# Type-II Quantum Dot Sensitized Solar Cell

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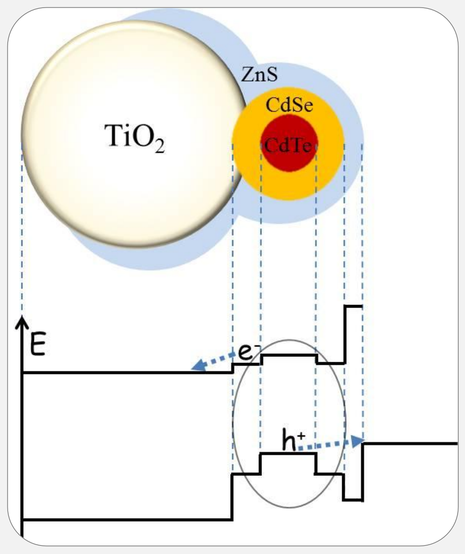
Type-II hetero-structure CdTe/CdSe core/shell nano-crystals (quantum dots, QDs) are explored as sensitizers in a quantum dot-sensitized photo-electrochemical solar cell. These QDs comprise of a hole-localizing core and an electron-localizing shell. Among their advantages is the significant red-shift of the absorption edge of the hetero-structured QD relative to its two constituents due to spatially indirect absorption, intra-particle exciton dissociation upon photo-excitation, and a relatively small content of the less abundant Tellurium element. The full cell shows efficient charge separation despite hole localization in the CdTe core. Monochromatic incident photon-to-current conversion efficiency measurement shows a spectrally broad photo-response spanning the whole visible spectrum and reaching up to about 900 nm with a total cell efficiency of 1.3%.

## Schematic representation of the system

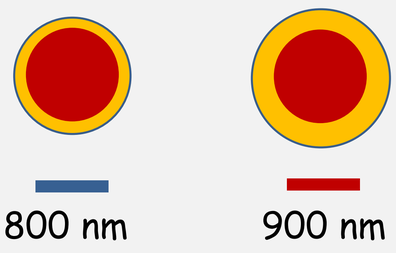



Type-II CdTe/CdSe core/shell QDs adsorbed on a nano-crystalline $TiO_2$ via a linker and over coated by a ZnS shell

Assumed energy band diagram of the crystalline $TiO_2$, CdTe/CdSe QD, ZnS coating, and the polysulfide electrolyte

