

CV

SIDDHARTHA MUKHERJEE

Present Affiliation: Assistant Professor, [Department of Chemical Engineering, Indian Institute of Technology Guwahati](#), Guwahati, Assam 781039, India.

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Research Interests: Microfluidics, Nanofluidics, Active matter, Complex fluids, Fluid-structure interaction.

ACADEMIC POSITIONS

1) Assistant Professor, December 30, 2024 – Present.

[Department of Chemical Engineering, Indian Institute of Technology Guwahati](#), Guwahati, Assam 781039, India.

2) Assistant Professor, June 10, 2024 – December 16, 2024.

[Department of Chemical Engineering, Birla Institute of Technology \(BIT\), Mesra](#), Ranchi, Jharkhand 835215, India.

Teaching: For the Monsoon 2024 semester, I taught the following courses:

- ❖ Fluid Mechanics (undergraduate 2nd year course),
- ❖ Plant Design (undergraduate 4th year course),
- ❖ Microfluidics (undergraduate 4th year elective course).

Research: My research involved exploring some avenues of small-scale fluid-structure interactions and its applications.

3) Postdoctoral Fellow, September 1, 2023 – June 8, 2024.

[Physics of Complex Fluids Group \(PCF\)](#), Faculty of Science and Technology (TNW), University of Twente, P.O. Box 217, 7500 AE, Enschede, The Netherlands.

Description: Worked with [Prof. Frieder Mugele](#) towards the Atomic Force Microscopy (AFM) force distance spectroscopy measurements under controlled electrochemical conditions as well as working on the quantitative interpretation and modelling of the experiments under applied bias voltage and/or under illumination.

4) C V Raman Postdoctoral Fellow, February 10, 2023 – August 16, 2023.

[Microfluidics and Microswimmers Lab](#), Department of Mechanical Engineering, Indian Institute of Science, Bengaluru 560012, INDIA.

Research Domain: Active Matter, micro-hydrodynamics.

Description: Worked with Dr. [Shubhadeep Mandal](#) on the projects

- The motion of active droplets and particles under gravity.

- Controlled navigation of micro-swimmers in micro-confinements subjected to a Poiseuille flow.

EXPERIENCE

Senior Research Fellow, June 1, 2022 – January 31, 2023.

Department of Mechanical Engineering, Indian Institute of Technology Kharagpur, India.

Research Domain: Fluid-structure interaction, microfluidics.

Description: Worked with Prof. [Suman Chakraborty](#) on the projects

- Electrokinetics in deformable microchannels,
- Electrokinetics in non-uniform microchannels with applications in extensional rheometry.

The objective was to develop theoretical and numerical models in studying electrokinetics phenomena like electroosmosis, streaming potential in the context of flow through deformable microchannels, and in the context of flow through non-uniform microchannels.

EDUCATION

Doctor of Philosophy (PhD), May 2022.

Advanced Technology Development Centre (ATDC), Indian Institute of Technology Kharagpur, India.

Master of Technology (M. Tech), 2016.

Department of Chemical Engineering, Indian Institute of Technology Kanpur, India.

CGPA: 8.57/10

Bachelor of Engineering (B.E.), 2013.

Department of Chemical Engineering, Jadavpur University, India.

CGPA: 8.47/10

RESEARCH PROJECTS

DOCTORAL PROJECT - IIT Kharagpur (July 2016 – May 2022):

Thesis Title: “Harnessing Viscoelastic Rheology in Microfluidics: Insights on Electrokinetic Transport”.

Supervisors: Prof. Suman Chakraborty and Prof. Sunando DasGupta

Description: The broad area of my doctoral research was microfluidics with particular emphasis on the electrokinetic flow of viscoelastic fluids. Different aspects of the electrokinetic flow of viscoelastic fluids in narrow confinements were explored which included:

- the interplay of steric factor and interfacial slip on the electroosmotic flow ([Link](#)),
- the effect of the wall depletion layer on electroosmosis ([Link](#)),
- the interplay of surface charge and Joule heating-induced thermal gradient on the electroosmotic flow and the resulting hydrodynamic dispersion ([Link](#)),
- the thermally-driven electrokinetic transport and the associated hydrodynamic dispersion characteristics ([Link](#)), and
- the coupling of solid mechanics, fluid mechanics, and electrokinetics on the deformation

characteristics of a deformable microfluidic channel ([Link](#)).

