Supporting Information

Cobalt(III)-Catalyzed Synthesis of Pyrroles from Enamides and Alkynes.

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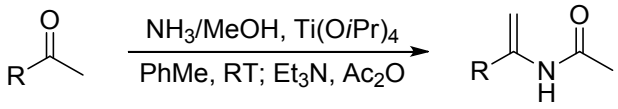
Content

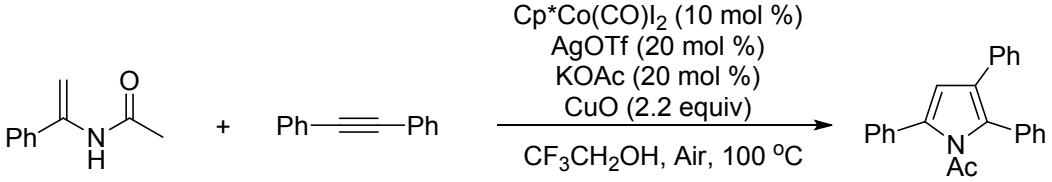
General All reactions were performed under air in a flame-dried reaction flask. N-acyl enamides[1] were synthesized according to published procedures. Methyl 2-acetamidoacrylate (**1l**) and N-vinylacetamide (**1n**) were purchased from Tokyo Chemical Industry Co., Ltd. The other materials and solvents were purchased from common commercial sources and used without additional purification, if there is no special version. ^{1}H NMR spectra were recorded at 400 MHz using TMS as internal standard. ^{13}C NMR spectra were recorded at 100 MHz using TMS as internal standard. The multiplicities are reported as follows: singlet (s), doublet (d), doublet of doublets (dd), multiplet (m), and broad resonances (br). Mass spectroscopy data of the products were collected on an HRMS-TOF instrument.

Preparation of Enamides[1]



10 mmol (1 equiv) of the acetophenone was dissolved in 6 mL of toluene taken in a dry 3-necked 50 mL RB flask under nitrogen. The resultant solution was stirred and cooled in an ice/water bath. To the resultant cold stirring solution was added 7N NH_3 in MeOH (2.14 mL, 15.0 mmol, 1.5 equiv) followed by dropwise addition of Ti(O*i*-Pr)$_4$ (5.92 mL, 20.0 mmol, 2.0 equiv). After 10 min, the ice/water cooling bath was removed, and the solution was stirred at rt for 20 h. Then the reaction mixture was then cooled in an ice/water bath (~5 °C) and treated with Et_3N (5.58 mL, 40.0 mmol, 4.0 equiv) followed by Ac_2O (1.89 mL, 20.0 mmol, 2.0 equiv). The cooling bath was then removed and the solution was stirred at rt for 3 h. The reaction mixture was then treated with EDTE (*N*,*N*,*N*′,*N*′-tetrakis(2-hydroxypropyl)ethylenediamine) (4.51 mL, 21.0 mmol, 2.1 equiv) at rt, and the solution was then heated at about 55 °C for 15 min. The reaction mixture was allowed to cool to rt, and was then poured into a separatory funnel containing a solution made from water (30 mL) and NH_4OH (10 mL) and also EtOAc (50 mL). Additional water and EtOAc were used to rinse all the flask contents into the separatory funnel. The mixture was shaken, and from the resultant two clear phases the lower aqueous phase was removed. The aqueous phase was extracted again with EtOAc (50 mL), and the combined organic extracts were dried (Na_2SO_4), filtered, and concentrated to give the crude product. The pure product was isolated by flash column chromatography (Petroleum ether /ethyl acetate = 5/1).

Typical Procedure for the Product

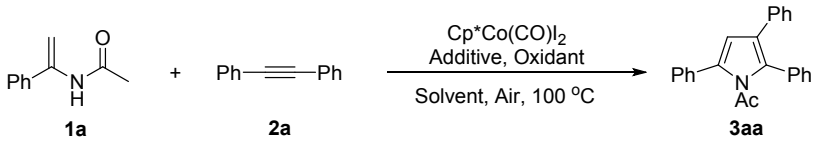


1 **2** **3**

Enamides **1** (0.1 mmol) and Alkynes **2** (0.15 mmol) was added to a mixture of

$Cp^*Co(CO)I_2$ (10 mol %), CuO (0.22 mmol), AgOTf (20 mol %), KOAc (20 mol %) in CF_3CH_2OH (1 mL). The mixture was stirred at 100 °C in air for 8 h. After completion the reaction mixture was cooled to ambient temperature and the solvent was removed in vacuo to provide a crude product, which was purified by column chromatography on silica gel to afford pure products **3.**

The optimization of reaction conditions



1a **2a** **3aa**

entry	Additive **1**	Additive **2**	Oxidant	Solvent	Yield[b] (%)
1[c]	Na_2CO_3	TBAI	Ag_2CO_3	CF_3CH_2OH	NR
2	AgOTf	KOAc	$Cu(OAc)_2$	CF_3CH_2OH	30
3	AgOTf	KOAc	AgOAc	CF_3CH_2OH	22
4	AgOTf	KOAc	Ag_2CO_3	CF_3CH_2OH	16
5	AgOTf	KOAc	O_2	CF_3CH_2OH	30
6	AgOTf	KOAc	BQ	CF_3CH_2OH	trace
7	AgOTf	KOAc	CuO	CF_3CH_2OH	91
8	AgOTs	KOAc	CuO	CF_3CH_2OH	45
9	$AgBF_4$	KOAc	CuO	CF_3CH_2OH	NR
10	AgOTFA	KOAc	CuO	CF_3CH_2OH	30
11	$AgSbF_6$	KOAc	CuO	CF_3CH_2OH	40
12	AgOTf	NaOAc	CuO	CF_3CH_2OH	79
13	AgOTf	LiOAc	CuO	CF_3CH_2OH	64
14	AgOTf	KOAc	CuO	PhMe	32
15	AgOTf	KOAc	CuO	DCE	45
16	AgOTf	KOAc	CuO	DMF	trace
17	AgOTf	KOAc	CuO	Dioxane	12
18	-	AgOAc	CuO	CF_3CH_2OH	80
19	-	KOAc	CuO	CF_3CH_2OH	Trace
20	AgOTf	-	CuO	CF_3CH_2OH	Trace

[a] Reactions were carried out by using **1a** (0.1 mmol), **2a** (0.15 mmol), $Cp^*Co(CO)I_2$ (10 mol %), oxidant (2.2 equiv), additive **1** (20 mol %), additive **2** (20 mol %), Solvent (1.0 mL), 100 °C, air, 8 h. [b] Isolated yield. [c] $Co(OAc)_2 \cdot 4H_2O$ (10 mol %), Ag_2CO_3 (4 equiv), TBAI (3 equiv), Na_2CO_3 (3 equiv), pyridine (2 equiv), $PhCF_3$ (1.0 mL), 100 °C. TBAI = Tetrabutylammonium Iodide.

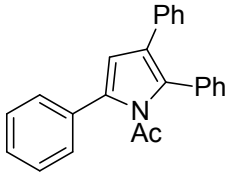
Gram-Scale Reaction

Enamides **1a** (5 mmol) and Alkynes **2a** (7.5 mmol) was added to a mixture of

$Cp^*Co(CO)I_2$ (5 mol %), CuO (0.22 mmol), AgOTf (20 mol %), KOAc (20 mol %) in CF_3CH_2OH (5 mL). The mixture was stirred at 100 °C in air for 8 h. After completion the reaction mixture was cooled to ambient temperature and the solvent was removed in vacuo to provide a crude product, which was purified by column chromatography on silica gel to afford pure products **3a** (1.1g, 66%)**.**

Characterization of products

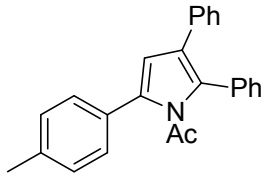
1-(2,3,5-triphenyl-1H-pyrrol-1-yl)ethanone



3aa

Yield: 91%; white solid; m.p = 129-130 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.35-7.43 (m, 10H), 7.16-7.18 (m, 5H), 6.53 (s, 1H), 2.02 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.9, 134.9, 134.8, 133.5, 132.9, 131.0, 130.9, 128.5, 128.5, 128.5, 128.2, 128.1, 127.7, 126.3, 125.6, 113.6, 28.7. HRMS (EI-TOF) calcd for $C_{24}H_{19}NO$ (M^+): 337.1467, found: 337.1465

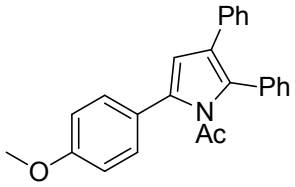
1-(2,3-diphenyl-5-(p-tolyl)-1H-pyrrol-1-yl)ethanone



3ba

Yield: 93%; Yellow solid; m.p = 123-124 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.31-7.35 (m, 7H), 7.17-7.25 (m, 7H), 6.49 (s, 1H), 2.39 (s, 3H), 2.02 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 173.0, 134.9, 134.9, 137.5, 132.9, 131.0, 130.7, 130.6, 129.2, 128.4, 128.2, 128.2, 128.1, 126.2, 125.5, 113.3, 28.7, 21.3. HRMS (EI-TOF) calcd for $C_{25}H_{21}NO$ (M^+): 351.1623, found: 351.1619.

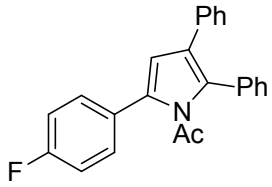
1-(5-(4-methoxyphenyl)-2,3-diphenyl-1H-pyrrol-1-yl)ethanone



3ca

Yield: 90%; Yellow solid; m.p = 118-119 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.34-7.37 (m, 7H), 7.15-7.19 (m, 5H), 6.95 (d, 2H, *J* = 8Hz), 6.46 (s, 1H), 3.84 (s, 3H), 2.00 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 173.0, 159.3, 135.0, 134.7, 133.0, 131.0, 130.5, 129.9, 128.4, 128.2, 128.2, 128.0, 126.2, 125.9, 125.5, 114.0, 113.1, 55.4, 28.7. HRMS (EI-TOF) calcd for $C_{25}H_{21}NO_2$ (M^+): 367.1572, found: 367.1568.

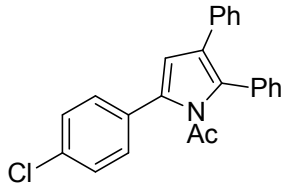
1-(5-(4-fluorophenyl)-2,3-diphenyl-1H-pyrrol-1-yl)ethanone



3da

Yield: 60%; Yellow solid; m.p = 141-142 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.36-7.41 (m, 7H), 7.07-7.19 (m, 7H), 6.48 (s, 1H), 1.99 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.8, 163.7, 161.2 (d, $J_{C\text{-}F}$ = 251.0 Hz), 134.8, 134.0, 132.9, 130.9, 130.8, 130.5, 130.4 (d, $J_{C\text{-}F}$ = 8.1 Hz), 129.6 (d, $J_{C\text{-}F}$ = 3.7 Hz), 128.6, 128.3, 128.2, 126.4, 125.6, 115.6, 115.3 (d, $J_{C\text{-}F}$ = 21.7 Hz), 113.8, 28.6. HRMS (EI-TOF) calcd for $C_{24}H_{18}FNO$ (M^+): 355.1372, found: 355.1369.

1-(5-(4-chlorophenyl)-2,3-diphenyl-1H-pyrrol-1-yl)ethanone

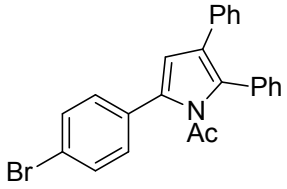


3ea

Yield: 84%; Yellow solid; m.p = 124-125 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.34-7.38 (m, 10H), 7.15-7.19 (m, 10H), 6.51 (s, 1H), 2.01 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.7, 134.6, 133.8, 133.6, 132.7, 131.9, 131.1, 130.9, 129.8, 128.6, 128.6,

128.3, 128.2, 128.2, 126.4, 125.8, 114.0, 28.4. HRMS (EI-TOF) calcd for $C_{24}H_{18}ClNO$ (M^+): 371.1077, found: 371.1075.

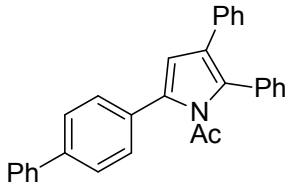
1-(5-(4-bromophenyl)-2,3-diphenyl-1H-pyrrol-1-yl)ethanone



3fa

Yield: 71%; Yellow solid; m.p = 127-128 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.53 (d, 2H, *J* = 8Hz), 7.28-7.38 (m, 7H), 7.14-7.20 (m, 5H), 2.01 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.7, 134.6, 133.8, 132.7, 132.4, 131.6, 131.1, 130.9, 130.1, 128.6, 128.4, 128.2, 128.2, 126.4, 125.8, 121.7, 114.1, 28.6. HRMS (EI-TOF) calcd for $C_{24}H_{18}BrNO$ (M^+): 415.0572, found: 415.0568.

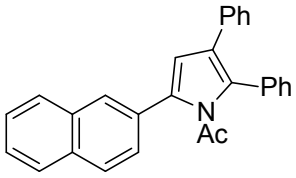
1-(5-([1,1'-biphenyl]-4-yl)-2,3-diphenyl-1H-pyrrol-1-yl)ethanone



3ga

Yield: 75%; Yellow solid; m.p = 165-166 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 6.74-6.77 (m, 4H), 6.64 (d, 2H, *J* = 7Hz), 6.60 (t, 2H, *J* = 8Hz), 6.53 (s, 6H), 6.38-6.39 (m, 5H), 5.88 (s, 1H), 2.17 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 173.1, 140.5, 140.4, 134.9, 134.6, 132.9, 132.4, 131.1, 131.1, 128.9, 128.8, 128.5, 128.3, 127.5, 127.2, 127.1, 126.3, 125.7, 113.8, 28.8. HRMS (EI-TOF) calcd for $C_{30}H_{23}NO$ (M^+): 413.1780, found: 413.1782.

1-(5-(naphthalen-2-yl)-2,3-diphenyl-1H-pyrrol-1-yl)ethanone

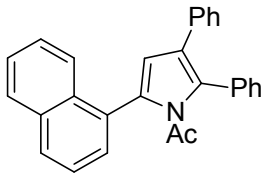


3ha

Yield: 90%; Yellow solid; m.p = 141-142 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.84-

7.91 (m, 4H), 7.47-7.55 (m, 3H), 7.37 (s, 5H), 7.13-7.21 (m, 5H), 6.64 (s, 1H), 2.03 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 173.1, 134.9, 134.9, 133.4, 132.9, 132.7, 131.3, 131.1, 131.0, 128.5, 128.3, 128.2, 128.1, 128.1, 127.8, 127.0, 126.7, 126.6, 126.3, 125.8, 114.2, 28.7. HRMS (EI-TOF) calcd for $C_{28}H_{21}NO$ (M^+): 387.1623, found: 387.1629.

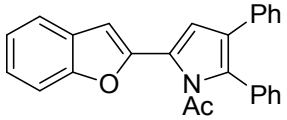
1-(5-(naphthalen-1-yl)-2,3-diphenyl-1H-pyrrol-1-yl)ethanone



3ia

Yield: 85%; White Solid; m.p = 167-168 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.88-7.94 (m, 3H), 7.48-7.56 (m, 4H), 7.36-7.40 (m, 5H), 7.15-7.21 (m, 5H), 6.60 (s, 1H), 1.80 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.9, 134.9, 133.6, 133.4, 133.0, 132.5, 131.7, 130.9, 130.7, 128.8, 128.5, 128.5, 128.3, 128.3, 128.2, 128.0, 126.8, 126.3, 126.2, 125.7, 125.6, 125.3, 115.2, 27.7. HRMS (EI-TOF) calcd for $C_{28}H_{21}NO$ (M^+): 387.1623, found: 387.1622.

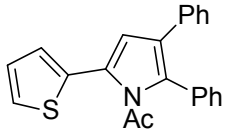
1-(5-(benzofuran-2-yl)-2,3-diphenyl-1H-pyrrol-1-yl)ethanone



3ja

Yield: 75%; Green Solid; m.p = 104-105 °C ; ^{1}H NMR (DMSO-*d6*, 400 MHz) δ 7.68 (d, 1H, *J* = 8Hz), 7.59 (d, 1H, *J* = 8Hz), 7.44-7.45 (m, 3H), 7.17-7.38 (m, 9H), 7.12 (s, 1H), 7.07 (s, 1H), 2.12 (s, 3H). ^{13}C NMR (DMSO-*d6*, 100 MHz) δ 172.3, 154.1, 148.0, 133.9, 131.8, 131.6, 130.7, 128.7, 128.4, 128.3, 127.8, 126.5, 124.9, 124.6, 123.3, 123.3, 121.2, 114.8, 111.0, 104.2, 27.2. HRMS (EI-TOF) calcd for $C_{26}H_{19}NO_2$ (M^+): 377.1416, found: 377.1417.