## Legend

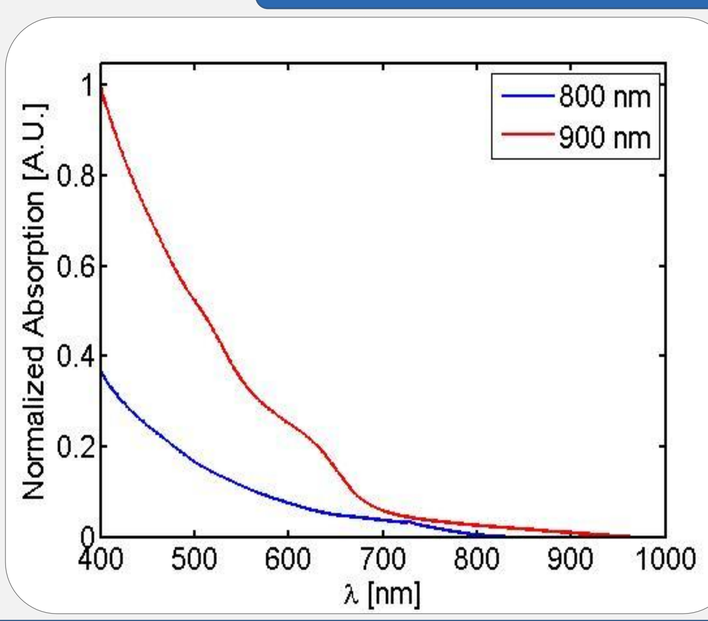
Type-II CdTe/CdSe QDs

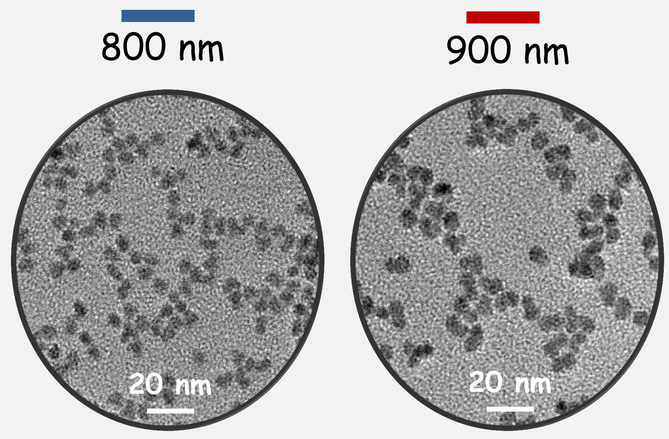



same core (CdTe) diameter; thicker CdSe shell in the 900 nm sample

## Characterization of QDs

Absorption spectra of CdTe/CdSe QDs in toluene

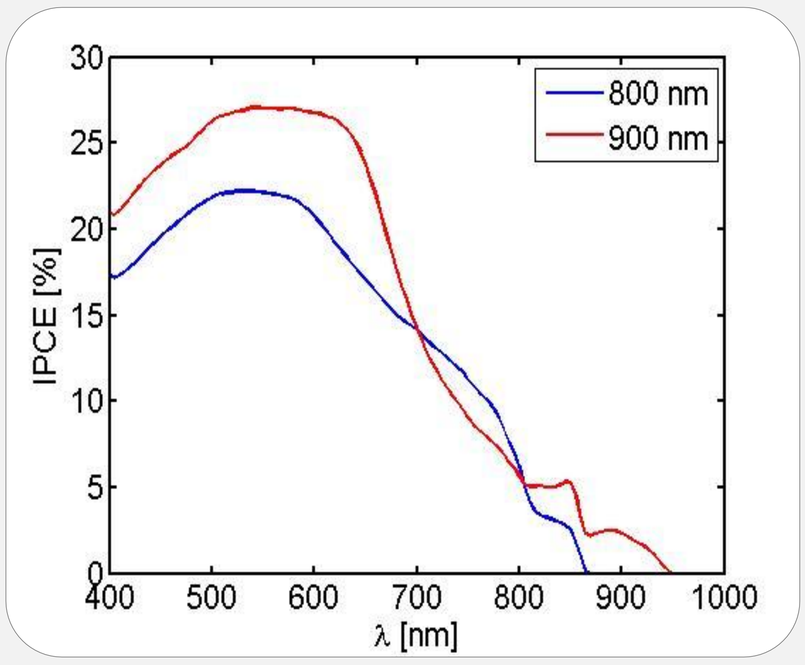


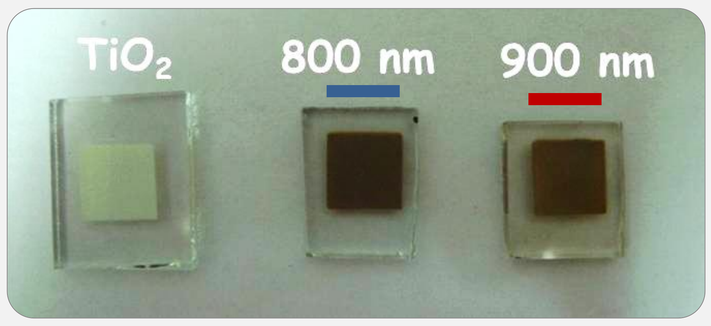

TEM images

## Electrical Characterization

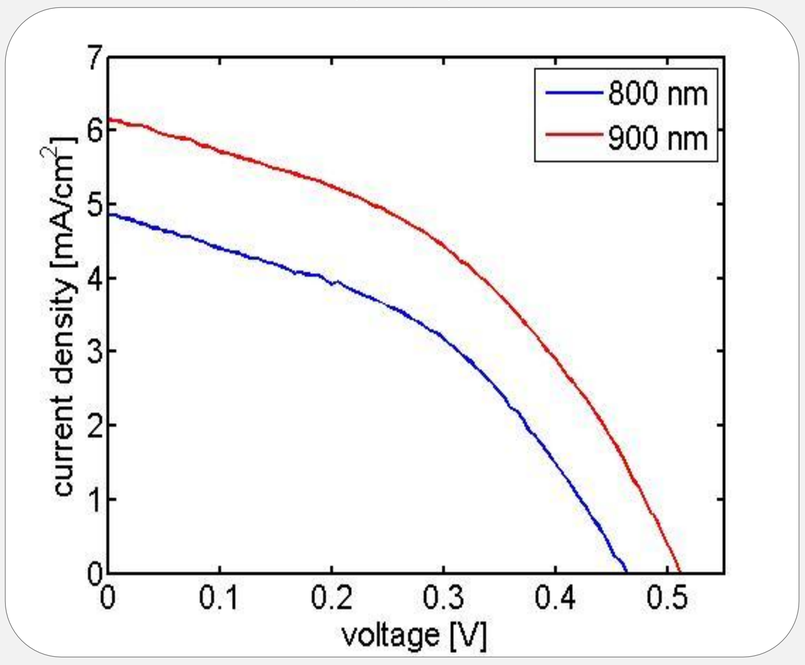
### Incident Photon to Current Conversion Efficiency (IPCE)




QDs adsorbed on $TiO_2$ electrode




### Current density vs. Voltage (J-V)




| Cell type | $V_{OC}$ [mV] | $J_{SC}$ [mA/cm²] | FF | η [%] |
|---|---|---|---|---|
| CdTe/CdSe – 800 nm | 458 | 4.85 | 0.43 | 0.95 |
| CdTe/CdSe – 900 nm | 508 | 6.14 | 0.43 | 1.34 |

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