

NICOLAS MOLINA VERGARA (RESUME)

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Profile Summary

Nicolas Molina obtained his M.Sc. in Mechanical & Metallurgical Engineering from the Pontificia Universidad Católica de Chile (#1 in Latin America Rank 2023), being awarded three tribology-oriented research internships in France, Poland, and USA, showcasing his current global perspective and adaptability to fast-paced environments. He is currently a Ph.D. student in Materials Science & Engineering at the University of Texas at Austin working under the supervision of Dr. Filippo Mangolini. His doctoral research focuses on diffusion processes in thin films. In May 2023, he was awarded the prestigious Elmer E. Klaus Fellowship by the Society of Tribologists and Lubrication Engineers. Among his other highlights are:

1. Trained in the operation, data acquisition, and data processing of over 20 instruments, with the first systematic compilation and writing of SOPs for his research group, **demonstrating his abilities to document and specialize in a wide range of cutting-edge techniques for his research and efficient troubleshooting through documentation.**
2. Publication of 8 peer-reviewed journal articles (3 first author, 5 co-author) with a total of 49 citations, and 7 presentations in scientific/engineering conferences, **demonstrating strong problem-solving abilities in collaboration with interdisciplinary research teams, as well as written and oral scientific communication skills.**
3. Graduate student mentor for K-12 teachers and first-year Ph.D. students, including an advanced teaching preparation certificate, **showing his community involvement and passion for teaching, planning, and execution of projects.**

Education

The University of Texas at Austin, Austin, TX Aug 2020 – May 2025

Ph.D. in Materials Science and Engineering | GPA 4.0

- **Research thesis:** Spectroscopic and spectrometric evaluation of surface and bulk chemical processes occurring in solid thin film lubricants upon tribological testing and aging under different environmental conditions.
- **Relevant Coursework:** *Advanced Methods for Surface Analysis, Practical Electron Microscopy, Thin Film Mechanics*

Pontificia Universidad Católica de Chile, Santiago, Chile Aug 2018 – Jul 2020

Master of Science in Engineering, Mechanical Engineering | Highest distinction (A+)

- **Research thesis:** Erosion under turbulent slurry flow — An experimental determination of particle impact conditions and distribution thereof by image processing.
- **Relevant Coursework:** *Nanoscience and Nanotechnology for Engineers, Surface Engineering and Tribology*

Pontificia Universidad Católica de Chile, Santiago, Chile Mar 2014 – Jul 2018

Bachelor of Science in Engineering, Mechanical Engineering (major), Materials Science (minor) | Highest distinction (A+)

- **Relevant Coursework:** *Sustainable Energy, Environmental Degradation of Materials, Environmental Fluid Mechanics*

Highlighted Skills

Surface Analysis: ToF-SIMS, XPS, XRD, GIXRD, XRR, GISAXS, FIB, SEM, STEM, EDS, VASE (Ellipsometry), Profilometry

Cleanroom: PVD (E-beam, DC sputtering, RF sputtering) — Multilayer thin films of metals, oxides, and nitrides

Data driven analytics: Python (Matplotlib, Numpy, Scipy, CV2, Skimage), Mathematica, MATLAB (MVSA, PCA), Maple

Computer-aided design (CAD/FEM): Abaqus FEA, Autodesk Inventor Professional, Fusion 360

Languages: Spanish (*Native*)

Professional Associations

Society of Hispanic Professional Engineers (SHPE), Graduate student member Jul 2022 – Present

Society of Tribologists and Lubrication Engineers (STLE), Graduate student member Feb 2022 – Present

NICOLAS MOLINA VERGARA (CV)

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Highlighted Research Experience

Laboratory for Applied Surface Science (LASS), The University of Texas at Austin, Austin, TX Aug 2020 – Present
Graduate Research Assistant

- **Project:** Quantifying $^2\text{H}_2\text{O}$ diffusion in MoS_2 coatings using ToF-SIMS depth profiling
 - **Tasks:** In-situ dosing of $^2\text{H}_2\text{O}$ in UHV for real time acquisition of sorption process, semi-quantitative elemental depth-profile using the full spectrum SIMS method (FSM), depth-dependent diffusivity modeling
- **Project:** A mechanochemistry study of ZDDP tribofilm formation via ToF-SIMS
 - **Tasks:** Optimized ToF-SIMS settings for depth profiling of small ROI ($1.5\mu\text{m}\times 0.5\mu\text{m}$), use of combinatorics and MVSA (PCA, NMF) to elucidate the region of contribution of different molecular ion fragments
- **Project:** Study of amorphous carbon tribofilms formed on Pt-Au alloys via ToF-SIMS depth profiling
 - **Tasks:** Optimized ToF-SIMS settings for the reduction of acquisition time for a large set of ROI (24), use of combinatorics and molecular formula prediction (MFP) to analyze the organic products on the surface
- **Project:** In situ high-temperature X-ray studies of Ag thin films deposited on Si with different adhesion layers (Ti, Cr)
 - **Tasks:** Design and manufacture of custom XRD/XRR holder for high-temperature studies (up to $300\text{ }^\circ\text{C}$), cleanroom deposition, optimization of acquisition parameters, data analysis and visualization
- **Project:** Fundamental mechanism of heat and mass transport of self-lubricating TiSiN-Ag thin film coatings
 - **Tasks:** Design of experiments (DOE), statistical testing methods, programming, data analysis and visualization, commitment to meeting deadlines for our collaborators in Europe
- **Project:** Quantification of hard X-ray photoelectron spectroscopy (HAXPS) — Calculation of relative sensitivity factors
 - **Tasks:** Data processing of up-to-date databases (from 1973 to 2022) with the outcome of a calculator for RSFs
- **Weekly reading:** UnTools (*website*) — Tools for better thinking: Thinking tools and frameworks to help solve problems, make decisions and understand systems.

