

Prof. Taleana Huff

Department of Chemistry (cross-appointed to Physics) • Office # 411

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RESEARCH FOCUS

- ❖ Atomically Precise Manufacturing
- ❖ Molecular Interfaces for Advanced Semiconductor Manufacturing
- ❖ Quantum Materials and Atomic-Scale Devices
- ❖ Surface Chemistry and Charge Dynamics
- ❖ Advanced Scanning Probe Microscopy and Nanospectroscopy

PROFESSIONAL APPOINTMENTS

2025-Present **Assistant Professor**

Queen's University – Kingston, ON

- Leading an independent research program in atomically precise surface science, molecular nanotechnology, and quantum materials, with a focus on understanding and controlling molecule–surface interactions, surface reactivity, molecular self-assembly, and charge dynamics.
- Advancing experimental methodologies in scanning tunneling microscopy (STM), qPlus atomic force microscopy (AFM), and ångström-resolution tip-enhanced Raman spectroscopy (TERS) to enable structural, electronic, and chemical characterization of individual molecules and surfaces.
- Developing atomically precise coatings, molecular interfaces, and quantum devices through atom-by-atom fabrication on technologically relevant metal and semiconductor surfaces.
- Supervising postdoctoral fellows, graduate students, and undergraduate researchers, providing mentorship and training in ultra-high vacuum (UHV) techniques, cryogenic instrumentation, advanced microscopy, and scientific communication.
- Establishing interdisciplinary collaborations spanning chemistry, physics, engineering, and industry while securing competitive research funding to develop experimental infrastructure and long-term research programs.
- Teaching undergraduate and graduate courses in chemistry and physics while contributing to departmental, university, and professional service.

- 2021-2025 **Senior Research Scientist & Technical Team Lead**
CBN Nanotechnologies Ltd. – Ottawa, ON
- Led multidisciplinary teams of physicists, chemists, theorists, and engineers to advance atomically precise manufacturing through mechanosynthesis and characterization of molecular structures on silicon.
 - Directed experimental programs using ultra-high vacuum scanning probe microscopy (STM, qPlus AFM) and X-ray photoelectron spectroscopy (XPS) to investigate molecule–surface interactions, validate molecular designs, and support iterative development with density functional theory (DFT) collaborators.
 - Developed novel instrumentation and experimental methodologies for atom-by-atom fabrication and characterization of three-dimensional molecular architectures on semiconductor surfaces.
 - Disseminated research through peer-reviewed publications, conference presentations, communication with industrial stakeholders, and mentorship of junior scientists.
- 2020-2021 **Research Associate**
Nanotechnology Research Centre - National Research Council Canada – Edmonton, AB
- Conducted research in atomically precise nanotechnology using ultra-high vacuum (UHV) scanning probe microscopy, including scanning tunneling microscopy (STM), non-contact atomic force microscopy (AFM), and atomic-scale lithography to fabricate and characterize atomic electronic devices.
 - Developed experimental approaches for integrating soft nanostructures and biological materials with cryogenic UHV systems, expanding the application of scanning probe microscopy to hybrid nanoscale systems.
 - Designed ultra-high vacuum "nano-packaging" methodologies to encapsulate and protect atomically fabricated electronic structures while collaborating with engineering and machine shop staff to develop specialized vacuum-compatible hardware.
 - Collaborated with government, academic, and industrial partners while disseminating research through publications, technical reports, and multidisciplinary collaborations.
- 2017-2020 **Nanoelectronics Development Scientist**
Quantum Silicon Incorporated – Edmonton, AB
- Contributed to the development of atomically precise electronic devices by designing, fabricating, and characterizing atomic-scale circuits while working

with multidisciplinary teams of physicists, theorists, engineers, and industrial partners.

