One-pot **sustainable preparation of sunlight active ZnS@Graphene nano-composite using Zn containing surface active ionic liquid**

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Supporting Information

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Annexure S1

HPLC calibration

CIP was analysed using a high performance liquid chromatography (HPLC) system (JASCO UV plus 2075, Japan) coupled with UV/Vis detector selected at l=254 nm and a Shodex C18M 4E analytical column (4.6 I.D × 250 mm), separation factor (α1=2.42 and α2=1.47) with a constant temperature of 25°C and pressure maximum 20 MPa and minimum 0.2 MPa. The eluent consists of 60:10:30 (v/v) acetonitrile: water: formic acid (25mM) (TCI, Japan) with a flow rate of 0.6mL/min. The formulas used to determine apparent quantum efficiency are provided in Annexure S1, Electronic Supporting Information, ESI.

Apparent quantum efficiency (AQE) determination

$$Apparent\ quantum\ efficiency\ (\%) = \frac{Mols\ of\ reacted\ electrons\ per\ unit\ time}{Mols\ of\ incident\ photons\ per\ unit\ time} \times 100$$

(S1)

Mols incident photons per unit time ($N_{Einstein}$) = $\frac{Number\ incident\ photons\ per\ unit\ time}{N_A}$

Number of incident photons N_p per unit time can be calculated by: $N_p = \frac{Intensity\ (E)}{Photon\ energy\ (Ep)}$ and $photon\ energy\ (Ep) = \frac{hc}{\lambda}$

(S2)

E = Irradiance × reactor area illuminated

$$E_p = \frac{(6.625\ \times 10^{-34} J.s)(3 \times 10^{17} nm.s^{-1})}{\lambda(nm)} = \frac{19.88 \times 10^{-17}}{\lambda(nm)} = 4.73 \times 10^{-19} J$$

(S3)

$N_p = \frac{E}{E_p} = 0.00189/4.73\times10^{-19} = 1.73\times10^{16}$ J (S4)

$N_{Einstein} = \frac{N_p}{N_A} = 2.87\times10^{-6}$ mols.s^{-1} (S5)

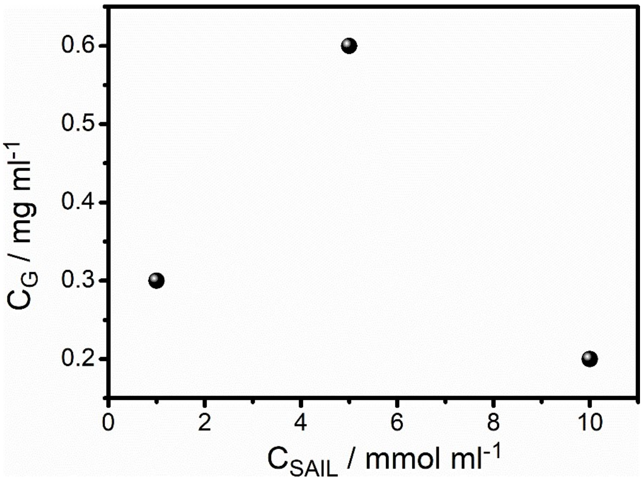


Figure S1: Concentration of exfoliated graphene (C_G) as a function of concentration of $[C_{16}mim][ZnCl_3]$.