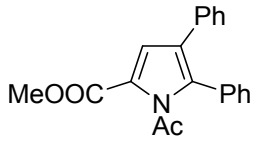
1-(2,3-diphenyl-5-(thiophen-2-yl)-1H-pyrrol-1-yl)ethanone



3ka

Yield: 40%; Yellow Solid; m.p = 169-170 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.33-7.36 (m, 6H), 7.15-7.20 (m, 6H), 7.07 (dd, *J* = 8Hz, 1H), 6.60 (s, 1H), 2.03 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.9, 134.8, 134.1, 132.9, 131.0, 130.6, 128.6, 128.3, 128.2, 128.2, 127.6, 127.3, 127.1, 126.4, 126.1, 125.6, 114.9, 28.4. HRMS (EI-TOF) calcd for $C_{22}H_{17}NOS$ (M^+): 343.1031, found: 343.1035.

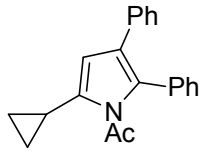
Methyl 1-acetyl-4,5-diphenyl-1H-pyrrole-2-carboxylate



3la

Yield: 80%; Yellow liquid; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.28-7.38 (m, 5H), 7.12-7.21 (m, 6H), 3.88 (s, 3H), 2.31 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 174.0, 161.2, 134.6, 134.0, 130.7, 129.0, 128.6, 128.3, 128.1, 126.5, 124.9, 123.0, 118.5, 51.9, 28.9. HRMS (EI-TOF) calcd for $C_{20}H_{17}NO_3$ (M^+): 319.1208, found: 319.1217.

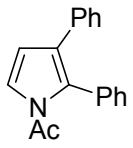
1-(5-cyclopropyl-2,3-diphenyl-1H-pyrrol-1-yl)ethanone



3ma

Yield: 30%; Yellow Solid; m.p = 97-98 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.33-7.35 (m, 3H), 7.26-7.28 (m, 2H), 7.08-7.18 (m, 5H), 6.10 (s, 1H), 2.18-2.25 (m, 1H), 2.04 (s, 3H), 0.90-0.93 (m, 2H), 0.69-0.70 (m, 2H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.5, 138.2, 134.7, 133.1, 130.0, 129.9, 128.5, 128.2, 127.7, 127.6, 127.4, 125.6, 124.7, 109.2, 27.7, 8.9, 6.6. HRMS (EI-TOF) calcd for $C_{21}H_{19}NO$ (M^+): 301.1467, found: 301.1469.

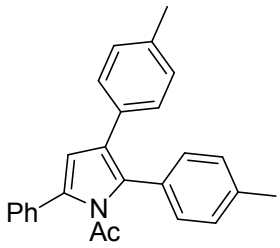
1-(2,3-diphenyl-1H-pyrrol-1-yl)ethanone



3na

Yield: 20%; Yellow Solid; m.p = 111-112 °C ;^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.44 (d, 1H, *J* = 4Hz), 7.36-7.37 (m, 3H), 7.30-7.32 (m, 2H), 7.10-7.20 (m, 5H), 6.53 (d, 1H, *J* = 4Hz), 2.22 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 169.2, 134.7, 133.5, 131.0, 128.4, 128.2, 128.1, 128.1, 128.0, 126.3, 120.9, 112.6, 24.9. HRMS (EI-TOF) calcd for $C_{18}H_{15}NO$ (M^+): 261.1154, found: 261.1150.

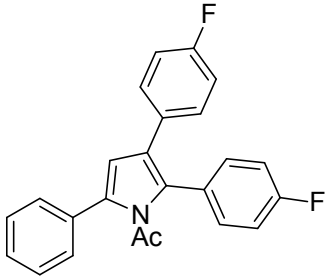
1-(5-phenyl-2,3-di-p-tolyl-1H-pyrrol-1-yl)ethanone



3ab

Yield: 81%; Brown liquid; m.p = 128-129 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.40-7.41 (m, 4H), 7.33-7.35 (m, 1H), 7.22-7.24 (m, 2H), 7.16 (d, 2H, *J* = 8Hz), 7.07 (d, 2H, *J* = 8Hz), 7.01 (d, 2H, *J* = 8Hz), 6.50 (s, 3H), 2.38 (s, 3H), 2.28 (s, 3H), 2.01 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 173.0, 137.9, 135.8, 134.6, 133.6, 132.0, 130.9, 129.9, 129.2, 128.9, 128.5, 128.4, 128.0, 127.5, 125.3, 113.7, 28.7, 21.4, 21.1. HRMS (EI-TOF) calcd for $C_{26}H_{23}NO$ (M^+): 365.1780, found: 365.1783.

1-(2,3-bis(4-fluorophenyl)-5-phenyl-1H-pyrrol-1-yl)ethanone

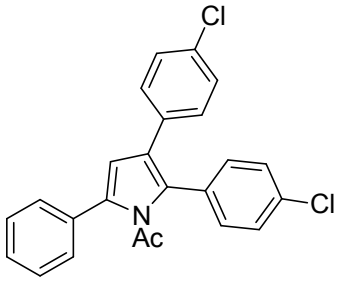


3ac

Yield: 89%; Yellow Solid; m.p = 125-126 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.42 (d, 4H, *J* = 4 Hz), 7.35-7.38 (m, 1H), 7.28-7.32 (m, 2H), 7.03-7.11 (m, 2H), 6.48 (s, 1H), 2.03 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.7, 162.6 (d, J_{C-F} = 247.3 Hz), 161.6 (d, J_{C-F} = 243.8 Hz), 134.8, 133.3, 132.9 (d, J_{C-F} = 8.1 Hz), 130.7 (d, J_{C-F} = 3.6 Hz), 130.0, 129.7 (d, J_{C-F} = 7.2 Hz), 128.7, 128.6 (d, J_{C-F} = 3.6 Hz), 128.4, 127.9, 125.0, 115.5 (d, J_{C-F} = 21.6 Hz), 115.2 (d, J_{C-F} = 20.7 Hz), 113.5, 28.7. HRMS (EI-TOF)

calcd for $C_{24}H_{17}F_2NO$ (M^+): 373.1278, found: 373.1279.

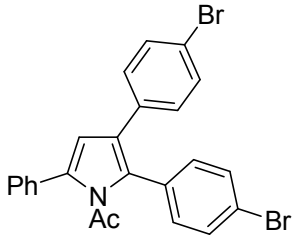
1-(2,3-bis(4-chlorophenyl)-5-phenyl-1H-pyrrol-1-yl)ethanone



3ad

Yield: 90%; Yellow Solid; m.p = 151-152 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.36-7.43 (m, 5H), 7.33 (d, 2H, *J* = 8Hz), 7.25 (d, 2H, *J* = 8Hz), 7.18 (d, 2H, *J* = 8Hz), 7.06 (d, 2H, *J* = 8Hz), 6.48 (s, 1H), 2.03 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.6, 135.1, 134.3, 133.2, 133.1, 132.4, 132.3, 130.9, 130.0, 129.5, 128.7, 128.5, 128.4, 128.0, 124.9, 113.4, 28.8. HRMS (EI-TOF) calcd for $C_{24}H_{17}Cl_2NO$ (M^+): 405.0687, found: 405.0686.

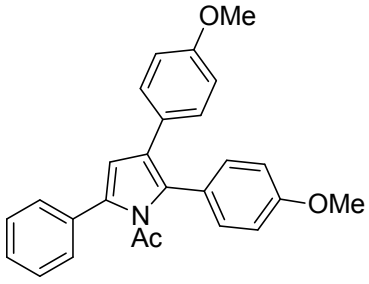
1-(2,3-bis(4-bromophenyl)-5-phenyl-1H-pyrrol-1-yl)ethanone



3ae

Yield: 71%; Yellow solid; m.p = 161-162 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.49 (d, 2H, *J* = 8Hz), 7.37-7.43 (m, 5H), 7.33 (d, 2H, *J* = 8Hz), 7.18 (d, 2H, *J* = 8Hz), 7.00 (d, 2H, *J* = 8Hz), 6.48 (s, 1H), 2.03 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.6, 135.2, 133.5, 133.1, 132.7, 131.7, 131.5, 131.4, 130.0, 129.8, 138.8, 128.4, 128.0, 124.9, 122.6, 120.4, 113.4, 28.8. HRMS (EI-TOF) calcd for $C_{24}H_{17}Br_2NO$ (M^+): 492.9677, found: 492.9675.

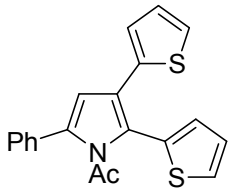
1-(2,3-bis(4-methoxyphenyl)-5-phenyl-1H-pyrrol-1-yl)ethanone



3af

Yield: 60%; Yellow liqud; m.p = 108-109 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.32-7.41 (m, 5H), 7.26 (d, 2H, *J* = 8Hz), 7.10 (d, 2H, *J* = 8Hz), 6.89 (d, 2H, *J* = 8Hz), 6.74 (d. 2H, *J* = 8Hz), 6.48 (s, 1H), 3.82 (s, 3H), 3.75 (s, 3H), 2.01 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 173.1, 159.4, 158.0, 134.5, 133.7, 132.4, 130.3, 129.2, 128.5, 128.3, 127.5, 127.4, 125.2, 125.1, 113.9, 113.7, 113.6, 55.2, 55.2, 28.7. HRMS (EI-TOF) calcd for $C_{26}H_{23}NO_3$ (M^+): 397.1678, found: 397.1682.

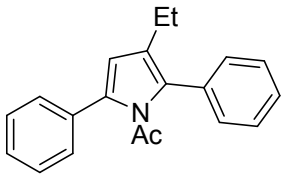
1-(5-phenyl-2,3-di(thiophen-2-yl)-1H-pyrrol-1-yl)ethanone



3ag

Yield: 80%; Yellow Solid; m.p = 131-132 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.54 (d, 1H, *J* = 0.8Hz), 7.34-7.53 (m, 5H), 7.09-7.20 (m, 3H), 6.91-6.93 (m, 2H), 6.58 (s, 1H), 2.07 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.8, 136.6, 136.1, 133.2, 132.6, 131.6, 128.9, 128.6, 128.3, 128.0, 127.4, 127.0, 124.4, 124.3, 122.7, 121.6, 112.6, 27.9. HRMS (EI-TOF) calcd for $C_{20}H_{15}NOS_2$ (M^+): 349.0595, found: 349.0591.

1-(3-ethyl-2,5-diphenyl-1H-pyrrol-1-yl)ethanone

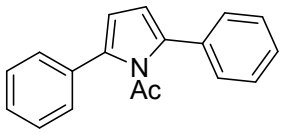


3ah

Yield: 80%; Yellow Solid; m.p = 81-82 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.30-7.41 (m, 10H), 6.25 (s, 1H), 2.36 (q, 2H, *J* = 8Hz), 1.99 (s, 3H), 1.13 (t, 3H, *J* = 8Hz). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.5, 134.8, 134.0, 133.3, 130.9, 130.2, 128.6, 128.3,

127.6, 127.6, 127.3, 113.8, 28.4, 19.0, 15.2. HRMS (EI-TOF) calcd for $C_{20}H_{19}NO$ (M^+): 289.1467, found: 289.1473.

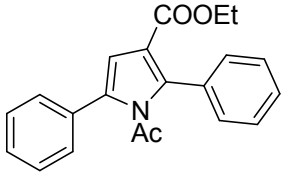
1-(2,5-diphenyl-1H-pyrrol-1-yl)ethanone



3ai

Yield: 60%; Yellow Solid; m.p = 105-106 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.31-7.39 (m, 10H), 6.30 (s, 2H), 2.10 (s, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 173.1, 135.9, 133.6, 128.7, 128.4, 127.6, 112.9, 28.7. HRMS (EI-TOF) calcd for $C_{18}H_{15}NO$ (M^+): 261.1154, found: 261.1160.

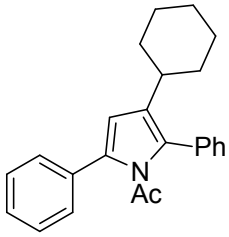
Ethyl 1-acetyl-2,5-diphenyl-1H-pyrrole-3-carboxylate



3aj

Yield: 25%; Yellow Solid; m.p = 92-94 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.42 (s, 5H), 7.35-7.40 (m, 5H), 6.77 (s, 1H), 4.13 (q, 2H, *J* = 8Hz), 1.99 (s, 3H), 1.14 (t, 3H, *J* = 8Hz). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.9, 164.1, 138.4, 134.3, 132.5, 131.7, 130.6, 128.8, 128.6, 128.0, 127.9, 116.3, 112.9, 60.0, 28.6, 14.1. HRMS (EI-TOF) calcd for $C_{21}H_{19}NO_3$ (M^+): 333.1365, found: 333.1366.

1-(3-cyclohexyl-2,5-diphenyl-1H-pyrrol-1-yl)ethanone

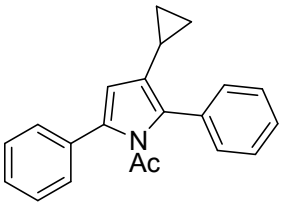


3ak

Yield: 35%; Yellow solid; m.p = 127-128 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.30-7.42 (m, 10H), 6.26 (s, 1H), 2.31 (t, 1H, *J* = 8Hz), 1.98 (s, 3H), 1.72-1.74 (m, 4H),

1.56 (s, 1H), 1.38 (q, 2H, *J* = 12Hz), 1.18-1.20 (m, 3H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.4, 134.7, 134.1, 133.4, 131.9, 130.3, 130.3, 128.5, 128.3, 127.6, 127.2, 112.3, 34.9, 34.5, 28.4, 26.6, 26.1. HRMS (EI-TOF) calcd for $C_{24}H_{25}NO$ (M^+): 343.1936, found: 343.1934.

1-(3-cyclopropyl-2,5-diphenyl-1H-pyrrol-1-yl)ethanone

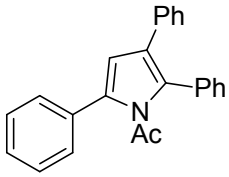


3al

Yield: 20%; Yellow Solid; m.p = 117-118 °C ; ^{1}H NMR ($CDCl_3$, 400 MHz) δ 7.42-7.43 (m, 4H), 7.30-7.37 (m, 6H), 5.88 (s, 1H), 2.00 (s, 3H), 1.61-1.68 (m, 1H), 0.77-0.82 (m, 2H), 0.57-0.61 (m, 2H). ^{13}C NMR ($CDCl_3$, 100 MHz) δ 171.6, 134.5, 133.4, 132.7, 131.1, 129.8, 128.1, 127.8, 127.8, 127.5, 127.0, 126.9, 109.5, 27.9, 7.5, 6.7. HRMS (EI-TOF) calcd for $C_{21}H_{19}NO$ (M^+): 301.1467, found: 301.1470.

