Supporting Information

Bromine Radical-Enhanced HAT Activity Leading to Stoichiometric Couplings of Methylarenes with Acid Chlorides

Qiao-Lin Wang[a], Huawen Huang*[a], Guojiang Mao[b], and Guo-Jun Deng*[a]

[a] Key Laboratory for Green Organic Synthesis and Application of Hunan Province, Key Laboratory of Environmentally Friendly Chemistry and Application of Ministry of Education, College of Chemistry, Xiangtan University, Xiangtan 411105, China.
E-mail: hwhuang@xtu.edu.cn; gjdeng@xtu.edu.cn.
[b] School of Chemistry and Chemical Engineering, Henan Normal University, Xinxiang, 453007, P. R. China.

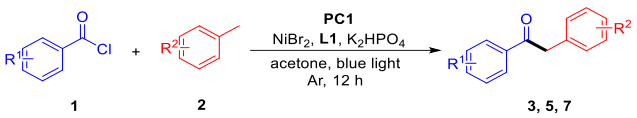
List of Contents

1. General information

All reactions were carried out with magnetic stirring and in dried glassware. Standard syringe techniques were applied for transfer of dry solvents. All reagents and solvents were commercially available and used without any further purification unless specified. The reactions via general procedure was carried out under an atmosphere of argon unless otherwise noted. Column chromatography was performed using silica gel (200-300 mesh) or thin layer chromatography was performed using silica gel (GF254). ^{1}H NMR and ^{13}C NMR spectra were recorded on Bruker-AV (400 and 100 MHz, respectively) instrument using $CDCl_3$ as solvent. Mass spectra were measured on Agilent 5975 GC-MS instrument (EI). High-resolution mass spectra (ESI) were obtained with the Thermo Scientific LTQ Orbitrap XL mass spectrometer. The structures of known compounds were further corroborated by comparing their ^{1}H NMR, ^{13}C NMR data and HRMS data with those in literature. Melting points were measured with a YUHUA X-5 melting point instrument and were uncorrected.

2. Experiment section

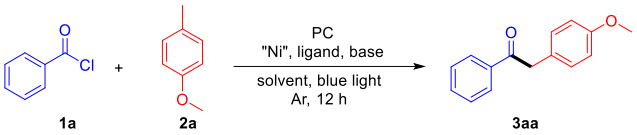
2.1 Typical experimental procedure for the acylation



To a Schlenk tube was added **1** (0.2 mmol), **2** (0.4 mmol, 2.0 eqiuv), **PC1** (0.004 mmol, 2 mol%), $NiBr_2$ (0.01 mmol, 5 mol%), **L1** (0.01 mmol, 5 mol%), K_2HPO_4 (0.4 mmol, 2.0 equiv), acetone (3 mL). Then the mixture was stirred at room temperature in argon atmosphere (1 atm) under 35 W blue LED light for 12 h until complete consumption of starting material as monitored by TLC and GC-MS analysis. After the reaction was finished, the reaction mixture was washed with brine. The aqueous phase was re-extracted with EtOAc (3×10 mL). The combined organic extracts were dried over Na_2SO_4 and concentrated in vacuum. The residue was purified by silica gel flash column chromatography (hexane/ethyl acetate = 100 : 1 to 20 : 1) to afford the desired products **3**, **5** and **7**.

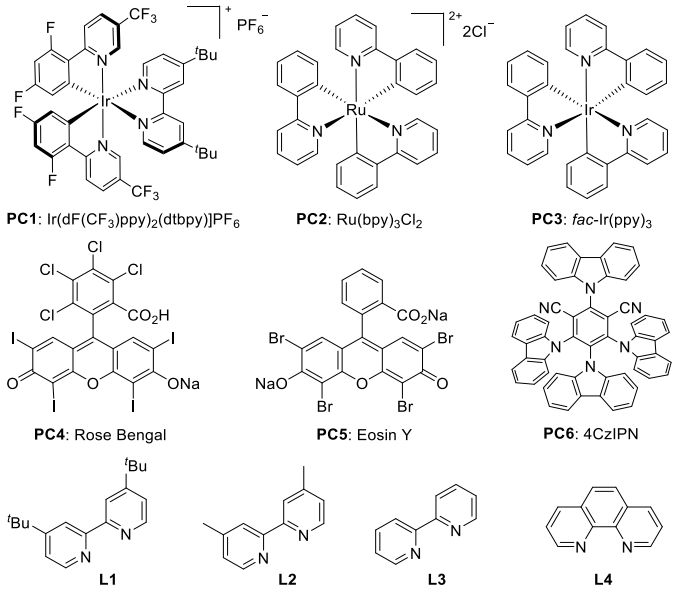
2.2 Optimization of reaction conditions

Table S1.



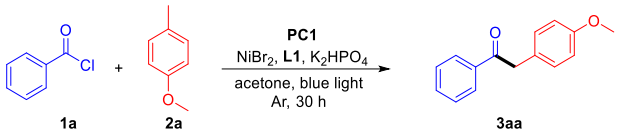
Entry	[PC]	[Ni]	Ligand	Base	Additive	Solvent	Yield (%) [b]
1	**PC1**	$NiBr_2$	**L1**	K_2HPO_4	–	acetone	83
2	–	$NiBr_2$	**L1**	K_2HPO_4	–	acetone	0
3[c]	**PC1**	$NiBr_2$	**L1**	K_2HPO_4	–	acetone	0
4	**PC1**	–	**L1**	K_2HPO_4	–	acetone	42
5	**PC1**	$NiBr_2$	–	K_2HPO_4	–	acetone	43
6	**PC2**	$NiBr_2$	**L1**	K_2HPO_4	–	acetone	0
7	**PC3**	$NiBr_2$	**L1**	K_2HPO_4	–	acetone	0
8	**PC4**	$NiBr_2$	**L1**	K_2HPO_4	–	acetone	0
9	**PC5**	$NiBr_2$	**L1**	K_2HPO_4	–	acetone	0
10	**PC6**	$NiBr_2$	**L1**	K_2HPO_4	–	acetone	43
11	**PC1**	$NiCl_2$	**L1**	K_2HPO_4	–	acetone	49
12	**PC1**	$Ni(PPh_3)_3Cl_2$	**L1**	K_2HPO_4	–	acetone	35
13	**PC1**	$Ni(acac)_2$	**L1**	K_2HPO_4	–	acetone	42
14	**PC1**	NiI_2	**L1**	K_2HPO_4	–	acetone	28
15	**PC1**	$Ni(OTf)_2$	**L1**	K_2HPO_4	–	acetone	37
16	**PC1**	$Ni(OAc)_2$	**L1**	K_2HPO_4	–	acetone	40
17	**PC1**	NiF_2	**L1**	K_2HPO_4	–	acetone	31
18	**PC1**	$Ni(COD)_2$	**L1**	K_2HPO_4	–	acetone	38

19	**PC1**	$NiBr_2$	**L2**	K_2HPO_4	–	acetone	61
20	**PC1**	$NiBr_2$	**L3**	K_2HPO_4	–	acetone	55
21	**PC1**	$NiBr_2$	**L4**	K_2HPO_4	–	acetone	79
22	**PC1**	$NiBr_2$	**L1**	^{t}BuONa	–	acetone	trace
23	**PC1**	$NiBr_2$	**L1**	Cs_2CO_3	–	acetone	trace
24	**PC1**	$NiBr_2$	**L1**	pyridine	–	acetone	51
25	**PC1**	$NiBr_2$	**L1**	KH_2PO_4	–	acetone	62
26	**PC1**	$NiBr_2$	**L1**	K_2HPO_4	–	CH_3CN	66
27	**PC1**	$NiBr_2$	**L1**	K_2HPO_4	–	THF	trace
28	**PC1**	$NiBr_2$	**L1**	K_2HPO_4	–	DMF	0
29	**PC1**	$NiBr_2$	**L1**	K_2HPO_4	–	DMSO	0
30	**PC1**	$NiBr_2$	**L1**	K_2HPO_4	–	DCE	50
31	**PC1**	$NiBr_2$	**L1**	K_2HPO_4	NH_4Br	acetone	74
32	**PC1**	$NiCl_2$	**L1**	K_2HPO_4	NH_4Br	acetone	84
33	**PC1**	$Ni(COD)_2$	**L1**	K_2HPO_4	NH_4Br	acetone	59
34	**PC1**	$NiCl_2$	**L1**	K_2HPO_4	LiBr	acetone	65
35	**PC1**	$NiCl_2$	**L1**	K_2HPO_4	TBAB	acetone	58
36	**PC1**	$NiCl_2$	**L1**	K_2HPO_4	NaBr	acetone	75
37	**PC1**	$NiCl_2$	**L1**	K_2HPO_4	LiCl	acetone	55
38	**PC1**	$NiCl_2$	**L1**	K_2HPO_4	NH_4I	acetone	0



[a] Reaction conditions: **1a** (0.2 mmol), **2a** (0.4 mmol, 2.0 eqiuv), photocatalyst (0.004 mmol, 2 mol%), "Ni" catalysts (0.01 mmol, 5 mol%), ligand (0.01 mmol, 5 mol%), base (0.4 mmol, 2.0 equiv), additive (0.1 mmol, 50 mol%), solvent (3 mL). Then the mixture was stirred at room temperature in Ar atmosphere (1 atm) under 35 W blue LED light for 12 h at room temperature. [b] Isolated yields. [c] Without additional light.

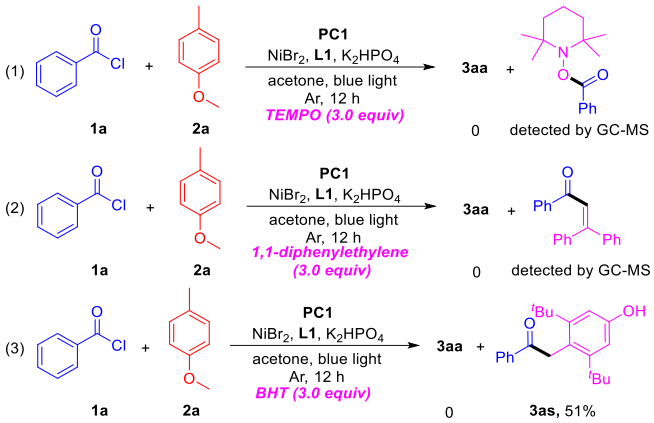
2.3 Scale-up experiment



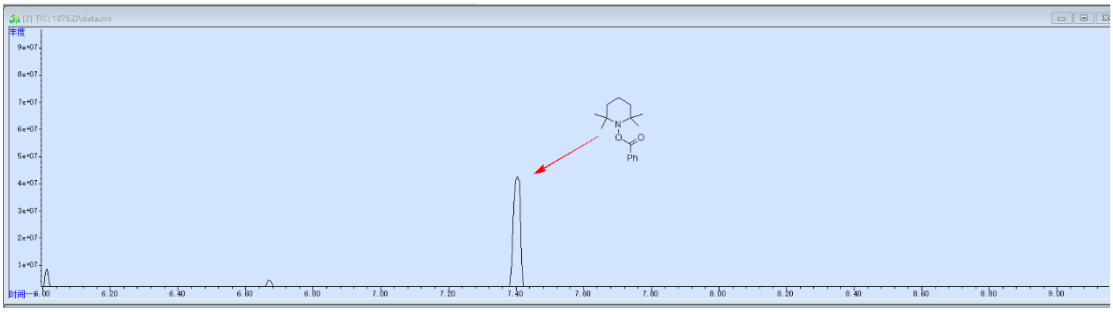
A 50 mL Schlenk tube was added **1a** (2.0 mmol), **2a** (4 mmol, 2.0 eqiuv), **PC1** (0.04 mmol, 2 mol%), $NiBr_2$ (0.1 mmol, 5 mol%), **L1** (0.1 mmol, 5 mol%), K_2HPO_4 (4 mmol, 2.0 equiv), acetone (20 mL). Then the mixture was stirred at room temperature in argon atmosphere (1 atm) under 35 W blue LED light for 30 h. After the reaction was finished, the reaction mixture was washed with brine. The aqueous phase was re-extracted with EtOAc (3×10 mL). The combined organic extracts were dried over Na_2SO_4 and concentrated in vacuum. The residue was purified by silica gel flash column chromatography (hexane/ethyl acetate = 10 : 1) to afford the desired products **3aa** in 69% yield.

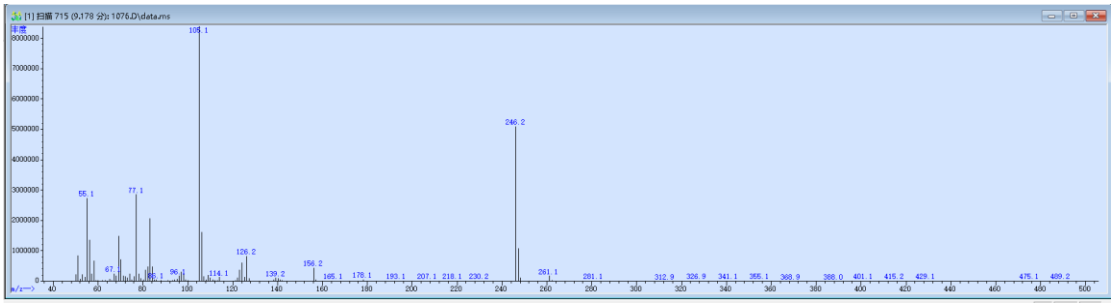
3. Mechanistic studies

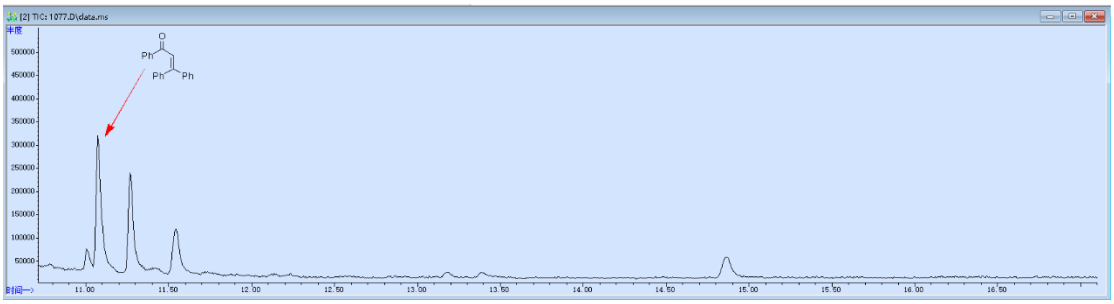
3.1 Radical trapping experiments

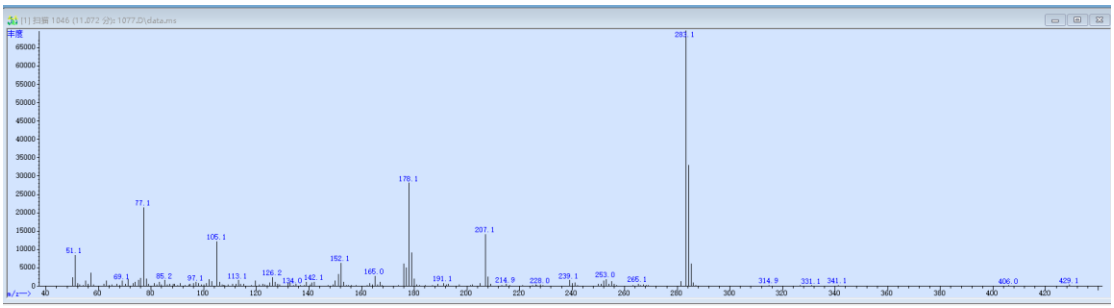


Three reactions of radical trapping experiments were performed. A solution of TEMPO (3.0 equiv, 0.6 mmol), BHT (3 equiv, 0.6 mmol) or 1,1-diphenylethene (3 equiv, 0.6 mmol), **1a** (0.2 mmol), **2a** (0.4 mmol, 2.0 eqiuv), **PC1** (0.004 mmol, 2 mol%), $NiBr_2$ (0.01 mmol, 5 mol%), **L1** (0.01 mmol, 5 mol%), K_2HPO_4 (0.4 mmol, 2.0 equiv), acetone (3 mL). Then the mixture was stirred at room temperature in argon atmosphere (1 atm) under 35 W blue LED light for 12 h. The benzylation were completely quenched and no benzylation products were detected.

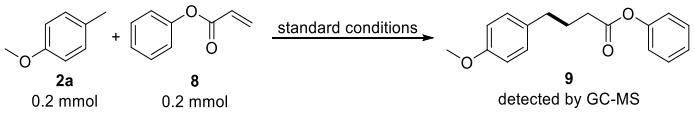








3.2 Benzyl radical trapping experiments

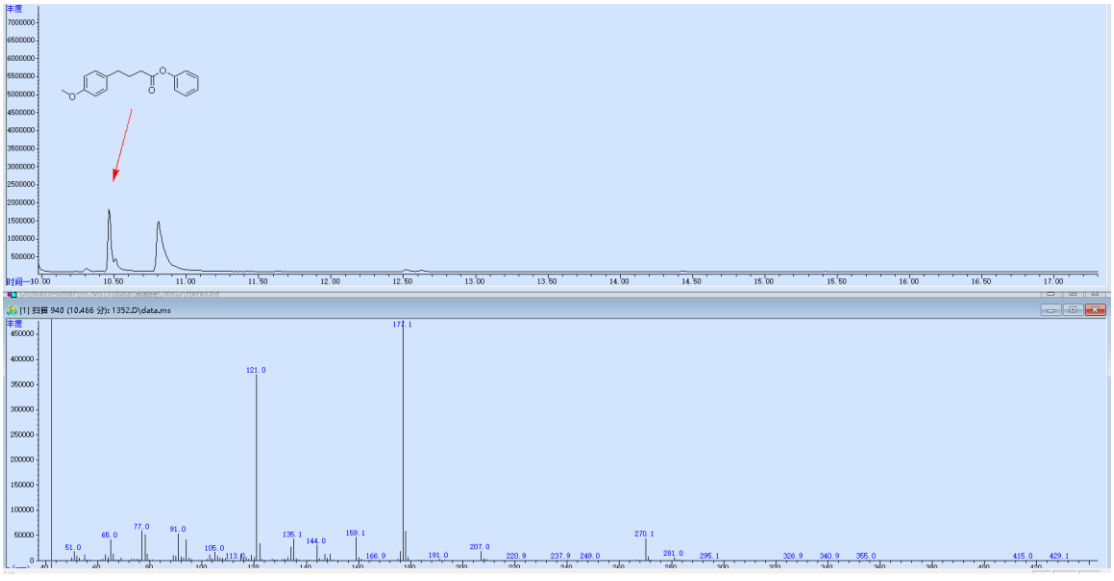


2a
0.2 mmol

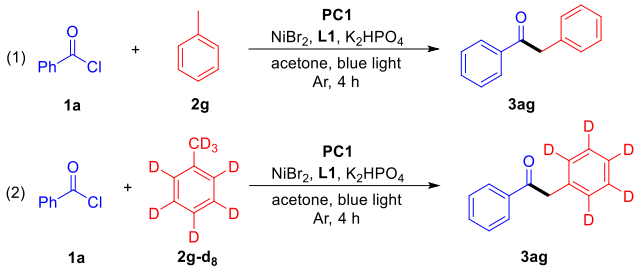
8
0.2 mmol

9
detected by GC-MS

To a Schlenk tube was added **1a** (0.2 mmol), **8** (0.2 mmol, 1.0 eqiuv), **PC1** (0.004 mmol, 2 mol%), $NiBr_2$ (0.01 mmol, 5 mol%), **L1** (0.01 mmol, 5 mol%), K_2HPO_4 (0.4 mmol, 2.0 equiv), acetone (3 mL). Then the mixture was stirred at room temperature in argon atmosphere (1 atm) under 35 W blue LED light for 12 h. Phenyl 4-(4-methoxyphenyl)butanoate (**9**) could be detected by GC-MS.

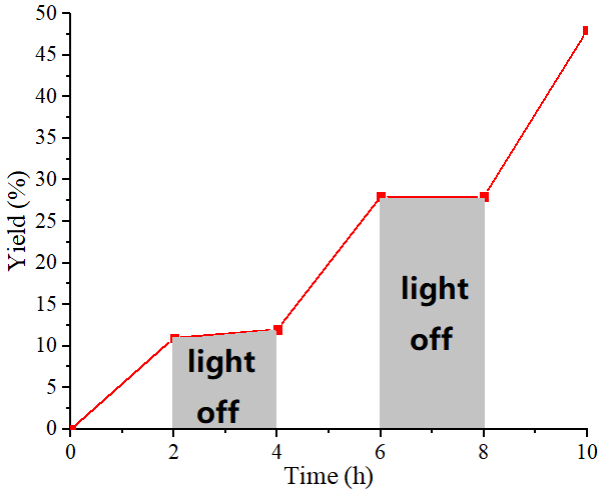


3.3 Kinetic isotope effect



Two parallel reactions of toluene (**2g**) or toluene-d_8 (**2g-d$_8$**) were performed. A solution of toluene (**2g**, 2.0 equiv), or toluene-d_8 (**2g-d$_8$**, 2.0 equiv), **1a** (0.2 mmol), **PC1** (0.004 mmol, 2 mol%), $NiBr_2$ (0.01 mmol, 5 mol%), **L1** (0.01 mmol, 5 mol%), K_2HPO_4 (0.4 mmol, 2.0 equiv), acetone (3 mL). Then the mixture was stirred at room temperature in Ar atmosphere (1 atm) under 35 W blue LED light for 4 h. The aqueous phase was re-extracted with EtOAc (3×10 mL). The combined organic extracts were dried over Na_2SO_4 and concentrated in vacuum. The solvent was removed on a rotary evaporator under reduced pressure. The residue was measured by GC, and the product **3ag** in 26% yield and **3ag-d$_7$** in 4% yield by using dodecane as the internal standard.

3.4 Light on/off experiment



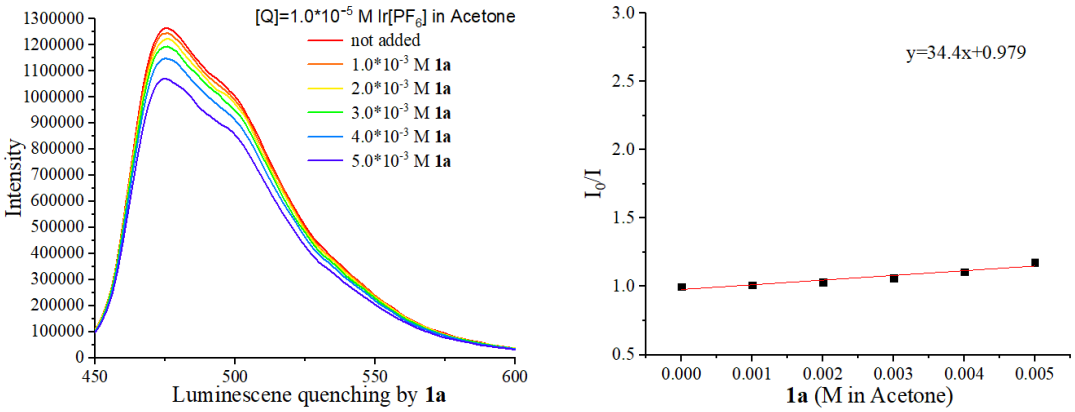
3.5 Stern–Volmer quenching[1]

Formulation solution: Benzoyl chloride (**1a**, 351.4 mg) was dissolved in acetone in a 25 mL volumetric flask to set the concentration to be 0.1 M. 1-methoxy-4-methylbenzene (**2a**, 315 μL) was dissolved in acetone in a 25 mL volumetric flask to set the concentration to be 0.5 M. $NiBr_2$ (13.6 mg) was dissolved in acetone in a 10 mL volumetric flask to set the concentration to be 0.005 M. **L1** (6.7 mg) was dissolved in acetone in a 5 mL volumetric flask to set the concentration to be 0.005 M. Photocatalyst $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (2.8 mg) was dissolved in acetone (25.0 mL) to set the concentration to be

0.1 mM.

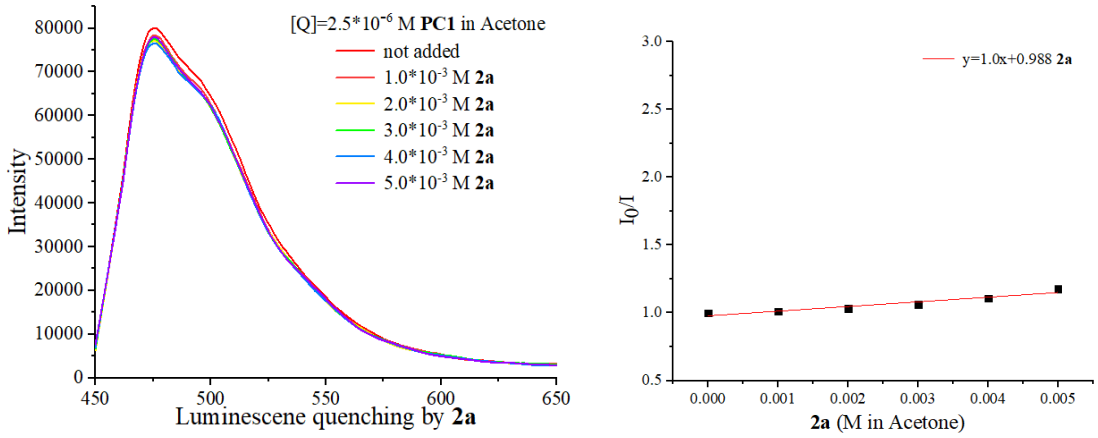
Experimental procedure: The resulting 0.1 M solution (50 μL) was added to cuvette to obtain different concentrations of catalyst solution. This solution was then diluted to a volume of 2.0 mL by adding further solvent (acetone) to prepare a 2.5 μM solution. The resulting mixture was sparged with nitrogen for 3 minutes and then irradiated at 425 nm. Fluorescence emission spectra were recorded (3 trials per sample). Into this solution, 20.0 μL of a benzoyl chloride solution was successively added and uniformly stirred, and the resulting mixture was bubbled with nitrogen for 3 minutes and irradiated at 425 nm. Fluorescence emission spectra of 0 μL, 20.0 μL, 40.0 μL, 60.0 μL, 80.0 μL, 100.0 μL, fluorescence intensity. Follow this method and make changes to the amount to obtain the Stern–Volmer relationship in turn.

(a) $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ quenched by **1a** in acetone.

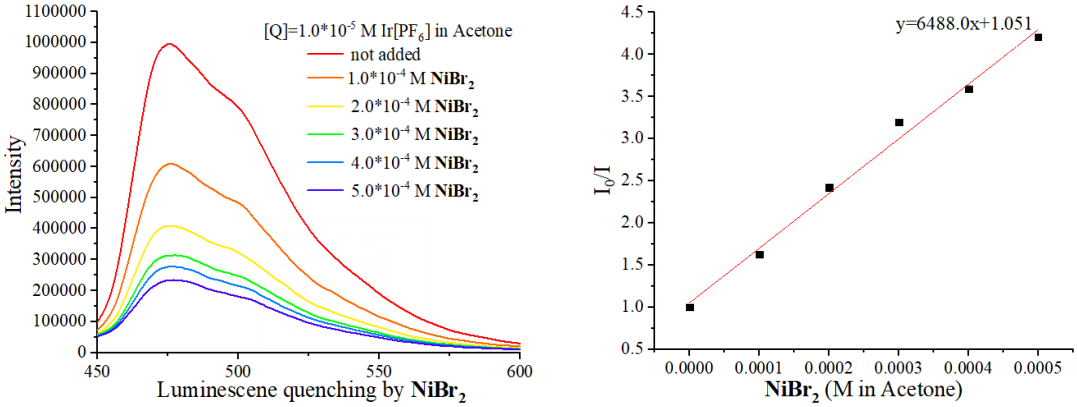


The emission intensity of the $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ catalyst solution slightly affected by the gradual increase of the amount of **1a**.

(b) $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ quenched by **2a** in acetone. Linear quenching is not observed.

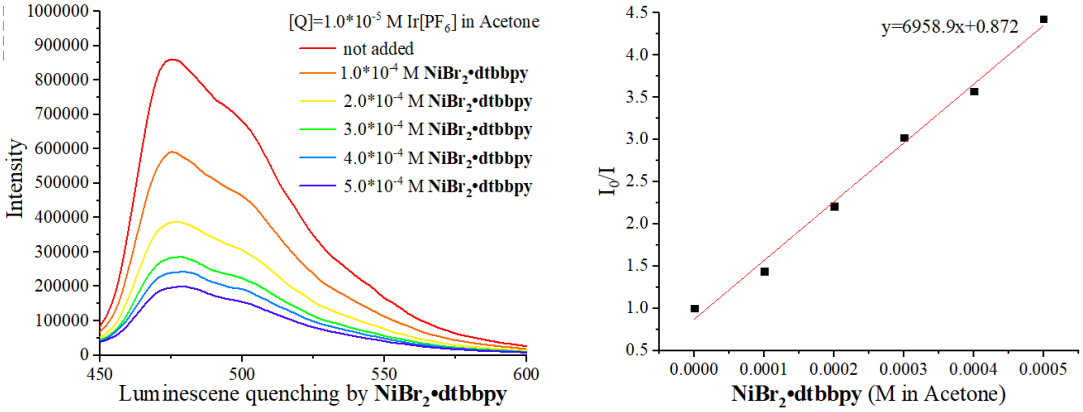


(c) Ir[dF(CF$_3$)ppy]$_2$(dtbbpy)PF$_6$ quenched by **NiBr$_2$** in acetone.



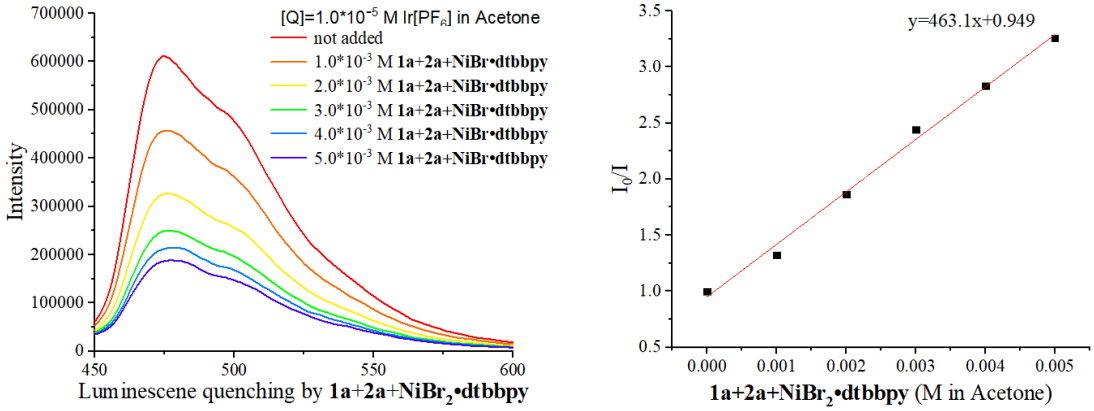
The emission intensity of the Ir[dF(CF$_3$)ppy]$_2$(dtbbpy)PF$_6$ catalyst solution strongly affected by the gradual increase of the amount of **NiBr$_2$**.

(d) Ir[dF(CF$_3$)ppy]$_2$(dtbbpy)PF$_6$ quenched by **NiBr$_2$•dtbbpy** in acetone.

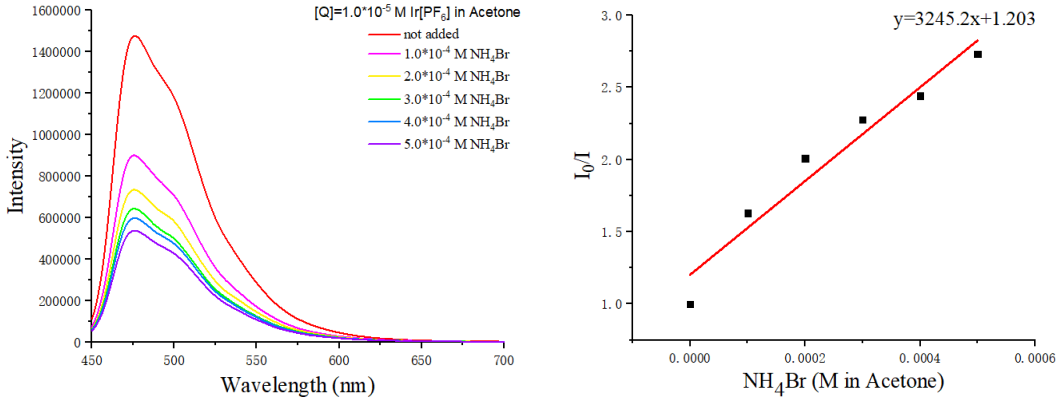


The emission intensity of the Ir[dF(CF$_3$)ppy]$_2$(dtbbpy)PF$_6$ catalyst solution strongly affected by the gradual increase of the amount of **NiBr$_2$•dtbbpy**.

(e) Ir[dF(CF$_3$)ppy]$_2$(dtbbpy)PF$_6$ quenched by **NiBr$_2$•dtbbpy**+**1a**+**2a** in acetone.

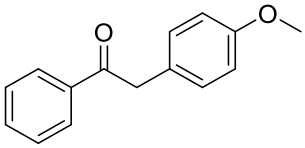


(f) Ir[dF(CF_3)ppy]$_2$(dtbbpy)PF_6 quenched by NH_4Br in acetone



The emission intensity of the Ir[dF(CF_3)ppy]$_2$(dtbbpy)PF_6 catalyst solution strongly affected by the gradual increase of the amount of NH_4Br.

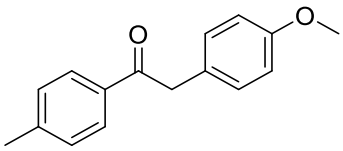
4. Analytical data



2-(4-Methoxyphenyl)-1-phenylethan-1-one (3aa)

Yield: 37.5 mg, 83%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 7.5 Hz, 2H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.18 (d, *J* = 8.5 Hz, 2H), 6.87 (d, *J* = 8.6 Hz, 2H), 4.23 (s, 2H), 3.78 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.9, 158.5, 136.5, 133.1, 130.4, 128.6, 128.6, 126.4, 114.1, 55.2, 44.6.

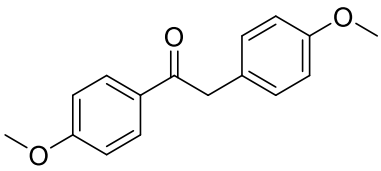
These spectroscopic data correspond to reported data.[2]



2-(4-Methoxyphenyl)-1-(*p*-tolyl)ethan-1-one (3ba)

Yield: 40.3 mg, 84%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.91 (d, *J* = 8.0 Hz, 2H), 7.24 (d, *J* = 8.1 Hz, 2H), 7.18 (d, *J* = 8.6 Hz, 2H), 6.86 (d, *J* = 8.6 Hz, 2H), 4.19 (s, 2H), 3.77 (s, 3H), 2.39 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.6, 158.4, 143.9, 134.0, 130.4, 129.3, 128.7, 126.7, 114.0, 55.2, 44.5, 21.6.

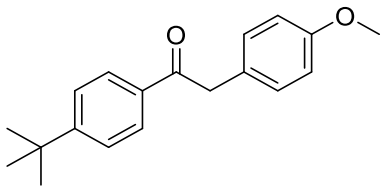
These spectroscopic data correspond to reported data.[3]



1,2-Bis(4-methoxyphenyl)ethan-1-one (3ca)

Yield: 45.1 mg, 88%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.99 (d, *J* = 8.9 Hz, 2H), 7.18 (d, *J* = 8.6 Hz, 2H), 6.92 (d, *J* = 8.9 Hz, 2H), 6.86 (d, *J* = 8.6 Hz, 2H), 4.17 (s, 2H), 3.85 (s, 3H), 3.78 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 196.5, 163.4, 158.4, 130.9, 130.3, 129.5, 126.9, 114.0, 113.7, 55.4, 55.2, 44.3.

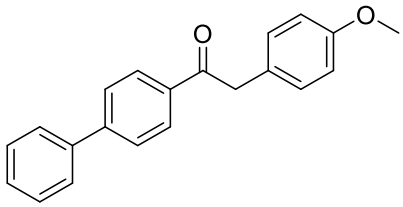
These spectroscopic data correspond to reported data.[3]



1-(4-(*tert*-Butyl)phenyl)-2-(4-methoxyphenyl)ethan-1-one (3da)

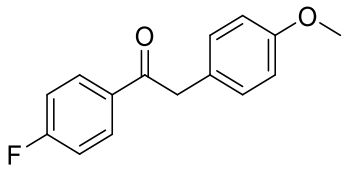
Yield: 49.1 mg, 87%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.96 (d, *J* = 8.2 Hz, 2H), 7.47 (d, *J* = 8.1 Hz, 2H), 7.19 (d, *J* = 8.2 Hz, 2H), 6.87 (d, *J* = 8.2 Hz, 2H), 4.21 (s, 2H), 3.79 (s, 3H), 1.33 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.5, 158.4, 156.8, 134.0, 130.4, 128.6, 126.7, 125.5, 114.1, 55.2, 44.5, 35.1, 31.0.

These spectroscopic data correspond to reported data.[4]



1-([1,1'-Biphenyl]-4-yl)-2-(4-methoxyphenyl)ethan-1-one (3ea)

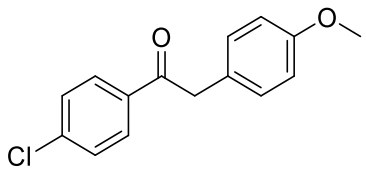
Yield: 48.9 mg, 81%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.08 (d, *J* = 7.9 Hz, 2H), 7.67 (d, *J* = 7.8 Hz, 2H), 7.62 (d, *J* = 7.1 Hz, 2H), 7.47 (t, *J* = 7.2 Hz, 2H), 7.43 – 7.36 (m, 1H), 7.21 (d, *J* = 7.8 Hz, 2H), 6.88 (d, *J* = 7.6 Hz, 2H), 4.26 (s, 2H), 3.79 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.5, 158.5, 145.7, 139.8, 135.2, 130.4, 129.2, 128.9, 128.2, 127.2, 127.2, 126.5, 114.1, 55.2, 44.7. HRMS (ESI) m/z calcd for $C_{21}H_{18}O_2Na$ $(M+Na)^+$ 325.1199, found 325.1208.



