Electronic Supplementary Material (ESI) for RSC Advances.

Oxalate capped Iron Nano: From Methylene blue degradation to Bis(indolyl)methane synthesis

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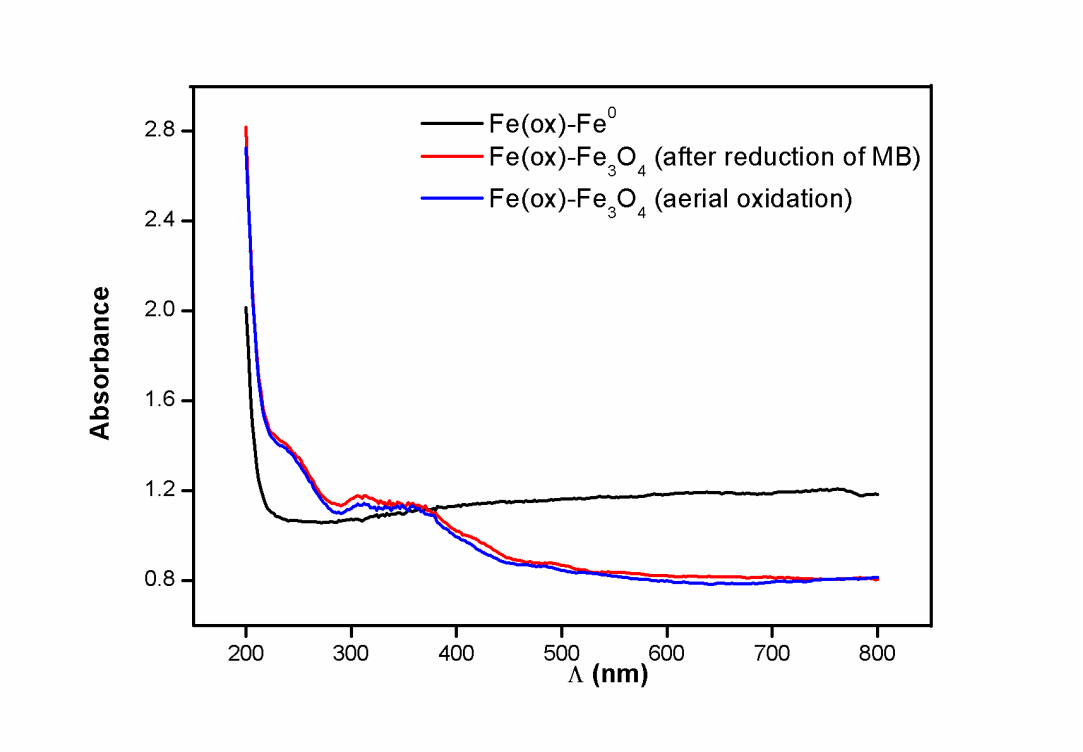


Fig. **S1**. UV-vis spectrum of Fe(ox)-Fe^0, before and after the oxidation.

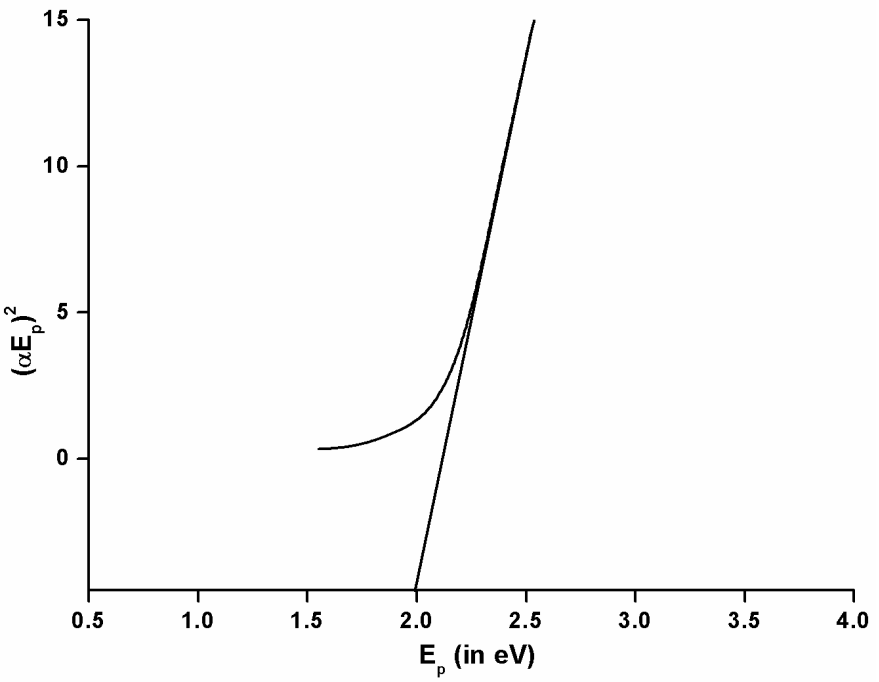


Fig. S2. Band gap value of Fe(ox)-Fe_3O_4.

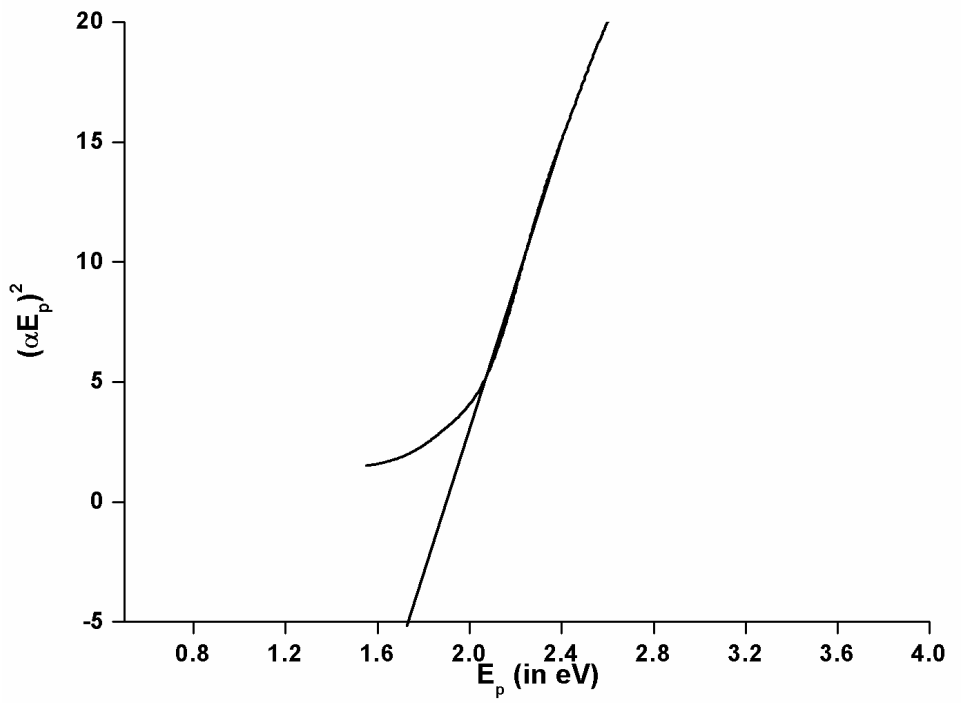


Fig. S3. Band gap value of Fe_3O_4.

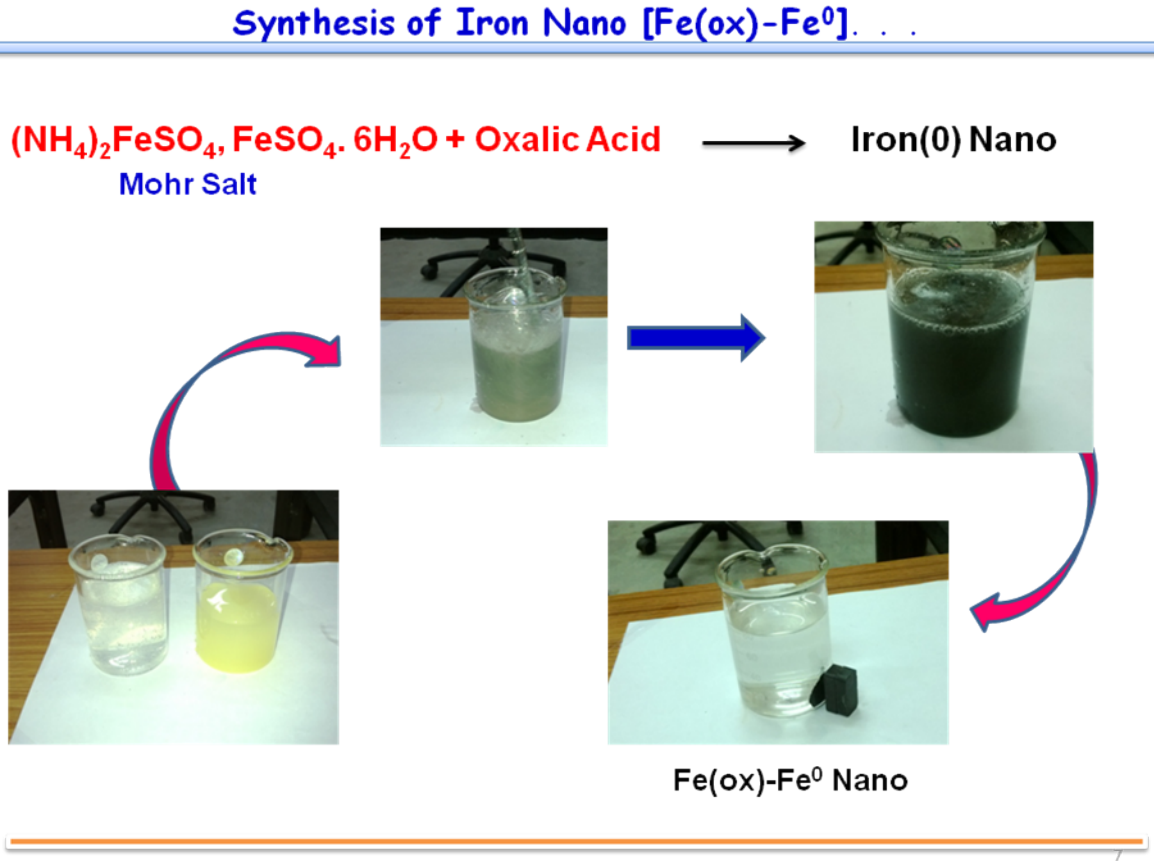


Fig. S4. Synthetic procedure of Fe(ox)-Fe^0.

