

ACKNOWLEDGEMENT OF TRADITIONAL TERRITORY

The University of Waterloo acknowledges that much of our work takes place on the traditional territory of the Neutral, Anishinaabeg, and Haudenosaunee peoples. Our main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River.



WATERLOO INSTITUTE FOR NANOTECHNOLOGY
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WIN

2017-2022

5 YEAR REPORT



UNIVERSITY OF
WATERLOO



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

I would like to congratulate the Waterloo Institute for Nanotechnology (WIN) on its accomplishments over the reporting period. In the last few years, WIN has been extremely active, nurturing new international partnerships and encouraging interdisciplinary collaborations via targeted seed funding. The Institute also effectively managed operations during the recent pandemic, by not only adapting quickly to new internal operational processes, but also identifying how nanotechnology can be applied directly to address COVID-related challenges. As a result, research teams were able to join the global fight against COVID, addressing its short- and long- term effects, and developing new sensors, diagnostic tools, antiviral coatings and treatments, and drug and vaccine delivery technologies.

In 2018, WIN introduced the Interdisciplinary Research Funding Program (IRFP) to support new collaborations in traditionally dissimilar disciplines and to also support partnerships with national and international institutes through annual competitions. In total, five competitions have been held, supporting 24 joint projects with partners in the Netherlands, the National Research Council, the Water Institute, and other faculties at the University.

With an intent to drive innovation, WIN has created

opportunities for complementary disciplines to form collaborations, such as showcasing the connections between nanotechnology and quantum science through the Quantum-Nano Collision Series with the Institute for Quantum Computing (IQC) and a workshop on Quantum Materials and Devices with the Indian Institute for Science, which were held in 2021. A workshop on Artificial Intelligence for Science and Engineering was also organized in 2022 with Waterloo.AI. These events are important, as they create more connections between faculties, departments, and units at the University, and act as an exemplar for the broader academic community.

Importantly, WIN has also remained committed to the objectives and ideals that have been established through the United Nations' Sustainable Development Goals (UNSDG). It has done this by mapping its four thematic research areas and ensuring that its programs, events, and seed-funding grants are linked to specific SDGs.

The Institute has successfully organized and hosted important and impactful events in recent years. In November 2020, the Institute hosted the International Workshop on Sustainable Nanotechnology - its first fully virtual large-scale event, welcoming 250 attendees across five continents. This event led to the development of the



DR. CHARMINE DEAN

VICE PRESIDENT,
RESEARCH AND INTERNATIONAL

International Network for Sustainable Nanotechnology (N4SNano) along with co-founders from UCLA, MESA+, and Sydney Nano. In February 2022, WIN co-hosted the inaugural Global Summit Launch to promote the message of N4SNano, inviting prominent researchers to engage in discussions on sustainable nanotechnology for good-health and well-being (UNSDG #3). These events demonstrate how WIN is driving the development of nanotechnology for a just, equitable, and sustainable world.

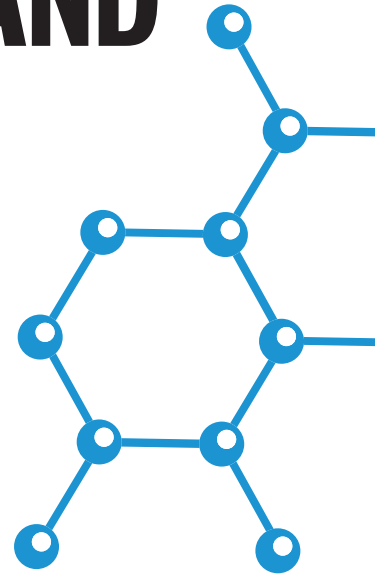
WIN's achievements over the reporting period embody the true spirit of the University of Waterloo. The Institute has promoted collaborations across disciplines to discover solutions to complex problems in our world. Indeed, nanotechnology is an enabling technology, unprecedented in its ability and potential to drive radical and positive change to improve society.

Congratulations to Professor Mitra for his renewal as Executive Director of WIN and congratulations to the entire WIN family of staff and faculty on all its recent achievements. I look forward to seeing what heights WIN will reach in the next five years.



2017 TO 2022

DIRECTOR'S ADDRESS AND EXECUTIVE SUMMARY



SUSHANTA MITRA
EXECUTIVE DIRECTOR

It has been a privilege to lead one of the world's premier nanotechnology institutes, in the heart of Canada's innovation region. Over the last five years, we have accomplished great things, and together with your support, we can easily reach our next growth trajectory.

This report summarizes the activities and operations of the past five years, listing changes and improvements to WIN that address the current needs of the WIN membership, UW and that of the community at large, as well as new activities and programs to support all in research, training and education.

New Organizational Structure: WIN was founded in 2008, a traditional and hierarchy-based administrative framework was put into place which served its purpose during its formation and start. But a decade later, it was important to re-evaluate the function of WIN's administrative duties and team complement. Through a consultation process with WIN members in 2017, new positions at WIN have been created, with specific roles and responsibilities. Additionally, a circular framework replaces a hierarchy structure, where each member has an equal voice and respected opinion (see page 11). This reflects the values of traditional Indigenous Wisdom (page 11), as inspired by Dr Gregory Cajete who stated, "Thinking outside the box, living within the circle."

This philosophy has also been translated to WIN committees and Boards, where equity, diversity and inclusion principles have been incorporated, achieving gender parity on the WIN Board of Directors (60:40 split of women to men) and seeking members who can bring a fresh approach and view, especially for under-represented groups (page 5).

Research Partnerships and Programs: Innovation at WIN happens at the intersection of natural sciences, engineering and non-STEM disciplines. Working closely with the Faculties of Arts, Environment, and Health, WIN leverages diverse perspectives to solve the complex problems of today. This also provides an enriching experience for our researchers and students. We understand that the current challenges are multifaceted and WIN cannot resolve them by working in isolation.

Here, strategic partnerships are so important, giving perspective on what is happening elsewhere and how we can learn from best-practices, recruiting top talent, and finding new markets for our technology (page 18). New co-op and internship positions for students have evolved in international laboratories in Japan, China and Thailand from our partnerships as well, providing a very important influential vehicle for students to grow their networks and gain experience in international laboratories (page 48)

The International Network for Sustainable Nanotechnology (N4SNano) was also launched in 2021, to promote nanotechnology as a key mechanism for sustainability, bringing positive and impactful solutions to society (page 59).

Funding: There is a saying in academia: “Good research comes from good money.” WIN works hard to find appropriate funding sources for research activities, scholarships for students and supporting first-stages research partnerships. Since 2017, WIN has helped WIN members secure funding from Canadian-based agencies and from international programs such as the German Research Foundation (DFG) International Research and Training Groups (IRTG). WIN also sponsors seed funding competitions with international partners such as the MESA+ Institute for Nanotechnology at the University of Twente, IISc-Bangalore for Quantum Materials & Devices, and the University of Bordeaux as part of the Interdisciplinary Research Funding Program (IRFP) at WIN (page 19).

WIN also champions student scholarships and fellowships for international work experience through Mitacs, the NIMS Graduate Student Internship, the Soochow-WIN PhD Scholarship and PDF Fellowship. And along with the annual Nanofellowship Competition made possible by a generous endowment from an anonymous donor, the WIN-Velocity Entrepreneurship Scholarship was started in 2022

to encourage business-minded first-year Masters students in science and engineering to pursue start-up activities as a result of research in “deep-tech” (page 42-43).

Knowledge Mobilization: Knowledge is a very important tool in the success of any endeavour, and sharing this knowledge is very important to our community, helping to empower the audience to understand and utilize information to help with decision-making and addressing daily problems.

WIN has been very active on this front during the last five years, launching of interdisciplinary mixers and workshops, new Seminar Series including industry, innovation and entrepreneurship, and the Quantum Collision Series with our sister institute, the Institute for Quantum Computing (IQC). WIN also hosted and supported several international conferences, including the World Fuel Cell Conference, the International Symposium: Frontiers in Nanoscience & Nanotechnology, the International Workshop on Sustainable Nanotechnology, and the N4SNano Global Summit. Additionally, WIN has authored several editorial articles on the impact and potential of nanotechnology for a sustainable future (page 70).

Outreach: It is so important to let our community know what happens at UW and WIN on a regular basis. WIN engages its members through Town Hall meetings, and has organized several events to invite the public in and showcase the research excellence at WIN. This not only helps connect the people in our community with all of the innovation and research that happens in the QNC and at UW in Nanotechnology, but we also meet with new and potential students hoping to become the next generation of scientists and engineers. WIN is also a proud supporter of regional and national science fairs, and opens its doors to high school students every summer for the Shad Canada Program (page 76).

Going forward, WIN will continue to support researchers and students in these areas. From quantum phenomena to real-world devices, these innovations will provide solutions to global challenges in energy, water, public health and more. WIN will seize the opportunities of the next industrial revolution.

- Sushanta Mitra, WIN Executive Director



1.0

GOVERNANCE AND ADMINISTRATIVE STRUCTURE

The Waterloo Institute for Nanotechnology is one of eight University Centres at the University of Waterloo, with the primary purpose of promoting the research excellence of UW in the areas of nanotechnology and its applications. In June 2008, the University of Waterloo Senate Graduate and Research Council officially approved and founded WIN.

WIN works closely with these governing and advisory bodies to ensure the effective and efficient operation of the institute and has formed several committees to oversee various operations and functions within WIN and the QNC.

1.1 WIN BOARD OF DIRECTORS

1. The primary executive authority of WIN is its Board of Directors (BoD), which provides operational oversight and approval for WIN activities. Currently, there are 14 members of the Board, including five external members (four from academia and one from government) and nine internal members (including Deans of Science and Engineering at UW and WIN professors), chaired by UW's Vice-President of Research & International.

Since 2018, WIN has been working to incorporate principles of equity, diversity and inclusion (EDI) on its governing board. Striving for gender parity, WIN has achieved and surpassed this goal in 2022; there are currently eight women-identifying and six male-identifying members on the BoD.

CURRENT COMPOSITION OF THE WIN BOARD OF DIRECTORS (2022)

CHAIR

Charmaine Dean Vice-President, University Research & International (VPRI), 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, Professional Engineers Ontario & 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
Yimin Wu	Professor, Department of Mechanical & Mechatronics Engineering
Mary Wells	Faculty of Engineering (or designate), University of Waterloo
Boxin Zhao	Chemical Engineering, University of Waterloo

From 2017 to 2021, WIN has benefited from the leadership and advice of past members, from industry and academia, each imparting their knowledge and experience to help WIN achieve its annual goals.

FORMER BOD MEMBERS INCLUDE:

Chris Backhouse	Professor, Department of Electrical & Computer Engineering, University of Waterloo
Rina Carlini	President, CEO and co-Founder, Optimal Innovations Group, Toronto
Holger Kleinke	Professor, Department of Chemistry, University of Waterloo, (Former) Interim Executive Director, WIN
Linda Nazar	Professor, Department of Chemistry, University of Waterloo
Pearl Sullivan	Former Dean, Faculty of Engineering, University of Waterloo
Michael Tam	Professor, Department of Chemical Engineering, University of Waterloo

From 2020 to 2021, WIN was honoured and humbled to welcome Cynthia Wesley-Esquimaux, PhD, as the first Indigenous member of WIN's Board of Directors. Her achievements and contributions to society are astounding; Wesley-Esquimaux was appointed as an "Honourary Witness" for the Truth and Reconciliation Commission of Canada and serves as Chair for Truth and Reconciliation in Canada at Lakehead University, where she also served as Vice-Provost, Indigenous Initiatives, for three years. She was also the inaugural Nexen Chair for Indigenous Leadership at the Banff Centre for Arts and Creativity and remains a faculty member within the Indigenous Learning program. Her contributions to WIN have been invaluable, providing increased knowledge and understanding of Indigenous practices and wisdom, to better communicate with and serve society.

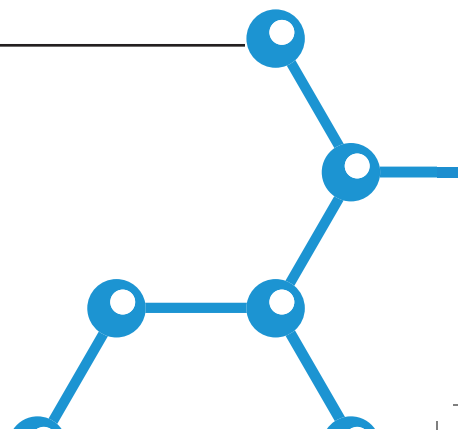
1.2 INTERNATIONAL SCIENTIFIC ADVISORY BOARD

- › The International Scientific Advisory Board (ISAB) is an external expert committee assembled to advise the WIN Executive Director and Board of Directors on important matters pertaining to nanotechnology in regions around the world, on an annual or bi-annual basis (as determined by activity and need). Since 2017, the ISAB has met four times – in 2018 (in-person), 2019 (in-person), 2021 (virtual) and 2022 (hybrid). As of June 2022, the WIN ISAB consists of the following members:

Linda Nazar	ISAB Chair Professor, Department of Chemistry, University of Waterloo Canada Research Chair in Solid State Energy Materials
Adrien Côté	Executive Director, Velocity, University of Waterloo
Mônica Cotta	Professor, Gleb Wataghin Institute of Physics, University of Campinas Associate editor, ACS Applied Nano Materials
Sushanta Mitra	Executive Director, Waterloo Institute for Nanotechnology, Professor, Mechanical and Mechatronics Engineering, University of Waterloo
Ajay Sood	Principal Scientific Advisor to the Government of India Honorary Professor, Indian Institute of Science Fellow of the Royal Society Associate Editor, ACS Nano Executive Editor, Solid State Communications
Chen Wang	Senior Investigator and Director, National Center for Nanoscience and Technology of China Adjunct Professor, University of Chinese Academy of Sciences
Sir Mark Welland	Director, Maxwell Centre, Deputy Vice-Chancellor and Special Adviser on China, Master of St Catharine's College, University of Cambridge Fellow of the Royal Society
Albert van den Berg	Scientific co-Director, MESA+ Institute for Nanotechnology Professor, Faculty of Electrical Engineering, Biomedical and Environmental Sensor Systems, University of Twente

WIN extends its gratitude to members of the ISAB who served from 2017-2021 for their wisdom, knowledge and advice to help make the institute an internationally recognized world-class centre:

Fernando Galembeck	ISAB Chair, Professor, Universidade Estadual de Campinas, Brazil
Savvas Chamberlain	Former ISAB Chair, Founder of DALSA
Kazuhito Hashimoto	President, National Institute for Materials Science, Japan
Iain Klugman	CEO, Communitech
Eugenia Kumacheva	Professor and Canada Research Chair in Advanced Functional Materials, University of Toronto
Richard Martel	Professor and Canada Research Chair in Electrically Conductive Nanostructures and Interfaces, Université de Montréal
John Thompson	Former ISAB Chair and (Former) Associate Vice President Research, University of Waterloo



1.3 WIN COMMITTEES

1.3.1 WIN EXECUTIVE COUNCIL

In Fall 2021, the WIN Executive Council (EC) was formed to oversee the routine operations of WIN and strategic planning of the institute, to ensure all mandates and objectives are completed, including those recommended by the Governing and Advisory Boards. The EC is composed of at least one Lead or Co-Lead from the Connected Devices, Next Generation Energy Systems, and Therapeutics & Theranostics research themes, as well as at least one representative from the Smart and Functional Materials theme working group. The EC met regularly in the 2021-22 academic year reviewing WIN activities and effective operation of the institute.

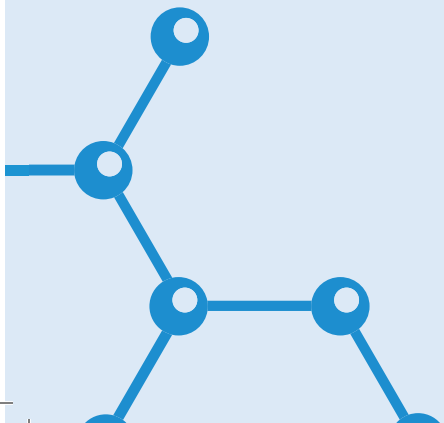
1.3.2 SPACE COMMITTEE

WIN is directly responsible for the allocation and management of the Nanotechnology space within the Quantum-Nano Centre (QNC) in consultation with key stakeholders, the Faculty of Engineering and Faculty of Science. The WIN Space Committee was created to plan, allocate, track, manage and report on all assignable space in the most efficient, transparent and equitable manner. The WIN Space Committee is currently composed of the following members:

- › WIN Member representing the Faculty of Engineering
- › WIN Member representing the Faculty of Science
- › Executive Director, WIN
- › Manager, Space Planning, Provost
- › QNC Facility Technician, Provost Office
- › Secretariat: Operations Assistant, WIN

The Space Committee is chaired by one of the Faculty representatives and serves for two years with the first chair serving three years for continuity. The current committee chair will rotate off at the end of their term and will alternate between Science and Engineering.

The mandate of the WIN Space Committee is to develop policy on management of space and communicate such policy to the WIN and QNC stakeholders involving office spaces, laboratories, common space, student areas, and accessibility infrastructure (keys, FOBs, elevators, etc). The committee will also make recommendations on space usage and allocation within WIN, moderate resolutions of competition for space, and propose major renovations for and the creation of space.



1.3.3 QNC HEALTH AND SAFETY COMMITTEE

The Quantum Nano Centre (QNC) Health and Safety Committee is designed and assembles to review issues across the QNC facility (i.e., including common areas that are under WIN and Institute for Quantum Computing (IQC)) related to the safety of workers, including preventative safety measures, work practices, compliance and overall safety awareness.

The committee keeps records of all health and safety inspections conducted by the associated departments within Nanotechnology. The committee supports the Health and Safety Coordinators (HSC) in carrying out their duties under the Health, Safety and Environment Management System and contributes toward the building of a “safety first” culture. The QNC Health and Safety Committee activities include:

- › Recording of all health and safety inspections conducted in all laboratories housed in QNC building
- › Coordinating with Department inspections, assisting with the completion of risk assessments, reviewing incident investigations, and assisting with the identification of hazards and controls
- › Making recommendations to the Department Heads, as appropriate, with respect to hazard control, safe work procedures, and training needs
- › Reporting to Institute Directors and Department Heads on incidents, concerns identified or brought forward that have not been addressed, and any issues related to compliance

The Health and Safety Committee currently consists of the following individuals:

- › Chair: Representative from the Faculty of Engineering or Science (rotating)
- › WIN Member representing either Faculty of Science or Faculty of Engineering
- › QNC Facility Technician, Provost Office
- › Representative from the UW Safety Office
- › Secretary (non-voting)

The QNC Health and Safety Committee is chaired by one of the Faculty representatives, serving for two years with the first chair serving three years for continuity.

1.3.4 SPECIAL PROJECTS AND RESEARCH COMMITTEE (SPARC)

The Special Projects and Research Committee (SPARC) serves as an advisory committee to the Executive Director of WIN on the strategic development of research areas at the institute, including prioritization and funding of research projects and opportunities. The mandate of the SPARC includes:

- › Review and identify priority interdisciplinary areas where WIN can invest resources to become recognized experts, and recommend teams to submit proposals around themes areas
- › Oversee the transparent, equitable competitive research grants process and awards from WIN’s SPARC account
- › Provide feedback and recommendations regarding internal research programs, processes and coordination of WIN programs with those of the Office of Research and Faculties
- › To be an advisory committee for the Executive Director, to consult on research-related policy and ensure the interests of WIN stakeholders are represented (Members, Office of Research and Faculties)

The SPARC Membership currently consists of the following personnel:

- › Associate Vice-President Interdisciplinary Research (Committee Chair)
- › Associate Dean of Research and External Partnerships, Faculty of Engineering
- › Associate Dean of Research, Faculty of Science
- › WIN Faculty Member, representing the Faculty of Engineering
- › WIN Faculty Member, representing Faculty of Science
- › Secretariat – WIN Assistant Director of Research Programs

1.3.5 NANOFELLOWSHIP COMMITTEE

The WIN Nanofellowship Committee was founded to steward the fair and optimal disbursement of funds for the annual Nanofellowship competition for graduate students engaged in nanotechnology research. In 2018, Nanofellowship Committee Terms of Reference were formalized to perform the following functions and a Committee Chair was nominated to create an overall transparent process:

- › Review and understand all information pertaining to the Nanofellowship competition, including the original Memorandum of Understanding, competition guidelines and application procedure
- › Provide sound advice and guidance on competition execution
- › Evaluate applicants and nominate awardees based on approved evaluation criteria and eligibility
- › Provide guidance on strategic use of Nanofellowships for student recruitment and identify new opportunities for graduate student recruitment within Canadian and international universities
- › Ensure best practices for competition for compliance with all UW regulations and those set forth by other scholarship agencies

The present Nanofellowship Committee consists of the following individuals:

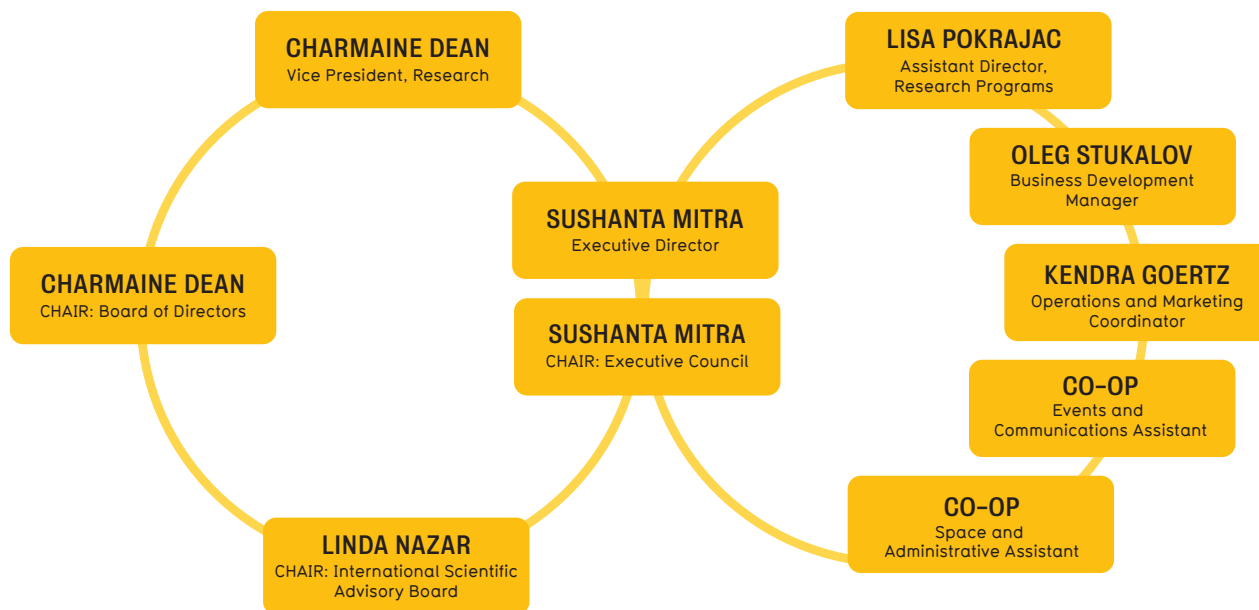
- › Assistant Vice President, Graduate Studies
- › Associate Dean, Graduate Studies, Faculty of Engineering
- › Associate Dean, Graduate Studies, Faculty of Science
- › WIN Faculty Member representing Engineering
- › WIN Faculty Member representing Science
- › WIN Executive Director
- › Assistant Director Research Programs, WIN (non-voting member) as support staff for the committee

The Nanofellowship Committee meets annually to discuss fellowship competition details and strategy, and for application evaluation and awardee selection. For adjudication purposes, designates are appointed by the Associate Deans of Graduate Studies for both the Faculties of Engineering and Science.

1.4 WIN ADMINISTRATION AND ORGANIZATIONAL STRUCTURE

Indigenous wisdom has influenced WIN's Administration since 2017, removing the concept of hierarchy to a circular structure, where everyone's thoughts and ideas are heard and respected. This reflects the values and ethos of First Nations Indigenous Peoples as inspired by Dr George Cajete who stated: "Thinking outside the box, living within the circle."

FIGURE 1: WIN'S ORGANIZATIONAL STRUCTURE



1.4.1 WIN STAFF

The WIN team consists of the Executive Director, Assistant Director of Research Programs, Business Development Manager, Operations and Marketing Coordinator, Events and Communications Assistant (co-op) and Space and Administrative Assistant (co-op).

The Assistant Director of Research Programs (ADPR) provides higher-level coordination and management of WIN's scientific and engineering programs for academic and international partnerships, faculty awards, scholarships, mobility and outreach, including an active role in technical writing, presentations and promotions.

The Business Development Manager (BDM) position was created in 2018, which includes responsibilities of proactively engaging prospective industry research partners within Canada and internationally, assisting

WIN faculty members in working with industry including preparation of grant applications, and representing and supporting the needs of WIN's members' research commercialization activities in collaboration with WatCO and Velocity.

The Operations and Marketing Coordinator administrative provides support for WIN's daily operational activities and assisting with WIN-led events (seminars, symposia). This role works closely with various WIN colleagues to ensure the successful execution of WIN's mission with effective knowledge mobilization, promotion and planning and execution of innovative events and production of dynamic annual reports.



“The team at WIN has been very supportive of my professional growth, giving me the opportunity to gain hands-on experience in marketing, communications, and events! I know the skills I have developed in this position will benefit me after graduation and as I move into my future career.”

EMILY PEDEN, 4B POLITICAL SCIENCE STUDENT,
COMMUNICATIONS AND EVENTS ASSISTANT (CO-OP) FOR WIN,
MAY-DECEMBER 2022

1.4.2 STUDENT TRAINING AND CO-OPERATIVE EDUCATION

WIN is committed to providing professional training and guidance to its students to help them excel in their current course of study at UW, and prepare them for their future careers. Each year, WIN hires one or two students in the Co-operative Education program, teaching valuable skills in nanotechnology-based research support, marketing and communications, project- and data management, events coordination, and office administration. WIN has benefitted greatly from these bright and enthusiastic young minds, who provide new ideas and positive energy to our institute.

