Raphael Kay
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Education

2023/27 **Ph.D., Materials Science and Mechanical Engineering**
Harvard University
Mentored 4, coached 10+
Advisor: Prof. Joanna Aizenberg

2020/22 **M.A.Sc., Mechanical Engineering**
University of Toronto
4.00/4.00; 10+ Fellowships, Awards, and Distinctions; mentored 4, coached 10+
Top Graduate/Thesis, Department of Mechanical Engineering (***1/89***)
Advisor: Prof. Benjamin Hatton

2016/20 **B.A., Architecture, Technology**
University of Toronto
3.95/4.00; 15+ Fellowships, Awards, and Distinctions
Top Graduate, Faculty of Architecture (***1/230***)

Selected Awards, Scholarships, Fellowships, and Distinctions

2023 **Stanford Graduate Fellowship** ($300 000, declined)
Admission fellowship, awarded to support ~100 'outstanding students pursuing doctoral degrees in science and engineering' at Stanford of the ~13 000 applicants (***top ~0.8%*****).**

2023 **Stanford Knight Hennessey Scholarship Finalist**
Selected as one of ~160 Knight Hennessey Scholar Finalists from a pool of over 7000 applicants (***top ~2%***).

2023 **Top Graduating Student, Department of Mechanical and Industrial Engineering**
Recognized by the Department of Mechanical and Industrial Engineering at the University of Toronto as the top graduating student and chosen as the singular Governor General's Gold Medal nominee from the department in 2022. Graduating rank: 1/89 (***top ~1%***).

2022 **Berkeley Fellowship** ($70 000, declined)
Admission fellowship, awarded to the top (singular) admitted doctoral student in the Architecture department at UC Berkeley (***top ~1%*** of applicant pool).

2022 **Hatch Graduate Scholarship for Sustainable Energy Research** ($10 000)
Awarded by the Institute for Sustainable Energy to fund 'research and training of world-class researchers and engineers in the fields of recovery and utilization of energy derived sustainably from the sun and other sources'.

2022 **MITACS Globalink Research Award** ($6 000, declined)
Awarded by MITACS to support an international research proposal and visit to the Hub for Biotechnology in the Built Environment at Newcastle University.

2022 **Thomas H. Hogg Overseas Fellowship** ($10 000/year, renewable for three years, declined)
Awarded by the University of Toronto to support ambitious international research on topics pertaining to fluid mechanics, heat transfer, thermodynamics, or energy.

2022 **Three Minute Thesis Semi-Finalist, University of Toronto**
Selected as one of 27 university-wide semi-finalists for my communications presentation on my research, titled 'Crustacean buildings and slime mold railways'.

2021 **International Experience Award** ($8 000)
Awarded by the Centre for International Experience at the University of Toronto to support an international research collaboration as a Harvard Fellow within the John A. Paulson School of Engineering and Applied Sciences at Harvard University.

2021 **Michael Smith Foreign Study Scholarship** ($6 000)
Awarded by the National Sciences and Engineering Research Council of Canada to support an international research collaboration as a Harvard Fellow within the John A. Paulson School of Engineering and Applied Sciences at Harvard University.

2021 **Canada Graduate Scholarship** ($17 500)
Awarded by the National Sciences and Engineering Research Council of Canada to support 'research efforts of the top graduate students in all disciplines of academic study within the country' (***top ~0.4%*** of graduate student body in Canada).

2021 **Ontario Graduate Scholarship** ($15 000, declined)
Awarded by the Government of Ontario to the 'top graduate students in all disciplines of academic study within the province' (***top ~1%*** of graduate student body in Ontario).

2021 **C.W. Bowman Graduate Scholarship in Energy Research** ($5 000)
Awarded by the Centre for Global Engineering for 'innovative research on global energy systems relating to the environment and sustainability'.