1-(4-Fluorophenyl)-2-(4-methoxyphenyl)ethan-1-one (3fa)

Yield: 37.6 mg, 77%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.08 – 7.99 (m, 2H), 7.17 (d, *J* = 8.6 Hz, 2H), 7.12 (t, *J* = 8.6 Hz, 2H), 6.87 (d, *J* = 8.6 Hz, 2H), 4.20 (s, 2H), 3.78 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 196.3, 165.7 (d, *J* = 253.3 Hz), 158.5, 132.9 (d, *J* = 3.0 Hz), 131.2 (d, *J* = 9.2 Hz), 130.4, 126.2, 115.7 (d, *J* = 21.7 Hz), 114.2, 55.2, 44.6.

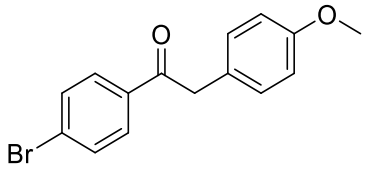
These spectroscopic data correspond to reported data.[5]



1-(4-Chlorophenyl)-2-(4-methoxyphenyl)ethan-1-one (3ga)

Yield: 37.4 mg, 72%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.94 (d, *J* = 8.6 Hz, 2H), 7.42 (d, *J* = 8.6 Hz, 2H), 7.16 (d, *J* = 8.6 Hz, 2H), 6.87 (d, *J* = 8.6 Hz, 2H), 4.19 (s, 2H), 3.78 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 196.7, 158.6, 139.5, 134.8, 130.4, 130.0, 128.9, 126.0, 114.2, 55.2, 44.6.

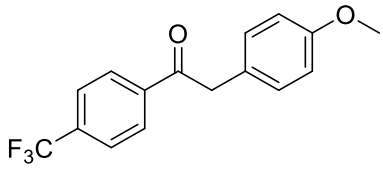
These spectroscopic data correspond to reported data.[6]



1-(4-Bromophenyl)-2-(4-methoxyphenyl)ethan-1-one

Yield: 40.1 mg, 66%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.94 (d, *J* = 8.6 Hz, 1H), 7.86 (d, *J* = 8.6 Hz, 1H), 7.59 (d, *J* = 8.6 Hz, 1H), 7.42 (d, *J* = 8.6 Hz, 1H), 7.16 (d, *J* = 7.8 Hz, 2H), 6.87 (d, *J* = 8.6 Hz, 2H), 4.19 (s, 2H), 3.79 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 196.7, 158.6, 139.5, 134.8, 130.4, 130.0, 128.9, 126.0, 114.2, 55.2, 44.6.

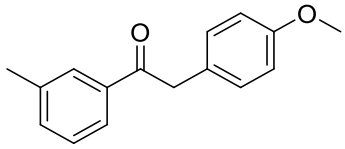
These spectroscopic data correspond to reported data.[5]



2-(4-Methoxyphenyl)-1-(4-(trifluoromethyl)phenyl)ethan-1-one (3ia)

Yield: 30.0 mg, 51%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.10 (d, *J* = 7.5 Hz, 2H), 7.72 (d, *J* = 7.6 Hz, 2H), 7.17 (d, *J* = 7.2 Hz, 2H), 6.88 (d, *J* = 6.7 Hz, 2H), 4.25 (s, 2H), 3.79 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 196.9, 158.7, 139.15, 134.3 (q, *J* = 32.5 Hz), 130.4, 128.9, 125.6 (d, *J* = 11.2 Hz), 125.6 (d, *J* = 3.6 Hz), 123.5 (d, *J* = 270.9 Hz), 114.24, 55.19, 44.92.

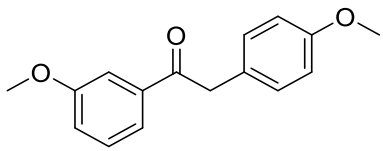
These spectroscopic data correspond to reported data.[5]



2-(4-Methoxyphenyl)-1-(m-tolyl)ethan-1-one (3ja)

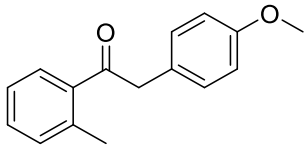
Yield: 35.5 mg, 74%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.80 (d, *J* = 8.4 Hz, 2H), 7.37-7.31 (m, 2H), 7.18 (d, *J* = 8.1 Hz, 2H), 6.86 (d, *J* = 8.1 Hz, 2H), 4.21 (s, 2H), 3.78 (s, 3H), 2.40 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 198.1, 158.4, 138.4, 136.6, 133.8, 130.6, 129.0, 128.4, 126.5, 125.8, 114.1, 55.2, 44.6, 21.4.

These spectroscopic data correspond to reported data.[3]



1-(3-Methoxyphenyl)-2-(4-methoxyphenyl)ethan-1-one (3ka)

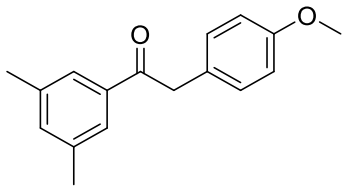
Yield: 39.4 mg, 77%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.60 (d, *J* = 7.7 Hz, 1H), 7.52 (s, 1H), 7.36 (t, *J* = 7.9 Hz, 1H), 7.18 (d, *J* = 8.5 Hz, 2H), 7.10 (d, *J* = 7.5 Hz, 1H), 6.86 (d, *J* = 8.6 Hz, 2H), 4.21 (s, 2H), 3.83 (s, 3H), 3.78 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.7, 159.8, 158.5, 137.9, 130.4, 129.5, 126.4, 121.2, 119.5, 114.1, 112.8, 55.4, 55.2, 44.7. HRMS (ESI) m/z calcd for $C_{16}H_{16}O_3Na$ $(M+Na)^+$ 279.0992, found 279.0999.



2-(4-Methoxyphenyl)-1-(o-tolyl)ethan-1-one (3la)

Yield: 32.2 mg, 67%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.71 (d, *J* = 7.6 Hz, 1H), 7.36 (t, *J* = 7.4 Hz, 1H), 7.24 (q, *J* = 7.7, 7.3 Hz, 2H), 7.14 (d, *J* = 8.5 Hz, 2H), 6.86 (d, *J* = 8.6 Hz, 2H), 4.15 (s, 2H), 3.78 (s, 3H), 2.43 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 201.8, 158.5, 138.4, 137.6, 131.9, 131.2, 130.5, 128.5, 126.4, 125.6, 114.0, 55.2, 47.5, 21.2.

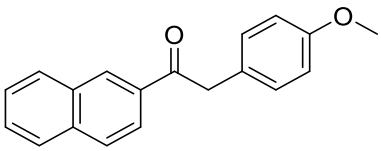
These spectroscopic data correspond to reported data.[7]



1-(3,5-Dimethylphenyl)-2-(4-methoxyphenyl)ethan-1-one (3ma)

Yield: 36.1 mg, 71%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.61 (s, 2H), 7.17 (d, *J* = 8.7 Hz, 3H), 6.86 (d, *J* = 8.6 Hz, 2H), 4.20 (s, 2H), 3.78 (s, 3H), 2.36 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 198.3,

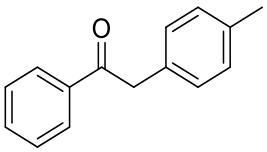
158.4, 138.2, 136.7, 134.7, 130.4, 126.6, 126.3, 114.0, 55.2, 44.6, 21.2. HRMS (ESI) m/z calcd for $C_{17}H_{18}O_2Na$ $(M+Na)^+$ 277.1199, found 277.1206.



2-(4-Methoxyphenyl)-1-(naphthalen-2-yl)ethan-1-one (3na)

Yield: 36.4 mg, 66%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.55 (s, 1H), 8.06 (dd, *J* = 8.7, 1.8 Hz, 1H), 7.97 (d, *J* = 8.4 Hz, 1H), 7.88 (t, *J* = 8.4 Hz, 2H), 7.62 – 7.53 (m, 2H), 7.24 (d, *J* = 8.6 Hz, 2H), 6.88 (d, *J* = 8.6 Hz, 2H), 4.36 (s, 2H), 3.78 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.9, 158.5, 135.5, 133.9, 132.5, 130.5, 130.3, 129.6, 128.5, 128.5, 127.7, 126.8, 126.6, 124.3, 114.1, 55.2, 44.7.

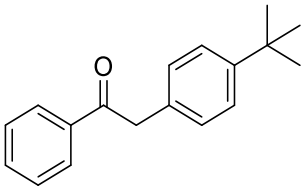
These spectroscopic data correspond to reported data.[5]



1-Phenyl-2-(*p*-tolyl)ethan-1-one (3ab)

Yield: 32.8 mg, 78%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 7.0 Hz, 2H), 7.59 – 7.51 (m, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.21 – 7.07 (m, 4H), 4.25 (s, 2H), 2.32 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.8, 136.6, 136.5, 133.1, 131.4, 129.4, 129.3, 128.6, 128.6, 45.1, 21.1.

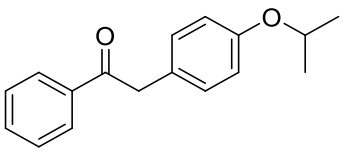
These spectroscopic data correspond to reported data.[2]



2-(4-(*tert*-Butyl)phenyl)-1-phenylethan-1-one (3ac)

Yield: 42.4 mg, 84%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.03 (d, *J* = 8.2 Hz, 2H), 7.55 (t, *J* = 7.3 Hz, 1H), 7.46 (t, *J* = 7.6 Hz, 2H), 7.35 (d, *J* = 8.3 Hz, 2H), 7.20 (d, *J* = 8.3 Hz, 2H), 4.26 (s, 2H), 1.30 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.8, 149.6, 136.6, 133.1, 131.3, 129.1, 128.6, 128.6, 125.6, 44.9, 34.4, 31.3.

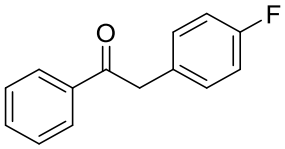
These spectroscopic data correspond to reported data.[8]



2-(4-Isopropoxyphenyl)-1-phenylethan-1-one (3ad)

Yield: 44.2 mg, 87%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 7.3 Hz, 2H), 7.55 (t, *J* = 7.3 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.16 (d, *J* = 8.5 Hz, 2H), 6.84 (d, *J* = 8.6 Hz, 2H), 4.50 (p, *J* = 6.1 Hz, 1H), 4.21 (s, 2H), 1.32 (s, 3H), 1.30 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 198.0, 156.8, 136.5, 133.0, 130.4, 128.6, 128.6, 126.2, 116.0, 69.8, 44.6, 22.0.

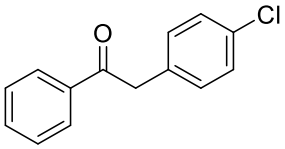
These spectroscopic data correspond to reported data.[5]



2-(4-Fluorophenyl)-1-phenylethan-1-one (3ae)

Yield: 28.7 mg, 67%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: ^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.01 (d, *J* = 8.1 Hz, 2H), 7.58 (t, *J* = 7.4 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 2H), 7.2 – 7.21 (m, 2H), 7.02 (t, *J* = 8.7 Hz, 2H), 4.27 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.4, 161.7 (d, *J* = 243.9 Hz), 136.4, 133.3, 131.0 (d, *J* = 8.0 Hz), 130.1 (d, *J* = 3.2 Hz), 128.7, 128.5, 115.5 (d, *J* = 21.2 Hz), 44.5.

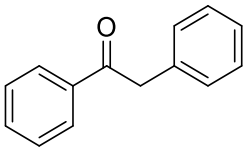
These spectroscopic data correspond to reported data.[8]



2-(4-Chlorophenyl)-1-phenylethan-1-one (3af)

Yield: 29.9 mg, 65%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.00 (d, *J* = 8.3 Hz, 2H), 7.58 (t, *J* = 7.4 Hz, 1H), 7.47 (t, *J* = 7.7 Hz, 2H), 7.30 (d, *J* = 8.4 Hz, 2H), 7.19 (d, *J* = 8.3 Hz, 2H), 4.26 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.1, 136.3, 133.3, 132.9, 132.8, 130.9, 128.8, 128.7, 128.5, 44.7.

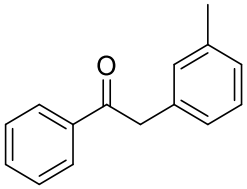
These spectroscopic data correspond to reported data.[2]



1,2-Diphenylethan-1-one (3ag)

Yield: 27.5 mg, 70%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 7.0 Hz, 2H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.37 – 7.29 (m, 2H), 7.29 – 7.21 (m, 3H), 4.29 (s, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.6, 136.5, 134.5, 133.1, 129.4, 128.6, 128.6, 128.6, 126.9, 45.5.

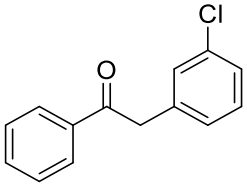
These spectroscopic data correspond to reported data.[2]



1-Phenyl-2-(*m*-tolyl)ethan-1-one (3ah)

Yield: 26.9 mg, 64%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 7.0 Hz, 2H), 7.55 (t, *J* = 7.3 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.21 (t, *J* = 7.5 Hz, 1H), 7.08 (s, 1H), 7.06 (d, *J* = 9.2 Hz, 2H), 4.24 (s, 2H), 2.32 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.5, 136.9, 136.8, 133.4, 133.1, 130.3, 130.3, 128.6, 128.3, 127.2, 126.1, 43.5, 19.8.

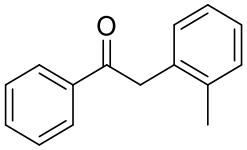
These spectroscopic data correspond to reported data.[2]



2-(3-Chlorophenyl)-1-phenylethan-1-one (3ai)

Yield: 25.3 mg, 55%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 7.4 Hz, 2H), 7.58 (t, *J* = 7.3 Hz, 1H), 7.48 (t, *J* = 7.7 Hz, 2H), 7.30 – 7.21 (m, 3H), 7.18 – 7.11 (m, 1H), 4.27 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 196.8, 136.3, 136.3, 134.4, 133.4, 129.8, 129.6, 128.7, 128.5, 127.7, 127.1, 44.9.

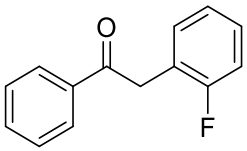
These spectroscopic data correspond to reported data.[9]



1-Phenyl-2-(*o*-tolyl)ethan-1-one (3aj)

Yield: 21.9 mg, 52%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.03 (d, *J* = 8.1 Hz, 2H), 7.58 (t, *J* = 7.4 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 2H), 7.23 – 7.09 (m, 4H), 4.31 (s, 2H), 2.26 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.5, 136.9, 136.8, 133.4, 133.1, 130.3, 130.3, 128.6, 128.3, 127.2, 126.1, 43.5, 19.8.

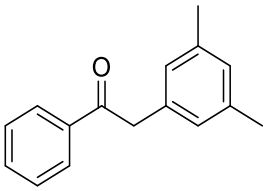
These spectroscopic data correspond to reported data.[10]



2-(2-Fluorophenyl)-1-phenylethan-1-one (3ak)

Yield: 19.7 mg, 46%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.05 (d, *J* = 7.8 Hz, 2H), 7.59 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 2H), 7.32 – 7.20 (m, 2H), 7.16 – 7.03 (m, 2H), 4.34 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 196.3, 160.9 (d, *J* = 243.9 Hz), 136.4, 133.3, 131.6 (d, *J* = 4.3 Hz), 128.9 (d, *J* = 8.1 Hz), 128.5 (d, *J* = 28.1 Hz), 1241, 124.1, 121.8 (d, *J* = 1.6 Hz), 115.4 (d, *J* = 21.9 Hz), 38.6.

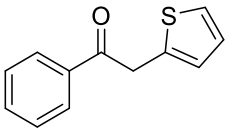
These spectroscopic data correspond to reported data.[8]



2-(3,5-Dimethylphenyl)-1-phenylethan-1-one (3al)

Yield: 34.5 mg, 77%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.02 (d, *J* = 7.5 Hz, 2H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 6.88 (s, 3H), 4.20 (s, 2H), 2.28 (s, 7H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.9, 138.2, 136.6, 134.3, 133.1, 128.6, 128.6, 128.6, 127.2, 45.4, 21.2.

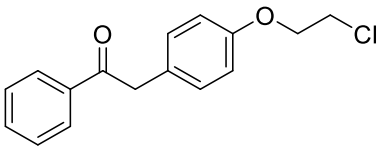
These spectroscopic data correspond to reported data.[2]



1-Phenyl-2-(thiophen-2-yl)ethan-1-one (3am)

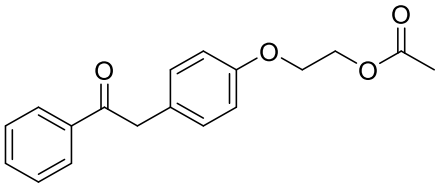
Yield: 26.3 mg, 65%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.02 (d, *J* = 7.0 Hz, 2H), 7.57 (t, *J* = 7.4 Hz, 1H), 7.47 (t, *J* = 7.6 Hz, 2H), 7.22 (dd, *J* = 5.1, 1.3 Hz, 1H), 6.97 (dd, *J* = 5.1, 3.5 Hz, 1H), 6.93 (dt, *J* = 3.6, 1.1 Hz, 1H), 4.48 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 195.9, 136.0, 135.4, 133.4, 128.7, 128.5, 126.8, 126.8, 125.1, 39.3.

These spectroscopic data correspond to reported data.[11]



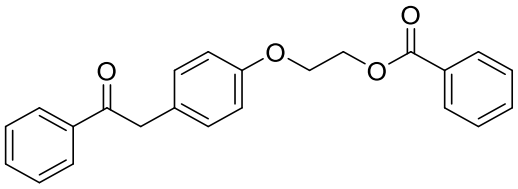
2-(4-(2-Chloroethoxy)phenyl)-1-phenylethan-1-one(3an)

Yield: 46.0 mg, 84%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.00 (d, *J* = 7.4 Hz, 2H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.18 (d, *J* = 8.5 Hz, 2H), 6.87 (d, *J* = 8.6 Hz, 2H), 4.23 (s, 2H), 4.19 (t, *J* = 5.9 Hz, 2H), 3.79 (t, *J* = 5.9 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.8, 157.1, 136.5, 133.1, 130.6, 128.6, 128.5, 127.2, 114.9, 68.0, 44.5, 41.9. HRMS (ESI) m/z calcd for $C_{16}H_{15}O_2ClNa$ $(M+Na)^+$ 297.0653, found 297.0665.



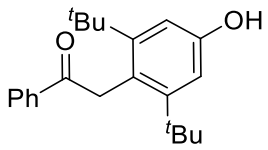
2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl acetate (3ao)

Yield: 44.7 mg, 75%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 6.7 Hz, 2H), 7.64 – 7.51 (m, 1H), 7.48 – 7.44 (m, 2H), 7.19 (d, *J* = 7.4 Hz, 2H), 6.88 (d, *J* = 7.8 Hz, 2H), 4.40 (s, 2H), 4.23 (s, 2H), 4.15 (s, 2H), 2.09 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.8, 171.0, 157.4, 136.5, 133.1, 130.5, 128.6, 128.5, 127.0, 114.8, 65.9, 62.81, 44.6, 20.9. HRMS (ESI) m/z calcd for $C_{18}H_{18}O_4Na$ $(M+Na)^+$ 321.1097, found 321.1114.



2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl benzoate (3ap)

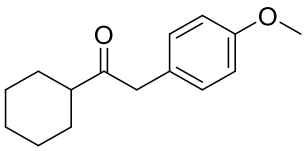
Yield: 53.3 mg, 74%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.05 (d, *J* = 7.0 Hz, 2H), 8.01 (d, *J* = 6.9 Hz, 2H), 7.58 – 7.54 (m, 2H), 7.48 – 7.41 (m, 4H), 7.19 (d, *J* = 7.5 Hz, 2H), 6.91 (d, *J* = 7.5 Hz, 2H), 4.65 (s, 2H), 4.28 (s, 2H), 4.23 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ:197.8, 166.5, 157.5, 136.5, 133.1, 133.1, 130.5, 129.8, 129.7, 128.6, 128.5, 128.3, 127.0, 114.9, 66.0, 63.3, 44.6. HRMS (ESI) m/z calcd for $C_{23}H_{20}O_4Na$ $(M+Na)^+$ 383.1254, found 383.1272.



2-(2,6-Di-*tert*-butyl-4-hydroxyphenyl)-1-phenylethan-1-one (3ar)

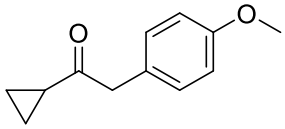
Yield: 33.1 mg, 51%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.04 (d, *J* = 7.4 Hz, 2H), 7.56 (t, *J* = 7.3 Hz, 1H), 7.46 (t, *J* = 7.6 Hz, 2H), 7.05 (s, 2H), 5.13 (s, 1H), 4.20 (s, 2H), 1.42 (s, 18H); ^{13}C NMR

(100 MHz, $CDCl_3$) δ: 198.3, 152.7, 136.9, 135.9, 133.0, 128.6, 128.5, 126.2, 124.9, 45.2, 34.3, 30.2. HRMS (ESI) m/z calcd for $C_{22}H_{28}O_2Na$ $(M+Na)^+$ 347.1982, found 347.1991.



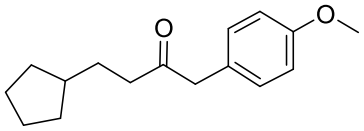
1-Cyclohexyl-2-(4-methoxyphenyl)ethan-1-one (5aa)

Yield: 30.2 mg, 65%; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ: ^1H NMR (400 MHz, Chloroform-*d*) δ 7.10 (d, *J* = 8.6 Hz, 2H), 6.86 (d, *J* = 8.6 Hz, 2H), 3.79 (s, 3H), 3.66 (s, 2H), 2.45 (tt, *J* = 11.6, 3.4 Hz, 1H), 1.87 – 1.70 (m, 4H), 1.69 – 1.64 (m, 1H), 1.41 – 1.17 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 211.7, 158.4, 130.4, 126.4, 114.0, 55.2, 49.9, 47.0, 28.5, 25.8, 25.6. HRMS (ESI) m/z calcd for $C_{15}H_{20}O_2Na$ $(M+Na)^+$ 255.1356, found 255.1451.



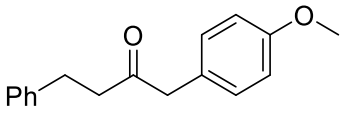
1-Cyclopropyl-2-(4-methoxyphenyl)ethan-1-one (5ba)

Yield: 25.1 mg, 66%; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ: 7.14 (d, *J* = 8.6 Hz, 2H), 6.87 (d, *J* = 8.6 Hz, 2H), 3.79 (s, 3H), 3.76 (s, 2H), 1.96 (tt, *J* = 7.8, 4.5 Hz, 1H), 1.07 – 0.98 (m, 2H), 0.86 – 0.86 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 208.8, 158.5, 130.5, 126.4, 114.0, 55.2, 49.8, 19.9, 11.3. HRMS (ESI) m/z calcd for $C_{12}H_{14}O_2Na$ $(M+Na)^+$ 213.0886, found 213.0894.



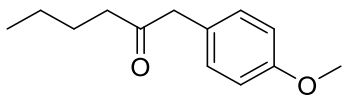
4-Cyclopentyl-1-(4-methoxyphenyl)butan-2-one (5ca)

Yield: 22.6 mg, 46%; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ: 7.12 (d, *J* = 8.6 Hz, 2H), 6.86 (d, *J* = 8.6 Hz, 2H), 3.80 (s, 3H), 3.62 (s, 2H), 2.44 (t, *J* = 7.2 Hz, 2H), 1.75 – 1.64 (m, 3H), 1.58 – 1.52 (m, 4H), 1.50 – 1.45 (m, 2H), 1.09 – 0.96 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 209.2, 158.5, 130.4, 126.4, 114.1, 55.2, 49.2, 41.1, 39.6, 32.4, 29.9, 25.1. HRMS (ESI) m/z calcd for $C_{16}H_{22}O_2Na$ $(M+Na)^+$ 269.1512, found 269.1523.



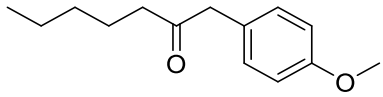
1-(4-Methoxyphenyl)-4-phenylbutan-2-one (5da)

Yield: 40.2 mg, 79%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.25 (t, *J* = 7.1 Hz, 2H), 7.17 (t, *J* = 7.3 Hz, 1H), 7.12 (d, *J* = 6.7 Hz, 2H), 7.06 (d, *J* = 8.6 Hz, 2H), 6.84 (d, *J* = 8.6 Hz, 2H), 3.77 (s, 3H), 3.58 (s, 2H), 2.85 (t, *J* = 7.1 Hz, 2H), 2.79 – 2.70 (t, *J* = 7.1 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 207.8, 158.5, 140.9, 130.3, 128.4, 128.2, 126.0, 126.0, 114.1, 55.2, 49.4, 43.2, 29.7. HRMS (ESI) m/z calcd for $C_{17}H_{18}O_2Na$ $(M+Na)^+$ 277.1199, found 277.1209.



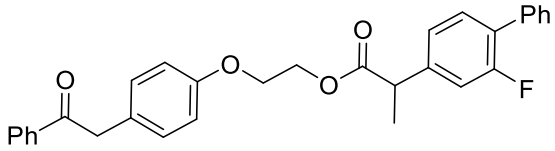
1-(4-Methoxyphenyl)hexan-2-one (5ea)

Yield: 21.0 mg, 51%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.11 (d, *J* = 8.6 Hz, 2H), 6.86 (d, *J* = 8.6 Hz, 2H), 3.79 (s, 3H), 3.61 (s, 2H), 2.43 (t, *J* = 7.4 Hz, 2H), 1.52 (p, *J* = 7.5 Hz, 2H), 1.25 (p, *J* = 7.4 Hz, 2H), 0.86 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 209.1, 158.5, 130.3, 126.4, 114.1, 55.2, 49.2, 41.5, 25.8, 22.2, 13.8. HRMS (ESI) m/z calcd for $C_{13}H_{18}O_2Na$ $(M+Na)^+$ 229.1199, found 229.1208.



1-(4-Methoxyphenyl)heptan-2-one (5fa)

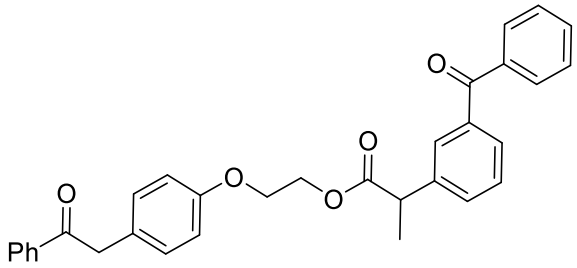
Yield: 23.3 mg, 53%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.11 (d, *J* = 8.5 Hz, 2H), 6.86 (d, *J* = 8.6 Hz, 2H), 3.79 (s, 3H), 3.61 (s, 2H), 2.42 (t, *J* = 7.4 Hz, 2H), 1.54 (p, *J* = 7.5 Hz, 2H), 1.30 – 1.19 (m, 4H), 0.86 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 209.1, 158.5, 130.3, 126.4, 114.1, 55.2, 49.2, 41.8, 31.3, 23.4, 22.4, 13.9. HRMS (ESI) m/z calcd for $C_{14}H_{20}O_2Na$ $(M+Na)^+$ 243.1356, found 243.1363.



2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(2-fluoro-[1,1'-biphenyl]-4-yl)propanoate (7aa)

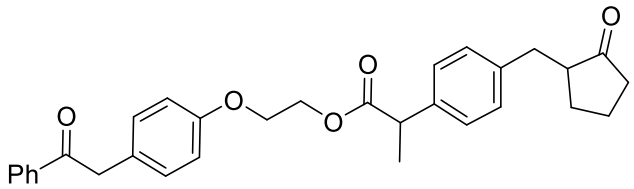
Yield: 58.8 mg, 61%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.99 (d, *J* = 7.3 Hz, 2H), 7.55 (d, *J* = 7.6 Hz, 1H), 7.51 (d, *J* = 8.2 Hz, 2H), 7.44 (q, *J* = 7.7 Hz, 4H), 7.35 (d, *J* = 7.3 Hz, 2H), 7.20 – 7.09 (m, 4H), 6.83 (d, *J* = 8.6 Hz, 2H), 4.48 – 4.38 (m, 2H), 4.20 (s, 2H), 4.12 (t, *J* = 4.7 Hz, 2H), 3.79 (q, *J* = 7.1 Hz, 1H), 1.53 (d, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.8, 173.9, 159.6 (d, *J* = 246.8 Hz), 157.4, 141.5 (d, *J* = 7.7 Hz), 136.5, 135.4, 133.1, 130.7 (d, *J* = 3.9 Hz), 130.5, 128.9 (d, *J* = 2.9 Hz),

128.6, 128.5, 128.4, 127.8 (d, *J* = 13.5 Hz), 127.6, 127.0, 123.5 (d, *J* = 3.4 Hz), 115.2 (d, *J* = 23.5 Hz), 114.8, 65.8, 63.3, 44.8, 44.5, 18.3. HRMS (ESI) m/z calcd for $C_{31}H_{27}O_4FNa$ $(M+Na)^+$ 505.1786, found 505.1799.



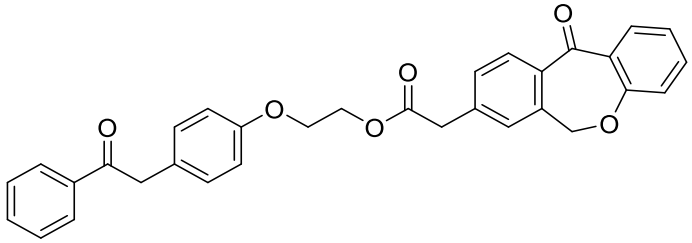
2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(3-benzoylphenyl)propanoate (7ab)

Yield: 54.1 mg, 55%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.00 (d, *J* = 7.0 Hz, 2H), 7.77 (t, *J* = 7.8 Hz, 3H), 7.65 (d, *J* = 7.7 Hz, 1H), 7.60 – 7.53 (m, 3H), 7.48 – 7.43 (m, 4H), 7.39 (t, *J* = 7.7 Hz, 1H), 7.15 (d, *J* = 8.5 Hz, 2H), 6.80 (d, *J* = 8.6 Hz, 2H), 4.49 – 4.35 (m, 2H), 4.21 (s, 2H), 4.10 (d, *J* = 4.8 Hz, 2H), 3.83 (q, *J* = 7.2 Hz, 1H), 1.53 (d, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.8, 196.4, 174.0, 157.3, 140.5, 137.8, 137.4, 136.4, 133.1, 132.5, 131.5, 130.5, 130.0, 129.2, 129.0, 128.6, 128.5, 128.5, 128.2, 127.0, 114.8, 65.7, 63.2, 45.2, 44.5, 18.4. HRMS (ESI) m/z calcd for $C_{32}H_{28}O_5Na$ $(M+Na)^+$ 515.1829, found 515.1836.



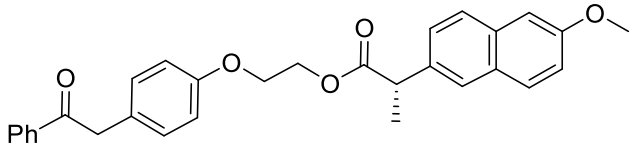
2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(4-((2-oxocyclopentyl)methyl)phenyl)propanoate (7ac)

Yield: 60.0 mg, 62%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 7.0 Hz, 2H), 7.56 (t, *J* = 7.3 Hz, 1H), 7.46 (t, *J* = 7.7 Hz, 2H), 7.21 (d, *J* = 8.1 Hz, 2H), 7.17 (d, *J* = 8.6 Hz, 2H), 7.09 (d, *J* = 8.1 Hz, 2H), 6.83 (d, *J* = 8.6 Hz, 2H), 4.46 – 4.41 (m, 1H), 4.39 – 4.33 (m, 1H), 4.23 (s, 2H), 4.10 (t, *J* = 4.8 Hz, 2H), 3.73 (q, *J* = 7.1 Hz, 1H), 3.11 (dd, *J* = 13.9, 4.0 Hz, 1H), 2.47 (dd, *J* = 13.9, 9.7 Hz, 1H), 2.39 – 2.26 (m, 2H), 2.16 – 2.00 (m, 2H), 1.98 – 1.91 (m, 1H), 1.78 – 1.64 (m, 2H), 1.58 – 1.50 (m, 1H), 1.48 (d, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 220.2, 197.8, 174.5, 157.4, 138.8, 138.1, 136.5, 133.1, 130.5, 129.0, 128.6, 128.5, 127.5, 127.0, 114.8, 65.8, 63.0, 50.9, 44.9, 44.5, 38.1, 35.1, 29.2, 20.5, 18.5. HRMS (ESI) m/z calcd for $C_{31}H_{32}O_5Na$ $(M+Na)^+$ 507.2142, found 507.2149.



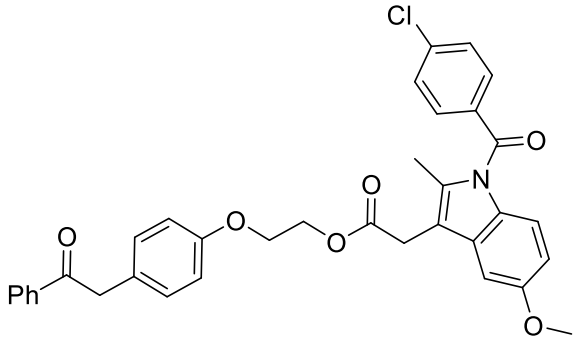
2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(11-oxo-6,11-dihydrodibenzo[b,e]oxepin-8-yl)acetate (7ad)

Yield: 67.8 mg, 67%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.11 (d, *J* = 2.4 Hz, 1H), 8.06 – 7.95 (m, 2H), 7.92 – 7.84 (m, 1H), 7.59 – 7.52 (m, 2H), 7.51 – 7.39 (m, 4H), 7.36 (d, *J* = 7.4 Hz, 1H), 7.17 (d, *J* = 8.5 Hz, 2H), 7.01 (d, *J* = 8.4 Hz, 1H), 6.86 (d, *J* = 8.6 Hz, 2H), 5.17 (s, 2H), 4.45 (t, *J* = 4.7 Hz, 2H), 4.22 (s, 2H), 4.15 (t, *J* = 4.7 Hz, 2H), 3.68 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.8, 190.8, 171.4, 160.5, 157.4, 140.4, 136.5, 136.3, 135.5, 133.1, 132.7, 132.5, 130.5, 129.5, 129.2, 128.6, 128.6, 127.8, 127.5, 127.0, 125.1, 121.1, 114.8, 73.6, 65.8, 63.3, 44.6, 40.0. HRMS (ESI) m/z calcd for $C_{32}H_{26}O_6Na$ $(M+Na)^+$ 529.1622, found 529.1629.



2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl (S)-2-(6-methoxynaphthalen-2-yl)propanoate (7ae)

Yield: 67.4 mg, 72%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.01 (d, *J* = 7.2 Hz, 2H), 7.69 – 7.63 (m, 3H), 7.56 (t, *J* = 7.4 Hz, 1H), 7.46 (t, *J* = 7.6 Hz, 2H), 7.39 (d, *J* = 8.6 Hz, 1H), 7.16 – 7.07 (m, 4H), 6.78 (d, *J* = 8.5 Hz, 2H), 4.44 (dt, *J* = 12.1, 4.8 Hz, 1H), 4.36 (dt, *J* = 12.1, 4.6 Hz, 1H), 4.21 (s, 2H), 4.09 (t, *J* = 4.8 Hz, 2H), 3.90 (s, 3H), 3.90 – 3.85 (m, 1H), 1.57 (d, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 197.8, 174.6, 157.6, 157.4, 136.5, 135.4, 133.7, 133.1, 130.5, 129.3, 128.9, 128.6, 128.5, 127.1, 127.0, 126.2, 125.9, 118.9, 114.9, 105.5, 65.9, 63.1, 55.3, 45.3, 44.6, 18.5. HRMS (ESI) m/z calcd for $C_{30}H_{28}O_5Na$ $(M+Na)^+$ 491.1829, found 491.1836.



2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(1-(4-chlorobenzoyl)-5-methoxy-2-methyl-1H-indol-3-yl)acetate (7af)

Yield: 39.3 mg, 33%; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.94 (d, *J* = 6.9 Hz, 2H), 7.65 (d, *J* = 8.5 Hz, 2H), 7.54 (t, *J* = 7.4 Hz, 1H), 7.41 (dt, *J* = 7.6, 3.4 Hz, 4H), 7.04 (dd, *J* = 5.6, 2.9 Hz, 3H), 6.70 (d, *J* = 8.5 Hz, 2H), 6.61 (dd, *J* = 9.1, 2.5 Hz, 1H), 6.40 (d, *J* = 9.0 Hz, 1H), 4.83 (s, 2H), 4.43 – 4.34 (m, 2H), 4.09 – 4.02 (m, 2H), 3.78 (s, 3H), 3.74 (s, 2H), 2.27 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 195.4, 170.4, 168.7, 156.2, 155.9, 139.1, 136.4, 133.4, 133.3, 133.3, 131.3, 130.9, 130.4, 130.3, 129.9, 129.1, 128.6, 128.2, 115.0, 114.5, 114.4, 112.3, 101.3, 65.8, 63.5, 55.6, 36.5, 30.3, 20.5. HRMS (ESI) m/z calcd for $C_{35}H_{30}O_6NClNa$ $(M+Na)^+$ 618.1654, found 618.1662.

5. Reference

[1] E. D. Nacsa, D. W. C. MacMillan, *J. Am. Chem. Soc.* **2018**, *140*, 3322.

[2] P. E. Krach, A. Dewanji, T. Yuana, M. Rueping, *Chem. Commun.* **2020**, *56*, 6082.

