78 Faculty Members

20 Research Chairholders

3 Faculties

9 Departments

240 (2014-2015) nanofellowships awarded

7 rounds of nanofellowships competitions

40 nanofellowships awarded since 2008

240 nanofellowships awarded since 2008

489 publications by WIN researchers in 2014

2,583 since 2008

24,596 cumulative citations for all WIN publications since 2008

7 papers from industrial collaboration in 2014

22 papers from international collaboration in 2014
2 international workshops

- 17 international workshops since 2008
- 17 international partners in nine countries

1 distinguished lecture

54 nano graduate student seminars

18 seminars
WIN will be seven years old in June of 2015 and two years into its second five-year mandate of the Senate Research and Graduate Council.

The success of the institute is firmly etched in the record of scientific productivity, impact and stature of WIN members (78 faculty with 2,583 peer-reviewed publications and 24,596 citations since 2008; 25 members with an h-index of 25 or more).

One of the major challenges presented to WIN from its beginning was to create an environment conducive to interdisciplinary collaboration in nanotechnology, not only between researchers from the many different departments and disciplines at University of Waterloo, but across international boundaries. Although there is still much to be done in this regard, figures for the numbers of collaborative publications involving WIN faculty (49 in 2014 alone) and WIN faculty with external collaborators (29 papers in 2014) provides compelling evidence that collaboration is active and growing.

Another first for WIN and its graduate student community in 2014 was the formation of a Graduate Student Society, WINGSS, to stimulate greater interaction and engagement between nanotechnology graduate students in the QNC building. WINGSS has been a great success holding several well-attended events over the year.

The 2014-15 year will be remembered as the first year when facilities and systems were fully operational in QNC. Common facilities (Quantum NanoFab and Metrology) shared by IQC and WIN were functional, laboratory renovations essentially complete and nano-space in QNC is 95 per cent occupied. This could not have been achieved without the dedication and hard work of WIN staff over the past two years.

With all systems go in QNC, WIN is poised for the most productive and exacting period in its short existence, as it achieves its vision to be a global centre of excellence for nanotechnology and its applications.

Dr. Arthur J. Carty
vision

A Global Centre of Excellence for Nanotechnology and its Applications

mission and objectives

1. Research, technology development and innovation in key theme areas of nanotechnology
2. Stimulate recruitment and retention of the best and brightest research talent
3. Facilitate multidisciplinary research and collaboration
4. Partner with leading universities in nanotechnology around the world
5. Foster industry partnerships and commercialization
6. Creative stewardship and management of nano facilities/research in the Mike & Ophelia Lazaridis Quantum-Nano Centre
WIN was founded on four principal research areas. NanoMaterials; NanoElectronics; NanoBioSystems; and NanoInstrumentation. From these four pillars, several focussed research groups emerged with world class strengths in energy and sustainable materials; devices and fabrication; nanomedicine and targeted delivery; photonics and optics; and metrology and manufacturing.

Today, we still have these four foundational pillars, and several new strategic orientations in the area of Sustainable Nanomaterials; Biosensors for Detection and Analysis of Disease; Quantum Electronics and Materials; and Energy Harvesting, Storage and Conversion. These interdisciplinary thrusts are born in WIN labs; grown through international collaboration and matured by industrial engagement and support.

“Innovation happens at the interface of traditional disciplines.”
Nanotechnology is sometimes referred to as, “building structures at a scale the way nature does.” Incorporating natural, renewable materials as the fundamental building blocks of engineered structures can lead to cheaper, stronger, greener solutions for industry.

WIN members already have a proven track record in engineering using sustainable nanomaterials from renewable sources. Dr. Leonardo Simon is a recognized leader – incorporating wheat straw into plastic car parts with Ford Motor Company. Drs. Duhamel, Gauthier, Taylor and Liu collaborate with Ecosynthetix Inc., a producer of starch-based BioLatex® to replace petroleum-based binding agents in the paper industry.

This past year has seen new stars emerge in sustainable materials, and grow international collaborations. Dr. Michael Tam is not new to international research. A University Research Chair, Professor Tam of Chemical Engineering participates in international workshops around the world, including three Canada-Brazil Nanotechnology workshops. With more than 250 international journal articles, Tam is a recognized expert in functional colloids and nano materials. Tam has industrial research partnerships with Celluforce, FP Innovations, PetroChina and Shlumberger.

