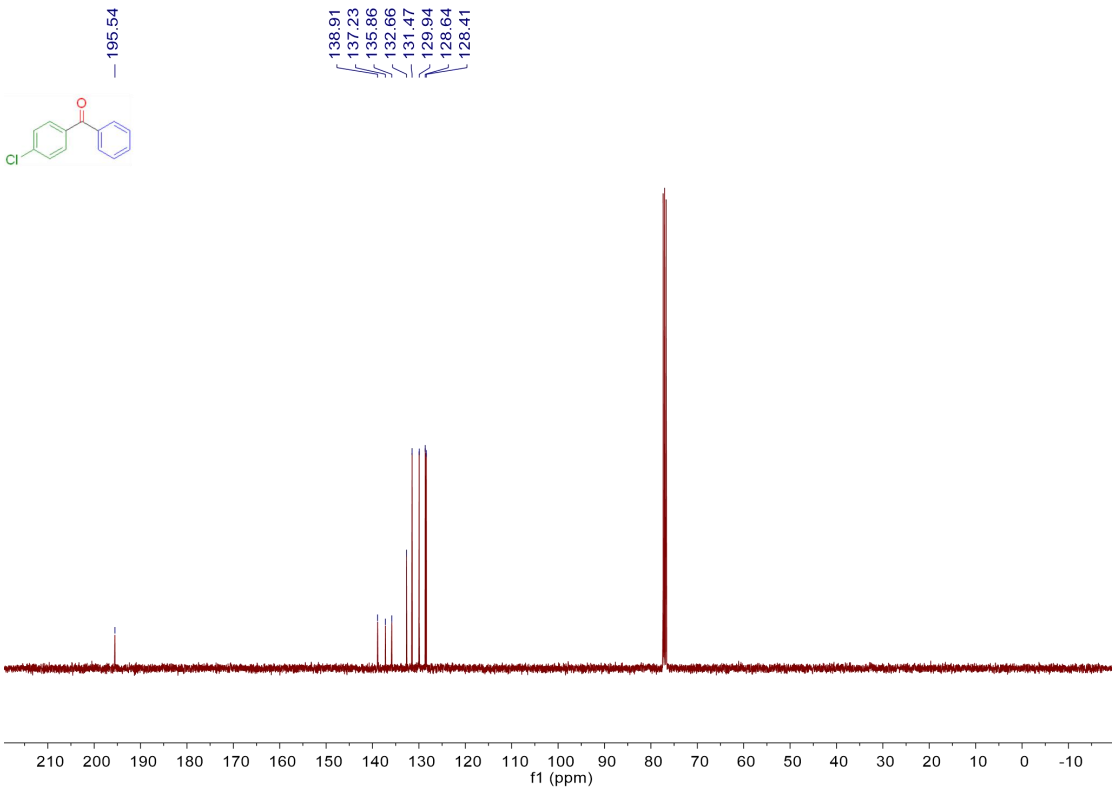


^{19}F NMR (377 MHz, $CDCl_3$) of **4j**

(4-chlorophenyl)(phenyl)methanone (**4k**)

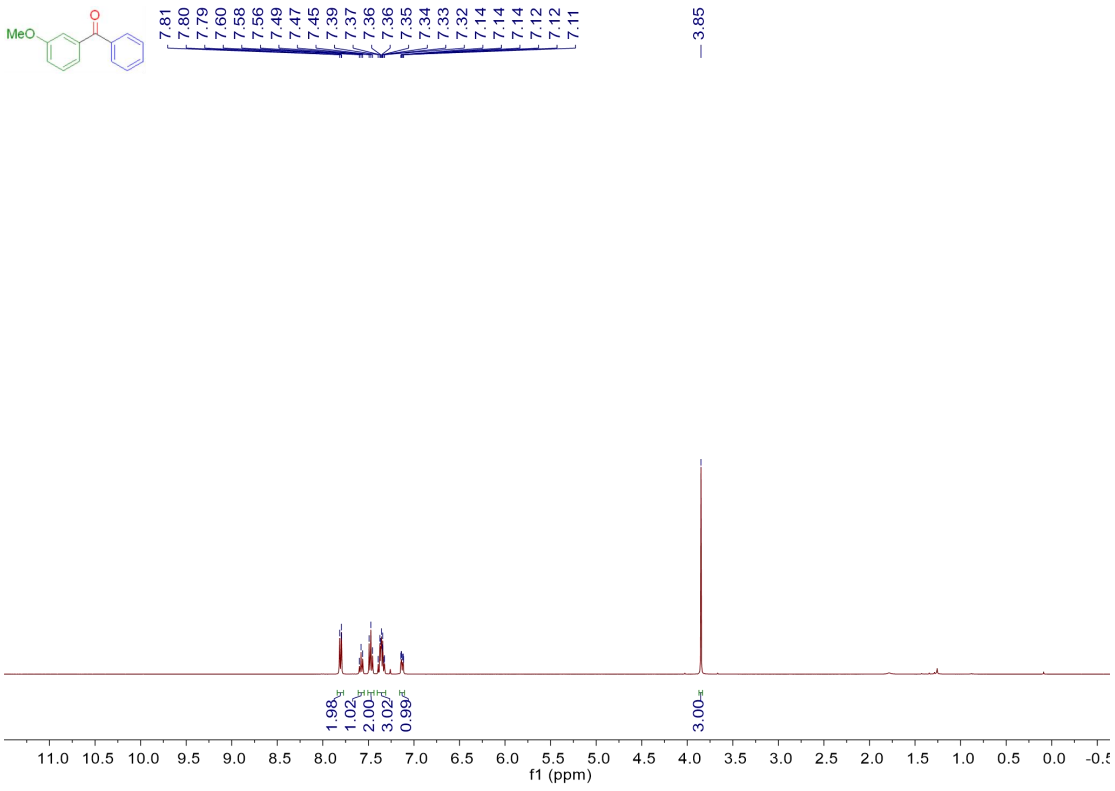


^{1}H-NMR (400 MHz, $CDCl_3$) of **4k**

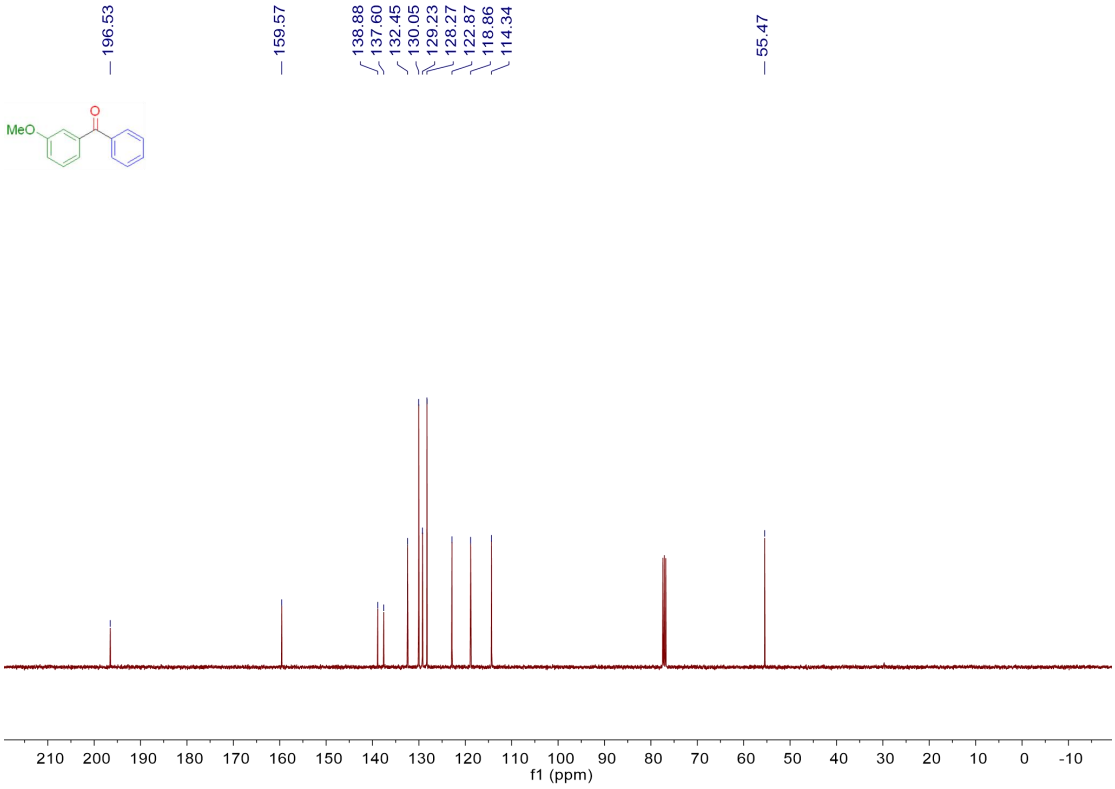


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4k**

(3-methoxyphenyl)(phenyl)methanone (**4l**)

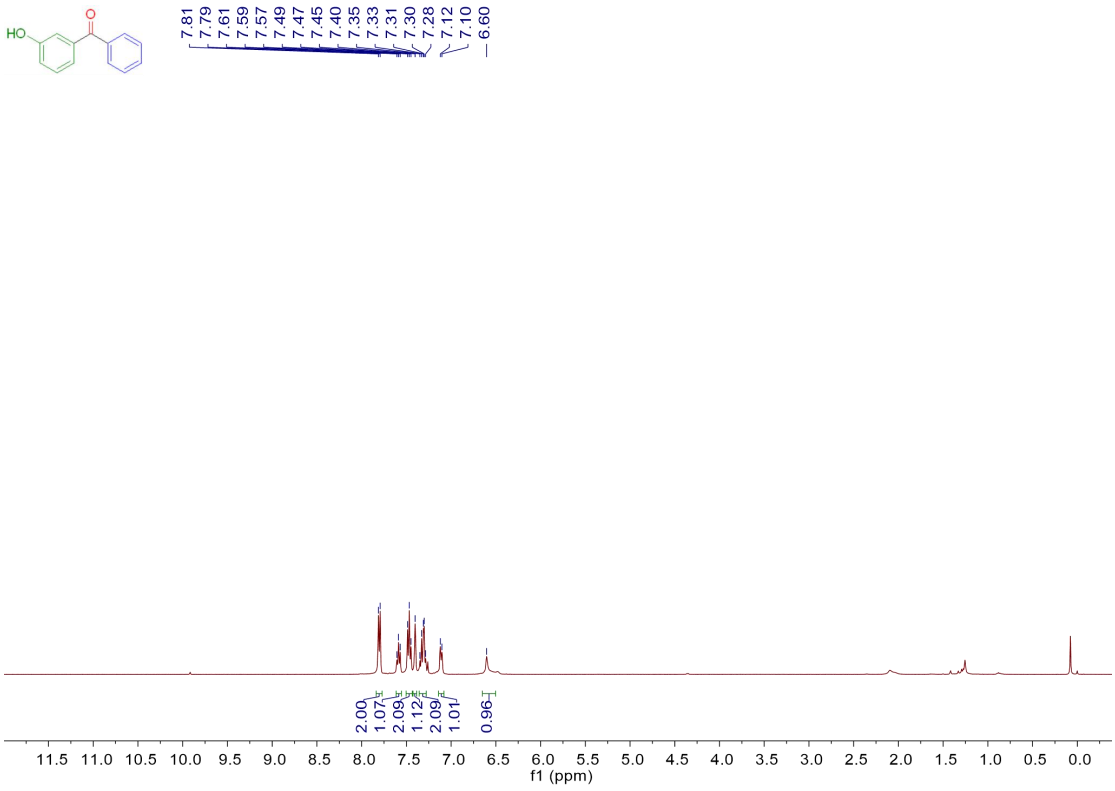


^{1}H-NMR (400 MHz, $CDCl_3$) of **4l**

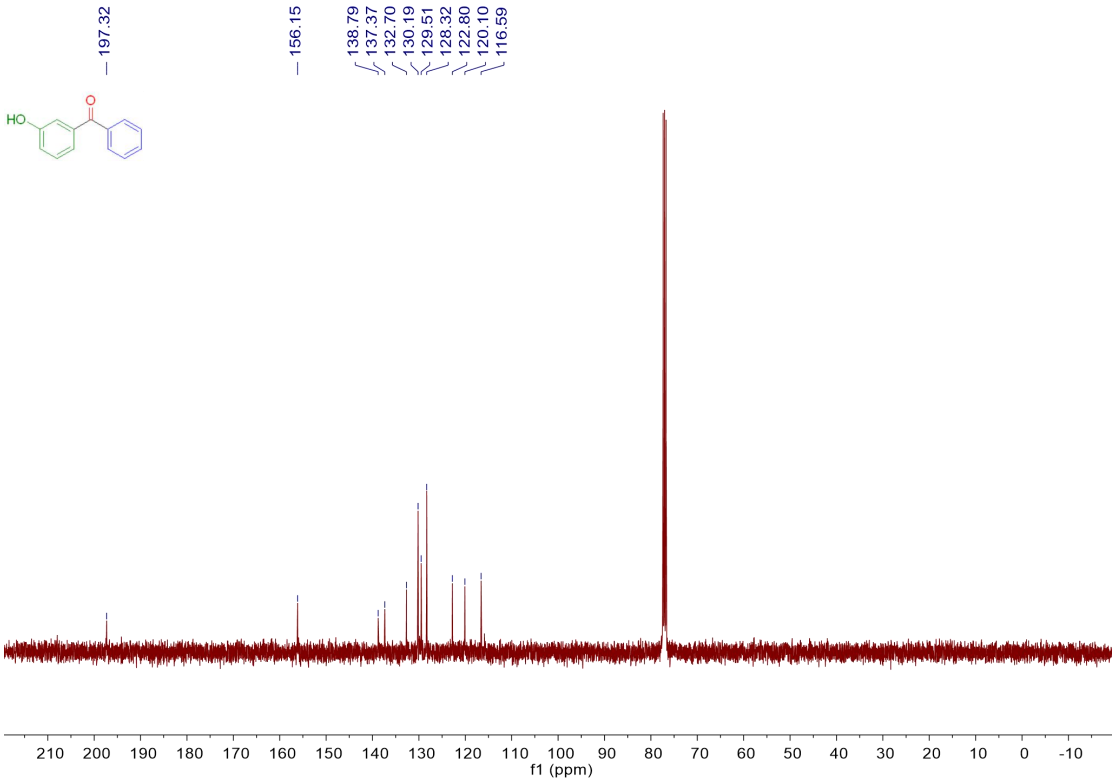


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4l**

(3-hydroxyphenyl)(phenyl)methanone (**4m**)

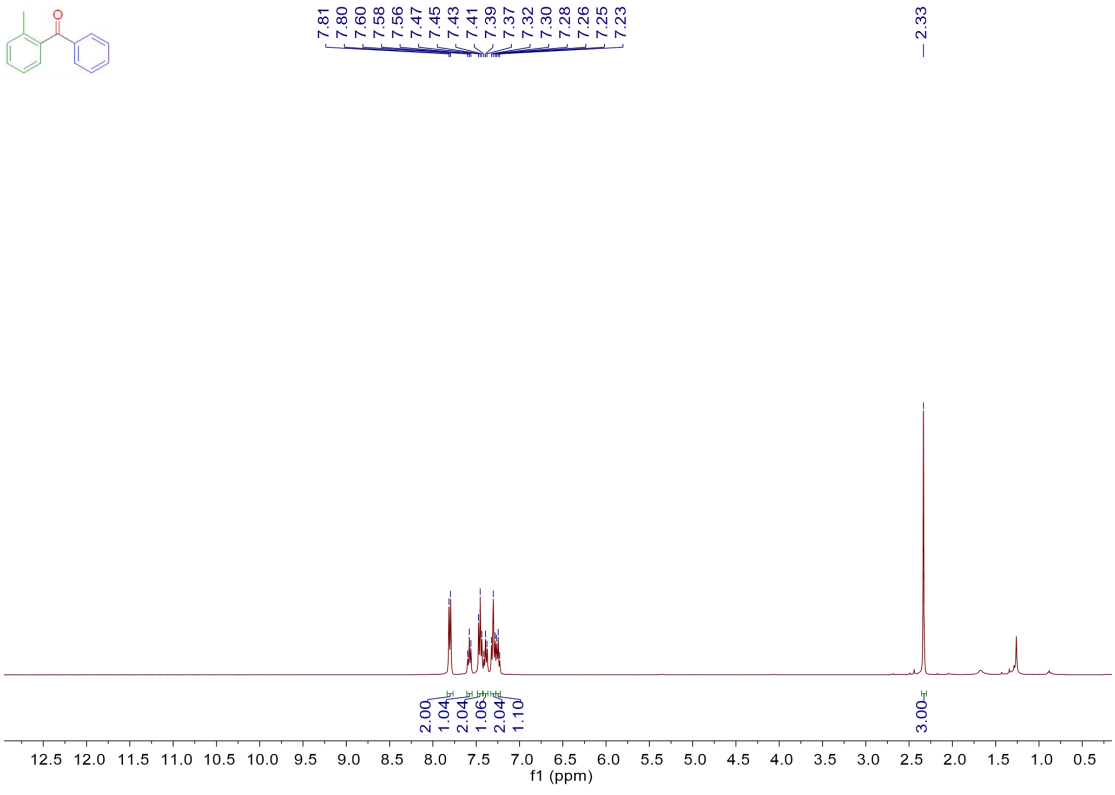


^{1}H-NMR (400 MHz, $CDCl_3$) of **4m**

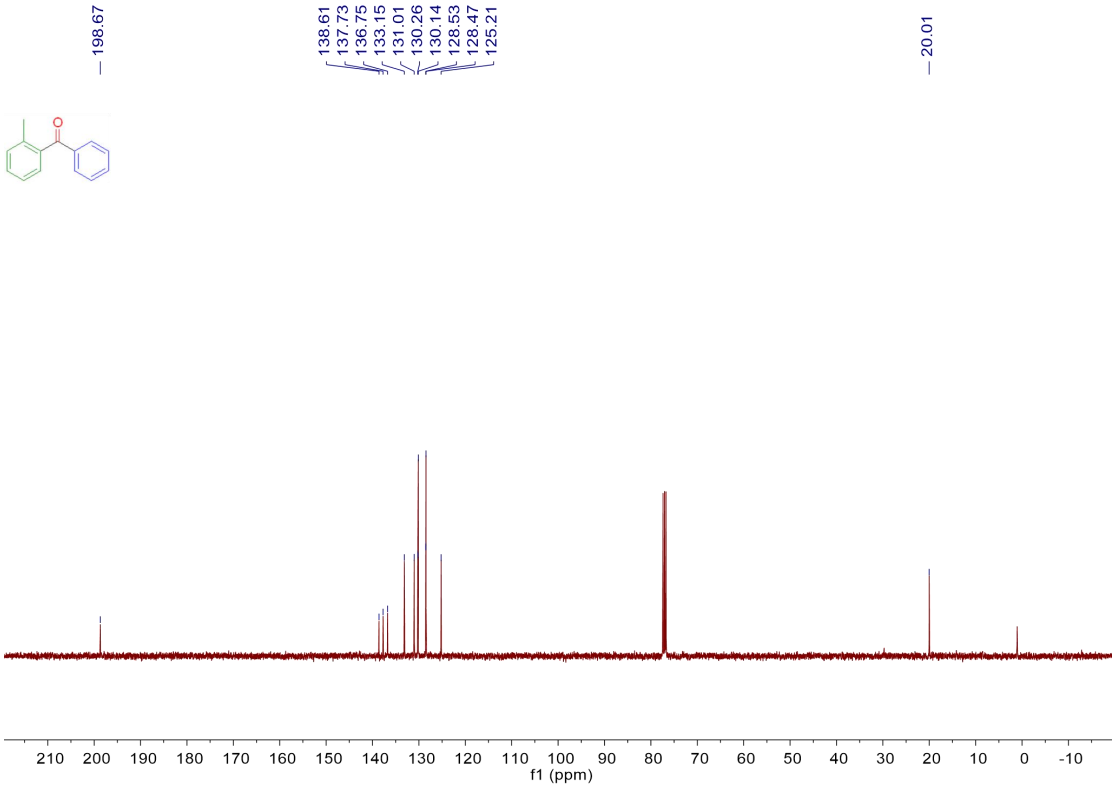


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4m**

phenyl(o-tolyl)methanone (**4n**)

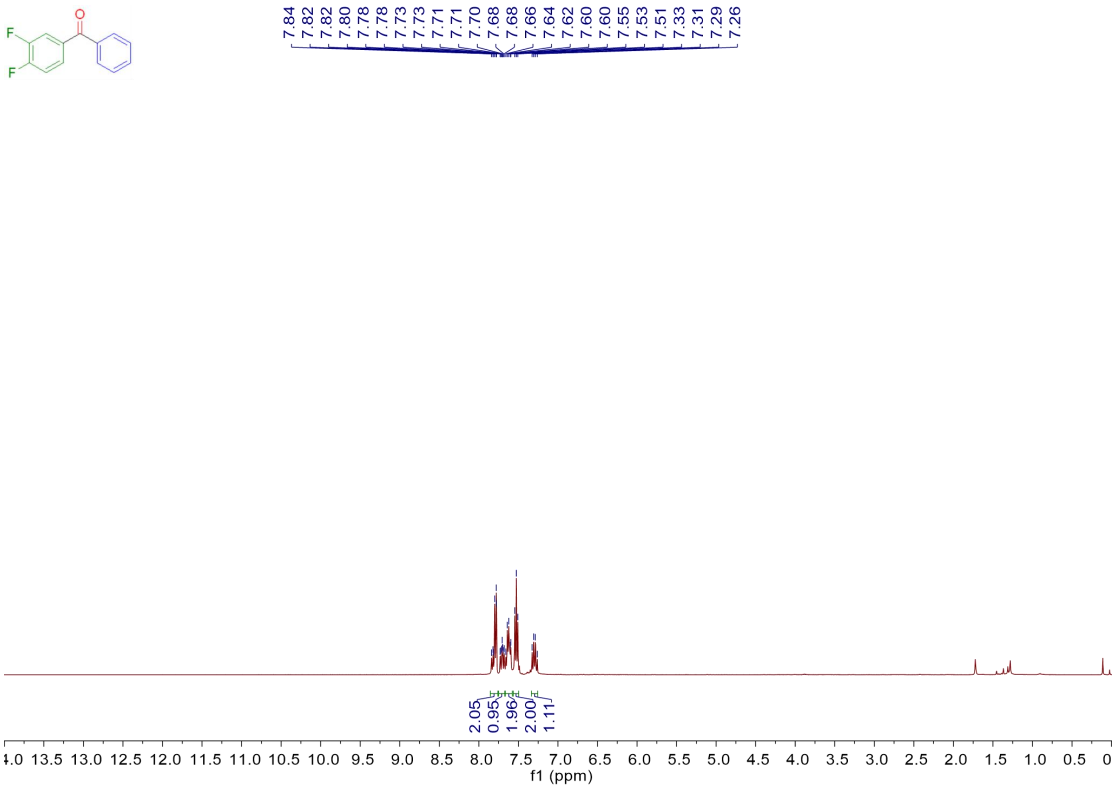


^{1}H-NMR (400 MHz, $CDCl_3$) of **4n**

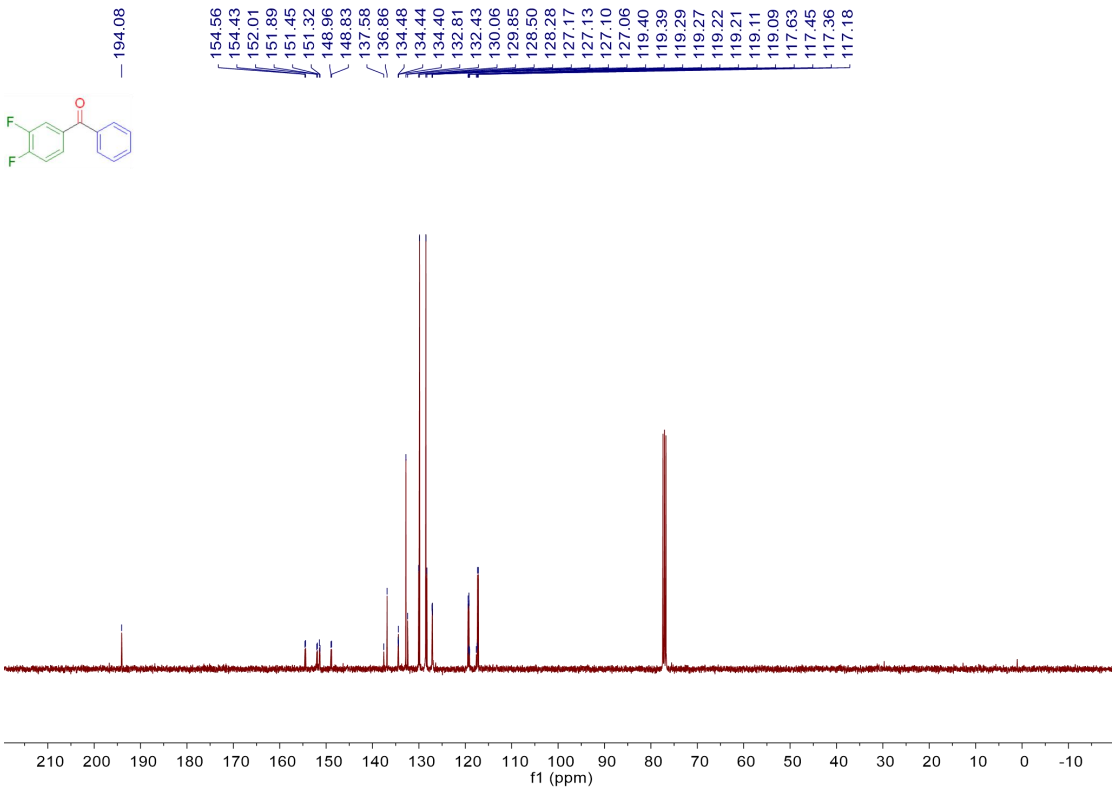


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4n**

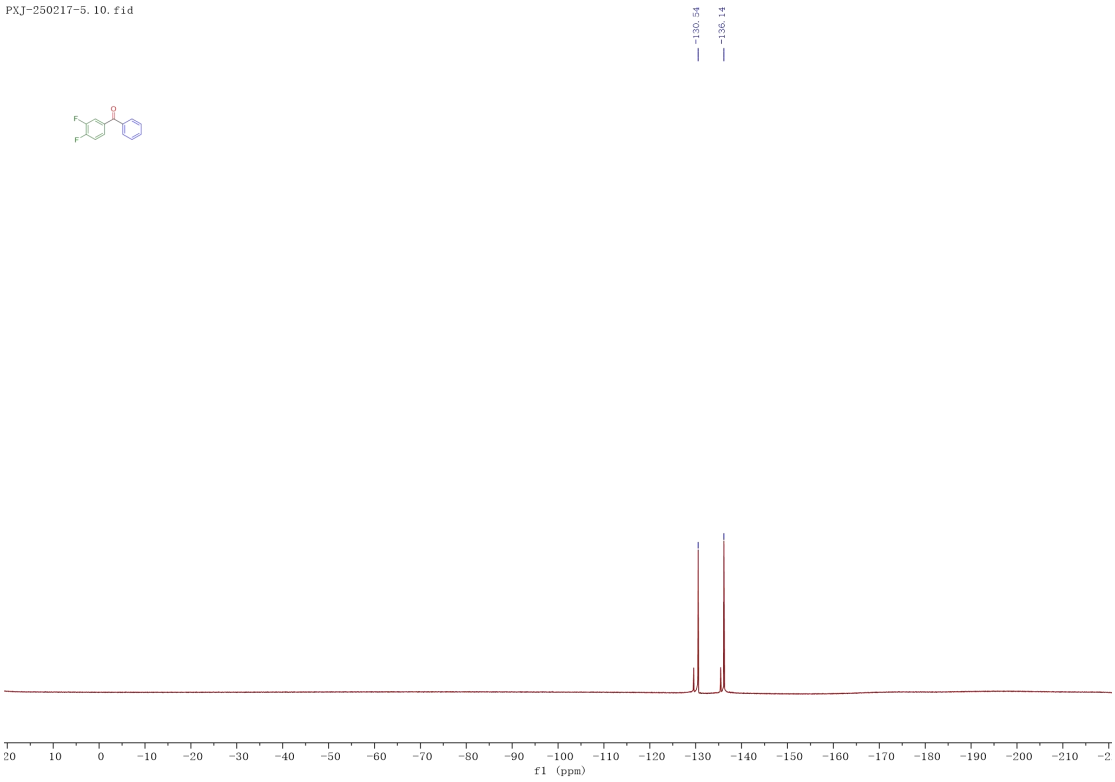
(3,4-difluorophenyl)(phenyl)methanone (**4o**)



