WATERLOO INSTITUTE FOR NANOTECHNOLOGY PRESENTS

Nanotechnology for a Sustainable Future

An International Workshop

November 19 - 20, 2020

Online via WebEx

WATERLOO INSTITUTE FOR nanotechnology

UNIVERSITY OF WATERLOO

NL Netherlands

Nanotechnology for a Sustainable Future

Professor Sushanta Mitra

Executive Director

Waterloo Institute for Nanotechnology

Welcome everyone to the International Workshop on Nanotechnology for a Sustainable Future!

In this unique event, WIN's first fully virtual workshop, we are happy to host research leaders from five countries spanning four continents – Australia, Japan, the Netherlands, USA and Canada – who will present latest findings and discuss current affairs of nanotechnology research and applications in energy, healthcare, ICT and also how nanotechnology directly relates to society, through policy and science diplomacy, and resource management within a circular economy.

In 2012, the United Nations set out to produce a set of universal goals to meet urgent environmental, political and economic challenges facing our world and created the Sustainable Development Goals (SDG) to tackle the most persistent and critical challenges our society faces today. All 17 of these goals are interconnecting – where success in one can bring about success in others. At WIN, we are one of the global leaders to formally map our research themes to these SDGs, working to find how nanotechnology can enable and deliver solutions to real-world problems. WIN researchers and partners are directly addressing SDGs for good health (#3), clean water (#6), energy and environment (#7, 13, 14 & 15), innovation & infrastructure (#9 & 11), and responsible consumption and production (#12). Successes here lead to reduced poverty and hunger (#1 & 2), improved equality, education and economic growth (#4, 5, 8 & 10) which in turn will lead to the ultimate, universal goal – peace, justice and strong institutions (#16).

WIN is constantly striving to be an exemplar in cross-disciplinary research and breaking down barriers to bring together traditionally dissimilar research areas for a 360° view of critical research problems. At this workshop, we aim to create a *Network4Sustainable Nanotechnology* – a strong partnership to define technological challenges and societal impacts, and assemble well-balanced teams (SDG #17) to tackle current and emerging global challenges.

Though we are unable to meet in person, I am confident that during this global pandemic we are more close to each other than being far apart. Collectively, we will be able to put forward a pathway that would enable sustainable use of nanotechnology for the economic prosperity of our hyper-connected world and at the same time create a more just and sustainable future for humankind. I invite everyone to work together in this year of opportunity!

Sincerely,
Dr. Sushanta Mitra, P.Eng.,
FASME, FCSME, FEIC, FRSC, FINAE, FCAE, FAPS, FAAAS
Executive Director, Waterloo Institute for Nanotechnology
Professor, Mechanical & Mechatronics Engineering
Professor, Physics & Astronomy (Cross-Appointed)
Professor, Chemical Engineering (Cross-Appointed)

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**various sessions of the program will be recorded to enable virtual viewing across four continents*

Thursday 19 November 2020 (EST)

Click here to register for Day 1 of the conference

TIME	SCHEDULE
17h00-17h10	**Registration**
17h10 – 17h30 EST (23h10CET; 7h10JST; 9h10AEST)	**Welcoming remarks**
17h10 – 17h13	**Charmaine Dean**, Vice President, Research and International, University of Waterloo
17h14 – 17h16	**H.E. Ines Coppoolse**, Ambassador of the Kingdom of the Netherlands to Canada
17h17 – 17h19	**Alejandro Adem**, President, Natural Science and Engineering Research Council (NSERC) Canada
17h20 – 17h22 (7h20 – 7h22 JST)	**Michinari Hamaguchi**, President, Japan Science and Technology Agency (JST)
17h22 – 17h25 (9h22 – 9h25 AUDT)	**Ben Eggleton,** University of Sydney Nano Institute (Sydney Nano)
17h25 – 17h28 (14h25 – 14h28 PST)	**Paul Weiss,** Distinguished Professor, University of California at Los Angeles; Editor-in-Chief, ACS Nano
17h28 – 17h30	**Sushanta Mitra**, Executive Director, Waterloo Institute for Nanotechnology (WIN)
	Session 1: Nanotechnology & Society, Policy and Science Diplomacy (UNSDG #8, 10, 16, 17); Session Lead: Jun'ichi Sone
17h30 – 17h50 (23h30 – 23h30 CET)	Speaker 1 NL: **Albert van den Berg**, co-Scientific Director, MESA+ Institute for Nanotechnology, Netherlands: "Nano4Society"
17h50 – 18h10 (7h50 – 8h10 JST)	Speaker 1 JST: **Jun'ichi Sone**, Principal Fellow, Centre for Research and Development, JST Japan: "R&D Strategy of Nanotechnology and Materials for a Sustainable Future in Japan"

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18h10 – 18h30 (10h10 – 10h30 AEDT)	Speaker 1 AUS: **Steven Maguire**, Professor of Strategy, Innovation and Entrepreneurship University of Sydney Business School, Sydney Nano Member: "Integrating Social Sciences with Nanosciences for a Sustainable Future"
18h30 – 18h50	Speaker 1 Canada: **Marc Fortin**, Vice President, Research Partnerships, NSERC: "The Role of NSERC is Supporting and Shaping the Canadian Research Ecosystem"
	Session 2: Industry & Innovation (UNSDG #9, 11) Session Lead: Elicia Maine
18h50 – 19h10 (8h50 – 9h10 JST)	Speaker 2 JST: **Toyohiro Chikyow**, Assistant General Manager, Group Leader of Materials Data & Integrated System, NIMS: "Challenge for New Materials Design by Data-driven Materials Science and High Throughput Experimentation"
19h10 – 19h30 (11h10 – 11h30 AEDT)	Speaker 2 AUS: **James Rabeau**, Professor, School of Physics, University of Sydney, Sydney Nano Member: "Toward Practical Quantum Sensors – Research and Industry Collaboration"
19h30 – 19h50 (16h30 – 16h50 PST)	Speaker 2 SFU: **Elicia Maine,** Professor of Innovation and Entrepreneurship, Beedie School of Business, Simon Fraser University: "Enabling Nanotechnology Solutions for a Sustainable Future: Endowing University Spinoffs Pre-Formation"
	Session 3: Energy & Environment (UNSDG #7, 13) Session Lead: Sushanta Mitra
19h50 – 20h10 (9h50 – 10h10 JST)	Speaker 3 JST: **Takanobu Watanabe**, Professor, School of Fundamental Science and Engineering, Waseda University: "Energy Harvesting Si Devices"
20h10 – 20h30 (12h10 – 12h30 AEDT)	Speaker 3 AUS: **Anita Ho-Baillie**, Professor, John Hooke Chair of Nanoscience, University of Sydney, Sydney Nano Member: "Perovskite Solar Cells"
	Session 4: Devices & Technology for Healthcare (including Covid-19) and Communications/Photonics (UNSDG #3, 9 & 11)) Session Lead: Sushanta Mitra
20h30 – 20h50 (12h30 – 12h50 AEDT)	Speaker 4 AUS: **Allison Tong,** Principal Research Fellow, School of Public Health, University of Sydney, Sydney Nano Member: "Research Priorities for Sensor Technology to Address COVID-19"

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Friday 20 November 2020 (EST)

