Pd-Catalysed Decarboxylative Suzuki Reactions and Orthogonal Cu-based *O*-Arylation of Aromatic Carboxylic Acids

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Supporting Information

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1. General Information…….....

a. Materials

All reactions were carried out in oven-dried vials. The solvents, i.e. DMSO, NMP, DMF, DMAc, diglyme, were bought from Sigma-Aldrich (Sealed under argon) without further purification. All benzoic acids were purchased from Alfa Aesar, TCI or Sigma-Aldrich. All aryl boronic acids were purchased from Alfa Aesar, J&K or Sigma-Aldrich and used directly. All Ag and Cu salts were bought from Sigma-Aldrich, Strem, or Alfa Aesar. All the other reagents and solvents were bought from Sinopharm Chemical Reagent Co. Ltd or Alfa Aesar and were purified when necessary.

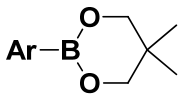
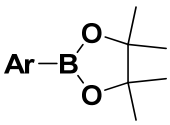
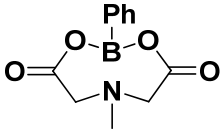
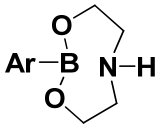
b. Methods

^{1}H-NMR, ^{13}C-NMR, ^{19}F-NMR spectra were recorded on a Bruker Advance 400 spectrometer at ambient temperature in $CDCl_3$ unless otherwise noted. Data for ^{1}H-NMR are reported as follows: chemical shift (δ ppm), multiplicity, integration, and coupling constant (Hz). Data for ^{13}C-NMR are reported in terms of chemical shift (δ ppm). Data for ^{19}F-NMR are reported as follows: chemical shift (δ ppm), multiplicity, integration, and coupling constant (Hz). Gas chromatographic (GC) analysis was acquired on a Shimadzu GC-2014 Series GC System equipped with a flame-ionization detector. GC-MS analysis was performed on Thermo Scientific AS 3000 Series GC-MS System. High-resolution mass spectra (HRMS) were recorded on a BRUKER VPEXII spectrometer with EI mode. Elementary analysis was carried out on Elementar Vario EL III elemental analyzer. Organic solutions were concentrated under reduced pressure on a Buchi rotary evaporator. Flash column chromatographic purification of products was accomplished using forced-flow chromatography on Silica Gel (200-300 mesh).

2. Experimental Section…….

a. Synthesis of the arylboron reagents.

Table S1

	Sylvain Darses; Guillaume Michaud; Jean-Pierre Geneˆt *Eur. J. Org. Chem.,* **1999**,1875.
	Franklin A.Davis; Ignatius J.Turchi; Bruce E.Maryanoff; Robert O.Hutchins *J. Org. Che*m*.,* **1972**, *37*, 1583.
	H. G. Kuivila; A. H. Keough, E. J. Soboczenski *J. Org. Chem.,* **1954**, *19*, 780.
	Eric P. Gillis; Martin D. Burke *J. Am. Chem. Soc.,* **2007**, *129*, 6716.
	Robert L. Letsinger; Ivan Skoog *J. Am. Chem. Soc.,* **1955**, *77*, 2491.

b. Preparation of the catalyst:

Preparation of palladium (II) trifluoroacetate:

A 50 ml oven-dried flask was charged with $Pd(OAc)_2$ (1.0 g, 4.46 mmol). 25 ml trifluoroacetatic acid was added. The mixture was stirred and heated to reflux (at 90 °C) in an oil bath. A gray-brown solid was formed as the mixture was heated. The solid was isolated by filtration and washed with trifluoroacetic acid (*ca.* 10 ml). The residue was dried under vacuum at 40°C for 3 h offering a brownish powder.
Reference: Daniel P. Bancroft; F. Albert Cotton; Mark Verbruggen *Acta Cryst.* **1989**, *C45*, 1289.

Preparation of bis(acetonitrile) palladium (II) *p*-toluenesulfonate:

To a clear dark orange solution of $Pd(OAc)_2$ (0.33 g, 1.47 mmol) in acetonitrile (30 ml) a solution of *p*-toluenesulfonic acid (1.5 g, 7.9 mmol) in acetonitrile (40 ml) was added dropwise with stirring. The color gradually changed to pale yellow. Subsequently diethyl ether (50 ml) was added, and this resulted in precipitation of fine pale yellow microcrystals. The suspension was set aside over night and the supematent liquid was decanted. The crystals were washed with diethyl ether, dried under a slight vacuum, and shown to be $Pd(MeCN)_2(OTs)_2$.
Reference: E. Drent; J. A. M. van Broekhoven; M. J. Doyle *J. Organomet. Chem.,* **1991**, *417*, 235.

Preparation of bis(acetonitrile)dichloropalladium(II):

A suspension of $PdCl_2$ (1.00 g, 5.65 mmol) was heated to reflux in CH_3CN (50 ml) with vigorous stirring for 10 h under N_2. Hot filtration of the resultant wine-red coloured solution through a ceolite pad into stirred petroleum spirit (40–60 ^oC) at room temperature afforded a yellow-orange solid. Recrystallisation from CH_3CN (100 ml), DCM (150 ml) and hexane (50 ml) gave $(CH_3CN)_2PdCl_2$ as a bright yellow powdery solid.

Reference: Mathews, Christopher J.; Smith, Paul J.; Welton, Tom *J. Mol. Catal. A Chem.*, **2003**, *206*, 77.

c. Optimization of the reaction conditions:

General Procedure:

A 10ml oven-dried vial was charged with $Pd(TFA)_2$ (0.04 mmol), Ag_2CO_3 (0.6 mmol), 2,4,6-trimethoxybenzoic acid (0.2 mmol), benzeneboronic acid (0.4 mmol). DMSO (1.0 ml) was added by syringe at room temperature. The vial was then sealed and the mixture was allowed to stir at the appointed temperature (120 ± 5 °C) for 2 h. Upon completion of the reaction, the mixture was cooled to room temperature and diluted with ethyl acetate, and analyzed by gas chromatography.

STable2
Decarboxylative Suzuki coupling between 2,4,6-trimethoxybenzoic acid and organoboron reagents[a].

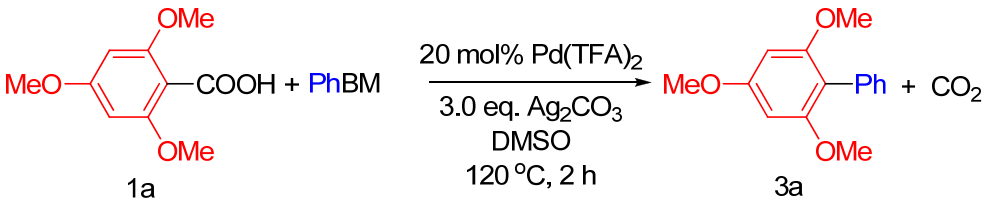
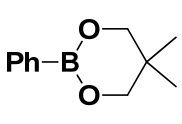
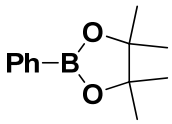
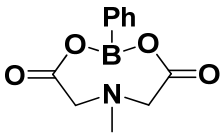
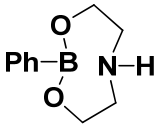


Table S2

PhBM	**$PhB(OH)_2$**	**$PhBF_3K$**				
Yield[%][b]	96	95	86	60	6	10

[a] Condition for this transformation: 0.2 mmol of, 0.4 mmol of benzeneboronic acid, 20% mol of catalyst, 3.0 equiv.Ag_2CO_3, 1ml DMSO, 120°C, 2 h. GC yields were determined with the use of benzophenone as an internal standard. [b]Yields were based on 2,4,5-trimethoxybenzoic acid.

STable 3

Various conditions towards the decarboxylative cross-coupling between 2,4,6-trimethoxybenzoic acid and benzeneboronic acid[a]

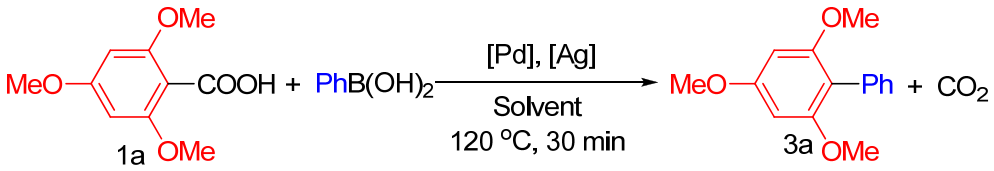


Table S3

Entry	Pd Source	Ag Source	Solvent	Yield [%][b]
1	$Pd(TFA)_2$	Ag_2CO_3	DMF	10
2	$Pd(TFA)_2$	Ag_2CO_3	NMP	trace
3	$Pd(TFA)_2$	Ag_2CO_3	DMSO:DMF=1:9	69
4	$Pd(TFA)_2$	Ag_2CO_3	DMSO:NMP=1:9	80
5	$Pd(OAc)_2$	Ag_2CO_3	DMSO	51
6	$PdCl_2$	Ag_2CO_3	DMSO	53
7	$Pd(CH_3CN)_2Cl_2$	Ag_2CO_3	DMSO	54
8	**$Pd(TFA)_2$**	**Ag_2CO_3**	**DMSO**	**96**
9[c]	$Pd(TFA)_2$	Ag_2CO_3	DMSO	95
10[d]	$Pd(TFA)_2$	Ag_2CO_3	DMSO	61
11[e]	$Pd(TFA)_2$	Ag_2CO_3	DMSO	35
12	/	Ag_2CO_3	DMSO	0
13	$Pd(TFA)_2$	/	DMSO	trace
14	$Pd(CH_3CN)_4(BF4)_2$	Ag_2CO_3	DMSO	74
15	$Pd(CH_3CN)_2(OTS)_2$	Ag_2CO_3	DMSO	61
16	$Pd(TFA)_2$	Ag_3PO_4	DMSO	36
17	$Pd(TFA)_2$	Ag_2O	DMSO	79
18	$Pd(TFA)_2$	AgOAc	DMSO	22
19	$Pd(TFA)_2$	AgTFA	DMSO	7
20	$Pd(TFA)_2$	AgF_2	DMSO	53
21	$Pd(TFA)_2$	AgOTs	DMSO	5
22	$Pd(TFA)_2$	AgOMs	DMSO	4
23	$Pd(TFA)_2$	Ag_2SO_4	DMSO	6
24	$Pd(TFA)_2$	$AgBF_4$	DMSO	26
25	$Pd(TFA)_2$	$AgNO_3$	DMSO	16

[a]Condition for this transformation: 0.2 mmol of 2,4,6-trimethoxybenzoic acid, 0.4 mmol of benzeneboronic acid, 20% mol of catalyst, 3.0 equiv. [Ag], 1ml of solvent, 120°C, 30 min. GC yields were determined with the use of benzophenone as an internal standard. [b]Yields were based on 2,4,5-trimethoxybenzoic acid. [c] 10min. [d] 10 mol% $Pd(TFA)_2$. [e] 5 mol% $Pd(TFA)_2$.

d. General Procedure for Pd-catalysed decarboxylative Suzuki cross-coupling:

General procedure :

Palladium(II) trifluoroacetate (0.04 mmol), Ag_2CO_3 (0.6 mmol), benzoic acid (0.2 mmol) and the aryl boronic reagent (0.4 mmol) were placed in an oven-dried 10 ml vial. Then DMSO (1 ml) was added with a syringe. The vial was sealed and stirred at 120±5°C for the appointed time. Upon completion of the reaction, the mixture was cooled to room temperature and diluted with diethyl ether (30 ml). It was then filtered through a short silica column to remove the deposition. The organic layers were washed with water (50 ml×2), and then with brine, dried over $MgSO_4$, and filtered. The solvents were removed. Purification of the residue by column chromatography (silica gel, ethyl acetate/petroleum ether) yielded the desired product.

STable 4

Various conditions towards the Cu-catalysed cross-coupling between 2,4,6-trimethoxybenzoic acid and benzeneboronic acid[a]

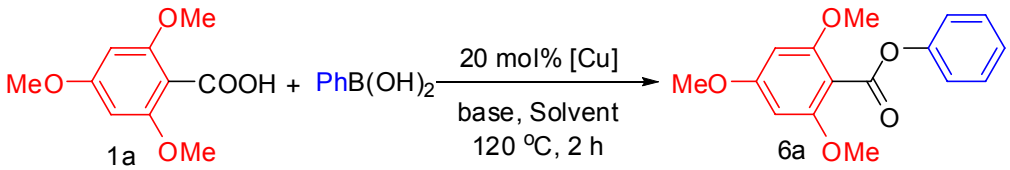


Table S4

Entry	Cu Source	Base	Solvent	Yield [%][b]
1[c]	CuF_2	Ag_2CO_3	DMSO	87
2	CuF_2	Ag_2CO_3	DMSO	35
3	$Cu(OAc)_2$	Ag_2CO_3	DMSO	78
4	$CuCl_2$	Ag_2CO_3	DMSO	82
5	CuI	Ag_2CO_3	DMSO	85
6	**$Cu(OTf)_2$**	**Ag_2CO_3**	**DMSO**	**93**
7	/	Ag_2CO_3	DMSO	0
8	$Cu(OTf)_2$	/	DMSO	trace
9	$Cu(OTf)_2$	AgOAc	DMSO	16
10	$Cu(OTf)_2$	AgOTs	DMSO	trace
11	$Cu(OTf)_2$	Ag_2O	DMSO	77
12	$Cu(OTf)_2$	Ag_2CO_3	DMF	74
13	$Cu(OTf)_2$	Ag_2CO_3	NMP	61
14	$Cu(OTf)_2$	Ag_2CO_3	Toluene	10
15	$Cu(OTf)_2$	Ag_2CO_3	Diglyme	0
16	$Cu(OTf)_2$	Ag_2CO_3	DMAc	75
17[d]	$Cu(OTf)_2$	K_2CO_3	DMSO	trace
18[d]	$Cu(OTf)_2$	Na_2CO_3	DMSO	trace
19[d]	$Cu(OTf)_2$	Prydine	DMSO	36

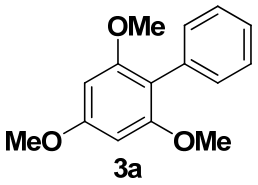
[a] Condition for this transformation: 0.2 mmol of 2,4,6-trimethoxybenzoic acid, 0.4 mmol of benzeneboronic acid, 20% mol of catalyst, 2.0 equiv. base, 1ml of solvent, 120°C, 2 h. GC yields were determined with the use of benzophenone as an internal standard. [b] Yields were based on 2,4,5-trimethoxybenzoic acid. [c] 1.0 eq. CuF2. [d] 200 mg 4Å MS,1 atm O_2 as the oxidant.

e. General procedure for the Cu-catalysed *O*-arylation of aromatic carboxylic acids

General procedure :

Copper(II) trifluoromethanesulfonate (0.04 mmol), Ag_2CO_3 (0.4 mmol), benzoic acid (0.2 mmol) and the aryl boronic acid (0.4 mmol) were placed in an oven-dried 10 ml vial. Then DMSO (1 ml) was added with a syringe. The vial was sealed and stirred at 120±5°C for the appointed time. Upon completion of the reaction, the mixture was cooled to room temperature and diluted with diethyl ether (30 ml). It was then filtered through a short silica column to remove the deposition. The organic layers were washed with water (50 ml×2), and then with brine, dried over $MgSO_4$, and filtered. The solvents were removed. Purification of the residue by column chromatography (silica gel, ethyl acetate/petroleum ether) yielded the desired product.

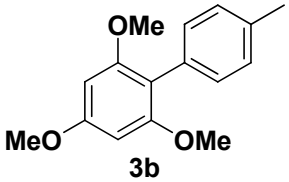
3. Characterization of the Products…….



3a

2,4,6-trimethoxybiphenyl (3a). Spectral data corresponds to that previously reported. Colorless solid (45 mg, 92% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.71 (s, 6H), 3.86 (s, 3H), 6.23 (s, 2H), 7.33 (m, 5H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.39, 55.90, 90.99, 112.62, 126.49, 127.63, 131.22, 134.14, 158.39, 160.53.

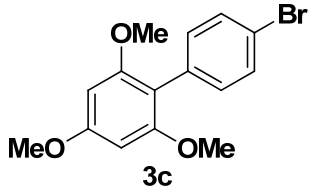
Reference: Ikuya Ban; Tomoko Sudo; Tadashi Taniguchi; Kenichiro Itami *Org. Lett.* **2008**, *10*, 3607.



3b

2,4,6-trimethoxy-4'-methylbiphenyl (3b). Spectral data corresponds to that previously reported. Colorless solid (45 mg, 87% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.36 (s, 3H), 3.69 (s, 6H), 3.84 (s, 3H), 6.22 (s, 2H), 7.17-7.23 (m, 4H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 21.39, 55.41, 55.92, 91.00, 112.54, 128.54, 128.91, 131.07, 136.04, 158.49, 160.45.

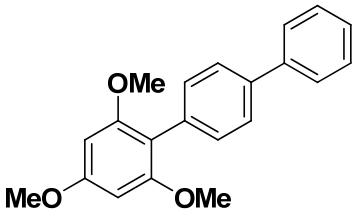
Reference: Ikuya Ban; Tomoko Sudo; Tadashi Taniguchi; Kenichiro Itami *Org. Lett.* **2008**, *10*, 3607.



3c

4'-bromo-2,4,6-trimethoxybiphenyl (3c). Spectral data corresponds to that previously reported. Colorless solid (61 mg, 95% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.72 (s, 6H), 3.86 (s, 3H), 6.22 (s, 2H), 7.20 (d, 2H, ***J***=8.0 Hz), 7.48 (d, 2H, ***J***=8.0 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$): δ 55.40, 55.85, 90.94, 111.21, 120.50, 130.79, 133.00, 133.06, 158.22, 160.82.

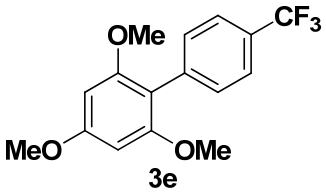
Reference: Ikuya Ban; Tomoko Sudo; Tadashi Taniguchi; Kenichiro Itami *Org. Lett.* **2008**, *10*, 3607.



3d

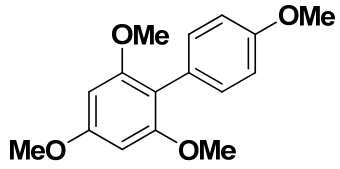
4'-phenyl-2,4,6-trimethoxybiphenyl (3d). Colorless solid (64 mg, 94% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.74 (s, 6H), 3.87 (s, 3H), 6.25 (s, 2H), 7.32 (m, 1H), 7.43 (m, 4H), 7.62 (m, 4H). ^{13}C-NMR (100 MHz, $CDCl_3$): δ 55.42, 55.95, 91.02, 112.07, 126.45, 126.98, 127.18, 128.67, 131.64,

133.17, 139.18, 141.39, 158.46, 160.63. HRMS (EI) calcd for $C_{21}H_{20}O_3$: 320.1412; found: 320.1407.



3e

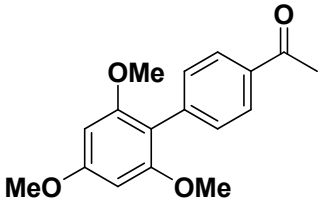
2,4,6-trimethoxy-4'-(trifluoromethyl)biphenyl (3e). Colorless solid (56 mg, 89% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.71 (s, 6H), 3.85 (s, 3H), 6.23 (s, 2H), 7.44 (d, 2H, ***J***=8.0 Hz), 7.60 (d, 2H, ***J***=8.0 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.40, 55.83, 90.96, 111.05, 124.47(q, ***J***=3.5 Hz), 124.57(q, ***J***=271 Hz, CF_3), 128.32(q, ***J***=32.1 Hz), 131.67, 138.20(d, ***J***=1.4 Hz), 158.30, 161.17. ^{19}F-NMR(377 MHz, $CDCl_3$): δ -62.29 (s). HRMS (EI) m/z calcd for $C_{16}H_{15}F_3O_3$: 312.0973; found: 312.0914.



3f

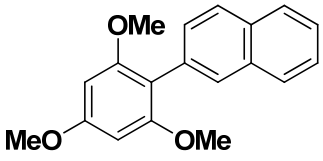
2,4,4',6-tetramethoxybiphenyl (3f). Spectral data corresponds to that previously reported. Colorless solid (40 mg, 72% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.72 (s, 6H), 3.83 (s, 3H), 3.86 (s, 3H), 6.22 (S, 2H), 6.93 (d, 2H, ***J***=8.8Hz), 7.26 (d, 2H, ***J***=8.8Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.13, 55.39, 55.91, 90.89, 112.05, 113.25, 126.14, 132.20, 158.12, 158.43, 160.28.

Reference: Jean-Michel Becht; Cedric Catala; Claude Le Drian; Alain Wagner *Org. Lett.* **2007**, *9*, 1781.



3g

1-(2',4',6'-trimethoxybiphenyl-4-yl)ethanone (3g). Colorless solid (48 mg, 84% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.61 (s, 3H), 3.72 (s, 6H), 3.87 (s, 3H), 6.23 (s, 2H), 7.44 (m, 2H, ***J***=8.4 Hz), 7.97 (m, 2H, ***J***=8.4Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 26.57, 55.42, 55.87, 90.95, 111.32, 127.69, 131.56, 135.14, 139.78, 158.27, 161.14, 197.98. HRMS (EI) m/z calcd for $C_{17}H_{18}O_4$: 286.1205; found: 286.1198.

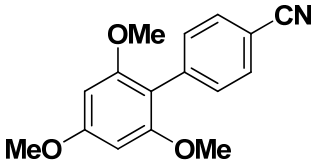


3h

2-(2,4,6-trimethoxyphenyl)naphthalene (3h). Spectral data corresponds to that previously reported. Colorless solid (54 mg, 92% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.78 (s, 6H), 3.94 (s, 3H), 6.34 (s, 2H), 7.53 (m, 3H), 7.90 (m, 4H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.44, 55.96, 91.15, 112.57, 125.48, 125.53, 126.86, 127.68, 128.10, 128.90, 129.84, 129.99, 130.96, 131.80, 132.40, 133.43, 158.62,

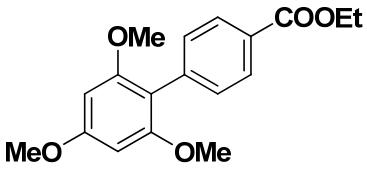
160.74. HRMS (EI) m/z calcd for $C_{17}H_{18}O_4$: 294.1256; found: 294.1263.

Reference: Ikuya Ban; Tomoko Sudo; Tadashi Taniguchi; Kenichiro Itami *Org. Lett.* **2008**, *10*, 3607.



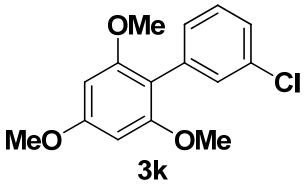
3i

2',4',6'-trimethoxybiphenyl-4-carbonitrile (3i). Colorless solid (39 mg, 72% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.72 (s, 6H), 3.86 (s, 3H), 6.22 (S, 2H), 7.44 (m, 2H, ***J***=8.8 Hz), 7.63 (m, 2H, ***J***=8.8 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.45, 55.82, 90.93, 109.82, 110.50, 119.49, 131.29, 132.20, 139.61, 158.15, 161.47. HRMS (EI) m/z calcd for $C_{16}H_{15}NO_3$: 269.1052; found: 269.1021.



3j

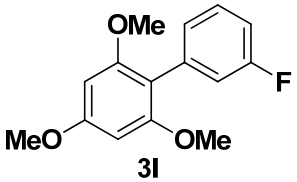
Ethyl 2',4',6'-trimethoxybiphenyl-4-carboxylate (3j). Colorless solid (51 mg, 81% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.39 (t, 3H, ***J***=7.2 Hz), 3.72 (s, 6H), 3.86 (s, 3H), 4.38 (q, 2H, ***J***=7.2 Hz), 6.23 (S, 2H), 7.40 (d, 2H, ***J***=8.4 Hz), 8.05 (d, 2H, ***J***=8.4 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 14.40, 55.40, 55.85, 60.68, 90.96, 111.55, 128.40, 128.83, 131.31, 139.34, 158.28, 161.03, 166.80. HRMS (EI) m/z calcd for $C_{18}H_{20}O_5$: 316.1311; found: 316.1292.



3k

3'-chloro-2,4,6-trimethoxybiphenyl (3k). Spectral data corresponds to that previously reported. Colorless solid (47 mg, 85% yield). ^{1}H-NMR (400 MHz, $CDCl_3$): δ 3.72 (s, 6H), 3.86 (s, 3H), 6.21 (s, 2H), 7.26 (m, 4H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.41, 55.87, 90.81, 111.04, 126.58, 128.78, 129.53, 131.35, 133.34, 136.0, 158.27, 160.92.

Reference: Ikuya Ban; Tomoko Sudo; Tadashi Taniguchi; Kenichiro Itami *Org. Lett.* **2008**, *10*, 3607.

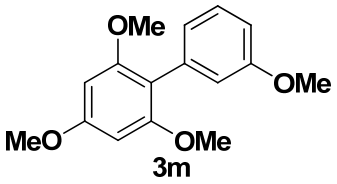


3l

3'-fluoro-2,4,6-trimethoxybiphenyl (3l). Spectral data corresponds to that previously reported. Colorless solid (51 mg, 97% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.73 (s, 6H), 3.86 (s, 3H), 6.22 (s, 2H), 6.97 (t, 1H, ***J***=8.4Hz), 7.05 (d, 1H, ***J***=10.0Hz), 7.10 (d, 1H, ***J***=7.6Hz), 7.32 (m, 1H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.41, 55.87, 90.82, 111.19, 113.33 (d, ***J***=21 Hz), 118.22 (d, ***J***=21

Hz), 126.99 (d, ***J***=2.5 Hz), 128.81 (d, ***J***=8.1 Hz), 136.29 (d, ***J***=8.6 Hz), 158.26, 160.85, 162.40 (d, ***J***=239.1 Hz). ^{19}F-NMR (377 MHz, $CDCl_3$): δ -115 (s, 1F).

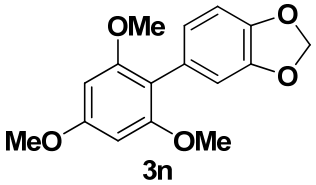
Reference: Ikuya Ban; Tomoko Sudo; Tadashi Taniguchi; Kenichiro Itami *Org. Lett.* **2008**, *10*, 3607.



3m

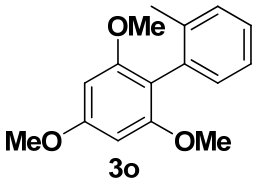
2,3',4,6-tetramethoxybiphenyl (3m). Spectral data corresponds to that previously reported. Colorless solid (40 mg, 73% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.72 (s, 6H), 3.81 (s, 3H), 3.86 (s, 3H), 6.22 (s, 2H), 6.84 (ddd, 1H, J_1=8.4 Hz, J_2=2.8 Hz, J_3=0.8 Hz), 6.88 (m, 1H), 6.91 (m, 1H), 7.30 (t, 1H, ***J***=8.0 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.14, 55.39, 55.92, 90.97, 112.1, 112.44, 117.01, 123.73, 128.47, 135.49, 158.40, 158.98, 160.58.

Reference: Ikuya Ban; Tomoko Sudo; Tadashi Taniguchi; Kenichiro Itami *Org. Lett.* **2008**, *10*, 3607.



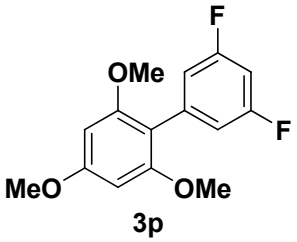
3n

5-(2,4,6-trimethoxyphenyl)benzo[d][1,3]dioxole (3n). Colorless solid (40 mg, 70% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.73 (s, 6H), 3.85 (s, 3H), 5.96 (s, 2H), 6.22 (s, 2H), 6.81(m, 3H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.38, 55.92, 90.97, 100.80, 107.89, 111.81, 112.12, 124.44, 127.54, 146.11, 147.0, 158.47, 160.43. HRMS (EI) m/z calcd for $C_{16}H_{16}O_5$: 288.0998; found: 288.0918.



3o

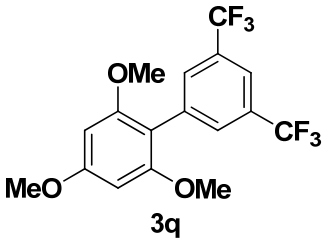
2,4,6-trimethoxy-2'-methylbiphenyl (3o). Colorless solid (17 mg, 32% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.07 (s, 3H), 3.69 (s, 3H), 3.86 (s, 3H), 6.22 (s, 2H), 7.11 (m, 1H), 7.21 (m, 3H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 19.77, 55.36, 55.83, 90.75, 111.87, 125.19, 127.08, 129.51, 131.29, 134.16, 137.81, 158.34, 160.64. HRMS (EI) m/z calcd for $C_{16}H_{18}O_3$: 258.1256; found: 258.1222.



3p

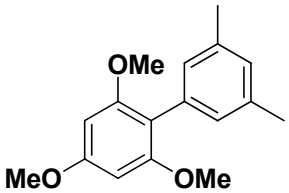
3',5'-difluoro-2,4,6-trimethoxybiphenyl (3p). Colorless solid (48 mg, 85% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.74 (s, 6H), 3.86 (s, 3H), 5.99 (s, 2H), 6.21 (s, 2H), 6.72 (m, 1H), 6.86 (m, 2H).

^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.41, 55.84, 90.79, 101.85 (t, ***J***=25 Hz), 110.19 (t, ***J***=2.2 Hz), 114.18 (q, ***J***=5.5 Hz), 137.39 (t, ***J***=9.9 Hz), 158.15, 161.17 (t, ***J***=5.7 Hz), 163.60 (d, ***J***=13.2 Hz). ^{19}F-NMR (377 MHz, $CDCl_3$): δ -112(s). HRMS (EI) m/z calcd for $C_{15}H_{14}F_2O_3$: 280.0911; found: 280.0893.



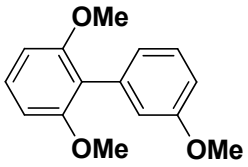
3q

2,4,6-trimethoxy-3',5'-bis(trifluoromethyl)biphenyl (3q). Colorless solid (71 mg, 93% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.74 (s, 6H), 3.86 (s, 3H), 5.99 (s, 2H), 6.21 (s, 2H), 6.72 (m, 1H), 6.86 (m, 2H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.45, 55.79, 90.83, 109.25, 120.05 (m), 123.73 (q, ***J***=273.2 Hz), 130.57 (q, ***J***=31.8 Hz), 131.695 (d, ***J***=3.0 Hz), 136.26, 158.19, 161.65. ^{19}F-NMR (377 MHz, $CDCl_3$): δ -62.7(s). HRMS (EI) m/z calcd for $C_{17}H_{14}F_6O_3$: 380.0847; found: 380.0842.



3r

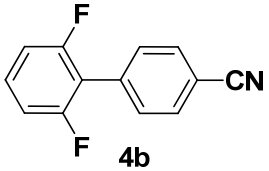
2,4,6-trimethoxy-3',5'-dimethylbiphenyl (3r). Colorless solid (51 mg, 95% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.33 (s, 6H), 3.70 (s, 6H), 3.84 (s, 3H), 6.21 (s, 2H), 6.92 (s, 3H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 21.50, 55.40, 55.95, 90.95, 112.86, 128.58, 128.98, 133.93, 136.93, 158.48, 160.43. HRMS (EI) m/z calcd for $C_{17}H_{20}O_3$: 272.1412; found: 272.1408.



4a

2,3',6-trimethoxybiphenyl (4a). Spectral data corresponds to that previously reported**.** Colorless solid (26% and 91% yield respectively). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.73 (s, 6H), 3.81 (s, 3H), 6.65 (d, 2H, ***J***=8.8 Hz), 6.90 (m, 3H), 7.29 (m, 2H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.16, 55.96, 104.23, 112.38, 116.69, 119.45, 123.39, 128.58, 128.73, 135.52, 157.73, 159.03.

Reference: Jean-Michel Becht; Arnaud Gissot; Alain Wagner; Charles Mioskowski. *Chem. Eur. J.* **2003**, *9*, 3209.

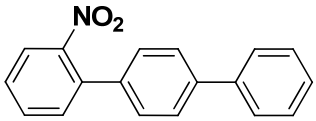


4b

2',6'-difluorobiphenyl-4-carbonitrile (4b). Spectral data corresponds to that previously reported**.** Colorless solid (13% and 67% yield respectively). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.76 (s, 6H), 6.67 (d, 2H, ***J***=8.0 Hz), 6.99-7.05 (m, 1H), 7.07-7.11 (m, 1H), 7.13-7.16 (m, 1H), 7.31 (t, 1H, ***J***=8.0 Hz),

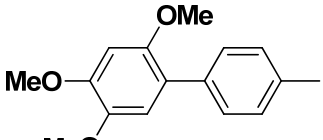
7.36-7.39(m, 1H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 111.96 (q, ***J***=19.6 Hz), 116.72 (t, ***J***=18.5 Hz), 118.62, 130.25 (t, ***J***=9.9 Hz), 131.13 (t, ***J***=1.2 Hz), 132.01, 134.10, 158.57 (d, ***J***=6.3 Hz), 161.05 (d, ***J***=6.5 Hz). ^{19}F-NMR (377 MHz, $CDCl_3$): δ -114.34 (s, 2F).

Reference: Rui Shang; Yao Fu; Yan Wang; Qing Xu; Hai-Zhu Yu; Lei Liu *Angew. Chem. Int. Ed.* **2009**, *48*, 9350.



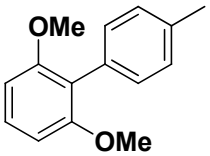
4c

4'-phenyl-2-nitrobiphenyl (4c). Yellow solid (15% and 64% yield respectively). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.38 (m, 3H), 7.47 (m, 4H), 7.64 (m, 5H), 7.87 (m, 1H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 124.17, 127.17, 127.45, 127.61, 128.21, 128.37, 128.86, 131.98, 132.32, 136.02, 136.29, 140.42, 141.17, 149.37. HRMS (EI) m/z calcd for $C_{18}H_{13}NO_2$: 275.0946; found: 275.0914.



5a

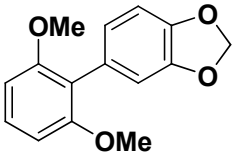
2,4,5-trimethoxy-4'-methylbiphenyl (5a). Colorless solid (34 mg, 65% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.42 (s, 3H), 3.79 (s, 3H), 3.90 (s, 3H), 3.97 (s, 3H), 6.66 (s, 1H), 6.91 (s, 1H), 7.25 (d, 2H, ***J***=7.6 Hz), 7.44 (d, 2H, ***J***=7.2 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 21.21, 56.21, 56.59, 56.76, 98.45, 114.49, 122.47, 128.86, 129.28, 135.46, 136.36, 143.29, 148.79, 150.75. HRMS (EI) m/z calcd for $C_{16}H_{18}O_3$: 258.1256; found: 258.1207.



5b

2,6-dimethoxy-4'-methylbiphenyl (5b). Spectral data corresponds to that previously reported. Colorless solid (33 mg, 73% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.38 (s, 3H), 3.72 (s, 6H), 6.64 (d, 2H, ***J***=8.8 Hz), 7.23 (m, 5H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 21.41, 55.94, 104.26, 106.24, 128.47, 128.56, 130.77, 131.08, 136.33, 157.83.

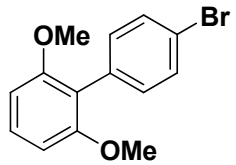
Reference: Gupta, Arun Kumar; Rim, Chul Yun; Oh, Chang Ho. *Synlett* **2004**, *12*, 2227.



5c

5-(2,6-dimethoxyphenyl)benzo[d][1,3]dioxole (5c). Spectral data corresponds to that previously reported. Colorless solid (42 mg, 81% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.73 (s, 6H), 5.96 (s, 2H), 6.63 (d, 2H, ***J***=8.8 Hz), 6.83(m, 3H), 7.25(t, 3H, ***J***=8.2 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.97, 100.87, 104.24, 107.96, 111.58, 119.16, 124.23, 127.52, 128.55, 146.35, 147.08, 157.84.

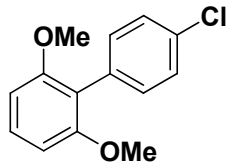
Reference: Jean-Michel Becht; Arnaud Gissot; Alain Wagner; Charles Mioskowski. *Chem. Eur. J.* **2003**, *9*, 3209.



5d

4'-bromo-2,6-dimethoxybiphenyl (5d). Colorless solid (42 mg, 72% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.73 (s, 6H), 6.64 (d, 2H, ***J***=8.4 Hz), 7.22 (d, 2H, ***J***=8.4 Hz), 7.28 (t, 1H, ***J***=8.4 Hz), 7.51 (d, 2H, ***J***=8.4 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.91, 104.24, 118.29, 120.85, 129.04, 130.86, 132.74, 133.08, 157.54.

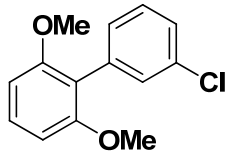
Reference: Jean-Michel Becht; Claude Le Drian *Org. Lett*., **2008**, *10*, 3161.



5e

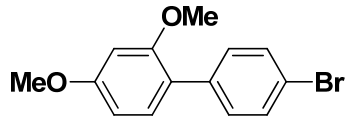
4'-chloro-2,6-dimethoxybiphenyl (5e). Spectral data corresponds to that previously reported. Colorless solid (37 mg, 76% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.73 (s, 6H), 6.65 (d, 2H, ***J***=8.4 Hz), 7.26-7.30 (m, 3H), 7.36 (d, 2H, ***J***=8.8 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.90, 104.23, 118.30, 127.92, 129.0, 132.38, 132.56, 132.60, 157.60.

Reference: Jean-Michel Becht; Cedric Catala; Claude Le Drian; Alain Wagner *Org. Lett*., **2007**, *9*, 1781.



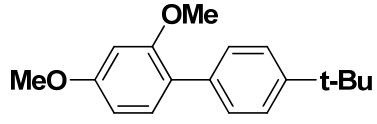
5f

3'-chloro-2,6-dimethoxybiphenyl (5f). Colorless solid (32 mg, 64% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.73 (s, 6H), 6.64 (d, 2H, ***J***=8.0 Hz), 7.21-7.34 (m, 5H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.91, 104.19, 118.16, 126.86, 128.83, 129.18, 129.24, 131.08, 133.43, 136.03, 157.59. HRMS (EI) m/z calcd for $C_{14}H_{13}O_2Cl$: 248.0604; found: 248.0598.



5g

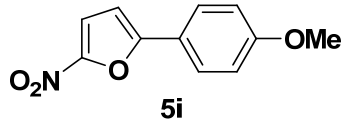
4'-bromo-2,4-dimethoxybiphenyl (5g). Colorless solid (33 mg, 57% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.79 (s, 3H), 3.84 (s, 3H), 6.55 (s, 1H), 6.56 (m, 1H), 7.36 (d, 2H, ***J***=9.2 Hz), 7.49 (d, 2H, ***J***=9.2 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.45, 55.53, 99.08, 104.79, 120.55, 122.35, 131.04, 131.08, 131.10, 137.30, 157.38, 160.63. HRMS (EI) m/z calcd for $C_{14}H_{13}BrO_2$: 292.0099; found: 292.0097.



5h

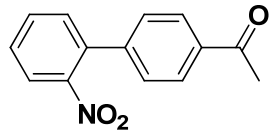
4'-tert-butyl-2,4-dimethoxybiphenyl (5h). Colorless solid (35 mg, 66% yield). ^{1}H-NMR (400 MHz,

$CDCl_3$) δ 1.27 (s, 9H), 3.71 (s, 3H), 3.76 (s, 3H), 6.47 (m, 2H), 7.17(d, 1H, ***J***=9.6 Hz), 7.35 (m, 4H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 30.37, 33.45, 54.36, 54.48, 97.93, 103.55, 122.43, 123.92, 127.99, 130.19, 134.32, 148.18, 156.47, 159.1. HRMS (EI) m/z calcd for $C_{18}H_{22}O_2$: 270.1620; found: 270.1614.



5i

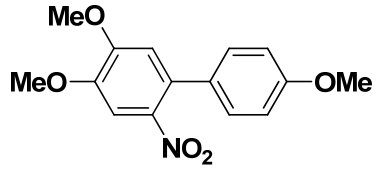
2-(4-methoxyphenyl)-5-nitrofuran (5i). Yellow solid (37 mg, 85% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.87 (s, 3H), 6.70 (d, 1H, ***J***=3.6 Hz), 6.98 (d, 2H, ***J***=8.8 Hz), 7.40 (d, 1H, ***J***=3.6 Hz), 7.74 (d, 2H, ***J***=8.8 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.47, 106.38, 114.53, 114.66, 120.68, 127.03, 157.1, 161.46, 167.72. HRMS (EI) m/z calcd for $C_{11}H_9NO_4$: 219.0532; found: 219.0454.



5j

1-(2'-nitrobiphenyl-4-yl)ethanone (5j). Spectral data corresponds to that previously reported. Yellow solid (15 mg, 32% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.64 (s, 3H), 7.43(m, 3H), 7.54 (m, 1H), 7.66 (m, 1H), 7.94 (d, 1H, ***J***=8.4 Hz), 8.02 (d, 2H, ***J***=8.4 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 26.67, 124.43, 128.25, 128.68, 128.91, 130.92, 131.74, 132.62, 135.52, 136.68, 142.35, 197.49.

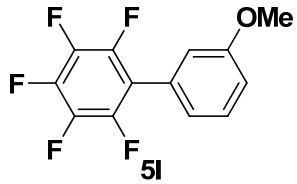
Reference: Lukas J. Goossen; Nuria Rodriguez; Bettina Melzer; Christophe Linder; Guojun Deng; Laura M. Levy. *J. Am. Chem. Soc.* **2007**, *129*, 4824.



5k

4,4',5-trimethoxy-2-nitrobiphenyl (5k). Spectral data corresponds to that previously reported. Yellow solid (26 mg, 43% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.85 (s, 3H), 3.95 (s, 3H), 3.97 (s, 3H), 6.77 (s, 1H), 6.95 (d, 2H, ***J***=8.8 Hz), 7.22 (d, 2H, ***J***=8.8 Hz), 7.51 (s, 1H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.32, 56.42, 56.45, 107.85, 113.73, 114.04, 129.25, 130.45, 130.92, 141.22, 147.86, 152.18, 159.42.

Reference: Becht, Jean-Michel; Catala, Cedric; Drian, Claude Le; Wagner, Alain *Org. Lett.* **2007**, *9*, 1781.

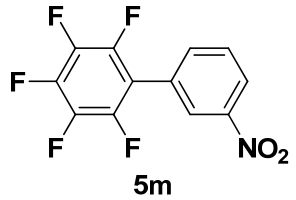


5l

2,3,4,5,6-pentafluoro-3'-methoxybiphenyl (5l). Spectral data corresponds to that previously reported. Colorless solid (39 mg, 72% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.84 (s, 3H), 6.94 (s, 1H), 6.99 (m, 1H), 7.40 (t, 1H, ***J***=8.0 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.4, 114.96, 115.95, 115.95 (dt, ***J***=4.1 Hz, ***J***=18.0 Hz), 122.56, 127.58, 129.81, 137.93 (dm, ***J***=250.4 Hz), 140.55 (dm,

J=246.8 Hz), 144.26 (dm, ***J***=246.8 Hz), 159.8. ^{19}F-NMR (377 MHz, $CDCl_3$) δ -162.29 (m, 2F), -155.63 (t, 1F, ***J***=21.5 Hz), -142.80 (dd, 2F, ***J***=23.4 Hz, ***J***=8.3 Hz).

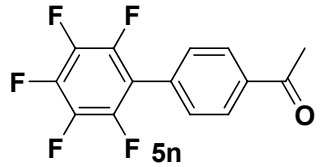
Reference: Lafrance, M.; Rowley, C. N.; Woo, T. K.; Fagnou, K. *J. Am. Chem. Soc.* **2006**, *128*, 8754.



5m

2,3,4,5,6-pentafluoro-3'-nitrobiphenyl (5m). Spectral data corresponds to that previously reported. Yellow solid (47 mg, 81% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.71 (m, 1H),7.78 (m, 1H), 8.35 (m, 2H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 113.59 (dt, ***J***=3.6 Hz, ***J***=16.9 Hz), 124.23, 125.26, 128.06, 129.89, 136.09, 138.02 (dm, ***J***=254.9 Hz), 141.26 (dm, ***J***=255 Hz), 144.16 (dm, ***J***=248.3 Hz), 148.47. ^{19}F-NMR (377 MHz, $CDCl_3$) δ -160.83 (m, 2F), -152.76 (t, 1F, ***J***=21.1 Hz), -142.84 (dd, 2F, ***J***=22.2 Hz, ***J***=8.3 Hz).

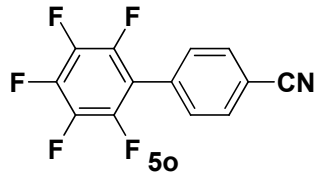
Reference: Rui Shang; Yao Fu; Yan Wang; Qing Xu; Hai-Zhu Yu; Lei Liu *Angew. Chem. Int. Ed.* **2009**, *48*, 9350.



5n

1-(2',3',4',5',6'-pentafluorobiphenyl-4-yl)ethanone (5n). Spectral data corresponds to that previously reported. Colorless solid (49 mg, 85% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.66 (s, 3H), 7.55 (d, 2H, ***J***=8.4 Hz), 8.08 (d, 2H, ***J***=8.0 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$): δ 26.61, 114.89 (dt, ***J***=4.1 Hz, ***J***=16.1 Hz), 128.56, 130.48, 131.06, 137.52, 137.93 (dm, ***J***=244.9 Hz), 140.87 (dm, ***J***=253.6 Hz), 144.09 (dm, ***J***=247.4 Hz), 197.29. ^{19}F-NMR (377 MHz, $CDCl_3$) δ -161.54 (m, 2F), -154.03 (t, 1F, ***J***=20.4 Hz), -142.78 (dd, 2F, ***J***=22.2 Hz, ***J***=8.3 Hz).

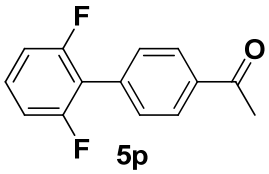
Reference: Lafrance, M.; Shore, D.; Fagnou, K. *Org. Lett.* **2006**, *8*, 5097.



5o

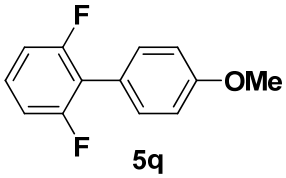
2',3',4',5',6'-pentafluorobiphenyl-4-carbonitrile (5o). Spectral data corresponds to that previously reported. Colorless solid (53 mg, 98% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.59 (d, 2H, ***J***=7.6 Hz), 7.82 (d, 2H, ***J***=7.6 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 113.46, 114.18 (dt, ***J***=3.5 Hz, ***J***=16.7 Hz), 118.15, 130.97, 131.06, 132.54, 138.08 (dm, ***J***=252.0 Hz), 141.29 (dm, ***J***=254.6 Hz), 144.14 (dm, ***J***=252.4 Hz). ^{19}F-NMR (377 MHz, $CDCl_3$) δ -161.01 (m, 2F), -152.94 (t, 1F, ***J***=21.3 Hz), -142.76 (dd, 2F, ***J***=21.9 Hz, ***J***=8.3 Hz).

Reference: Lafrance, M.; Shore, D.; Fagnou, K. *Org. Lett.* **2006**, *8*, 5097.



5p

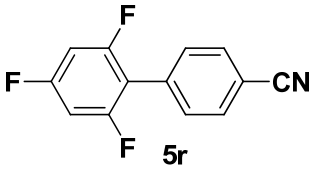
1-(2',6'-difluorobiphenyl-4-yl)ethanone (5p). Colorless solid (23 mg, 50% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.65 (s, 3H), 7.01 (m, 2H), 7.33 (m, 1H), 7.58 (d, 2H, ***J***=8.0 Hz), 8.05 (d, 2H, ***J***=8.4 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.29, 111.6 (dd, ***J***=7.4 Hz, ***J***=19.7 Hz), 117.49 (t, ***J***=19.4 Hz), 128.20, 129.71 (t, ***J***=10.0 Hz), 130.63, 134.13, 136.63, 159.98 (dd, ***J***=6.1 Hz, ***J***=247.6 Hz). ^{19}F-NMR (377 MHz, $CDCl_3$) δ -114.21 (s, 2F). HRMS (EI) m/z calcd for $C_{14}H_{10}OF_2$: 232.0700; found: 232.0643.



5q

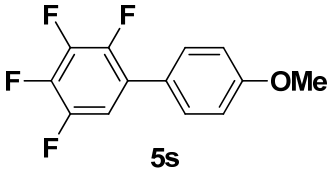
2,6-difluoro-4'-methoxybiphenyl (5q). Spectral data corresponds to that previously reported. Colorless solid (23 mg, 52% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.85 (s, 3H), 6.97 (m, 4H), 7.23 (m, 1H), 7.41 (d, 2H, ***J***=8.4 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.29, 111.6 (dd, ***J***=7.4 Hz, ***J***=19.7 Hz), 113.81, 118.19 (t, ***J***=18.4 Hz), 121.28, 128.34 (t, ***J***=10.1 Hz), 131.52, 159.49, 160.21 (dd, ***J***=7.5 Hz, ***J***=246.7 Hz). ^{19}F-NMR (377 MHz, $CDCl_3$) δ -114.77 (s, 2F).

Reference: Wei, Ye; Kan, Jian; Wang, Min; Su, Weiping; Hong, Maochun *Org. Lett.* **2009**, *11*, 3346.



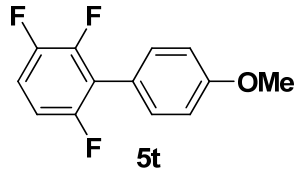
5r

2',4',6'-trifluorobiphenyl-4-carbonitrile (5r). Colorless solid (29 mg, 64% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 6.80 (m, 2H), 7.55 (m, 2H), 7.75 (m, 2H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 99.89 (m), 111.26, 117.47, 130.05, 131.11, 132.25, 157.84 (dd, ***J***=9.1 Hz, ***J***=14.7 Hz), 160.29 (m), 162.80 (t, ***J***=15.1 Hz). ^{19}F-NMR (377 MHz, $CDCl_3$) δ -111.06 (d, 2F), -106.43 (t, 1F). HRMS (EI) m/z calcd for $C_{13}H_6NF_3$: 233.0452; found: 233.0428.



5s

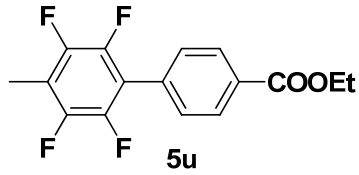
2,3,4,5-tetrafluoro-4'-methoxybiphenyl (5s). Colorless solid (35 mg, 68% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.85 (s, 3H), 6.97-7.05 (m, 3H), 7.40-7.43 (m, 2H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.36, 110.47 (dt, ***J***=3.2 Hz, ***J***=19.7 Hz), 114.31, 125.13(m), 125.39, 129.30 (d, ***J***=0.8 Hz), 139.32 (dm, ***J***=252.9 Hz), 141.25 (dm, ***J***=251.2 Hz), 144.79 (dm, ***J***=242.4 Hz), 147.04 (dm, ***J***=244.4 Hz), 160.4. ^{19}F-NMR (377 MHz, $CDCl_3$) δ -158.11 (m, 1F), -155.50 (m, 1F), -144.12 (m, 1F), -139.92 (m, 1F). HRMS (EI) m/z calcd for $C_{13}H_8FO_4$: 256.0511; found: 256.0465.



5t

2,3,6-trifluoro-4'-methoxybiphenyl (5t). Spectral data corresponds to that previously reported. Colorless solid (46 mg, 98% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.86 (s, 3H), 6.89 (m, 1H, ***J***=2.4 Hz, ***J***=3.6 Hz, ***J***=9.2 Hz), 7.00 (d, 2H, ***J***=9.2 Hz), 7.40 (m, 2H, ***J***=8.8 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 99.89 (m), 111.26, 117.47, 130.05, 131.11, 132.25, 157.84 (dd, ***J***=9.1 Hz, ***J***=14.7 Hz), 160.29 (m), 162.80 (t, ***J***=15.1 Hz). ^{19}F-NMR (377 MHz, $CDCl_3$) δ -142.20 (dd, ***J***=15.1 Hz, ***J***=21.1 Hz 1F), -138.16 (dd, ***J***=4.5 Hz, ***J***=20.7 Hz, 1F), -120.0 (dd, ***J***=4.1 Hz, ***J***=15.1 Hz, 1F). HRMS (EI) m/z calcd for $C_{13}H_9OF_3$: 238.0605; found: 238.0604.

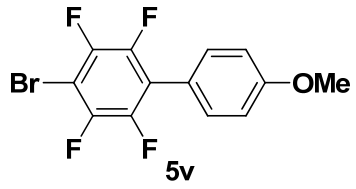
Reference: Rui Shang; Yao Fu; Yan Wang; Qing Xu; Hai-Zhu Yu; Lei Liu *Angew. Chem. Int. Ed.* **2009**, *48*, 9350.



5u

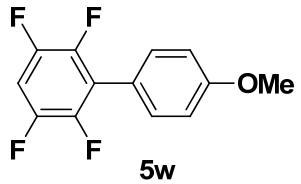
Ethyl 2',3',5',6'-tetrafluoro-4'-methylbiphenyl-4-carboxylate (5u). Spectral data corresponds to that previously reported. Colorless solid (45 mg, 72% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 1.42 (t, 3H, ***J***=7.2 Hz), 2.33 (t, 3H, ***J***=2.4 Hz), 4.41 (q, 2H, ***J***=7.2 Hz), 7.53 (dm, 2H, ***J***=8.4 Hz), 8.15 (dm, 2H, ***J***=8.4 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 7.68, 14.34, 61.24, 116.61 (t, ***J***=18.6 Hz), 117.06 (t, ***J***=15.6 Hz), 129.71, 130.27 (t, ***J***=1.8 Hz), 130.91, 132.28, 143.57 (dm, ***J***=239.2 Hz), 145.42 (dm, ***J***=245.8 Hz), 166.11. ^{19}F-NMR (377 MHz, $CDCl_3$) δ -145.26 (dd, ***J***=12.8 Hz, ***J***=22.2 Hz 2F), -143.58 (dd, ***J***=12.1 Hz, ***J***=21.5 Hz, 2F).

Reference: Rui Shang; Yao Fu; Yan Wang; Qing Xu; Hai-Zhu Yu; Lei Liu *Angew. Chem. Int. Ed.* **2009**, *48*, 9350.



5v

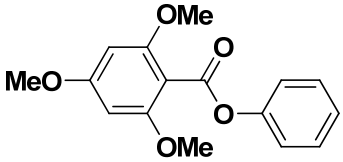
4-bromo-2,3,5,6-tetrafluoro-4'-methoxybiphenyl (5v). Colorless solid (62 mg, 92% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.86 (s, 3H), 7.01 (d, 2H, ***J***=8.8 Hz), 7.39 (d, 2H, ***J***=8.8 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.33, 97.94 (t, ***J***=22.6 Hz), 114.22, 118.95, 120.10 (t, ***J***=16.2 Hz), 131.36, 144.10 (dm, ***J***=247.2 Hz), 145.35 (dm, ***J***=245.8 Hz), 160.38. ^{19}F-NMR (377 MHz, $CDCl_3$) δ -142.43 (m, 2F), -133.90 (m, 2F). HRMS (EI) m/z calcd for $C_{13}H_7OF_4Br$: 333.9616; found: 333.9616.



5w

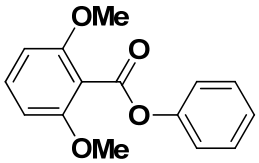
2,3,5,6-tetrafluoro-4'-methoxybiphenyl (5w). Spectral data corresponds to that previously reported. Colorless solid (32 mg, 62% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.86 (s, 3H), 7.01 (m, 3H), 7.40 (m, 2H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.31, 104.27 (t, ***J***=22.6 Hz), 114.13, 119.56 (t, ***J***=1.8 Hz), 121.26 (t, ***J***=16.1 Hz), 131.43 (t, ***J***=1.5 Hz), 143.78 (dm, ***J***=242.5 Hz), 146.29 (dm, ***J***=245.6 Hz), 160.23. ^{19}F-NMR (377 MHz, $CDCl_3$) δ -144.26 (m, 2F), -139.44 (m, 2F).

Reference: Rui Shang; Yao Fu; Yan Wang; Qing Xu; Hai-Zhu Yu; Lei Liu *Angew. Chem. Int. Ed.* **2009**, *48*, 9350.



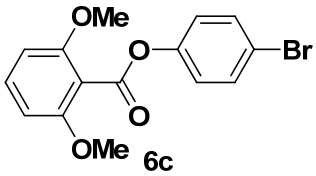
6a

phenyl 2,4,6-trimethoxybenzoate (6a). Colorless solid (51 mg, 90% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.84 (s, 3H), 3.86 (s, 6H), 6.15 (s, 2H), 7.23-7.25 (m, 3H), 7.38-7.41 (m, 2H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.48, 55.09, 90.75, 105.45, 121.88, 125.64, 129.30, 151.31, 159.14, 163.05, 164.82. HRMS (EI) m/z calcd for $C_{16}H_{16}O_5$: 288.0998; found: 288.0990.



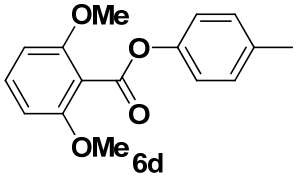
6b

phenyl 2,6-dimethoxybenzoate (6b). Colorless solid (49 mg, 95% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.86 (s, 6H), 6.59 (d, 2H, ***J***=8.4 Hz), 7.21-7.27 (m, 3H), 7.32 (t, 1H, ***J***=8.4 Hz), 7.37-7.42 (m, 2H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 56.16, 104.06, 112.53, 121.88, 125.85, 129.40, 131.63, 151.18, 157.69, 165.05. HRMS (EI) m/z calcd for $C_{15}H_{14}O_4$: 258.0892; found: 258.0899.



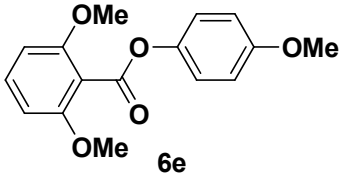
6c

4-bromophenyl 2,6-dimethoxybenzoate (6c). Colorless solid (45 mg, 68% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.86 (s, 6H), 6.59 (d, 2H, ***J***=8.4 Hz), 7.15 (d, 2H, ***J***=8.4 Hz), 7.33 (t, 1H, ***J***=8.4 Hz), 7.51 (d, 2H, ***J***=8.4 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 56.14, 104.04, 112.06, 118.91, 123.71, 131.85, 132.43, 150.18, 157.69, 164.68. HRMS (EI) m/z calcd for $C_{15}H_{13}BrO_4$: 335.9997; found: 335.9992.



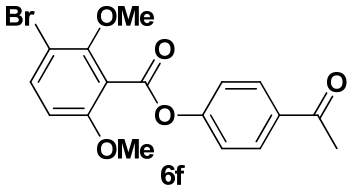
6d

p*-tolyl 2,6-dimethoxybenzoate (6d).** Colorless solid (44 mg, 81% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.34 (s, 3H), 3.85 (s, 6H), 6.58 (d, 2H, ***J=8.4 Hz), 7.11-7.20 (m, 4H), 7.30 (t, 1H, ***J***=8.4 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 20.92, 56.51, 104.06, 112.65, 121.54, 129.92, 131.56, 135.44, 148.93, 157.66, 165.26. HRMS (EI) m/z calcd for $C_{16}H_{16}O_4$: 272.1049; found: 272.1045.



