

Supporting information

Nanoparticle-supported and magnetically recoverable organic–inorganic hybrid copper (II) nanocatalyst: a selective and sustainable oxidation protocol with high turnover number

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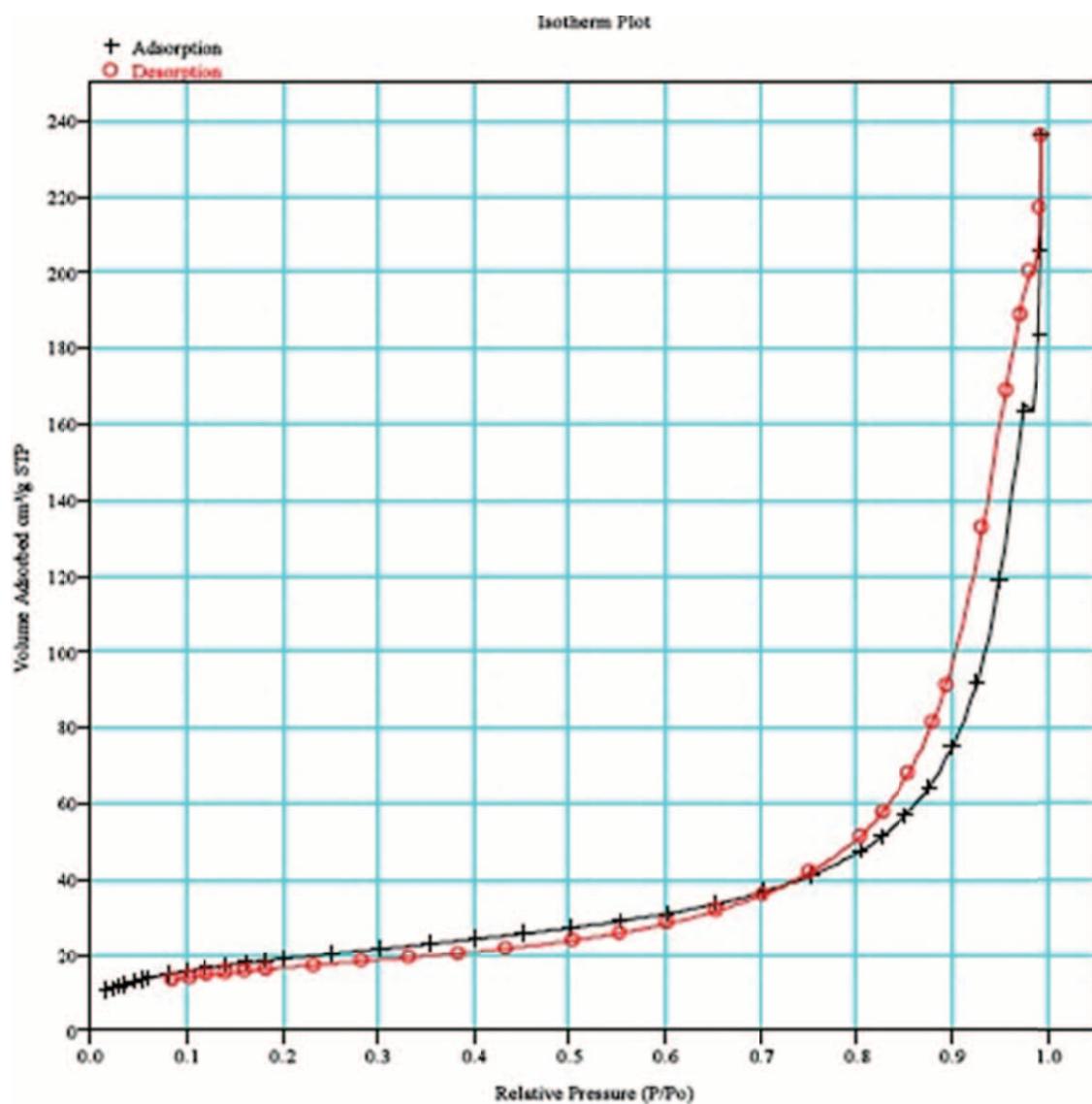


