

Work II: Realization of Planar Focusing Configuration based on Hyperbolic Metasurface

In this work, a Type-II hyperbolic metasurface is realized using a novel unit cell geometry, confirmed by its effective constitutive parameters. The x-hyperbolic dispersion of the unit cell is utilized for in-plane partial focusing of in-plane polarized light by the hyperbolic metasurface designed by arranging the unit cells in the shape of a plano-concave lens.

- Design of a Type-II hyperbolic metasurface unit cell and scattering parameter calculation in EM solver of CST Microwave Studio.
- Performing retrieval of effective constitutive parameters of the metasurface using a standard retrieval procedure in MATLAB.
- Developing a metasurface model to computationally realize partial in-plane focusing using the hyperbolic dispersion.

IAS SRFP Research Fellow

(15/05/2023 - 15/07/2023)

MSDLab, Department of Electronic Systems and Engineering, Indian Institute of Science Bengaluru

Project: **Device simulation-based characterization of field effect transistors using Synopsys Sentaurus TCAD Suite**

Faculty Advisor :Prof. Mayank Shrivastava; *Mentor* :Dr. Harsha B. Varrier

- Understanding the theory of quantum tunneling in tunnel field effect transistors and its simulation.
- Device modeling and simulation of TFET and MOSFET using Sentaurus Device Editor and Sentaurus Device modules.
- Integrated analysis and comparison of device performance based on doping concentration, band diagrams, surface potential, output and transfer characteristics using Sentaurus Workbench and Sentaurus Visual modules.

Computational physics mini project

(Semester VI)

Department of Physics, National Institute of Technology Calicut

Project: **Simulation of Simple Harmonic Oscillator using Python**

Guide :Dr. Anoop Varghese (Assistant Professor)

Damped and undamped simple harmonic motion was modeled and simulated using fourth order Runge-Kutta method.

Summer Research Intern

(04/05/2023 - 15/07/2023)

Centre for Nanoscience and Engineering, Indian Institute of Science Bengaluru

Project: **Optimization of tin oxide as electron transport layer in perovskite solar cells**

Faculty Advisor :Prof. Aditya Sadhanala; *Mentors* :Dr. Laxman Gowda and Dr. Priyanka Kajal

- Optimization of tin oxide electron transport layer in large area perovskite solar cells using ultrasonic spray coating and airbrush spray coating techniques.
- Effect of deposition techniques on carrier mobility, bandgap, transmittance and recombination rate of tin oxide as ETL was studied. Analysis and comparison between physical parameters of the coatings by different deposition techniques after the characterisation of samples were done.
- Training in slot die deposition of lead halide perovskite layer, spin coating of tin oxide films, analyzing IV measurements of PSCs using Keithley 2400 software, using glove box to measure

samples for precursor preparation and four-step substrate cleaning for deposition.

- A tour of the clean room facility and characterization facilities like Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD), Transmission Electron Microscopy (TEM), and UV-Vis spectrometry was offered by the host department.

CONFERENCE PROCEEDINGS

- **S. M. Biju, S. Gokul, P. Sandra and N. Yogesh*** “**Space-Coiled Photonic Structures for Wave-shaping and Light Confinement Applications**” accepted for technical presentation in Photonics and Electromagnetics Research (PIERS) Conference 2024, Chengdu, China.
- **S. Gokul, S. M. Biju, P. Sandra, M. Pavithra, K. Ravichandran, B. Asrafali, Zhengbiao Ouyang and N. Yogesh*** “**Realization of Planar Focusing Configuration Based on Hyperbolic Metasurface**” accepted for technical presentation in Photonics and Electromagnetics Research (PIERS) Conference 2024, Chengdu, China.
- **S. Gokul, P. Sandra, S. M. Biju and N. Yogesh*** “**Beating the optical resolution limit with negative refractive index: material - numerical demonstration of sub-wavelength focusing by negative index slab**” presented as poster in Confluentia 2023, in-house symposium of Department of Physics, National Institute of Technology Calicut.
- Attended International Conference on Photonics 2023, Indian Institute of Science Bengaluru.

RELEVANT COURSES

Optics	(PH2006D)	Modern Optics	(PH3025D)
Fiber Optics	(PH3021D)	Laser Physics	(PH4001D)
Nanophotonics	(PH4024D)	Optics Lab	(PH3091D)
Light-Matter Interaction in Resonators		(PH4025D)	
Fundamentals of Nano and Quantum Photonics		(NPTEL Swayam)	
Electromagnetics - I, II		(PH2004D,PH2008D)	
Electromagnetics Lab		(PH3092D)	
Condensed Matter Physics - I,II		(PH3002D,PH3004D)	
Solid State Devices		(PH4029D)	
Solid State Devices Lab		(PH3093D)	

EXPERIMENTAL SKILLS

Spin coating, ultrasonic spray coating, slot-die coating.
Solar simulator and IV measurement
Four-step substrate cleaning
Mach-Zehnder interferometer
Fabry-Perot interferometer
Microwave bench optimization

COMPUTATIONAL SKILLS

C++, Python languages
Synopsys Sentaurus TCAD
COMSOL Multiphysics
CST Studio Suite
MATLAB

VOLUNTEERING

- *Hands-on Experimental and Computational Training in Emerging areas of Optics and Photonics (HECTOP)* organized by Department of Physics, National Institute of Technology Calicut : Organization and management of workshop activities including computational training and experimental demonstration.
 - *Plasma Exhibition at Kozhikode (Kerala) 2023* organized by Institute of Plasma Research (IPR) Gandhinagar, Gujarat, India: Scientific volunteer in experimental demonstration, trained from IPR on plasma and its application.
 - *Optica Student Chapter, National Institute of Technology Calicut*: Executive student member working with research scholars in starting the chapter in the institute.
 - *Bhauthiki the Physics Association, Department of Physics, National Institute of Technology Calicut*: Re-establishment of the association and its activities like invited talks, workshops, and National Science Day outreach program in schools.
 - *National Service Scheme*: Organizing social awareness campaigns on gender education, women empowerment, blood donation, etc.
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EXTRA-CURRICULAR ACTIVITIES

- *Indian Society of Technical Education (ISTE)*: Treasurer/ Content Writer - planned and authored blog posts and organized on campus events for students.
 - *Tathva '23 techno-management fest*: Organized and managed workshops. Curated media outreach content.
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REFERENCES

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