Click here to register for Day 2 of the conference

TIME	SCHEDULE
	Session 2 (continued): Industry & Innovation (UNSDG #9, 11) Session Lead: Oleg Stukalov
9h20 – 9h50 (15h20 – 15h50 CET)	Speaker 2 NL: **Ronny van't Oever,** CEO Micronit, Chair MinacNed: "Nano SME activities"
9h40 – 10h00	Speaker 2 WIN: **Oleg Stukalov**, WIN Business Development Manager, UWaterloo: "Overview of Nanotechnology Entrepreneurship at the University of Waterloo"
10h00 – 10h20 (16h00 – 16h20 CET)	Speaker 2B NL: **Adrienne Sips**, Research Coordinator Safety of Nanotechnology and Advanced Materials National institute for Public Health & the Environment (RIVM): "Modern Innovation: Get Together, Work Together"
	Session 3 (continued): Energy & Environment (UNSDG #7, 13) Session Lead: Sushanta Mitra
10h20 – 10h40 (16h20 – 16h40 CET)	Speaker 3 WIN: **Linda Nazar**, Professor, Department of Chemistry UWaterloo and WIN Member: "Unravelling the Complexities of Electrochemical Energy Storage at the Nanoscale"
10h40 – 11h00	Speaker 3 NL: **Pieter Telleman**, Business Director MESA+: "Triple Helix Government-Industry-Research Institute"
11h00 – 11h20	Speaker 3 Canada: **David Sinton**, Professor, Department of Mechanical and Industrial Engineering, University of Toronto: "Electrochemical Systems for CO_2 Conversion to
11h20 – 11h35	**Morning Break**
	Session 4 (continued): Devices & Technology for Healthcare (including Covid-19) and Communications/Photonics (UNSDG #3, 9 & 11)) Session Lead: Albert van den Berg
11h15 – 11h35 (17h15 – 17h35 CET)	Speaker 4 NL: **Albert van den Berg**, co-Scientific Director MESA+, Chair NanoNextNL: "From Lab-on-Chip to Organ-on-Chip"
11h35 – 11h55	Speaker 4 WIN: **Karim Karim,** Executive Director of Centre for Bioengineering and Biotechnology, and WIN Member, UWaterloo: "Reveal Dual Energy Detector"

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11h55 – 12h15	Speaker 4 Canada: **Warren Chan**, Director, Institute for Bioengineering, University of Toronto: "Challenge of Delivering Nanoparticles to Solid Tumors"
12h15 – 13h30	**Lunch Break**
	Session 5 (continued): Resource Management and the Circular Economy (UNSDG #6, 11, 12, 13, 17) Session Lead: Jatin Nathwani
13h30 – 13h50 (19h30 – 19h50 CET)	Speaker 5 NL: **Karin Schroen**, Professor of Food Process Engineering, Wageningen University: "Nano4Agri/Food"
13h50 – 14h10 (19h50 – 20h10 CET)	Speaker 5B NL: **Guus Rijnders**, co-Scientific Director MESA+, Chair NanoLab NL: "Nanomaterials for energy & sustainability and NanoLabNL facilities"
14h10 – 14h30	Speaker 5 WIN: **Goretty Dias,** Professor School of Environment, Enterprise and Development and WIN Member, UWaterloo: "Circularity, Resources, and Technology: Achieving Sustainable Development"
14h30 – 14h50	Speaker 5 WIN: **Jatin Nathwani**, Executive Director Waterloo Institute for Sustainable Energy and WIN Member, UWaterloo: "Sustaining a Clean Energy Transition Beyond COVID"
14h50 – 18h00	**Afternoon Break**
	Session 4 (continued): Devices & Technology for Healthcare (including Covid-19) and Communications/Photonics (UNSDG #3, 9 & 11)) Session Lead: Sushanta Mitra
18h00 – 18h20 (8h00 – 8h20 JST 21 Nov)	Speaker 4 JST: **Ken Uchida**, Professor, Department of Materials Engineering, University of Tokyo: "Nanoscale Thermal Management for Low-energy Integrated Electronics in the Internet-of-Things Era"
	Session 5 (continued): Resource Management and the Circular Economy (UNSDG #6, 11, 12, 13, 17) Session Lead: Ben Eggleton
18h20 – 18h40 (8h20 – 8h40 JST 21 Nov)	Speaker 5 JST: **Ryotaro Matsuda**, Department of Materials Chemistry, Nagoya University: "Management of Gas and Heat by Nanoporous Metal Complexes"
18h40 – 19h00 (10h40 – 11h00 21 Nov)	Speaker 5 AUS: **Ali Abbas**, Professor, School of Chemical and Biomolecular Engineering, University of Sydney, Sydney Nano Member: "Opportunity and Challenges of Nanomaterials in the Circular Economy"

AUS: Australia
JST: Japan Science & Technology Agency
NIMS: National Institute for Materials Science
NL: Netherlands
RIVM: National Institute for Public Health and the Environment, Netherlands
WIN: Waterloo Institute for Nanotechnology

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Charmaine Dean

Vice President, Research and International
University of Waterloo
Waterloo, Ontario, Canada

Biography/Research Interests

Charmaine Dean is Vice President, Research and International at the University of Waterloo. In this role, she is focused on building upon foundational strengths to heighten the emphasis on collaborations, and link related external portfolios in a systematic approach to industrial partners and entrepreneurship. From 2011 to 2017, Dr. Dean served as Dean of Science at Western University. Prior to her service at Western, she played a major role in establishing the Faculty of Health Sciences at Simon Fraser University in her capacity of Associate Dean of that Faculty. Previously, she was the founding Chair of the Department of Statistics and Actuarial Science at Simon Fraser University. An engaged member of several relevant boards including, Compute Ontario, the Southern Ontario Smart Computing Innovation Platform, the Vector Institute for Artificial Intelligence and the Institute for Cybersecurity and Privacy, Dr. Dean has also served as a board member for the US National Institute of Statistical Sciences (NISS) Corporation, the National Institute for Complex Data Structures and the Canadian Statistical Sciences Institute. She is dedicated to developing outstanding computing capabilities for researchers and for building capacity in Canada and is interested in bringing together diverse communities to drive forward a unified direction for data management activities and priorities.

H.E. Ines Coppoolse

Ambassador of the Kingdom of the Netherlands to Canada

Biography/Research Interests

Her Excellency Ines Coppoolse, Ambassador of the Kingdom of the Netherlands to Canada, studied International Relations at the University of Amsterdam and started her career at the Ministry of Foreign Affairs in 1992. She held various positions at the Ministry of Foreign Affairs, including Deputy Permanent Representative at the Permanent Mission to the UN in Vienna. Prior to being appointed Ambassador to Canada in 2020, she was the Dutch Ambassador to Sweden.

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Alejandro Adem

President
Natural Sciences and Engineering Research Council of Canada (NSERC)
Ottawa, Canada

Biography/Research Interests

Professor Alejandro Adem recently started in a new role as President of NSERC. As a highly accomplished researcher in the field of mathematics and a faculty member at the University of British Columbia, he has significant leadership experience in research and innovation. Before joining NSERC, he was CEO and Scientific Director of Mitacs. At Mitacs, Professor Adem oversaw an unprecedented expansion of its programs, with the goal of delivering 10,000 internships annually across Canada and abroad. He worked closely with stakeholders to launch the Mitacs Canadian Science Policy Fellowship in 2016 and established an Indigenous engagement initiative. He has served on a variety of scientific, editorial, and governance boards for the worldwide mathematical sciences community, including the Advisory Board for the Association for Women in Mathematics and the International Mathematical Union's Committee for Women in Mathematics.

Michinari Hamaguchi

President
Japan Science and Technology Agency (JST)
Tokyo, Japan

Biography/Research Interests

Michinari Hamaguchi earned his PhD in medicine from Nagoya University. He was appointed Research Associate at the Nagoya University School of Medicine in 1980, and since then, he had been working at Nagoya University, except for the time he pursued his research at the Rockefeller University in the U.S. from 1985-1988. He served as the President of Nagoya University from Apr. 2009 - Mar. 2015 before becoming the President of JST in Oct. 2015. He currently serves as Chairpersons of the Japanese National Commission for UNESCO and the Council for Science and Technology, Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan.

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Benjamin Eggleton

Director of the University of Sydney Nano Institute
Sydney, Australia

Biography/Research Interests

Professor Benjamin Eggleton is the Director of The University of Sydney Nano Institute. He also currently serves as co-Director of the NSW Smart Sensing Network (NSSN). Eggleton obtained his Ph.D. degree in Physics from the University of Sydney in 1996. He then joined Bell Laboratories, Lucent Technologies as a Postdoctoral Member of Staff in the Optical Physics Department and was subsequently promoted to Research Director within the Specialty Fiber Business Division of Bell Laboratories, where he was engaged in forward-looking research supporting Lucent Technologies business in optical fiber devices. Eggleton is the author or coauthor of more than 500 journal publications, including Science, Nature Photonics, Nature Physics, Nature Communications, Physical Review Letters and Optica and over 200 invited presentations. His journal papers have been cited 23,000 times according to WebofScience with an h-number of 76 (100 in Google Scholar). Eggleton is a Fellow of the Australian Academy of Science (AAS), the Australian Academy of Technology and Engineering (ATSE), the Optical Society of America, IEEE Photonics and SPIE. He is Editor-in-Chief of APL Photonics.

