NANO ONTARIO CONFERENCE 2016

November 10 & 11 | Guelph Delta Inn | NanoOntario.ca

Hosted by University of Guelph

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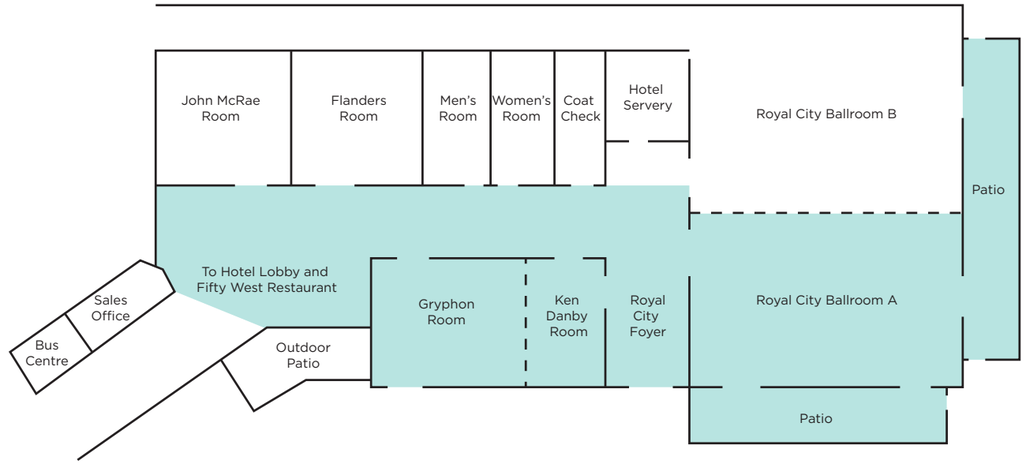
DELTA HOTEL CONFERENCE CENTRE



Oral Sessions and the Industry-Academia Panel sessions will take place in the Royal City Ballroom.
All Poster Sessions will take place in the Gryphon/Ken Danby Room.
Registration and Exhibitors will be in the Royal City Foyer.

John Dutcher is a Professor, senior Canada Research Chair, and Director of the Nanoscience program at the University of Guelph. He studies soft matter and biological physics focusing on novel biological nanoparticles and bacterial cells (www.physics.uoguelph.ca/dutcherlab). John is a Fellow of the American Physical Society, and serves on the Editorial Board of several journals. He is also a Founder of Mirexus Biotechnologies, a Guelph-based company that is commercializing natural nanoparticles discovered in his University of Guelph laboratory.

MESSAGE FROM CONFERENCE CHAIR

It is my pleasure to welcome you to the 7th Annual Nano Ontario Conference, hosted this year by the University of Guelph. This meeting provides us with the opportunity to come together to discuss the latest developments in nanoscience and nanotechnology with academic, industrial and government researchers. We have excellent keynote and invited speakers, an industry-academia panel, interactive poster sessions and an evening reception that will provide participants with excellent networking opportunities.

The themes for this year's conference are Nanobio and Sustainability, which are two very important areas for nanoscience and nanotechnology. Sustainability in energy, water, and materials is becoming increasingly important to society, and nano offers great possibilities for developing novel approaches to sustainable technologies. Biological materials and mechanisms inspire many approaches in nanoscience and nanotechnology, and this brings new fundamental understanding and a wide range of applications in industry and medicine.

The University of Guelph is deeply invested in the study of the science and technology of materials at the nanoscale. From the BSc Nanoscience undergraduate program that is the first of its kind in Canada, to the wide range of state-of-the-art research infrastructure available in the Advanced Analysis Centre and the Electrochemical Technology Centre, to leading edge nanoscience research programs in four different Colleges, the University of Guelph provides a unique environment for the study of materials at the molecular level.

I would like to thank our sponsors who have provided generous financial support for the conference.

Once again, welcome to the 2016 Nano Ontario Conference. I hope that you take full advantage of opportunities to interact with other researchers and companies at the conference, and that this leads to new research collaborations.

Dr. John Dutcher
2016 Conference Chair

MESSAGE FROM NANO ONTARIO

The 7th Annual Nano Ontario Conference, one of the key events of our year will be hosted on November 10-11th 2016 by the University of Guelph at the Delta Hotel in Guelph. The Organising Committee, chaired by Dr. John Dutcher, Canada Research Chair in Soft Matter and Biological Physics and Director of the Nanoscience Program at Guelph, has forged an exciting program around the twin themes of Nanobio and Sustainability. Four eminent keynote speakers will address topics of current interest in the theme areas, with contributed papers, an industry-academia panel, a poster session, and social events rounding out the program.

