Supporting Information

Synthesis of rGO–Zn0.8Cd0.2S via in situ reduction of GO for the realization of a Schottky diode with low barrier height and highly enhanced photoresponsivity

Mrinmay Das[a], Joydeep Datta[a], Rajkumar Jana[a], Sayantan Sil[a], Soumi Halder[a] and Partha P. Ray*[a]

[a.] Department of Physics, Jadavpur University, Kolkata – 700 032, India

[b.] Department of Physics, Bejoy Narayan Mahavidyalaya, Itachuna, Hooghly-712147, India

*Corresponding Author, e-mail:partha@phys.jdvu.ac.in;

Phone: +91-9475237259; Fax: +91-3324138917

Electron dispersive X-ray (EDX) analysis:

The energy dispersive X-ray (EDX) spectrum of the rGO-ZnCdS sample is shown in Fig. S1. The EDX spectrum confirms the presence of C, S, Zn and Cd elements, and the molar ratio of Zn to Cd is found to be aprroximtely 0.76:0.24.

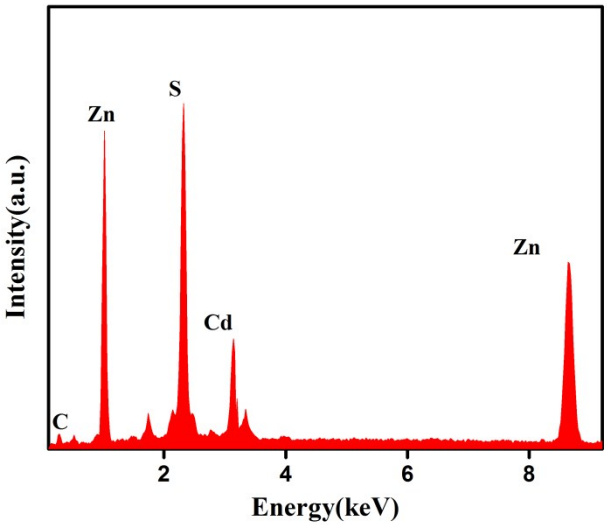

Fig. S1. The electron dispersive X-ray (EDX) spectrum for rGO-ZnCdS sample

I-V characteristics and Richardson constant evaluation:

The I-V characteristic curves of the SBDs for different weight ratio of rGO in rGO-ZnCdS composite (rGO= 0.25%, 0.5%, 1% and 2%) is presented in Fig. S2.

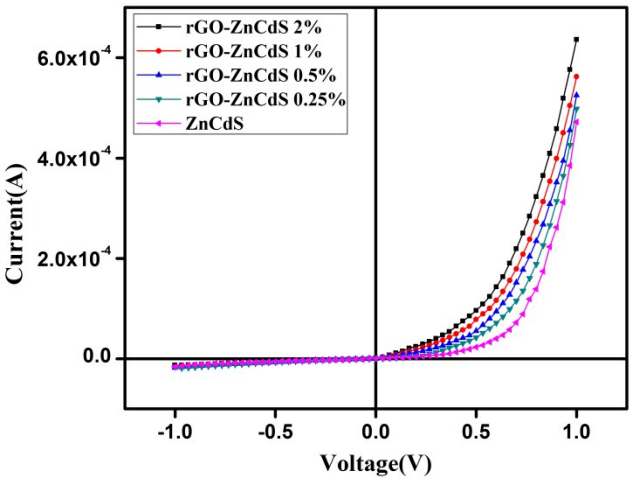

Fig. S2. The I-V characteristics curve of Al/ZnCdS/ITO and Al/rGO-ZnCdS/ITO Schottky diodes for different rGO weight ratios

The current-voltage(I-V) relation of the schottky diode is given by the standard equation:

$$I = I_0\left[exp\left(\frac{qV}{nkT}\right) - 1\right] \quad \textbf{(3)}$$

Where, I is forward current, I_0 the reverse saturation current, V the applied bias, q the electronic charge, k the Boltzman constant and T is the absolute temperature. n is the ideality factor, a constant taken into account for non-ideal behaviour of diode. I_0 can be represented by [38]:

$$I_0 = AA^{*}T^2\, exp\left(\frac{-q\phi_b}{kT}\right) \quad \textbf{(4)}$$

Where, A, A^* and ϕ_b are effective diode area, Richardson constant and Schottky barrier height respectively. Effective diode area was maintained at 7.065 x 10^{-6} m^2. Richardson constant for both materials was derived from equation (4) by plotting $ln(I_0/T^2)$ vs q/kT, which is shown in Fig. S3. The obtained values were 0.043 and 0.002 for ZnCdS and rGO-ZnCdS respectively.