Paul Weiss

Distinguished Professor of Chemistry & Biochemistry, and Materials Science & Engineering, University of California at Los Angeles, USA
Editor-in-Chief, ACS Nano

Biography/Research Interests

Paul S. Weiss graduated from MIT with S.B. and S.M. degrees in chemistry in 1980 and from the University of California at Berkeley with a Ph.D. in chemistry in 1986. He is a nanoscientist and holds a UC Presidential Chair and a distinguished professor of chemistry & biochemistry, bioengineering, and materials science & engineering at UCLA, where he was previously director of the California NanoSystems Institute. He also currently holds visiting appointments at Harvard's Wyss Institute and several universities in Australia, China, and South Korea. He studies the ultimate limits of miniaturization, developing and applying new tools and methods for atomic-resolution and spectroscopic imaging and patterning of chemical functionality. He and his group apply these advances in other areas including neuroscience, and microbiome studies, and high-throughput gene editing. He led, coauthored, and published the technology roadmaps for the BRAIN Initiative and the U. S. Microbiome Initiative. He has won a number of awards in science, engineering, teaching, publishing, and communications. He is a fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, the American Chemical Society, the American Institute for Medical and Biological Engineering, the American Physical Society, the American Vacuum Society, the Canadian Academy of Engineering, the Materials Research Society, and an honorary fellow of the Chinese Chemical Society. He is the founding and current editor-in-chief of ACS Nano.

Sushanta Mitra

Executive Director, Waterloo Institute for Nanotechnology
Professor, Department of Mechanical and Mechatronics Engineering
University of Waterloo
Waterloo, Ontario, Canada

Biography/Research Interests

Sushanta Mitra is the Executive Director of the Waterloo Institute for Nanotechnology and a Professor in Mechanical and Mechatronics Engineering at the University of Waterloo. His research interests are in the fundamental understanding of fluid transport in micro and nano-scale confinements with applications in energy, water, and bio-systems. For his contributions in science and engineering, he is an elected Fellow of number of professional bodies including the Canadian Academy of Engineering, the American Physical Society, the Royal Society of Chemistry and the American Association for the Advancement of Science.

Albert van den Berg

Co-Scientific Director
MESA+ Institute for Nanotechnology
Professor, Faculty of Electrical Engineering
Biomedical and Environmental Sensor Systems (BIOS)
University of Twente
Enschede, Netherlands

Abstract: Nano4Society: Nanotech- driven innovation in the Dutch ecosystem

Nano4Society is a dutch nanotechnology foundation and ecosystem that aims at promoting nanotechnology development and application in in four major areas: health, energy/sustainability, agro/food and safety/security. Examples of nano-enabled solutions in these areas will be given and a sketch of the underlying academic and industrial network as well as governmental and civil embedding will be given as example of how we envisage innovation to take place in the coming years.

Biography/Research Interests

Albert van den Berg received his MSc in applied physics in 1983, and his PhD in 1988 both at the University of Twente, the Netherlands. From 1988-1993 he worked in Neuchatel, Switzerland, at the CSEM and the University (IMT) on miniaturized chemical sensors. From 1993 until 1999 he was research director Micro Total Analysis Systems (µTAS) at MESA, University of Twente. In 1998 he was appointed as part-time professor “Biochemical Analysis Systems”, and later in 2000 as full professor on Miniaturized Systems for (Bio)Chemical Analysis in the faculty of Electrical Engineering. In 2002 he received the Simon Stevin Master award from the Dutch Technical Science foundation (STW). In 2003 he headed a 10 MEuro national research program on nanofluidics (NanoNed). In 2005 he spent 6 months in San Diego (USA) at the La Jolla Institute for Allergy and Immunology (LIAI, group Green) during a sabbatical leave, while he received an Advanced Research Grant from ERC in 2008. In 2009 he received the Spinoza prize, the most prestigious dutch scientific award, for his achievements in lab-on-a-chip research. In 2010 he was appointed as honorary University Professor at the University of Twente. Albert van den Berg is member of the Royal Dutch Academy of Sciences (KNAW), the Dutch Health council, board member of the Chemical and Biological Microsystems Society, member of the Dutch chemical society (KNCV) and deputy chair of the journal Lab on a Chip. He has co-authored over 220 papers (H=36) and over 10 patents, and has been involved in > 5 spin-off companies. His current research interests focus on microanalysis systems and nanosensors, nanofluidics and single cells and tissues on chips, especially with applications in personalized health care and development of sustainable (nano)technologies.

Jun'ichi Sone

Principal Fellow
Center for Research and Development Strategy (CRDS)
Japan Science and Technology Agency (JST)
Tokyo, Japan

Abstract: R&D Strategy of Nanotechnology and Materials for a Sustainable Future in Japan

The environment surrounding us is changing dramatically, such as climate changes due to increasing greenhouse gas emission, the resulting intensification of natural disasters, the emergence of new infectious diseases such as coronavirus, which have a great impact on the lives and economic activities of people over the world. On the other hand, progress in digitalization is bringing about the change of our way of life. Under such circumstances, expectations for nanotechnology based on material science are becoming high, particularly from the standpoint of SDGs. Specifically, those are the evolution of materials and devices enabling new services and products that are about to be created by digitalization, solving serious environment and energy issues, and solving health and medical issues due to progressing aging. To meet these expectations, the Japanese government is working to develop a strategy to strengthen its material innovation capabilities, which will be addressed in the workshop. At the same time, these issues above cannot be dealt with by a single country, and international cooperation becomes important. As one of such activities, cooperation activities in the Asian Nanotechnology Forum will be introduced, where promotion of research and development, human resource development for nanotechnology, and its commercialization in Asian countries are discussed.

Biography/Research Interests

After graduating from the master course of the Science Department of the University of Tokyo in 1975, Jun'ichi Sone joined NEC Corporation. He engaged in the research of semiconductor devices and superconducting Josephson junction devices. He earned a Doctoral degree of Science in 1983 from the University of Tokyo. He served as General Manager of Fundamental Research Laboratories and Vice President of Central Research Laboratories of NEC Corporation. In 2008, he obtained concurrent position of Research Supervisor of the CREST program of JST named "Creation of Nanosystems". He joined National Institute for Materials Science as Executive Vice President in 2010. He served President of the Society of Nanoscience and Nanotechnology in Japan from 2012 to 2016. He joined the Center for Research and Development Strategy of JST as Principal Fellow in 2015. He obtained an award of JSAP Fellow in 2008. He is an Executive Vice President Emeritus of National Institute for Materials Science.

Steven Maguire

Professor

University of Sydney Business School

University of Sydney Nanotechnolgoy Institute (Sydney Nano)

Sydney, Australia

Abstract: Integrating Social Sciences with Nanosciences for a Sustainable Future

The inaugural Sydney Nano Catalyst project, Engaged Innovation Scholarship for Impact, is introduced and related to different roles that social science can play when integrated with nanoscience in order to secure a sustainable future. Although universities have long been recognized as engines of innovation, they are rarely approached as living laboratories for studying innovation 'in the making' as we do with Engaged Innovation Scholarship, which refers to the systematic translation and application of existing scholarly knowledge about innovation while also producing new knowledge about it. By embedding Business School &/or other social science researchers alongside natural scientists as members of multidisciplinary teams, innovation is catalysed at the same time as it is studied. Importantly for sustainability, which is an inescapably value-laden concept, the balance of instrumentality and normativity characterizing this catalysis can be adjusted to shape the nature of impacts in addition to their timing.

