

## Supporting Information

### Synthesis of Heterogeneous Nano Catalysts Comprising of Polyoxometalates Ionic Liquids Based Magnetic Nanocomposites for Oxidation of Thiobenzoic acid and 2,2'-Dinitro-5,5'-dithiodibenzoic acid

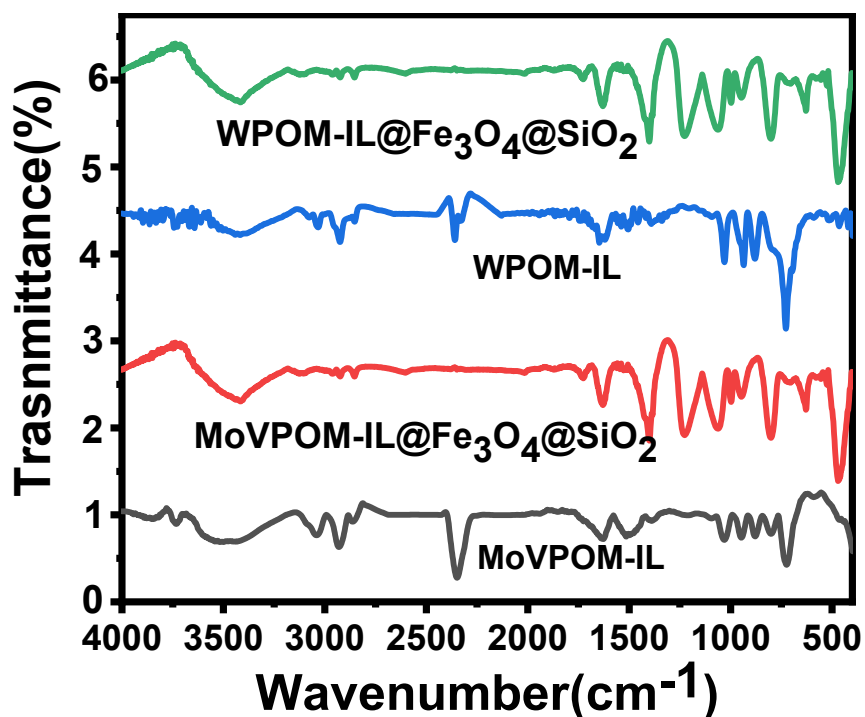
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### Instruments and Measurements

Fourier transform infrared (FTIR) was performed with Shimadzu 8400S having wavenumber range 4000-400  $\text{cm}^{-1}$  using KBr pellets at room temperature. Based on peak intensity FTIR peaks are shortened as w (weak), vs (very sharp), s (sharp), bo (broad), br (branched), and m (medium). UV/visible spectrum was obtained with UV-1800 Shimadzu spectrophotometer having wavelength range 200-800 nm. The F-7000 FL spectrophotometer, equipped with an emission spectrum display having scan speed of 1200  $\text{nm min}^{-1}$  Ex and Em slits of 6 nm and PMT 300 V was used to measure fluorescence. Thermogravimetric analysis was performed with SDT Q600 V20.9 Build 20 with a flow rate of 100  $\text{ml min}^{-1}$  and heat flow of 20 $^{\circ}\text{Cmin}^{-1}$ . Temperature was kept from 20 $^{\circ}\text{C}$  to 950 $^{\circ}\text{C}$  under  $\text{N}_2$  atmosphere. A vibrating sample magnetometer was used to study the magnetic properties. Scanning electron microscope (SEM) was performed using JSM5910 (JEOL, Japan) for determining porosity percentage, pore distribution and fibre thickness of compounds. Oxidative desulfurization was confirmed using reverse phase high performance liquid chromatography (RP-HPLC) with Shimadzu 10A having Welchrom C-18 column (4.6  $\times$  250 mm) at wavelength 254nm and flow rate of 1  $\text{mL min}^{-1}$ . C, H, N

elemental % was confirmed using Thermo-Finnigan FLASH EA 1112 Series. PXRD of synthesized compound was performed with X-ray diffractometer (D8 Advance Bruker) with a scan rate of  $0.1^\circ$  per second. GC-MS was performed with GC6890N-MS5973 to confirm the oxidation of thiobenzoic acid into dibenzoyl sulphone. Bruker Avance III HD 400 MHz was used for  $^1\text{H}$ NMR and  $^{13}\text{C}$ NMR for the confirmation of successful oxidation of thiobenzoic acid.