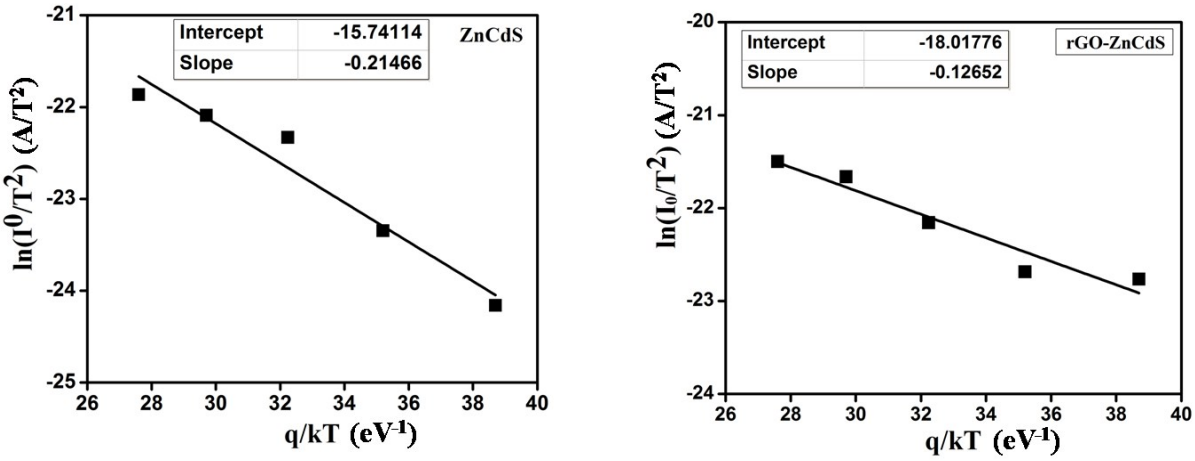

Fig. S3. Plot of $ln(I_0/T^2)$ vs q/kT to determine richardson constant for ZnCdS and rGO-ZnCdS

Dielectric constant measurement:

The dielectric constant was obtained by measuring capacitance against frequency of the film. Fig. S4 represents the plot of capacitance against frequency at constant bias

potential. In higher frequency regime the capacitance of the films were saturated, which was selected as the stable situation of the material film. Hence the dielectric constant of the material film was evaluated by employing the equation:

$$\varepsilon_r = \frac{CL}{\varepsilon_0 A}$$

Where, ε_0 is the permittivity of free space, C is the capacitance (at saturation), L is the thickness of film and A is the effective area.

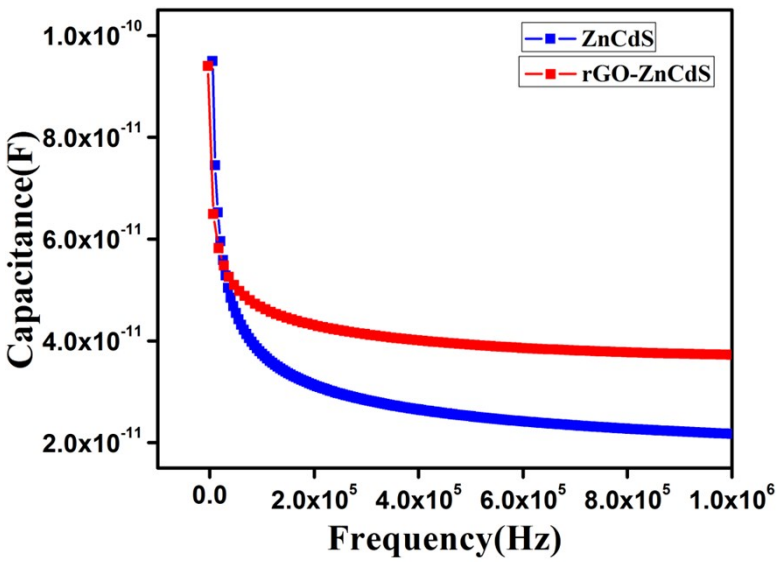

Fig. S4. Plot of capacitance vs frequency for ZnCdS and rGO-ZnCdS