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Erik Cheng

Computational materials scientist

Research interests: nonequilibrium interfacial chemistry, atomic layer etching, scientific machine learning

Education

2018–Present **PhD in Materials Science and Engineering**, *University of Texas at Austin.*
PhD candidate. Expected graduation in 2023.
- **Dissertation:** Data-driven Prediction of Nonequilibrium Chemistry in Atomic Layer Etching of Silicon-Based Dielectrics
- **Supervisor:** Gyeong S. Hwang
- **Committee** Dr. Graeme Henkelman, Dr. Laxminarayan L. Raja, Dr. John G. Ekerdt, Dr. Gyeong Hwang (chair)

2019–Present **M.S. in Statistics**, *University of Texas at Austin.*
Expected completion in Fall 2021

2014–2018 **B.S. in Chemistry**, *University of California, Berkeley.*

Research Experience

2018–Present **Graduate Research Assistant**, *University of Texas at Austin*, Austin, advised by Dr. Gyeong S. Hwang.
- Developing mechanistic models of plasma enhanced atomic layer etching mechanisms of silicon nitride with fluorocarbon precursors.
- Utilizing ab initio techniques for study of solid state materials and solid-gas interfacial chemistry.
- Developing methods applying high throughput computing and machine learning for data driven investigation of non-equilibrium surface chemistry/plasma processes.
- Developing framework for prediction of long-term structures under varied process conditions via a generative deep learning approach.

6/2020 – 8/2020 **Research Intern**, *Tokyo Electron America*, Austin, TX, with Dr. Peter Ventzek.
- Studied plasma based atomic layer etching of silicon nitride with fluorocarbon precursors.
- Applied machine learning techniques to characterize and analyze key features in simulation data.
- Developed models of carbon-based photoresist materials.

6/2017–8/2017 **Nanomaterials Intern**, *Nano Precision Medical*, Emeryville, CA, with Drs. Tomoyuki Yoshie, Lyle Gordon, and Hoda Amani Hamedani.
- Improved permeance model of porous films for use in analysis of permporometry data by accounting for pore constriction from adsorb layer formation. Incorporated model into Python script for automated parametric fitting.
- Introduced improvements to, and validated, theoretical model of current generation in titanium anodization.
- Designed and conducted experiments to determine effect of two step anodization on resulting titania characteristics. Characterized films with Wyko profilometry and various imaging tools, including skimage and ImageJ.

6/2016–8/2016 **R&D Student Intern**, *Sandia National Labs*, Albuquerque, NM, with Dr. Carlos Perez and Christian Arrington.

- Studied effects of anodization conditions on results of aluminum anodization. Maintained anodizing solutions and equipment and quantified experimental results using weight, digital optical microscopy, and profilometry.
- Studied effects of parameters in electroplating and patterning pipeline on quality of patterned electroplated gold.
- Created electrodeposited patterns of gold on nickel substrates, studying the effect of varying factors in template creation, strikes, and electrodeposition bath.

5/2015–5/2017 **Undergraduate Research Assistant**, *University of California, Berkeley*, Berkeley, CA, advised by Prof. Rich Saykally.

- Studied the evaporation behavior of aqueous solutions of acids and bases using Raman thermometry techniques.
- Maintained and operated experimental apparatus, including laser/optics, liquid pumps, and vacuum chamber.
- Determined quality of data by observation of Raman spectrum features and analysis of data through processing in MATLAB and Igor, assessing results using theoretical cooling models.

6/2013–8/2013 **Electronics Assistant**, *University of Northern Iowa*, Cedar Falls, IA, advised by Prof. Tim Kidd.

- Studied materials composition of MoS_2 nanoparticles using SEM and EDX techniques.
- Constructed and debugged electronics kits and go-karts for university science summer camp.
- Prepared presentation materials of research results.

Teaching and Mentoring Experience

8/2020–5/2021 **Graduate Mentor**, *University of Texas at Austin*, Austin, TX.

- Mentor for an undergraduate student through the Texas Research Experience (TREX) program.
- Responsible for introducing student to literature review and basic research skills in computational chemistry.

8/2017 – 5/2018 **Undergraduate Student Instructor, CS/STAT/INFO C8**, *University of California at Berkeley*, Berkeley, CA, with Prof. Ani Adhikari.

- Delivered weekly lectures on Python programming and inferential statistics to sections of about 30 students.
- Supervised programming and statistics lab exercises, addressed student questions and managed technical issues.
- Created instructional documents, practice and exam problems, and assisted in general course responsibilities.
- Evaluations available upon request.

1/2017–5/2017 **Course Tutor, CS/STAT/INFO C8**, *University of California at Berkeley*, Berkeley, CA, with Profs. David Wagner and John Denero.

