ADVAIT RISBUD (he, him)

Materials Science and Chemistry, Indian Institute of Technology Bombay

✉ advaitrisbud@iitb.ac.in | 🌐 sites.google.com/view/advaitrisbud | ⓖ github.com/advaitrisbud

EDUCATION

Indian Institute of Technology (IIT) Bombay, Mumbai, India *[2020-Present]*
Bachelor of Technology in Metallurgical Engineering and Materials Science and Master's in Chemistry   GPA: 8.7/10

RESEARCH INTERESTS AND HIGHLIGHTS

My field of study lies at the intersection of molecular spectroscopy, quantum optics, and biophysical chemistry. My research interests are in investigating molecular mechanisms of relevance to chemical biology and quantum materials science by tracking their photophysical signatures. I have previously worked on using ultrafast spectroscopy for studying photocatalysis, and on colour-center based quantum sensing. My master's thesis is focused on capturing the conformational dynamics of proteins using smFRET microscopy and commenting on the energetics of conformational changes.

SCHOLASTIC ACHIEVEMENTS

- **Department Rank 11** among a batch of **142 students** in the Materials Science Department
- Secured **98.6 percentile** in the JEE Advanced Examination | **99.61 percentile** in JEE Mains Examination
- Awarded the **Chanakya Fellowship** by I-Hub Quantum Technology Foundation at IISER Pune
- Awarded the Mitacs Globalink Research Intern Fellowship for a 3-month internship in Canada
- Part of the team to be awarded **Young Researcher's Prize** by **IEEE-Ocean Engineering Society** at the Underwater Technology Competition organized by the University of Tokyo, Japan with teams from **18+ countries**

RESEARCH EXPERIENCE

Probing Ribosome-protein interactions through smFRET microscopy *[May '24-Ongoing]*
Master's Thesis Project *Guide: Prof. Arindam Chowdhury*

- Created a smFRET setup with a reduced number of optical elements resulting in a higher photon signal from the sample and simultaneous focus in dual channel imaging leading to improved colocalization of fluorophores
- Developed a pipeline for Hidden Markov modelling of smFRET data and dwell-time calculation of conformations
- Automated the data analysis from single-particle data using a scalable codebase in python
- Devised an algorithm to automatically convert single molecule spectral movies to kymograms; includes direct identification of particles and extraction of corresponding spectra thus requiring minimum user input

Spectroscopic Investigation of Carbon Nitride based Photocatalysts *[Summer '23]*
Solarspec Laboratory, University of British Columbia *Guide: Prof. Robert Godin*

- Synthesised CN_x at various temperatures from urea and dicyandiamide (DCDA) precursors
- Synthesised CN_x nanosheets (CNNS) at multiple temperatures from urea-based CN_x by **thermal exfoliation**
- Synthesised a **linker-controlled polymer** photocatalyst from FAT-CN_x (formic acid treated) and FAT-CNNS
- Analysed the charge-carrier dynamics of electrons and holes in CN_x based photocatalysts using transient absorption (TAS), transient photoluminescence (tr-PL/TCSPC), UV-vis absorption, emission, and FT-IR spectroscopy
- Investigated the **change in band-gap** of the CN_x based on synthesis temperature and type of precursor

Detection of Senescence Using Quantum Controlled Sensors in Diamond *[Aug '23-May '24]*
Bachelor's Thesis Project *Guide: Prof. Kasturi Saha*

- Modelled the T_1 relaxation of NV centers in diamond in spherical and planar geometries
- Computed dipolar interactions between surface spins of nanodiamonds for different sample geometries
- Performed FLIM measurements on human glioblastoma cells to elucidate the clustering behaviour of nanodiamonds
- Designed and optimised the optical T_1-relaxometry protocol for nitrogen-vacancy centers in diamond
- Analysed the thermal drift in the nanopositioning system using single-particle tracking of fiduciary markers