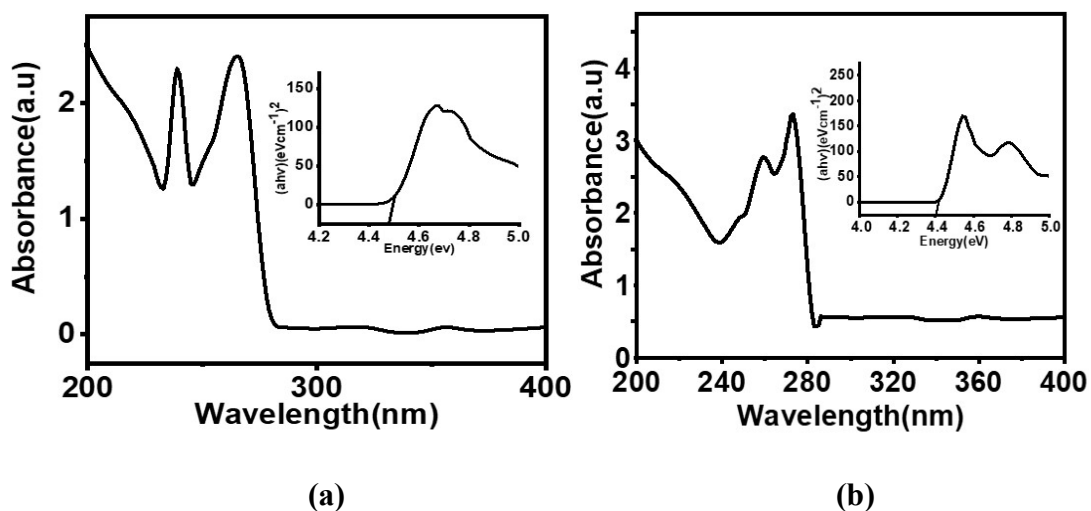


**Figure S1.** FT-IR spectrum of MoVPOM-IL, MoVPOM-IL@Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>, WPOM-IL and WPOM-IL@Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub> using KBr pellet and ambient temperature condition confirming the formation of nanocomposite from POM-ILs

**Table S1.** FT-IR data of MoVPOM-IL, MoVPOM-IL@Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>, WPOM-IL and WPOM-IL@Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub> with specific assignments

MoVPOM-IL	WPOM-IL	MoVPOM-IL@	WPOM-IL@Fe <sub>3</sub> O <sub>4</sub> @SiO	Assignment
		IL@		
			IL@Fe <sub>3</sub> O <sub>4</sub> @SiO	
		Fe <sub>3</sub> O <sub>4</sub> @SiO <sub>2</sub>		
			2	

2958,2928,285	2956,2928,285	2961,2928,285	2963,2928,2854	C-H
2	0	2		
1631	1627	1620	1623	O-H
1034	–	1062	–	S=O
–	1038	–	1062	P-O
943	–	949	–	Mo=O
–	935	–	943	W=O
–	885,814	–	872,803	W-O-W
782	–	792	–	Mo-O-Mo
672		681		V-O-V
–	–	587	574	Fe-O
–		995	1015	Fe-O-Si
		1230	1233	O-Si-O
			716	Co-O



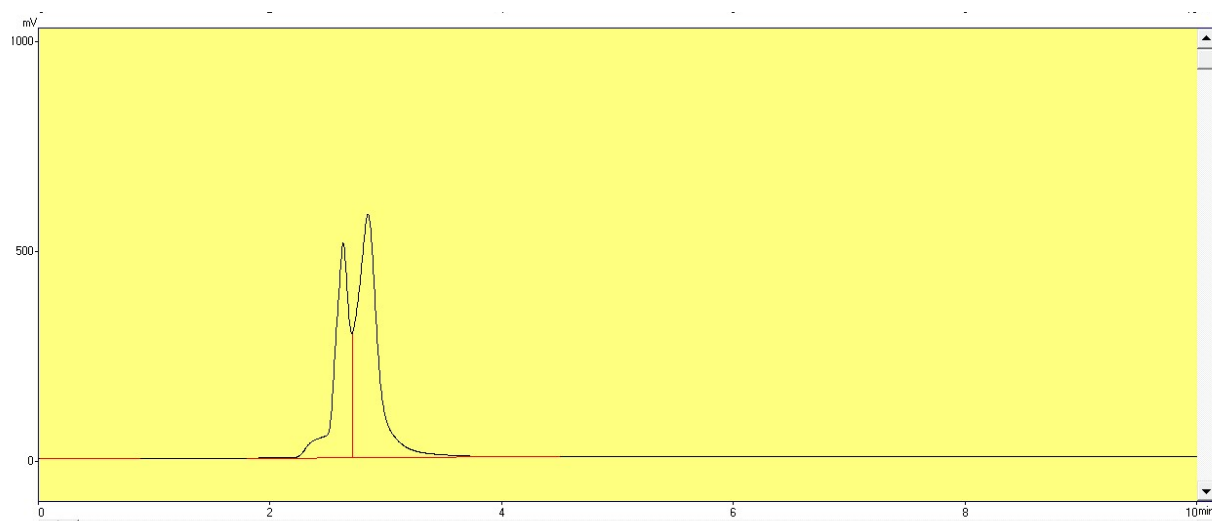
**Figure S2.** UV/Vis spectroscopy graph of MoVPOM-IL(a) and WPOM-IL(b) recorded with quartz cuvette having 1 cm path length using ethanol as reference solvent at wavelength 200-800 nm. Molarity of solution was  $10^{-6}$  M. Tauc plot also drawn for measuring energy band gap.

**Table S<sub>2</sub>.** %weight, K value and % atomic weight of each element present in MoVPOM-IL@Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub> calculated from EDX graph of MoVPOM-IL@Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>.

