Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supporting Information

Band Engineered P-type RGO-CdS-PANI Ternary Nanocomposites for Thermoelectric Applications

Priyesh V. More[a]*, Abhijit Dey[b], Chaitanya Hiragond[a] and P. K. Khanna[a]*

Seebeck coefficient /Thermoelectric Power (S) Measurements

To evaluate the seebeck coefficient, samples with a dimension of 30 mm (l) × 6 mm (w) × 1 mm (t) of the polymer nanocomposite film were made and placed on fibreglass (thermal insulated). A Peltier heater was placed at one edge of the sample with an epoxy adhesive (thermally conductive but electrically insulating 2763 Stycast) while at the other edge, a copper piece (drainage of heat) was connected with the Peltier cooling module. The voltage drop and temperature gradient along the film was monitored with thermocouples arranged in series (electrically insulated from the sample with 2763 Stycast) with two copper wires. To nullify the error of the measurements, thermal gradient and voltage drop were measured at the same point by connecting two copper films to the samples with Dupont 43929N, a thermally and electrically conductive silver epoxy paste. The contacts and thermocouple were connected to these films. Keithley 2182A nanovoltmeter was used to measure the seebeck voltage at room temperature.

Electrical Resistivity Measurements

The expected electrical resistivities of samples are in the range of metals. Hence, electrical resistivity was monitored by adopting four probe delta mode method. The least possible current was generated (100mA) by Keithley 6220 and corresponding voltage was measured with a Keithley 2182A nanovoltmeter. The least current was selected to avoid sample heating at low temperature. The samples with a dimension of 8mm × 3mm × 1mm were used to measure the electrical conductivities for polymer nanocomposite samples.

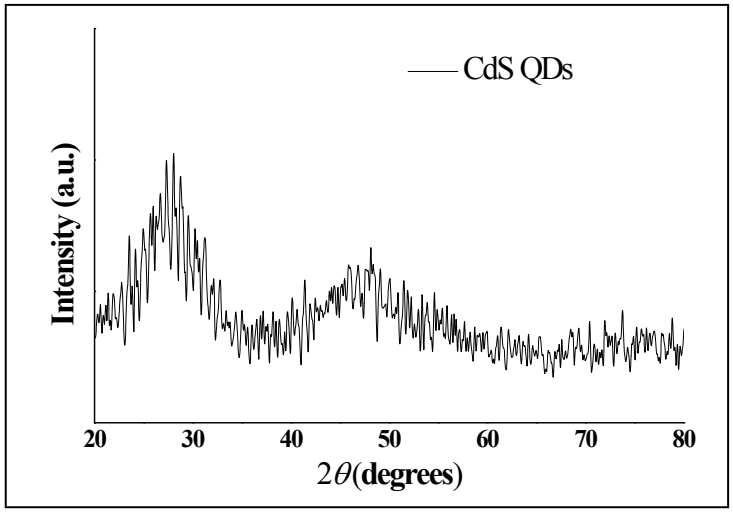

Figure SI.1: XRD pattern of CdS QDs when synthesized alone in absence of RGO. The broad profile is due to highly amorphous and small particle size of CdS QDs. The peaks (111), (220) and (311) corresponding to zinc blende (cubic) crystal structure of CdS may have merged together to give a broad profile.

Figure SI. 2: Photograph showing re-dispersion of RGO/CdS/PANI nanocomposite with 0.4 wt% G4 loading in DMF as solvent. The sample can also be re-dispersed in ethanol and showed stability for 08 weeks and counting.

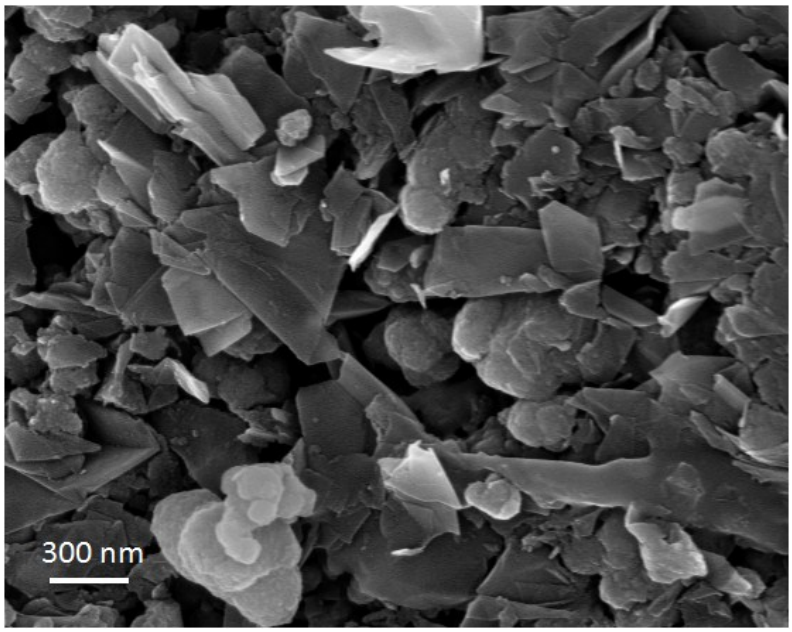

Figure SI. 3: SEM image of RGO/CdS/PANI nanocomposite with 0.4 wt% G3 loading showing sub-micron sized exfoliated RGO/CdS nanocomposite and globular PANI particles.