References

1 Reeves, J. T.; Tan, Z.; Han, Z.; Li, G.; Zhang, Y.; Xu, Y.; Reeves, D. C.; Gonnella, D. C.; Ma, S. L.; Lee, H. W.; Lu, B. Z.; Senanayake, C. H. *Angew. Chem. Int. Ed*. 2012, *51*, 1400 –1404.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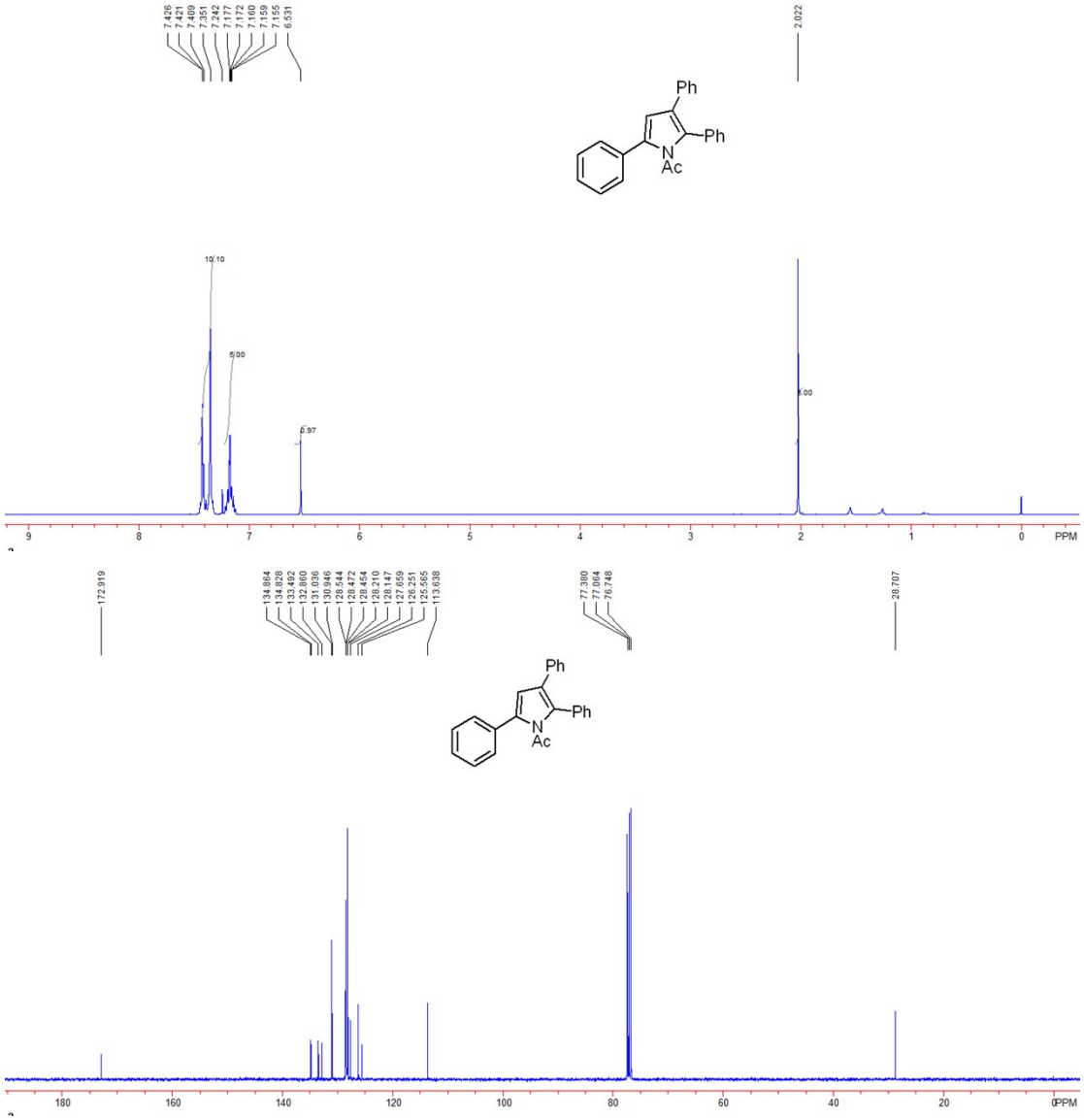
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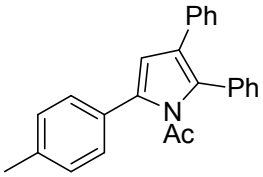
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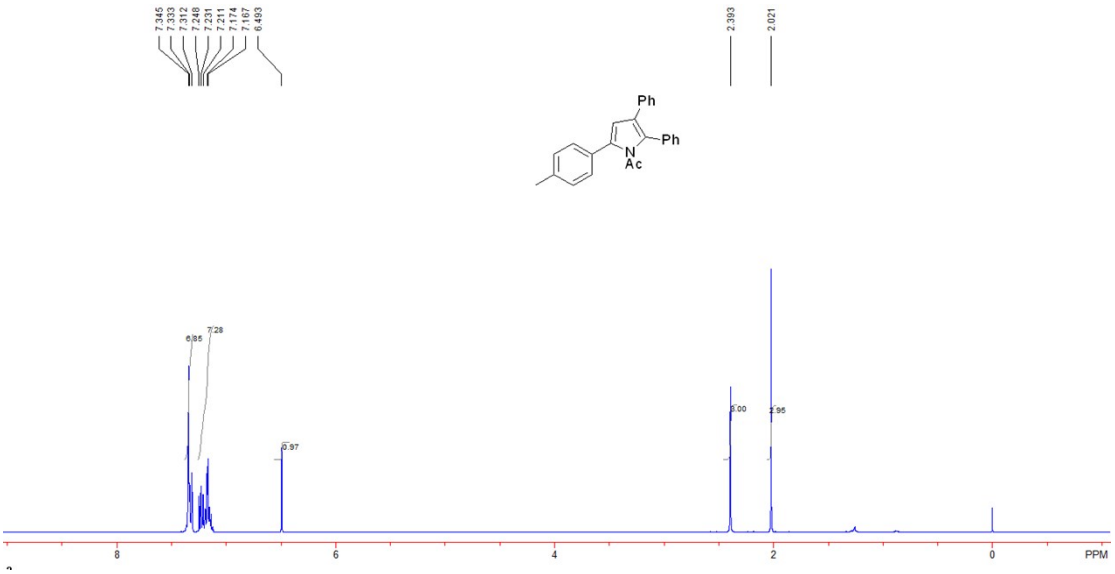
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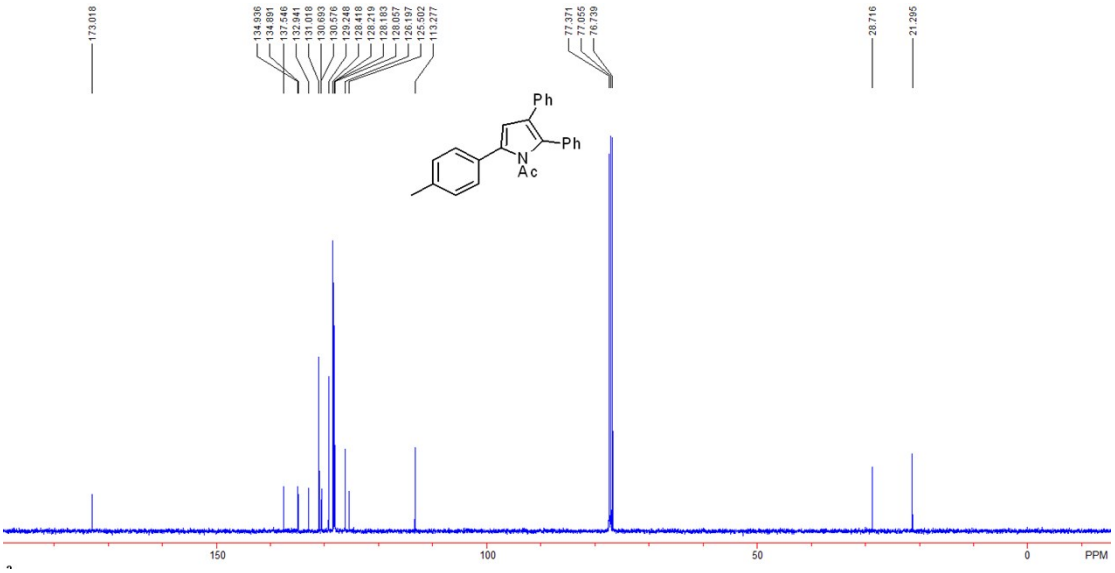
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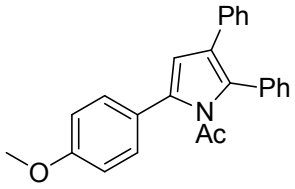
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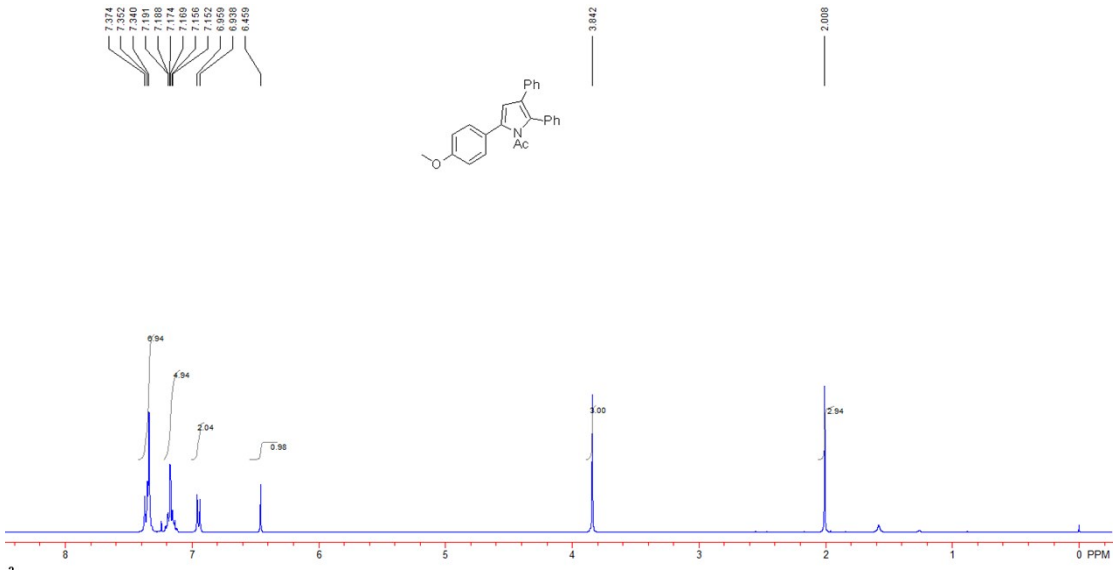
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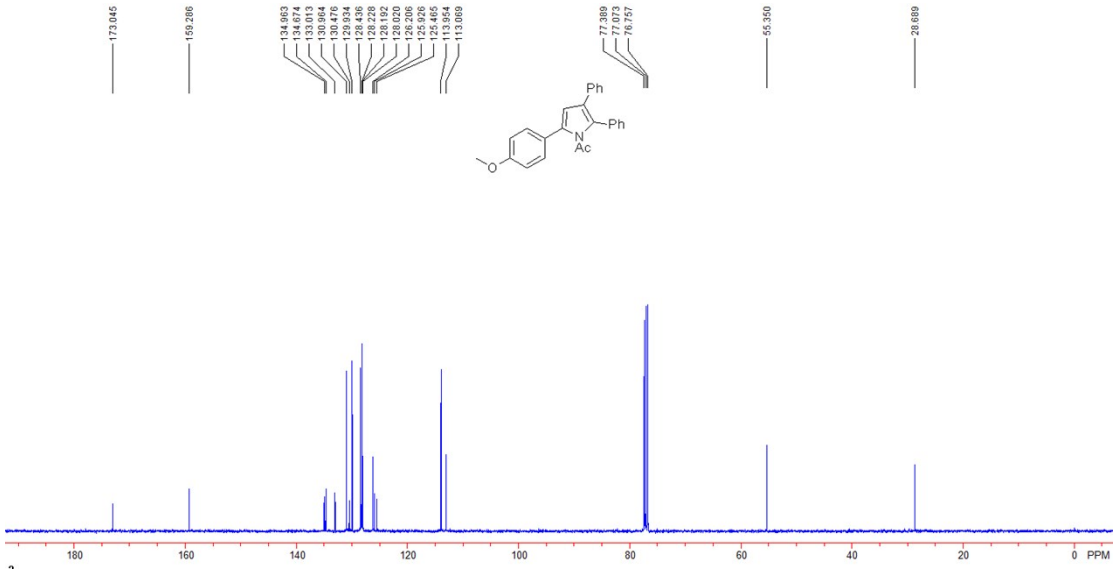