Biography/Research Interests

Since January 2019, Steven Maguire is Professor of Strategy, Innovation and Entrepreneurship at the University of Sydney Business School (Australia) where, as the School's first Fellow of Multidisciplinary Innovation, he collaborates with scholars from other faculties and multidisciplinary institutes, including Sydney Nano, to develop impactful, multidisciplinary teaching and research programs. He is currently leading the implementation of the inaugural Catalyst research program at Sydney Nano, "Engaged Innovation Scholarship for Impact"; as well as the development of a new, highly multidisciplinary Major in Innovation & Entrepreneurship for undergraduate students across the University of Sydney. Prior, he worked for 20 years at McGill University (Canada) where he was Founding Director of the Marcel Desautels Institute for Integrated Management which, under his leadership, became an important hub of multidisciplinary programming focusing on sustainability, innovation and entrepreneurship. His research, which focuses on technological innovation and institutional entrepreneurship driven by the emergence of novel risks to human health and the environment, is published in leading journals and has earned substantial research funding with co-investigators (> $25 million) as well as numerous awards.

Marc Fortin

Vice President
Research Partnerships
Natural Sciences and Engineering Research Council of Canada
Ottawa, Canada

Abstract: The Role of NSERC is Supporting and Shaping the Canadian Research Ecosystem

NSERC is the national research funding agency in the natural sciences and engineering in Canada. NSERC supports the best Canadian researchers to generate new knowledge through fundamental science, supports the training of the best future talent and provides funding for the application of new knowledge to generate impact for society. NSERC has recently increased its funding of fundamental research as well as revised funding programs to include a broader range of partner organizations that can be users of new knowledge and technologies. NSERC will support the development and the growth of partnerships between Canadian researchers and international colleagues as this will leverage our collective investments in research. We will discuss the development of a new international research support program.

Biography/Research Interests

Marc Fortin is Vice President of Research Partnerships at the Natural Sciences and Engineering Research Council of Canada (NSERC). Dr. Fortin leads research support programs that bring together academic researchers with other organizations to generate new knowledge and new impact for Canada.

Dr. Fortin has led the development of policies, strategies and programs designed to support research partnerships across organizations and disciplines to generate benefits for Canada and Canadians. He has worked extensively at the national and international levels to leverage research to generate impact for the policy, industry, regulatory or decision-maker communities. He has provided advice to Governments in topics at the interface of science, policy and society. He has led the development of research support programs focused on impact for Canada that have changed the relationships between partners in the innovation space.

Prior to joining NSERC, Dr. Fortin held senior positions leading research organizations in academia and government. He has led science and technology branches as Assistant Deputy Minister at the Department of National Defence and at Agriculture and Agri-Food Canada for the last 12 years. He was Associate Professor at McGill University where he held leadership positions (Department Chair and Associate Dean – Research) for the previous 16 years.

Dr. Fortin was a molecular geneticist, with a B.Sc. and a M.Sc. from Université Laval and a Ph.D. in Plant Molecular Biology from McGill University. He did post-doctoral work in molecular genetics at the University of California and the University of Chicago.

Toyohiro Chikyow

Assistant General Manager
Group Leader of Materials Data & Integrated Systems
National Institute for Materials Science (NIMS)
Tsukuba, Japan

Abstract: Challenge for New Materials Design by Data Driven Materials Science and High- throughput Experimentation

In the past decades, materials science has been a source of innovation and many products were manufactured by new materials. However, it was also found that a small number of materials were known for their properties although a large number of crystal structures were not reported. That means that there are unknown materials not yet discovered. To find such undiscovered materials, we have to prepare cutting edge tools to row the unknown the “materials field”. They are virtual screening by informatics and high throughput experimentations. Recently the data driven materials science has been giving great impact to materials science. It is a great tool to survey the material field virtually as the first screening. The serious issue, however is the insufficient data. Open data such as Materials project is not enough for screening by machine learning. For this purpose, we propose an automatic first principle calculation for the interested area of the field. The combinatorial synthesis can help to investigate the candidates experimentally. The newly designed combinatorial system can work automatically to make ternary alloys on substrates. Also, the calculated data and experimental data are storage in the data server and can be reused for other predictions. In this workshop, the recent trend of data driven materials science is reviewed in terms of data driven materials science and high throughput experimentation.

Biography/Research Interests

Professor Toyohiro Chiyow was born in Fukuoka, Japan in 1959. He graduated from Waseda University with a Bachelors in1983, Masters in 1985, and a Ph.D degree in 1989. He joined National Research Institute for Metals (NRIM) to start GaAs quantum dots research for 10 years. The NRIM was reorganized to be the National Institute for Materials Science (NIMS) in 2001. There he has been developing combinatorial synthesis systems and high throughput characterization tools to find new materials in collaboration at the Tokyo Institute of Technology. He applied these tools for metal gate, higher-k dielectric, memory materials such as ReRAM or atomic switch. He currently investigates the materials informatics where the high throughput experimentation and information technology are integrated to discover the new materials.

James Rabeau

Professor
School of Physics
University of Sydney Nanotechnolgoy Institute (Sydney Nano)
Sydney, Australia

Abstract: Toward Practical Quantum Sensors - Research and Industry Collaboration

Diamond can host a variety of optically active defect centres. These fluorescent “colour centres” have long been recognized for their potential applications in quantum and biological sciences. Success in any of these areas requires a multi-disciplinary and “mission-driven” approach covering materials science, quantum optics, engineering, chemistry and biology. This talk will cover some of the underlying science that enables the use of the unique nitrogen-vacancy (NV) colour centre in diamond as a basis for practical quantum technology. The NV centre as a qubit for quantum computing has been shown in the laboratory, is increasingly being studied in nanodiamond particles for their potential in biomedical imaging and is currently being used in high-sensitivity magnetic field sensing with some commercial demonstration already made. I will discuss our current project at the University of Sydney developing a prototype diamond magnetometer and the importance of making strong industry connections to realise our goals.

Biography/Research Interests

James Rabeau joined the University of Sydney in January 2019. Prior to his position as Professor in the School of Physics and the executive team at Sydney Nano, he spent a number of years in industry. Most recently he was a program manager at Microsoft Quantum Computing, he has led the strategy unit at Macquarie University and was a Director at Deloitte in the Data Analytics practice. Professor Rabeau strives to combine his research expertise and industry/commercial experience to bring cutting edge technology into the world to solve real problems. Currently his focus is on applications for quantum sensing using diamond. He received his PhD in CVD diamond growth at Heriot-Watt University in 2003.

Elicia Maine

Special Advisor on Innovation to the Vice-President, Research & International
Professor of Innovation & Entrepreneurship, at the Beedie School of Business
Simon Fraser University
Vancouver, British Columbia

Abstract: Enabling Nanotechnology Solutions for a Sustainable Future: Endowing University Spinoffs Pre-Formation

University spin-offs are important mechanisms for creating and capturing value from nanotechnology inventions. With the downsizing of corporate research labs, breakthrough inventions are increasingly happening in university research labs, and are not easily translated directly to incumbent manufacturers or chemical multinational firms. Nanotechnology ventures spun out of universities are of increasing importance for the creation and commercialization of climate solutions, such as clean energy generation, energy storage, and carbon capture. But these ventures are also risky businesses that face daunting challenges in their route from the lab to the market. Innovations in nanomaterials, which underlie new product development across many industries, typically take 5–15 years to turn into a commercial product, and can take far longer to penetrate multiple markets. Over these prolonged commercialization times, nanomaterials ventures face high capital costs and sustained uncertainty, deterring investment. Given these long timelines, high uncertainties and high capital requirements, early stage decisions made regarding research objectives, technology-market matching, invention viability, alliance partnership formation, IP strategy, and timing of venture formation are of critical importance. Academic scientists are uniquely positioned to shape commercialization opportunities long before the university spin-off is founded. Four pre-formation entrepreneurial capabilities with which these science-based university spin-offs are endowed for success are presented. Recommendations are made for scientist-entrepreneurs, investors, university leadership, and for innovation policymakers.

