

## Supplementary Information

### New Zn (II) Complex-Composite Material: Piezo-Enhanced Photomineralization of Organic Pollutants and Wastewater from Lubricant Industry

Venkateshwar Rao D.,<sup>a</sup> Mahesh Subburu,<sup>a</sup> Ramesh Gade,<sup>a</sup> Prabhakar chetti,<sup>b</sup> Manohar Basude,<sup>a</sup> Narendra Babu S.,<sup>c</sup> Penumaka Nagababu<sup>d</sup> and Someshwar Pola<sup>a\*</sup>

<sup>a</sup>Material Research lab, Department of Chemistry, Osmania University, Hyderabad, India.

<sup>b</sup>Department of Chemistry, National Institute of Technology, Kurukshetra, India.

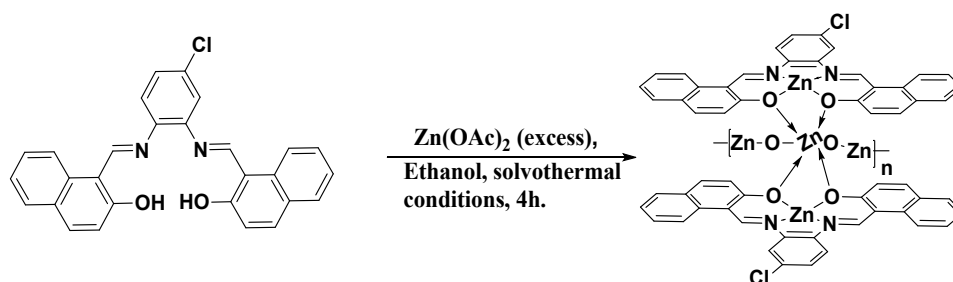
<sup>c</sup>Department of Physics, Osmania University, Hyderabad, India.

<sup>d</sup>Environmental Materials Division, CSIR-National Environmental Engineering Research Institute, Nagpur, India.

\*Corresponding author: E-mail address: [somesh.pola@gmail.com](mailto:somesh.pola@gmail.com) Tel: + 919959972288

#### 1. Synthesis of ZnO-[Zn(CPAMN)] complex composite

The [Zn(CPAMN)] complex (1.00 mmol), Zn(OAc)<sub>2</sub>.2H<sub>2</sub>O (1.00 mmol), stearic acid (3.00 mmol) and Polyvinyl alcohol (2.00 mmol) dissolved in ethanol (50 ml) then heated at 100°C under solvothermal conditions for 4h (Scheme 3). After cooling the formed precipitate was filtered and washed with deionized water. The obtained solid material sintered at 300 °C for 3 hours and the elemental composition of the material was confirmed through XPS data.



Scheme S1. Synthesis of ZnO-[Zn(CPAMN)] complex composite materials

#### 2. Piezo-photocatalytic activity studies

The mineralization of MR/RhB dye solutions were used to evaluate the ability of the piezo-photocatalytic system. The photodegradation reactions were achieved in the presence of visible light ( $\lambda > 400$  nm) treatment and ultrasonic-vibration, produced by 500 W Tungsten lamp (LPML, Techinstro, India) and Ultrasonic system (35 kHz, 160 W), respectively. In a characteristic piezo-photocatalytic performance, 50 mg of catalyst was suspended into the dye aq. solutions ( $5 \times 10^{-5}$  M). The solution was initially stirred for 60 min in the dark to create an adsorption-desorption steadiness between the catalyst and the dye solution. In the mineralization procedure, the temperature was kept at ambient condition through ice-cold water flow to

eliminate the effect of temperature on the degradation process. 3 mL of the dye solution was taken with a period of 10 min, at the same time remove the catalyst through a centrifugation process. The absorption intensity of the respective dye in supernatant was recorded through JASCO V-760 UV-Vis spectrophotometer.