Institute for Sustainable Technologies (Łukasiewicz Research Network), Radom, Poland Aug 2019 – Sep 2019
International Research Intern

- Developed an image processing algorithm in Python for the automated detection of erosive wear scars using 3D coherence scanning interferometry (CSI)

Laboratory for Applied Surface Science (LASS), The University of Texas at Austin, Austin, TX Jan 2019 – Mar 2019
International Research Intern

- Identified a missing link in the scientific literature about the effects of halide impurities on the lubricating properties of a phosphonium-based ionic liquid

National Institute for Research in Digital Science and Technology (INRIA), Grenoble, France Jan 2018 – Mar 2018
International Research Intern

- Implemented and tested the Alternating Direction Method of Multipliers (ADMM) in Python within the context of accelerated numerical techniques for frictional contact problems (non-smooth dynamical systems)

Corrosion and Materials Degradation, Pontificia Universidad Católica de Chile, Santiago, Chile Mar 2017 – Sep 2018
Undergraduate Research Assistant

- Performed material degradation and failure analysis on slurry pipelines subjected to different abrasive flow conditions

Certifications

Center for Teaching and Learning, The University of Texas at Austin, Austin, TX

Dec 2021

Advanced teaching preparation certificate

- Workshops devoted to learn about, observe, practice, receive feedback on, and reflect upon classroom teaching techniques. Contents: 1) Students with disabilities: How do I provide equal access and foster inclusion through academic accommodations?, 2) Understanding your role: How do I work effectively with students and faculty?, 3) How we learn: How can I use pedagogical theory to make learning last?, 4) Embracing (dis)comfort: What are some proactive strategies for unexpected classroom moments?, 5) Drafting teaching statements: How do I articulate my beliefs about teaching?, 6) Student well-being: How do I promote students' mental health in my teaching?, 7) Teaching as research: How do I apply a scholarly lens to my teaching?

CIEN-UC, CSIC-Madrid-Spain, Pontificia Universidad Católica de Chile, Santiago, Chile

Nov 2018

Materials characterization certificate

- Solid surface characterization by electron microscopy and spectroscopy (XPS, XAS, LEEM/PEEM, CEMS/ILEEMS)

Leadership & Community Involvement

Nanosystems Engineering Research Center (NASCENT), Austin, TX

Jun 2022 – Jul 2022

Graduate student mentor for K-12 teachers

- Planning and execution of the research project: *Effect of preloading on the annealing of diffusion couples*
- Mentorship and training in the design of loading devices, sample preparation, SEM and EDS training
- Honors & awards: Most outstanding mentor award (3rd place)

Nanosystems Engineering Research Center (NASCENT), Austin, TX

Sep 2021 – Dec 2021

Graduate student mentor for first-year Ph.D. students

- Mentoring 2 first-year Ph.D. students from the Cockrell School of Engineering
- Weekly mentorship (time management, conflict management, laboratory best practices)

Nanosystems Engineering Research Center (NASCENT), Austin, TX

Jun 2021 – Jul 2021

Graduate student mentor for K-12 teachers

- Planning and execution of the project: *Testing the wettability of hydrophobic screen protectors sold on Amazon*
- Mentorship and training in product design (concept generation, concept selection), and construction of 3D printed goniometer for middle school classroom activities

ATX Bridges International, Austin, TX

Sep 2020 – Present

International student volunteer

- Connecting the diverse cultures of international and American students at UT through practical service, social connections, and spiritual exploration
- Activities: Support in weekly events (coordination, discussion moderator, games execution)

Honors & Awards

Agnes T. and Charles F. Wiebusch Fellowship, Cockrell School of Engineering (UT Austin)

Jun 2024

John B. Goodenough Travel Award, Texas Materials Institute (UT Austin)

Mar 2024

Professional Development Award, Cockrell School of Engineering (UT Austin)