In May 2022, WIN hired Emily Peden from the Political Science program at UW for an eight-month term as the Communications and Events Assistant, where she manages the WIN website, prepares announcements for online and social media circulation, co-organizes events and many administrative duties.

1.5 WIN RENEWAL AS A UNIVERSITY CENTRE (2019)

As a Senate-approved University Centre, WIN is required to apply for renewal every five years for continued operation and support from UW. In 2019, WIN prepared a comprehensive document of activities, outcomes and impact from 2013 to 2018 as part of its application for renewal as a UW-supported research institute. This 108-page document was submitted in February 2019 to the UW Senate Committee along with a 365-page Appendix of supporting documentation and full list of publications. The application also included many enthusiastic letters of support from internal UW partners, including Associate Vice Presidents, UW Deans, and WIN Members. A prominent international partner also provided their outstanding support for WIN's renewal as well.

The application was reviewed and approved by UW Senate, providing continued support and funding of \$350,000 per year for an additional five-year term. WIN is thankful to all who supported this renewal, and we are proud to continue to serve the nanotechnology community since that time.

Below are some examples of Letters of Support from WIN's strategic partners.





ASSOCIATE VICE-PRESIDENT, GRADUATE STUDIES AND POSTDOCTORAL AFFAIRS
519-888-4567, ext. 43439
gsa-avp@uwaterloo.ca | uwaterloo.ca/gspa

Dr. Charmaine Dean
Vice-President, Research and International
University of Waterloo

February 12, 2019

Dear Dr. Dean,

It is my great pleasure to write this letter in support of the Waterloo Institute for Nanotechnology (WIN). I have worked closely with WIN's Executive Director and Assistant Director, Research Programs in number of initiatives that are meant to enhance the graduate student and post-doctoral experiences at Waterloo.

Often these initiatives involve international partners, which creates more complexity to the overall process. In the recent past, my office was instrumental in putting together an exciting graduate student program with the National Institute for Materials Science (NIMS), Japan. It took a very creative process to create the agreement, particularly when intellectual property details are involved. Similarly, my office is currently working on an important post-doctoral funding initiative with Soochow University, China, to allow WIN members to access top global talent with significant funding provided by Soochow University. Programs such as these allow us to build relationships between faculty members, and at the same time graduate students and post-doctoral fellows can experience new culture, new workplace, and also excellent scientific endeavours.

I am very happy to see all these new initiatives in WIN. I fully support the renewal of the institute. I look forward to work closely with WIN in coming years on many such interesting and exciting opportunities.

Sincerely,

A handwritten signature in black ink that reads "Jeffrey M. Casello".

Jeffrey M. Casello, PhD
Associate Vice President Graduate Studies and Postdoctoral Affairs



200 UNIVERSITY AVENUE WEST, WATERLOO, ON, CANADA N2L 3G1

8 February 2019

To: Dr. Charmaine Dean
Vice-President Research and International
University of Waterloo

Dear Charmaine,

Please accept this letter of support on behalf of the Institute for Functional Nano- and Soft Materials (FUNSOM) and the College of Nanoscience and Technology (CNST) at Soochow University, China, for the Waterloo Institute for Nanotechnology (WIN) as it applies for renewed mandate for another five-year term.

WIN is a long-time and valued partner of Soochow University with similar vision and goals to ensure the highest quality training of students, innovation in research, and internationalization. To realize our common objectives, the Soochow University, WIN and Suzhou Industrial Park (SUN-WIN-SIP) Joint Research and Education Institute was formed in 2012. Since then, the SUN-WIN-SIP Joint Institute has facilitated research and commercialization support resulting in 24 jointly-funded projects (¥11.4M or \$2.2M CAD), almost 40 research publications, several patents and a successful electronics technology company housed at Nanopolis in Suzhou China.

We are now commencing the second phase of our partnership, to even further promote the entrepreneurial ecosystems at both Waterloo and in Suzhou, with a primary focus on research that has immediate market readiness or direct technology transfer potential. To this end, FUNSOM and CNST are pleased to host a workshop later in 2019, with special focus on connectivity, sustainability and healthy communities. Networking sessions with local industries will be planned for potential partnership as well. This workshop will be the fifth since the SUN-WIN partnership began, allowing a venue for collaborators to meet and for new ideas to form. We look very forward to welcoming the WIN delegation this year.

Both WIN and Soochow University are also dedicated to the highest-quality education and instruction for our students. Through the SUN-WIN Joint Education Programs, we

are proud of the 35 graduate students who have been trained within WIN research groups since 2013, and we are committing a \$10,000 USD scholarship per year for the UW-Soochow PhD program to ensure the program's continuity. We are also very happy to announce the new Post-Doctoral Fellowship Program valued at a minimum of ¥200,000-300,000 (\$40-60k CAD) to attract the world's best young talents to our institutions which we anticipate will commence this year.

I am most enthusiastic about the new direction of WIN under the leadership of Dr. Sushanta Mitra – he is a champion of interdisciplinary research and understands very well the importance and impact of strong international partnerships. I expect that our relationship will grow even stronger in the next five years, supporting even more nanotechnology-based start-up companies, funding new and innovative joint research projects, and training the next generation of outstanding scientists and engineers.

I urge the University of Waterloo to continue its support of WIN so we may carry on our work in providing the highest quality education for students, promoting leading-edge innovation, and tackling the global challenges faced by society today.

Yours sincerely,



Shuit-Tong Lee, Prof. Dr.
Member, Chinese Academy of Sciences
Fellow, TWAS
Director, Institute of Functional Nano and Soft Materials
Dean, College of Nano Science and Technology
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Dr. Charmaine Dean
Vice-President, Research and International
University of Waterloo, Canada

Friday, 8 February 2019

Re: Letter of Support for the Waterloo Institute for Nanotechnology

Dear Dr. Dean:

I have been WIN member since 2008 and have seen over the years the growth of the institute. It is one of the few research institutes on campus, which truly believes in interdisciplinary research. Also, it has created a very nice balance between fundamental science and applied research.

Currently, I am the Theme Lead for the "Therapeutics and Theranostics" group and the Executive Director, Dr. Sushanta Mitra, has undertaken a significant number of initiatives under this theme. WIN has moved into a model where it is truly serving its members through a bottom-up approach where Theme Leads and co-Leads are very often consulted for various initiatives.

Such member-driven initiatives are essential for the long-term sustainability of the institute. Also, it has created a very transparent governance process when any new opportunities are now disseminated to all members, particularly targeted to each thematic areas, so that the response from WIN members are more targeted and provide an overall value addition to individual researchers.

I commend WIN for initiating the Interdisciplinary Research Funding program (IRFP), the first of its kind in the campus where significant amount of funding is provided to high-risk discovery and applied research. I have been the recipient of one WIN IRFP award, which helped me to work together researchers (as Co-PI) from the Faculty of Applied Health Sciences. Such innovative initiatives are critical for the research institute and would help to create disruptive technologies.

Under new leadership, WIN has also focused on translational research and commercialization. WIN's Business Development Manager works with number of nanotechnology-based start-up companies to help them connect with broader stakeholders. These new initiatives within WIN would definitely help the university to articulate the fantastic research that is taking place, having significant impact for all Canadians.

WIN's future looks very promising and it is rightly posed to grab the opportunities that are made available by convergence of technologies under Industry 4.0. I definitely support the renewal of WIN for next five years and wish the institute more success in the coming years.

Sincerely,

My best regards,

Karim S. Karim, PhD PEng MBA
Associate Dean - Outreach, Faculty of Engineering
Professor, Department of Electrical and Computer Engineering
University of Waterloo, Waterloo, ON N2L3G1 Canada

2.0

RESEARCH EXCELLENCE, PARTNERSHIPS AND TECHNOLOGY TRANSFER

2.1 KEY THEME RESEARCH AREAS OF NANOTECHNOLOGY AT WIN

Until 2017 WIN had four thematic areas:

1. **Nanomaterials:** Processes and Manufacturing; Energy and Environment
2. **Nanoelectronics:** Quantum Optics & Nanophotonics; Materials, Modelling & Fabrication
3. **Nanoinstrumentation:** Metrology & Nanopositioning; Nanofluidics, Lab-on-Chip & Micro-Electro-Mechanical Systems
4. **Nanobiosystems:** Life Sciences & Healthcare

Starting in Fall 2017, WIN conducted an extensive consultation among its members, Department Chairs, Deans and other external stakeholders (government, industry) and devised four new thematic thrust areas:

1. **Smart & Functional Materials:** including but not limited to fundamental condensed matter physics, soft matter, materials characterization, nanomaterials, graphene and other 2D materials, quantum materials, nanoparticles, quantum dots, carbon nanotubes, DNA self-assembly, biomaterial and nanocellulose, new materials for additive manufacturing (i.e., 3D printing), protein, enzymes, biopolymers, biomaterials, electronic and photo-active materials.
2. **Connected Devices:** including but not limited to sensors (quantum-, nano- and microsensors), MEMS/NEMS, flexible electronics, wearable devices, lab-on-chip, use of internet-of-things and artificial intelligence for sensors, human-machine interfaces, photonic-devices and other connected devices.
3. **Next Generation Energy Systems:** including but not limited to fundamental understanding of transport processes in energy devices, battery, fuel cells, catalysis, solar cells, low-carbon sustainable technologies, artificial photosynthesis.
4. **Therapeutics & Theranostics:** including but not limited to targeted drug delivery, tissue engineering, minimally invasive treatment of diseases, immunotherapy, and medical imaging.

In 2018 through a consultation process within each thematic group, leads and co-leads were identified to work closely with WIN staff to 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. Theme leads and co-leads serve a 2-year term. The Smart & Functional Materials theme has the largest number of faculty members and hence instead of having only leads and co-leads, a Working Committee model is best suited for this thematic group.



SMART AND FUNCTIONAL MATERIALS WORKING COMMITTEE

2.1.1 SMART & FUNCTIONAL MATERIALS

This group is by far the largest and most diverse in terms of research areas, and therefore it organizes itself via a group of seven faculty members serving as a committee:

Hany Aziz (ECE): organic electronics, properties of organic semiconductors, OLED display materials, organic photovoltaic devices

John Honek (Chem, cross-appointed with Pharmacy): protein and enzyme structure/function and their applications for bionanotechnology in medicine

Yuning Li (ChE, cross-appointed with Chemistry): synthesis and characterization of organic semiconductors for printed, flexible and organic electronics

Carolyn Ren (MME): micro/nanofluidics, lab-on-a-chip, protein separation, live-colony detection

Michael Tam (ChE): novel chemistries and applications of cellulose nanocrystals

Boxin Zhao (ChE): bio-inspired polymers, adhesion phenomena on the nanoscale and biomimicry

2.1.2 CONNECTED DEVICES

Vassili Karanassios (Chem; and a founding member of WIN): portable analytical tools for spectrochemical environmental analysis

Na Young Kim (ECE): semiconductor quantum processors and devices using exotic nanomaterials

Carolyn Ren (MME): micro/nanofluidics, lab-on-a-chip, protein separation, live-colony detection



CONNECTED DEVICES



NEXT GENERATION ENERGY SYSTEMS

2.1.3 NEXT GENERATION ENERGY SYSTEMS

Linda Nazar (Chem): Tier 1 Canada Research Chair in Solid State Energy Materials and author of over 300 research papers, review articles, and patents

Eihab Abdel-Rahman (SDE): new phenomena in microelectromechanical systems (MEMS) and the development of new radio frequency switches, micro-mass sensors, micro-power generators, atomic force microscopy techniques, and a micro-gyroscope

Michael Pope (ChE): large-area graphene monolayers for improving performance of supercapacitors and batteries, studying electrocatalytic effects in porous electrode systems and for development of graphene-based water treatment membranes

2.1.4 THERAPEUTICS & THERANOSTICS

Karim S. Karim (ECE): silicon thin-film applied research, microelectronic circuits, device and process development for large area electronics

Alfred Yu (ECE): ultrasound imaging using nanomaterials as contrast agents

THERAPEUTICS AND THERANOSTICS

2.2 ALIGNED RESEARCH AND BUSINESS PROCESSES WITH UN SDGS

In 2015, all United Nations Member States adopted the Agenda for Sustainable Development for 2030, providing a shared blueprint for peace and prosperity for people and planet. The 17 Sustainable Development Goals (SDG) were formulated to help end poverty and other deprivations but adopting strategies to improve global challenges such as improving health and living conditions, leading to sustainable development, economic growth and environmental protection.

WIN is directly in tune with these global challenges, seeking solutions to ensure good health (SDG 3), clean water and energy (SDGs 6 & 7), industry & innovation (SDG 9), sustainable cities and communities (SDG 11), and climate action (SDG 13). Below is a break-down of each WIN thematic area and how they are mapped to specific development goals:

FIGURE 2: UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS, WITH THOSE APPLICABLE TO WIN RESEARCH ENLARGED



SMART AND FUNCTIONAL MATERIALS

- #3 Good health and well-being
- #6 Clean Water and Sanitation
- #9 Innovation and Infrastructure

CONNECTED DEVICES

- #6 Clean Water and Sanitation
- #9 Innovation and Infrastructure
- #11 Sustainable Cities and Communities

NEXT GENERATION ENERGY SYSTEMS

- #7 Affordable and Clean Energy
- #11 Sustainable Cities and Communities
- #13 Climate Action

THERAPEUTICS AND THERANOSTICS

- #3 Good Health and Well-Being

2.3 PUBLICATIONS, CITATIONS AND IMPACT – BIBLIOMETRIC ANALYSIS

Bibliometric analysis is important for universities and research centres. WIN was one of the first at UWaterloo to use these tools to show the research impact of its membership and allowing WIN to make tactical decisions to allocate appropriate resources to foster new academic relationships.

In 2018, WIN championed bibliometric analyses within the University of Waterloo through the use of tools such as SciVal and Scopus (Elsevier). In this way, WIN can identify key strengths based on global comparative indices such as field-weighted citation impact (FWCI*) and collaborations (the principal metrics used by research institutes). The FWCI is calculated based on all publications by WIN members taking into account all categories of peer-reviewed journals. The table below provides the key comparable indicators for WIN publications for the five-year span between 2016 and 2021:

GROUP (2016-2021)	TOTAL PUBLICATIONS	TOTAL CITATIONS	FWCI	OUTPUT IN TOP 10% CITATION PERCENTILE	COLLAB: NAT'L	COLLAB: INT'L	COLLAB: INDUSTRY
WIN Members (total)	3,781	85,928	1.72	28.7%	11.4%	50.3%	4.1 %
Smart & Functional Materials	2,283	49,337	1.58	26.5%	10.0%	49.4%	3.7%
Connected Devices	1,581	22,852	1.39	20.9%	11.8%	45.7%	4.9%
Next Generation Energy Systems	1,429	46,983	2.15	36.8%	8.9%	50.5%	3.5%
Therapeutics & Theranostics	1,489	29,093	1.50	28.7%	12.7%	50.7%	2.8%

*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)

2.3.1 BIBLIOMETRICS & RESEARCH IMPACT COMMUNITY



FIGURE 3: BRIC CONFERENCE HELD ONLINE IN APRIL 2021

Presentations from April 2021 are posted for viewing on the BRIC YouTube channel.

Hosted virtually by WIN April 27-29, 2021

The Bibliometrics & Research Impact Community (BRIC) was initiated in 2017 to provide a forum to discuss bibliometric and research impact support services, and since then it has grown into an international event. A conference has been held every year since 2017 (except in 2020 which was postponed due to the pandemic). WIN has been a participant since 2019, and in 2021 the conference was hosted by WIN with presentations from 26 speakers and saw attendance average 92 people per day. WIN's Assistant Director Research Programs gave a presentation on "The Use of Bibliometrics at the Waterloo Institute for Nanotechnology" illustrating the use of SciVal tools for membership publication output and impact that is calculated annually for total WIN members and each of the four key research themes at WIN.

2.4 INTERDISCIPLINARY RESEARCH

Interdisciplinary research has always been a central component of nanoscience and nanotechnology at WIN, with the Faculties of Engineering, Mathematics and Science at the University of Waterloo playing prominent roles. However, today's problems are so complex, be it the global challenges in energy, water, public health, a single disciplinary approach is not good enough.

WIN is poised to unleash its true potential by integrating discipline specific fundamental research with interdisciplinary knowledge spanning across each of the six Faculties and sister institutes at the University of Waterloo, as well as national and international institutions. This will enable our brightest minds to collaborate as a team and solve daunting global challenges with a 360-degree perspective.

Towards this effort, WIN hosted research mixers with the Faculties of Arts, Environment, and Health in 2017 and 2018. The first such mixer, "Nanotechnology and Society" was co-hosted with the Faculty of Arts to showcase prospective cross-disciplinary collaborations in research, with the hope to integrate perspectives and expertise from the social sciences and humanities with science, engineering and mathematics. In February 2018, the second interdisciplinary mixer was held with the Faculty of Environment, which provided an opportunity for researchers on both sides to discuss ways to solve challenges pertaining to environmental remediation, protection and future resource planning. And the third mixer in April 2018 with the Faculty of Health allowed researchers from both groups to discuss areas of cooperation for disease detection and prevention. Here, issues such as quality medical treatments, advances in drug delivery and design, policy planning and other issues pertaining to global health were discussed. In early 2018, the first Interdisciplinary Research Funding Program (IRFP) competition was called to kickstart new interdisciplinary research collaborations at UW.

Since 2018, WIN has broadened its scope for interdisciplinary workshops and mixers to include sister institutes at UW (Water Institute, Waterloo.Ai, Centre for Bioengineering & Biotechnology), other Canadian institutions (National Research Council, University of Guelph), and international partners (MESA+, Indian Institute of Science-Bangalore, University of Bordeaux), each with its own dedicated seed-funding program to support new collaborations.

2.4.1 WIN INTERDISCIPLINARY RESEARCH FUNDING PROGRAM (IRFP)

The WIN-IRFP was designed to provide seed funding for interdisciplinary research not typically supported by traditional granting agencies. The intent of the program is to help WIN researchers work on "high risk-high reward" blue-sky discovery research. These projects are designed to provide some initial data points and insights as a first step to enable researchers to target various established funding programs. The WIN-IRFP is possible through a \$1.5 million investment in strategic funding for interdisciplinary research.

Since 2017, five (5) internal, national and international IRFP competitions have been held, supporting collaborative research within UW and with our external partners.

2.4.1.1 UW INTERNAL (2018 AND 2020)

In March 2018 the first IRFP call went out to all WIN members for awards up to \$100,000 each for one year, with the criteria that the co-PI must be from a faculty other than Science and Engineering (excluding non-science or engineering WIN members in other faculties). WIN received nine applications and four outstanding projects were chosen:

1. *An Innovative New Micro-CT System for Cardiovascular Imaging Research - \$100,000*
 - › WIN Co-Investigator: Karim Karim, Department of Electrical and Computer Engineering
 - › WIN Co-Investigator: Peter Levine, Department of Electrical and Computer Engineering
 - › Faculty of Health Co-Investigator: Robin Duncan, Department of Kinesiology and Health Sciences
2. *Hydrophobic Engineering of Nanodimensional Protein Capsules for Therapeutics - \$99,031*
 - › WIN Co-Investigator: John Honek, Department of Chemistry
 - › Faculty of Health Co-Investigator: Ken Stark, Department of Kinesiology and Health Sciences
3. *Novel Theoretical Framework for the Prediction of Non-equilibrium Systems - \$50,000*
 - › WIN Co-Investigator: Luis Ricardez Sandoval, Department of Electrical and Computer Engineering
 - › Faculty of Mathematics Co-Investigator: Ricardo Fukasawa, Department of Applied Mathematics
4. *Mapping Lipid and Mitochondria Depots in Fully Hydrated Tissue with Nanometer Resolution - \$50,000*
 - › WIN Co-Investigator: German Sciaini, Department of Chemistry
 - › Faculty of Health Co-Investigator: Michaela Devries-Aboud, Department of Kinesiology and Health Sciences

“The WIN-IRFP funding provided a critical boost in the scale-up efforts for our product, the X-ray sensor. This would be nearly impossible without WIN’s financial support.”

KARIM KARIM, ASSOCIATE VICE-PRESIDENT OF COMMERCIALIZATION AND ENTREPRENEURSHIP, AND PROFESSOR IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

In January 2020, the second call for the Interdisciplinary Research Fund Program (IRFP) was announced to seed innovative research that leads to big impacts in the following **three key targeted global challenges**: (a) climate change; (b) reduction of global waste; and (c) biodiversity loss. These topics were chosen in direct alignment with the United Nations Sustainable Development Goals to tackle the most persistent and critical challenges our society faces today.

Three projects were awarded for the 2020 WIN-IRFP competition: This round was also aligned with the 2020 New Frontiers in Research Fund Transformation Competition (NFRF-T) to incentivize and support applications to this program:

1. *Reducing Carbon Dioxide Emissions from Electricity and Transportation Sectors by Smart Electrochemical Energy Materials and Systems* - \$150,000
 - a. WIN Principal Investigator: Zhongwei Chen, Department of Chemical Engineering
2. *Developing a Multi-billion Dollar Solar Panel Recycling Industry in Canada* - \$50,000
 - a. WIN Principal Investigator: Ting Tsui, Department of Chemical Engineering
 - b. WIN Co-Investigator: Siva Sivoththaman, Department of Computer and Electrical Engineering
 - c. WIN Co-Investigator: Yuning Li, Department of Chemical Engineering
 - d. Co-Investigator: Steven Young, School of Environment, Economics and Development
3. *Overcoming the Inertia of Petroculture by Transforming the Biomass Conversion Technology* - \$25,000
 - a. WIN Principal Investigator: Anna Klinkova, Department of Chemistry
 - b. Co-Investigator: Goretty Dias, School of Environment, Economics and Development

“As an Early Career Researcher, the WIN-based seed funding programs and IRFP have been immensely helpful in starting my laboratory and attracting excellent students for my group. The WIN-organized workshops and symposia have also introduced me to outstanding researchers internationally and within UW, who have helped broaden the breadth and scope of my research to make a real difference in issues that are critical today, such as the environment, waste management, sustainable agriculture and renewable fuels. I am very grateful to WIN for these opportunities to support my research at the University of Waterloo. Thank you Sushanta and the WIN team!”

-ANNA KLINKOVA, DEPARTMENT OF CHEMISTRY

FIGURE 4: ADVERTISEMENT FOR THE WI-WIN SEED FUNDING COMPETITION IN FEBRUARY 2022



In February 2022, the Water Institute (WI) and WIN announced a call for proposals for the inaugural WI-WIN Seed Grant Program Winter 2022 competition targeting new research or technology developments at the intersection of water and nanotechnology which address contaminants of emerging concern (CECs), including microplastics, which can potentially cause ecological or human health impacts. Six applications were received from teams that included one WIN Core Faculty member and one WI member. Four projects were selected for funding of \$25,000 each, and an additional two were awarded \$25,000 from the WIN Interdisciplinary Research Funding Program (IRFP).

Recipient Teams:

1. *Investigating the colloidal behaviour of microplastics towards effective detection in aquatic environments.*
 - › WI Co-Investigator: Philippe Van Cappellen, Department of Earth and Environmental Sciences
 - › WIN Co-Investigator: Boxin Zhao, Department of Chemical Engineering
2. *Rapid detection of E. coli in water systems using microfluidic microwave sensor*
 - › WI Co-Investigator: Carolyn Ren, Department of Mechanical & Mechatronics Engineering
 - › WIN Co-Investigator: Emmanuel Ho, School of Pharmacy
3. *Hyper-efficient gas transfer nanobubble systems for enhanced degradation of endocrine-disrupting compounds and environmental estrogens*
 - › WI Co-Investigator: Mark Servos, Department of Biology
 - › WIN Co-Investigator: Norman Zhou, Department of Mechanical & Mechatronics Engineering
4. *Towards Synergistic Design of Methodology for Electrochemical Treatment of 1,4-dioxane and Similar CEC*
 - › WI Co-Investigator: Anna Klinkova, Department of Chemistry (also WIN member)
 - › WIN Co-Investigator: XiaoYu Wu, Department of Mechanical and Mechatronics Engineering

WIN also supported two additional joint projects at \$25,000 each:

1. *Photocatalytic recovery and upcycling of micro-plastic waste into value-added products and their market potential*

- › WI Co-Investigator: Roy Brower, WI Executive Director, Department of Economics
- › WIN Co-Investigator: Yimin Wu, Department of Mechanical & Mechatronics Engineering

1. *High-sensitivity mercury and Covid detection in drinking and wastewater*

- › WI Co-Investigator: Mustafa Yavuz, Department of Mechanical & Mechatronics Engineering (also WIN member)
- › WIN Co-Investigator: Juewen Liu, Department of Chemistry (also WI member)

MEETING WITH WIN, WI AND UTRECHT UNIVERSITY ON MICROPLASTICS RESEARCH



“The WI is thrilled to collaborate with WIN in supporting new interdisciplinary research collaborations that aim to develop new, innovative applications of nanotechnology to address contaminants of emerging concern in water environments.”

ROY BROUWER, EXECUTIVE DIRECTOR, THE WATER INSTITUTE

WIN-WATERLOO.AI WORKSHOP ON: ARTIFICIAL INTELLIGENCE FOR SCIENCE & ENGINEERING

A Workshop on AI for Science & Engineering was co-hosted by WIN and Waterloo.AI, which focused on the power of AI to enhance science and engineering discovery, improving and accelerating traditional R&D methods to manufacture better products and materials we use every day.