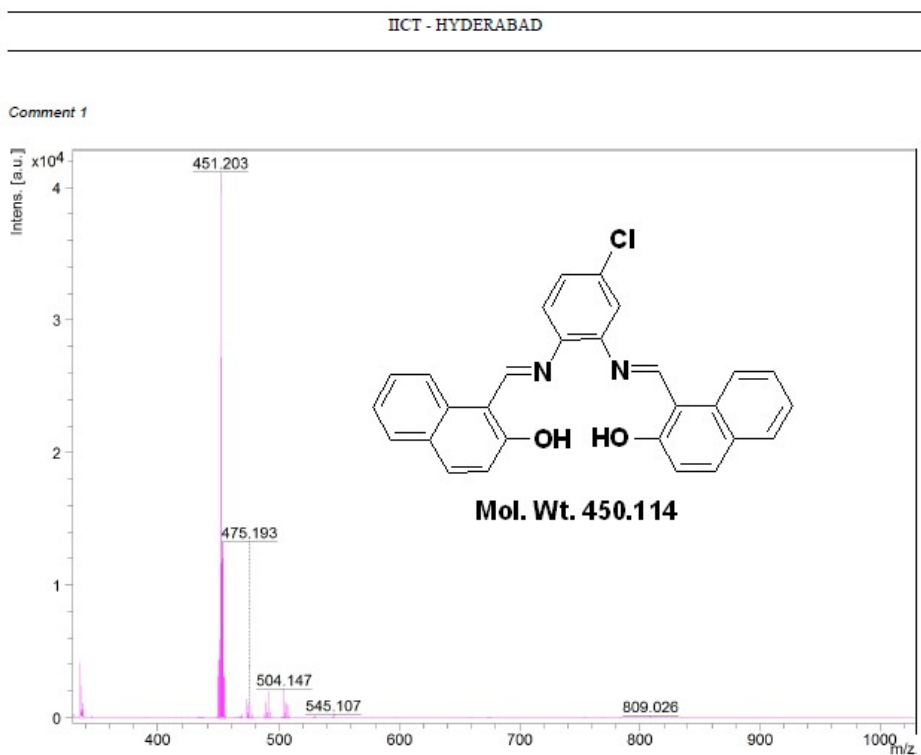


Figure S1. Maldi mass spectrum of CPAMN ligand

Comment 1

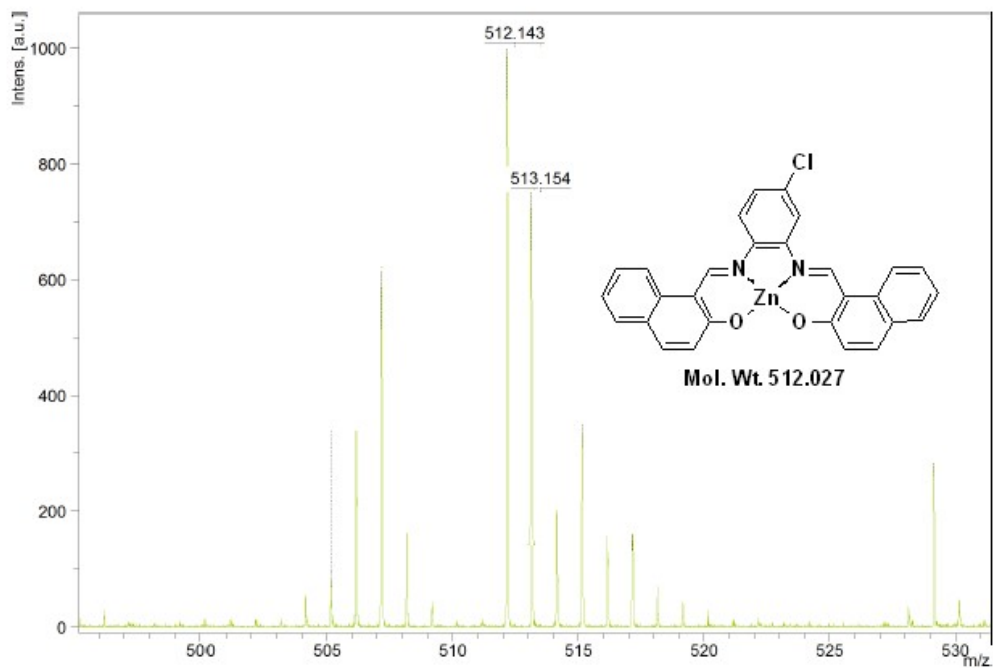


Figure S2. Maldi mass spectrum of [Zn(CPAMN)] complex