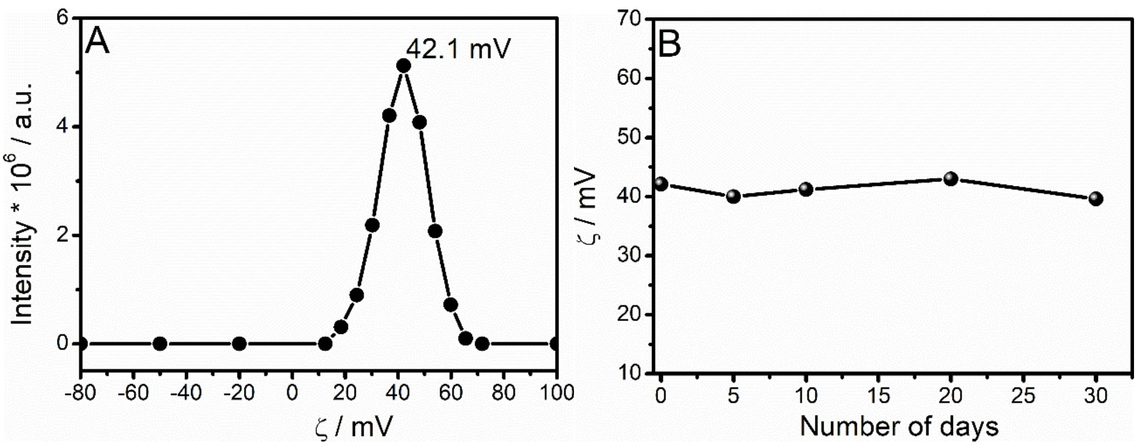


Figure S2: (A) Zeta (ζ) potential value of graphene dispersion in aqueous solution of SAIL at concentration of 5 mmol L^{-1}; (B) Variation of ζ-potential of graphene dispersion in aqueous solution of 5 mmol L^{-1} concentration of SAIL as a function of days

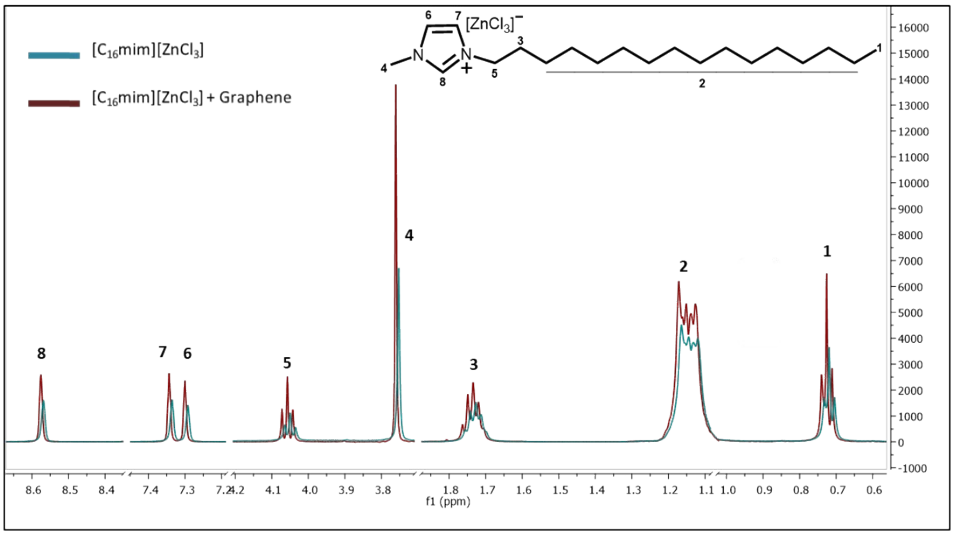


Figure S3: ^{1}H NMR spectra of MIL in 10% D_2O with and without graphene.

