

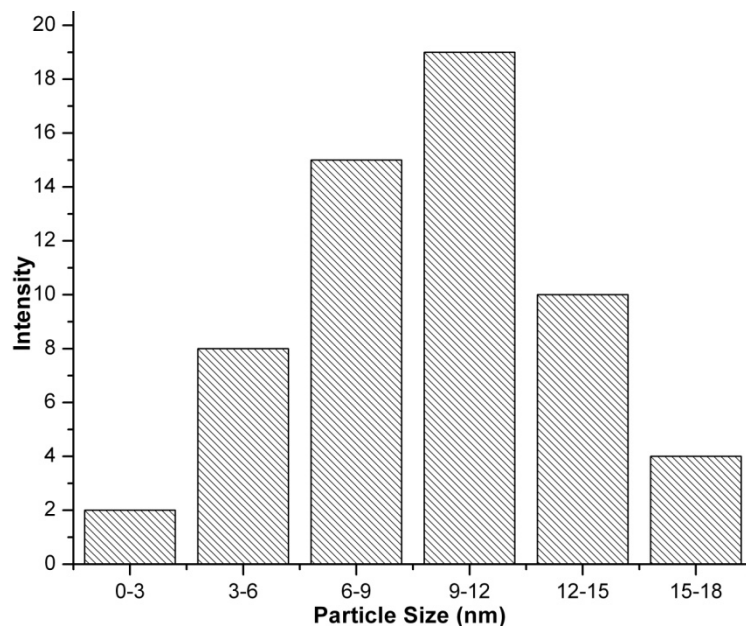
## Electronic Supplementary Information

### **Nanoparticles of magnetite coated with ruthenium via SePh layer as magnetically retrievable catalyst for selective synthesis of primary amides in aqueous medium**

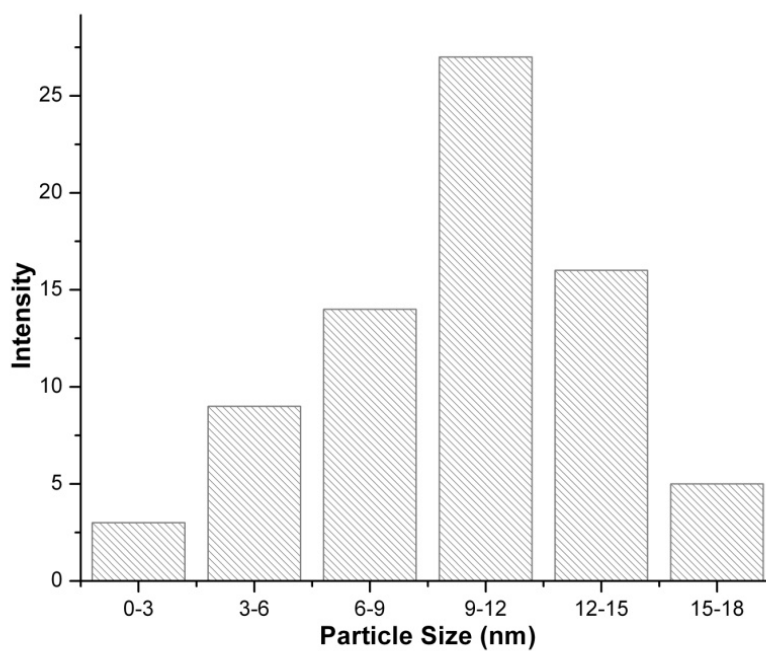
Hemant Joshi,<sup>a</sup> Kamal Nayan Sharma,<sup>a</sup> Alpesh K. Sharma,<sup>a</sup> Om Prakash,<sup>a</sup> Arvind Kumar<sup>b</sup> and Ajai Kumar Singh\*<sup>a</sup>

<sup>a</sup>Department of Chemistry, Indian Institute of Technology Delhi, New Delhi 110016, India

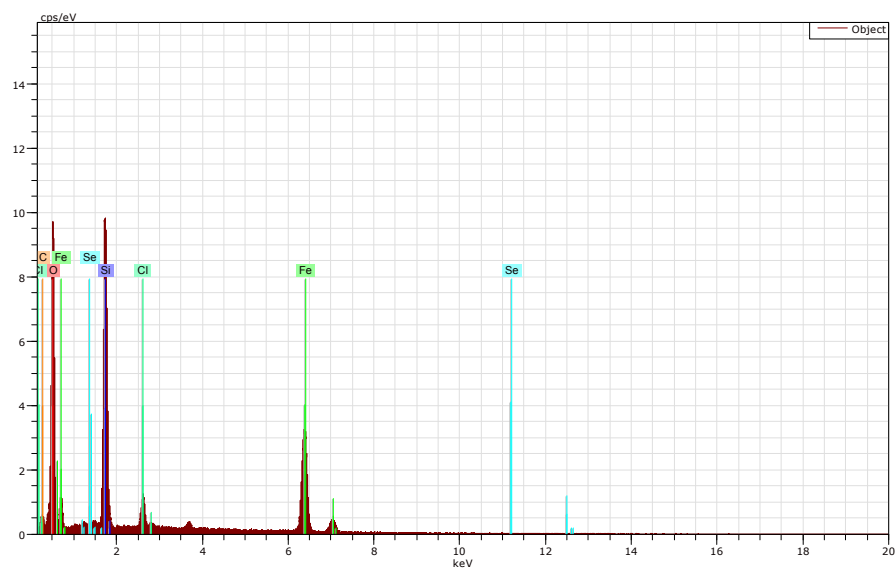
<sup>b</sup>Analytical Sciences Division, Indian Institute of Petroleum, Dehradun 248005, India.



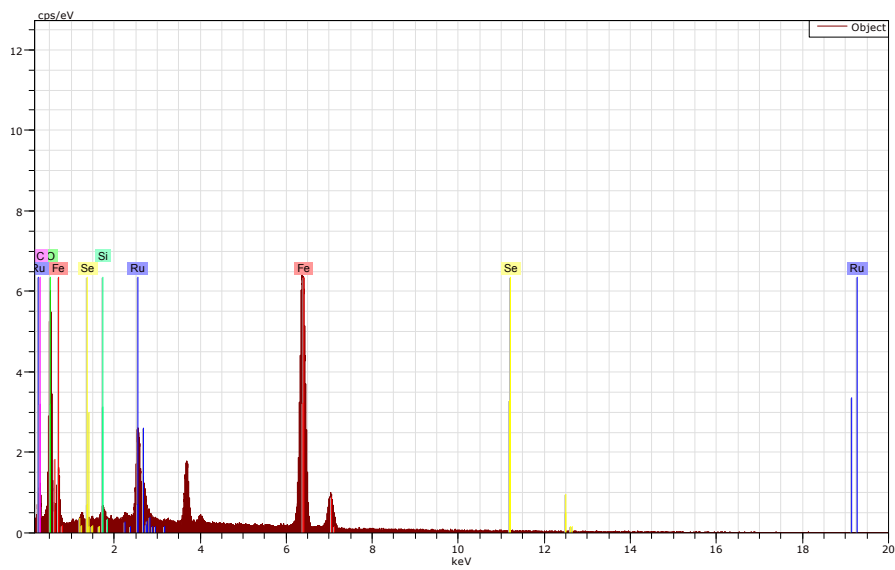
**Figure S1.** Size distribution curve of Fe<sub>3</sub>O<sub>4</sub> NPs.



**Figure S2.** Size distribution curve of Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>@SePh@Ru(OH)<sub>x</sub> NPs.