[3] X. Chen, Z. Chen, C. M. So, *J. Org. Chem.* **2019**, *84*, 6337.

[4] A. D. Benischke, M. Leroux, I. Knoll, P. Knochel, *Org. Lett.* **2016**, *18*, 3626.

[5] L.-Z. Yuan, D. Renko, I.Khelifi, O. Provot, J.-D. Brion, A. Hamze, M. Alami, *Org. Lett.* **2016**, *18*, 3238.

[6] H. Shi, C. Du, X. Zhang, F. Xie, X. Wang, S. Cui, X. Peng, M. Cheng, B. Lin, Y. Liu *J. Org. Chem.* **2018**, *83*, 1312.

[7] C. Xu, H.-M. Li, Z.-Q. Wang, W.-J. Fu, Y.-Q. Zhang, B.-M. Ji, *Australian J. Org. Chem.* **2012**, *65*, 366.

[8] K. Huang, G. Li, W.-P. Huang, D.-G. Yu, Z.-J. Shi, *Chem. Commun.* **2011**, *47*, 7224.

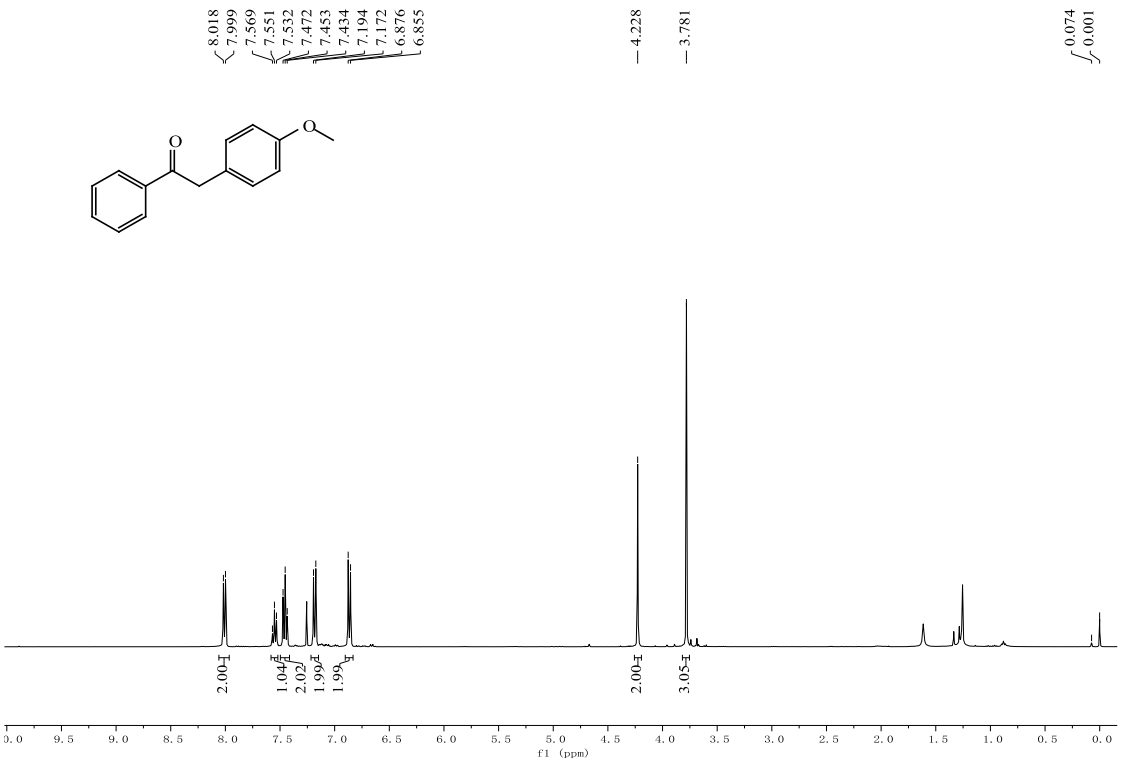
[9] S. Xie, Z.-J. He, L.-H. Zhang, B.-L. Huang, X.-W. Chen, Z.-S. Zhan, F.-M. Zhang, *Chem. Commun.* **2021**, *57*, 2069.

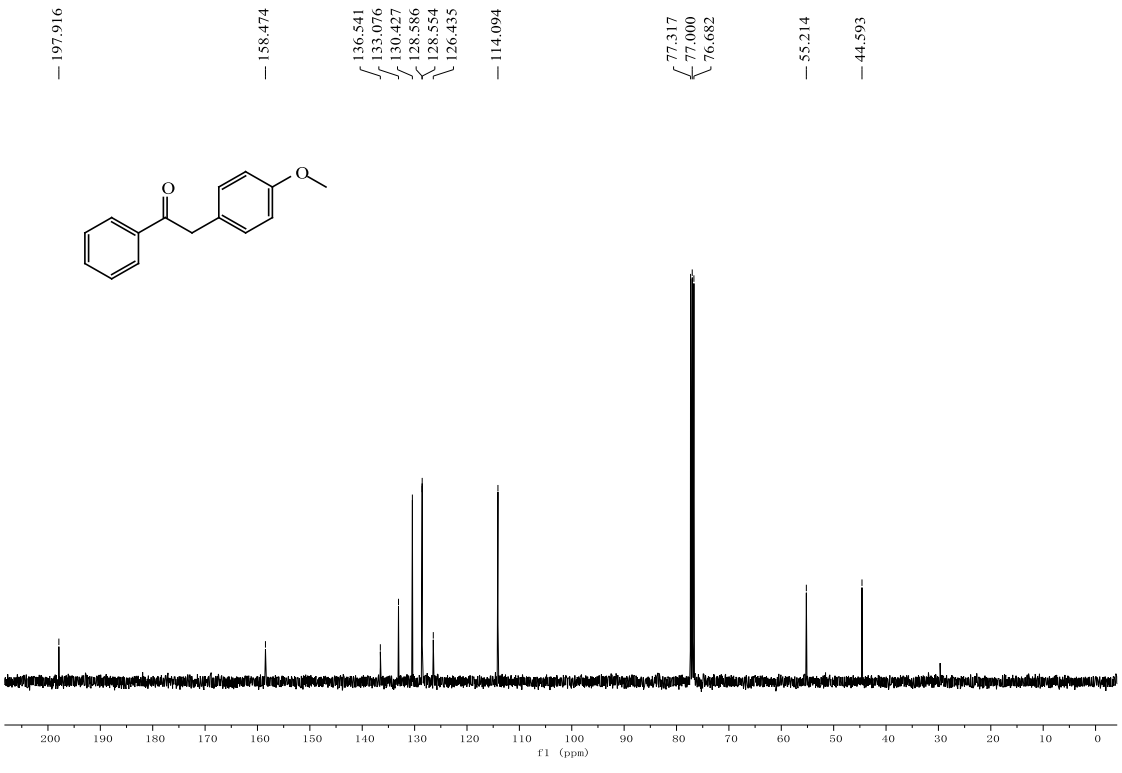
[10] N. Marion, E. C. Ecarnot, O. Navarro, D. Amoroso, A. Bell, S. P. Nolan, *J. Org. Chem.* **2006**, *71*, 3816.

[11] H. Mo, D. Chen, L. Xu, D. Chen, F. Pan, J. Yang, *Synthesis*, **2015**, *47*, 209.

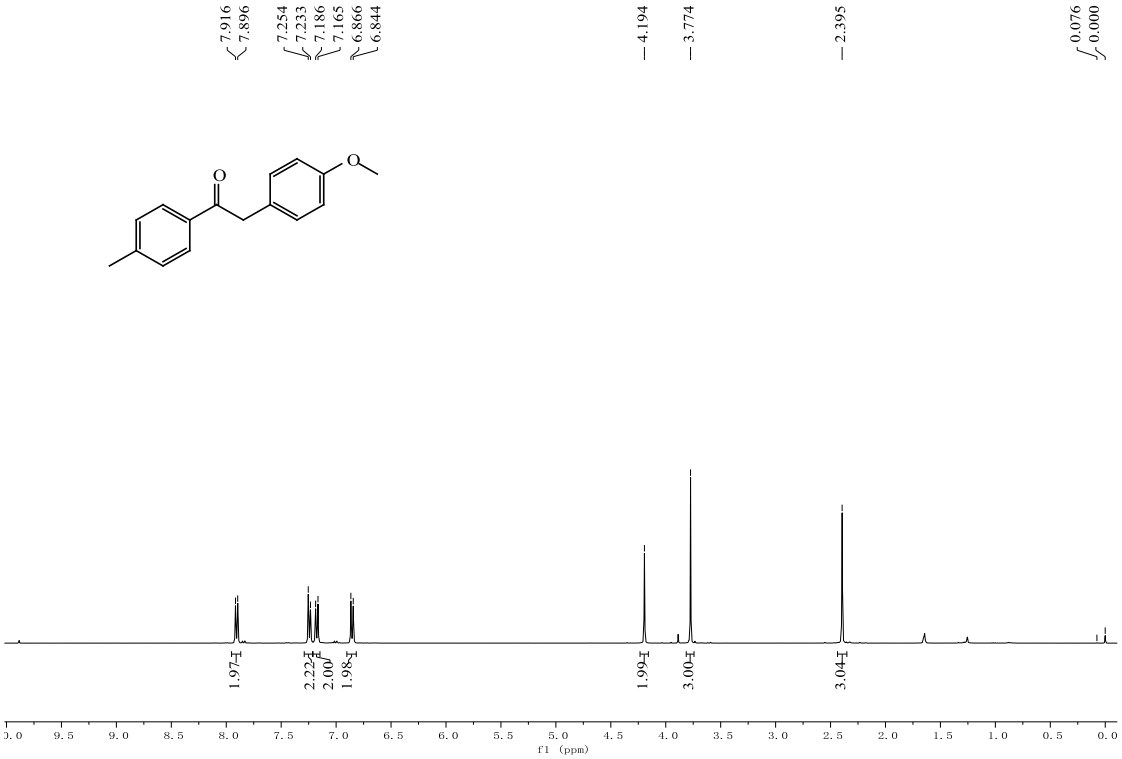
6. Spectra

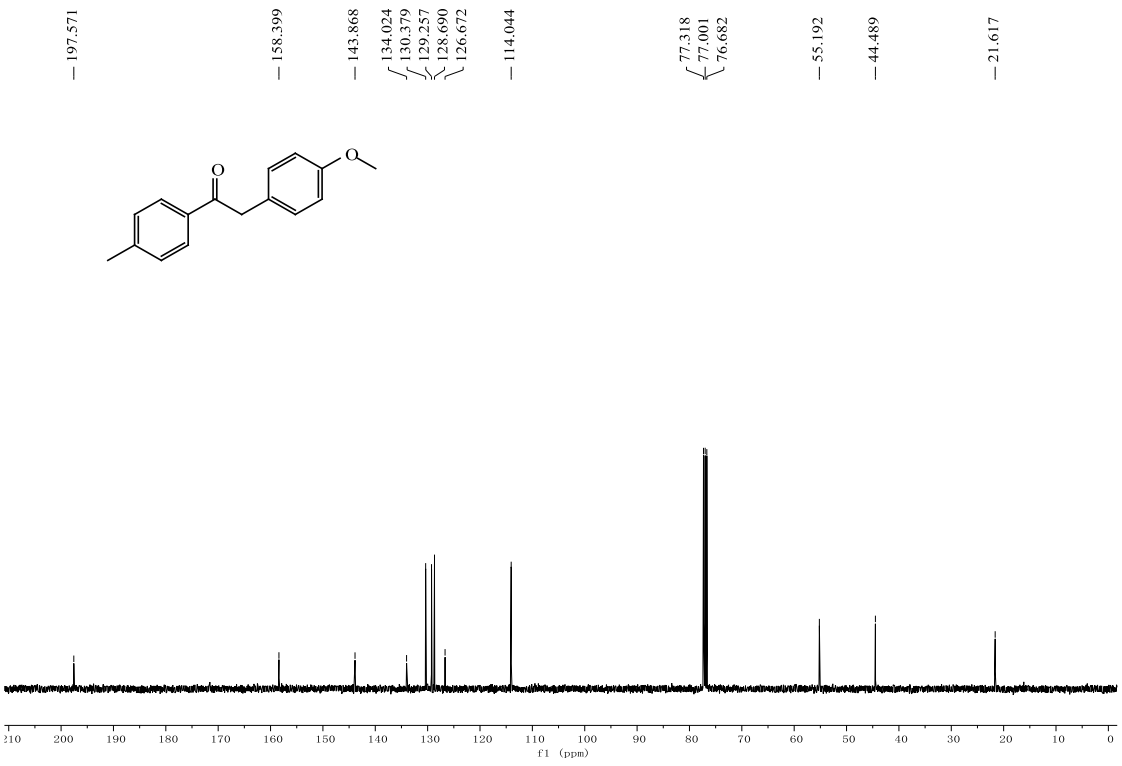
2-(4-Methoxyphenyl)-1-phenylethan-1-one (3aa)



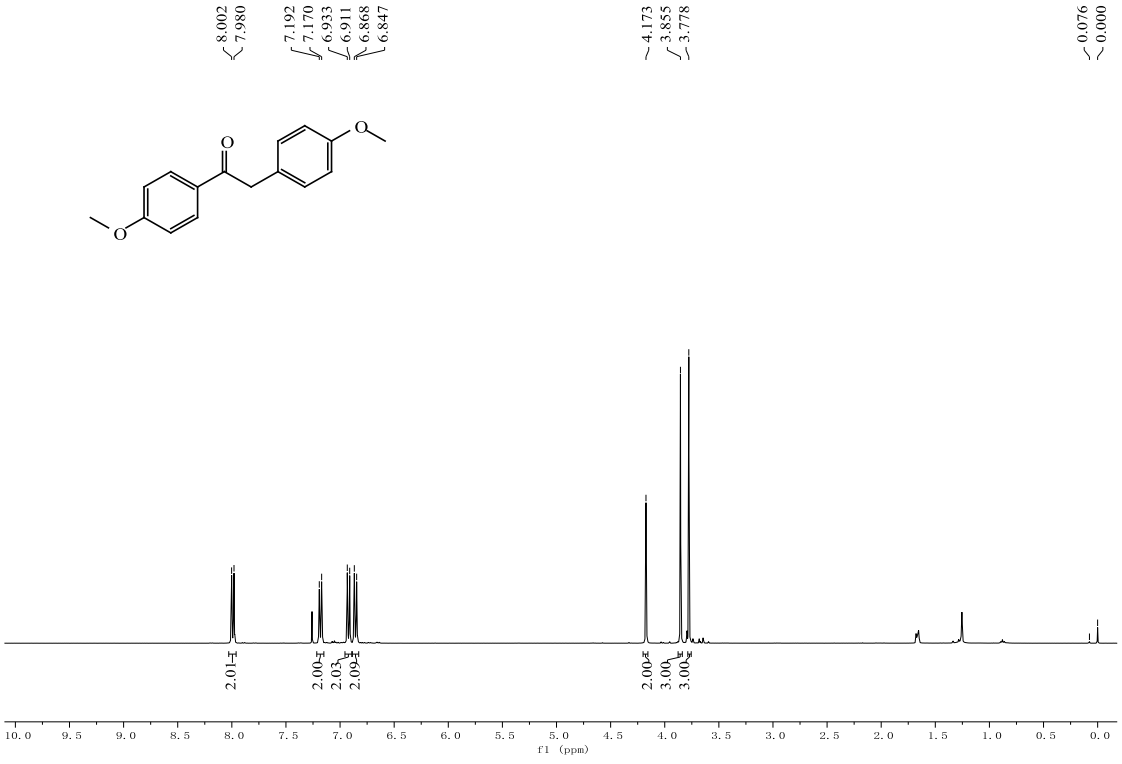


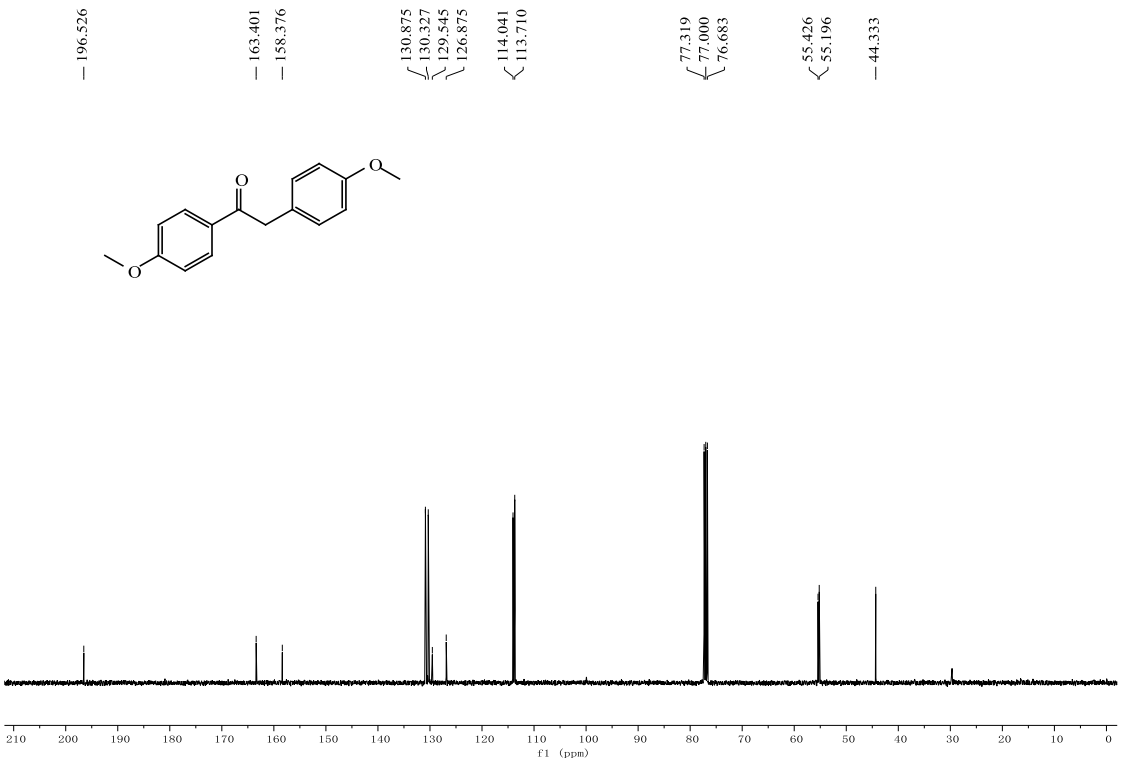
2-(4-Methoxyphenyl)-1-(*p*-tolyl)ethan-1-one (3ba)



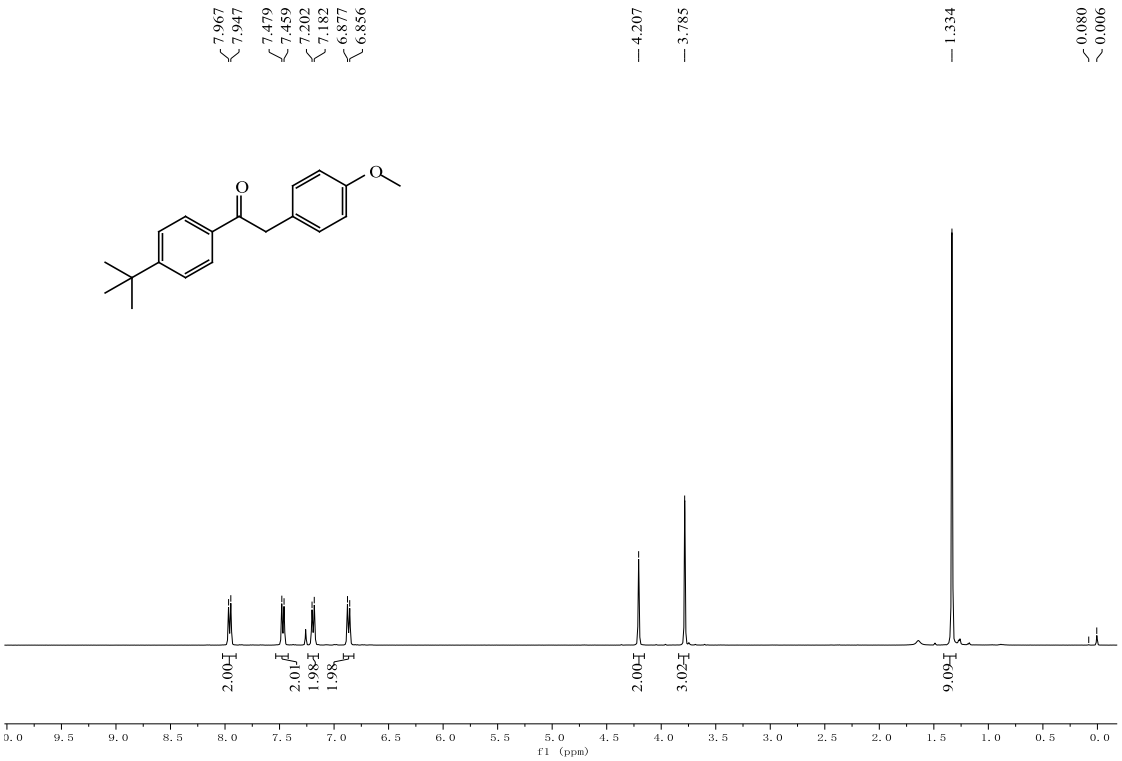


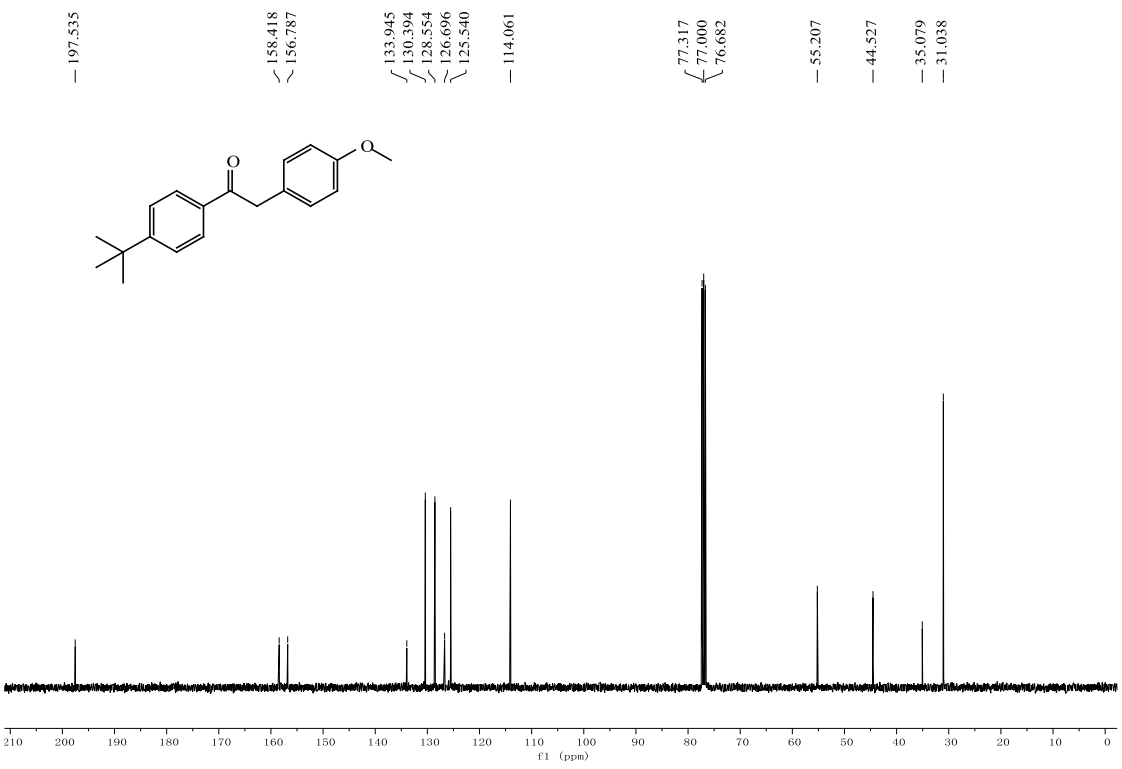
1,2-Bis(4-methoxyphenyl)ethan-1-one (3ca)



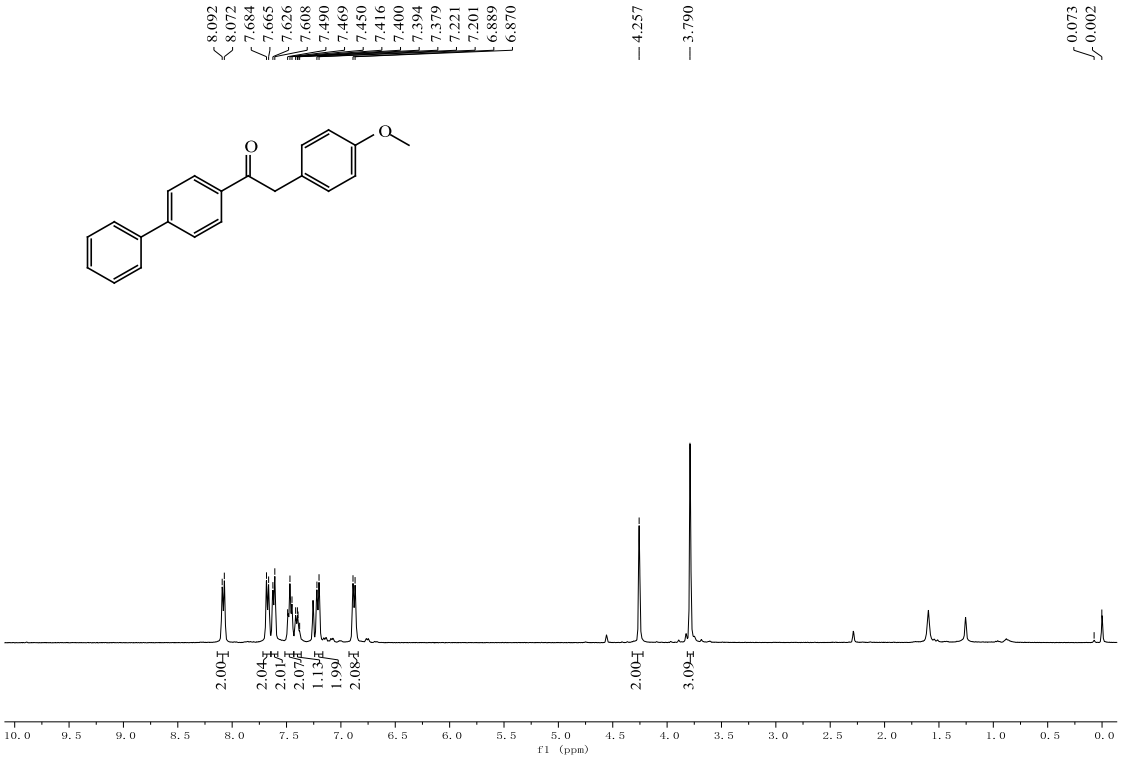


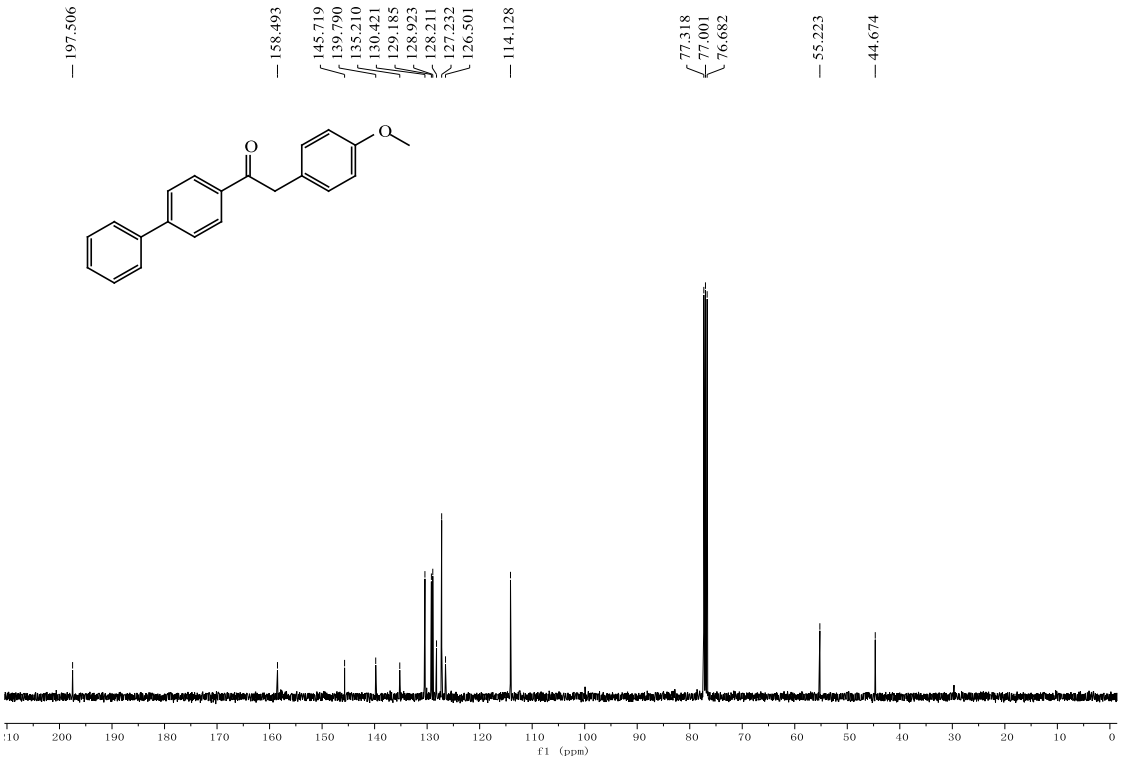
1-(4-(*tert*-Butyl)phenyl)-2-(4-methoxyphenyl)ethan-1-one (3da)



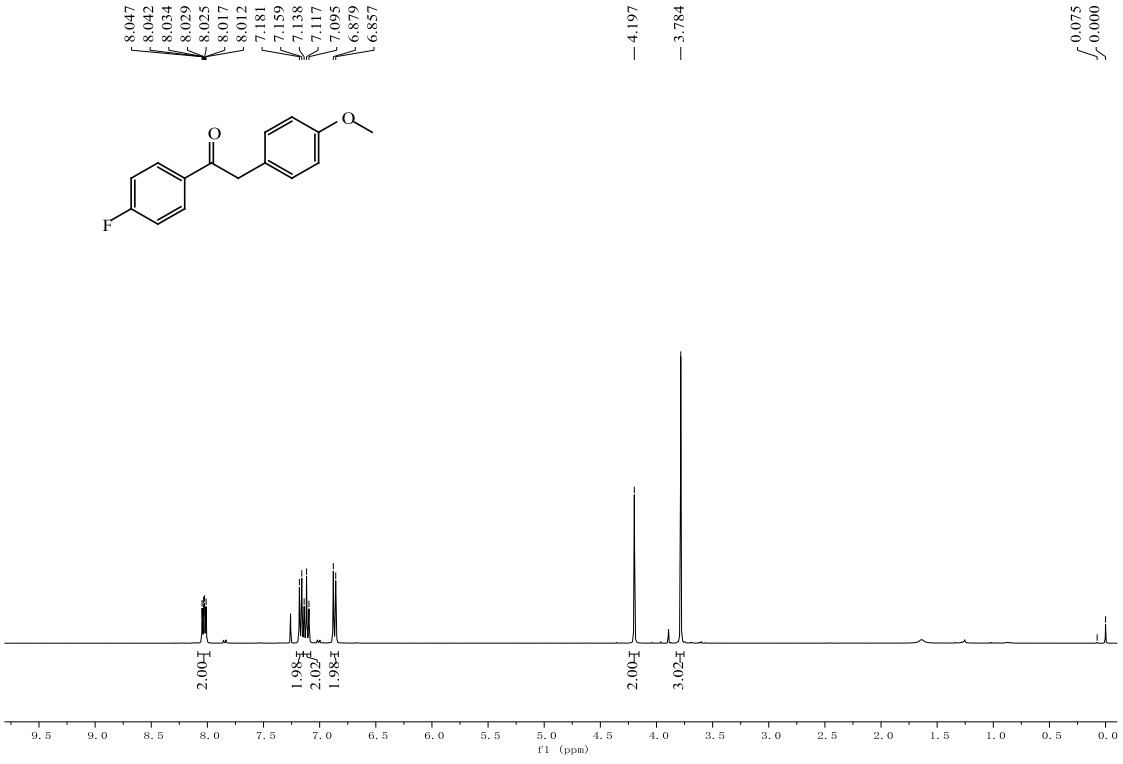


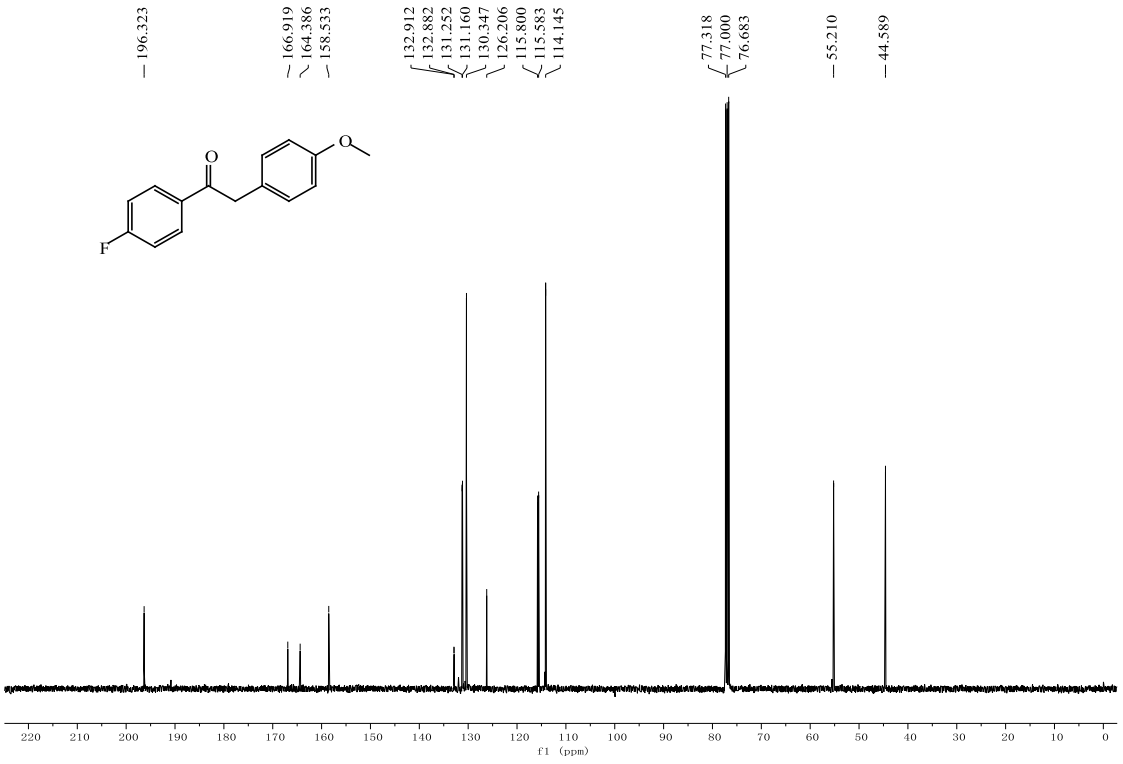
1-([1,1'-Biphenyl]-4-yl)-2-(4-methoxyphenyl)ethan-1-one (3ea)