Fig. S1 BET Isotherm Plot for Fe_3O_4 -LD-Cu nanocatalyst

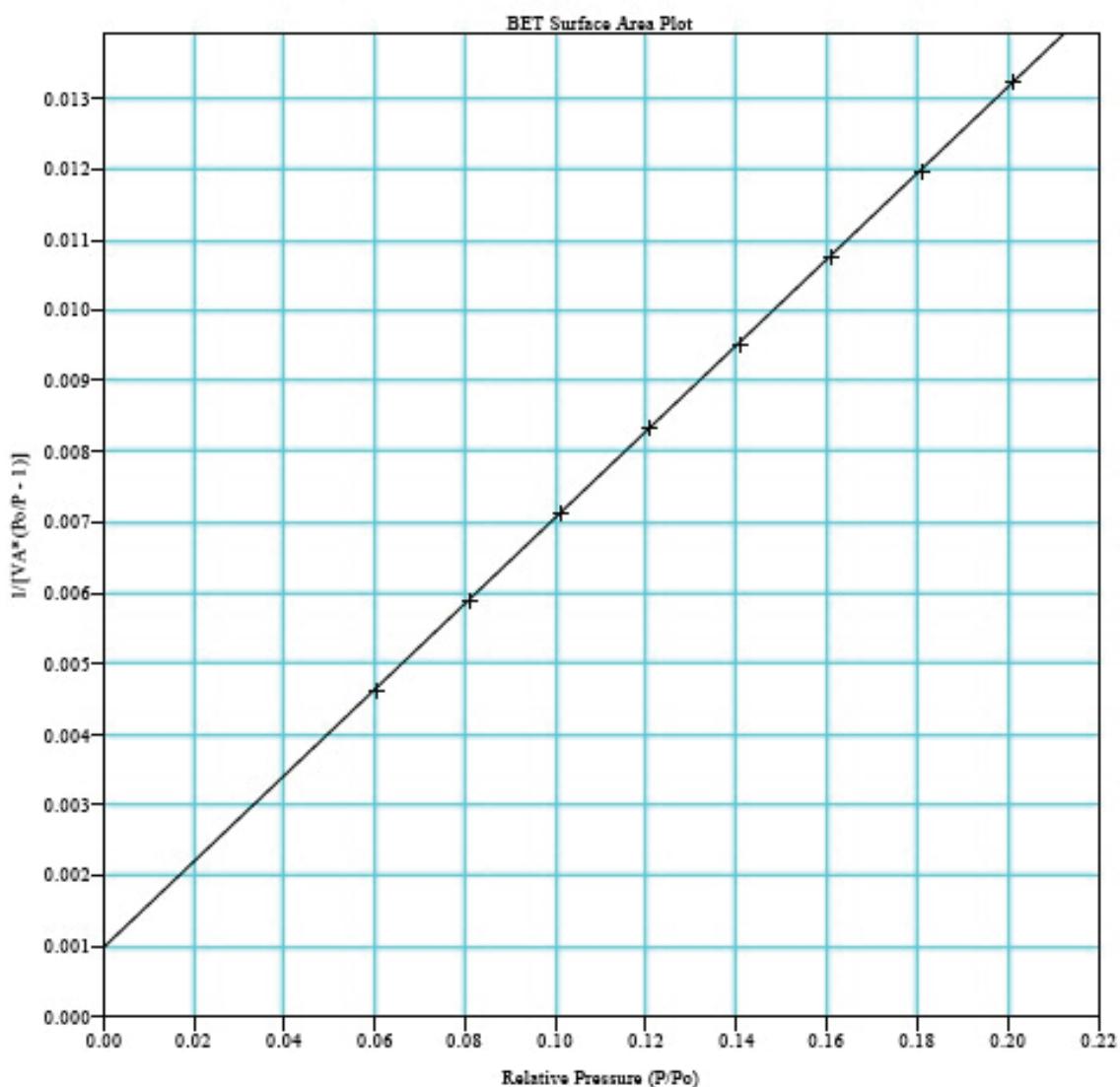


Fig. S2 BET Surface area Plot for Fe_3O_4 -LD-Cu nanocatalyst

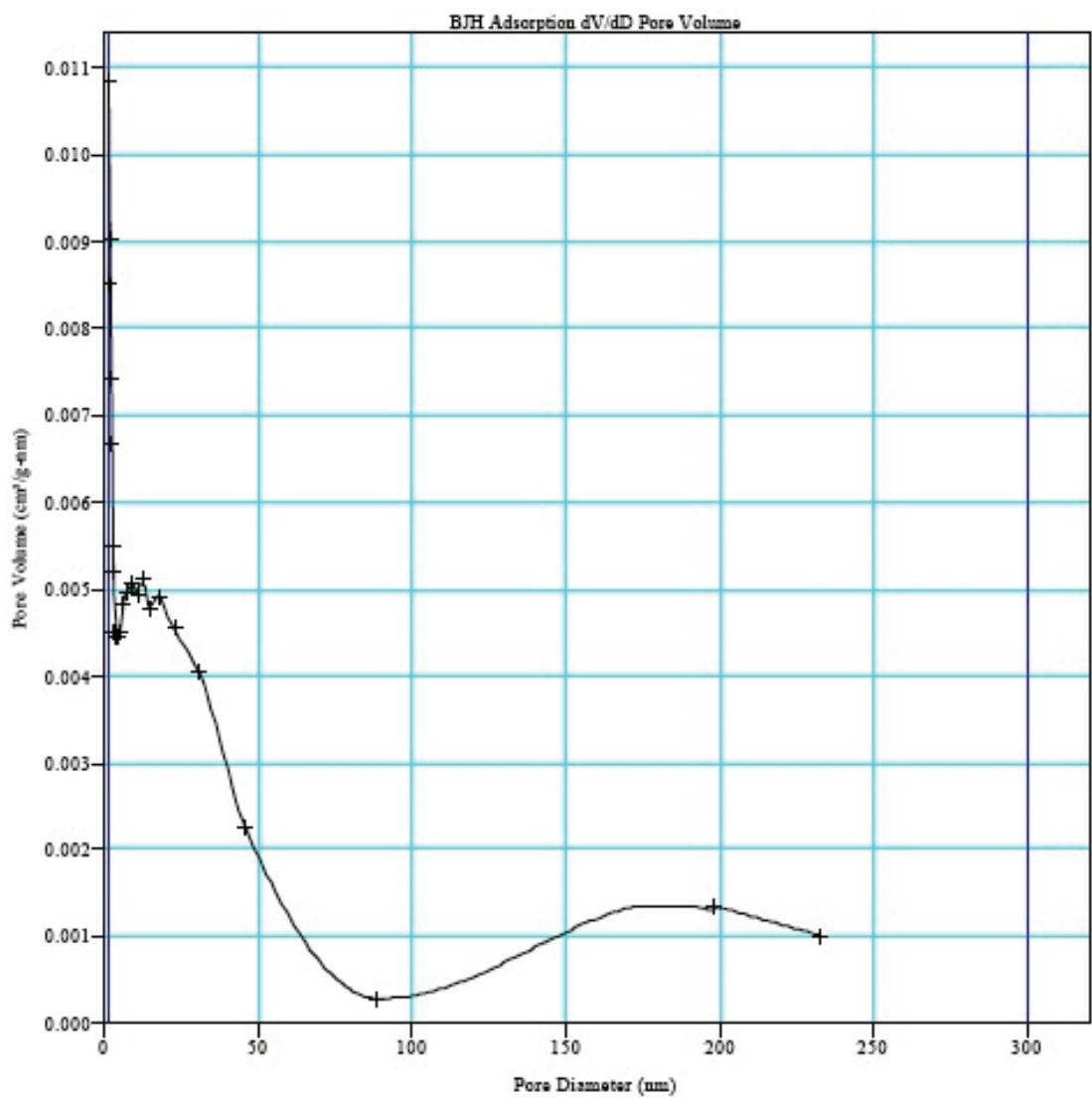


Fig. S3 BJH Adsorption dV/dD Pore Volume for Fe₃O₄-LD-Cu nanocatalyst

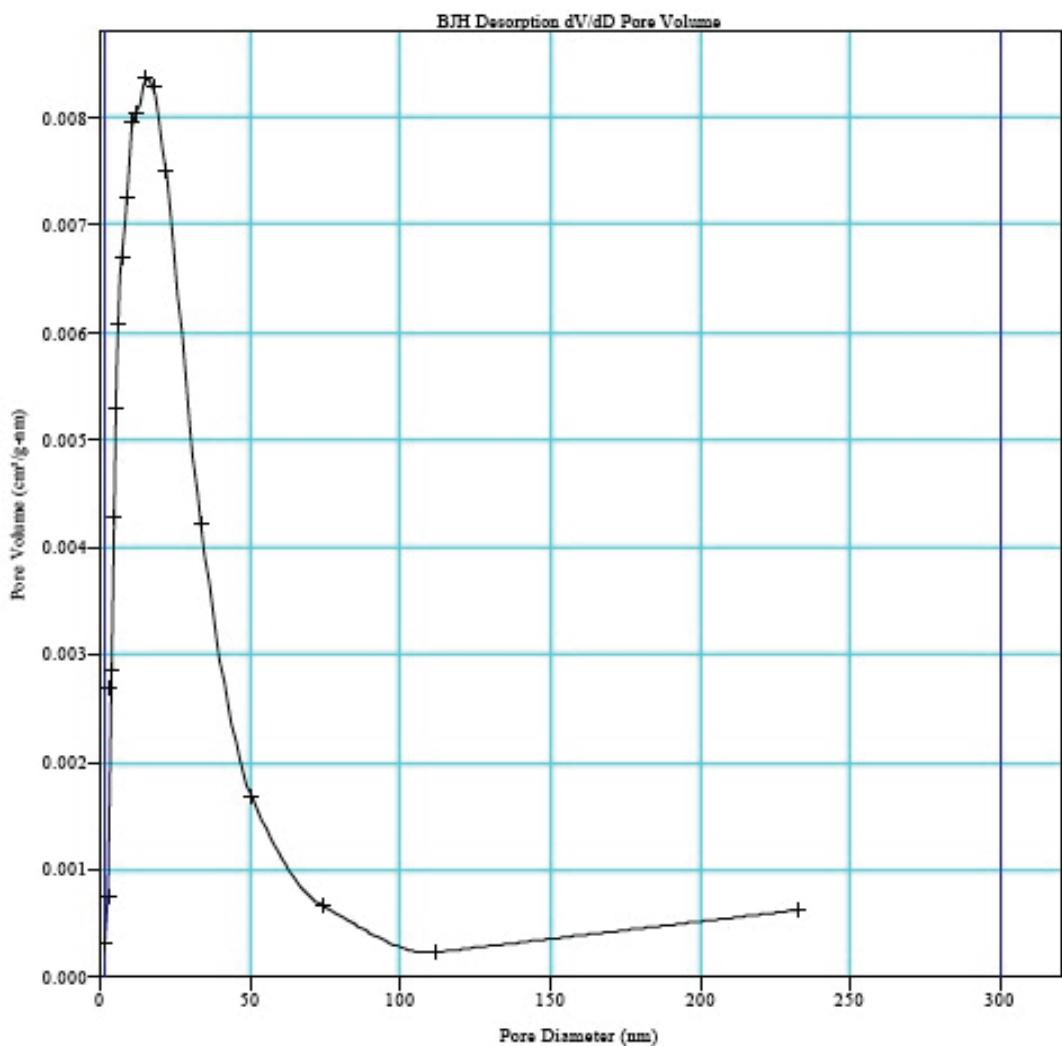


Fig. S4 BJH Desorption dV/dD Pore Volume for Fe_3O_4 -LD-Cu nanocatalyst

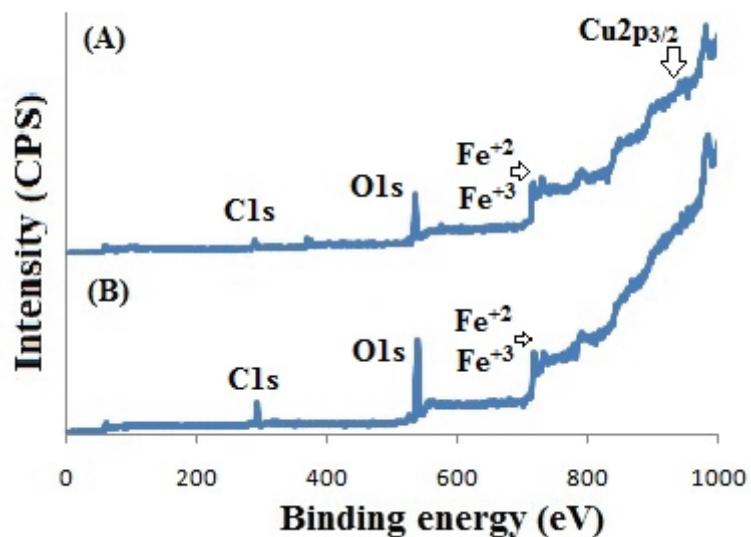


Fig.S5 XPS analysis of Fe_3O_4 and Fe_3O_4 -LD-Cu nanocatalyst

Table-S1 Oxidation of Benzyl alcohol at different Benzyl alcohol /H₂O₂ ratios.^a

Entry	Benzyl alcohol / H ₂ O ₂ (mmol)	T(h)	Yield(±1,by GC)
1	1:1	24	76
2	1:1.1	5	95
3	1:1.2	12	95
4	1:1.4	3.0	90
5	1:1.5	1.5	90
6	1:2	0.5	90

(a) All reaction carried out at 70° C by using Fe₃O₄-LD-Cu nanocatalyst (25 mg).

