Anand Kumar

Department of Physics, IIT Bombay, Mumbai, India

✆ +91 800 416 7260 ✉ anandkumar@iitb.ac.in

RESEARCH INTEREST

Nanophotonics, Quantum Optics, 2D Materials, Semiconductor Physics, Experimental Condensed Matter.

EDUCATION

M.Sc. (Physics) + M.Tech. (Material Science) [July 16 - Present]

IIT Bombay, Mumbai, India
Specialization: M.Sc. in Physics and M.Tech.in Nanoscience and Nanotechnology
CGPA: 7.94/10.00[a]
Master's Thesis SPI: 10/10[b]

B.Sc. (with Honours) in Physics [July 2013 - May 2016]

Banaras Hindu University (BHU), Varanasi, India
CGPA: 8.11/10.00

[a] till Sixth Semester
[b] Matser Thesis Stage-1

CONFERENCES

Nano India 2019

- **Anand Kumar**, Anuj Singh, Prof. Anshuman Kumar, **Large Scale Low Cost Nano-Plasmonic Array Fabrication**, Poster presented at: Nano India 2019 | Biennial National Conference; April 26-27th, 2019; Mahatma Gandhi University, Kerala, India.
- Awarded **First Prize** by Department of Science and Technology for best poster presentation.
- This work focus on the fabrication of nanocone structure over large scale and a prototype for detection of TNT gas detector.

International Workshop on Advances in 2D Materials (IW2DM) 2019

- Abhay Anand V S, **Anand Kumar**, Aneesh M Joseph, Achanta Venu Gopal, Anshuman Kumar, **Designing Plasmonics Nanostructures for Valleytronics Application**, Poster presented at: International Workshop on Advances in 2D Materials; July 22-23rd 2019; Indian Institute of Science Education Research (IISER) Thiruvananthapuram, Kerala, India.
- This work present the fabrication spiral nanostructure via electron beam lithography technique to study the valley quantum degree of freedom of electron.

International Conference on Optics Electro-Optics (ICOL) 2019

- Anuj Kumar Singh, **Anand Kumar**, Saurabh Dixit, Anshuman Kumar, Investigation of interaction of light with plasmonic nanostructures fabricated by nanosphere lithography, Presented at: ICOL-2019, Octobor 19-22nd 2019, Instruments Research & Development Establishment (IRDE), Dehradun, Uttarakhand, India.
- This work present the fabrication plasmonics nanostructure via nanosphere lithography technique and detection of R6G (Rhodamine 6G) dye by SERS (Surface-Enhanced Raman Spectroscopy). This work has been submitted to **Springer Nature** for conference proceeding.

International Conference on Atomic, Molecular, Optical & Nano Physics with Applications (CAMNP 2019)

- Mouli Hazra, Yashika Gupta, **Anand Kumar**, Anshuman Kumar, **Effective Medium Theory for Lorentz Drude Nano-Structures**, Talk at: CAMNP 2019 Conference; December 18-20th, 2019, Department of Applied Physics, Delhi Technological University, New Delhi, India. (Submitted to **Springer** for conference proceeding)
- This work present synthesis of metal nano-particle and self Assembly of nano-particles.
- Optical Characterization of metal nano-particles.

RESEARCH EXPERIENCE

Excitons in 2D Materials **[Ongoing 2018]**
Guide: Prof. Anshuman Kumar, IIT Bombay, India

- Studying **Excitons** in 2D materials and selective excitation of various kind of excitons in 2D materials using large scale plasmonincs Nanocones array.
- Fabricating large scale nanocone array using **Colloidal Lithography** and **Reactive Ion Etching** process.
- Studying strain induced on 2D material by periodic array of nanocone array.
- Studying robust **Superhydrophobicity** nature of nanocone array using **Contact Angle Measurement**.
- WSe_2 growth using **C**hemical **V**apour **D**eposition (CVD) and scotch tape method to transfer 2D materials flake.

FET (Field Effect Transistor) Fabrication and Nanopatterning **[Summer 2018]**
*Guide: Dr. Kiran Shankar Hazra, **I**nstitute of **N**ano **S**cience & **T**echnology **(INST)**, Mohali, India*

- Fabrication of MoS_2 based **FET** device and effect of nanopatterning such as Nano-Ribbons on its electrical characterization. Patterning was done using Laser Patterning Technique.
- Fabrication of the gold contacts over MoS_2 thin film was done using **Projection Lithography**.
- Electrical Characterization of the FET was done using **Keithley Source-meter**.
- MoS_2 growth using **C**hemical **V**apor **D**eposition (CVD) method.

Virtual Oculus **[2016]**
Guide: Prof. Tapanendu Kundu, IIT Bombay
(*Presented at Techfest-2016, IIT Bombay, Asia's Largest Science and Technology Festival)*

- This project developed a prototype with the objective to provide an aid to the visually impaired person to recognize a person using **Face Detection** and **Face Recognition** technique.
- **Python Libraries** is used for face detection and recognition in real time and a text-to-speech interface is provided to the user.

COURSE PROJECTS

Quantum Tunneling **[2017]**
Instructor: Prof. P.P. Singh, IIT Bombay

- Worked in a group of three student and animate the phenomena of transmission and reflection of **Plane** wave impinging on step potential and a **Gaussian wave packet** impinging on square potential barrier using **Python Libraries**.

