Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information

for

Nano-$NiFe_2O_4$ catalyzed microwave assisted one-pot regioselective synthesis of novel 2-alkoxyimidazo[1,2-*a*] pyridines under aerobic conditions

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ESI 1.Detailed method for the preparation of $NiFe_2O_4$:

The $NiFe_2O_4$nanoparticles were prepared by simple co-precipitation method[1] from easily available starting materials ferric chloride ($FeCl_3.6H_2O$) and nickel chloride ($NiCl_2.6H_2O$), distilled water and sodium hydroxide. In a typical synthetic protocol, 0.2 M (20 mL water) ferric chloride solution and 0.1 M (20 mL water) solution of nickel chloride were prepared and mixed under vigorous stirring for 2 h at 80 °C.After that, 0.3 M NaOH was added drop by drop into the solutions till the pH is reached upto 12 andbrown colour precipitates were formed. Finally, the precipitates were separated bycentrifugation and dried in hot air oven for 4 h at 100 °C. Then calcinated it at 550°C for 6 h. Formation of $NiFe_2O_4$NPs were confirmed by FT-IR, powder XRD, HR-TEM, FESEM and EDAX studies.

ESI 2.Characterization of nano-$NiFe_2O_4$:

ESI 2.1.Energy-dispersive X-ray spectroscopy (EDAX) of nano-$NiFe_2O_4$

EDAX of nano-$NiFe_2O_4$proved that the material contains only Ni, Fe, O elements and no other impurities are observed in the material.

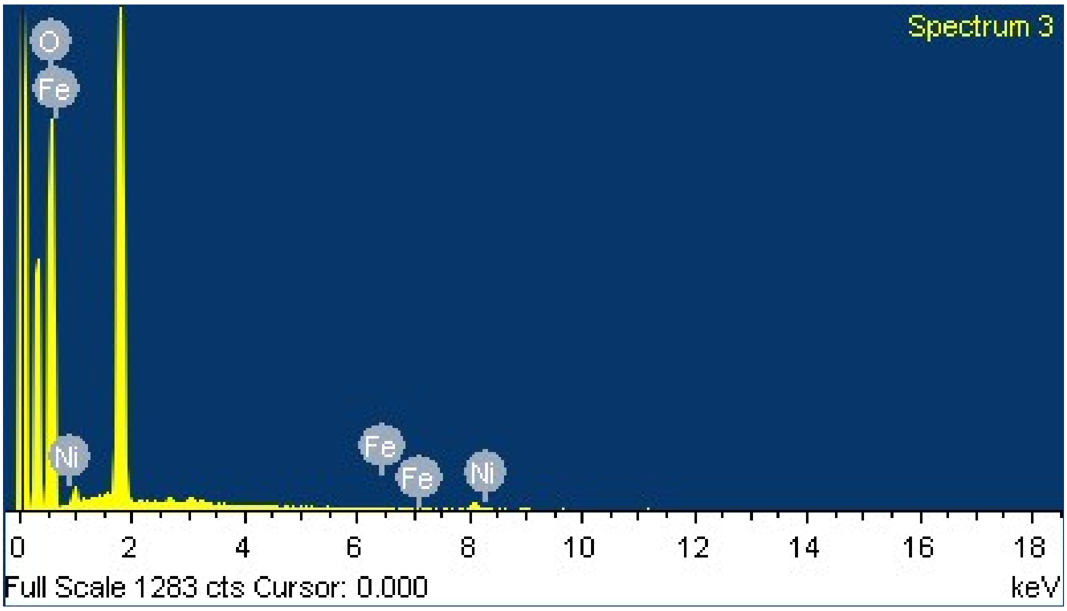


Fig. 1S EDAX of nano-$NiFe_2O_4$

ESI 2.2.FESEM image of nano-$NiFe_2O_4$:

The field emission scanning electron microscope image of $NiFe_2O_4$ also confirms the formation of spherical particles.

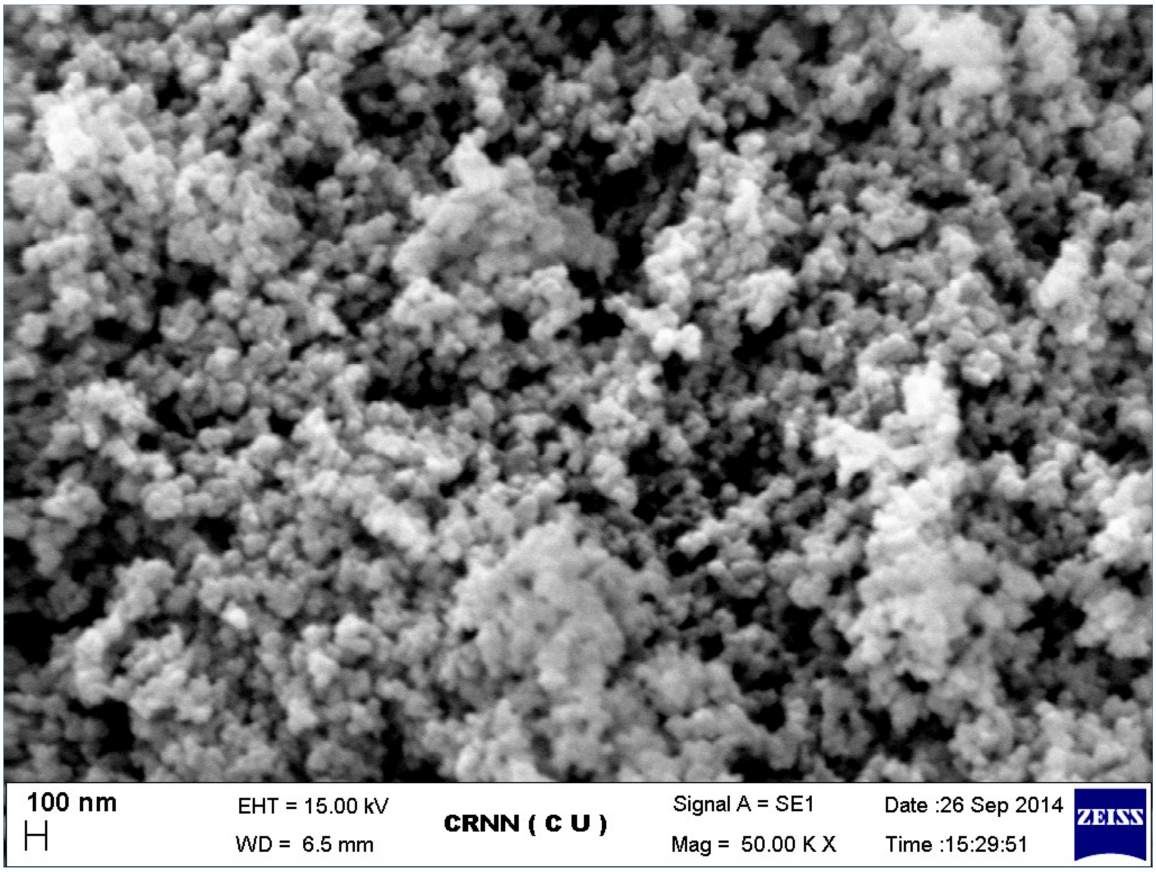


Fig. 2S FESEM image of nano-$NiFe_2O_4$:

ESI 2.3.FTIR Spectra of nano-$NiFe_2O_4$:

An intrinsic stretching vibrations at 600 and 535 cm-1 were assign for tetrahedral site of ferrite (Fe-O) and 817 cm-1 for Fe-OH group were observed in FT-IR of nano-NiFe2O4 (Fig. 5S).

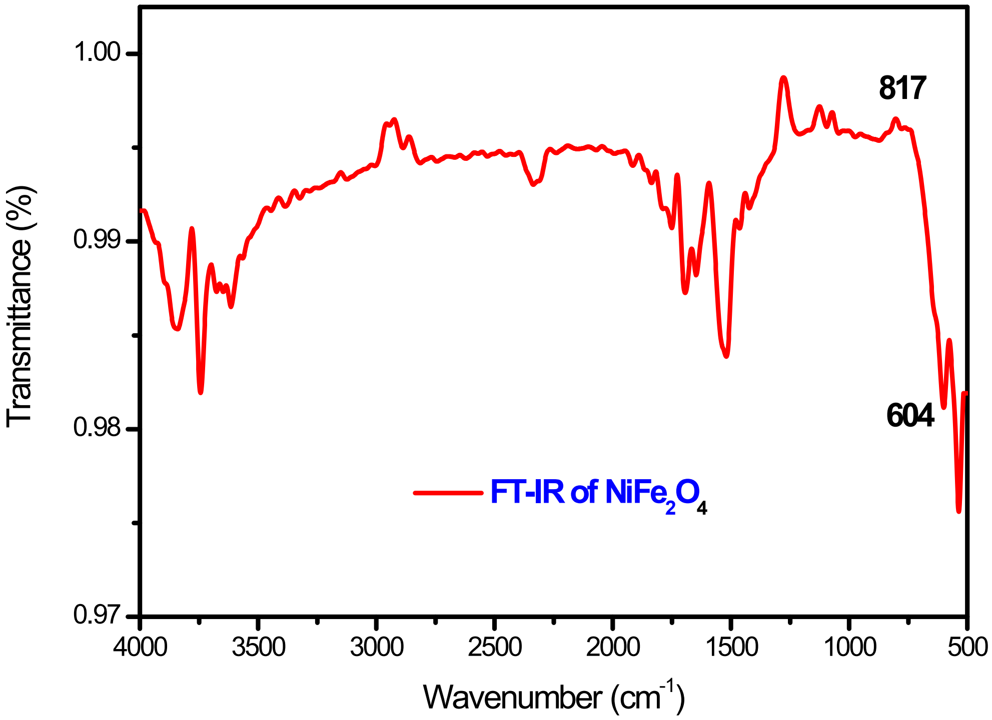


Fig. 3SFTIR Spectra of nano-$NiFe_2O_4$

ESI 3.Methods for the preparation of $CuFe_2O_4$:

The preparation of $CuFe_2O_4$ nanoparticles were carried out following reported procedure[3]. Solution of$Cu(NO_3)_2$(0.001 mol), and $FeCl_3.6H_2O$ (0.002 mol) were prepared and vigorously mixed under stirring for 2 h at 80 ^{0}C.Subsequently, 0.3 M NaOH was added drop by drop into the solutions till the pH is reached upto 12 and black precipitate is formed. Then centrifuged and rinsed with distilled water and left in an atmosphere environment to dry. The resulting powder is then calcinated at 850° C in an oven for 2 hours.

ESI 4.Preparation of $CoFe_2O_4$

The preparation of $CoFe_2O_4$ nanoparticles were carried out following reported procedure[4]. First, 2.0 g of anhydrous sodium acetate wasdissolved in 30 mL of ethylene glycol, and the mixture was stirred vigorously at room temperature to give a transparent solution. Subsequently, 1.5 mmol of cobalt hydrous chlorides ($CoCl_2 \cdot 6H_2O$) and 3.0 mmol of ferric hydrous chloride ($FeCl_3 \cdot 6H_2O$) was added slowly to the above solution (the stoichiometric molar ratio of Co^{2+}/Fe^{3+} was 1 : 2). This mixture was then vigorously stirred at 70^{0}C for at least 2 h to form a homogeneous solution. Then centrifuged and rinsed with distilled water and left in an atmosphere environment to dry. The resulting powder is then calcinated at 850° C in an oven for 2 hours.

ESI 5. General Information:

All reagents were obtained from commercial sources and used as received, except all solvents which were distilled prior to use. All reactions were carried out with oven-dried glassware under air and all the M.W. reactions were carried out in a sealed M.W. tube under closed air system. A monomode microwave reactor (CEM Discover 908005 Microwave Digestion System with Max. Microwave Power 300W, Volts 90/140 VAC, Freq. 50/60 Hz from CEM Corporation, USA) has been used for all the reactions. Technical grade petroleum ether and ethyl acetate were used for column chromatography. Analytical TLC was performed on Merck 60 F254 silica gel plates (0.25 mm thickness). Column chromatography was performed on silica gel (60-120 mesh size, HIMEDIA, India). ^{1}H NMR spectra were determined on a Bruker 500, 400 and 300 MHz spectrometer as solutions in $CDCl_3$. Chemical shifts are expressed in parts per million (δ) and the signals were reported as s (singlet), d (doublet), t (triplet), m (multiplet) and coupling constants *J* were given in Hz. ^{13}C NMR spectra were recorded at 125, 100 and 75 MHz in $CDCl_3$ solution. Chemical shifts are expressed in parts per million (δ) and are referenced to $CDCl_3$ (δ = 77.16) as internal standard. All FT-IR was recorded on a BRUKER ALPHA spectrophotometer.

ESI 6. General method for the synthesis of 2-alkoxy-3-arylimidazo[1,2-*a*]pyridines: Representative experimental procedure for the 2-ethoxy-3-phenylimidazo[1,2-*a*]pyridine:

(a) Conventional heating Condition:

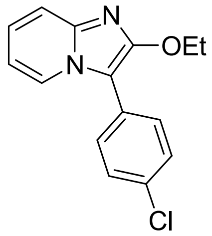
A mixture of *β*-nitrostyrene (1 mmol), 2-aminopyridine (1.3 mmol), ethanol (2 ml) and $NiFe_2O_4$ (10 mol %) refluxed for 4 hours under open atmosphere. After completion of the reaction (monitored by TLC) the reaction mixture was cooled to room temperature and extracted with ethyl acetate, washed with water with Brine solution. The organic phase was dried over anhydrous Na_2SO_4. The crude product was obtained by evaporation of solvent in vacuum which was purified by column chromatography over silica gel (60–120 mesh) using mixture of petroleum ether and ethyl acetate (9:1) as an eluting solvent to afford the pure product.

(b) MW irradiation Conditions:

A mixture of β-nitrostyrene (1 mmol), 2-aminopyridine (1.3 mmol) and ethanol (2 ml) was taken in a sealed MW tube with a magnetic bar in presence of $NiFe_2O_4$ (10 mol %) and was irradiated at under MW condition (70 W) for 5 minutes. After that, the mixture was cooled to room temperature and the catalyst separated by a strong external magnet and finally, product was extracted with ethyl acetate, washed with water with Brine solution. The organic phase was dried over anhydrous Na_2SO_4. The crude product was obtained by evaporation of solvent in vacuum which was purified by column chromatography over silica gel (60–120 mesh) using mixture of petroleum ether and ethyl acetate (9:1) as an eluting solvent to afford pure 2-ethoxy-3-phenylimidazo[1,2-*a*]pyridine. This protocol was followed for all the products listed in Table 2. The products were confirmed by FT-IR, ^1H NMR and ^{13}C NMR spectroscopy and elemental analysis. The spectroscopic data and elemental analysis of all the compounds has been given in S7.

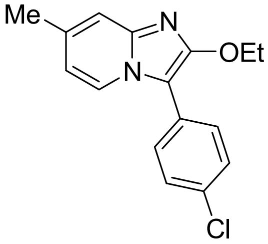
ESI 7. Detailed spectral data of the 2-alkoxy-imidazopyridine derivatives listed in Table 2.

The ^{1}H and ^{13}C NMR spectra were recorded 300 MHz, 400 MHz or 500 MHzBruker NMR spectrometer and $CDCl_3$ was used as solvent.