Biography/Research Interests

Elicia Maine is the W.J. VanDusen Professor of Innovation & Entrepreneurship, at the Beedie School of Business. She is also the Founder and Academic Director for the Invention to Innovation (i2I) program, a "mini MBA" in Science & Technology Commercialization, which develops entrepreneurial mindset in graduate scientists and engineers. In partnership with Mitacs, the i2I program is now being delivered in a hybrid online format across Canada, and was recently recognized with an international award from the global business school accreditation council. Professor Maine has deep interdisciplinary roots, with degrees in Materials Engineering, English, Technology & Policy and Technology Management from Queen's, M.I.T., and the University of Cambridge. Her research, published in Research Policy and Technovation as well as in Nature Materials and Nature Nanotechnology, focuses on the dynamics of innovation in the advanced materials, nano-materials, biotechnology, and clean tech sectors with a focus on science & technology ventures. She cares deeply about the impact that university inventions can make in solving large societal challenges, such as climate change and treating or preventing disease. She is a frequent and dynamic keynote speaker and panelist, serves on the Boards of Directors of the Foresight Clean Tech Accelerator, Innovate BC's New Ventures BC, and the Composites Knowledge Network, and is an active mentor to scientist-entrepreneurs. Professor Maine was awarded the 2017 TD / Canada Trust Distinguished Teaching Award and was recognized as one of BC's Most Influential Women 2018: STEM Stars. As Special Advisor on Innovation to the VP Research and International (VPRI), Maine provides leadership, integration, and alignment for innovation initiatives at Simon Fraser University (SFU). A key element of Maine's role is increasing SFU's reputation and credibility as a leader in innovation. This includes advocating for faculty and students in reducing barriers to creativity and innovation, overseeing the next evolution of the SFU Innovates strategy and mobilizing the SFU community around the associated initiatives and programming. Together with the VPRI, Maine supports excellence and research growth at SFU.

Takanobu Watanabe

Professor, School of Fundamental Science and Engineering
Waseda University
Tokyo, Japan

Abstract: Energy Harvesting Si Devices

Energy harvesting is an eagerly anticipated technology to generate electric power from ambient energy sources toward future Internet of Things (IoT) society. Thermoelectric generator (TEG) is an ultimate energy harvester to generate semipermanent power from heat energies via Seebeck effect. Recently, silicon nanowires (Si-NWs) emerged as a promising thermoelectric (TE) material, and the speaker is currently developing a Si-based micro TEG device which can be fabricated by the CMOS technology. Conventional demonstrations of Si-based TEG employed long Si-NWs suspended on a cavity to avoid the bypass of the heat current. Contrary, my research group proposed a novel design concept of planar and short Si-NW TEG without cavity structure. Our proposed device is driven by a steep temperature gradient exuding around a heat flow perpendicular to the substrate, and there is no need to suspend the nanowires on a cavity. The power density is scalable by shortening Si-NW to sub-µm length. It has been experimentally confirmed that the thermoelectric power was enhanced by shortening the nanowire, and tens of uW/cm2-class power generation was achieved.

Biography/Research Interests

Takanobu Watanabe was born in 1972. He received the Ph. D. degree from Waseda University in 1999. From 1997 to 2002 he was a JSPS research fellow. In 2003 he joined the faculty of Science and Engineering at Waseda University, and is presently a Professor at Waseda University. From 2003 to 2007 he was a principal investigator of a JST-PRESTO project, in which he developed a highly transferable molecular simulation method. In 2006, he was a Visiting Professor at the University of Southern California. He is currently a principal investigator of a JST-CREST project to develop the silicon-based micro thermoelectric generator. From 2018 he has been directing Research Institute for Ambientronics at Waseda University. From 2020 he serves also concurrently as the fellow of JST-CRDS. He is a member of the Japan Society of Applied Physics, and the IEEE.

Anita Ho-Baillie

John Hooke Chair of Nanoscience
Professor
University of Sydney School of Physics Member, University of Sydney Nanotechnolgoy Institute (Sydney Nano)
Sydney, Australia

Abstract: Perovskite Solar Cells

In this presentation, I will talk about some of the research on perovskite solar cells in my group including tandem solar cells and stability of perovskite solar cells. I will talk about the degradation mechanisms of perovskite cells under thermal stress and strategies developed to overcome thermal instability. Our perovskite solar cells were the first to exceed the strict requirements of International Electrotechnical Commission standards for damp heat and humidity freeze. Such a major breakthrough represents an important step towards commercial viability.

Biography/Research Interests

Anita Ho-Baillie is the John Hooke Chair of Nanoscience at the University of Sydney. She is a Clarivate Highly Cited Researcher in 2019 and 2020. Her research interests including engineering of solar materials and devices at nanoscale integrating them onto all kinds of surfaces generating clean energy for different applications. Her achievements include setting solar cell energy efficiency world records in various categories and reporting of highly durable perovskite solar cells placing her research at the forefront internationally.

Allison Tong

Principal Research Fellow
Professor
University of Sydney School of Public Health Member
University of Sydney Nanotechnolgoy Institute (Sydney Nano)
Sydney, Australia

Abstract: Research Priorities for Sensor Technology to Address COVID-19

The control of transmission and clinical management of COVID-19 remains a global challenge. In response, there has been increasing interest in developing sensor technology to improve the detection and surveillance of COVID-19. We aimed to identify research priorities among diverse stakeholders regarding the development and application of sensor technology to mitigate the impact of COVID-19. Consumers (including patients with or who had recovered from COVID-19), health professionals, scientists, engineers, researchers, industry representatives and policy makers completed a survey (n=43) and participated in an online workshop (n=65). The top three research priorities were: develop an instant point-of-care screening test for COVID-19, detect how infectious a person with COVID-19 is, and to identify the individual level of protective immunity to COVID-19 and its change over time. These priorities reflected the urgent need to enable more efficient clinical decision-making, to minimise disruption to people's lives and the economy, to protect the community including vulnerable populations, and to be prepared for future phases of the COVID-19 pandemic. Allocating resources to advance sensor technology in the most critical areas of need as identified by diverse stakeholders can strengthen the response to the COVID-19 pandemic and preparedness for future pandemics.

Biography/Research Interests

Allison Tong is a Principal Research Fellow at the Sydney School of Public Health, The University of Sydney; and holds a National Health and Medical Research Council Investigator Fellowship. She is a patient-centred outcomes researcher with an interest in patient involvement in research and co-production of clinical trials. She leads the global Standardised Outcomes in Nephrology (SONG) Initiative, which aims to establish consensus-based core outcomes across the spectrum of chronic kidney disease (www.songinitiative.org) and the international COVID-19 Core outcomes Set (COVID-19-COS, www.covid-19-cos.org) project. She established the Patient-Centred Research Network (PACER, www.pacernetwork.org.au) network, which aims to facilitate knowledge exchange, cross-disciplinary collaboration, and innovation in conducting and implementing patient-centred outcomes research and patient involvement in research.

Ronny van't Oever

CEO Micronit
MinacNed member
Chair nanotech roadmap of the Netherlands
Enschede, Netherlands

Abstract: Nano SME Activities

The ecosystem of companies using and supporting nanotechnology is historically strong. A brief historical perspective and overview of the nanotechnology related industry and its innovation power will be provided. Special attention will be given to recent COVID-19 related activities of the industry. Examples of medical devices and personalized diagnostics that are increasingly enabled by micro and nanotechnologies will be provided. In the recent decade semiconductor and MEMS related technologies have been used to develop products that solve the problems of today's society. The maturity level of the industry has progressed significantly and the tools are now ready to realize an enormous impact and possibly even disrupt the way people stay healthy. The market is moving from healthcare for people that are already ill to prevention and health and wellbeing management. A whole new industry that uses nanotechnology based solutions applied to health and wellbeing applications is emerging. The Netherlands has a rich ecosystem of nanotechnology companies that enable disruptive approaches for several large societal challenges.

Biography/Research Interests

In 1999, Ronny van 't Oever co-founded Micronit Microfluidics, currently known as Micronit Microtechnologies. Since 2011, he serves as Chief Executive Officer for this company. Prior to starting Micronit, Ronny van't Oever began his career at the Abbott Diagnostics Division in Santa Clara, California. With a passion to bring innovative products to the market, he recognizes the need to connect government, research institutes and industry. Therefore, he currently holds the position of member of the board of NanoNextNL for the nanotechnology roadmap for the Netherlands. NanoNextNL is a consortium of more than one hundred companies, universities, knowledge institutes and university medical centres, which is aimed at research into micro and nanotechnology. Ronny van 't Oever graduated with a master's degree in Physics at the University of Twente in Enschede. In 2007, he was awarded 'Engineer of the year' in the Netherlands.