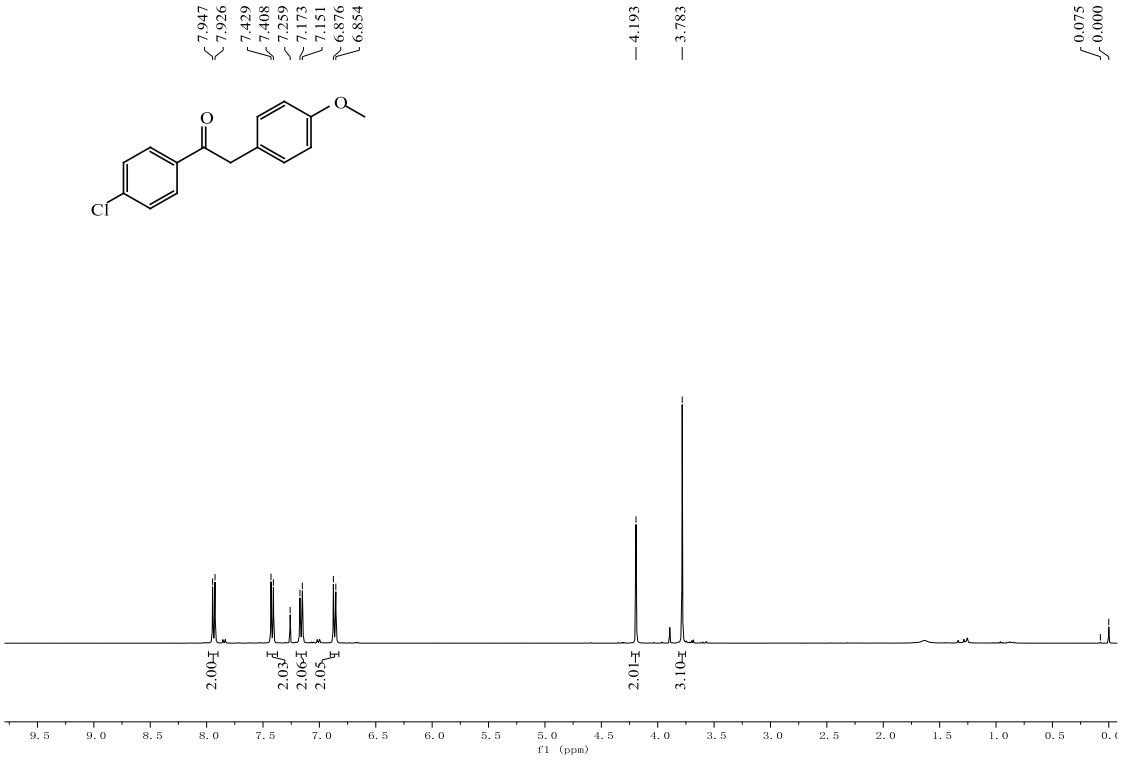


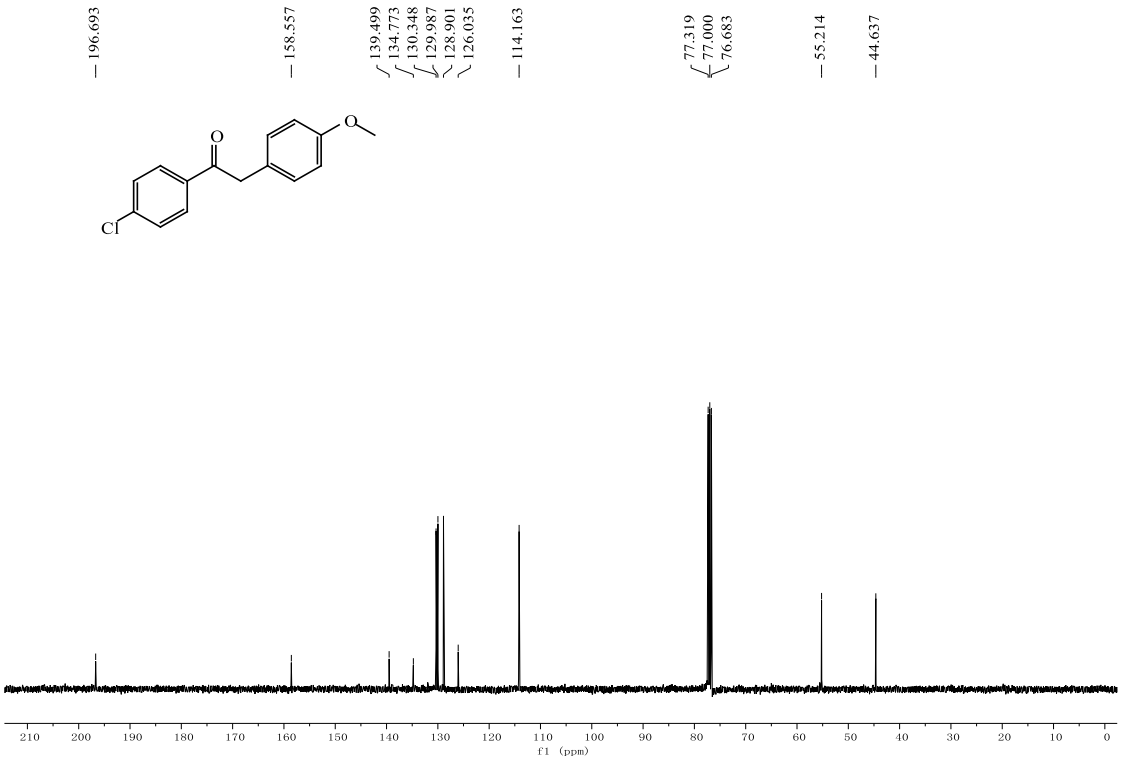
1-(4-Fluorophenyl)-2-(4-methoxyphenyl)ethan-1-one (3fa)



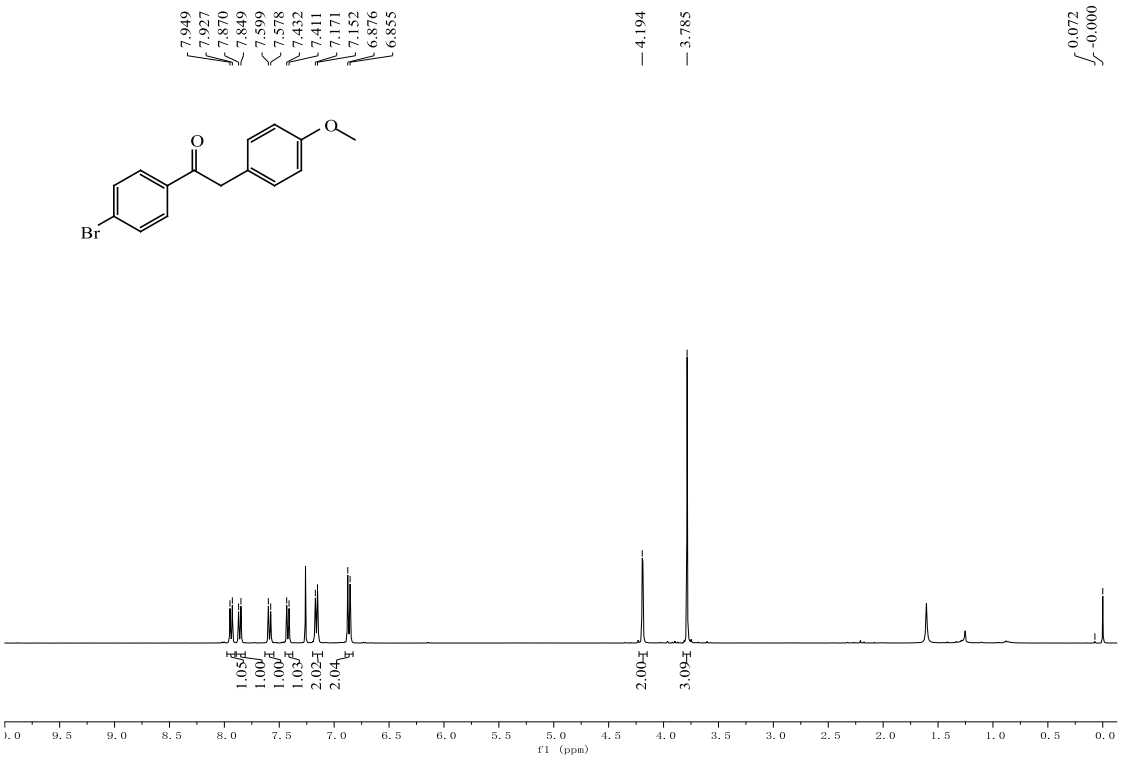


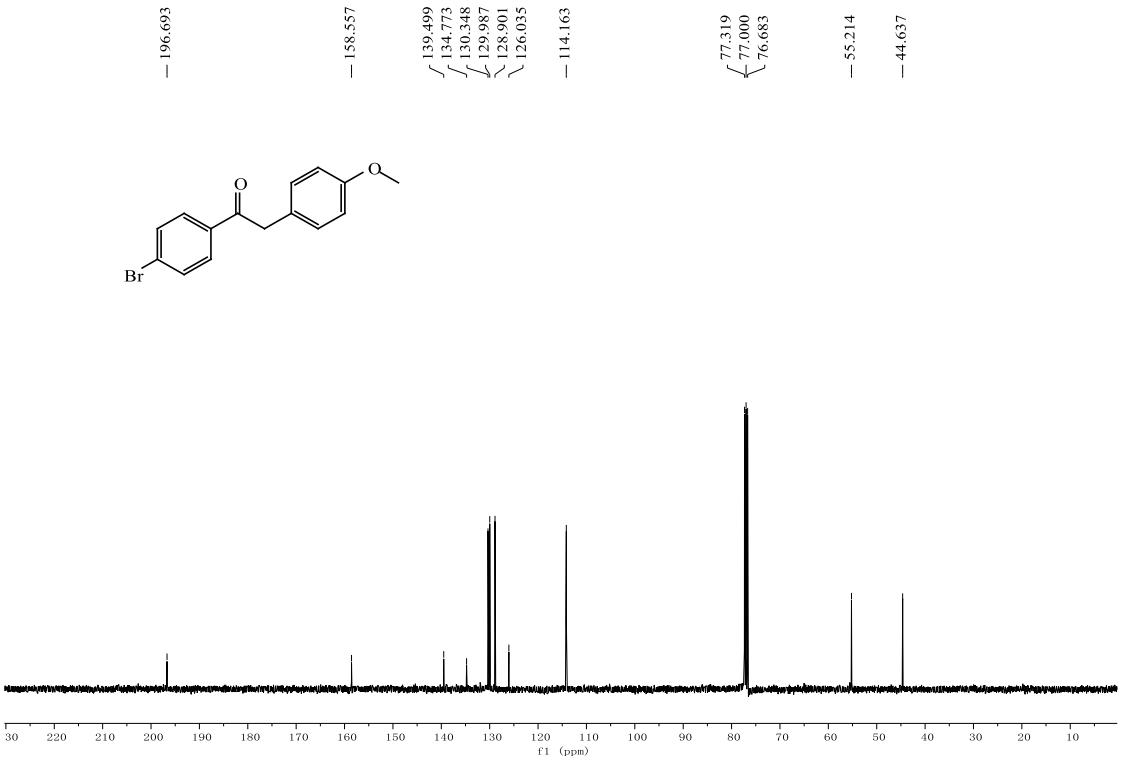
1-(4-Chlorophenyl)-2-(4-methoxyphenyl)ethan-1-one (3ga)



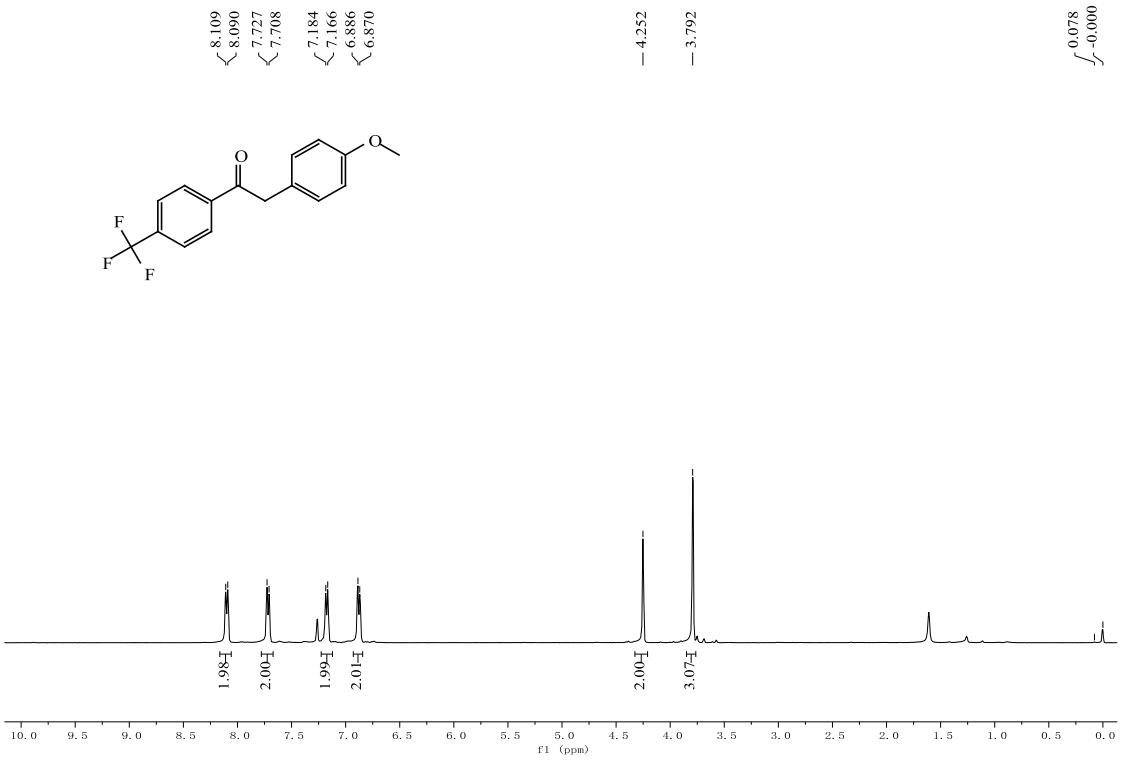


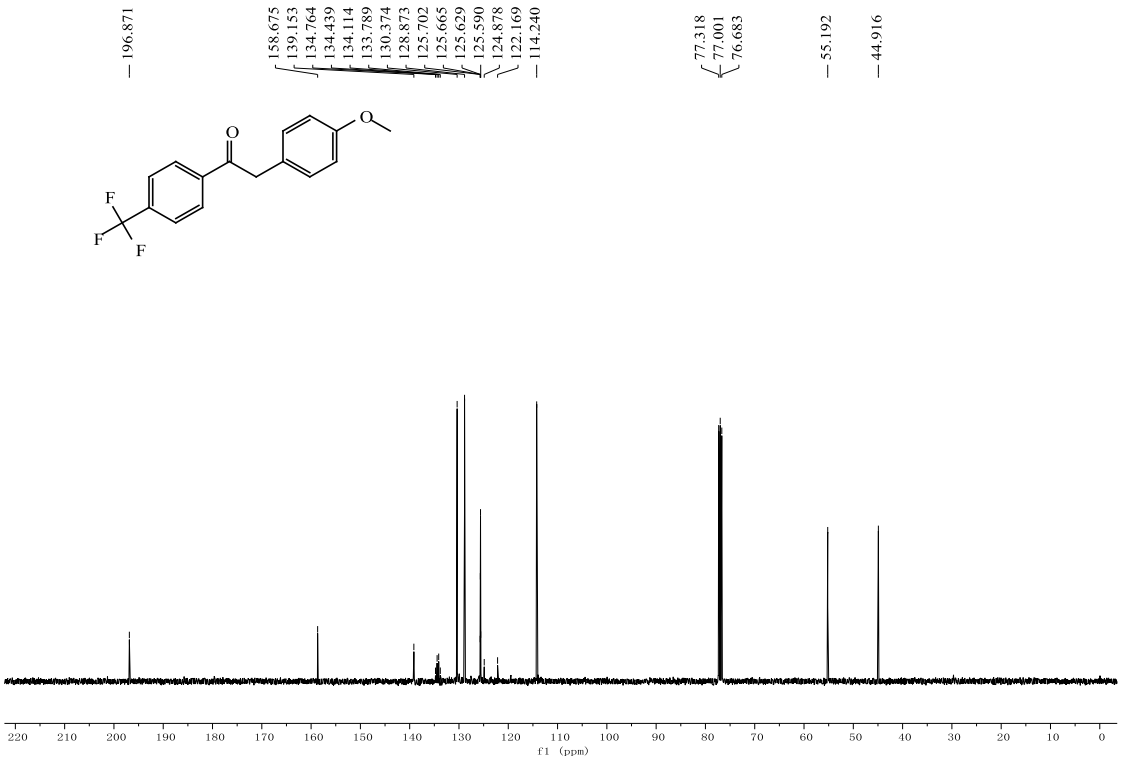
1-(4-Bromophenyl)-2-(4-methoxyphenyl)ethan-1-on e(3ha)



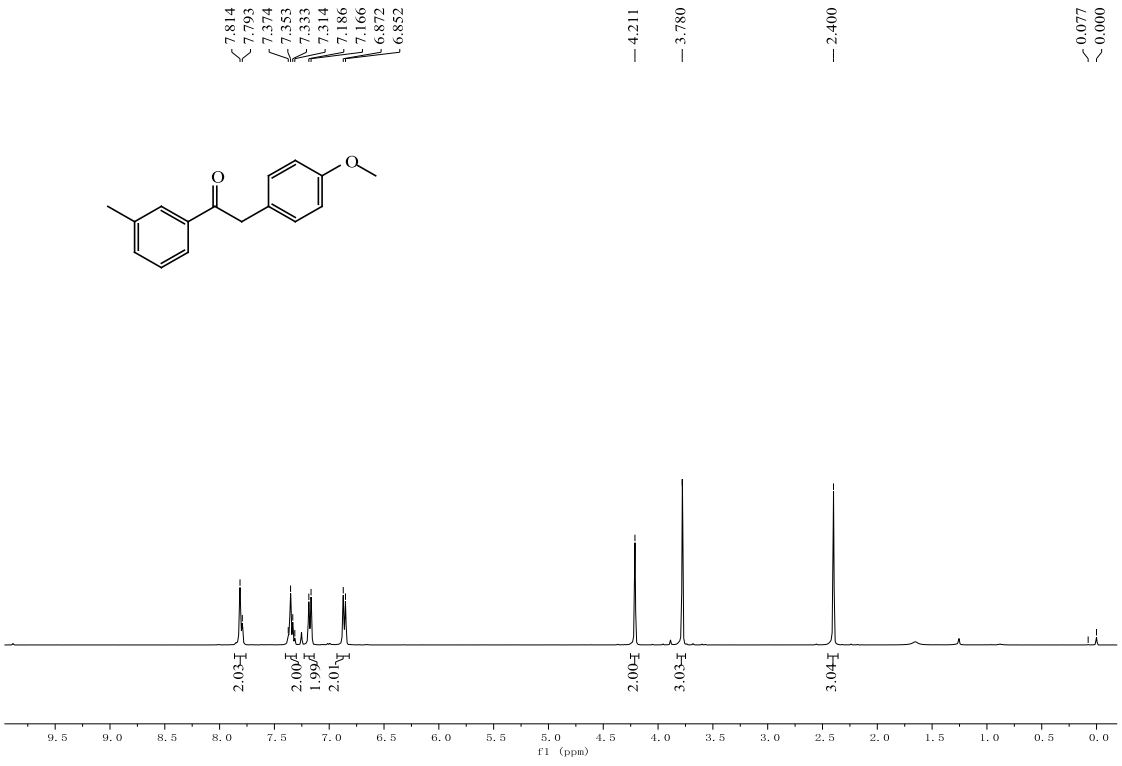


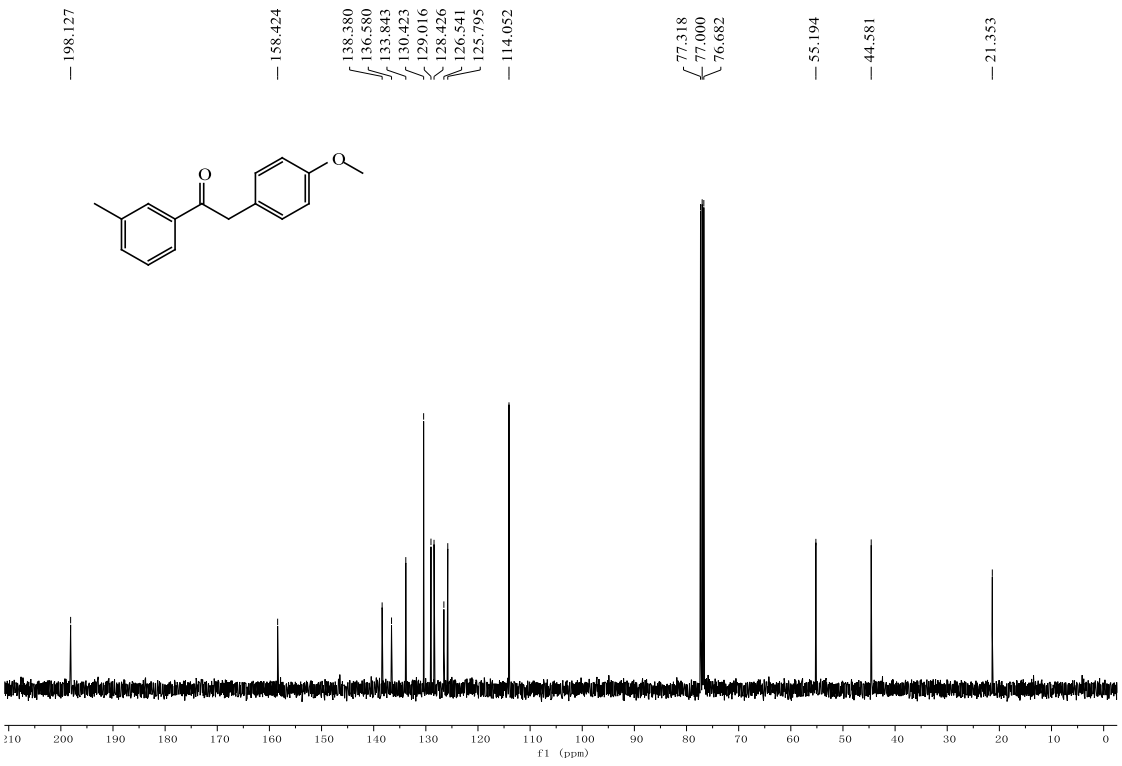
2-(4-Methoxyphenyl)-1-(4-(trifluoromethyl)phenyl)ethan-1-one (3ia)



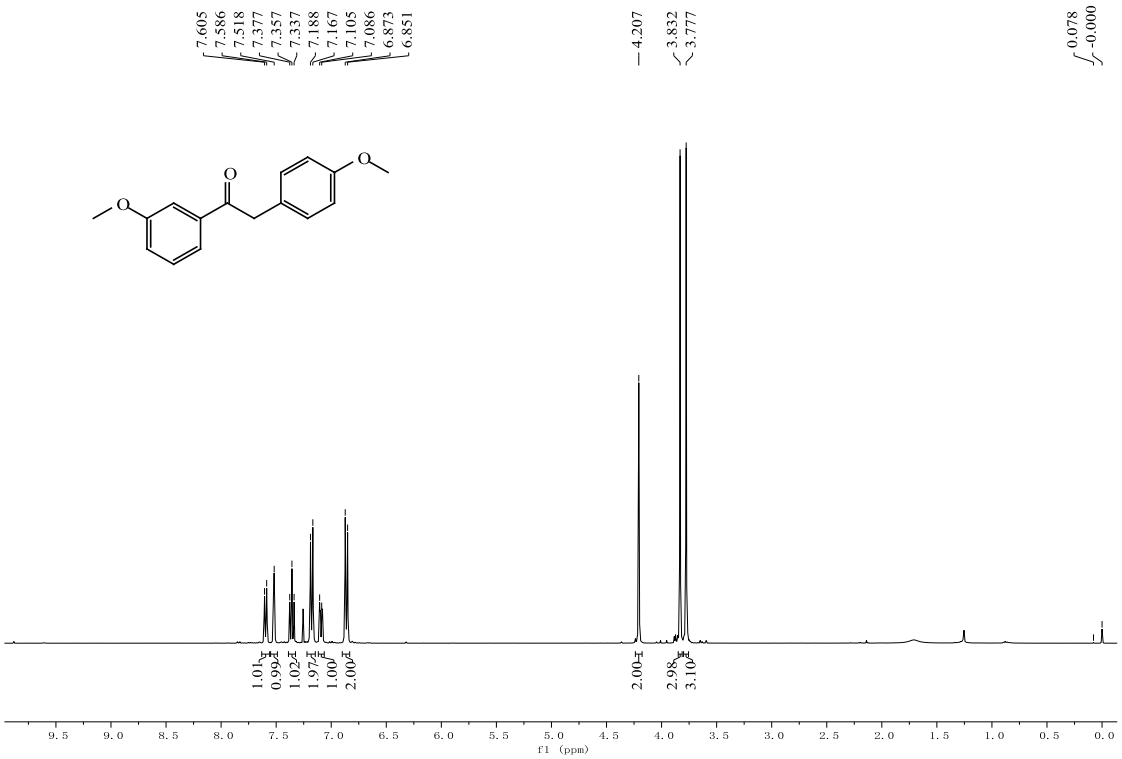


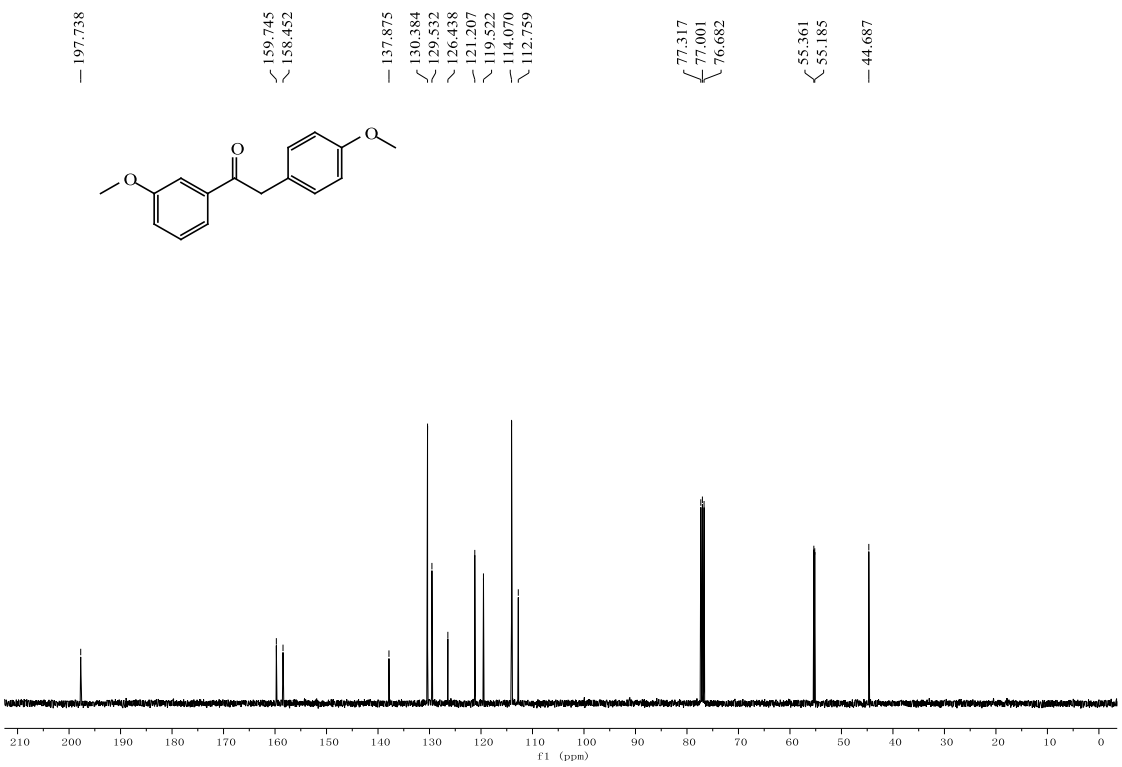
2-(4-Methoxyphenyl)-1-(*m*-tolyl)ethan-1-one (3ja)



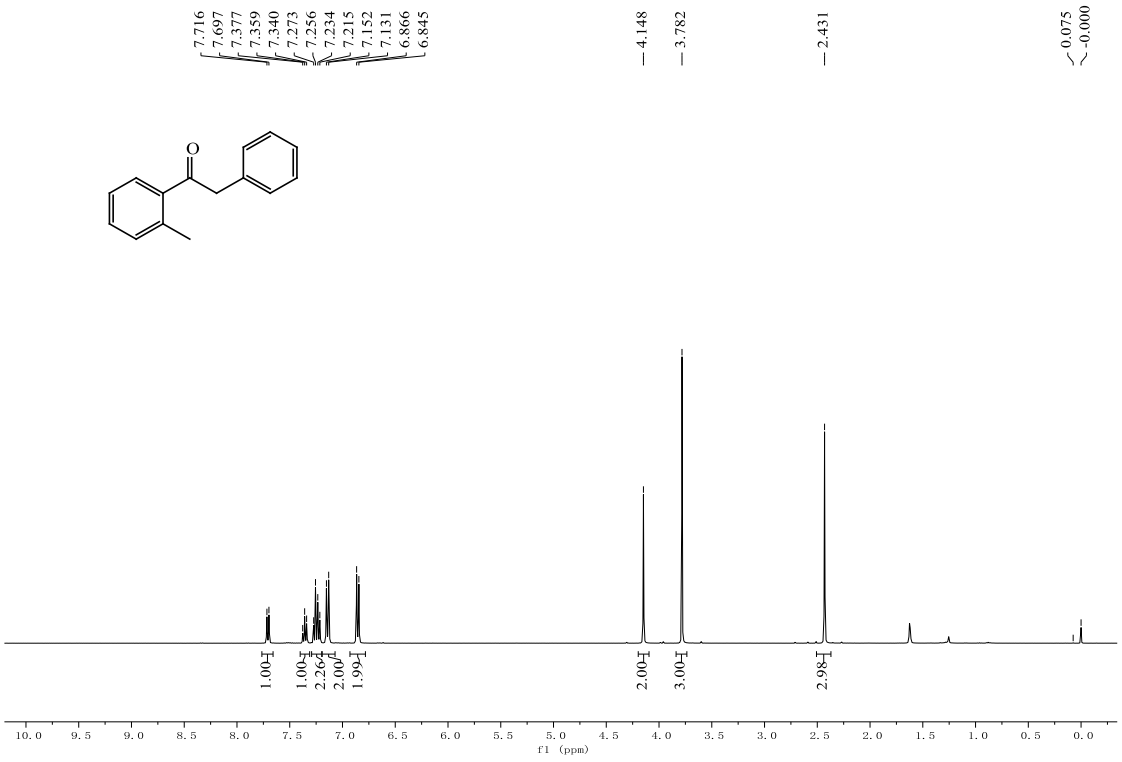


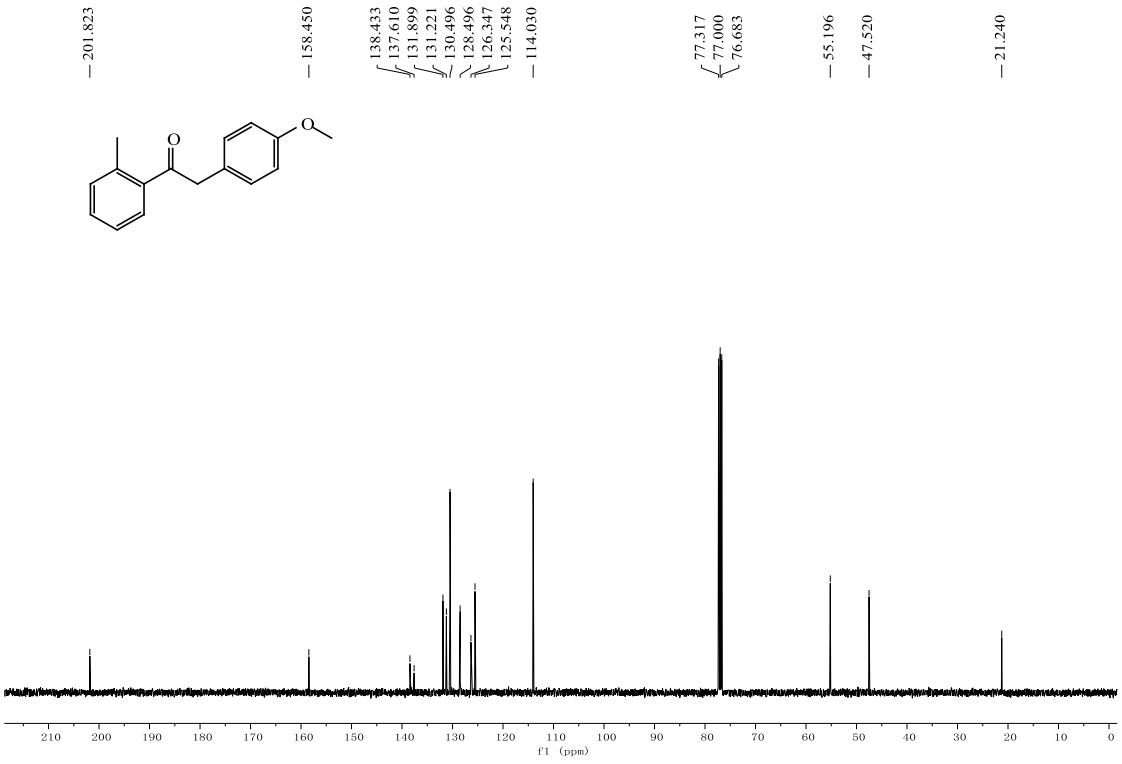
1-(3-Methoxyphenyl)-2-(4-methoxyphenyl)ethan-1-one (3ka)



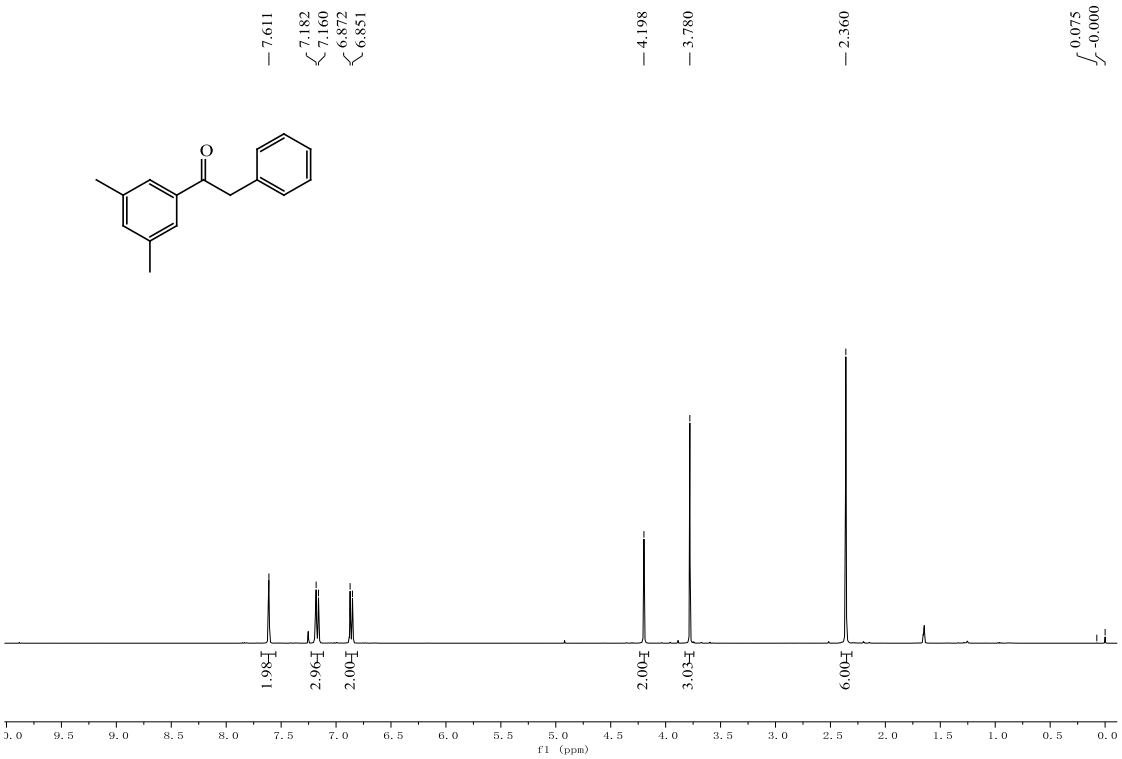


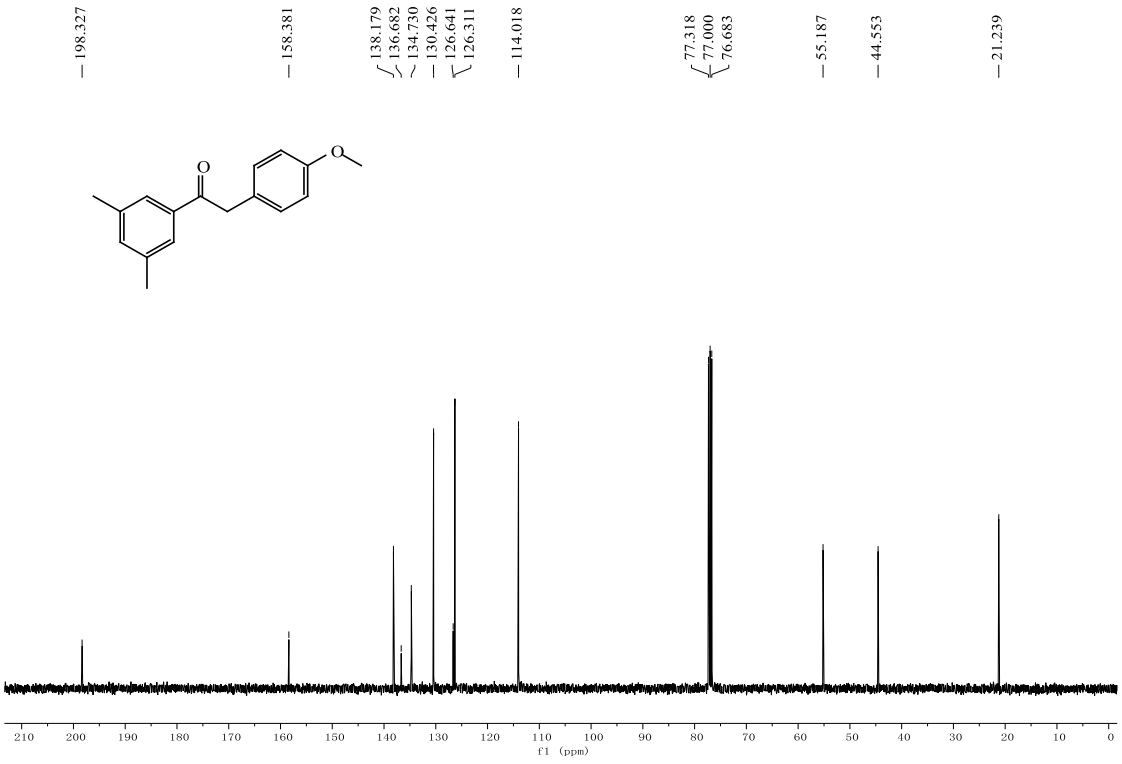
2-(4-Methoxyphenyl)-1-(*o*-tolyl)ethan-1-one (3la)