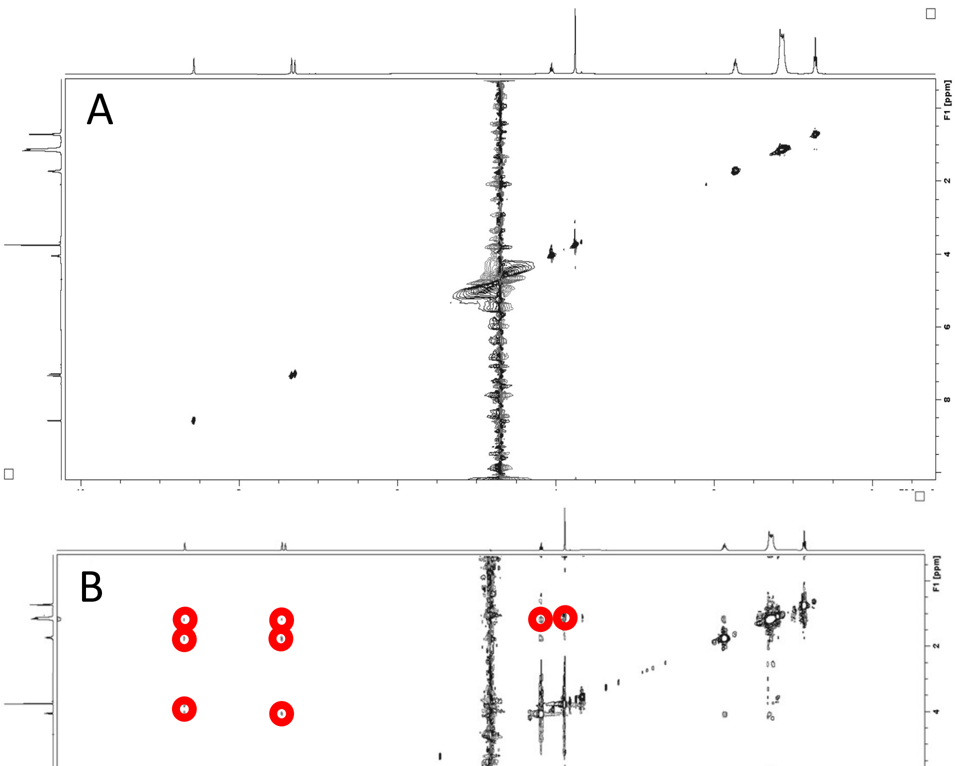


Figure S4: (A) 2D ^1H-^1H NOESY spectra of aqueous solution of [C_{16}mim][$ZnCl_3$] in absence of graphene; (B) 2D ^1H-^1H NOESY spectra of aqueous solution of [C_{16}mim][$ZnCl_3$] in the presence of graphene. Red circles in B shows the presence of correlation peaks between the alkyl chain of [C_{16}mim][$ZnCl_3$].

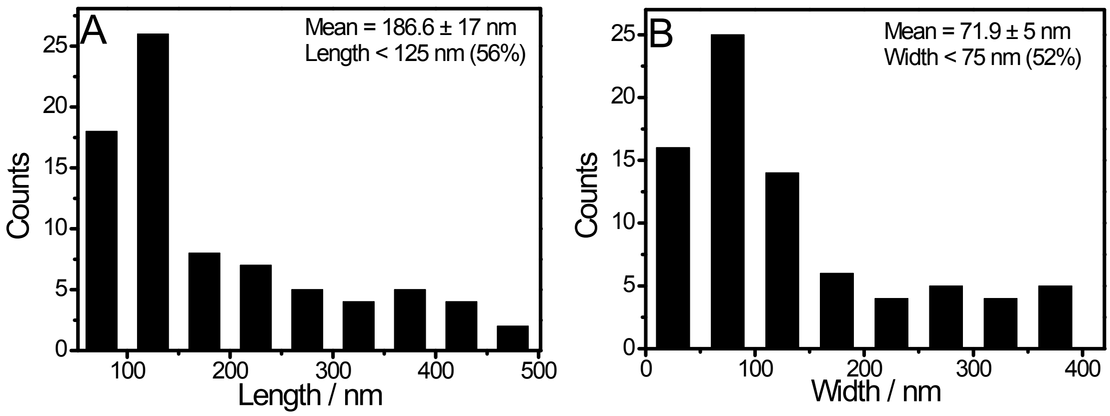


Figure S5: Statistical data of (A) length and; (B) width obtained from analysis of AFM images of graphene sheets.

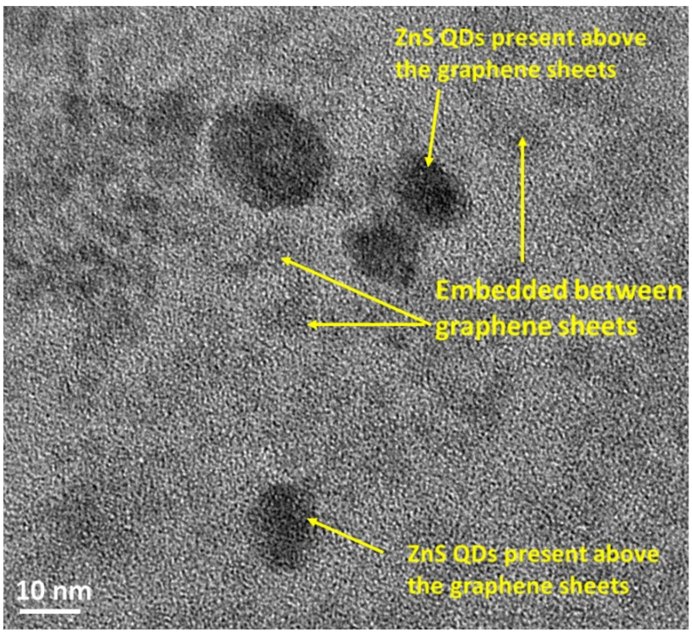


Figure S6: TEM image of prepared ZnS@G NCs showing ZnS QDs embedded between the graphene sheets and present above the graphene sheet.

