Electronic Supplementary Material (ESI) for Chemical Communications

Observations on transition metal free biaryl coupling: Potassium *tert*-butoxide alone promotes the reaction without diamine or phenanthroline catalysts.

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SUPPLEMENTARY INFORMATION

General Information

Potassium *tert*-butoxide (98+%) purchased from Acros Organics was used without further purification. Anhydrous benzene (99.8%, SureSeal^{TM}) was purchased from Sigma-Aldrich and used without further purification using standard Schlenk techniques.

1,10-Phenanthroline (anhydrous, 99%) was purchased from Alfa Aesar. Ammonia solution (28% solution in water) was purchased from VWR International. All other commercially available aromatic iodides were used without further purification. Analysis by thin layer chromatography (TLC) was conducted using aluminium-backed plates pre-coated (250 μm) with silica (Merck, TLC silica gel 60 F_{254}). TLC plates were visualised using ultraviolet light (254 nm), and then using $KMnO_4$ solution and heating. Flash chromatography was performed using silica gel (Merck Kieselgel 60) 0.04/0.063mm (230-400 mesh) silica gel.

^{1}H and ^{13}C NMR spectra were recorded on a Bruker AMX500 or AMX600 using $CDCl_3$ as the deuterated solvent. Coupling constants are reported in Hertz (Hz). ^{13}C NMR spectra were recorded at 125 MHz or 150 MHz on either a Bruker AMX500 or AMX600 MHz spectrometer, and are reported in ppm. Mass spectra were measured on a Thermo Finnigan MAT900 XP operating in EI and CI mode. Melting points were measured using Gallenkamp apparatus and are uncorrected.

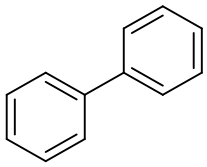
Purification procedure for commercially-available 1,10-phenanthroline

1,10-phenanthroline (anhydrous, 99%) purchased from Alfa Aesar (3.0 g, 16.6 mmol, 1.0 eq.) was dissolved in CH_2Cl_2 (100 mL) and methanesulfonic acid (3.2 g, 33.3 mmol, 2.0 eq.) was added. This mixture was then transferred to a separating funnel and washed with ammonia (28% sol'n in water) (3 x 100 mL) in successive portions. The organic layer was then separated, dried over $MgSO_4$, filtered and concentrated *in vacuo* to afford a white solid. This solid was consequently recrystallised from chloroform/petrol to afford the product as colourless plates which were filtered and dried in a vacuum oven overnight (2.3 g, 77%); m.p. 115–116 °C (CH_3Cl/PE) (lit. 118 °C from PE).[1] M.p. without purification was 90–99 °C.

General procedure for the arylation of benzene with aryl iodides.

Potassium *tert*-butoxide (101 mg, 0.90 mmol, 4.0 eq), aryl iodide (0.225 mmol, 1.0 eq) and benzene (2.4 mL, 120 eq.) were stirred in a flame-dried, pressure resistant tube for 6 h under an argon atmosphere. The external bath temperature was set at 170 ^oC. After cooling to rt, the reactions were quenched with 1 M aqueous HCl solution (5 mL), and diluted with Et_2O (5 mL). The organic layer was separated, and the aqueous layer extracted three times with Et_2O (3 x 10 mL). The organic layers were combined, washed with brine (10 mL) and dried over $MgSO_4$. The organic portion was filtered, concentrated *in vacuo* and purified *via* flash chromatography (100% petroleum ether 40-60 ^oC).[2]

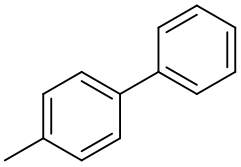
Biphenyl 2a



Synthesised according to the general procedure using iodobenzene as the limiting reagent. White solid, 77%; m.p.; 69–70 ^oC (lit. 69-70 ^oC) [3]; ^1H NMR (600 MHz, $CDCl_3$) δ_H 7.60 (d, J = 7.8 Hz, 4H), 7.45 (t, J = 7.6 Hz, 4H), 7.35 (t, J = 7.1 Hz, 2H); ^{13}C NMR (150 MHz, $CDCl_3$) δ_C 141.3 (C_q), 128.9 (CH), 127.4 (CH), 127.3 (CH); LRMS (EI) 154 (100), 128 (4), 115 (4) 76 (5). Data in agreement with literature values.[4]

[1] C.W.N. Cumper, D.G. Redford, A.I. Vogel, *J. Chem. Soc*., **1962**, 1158.
[2] 3-Phenyl pyridine purified *via* column chromatography using 0-2% MeOH/CH_2Cl_2.
[3] K.C. Chan, R.L. Ruang, *J. Chem. Soc.*, **1965**, 2649.
[4] M.E. Buden, J.F. Guastavino, R.A. Rossi, *Org. Lett.*, **2013**, 1174.

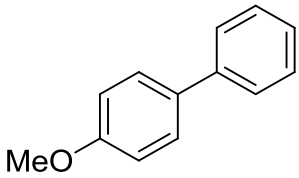
4-Methylbiphenyl 2b



Synthesised according to the general procedure using 4-iodotoluene as the limiting reagent. White solid, 66%; m.p.; 45–46 ^{o}C (lit. 46 ^{o}C) [5]; ^{1}H NMR (600 MHz, $CDCl_3$) δ_H 7.60 (d, *J* = 8.3 Hz, 2H), 7.51 (d, *J* = 8.1 Hz, 2H), 7.44 (t, *J* = 7.6 Hz, 2H), 7.34 (t, *J* = 7.5 Hz, 1H), 7.27 (d, *J* = 7.9 Hz, 2H), 2.41 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$)* δ_C 141.3 (C_q), 138.5 (C_q), 137.2 (C_q), 129.6 (CH), 128.8 (CH), 127.1 (CH), 127.1 (CH), 21.2 (CH_3); LRMS (EI) 168 (100), 167 (52), 152 (18), 115 (6), 91 (4). Data in agreement with literature values.[4]

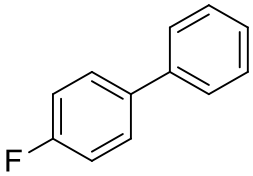
*Two signals are coincident.

4-Methoxybiphenyl 2c



Synthesised according to the general procedure using 4-iodoanisole as the limiting reagent. White solid, 48%; m.p.; 84–85 ^{o}C (lit. 84-85 ^{o}C)[6]; ^{1}H NMR (600 MHz, $CDCl_3$) δ_H 7.57-7.53 (m, 4H), 7.42 (t, *J* = 7.6 Hz, 2H), 7.31 (t, *J* = 7.4 Hz, 1H), 6.99 (d, *J* = 8.8 Hz, 2H), 3.86 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$) δ_C 159.2 (C_q), 140.9 (C_q), 133.9 (C_q), 128.8 (CH), 128.3 (CH), 126.9 (CH), 126.8 (CH), 114.3 (CH), 55.5 (CH_3); LRMS (EI) 184 (100), 169 (31), 152 (7), 141 (37), 115 (29). Data in agreement with literature values.[4]

4-Fluorobiphenyl 2d

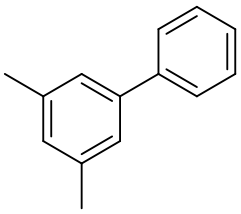


Synthesised according to the general procedure using 4-fluoroiodobenzene as the limiting reagent. White solid, 64%; m.p.; 69–70 ^{o}C (lit. 69 ^{o}C)[7]; ^{1}H NMR (600 MHz, $CDCl_3$) δ_H 7.56-7.54 (m, 4H), 7.44 (t, *J* = 7.5 Hz, 2H), 7.35 (t, *J* = 7.4 Hz, 1H), 7.13 (t, *J* = 8.6 Hz, 2H); ^{13}C NMR (150 MHz, $CDCl_3$) δ_C 163.4 (C_q), 161.8 (C_q), 140.4 (C_q), 137.4 (d, *J* = 3.2 Hz) (C_q), 128.9 (CH), 128.8 (d, *J* = 8.0 Hz) (CH), 127.4 (CH),

[5] T. Mino, Y. Shirae, M. Sakamoto, T. Fujita, *J. Org. Chem.*, **2005**, 2191.
[6] M. Kuriyama, S. Matsuo, O, Onomura, M. Shinozawa, *Org. Lett.*, **2013**, 2716.
[7] A.L. Allred, L.W. Bush, *Tetrahedron*, **1968**, 6883.