The workshop was held over three days, from 18 to 20 January 2022, hosting three keynote speakers and 23 short technical talks by researchers from UW's Faculties of Engineering, Mathematics and Science and from the University of Bordeaux in each of the following six thematic areas:

1. AI for Security and Public Health Monitoring (nanodevices and algorithms that maximize public health)
2. AI for New Materials Discovery (algorithms that help with predicting the properties of chemicals and nanomaterials as a way to better understand their potential applications)
3. AI for Medical Applications and Diagnoses (nanodevices and algorithms that can diversify how diseases are diagnosed and treated)
4. AI for Water Quality & Environment (protecting the environment through nanodevices and algorithms that identify microplastics water contaminants and chemicals)
5. AI for Improved Manufacturing and Industry Applications (nanodevices and implementing algorithms that optimize manufacturing)
6. Foundational AI (fundamentals of AI/ML and development)

The workshop featured prominent researchers from the University of Waterloo, University of Bordeaux in France, and was commenced by Jill Becker, CEO of Keobotix Inc (Boston MA) who gave the first keynote talk on "Transforming Materials Discovery Today" which also served as the first WIN-Industry Seminar for 2022. The workshop also welcomed Professor Laurent Simon from the University of Bordeaux for his keynote "AI and the University of Bordeaux: Opportunities and Challenges" on Day 2 of the workshop, and Professor Wilfred van der Wiel from the Centre for Brain-Inspired Nano Systems (BRAINS) at University of Twente for his keynote "Material Learning" on the final day of the workshop. The event attracted an audience from academia and industry, from Canada, France and the Netherlands.

This event was truly interdisciplinary and integrative, as evidenced by the diverse and broad range of academic backgrounds. This workshop is the first step in starting collaboration between nanotech and AI researchers. The next phase of collaboration will be a seed-funding competition between UW and Bordeaux researchers, to support joint research projects at the intersection of nano- and AI technologies. Based on the theme across the sessions, all the projects within each of the sessions had integrated the Sustainable Developmental Goals set by the United Nations. Both WIN and Waterloo.AI have committed \$50,000 CAD each, to be matched by the University of Bordeaux for joint projects with team members from each group. These projects will be supported through the initial stages to target international funding programs such as NSERC Alliance International, and the Discovery Acceleration for the Deployment of Emerging Materials (DIADEM) by the Government of France, to be launched in 2024.

FIGURE 5: JILL BECKER FEATURED AS KEYNOTE INDUSTRY SPEAKER FOR WIN-WATERLOO.AI WORKSHOP IN JANUARY 2022



“AI and nanotechnology are two fields that are impacting science, engineering, business, and society at large in a transformative way. In fact, the full potential of AI is realized only when paired with other fields, like nanotechnology, enabling us to make new discoveries that seem impossible otherwise. The WIN and Waterloo.ai joint seminar on AI for Science & Engineering held in January 2022 was a seed that we planted to kickstart a new joint research program, hopefully leading to new fruitful internal and external collaborations. We at Waterloo.AI were delighted to get participation by researchers from France and the Netherlands. Such fantastic opportunities would not have been available to our researchers without activities like this, and WIN did an excellent job planning and organizing the event. I look forward to the next phase in the WIN-Waterloo.ai relationship and the amazing things we can achieve together!”

VIJAY GANESH, CO-DIRECTOR, WATERLOO.AI

2.4.1.2 SEED FUNDING WITH CANADIAN PARTNERS

In June 2021, a workshop titled, “Exploring R&D Trends and Innovation Opportunities in Nanomaterials and Nano-enabled Sensors with the National Research Council and NRC Nanotechnology Research Centre” was held virtually for WIN and NRC members.

This workshop was an opportunity for researchers from WIN and National Research Council (NRC)-Nano (Edmonton) to learn more about our organizations, and the ground-breaking research in the areas of nanomaterials and nano-enabled sensors conducted on each side. This was also a very important opportunity to expand our network of nanotechnology researchers in Canada. The workshop featured overview presentations from WIN Executive Director Sushanta Mitra and NRC Nanotechnology Research Centre Director General Guillermo Ordorica-Garcia and a review of NRC funding programs by NRC Director for National Programs, Rachelle Bruton. This was followed by full technical presentations (20 minutes) and a networking session for a 5-minute elevator pitch by the following researchers:

Full presentations from NRC-Nano include:

- › Adam Johan Bergren: Detection & Automation Team Overview & Remote Environmental Monitoring (UNSDG # 9, 13)
- › Abebaw Jemere: Nanoenabled Electrochemical Sensors (UNSDG #9)
- › Wayne Hiebert: Optomechanics and Sensing (UNSDG #9)
- › Byoungyoul Park: MEMS-Based Deformable Mirrors and/or Printed Actuators (UNSDG #9, 13)

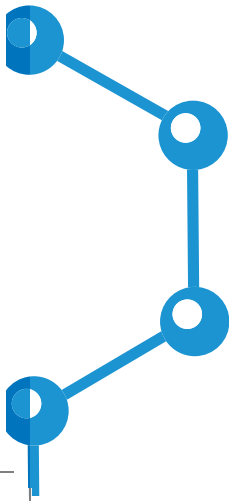
And from WIN:

- › Eihab Abdel-Rahman (SDE): MEMS Inertial Sensors (UNSDG #9)
- › Boxin Zhao (ChE): Silver-decorated polypyrrole nanowires for sensing volatile organic compounds (VOC's) (UNSDG #9, 13)
- › Shirley Tang (Chem): Portable and Wearable Medical Devices: A nanotechnology approach (UNSDG #3, 9)

WIN members participating in 5-minute pitch sessions include:

- › Yimin Yu (MME): Flexible Artificial Synapses for Memory and Neuromorphic Computing (UNSDG #9) Adrian Lupascu (PAS): Quantum Sensing with Superconducting Qubits (UNSDG #9)
- › Juewen Liu (Chem): Functional DNA-based Biosensors (UNSDG #3, 9)
- › Kevin Musselman (MME): Metal Oxide Films and 2D Nanoparticles for Sustainability and Health Applications (UNSDG #3, 9, 11)
- › Beth Weckman (MME): Electrochemical Sensors in Fire Safety Applications (UNSDG #9)

A seed funding competition was called in September 2021 for joint WIN-NRC projects. Funded through the WIN IRFP, this call was designed to kickstart projects, finding initial data points and insights leading to successful applications to various national and international calls as they arise, targeting in particular NRC collaborative R&D programs such as: (1) Challenge programs for disruptive technologies to address economic, social, and environmental challenges facing Canada, (2) Supercluster support programs for the 5 Innovation Superclusters and (3) Ideation fund initiatives for exploratory research by NRC researchers collaborating with external partners.



In December 2021, nine joint projects were funded, with a total cash envelope of \$310,000 CAD provided by WIN, matched by NRC for in-kind contributions through facilities use and access to NRC technical expertise. Below lists the PIs awarded, along with their project titles and amounts funded.

1. *Theranostic Nanomedicine: Dendrite Cell Leveraged Nanotechnology for Immunosensing and in-situ Immune Modulation - \$30,000 cash (WIN) and \$78,000 in-kind (NRC)*
 - › WIN Principal Investigator: Pu Chen, Department of Chemical Engineering
 - › NRC Principal Investigator: Yimei Jia
 - › NRC Co-Investigator: Marianna Kulka
2. *Rapid and Portable Multiplex Device for the Diagnosis of Flu-like Symptoms Caused by SARS-CoV-2, Human Rhinovirus and Influenza Virus - \$30,000 cash (WIN) and \$50,000 in-kind (NRC)*
 - › WIN Principal Investigator: Emmanuel Ho, School of Pharmacy
 - › NRC Principal Investigator: Nikola Pekas
3. *Magnetic Nanoparticle Coupled Aptamers for Biosensing and Enrichment of Exosomes - \$47,225 cash (WIN) and \$55,000 in-kind (NRC)*
 - › WIN Principal Investigator: Juewen Liu, Department of Chemistry
 - › NRC Principal Investigator: Marianna Kulka
4. *Nano-cantilever biogenic-amine sensors for food safety and waste - \$50,000 cash (WIN) and \$37,000 in-kind (NRC)*
 - › WIN Principal Investigator: Kevin Musselman, Department of Mechanical and Mechatronics Engineering
 - › NRC Principal Investigator: Kenneth Bosnick
 - › WIN Co-Investigator: Elhab Abdel-Rahman, Department of Systems Design Engineering
 - › WIN Co-Investigator: Mustafa Yavuz, Department of Mechanical and Mechatronics Engineering
5. *Printed 2D Nanomaterials for Flexible, Near-Infrared Sensors - \$30,000 cash (WIN) and \$50,000 in-kind (NRC)*
 - › WIN Principal Investigator: Michael Pope, Department of Chemical Engineering
 - › NRC Principal Investigator: Neil Graddage
6. *Development and implementation of cathodoluminescence system for the characterization of light emitting nanomaterials and nanostructures with atomic spatial resolution - \$30,000 cash (WIN) and \$50,125 in-kind (NRC)*
 - › WIN Principal Investigator: German Sciaini, Department of Chemistry
 - › NRC Principal Investigator: Mark Salamons
 - › NRC Co-Investigator: Michael Fleischauer
7. *Towards multiplexed point-of-care testing of disease biomarkers using molecularly imprinted polymer-based nanosensors - \$30,000 cash (WIN) and \$43,324 in-kind (NRC)*
 - › WIN Principal Investigator: Shirley Tang, Department of Chemistry
 - › NRC Principal Investigator: Abebaw Jemere

8. *Internet of things of low power field effect transistor-based sensor for CO2 detection - \$30,000 cash (WIN and \$50,000 in-kind (NRC)*
 - > WIN Principal Investigator: Yimin Wu, Department of Mechanical and Mechatronics Engineering
 - > NRC Principal Investigator: Adam Bergren
9. *3D imaging & machine learning for nanoplastic identification and classification - \$30,000 cash (WIN) and \$50,000 in-kind (NRC)*
 - > WIN Principal Investigator: Boxin Zhao, Department of Chemical Engineering
 - > NRC Principal Investigator: Misa Hayashida
 - > WIN Co-Investigator: Qinqin Zhu, Department of Chemical Engineering

FIGURE 6: WIN-NRC NANOTECHNOLOGY WORKSHOP HELD VIRTUALLY IN JUNE 2021

National Research Council Canada Conseil national de recherches Canada

WATERLOO INSTITUTE FOR nanotechnology

2021 Nanotechnology Workshop

Exploring R&D Trends and Innovation Opportunities in Nanomaterials and Nano-enabled Sensors

Virtual Event on Tuesday, June 22, 2021
9:00 AM – 12:45 PM MT / 11:00 AM – 2:45 PM ET

3 GOOD HEALTH AND WELL-BEING
 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
 11 SUSTAINABLE CITIES AND COMMUNITIES
 13 CLIMATE ACTION

Lufiana Mina
 Michelle Hiltz
 Uta P.
 Bulter
 Catherine
 Beth Weckman

“The financial support from WIN for the joint call with NRC allowed me to start building a new and exciting research direction in the area of MEMS-based pollutants sensors. Working with collaborators at Waterloo and NRC will help achieve a critical mass of research to compete in future funding calls.”

KEVIN MUSSELMAN, DEPARTMENT OF MECHANICAL & MECHATRONICS ENGINEERING



FIGURE 7: WIN DELEGATION VISIT TO MESA+ INSTITUTE FOR NANOTECHNOLOGY, UNIVERSITY OF TWENTE, NETHERLANDS IN OCTOBER 2019

2.4.1.3 INTERNATIONAL SEED FUNDS

MESA+ Institute for Nanotechnology, University of Twente, NL: In October 2019, a delegation of 10 WIN members and staff travelled to the MESA+ Institute for Nanotechnology at the University of Twente in Enschede, Netherlands, for a workshop on “New Interdisciplinary Research Opportunities to Combat Urgent Global Challenges in Health, Information & Communications Technology, and Energy”. WIN members in attendance included Shawn Wettig (Pharmacy), Hamed Majedi (ECE), Anna Klinkova (Chem), Boxin Zhao (ChE), Yuning Li (ChE), Derek Schipper (Chem), and Kevin Musselman (MME).

To support new collaborations, the WIN-MESA+ Seed Funding Program was announced on 16th October 2019 at the workshop opening, with €150,000 committed by MESA+ and matched by WIN at \$225,000 CAD from its Interdisciplinary Research Funding Program (IRFP).

In December 2019, five joint applications were received by teams from WIN and MESA+ Institute for Nanotechnology at the University of Twente in the Netherlands. Three projects were selected for funding at \$75,000 CAD each on the WIN side, matched by MESA+ at €50,000 each for the Dutch PIs:

1. *Integrated solution to ammonia and carbon dioxide recycling to fertilizers and fuels* –
 - › WIN Co-Investigator: Anna Klinkova, Department of Chemistry
 - › MESA+ Co-Investigator: Jeff Wood, Professor, Faculty of Science & Technology, University of Twente
2. *On-chip platform for tunable nonlinear optics and reconfigurable quantum photonics* –
 - › WIN Co-Investigator: Hamed Majedi, Department of Electrical and Computer Engineering
 - › WIN Co-Investigator: Bo Cui, Department of Electrical and Computer Engineering
 - › MESA+ Co-Investigator: Klaus Boller, Professor, Faculty of Science & Technology, University of Twente
3. *Laser-synthesized 2D nanosheets for epitaxial growth of functional oxides on any substrate* –
 - › WIN Co-Investigator: Kevin Musselman, Department of Mechanical and Mechatronics Engineering
 - › MESA+ Co-Investigator: Gertjan Koster, Professor, Faculty of Science & Technology, University of Twente

Indian Institute for Science, Bangalore, India:

In February 2021, WIN hosted an International Workshop on Quantum Materials & Quantum Devices with Indian Institute of Science Bangalore (IISc-Bangalore) Quantum Materials & Devices Division. Four WIN members who are also joint members of the Institute for Quantum Computing (IQC) participated, including Na Young Kim (ECE), Guoxing Miao (ECE), Adam Wei Tsen (Chem), and Youngki Yoon (ECE). Kevin Musselman (MME) and Zbigniew Wasilewski (ECE), also participated; although they are not members of IQC, they work extensively with quantum materials.



FIGURE 8: WIN-IISC BANGALORE WORKSHOP ON QUANTUM MATERIALS & QUANTUM DEVICES IN FEBRUARY 2021

This workshop was designed to kick-start productive and impactful collaboration with IISc-Bangalore, which is well known for the high calibre of research in this field. The workshop featured Vibhor Singh, Varun Raghunathan, Jaydeep Basu, Abhishek Singh Kausik Majumdar and Mayank Shrivastava, each of whom are prominent IISc-Bangalore researchers in this field.

The workshop spanned two days, from February 17-18, 2021, with over 112 audience members in attendance from WIN, IQC and IISc-Bangalore.

To incent collaboration, WIN and IISc will sponsor a joint seed funding competition later in 2022. Many of the presentations were recorded and posted on WIN's YouTube channel for viewing.

2.4.1.4 KEY PERFORMANCE INDICATORS FOR SEED FUNDING COMPETITIONS

WIN is the first research institute at UWaterloo to create a list of metrics – key performance indicators or KPI – to define expectations and deliverables. In this way, WIN and its members hold themselves accountable for the activities and results of these endeavors. For the WIN IRFP, the following KPI were defined and expected after one year of project completion:

- i. Application to major funding programs to a minimum of a ten-fold increase in initial seed funding amount (i.e. \$50,000 IRFP to gain external funding totaling at least \$500,000 CAD)
- ii. At least one established national or international collaboration (or increased scope of network)
- iii. At least two publications with cross-faculty authors in reputable peer-reviewed journals
- iv. Invitations to give presentations at significant national or international conferences

2.5 COMMERCIALIZATION PARTNERSHIPS

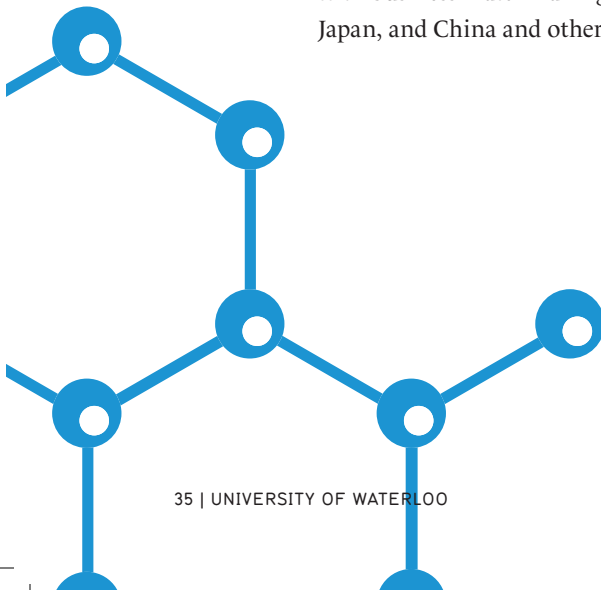
2.5.1 STARTUP CATALYST PROGRAM

The goal of startup support program is to help nanotechnology-based companies created with help of WIN members and also founded by nanotechnology engineering graduates. When such companies grow, they often become industry partners on various research projects. WIN's BDM helps startups with business connections, shares funding opportunities, edit grant proposals, and provides sound business advice. WIN also invites startups to participate in international partnership-building events. The program is designed to be an addition to others support systems on campus, such as Velocity and WatCo, and its activities are coordinated with campus partners.

WIN created an advisory team consisting of Adrien Côté (Executive Director of Velocity) and John Dick (Director of Concept), Professors Roderick Slavcev (Pharmacy; Director of Translational Initiatives for Faculty of Science, Director of Science Innovation Hub) and Eric Prouzet (Chemistry; entrepreneur, and entrepreneurship teacher). Based on consultations, WIN will focus its startup support on two activities:

Activity 1: Support entrepreneurial students (with priority given to Masters, and PhD students, and postdoctoral fellows) and faculty researchers at very early stages in close partnership with Concept, Science Innovation Hub (formerly Velocity Science), and WatCO (technology transfer office).

Activity 2: Continue helping existing UWaterloo-affiliated nanotechnology spinoffs companies with business matchmaking using WIN national and international connections in the Netherlands, Japan, and China and others as they develop.

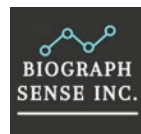


As an example of most recent activities, BioGraph Sense Inc, a spinoff from Mustafa Yavuz's laboratory (MME) benefited from advice related to up-scaling and market focus (also participant in the partnership with Brainport eco-system, see above). AquaSensing Inc, a spin-off from Norman Zhou's lab (also MME) received assistance in developing B2B relations for flood monitoring in industrial environments. LeNano Diagnostics Inc, a spin-off from Shirley Tang's lab (Chemistry), received help related to drafting a grant application to a federal funding agency for the further development of a point-of-care diagnostics device. Halion Displays Inc, a company created by Nanotechnology Engineering graduates received assistance in finding a suitable lab space in the region.



BifTek Lasers Inc.

////////



2.6 PARTNERSHIP WITH GREENHOUSE – INNOVATION FOR STUDENTS AND STUDENT TRAINING AT UW

WIN is working with GreenHouse, a social impact incubator focused on sustainability for social and environmental change from St Paul's College, and the Waterloo Indigenous Student Centre (WISC). A student training program is being developed, involving co-operative education placements in WIN research laboratories, planning to hire both Indigenous and non-Indigenous youths to work on projects focused on social innovation. At the completion of the project, students will participate in an "Elevator Pitch" competition, earning seed funding to support their social enterprise.

2.7 PARTNERSHIP WITH ONTARIO GENOMICS

WIN initiated a partnership with Ontario Genomics (OG) to commence potential industry-academic research collaborations with the OG-powered Can-DESyNe Network. This partnership will help explore potential opportunities to stimulate interdisciplinary translational research and training in the intersecting areas of nanotechnology and engineering biology. The Can-DESyNe network leverages and connects existing and new regional and sector-specific resources, multinationals, established SMEs, innovative start-ups and academic expertise to establish Canada as a global leader in novel, industrial-scale advanced bio-manufacturing technologies and biotechnologies.

Three key priority areas include:

1. Low-carbon manufacturing (UN SDGs #9, 11, 12, 13)
2. Advanced Engineering Health Technologies (UN SDGs #3, 12)
3. Food Security- Alternative proteins and cellular agriculture (UNSDGs #2, 3, 9, 13)

WIN invited its membership to contribute to this search, to identify research projects with appropriate industry partners. A seed-funding competition will be announced in support of joint projects with high lab-to-market potential.

2.8 INTERNATIONAL PARTNERSHIPS

FIGURE 9: WIN INTERNATIONAL PARTNERS



2.8.1 WIN-NANOTEC THAILAND

The National Nanotechnology Center (NANOTEC) is the premier national nanotechnology hub in Thailand, established on 13 August 2003. Research themes at NANOTEC align very well with all four of WIN's key thematic areas. The agreement will allow opportunities for exploration and discovery for innovation in research and commercialization and help facilitate inclusion to significant Asia-based funding programs and networks. A key outcome of this agreement is the formation of co-operative education work-term placements for undergraduate students in the Nanotechnology Engineering program, starting in Fall 2019.

2.8.2 JAPANESE INDUSTRY PROMOTION

In April 2020, WIN spearheaded an MOU between the University of Waterloo and Landing Pad Tokyo (LPT), a subsidiary of the Japanese Industry Promotion Association (JIPA). LPT's mandate is to match the technological needs of its Japanese-member SMEs with those of Canadian startups. During the 2020-21 reporting period, over ten WIN- and UW-affiliated startups were introduced to Japanese partners.

FIGURE 10: LANDING PAD TOKYO DELEGATION VISITING WIN, JUNE 2022.



FROM LEFT TO RIGHT: Shin Takeuchi, PhD (President and CEO of Nissin Inc.), Ms. Chieko Bond (Director, Business Development and Canadian Operations, Landing Pad Tokyo), Professor Kevin Musselman (Dept. of Mechanical and Mechatronics Engineering, University of Waterloo) Professor Sushanta Mitra (Executive Director, WIN) and Oleg Stukalov, PhD (Business Development Manager, WIN).

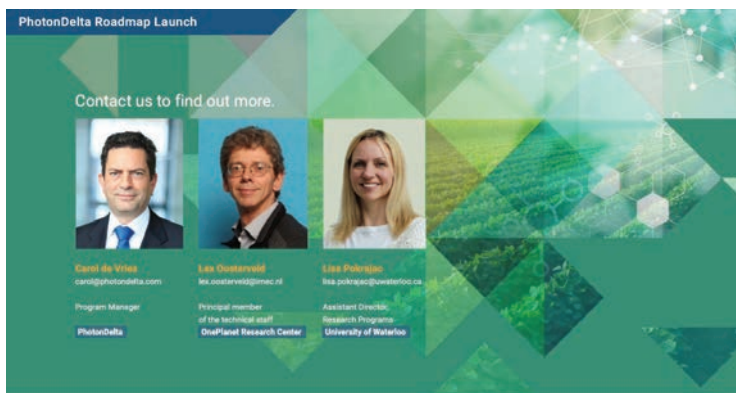
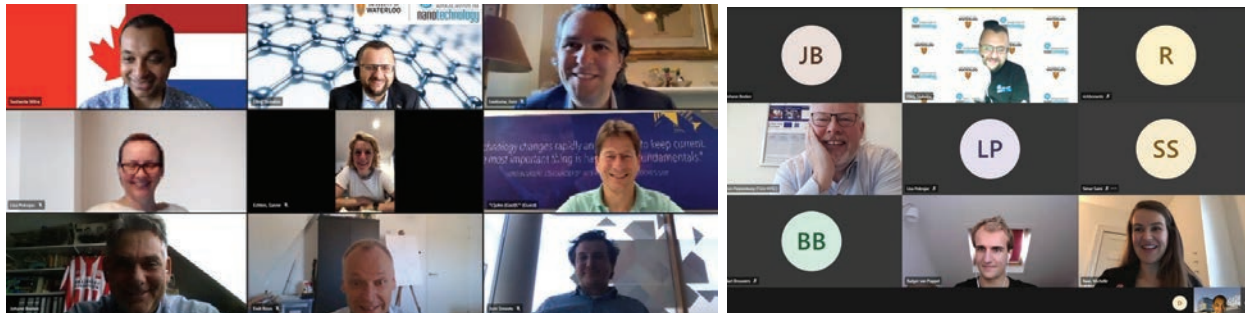
2.8.3 REGION OF EINDHOVEN ENTREPRENEURSHIP ECOSYSTEM

WIN and Brainport (the economic development agency for the region of Eindhoven, Netherlands) have agreed to create a joint seed funding program to facilitate joint applied research projects between WIN affiliated spinoff companies, WIN faculty members and partners in Eindhoven. Brainport identified various local parties: PhotonDelta (Public-private partnership and a fund supporting integrated photonics technologies), High-Tech Systems Centre at the Technical University of Eindhoven, and HighTech XL (business incubator dedicated to the commercialization of academic research). To facilitate the engagement process, WIN hosted a virtual event on November 3, 2020. Twenty participants attended, including representatives from eight start-up companies from both sides.

Following this event, a Memorandum of Understanding (MOU) was created and finalized, and a joint funding program for further partnership-build was called in 2022. Please see Section 3.6 for the details of the joint funding program and activities.

WIN's relations with the Brainport Eindhoven region of the Netherlands continues to grow in multiple directions including the Agrifood Roadmap for Integrated Photonics Devices. PhotonDelta catalyzes rapid development and deployment of integrated photonics technologies. These are cases where photonic sources like LEDs are integrated on the same silicon chip; includes optical computers, sensors, optical switches for internet, etc. PhotonDelta engaged WIN expertise in brainstorming of various applications specifically in the context of Canadian agriculture, where such devices could find their use.

