Waterloo Institute for Nanotechnology

TWENTY SEVENTEEN TWENTY EIGHTEEN

2017 - 2018

UNIVERSITY OF WATERLOO | WATERLOO INSTITUTE FOR nanotechnology

WIN ANNUAL REPORT

Annual Report

Our people

92
faculty members

20
research chairs

Lectures

3
distinguished lectures

15
seminars

2
innovation seminars

1
industry seminar

Departments

9

- Biology
- Chemistry
- Chemical Engineering
- Electrical & Computer Engineering
- Mathematics
- Mechnical & Mechatronics Engineering
- Systems Design Engineering
- Pharmacy
- Physics

Research

4,208
papers published
since 2008

554
papers published
in 2017

24
papers from WIN international collaboration
in 2017

71,030
citations
since 2008

Nano-fellowships

10
rounds of nanofellowship competitions

41
nanofellowships awarded
2017 - 2018

354
nanofellowships awarded
since 2008

International

21
international partners in eleven countries

24
papers from WIN international collaboration
in 2017

A message from the Executive Director

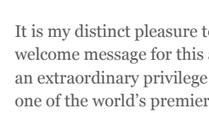
It is my distinct pleasure to write my inaugural welcome message for this annual report. It is an extraordinary privilege to lead and serve one of the world's premier nanotechnology institutes, in the heart of Canada's innovation region. Over the last ten months, I had the opportunity to listen to your aspirations, hopes and vision of where you would like see WIN go in the next decade.

With your support, I developed an action plan that will help us reach our next growth trajectory. As an institute, we are uniquely positioned to bridge the entire scale of the nanotechnology research landscape –from quantum phenomena to real-world devices. These innovations will provide solutions to global challenges in energy, water, public health and more.

Through our interdisciplinary research endeavors and integrating knowledge across multiple disciplines, we are on the cutting-edge to lead the Industry 4.0 agenda. WIN will seize the opportunities of the next industrial revolution.

Your passion, vigor and empathy will take us collectively to new heights. I look forward to being the cheerleader for this incredible journey that we will embark upon in the near future.

Cordially,



Dr. Sushanta K. Mitra
Executive Director
Waterloo Institute for Nanotechnology

A message from the Chair of the Board of Directors

Innovation in science and engineering has driven breakthroughs and discoveries at the Waterloo Institute for Nanotechnology for a decade, but the next decade will demand even more.

With a vision that builds upon cutting-edge research by leveraging new possibilities for strength and connections, the team at WIN recognizes that leading in the fourth industrial revolution requires reaching beyond science.

Substantial strides have been made during the last year to design a Board of Directors with a membership in which more than 50 per cent are female, a vast increase over previous years where female representation was only 10 to 20 per cent. Likewise, the International Scientific Advisory Board is benefiting from an increase in new members who provide international perspectives.

Looking to the future, the focus is on propelling WIN to the next level by breaking down silos and creating more synergy among Faculties. Networking activities lead to new prospects and partnerships which spur funding for inter-disciplinary research and, in turn, champion the nanotechnology agenda.

I'd like to extend my sincere thanks to Sushanta Mitra for his leadership during his first year as Executive Director at WIN and his vision for the year ahead. Synergy, interdisciplinary research, and new partnerships will put WIN in an ideal situation to support the UN Sustainable Development Goals – a tremendous opportunity for nanotechnology and to address some of humanity's most pressing issues.

Charmaine Dean
Vice President
University Research

A Global Centre of Excellence for Nanotechnology and its Applications

Mission & Objectives

Research, technology development and innovation in key areas of nanotechnology

Stimulate recruitment and retention of the best and the brightest research talent

Facilitate multidisciplinary research and collaboration

Partner with leading universities in nanotechnology around the world

Foster industry partnerships and commercialization

Manage the "nanotechnology" space, facilities and infrastructure in the Mike & Ophelia Lazaridis Quantum-Nano Centre

Thematic Areas

Smart and Functional Materials

This includes but not limited to fundamental condensed matter physics, soft matter, materials characterization, nanomaterials, graphene and other 2-D materials, quantum materials, nanoparticles, quantum dots, carbon nanotubes, DNA self-assembly, bio-material and nanocellulose, new materials for additive manufacturing (i.e., 3-D printing)

Next Generation Energy Systems

This includes but not limited to fundamental understanding of transport processes in energy devices, battery, fuel cells, catalysis, low-carbon sustainable technologies, artificial photosynthesis.

Connected Devices

This includes 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, and other connected devices.

Therapeutics and Theranostics

This includes but not limited to targeted drug delivery, tissue engineering, minimally invasive treatment of diseases, immunotherapy, and medical imaging.

Personalized Medical Care

"at this point the potential efficiencies our research can provide the medical community are limitless."

Dr. Shirley Tang
Associate Professor
Department of Chemistry,
University of Waterloo.

Personalized medicine, or precision medicine, will be central to a robust and efficient health care system in the future. Dr. Shirley Tang's research in the area of Smart and Functional Materials will help lead to a more personalized medical system.

According to the Canadian Institute for Health Information, total health care spending in Canada reached $242 billion in 2017. This represents 11.5 percent of Canada's gross domestic product. Over the coming decades the Canadian healthcare system will change.

Queen's University School of Public Policy Studies Health Policy Council highlighted the changing landscape of healthcare in Canada. They found that the health-care landscape is one of chronic disease, such as diabetes, dementia, heart failure and other chronic conditions. The Health Policy Council recommended that Canada needs to "de-hosptialize" the system to some degree and offer care to Canadians in their homes and local communities.

To maintain and improve the health care services Canadians have come to expect researchers at the Waterloo Institute for Nanotechnology (WIN) are developing innovative new technologies. This research will lead to greater personalized medicine.

Dr. Tang's is one of Canada's preeminent research leaders in Smart and Functional Materials. In 2013, she received a Grand Challenges Canada Grant for "a handy device for rapid screening of diarrheal pathogens in water: prevention of Diarrhea at its source." Her most recent research focuses on biomimetic materials and single-walled carbon nanotube (CNT).

Her lab is designing single-walled CNTs bio-hybrid structures to impart specific bio-functionalities, such as early stage pathogen detection. This research is at the cutting edge of nanotechnology. Their goal is to provide revolutionary new tolls for bio-analysis, drug delivery, disease diagnostics and therapy.

Their research led to the development and patent of a glucometer type device. This patented device feeds samples on a test strip through a filtering membrane, across a receptor field and onto a network of carbon nanotubes. The nanotube bands printed on strips for the device test for pathogens. A chemical interaction between the sample and the receptor produces an electrical signal, which exposes hidden threats. The portable nature of their device allows medical-professionals and even patients to administer these tests in the field.

Dr. Tang's believes the primary goal of their research should be to help improve lives through scientific breakthroughs.

"Our research will deliver new tools and revolutionize our health-care system by empowering people to self-diagnose and monitor their own health," said Dr. Shirley Tang.

"As we move to a more decentralized medical system it is vital that medical practitioners and patients have the tools to safely administer treatment. More personalized medical will reduce the amount of resources our health care system needs to allocate for drug delivery and disease diagnostics."

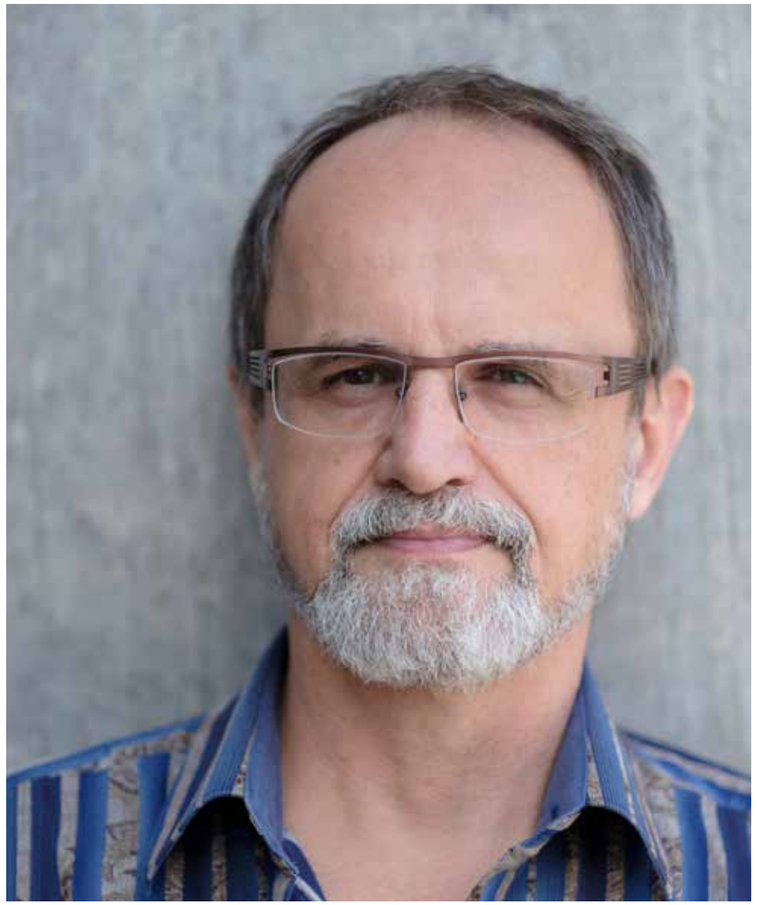
Dr. Tang said, "at this point the potential efficiencies our research can provide the medical-community are limitless."

This research is only possible at the University of Waterloo and WIN, because of the collaboration between multiple departments.

"A real strength of WIN is the intense focus on interdisciplinary research. WIN members can discuss challenges and problems they are facing with one another and apply for funding opportunities together," said Tang.

Dr. Shirley Tang is an Associate Professor in the Department of Chemistry at the University of Waterloo.