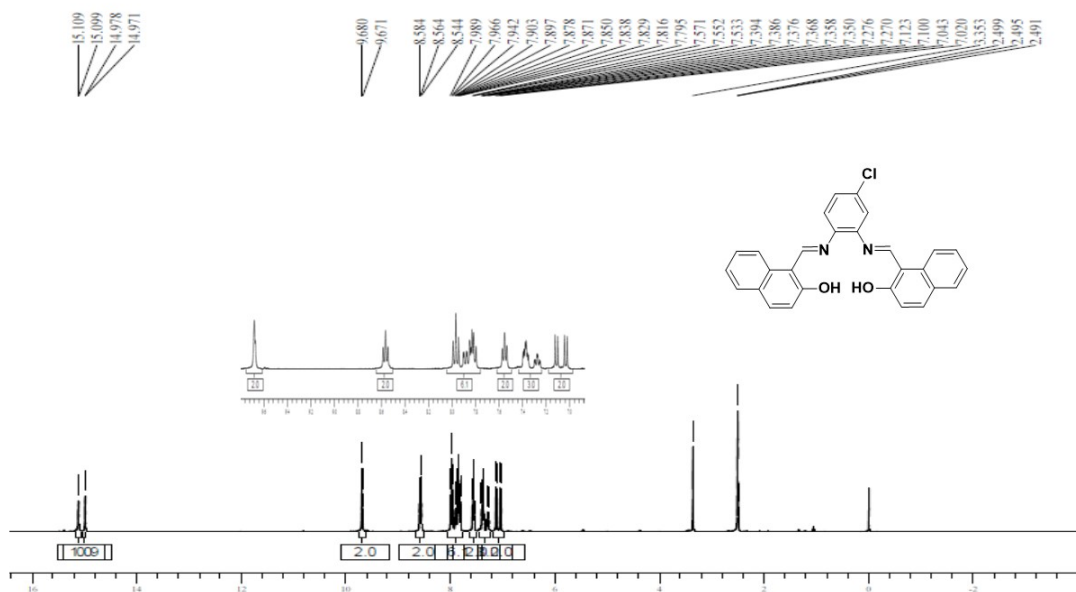


Figure S3. <sup>1</sup>H-NMR spectral pattern of CPAMN ligand

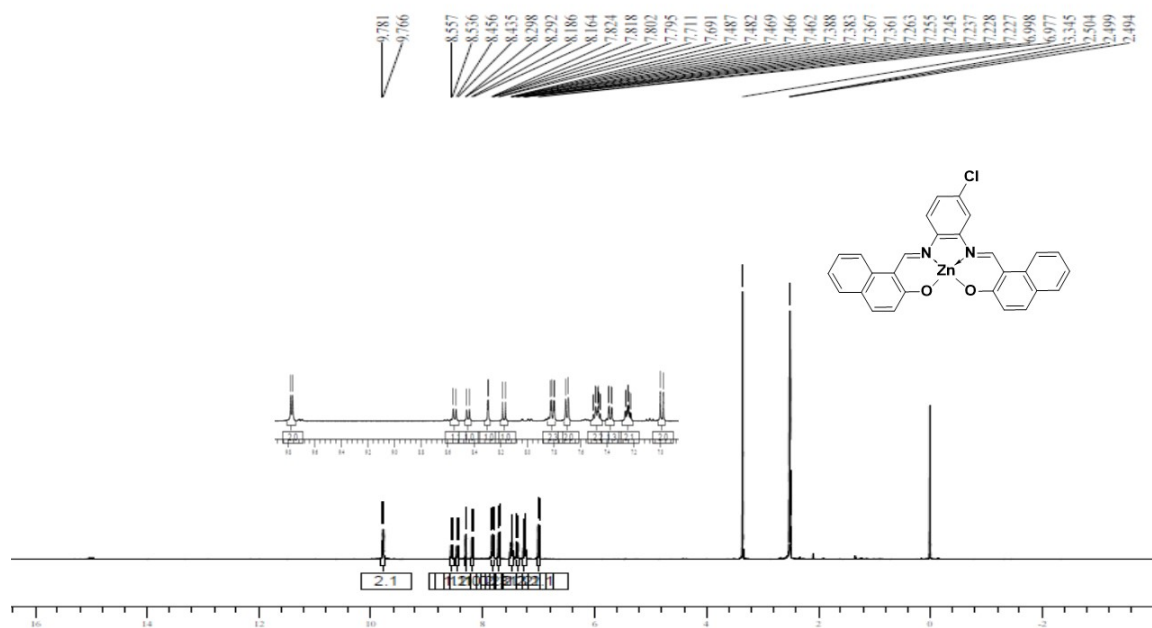


