

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/Faculty Member: Tarunisree M
- b. Name of the Institution/Start-up: Anant Viriya
- c. Name of the Department: Nanotechnology
- d. Degree registered for/Product being developed (for start-up) : Product being developed

(ii) Project/Research topic Details:

- a. Project Title/Research Title: Design of a metalens to polarize natural sunlight
- b. Sub area: Clean tech
- c. Area Description: We are designing a Graphene based Photonic lens which will make the harmonics (Frequency and Amplitude) of natural sunlight comparable with EV band gap of electrons in PV Cell to increase the efficiency.
- d. Aims & Objective (in Bullets):
 - Developing a photonic lens that can be installed on top of any PV Cell to step up its efficiency.
 - ❖ Design and simulation of graphene meta-lens exploiting photonic band-gap properties.
 - ❖ Fabrication of meta-lens on top of a PV cell and perform the characterization to evaluate overall efficiency of the PV cell
- e. Duration (MM/YYYY): 12/2022 (6 months)
 - Simulation and getting the consumables- 2 months
 - Fabrication - 2 months
 - Characterisation - 2 months
- f. Project Summary (1000 words):
 - Solar concentrators are used to focus light on the PV panel at a single point. These concentrators are made in different shapes. These concentrators use Fresnel lenses. As these concentrators focus light on the small area(PV), there is an increase in solar cell efficiency.
 - The heat loss behavior, variations in temperature makes solar concentrators less applicable.
 - Graphene material is one of the suitable materials to overcome the heat losses and tuning of required wavelength.
 - Combining graphene with metals or dielectric, the tunable metasurface can achieve diverse functions, such as optical phase or amplitude modulation as metasurfaces realize the modulation of phase through interaction between electromagnetic waves and free electrons providing a new method for lenses designing.

- Developing a photonic lens that can be installed on top of any PV Cell to step up its efficiency.
 - ❖ Design and simulation of graphene meta-lens exploiting photonic band-gap properties and also the polarization properties of graphene.
 - ❖ Fabrication of meta-lens on top of a PV cell and perform the characterization to evaluate overall efficiency of the PV cell

(Separate page may be attached to justify the requirements)

g. Technical Details

- a. TRL: Research to prove Feasibility
- b. Methodology: Our methodology is divided into two ways

a) Material Modeling and Simulation:

1. Identify the different layers of lens. Check adhesiveness and manufacturability.
2. The range of physical parameters will be understood via existing literature.
3. Lumerical FDTD is used for designing the metamaterial.
4. The EM analysis from Lumerical FDTD is given as input to Zemax Optics studio.
5. The lens part is developed in the Zemax studio

b) Physical Simulation and Optimization:

1. The selected material will be applied on top of the Solar panel.
2. The design parameters like acceptance angle, position of the filtering material etc'. are varied.
3. The combination which gives more efficiency comparatively is considered for optimization.
4. The performance metrics of the Solar panel will be compared with the real time used Solar panel.

c. Design & development: Design is based on Graphene based Photonic lens. The Graphene-based metamaterials leverage the size of the cell to impact light interaction with its lattice. This gives rise to new EM properties displayed. Optimizing the molecular structure, we can get a productive effect which will enhance the wave harmonics of Sunlight.

- d. Facilities and Instrumentation required

1. Softwares required (either of the two)
 - a. COMSOL
 - (Wave + Ray + MEMS Module)
 - b. ANSYS
 - (Lumerical-DGTD +FDTD+Zemax OpticStudio)

*Recommended

- c. Nanohub

2. Apparatus required

1. RIE (Reactive ion etching)
2. Lithography / e-beam,
3. Thin-film deposition,
4. Spin-coating
5. Scanning Electron Microscope (SEM)
6. DC & Thermal probe stations

- e. Consumables (Scientific materials)
1. Graphene metamaterial
 2. SOI Wafer

h. Expected output and outcome

We are expecting an increase in the efficiency of the solar panel compared to the other solar panel technologies when the lens part is placed on top of it.

i. Industry/Institute CollaborationIf, yes

- (i) Name of the Collaborating Institute: KCG College of Technology, Chennai
- (ii) Collaboration Details: Providing access to COMSOL and ANSYS simulation tools for optimization of design parameters
- (iii) Additional Details if any

j. Funding required from I-STEM (with justification) :

Sr.No	Items	Project Cost Own Share	IStem_Nano support sought
1.	Outsourcing Charges for R&D/Design Engg/Consultancy/Testing/Expert cost	15,000	4,00,000
2.	Raw material/ Consumables/Spares	5,000	1,45,000
3.	Fabrication /Synthesis charges of working model or process	55,000	2,45,000
4.	Contingency - (Ceiling 10% of approved project cost)	14,150	85,850

k. 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

Instrument name	Institute name	Approximate cost value in INR
Scanning Electron Microscope (SEM)	Indian Institute of Science (IISc) Bengaluru	80,000
DC probe stations	Indian Institute of Technology (IIT) Hyderabad	70,000

Note: These are only approximate cost values.We have requested for the cost details in the portal.

- ii. Consumable charges

Material	Manufacturer Details	Approximate cost value in INR
Graphene monolayer	Ultrananotech Private Limited	15,000
Silicon On Insulator	Ultrananotech Private Limited	15,000

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

Instrument name	Institute name	Approximate cost value in INR
Reactive ion etching system (RIE)	Indian Institute of Technology (IIT) Roorkee	60,000
Electron beam Lithography	University of Hyderabad, Hyderabad	80,000
Thin-film deposition	Indian Institute of Science (IISc) Bengaluru	70,000
Spin-Coating	National Institute of Technology (NIT) Karnataka Surathkal	50,000

Note: These are only approximate cost values. We have requested for the cost details in the portal.

ii. Consumable charges (if any)

Material Cost	Manufacturer Details	Approximate cost value in INR
Graphene monolayer	Ultrananotech Private Limited	30,000
Silicon On Insulator	Ultrananotech Private Limited	15,000

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

Note: These are only approximate cost values. We have requested for the cost details in the portal.

b. Consumable charges (if any)

Materials	Manufacturer Details	Approximate cost value in INR
Graphene monolayer	Ultrananotech Private Limited	30,000

Silicon On Insulator	Ultrananotech Private Limited	15,000
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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): TARUNISREEM PAN: DTRPM0232F

Bank Account No: 500101011911462 Name of the Branch: Katpadi, VIT University
Campus, katpadi, Vellore

IFSC Code: CIUB0000293

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.