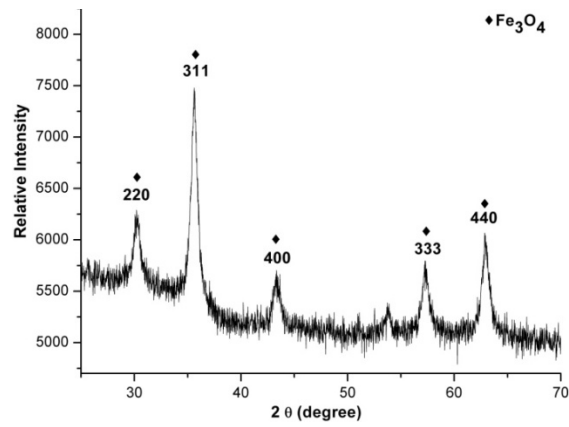


**Figure S3.** TEM-EDX of Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>@SePh NPs.

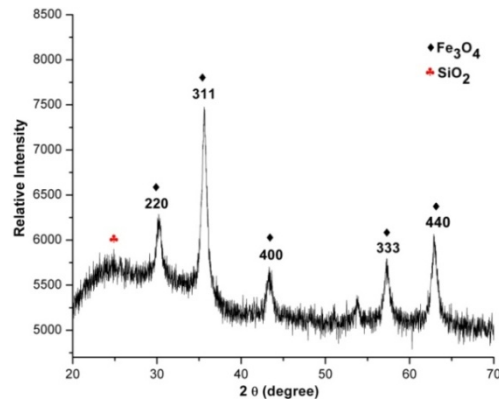


**Figure S4.** TEM-EDX of Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>@SePh@Ru(OH)<sub>x</sub> NPs.

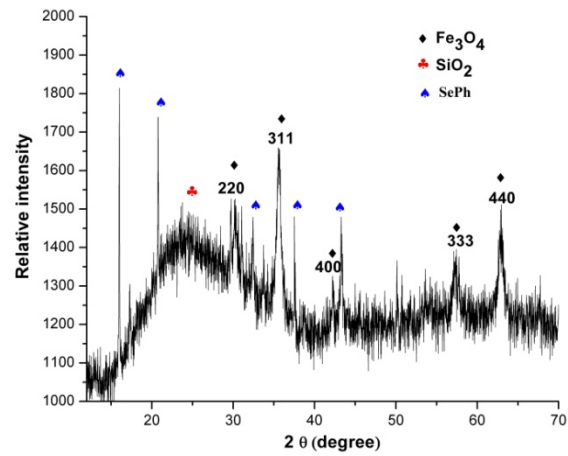
(a)



(b)

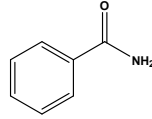


(c)



**Figure S5.** PXRD of (a)  $\text{Fe}_3\text{O}_4$ , (b)  $\text{Fe}_3\text{O}_4@SiO_2$ , (c)  $\text{Fe}_3\text{O}_4@SiO_2@SePh$ , NPs.

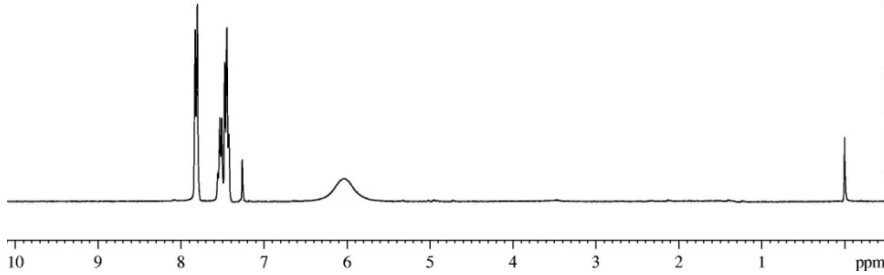
# NMR Spectra of all products



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PROCNO   1

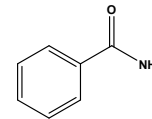
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INSTRUM  av300
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PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       16
DS       2
SWH      6172.839 Hz
FIDRES   0.094190 Hz
AQ       5.3084660 sec
RG       362
DW       81.000 usec
DE       6.00 usec
TE       300.0 K
D1       1.0000000 sec
TD0      1
    
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```

----- CHANNEL f1 -----
NUC1    1H
P1      10.25 usec
PL1     -2.00 dB
SFO1    300.1318534 MHz

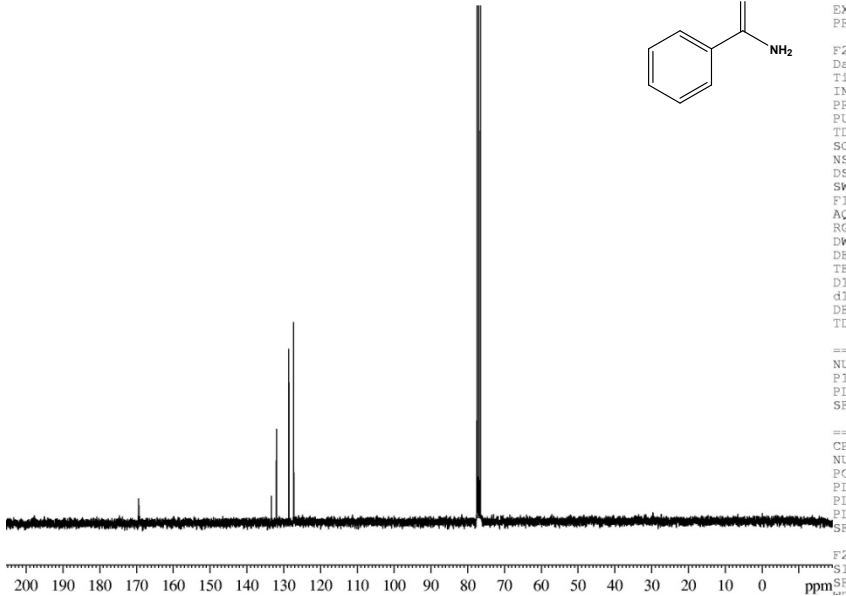
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SF      300.1300053 MHz
WDW     EM
SSB     0
LB      0.30 Hz
GB      0
PC      1.00
    
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Current Data Parameters
NAME      June-23-2013
EXPNO    5
PROCNO   1

F2 - Acquisition Parameters
Date_    20130623
Time     16.35
INSTRUM  av300
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       536
DS       4
SWH      17985.611 Hz
FIDRES   0.274439 Hz
AQ       1.8219508 sec
RG       32768
DW       27.800 usec
DE       6.00 usec
TE       300.0 K
D1       2.0000000 sec
d11      0.0300000 sec
DELTA    1.89999998 sec
TD0      1
    
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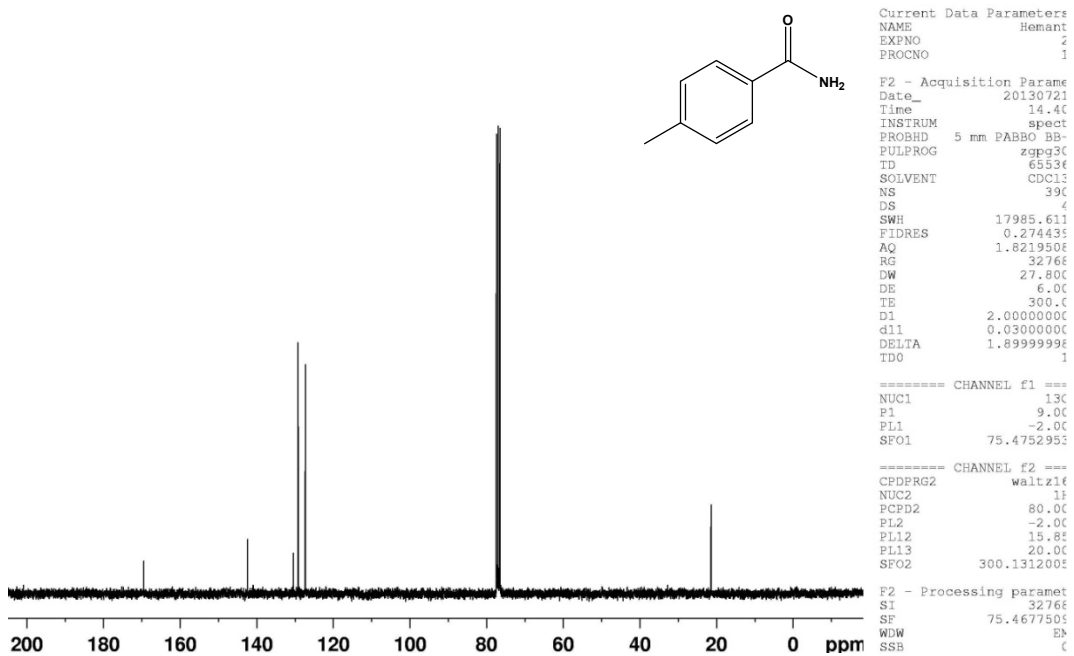
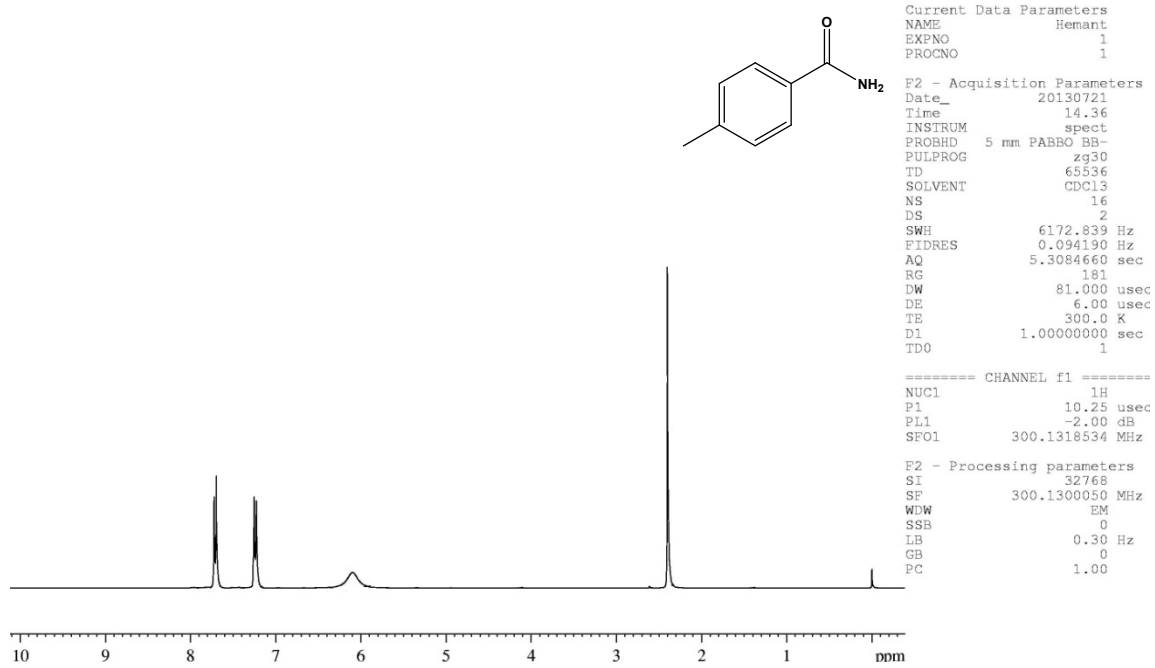