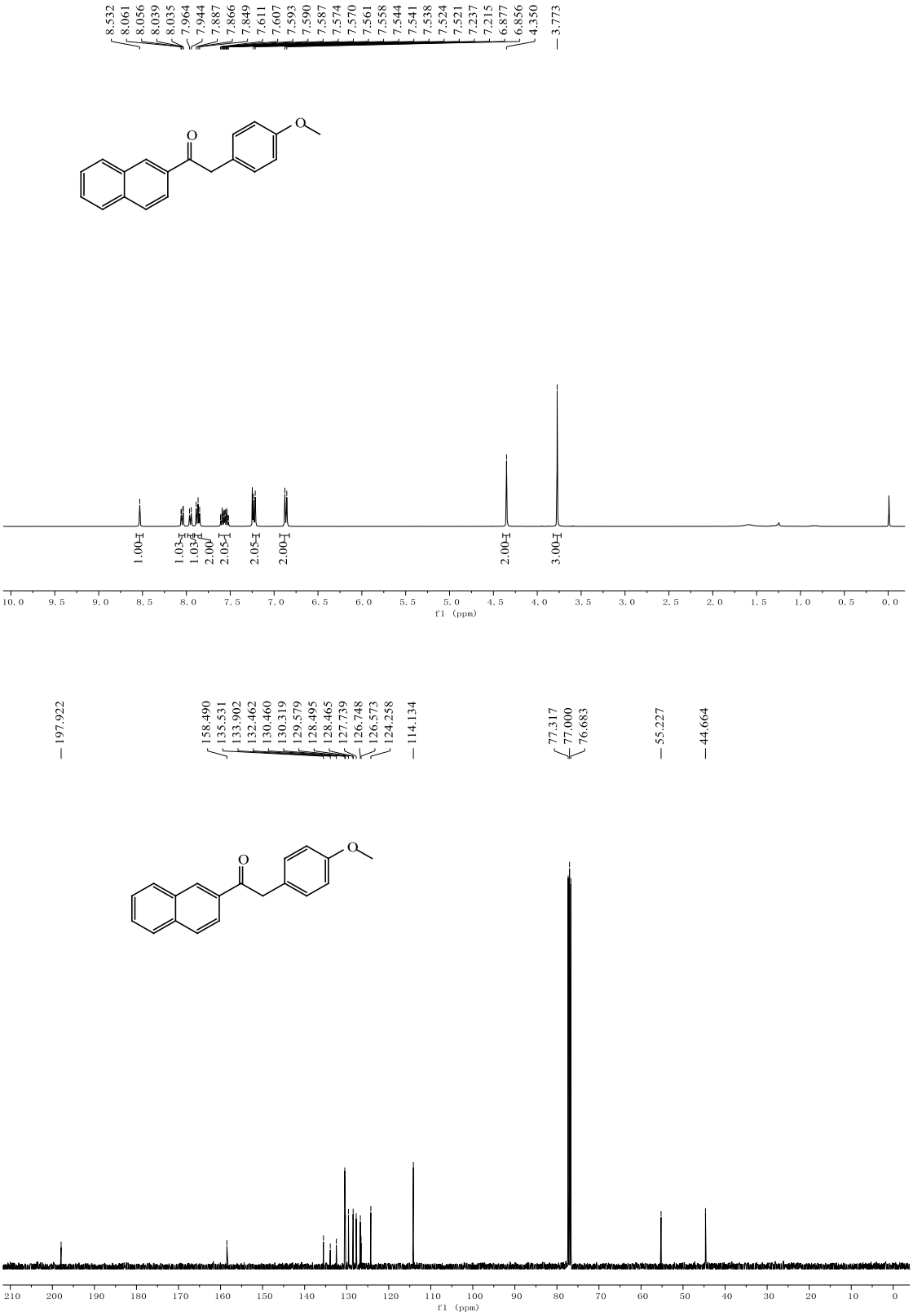


1-(3,5-Dimethylphenyl)-2-(4-methoxyphenyl)ethan-1-one (3ma)

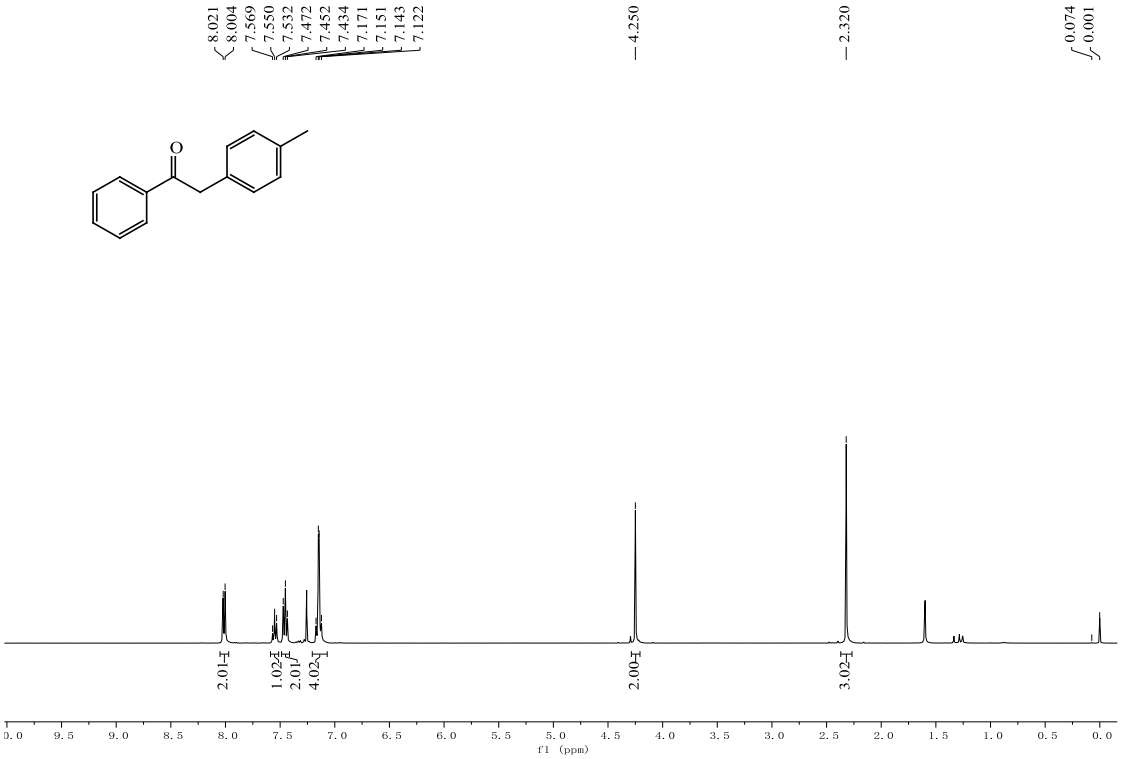


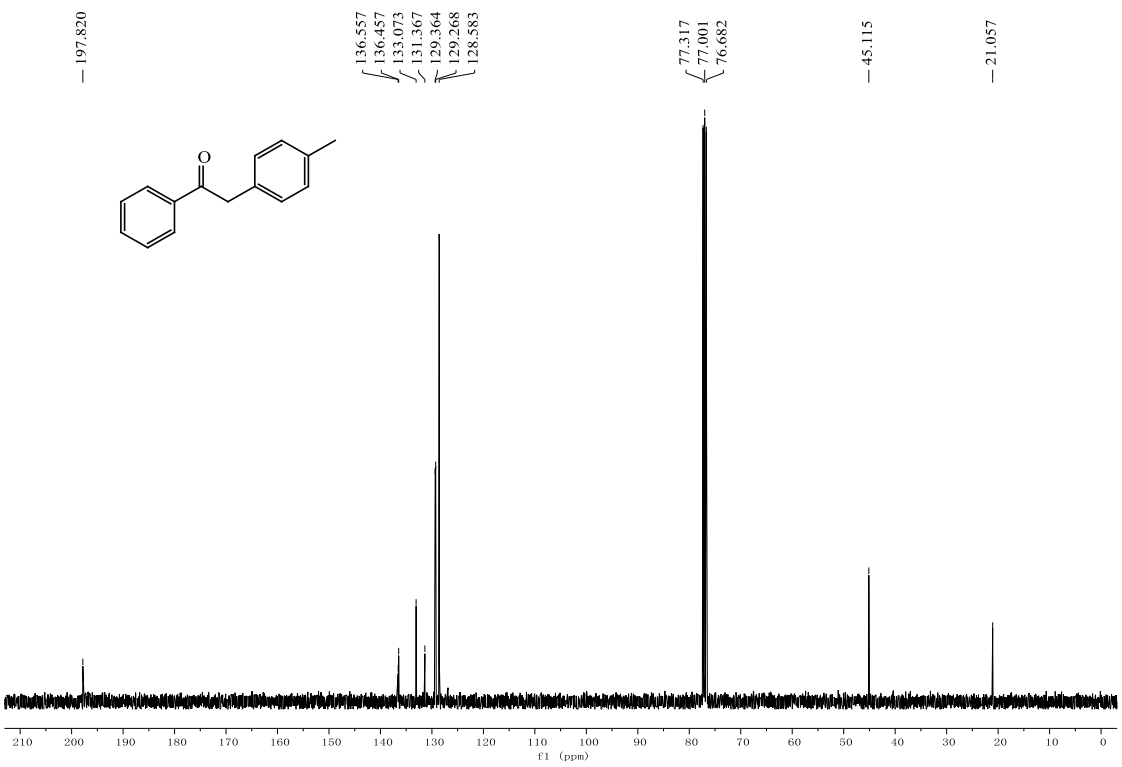


2-(4-Methoxyphenyl)-1-(naphthalen-2-yl)ethan-1-one (3na)

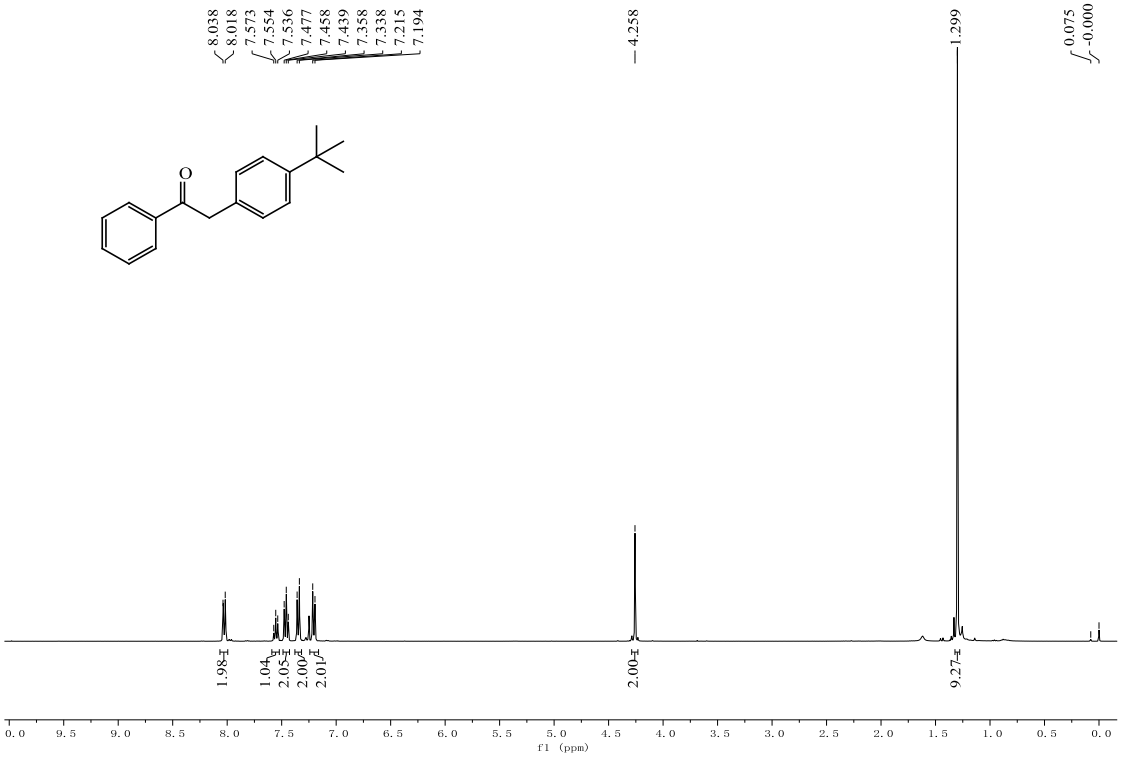


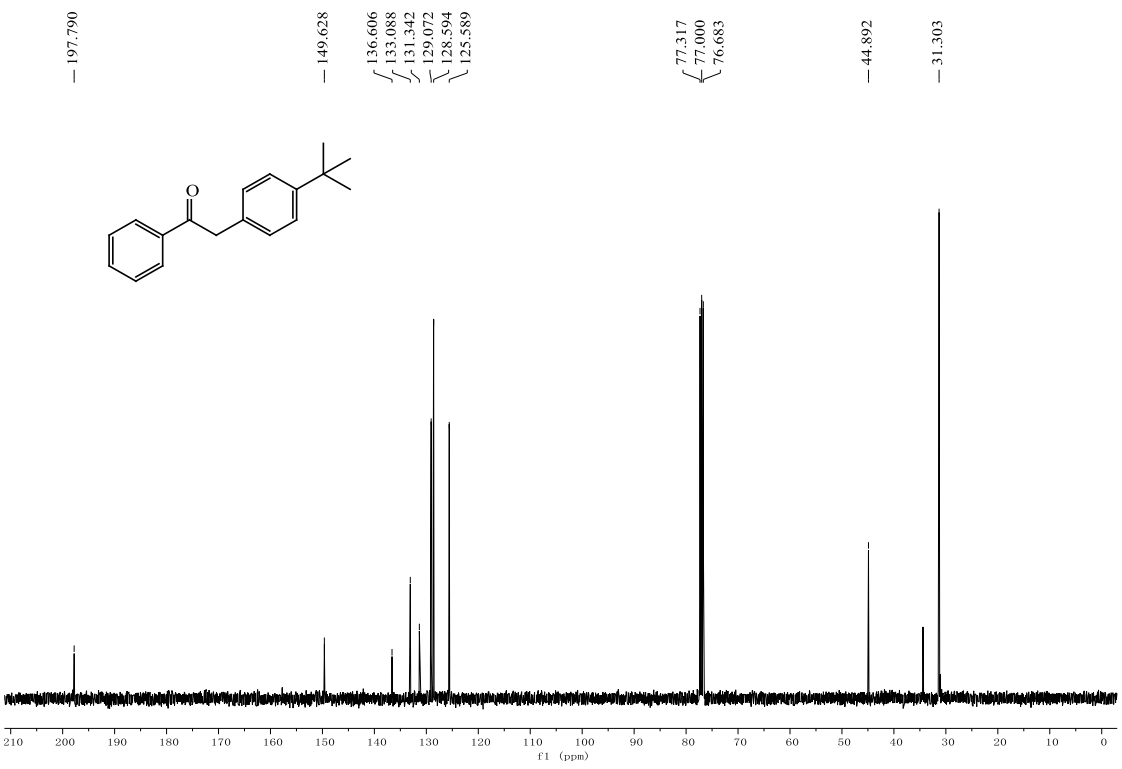
1-Phenyl-2-(*p*-tolyl)ethan-1-one (3ab)



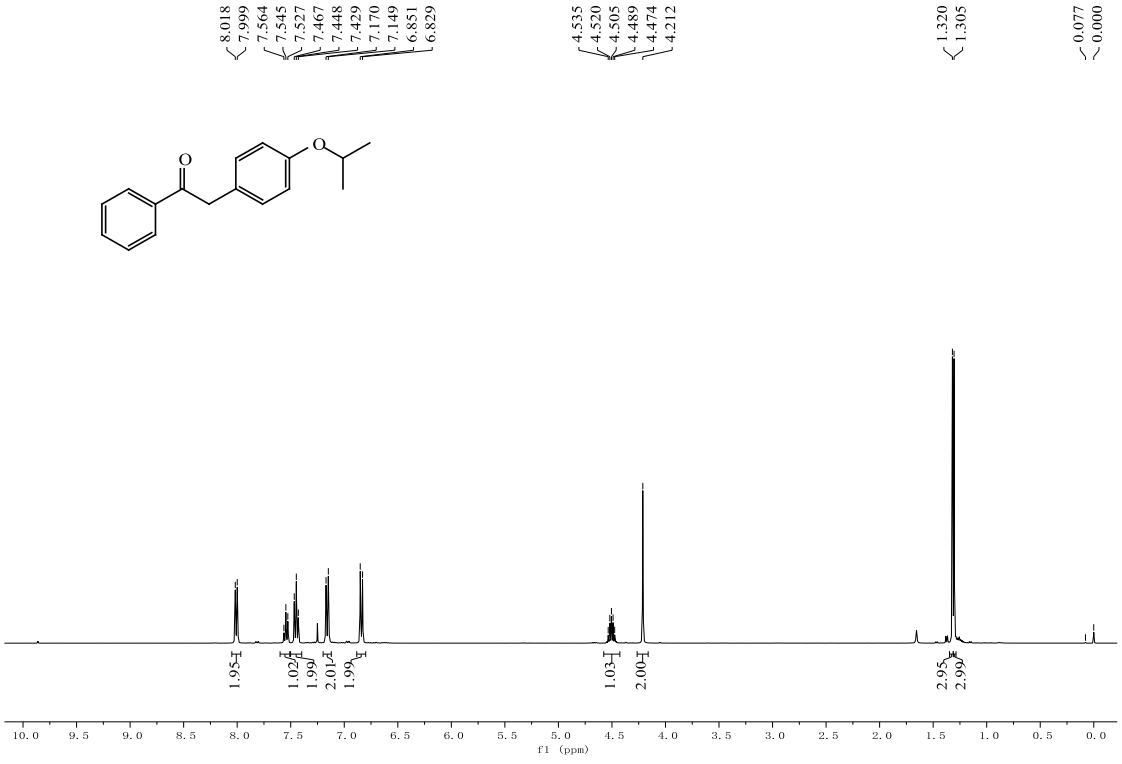


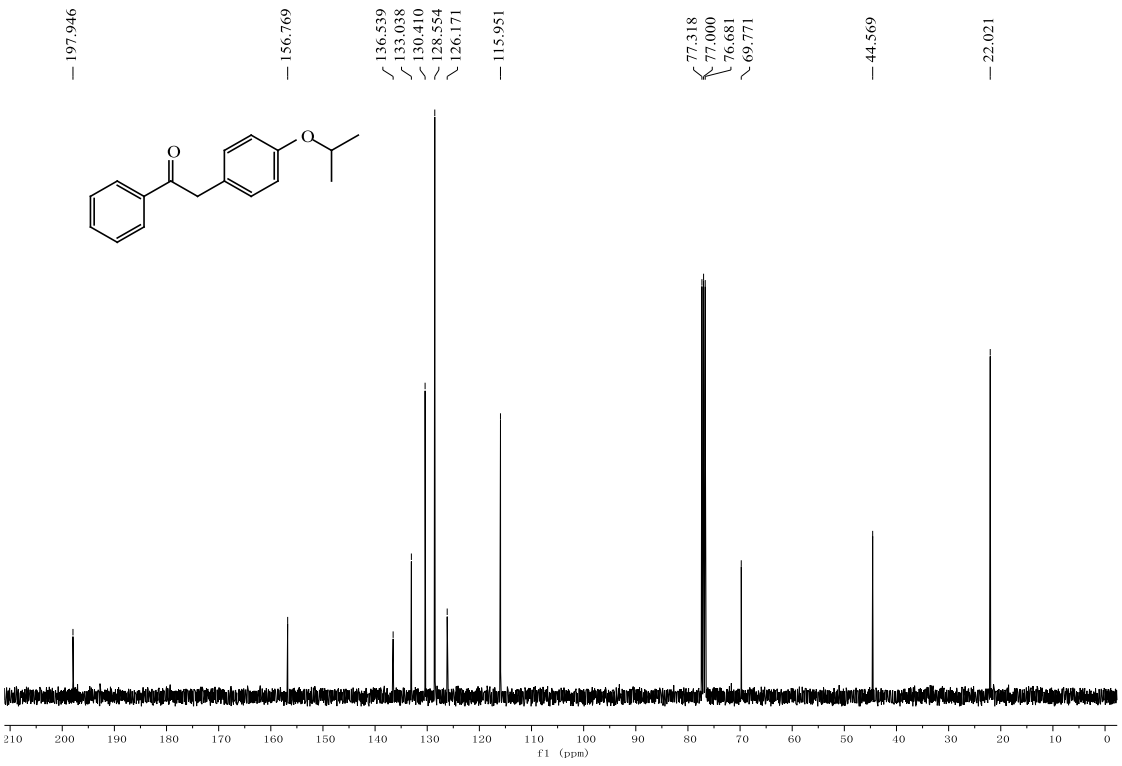
2-(4-(*tert*-Butyl)phenyl)-1-phenylethan-1-one (3ac)



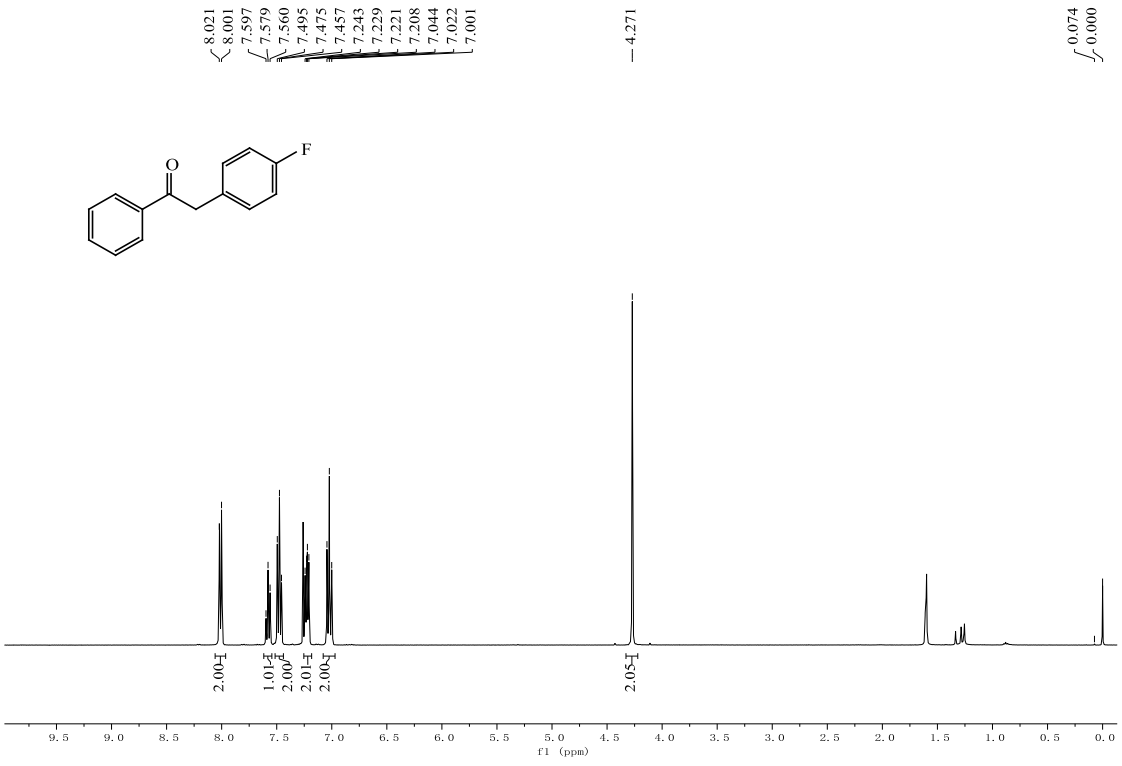


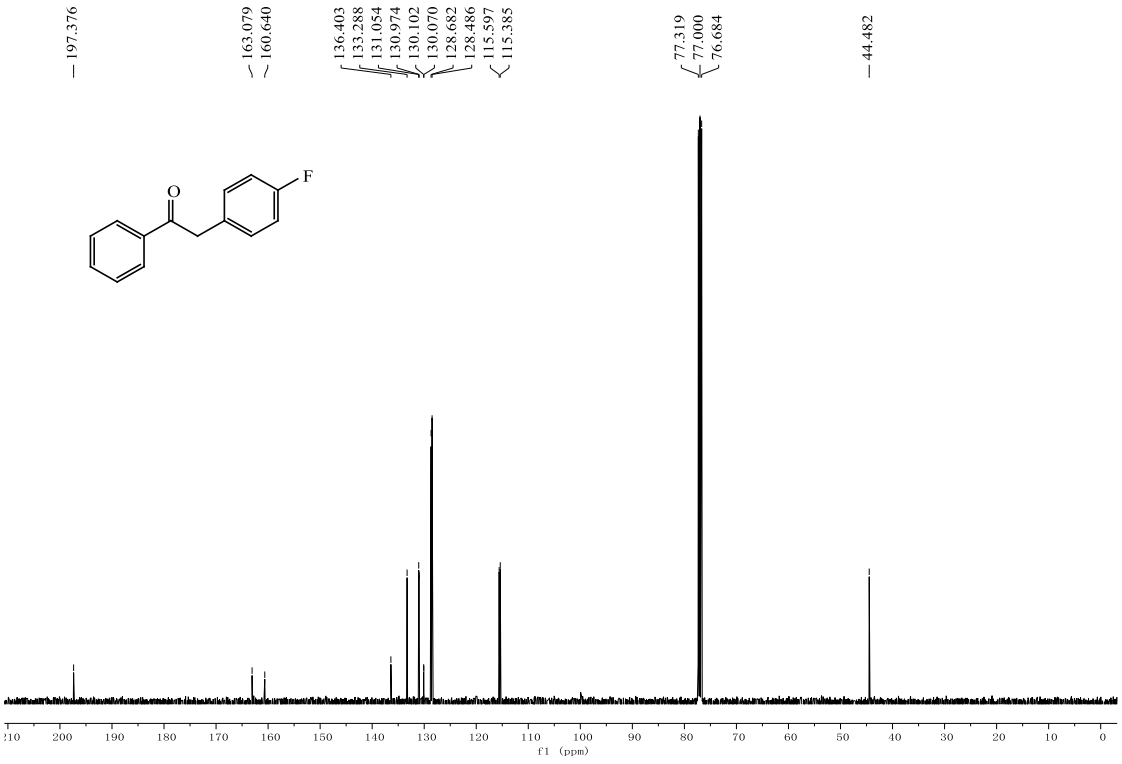
2-(4-Isopropoxyphenyl)-1-phenylethan-1-one (3ad)



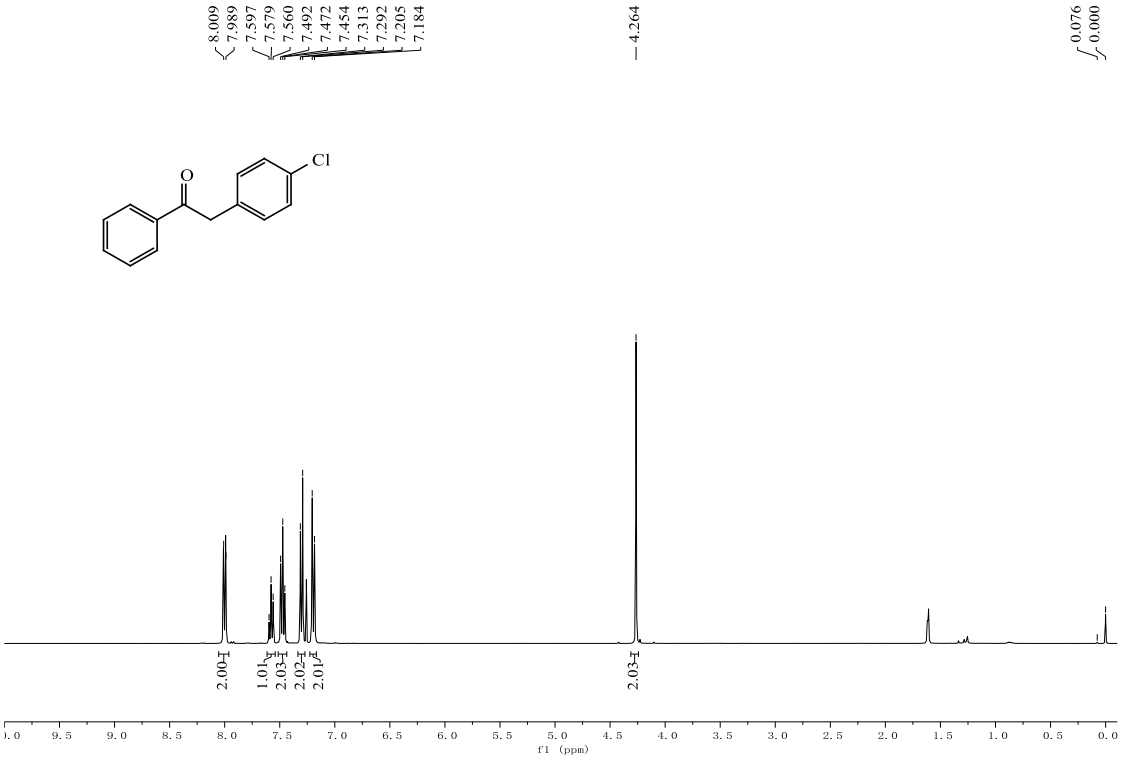


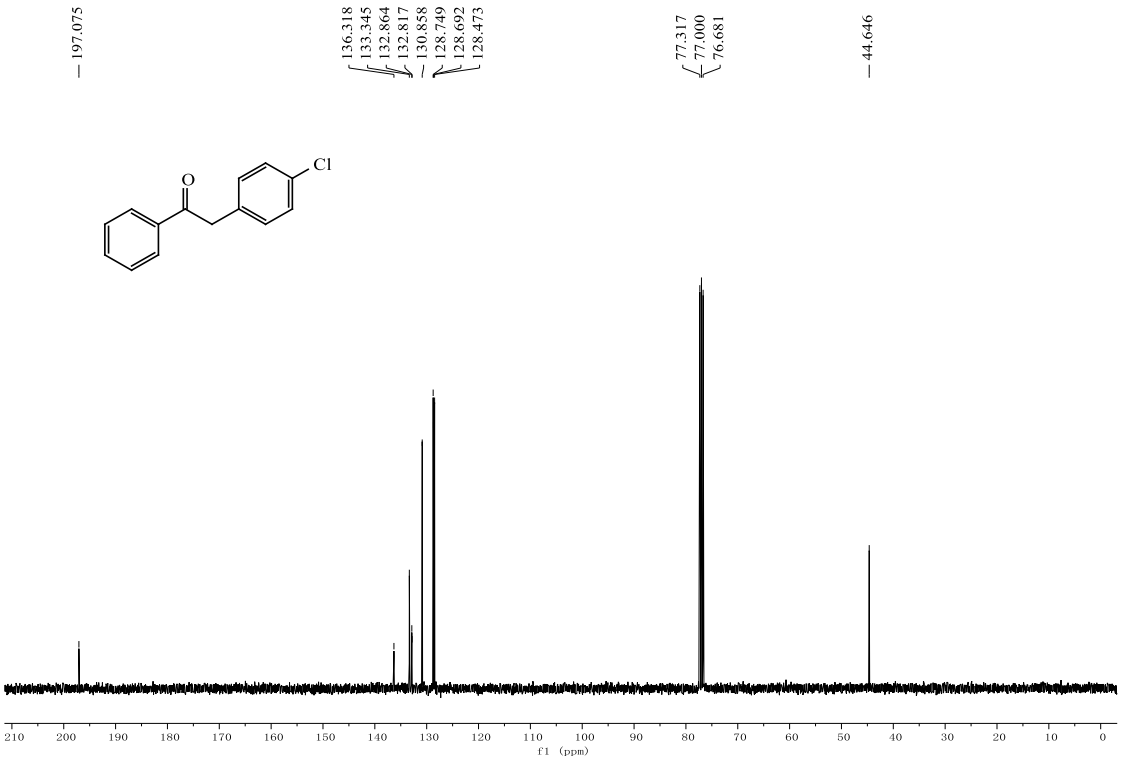
2-(4-Fluorophenyl)-1-phenylethan-1-one (3ae)



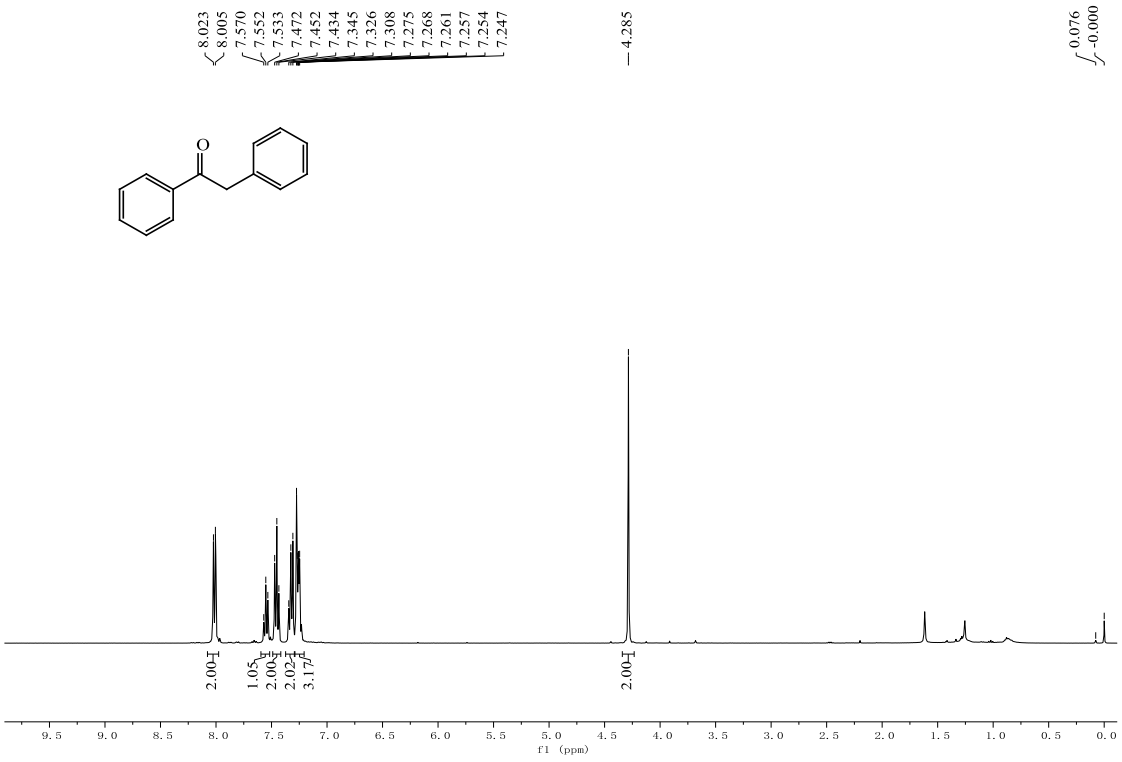


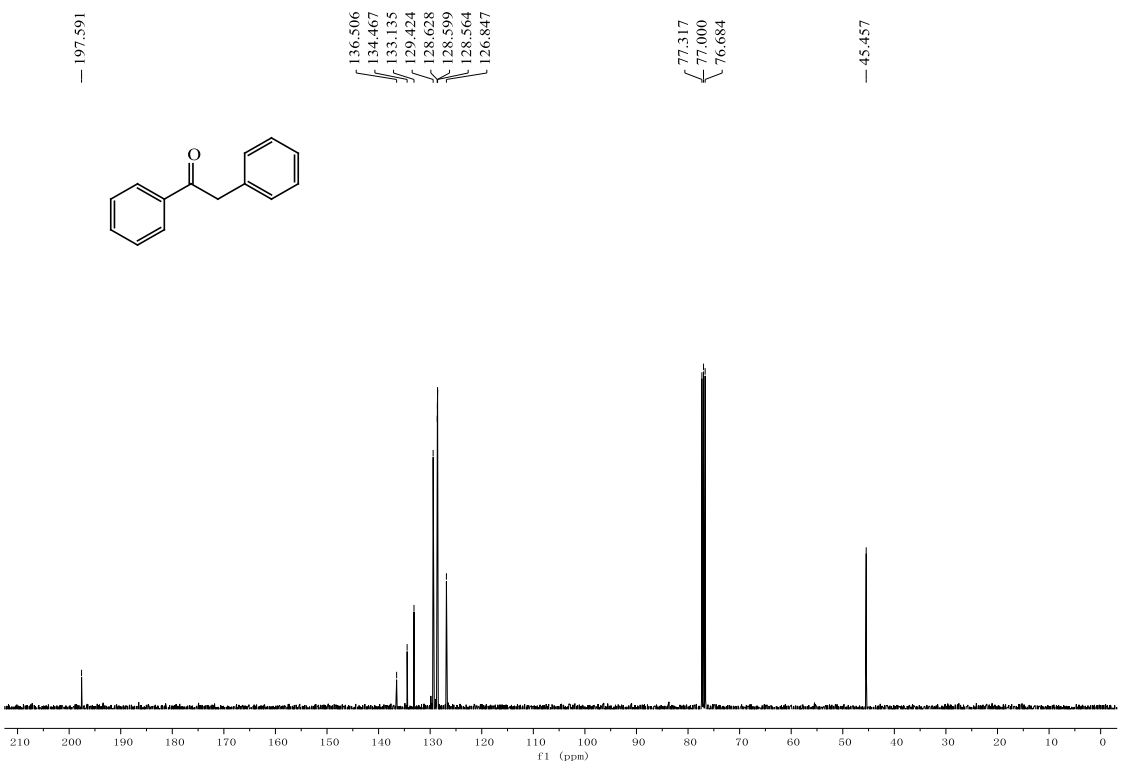
2-(4-Chlorophenyl)-1-phenylethan-1-one (3af)