This year, Tam became the lead PI in a $1M NSERC CRD grant entitled, “Advanced Sustainable Materials Derived from Agro- and Hardwood-based Feedstocks.” This bilateral Canada-Brazil research collaboration involves the Canadian Team of EcoSynthetix and WIN researchers Michael Tam, Leonardo Simon and Boxin Zhao; and the Brazilian Team at Suzano Pulp and Paper, Universidade Federal de Viçosa (UFV) and the Nanotechnology National Laboratory in Brazil. The objective is to utilize biobased raw materials instead of non-sustainable petroleum-based feedstocks. The underlying strategy is to recombine the properties of nature’s most abundantly produced biopolymers, cellulose, starch and lignin to develop advanced sustainable materials to enhance material properties and produce new renewable products.

...“building structures at a scale the way nature does.”
thrust 1

ADVANCED POLYMERS:
SUSTAINABLE NANOMATERIALS

Leonardo Simon, Michael Tam, Boxin Zhao
SHIRLEY TANG  CNT’S USED TO DETECT PATHOGENS IN WATER

Shirley Tang is one busy person. She is the Director of the Nanotechnology Engineering Undergraduate program. With almost 500 students and over 50 dedicated Nano courses and labs she runs the largest nanotechnology undergraduate program in North America.

And she still has time to work on research that saves lives in other parts of the world. Tang was the recipient of a $100,000 Grand Challenges Award for a handy device for rapid screening of diarrheal pathogens in water. The aim is to save lives in countries without adequate public health infrastructure by providing individuals an easy-to-use tool to check water contamination prior to consumption.

The device contains three components: a porous membrane for large contaminant filtration; receptor molecules to capture specific pathogens; and a highly sensitive thin-film of carbon nanotubes to detect the pathogens. The genius is using basic, conventional silk-screening techniques to pattern the CNT electrodes onto low cost paper for use as test strips to monitor the water.

JOHN YEOW  LAB-ON-A-CHIP DEVICES AND ULTRASONIC IMAGING

As Canada Research Chair in Micro and Nanodevices, John Yeow develops nanodevices (machines that work on a molecular level) and highly selective sensors that create new medical instruments for diagnosing and treating disease. His team has world-class expertise in ultrasonic transducers for imaging and nanomaterial-based sensors for biomedical applications.

In 2014, Yeow spent part of a sabbatical at Soochow University, China, a partnership pioneered by WIN. He worked with his collaborator Dr. Jeff Sun, to commercialize an ultrasonic non-destructive testing system in the Suzhou Industrial Park. But this is not the first time Yeow has conducted research and commercialized it through international collaboration. Yeow previously leveraged a WIN visit to Bigtec Labs Inc. in Bangalore, India, securing a $1.3M Grand Challenges award for a Lab-On-A-Chip device where a faint trace of analyte is concentrated on the tip of a MEMS cantilever.

Yeow is the Editor-in-Chief of IEEE Nano Magazine and has been inducted as a Fellow of the Engineering Institute of Canada.
thrust 2
BIO SENSORS, BIODEVICES
FOR DETECTION AND
ANALYSIS OF DISEASES

Karim Karim, Shirley Tang, John Yeow
JONATHAN BAUGH  BUILDING COMPUTERS WITH ARTIFICIAL ATOMS

The structure of quantum mechanics tells us that even a modest number of quantum bits (qubits) can store a tremendous amount of information. For example, the information that can be stored in 100 qubits compared to a single qubit is equivalent to the scale of the observable universe compared to the thickness of a sheet of paper!

Quantum mechanical properties such as superposition and entanglement emerge at the nanoscale. Jonathan Baugh is trying to harness these strange effects for advanced computing and sensing applications.

“We’re working on devices where one qubit is on a scale of about 30 nm, which can ultimately lead to a much higher density of qubits on a chip than other approaches.”

It has been suggested that once you have a working processor with even 30 or 40 qubits, you can outperform the most powerful classical computers in the world on certain problems, like simulating quantum chemistry.

“As we scale up to 100 or 1000 qubits and consider the enormous amount of information that is being stored, no one yet knows how to build or test such a system. And that’s a problem that is actually being worked on here in the QNC.”

Baugh is building artificial atoms on a semiconductor chip. One of the challenges is that each fabricated atom is imperfect, so he must improve reproducibility of the ‘atoms’ and also learn how to compensate for small differences in their control parameters.