Additional projects during doctoral tenure:

Collaborative projects with fellow research scholars:

- Energy conversion in physiologically relevant microvessels by utilizing the interplay between electrokinetics and hydrodynamics in narrow conduits ([Link](#)).
- Analyzing the capillary filling dynamics to establish a universal signature of the oscillatory dynamics of the capillary front ([Link](#)).

Collaborative projects with faculties of other Institutes:

- Hydrodynamics of droplet coalescence of polymeric fluids towards establishing a universal relation of the temporal evolution of the necking radius ([Link](#)).
- The electrophoretic motion of a non-uniformly charged particle in a viscoelastic fluidic medium ([Link](#)).

MASTER'S PROJECT- IIT Kanpur (December 2014-May 2016):

Thesis Title: "Laminar forced convection in non-Newtonian fluids through ducts of different cross-sections".

Supervisor: Dr. Raj. P. Chhabra, Department of Chemical Engineering, IIT Kanpur

Description: Laminar forced convection through semi-circular and other cross-sectional ducts was numerically simulated for both power-law as well as Bingham plastic fluids ([Link](#)) which included

- the flow and temperature field characteristics over a wide range of parameters (e.g., power-law index, Bingham number), in terms of the hydrodynamic entrance length, friction factor, local and average Nusselt numbers for different thermal boundary conditions in both developing as well as fully developed regions.

Additional Project:

- Natural convection from an array of two spheres submerged in power-law fluids.

BACHELOR'S PROJECT- Jadavpur University (July 2012- April 2013):

Title: "Experimental studies on removal of mercury using bacteria and micro algal biomass".

Supervisor: Prof. Ranjana Chowdhury, Department of Chemical Engineering, Jadavpur University.

Objectives:

- To determine the efficacies of mercury removal using initial mercuric ion concentration.
- To determine the growth kinetics of mercury resistant bacteria.
- Characterization of mercury removal capacity of microalgae.

LIST OF PUBLICATIONS

Journal Papers (upcoming):

1. **Mukherjee, S.**, Mandal, S., Motion of a chemically active droplet in an external force (under review in *Journal of Fluid Mechanics*).
2. Laha S., **Mukherjee S.** & Chakraborty S., Dynamical Response of Deformable Microchannels under Pressure-Driven Flow of Aqueous Polymer Solutions (under review in *Flow*).
3. **Mukherjee S.** & Bhattacharjee S., Mass Transfer of a neutral solute across a Deformable Microchannel with porous wall (to be submitted in *Physics of Fluids*).
4. **Mukherjee, S.**, Roy D., Chakraborty S., Electroosmotic flow in non-uniform microchannels and its implications in hydrodynamic dispersion (in preparation).

Journal Papers (Published):

1. Roy R., Guha A., **Mukherjee S.**, & Chakraborty S. (2024). "Elasticity of Polymeric Fluids Augments Salinity-Gradient-Induced Electric Potential across a Microfluidic Channel," *Journal of Colloid and Interface Science*, 678, Part C, [Link](#).
2. **Mukherjee, S.**, Dhar, J., Dasgupta, S., & Chakraborty, S. (2022). "Electrokinetically Augmented Load Bearing Capacity of a Deformable Microfluidic Channel," *Physics of Fluids*, 34, 082019, [Link](#).
3. Ghosh U., **Mukherjee, S.**, & Chakraborty, S. (2021). "Electrophoretic motion of a non-uniformly charged particle in a viscoelastic medium in thin electrical double layer limit," *Journal of Fluid Mechanics*, 924, [Link](#).
4. Roy, R., **Mukherjee, S.**, Lakkaraju, R., & Chakraborty, S. (2020). "Streaming potential in bio-mimetic microvessels mediated by capillary glycocalyx," *Microvascular Research*, 132, 104039, [Link](#).
5. **Mukherjee, S.**, DasGupta, S., & Chakraborty, S. (2020). "Temperature-gradient-induced massive augmentation of solute dispersion in viscoelastic micro-flows," *Journal of Fluid Mechanics*, 897, [Link](#).
6. Paul, A., **Mukherjee, S.**, Dhar, J., Ghosal, S., & Chakraborty, S. (2020). "The effect of the finite size of ions and Debye layer overspill on the screened Coulomb interactions between charged flat plates," *Electrophoresis*, 41(7-8), 607-614, [Link](#).
7. Varma, S. C., Saha, A., **Mukherjee, S.**, Bandopadhyay, A., Kumar, A., & Chakraborty, S. (2020). "Universality in coalescence of polymeric fluids," *Soft Matter*, 16(48), 10921-10927, [Link](#).
8. Dhar, J., **Mukherjee, S.**, Raj. K. M., & Chakraborty, S. (2019). "Universal oscillatory dynamics in capillary filling", *EPL (Europhysics Letters)*, 125(1), 14003, [Link](#).
9. **Mukherjee, S.**, Dhar, J., DasGupta, S., & Chakraborty, S. (2019). "Patterned surface charges coupled with thermal gradients may create giant augmentations of solute dispersion in electro-osmosis of viscoelastic fluids", *Proceedings of the Royal Society A*, 475(2221), 20180522, [Link](#).
10. **Mukherjee, S.**, Biswal, P., Chakraborty, S., & DasGupta, S. (2017). "Effects of viscous dissipation during forced convection of power-law fluids in microchannels", *International Communications in Heat and Mass Transfer*, 89, 83-90, [Link](#).
11. **Mukherjee, S.**, Das, S. S., Dhar, J., Chakraborty, S., & DasGupta, S. (2017). "Electroosmosis of viscoelastic fluids: Role of wall depletion layer", *Langmuir*, 33(43), 12046-12055, [Link](#).
12. **Mukherjee, S.**, Goswami, P., Dhar, J., Dasgupta, S., & Chakraborty, S. (2017). "Ion-size dependent electroosmosis of viscoelastic fluids in microfluidic channels with interfacial slip", *Physics of Fluids*, 29(7), 072002, [Link](#).