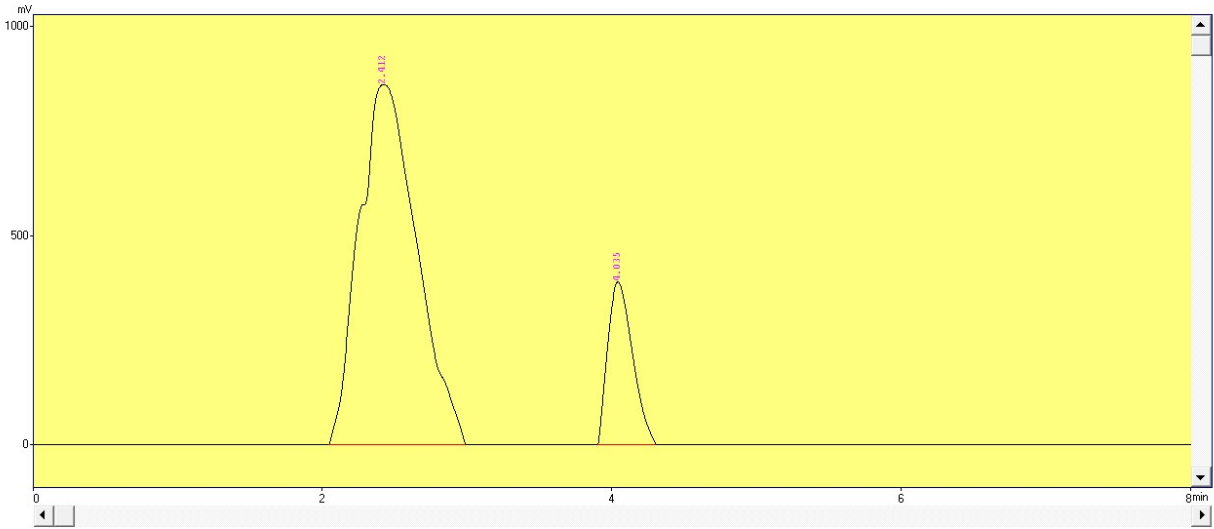
Element	% weight of element	K value	% atomic weight
C	0.6383	0.0531	1.6675
N	2.1926	0.1565	4.9147
V	8.0488	0.1580	4.9618
O	12.1010	0.7563	23.7509
Fe	29.3366	0.5253	16.4965
Mo	5.6064	0.0584	1.8339
Si	37.3022	1.3279	41.7014
S	4.7737	0.1488	4.6729

**Table S3** %weight, K value and % atomic weight of each element present in WPOM-IL@Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub> obtained EDX plot of WPOM-IL@Fe<sub>3</sub>O<sub>4</sub>@SiO<sub>2</sub>.

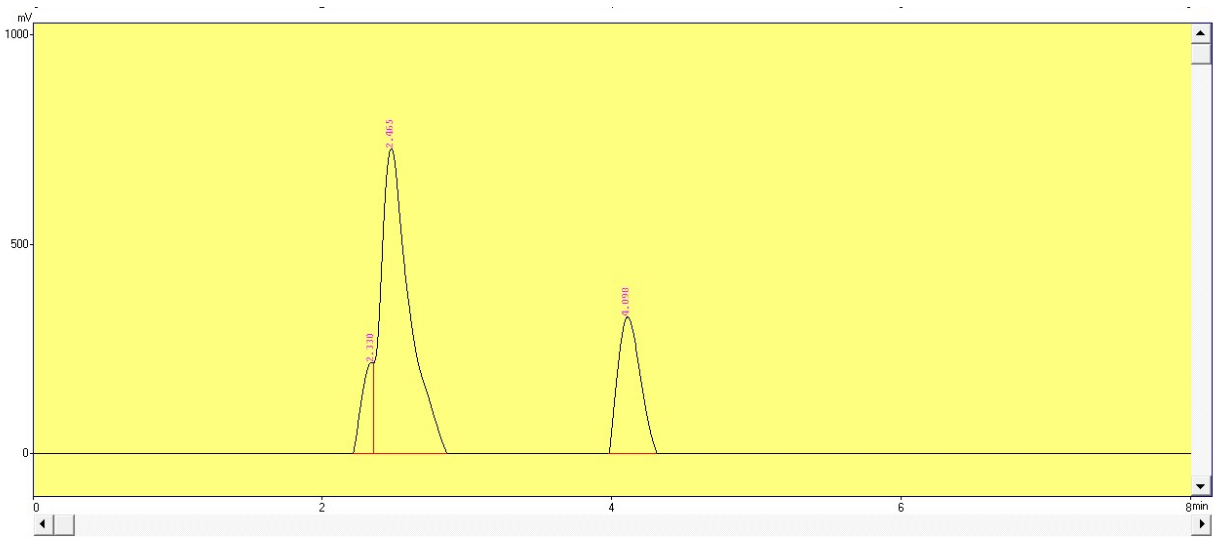
Element	% weight of element	K value	% atomic weight
C	0.4992	0.0415	1.7572
N	0.6294	0.0449	1.9011
O	9.4638	0.5915	25.0455
Fe	22.8565	0.4092	17.3265
Si	29.1729	1.0385	43.9725
W	35.7716	0.1946	8.2398
P	0.9333	0.0301	1.2745
Co	0.6728	0.0114	0.4827