^{1}H-NMR (400 MHz, $CDCl_3$) of **4o**

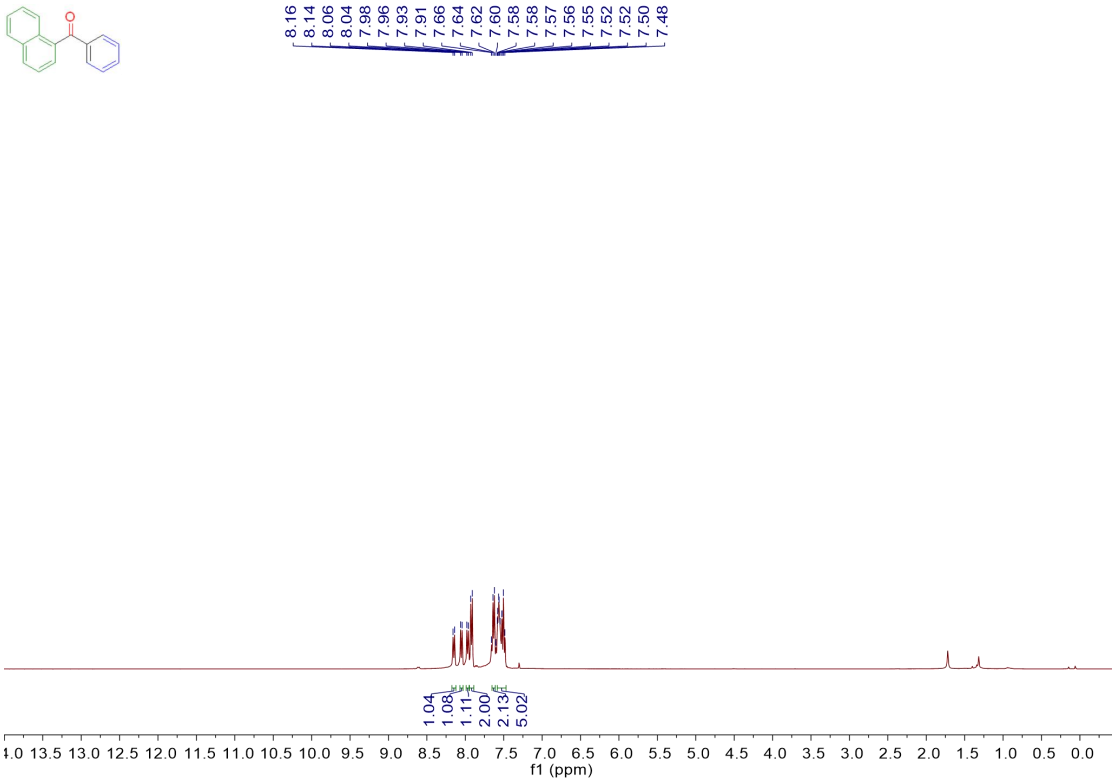


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4o**

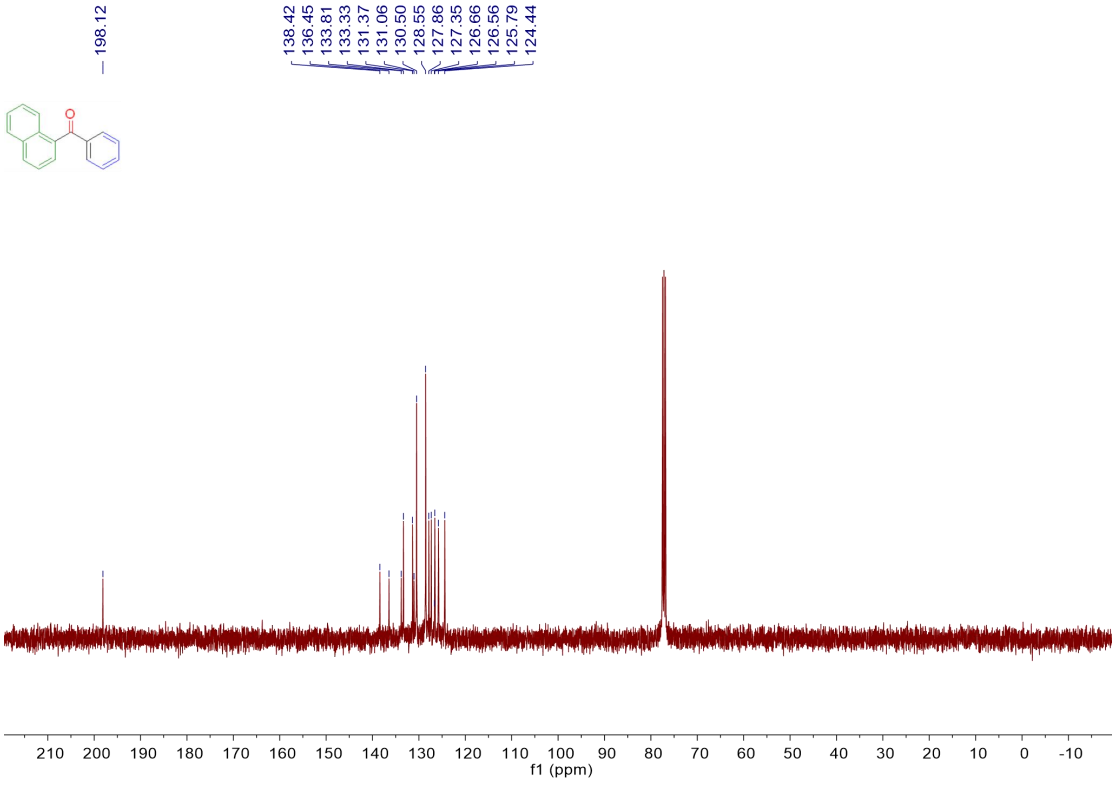


^{19}F NMR (377 MHz, $CDCl_3$) of **4o**

naphthalen-1-yl(phenyl)methanone (**4p**)

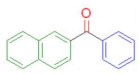


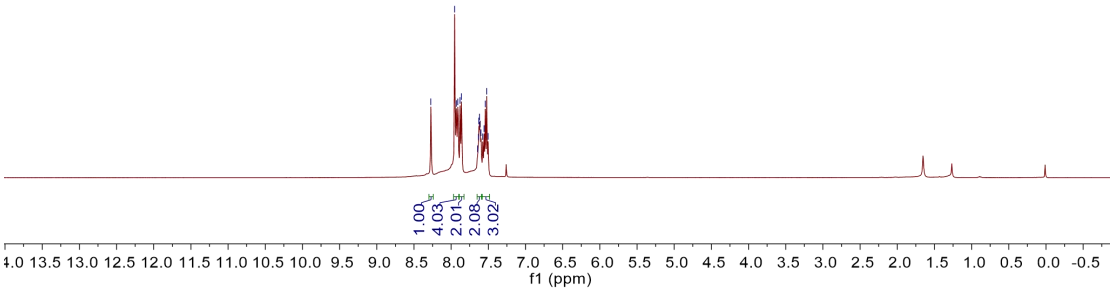
^{1}H-NMR (400 MHz, $CDCl_3$) of **4p**



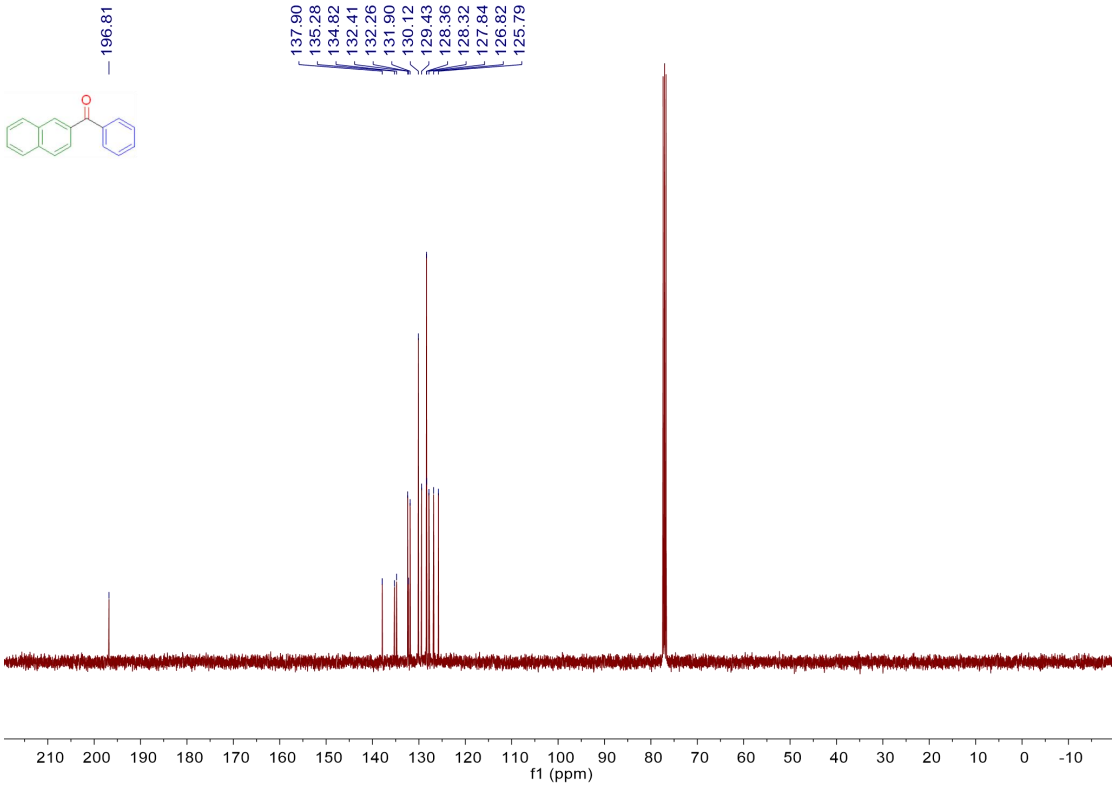
^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4p**

naphthalen-2-yl(phenyl)methanone (**4q**)



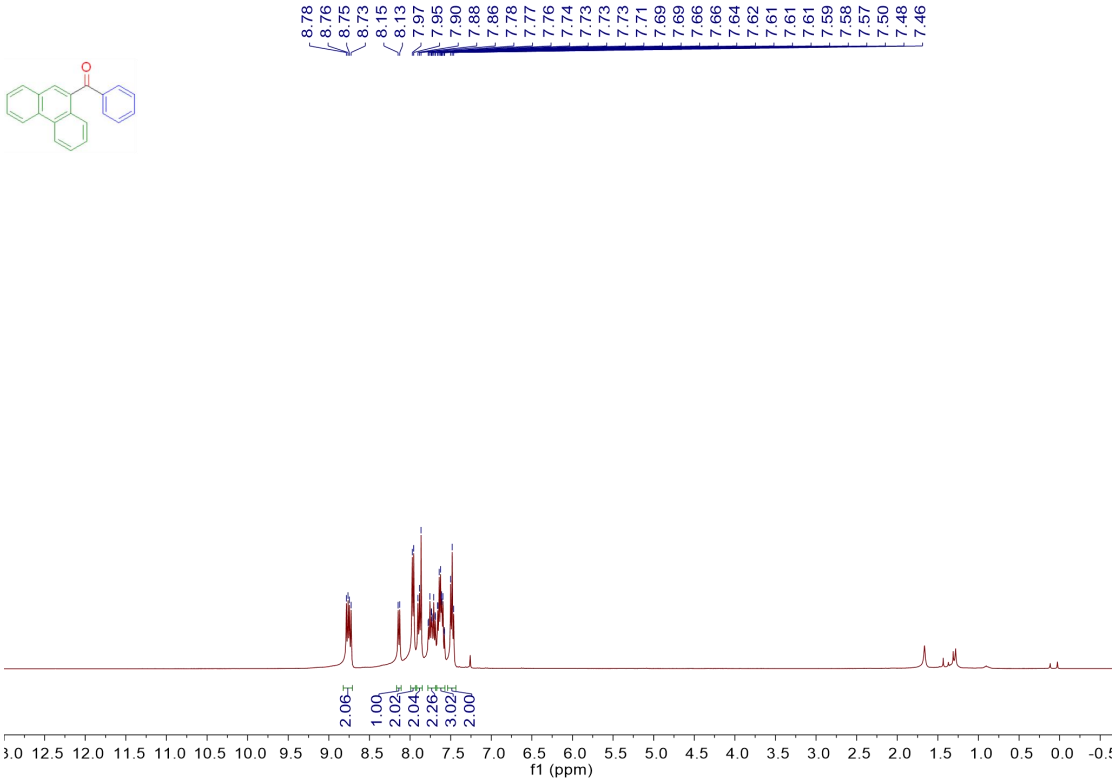


^{1}H-NMR (400 MHz, $CDCl_3$) of **4q**

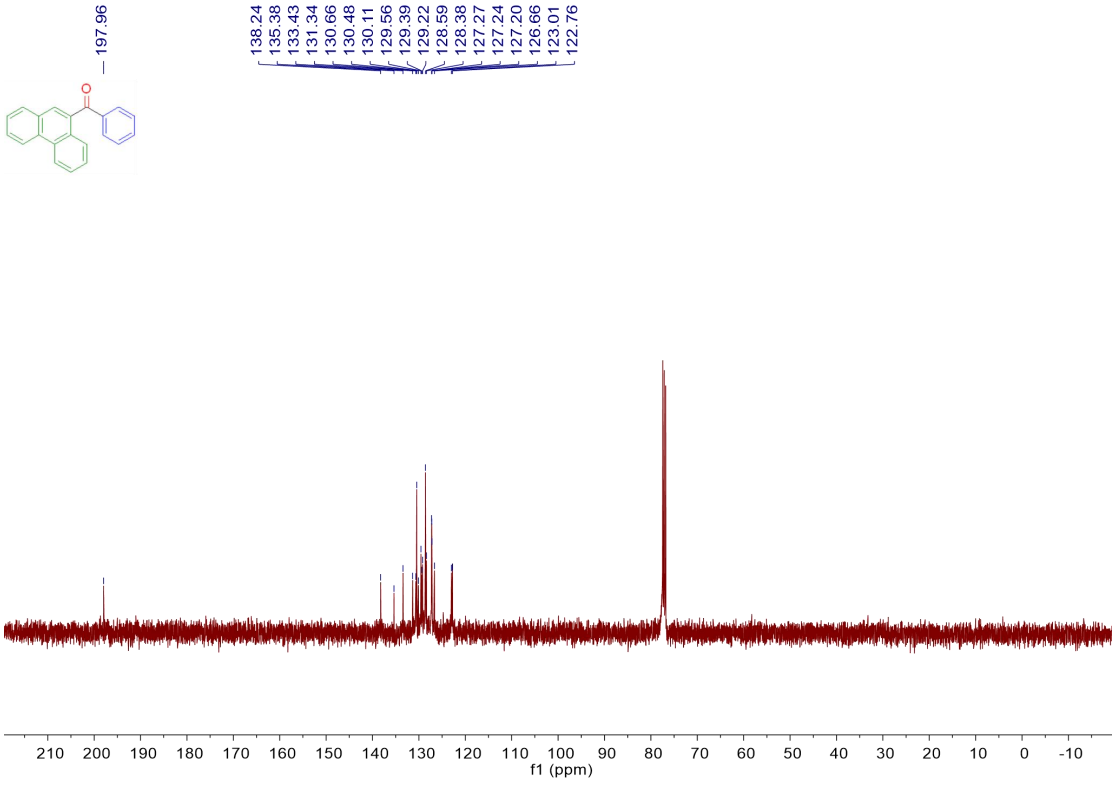


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4q**

phenanthren-9-yl(phenyl)methanone (**4r**).

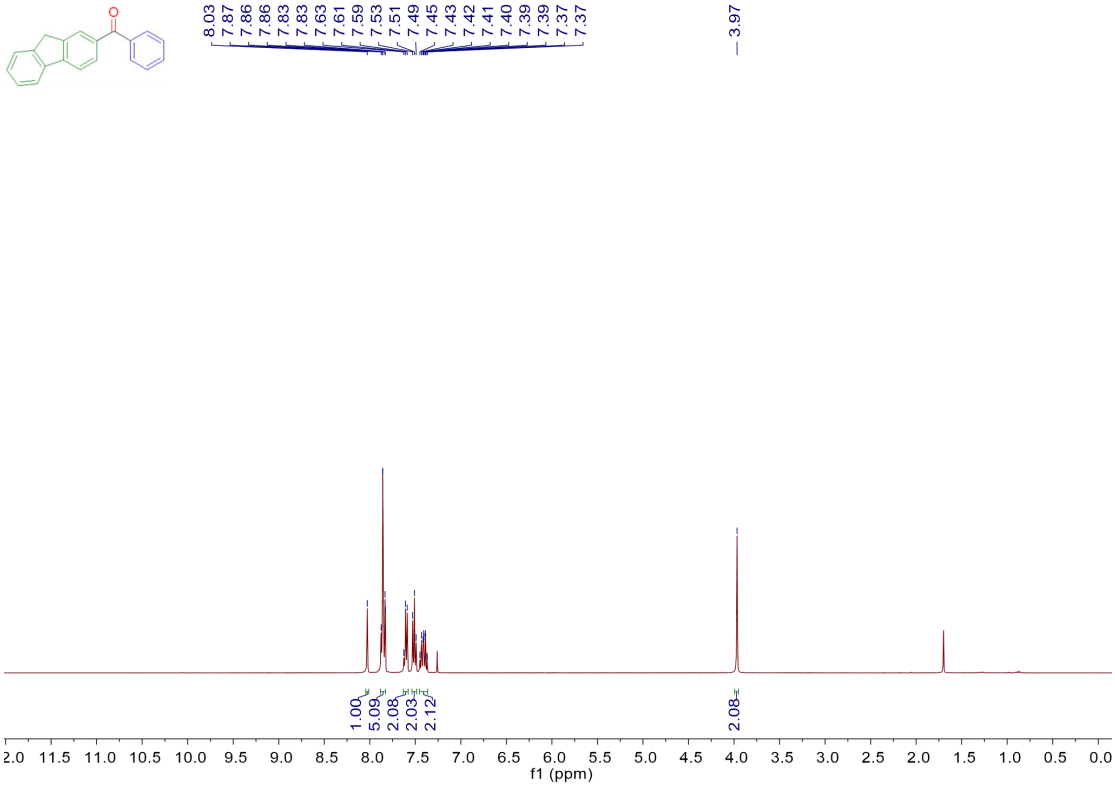


^{1}H-NMR (400 MHz, $CDCl_3$) of **4r**

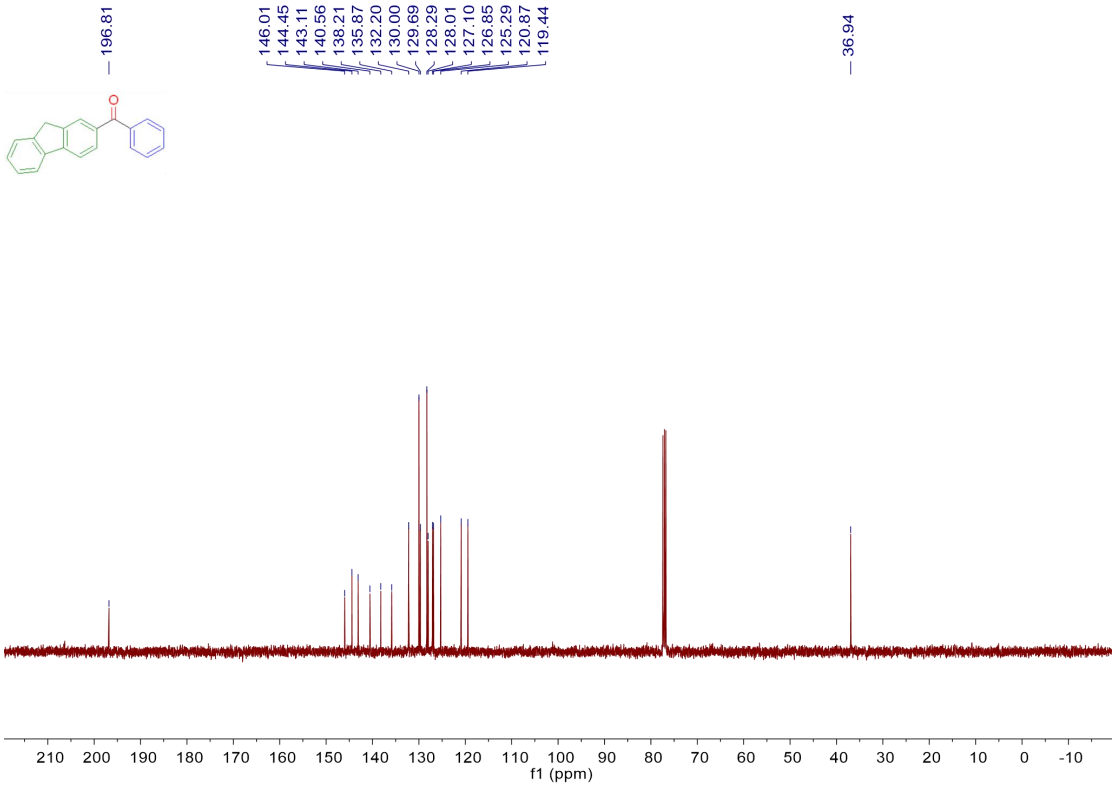


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4r**

(9H-fluoren-2-yl)(phenyl)methanone (**4s**)

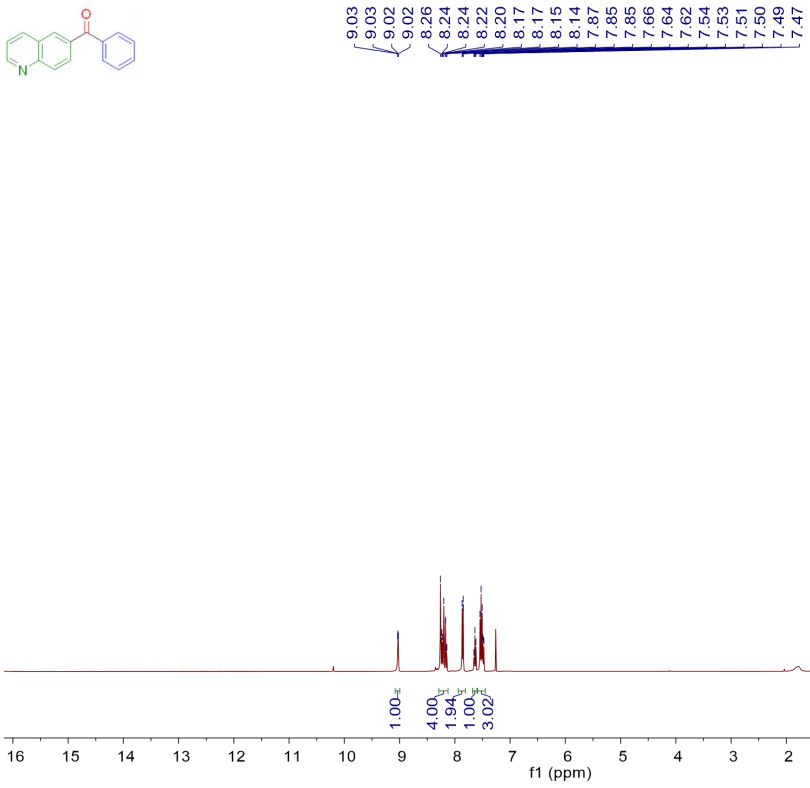


^{1}H-NMR (400 MHz, $CDCl_3$) of **4s**

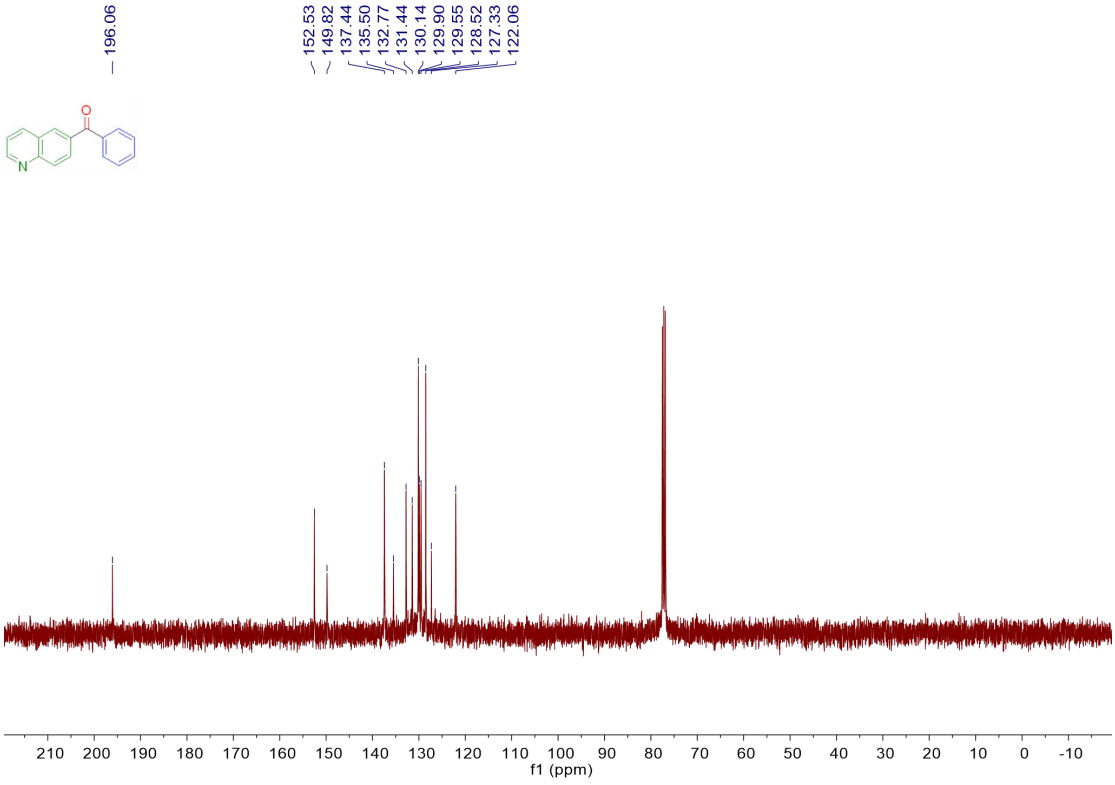


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4s**

phenyl(quinolin-6-yl)methanone (**4t**)

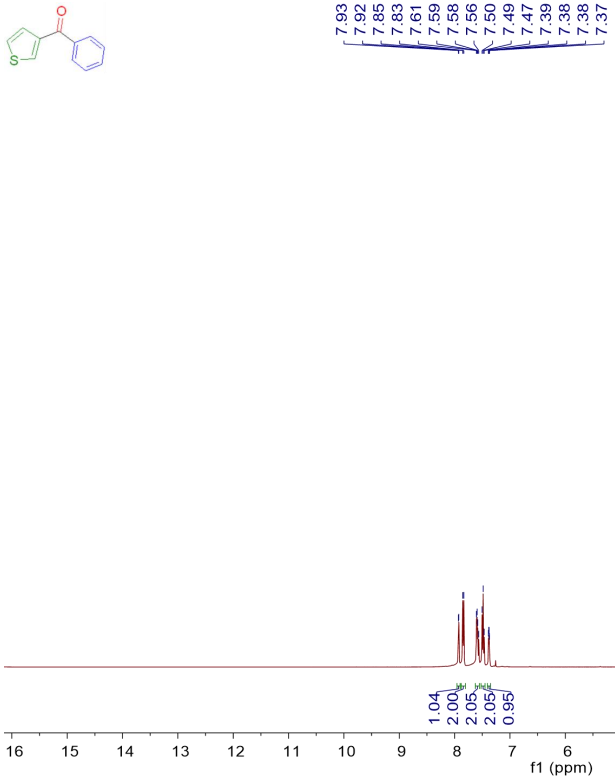


^{1}H-NMR (400 MHz, $CDCl_3$) of **4t**

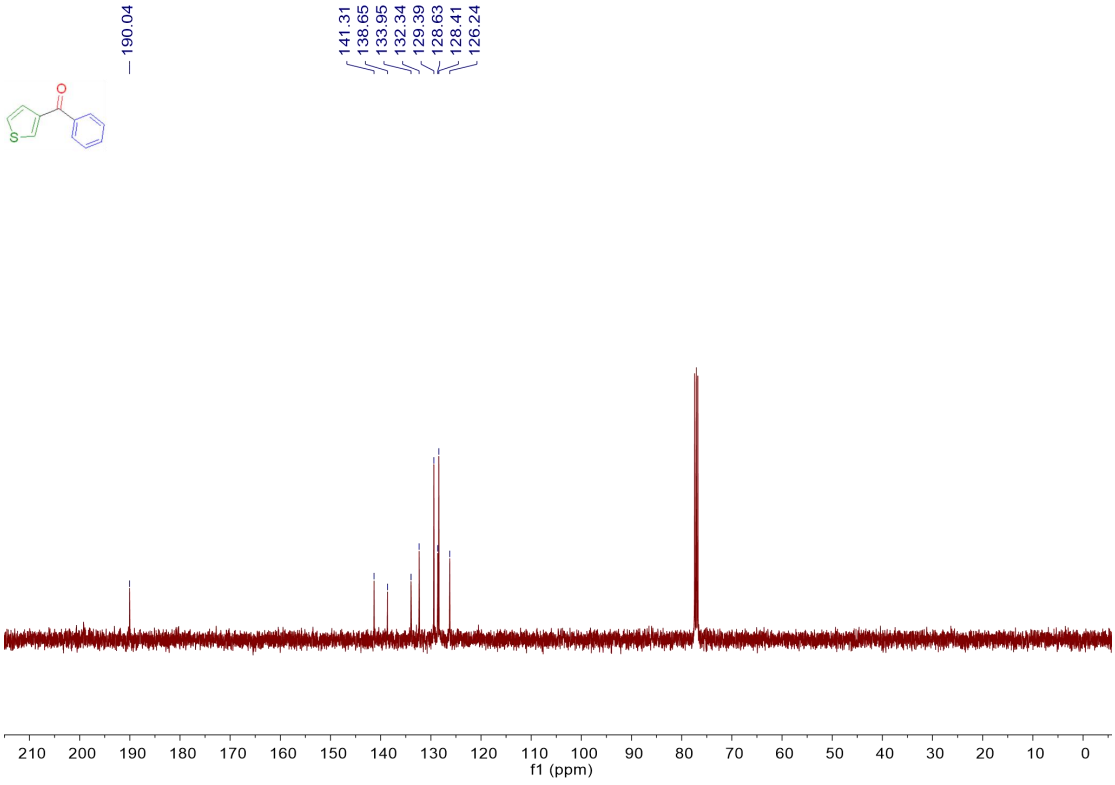


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4t**

phenyl(thiophen-3-yl)methanone (**4u**)