Dec 2023 and Apr 2024

Elmer E. Klaus Fellowship, Society of Tribologists and Lubrication Engineers (STLE)

May 2023

Alfred and Nellie King Graduate Fellowship, Cockrell School of Engineering (UT Austin)

Jun 2022

Grants in Aid of Research (GIAR), Sigma Xi, The Scientific Research Honor Society

Jun 2022

Best Master's Thesis, School of Engineering, Pontificia Universidad Católica de Chile

Jul 2020

Fully-Funded Master's Scholarship, National Research & Development Agency, Chile

Jan 2019

Fully-Funded Bachelors' Scholarship, National Research & Development Agency, Chile

Jan 2014

Conferences

1. **2024 Gordon Research Seminar (GRS) and Conference (GRC)**, Maine, US (Jun 2024). *Oral and poster presentation. Discussion leader.* Quantifying the diffusivity of water in MoS₂ coatings: a fundamental, surface-analytical study.
2. **78th STLE Annual Meeting & Exhibition**, Minnesota, US (May 2024). *Oral presentation.* Elucidating the Chemical and Structural Characteristics of Mechanocatalytically-Formed Carbonaceous Films on Platinum-Gold Surfaces.
3. **78th STLE Annual Meeting & Exhibition**, Minnesota, US (May 2024). *Oral presentation. Session chair and co-chair.* Effect of molybdenum disulfide coating deposition conditions on water sorption/desorption via ToF-SIMS.
4. **2023 Tribology Frontiers Conference**, Ohio, US (Nov 2023). *Oral presentation.* Towards quantification of the depth-dependent diffusivity of water in molybdenum disulfide solid lubricant coatings.
5. **77th STLE Annual Meeting & Exhibition**, California, US (May 2023). *Poster presentation.* Spectroscopic evaluation of surface chemical processes occurring in MoS₂ upon aging.
6. **2022 Tribology Conference GRC**, Maine, US (Jun 2022). *Poster presentation.* Tuning the surface reactivity and tribological performance of phosphonium-based ionic liquid at steel/steel interfaces.
7. **22nd International Conference on Wear of Materials**, Florida, US (Apr 2019). *Oral presentation.* Application of FFT analysis for the study of directionality of wear scars in exposure to slurry flow of varying velocity.

Publications

1. Edwards, C., Lien, H. M., **Molina, N.**, Mangolini, F. (2024). Effect of Europium and Gadolinium Alloying Elements on the Tribological Response of Low Hydrogen Content Amorphous Carbon. *ACS Applied Materials & Interfaces*, 16(22), 29314–29323.
2. **Molina, N.**, Mangolini, F. (2024). Establishing links between storage environmental conditions, annealing parameters and water mobility in molybdenum disulfide coatings. *Tribology & Lubrication Technology*, Vol. 80, N. 7.
3. Chrostowski, R., Curry, J. F., Dugger, M. T., **Molina, N.**, Babuska, T. F., Celio, H., ... & Mangolini, F. (2023). Spectroscopic Evaluation of Surface Chemical Processes Occurring in MoS₂ upon Aging. *ACS Applied Materials & Interfaces*, 15(30), 37047-37058.
4. Espinoza-Jara, A., Walczak, M., **Molina, N.**, Jahn, W., & Brevis, W. (2022). Erosion under turbulent flow: A CFD-based simulation of near-wall turbulent impacts with experimental validation. *Engineering Applications of Computational Fluid Mechanics*, 16(1), 1526-1545.
5. Li, Z., Jennings, Z. Y., Yan, J., **Molina, N.**, Lien, H. M., Chrostowski, R., ... & Mangolini, F. (2022). Effect of tribologically-induced changes in surface termination of silicon-containing diamond-like carbon coatings on the resistance to biomolecule adsorption. *Carbon*, 199, 132-140.
6. Li, Z., Celio, H., Dolocan, A., **Molina, N.**, Kershaw, J., Morales-Collazo, O., ... & Mangolini, F. (2021). Tuning the surface reactivity and tribological performance of phosphonium-based ionic liquid at steel/steel interfaces by bromide/phosphate anion mixtures. *Applied Surface Science*, 570, 151245.
7. **Molina, N.**, Walczak, M., Kalbarczyk, M., & Celentano, D. (2021). Erosion under turbulent slurry flow: Effect of particle size in determining impact velocity and wear correlation by inverse analysis. *Wear*, 474, 203651.
8. **Molina, N.**, Walczak, M., & Michalczewski, R. (2020). Erosion under turbulent slurry flow: An experimental determination of particle impact angle, impact direction, and distribution thereof by image processing. *Wear*, 454, 203302.
9. **Molina, N.**, Aguirre, J., & Walczak, M. (2019). Application of FFT analysis for the study of directionality of wear scars in exposure to slurry flow of varying velocity. *Wear*, 426, 589-595.