2021 **Bert Wasmund Graduate Fellowship in Sustainable Energy Research** ($1 150)
Awarded by the Department of Mechanical Engineering for 'innovative research on the recovery and utilization of energy derived sustainably from the sun'.

2020 **Governor General's Silver Medal Nominee**
Recognized by the University of Toronto as one of the ***top ~0.03%*** graduates in the undergraduate student body. Nomination offered to ~20/15 000.

2020 **Top Graduating Student, Faculty of Architecture**
Recognized by the Daniels Faculty of Architecture as the top graduate of the Honours Bachelor of Arts program in 2020. Graduating rank: 1/230 (***top ~0.4%***).

2020 **University of Toronto Academic Merit Award** ($500)
Awarded by the Daniels Faculty of Architecture to the highest performing graduating students (19/230, ***top ~8%***).

2020 **NSERC Undergraduate Student Research Award** ($6 500)
Awarded one of the few departmental placements by the Department of Materials Science and Engineering to carry out a proposed research study under the supervision of a faculty member.

2019 **Oxford Rhodes Scholarship Finalist**
Selected by the Ontario Rhodes Scholarship Selection Committee, chaired by the Honourable Dennis O'Connor, as one of 13 provincial finalists for the scholarship from a pool of over 100 000 students. Awarded to ***top ~0.01%*** (13/100 000) of provincial student body.

2019 **Oxford Rhodes Scholarship Nominee**
Selected by the University of Toronto as one of six graduating students, from a pool of over 15 000, to be presidentially endorsed for the Oxford Rhodes Scholarship. Nomination offered to ***top ~0.04%*** (6/15 000) of the student body.

2019 **Leaders of Tomorrow Award** ($2 500)
Awarded by the French engineering company, SOPREMA, to 'the professionals of tomorrow, researching new methods and ideas that will shape the buildings of the future' (awarded to 1 graduating student of 230, ***top ~0.4%***).

2019 **University of Toronto Scholar** ($1 500)
Awarded by the University of Toronto to the most outstanding undergraduate students (***top ~4%).***

2019 **NSERC Undergraduate Student Research Award** ($6 500)
Awarded one of the few departmental placements by the Department of Materials Science and Engineering to carry out a proposed research study under the supervision of a faculty member.

2018 **NSERC Undergraduate Student Research Award** ($6 500)
Awarded one of the few departmental placements by the Department of Civil and Mineral Engineering to carry out a proposed research study under the supervision of a faculty member.

2017 **Cansbridge Fellowship Finalist**
Selected as one of 30 finalists, from a pool of 360 applicants, for the National Cansbridge Fellowship to travel and work abroad (***top ~8%*** of applicant pool).

2016 **Lynn MacGillivray Memorial Scholarship** ($300)
Awarded on the basis of scholarly achievement in English/Social Studies in Secondary School (***top ~0.3%*** of class, 1/300).

2016 **Rob Crombie Memorial Scholarship** ($2 000)
Awarded on the basis of scholarly achievement and contribution to the Arts in Secondary School (***top ~0.3%*** of class, 1/300).

Formal Research Activities

2023/27 **Graduate Researcher, John A. Paulson School of Engineering and Applied Sciences**
Biomineralization and Biomimetics Lab, Harvard University, Prof. Joanna Aizenberg.
Conceiving and leading a range of projects developing/demonstrating liquid windows as a general platform for universally controlling sunlight, thermal exchange, and indoor climate.
Directly mentored *4* undergraduate students. Distantly coached *10+* others.

2022/23 **Research Fellow, John A. Paulson School of Engineering and Applied Sciences**
Biomineralization and Biomimetics Lab, Harvard University, Prof. Joanna Aizenberg.
Conceived/developed what we believe to be the first platform capable of universally manipulating a beam of sunlight within buildings.
Directly mentored *2* undergraduate students. Distantly coached *10+* others.