13. **Mukherjee, S.**, Gupta, A. K., & Chhabra, R. P. (2017). "Laminar forced convection in power-law and Bingham plastic fluids in ducts of semi-circular and other cross-sections," *International Journal of Heat and Mass Transfer*, 104, 112-141, [Link](#).

Publication statistics (using Google scholar): Total citations – 240, h-index: 9, i10-index: 9.

Conference Papers:

1. Dijkhuizen M., Shukla C., **Mukherjee S.**, Su S., Siretanu I., Mei B., Altomare M., Mul G., Frieder Mugele F. (2024). "In situ and operando characterization of photocatalytically active faceted nanoparticle-electrolyte interfaces by AFM" **NWO Physics 2024**, January 23-24, 2024, Veldhoven, Eindhoven, The Netherlands.
2. Mandal S. & **Mukherjee S.** (2023). "Dynamics of Forced Active Droplets" 1st Indian Conference on Micro nano fluidics (**ICOM**), September 29 - October 1, 2023, Indian Institute of Technology Madras, Chennai, Tamil Nadu 600036, India, India.
3. Roy D., Roy R., Guha A., **Mukherjee S.**, & Chakraborty, S. (2022). "Electrokinetics in hyperbolically contracting micro-channels" Proceedings of the 9th International and 49th National Conference on Fluid Mechanics and Fluid Power (**FMFP**), December 14-16, 2022, Indian Institute of Technology Roorkee, Roorkee-247667, Uttarakhand, India.
4. Roy R., Guha A., **Mukherjee S.**, & Chakraborty, S. (2022). "Dilute Polymeric fluids Augmenting Salinity gradient induced Potential" Proceedings of the 9th International and 49th National Conference on Fluid Mechanics and Fluid Power (**FMFP**), December 14-16, 2022, Indian Institute of Technology Roorkee, Roorkee-247667, Uttarakhand, India.
5. Vegesina, S., Saha, A., **Mukherjee, S.**, Bandopadhyay, A., Kumar, A., & Chakraborty, S. (2022). "Universal behaviour in coalescence of polymeric droplets," **APS March Meeting 2022**, March 14–18, 2022; Chicago, USA.
6. **Mukherjee, S.**, Ghosh, U., & Chakraborty, S. (2021). "Viscoelasticity modulated electrophoretic motion of a non-uniformly charged particle," International Conference on Complex Fluids and Soft Matter (**CompFlu 2021**), 13th-15th December 2021, Indian Institute of Technology Gandhinagar, Palaj, Gujarat, India.
7. **Mukherjee, S.**, Dhar, J., DasGupta, S., & Chakraborty, S. (2018). "Forced convection in electroosmotic flow of Phan-Thien-Tanner fluids," 1st International Conference on Mechanical Engineering (**INCOM18**), 4th-6th January 2018, Dept. of Mechanical Engineering, Jadavpur University, Kolkata, India.
8. **Mukherjee, S.**, Dasgupta N., & Chhabra, R. P. (2015). "Natural convection from an array of two spheres submerged in power-law fluids," 68th Annual Session of the Indian Institute of Chemical Engineers (**CHEMCON 2015**), 27th-30th December 2015, Dept. of Chemical Engineering, Indian Institute of Technology Guwahati, Guwahati, India.