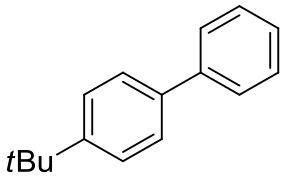
127.1 (CH), 115.7 (d, *J* = 21.3 Hz) (CH); LRMS (EI) 172 (100), 152 (5). Data in agreement with literature values.[4]

3,5-Dimethylbiphenyl 2e



Synthesised according to the general procedure using 5-iodo-*m*-xylene as the limiting reagent. Colourless oil, 48%; ^{1}H NMR (600 MHz, $CDCl_3$) δ_H 7.58 (dd, *J* = 8.3, 1.3 Hz, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.33 (t, *J* = 7.4 Hz, 1H), 7.21 (br s, 2H), 7.00 (br s, 1H), 2.38 (s, 6H); ^{13}C NMR (150 MHz, $CDCl_3$) δ_C 141.6 (C_q), 141.4 (C_q), 138.4 (C_q), 129.0 (CH), 128.7 (CH), 127.3 (CH), 127.2 (CH), 125.2 (CH), 21.5 (CH_3); LRMS (EI) 182 (100), 167 (36), 152 (11), 115 (5). Data in agreement with literature values.[8]

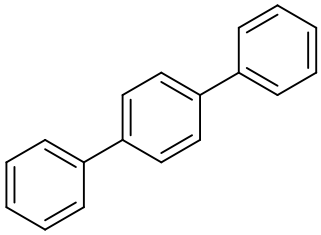
4-*tert*-butylbiphenyl 2f



Synthesised according to the general procedure using 1-*tert*-butyl-4-iodobenzene as the limiting reagent. White solid, 30%; m.p.; 48–49 ^{o}C (lit. 48-49 ^{o}C); ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 7.60 (d, *J* = 7.2 Hz, 2H), 7.55 (d, *J* = 8.4 Hz, 2H), 7.47 (d, *J* = 8.4 Hz, 2H), 7.43 (t, *J* = 7.5 Hz, 2H), 7.33 (t, *J* = 7.3 Hz, 1H), 1.37 (s, 9H); ^{13}C NMR (125 MHz, $CDCl_3$) δ_C 150.3 (C_q), 141.1 (C_q), 138.4 (C_q), 128.7 (CH), 127.1 (CH), 127.0 (CH), 126.8 (CH), 125.8 (CH), 34.6 (C_q), 31.4 (CH_3); LRMS (EI) 210 (36), 195 (100), 178 (11), 167 (19), 152 (9), 115 (4). Data in agreement with literature values.[9]

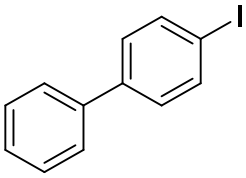
[8] X. Li, X-Y. Yan, H-H. Chang, L-C. Wang, Y. Zhang, W-W. Chen, Y-W. Li, W-L. Wei, *Org. Biomol. Chem.* **2012**, *10*, 495.
[9] (a) M.J. Inglesias, A. Prieto, M.C. Nicasio, *Org. Lett.*, **2012**, 4318. (b) X-H. Fan, L-M. Yang, *Eur. J. Org. Chem.*, **2010**, 2457.

_p_-Terphenyl 2g



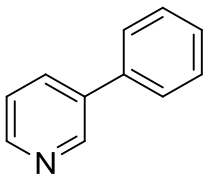
Synthesised according to the general procedure using 1,4-diiodobenzene as the limiting reagent. White solid, 21%; m.p.; 212–213 ^{o}C (lit. 212-213 ^{o}C)[5]; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 7.68 (s, 4H), 7.65 (d, J = 7.1 Hz, 4H), 7.46 (t, J = 7.4 Hz, 4H), 7.36 (t, J = 7.4 Hz, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ_C 140.8 (C_q), 140.2 (C_q), 128.9 (CH), 127.6 (CH), 127.4 (CH), 127.1 (CH); LRMS (EI) 230 (100), 195 (15), 152 (13), 115 (9). Data in agreement with literature values.[4]

4-Iodobiphenyl 2h



Synthesised according to the general procedure using 1,4-diiodobenzene as the limiting reagent. White solid, 30%; m.p.; 107–108 ^{o}C (lit. 109-110 ^{o}C)[10]; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 7.77 (m, 2H), 7.55 (m, 2H), 7.44 (m, 2H), 7.38-7.32 (m, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ_C 140.8 (C_q), 140.1 (C_q), 137.9 (CH), 129.1 (CH), 129.0 (CH), 127.8 (CH), 127.0 (CH), 93.1 (C_q); LRMS (EI) 280 (100), 152 (55). Data in agreement with literature values.[11]

3-Phenylpyridine 2i



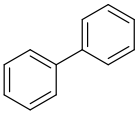
Synthesised according to the general procedure using 3-iodopyridine as the limiting reagent. Colourless oil, 37%; NMR (600 MHz, $CDCl_3$) δ_H 8.87 (br s, 1H), 8.61 (br s, 1H), 7.89 (dt, J = 7.9, 1.7 Hz, 1H), 7.59 (d, J = 7.1 Hz, 2H), 7.49 (t, J = 7.5 Hz, 2H), 7.43-7.37 (m, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ_C 148.5 (CH), 148.3 (CH), 137.9 (C_q), 136.9 (C_q), 134.6 (CH), 129.2 (CH), 128.2 (CH), 127.3 (CH), 123.8 (CH); LRMS (EI) 155 (100), 127 (8), 115 (3). Data in agreement with literature values.[4]

[10] Y. Qin, W. Wei, M. Luo, *Synlett*, **2007**, 2410
[11] K. Kulbitski, G. Nisnevich, M. Gandelman, *Adv. Synth. Catal.*, **2011**, *353*, 1438.