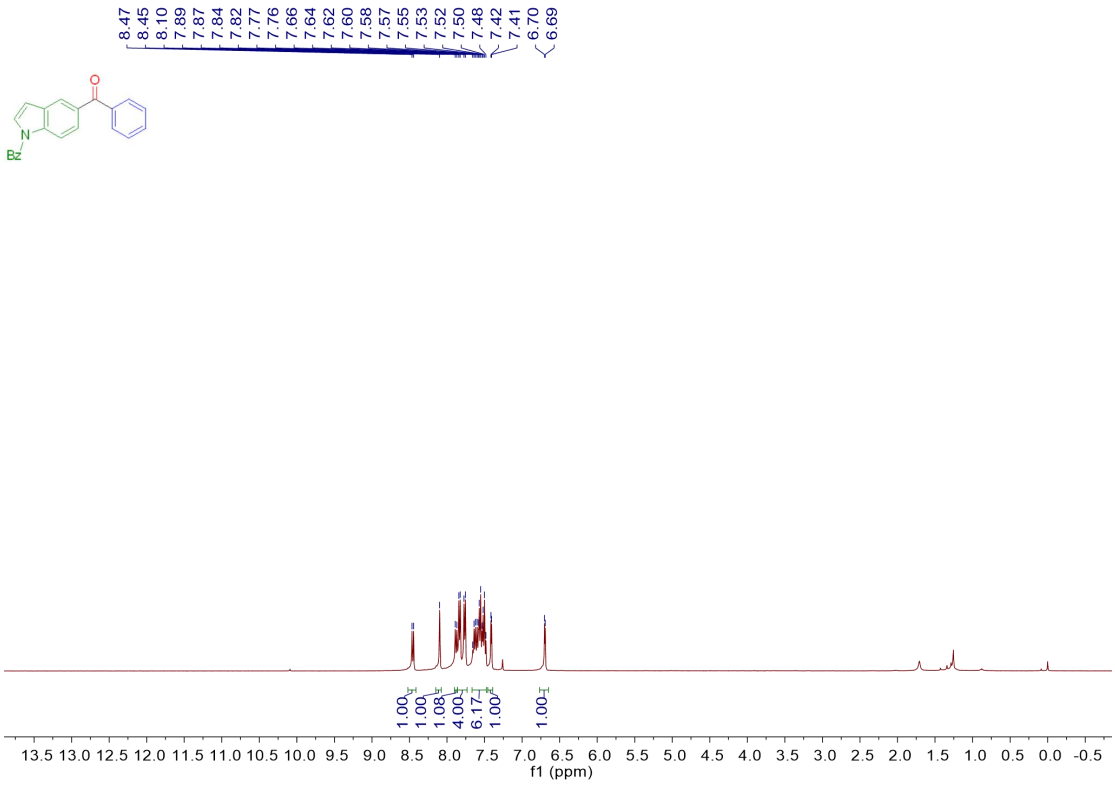


^{1}H-NMR (400 MHz, $CDCl_3$) of **4u**

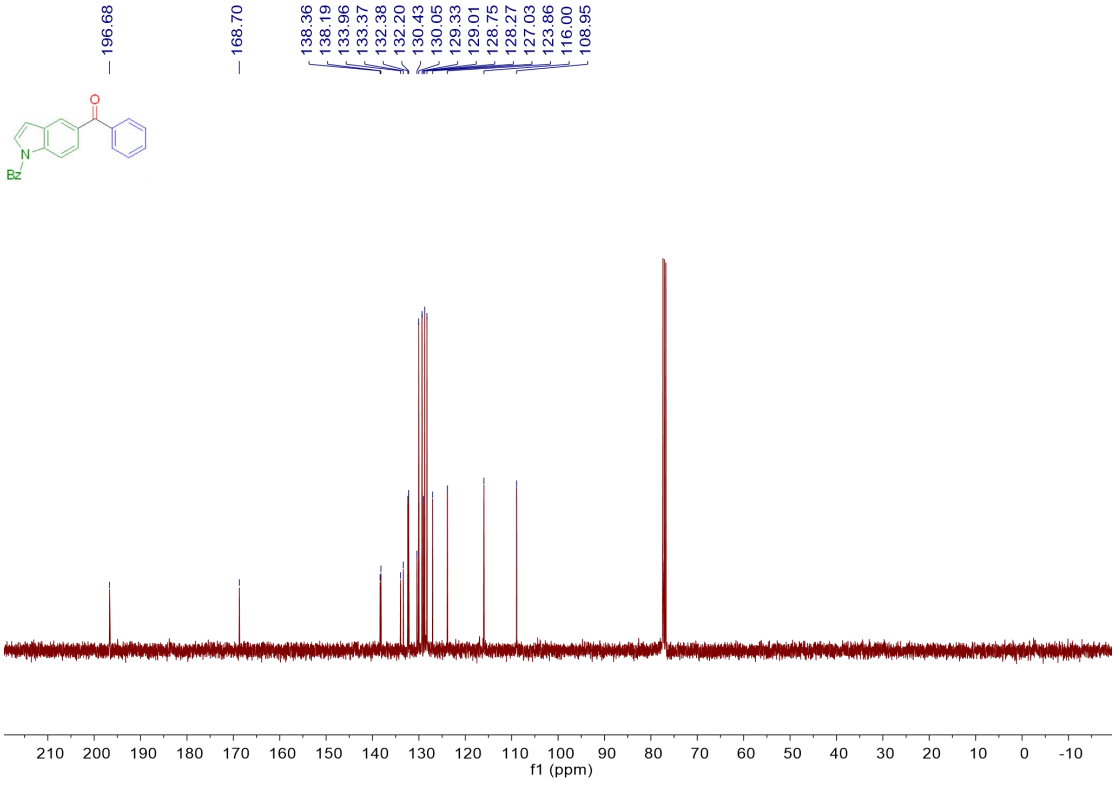


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4u**

(1H-indole-1,5-diyl)bis(phenylmethanone) (**4v**)

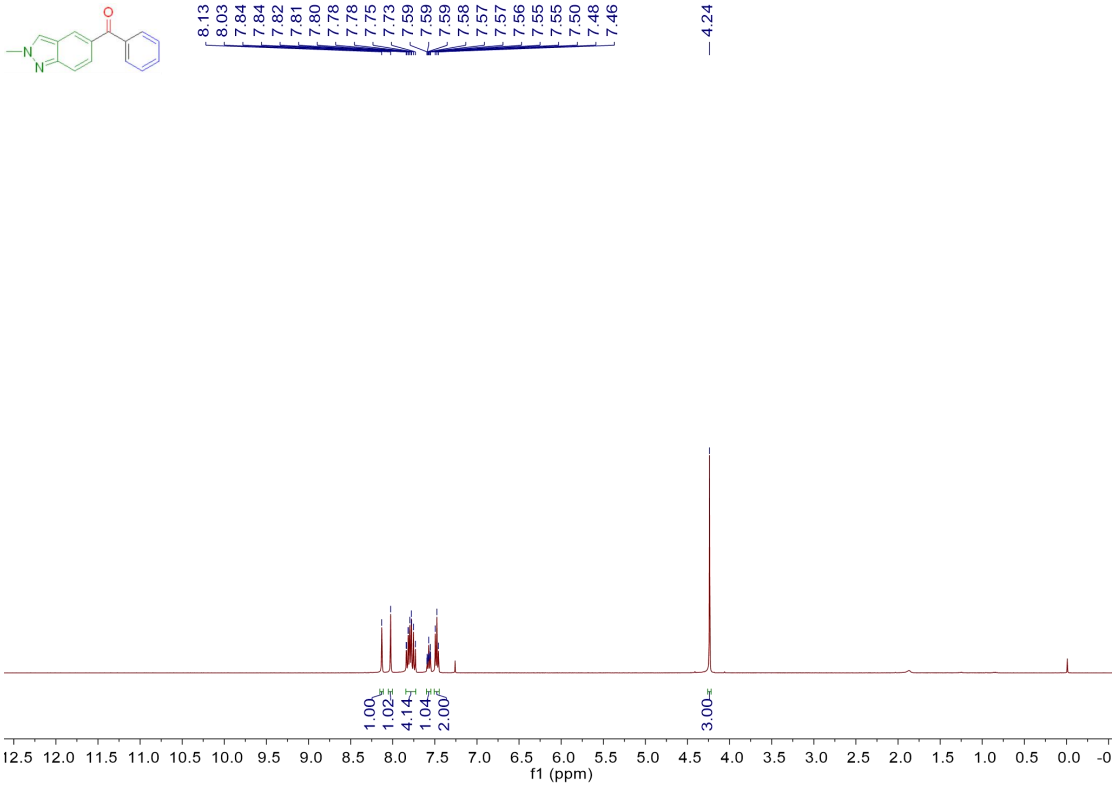


^{1}H-NMR (400 MHz, $CDCl_3$) of **4v**

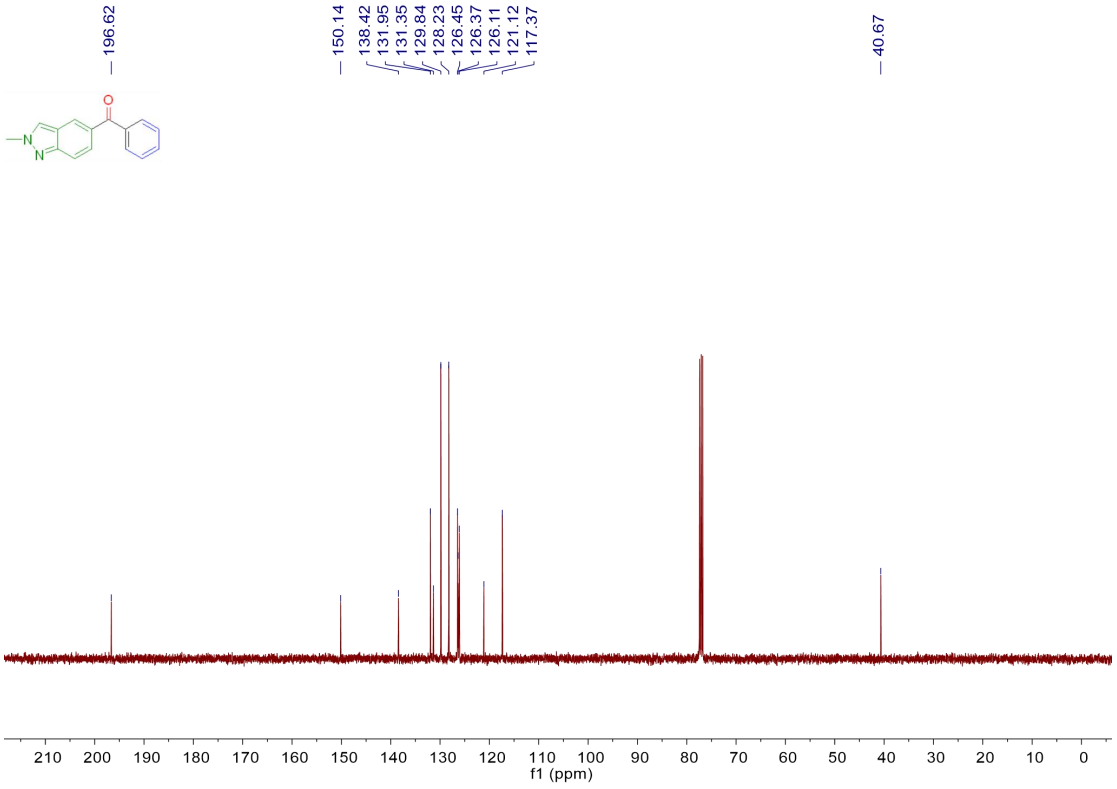


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4v**

(2-methyl-2H-indazol-5-yl)(phenyl)methanone (**4w**)

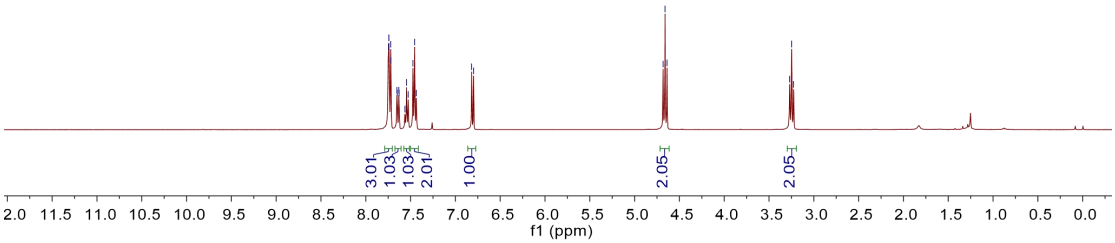


^{1}H-NMR (400 MHz, $CDCl_3$) of **4w**

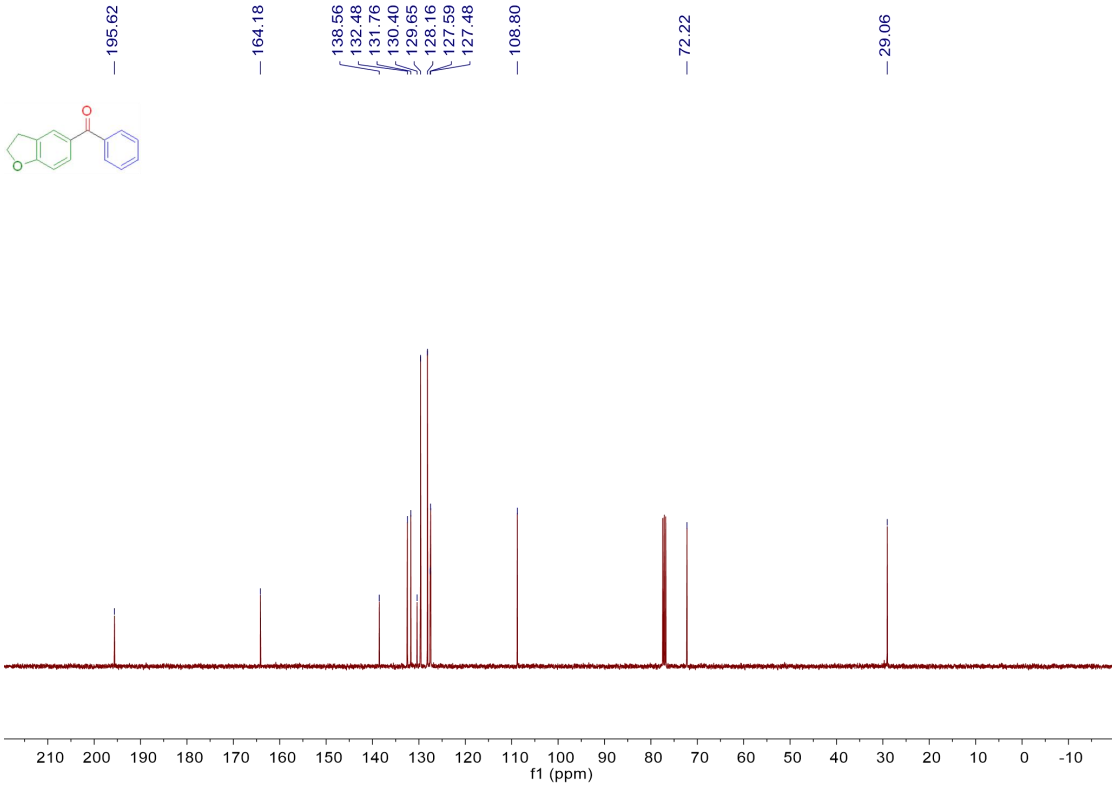


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4w**

(2,3-dihydrobenzofuran-5-yl)(phenyl)methanone (**4x**)

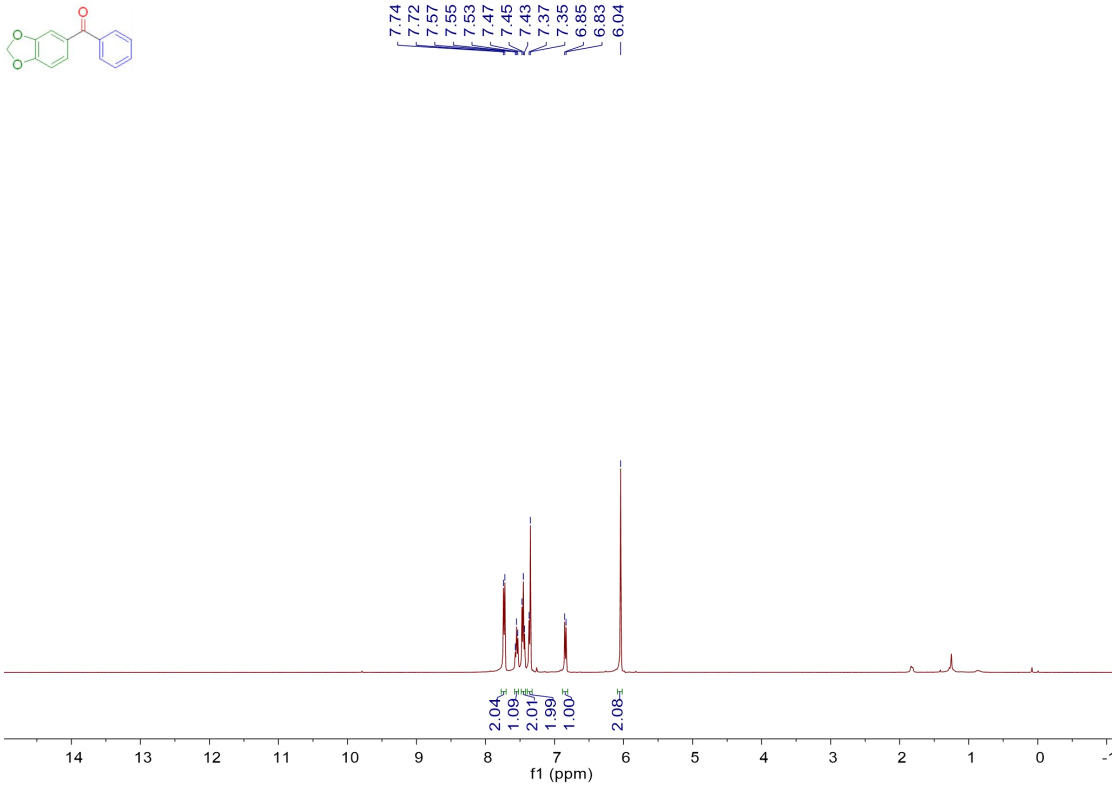


^{1}H-NMR (400 MHz, $CDCl_3$) of **4x**

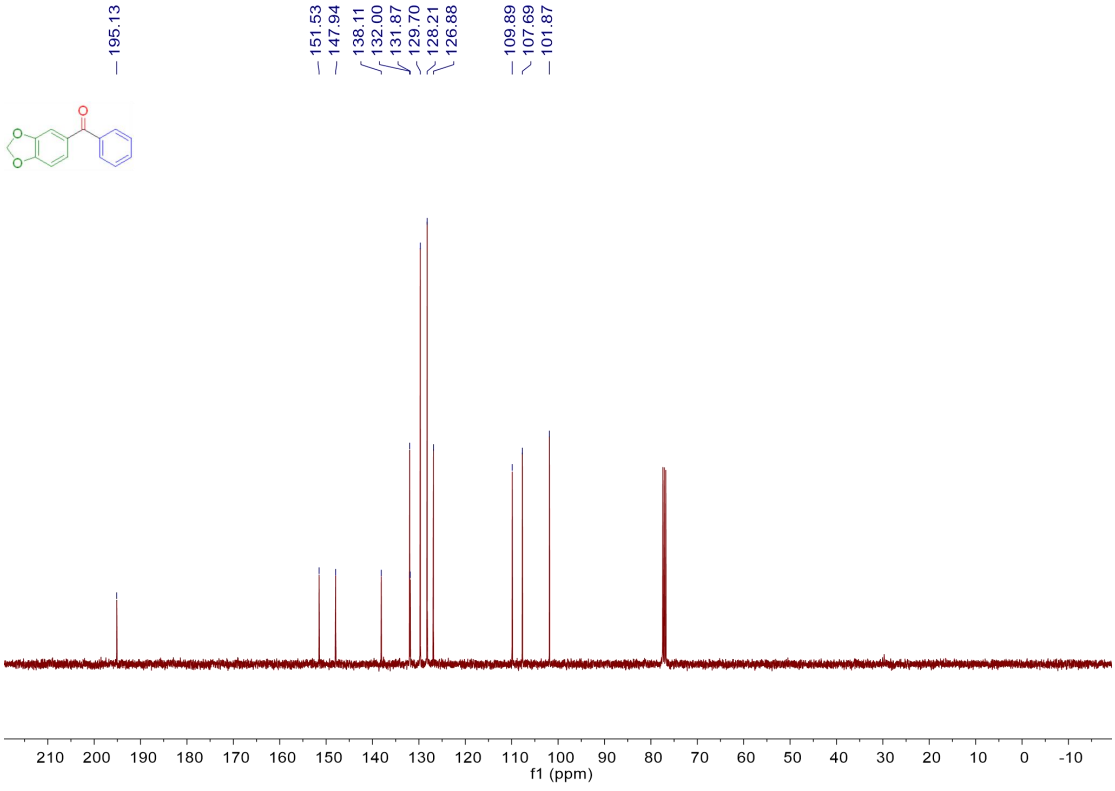


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4x**

benzo[d][1,3]dioxol-5-yl(phenyl)methanone (**4y**).

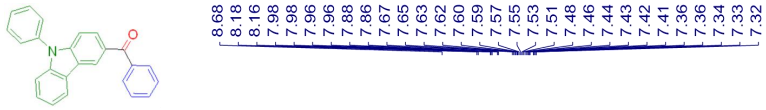


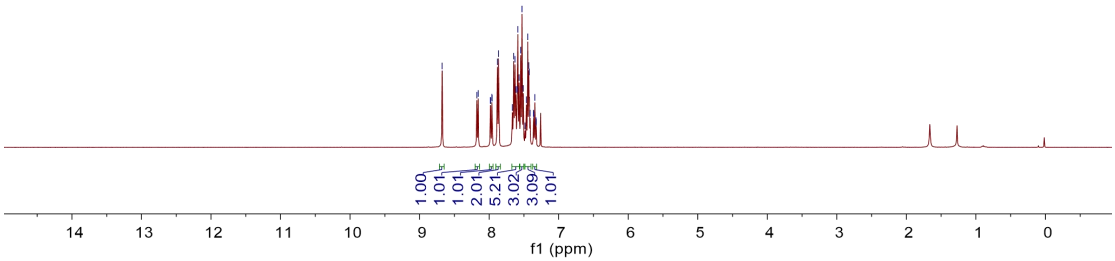
^{1}H-NMR (400 MHz, $CDCl_3$) of **4y**



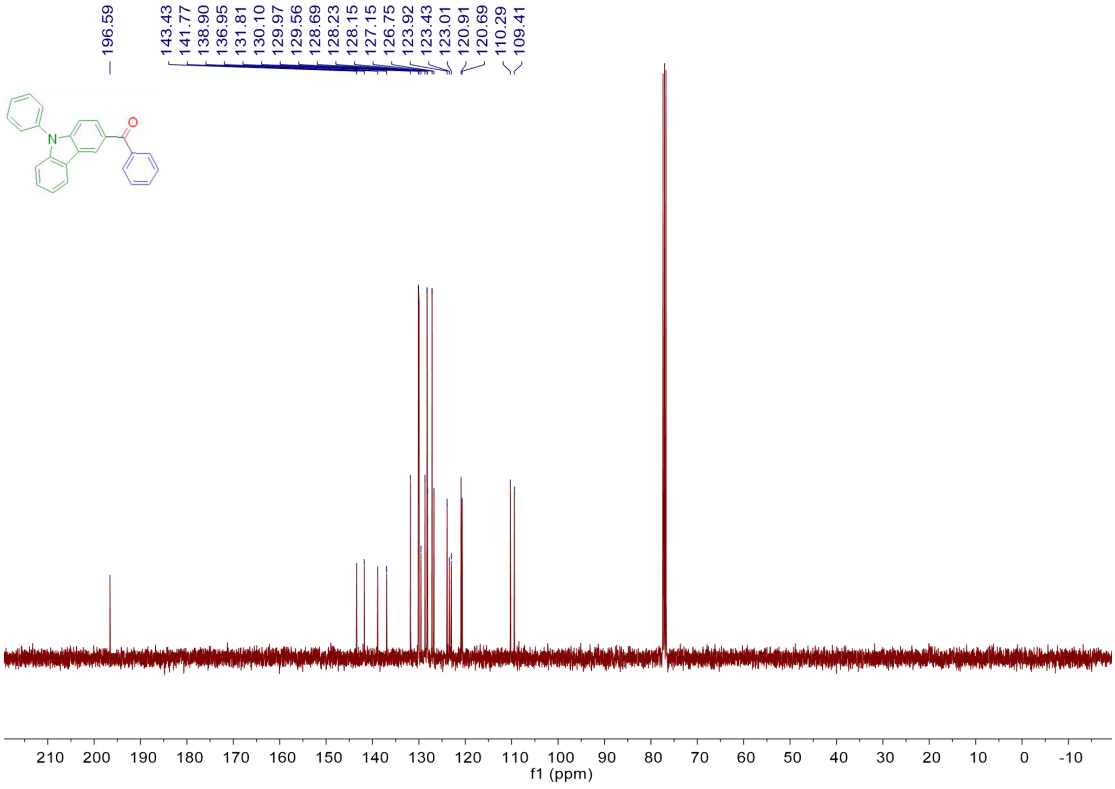
^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4y**

phenyl(9-phenyl-9H-carbazol-3-yl)methanone (**4z**).



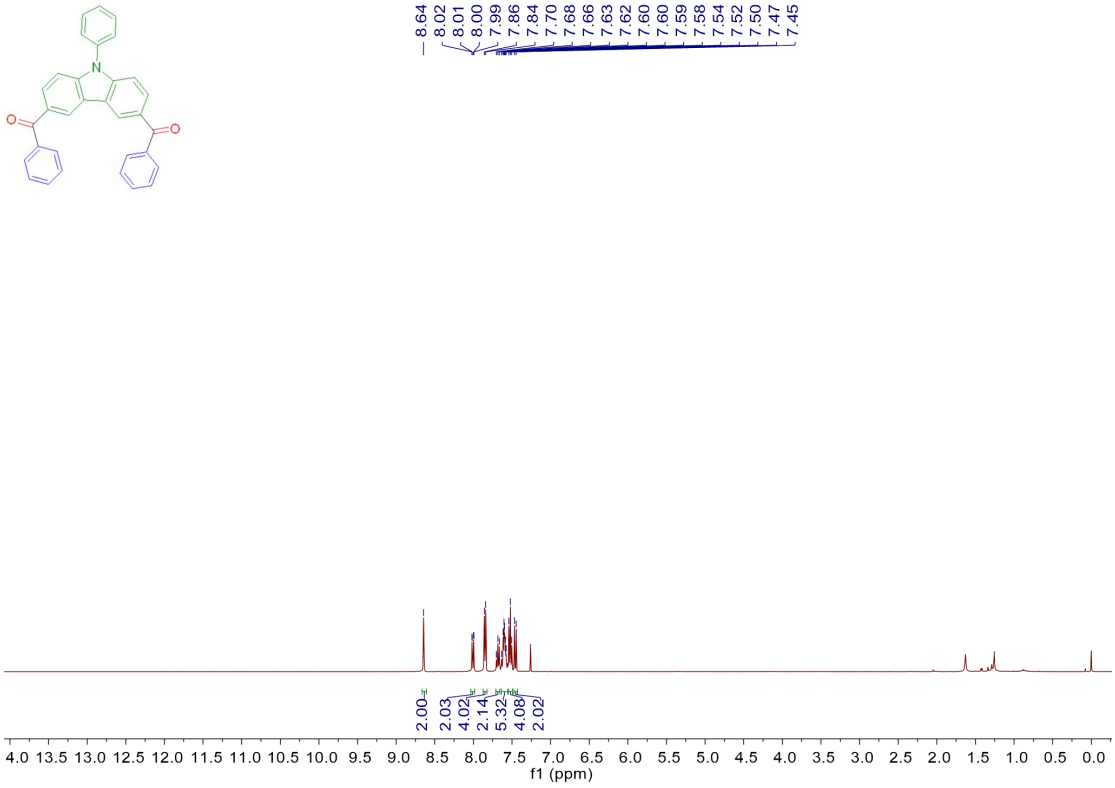


^{1}H-NMR (400 MHz, $CDCl_3$) of **4z**

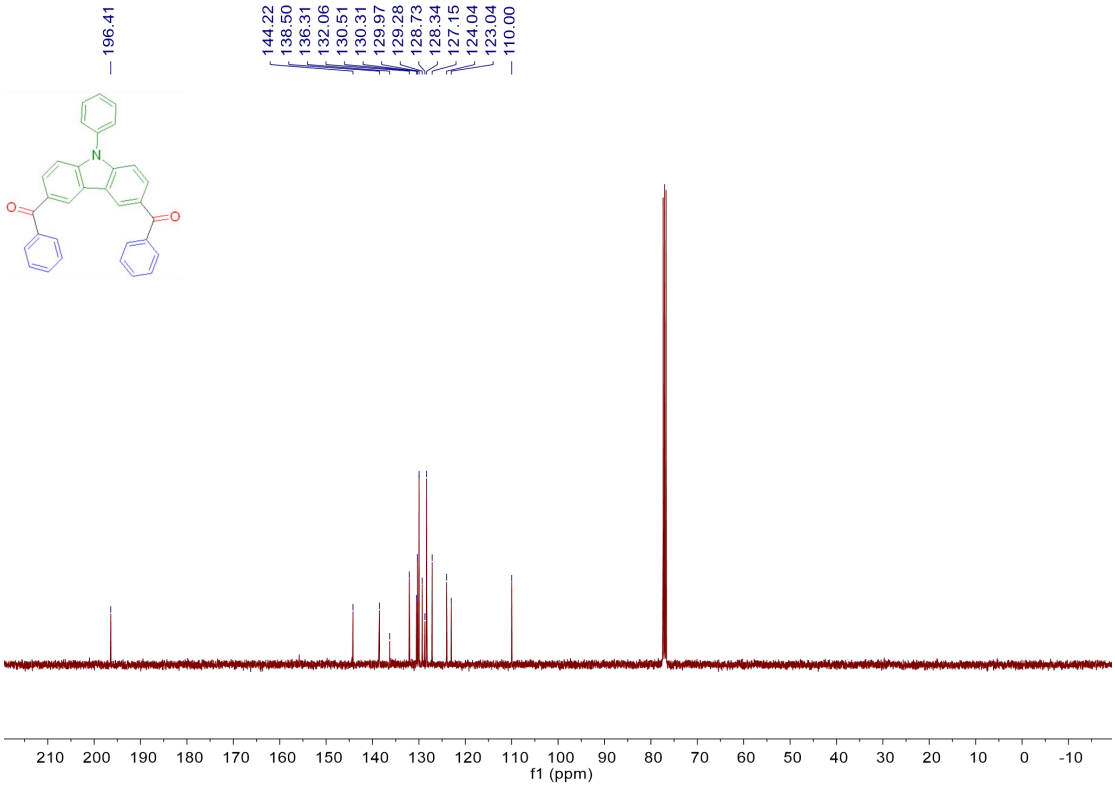


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4z**

(9-phenyl-9H-carbazole-3,6-diyl)bis(phenylmethanone) (**4aa**)

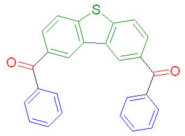


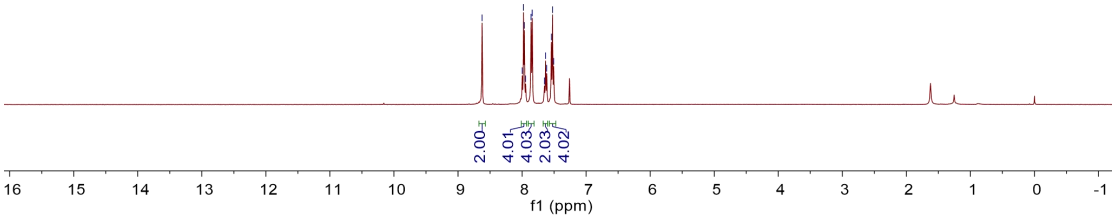
^{1}H-NMR (400 MHz, $CDCl_3$) of **4aa**



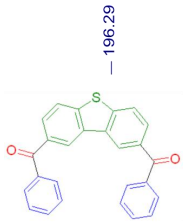
^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4aa**

dibenzo[b,d]thiophene-2,8-diylbis(phenylmethanone) (**4ab**).