Table-S2 Yield of product at different time interval by oxidation of Benzyl alcohol to benzaldehyde

Entry	Air oxidation ^a		H ₂ O ₂ oxidation ^b	
	T (h)	Yield(±1, by GC)	T (h)	Yield(±1, by GC)
1	0.5	30	0.5	40
2	1	35	1	56
3	1.5	42	1.5	68
4	2	45	2	75
5	2.5	48	2.5	80
6	3	50	3	85
7	3.5	52	3.5	89
8	4	55	4	96
9	4.5	58	4.5	96
10	5	60	5	96
11	5.5	60	5.5	96
12	6	60	6	96

(a) All reaction carried out at 25-30 °C by using Fe₃O₄-LD-Cu nanocatalyst (25 mg) and air as oxidant. (b) All reaction carried out at 70 °C by using Fe₃O₄-LD-Cu nanocatalyst (25 mg) and H₂O₂ as oxidant (Benzyl alcohol: H₂O₂ (30% v/v) mole ratio = 1: 1.1)

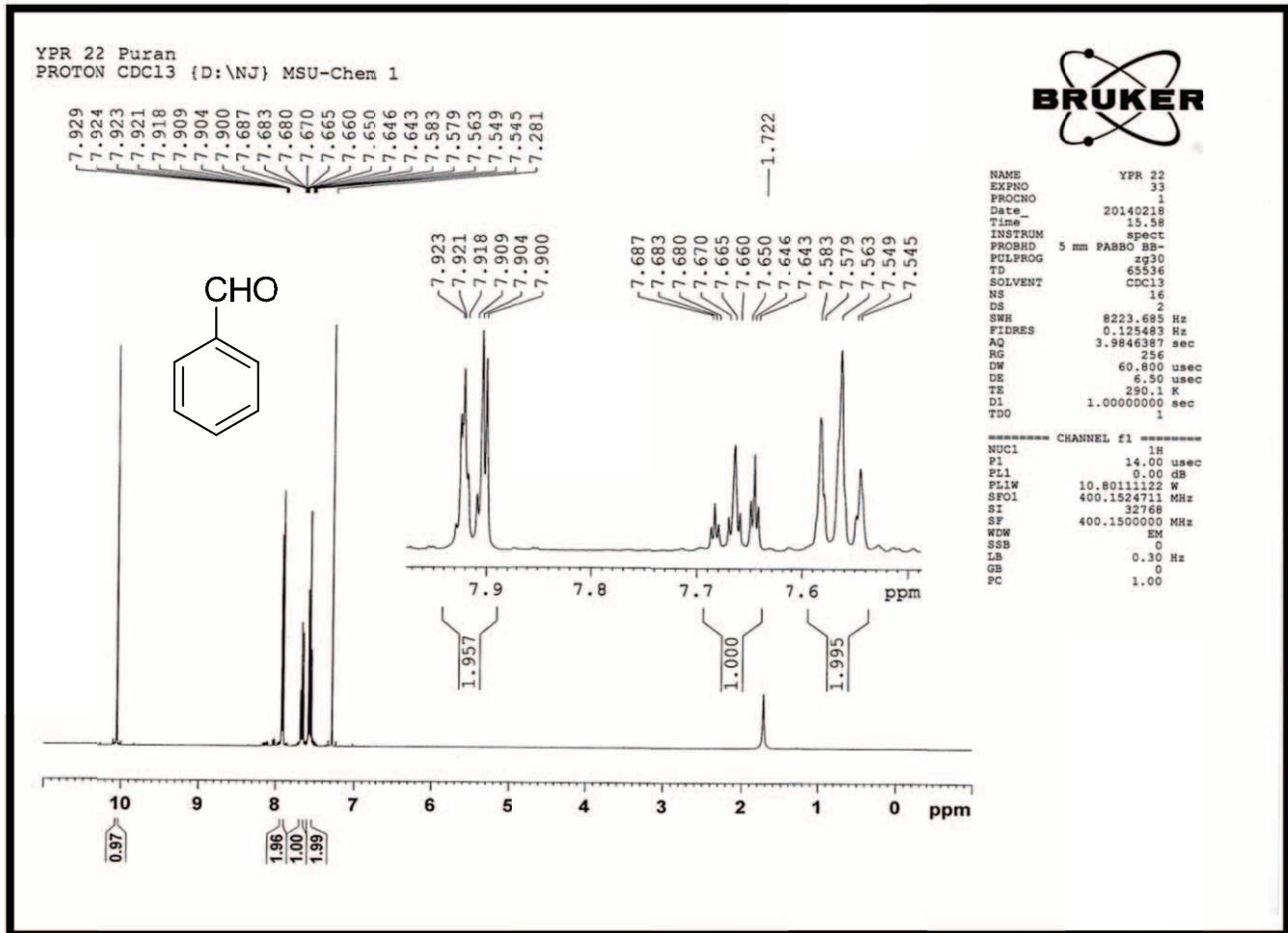


Fig. S6 ¹H NMR spectra of benzaldehyde (CDCl₃, Table-2, Entry-1)