2022/22 **Visiting Researcher, Hub for Biotechnology in the Built Environment**
School of Architecture, Newcastle University, Dr. Marin Sawa.
Researched new materials and methods for synthesizing cyanobacteria-based, building-integrated solar panels, toward closed-loop 'living' buildings capable of solar shading, sensing, and harvesting.

2022/22 **Visiting Research Fellow, John A. Paulson School of Engineering and Applied Sciences**
Biomineralization and Biomimetics Lab, International Experience Award, Michael Smith Foreign Study Scholarship, Harvard University, Prof. Joanna Aizenberg.
Co-conceived and led projects to develop a class of biologically-inspired nano-porous optical materials, capable of modulating solar reflectance for energy efficient buildings.

2020/22 **Functional and Adaptive Surfaces Group, Materials Science and Engineering**
Graduate Student, Hatch Graduate Scholarship for Sustainable Energy Research, Canada Graduate Scholarship, C.W. Bowman Graduate Scholarship in Energy Research, Bert Wasmund Graduate Fellowship in Sustainable Energy Research, University of Toronto, Prof. Benjamin Hatton.
Co-conceived and led multiple projects at the intersection of microfluidics, nonlinear pattern dynamics, and liquid self-organization, towards developing a new class of 'optofluidic' materials for zero-energy buildings.

Directly mentored *4* undergraduate students. Distantly coached *10+* others.

2020/20 **Functional and Adaptive Surfaces Group, Materials Science and Engineering**
NSERC Undergraduate Student Research Award, University of Toronto, Prof. Benjamin Hatton
Conceived and led project leveraging hydrodynamic fluid instabilities to control temperature flux and light transmission in building facades.

2019/20 **Sustainable Built Environment Performance Assessment Group, School of the Environment**
Undergraduate Researcher, University of Toronto, Prof. John Robinson
Led project addressing the discrepancy between perceived indoor air quality and measured indoor air quality, and set best practices for alleviating and further understanding this discrepancy.

2019/20 **Functional and Adaptive Surfaces Group, Materials Science and Engineering**
NSERC Undergraduate Student Research Award, University of Toronto, Prof. Benjamin Hatton
Led project designing, prototyping, and testing micro-fluidic window system, inspired by biological capillary temperature regulation.

2018/19 **Siegel Group, Indoor Air Quality, Civil and Mineral Engineering**
NSERC Undergraduate Student Research Award, University of Toronto, Prof. Jeffery Siegel
Led project comparing microbial research within lab setting to microbial growth in field setting. Conducted experiments investigating particulate matter emissions from indoor sources, and filter forensics experiments studying new measurement techniques for quantifying and understanding indoor air quality.

Informal Research Activities

2019/20 **Self-Propelling Autonomous Robotic Locomotion**
University of Waterloo, University of Toronto, Prof. David Correa
Co-designed and fabricated (w/ Kevin Nitièma) self-propelling hygroscopic robot with capability to crawl without active energy.

2019/19 **Sustainable Design Team, Net Positive Data Centre**
Living Lab of Sustainability, University of Toronto, Prof. John Robinson
Provided design suggestions to the Managing Director of University of Toronto Planning for one of the first net-energy positive buildings in Toronto (course code: ENV461).

Non-academic Activities/Employment

2017/18 **Founder, TAP Parking,** Toronto, Ontario
Co-founded a startup concept that connects drivers with empty driveways in areas where parking opportunities are scarce and expensive. Eventually met with leading competitor, Rover, to discuss ways to work together to solve ultimate goal of alleviating parking stress.

Volunteer Work

2017/17 **Volunteer, Public Architecture,** San Francisco, California (remote work)
Worked with leader in social-impact environmental design, specifically facilitating the connection between non-profit organizations and pro bono design work.

Selected Certifications

2019 **Delft University of Technology**, Certificate, Planning and Design with Water for Sustainability
Chosen as one of three students to represent Canada in multinational water management program. Collaborated with students from 52 countries to engineer flood-protection solutions along coastlines.