With the rapidly expanding growth of nano as an enabler of industrial and societal innovation there is an increasing need for an organisation such as Nano Ontario, an incorporated, not for profit company representing the interests of academic, industrial, government, and financial members in the safe development of nanotechnology in Ontario. Our members work together to raise the profile, increase R and D, build investment, and drive economic returns from nanotechnology in Ontario and across Canada.

In 2016, Nano Ontario continued to build on the initiative to establish a Nanotechnology Innovation Centre (NIC) in Suzhou Jiangsu Province in collaboration with Nanopolis in the Suzhou Industrial Park (SIP). The NIC, an initiative based on the Ontario-Jiangsu S and T Agreement, provides space and services to help Ontario nano companies to find partners and do business in China.

Following the successful launch of the NIC last year, Nano Ontario will have a booth at the Canadian Pavilion during the CHINano 2016 Conference and Exhibit in Suzhou, October 26-28th, 2016. A Canadian delegation of academic researchers, companies, and Nano Ontario Board members will be actively participating. Elected Nano Ontario Officers for 2016 are: Arthur J. Carty, Chair, Board of Directors; Peter Mascher, Vice Chair; Alain Francq, Treasurer; Kuyler Neable, Secretary.

To learn more about the vision and objectives of Nano Ontario, or to join Nano Ontario as a voting member, contact: www.nanoontario.ca.

Dr. Arthur J. Carty
Chair, Board of Directors

Dr. Carty is the Executive Director of the Waterloo Institute for Nanotechnology (WIN). From 2004 - 2008 he served as Canada's National Science Advisor to the Prime Minister and from 1994 - 2004 as President of the National Research Council (Canada). A graduate (BSc, PhD, Chemistry) of Nottingham University, he spent two years at Memorial University and 27 years at the University of Waterloo as Professor, Chair and Dean of Research. He has 316 publications and five patents to his credit. His many honours include: Fellow of the Royal Society of Canada, E.W.R. Steacie Award, Montreal Medal, Alcan Award, Queen Elizabeth 11 Golden Jubilee Medal and Diamond Jubilee Medal. He holds 14 honorary doctorates, three honorary professorships, and has received Canada's highest civilian honour, the Order of Canada. He is an Officier de l'Ordre National du Merite (France) and recipient of Taiwan's National Science Council Science Professional Medal.

PROGRAM

Day 1 - Nov. 10, 2016		
Time	Event	Location
12:00 - 1:00 PM	Registration	Hallway
1:00 - 1:05 PM	**Opening remarks** John Dutcher, Conference Chair, University of Guelph	Royal City Ballroom A
1:05 - 1:10 PM	**Welcoming message** Tony Vannelli, Dean, College of Physical and Engineering Science, University of Guelph	Royal City Ballroom A
1:10 - 1:15 PM	**Welcoming message** Arthur Carty, Chair, Board of Directors, Nano Ontario	Royal City Ballroom A
Session 1 - Session Chair: Christopher Yip, University of Toronto		
1:15 - 2:00 PM	**Keynote** **Molly Shoichet,** University of Toronto *Nanodrugs and Nanocarriers Provide Macro-Opportunities for Change*	Royal City Ballroom A
2:00- 2:50 PM	**Invited presentations** **Frank Gu,** University of Waterloo *Development of Mucoadhesive Nanoparticles for the Treatment of Ocular Diseases* **Gilbert Walker,** University of Toronto *Nanostructured Polymer Surfaces for Biofouling Control in Marine Environments*	Royal City Ballroom A
2:50 - 3:05 PM	**Health Break**	
Session 2 - Session Chair: Martin Kurylowicz, Mirexus Biotechnologies		
3:05 - 3:50 PM	**Keynote** **Alejandro Marangoni,** University of Guelph *Characterization of the Nanoscale in Triglyceride Crystal Networks*	Royal City Ballroom A
3:50 - 4:40 PM	**Invited presentations** **Sabrina Leslie,** McGill University *Squeezing New Information Out of Macromolecules Using Adjustable Nanoconfinement* **Hendrick de Haan,** University of Ontario Institute of Technology *Exploring the Structure of PhytoSpherix Nanoparticles via Atomistic and Coarse-Grained Simulations*	Royal City Ballroom A
4:40 PM- 6:30 PM	**Poster session and industry-academia networking reception**	Gryphon/Ken Danby Room

