# NICOLAS MOLINA VERGARA (RESUME)

Austin, TX | 512-809-6163 | namolina@utexas.edu | LinkedIn | Google Scholar

## *Highlighted Skills*

**Surface Analysis:** ToF-SIMS, XPS, (GI)XRD, 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), MATLAB (MVSA), Mathematica (PDE), Maple
**Computer-aided design** (*CAD/FEM*)**:** Abaqus FEA, Autodesk Inventor Professional, Fusion 360

## *Education*

**The University of Texas at Austin**, Austin, TX — Aug 2020 – **May 2026 (Expected)**
*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+)

## *Professional Associations*

**American Vacuum Society (AVS)**, Graduate Student Member — Aug 2024 – Present
**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

## *Profile Summary*

**Nicolas Molina** obtained his M.Sc. in Mechanical & Metallurgical Engineering from the Pontificia Universidad Católica de Chile (#1 in QS Latin America Rankings 2026), 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. Mangolini and Dr. Rodin. His doctoral research focuses on diffusion processes in thin films. In November 2024, he was awarded the prestigious National Graduate Student Award by the American Vacuum Society for his contributions to SIMS diffusion studies. 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 11 peer-reviewed journal articles with a total of 97 citations, 13 presentations in scientific/engineering conferences, and serving as a session chair in 3 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 3 K-12 teachers, 4 undergraduate, and 3 PhD students, including an advanced Engineering Education Certificate, **demonstrating community involvement and passion for teaching and project execution.**

## *Career Objective*

Seeking a challenging role as a **Postdoctoral Researcher**, leveraging my background in **surface/interfacial analytical techniques** to contribute effectively to the development of advanced manufacturing and characterization processes.

**NICOLAS MOLINA VERGARA (CV)**
Austin, TX | 512-809-6163 | namolina@utexas.edu | LinkedIn | Google Scholar

## *Highlighted Research Experience*

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

- **Project:** Standardless, Quantitative SIMS using the Full Spectrum Method (FSM)
  - *Tasks:* Implemented FSM to polymers (PP, PS, PTFE, PET) and inorganic materials ($MoS_2$, $AuPt_x$), mitigating matrix effects and improving stoichiometric estimation without reference standards, pioneering a methodology for quantitative, ML-ready chemical mapping of complex materials; ion-matter simulation (SDTrimSP).

- **Project:** Quantifying $^2H_2O$ diffusion in $MoS_2$ coatings using ToF-SIMS depth profiling
  - *Tasks:* Operate and troubleshoot ToF-SIMS data acquisition as the sole IONTOF M6 superuser on campus; implement in-situ dosing of $D_2O$ in UHV for real-time acquisition of the sorption process; diffusion modeling

- **Project:** A mechanochemistry study of ZDDP tribofilm formation via ToF-SIMS
  - *Tasks:* Optimized ToF-SIMS settings for depth profiling of a small ROI (1.5μm×0.5μm), 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 a custom XRD/XRR holder for high-temperature studies (up to 300 °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, and 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

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

- Developed a Python image processing algorithm for automated wear scar detection using 3D CSI interferometry

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

- Identified a research gap on frictional heating and halide effects in phosphonium-based ionic liquid lubrication

**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

## *Academic Experience*

**Cockrell School of Engineering, The University of Texas at Austin**, Austin, TX — Aug 2024 – May 2025

*Engineering Education Certificate*

- Demonstrated commitment to education through the successful completion of a year-long, 16-credit graduate certificate program. Gained a deep understanding of learning theories, effective teaching methodologies, curriculum development, and assessment practices. Applied theoretical knowledge in a practical setting by teaching five lectures of the *Materials Engineering* (ME334) course and two lectures of the *Teaching Engineering* (ME398T) course. Most recently, I had an invited talk by the director of the Center for Engineering Education about AI use in academic research. This training equips me with essential skills to excel in a faculty role and contribute meaningfully to engineering education.