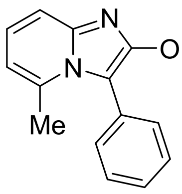
3-(4-chlorophenyl)-2-ethoxy*H*-imidazo [1,2-*a*]pyridine

Gummy mass (entry 1, Table 2, Isolated yield 85%); ^{1}H NMR (300MHz, $CDCl_3$): δ 8.31 (d, *J* = 3.0 Hz, 1H), 7.32-7.27 (m, 4H), 7.23 (t, *J* = 3.0 Hz,1H), 6.88 (t,*J* = 3.0 Hz, 1H), 6.56 (d, *J* = 3.0 Hz), 4.50-4.43(m, 2H), 1.45 (t,*J* = 7.2 Hz, 3H); ^{13}C NMR (75MHz, $CDCl_3$): δ 161.38, 161.02, 148.87, 137.69, 131.69, 131.64, 130.27, 129.21, 128.10, 118.22, 116.48, 63.08, 14.37; Anal calc for $C_{17}H_{17}ClN_2O$: C, 66.06; H, 4.80; N, 10.27 %; Found: C, 66.01; H, 4.85; N, 10.30 %.



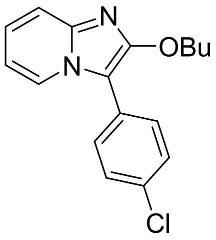
3-(4-chlorophenyl)-2-ethoxy-7-methyl*H*-imidazo[1,2-*a*]pyridine

Gummy mass (entry 2, Table 2, Isolated yield 80%); ^{1}H NMR (300MHz, $CDCl_3$): δ 8.15 (d, *J* = 5.1 Hz, 1H), 7.18 (d, *J*= 6.3 Hz, 2H), 7.27 (d, *J* = 6.3 Hz, 2H), 6.73 (d, *J* = 5.1 Hz, 1H), 6.44 (s, 1H), 4.43 (q, *J* = 6.9 Hz, 2H), 2.22 (s, 3H), 1.43 (t, *J* = 6.9 Hz, 3H); ^{13}C NMR (75MHz, $CDCl_3$): δ 161.02, 149.16, 148.59, 139.65, 138.01, 136.40, 130.66, 130.17, 128.41, 119.77, 116.78, 63.16, 21.09, 14.37; Analcalc for $C_{16}H_{15}ClN_2O$: C, 67.02; H, 5.27; N, 9.75 %; Found: C, 66.91; H, 5.30; N, 9.79 %.



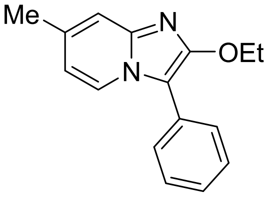
2-ethoxy-5-methyl-3-phenyl*H*-imidazo [1,2-*a*]pyridine

Gummy mass (entry 3, Table 2, Isolated yield 85%); ^{1}H NMR (300MHz, $CDCl_3$): δ 7.32-7.25 (m, 4H), 7.21-7.16 (m, 2H), 6.73 (d, J = 6.0 Hz 1H), 6.25 (d, J = 8.1 Hz 1H), 4.48-4.41 (m, 2H), 2.45 (s, 3H), 1.41 (t,J = 6.9 Hz, 3H); ^{13}C NMR (75MHz, $CDCl_3$): δ 160.86, 160.81, 157.72, 137.90, 131.66, 130.21, 129.23, 128.01, 117.50, 113.09, 62.98, 24.48, 14.36. Anal calc for $C_{16}H_{16}N_2O$: C, 76.16; H, 6.39; N, 11.10 %; Found: C, 76.12; H, 6.43; N, 11.16 %.



2-butoxy-3-(4-chlorophenyl)*H*-imidazo [1,2-*a*]pyridine

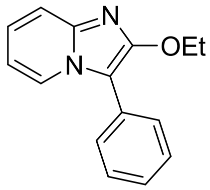
Gummy mass (Table 2, entry 4, yield 84%); ^{1}H NMR (400MHz, $CDCl_3$): δ 8.31 (d, J = 4.8Hz, 1H), 7.53-7.49 (m, 1H), 7.26-7.18 (m, 4H), 6.92 (t,J = 5.2 Hz, 1H), 4.41-4.10 (t, J = 6.4 Hz, 2H), 1.82-1.76 (m, 2H), 1.53-1.47 (m, 2H), 1.00-0.97 (t,J = 7.2 Hz, 3H); ^{13}C NMR (100MHz, $CDCl_3$): δ 161.31, 157.75, 148.82, 138.60, 137.67, 134.40, 132.31, 129.17, 128.10, 118.20, 116.47, 67.44, 30.85, 21.17, 14.45. Anal calc for $C_{17}H_{17}ClN_2O$: C, 67.88; H, 5.70; N, 9.31 %; Found: C, 67.3; H, 5.75; N, 9.27 %.



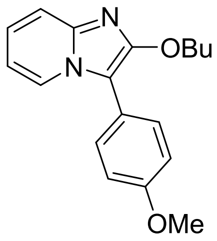
2-ethoxy-7-methyl-3-phenyl*H*-imidazo [1,2-*a*]pyridine

Gummy mass (Table 2, entry 5, Isolated yield- 85%); ^{1}H NMR (500MHz, $CDCl_3$): δ 8.16 (d, J = 5.0 Hz, 1H), 7.33-7.26 (m, 3 H), 7.23-7.20 (m, 2H), 6.71-6.70 (d, J = 5.0 Hz 1H), 6.412 (s, 1H), 4.47-4.43 (m, 2H), 2.20(s, 1H), 1.45-1.43 (t, J = 7.0 Hz,3H);^{13}C NMR (125MHz, $CDCl_3$): δ 161.25, 160.70, 149.04, 148.30, 131.78, 130.25, 129.22, 128.94, 127.36, 119.53, 116.92, 63.03, 21.04, 14.39. Anal calc for $C_{16}H_{16}N_2O$:

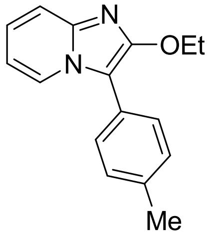
C, 76.16; H, 6.39; N, 11.10 %; Found: C, 76.12; H, 6.44; N, 11.16 %.


2-ethoxy-3-phenyl*H*-imidazo [1,2-*a*]pyridine

Gummy mass (Table 2, entry 6, Isolated yield- 85%); ^{1}H NMR (500MHz, CDCl$_3$): δ 8.33 (d, *J* = 4.0 Hz, 1H), 7.47 (t, *J* = 6.0 Hz, 1 H), 7.33-7.21 (m, 5H), 6.89 (d, *J* = 5.0 Hz, 1H), 6.56 (d, *J* = 8.0 Hz, 1H), 4.50-4.46 (m, 2H), 1.27 (t, *J* = 7.5 Hz,3H);^{13}C NMR (75MHz, CDCl$_3$): δ 161.37, 160.98, 148.86, 147.92, 131.67, 130.26, 129.19, 128.90, 127.37, 120.00, 116.46, 63.06, 14.35. Anal calc for $C_{15}H_{14}N_2O$: C, 75.65; H, 6.92; N, 11.76 %; Found: C, 75.60; H, 5.95; N, 11.82 %.

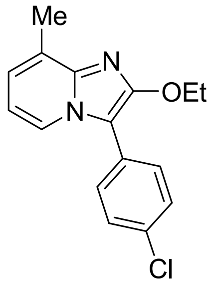

2-butoxy-3-(4-methoxyphenyl) *H*-imidazo[1,2-*a*]pyridine

Gummy mass (Table 2, entry 7, Isolated yield- 84%); ^{1}H NMR (500MHz, CDCl$_3$): δ 8.34 (d, *J* = 4.0 Hz, 1H), 7.49 (t,*J* = 8.0 Hz, 1H), 7.26 (t,*J* = 4.5 Hz, 1H), 6.89 (d, *J* = 5.5 Hz 1H), 6.72 (d, *J* = 8.5 Hz, 1H), 6.57 (d, *J* = 8.0 Hz 1H), 4.38 (t,*J* = 6.5 Hz, 2H), 1.84-1.78(m, 2H), 1.55-1.49 (m, 2H), 1.007-0.978 (t, 3H);^{13}C NMR (125MHz, CDCl$_3$): δ 165.95, 161.31, 148.56, 144.79, 137.73, 133.67, 130.61, 128.55, 128.49, 118.48, 118.43, 116.57, 67.48, 30.80, 21.16, 19.61. Anal calc for $C_{18}H_{20}N_2O_2$: C, 72.95; H, 6.80; N, 9.45 %; Found: C, 72.91; H, 6.77; N, 9.40 %.


2-ethoxy-3-*p*-tolyl*H*-imidazo [1,2-*a*]pyridine

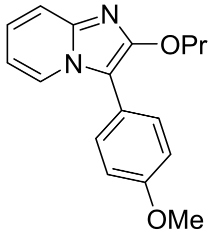
Gummy mass (Table 2, entry 8, Isolated yield- 86%); ^{1}H NMR (500MHz, CDCl$_3$): δ 8.17 (d, *J* = 5.0

Hz, 1H), 7.28 (t, *J* = 8.0 Hz,2H), 7.2 (d,*J* = 8.0 Hz, 1H), 7.00 (d, *J* = 8.0 Hz,. 1H), 6.88 (d, *J* = 5.0 Hz, 1H), 6.71 (d, *J* = 5.0 Hz 1H), 4.447-4.404 (m, 2H), 2.25(s, 3H), 1.42 (t, *J* = 7.0 Hz,3H); ^{13}C NMR (125MHz, $CDCl_3$): δ 161.28, 149.16, 148.57, 138.46, 138.01, 135.19, 131.61, 130.28, 128.56, 119.33, 116.68, 63.66, 21.13, 14.21. Anal calc. for $C_{16}H_{16}N_2O$: C, 76.16; H, 6.39; N, 11.10 %; Found: C, 76.12; H, 6.44; N, 11.06 %.



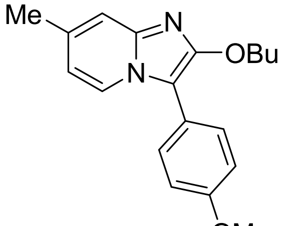
3-(4-chlorophenyl)-2-ethoxy-8-methyl*H*-imidazo[1,2-*a*]pyridine

Gummy mass (Table 2, entry 9, Isolated yield- 81%); ^{1}H NMR (500MHz, $CDCl_3$): δ 7.99 (d, *J* = 6.5 Hz, 1H), 7.91 (d, *J* = 8,5 Hz, 2H), 7.40 (d, *J* = 8.5 Hz, 2H), 6.96 (d, *J* = 6.5 Hz, 1H), 6.70 (t,*J* = 6.5 Hz, 1H), 4.15-4.11 (m, 2H), 2.67 (s, 3H), 1.27 (t,*J* = 9.0 Hz, 3H); ^{13}C NMR (125MHz, $CDCl_3$): δ 161.17, 149.29, 148.55, 139.21, 137.82, 135.90, 130.68, 130.07, 128.63, 119.17, 116.66, 63.93, 21.01, 14.67; Anal calc. for $C_{16}H_{15}ClN_2O$: C, 67.02; H, 5.27; N, 9.77 %; Found: C, 66.93; H, 5.23; N, 9.80 %.



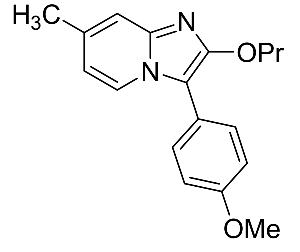
3-(4-methoxyphenyl)-2-propoxyimidazo [1,2-*a*]pyridine

Gummy mass (Table 2, entry 10, Isolated yield- 80%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.30 (d, *J* = 6.5 Hz, 1H), 7.48 (t, *J* = 6.5 Hz, 1H), 7.25 (d, *J* = 8.5 Hz, 1H), 6.92 (d, *J* = 6.5 Hz, 2H), 6.74 (d,*J* = 6.5 Hz, 2H), 6.55 (d,*J* = 6.5 Hz, 1H), 4.41-4.35 (m, 2H), 3.76 (s, 3H), 1.85-1.67 (m, 2H), 1.00 (t,*J* = 9.0 Hz, 3H); ^{13}C NMR (125MHz, $CDCl_3$): δ 171.28, 148.77, 142.06, 137.89, 136.91, 131.12, 129.11, 128.41, 118.06, 116.53, 113.48, 67.04, 60.51, 21.15, 14.30. Anal calc. for $C_{16}H_{15}ClN_2O$: C, 72.32; H, 6.43; N, 9.92 %; Found: C, 72.29; H, 6.46; N, 9.96%.



Gummy mass (Table 2, entry 11, Isolated yield- 86%); ^{1}H NMR (300MHz, $CDCl_3$): δ 8.38 (d, *J* = 5.1

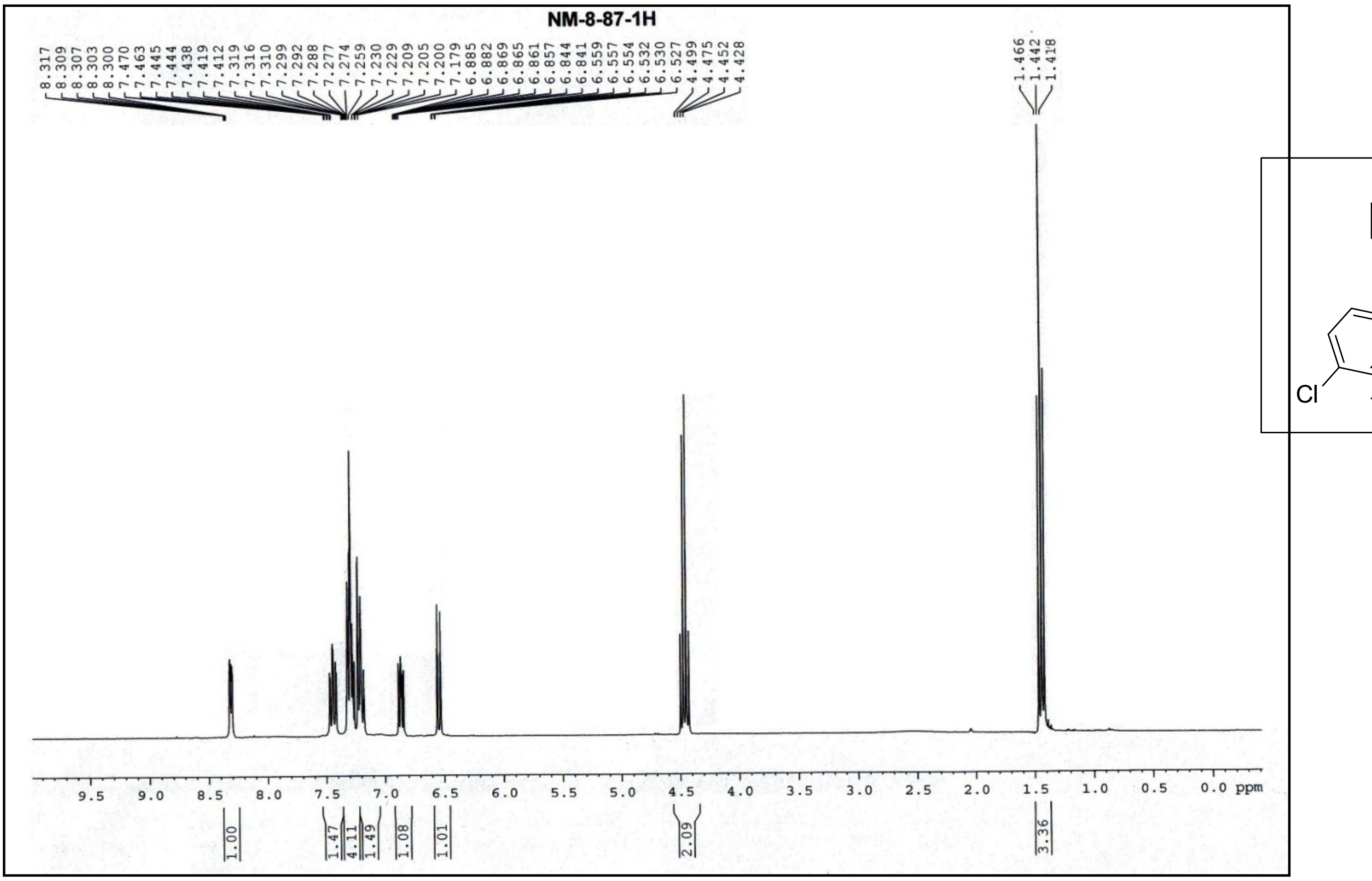
Hz, 1H), 7.65 (d, *J*= 6.3 Hz, 2H), 7.58 (d, *J* = 6.3 Hz, 2H), 6.68 (d, *J* = 5.1 Hz, 1H), 6.46 (s, 1H), 4.46 (q, *J* = 6.9 Hz, 2H), 3.85 (s, 3H), 2.31 (s, 3H), 1.76 (m, 2H), 1.5 (m, 1H), 0.91 (t, 3H); ^{13}C NMR (75MHz, $CDCl_3$): δ 161.15, 148.07, 147.17, 131.14, 129.13, 125.14, 119.43, 118.13, 113.50, 62.95, 55.39, 55.38, 29.84, 21.17, 14.43; Analcalc for $C_{19}H_{22}N_2O_2$: C, 73.52; H, 7.14; N, 9.03 %; Found: C, 73.44; H, 7.19; N, 9.09 %.