Protecting Canada's Northern Sovereignty



Waterloo Institute for Nanotechnology (WIN) members, in partnership with the Institute for Quantum Computing (IQC), is developing the next generation of radar, quantum radar. Dr. Zbig Wasilewski, Professor in the Department of Electrical and Computer Engineering and WIN Endowed Chair, is fabricating the materials for quantum radar.

The two other co-PIs on this project are Dr. Jonathan Baugh and Dr. Mike Reimer. Dr. Baugh is a member of both WIN and IQC, while Dr. Reimer main focus is on quantum photonics as a member of IQC.

In April 2018, the Government of Canada announced they would invest $2.7 million in the joint quantum radar project. The state-of-the-art facilities in Lazaridis Centre make this project possible. Dr. Wasilewski's Molecular Beam Epitaxy (MBE) lab will grow the quantum material to adequate perfection to meet the challenge. The IQC houses the necessary quantum device processing and photonic labs. This ambitious project is not possible at many research institutions in the world.

The MBE lab allows Wasilewski to create quantum structures with atomic precision. These materials will in turn form the foundation of the quantum radar.

"Many challenges lie ahead," said Wasilewski.

"Building up quantum illumination sources to the scale needed for quantum radar calls for the very best in material growth, nanofabrication and quantum engineering. We have an excellent interdisciplinary team with the diverse expertise needed to tackle all these challenges. It would be hard to assemble a better one in Canada or internationally."

Dr. Jonathan Baugh said, "By developing a fast, on-demand source of quantum light, we hope to bring techniques like quantum illumination from the lab to the real world. This project would not be possible without the right team, and we are fortunate to have a uniquely strong multidisciplinary collaboration based entirely at Waterloo, one which strengthens ties between WIN and IQC."

The proposed quantum radar will help operators cut through heavy background noise and isolate objects in Canada's far north. Standard radar systems are unable to detect stealth aircraft in the high-arctic due to the aurora borealis. This natural phenomenon sends electromagnetic energy at varying wavelengths down to Earth.

It is hypothesized that quantum radar works by separating two entangled light particles. You keep one on earth and send the entangled partner into the sky. If the light particle bounces off of your source and back to your detector you have located a stealth aircraft.

Quantum radar's viability outside of a lab still needs to be determined. The goal of this project is to demonstrate its capability in the field.

The $2.7 million is being invested under the Department of National Defence's All Domain-Situational Awareness (ADSA) Science and Technology program.

"We have an excellent interdisciplinary team with the diverse expertise needed to tackle all these challenges. It would be hard to assemble a better one in Canada or internationally."

Dr. Zbig Wasilewski
Professor
Department of Electrical and Computer Engineering and WIN Endowed Chair, University of Waterloo

Nanogenerators and the Future of Energy

There are many researchers searching for new and clean sources of energy. However, few are conducting research at the intersection of nanotechnology and quantum phenomenon. Dr. Dayan Ban, Professor in the Department of Electrical and Computer Engineering, is conducting seminal research in the area of quantum photonics and nanoelectronics.

His main objective is to develop advanced semiconductor quantum photonic and nanoelectronic devices for terahertz communication, terahertz imaging, sensing and energy harvesting. Dr. Ban designed and created prototypes of high-performance quantum devices. These devices convert infra-red light directly to visible light (green) at room temperature. These experiments led Dr. Ban to fabricate a hybrid energy harvester based on a nanogenerator and solar cell.

The United States Energy Information Administration projects a 28 percent increase in world energy use by 2040. To reduce the burden on the world's limited energy resources novel technologies must be developed to harvest energy from non-traditional sources.

Dr. Ban and his collaborators are focused on harvesting energy from ambient sources, such as vibration, thermal, acoustic or solar. This energy can also be harvested from remote sources, such as radio-frequency or acoustic beacons. An example is the powering of sensors on an airplane wing through the mechanical vibration of the plane itself. Thermoelectric generators can be attached to a heat-generating source such as an engine.

"Our goal is to use nanotechnology to develop nanogenerators and light emitting diode to be commercialized for general applications," said Ban.

"This research is only possible at the Waterloo Institute for Nanotechnology. The diverse group of researchers provides all of us with an opportunity to collaborate and proposed unique solutions to society's challenges."

We do not currently know the full extent of the application for these nanogenerators. However, the ability to harvest energy from mechanical, thermoelectric or light sources will drastically reduce the carbon emissions associated with traditional forms of energy production.

Dr. Dayan Ban is a member of the Next Generation Energy Systems thematic group.

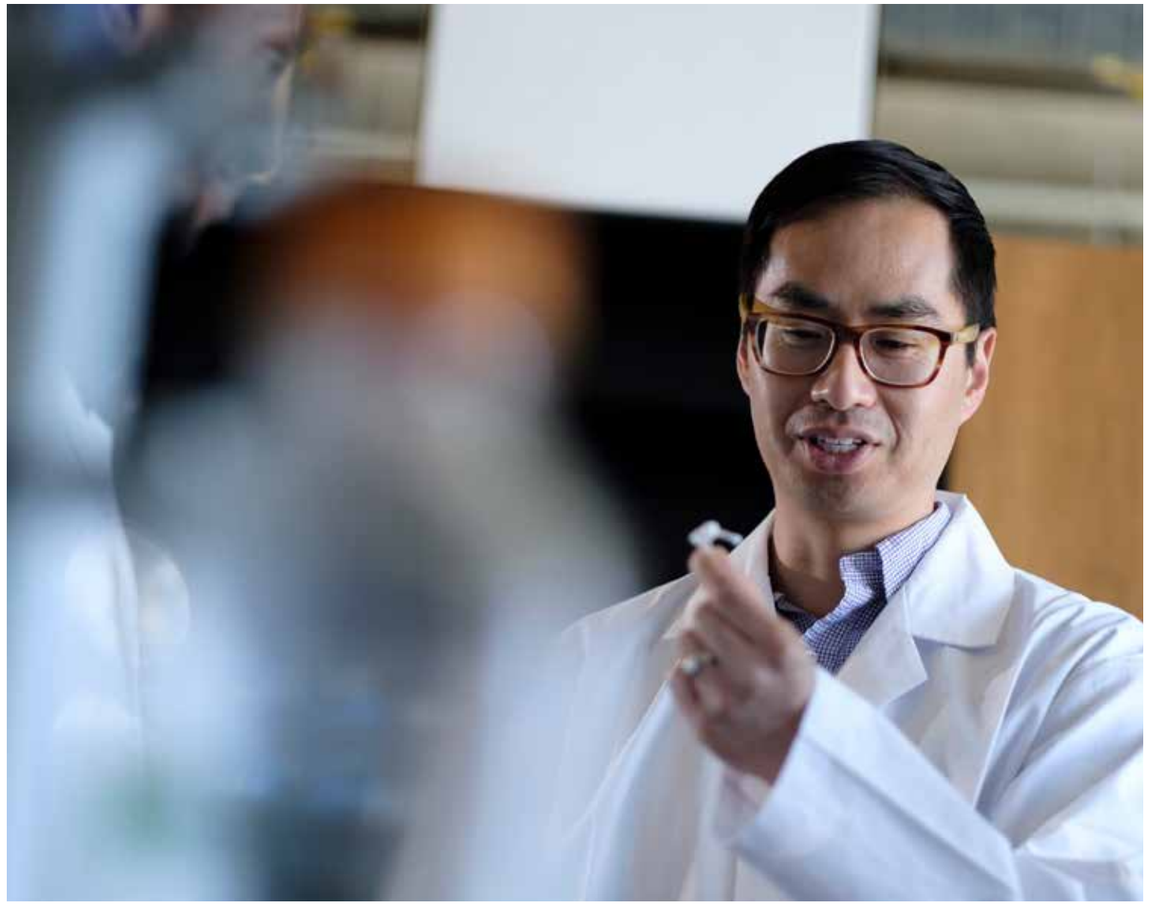
"This research is only possible at the Waterloo Institute for Nanotechnology. The diverse group of researchers provides all of us with an opportunity to collaborate and proposed unique solutions to society's challenges."

Dr. Dayan Ban
Professor
Department of Electrical and Computer Engineering, University of Waterloo

HIV Prevention

Dr. Emmanuel Ho
Professor
School of Pharmacy,
University of Waterloo

"What we don't know yet is if this can be a stand-alone option for preventing HIV transmission or if it might be best used in conjunction with other prevention strategies,"



According to the World Health Organization (WHO), about 36.7 million people were living with HIV at the end of 2016. Since the WHO began tracking the epidemic an estimated 70 million people have been infected with the HIV virus.

Dr. Emmanuel Ho, Associate Professor at the School of Pharmacy and WIN member, unveiled an important new product in the fight against HIV. His research group developed an implant that focuses on preventing the contraction of HIV.

The tool, a vaginal implant, decreases the number of cells the HIV virus can target in a woman's genital tract. The implant has a hallow tube and two pliable arms to hold it in place. Hydroxychloroquine (HCQ) is disseminated slowly through the porous materials of the tube and absorbed by the walls of the vaginal tract. The design of the implant allows for the drug to be released and absorbed directly.

"We know that some drugs taken orally never make it to the vaginal tract, so this implant could provide a more reliable way to encourage T cells not to respond to infection and therefore more reliably and cheaply prevent transmission," said Dr. Emmanuel Ho.

When an individual contracts HIV their immune system mobilizes the body's T cells, which are in turn corrupted by the virus. Dr. Ho's research group discovered that HCQ keeps the T cells resting and they do not attempt to fight the virus. Therefore, they are not infected.

When the T cells stay resting, it's referred to as being immune quiescent. "No one has ever kind of shown that we can actually use a drug to create this immune-quiescence state," said Ho.

There are major issues with access to condoms and anti-HIV drugs in developing countries. The implant is discrete and offers women a long-term method of protecting themselves. Through this implant and research, Dr. Ho is using nanotechnology and nanomedicine to help meet a global challenge. There is still more work to be done.