**Center for Teaching and Learning, The University of Texas at Austin**, Austin, TX — Dec 2021

*Advanced Teaching Preparation Certificate*

- Completed a teaching-development program covering inclusive pedagogy, student–faculty engagement, evidence-based methods, classroom management, teaching philosophy, student mental-health support, and reflective practice.

**School of Engineering, Pontificia Universidad Católica de Chile**, Santiago, Chile — Mar 2020 – Jul 2020

*Teaching Assistant Coordinator of **Graduate Seminar** (ICM3821)*

- Coordinated and managed the feedback process for graduate student seminar presentations.

**School of Engineering, Pontificia Universidad Católica de Chile**, Santiago, Chile — Aug 2016 – Dec 2018

*Teaching Assistant Coordinator of **Properties and Strength of Materials** (ING1024) and **Materials Science** (ICM2403)*

- Successfully managed evaluation systems and coordinated teams of up to 15 teaching assistants. Developed comprehensive learning materials, including tutorials, homework, study guides, laboratory guides, and exam solutions.

**School of Engineering, Pontificia Universidad Católica de Chile**, Santiago, Chile — Aug 2015 – Jul 2016

*Teaching Assistant of **Properties and Strength of Materials** (ING1024)*

- Led exercise and discussion sessions.

## *Leadership & Community Involvement*

**Surface Ventures**, Leeds, England, UK — Oct 2024 – Present

*USA Ambassador*

- Surface Ventures is a non-profit organization dedicated to promoting cutting-edge research in surface science.
- As an ambassador, I contribute to event promotion, webinar moderation, and outreach to potential partners in the US.

**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 (3$^{rd}$ 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

## *Honors & Awards*

**John and Mary Booker Endowed Graduate Fellowship**, Cockrell School of Engineering (UT Austin) Jun 2025
**Dorothy M. and Earl S. Hoffman Award**, American Vacuum Society (AVS) Nov 2024
**Applied Surface Science Division, Student Award (2nd place)**, American Vacuum Society (AVS) Nov 2024
**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, Apr 2024, Dec 2024, May 2025
**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 Bachelor's Scholarship**, National Research & Development Agency, Chile Jan 2014

## *Certifications*

**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)

## *Conferences*

1. **AVS 71st International Symposium & Exhibition**, North Carolina, US (Sep 2025). *Oral presentation*. Standardless, Quantitative ToF-SIMS using the Full Spectrum Method (FSM).
2. **AVS 71st International Symposium & Exhibition**, North Carolina, US (Sep 2025). *Poster presentation*. Standardless, Quantitative ToF-SIMS depth profiling using the Full Spectrum Method (FSM).
3. **79th STLE Annual Meeting & Exhibition**, Georgia, US (May 2025). *Oral presentation*. ***Session chair***. *EV101 educational course volunteer*. Unraveling the mystery of water transport in $MoS_2$: A ToF-SIMS investigation.
4. **AVS 70th International Symposium & Exhibition**, Florida, US (Nov 2024). *Oral presentation*. Advancements in tracer diffusion modeling with ToF-SIMS depth profiling.
5. **AVS 70th International Symposium & Exhibition**, Florida, US (Nov 2024). *Oral presentation*. Effect of europium and gadolinium alloying elements on the tribological response of low hydrogen content amorphous carbon.
6. **AVS 70th International Symposium & Exhibition**, Florida, US (Nov 2024). *Poster presentation*. ToF-SIMS characterization of mechanocatalytically-formed carbonaceous films on nanocrystalline $Pt_{0.9}Au_{0.1}$ alloy: Insights into chemistry, structure, and friction behavior.
7. **2024 Tribology Gordon Research Seminar (GRS) and Conference (GRC)**, Maine, US (Jun 2024). *Oral and poster presentation*. ***Discussion leader***. Quantifying the diffusivity of water in $MoS_2$ coatings: A surface-analytical study.
8. **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.
9. **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.
10. **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.
11. **77th STLE Annual Meeting & Exhibition**, California, US (May 2023). *Poster presentation*. Spectroscopic evaluation of surface chemical processes occurring in MoS2 upon aging.
12. **2022 Tribology Gordon Research Conference (GRC)**, Maine, US (Jun 2022). *Poster presentation*. Tuning the surface reactivity and tribological performance of phosphonium-based ionic liquid at steel/steel interfaces.
13. **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.