- Advanced atom-scale manufacturing through the development of novel sensors, software tools, and experimental methodologies for atomic fabrication, error correction, and surface characterization.
- Designed ultra-high vacuum (UHV) instrumentation, including scanning tunneling microscopy (STM) and non-contact atomic force microscopy (AFM), to support technology development and experimental validation.
- Collaborated with theory teams to iteratively validate atomic circuit designs through close integration of modeling and experiment.
- Contributed to technology commercialization through intellectual property development, patent preparation, technical documentation, and support for business development, funding proposals, and investment activities.

2011-2012

Console Operator

NASA/University of North Dakota – Grand Forks, ND

- Operated the International Space Station Agricultural Camera (ISSAC) in support of infrared remote sensing of agricultural systems.
- Planned daily imaging operations by coordinating satellite tracking, orbital constraints, and mission objectives with NASA personnel.
- Developed Python software to calculate optical correction factors and automate identification of optimal imaging opportunities using satellite trajectories and weather forecast data.
- Supported mission operations through scientific data analysis, software development, and operational planning for Earth observation experiments.

EDUCATION

2015-2020

Doctor of Philosophy (Ph.D.) in Physics (Condensed Matter)

University of Alberta, Edmonton, AB

Thesis: *Atomic Electronics With Silicon Dangling Bonds: Error Correction, Logical Gates, and Electrostatic Environment*

- Developed atomically precise electronic devices using scanning tunneling microscopy (STM) and atomic force microscopy (AFM), including atomic wires, logic gates, and quantum-dot architectures on hydrogen-terminated silicon.
- Pioneered mechanosynthetic error-correction techniques and atom-scale electrostatic characterization methods that formed the scientific foundation for Quantum Silicon Inc.

2013-2015

Master of Science (M.Sc.) in Physics (Condensed Matter)

University of Alberta, Edmonton, AB

Thesis: *Atomic Force Microscopy Characterization of Hydrogen Terminated Silicon (100) 2x1 Reconstruction*

- Established qPlus atomic force microscopy within the research group and investigated chemical-bond contrast on hydrogen-terminated silicon through combined experiment and density functional theory.

2008-2012 **Bachelor of Science (B.Sc.) in Physics (Magna Cum Laude)**
University of North Dakota, Grand Forks, ND

Thesis: *Correlating Gamma-Ray Bursts to Galaxy Clusters*

- Conducted statistical analysis of astronomical datasets to investigate correlations between galaxy clusters and gamma-ray bursts.

HONOURS & AWARDS

- **Douglas R. Colton Medal for Research Excellence**, CMC Microsystems (2021)
Awarded for outstanding contributions to microsystems and nanotechnology by a recent Canadian M.Sc. or Ph.D. graduate. Nominated by the University of Alberta.
- **Faculty of Science Dissertation Award**, University of Alberta (2020)
Recognizes an exceptional doctoral dissertation that exemplifies scholarly excellence and makes significant national and international contributions to knowledge.
- **Top Five Best Images**, Images of Research Competition, University of Alberta (2019)
Probability
- **Best Student Poster**, International Conference on Non-Contact Atomic Force Microscopy (2018)
A Study of the Electrostatic Environment: Determining Charge Defect Depth in Silicon Using a Moving Dangling Bond Point-Probe
- **Second Place Poster**, University of Alberta Research Symposium (2018)
A Study of the Electrostatic Environment: Determining Charge Defect Depth in Silicon Using a Moving Dangling Bond Point-Probe
- **Research Award**, National Institute for Nanotechnology (2017)
Indications of Chemical Bond Contrast in AFM Images of a Hydrogen-Terminated Silicon Surface
- **Best Poster**, University of Alberta Research Symposium (2016)
NC-AFM Study of Single Silicon Dangling Bonds on H-Si(100)

- **3 Minute Thesis Semi-Finalist**, University of Alberta (2016)
Low-Power and Ultra-Fast
- **Best Talk**, University of Alberta Research Symposium (2015)
Atomic-Scale NC-AFM of H:Si(100): Force Extraction and Characterization

PUBLICATIONS

* indicates corresponding author. **Bold** indicates curriculum vitae owner.

