

Curriculum Vitae

TATSAT BANERJEE

First Year Student,
Doctor of Philosophy Program,
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Personal Details

Nationality: Indian

Date of Birth: 8th December, 1992

Areas of Interest

I am currently interested in the application of the principles of nanoscale material synthesis and nanodevice fabrication in the domain of healthcare technology and photonics. I am more inclined towards specific areas like:

- Synthesis and characterization of nanomaterials
- Targeted drug delivery via functional nanosystems
- Multifunctional nanomaterials for bio-imaging
- Three dimensional photonic crystals
- Directed self-assembly of nanoparticles
- Fluorescence spectroscopy
- Photocatalytic water splitting
- Colloidal Interaction at soft-interfaces

Academic Details

- **Doctor of Philosophy in Chemical and Biomolecular Engineering (2016-2021) – Johns Hopkins University**, Baltimore – 21218, Maryland, USA.
- **Master of Technology in Chemical Engineering (2014-2016) – IIT Kanpur**, Kanpur – 208016 (UP), India. Final CPI (*out of 10*): 9.67.
- **Bachelor of Engineering in Chemical Engineering (2010-2014) – Jadavpur University**, Kolkata, India – *First Class Honors*. Final CGPA (*out of 10; absolute scale*): 8.66; Percentage: 80.63.
- **Higher Secondary Examination (2008-2010) – West Bengal Council of Higher Secondary Education** (*School: Hindu School, Kolkata*). Percentage: 88.2 (overall), 93.33 (in pure science subjects).
- **Madhyamik Pariksha (2006-2008) – West Bengal Board of Secondary Education** (*School: Hindu School, Kolkata*). Percentage: 95.38 (overall), 98.00 (in pure science subjects).

Scholastic Achievements

- Recipient of the **Academic Excellence Award** for the year 2014-2015, from the Senate Scholarship and Prize Committee, **IIT Kanpur**, for distinctive academic achievements.
- Awarded **Best Poster Presentation Award** for project poster presentation at **IIT Kanpur** (2012).
- Ranked within **top 1%** in **Graduate Aptitude Test in Engineering (GATE) 2014** (*Chemical Engineering stream*) [*GATE is an all-India exam required for Graduate admission in all the engineering institutes of the country*].
- Recipient of Summer **Undergraduate Research Grant for Excellence (SURGE) 2013**, granted by IIT Kanpur [*SURGE 2013 was awarded to only around one hundred students all over the country, among*

which fifty students were chosen from IITK itself and rest were selected from all other IITs, NITs and different universities of India].

- Recipient of **Summer Undergraduate Research Grant for Excellence (SURGE) 2012**, granted by **IIT Kanpur**.
- Secured **projected rank 28** out of 4,50,000 candidates in Higher Secondary Examination 2010, organized by West Bengal Council of Higher Secondary Education (WBCHSE).
- Ranked within **top 0.4%** in **West Bengal Joint Entrance Examination (WBJEE) 2010**, for the entry in the engineering colleges of West Bengal.

Research Projects

A) NIR Light Driven Efficient Fluorescent Bioimaging by Upconverting Nanostructure conjugated Fluorophores: *Dec 2014 – June 2016*

- Mentored by **Prof. Sri Sivakumar and Prof. Ashutosh Sharma**.
- The Project was completed at the *Interfacial Engineering Lab* and the *Nanoscience & Nanotechnology Lab*, Department of Chemical Engineering, **IIT Kanpur**, as a part of MTech Thesis work.
- We developed a way of fabricating a functional nanosystem – which is extremely stable, highly biocompatible, and capable of crossing the cell membrane barrier in different cell lines – by covalently attaching different conventional small molecule organic dyes onto upconverting lanthanide doped nanoparticles via “Click” chemistry.
- The as-synthesized nanoconjugates were successfully utilized to harness both visible and NIR excitations and thus we achieved several key advantages in multiplex imaging like high tissue penetration depth, minimum photodamage, low autofluorescence, and high detection sensitivity.

