



WIN

2022-2023

ANNUAL REPORT



UNIVERSITY OF
WATERLOO



WATERLOO INSTITUTE FOR

nanotechnology



OUR PEOPLE

112 faculty members

RESEARCH

9,429

papers published

247,667

citations

Since 2008

*Scopus/SciVal evaluation as of April 2023

INTERNATIONAL

43 international partners in 16 countries

11 DEPARTMENTS

- ▶ Applied Mathematics
- ▶ Biology
- ▶ Chemical Engineering
- ▶ Chemistry
- ▶ Civil and Environmental Engineering
- ▶ Electrical and Computer Engineering
- ▶ Mechanical and Mechatronics Engineering
- ▶ Physics & Astronomy
- ▶ School of Environment, Enterprise, and Development
- ▶ School of Pharmacy
- ▶ Systems Design Engineering

SCHOLARY TALKS

3 WIN Seminars

3 WIN Thematic Seminars

4 distinguished lectures

2 WIN Quantum Nano Collision Seminars

2 Industry Seminars

2 Innovation Seminars

5 WIN Joint Seminars

2 Workshops

NANOFELLOWSHIPS

43

nanofellowships awarded in 2022-2023

15

rounds of nanofellowship competitions

555

nanofellowships awarded (since 2008)



UNIVERSITY OF
WATERLOO



WATERLOO INSTITUTE FOR
nanotechnology

MESSAGE FROM THE **EXECUTIVE DIRECTOR**



SUSHANTA MITRA

EXECUTIVE DIRECTOR

After two years of COVID-19 safety restrictions and working from home, the familiar hustle and bustle of the QNC returned as most people gradually came back to the office. At WIN, we recognized the importance and need for all to have a sense of belonging and community, and have worked tirelessly to bring students, faculty, staff and visitors together again. To help make all individuals in our community feel safe, valued and supported, we implemented new initiatives to connect our members within our campus and beyond.

In the past year, we organized many in-person events, seminars and other activities to help build and maintain important relationships and networks. To build a stronger community spirit, the Coffee & Connections event was launched in Fall 2022 and is held regularly to bring students, staff and faculty together for cookies, coffee and conversation. In March 2023, WIN welcomed NRC researchers to showcase their research findings with WIN members, and in April 2023 the WIN-Arts Mash-Up was hosted to bridge the gap between nanotechnology and the arts - connecting those with different skills and ideas in economics, policy and design to alternative energies. WIN also partnered with the Department of Chemical Engineering and launched the Sustainable Future Perspectives Series, to facilitate discussions on how nanotechnology can help find solutions to world issues as outlined by the UN Sustainable Development Goals (UNSDGs).

And of course, this spirit flowed to the international community, from hosting the first Network for Sustainable Nanotechnology (N4SNano) Global Summit to new linkages with the EU and the Indo-Pacific Region.

These activities have brought a great deal of liveliness and excitement back to Waterloo, illustrating WIN's commitment to faculty, students, visitors and to the larger Waterloo community. WIN is happy to continue to support researchers in nanotechnology in the years to come. Let's continue to work together to make this an exciting and inclusive research enterprise.



UNIVERSITY OF
WATERLOO



DR. CHARMAINE DEAN

**VICE PRESIDENT
RESEARCH AND INTERNATIONAL**

MESSAGE FROM THE **CHAIR OF THE BOARD OF DIRECTORS**

WIN has been actively involved in several efforts over the past year to engage leaders across campus and beyond, to build community within WIN's membership to align with needs and expectations of various stakeholders, and importantly, to drive emphasis on the high profile of Waterloo's research in nanotechnology and related areas. One key effort has been proactively working with the Deans of our six Faculties to ensure that we collectively work to promote nanoscience and nanotechnology within our campus and beyond. In fall 2022, WIN connected with the Deans and Associate Deans of each Faculty to learn more about their individual priorities for the academic year and how to boost interdisciplinary collaboration. The results were impressive. Highlights include the WIN-Arts Mash-up on Alternative Energies and the Hydrogen Economy, which brought together STEM researchers with economists for a joint seed-funding call; a joint WIN-CBB-Faculty of Health workshop on Healthcare Technologies and a follow-up seed funding call; and a co-sponsored seed funding call on Artificial Intelligence (AI) and Machine Learning (ML) for sensors and materials discovery with Waterloo AI and the University of Bordeaux.

WIN has also been actively involved in community building. Outreach through weekly Coffee & Connection get togethers and monthly Pitches & Demos events are helping to make QNC a "Home of Nano". These initiatives have been instrumental in allowing graduate students, post-doctoral fellows, faculty members and staff to interact with internal and external stakeholders including industry and start-ups in the region. They are also critical as we build community and re-establish ties and our working culture in a post-COVID environment.

Additionally, WIN has created a taskforce on a Framework for WIN Members' Research Excellence, as suggested by WIN's International Scientific Advisory Board (ISAB) in 2022. As QNC is a valuable space to conduct research, providing a specific advantage for WIN members to work and collaborate, data on WIN members' research activities from 2017 to present were collected and analysed. Once completed, this analysis will help in the development of a vision for WIN's core members for the next three to five years with a focus on accelerating success in significant national and international granting programs.

Inclusive Research and Training is a top priority for WIN, and I am thrilled that WIN has recruited such excellent Early Career Researchers (ECR) from various equity-deserving groups. WIN is also proud to support ECRs with seed funding programs to support new projects and help connect researchers with national and international partners. An excellent example of this is the WIN-Indian Institute of Science Bangalore (IISc) Joint Seed Funding Call for Quantum Materials and Devices.

I look forward to continuing a productive partnership with WIN's Executive Director, Sushanta Mitra, and his team to further nanotechnology research locally, nationally, and globally.

STAFF AND GOVERNANCE

WIN MANAGEMENT AND ADMINISTRATION

Sushanta Mitra	Executive Director
Lisa Pokrajac	Assistant Director, Research Program
Oleg Stukalov	Business Development Manager
Kendra Goertz	Marketing and Operations Coordinator
Kyle Murphy	Space Coordinator

BOARD OF DIRECTORS

CHAIR

Charmaine Dean	Vice-President, Research & International, University of Waterloo
-----------------------	--

MEMBERS

Warren Chan	Director, Institute of Biomaterials & Biomedical Engineering, University of Toronto
Lora Field	Team Leader, Cleantech and Advanced Manufacturing Branch, Ontario Investment Office
Karin Hinzer	Professor, Electrical Engineering and Computer Science, University of Ottawa
Na Young Kim	Professor, Electrical and Computer Engineering, University of Waterloo
Anna Klinkova	Assistant Professor, Department of Chemistry, University of Waterloo
Bob Lemieux	Dean, Faculty of Science (or designate), University of Waterloo
Sushanta Mitra	Executive Director, Waterloo Institute for Nanotechnology (WIN), University of Waterloo
Carolyn Ren	Professor, Mechanical and Mechatronics Engineering, University of Waterloo
Marisa Sterling	President, PEO & Assistant Dean and Director of Diversity, Inclusion and Professionalism
David Sinton	Professor, Mechanical and Industrial Engineering, University of Toronto
Shirley Tang	Professor & Associate Dean Research, Faculty of Science, Chemistry, University of Waterloo
Mary Wells	Dean, Faculty of Engineering (or designate), University of Waterloo
Yimin Wu	Professor, Mechanical and Mechatronics Engineering, University of Waterloo
Boxin Zhao	Professor, Chemical Engineering, University of Waterloo

WIN INTERNATIONAL SCIENTIFIC ADVISORY BOARD

CHAIR

Linda Nazar	University Professor & Canada Research Chair in Solid State Energy Materials
--------------------	--

MEMBERS

Adrien Côté	Executive Director, Velocity
Kazuhiro Hono	President, National Institute for Materials Science, Japan
Sushanta Mitra	Executive Director, Waterloo Institute for Nanotechnology (WIN), University of Waterloo
Ajay Sood	Principal Scientific Adviser to the Government of India
Albert van den Berg	Distinguished Professor, University of Twente and Scientific Director of MESA, Netherlands
Chen Wang	Director General of National Center for Nanoscience and Technology, China
Sir Mark Welland	Head of the Nanoscience Centre at the University of Cambridge and Master of St Catharine's College Cambridge, United Kingdom

EXECUTIVE COUNCIL

CHAIR

Sushanta Mitra Executive Director, Waterloo Institute for Nanotechnology (WIN), University of Waterloo

MEMBERS

Dayan Ban Professor and Associate Director, Nanotechnology Engineering, University of Waterloo
Kyle Daun Professor, Mechanical and Mechatronics Engineering, University of Waterloo
Emmanuel Ho Associate Professor, Graduate Officer, School of Pharmacy, University of Waterloo
Carolyn Ren Professor, Mechanical and Mechatronics Engineering, University of Waterloo
Na Young Kim Associate Professor, Electrical and Computer Engineering, University of Waterloo
Boxin Zhao Professor, Chemical Engineering, University of Waterloo Endowed Chair in Nanotechnology

SPACE COMMITTEE

CHAIR

Zbig Wasilewski Professor, Department of Electrical and Computer Engineering, Faculty of Engineering

MEMBERS

Chris Kleven QNC Facility Technician, Provost
Kendra Goertz Operations & Marketing Coordinator, WIN
Sushanta Mitra Executive Director, Waterloo Institute for Nanotechnology (WIN), University of Waterloo
Scott Nicoll Manager, Space Planning, Provost
Juewen Liu Professor, Department of Chemistry, Faculty of Science

HEALTH AND SAFETY COMMITTEE

CHAIR

Laura Deakin Continuing Lecturer; Associate Dean of Science, Student Relations; Associate Director of Nanotechnology Engineering, Program

MEMBERS

Yuning Li Professor, Chemical Engineering
Dhanajai Borwankar Senior Safety Officer, Safety Office
Chris Kleven QNC Facility Technician, Provost
Kendra Goertz Operations & Marketing Coordinator, WIN

SPECIAL PROJECTS AND RESEARCH COMMITTEE (SPARC)

CHAIR

Bernard Duncker Associate Vice-President Interdisciplinary Research, Office of Research

MEMBERS

David Clausi Associate Dean of Research and External Partnerships, Faculty of Engineering
Shirley Tang Associate Dean of Research, Faculty of Science
Zbig Wasilewski Professor, Department of Electrical and Computer Engineering, Faculty of Engineering
Lisa Pokrajac Assistant Director, Research Programs, WIN

WIN THEMATIC AREAS

Since 2017, WIN focuses on four thematic areas – Smart & Functional Materials, Connected Devices, Next Generation Energy Systems and Therapeutics & Theranostics. Each of these thematic groups are overseen by leads and co-leads who work together with the WIN staff over two-year terms. Theme leads and co-leads offer guidance and advice on the best ways to support and promote each research theme, particularly in terms of funding opportunities and external academic, industry or international partnerships.