Biphenyl 2a

JC871

PROTON.ucl CDCl3 /v/Bruker/TOPSPIN jdw 14

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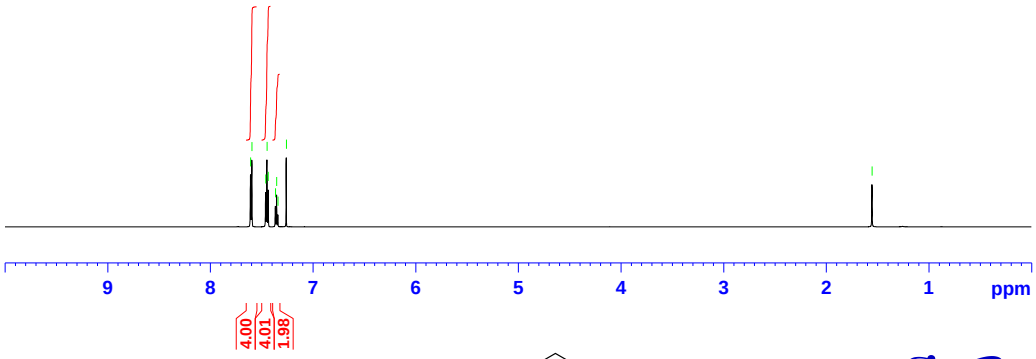

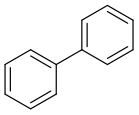

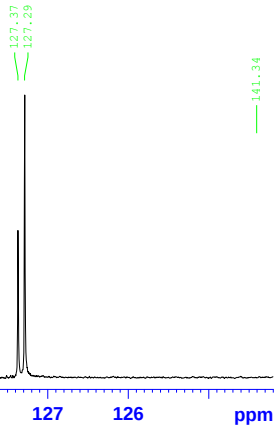

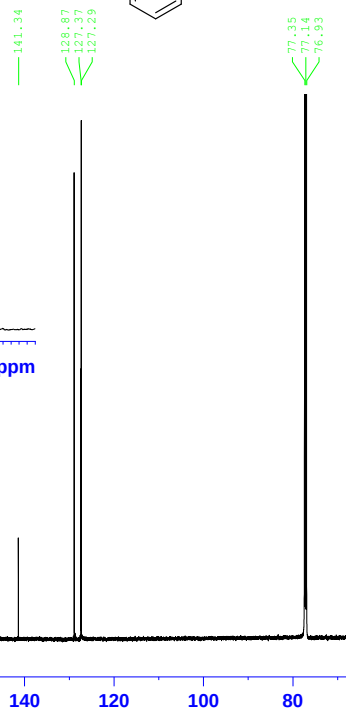


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4-Methylbiphenyl 2b

JC819
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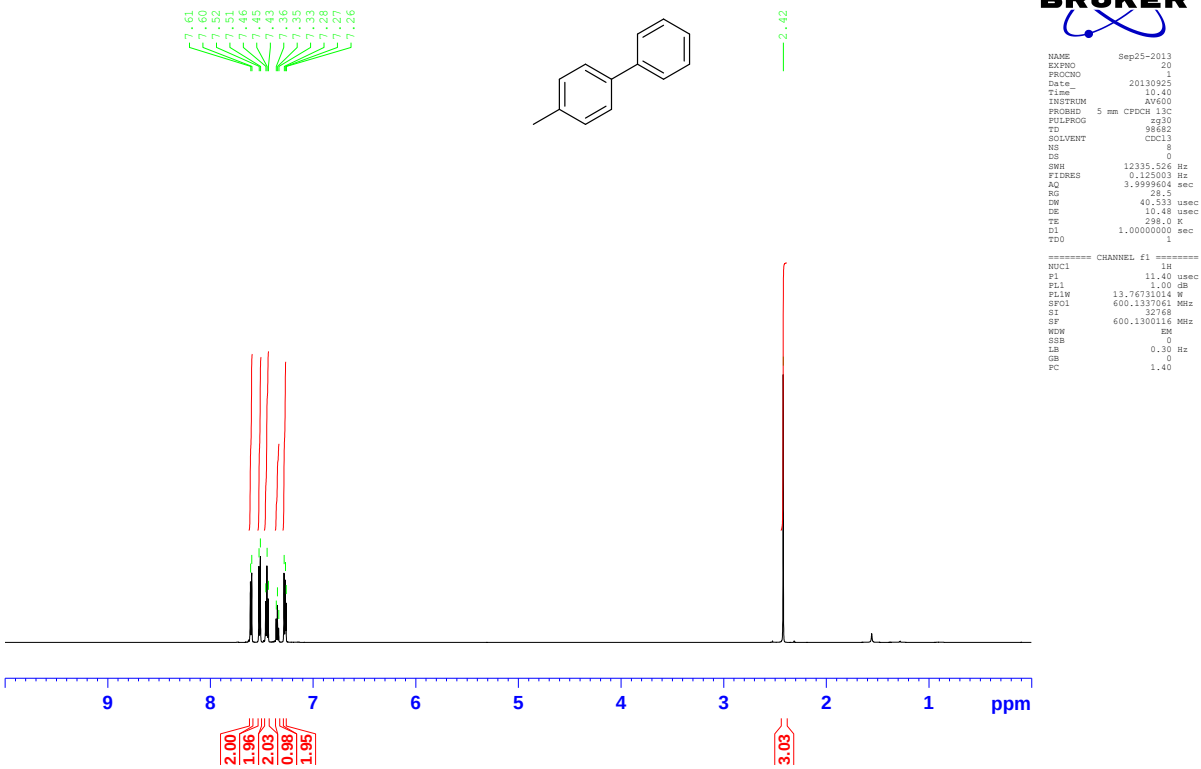


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JC819
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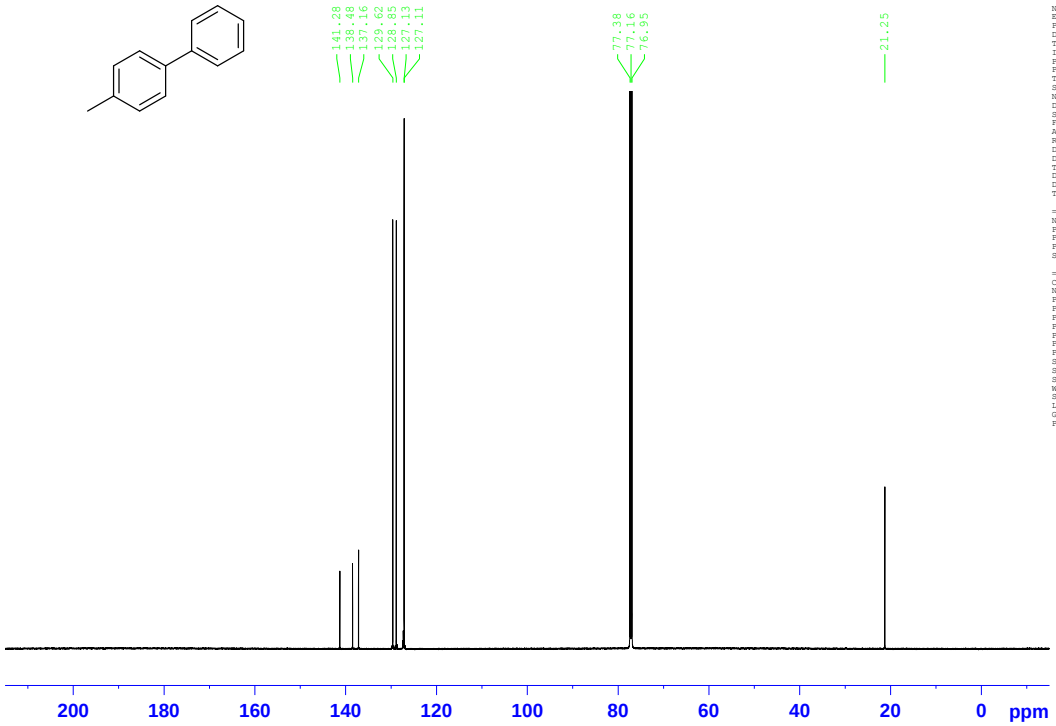