INDUSTRIAL EXPOSURE

Larsen & Toubro Defence | Mechanical Designer | *Subsea Surveillance Vehicle, Mumbai (IN)*   *[2020-2024]*
- The project is a joint effort by IIT Bombay and Larsen & Toubro Ltd. under the IMPRINT II.C scheme
- Currently in its **fabrication and testing stage**; the ROV is to be deployed in seawaters for **scanning and surveillance**
- Simulated the performance of **5+** end cap designs for pressure hulls such as **honeycomb structures** to maximize safety factor against compressive and buckling stresses; achieving a final safety factor of **>2**
- Designed and optimized the tether mount after **simulating its performance** against a range of operating forces

Drona Aviation | Mechanical Designer | *Mass Manufacturable ROV*   *[2020-2022]*
- Key member of a team working to create a **customizable ROV** for the consumer electronics market
- Designed and manufactured the main hull with **scalable** and **robust** wire routing between hulls and thruster
- Analysed multiple techniques for waterproofing miniature **brushed DC motors** to enhance life at rated RPM

ACADEMIC PROJECTS

Dynamic Analysis of a Mobile Stand   *[Spring '21]*
Course Project, Theory Of Machines & Machine Design   Prof. Shantanu Tripathi

- Redesigned the structure to achieve an increase in minimum safety factor to **>1.6** for a **30%** increase in load after **evaluating potential points of failure** using simulations via **Ansys Mechanical** and **MSC Adams**
- Ideated and modeled a **spring-based locking mechanism** for arresting one degree of freedom
- Proposed an **analytical solution** to **increase toppling load** and **angle of repose** by up to **40%**

Failure Analysis of 3-D Printed PLA Microstructures   *[Autumn '22]*
Course Project, Mechanical Behaviour of Materials   Prof. Anirban Patra

- Manufactured PLA based dog-bone samples via 3-D printing, in iso-strain and iso-stress configurations
- Created a **cooling profile** of samples for in situ temperature calculation during mechanical testing
- Tested samples to failure in a UTM and **analysed the fracture surface** to compare between configurations
- Performed **FEM calculations** in ANSYS to simulate the failure of samples; results can be found here

Image Super-Resolution using Deep CNNs   *[Spring '22]*
Course Project, Introduction to Machine Learning   Prof. Amit Sethi

- Implemented a deep neural network architecture to learn a mapping between images of low and high resolution
- Degraded images using bilinear interpolation via the OpenCV library in python; achieved a final SSIM of 0.689

KEY PROJECTS

Matsya, Autonomous Underwater Vehicle (AUV)   *[2020-2024]*
RoboSub, SAUVC & US Office of Naval Research   Guide: Prof. Leena Vachhani

*An all-student team of **55+ members** that works on building a robust and highly modular autonomous underwater vehicle (AUV), focus of the project is competing at RoboSub along with **industry collaborations** on research projects for commercialization*
- Stood 4th in the world amongst 41 teams at RoboSub 2024, won the first prize for best technical paper which has been accepted in the Naval Engineers Journal of the American Society of Naval Engineers (ASNE)
- Featured in Janes, a journal in the field of defense for the team's innovations in the underwater domain

Team Advisor   *[2023-2024]*
- Advised a team of 55+ undergraduates on technical aspects of underwater robot design and manufacturing
- Liased with academic and industrial stakeholders on collaborative projects and outreach initiatives

Mechanical Sub-Division Head   *[2022-2023]*
- **Designed and assembled** a pneumatics system involving **directional control valves** (solenoid-based), **pressure regulators** and **pressurized CO_2 cylinders** to actuate torpedo shooters and marker droppers
- **Manufactured** custom penetrators for waterproofing of underwater hulls **reducing cost** by **90 %**
- Led a project to replace water-jet cut aluminium frames with fiber-reinforced composites manufactured in-house to increase **strength to weight ratio** at a reduced cost; **bringing down costs** by a **factor of 4x**
- Presented the developments made by the team in the IIT Research Conclave at IIT Delhi

Mechanical Designer   *[2021-2022]*
- Designed and manufactured a **rail-based mounting mechanism** for thrusters in a **cylindrical cavity**
- **Reduced time** for redesigning the marker-dropper by **80%** using adaptive equations in SOLIDWORKS

- Ideated an underwater pressure hull for a swarm AUV **optimizing** for space, weight, and accessibility