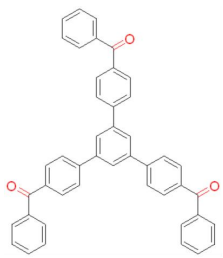


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ab**

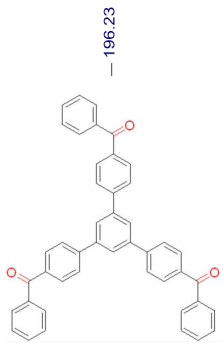


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ab**

1,3,5-Tris(4-benzoylphenyl)benzene (**4ac**)

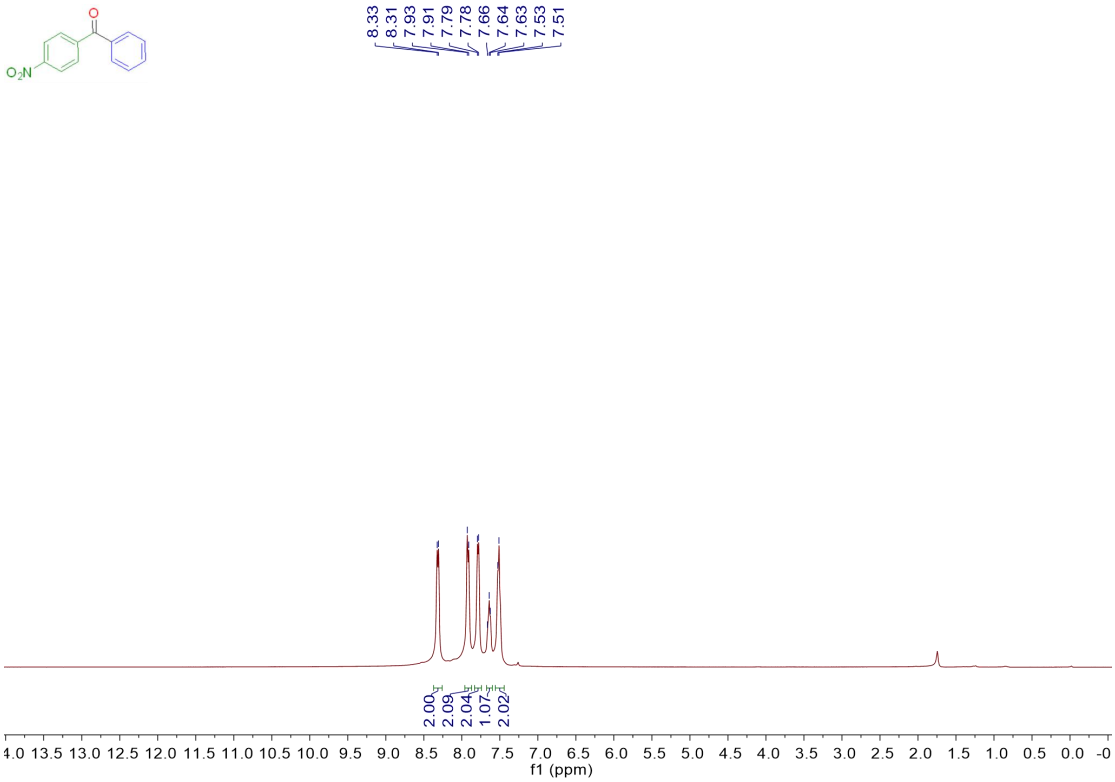


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ac**

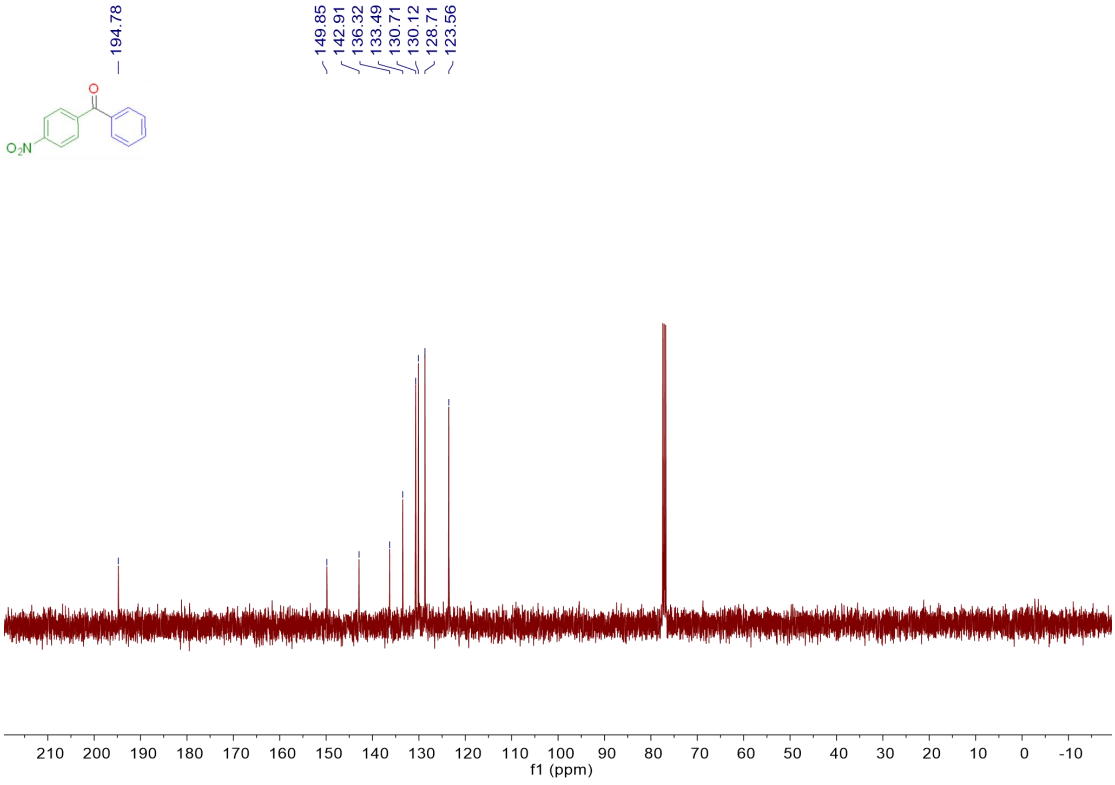


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ac**

(4-nitrophenyl)(phenyl)methanone (**4ad**)

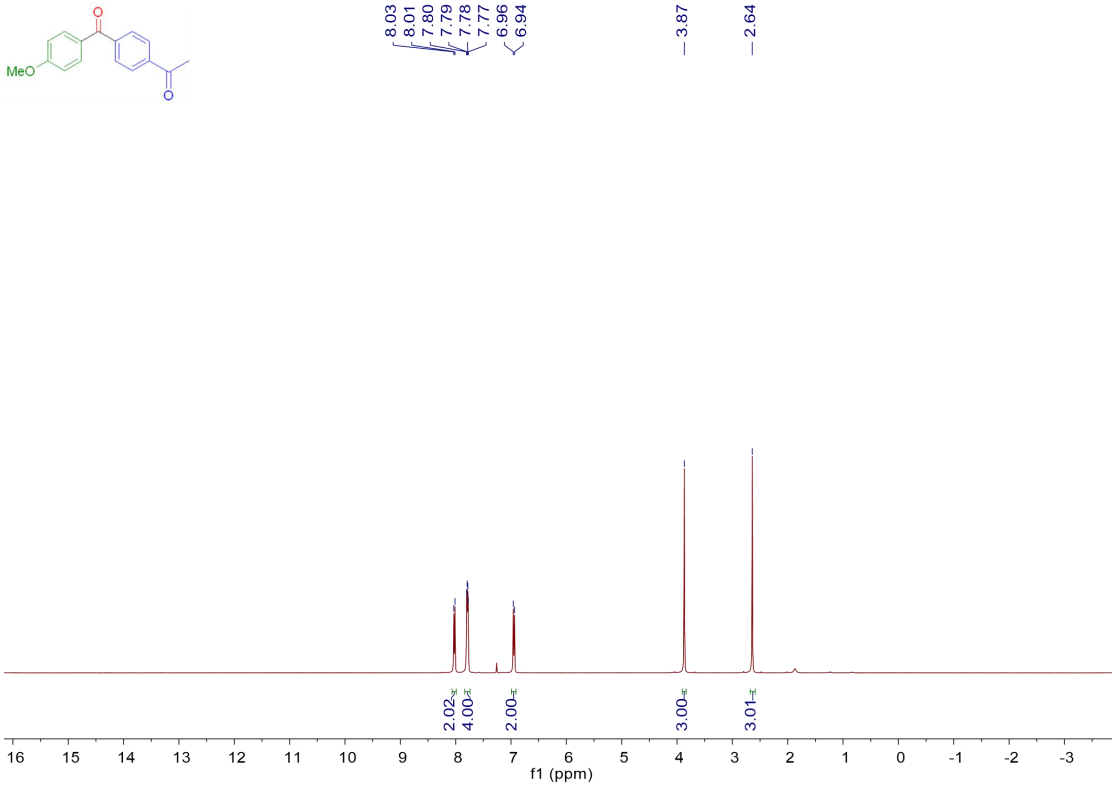


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ad**

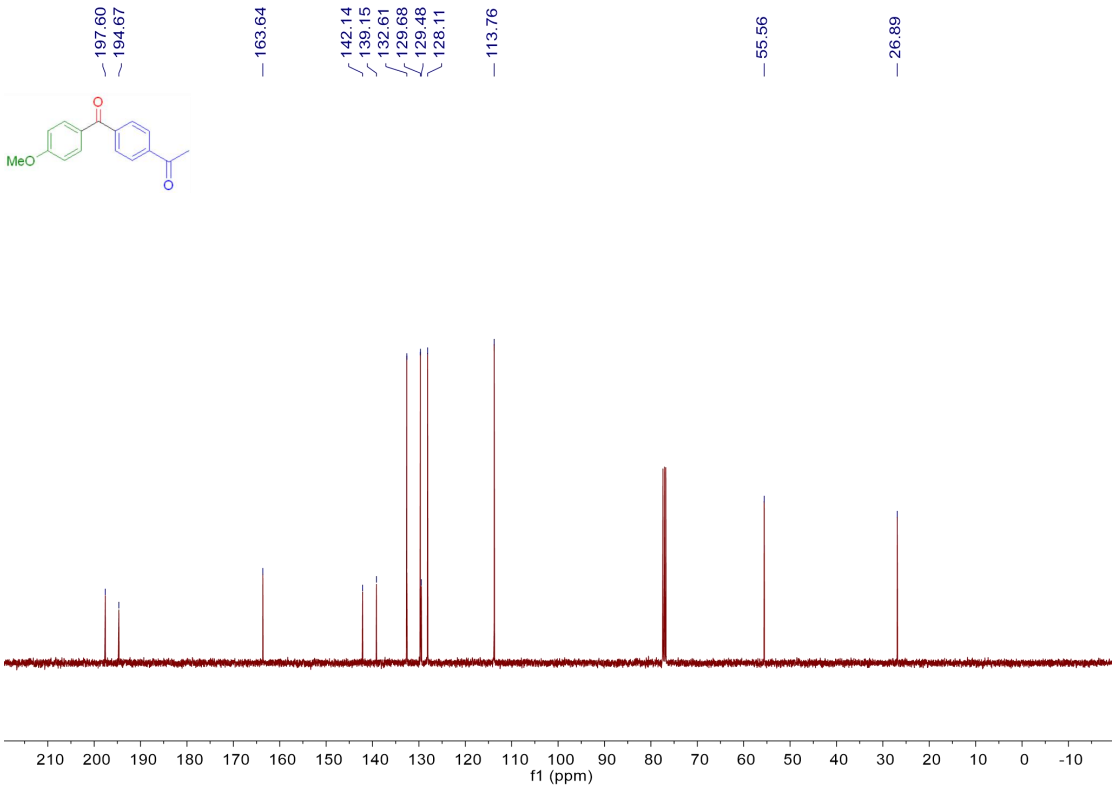


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ad**

1-(4-(4-methoxybenzoyl)phenyl)ethan-1-one (**4ae**)

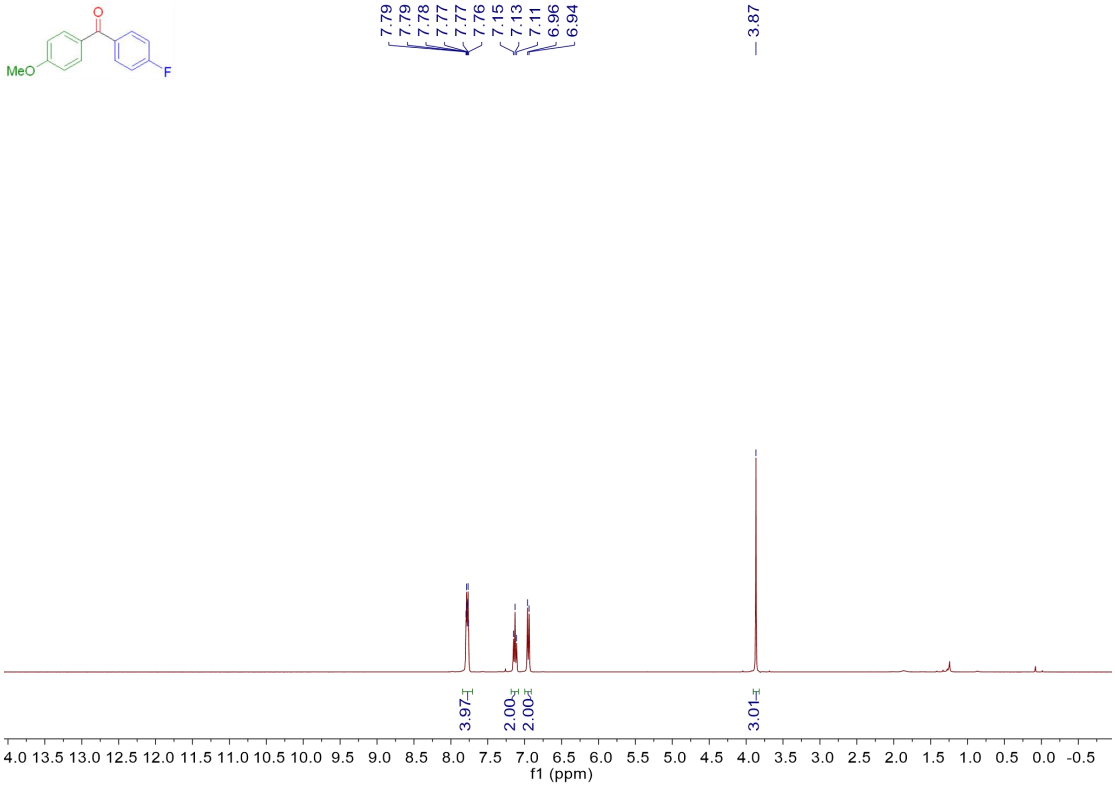


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ae**

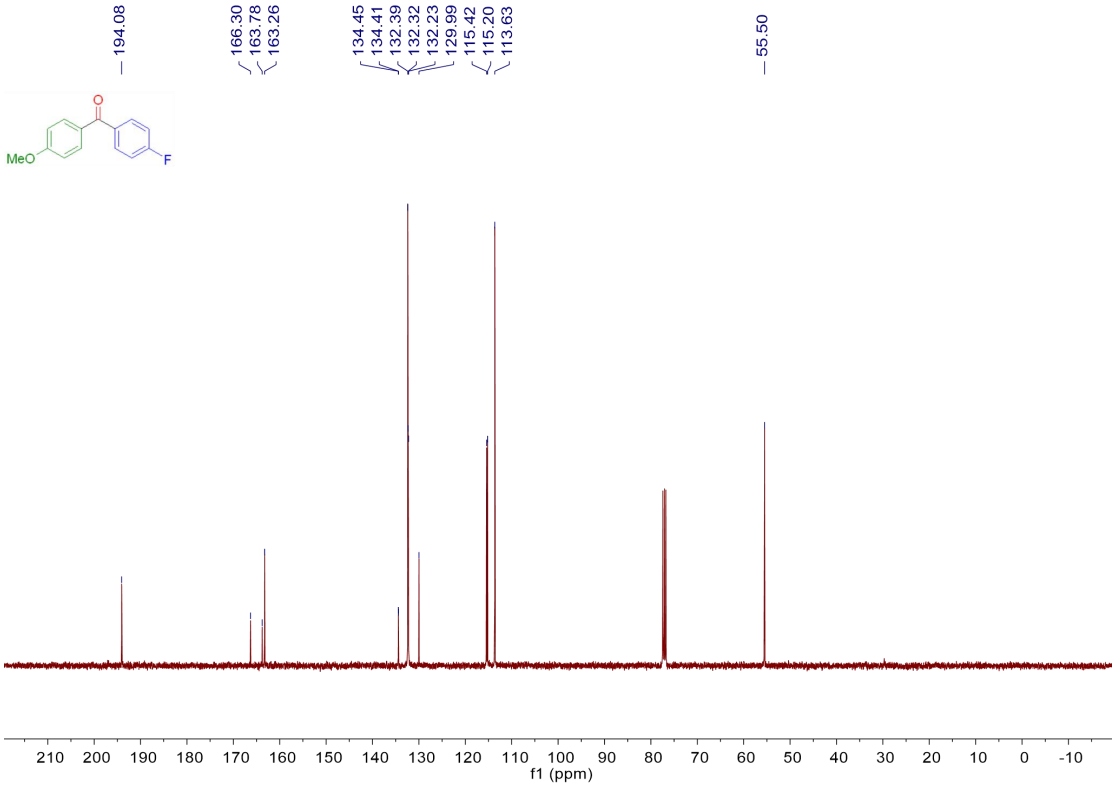


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ae**

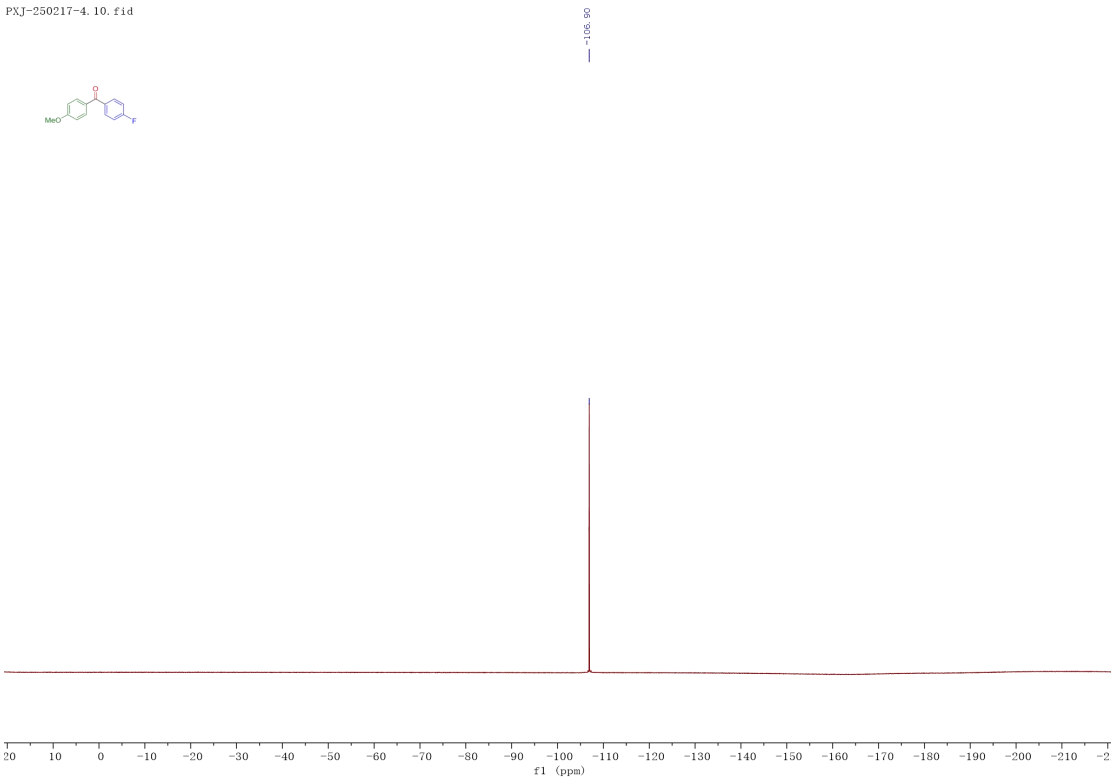
(4-fluorophenyl)(4-methoxyphenyl)methanone (**4af**).



^{1}H-NMR (400 MHz, $CDCl_3$) of **4af**

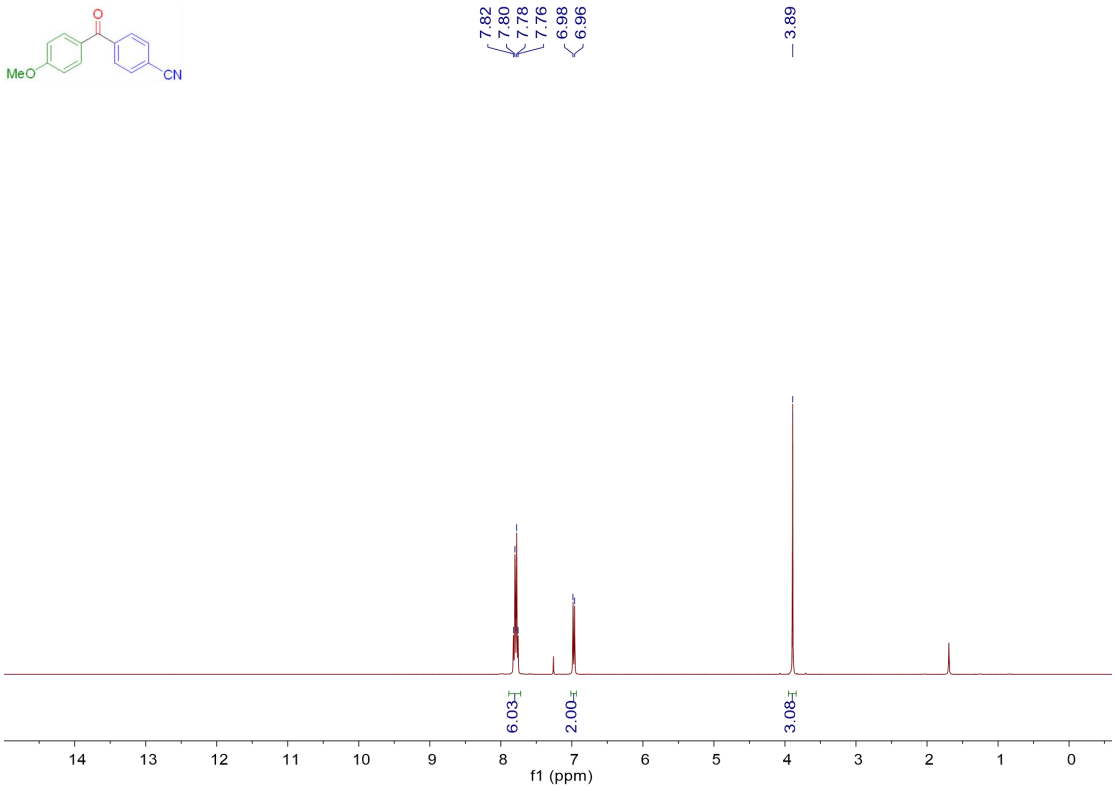


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4af**

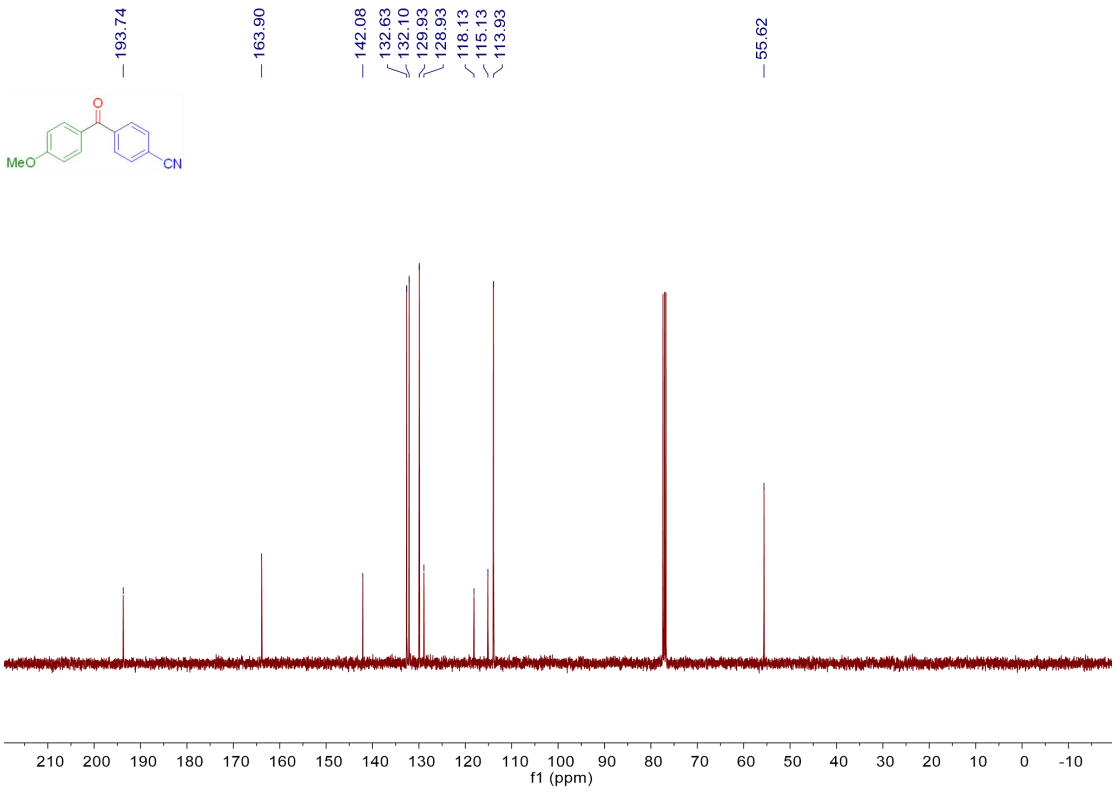


^{19}F NMR (377 MHz, $CDCl_3$) of **4af**

4-(4-methoxybenzoyl)benzonitrile (**4ag**)

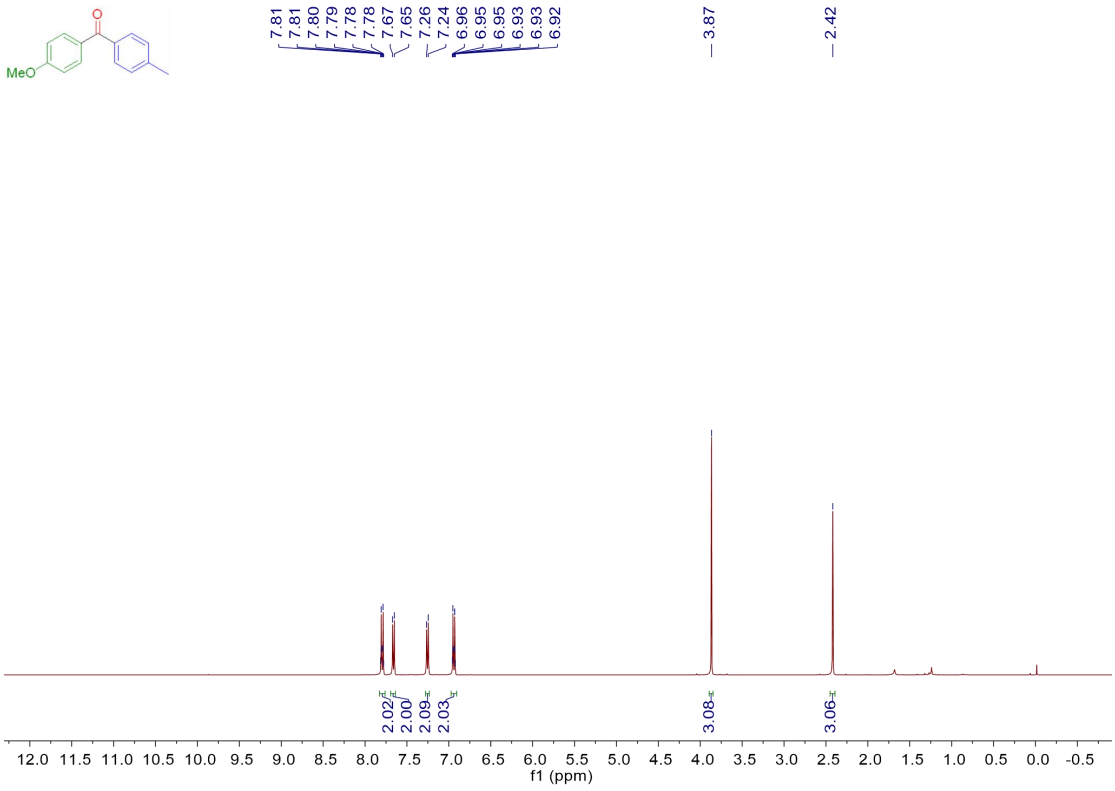


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ag**

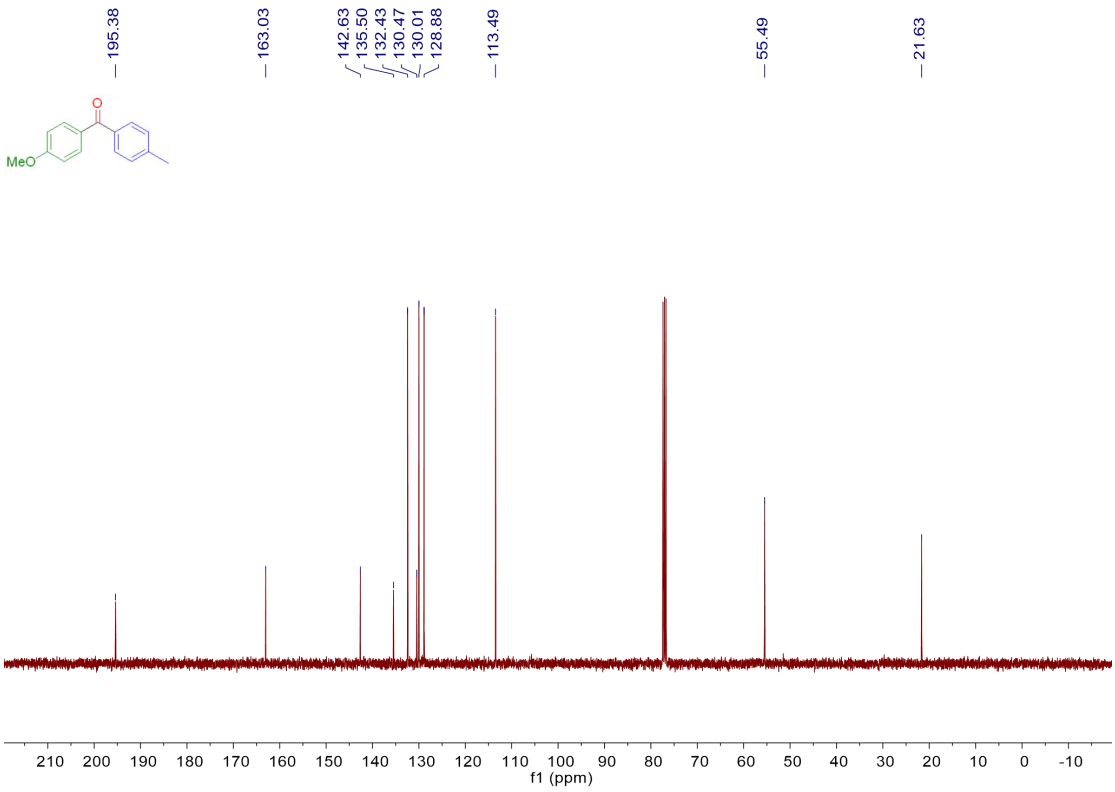


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ag**

(4-methoxyphenyl)(p-tolyl)methanone (**4ah**)