"What we don't know yet is if this can be a stand-alone option for preventing HIV transmission or if it might be best used in conjunction with other prevention strategies," said Ho. "We aim to answer these questions with future research."

Dr. Emmanuel Ho is part of the Therapeutics and Theranostics thematic group at WIN. His research group focuses primarily on the fabrication and characterization of innovative biomaterials for drug delivery, medical devices, biodegradable films and hydrogels.

Funding the Next Generation of X-Ray Technology

Dr. Karim Karim
Professor in the Department of Electrical and Computer Engineering, University of Waterloo

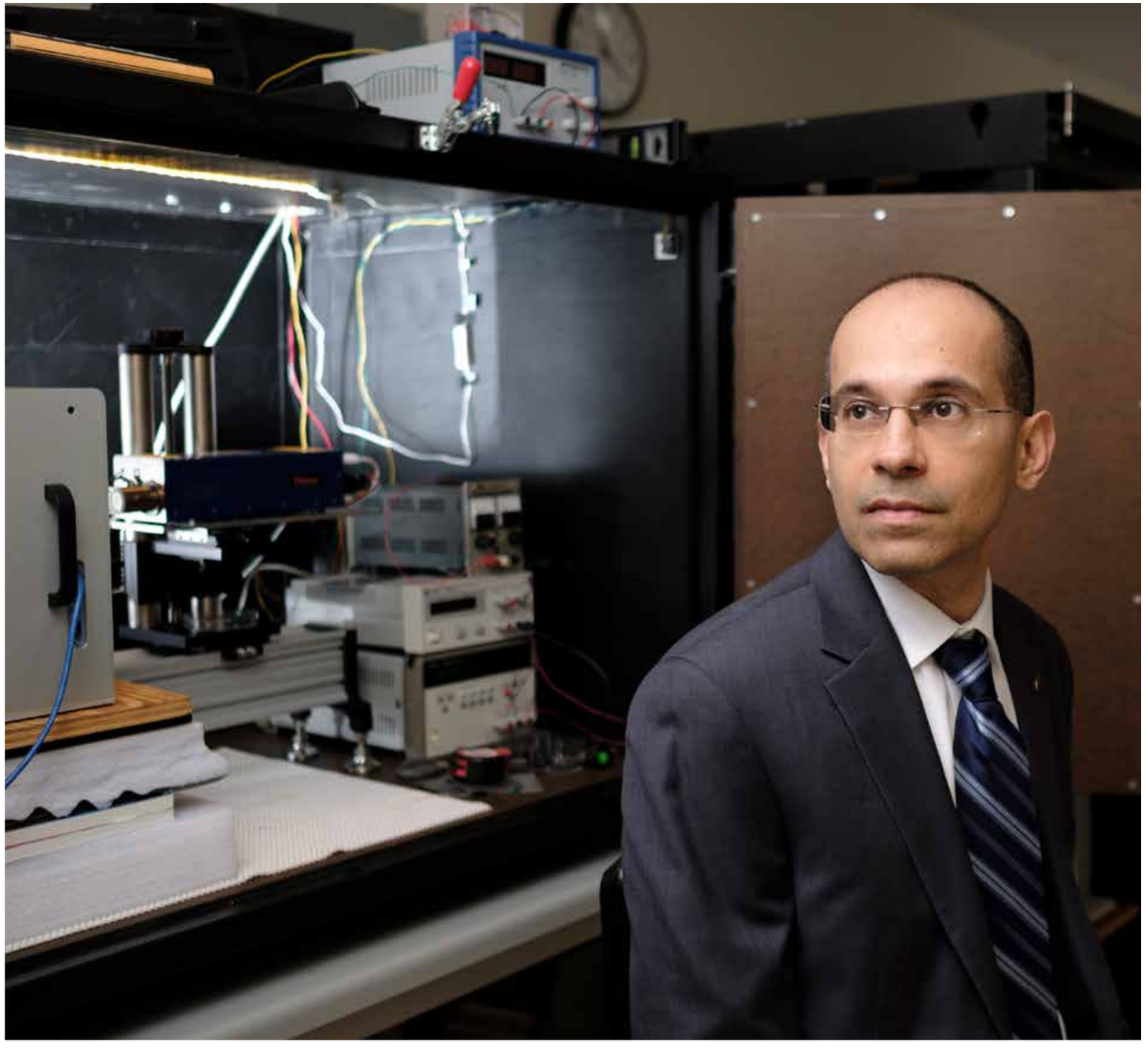
This year the Waterloo Institute for Nanotechnology (WIN) announced a new funding program for WIN members. The WIN Interdisciplinary Research Funding Program (WIN-IRFP) is a competitive program aimed at providing seed funding and support for interdisciplinary research.

Dr. Karim Karim, Professor in the Department of Electrical and Computer Engineering and WIN member, and his partners are one of the inaugural projects under the WIN-IRFP. Dr. Karim and his partners, Dr. Robin Duncan and Dr. Peter Levine, are developing a low-cost, efficient x-ray machine.

The innovative micro-CT system for cardiovascular imaging research is a more accessible alternative to magnetic resonate imaging. Their micro-CT system exposes the subject to a lower radiation dose and produces a higher resolution image of low density materials, including soft tissue.

"The WIN-IRFP will help us scale-up and commercialize our product. We would not be able to do this without WIN's support," said Dr. Karim.

A key requirement of the program is the co-applicant must be a full-time faculty member from outside of the Faculty of Engineering and the Faculty of Science. In this specific instance, Dr. Robin Duncan, from the Department of Applied Health Sciences is a co-PI. Dr. Peter Levine, from the Department of Electrical and Computer Engineering and WIN member, is the third co- PI on their micro-CT system.



"The WIN-IRFP will help us scale-up and commercialize our product. We would not be able to do this without WIN's support,"

WIN will award three awards per year, at a value of $100,000 each, for the next five years. The intent of the program is to help WIN researchers work on "high risk-high reward" blue-sky discovery research. These projects should 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.

Other projects funded through this program include hydrophobic engineering of nanodimensional protein capsules for therapeutics, a novel theoretical framework for the prediction of non-equilibrium systems and mapping lipid and mitochondria depots in fully hydrated tissue with nanometer resolution.

Championing Interdisciplinary Research in Waterloo

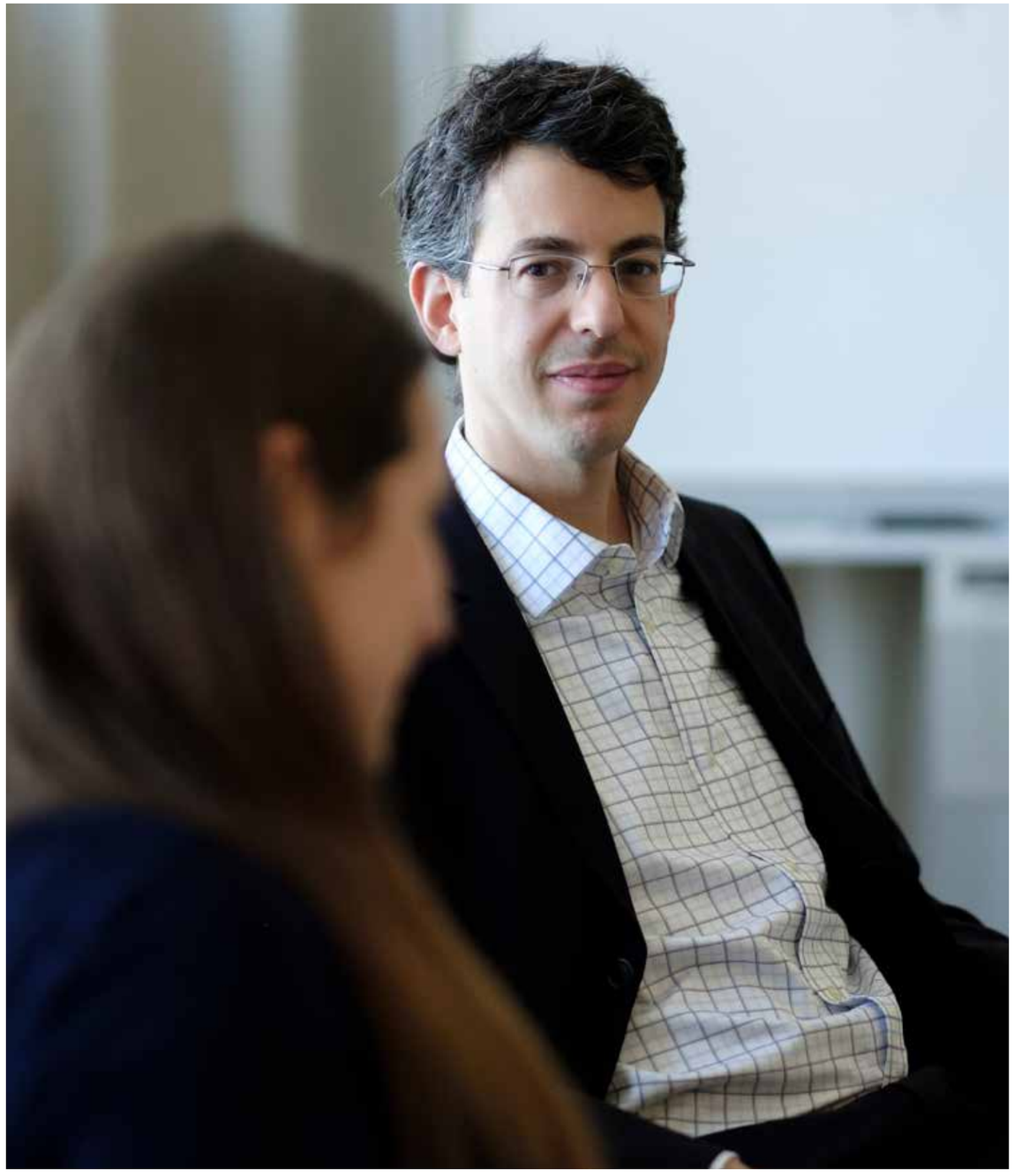
Interdisciplinary research has always been a central component of nanoscience and nanotechnology at WIN. Since the Institutes inception both the Faculty of Engineering and-Science at the University of Waterloo played a prominent role. However, today's problems are so complex, be it the global challenges in energy, water, public health, that a single disciplinary approach is not be good enough.

