

# 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:  | MADHUKESWARA R S                                   |
| b. Name of the Institution: | Government College for Women(Autonomous),          |
| c.                          | Mandya (Working)                                   |
|                             | J S S Academy of Technical Education (PhD Scholar) |
| d. Name of the Department:  | Department of Physics                              |
| e. Degree registered for:   | Ph.D                                               |
| f. Contact:                 | 9164556618/8310348725                              |

***(ii) Project/Research topic Details:***

- a. Project Title/Research Title: Thickness and temperature effects on solution-processed Titanium Dioxide And Copper Oxide Thin Films -based solar cells and sensors
- b. Generic Title: fabrication and characterization of  $\text{TiO}_2/\text{CuO}$ -based sensors and solar cells.
- c. Subarea: Condensed Matter Physics.
- d. 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.
- e. Aims & Objective: Our goal is to investigate how thickness, doping, precursor concentration, and temperature affect the properties of solution-processed  $\text{TiO}_2/\text{CuO}$ -based solar cells, including open-circuit voltage, saturation current density, fill factor, and efficiency, as well as sensor properties, including sensitivity, selectivity, speed, and stability of thin films..
- f. Duration (MM/YYYY): 3 months
- g. Project Summary: Synthesis of doped and undoped  $\text{TiO}_2/\text{CuO}$  thin films using low-cost, straightforward, non-vacuum chemical techniques like spray pyrolysis (SPD) and Chemical Bath Deposition (CBD) In order to fabricate homojunction and heterojunction solar cells, gas and humidity sensors, 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. Following the metallization of silver and aluminium using sputtering and thermal evaporation methods, studies on the Ohmic and Schottky properties of thin  $\text{TiO}_2/\text{CuO}$  films were conducted. 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. Examining the sensitivity, speed, selectivity, and stability of a manufactured gas/humidity sensor for various gases and relative humidity at various ppm. Establish the viability of SPD and CBD for the mass production of  $\text{TiO}_2/\text{CuO}$  thin films for the manufacture of sensors and solar cells.

a. **Technical Details**

- a. TRL: NIL
- b. Methodology: Spray pyrolysis/CBD
- c. Design & development:
- Synthesis of doped and undoped  $\text{TiO}_2/\text{CuO}$  thin films by SPD and CBD on pre-cleaned substrates
  - Aiming for optimum film properties for solar and sensor applications
  - Metalization at the front and back contact points, followed by device analyses
  - Optimization of the performance of the device towards the achievement of a higher figure of merit.
- 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, Bandgap)
  - 7) EDAX (Composition)
  - 8) FTIR and XPS (chemical bonding, oxidation states, band gap)
  - 9) AFM (grain size, roughness)
  - 10) Raman PL (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:**

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, Quartz)                                                                                                | 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, GAS SENSING STUDIES, SO ON |                                                                                                                                                                                                                |
| 3      | Metallization (front metallization of Silver by R F Sputtering and back metallization of aluminum by 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 2<sup>nd</sup> 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):Madhukeswara R S

PAN: AGRPM4072D

Bank Account No: 64051207238

Name of the Branch:SBI, Pandavapura Branch

IFSC Code: SBIN0040044

***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.***