3-(4-methoxyphenyl)-7-methyl-2-propoxy *H*-imidazo[1,2-*a*]pyridine

Gummy mass (Table 2, entry 12, Isolated yield-83%); ^{1}H NMR (300MHz, $CDCl_3$): δ 8.18 (d, *J* = 4.2 Hz, 1H), 7.30 (d, *J*= 4.8 Hz, 2H), 7.25 (d, *J* = 4.8 Hz, 2H), 6.69 (d, *J* = 5.1 Hz, 1H), 6.46 (s, 1H), 4.43 (q, *J* = 7.2 Hz, 2H), 3.75 (s, 3H), 2.23 (s, 3H), 1.71 (m, 2H), 0.89 (t,*J* = 6.6 Hz. 3H); ^{13}C NMR (75MHz, $CDCl_3$): δ 160.98, 148.86, 147.92, 131.64, 130.23, 129.19, 128.92, 128.08, 120.01, 116.43, 60.54, 30.85, 21.18, 19.11, 14.34; Analcalc for $C_{18}H_{20}N_2O_2$: C, 72.95; H, 6.80; N, 9.45 %; Found: C, 72.91; H, 6.76; N, 9.49.

ESI 8. Copy of ^{1}H NMR and ^{13}C NMR spectra of all compounds: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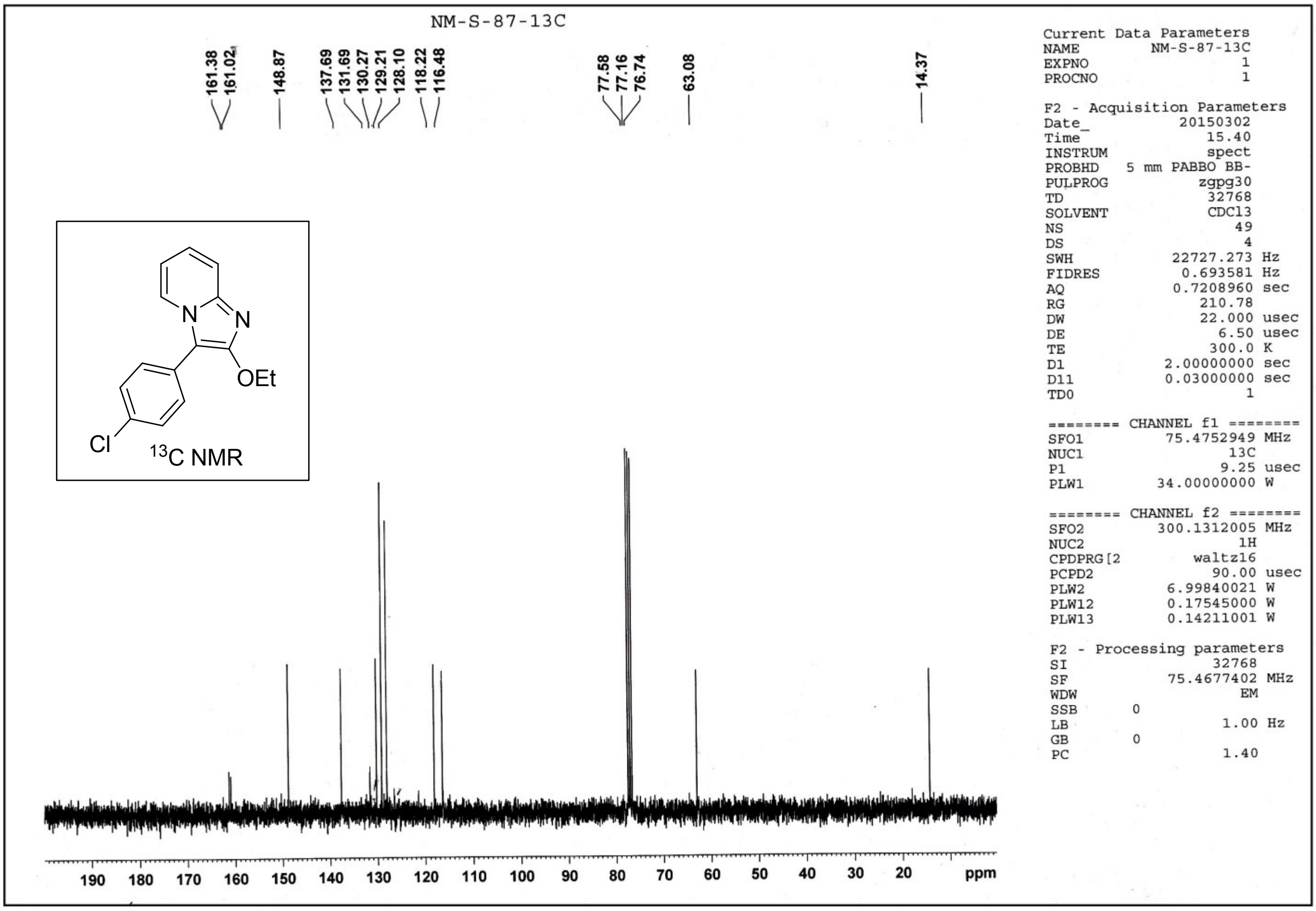

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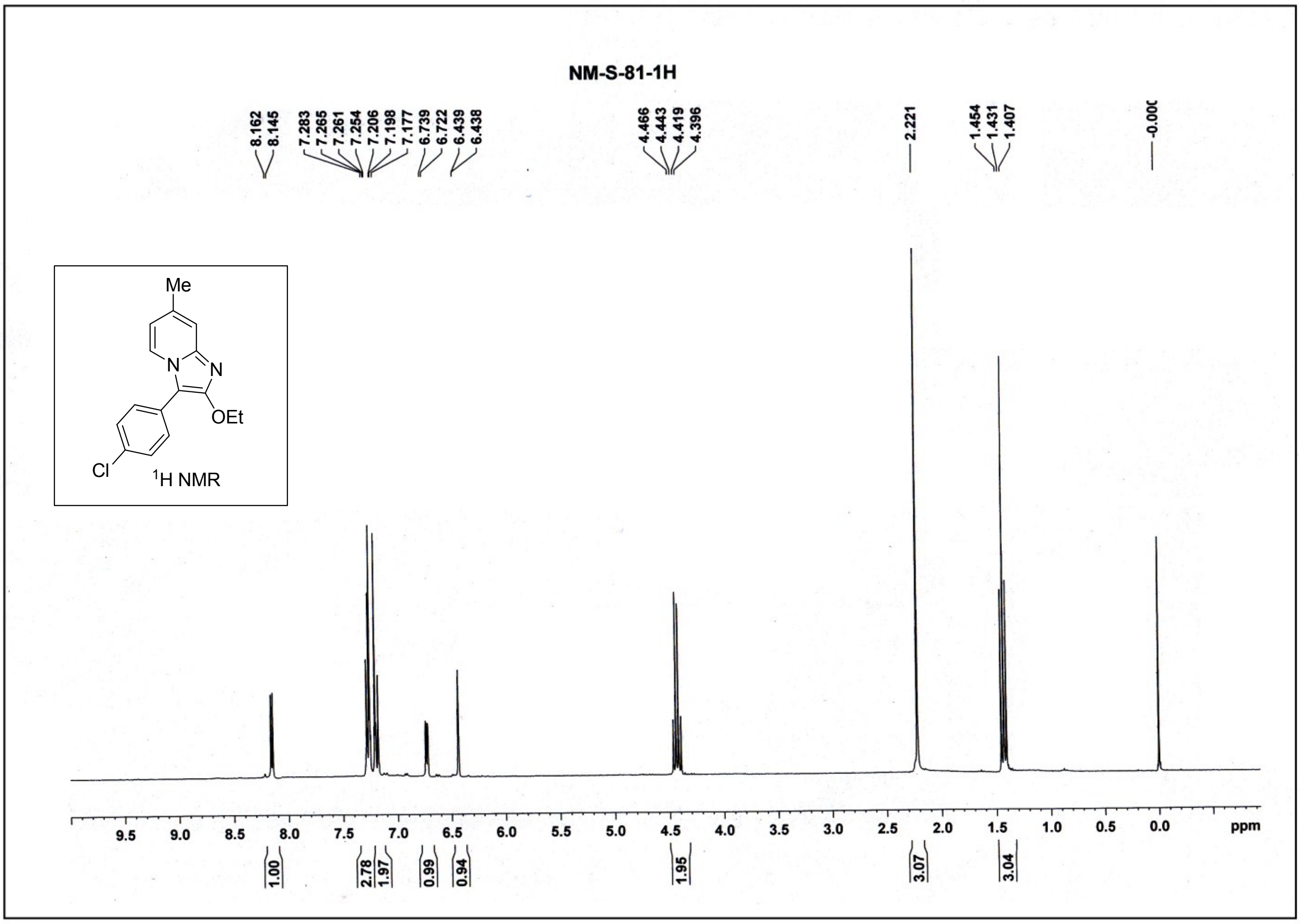
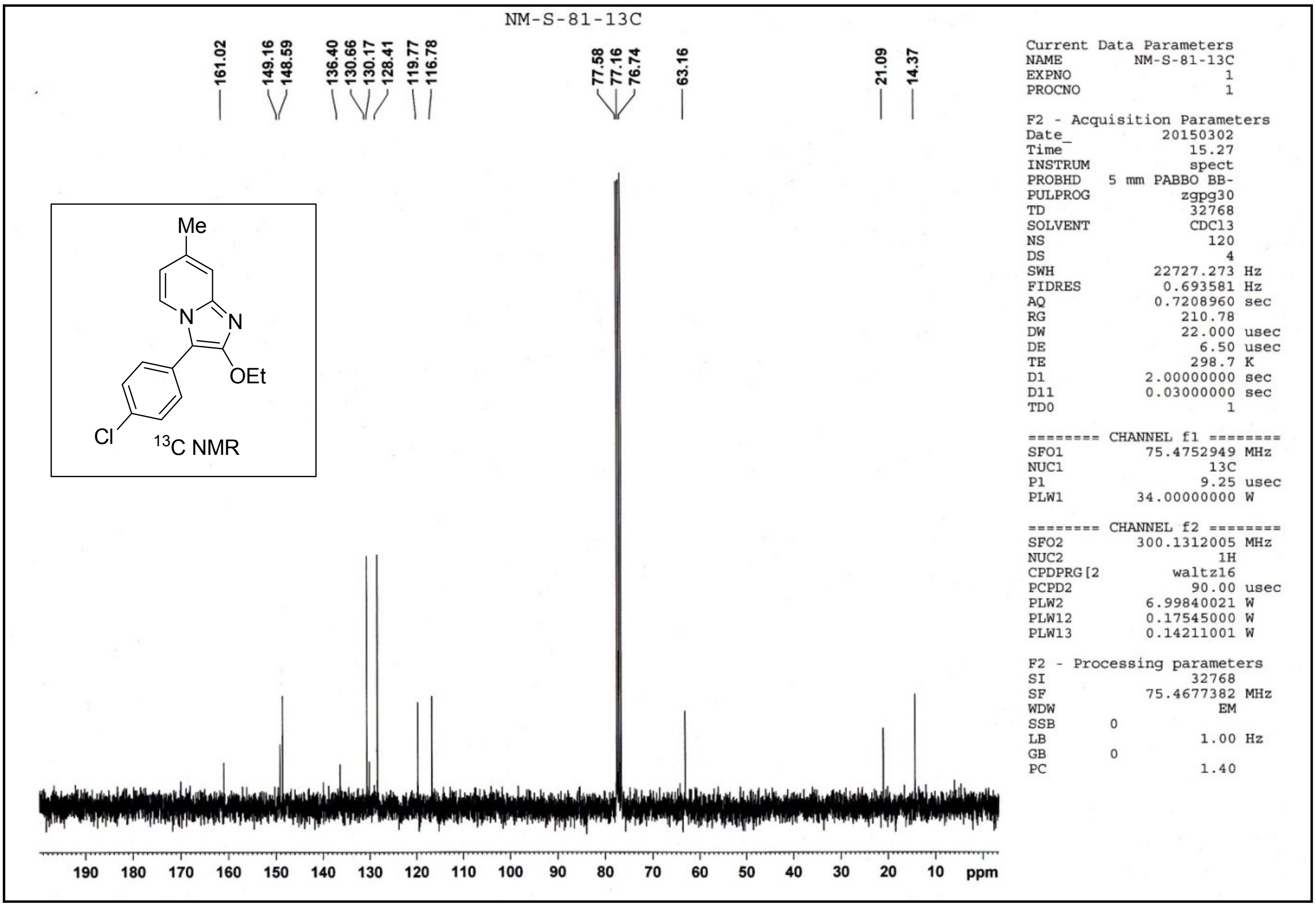
======== CHANNEL f1 ========
SFO1         75.4752949 MHz
NUC1                13C
P1                  9.25 usec
PLW1         34.00000000 W

======== CHANNEL f2 ========
SFO2        300.1312005 MHz
NUC2                 1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2          6.99840021 W
PLW12         0.17545000 W
PLW13         0.14211001 W