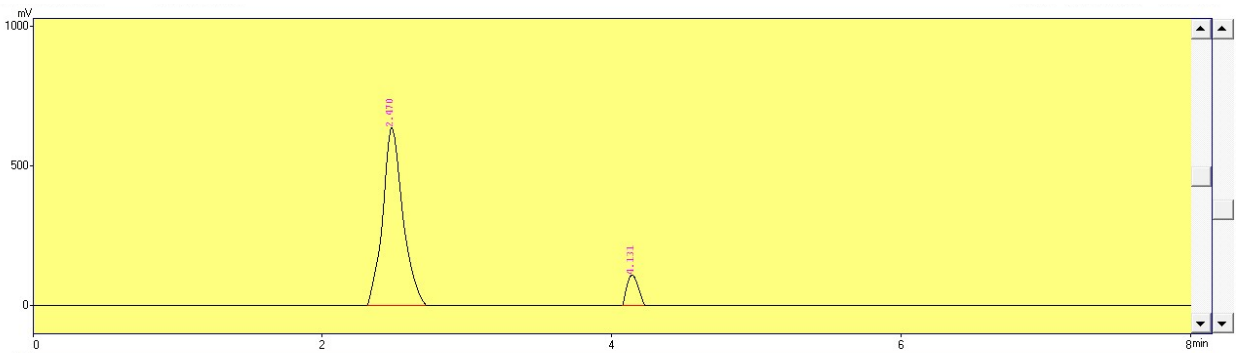
**(a)**



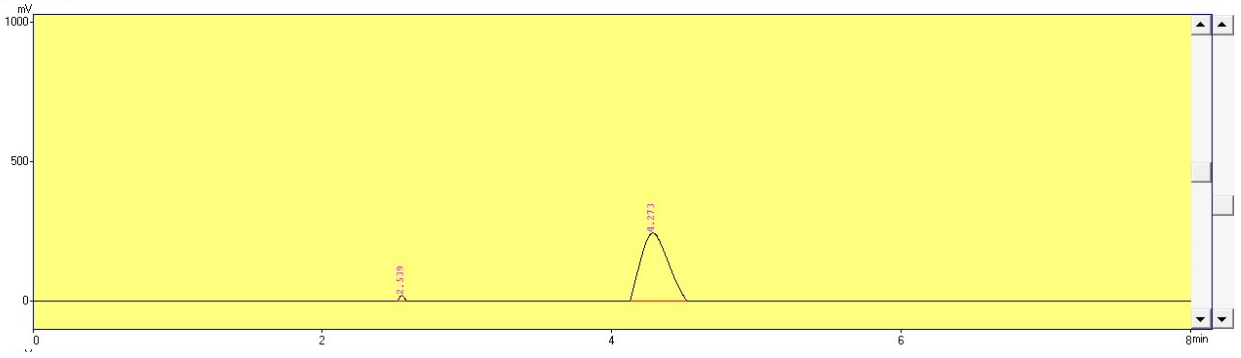
(b)



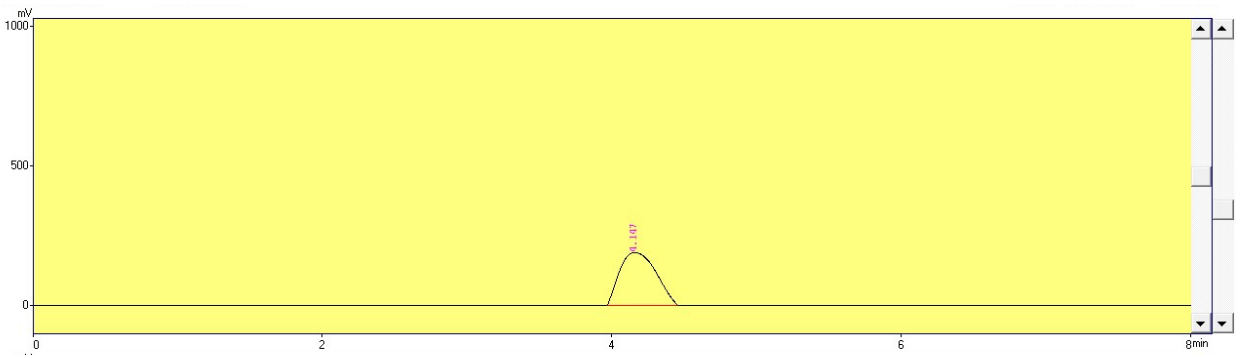
(c)



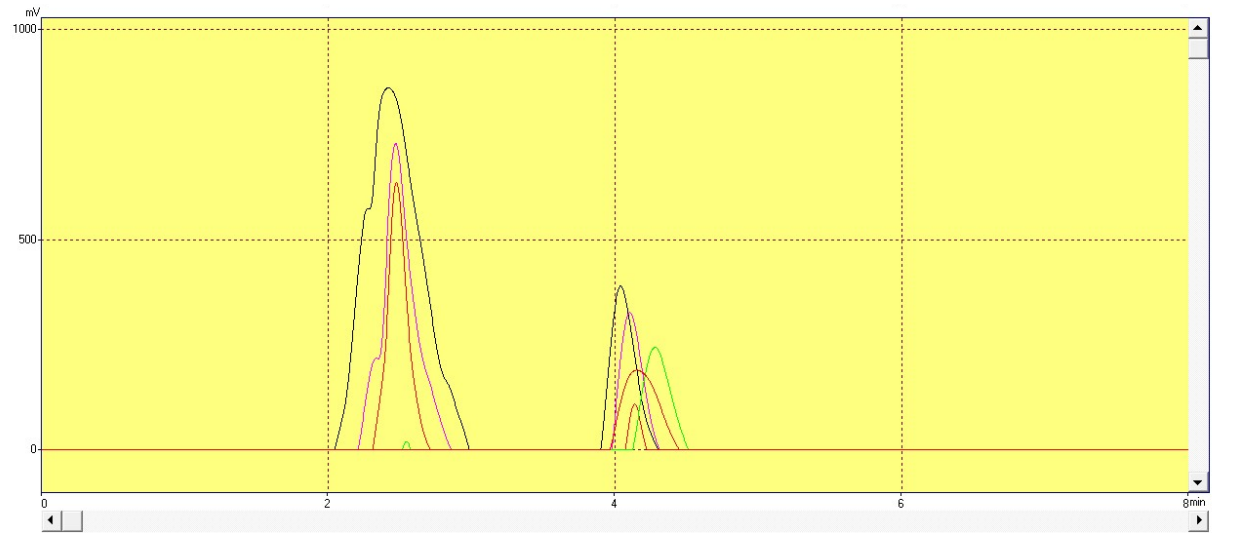
(d)