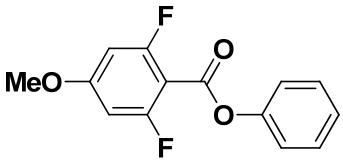
6e

4-methoxyphenyl 2,6-dimethoxybenzoate (6e). Colorless solid (51 mg, 89% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.79 (s, 3H), 3.86 (s, 6H), 6.58 (d, 2H, ***J***=8.0Hz), 6.91 (dt, 2H, ***J***=3.0 Hz, ***J***=9.2 Hz), 7.17 (dt, 2H, ***J***=3.0 Hz, ***J***=9.2 Hz), 7.31 (t, 1H, ***J***=8.4 Hz). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.61, 56.14, 104.05, 112.06, 114.45, 112.60, 114.45, 122.60, 131.56, 144.67, 157.34, 157.63, 165.43. HRMS (EI) m/z calcd for $C_{16}H_{16}O_5$: 288.0998; found: 288.0992.



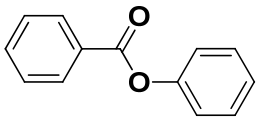
6f

4-acetylphenyl 3-bromo-2,6-dimethoxybenzoate (6f). Colorless solid (50 mg, 66% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.62 (s, 3H), 3.89 (s, 3H), 3.98 (s, 3H), 6.68 (d, 1H, ***J***=9.2 Hz), 7.35 (dt, 2H, ***J***=2.4 Hz, ***J***=8.8 Hz), 7.59 (d, 1H, ***J***=9.2 Hz), 8.05 (dt, 2H, ***J***=2.8 Hz, ***J***=8.8 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 26.62, 56.46, 62.39, 107.86, 108.61, 118.77, 121.87, 130.08, 135.07, 135.35, 154.47, 155.04, 156.97, 163.35, 196.85. HRMS (EI) m/z calcd for $C_{17}H_{15}BrO_5$: 378.0103; found: 378.0097.



6g

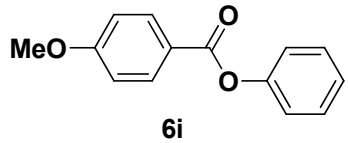
phenyl 2,6-difluoro-4-methoxybenzoate (6g). Colorless solid (33 mg, 62% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.87 (s, 3H), 6.56 (d, 2H, ***J***=10.4 Hz), 7.28 (m, 3H), 7.45 (t, 2H, ***J***=7.6 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 56.12, 98.80 (dd, ***J***=3.0 Hz, ***J***=26.4 Hz), 102.54 (t, ***J***=16.4 Hz), 121.69, 126.09, 129.49, 150.51, 159.96 (t, ***J***=2.7 Hz), 162.76 (dd, ***J***=9.2 Hz, ***J***=247.2 Hz), 164.12. ^{19}F-NMR (377 MHz, $CDCl_3$) δ -106.59 (s, 2F). HRMS (EI) m/z calcd for $C_{14}H_{10}F_2O_3$: 264.0598; found: 264.0594.



6h

phenyl benzoate (6h). Spectral data corresponds to that previously reported. Colorless solid (28 mg, 70% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.22 (d, 2H, ***J***=7.2 Hz), 7.27 (t, 1H, ***J***=7.6 Hz), 7.43 (t, 2H, ***J***=8.0 Hz), 7.51 (t, 2H, ***J***=7.6 Hz), 7.64 (t, 1H, ***J***=7.6 Hz), 8.21 (d, 2H, ***J***=7.2 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 121.74, 125.91, 128.59, 129.52, 129.62, 130.19, 133.60, 151.0, 165.22.

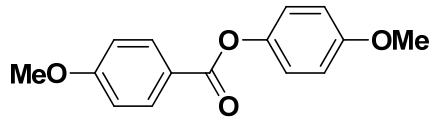
Reference: Jessica Salvadori; Evita Balducci; Silvia Zaza; Elena Petricci; Maurizio Taddei *J. Org. Chem.*, **2010**, *75*, 1841.



6i

phenyl 4-methoxybenzoate (6i). Spectral data corresponds to that previously reported. Colorless solid (45 mg, 93% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.88 (s, 3H), 6.98 (d, 2H, ***J***=9.2 Hz), 7.23 (m, 3H), 7.41 (t, 2H, ***J***=7.6 Hz), 8.15 (d, 2H, ***J***=8.8 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.52, 113.87, 121.83, 125.73, 129.45, 132.31, 151.14, 163.94, 164.93.

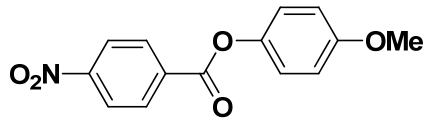
Reference: Changming Qin; Huayue Wu; Jiuxi Chen; Miaochang Liu; Jiang Cheng; Weike Su; Jinchang Ding *Org. Lett.* **2008**, *10*, 1537.



6j

4-methoxyphenyl 4-methoxybenzoate (6j). Spectral data corresponds to that previously reported. Colorless solid (36 mg, 71% yield).^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.81 (s, 3H), 3.88 (s, 3H), 6.92 (d, 2H, ***J***=8.8 Hz), 6.97 (d, 2H, ***J***=8.8 Hz), 7.11 (d, 2H, ***J***=8.8 Hz), 8.14 (d, 2H, ***J***=8.8 Hz). ^{13}C-NMR (100MHz, $CDCl_3$) δ 55.51, 55.62, 113.83, 114.50, 121.98, 122.56, 132.26, 144.56, 157.24, 163.86, 165.30.

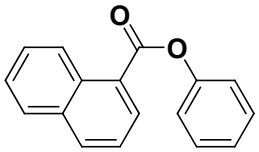
Reference: Helmi Neuvonen; Kari Neuvonen; Paavo Pasanen *J. Org. Chem.*, **2004,** *69***,** 3794.



6k

4-methoxyphenyl 4-nitrobenzoate (6k). Spectral data corresponds to that previously reported. Colorless solid (25 mg, 46% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.83 (s, 3H), 6.96 (dt, 2H, ***J***=3.2 Hz, ***J***=9.2 Hz), 7.15 (dt, 2H, ***J***=3.2 Hz, ***J***=9.2 Hz), 8.36 (m, 4H). ^{13}C-NMR (100 MHz, $CDCl_3$) δ 55.65, 114.68, 122.19, 123.71, 131.26, 135.11, 144.02, 150.89, 157.70, 163.68.

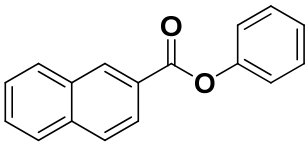
Reference: Helmi Neuvonen; Kari Neuvonen; Paavo Pasanen *J. Org. Chem.*, **2004,** *69***,** 3794.



6l

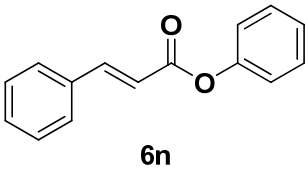
phenyl 1-naphthoate (6l). Spectral data corresponds to that previously reported. Colorless solid (30 mg, 62% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.27-7.32 (m, 3H), 7.44-7.48 (m, 2H), 7.54-7.58 (m, 2H), 7.61-7.66 (m, 1H), 7.91 (d, 1H, ***J***=8.0 Hz), 8.09 (d, 1H, ***J***=8.0 Hz), 8.47 (dd, 1H, ***J***=1.2 Hz, ***J***=7.2 Hz), 9.04 (d, 1H, ***J***=8.0 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 120.87, 123.51, 124.74, 124.90, 125.39, 127.14, 127.66, 128.53, 130.17, 130.68, 132.92, 133.27, 144.99, 164.80.

Reference: Ramesh, Chinnasamy; Nakamura, Ryo; Kubota, Yoshihiro; Miwa, Minoru; Sugi, Yoshihiro *Synthesis* **2003**, *4*, 501.



6m

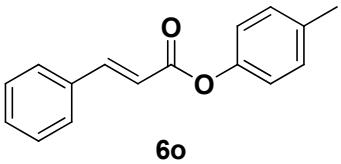
phenyl 2-naphthoate (6m). Colorless solid (33 mg, 66% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.24-7.30 (m, 3H), 7.45 (t, 2H, ***J***=8.4 Hz), 7.55-7.59 (m, 2H), 7.60-7.64 (m, 2H), 7.94 (td, 3H, ***J***=22.4 Hz, ***J***=8.0 Hz), 8.19 (dd, 1H, ***J***=8.8 Hz, ***J***=1.6 Hz), 8.79 (s, 1H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 121.81, 125.51, 125.95, 126.84, 126.88, 127.88, 128.43, 128.66, 129.53, 129.56, 135.87, 131.96, 132.56, 151.13, 165.40. HRMS (EI) m/z calcd for $C_{17}H_{12}O_2$: 248.0837; found: 248.0839.



6n

phenyl cinnamate (6n). Spectral data corresponds to that previously reported. Colorless solid (40 mg, 89% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 6.63 (d, 1H, ***J***=16.4 Hz) 7.16-7.18 (m, 2H), 7.22-7.26 (m, 1H), 7.38-7.42 (m, 5H), 7.56-7.59 (m, 2H), 7.87 (d, 1H, ***J***=16.0 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 117.37, 121.68, 125.82, 128.34, 129.04, 129.48, 130.73, 134.23, 146.60, 150.87, 165.42.

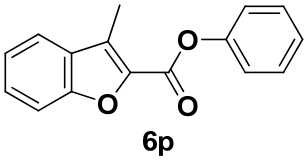
Reference: Suman De Sarkar; Stefan Grimme; Armido Studer *J. Am. Chem. Soc.*, **2010**, *132*, 1190.



6o

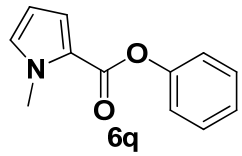
p*-tolyl cinnamate (6o).** Spectral data corresponds to that previously reported. Colorless solid (31 mg, 65% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.38 (s, 3H), 6.65 (d, 1H, ***J=16.0Hz), 7.07 (d, 2H, ***J***=8.0Hz), 7.22 (d, 2H, ***J***=8.0Hz), 7.43 (m, 3H), 7.59 (m, 2H), 7.88 (d, 1H, ***J***=16.0Hz). ^{13}C-NMR (100MHz, $CDCl_3$) δ 20.92, 117.46, 121.34, 128.32, 129.01, 129.99, 130.68, 134.26, 135.44, 146.42, 148.60, 165.64

Reference: Kaitner, B.; Stilinovic, V. *Acta Cryst.* **2007**, *E63*, o4347.



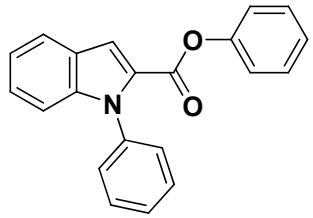
6p

phenyl 3-methylbenzofuran-2-carboxylate (6p). Colorless solid (26 mg, 52% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 2.67 (s, 3H), 7.25-7.36 (m, 4H), 7.42-7.51 (m, 3H), 7.59 (d, 1H, ***J***=7.6 Hz), 7.68 (d, 1H, ***J***=8.0 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 9.61, 112.35, 121.29, 121.78, 123.38, 126.17, 127.75, 128.35, 129.02, 129.57, 140.13, 150.25, 154.75, 158.85. HRMS (EI) m/z calcd for $C_{16}H_{12}O_3$: 252.0786; found: 252.0780.



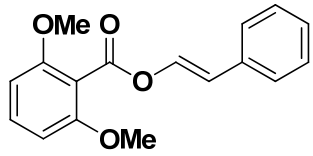
6q

phenyl 1-methyl-1H-pyrrole-2-carboxylate (6q). Colorless solid (30 mg, 74% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.95 (s, 3H), 6.19 (dd, 1H, ***J***=2.4 Hz, ***J***=4.0 Hz), 6.87 (t, 1H, ***J***=2.4 Hz), 7.16 (t, 1H, ***J***=2.4 Hz), 7.17-7.19 (m, 2H), 7.21-7.25 (m, 1H), 7.37-7.42 (m, 2H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 35.83, 107.31, 118.17, 120.60, 120.97, 124.57, 128.36, 129.56, 149.65, 158.64. HRMS (EI) m/z calcd for $C_{12}H_{11}NO_2$: 201.0790; found: 201.0787.

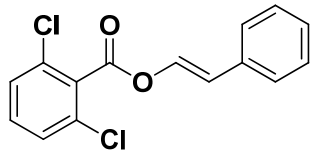


6r

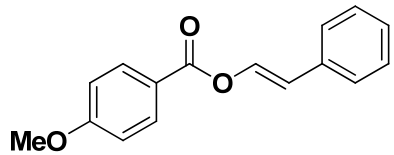
phenyl 1-phenyl-1H-indole-2-carboxylate (6r). Colorless solid (40 mg, 64% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 7.11 (t, 3H, ***J***=9.2 Hz), 7.18-7.23 (m, 2H), 7.28-7.39 (m, 5H), 7.41-7.51 (m, 3H), 7.69 (s, 1H), 7.77 (d, 1H, ***J***=8.0 Hz), 8.09 (d, 1H, ***J***=8.0 Hz), 8.47 (dd, 1H, ***J***=1.2 Hz, ***J***=7.2 Hz), 9.04 (d, 1H, ***J***=8.0 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 111.72, 113.06, 121.55, 121.70, 122.71, 125.77, 126.08, 126.18, 128.01, 128.12, 128.29, 129.16, 129.38, 138.30, 141.19, 150.53, 159.57. HRMS (EI) m/z calcd for $C_{21}H_{15}NO_2$: 313.1103; found: 313.1098.



(E)-styryl 2,6-dimethoxybenzoate (6s). Colorless solid (53 mg, 95% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 3.83 (s, 6H), 6.47 (d, 1H, ***J***=12.8 Hz), 6.58 (d, 2H, ***J***=8.4 Hz), 7.21-7.37 (m, 6H), 8.08 (d, 1H, ***J***=12.8 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 56.12, 104.03, 111.85, 115.79, 126.32, 127.39, 128.72, 131.84, 134.32, 136.87, 157.82, 163.61.
HRMS (EI) m/z calcd for $C_{17}H_{16}O_4$: 284.1049; found: 284.1041.



(E)-styryl 2,6-dichlorobenzoate (6t). Colorless solid (21 mg, 36% yield). ^{1}H-NMR (400 MHz, $CDCl_3$) δ 6.50 (d, 1H, ***J***=12.8 Hz), 7.18-7.33 (m, 8H), 7.98 (d, 1H, ***J***=12.4 Hz). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 116.35, 125.46, 126.84, 126.99, 127.77, 130.42, 131.34, 132.52, 135.08, 160.83.
HRMS (EI) m/z calcd for $C_{15}H_{10}Cl_2O_2$: 292.0058; found: 292.0054

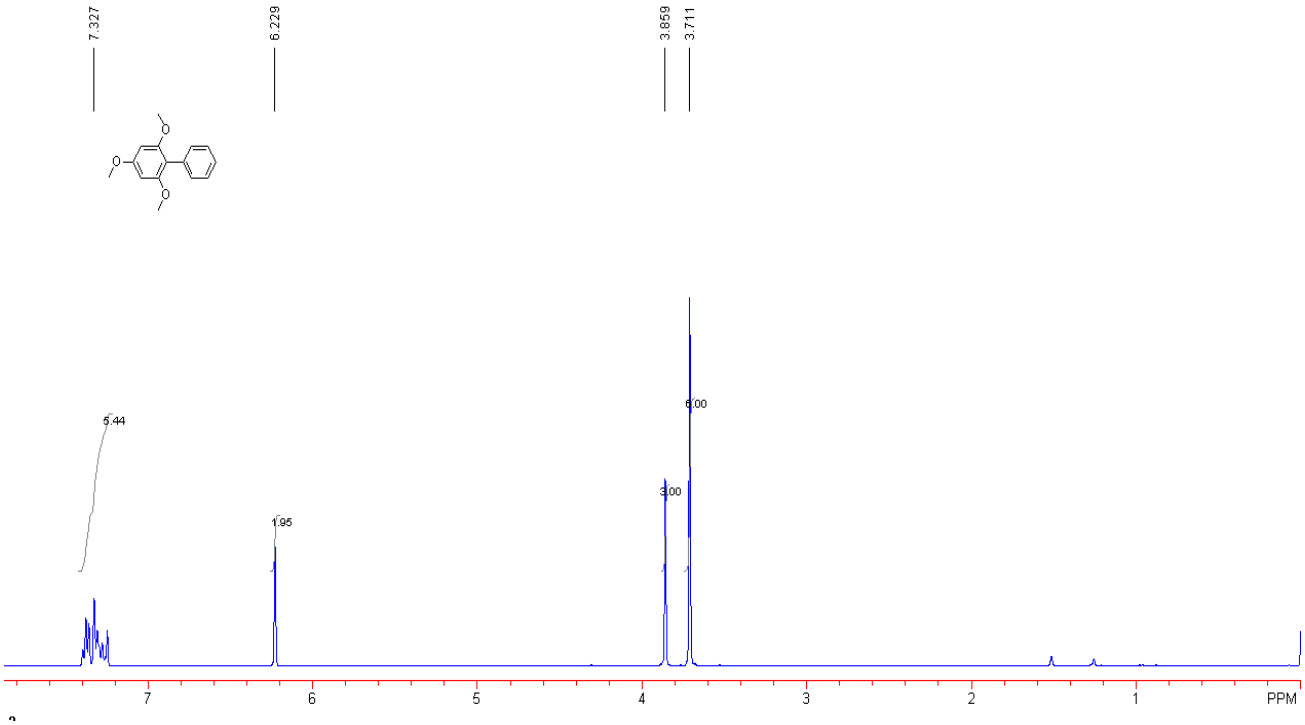


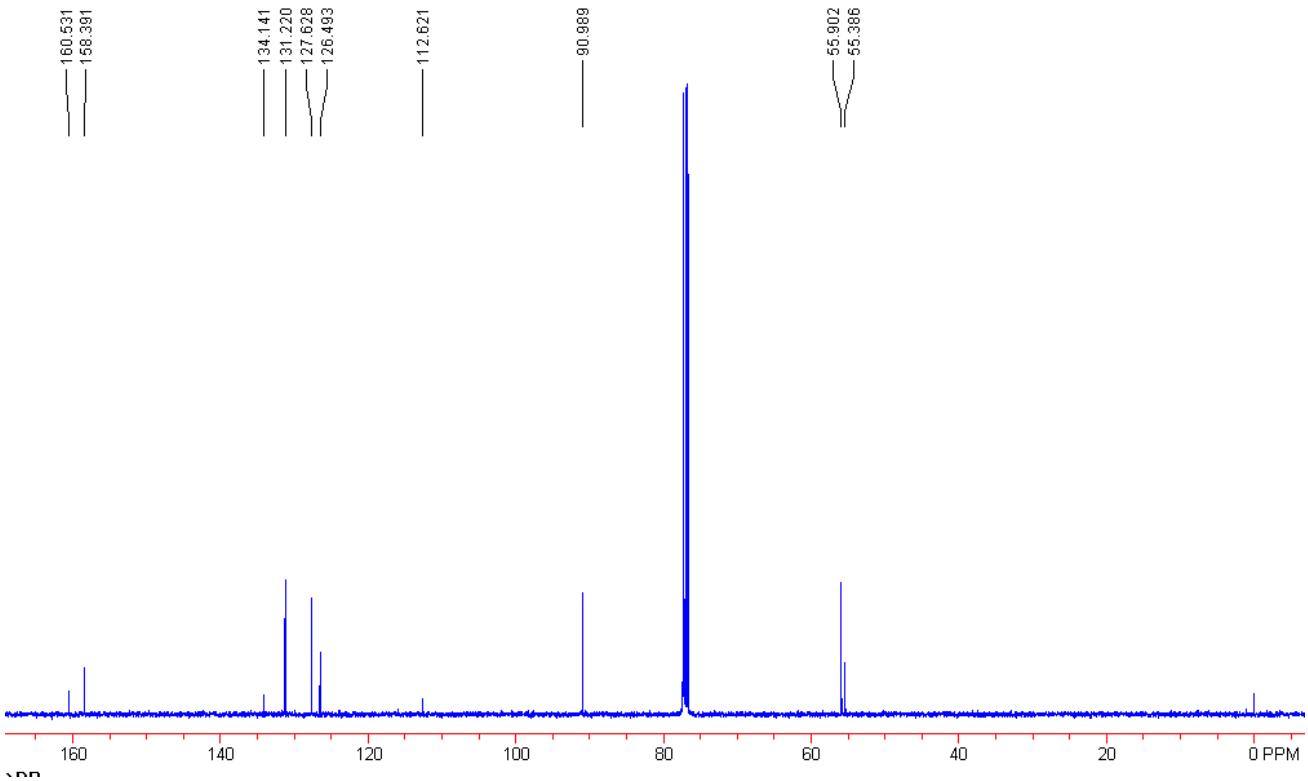
(E)-styryl 4-methoxybenzoate (6u). Yellow solid (31 mg, 62% yield). ^{1}H-NMR (400 MHz, $CDCl_3$)

δ 3.88 (s, 3H), 6.55 (d, 1H, ***J***=12.8 Hz), 6.96 (d, 2H, ***J***=8.8 Hz), 7.22-7.26 (m, 1H), 7.30-7.40 (m, 4H), 8.06-8.12 (m, 3H). ^{13}C-NMR(100 MHz, $CDCl_3$) δ 55.51, 113.92, 115.39, 121.20, 126,26, 127.37, 128.75, 132.19, 134.40, 136.67, 163.40, 164.02.
HRMS (EI) m/z calcd for $C_{16}H_{14}O_3$: 254.2806; found: 254.2802

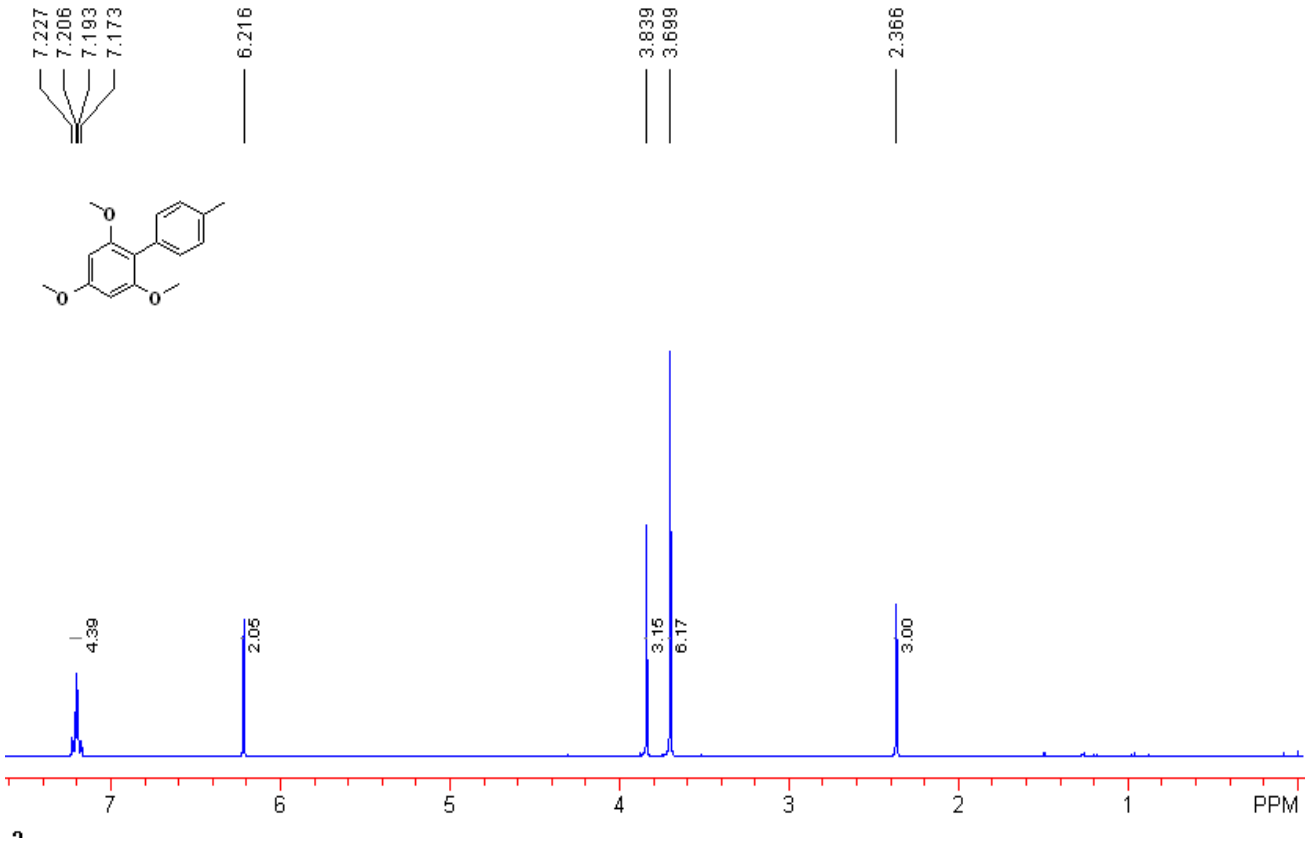
Spectra Data (^{1}H, ^{13}C, ^{19}F) of all products

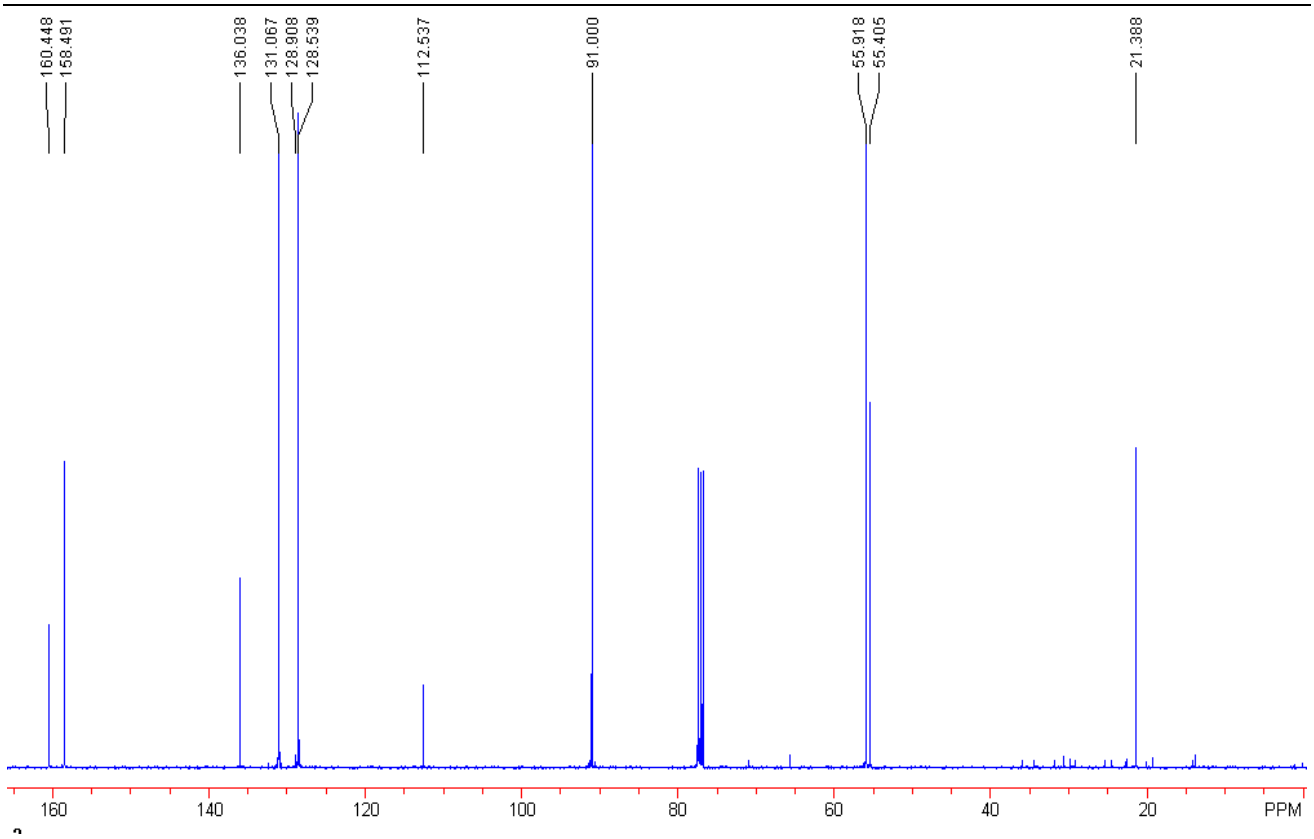
2,4,6-trimethoxybiphenyl (3a).



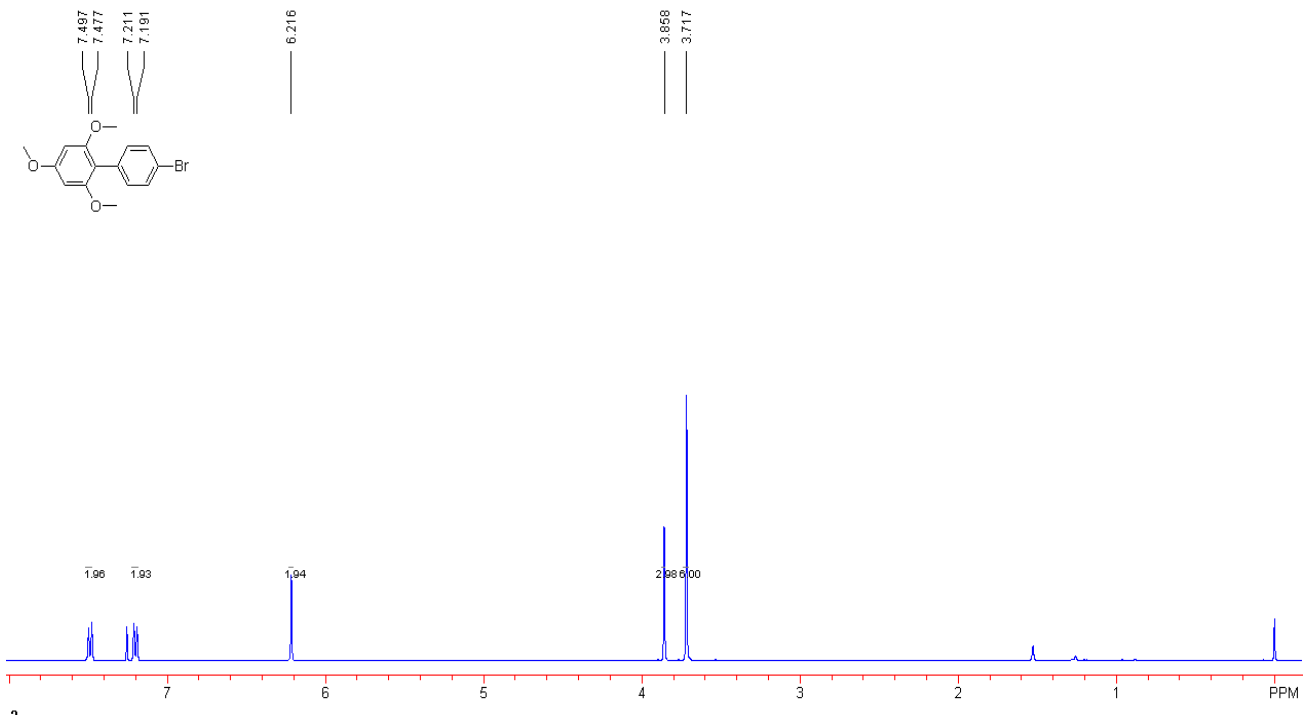


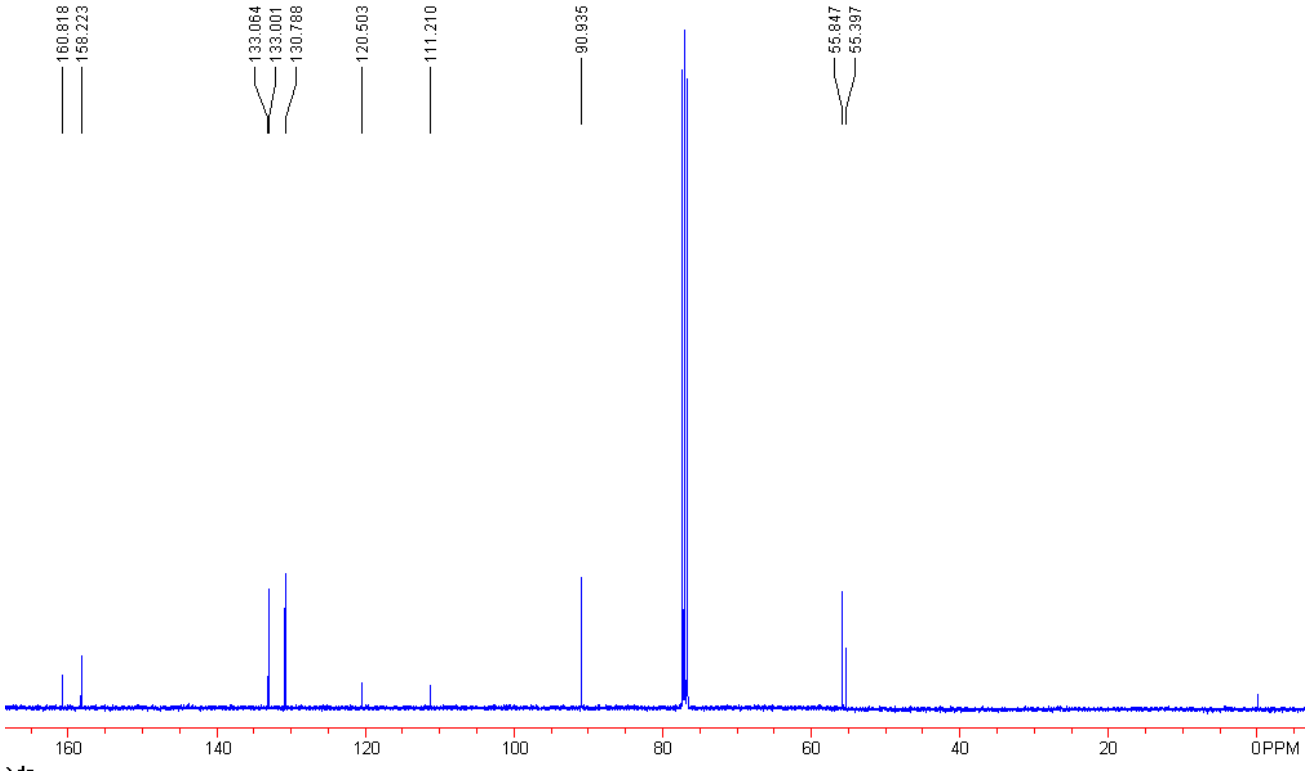
2,4,6-trimethoxy-4'-methylbiphenyl (3b).



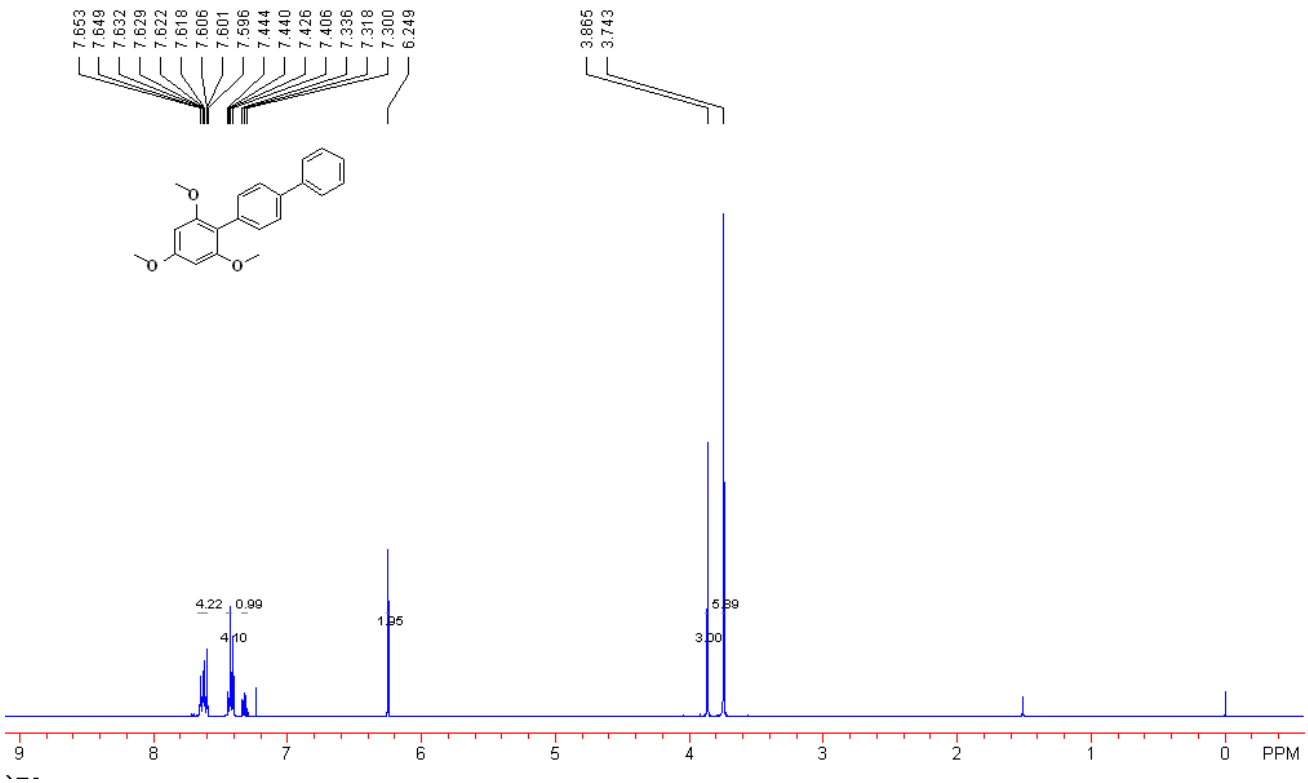


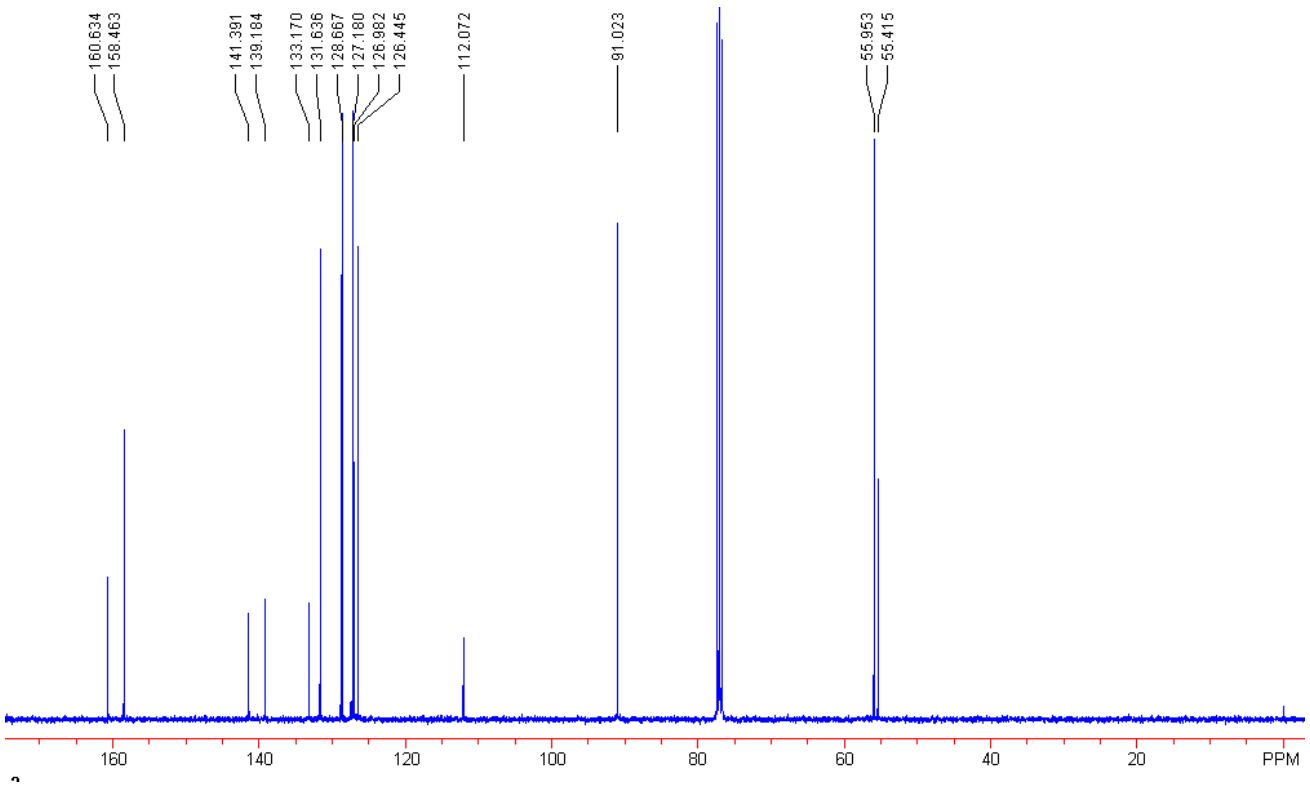
4'-bromo-2,4,6-trimethoxybiphenyl (3c).



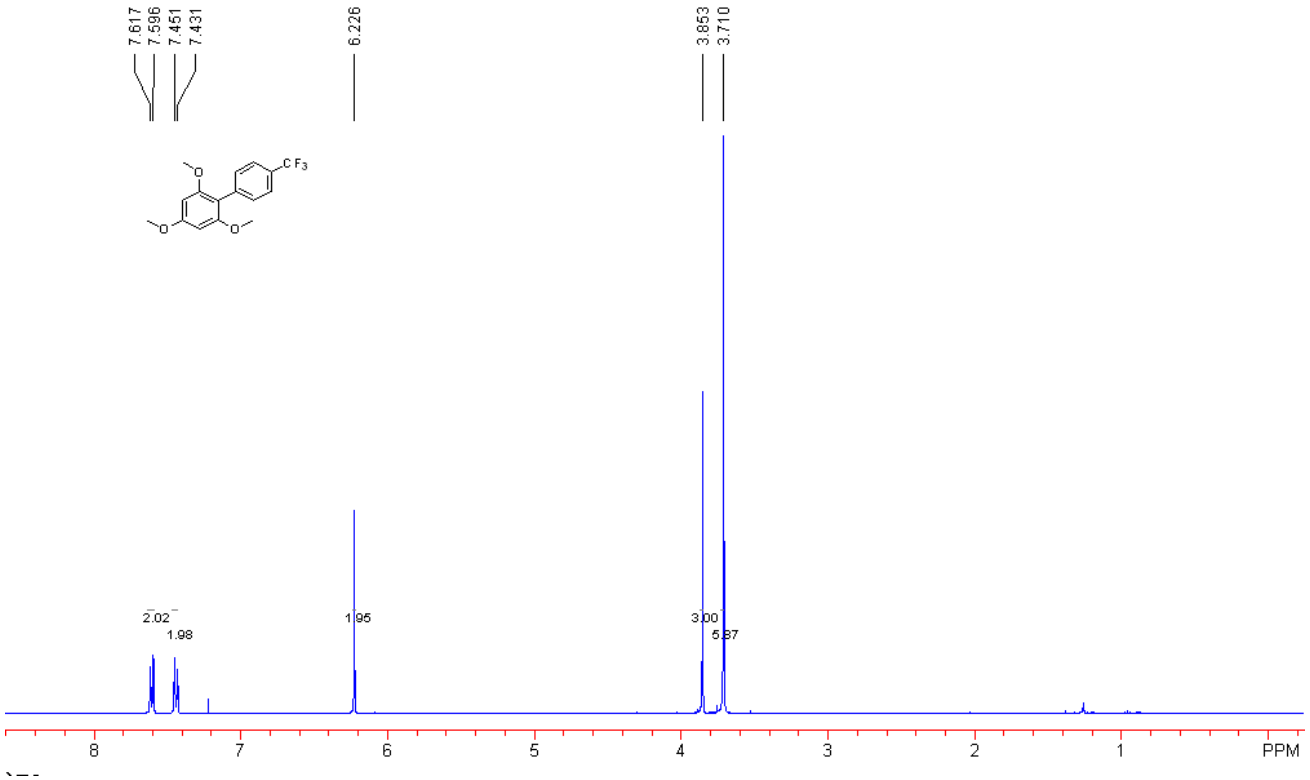


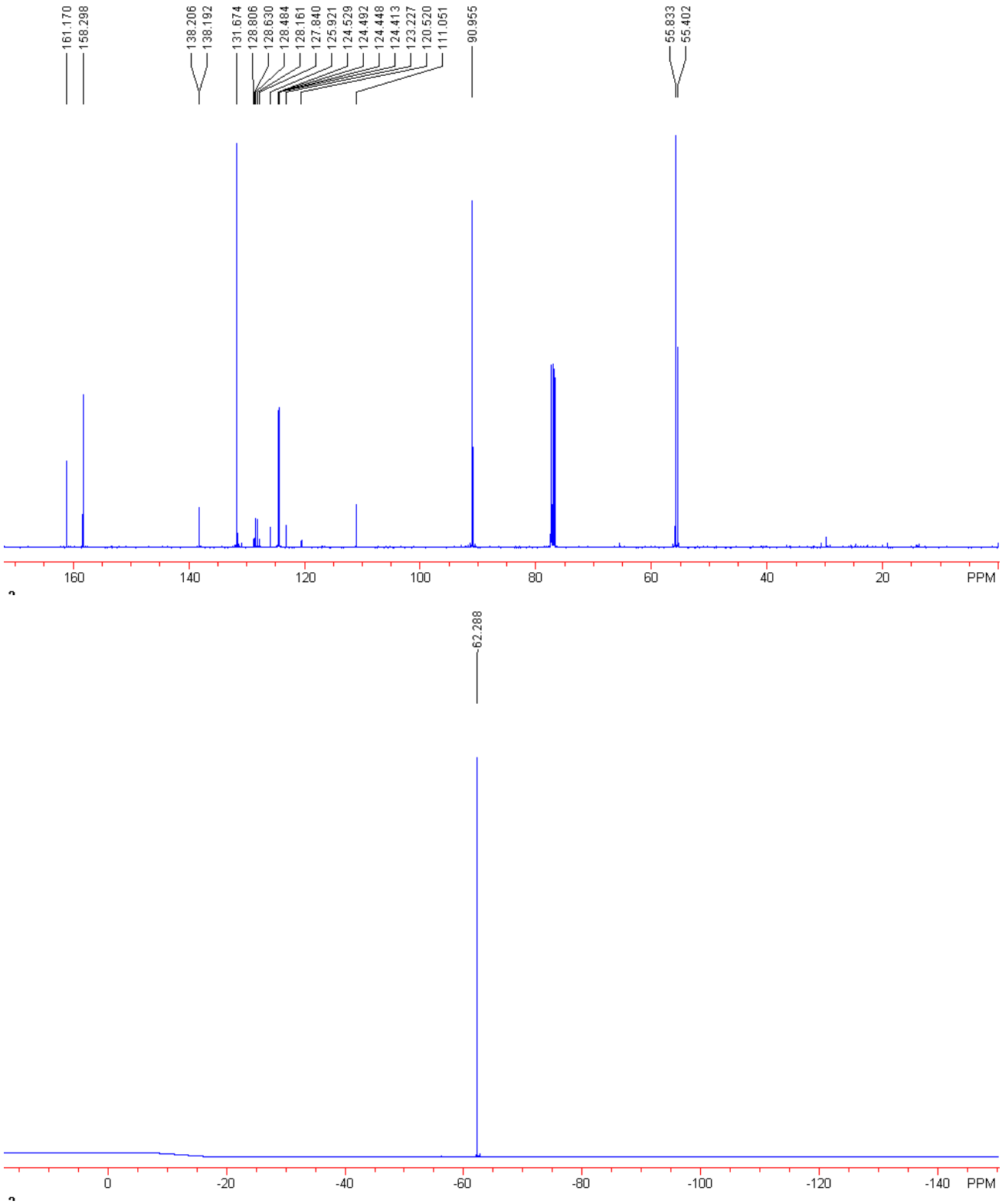
4'-phenyl-2,4,6-trimethoxybiphenyl (3d).



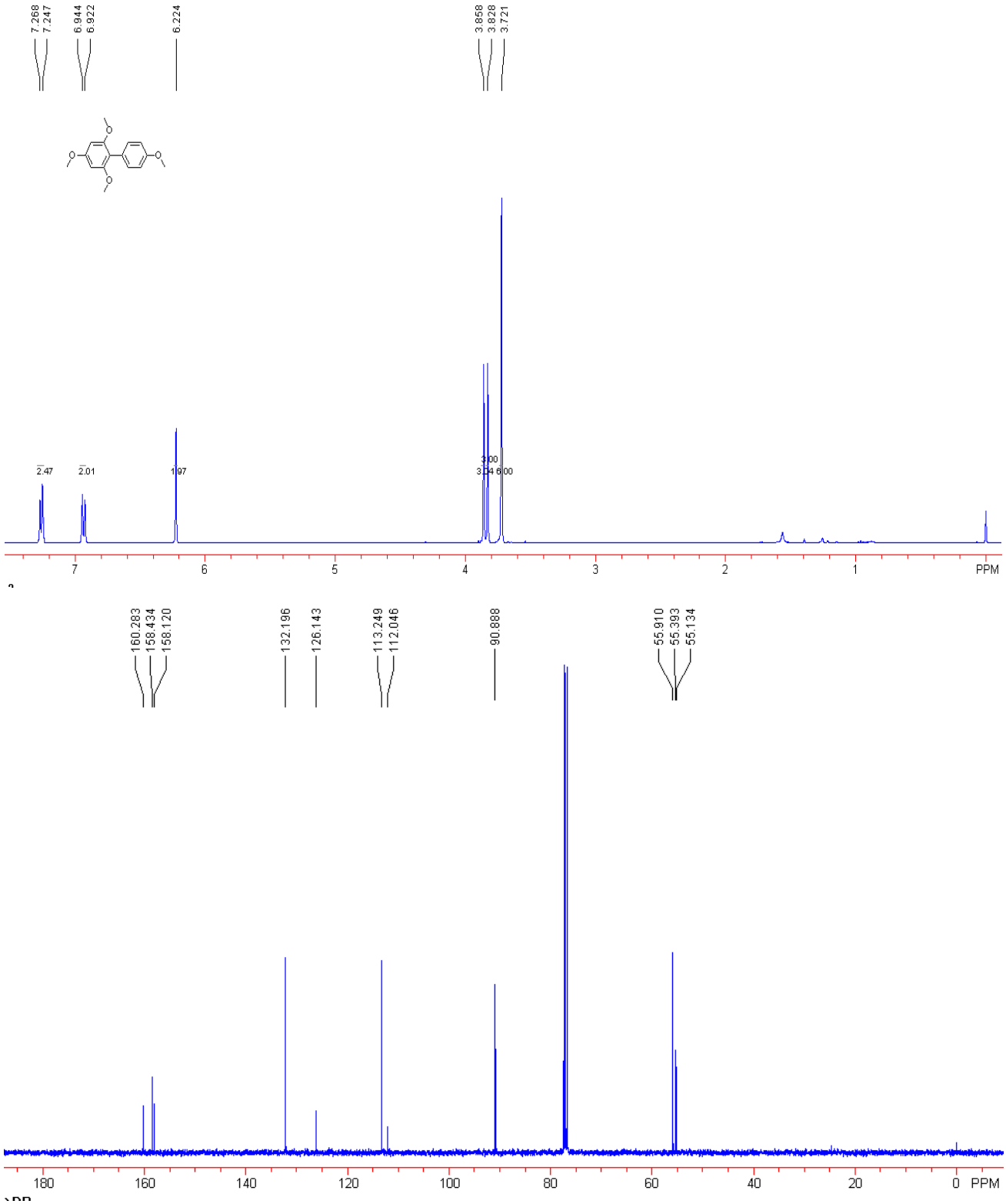


2,4,6-trimethoxy-4'-(trifluoromethyl)biphenyl (3e).

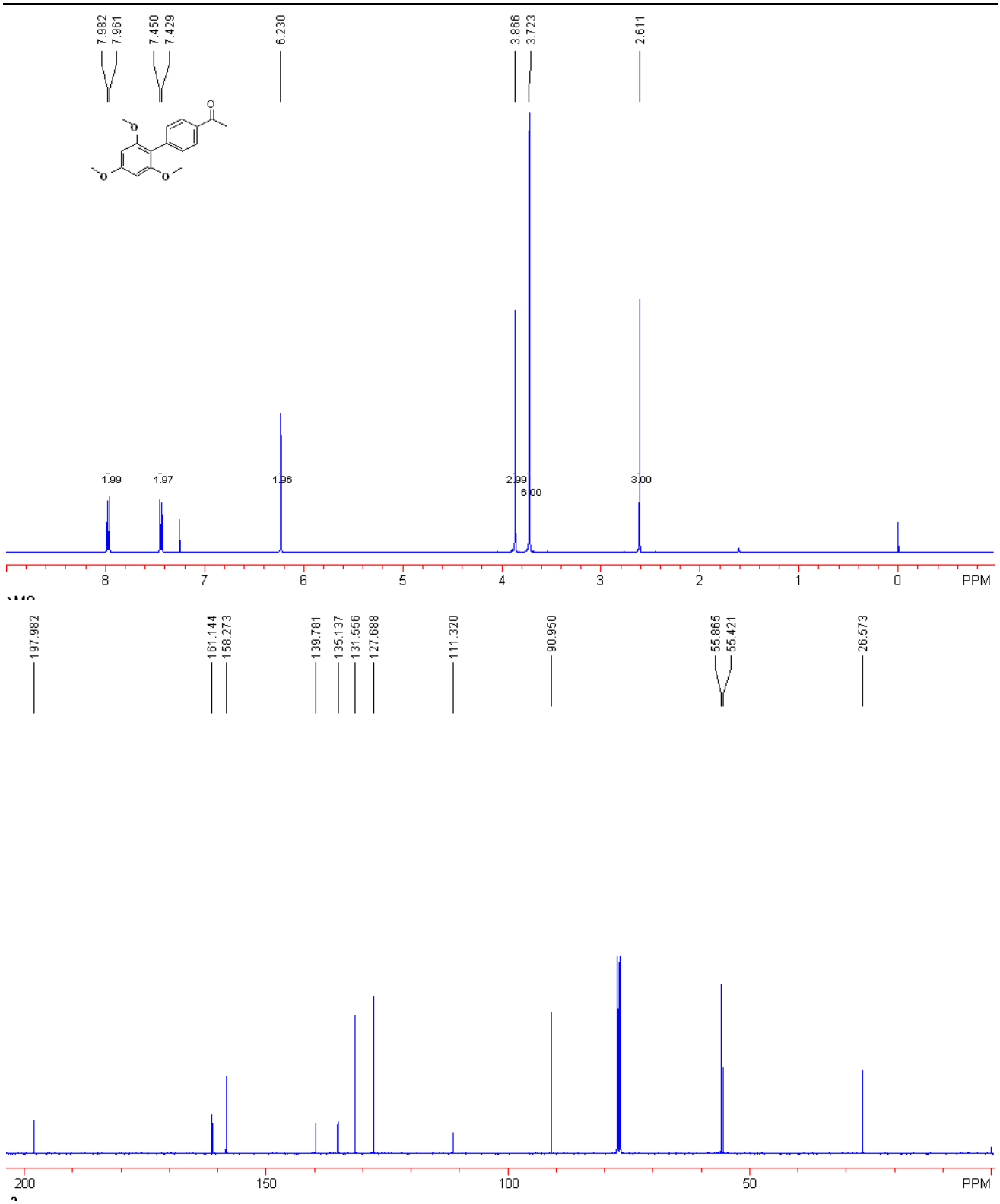




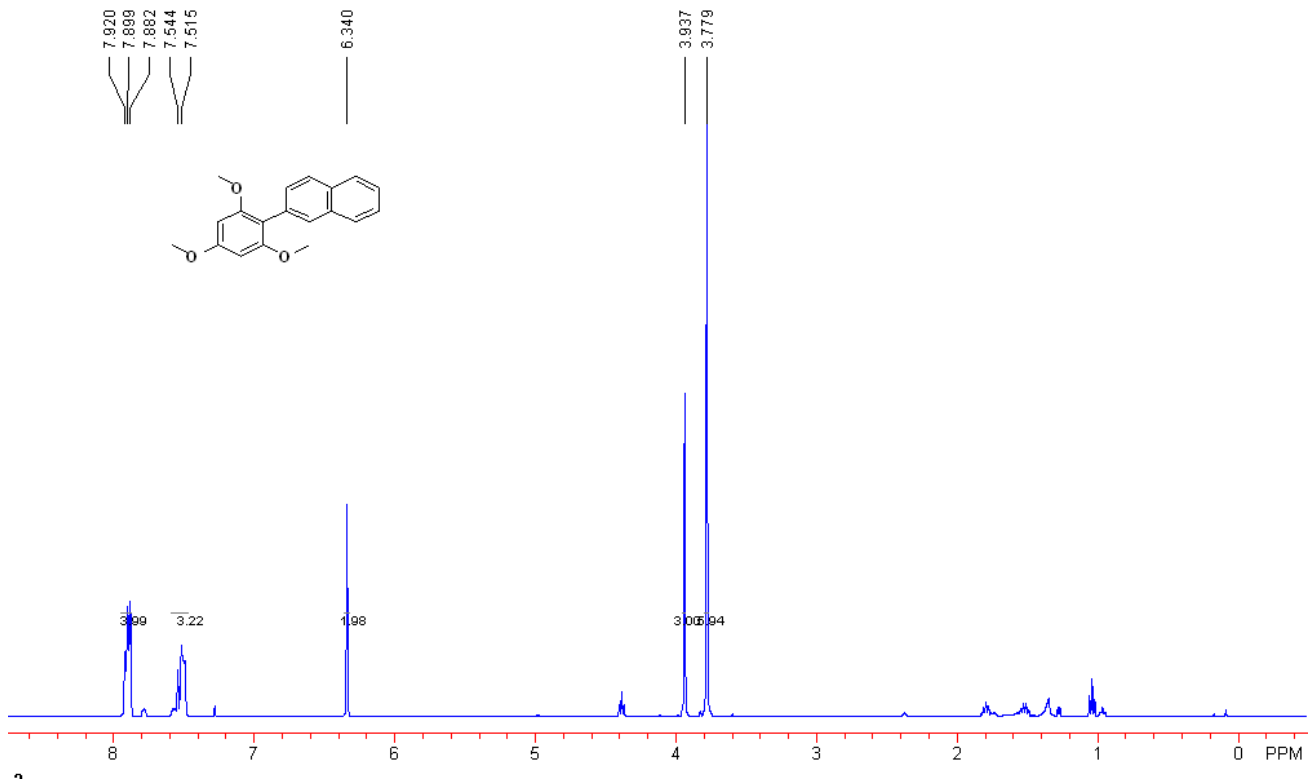
2,4,4',6-tetramethoxybiphenyl (3f).