F2 - Processing parameters
SI                 32768
SF            75.4677402 MHz
WDW                   EM
SSB       0
LB                  1.00 Hz
GB        0
PC                  1.40
```


NM-S-81-1H
8.162
8.145
7.283
7.265
7.261
7.254
7.206
7.198
7.177
6.739
6.722
6.439
6.438
4.466
4.443
4.419
4.396
2.221
1.454
1.431
1.407
-0.000
Me
N
N
OEt
Cl
^{1}H NMR
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
1.00
2.78
1.97
0.99
0.94
1.95
3.07
3.04



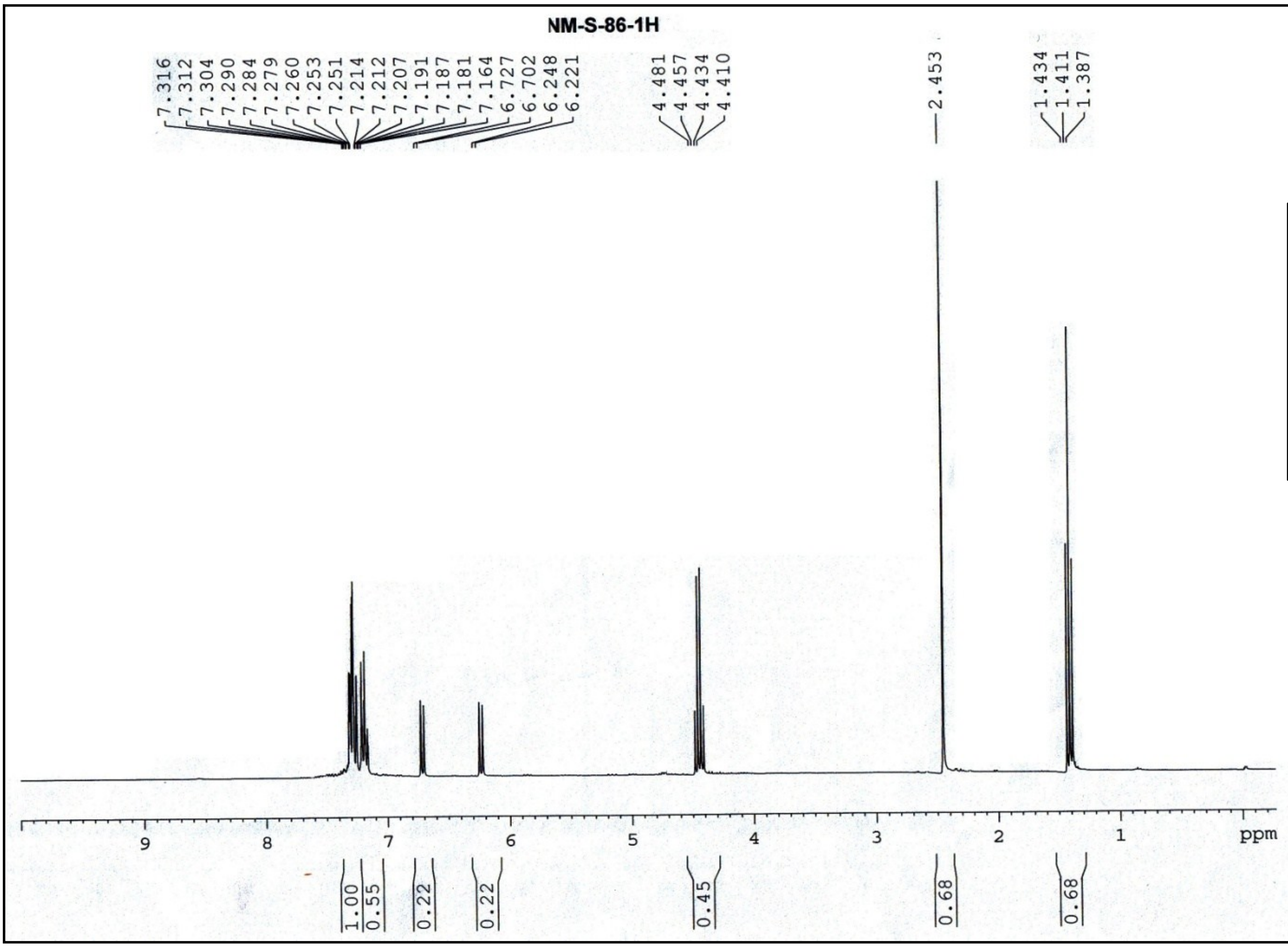
```
Current Data Parameters
NAME          NM-S-81-13C
EXPNO                   1
PROCNO                  1

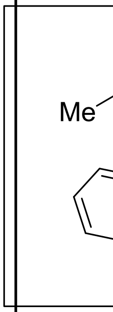
F2 - Acquisition Parameters
Date_            20150302
Time                15.27
INSTRUM             spect
PROBHD   5 mm PABBO BB-
PULPROG           zgpg30
TD                 32768
SOLVENT            CDCl3
NS                   120
DS                     4
SWH            22727.273 Hz
FIDRES          0.693581 Hz
AQ             0.7208960 sec
RG                210.78
DW                22.000 usec
DE                  6.50 usec
TE                 298.7 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                    1

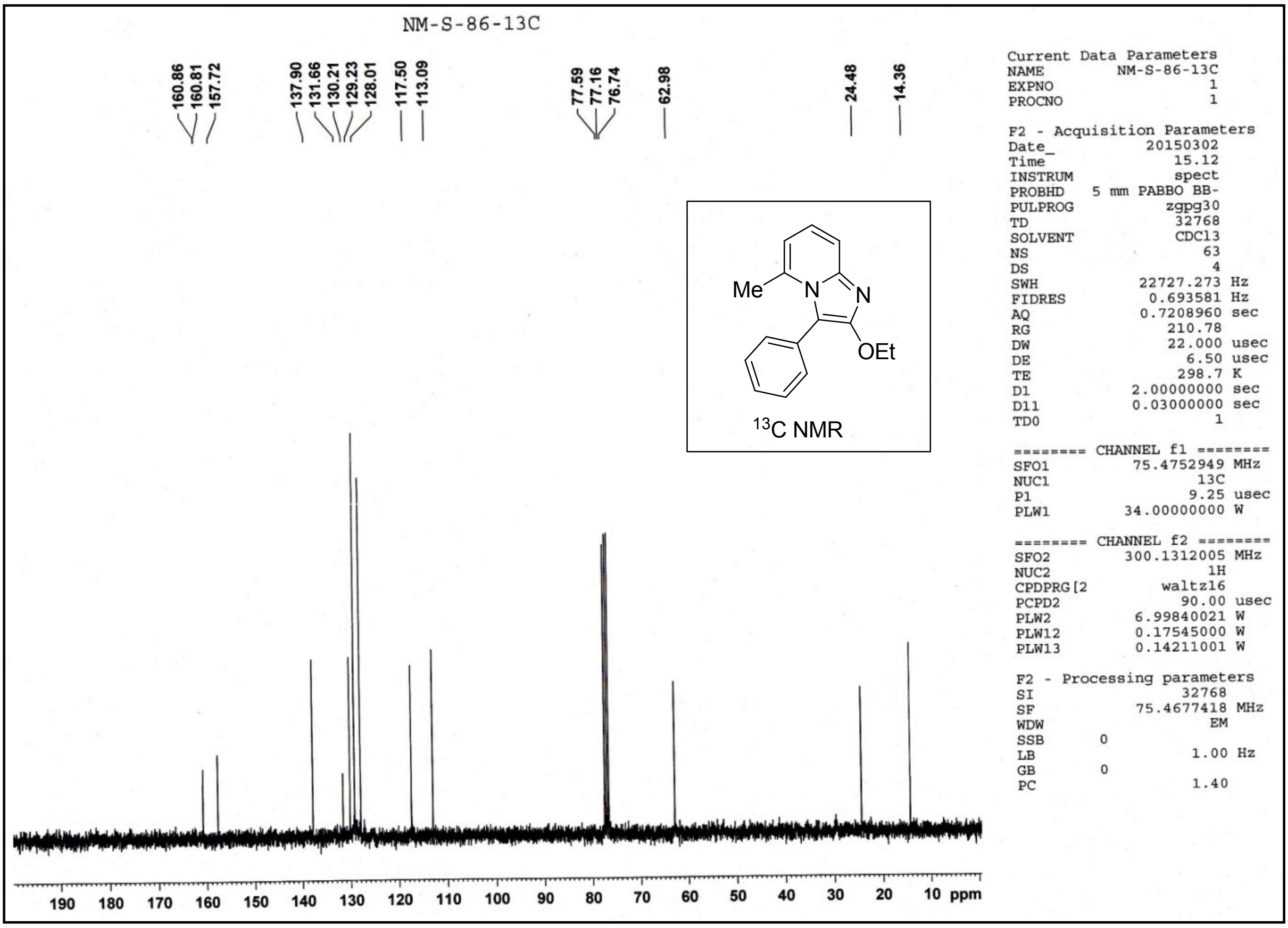
======== CHANNEL f1 ========
SFO1          75.4752949 MHz
NUC1                 13C
P1                  9.25 usec
PLW1         34.00000000 W

======== CHANNEL f2 ========
SFO2         300.1312005 MHz
NUC2                  1H
CPDPRG[2          waltz16
PCPD2              90.00 usec
PLW2          6.99840021 W
PLW12         0.17545000 W
PLW13         0.14211001 W

F2 - Processing parameters
SI                 32768
SF            75.4677382 MHz
WDW                   EM
SSB       0
LB                  1.00 Hz
GB        0
PC                  1.40
```


NM-S-86-1H
7.316
7.312
7.304
7.290
7.284
7.279
7.260
7.253
7.251
7.214
7.212
7.207
7.191
7.187
7.181
7.164
6.727
6.702
6.248
6.221
4.481
4.457
4.434
4.410
2.453
1.434
1.411
1.387
9
8
7
6
5
4
3
2
1
ppm
1.00
0.55
0.22
0.22
0.45
0.68
0.68


Me



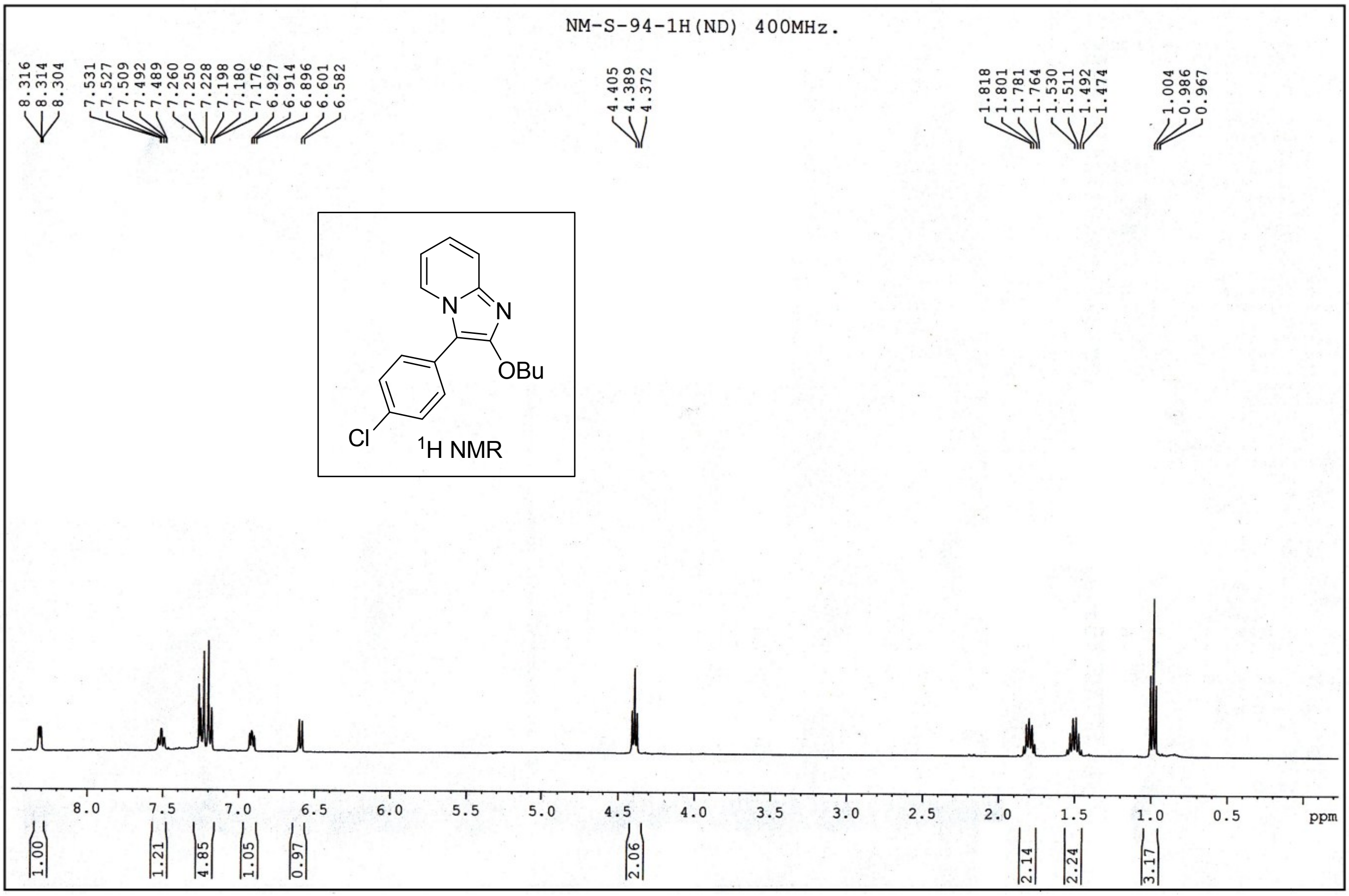
```
Current Data Parameters
NAME           NM-S-86-13C
EXPNO                    1
PROCNO                   1

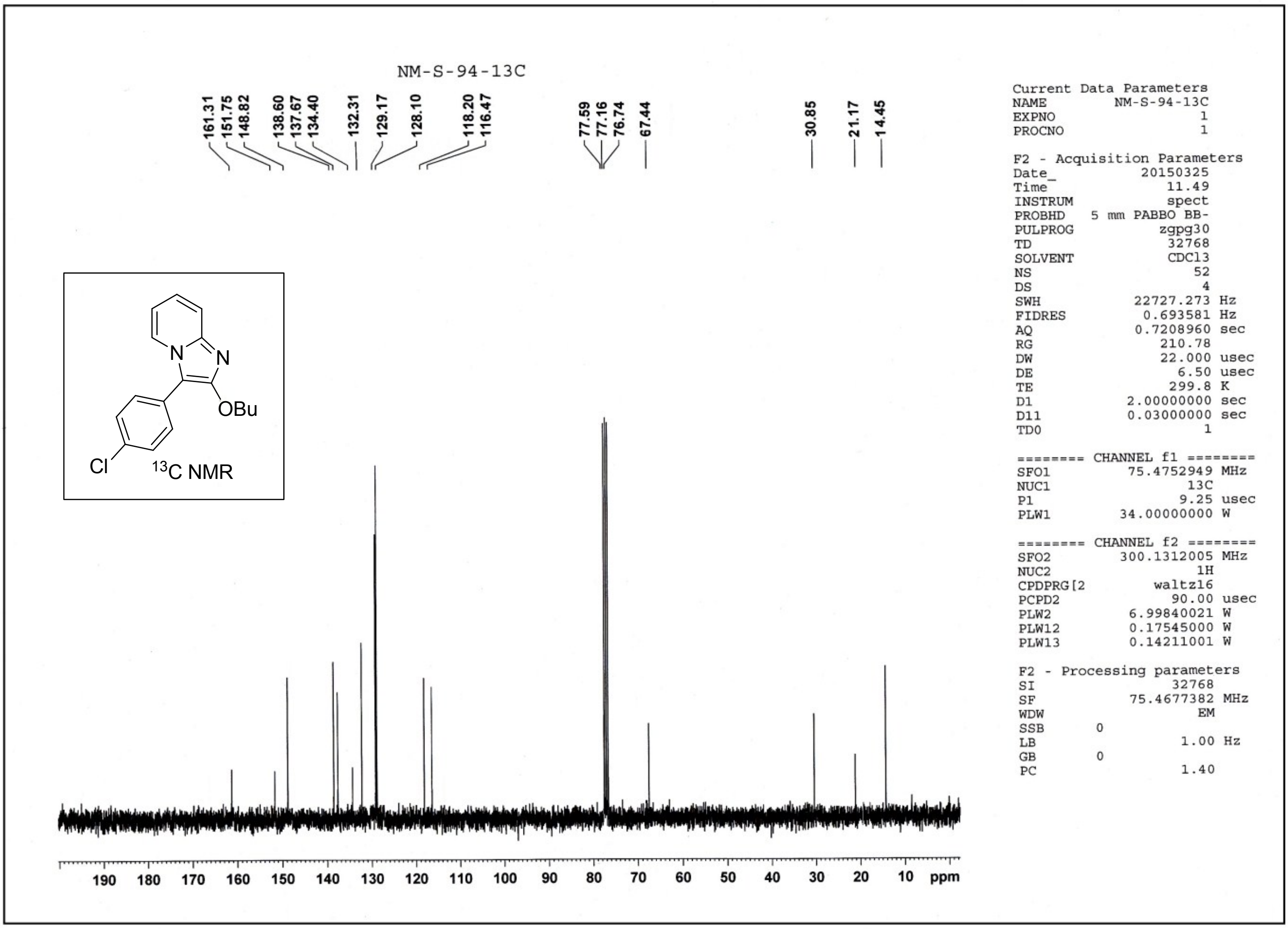
F2 - Acquisition Parameters
Date_             20150302
Time                 15.12
INSTRUM              spect
PROBHD    5 mm PABBO BB-
PULPROG            zgpg30
TD                   32768
SOLVENT              CDCl3
NS                      63
DS                       4
SWH            22727.273 Hz
FIDRES          0.693581 Hz
AQ             0.7208960 sec
RG                  210.78
DW                  22.000 usec
DE                    6.50 usec
TE                   298.7 K
D1              2.00000000 sec
D11             0.03000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1          75.4752949 MHz
NUC1                   13C
P1                    9.25 usec
PLW1           34.00000000 W