Submitted Manuscripts

(18.) Blue, B.*, Morin, M.*, Inayeh, A., Cranston, R., Mackie, C.J., Savoie, M., Bottomley, A., Imperiale, C.J., Ahmed, Z., Addou, R., Asani, A., Barrera-Ramirez, E., Barton, J., Cheng, D., Cowie, M., Deimert, C., Enright, T., Fan, J.Z., Freitas Jr., R.A., Godfrey, A.T.K., Groome, R., Guo, S.Y., Clarcia, K.A., Hill, A., **Huff, T.**, Jobes, M., Kirby, R.J., Lilak, S., Ma, H., Maahs, A.C., MacLean, O., Maley, S.M., Marshall, M., McCallum, T., Merkle, R., Moses, M., Myall, J., Plumadore, R., Powell, A., Rodriguez, H., Rohe, S., Sandoval, L., Sayed-Akhmad, K., Scheffel, B., Tanveer, K., Thanabalasingam, B., Therien, D.A.B., Wong, J.L., Wotton, R., Yu, C., Allis, D.G., Drew, M., Kennedy, M.R., Takatani, T., Taucer, M., Vobornik, D., Yamachika, R., Durand, M. (2026). *Towards Atom-by-Atom Fabrication: Mechanosynthetic Donation and Abstraction*. Submitted to **Science**. Preprint: <https://arxiv.org/abs/2606.13876>

(17.) Cowie, M.*, Deimert, C., Groome, R., Inayeh, A., Kirby, R.J., Mackie, C.J., Myall, J., Rohe, S., Sandoval, L., Sayed-Akhmad, K., Thanabalasingam, B., Wotton, R., Addou, R., Asani, A., Blue, B., Bottomley, A., Clarcia, K.A., Enright, T., Fan, J.Z., Freitas Jr., R.A., Godfrey, A.T.K., Guo, S.Y., Hill, A., **Huff, T.**, Jobes, M., Ma, H., Maahs, A.C., MacLean, O., Maley, S.M., Marshall, M., McCallum, T., Merkle, R.C., Morin, M., Plumadore, R., Rodriguez, H., Savoie, M., Scheffel, B., Wong, J.L., Allis, D.G., Barton, J., Drew, M., Kennedy, M.R., Takatani, T., Taucer, M., Vobornik, D., Yamachika, R., Durand, M. (2026). *Atomically Precise Mechanosynthesis of Carbon Structures on Hydrogenated Si(100) by Inverted-Mode STM*. Submitted to **Science**. Preprint: <https://arxiv.org/abs/2605.27250>

(16.) Kirby, R.J.*, Culum, N.M., Rodriguez, H., McCallum, T., Scheffel, B., Lilak, S., Shields, S., Godfrey, A.T.K., Rohe, S., Plumadore, R., Addou, R., Hill, A.J., Drew, M., **Huff, T.**, Enright, T.*, Morin, M.* (2026). *Probing sp and sp^3 Carbon Radicals in UHV by Iodine Capture*. Submitted to **Journal of the American Chemical Society**. Preprint DOI: <https://doi.org/10.26434/chemrxiv-2021-s99bm-v2>

(15.) Barrera, E., Thanabalasingam, B., Addou, R., Allis, D.G., Asani, A., Barton, J., Bernots, T., Blue, B., Bottomley, A., Cheng, D., Choi, B., Cowie, M., Deimert, C., Drew, M., Durand, M., Enright, T., Freitas Jr., R.A., Godfrey, A.T.K., Groome, R., Guo, S.Y., Haird, S., Hill, A., **Huff, T.**, Imperiale, C., Inayeh, A., Jeyachandra, J., Jobes, M., Kennedy, M.R., Kirby, R.J., Krykunov, M., Lilak, S., Ma, H., Maahs, A., Mackie, C.J., MacLean, O., Marshall, M., McCallum, T., Merkle, R.C., Morin, M., Myall, J., Ofitserov, A., Ou, S., Plumadore, R., Powell, A., Prokopenko, M., Rodriguez, H., Rohe, S., Sandoval, L., Savoie, M., Sayed-Akhmad, K., Scheffel, B., Takatani, T., Therien, D.A., Van Barr, F., Vobornik, D., Wong, J., Wotton, R., Yamachika, R., Yu, C., Taucer, M. (2026). *Inverted-Mode Scanning Tunneling Microscopy for*