(e)

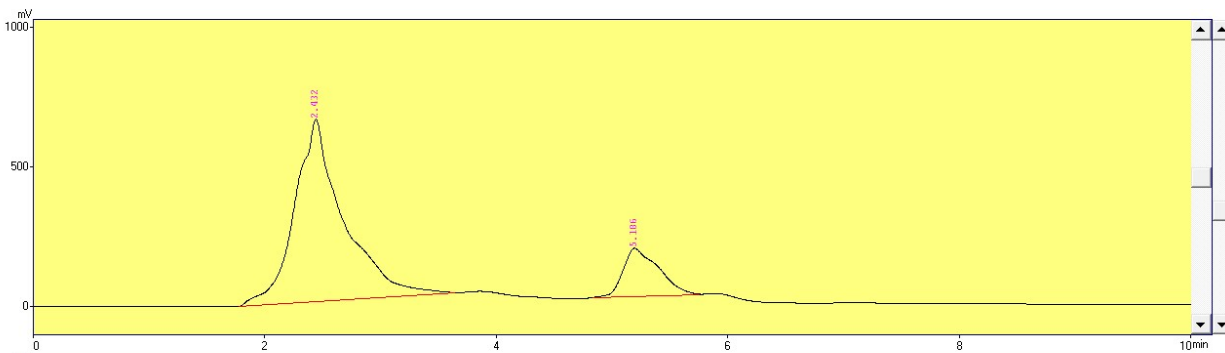


(f)

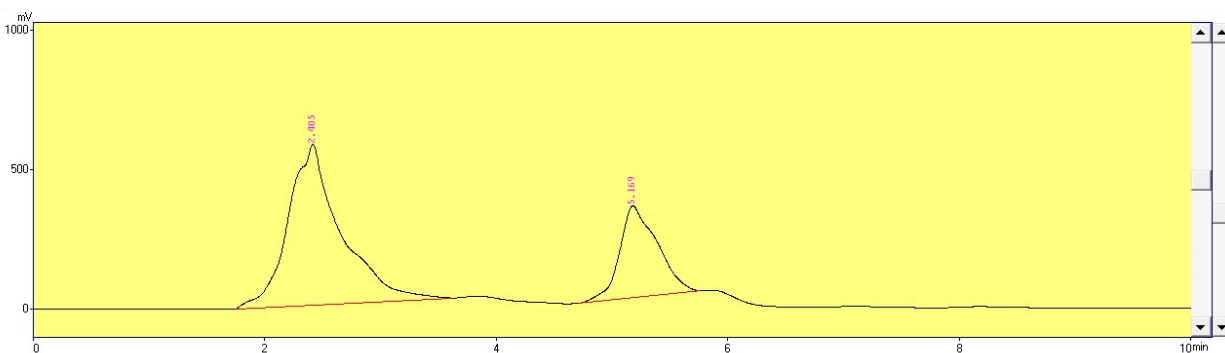


(g)

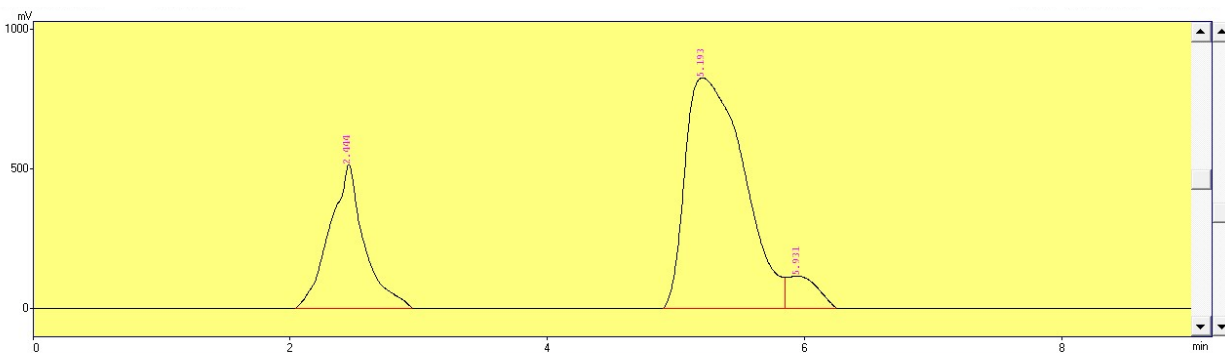
**Figure S3.** Chromatograms showing oxidation of thiobenzoic acid before reaction(a), after 20 minutes reaction(b), after 40 minutes reaction(c), after 60 minutes reaction(d) after 80 minutes reaction(e), after 100 minutes reaction(f) and stack graph(g).