And there is a lot of interesting physics on the way to these solutions. “When we build new devices, we see new physics. And we study it so that we can see how to harness it and apply it to quantum computing, quantum sensing, and advanced classical devices.”

What’s attractive about Baugh’s approach to developing solid-state quantum devices is a sense of inherent scalability, as it builds on the experience of the semiconductor electronics industry. This approach is also poised to benefit from the use of novel nanomaterials such as nanowires, carbon nanotubes, graphene and epitaxial heterostructures.

RAFFI BUDAKIAN  WIN/IQC NANOTECHNOLOGY ENDOWED CHAIR IN SUPERCONDUCTIVITY

Dr. Raffi Budakian came to Waterloo for one reason. To design and build ultra-sensitive instruments that allow us to look at nature in fundamentally new ways. Budakian is an expert in magnetic resonance force microscopy (MRFM), a technique that can image structures at the atomic scale.

“You can make slice-by-slice images of very tiny things without destroying them, and you can get chemical information by learning what the atoms are inside and how they’re arranged.”

The key is to detect a single electron spin, which can be as deep as 100 nm below the sample surface. “We just need to detect forces: if we can measure the magnetic field, we can know its spin. Specifically, a sample is placed on a tiny cantilever which is passed over a magnetic resonance device to encode the spins. The movement of the cantilever gives us the measurement.

The research challenge is nanoengineering an instrument small enough, and precise enough, to make these measurements. At the nanoscale, Budakian actually “grows” his instruments. He places tiny gold particle catalysts on a silicon surface and heats them up in a furnace with Silane gas, which contains silicon that bonds to the gold. The catalyst reacts; the silicon binds; and eventually a silicon rod is standing tall on the surface. The rod is about 50 nanometers across and 20 microns long and will serve as the cantilever. A molecule of what we want to interact is attached to the tip of this rod and is brought near an object that generates the magnetic field gradient and resonance. From that, we get our measurements and then our image.”

What is really exciting is that advances in nanotechnology can’t proceed without the tools to see and engineer new materials and devices at the nanoscale. And we are growing these tools, right in our lab.
thrust 3
QUANTUM ELECTRONICS/PHOTONICS
MOLECULAR BEAM EPITAXY (MBE)
PAVLE RADOVANOVIC  NANO-LIGHTING: LIFE BEYOND THE INCANDESCENT BULB

Dr. Pavle Radovanovic, Canada Research Chair in Spectroscopy of Nanoscale Materials, is examining how nanomaterials are used to produce new energy-efficient materials for lighting.

The incandescent light bulb is one of the technologies that has survived since Thomas Edison first invented it over 100 years ago. But, they are very inefficient, using only 5 per cent of the energy for lighting while the rest is lost as heat. Compact Fluorescent Lamps (CFL) and Light-Emitting-Diodes (LED) are more efficient, but they are expensive and emit a cool blue hue that hinders the adoption of the technology by the masses.

“Nano-lighting” is based on chemically modified nanoparticles that emit light. Radovanovic and his team discovered a method to attach organic chromophores to gallium oxide nanoparticles such that they are electronically coupled and behave as one entity. Furthermore, the colour of the emitted white light can be “tuned” based on the size of the nanoparticle, producing that warm, pleasant glow. And the cost-manufacturing model is simple as the basic materials are widely available and can be dispersed in solution and spray-coated during the LED production process.

The result is an easier-to-produce LED bulb that is pleasing to the eye and would be less expensive to consumers. His lab is spinning off a company to commercialize the science, seeking Venture Capital investment and partnering with top OEM lighting manufacturers.

ZHONGWEI CHEN  ADVANCED NANOSTRUCTURED MATERIALS FOR NEXT GENERATION BATTERIES

One of the great challenges in the twenty-first century is undoubtedly energy generation and storage. One area of promise is the development of next-generation rechargeable batteries with low environmental impact and low cost that enables adoption by society. The performance of these batteries strongly depends on the properties of materials.

Metal-air batteries have extremely high energy density and are lightweight because oxygen in ambient air is used as the primary source of fuel. Dr. Zhongwei Chen is developing novel bi-functional catalysts capable of catalyzing both the oxygen reduction (battery discharge) and oxygen evolution (battery recharge) reactions to create rechargeable zinc-air batteries. These batteries boast energy storage densities five to ten times higher than conventional lithium-ion batteries and show strong potential to revolutionize energy storage for automobiles, portable electronics, and grid-scale applications.