======== CHANNEL f2 ========
SFO2         300.1312005 MHz
NUC2                    1H
CPDPRG[2           waltz16
PCPD2                90.00 usec
PLW2            6.99840021 W
PLW12           0.17545000 W
PLW13           0.14211001 W

F2 - Processing parameters
SI                   32768
SF              75.4677418 MHz
WDW                     EM
SSB      0
LB                    1.00 Hz
GB       0
PC                    1.40
```


NM-S-94-1H(ND) 400MHz.
8.316
8.314
8.304
7.531
7.527
7.509
7.492
7.489
7.260
7.250
7.228
7.198
7.180
7.176
6.927
6.914
6.896
6.601
6.582
4.405
4.389
4.372
1.818
1.801
1.781
1.764
1.530
1.511
1.492
1.474
1.004
0.986
0.967
N
N
OBu
Cl
¹H NMR
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.00
1.21
4.85
1.05
0.97
2.06
2.14
2.24
3.17



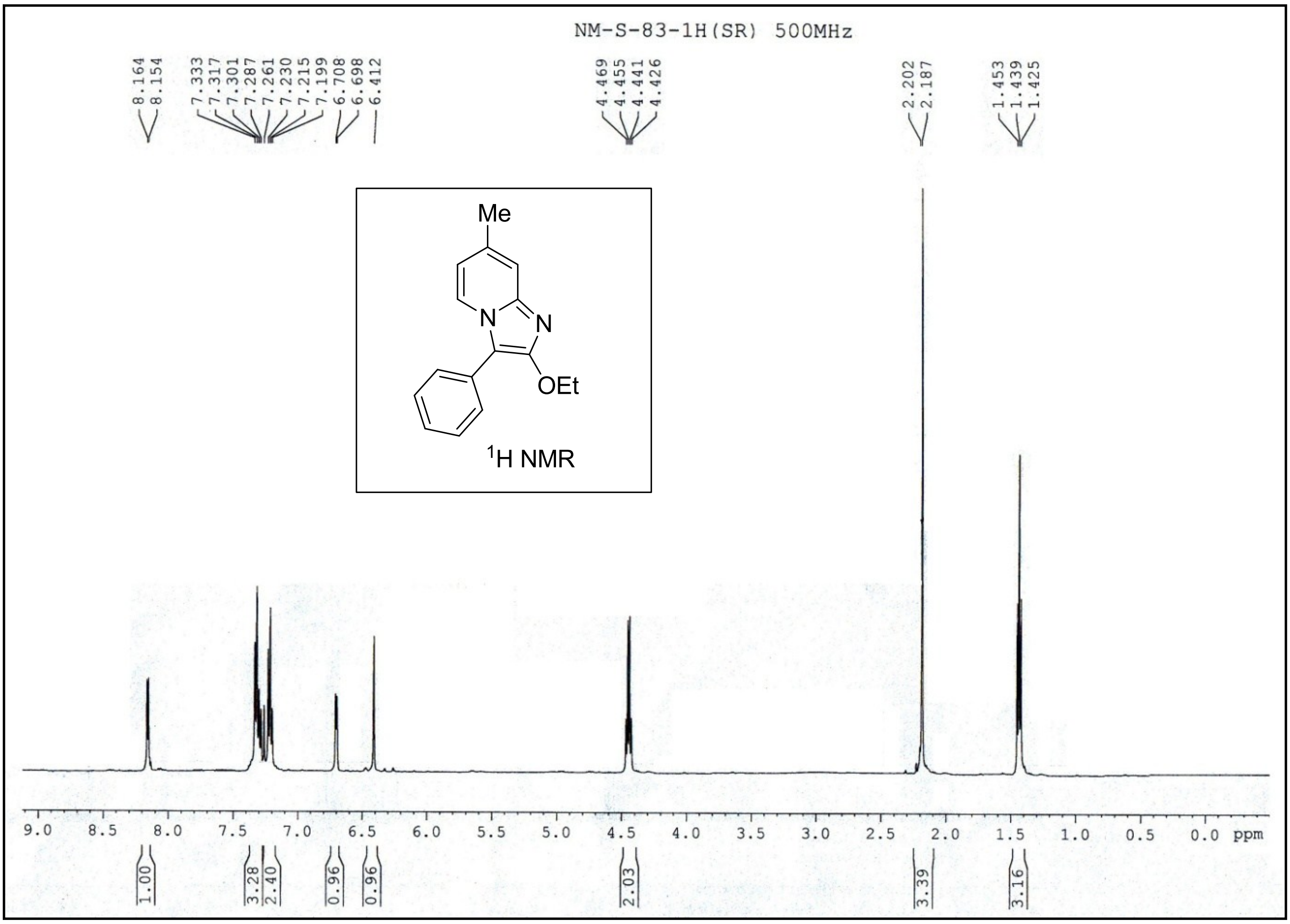
```
Current Data Parameters
NAME          NM-S-94-13C
EXPNO                   1
PROCNO                  1

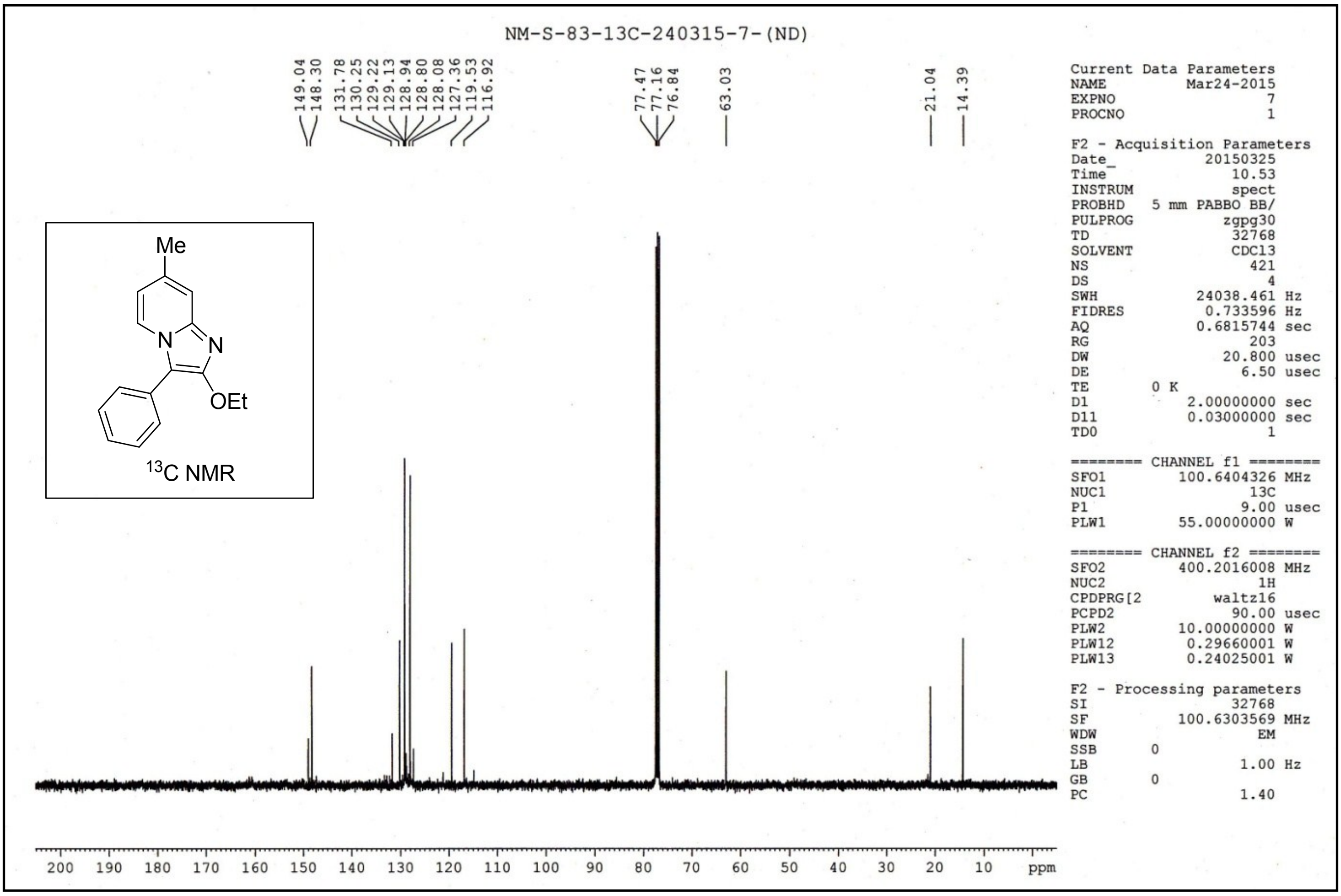
F2 - Acquisition Parameters
Date_            20150325
Time                11.49
INSTRUM             spect
PROBHD    5 mm PABBO BB-
PULPROG           zgpg30
TD                 32768
SOLVENT            CDCl3
NS                    52
DS                     4
SWH            22727.273 Hz
FIDRES          0.693581 Hz
AQ             0.7208960 sec
RG                210.78
DW                22.000 usec
DE                  6.50 usec
TE                 299.8 K
D1            2.00000000 sec
D11           0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         75.4752949 MHz
NUC1                13C
P1                  9.25 usec
PLW1         34.00000000 W

======== CHANNEL f2 ========
SFO2        300.1312005 MHz
NUC2                 1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2          6.99840021 W
PLW12         0.17545000 W
PLW13         0.14211001 W

F2 - Processing parameters
SI                 32768
SF            75.4677382 MHz
WDW                   EM
SSB      0
LB                  1.00 Hz
GB       0
PC                  1.40
```


NM-S-83-1H(SR) 500MHz
8.164
8.154
7.333
7.317
7.301
7.287
7.261
7.230
7.215
7.199
6.708
6.698
6.412
4.469
4.455
4.441
4.426
2.202
2.187
1.453
1.439
1.425
Me
N
N
OEt
^{1}H NMR
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0 ppm
1.00
3.28
2.40
0.96
0.96
2.03
3.39
3.16



NM-S-83-13C-240315-7-(ND)

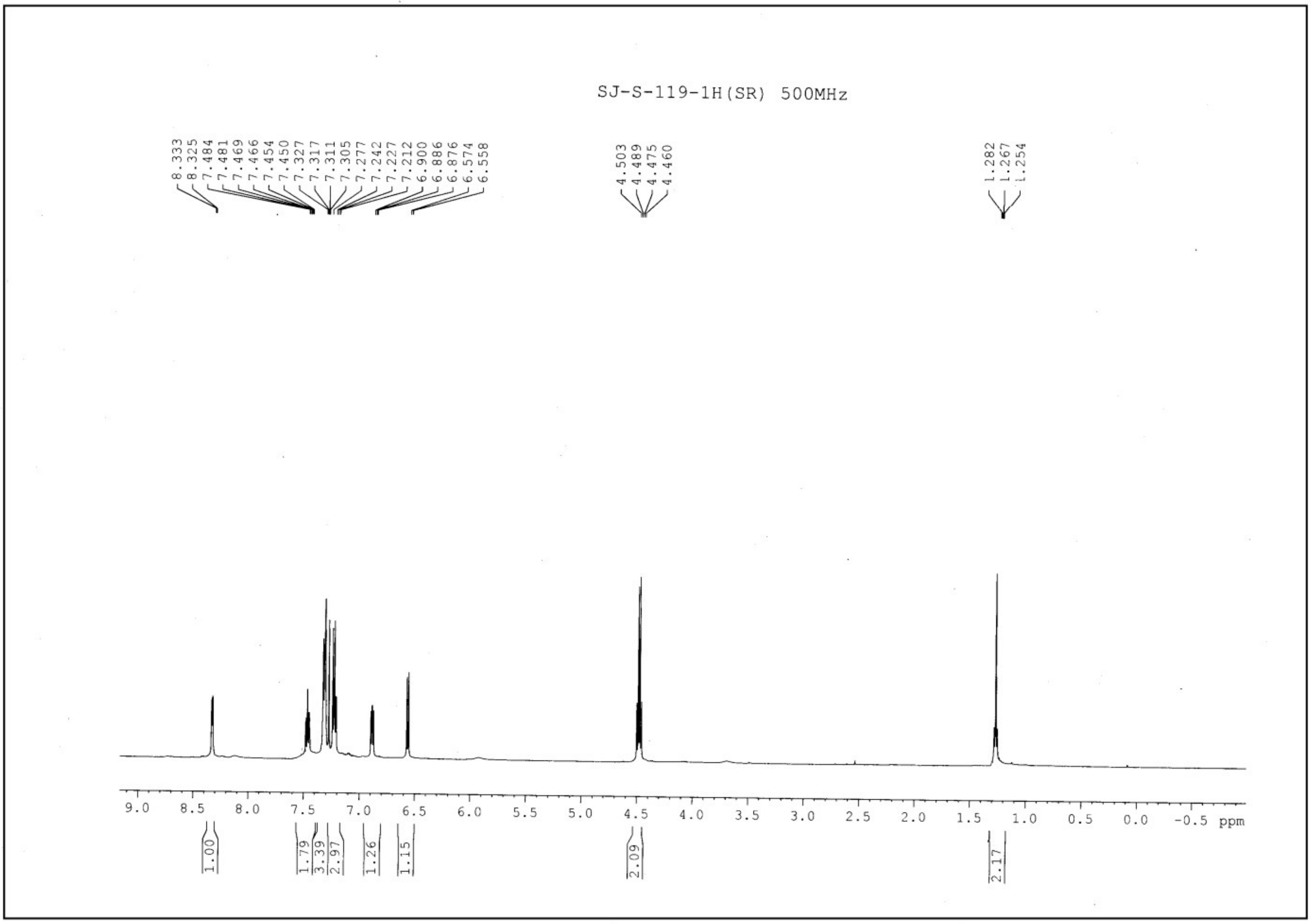
```
Current Data Parameters
NAME           Mar24-2015
EXPNO                   7
PROCNO                  1