Atomically Precise Fabrication. Submitted to **Nature Communications**. Preprint:

<https://arxiv.org/abs/2512.24431>

(14.) **Huff, T.***, Blue, B., McCallum, T., Morin, M., Allis, D.G., Addou, R., Barton, J., Bottomley, A., Cheng, D., Culum, N.M., Drew, M., Enright, T., Godfrey, A.T.K., Groome, R., Hill, A.J., Inayeh, A., Kennedy, M.R., Kirby, R.J., Krykunov, M., Lilak, S., Ma, H., Mackie, C.J., MacLean, O., Myall, J., Plumadore, R., Powell, A., Rodriguez, R., Sandoval, L., Savoie, M., Scheffel, B., Taucer, M., Therien, D.A.B., Vobornik, D. (2025).

Molecular Tools for Non-Planar Surface Chemistry. Submitted to **Small**. Preprint:

<https://arxiv.org/abs/2508.16798>

Refereed Journal Articles

(13.) Pitters, J., Croshaw, J., Achal, R., Livadaru, L., Ng, S., Lupoiu, R., Chutora, T., **Huff, T.**, Walus, K., Wolkow, R.A.* (2024). [Atomically Precise Manufacturing of Silicon Electronics](#). **ACS Nano**, **18**(9), 6766–6816.

(12.) Croshaw, J.*, **Huff, T.**, Rashidi, M., Wood, J., Lloyd, E., Pitters, J.L., Wolkow, R.A.* (2021). [Ionic Charge Distributions in Silicon Atomic Surface Wires](#). **Nanoscale**, **13**, 3237–3245.

(11.) Croshaw, J., Dienel, T., **Huff, T.**, Wolkow, R.A.* (2020). [Atomic Defect Classification of the H-Si\(100\) Surface Through Multi-Mode Scanning Probe Microscopy](#). **Beilstein Journal of Nanotechnology**, **11**, 1346–1360.

(10.) Ng, S.S.H.*, Retallick, J., Chiu, H.N., Lupoiu, R., Livadaru, L., **Huff, T.**, Rashidi, M., Vine, W., Dienel, T., Wolkow, R.A., Walus, K. (2020). [SiQAD: A Design and Simulation Tool for Atomic Silicon Quantum Dot Circuits](#). **IEEE Transactions on Nanotechnology**, **19**, 137–146.

(9.) Achal, R.*, Rashidi, M., Croshaw, J., **Huff, T.**, Wolkow, R.A. (2020). [Detecting and Directing Single Molecule Binding Events on H-Si\(100\) with Application to Ultra-dense Data Storage](#). **ACS Nano**, **14**(3), 2947–2955.

(8.) **Huff, T.***, Dienel, T., Rashidi, M., Achal, R., Livadaru, L., Croshaw, J., Wolkow, R.A.* (2019). [Electrostatic Landscape of a Hydrogen-Terminated Silicon Surface Probed by a Moveable Quantum Dot](#). **ACS Nano**, **13**(9), 10566–10575.

(7.) Rashidi, M.*, Vine, W., Dienel, T., Livadaru, L., Retallick, J., **Huff, T.**, Walus, K., Wolkow, R.A. (2018). [Initiating and Monitoring the Evolution of Single Electrons Within Atom-Defined Structures](#). **Physical Review Letters**, **121**(16), 166801.

(6.) Achal, R.*, Rashidi, M., Croshaw, J., Churchill, D., Taucer, M., **Huff, T.**, Cloutier, M., Pitters, J.L., Wolkow, R.A. (2018). [Lithography for Robust and Editable Atomic-Scale Silicon Devices and Memories](#). **Nature Communications**, **9**, 2778.

