

DEBJIT GHOSHAL

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OBJECTIVE

My goal is to lead a research program that addresses key challenges in the field of 2D materials by advancing the fundamental science behind their growth, structural and chemical modifications and electronic property modulation. Through various interconnected thrusts and emphasis on both fundamental science and broad applicability, my research will provide a unified framework for understanding and harnessing the properties of 2D materials. This approach will not only deepen our understanding of atomic-scale phenomena but also unlock the potential of these materials for diverse applications, spanning from advanced electronics to chemical/biosensing and catalysis.

EDUCATION

Ph.D., Rensselaer Polytechnic Institute, Chemical and Biological Engineering, Aug 2015 – Aug 2020

M.Tech, IIT Kharagpur, Chemical Engineering, Aug 2013 – May 2015

B.Tech, West Bengal University Of Technology, India, Chemical Engineering, Aug 2009 – May 2013

EMPLOYMENT HISTORY

Assistant Professor- IIT Guwahati, Department of Chemical Engineering May 2025- Present

- Develop scalable techniques for growth of high quality 2D materials.
- Tailor properties of 2D materials via chemical functionalization, doping and phase engineering.
- Develop next generation sensing technologies from 2D materials.

Post-Doctoral Research Associate – NREL

April 2022 – May 2025

Mentors: Dr. Elisa Miller and Dr. Jao van de Lagemaat

- Develop vapor-based techniques for large area epitaxial growth of 2D MoS₂ for optoelectronics.
- Develop approaches for light activated doping in 2D materials.
- Demonstrate controlled defect engineering in 2D materials for applications in photonics.
- Develop high throughput optical spectroscopy techniques for characterization of defects/doping in monolayer TMDCs.

Post-Doctoral Research Associate – University of Wisconsin Madison

Nov 2020 – Apr 2022

Mentors: Prof. Michael Arnold and Prof. Max Lagally

- Develop vapor-based techniques for epitaxial growth of graphene on Germanium substrates for next generation electronic devices.
- Demonstrate passivation of Germanium substrates to ambient oxidation by epitaxial graphene growth.

Graduate Research Assistant – RPI

Aug 2015 – Aug 2020

Mentors: Prof. Sufei Shi and Prof. Nikhil Koratkar

- Investigate the growth mechanisms that govern 2D material synthesis and demonstrate morphology-controlled growth.
- Highlight the importance of morphology-controlled growth in 2D materials by demonstrating how tailored morphologies are critical for specific applications in electronics, optoelectronics and catalysis.
- Develop facile vapor-based techniques for growth of heterostructures of 2D materials.

TEACHING EXPERIENCE

Rensselaer Polytechnic Institute (Teaching Assistant)

- Chemical Reaction Engineering (Fall 2016)
- Aerostructure and Control Lab (Spring 2018)
- Energy, Entropy and Equilibrium (Spring 2019)
- Chem ENGR Lab I (Fall 2019)
- Energy, Entropy and Equilibrium (Spring 2020)
- Chemical Process Design (Spring 2020)

Educational Video: Made a video for the general audience to educate them about **2D materials**. Link attached.

<https://www.youtube.com/watch?v=FUqMm4C9LaQ&t=206s>

MENTORING and TRAINING EXPERIENCE

- 0 Ph.D. and 0 Postdoctoral fellows (from all sources) working at present.
- 3 graduate students and 7 undergraduate students – currently pursuing either advanced degrees or working in industry have been mentored in the past.
- Trained users on the CVD tool (6 users) and on Renishaw PL/ Raman tool (30 users).

AWARDS and HONORS

- Postdoc Proposal Writing Award, *Materials, Chemical and Computational Science (MCCS) division*, National Renewable Energy Lab (NREL), 2023
- Graduate Student Award in AIChE session on *Electronic and Photonic Materials (Area 8E)* 2019
- Howard P Isermann Fellowship, Rensselaer Polytechnic Institute, 2015-16
- MHRD Scholarship, Indian Institute of Technology Kharagpur 2013-15

PROPOSAL WRITING EXPERIENCE

- Wrote a proposal for a Science Undergraduate Laboratory Internship (SULI) sponsored and managed by the DOE Office of Science's Office. The intern was funded on a project titled "Growth and Defect Engineering in 2D Transition Metal Dichalcogenides (TMDCs)" during Spring 2023.
- Submitted a Laboratory Directed Research and Development (LDRD) SEED proposal on "Fabricating Next Generation Membranes from Large-area Atomically Thin 2D Layered Materials for Advanced Separation Technologies" and received the **Postdoctoral Proposal Award**.