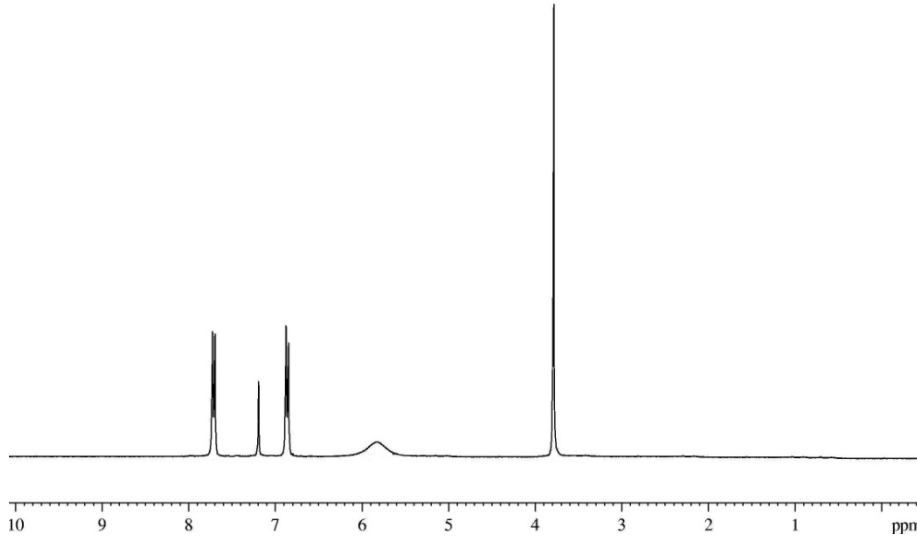
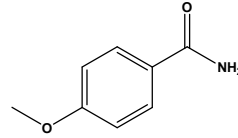
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----- CHANNEL f1 -----
NUC1    13C
P1      9.00 usec
PL1     -2.00 dB
SFO1    75.4752953 MHz

----- CHANNEL f2 -----
CPDPRG2  waltz16
NUC2     1H
PCPD2    80.00 usec
PL2     -2.00 dB
PL12    15.85 dB
PL13    19.00 dB
SFO2    300.1312005 MHz

F2 - Processing parameters
SI      32768
SF      75.4677490 MHz
    
```





```

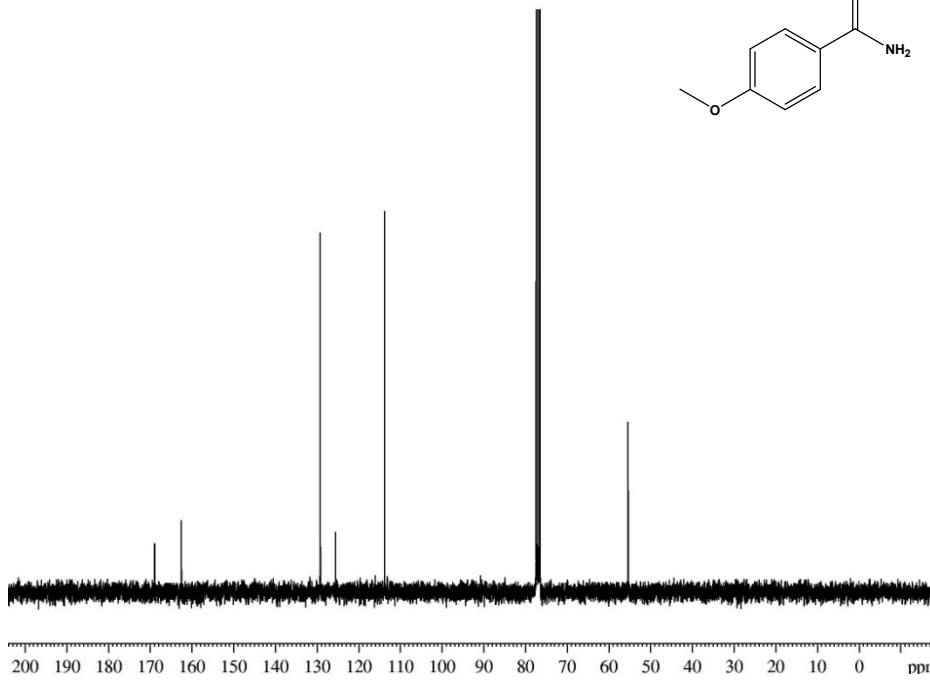
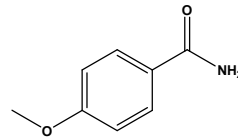
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EXPNO    16
PROCNO   1

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Time     23.16
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       16
DS       2
SWH      6172.839 Hz
FIDRES   0.094190 Hz
AQ       5.3084660 sec
RG       228.1
DW       81.000 usec
DE       6.00 usec
TE       300.0 K
D1       1.00000000 sec
TDO      1

----- CHANNEL f1 -----
NUC1     1H
P1       10.25 usec
PL1      -2.00 dB
SFO1     300.1318534 MHz

F2 - Processing parameters
SI       32768
SF       300.1300261 MHz
WDW      EM
SSB      0
LB       0.30 Hz
GB       0
PC       1.00

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Current Data Parameters
NAME      Hemant
EXPNO    19
PROCNO   1