SMART AND FUNCTIONAL MATERIALS

As Smart and Functional materials has the largest number of faculty members this model is best suited for this thematic group.

Professor Kyle Daun

Mechanical and Mechatronics Engineering

Research interests: combustion and heat transfer phenomena, heat conduction from aerosols, laser-based nanoparticle metrology, optical tomography and design optimization of combustion devices

Professor John Honek

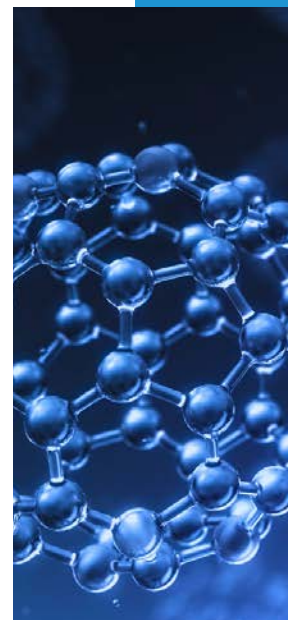
Chemistry (cross-appointed with Pharmacy)

Research interests: bionanotechnology, mechanistic enzymology, recombinant DNA and biophysical methods, medicinal chemistry and molecular modelling

Professor Boxin Zhao

Chemical Engineering

Research interests: fundamental and practical aspects of adhesion, wetting, and friction of soft bio-nanomaterials



CONNECTED DEVICES

Professor Vassili Karanassios

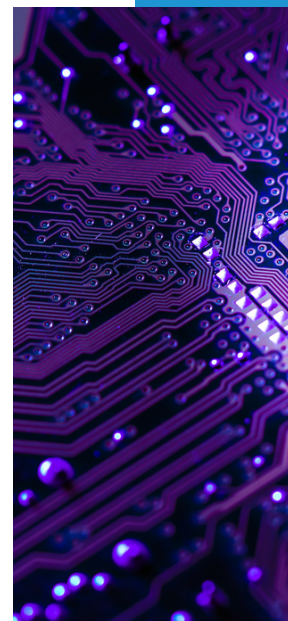
Chemistry

Research interests: micro- and nano-analytical chemistry and instrumentation

Professor Na Young Kim

Electrical and Computer Engineering

Research interests: large-scale solid-state quantum computer, quantum simulator for quantum information processing and communications



SOCIETAL IMPACT OF RESEARCH



To achieve societal impact and sustainable future, WIN's thematic areas are mapped with the United Nations Sustainable Development Goals (SDGs).

NEXT GENERATION ENERGY SYSTEMS

Professor Dayan Ban

Electrical and Computer Engineering

Research interests: near-infra red light conversion, design and fabrication of high-performance quantum devices and ultra-sensitive surface plasmon sensors

Professor Yimin A. Wu

Mechanical and Mechatronics Engineering

Research interests: energy materials, electronic materials, photonic materials, responsive materials, in situ multimodal characterizations, interfacial science and engineering

7 AFFORDABLE AND CLEAN ENERGY



11 SUSTAINABLE CITIES AND COMMUNITIES



13 CLIMATE ACTION



THERAPEUTICS AND THERANOSTICS

Professor Emmanuel Ho

School of Pharmacy

Research interests: biomaterials for drug delivery systems such as nanoparticles, medical devices, biodegradable films, hydrogels, etc.

Professor Carolyn Ren

Mechanical and Mechatronics Engineering

Research interest: micro/nano-fluidics, lab-on-a-chip, protein separation, live-colony detection

3 GOOD HEALTH AND WELL-BEING



SCHOLARLY OUTPUT

Publications, Citations and Impact

BIBLIOMETRIC ANALYSES

Through the tools available through SciVal and Scopus (Elsevier), WIN can identify key strengths based on global comparative indices such as field-weighted citation impact (FWCI*) and collaborations.

Total Publications, Citations and Collaborations

2017 to 2022, based on SciVal (Scopus) data

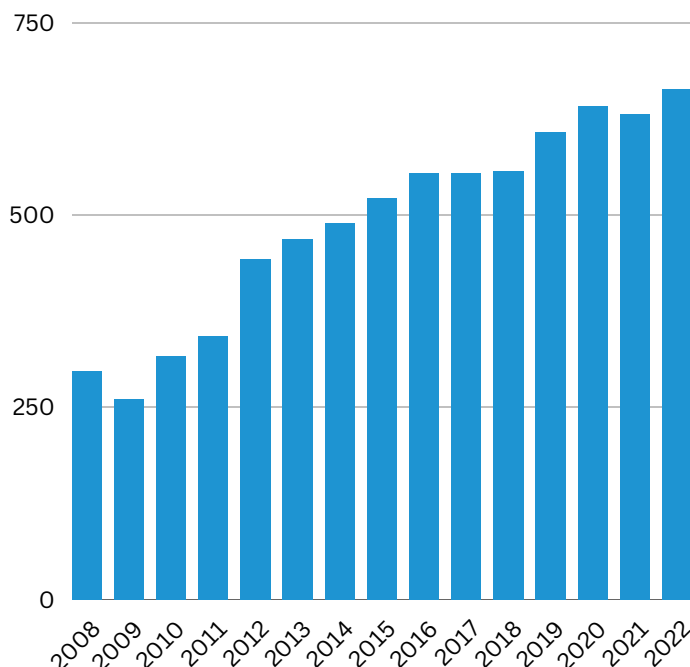
GROUP	TOTAL PUBLICATIONS	CITATIONS	FWCI*	NATIONAL	INTERNATIONAL	OUTPUT IN TOP 10% CITATION PERCENTILE	INDUSTRY
WIN Members (total)	3,987	93,272	1.65	18.6%	10%	53.1%	4.8%
Smart and Functional Materials	2,638	61,934	1.66	18.5%	9.1%	54%	4.4%
Connected Devices	1,574	25,750	1.4	14%	10.9%	48.9%	6%
Next Generation Energy Systems	1,594	54,231	2.08	24.7%	7.4%	57.6%	4%
Therapeutics and Theranostics	1,497	32,272	1.47	18.1%	10.5%	55.9%	4.5%

*FWCI: Field-weighted citation impact compares the number of citations received by a researcher with the average number of citations received by all other similar publications indexed in the Scopus database (ie: a score of 1.44 means the publications have been cited 44% more times than average)

Our numbers in 2022

# PUBLICATIONS	# CITATIONS	SFWCI	% PUBS TOP 10%
663	3300	1.75	17%

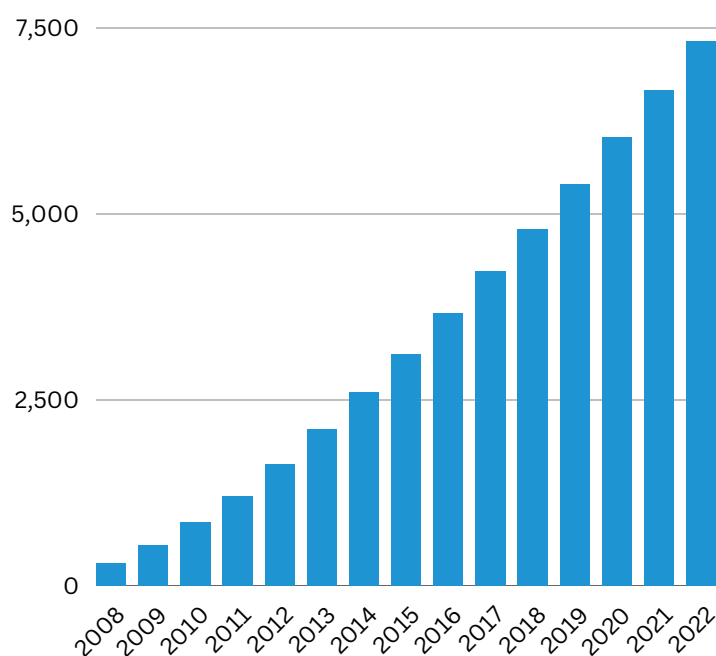
Total Publications by WIN Members



WIN Publications in High Impact Factor Journals

Nature Reviews Materials	76.68 (1)
Nature	69.50 (1)
Nature Energy	67.44 (1)
Science	63.83 (1)
Progress in Materials Science	48.17 (1)
Joule	46.05
Energy and Environmental Science	39.71 (3)
Advanced Materials	32.09 (1)
Progress in Polymer Science	31.28 (1)

Cumulative Publications by WIN Members



WIN Publications in High Impact Factor Journals

Langmuir	13 (IF 4.33)
ACS Applied Materials and Interfaces	12 (IF 10.38)
Applied Chemical Physics	11 (IF: 4.30)
Nano Energy	10 (IF 19.07)
Advanced Functional Materials	9 (IF: 19.92)
Analytical Chemistry	9 (IF 8.01)
Angewandte Chemie	9 (IF 15.34)
Computers and Chemical Engineering	8 (IF: 4.13)
Advanced Materials	7 (IF 32.09)

INTERDISCIPLINARY RESEARCH FUNDING PROGRAM (IRFP)

The Interdisciplinary Research Funding Program (IRFP) was introduced in 2018 to foster and support collaborative research in traditionally dissimilar fields, which would not usually be supported by main-stream funding agencies. The program was designed to support new ideas in “blue-sky discoveries” which can then springboard into larger networks and granting schemes.

Since 2018, the program has expanded to include seed-funding for strategic international partnerships in common priority research areas. In 2022-23, the IRFP supported international collaborations with the Indian Institute for Science, Bangalore, India (page 12 - 13) and the WIN-Faculty of Arts Challenge on Alternative Energies and the Hydrogen Economy (page 11).

NATIONAL RESEARCH COUNCIL (NRC) WORKSHOP

On March 9th 2023, WIN hosted the WIN – NRC Workshop for Nanomaterial & Nano-enabled Sensors. This workshop provided an opportunity for WIN and NRC researchers to showcase the results of their joint projects funded by the Interdisciplinary Research Funding Program (IRFP) in December 2021.

Here, nine outstanding applications received funding of \$310,000 CAD in cash from WIN, matched at \$463,780 for in-kind contribution from NRC, for a grand total of almost \$774,000 in support of new joint projects. The projects were supported for one year, and the initial data-points generated will allow teams to apply to NRC Grand Challenges programs with envelopes often in the millions of dollars.