WIN has significant foundational strengths in the disciplines of Physics, Chemistry, Biology, Chemical Engineering, Mechanical and Mechatronics Engineering, Pharmacy, Systems Design Engineering, Electrical and Computer Engineering and Mathematics. Under the leadership of the new Executive Director, Dr. Sushanta Mitra, WIN is posed to unleash its true potential by integrating discipline specific fundamental research with interdisciplinary knowledge spanning across the Faculty of Arts, Environment and Applied Health Sciences. This will enable our brightest minds to collaborate as a team and solve the daunting global challenges with a 360-degree perspective.

Towards this effort, WIN hosted a research mixer entitled, "Nanotechnology and Society" with the Faculty of Arts to showcase prospective cross-disciplinary collaborations in research. The hope is to integrate perspectives and expertise from the social sciences and humanities with science and engineering. Designed to provide an opportunity to engage in conversation on multifaceted themes, diversified teams, and network-building, this program help UW researchers identify large-scale problems and practical solutions for the challenges of today.

Since the research mixer "Nanotechnology and Society," WIN hosted two additional interdisciplinary mixers. The mixer with the Faculty of Environment in February 2018 provided an opportunity for researchers on both sides to discuss ways to solve challenges pertaining to environmental remediation, protection and future resource planning. The mixer with the Faculty of Applied Health Sciences (AHS) in April 2018 allowed WIN and AHS researchers to discuss areas of cooperation for disease detection and prevention. In addition, issues such as quality medical treatments, advances in drug delivery and design, policy planning and other issues pertaining to global health were discussed. These research mixers helped form the foundation of the WIN-IRFP.

The WIN-IRFP was designed to provide seed funding for interdisciplinary research not typically supported by traditional granting agencies. The IRFP aims to help WIN researchers work on "high risk-high reward" blue-sky discovery research providing initial data and insights enabling researchers to target various large-scale, established funding programs.



WIN Rising Star Award 2018

"WIN successfully makes the connection between fundamental science and applications that solve a societal challenge,"

Dr. Bruno Ehrler
Scientific Group Leader
Institute AMOLF

This year marked many new beginnings for the Waterloo Institute for Nanotechnology (WIN). We welcomed a new Executive Director, launched a corporate partnership program and continued to engage with the global community. One the new initiatives at WIN is the Rising Star Award.

The goal of this program is to bring an emerging leader in the field of nanotechnology to the Institute for a few days. It is an opportunity for a relatively young researcher to interact with more established WIN researchers. It is also an opportunity for WIN to former stronger connections within the global community.

The inaugural recipient of the WIN Rising Star Award was Dr. Bruno Ehrler. He is a Scientific Group Leader at the Institute AMOLF in the Netherlands. Ehrler heads the Hybrid Solar Cell group and has raised venture capital funding worth 2 million EUR. He holds a PhD from the University of Cambridge, where he developed the first two-bandgap single-junction solar cell.

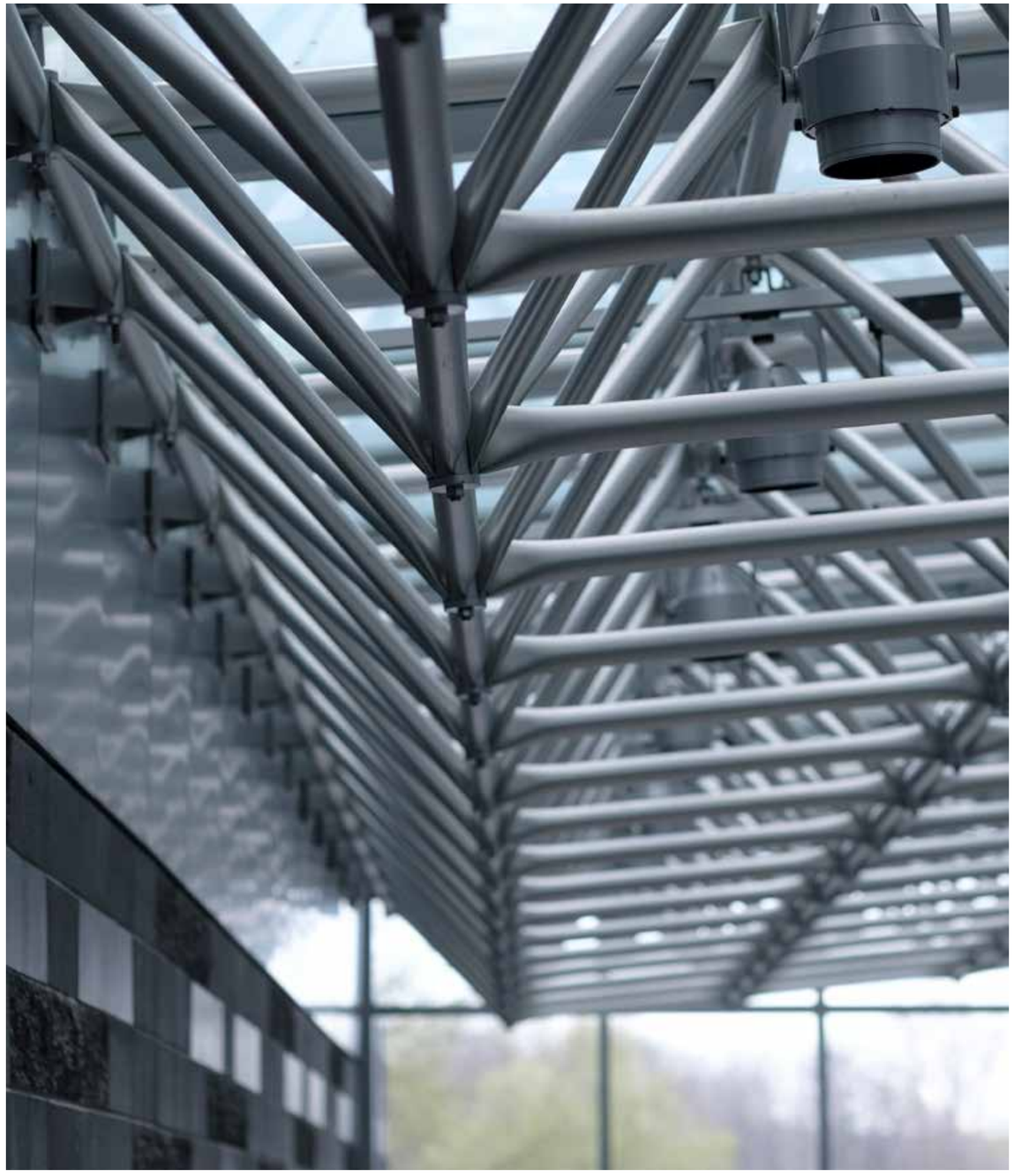
Upon receiving the news Dr. Bruno Ehrler said, "I feel very honoured to be the inaugural recipient of the Rising Star Award. During my last visit to WIN, I was impressed by the Institute and what has been achieved in the past 10 years."

"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," said Ehrler.

In reference to his own research he said, "this award is an acknowledgement of the fundamental science my team has been doing to tackle the transition to a sustainable energy future."

The award recipient receives $10,000 CAD as an honorarium at the International Symposium: Frontiers in Nanoscience and Nanotechnology. They must be a full-time faculty member who received their PhD in science or engineering in 2008 or later. Their research interests must align with one or more of the Institute's thematic areas. A successful applicant must be a full-time faculty member from outside of the University of Waterloo.

For the inaugural year of this award, WIN received applications from all over world. They represented a variety of research areas in nanoscience and nanotechnology.



New WIN Members

This past year saw five new members join the Waterloo Institute for Nanotechnology (WIN). These new members come from a variety of departments at the University of Waterloo and represent the future of nanotechnology and nanoscience.

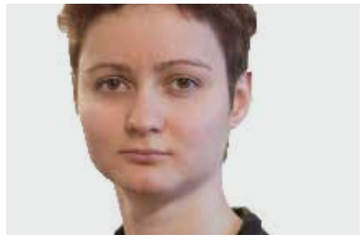
Dr. Michel Gingras is a Professor in the Department of Physics and Astronomy and Canada Research Chair in Condensed Matter Physics and Statistical Mechanics. Dr. Gingras' main interests are in the field of theoretical condensed matter physics, with a focus on systems with random disorder. His lab group also examines the strongly correlated classical and quantum condensed matter systems subject to strongly competing, or frustrated, interactions. Dr. Gingras joined the Smart and Functional Materials thematic group.

Dr. Jeff Gostick is an Associated Professor in the Department of Chemical Engineering. Dr. Gostick is exploring the use of electrospun nanofibrous materials for electrode applications. Simultaneously, his group is developing various modelling tools to help in the search for the optimum structure of a given application. They are also developing overall cell scale models of performance, down to sub-pore scale models of fluid flow and reaction. Dr. Gostick joined the Next Generation Energy Systems thematic group.

Dr. David Hawthorn is an Associate Professor in the Department of Physics and Astronomy. He leads the Quantum Materials Spectroscopy group, which studies quantum materials using resonant soft x-ray scattering and x-ray absorption spectroscopy. Their primary objective is to investigate the intertwined order in quantum materials and shed light on the long-standing mysteries of high temperature superconductors. Dr. Hawthorn joined the Smart and Functional Materials thematic group.