Nanotechnology for a Sustainable Future

Oleg Stukalov

Business Development Manager
Waterloo Institute for Nanotechnology
University of Waterloo
Waterloo, Ontario, Canada

Abstract: Overview of Nanotechnology Entrepreneurship at the University of Waterloo

The Toronto-Waterloo Region Corridor has the world's second-highest density of start-ups trailing only behind Silicon Valley. As a direct outcome of the founding principles of experiential learning and entrepreneurial freedom, the University of Waterloo's impact on Canada's economy was estimated at CAD$170 million in 2018-19 alone. UW is home to Canada's only undergraduate nanotechnology engineering program and the nation's second-largest research program in the field. In combination, these programs feed into an impressive pipeline of world-leading nanotechnology start-up companies. Two already established and distinct routes towards creating such companies will be presented, together with a third one evolving rapidly.

Biography/Research Interests

Dr. Oleg Stukalov manages industry relations and supports start-ups companies at the Waterloo Institute for Nanotechnology. He holds a PhD in Applied Physics from Belarus Academy of Sciences and studied organic electronics materials. Shortly following his PhD, Oleg received the prestigious NATO Science Fellowship postdoctoral award and joined the Department of Physics at the University of Guelph. His research in the area of bio-nanotechnology resulted in a serendipitous lab discovery, which led to the foundation of a spin-off company, Mirexus Biotechnologies Inc. in 2008. Oleg served as a CEO until he passed company leadership to new management in 2012 and joined academia in a new capacity.

Adriënne J.A.M. Sips

Research coordinator Safety of Nanotechnology and Advanced Materials
RIVM
Netherlands

Abstract: Modern Innovation: Get Together, Work Together

The European Green Deal (GD) defines the Commission's commitment to tackling climate change and environmental-related challenges, setting ambitious goals like a zero-pollution approach for a toxicity-free environment. Modern innovation principles are put in place to achieve these transformative objectives. Preparedness, resilience, co-creation and citizens involvement are thought to be critical aspects. Key Enabling Technologies like nano-technology are expected to be conditional for reaching some of the transitions and goals of the European Green Deal. However, the adequacy of safety regulation for nano-technology is still under debate, in Europe as well as outside Europe. Present innovation policies are focussed on promoting technology development, whilst lacking a simultaneous, proportional push for appropriate risk governance. This is a unique situation, since regulation and standardisation determine market introduction and acceptance of innovations. For nanotechnology this resulted in a situation of ongoing uncertainty about safety of production processes, products and waste handling, thereby affecting the full exploitation of the economic potential of nanotechnology. The ambitious goals of the Green Deal promote high speed and game changing technology development transforming the ways in which people work, live and interact. Regulators, industry and civil society organizations are struggling to cope with all transitions and the uncertainties that come along. During this presentation initial ideas will be discussed on how a so-called Integrated Innovation System (IIS) could shed light on technology development, development of regulations and societal acceptance at the same time.

Biography/Research Interests

Adriënne Sips, PhD, is the research coordinator in nanotechnology and advanced materials, former coordinator of theme Risk Analysis and Technology Assessment (RATA) in the Dutch Nanotechnology Programme NanoNextNL (www.nanonextnl.nl), board member of the dutch Nano4Society foundation, member of the interministry workgroup on nanosafety, co-chair and founder of the RIVM WGnanotech, senior toxicokineticist, and vast experience as manager in various departments within RIVM. She has been involved in a broad spectrum of research activities and in bridging science to policy development at both national and international levels. She is one of the developers of the EU Flagship Project NANoREG and NanoReg2. She has coordinated the development of the H2020 Gov4Nano project proposal on risk governance of nanotechnology meeting the demands of modern innovation. She is one of the pioneers and developers of concepts as Safe by Design and Safe Innovation for chemicals bridging the world of safety research and technological innovations in the domain of nanotechnology. She is also co-initiator of RIVM projects on risks associated to novel technologies and the applicability of present and new risk governance systems.

Nanotechnology for a Sustainable Future

Linda Nazar

Canada Research Chair in Solid State Energy Materials
Professor
Department of Chemistry
Waterloo Institute for Nanotechnology
University of Waterloo
Waterloo, Ontario, Canada

Abstract: Unravelling the Complexities of Electrochemical Energy Storage at the Nanoscale

All of today's Li-ion energy storage devices (rechargeable batteries) work on the principle of reversible storage of electrons and Li-ions in bulk materials. Transport of these charge carriers is by solid state intercalation chemistry, where little change occurs to the framework that hosts them during the redox cycling of the cell. This can provide high power, but limited energy storage capability. Cells that operate on the basis of "chemical transformation" represent exciting new technologies that could meet the needs for high energy density storage that go beyond Li-ion. Nonetheless, they require thoughtfully designed nanomaterials for the cathode, different electrolyte strategies than those used for Li-ion batteries and advanced cell engineering. Guiding nanomaterials development for both the cathode and electrolyte also requires developing an understanding of the underlying chemistry of redox processes. The talk will address aspects of our fundamental investigations involving probes of redox chemistry and chemical speciation, along with new multifunctional nanostructured conductive materials for the electrodes which allow us to control processes at the electrolyte interface.

Biography/Research Interests

Linda Faye Nazar FRS FRSC OC is the Senior Canada Research Chair in Solid State Energy Materials and Distinguished Research Professor of Chemistry at the University of Waterloo. She develops materials for electrochemical energy storage. In 2020, she was awarded the prestigious Materials Research Society Medal, and inducted into the Royal Society London in recognition of her work.

Professor Linda Nazar's research focuses on developing new materials that can store and deliver electrochemical energy, and on advancing next-generation rechargeable battery research and design. Her research program encompasses complex material synthesis, physical/structural characterization, electrochemical testing and electrode design. Promising new directions particularly lie in nanomaterials, offering the possibility of moving into the realm of high-capacity systems that operate on the basis of intimate contact of the redox active components. The research employs a range of physical chemistry techniques, including ex-situ and in-situ studies involving X-ray/neutron diffraction, X-ray, impedance and NMR spectroscopies, combined with fundamental electrochemical studies used to examine the underlying processes in solids.

Professor Nazar has numerous awards, including Thomson Reuters Highly Cited Researcher for the past six years (2014 -2020); Fellow of the Royal Society UK (2020); MRS Medal (USA; 2020); Chemical Institute of Canada Medal (2019); Bailar Medal (Univ Illinois UC, 2019); Officer of the Order of Canada (2015); Fellow of the Royal Society of Canada (2011); IUPAC Distinguished Woman in Chemistry (2011); Distinguished Lecturer, Lawrence Berkeley National Laboratory (2011), the Rio Tinto Alcan Award of the Canadian Society for Chemistry (2011), and Moore Distinguished Scholar (California Institute of Technology) (2010).

Pieter Telleman

Managing Director
MESA+ Institute for Nanotechnology
University of Twente
Enschede, Netherlands

Abstract: Triple Helix Government-Industry-Research Institute

Universities have traditionally operated as support structures for innovation, providing training, research results and knowledge. Increasingly, intellectual capital was valued as much as financial capital and universities started to adopt valorization of knowledge as a key performance indicator. Abandoning the linear model of market pull and technology push universities started to play an active role in innovation where they were no longer sub-ordinate to industry or government, giving rise to the term triple helix. The model of a triple helix was introduced by Leydesdorff and Etzkowitz in the nineties as a model to describe the relationship between university, government and companies. In this relationship the participating parties at least in part take over some of their roles in an effort to structurally increase innovation in a knowledge driven society. This new dynamic contributed to new ways of business operations and policy making. No doubt, the collaboration between universities, government and industry provided a necessary way to provide society with a return of investment in scientific research. However, in the slip stream of the success of the triple helix funding of scientific research increasingly depends on growing financial contributions from industry. Funding of curiosity-driven scientific research is steadily declining in The Netherlands and in Europe. As we are observing these trends new models like the quadruple helix and upwards to n-tuple helices are introduced that build on the triple helix. Are we loosing the balance between unhampered research based on curiosity and strategic and thematic research?