(5.) **Huff, T.***, Labidi, H., Rashidi, M., Livadaru, L., Dienel, T., Achal, R., Vine, W., Pitters, J., Wolkow, R.A.* (2018). [Binary Atomic Silicon Logic](#). **Nature Electronics**, **1**(12), 636–643.

(4.) Rashidi, M.*, Lloyd, E., **Huff, T.**, Achal, R., Taucer, M., Croshaw, J., Wolkow, R.A. (2017). [Resolving and Tuning Carrier Capture Rates at a Single Silicon Atom Gap State](#). **ACS Nano**, **11**(11), 11732–11738.

- (3.) Huff, T.*, Labidi, H., Rashidi, M., Koleini, M., Achal, R., Salomons, M.H., Wolkow, R.A.* (2017). [*Atomic White-Out: Enabling Atomic Circuitry through Mechanically Induced Bonding of Single Hydrogen Atoms to a Silicon Surface*](#). **ACS Nano**, **11**(9), 8636–8642.
- (2.) Labidi, H.*, Koleini, M.*, Huff, T., Salomons, M., Cloutier, M., Pitters, J.L., Wolkow, R.A. (2017). [*Indications of Chemical Bond Contrast in AFM Images of a Hydrogen-Terminated Silicon Surface*](#). **Nature Communications**, **8**, 14222.
- (1.) Labidi, H.*, Kupstas, M., Huff, T., Salomons, M., Vick, D., Taucer, M., Pitters, J., Wolkow, R.A. (2015). [*New Fabrication Technique for a Highly Sensitive qPlus Sensor with Well-Defined Spring Constant*](#). **Ultramicroscopy**, **158**, 33–37.

PATENTS

- *Initiating and Monitoring the Evolution of Single Electrons within Atom-Defined Structures*. **U.S. Patent No. 11,047,877**, issued June 29, 2021. Co-inventor (with Robert A. Wolkow, Mohammad Rashidi, Wyatt Vine, Thomas Dienel, Lucian Livadaru, Jacob Retallick, Konrad Walus, and Taleana Huff). Assignee: **Quantum Silicon Inc.**
- *Multiple Silicon Atom Quantum Dot Devices Inclusive Thereof*. **U.S. Patent No. 10,937,959 B2**, issued March 2, 2021. Co-inventor (with Robert A. Wolkow, Roshan Achal, Hatem Labidi, Lucian Livadaru, Paul Piva, Mohammad Rashidi, and Taleana Huff). Assignee: **Quantum Silicon Inc.**

RESEARCH FUNDING

Years	Program	Role	Amount
2025-2030	Bruce Mitchell Award	Principal Investigator	\$1,730,000
2026-2031	Natural Sciences and Engineering Research Council of Canada (NSERC) – Discovery	Principal Investigator	\$187,500
2025-2026	New Frontiers in Research Fund (NFRF) – Transformation	Co-Principal Investigator	\$87,500
Total Research Support			\$2,005,000

TEACHING EXPERIENCE

Years	Role	Course	Institution
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2026	Instructor	CHEM 421 – Advanced Topics in Physical Chemistry	Queen's University
2013	Teaching Assistant	ENPH 101 – Introductory Engineering Physics Laboratory	University of Alberta
2010	Teaching Assistant	Introductory Aerospace Physics Laboratory	University of North Dakota
2010	Tutor	Undergraduate Calculus and General Chemistry	University of North Dakota

HIGHLY QUALIFIED PERSONNEL (HQP) TRAINING

HQP	Position	Year(s)	Status	Scholarships/Awards	Outcome
Emmett Desroche	Graduate Student – PhD	2025-Present	In Progress		
Sophia Nicolescu	Summer Undergraduate Research Student	2026-Present			
Trent McKinley	Summer Undergraduate Research Student	2026-Present			
Jamie Black (4 th year thesis student)	4th-Year Engineering-Physics Thesis Student	2025-2026	Completed		BSc., Queen's