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4-Methoxybiphenyl 2c

JC859

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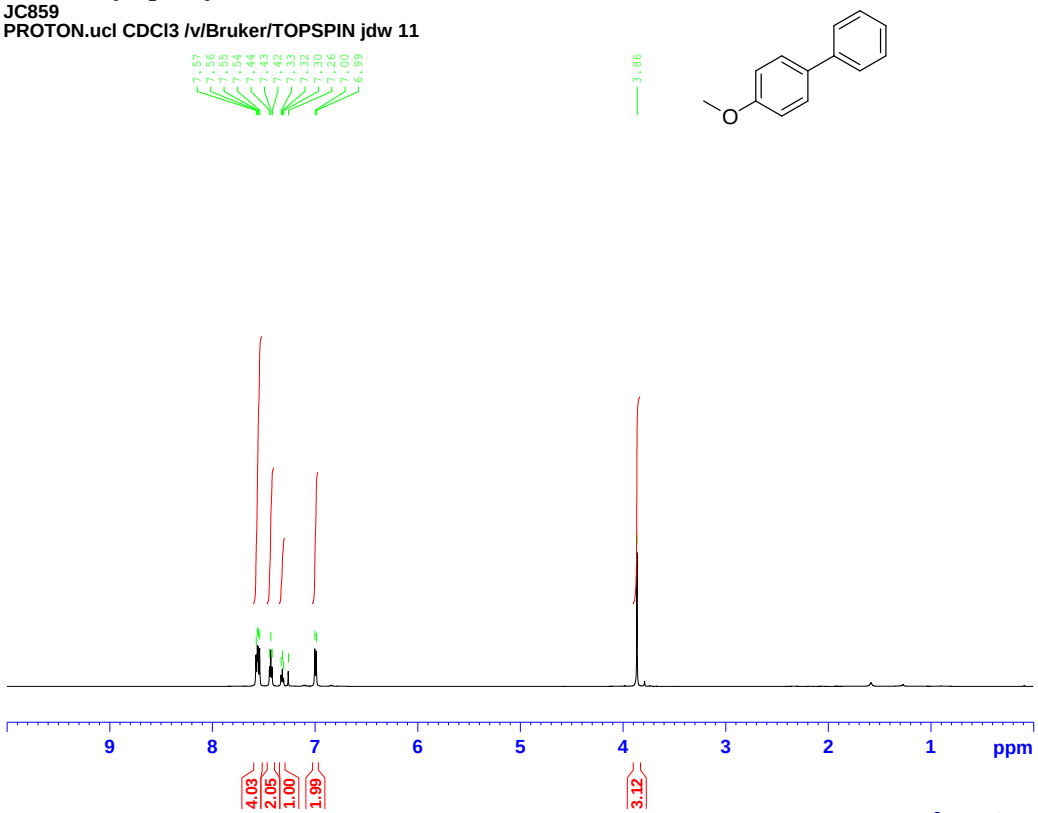

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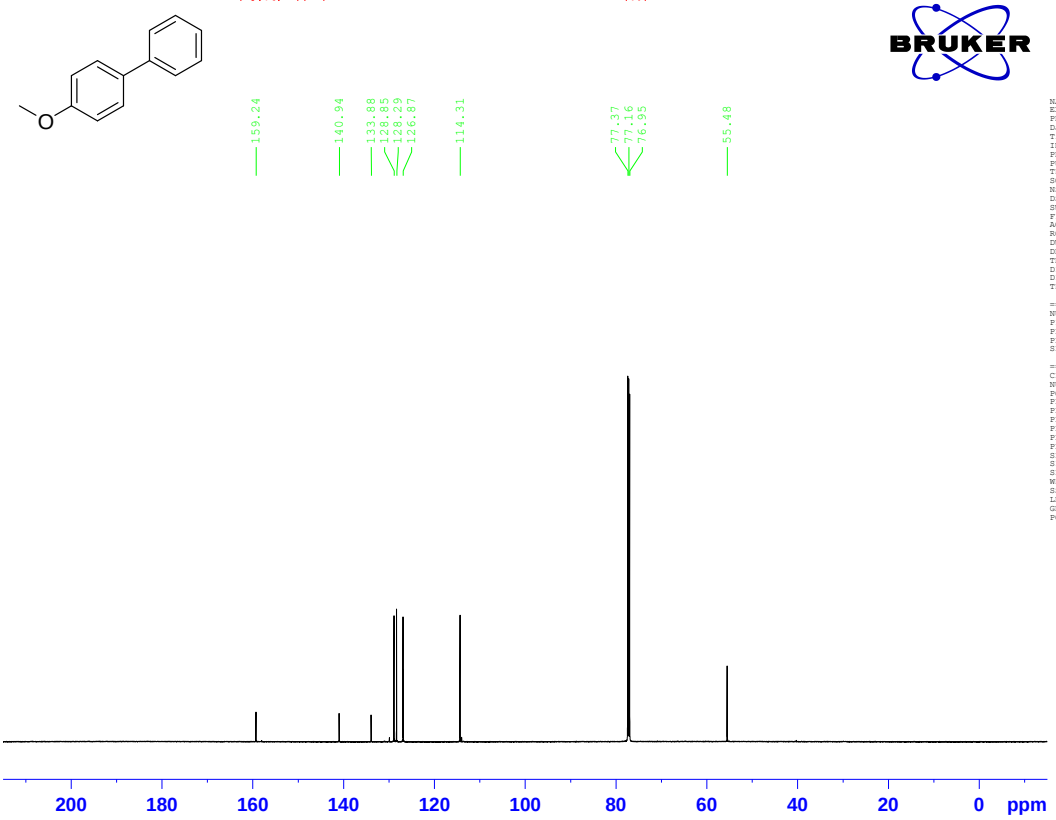


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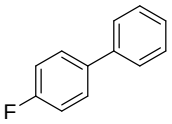
PL12W            0.32798135 W
PL13W            0.17332016 W
SFO2           600.1324005 MHz
SI                    65536
SF             150.9027930 MHz
WDW                      EM
SSB                       0
LB                     1.00 Hz
GB                        0
PC                     1.40
```

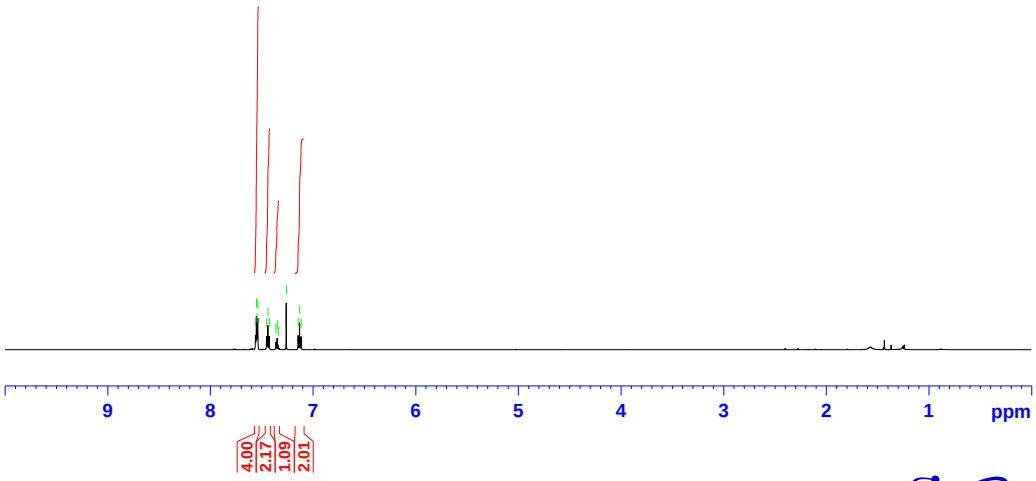
4-Fluorobiphenyl 2d

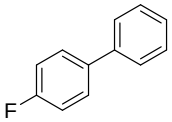
JC847
PROTON.ucl CDCl3 /v/Bruker/TOPSPIN jdw 48




