PONDICHERRY UNIVERSITY
PUDUCHERRY

EXECUTIVE SUMMAY OF THE FINAL REPORT OF THEWORK DONE ON THE PROJECT

01	Title of the Project	Nanocrystalline Dye -Sensitized Solar Cell: An Experimental and Theoretical investigation for high performance
02	Name adress of Principal Investigator	Dr. Ramaswamy Murugan Professor Department of Physics, Pondicherry University, Puducherry 605014
03	Name and Adress of the institution	Department of Physics School of Physical, Chemical and Applied Sciences Pondicherry University, R V Nagar, Kalapet Puducherry 605014
04	UGC approval letter No. & Date	F. No. 41-918/2012 (SR) dated 23-07-2012
05	Date of implication	28-08-2012
06	Tenure of the project	Three years (01-07-2012 to 30-06-2015)
07	Total grand allocated	Rs. 7,66,240/-
08	Total Grand received	Rs. 7,66,240/-
09	Final expenditure	Rs. 7,27,740/-
10	Title of the Project	Nanocrystalline Dye-Sensitized Solar Cell: An Experimental and Theoretical investigation for high performance
11	Objectives of the project	Developing efficient Dye-Sensitized Solar Cells using natural dyes.
12	Whether objectives were achieved	• The extracts obtained from the fruits of ivy gourd and flowers of red frangipani were used as sensitizers in DSSCs • Demonstrated improved efficiency in the fabricated DSSC from the red frangipani flower extracts as a sensitizer. • The natural dyes extracted from Hierochloe odorata (HO), Torulinium odoratum (TO) and Dactyloctenium aegyptium (DA) grasses were successfully used as light harvesters in dye-sensitized solar cells
13	Achievements of the project	• Significant improvements in the solar cell efficiency using natural dye sensitizers • Extraction of light harvesters from natural resources
14	Summary of the findings (in 500 words	The extracts obtained from the fruits of ivy gourd and flowers of red frangipani were used as sensitizers in DSSCs. The DSSC fabricated with the extract of flowers of red frangipani exhibited an efficiency of around 0.30 %, whereas the cell based on the ivy gourd fruits extract gave an efficiency of approximately 0.08 %. The improved efficiency of the cell is

		based on the red frangipani flowers extract due to the presence of alcoholic groups in anthocyanins. The alcoholic group in anthocyanins favored the maximum binding on the surface of TiO_2 nanostructure. The UV-Vis measurements and surface concentration studies indicated that the β-carotene in the extract of fruits of ivy gourd shows less adsorbing property than that of red frangipani flower extract. Investigations on the fabricated cells revealed that the DSSC fabricated with anthocyanin pigments present in the extract of flowers of red frangipani shows better performance. The natural dyes extracted from Hierochloe odorata (HO), Torulinium odoratum (TO) and Dactyloctenium aegyptium (DA) grasses were successfully used as light harvesters in dye sensitized solar cells. The result shows that the maximum efficiency obtained for the cell fabricated with HO grass dye is around 0.46%. In contrast, the conversion efficiency of the cells fabricated with TO and DA dyes are 0.32% and 0.24%, respectively. The FTIR spectra for the extracted dyes replicate the structural properties of the chlorophyll molecule. Similarly, LC-MS studies reveal the molecular ion (M+) signals at m/z ~871.55 responsible for the presence of light-harvesting pigment Pheophytin a, which is a derivative of chlorophyll. The electron transport mechanism and internal resistance of the DSSCs were investigated by the electrochemical impedance spectroscopy (EIS) to clarify the relationships between the performance of DSSCs and their internal resistances. The charge transfer resistance (R_2) for HO dye is low compared to TO and DA dyes, which is well reflected in the photoelectric conversion efficiency of the cell. Hence the high efficiency of DSSC with HO dye is due to the high binding of dye molecules with the TiO_2 layer and less charge transfer resistance at the TiO_2-dye-electrolyte interface The influence of ZnO, ZnO:Al, ZnO:Ta and ZnO:Al,Ta seed layer on the structure, morphology and optical properties of the resulting hydrothermally grown ZnO nanorods were investigated. The high alignment and increase in the length of ZnO nanorods grown on ZnO:Ta seed layer is due to the enhanced crystallinity and morphology of the seed layer. The optical properties of both doped ZnO seed layer and ZnO nanorods grown on the doped ZnO seed layer indicate higher transmittance than the nanorods grown on undoped ZnO seed layer. When ZnO nanorods are grown on doped seed layers, the energy band gap increases from 3.09 eV to 3.26 eV. This unique property of Al, Ta doped ZnO can fabricate nano optoelectronic devices and photovoltaic devices due to their improved optical properties.
15	Contribution to the society	The present societies' demand for sustainable and environmentally friendly energy sources makes the research on solar cell development a highly relevant study to both society and the scientific community
16	Whether any Ph.D. enrolled/ produced out of the project	No
17	No. publications out of the project	Yes, significant publications are made in the following peer-reviewed journals:

		1. Performance of dye-sensitized solar cells fabricated with extracts from fruits of ivy gourd and flowers of red frangipani as sensitizers. **Spectrochim, Acta. Part A: Molecular and Biomolecular Spectroscopy 104 (2013) 35-40. (Impact Factor: 4.098) (citation: 136)** 2. Room temperature ferromagnetic properties of Cu_2O microcrystals. Published in **Journal of Alloys and Compounds, *579*, (*2013*) 572-575 (Impact Factor: 4.175).** 3. Green grasses as light harvesters in dye-sensitized solar cells. **Spectrochim, Acta. Part A: Molecular and Biomolecular Spectroscopy 135 (2015) 947-952. (Impact Factor: 4.098) (citation: 43)**

PRINCIPAL INVESTIGATOR

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DEAN (Research)

23.11.2015

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