- Led weekly tutoring sections of 5 students, reviewing and reinforcing concepts of Python programming and inferential statistics.
- Held office hours, graded homework, and assisted in preparation of course materials and software.
- Evaluations available upon request.

1/2015 – 5/2018 **Instructor and Course Facilitator, MATH 98/198**, *University of California at Berkeley*, Berkeley, CA.

- Instructed small groups of students in both basic and advanced methods for solving the Rubik's cube.
- Organized course logistics.

Journal Publications

1. **Cheng**, **E. S.** & Hwang, G. S. A Scheme for ML-based Prediction of Adsorption Isotherms on Amorphous Surfaces and its Application to Physisorption of MeF on SiN (In preparation).
2. **Cheng**, **E. S.**, Yang, T.-H. & Hwang, G. S. On the Chemical Nature of Amorphous Silicon Nitride Surfaces and Reactivity Towards HFC Precursors Under ALE conditions (In preparation).
3. **Cheng**, **E. S.**, Yang, T.-H. & Hwang, G. S. Tight-binding Molecular Dynamics Investigations of Ar^+ bombardment of SiN (In preparation).
4. Yang, T.-H., **Cheng**, **E. S.** & Hwang, G. S. HCl Adsorption Dynamics on Nitrogen Rich, Hydrogen-Terminated β Silicon Nitride (0001) Surfaces and Their Effects on DCS Adsorption and Decomposition (In preparation).
5. **Cheng**, **E. S.** & Hwang, G. S. Dissociative chemisorption of methyl fluoride and its implications for atomic layer etching of silicon nitride. *Applied Surface Science* **543,** 148557. ISSN: 0169-4332. `https://doi.org/10.1016/j.apsusc.2020.148557` (2021).
6. Rizzuto, A. M., **Cheng**, **E. S.**, Lam, R. K. & Saykally, R. J. Surprising Effects of Hydrochloric Acid on the Water Evaporation Coefficient Observed by Raman Thermometry. *Journal of Physical Chemistry C* **121,** 4420–4425. ISSN: 19327455. `https://doi.org/10.1021/acs.jpcc.6b12851` (2017).

Talks

1. **Cheng, E.S.** Fundamental Understanding of Silicon Nitride ALE from Atomistic Simulations *TTCA and L&L Technical Seminar, Tokyo Electron (Invited Talk)* (September 2021)
2. **Cheng, E.S.** Hwang, G. S. Ventzek, P. Chen, Z. Structural and Compositional Evolution of SiN Surfaces Under Low Energy Ar^+ Bombardment. *Selected for Live Contributed Talk in ALD/ALE 2021 (Virtual)* (June 2021)
3. **Cheng, E.S.** Hwang, G. S. Ventzek, P. Ranjan, A. The Role of CH_3F Exposure in ALE of Silicon Nitride: First-Principles Based Evaluation. *Talk accepted to AVS 67* (Withdrawn for 2021 meeting)

Posters

1. **Cheng, E.S.** Hwang, G. S. Ventzek, P. Chen, Z. First-Principles Based Investigation of Low Energy Ion Bombardment on CH_3F-Covered Silicon Nitride Surfaces. *Poster accepted to AVS 67 (Withdrawn for 2021 meeting)* (June 2021)
2. **Cheng, E.S.** Hwang, G. S. Ventzek, P. Chen, Z. On the Reactivity of SiN Surfaces Damaged by Ion Bombardment Towards CH_3F and CF_4 Precursors. *On-Demand Poster to ALD/ALE 2021 (Virtual)* (June 2021)
3. **Cheng, E.S.**, Hwang, G. S. Adsorbate-induced Enhancement of Atomic Layer Etching of Silicon Nitride with Methyl Fluoride. *Poster presented at Graduate and Industry Networking Conference at University of Texas at Austin.* Austin, TX, February 2019
4. **Cheng, E.S.**, Chen, M., Nolan, D. Understanding Bias in Sampling Users with Twitter's Streaming API. *Poster presented at UC Berkeley College of Chemistry Undergraduate Research Fair.* Berkeley, CA May 2017
5. **Cheng, E. S.**, Perez, C. Anodization as a Low Cost, Scalable, and Tunable Nanoscale Manufacturing Technique. *Poster presented at Rio Grande Symposium for Advanced Materials.* Albuquerque, NM, October 2016
6. **Cheng, E. S.**, Kidd, T. Chemical Analysis of MoS_2 Nanoparticles Formed by Ultrasonic Exfoliation. *Poster presented at University of Northern Iowa Undergraduate Research Symposium.* Cedar Falls, IA, August 2013

Awards and Honors

7/2021 **Professional Development Award**, *Univesrity of Texas at Austin.*
Funding awarded to provide support for students to attend major professional meetings at which they present an original paper based on their research at UT.