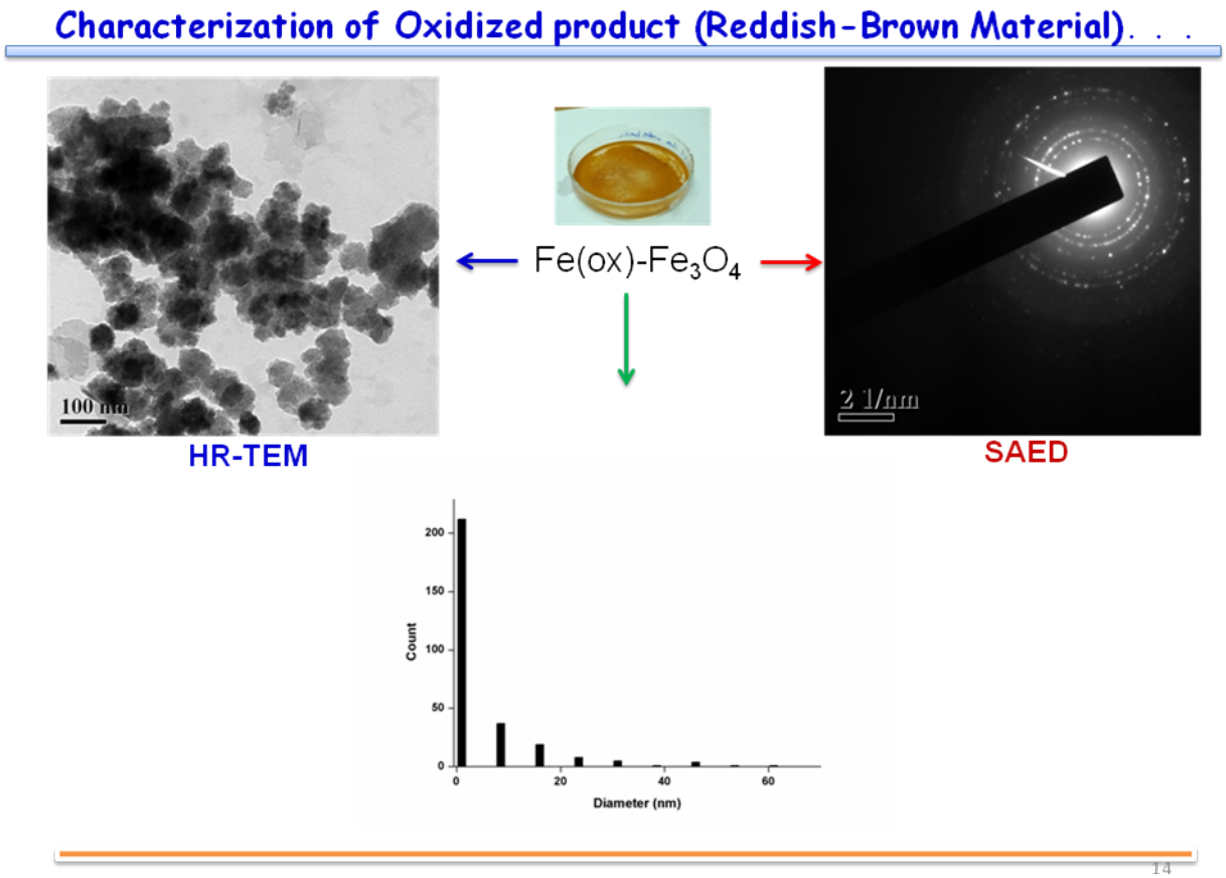


Fig. S5. TEM, particle distribution, and SAED pattern of Fe_3O_4.

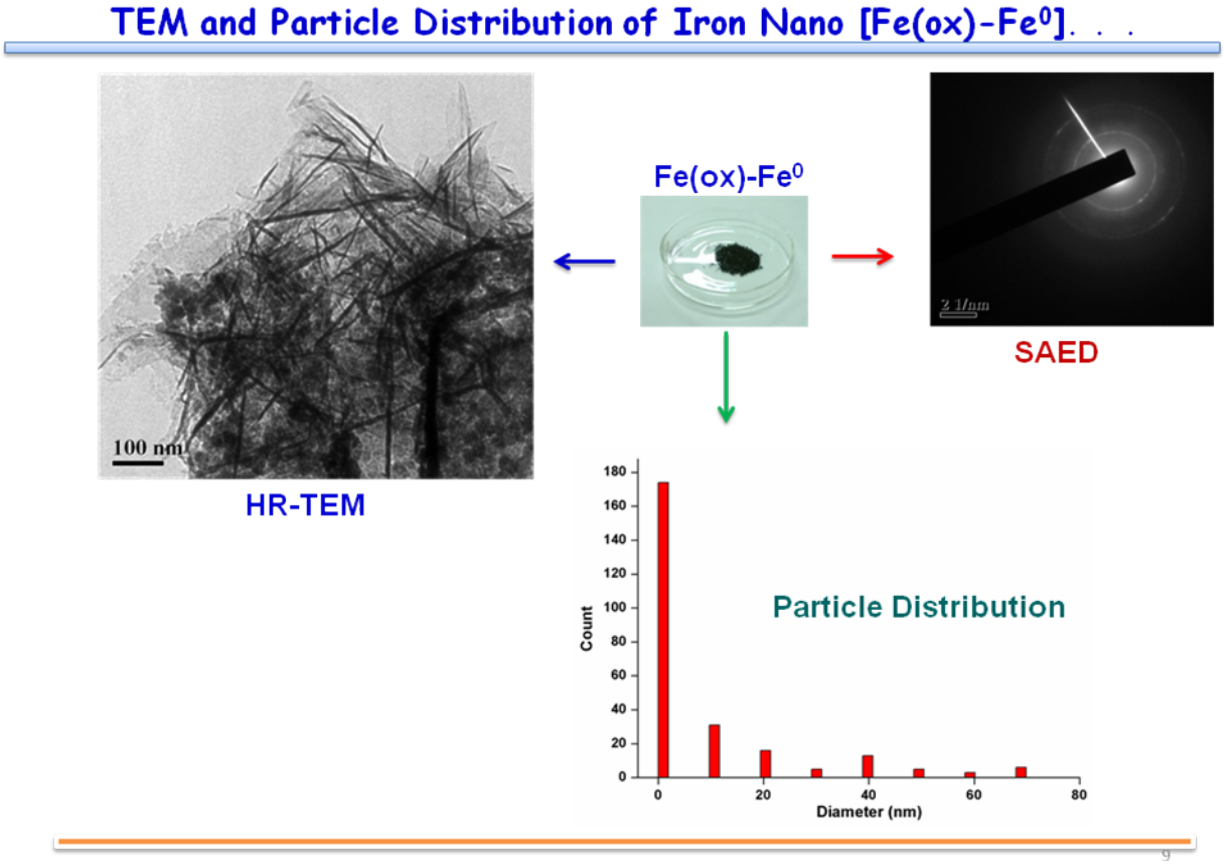
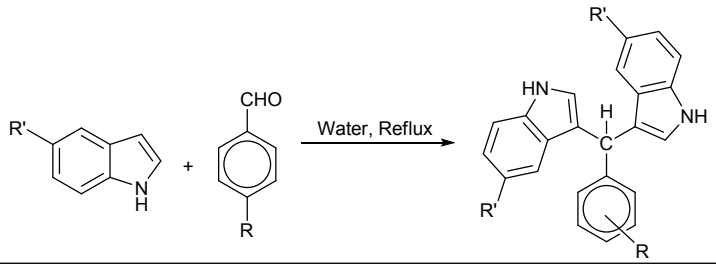


Fig. S6. TEM, particle distribution, and SAED pattern of Fe(ox)-Fe^0.

