

Nikhil R. Agrawal - Curriculum Vitae

Process Engineer
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EDUCATION

Ph.D. in Chemical Engineering August 2024

University of California, Berkeley, USA

Specialization area: Electrolysis, Electrolytes, Polyelectrolytes, Separation Processes, Mathematical Modeling

Thesis title: *Modified Gaussian Renormalized Fluctuation Theory for Electrolytes at Interfaces*

Advisor: Prof. Rui Wang

B. Tech. and M. Tech (Dual Degree) in Chemical Engineering July 2018

Indian Institute of Technology (IIT), Delhi, India

Institute Silver Medal for highest GPA in the program

Specialization area: Multiphase Reactors, Techno-economic analysis of processes, Mathematical Modeling

Master's thesis title: *Microscopic characterization of particle packings in packed bed reactors*

Master's thesis advisor: Prof. Shantanu Roy, Executive Director, IIT Delhi- Abu Dhabi

WORK EXPERIENCE

Semiconductor Product Development & Strategic Customer Engagement

Process Engineer | Global Products Group, Lam Research, Oregon, USA

Sep'24 - Present

Lead Engineer on company's engagement with Taiwan based world's largest semiconductor manufacturing company on Lam's Striker Oxide DH product line. Responsible for:

- Coordinating and driving a multinational team of software, mechanical, electrical, and RF plasma engineers, together with Lam's Field Service Engineers in Taiwan, to ensure smooth project execution.
- Designing Lam's Strike Oxide DH architectures through the application of Techno-Economic Analysis and Life-Cycle Assessment, ensuring a balanced focus on cost-efficiency, process performance, and environmental sustainability.
- Leading the first successful production deployment of silicon oxide and silicon nitride film stack on Striker Oxide DH systems.
- R&D to develop new deposition processes for various thin film materials crucial for modern integrated circuits.

In general, alongwith senior leadership I engage with customers in key markets (USA, South Korea, China, Taiwan, and Singapore), aligning customer needs with Lam's business strategy for the Striker Oxide DH product line.

Electrochemistry for energy storage, chemical manufacturing, and rare earths extraction Aug '18 - Aug '24

Ph.D. Candidate | Chemical Engineering, University of California, Berkeley, USA

Original research work to explain how highly concentrated salt solutions behave near charged surfaces, leading to 7 first author research publications and multiple conference presentations. Some applications of work are:

- lithium/sodium ion batteries, hydrogen fuel cells, electrolysis for hydrogen production
- rare earth mineral extraction and separation processes, ex: direct lithium extraction, molten salt electrolysis
- membrane separation processes for water desalination, waste water and chemical waste treatment

Advanced ML and Bayesian Modeling for quantifying uncertainty in material models Mar '24 - June '24
Semester Intern | Physics Division, Lawrence Livermore National Laboratory, USA

Collaborated with a 10+ member multidisciplinary team to deploy Bayesian and deep-learning methods for quantifying predictive uncertainty in materials simulations, expanding my understanding of modern AI/ML technologies relevant across industries.

Data Science, Cloud Computing, and Monte-Carlo simulations for complex systems June '23 - Aug '23
Summer Intern | Center of Computational Biology, Flatiron Institute, New York, USA

Conducted large-scale hybrid Monte-Carlo and Molecular dynamics simulations to model protein behavior during cell division, building capabilities in Monte-Carlo methods, cloud-based computation, and scientific data engineering.

Reactor Catalyst-Packing optimization for efficiency gains in refining operations Jan '17 - July '18
Master's Candidate | Department of Chemical Engineering, IIT Delhi, India

Designed and validated a mathematical model describing catalyst-bed microstructure, providing insights that could improve packing-methods and led to 2 publications.

Large scale computer simulations to optimize catalyst packing in packed bed reactors May '17 - July '17
Visiting Researcher | Mentor: Prof. Dr. Thorsten Pöschel, University of Erlangen-Nuremberg, Germany

Part of a multinational India-Germany research team to optimize catalyst-packing in packed-bed reactors for improved crude-oil refining efficiency, applied cloud computing and Monte Carlo simulations to evaluate and refine packing strategies.