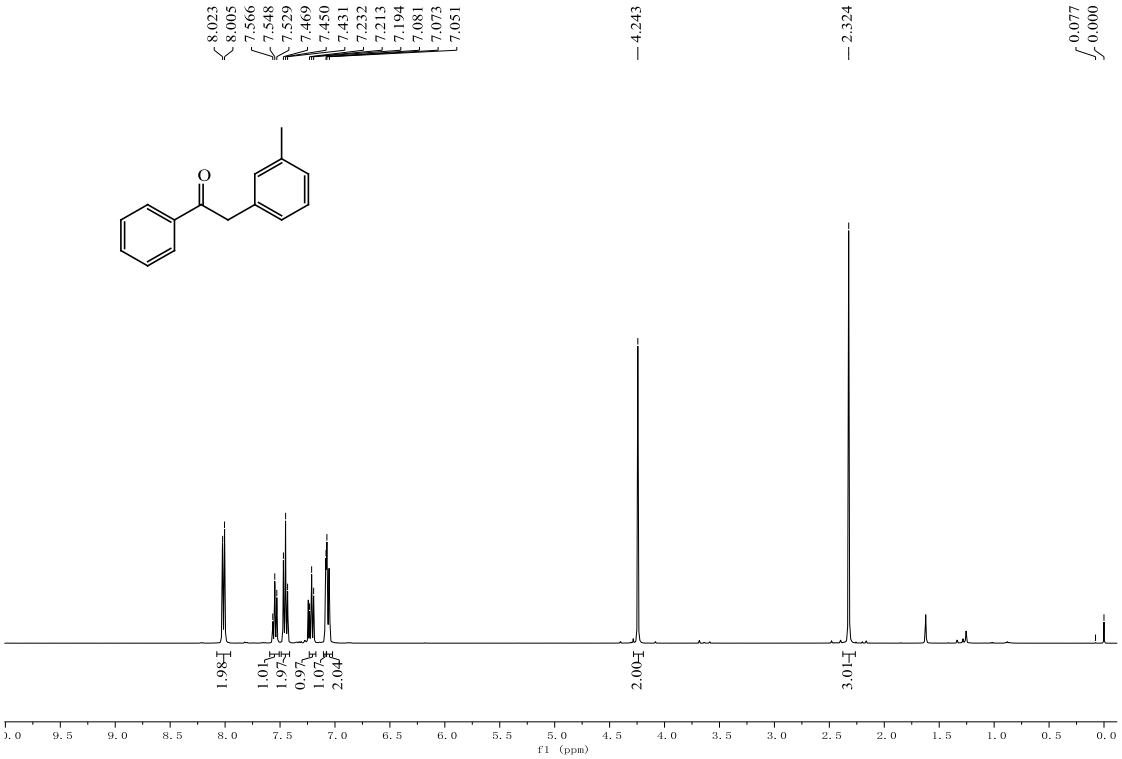


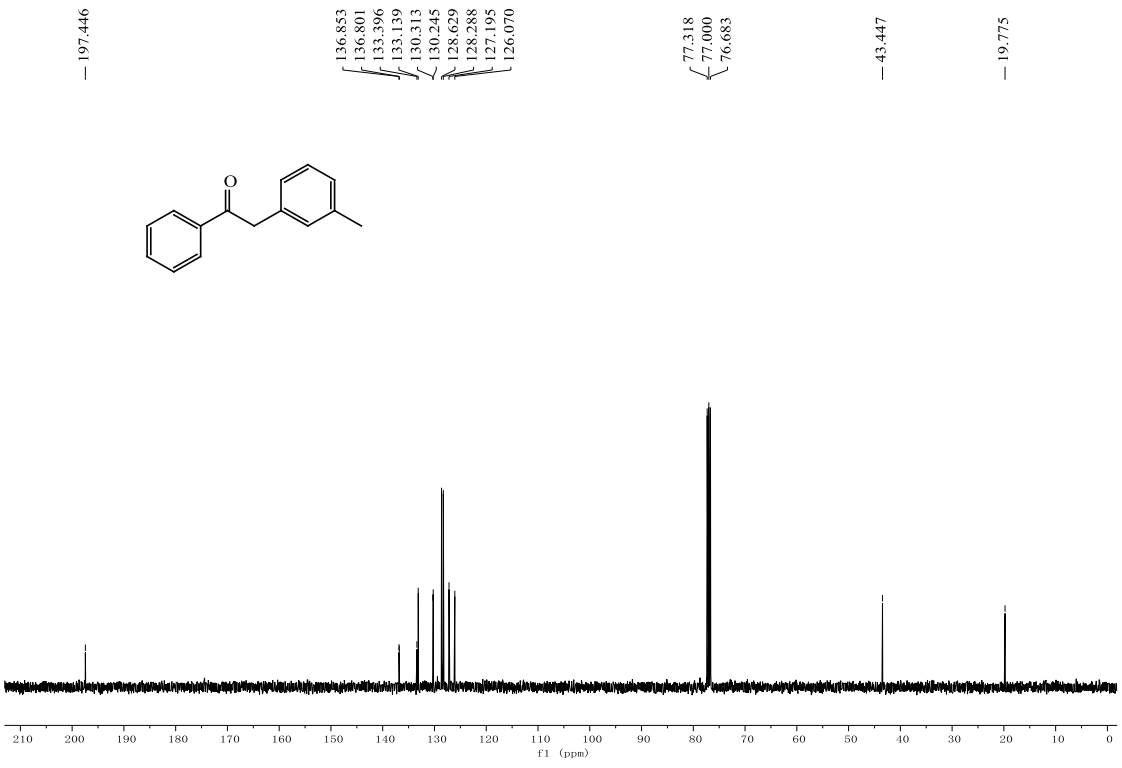
1,2-Diphenylethan-1-one (3ag)



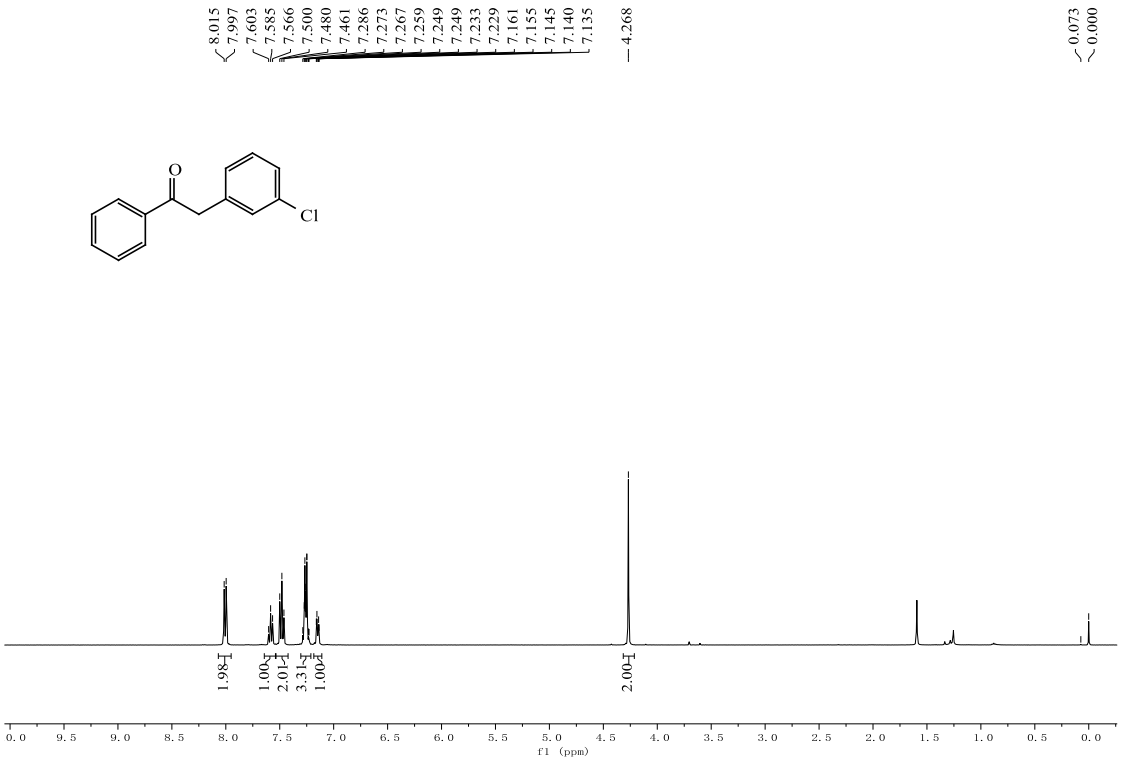


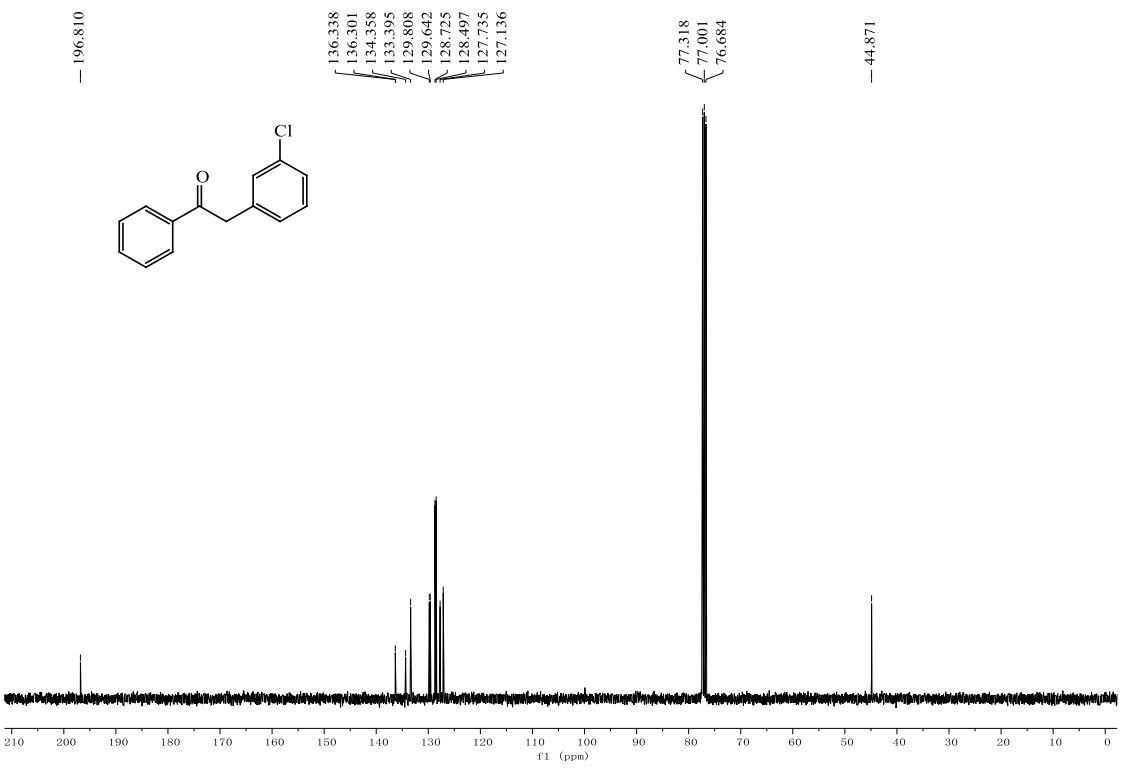
1-Phenyl-2-(*m*-tolyl)ethan-1-one (3ah)



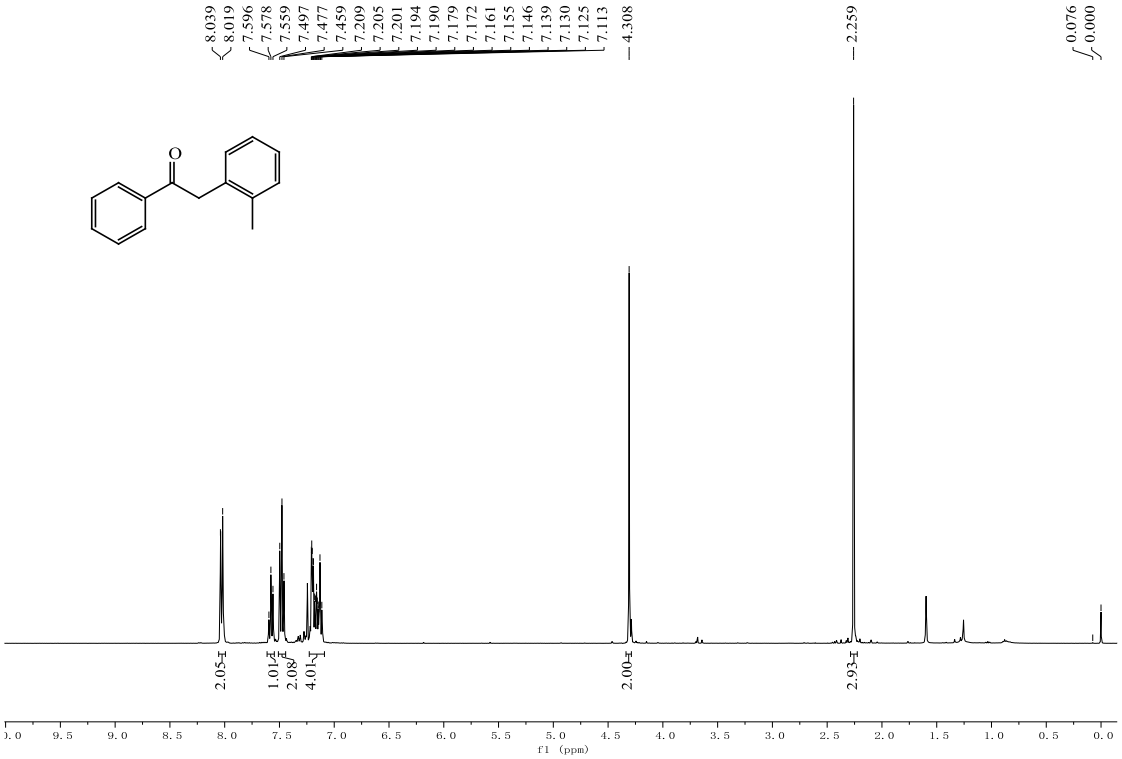


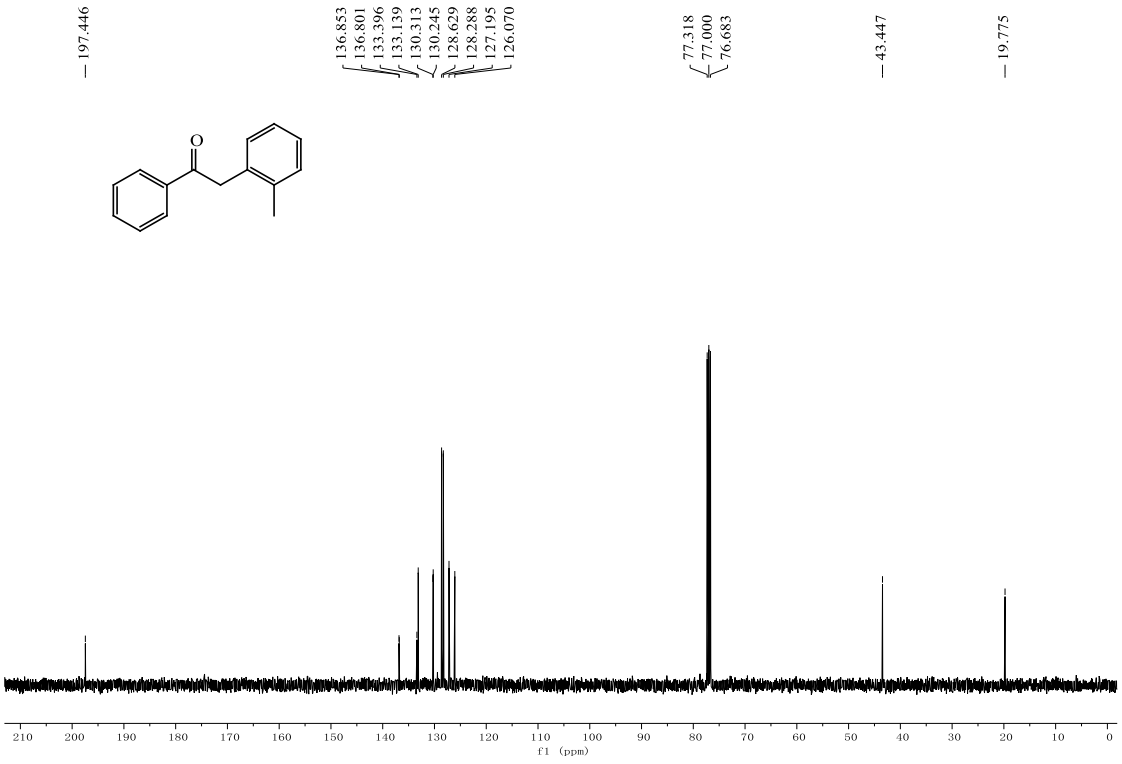
2-(3-Chlorophenyl)-1-phenylethan-1-one (3ai)



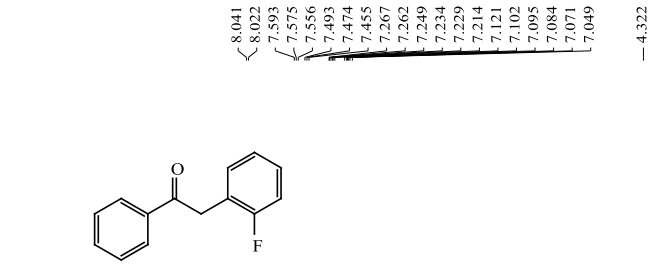


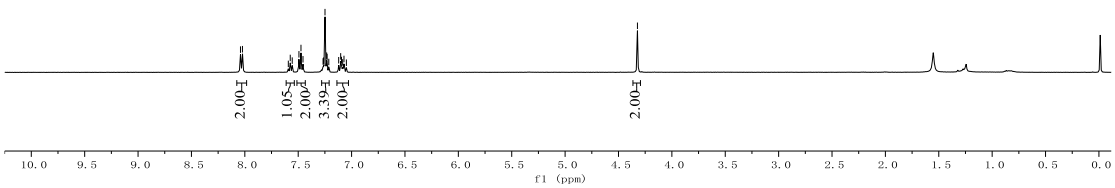
1-Phenyl-2-(*o*-tolyl)ethan-1-one (3aj)

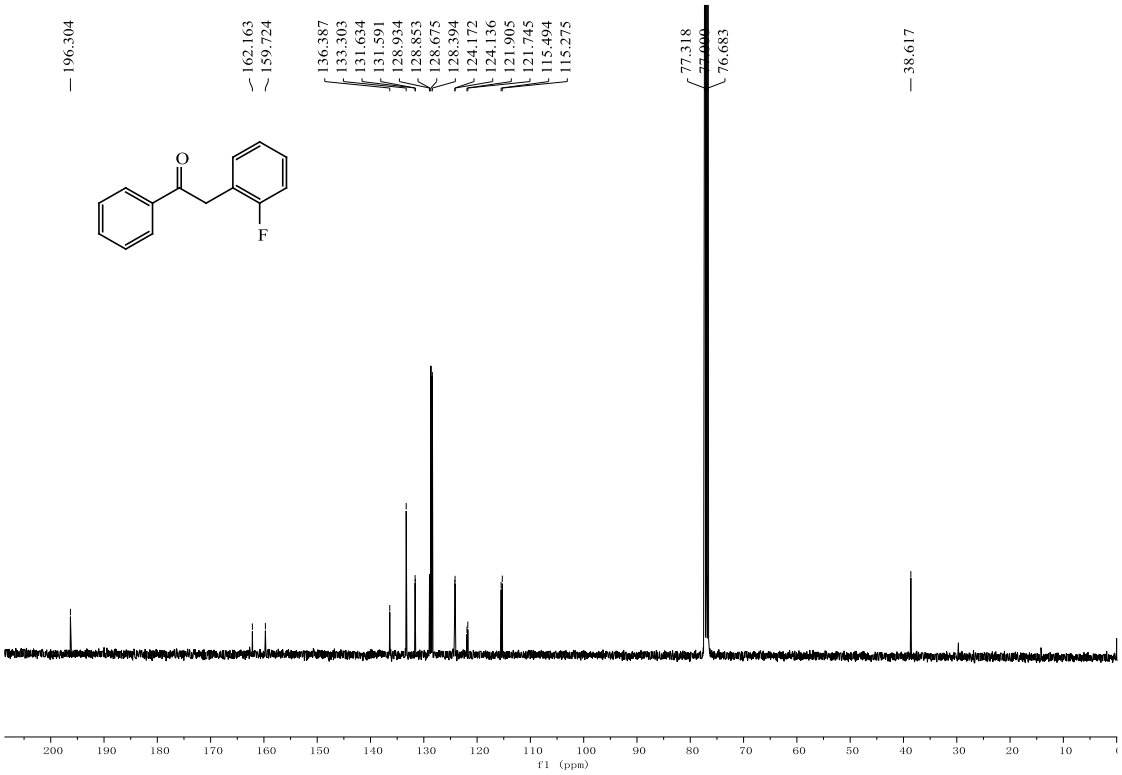




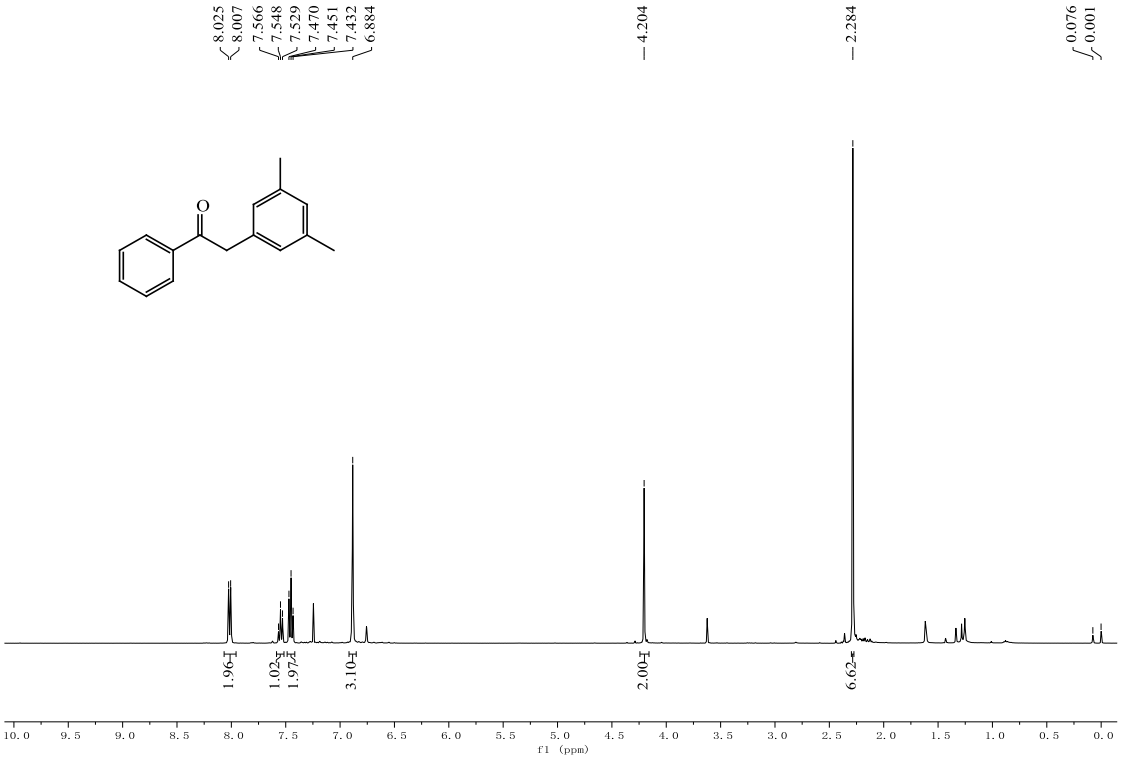
2-(2-Fluorophenyl)-1-phenylethan-1-one (3ak)

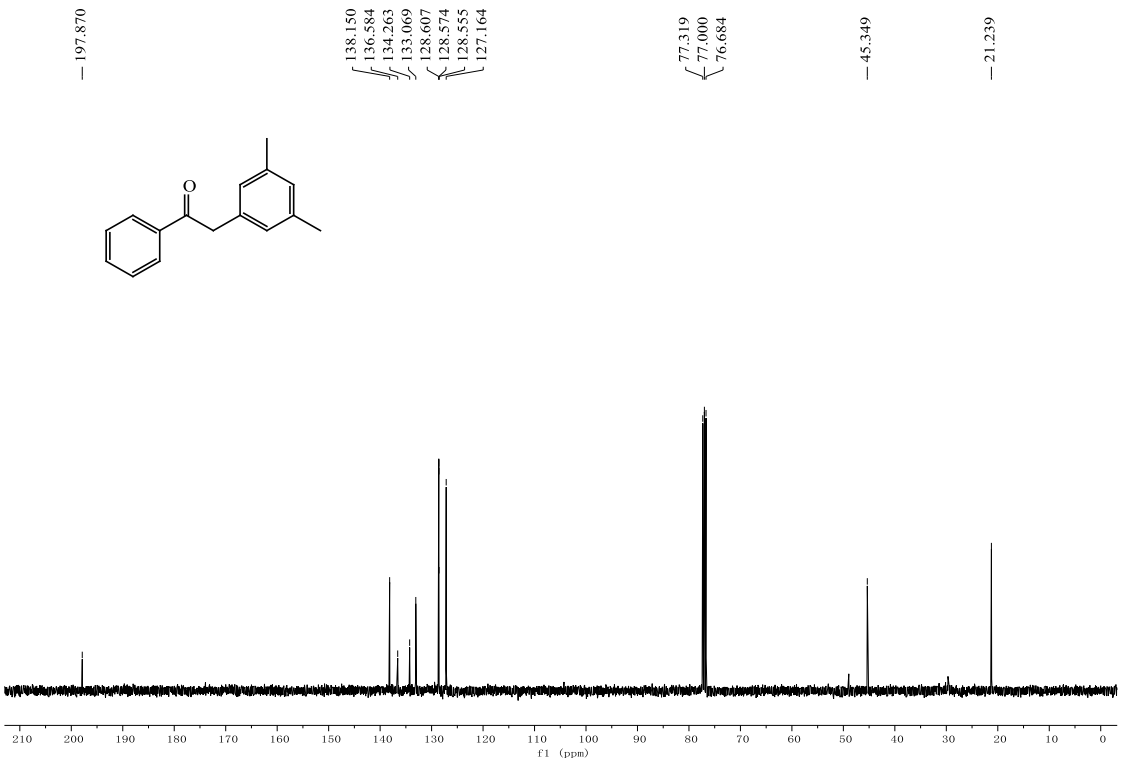




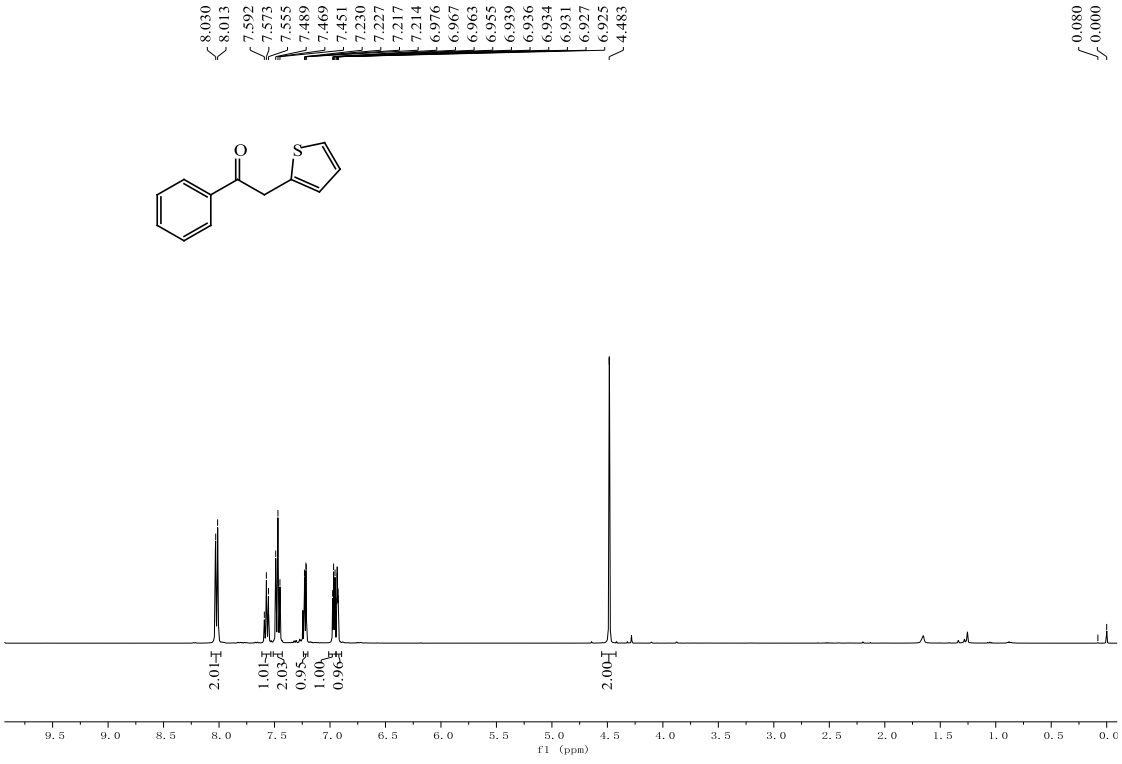


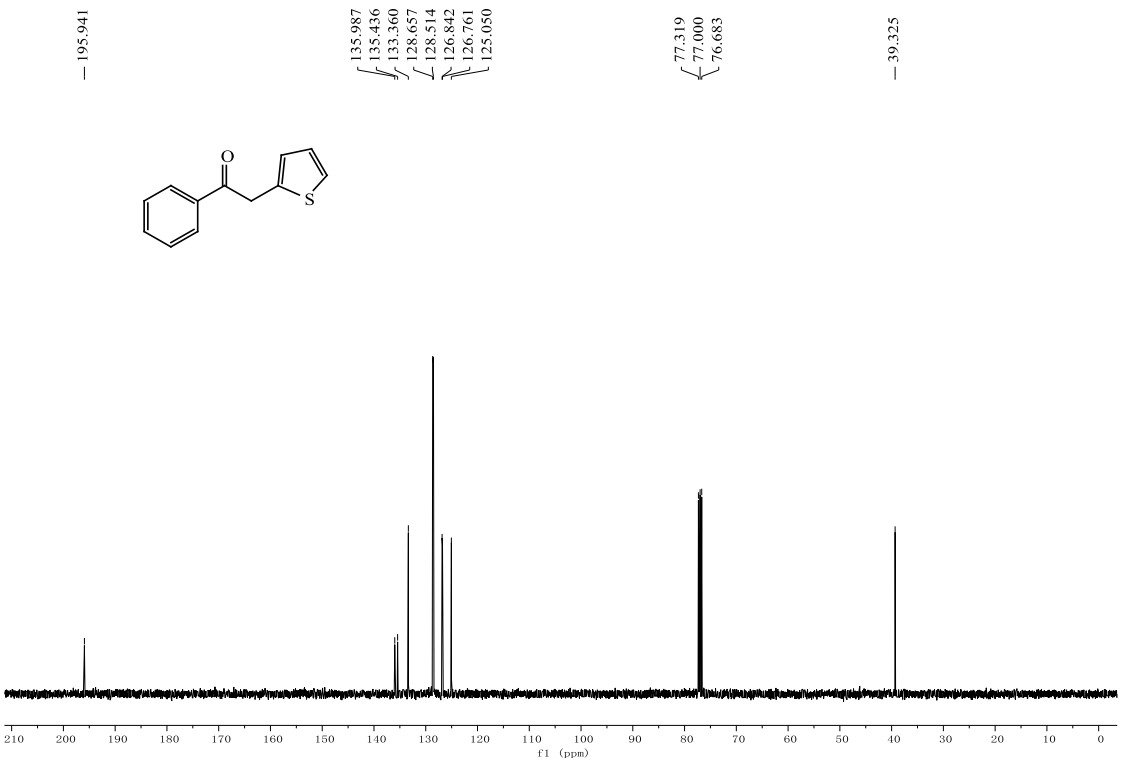
2-(3,5-Dimethylphenyl)-1-phenylethan-1-one (3al)



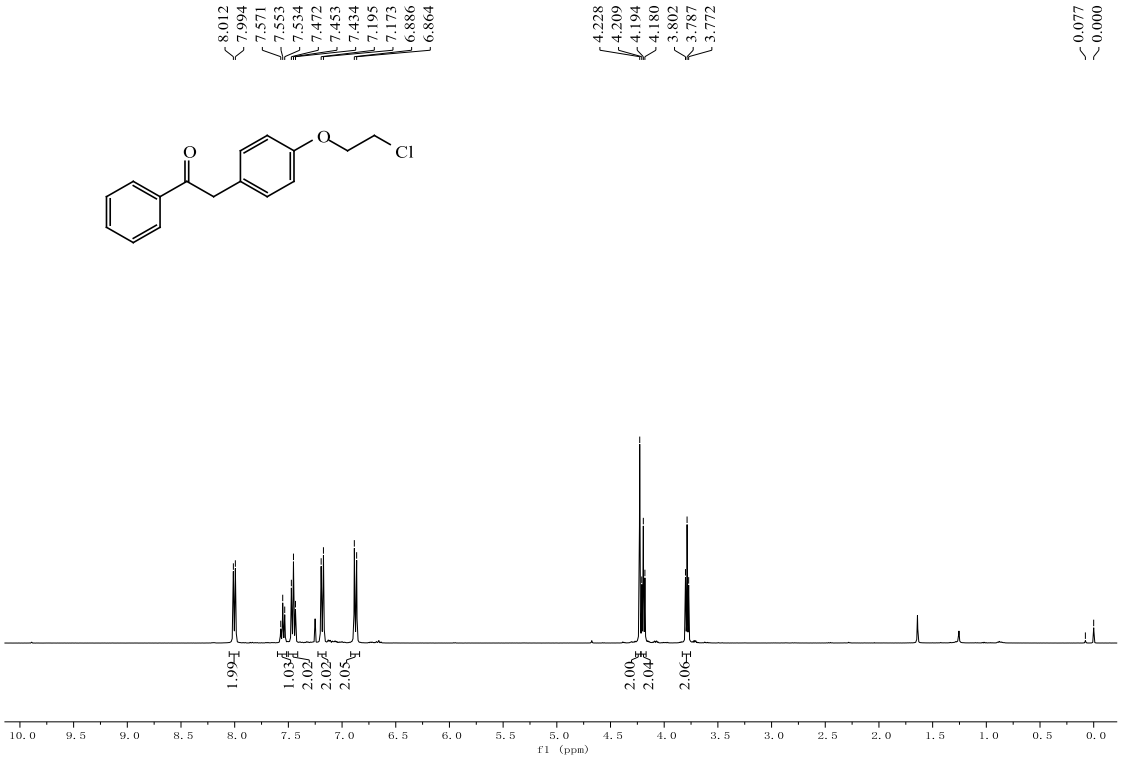


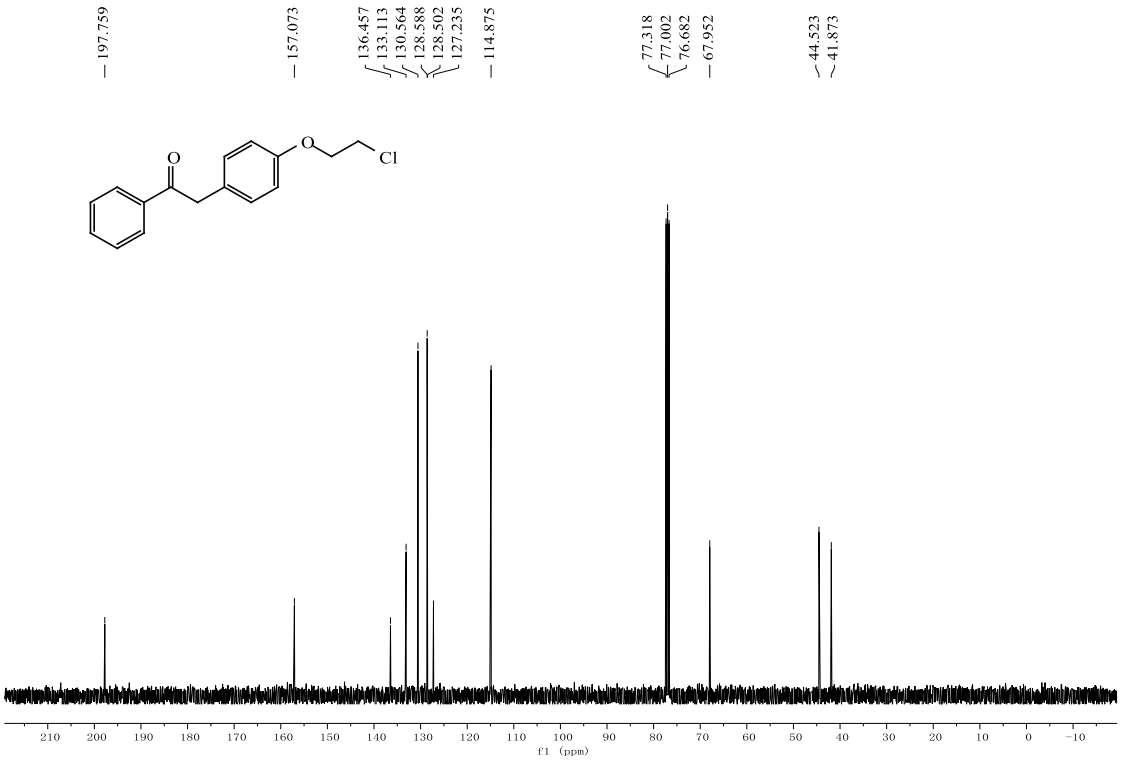
1-Phenyl-2-(thiophen-2-yl)ethan-1-one (3am)