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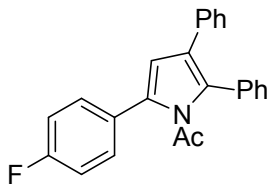
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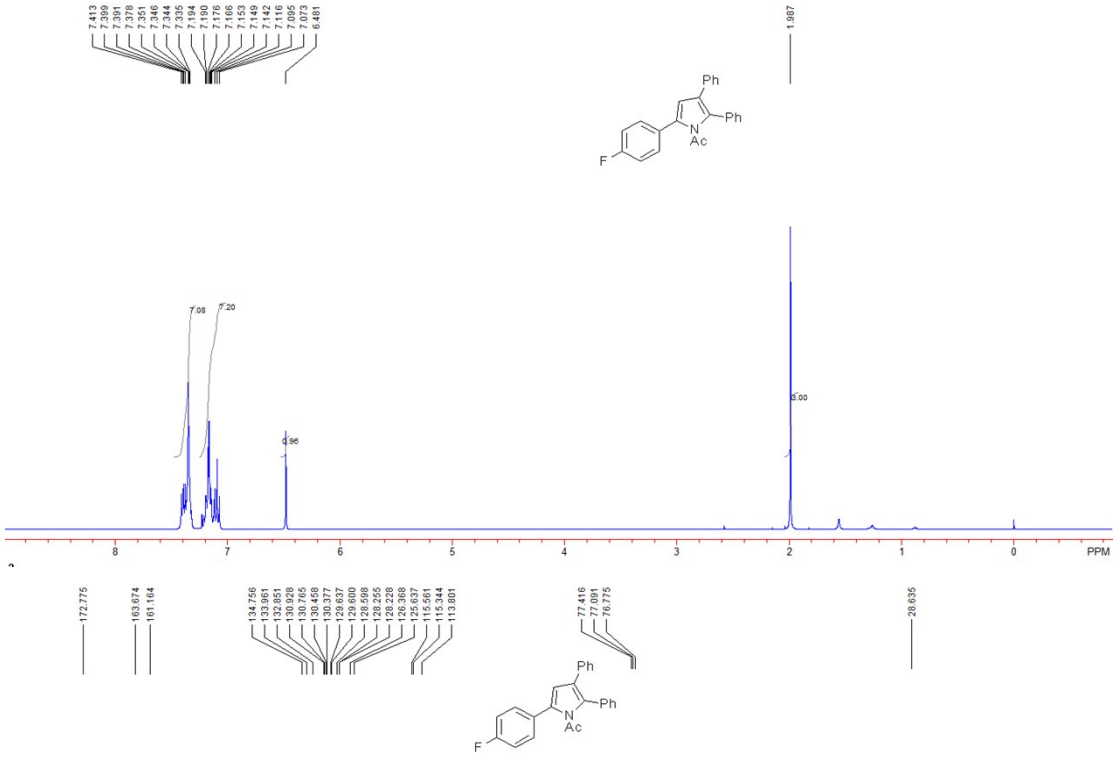
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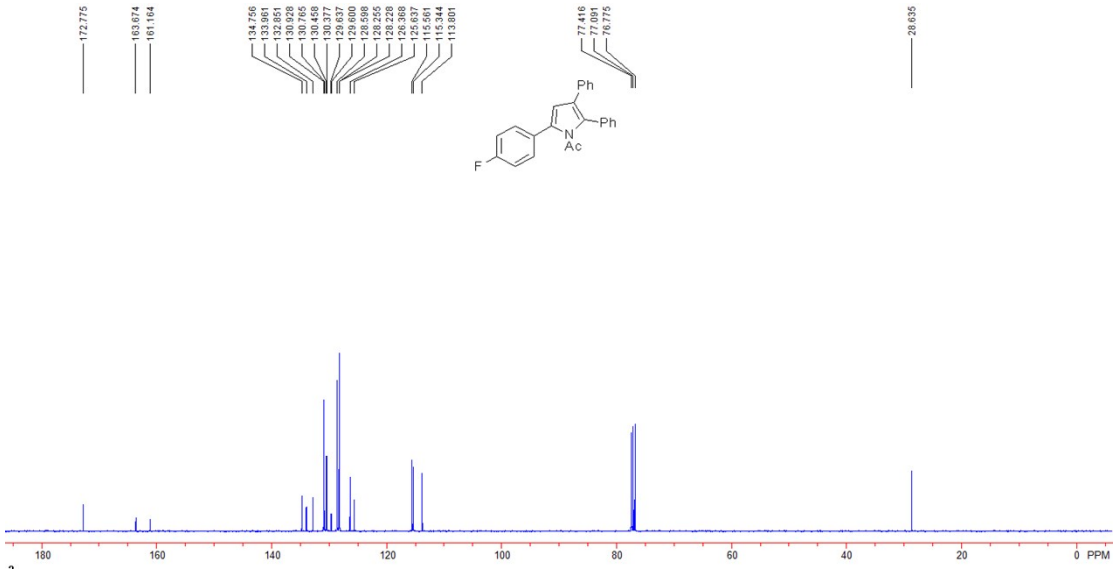
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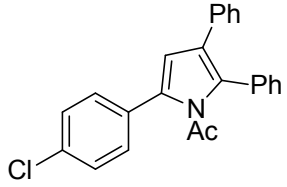
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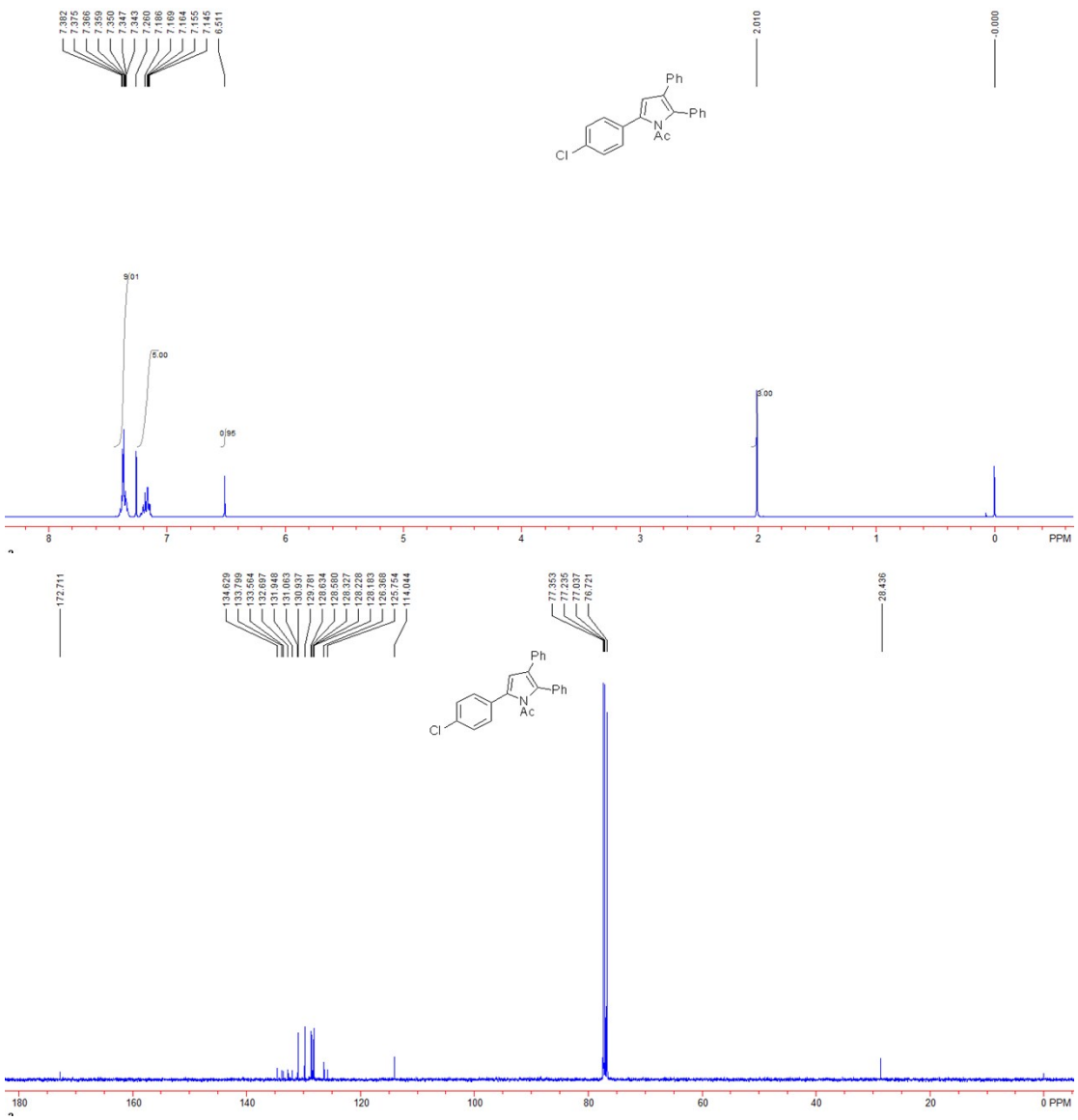
3ea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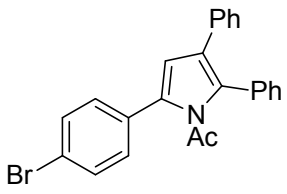
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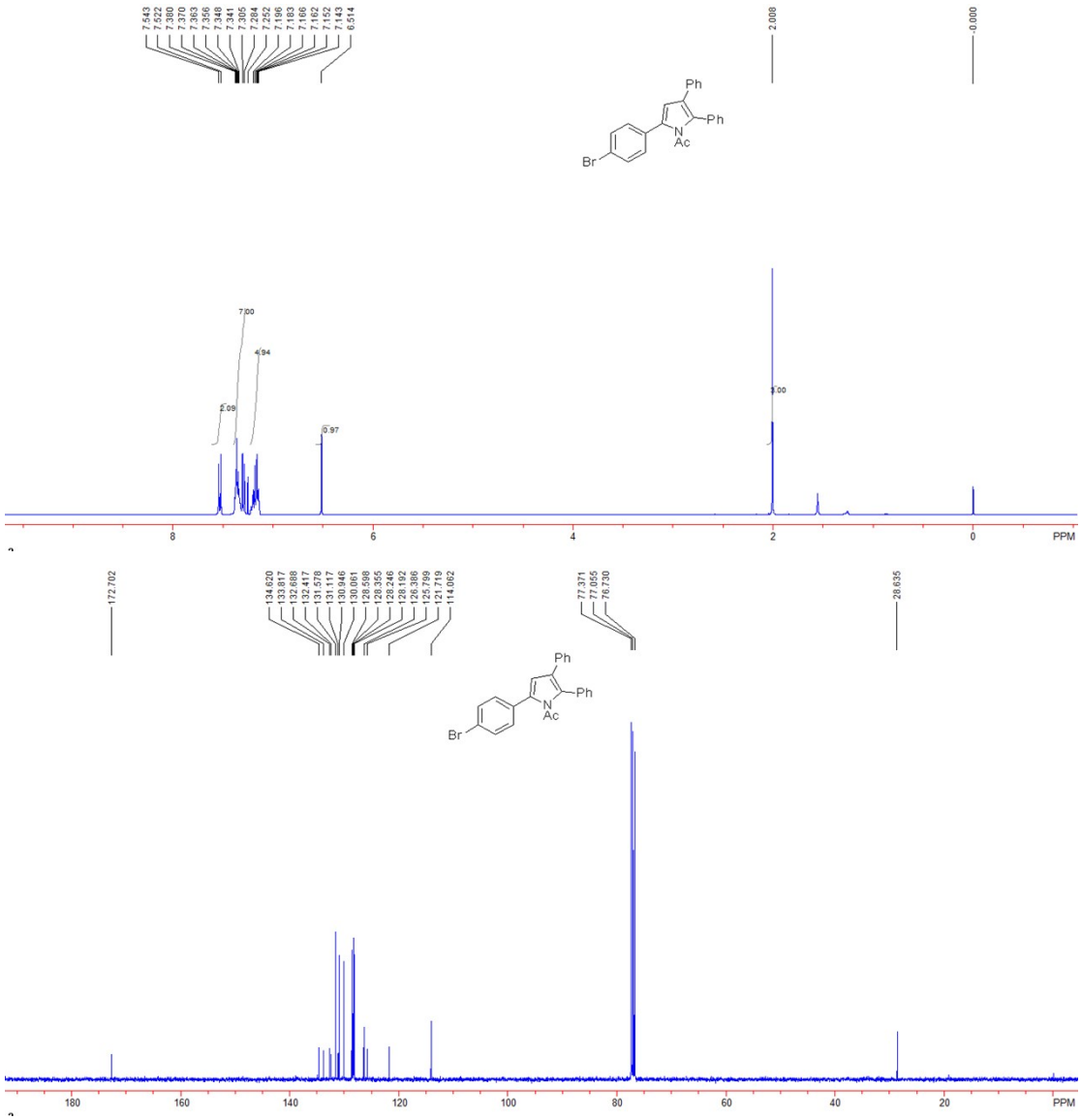
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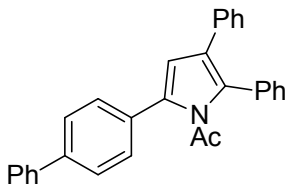
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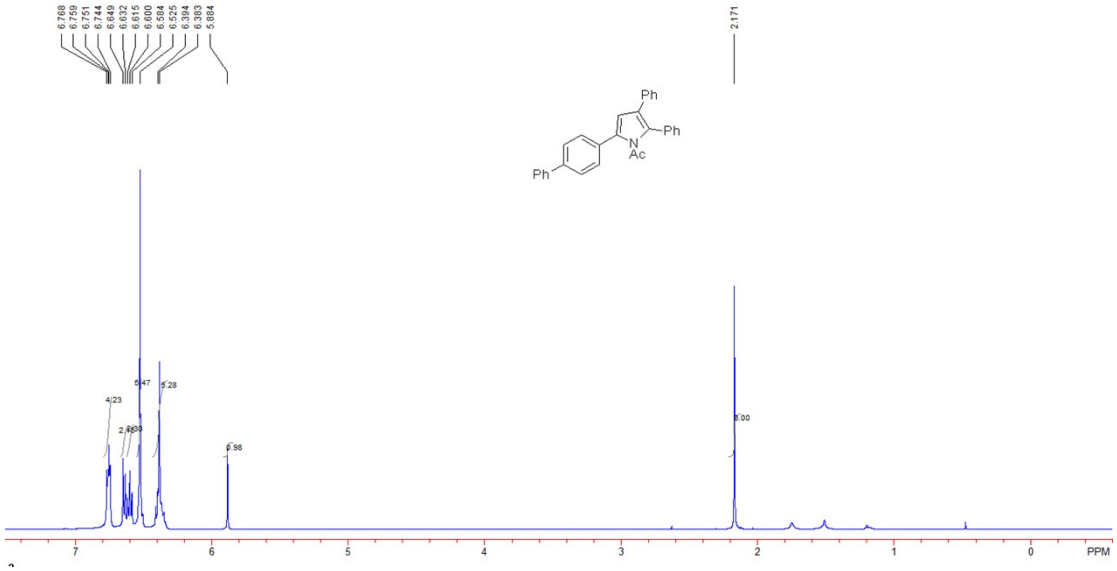
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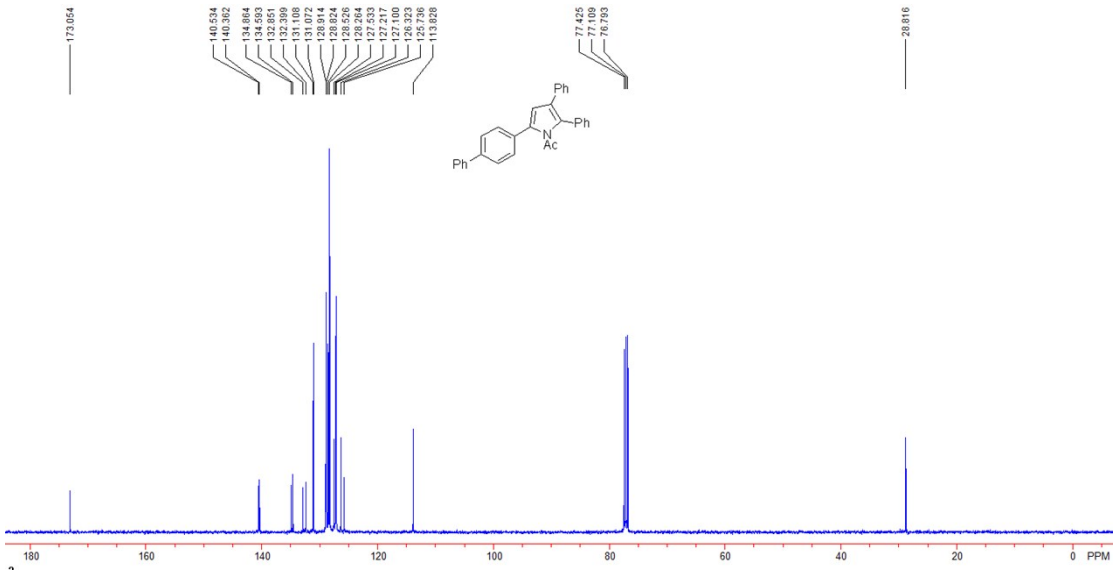