Table S1 condensation reaction between aldehyde and indoles in water

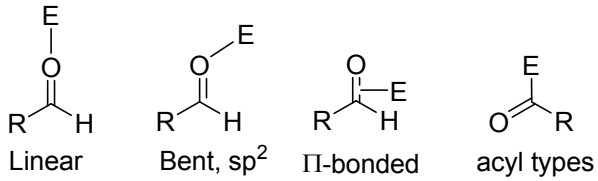


#	R	R'	**Product**	Time (h)	Yield (%)
3	Br	H	**1c**	6	21
4	Me	H	**1b**	6	8
7	NO_2	Br	**1g**	6	12
8	Me	OMe	**1h**	6	10
10	H	OMe	**1j**	6	<5

Involvement of Fe(ox)-Fe_3O_4 as a catalyst in in the condensation reaction between aldehydes and indoles:

There are several different possible modes of coordination of carbonyl group to metal catalysts. Mainly four types of coordination modes of aldehyde have been proposed (scheme 1).[1]

Scheme 1. Possible coordination mode of aldehyde with metal catalyst



It is expected that after binding of C=O to metal catalyst, there must be a shift in both the C=O and C-H stretching band of aldehyde as compared to free aldehyde. The material was prepared for the study by grinding the 1:1 mixture of aldehyde and catalyst in a motor pestle for 0.5 h. The two material; Fe_3O_4 and Fe(ox)-Fe_3O_4 was chosen for the study. The FTIR spectra of free 4-bromo benzaldehyde (**2a**) shows two peaks at 2763 and 2855 cm^{-1} due to C-H stretching vibration and another two peaks at 1693 and 1577 cm^{-1} due the C=O stretching vibration of **2a**. In the mixture of **2a** and Fe(ox)-Fe_3O_4, the C-H stretching vibration at 2763 cm^{-1} of **2a** shifted to lower wavenumber, which indicates the binding of **2a** with Fe(ox)-Fe_3O_4 catalyst (Fig. S7). On the other hand the C=O stretching vibration at 1693 for free **2a** also shifted to lower wavenumber in the mixture of **2a** and Fe(ox)-Fe_3O_4 sample (Fig. S8), which also suggested the interaction of

2a with Fe(ox)-Fe_3O_4. In case of Fe_3O_4 material, less shift of C=O and C-H stretching vibration was observed as compared to Fe(ox)-Fe_3O_4.

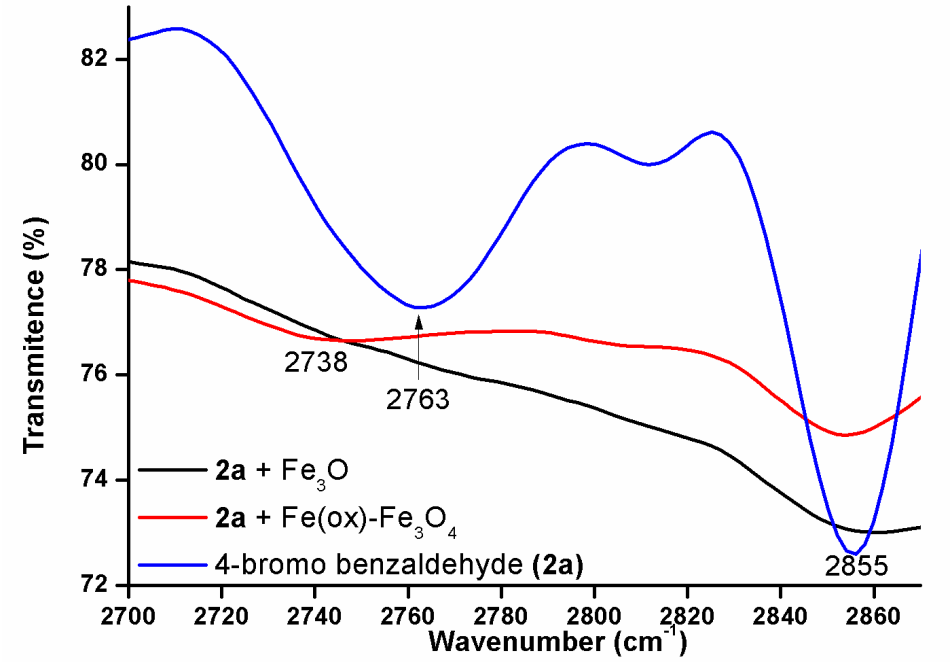


Fig. S7. FTIR spectra of 4-bromo benzaldehyde (C-H stretching band) on Fe_3O_4 and Fe(ox)-Fe_3O_4.

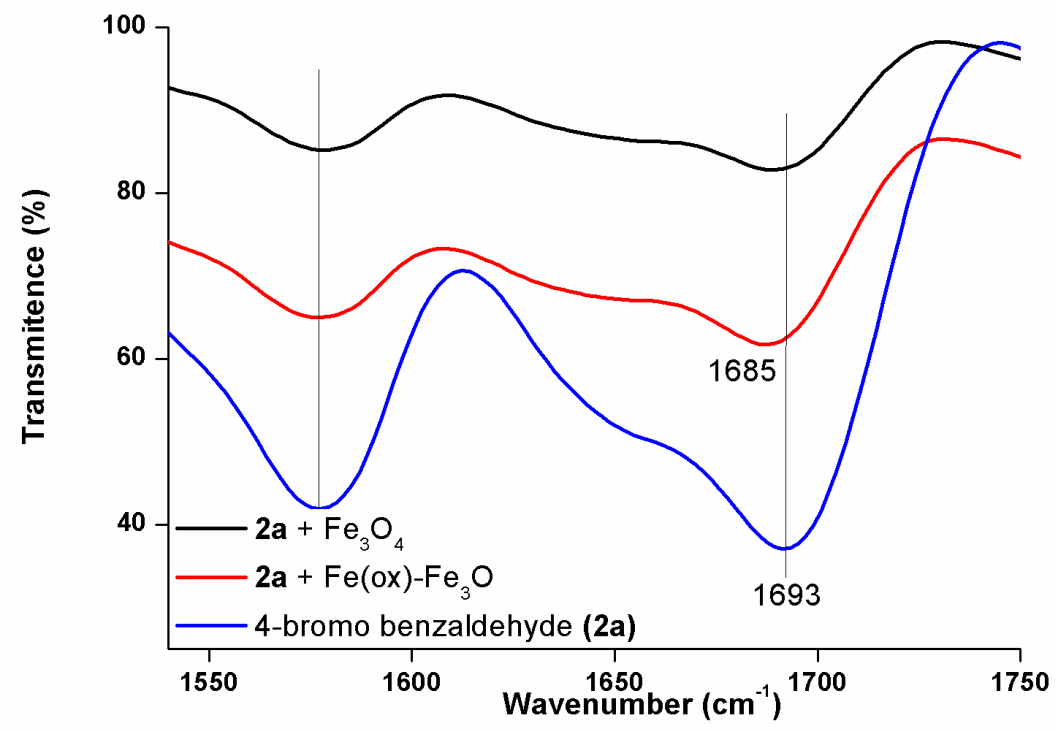


Fig. S8. FTIR spectra of 4-bromo benzaldehyde (C-O stretching band) on Fe_3O_4 and Fe(ox)-Fe_3O_4.

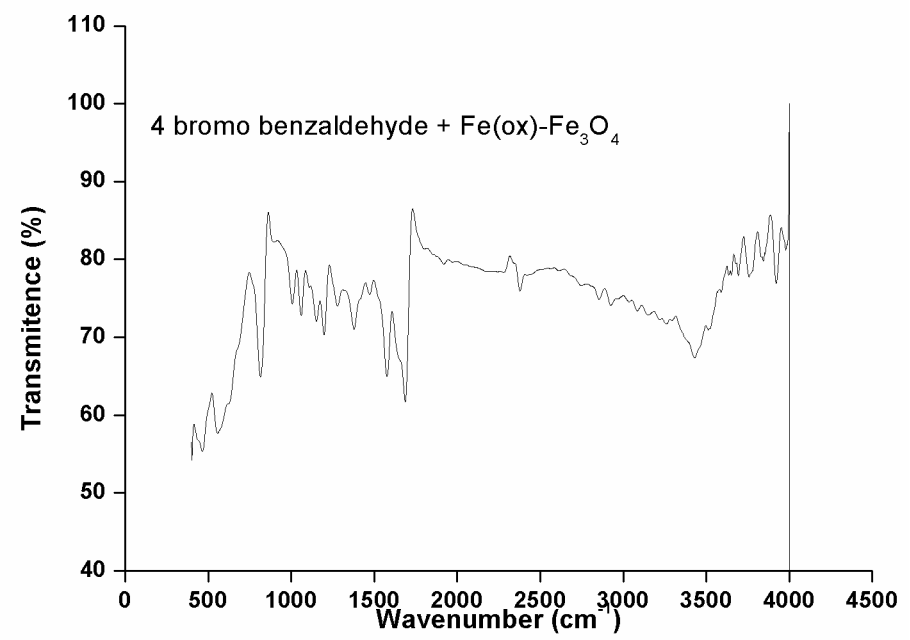


Fig. S9. FTIR spectra of 4-bromo benzaldehyde on Fe(ox)-Fe_3O_4.