**(a)**

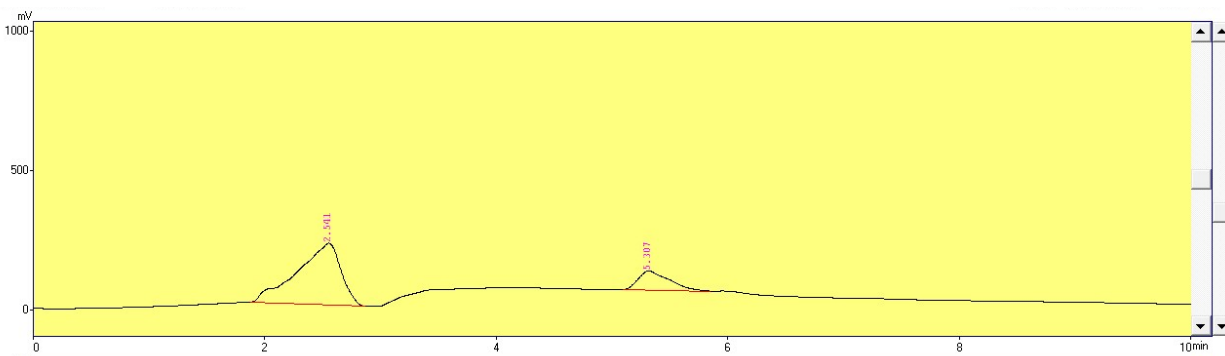


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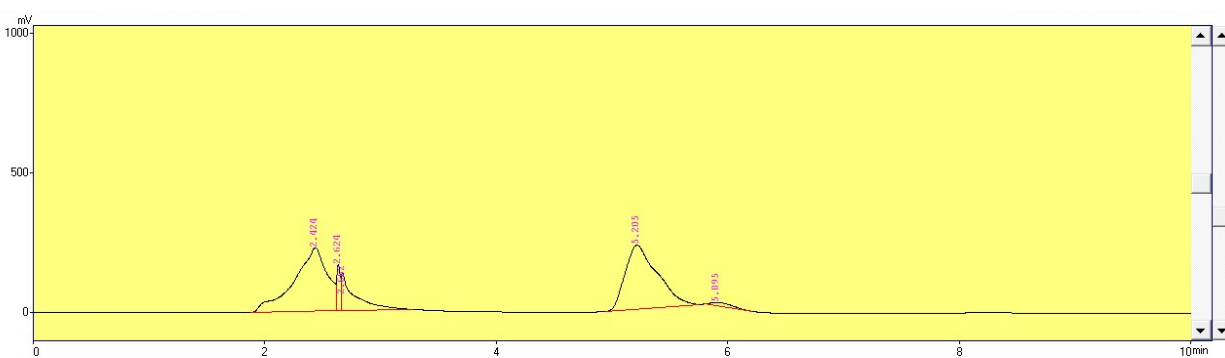


**(c)**

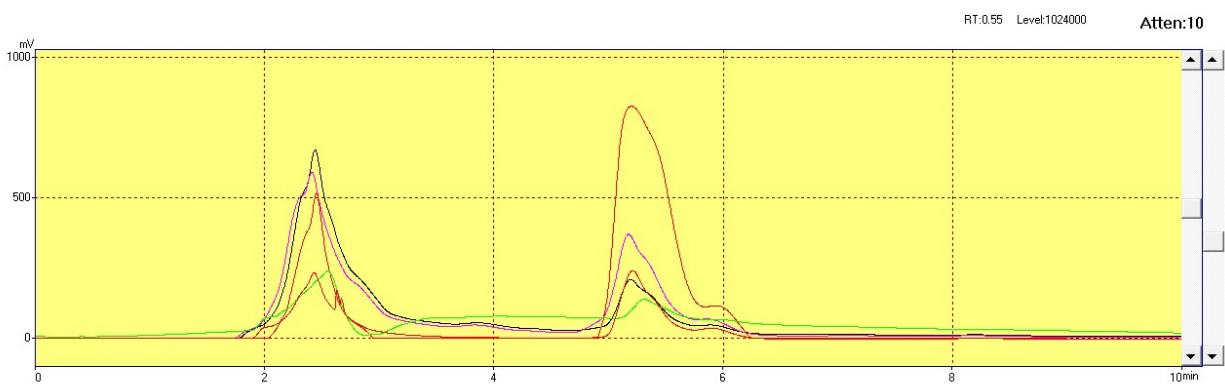




(d)

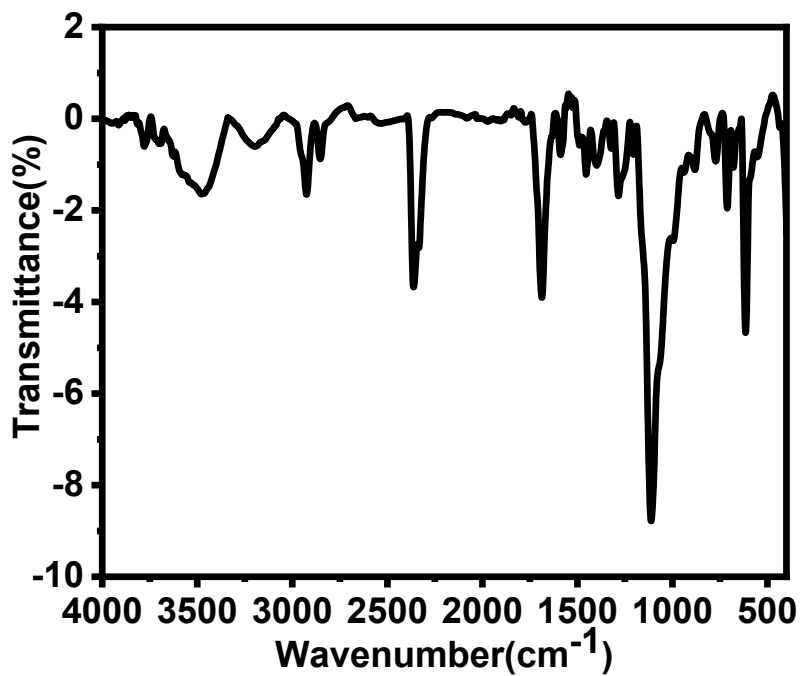


(e)