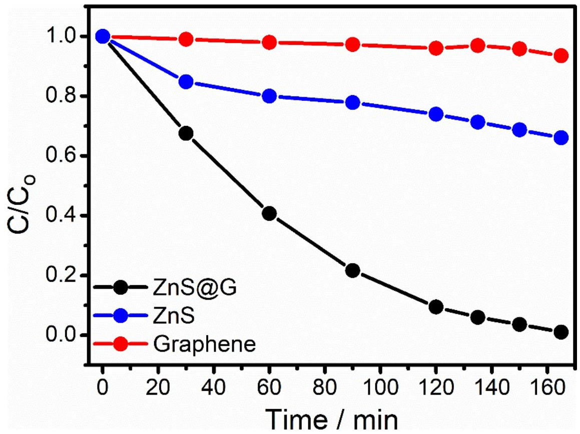


Figure S7: Catalytic performance of ZnS@G NCs, ZnS QDs and Graphene towards the degradation of RhB dye under sun light.

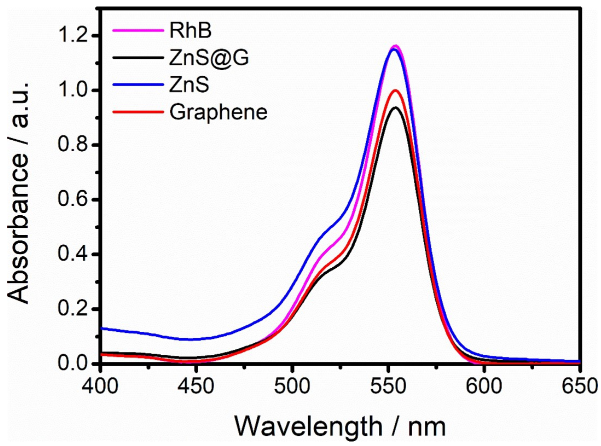
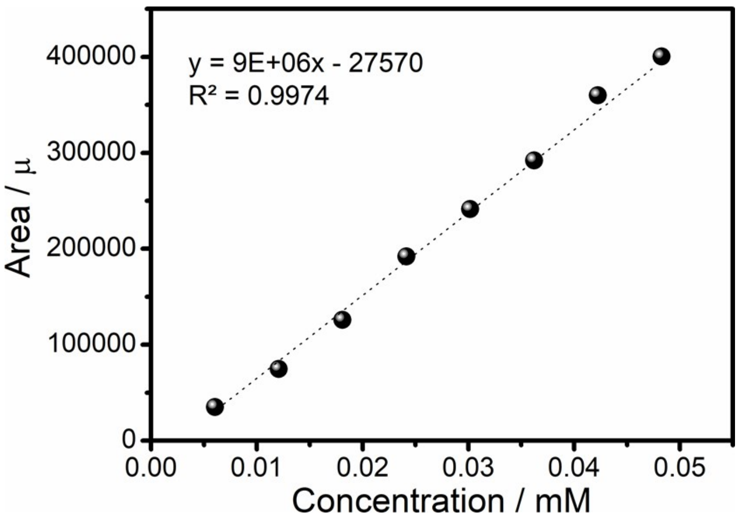
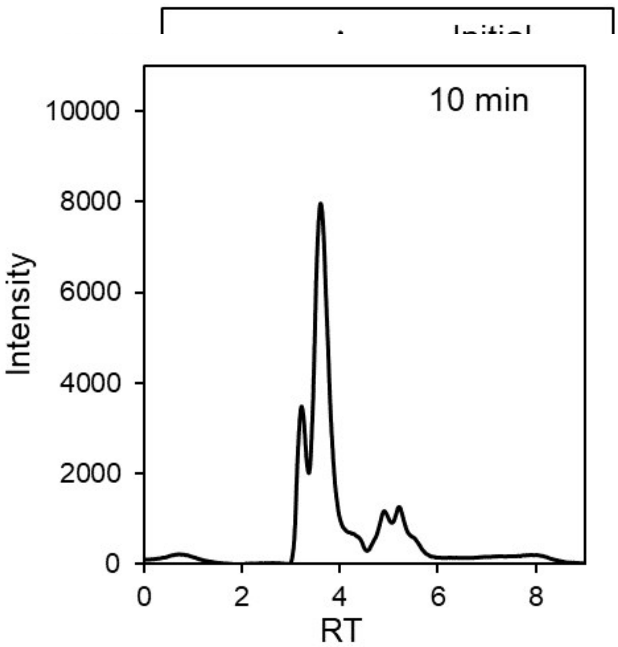
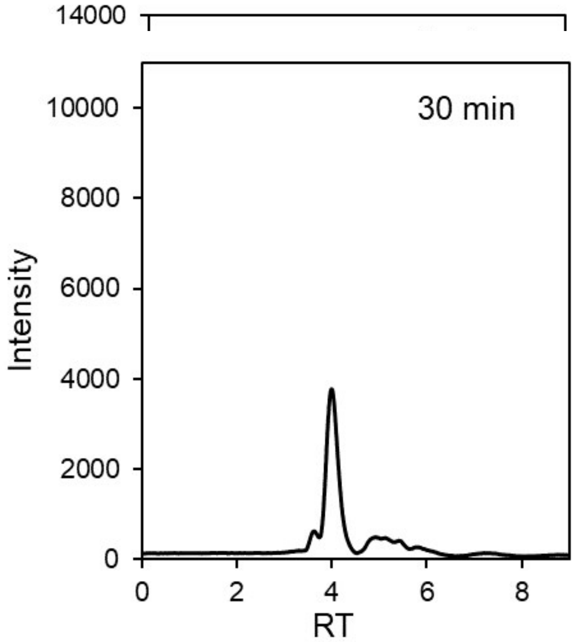
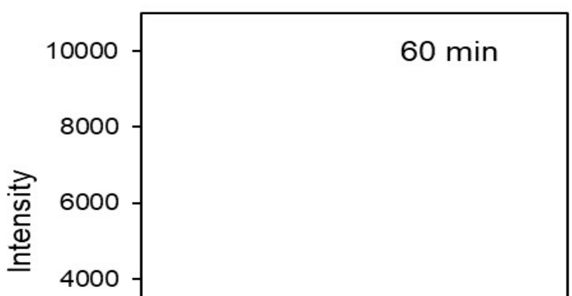