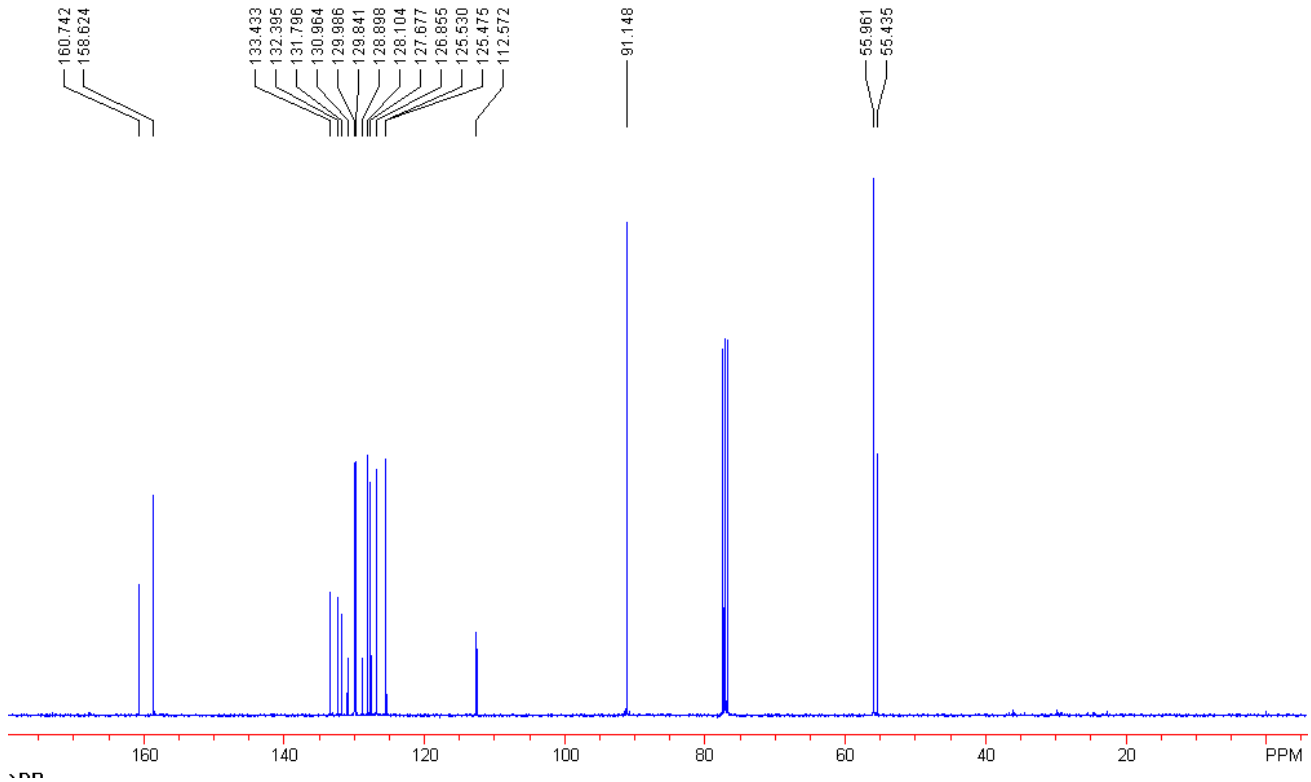


1-(2',4',6'-trimethoxybiphenyl-4-yl)ethanone (3g).

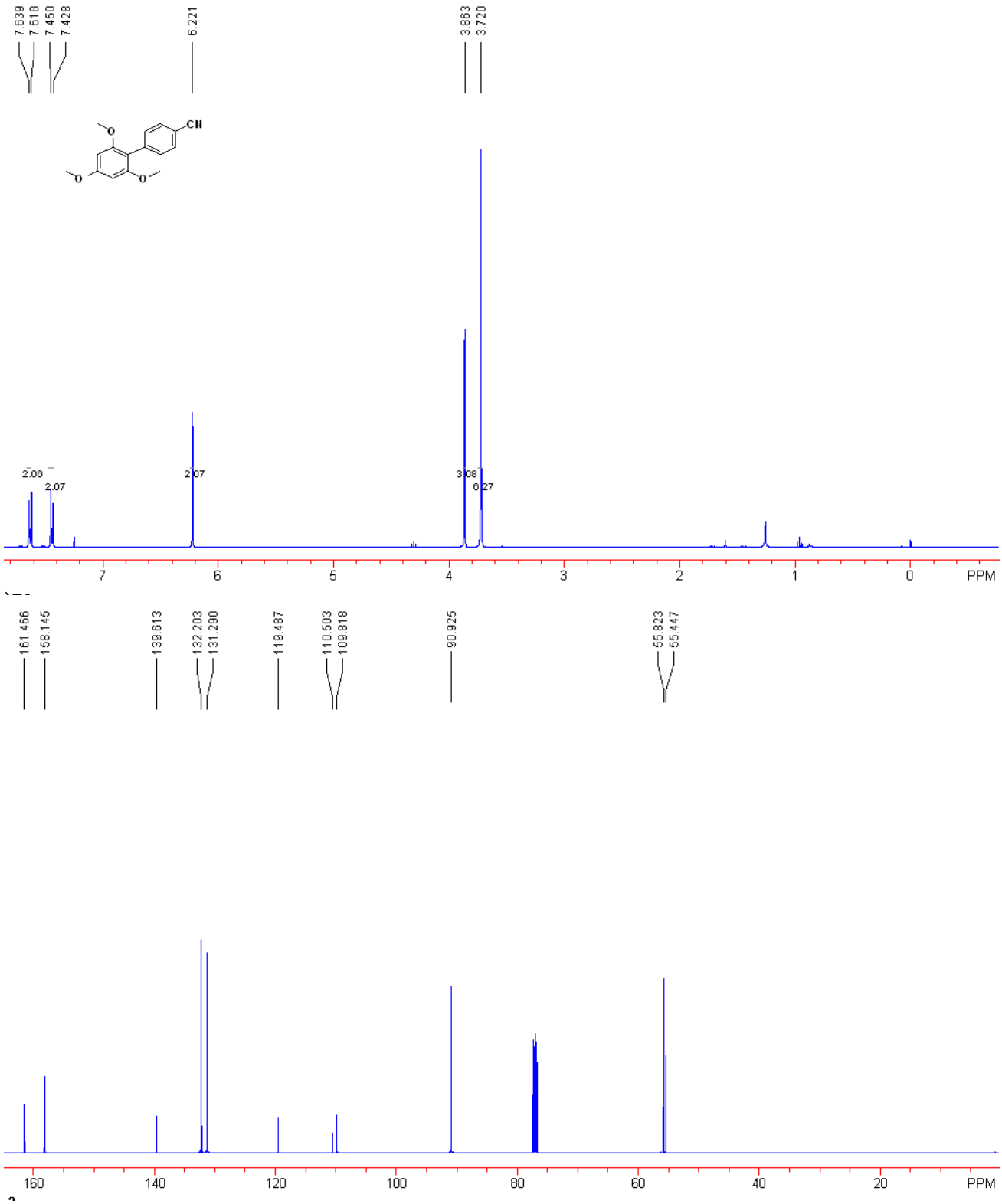


2-(2,4,6-trimethoxyphenyl)naphthalene (3h).

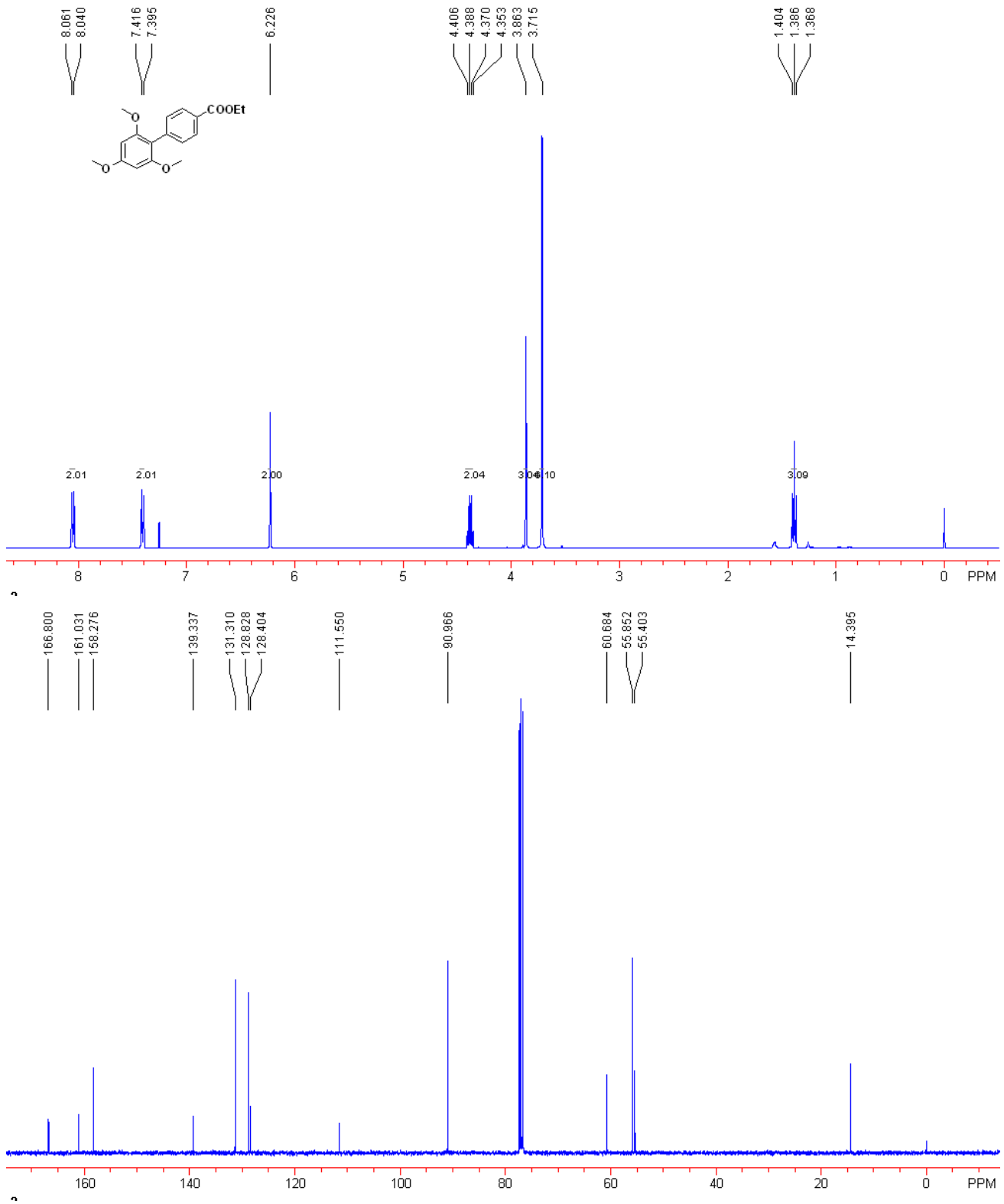




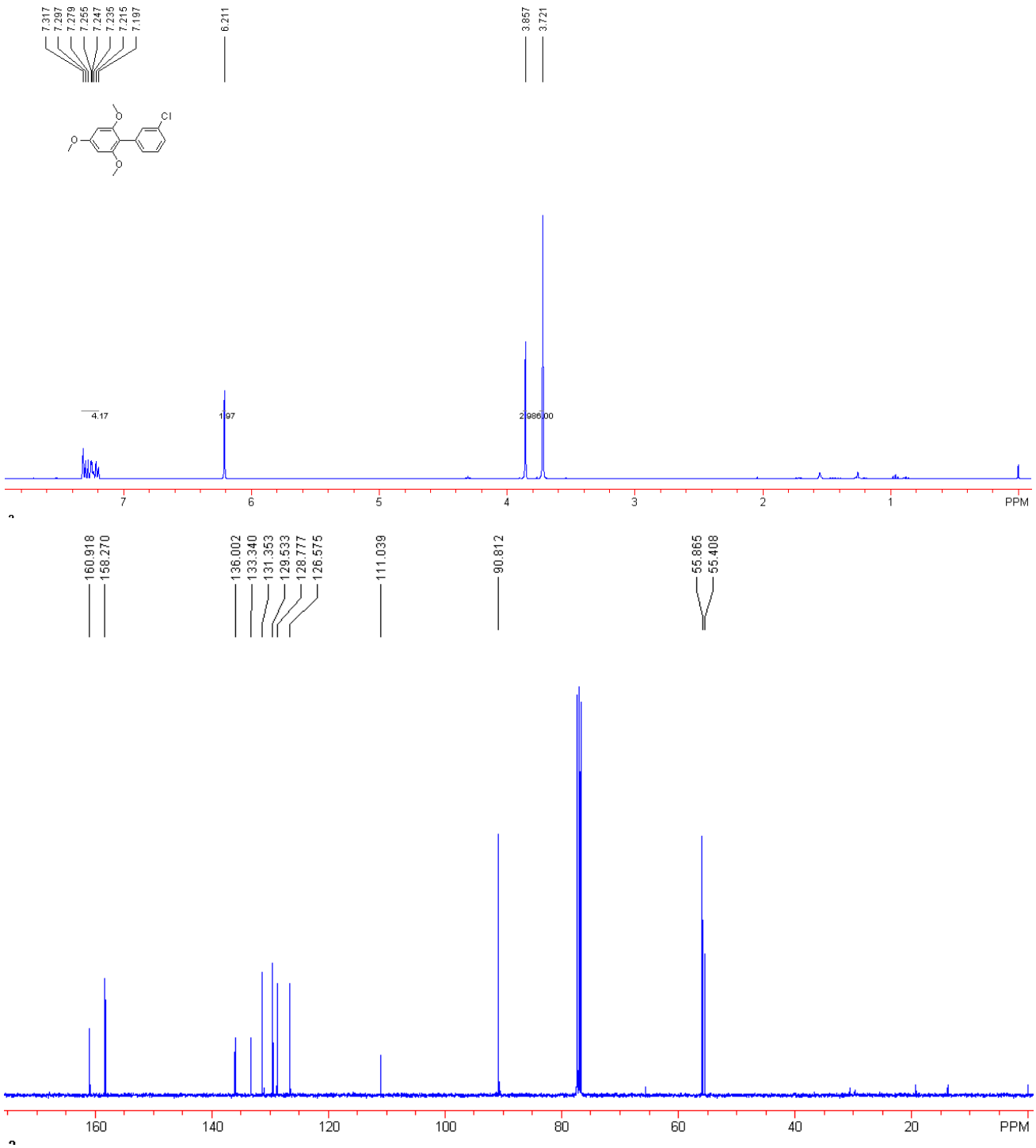
2',4',6'-trimethoxybiphenyl-4-carbonitrile(3i).



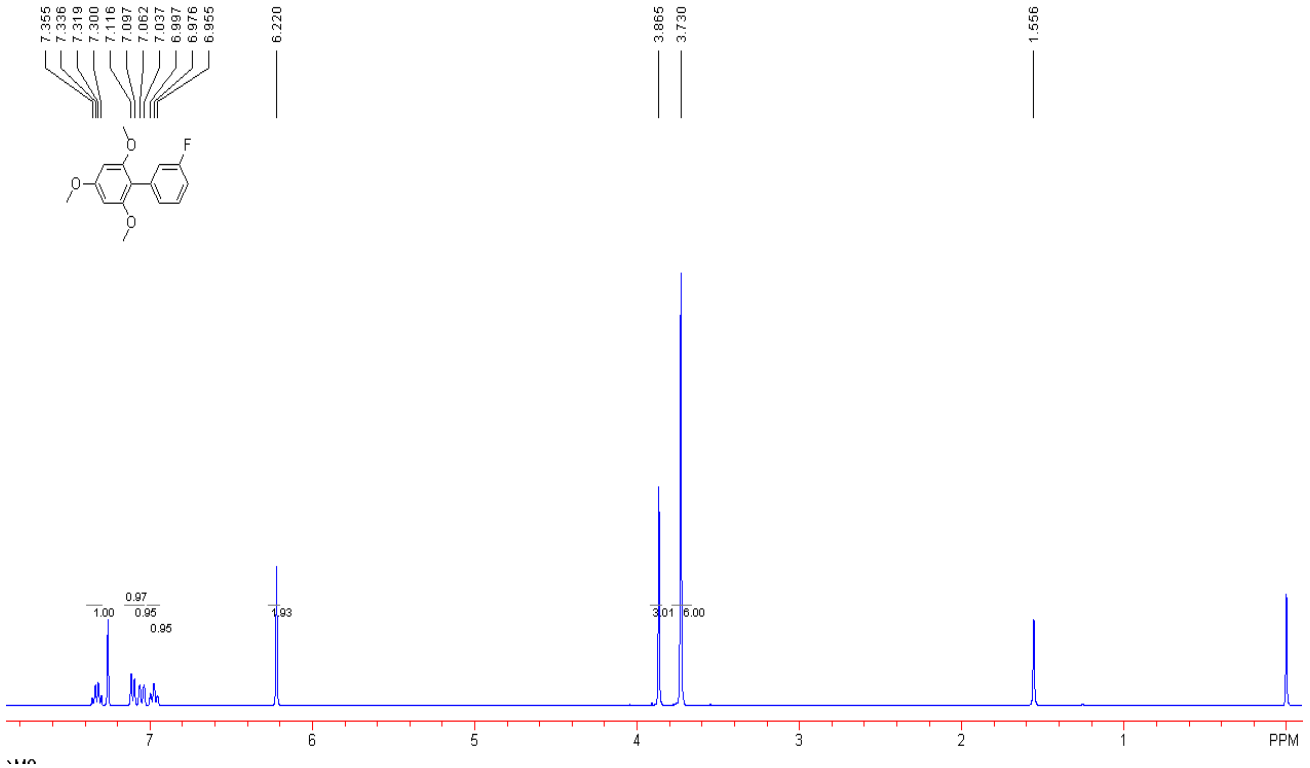
Ethyl 2',4',6'-trimethoxybiphenyl-4-carboxylate (3j).



3'-chloro-2,4,6-trimethoxybiphenyl(3k).



3'-fluoro-2,4,6-trimethoxybiphenyl (3l).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3.730
1.556
O
F
O
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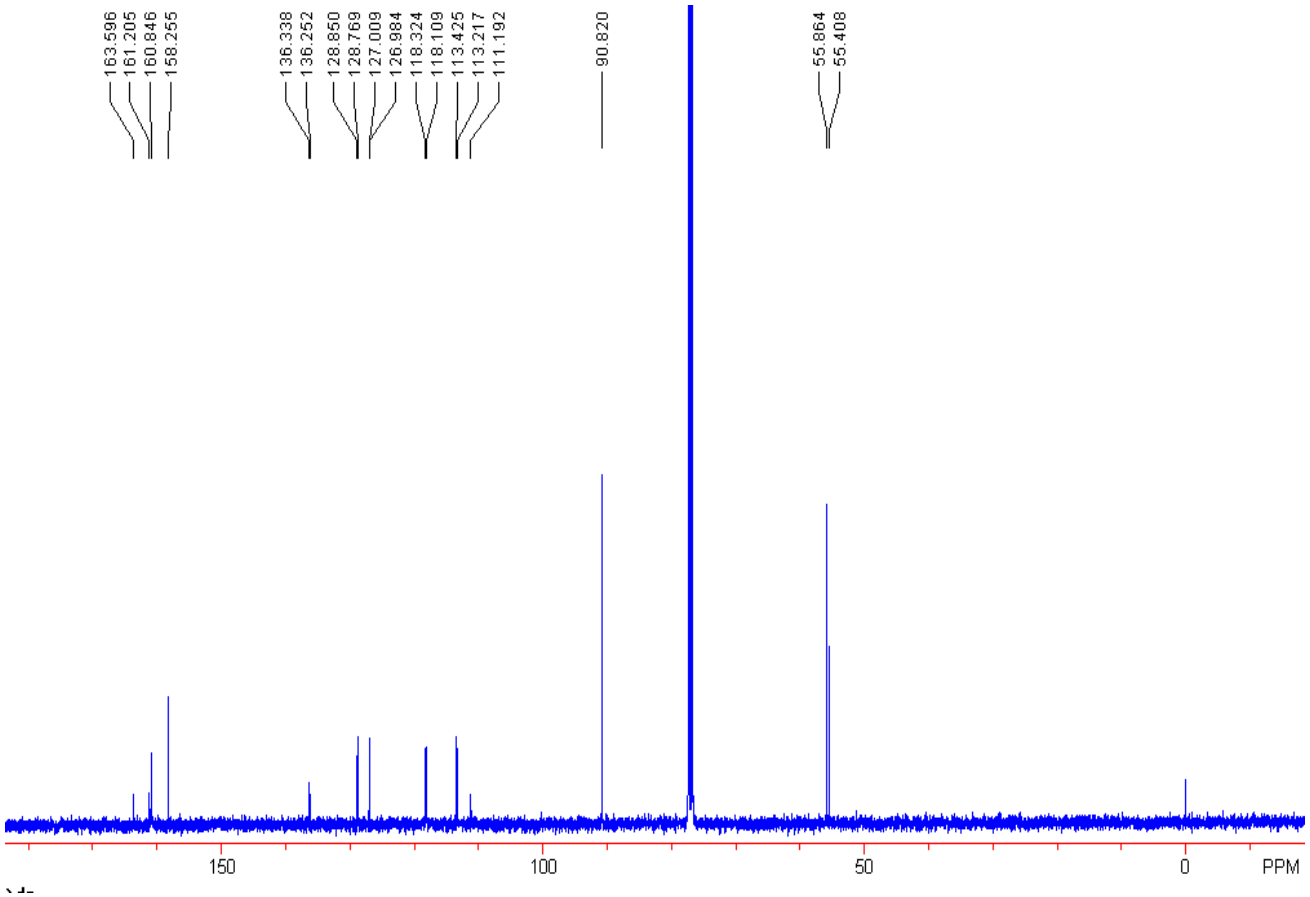
4
3
2
1
PPM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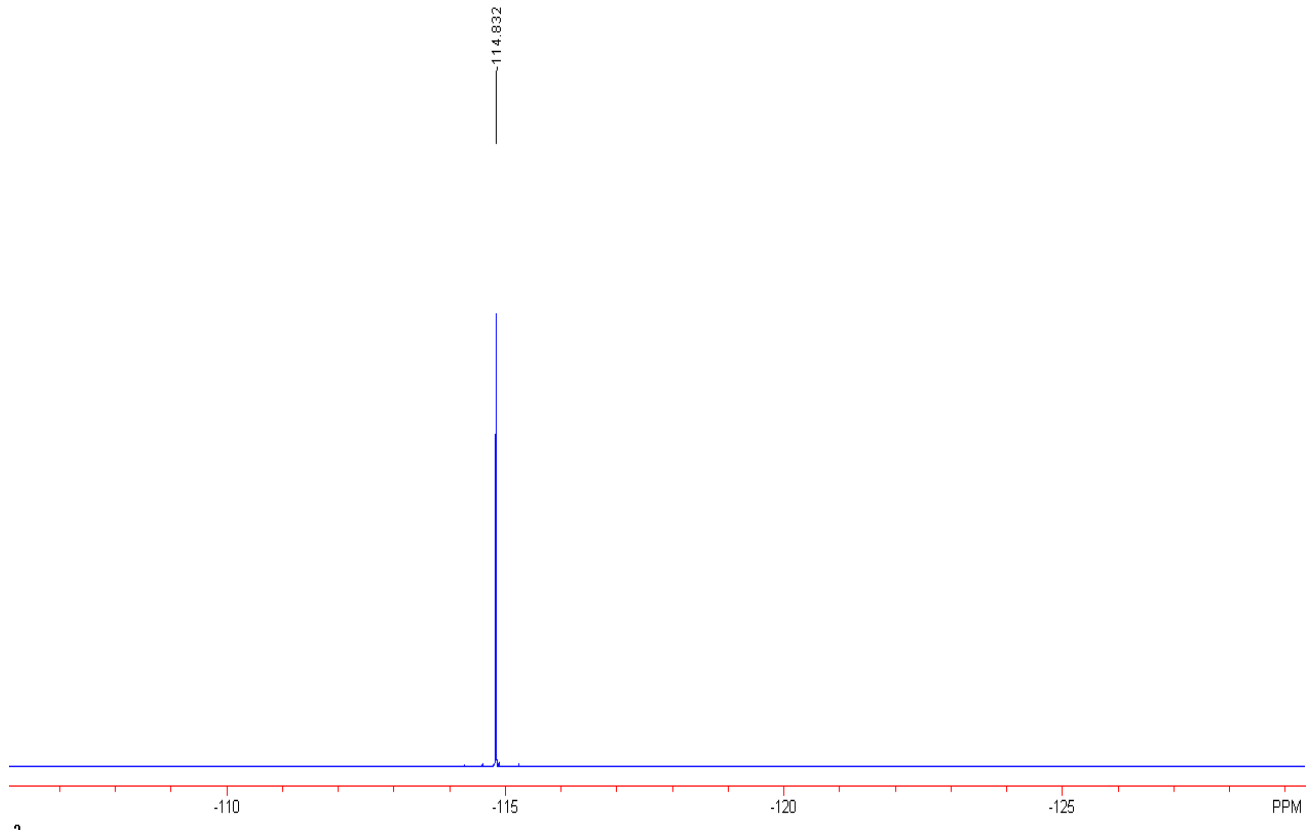
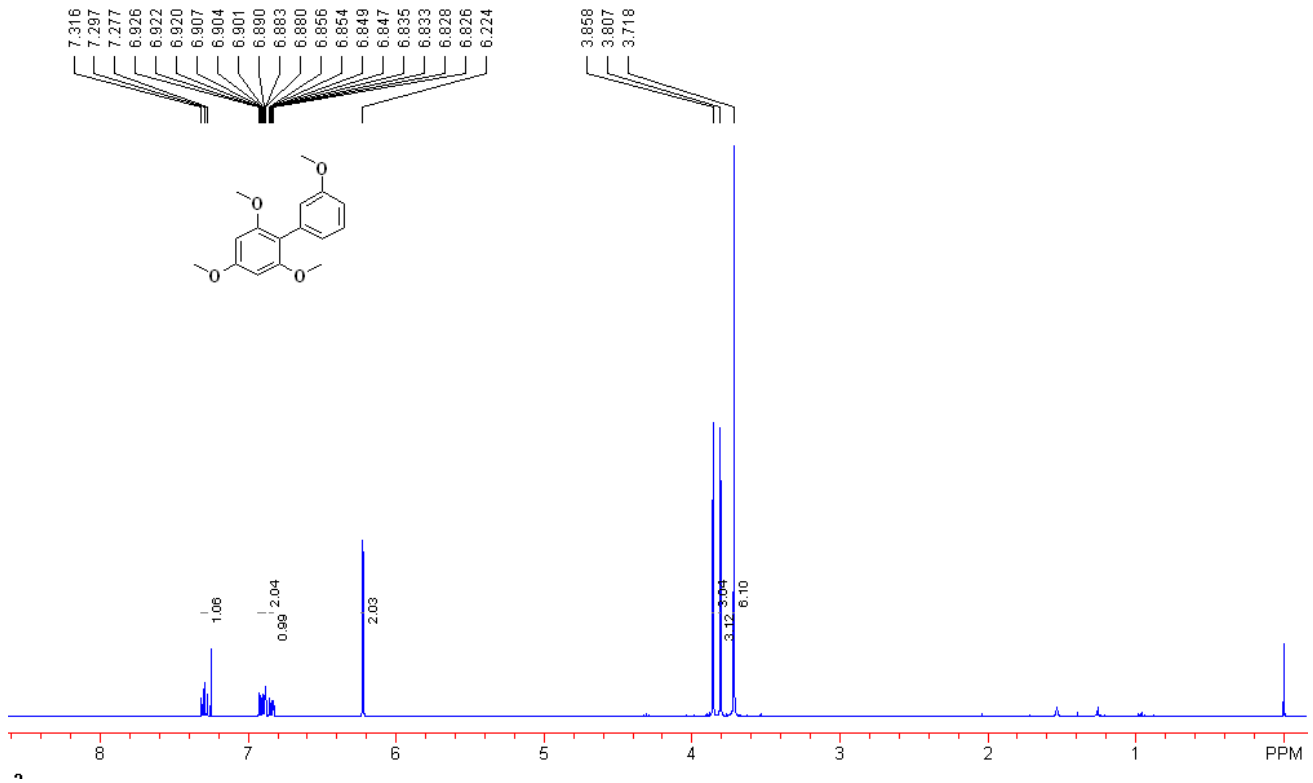
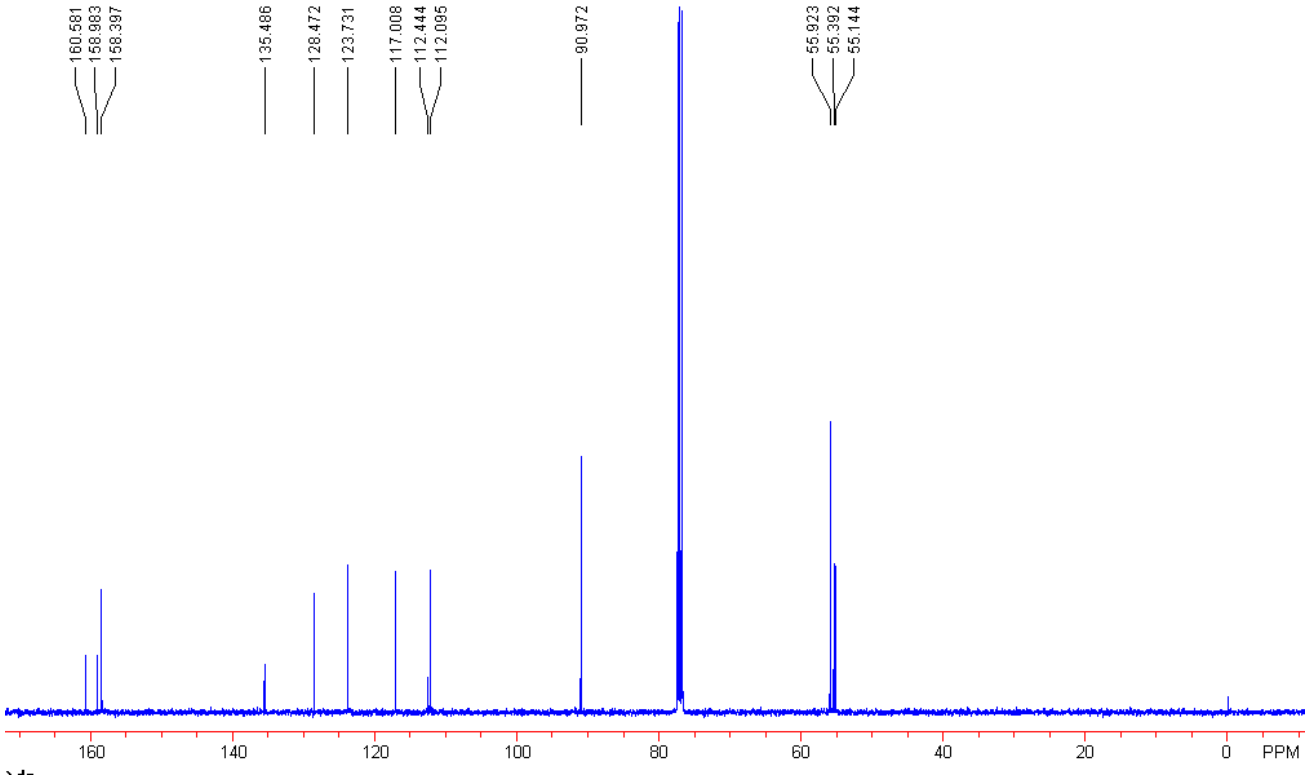
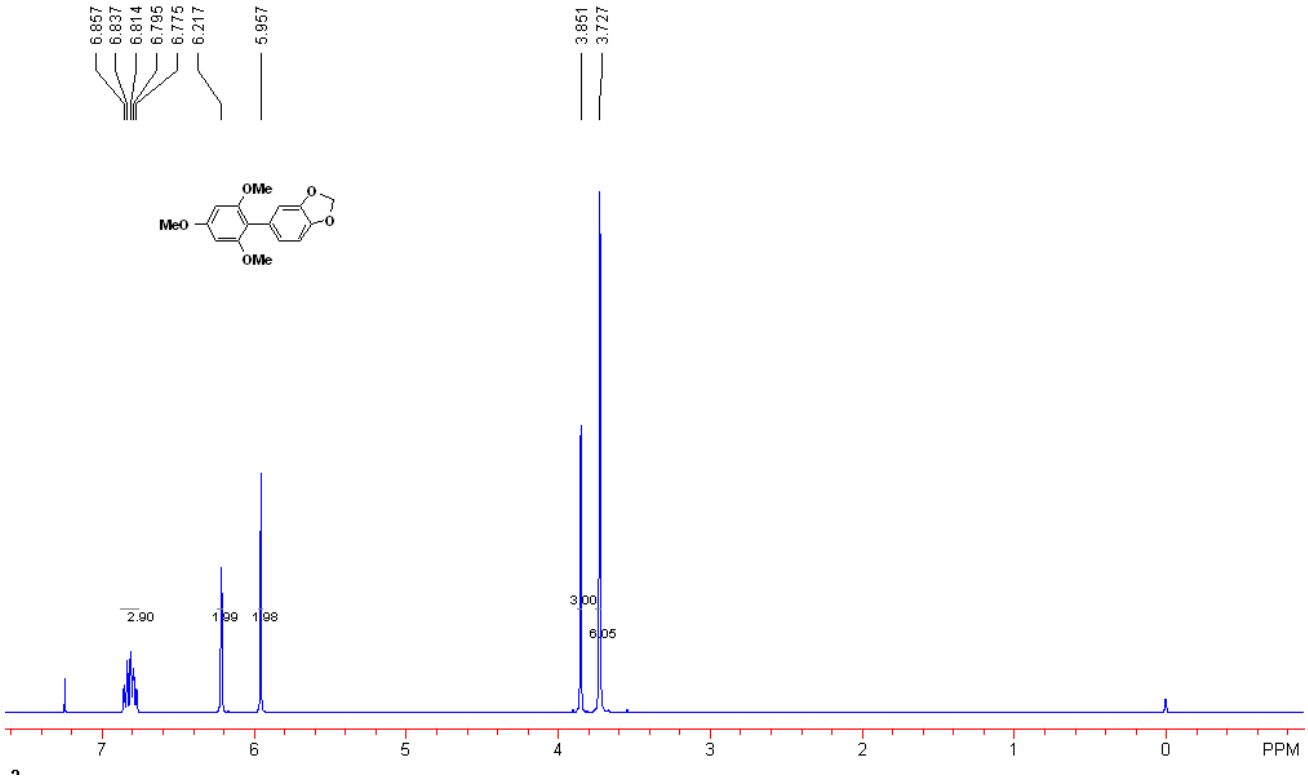


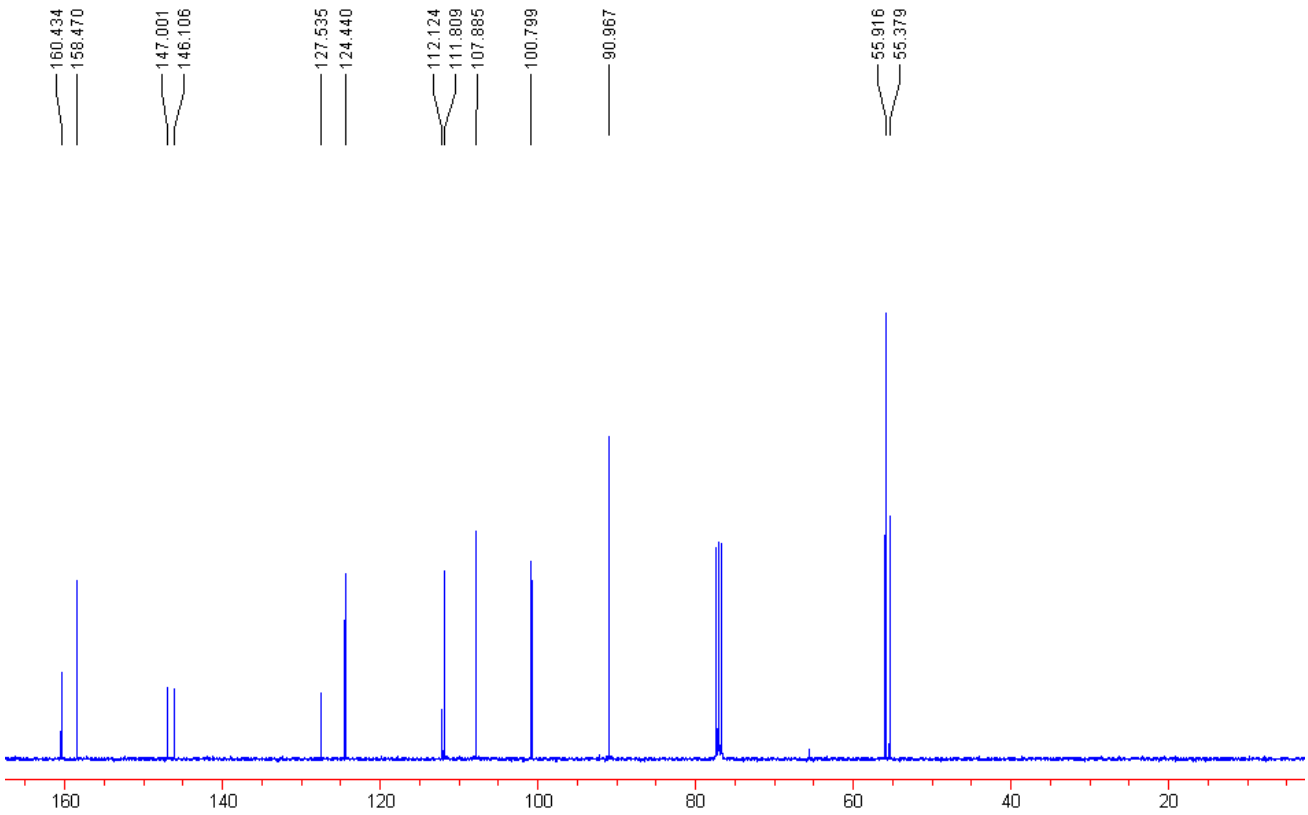
2,3',4,6-tetramethoxybiphenyl (3m).



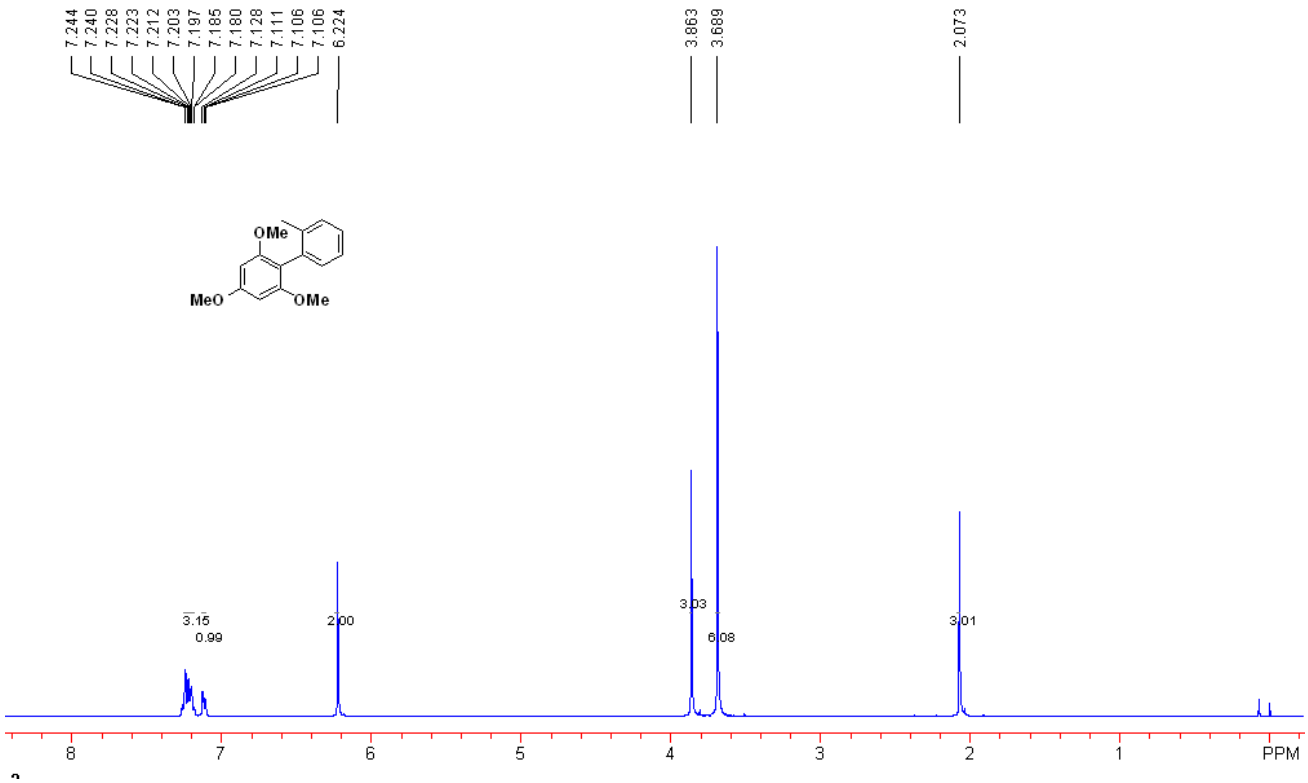


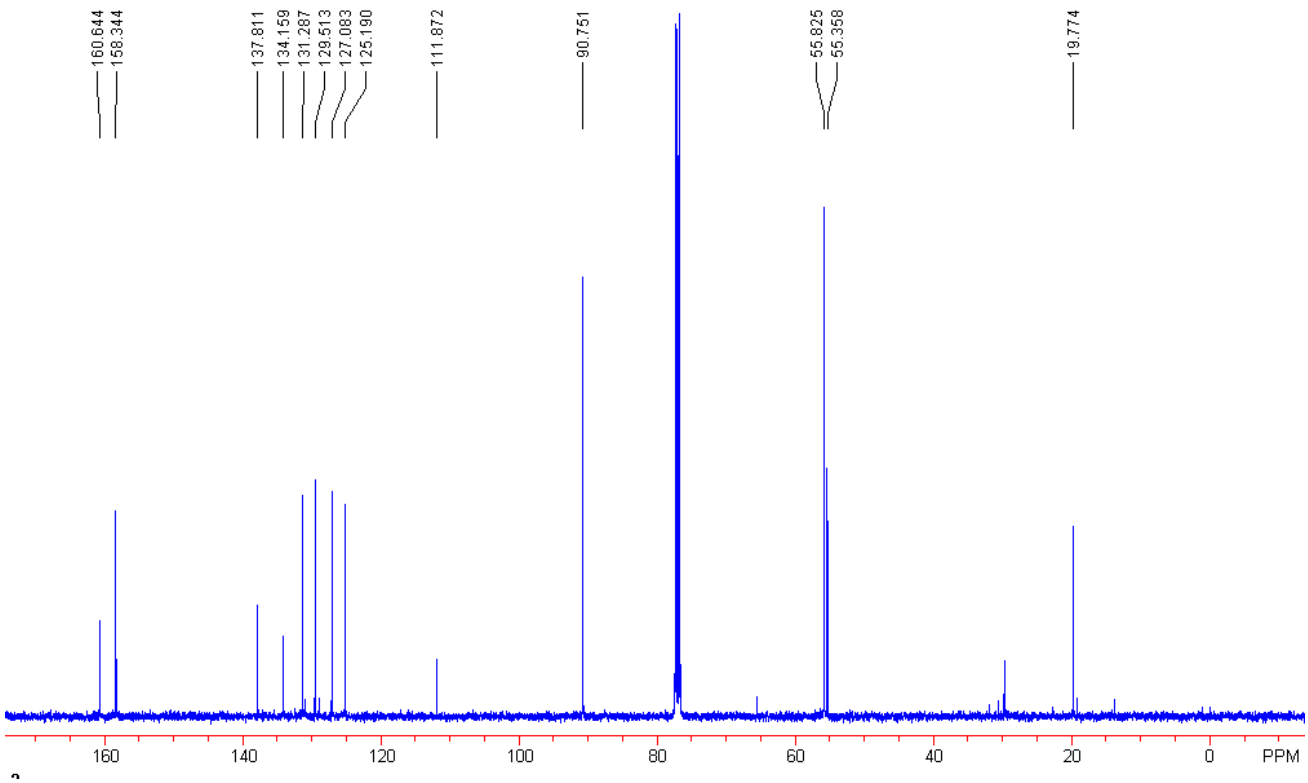
5-(2,4,6-trimethoxyphenyl)benzo[d][1,3]dioxole (3n).



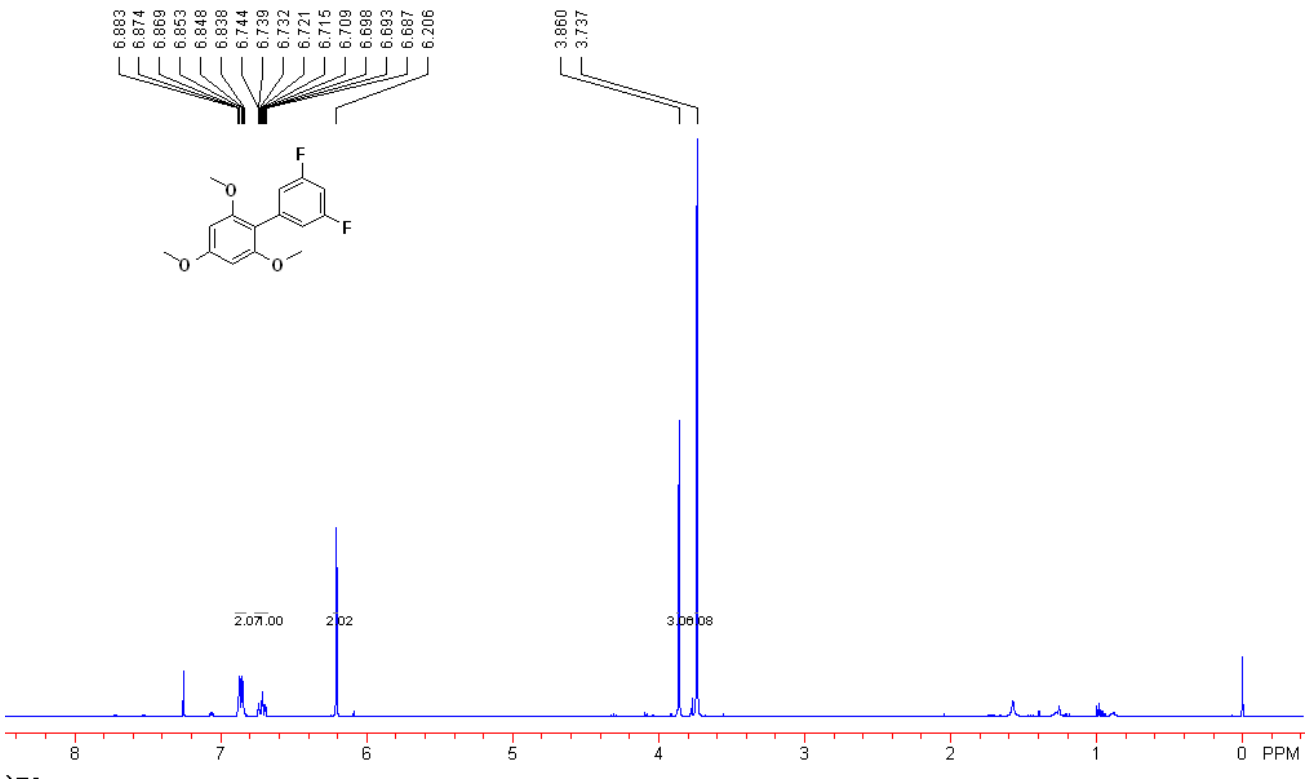


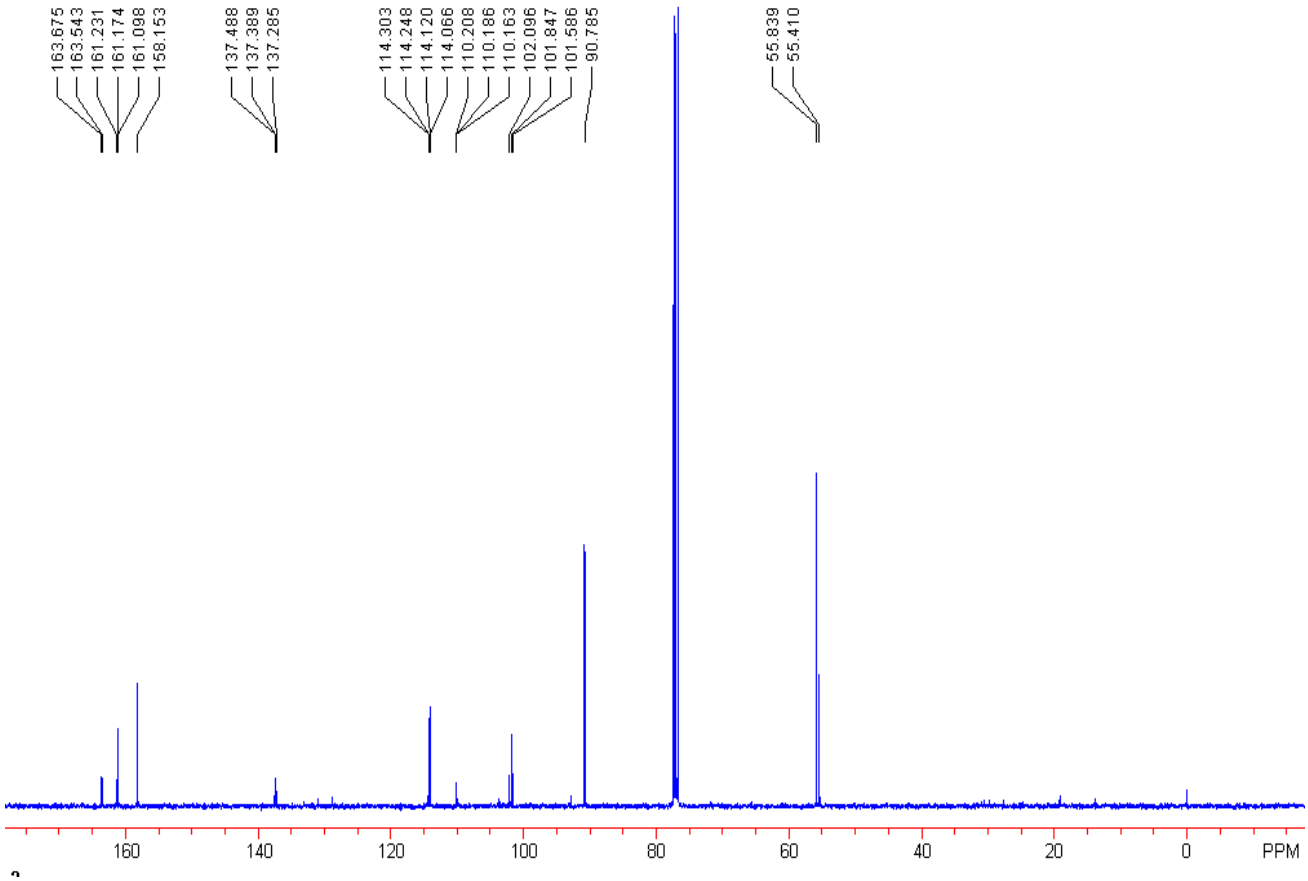
2,4,6-trimethoxy-2'-methylbiphenyl (3o).

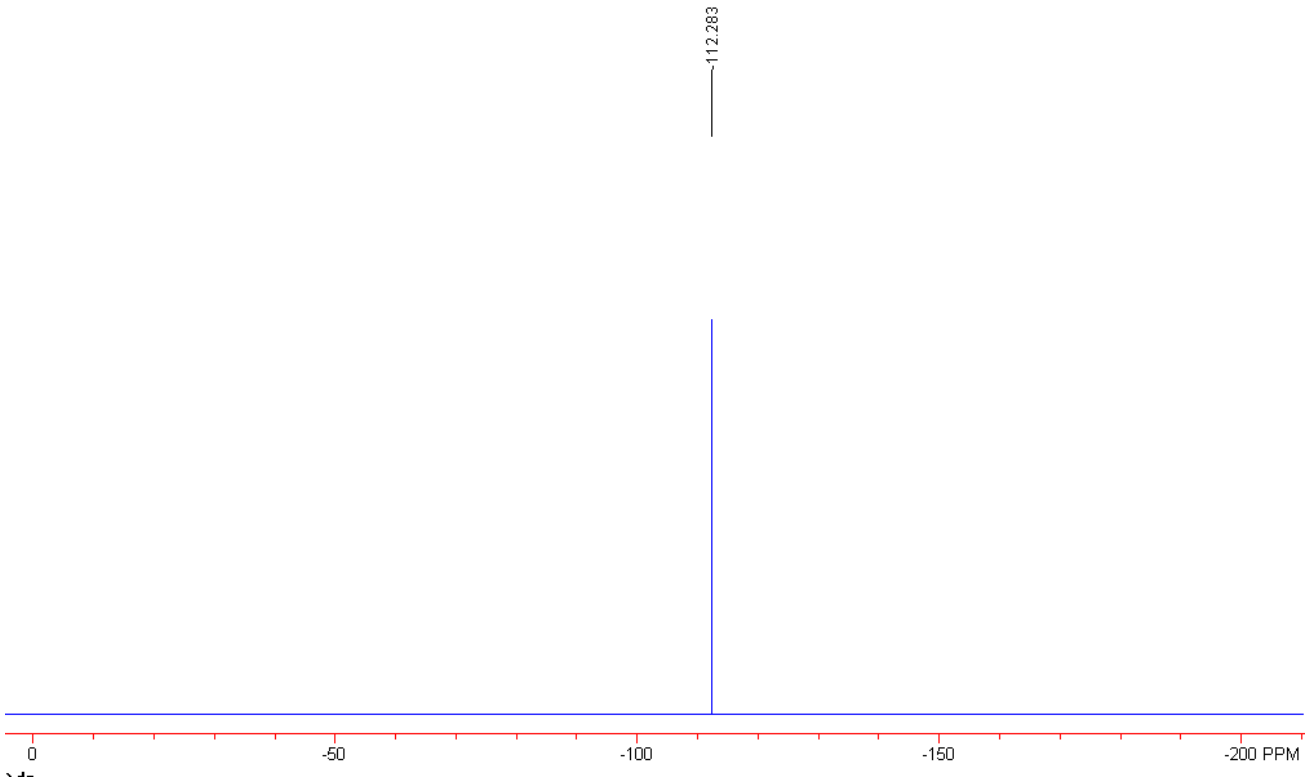




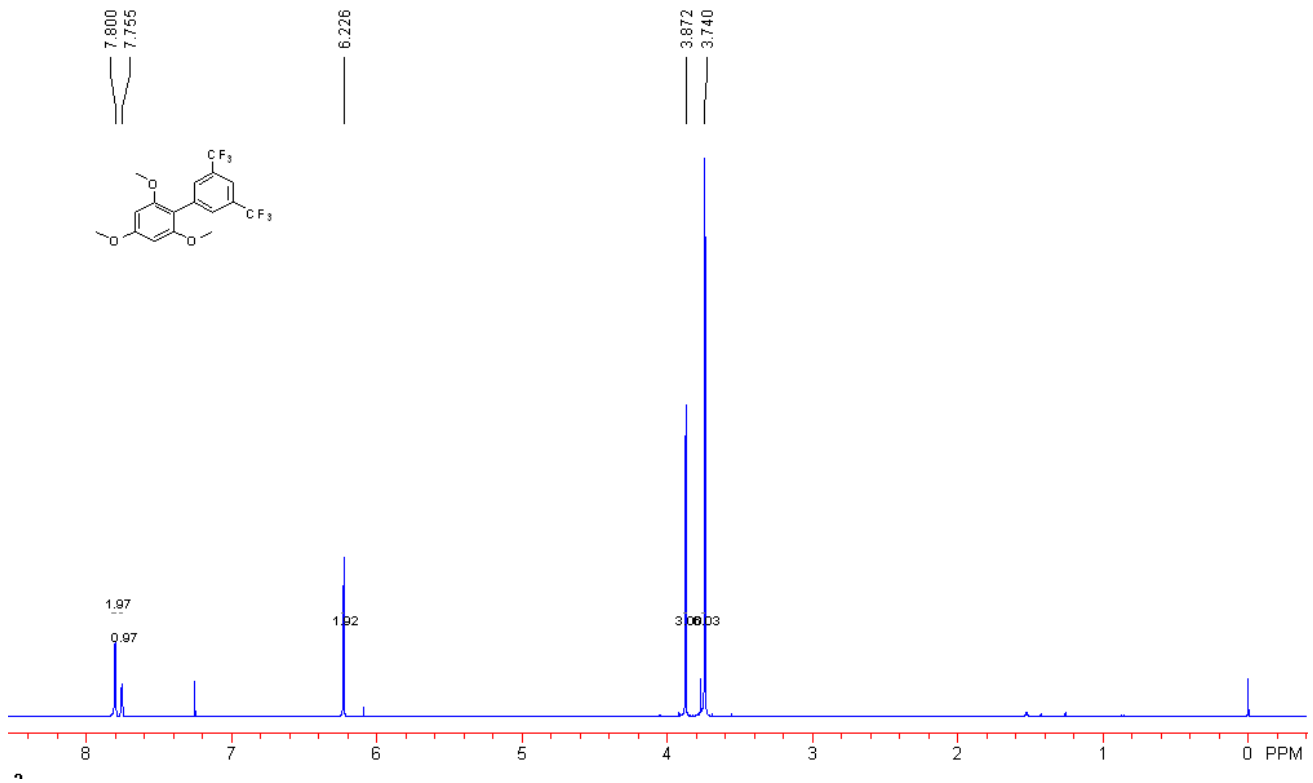
3',5'-difluoro-2,4,6-trimethoxybiphenyl (3p).