Dr. Armaghan Salehian is an Associate Professor in the Department of Mechanical and Mechatronics Engineering at the University of Waterloo. Her research interests include the application of smart materials for energy harvesting, sensing, and actuation of mechanical systems. She has performed extensive research on wrinkle modelling, flatness control, and vibrations modelling of space membranes. In the past, she worked with Lockheed Martin, the United States Air Force Office of Scientific Research. Dr. Salehian joined the Connected Devices thematic group.

Dr. Emmanuel Ho is an Associate Professor in the School of Pharmacy at the University of Waterloo. His research is focused on the development and characterization of innovative nanomedicines, medical devices and biomaterials for imaging, treatment and disease prevention. Dr. Ho is the past President of the Canadian Chapter of the Controlled Release Society (CCCRS). He is currently an Associate Editor for the Journal of Pharmacy & Pharmaceutical Sciences. Dr. Ho joined the Therapeutics and Theranostics thematic group.



Dr. Anna Klinkova is an Assistant Professor in the Department of Chemistry at the University of Waterloo. Her research is focused on developing efficient and scalable approaches to advanced nanomaterials for applications in alternative energy and catalysis. Her goal is to gain a systematic understanding of the effects of nanocrystal composition, shape, and surface chemistry on their physicochemical properties relevant to photo- and electrocatalysis, enantioselective catalysis, and light harvesting in solar cells. Dr. Anna Klinkova joined the Smart and Functional Materials and Next Generation Energy Systems thematic groups.

Dr. Xianguo Li is a Professor in the Department of Mechanical and Mechatronics Engineering. His main research interests and activities are in the area of thermal science, including energy systems and storage. Research projects include thermodynamics, fluid dynamics, hydrodynamic stability, multiphase flow, heat and mass transfer. Dr. Li is the Founding Editor-in-Chief of the International Journal of Green Energy. Dr. Li joined the Next Generation Energy Systems thematic group.

The Next Generation of Undergraduate Nanostudents

The Nanotechnology Engineering undergraduate program is in its 13th year and is one of the largest programs in North America with 500 students currently enrolled, and over 850 alumni graduated.

Nanotechnology Engineering (NE)

The NE undergraduate program has its home in the Lazaridis Centre with two 120 seat lecture theatres and a suite of teaching labs in circuits, chemistry and nanobio. The NE program run collaboratively by Chemical Engineering; and Chemistry, graduating over 100 professionals with hands-on materials science, clean-room fabrication and nanotools experience.

The Waterloo Nanotechnology Conference (WNC), formerly Waterloo Undergraduate Nanotechnology Conference (WUNC), ran its 3rd annual event in the Lazaridis QNC. The organizing committee invited top academics, industrialists, entrepreneurs and government officials.

Dr. Joanna Aizenberg, Professor of Materials Science at Harvard Univeristy, was the WIN distinguished lecturer and keynote speaker at the 2017 WNC. Over 200 students attended this annual conference in 2017.

Materials and Nanoscience (MNS)

The MNS degree program is an interdepartmental effort between physics and chemistry that bridges materials, nanotechnology and nanosciences. The program prepares students for careers in industrial or commercial settings where composite materials, energy storage devices, and solar cells are involved.

The Materials and Nanoscience Society (MNs) was launched in 2016 to enhance nanoscience education with social activities, professional development and leadership opportunities.

The Society works to bridge between concepts learned in class and modern nanotechnology applications, providing hands on skills manipulating chemistry and physics at the nanoscale, including ferrofluid synthesis, production of quantum dots, and design of superhydrophobic surfaces. Partnering with the Department of Chemistry, the Society also hosts a public lecture seminar series featuring a wide range of topics from superconductors to nanofabrication of flexible electronics.

Collaborative Nano Graduate Program

Launched in 2010, the Collaborative Graduate Nano program allows students to pursue a Master's or Doctoral degree in nanotechnology in one of the seven departments: Biology, Chemistry, Physics, Chemical Engineering, Electrical and Computer Engineering, Mechanical and Mechatronics Engineering, and Systems Design Engineering.

Enrolment in the Graduate Nano program increased to 180 graduate students in 2017.

Core course modules address foundational elements of nanotechnology, while a wide range of nanotechnology elective courses allow students to customize their education and broaden their perspective. In addition, WIN encourages all graduate students to pursue intellectual exchanges among themselves, faculty and industry by attending WIN distinguished lectures and faculty seminars.

WIN Nanofellowship

Every year, WIN awards dozens of Nanofellowships valued at $10,000 (CAD) to outstanding graduate students for their scholarly achievements.

2017-18 Recipients

Mina Abdelmalek
Abdul Aziz Almutairi
Dawood Alsaedi
Kiana Amini
Mohsen Asad
Hassan Askari
Eduardo Barrera Ramierez
Paul Chen
Matthew Courtney
Jing Fu
Nathan Grishkewich
Gyu Chull Han
Gillian Hawes
Marie Hébert
Andrew Holmes
Khaled Ibrahim
Kavish Kaup
Grigoriy Kimaev
Ivan Kochetkov
Monika Kulak
Huyunjae Lee
Matthew Li
Yibo Liu
Rhiannon Lohr
Alam Mahmud
Rasool Nasseri Pourtokalo
Moon Guy Park
Ran Peng
Paolo Russo
Ida Sadeghi
Mostafa Saquib
Rohit Saraf
Runjhun Saran
Alison Scott
Behrooz Semnani
Yinqiu Shi
Tejinder Singh
Man Chun Tam
John Tse
Jun Geun Um
Demin Yin

Waterloo Institute for Nanotechnology Graduate Student Society (WINGSS)

WINGSS and WIN continue to work closely together to advance nanotechnology and nanoscience for our graduate students. WINGSS brings together graduate students from across disciplines to promote social interaction and facilitate inter-departmental collaboration WINGSS' Executives provide a collective voice for nanotechnology graduate students to participate in the development of policies related to the collaborative nanotechnology graduate program and offer insights into the nanofacilities and services.

It organizes social mixers, an annual career night and a graduate student research symposium. The most recent night included panelists from industry, government, academia and alumni. Over 100 students attended this event.

Jonathan Atkinson
PhD, ECE (President)

Monika Kulak
PhD, Chem (VP Social)

Shahidul Islam
PhD, Chem Eng (VP Academic)

Muhammad Hassan Khan
MSc, Chem Eng (VP Finance)

Industry Partnerships

In 2018, WIN officially unveiled its new Corporate Partnerships Program (CPP). The long-term goal of this program is to enable multiple industry partners to access the talent of WIN researchers and utilize the state-of-the-art nanotechnology equipment and tools. These industry partners are strategically aligned with WIN's four thematic areas and the overall needs of the Canadian economy.

WIN welcomed a new Business Development Manager this past February. This new position within WIN allows for more targeted engagements with industry partners. The Business Development Manager will also work with WIN's Assistant Director of Research Programs (ADRP) to increase the conversion ratio of individual projects, such as NSERC Engage, into larger funding initiatives.

Another objective is to increase the Institute's engagement with our startup community and spin-offs from WIN members and students. WIN will also identify areas of commonality among the start-ups in the Region of Waterloo's entrepreneurial eco-system. The hope is that these collaborations will lead to future corporate partners.

Startup Catalyst Program

The goal of this startup program is to support the many startups within WIN and the larger Region of Waterloo eco-system. Members will have access to the world-class talent of WIN researchers, be introduce to prospective business partners and investors, and access research equipment at an academic discount. The Business Development Manager will work with the Executive Director to identify potential candidates for the startup catalyst program.

WIN's new Senior Facility Microscopist and Staff Scientist will work with WIN researchers, their industry partners and startups to fully utilize the facilities located in the Lazaridis Centre.

Corporate Partnership Program (CPP)

The Business Development Manager and Assistant Director of Research Program Manager (ADRP) assists CPP members in drafting problem statements based on the needs of the industry member. They will organize a call for research proposals. The ADRP will support faculty members throughout the grant application process and work with the Office of Research to assist in the establishment of new research agreements.

International

China

Soochow University and the Suzhou Industrial Park (SIP)

The strong and productive partnership between WIN, Soochow University (SUN) and the Suzhou Industrial Park (SIP) continues to grow each year. In 2011, the Joint SUN-WIN-SIP Research and Education Institute was formed, supporting joint research collaborations, student exchanges, and to stimulate entrepreneurship and innovation in nanotechnology.

In April 2018, WIN Executive Director, Dr. Sushanta Mitra, travelled to Soochow for the first meetings with the Director of the Institute for Functional Nano & Soft Materials (FUNSOM), Dr. Shuit Tong Lee, and the Dean of the College of Nano Science & Technology (CNST), Dr Xuhui (Jeff) Sun. As a result of the executive discussions, the SUN-WIN-SIP Joint Research and Education Institute will expand in 2018 to include a competitive Postdoctoral Fellowship program to bring the world's brightest young researchers to UW and Soochow University to advance knowledge and innovation in nanotechnology.

Plans are also underway to offer 10 WIN associated startup companies a soft landing site at Nanopolis-based offices located in Suzhou, as well as assemble a delegation of companies to attend the ChiNano 2018 Conference and Exhibition in October 2018. This approach will expose Canadian technology companies to the large- and emerging markets of Asia, where there is high demand for new technologies in medical and environmental sectors. The companies will benefit from engaging with prospective Chinese partners for future market entries, networking with investors and finding scale-up manufacturing partners.

Tsinghua University

WIN Member, Prof. Zhongchao Tan, has championed the joint research centre for Micro/Nano Energy & Environment Technology with Tsinghua University. This research center focuses on micron/nano technologies for clean energy and environment remediation.

The (proposed) director of the centre is Associate Professor Qinghai Li from the Department of Thermal Energy at Tsinghua University, and the Lead Researcher from the University of Waterloo is Professor Zhongchao Tan from the Department of Mechanical and Mechatronics Engineering. Other WIN members who are contributing to the expertise of the joint centre include: Zhongwei Chen (ChE); Siva Sivoththaman (ECE); Flora Ng (ChE); Kyle Daun (MME); John Wen (MME). The University of Waterloo has committed to $200,000 CAD in funding to the operation of the joint centre, with a contribution from WIN of $10,000 over three years.