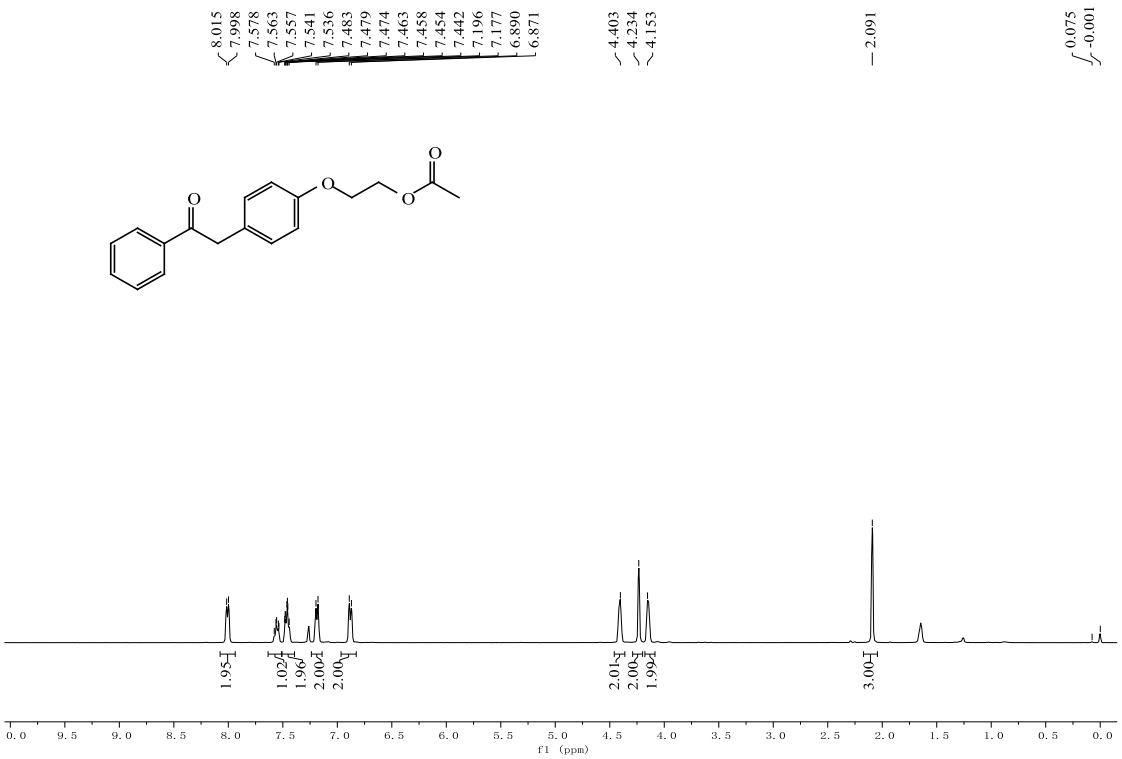


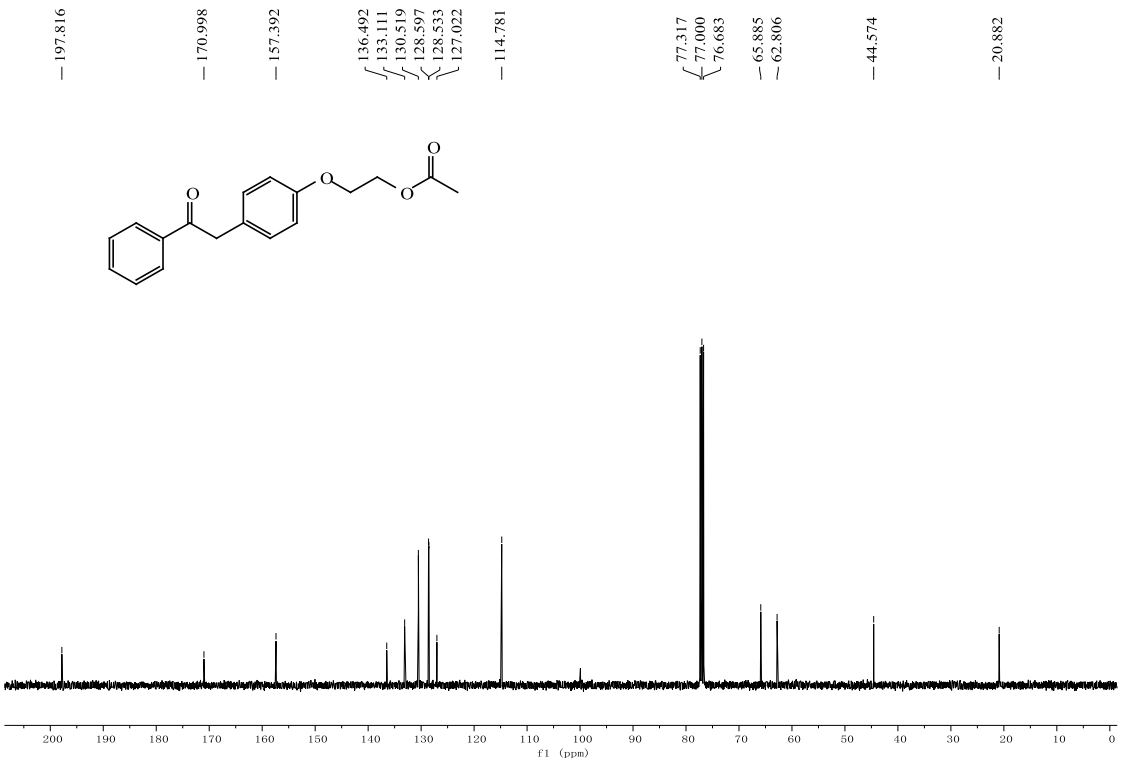
2-(4-(2-Chloroethoxy)phenyl)-1-phenylethan-1-one(3an)



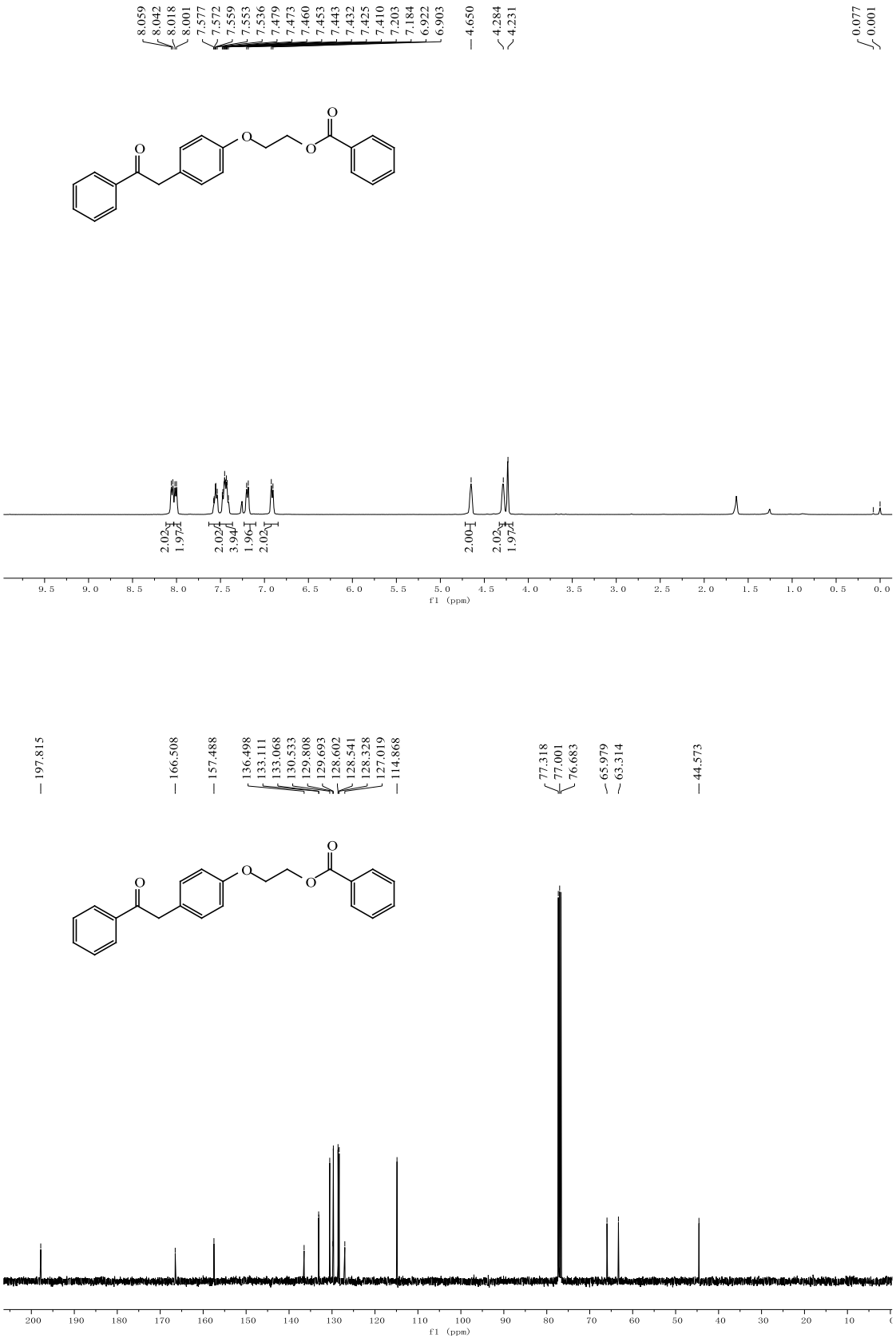


2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl acetate (3ao)

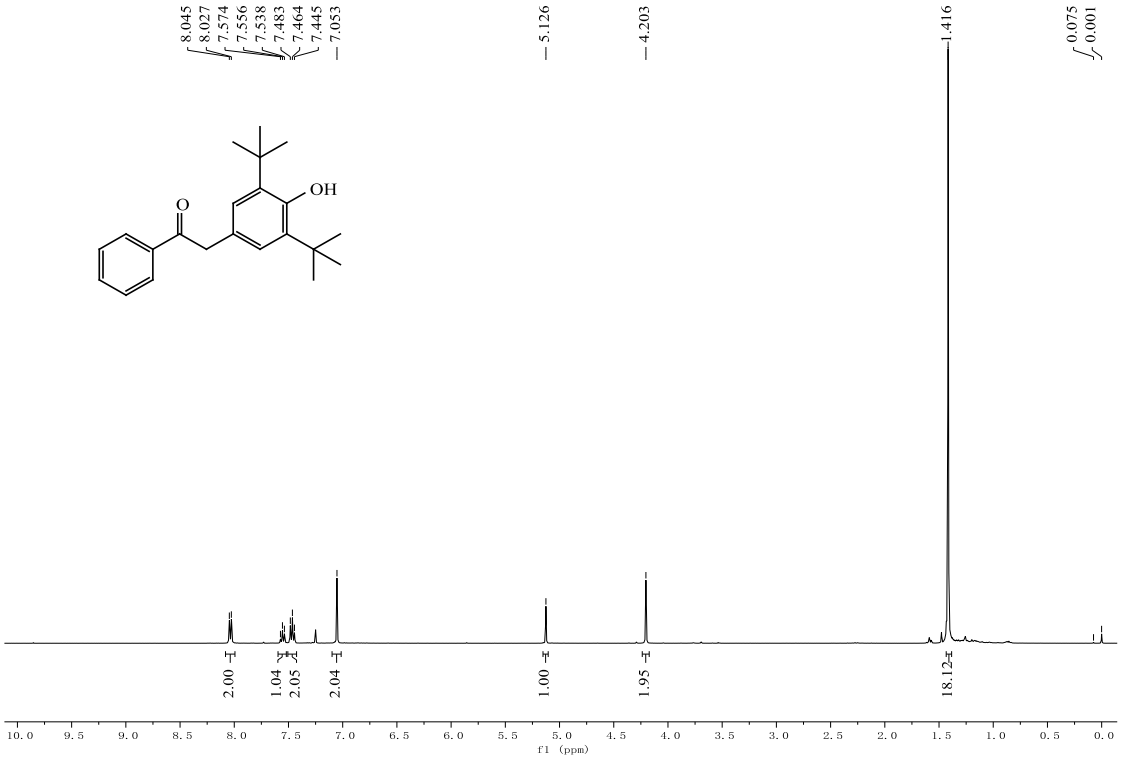


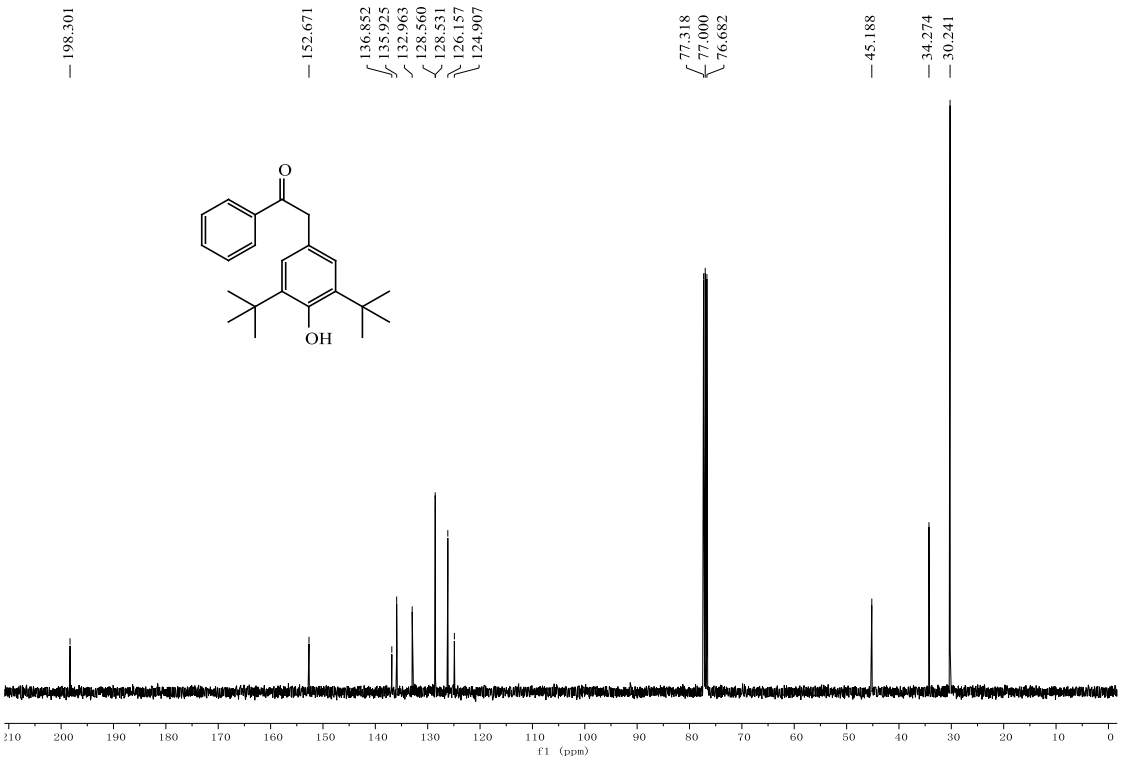


2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl benzoate (3ap)

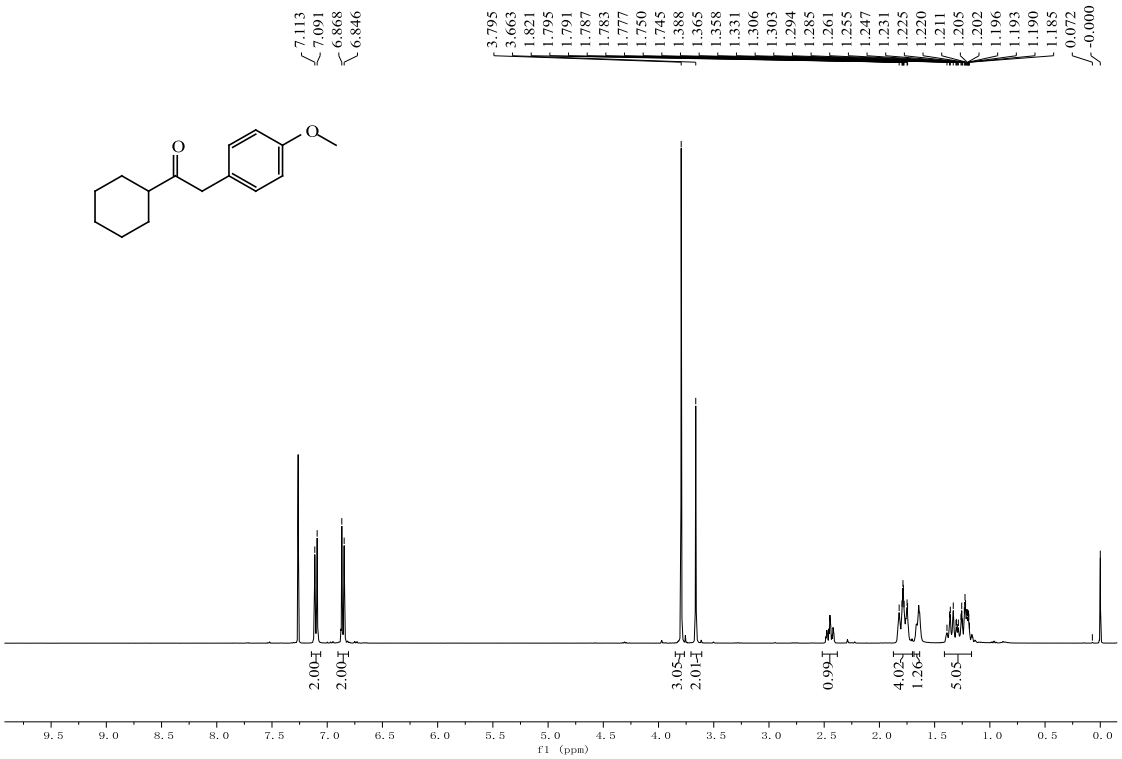


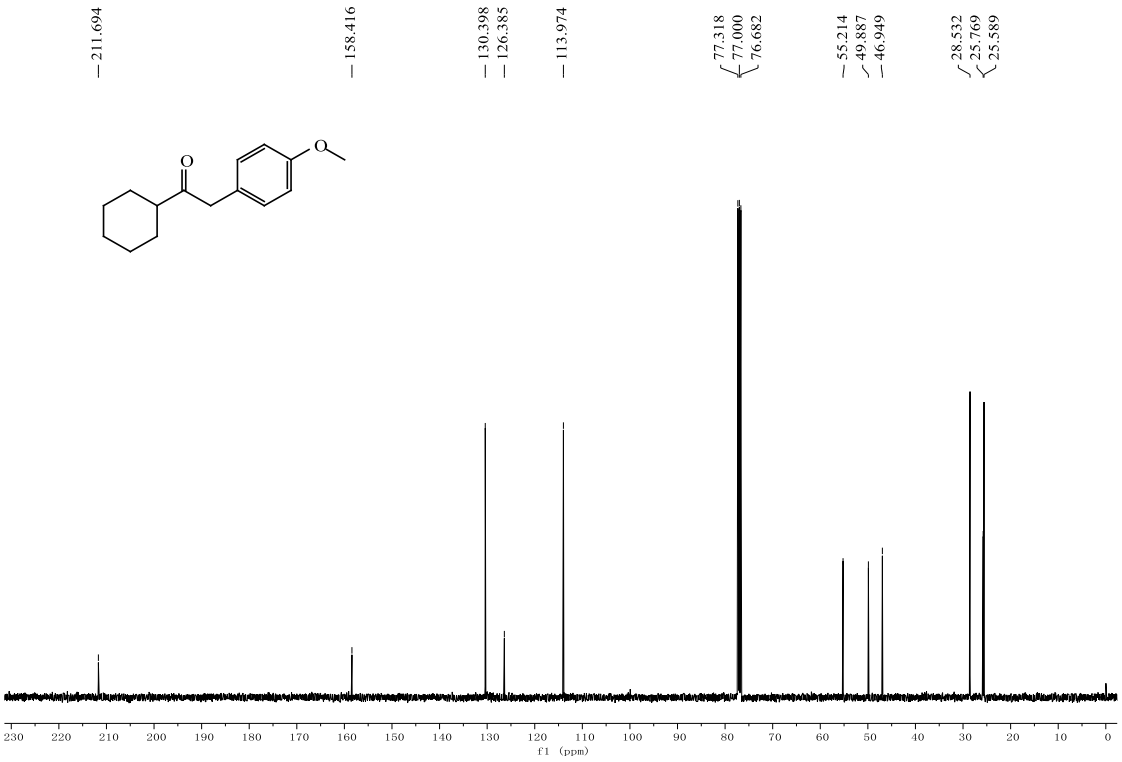
2-(2,6-Di-*tert*-butyl-4-hydroxyphenyl)-1-phenylethan-1-one (3ar)



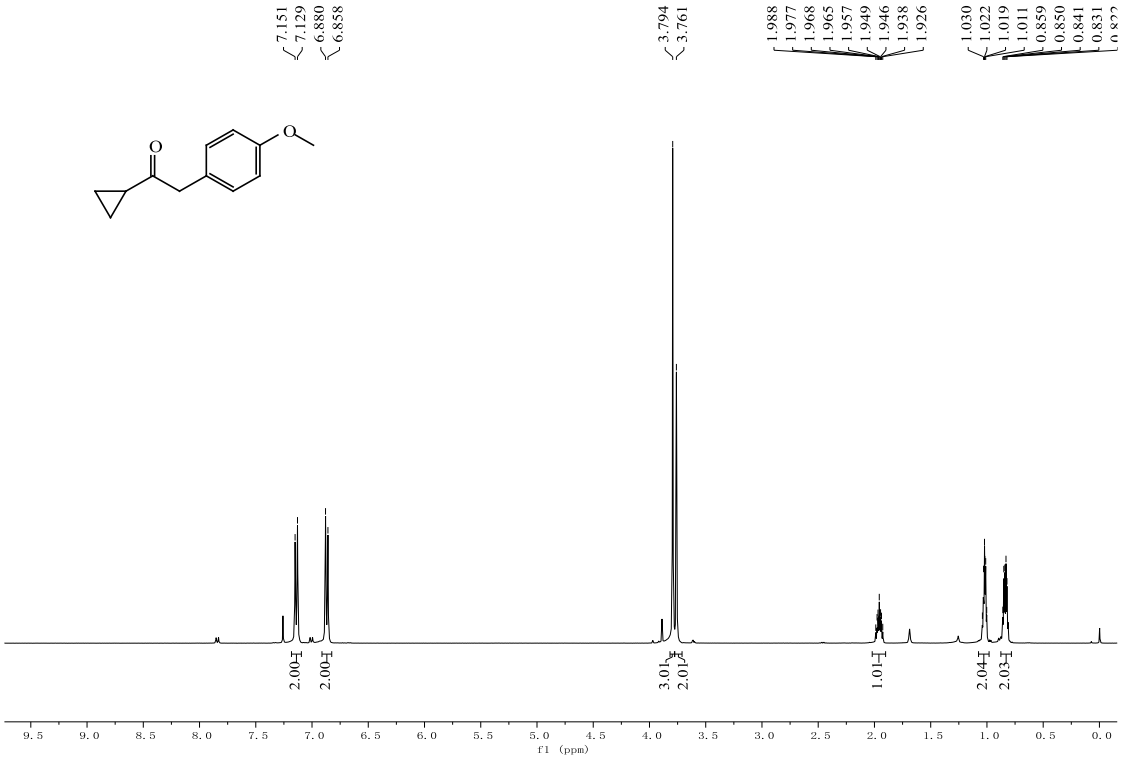


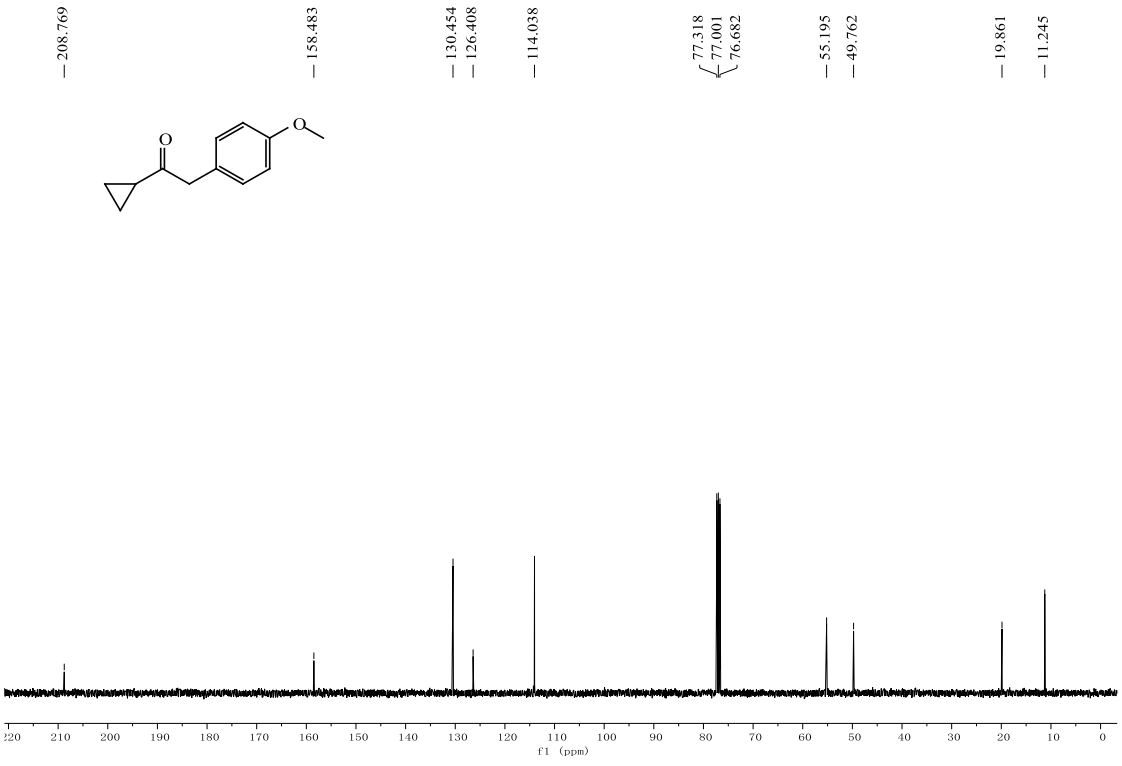
1-Cyclohexyl-2-(4-methoxyphenyl)ethan-1-one (5aa)



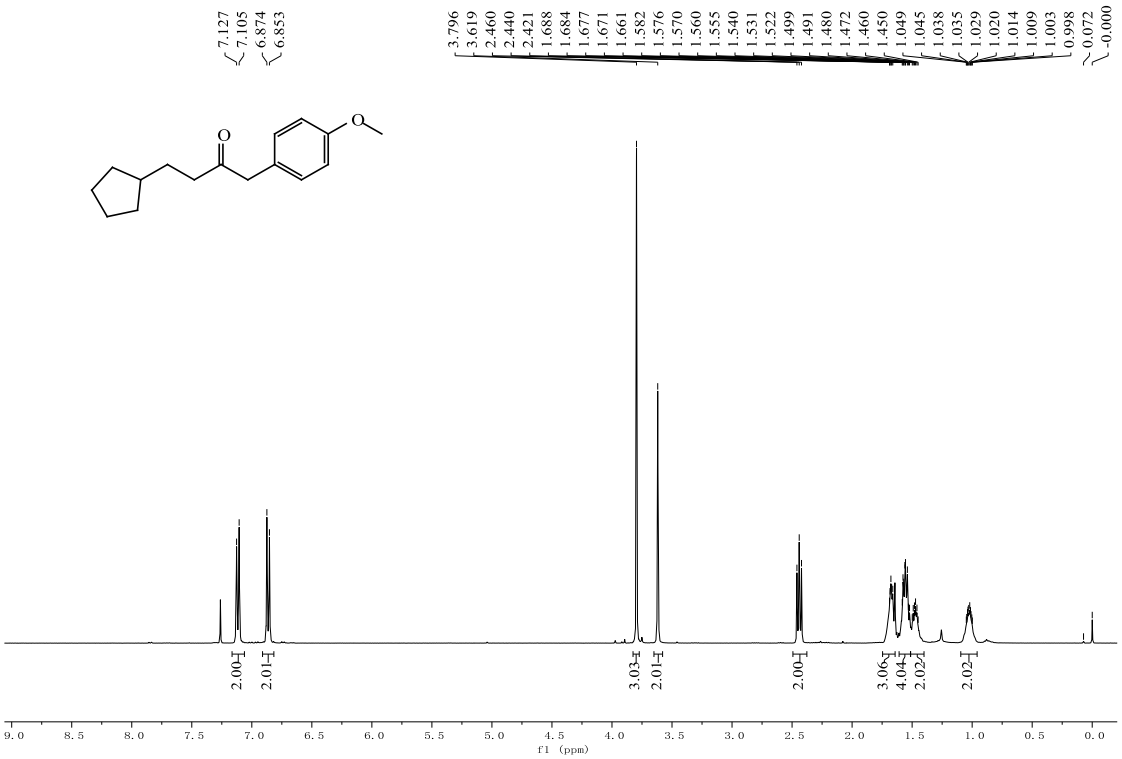


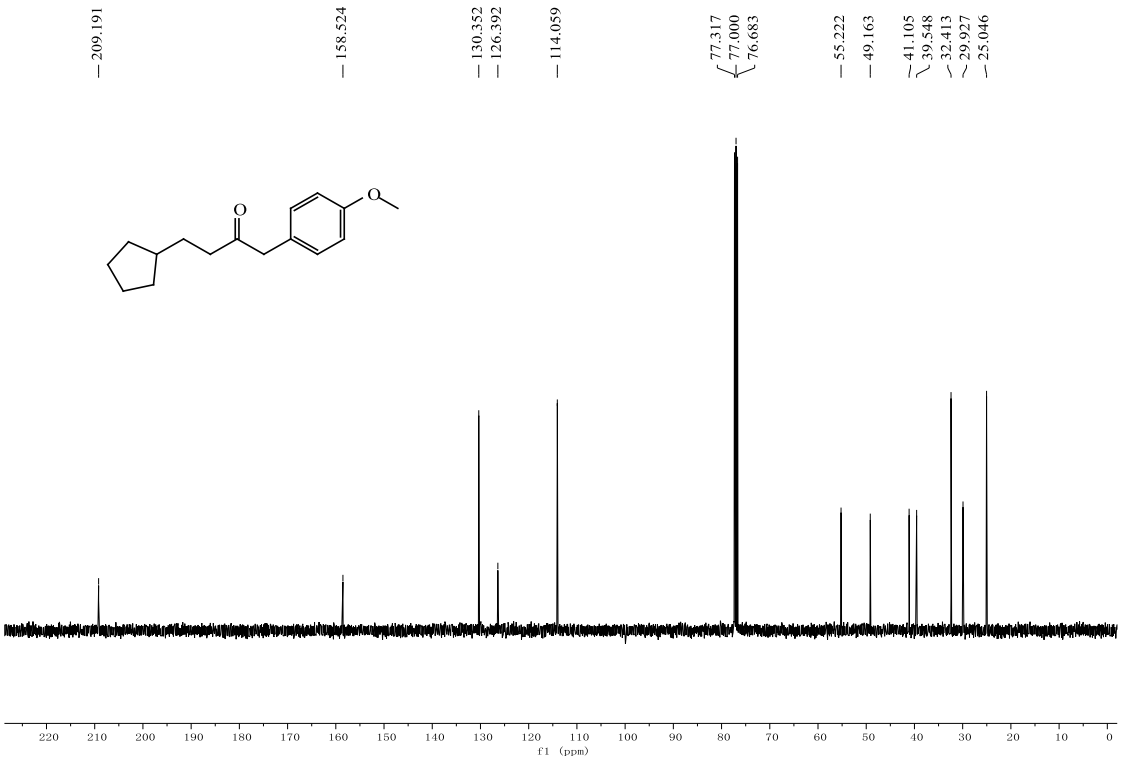
1-Cyclopropyl-2-(4-methoxyphenyl)ethan-1-one (5ba)



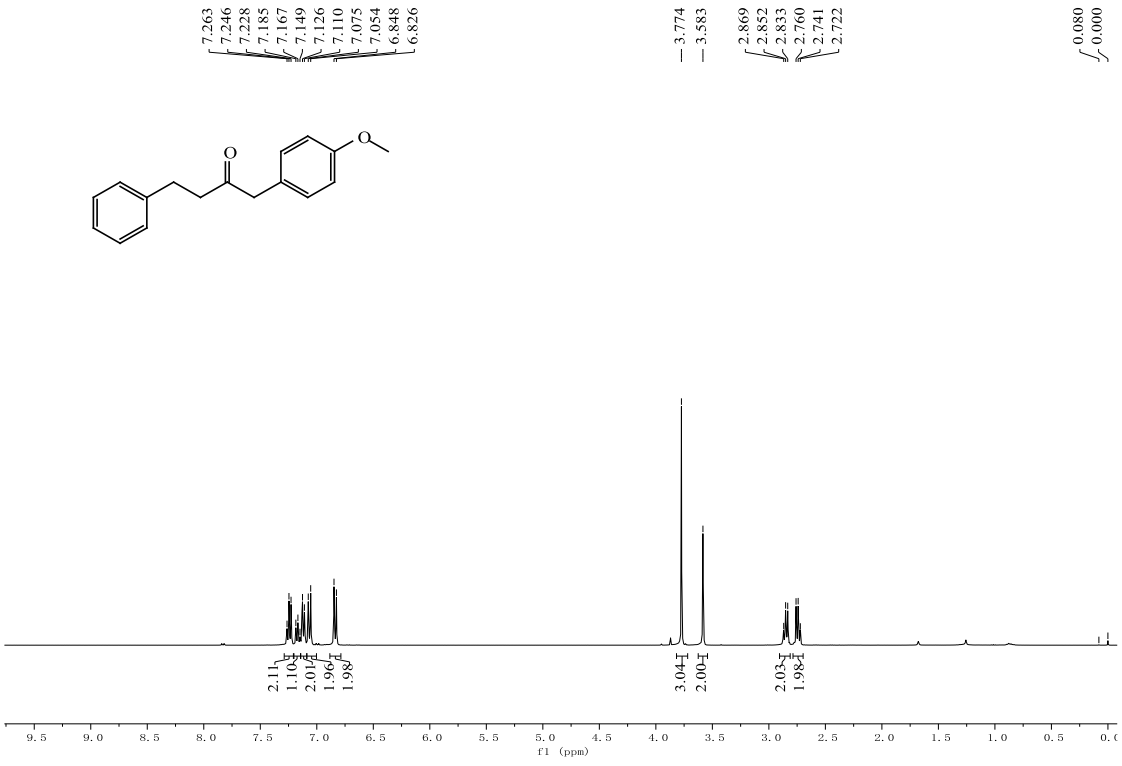


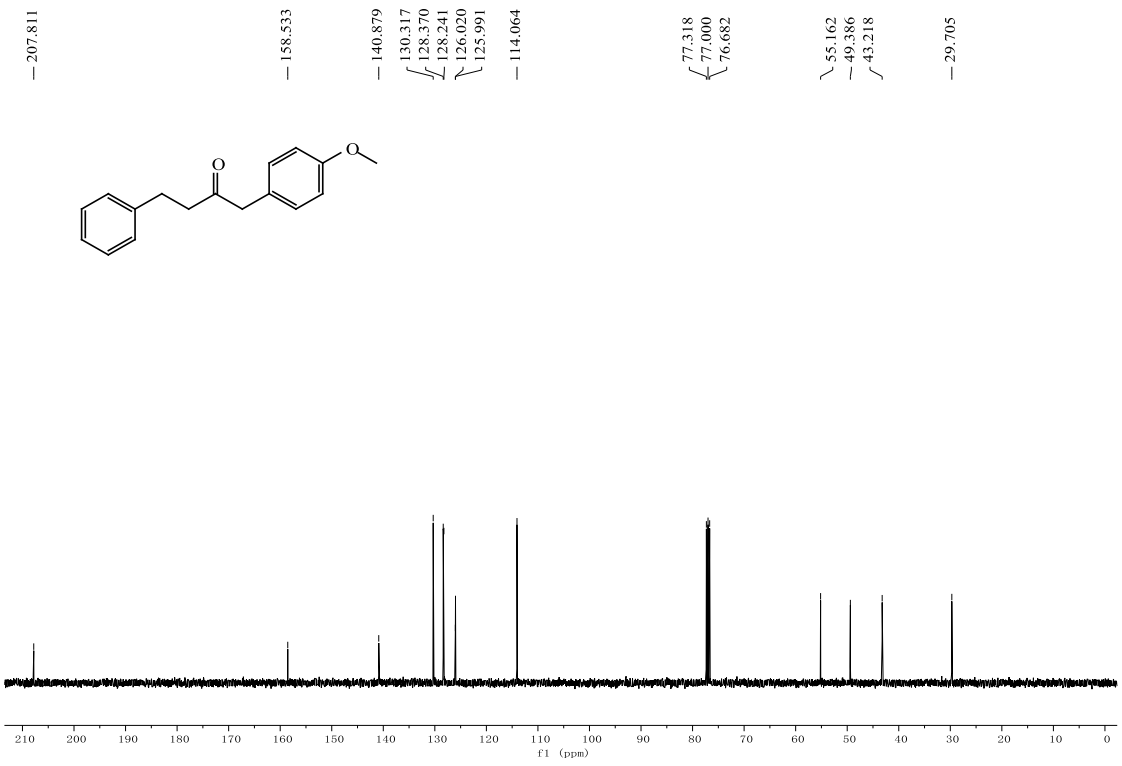
4-Cyclopentyl-1-(4-methoxyphenyl)butan-2-one (5ca)