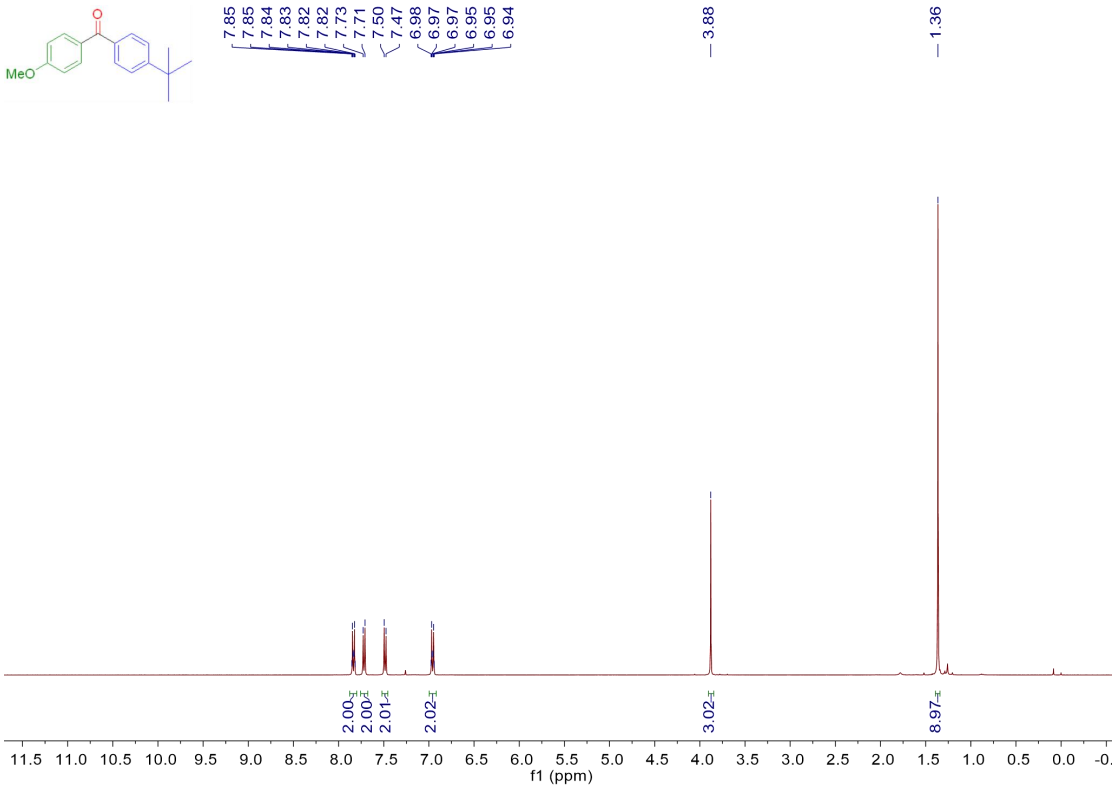


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ah**

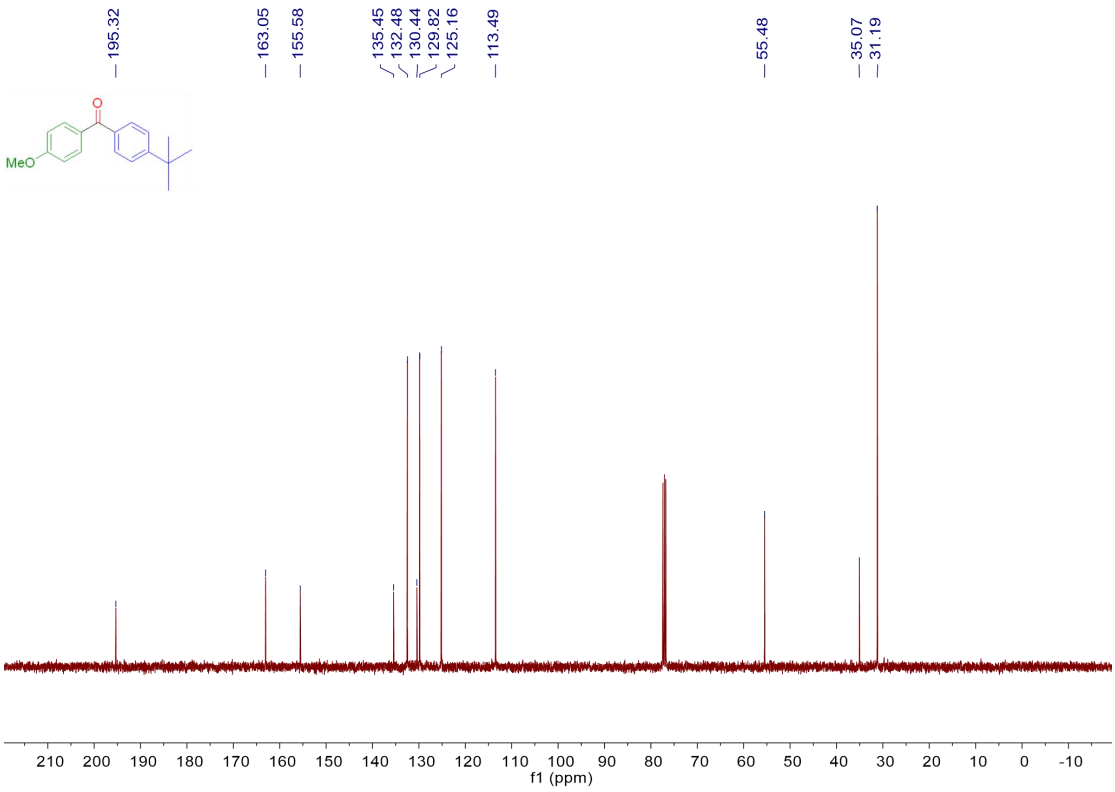


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ah**

(4-(tert-butyl)phenyl)(4-methoxyphenyl)methanone (**4ai**)

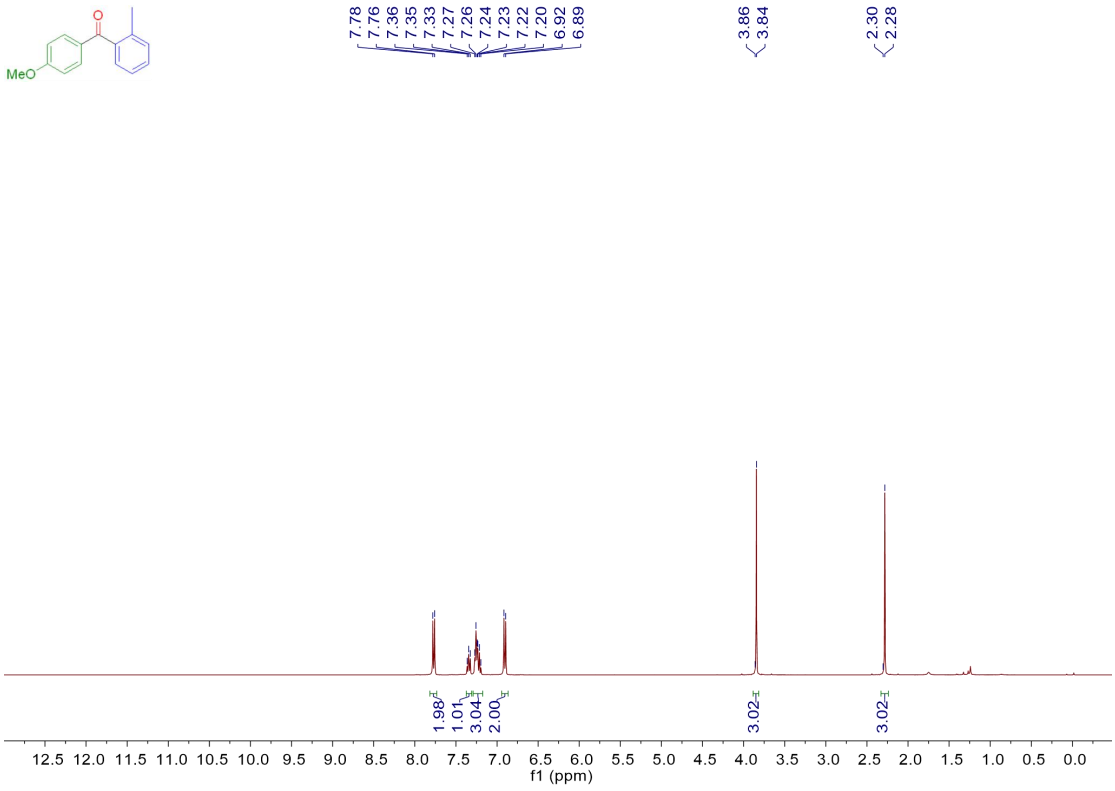


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ai**

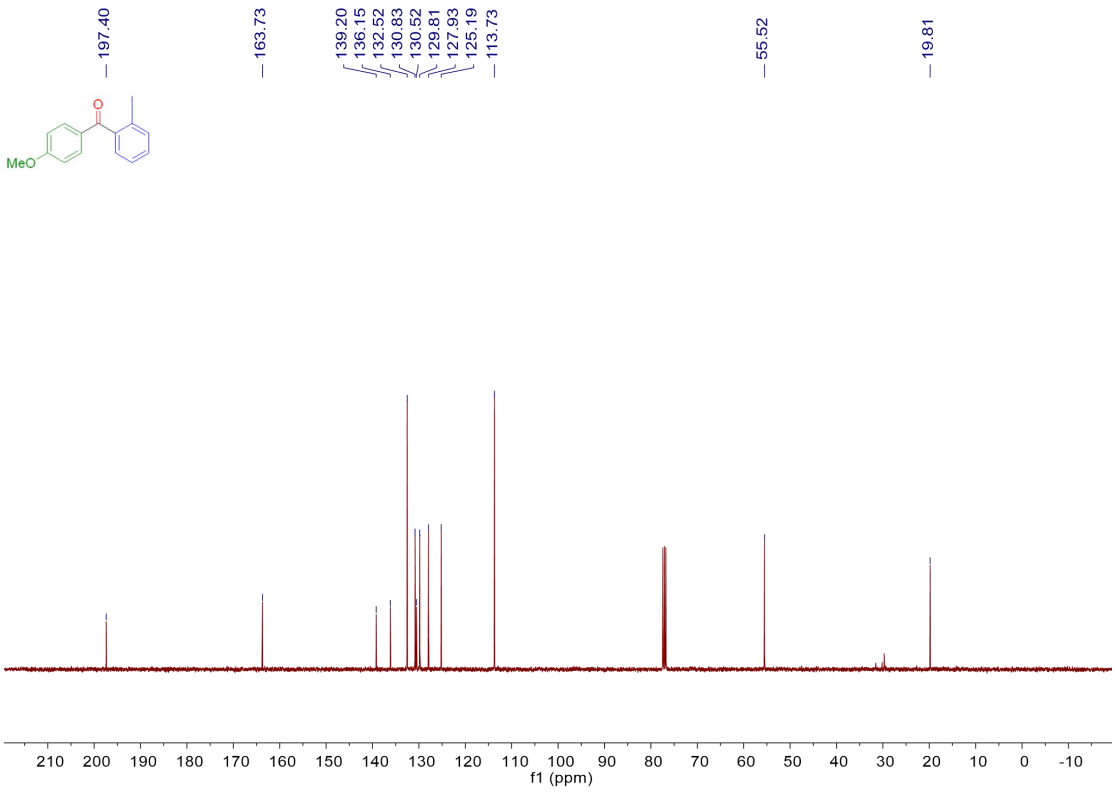


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ai**

(4-methoxyphenyl)(o-tolyl)methanone (**4aj**)

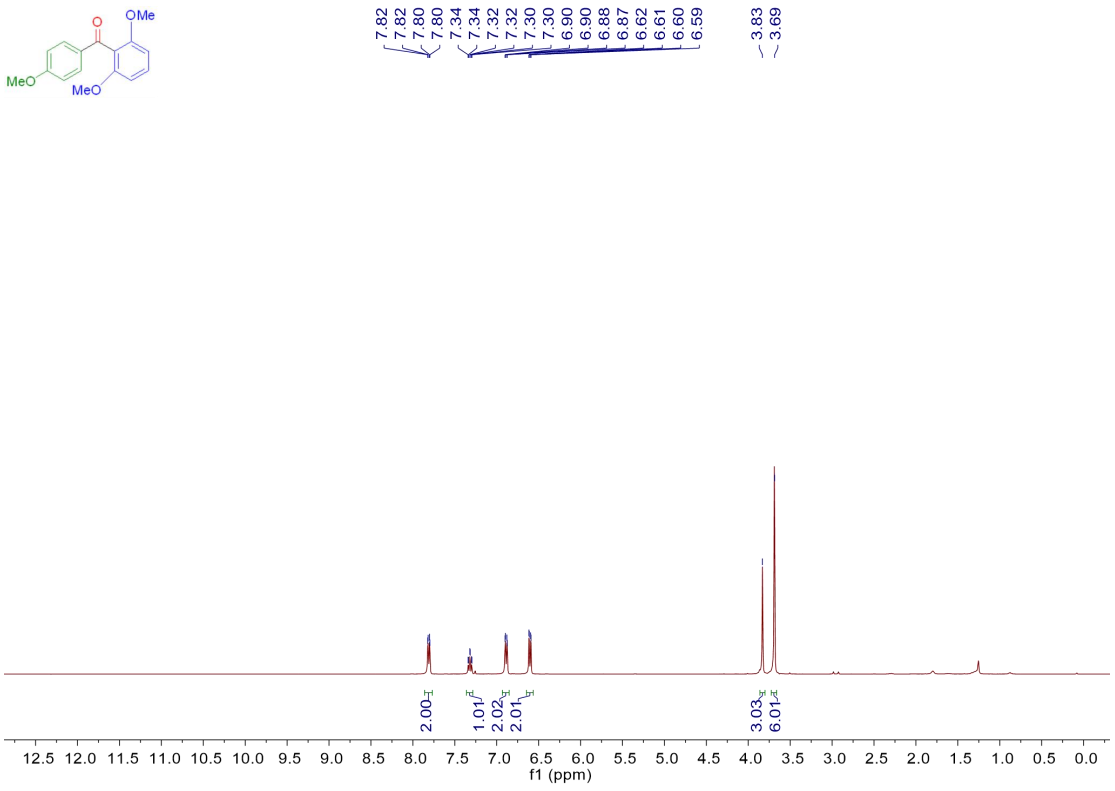


^{1}H-NMR (400 MHz, $CDCl_3$) of **4aj**

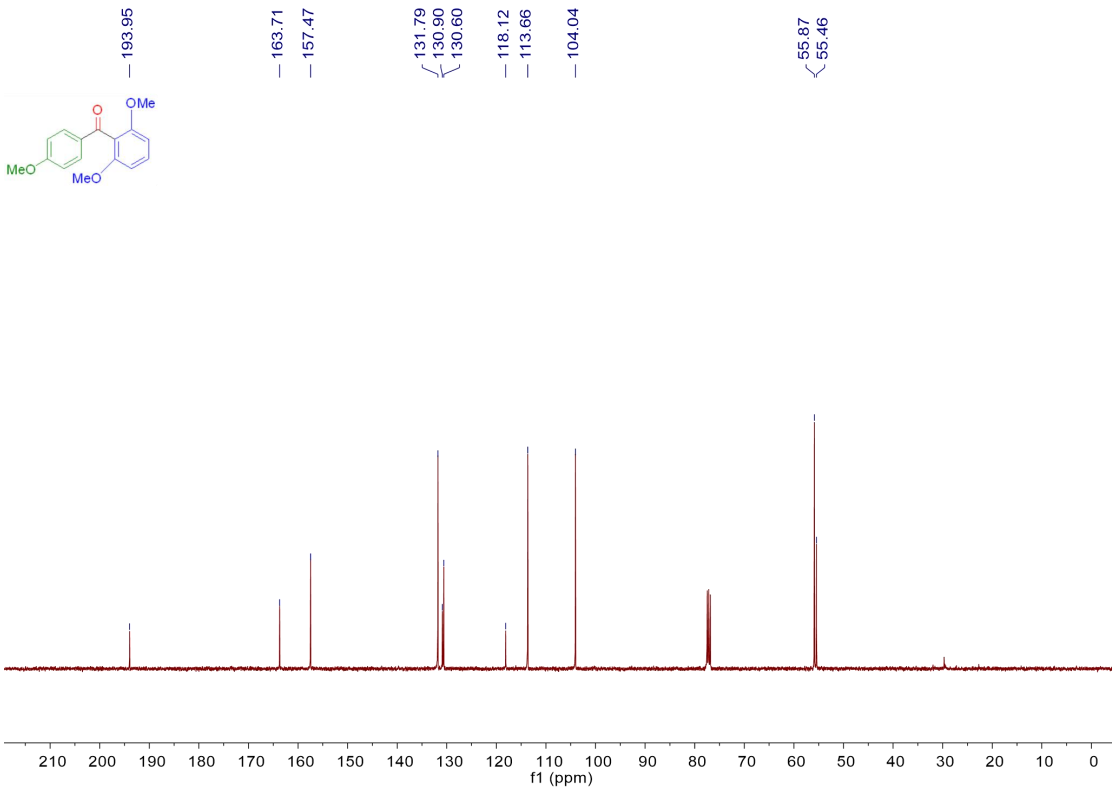


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4aj**

(2,6-dimethoxyphenyl)(4-methoxyphenyl)methanone (**4ak**)

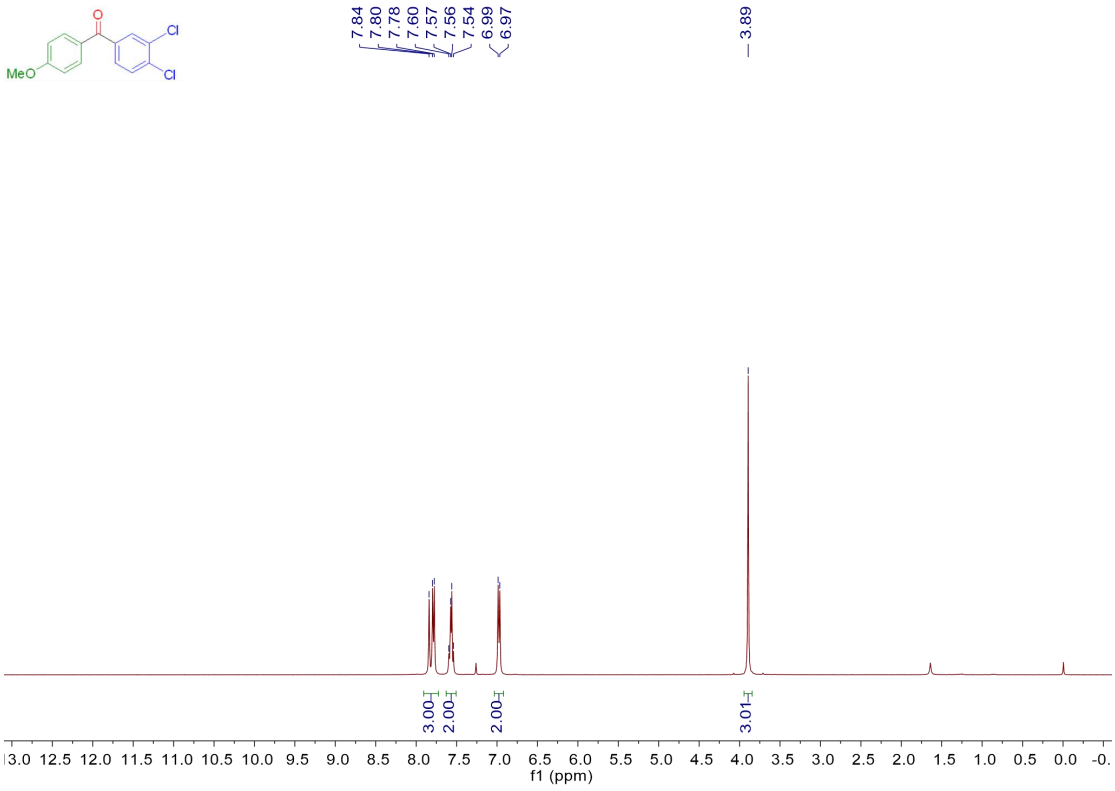


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ak**

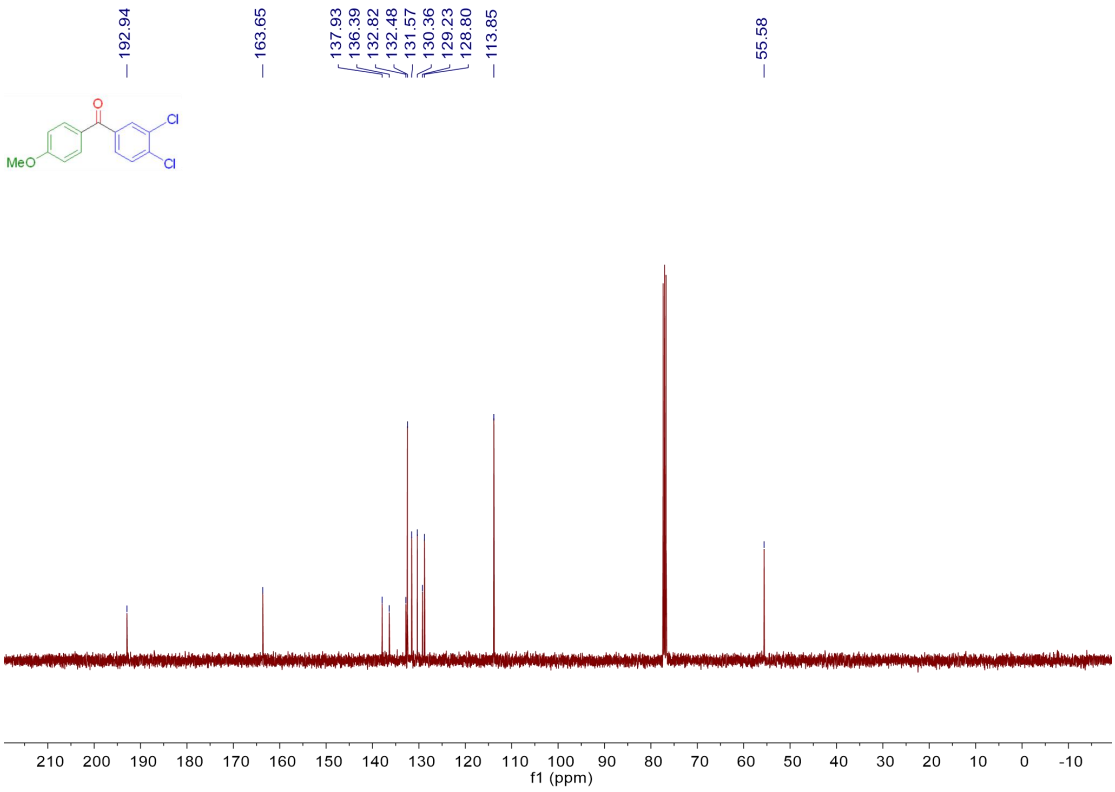


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ak**

(3,4-dichlorophenyl)(4-methoxyphenyl)methanone (**4al**)

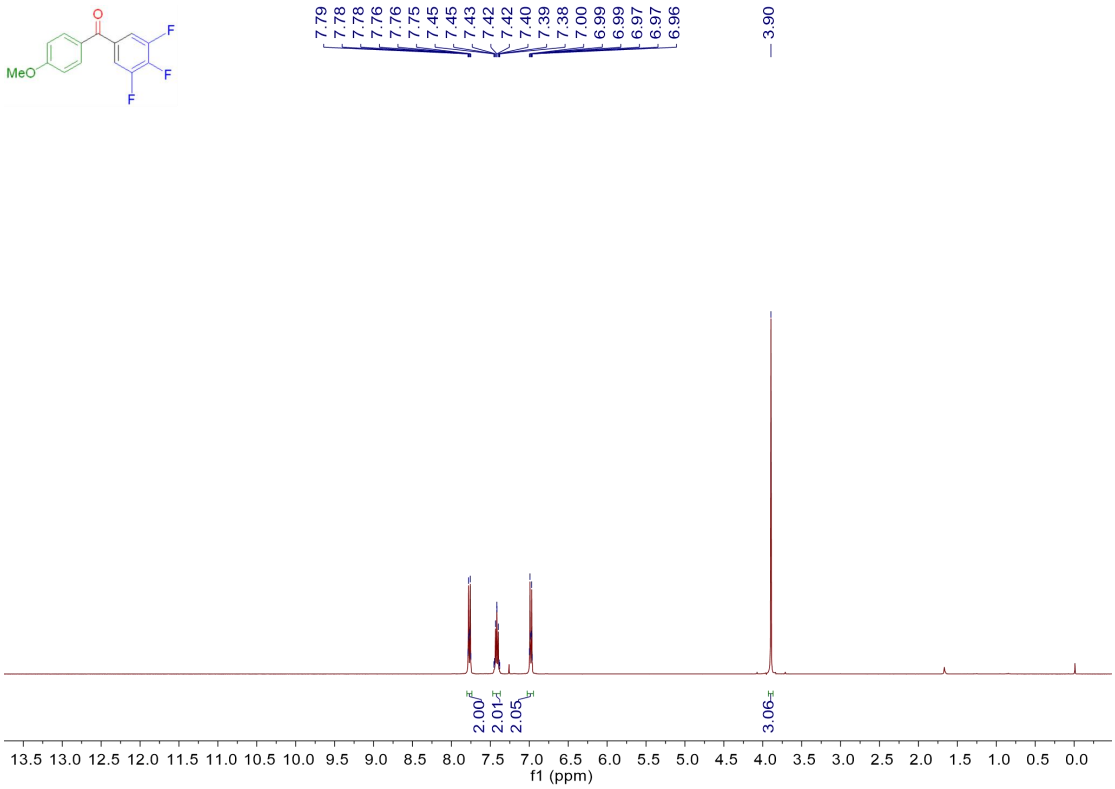


^{1}H-NMR (400 MHz, $CDCl_3$) of **4al**

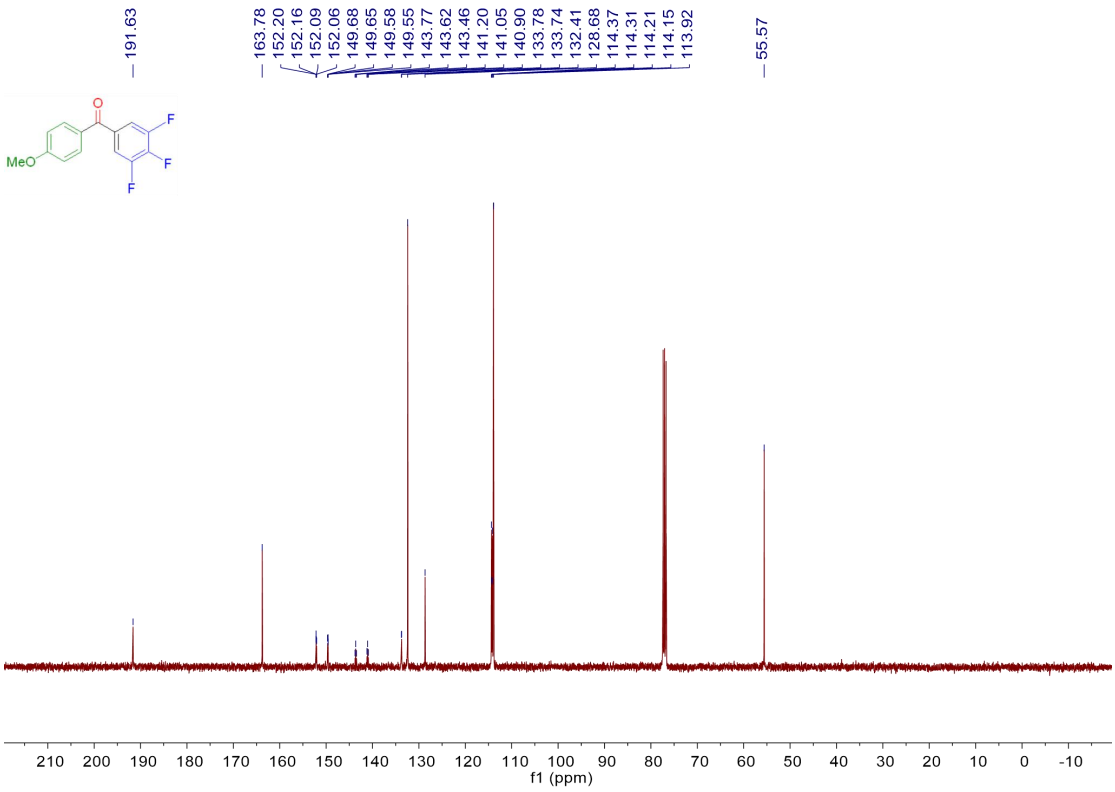


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4al**

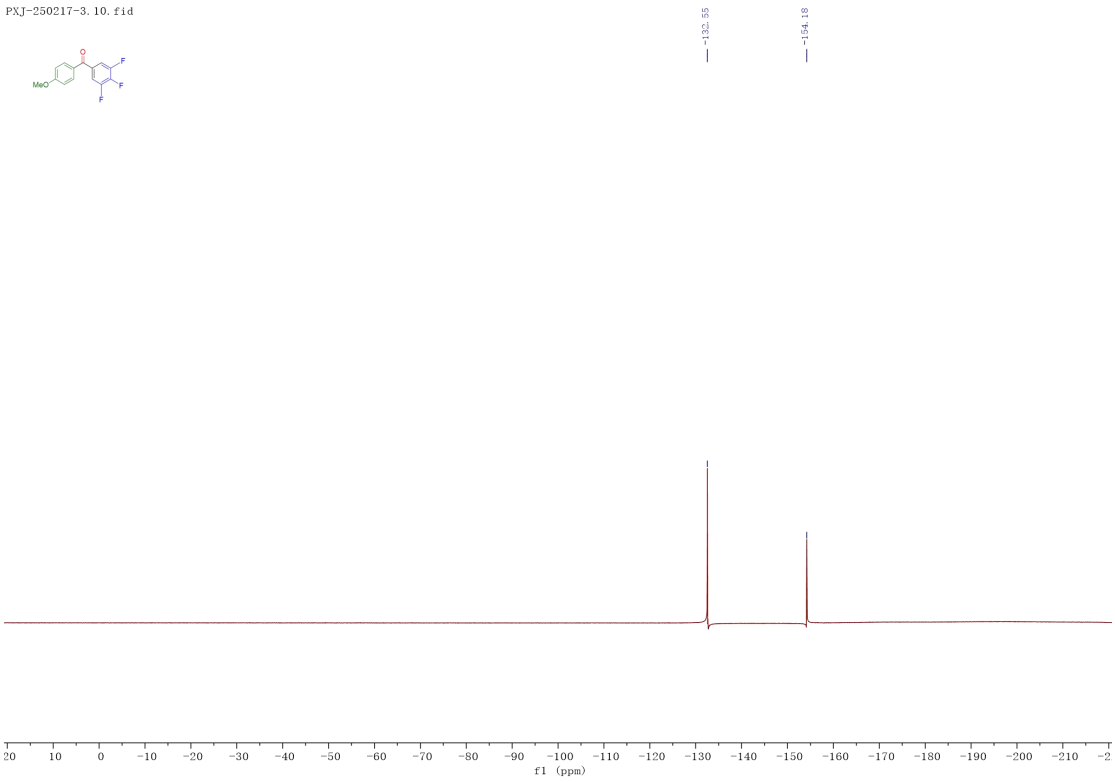
(4-methoxyphenyl)(3,4,5-trifluorophenyl)methanone (**4am**)