5/2020 – 5/2024 **Engineering Doctoral Fellowship**, *Univesrity of Texas at Austin.*
4-year fellowship for outstanding graduate students, based on advisor nomination.

11/2019 **Third Place Winner**, *HackTX 2019.*
Developed a random walk model and website to predict wildfire spread, trained on Tweet data filtered by relevancy to wildfire events. Part of team of 5.

9/2019 – 5/2020 **Engineering Foundation Endowed Graduate University Fellowship**, *University of Texas at Austin.*
Awarded to outstanding continuing graduate students in the Cockrell School of Engineering based off of advisor nomination.

4/2019 **Phi Kappa Phi inductee**, *University of Texas at Austin.*
Invited for being in top 10% of undergraduate seniors and graduate students.

2/2019 **Second Place, Texas Materials Institute Materials Science and Engineering Program 2019 Research Poster Contest**, *University of Texas at Austin.*
Awarded for the poster "Adsorbate-induced Enhancement of Atomic Layer Etching of Silicon Nitride with Methyl Fluoride"

9/2018- 5/2019 **Temple Foundation Graduate Fellowship**, *University of Texas at Austin.*
Awarded for outstanding academic performance among incoming first year graduate students.

12/2017 **Dean's List**, *University of California at Berkeley.*
Term GPA in top 10 percent of undergraduate students in College of Chemistry.

Professional Service

9/2017 – 5/2018 **Module Developer**, *CUNEIF 102A*, Berkeley, CA.
- Developed Jupyter-based course module for teaching computational linguistics.
- Implemented demonstrations of key concepts in computational linguistics/NLP using Python and scipy stack.
- Coordinated with Prof. Niek Veldhuis to incorporate key insights elucidated from Ancient Sumerian corpus.

2/2017– 6/2017 **Data Science Consultant**, *Thousand Currents (formerly IDEX)*, Berkeley, CA.
- Team member in the Data Science for Social Good group through Berkeley Institute of Data Science to work with Thousand Currents.
- Cleaned Salesforce data and providing business insights through analysis of donor data.
- Created an R Shiny app for clients to more intuitively access and read data acquired from Salesforce Nonprofit Cloud.

Coursework

Materials Science, Chemistry

UT Austin (Graduate) Simulation of Materials, Molecular Modeling Methods and Applications, Statistical Mechanics, Nanomaterials Chemistry and Engineering, Solid State Properties of Materials, Phase Transformations

UC Berkeley (Graduate) Quantum Mechanics

UC Berkeley (Undergrad) Quantum Mechanics, Statistical Mechanics, Advanced Inorganic Chemistry I/II, Advanced Organic Chemistry I/II, Computational Chemistry, Physical Chemistry Lab

Statistics, Data Science, CS, Math

UT Austin (Graduate)	Foundations of Predictive Machine Learning, Mathematical Statistics I/II, Bayesian Statistical Methods, Design and Analysis of Experiments, Regression Analysis, Introduction to Scientific Programming
UC Berkeley (Undergrad)	Principles and Techniques of Data Science, Mathematical Statistics, Probability for Data Science, Linear Models, Advanced Linear Algebra, Concepts in Computing with Data, Data Structures, Structure and Interpretation of Computer Programs

Skills

- **Languages (proficient):** Python
- **Languages (familiar):** Bash, R
- **Languages (basic):** C++, MATLAB, Java, SQL, awk
- **Platforms** Windows, Linux, HPC
- **Key Python packages:** `scipy` stack (`numpy`, `scipy`, `pandas`, `matplotlib`), `sklearn`, `PyTorch`, `Atomic Simulation Package` (ASE)
- **Computational chemistry packages (Proficient):** `VASP`, `DFTB+`
- **Computational chemistry packages (Familiar):** `Gaussian`, `GAMESS`, `LAMMPS`
- **Statistics:** Hypothesis Testing, Parameter Estimation, Nonparametric Methods, Experiment Design, Linear Models
- **Miscellaneous tools:** Microsoft Office, git, LaTeX, Chemdraw, GIMP, VMD

Memberships

Member	American Vacuum Society

Languages

English	Native
Mandarin	Professional proficiency for spoken; elementary reading/writing
German	Elementary

Interests

Speedcubing	`https://www.worldcubeassociation.org/persons/2012CHEN23`
Tetris	`https://jstris.jezevec10.com/u/chenge/ranking`
Rock climbing	`https://www.mountainproject.com/user/200101190/erik-cheng`
Chess	`https://www.chess.com/member/chengeaa` `https://lichess.org/@/chenge`

References

Available upon request.

Work status

U.S. Citizen