Biography/Research Interests

Pieter Telleman is managing director of the MESA+ Institute ate The University of Twente. He received MSc degrees in organic chemistry and biochemistry at the University of Nijmegen, The Netherlands, and an MBA from the Technical University of Denmark. He has a PhD in medicine from the University of Amsterdam. He conducted postdoctoral fellowships in gene- and immunotherapy of cancer at Harvard Medical School. After moving to the Technical University of Denmark he started applying micro- and nanotechnology to chemistry and life sciences at the Institute of Nanotechnology and became managing director of the Institute.

David Sinton

Canada Research Chair in Microfluidics and Energy
Professor, Department of Mechanical and Industrial Engineering
University of Toronto
Toronto, Ontario, Canada

Abstract: Electrochemical Systems for CO_2 Conversion to Products

Renewably powered CO_2 electrocatalysis presents an opportunity to de-carbonize chemical production. Ultimate application of CO_2 reduction will require electrocatalytic systems that provide reactants, electrons, and products at high rate and efficiency, and that are compatible with upstream and downstream processes. I will outline our progress on membrane electrode assembly based cells to meet this challenge. To accommodate O_2 impurities from upstream processes we develop a hydrated ionomer catalyst coating that selectively slows O_2 transport and stabilizes the copper catalyst. To increase reaction rate and energy efficiency we develop an adlayer catalyst strategy that increases local CO_2 availability and tunes intermediate adsorption for ethylene production. For ethanol production we focus on minimizing product cross-over to the anode, and achieve ethanol production in excess of the 10wt% - comparable to bio-ethanol production and compatible with downstream processes. Lastly I will highlight learnings, challenges and opportunities arising from our system scaling efforts in the 2020 Carbon XPRIZE competition.

Biography/Research Interests:

David Sinton is a Professor in the Department of Mechanical & Industrial Engineering at the University of Toronto. He is the Canada Research Chair (Tier 1) in Microfluidics and Energy. He was the Associate Chair of Research in Mechanical & Industrial Engineering, as well as the Interim Vice-Dean of Research in the Faculty of Applied Science & Engineering. Prior to joining the University of Toronto, Dr. Sinton was an Associate Professor and Canada Research Chair (Tier 2) at the University of Victoria, and a Visiting Associate Professor at Cornell University. He received a BASc from the University of Toronto, MEng from McGill University and his PhD from the University of Toronto. The Sinton Lab develops fluid systems for applications in energy and analysis. The group is application-driven and is currently developing fluid systems to produce renewable fuels from CO_2 to develop energy efficient industrial working fluids, and to quantify the environmental impacts of future climate conditions. The group previously developed a library of industrial fluid testing systems to improve chemical performance in the energy industry, now commercialized through the start-up Interface Fluidics Ltd. Dr. Sinton was selected to be an NSERC E.W.R. Steacie Memorial Fellow in 2016. He is also a Fellow of the Canadian Society for Mechanical Engineering, a Fellow of the American Society of Mechanical Engineers, a Fellow of the Engineering Institute of Canada, a Fellow of the American Association for the Advancement of Science, and a Fellow of the Canadian Academy of Engineering. He serves on the advisory board of the journal Lab on a Chip.

Karim S. Karim

Executive Director, Center for Bioengineering and Biotechnology
Waterloo Institute for Nanotechnology
Professor, Department of Electrical and Computer Engineering
University of Waterloo
Waterloo, Ontario, Canada

Abstract: World's First Portable Dual Energy X-ray Detector for the Screening and Monitoring of COVID-19 Pneumonia

Dual-energy (DE) radiography is a technique that can remove specific anatomical noise from a radiograph and generate tissue-subtracted images. Typically, a trio of images is presented comprised of a standard digital radiography (DR) image, a soft-tissue image where the bone tissue has been removed, and a bone image where the soft tissue is not present. Dual energy X-ray images have been demonstrated clinically over 20 years to provide significantly better detection of pulmonary diseases (including pneumonia, pneumothorax, lung nodules, and tuberculosis) compared to traditional digital X-ray. However, current dual-energy X-ray approaches use two sequential, spectrally different X-ray exposures that cause motion artifact streaks in the image and also demand a fixed bulky system with a special X-ray source and a well-defined source to detector geometry. In this research, we will describe the decade long ideation, development and commercialization of a portable, single-shot, dual-energy large area flat-panel X-ray detector that achieves dual energy images, excellent dose efficiency with zero motion artifact. This detector, called Reveal, is US FDA cleared and is being used for the detection of pneumonia (including COVID-19) and lung cancer in multiple hospitals across Canada. The Reveal detector is universally compatible with all X-ray systems (CR, DR, fixed, mobile) enabling a high impact performance improvement to the entire global install base of 500,000 medical X-ray machines. Like color photographic film replaced black and white film, Reveal is initiating a global transition from black and white X-ray to dual energy or color X-ray to usher in a new era of higher sensitivity, point-of-care X-ray diagnostics for better patient outcomes and value driven healthcare.

Biography/Research Interests

Karim S. Karim received his BASc and PhD in Electrical Engineering from the University of Waterloo, and an MBA in Health Sector Management from the University of Toronto. He is the Executive Director for the Center for Bioengineering and Biotechnology and a Professor of Electrical and Computer Engineering at the University of Waterloo. Since 1998, Karim has developed novel X-ray imaging devices and methods. He has trained over 40 PhD and MASc students, has co-authored 250+ publications and has 50+ patents. Karim has supported multiple startups and founded multiple companies in the past two decades including KA Imaging, a University of Waterloo spinoff where he is the Chief Technology Officer (CTO). KA Imaging is commercializing his X-ray research including Reveal, the world's only portable dual energy spectral X-ray detector that recently received US FDA 510(k) clearance and is now being used clinically in North America to detect lung cancer and pneumonia (including COVID-19) with higher sensitivity than conventional X-rays. Some of the pixel circuit technology developed during Karim's graduate work is also now used in ultrasonic fingerprint sensors in commercial mobile phones and tablets including the Samsung S10.

Albert van den Berg

Co-Scientific Director
MESA+ Institute for Nanotechnology
Professor, Faculty of Electrical Engineering
Biomedical and Environmental Sensor Systems (BIOS)
University of Twente
Enschede, Netherlands

Abstract: From Lab on Chip to Organ on Chip

The recent rapid developments in bionanotech and micro/nanofluidic technologies has enabled the realization of miniaturized laboratories. These Labs-on-Chips will play an important role in future medicine, both in point-of-care devices for drug or biomarker monitoring, as well as in early diagnostic devices. We developed a pre-filled ready-to-use capillary electrophoresis platform for measuring ions in blood. It is used to monitor lithium in finger-prick blood of manic-depressive patients, but can also be used for measuring calcium in blood for prevention of milk fever, or for measuring creatinine in blood or sodium in urine for early detection of ESRD. Microfluidics can also be exploited to manipulate and experiment with cells on chip. We have developed a microsystem for sperm analysis and selection for artificial insemination, where we can electrically detect and sort healthy sperm cells. Using microdevices we have been able to electroporate and transfect genes into individual cells, and a microdroplet platform was used for encapsulation of single cells in microdroplets, ordering of these microdroplets and 1:1 fusion of these droplets to form hybridomas. Apart from diagnostic and cell manipulation devices, microfluidic devices are increasingly used to realise advanced disease and organ-models, as illustrated by the blood-brain barrier chip and a blood vessel on a chip to study atherosclerosis. These Organs on Chip may lead to more rapid and cheaper drug development, personalised medicine and improved disease models, while minimizing or even eliminating animal testing (3R principle). Very recently, we started studying plat cells (phytoplankton, coccolithophores) on chip to investigate the carbon sequestrating capabilities under varying conditions and the potential role of this plankton in negative (carbon) emission technologies (NET).