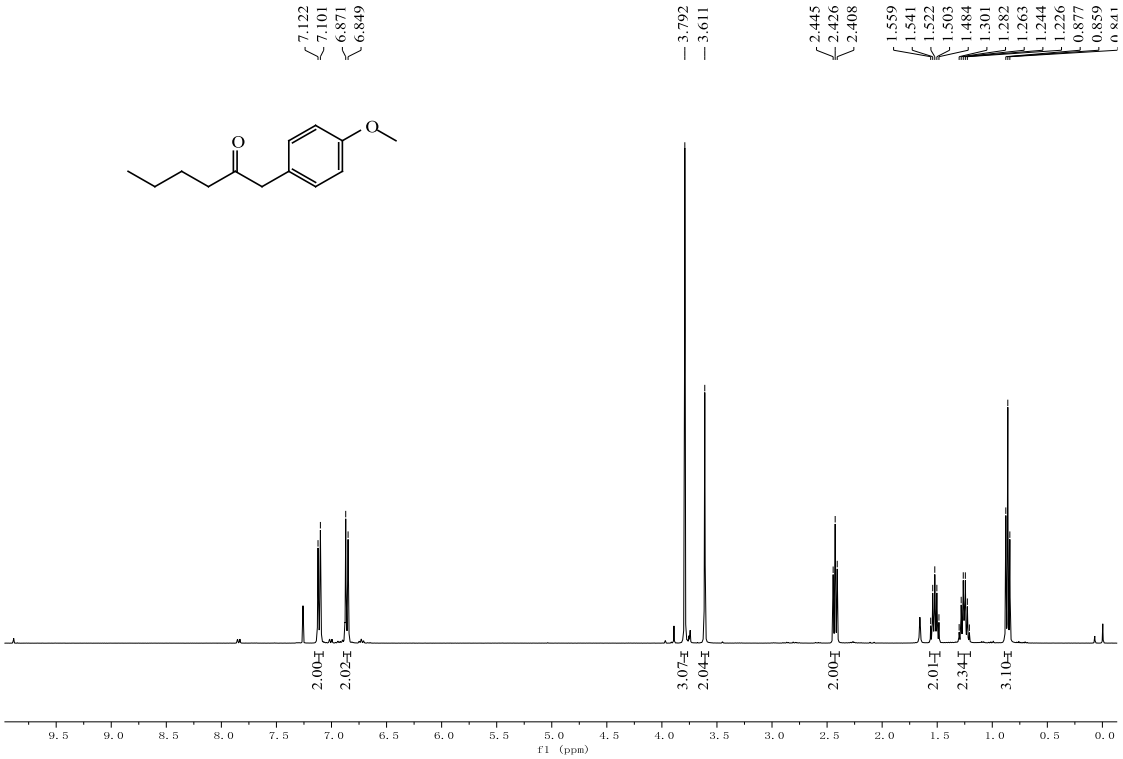


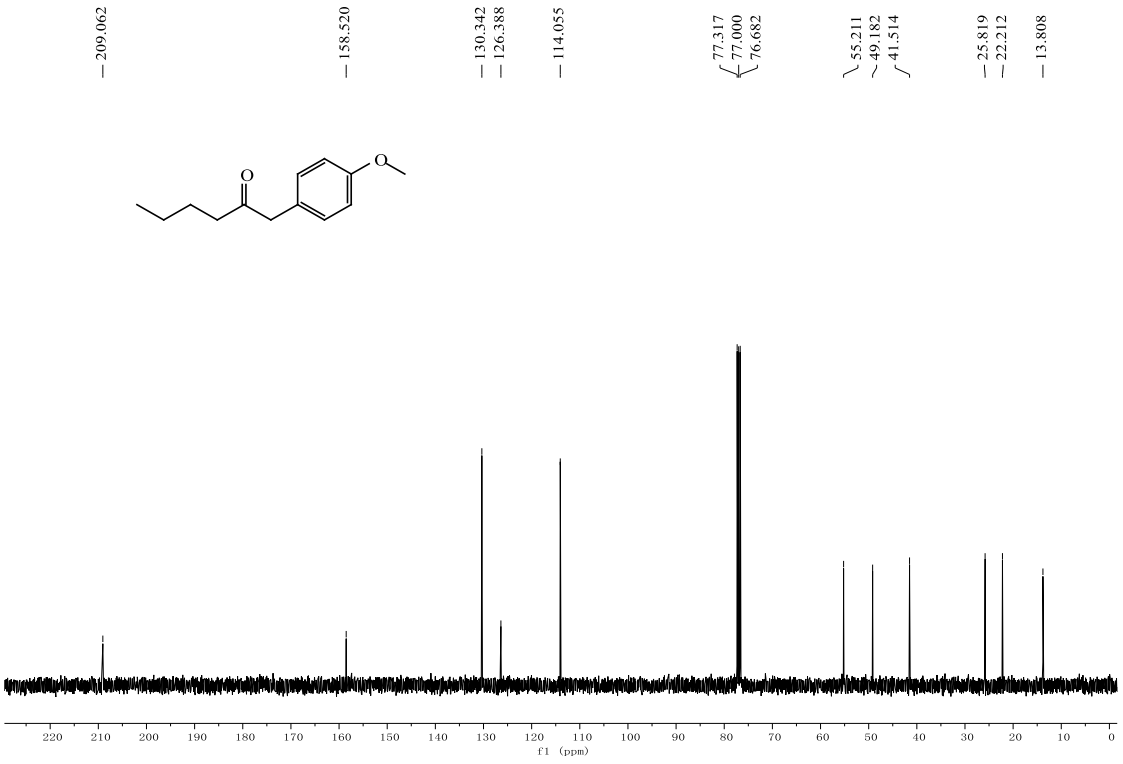
1-(4-Methoxyphenyl)-4-phenylbutan-2-one (5da)



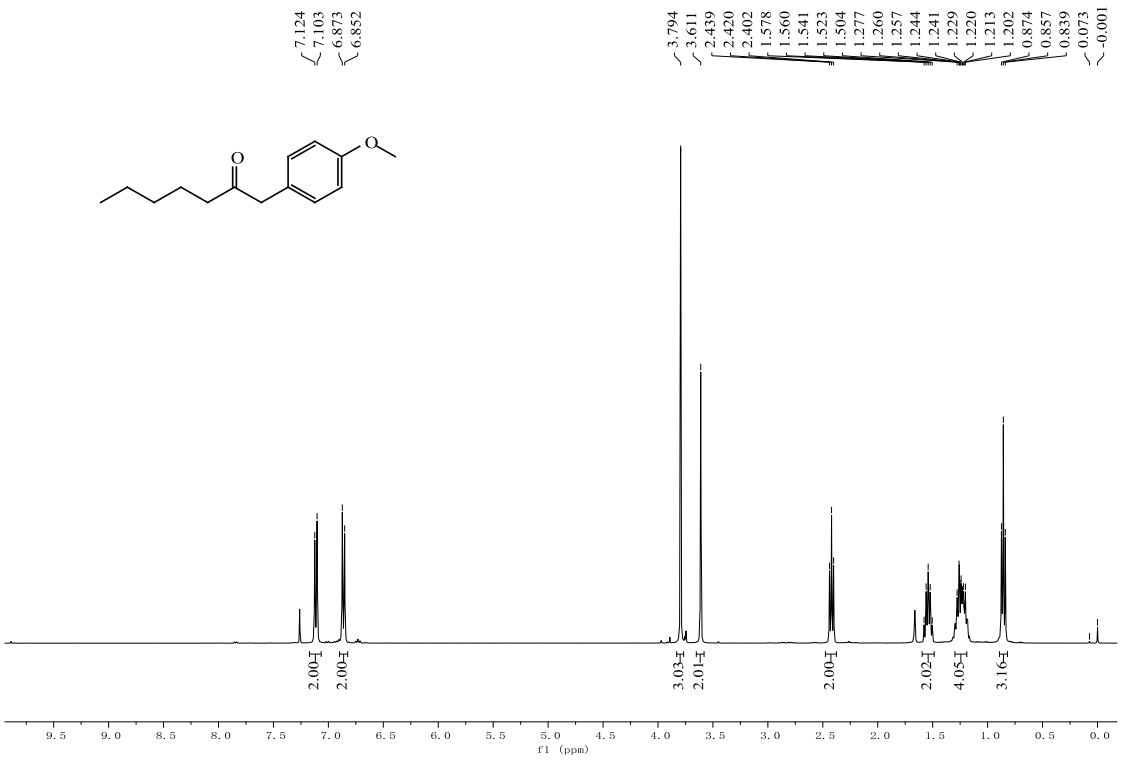


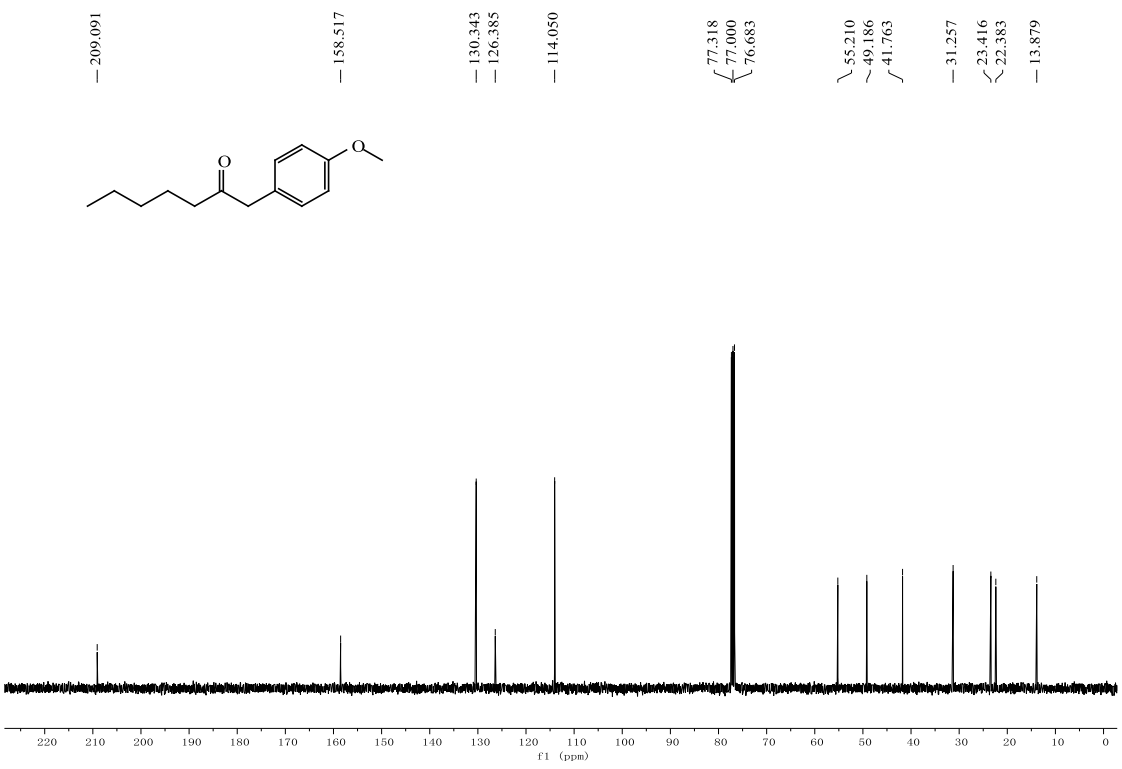
1-(4-Methoxyphenyl)hexan-2-one (5ea)



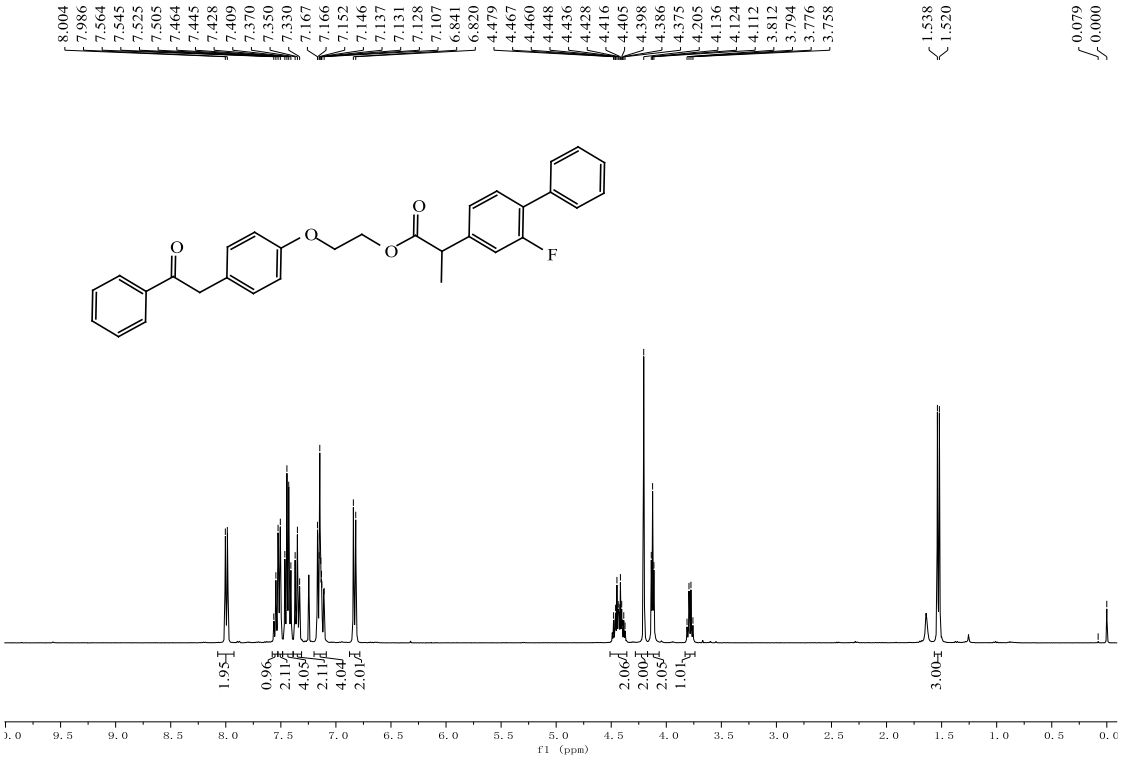


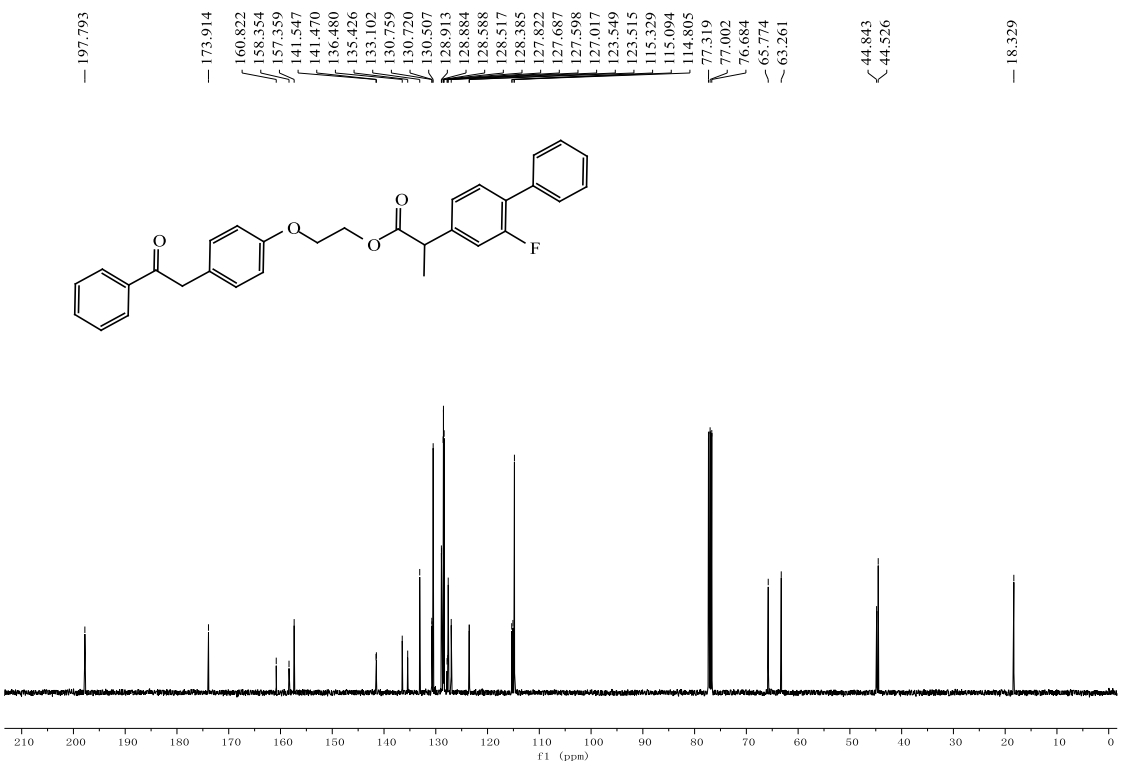
1-(4-Methoxyphenyl)heptan-2-one (5fa)



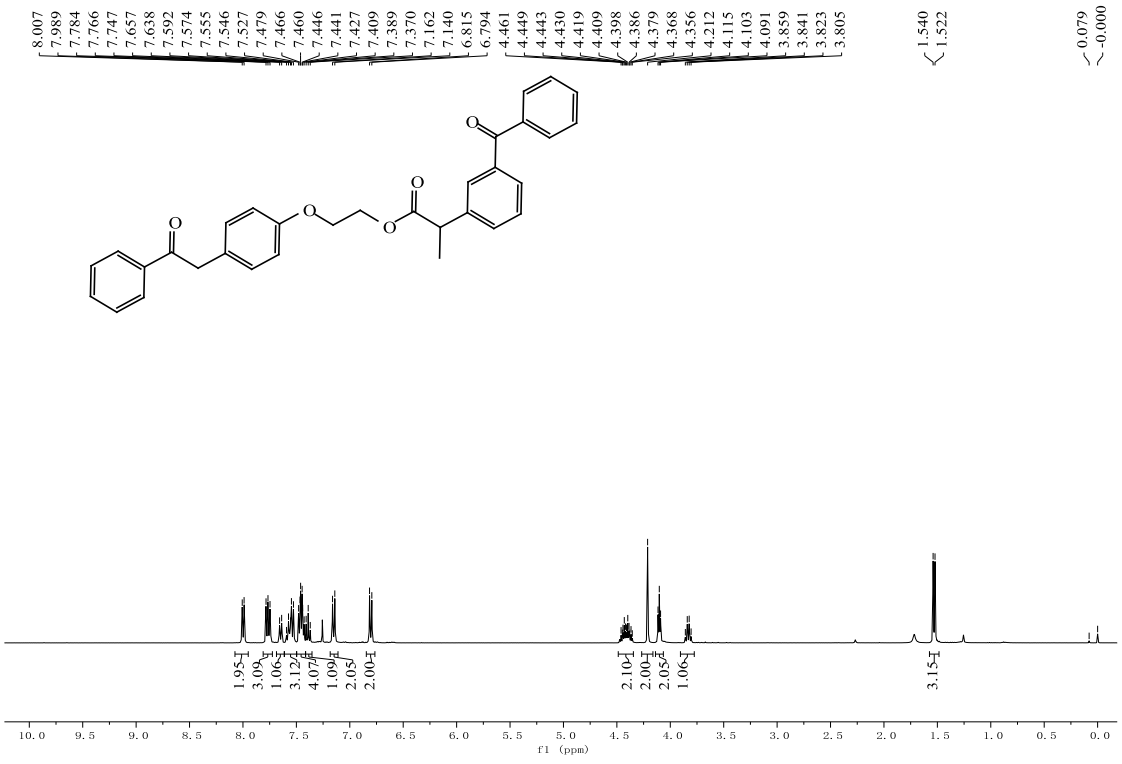


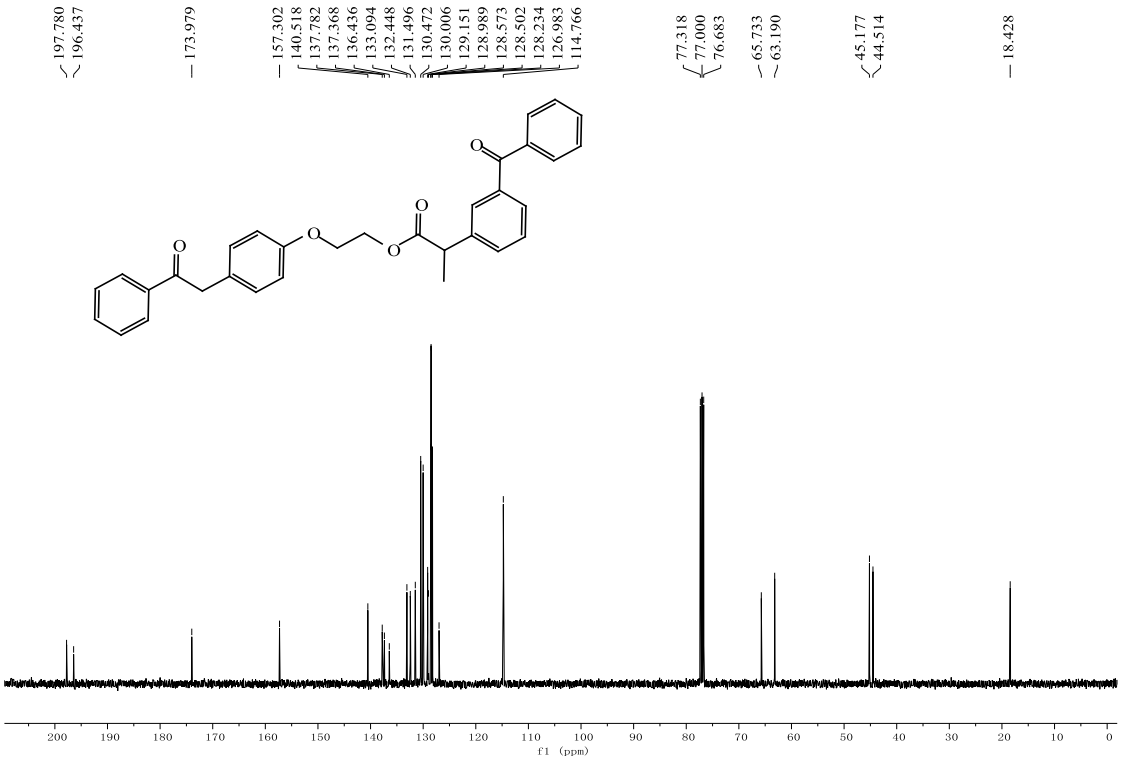
2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(2-fluoro-[1,1'-biphenyl]-4-yl)propanoate (7aa)





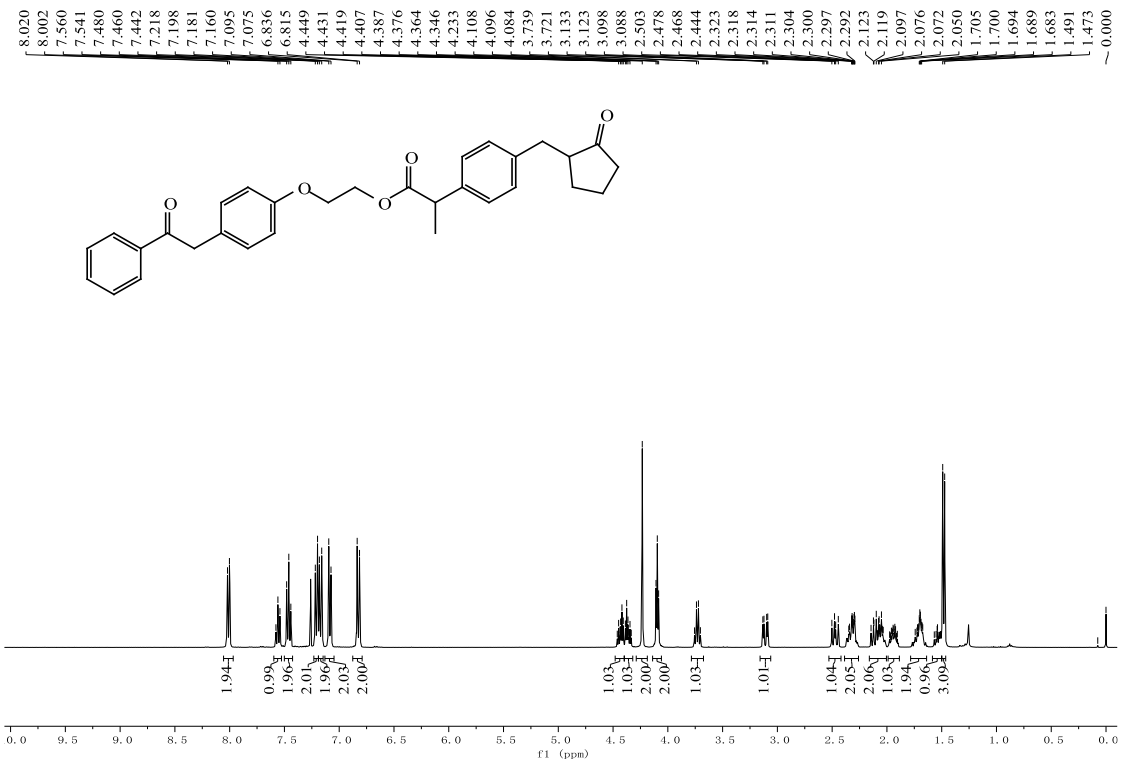
2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(3-benzoylphenyl)propanoate (7ab)

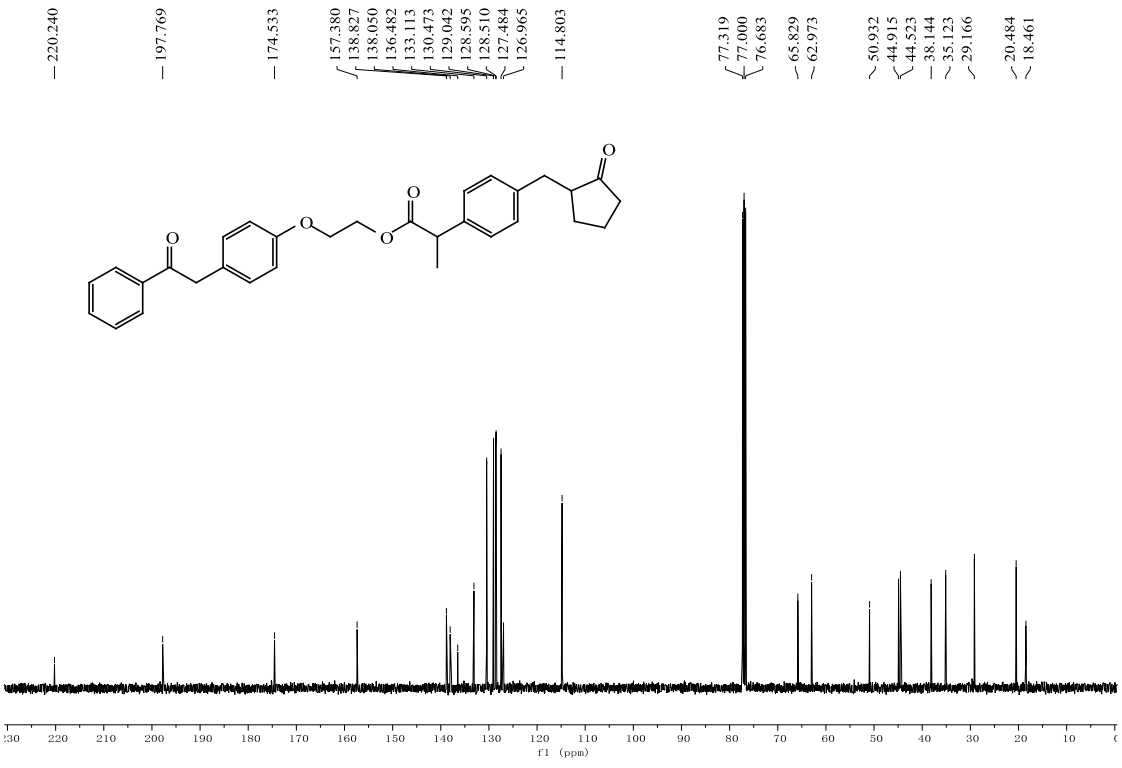




2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(4-((2-oxocyclopentyl)methyl)phenyl)propanoate

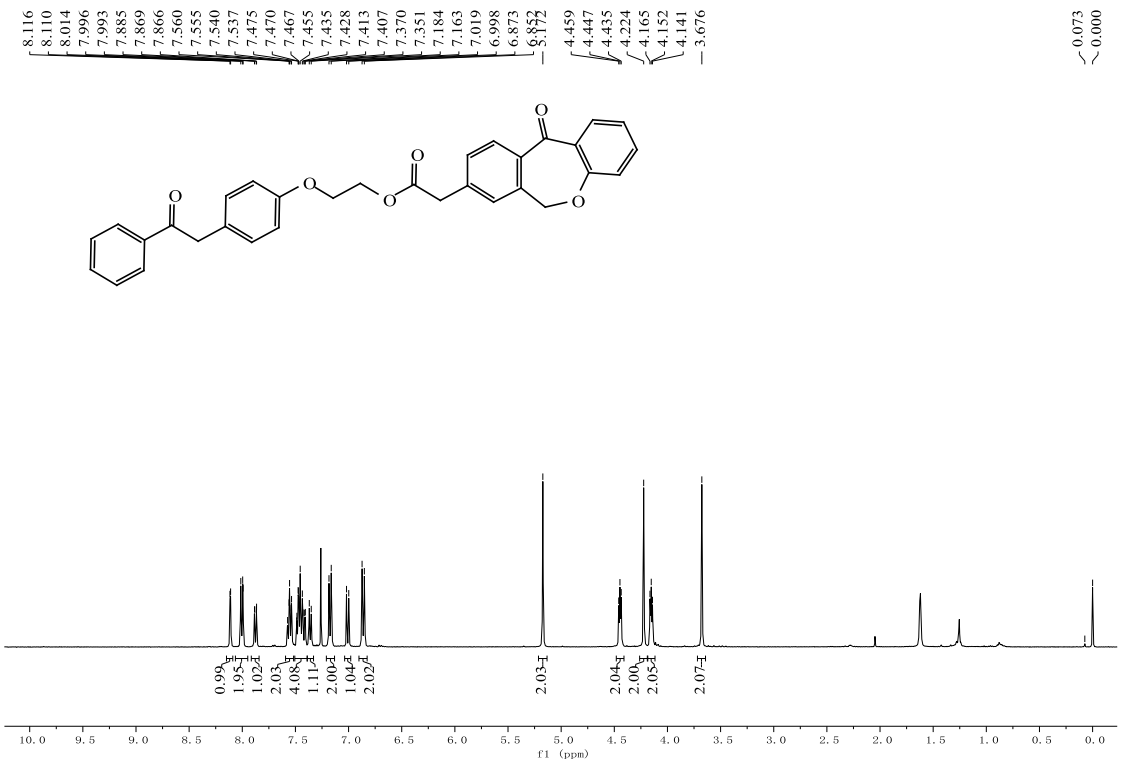
(7ac)

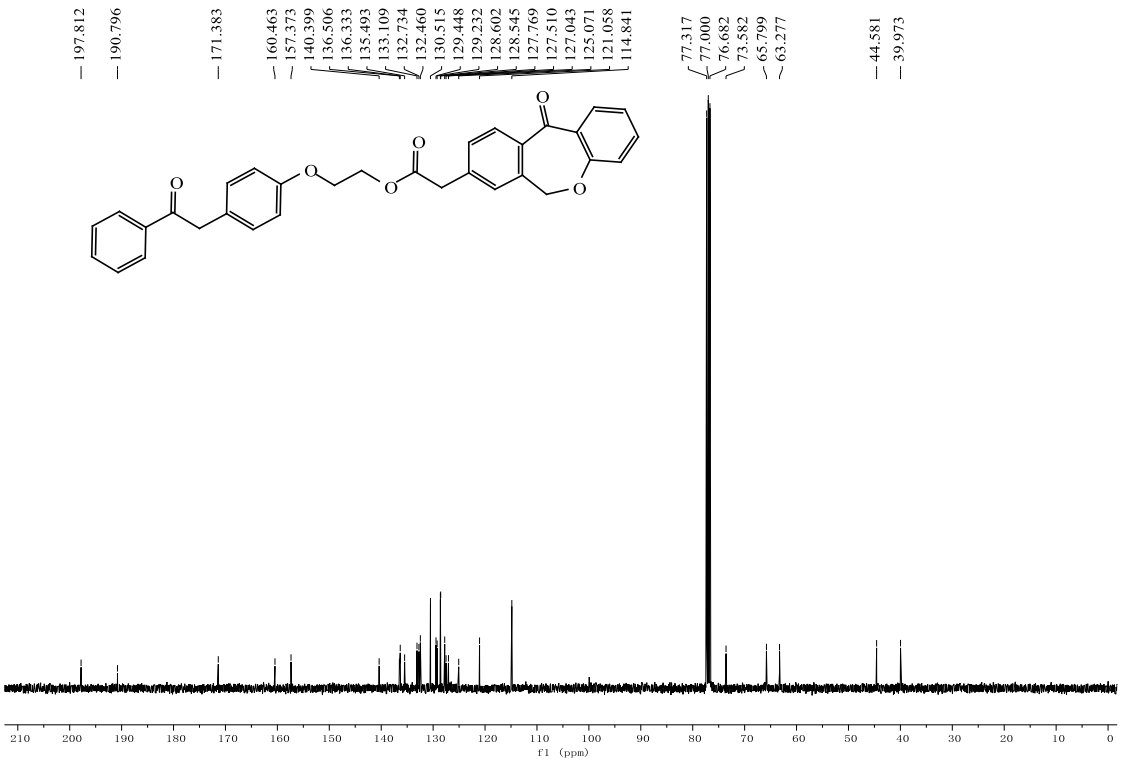




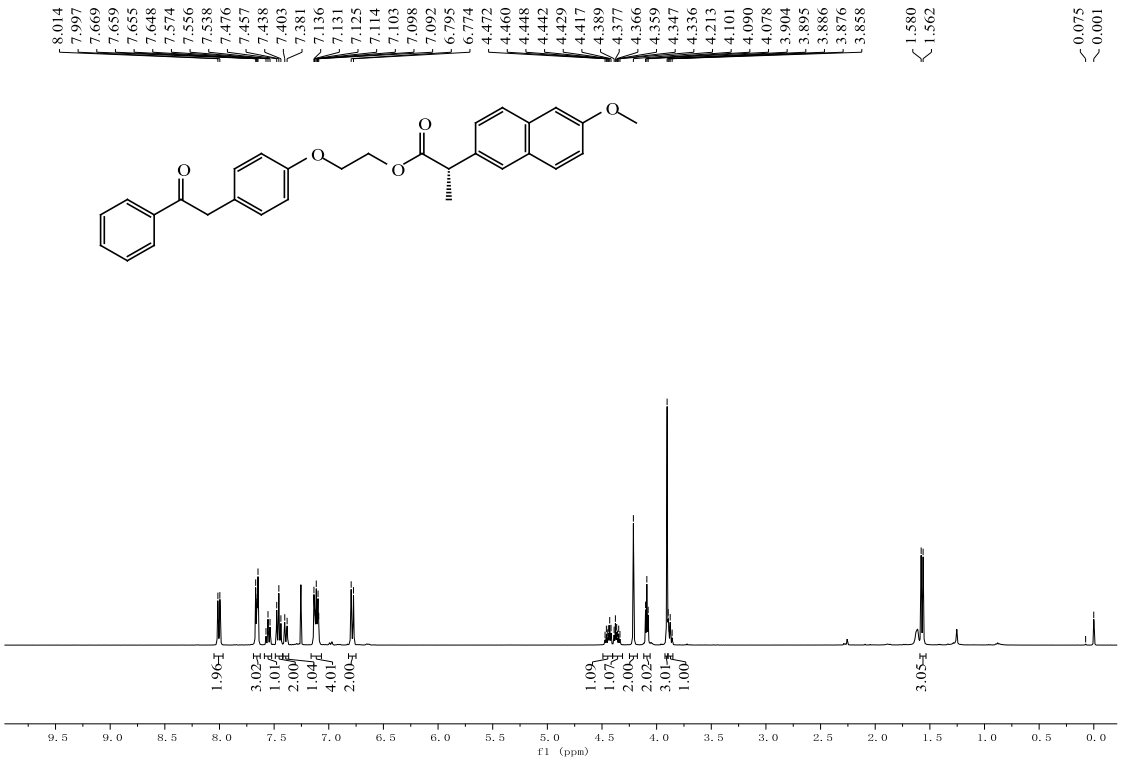
2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(11-oxo-6,11-dihydrodibenzo[b,e]oxepin-8-yl)acetate

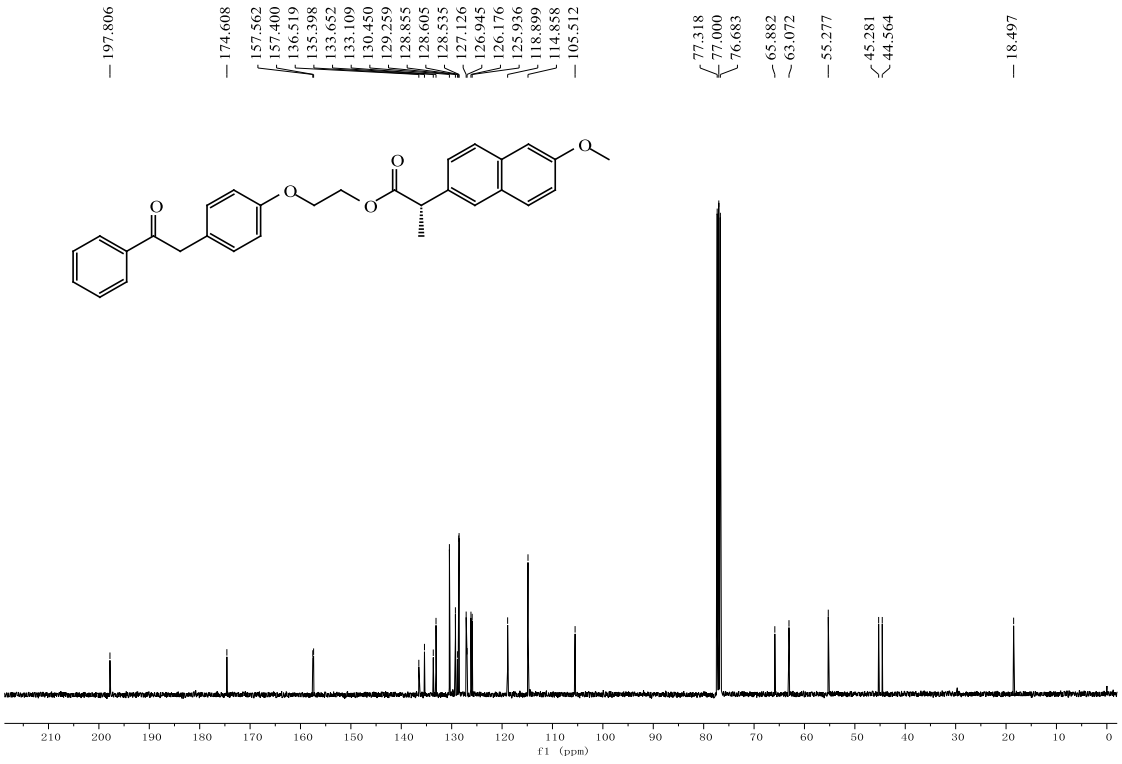
(7ad)





2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl (*S*)-2-(6-methoxynaphthalen-2-yl)propanoate (7ae)





2-(4-(2-Oxo-2-phenylethyl)phenoxy)ethyl 2-(1-(4-chlorobenzoyl)-5-methoxy-2-methyl-1H-indol-3-yl)acetate (7af)