2,4,6-trimethoxy-3',5'-bis(trifluoromethyl)biphenyl (3q).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CF3
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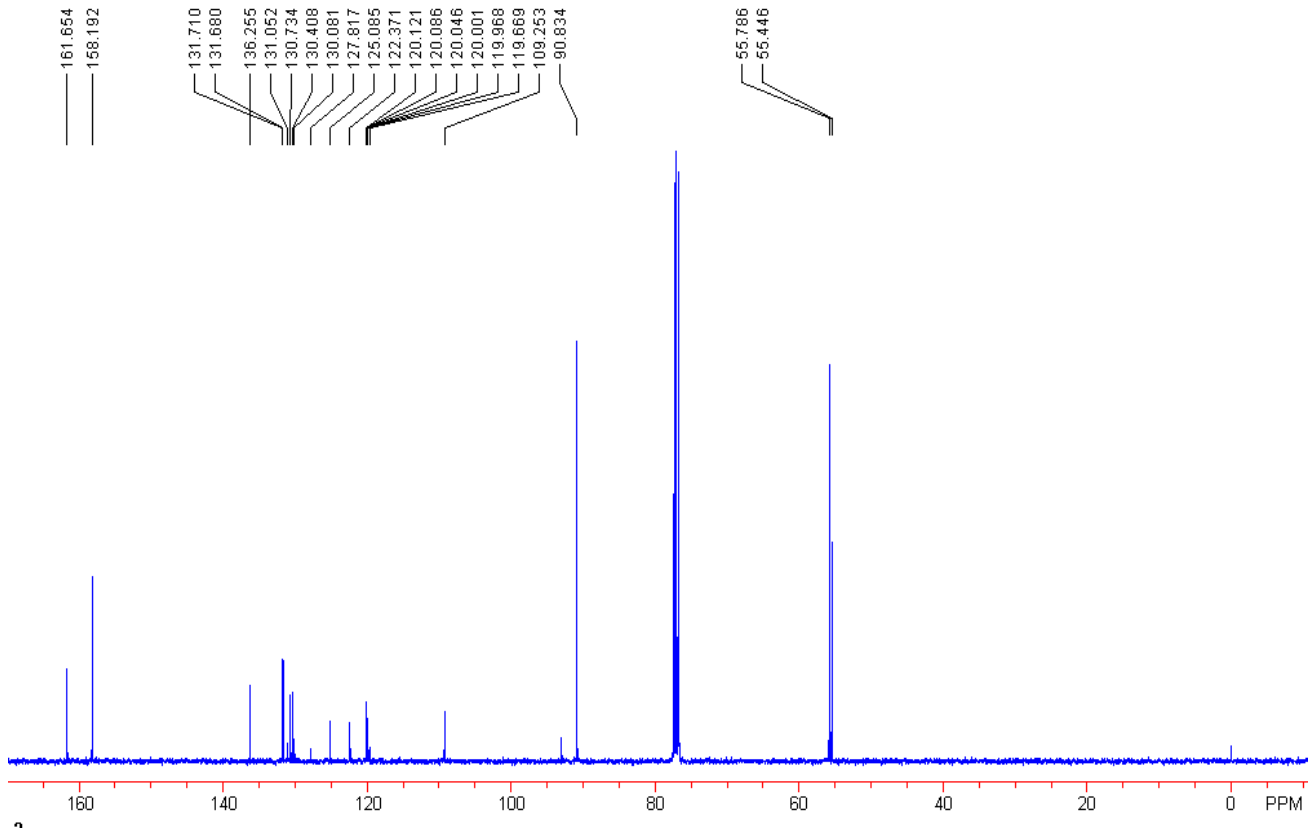
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120.046
120.001
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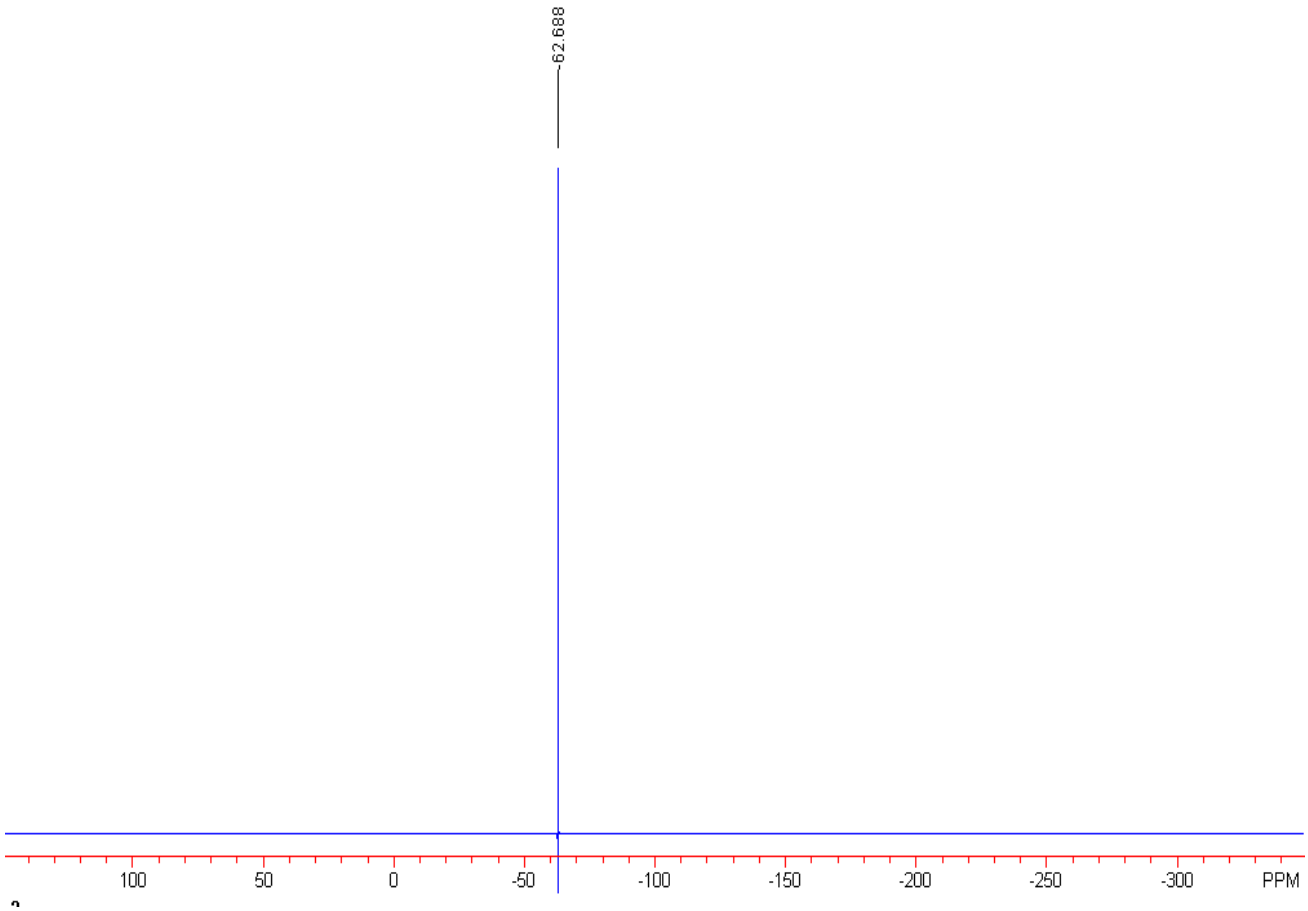
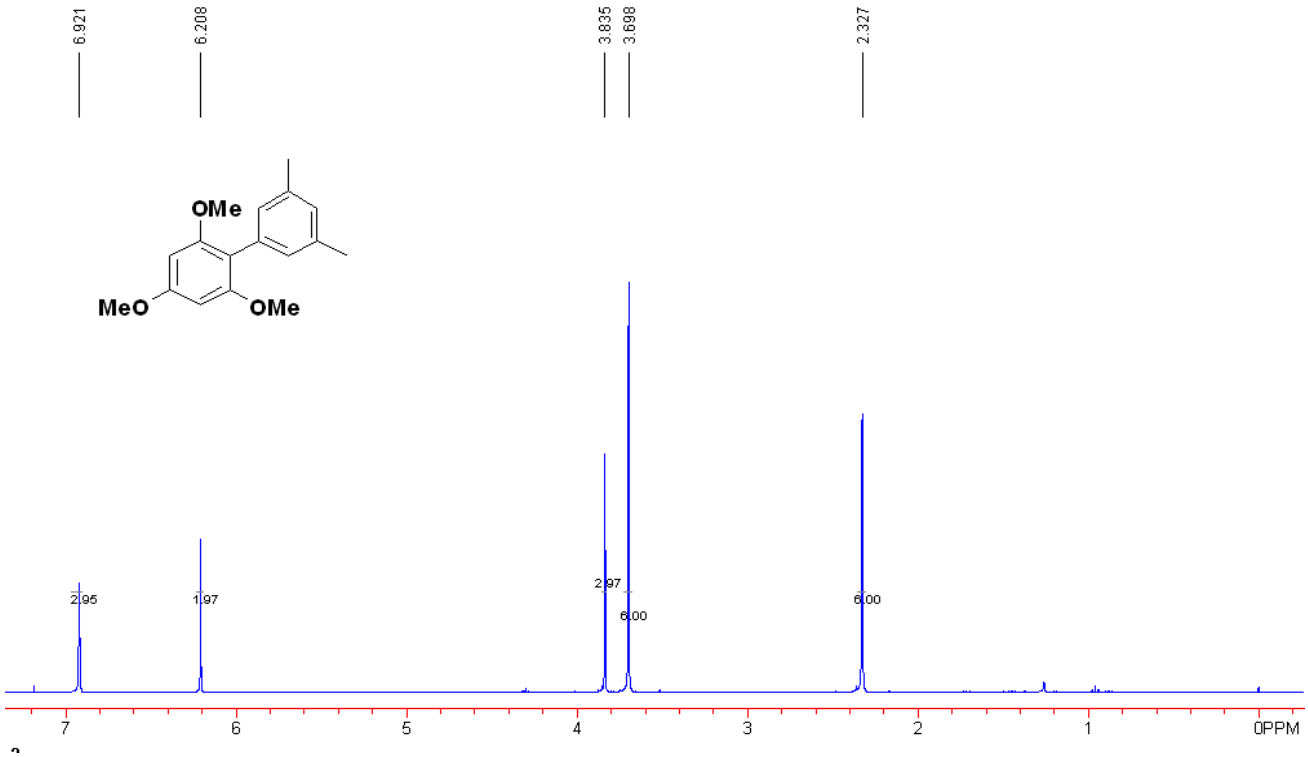
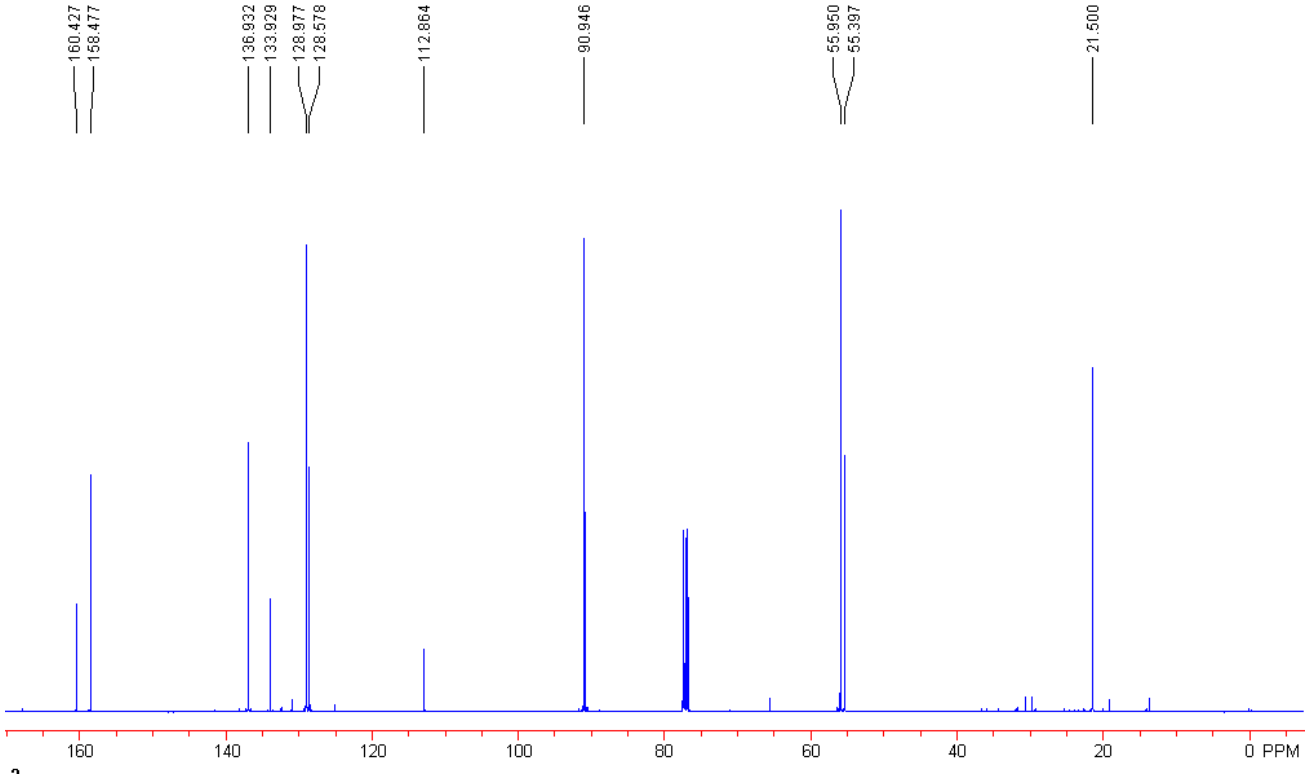
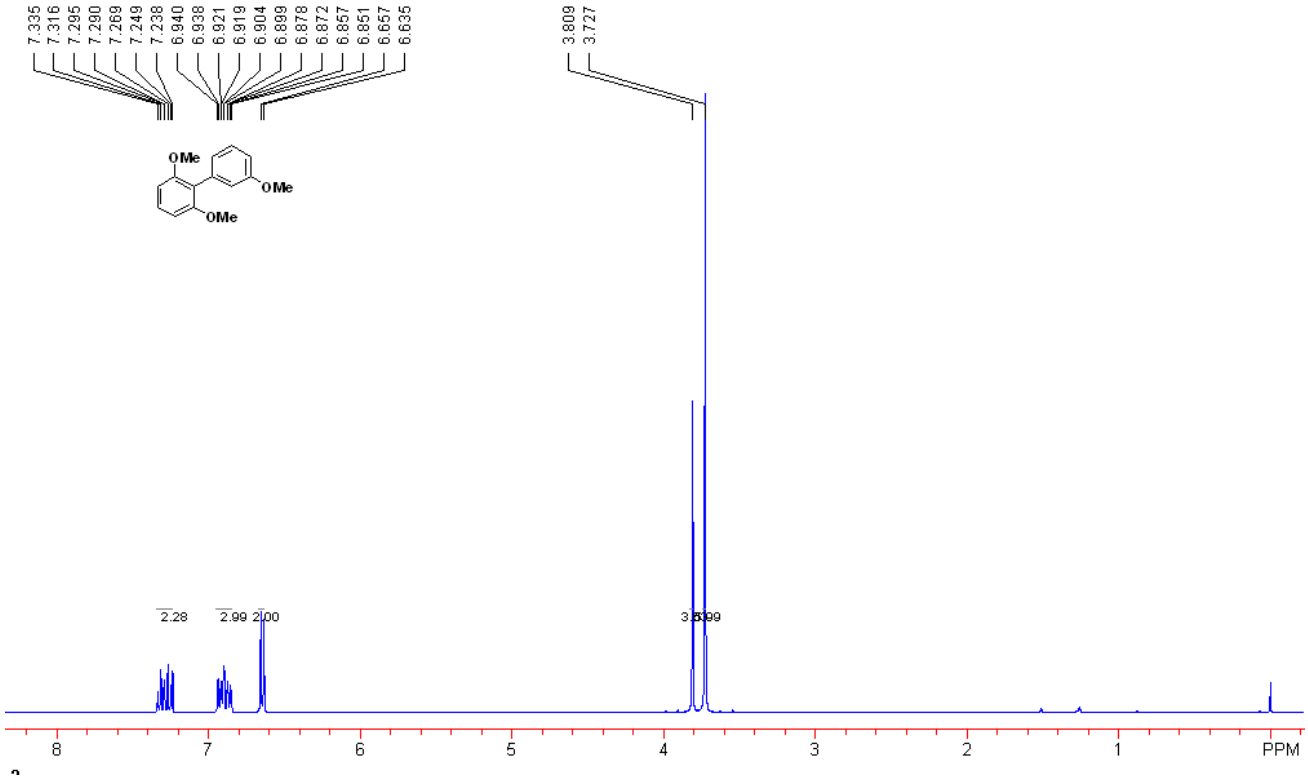


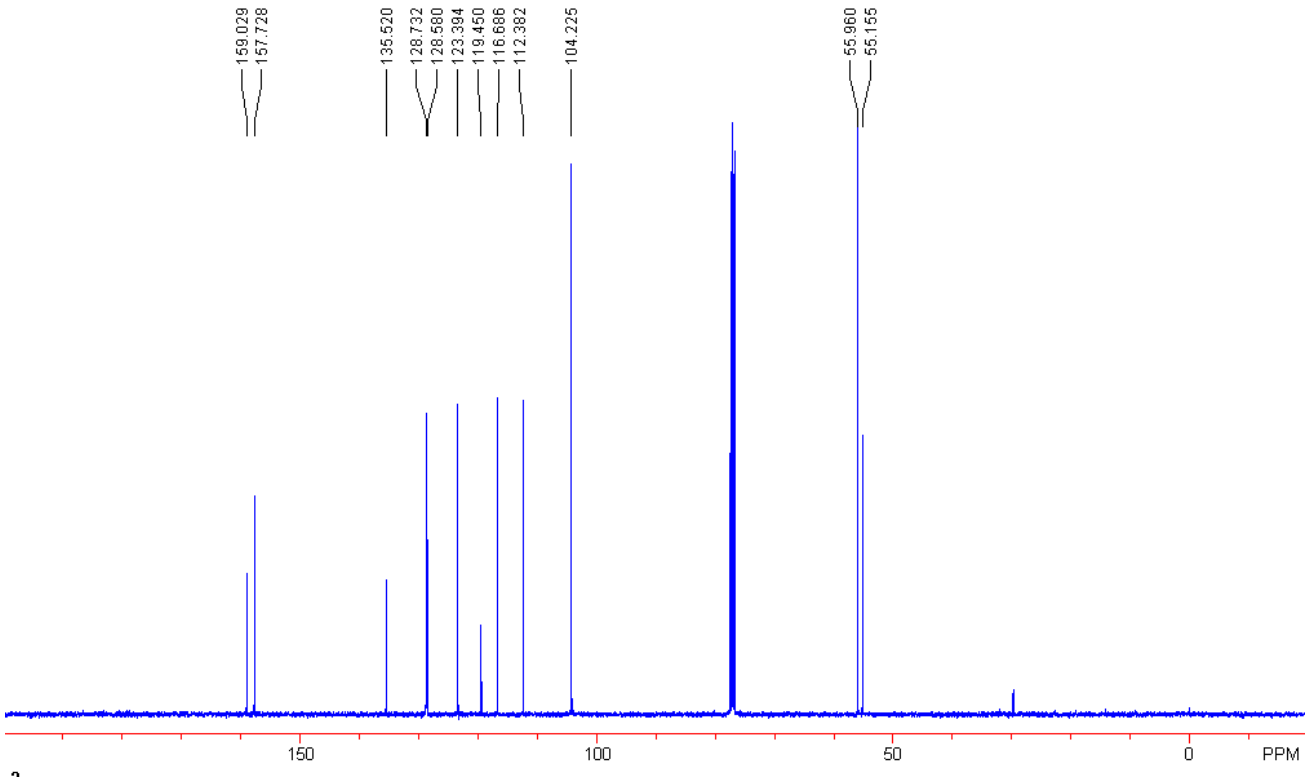
2,4,6-trimethoxy-3',5'-dimethylbiphenyl (3r).



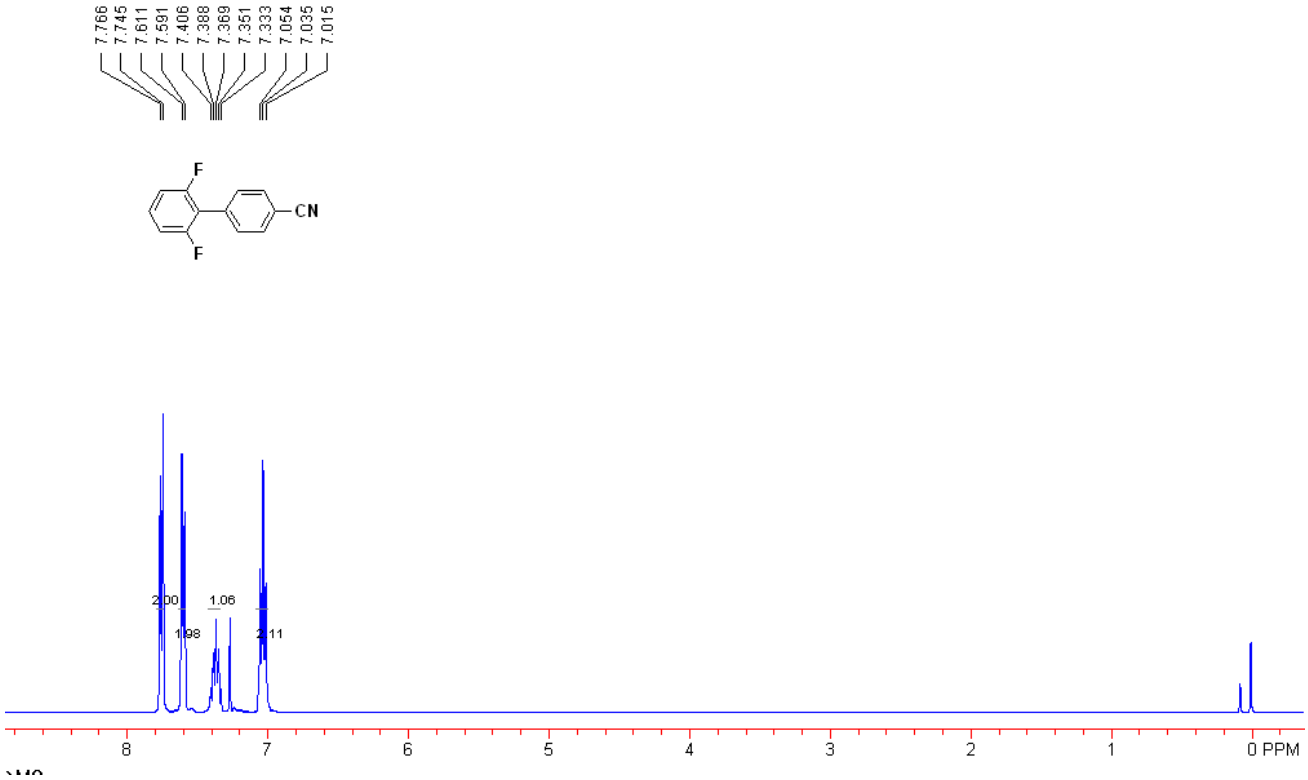


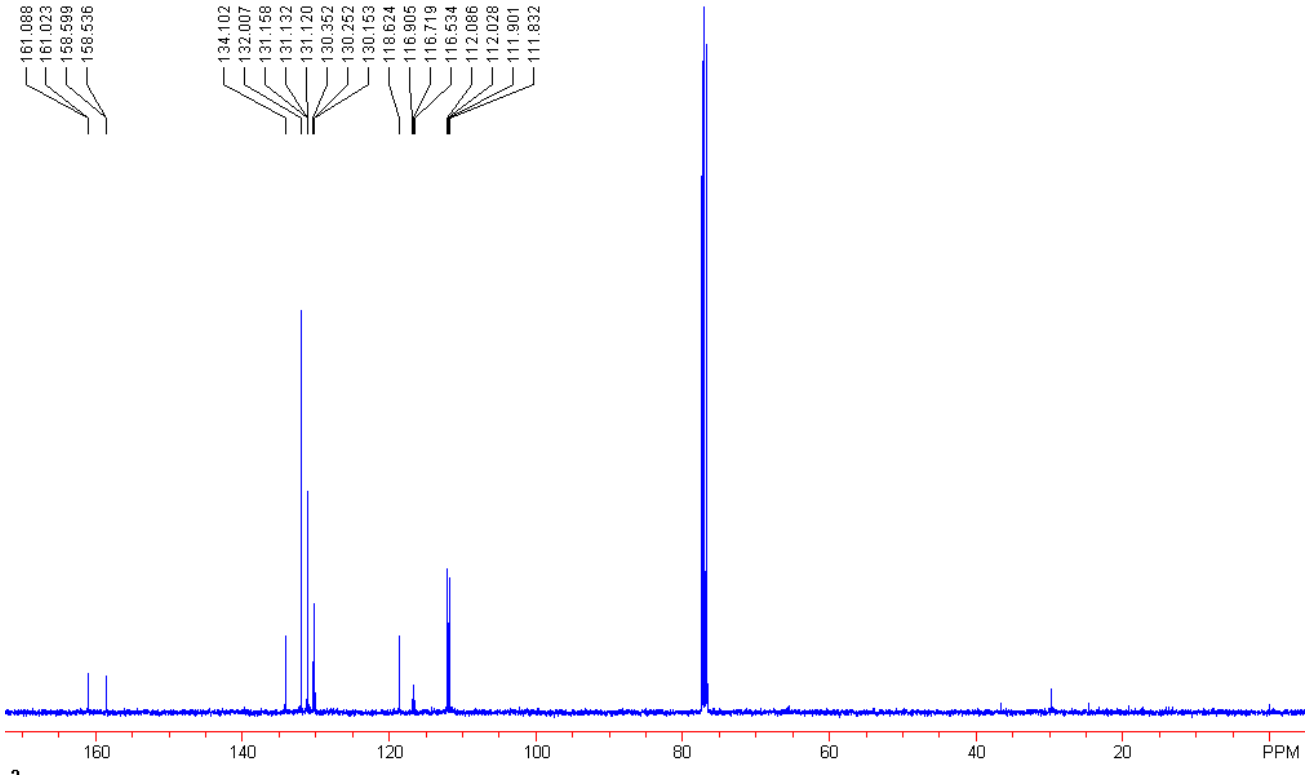
2,3',6-trimethoxybiphenyl (4a).

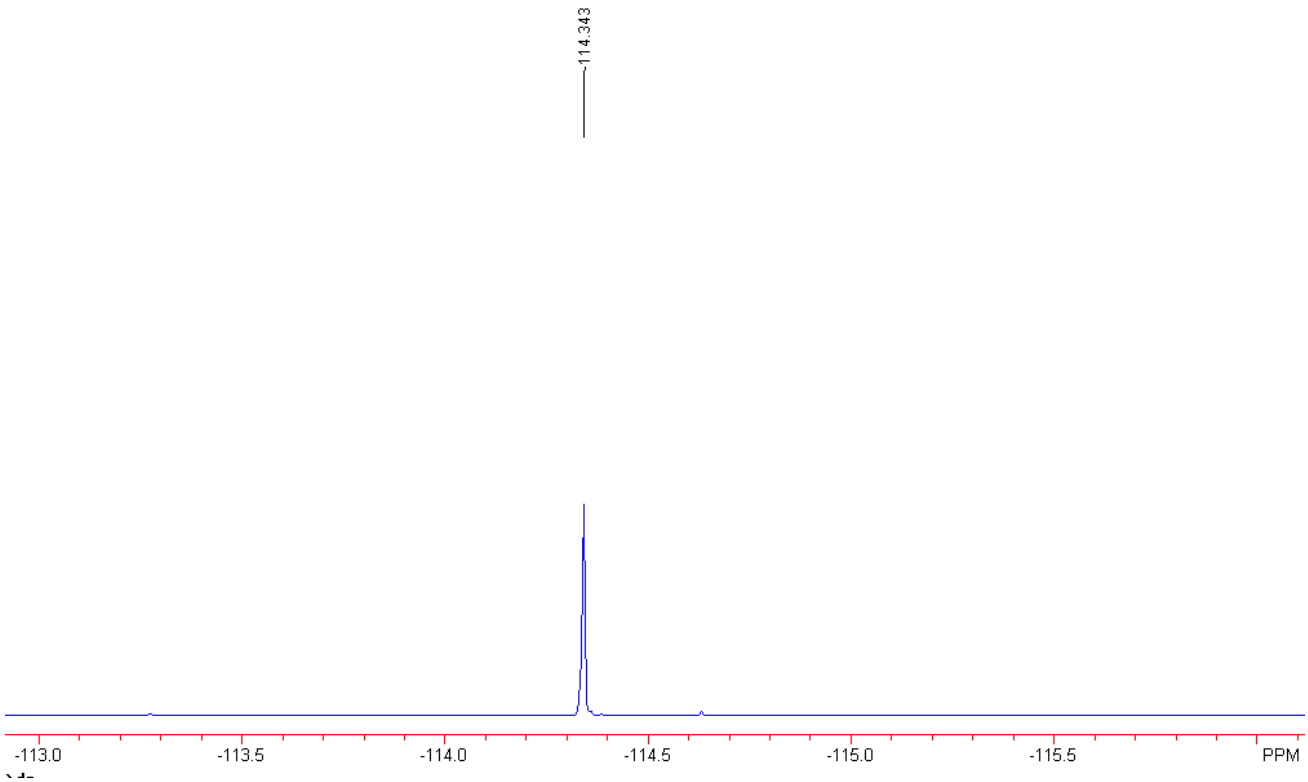




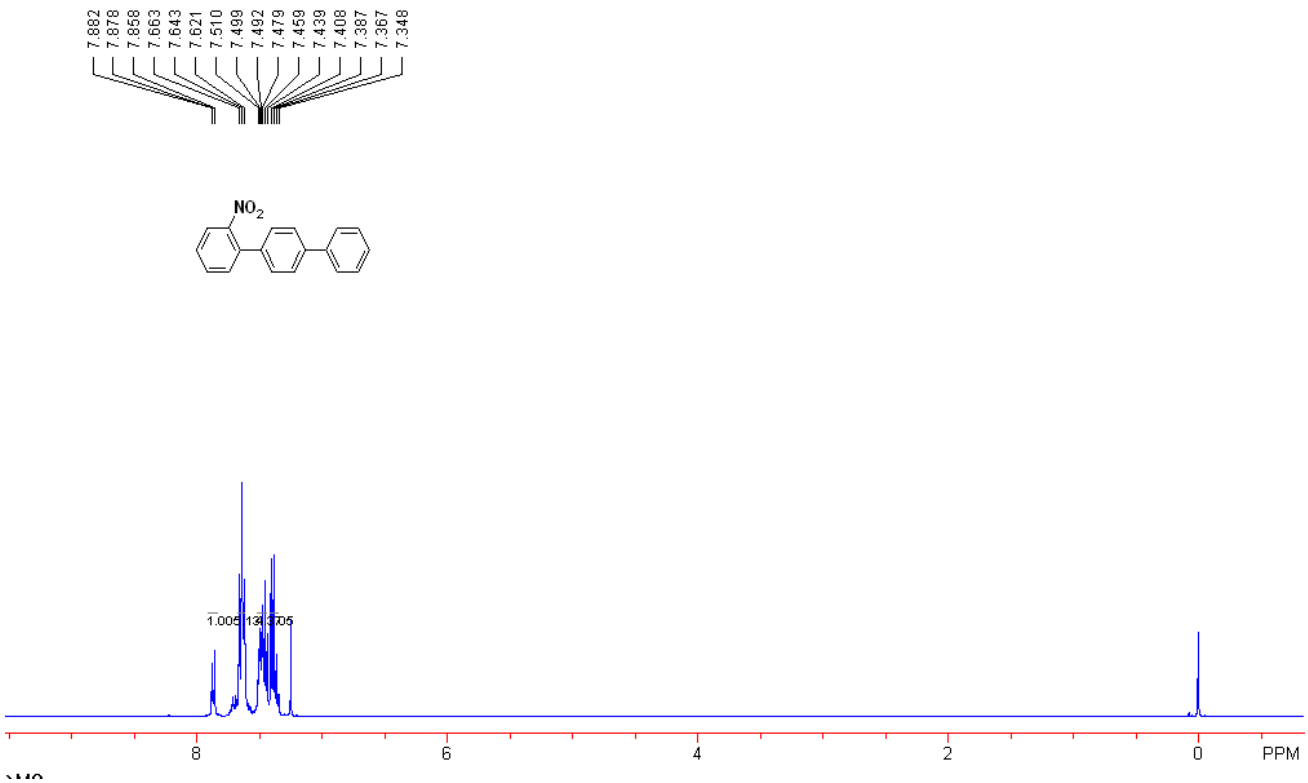
2',6'-difluorobiphenyl-4-carbonitrile (4b).

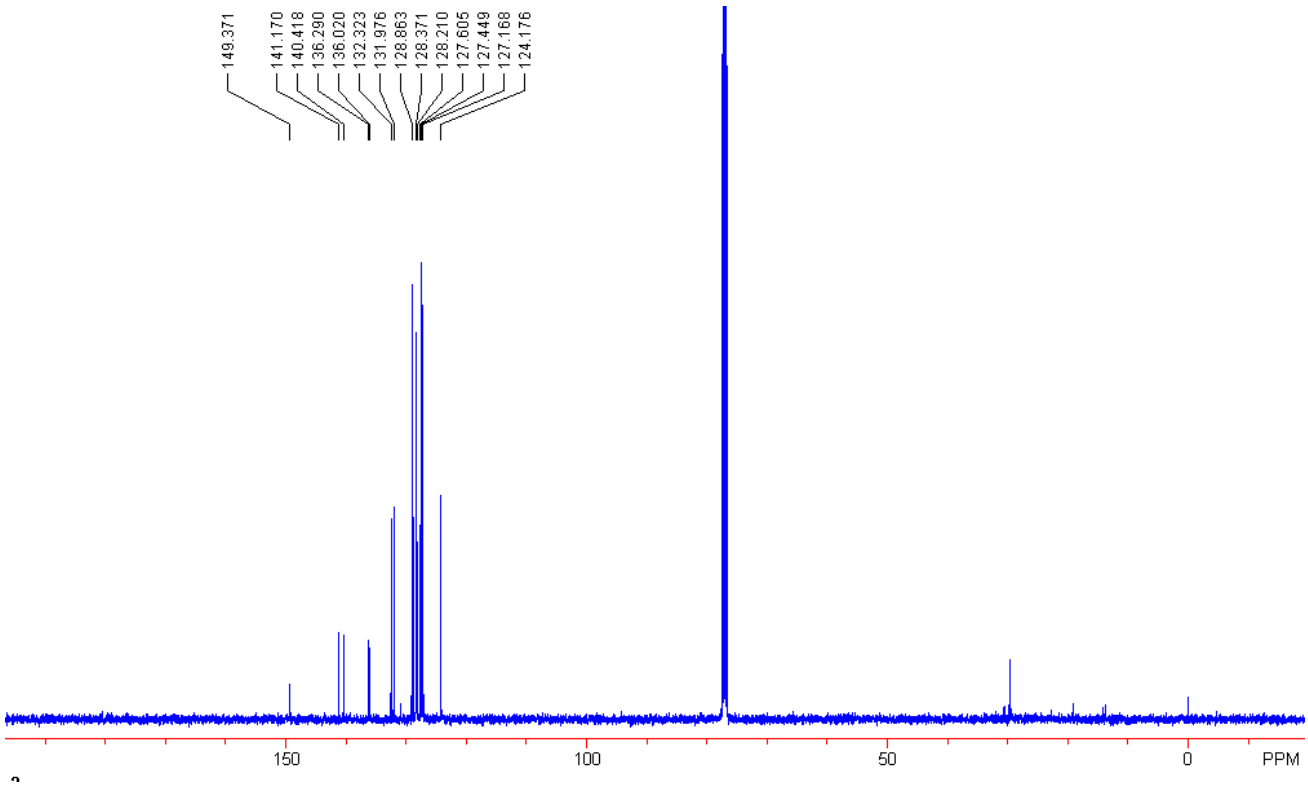




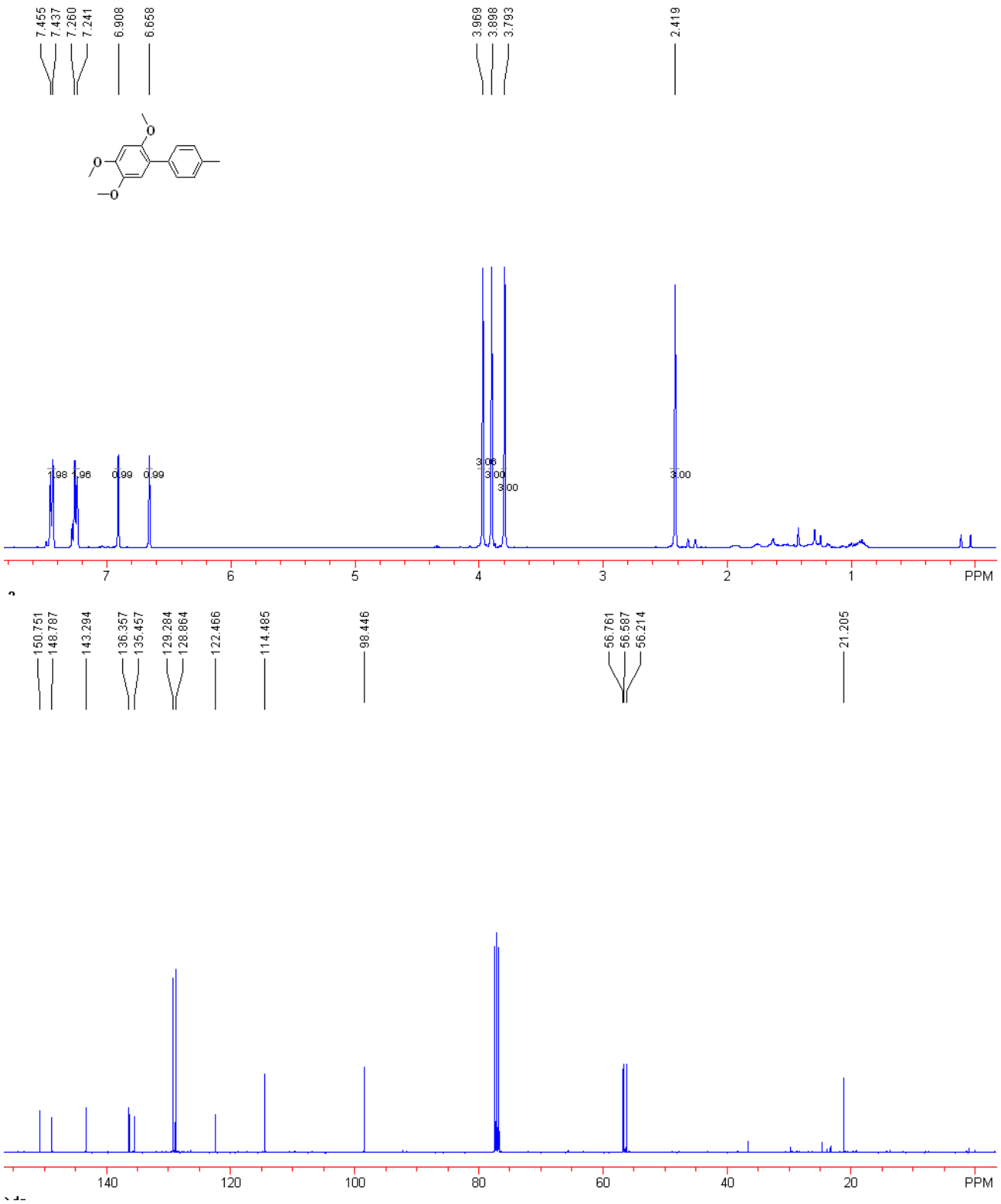


4'-phenyl-2-nitrobiphenyl (4c).

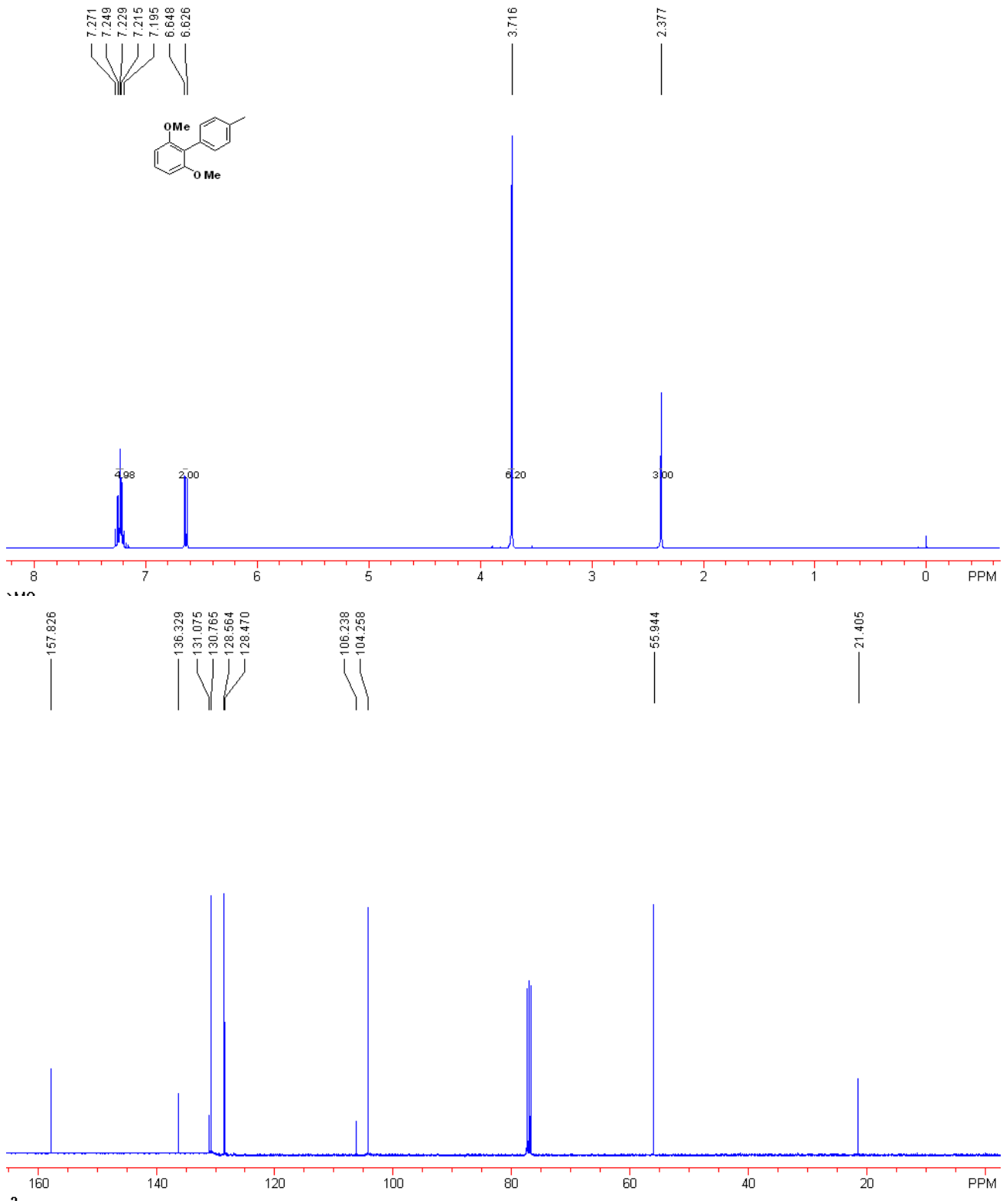




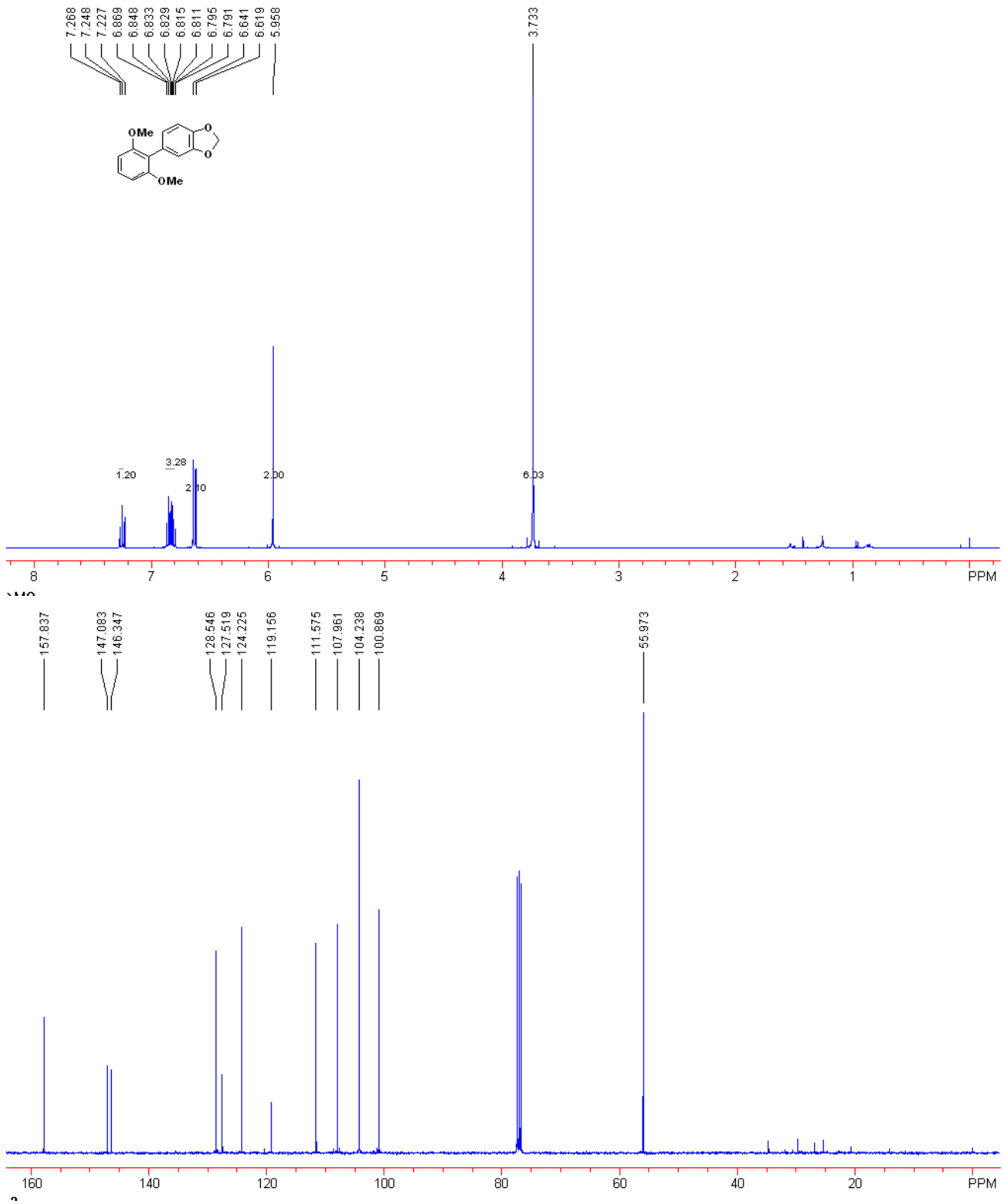
2,4,5-trimethoxy-4'-methylbiphenyl (5a).



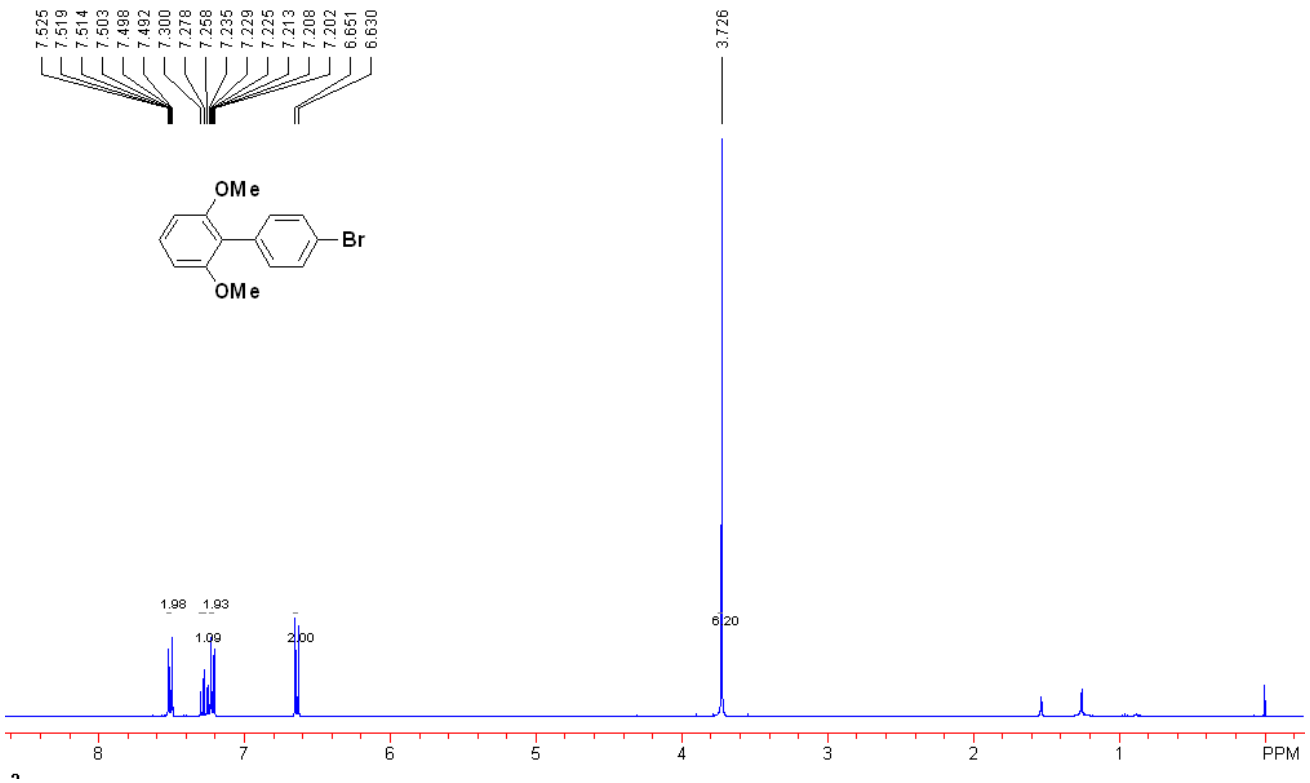
2,6-dimethoxy-4'-methylbiphenyl (5b).

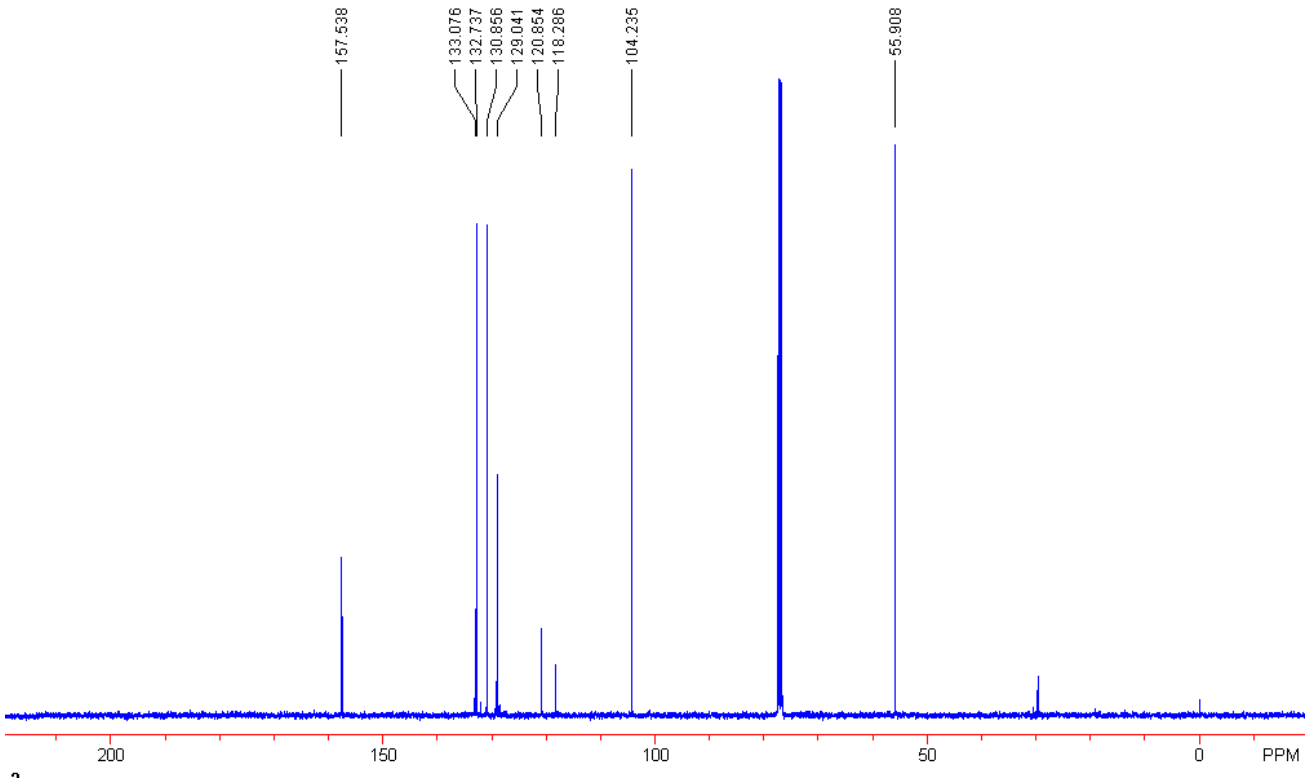


5-(2,6-dimethoxyphenyl)benzo[d][1,3]dioxole (5c).

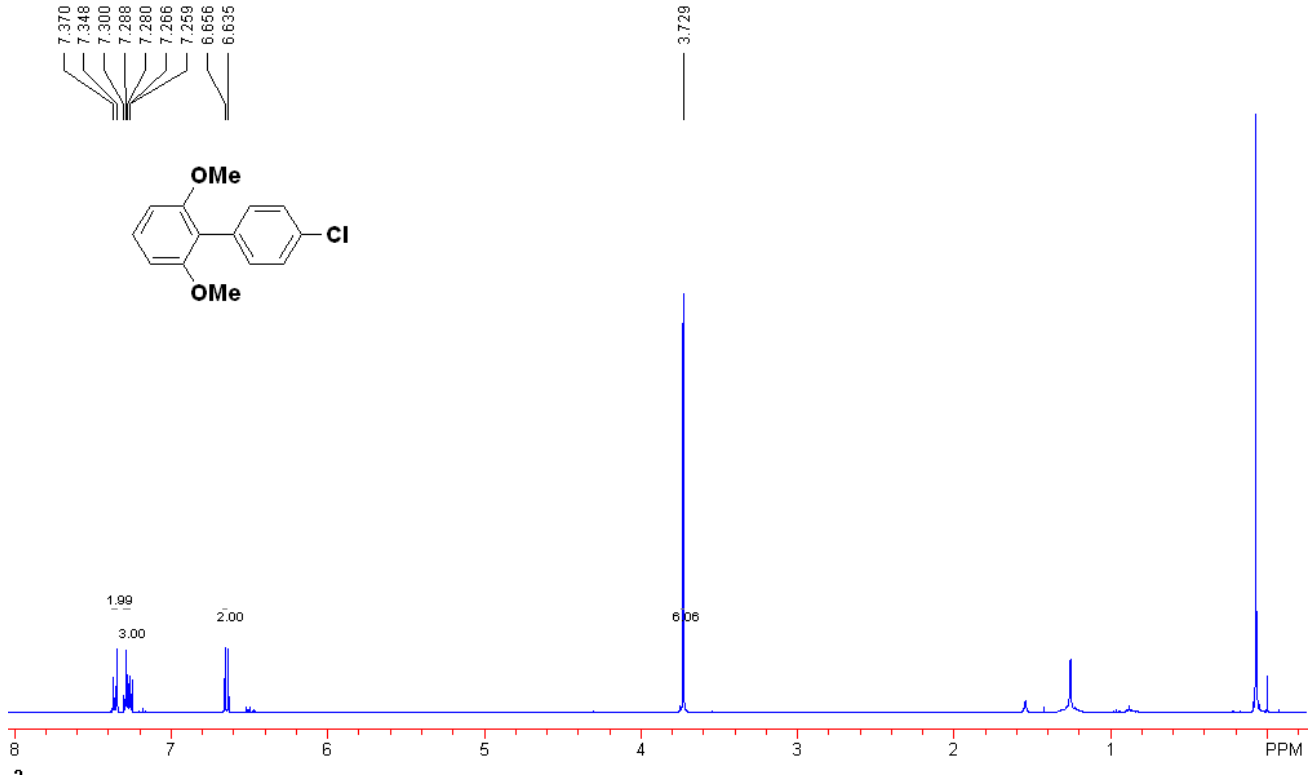


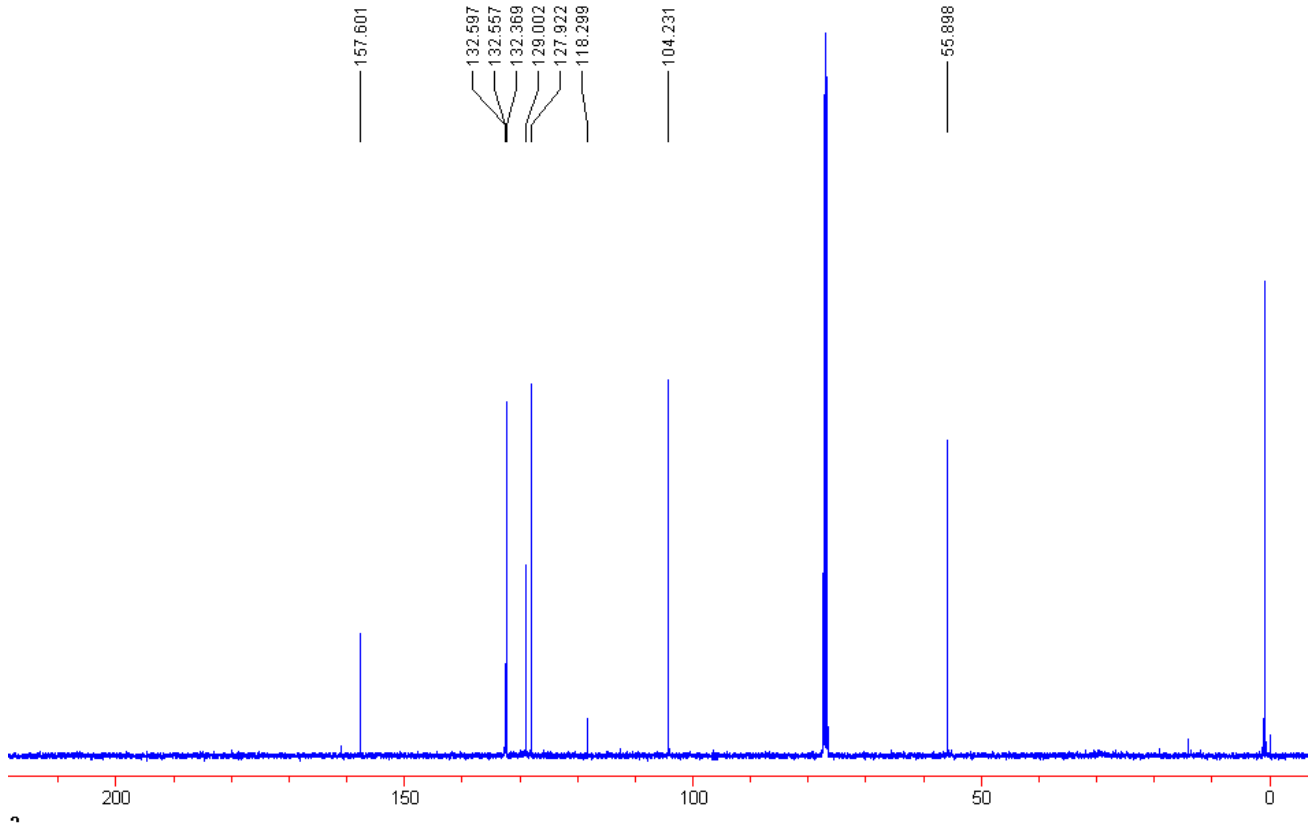
4'-bromo-2,6-dimethoxybiphenyl (5d).





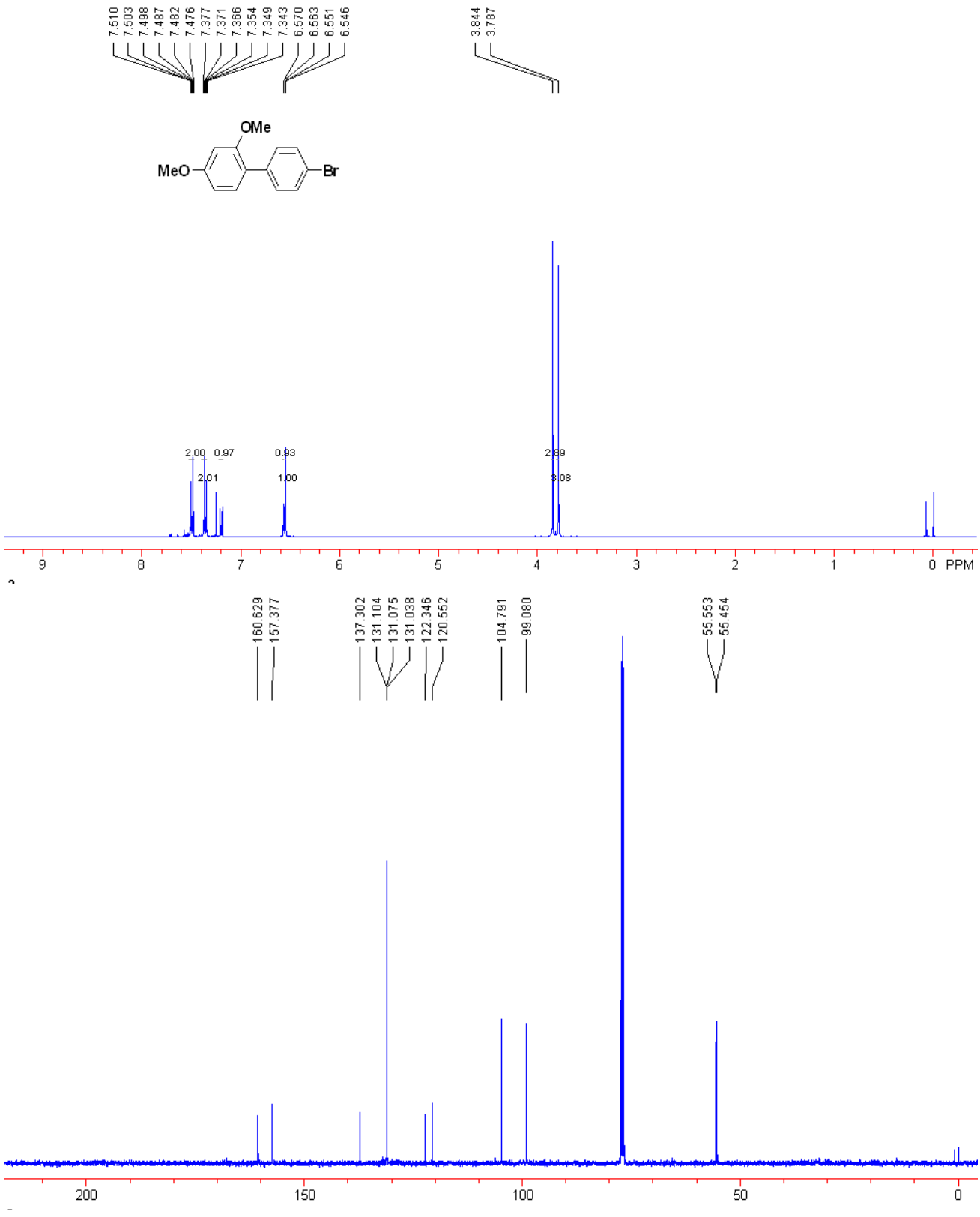
4'-chloro-2,6-dimethoxybiphenyl (5e).



