Supporting Information for

Dependence of electron recombination time and light to electricity conversion efficiency on shape of nanocrystal light sensitizer

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Materials and Methods

Synthesis of CdS nanocrystals with various shapes: Cadmium acetate, Cd(CH\textsubscript{3}COO)\textsubscript{2}.2H\textsubscript{2}O and thioacetamide, CH\textsubscript{3}CSNH\textsubscript{2} have been taken in 7:10 ratio in a 50 ml Teflon container. Solvent mixtures (structure directing agents) with various ratios of ethylene glycol (EG) and ethylenediamine (EN) have been added to it while kept in an ice-bath and has been stirred for few minutes. They are then kept in stainless steel autoclaves and the reaction was then carried out at 180\textdegree C, 4 hours. Later the product was collected by centrifugation, washed by water and ethanol for several times and dried at 70\textdegree C in vacuum to get yellow powders which were subjected to further characterization and experiments.

Preparation of TiO\textsubscript{2} layers: TTIP (Titanium tetra-isopropoxide) has been dissolved in slightly acidic iso-propanol-water mixture and it’s been stirred for 24 hours resulting in a clear solution. FTO-glasses has been dipped in it and heated at 120\textdegree C to get a transparent and compact layer of TiO\textsubscript{2}. TTIP added in 6 N HCl soln. and stirred for 30 minutes in a ice-bath. Then 15 ml of it has been put in a Teflon container along with the FTO-glasses with compact layer and a hydrothermal reaction has been carried out in autoclave at 150\textdegree C for 4 hours to grow vertically aligned TiO\textsubscript{2}– nanorods on the FTO-glasses. Again, it has been put in a 0.4 N TiCl\textsubscript{4} solution at 100\textdegree C for an hour to get a scattering layer of TiO\textsubscript{2}. After that the electrodes have been annealed at 450\textdegree C for an hour resulting a composite TiO\textsubscript{2}film with ~15\textmu m thickness.
**Sensitization:** The electrodes have been put in a solution of Thiolglycolic acid (TGA) in acetonitrile which acts as a bilinker molecule for 12 hours to attach the CdS nanocrystals with TiO$_2$. After that they have been immersed in dispersions of various CdS nanopowders in toluene for 48 hours. The CdS-TiO$_2$ was additionally co-sensitized by cadmium selenide (CdSe) nanoparticles to shift absorption onset towards longer wavelengths$^8$ and by zinc sulfide (ZnS)$^3$ for optimization of the trap states. Both CdSe and ZnS were coated using SILAR method. In brief, the electrodes were dipped in a 0.03 M cadmium nitrate solution (Cd$^{2+}$ source) and a 0.03 M selenium di-oxide solution with 0.06 M sodium borohydride (Se$^{2-}$ source) in cycle, 30s cycles in each cases, total 6 cycles. It’s been carried out in Nitrogen-atmosphere. Both solutions were in ethanol and in the second solution, sodium borohydride reduced selenium dioxide to produce selenide-ion. ZnS coating has also been done by SILAR where 0.2 M zinc acetate and 0.2 M sodium sulphide, both in aqueos solution have been served as the Zn$^{2+}$ and S$^{2-}$ sources respectively. 2 cycles of 1 minute each have been carried out.

**Solar Cell Fabrication:** Scotch-tape (thickness ~ 50 μm) has been put on the sides of the photoanode which acted as the spacer. A drop of sodium polysulphide electrolyte (1 M Na$_2$S, 1 M S) was used as the electrolyte and Cu$_2$S electrode obtained from a piece of brass has been served as the dark cathode. A sandwich type cell has been made of typically 5 mm X 5 mm of active area and further characterizations have been carried out.
Figure S1: Powder XRD patterns of CdS samples with different morphologies
Figure S2: UV-Vis spectra for CdS powder samples of different shapes.

Figure S3: SEM micrograph of as-synthesized TiO$_2$ nanorod (absorption layer) vertically aligned on FTO substrate coated with a compact and transparent layer of TiO$_2$. 
Figure S4: UV-Vis spectra of photoanodes with TiO$_2$ sensitized by various shapes of CdS

Figure S5: UV-Vis spectra of photoanodes with TiO$_2$ sensitized by CdSe (SILAR) and tetrapod-CdS (linker assisted)
Figure S6: Recombination resistances of solar cells sensitized by various shapes of CdS (only)