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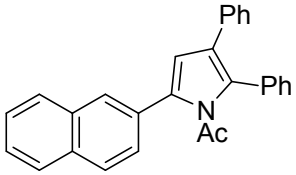
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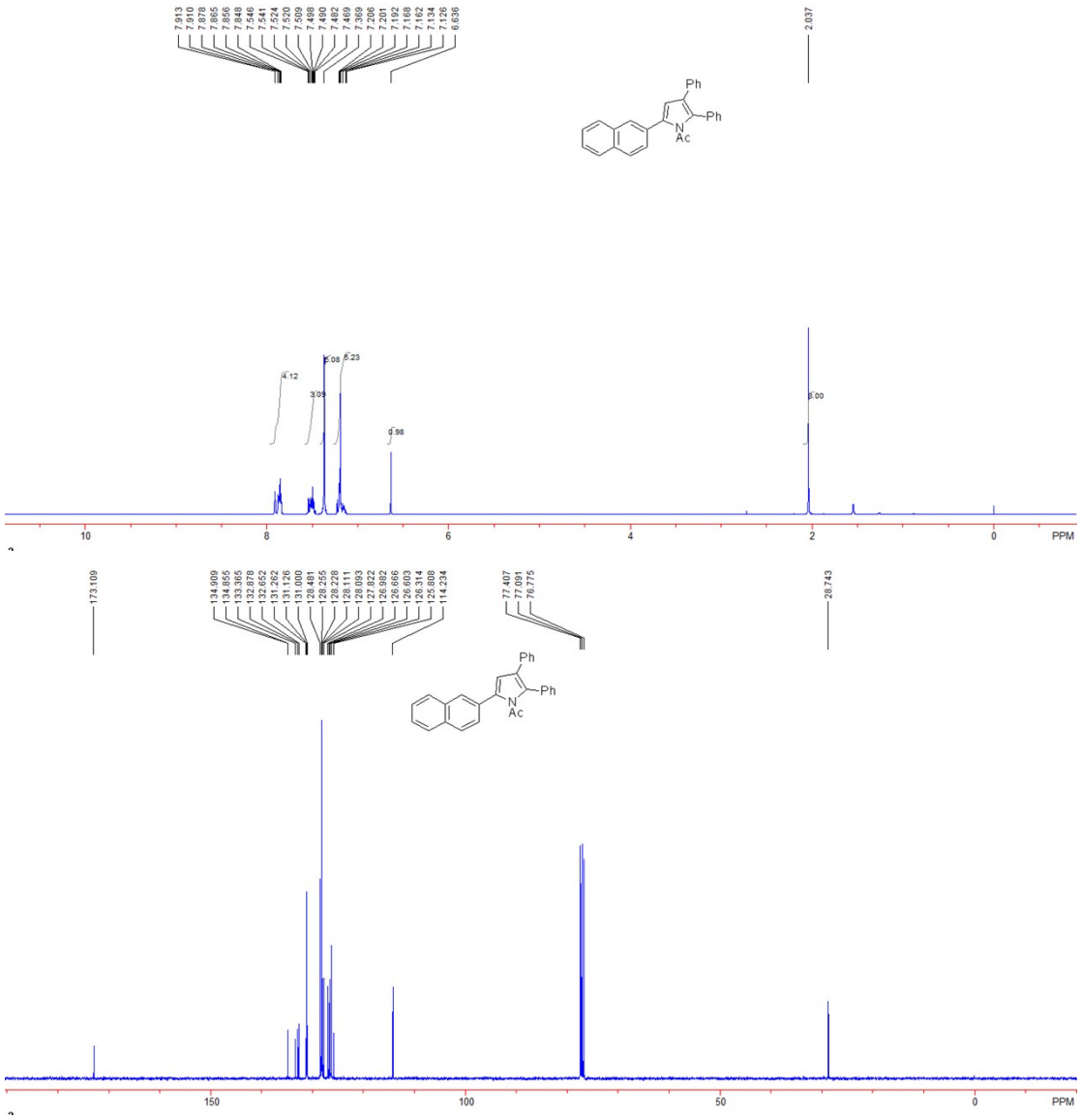
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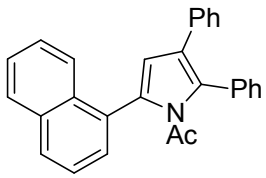
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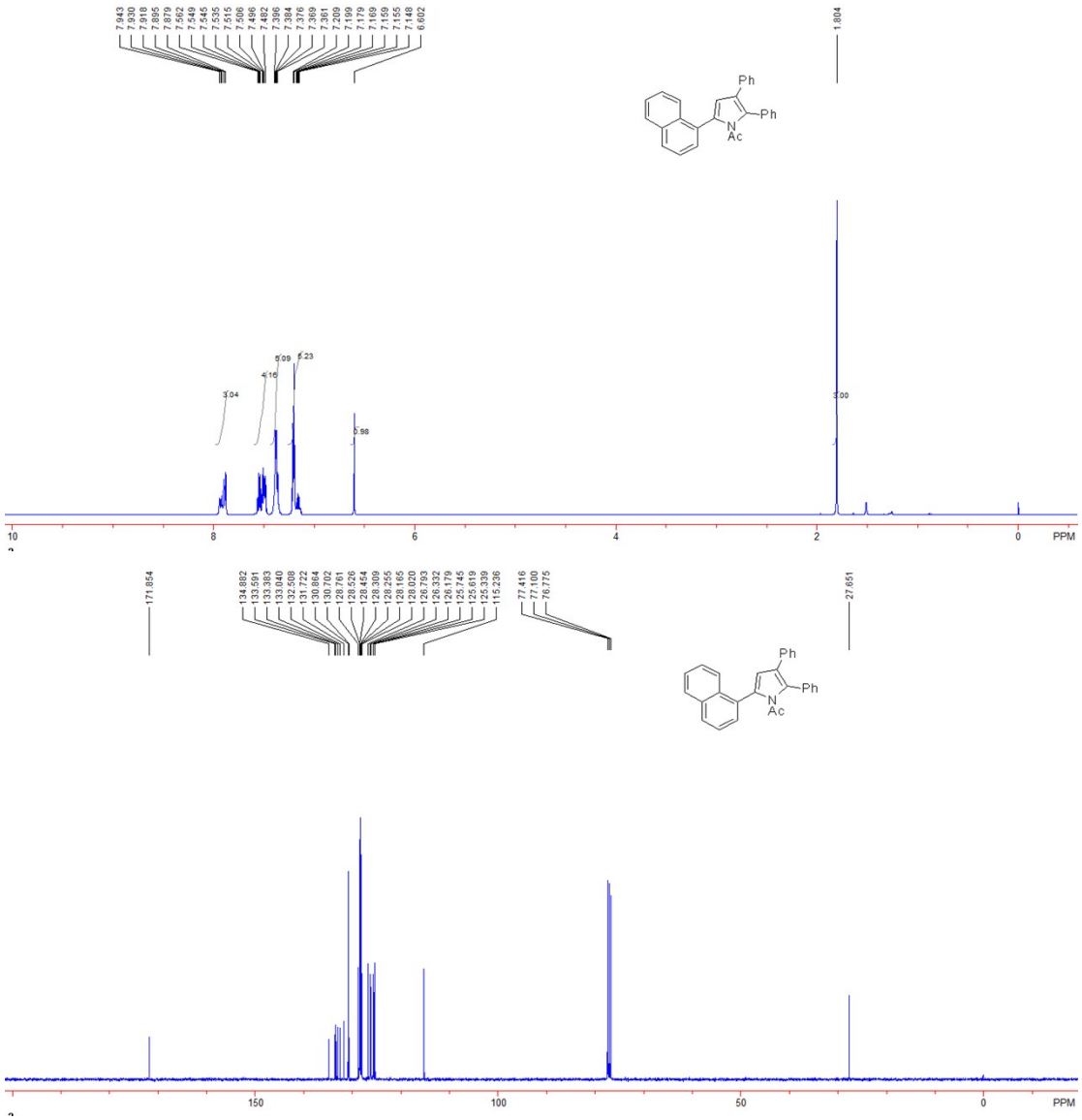
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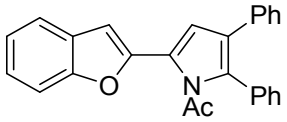
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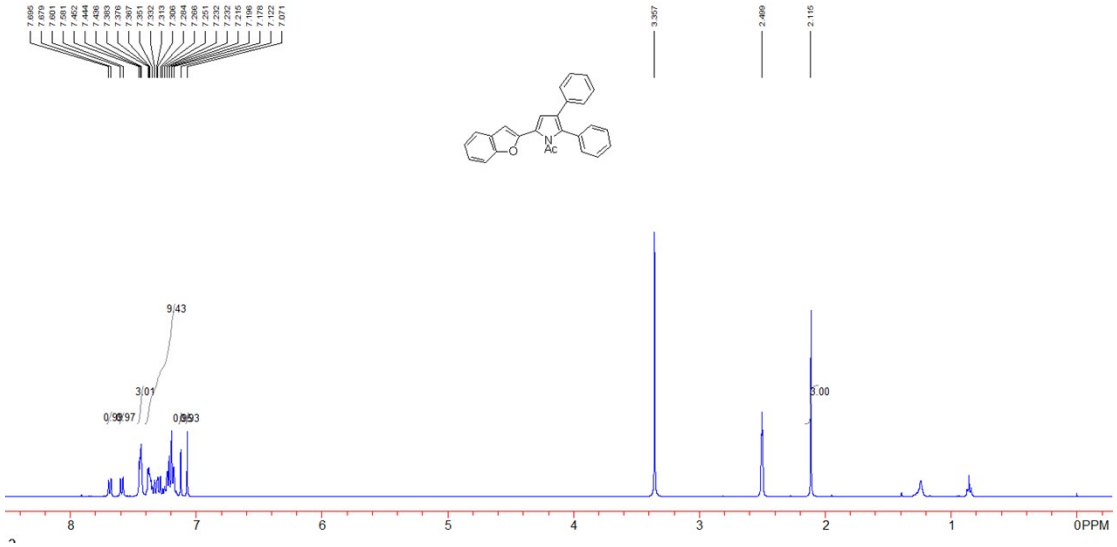
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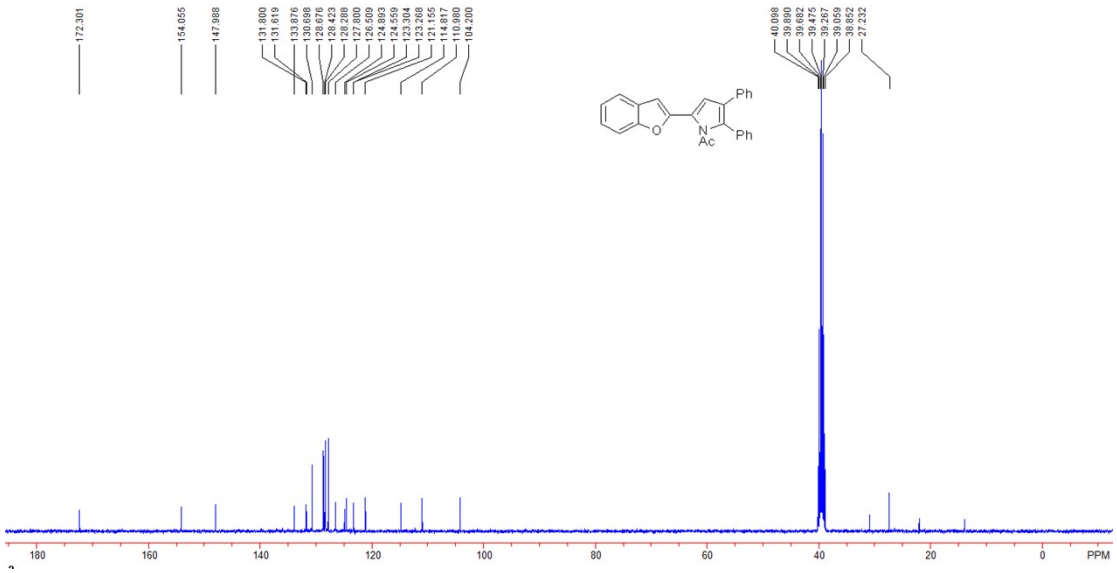
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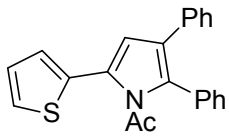
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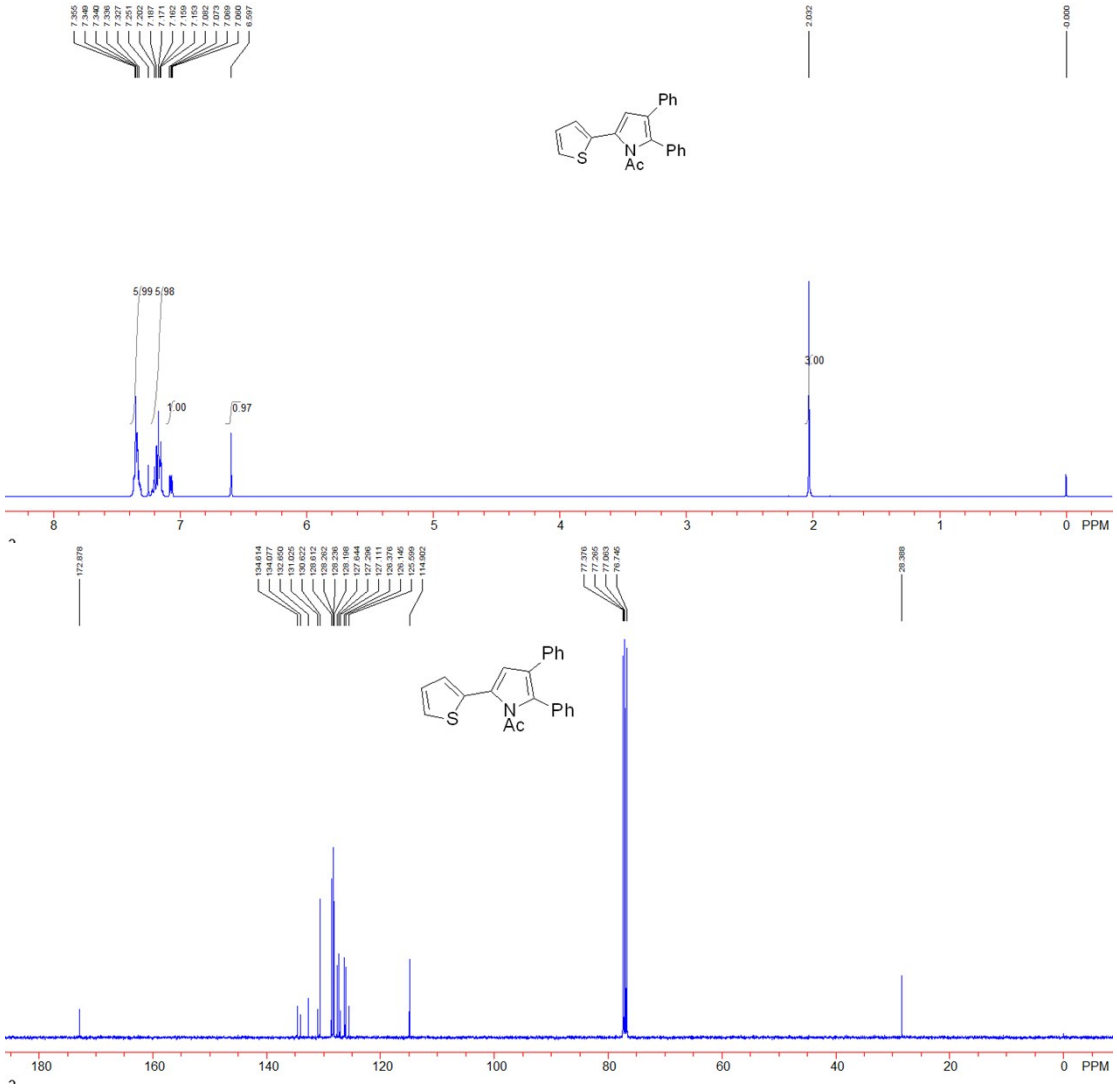