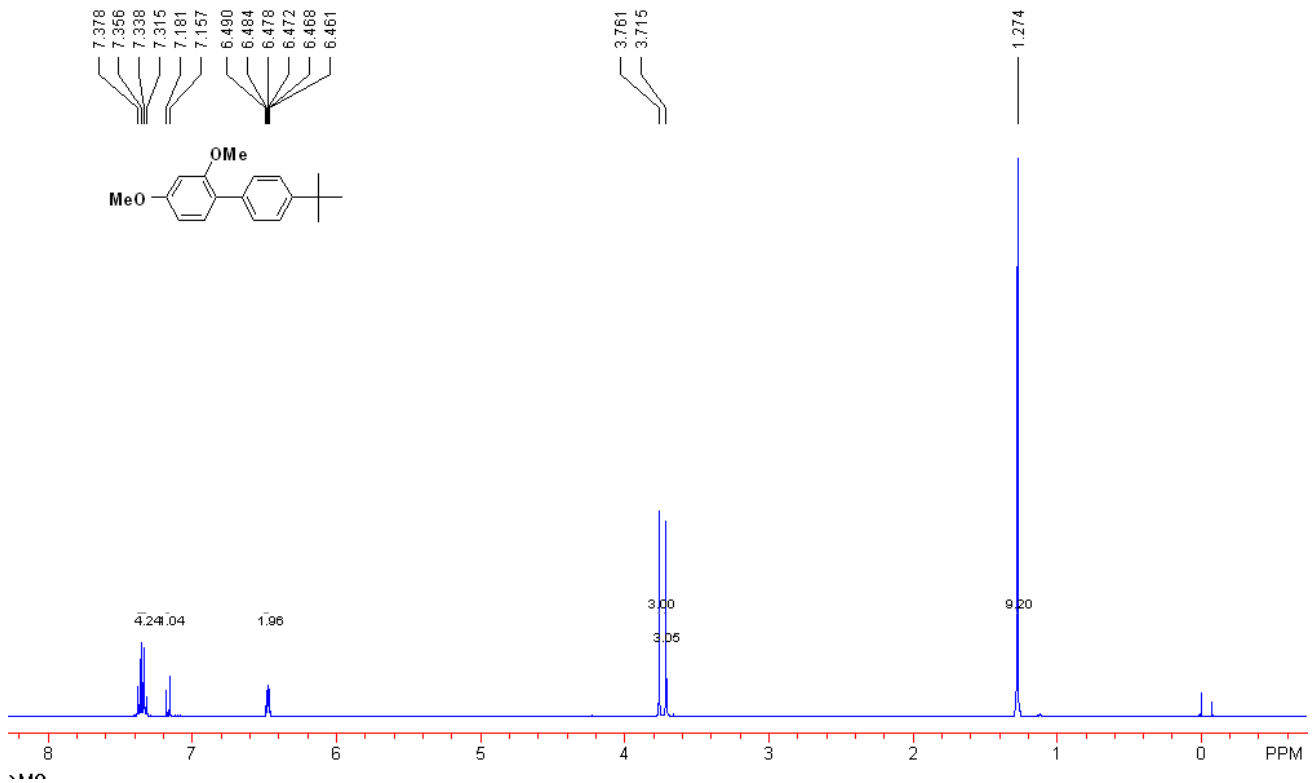


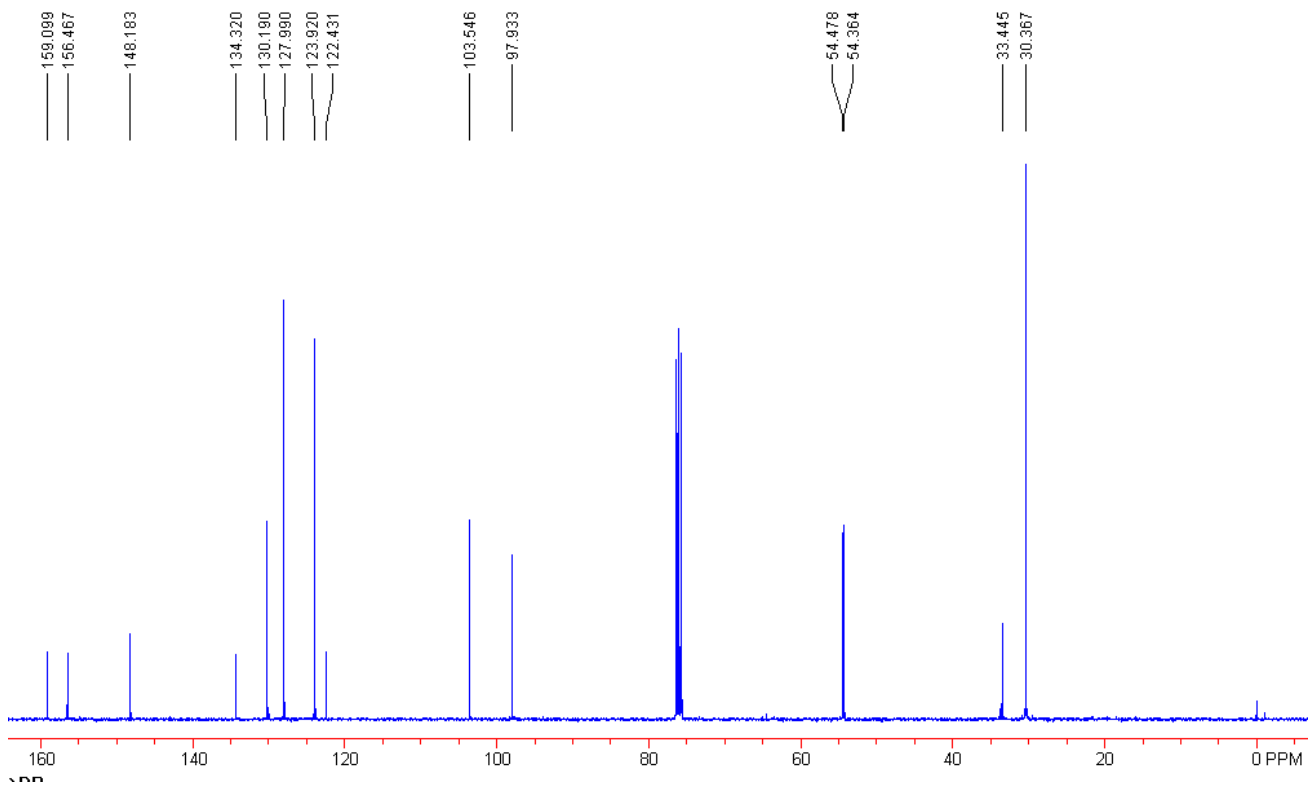
3'-chloro-2,6-dimethoxybiphenyl (5f).

4'-bromo-2,4-dimethoxybiphenyl (5g).

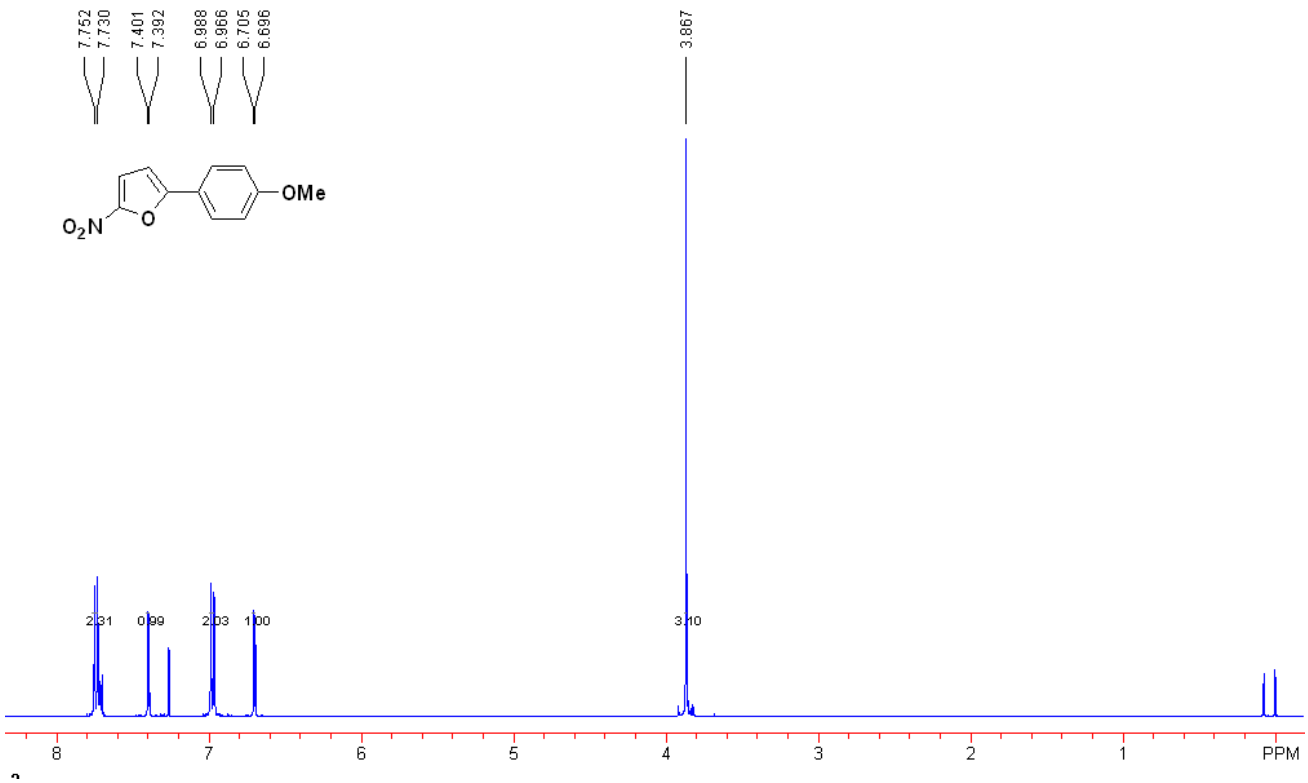


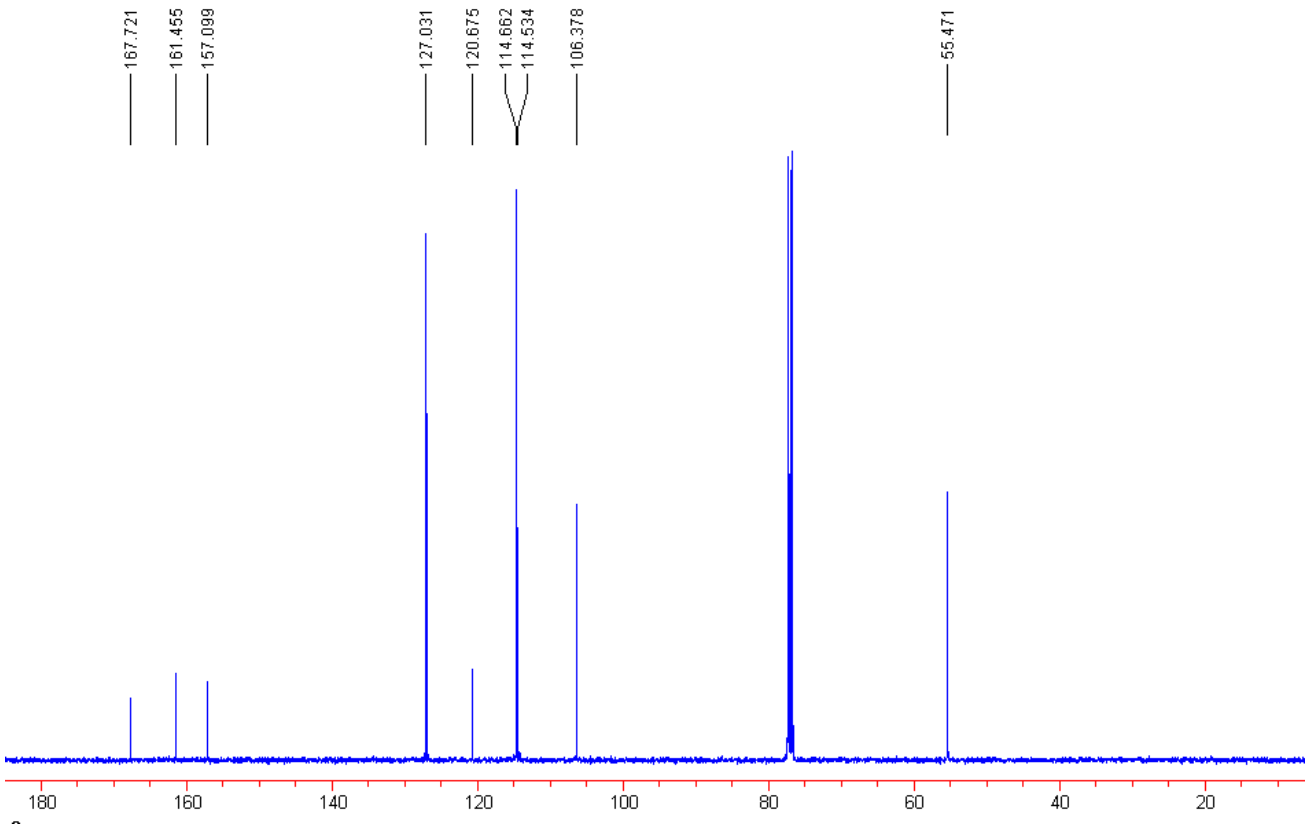
4'-tert-butyl-2,4-dimethoxybiphenyl (5h).



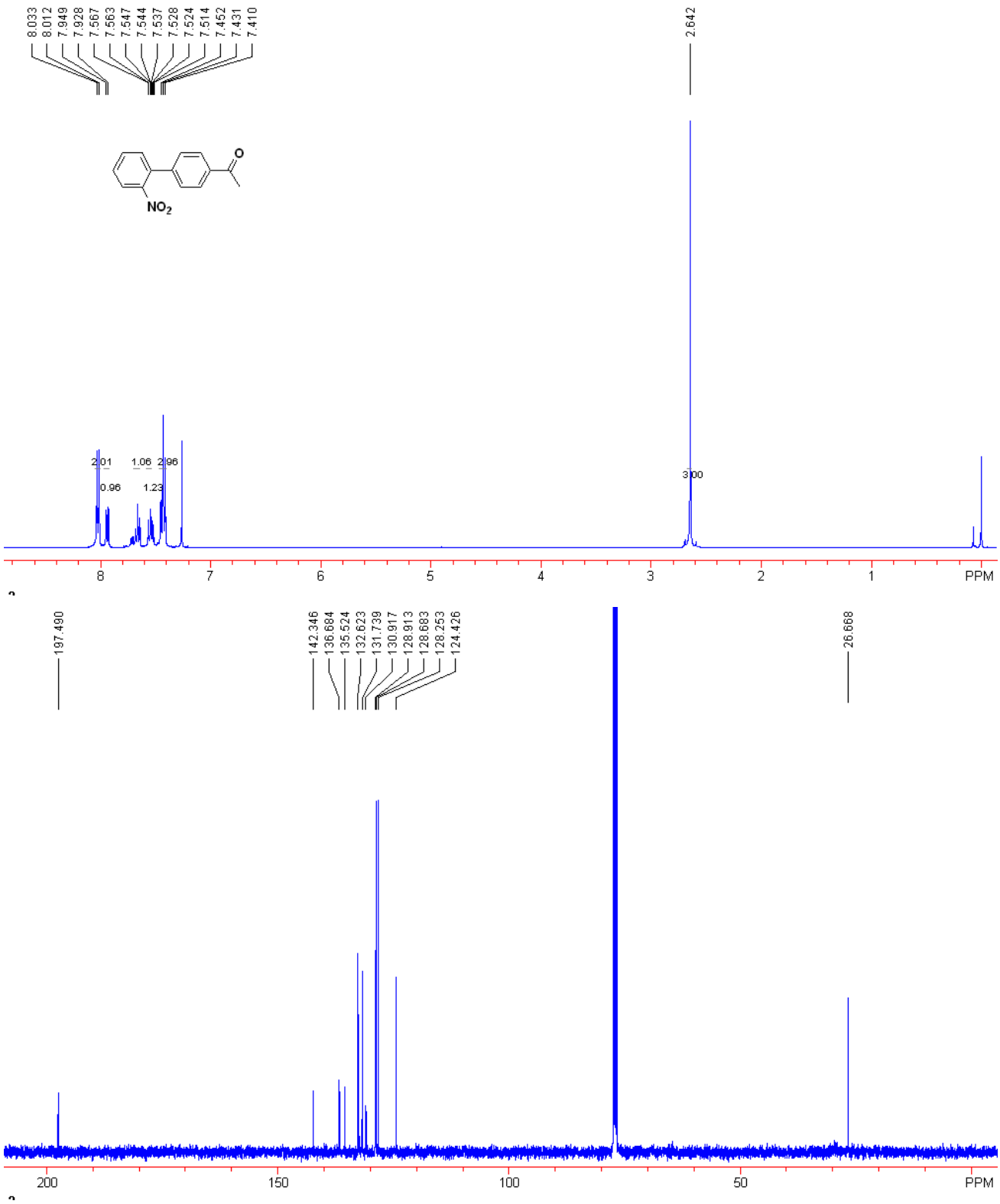


2-(4-methoxyphenyl)-5-nitrofuran (5i).

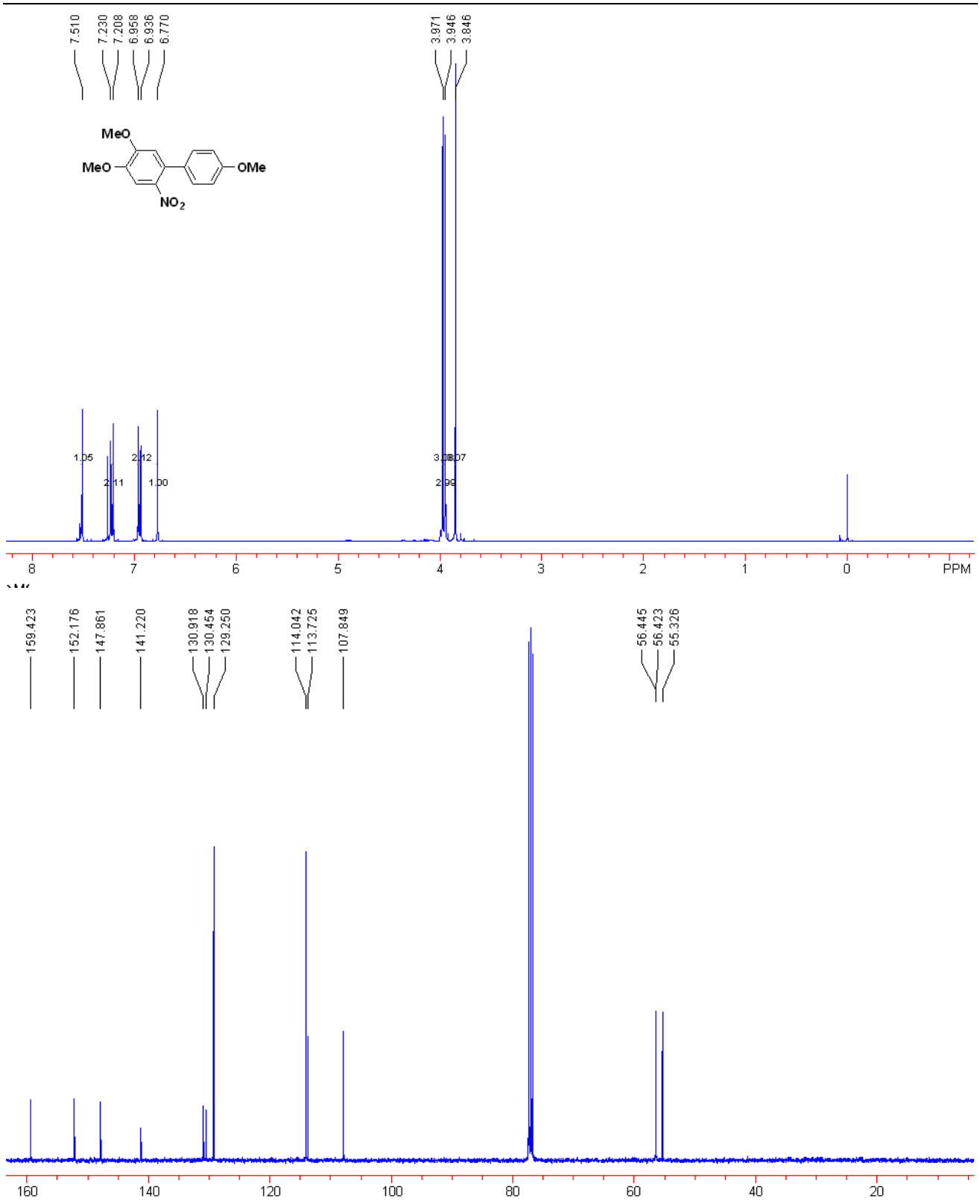




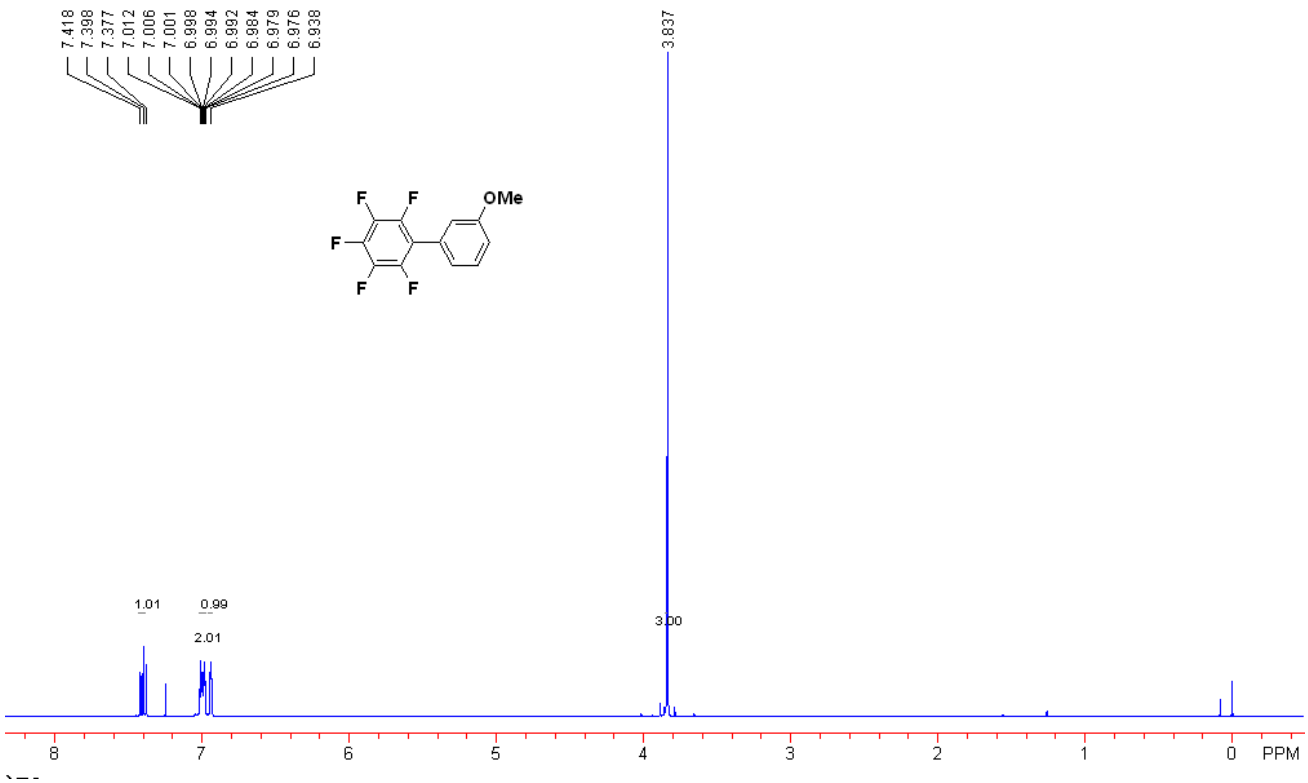
1-(2'-nitrobiphenyl-4-yl)ethanone (5j).



4,4',5-trimethoxy-2-nitrobiphenyl (5k).



2,3,4,5,6-pentafluoro-3'-methoxybiphenyl (5l).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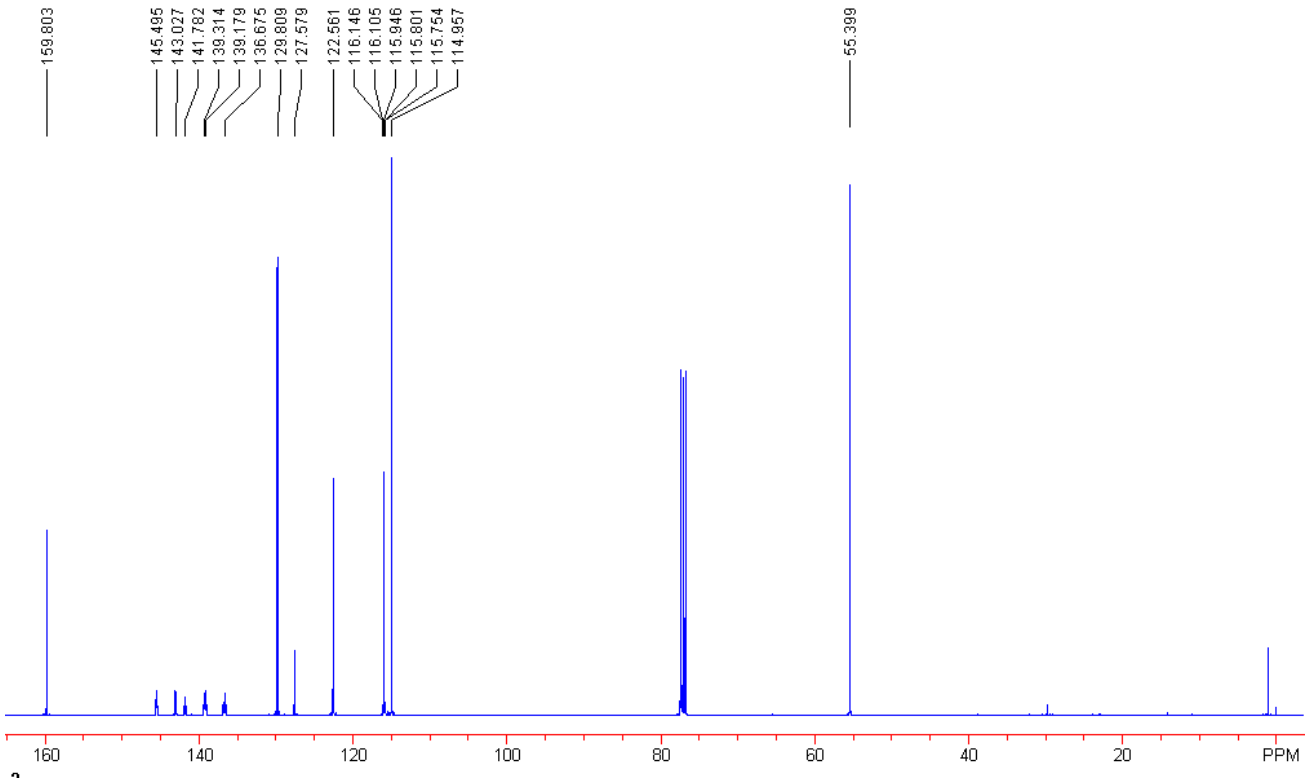
PPM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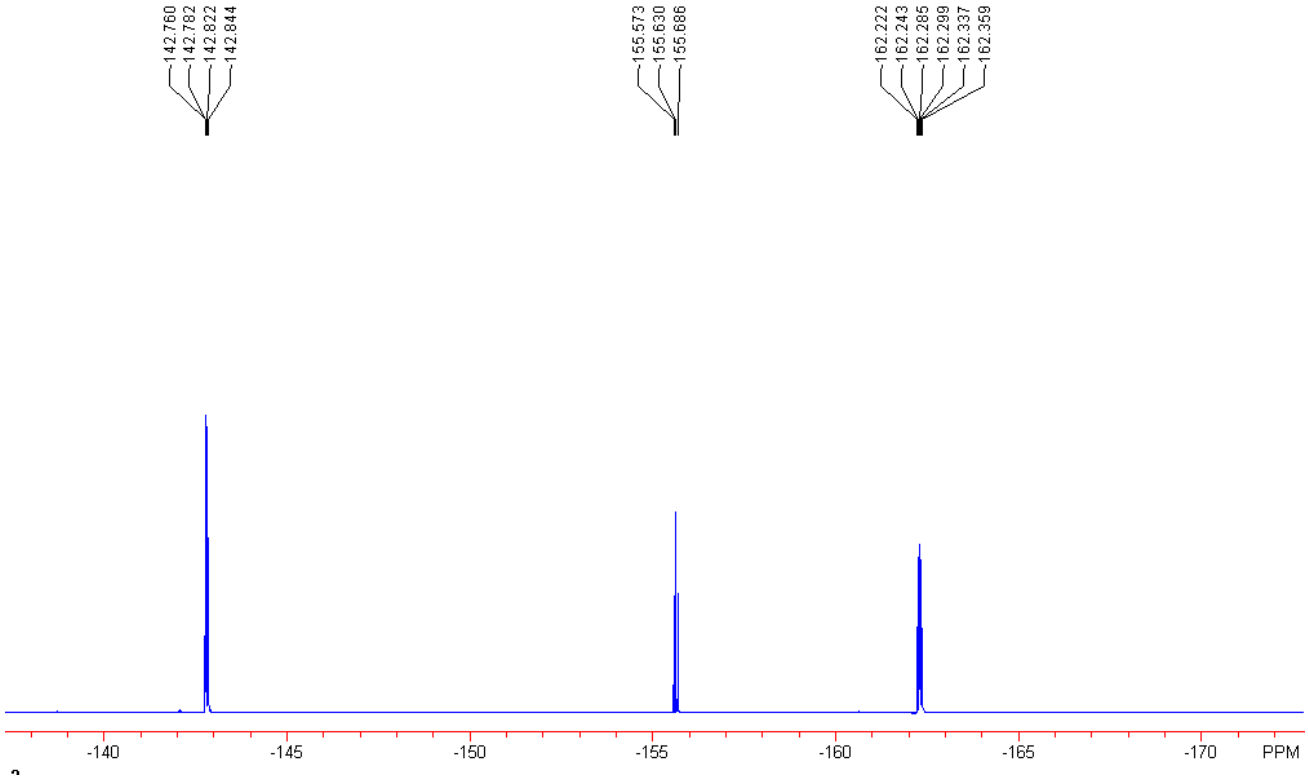
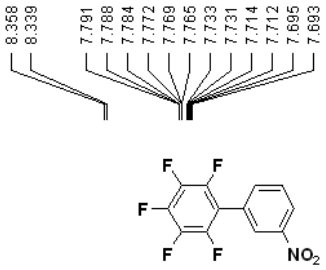
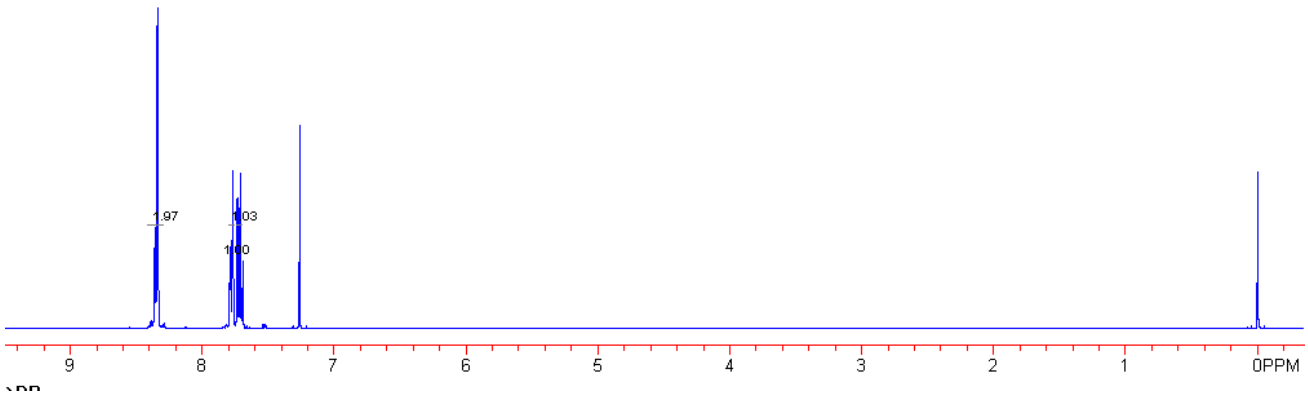
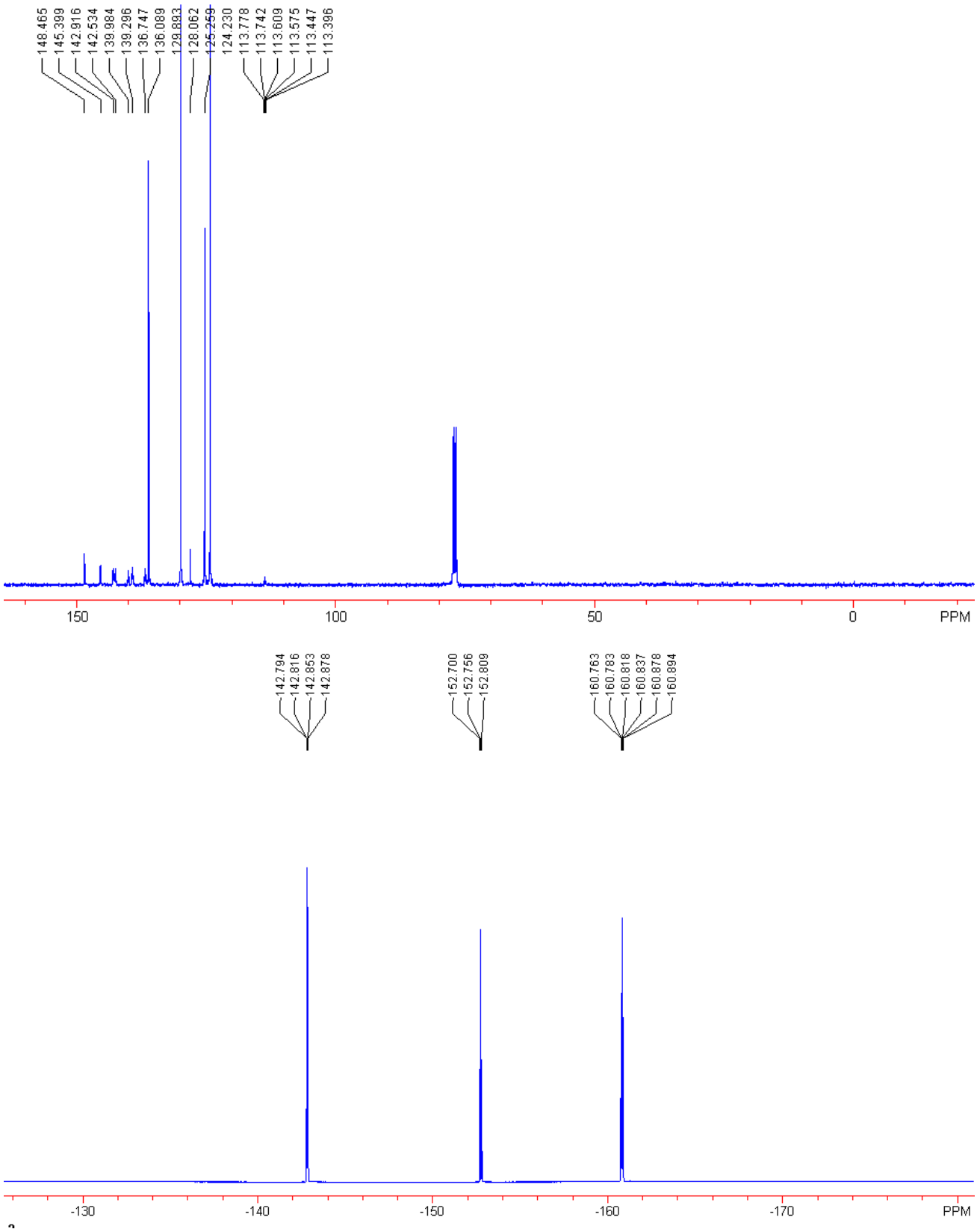


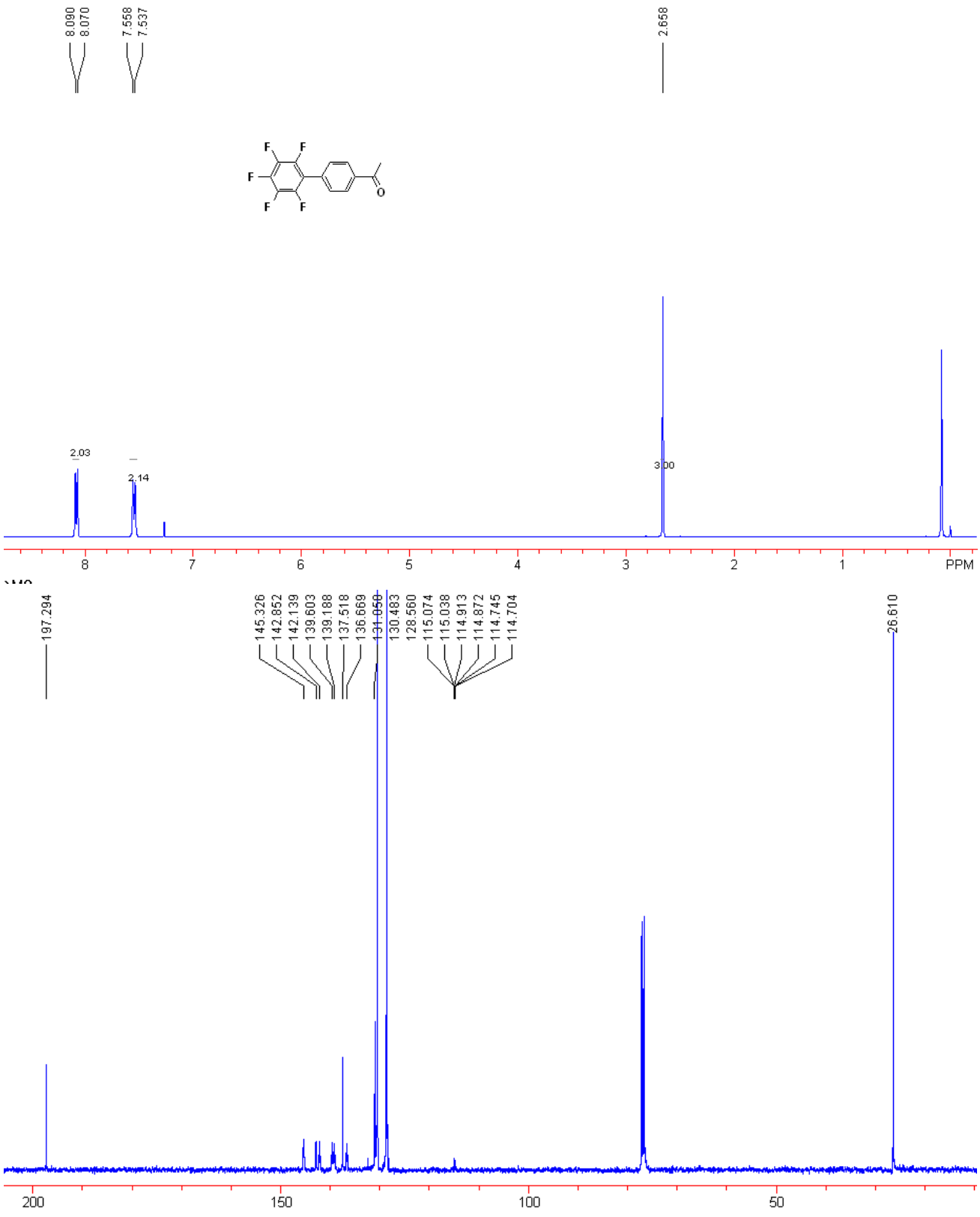
2,3,4,5,6-pentafluoro-3'-nitrobiphenyl (5m).







1-(2',3',4',5',6'-pentafluorobiphenyl-4-yl)ethanone (5n).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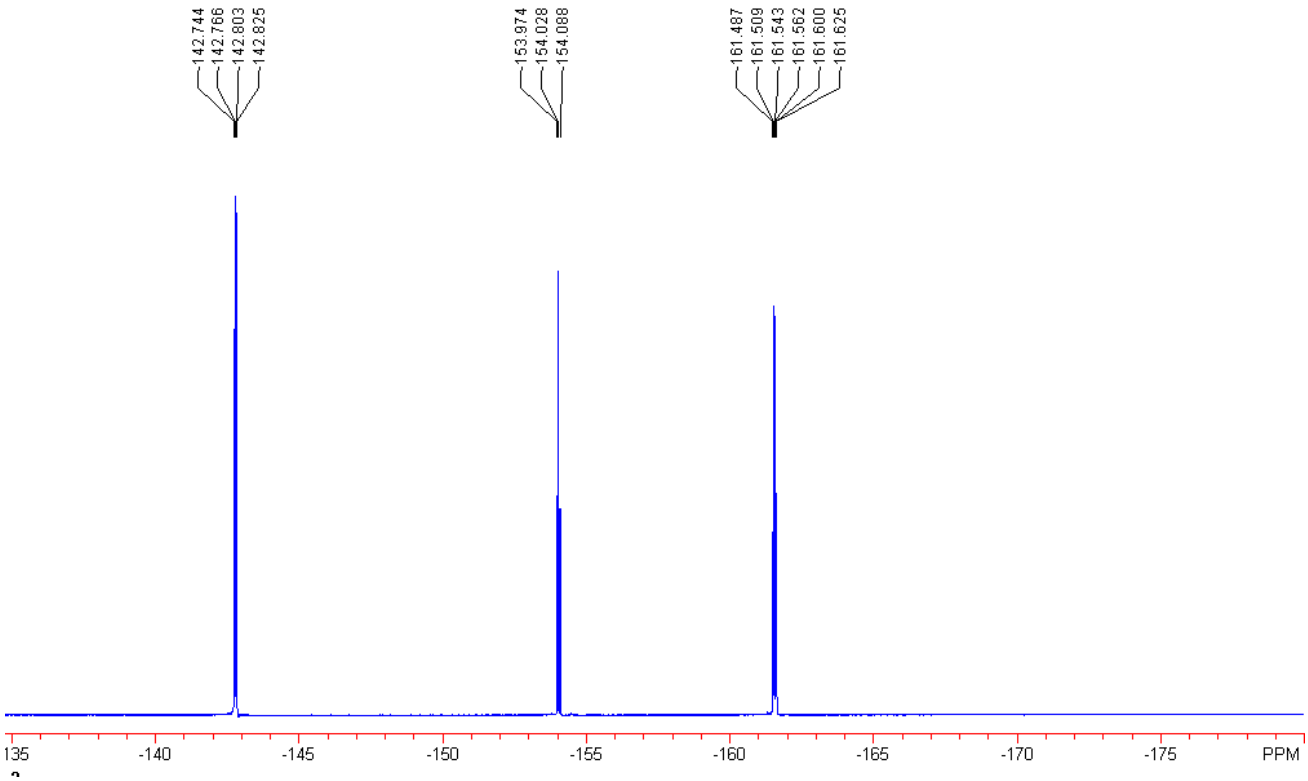
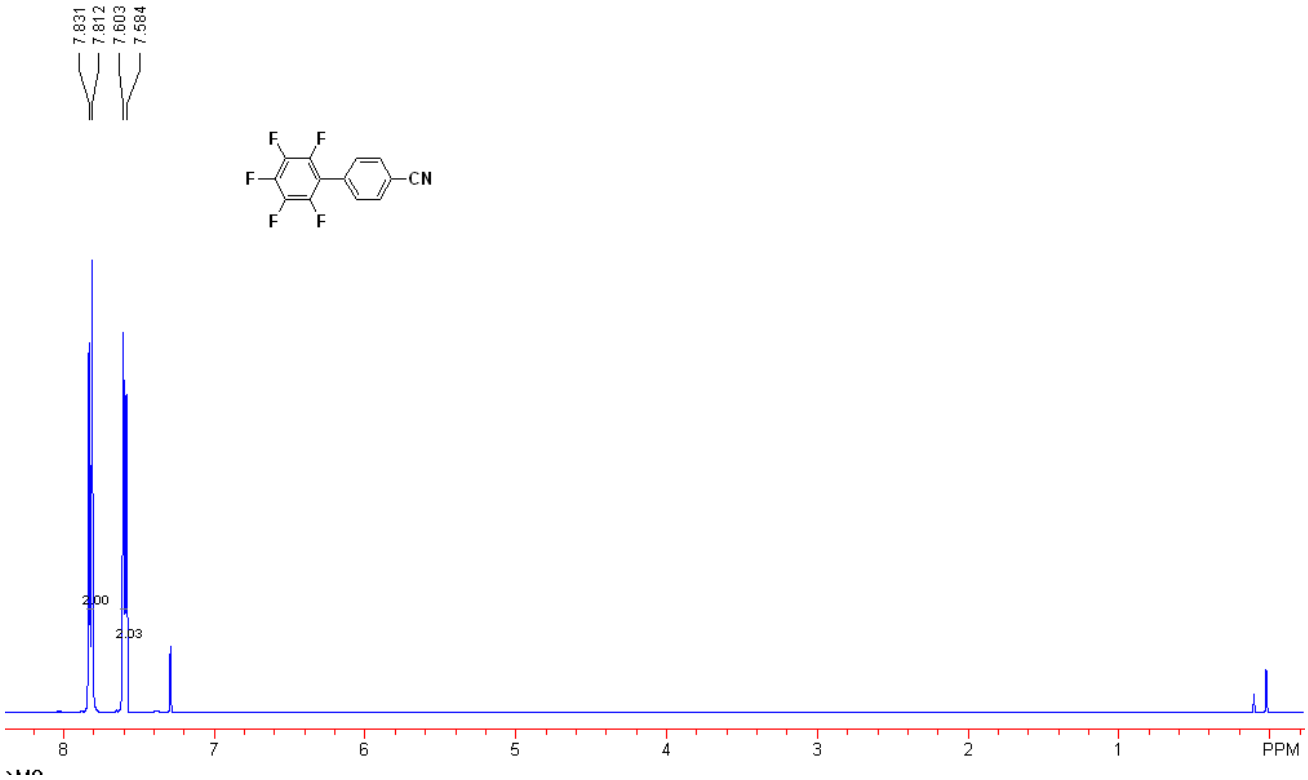
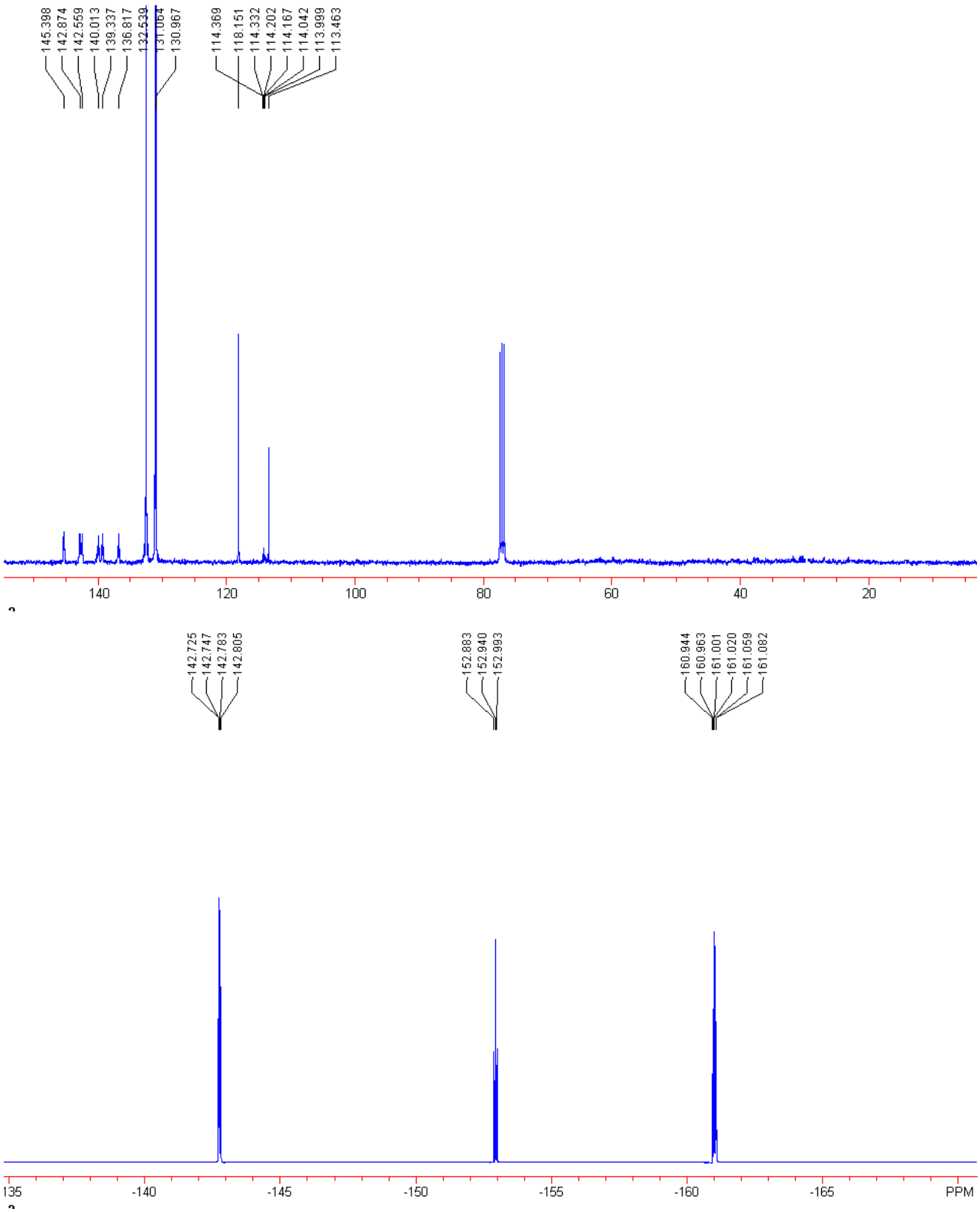
8.070
7.558
7.537
2.658
F
F
F
F
F
O
2.03
2.14
3.00
8
7
6
5
4
3
2
1
PPM
197.294
145.326
142.852
142.139
139.603
139.188
137.518
136.669
131.056
130.483
128.560
115.074
115.038
114.913
114.872
114.745
114.704
26.610
200
150
100
50

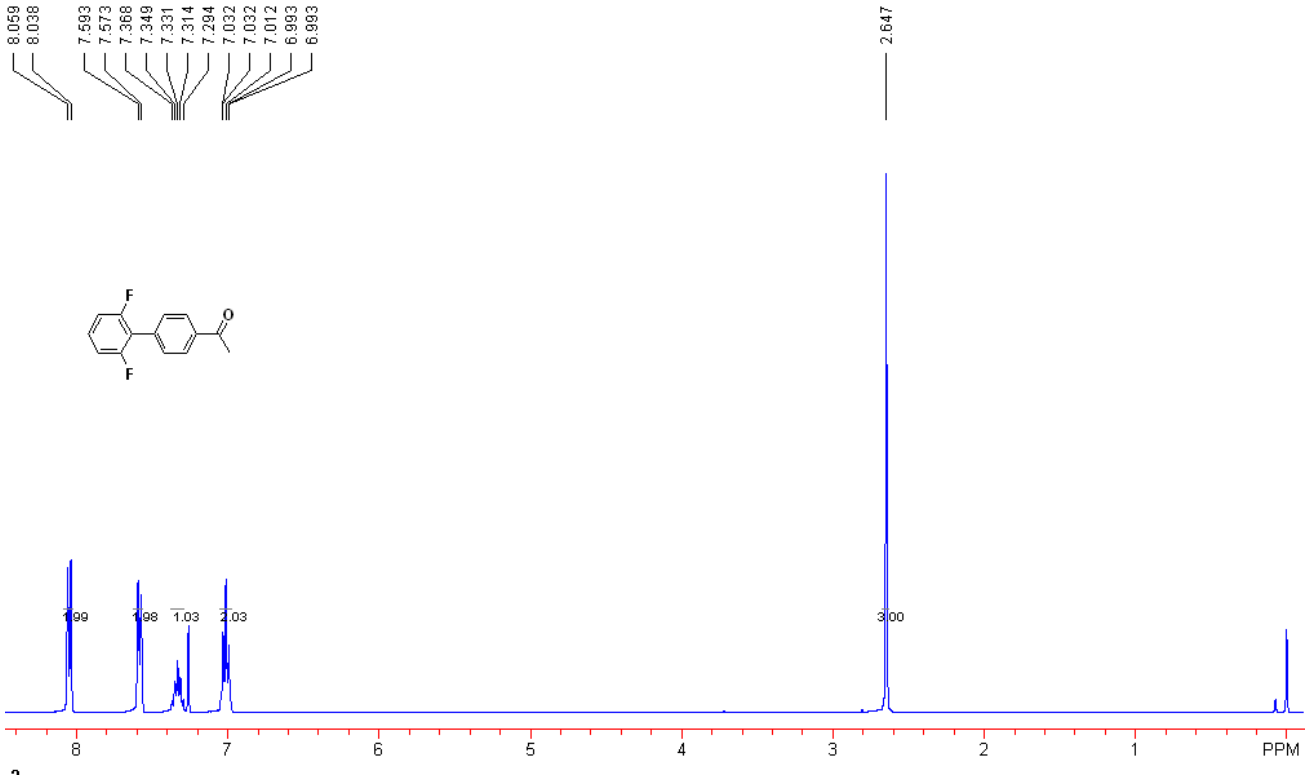


2',3',4',5',6'-pentafluorobiphenyl-4-carbonitrile (5o).