```
NAME                JC847600
EXPNO                     20
PROCNO                     1
Date_               20130911
Time                   21.26
INSTRUM                AV600
PROBHD     5 mm CPDCH 13C
PULPROG                zg30
TD                     98682
SOLVENT                CDCl3
NS                         8
DS                         0
SWH                12335.526 Hz
FIDRES             0.125003 Hz
AQ                 3.9999604 sec
RG                      40.3
DW                    40.533 usec
DE                    10.48 usec
TE                    298.0 K
D1                 1.00000000 sec
TD0                        1

======== CHANNEL f1 ========
NUC1                      1H
P1                     11.40 usec
PL1                     1.00 dB
PL1W              13.76731014 W
SFO1              600.1337061 MHz
SI                       32768
SF                600.1300116 MHz
WDW                       EM
SSB                        0
LB                      0.30 Hz
GB                         0
PC                      1.40
```

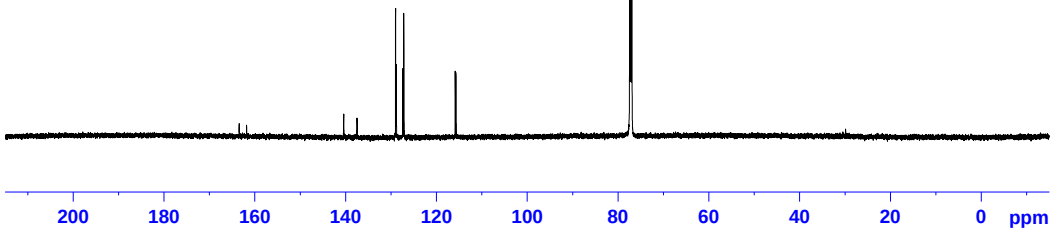





```
NAME                JC855600
EXPNO                     11
PROCNO                     1
Date_               20130918
Time                   16.42
INSTRUM                AV600
PROBHD     5 mm CPDCH 13C
PULPROG             zgpg30
TD                     78942
SOLVENT                CDCl3
NS                       128
DS                         0
SWH                43859.648 Hz
FIDRES             0.555593 Hz
AQ                 0.8999888 sec
RG                      1030
DW                   11.400 usec
DE                    20.22 usec
TE                    298.0 K
D1                 2.00000000 sec
D11                0.03000000 sec
TD0                        1

======== CHANNEL f1 ========
NUC1                      13C
P1                      9.80 usec
PL1                     5.00 dB
PL1W              26.76886177 W
SFO1              150.9201628 MHz

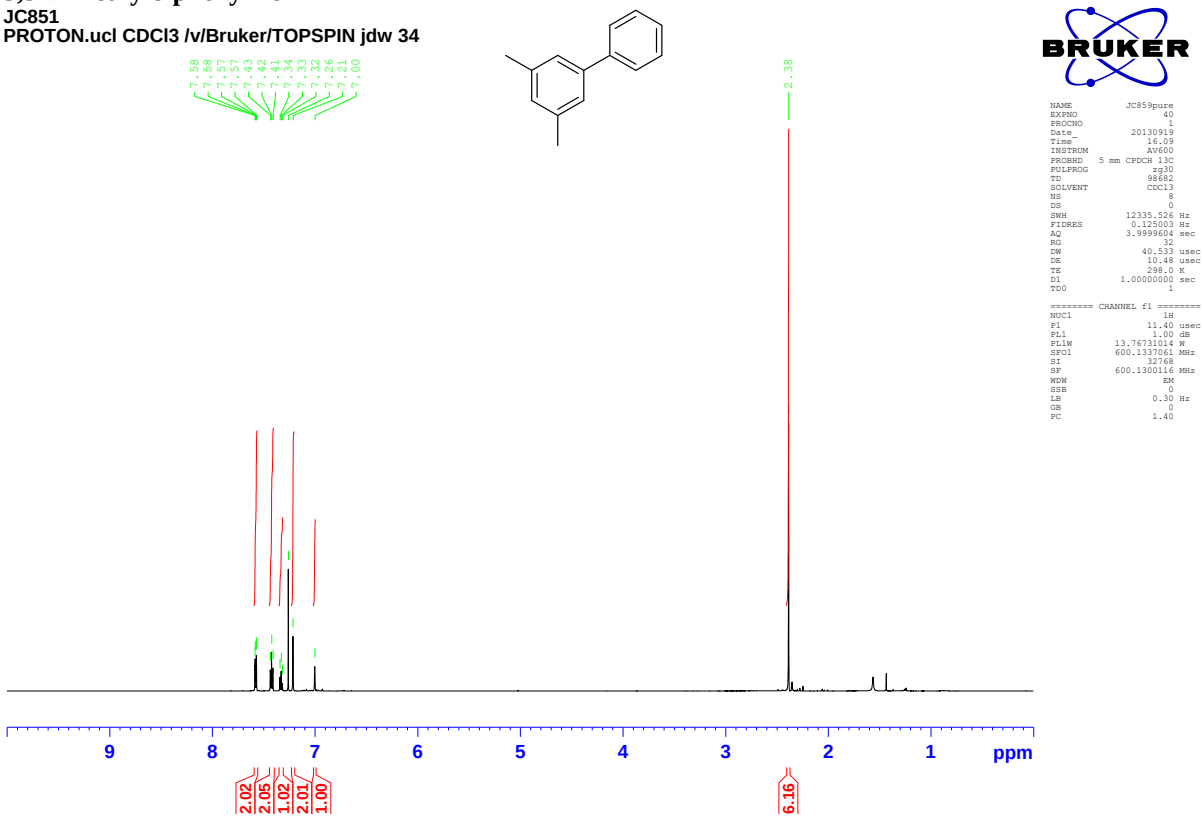
======== CHANNEL f2 ========
CPDPRG2                waltz16
NUC2                      1H
PCPD2                  70.00 usec
PL2                     1.00 dB
PL12                   17.23 dB
PL13                   20.00 dB
PL2W              13.76731014 W
PL12W              0.32798135 W
PL13W              0.17332016 W
SFO2              600.1324005 MHz
SI                       65536
SF                150.9027930 MHz
WDW                       EM
SSB                        0
LB                      1.00 Hz
GB                         0
PC                      1.40
```

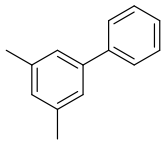


3,5-Dimethylbiphenyl 2e

JC851

PROTON.ucl CDCl3 /v/Bruker/TOPSPIN jdw 34






```
NAME                 JC859pure
EXPNO                       40
PROCNO                       1
Date_                 20130919
Time                     16.09
INSTRUM                  AV600
PROBHD     5 mm CPDCH 13C
PULPROG                  zg30
TD                      98682
SOLVENT                 CDCl3
NS                          8
DS                          0
SWH                 12335.526 Hz
FIDRES              0.125003 Hz
AQ                  3.9999604 sec
RG                         32
DW                     40.533 usec
DE                     10.48 usec
TE                     298.0 K
D1                  1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
NUC1                       1H
P1                     11.40 usec
PL1                     1.00 dB
PL1W                13.76731014 W
SFO1               600.1337061 MHz
SI                        32768
SF                 600.1300116 MHz
WDW                        EM
SSB                         0
LB                       0.30 Hz
GB                          0
PC                       1.40
```

JC851

C13CPD.ucl CDCl3 /v/Bruker/TOPSPIN jdw 34