Tsien Excellent in Engineering Program (TEEP+)

The TEEP+ Summer School is co-organized by TEEP and the Center for Micro and Nano Mechanics (CMMNM) at Tsinghua University. The theme for the 2018 Summer School is "Nano-X Innovation for Sustainability" with the following themes: Nano-mechanics for sustain ability; Nano-optics for sustainabili ty; Nano-biotechnology for sustain ability; and Nano-AI for sustainabili ty. WIN researchers were invited to participate in the TEEP+ event, to help develop a dedicated program for student-led innovation. Several WIN members will travel to Tsinghua University in July to participate in this educational program.

National Center for Nanoscience and Technology

WIN is fortunate to have China represented on its International Scientific Advisory Board (ISAB) by Dr Chen Wang, Director General of National Center for Nanoscience and Technology.

Dr. Bai Chunli, President of the Chinese Academy of Sciences, who also delivered a WIN Distinguished Lecture in June 2017, nominated Dr. Chen Wang.

It's WIN vision to be a global centre of excellence in nanotechnology and its applications.

International

Continued

Germany

The Centre for NanoIntegration Duisburg-Essen (CENIDE)

In June 2017, a delegation of 12 WIN members and staff attended a workshop in advanced nanomaterials for energy & environment, nanobiosystems & technology, and nanodevice and tool design at the Centre for NanoIntegration University of Duisburg-Essen (CENIDE). The workshop was designed to bring together leading talents in this research area, which resulted in new collaborations and strengthened existing partnerships. A Second Reciprocal WIN-CENIDE Workshop in smart & functional materials for energy application and device design is planned for June 2018 at UW, with technical presentations, poster and networking sessions planned. There will also be a full afternoon session dedicated to the DFG-IRTG/NSERC-CREATE joint proposal on "Hybrid-architectures of 2D materials with interface-controlled functionality" for graduate student training programs in this field.

Japan

National Institute for Materials Science (NIMS)

In November 2017 and January 2018, WIN Executive Director, Sushanta Mitra travelled to Japan to meet with lead researchers at the National Institute for Materials Science (NIMS) and to discuss the NIMS Collaborative Joint PhD Program designed to sponsor UW doctoral students to conduct research for 6 to 12 months at a research laboratory at NIMS. The MoU is near finalization, with plans for signing ceremony set for June 2018 to implement program for the 2018-19 academic year.

NIMS President, Dr Kazuhito Hashimoto, has accepted an invitation to serve as a Members of WIN's International Scientific Advisory Board, and will take part in WIN's 10th year anniversary celebrations in June 2018.

United Kingdom

University of Cambridge

Following the WIN-Cambridge workshop in Advanced materials for Energy and Healthcare held at the University of Cambridge in July 2016, a WIN-Cambridge Seminar Series has been implemented to support collaboration and foster joint research initiatives. The first academic exchange occurred in March 2017 when Professor Arokia Nathan visited UW, for a presentation as part of the WIN Distinguished Lecture Series titled, "Transparent & Flexible Oxide Nanoelectronics".

The second WIN-Cambridge exchange occurred in January 2018, when WIN member Prof Juewen Liu travelled to Cambridge to give a seminar, "DNA & Nanomaterials as Enzyme Mimics" and meet with prominent University of Cambridge researchers in both the Department of Bioengineering and the Department of Chemistry.

The third academic exchange in June 2018 invites Sir Mark Welland, Head of the Electrical Engineering Department to UW for a Distinguished Lecture. WIN also welcomes Sir Welland as a new member of the International Scientific Advisory Board (ISAB).

Taiwan

National Chiao Tung University (NCTU) and Centre for Micro/Nanoscience & Technolog (CMNST)

NCKU CMNST collaboration and renewal: WIN Executive Director, Sushanta Mitra, travelled to Taiwan in April 2018 to meet with research partners at National Taiwan University (NTU), National Chiao Tung University (NCTU) and National Cheng Kung University (NCKU). At NCKU, Dr Mitra met with Prof Ingann Chen, Director of the Centre for Micro/Nanoscience & Technology (CMNST) to discuss continuation of the WIN-NCKU partnership and MoU renewal. A workshop between WIN and CMNST is planned for late 2018 or early 2019 in advances in connected devices and other areas of mutual research strength and interest.

Mitacs Memorandum of Understanding (MoU)

Indian Institutes of Technology

In September 2017, WIN Executive Director, Dr 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 will sponsor 10 UW student placements at Indian-based start-up companies and 5 Indian Institutes of Technology-based students to work at WIN research labs for commericialization and technology-transfer training. The 12-24 week program is to accept its first students in September 2018.

India

National Chiao Tung University (NCTU) and Centre for Micro/Nanoscience & Technolog (CMNST)

Canadian researchers are pushing the boundaries of technological innovation. However, with a relatively small population, the North American market cannot sustain growth. Looking east, with the large and emerging markets in South and East Asia, the partnership between Canadian research institutes and India is strategic and beneficial for both sides. Along with WIN's vision to partner with the best science and technology institutes in the world, planned partnerships with the prestigious Indian Institutes of Technology system and other distinguished universities are advantageous and promising. Discussions are currently under way to revitalize the WIN-India partnerships and foster new relationships within the coming year, specifically with IITKharagpur, IIT-Delhi and the University of Calcutta.

Netherlands

MESA+ Institute

WIN initiated a new partnership with the Kingdom of the Netherlands. Dr. Albert van den Berg, Scientific Director of MESA+, recently join the International Scientific Advisory Board for WIN. The Netherlands will be a central focus at WIN's International Symposium: Frontiers in Nanotechnology and Nanoscience. The Netherlands will be a central part of WIN's renewed focus on the European Union.

Life in the Mike & Ophelia Lazaridis Quantum-Nano Centre

WIN is responsible for managing the space and infrastructure on the “nano” side of the Lazaridis Centre.

Lounges
3

Students
213

Meeting Rooms
3

Student Offices
41

Laboratories
50

Seminar Room
1

Kitchens
4

Roof-top Patio
1

The Quantum Nanofab

323 lab members (users) have been registered under 74 individual Principle Investigators (since 2014)

187 individual nanofabrication-based research projects have been registered (since 2014)

Fiscal Year 2017/18:

Continued substantial growth in facility use: a total of over 21,000 hours of equipment use was invoiced for the year, representing a year-over-year growth of 94% (a new record)

836 hours of hands-on equipment training logged by Quantum NanoFab Staff.

118 active lab members under 48 Principle Investigators

10 of 48 active PI's are external to UW:

- 5 from other academic institutions
- 4 from industry
- 1 government (NRC Ottawa)

Inaugural meeting of the Quantum NanoFab Users Advisory Committee held in December 2017.

Substantial investments from CFREF-TQT grant: multiple new equipment installations completed this past fiscal year including:

- Heidelberg MLA150 Maskless Aligner system
- JEOL JSM 7200F Scanning Electron Microscope
- Evaporator from Angstrom Engineering dedicated to p-type ohmic contact formation
- Tousimis Autosamdri 815B Critical Point Dryer
- Bruker Dimension FastScan Scanning Probe Microscope
  Bruker DektakXT Stylus profilometer
- Bruker Contour GT Elite 3D Optical Metrology system
- Novascan & Bioforce Nanosciences UV/Ozone cleaning systems: 1 for QNC & 1 for RAC1
- Plasma Etch PE-50 O2/Ar plasma cleaning system
- Accessories for JEOL JBX 6300FS 100kV EBL system including mul tiple substrate cassettes and a pre-alignment microscope

Lab infrastructure remains stable and in excellent condition thanks to continued oversight by UW Plant Operations Maintenance group

Inaugural Lab User survey completed in June 2017 suggests widespread appreciation and satisfaction with Quantum NanoFab infrastructure and staff.

The Nano Metrology Facility

The Metrology Facility occupies 9000 sq feet on the floor below the quantum nanofab. WIN and IQC members and graduate students use the equipment for a cost recovery access fee. To expand the use of the Zeiss Libra 200MC electron microscope in 2017, a Senior Microscopist and Staff Scientist was hired to provide dedicated service and support to stakeholders in the QNC.