B) Fabrication of 3D Photonic Crystal by “Click” Chemistry: *May – July, 2013 and Dec 2014 – June 2016*

- Mentored by **Prof. Sri Sivakumar and Prof. Ashutosh Sharma**.
- The project was started under SURGE 2013 program and was completed at the *Interfacial Engineering Lab* and the *Nanoscience & Nanotechnology Lab*, Department of Chemical Engineering, **IIT Kanpur**, as a part of MTech Thesis work.
- Three dimensional photonic crystal was fabricated by incorporating “Click” chemistry in conventional bottom-up self-assembly tools like horizontal sedimentation, vertical deposition, and spin coating. The post-nucleation convective assembly driven colloidal crystal growth process was arrested and CuAAC was introduced to form a covalently linked crystal structure in a layer-by-layer fashion.
- The structure exhibited a specific photonic bandgap and reflectance obtained from that 3D photonic structure for the particular wavelength of light has been fine tuned by controlling the number of layers and thereby the size of the assembly.

C) Overall Photocatalytic Water Splitting Under Visible Light Irradiation *February 2013 – March 2014*

- Mentored by **Prof. Alakananda Mukherjee**.
- This project was done at the Department of Chemical Engineering, **Jadavpur University**, Kolkata, as bachelor thesis project.

- A facile and efficient approach was developed to decompose water under visible light irradiation in single step. Semiconductor catalyst Cu_2O was modified with nanoparticulate RuO_2 co-catalyst (via incipient wetness impregnation method) and as-prepared system was used as a photocatalyst to split water with appreciable quantum efficiency.

D) Imparting Periodicity in Assembly of Nanoparticles

May- July, 2012

- Mentored by **Dr. Sri Sivakumar**.
- The project was done at Nanoscience and Nanotechnology Lab, Department of Chemical Engineering, **Indian Institute Technology (IIT) Kanpur** under SURGE 2012 program.
- A nanoparticle monolayer was prepared onto a silicon wafer by employing Copper (I)-catalyzed-Azide-Alkyne Cycloaddition (a “Click” chemistry reaction). By varying the parameters of the “Click” reaction like concentration of nanoparticle dispersion, solvent, method of nanoparticle deposition (horizontal sedimentation & vertical deposition) on the silicon wafer etc a sweet-spot was achieved successfully, where decent periodicity was obtained.
- Due to this part of work, I was acknowledged in the paper: **ACS Applied Materials & Interfaces** 5.19 (2013): 9554-9562. [[DOI: 10.1021/am402398h](https://doi.org/10.1021/am402398h)]

Publication

- **Tatsat Banerjee**, and Alakananda Mukherjee. “Overall Water Splitting under Visible Light Irradiation using Nanoparticulate RuO_2 Loaded Cu_2O Powder as Photocatalyst”, *Energy Procedia* (Elsevier) 54 (2014): 221-227 (Proceedings of 4th International Conference on Advances in Energy Research (ICAER 2013)). [[DOI: 10.1016/j.egypro.2014.07.265](https://doi.org/10.1016/j.egypro.2014.07.265).]

Key Academic Projects

A) Self- Assembly at Liquid-Liquid Interface:

July – Nov 2014

- Course Project in *Nanofabrication* (CHE 679A) under **Prof. Ashutosh Sharma**, IIT Kanpur.
- Self-assembly process of nanoparticles at two phase liquid-liquid interface and three phase water-oil-air interface was studied. Effect of nanoparticle size & their surface wettability, ligand type & concentration, solvent type, etc. on the assembly was explored. The underlying mechanism of the interface driven assembly were analyzed.