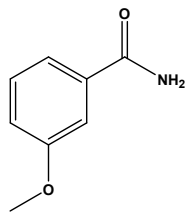
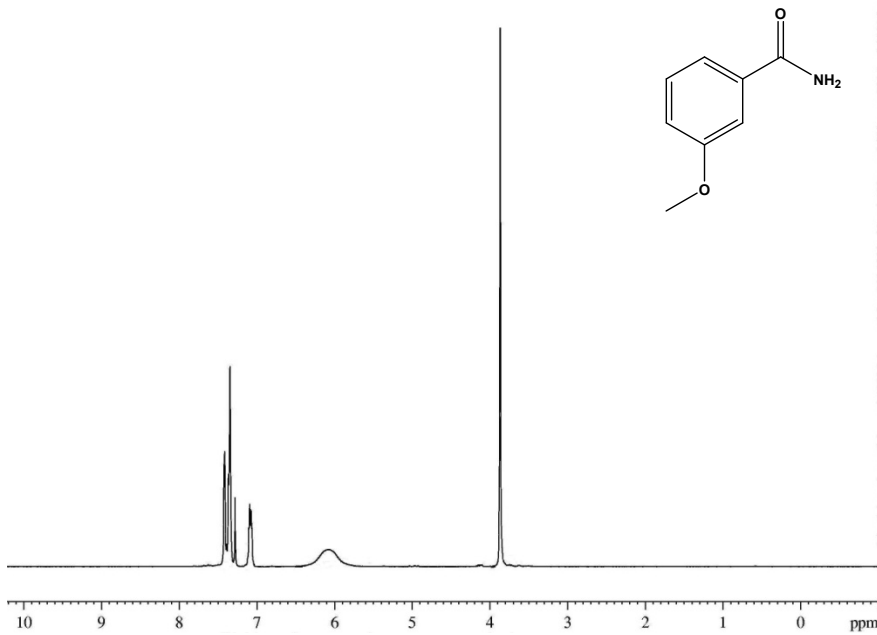
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Time     20.35
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       543
DS       4
SWH      17985.611 Hz
FIDRES   0.274439 Hz
AQ       1.8219508 sec
RG       2580.3
DW       27.800 usec
DE       6.00 usec
TE       300.0 K
D1       2.00000000 sec
d11      0.03000000 sec
DELTA    1.89999998 sec
TDO      1

===== CHANNEL f1 =====
NUC1     13C
P1       9.00 usec
PL1      -2.00 dB
SFO1     75.4752953 MHz

===== CHANNEL f2 =====
CPDPRG2  waltz16
NUC2     1H
PCPD2    80.00 usec
PL2      -2.00 dB
PL12     15.85 dB
PL13     20.00 dB
SFO2     300.1312005 MHz

F2 - Processing parameters
SI       32768
SF       75.4677500 MHz

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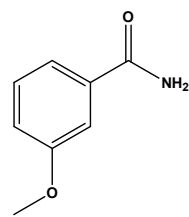
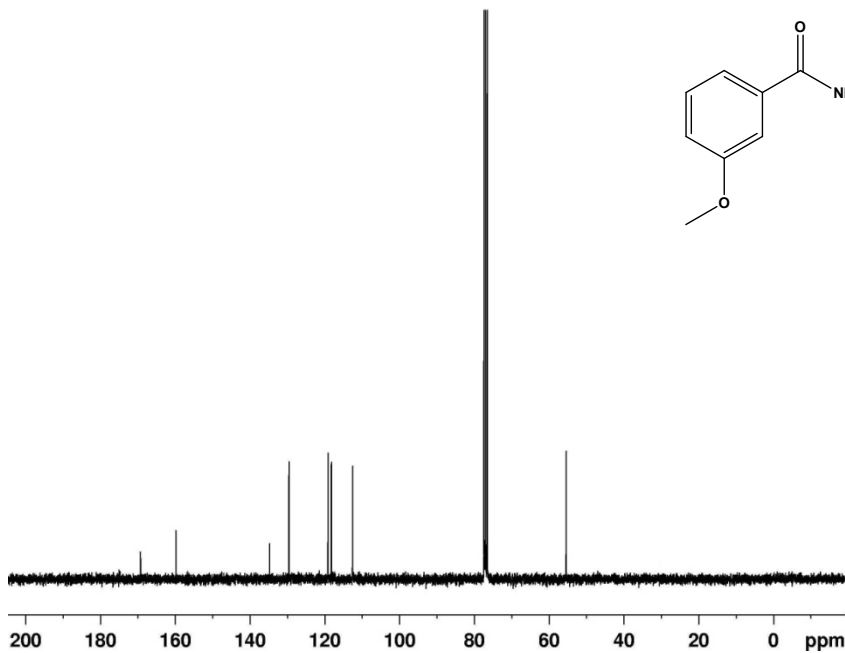
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EXPNO    25
PROCNO   1

F2 - Acquisition Parameters
Date_    20130915
Time     15.51
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       16
DS       2
SWH      6172.839 Hz
FIDRES   0.094190 Hz
AQ       5.3084660 sec
RG       287.4
DW       81.000 usec
DE       6.00 usec
TE       300.0 K
D1       1.0000000 sec
TDO      1

===== CHANNEL f1 =====
NUC1     1H
P1       10.25 usec
PL1      -2.00 dB
SFO1     300.1318534 MHz