1-(2',6'-difluorobiphenyl-4-yl)ethanone (5p).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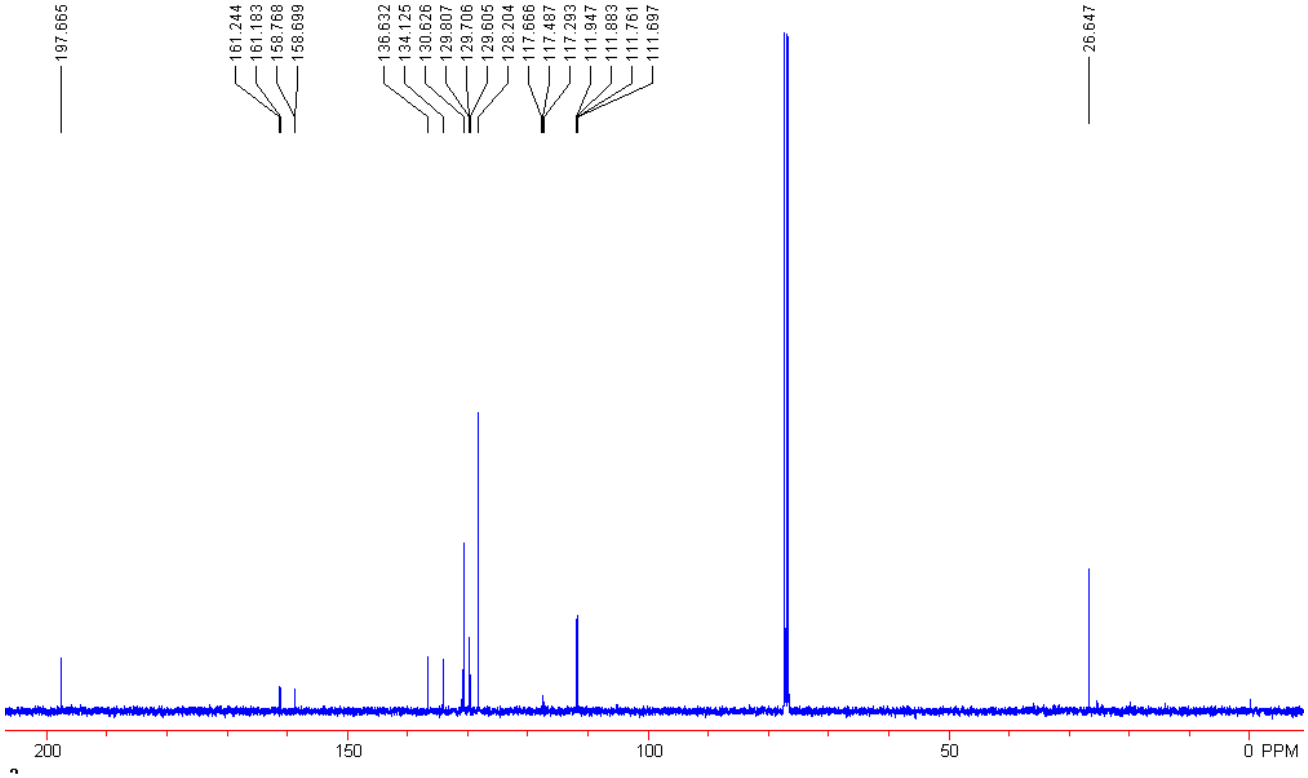
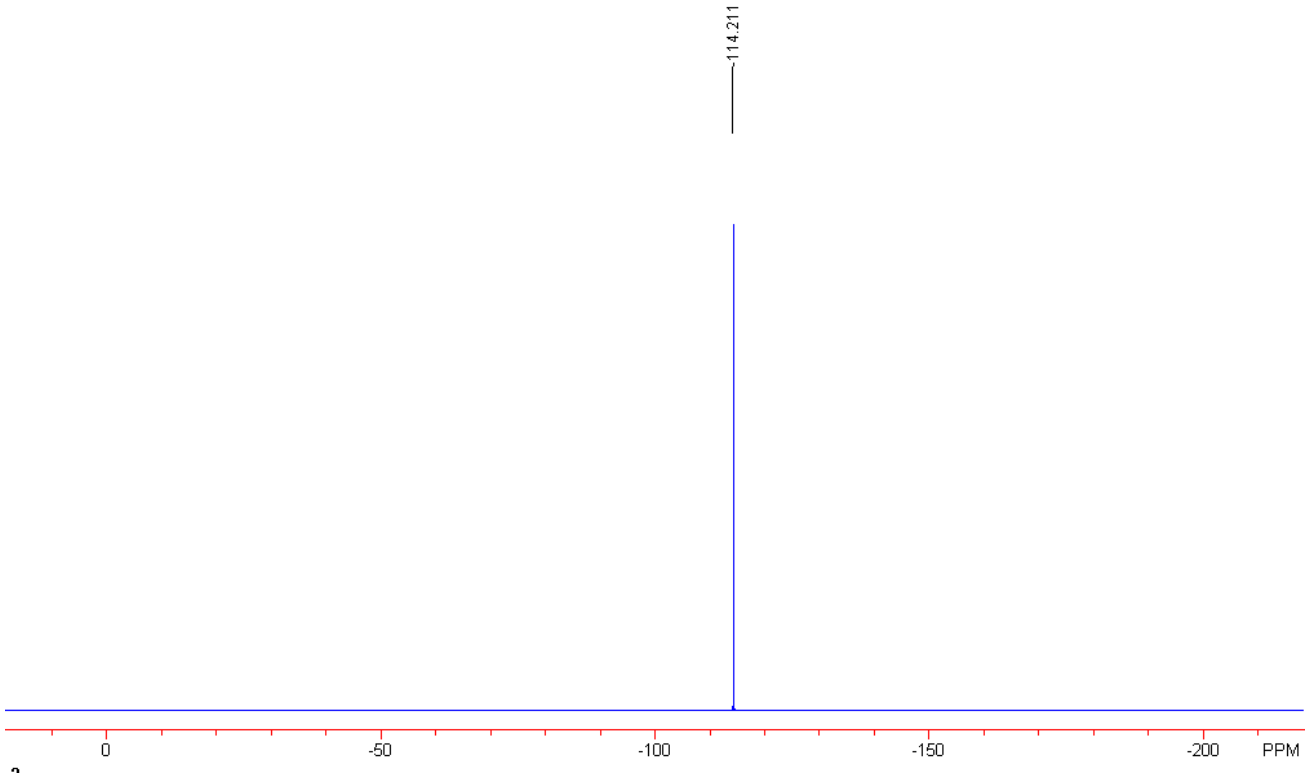
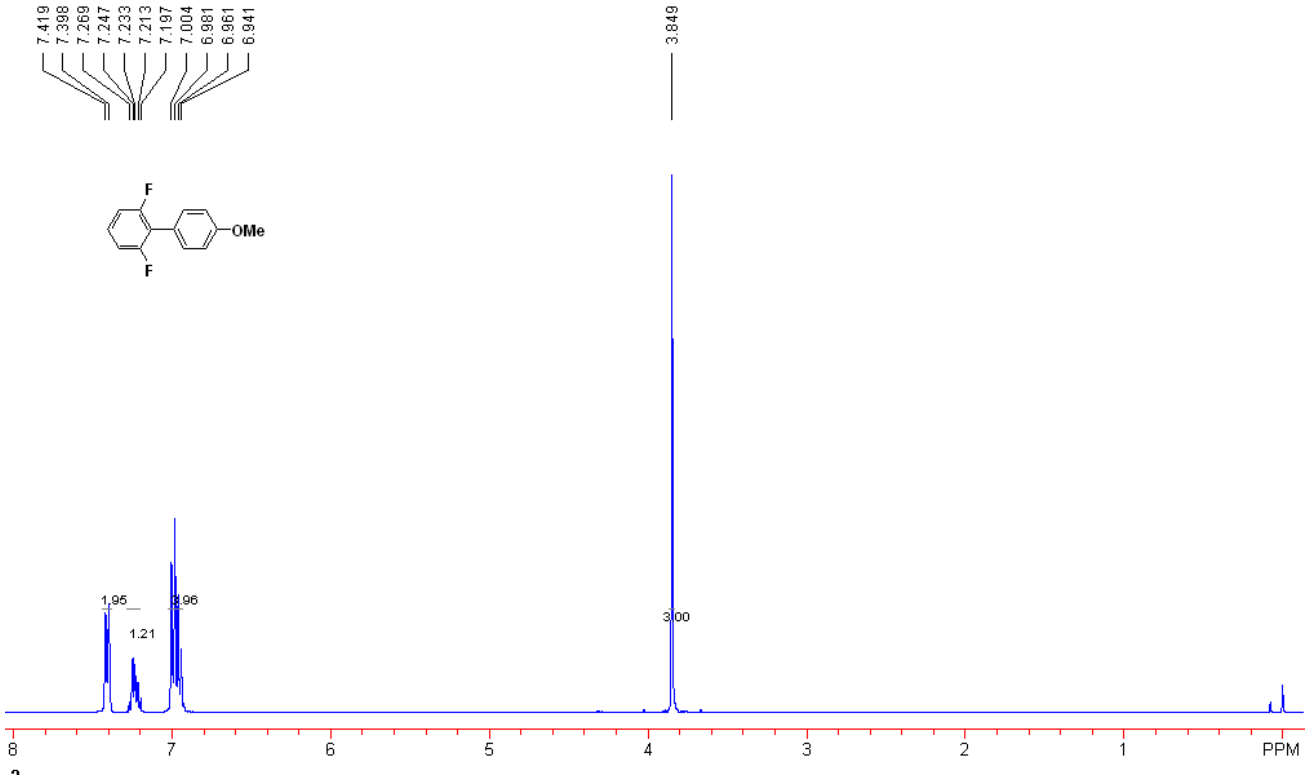
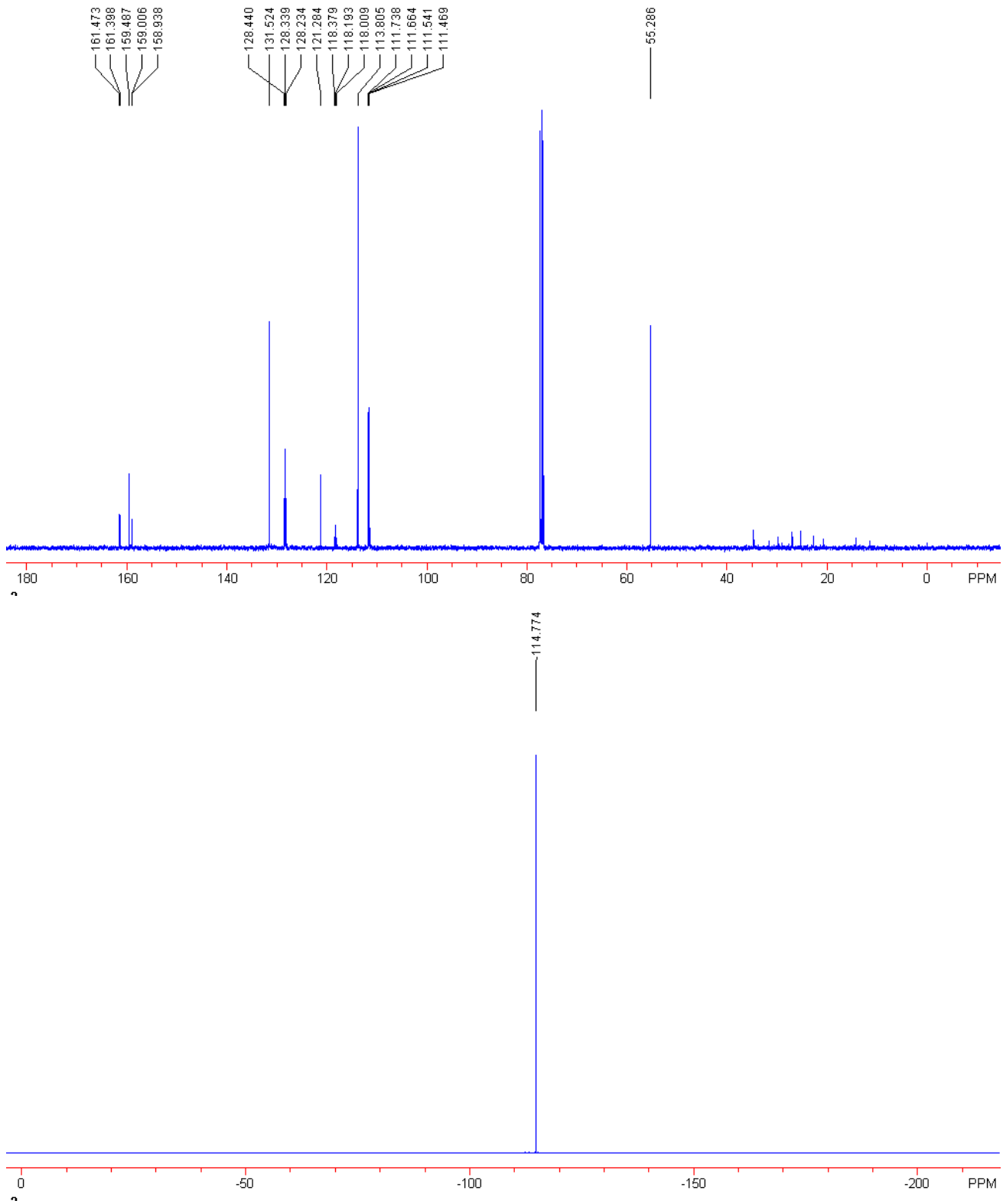
8.038
7.593
7.573
7.368
7.349
7.331
7.314
7.294
7.032
7.012
6.993
6.993
2.647
F
O
F
1.99
1.98
1.03
2.03
3.00
8
7
6
5
4
3
2
1
PPM


197.665
161.244
161.183
158.768
158.699
136.632
134.125
130.626
129.807
129.706
129.605
128.204
117.666
117.487
117.293
111.947
111.883
111.761
111.697
26.647
200
150
100
50
0 PPM

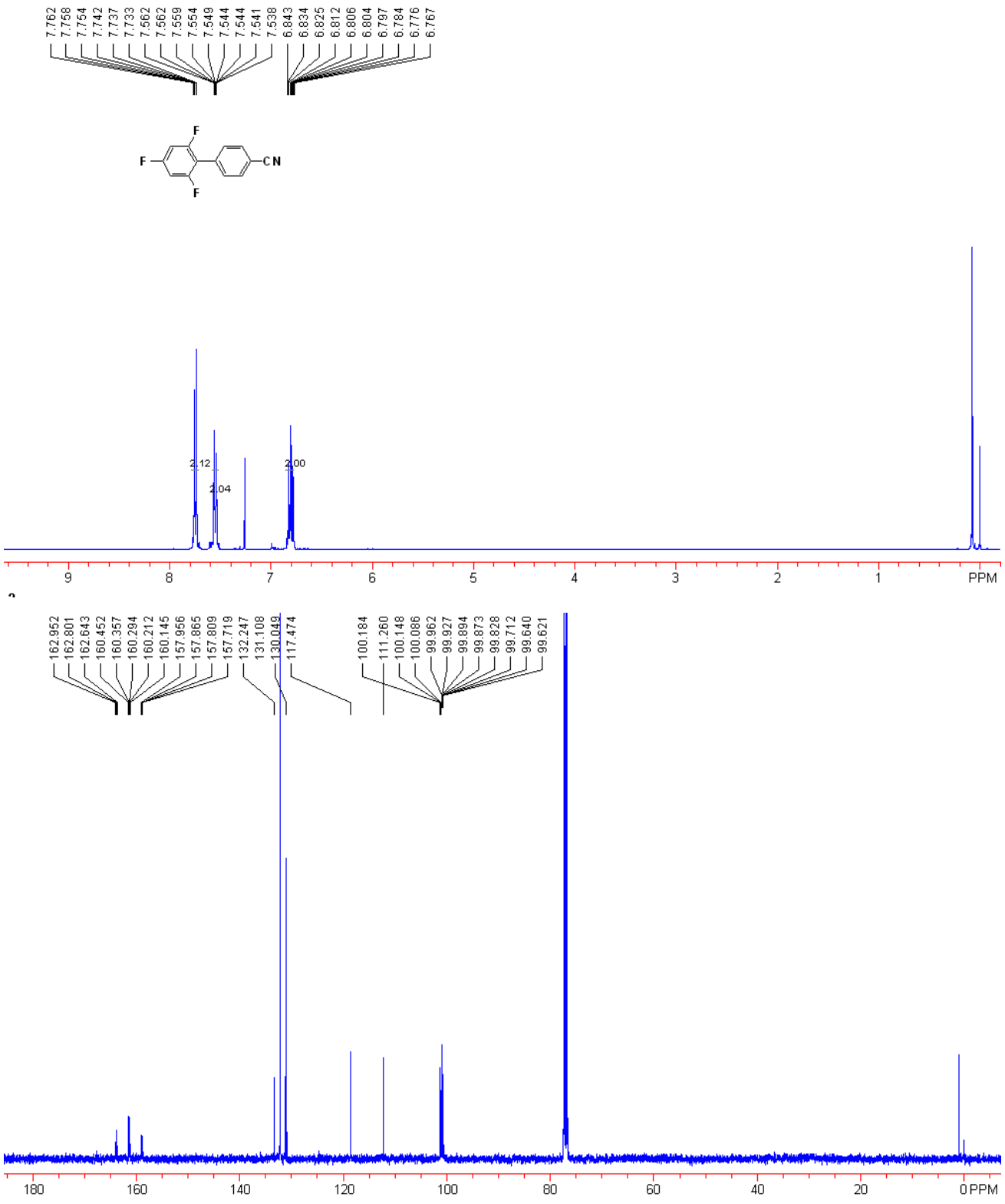


2,6-difluoro-4'-methoxybiphenyl (5q).





2',4',6'-trifluorobiphenyl-4-carbonitrile (5r).


7.762
7.758
7.754
7.742
7.737
7.733
7.562
7.562
7.559
7.554
7.549
7.544
7.544
7.541
7.538
6.843
6.834
6.825
6.812
6.806
6.804
6.797
6.784
6.776
6.767
F
F
F
CN
2.12
2.04
2.00
9
8
7
6
5
4
3
2
1
PPM
162.952
162.801
162.643
160.452
160.357
160.294
160.212
160.145
157.956
157.865
157.809
157.719
132.247
131.108
130.049
117.474
100.184
111.260
100.148
100.086
99.962
99.927
99.894
99.873
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99.712
99.640
99.621
180
160
140
120
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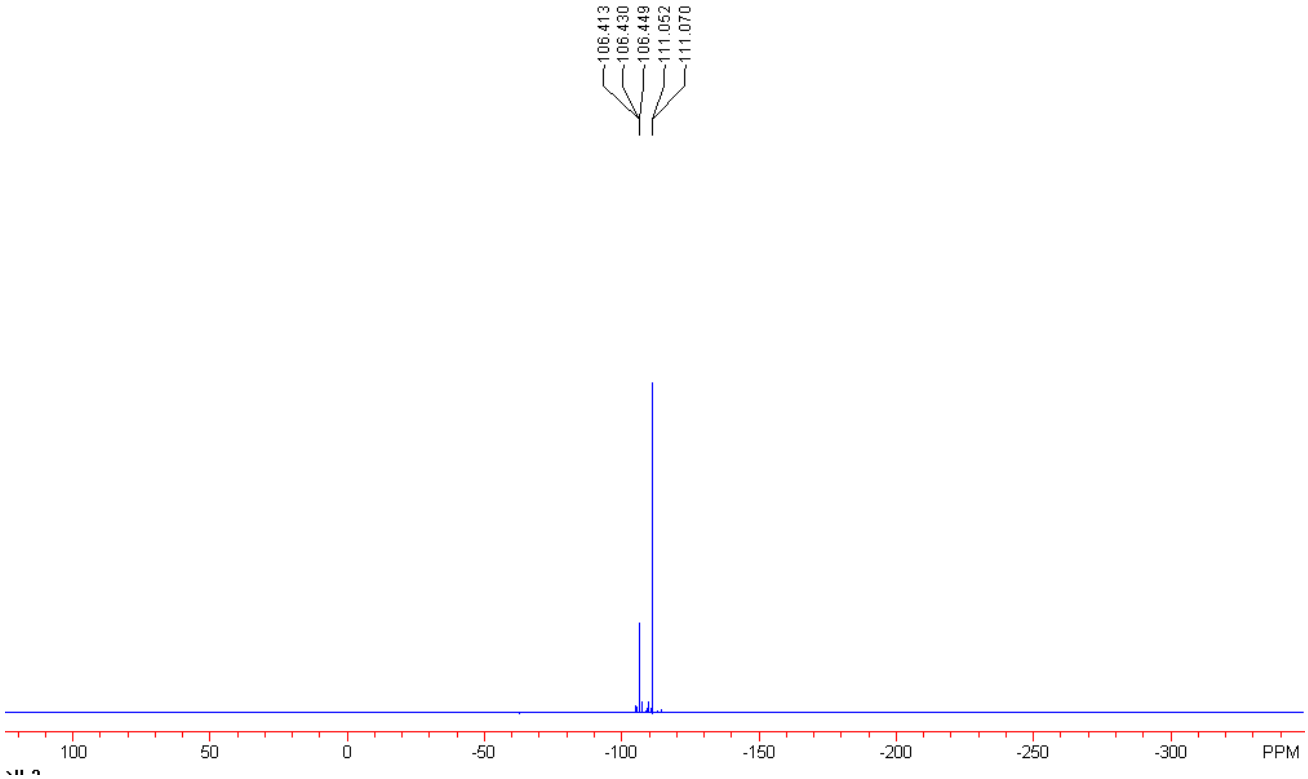
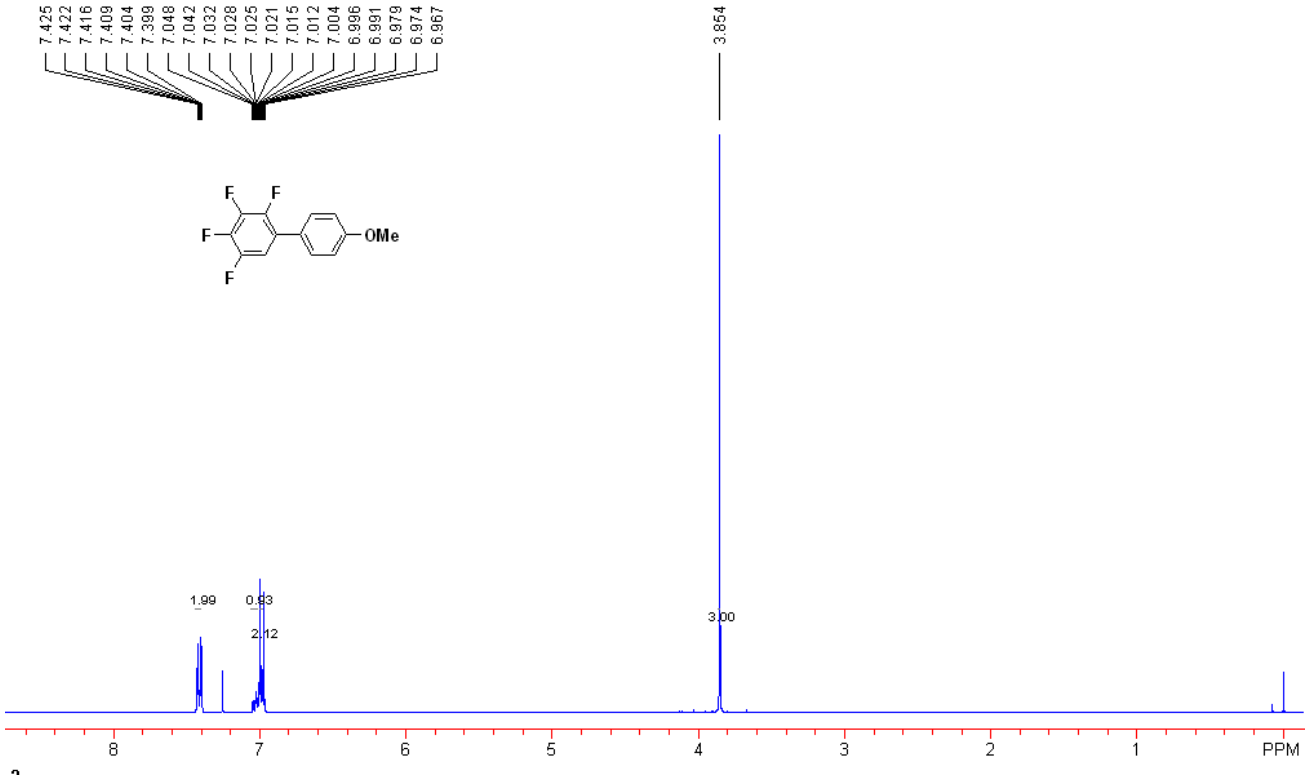
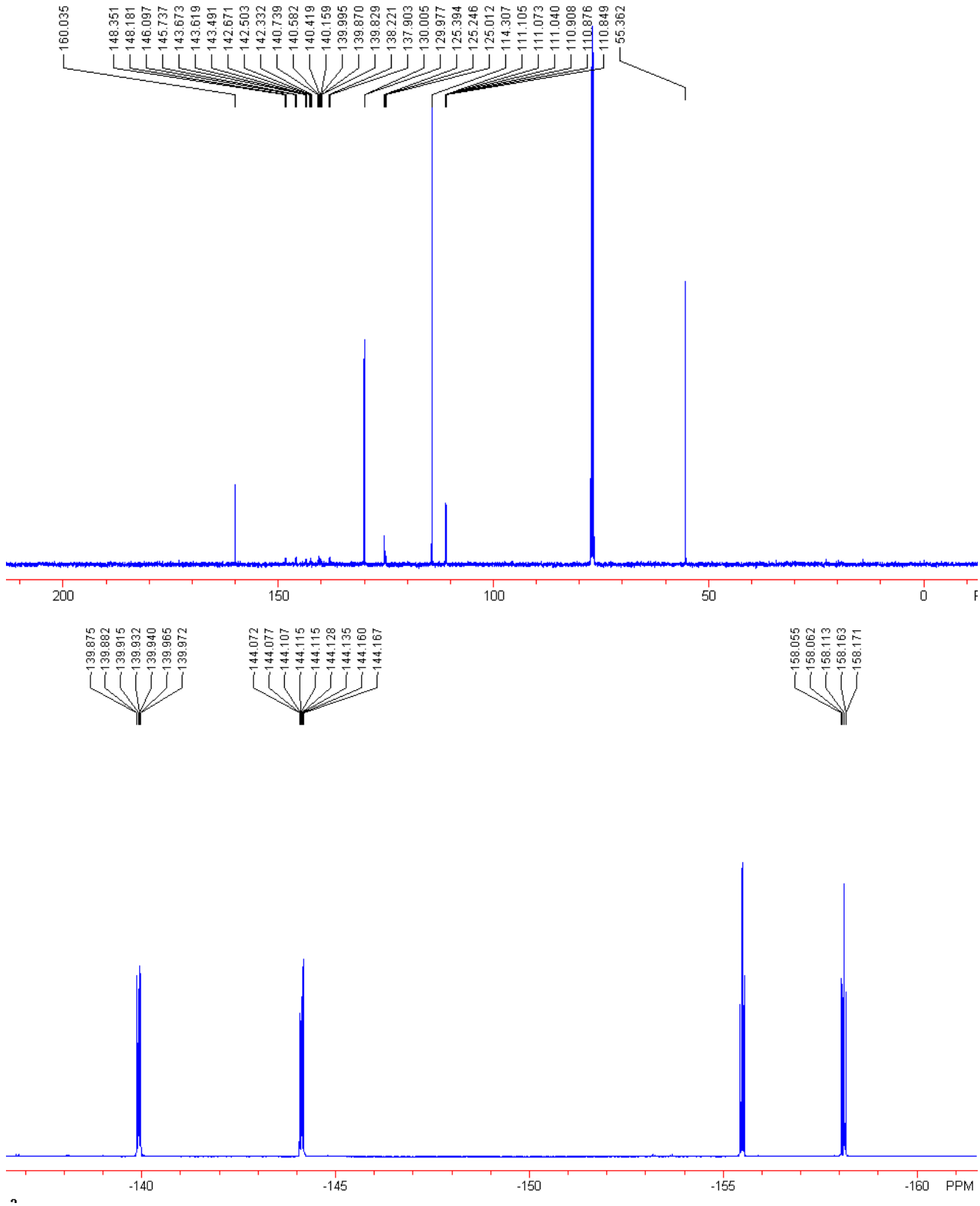
80
60
40
20
0 PPM

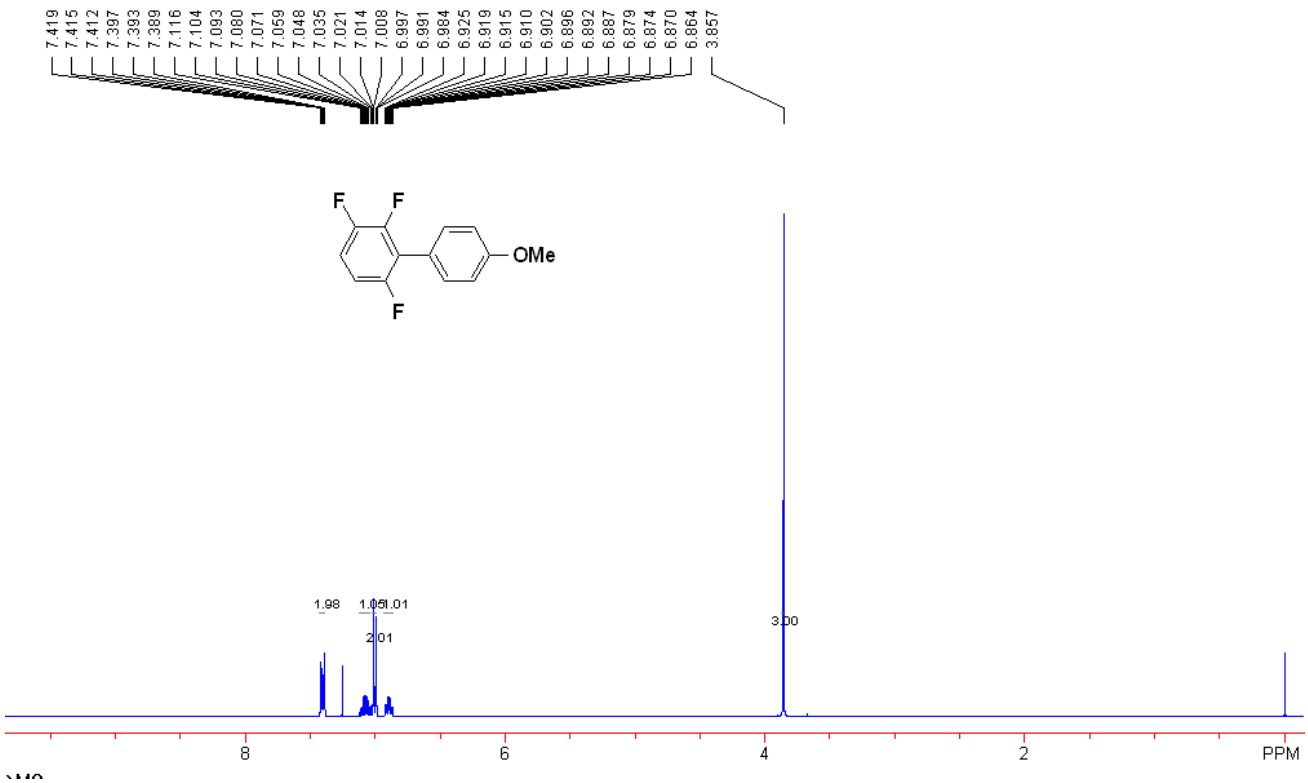


2,3,4,5-tetrafluoro-4'-methoxybiphenyl (5s).





2,3,6-trifluoro-4'-methoxybiphenyl (5t).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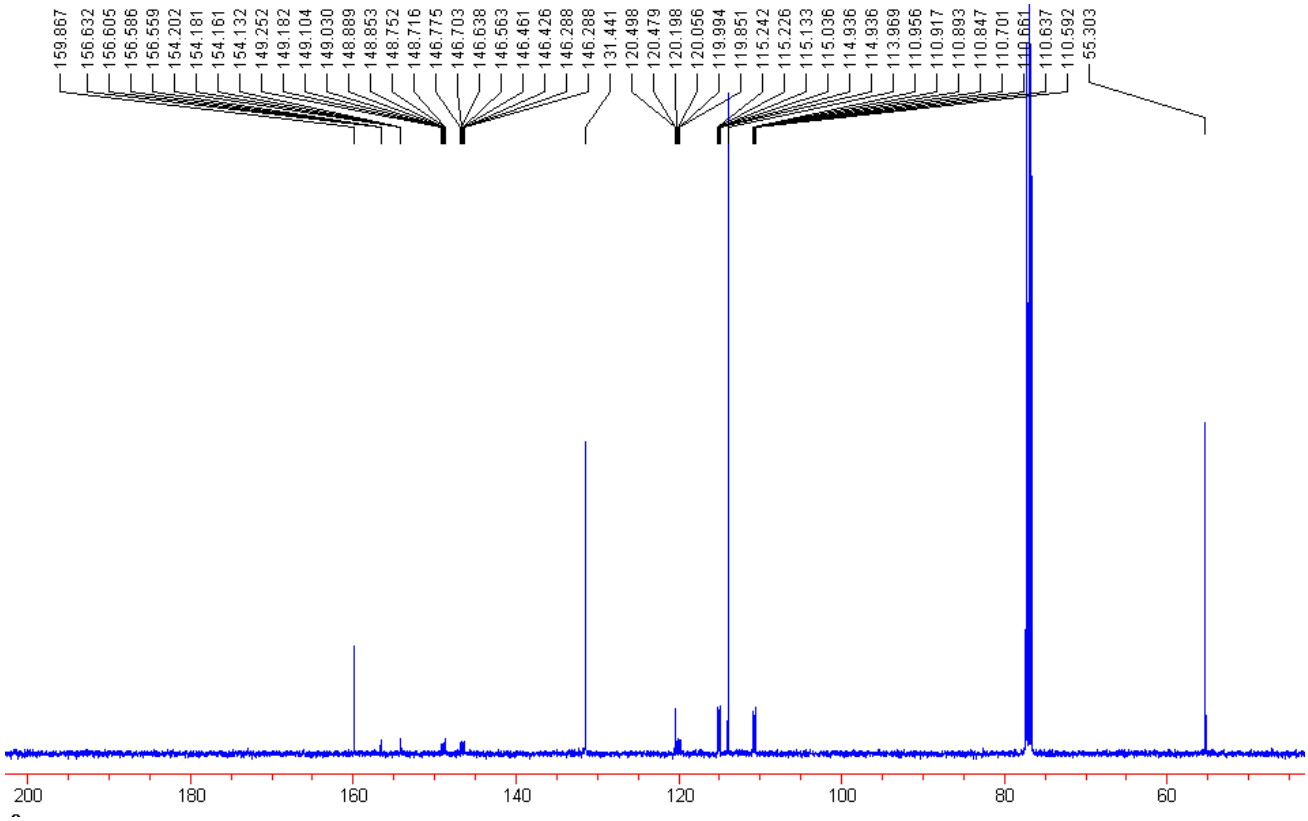
7.397
7.393
7.389
7.116
7.104
7.093
7.080
7.071
7.059
7.048
7.035
7.021
7.014
7.008
6.997
6.991
6.984
6.925
6.919
6.915
6.910
6.902
6.896
6.892
6.887
6.879
6.874
6.870
6.864
3.857
F
F
OMe
F
1.98
1.05
1.01
2.01
3.00
8
6
4
2
PPM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156.559
154.202
154.181
154.161
154.132
149.252
149.182
149.104
149.030
148.889
148.853
148.752
148.716
146.775
146.703
146.638
146.563
146.461
146.426
146.288
146.288
131.441
120.498
120.479
120.198
120.056
119.994
119.851
115.242
115.226
115.133
115.036
114.936
114.936
113.969
110.956
110.917
110.893
110.847
110.701
110.661
110.637
110.592
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120
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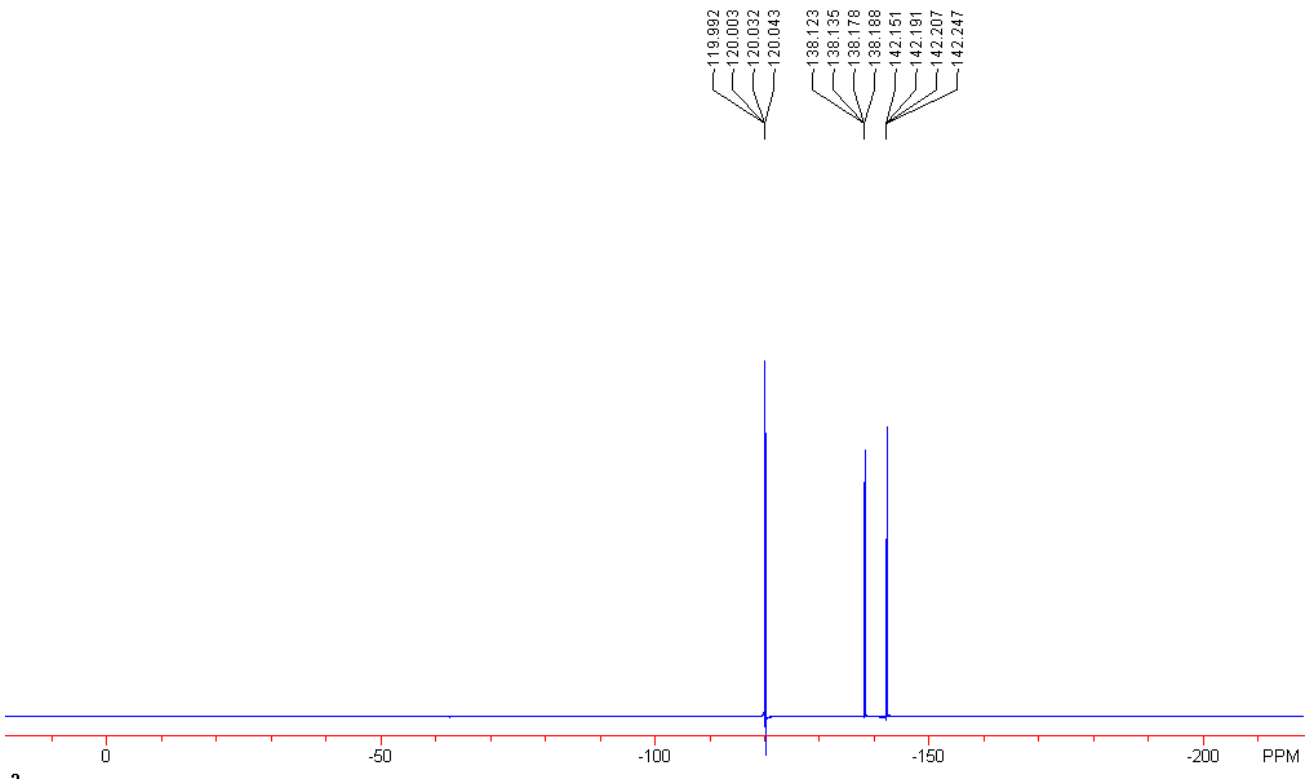
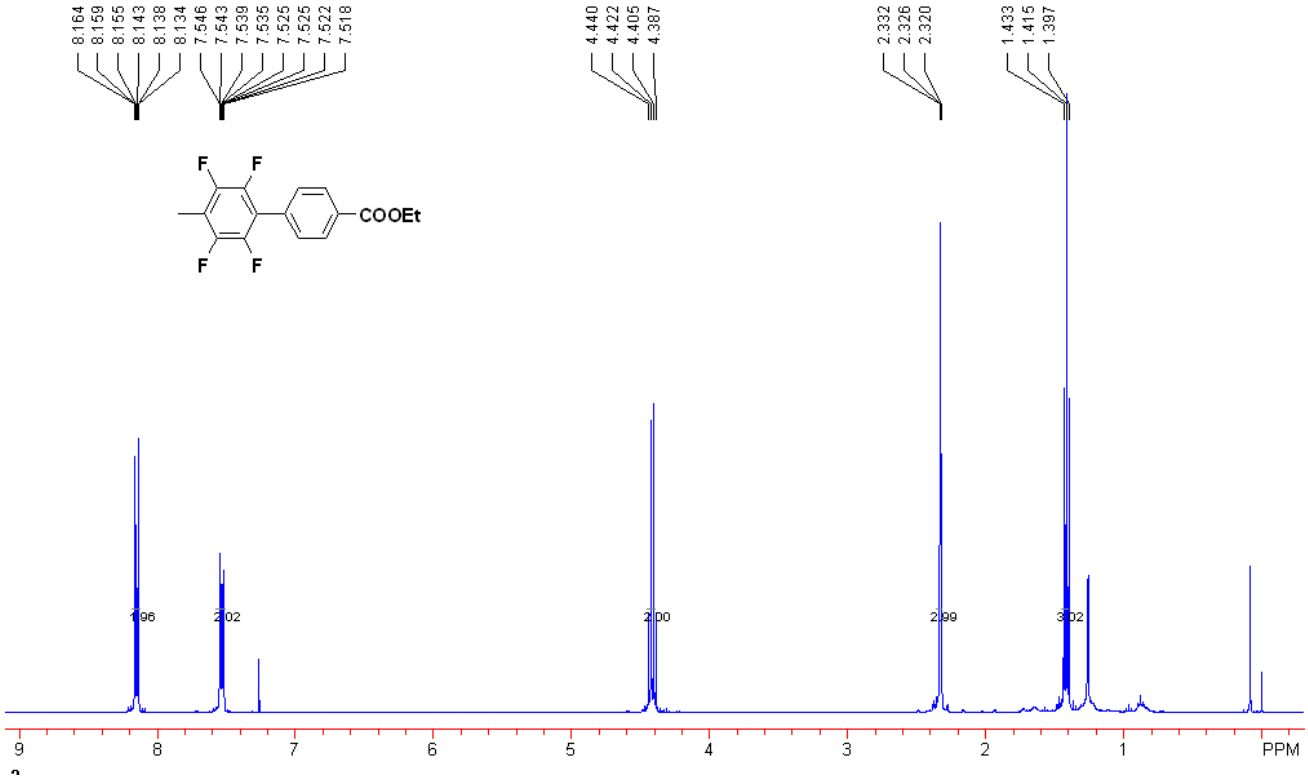
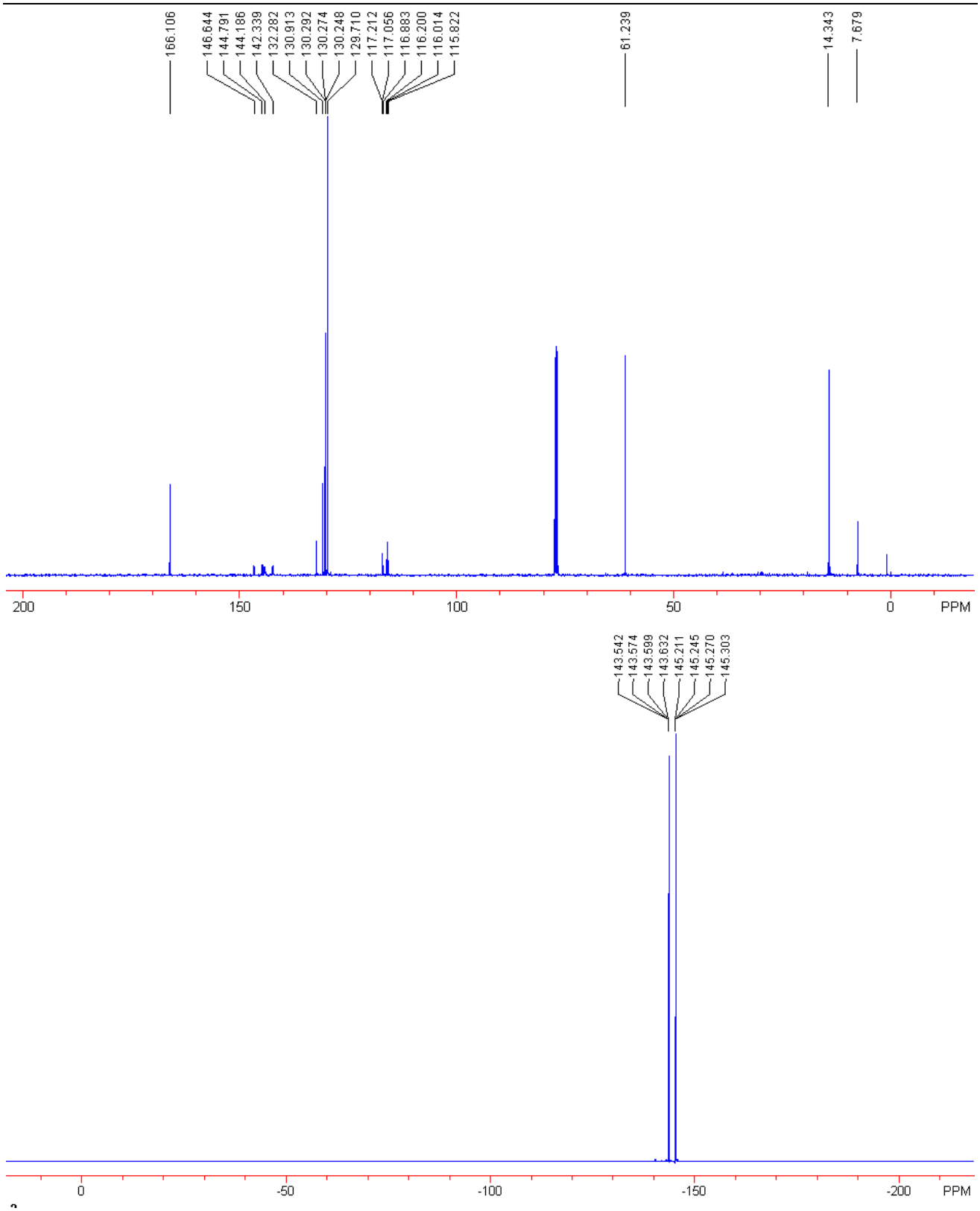
80
60

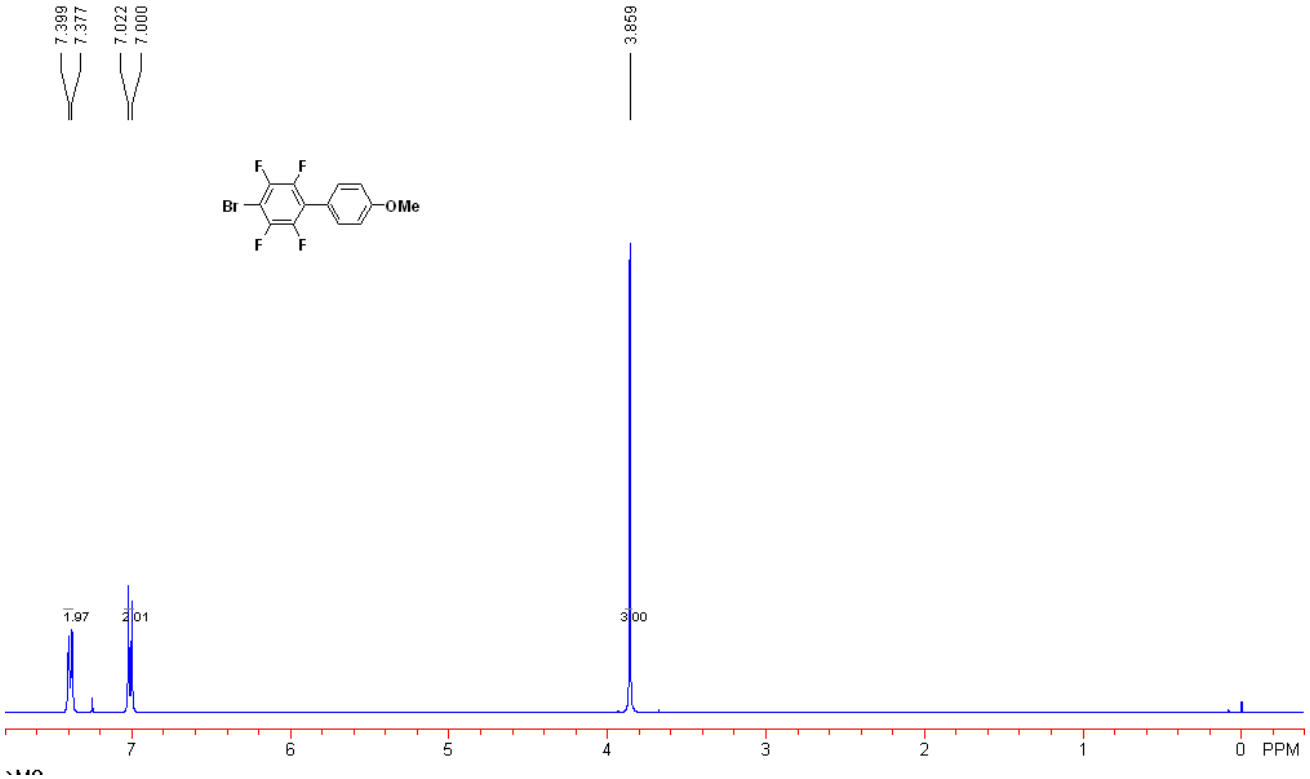


Ethyl 2',3',5',6'-tetrafluoro-4'-methylbiphenyl-4-carboxylate (5u).





4-bromo-2,3,5,6-tetrafluoro-4'-methoxybiphenyl (5v).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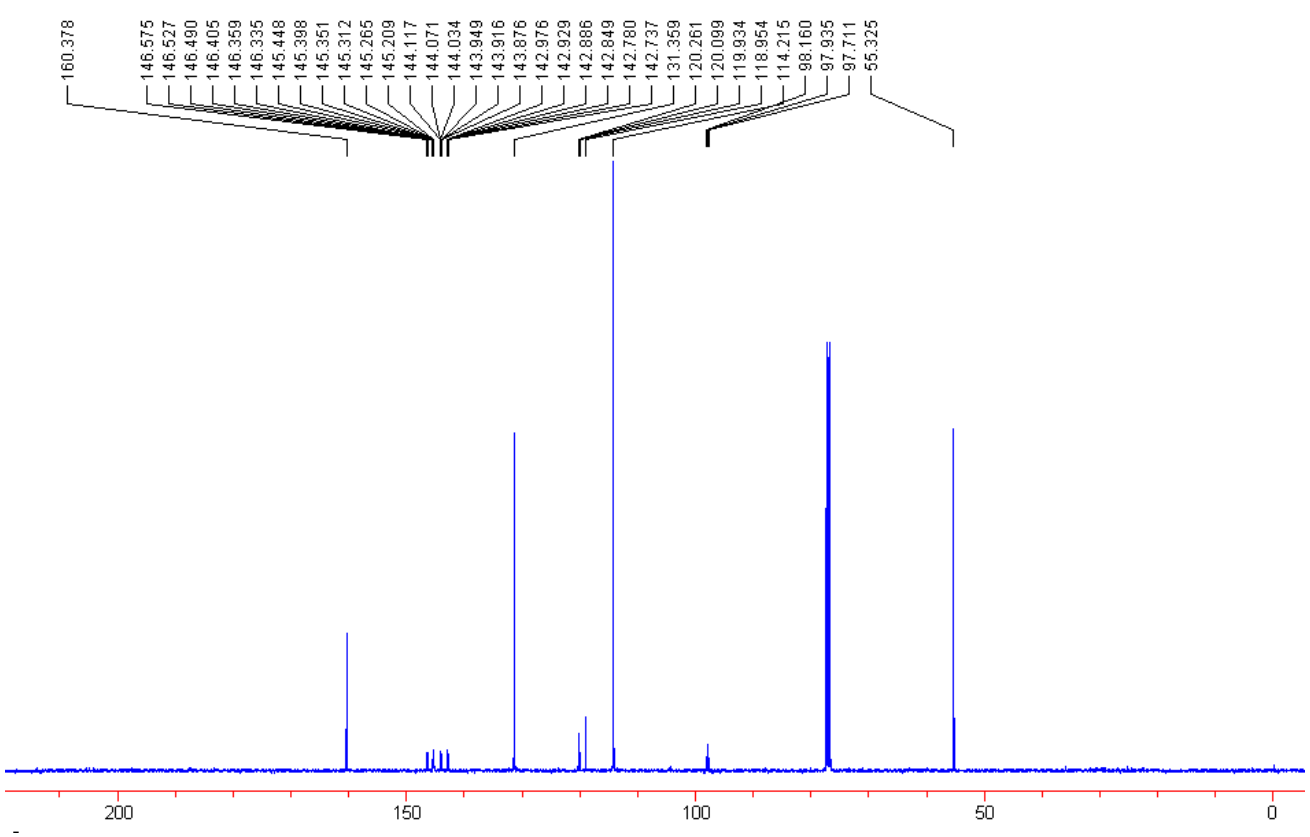
7.377
7.022
7.000
3.859
F
F
Br
OMe
F
F
1.97
2.01
3.00
7
6
5
4
3
2
1
0
PPM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146.405
146.359
146.335
145.448
145.398
145.351
145.312
145.265
145.209
144.117
144.071
144.034
143.949
143.916
143.876
142.976
142.929
142.886
142.849
142.780
142.737
131.359
120.261
120.099
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118.954
114.215
98.160
97.935
97.711
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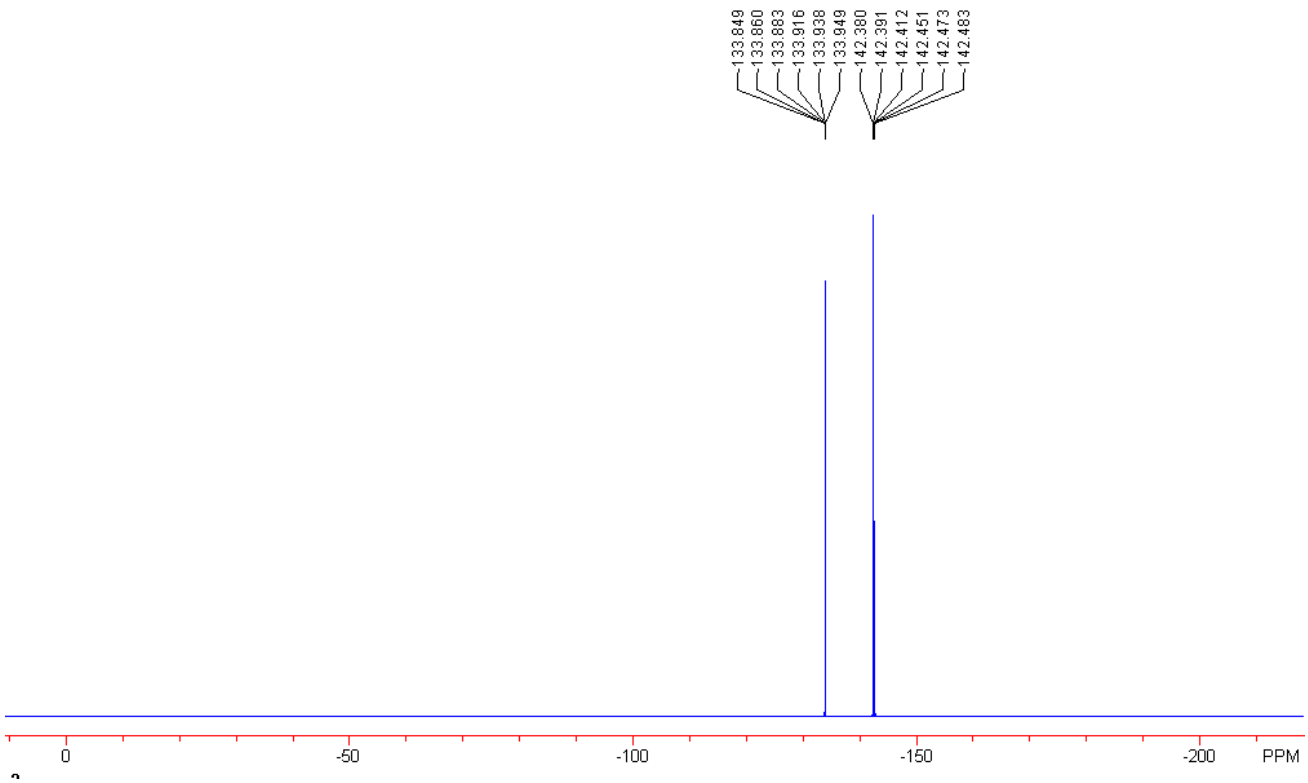
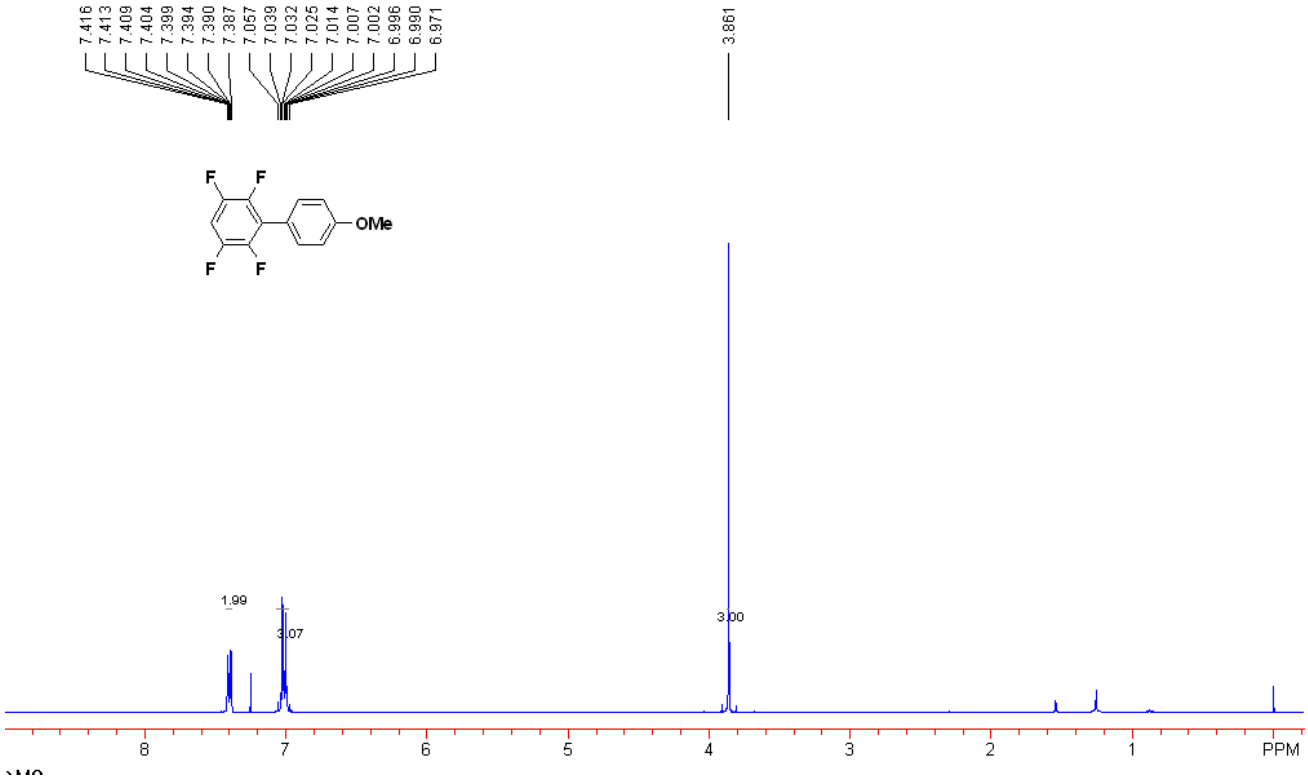
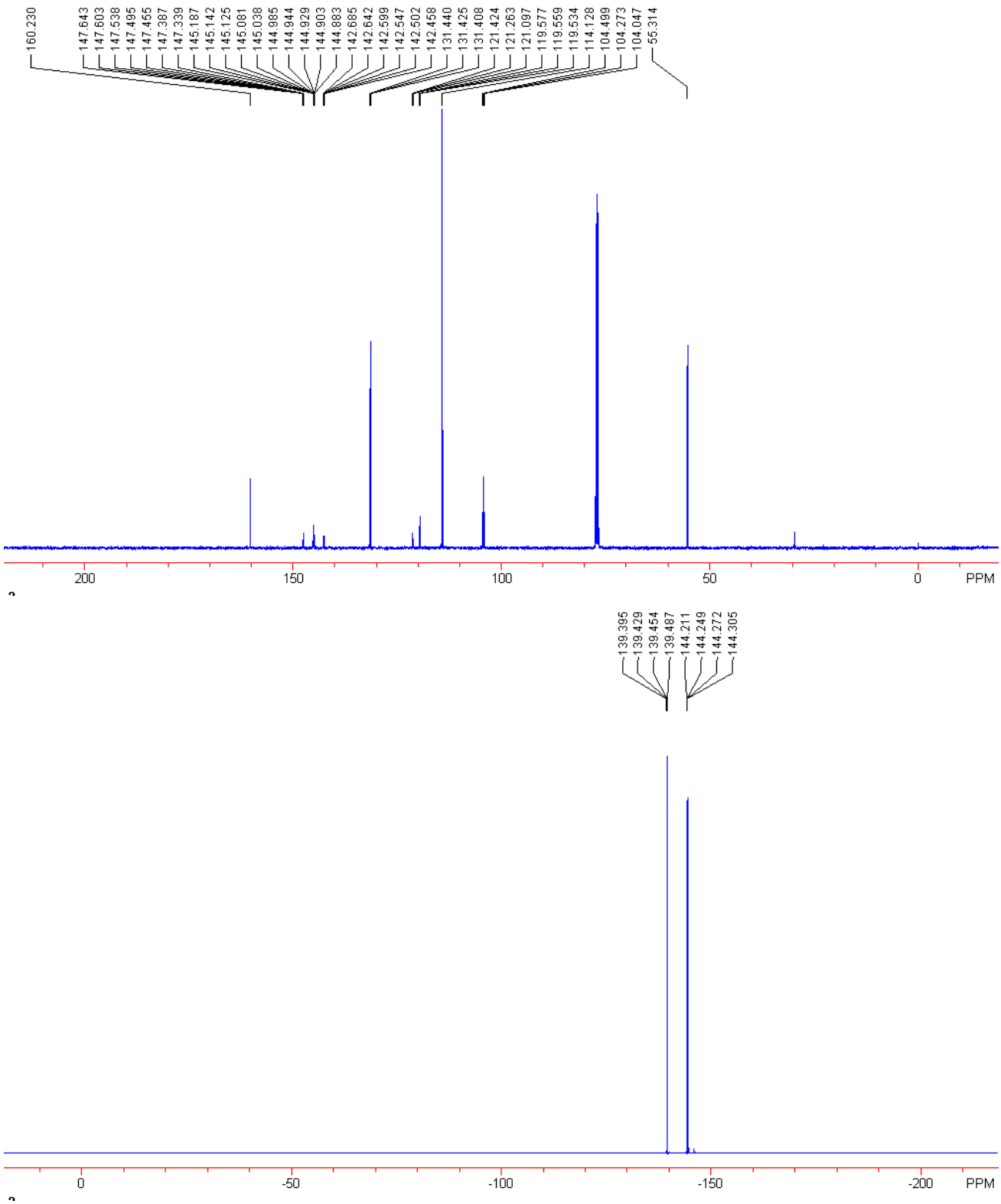
200
150
100
50
0

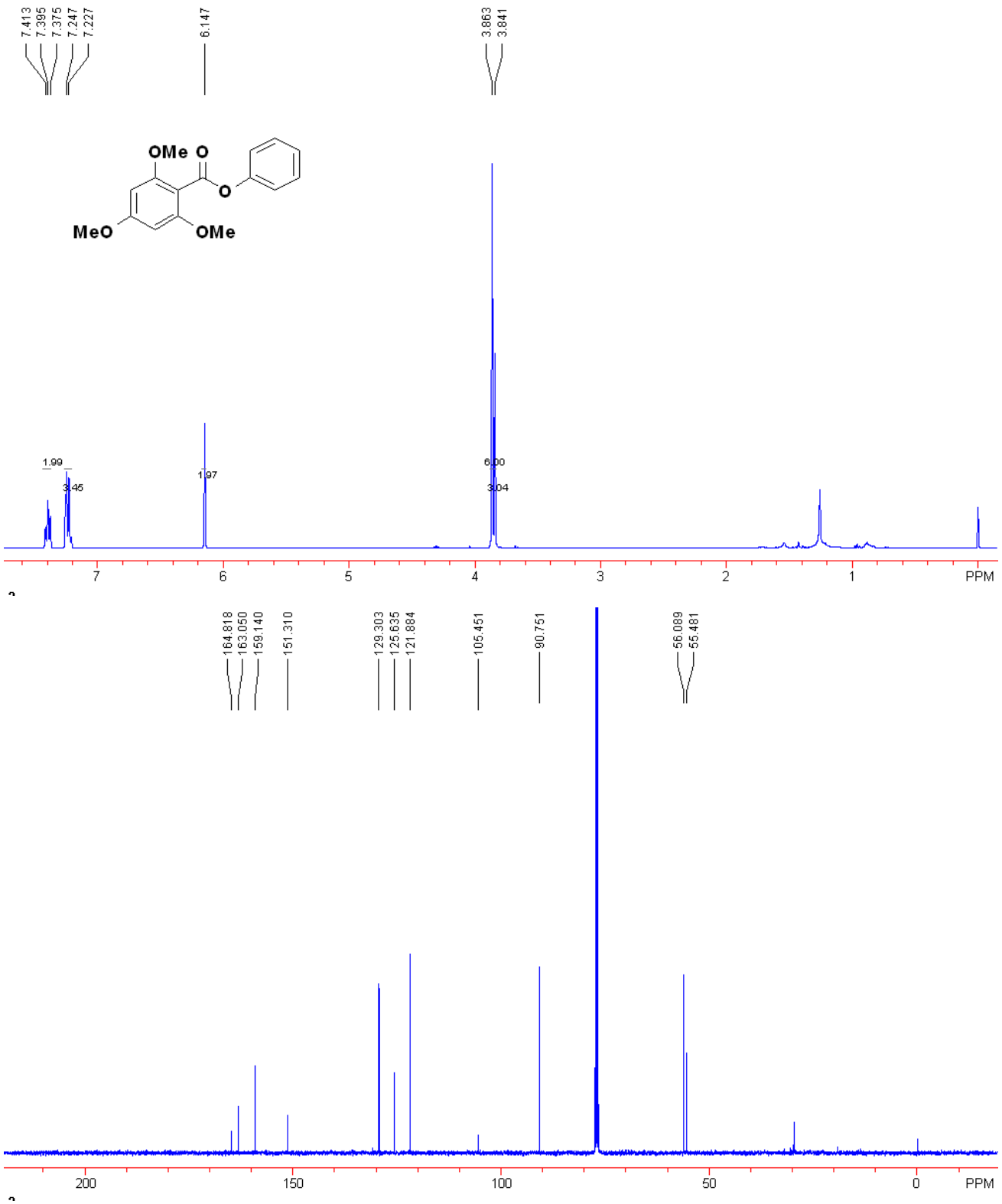


2,3,5,6-tetrafluoro-4'-methoxybiphenyl (5w).