FIGURE 11: ONLINE MIXER FOR WIN AND BRAINPORT ECONOMIC DEVELOPMENT FOR THE REGION OF EINDHOVEN, NETHERLANDS



PHOTONDELTA ROADMAP LAUNCH
for Integrated Photonics for the Agri-Food Industry Contacts – Carol deVries from PhotonDelta, Lex Oosterveld from OnePlanet Research Centre and Lisa Pokrajac from WIN



PhotonDelta High Tech Campus 41 +31 (0)65 112 43 37
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The Netherlands office@photondelta.com



3.0 FUNDING

An integral function of research institutes is to help faculty and students with all aspects of funding whether from provincial, national, international or non-profit independent organizations. WIN's support takes the form of identifying viable programs, assembling team talent, assisting on grant writing and budget preparation, and providing seed-funding to get projects off the ground.

During the past five years, WIN has been very active in supporting applications to large and prestigious programs with significant envelopes. Below lists the awards in which WIN members have been granted, with the help of WIN staff support.

3.1 CANADIAN FOUNDATION FOR INNOVATION

The Canadian Foundation for Innovation (CFI) invests in research facilities and equipment in Canada's universities, colleges, research hospitals, and not-for-profit organizations. These federal funds are allocated to "help build and sustain Canada's research landscape to attract and retain the world's top talent, retain the next generation of researchers, support private sector innovation and create high-quality jobs that strengthen Canada's position in today's economy."

For the 2020 CFI-IF competition, WIN dedicated \$1M for nanotechnology infrastructure and supported PIs to ensure high quality for success, including a project charter to outline objectives and share responsibilities for competing the application. WIN and its Special Projects and Research Committee (SPARC) were involved in reviewing and editing the proposals. For the 2020 round, the project titled "Waterloo Centre for Electrochemical Energy Storage and Conversion", led by Linda Nazar of the Department of Chemistry, with Co-PIs Zhongwei Chen and Michael Pope, both from the Department of Chemical Engineering, was awarded \$2.089 M CAD with an \$800,000 CAD allocation from the WIN envelope. This project addresses the need for aggressive research in advanced energy storage to meet global demands to develop innovative and inexpensive new-generation energy storage batteries. A UW-based centre for energy conversion and storage involves significant renovation to accommodate a dry room and several significant hardware and equipment purchases. Congratulations to the team, and we look forward to the promising outcomes of this Centre at UW!

3.2 HORIZON EU AND CANADIAN INSTITUTE FOR HEALTH RESEARCH

A group of researchers from the EU approached Juewen Liu (Chem) to partner on a project related to developing new technologies for remote monitoring of the elderly when they transition between layers of healthcare. The UW team, consisting of Liu, Shirley Tang (Chem), George Shaker (ECE), and Jenn Boger (SDE), assembled an applied research plan involving laboratories at the Research Institute on Ageing (RIA) requesting \$1.2M from CIHR. In coordination with CBB, WIN's BDM approached several Canadian companies, which resulted in a partnership commitment from e-health company headquartered in Kitchener, and a great deal of the grant writing and editing was done by WIN's BDM and ADRP. Although the application was not funded by Horizon EU, a new valuable relationship has been developed with a company in the remote diagnostics space.

3.3 DESIGNATED FUNDING FOR COVID-19 PROJECTS

The recent pandemic has been an exemplar of humanity's ability to work together for a common good. WIN faculty have tackled COVID-19 and public needs through innovative and groundbreaking research ranging from new nanostructured antibacterial coatings for surfaces and protective gear, sensors for rapid detection and imaging, and battery technology to efficiently power medical devices. Some groups modelled virus structure through computer simulations for therapeutics and vaccine discovery, while others have teamed up with local startups to provide fast-to-market technology such as point-of-care tests of COVID-19 virus in patient's bodily fluids, and wearable medical IoT devices for patient monitoring.

In response to the COVID-19 pandemic, both NSERC and Mitacs called out to Canada's talented researchers with their COVID-19 Research Competition to address the global crisis. NSERC's total envelope was \$15M in funding. WIN members were recipients of eleven of these awards totaling over half a million dollars. For many of these projects, WIN members received direct assistance from WIN's BDM.

WIN MEMBER	DEPARTMENT	PROJECT TITLE	FUNDER
Aucoin, Marc	ChE	COVID-19: Inactivation of human coronaviruses in aqueous solutions using UV-C	NSERC Alliance COVID-19
Ban, Dayan	ECE	A remote, high-throughput temperature monitoring system for COVID-19 screening	NSERC Alliance COVID-19
Hopkins, Scott	Chem	Ultraviolet Photodissociation (UVPD) Spectroscopy of DMS-selected COVID-19 peptide residues	NSERC Alliance COVID-19
Hopkins, Scott	Chm	UVPD of DMS-MS-selected SARS-CoV-2 peptides	MITACS Accelerate COVID-19
Liu, Juewen	Chem	Development of localized surface plasmon resonance biosensor for COVID-19 antibodies in blood	NSERC Alliance COVID-19
Mitra, Sushanta	MME	Characterization of nano-bubble enabled disinfection system for COVID-19	NSERC Alliance COVID-19
Mitra, Sushanta	MME	Testing of antiviral coatings for COVID-19	NSERC Alliance COVID-19

WIN MEMBER	DEPARTMENT	PROJECT TITLE	FUNDER
Mitra, Sushanta Liu, Juewen	MME Chem	Development of paper-based Rapid Diagnostic Kit for COVID-19	MITACS Accelerate COVID-19
Maheshwari, Vivek	Chem	Low cost wearable and continuous temperature sensor for COVID-19 pre-screening with remote monitoring (TEMPOS)	MITACS Accelerate
Mitra, Sushanta	MME	Characterization of antiviral coatings: Wetting studies and efficacy	MITACS Accelerate COVID-19
Musselman, Kevin	MME	Development of COVID-19 antiviral coatings for N95 respirators	NSERC Alliance COVID-19
Pope, Michael	ChE	COVID-19: Indoor light-activated, self-cleaning surfaces for continuous decontamination of transparent PPE	NSERC Alliance COVID-19
Pope, Michael Tang, Shirley	ChE Chem	COVID-19: Indoor light-activated, self-cleaning surfaces for continuous decontamination of air in HVAC systems	MITACS Accelerate COVID-19
Poudineh, Mahla	ECE	Purification of SARS-CoV-2 Virus-Like Particles (VLPs) Using a Microfluidic Technique for Downstream COVID-19 Vaccine Production	NSERC Alliance COVID-19
Poudineh, Mahla	ECE	Design and Evaluation of Microfluidics Based RT-LAMP Device	MITACS Accelerate COVID-19
Ren, Carolyn Ho, Emmanuel	MME Pharmacy	Development of a Microwave Enabled Bio-Nano-Microfluidic Device for Point-of-Care Diagnosis of COVID-19	Canadian Institutes for Health Research (CIHR)
Slavcev, Roderick Aucoin, Mark	Pharmacy ChE	Hybrid bacteriophage platforms for the production of non-invasive, self-adjuvanted, and targeted DNA vaccines against SARS-CoV-2	MITACS Accelerate COVID-19
Slavcev, Roderick Aucoin, Marc Poudineh, Mahla Wettig, Shawn	Pharmacy ChE ECE Pharmacy	Generating a COVID-19 vaccine using ministring DNA and virus-like particles	MITACS Accelerate COVID-19
Tam, Michael	ChE	COVID-19: Development of Sustainable and Compostable Face Masks for Enhanced Protection Against COVID-19 Virus Particles	NSERC Alliance COVID-19
Tam, Michael Musselman, Kevin	ChE MME	Advanced Engineering Processes and Materials to Produce Compostable Masks and Antimicrobial Coatings for PPE	CFI-EOF
Tang, Shirley	Chem	Portable COVID-19 diagnostic system using saliva sample	MITACS Accelerate COVID-19
Yavuz, Mustafa	MME	Real-time COVID-19 detection in wastewater from long-term care homes	NSERC
Yavuz, Mustafa	MME	Real-time COVID-19 detection in wastewater from long-term care homes	MITACS Accelerate COVID-19
Zhou, Norman	MME	100% Canadian Sourced Enhanced Antiviral Medical Masks for COVID-19 and PPE Innovation	MITACS Accelerate COVID-19

3.4 NSERC COLLABORATIVE RESEARCH AND TRAINING EXPERIENCE PROGRAM

3.4.1 DFG-IRTG/NSERC CREATE

In May 2022 the proposal titled “Scalable 2D-Materials Architectures (2D-MATURE): Synthesis and Processing, Characterization and Functionality, Implementation and Demonstrations” was prepared by a team of WIN members lead by Michael Pope in cooperation with researchers from the Centre for Nano integration at Duisburg-Essen (CENIDE) at the University of Duisburg-Essen in Germany. Submitted to the German Research Foundation (DFG) International Research Training Group (IRTG) and the NSERC CREATE programs, it was selected for full funding for €4.5M for 4.5 years by DFG and \$1.65M CAD by NSERC CREATE over 6 years, with the possibility of renewal by DFG for an additional 4.5 years.

The program will provide training in the development of 2D materials for a wide range of applications, for electronics and opto-electronics, energy storage devices (batteries and supercapacitors) and flexible electronics and optical displays, to name a few. The WIN team involved in 2D-MATURE is an impressive team of experts in the field, each contributing their knowledge and experience to the program to ensure success. The team includes, PI Michael Pope (ChE), with co-PIs Kevin Musselman (MME), Rodney Smith (Chem), Zhongwei Chen (ChE), Na Young Kim (ECE), Irene Goldthorpe (ECE), Kyle Daun (MME), and German Sciaini (Chem). WIN collaborators include William Wong (ECE) and Adam Tsen (Chem).

Since the first days, WIN has been instrumental in cultivating and nurturing the WIN-CENIDE partnership, which officially commenced in 2013 when WIN member Kyle Daun invited then-CENIDE Scientific Director Christof Schulz to deliver a WIN seminar at the QNC. During this visit, both institutions recognized their similar visions and complementary strengths, which resulted in several visits, exchanges, and the WIN-CENIDE Memorandum of Understanding for Cooperation in Research which was signed in 2016. WIN championed three in-person workshops, supported by the International Research and Partnership Grant (IRPG) from the Office of Research, for a total of \$45,000 for which WIN provided \$11,000. The first workshop was held in CENIDE in June 2016 served as discovery, introducing WIN and CENIDE members to each respective areas of expertise. The second workshop in June 2018 brought a CENIDE delegation to UW, which honed and defined potential research projects for upcoming international funding calls, and the DFG-IRTG/NSERC CREATE were earmarked for having a high potential of success.

Intense work on the project commenced for that year, and a third workshop at CENIDE brought a select group of WIN members back to CENIDE for further refinement of the proposal and each team members’ respective roles. After the proposal was submitted to the DFG and positive comments for improvement returned to the team, a fourth workshop was held online in June 2020 to further refine the proposal and incorporate the committee’s suggestions for submission in September 2021.

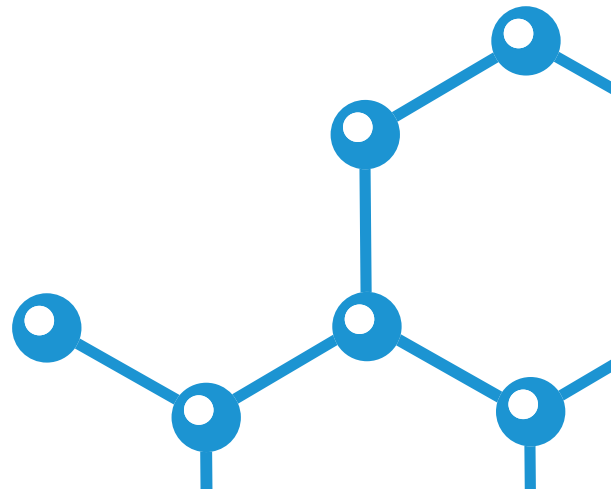




FIGURE 12: WIN ED SUSHANTA MITRA PROVIDING OPENING REMARKS AND WELCOMING CEINDE MEMBERS TO WIN AT THE SECOND JOINT WIN-CEINDE WORKSHOP IN JUNE 2018



FIGURE 13: CEINDE DELEGATION AND WIN MEMBERS AT SECOND WORKSHOP IN JUNE 2018 VISITING ELORA ONTARIO

WIN staff contributed significantly to the contents of both the DFG-IRTG and NSERC CREATE grants, providing input and information on UW resources for EDI, data management, student well-being and environment. WIN is also contributing resources and support during the program, including:

1. Communications and event support for at least one seminar, one workshop, and one symposium per year, amounting to \$67,500 to support of travel and accommodations for guest speakers at the UW workshops and \$81,000 in-kind contributions for planning, coordination and communications support over the 9-year duration.
2. Travel support, via the WIN-Mitacs International Globalink Program. WIN will support mobility for one inbound and one outbound student per year, for a total of \$6,000 per year (or \$54,000 over the 9-year duration). This amount will be matched by Mitacs.
3. Project management: WIN personnel will commit 20 hours per month to help the Program Coordinator arrange training activities, trainee mobility, and access to research facilities within and outside the University of Waterloo. This amounts to an in-kind contribution of \$129,600 over the project duration.
4. Industry liaison support via the Business Development Manager's time and expertise, as well as access to industry networks. The BDM will coordinate annual half-day skills development workshops in nanotechnology entrepreneurship and intellectual property protection. This amounts to an in-kind contribution of \$81,000 over the project's duration.
5. WIN Nanofellowship program: CREATE trainees enrolled at the University of Waterloo will be eligible to apply for a 1-year, \$10,000 WIN Nanofellowship to supplement their base stipend. Based on historical success rates, it is anticipated that 11 trainees will receive Nanofellowships, for a total contribution of \$110,000 over the project duration.

Total WIN commitment over 9-years: \$523,100 CAD

3.4.2 TRAINING IN SUSTAINABLE NANOTECHNOLOGY

In January 2022, WIN submitted an Expression of Interest (EOI) for the 2022-23 NSERC Collaborative Research and Training Experience (CREATE) program titled, “Training in Sustainable Nanotechnology for Novel Materials Design & Production (TSNano)”. The proposed training program aims to create a paradigm shift in R&D training by focusing on “sustainability” as a core philosophy, from concept to design, to manufacture, to end-of-use considerations. The ultimate goal is to teach the next generation of scientists and engineers to move away from the economic “take-make-waste” model of economic growth to encompass responsibility and zero-waste aspects of the circular economy.

The research program will focus on developing novel materials for energy, clean technologies, and biowaste conversion into valued products while incorporating fundamental sustainability principles. TSNano combines the expertise of WIN faculty in Science and Engineering, with the complementary expertise of researchers from the Faculties of Arts, Applied Health and Environment, providing a truly interdisciplinary, holistic approach to R&D. Such knowledge and skills are in high demand within Canada and around the world, to mitigate the collective effects of over-use of finite resources and irresponsible disposal of waste. This model also represents an important opportunity for the Canadian economy. The team consists of PI Sushanta Mitra (MME), with WIN co-PIs Goretty Dias (SEED), Anna Klinkova (Chem), Tizazu Mekonnen (ChE), Kevin Musselman (MME), Yimin Wu (MME), Steven Young (SEED), and Qinqin Zhu (ChE). The team also includes UW co-PIs Hannah Neufeld (AHS) and Anindya Sen (Econ), along with David Sinton from the Department of Mechanical and Industrial Engineering at the University of Toronto.

TSNano was selected by the University of Waterloo through an internal evaluation process as part of its quota for the year to submit a Letter of Interest (LOI) to the Regular Stream for the 2022-23 competition in April. Although this proposal was not invited by NSERC for submission for September 2022, WIN will continue developing the program content over the next year and resubmit for future CREATE grants.

3.5 ONTARIO RESEARCH FUND

In the Fall 2021, Ontario Government announced new call for proposals, for preference given to projects focussed on critical metals and transportation electrification. WIN’s BDM, Oleg Stukalov, spearheaded the development of the \$6M grant application (\$2M request from ORF, and \$400k cash and \$1.75M in-kind matching from industry) for the Consortium on Nickel Recycling (CONR). The ever-growing consumer demand for electrical vehicles have put pressure on battery manufacturers to secure supplies of nickel, for which severe shortage is predicted in the next 5-10 years. These predictions put a higher emphasis on recycling of nickel from spent and recalled Li-ion batteries.

CONR plans to focus on developing vapour metallurgy approach to nickel recycling, resulting in waste-free recovery of nickel in highly pure form and converting it into value-added products. The application co-PIs were WIN members Yimin Wu (MME) and Jeff Gostick (ChE). Two Ontario-based companies showed interest in contributing cash towards ORF funding. Due to issues pertaining to licensing and IP, the final was not submitted in 2022. WIN BDM continues working with the co-PIs and two companies to come to terms of collaboration suitable for all. The proposal will be repurposed for other grants programs, such as the NSERC Alliance grants.

3.6 INTERNATIONAL COMMERCIALIZATION SUPPORT – BRAINPORT DEVELOPMENT CORPORATION, EINDHOVEN REGION, NETHERLANDS

WIN and Brainport have agreed to create a joint seed funding program to facilitate joint applied research projects between WIN Startup Catalyst affiliated spinoff companies, WIN faculty members, and partners in Eindhoven. In November 2020, immediately after the workshop (previously mentioned on page 35) WIN announced a seed funding

program with an overall budget of \$90,000. The joint seed funding program was to be delivered in two stages: Stage I with total budget of \$15,000 supported group business travel to Eindhoven for engagement with potential partners, and Stage II will follow and fund direct research in collaboration with partners in the region, both academic and private. WIN received three applications for the Stage I call in October 2021:

Project 1: Lead - Professor Carolyn Ren, MME. *“Wearable active compression sleeve for treating breast cancer-related lymphedema”*. Other team members include Run Ze Gao (MME, PhD Candidate and co-inventor) and Jacqueline Kormylo (Kinesiology, MSc Candidate and collaborator)

Project 2: Lead - Professor Derek Schipper, Chemistry. *“From waste plastic to construction magic”*. Other team members include Boris Nazareth (Chemistry, PhD Candidate and co-inventor)

Project 3: Lead - Professor Mustafa Yavuz, MME. *“Electronic tests for early detection of diseases”*. Other team members include Inna Novodchuk, PhD (former PhD student, co-inventor). The teams traveled to Eindhoven at the end of May 2022 and are now engaged in detailed discussions with prospective partners. We anticipate to receive full applications sometime in Winter 2023.

3.7 SCHOLARSHIPS AND FELLOWSHIPS FOR TRAINING

WIN funding also encompasses support for students and trainees, to help develop their skills needed to meet the current and future workplace demands for the needs of industry, government and academia. WIN manages many prestigious scholarship and mobility programs to ensure student success within Canada and to help expand the students’ international networks.

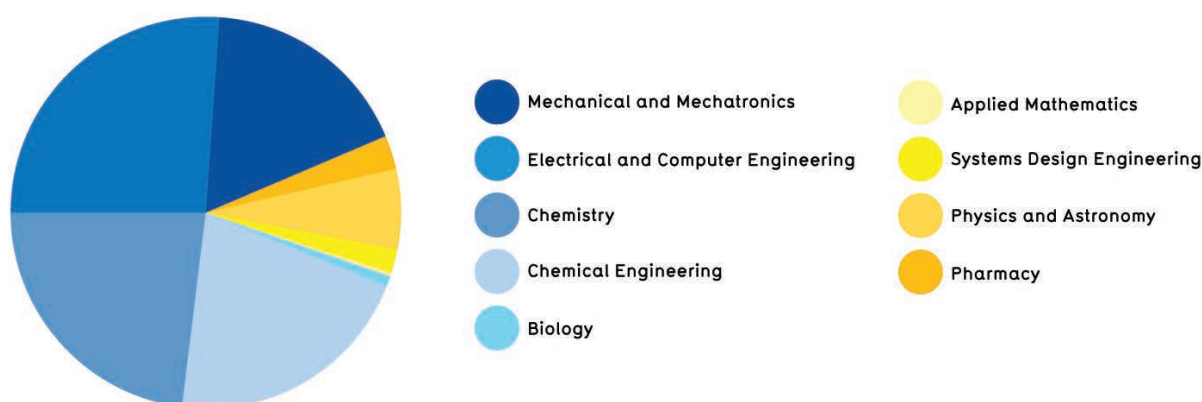
3.7.1 SCHOLARSHIPS FOR UW GRADUATE STUDENTS

3.7.1.1 WIN Nanofellowship

WIN provides significant funding to attract and retain graduate students in the form of scholarships made possible by a generous donation from an anonymous donor. Interest from the \$10.5M endowment has provided funds for approximately 600 scholarships in nanotechnology, also known as “Nanofellowships” since its first call in 2008. Each Nanofellowship is valued at \$10,000 provided on top of the graduate students’ guaranteed departmental funding support.

Nanofellowships are awarded to outstanding students conducting nanotechnology research through an annual competition which is open to Canadian and international students. Since 2017, Nanofellowships have been awarded to 234 graduate students, for a total of \$2.34M CAD, distributed among nine departments at UW.

FIGURE 14: NANOFELLOWSHIP AMOUNTS AWARDED BY DEPARTMENT, 2017-2022



3.7.1.2 WIN-Velocity Scholarship Program

In January 2022, WIN and Velocity announced the WIN-Velocity Scholarship. This scholarship aims to support first-year UW Masters students who are studying nanotechnology in Science and Engineering, while also pursuing commercialization and entrepreneurship activities for establishing a “deep-tech” start-up company. Students participating in the program will receive mentorship and advice for start-up and entrepreneurial activities from Velocity.

The WIN-Velocity Scholarship, with a value equivalent to a two-year Graduate Research Studentship (GRS), has been made possible by a financial contribution from the Waterloo Institute for Nanotechnology (WIN) to support domestic research-based master’s students who will be registered full time in their first year of graduate studies in the Faculty of Engineering and/or Faculty of Science.

In April 2022, the first WIN-Velocity Scholarship winner was selected: Brian Rojko from Electrical & Computer Engineering will be starting his Master of Applied Science (MAsc) in September 2022 with WIN Member, Professor Manoj Sachdev. Congratulations to Brian!

3.7.2 SCHOLARSHIPS FOR MOBILITY AND INTERNATIONAL STUDENTS

3.7.2.1 WIN-Mitacs Funding Program

In September 2017, WIN Executive Director, Sushanta Mitra met with Mitacs CEO Alejandro Adem and CRO Ridha Ben-Mrad, to discuss a program for undergraduate entrepreneurship and innovation. The purpose of this program is to connect Canadian business and technology enterprises with emerging global markets using the vehicle of international student training. The program would provide 2-way mobility of students from the University of Waterloo and selected partner countries with commercial business (both well-established industries and new start-up ventures) with the purpose of not only advancing leading-edge innovation, but also to identify demands and access large and growing markets, especially in Asia. This joint venture represents a unique model with international bridges at the undergraduate level, as the focus would not be for graduate student recruitment; instead, ideal candidates to the program possess significant business acumen, with a decreased emphasis on academic performance.

The MoU was finalized in February 2018 at a signing ceremony in New Delhi at an event corresponding with the Canadian Prime Minister’s visit to India. The program was updated in 2019 to include all Mitacs Partner countries and is set for renewal in 2022.



FIGURE 15: ALEJANDRO ADEM, THEN CEO MITACS (CURRENT NSERC PRESIDENT) AND SUSHANTA MITRA, WIN ED, SIGN THE WIN-MITACS AGREEMENT IN 2018

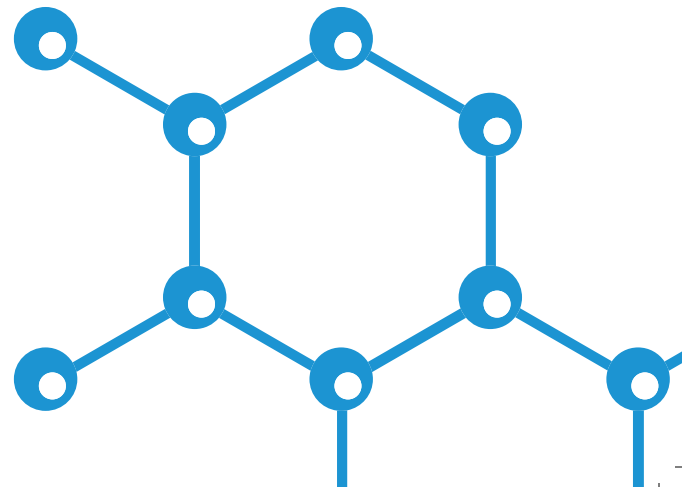


FIGURE 16: SUSHANTA MITRA VISITING SOOCHOW UNIVERSITY'S COLLEGE OF NANOSCIENCE & TECHNOLOGY



3.7.2.2 WIN-Soochow University PhD Scholarships and Postdoctoral Fellowships

Soochow University is sponsoring a scholarship for PhD students for \$10,000 CAD per year for four years to complete this split-residency program (50% of time at UW, 50% at Soochow for research). The student will earn a doctorate from UW, with a certificate of international research experience from Soochow University. Additionally, Soochow University is offering a Post-doctoral Fellowship of minimum value of \$40,000 CAD per year for two years with split residency. For both programs, candidates can be from anywhere in the world and must meet the minimum eligible requirements. It is expected that five PhD students and three post-doctoral fellows will be awarded per year for three years.

3.7.2.3 WIN-NIMS Graduate Student Fellowship

In October 2018, the Co-operative Graduate Agreement between UW and National Institute for Materials Science (NIMS) Japan was finalized, allowing PhD students from UW to engage in cutting-edge research in novel materials development and gaining experience in an international setting. Working in state-of-the-art facilities at NIMS, UW students can travel to the NIMS laboratories in Tsukuba Japan and work directly with NIMS researchers, who are world leaders in their field.

The Fellowship provides funds for student living expenses and accommodations while in Japan, for the 6- to 12-month residency at NIMS. This translates to approximately \$1,500 CAD/month for living costs and \$800 CAD/month for dormitory fees totaling \$13,800 CAD for six months, or up to \$27,600 CAD for one year per student.