Figure S4. <sup>1</sup>H-NMR spectral pattern of [Zn(CPAMN)] complex

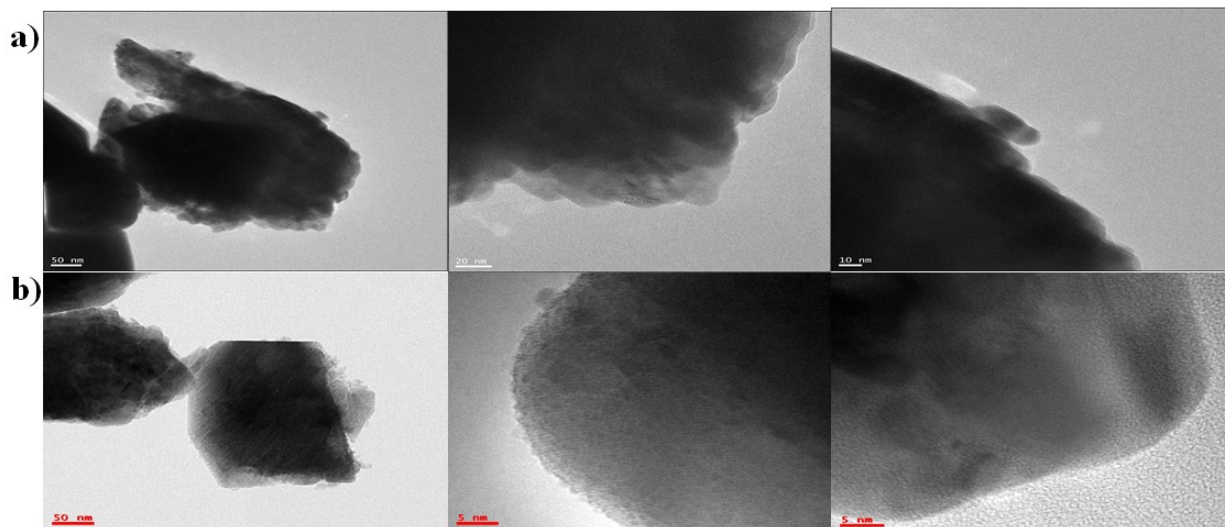
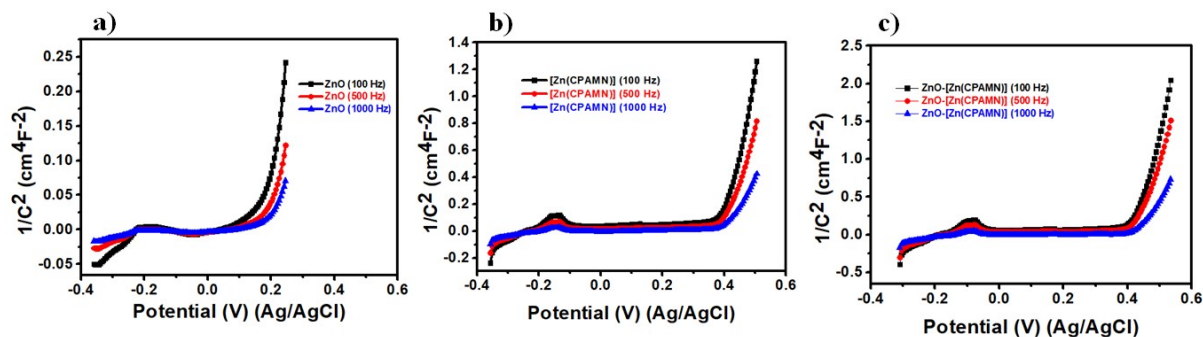
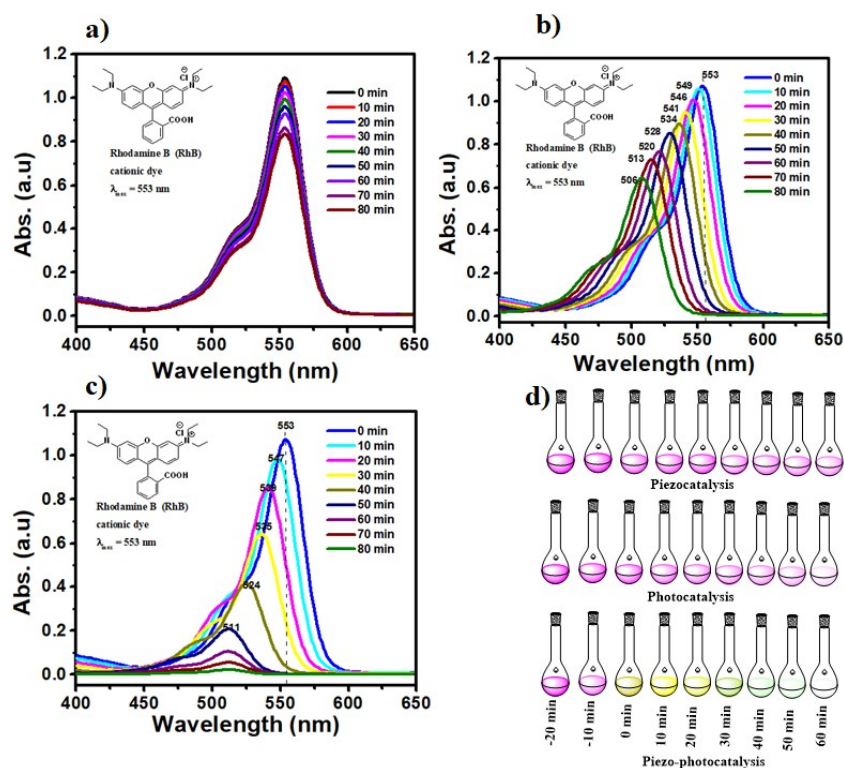