Professor Zhongwei Chen has gained global recognition as a pioneer in nanostructured materials development for fuel cell and rechargeable metal-air battery technologies, most notably for his work developing platinum alloy, heteroatom doped carbon nanotube and graphene based catalysts. These advanced nanostructures and materials are developed by chemical vapour deposition, microwave irradiation assisted growth, and wet-chemistry techniques and characterized by scanning and transmission electron microscopy, x-ray diffraction, x-ray photoelectron spectroscopy and Raman spectroscopy.

Chen has partnered with industry, including Ballard Power Systems, General Motors, and Hydro One to accelerate translation of his battery technologies into next generation electric vehicles and smart grids, and his fuel cell innovations into automotive and telecommunications power backup applications.
GLOBAL IMPACT

In 2014, WIN members produced 22 papers with our international partners.

WIN is working towards realizing its vision to be “A Global Centre of Excellence for Nanotechnology and its Applications” by collaborating with world-renowned institutions in nanotechnology. International collaboration engages WIN members and accelerates breakthroughs in research and commercialization.

INDIA STRONG PRESENCE AT THE COMMONWEALTH SCIENCE CONFERENCE (CSC) IN BANGALORE, INDIA, NOVEMBER 25-28, 2014

The first Commonwealth Science Conference (CSC) in nearly 50 years was hosted by the Royal Society of London and the Government of India with the goals of celebrating excellence in Commonwealth science, fostering international cooperation and inspiring young scientists. The conference attracted more than 370 participants from 30 countries. WIN had a strong presence at the CSC with five members specially invited to make up the Canadian contingent, and three members having speaking roles.

WIN Executive Director Dr Arthur Carty served on the Steering Committee and acted as convenor for the Canadian contingent. He provided an overview of “Science in Canada”.

Dr Linda Nazar, Chemistry Professor and Canada Research Chair in Solid State Materials gave a Plenary Lecture on “Electrochemical Energy Storage and Climate Change”.

Mohit Verma, Nanotechnology PhD student and WIN Nanofellowship recipient, won a prize for his poster entitled “Detecting Bacteria using a “Chemical Nose” Biosensor based on Gold Nanoparticles”.

BRAZIL

WIN and Brazil’s Ministry of Science, Technology and Innovation (MCTI) hosted the third Brazil-Canada Nanotechnology Workshop on Sustainable Nanomaterials in Belo Horizonte, Brazil in May 2014. Over 85 researchers, industry and government representatives from Canada and Brazil attended the workshop. WIN members in attendance were Mario Gauthier, Leonardo Simon, Michael Tam, Scott Taylor and Boxin Zhao, accompanied by WIN Executive Director Arthur Carty and Managing Director Alain Francq.

The workshop resulted in a proposed 2+2 Brazil-Canada Academic-Industry partnership between two top nanotechnology institutes (Brazilian Nanotechnology National Laboratory (LNNano)/CNPEM and WIN) and two leading industrial companies in sustainable nanomaterials (EcoSynthetix (Canada) and Suzano (Brazil)). A novel $2M per year research program was developed and submitted to the respective countries to fund industry research collaboration on both sides.

WIN participates in scholarly exchanges and visits with LNNano/CNPEM to strengthen ties and enhance collaboration. WIN invited Dr Christoph Deneke and Dr Carlos Cesar Bufon of LNNano to deliver a WIN seminar in March and May 2015, respectively.
FRANCE

Building on the successful partnership between WIN and University of Bordeaux, the University of Waterloo hosted a Waterloo-Bordeaux workshop on May 19-22, 2014 to broaden the collaboration across the universities. In addition to new themes in health, water and energy, a third workshop in Nanotechnology and Functional Materials was held. The workshop was attended by 30 University of Bordeaux faculty and students, and featured 15 presentations showcasing the results and progress of the IDS-FunMat joint research projects. The workshop outlined new areas for collaboration including sustainable nanomaterials; new inorganic materials for solar photovoltaics; next generation lighting; and bio-sensors, bio-devices for the detection and diagnosis of diseases in the developing world.