In 2020, two UW graduate students in Nanotechnology were chosen to participate in this program – Monika Snowdon (Chem) and Sirshendu Misra (MME).

“WIN has been so helpful – managing this program and helping with the application. I would have never had this amazing experience without WIN’s assistance. It has really broadened my research focus and helped me create a network of outstanding international, professional contacts.”

SIRSHENDU MISRA, PHD STUDENT

3.8 PALETTE SKILLS

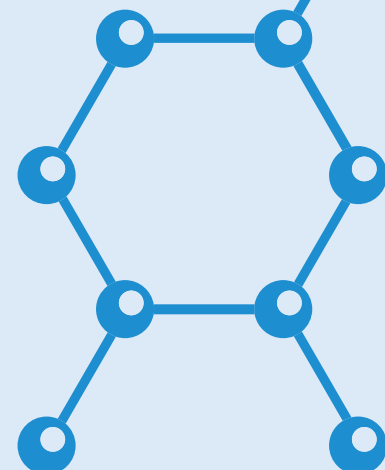
In the Fall 2021, WIN and WatSPEED submitted a joint funding application to the not-for-profit (NFP) organization Palette Skills, which financially supports the creation of “rapid upskilling” programs for growing industry sectors. WIN proposed the creation of a skills-upgrading program focusing on Point-of-Care medical devices. The proposed program would be suitable for graduates of Canadian universities and newcomers with higher degrees in the areas of biology and chemistry.

Several companies agreed to participate in this timely initiative, including Nicoya Lifesciences Inc, NERv Inc, and Verv Technologies Inc, each of whom provided support letters. WIN also plans to partner with OBIO, an NFP dedicated to supporting biotech and medical startup companies in Ontario and beyond. If funding is approved, WIN will work with several professors to develop several highly specialized, hands-on biomedical engineering courses, while OBIO will provide training in the areas such as sales, marketing, and regulatory approvals. Participating companies will be involved in the course design and will provide the participants with mini-internship placements.

“The proposal we received from the WIN team for the training in medical device areas was one of the strongest and we look forward to working with them to make it a reality.”

APRIL PHILPOTS, ASSOCIATE DIRECTOR, STRATEGY AND SPECIAL PROJECTS, WATSPEED

4.0 KNOWLEDGE MOBILIZATION



One of the key functionalities of a research institute is to create a platform for knowledge exchange and dissemination that would help to enrich the WIN members and the associated highly qualified personnel. WIN has been organizing a number of such seminar/workshop series since 2009 to provide an opportunity for faculty and students to meet and interact with nanotechnology experts from around the world, and drive research collaboration.

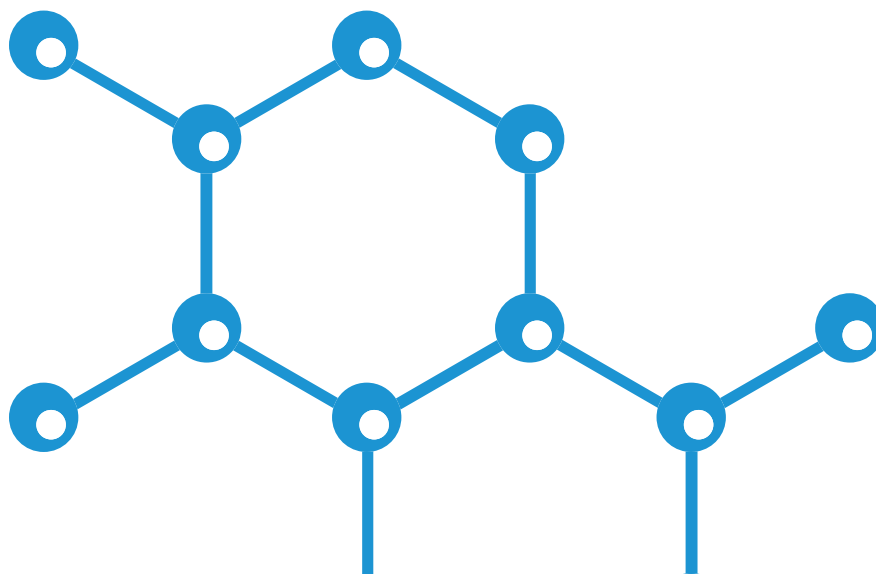
4.1 WIN SEMINAR SERIES – RESEARCH

4.1.1 DISTINGUISHED LECTURE SERIES

Since 2017, WIN has hosted 18 world-leading researchers in broad areas of Nanotechnology as WIN Distinguished Lecturers (WIN-DLS). This is a prestigious WIN seminar series and the individuals who deliver WIN-DLS are exceptional scientists who have made exceptional contributions in the broad fields of nanoscience and nanotechnology.

2017-03-24	Arokia	Nathan	University of Cambridge	Transparent and Flexible Oxide Nano-Electronics
2017-04-10	Shuit-Tong	Lee	Institute for Functional Nano & Soft Materials, Soochow University	Silicon Nanostructures for Biomedical and Energy Applications
2017-05-24	Andrew	deMello	Swiss Federal Institute of Technology (ETH) Zurich	Droplet-based Microfluidics: High-throughput Experimentation One Drop at a Time
2017-06-17	Chunli	Bai	Chinese Academy of Sciences	Bioscience and Nanotechnology in China: From Fundamental Research to Applications
2017-09-26	Philip	Kim	Harvard University	Experimenting at the Nanoscale
2017-10-07	Howard	Stone	Princeton University	Surprising Responses in Common Fluid Flows: (i) Surface-attached Bacteria, Biofilms, and Flow; and (ii) Trapping of Bubbles in Stagnation Point Flows

2017-11-18	Joanna	Aisenberg	Harvard University	New Bio-inspired Materials: When Nanotechnology Meets Chemistry, Optics and Surface Science
2018-03-07	Zhong Lin	Wang	Georgia Institute of Technology	From Maxwell's Displacement Current to Nanogenerator Driven Self-Powered Sensors and Systems
2018-09-25	Luke	Lee	National University of Singapore	Ultrafast Photonic PCR and Organiods on Chip for Personalized Precision Medicine
2018-10-30	Max	Lu	University of Surrey UK	Accelerating Innovation in Nanomaterials through Partnerships
2018-11-06	Arun	Majumdar	Stanford University	Navigating the Turbulence of the Global Energy System
2019-04-30	Paul	Weiss	University of California, Los Angeles	Precise Chemical, Physical, and Electronic Nanoscale Contacts
2019-10-21	Wallace	Leung	Hong Kong Polytechnic University	Novel Nanofiber Technologies for Energy and Environment
2019-10-31	Federico	Rosei	Institut national de la recherche scientifique	Multifunctional Materials for Emerging Technologies
2020-09-23	Joseph	Heremans	Ohio State University	The Thermal Chiral Anomaly in ideal field-induced Weyl semimetals
2020-10-22	Liangbing	Hu	University of Maryland	Materials Innovations for Emerging Energy Technologies
2022-04-19	Ian	Manners	University of Victoria	Functional Nano and Micron-Scale Materials via Seeded Self-Assembly Driven by Crystallization
2022-06-09	Yury	Gogotsi	Drexel University	The Fascinating World of Two-Dimensional Carbides and Nitrides (MXenes)



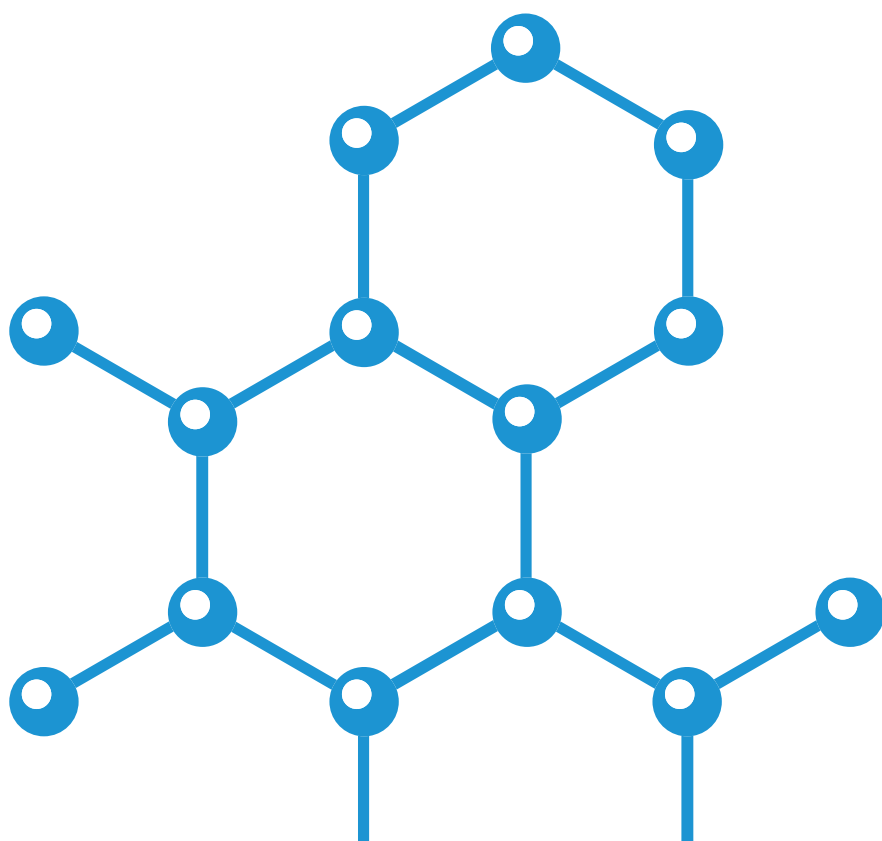
4.1.2 WIN SEMINAR SERIES

WIN also hosts regular seminar series inviting prominent researchers from the fields of nanoscience and nanotechnology who deliver lectures and interaction with WIN members. A number of such seminars have resulted in new research collaborations for WIN members. Since 2017, WIN has hosted 47 Seminar speakers.

DATE OF SEMINAR	NAME OF PRESENTER	AFFILIATION	TALK TITLE
2017-04-13	Alberto Salleo	Stanford University	What Do Polymers Have To Do With Pavlov's Dog?
2017-05-03	Stanley Whittingham	State University of New York at Binghamton	The Ultimate Limits of Intercalation Reactions for Li-Batteries
2017-05-29	Harald Hillebrecht	University of Freiburg	Inorganic Energy Materials - Contributions from Solid State Chemistry
2017-07-06	Hiroto Nishihara	Tohoku University	Design and development of functional porous materials
2017-07-20	Andy (Xueliang) Sun	University of Western Ontario	Nanostructured Materials for Energy Conversion and Storage
2017-08-24	Hao Zeng	State University of New York Buffalo	Chalcogenide Compounds - A Magical Class of Functional Materials
2017-09-07	Itaru Kamiya	Quantum Interface Laboratory, Toyota Technological Institute	Epitaxial Growth and Characterization of InAs-based Structures on GaAs
2017-09-13	Warren Jackson	Xerox PARC	Self Aligned Imprint Lithography
2017-10-17	Jean-Pierre Landesman	McMaster University	Investigations on some side effects and defect formation during plasma etching of nanostructures using III-V semiconductors
2017-11-02	Jun Yang	University of Western Ontario	Conductive Bacterial Nanowires: Fundamentals and Applications for Environment and Energy
2017-11-06	Philip Klipstein	Antimonide Based Compound Semiconductor Research Program (ABCS)	InAs/GaSb/AlSb Superlattice Detectors and Topological Superlattices
2017-11-13	Wei Lu	University of Michigan	Memory and Computing Systems Based on Reconfigurable Materials: Merging Electronics with Ionics
2017-11-21	Catherine Murphy	University of Illinois at Urbana-Champaign	Gold Nanocrystals: Physics, Chemistry, Biology, and Ecology
2017-11-24	Bruno Ehrler	Hybrid Solar Cells Group, AMOLF	Beyond solar cell efficiency limits with down conversion and tandem solar cells
2017-12-15	Kalaichelvi Saravananmuthu	McMaster University	Optochemical waves: from bio-inspired optics, 3-D printing to materials for all-optical encoding
2018-02-18	Mikael Fogelström	Chalmers University of Technology	Plasmons and Sensing in Graphene Devices
2018-03-23	Joshua Milstein	University of Toronto	Counting Single Molecules at the Nanoscale

DATE OF SEMINAR	NAME OF PRESENTER	AFFILIATION	TALK TITLE
2018-04-27	Siddhartha Das	University of Maryland	Water and Ions at Nanoscopic Interfaces
2018-05-04	Muhammad R. Hajj	Virginia Tech	Identification of Nonlinear Piezoelectric Coefficients
2018-06-13	Céline Ternon	Institut polytechnique de Grenoble	2-D Nanonets- from nanostructured material to highly promising macroscale functional devices
2018-07-10	Neelesh A. Patankar	Northwestern University	Computational biophysics of organisms and organ physiology
2018-07-16	Peter Khalifah	Stony Brook University	New approaches for powder diffraction that extend the spatial resolution, temporal resolution, and sensitivity to defects in studies of battery materials
2018-07-20	Peter Khalifah	Stony Brook University	New approaches for powder diffraction that extend the spatial resolution, temporal resolution, and sensitivity to defects in studies of battery materials
2018-07-30	Jeffrey F. Rhoads	Purdue University	Research at a Technical Intersection: Energetic Materials and MEMS
2018-11-15	Robert Hickey	Pennsylvania State University	Utilizing Solvent- and Polymerization-Induced Morphology Transitions to Create Nanostructured Materials
2019-02-07	Ned Djilali	University of Victoria	Modelling and Simulation of Transport Phenomena in Fuel Cell Electrodes
2019-02-25	Niels Benson	University of Duisburg-Essen	Printable Silicon for a Novel RFID System Approach
2019-04-04	Ye Tao	Advanced Electronics and Photonics Research Centre, NRC	Printed Electronics and Its Role in the Development of Battery-Free Sensors
2019-04-08	Atsushi Takahara	Kyushu University	Surface and Interface Characteristics of Polyelectrolyte Brushes
2019-04-12	Kui Jiao	Tianjin University	Multiphase Multi-scale Transport in Proton Exchange Membrane Fuel Cell and Development of Simulation Tools
2019-05-08	Henryk Turski	Institute of High-Pressure Physics Polish Academy of Sciences	New Concepts in Nitride Light Emitters
2019-05-09	Hongbo Zeng	University of Alberta	Hydrophobic Interactions in Water and Hydrophilic Interaction in Oil of Polymers, Emulsions and Bubbles
2019-05-16	Paul Simmonds	Boise State University	Hydrophobic Interactions in Water and Hydrophilic Interaction in Oil of Polymers, Emulsions and Bubbles
2019-06-25	Edward Roberts	University of Calgary	Doped Carbon and Graphene Materials for Electrochemical Applications
2019-07-04	Fadi Alsaleem	University of Nebraska	Micro-Electro-Mechanical Neural Integrated Sensing and Computing Units for Wearable Device Applications
2019-07-29	George W. Hanson	University of Wisconsin-Milwaukee	Gyrotropic Graphene and Substrate Models, and Faraday Rotation with Nonreciprocal Quasi-Two-Dimensional Structures
2019-09-05	Jian Ji	Zhejiang University	Surface Engineering of Biomedical Materials via Bio-Inspired Strategy

DATE OF SEMINAR	NAME OF PRESENTER	AFFILIATION	TALK TITLE
2019-10-09	Seonghwan Kim	University of Calgary	Recent progress on the development of multi-modal chemical sensors with metal-organic frameworks
2019-11-22	Zachary Hudson	University of British Columbia	Multiblock Nanofibers from Organic Electronic Materials
2020-01-16	Tianzhun Wu	Chinese Academy of Sciences	New technologies for high-performance retina prosthesis based on micro/nano engineering
2020-02-26	David H. Waldeck	University of Pittsburgh	Adventures with Chiral Induced Spin Selectivity
2020-03-18	Mike Fleischauer	NRC-Nanotechnology Research Centre and University of Alberta	In-situ Characterization of Lithium-rich Battery Electrode Materials
2020-06-15	Matthew Jordan	McMaster University	Big Science At Small Scale: How The Manhattan Project Influenced Today's Nano Landscape
2021-02-23	Ning Chen	Canadian Light Source	X-ray absorption spectroscopy: a molecular scale approach, Theoretical to experimental
2021-10-19	Jason R. Hattrick-Simpers	University of Toronto	How Robots Can Teach Us To Trust A.I.
2022-03-16	Qing-Hua Xu	National University of Singapore	Plasmon Enhanced Optical Properties and Their Biomedical Applications
2022-06-24	Evgeny Pavlov	New York University	Stress-Induced Mitochondrial Uncoupling (SIMU): many ways for the mitochondrion to die



4.1.3 WIN MEMBERS AND THEMATIC SERIES

WIN initiated the new seminar series to provide our own members with a platform to share their most recent research advances, new directions and engage other WIN members in collaboration discussions. The series turned to be very productive, specifically for early carrier researchers and resulted in several new collaborations, followed by new grant applications. This also allowed graduate students and post-doctoral fellows to deliver a joint presentation with the WIN members.

DATE OF SEMINAR	NAME OF PRESENTER	ASSOCIATED THEME	DEPARTMENT	TITLE OF TALK
2020-01-23 – WIN Member Series	Juewen Liu	Smart and Functional Materials, Theranostics and Therapeutics	Department of Chemistry	Building biosensors by combining DNA and nanoparticles
2020-02-06 – WIN Member Series	Mahla Poudineh	Theranostics and Therapeutics	Department of Electrical Engineering	Next-Generation Enabling Technologies for Diagnosing Disease and Monitoring Therapy
2020-02-12 – WIN Member Series	Anna Klinkova	Smart and Functional Materials, Next Generation Energy Systems	Department of Chemistry	Performance and structural stability of cathodic electrocatalysts with complex nanoscale morphology
2020-06-29 – WIN Member Series	Melanie Campbell	Theranostics and Therapeutics	Department of Physics and Astronomy	Using the retina to look into the brain in Alzheimer's disease
2021-02-04 – WIN Member Series	Hamed Shahsavani	Smart and Functional Materials	Department of Chemistry	Liquid Crystal Networks for Small-Scale Bioinspired Soft Robots and Devices
2021-04-21 – WIN Member Series	XiaoYu Wu	Next Generation Energy Systems	Department of Mechanical and Mechatronics Engineering	Mixed conducting oxides for sustainable energy conversion and chemical production
2021-11-17 – Thematic Seminar	Michael Tam and Yebin Lee (PhD candidate)	Smart and Functional Materials	Department of Chemical Engineering	Sustainable Nanomaterials for Environmental Management Systems
2022-01-26 – Thematic Seminar	Vassili Karanassios	Connected Devices	Department of Chemistry	Applications of Artificial Intelligence (AI) for Spectral Interference Correction in optical emission spectrometry and of Machine Learning for development of nano-materials for sustainable energy
2022-02-16 – Thematic Seminar	Vivek Maheshwari and Hua Fan (Post-doctoral fellow)	Next Generation Energy Systems	Department of Chemistry	Electrical double layer as a medium to control material synthesis
2022-03-23 – Thematic Seminar	Boxin Zhao and Lukas Bauman (PhD Candidate)	Smart and Functional Materials	Department of Chemical Engineering	Smart Polymers and Bio-nanomaterials for Advanced Sustainable Manufacturing
2022-04-27	Evelyn Yim and Yuan Yao (Post-doctoral fellow)	Therapeutics and Theranostics	Department of Chemical Engineering	Engineering cell niches with biomaterials topographies for tissue engineering applications

4.1.4 QUANTUM-NANO COLLISION (QNC) SERIES

Quantum science and nanotechnology go hand-in-hand, with new functional materials designed to enable quantum phenomena to develop new devices that are smaller, lighter, self-powered and much more efficient to replace larger electronics currently in use. The future of technology resides in the very small, with quantum and nanotechnology researchers leading the way.

WIN has led the charge in this regard in 2021, with a virtual workshop with the Indian Institute of Science-Bangalore (IISc-B) as described in Section 2.4.1.3, and supported WIN-IQC research collaboration for next-generation trapped ion systems for quantum computing. With this momentum, the Quantum-Nano Collision (QNC) Series started in Fall 2021 to spotlight the research at the quantum-nano intersection. Since November 2021, four WIN members have participated in this series virtually.

DATE OF SEMINAR	NAME OF PRESENTER	ASSOCIATED THEME	DEPARTMENT	TITLE OF TALK
2021-11-29	Na Young Kim	Connected Devices	Department of Electrical and Computer Engineering	Where Quantum and Nano Collide
2022-01-19	Kevin Musselman	Smart and Functional Materials AND Next Generation Energy Systems	Department of Mechanical and Mechatronics Engineering	Nanomaterial-driven improvements in quantum-tunneling metal-insulator-metal diodes
2022-04-20	Zbig Wasilewski	Smart and Functional Materials	Department of Electrical and Computer Engineering	Towards room temperature, compact sources of coherent terahertz radiation
2022-05-18	Jonathan Baugh	Smart and Functional Materials AND Connected Devices	Department of Chemistry	Single-electron devices and their applications in quantum information

Going forward, the QNC series will continue in-person in the Quantum-Nano Centre, to bring together both sides of quantum and nano research.

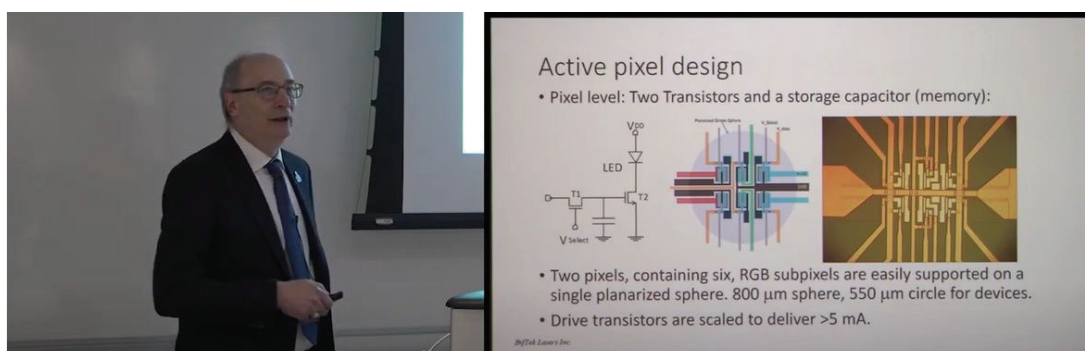
4.2 WIN SEMINAR SERIES – COMMERCIALIZATION AND ENTREPRENEURSHIP

4.2.1 INDUSTRY SEMINAR SERIES

In 2018 WIN started a new seminar series designed specifically to engage industry. Within this program, companies are invited throughout the year to give seminar presentations at WIN. Company representatives with highly ranked roles at high levels within the enterprise are invited, such as the Lead Scientist, Vice-President of Research and Development (or equivalent). These seminars are designed to provide industry insights for our members with a high likelihood of future follow-up for industry research collaborations. The WIN Industry Seminars are accompanied by pre-arranged one-on-one meetings with faculty members whose research has a strong overlap of interests with the company's R&D needs. In 2018, WIN hosted three speakers in the Industry Seminars Series:

1. May 3, 2018. Jamal Zeinalov, PhD, Co-founder and CEO, Atomic Works Inc. The company develops software simulation platforms to assist in the discovery of new materials and structures on a molecular scale.
2. July 30, 2018. Michael Scott, Senior Vice-President of Product Development, BlueRock Therapeutics Inc. Dr Scott has more than 20 years of experience in the field of cardiovascular medical devices and in the stem cell therapeutics landscape. Dr Scott's R&D team focused on development of a cell therapy platform for delivery of dopaminergic neurons to treat Parkinson's disease and cardiomyocytes to treat congestive heart failure.
3. November 9, 2018. Elena Polyakova, Founder and CEO, Graphene Laboratories Inc has co-authored papers with Nobel and Kavli prize winners. Founded in 2009, her company is a pioneer in the commercial graphene production industry.
4. May 30, 2019. Douglas Dykaar is the founder of DifTek Lasers, Inc. "High-performance Backplane Devices for LED Video Walls"

FIGURE 17: DOUGLAS DYKAAR IS GIVING AN INDUSTRY SEMINAR ON THE TOPIC OF BACKPLANE ELECTRONIC DESIGN FOR LED DISPLAY WALLS. MAY 30, 2019



5. September 30, 2019. Ronald Li, Co-founder and CEO of Novoheart Inc. CBB and WIN Joint Industry Seminar: Advances of Stem Cell Biotechnology for Development of Bio-artificial Human Heart
6. June 13, 2022. Tiffany Santos, Director, Western Digital Corporation. "Spins, Bits, and Flips: Essentials for High-Density Magnetic Random-Access Memory"

4.2.2 WIN INNOVATION SERIES

These series are meant to bridge the basic lab research with translational activities involving transfer of academic technologies. We invite speakers from both academic institutions (professors who invented new technologies, managers of innovation support departments, etc.) as well as non-academic speakers involved in supporting or promoting deep tech innovations (e.g. business incubators). In 2018, WIN hosted two speakers in the Innovation Seminar Series:

1. March 23, 2017. Andrew Myles and Dr. Adam Bergren: “From Fundamental Science to Rock and Roll: The Heisenberg Molecular Overdrive”
 2. November 21, 2017. Amit Goyal & Dr. Thomas Thundat: “University at Buffalo’s RENEW Institute”
 3. May 10, 2018. Patricio Mendez, Weldco/Industry Chair in Welding and Joining; Director, Canadian Center for Welding and Joining; Department of Chemical and Materials Engineering, University of Alberta, Alberta, Canada: “Moving Heat Sources in Welding and Additive Manufacturing”
 4. November 29, 2018 (co-hosted with the Department of Chemical Engineering). Janusz A. Kozinski, formerly founding Dean of Lassonde School of Engineering at York University and Associate Vice-Principal for Research & International Relations at McGill University: “The New Phenomena Arising During Exotic Combustion in Supercritical Water”
- › January 24, 2019. Eric Luvisotto, Technology Transfer Manager, Waterloo Commercialization (WatCO), Office of Research: “IP101 and Commercialization”
 - › October 7, 2020. Michael Raspuzzi, the Global Virtual and Boston Director for the Knowledge Society: “Intersectional Innovation - Learning and Prototyping Across Discipline”
 - › May 16, 2022. Kumar Sadayappan, James Chen, and Babak Shalchi from CanmetMATERIALS on “Research on Critical Material at Canmet MATERIALS”

4.2.3 WIN ENTREPRENEURSHIP SERIES

As part of WIN Startup Catalyst program (see Page 35 for description), these newly created series are specifically designed to complement the existing campus programming for entrepreneurs by Velocity program. In the series, WIN invites founders of nanotechnology startups to discuss the best practices and pitfalls of creating academic spinoff companies. In 2020, WIN hosted several events in the series:

- › June 10, 2020. Oleg Stukalov (WIN Business Development Manager) and Carly Cameron (Program Manager, Velocity Campus): “Series Kick Start”
- › June 22, 2020. Ling Loerchner, Technology Transfer Manager, WatCO: “Five steps in commercialization workflow of your research”
- › July 6, 2020. Panel discussion on Business of Research Equipment
 - › Ryan Denomme, UW Alumni 2010, 2012, Founder and CEO, Nicoya Lifesciences Inc.
 - › Thierry Lafrance, Founder and President, MĚKANIC
 - › Duncan Casey, founder of everywhereHPLC, and Industry Liaison Fellow in the Bristol Centre for Functional Nanomaterials, University of Bristol
- › July 27, 2020. Panel discussion on Business of Research Chemicals
 - › Darren Anderson, Co-inventor, Founder and CEO, VIVE Crop Protection (Toronto)
 - › Elena Polyakova, Co-inventor, Founder and CEO, Graphene Labs Inc.