F2 - Processing parameters
SI       32768
SF       300.1300000 MHz
WDW      EM
SSB      0
LB       0.30 Hz
GB       0
PC       1.00
  
```



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Current Data Parameters
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EXPNO    26
PROCNO   1

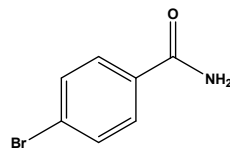
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Time     16.01
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       610
DS       4
SWH      17985.611
FIDRES   0.274435
AQ       1.8219506
RG       32768
DW       27.800
DE       6.00
TE       300.0
D1       2.0000000
d11      0.0300000
DELTA    1.8999999
TDO      1

===== CHANNEL f1 =====
NUC1     13C
P1       9.00
PL1      -2.00
SFO1     75.4752953

===== CHANNEL f2 =====
CPDPRG2  waltz16
NUC2     1H
PCPD2    80.00
PL2      -2.00
PL12     15.88
PL13     20.00
SFO2     300.1312005

F2 - Processing parameters
SI       32768
SF       75.4677501
WDW      EM
SSB      0
  
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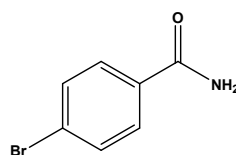
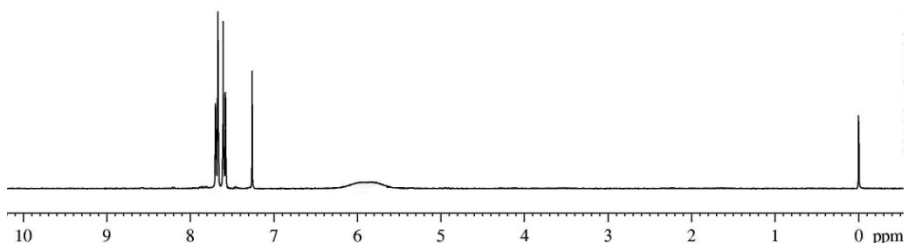


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 NAME Hemant  
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 Date\_ 20130721  
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 INSTRUM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 16  
 DS 2  
 SWH 6172.839 Hz  
 FIDRES 0.094190 Hz  
 AQ 5.3084660 sec  
 RG 362  
 DW 81.000 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 1.0000000 sec  
 TD0 1

===== CHANNEL f1 =====  
 NUC1 1H  
 P1 10.25 usec  
 PL1 -2.00 dB  
 SFO1 300.1318534 MHz

F2 - Processing parameters  
 SI 32768  
 SF 300.1300058 MHz  
 WDW EM  
 SSB 0  
 LB 0.30 Hz  
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 PC 1.00



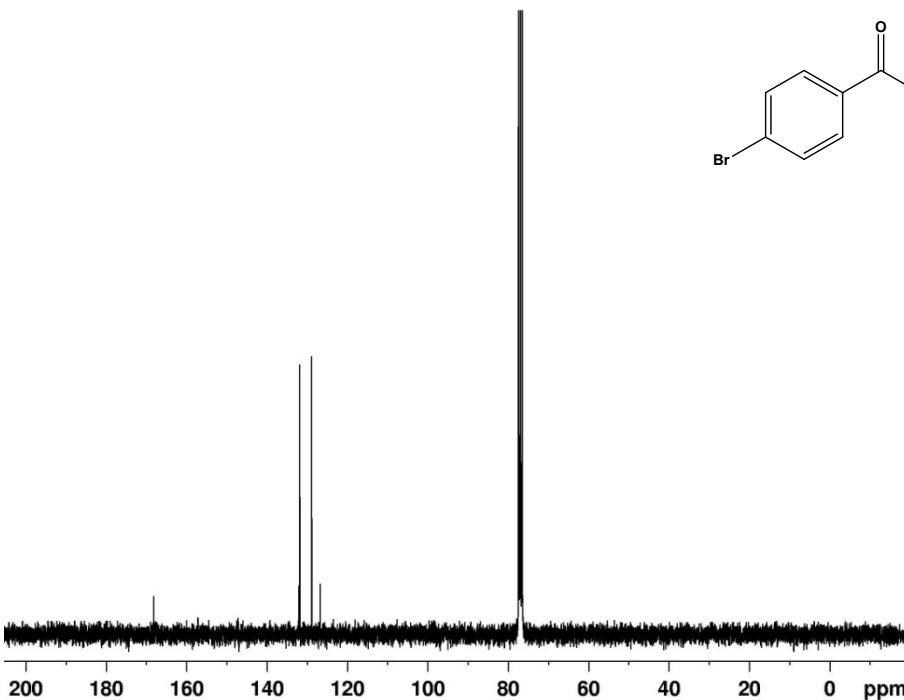
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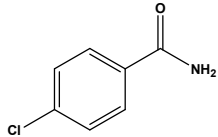
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 Time 15.30  
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 PROBHD 5 mm PABBO BB-  
 PULPROG zgpg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 2100  
 DS 4  
 SWH 17985.611  
 FIDRES 0.274435  
 AQ 1.8219508  
 RG 32768  
 DW 27.800  
 DE 6.00  
 TE 300.0  
 D1 2.0000000  
 d11 0.0300000  
 DELTA 1.8999999  
 TD0 1

===== CHANNEL f1 ====  
 NUC1 13C  
 P1 9.00  
 PL1 -2.00  
 SFO1 75.4752953

===== CHANNEL f2 ====  
 CPDPRG2 waltz16  
 NUC2 1H  
 PCPD2 80.00  
 PL2 -2.00  
 PL12 15.85  
 PL13 20.00  
 SFO2 300.1312005

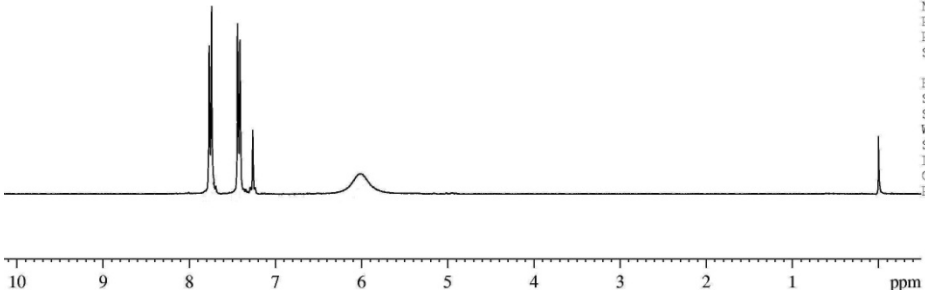
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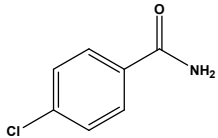
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 NAME July-14-2013  
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 PULPROG zg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 16  
 DS 2  
 SWH 6172.839 Hz  
 FIDRES 0.094190 Hz  
 AQ 5.3084660 sec  
 RG 362  
 DW 81.000 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 1.0000000 sec  
 TD0 1



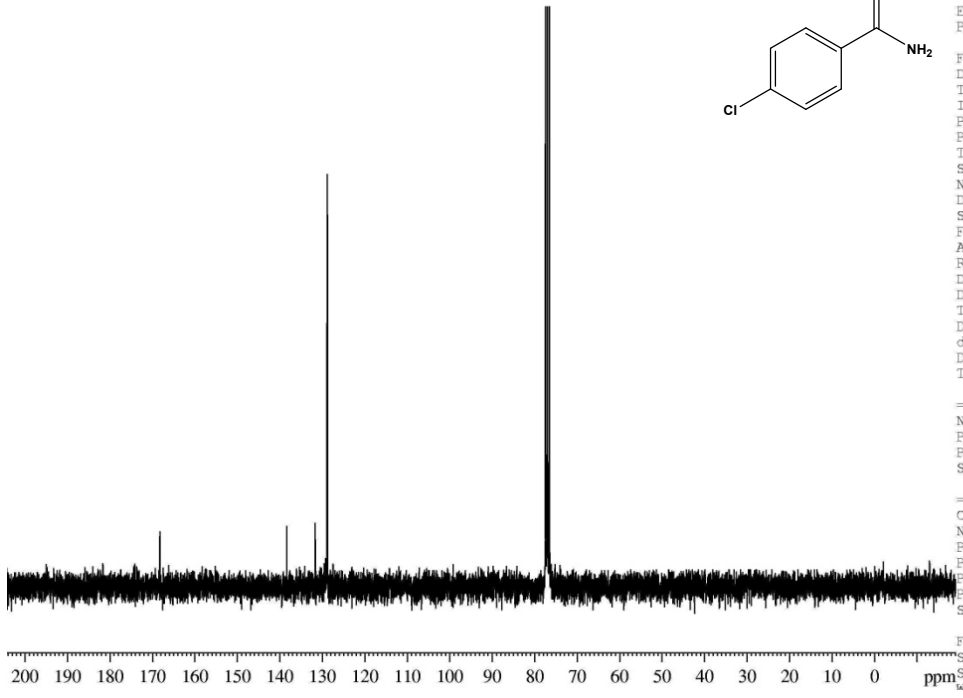
===== CHANNEL f1 =====  
 NUC1 1H  
 P1 10.25 usec  
 PL1 -2.00 dB  
 SF01 300.1318534 MHz

F2 - Processing parameters  
 SI 32768  
 SF 300.1300053 MHz  
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 LB 0.30 Hz  
 GB 0  
 PC 1.00



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 EXPNO 6  
 PROCNO 1

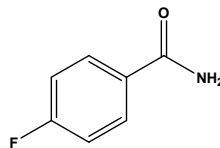
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 Date\_ 20130714  
 Time 17.55  
 INSTRUM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zgpg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 542  
 DS 4  
 SWH 17985.611 Hz  
 FIDRES 0.274439 Hz  
 AQ 1.8219508 sec  
 RG 32768  
 DW 27.800 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 2.0000000 sec  
 d11 0.0300000 sec  
 DELTA 1.89999998 sec  
 TD0 1



===== CHANNEL f1 =====  
 NUC1 13C  
 P1 9.00 usec  
 PL1 -2.00 dB  
 SF01 75.4752953 MHz

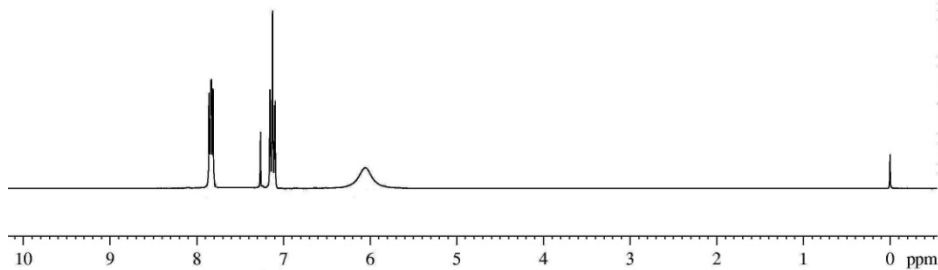
===== CHANNEL f2 =====  
 CPDPRG2 waltz16  
 NUC2 1H  
 PCPD2 80.00 usec  
 PL2 -2.00 dB  
 PL12 15.85 dB  
 PL13 20.00 dB  
 SF02 300.1312005 MHz

F2 - Processing parameters  
 SI 32768  
 SF 75.4677490 MHz  
 WDW EM



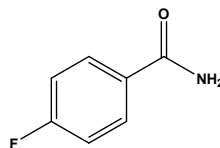
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 PROBHD 5 mm PABBO BB-  
 PULPROG zg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 16  
 DS 2  
 SWH 6172.839 Hz  
 FIDRES 0.094190 Hz  
 AQ 5.3084660 sec  
 RG 322.5  
 DW 81.000 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 1.00000000 sec  
 TDO 1



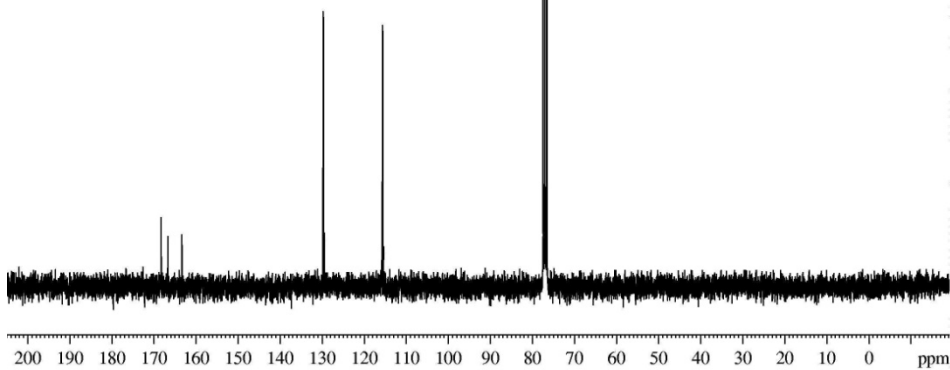
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 NUC1 1H  
 P1 10.25 usec  
 PL1 -2.00 dB  
 SFO1 300.1318534 MHz

F2 - Processing parameters  
 SI 32768  
 SF 300.1300040 MHz  
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 SSB 0  
 LB 0.30 Hz  
 GB 0  
 PC 1.00



Current Data Parameters  
 NAME Hemant  
 EXPNO 20  
 PROCNO 1

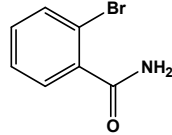
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 Time 21.50  
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 PROBHD 5 mm PABBO BB-  
 PULPROG zgpg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 978  
 DS 4  
 SWH 17985.611 Hz  
 FIDRES 0.274439 Hz  
 AQ 1.8219508 sec  
 RG 32768  
 DW 27.800 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 2.00000000 sec  
 d11 0.03000000 sec  
 DELTA 1.89999998 sec  
 TDO 1



===== CHANNEL f1 =====  
 NUC1 13C  
 P1 9.00 usec  
 PL1 -2.00 dB  
 SFO1 75.4752953 MHz

===== CHANNEL f2 =====  
 CPDPRG2 waltz16  
 NUC2 1H  
 PCPD2 80.00 usec  
 PL2 -2.00 dB  
 PL12 15.85 dB  
 PL13 20.00 dB  
 SFO2 300.1312005 MHz

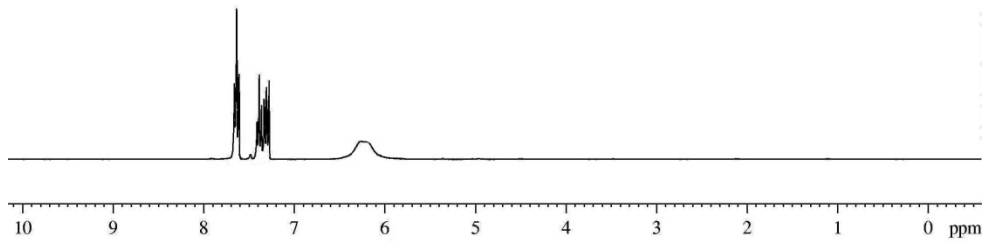
F2 - Processing parameters  
 SI 32768  
 SF 75.4677498 MHz  
 WDW EM



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Current Data Parameters
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EXPNO    21
PROCNO   1

F2 - Acquisition Parameters
Date_    20130913
Time     0.32
INSTRUM spect
PROBHD   5 mm PABBO BB-
PULPROG zg30
TD       65536
SOLVENT  CDCl3
NS       16
DS       2
SWH      6172.839 Hz
FIDRES   0.094190 Hz
AQ       5.3084660 sec
RG       203.2
DW       81.000 usec
DE       6.00 usec
TE       300.0 K
D1       1.00000000 sec
TD0      1
  
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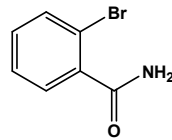


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===== CHANNEL f1 =====
NUC1    1H
P1      10.25 usec
PL1     -2.00 dB
SFO1    300.1318534 MHz
  