The workshop this year was a return to in-person events, hosted by WIN. The morning kicked off with 20 minute technical presentations from each of the WIN-NRC jointly funded projects, describing their progress. Then while breaking for a networking lunch, selected graduate students of the participating researchers gave poster presentations. The workshop concluded with facility tours of the Quantum Nano Center and G2Nano; and everyone was invited back to the WIN 3rd floor lounge for Coffee and Connections.

Presenters: [Full Agenda](#)

- Misa Hayashida (NRC,) with Boxin Zhao & Aleksander Cholewinski (WIN/ChE)
- Marianna Kulka (NRC,) & Juewen Liu (WIN)
- Mark Salomons (NRC,) & German Sciaini (WIN) (with Michael Fleischauer)
- Adam Bergren (NRC) & Yimin Wu (WIN)
- Abebaw Jemere (NRC) & Shirley Tang (WIN)
- Kenneth Bosnick (NRC) & Kevin Musselman (WIN)
- Neil Graddage (NRC) & Michael Pope (WIN)
- Emmanuel Ho (WIN) & Nikola Pekas (NRC)
- Lei Zhang, Pu Chen (WIN) & Yimei Jia (NRC) with Marianna Kulka (NRC)



WIN - ARTS MASH UP

On 5 April 2023, WIN hosted a second workshop this term with UW's Faculty of Arts. This "Mash Up" event focused on the theme of "Alternate Energy and the Hydrogen Economy" which has become a topic of intense interest. Due to rising concerns of the damaging impacts of climate change and the current geo-political reliance on carbon-based fuel, there is a significant demand to develop carbon neutral energy sources. The goal of this joint workshop was to bring together researchers from the Faculty of Arts and WIN to discuss these energy technologies through the lenses of politics, society, policy and economy of scale and how these discussions are key to creating a resilient energy future for Canada and beyond.

The day began with opening remarks from Bernard Duncker, Associate Vice President of Research and International along with Ramona Bobocel, Interim Associate Dean of Research, Faculty of Arts and Sushanta Mitra, Executive Director, Waterloo Institute for Nanotechnology. The remainder of the workshop continued with short five-minute presentations from WIN and Arts researchers, as an opportunity to pitch their research and collaboration interests. The list of presenters can be found [HERE](#). The presentations were followed by a networking lunch, where all attendees were encouraged to interact and share ideas, providing the space to follow up on the calls for collaboration from the presentations.

The WIN and Faculty of Arts Joint Seed Grant Program Addressing the Challenges of Moving to Alternative Energies and the Hydrogen Economy was announced at the end of this workshop, to support the joint projects in compiling initial data points and insights to enable researchers to target various funding programs, including "New Frontiers in Research Fund (NFRF) International Joint Initiative for Research in Climate Change Adaptation and Mitigation."

An envelope of \$45,000 CAD was available for this call, which will support the following joint projects for \$15,000 each for one year:

- Low GHG Emissions Methods to Produce Hydrogen from Methane and Calculate Optimal Taxes, with Eihab Abdel-Rahman (SDE) and Anindya Sen (Econ)
- impacts of a transition to hydrogen-based aviation transport systems on economy and gender equality with XiaoYu Wu (MME) and Ana Ferrer (Econ)
- Preliminary Investigations on Technical, Policy and Economic Barriers for Airport Hydrogen Storage with John Wen (MME) and Anindya Sen (Econ)

This successful event was a great opportunity for researchers and faculty from different areas within the University to collaborate and work together towards a common goal and break down silos in the process. The diverse expertise and skills from both parties are the foundation for strong interdisciplinary projects, and this workshop, serves as a model for future WIN and Faculty of Arts joint events and partnerships.

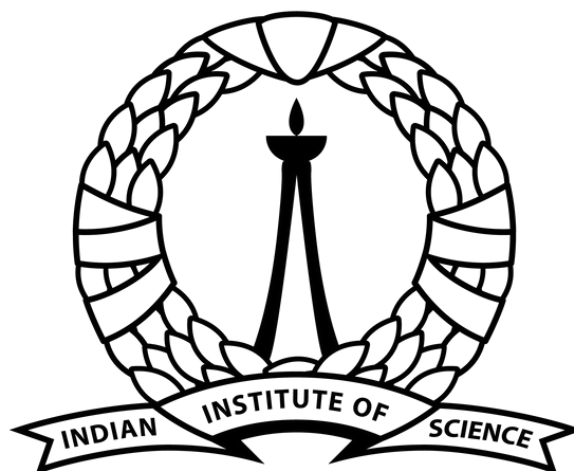




INDIAN INSTITUTE OF SCIENCE BANGALORE

The WIN-Indian Institute of Science (IISc) Bangalore partnership officially commenced in February 2021 with a virtual workshop on Quantum Materials & Devices, where six researchers from both sides presented over two days on Quantum Technologies and Quantum Materials & Engineering. This workshop was designed to engage in international collaboration on this very important topic. Recognizing the research excellence on both sides and clear complementary expertise in these fields, WIN and IISc Bangalore formalized an official memorandum of understanding (MOU) for research cooperation in November 2022. The finalization of this MOU allowed for the next steps in our partnership, opening pathways to research collaboration in this field.

A seed funding program was initiated to support joint projects, with WIN committing \$195,000 CAD, matched by IISc Bangalore at the equivalent of INR 75 Lakh. Three outstanding applications were received in December, which were reviewed by selection committees at WIN and IISc Bangalore. We are thrilled to announce that each application will receive full funding of \$65,000 CAD for WIN researchers, and Rs. 25 Lakhs (INR 2.5M) for IISc Bangalore researchers over two years.



भारतीय विज्ञान संस्थान

Details of projects awarded:

1. Novel Environment-Friendly C-based Quantum Materials for EVENTS Electroluminescent Devices for Single Photon Emission & Flat Panel Displays to Hany Aziz (ECE) with Asha Bhardawj (IISc)
2. Development of Electrostatically-defined Quantum Dots in Twisted Bilayer Graphene for Quantum Technology Applications to Jonathan Baugh (Chem) and Chandni U (IISc)
3. Quantum Sensing of Oxidative Stress in Sperm via Nitrogen Vacancy Centres to Veronika Magdanz (SDE) with David Cory (IQC) and Ambarish Ghosh (IISc)

The awards were officially announced on 14 March 2023 during an official visit of UW's President Vivek Goel to India as part of the UW's tour of the Indo-Pacific strategy to initiate new ties and strengthen existing partnerships in this region. Representatives from UW who accompanied President Goel on this tour included Associate Vice President, International, Ian Rowlands, Associate Director of International Relations, Amelia Burton, and WIN Executive Director, Sushanta Mitra.

HANY AZIZ

Hany Aziz is a Professor in the Department of Electrical and Computer Engineering, specializing in the materials needed to develop electronic devices like screens, sensors, and displays for computers, monitors and imaging devices. His project focuses on developing colloidal quantum dots (QDs), a class of nanometer sized materials with extraordinary electronic and optical properties used for optoelectronic devices.

Aziz has worked with QDs for the past several years, and his lab has made significant progress and breakthroughs in this area. As QDs are expected to drive a new generation of devices that will revolutionize many existing and novel consumer electronics, the global market for QDs is expected to increase significantly over the next few years. However, since QDs currently use heavy metals and toxic chemicals, there are serious challenges for manufacturing and at the end of product life – when these electronic devices end up in landfills, the chemicals leach into the soil which lead to significant health and environmental risks.



"This research funding has really helped my research get into the space of developing green alternatives in quantum dot materials and allows me to work with our talented counterparts at IISc Bangalore."

PROFESSOR HANY AZIZ

Since the Aziz lab cannot synthesize carbon-based QDs on their own, this partnership allows for greener alternatives for the methods and materials to produce them. In this collaboration, Aziz is working with Professor Asha Bhardawj from IISc to develop carbon-based QDs for these devices using environmentally friendly materials and processes, in particular, replacing heavy metals with carbon. Without this seed funding program, the research at UW would have been limited to the use of heavy metals for QD synthesis.

The outcomes of this work will directly serve UNSDG Goal 12 to "ensure sustainable production and consumption patterns" by eliminating toxic chemicals from a range of consumer electronics that constitutes a fragment of the global electronic waste, the latter predicted to grow significantly in the years to come. The collaboration will also provide training to one PhD student in Canada and two Research Associates in India, providing them with unique skills and hands-on experience in this emerging area.

**12 RESPONSIBLE
CONSUMPTION
AND PRODUCTION**



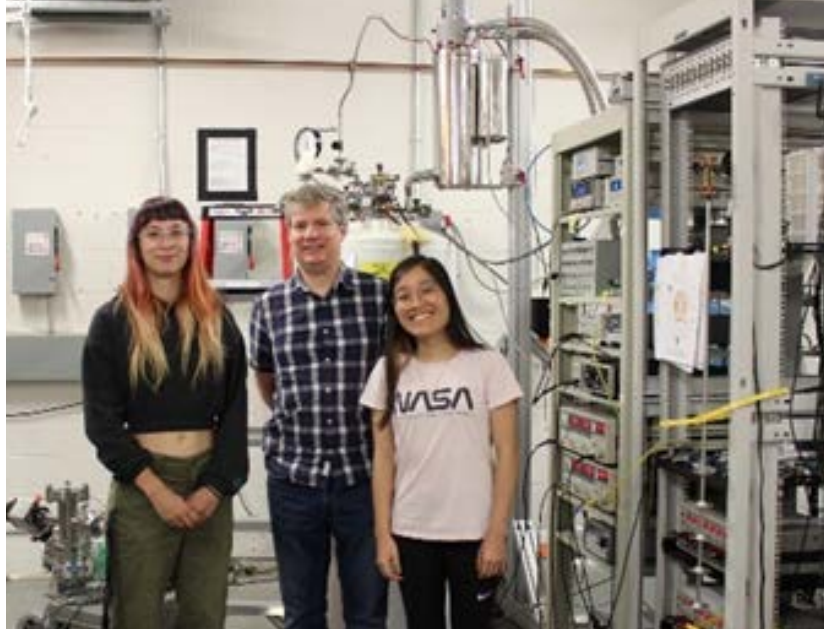
JONATHAN BAUGH

Jonathan Baugh is a Professor in the Department of Chemistry whose area of expertise is quantum materials and devices. Originally from Chattanooga, Tennessee, Professor Baugh completed his PhD in Physics at the University of North Carolina at Chapel Hill. Shortly after, Baugh joined UW to complete his post-doctoral research with Raymond LaFlamme, founding Executive Director of the Institute for Quantum Computing (IQC).

During his time as a Research Assistant Professor at UW, Baugh had the opportunity to visit the University of Tokyo through a JSPS fellowship. During his time there, he was introduced to quantum dot devices and learned the fundamentals of nanofabrication. These research experiences led him to the study of semiconductor nanostructures and their integration into devices for new applications.