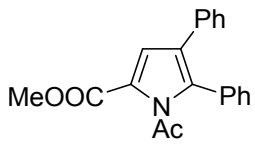

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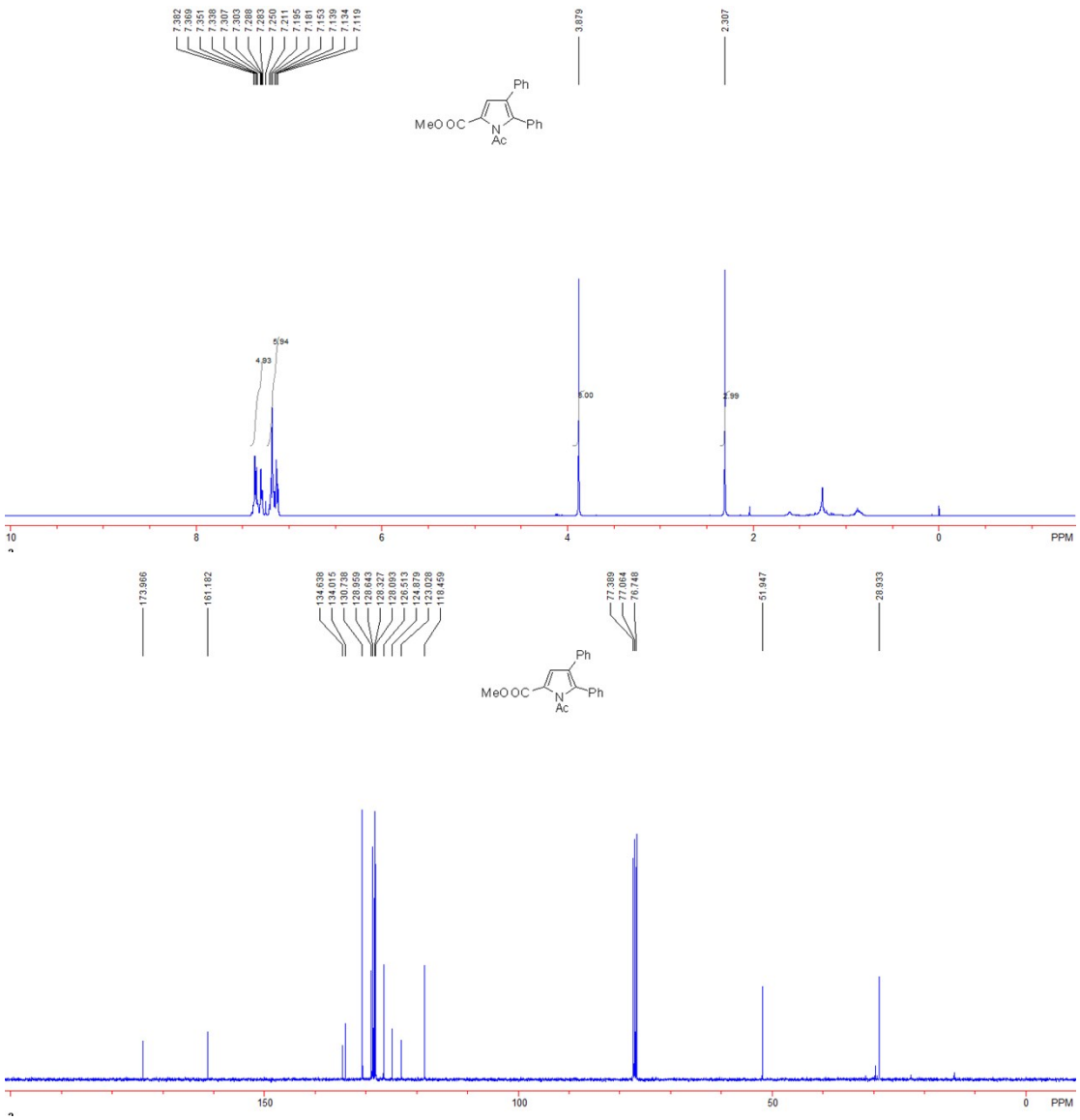
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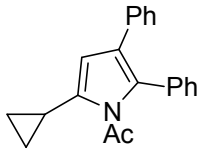
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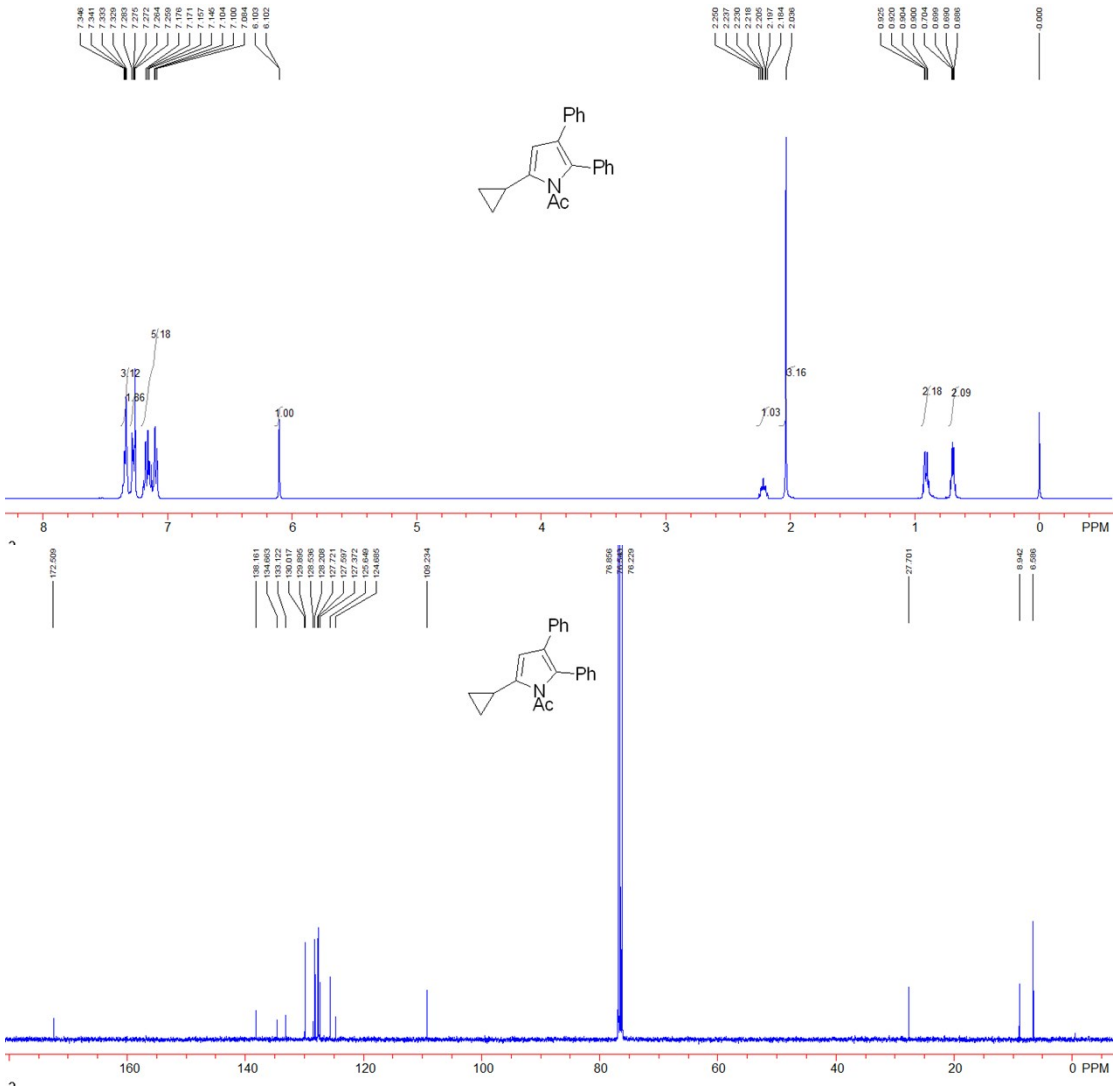
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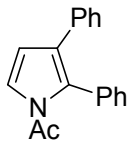
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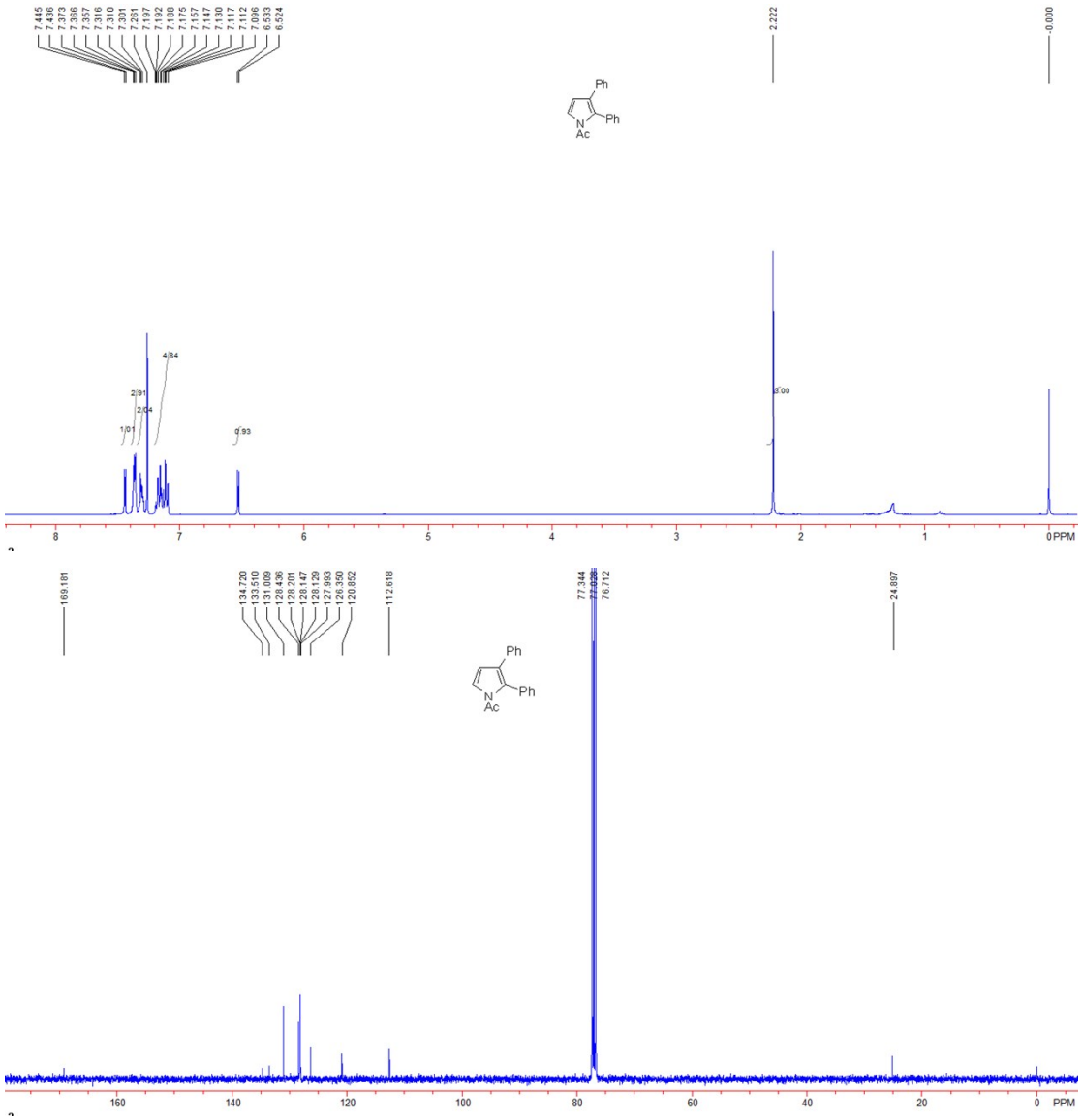
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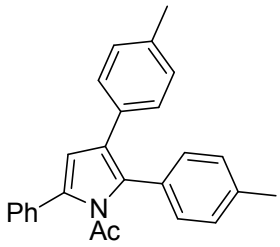
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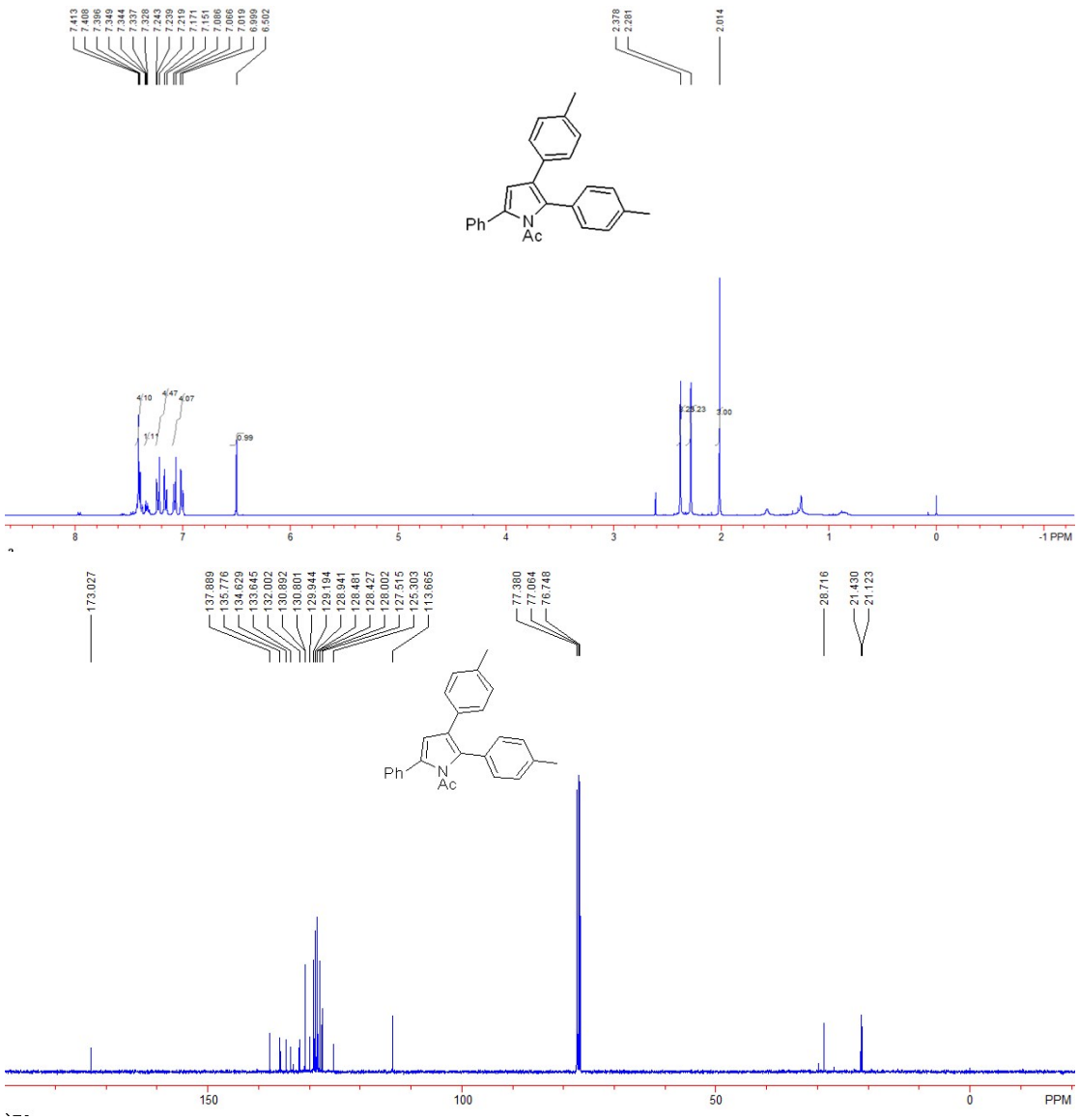
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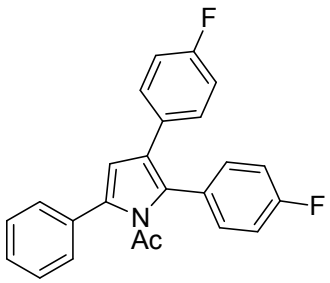
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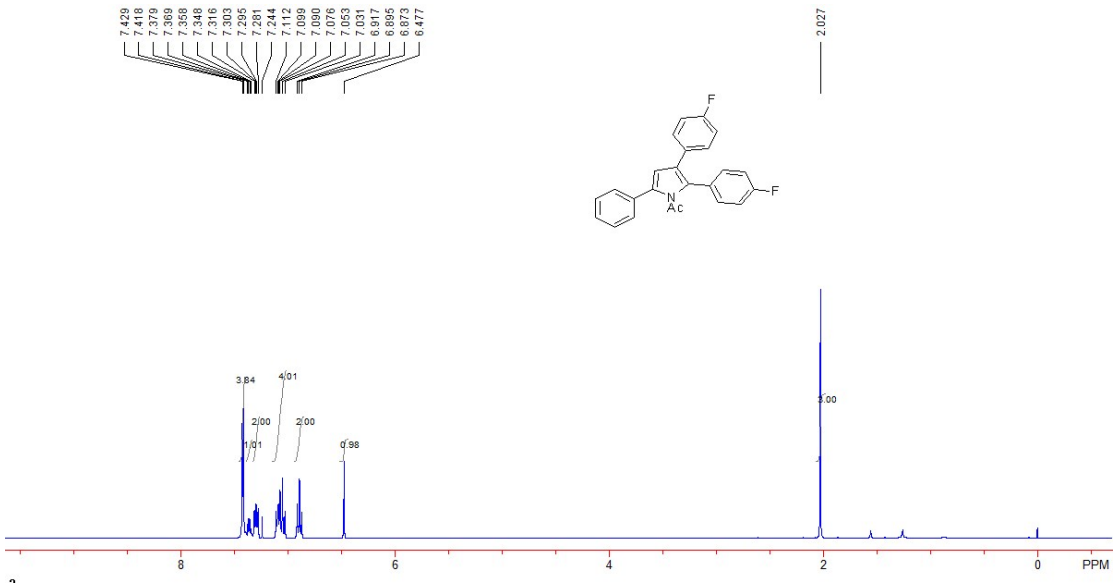
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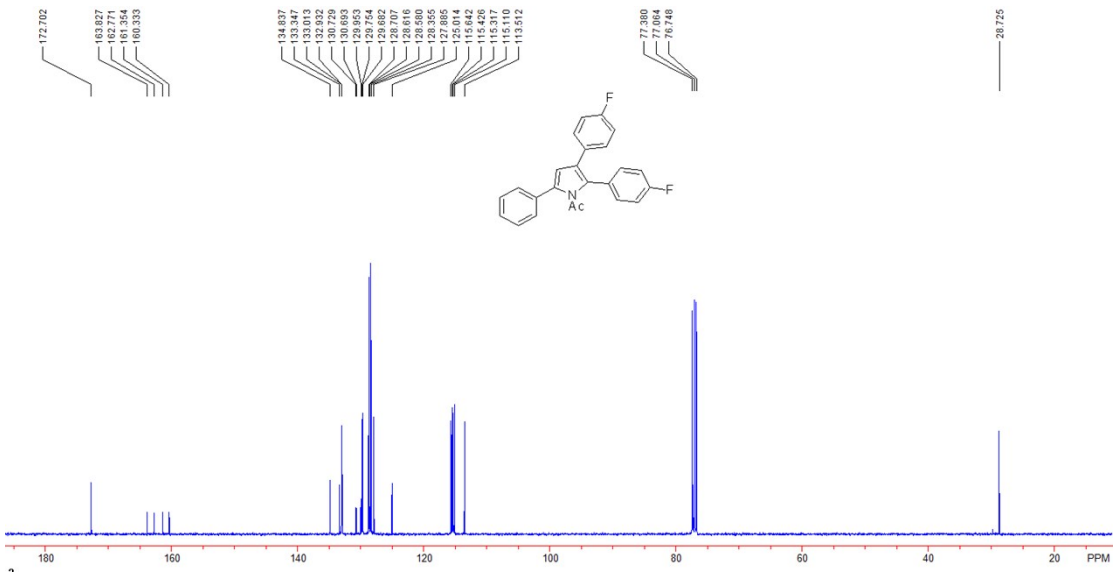
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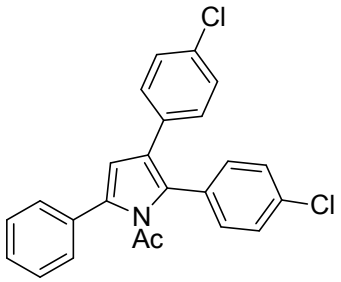
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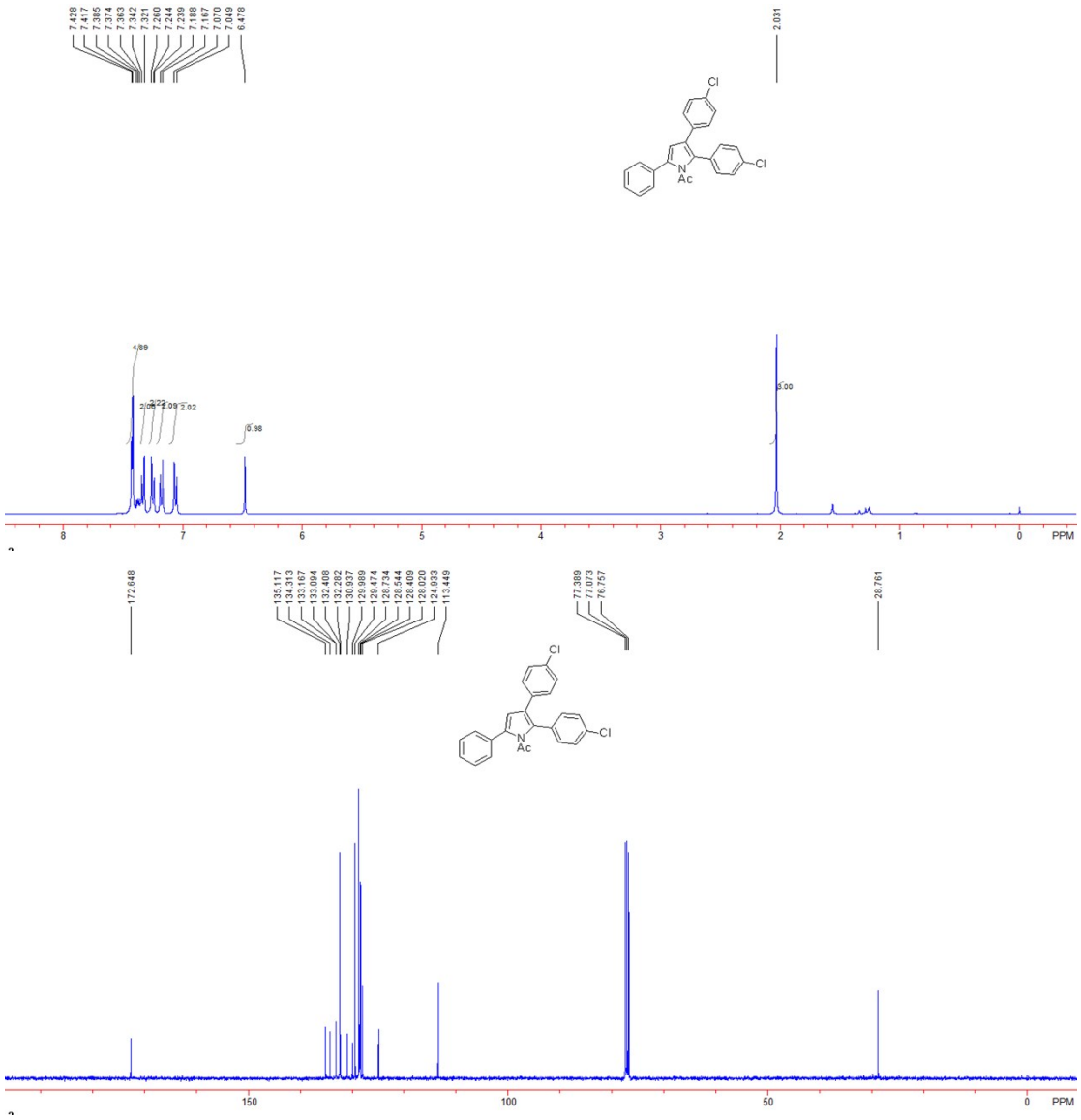
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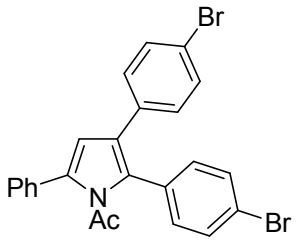
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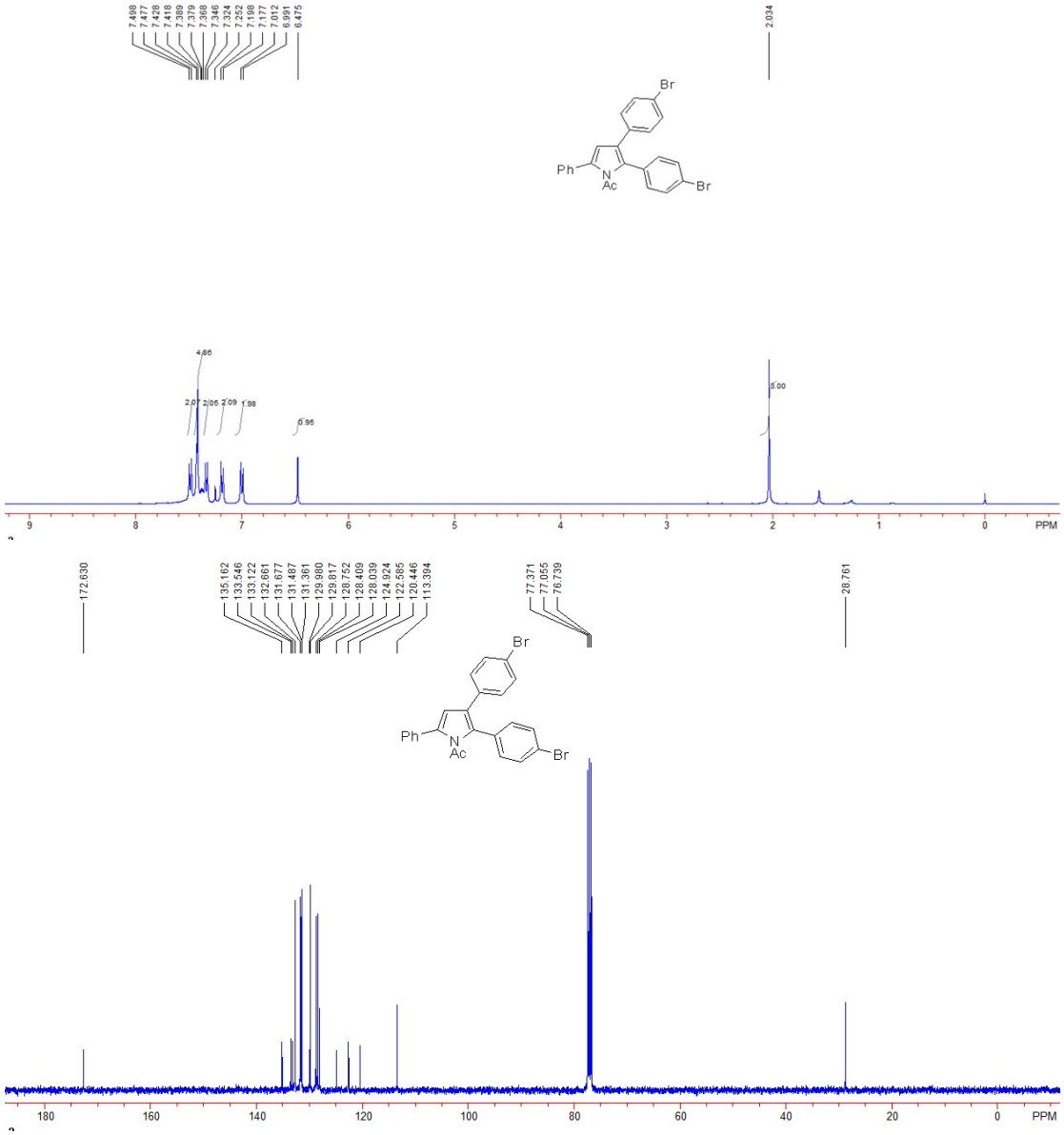
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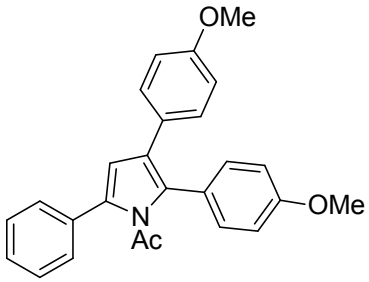
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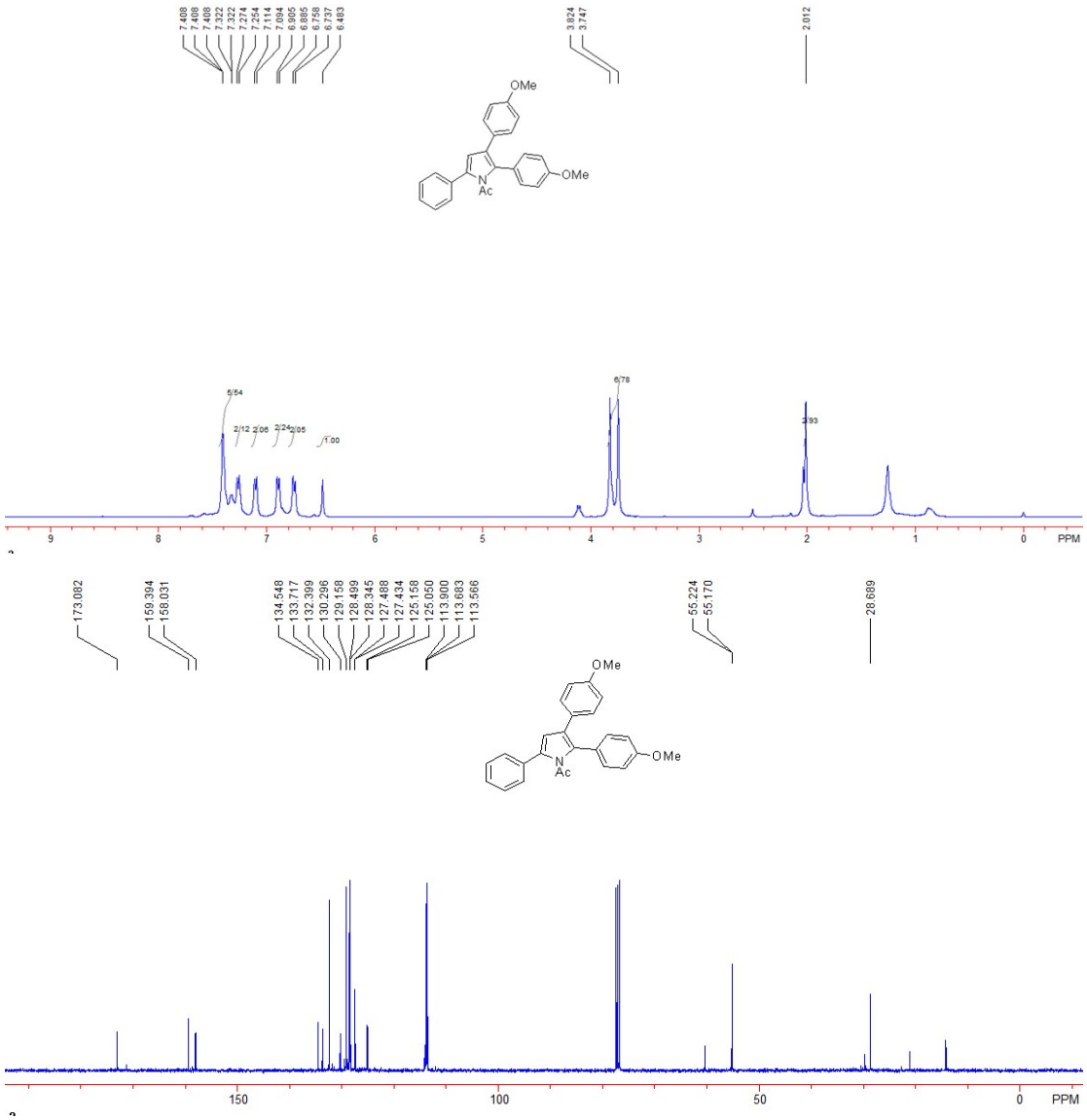
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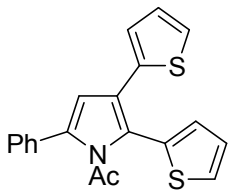