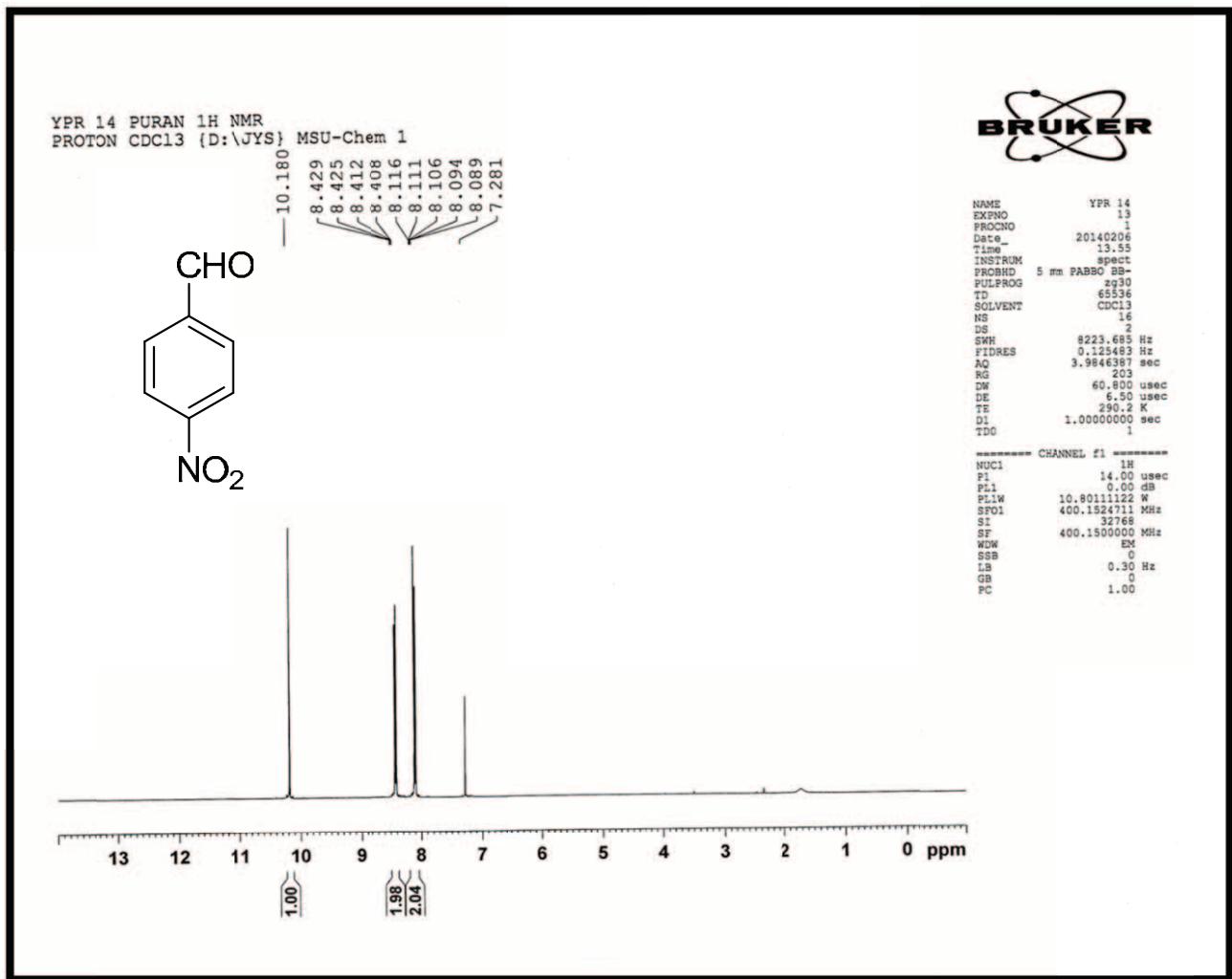


Fig. S7 ¹H NMR spectra of 4-nitrobenzaldehyde (CDCl₃, Table-2, Entry-2)

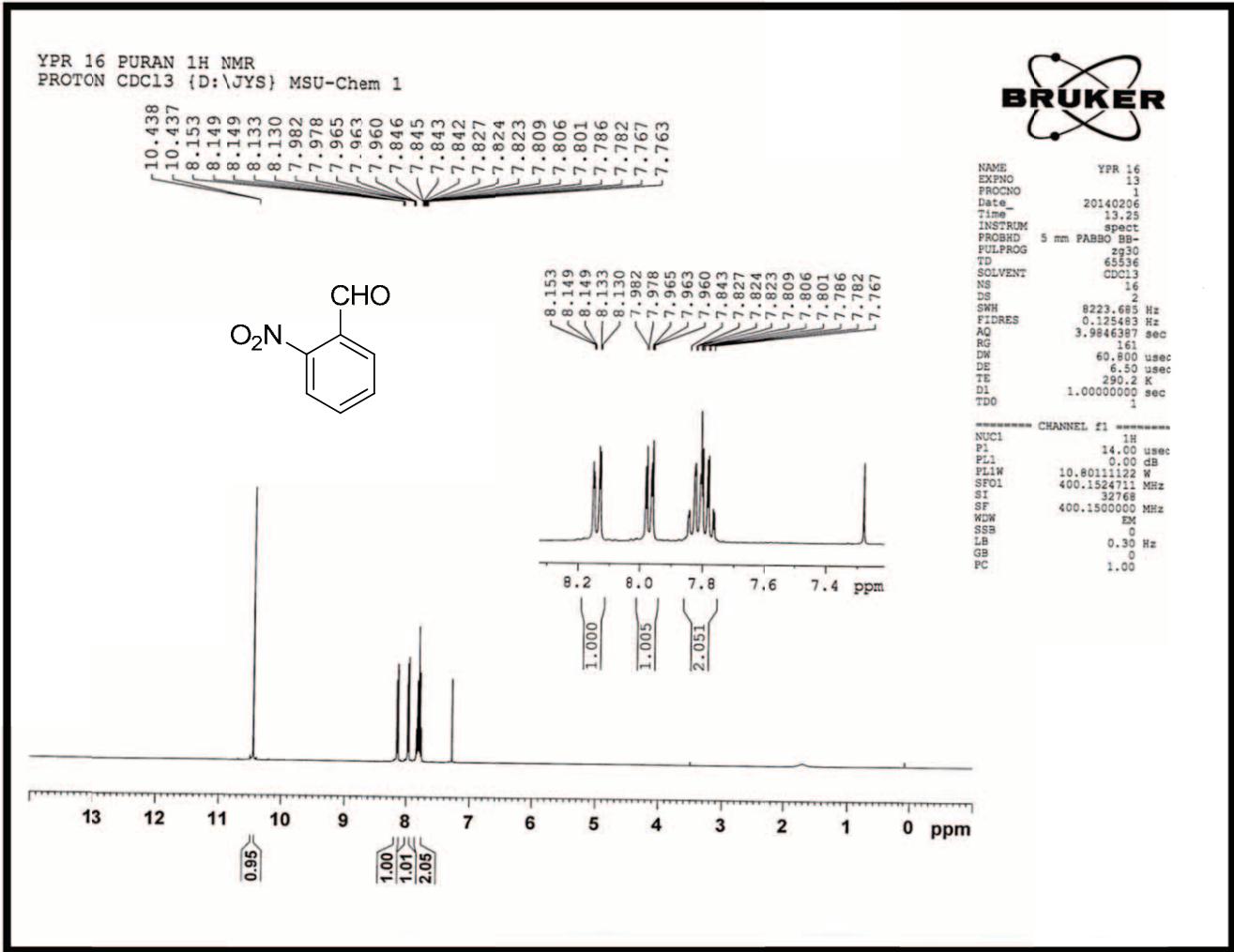


Fig. S8 ¹H NMR spectra of 2-nitrobenzaldehyde (CDCl₃, Table-2, Entry-3)