ISRAEL

The University of Waterloo and Technion-Israel Institute of Technology signed a partnership agreement in March 2014 to accelerate research and commercialization in the key areas of quantum information science, nanotechnology and water. A $1.6-million gift by The Gerald Schwartz and Heather Reisman Foundation in 2015 will help advance collaboration between two of the world’s top innovation universities. Ten University of Waterloo-Technion projects in total were awarded funding, eight of which were by WIN members.

UNITED KINGDOM

A University of Bristol-WIN workshop in Nanotechnology and Quantum Information will be held in the Quantum-Nano Centre on June 15-16, 2015. Led by WIN member, Dr Zoya Leonenko, the workshop will bring together lead researchers from the University of Bristol and University of Waterloo to initiate collaboration. University of Bristol and University of Waterloo share similar objectives in the priority areas of nanotechnology and quantum information research.

ASIA

WIN’s partners in China, Japan and Taiwan continue to drive WIN toward achieving its vision across the Asia-Pacific Region. WIN will host a WIN-Taiwan workshop in the QNC in August 2015 to foster new joint projects and grow existing partnership. In China, WIN member, Dr John Yeow, spent one year at Soochow University as an adjunct professor and conducting research with his collaborator at Soochow University, Dr Xuhui Sun. In Canada, a team of five Soochow University administrators was housed in the QNC for ten months to learn best practices at the University of Waterloo.

“WIN has been a CATALYST for numerous research partnerships”

— MICHAEL TAM, WIN Member, University Research Chair

*More stories on the WIN international collaboration available in the WIN International Booklet: uwaterloo.ca/institute-nanotechnology/partnership-and-collaboration/international
Nano startup companies are “started” by nano students in the Quantum Nano Centre. They begin as early as first year and often formalize into 4th year design team projects. WIN members are often supervisors of these student teams and offer advice, access to their labs and encouragement to commercialize the intellectual property. If a company is formed, it needs specific cultivation and support to survive and flourish.

The University of Waterloo and the Waterloo Region start-up ecosystem provides fledgling companies with world-class business incubation advice and acceleration services, including access to space, mentoring and capital. However, that is not enough for nanotechnology start-ups.

WIN’s Entrepreneurial Support Program facilitates access to nanotechnology researchers, specialized facilities and potential nanotechnology employees that are critical for the early stage R and D phase. Additionally, WIN provides introduction to nano-specific networks (NanoOntario, NanoCanada), social media audiences and promotion; as well as connectivity to nano-specific VC, IP and international research partners.

Here are a few examples from this year’s Nanotechnology Start-Up Community.
“We created Suncayr to solve the problem of not knowing when to reapply sunscreen.”

Suncayr Inc. was founded by four University of Waterloo nanotechnology undergraduate students. The company designs a UV-Sensitive ink that when applied to the skin will change colour in the sun, letting you know when to re-apply sunscreen.

The company has won an impressive list of early start-up and design awards. The Norman Esch Award, Baylis Medical Award, Google 40 Forward Contest and most recently the team was runner-up in the International James Dyson Award which received hundreds of entries from 18 countries.

“We know we wouldn’t have been able to make it this far, especially with the advice and mentorship provided by the Waterloo Institute for Nanotechnology.” Andrew Martinko.

Qidni Labs Inc. was founded by WIN Nanofellowship winner, Dr. Morteza Ahmadi.

“Currently we are working on a new nano-filtration technology that allows us to build highly-robust filters with pores as small as five nanometers. That way, we get better selectivity on the molecules.” Ahmadi said.

A dialysis machine tries to mimic a human kidney by removing certain salts and waste products from the blood using porous membranes. Qidni Labs developed a dialyzer using nanotechnology. The pores on the kidney are 7.2 nanometres (or 7.2 billionths of a metre).

The Canadian Space Agency recently awarded the company a $200,000 grant to work on a prototype to filter fluids in space including engine fuel, coolant, radar cooling systems and odor/bacteria/virus removal from water and air. The proposed nano-filters are mass-producible, bio-compatible and can be assembled into any shape and size. The nano-filtration technology is a major improvement from existing filters. They are thinner, lighter, have an increased permeability and can be customized according to the application. qidni.com

NERv is developing an implantable biosensor that will give doctors early warning of infection or bleeding after surgery”

“NERv is developing an implantable biosensor that will give doctors early warning of infection or bleeding after surgery.” Youssef Helwa, CEO

NERv’s first product is a post-surgical implantable biosensor chip, designed to detect common post-operative complications such as internal bleeding, Ischaemia, inflammation, septic shocks, blood poisoning and staple line breakage. The device incorporates technologies from the field of Nanotechnology, Chemistry, BioMEMS and Circuitry.