```

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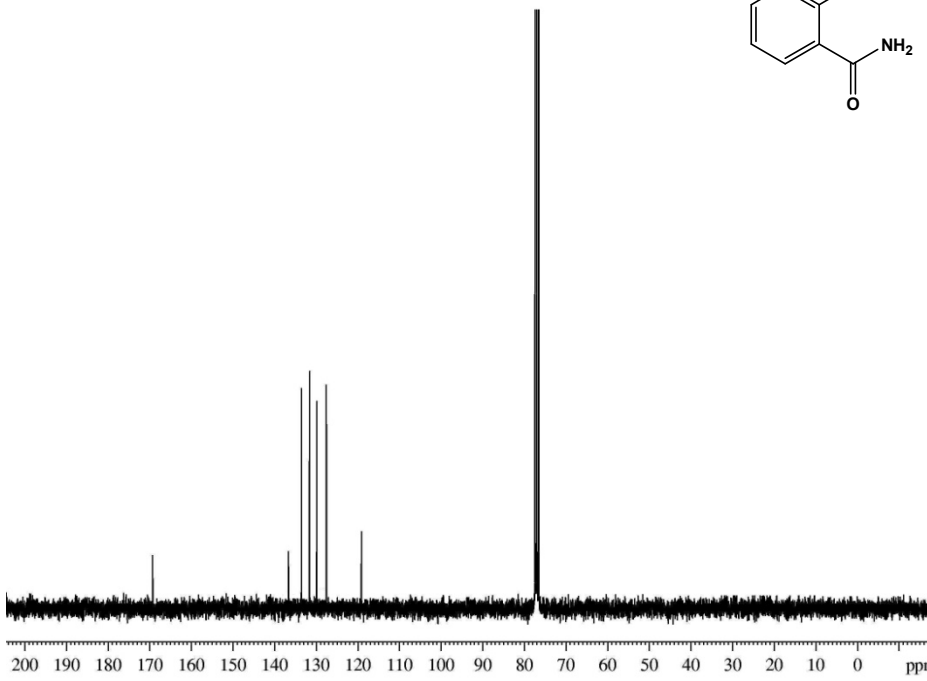
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SI      32768
SF      300.1300000 MHz
WDW     EM
SSB     0
LB      0.30 Hz
GB      0
PC      1.00
  
```



```

Current Data Parameters
NAME      Hemant
EXPNO    22
PROCNO   1

F2 - Acquisition Parameters
Date_    20130913
Time     0.40
INSTRUM spect
PROBHD   5 mm PABBO BB-
PULPROG zgpg30
TD       65536
SOLVENT  CDCl3
NS       500
DS       4
SWH      17985.611 Hz
FIDRES   0.274439 Hz
AQ       1.8219508 sec
RG       32768
DW       27.800 usec
DE       6.00 usec
TE       300.0 K
D1       2.00000000 sec
d11      0.03000000 sec
DELTA    1.89999998 sec
TD0      1
  
```



```

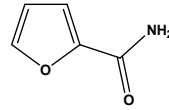
===== CHANNEL f1 =====
NUC1    13C
P1      9.00 usec
PL1     -2.00 dB
SFO1    75.4752953 MHz
  
```

```

===== CHANNEL f2 =====
CPDPRG2 waltz16
NUC2    1H
PCPD2   80.00 usec
PL2     -2.00 dB
PL12    15.85 dB
PL13    20.00 dB
SFO2    300.1312005 MHz
  
```

