Supporting Information

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Photo-to-thermal conversion: effective utilization of futile solid-state Carbon Quantum Dots (CQDs) for energy harvesting applications

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S1. Photoluminescence quantum yield determination (CAU quantum dots)

For calculation of quantum yield, quinine sulfate was used as the standard. Quinine sulfate (φ = 0.54) was dissolved in 0.1 M H_2SO_4 (having refractive index, η of ~1.33) while the CQDs were dispersed in water (η ~ 1.33). Three concentrations of both the solutions were prepared, all of which had absorbance less than 0.1 a. u. at 352 nm. The fluorescence spectra of both the samples and the standard were recorded at same excitation wavelength of 352 nm. Then by incorporating the integrated photoluminescence intensities (excited at 352 nm) and the absorbance magnitudes (at 352 nm) of the CQDs and of the reference, quinine sulfate, in the equation for calculating the PL QY, quantum yield of the carbon dot sample was determined.

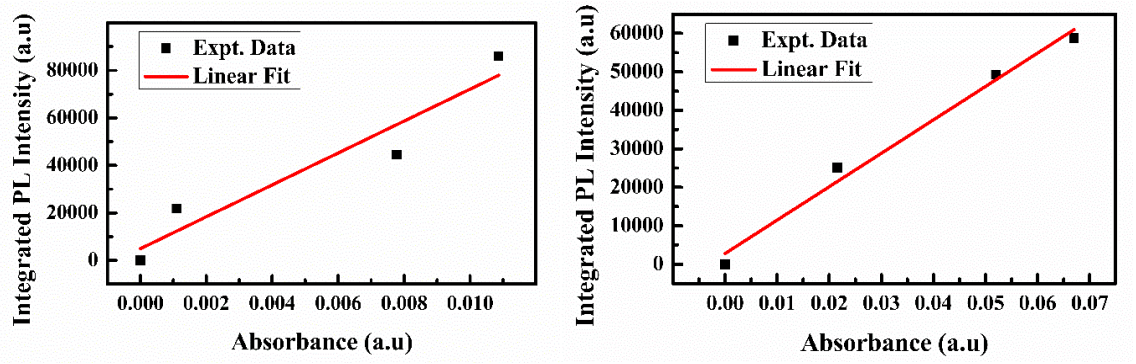


Figure S1: Plot of integrated PL intensity vs absorbance of (a) quinine sulphate (standard) and (b) of the CAU quantum dots (aqueous dispersion) at three different concentrations.

PL quantum yield of CAU quantum dots in aqueous dispersed form,

$$\varphi_{CAU} = \varphi_{qs} \times \frac{grad_{CAU}}{grad_{qs}} \times \frac{\eta_{CAU}^2}{\eta_{qs}^2}$$

$$= 0.54 \times \left(\frac{0.868 \times 10^6}{6.714 \times 10^6}\right) \times \frac{1.33^2}{1.33^2}$$

$$= 6.98\ \%$$

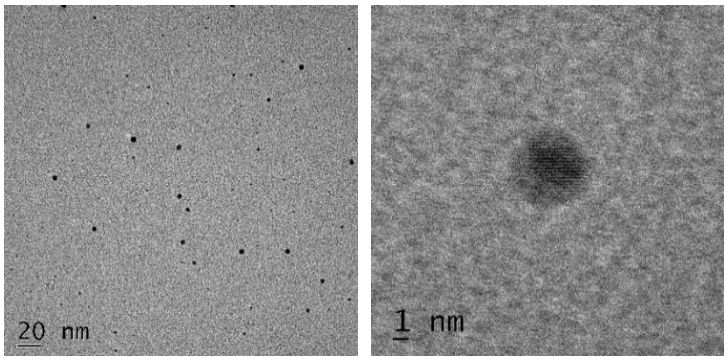
CATU carbon quantum dots

Synthesis

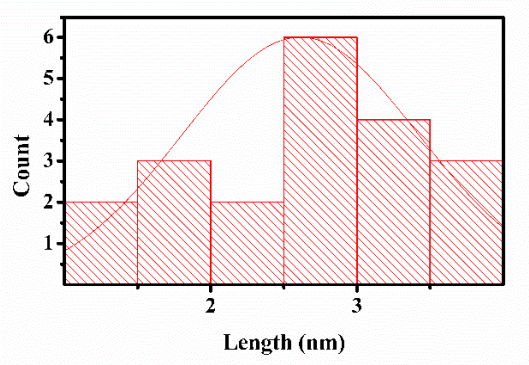
The synthesis is based on a method reported by Meng Li *et al*.[1]. Citric acid (500 mg) and thiourea (500 mg) were mixed well with 30 mL of deionized water to form a homogeneous solution. This solution was then heated using a domestic microwave oven at a power of 800 W for 7 minutes to obtain a brown solid. Once the sample cooled down to room temperature, it was sonicated well with ~ 20 mL deionized water followed by filtration and centrifugation at 13000 rpm for 45 minutes. The upper half of the aqueous solution of the carbon dots was recovered from the centrifuge tube and later subjected to dialysis against deionized water in a dialysis bag with molecular weight cut-off of 1 kDa for 4 days. The as purified solution was then freeze-dried to obtain brown solid CATU quantum dot powder.