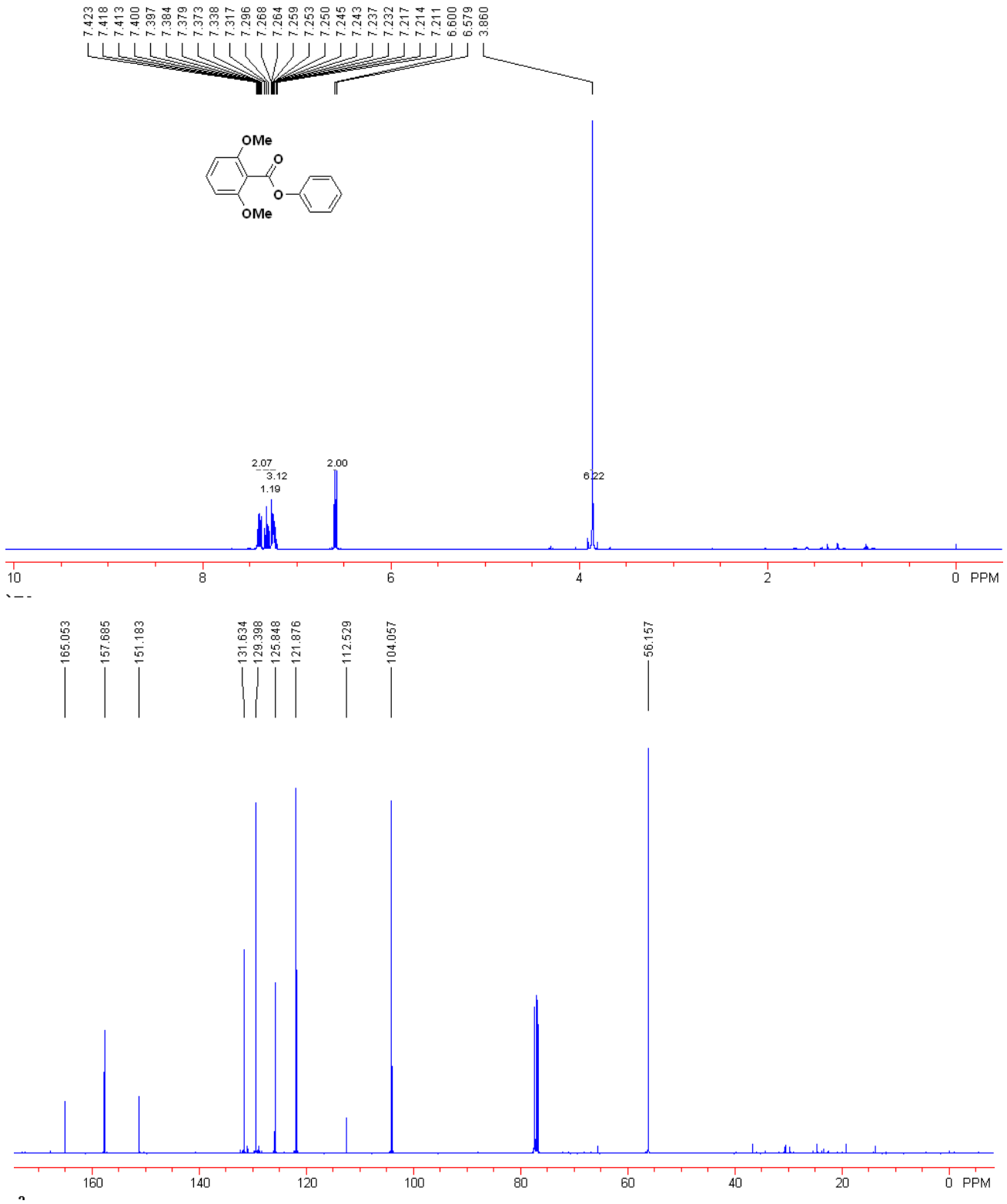




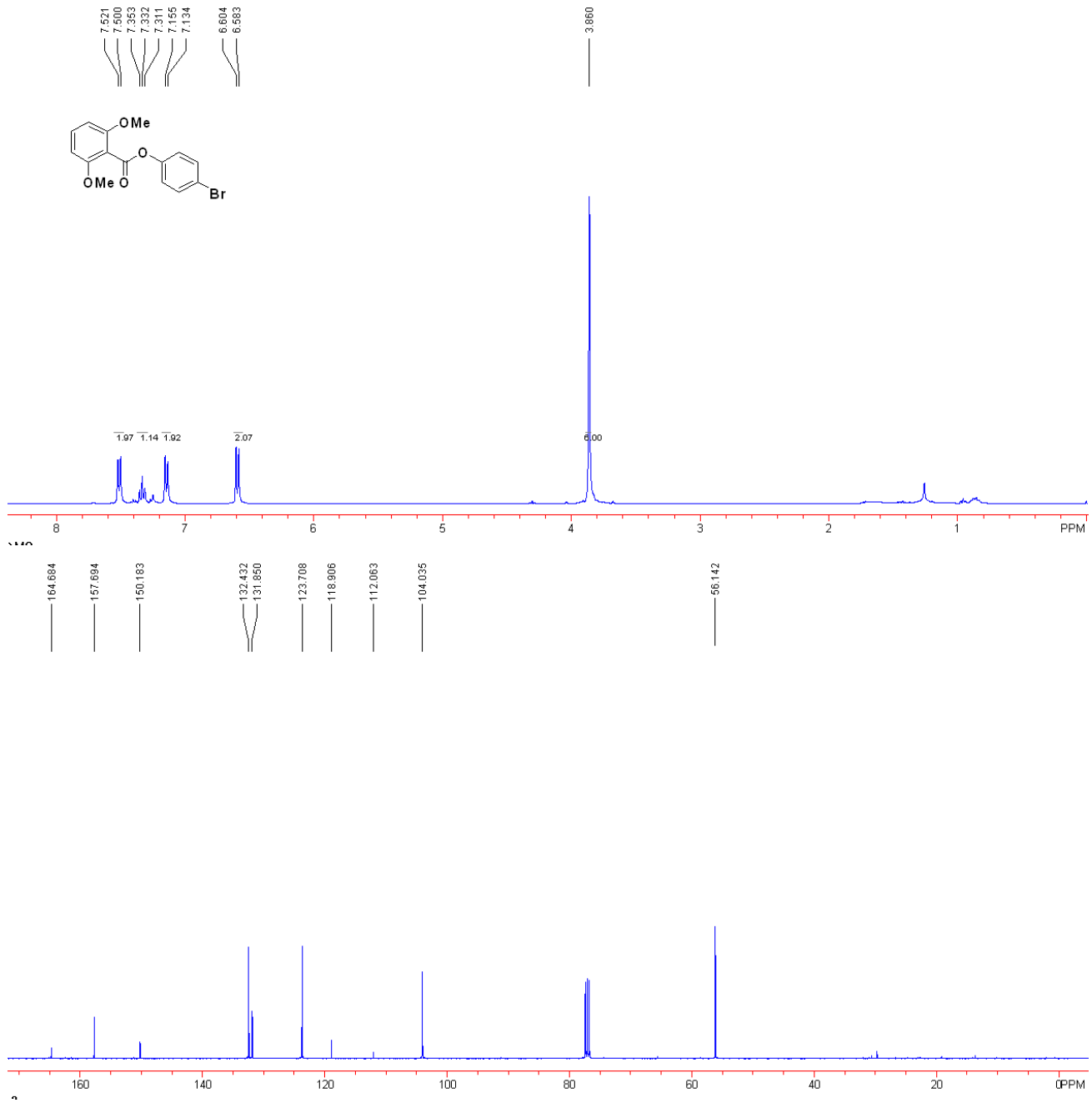
phenyl 2,4,6-trimethoxybenzoate (6a).



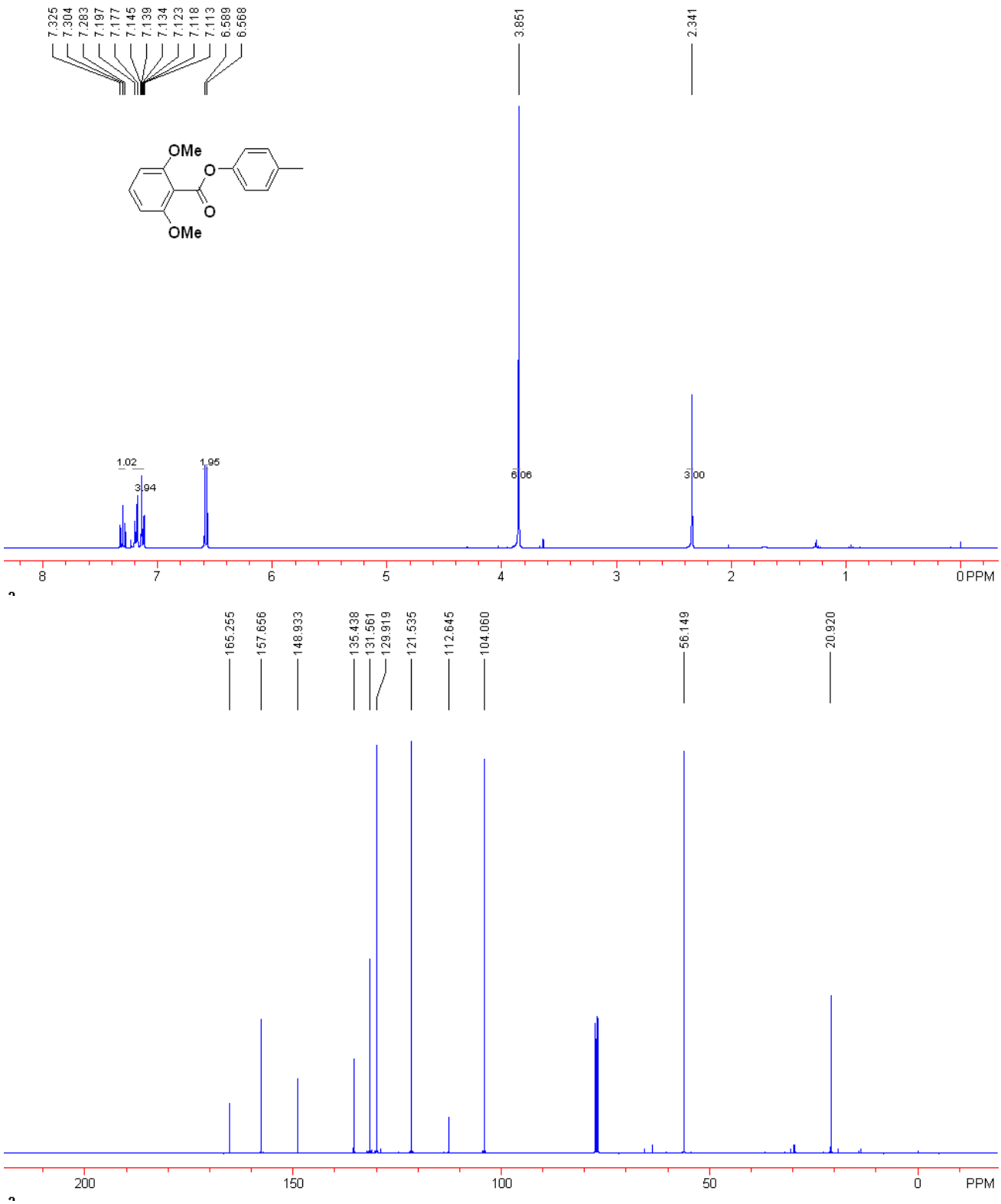
phenyl 2,6-dimethoxybenzoate (6b).



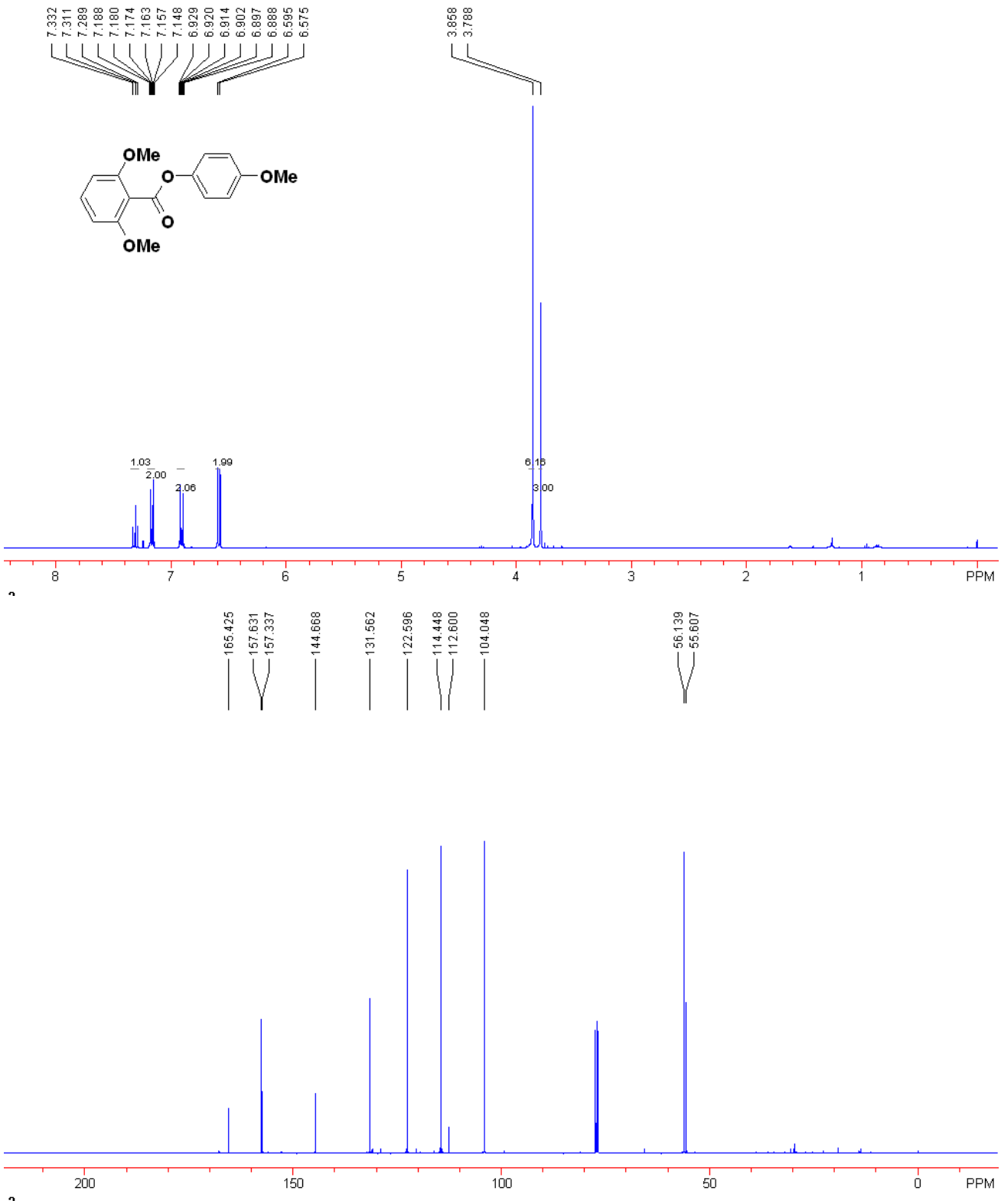
4-bromophenyl 2,6-dimethoxybenzoate (6c).



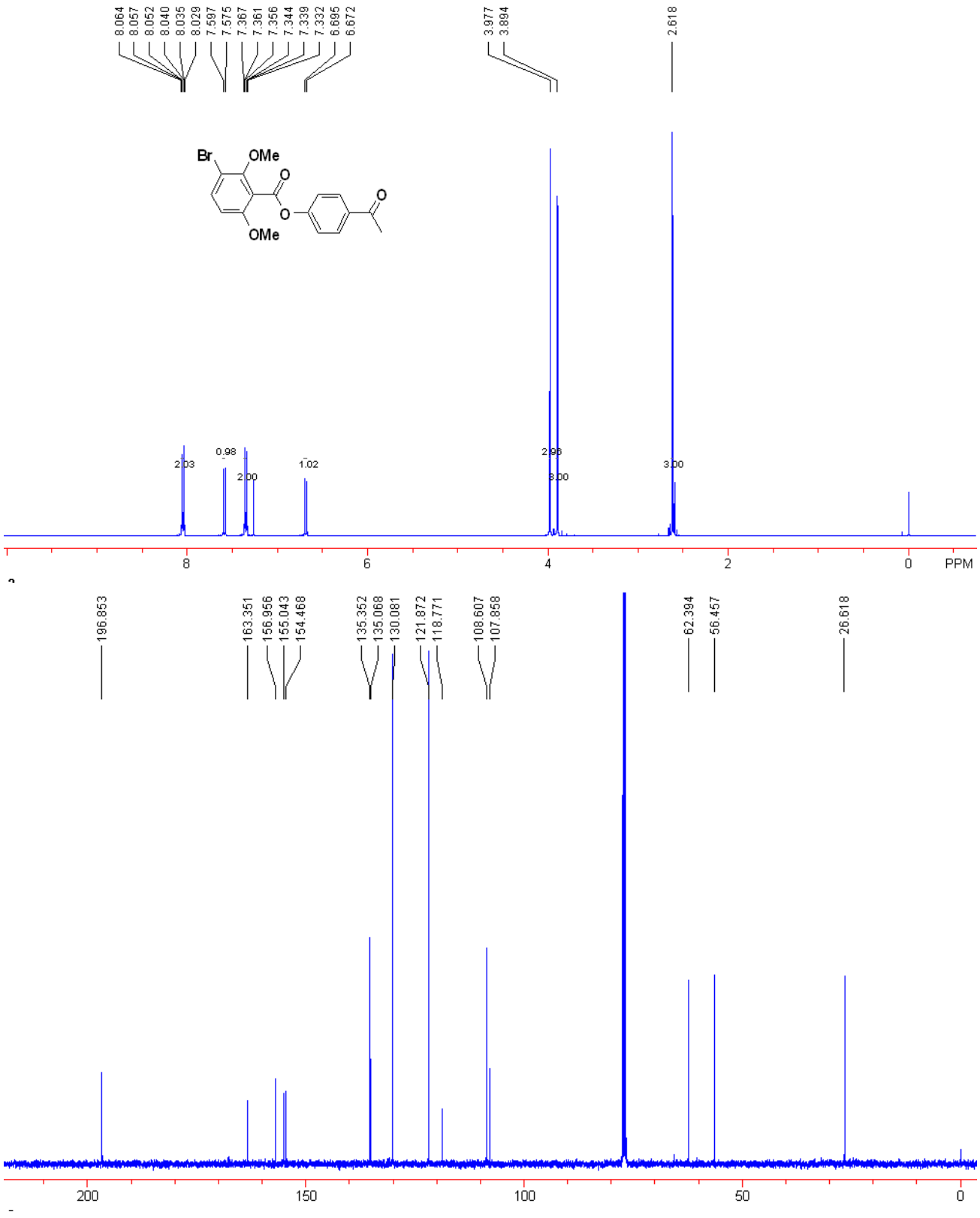
_p_-tolyl 2,6-dimethoxybenzoate (6d).



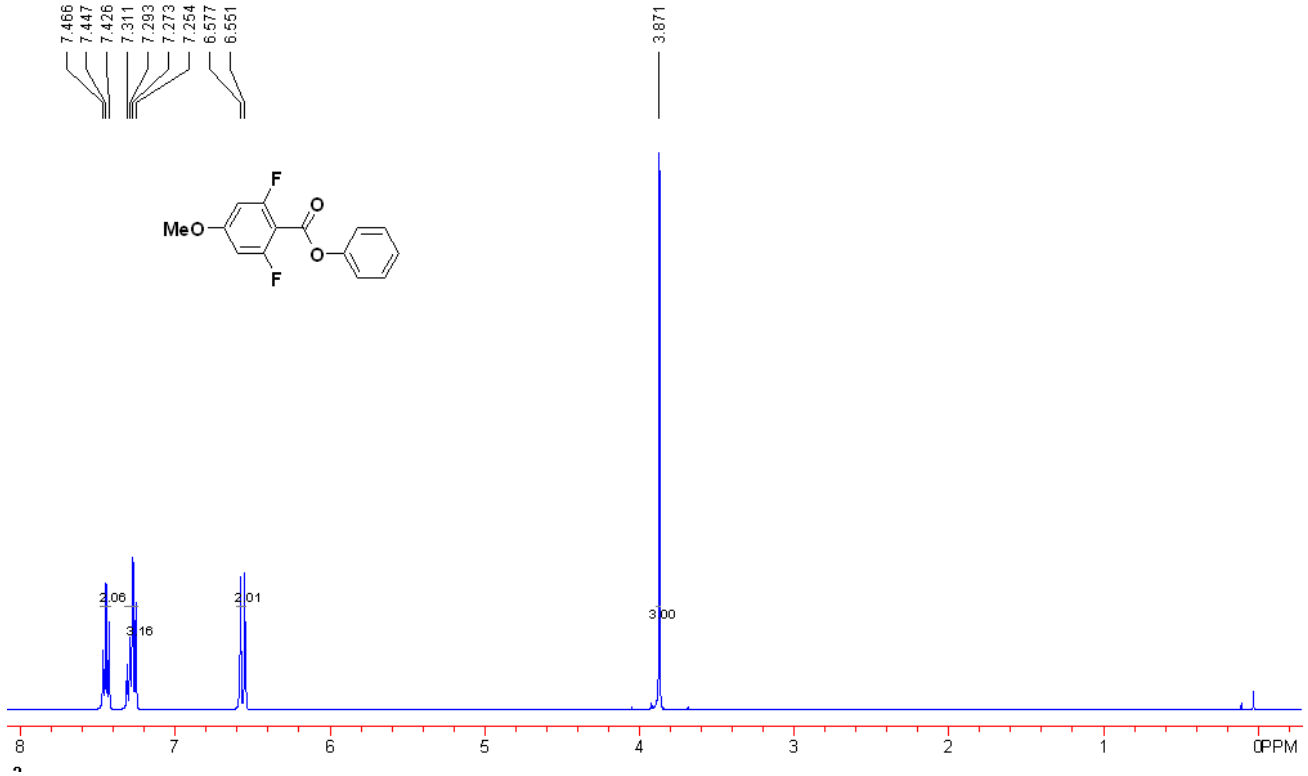
4-methoxyphenyl 2,6-dimethoxybenzoate (6e).



4-acetylphenyl 3-bromo-2,6-dimethoxybenzoate (6f).



phenyl 2,6-difluoro-4-methoxybenzoate (6g).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7.293
7.273
7.254
6.577
6.551
3.871
F
O
MeO
O
F
2.06
3.16
2.01
3.00
8
7
6
5
4
3
2
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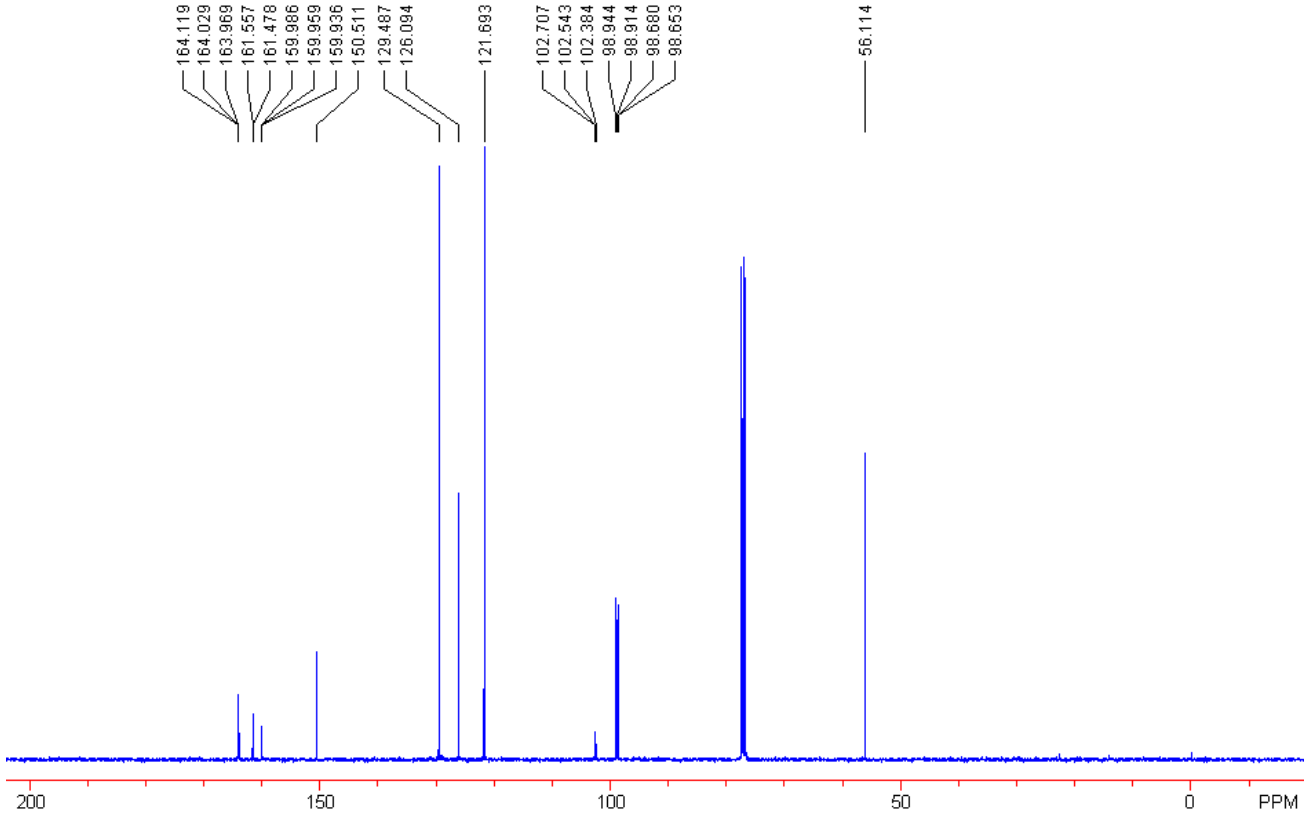
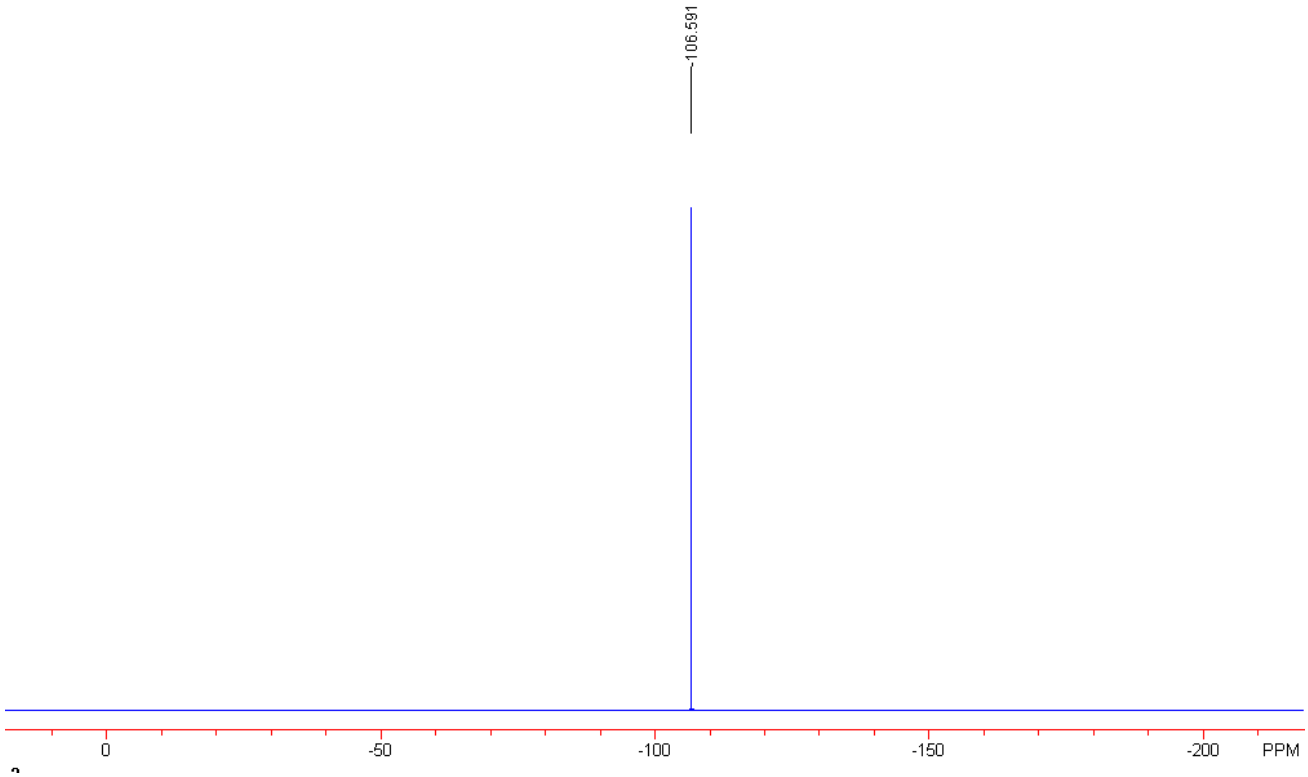
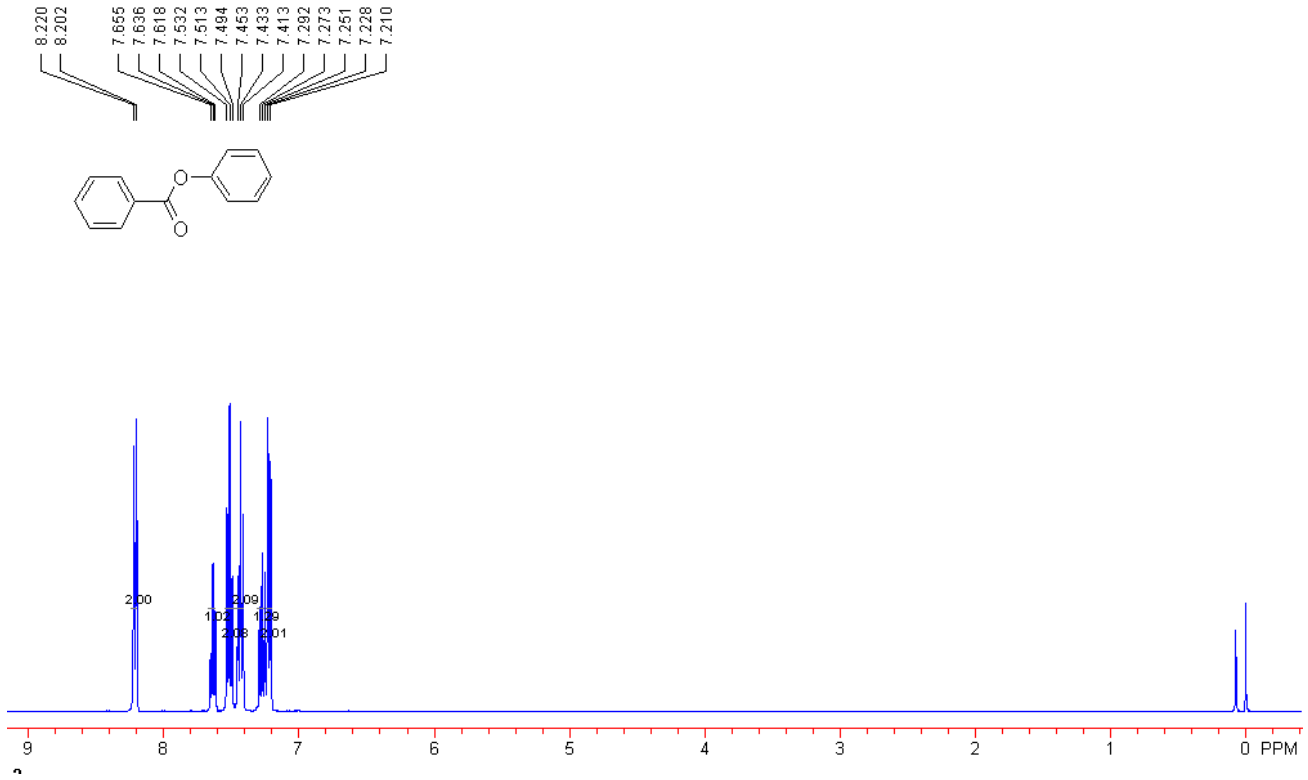
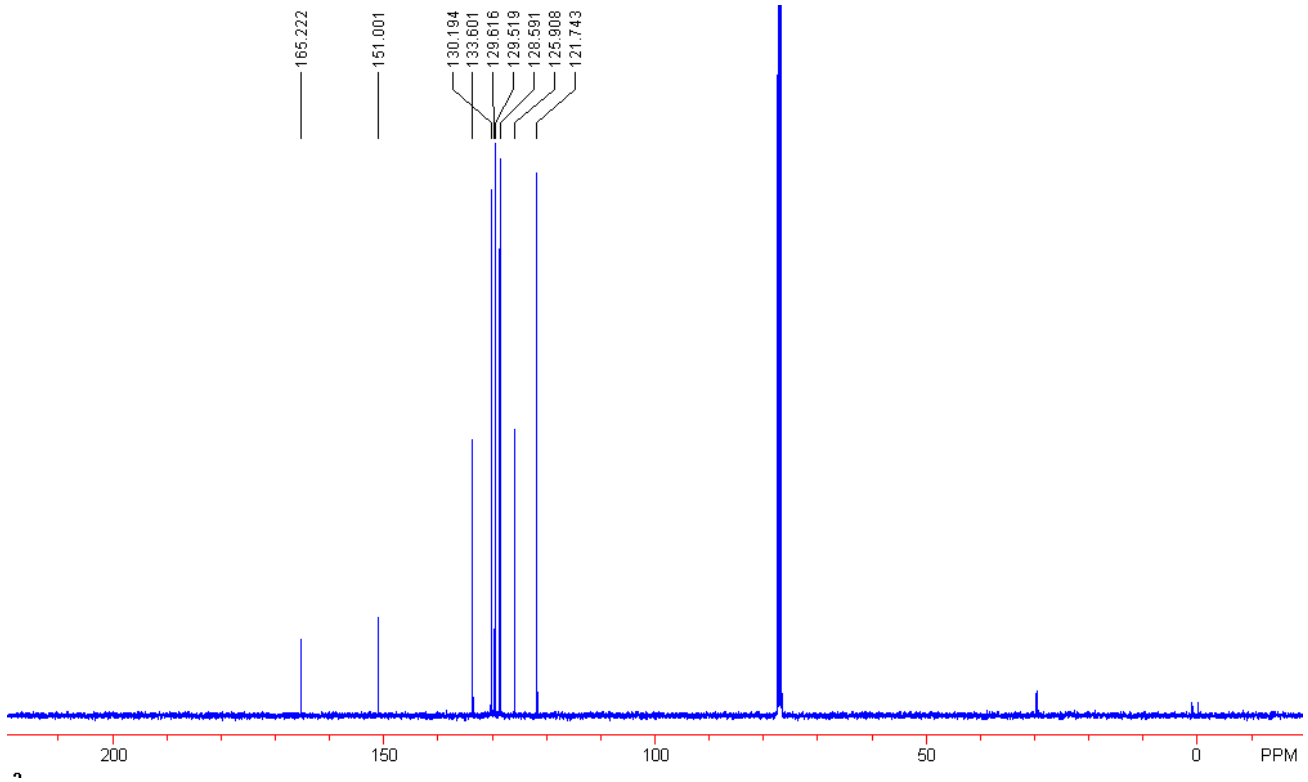
0PPM


164.119
164.029
163.969
161.557
161.478
159.986
159.959
159.936
150.511
129.487
126.094
121.693
102.707
102.543
102.384
98.944
98.914
98.680
98.653
56.114
200
150
100
50
0
PPM

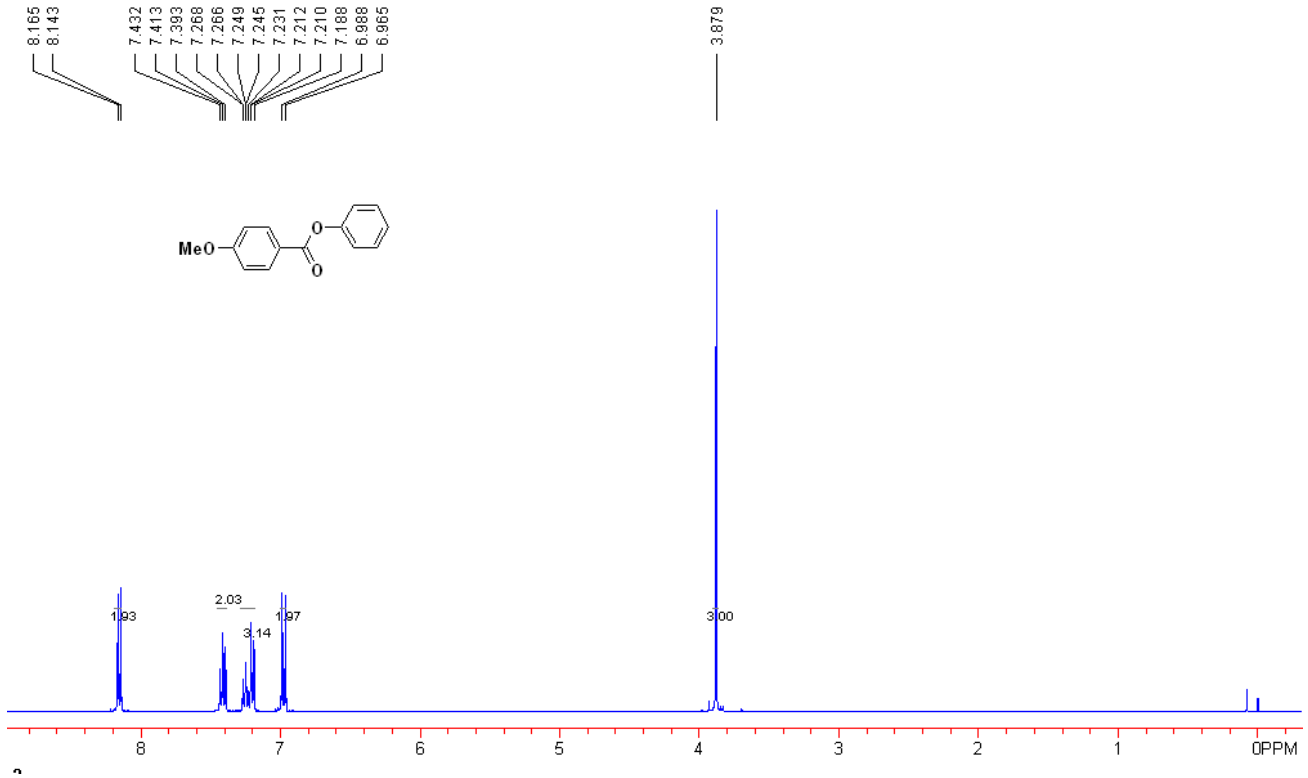


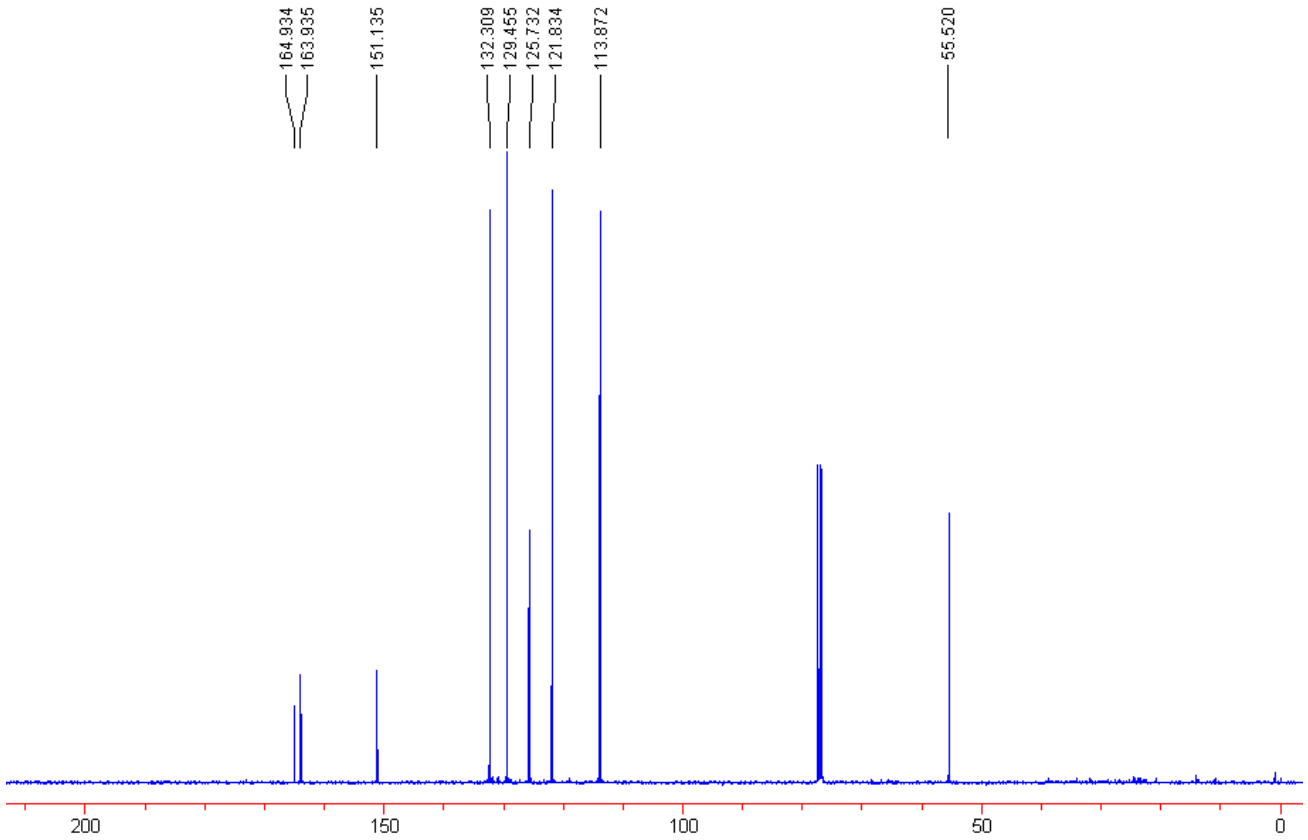
phenyl benzoate (6h).



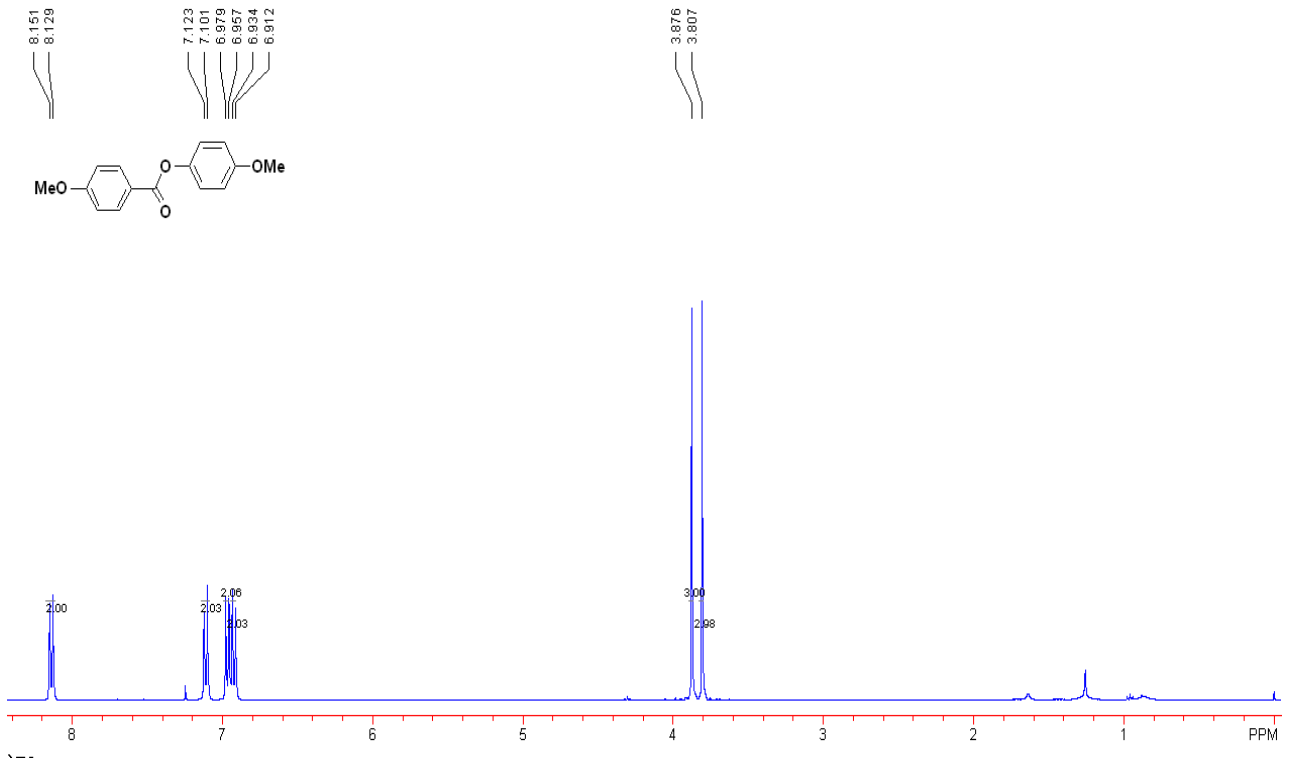


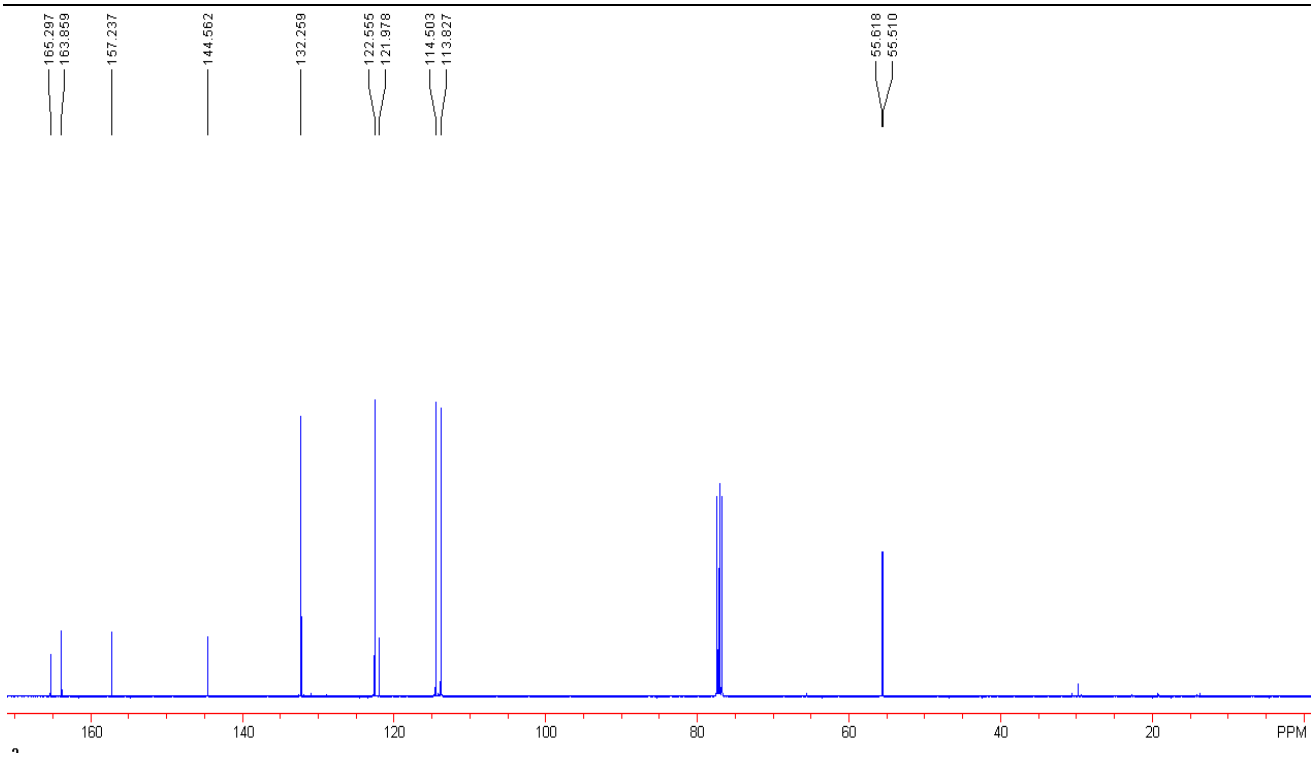
phenyl 4-methoxybenzoate (6i).



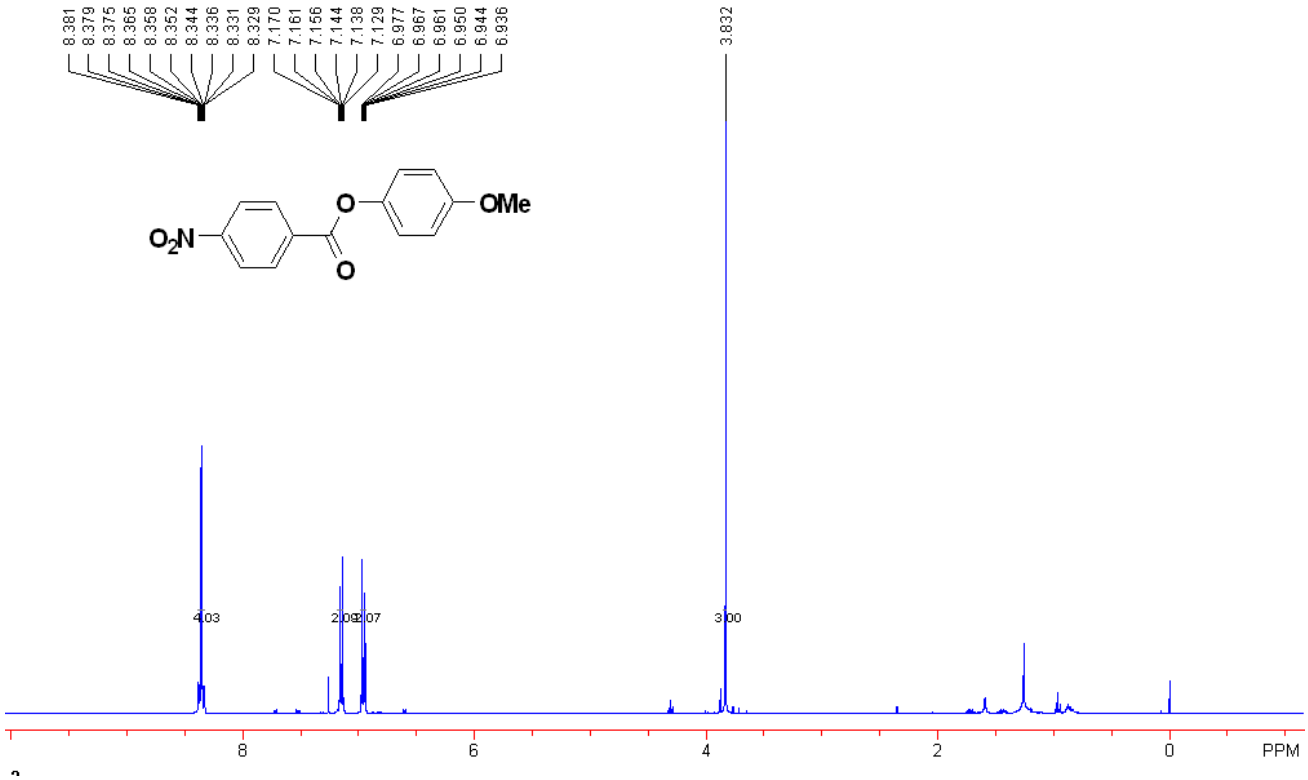


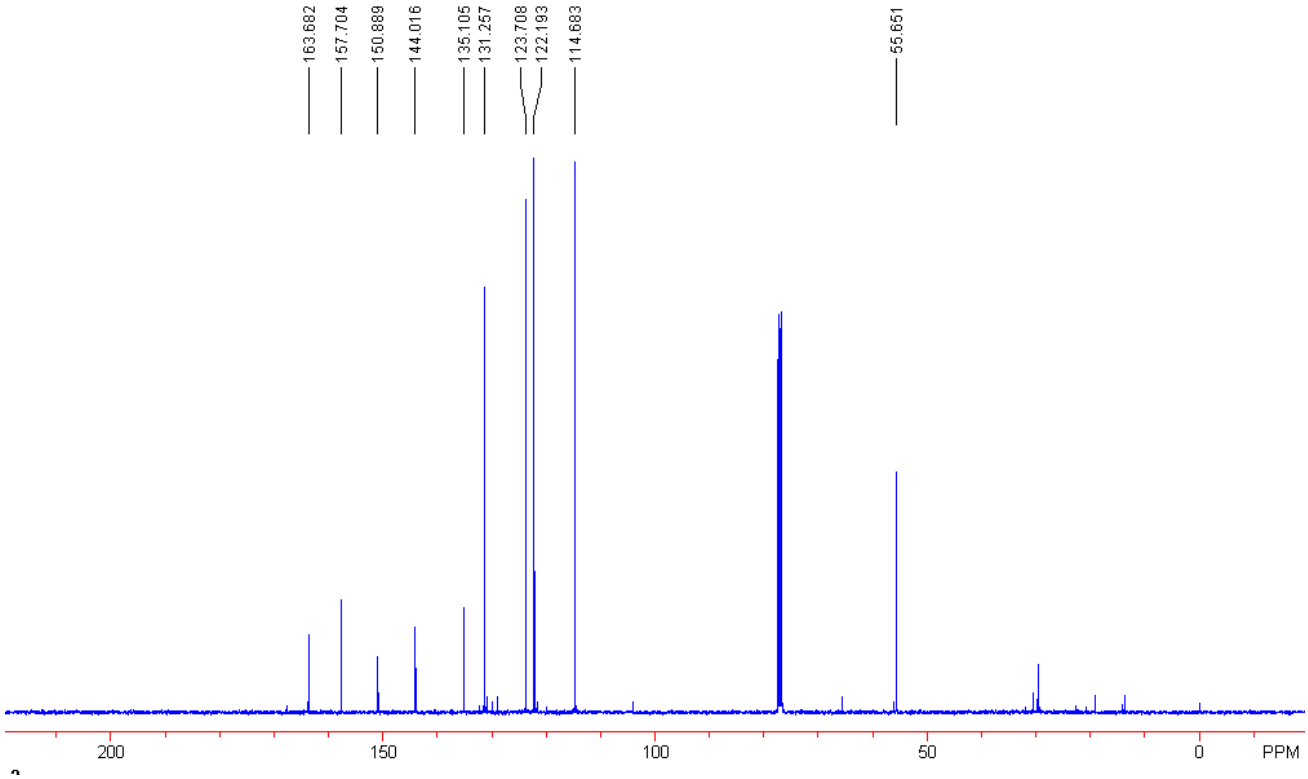
4-methoxyphenyl 4-methoxybenzoate (6j).