In the project awarded for seed funding, Professor Baugh is teaming up with Professor Chandni U from IISc to develop quantum dots that incorporate a unique form of graphene for novel quantum computing and sensing applications. Graphene is a 2-dimensional sheet of carbon atoms arranged in a honeycomb pattern that gives it many remarkable properties, from being 100 times stronger than steel, to excellent thermal and electrical conductivity. New quantum properties were discovered when two graphene sheets are stacked and twisted, creating a large-scale order called a Moiré pattern that significantly affects the electrical properties ranging from insulation to superconductivity. When these various phases are seamlessly tuned together using electrical control, a unique platform for quantum devices is created.

Quantum bits, or qubits, are the fundamental building blocks for quantum computing and sensing applications. A promising type of qubit is based on manipulating a single electron within a zero-dimensional nanoscale region – this is known as a quantum dot. This joint WIN-IISc project seeks to develop the first quantum dots that will exploit the unique properties of twisted bilayer graphene to obtain robust and high-performance qubits.



“One of the biggest challenges for us is fabricating devices with these new materials, and we are excited to work with partners who have this know-how. To independently develop a research project along this line would take my group at least two years, so this collaboration saves us valuable time. That is why programs such as these organized by WIN are so important.”

PROFESSOR JONATHAN BAUGH

The IISc collaboration is an exceptional opportunity for Baugh to advance his research through the partnership with Chandni, whose group is skilled in developing bilayer graphene devices. This is an area of expertise complementary to Baugh’s; his group instead focuses on measuring these devices at very low temperatures and developing qubits using laboratory infrastructure here at UW. In turn, Chandni’s group benefits from the state-of-the-art characterization facilities at UW – a truly complementary and interdisciplinary collaboration.

**9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE**



VERONIKA MAGDANZ

In September 2022, Veronika Magdanz joined UWaterloo as an Assistant Professor in the Department of Systems Design Engineering. Her research focuses on biomedical engineering, specifically the development of magnetically controlled microrobots inspired by sperm cells.

Magdanz's joint project with Professor Ambarish Ghosh from IISc involves quantum sensing to detect reactive oxidative species (ROS) in sperm to evaluate sperm quality and male fertility. Expanding on the known relationship between male fertility and free radical presence, ROS measurements can help diagnose male infertility and develop potential treatments.

What is so exciting about this project is the use of diamonds containing nitrogen vacancy centers (NV) which have shown great promise as novel probes for biophysical measurements. NV-center containing nanodiamonds can be used to detect paramagnetic species such as free radicals, which are normally difficult to detect using conventional techniques. Nitrogen vacancy centers in diamond show excellent photostability and biocompatibility (cellular and systemic to whole animal level), unique room-temperature spin properties with optical read-out, and are chemically inert.

The announcement of the WIN-IISc seed funding call targeting quantum technology was a wonderful opportunity for Magdanz to reconnect with her former colleagues at IISc. The WIN-IISc partnership enabled Magdanz to reach out to her network of international contacts and advance her work alongside the skilled researchers at Bangalore.

With Ghosh's knowledge in crystal nanodiamonds combined with Magdanz's expertise in microrobotics, the team hope to achieve NV centers for detecting oxidative stress in sperm and predict DNA damage caused by ROS. The detection of ROS would therefore give implications for infertility treatment with antioxidants or other drugs.



3 GOOD HEALTH AND WELL-BEING



"This project will enable us to use quantum sensing to detect oxidative stress in sperm, which will contribute to a better understanding of male infertility. The WIN-IISc seed funding will help us to use nano diamonds to enable quantum sensing."

PROFESSOR VERONIKA MAGDANZ

EARLY CAREER RESEARCHERS

Veronika Magdanz

WIN welcomed Veronika Magdanz as a Core Member in October 2022 shortly after she joined the University as an Assistant Professor in the Department of Systems Design Engineering.

Magdanz' research is a novel example of the role nanotechnology plays in medicine and the kind of biomedical engineering possible at the micro- and nanoscales. Her expertise lies in the development of sperm-based micro- and nanorobots that are wirelessly controlled by magnetic fields. At the Magdanz Lab, the overarching vision for these tiny robots is to create more targeted and less invasive medical treatments.

Although Magdanz has only recently joined UW as a faculty member, her connection to Waterloo goes back to the early days of her academic life. Her research journey began at Technische Universität (TU) Braunschweig, where she completed her Diplom-Studies in Biotechnology. In her third year, she received a scholarship to participate in the International Study and Training Partnerships (ISAP/DAAD) exchange program and spent two academic study terms in the Department of Chemical Engineering at the University of Waterloo.

Her interests in micro- and nanotechnology started during her first thesis project, where she learned more about microfabrication and microfluidic chips at the University of British Columbia (UBC). This experience led Magdanz to complete her PhD at the Institute for Integrative NanoSciences in the Leibniz Institute for Solid State and Materials Research (IFW) Dresden, where she was introduced to sperm cell research and began to explore sperm-inspired microrobots.

Shortly after working in a sperm cell biology lab at TU Dresden as a post-doc, Magdanz joined the Institute for Bioengineering of Catalonia (IBEC), in the Smart Nano Biodevices group and focused on bio-printing and bio-sensing. Now at the University of Waterloo, the Magdanz Lab continues to advance sperm cell research and explores the interaction between nano particles and nanodevices to improve and optimize medical interventions.



Conrard Giresse Tetsassi feugmo

In November 2022, WIN welcomed new Core Member Conrard Giresse Tetsassi Feugmo, Assistant Professor in the Department of Chemistry at the University of Waterloo.

Tetsassi Feugmo's research lays at the intersection of nanotechnology and machine learning (ML), where his work demonstrates how the latter can improve the research and design process of nanomaterials. The ML approach reduces the time needed and helps narrow down the search for these nanomaterials and their properties.

Tetsassi Feugmo completed his undergraduate in Chemistry and his master's degree in chemistry with a specialization in Computational Chemistry at the University Yaounde I in Cameroon. Tetsassi Feugmo was then granted a prestigious scholarship to embark on an advanced specialized master's program in Nanotechnologies at the Catholic University of Louvain-la-Neuve in Belgium.

Throughout this program, he immersed himself in the field of computational materials science, dedicating his research to enhancing the non-linear optical properties of functionalized materials. This experience sparked his interest in physics and computer science and led him to pursue a PhD in Computational Chemistry at the University of Namur.

Post graduation, Tetsassi Feugmo embarked on a path of impactful research. Initially, he served as a postdoctoral associate at the University of Western Ontario before assuming the role of Research Officer at the National Research Council of Canada (NRC). Notably, his expertise led him to become a driving force behind the integration of machine learning and artificial intelligence in materials exploration. Furthermore, within the newly established facility in Mississauga, he played a pivotal role in overseeing the entire spectrum of activities pertaining to materials discovery and took charge of establishing an AI studio dedicated to innovative design processes. Driven by a desire for a more expansive scope, Tetsassi Feugmo transitioned from industry to academia, seeking a return to a diverse range of research projects and the opportunity to collaborate with students once again. This was a gratifying experience for him, rekindling the connection he missed after dedicating six years to serving as a Teaching Assistant during his PhD journey.

As a new professor at UW, Tetsassi Feugmo leverages computational techniques and machine learning to streamline and optimize the design processes for multi-component alloys and oxides. These innovative approaches find immediate applications in improving energy conversion and storage systems, as well as advancing the field of semiconductor gas sensors. In his role as an AI specialist, Tetsassi Feugmo seized the opportunity to spearhead a collaborative effort between WIN and Université de Bordeaux (UB). Together with Professor Kevin Musselman, a fellow WIN Member, he embarked on the endeavor to develop AI-assisted sensor devices, marking a significant stride in their collective expertise.



"I think I'm in the right position here at UW. The advantage of working at Waterloo is that you have the opportunity to collaborate with different teams. WIN enables us to work together with researchers of different expertise and put together a great team."

CONRARD GIRESSSE TETSASSI FEUGMO

Yverick Rangom

Yverick Rangom is an Assistant Professor in the Department of Chemical Engineering, who has also recently joined WIN as a Core member in November 2022.

In the global race towards electric vehicles, the demand for capable batteries has grown at an exponential rate. However, the high price tag is an obstacle for many Canadians in today's economy. Rangom's work demonstrates how nanotechnology in battery research can help tackle this issue and discover new solutions. Many batteries have the issue of heating up excessively when charging fast, and this causes internal side reactions that damage them quickly. His research involves exploring solutions to allow fast charging while increasing charge conductivity thus keeping temperatures cooler.

Originally from the Island of Martinique in the French Caribbean, Rangom began his academic journey at an engineering school in France that specialized in aerospace and automotives, giving him a background for and interest in automotives engineering. Afterward, Rangom came to University of Laval in Quebec to complete his undergraduate degree in mechanical engineering with a primary interest in cars and transportation, and continued his studies in Physics at York University. It was here where he gained a deeper understanding of fundamental science necessary to innovate effectively in highly technological advanced field of electrochemical energy storage.

Rangom then came to UWaterloo to pursue a masters degree in Electrical Engineering with Linda Nazar and Bo Cui as his supervisors. His graduate student work involved high frequency response supercapacitors utilizing electrodes with much improved electrical conductivity. Rangom was then accepted into doctoral studies at the University of Queensland in Brisbane, Australia, where he further studied electrode design and stability, this time focusing on lithium and sodium ion batteries. During his time in Queensland, Rangom collaborated with Michael Pope from the Department of Chemical Engineering and later joined Pope's lab upon graduation as a post-doctoral fellow. Here he worked on electrical vehicles and fast charging using state-of the art facility equipment available at UW.

In 2022, Rangom was offered a faculty member position with the Department of Chemical Engineering and joined the University as an Assistant Professor where he is continuing research in lithium-ion batteries. The goal of his work is to create more robust and capable electrodes that last longer under repeated fast charging sessions and require less expensive thermal management solutions, providing a technological answer to the high cost of electric vehicles.

By creating the next generation of "transportation grade" Li-ion batteries that are less prone to joule heating and can be charged more often opening an avenue for equipping vehicles with reduced sized battery packs, which in turn will substantially lower the purchase cost of electric vehicles and promote a more vibrant used car market.

Rangom explains that regular cars mean people are dependent on oil companies, but electric vehicles empower people – because they can readily be integrated into a loop of local renewable energy production (with solar) and consumption that by-passes giant multinational energy conglomerates.



"Batteries and nanotechnology are part of a high technology path to give power back to the people"

YVERICK RANGOM

WIN BUSINESS DEVELOPMENT

Engaging Industry

NSERC ALLIANCE GRANTS

Business development activities at WIN involve working directly with researchers to connect them with industrial partners for federal and provincial granting programs, such as the NSERC Alliance Grants.