Published Refereed Research Contributions

2023 **Kay, R**.*, Jakubiec, J.A., Katrycz, C., & Hatton, B. D.* (2023). Multilayered optofluidics for sustainable buildings. *Proceedings of the National Academy of Sciences* 120, e2210351120. https://doi.org/10.1073/pnas.2210351120. *Corresponding.

Selected press: *[IEEE Spectrum] [Editorial Highlight, PNAS] [Research Highlight, Communications Engineering] [UofT Engineering News] [CBC What on Earth] [UofT News] [Anthropocene] [Habitability] [Interesting Engineering] [Engineering and Technology] [American Society of Mechanical Engineers] [Parametric Architecture] [News Azi] [Lab Manager] [Ars Technica] [Green Savers] [Basic Thinking] [New Atlas] [Tech Explore] [Today Headline] [Tech Times] [Morning News] [ScienMag] [Bioengineer] [Galaxy Concerns] [Learning from Nature].*

2022 **Kay, R**.*, Katrycz, C., Nitièma, K., Jakubiec, J. A., & Hatton, B. D.* (2022). Decapod-inspired pigment modulation for active building facades. *Nature Communications* 13, 4120. https://doi.org/10.1038/s41467-022-31527-6. *Corresponding.

Selected press: *[Nature] [Editorial Highlight, Nature Communications] [Bloomberg News] [Bloomberg Navigator] [Fast Company] [UofT News] [UofT Engineering News] [CBC What on Earth] [UofT Defy Gravity] [Inverse] [Mirage News] [Tech Xplore] [Tech News] [Morning News] [EurekAlert, AAAS] [Optics and Photonics News] [Interesting Engineering] [News Azi] [Tech Times] [DNYUZ] [Bioengineer] [ScienMag] [New Atlas] [Inceptive Mind] [Intelligent Living] [HVAC & R News] [Novae Res Urbis, Toronto Edition].*

2022 **Kay, R**.*, Mattacchione, A., Katrycz, C., & Hatton, B. D.* (2022). Stepwise slime mould growth as a template for urban design. *Scientific Reports*, 12(1), 1322. https://doi.org/10.1038/s41598-022-05439-w. *Corresponding.

Selected press: *[UofT News] [UofT Engineering News] [UofT Alumni News] [Varsity News] [Mirage News] [Terra Daily] [True Viral News] [Phys.org] [Blog TO].*

2022 **Kay, R**.*, Katrycz, C. W., Heimlich, E. J., & Hatton, B. D.* (2022). Programmable droplets: Leveraging digitally-responsive flow fields to actively tune liquid morphologies. *PLOS One* 17, e0264141. https://doi.org/10.1371/journal.pone.0264141. *Corresponding.

2022 **Kay, R**.*, Nitièma, K., Katrycz, C., Jakubiec, J. A., Hoban, N., & Hatton, B. D. (2022). Shape-programmable fluid bubbles for responsive building skins. *Journal of Building Engineering*, 48: 103942. doi:https://doi.org/10.1016/j.jobe.2021.103942. *Corresponding.

2020 **Kay, R**., K. Nitièma, & Correa, D. The bio-inspired design of a self-propelling robot driven by changes in humidity, in *Proceedings of the 38th eCAADe Conference*, L. Werner and D. Koering, Editors. 2020: Berlin, Germany. p. 233-242. http://papers.cumincad.org/cgi-bin/works/Show?ecaade2020_195.

Press: *[UofT Architecture] [SOPREMA].*

Working Refereed Research Contributions

2023 **Kay, R**.*, Katrycz, C.*, Nitièma, K., Heimlich, E.J. & Hatton, B. D. Smart windows based on pneumatically-tunable pigment displacement, for submission to *Advanced Materials*.

2023 **Kay, R.***, Jakubiec, J. A.* & Hatton, B. D. Energy assessment of building-integrated optofluidics, for submission to *Applied Energy*.