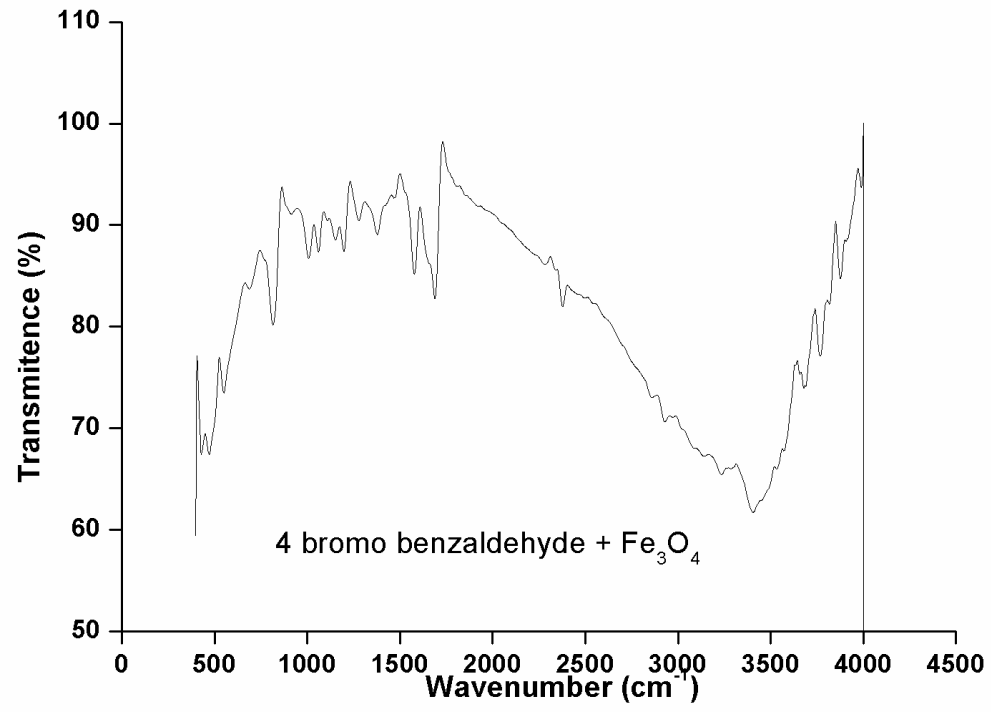


Fig. S10. FTIR spectra of 4-bromo benzaldehyde on Fe_3O_4.

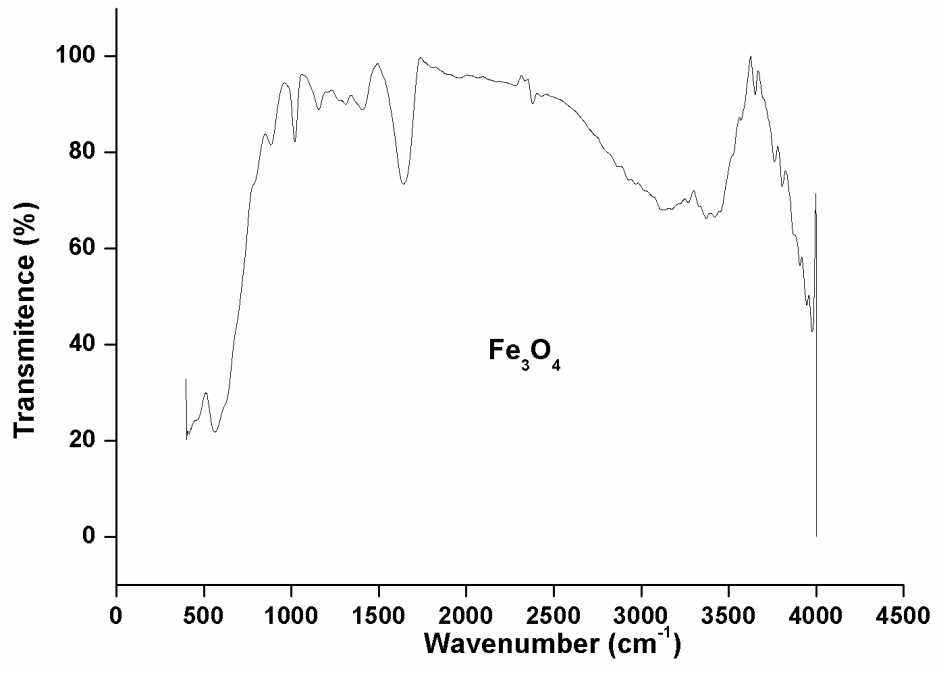


Fig S11. FTIR spectra of Fe_3O_4.

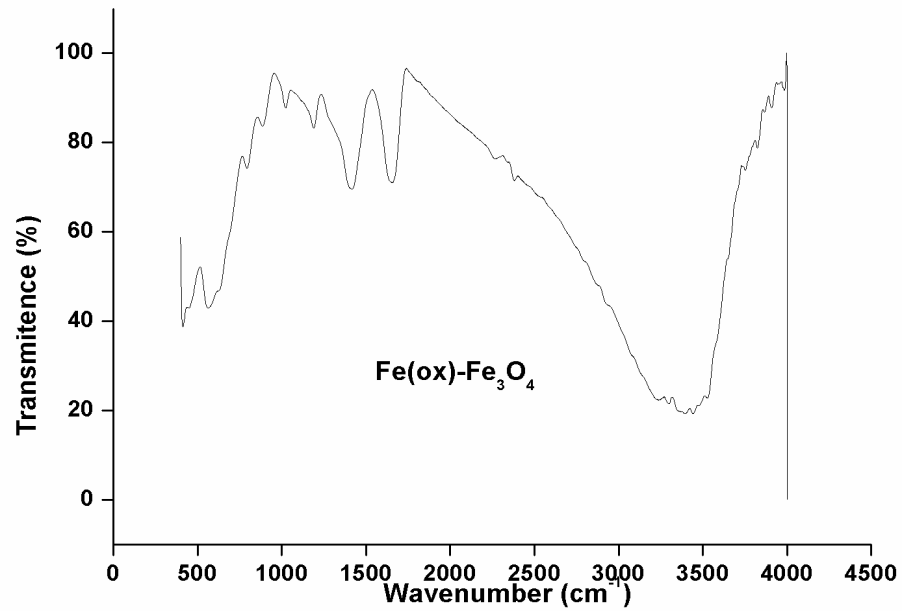


Fig S12. FTIR spectra of Fe(ox)-Fe_3O_4.

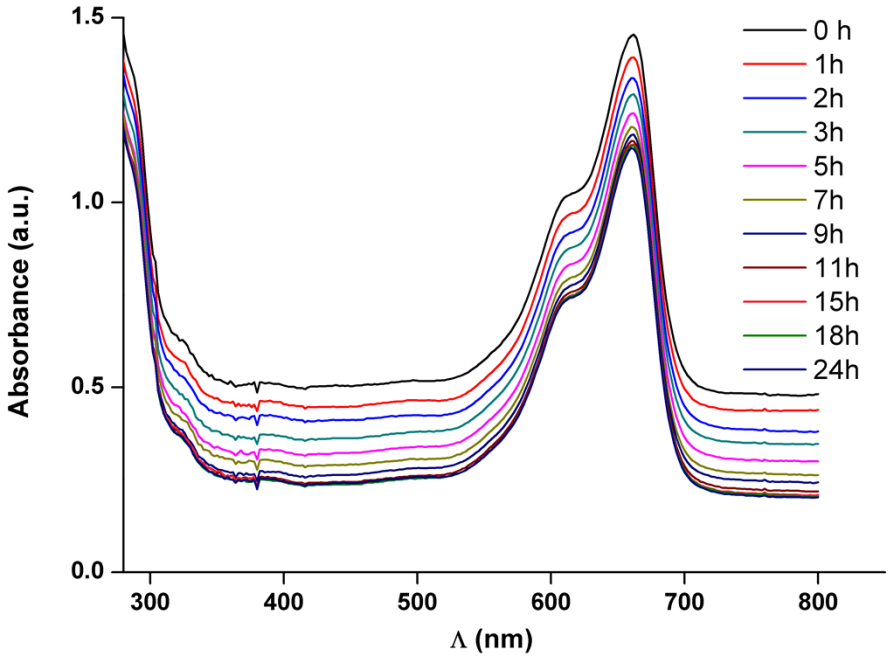


Fig S13. Absorbance *versus* wavelength plot of Fe(ox)-Fe_3O_4 promoted reaction of methylene blue in dark.

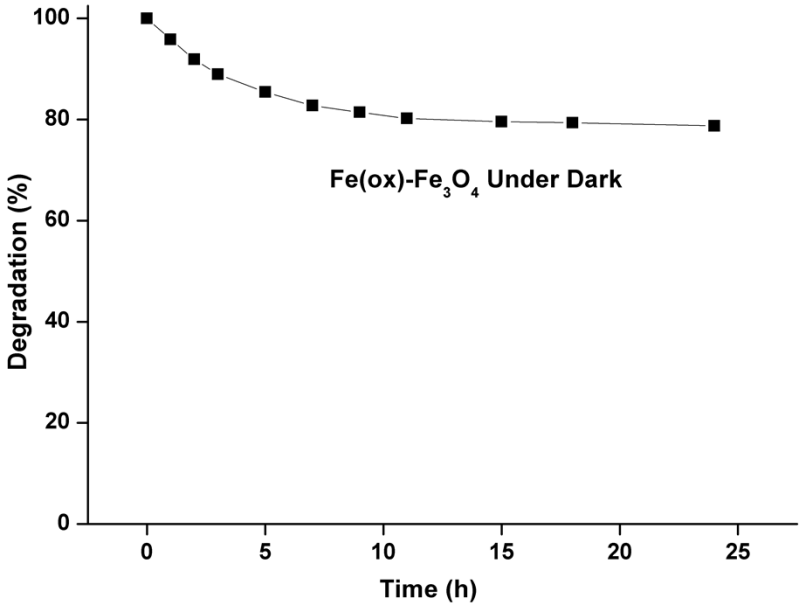


Fig S14. Degradation (%) *versus* time plot of Fe(ox)-Fe_3O_4 promoted reaction of methylene blue in dark.