Zeiss Libra 200 MC STEM

Zeiss Auriga FIB-SEM

Zeiss GeminiSEM FE-SEM

Pacific Nanotechnology, Inc.
Nano-R AFM

PANaltyical X'Pert Pro
high-resolution MRD

Anton Paar SAXSess

Quantum Design MPMS-3 SQUID VSM

Our People


Andrei Sazonov


Anna Klinkova


Armaghan Salehian


Bo Cui


Boxin Zhao


Carolyn Ren


Chris Backhouse


David Cory


David Hawthorn


Dayan Ban


Derek Schipper


Dongqing Li


Eihad Abdel-Rahman


Elizabeth Meiring


Emmanuel Ho


Eric Prouzet


Evelyn Yim


Flora Ng


Garry Rempel


German Sciaini


Graham Murphy


Guo-Xing Miao


Hamed Majedi


Hany Aziz


Holger Kleinke


Irene Goldthorpe


James Forrest


Jan Kycia


Janusz Pawliszyn


Jean Duhamel


Jeff Gostick


John Honek


John Wen


John Yeow


Jonathan Baugh


Juewen Liu


Karim Karim


Kevin Musselman


Kyle Daun


Lan Wei

Leonardo Simon

Linda Nazar

Luis Ricardez-Sandoval

Marc Aucoin

Marianna Foldvari

Mario Gauthier

Mark Matsen

Melanie Campbell

Michael Pope

Michael Tam

Michel Gingras

Moira Glerum

Mustafa Yavuz

Na Young Kim

Nasser Abukhdeir

Norman Zhou

Patricia Nieva

Pavle Radovanovic

Peter Levine

Pierre-Nicolas Roy

Pu Chen

Raafat Mansour

Raffi Budakian

Robert Varin

Roderick Slaveev

Rodney Smith

Russell Thompson

Scott Taylor

Shahrzad Esmaeili

Shawn Wettig

Shirley Tang

Simarjeet Saini

Siva Sivoththaman

Sushanta Mitra

Ting Tsui

Tong Leung

Vassili Karanassios

Vivek Maheshwari

Our People

Continued


William Wong


Xianguo Li


Xiaosong Wang


Youngki Yoon


Yuning Li


Zbig Wasilewski


Zhongchao Tan


Zhongwei Chen

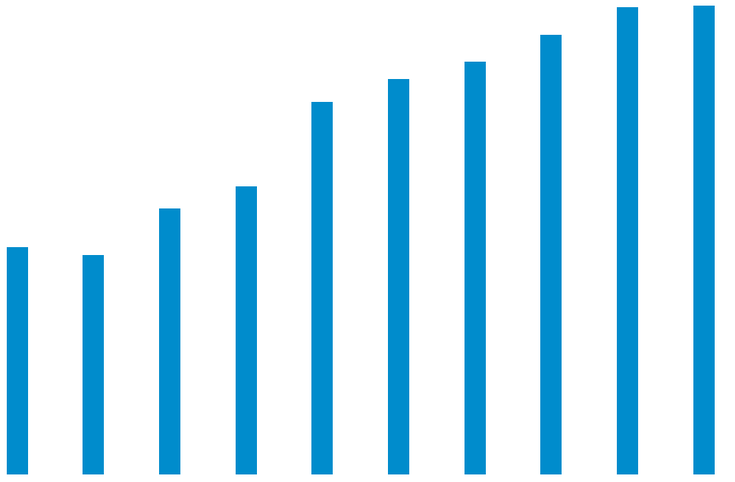

Zoran Miskovic


Zoya Leonenko

Scholarly Output

Category Normalized Citation Impact (CNCI) in 2017: 1.45
Journal Normalized Citation Impact (JNCI) in 2017: 1.04
CNCI cumulative (2008-2017): 1.42
JNCI cumulative (2008-2017): 1.12

Year
Per Year
Cumulative



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Per Year	**269**	**260**	**315**	**341**	**441**	**468**	**489**	**521**	**553**	**554**
Cumulative	269	529	844	1185	1626	2094	2583	3104	3657	4208

4,208
papers published since 2008

71,030
citations since 2008

24
papers from WIN international collaboration

554
papers published since 2016

WIN papers published in high impact factor journals* (2017)

Chemical Reviews (47.9)
Energy & Environmental Science (25.4)
Nature Physics (22.8)
Advanced Materials (19)
Advanced Energy Materials (15.2)
ACS Nano (13.3)
Journal of the American Chemical Society (13)
Nano Letters (12.7)
Nature Communications (12.1)
Angewendte Chemie- International Edition (11.7)

Most Frequently Selected Journals for WIN Papers (2017)

ACS Applied Materials Interfaces (21)
Scientific Reports (13)
Journal of Materials Chemistry A (10)
Journal of Materials Chemistry B (9)
Advanced Materials (8)
Nanoscale (8)
Analytical Chemistry (8)
Macromolecules (8)
RSC Advances (8)
ACS Nano (7)

*the impact factor of an academic journal is a measure reflecting the yearly average number of citations to recent articles published in that journal. It is frequently used as a proxy for the relative importance of a journal within its field.

Most Frequently Cited Publications

Smart & Functional Materials

Recent Advances in the Application of Cellulose Nanocrystals, Grishkewich, Nathan; Mohammed, Nishil; Tang, Juntao; **Tam, Kam Chiu** CURRENT OPINION IN COLLOID & INTERFACE SCIENCE, V 29 pp 32-45, May 2017 (24 citations).

Polymer Assemblies with Nanostructure-Correlated Aggregation-Induced Emission, Huo, Meng; Ye, Qiquan; Che, Hailong; **Wang, Xiaosong;** Wei, Yen; Yuan, Jinying. MACROMOLECULES, V50 I3 pp 1126-1133, Feb 2017 (50 citations).

Connected Devices

Ultrastrong coupling of a single artificial atom to an electromagnetic continuum in the nonperturbative regime, Forn-Diaz, P; Garcia-Ripoll, J J; Peropadre, B; Orgiazzi, JL; Yurtalan, MA; Belyansky, R; Wilson, CM; **Lupascu, A.** NATURE PHYSICS, V13 I1 pp39-43, Jan 2017 (70 citations).

Degradation Mechanisms in Organic Light-Emitting Diodes with Polyethylenimine as a Solution-Processed Electron Injection Layer. Stolz, Sebastian; Zhang, Yingjie; Lemmer, Uli; Hernandez-Sosa, Gerardo; **Aziz, Hany.** ACS APPLIED MATERIALS & INTERFACES. V9 I3 pp2776-2785, Jan 2017 (10 citations).

Recent progress in the development of n-type organic semiconductors for organic field effect transistors, Quinn, Jesse T. E.; Zhu, Jiaxin; Li, Xu; Wang, Jinliang; **Li, Yuning.** JOURNAL OF MATERIALS CHEMISTRY C , V5 I34 pp 8654-8681, Sep 2017 (10 citations).

Next Generation Energy Systems

Suppression of Dendrite Formation and Corrosion on Zinc Anode of Secondary Aqueous Batteries, Sun, Kyung E. K.; Hoang, Tuan K. A.; The Nam Long Doan; Zhu, Yan Yu Xiao; Tian, Ye; **Chen, P.** ACS APPLIED MATERIALS & INTERFACES , V9 I11 pp9681-9687, March 2017 (10 citations)

Strings of Porous Carbon Polyhedrons as Self-Standing Cathode Host for High-Energy-Density Lithium-Sulfur Batteries, Liu, Yazhi; Li, Gaoran; Fu, Jing; **Chen, Zhongwei;** Peng, Xinsheng. ANGEWANDTE CHEMIE-INTERNATIONAL EDITION, V56 I22 SI pp6176-6180, May 2017 (14 citations)

In Situ Polymer Graphenization Ingrained with Nanoporosity in a Nitrogenous Electrocatalyst Boosting the Performance of Polymer-Electrolyte-Membrane Fuel Cells, Fu, Xiaogang; Zamani, Pouyan; Choi, Ja-Yeon; Hassan, Fathy M.; Jiang, Gaopeng; Higgins, Drew C.; Zhang, Yining; Hoque, Md Ariful; **Chen, Zhongwei,** ADVANCED MATERIALS, V29 I7 Article UNSP 1604456, Feb 2017 (11 citations)

A Comprehensive Approach toward Stable Lithium-Sulfur Batteries with High Volumetric Energy Density, Pang, Quan; Liang, Xiao; Kwok, Chun Yuen; Kulisch, Joern; **Nazar, Linda F.** ADVANCED ENERGY, V7 I6, Mar 2017 (17 citations).

Interwoven MXene Nanosheet/Carbon-Nanotube Composites as Li-S Cathode Hosts, Liang, Xiao; Rangom, Yverick; Kwok, Chun Yuen; Pang, Quan; **Nazar, Linda F.** ADVANCED MATERIALS, V29 I3, Jan 2017 (40 citations).

Therapeutics & Theranostics

Biocompatibility of hydrogel-based scaffolds for tissue engineering applications, Naahidi, Sheva; Jafari, Mousa; Logan, Megan; Wang, Yujie; Yuan, Yongfang; Bae, Hojae; Dixon, Brian; **Chen, P.** BIOTECHNOLOGY ADVANCES, V35 I5 pp530-544 Oct 2017 (9 citations).

Open Port Probe Sampling Interface for the Direct Coupling of Biocompatible Solid-Phase Microextraction to Atmospheric Pressure Ionization Mass Spectrometry, Gomez-Rios, German Augusto; Liu, Chang; Tascon, Marcos; Reyes-Garces, Nathaly; Arnold, Don W.; Covey, Thomas R.; **Pawliszyn, Janusz.** ANALYTICAL CHEMISTRY, V89 I7 pp3805-3809 (19 citations).

Metal Sensing by DNA, Zhou, Wenhu; Saran, Runjhun; **Liu, Juewen.** CHEMICAL REVIEWS, V117 I12 pp8272-8325, Jun 2017 (44 citations).

Molecular Imprinting on Inorganic Nanozymes for Hundred-fold Enzyme Specificity, Zhang, Zijie; Zhang, Xiaohan; Liu, Biwu; **Liu, Juewen.** JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, V139 I15 pp5412-5419, Apr 2017 (29 citations).

Surface modification of nanozymes, Liu, Biwu; **Liu, Juewen.** NANO RESEARCH. V10 I4 pp1125-1148, Apr 2017 (31 citations).

Scholarly Talks

15
seminars

3
distinguished lectures

2
innovation seminars

1
indsutry seminar

The WIN Distinguished Lectures and Seminar Series provide an opportunity for faculty and students to meet and interact with nanotechnology experts around the world, and drive research collaborations.