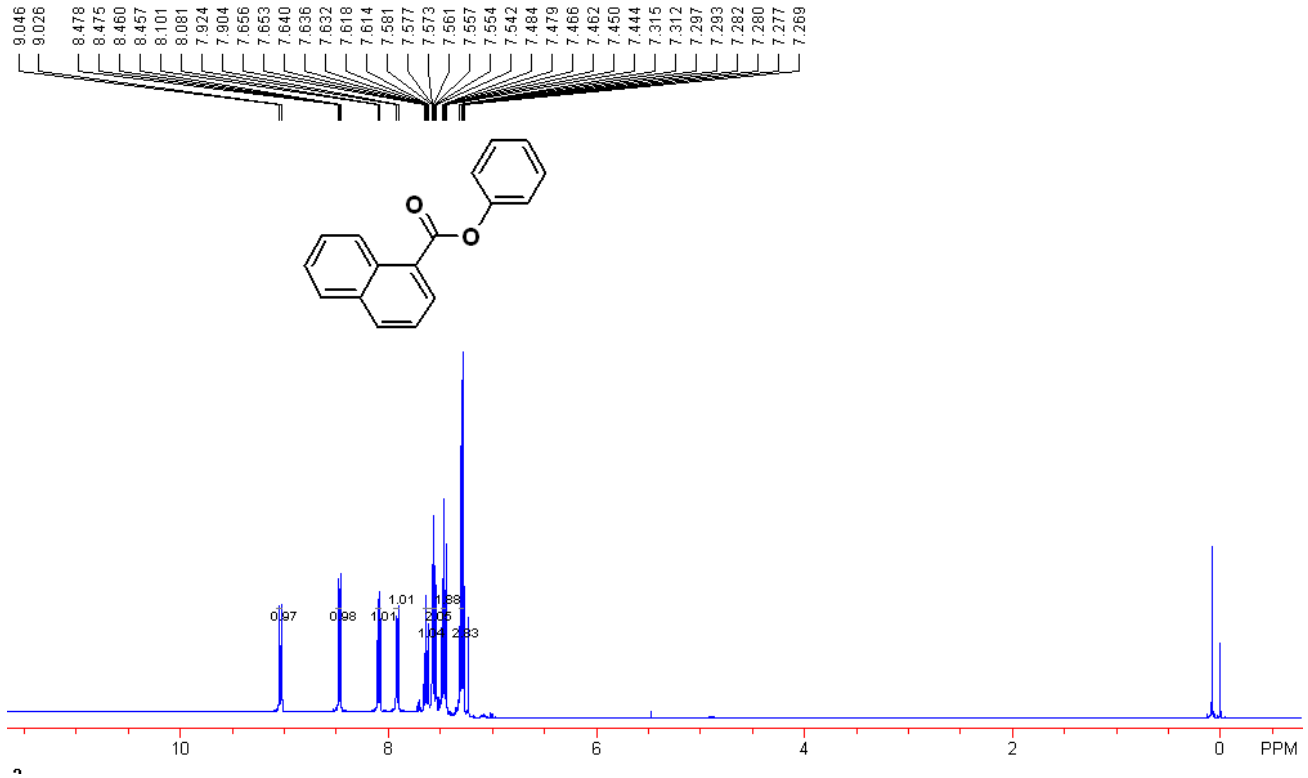


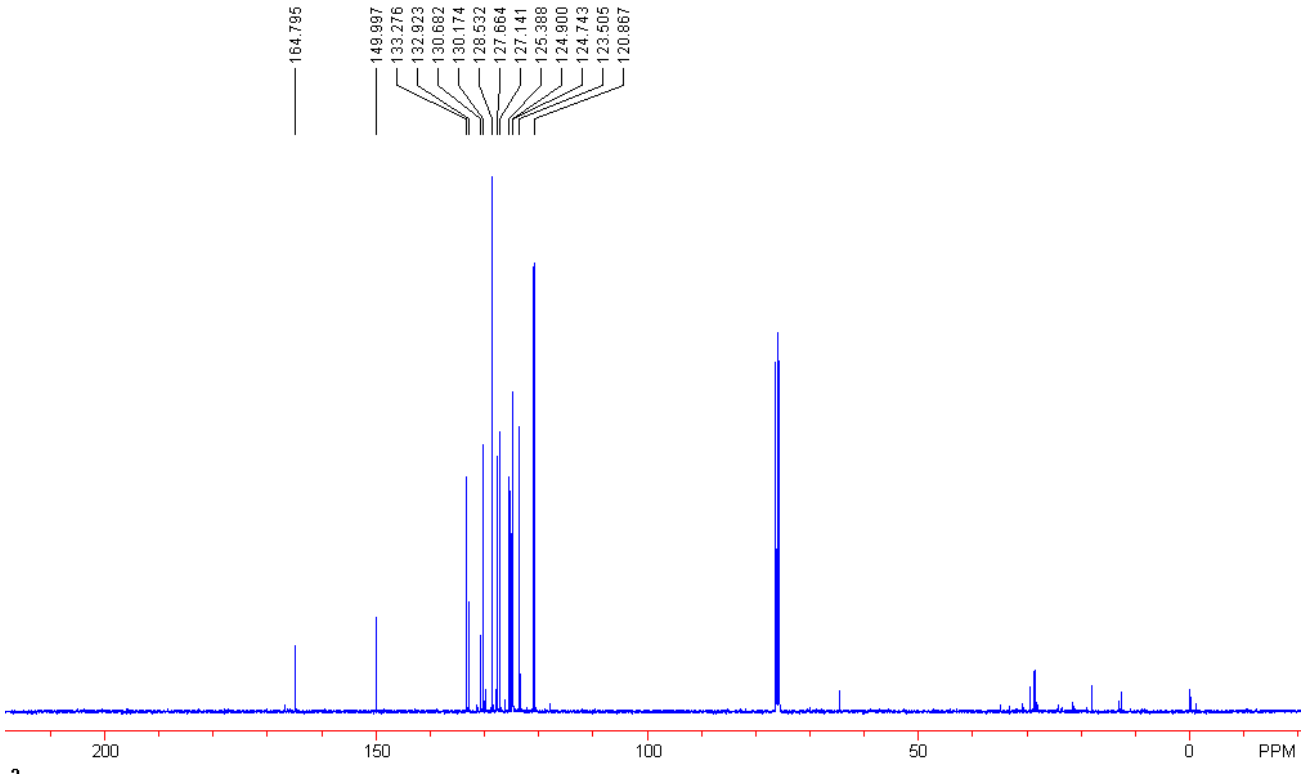
4-methoxyphenyl 4-nitrobenzoate (6k).





phenyl 1-naphthoate (6l).





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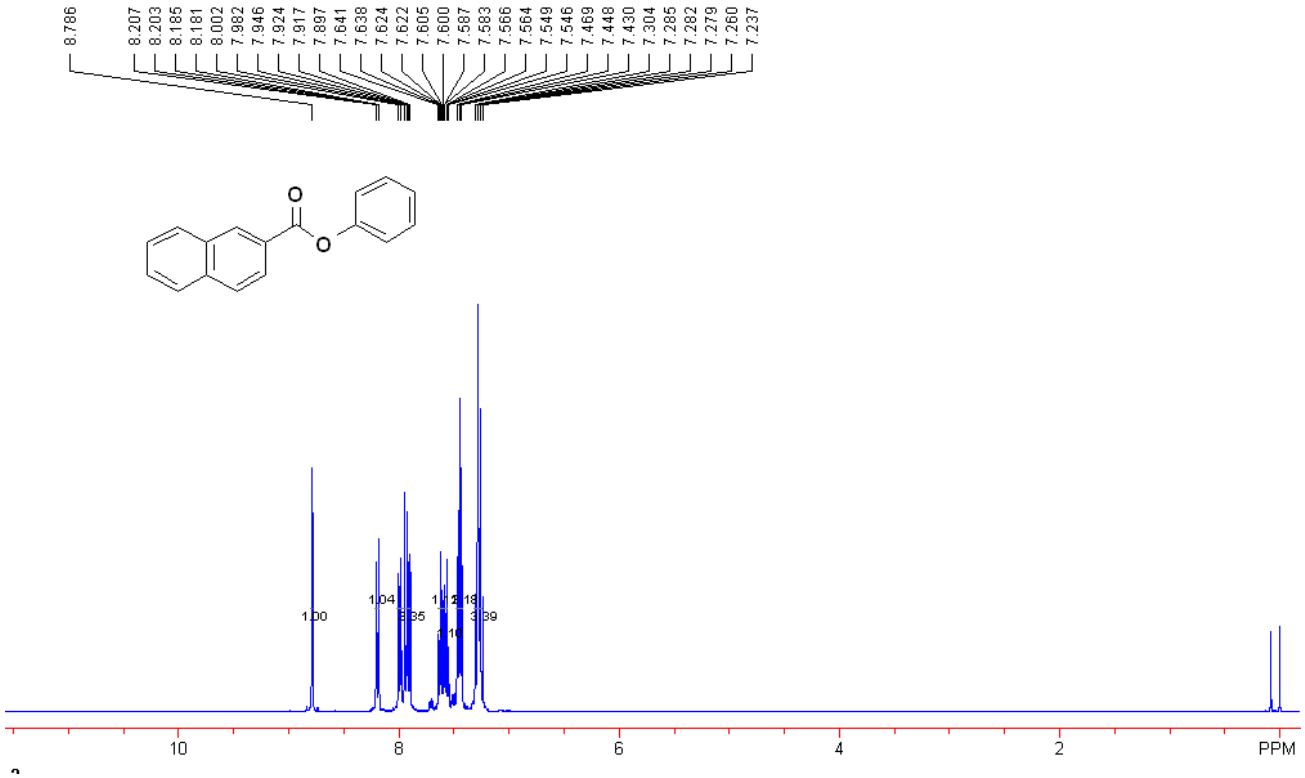
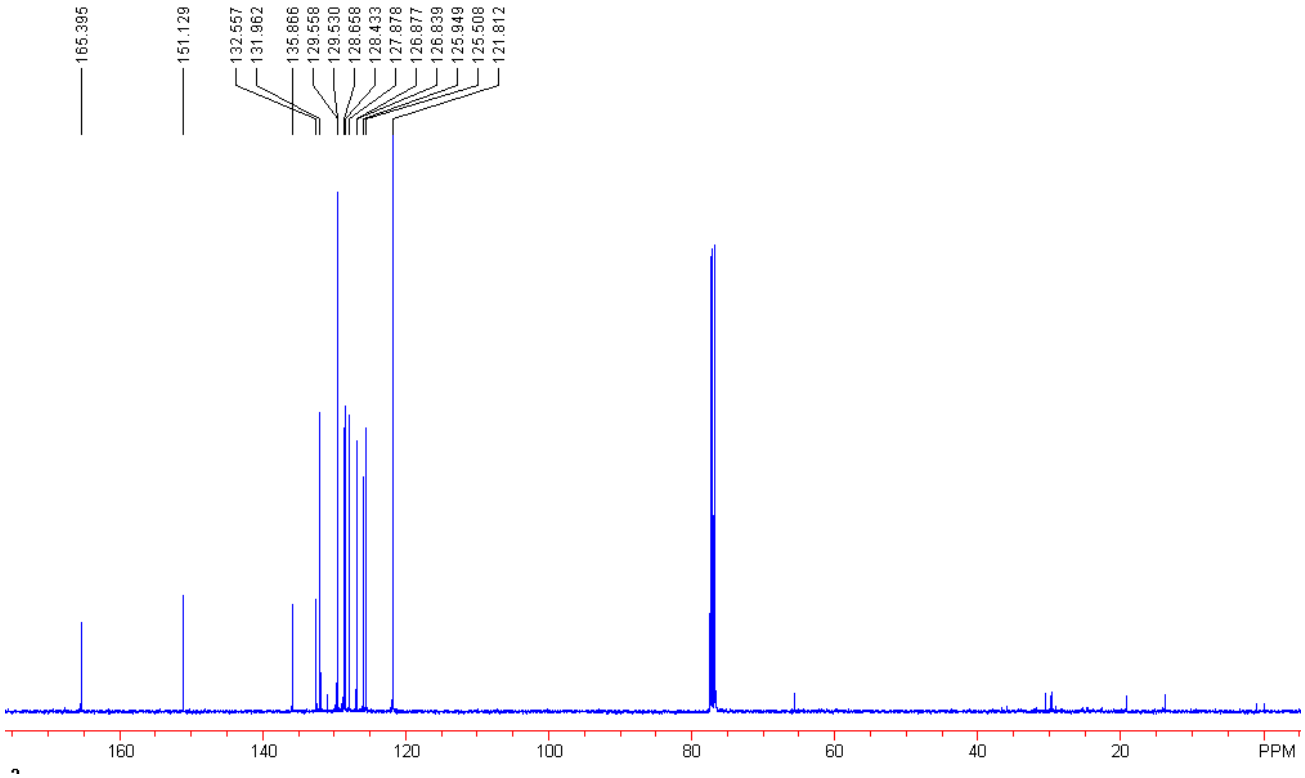
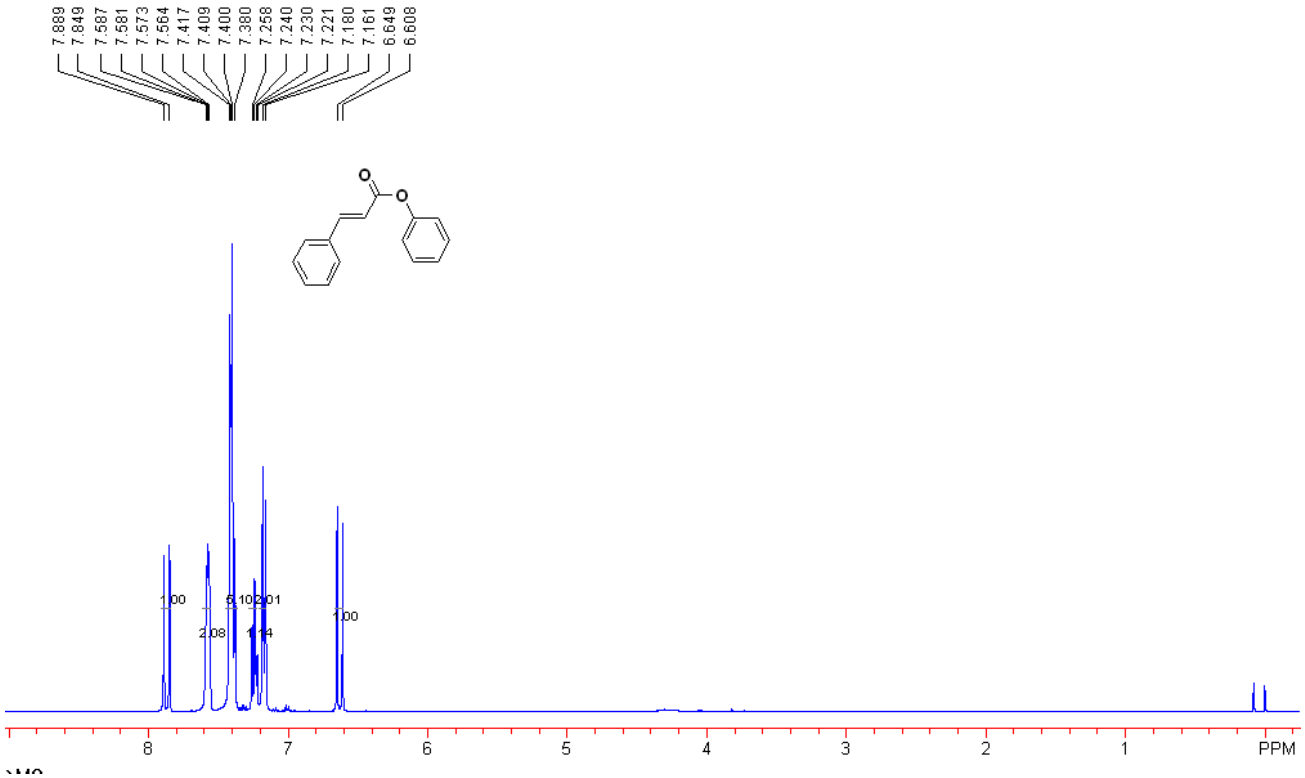
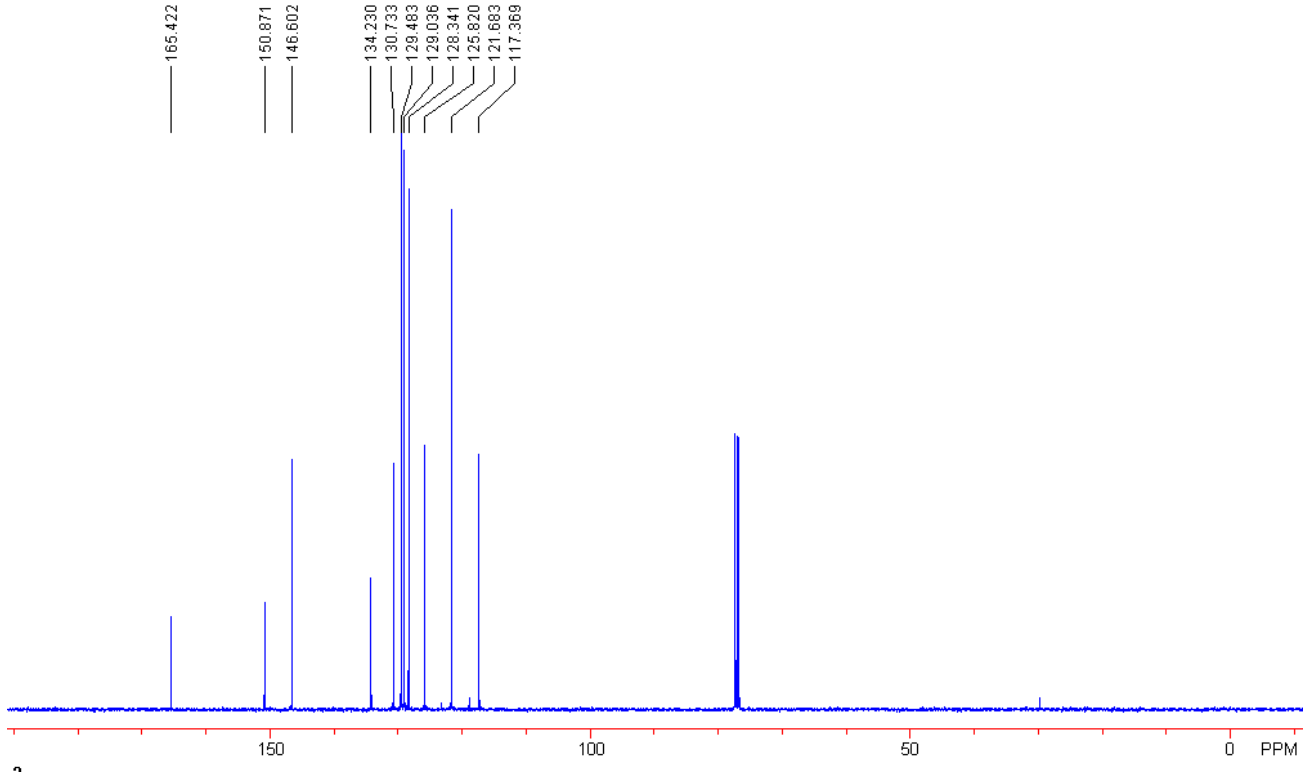




phenyl cinnamate (6n).





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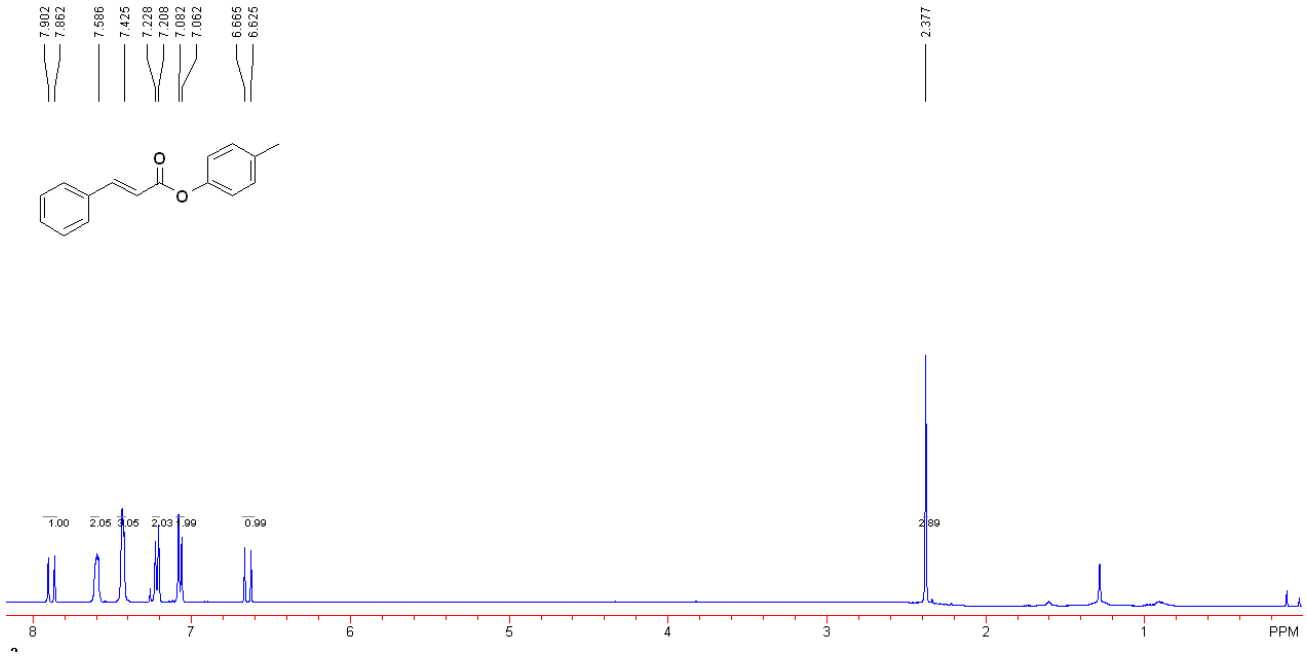
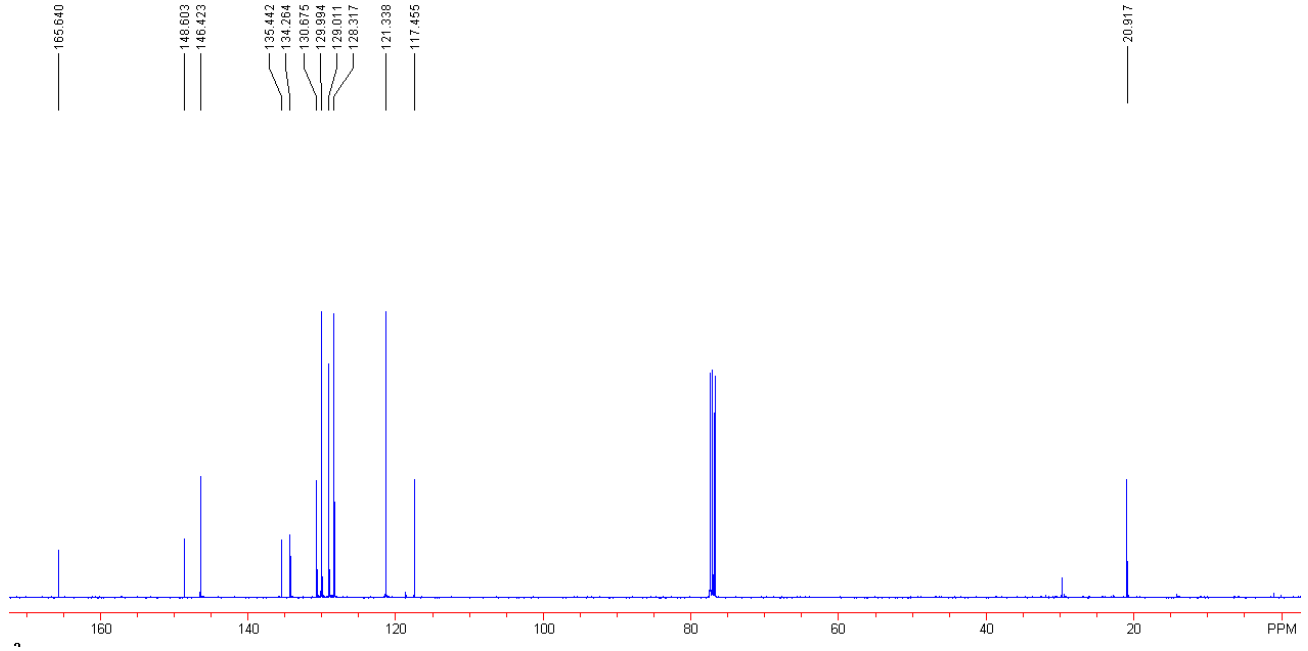
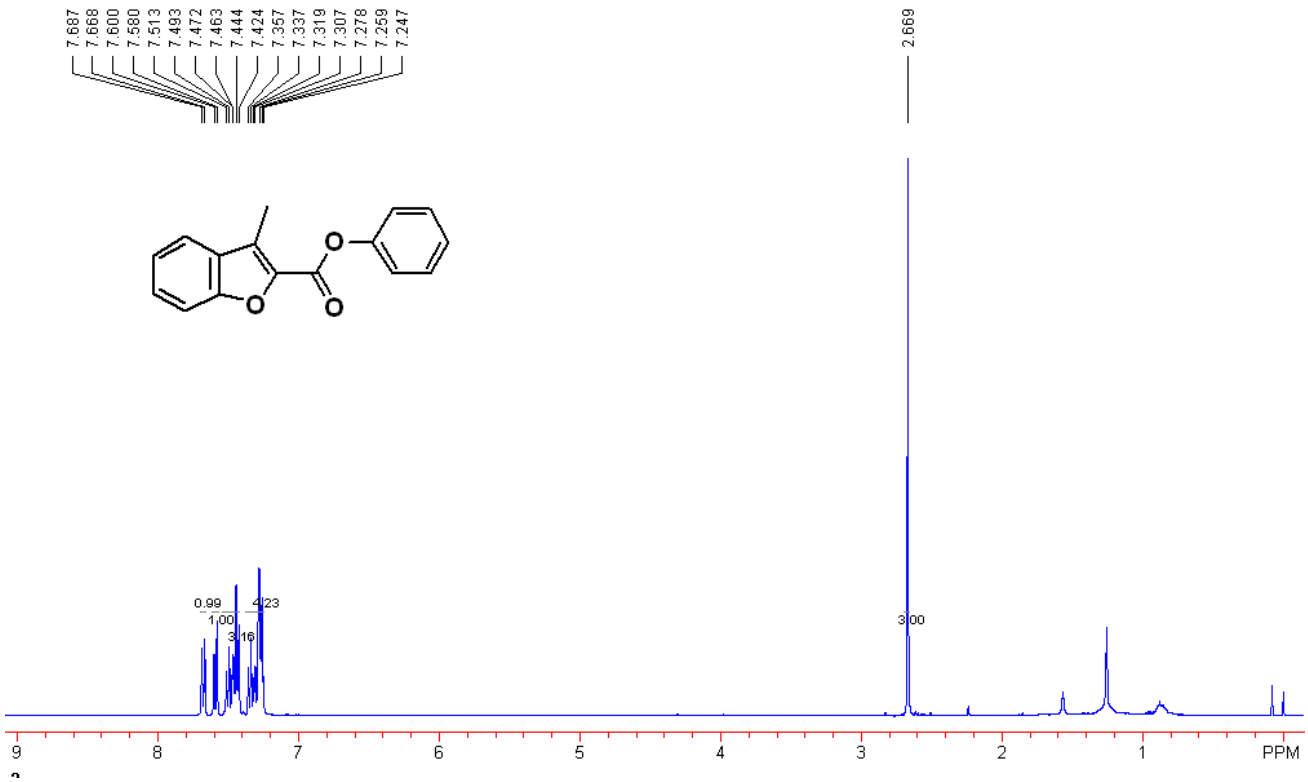
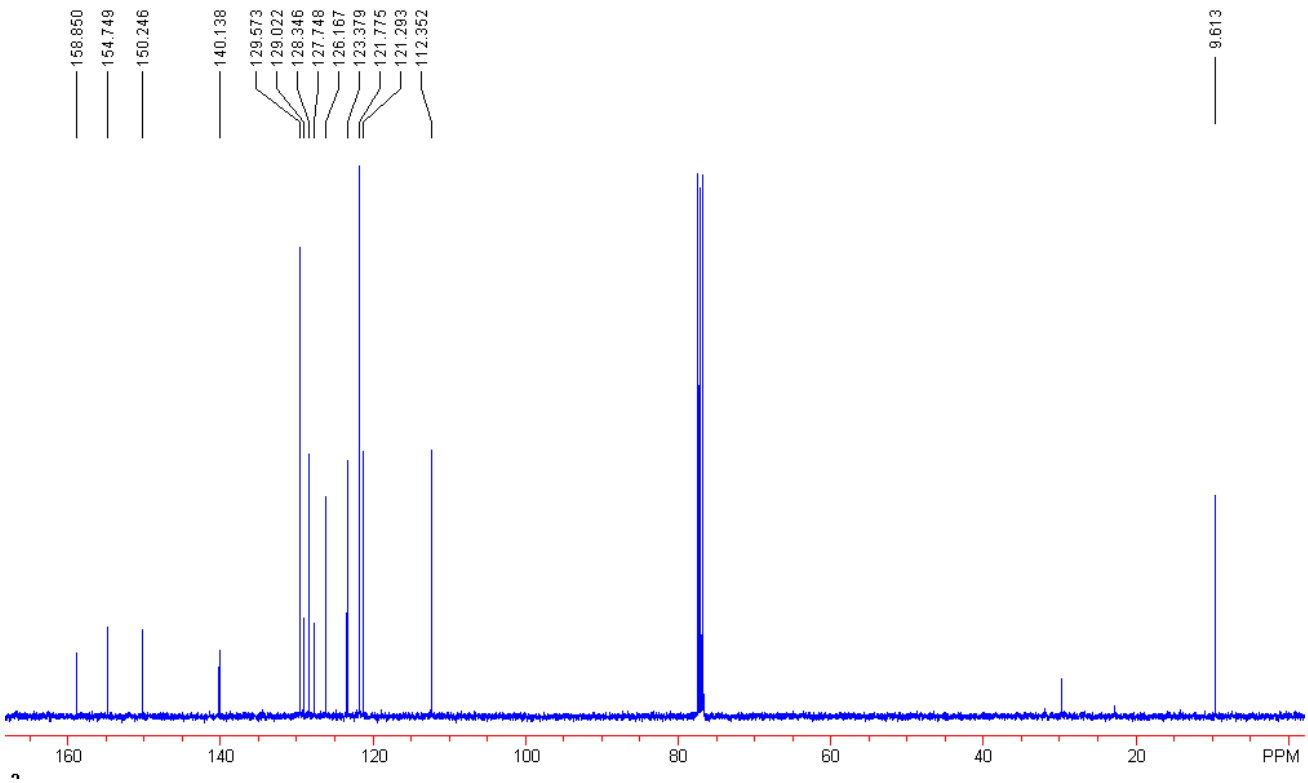


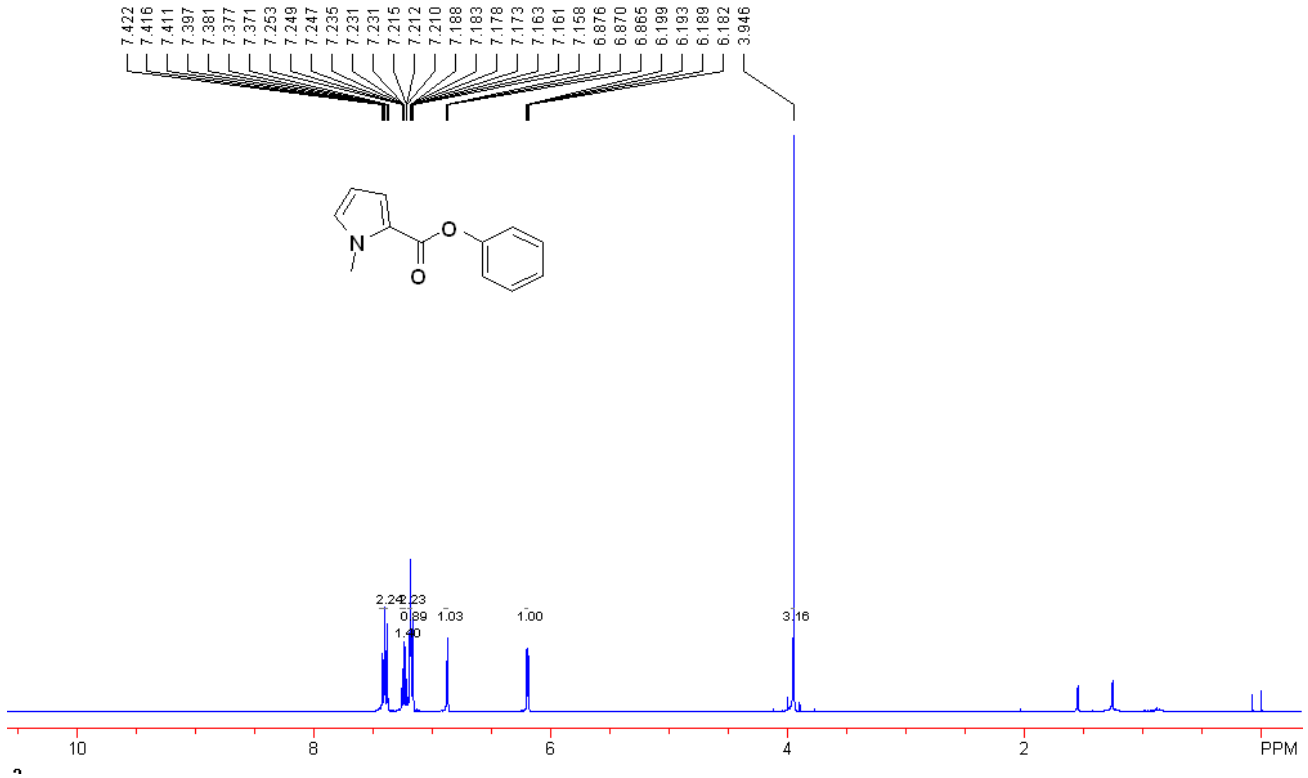


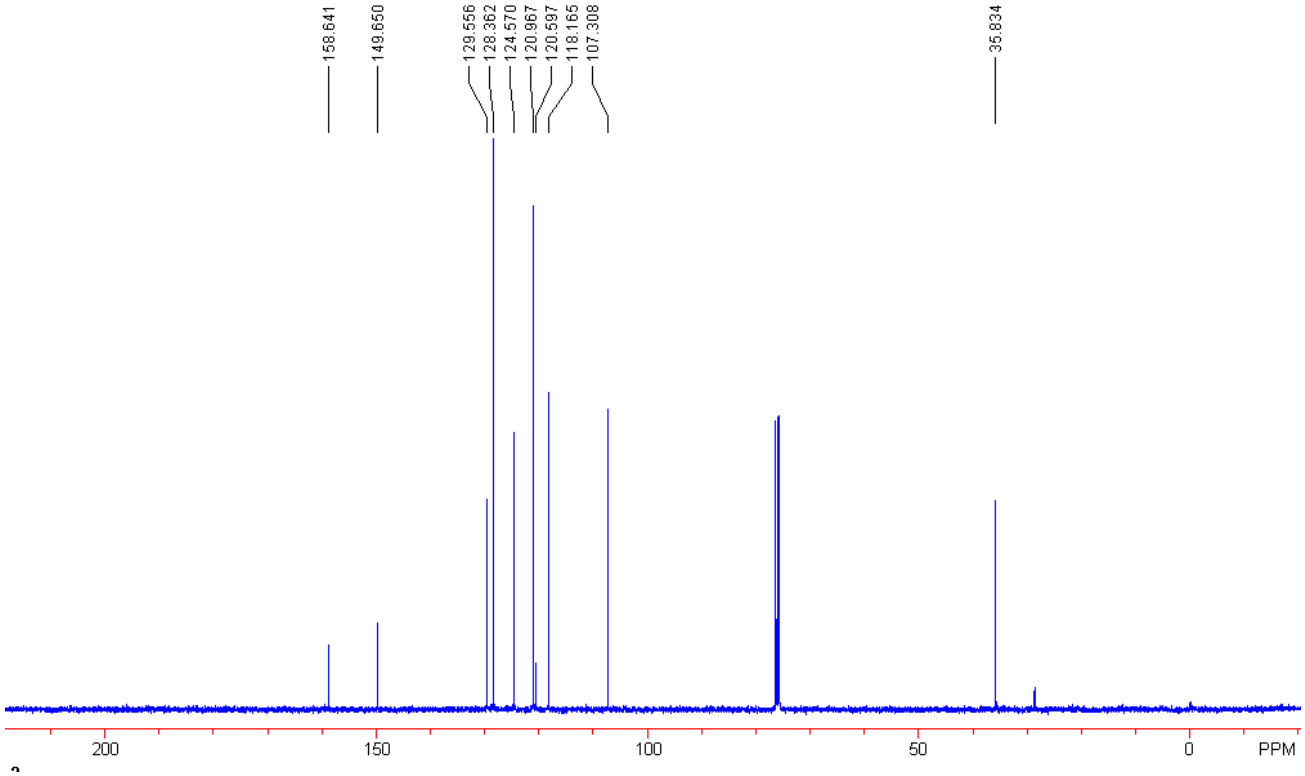
phenyl 3-methylbenzofuran-2-carboxylate (6p).



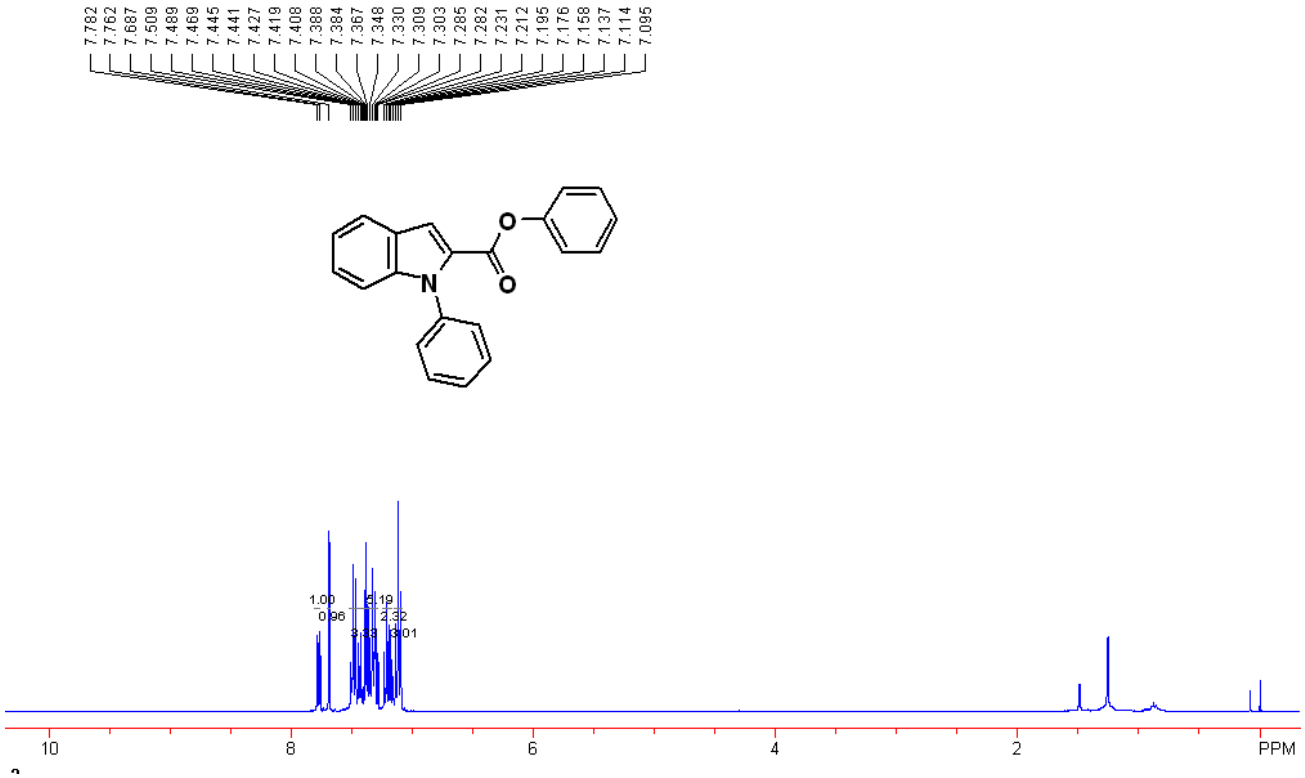


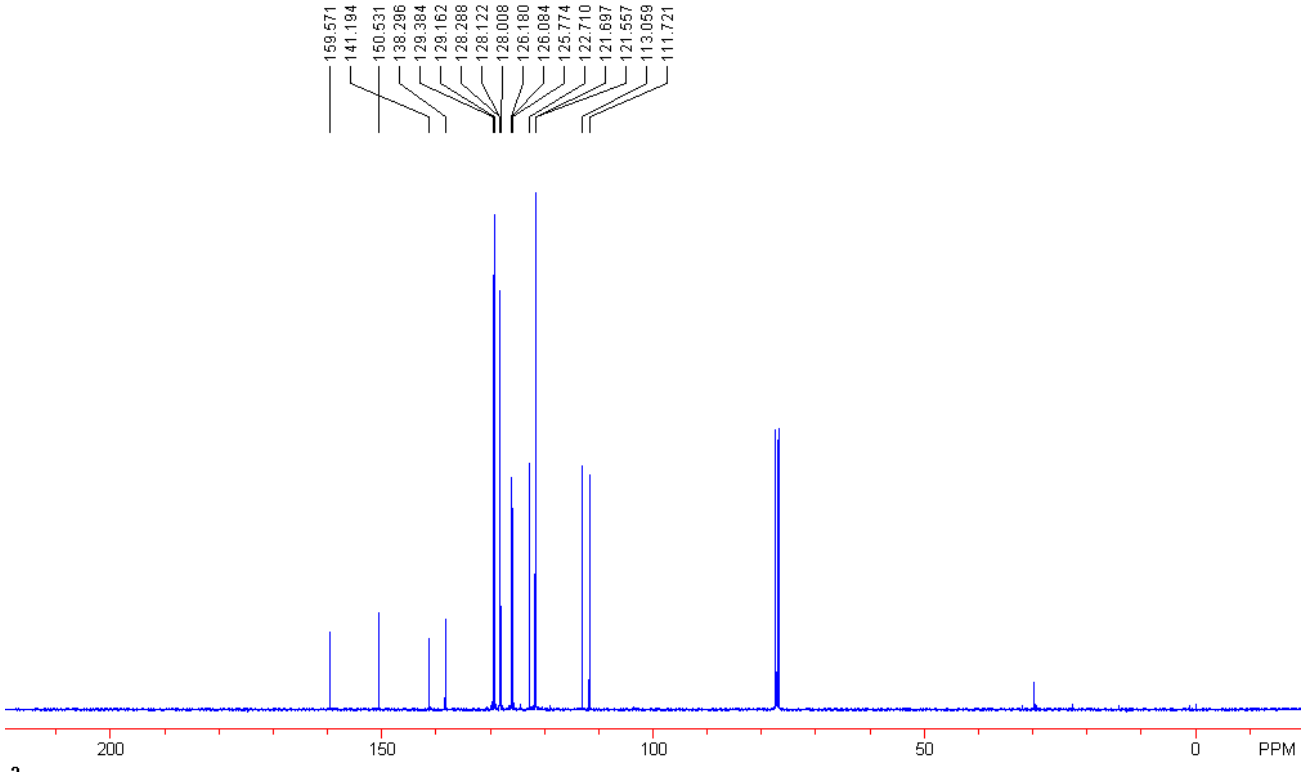
phenyl 1-methyl-1H-pyrrole-2-carboxylate (6q).



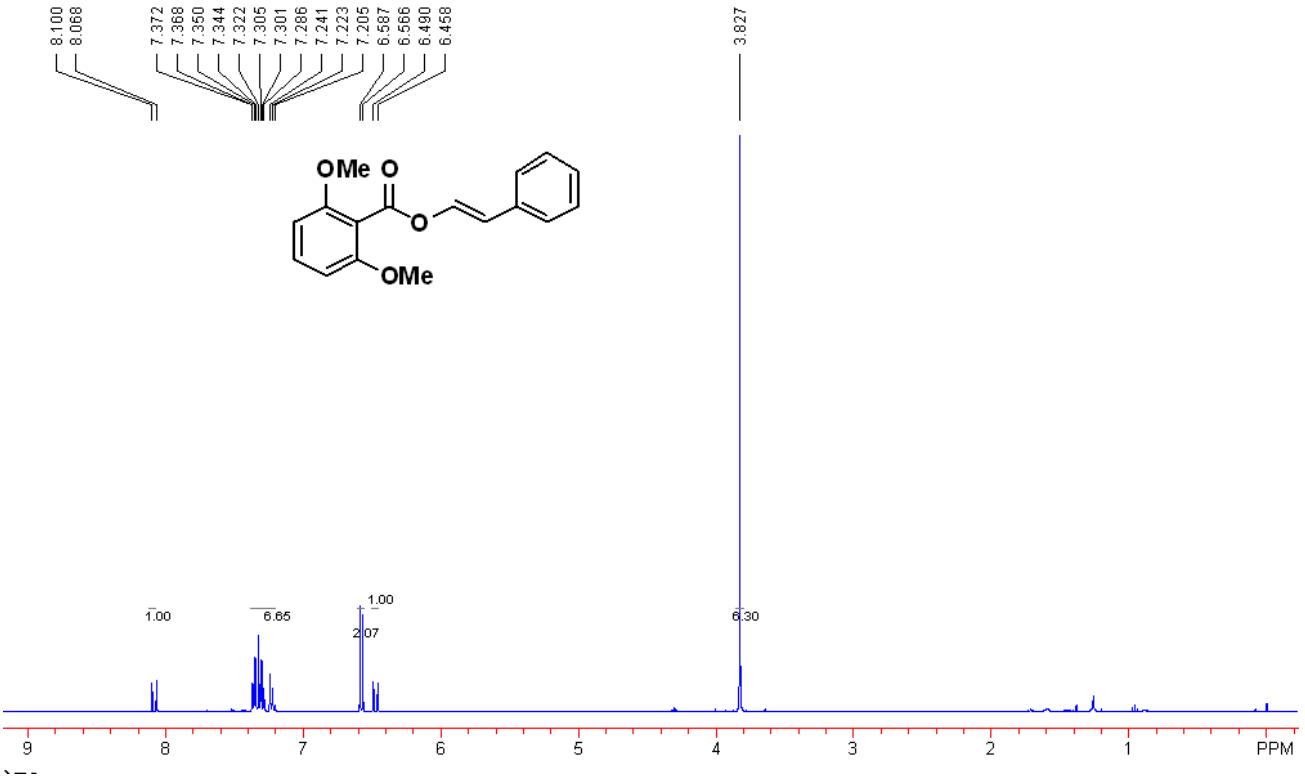


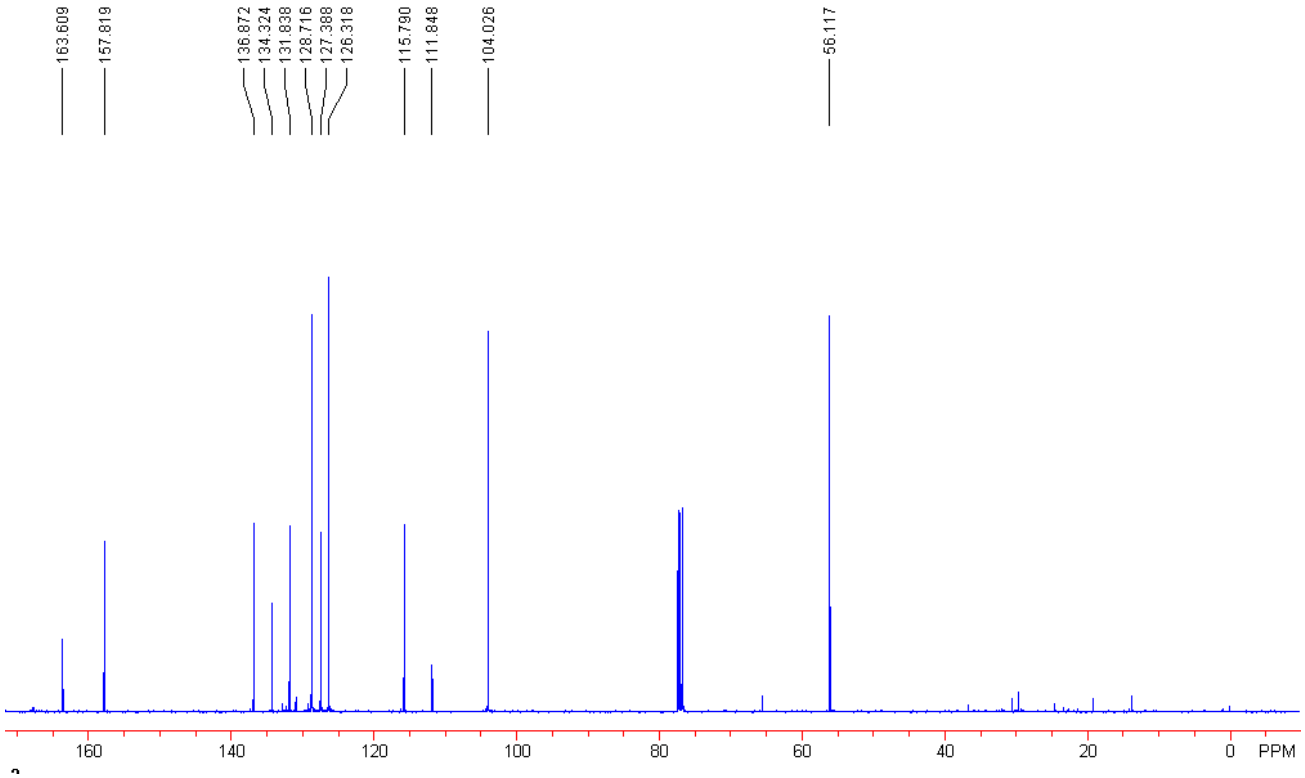
phenyl 1-phenyl-1H-indole-2-carboxylate (6r).



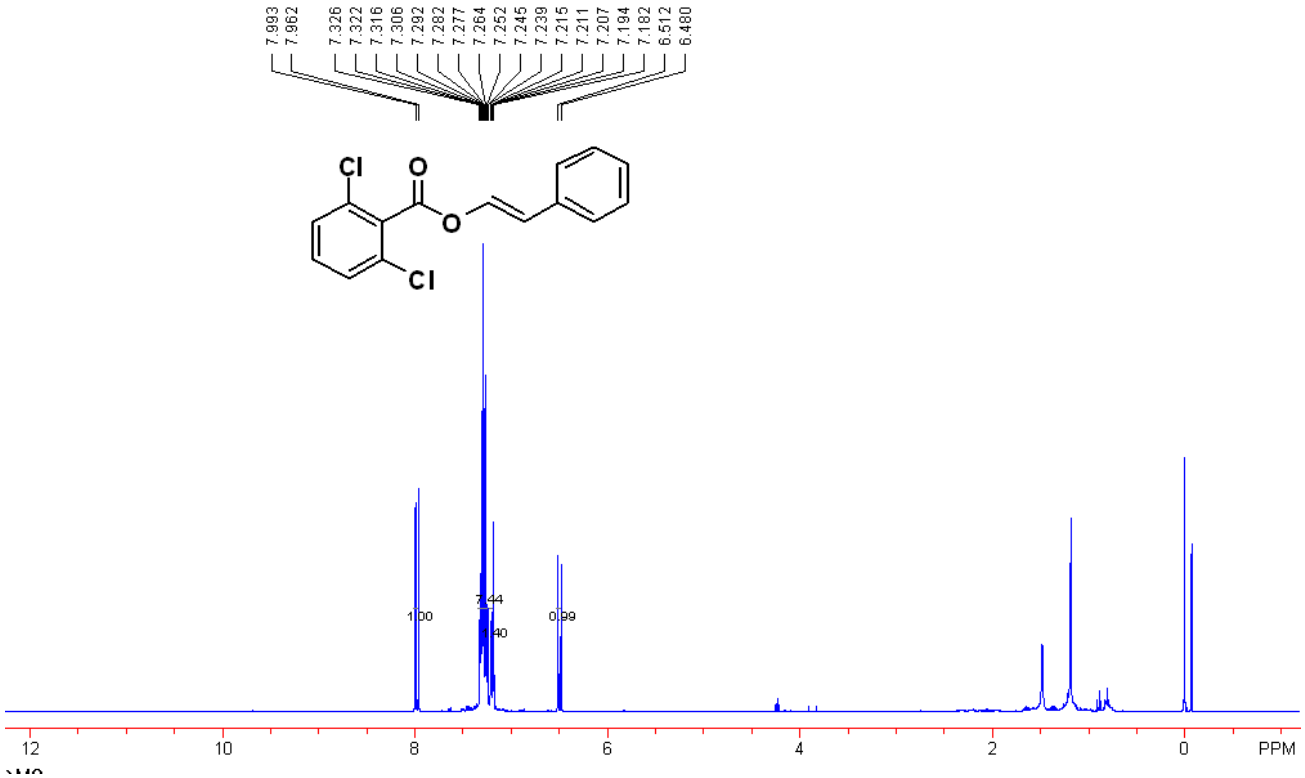


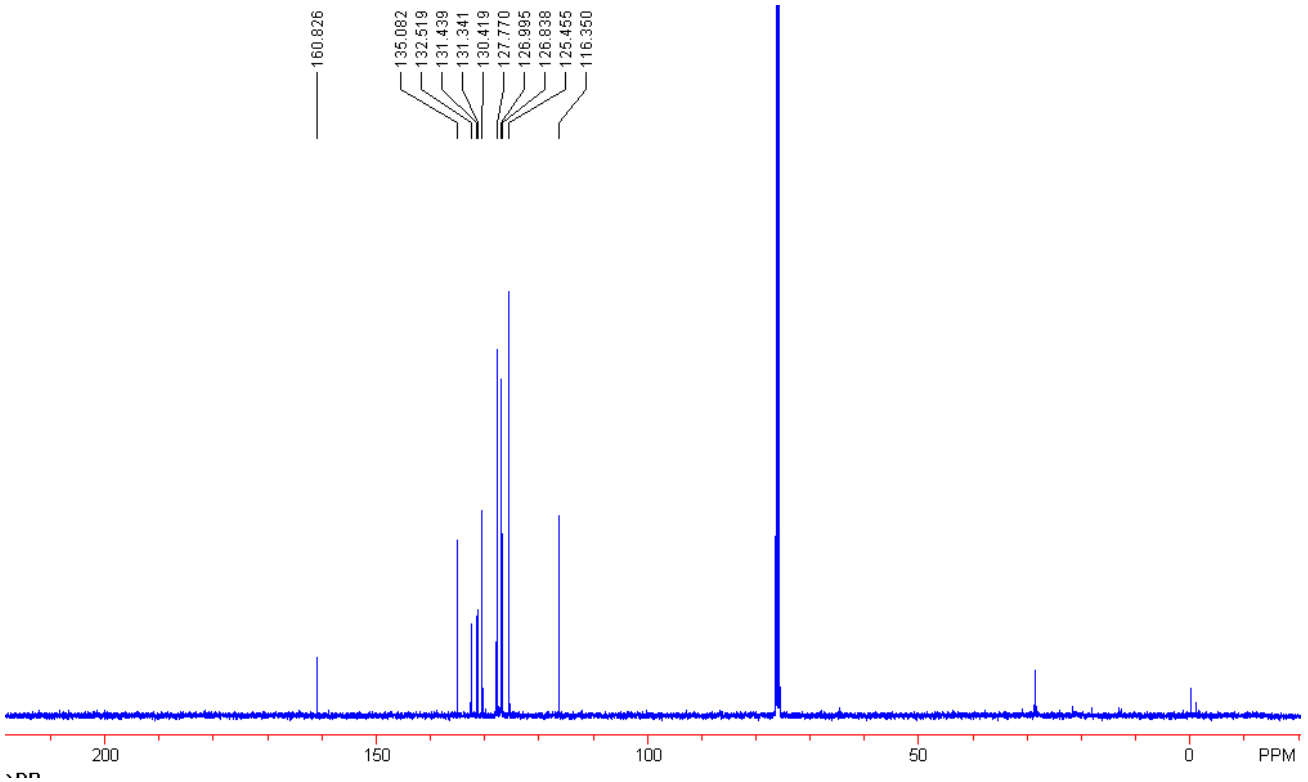
(E)-styryl 2,6-dimethoxybenzoate (6s).



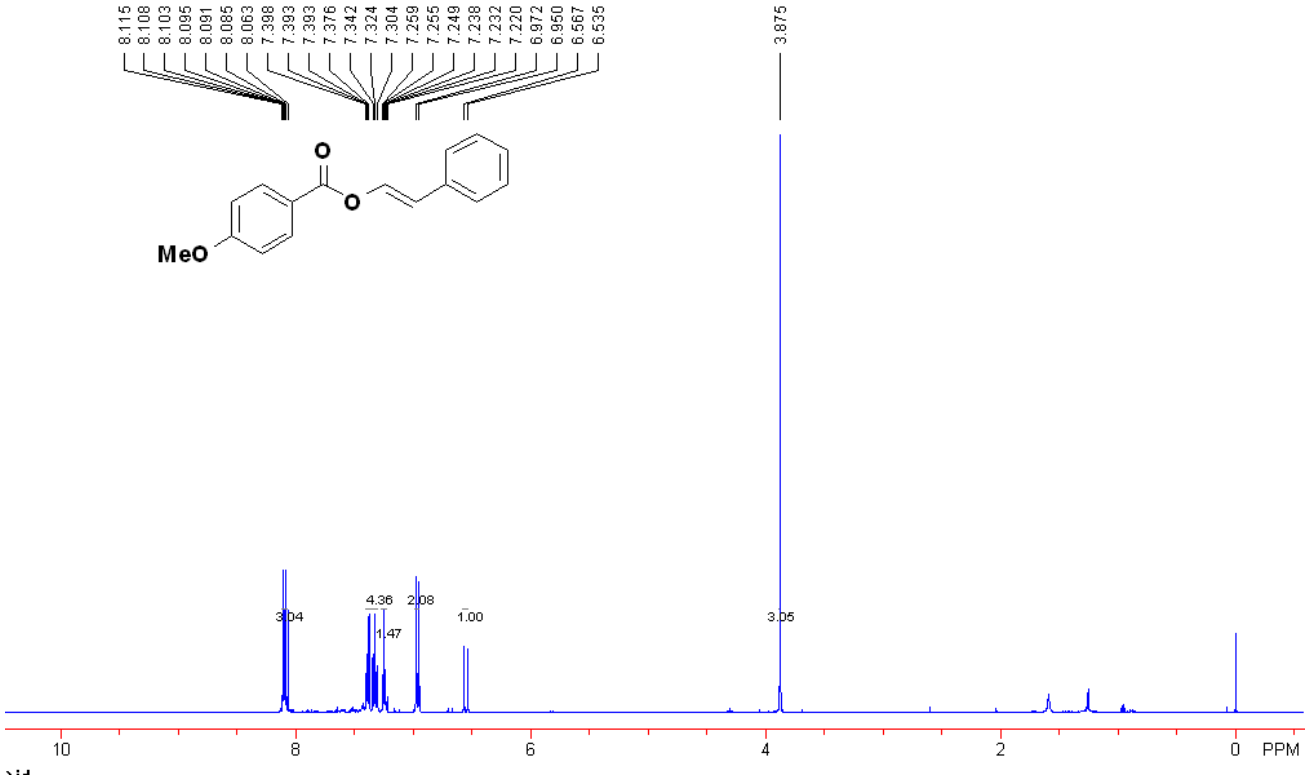


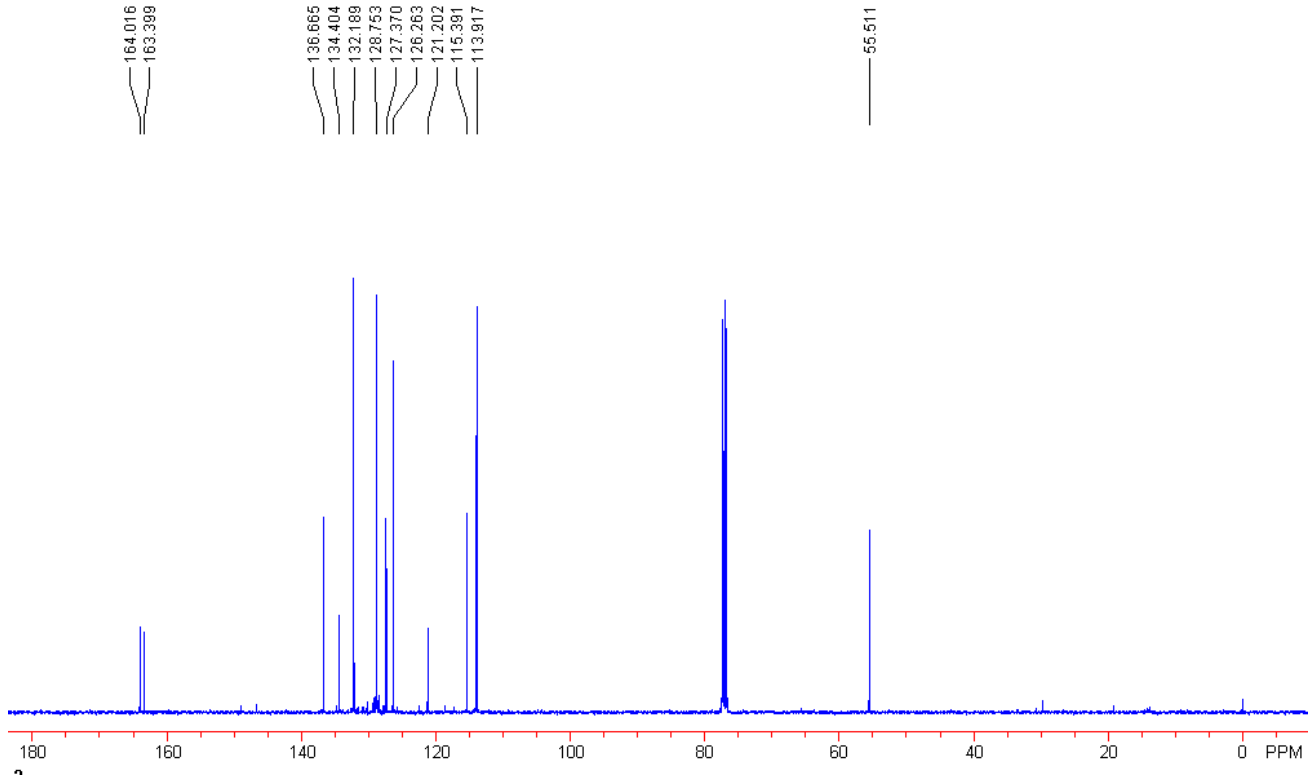
(E)-styryl 2,6-dichlorobenzoate (6t).





(E)-styryl 4-methoxybenzoate (6u).

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