Day 2 - Nov. 11, 2016		
Time	Event	Location
8:00 – 8:30 AM	Registration	Hallway
Session 3 - Session Chair: Jose Moran-Mirabal, McMaster University		
8:30 - 9:15 AM	**Keynote** **Greg Scholes,** Princeton University *Using Coherence to Enhance Function in Chemical and Biophysical Systems*	Royal City Ballroom A
9:15 - 10:30 AM	**Invited presentations** **Michael Tam,** University of Waterloo *Cellulose Nanocrystals – A Promising Sustainable Nanomaterial for Advanced Engineering Applications* **Emily Cranston,** McMaster University *Nanocellulose Aerogels as Universal Substrates for Functional Nanoparticle Devices* **Amar Mohanty,** University of Guelph *Biodegradable Green Nanocomposites in Food Packaging Uses for a Sustainable Future*	Royal City Ballroom A
10:30 - 10:45 AM	**Health Break**	Royal City Ballroom A
10:45 - 11:45 AM	**Poster session and networking**	Gryphon/Ken Danby Room
11:45 AM- 2:00 PM	Buffet lunch and **Industry-Academia Panel**	Hallway, Royal City Ballroom A
Session 4 - Session Chair: Zoya Leonenko, University of Waterloo		
2:00 - 2:45 PM	**Keynote** **John Katsaras,** Oak Ridge National Laboratory *Neutrons "See" Nanoscopic Lipid Domains in Model Membranes and Those of Live Bacteria*	Royal City Ballroom A
2:45 - 3:00 PM	**Health Break**	Royal City Ballroom A
3:00 - 3:50 PM	**Invited presentations** **Jacek Lipkowski,** University of Guelph *PMIRRAS Studies of Potential Controlled Insertion of Alamethicin into a Model Biomembrane Supported at the Au(111) Electrode* **James Harden,** University of Ottawa *XPCS Studies of Collective Dynamics and Mechanical Evolution in Soft Nanostructured Materials*	Royal City Ballroom A
3:50 - 4:00 PM	**Poster awards presentation & closing remarks**	Royal City Ballroom A

KEYNOTE SPEAKERS

Molly Shoichet
University of Toronto
Donnelly Centre for Cellular & Biomolecular Research

Alejandro Marangoni
University of Guelph
Department of Food Science

Greg Scholes
Princeton University
Department of Chemistry

John Katsaras
Oak Ridge National Laboratory
Biology & Soft Matter Division

Dr. MOLLY SHOICHET
University of Toronto, Donnelly Centre for Cellular & Biomolecular Research

MOLLY SHOICHET holds the Tier 1 Canada Research Chair in Tissue Engineering at the University of Toronto. She has published over 530 papers, patents and abstracts and has given over 325 lectures worldwide. She currently leads a laboratory of 25 and has graduated 148 researchers. She founded two spin-off companies, and is actively engaged in translational research and science outreach. Dr. Shoichet is the recipient of many prestigious distinctions and the only person to be a Fellow of Canada's 3 National Academies: Canadian Academy of Sciences of the Royal Society of Canada, Canadian Academy of Engineering, and Canadian Academy of Health Sciences. Dr. Shoichet was the L'Oreal-UNESCO For Women in Science Laureate for North America in 2015 and elected Foreign Member of the US National Academy of Engineering in 2016. She holds the Order of Ontario, Ontario's highest honour and is a Fellow of the American Association for the Advancement of Science. In 2013, her contributions to Canada's innovation agenda and the advancement of knowledge were recognized with the QEII Diamond Jubilee Award. In 2014, Dr. Shoichet was given the University of Toronto's highest distinction, University Professor, a distinction held by less than 2% of the faculty. Dr. Shoichet received her SB from the Massachusetts Institute of Technology (1987) and her PhD from the University of Massachusetts, Amherst in Polymer Science and Engineering (1992).

Nanodrugs and Nanocarriers Provide Macro-Opportunities for Change

Protein and drug delivery strategies are challenging. Proteins are often denatured by the strategies designed for their release whereas drugs often have limited loadings. To overcome these limitations, we have designed a series of delivery strategies that open up new opportunities.

The typical protein delivery strategy relies on its encapsulation in polymeric nanospheres; however, this inevitably exposes proteins to organic solvents and shear forces, thereby denaturing the proteins and reducing their potency. Taking advantage of electrostatic interactions between poly(lactic-co-glycolic acid) nanospheres and proteins, we demonstrate controlled protein release in an encapsulation-free system. Without exposing proteins to typical formulation conditions, we preserve their bioactivity and are able to deliver greater amounts.