Distinguished Lectures

Dr. Philip Kim	Harvard University	Physics on the frontier of quantum: experimenting at the nanoscale
Dr. Joanna Aizenberg	Harvard University	New bio-inspired materials: when nanotechnology meets chemistry, optics and surface science
Dr. Zhong Lin (Z.L.) Wang	Georgia Institute of Technology	From Maxwell's Displacement Current to Nanogenerator Driven Self-Powered Senors and Systems

WIN Seminars

Dr. Stanley Whittingham	State University of New York	The Ultimate Limits of Intercalation Reactions for Li-Batteries
Dr. Don Siegel	University of Michigan	Atomic Scale Modeling of Solid Electrolytes: Mechanical Properties and Beyond
Dr. Harald Hillebrecht	University of Frieburg	Inorganic Energy Materials-Contributions from Solid State Chemistry
Dr. Hirotomo Nishihara	Tohoku University	Design and development of functional porous materials
Dr. Andy (Xueliang) Sun	University of Western Ontario	Nanostructured Materials for Energy Conversion and Storage
Dr. Hao Zeng	University of Buffalo	Chalcogenide Compounds- A Magical Class of Functional Materials
Dr. Itaru Kamiya	Toyota Technological Institute	Epitaxial Growth and Characterization of InAsbased Structures on GaAs
Dr. Warren Jackson	Xeroc PARC	Self Aligned Imprint Lithography
Dr. Jean-Pierre Landesman	McMaster University	Investigations on some side effects and defect formation during plasma etching of nanostructures using III-V semiconductors
Dr. Jun Yang	University of Western Ontario	Conductive Bacterial Nanowires: Fundamentals and Applications for Environment and Energy
Dr. Philip Klipstein	Antimonide Based Compound Semiconductor Research program (ABCS), Semiconductor Devices (SCD)	Nanostructured Materials for Energy Conversion and Storage
Dr. Wei Lu	University of Michigan	Memory and Computing Systems Based on Reconfigurable Materials: Merging Electronics with Ionics
Dr. Catherine Murphy	University of Illinois at Urbana-Champaign	Gold Nanocrystals: Physics, Chemistry, Biology and Ecology
Dr. Bruno Ehrler	Hybrid Solar Cells Group, AMOLF	Beyond solar cell efficiency limits with down conversion and tandem solar cells
Dr. Kalaichelvi (Kalai) Saravanamuttu	McMaster University	Optochemical waves: from bio-inspired optics, 3-D printing to materials for alloptical encoding
Dr. Mikael Fogelstrom	Chalmers University of Technology	Plasmons and Sensing in Graphene Devices
Dr. Siddhartha Das	University of Maryland	Water and Ions at Nanoscopic Interfaces
Dr. Muhammad Hajj	Virginia Tech	Identification of Nonlinear Piezoelectric Coefficients

WIN Innovation Seminars

Dr. Amit Goyal and Dr. Thomas Thundat	SUNY-UB, University of Buffalo	University of Buffalo's RENEW Institute
Dr. Patricio Mendez	University of Alberta	Moving Heat Sources in Welding and Additive Manufacturing

WIN Industry Seminars

Dr. Jamal Zeinalov	Atomic Works	Atomic Works: Molecular Dynamics and DFT hybrid simulation software platform and applications

Staff and Governance

WIN Management and Administration

Sushanta Mitra *Executive Director*
Caroline Brookes *Executive Assistant*
Lisa Pokrajac *Assistant Director, Research Programs*
Jisu Kwon *Financial & Administrative Coordinator*
Chris Kleven *QNC Faculty Technician*
Stefan Heinemann *Sr. Facility Microscopist*
Oleg Stukalov *Business Development Manager*
Matthew Rae *Communications and Events Coordinator*
Charlotte Armstrong *Operations Assistant*

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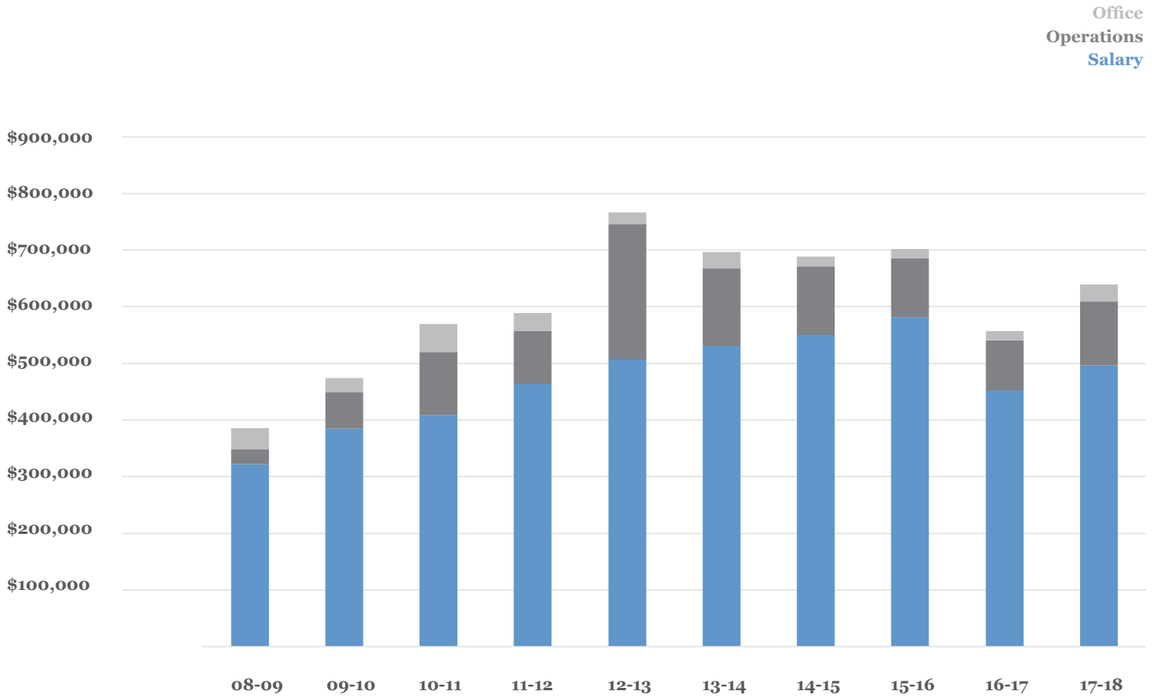
Professor, University of Cambridge, UK

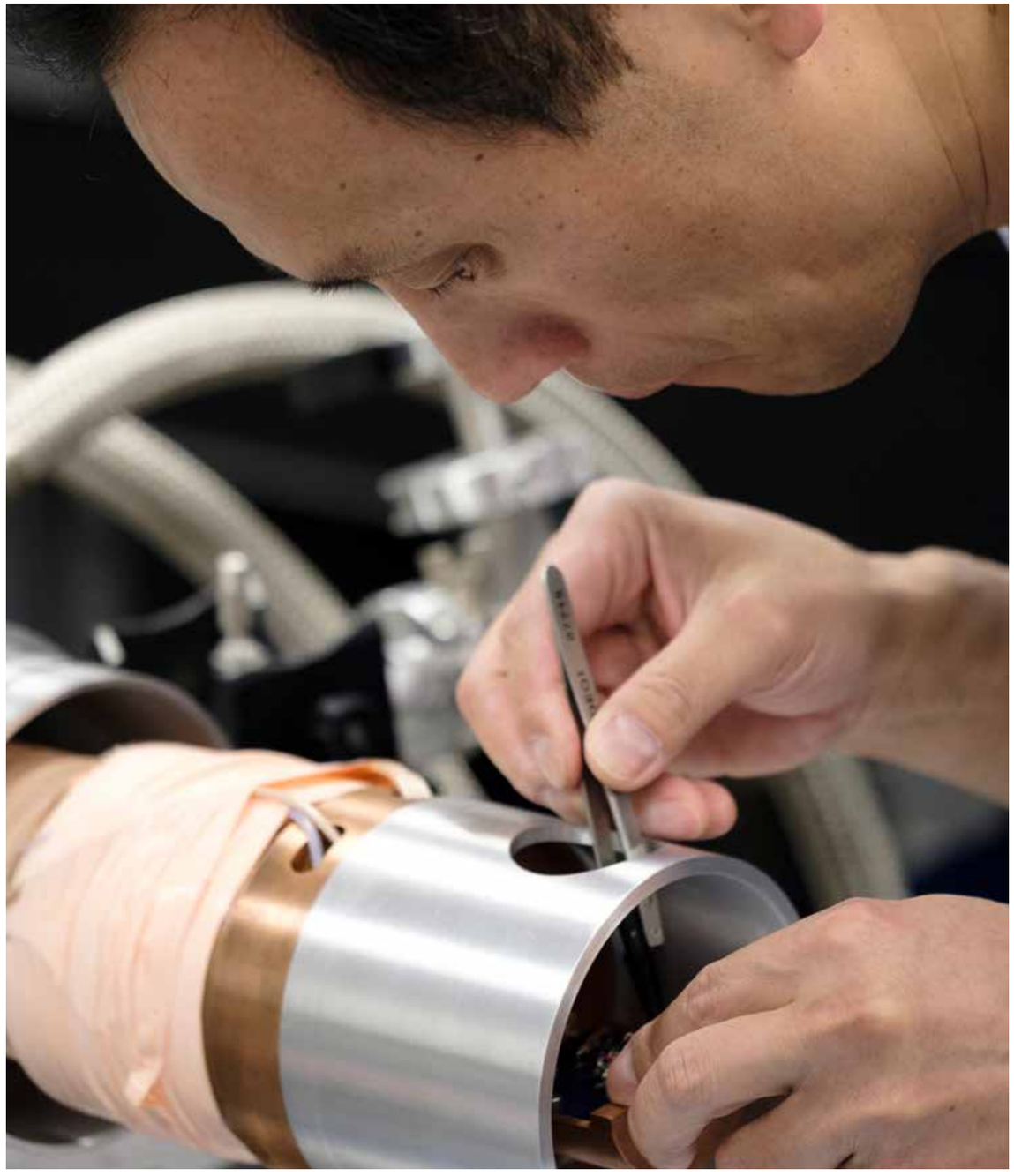
Albert van den Berg
Distinguished Professor, University of Twente and Scientific Director of MESA, Netherlands

Kazuhito Hashimoto
President, NIMS, Japan

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

By the numbers





Waterloo Institute for Nanotechnology
Mike and Ophelia Lazaridis Quantum-Nano Centre
200 University Ave W Waterloo ON Canada N2L 3G1

nano.uwaterloo.ca
519-888-4567

Facebook: uwnano
Twitter: WINano

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