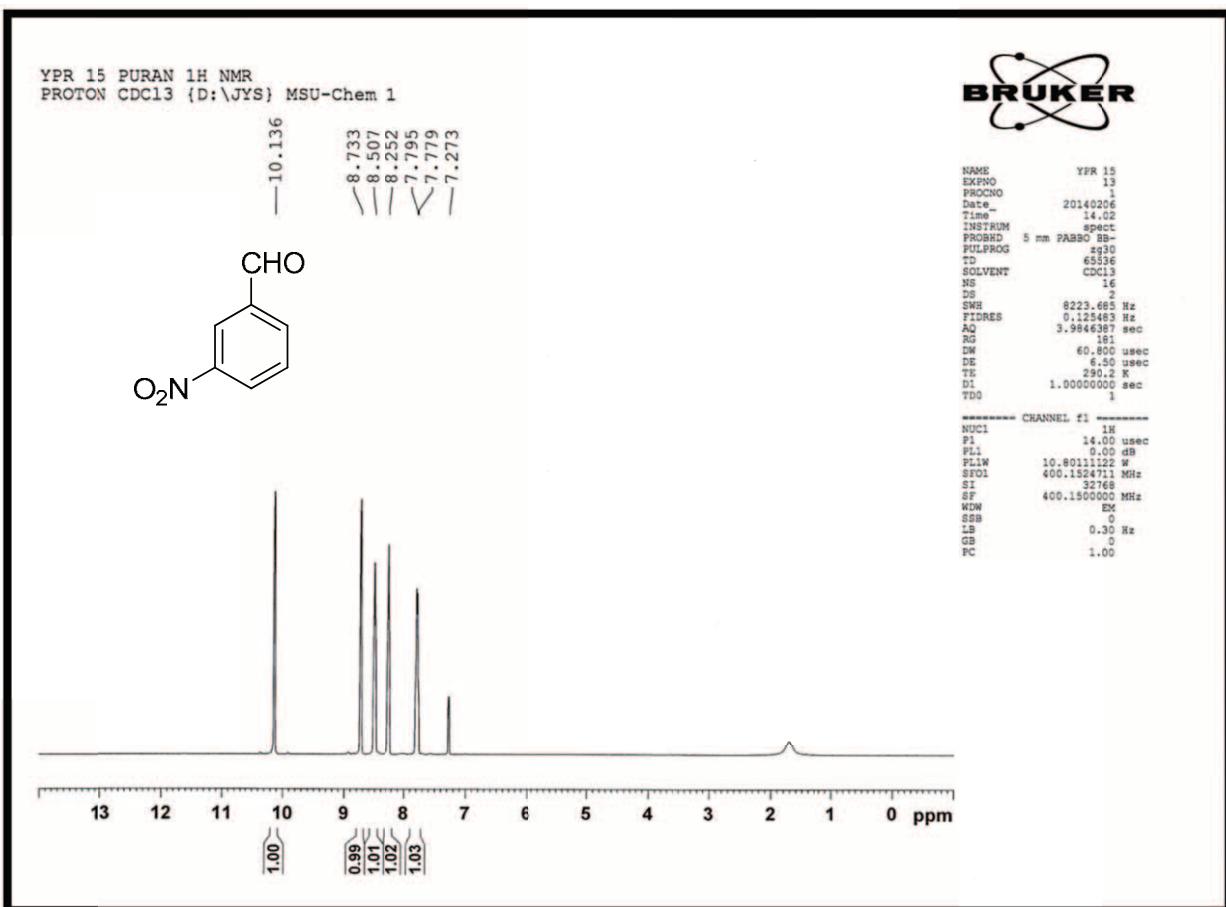
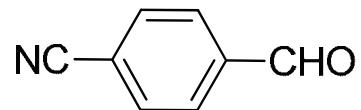


Fig. S9 ¹H NMR spectra of 3-nitrobenzaldehyde (CDCl₃, Table-2, Entry-4)

YPR B puran singh
PROTON CDCl₃ {D:\NJ} MSU-Chem 1



9.883 7.841 7.006



NMRE YPR B
EXPNO 13
PROCNO 1
Date 20140205
Time 16.37
INSTRUM spect
PROBHD 5 mm PABBO BB
PULPROG zg30
TD 65536
SOLVENT CDCl₃
NS 16
DS 2
SWH 8223.683 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 64
DW 60.00 usec
DE 6.50 usec
TE 290.2 K
DI 1.0000000 sec
TDO 1

***** CHANNEL f1 *****
NUC1 1H
P1 14.00 usec
PL1 0.00 usec
PLW 10.80111711 °W
SI 400.1524711 MHz
SF 400.1500000 MHz
NOW 0
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



Fig. S10 ¹HNMR spectra of 4-cynobenzaldehyde (CDCl₃, Table-2, Entry-5)



Fig. S11 ^1H NMR spectra of 4-methylbenzaldehyde (CDCl₃, Table-2, Entry-6)

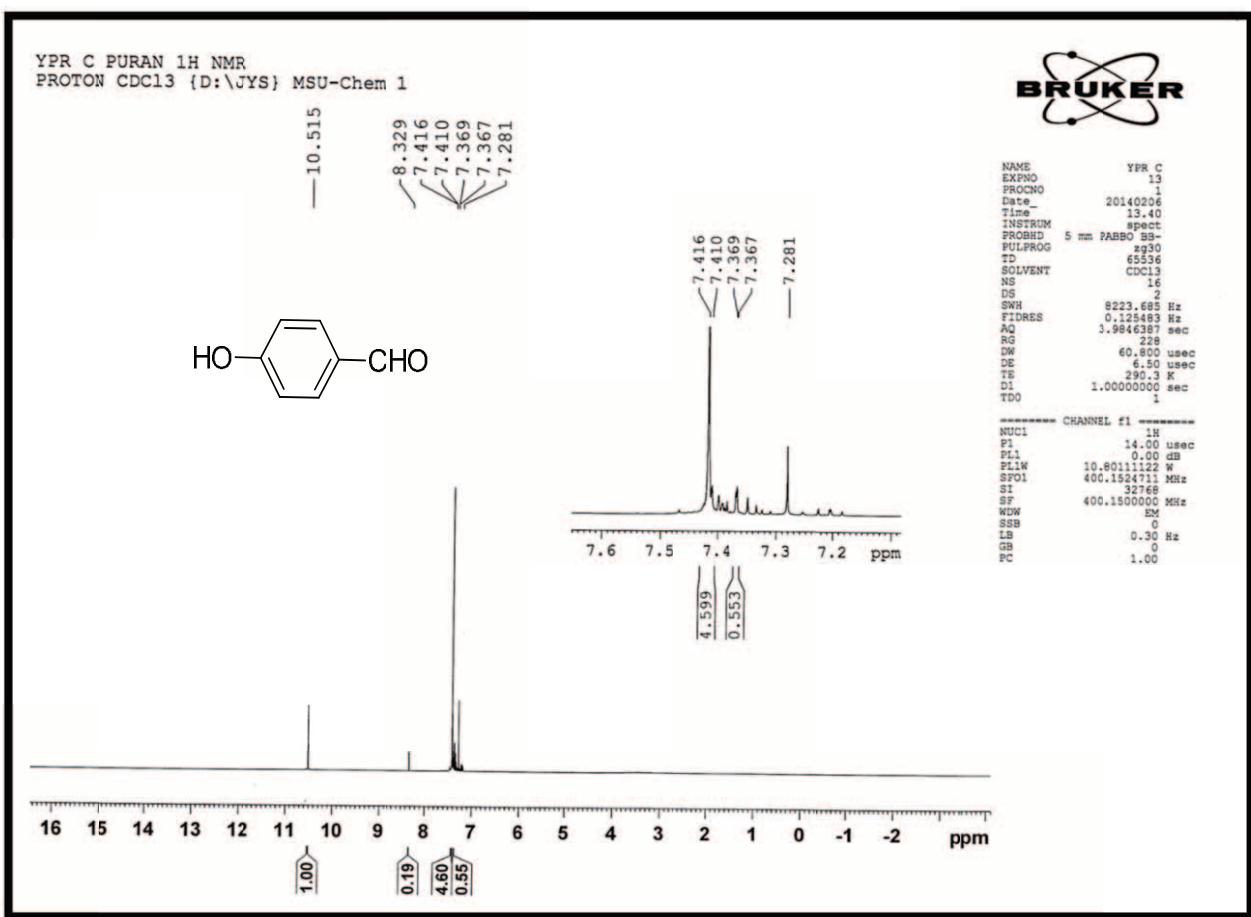
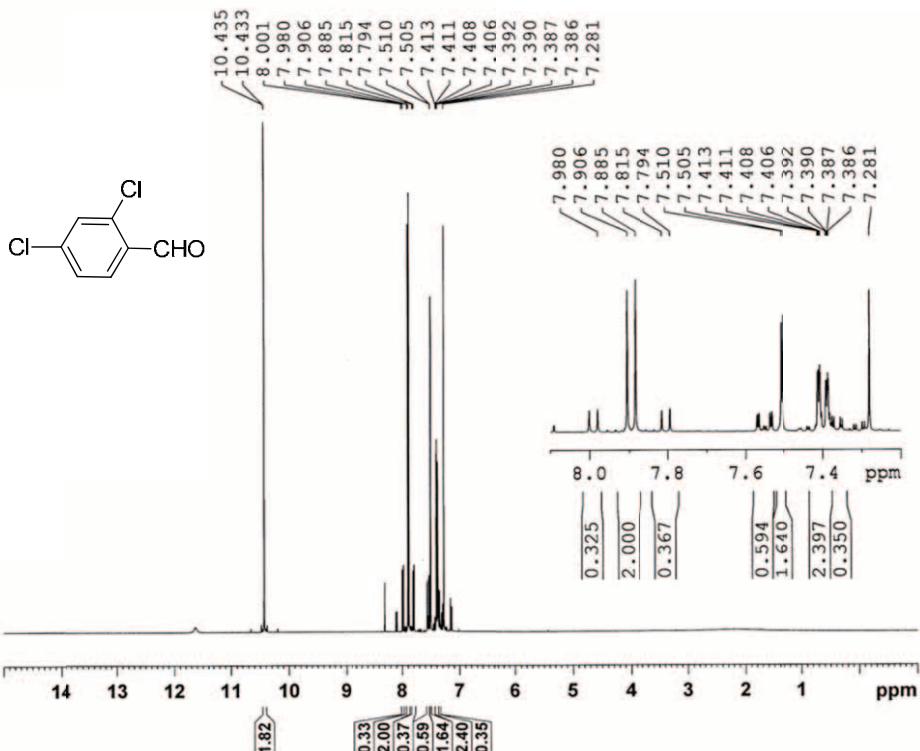