Design optimization to increase cooling efficiency in nuclear reactors May '16 - July '16
Summer Intern | Porous Media Group, Institut de Mecanique des Fluides de Toulouse (IMFT), France

Worked at one of the world's largest fluid mechanics institutes and developed a software tool to analyze experimental images, enabling faster optimization of reactor design.

Design of solar-powered photocatalysts for conversion of CO₂ into commodity chemicals May '15 - April '16
Undergraduate Researcher | Mentor: Prof. Sudhasatwa Basu, Chemical Engineering, IIT Delhi, India

Photo-catalysis is the use of semiconducting materials and solar energy-generated electrons to drive chemical reactions, a principle shared with photovoltaic devices. In this project, I

- synthesized and characterized structure of semiconductor-graphene/silica nanocomposite catalysts, and
- analyzed the photo-catalytic activity of these catalysts through dye degradation in a *self-designed reactor*.

JOURNAL PUBLICATIONS

On the topic of electrolysis, electrolytes, and polyelectrolytes:

1. Electrostatic Correlation Augmented Self-Consistent Field Theory and Its Application to Polyelectrolyte Brushes
Chao Duan, Nikhil R. Agrawal, and Rui Wang, *Physical Review Letters* (2025) 134, 048101
2. Understanding long-range opposite-charge repulsion in multivalent salt solutions
Nikhil R. Agrawal, Carlo Carraro and Rui Wang, *J. Chem. Phys.* 161, 204902 (2024)
3. Nature of overcharging and charge inversion in electrical double layers
Nikhil R. Agrawal, Chao Duan, and Rui Wang, *J. Phys. Chem. B* 2024, 128, 1, 303–311
4. Ion correlation-driven like-charge attraction in multivalent salt solutions
Nikhil R. Agrawal, Ravtej Kaur, Carlo Carraro and Rui Wang, *J. Chem. Phys.* 159, 244905 (2023)
5. Non-monotonic salt concentration dependence of inverted electrokinetic flow
Nikhil R. Agrawal and Rui Wang, *AICHE Journal*, e18269, 2023.

6. Self-consistent description of vapor-liquid interface in ionic fluids
Nikhil R. Agrawal and Rui Wang, *Physical Review Letters* (2022), 129, 228001.
7. Electrostatic correlation induced ion condensation and charge inversion in multivalent electrolytes
Nikhil R. Agrawal and Rui Wang, *Journal of Chemical Theory and Computation* (2022), 18, 6271-6280
8. Sturm-Liouville theory inspired method to solve the Modified Gaussian Renormalized Fluctuation theory for electrolytes
Nikhil R. Agrawal, Carlo Carraro and Rui Wang, *in preparation*.

On the topic of trickle bed reactors, multiphase reactors, and process intensification:

1. A first-order segregation phenomenon in fluid-immersed granular systems
Prapanch Nair, LAT Cisneros, CRK Windows-Yule, Nikhil R. Agrawal, Shantanu Roy, and Thorsten Pöschel, *Powder Technology* 373 (2020): 357-361.
2. Isotropy of sphere packings in a cylindrical confinement
Nikhil R. Agrawal, Prapanch Nair, Thorsten Pöschel and Shantanu Roy, *Chemical Engineering Journal* 377 (2019): 119820.