Fig **S15**. 1H and 13C NMR spectrum of compound **1a** in acetone-d_6

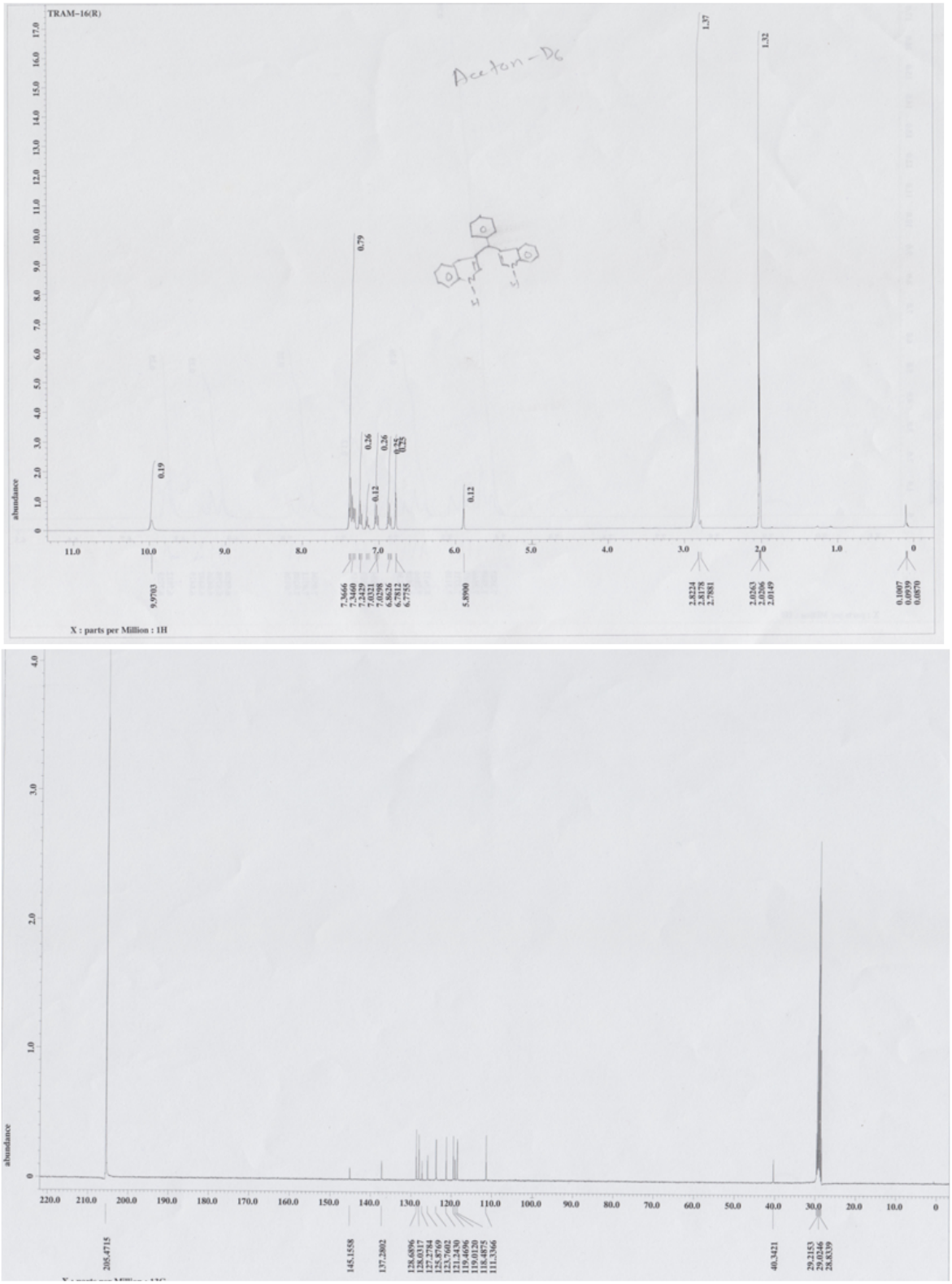


Fig **S16**. ^{1}H and ^{13}C NMR spectrum of compound **1b** in acetone-d_6

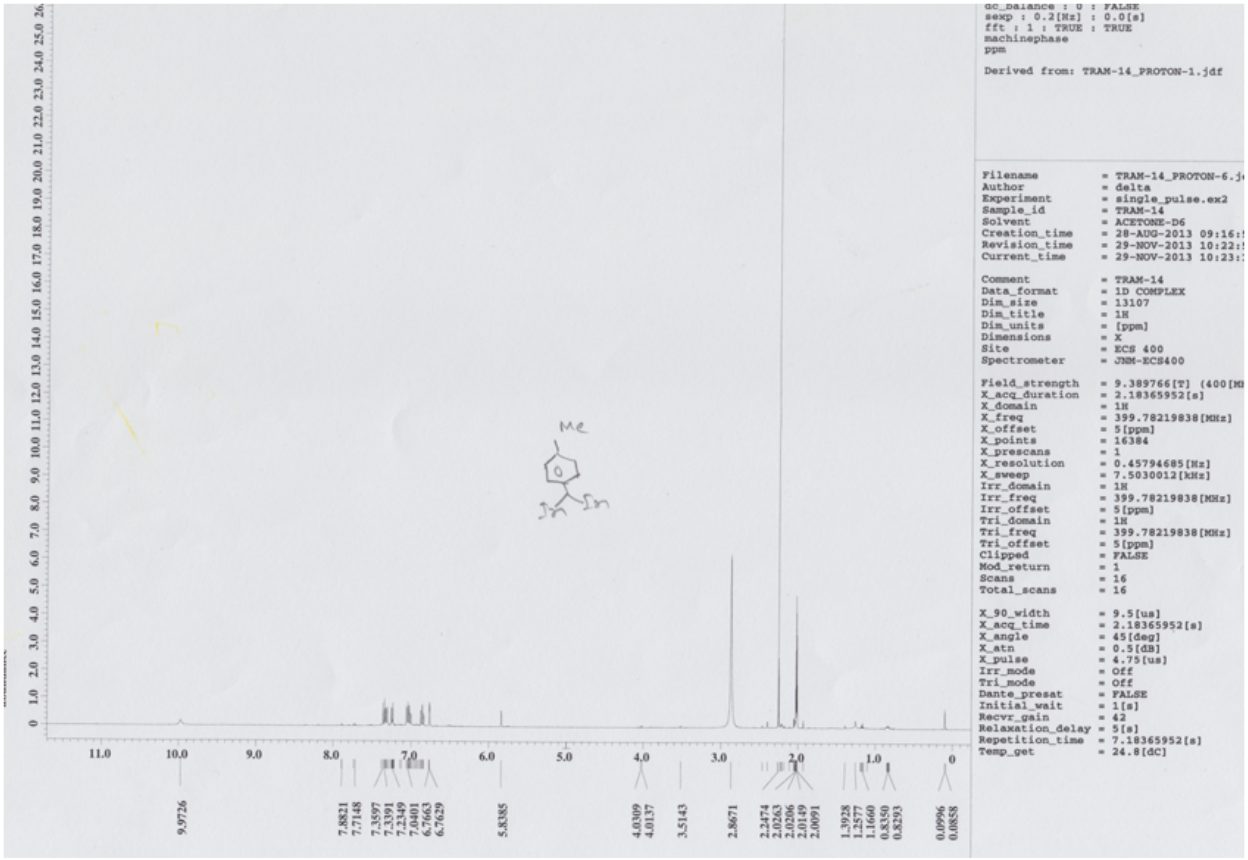


Fig **S17**. ^{1}H and ^{13}C NMR spectrum of compound **1c** in DMSO-d_6

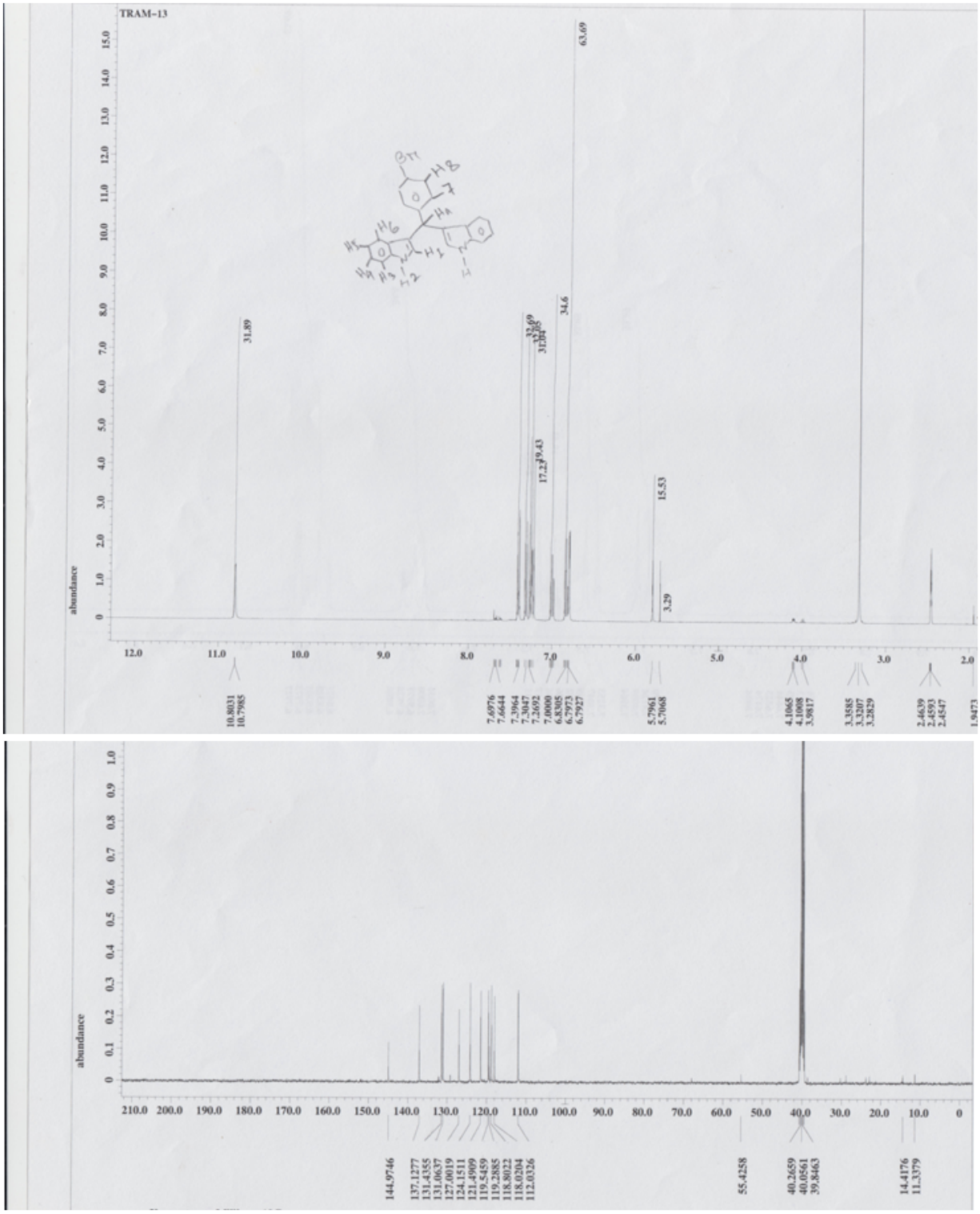


Fig **S18**. ^{1}H and ^{13}C NMR spectrum of compound **1d** in Acetone-d_6