Fig. S12 ¹HNMR spectra of 4-hydroxybenzaldehyde (CDCl₃, Table-2, Entry-7)

YPR 26 (PURAN)
PROTON CDCl₃ {D:\AVS} MSU-Chem 1



NAME YPR 26
EXPNO 53
PROCNO 1
Date 20140222
Time 12.46
INSTRUM spect
PROBHD 5 mm PABBO BB
PULPROG zg30
TD 65536
SOLVENT CDCl₃
NS 16
DS 2
SWH 8223.685 Hz
FIDRES 0.125483 Hz
AQ 3.9846387 sec
RG 228
DW 60.800 usec
DE 6.50 usec
TE 290.0 K
TM 1.0000000 sec
D1 1.0000000 sec
TDO 1

===== CHANNEL f1 =====

NUC1 1H
P1 14.00 usec
PL1 0.00 dB
PL1W 10.8011764 Hz
SF01 400.1524712 MHz
SI 32768
SF 400.1500000 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

Fig. S13 ¹H NMR spectra of 2,4-dichlorobenzaldehyde (CDCl₃, Table-2, Entry-8)

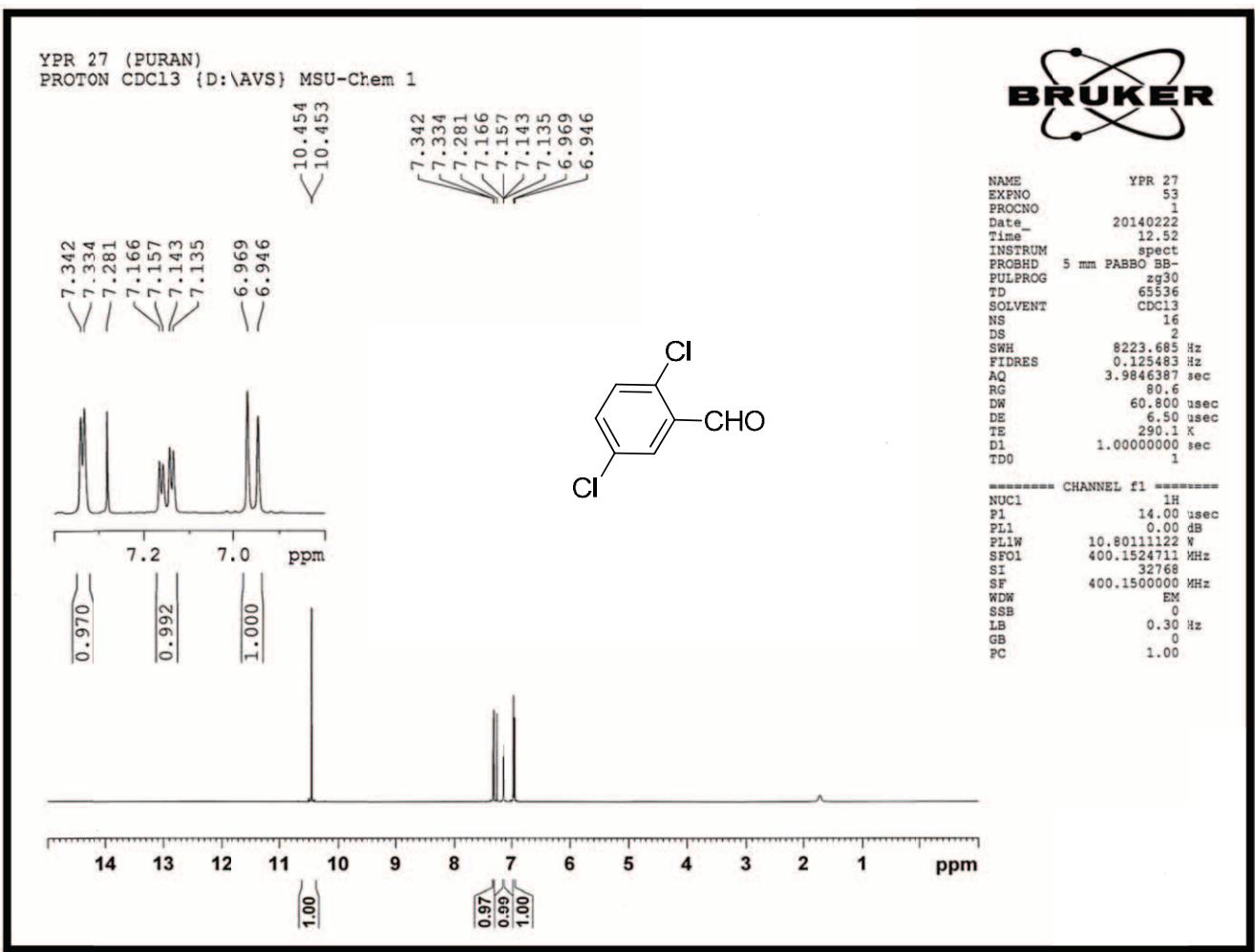


Fig. S14 ¹H NMR spectra of 2,5-dichlorobenzaldehyde (CDCl₃, Table-2, Entry-9)