In 2022, WIN provided liaison, networking, technical and writing support to teams applying for the NSERC Alliance Mission Grant. WIN Members Mahla Poudineh (ECE) and Michael Pope (ChE) submitted a proposal for the development of gas-phase microfluidic devices combined with electrochemical sensing for methane emissions monitoring, with industry partner, Pro-Flange Ltd. This proposal was successful, and the project is currently underway

NSERC-SSHRC JOINT CALL FOR SUSTAINABLE AGRICULTURE

With the assistance of the WIN Business Development Manager, Professors Eihab Abdel Rahman (SDE), Raafta Mansour (ECE) and Alex Penlidis (ChE) have been working on a proposal to develop portable, inexpensive but sensitive field-deployable sensors for monitoring greenhouse gas (GHG) emissions from agricultural settings. WIN has been instrumental in connecting the team with various companies working in the field of farm animal feed and plant agriculture, as well as engaging prospective collaborators at the University of Guelph. The team will submit the full proposal in Fall 2023.

DELEGATION FROM BRAINPORT DEVELOPMENT, EINDHOVEN

Over the last two years, WIN has been steadily growing its partnership with Brainport Development, an economic development organization for the region of Eindhoven in the Netherlands. Shortly after international travel became possible again, WIN hosted a delegation from the Netherlands in early May 2022.

The delegation included:

- Harman Idema, Consul General, Consulate-General of the Netherlands in Toronto
- Sanne Echten, Senior Advisor, Innovation, Technology and Science, Embassy of the Netherlands in the USA
- Michelle Baas, Senior Advisor, Economic Affairs (Technology and Science)
- Johann Beelen, Business Development Manager, USA and Canada
- Carol de Vries, Chief Technology Officer, PhotonDelta
- Andrew Dasselar, Director, Netherlands Foreign Investment Agency

During the visit, PhotonDelta showed interest in partnering with WIN and using its extended network to develop joint projects for the use of nanophotonic devices in agriculture. Discussions continued over the summer, evolving into plans for accessing Mitacs Accelerate International funding for graduate student exchange.

WIN GROUP TRAVEL TO EINDHOVEN

In fall 2021, WIN announced an internal call for proposals for partnering with Eindhoven-based innovation entities. Three proposals received funding in support of group travel to Eindhoven.

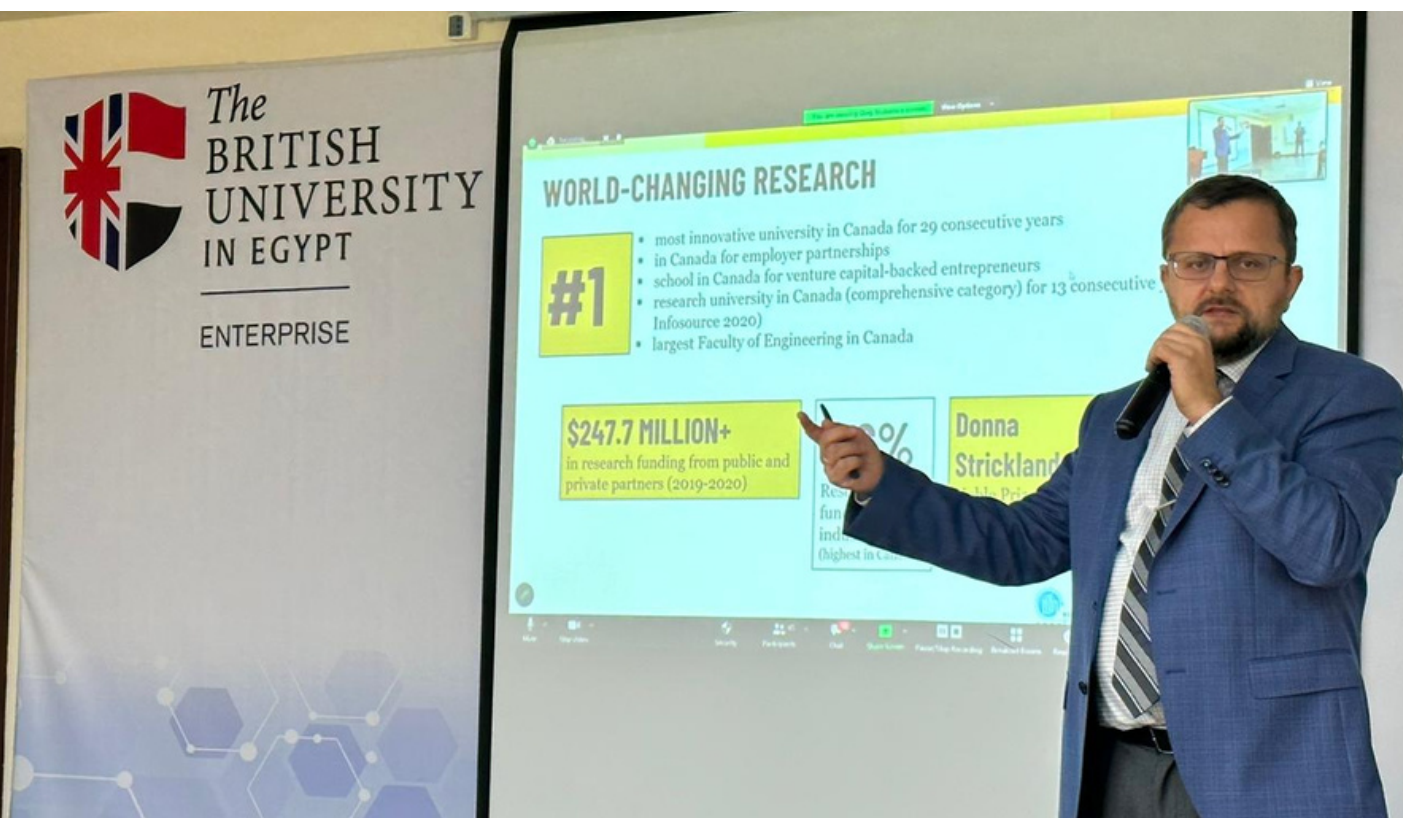
On May 23rd to the 25th 2022, the WIN team organized a group travel for the recipients of the grant. The delegation consisted of Sushanta Mitra, Lisa Pokrajac, Oleg Stukalov representing WIN, and Inna Novodchuk (former PhD student in Yavuz's lab), Pranav Gavirneni (PhD student in ECE, representing Prof. William Wong), Derek Schipper (Chemistry), Mustafa Yavuz (MME), and Carolyn Ren (MME). Ren was joined by her collaborator Jacky Kormylo, an MSc student in the Faculty of Health.

Key outcomes of the visit include:

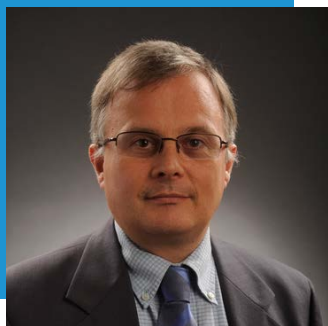
- HighTechXL (startup creation and incubation program) negotiations with Yavuz's team for a license for their medical diagnostics invention
- Ren met to several key prospective business partners for her lab's innovative compression sleeve medical device
- Schipper and Ren were involved in preliminary meetings with the view of attracting them to partner with HighTechXL startup creation program
- Gavirneni was involved in collaboration discussions with leadership of Holst Centre (applied research and commercialization institute) located on High Tech Campus (former Philips Research Campus).
- WIN and Holst Centre are working to develop an internship program for UW students to work at Holst Centre on projects related to flexible electronics, photonics, portable medical diagnostics, etc. MOU is being developed to guide the process

NANOTECHNOLOGY ENTREPRENEURSHIP BOOTCAMP FOR AFRICAN GRADUATE STUDENTS

In January 2023, Oleg Stukalov served as an instructor at the nanotechnology entrepreneurship bootcamp organized by UNESCO's branch in Egypt in partnership with The British University in Egypt (BUE) in Cairo. The bootcamp hosted about 25 graduate students and postdocs from various African countries. Stukalov made a presentation covering three topics – an overview of the nanotechnology research and entrepreneurship eco-system at the University of Waterloo, personal nanotech entrepreneurial journey, and IP protection. Stukalov also served as a mentor for the student team while they were preparing for the final pitch competition.



NEW TO THE WIN MEMBERSHIP IN 2022



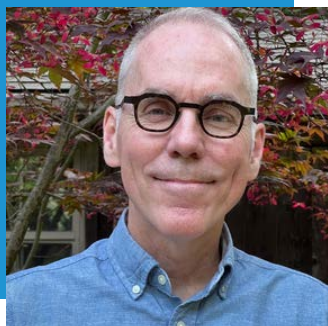
ERIC CROISET

Professor

Department of Chemical Engineering

Faculty of Engineering

Research interests: Reaction engineering, solid oxide fuel cell (SOFC) syngas/hydrogen production, carbon capture and sequestration (CCS), process simulation, reactions in Supercritical water, green reaction engineering, large scale optimization of energy systems, CO₂ capture from large point sources



JOHN CORRIGAN

Professor and Department Chair

Department of Chemistry

Faculty of Science

Research interests: Nanomaterials, nanoclusters, metal-chalcogenolate complexes: synthesis and reaction chemistry, structural chemistry, organometallic chemistry



KOMAL HABIB

Assistant Professor

School of Environment, Enterprise and Development (SEED)

Faculty of Environment

Research interests: Resource and waste management, material and energy flow analysis from micro- to macro-scale and exploring resource dependency of future clean energy systems



MILAD KAMKAR

Assistant Professor

Department of Chemical Engineering

Faculty of Engineering

Research interests: Additive manufacturing, linear and nonlinear rheology nanomaterials synthesis, interfacial assembly, complex fluids such as emulsions, polymer processing, electrical applications such as electromagnetic shielding and sensors, sustainable materials, smart aerogels



VERONIKA MAGDANZ

Assistant Professor

Department of Systems Design Engineering

Faculty of Engineering

Research interests: Microrobots, sperm cells, magnetic actuation, remote control, wireless, soft robots, medical robots, bioprinting, 3D printing



YVERICK RANGOM

Assistant Professor

Department of Chemical Engineering

Faculty of Engineering

Research interests: Carbon electrodes for energy storage alkali-ion storage mechanisms, solid electrolyte interphase formation mechanisms, heterogeneous material joining techniques and processes, electrically and ionically conductive materials and composites, mechanical properties of composite materials, manufacturing, nanotechnology, filtration devices



CONRARD TETASSI

Assistant Professor

Department of Chemistry

Faculty of Engineering

Research interests: Computational chemistry, machine learning, materials sciences, nonlinear optics, vibrational and electronic spectroscopies, high performance computing and software development, data solutions for sciences, computational electrochemistry and surface science

INTERNATIONAL

As of April 2023, WIN has 43 international research partners in 16 countries: Australia, Brazil, Czech Republic, China (including Hong Kong), France, Germany, India, Israel, Japan, South Korea, Netherlands, Poland, Taiwan, Thailand, United Kingdom and United States.