PUBLICATIONS

FIRST AUTHOR:

1. **Ghoshal, D.**; Paul, G.; Sagar, S.; Shank, C.; Hurley, L.; Hooper, N.; Tan, J.; Burns, K.; Hachtel, J.A; Ferguson, A.J.; Blackburn, J.L.; Lagemaat, J.; Miller, E. Spatially precise light-activated dedoping in wafer-scale MoS₂ films. *Advanced Materials* 2025, 37(3), 2409825(1-9).
2. **Ghoshal, D.**; Shang, H.; S., Xin; W., Xixing; Chen, D.; Wang, T.; Lu, Z.; Gupta, T.; Efstathiadis, H.; West, D.; Koratkar, N.; Lu, T-M; Zhang, S.; Shi, S-F. Orientation Controlled Large Area Epitaxial PbI₂ Thin Films with Tunable Optical Properties. *ACS Appl. Mater. Interfaces* 2021, 13, 27, 32450–32460.
3. **Ghoshal, D.**; Kumar, R.; Koratkar, N. Controlled Re Doping in MoS₂ by Chemical Vapor Deposition. *Inorg. Chem. Commun.* 2020, 108329 (1-4).
4. **Ghoshal, D.**; Jain, R.; Koratkar, N. Graphene's Partial Transparency to van der Waals and Electrostatic Interactions. *Langmuir* 2019, 35, 12306–12316. **[Highlighted on Cover]**
5. **Ghoshal, D.**; Wang, T.; Tsai, H.-Z.; Chang, S.-W.; Crommie, M.; Koratkar, N.; Shi, S.-F. Catalyst-Free and Morphology-Controlled Growth of 2D Perovskite Nanowires for Polarized Light Detection. *Advanced Optical Materials* 2019, 7(15), 1900039 (1-7).
6. **Ghoshal, D.**; Yoshimura, A.; Gupta, T.; House, A.; Basu, S.; Chen, Y.; Wang, T.; Yang, Y.; Shou, W.; Hachtel, J. A.; Lu, T.M.; Basuray, S.; Meunier, V; Shi, S.-F.; Koratkar, N. Theoretical and Experimental Insight into the Mechanism for Spontaneous Vertical Growth of ReS₂ Nanosheets. *Advanced Functional Materials* 2018, 28(30), 1801286 (1-12).

CO-AUTHORED:

1. Schichtl, Z; Carvalho, O. Q; Tan, J; Saund, S; **Ghoshal, D.**; Wilder, L; Gish, M; Nielander, A; Stevens, M; Greenway, A. Underpinning Photoelectrochemical Solar Fuel Production. *Chemical Reviews* 2025, 125(10), 4768-4839.
2. Karmakar, R; Taank, P; **Ghoshal, D.**; Yadav, P; Mandal, D; Shrivastava, M; Agarwal, A; Miller, E; Beard, M; Adarsh, K.V. Highly Efficient Multiple Carrier Generation at Extreme Low Energy Threshold ~1.22 E_g in Atomically Thin Transition Metal Dichalcogenides. *Phys. Rev. Lett.*, 2025, 134, 026903 (1-7).
3. Bo, T; **Ghoshal, D.**; Wilder, L. Miller, E.M; Mirkin M.V. High-Resolution Mapping of Photocatalytic Activity by Diffusion-Based and Tunneling Modes of PhotoScanning Electrochemical Microscopy (PhotoSECM). *ACS Nano* 2025, 19, 3, 3490– 3499.
4. Myers, A.; Sulas-Kern, D.; Fei, R; **Ghoshal, D.**; Hermosilla-Palacios, M.; Blackburn, J. Quantifying Carrier Density in Monolayer MoS₂ by Optical Spectroscopy. *J. Chem. Phys.* 2024, 161, 044706 (1-8).
5. Cheng, Y.-H.; Kargupta, R.; **Ghoshal, D.**; Li, Z.; Chande, C.; Feng, L.; Chatterjee, S.; Koratkar, N.; Motkuri, R. K.; Basuray, S. ESSENCE – A Rapid, Shear-Enhanced, Flow-through, Capacitive Electrochemical Platform for Rapid Detection of Biomolecules. *Biosens. Bioelectron.* 2021, 182, 113163 (1-11).
6. Pandey, J.; **Ghoshal, D.**; Dey, D.; Gupta, T.; Taraphder, A.; Koratkar, N.; Soni, A. Local Ferroelectric Polarization in Antiferroelectric Chalcogenide Perovskite Thin Films. *Phys. Rev. B* 2020, 102 (20), 205308 (1-6).
7. Gupta, T.; **Ghoshal, D.**; Yoshimura, A.; Basu, S.; Chow, P.K.; Lakhnot, A.; Pandey, J.; Warrender, J.; Efstathiadis, H.; Soni, A; Osei-Agyemang, E.; Balasubramanian, G.; Zhang, S.;