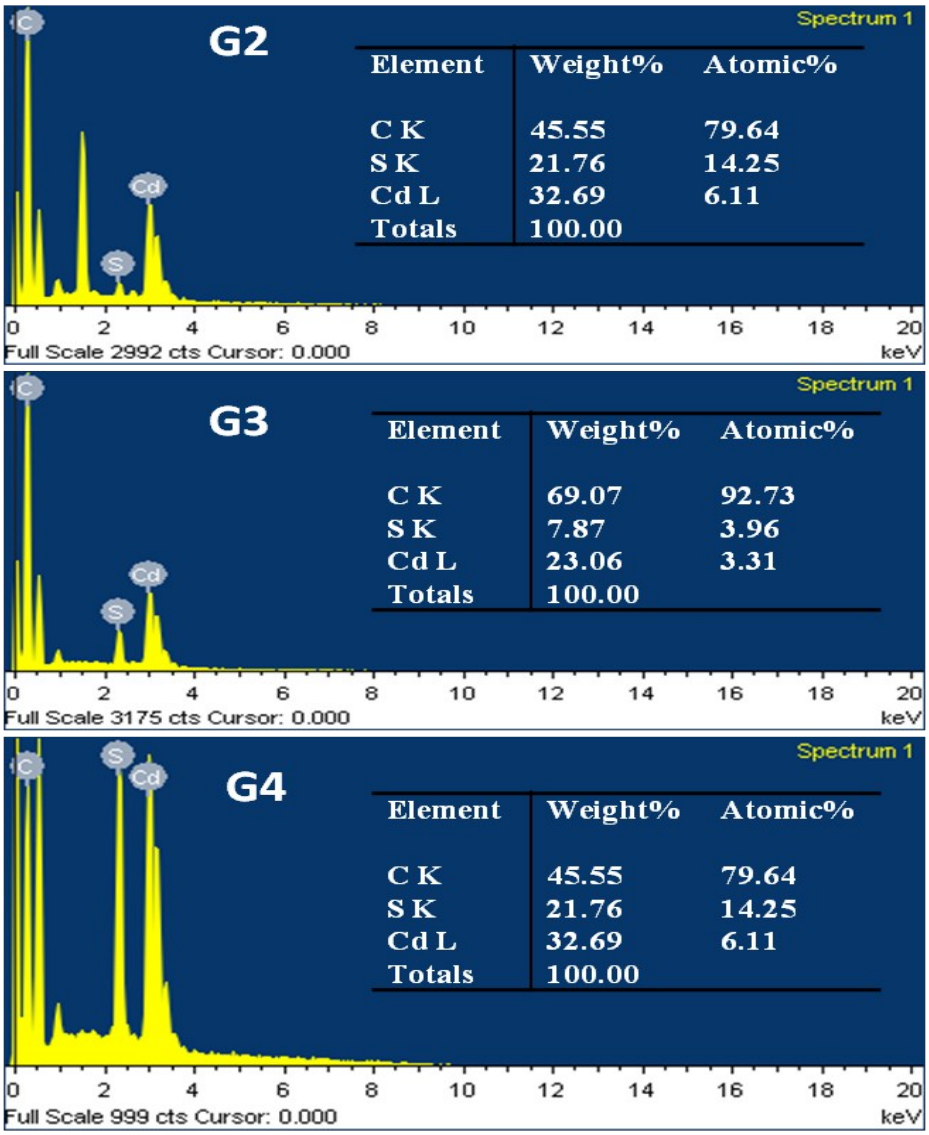

Figure SI 3: EDX analysis of samples G2, G3 and G4 showing presence of Cd, S and C in the samples. The increase in elemental Cd and S in G4 sample as compared to G2 and G3 is clearly evident.

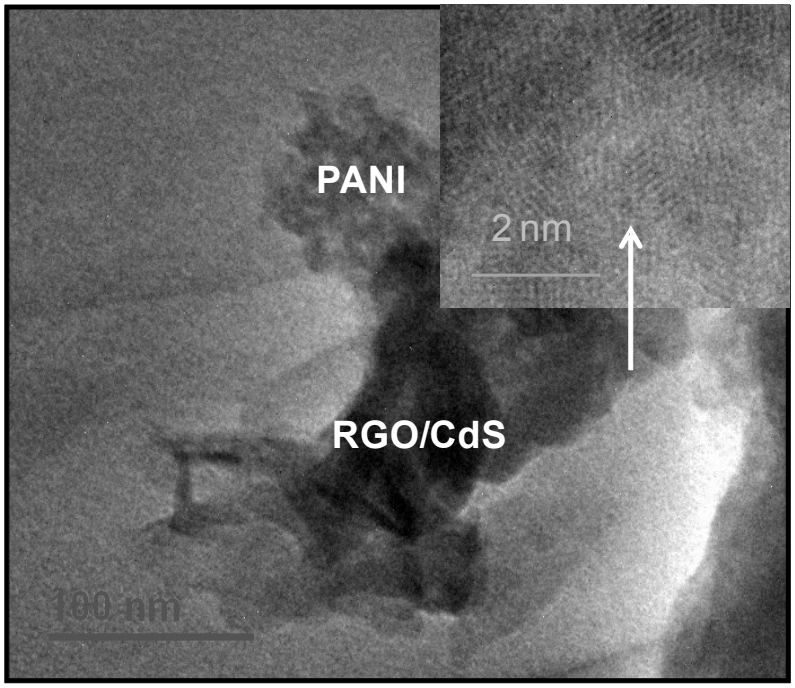

Figure SI. 5: TEM image of RGO/CdS/PANI nanocomposite with 0.4 wt% G3 loading showing the presence of exfoliated RGO sheets, PANI particles and lattice fringes of CdS QDs present on RGO surfaces.