Structure Factor Calculations Spherical Nanoparticles **[2017]**
Instructor: Prof. Sunita Srivastava, IIT Bombay

- Theoretical Calculation of Structure Factor for spherical nano-particle using Python Libraries and comparative study of experimental results.

Crystal Structure Determination **[2016]**
Instructor: Prof. P.P. Singh, IIT Bombay

- Worked in a group of three student and studied the various techniques used for determination of crystal structure and analyzed data obtained for powdered sample from **XRD**.

SKILLS

- **Fabrication Hands-on Experience:** Gold Nanoparticle Synthesis, Gold Platelets Synthesis, Pervoskite Synthesis, Bowtie Nanostructure using Colloidal Lithography Trechnique.
- **Synthesis Hands on Experience:** Gold Nanoparticle, Gold Platlets, MoS_2 synthesis by CVD.
- **2D Material Transfer Skills:** Mechanical Exfoliation using Scotch Tape, Dry Transfer stamping method using microscope, Polymer Assisted Wet Transfer Technique.
- **Scientific Instruments Hands-on Experience:** Plasma Asher, Projection Lithography, Thermal Evaporator, AFM, SEM, UV-Visible Spectroscopy, PL Spectroscopy, Reflectometer, Sourcemeter, Digital Storage Oscilloscope (DSO), XRD.

- **Programming and Simulators:** C++, Fortran, LaTeX, Mathematica, **Python** (**Libraries:** Numpy, Matplotlib, OpenCV, Scipy, GDSPY), **Lumerical(FDTD)**, **COMSOL**, ImageJ.
- **Software and OS:** Origin Pro, Adobe Illustrator, AutoCAD, Solid Works, MS-Office, Windows, Linux, MS-DOS.
- Hands on experience in building up a microscope based **Transfer Setup** for 2D materials transfer.

KEY COURSES TAKEN

- **Physics:** Classical Mechanics, Quantum Mechanics, Statistical Physics, Light Matter Interaction, Introduction to Nanoscience & Nanotechnology, Advanced Laboratory Techniques in Nanosience, Nanomaterials Nanostructures & Nanofabrication, Physics of Nanostructures & Nanoscale Devices, Thin Film Physics and Technology, Advanced Simulation Techniques in Physics, Communication Skills.
- **Material Science:** Thermodynamics of Materials, Transport Phenomena, Colloidal & Interfacial Science, Mechanical Behaviour of Materials, Phase Transformations.

WORK SHOP

RC Plane Designing, IIT Bombay, Mumbai, India **[2016]**
Organized By: *Aeromodelling Club IIT Bombay*

- Worked in a group of four student and designed a RC Plane with successful execution.

SCHOLASTIC ACHIEVEMENTS

- Qualified **JRF(Junior Research Fellowship) CSIR-(NET)** and awarded **218**th AIR out of 3973 candidates. **[December-2017]**
  (Council of Scientific & Industrial Research (CSIR), India, a premier national R&D organization, is among the worlds largest publicly funded R&D organization.)
- Secured AIR **144**th in **IIT-JAM Physics** out of 10989 students. **[2016]**
  (IIT-JAM is an admission test to Master of Science and other post-graduate science programs at the IITs, IISC, IISERs and other institutes conducted by IIT)
- Secured AIR **223**th (94.65 Percentile) and AIR **369**th (94.95 Percentile) in **JEST** (Joint Entrance Screening Test) exam. **[2016 and 2018]**
  (JEST is an examination conducted for admission to Ph.D. and Integrated Ph.D. Programme in Physics)
- Secured **712**th rank (State Rank) in **NSTSE** (National Level Science Talent Search Examination). **[2012]**
  (NSTSE is a diagnostic test which helps students improve their overall learning ability and educational performance.)
- Achieved **Top 10** rank in Glorious Event and Production-2009. **[2009]**
  (This is a Diagnostic test sponsored by Institute of Information & Computer Technology (Affiliated with SSAR SOCIETY) and Pioneer Academic.)

AIR = **A**ll **I**ndia **R**ank

OTHERS

- **Organization:**
  - ✏ OSA Student Chapter IITB
  - ✏ IEEE Student Chapter IITB
- **Interest:**Coding and Scripting, Rubik's, Badminton, Swimming
- **Language:** Hindi, English, Spanish

REFEREES

- Prof. Anshuman Kumar, Department of Physics, IIT Bombay
  Email : anshuman.kumar@iitb.ac.in, Webpage: `https://www.anshuman.tech/`
- Prof. Pramod Kumar, Department of Physics, IIT Bombay
  Email : pramod_k@iitb.ac.in, Webpage: `www.phy.iitb.ac.in/en/content/pramod-kumar`

- Prof. P. P. Singh, Department of Physics, IIT Bombay
  Email : ppsingh@phy.iitb.ac.in, Webpage: www.phy.iitb.ac.in/en/content/pramod-kumar
- Dr. Kiran Shnakar Hazra, INST Mohali
  Email : kiran@inst.ac.in, Webpage: http://www.phy.iitb.ac.in/en/employee-profile/p-p-singh