Physico-chemical characterizations

S2. TEM



(a) (b)



(c)

Figure S2: (a) TEM image of CATU quantum dots (b) HRTEM image of CATU quantum dots with the lattice spacing ~ 0.203 nm (c) Histogram showing the size distribution of the particles.

S3. Raman spectrum

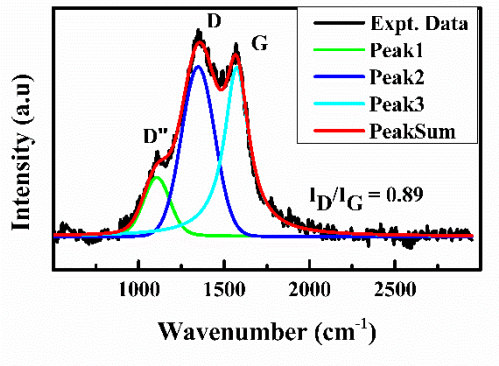


Figure S3: Raman spectrum of CATU dots with its characteristic D and G peaks.

S4. FTIR spectrum

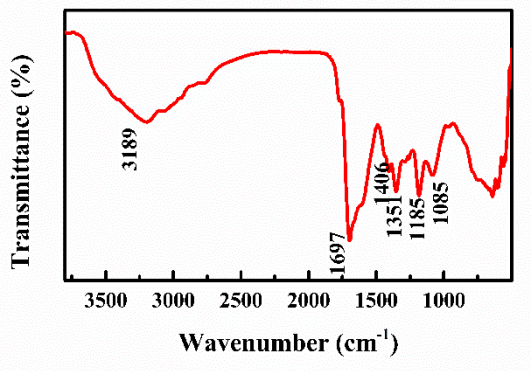


Figure S4: FTIR spectrum of CATU carbon dots in powder form.

S5. Optical Characterizations

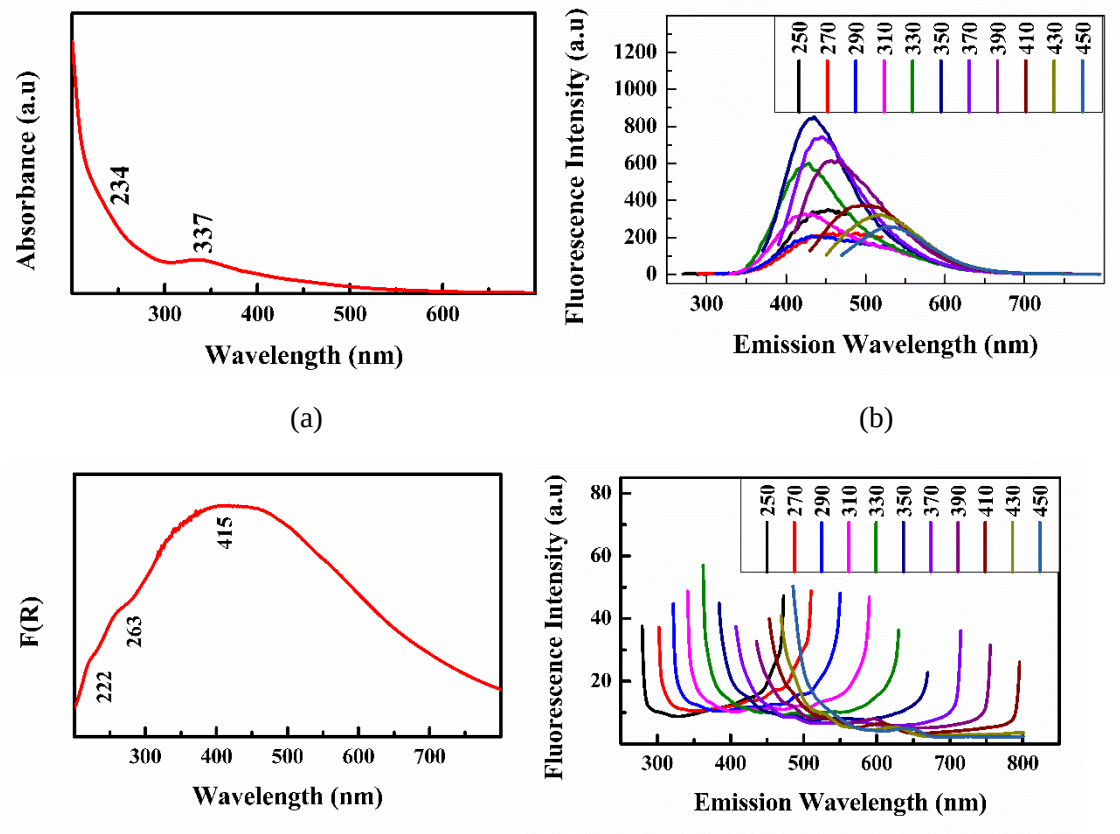
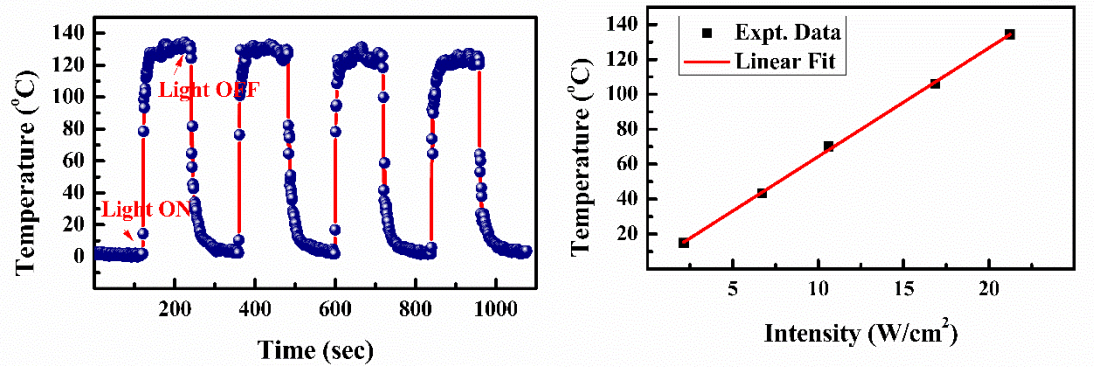