AUSTRALIA	University of Sydney Institute for Nanotechnology (Sydney Nano)
BRAZIL	Brazilian National Nanotechnology Laboratory (LNNano) Federal University of ABC (UFABC)
CZECH REPUBLIC	Technical University of Liberec (TUL) Central European Institute of Technology (CEITEC)
CHINA	Soochow University (SU) Suzhou Industrial Park (SIP) Tsinghua University Chinese Academy of Sciences National Center for Nanoscience and Technology
HONG KONG	Hong Kong Polytechnical University (PolyU)
FRANCE	Université de Bordeaux
GERMANY	Center for Nano Integration Duisburg-Essen (CENIDE)
INDIA	Indian Institute of Science (IISc) Indian Institutes of Technology – Bombay (IITB); Kharagpur (IITKGP) Delhi (IITD) Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) University of Calcutta
ISRAEL	Technion-Israel Institute of Technology Bar-Ilan University Institute for Nanotechnology (BINA)
JAPAN	Japan National Institute for Materials Science (NIMS)
NETHERLANDS	University of Twente, MESA+ Institute for Nanotechnology Brainport Developments PhotonDelta HighTechXL Technical University Eindhoven Saxion University
POLAND	MISMap College of the University of Warsaw
SOUTH KOREA	Korean Advanced Nano Fab Centre
TAIWAN	Academia Sinica (AS) National Taiwan University (NTU) National Tsinghua University (NTHU) National Chiao Tung University (NCTU) National Cheng Kung University (NCKU) National Program on Nanotechnology (NPNT)
THAILAND	National Nanotechnology Center, Thailand (NANOTEC)
UNITED KINGDOM	University of Cambridge University of Bristol
UNITED STATES	Oak Ridge National Laboratories State University of New York (SUNY) Buffalo California Los Angeles (UCLA)

CZECH REPUBLIC

This year WIN welcomes two internationally renowned universities from the Czech Republic as partners – the Technical University of Liberec (TUL) and the Central European Institute of Technology (CEITEC) located within the Brno University of Technology.

TUL is well-known for its Institute for Nanomaterials, Advanced Technologies and Innovation, and WIN welcomed Professor Jan Valtera, Vice-Dean International as a Visiting Scholar in Spring 2023. In the same term, a Memorandum of Understanding (MOU) between WIN and CEITEC was drafted and signed, allowing bilateral cooperation in joint research and associated activities for collaboration.

The Czech Republic has a rich history of science and technology education and innovation, with Brno known as the “City of Electron Microscopy”. This partnership will allow WIN exposure to international electron microscopy companies such as Tescan and ThermoFischer who have a significant presence in Brno. These partnerships also presents excellent opportunities to engage with a leading Central/Eastern Europe community; the region is underrepresented but is well known for its quality of education and rich history for quality research.

INDIA

As the Indo-Pacific Region is the world’s fastest growing-region, encompassing 40 economies and over four billion people, it is easy to recognize the significant opportunities for Canadian business and growth in this area. In line with the Federal Government’s strategy for the Indo-Pacific Region, UW has earmarked this area as a critical and strategic area for academic partnership.

In March 2023, UW and Waterloo International organized a trip for President Vivek Goel, to visit several universities and research institutes as part of UW’s strategy for increased activity, partnership and collaboration within this region for the purpose of “presence-building.” President Goel was accompanied by Associate Vice President, International, Ian Rowlands and WIN Executive Director, Sushanta Mitra.

During their visit, the delegation met with many government officials and business representatives, including the Canadian Consulate General, and the High Commission of Canada in India in New Delhi, the Canadian Consul General in Mumbai, the Canada-India Business Council of Canada in Bangalore Innovation Summit, and the Gujarat International Finance Tec “GIFT” City.

Partnership building with key academic institutions in India was also a top priority, with the delegation visiting the Indian Institute of Technology (IIT) Madras, IIT-Delhi, IIT-Kharagpur, IIT-Bombay, Jadavpur University, Sister Nivedita University, and the Association of Commonwealth Universities. On the final day, Mitra and Rowlands visited Tata Institute for Social Sciences.

The Waterloo delegation to India provided an opportunity to touch base on current partnerships and introduce new ones with many of India’s top universities, which are critical for the University as outlined in the Strategic Plan 2020-2025 and Waterloo at 100.

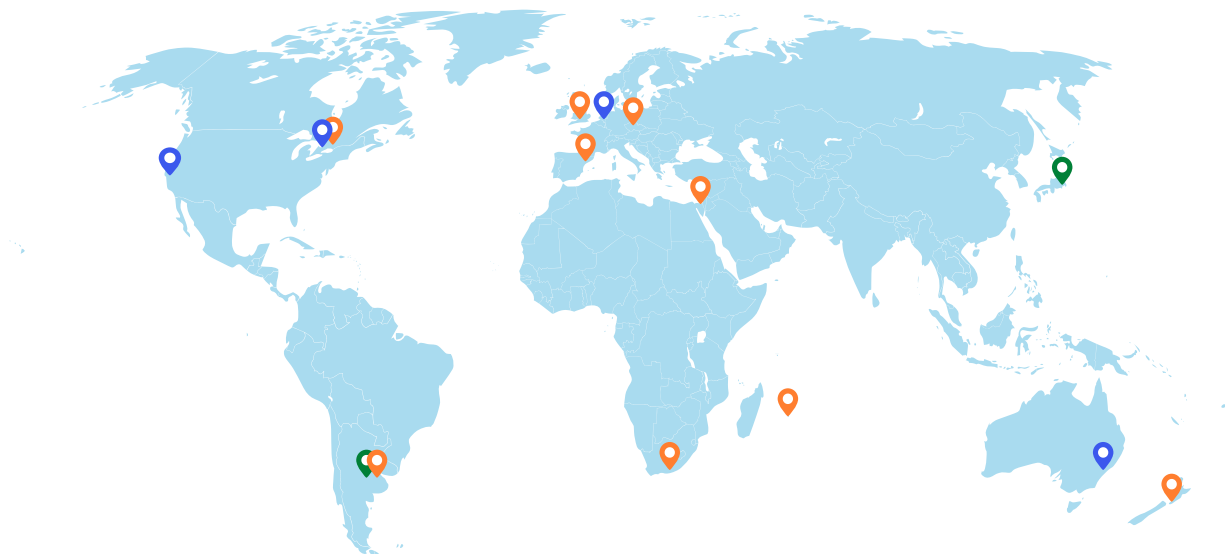
This trip was the first key step towards bringing together the specialists and leaders in common and specific research areas, and WIN looks forward to increasing engagement with the top Indian universities over the coming years.

INTERNATIONAL NETWORK

FOR SUSTAINABLE NANOTECHNOLOGY



NETWORK4SUSTAINABLE
NANOTECHNOLOGY



Founding Members



Academic Members



Supporting Members

The International Network for Sustainable Nanotechnology (N4SNano) is a consortium of leading organizations in the field of nanotechnology representing institutes, universities, non-profit and governmental agencies. Founding members of the Network are from the Waterloo Institute for Nanotechnology (WIN) in Canada, MESA+ Institute for Nanotechnology from the Netherlands, the University of Sydney Nano Institute (Sydney Nano), and the University of California Los Angeles (UCLA). The Japan Science and Technology Agency (JST) has been a supporting member since its inception.

2022 was an eventful year for the network. In August, the official Global Summit on “Nanotechnology for a Healthier and Sustainable Future” was held in Waterloo, Canada and Sydney, Australia. The Summit featured four thematic sessions, three directly related to nanotechnology, including nanomedicine, agricultural nanotechnology, digital health & AI diagnostics, and the fourth focusing on equity, diversity & inclusion as it relates to sustainability. At Sydney, the global leaders in nanotechnology research took part in an exhilarating debate surrounding the topic “will personalized medicine provide a healthier and sustainable future for us all?” with speakers from several institutions across both Canada and Australia.

In November 2023, the Global Summit will be held at Sydney Nano on Energy and Sustainability.

N4SNANO GLOBAL SUMMIT

After the successful launch event in February 2022, the inaugural N4SNano Global Summit took place at the University of Waterloo on 10 - 11 August 2022 (ET), with the satellite events at the University of Sydney on 11 - 12 August 2022 (AEST) in a hybrid setting. This event featured four thematic sessions, three of which were directly related to nanotechnology, including nanomedicine, agricultural nanotechnology, digital health & AI diagnostics, and the fourth focusing on equity, diversity & inclusion related to sustainability.

The full agenda of the Global Summit is found [here](#), with links to the presentations found [here](#).

DAY 1

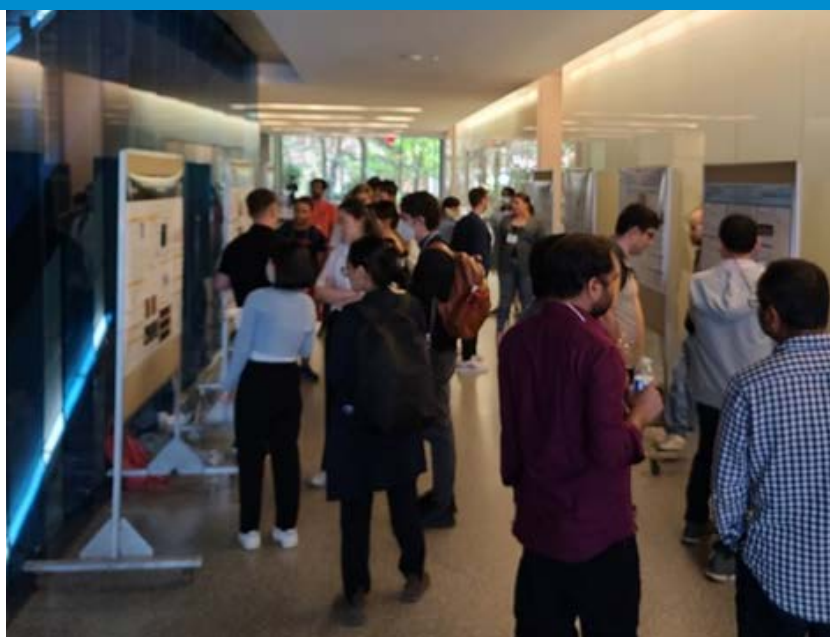
Day 1 of the Global Summit opened with a technical talk on nanomedicine titled, “Operating Biological Logic Gates by Gold Nanoparticle-Fluorophore Conjugates,” by Professor Dror Fixler, Director of the Institute for Nanotechnology at Bar-Ilan University in Israel (BINA), and a second talk by Professor Jianhua Hao from Hong Kong Polytechnic University on “Pathogenic Virus Detection Using Up conversion Luminescence Nanomaterial-based Biosensor toward Point-of-Care Diagnostics”, along with short talks by researchers from South Africa, Australia and UW.