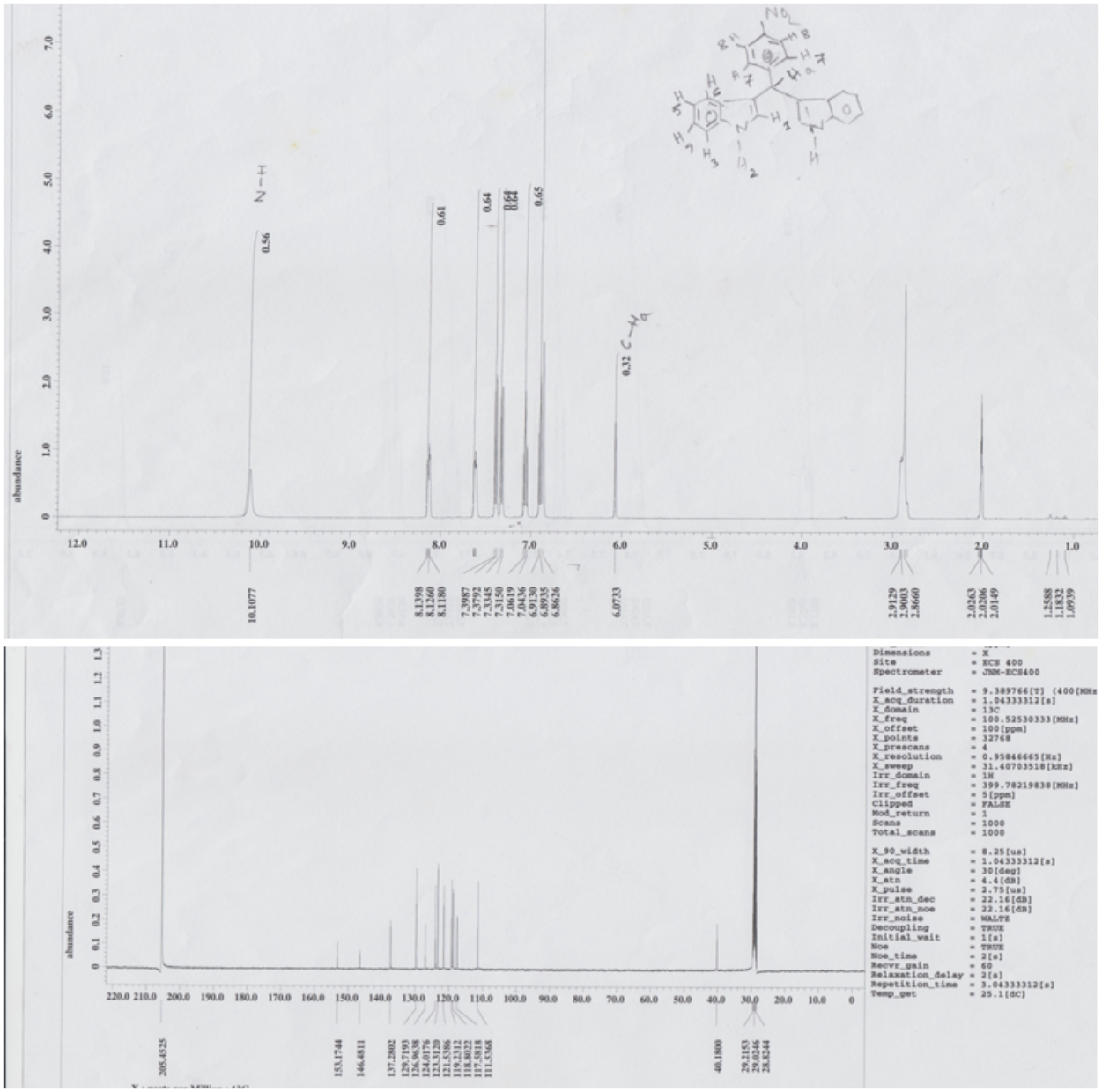


Fig **S19**. ^{1}H and ^{13}C NMR spectrum of compound **1e** in Acetone-d_6

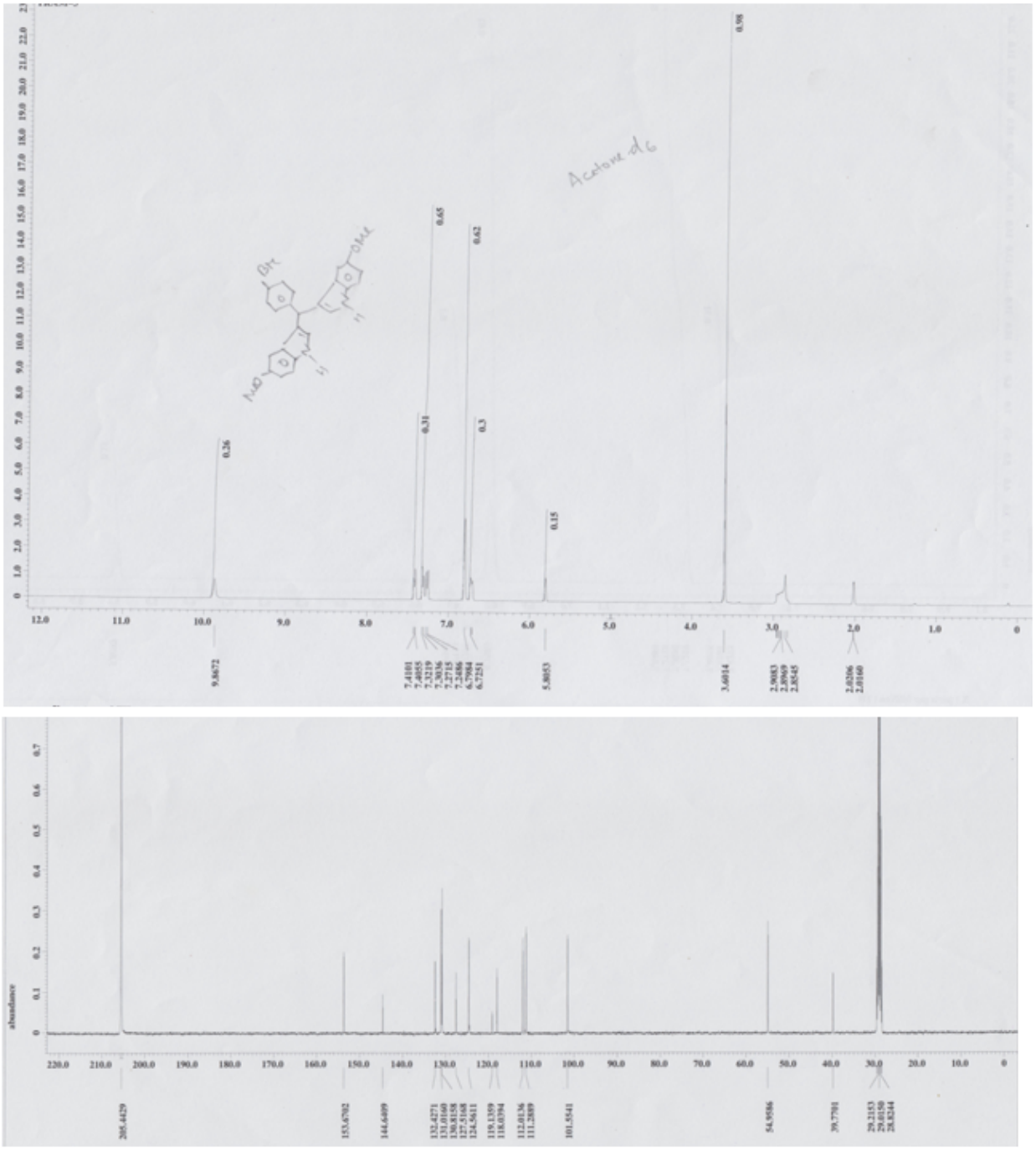


Fig **S20**. ^{1}H and ^{13}C NMR spectrum of compound **1f** in Acetone-d_6

Fig **S21**. ^{1}H and ^{13}C NMR spectrum of compound **1g** in Acetone-d_6

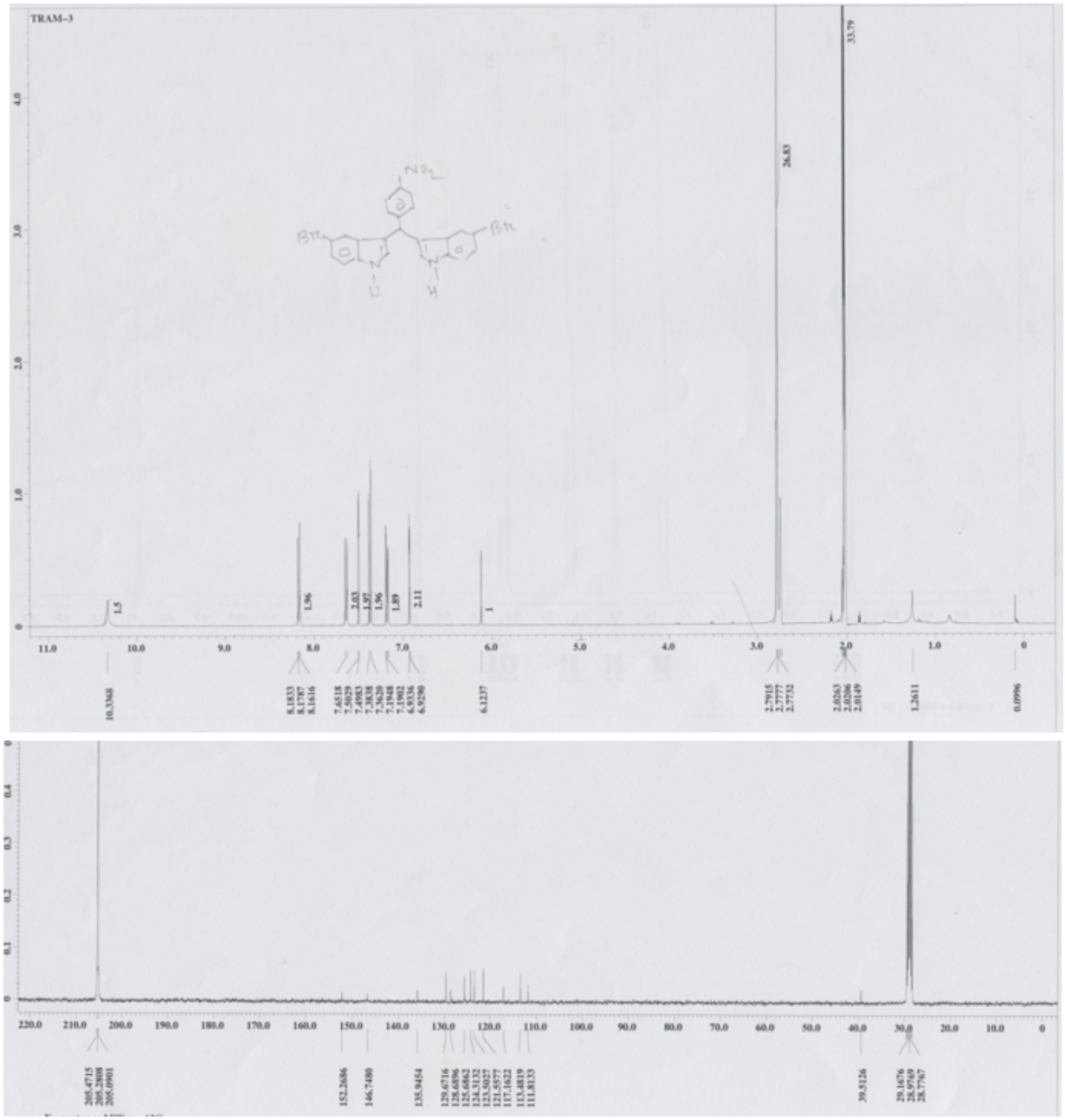