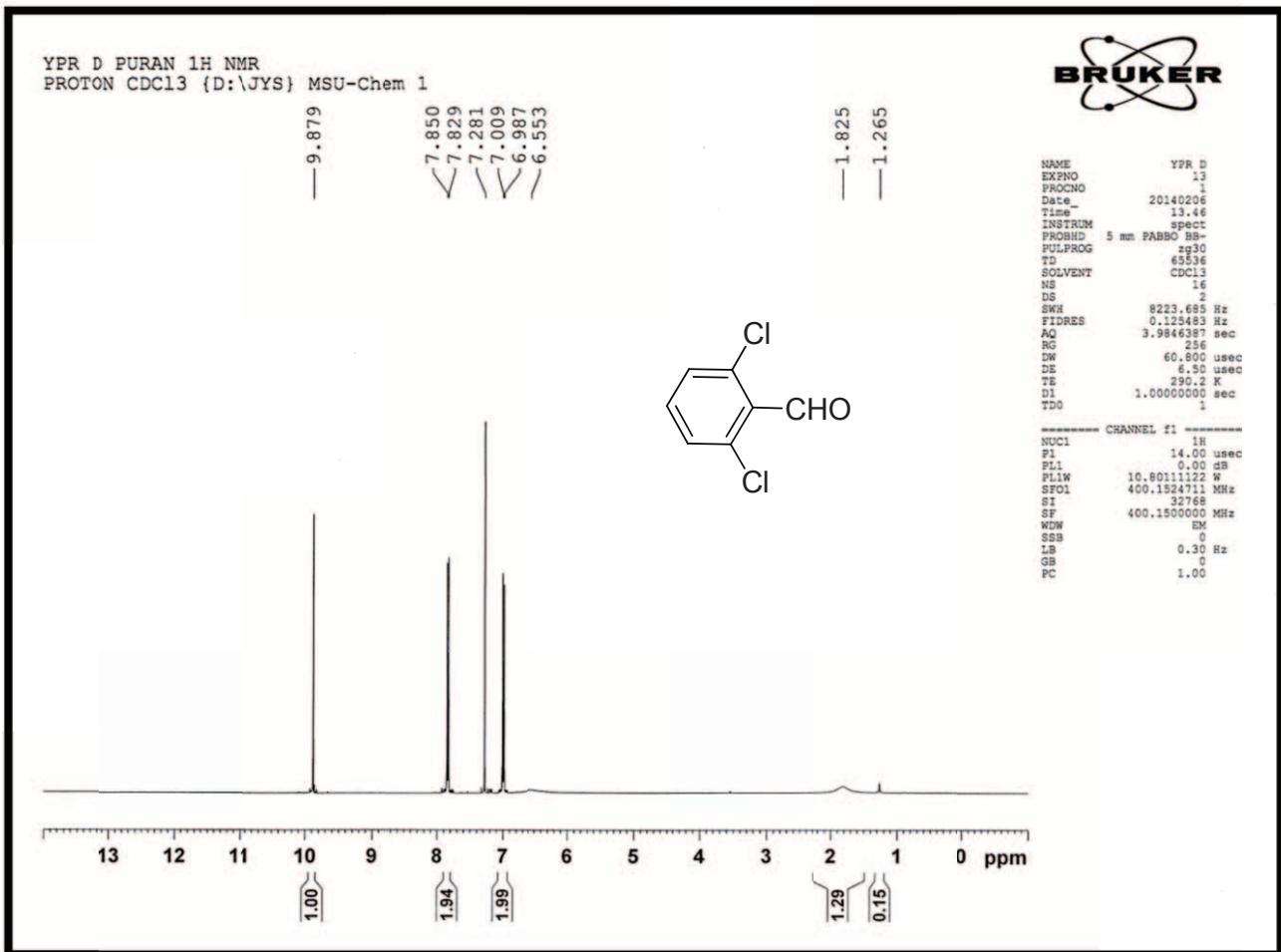


Fig. S15 ¹HNMR spectra of 2,6-dichlorobenzaldehyde (CDCl₃, Table-2, Entry-10)

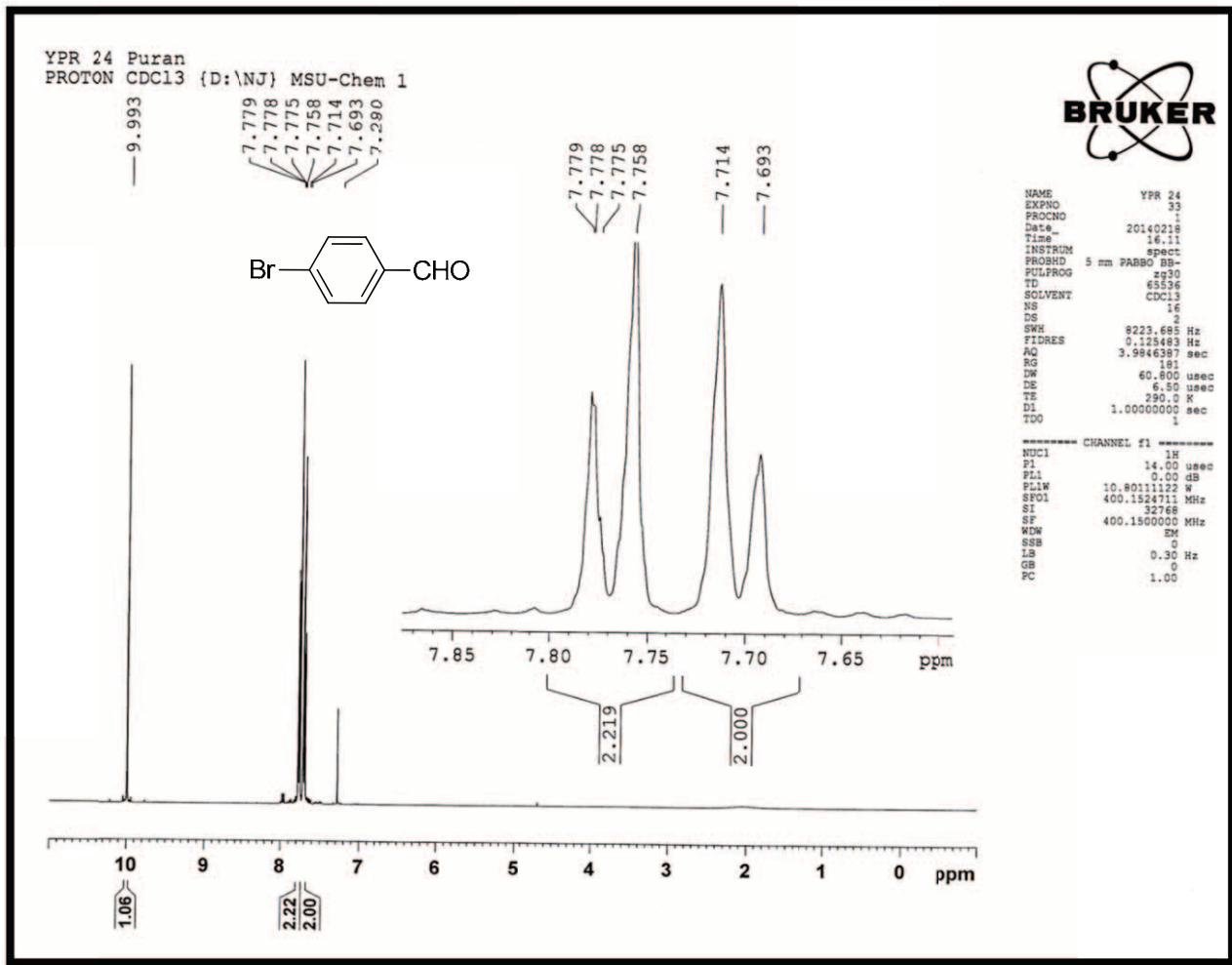


Fig. S16 ¹HNMR spectra of 4-bromobenzaldehyde (CDCl₃, Table-2, Entry-11)