```
NAME                 JC859pure
EXPNO                       41
PROCNO                       1
Date_                 20130919
Time                     16.30
INSTRUM                  AV600
PROBHD     5 mm CPDCH 13C
PULPROG                zgpg30
TD                      78942
SOLVENT                 CDCl3
NS                        128
DS                          0
SWH                 43859.648 Hz
FIDRES              0.555593 Hz
AQ                  0.8999888 sec
RG                       1030
DW                     11.400 usec
DE                      20.22 usec
TE                     298.0 K
D1                  2.00000000 sec
D11                 0.03000000 sec
TD0                         1

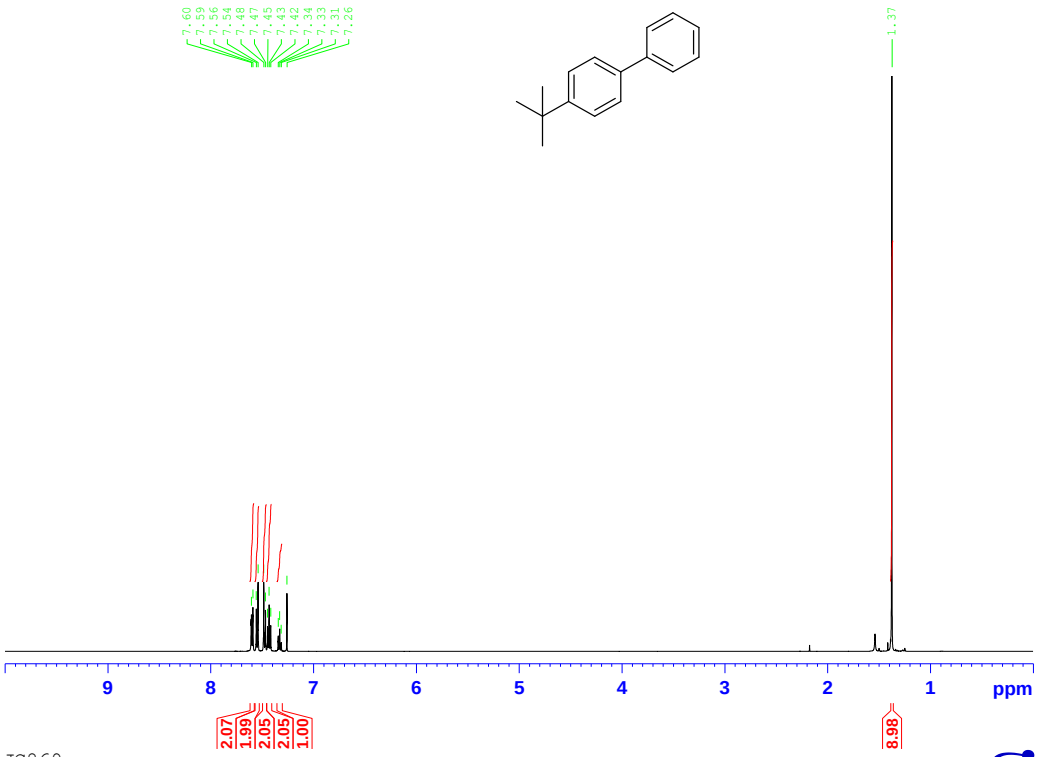
======== CHANNEL f1 ========
NUC1                       13c
P1                      9.80 usec
PL1                     5.00 dB
PL1W               26.76886177 W
SFO1               150.9201628 MHz

======== CHANNEL f2 ========
CPDPRG2                waltz16
NUC2                       1H
PCPD2                  70.00 usec
PL2                     1.00 dB
PL12                   17.23 dB
PL13                   20.00 dB
PL2W                13.76731014 W
PL12W               0.32798135 W
PL13W               0.17332016 W
SFO2               600.1324005 MHz
SI                        65536
SF                 150.9027930 MHz
WDW                        EM
SSB                         0
LB                       1.00 Hz
GB                          0
PC                       1.40
```

4-*tert*-butylbiphenyl 2f

JC869

PROTON.ucl CDCl3 v2 jdw 45



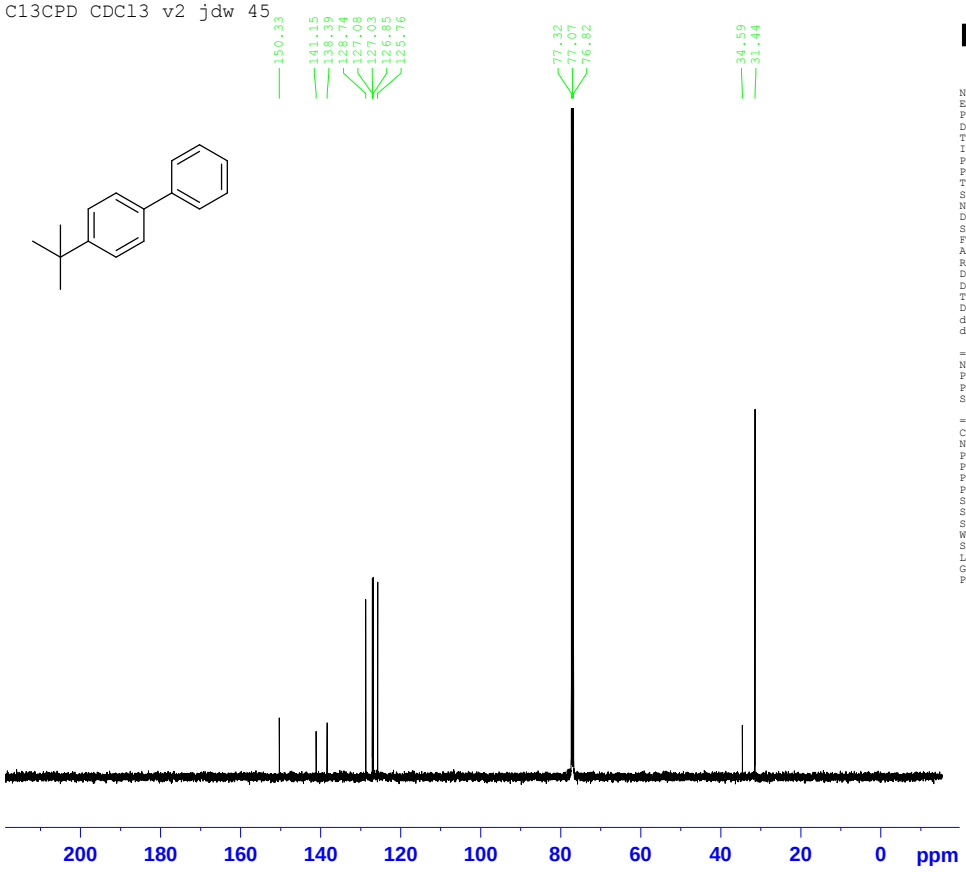
BRUKER

```
NAME                 JC869
EXPNO                   30
PROCNO                   1
Date_             20130920
Time_                 5.36
INSTRUM             drx500
PROBHD       5 mm Multinu
PULPROG             zg30
TD                  65536
SOLVENT             CDCl3
NS                     16
DS                      0
SWH              10330.578 Hz
FIDRES            0.157632 Hz
AQ                3.1720407 sec
RG                    362
DW                48.400 usec
DE                 6.00 usec
TE                 300.0 K
D1              1.00000000 sec

