Development and investigation of multijunction hybrids of nanocrystalline TiO_2/quantum dots/conducting polymer nanowires for solar cells applications.

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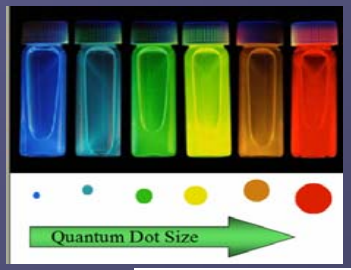
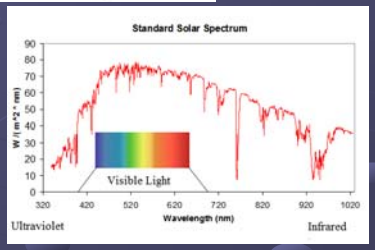
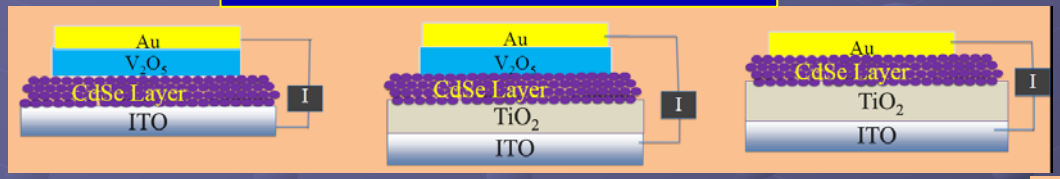
Solar cells based on inorganic quantum dots are promising candidates for the next generation of energy production because they can be made using low cost materials and processes. Quantum dots spectral light absorption can be controlled by their size and composition. By creating a cell with an array of differently sized quantum dots, a device with an absorbance range corresponding to the solar spectrum can be attained.

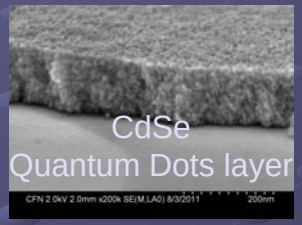
We proposed to develop a series of devices having spectral absorbance ranges well matched to the incident solar spectrum by using an array of differently-sized quantum dots – thereby providing a pathway to higher efficiencies.

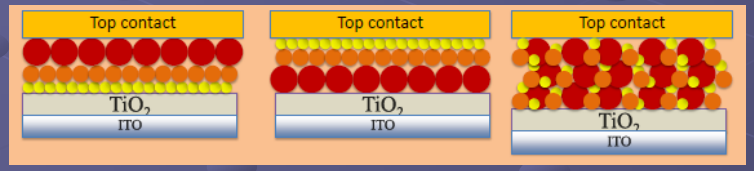


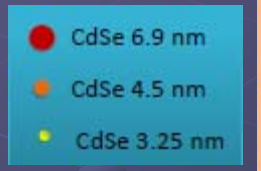


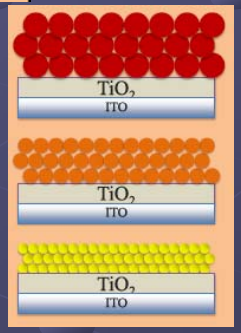
Types of tested photovoltaic devices





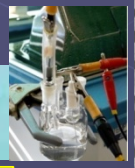






CdTe Nanostructures Preparation

1) Electrochemical method



a) $HTeO_3^- + 5H^+ + 4e \rightarrow Te + 3H_2O$

b) $Cd^{2+} + Te + 2e \rightarrow CdTe$

2) Electrochemical/chemical method

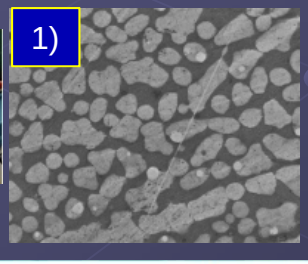
a) $Cd^{2+} + 2e \rightarrow Cd$ (electrochemical deposition)

b) $Cd + 2OH^- \rightarrow Cd(OH)_2$

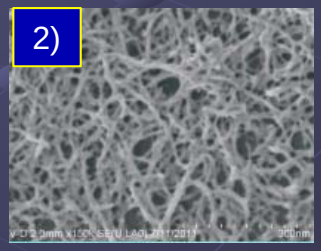
c) $Cd(OH)_2 + Te^{2-} \rightarrow CdTe + 2OH^-$

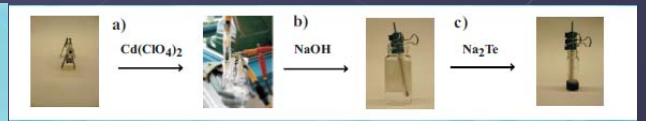
CdTe Quantum Dots layers

1)



2)





Notable outcomes from these studies:

- development of two novel synthetic routes for CdTe nanoparticles preparation (electrochemical and chemical methods)
- evidence from SEM and AFM studies that morphology of CdTe deposits depends on the applied potential in the electrochemical method and on cadmium deposition time in electrochemical/chemical method
- evidence that CdTe nanostructures, formed by both methods, are photosensitive, however they differ in measured photocurrents
- fabrication and characterization of solar cells from the CdSe quantum dots of various sizes
- photovoltaic cell performance improvement was achieved for: multilayer quantum dots films, presence of top and bottom oxide contact layers, increased annealing temperatures and mixture of various quantum dots sizes