- Shi, S-F.; Lu, T-M.; Meunier, V.; Koratkar, N. An Environmentally Stable and Lead-Free Chalcogenide Perovskite. *Advanced Functional Materials* 2020, 30, 2001387 (1-9).
8. Chatterjee, S.; Anikin, A.; **Ghoshal, D.**; Hart, J. L.; Li, Y.; Intikhab, S.; Chareev, D. A.; Volkova, O. S.; Vasiliev, A. N.; Taheri, M. L.; Koratkar, N.; Karapetrov, G.; Snyder, J. Nanoporous Metals from Thermal Decomposition of Transition Metal Dichalcogenides. *Acta Mater.* 2020, 184, 79–85.
 9. Gupta, R.; Chauhan, R. P.; Chakarvarti, S. K.; Jaiswal, M. K.; **Ghoshal, D.**; Basu, S.; Suresh, S.; Bartolucci, S. F.; Koratkar, N.; Kumar, R. Enhanced Field Emission from Copper Nanowires Synthesized Using Ion Track-Etch Membranes as Scaffolds. *Journal of Materials Science: Materials in Electronics* 2018, 29 (22), 19013–19027.
 10. Mohanty, D.; Lu, Z.; Sun, X.; Xiang, Y.; Wang, Y.; **Ghoshal, D.**; Shi, J.; Gao, L.; Shi, S.; Washington, M. Metalorganic Vapor Phase Epitaxy of Large Size CdTe Grains on Mica through Chemical and van Der Waals Interactions. *Physical Review Materials* 2018, 2 (11), 113402 (1-11).
 11. Bianco, A.; Chen, Y.; Chen, Y.; **Ghoshal, D.**; Hurt, R. H.; Kim, Y. A.; Koratkar, N.; Meunier, V.; Terrones, M. A Carbon Science Perspective in 2018: Current Achievements and Future Challenges. *Carbon* 2018, 132, 785-801.
 12. Chilkoor, G.; Karanam, S. P.; Star, S.; Shrestha, N.; Sani, R. K.; Upadhyayula, V. K. K.; **Ghoshal, D.**; Koratkar, N. A.; Meyyappan, M.; Gadhamshetty, V. Hexagonal Boron Nitride: The Thinnest Insulating Barrier to Microbial Corrosion. *ACS Nano* 2018, 12 (3), 2242- 2252.
 13. Yarali, M.; Wu, X.; Gupta, T.; **Ghoshal, D.**; Xie, L.; Zhu, Z.; Brahmi, H.; Bao, J.; Chen, S.; Luo, T.; Koratkar, N.; Mavrokefalos, A. Effects of Defects on the Temperature-Dependent Thermal Conductivity of Suspended Monolayer Molybdenum Disulfide Grown by Chemical Vapor Deposition. *Advanced Functional Materials* 2017, 1704357 (1–8).

INVITED TALKS

- *2D Materials for Optoelectronics and Energy Harvesting*, **Indian Institute of Technology Kanpur Chemical Engineering Departmental Seminar 2024.**
- *Tailored Growth and Manipulation of 2D Materials for Optoelectronics and Energy Harvesting*, **University of Texas San Antonio Chemical Engineering Departmental Seminar 2023.**
- *Understanding structure property relationships in 2D Transition Metal Dichalcogenides for optoelectronic applications*, Area 8E: Electronic and Photonic Materials, **AIChE 2023.**
- *Defect Engineering in Large Area MoS₂ for Optoelectronics*, **2D Transition Metal Dichalcogenides 2023.**
- *Morphology Controlled Growth of Emerging 2D Semiconductors for Optoelectronics and Energy Harvesting*, **Indian Institute of Technology Mandi Departmental Seminar 2019.**

CONTRIBUTED TALKS

- *Understanding laser soaking effects on improved quantum yields in 2D TMDCs* (Talk), **ECS Spring Meeting 2023**
- *2D materials in optoelectronics, energy harvesting and beyond* (Poster), Prospective Faculty Candidates session Area 8E: Electronic and Photonic Materials, **AIChE 2023**
- *Orientation Controlled Large Area Epitaxial PbI₂ Thin Films with Tunable Optical Properties* (Talk)

Area 8E: Electronic and Photonic Materials, **AIChE 2021**

- *Catalyst-Free and Morphology-Controlled Growth of 2D Perovskite Nanowires for Polarized Light Detection* (Talk) Area 8E: Electronic and Photonic Materials, **AICHE 2019**
- *Controlled Growth Of 2D Perovskite Nanowires for Optoelectronics* (Poster), **MRS 2019**
- *Spontaneous out of plane ReS₂ for energy harvesting applications* (Talk), Area 8E: Electronic and Photonic Materials, **AICHE 2018**

PROFESSIONAL EXPERIENCE AND SERVICES:

- Peer reviewing manuscripts for multiple journals (Carbon, Nature Communications, Small, Advanced Functional Material, ACS Applied Electronic Materials, Materials Lab, Micro and Nano Letters).
- Co-Chair for “Materials for Energy Storage II: Beyond Lithium-Ion” session of 8E Division at AIChE 2025.
- Co-Chair for “Materials for Energy Storage I: Advances in Batteries” session of 8E Division at AIChE 2025.
- Chair for “Quantum Materials” session of 8E Division at AIChE 2024.
- Co-Chair for “Materials for Energy Generation and Conversion” session of 8E Division at AIChE 2024.
- Co-Chair for “Materials for Energy Storage” session of 8E Division at AIChE 2024.
- Session Chair at the 245th ECS Meeting titled “B06 - 2D Materials (B06-2D Materials-Energy and Electrochemistry 2)”.
- Session Co-Chair at the 243rd ECS Meeting titled “B06 - 2D Materials (Electrical and Optical Properties and Devices)”.
- Co-Chair for “Quantum Materials” session of 8E Division at AIChE 2023.
- Judge for graduate student award for area 8E at AIChE 2023.