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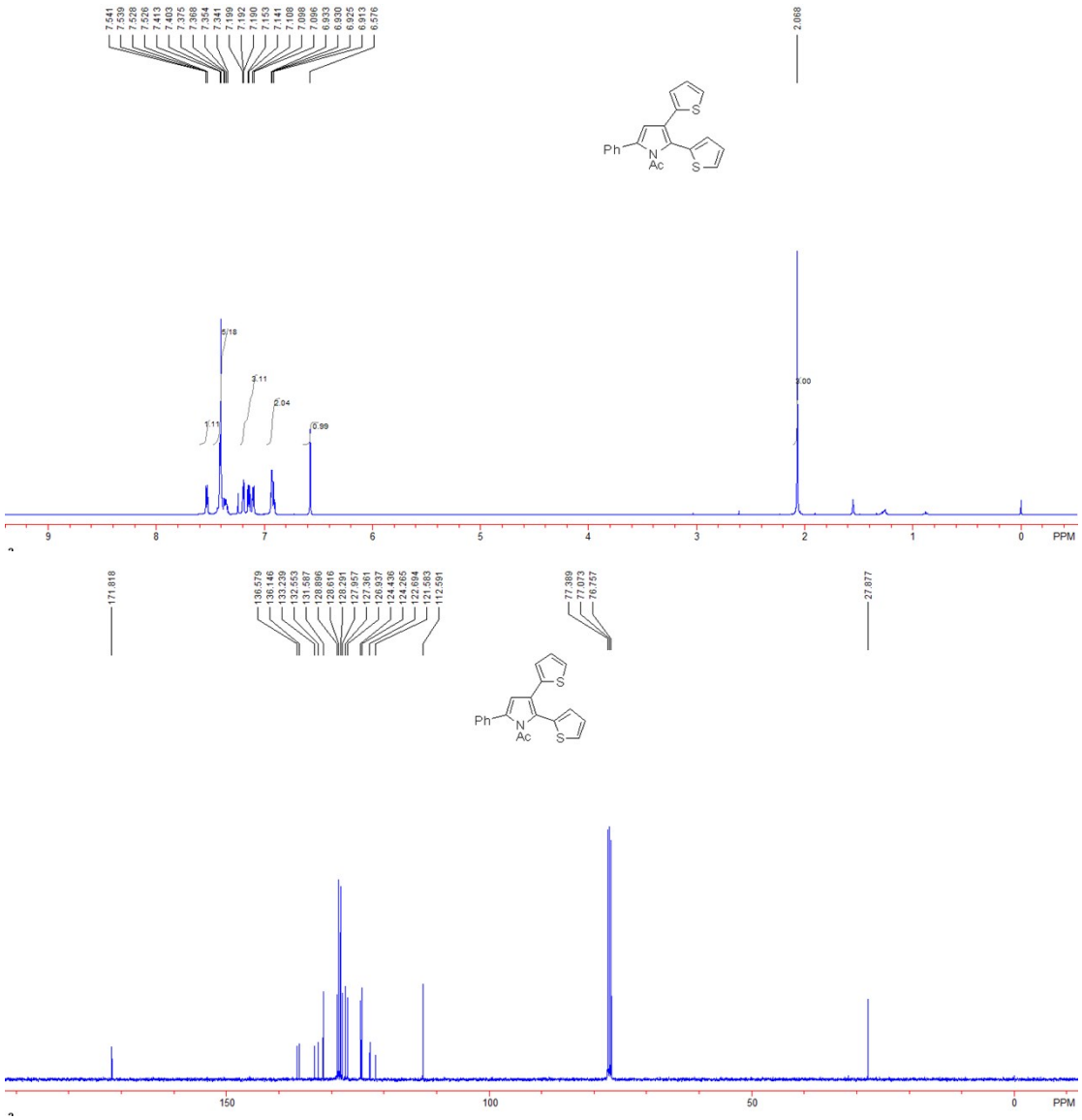
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7.190
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7.141
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7.096
6.933
6.930
6.925
6.913
6.576
2.068
Ph
N
Ac
S
S
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2.04
0.99
1.11
3.00
9
8
7
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5
4
3
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1
0
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133.239
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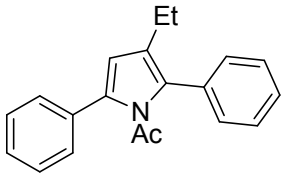
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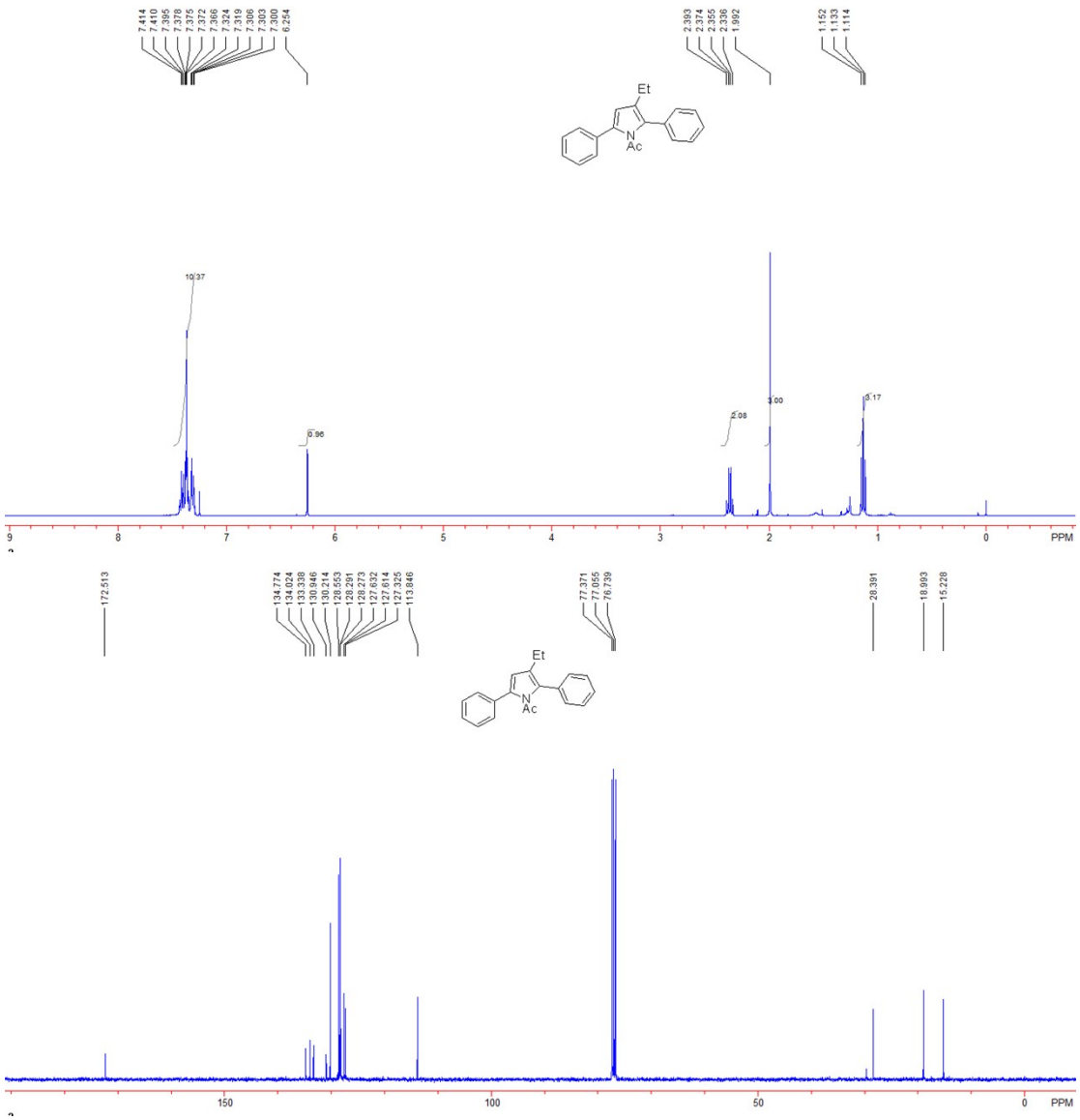
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7.324
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7.306
7.303
7.300
6.254
2.393
2.374
2.355
2.336
1.992
1.152
1.133
1.114
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Ac
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2.08
3.00
3.17
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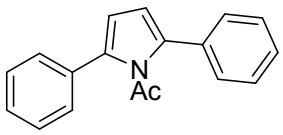
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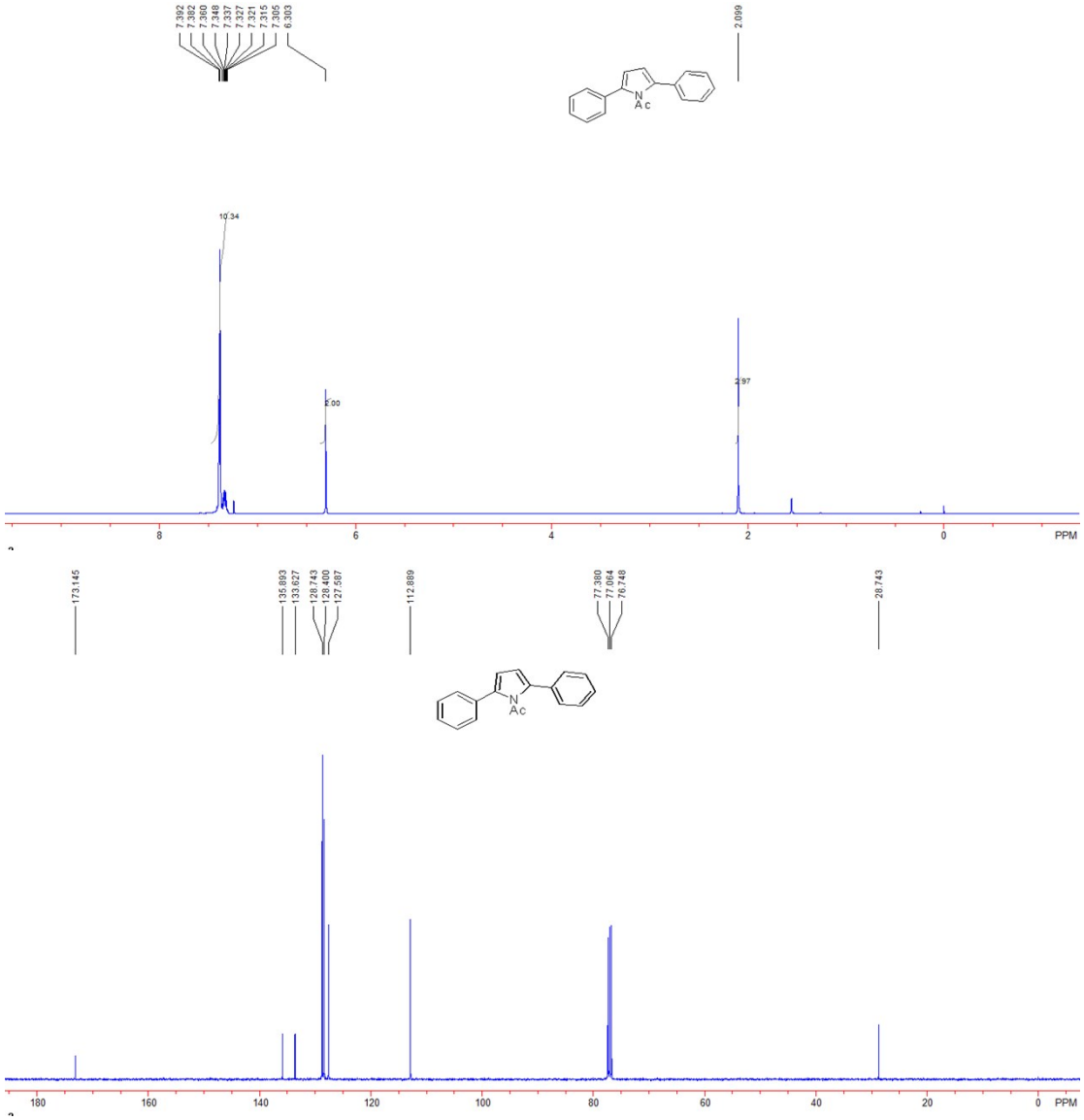
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7.315
7.305
6.303
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Ac
10.34
2.00
2.97
8
6
4
2
0
PPM
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135.893
133.627
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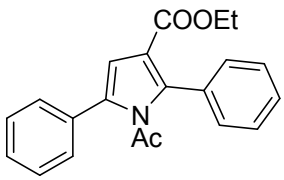