The typical chemotherapeutic drug delivery strategy relies on its encapsulation in polymeric (or liposomal) nanomicelles; yet the amount of drug loaded is always limited, resulting in mostly vehicle delivery. Taking advantage of the fundamental binding of taxol and tubulin, we designed polymers that enable enhanced drug loading. Given the limited solubility of chemotherapeutic drugs and systemic side effects associated with typical excipients, the increased drug loading results in greater in vivo efficacy.

Dr. ALEJANDRO MARANGONI
University of Guelph
Department of Food Science

ALEJANDRO G. MARANGONI is a professor and Tier I Canada Research Chair in Food, Health and Aging at the University of Guelph, Canada. His work concentrates on the physical properties of lipidic materials in foods, cosmetics and biolubricants. He has published over 300 refereed research articles, 60 book chapters, 13 books, and over 40 patents. He is the recipient of many awards including the 2013 AOCS Stephen Chang award, the 2014 IFT Chang Award in Lipid Science, the 2014 Supelco/Nicholas Pelick Award, and the 2015 ISF Kaufmann Medal. Marangoni was honored as one of the 10 most influential Hispanic Canadians in 2012 and a Fellow of the American Oil Chemists' Society in 2015. He is the first co-editor in Chief of Current Opinion in Food Science and Technology, and past Editor-in-Chief of Food Research International. Dr. Marangoni has trained over 100 people in his laboratory; many occupy positions of importance in the academe and industry, including eleven professors at major North American universities.

Characterization of the Nanoscale in Triglyceride Crystal Networks

Fats and oils are extremely useful natural products which are widely used in foods, cosmetics and industrial applications. As the concern for the environment and health grows, consumers are demanding more natural, green and sustainable materials in everyday consumer products. Fats and oils are complex multicomponent mixtures of triacylglycerol molecular species. The nature of these molecular species are a function of both fatty acid composition and distribution within the TAG molecule. The purpose of this talk is to discuss the structure of fats and oils, from constituent TAG molecules to the crystals they form. Upon crystallization, TAG molecules form lamellae which stack epitaxially to form highly asymmetric nanoplatelets. These nanoplatelets rapidly aggregate into colloidal structures of differing morphologies and size depending on external fields and concentration, forming networks which are responsible for the binding of oil, water vapour barrier properties, and mechanical properties of the fat.

Our work has focused on developing an understanding of the functionality of fats from a structural perspective. Early work focused on the quantification of structure using small deformation rheological techniques. More recent work has focused on the use of scattering methods, in particular Ultra-Small Angle X-ray Scattering at synchrotron facilities to quantify atomic scale structure to mesoscale structure simultaneously, in a non-destructive fashion. These scattering patterns yield information on the size of the scattering units and the spatial distribution of mass of these scatterers. We then relate this structural fingerprint to macroscopic functionality.

In this talk we will outline the discovery of the nanoscale in fat crystal networks, the development of techniques to characterize it and finally attempts at relating this structural length scale to functionality of fats. A final perspective of future challenges will be offered.

Dr. GREG SCHOLES
Princeton University
Department of Chemistry

GREG SCHOLES is the William S. Tod Professor of Chemistry at Princeton University. Originally from Melbourne, Australia, he later undertook postdoctoral training at Imperial College London and University of California Berkeley. He started his independent career at the University of Toronto (2000-2014) where he was the D.J. LeRoy Distinguished Professor. Dr. Scholes is the Deputy Editor for the Journal of Physical Chemistry Letters, Fellow of the Royal Society of Canada, a Senior Fellow in the Canadian Institute for Advanced Research program Biology, Energy, Technology, and a Professorial Fellow at the University of Melbourne. Dr. Scholes has had a long-standing interest in mechanisms of electronic energy transfer and the photophysics of molecular excitons. Current research concerns working out design principles for directing and regulating light-initiated energy flow in man-made and natural systems, like proteins involved in photosynthesis.

Using Coherence to Enhance Function in Chemical and Biophysical Systems

Coherence phenomena arise from interference, or the addition, of wave-like amplitudes in phase. While coherence has been shown to yield transformative new ways for improving function, advances have been limited to pristine matter, as quantum coherence is considered fragile. Recent evidence of coherence in chemical and biological systems, however, concludes that the phenomena is robust and can survive in the face of disorder and noise. I will present the state of recent discoveries. For example, two-dimensional electronic spectroscopy data allow quantitative analysis of vibronic coherence in the photosynthetic light harvesting complexes [1]. I will show how vibronic coherence plays a special role in downhill energy transfer, increasing energy transfer rates remarkably—even when electronic coupling is weak. I will conclude with a forecast for the role of function as a design element in realizing coherence [2].