SELECTED PRESENTATIONS

1. **Modified Gaussian Renormalized Fluctuation Theory for Electrolytes at Interfaces**
2025 AIChE Annual Meeting, Oral Presentation
Nikhil R. Agrawal and Rui Wang
2. **Thermodynamics and transport of concentrated electrolytes at interfaces**
2025 AIChE Annual Meeting, Poster Presentation
Nikhil R. Agrawal and Rui Wang
3. **Ion correlation induced non-monotonic height change and microphase separation of poly-electrolyte brushes**
2024 American Physical Society March Meeting, Oral Presentation
Rui Wang, Chao Duan, Takashi Yokokura, and Nikhil R. Agrawal
4. **Beyond mean-field Poisson-Boltzmann: A self-consistent theory for electrical double layers**
Energy Conversion Group, Lawrence Berkeley National Laboratory, Invited Presentation, Feb 2023
Nikhil R. Agrawal and Rui Wang
5. **Modified Gaussian Renormalized Fluctuation theory: A self-consistent electrolyte solution theory**
Pitzer Center for Theoretical Chemistry, UC Berkeley, Invited Presentation, Jan 2023
Nikhil R. Agrawal and Rui Wang
6. **Self-consistent theory to describe charge inversion and like-charge attraction in multivalent electrolytes**
2023 American Physical Society March Meeting, Oral Presentation
Nikhil R. Agrawal and Rui Wang
7. **A self-consistent theory for complex electrostatic phenomena at interfaces**
2022 American Chemical Society Colloid and Surface Science Symposium, Oral Presentation
Nikhil R. Agrawal and Rui Wang
8. **Beyond mean-field Poisson-Boltzmann: A self-consistent theory for electrical double layers**
Formulation and Material Science Division, Dow Chemicals, Invited Presentation, 2022
Nikhil R. Agrawal

COURSEWORK AND CERTIFICATIONS

- Process Engineering for Silicon wafers (Lam Research)
- Process Integration for Semiconductor manufacturing (Lam Research)
- Electroplating for Semiconductor manufacturing (Lam Research)
- Deposition and Etch for Semiconductor manufacturing (Lam Research)
- Fundamentals of Deep Learning (NVIDIA)
- Data Parallelism: How to Train Deep Learning Models on Multiple GPUs (NVIDIA)
- Model Parallelism: Building and Deploying Large Neural Networks (NVIDIA)
- Bayesian Data Analysis and Machine Learning for Physical Sciences (UC Berkeley)
- Machine Learning, Statistical Models, and Optimization for Physical Sciences (UC Berkeley)

AWARDS AND HONORS

- Langmuir Graduate Student Oral Presentation Awards Finalist, American Chemical Society 2022
- *Institute Silver Medal* from IIT Delhi for highest GPA in the dual degree program in Chemical Engg. 2018
- IIT Delhi *Semester Merit Award* for 9 out of 10 semesters for being among *top 7%* meritorious students across the dual degree program, *consecutively for 8 semesters* 2013-2017
- *Significant Contribution to Research Activities* Award by Chemical Engineering Society, IIT Delhi 2017
- *Kishore Vaigyanik Protsahan Yojana* (KVPY) Fellowship by Dept. of Science and Technology, India 2013
- Was among the *Nation's Top 1%* merit holders in National Standard Examination in Physics (NSEP) conducted by the Indian Association of Physics Teachers (IAPT) 2013

LEADERSHIP ROLES

Secretary, SPIC MACAY, BRCA, IIT Delhi

2015 - 2016

SPIC MACAY: *Society for Promotion of Indian Classical Music And Culture Amongst Youth*

One of the 11 club secretaries of the Board of Recreational and Cultural Activities (BRCA), IIT Delhi.

- Led a team of 13, one each from every hostel in IIT Delhi, to organize marketing, publicity, and hospitality of club events like dance workshops and music concerts
- Successfully secured a sponsorship of Rs. 1 lac from the Gas Authority of India Ltd. (GAIL) to organize *Saaz*, the classical music night of Rendezvous 2015 (IIT Delhi's annual cultural festival), where Grammy Award winner Pt. Vishwa Mohan Bhatt performed.
- Overall coordinator of SPIC MACAY's VIRASAT '16, annual classical music festival of IIT Delhi; headed a team of 15 to organize a 2 week long series of cultural events

Event Coordinator, IIT Delhi Alumni Association

April '16

Lead a team of student volunteers for audience management in a seminar on "Ethics and Happiness" by *Nobel Laureate 14th Dalai Lama*

MISCELLANEOUS

Programming Skills

Python, C++, PyTorch, GPyTorch ,TensorFlow, Scikit Learn, Bash

Technical softwares

JMP, MATLAB, Aspen, COMSOL, FLUENT, ParaView, Autodesk Inventor

Material Characterization

XSEM, STEM, SIMS, XRR, CV/IV (Hg Probe).

Other Interests

Sociology, Reading about emerging technologies and their impact on society