## *Submitted Publications*

1. **Molina, N.**, Dolocan, A., Babuska, T. F., Curry, J. F., Kallivokas L. F., Rodin, G. J., Mangolini, F. (2025). Water diffusion in $MoS_2$ under UHV conditions: A time-resolved ToF-SIMS depth profiling study. *Under preparation*.
2. **Molina, N.**, Rodin, G. J., Mangolini, F. (2025). On the selection of closed-form solutions for interpreting experimental data for mass transport through thin films. *Submitted to Physical Review Materials*.
3. **Molina, N.**, Dolocan, A., Curry, J. F., Rodin, G. J., Mangolini, F. (2025). A critical evaluation of concentration proxies in SIMS diffusion studies. *Submitted to Journal of Physics: Energy*.
4. Lien, H. M., **Molina, N.**, Chandross, M., Mangolini, F. (2025). Thermally-induced structural evolution in multi-component BMGs: A histogram-based EXAFS analysis. *Submitted to Materials Science & Engineering A*.
5. Robinson, D. A., Crutcher, K., Leveille, M., Babuska, T. F., **Molina, N.**, Reed, C. L., Sugar, J. D., Vitale, S. M, Banerjee, D., Mangolini, F., Dugger, M. T., Curry, J. F. (2025). Effect of thermal treatments on the bulk/interfacial structure and tribological properties of electrodeposited molybdenum sulfide coatings on stainless steel. *Under preparation*.

## *Peer-Reviewed Publications*

1. **Molina, N.**, Curry, J. F., Mangolini, F. (2025). Standardless, Quantitative SIMS using the Full Spectrum Method (FSM): Part I. Polymers. *Analytical Chemistry*.
2. Edwards, C., Babuska, T. F., **Molina, N.**, Bobbitt, N. S., Chandross, M., Curry, J. F., Mangolini, F. (2025). Mechanocatalytic formation of lubricious films on Pt-Au from ethanol and isopropanol vapor. *Carbon*, 120990.
3. Lien, H. M., **Molina, N.**, Lizaola, A., Chandross, M., & Mangolini, F. (2025). Effect of annealing on the tribological behavior of Zr-based bulk metallic glass. *APL Materials, 13*(1).
4. 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.
5. 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 $MoS_2$ upon Aging. *ACS Applied Materials & Interfaces*, 15(30), 37047-37058.
6. 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.
7. 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.
8. 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.
9. **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.
10. **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.
11. **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.

## *Other Publications*

1. **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.
2. Acary, V., Kanno, Y., & **Molina, N.** (2019). Alternating Direction Method of Multipliers (ADMM) for frictional contact. *HAL Open Science*, 05222639.

## *Professional References*

1. **Dr. Filippo Mangolini**
    - Associate Professor
    - Texas Materials Institute, Walker Department of Mechanical Engineering, The University of Texas at Austin
    - Contact: filippo.mangolini@austin.utexas.edu, 512-471-3244
    - *Relationship*: Doctoral supervisor
2. **Dr. Maura Borrego**
    - Professor and Director, Center for Engineering Education
    - Mechanical Engineering and Curriculum & Instruction, The University of Texas at Austin
    - Contact: maura.borrego@austin.utexas.edu, 512-471-3083
    - *Relationship*: Professor in the Engineering Education Certificate
3. **Dr. John F. Curry**
    - Senior Member of Technical Staff
    - Material, Physical, and Chemical Sciences Center, Sandia National Laboratories
    - Contact: jcurry@sandia.gov, 505-318-8885
    - *Relationship*: Doctoral external collaboration