PONDICHERRY UNIVERSITY

EXECUTIVE SUMMARY OF THE WORK DONE ON THE MAJOR RESEARCH PROJECT

1.	TITLE OF RESEARCH PROJECT (MATERIAL SCIENCE)	**"Fabrication of type II Quantum Dot structure for efficient and cost-effective Quantum Dot Sensitized Solar Cells"**
2.	NAME AND ADDRESS OF THE PRINCIPLE INVESTIGATOR	**Dr. R. Prasanth** Assistant Professor, Department of Green Energy Technology, Pondicherry University, Puducherry-605014. E-mail: prasanth.ravindran@gmail.com, prasanth.get@pondiuni.edu.in, 0413-2654955, 7639846141 (M)
3.	NAME AND ADDRESS OF INSTITUTION	Pondicherry University (A Central University) B.R. Ambedkar Administrative Building, R. Venkataraman Nagar, Kalapet Puducherry-605 014, India
4.	UGC APPROVAL LETTER NO. AND DATE	• *UGC-MRP, F.No. 43-404/2014(SR) Dated December 29, 2015* • *UGC-MRP, F.No. 43-404/2014(SR) Dated August 21, 2017*
5.	EFFECTIVE DATE OF STARTING OF THE PROJECT	July 01st 2015
6.	TENTURE OF THE PROJECT	July 01st 2015 to June 30th 2018
7.	TOTAL GRANT ALLOCATED	Rs. 13,19,000/-
8.	TOTAL GRANT RECEIVED	Rs. 10,41,960/-
9.	FINAL EXPENDITURE	Rs. 10,21,806/-
10.	TITLE OF THE PROJECT	Fabrication of type II Quantum Dot Structures for efficient and cost-efficient Quantum Dot Sensitized Solar Cells
11.	OBJECTIVE OF THE PROJECT	• Insitu fabrication of type II quantum dot structures in one dimensional TiO_2 nanostructure array electrodes • Investigate electron injection efficiency from quantum dot to TiO_2 with respect to size and shape of Quantum dot structures • Investigate the effect of surface modification on the carrier dynamics • Fabrication of solar cell structure with nanoparticle absorbers • I-V characterization and impedance analysis of solar cell structure with quantum dot absorbers and investigate the effect of surface modifications over the cell characteristics
12.	WHETHER OBJECTIVES WERE ACHIEVED	Yes, we showed that improved efficient in quantum dot solar cell We have also demonstrated type II structure quantum dot
13.	ACHIEVEMENTS FROM THIS PROJECT	Two publications resulted as follows 1. R. Sundheep, A. Asok, **R. Prasanth,** Surface engineering of CdTe quantum dots using ethanol as a co-solvent for enhanced current conversion efficiency in QDSSC, Sol. Energy. 180 (2019) 501–509. doi: 10.1016/j.solener.2019.01.057. 2. R Sundheep, **Prasanth R**. The effect of solvent dependent local field factor in the optical properties of CdTe quantum dots. J Mater Sci Mater Electron 2017; 28:3168. doi:10.1007/s10854-016-5905-3.

14.	SUMMARY OF THE FINDINGS (IN 500 WORDS)	Theoretical studies carried out on the experimental absorption spectra using a MATLAB programme written based on the Kramer's-Kronig relation and Maxwell Garnett effective medium theory showed that as the solvent dielectric constant decreases there is an increase in electronic lifetime in the QDs. These theoretical results were confirmed experimentally by adopting a low temperature aqueous synthesis of Core-Shell Type-II CdTe/CdS QDs with varying dielectric constants. A pronounced variation in shell growth was observed for solvents with low dielectric constant. The method adopted enabled the synthesis of Type-II QDs with precise shell thickness and meticulous control over their electronic properties. The better surface construction occurring in the case of low dielectric constant solvent further resulted in QDs with high photoluminescence quantum yield (PLQY). PLQY was enhanced from 45% to 84% for QDs synthesized in water-propanol solvent compared to the water solvent. The advantages of this modified solvent synthesis was tested by employing the Type II QDs with superior optical and electronic properties as light-absorbing materials in Quantum Dot sensitized solar cells (QDSSCs). Remarkably, the QDs were incorporated into a liquid electrolyte (sulfur-polysulfide) based QDSSCs. The synthesized QDs were deposited over the charge transport layer (TiO_2 nanoparticle) via Capping Ligand Induced Self used as counter electrode to complete the QDSSC architecture. By optimizing the shell thickness, PLQY and type II band alignment of the core-shell QDs a QDSSC exhibiting efficiency around 2.45% was fabricated.
15.	CONTRIBUTION TO THE SOCIETY (GIVE DETAILS)	One Ph.D Degree awarded. *Thesis titled:* Modelling and Characterization of Type II CdTe/CdS Core Shell Quantum Dots for QDSSC Applications – **R Sundheep** Centre for Green Energy Technology, Pondicherry University.
16.	WHETHER ANY PH.D. ENROLLED/PRODUCED OUT OF THE PROJECT	One PhD degree awarded and one enrolled.
17.	NUMBER OF PUBLICATIONS OUT OF THE PROJECT (PLEASE ATTACH)	1. R. Sundheep, A. Asok, **R. Prasanth,** Surface engineering of CdTe quantum dots using ethanol as a co-solvent for enhanced current conversion efficiency in QDSSC, Sol. Energy. 180 (2019) 501–509. doi: 10.1016/j.solener.2019.01.057. 2. R Sundheep, **Prasanth R**. The effect of solvent dependent local field factor in the optical properties of CdTe quantum dots. J Mater Sci Mater Electron 2017; 28:3168. doi:10.1007/s10854-016-5905-3.

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