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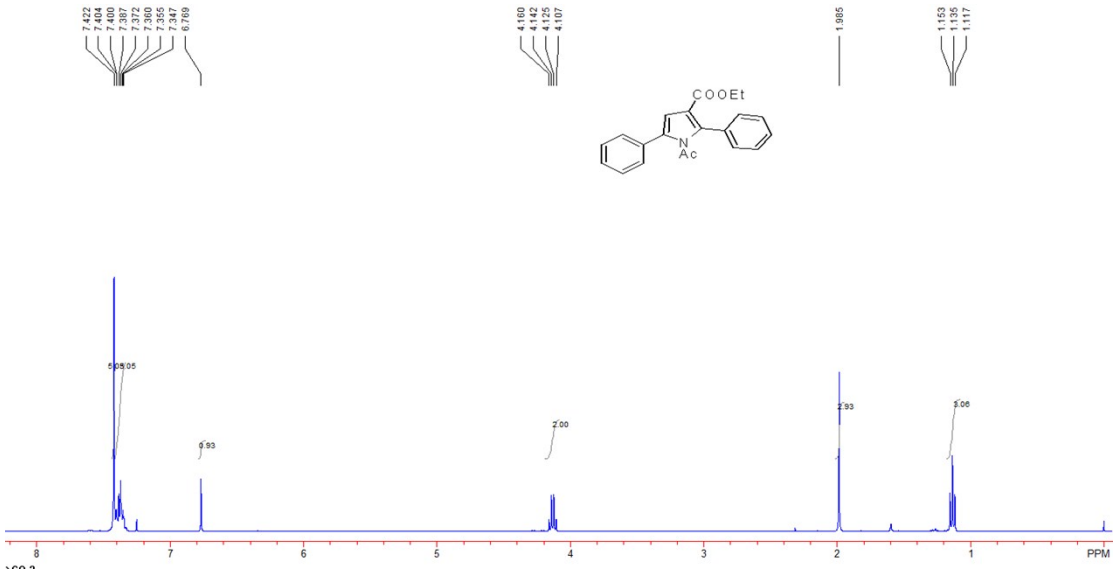
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1.135
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1
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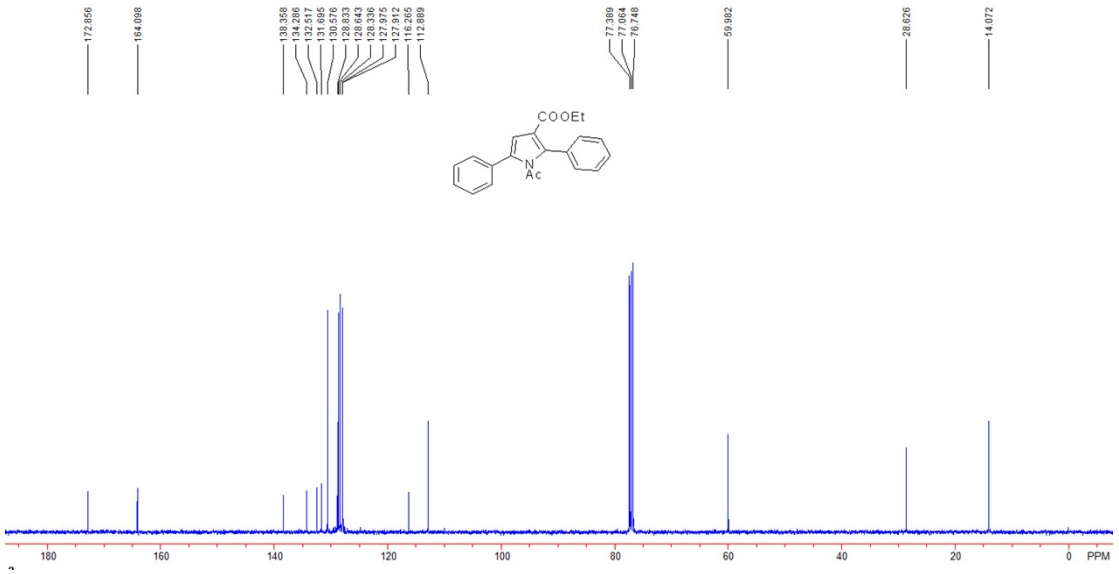
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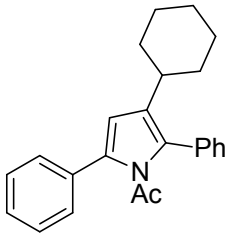
PPM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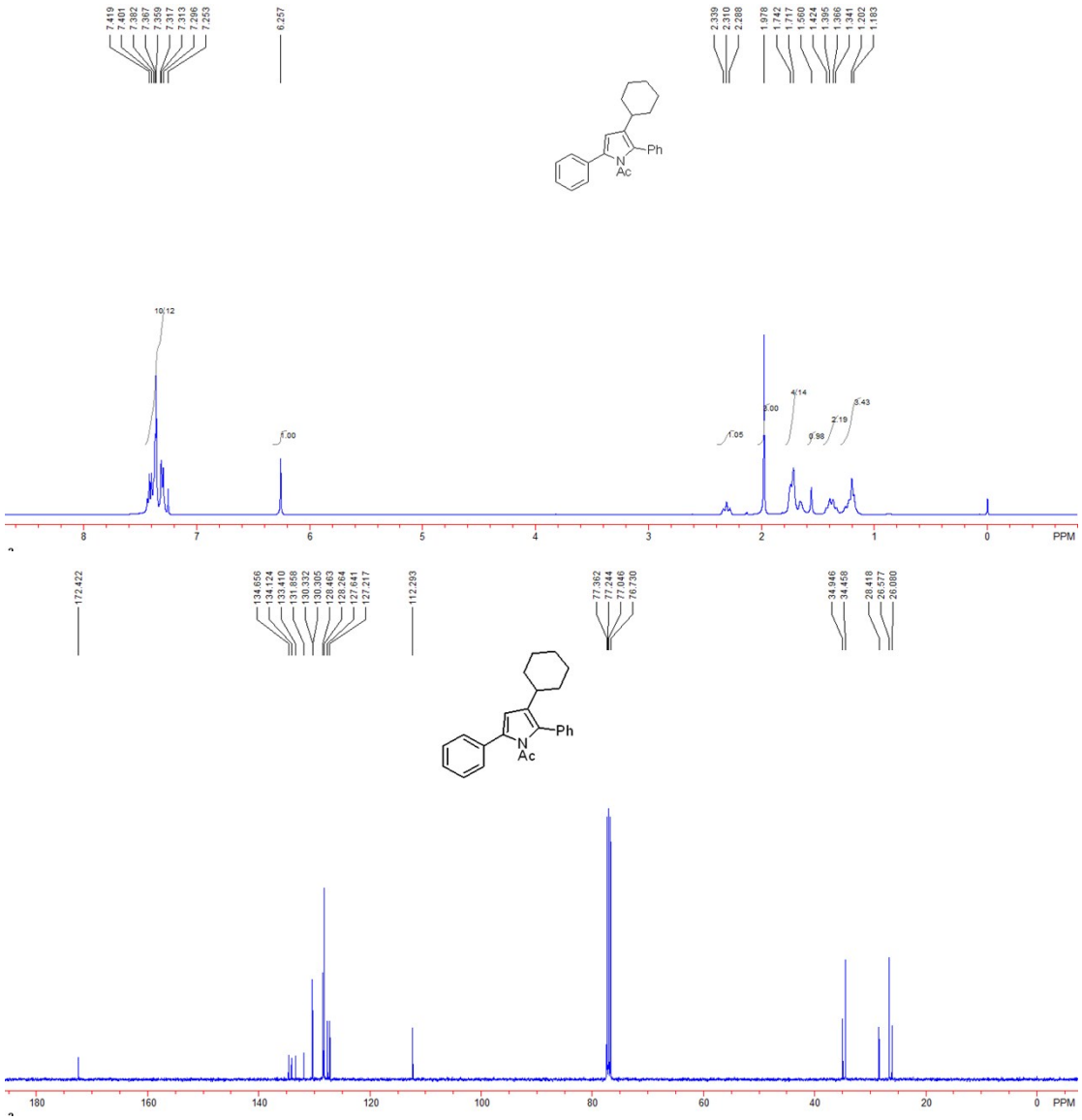
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1.366
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1.183
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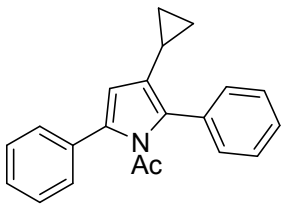
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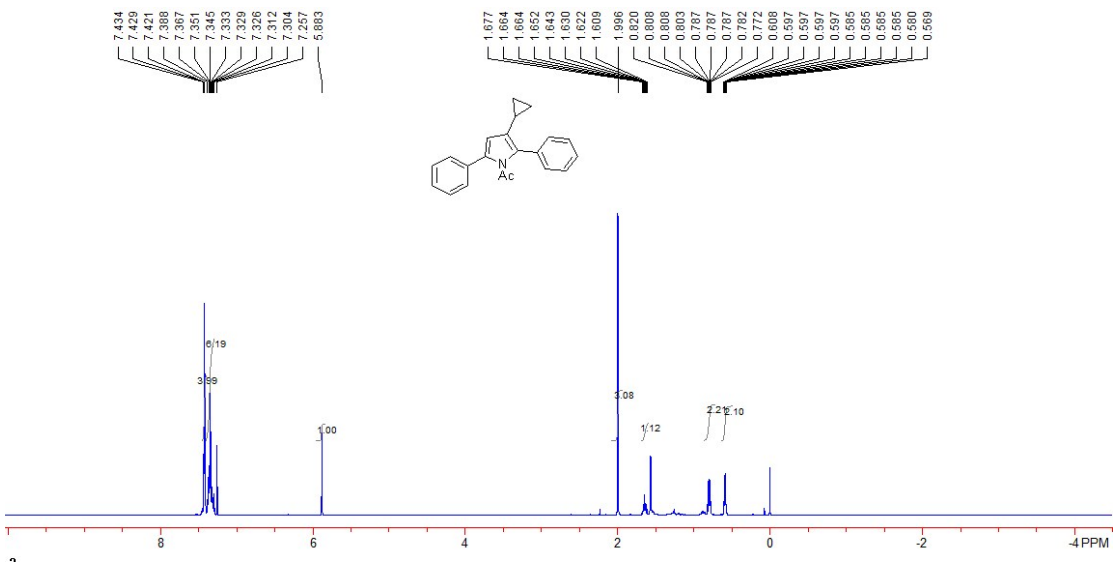
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1.644
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1.643
1.630
1.622
1.609
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0.808
0.808
0.803
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0.787
0.787
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0.772
0.608
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0.597
0.597
0.585
0.585
0.585
0.580
0.569
N
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6
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2
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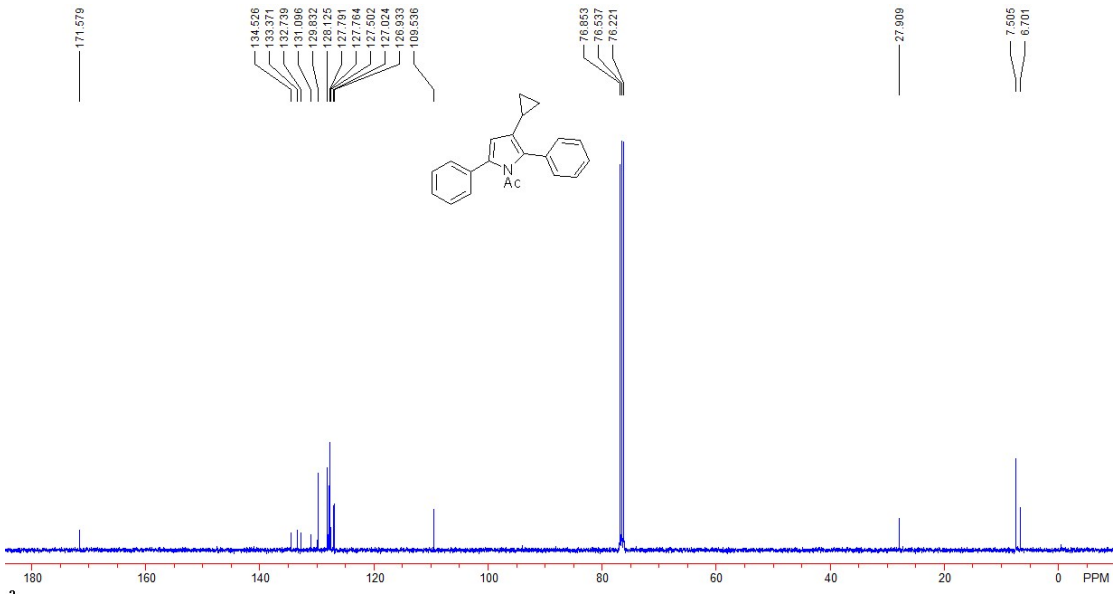
-2
-4 PPM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76.537
76.221
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7.505
6.701
N
Ac
180
160
140
120
100
80
60
40
20
0
PPM