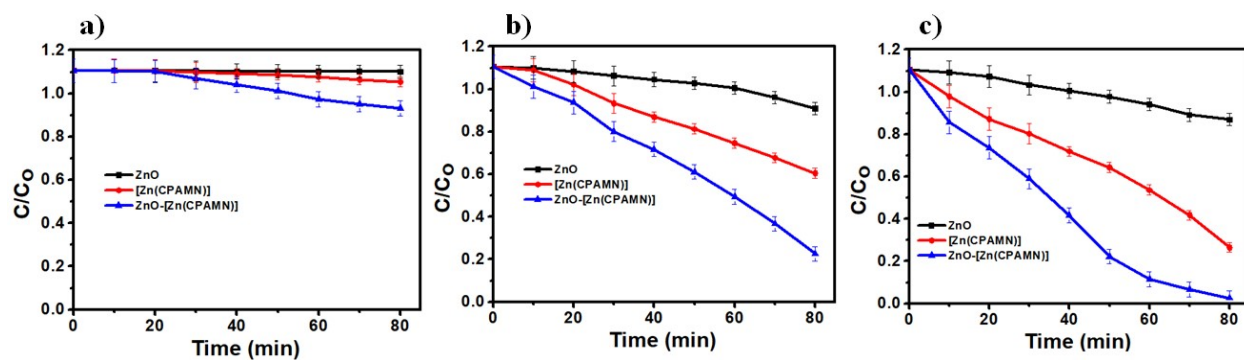
Figure S5 HRTEM images of a) ZnO and b) [Zn(CPAMN)] complex.



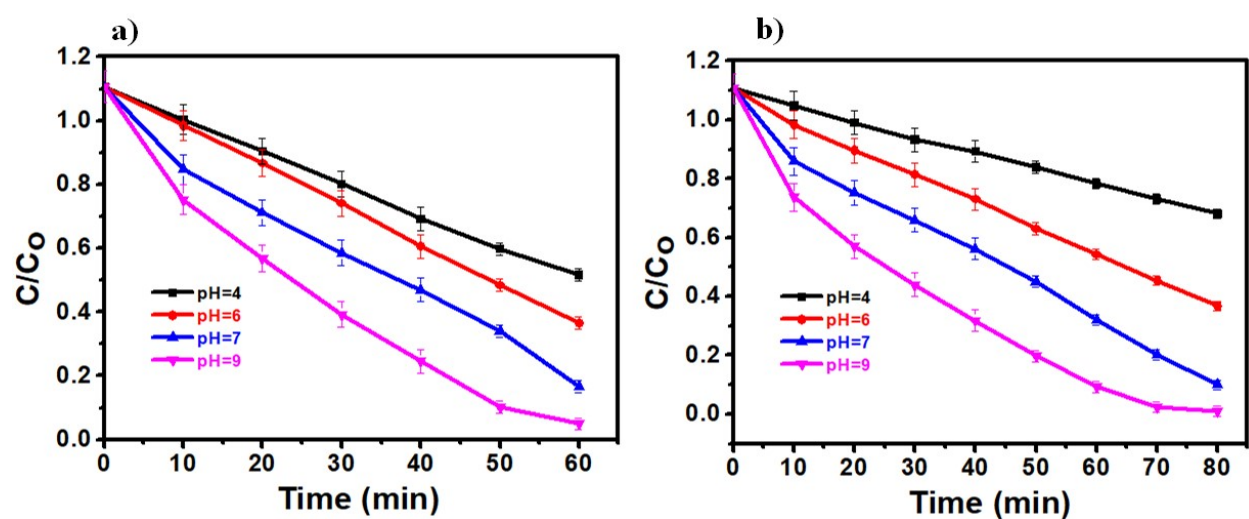
**Figure S6** Mott Schottky plots a) ZnO b) [Zn(CPAMN)] complex and ZnO-[Zn(CPAMN)] complex composite.