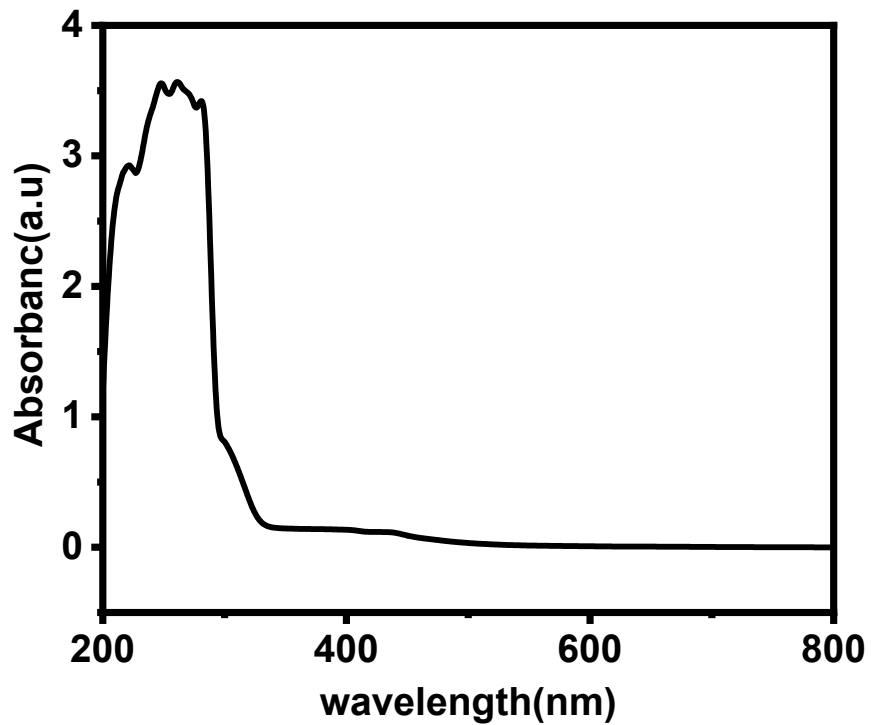


(f)

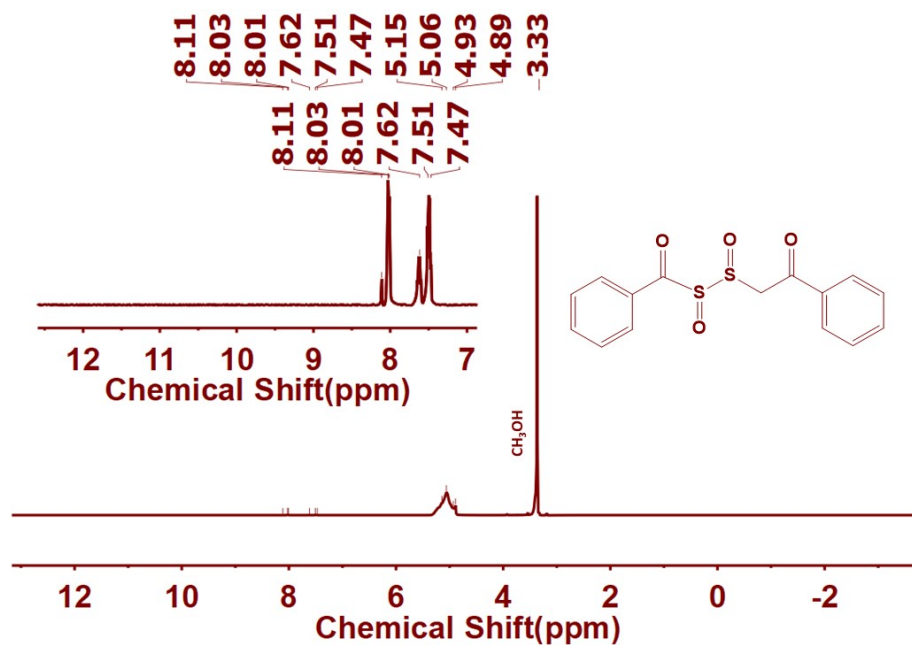
**Figure S4.** Chromatograms showing oxidation of 2,2-dinitro 5,5-dithiobenzoic acid after 20 minutes reaction(a), after 40 minutes reaction(b), after 60 minutes reaction(c), after 80 minutes reaction(d), after 100 minutes reaction(e) and stack graph(f).