Image Processing   *[2021]*
Seasons Of Code, Web and Coding Club, IIT Bombay

- Implemented image processing algorithms such as **Otsu thresholding**, **Lanczos resampling**, **Canny and Sobel edge detection filter**, using python (OpenCV & PIL) after analyzing their computational basis
- **Performed** blurring, grayscaling and smoothening operations on sample images **from scratch** using PIL

TECHNICAL SKILLS

Programming	Python (*PyTorch, pandas, numpy, scipy, OpenCV, PIL*), ImageJ, R
Software	PyMol, Coot, MATLAB, Simulink, SOLIDWORKS, ANSYS (Fluent and Mechanical), ROS, Git, LTSpice
Experimental Skills	Spectroscopy (FT-IR, TAS, TCSPC, Emission, UV-vis), Confocal Microscopy, Single-Molecule Spectroscopy with Diffraction Gratings, FLIM, FCS, High Temperature Synthesis, Hot Injection Synthesis

KEY COURSES UNDERTAKEN

Chemistry	Single-Molecule Fluorescence Spectroscopy, Molecular Spectroscopy, Condensed Matter Physics, Molecular Photochemistry, Process Kinetics, Phase Transformations, Colloids and Interface Science, Biomolecules*, Electrochemistry of Solutions and Interfaces*
Laboratory Courses	Heat Treatment, Instrumentation and Controls, Thin Films, Electrochemistry
Physics and Electrical	Ultrafast Sciences*, Quantum Optics**, Applied Solid State Physics, Quantum Mechanics-1, Statistical Mechanics, Electricity and Magnetism, Signal Processing, Digital Electronics
Miscellaneous	Numerical Analysis, Differential Equations, Linear Algebra, Stochastic Processes

(*=to be completed by Nov '24, **=Online Course)

MENTORSHIP, LEADERSHIP AND TEACHING ROLES

Head, Department Academic Mentorship Program (D-AMP) | *SMP, IITB*   *[2023-2024]*
D-AMP is a part of the institute-wide Student Mentor Program (SMP) which works to help assimilate students from all across the country into the life at IIT Bombay by providing academic mentorship during the early years of undergraduate and graduate school.

- Nominated as a representative of **600+** students of the Dept. of Metallurgical Engineering and Materials Science
- Co-leading a team of 35 D-AMP mentors that cater to the personal, academic, and career needs, of 200+ students
- Maintaining a blog with reviews on courses, internships, projects, as well as career maps of alumni
- Co-ordinating the academic rehabilitation program for MEMS to help students with acute academic difficulties
- Organising and executing speaker sessions on topics of relevance to 300+ undergraduates
- Ideated and executed the creation of the Inter-Disciplinary Dual Degree Program with the Chemistry Department

Institute Student Mentor | *SMP, IITB*   *[2023-2024]*

- Selected from a pool of 350+ applicants based on an interview, statement of purpose, and stringent peer reviews
- Appointed to guide 12 first-year undergraduate students navigate the perplexities of student life at IIT Bombay

Teaching Assistant

- PH 108: Basics of Electricity and Magnetism, *Prof. Alok Shukla*   *[Spring '21]*
- MM 305: Kinetics of Processes, *Prof. Ajay Panwar*   *[Autumn '23]*
- MS 101: Makerspace Lab, *Prof. Tanmay Bhandakkar*   *[Spring '22]*
- MM 318: Electronic, Magnetic, and Optical Materials, *Prof. Tanushree Choudhury* *[Spring '23]*
- MM 329: Diffusion and Phase Transformations, *Prof. Ashutosh Gandhi*   *[Autumn '24]*

EXTRACURRICULARS

- Composed an original song for the intra-college music contest; also awarded the award for best guitarist
- **Initiated a podcast series** to inform the IIT Bombay community on rural development in India
- Stood 3rd amongst all hostels in the Electronics and Robotics competition on embedded systems and mechatronics
- **Volunteered** in the National Service Scheme (NSS) to mentor and teach physics to an underprivileged student for JEE Advanced examination for 8 months, created problem sets, and took regular doubt clearing sessions resulting in the student's admission to **IIIT Bhopal**, a premier technology Institute in India
- Part of the high-school **football** and **table tennis** team competing in events at the Mumbai **city** and **district** level