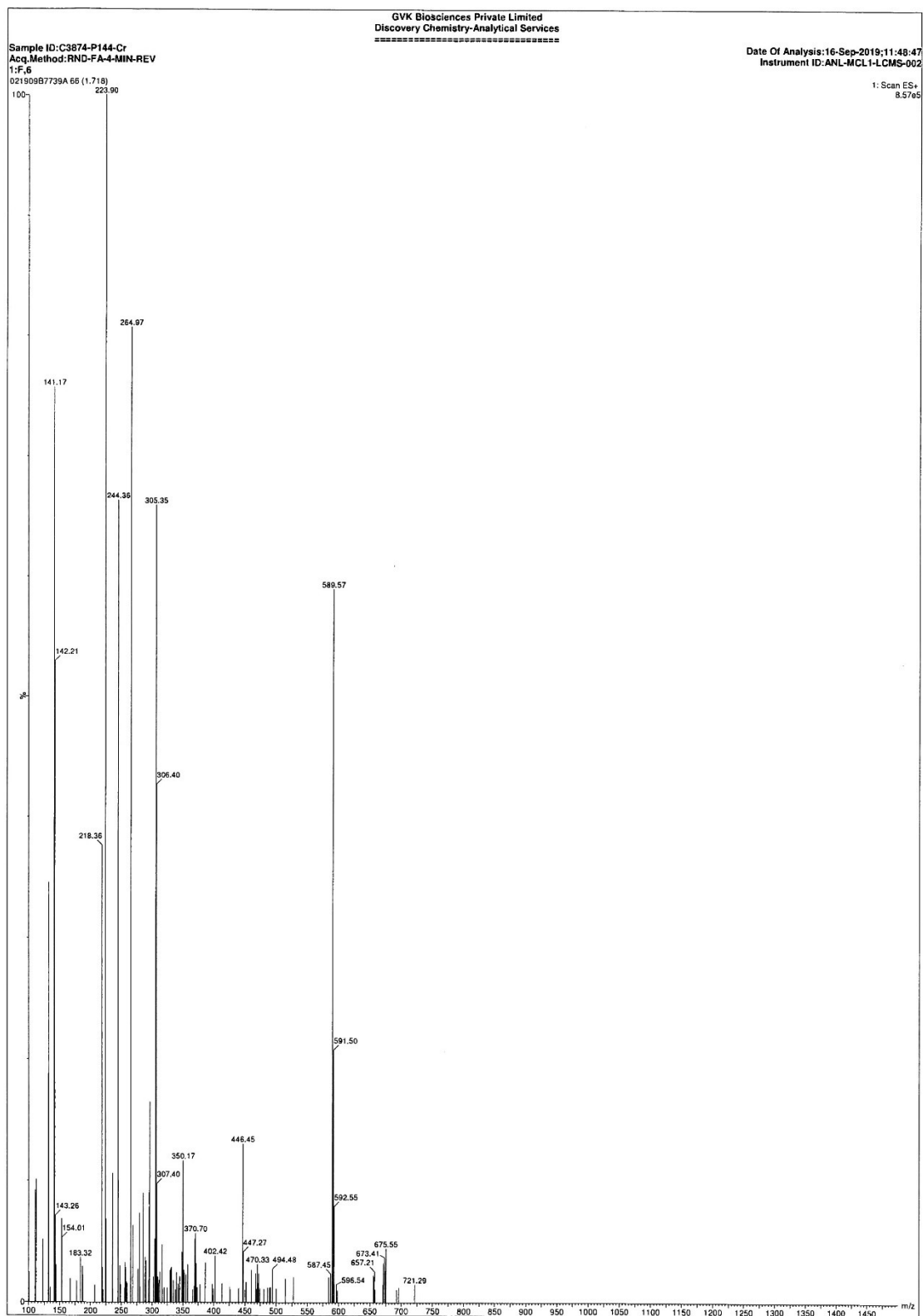
**Figure S7** UV-visible absorption spectrum of RhB dye solution mineralized in the presence of ZnO, [Zn(CPAMN)] and ZnO-[Zn(CPAMN)] catalyst through (a) piezocatalysis, (b) photocatalysis and (c) piezo-photocatalysis. (d) The conforming color modification of the sample solutions.