Figure S5: (a) UV-visible absorption spectrum of CATU dispersed in aqueous solution (b) UV-visible fluorescence emission spectrum of CATU (aqueous solution); legend indicates the excitation wavelengths (c) Diffuse reflectance spectrum (DRS) of CATU in powder form (d) Fluorescence emission spectrum in powder form of CATU dots (legend indicates the excitation wavelengths).

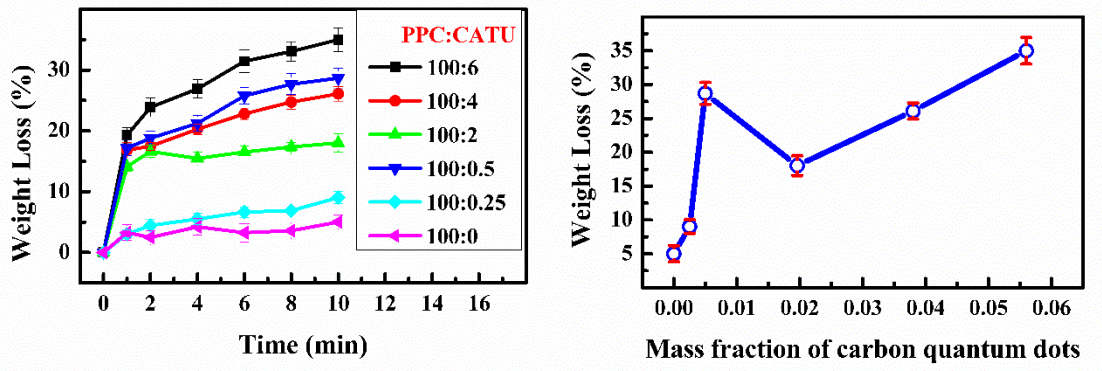
S6. Photo-to-thermal conversion characteristics



(a) (b)

Figure S6: (a) Temperature vs Time plot of CATU carbon dots upon irradiation with laser of intensity ~ 21.2 W/cm^2 (b) Linear variation of temperature increase in CATU sample versus laser intensities.

S7. PPC Degradation Studies



(a) (b)

Figure S7: (a) Weight loss with time upon irradiation of PPC:CATU composite samples with different concentrations of CATU carbon dots (b) Mass fraction of CATU in CATU-PPC composite versus the obtained weight loss upon laser irradiation.

S8. NMR studies of PPC degradation

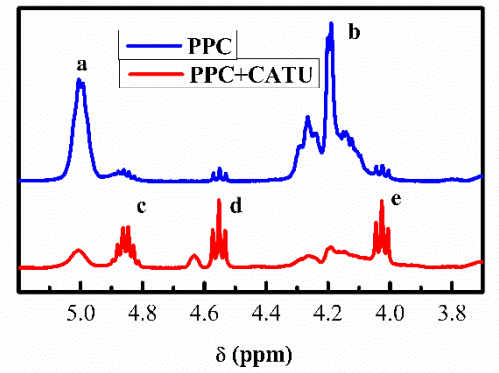


Figure S8: Plot of ^{1}H NMR spectrum of the polymer (PPC, before irradiation) and of the composite (PPC+CATU, after irradiation).

References

1. M. Li, M. Wang, L. Zhu, Y. Li, Z. Yan, Z. Shen and X. Cao, *Applied Catalysis B: Environmental* **2018**, 231, 269-276.