============ CHANNEL f1 ============
NUC1                   1H
P1                 17.40 usec
PL1                 0.00 dB
SFO1         500.1320005 MHz
SI                  65536
SF           500.1300140 MHz
WDW                    EM
SSB                     0
LB                   0.30 Hz
GB                      0
PC                   1.00
```

JC869

C13CPD CDCl3 v2 jdw 45



BRUKER

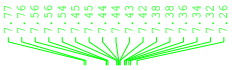
```
NAME                 JC869
EXPNO                   31
PROCNO                   1
Date_             20130920
Time_                 6.24
INSTRUM             drx500
PROBHD       5 mm Multinu
PULPROG           zgpg30
TD                  65536
SOLVENT             CDCl3
NS                    512
DS                      4
SWH              31446.541 Hz
FIDRES            0.479836 Hz
AQ                1.0420883 sec
RG                   4096
DW                15.900 usec
DE                 6.00 usec
TE                 300.0 K
D1              2.00000000 sec
d11             0.03000000 sec
d12             0.00002000 sec

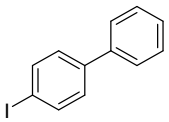
============ CHANNEL f1 ============
NUC1                  13C
P1                 6.40 usec
PL1                0.00 dB
SFO1         125.7715719 MHz

============ CHANNEL f2 ============
CPDPRG2          waltz16
NUC2                   1H
PCPD2             95.00 usec
PL2                0.00 dB
PL12              19.00 dB
PL13              19.00 dB
SFO2         500.1320005 MHz
SI                  32768
SF           125.7577814 MHz
WDW                    EM
SSB                     0
LB                  1.00 Hz
GB                      0
PC                   1.40
```

4-Iodobiphenyl 2h

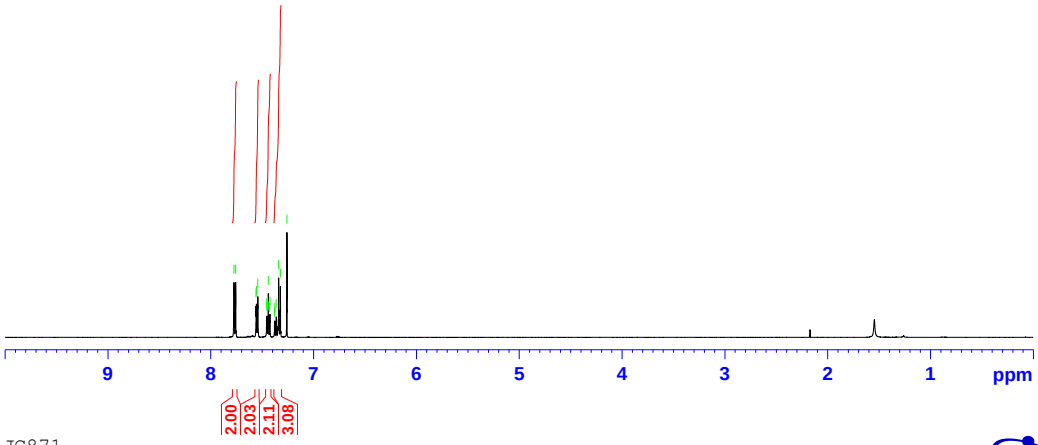
JC871
PROTON.ucl CDCl3 v2 jdw 36



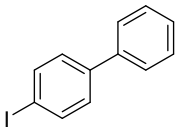


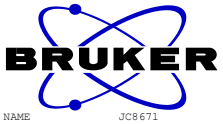

```
NAME                JC8671
EXPNO                   10
PROCNO                   1
Date_             20130920
Time_                 3.45
INSTRUM             drx500
PROBHD     5 mm Multinu
PULPROG             zg30
TD                 65536
SOLVENT            CDCl3
NS                    16
DS                     0
SWH           10330.578 Hz
FIDRES        0.157632 Hz
AQ            3.1720407 sec
RG                 724.1
DW                48.400 usec
DE                 6.00 usec
TE                300.0 K
D1            1.00000000 sec

============ CHANNEL f1 ============
NUC1                  1H
P1                 17.40 usec
PL1                0.00 dB
SFO1         500.1320005 MHz
SI                 65536
SF           500.1300140 MHz
WDW                   EM
SSB                    0
LB                  0.30 Hz
GB                     0
PC                  1.00
```



JC871
C13CPD CDCl3 v2 jdw 36

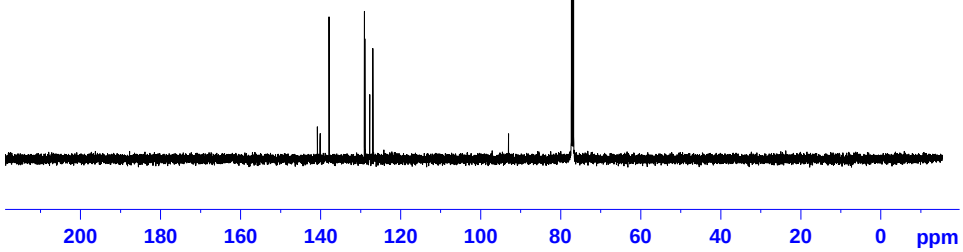




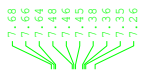

```
NAME                JC8671
EXPNO                   11
PROCNO                   1
Date_             20130920
Time_                 4.12
INSTRUM             drx500
PROBHD     5 mm Multinu
PULPROG            zgpg30
TD                 65536
SOLVENT            CDCl3
NS                   512
DS                     4
SWH           31446.541 Hz
FIDRES        0.479836 Hz
AQ            1.0420883 sec
RG                9195.2
DW                15.900 usec
DE                 6.00 usec
TE                300.0 K
D1            2.00000000 sec
d11           0.03000000 sec
d12           0.00002000 sec

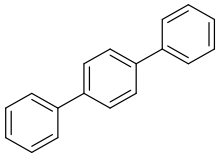
============ CHANNEL f1 ============
NUC1                 13C
P1                 6.40 usec
PL1                0.00 dB
SFO1        125.7715719 MHz

============ CHANNEL f2 ============
CPDPRG2          waltz16
NUC2                  1H
PCPD2              95.00 usec
PL2                0.00 dB
PL12              19.00 dB
PL13              19.00 dB
SFO2        500.1320005 MHz
SI                 32768
SF          125.7577814 MHz
WDW                   EM
SSB                    0
LB                  1.00 Hz
GB                     0
PC                  1.40
```



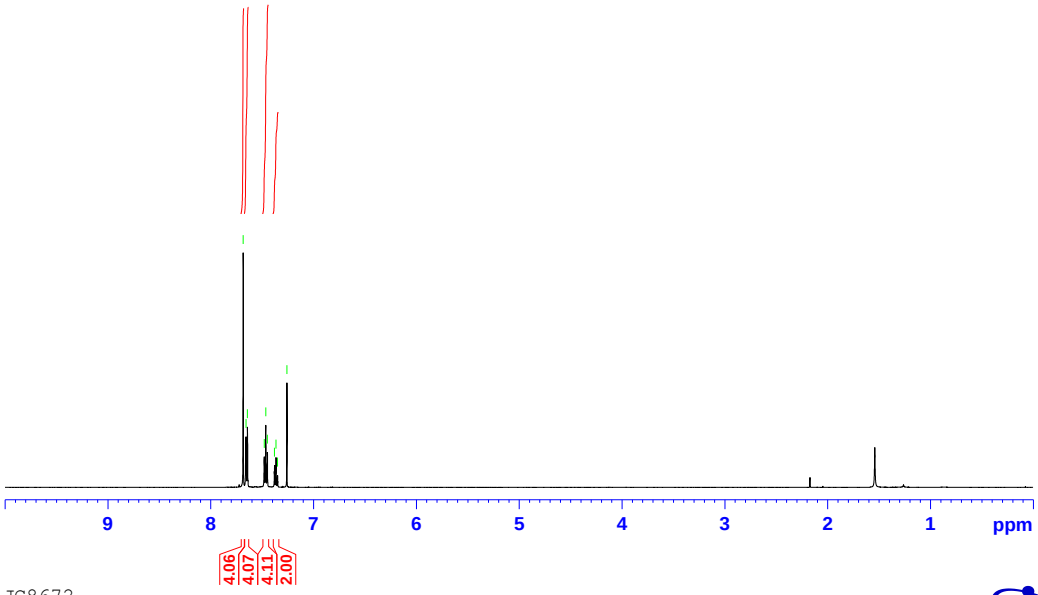
_p_-Terphenyl 2g
JC8672
PROTON.ucl CDCl3 v2 jdw 39



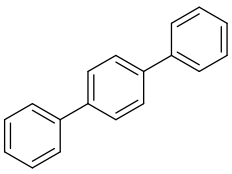


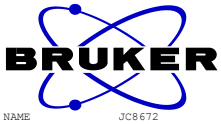