PARTICIPATION IN CONFERENCES, WORKSHOPS & SYMPOSIUMS

- ❖ Participated in the conference "**35th Dutch Soft Matter Meeting**" held on 6th May 2024 at Kinopolis, Enschede, The Netherlands.
- ❖ Participated in the conference "**OPERANDO SPM 2023 – International Conference on Nanoscale Catalysis and Energy Conversion**" held on 15-16th November 2023 at Harnack House Berlin,

Germany.

- ❖ Presented a poster on “**Controlled navigation of a micro-swimmer in micro-confinements subjected to a Poiseuille flow**” in 1st research symposium of the Mechanical Sciences Division, Indian Institute of Science, Bengaluru, 12-13th May 2023.
- ❖ Participated in the workshop “**Fluids Under Confinement (FUC-2023)**” held on 24-25th March 2023 at Indian Institute of Technology Kharagpur.

TRAININGS & INTERNSHIPS

Summer Internship: Studying the hydrodynamics of a packed bed biofilm reactor via Residence Time Distribution (RTD) experiments from 10th June 2011 to 1st August 2011.

Supervisor: Prof. Ranjana Chowdhury, Department of Chemical Engineering, Jadavpur University.

Industrial Training: Summer training project on the manufacturing process of purified terephthalic acid (PTA) from 14th May 2012 to 10th June 2012 in MCC PTA India Corp. Pvt. Ltd., Haldia.

POSITION OF RESPONSIBILITY

Student Mentoring:

- Student Mentor of Arghyadeep Paul, Undergraduate student of Mechanical Engineering Department, IIT Kharagpur (2019). We studied the effect of the finite size of ions and Debye layer overspill on the screened Coulomb interactions between charged flat plates. This work was published in **Electrophoresis** ([Link](#)).
- Student Mentor of Prayag Biswal, Undergraduate student of Chemical Engineering Department, IIT Kharagpur (2017). We studied the viscous dissipation effect during forced convection of power-law fluids in microchannels. This work was published in **International Communications in Heat and Mass Transfer** ([Link](#)).

Teaching Assistantship Duties:

- Developed lecture notes for the course named “**Advanced Concepts in Fluid Mechanics**” taught by Dr. Suman Chakraborty, Department of Mechanical Engineering, IIT Kharagpur as a part of the ‘National Programme on Technology Enhanced Learning (NPTEL)’ curriculum (2020).
- Teaching assistant for **Dept. Post-Graduate Committee (DPGC)** in the Department of Chemical Engineering at IIT Kanpur under Dr. Sri Sivakumar (December 2014- January 2015).
- Teaching assistant for the course **Ph.D. Seminar** in the Department of Chemical Engineering at IIT Kanpur under Dr. Raj. P. Chhabra (February-April 2015).
- Teaching assistant for the **Unit Operation Laboratory** in the Department of Chemical Engineering at IIT Kanpur under Dr. Deepak Kunzru (July-November 2015).

PROFESSIONAL ACTIVITIES

Journal Reviewer: Physics of Fluids, Applied Physics Letters, Journal of Applied Physics, Journal of The Institution of Engineers (India): Series C.

COMPUTER SKILLS

- Math packages: MATLAB, MAPLE, MATHEMATICA.
- CFD packages: COMSOL Multiphysics.

INSTRUMENT SKILLS

Instruments handled: Rheometer, Spin Coater, Goniometer, High-speed camera.

SCHOLASTIC ACHIEVEMENTS

- Achieved C V Raman Postdoctoral Fellowship for pursuing postdoctoral research at the Department of Mechanical Engineering, Indian Institute of Science (IISc), Bengaluru (2023).
- Ranked within the top 1.5% in the GATE 2014 Examination in Chemical Engineering (Rank - 225) and subsequently achieved the MHRD scholarship while pursuing the M. Tech. Degree at IIT Kanpur (August 2014 - April 2016).
- Achieved the Scholarship from the West Bengal Council of Higher Secondary Education (WBCHSE) in the scheme of scholarships for College & University students (2009).

LIST OF REFERENCES

- **Dr. Suman Chakraborty,**
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