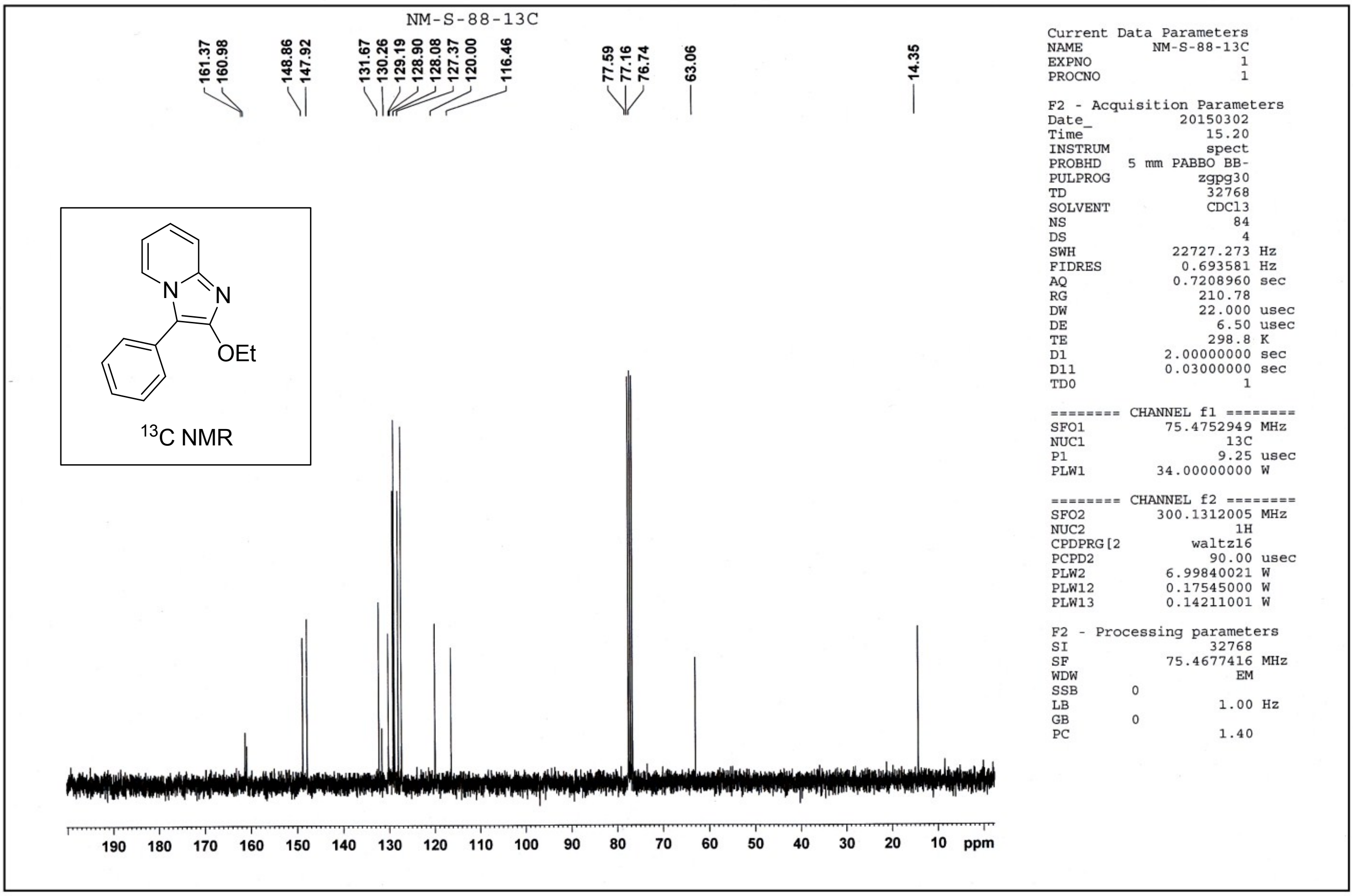
F2 - Acquisition Parameters
Date_            20150325
Time                10.53
INSTRUM             spect
PROBHD   5 mm PABBO BB/
PULPROG           zgpg30
TD                 32768
SOLVENT            CDCl3
NS                   421
DS                     4
SWH           24038.461 Hz
FIDRES         0.733596 Hz
AQ            0.6815744 sec
RG                   203
DW                20.800 usec
DE                  6.50 usec
TE         0 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1        100.6404326 MHz
NUC1                 13C
P1                  9.00 usec
PLW1        55.00000000 W

======== CHANNEL f2 ========
SFO2        400.2016008 MHz
NUC2                  1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2         10.00000000 W
PLW12         0.29660001 W
PLW13         0.24025001 W

F2 - Processing parameters
SI                 32768
SF          100.6303569 MHz
WDW                   EM
SSB        0
LB                  1.00 Hz
GB         0
PC                  1.40
```


SJ-S-119-1H(SR) 500MHz
8.333
8.325
7.484
7.481
7.469
7.466
7.454
7.450
7.327
7.317
7.311
7.305
7.277
7.242
7.227
7.212
6.900
6.886
6.876
6.574
6.558
4.503
4.489
4.475
4.460
1.282
1.267
1.254
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
ppm
1.00
1.79
3.39
2.97
1.26
1.15
2.09
2.17



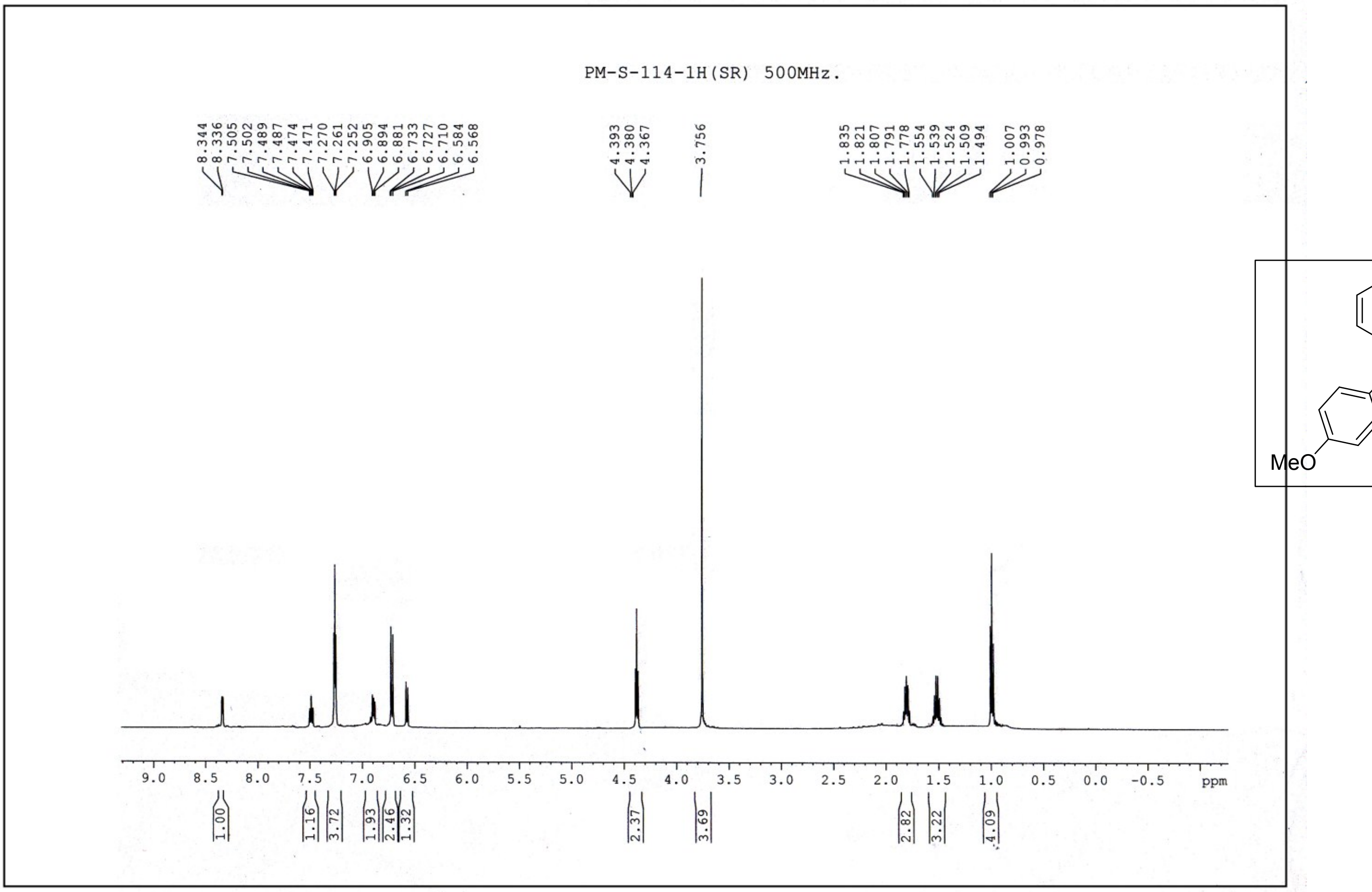
```
Current Data Parameters
NAME         NM-S-88-13C
EXPNO                  1
PROCNO                 1

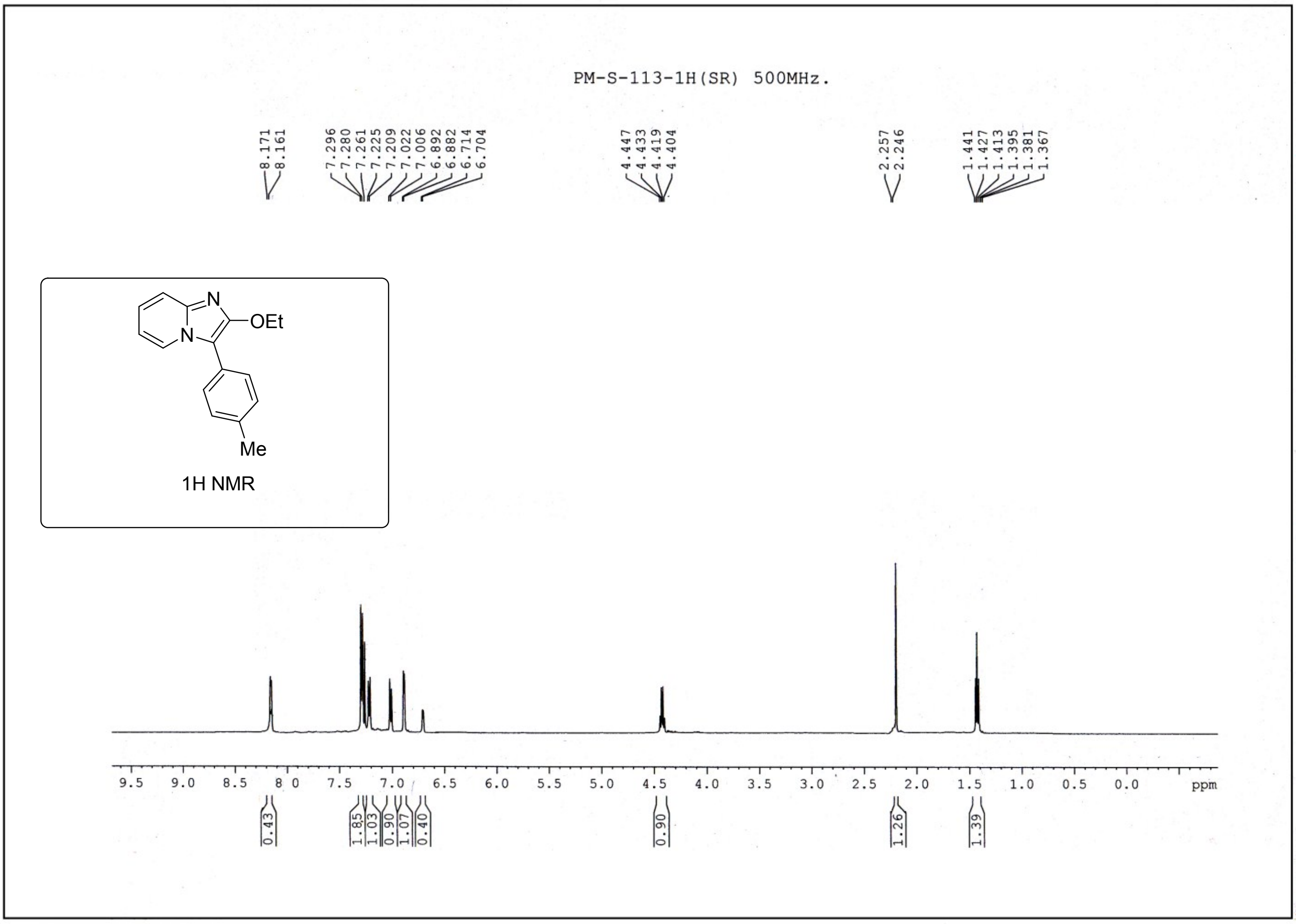
F2 - Acquisition Parameters
Date_           20150302
Time               15.20
INSTRUM            spect
PROBHD   5 mm PABBO BB-
PULPROG          zgpg30
TD                32768
SOLVENT           CDCl3
NS                   84
DS                    4
SWH           22727.273 Hz
FIDRES         0.693581 Hz
AQ            0.7208960 sec
RG               210.78
DW               22.000 usec
DE                 6.50 usec
TE                298.8 K
D1           2.00000000 sec
D11          0.03000000 sec
TD0                   1

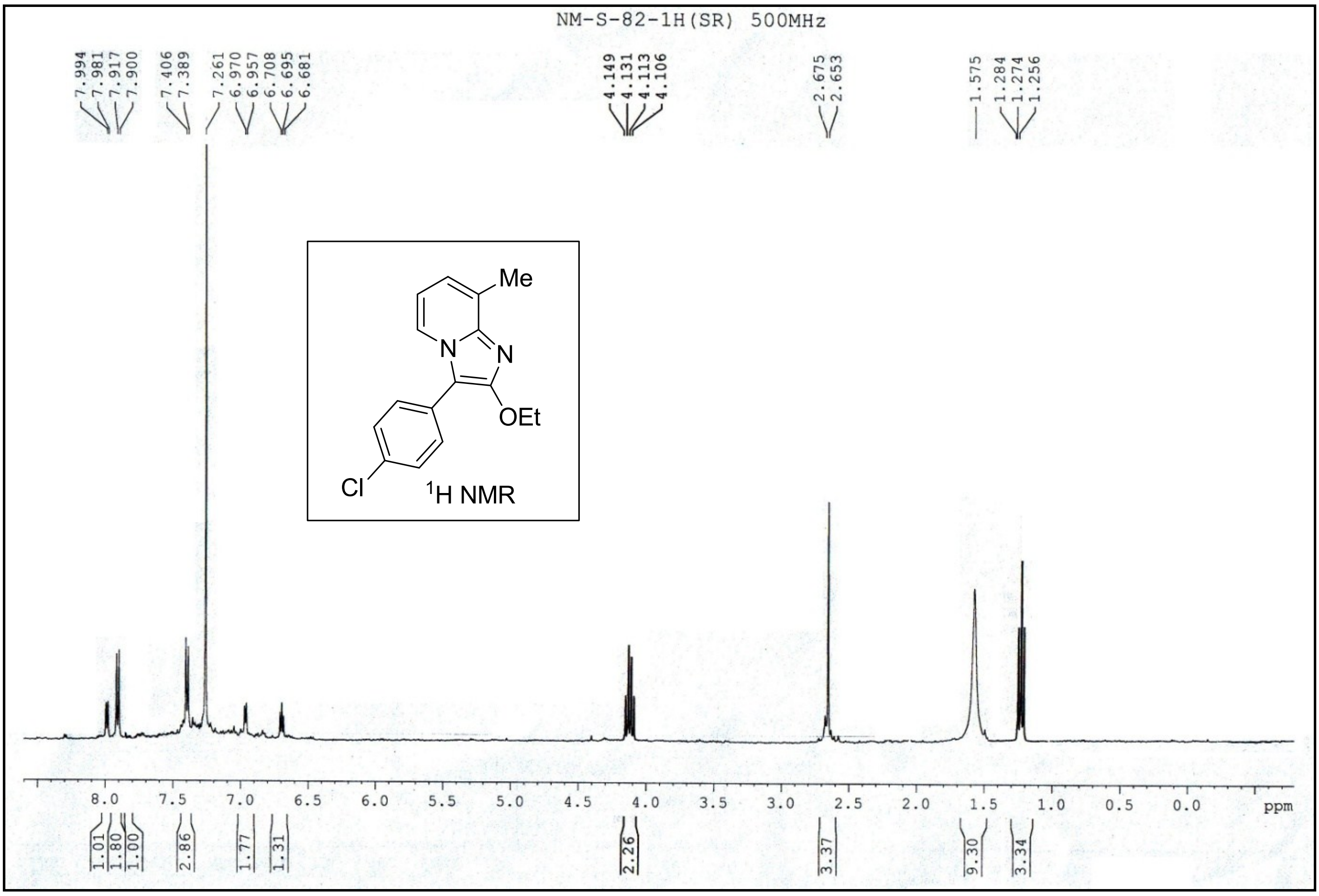
======== CHANNEL f1 ========
SFO1        75.4752949 MHz
NUC1               13C
P1                 9.25 usec
PLW1        34.00000000 W