B) Photoelectrochemical Water Oxidation using PSII & PSII inspired Hybrid Material

July – Nov 2014

- Course Project in *Introduction to Nanoscience & Nanotechnology* (CHE 674A) under **Dr. Sri Sivakumar**, IIT Kanpur.
- Efficient photocatalyst systems that can work as an electron accumulator for four-proton/four-electron water oxidation process were studied. In particular, performance of photoanode based on mesoTiO₂, modified by cyanobacterial PS II of *Thermosynechococcus elongatus* was explored using protein film photoelectrochemistry. Additionally, some bio-inspired nanocomposite catalyst systems were analyzed.

- Course Project in *Mathematical Methods in Chemical Engineering* (CHE 641A) under **Dr. Raj Ganesh S Pala**, IIT Kanpur.
- Developed MATLAB code to solve a PDE with convective boundary conditions at both ends, using finite difference method. The particular PDE modelled a system where simultaneous mass and heat transfer is taking place from a slab of papaya pulp to air, due to evaporative cooling. Basically, we have independently reproduced all the results from the paper:

da Silva, PRS. Et al., Chemical Engineering Science 114 (2014): 134-143 [DOI: [10.1016/j.ces.2014.04.010](https://doi.org/10.1016/j.ces.2014.04.010)].

Relevant Coursework

Graduate Courses:

- Nanofabrication
- Introduction to Nanoscience & Technology
- Mathematical Methods in Chemical Engineering
- Thermodynamics
- Process Engineering Principles in Microfabrication

Undergraduate Courses:

- Mechanics of Fluids
- Organic Chemistry
- Physical Chemistry
- Material Science & Engg.
- Engineering Thermodynamics

Detailed information is available on: www.tatsatbanerjee.in/courses-undertaken

Software Skills

- *Programming Languages:* C, C++, FORTRAN 90.
- *Packages:* MATLAB, OriginPro, Microsoft Office.
- *Operating Systems:* Windows 7, Windows XP, Linux (Ubuntu & Fedora).

Teaching Experience

- Teaching assistant in CHE 492A: **Unit Operations and Process Control Lab**, a final-year-undergraduate lab course, at IIT Kanpur.
- Teaching assistant in CHE 602: **Fundamentals of Chemical Engineering II (Thermodynamics and Reaction Engineering)**, a compulsory course for first-year PhD students of IIT Kanpur.

Extra-Curricular/Co-Curricular Activities

- An active public commentator. Once quoted by **The New York Times** [Shortened link to the article: <http://nyti.ms/rKMPRw>].
- Elected as a **Student Nominee, Department Postgraduate Committee**, among all the Graduate students of Chemical Engineering Department, IIT Kanpur [for 2015-2016 term].
- Worked as a **Social Secretary, Chemineers Society**, IIT Kanpur [May 2015-June 2016].
- Worked as the **Secretary, Web Development Wing, Vivekananda Samiti**, IIT Kanpur [August 2014-July 2015].
- Stood Second in a State Level Recitation Competition, organized by *West Bengal Govt. School Teachers' Association*.
- Stood First in a District Level Debate Competition, organized by *West Bengal Govt. School Teachers' Association*.

References

Prof Ashutosh Sharma

(MTech Thesis Supervisor)

Secretary, Department of Science & Technology, Govt. of India.
Institute Chair Professor & CV Seshadri Chair Professor,
Department of Chemical Engineering,
Indian Institute of Technology Kanpur.
Associate Editor, ACS Applied Materials & Interfaces.
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Prof Raj Ganesh S Pala

(MTech Thesis Committee Member & Course Project supervisor)

Associate Professor,
Department of Chemical Engineering,
and Material Science Program,
Indian Institute of Technology Kanpur.
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Prof Sri Sivakumar

(MTech Thesis and Summer UG projects supervisor)

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Department of Chemical Engineering,
and Material Science Program,
Indian Institute of Technology Kanpur.
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Prof Alakananda Mukherjee

(Bachelor's Thesis Supervisor)

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Department of Chemical Engineering,
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