During the lunch break there was a networking poster session for trainees and students. The second half of Day 1 covered the agricultural nanotechnology theme, featuring a keynote talk from Dr Jason White, Director of the Connecticut Agriculture Experiment Station titled, “Nanotechnology-enabled Agriculture: a path to global food security?” The student poster projects were evaluated for an award that was received by two outstanding students, Brian Youden (UW) and Anish Verma (Toronto Metropolitan University). In the evening, Waterloo hosted a banquet dinner at UW’s Federation Hall where the audience tuned in to the interactive debate on personalized medicine hosted at the University of Sydney.

DAY 2

Day 2 of the Summit opened with the plenary talk by Alexander Wong from Systems Design Engineering at UW, titled “Intelligent Design through Explainability and Trusted AI-driven Design for Healthcare,” followed by technical talks from speakers from South Africa and UW. The Summit concluded with a keynote address from Palesa Sekhajane, Director of Strategic Partnerships from Nelson Mandela University for the EDI and Sustainability session of the summit.



NANOFELLOWSHIPS

Since 2008, WIN's Nanofellowship program attracts and supports graduate students from Canada and around the world to pursue nanotechnology research at the University of Waterloo. Valued at \$10,000 each, each scholarship is made possible through a generous donation from an anonymous donor. Through an annual competition, the Nanofellowship is awarded to top graduate students for their outstanding research and contribution to the future of nanotechnology.

This year, WIN is proud to present 45 Nanofellowship Awardees who were honored at the 2022 Annual Research Leaders Gala and Holiday Reception. Congratulations to all the 2022-23 Nanofellowship winners!

- Md Fahim Al Fattah
- Negin Bouzari
- Irina Bukhteeva
- Li Chang
- Qiaoyun Chen
- Ali Ghatei Kalashami
- Hossein Golzar
- Tao Guo
- Lian Han
- Zhuoyang He
- Md. Milon Islam
- Rabiul Islam
- Muhammed Kayaharman
- Reza Kohandani
- Salman Lari
- Yasaman Maddah
- Jonathan David Mayry
- Cameron Meaney
- Kseniia Medvedeva
- Mohammad Ala Mohajerzadeh
- Dorsa Mohammadrezaei
- Ewomazino Constance Ojogbo
- Natalie Prislinger Pinchin
- Lanting Qian
- Youssra Rahham
- Md Masud Rana
- Daniel Rickert
- Soumyadeep Saha
- Fatemeh Samaeifar
- Sepideh Sarmast Sakhvidi
- Mayuri Sritharan
- Youchao Teng
- Avery To
- Lei Wang
- Yi Wang
- Ethan Watt
- Zhao Weinan
- Michael Wright
- HeeBong Yang
- Junjie Yin
- Brian Youden
- Zhuo Yu
- Jinhe Zhang
- Jinxuan Zhang

“The generous funding and career opportunities provided by the WIN Nanofellowship has helped kickstart my academic journey and fully focus on my research through supplying financial peace of mind.”

ETHAN WATT, MSC STUDENT, SCHOOL OF PHARMACY

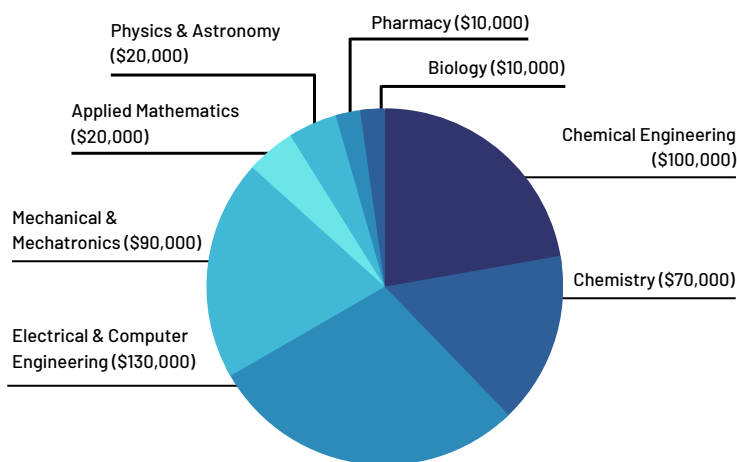
WIN would also like to thank the members of the Nanofellowship Committee for their thoughtful contributions and strategic advice to constantly improve the award program, and the Nanofellowship Evaluation Committee for their time and hard work to review and select the most deserving graduate students for the award.

CITIZENSHIP	APPLICANTS	AWARDEES
Canadian	26 (30%)	11 (24%)
International	60 (69%)	33 (73%)
Permanent resident	1 (1%)	1 (2%)

DEGREE PROGRAM	APPLICANTS	AWARDEES
PhD	62 (71%)	37 (82%)
MASc/MSc	25 (29%)	8 (18%)
Total	87	45

DEPARTMENT	APPLICANTS	AWARDEES
Applied Mathematics	2 (2%)	2 (4%)
Biology	1 (1%)	1 (2%)
Chemical Engineering	16 (18%)	10 (22%)
Chemistry	15 (17%)	7 (16%)
Electrical and Computer Engineering	25 (29%)	13 (29%)
Mechanical and Mechatronics Engineering	17 (20%)	9 (20%)
Pharmacy	4 (5%)	1 (2%)
Physics and Astronomy	5 (6%)	2 (4%)
Systems Design Engineering	2 (2%)	0
Total	87	45

AMOUNT AWARDED



"The WIN nanofellowship gave me a feeling of belonging to the academic and research society at the University of Waterloo that inspired me to grow more in academia, and provided financial support which helped me to concentrate more on research as a graduate student."

YASAMAN MADDAH, PHD CANDIDATE, DEPARTMENT OF CHEMICAL ENGINEERING

WIN RESEARCH CELEBRATION

On 2 December WIN hosted the 2022 Research Celebration and Holiday Reception to recognize the achievements of our researchers, graduate students and staff members in the QNC as well as the 2022 WIN Rising Star award recipient.



The WIN Rising Star Award was created to recognize an emerging leader in the field of nanoscience and nanotechnology and this year was awarded to Letian Dou, Associate Professor of Chemical Engineering at Purdue University. WIN also welcomed the 2021 Rising Star awardee Cao Thang Dinh, Assistant Professor of Chemical Engineering at Queen's University to give a keynote presentation titled, "Electrosynthesis of Renewable Fuels and Chemicals".

2022 WIN RESEARCH LEADERS AWARD

- | | | | |
|--------------------|-------------------|------------------|----------------|
| • Zhongwei Chen | • Adrian Lupascu | • German Sciaini | • John Yeow |
| • Kyle Daun | • Graham Murphy | • Rodney Smith | • Evelyn Yim |
| • Irene Goldthorpe | • Kevin Musselman | • Shirley Tang | • Aiping Yu |
| • David Hawthorn | • Linda Nazar | • William Wong | • Boxin Zhao |
| • Emmanuel Ho | • Michael Pope | • Adam Wei Tsen | • Norman Zhou |
| • Scott Hopkins | • Mahla Poudineh | • Yimin Wu | • Na Young Kim |

WIN also recognized two staff members for their outstanding contributions to WIN and the QNC by going above and beyond the call of duty to help support and advance nanotechnology research. Congratulations to:

Kendra Goertz,
Marketing and Operations Coordinator

Chris Kleven,
QNC Facility Technician

WIN RISING STAR AWARDS 2022

This year marked the fourth Rising Star Award Competition in Nanoscience & Nanotechnology. The program is designed to introduce full-time early career researchers, or "Rising Stars" to WIN/UWaterloo faculty which will lead to new partnerships and promote WIN as a world-class institute in Nanotechnology.

In 2022, WIN received applications from six outstanding researchers from around the world, including Canada, Singapore, the United States and the United Kingdom. This year's WIN Rising Star was awarded to Professor Letian Dou from Purdue University in Indiana USA, as chosen by a committee of three previous Rising Star awardees and the WIN Executive Director.

The WIN Rising Star Award provides a \$5,000 cash honorarium to be used to bring the Rising Star to UWaterloo and WIN to meet researchers and students, give guest lectures and seminars, and commence potential collaboration. Professor Letian Dou visited UW in June 2023 for WIN Day.

LETIAN DOU

Purdue University,
Davidson School of Chemical
Engineering



SHAD is an annual Canadian summer enrichment program, bringing exceptional high school students to Canadian university campuses each summer. In July 2019, six students visited WIN for one week, obtaining hands-on learning in experimental design. WIN member Chris Backhouse from the Department of Electrical Engineering, in collaboration with Sushanta Mitra, hosted the students and introduced them to paper-based microfluidics experiments, illustrating how to easily analyze a mix of fluids which has a variety of applications in medical diagnoses, environmental monitoring, food and water testing.

In July 2022, a second group of SHAD students visited the Micro Nano-Scale Transport Lab (MNT) – for three days where they toured the QNC and the Quantum-Nano Fabrication and Characterization Facility (QNFCF) and learned about some important techniques that take place in the QNFCF cleanroom. They also toured the undergraduate Nanotechnology Engineering labs located within the QNC, for those students who may be interested in attending UW's Nanotechnology Engineering program upon graduating high school.

During their visit, the students received preliminary training on the fabrication of paper devices for point-of-care testing, specifically on COVID-19 rapid tests. The project involved the use of gold nanoparticles that produce a color response when in contact with key markers such as COVID-19 proteins. They also learned how to prepare DNA-conjugated carbon nanoparticles through centrifugation. Students also assembled half-strip lateral flow assays (LFAs) and applied required chemicals to the paper to make test and control lines. The students also learned about different types of microfluidic chips and observed interesting features of nanomaterials using an optical microscope.

For the students, the SHAD Program and their time at WIN has been transformative.

"It has been really fun to be in this laboratory. I got to experience and learn new things from this program that I wouldn't have had a chance to do otherwise. I also met new friends and we learned a lot from each other too."