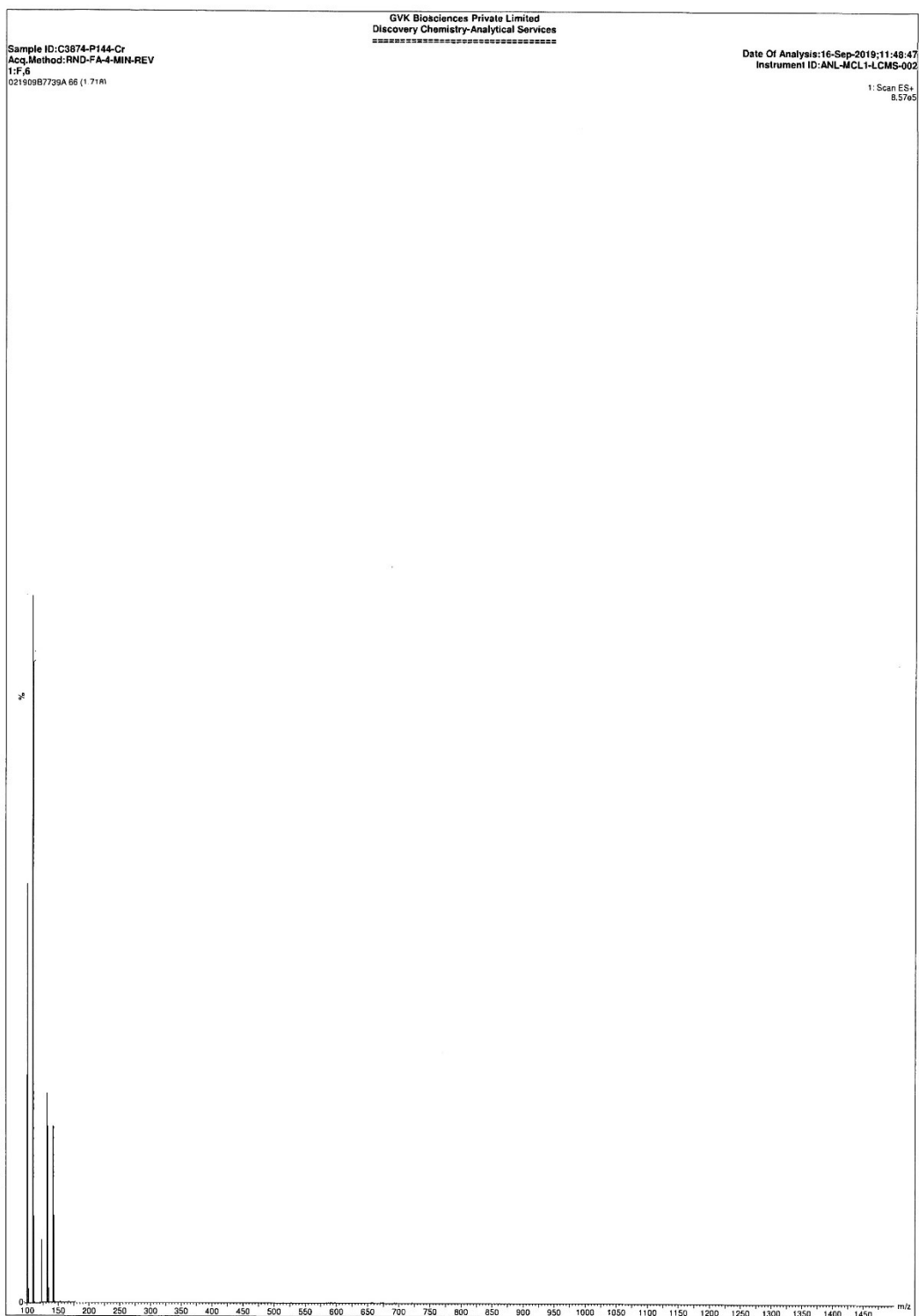
**Figure S8.** In the presence of a) ZnO, b) [Zn(CPAMN)] and c) ZnO-[Zn(CPAMN)] complex composites mineralization rates of RhB dye solution through piezocatalysis, photocatalysis and piezo-photocatalysis techniques.