```
NAME                 JC8672
EXPNO                    20
PROCNO                    1
Date_              20130920
Time_                  5.23
INSTRUM              drx500
PROBHD     5 mm Multinu
PULPROG              zg30
TD                  65536
SOLVENT             CDCl3
NS                     16
DS                      0
SWH             10330.578 Hz
FIDRES          0.157632 Hz
AQ              3.1720407 sec
RG                  724.1
DW                 48.400 usec
DE                  6.00 usec
TE                 300.0 K
D1              1.00000000 sec

========== CHANNEL f1 ==========
NUC1                   1H
P1                 17.40 usec
PL1                 0.00 dB
SFO1        500.1320005 MHz
SI                  65536
SF          500.1300140 MHz
WDW                    EM
SSB                     0
LB                 0.30 Hz
GB                      0
PC                   1.00
```



JC8672
C13CPD CDCl3 v2 jdw 39

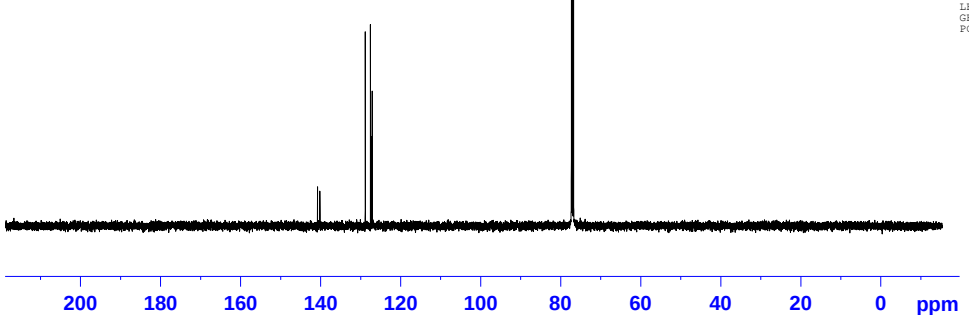





```
NAME                 JC8672
EXPNO                    21
PROCNO                    1
Date_              20130920
Time_                  5.50
INSTRUM              drx500
PROBHD     5 mm Multinu
PULPROG           zgpg30
TD                  65536
SOLVENT             CDCl3
NS                     512
DS                       4
SWH            31446.541 Hz
FIDRES          0.479836 Hz
AQ              1.0420883 sec
RG                   8192
DW                 15.900 usec
DE                  6.00 usec
TE                 300.0 K
D1              2.00000000 sec
d11             0.03000000 sec
d12             0.00002000 sec

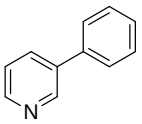
========== CHANNEL f1 ==========
NUC1                  13C
P1                  6.40 usec
PL1                 0.00 dB
SFO1        125.7715719 MHz

========== CHANNEL f2 ==========
CPDPRG2          waltz16
NUC2                   1H
PCPD2              95.00 usec
PL2                 0.00 dB
PL12               19.00 dB
PL13               19.00 dB
SFO2        500.1320005 MHz
SI                  32768
SF          125.7577814 MHz
WDW                    EM
SSB                     0
LB                 1.00 Hz
GB                      0
PC                   1.40
```



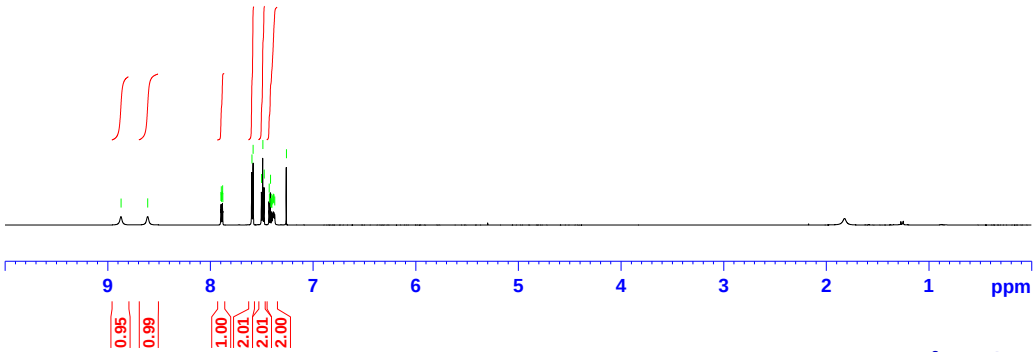
3-Phenylpyridine 2i

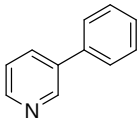
JC903wo
PROTON.ucl CDCl3 /v/Bruker/TOPSPIN jdw 11




```
NAME            Oct09-2013
EXPNO                   20
PROCNO                   1
Date_             20131009
Time                 10.32
INSTRUM              AV600
PROBHD   5 mm CPDCH 13C
PULPROG              zg30
TD                  98682
SOLVENT             CDCl3
NS                      8
DS                      0
SWH             12335.526 Hz
FIDRES          0.125003 Hz
AQ              3.9999604 sec
RG                   40.3
DW                40.533 usec
DE                10.48 usec
TE                298.0 K
D1             1.00000000 sec
TD0                     1

======== CHANNEL f1 ========
NUC1                    1H
P1                 11.40 usec
PL1                 1.00 dB
PL1W          13.76731014 W
SFO1         600.1337061 MHz
SI                   32768
SF            600.1300116 MHz
WDW                    EM
SSB                     0
LB                 0.30 Hz
GB                      0
PC                 1.40
```






```
NAME            Oct09-2013
EXPNO                   21
PROCNO                   1
Date_             20131009
Time                 10.45
INSTRUM              AV600
PROBHD   5 mm CPDCH 13C
PULPROG          zgpg30
TD                  78942
SOLVENT             CDCl3
NS                    128
DS                      0
SWH             43859.648 Hz
FIDRES          0.555593 Hz
AQ              0.8999888 sec
RG                   1030
DW               11.400 usec
DE                20.22 usec
TE                298.0 K
D1             2.00000000 sec
D11            0.03000000 sec
TD0                     1

======== CHANNEL f1 ========
NUC1                   13C
P1                  9.80 usec
PL1                 5.00 dB
PL1W          26.76886177 W
SFO1         150.9201628 MHz

======== CHANNEL f2 ========
CPDPRG2            waltz16
NUC2                    1H
PCPD2              70.00 usec
PL2                 1.00 dB
PL12               17.23 dB
PL13               20.00 dB
PL2W          13.76731014 W
PL12W          0.32798135 W
PL13W          0.17332016 W
SFO2         600.1324005 MHz
SI                   65536
SF           150.9027930 MHz
WDW                    EM
SSB                     0
LB                 1.00 Hz
GB                      0
PC                 1.40
```