CHLOE LEE-YOW





CANADA-WIDE SCIENCE FAIR

The Canada-Wide Science Fair (CWSF) is the country's largest annual youth science, technology, engineering and mathematics (STEM) event, bringing together top young scientists and their projects. The 2022 event was held virtually in May out of Fredericton NB, and over three days, visitors were welcomed to engage with student and exhibitors. WIN and the UW Nanotechnology Engineering (NE) Program organizers hosted a booth, where visitors were provided with a "Virtual Tour" of the QNC and NE laboratories, with the audience asking questions in real time. The virtual tour was organized and conducted by NE Director and Professor in Chemical Engineering, Ting Tsui and Senior Laboratory Demonstrator, Jennifer Coggan. The tour was well-attended with many likes and positive comments.

WIN was also approached by CWSF organizers to create a nanotechnology specific award. The award is for an outstanding project related to one of: smart and functional materials; connected devices; next generation energy systems; or therapeutics and theranostics. Awards are for three different categories: (a) 1 Senior Award and opportunity to visit WIN to present project at WIN's Research Day Celebration; (b) 1 Intermediate Award; and (c) 1 Junior Award. The total support for this award is \$4,500 per year.

The students awarded for best projects in nanotechnology-related themes at the 2022 CWSF are:

- Junior Winner: Sophia Zhang, Eastern Newfoundland NL for "Triboelectric Effect and Nanogenerator" (<https://projectboard.world/ysc/project/87183>) (how much for each?)
- Intermediate Winner: Katharine Morley, Vancouver Island BC for "Coagulant Conundrum: Exploring the Efficacy of Natural and Chemical Coagulants on Microplastics" (<https://projectboard.world/ysc/project/87379>)
- Senior Winner: Thomas Pronovost, Réseau Techoscience, QC for "Analyse ta foulée!" (Analyse your stride!) (<https://projectboard.world/ysc/project/88163>)



COMMUNITY BUILDING

COFFEE AND CONNECTIONS

This year WIN began a new event series titled: Coffee and Connections with Sushanta Mitra. This drop-in style event has provided an opportunity for the WIN community to come together in a casual environment to connect with each other outside of their labs or offices. This event also provides a space for attendees to discuss any WIN-related questions, comments, or concerns.



PITCHES & DEMOS

Pitches and Demos is a new networking event introduced this year that brings together the WIN community to showcase research achievements, current projects and pitch potential industry partnerships. Alongside WIN members, graduate students, postdocs, research associates, and members from local industry and business incubators are encouraged to give a 5-min pitch.

Event dates in 2022 - 2023:

- 6 May 2022
- 7 October 2022
- 4 November 2022
- 14 April 2023

SUSTAINABLE FUTURE PERSPECTIVES SERIES

WIN partnered with the Department of Chemical Engineering to organize a series of discourses on technology-based solutions to global challenges linked to the United Nations Sustainable Development Goals.

The inaugural event was held 6 October 2022, titled: Recycling Electronic Components: Reducing Global Waste.

In this event, Peidong Yang, distinguished professor in the Department of Chemistry at the University of California, Berkeley, was joined by WIN-members Dayan Ban (ECE, ChE and WIN) and Ting Tsui (ChE and WIN). The discussion was moderated by Sushanta Mitra (WIN) and Marios Ioannidis (ChE). It concluded with an open question period with the audience.

The second occurrence of the Sustainable Future Perspectives series was hosted on 12 April 2023 in the Faculty Hall of E7, titled “Recycling Battery Materials: Aiming for Net Zero.” This engaging panel discussion put a spotlight on sustainable alternatives to meeting the increasing demand for energy in the future.

The panel included WIN member, Zhongwei Chen (ChE), Michael Fowler (Canada Research Chair in Zero-Emission Vehicles & Hydrogen Energy, ChE) and guest speaker Khalil Amine, a Distinguished Fellow from the Argonne National Laboratory. WIN Executive Director, Sushanta Mitra and Azzam-Dullien Endowed Chair, Jeff Gostick were the event’s moderators.

A full audience of graduate students and battery experts led to a lively discussion on how we can build sustainable energy structures to meet future demand without depleting our resources, and whether there are enough trained students and personnel working in the field of batteries and energy storage to keep up with this demand.



UNDERGRADUATE **NANOTECHNOLOGY ENGINEERING**

The Nanotechnology Engineering (NE) program, Canada's first accredited Nanotechnology Engineering program, is designed to provide a practical education in key areas of nanotechnology, including the fundamental chemistry, physics, engineering of nanostructures and nanosystems, and quantum physics. Students in this Bachelor of Applied Sciences undergraduate program receive a comprehensive education in the rapidly developing nanotechnology field, allowing them to work across conventional disciplines in many industry sectors.

Though the program shares its home with WIN, the relationship between these students and our institute goes beyond a location. Many of WIN's international and industry partnerships resulted in co-op placements for NE students.



COLLABORATIVE NANOTECHNOLOGY

GRADUATE PROGRAM

The Collaborative Program in Nanotechnology at the University of Waterloo (UW) is a unique program not offered elsewhere in Canada. From basic research to direct application, this program encourages the collaboration of faculty, students and industry towards technological innovation, social benefit and economic growth. The goal of this distinctive program is to provide a rich and interdisciplinary educational journey, with the opportunity to pursue a nanotechnology related MASc, MSc or PhD in any one of the following six departments:

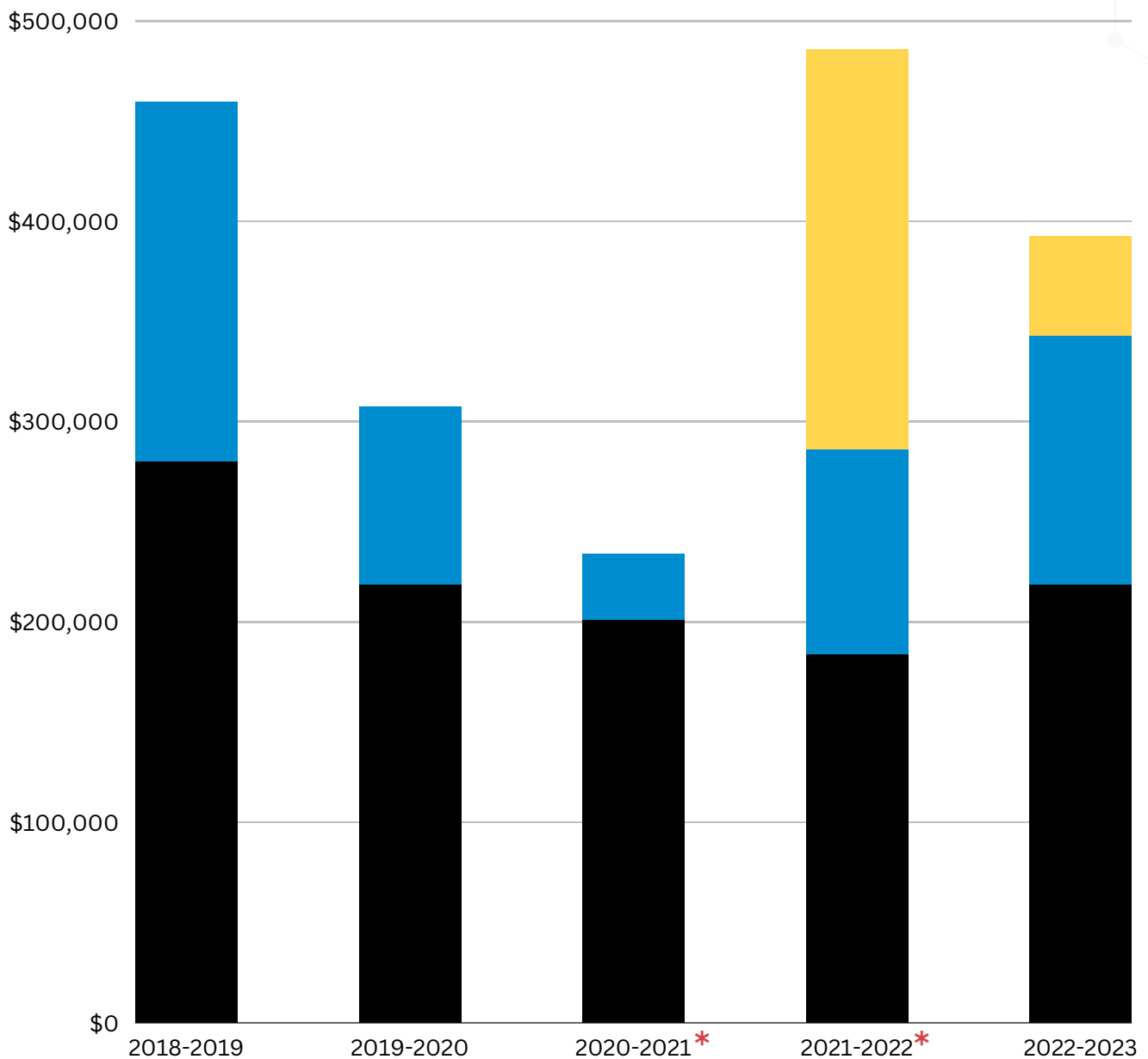
- Chemistry
- Physics
- Chemical Engineering
- Electrical and Computer Engineering
- Mechanical and Mechatronics Engineering
- Systems Design Engineering

The Mike & Ophelia Lazaridis Quantum-Nano Center's (QNC) cutting-edge labs and facilities is home to UW and WIN's nanotechnology research, and many courses offered in this program are taught by WIN members. Alongside research and instruction, WIN also strives to create a supportive environment for students by managing a welcoming main office for students to seek assistance, organizing key and office allocations and supporting their academic success through the Nanofellowship program. Outside of the lab, WIN encourages communication and collaboration between students by hosting many interactive and networking events and supports their extracurricular activities through the Waterloo Institute for Nanotechnology Graduate Student Society (WINGSS).



BUDGET

- WIN Funding to Members
- Office Operations
- Salary



*Impacted by COVID 19

LIFE IN THE QNC

42

WIN Professor
Research Laboratories

1

Visiting Professor
Office

200 +

Graduate
Students

3

Meeting
Rooms

1

Rooftop
Patio

1

Seminar
Room

4

Kitchens/Lounges

ACKNOWLEDGEMENT OF TRADITIONAL TERRITORY

We acknowledge that the University of Waterloo is located on the traditional territory of the Neutral, Anishnaabeg, and Haudenosaunee people. The University is situated on the Haldimand Tract, the land promised to the Six Nations that includes 10 kilometres on each side of the Grand River.



nano.waterloo.ca

WATERLOO INSTITUTE FOR NANOTECHNOLOGY
200 UNIVERSITY AVE. W., WATERLOO, ON, CANADA N2L 3G1