4.3 SYMPOSIA AND CONFERENCES

4.3.1 INTERNATIONAL SYMPOSIA ON FRONTIERS IN NANOSCIENCE AND NANOTECHNOLOGY

The first symposium, held on June 6, 2018, where renowned researchers from around the world participated in the day-long conference. The conference featured keynote speakers from the international scientific community, and showcased WIN excellence in each of the key theme research areas. The agenda for the 2018 International Symposium on Frontiers in NanoScience and Nanotechnology included:

Keynote Lectures:

- › Albert van den Berg, Scientific Director, MESA+ Institute, University of Twente, Netherlands
- › David Sinton, University of Toronto
- › Carlos Bof Buffon, Brazilian Nanotechnology National Laboratory (LN-Nano), CNPEM, Brazil
- › Quanshui Zheng, Tsinghua University, China

WIN Theme Lectures:

- › Boxin Zhao, Smart and Functional Materials
- › Vassili Karanassios and Na Young Kim, Connected Devices
- › Linda Nazar, Next Generation Energy Systems
- › Karim Karim, Therapeutics and Theranostics

In June 2019, WIN hosted the second International Symposium on Frontiers in Nanoscience and Nanotechnology. This two-day conference showcased prominent researchers from across the globe along with our own talented researchers within the key theme of Smart and Functional Materials. The agenda for the 2019 International Symposium on Frontiers of NanoScience and Nanotechnology included the following featured speakers:

Distinguished Lectures:

- › Hans-Jurgen Butt, Professor, Max Planck Institute for Polymer Physics, Germany: *“Nanostructuring surfaces to control wetting”*
- › President Kazuhito Hashimoto, National Institute for Materials Science, Japan: *“My experience of nanotechnology from basic research to practical application”*
- › Ajay Sood, Professor of Physics, Indian Institute of Science, India: *“Nanophotonics of two-dimensional crystals”*
- › Sir Mark Welland, Master of St Catharine’s College, and Deputy Vice-Chancellor, University of Cambridge, United Kingdom: *“Nanostructures in disease – pathology and treatment”*



FIGURE 18: PAVADEE AUNGKAVATTANA FROM NANOTEC THAILAND PRESENTS AT THE INTERNATIONAL SYMPOSIUM: FRONTIERS IN NANOSCIENCE & NANOTECHNOLOGY, JUNE 2019



FIGURE 19: STUDENTS PRESENT THEIR POSTERS AT THE INTERNATIONAL SYMPOSIUM, JUNE 2019

Keynote Speakers:

- › Pavaadee Aungkavattana, Deputy Executive Director, National Nanotechnology Centre (NANOTEC), Thailand: *“Nanotechnology in Thailand and its application: from lab to market”*
- › Marija Drndic, Professor, Department of Physics and Astronomy, University of Pennsylvania, USA: *“Can nanopatterned two-dimensional solid-state materials also filter Turkish coffee?”*
- › Drew Higgins, Assistant Professor, Department of Chemical Engineering, McMaster University, Canada: *“Nanomaterial electrocatalysts to enable sustainability for our energy and transportation sectors”*
- › Scott T. Retterer, Senior Research Staff Scientist, Centre for Nanophase Materials Science, Oak Ridge National Laboratory Tennessee: *“Hierarchical assembly – understanding formation, response, and evolution in multiscale heterogeneous materials”*

WIN Speakers:

- › Nasser Abukhdeir, Associate Professor, Department of Chemical Engineering: *“A generalized shapelet-based method for analysis of nanostructured surface imaging”*
- › James Forrest, Professor, Department of Physics and Astronomy: *“Polymer stable glass”*
- › Irene Goldthorpe, Associate Professor, Department of Electrical and Computer Engineering: *“Silver nanowires for printable, flexible transparent electrodes and e-textiles”*
- › Yuning Li, Professor, Department of Chemical Engineering: *“Development of polymer semiconductors for printed electronics”*
- › Kevin Musselman, Assistant Professor, Department of Mechanical and Mechatronics Engineering: *“Rapid, open-air manufacturing of functional oxide thin films by spatial atomic layer deposition”*
- › Carolyn Ren, Professor, Department of Mechanical and Mechatronics Engineering: *“Droplet microfluidic platform technologies for materials synthesis”*
- › Ting Tsui, Associate Professor, Department of Chemical Engineering: *“Manipulating cell behaviours using engineered surfaces”*
- › Xiaosong Wang, Professor, Department of Chemistry: *“Effect of ionic end group on hydrophobic hydration (HH) and hydrophobic effect-driven self-assembly (HEDSA) of metal carbonyl macromolecules”*

4.3.2 INTERNATIONAL WORKSHOP ON NANOTECHNOLOGY FOR A SUSTAINABLE FUTURE

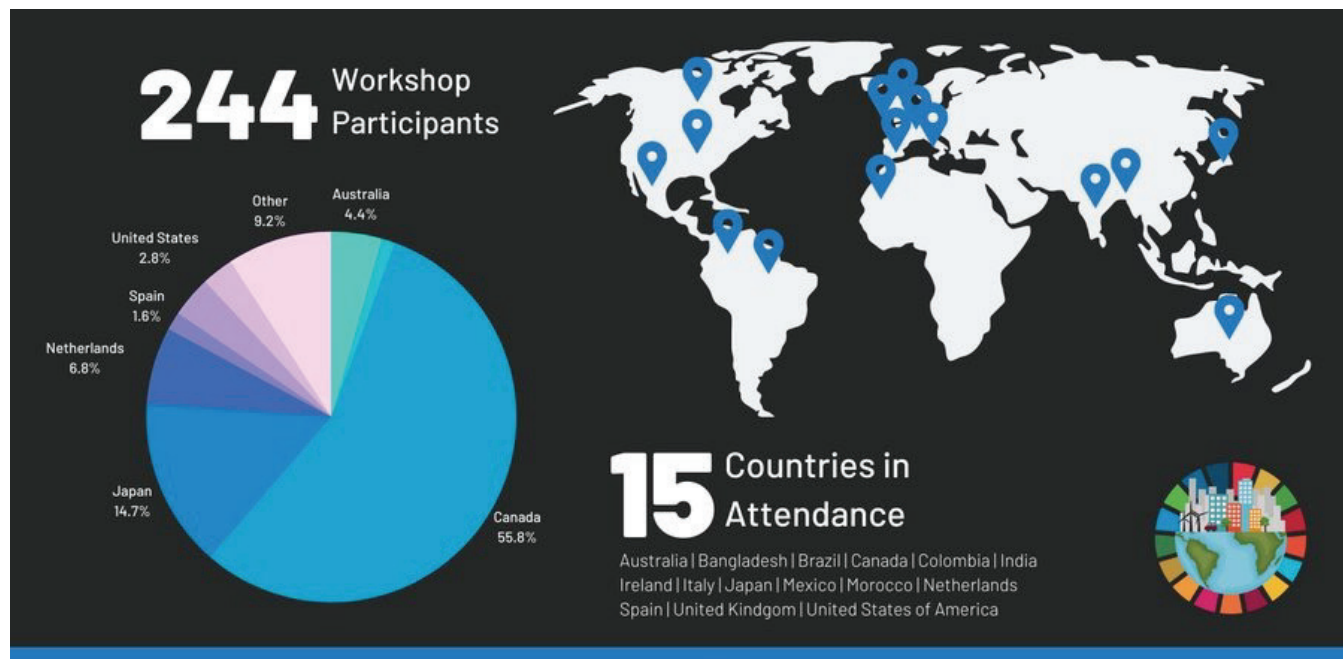


FIGURE 20: GOOGLE ANALYTICS RESULTS FROM INTERNATIONAL WORKSHOP ON NANOTECHNOLOGY FOR A SUSTAINABLE FUTURE IN NOVEMBER 2020

WIN constantly strives to be an exemplar in cross-disciplinary research, to break down barriers and create a 360-degree view of critical research problems. In November 2020, WIN hosted the “International Workshop on Nanotechnology for a Sustainable Future”. The workshop featured 26 speakers from five countries spanning four continents and was attended by 244 people from 15 countries. This virtual workshop served to define technological challenges and societal impacts and assemble well-balanced teams to work toward a just and sustainable society.

The participating institutions had well-defined priority theme areas for 2020-2021 and were discussed during the following five technical sessions, each mapped to one or more UNSDG:

Workshop Sessions:

- › Session 1: Nanotechnology and Society, Policy, and science Diplomacy (UN SDG #8, 10, 16, 17)
- › Session 2: Industry and Innovation (UN SDG #9, 11)
- › Session 3: Energy and Environment (UN SDG #7, 13)
- › Session 4: Devices and Technology for Healthcare (including COVID-19) and Communications/Photonics (UN SDG #3, 9, 11)
- › Session 5: Resource Management and the Circular Economy (UN SDG #6, 11, 12, 13, 17)

The workshop was opened by UW's Vice President of Research and International Dr Charmaine Dean. Co-organized by the Consulate of the Netherlands in Canada, Her Excellency Ines Copoolse, Ambassador of the Netherlands in Canada also gave welcoming remarks, and was joined by NSERC President Alejandro Adem, Japan Science & Technology Agency President Michinari Hamaguchi. University of Sydney Nanotechnology Institute Director Benjamin Eggleton and ACN Nano Editor-in-Chief Paul Weiss who also welcomed the audience.

Invited Lectures – International

- › Albert van den Berg, co-Scientific Director, MESA+ Institute for Nanotechnology, Netherlands: *"Nano4Society"*
- › Jun'ichi Sone, Principal Fellow, Centre for Research and Development Strategy, JST Japan: *"R&D Strategy of Nanotechnology and Materials for a Sustainable Future in Japan"*
- › Steven Maguire, Professor of Strategy, Innovation and Entrepreneurship University of Sydney Business School, Sydney Nano Member: *"Integrating Social Sciences with Nanosciences for a Sustainable Future"*

Invited Lectures – Canadian

- › Marc Fortin, Vice President, Research Partnerships, NSERC: *"The Role of NSERC is Supporting and Shaping the Canadian Research Ecosystem"*
- › Elicia Maine, Professor of Innovation and Entrepreneurship, Beedie School of Business, Simon Fraser University: *"Enabling Nanotechnology Solutions for a Sustainable Future: Endowing University Spinoffs Pre-Formation"*
- › David Sinton, Professor, Department of Mechanical and Industrial Engineering, University of Toronto: *"Electrochemical Systems for CO2 Conversion to Products"*
- › Warren Chan, Director, Institute for Bioengineering, University of Toronto: *"Challenge of Delivering Nanoparticles to Solid Tumors"*

WIN Speakers

- › Linda Nazar, Professor, Department of Chemistry, *"Unravelling the Complexities of Electrochemical Energy Storage at the Nanoscale"*
- › Karim Karim, Executive Director of Centre for Bioengineering and Biotechnology, Department of Electrical and Computer Engineering, *"Reveal Dual Energy Detector"*
- › Goretty Dias, Professor School of Environment, Enterprise and Development, *"Circularity, Resources, and Technology: Achieving Sustainable Development"*
- › Jatin Nathwani, Executive Director of Waterloo Institute for Sustainable Energy, Department of Civil and Environmental Engineering, *"Sustaining a Clean Energy Transition Beyond COVID"*

4.3.3 INTERNATIONAL NETWORK FOR SUSTAINABLE NANOTECHNOLOGY



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.

FIGURE 21: N4SNANO MEETING BETWEEN WIN AND SYDNEY NANO FOR JOINT SECRETARIATS



The Network's vision is to be recognized as a global leader, innovator, educator, influencer and thought leader. Its mission is to create a collaborative network of nanotechnology institutes and centres, industry, government agencies, not-for-profit organizations, and the end user community, to champion nanotechnology solutions for a sustainable future.

N4SNano's mandate involves addressing global challenges and engaging in outreach and knowledge mobilization activities in all major continents to promote nanotechnology in relation to the UNSDGs. An annual World Summit is being organized as a forum for world experts in nanotechnology and applications in relation to the UNSDGs to share ideas, learn about specific needs of different regions and the policies adopted by different governments to implement new technologies to address societal needs.

FIGURE 22: MAP INDICATING LOCATION OF N4SNANO MEMBERS WORLDWIDE



4.3.3.1 Global Summit: Nanotechnology for a Healthier and Sustainable Future

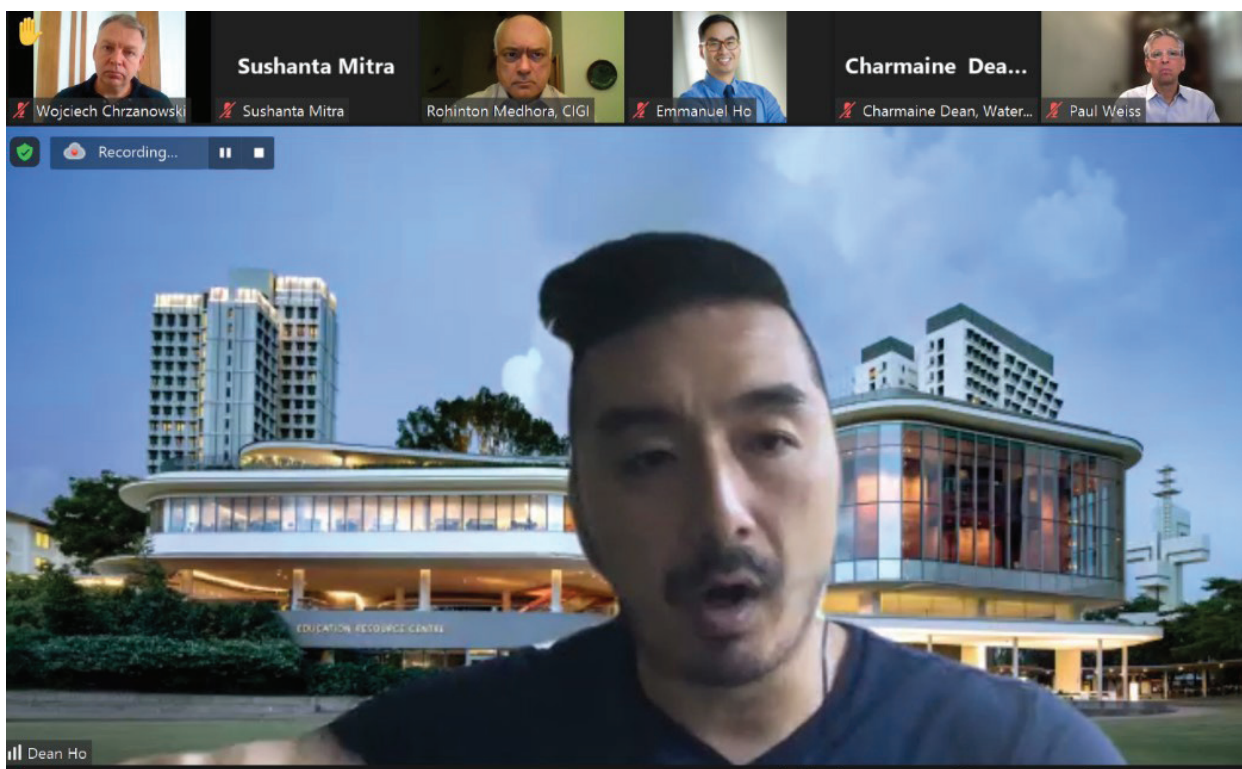
The 2022 Global Summit is focused on UN SDG#3 Good Health and Well-being. It is a small but important step towards achieving the larger ambitious vision of creating a world free of hunger, poverty, and disease where all life can thrive. The Global Summit will raise awareness and support capacity-building for the UN SDGs and their related thematic issues. Nanotechnology is a powerful tool that can be utilized to create a sustainable, healthy, and prosperous future.

To build awareness for the Network, and to build momentum for the Full Global Summit in August 2022, the N4SNano Global Summit Launch event was held virtually in February 2022.

Highlighting the importance of the sustainable developmental goals (SDGs) set out by the United Nations (UN), the University of Sydney Nano Institute co-hosted this virtual two-day event (22-23 February 2022 EST; 23- 24 Feb 2022 AUDT) introducing some of the research and advancements in health and wellbeing that will be discussed in further detail at the Global Summit in August. The theme for the first day was Digital Health and AI Diagnostics with the following speakers:

- › Dean Ho from the National University of Singapore (NUS) - *“Harnessing Digital Medicine to Optimize Nanotherapeutics”*
- › Kishor Wasan from the University of British Columbia - *“The Use of Artificial Intelligence and Machine Learning in the Discovery and Development of Novel Therapeutics for Emerging Infectious Diseases”*

FIGURE 23: DEAN HO DELIVERING HIS KEYNOTE TALK AT THE N4SNANO GLOBAL SUMMIT LAUNCH EVENT



For the second day of the Summit Launch, Nanomedicine was the theme focus, with presentations from:

- › Teri Odom from Northwestern University “*Shape Effects and Designer Nanoconstructs for Nanomedicine*”
- › Christine Allen from the University of Toronto “*Harnessing Automation and Machine Learning for Sustainable Drug Formulation Development*”
- › Both days held two separate panel sessions for each respective topic. For Digital Health and AI, some of the opportunities and challenges of the research were also highlighted such as how the models could be implemented in bad faith (this could be addressed by educating regulators on the potentials and setbacks of AI), and an opportunity for these models is how they improve the efficiency of the experimentation process; thus, they make the future of drug development sustainable. The panel session for Nanomedicine discussed the importance of having standardized data, various opportunities and challenges, and why science communication is vital for gaining the public’s trust about nanotechnology.

N4SNano Global Summit

Following the success of the Launch event in February, the inaugural N4SNano Global Summit was held at the University of Waterloo on August 10–11 2022 (EST), with the satellite events at the University of Sydney on August 11–12 2022 (AEST) in a hybrid (in-person and virtual).

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.

Day 1 of the Global Summit kicked off with a technical session on Nanomedicine, with Professor Dror Flixer,

plenary talk “Operating Biological Logic Gates by Gold Nanoparticle-Fluorophore Conjugates”, and a technical talk by Professor Jianhua Hao from Hong Kong Polytechnic University on “Pathogenic Virus Detection Using Upconversion Luminescence Nanomaterial-based Biosensor toward Point-of-Care Diagnostics”, along with short talks by researchers from South Africa, Australia and UW. The second session of Day 1 on Agricultural Nanotechnology featured a keynote talk from Dr Jason White, Director of the Connecticut Agriculture Experiment Station titled “Nanotechnology-enabled Agriculture: a path to global food security?”



FIGURE 24: JIANHUA HAO FROM HONG KONG POLYTECHNICAL UNIVERSITY PRESENTS HIS TECHNICAL TALK IN THE NANOMEDICINE SESSION OF THE N4SNANO GLOBAL SUMMIT IN THE QNC IN AUGUST 2022

On Day 1, a uniquely interactive debate on personalized medicine utilized in-person props, polling, and fun quizzes with prizes to be won. The debate was centred around the argument “will personalized medicine provide a healthier and sustainable future for us all?” and was moderated by Prof Wojciech Chrzanowski (University of Sydney). We had both national and international speakers including Professor Alice Motion (University of Sydney), Professor Michael Kassiou (University of Sydney) and Professor Evelyn Yim (University of Waterloo) speaking for personalized medicine while Dr Patrick A. Gladding (Ascot Cardiology Group, NZ), Professor Marcel Bally (The University of British Columbia, Canada) and Professor Stuart Prescott (University of New South Wales) argued against the topic.

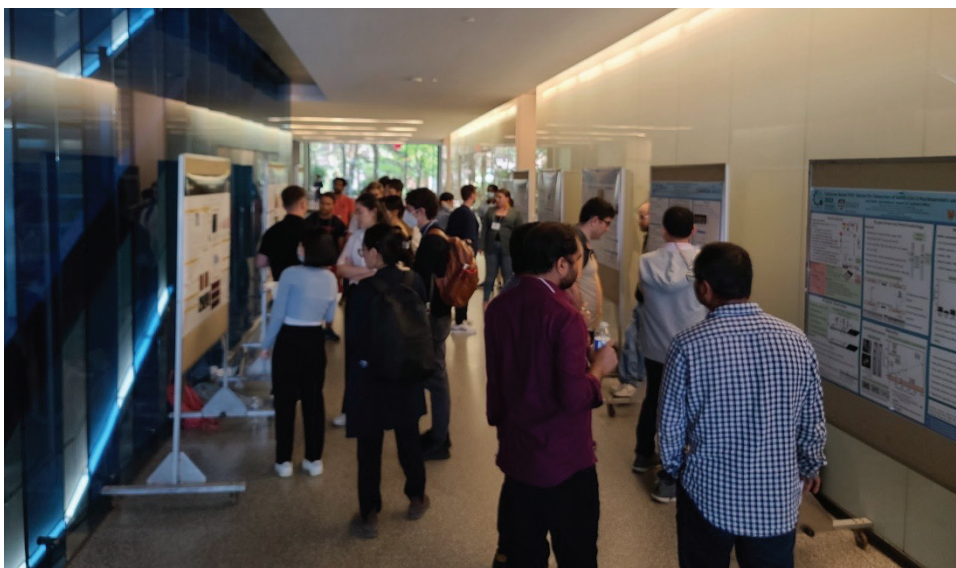


FIGURE 25: STUDENTS SHOWCASE THEIR RESEARCH AT THE POSTER SESSION AT THE QNC ON DAY 1 OF THE N4SNANO GLOBAL SUMMIT, AUGUST 2022

Day 1 also hosted a poster session for trainees and students over a networking lunch which were evaluated for a student award, given to two outstanding projects. Brian Youden from UW was awarded for his project “*Degradable Multifunctional Gold-Liposomes as an All-in-One Platform for Cancer Radiotherapy*” and Anish Verma from Toronto Metropolitan University for his project “*Epigenomic Monitoring of Cancer Stem Cell using Ultrasmall Gold Nanoprobes*”.

Congratulations to both students!

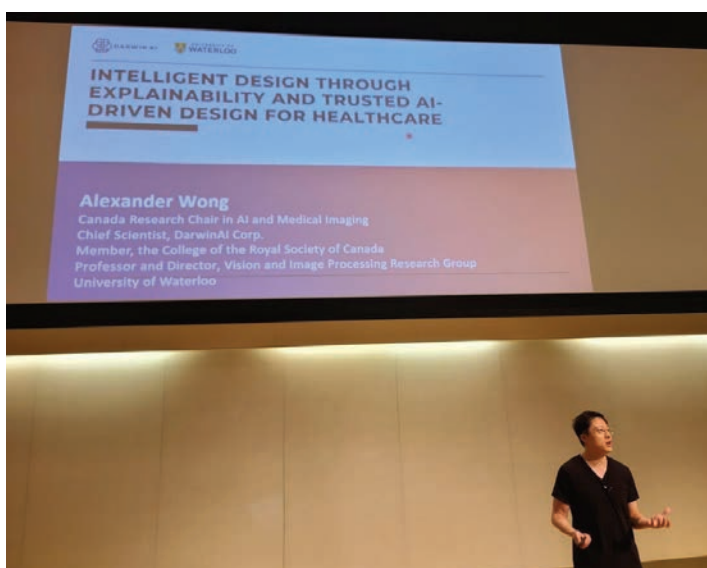


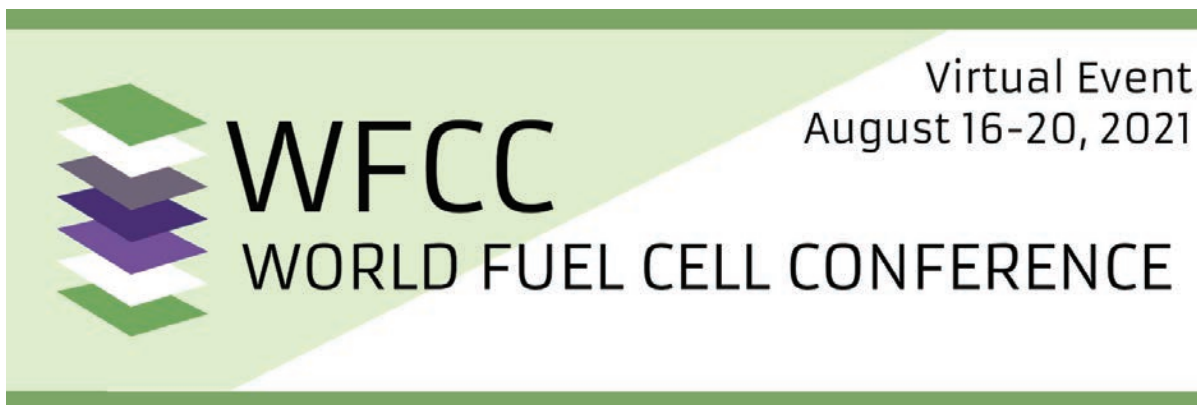
FIGURE 26: ALEXANDER WONG FROM THE DEPARTMENT OF SYSTEMS DESIGN ENGINEERING GIVES A PLENARY TALK FOR THE DIGITAL HEALTH & AI DIAGNOSTICS SESSION OF THE N4SNANO GLOBAL SUMMIT IN THE QNC IN AUGUST 2022

Day 2 of the Summit opened with the plenary talk by Alexander Wong from Systems Design Engineering at UW, “Intelligent Design through Explainability and Trusted AI-driven Design for Healthcare” for the session on Digital Health & AI Diagnostics, followed by technical talks from speakers from 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.