NERv has been designed to be placed inside the body (in-vivo) at the end of the operation prior to closure ex. laparoscopies, laparotomies, cesarean section, and intestinal surgeries,etc. The chip is very small, provides instantaneous feedback and is made entirely out of bio-compatible materials. It relies on using many of the body’s biomarkers to assess the body’s condition.

“Early detection and immediate action are key to quick recovery,” says Helwa. ne-rv.com

In only its second year, NanoQuan has secured key customers and is entering the lucrative space of printable electronics. NanoQuan dispersion technology allows manufacturers to change their materials properties by incorporating micro-nano particles in liquids, plastics and rubbers. The evenly dispersed nanoparticles enable new functions (strength and conductivity) and applications (conductive inks, coatings, lubricants) for customers in electronics, construction and manufacturing. WIN is working with NanoQuan, local semiconductor manufacturers and suppliers and WIN researchers on next generation thin film electronics manufacturing. nanoquan.com
September 2, 2014 marked the official opening of the Quantum NanoFab cleanroom in its new home in the Mike & Ophelia Lazaridis Quantum-Nano Centre. Since the opening, 87 faculty graduate and post-graduate lab users have been registered and trained to use the facility. These 87 users include 26 different faculty members from five different departments spanning the faculties of Science and Engineering. Interest in accessing the facility continues to grow and a new facility access protocol was established and published to facilitate usage for both internal and external users.

In the past year the NanoFab has seen the installation of several new pieces of equipment, including:

- ion mill for etching of thin films;
- twin chamber sputter system for the physical vapour deposition;
- rapid thermal processor for high-temperature processing of 4” and 6” wafers;
- 4-tube furnace with LTO, PolySi and SiC deposition and growth capabilities
- ellipsometer, film stress measurement and a 4-point probe for characterization;
- packaging lab including wire bonders, dicing saw, die bonder and hydrogen plasma cleaner

“\textbf{This opens the lab up for certain types of research where people need to use thick resists while pushing the limits on minimum feature size.}”

\textbf{– VITO LOGUIDICE,} Director of Operations for the NanoFab

\textbf{RESEARCH HIGHLIGHT}

WIN member, Simarjeet Saini, is an active user of the NanoFab and his group is developing nanophotonics chips for trapping light using semiconductor nanowires and surface plasmonic structures. The chips have applications in energy photovoltaics, photo-thermal conversion and novel color based biosensors that will allow anyone with a cellphone to detect contaminated water immediately. Some of these technologies are being commercialized through a venture funded start-up Nanolytix.

In this SEM, gallium arsenide (GaAs) nanowires are etched using a Cr mask on a GaAs substrate demonstrating the highly anisotropic nature of the etching process. The group demonstrated diameter dependent resonant coupling of the incident light due to the excitation of transverse optical modes resulting in strong spectral absorption peaks and highly efficient photo-thermal conversion.
The Zeiss Libra 200 MC Transmission Electron Microscope features a unique in-column double-corrected Omega energy filter, Kohler illumination, and monochromator. The information limit at 200 kV is better than 0.12 nm and energy resolution at 200 kV (with mono) is better than 0.20 eV. The STEM resolution is better than 0.3 nm and a unique custom-built Bruker quad detector with ~1 sr solid angle is one of the fastest in the world.

Defect-rich Zirconium Oxide spine-like nanostructures for ultra-efficient photoelectrochemical water splitting and for spintronics applications. These ZrO₂ nanomaterials were grown by advanced catalyst-assisted pulsed laser deposition technique in WATLab to create oxygen vacancy defects for green energy and nanoelectronics applications.