Fig **S22**. ^{1}H and ^{13}C NMR spectrum of compound **1h** in Acetone-d_6

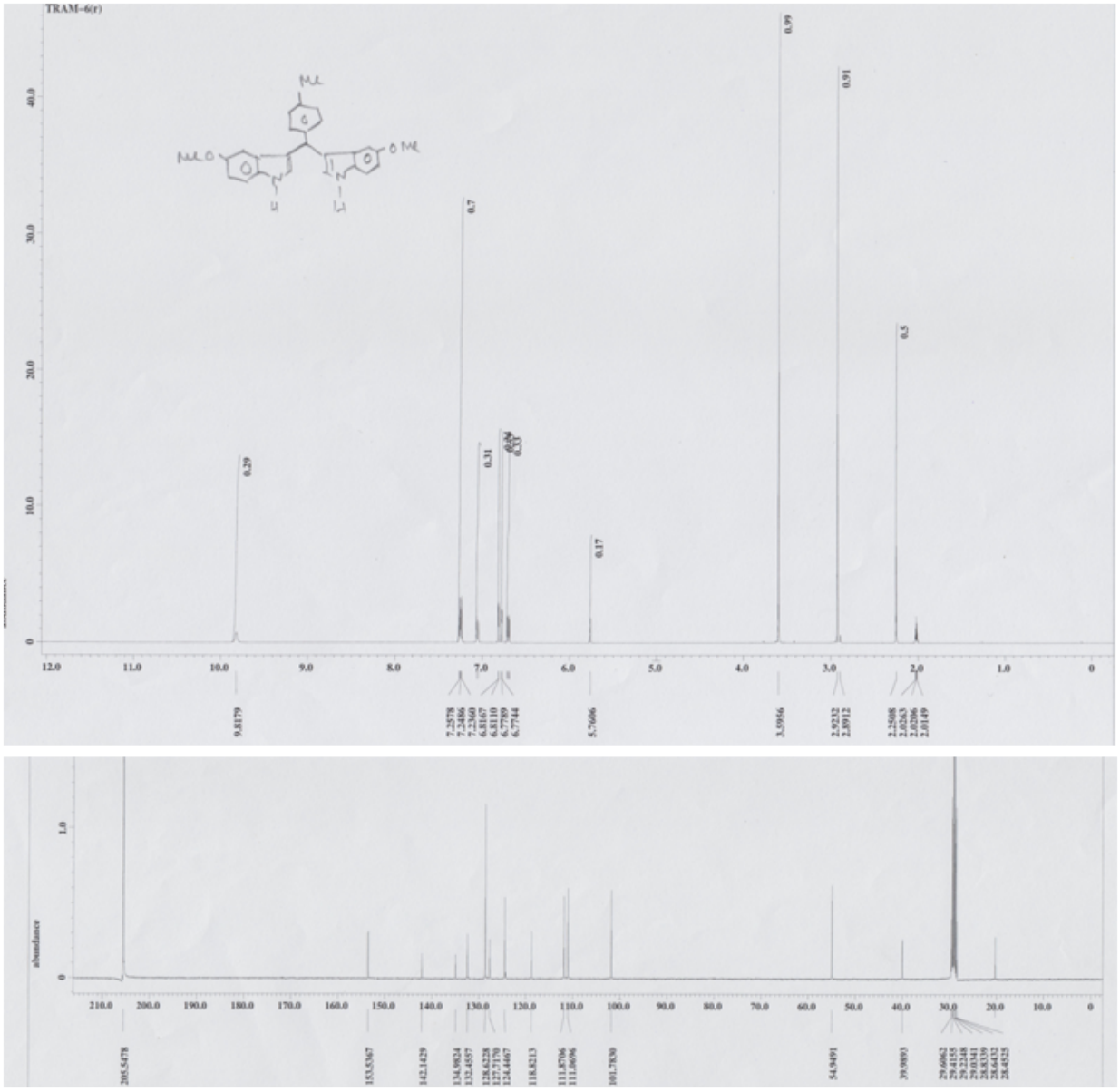


Fig **S23**. ^{1}H and ^{13}C NMR spectrum of compound **1i** in Acetone-d_6

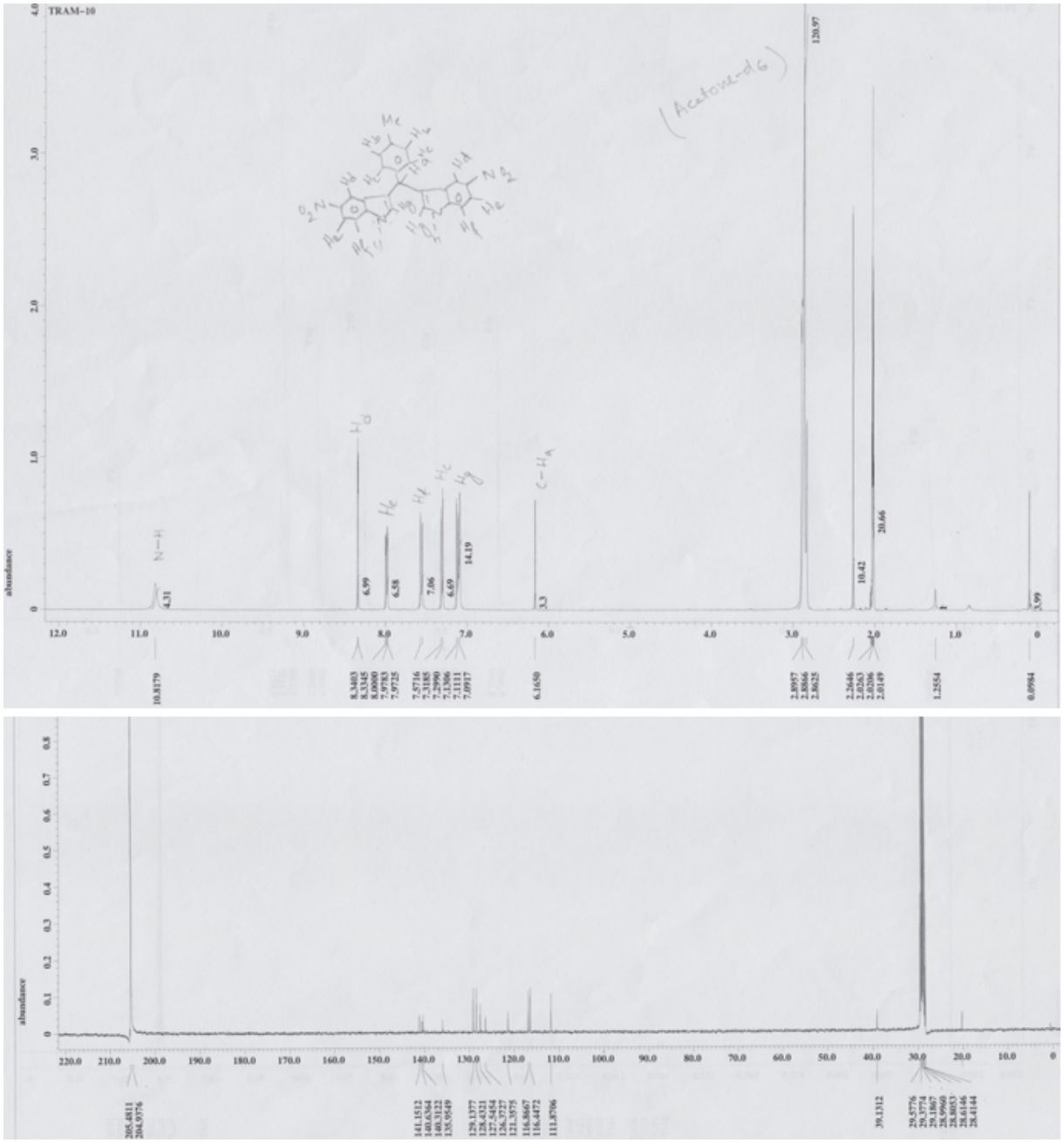
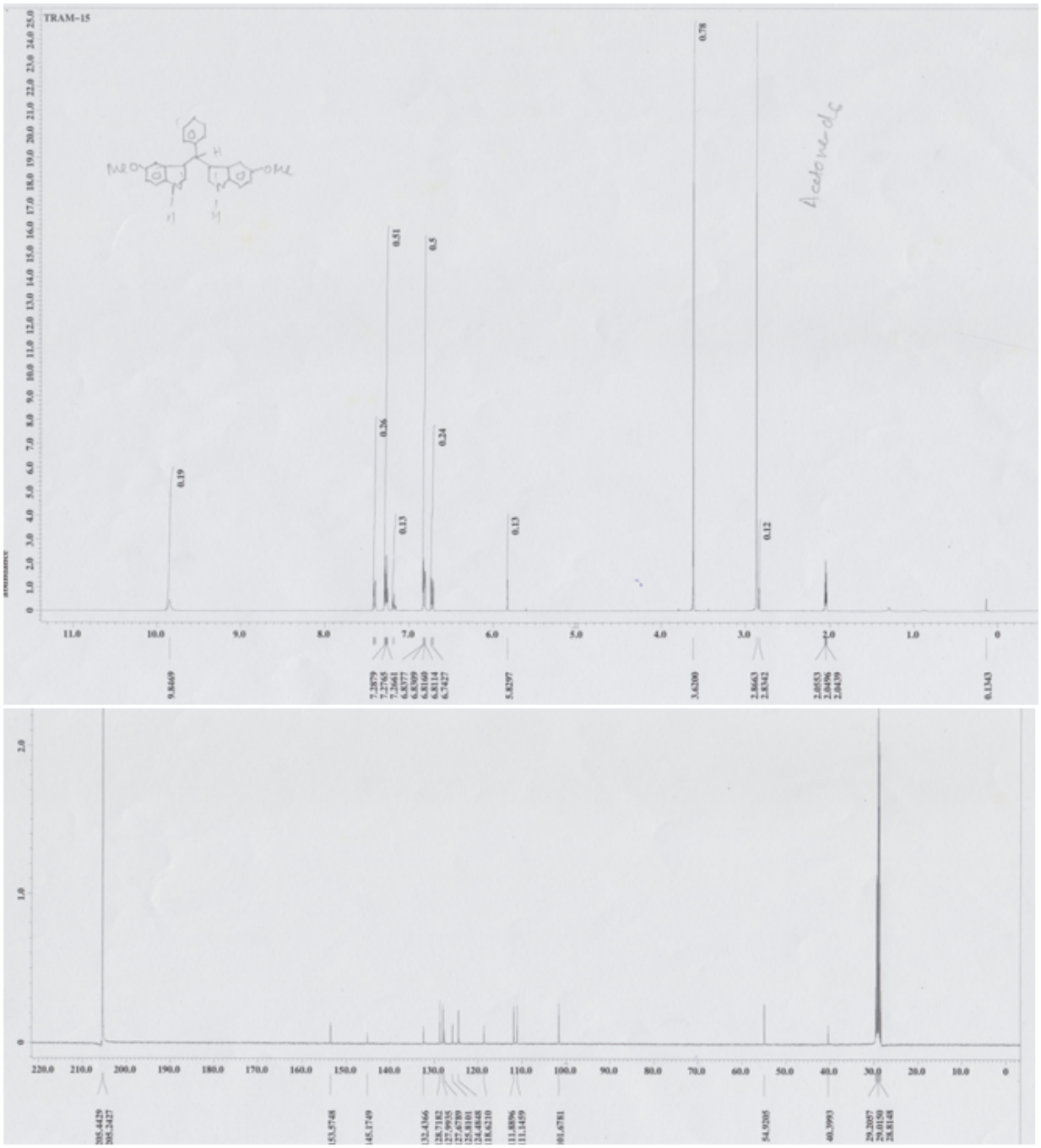


Fig **S24**. ^{1}H and ^{13}C NMR spectrum of compound **1j** in Acetone-d_6



References:

[1] (a) T. J. LuPage and Kenneth B. Wiberg, *J. Am. Chem. Soc*., 1988, **110**, 6643. (b) R. Gaba, M. Bhandari and R. Kakkar, *Adv. Mat. Lett*. 2013, **4**, 769. (C) J. Álvarez-Rodríguez, M. Cerro-Aarćon, A. Guerrero-Ruiz, I. Rodríguez-Ramos and A. Arcoya, *Appl. Catal., A*, 2008, **348**, 241. (d) A. Stolle, T. Gallert, C. Schmöger and B. Ondruschka, *RSC Adv*. , 2013, **3**, 2112 and references therein.