This symposium was followed by a panel discussion “Energy landscape: 2020 and Beyond” where a selected group of academics and government representatives discussed the current issues and challenges faced by society today in meeting our energy needs while understanding impact on the environment and viable mitigation strategies. Potential opportunities for economic development in these spaces were also discussed. The panel consisted of the following experts:

- › Moderator: Sushanta Mitra
- › Arun Majumdar: Jay Precourt Professor, Stanford University
- › Lora Field: Ontario Investment Office, Ministry of Economic Development, Job Creation and Trade
- › Juan Moreno-Cruz: Professor in Environment, Enterprise & Development and Canada Research
- › Chair in Low Carbon Emissions
- › Jatin Nathwani: Executive Director, Waterloo Institute for Sustainable Energy
- › Paul Parker: Professor in Environment, Enterprise & Development, University of Waterloo
- › Ian Rowlands: Vice President International, and Professor, Department of Civil and Environmental Engineering, University of Waterloo

4.3.5 WORLD FUEL CELL CONFERENCE



The World Fuel Cell Conference (WFCC) was established under the auspice of the International Association for Hydrogen Energy (IAHE) as an umbrella organization to lead and coordinate the information dissemination related to hydrogen and fuel cell R&D activities, development, advancement and education. The 2021 conference was held virtually and organized by IAHE Fuel Cell Division, hosted by the Waterloo Institute for Nanotechnology (WIN) and the Canadian Hydrogen and Fuel Cell Association (CHFCA).

The WFCC is a multidisciplinary conference on the latest development and advancement of hydrogen and fuel cells and provides a forum for the exchange of the latest scientific and technical information, for the dissemination of high-quality research results, and for the debate and shaping of future directions and priorities in hydrogen fuel cell science, technology, engineering, application and commercialization. This conference targeted technical issues and interconnections between fuel cells and hydrogen. The conference featured international speakers from both academia and industry, networking opportunities and a virtual 3MT contest.

The WIN team helped facilitate this virtual version of the conference, through the platform Pathable, which saw over 200 attendees, 5 sponsors, 7 exhibitors and had more than 30,000 page views. Along with the WIN team coordinating the conference, several of our members participated in WFCC 2021 as speakers and session chairs.

- › Zhongwei Chen, Chemical Engineering
- › Jeff Gostick, Chemical Engineering
- › Xianguo Li, Mechanical and Mechatronics Engineering
- › Shirley Tang, Chemistry
- › XiaoYu Wu, Mechanical and Mechatronics Engineering

WIN's Business Development Manager was involved in designing sponsorship packages and recruiting external sponsorships. Over twenty companies were engaged, with three sponsors committing their support to Platinum, Gold and Event levels. These injections contributed to the financial success of the conference. The WIN team was able to bring in the UWaterloo Departments of Chemical Engineering and Mechanical and Mechatronics Engineering and the Faculty of Science. Along with internal sponsors, the Toray Research Centre, Inc, Ivium Technologies BV, Netherlands and Anton Paar Canada Inc sponsored the Platinum, Gold and general sponsorship tiers.

“After the pandemic has caused cancellation of the annual World Fuel Cell Conference in 2020, WIN team stepped up to the challenge and saved the day. The virtual version of the popular conference was a resounding success, thanks to the technical and organizational support from WIN!”

XIANGUO LI, PROFESSOR, DEPARTMENT OF MECHANICAL
AND MECHATRONICS ENGINEERING

4.4 MIXERS AND INFORMATION SESSIONS

4.4.1 CIHR PANEL ON SCIENCE & ENGINEERING

Canadian Institutes for Health Research (CIHR) and Opportunities for Physical Science and Engineering:
A Panel Discussion. Held virtually on July 29, 2021

The Canada Institutes for Health Research (CIHR) is a federal agency composed of 13 different institutes, dedicated to supporting health care, medical and life sciences, and related areas of research. To help WIN members access the many CIHR funding opportunities, especially our researchers in the fields of hard-tech for medical applications, WIN organized a panel discussion on CIHR opportunities on finding appropriate partners and how to submit a successful proposal. The panelists included:

- › Warren Chan, Distinguished Professor, and Director of the Institute for Biomedical Engineering, University of Toronto, WIN Board of Directors Member
- › Juewen Liu, Professor, Department of Chemistry
- › Marianna Foldvari, Professor, School of Pharmacy
- › Nadine Quehl, Manager, Non-profit/Public Sector Partnerships, Office of Research
- › Sarah Lau, Grants and Contracts Manager, FANS/NRFR, Office of Research
- › Shirley Tang, Associate Dean Research for Faculty of Science, and Professor, Department of Chemistry

This event was suggested by Professor Chan at the 2021 Board of Directors meeting, to address the low CIHR application and success rate of researchers in the physical sciences and engineering. The panel addressed many issues researchers face in the application and team-building process during the virtual online question-and-answer session. The comments and advice provided by the expert panel of researchers and grants specialists from the Office of Research were well received by the audience.

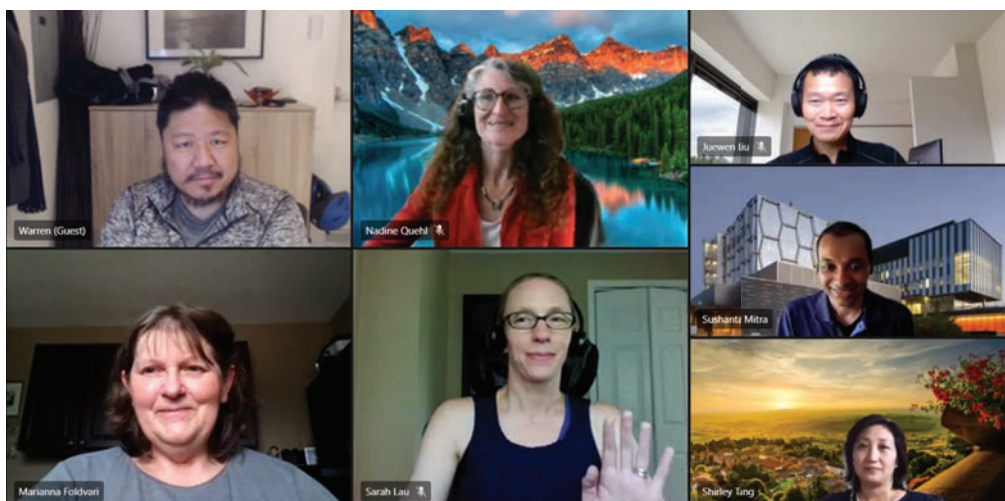


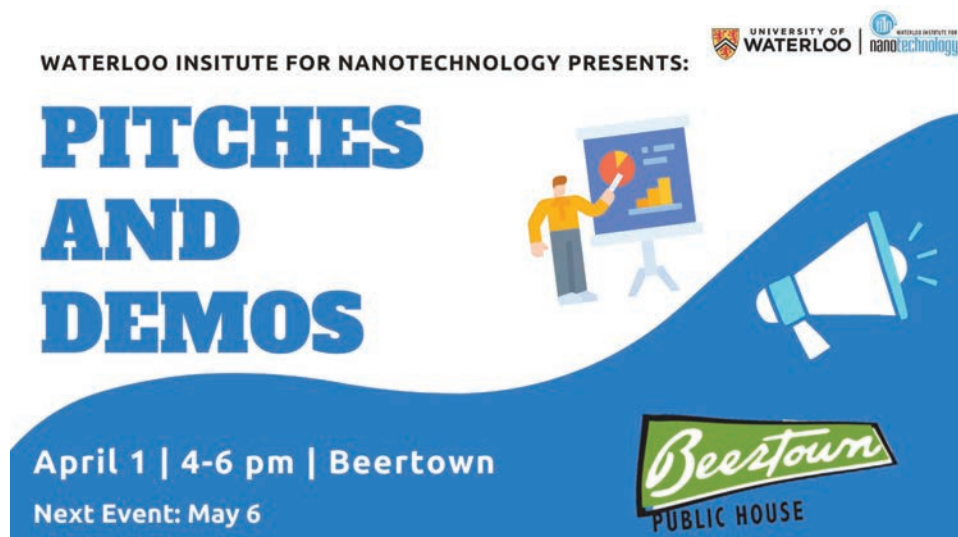
FIGURE 27: PANELISTS DISCUSSING THE OPPORTUNITIES FROM THE CANADIAN INSTITUTES FOR HEALTH RESEARCH (CIHR) FOR SCIENCE- AND ENGINEERING RESEARCHERS

4.4.2 WIN-WATER INSTITUTE LIVE PITCH EVENT

On February 15, The Waterloo Institute for Nanotechnology, Water Institute, and the Ontario Water Consortium have partnered to organize a “live business advising” event, where 6 water-related research innovations were presented to the panel of industry veterans. WIN membership was represented by Profs. Juewen Liu (Chemistry), Carolyn Ren (MME), Sushanta Mitra (MME), Mustafa Yavuz (MME), and Michael Tam (ChemEng). The industry panel included Erin Mahoney (Commissioner Environmental Services, York Region), Ted Mao (CTO of nanotechnology spinoff Evercloak Technology, former CTO of Trojan Technologies Inc.), Jodi Glover (CEO and founder of Realtech Inc.), and Enrico Vonghia (Director, Growth Initiatives and Competitive Intelligence, SUEZ Water Technologies & Solutions). The panel members offered business advice to the presenters, while watched by over 50 participants (faculty members, postdocs, and graduate students). The event style received very positive feedback, and WIN plans to replicate the event format for other areas, such as medical devices.

4.4.3 PITCHES AND DEMOS

FIGURE 28: PROMOTIONAL MATERIAL FOR INAUGURAL PITCHES AND DEMOS EVENT, APRIL 2022



WIN initiated a new type of networking event, where WIN members come together to present short pitch-type presentations on the developments in their laboratories with commercialization potential. Representatives of local business incubators, companies and startups are also invited. The first two such events in the Spring 2022 were held at Beertown restaurant in Uptown Waterloo. Some external guests from the local business community were also invited. After a summer break, the event will return in September on campus (subject to the health-related restrictions). The inaugural April 1 event was attended by David Caputo, the president of local company Trusscore, who is also a long-serving member of the Board of Directors at Communitech.



FIGURE 29: PROFESSOR RAAFAT MANSOUR (ECE) GIVES A PRESENTATION TO WIN MEMBERS AND THE BRAINPORT DELEGATION AT BEERTOWN FOR THE PITCHES & DEMOS EVENT IN MAY 2022

4.5 EDUCATING THE GENERAL PUBLIC

4.5.1 INTERACTIVE MEDIA FOR THE GENERAL PUBLIC

How can nanotechnology help fight a pandemic? To answer this question, the Waterloo Institute for Nanotechnology (WIN) partnered with the Games Institute (GI) to create a playful online education app. This project aims to explore and explain to the public how nanotechnology is used in our everyday lives using digital visual storytelling and game technology.

For the first joint WIN-GI effort, the research of WIN members Roderick Slavcev, Emmanuel Ho and Marc Aucoin on DNA-based nasal vaccine sprays is showcased. For this, WIN collaborated with Faculty of Arts Professor Lennart Nacke's Human-Computer Interaction (HCI) and Games Group to design the online app. The project visually shows how the DNA based vaccine nasal spray will enter the body to create an immune response in people. This is the first of many similar projects between WIN and GI designed to highlight aspects of key theme areas of nanotechnology and how it impacts our daily lives.

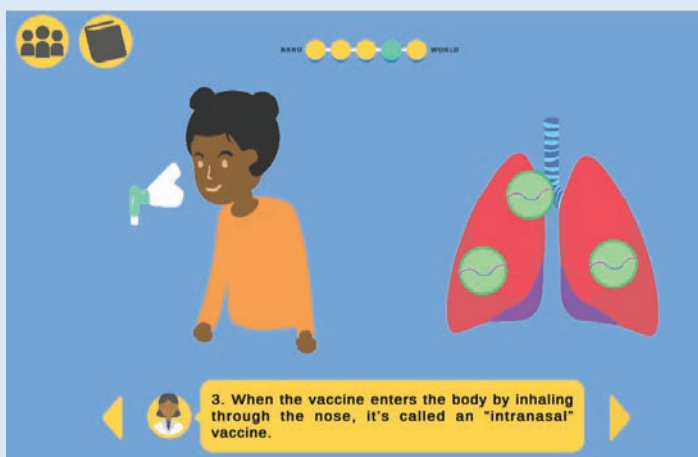


FIGURE 30: IMAGES FROM INTERACTIVE ONLINE "GAME" ON NANOTECHNOLOGY AND VACCINE DEVELOPMENT

4.5.2 PROFESSIONAL COURSES IN SUSTAINABLE NANOTECHNOLOGY

In 2021, WIN initiated a partnership with WatSPEED, a newly created entity at UW responsible for creating professional development courses for industry professionals. These discussions culminated with the joint application for course development funding submitted to Palette Skills in the Fall 2022. Other proposed modules will be developed in the future based on feedback from industry. (See page 49 for more details.)

4.5.3 EDITORIAL ARTICLES IN ACS NANO

This past year WIN was proud to contribute to two Virtual issues – the first published on 22nd October 2019, for which Executive Director Sushanta Mitra co-authored with 20 other Nano-centre directors and leaders, “Nano as a Rosetta Stone: The Global Roles and Opportunities for Nanoscience and Nanotechnology” which outlines the very important role of nanotechnology as the connective thread between traditionally different/divergent disciplines – the nanoscale is the scale of function in many areas – biology for example, novel materials for devices and energy. (ACS Nano 2019, 13, 10835-10855; <https://pubs.acs.org/doi/10.1021/acsnano.9b08042>)

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Nano as a Rosetta Stone: The Global Roles and Opportunities for Nanoscience and Nanotechnology

As we have for the last six years, nano center directors and leaders in nanoscience and nanotechnology from around the world met in Beijing, the day before China's Nano²⁰¹⁹. We shared our experiences on how our fields are perceived by our colleagues, institutions, countries, the public, and each other. We discussed our goals and strategies—where we are headed and how we interact with others in and beyond our fields. Here, we report some of the highest level issues that we face around the world. We also highlight some of the interesting areas now being explored at nano centers.

An overarching comment, and the title features “Nano as a Rosetta Stone,” is that nanoscience and nanotechnology connect fields together. As nanotechnology has grown as a field, we have taught each other approaches and languages, taken on each other's problems, and have developed new

relatively recently considered exotic materials, are now produced at the scale of hundreds of tons per year and widely used in Li-ion batteries.

We find no equivalent “Rosetta Stone” arising in other fields that could replace our efforts, so it remains to us to connect fields together and to foster new interdisciplinary areas

The group had divergent views on how and whether to formalize education in nanoscience and nanotechnology. A number of nano centers are establishing linkages and exchanges as a way to cross-pollinate ideas and to share best practices.

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The second article was titled “The Waterloo Institute for Nanotechnology: Societal Impact and a Sustainable Future” authored by Lisa Pokrajac, Linda Nazar, Zhongwei Chen, and Sushanta Mitra showcased the nanotechnology research excellence at WIN. This article was published in November 2019. (ACS Nano 2019, 13, 12247-12253; <https://pubs.acs.org/doi/10.1021/acsnano.9b08356>)

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The Waterloo Institute for Nanotechnology: Societal Impact and a Sustainable Future

The Waterloo Institute for Nanotechnology (WtIN) is Canada's largest nanotechnology institute and a world leader in the broader areas of nanoscience and nanotechnology. Located at the University of Waterloo (UW) in Waterloo, Ontario, Canada, it is truly an interdisciplinary research enterprise representing nine departments and schools spanning across the Faculties of Engineering, Science, and Mathematics.

As WtIN enters its 12th year of operation, we have set out to be world leaders in nanoscience and nanotechnology, meeting the targets for the United Nations Sustainable Development Goals (UN SDG) as set out in 2015 that will lead to sustainable development, economic growth, and environmental protection. We are pleased to assemble this WtIN Virtual Issue for ACS Nano, highlighting our members' research breakthroughs as well as ACS publications with special attention to energy harvesting and storage technology.

This past year has also brought some momentous achievements with the Nobel Prize in Physics awarded to Professor Donna Strickland and a November 2018 for her work on shared pulse laser amplification technology (only the third woman in history to receive this prestigious honor), and with the first images of a black hole by Professor Avery Broderick in April 2019.

The Waterloo Institute for Nanotechnology. Interdisciplinary research is a cornerstone of innovation—addressing today's complex challenges requires thinking beyond traditional disciplines to tackle large-scale challenges and to find practical solutions. The importance of nanotechnology as a truly interdisciplinary, enabling research area was recognized by WtIN only in its inception in 2006, and in 2008 the Waterloo Institute for Nanotechnology was founded. It is the largest nanotechnology institute in Canada and one of the premier research hubs in the world. Thus WtIN is naturally positioned as

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The Waterloo Institute for Nanotechnology: Societal Impact and a Sustainable Future

Lisa Palocz, Linda Hsiao, Zhongping Chen, and Sumanta Mitra*

IN *ACS Nano* 2016, 10, 11224-11230
 Published on December 20, 2016
 Copyright © 2016 American Chemical Society
[DOI: 10.1021/acs.nano.6b04500](#)

SUBJECTS: Batteries, Electrodes, Materials, Nanotechnology, Guller

PDF (1.4 MB)

ACS Nano

Figure 1

References

Figure 1

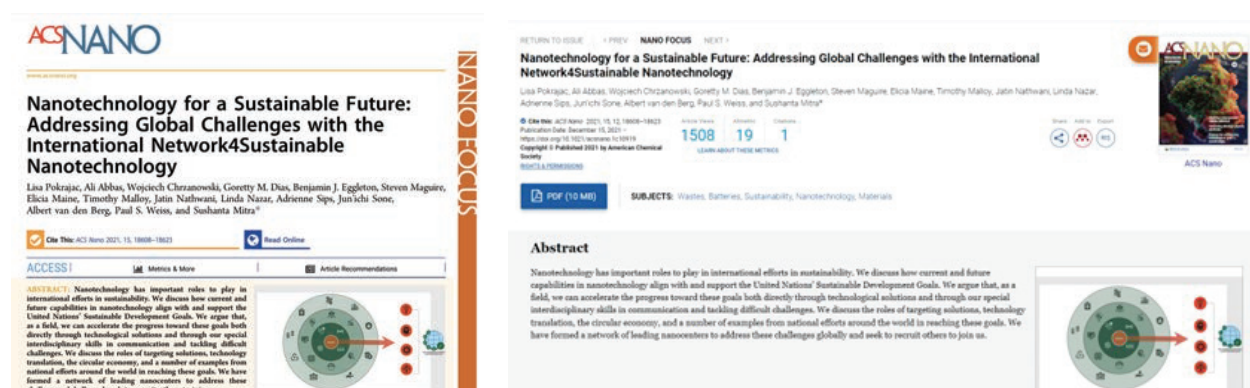
The Waterloo Institute for Nanotechnology (WIN) is Canada's largest nanotechnology institute and a world leader in the broader areas of nanoscience and nanotechnology. Located at the University of Waterloo (UW) in Waterloo, Ontario, Canada, it is truly an interdisciplinary research enterprise encompassing nine departments and schools spanning across the Faculties of Engineering, Science, and Mathematics.

As WIN enters its 12th year of operation, we have set out to be world leaders in nanoscience and nanotechnology, meeting the targets for the United Nations Sustainable Development Goals (UN SDGs) as set out in 2015 that will lead to sustainable development, economic growth, and environmental protection. We are pleased to assemble this WIN visual issue for *ACS Nano*, highlighting our members' research breakthroughs as shared in ACS publications, with special attention to energy harvesting and storage technology.

As WIN enters its 15th year of operation, we have set out to be world leaders in nanoscience and nanotechnology, meeting the targets for the United Nations Sustainable Development Goals that will lead to sustainable development, economic growth, and environmental protection.

The third article published in ACS Nano is “Nanotechnology for a Sustainable Future: Addressing Global Challenges with the International Network4Sustainable Nanotechnology”, published 15 December 2021 (ACS Nano 2021, 15, 12, 18608–18623; <https://doi.org/10.1021/acsnano.1c10919>). Following the success of the International Workshop on Nanotechnology for a Sustainable Future in November 2020, many of the speakers worked together in early 2021 to create this editorial piece to discuss the important role nanotechnology plays in sustainability effort – for today and the future. The resulting piece outlines how nanotechnology can accelerate progress towards achieving the objectives of the United Nations’ Sustainable Development Goals.

The editorial addresses the need for interdisciplinary expertise to find real and appropriate solutions, with the team of international authors incorporating their knowledge from Science, Engineering, Economics and Data & Information Science. The article also introduces the scientific community to the Network for Sustainable Nanotechnology (N4SNano) as a global forum to discuss new ideas in the field, and to find ways to bridge gaps between the S&T community and governmental policy makers to allow for much-needed adoption of new technologies.



4.5.4 WIN TERM REPORT

WIN publishes a comprehensive report each term and circulates to UW offices to ensure WIN partners and stakeholders stay informed of all WIN activities. The report includes a summary of WIN activities for research and commercialization support, international partnerships, WIN seminars, visitors and all other outreach and knowledge mobilization events.

5.0

OUTREACH

5.1 ENGAGE WIN

WIN has embarked on a number of new initiatives including the WIN Rising Star Award and WIN Research Leaders Gala. Another ongoing initiative is a fund-raising activity in partnership with the Office of Advancement at UW called “Engage WIN”. The committee was created to connect the excellent science and innovation conducted by our researchers to diverse stakeholders.

5.2 WOMEN IN NANOTECHNOLOGY SEMINAR



FIGURE 31: WOMEN IN NANOTECHNOLOGY PROMOTIONAL AD, JANUARY 2022

In January 2021, all students were invited to meet prominent women in nanotechnology to hear about their history, exciting research, and how they chose their successful career paths. This online seminar was designed to provide valuable information to all students, particularly female students, who may be interested in graduate work and careers in S&T but do not know what avenues are open to them.

The speakers included prominent researchers Zoya Leonenko and Melanie Campbell from Physics and Astronomy, Anna Klinkova from Chemistry, Armaghan Salehian from Mechanical & Mechatronics Engineering, and Qinqin Zhu from Chemical Engineering.

The question-and-answer session of the workshop allowed for audience interaction, and the presenters were asked many interesting questions, such as how they came to study in their respective fields and what motivated them to pursue doctorate degrees. Each chose their research questions based on the results they would like to see in their respective field of studies, and it was this passion that helped them choose this career path. WIN plans to make this an annual event.