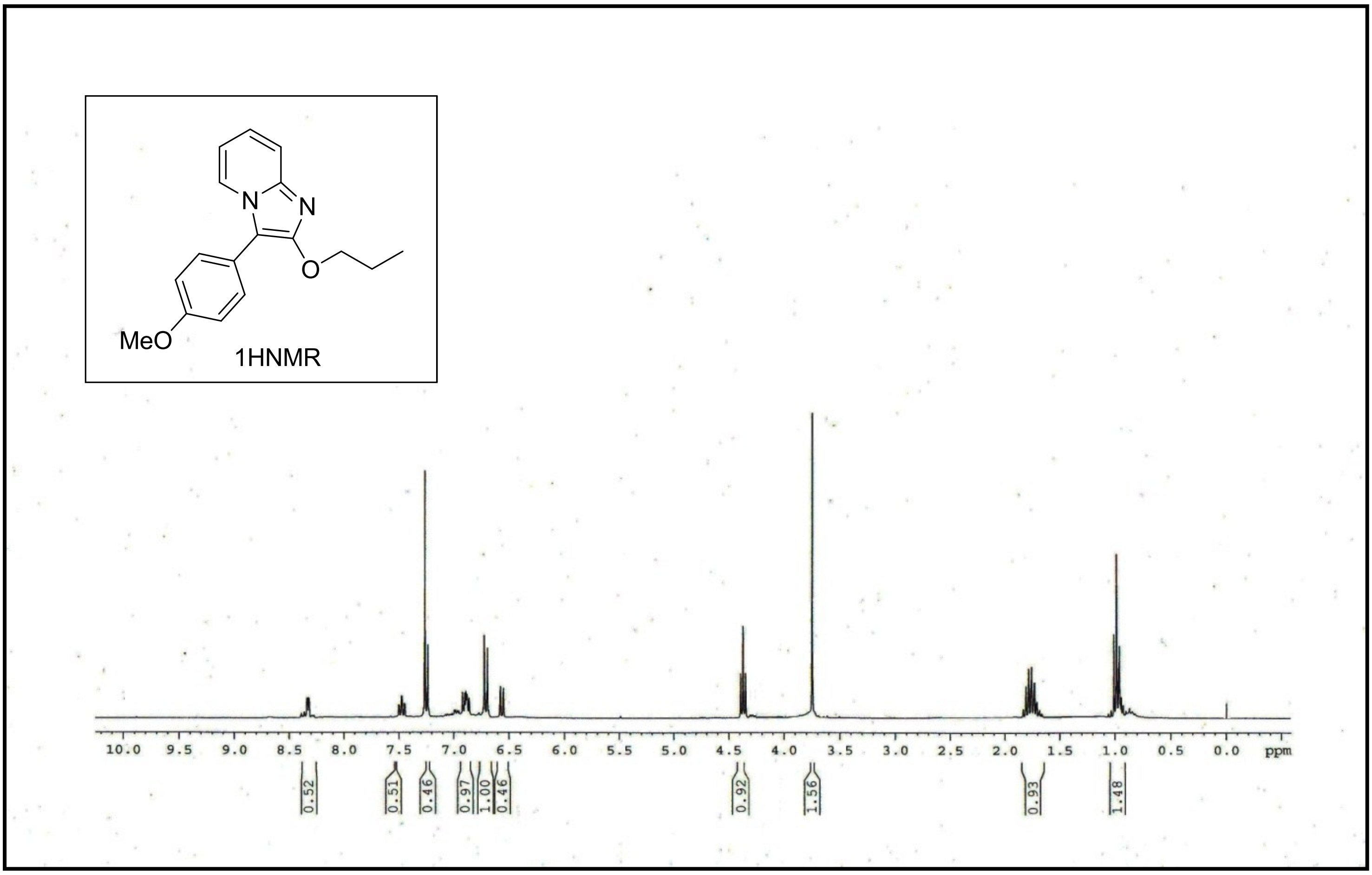
======== CHANNEL f2 ========
SFO2       300.1312005 MHz
NUC2                1H
CPDPRG[2       waltz16
PCPD2             90.00 usec
PLW2         6.99840021 W
PLW12        0.17545000 W
PLW13        0.14211001 W