^{1}H-NMR (400 MHz, $CDCl_3$) of **4am**

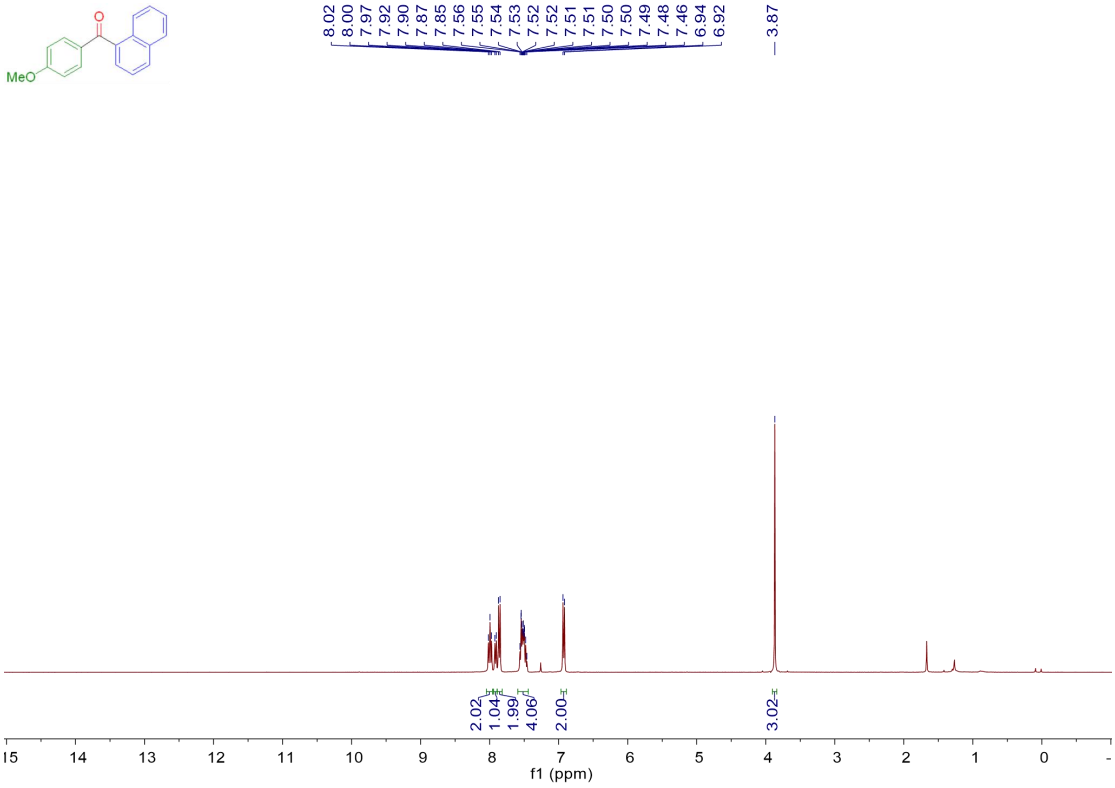


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4am**

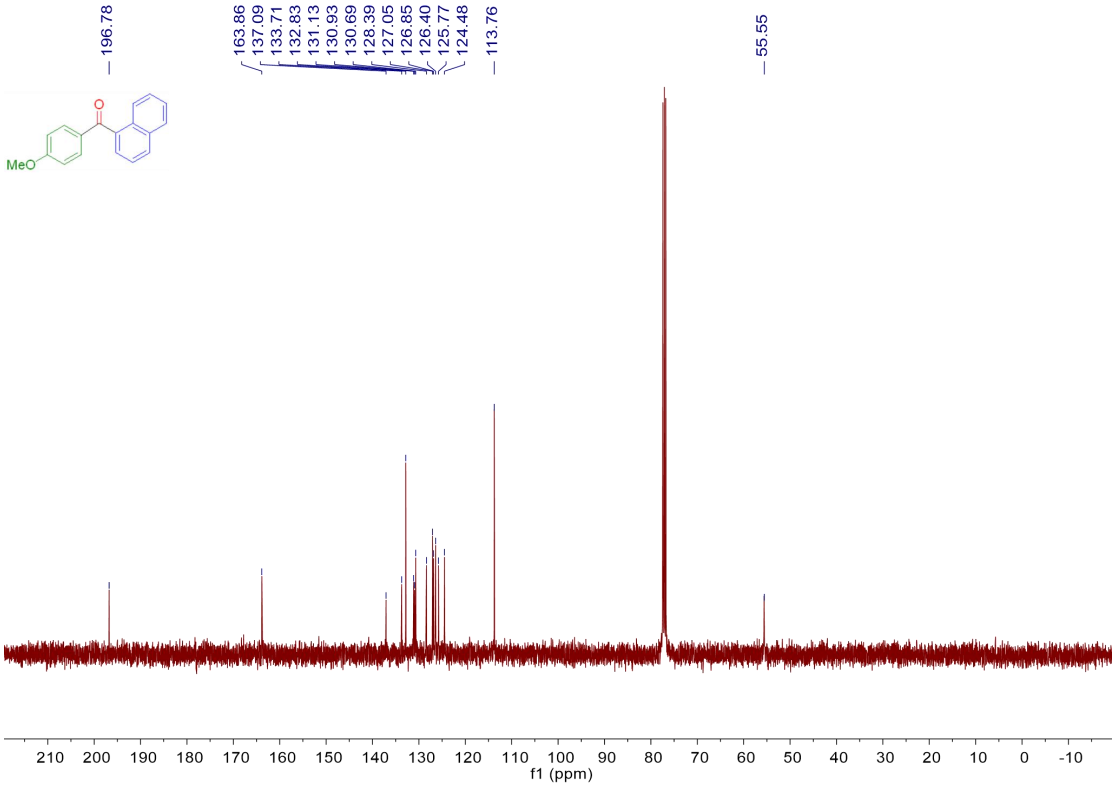


^{19}F NMR (377 MHz, $CDCl_3$) of **4am**

(4-methoxyphenyl)(naphthalen-1-yl)methanone (**4an**)

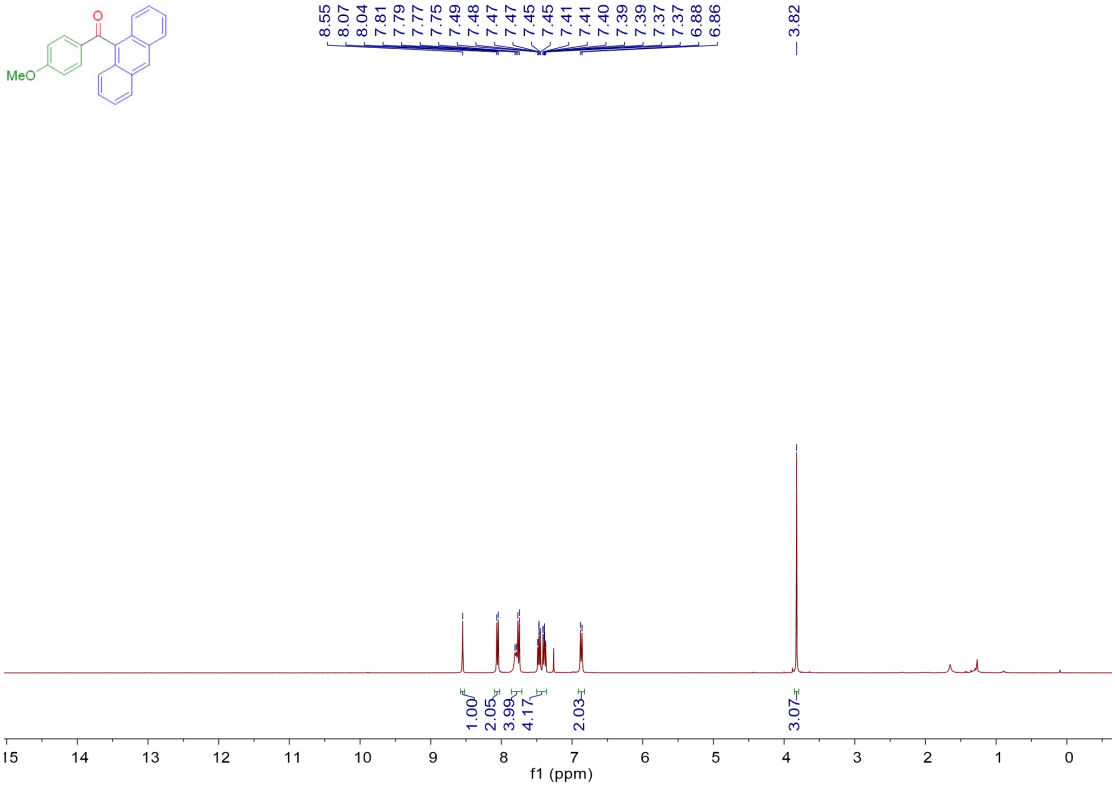


^{1}H-NMR (400 MHz, $CDCl_3$) of **4an**

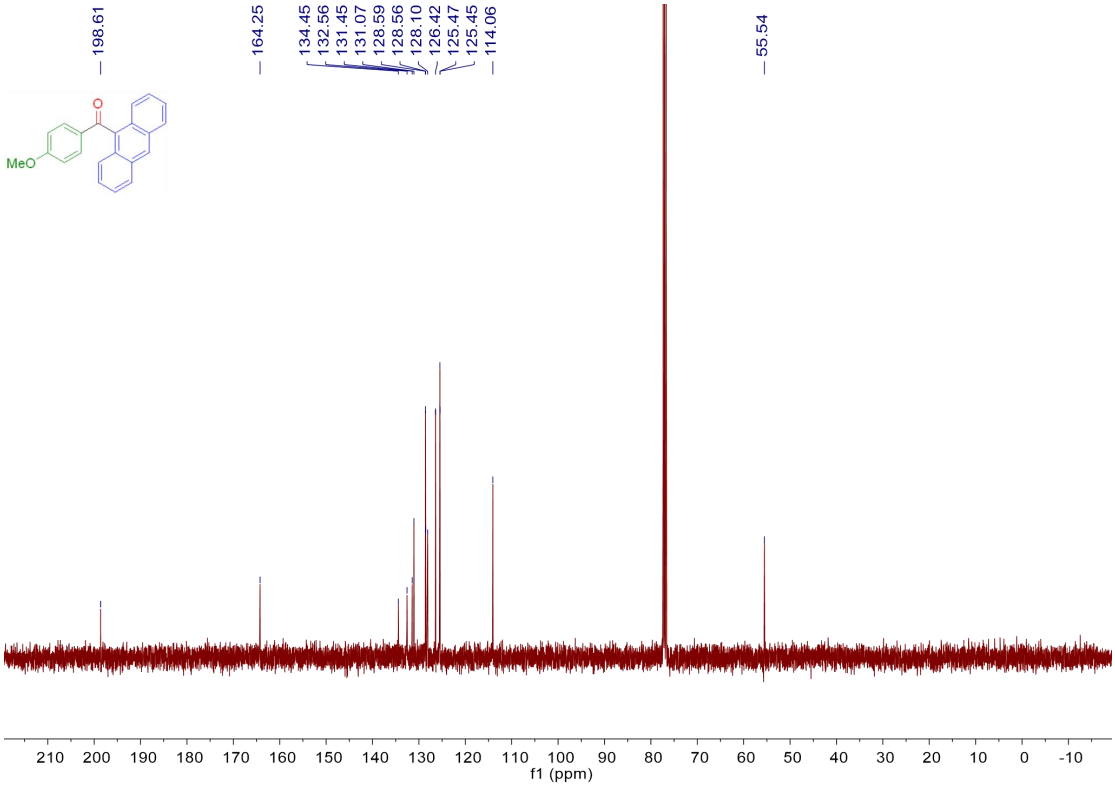


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4an**

anthracen-9-yl(4-methoxyphenyl)methanone (**4ao**)

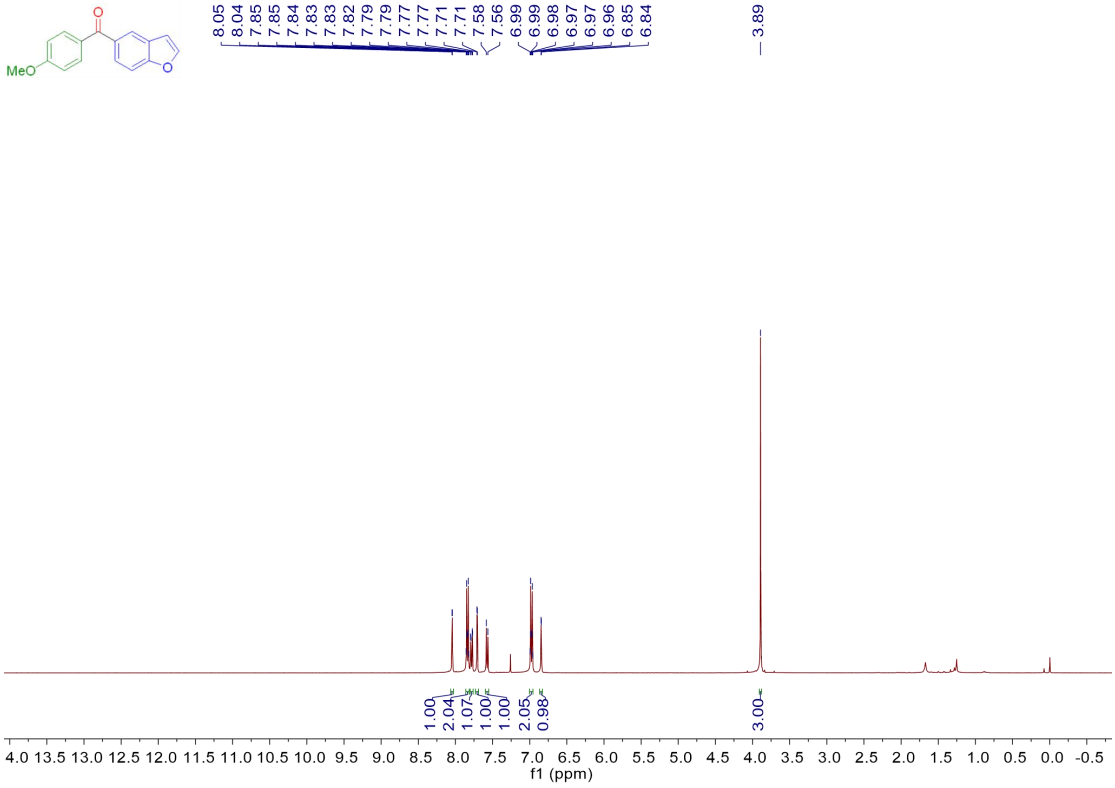


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ao**

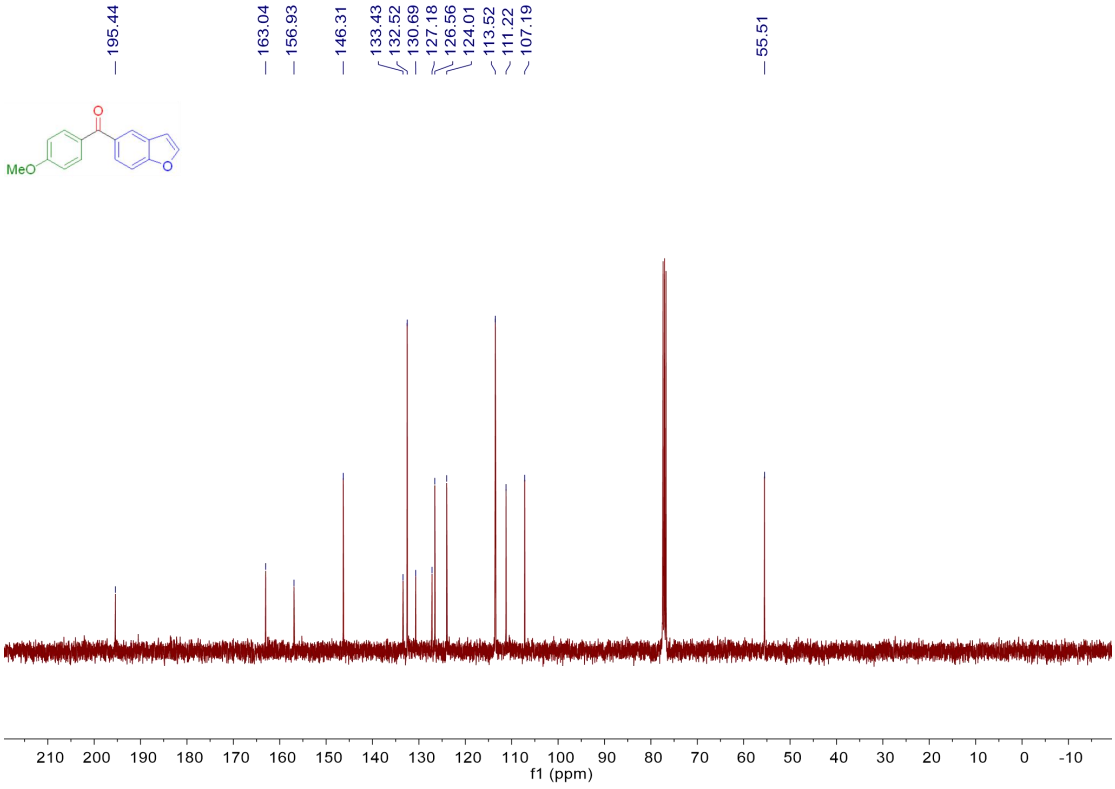


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ao**

benzofuran-5-yl(4-methoxyphenyl)methanone (**4ap**)

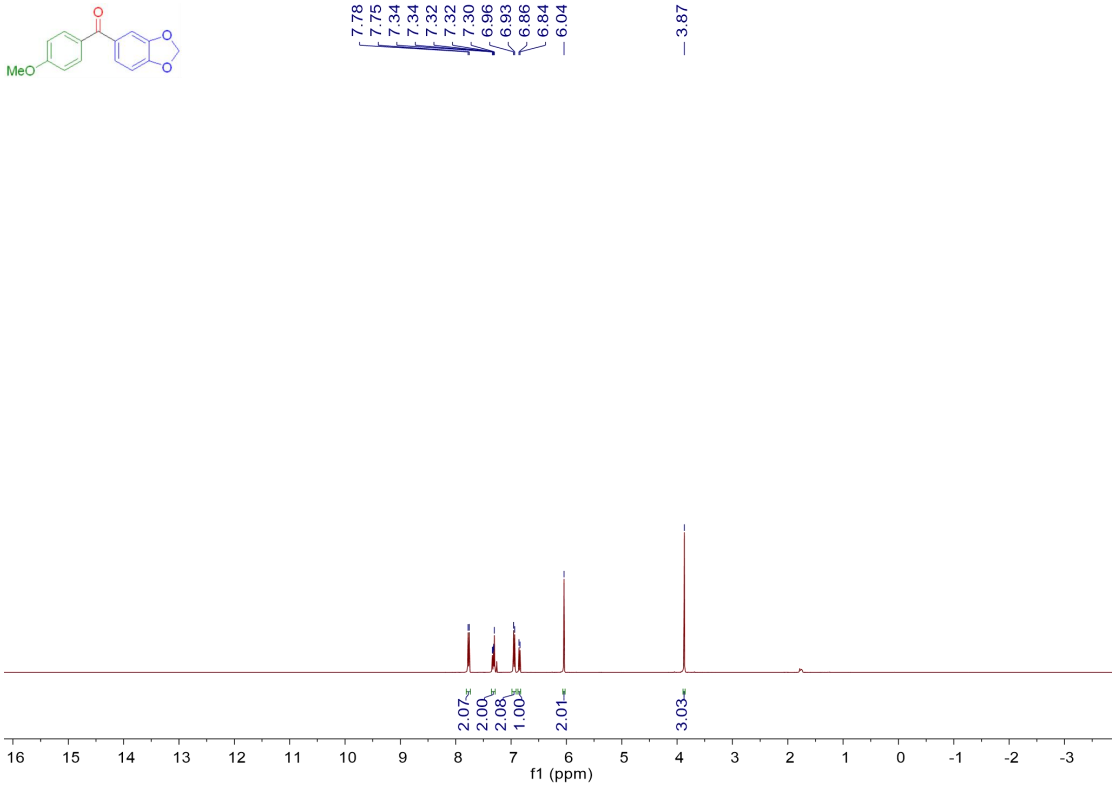


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ap**

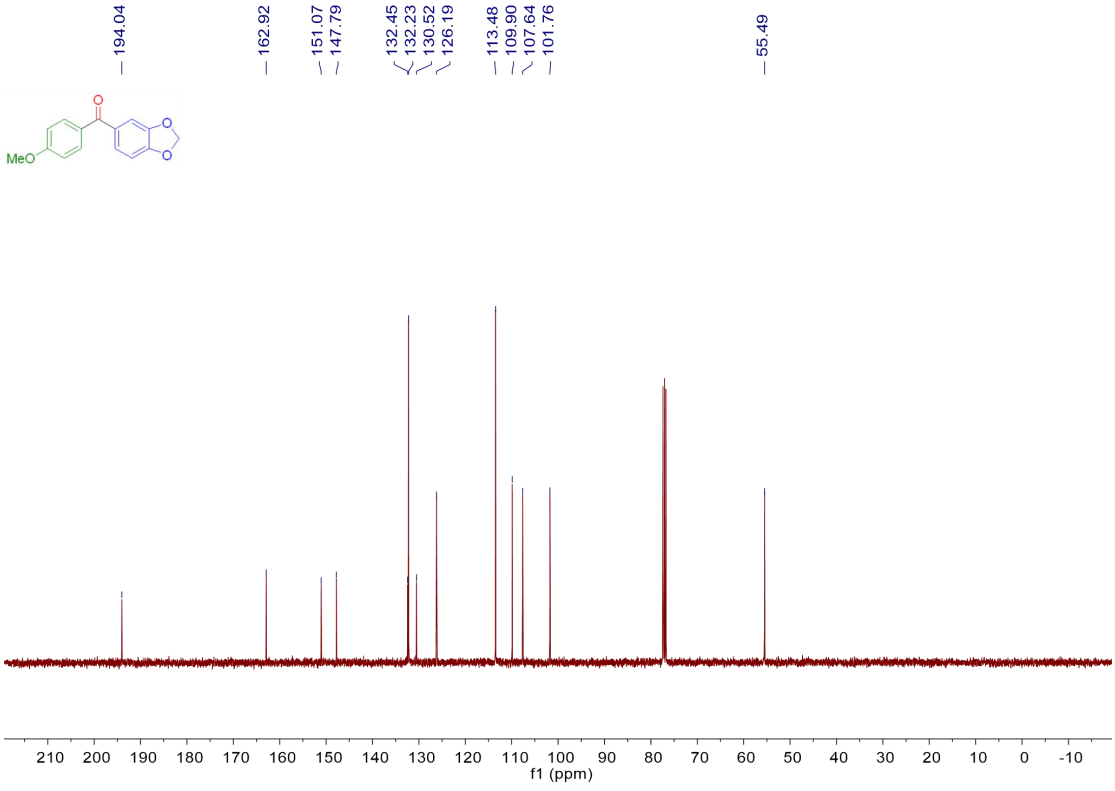


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ap**

benzo[d][1,3]dioxol-5-yl(4-methoxyphenyl)methanone (**4aq**)

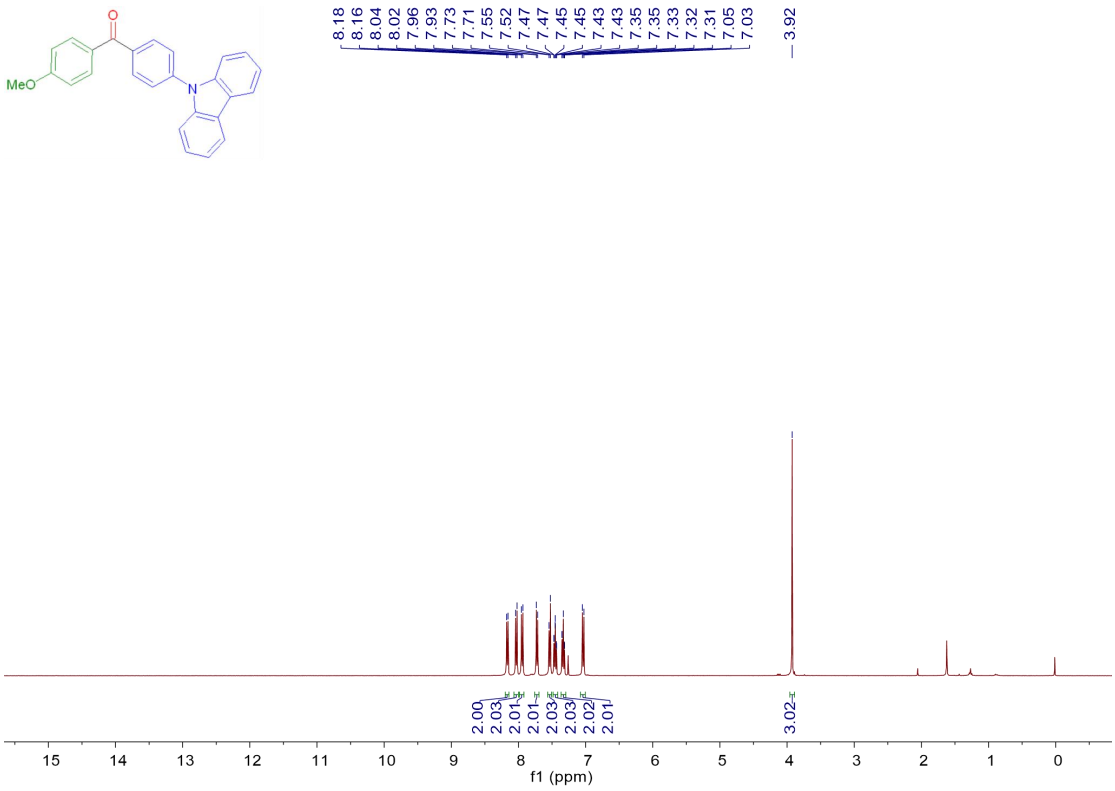


^{1}H-NMR (400 MHz, $CDCl_3$) of **4aq**

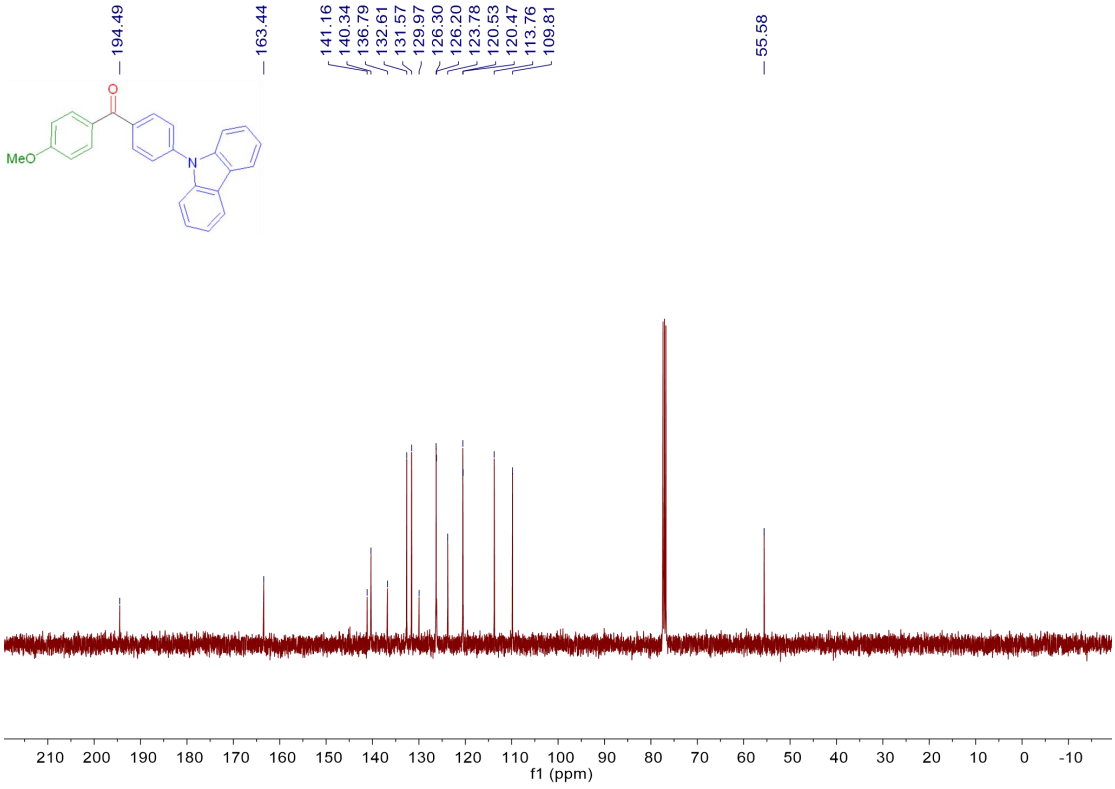


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4aq**

(4-(9H-carbazol-9-yl)phenyl)(4-methoxyphenyl)methanone (**4ar**)