Size-selected Platinum metal clusters (5 nm in size) obtained by the novel Nanogen source in WATLab. These Pt nanoclusters were generated by magnetron sputtering coupled to a quadrupole mass filter to produce the mass selection. These size-selected nanoclusters have potential applications in nanocatalysis and nanoplasmonics.
IDS-FUNMAT PROGRAM
WIN-UB (FRANCE) JOINT EDUCATION PROGRAM

The International Doctoral School in Functional Materials (IDS-FunMat) Program began in 2010, and to date 18 co-supervised PhD students have entered the program. 14 of the students are from University of Bordeaux and four are from other EU Universities. The scholarship program was initially sponsored by the Erasmus Mundus (EU) Program and by the Region of Aquitaine (France). In 2014, University of Waterloo Faculties of Engineering and Science provided full scholarships for two students in this program to match European contributions. WIN will provide funds for scholarships for the next academic year (for UB-WIN collaborations).

WIN-WARSAW (POLAND) SUMMER RESEARCH INTERNSHIP PROGRAM

Every summer, a group of graduate students from the University of Warsaw’s MISMaP program visits University of Waterloo for two months to participate in the WIN-Warsaw Summer Research Internship Program. Each student competes for a fellowship at MISMAP/UWarsaw in order to participate in this program. In July 2014, Zenata Matuszek, Dorota Sabat and Ewa Sitarska joined WIN members in the Faculty of Science working on several bionanosystems-based projects:

1. Characterization of new metal-dependent DNAzymes (Liu)
2. Microfluidic chip-based analysis of mitochondrial DNA (Glerum)
3. Biomolecular platforms for molecular recognition and new biomaterial function (Honek)

WIN-SUN (SOOCHOW, CHINA) EDUCATIONAL PROGRAMS

Dual Degree Bachelors/Masters (3+1+1) and Co-tutelle PhD (2+2) Programs

The Dual Degree Bachelors/Masters (3+1+1) was launched in September 2012, and since that time 17 students have been admitted into the program. In September 2014, six students joined WIN faculty in the Department Chemistry, and the Department Physics and Astronomy. All have been accepted to the MSc program for Fall 2015, each working on projects in Nanomaterials for Energy, Environment, and Manufacturing.

List of students in 3+1+1 program 2014-15: Hanbing Fan (Radovanovic); Liying Wang (Gauthier); Meng Xu (Nazar); Yun Wu (Tang); Na Zhou (Wang); Shipei Zhu (Cory)

Cotutelle PhD Program (2+2): Two students have applied for the University of Waterloo-Soochow PhD Co-tutelle Program, Wenbin Ji (Chemistry) and Qian Li (Systems Design Engineering).
Student Research Internship Program

In February 2015, WIN welcomed five Soochow students from the College of Nanoscience and Technology for a four-month research internship program. The students, each in their fourth-year of the BSc program at Soochow’s CNST received financial support from the China Scholarship Council, and completed their graduation thesis projects at WIN laboratories.

**Students:** Zhicheng Huang (Shirley Tang); Sida Shen (Juewen Liu); Na Sun (Tong Leung); Lulu Hu (Xiaosong Wang); Yuyan Chen (Frank Gu)

**NANOFELLOWSHIP**

WIN Nanofellowships are scholarships valued at $10,000 CAD, awarded to outstanding graduate students at University of Waterloo pursuing nanoscience and technology research. This prestigious scholarship program is designed to attract the best and brightest students within Canada and from around the world. Since 2008, WIN has held seven rounds of competitions and awarded 200 Nanofellowships. For the 2014-15 academic year, 40 Nanofellowships were awarded to students in the Faculties of Engineering and Science in six departments.

**40 Nanofellowship Winners in 2014-15:**

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<tr>
<th>Victor Chabot</th>
<th>Connor Hart</th>
<th>Timothy Leshuk</th>
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<td>Elizabeth Drolle</td>
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<td>Russel Fernandes</td>
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<td>Gordon Hall</td>
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(2014-2015) **40 nanofellowships awarded**

**7 rounds of nanofellowship competitions**

240 **nanofellowships awarded since 2008**
The WIN Distinguished Lectures and Seminar Series provide an opportunity for faculty and students to meet and interact with some of the best minds in the world.

**53 NANO GRADUATE STUDENT SEMINARS**

The WIN Nano Graduate Student Seminar Series provides an opportunity for nanotechnology graduate students of WIN members to present and discuss their research, to help foster knowledge exchange and dialogue between researchers and across disciplines.

Alexander Brukson  Erin Bedford  Limin Lu  Ripon Dey
Ali Sheikholeslam  Gordon Hall  Lina Voloshin  Robbie Henderson
Amirreza Shirani Bidabadi  Greg Holloway  Lisa Hutfluss  Robert Liang
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