2023 **Kay, R**., & Hatton, B. D. Fluid flow as a switchable thermal bridge, for submission to *Advanced Functional Materials*.

2023 **Kay, R.***, Cocks, R. J.*, Katrycz, C. & Hatton, B. D. Thermoresponsive viscous fingering for solar shading, undetermined destination.

Invited/Commissioned Published Articles

2023 **Kay, R**., What color-changing crustaceans can teach us about designing efficient buildings. Commissioned article. Architektur Aktuell Magazine. *Edition link*.

Non-refereed Research Contributions

2020 **Kay, R**.*, and Nitièma, K.* Bio-inspired fluid cell growth for adaptive optical transmission in buildings. Undergraduate Thesis. Faculty of Architecture, University of Toronto. *Equal contributions among authors.

2019 **Kay, R**.*, Chakwera, A.*, Patrick, B.*, Vashisth, S.*, Trewern, N.*, and Husodo, Y.* Vision for a net-positive data sciences centre: Report to the Department of Campus and Facilities Planning. University of Toronto. *Equal contributions among authors.

Filed Patents

2022 **Kay, R**., Hatton, B.D., Katrycz, C., and Nitièma, K. System for control of optical properties of light. Filed November 29, 2022. U.S. 18071496.

2022 **Kay, R**., Hatton, B.D., and Jakubiec, J.A. Fluidic device for regulating light transmission through the device. Filed November 29, 2022. PCT/CA2022/051747.

Scholarly Conference Presentations and Acceptances

2023 **Optofluidic skins for sustainable buildings**, in *Soft Optics*, 2023 Materials Research Society Fall Meeting, Boston, MA. November 29, 2023.

2022 **Smart, active, fluidic facades for energy efficient buildings***, in *Electrochemistry, energy storage and devices*, 33rd Canadian Materials Science Conference 2022, University of Toronto. June 23, 2022. *Abstract accepted but was unable to present due to research travel conflict.

2021 **Slime mould networks as a template for the design of cities**, in *Sustainability and Water*, 2nd University of Toronto Engineering Research Conference 2021, University of Toronto (virtual). July 8, 2021.

2021 **Biological microfluidics for smart optical control in buildings**, in *Functional and Emerging Materials*, 32nd Canadian Materials Science Conference 2021, Queen's University (virtual). June 4, 2021.

2020 **From pinecones to robots**, in *Cognizant Architecture - What if Buildings Could Think?*, 38th eCAADe Conference, TU Berlin (virtual). September 14, 2020. *Link*.

Selected Academic Presentations

2022 **Could the future of buildings be fluidic?** Talk in Soft, Fluid, Living Matter (SoFLivMat) seminar series, Yale University. October 25th, 2022.

2020 **Hypothesized design of a contactless delivery robot for SARS-CoV-2 testing and administration.** Final presentation: Physical Computing course, University of Toronto. *Link*.

Selected Interviews and Radio Show/Podcast Appearances

2023 **Could seafood-inspired skins slash emissions from buildings?** Interviewed for: *CBC What On Earth with Laura Lynch.*

2023 **How Does Nature Modify Light and Color? With Raphael Kay.** *Learning from Nature: The Biomimicry Podcast with Lily Urmann. Apple. Spotify.*

2023 **"The future of construction is liquid," claims a Harvard researcher.** *Habitability*.

2023 **'Liquid windows' inspired by squid skin could help buildings react to changing environments, save on energy costs.** *University of Toronto Engineering News*.