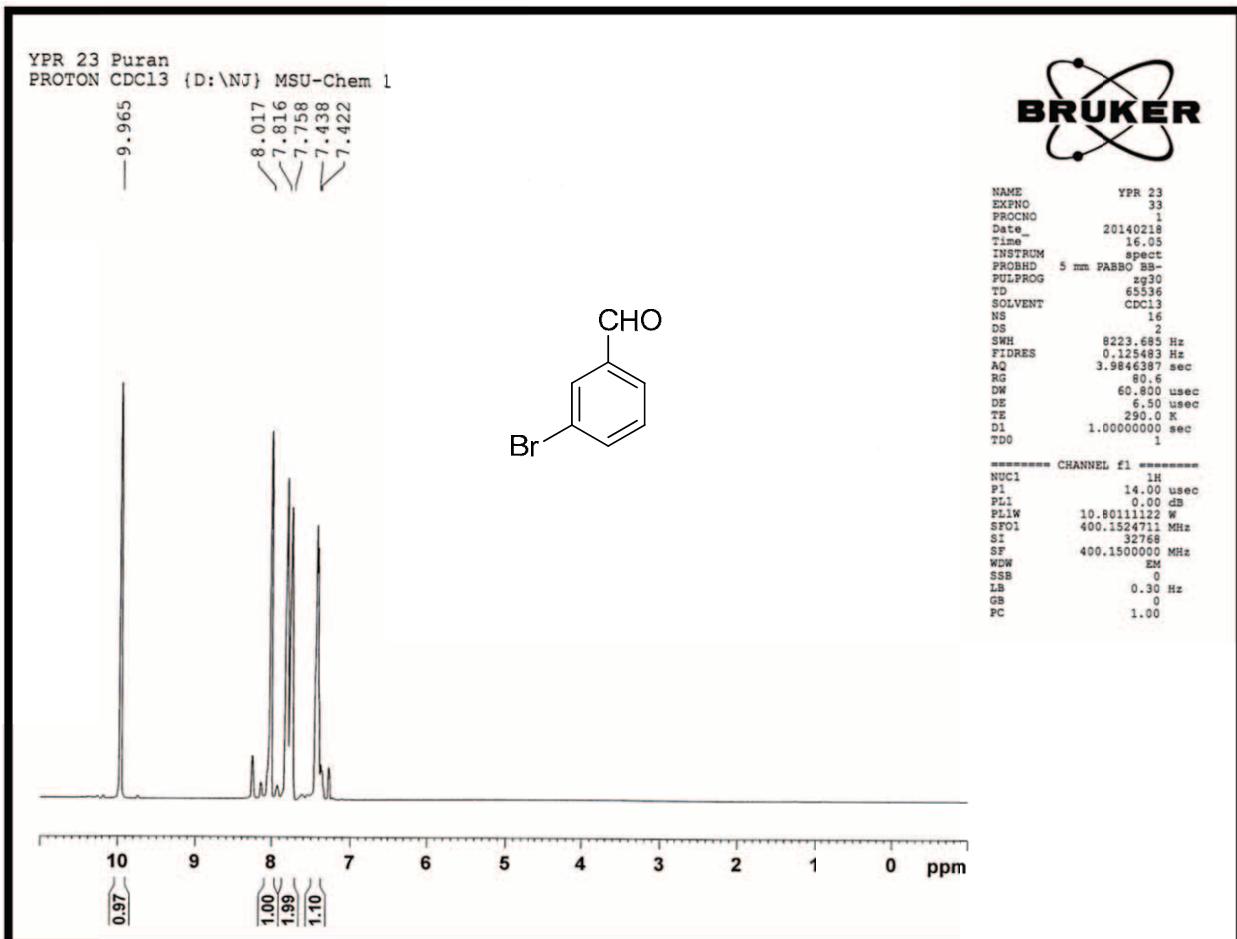


Fig. S17 ¹H NMR spectra of 3-bromobenzaldehyde (CDCl₃, Table-2, Entry-12)

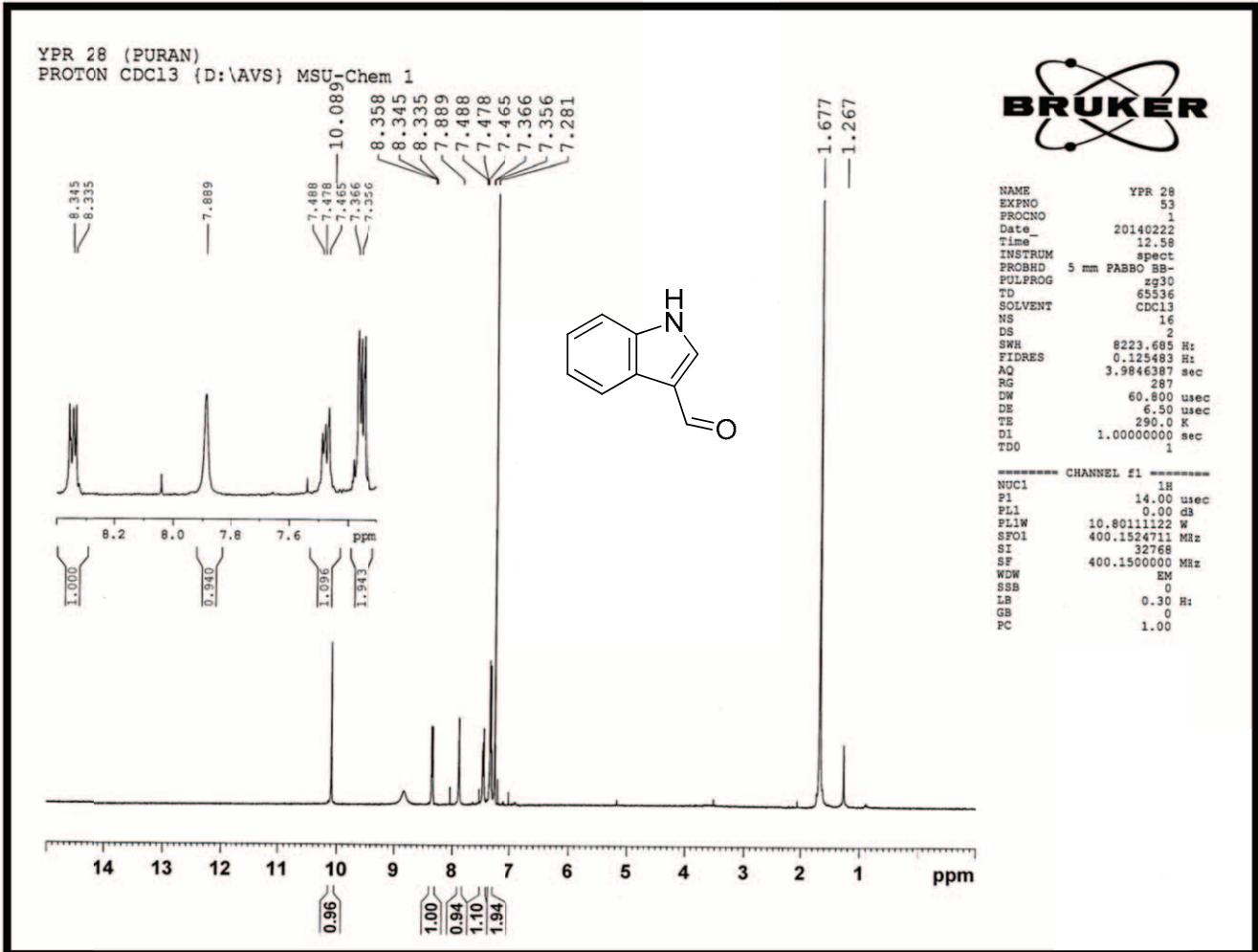


Fig. S18 ¹HNMR spectra of Indole-3-carboxaldehyde (CDCl₃, Table-2, Entry-13)