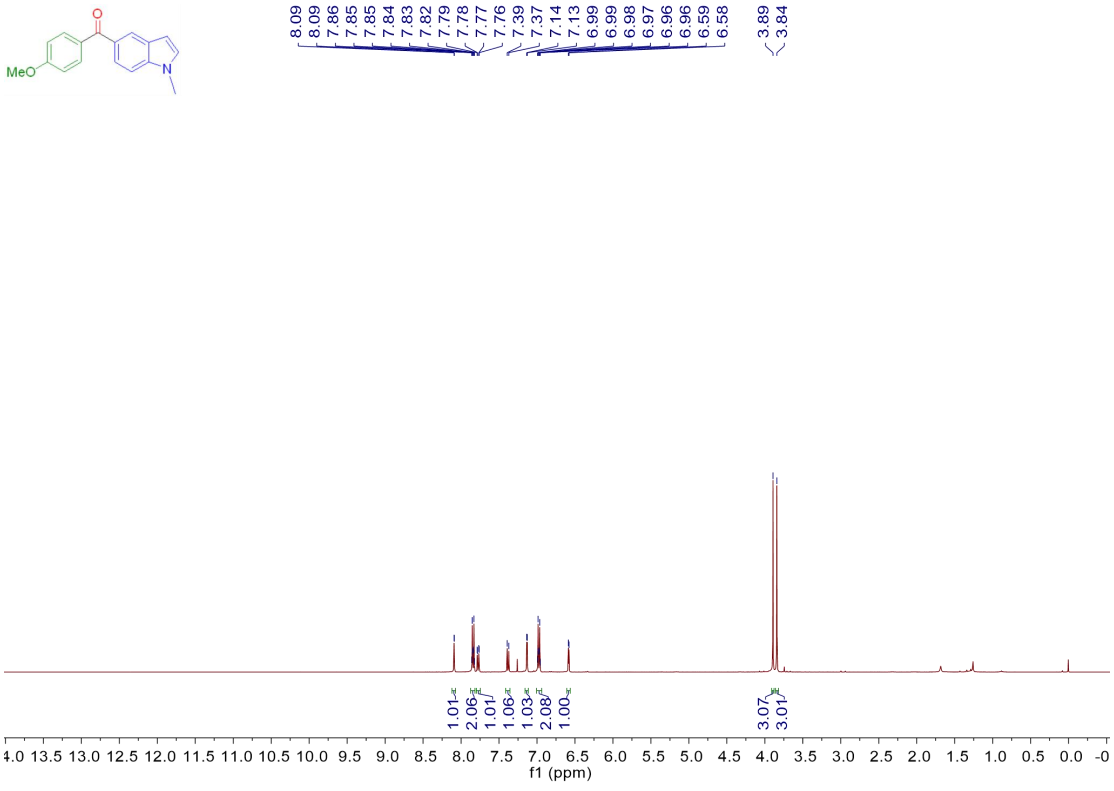


^{1}H-NMR (400 MHz, $CDCl_3$) of **4ar**

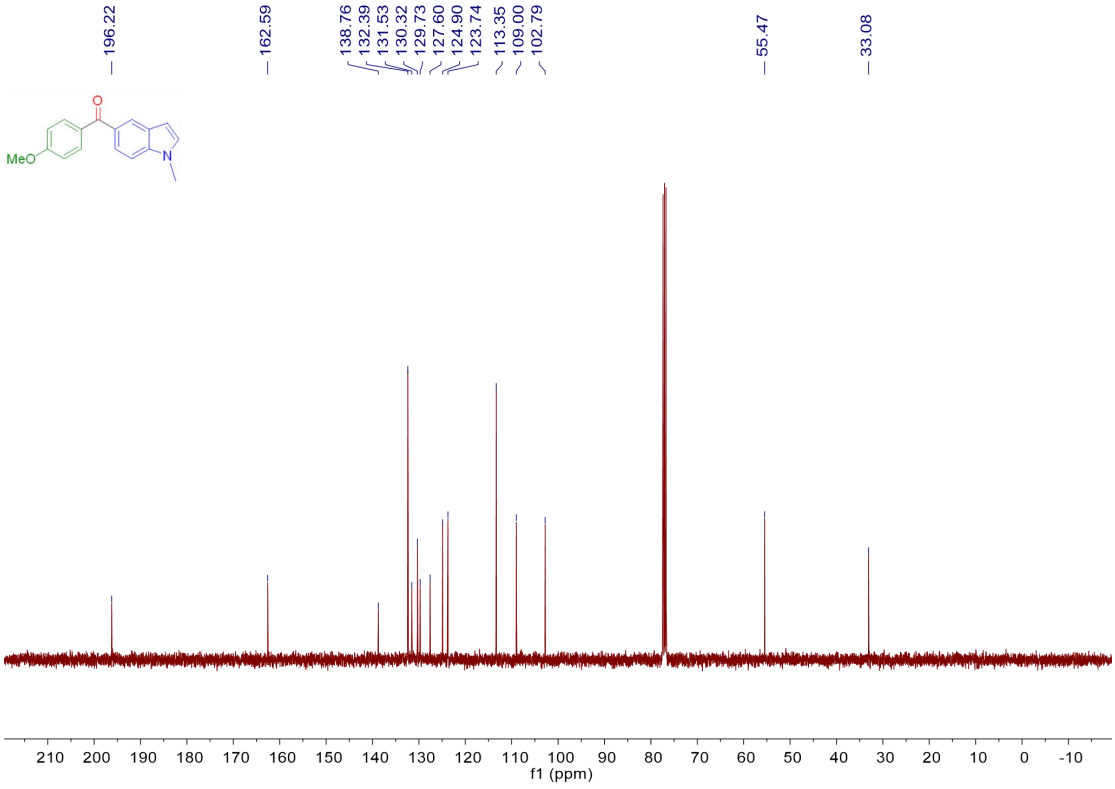


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4ar**

(4-methoxyphenyl)(1-methyl-1H-indol-5-yl)methanone (**4as**)

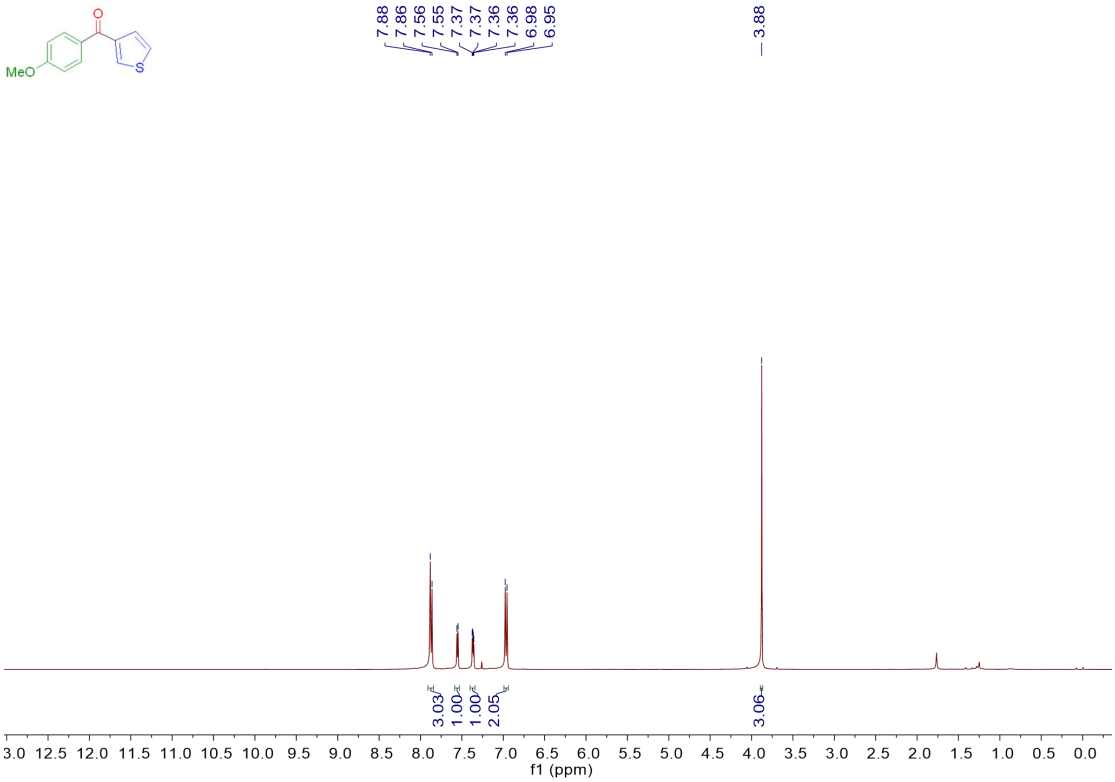


^{1}H-NMR (400 MHz, $CDCl_3$) of **4as**

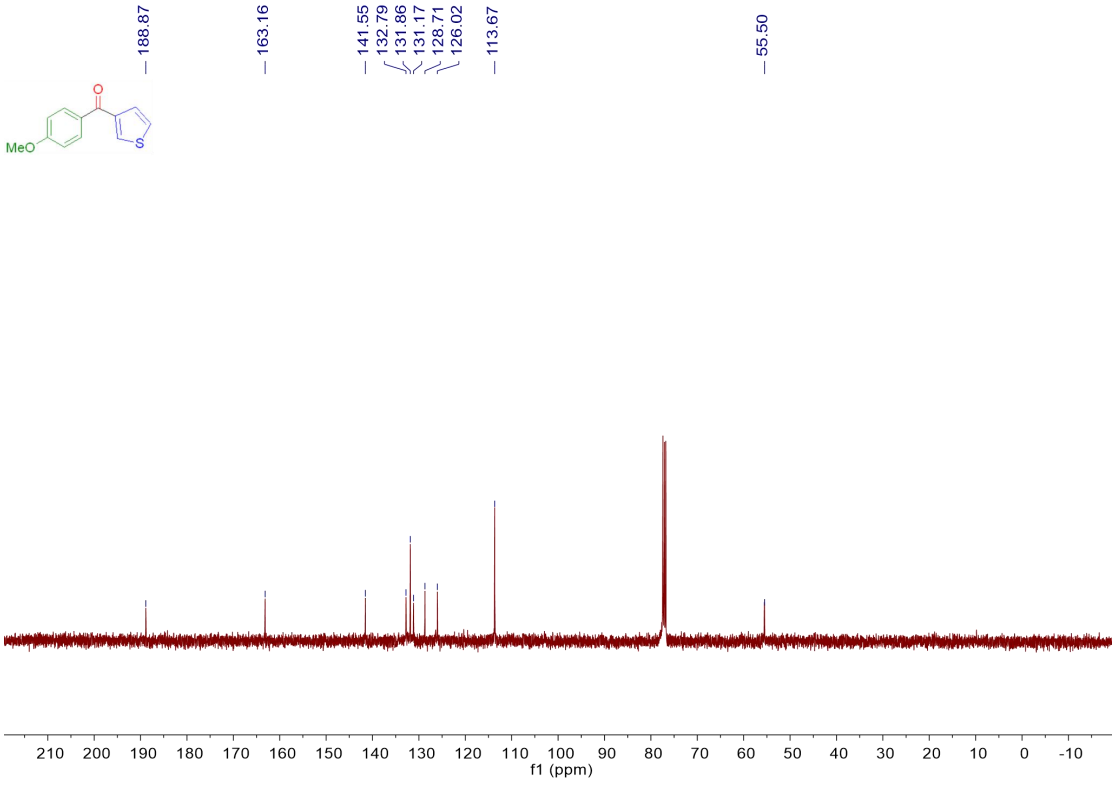


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4as**

(4-methoxyphenyl)(thiophen-3-yl)methanone (**4at**)

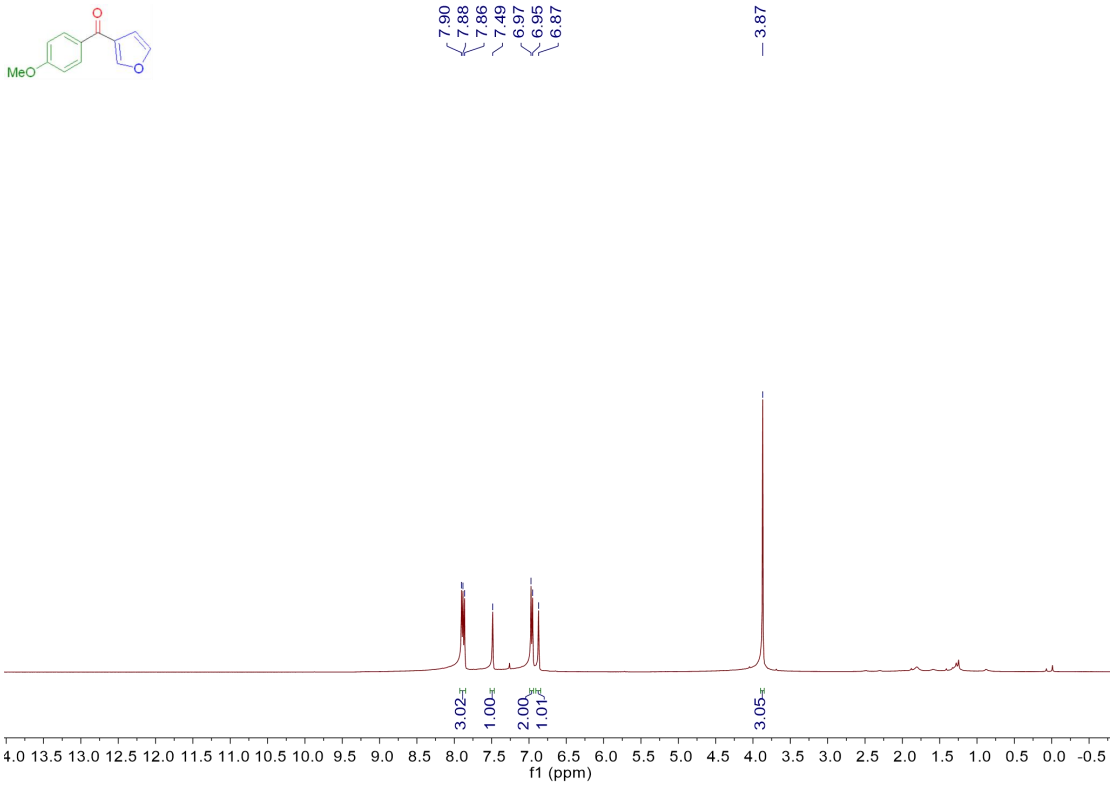


^{1}H-NMR (400 MHz, $CDCl_3$) of **4at**

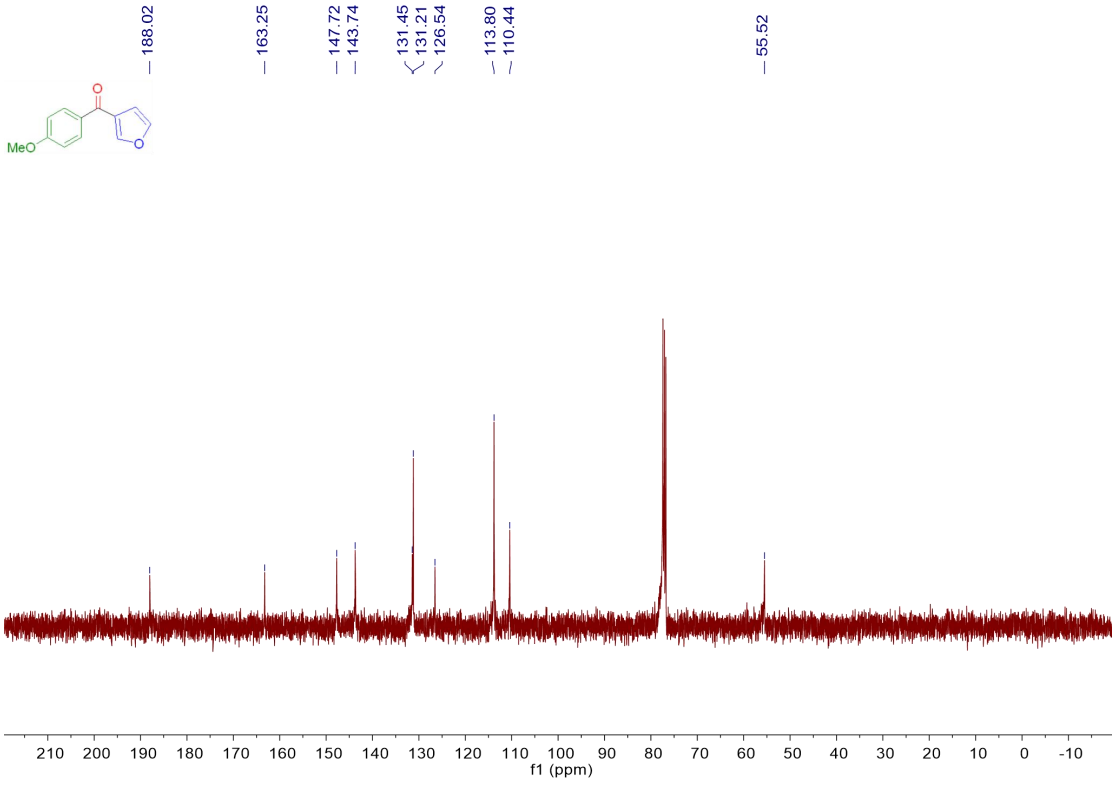


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4at**

furan-3-yl(4-methoxyphenyl)methanone (**4au**)

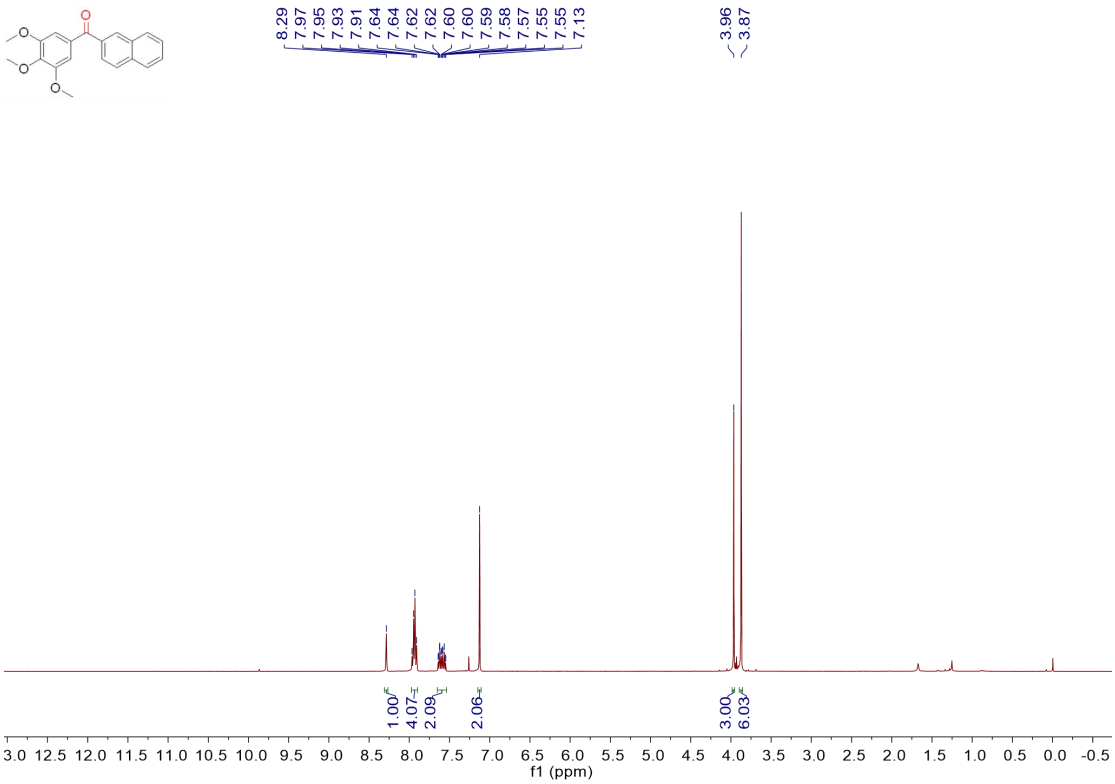


^{1}H-NMR (400 MHz, $CDCl_3$) of **4au**

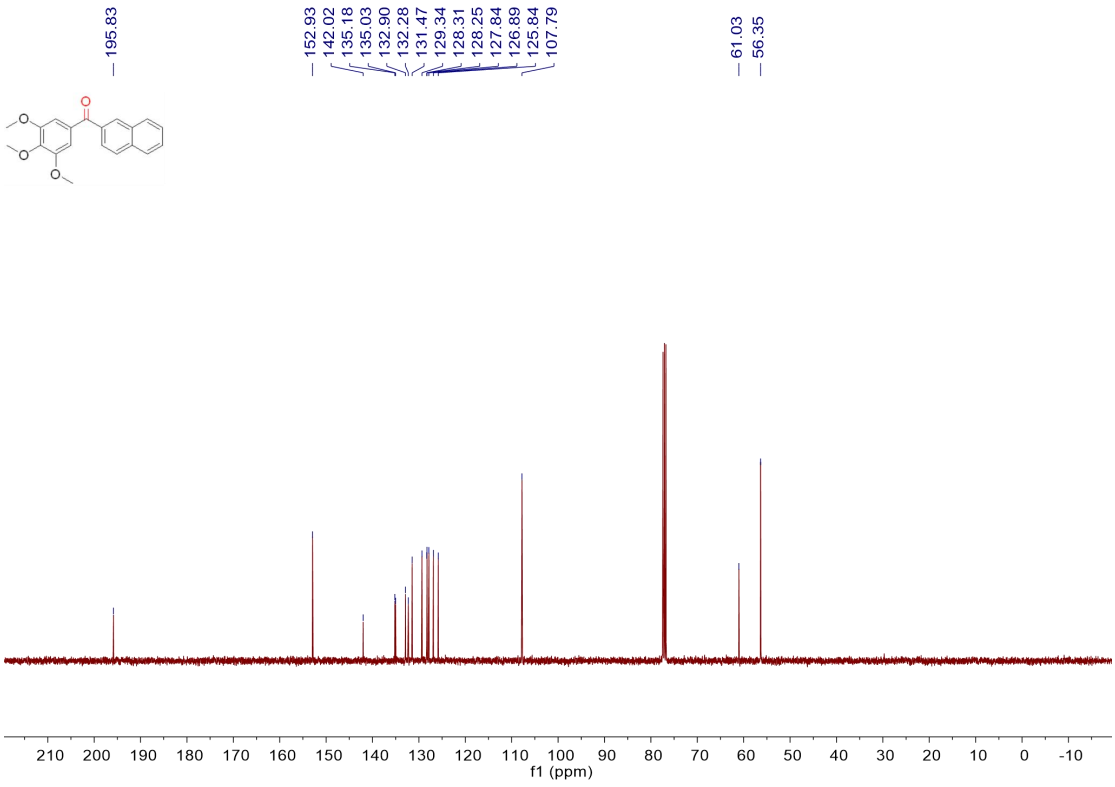


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4au**

Naphthylphenstatin (**7**)

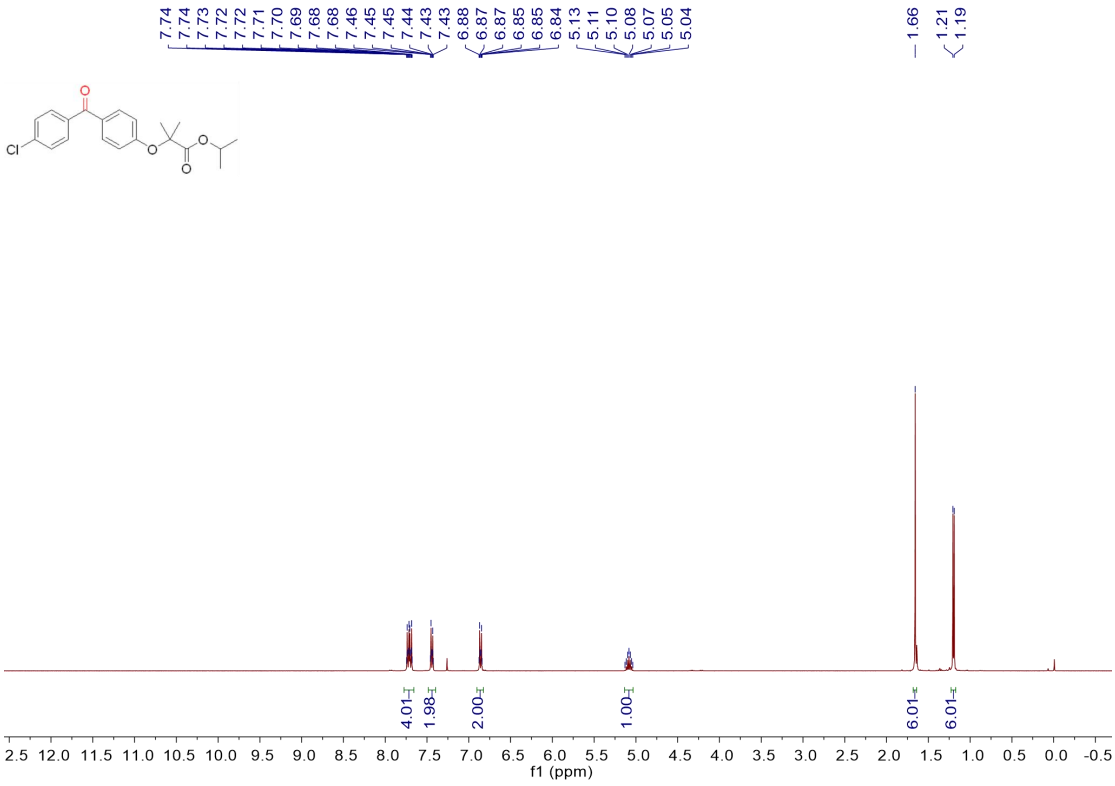


^{1}H-NMR (400 MHz, $CDCl_3$) of **7**

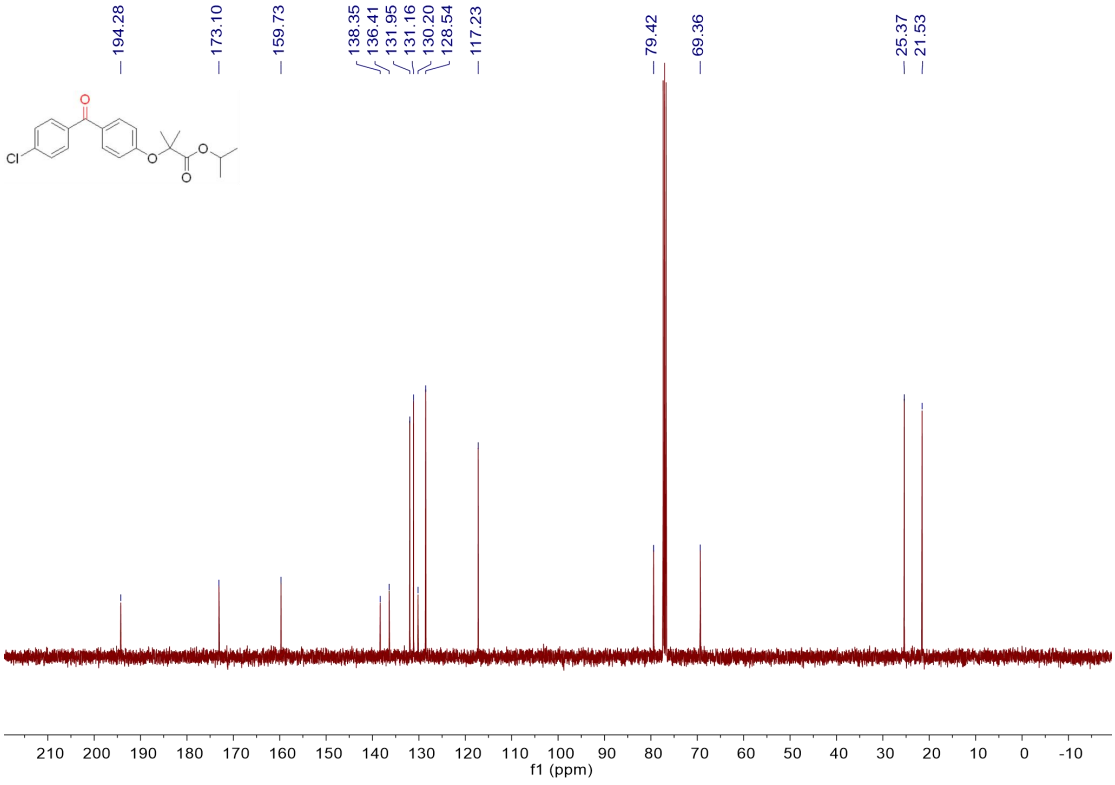


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **7**

Fenofibrate (**10**)