PRESENTATIONS

Invited Presentations

- **Invited Headline Presentation**, Science Talks – Alumni Weekend, Calgary, AB (2019)
Getting Moore from Less
- **Invited Headline Presentation**, Science Talks – Alumni Weekend, Edmonton, AB (2019)
Getting Moore from Less

Contributed Talks & Posters

- **Oral and Poster Presentation**, International Conference on Non-Contact Atomic Force Microscopy (2025)
Self-Excitation of qPlus Sensors on Silicon Surfaces: Probing Surface Charge-State Dynamics
- **Oral Presentation**, APS March Meeting, Boston, MA (2019)
The Near-Surface Electrostatic Environment of n-Doped Silicon Probed with a Moveable Dangling Bond Point-Probe
- **Poster Presentation**, International Conference on Non-Contact Atomic Force Microscopy (2018)
A Study of the Electrostatic Environment: Determining Charge Defect Depth in Silicon Using a Moving Dangling Bond Point-Probe
- **Poster Presentation**, University of Alberta Research Symposium (2018)
A Study of the Electrostatic Environment: Determining Charge Defect Depth in Silicon Using a Moving Dangling Bond Point-Probe
- **Oral Presentation**, International Conference on Non-Contact Atomic Force Microscopy (2017)
Atomic White-Out: Enabling Atomic Circuitry through Mechanically Induced Bonding of Single Hydrogen Atoms to a Silicon Surface
- **Poster Presentation**, University of Alberta Research Symposium (2016)
NC-AFM Study of Single Silicon Dangling Bonds on H-Si(100)
- **Poster Presentation**, International Conference on Non-Contact Atomic Force Microscopy (2016)
NC-AFM Study of Single Silicon Dangling Bonds on H-Si(100)
- **Oral Presentation**, University of Alberta Research Symposium (2015)
Atomic-Scale NC-AFM of H:Si(100): Force Extraction and Characterization
- **Poster Presentation**, Gordon Research Conference (2014)
Considerations of Silicon Atom-Scale Circuitry Fabrication: AFM Characterization of Dangling Bonds on H-Si(100)

PROFESSIONAL AND UNIVERSITY SERVICE

University Service

- **Member, Outreach Committee**, Department of Chemistry, Queen's University (2025–Present)
- **External Liaison**, Department of Chemistry, Queen's University (2026–Present)

Professional Service

- **Research Associate Seminar Committee Member**, National Research Council Canada (2020–2021)
Coordinated invited speakers, chaired seminar sessions, prepared presentation materials, and supported development of the seminar program.

Outreach Service

- **Career Night Panel Speaker**, Queen's Chemistry Student Council (2026)
Spoke to senior undergraduate students about career pathways from academic chemistry to industry.
- **Chemistry Magic Show Coordinator**, Science Rendezvous Kingston (2026)
Led a one-hour public chemistry stage show featuring demonstrations of colourful flames, flashes, reactions, and controlled explosions while coordinating volunteers, stage production, and laboratory safety.
- **USchool Presenter** (2019–2020)
Designed and delivered a hands-on *Cold Atoms* laboratory for Grade 6 and 7 students featuring demonstrations in cryogenic physics.
- **WISEST Volunteer** (2014, 2019)
Presented physics demonstrations and laboratory tours for young women participating in the Women in Scholarship, Engineering, Science and Technology (WISEST) outreach program.
- **Science Demonstrator**, Gateway to Science (2009–2012)
Delivered monthly science demonstrations for elementary and middle school students.
- **Science Olympiad Organizer** (2009–2010)
Assisted in organizing annual regional science competitions for middle and high school students.

Leadership

- **President**, Society of Physics Students, University of North Dakota (2010–2012)
- **Vice President of Finance**, Graduate Physics Students' Association, University of Alberta (2016)
- **Vice President of Communications**, Graduate Physics Students' Association, University of Alberta (2014)

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