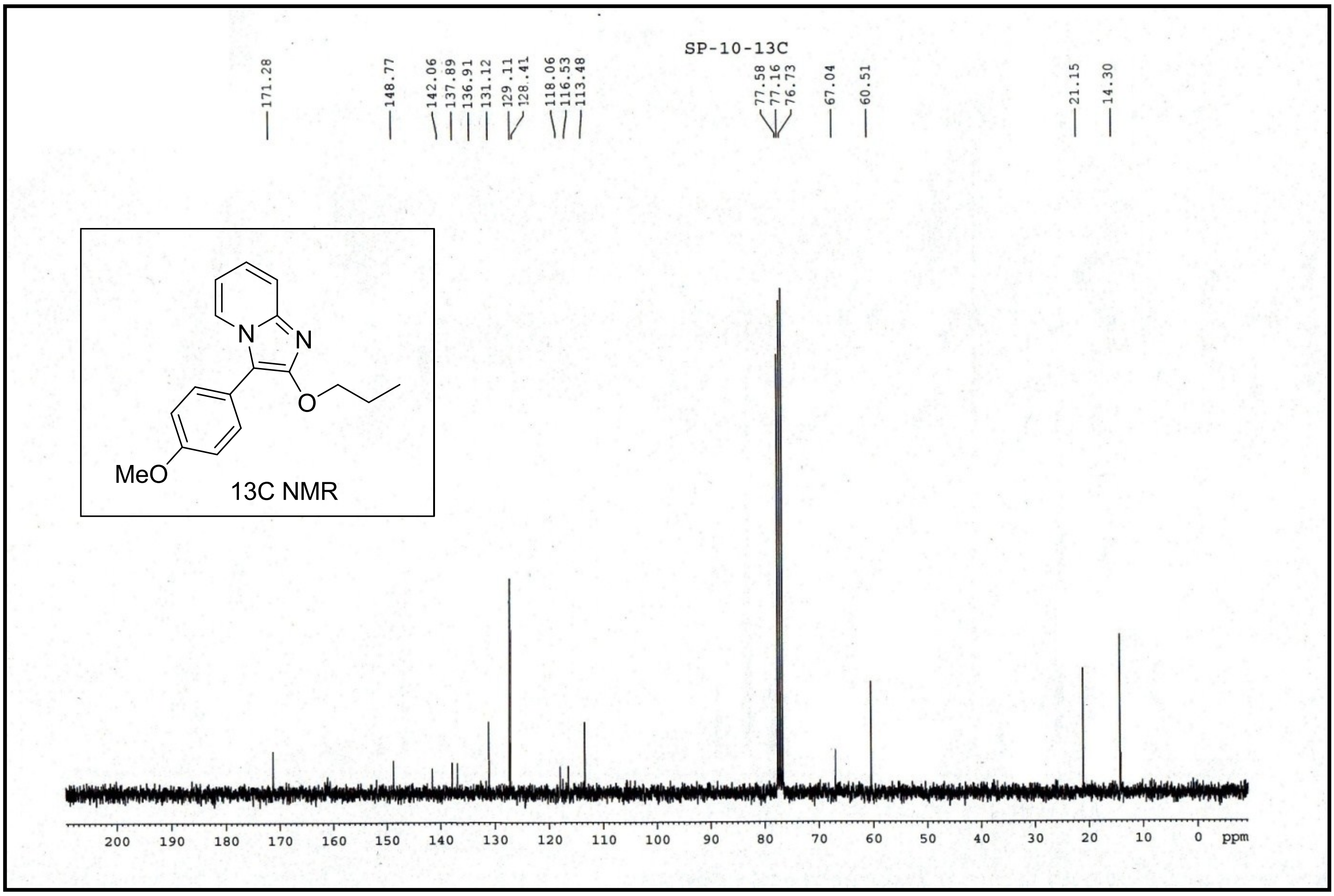
F2 - Processing parameters
SI                32768
SF           75.4677416 MHz
WDW                  EM
SSB       0
LB                 1.00 Hz
GB        0
PC                 1.40
```

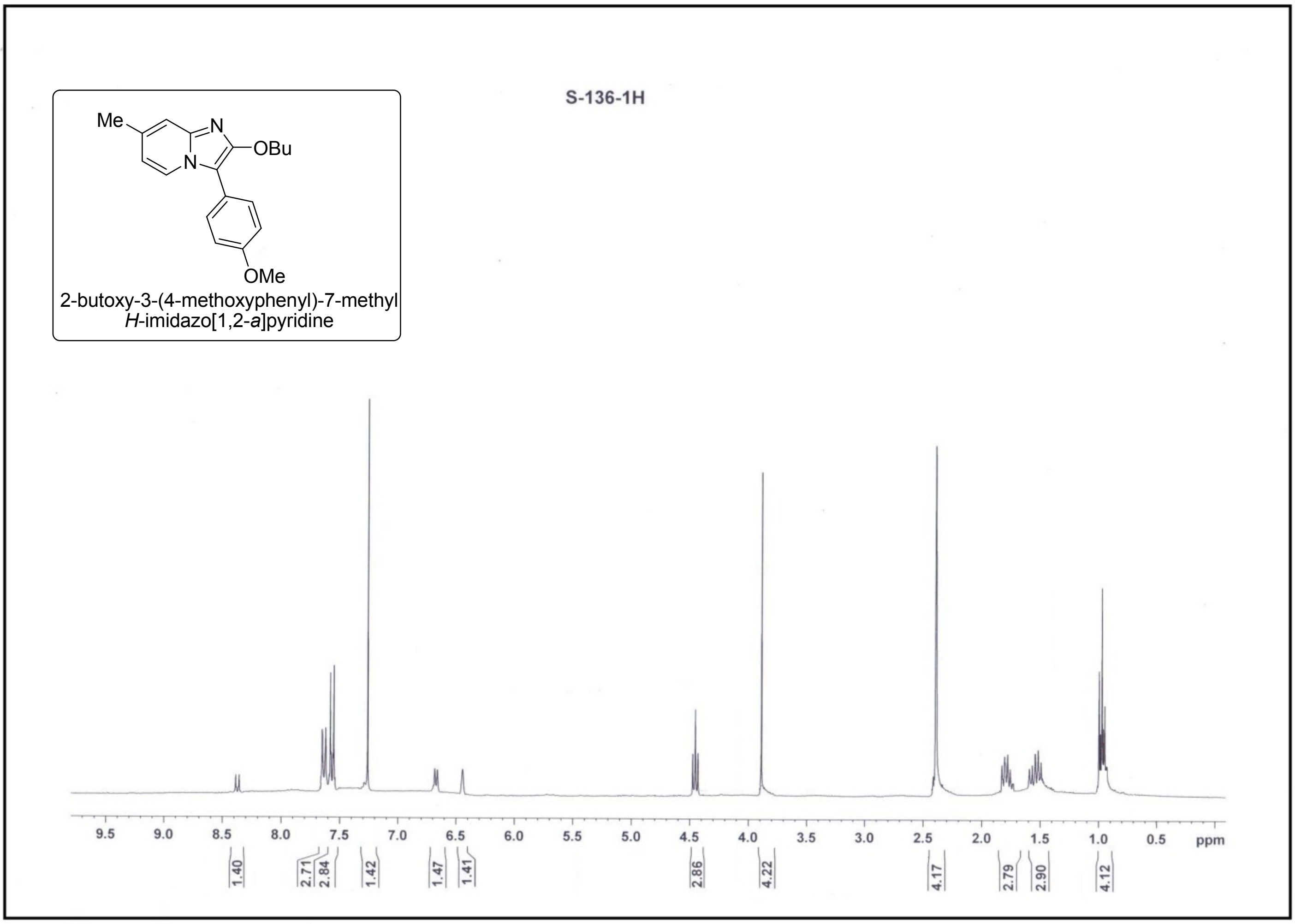

PM-S-114-1H(SR) 500MHz.
8.344
8.336
7.505
7.502
7.489
7.487
7.474
7.471
7.270
7.261
7.252
6.905
6.894
6.881
6.733
6.727
6.710
6.584
6.568
4.393
4.380
4.367
3.756
1.835
1.821
1.807
1.791
1.778
1.554
1.539
1.524
1.509
1.494
1.007
0.993
0.978
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
ppm
1.00
1.16
3.72
1.93
2.46
1.32
2.37
3.69
2.82
3.22
4.09
MeO

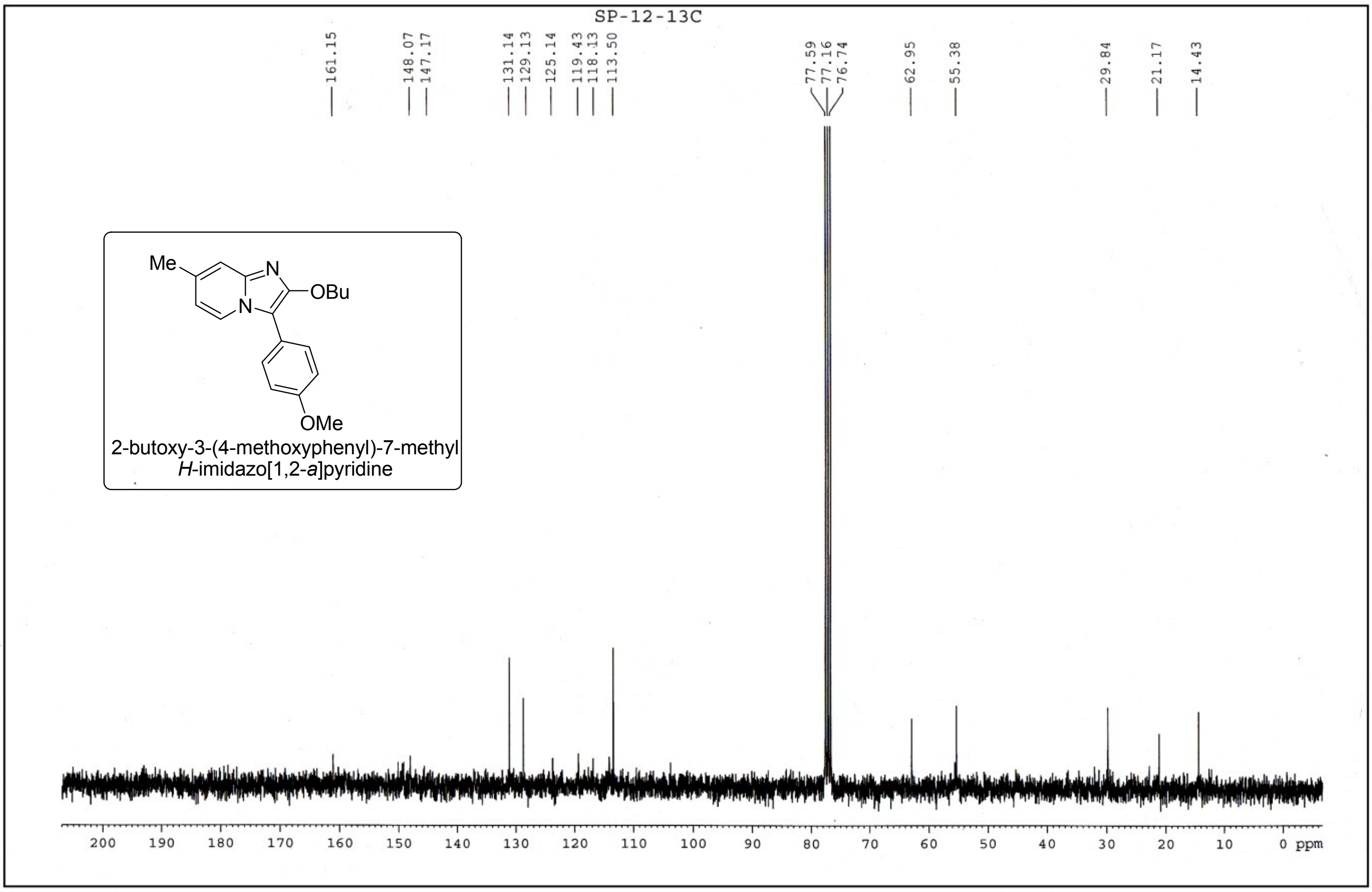

PM-S-113-1H(SR) 500MHz.
8.171
8.161
7.296
7.280
7.261
7.225
7.209
7.022
7.006
6.892
6.882
6.714
6.704
4.447
4.433
4.419
4.404
2.257
2.246
1.441
1.427
1.413
1.395
1.381
1.367
N
OEt
N
Me
1H NMR
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
0.43
1.85
1.03
0.90
1.07
0.40
0.90
1.26
1.39

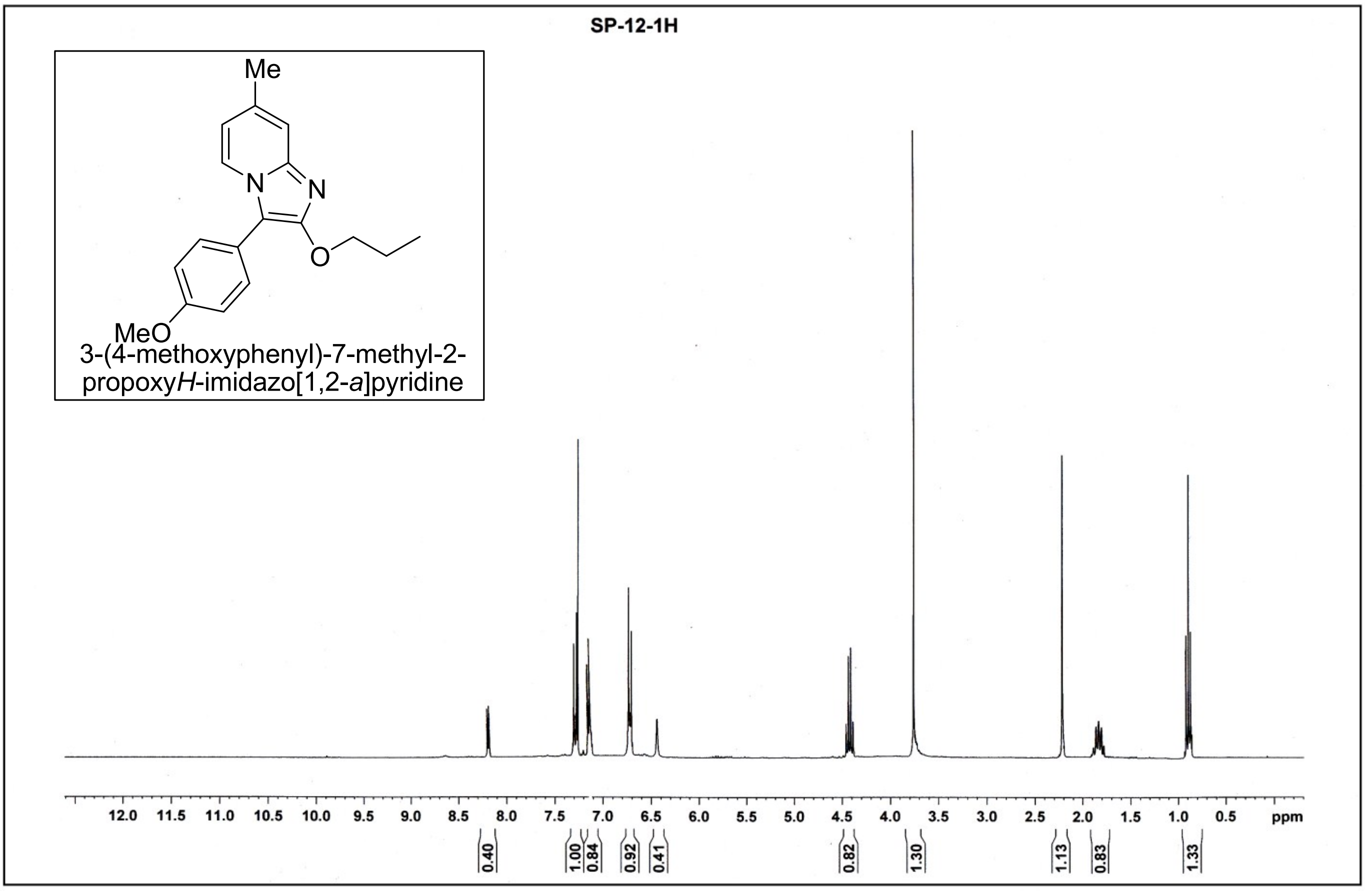

NM-S-82-1H(SR) 500MHz
7.994
7.981
7.917
7.900
7.406
7.389
7.261
6.970
6.957
6.708
6.695
6.681
4.149
4.131
4.113
4.106
2.675
2.653
1.575
1.284
1.274
1.256
Me
N
N
OEt
Cl
1H NMR
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
1.01
1.80
1.00
2.86
1.77
1.31
2.26
3.37
9.30
3.34

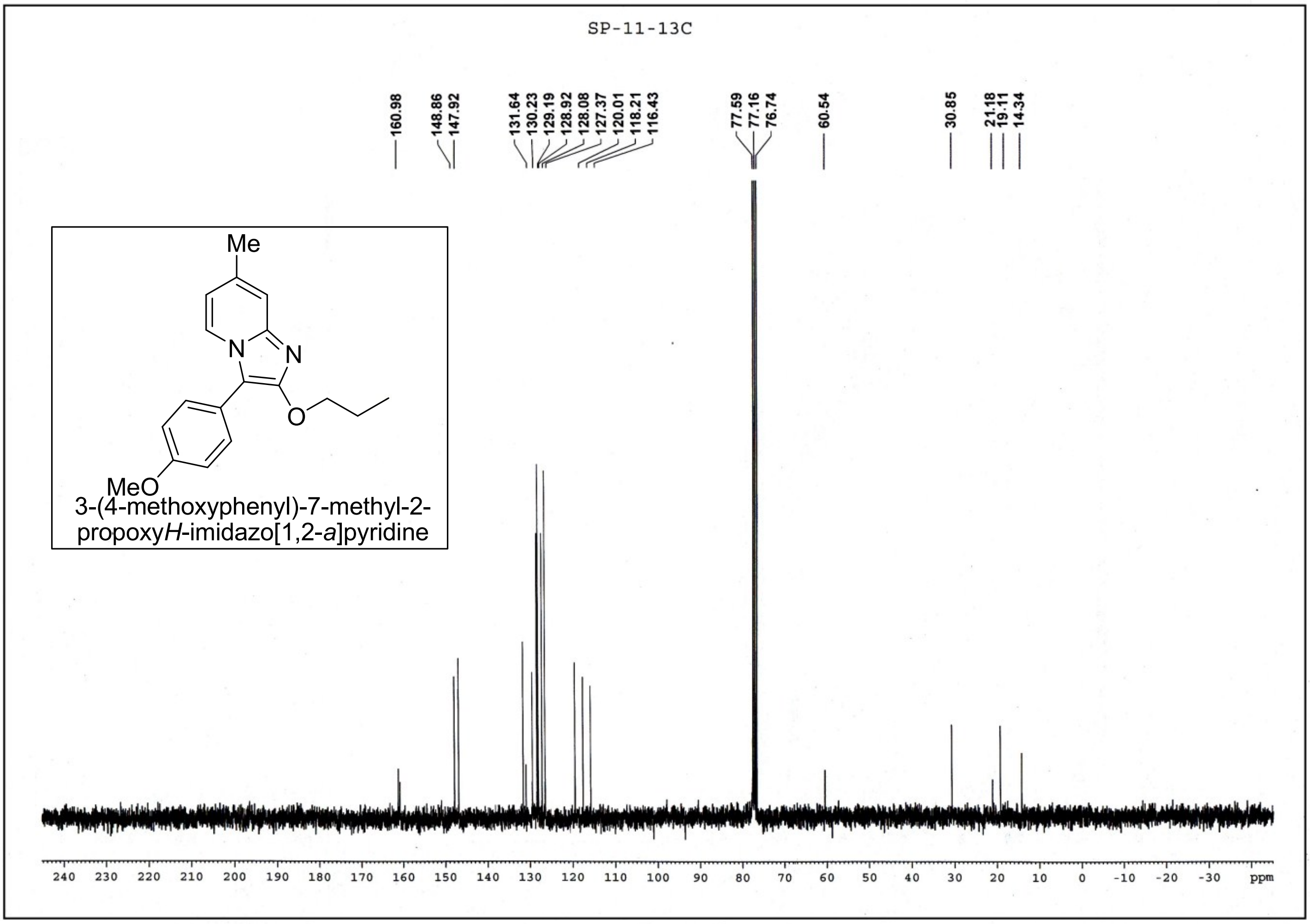

N
N
O
MeO
1HNMR
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
0.52
0.51
0.46
0.97
1.00
0.46
0.92
1.56
0.93
1.48


SP-10-13C
171.28
148.77
142.06
137.89
136.91
131.12
129.11
128.41
118.06
116.53
113.48
77.58
77.16
76.73
67.04
60.51
21.15
14.30
N
N
O
MeO
13C NMR
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


Me
N
OBu
N
OMe
2-butoxy-3-(4-methoxyphenyl)-7-methyl
H-imidazo[1,2-a]pyridine
S-136-1H
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.40
2.71
2.84
1.42
1.47
1.41
2.86
4.22
4.17
2.79
2.90
4.12


SP-12-13C
161.15
148.07
147.17
131.14
129.13
125.14
119.43
118.13
113.50
77.59
77.16
76.74
62.95
55.38
29.84
21.17
14.43
Me
N
OBu
N
OMe
2-butoxy-3-(4-methoxyphenyl)-7-methyl
H-imidazo[1,2-a]pyridine
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm


SP-12-1H
Me
N
N
O
MeO
3-(4-methoxyphenyl)-7-methyl-2-propoxy*H*-imidazo[1,2-*a*]pyridine
12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
0.40
1.00
0.84
0.92
0.41
0.82
1.30
1.13
0.83
1.33



ESI9.Recyclability of Catalyst:

We have examined reusability of the catalyst for the synthesis 2-ethoxy-3-phenylimidazopyridine. After each cycle nano-$NiFe_2O_4$ was recovered simply by using an external magnet, washed with ethanol and reused for subsequent reactions. The magnetic nano-catalyst was reused for eight times with minimum loss of catalytic activity (Figure 5S).

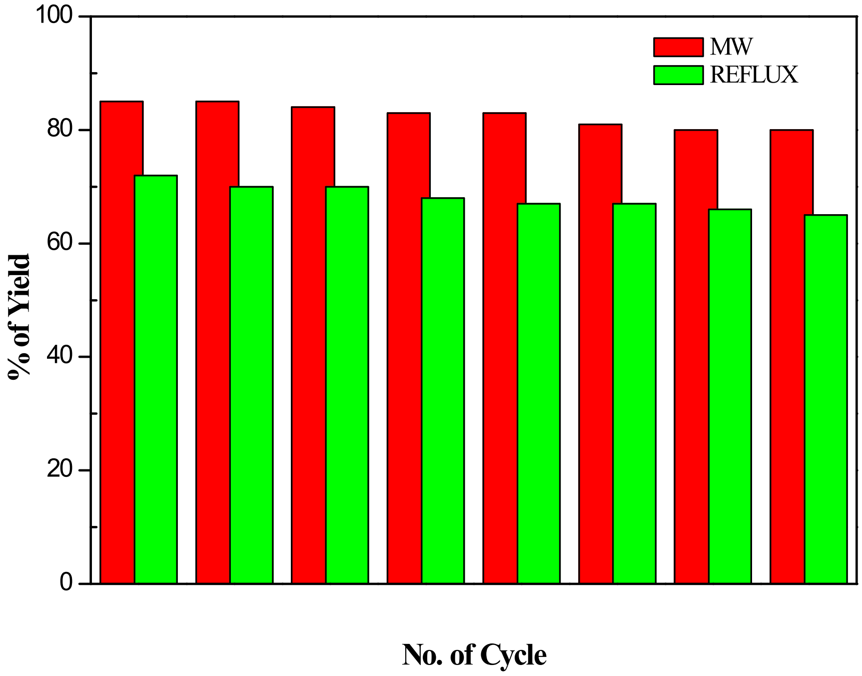


Fig. 4S Recyclability of nano-$NiFe_2O_4$catalyst

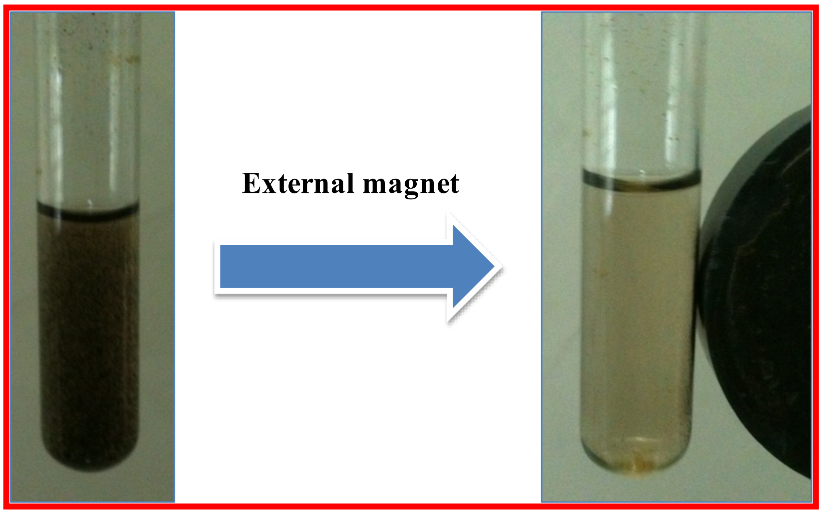


Fig. 5S Separation of magneticof nano-$NiFe_2O_4$catalyst by using an external magnet.

ESI 10.References:

[1]. For preparation of $NiFe_2O_4$: P. Sivakumar, R. Ramesh, A. Ramanand, S.Ponnusamy, C. Muthamizhchelvan,*J. Alloys and Compounds*, **2013**,*563*, 6–11.

[2] Zi-You Yu, Li-Feng Chen and Shu-Hong Yu, *J. Mater. Chem.A,***2014**, *2*, 10889.

[3] For preparation of $CuFe_2O_4$: K. Pradhan, S. Paul and A. R. Das, *Catal. Sci. Technol.*, **2014**, *4*, 822.

[4] For preparation of $CoFe_2O_4$: B. Y. Yu, S. Y.Kwak, *Dalton Trans.*, **2011**, *40*, 9989