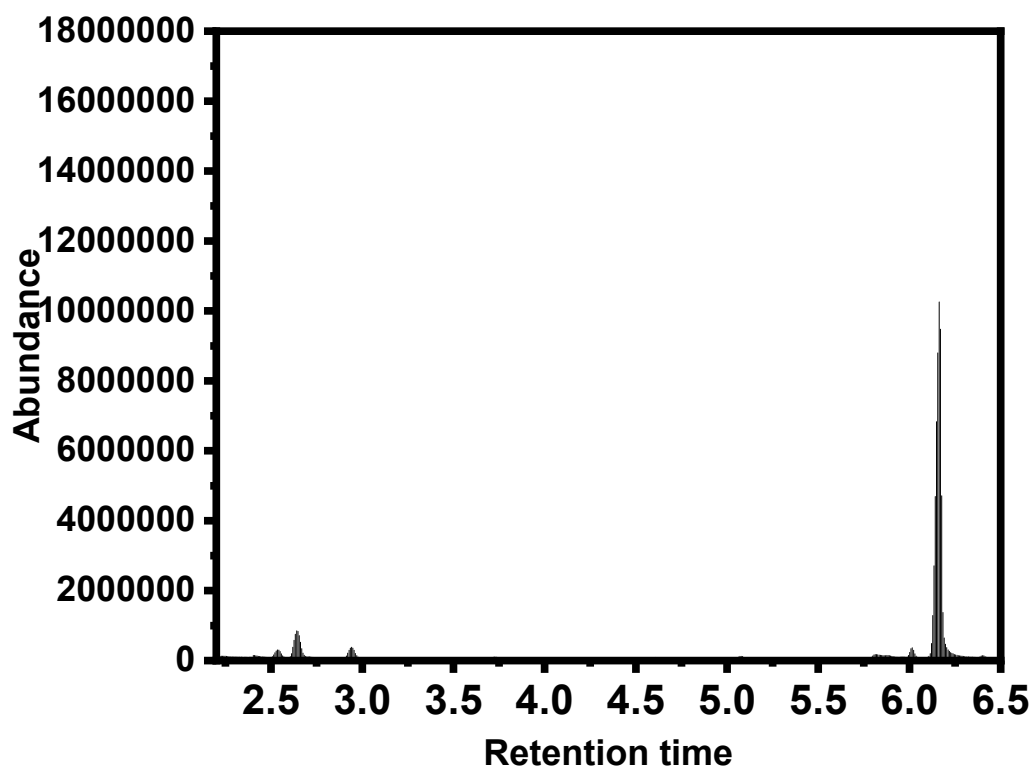
**Figure S5(a).** FTIR spectrum of dibenzoyl sulfone formed as a result of oxidation of thiobenzoic acid. Analysis was performed at ambient conditions.



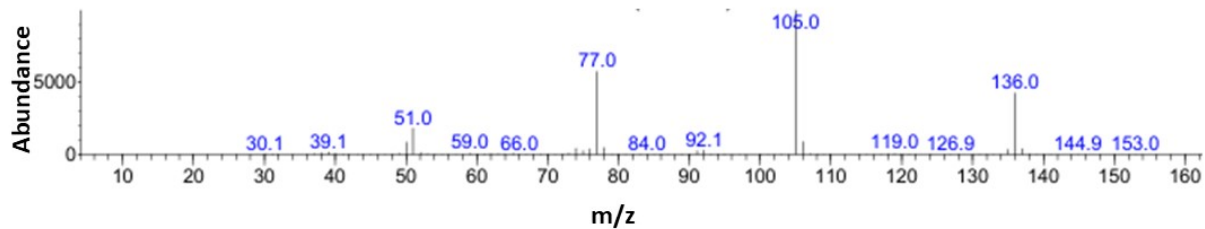
**Figure S5(b):** Uv/vis spectrum of dibenzoyl sulfone taken at 200-800 nm wavelength range



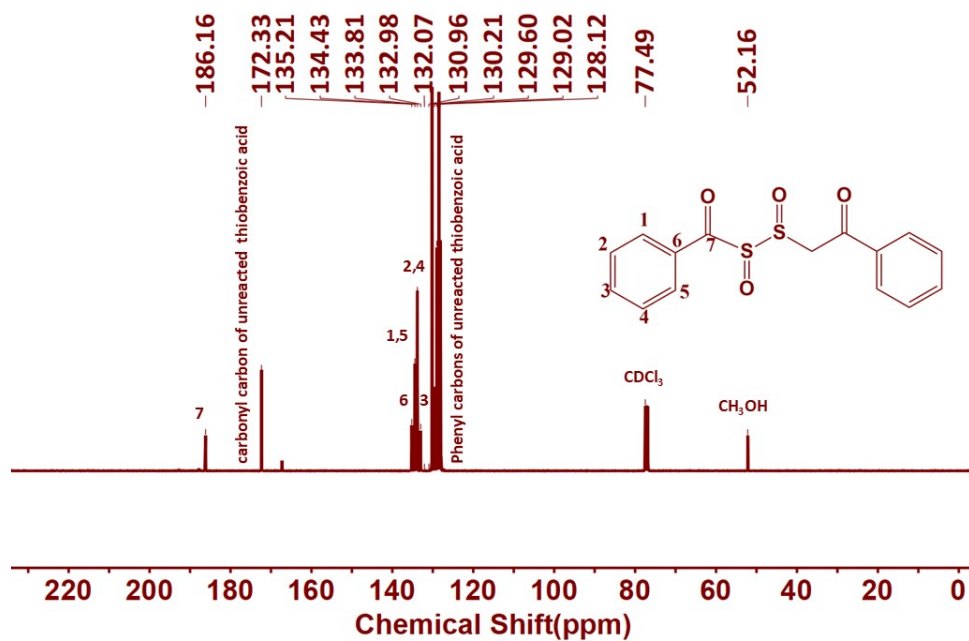
**Figure S5(c):**  $^1\text{H}$ NMR spectra of dibenzoyl sulfone of oxidation of thiobenzoic acid taken with methanol as reference solvent.



**Figure S5(d):** GC graph of dibenzoyl sulphone performed at room temperature.



**Figure S5(d):** Mass spectrum of dibenzoyl sulphone showing possible fragment formation



**Figure S5(e):** <sup>13</sup>C-NMR spectrum performed in CDCl<sub>3</sub> as reference solvent.