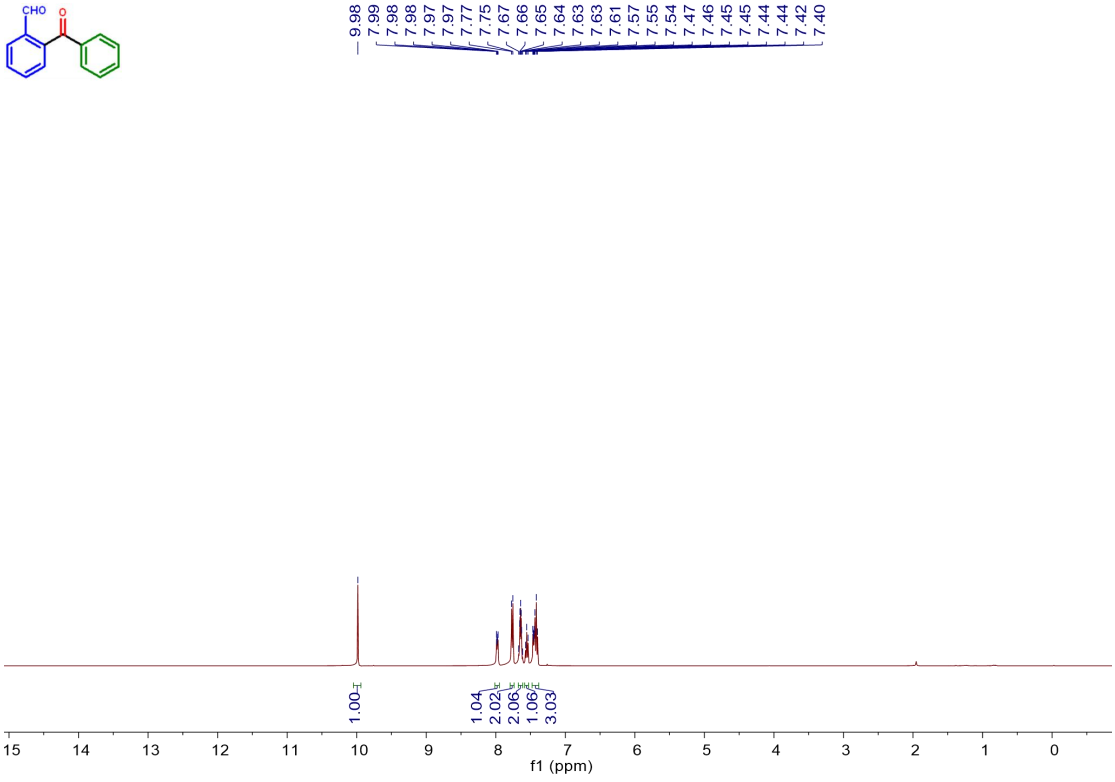


^{1}H-NMR (400 MHz, $CDCl_3$) of **10**

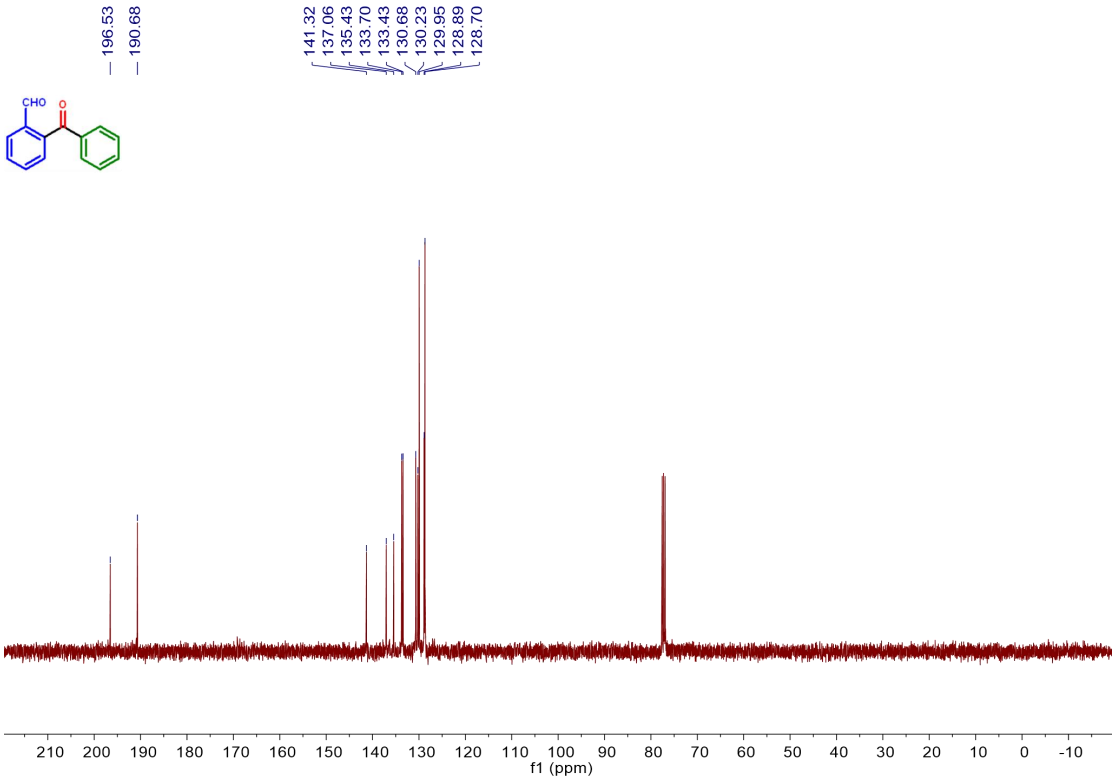


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **10**

2-benzoylbenzaldehyde (**4av**)

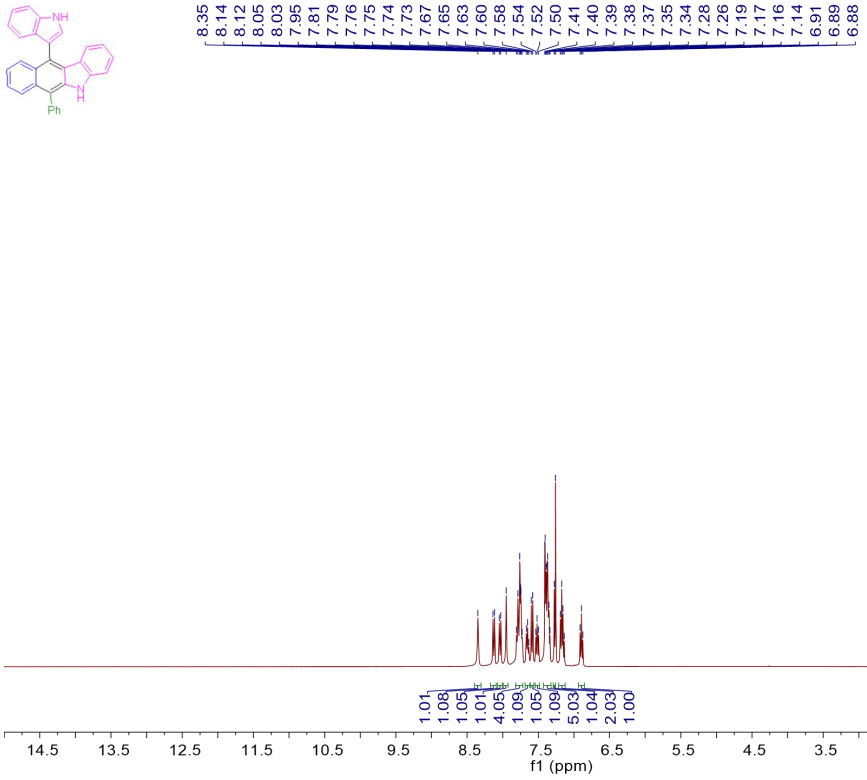


^{1}H-NMR (400 MHz, $CDCl_3$) of **4av**

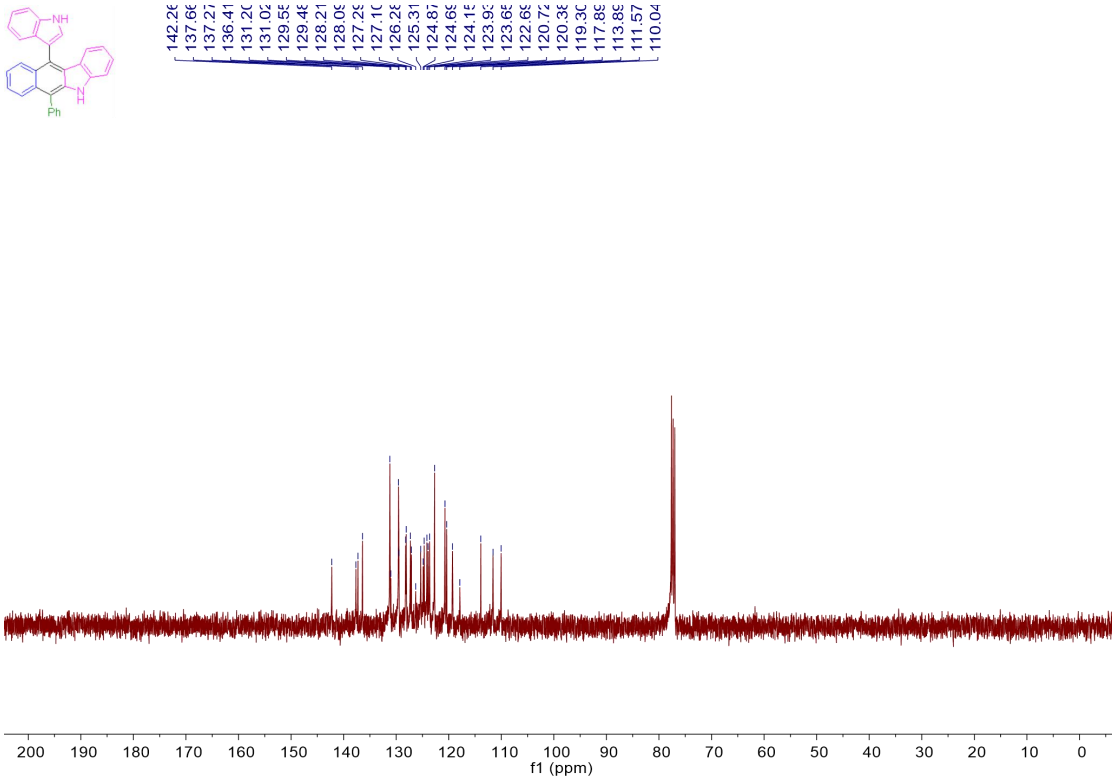


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4av**

11-(1H-indol-3-yl)-6-phenyl-5H-benzo[b]carbazole (**4av-1**)

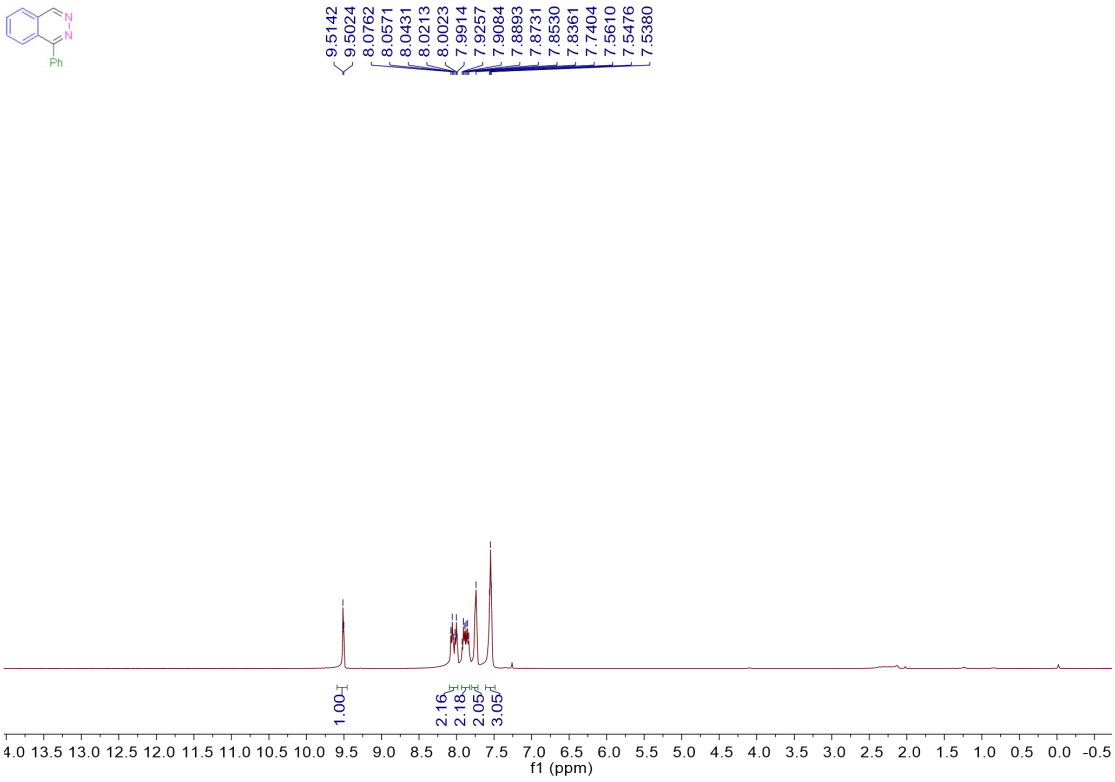


^{1}H-NMR (400 MHz, $CDCl_3$) of **4av-1**

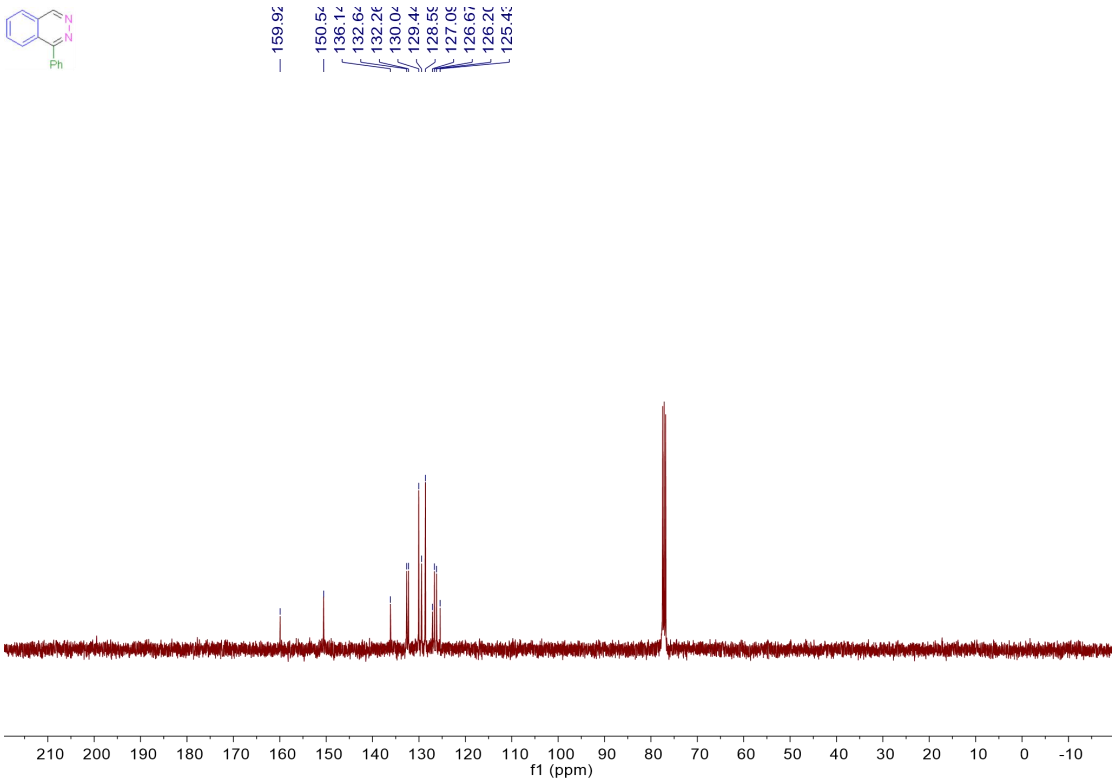


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4av-1**

1-phenylphthalazine (**4av-2**)

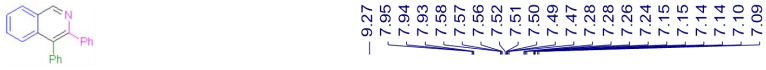


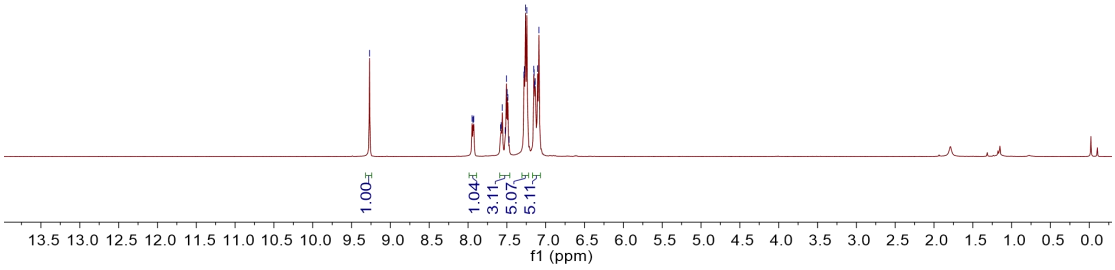
^{1}H-NMR (400 MHz, $CDCl_3$) of **4av-2**



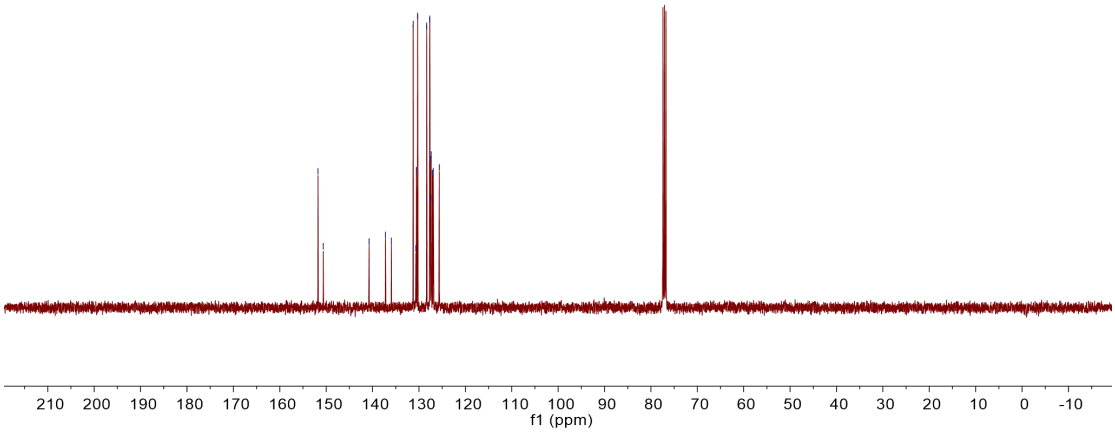
^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4av-2**

3,4-diphenylisoquinoline (**4av-3**)



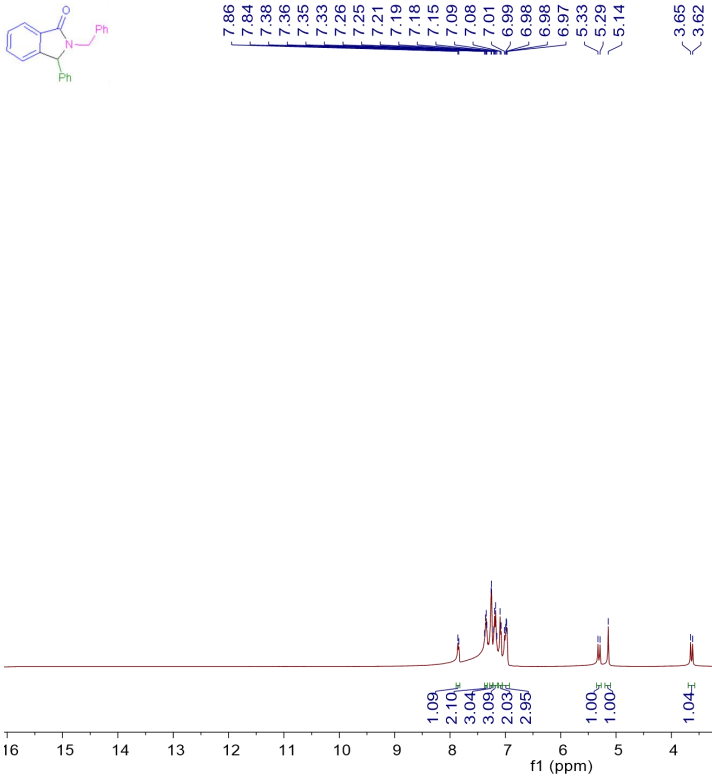


^{1}H-NMR (400 MHz, $CDCl_3$) of **4av-3**

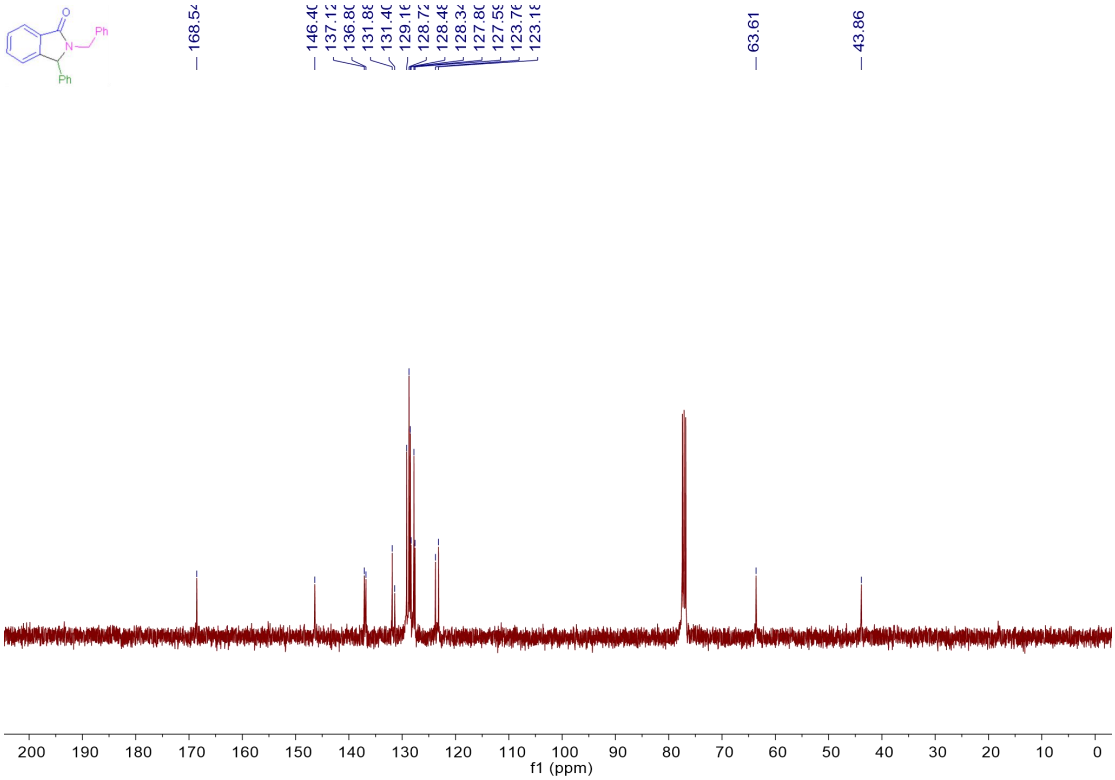


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4av-3**

2-benzyl-3-phenylisoindolin-1-one (**4av-4**)

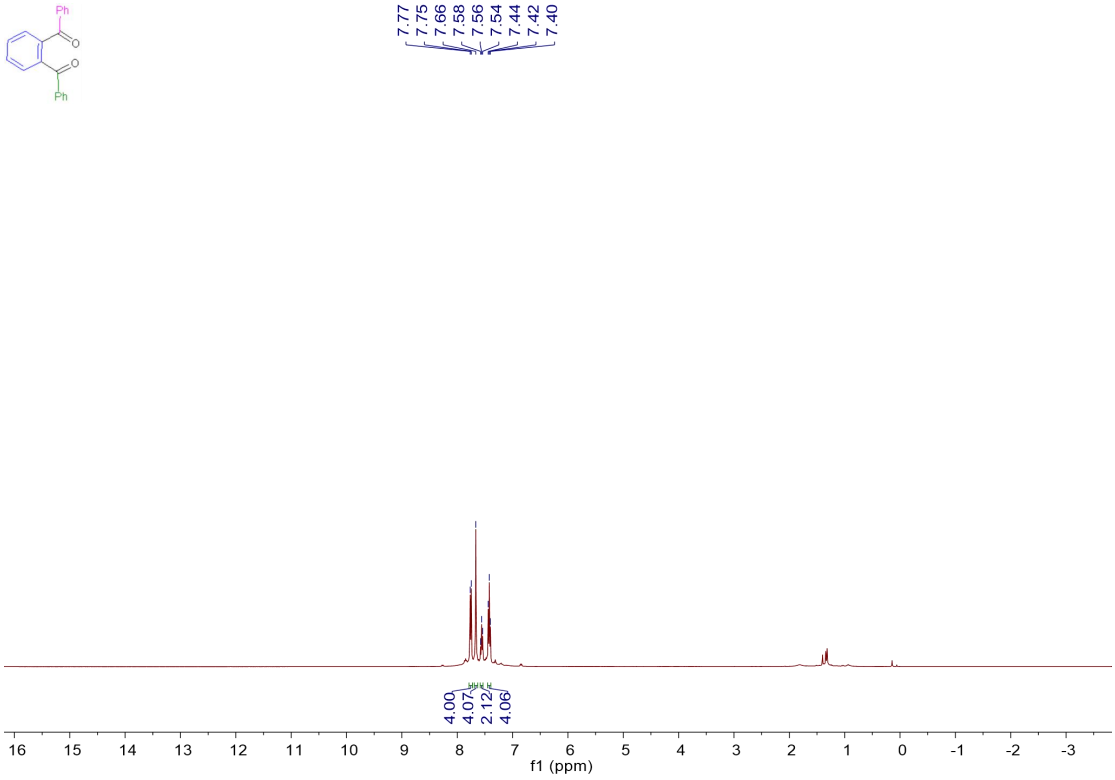


^{1}H-NMR (400 MHz, $CDCl_3$) of **4av-4**

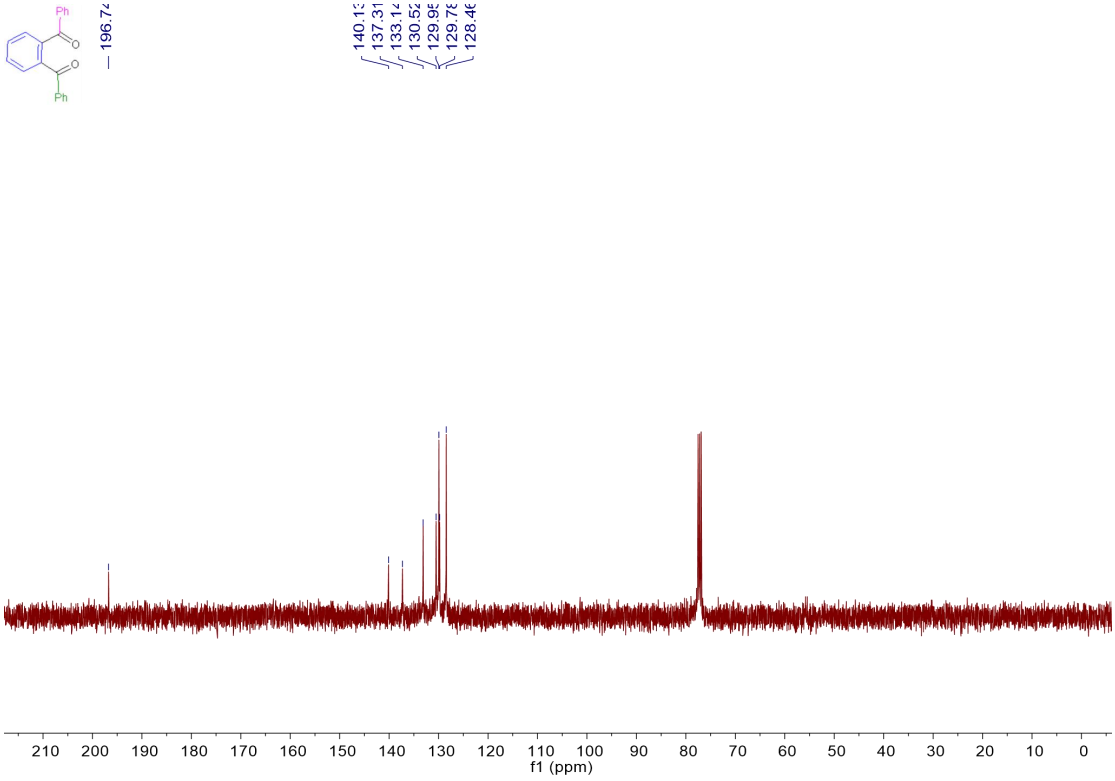


^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4av-4**

1,3-diphenylisobenzofuran (**4av-5**)



^{1}H-NMR (400 MHz, $CDCl_3$) of **4av-5**



^{13}C {^{1}H} NMR (100 MHz, $CDCl_3$) of **4av-5**

SI- § 8 Reference

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3. Song, B.; Rudolphi, F.; Himmler, T.; Gooßen, L. J., Practical Synthesis of 2-Arylacetic Acid Esters via Palladium- Catalyzed Dealkoxycarbonylative Coupling of Malonates with Aryl Halides. *Adv. Synth. Catal.,* **2011,** *353*, 1565-1574.
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