[1] Scholes, et al. "Lessons from nature about solar light harvesting" Nature Chem. 3, 763–774 (2011).

[2] Scholes, et al. Report on the DOE BESAC workshop on "Optimal Coherence in Chemical and Biophysical Dynamics".

Dr. JOHN KATSARAS
Oak Ridge National Laboratory
Biology & Soft Matter Division

John Katsaras is a Senior Scientist and Distinguished Research Staff at Oak Ridge National Laboratory. Previous to this, he was Principal Research Officer at the National Research Council of Canada. Dr. Katsaras' research is focused on studies of natural and model biomembrane systems using different neutron and X-ray scattering techniques, and molecular dynamics simulations.

Neutrons "See" Nanoscopic Lipid Domains in Model Membranes and Those of Live Bacteria

Biomembranes are the active boundary between cells and their surroundings. They are sophisticated and dynamic machines that perform a diverse array of functions, including selective transport, localization, communication and recognition, to name a few. It is also widely accepted that the plasma membrane is laterally heterogeneous, containing nanoscopic regions enriched in lipids which have physical properties different from those surrounding them. In biology, these functional lipid domains are commonly referred to as "rafts", and have been implicated in a wide range of cellular functions, including signal transduction, drug uptake, and interactions with pathogens. We have used small angle neutron scattering to study nanoscopic lipid domains in model membrane systems [1-3], and more recently in the Gram-positive bacterium *Bacillus subtilis*. Data from these studies will be presented, including first-ever evidence for the existence of lipid nanodomains in a living system, implying that lateral heterogeneity is a feature common to all biological membranes.

[1] F. A. Heberle, R. S. Petruzielo, J. Pan, P. Drazba, N. Kučerka, R. F. Standaert, G. W. Feigenson, J. Katsaras, J. Am. Chem. Soc. 135, 6853 (2013).

[2] F. A. Heberle, M. Doktorova, S.-L. Goh, R. F. Standaert, J. Katsaras, G. W. Feigenson, J. Am. Chem. Soc. 135, 14932 (2013).

[3]J. D. Nickels et al., J. Am. Chem. Soc. 137, 15772 (2015).

THE INDUSTRY-ACADEMIA PANEL

Commercialization of Sustainable Nanotechnologies &
Forging Sustainable Industry-Academia Partnerships

Darren Anderson
Vive Crop Protection

Richard Berry
Celluforce

Sabrina Leslie
McGill University

Phil Whiting
Mirexus Biotechnologies

Gilbert Walker
University of Toronto

Moderator:
Peter van Ballegooie
EcoSynthetix

Opening remarks:
Alejandra de Almeida
NSERC

NSERC CRSNG This panel was generously sponsored by NSERC.

INVITED SPEAKERS

Emily Cranston
Department of Chemical Engineering, McMaster University
Nanocellulose Aerogels as Universal Substrates for Functional Nanoparticle Devices

Hendrick de Haan
Department of Physics, University of Ontario Institute of Technology
Exploring the Structure of PhytoSpherix Nanoparticles via Atomistic and Coarse-Grained Simulations

Frank Gu
Canada Research Chair, Department of Chemical Engineering, University of Waterloo
Development of Mucoadhesive Nanoparticles for the Treatment of Ocular Diseases

James Harden
Department of Physics, University of Ottawa
XPCS Studies of Collective Dynamics and Mechanical Evolution in Soft Nanostructured Materials

Sabrina Leslie
Department of Physics, McGill University
Squeezing New Information Out of Macromolecules Using Adjustable Nanoconfinement

Jacek Lipkowski
Department of Chemistry, University of Guelph
PMIRRAS Studies of Potential Controlled Insertion of Alamethicin into a Model Biomembrane Supported at the Au(111) Electrode

Amar Mohanty
Premier's Research Chair, School of Engineering, University of Guelph
Biodegradable Green Nanocomposites in Food Packaging Uses for a Sustainable Future

Michael Tam
University Research Chair, Department of Chemical Engineering, University of Waterloo
Cellulose Nanocrystals - A Promising Sustainable Nanomaterial for Advanced Engineering Applications

Gilbert Walker
Canada Research Chair, Department of Chemistry, University of Toronto
Nanostructured Polymer Surfaces for Biofouling Control in Marine Environments

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