2023 **'Liquid windows' could be the answer to more sustainable buildings.** *Fast Company.*

2023 **Using Fluids to Control Energy Use in Buildings.** *American Society of Mechanical Engineers.*

2023 **Chameleon Skins Slash Building Energy Use**. *IEEE Spectrum.*

2022 **A Green Building Technique, Inspired by Fish Food.** *Bloomberg News.*

2022 **One Solution to the Climate Crisis is a Pane in the Glass.** *H2O Radio.*

2022 **These color-changing, energy-saving windows are inspired by an unlikely sea creature.** *Fast Company.*

2022 **Skin: the next frontier?** *Novae Res Urbis, Toronto Edition.*

2022 **Dynamic building facades inspired by marine organisms could reduce heating, cooling, and lighting costs.** *University of Toronto Engineering News.*

2022 **Could a 'virtual slime mould' design a better subway system?** *University of Toronto Engineering News.*

2022 **What slime mould can teach us about optimizing the TTC.** *The Varsity, University of Toronto.*

2020 **Check out the work of the Daniels Faculty's first-ever undergraduate thesis students**. *Faculty of Architecture, University of Toronto.*

2019 **A Graduate of the University of Toronto Faculty of Architecture Receives Soprema's Leaders of Tomorrow Award**. *Soprema.*

Selected Academic Research Features and Highlights

2023 **Optical tuner for sustainable buildings.** Research Highlight, *Communications Engineering*.

2023 **Optofluidics-based climate control in buildings.** Research Highlight, *Proceedings of the National Academy of Sciences.*

2023 **Pigmented fluids.** Included in the Biomimicry Design Toolkit, *bioSEA*.

2022 **Sea creatures' sunshades inspire low-cost 'smart' windows.** Research Highlight, *Nature*.

Selected Research Mentions in Magazines, Newspapers, and Blogs

2023 **'Liquid windows' inspired by squid skin could help buildings save energy.** *University of Toronto.*

2023 **Squid-inspired smart windows could slash building energy use.** *Anthropocene.*

2023 **Squid-like 'liquid windows' react to environment, saving energy costs.** *Interesting Engineering*.

2023 **Squid Skin Inspires Novel "Liquid Windows" For Greater Energy Savings.** *Galaxy Concerns*. *Ars Technica*.

2023 **'Liquid windows' could reduce buildings' energy consumption.** *Engineering and Technology*.

2023 **Researchers Develop Energy-Saving Multi-Layer "Liquid Window".** *Parametric Architecture*.

2023 **Multi-layer "liquid window" tech could help buildings save energy.** *New Atlas*.

2023 **Liquid windows: Energy-saving inspiration from squid skin.** *Tech Explore*. *Morning News. News Azi*.

2023 **Energy-saving inspiration from squid skin.** *Today Headline*.

2023 **'Liquid Windows' Could Help Buildings React to Changing Environments.** *Lab Manager.*

2023 **These Squid-Inspired Liquid Windows Could Help Buildings Preserve Energy.** *Tech Times*.

2023 **'Liquid windows' inspired by squid skin could help buildings react to changing environments, save on energy costs.** *ScienMag*. *Bioengineer*.

2022 **The Krill Building.** *Bloomberg Navigator*.

2022 **Krill-inspired dynamic facades could reduce building's heating and cooling costs**. *Inceptive Mind*.

2022 **Smart Windows Inspired by Marine Animals**. *Optica*.

2022 **Marine life inspires dynamic buildings.** *HVAC & R News.*

2022 **Krill-inspired solar shades could reduce energy bills by up to 30 percent.** *Interesting Engineering*.

2022 **Krill-Inspired Shading System Could Drastically Cut Energy Use.** *Intelligent Living.*

2022 **Researchers Developed Krill-Inspired Solar Shades That Could Significantly Reduce Energy Bills.** *Tech Times.*

2022 **Buildings can take inspiration from nature to become efficient — and beautiful.** *Inverse*.

2022 **Low-energy fluidic cells could shade and cool buildings dynamically.** *New Atlas.*

2022 **Dynamic building facades inspired by marine organisms could reduce heating, cooling and lighting costs.** *ScienMag.* EurekAlert, American Association for the Advancement of Science. *Bioengineer*. *Mirage News. TechXplore. Tech News. Morning News. DNYUZ. University of Toronto News. University of Toronto Defy Gravity Campaign*.