5.3 RESEARCH LEADERS CELEBRATION

It is very important to recognize the ongoing achievements of WIN members throughout each academic year, providing recognition and encouragement for the outstanding work they have done. Since 2018, WIN has recognized WIN members who have made significant contributions which include:

- a. Any individual or group receiving major grants with a value equal to or greater than \$500,000
- b. Major national or international awards
- c. Published books or other major scholarships and creativity

The first “WIN Research Leaders Gala and Reception” was held in June 2018, as part of WIN’s 10 Year Celebration with the following members awarded:

Jonathan Baugh, Zhongwei Chen, Kyle Daun, Marianna Foldvari, Michel Gingras, Karim Karim, Xianguo Li, Juewen Liu, Adrian Lupascu, Raafat Mansour, Kevin Musselman, Linda Nazar, Janusz Pawliszyn, Luis Ricardez Sandoval, Michael Tam, Adam Tsen, William Wong, Youngki Yoon, Alfred Yu, Boxin Zhao, Norman Zhou

Starting in November 2019, the Research Leaders Celebration has been held in the Fall term, in conjunction with the Nanofellowship Celebration, with the following WIN faculty recognized for their accomplishments:

2019: Dayan Ban, Jeffrey Gostick, Emmanuel Ho, Vassili Karanassios, Anita Layton, Zoya Leonenko, Yuning Li, Linda Nazar, Pavle Radovanovic, Siva Sivoththaman, Roderick Slavcev, Michael Tam, John Yeow

2020: Hany Aziz, Zhongwei Chen, Michel Gingras, Emmanuel Ho, Vassili Karanassios, Zoya Leonenko, Juewen Liu, Linda Nazar, Carolyn Ren, Derek Schipper, Zbigniew Wasilewski| Shawn Wettig, Yimin Wu, John Yeow, Aiping Yu, Alfred Yu

2021: Kyle Daun, Michel Gingras, Emmanuel Ho, Vassili Karanassios, Karim Karim, Zoya Leonenko, Yuning Li, Graham Murphy, Kevin Musselman, Linda Nazar, Pavle Radovanovic, Carolyn Ren, German Sciaini, Michael Tam, Shirley Tang, John Yeow, Alfred Yu

FIGURE 32: WIN RESEARCH LEADERS AWARD WINNERS, NOVEMBER 2019



Since 2017, the following students have been awarded a WIN Nanofellowship:

2017-2018: Mina Abdelmalek, Abdul Aziz Almutairi, Dawood Alsaedi, Kiana Amini, Mohsen Asad, Hassan Askari, Eduardo Barrera-Ramirez, Matthew Courtney, Jing Fu, Nathan Grishkewich, Gillian Hawes, Marie Hebert, Khaled Ibrahim, Kavish Kaup, Grigoriy Kimaev, Ivan Kochetkov, Monika Kulak, Hyunjae Lee, Matthew Li, Yibo Liu, Rhiannon Lohr, Alam Mahmud, Rasool Nasser-Pourtokalo, Moon Gyu Park, Ran Peng, Paola Russo, Ida Sadeghi, Mostafa Saquib, Rohit Saraf, Runjhun Saran, Alison Scott, Behrooz Semnani, Yingqi Shi, Tejinder Singh, Man Chun Alan Tam, John Tse, Jun Geun Um

2018-2019: Marcus Abramovitch, Kiana Amini, Hassan Askari, Matthew Courtney, Ya-Ping Deng, Alicia Dubinski, Run Ze Gao, Xiguang Gao, Gillian Hawes, Khaled Ibrahim, Kavish Kaup, Navjot Khaira, Se Young Kim, Chun Yuen Kwok, Hyunjae Lee, Yibo Lui, Rhiannon Lohr, Xiao Ming, Sirshendu Misra, Kissan Mistry, Hassan Moussa, Erika Ramos, Bohua Ren, Moslem Sadeghi Goughari, Elizabeth Salsberg, Serkho Selmani, Abhinandan Shyamsunder, Geoffrey Sinclair, Janine Thoma, Yannick Traore, Kai Xi Wang, Shirley Wong, Penghui Yin, Hyeonghwa Yu, Jing Zhang, Zijie Zhang, Kai Zhao, Yiju Zhao

2019-2020: Alaaeldin Ahmed, Ayman Alneamy, Elif Pinar Alsac, Hatameh Asgarimoghaddam, Lauren Blanc, Remi Casier, Jialu Chen, Hyunwoo Choi, Ya-Ping Deng, Run Ze Gao, Chulgi Hong, Christian Ieritano, Muhammad Shahidul Islam, Navjot Khaira, Asif Abdullah Khan, Ivan Kochetkov, Braden Kralt, Monika Snowden, Fenh Li, Dan Luo, Alireza Mashayekhi, Kissan Mistry, Ryan Moreira, Bohua Ren, Stephen Robinson-Enebeli, Moslem Sadeghi Goughari, Geoffrey Sinclair, Zachary Strike, Sina Talebi Moghaddam, Chunxia Tang, Janine Thoma, Yannick Traore, Alexandru Vasile, Guobin Wen, Luzhu Xu, Fan Ye, Penghui Yin, Hyeonghwa Yu, Zhen Zhang, Yiju Zhao, Laidong Zhou

2020-2021: Abdullah Alshehri, Delaney Anderson, Irfani Rahmi Ausri, Robert Bennett, Trevor Blaikie, Lauren Blanc, Elham Davoodi, Pablo Daniel Enrique, Tao Guo, Stephen Harrigan, Zhe Huang, ZhiCheng Huang, Christian Ieritano, Asif Abdullah Khan, Bohdan Khromets, Ahmad Malik Lakhani, Lingzi Ma, Sirshendu Misra, Ryan Moreira, Stanislav Musikhin, Michael Noden, Tyler Or, Morgan Robinson, Resul

Saritas, Supratik Sarkar, Thomas Storwick, Chunxia Tang, Avery To, Zhen Zhang, Laidong Zhou

2021-2022: Md Fahim Al Fattah, Mohamed Arabi, Saeed Mohammad Bamatraf, Zuolong Chen, Ewomazino Constance Ojogbo, Fabio Cuzzucoli, Chuying Feng, Bronwyn Forrest, Pranav Gavirneni, Hossein Golzar, Naman Gupta, Saeed Habibpour, Stephen Harrigan, Zain Hussain Warsi, Rabiul Islam, Muhammed Kayaharman, Shehryar Khan, A-Reum Kim, Robyn Klassen, Reza Kohandani, Salman Lari, Yebin Lee, Chang Li, Elif Pinar Alsac, Alireza Mashayekhi, Md Masud Rana, Avi Mathur, Kseniia Medvedeva, Nanqin Mei, Md Milon Islam, Stanislav Musikhin, Emir Nazdragic, Mohammad Okasha, Tyler Or, Daniel Rickert, Morgan Robinson, Resul Saritas, Amirali Shamsolhodaie, Mayuri Sritharan, Nicholas Wilson, Fan Ye, Junjie Yin, MoMo Zandieh, Maiwen Zhang

2022-2023: Negin Bouzari, Irina Bukhteeva, Li Chang, Qiaoyun Chen, Md Fahim Al Fattah, Ali Ghatei Kalasham, Hossein Golzar, Tao Guo, Lian Han, Zhuoyang He, Md Milon Islam, Rabiul Islam, Muhammed Kayaharman, Reza Kohandani, Salman Lari, Yasaman Maddah, Johanthan David Mayry, Cameron Meaney, Kseniia Medvedeva, Mohammad Ala Mohajerzadeh, Dorsa Mohammadrzaei, Ewomazino Constance Ojogbo, Anish Pal, Natalie Pinchin, Lanting Qian, Youssra Rahham, Md Masud Rana, Daniel Rickert, Soumyadeep Saha, Fatemeh Samaeifar, Sepideh Sarmast Sakhvidi, Mayuri Sritharan, Youchao Teng, Avery To, Yi Wang, Lei Wang, Ethan Watt, Zhao Weinan, Michael Wright, Heebong Yang, Junjie Yin, Brian Youden, Zhuo Yu, Jinhe Zhang, Jinxuan Zhang

For the outstanding graduate students who have been awarded a Nanofellowship, the Research Leaders Gala is an opportunity for the WIN community to congratulate each winner and provide them an opportunity to showcase their fine work and research results at the Nanofellowship Poster Session, held immediately after the Research Leaders Awards. Each student is required to attend this event and discuss their projects with WIN faculty and fellow graduate students and meet the donor of the very generous endowment.

5.4 WIN RISING STAR

The goal of this program is to bring an emerging leader in the field of nanotechnology to the Institute for several days, as an opportunity to interact with more established WIN researchers. It is also an opportunity for WIN to form stronger connections within the global community. This program commenced in 2018, recognizing Early Career Researchers (ECR) who are also full-time faculty members at an external research institution or university, whose fields of study align with one or more of WIN's thematic research areas. Each year, WIN receives outstanding applications from around the world.

The inaugural recipient of the WIN Rising Star Award was Bruno Ehrler, a Scientific Group Leader at the Institute AMOLF in the Netherlands who was awarded in June 2018.



DREW HIGGINS
Assistant Professor,
Chemical Engineering,
McMaster University



ROBERT HOYE
Lecturer and Royal Academy of
Engineering Research Fellow,
Department of Materials,
Imperial College London



BABAK ANASORI
Professor,
Purdue University



CAO THANG DINH
Assistant Professor,
Queen's University



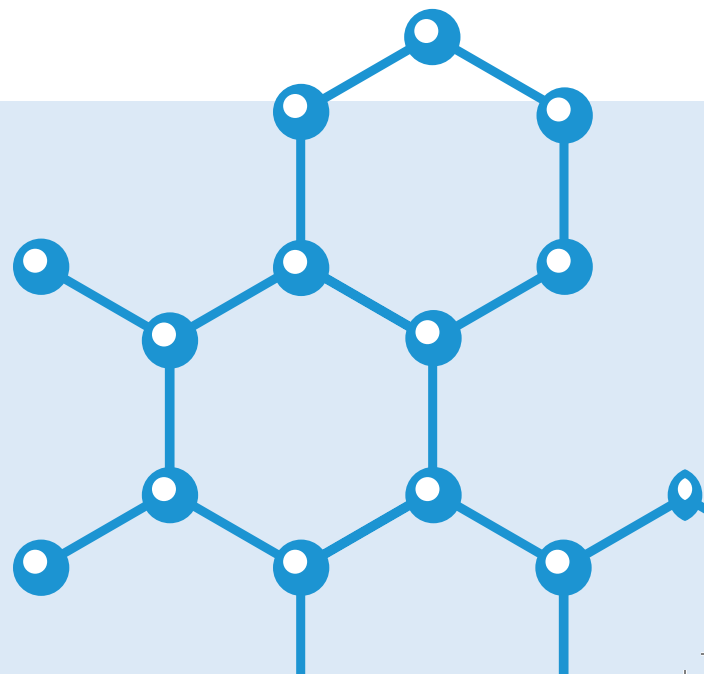
BRUNO EHRLER
Group Leader at Institute
AMOLF

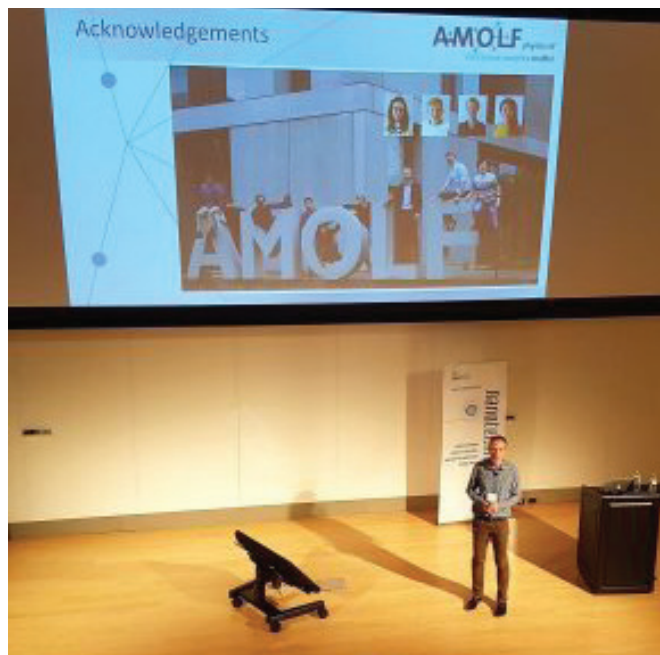
The next competition was held in Fall 2020, with two researchers recognized as Rising Stars – Drew Higgins from McMaster University, Canada, and Robert Hoye from Imperial College London, UK.

The most recent competition in Fall 2021 was also awarded to two exceptional young researchers – Babak Anasori from Purdue University, USA, and Cao Thang Dinh from Queen's University Canada.

The 2022 competition was launched in July 2022, with an advertisement in Chemistry & Engineering News (C&EN), and throughout various social media and internet channels.

All existing recipients and future ones will be part of the WIN family with a special designation “WIN Fellow”.





I feel very honoured to be the inaugural recipient of the Rising Star Award. The interdisciplinary approach that brings together the traditional fields to focus on a few select topics is inspiring. WIN successfully makes the connection between fundamental science and applications that solve a societal challenge.

BRUNO EHRLER, AMOLF RESEARCH INSTITUTE

FIGURE 34: BRUNO EHRLER FROM AMOLF INSTITUTE IN AMSTERDAM GIVES HIS RESEARCH PRESENTATION AS PART THE INTERNATIONAL SYMPOSIUM IN JUNE 2018

5.5 OUTREACH FOR HIGH-SCHOOL AND ELEMENTARY STUDENTS

5.5.1 SHAD CANADA

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 Professor Chris Backhouse from the Department of Electrical Engineering, in collaboration with Professor 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.



FIGURE 34: STUDENTS FROM THE SHAD PROGRAM CONDUCTING EXPERIMENTS IN THE MNT LABORATORY IN THE QNC, JULY 2022



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, SHAD STUDENT, JULY 2022

5.5.2 WATERLOO–WELLINGTON SCIENCE & ENGINEERING FAIR (WWSEF)

This fair is open to senior elementary/middle school and high school students from Waterloo, Wellington County and students of the Upper-Grand District, providing a forum to encourage the scientific curiosity of young minds in this region. Each year the fair hosts approximately 300 students, switching to a virtual platform during the pandemic. WIN is an annual supporter of the WWSEF for a sponsorship amount of \$1,000.

5.5.3 CANADA-WIDE SCIENCE FAIR (CWSF)

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 2022 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 at the 2022 CWSF, where visitors to the booth 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, Professor 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 for CWSF. 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. There are three such awards 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>)

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 Techscience, QC for "Analyse ta foulée!" (Analyse your stride!) (<https://projectboard.world/ysc/project/88163>)

5.6 WIN TOWN HALL

WIN works hard to connect with all its members and students, to understand their needs and how WIN can effectively serve. Town Hall meetings are gatherings to allow everyone to hear news, discuss challenges, stay informed and offer ideas. Since 2017, WIN has held three Town Hall meetings where important topics were discussed, ranging from the scope and mission of the institute, updating key theme areas, WIN 5-year renewal mandate, equipment and facilities within the QNC and the strategic vision for the 2022-27 cycle. All Town Hall events were well-attended, either in-person or virtually, and each provided significant action-items that WIN was able to pursue and accomplish.

5.6.1 NOVEMBER 2017 TOWN HALL

The first WIN Town Hall meeting was held on 28 November 2017 in person at the QNC, where the feedback and results of an online survey and in-person meetings were presented. This meeting provided a venue for an open, transparent and collegial engagement process. An informal discussion followed covering many topics including large-scale funding programs, how to manage and promote the broad-range of topics in nanotechnology while maintaining inclusivity and focus, and how nanotechnology research can be effective in Canada's natural resource economy landscape (oil, water, natural products, etc).

Based on this meeting and internal consultation, it was decided that the four original nanotechnology research themes crafted in 2008 (nanomaterials, nanoinstrumentation, nanoelectronics and nanobiomedicine) were to be re-evaluated and aligned towards emerging interests within the nanotechnology global community. The updated research theme areas now include smart & functional materials, connected devices, next generation energy systems, and therapeutics & theranostics (as detailed on page 18). Additionally, WIN championed internal and external partnership-building activities to promote these areas of excellence and target large-scale funding opportunities.

5.6.2 NOVEMBER 2018 TOWN HALL

The second Town Hall meeting was held on 12 November 2018, to provide the membership with details of strategic plan implementation over the previous year, to reflect on successes and offer suggestions on areas of improvement. An online survey was also forwarded with the results indicating improved satisfaction with the overall direction and focus of the institute.

5.6.3 FEBRUARY 2022 TOWN HALL

On February 24, WIN hosted its most recent Town Hall, which was open to all members. To open the meeting, WIN presented findings from the survey issued to the members in Fall 2021. In brief, the survey results are the following:

- › Over half of the 34 respondents were WIN members for more than 9 years
- › When asked if respondents feel engaged with WIN activities, only 3 chose "very strongly", 11 chosen "Strongly", 11 chose "Somewhat" and with the rest split between "Little" or "Very little"
- › When asked "what results has WIN helped you achieve", most popular choices were "Introduce International Connections" and "Increased Reputation" (21 and 19 out of 34, respectively), with "Promote Research", "Support Grants & Awards", and "Support Infrastructure" were next in popularity (15, 14, and 13 respectively), with "attract Funding" and "Introduce Industry Connections" attracting 10 responses. The last on the list with only 3 responses was related to "Support Commercialization"
- › When asked "What research support have you received", the vast majority of respondents chose "Networking" (27), followed by "Advertisement of New Funding" (16), "International Collaborations" (12), "Industrial Collaborations" (6), and "Proposal Writing" (6).
- › Other key announcements from the meeting included WIN's current and upcoming research priorities, including microplastics, new tools for materials Discovery – AI and ML, and nanomedicine, the new proposed Surface Characterization Facility, and summaries of WIN's Talent Development, Community engagement, Industry Connections, and Equity, Diversity & Inclusion plans as part of WIN's strategic plan for the next five years.

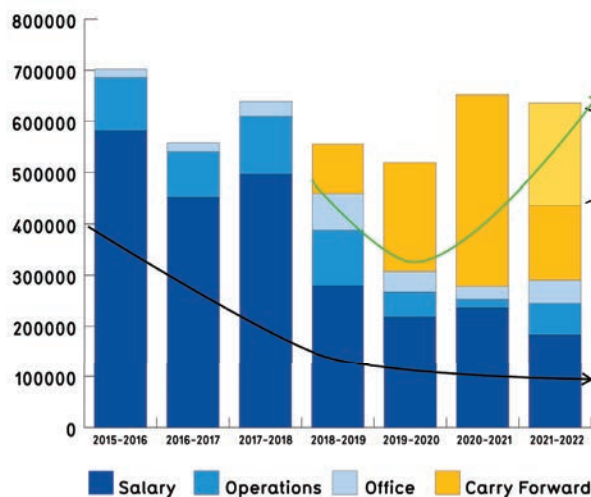
6.0

BUDGET AND FINANCIAL MANAGEMENT

On an annual basis, WIN creates a pro-forma budget in support of its annual plan following the UW-based activity-based budgeting system. The budget is reviewed by the WIN Budget Committee that is comprised of Thematic Leads and co-Leads (which is now the WIN Executive Council), to create a sustained budget for the Institute. WIN currently receives an operating grant of \$350,000 from the Office of Research, with an additional provision from the Provost's Office for the Business Development Manager position.

WIN is proud of its fiscal prudence and responsibility, managing costs and bringing those to help WIN researchers in the form of seed funding to kick-start interdisciplinary and international collaborations. The trend in expenditures since 2015-16 is seen in the table below:

FIGURE 35: WIN OPERATING BUDGET BY FISCAL YEAR SINCE 2015-16



It shows that since 2018, WIN is able to reduce its salary and operation expenditure. This has resulted in healthy carry forward for WIN, which WIN is able to invest back to its members such as the recent infusion of seed funding to WIN-NRC joint projects.

LIFE AT WIN

17 kitchens

3 meeting rooms

3 lounges

41 student offices

42 WIN professor research laboratories

WIN MEMBERS AS OF APRIL 2022



ADAM WEI TSEN
CHEMISTRY



ADRIAN LUPASCU
PHYSICS AND
ASTRONOMY



AIPING YU
CHEMICAL
ENGINEERING



ALFRED YU
ELECTRICAL
AND COMPUTER
ENGINEERING



ANITA LAYTON
APPLIED
MATHEMATICS



ANNA KLINKOVA
CHEMISTRY



ARMAGHAN SALEHIAN
MECHANICAL AND
MECHATRONICS
ENGINEERING



BETH WECKMAN
MECHANICAL AND
MECHATRONICS
ENGINEERING



BO CUI
ELECTRICAL
AND COMPUTER
ENGINEERING



BOXIN ZHAO
CHEMICAL
ENGINEERING



CAROLYN REN
MECHANICAL AND
MECHATRONICS
ENGINEERING



DAVID HAWTHORN
PHYSICS AND
ASTRONOMY



DAVID ROSE
BIOLOGY



DAYAN BAN
ELECTRICAL
AND COMPUTER
ENGINEERING



DEREK SCHIPPER
CHEMISTRY



DONGQING LI
MECHANICAL AND
MECHATRONICS
ENGINEERING



EIHAB M. ABDEL-RAHMAN
SYSTEMS DESIGN
ENGINEERING



ELIZABETH MEIERING
CHEMISTRY

WIN MEMBERS AS OF APRIL 2022



EMMANUEL HO
SCHOOL OF
PHARMACY



ERIC PROUZET
CHEMISTRY



EVELYN YIM
CHEMICAL
ENGINEERING



FLORA NG
CHEMICAL
ENGINEERING



GERMAN SCIAINI
CHEMISTRY



GORETTY DIAS
SCHOOL OF
ENVIRONMENT,
ENTERPRISE AND
DEVELOPMENT



GRAHAM MURPHY
CHEMISTRY



GUO-XING MIAO
ELECTRICAL
AND COMPUTER
ENGINEERING



HAMED MAJEDI
ELECTRICAL
AND COMPUTER
ENGINEERING



HAMED SHAHSAVAN
CHEMICAL
ENGINEERING



HANY AZIZ
ELECTRICAL
AND COMPUTER
ENGINEERING



HOLGER KLEINKE
CHEMISTRY



IRENE GOLDTHORPE
ELECTRICAL
AND COMPUTER
ENGINEERING



JAMES FORREST
PHYSICS AND
ASTRONOMY



JAN KYCIA
PHYSICS AND
ASTRONOMY



JANUSZ PAWLISZYN
CHEMISTRY



JATIN NATHWANI
CIVIL AND
ENVIRONMENTAL
ENGINEERING



JEAN DUHAMEL
CHEMISTRY

WIN MEMBERS AS OF APRIL 2022



JEFF GOSTICK
CHEMICAL
ENGINEERING



JOHN F HONEK
CHEMISTRY



JOHN YEOW
SYSTEMS DESIGN
ENGINEERING



JOHN Z WEN
MECHANICAL AND
MECHATRONICS
ENGINEERING



JONATHAN BAUGH
CHEMISTRY



JUEWEN LIU
CHEMISTRY



KARIM S KARIM
CHEMISTRY



KEVIN MUSSELMAN
MECHANICAL AND
MECHATRONICS
ENGINEERING



KYLE DAUN
MECHANICAL AND
MECHATRONICS
ENGINEERING



LAN WEI
ELECTRICAL
AND COMPUTER
ENGINEERING



LEONARDO SIMON
CHEMICAL
ENGINEERING



LINDA NAZAR
CHEMISTRY



LUIS RICARDEZ-SANDOVAL
CHEMICAL ENGINEERING



MAHLA POUDINEH
ELECTRICAL
AND COMPUTER
ENGINEERING



MANOJ SACHDEV
ELECTRICAL
AND COMPUTER
ENGINEERING



MARC AUCOIN
CHEMICAL
ENGINEERING



MARIANNA FOLDVARI
SCHOOL OF PHARMACY



MARIO GAUTHIER
CHEMISTRY

WIN MEMBERS AS OF APRIL 2022



MARK WILLIAM MATSEN
CHEMICAL ENGINEERING &
PHYSICS



MELANIE CAMPBELL
PHYSICS AND
ASTRONOMY



MICHAEL POPE
CHEMICAL
ENGINEERING



MICHAEL TAM
CHEMICAL
ENGINEERING



MICHEL GINGRAS
PHYSICS AND
ASTRONOMY



MOHAMMAD KOHANDEL
APPLIED MATHEMATICS



MOIRA GLERUM
BIOLOGY



MUSTAFA YAVUZ
MECHANICAL AND
MECHATRONICS
ENGINEERING



NA YOUNG KIM
ELECTRICAL AND
COMPUTER
ENGINEERING



NASSER M. ABUKHDEIR
CHEMICAL ENGINEERING



NORMAN ZHOU
MECHANICAL AND
MECHATRONICS
ENGINEERING



PATRICIA NIEVA
MECHANICAL AND
MECHATRONICS
ENGINEERING



PAVLE RADOVANOVIC
CHEMISTRY



PETER LEVINE
ELECTRICAL AND
COMPUTER
ENGINEERING



PIERRE-NICHOLAS ROY
CHEMISTRY



PU CHEN
CHEMICAL
ENGINEERING



QINQIN ZHU
CHEMICAL
ENGINEERING



RAAFAT MANSOUR
ELECTRICAL AND
COMPUTER
ENGINEERING

WIN MEMBERS AS OF APRIL 2022



RAFFI BUDAKIAN
PHYSICS AND
ASTRONOMY



RODERICK SLAVCEV
SCHOOL OF PHARMACY



RODNEY SMITH
CHEMISTRY



RUSSELL THOMPSON
PHYSICS AND
ASTRONOMY



SCOTT HOPKINS
CHEMISTRY



SCOTT TAYLOR
CHEMISTRY



SHAHRZAD ESMAEILI
MECHANICAL AND
MECHATRONICS
ENGINEERING



SHAWN WETTIG
SCHOOL OF
PHARMACY



SHIRLEY TANG
CHEMISTRY



SIMARJEET SAINI
ELECTRICAL AND
COMPUTER
ENGINEERING



SIVA SIVOTHTHAMAN
ELECTRICAL AND
COMPUTER
ENGINEERING



STEVEN YOUNG
SCHOOL OF
ENVIRONMENT,
ENTERPRISE AND
DEVELOPMENT



SUSHANTA MITRA
MECHANICAL AND
MECHATRONICS
ENGINEERING



TING TSUI
CHEMICAL
ENGINEERING



TIZAZU MEKONNEN
CHEMICAL
ENGINEERING



TODD HOLYOAK
BIOLOGY



TONG LEUNG
CHEMISTRY



VASSILI KARANASSIOS
CHEMISTRY



WIN MEMBERS AS OF APRIL 2022



VIVEK MAHESHWARI
CHEMISTRY



WILLIAM WONG
ELECTRICAL AND
COMPUTER
ENGINEERING



XIANGUO LI
MECHANICAL AND
MECHATRONICS
ENGINEERING



XIAOSONG WANG
CHEMISTRY



XIAOYU WU
MECHANICAL AND
MECHATRONICS
ENGINEERING



YIMIN WU
MECHANICAL AND
MECHATRONICS
ENGINEERING



YOUNGKI YOON
ELECTRICAL AND
COMPUTER
ENGINEERING



YUNING LI
CHEMICAL
ENGINEERING



ZBIGNIEW WASILEWSKI
ELECTRICAL AND
COMPUTER
ENGINEERING



ZHONGWEI CHEN
CHEMICAL
ENGINEERING



ZORAN MISKOVIC
APPLIED
MATHEMATICS



ZOYA LEONENKO
PHYSICS AND
ASTRONOMY