Figure S8: Variation in absorbance spectra of RhB dye using ZnS@G NCs and its counterparts after stirring for 30 min in dark.


y = 9E+06x - 27570
R² = 0.9974
Area / μ
Concentration / mM


10 min
Intensity
RT


30 min
Intensity
RT


60 min
Intensity

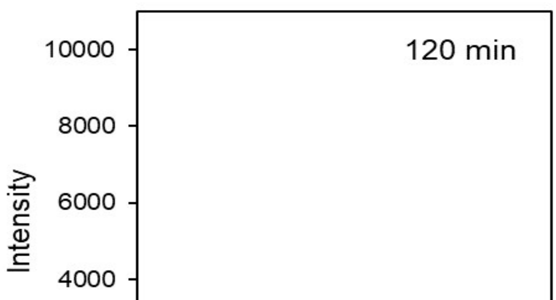

120 min
Intensity

Figure S10: HPLC spectra of CPI at different time intervals in the presence of ZnS@G NC under visible light.

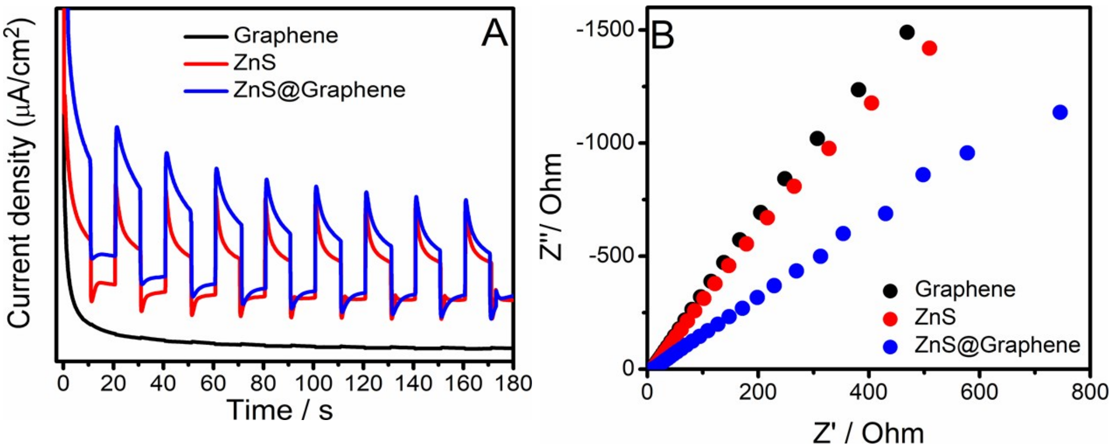


Figure S11: (A) Transient photocurrent; (B) EIS (Nyquist) plot at 0 V *vs*. RHE under illumination of ZnS@Graphene, ZnS, and Graphene.