

Indian Science Technology and Engineering facilities Map (I-STEM)

Invites application for

1. Partial financial support for using R&D facilities in other institutions through the I-STEM web portal to Users from Academic Institutions and Start-ups (Format-1)

Format for requesting support for accessing and using facilities through the I-STEM web portal.

(i) Details of the Personal Information

- a. Name of the Researcher: Bharath M J
- b. Name of the Institution: JSS Academy of Technical Education
- c. Name of the Department: Physics
- d. Degree registered for: Ph.D
- e. Contact: 9036684101

(ii) Project/Research topic Details:

Project Title/Research Title: Thickness and temperature effects on solution-processed TiO_2 / ZnO based Dye Sensitized solar cells

Generic Title: Fabrication & Characterization Of Low Cost Dye Sensitized Solar Cell Employing Natural Dyes

- a. Subarea: Condensed Matter Physics.
- b. Area Description: Condensed matter research Physics investigates the macroscopic and microscopic characteristics of matter. Condensed matter physicists research the physical properties of matter that result from interactions between numerous atoms and electrons, as well as how this matter forms
- c. Aims & Objective:
Our goal is to investigate how thickness, doping, precursor concentration, and temperature affect the properties of solution-processed TiO_2/ZnO Dye Sensitized solar cells, including open-circuit voltage, saturation current density, fill factor, and efficiency.
- d. Duration (MM/YYYY): 3 months
- e. Project Summary:
Synthesis of doped and undoped TiO_2/ZnO thin films using low-cost, straight forward, non-vacuum chemical techniques like Chemical Bath Deposition (CBD) and sol-gel spin coating (solgel) In order to fabricate Dye Sensitized solar cells. It is necessary to optimize the microstructural, morphological, compositional, optical, and electrical properties of films. Reduction of the sheet resistivity of films through methods such as doping, isochronal-isothermal annealing in vacuum or air, or thickness variation. Metallization of carbon and platinum using sputtering or thermal evaporation methods. Followed by Fabrication of DSSC using natural dyes and iodine free electrolytes. Optimization of open-circuit voltage, short-circuit current, fill factor, efficiency, series and shunt resistance, and the quantum efficiency of solar cells at various temperatures, as well as air mass and thickness. Establish the viability of CBD and spin coating for the mass production of TiO_2/ZnO thin films for the manufacture of Dye Sensitized solar cells.

a. Technical Details

- a. TRL: NIL
- b. Methodology: CBD /Sol-gel
- c. Design & development:
- Synthesis of doped and undoped TiO_2/ZnO thin films by CBD and spin coating on pre-cleaned substrates
 - Aiming for optimum film properties for dye sensitized solar cell applications
 - Synthesis of natural dyes and iodine free electrolytes
 - Metallization at the back contact followed by device analyses
 - Optimization of the performance of the device towards the achievement of a higher efficiency.
- d. Facilities and Instrumentation required:
- 1) XRD (structure, crystal size, crystallinity, stacking fault)
 - 2) Ellipsometry (thickness, refractive index, extinction coefficient, dielectric constant)
 - 3) Optical-profilometer (Thickness, roughness)
 - 4) SEM and TEM (grain size)
 - 5) Auger spectroscopy (AES) (composition of various films in the device)
 - 6) UV-VIS-NIR Spectrometer (optical parameters, Band gap)
 - 7) EDAX (Composition)
 - 8) FTIR and XPS (chemical bonding, oxidation states, band gap)
 - 9) AFM (grain size, roughness)
 - 10) RamanPL (bandgap, defects, stoichiometry)
 - 11) Ellipsometer (thickness, refractive index, optical band gap, extinction coefficient, attenuation coefficient)
 - 12) Four-point probe (resistivity, sheet resistance)
 - 13) Hall effect (n or p-type, electron or hole concentration, mobility)
 - 14) Thermal evaporation and RF Sputtering (Metallization)
 - 15) Agilent 4155C parameter analyzer and 4284 LCR meter (AC/DC characterization)
 - 16) Solar cell simulator (solar testing unit)
 - 17) Impedance Analyzer (C-V studies)
- e. Consumables (Scientific materials): Silver paste, n and p type Silicon wafers Si (100), ITO($10\Omega / \square \text{ cm}$)

b. Expected output and outcome:

High efficiency and light response may be features of synthesised low-cost TiO_2/ZnO dye sensitised solar cells. Potentially practical methods for mass production include spin coating and CBD.

c. Industry/Institute Collaboration

If, yes

- (i) Name of the Collaborating Industry/Institute
- (ii) Collaboration Details
- (iii) Additional Details if any

d. **Funding required from I-STEM (with justification:**

Sr. No	Particulars	Justification
1	Substrates (silicon, ITO)	As I do not have facilities at my institution and financial support from any funding agency, I am meeting all expenditure on my own, I require funding and also reimbursement from I-STEM for further studies.
2	Characterization (XRD,SEM,EDS,AFM,TEM, XPS, RAMAN, PL, ELIPSOMETRY,I-V, C-V, SOLAR SIMULATOR STUDIES, SO ON	
3	Metallization (front metallization of carbon or Platinum by R F Sputtering /thermal evaporation)	

Details of Requirements & Mode of the Engagement: (Attach the quotation for the consumables)

- (i) Short term Engagement:
 - a. Usage of testing/characterization facilities across the country (Characterization Mode)
 - i. Testing Charges: All characterization facilities available at CENSE, IISC. Charges are not mentioned in website
 - ii. Consumable charges
 - iii. Travel Cost (Boarding and Lodging, if any)
 - b. Usage of fabrication and testing facilities across the country (Fabrication Mode)
 - i. Fabrication and testing Charges: All fabrication and testing facilities available at CENSE, IISC. Charges are not mentioned in website
 - ii. Consumable charges (if any)
 - iii. Travel Cost (Boarding and Lodging, if any)
- (ii) Medium term Engagement:
 - a. Execution of project in any one of the Host Institution (Project Mode)
 - a. Fabrication and or testing Charges
 - b. Consumable charges (if any)
 - c. Travel Cost (Boarding and Lodging, if any)
 - b. Execution of project in Multi Host Institutions (Project Mode)
 - a. Fabrication and or testing Charges
 - b. Consumable charges (if any)
 - c. Travel Cost (Boarding and Lodging, if any)

(Round-trip to the Host Institution by 2nd class (Non-AC) railway via the nearest route)

Details of User's Bank Account:

(Please send a copy of the cancelled cheque/copy of the passbook carrying all the information needed)

Beneficiary Name (User's name): BHARATH M J

PAN: AUPPJ1658J

Bank Account No: 2890101005638

Name of the Branch: BGS HEALTH AND EDUCATION CITY

IFSC Code: CNRB0002890

Note: Proposed proposal must be executed within stipulated duration (max. 6 month) to avoid fund availability issues. Travel form will be provided by the I-STEM office. The users will submit the technical

report, original invoice (duly signed by the Head of the Institution) raised by the Host Institution through I-STEM portal only along with a copy of the travel forms and original tickets through post to the Nodal Officer, I-STEM, Indian Institute of Science, Bangalore. A scan copy of all the documents may be sent in advance.