```

F2 - Processing parameters
SI      32768
SF      75.4677500 MHz
WDW     EM
  
```

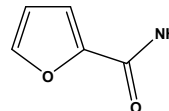
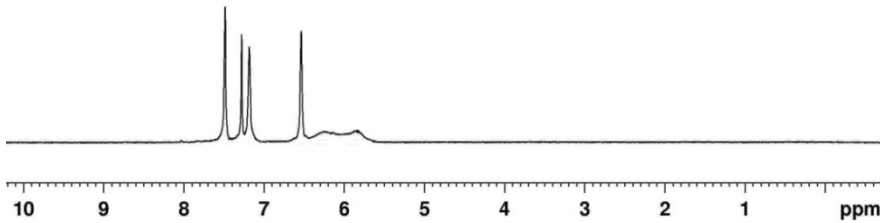


Current Data Parameters  
 NAME Hemant  
 EXPNO 24  
 PROCNO 1

F2 - Acquisition Parame  
 Date\_ 20130913  
 Time\_ 1.22  
 INSTRJM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 1f  
 DS 2  
 SWH 6172.835  
 FIDRES 0.094190  
 AQ 5.3084660  
 RG 228.1  
 DW 81.000  
 DE 6.00  
 TE 300.0  
 D1 1.00000000  
 TD0 1

===== CHANNEL f1 =====  
 NUC1 1f  
 P1 10.25  
 PL1 -2.00  
 SFO1 300.1318534

F2 - Processing paramet  
 SI 32768  
 SF 300.1300000  
 WDW EM  
 SSB C  
 LB 0.30  
 GB C  
 PC 1.00



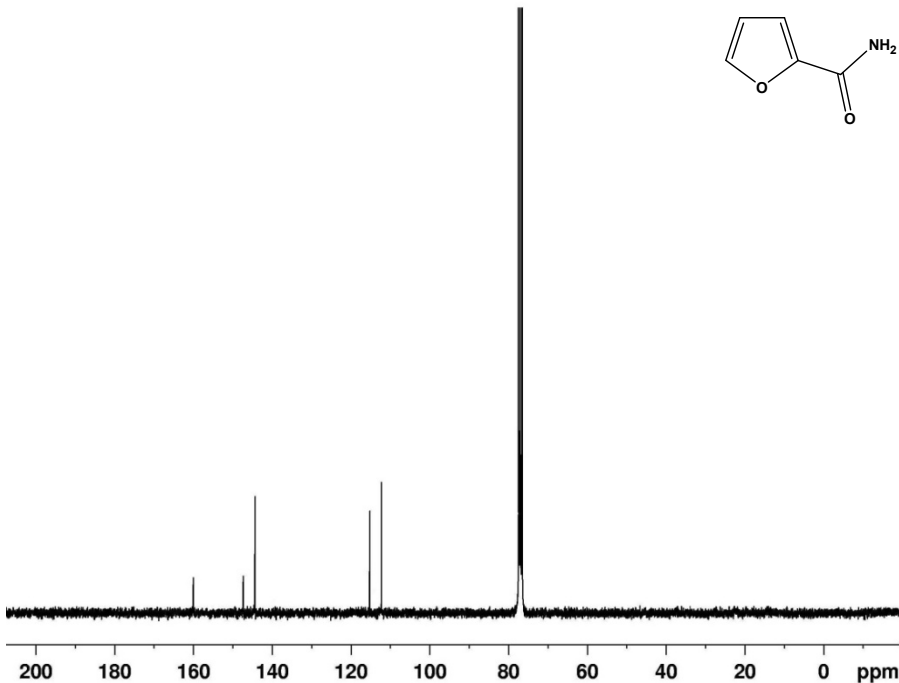
Current Data Parameters  
 NAME Hemant  
 EXPNO 23  
 PROCNO 1

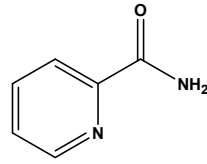
F2 - Acquisition Parame  
 Date\_ 20130913  
 Time\_ 1.28  
 INSTRJM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zgpg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 7505  
 DS 4  
 SWH 17985.611  
 FIDRES 0.274435  
 AQ 1.8219506  
 RG 32768  
 DW 27.800  
 DE 6.00  
 TE 300.0  
 D1 2.00000000  
 d11 0.03000000  
 DELTA 1.89999999  
 TD0 1

===== CHANNEL f1 =====  
 NUC1 13C  
 P1 9.00  
 PL1 -2.00  
 SFO1 75.4752953

===== CHANNEL f2 =====  
 CPDPRG2 waltz16  
 NUC2 1f  
 PCPD2 80.00  
 PL2 -2.00  
 PL12 15.85  
 PL13 20.00  
 SFO2 300.1312005

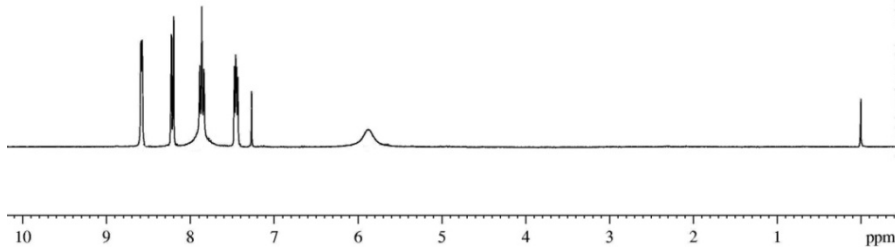
F2 - Processing paramet  
 SI 32768  
 SF 75.4677500  
 WDW EM  
 SSB C  
 PC 1.00





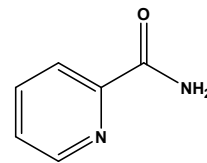
Current Data Parameters  
 NAME July-16-2013  
 EXPNO 45  
 PROCNO 1

F2 - Acquisition Parameters  
 Date\_ 20130716  
 Time 23.32  
 INSTRUM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 16  
 DS 2  
 SWH 6172.839 Hz  
 FIDRES 0.094190 Hz  
 AQ 5.3084660 sec  
 RG 362  
 DW 81.000 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 1.00000000 sec  
 TDO 1



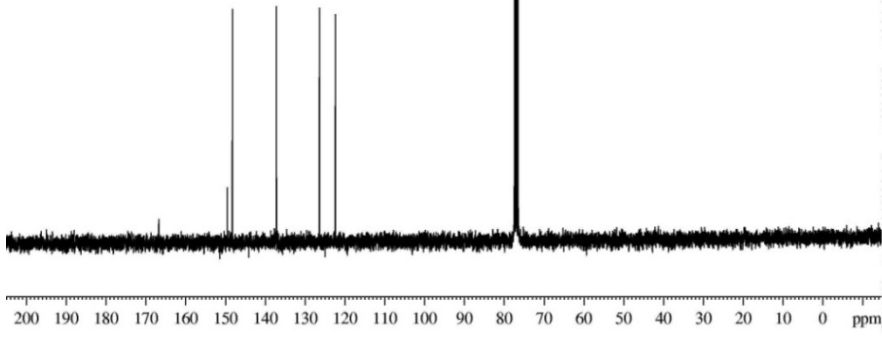
===== CHANNEL f1 =====  
 NUC1 1H  
 P1 10.25 usec  
 PL1 -2.00 dB  
 SFO1 300.1318534 MHz

F2 - Processing parameters  
 SI 32768  
 SF 300.1300028 MHz  
 WDW EM  
 SSB 0  
 LB 0.30 Hz  
 GB 0  
 PC 1.00



Current Data Parameters  
 NAME July-16-2013  
 EXPNO 46  
 PROCNO 1

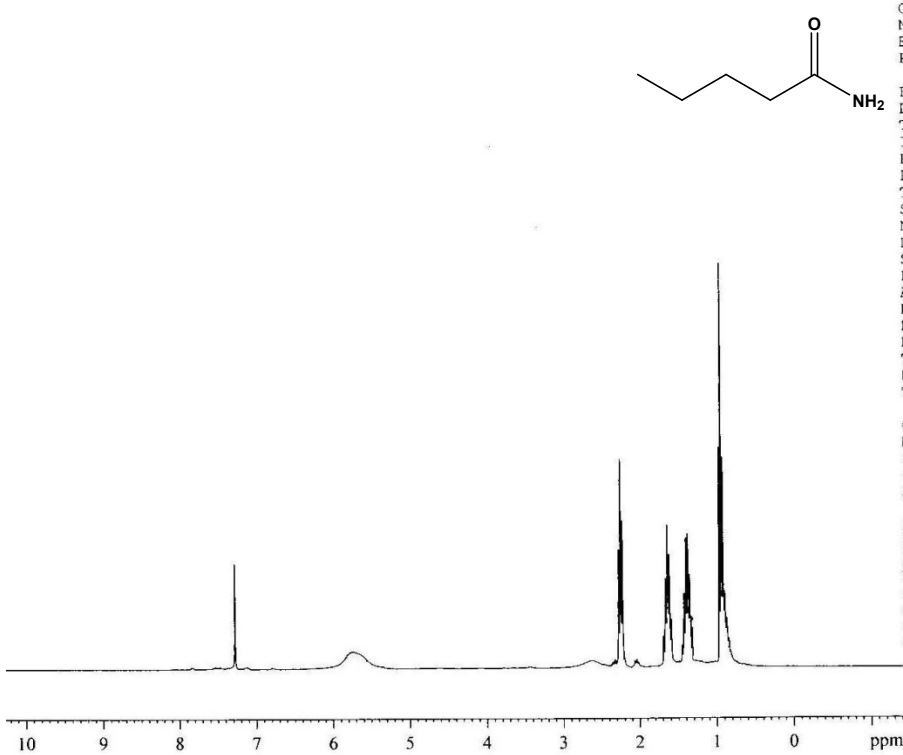
F2 - Acquisition Parameters  
 Date\_ 20130716  
 Time 23.38  
 INSTRUM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zgpg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 622  