**Figure S9** Effect of pH of the solution on piezo-photodegradation of MR and RhB dyes in the presence of ZnO-[Zn(CPAMN)] catalyst



**Figure S10 LC-MS data of IWW sample primary without exposed to ultrasonication and visible light irradiation**

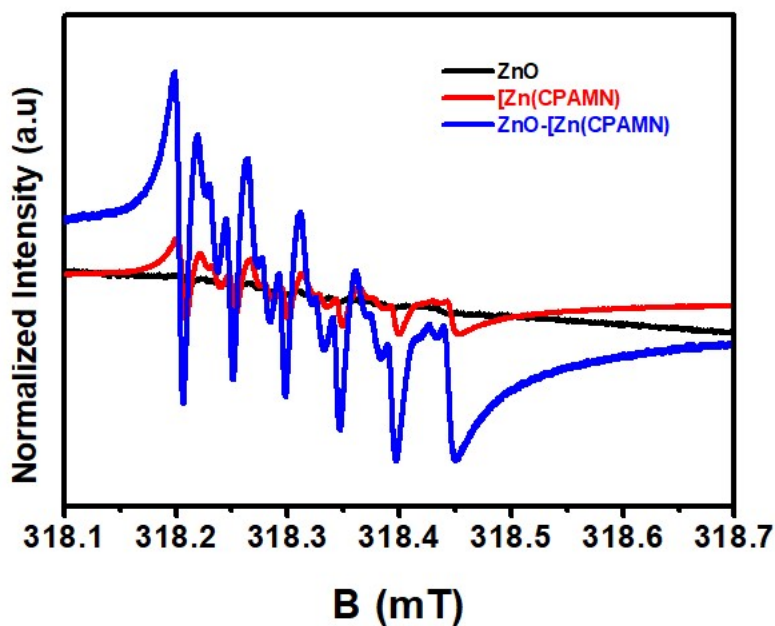


**Figure S11 LC-MS data of IWW sample primary after exposed to ultrasonication and visible light irradiation**



**Table S1 Compare the ZnO-[Zn(CPAMN)] piezo-photocatalyst with reported catalytic systems**

Catalytic system	Dyes or pollutants	Degradation time	References
ZnO-[Zn(CPAMN)]	MR, RhB and IWW	60 min, 80 min and 180 min	Present work
Bi <sub>0.5</sub> Na <sub>0.5</sub> TiO <sub>3</sub> @TiO <sub>2</sub>	RhB	90 min	1
BaTiO <sub>3</sub> nanowires	MO	80 min	2
ZnO nanoparticles	MB	120 min	3
ZnO nanowire	MB and crude oil pollutant	180 min and 20% in 6 h.	4
ZnO	Diclofenac	350 min	5
ZnO nanowires	MB	120 min	6
BaTiO <sub>3</sub> /KNbO <sub>3</sub>	lake blue 5B	180 min	7
ZnO/ZnS/MoS <sub>2</sub>	MB	60 min	8



**Figure S12 Spin trapping EPR spectra of ZnO, [Zn(CPAMN)] and ZnO-[Zn(CPAMN)] for DMPO- $\cdot\text{O}_2^-$  (in methanol dispersion)**

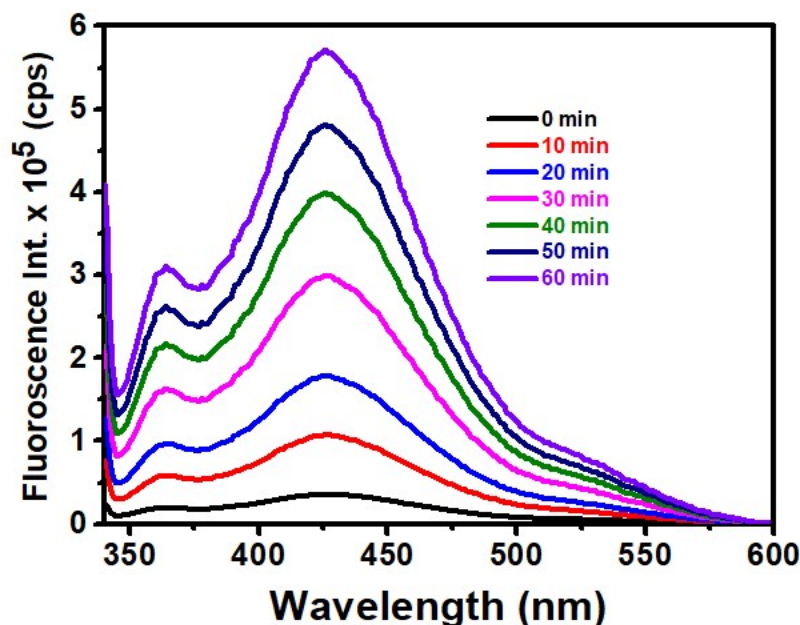


Figure S13 PL spectral increases under piezo-photocatalysis process with regular intervals of time on ZnO-[Zn(CPAMN)] complex composite in terephthalic acid.

## References

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