2022 **Researchers use 'virtual slime mould' to design TTC subway network less prone to disruption.** *University of Toronto News*.

2022 **Toronto researchers are using bright green slime to improve the TTC subway network.** *BlogTO.*

2022 **Using a 'virtual slime mold' to design a subway network less prone to disruption.** *Phys Org.*

2022 **Researchers use 'virtual slime mould' to design TTC subway network less prone to disruption.** *Mirage.*

2022 **Using a 'virtual slime mold' to design a subway network less prone to disruption.** *True Viral News.*

2022 **Could a 'virtual slime mould' design a better subway system?** *Terra Daily.*

2022 **Raphael kay uses 'virtual slime mould' to design a TTC subway network less prone to disruption.** *University of Toronto Alumni News.*

2020 **Molten Snowflakes**. Research Revealed Feature, *University of Toronto*.

Selected mentoring and coaching record (from 30+ instances):

2022/2023 **High-school level:** Germantown Friends School; St. John the Baptist High School.

Undergraduate level: Carnegie Mellon University, Boston University.

Graduate level: University of California, Merced; Rajk College for Advanced Studies.

Academic Review Positions

2022/23 **Academic Reviewer**, *Advanced Materials (indirect), Environment and Planning B: Urban Analytics and City Science*.

2022 **Project Reviewer**, *ADV-9381*, Graduate School of Design, Harvard University.

Selected Computational Skills

Graphic Design: Adobe Photoshop, Adobe Illustrator, Adobe InDesign, Adobe Premier Pro, Microsoft PowerPoint

3D/CAD Modeling and Rendering: Rhinoceros, SketchUp, Autodesk Fusion 360

Coding/Statistical Analysis: Python, MATLAB, R, Processing (including particle modelling), Grasshopper, Arduino, Microsoft Excel

Environmental and Physical Analysis: Ansys (thermal, fluid), COMSOL (thermal, fluid, structural), Diva, Ladybug, Karamba3D, RhinoCFD, Kangaroo, THERM, DesignBuilder, Climate Consultant, ArcGIS, Energy+ (building energy/thermodynamic simulation), Climate Studio (optical raytracing)

Selected Experimental Skills

Milli/Macro-fabrication: CNC Milling, Laser Cutting, 3D Printing, Solvent Welding, Machining/Woodshop, Electronics

Synthesis and Nanofabrication: Photonic Crystal, Bottom-Up Self-Assembly, Physical Vapor Deposition/Sputter Coating/Spin Coating, Soft Lithography/Molding, Micromachining,

Micro/Millifluidics, Plasma Bonding/Cleaning, Surface Functionalization, Biofilm growth, Hydrogels, Spinodal Decomposition/Phase Inversion Nanostructure Self-Assembly

Material Characterization: Rheometry (fluids), Spectrophotometry (UV/vis/NIR/MIR), Optical Profilometry, Biofilm Characterization

Imaging: Scanning Electron Microscopy, Confocal/Stereo/Fiber-Coupled Microscopy

Non-academic Leadership Activities and Achievements

2018/20 **Intramural Basketball, Dodgeball Captain**, University of Toronto
2019/19 **Orientation Leader**, University of Toronto Faculty of Architecture
2017/18 **Head of Recruitment,** Alpha Epsilon Pi, Tau Omega Chapter
2015/17 **Senior Basketball Camp Coach and Counsellor,** Upper Canada College Summer Camps
2008/16 **Provincial Club Basketball Player,** Ontario Basketball Association
2016/16 **Culture Club President**, North Toronto Collegiate Institute
2016/16 **Volunteer House League Basketball Head Coach**, North Toronto Basketball Association
2015/16 **Co-captain,** North Toronto Collegiate Institute senior basketball team
2013/14 **Captain,** North Toronto Collegiate Institute junior basketball team
2013/14 **Most Valuable Player**, North Toronto Collegiate Institute junior basketball team

November 2023