 DS 4  
 SWH 17985.611 Hz  
 FIDRES 0.274439 Hz  
 AQ 1.8219508 sec  
 RG 32768  
 DW 27.800 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 2.00000000 sec  
 d11 0.03000000 sec  
 DELTA 1.89999998 sec  
 TDO 1



===== CHANNEL f1 =====  
 NUC1 13C  
 P1 9.00 usec  
 PL1 -2.00 dB  
 SFO1 75.4752953 MHz

===== CHANNEL f2 =====  
 CPDPRG2 waltz16  
 NUC2 1H  
 PCPD2 80.00 usec  
 PL2 -2.00 dB  
 PL12 15.85 dB  
 PL13 20.00 dB  
 SFO2 300.1312005 MHz

F2 - Processing parameters  
 SI 32768  
 SF 75.4677500 MHz  
 WDW EM

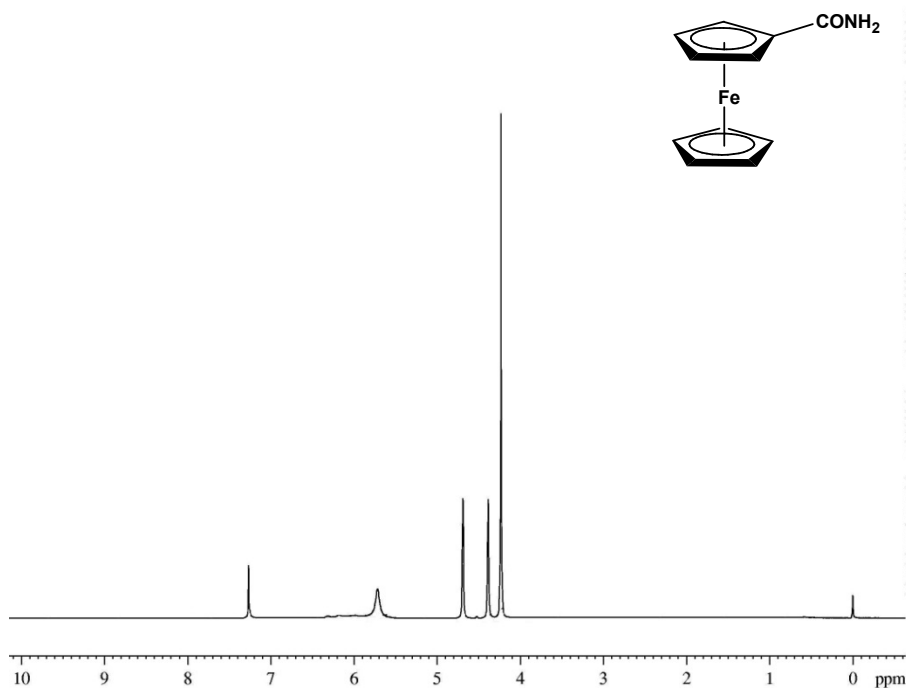


Current Data Parameters  
 NAME Nov 8- 2013  
 EXPNO 44  
 PROCNO 1

F2 - Acquisition Parameters  
 Date\_ 20131108  
 Time 16.13  
 INSTRUM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 12  
 DS 2  
 SWH 6172.839 Hz  
 FIDRES 0.094190 Hz  
 AQ 5.3084660 sec  
 RG 181  
 DW 81.000 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 1.00000000 sec  
 TDO 1

===== CHANNEL f1 =====  
 NUC1 1H  
 P1 10.25 usec  
 PL1 -2.00 dB  
 SF01 300.1318534 MHz

F2 - Processing parameters  
 SI 32768  
 SF 300.1300000 MHz  
 WDW EM  
 SSB 0  
 LB 0.30 Hz  
 GB 0  
 PC 1.00

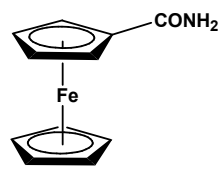
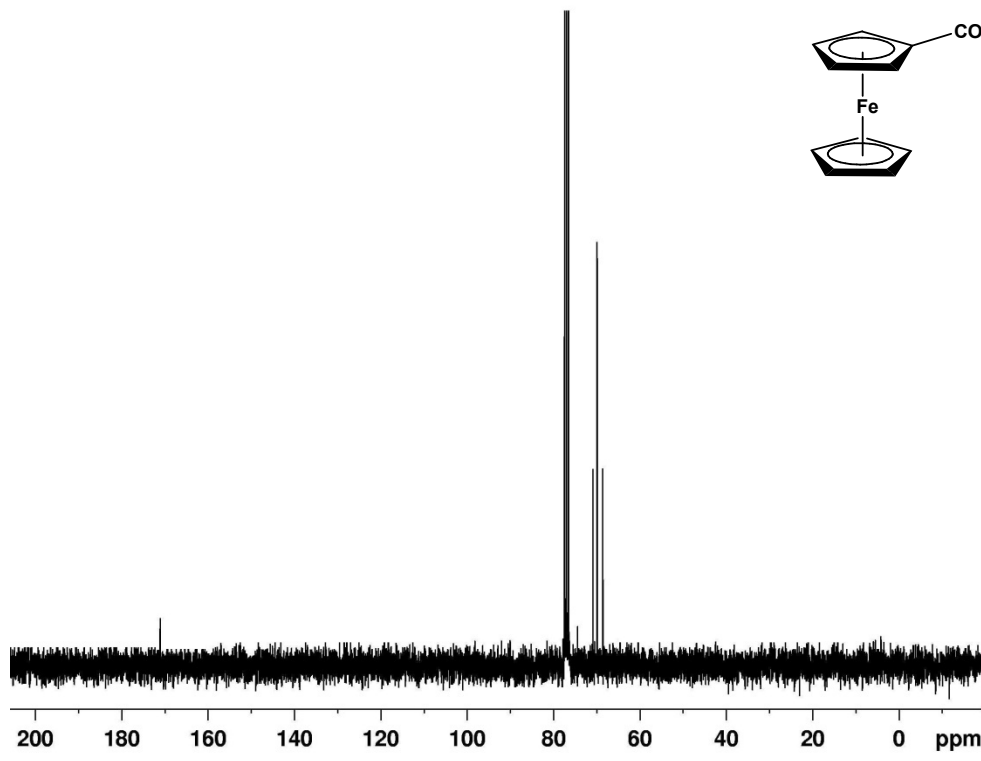


Current Data Parameters  
 NAME Sep-26-2013  
 EXPNO 69  
 PROCNO 1

F2 - Acquisition Parameters  
 Date\_ 20130927  
 Time 0.52  
 INSTRUM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 16  
 DS 2  
 SWH 6172.839 Hz  
 FIDRES 0.094190 Hz  
 AQ 5.3084660 sec  
 RG 203.2  
 DW 81.000 usec  
 DE 6.00 usec  
 TE 300.0 K  
 D1 1.00000000 sec  
 TDO 1

===== CHANNEL f1 =====  
 NUC1 1H  
 P1 10.25 usec  
 PL1 -2.00 dB  
 SF01 300.1318534 MHz

F2 - Processing parameters  
 SI 32768  
 SF 300.1300039 MHz  
 WDW EM  
 SSB 0  
 LB 0.30 Hz  
 GB 0  
 PC 1.00



Current Data Parameters  
 NAME Sep-27-2013  
 EXPNO 41  
 PROCNO 1

F2 - Acquisition Paramete  
 Date\_ 20130927  
 Time 16.53  
 INSTRUM spect  
 PROBHD 5 mm PABBO BB-  
 PULPROG zgpg30  
 TD 65536  
 SOLVENT CDCl3  
 NS 146  
 DS 4  
 SWH 17985.611  
 FIDRES 0.274435  
 AQ 1.821950E  
 RG 3276E  
 DW 27.80C  
 DE 6.0C  
 TE 300.0  
 D1 2.000000C  
 d11 0.030000C  
 DELTA 1.8999999E  
 TD0 1

==== CHANNEL f1 ===  
 NUC1 13C  
 P1 9.0C  
 PL1 -2.0C  
 SFO1 75.4752953

==== CHANNEL f2 ===  
 CPDPRG2 waltz16  
 NUC2 1H  
 PCPD2 80.0C  
 PL2 -2.0C  
 PL12 15.8E  
 PL13 20.0C  
 SFO2 300.1312005

F2 - Processing paramet  
 SI 3276E  
 SF 75.467749C  
 WDW EM  
 SSB C  
 LB 1.0C