Biography/Research Interests

Albert van den Berg received his MSc in applied physics in 1983, and his PhD in 1988 both at the University of Twente, the Netherlands. From 1988-1993 he worked in Neuchatel, Switzerland, at the CSEM and the University (IMT) on miniaturized chemical sensors. From 1993 until 1999 he was research director Micro Total Analysis Systems (µTAS) at MESA, University of Twente. In 1998 he was appointed as part-time professor “Biochemical Analysis Systems”, and later in 2000 as full professor on Miniaturized Systems for (Bio)Chemical Analysis in the faculty of Electrical Engineering. In 2002 he received the Simon Stevin Master award from the Dutch Technical Science foundation (STW). In 2003 he headed a 10 MEuro national research program on nanofluidics (NanoNed). In 2005 he spent 6 months in San Diego (USA) at the La Jolla Institute for Allergy and Immunology (LIAI, group Green) during a sabbatical leave, while he received an Advanced Research Grant from ERC in 2008. In 2009 he received the Spinoza prize, the most prestigious dutch scientific award, for his achievements in lab-on-a-chip research. In 2010 he was appointed as honorary University Professor at the University of Twente. Albert van den Berg is member of the Royal Dutch Academy of Sciences (KNAW), the Dutch Health council, board member of the Chemical and Biological Microsystems Society, member of the Dutch chemical society (KNCV) and deputy chair of the journal Lab on a Chip. He has co-authored over 220 papers (H=36) and over 10 patents, and has been involved in > 5 spin-off companies. His current research interests focus on microanalysis systems and nanosensors, nanofluidics and single cells and tissues on chips, especially with applications in personalized health care and development of sustainable (nano)technologies.

Warren C. W. Chan

Professor, Institute of Biomaterials & Biomedical Engineering (IBBME)
Donnelly Centre for Cellular and Biomolecular Research
University of Toronto
Toronto, Ontario, Canada

Abstract: Challenge of Delivering Nanoparticles to Solid Tumors

Nanotechnology involves the engineering of structures, materials, and particles in the size range of 1 to 100 nm. These nanostructures have unique biological, optical, electrical and magnetic properties that are in direct relationship to their size, shape, and surface chemistry. As a result of these properties, nanotechnology is currently exploited in medicine for diagnosing and treating diseases. In this presentation, the properties of nanomaterials and challenges associated with using them for cancer targeting will be discussed. Specifically, the discussion will focus on how biological fluids and serum proteins influence the morphology, surface chemistry, and targeting ability of the nanoparticles in cells outside and inside the body. We will further describe chemical strategies using DNA-based molecular assembly to address the nanoparticle “delivery” challenge.

Biography/Research Interests

Dr. Chan is currently the Canadian Research Chair in Nanoengineering in the Institute of Biomedical Engineering at the University of Toronto. He is also the Head of Biomedical Engineering Institute. Dr. Chan received his B.S. degree from the University of Illinois in 1996, Ph.D. degree from Indiana University in 2001, and post-doctoral training at the University of California (San Diego). He moved to Toronto in 2002 to lead the Integrated Nanotechnology/Biomedical Sciences Laboratory. His research interest is in the development and translation of nanotechnology for diagnosing and treating cancer and infectious diseases. He has received NSERC E. W. R. Memorial Steacie Fellowship, Kabiller Young Investigator Award in Nanomedicine, the BF Goodrich Young Inventors Award, Lord Rank Prize Fund award in Optoelectronics (England), and Dennis Gabor Award (Hungary). He is currently an Associate Editor of ACS Nano. Finally, he is also affiliated with a number of different departments at the University of Toronto: Department of Materials Science and Engineering, the Terrence Donnelly Center for Cellular and Biomolecular Research Chemistry, Chemistry and Chemical Engineering.

Nanotechnology for a Sustainable Future

Karin Schroen

Professor of Food Process Engineering
Wageningen University
Wageningen, Netherlands

Abstract: Micro- and Nanotechnology for Sustainable Food and Water Production

Micro- and nanotechnology both hold great promises to achieve both sustainable food and water production. Due to the very small scale at which they can probe phenomena, this leads to insights that otherwise could not be achieved. In this presentation, I will give a flavor of the multitude of applications in which micro- and nano technology are used. Examples will be taken from on sensing: on the land, such as tailored nutrient delivery for optimized growth, or in the factory, to minimize food waste, or even all the way at the consumers who could benefit from freshness sensors on food packages. Furthermore, separation methods are presented as way to obtain functional fractions from raw materials. Also, tools to analyze e.g. protein functionality as part of the proteins transition possible, will be presented in detail. In doing so, it is possible to improve current food and water processes greatly. Away from current options, I will also address options that are further into the future, such as measurement of digestion on chip, which would allow reversed food design. This can be taken even one step further when analyzed within organs on chip, leading to analysis of health effects. These are futuristic perspectives that may ultimately lead to the design of food that is healthy on a personalized level.

Biography/Research Interests

In September 2012, Karin Schroën was appointed as full professor in food process engineering at Wageningen University, the Netherlands. Currently she heads a research group of approximately 20 people, taking the micrometre and nano-scale as a starting point of investigation. Based on insights obtained at these scales, novel mild process technology is designed, typically for the emulsification, and membrane separation field. She is highly motivated by sustainable food processing concepts. She has 200 publications in scientific journals to her name, approximately 15 book chapters, and 7 patents. She is frequently asked as a (keynote) speaker at conferences, workshops etc. and takes part in many national en international communities dedicated to membrane technology, food technology, micro/nanotechnology, modelling, and so forth.

Guus Rijnders
Co-Scientific Director
MESA+ Institute for Nanotechnology
University of Twente
Enschede, Netherlands

Abstract: Nanomaterials for Energy & Sustainability and NanoLabNL Facilities

Climate change motivates the shift from fossil-fuels to renewable energy to decarbonize our world. Several hurdles have to be taken before we can take full advantage of such renewable energy sources. For instance, the electricity produced in wind and solar farms fluctuates heavily in time, and storage of intermittent renewable energy is therefore crucial for the successful realization of the energy transition in our society. In contrast to the traditional centralized electricity system, which doesn't require much storage as power generation can be adjusted to match demand, the future electricity system will be based on renewable energy generation in conjunction with decentralized energy storage. A lot of research is devoted to increase the conversion and storage capacity of, for instance, photovoltaics and batteries, respectively. In both technologies, the development of new materials with improved functional properties is key. In this contribution, I will highlight the recent developments in functional materials for use in photovoltaics and batteries. I will focus on atomic controlled growth of perovskite materials by pulsed laser deposition (PLD), and the structure-property relations of these materials. Furthermore, I will show recent advances in large area deposition using PLD.

Biography/Research Interests

Guus Rijnders is head of the inorganic materials science group and scientific director of the MESA+ institute, both at the University of Twente. Furthermore, he is chair of the board of NanolabNL, the consortium of cleanroom/nanotechnology laboratories in the Netherlands. His research is related to the materials science of complex materials, mostly used for electronic devices. The research focuses on the structure-property relation of atomically engineered complex (nano)materials, especially thin film complex oxides. The class of investigated materials includes, amongst others, 2D interfaces in oxides, ferromagnetic, ferroelectric as well as piezoelectric materials. He has advanced the field of atomic-controlled thin film growth of complex oxides by the development of in-situ high-pressure RHEED controlled PLD, which resulted in a significant revival in the field of atomic controlled growth of functional oxide materials. Next to the aforementioned scientific directions, he started public-private partnerships in the field of functional and smart materials, such as piezoelectric and ferroelectric materials, and their integration with electronic and micro electromechanical systems (MEMS), for applications in, amongst others, ultrasound and sensing devices. Recently, he started research directions in the field of neuromorphic computing (brain- inspired materials systems) and electronic storage materials and devices.

Nanotechnology for a Sustainable Future

Goretty Dias

Professor
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Faculty of Environment
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University of Waterloo
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Abstract: Circularity, Resources, and Technology: Achieving Sustainable Development

The Sustainable Development Goals and Agenda 2030 cannot be achieved with 'business-as-usual' approaches. Instead transformational and innovative thinking are required, including whole-systems approaches that consider the life-cycle of resource use and development. Getting such an aspirational agenda wrong is not an option. Getting it right means reduced risks to businesses caused by price volatility and supply chain disruptions, reduced geopolitical risks for critical materials, savings on raw material costs, job creation, and achieving environmental and social justice. This means that technology development cannot occur in a vacuum, but instead has to consider a systems approach, commonly called "cradle-to-grave", that looks at upstream, downstream, and indirect impacts associated with that technology system. Using an Industrial Ecology lens, we will explain and provide examples of the circular economy, and outline the most pressing resource concerns related to scarcity, and environmental and social conflicts. We will discuss the need for eco-design for circularity, and how to assess sustainability of early-stage technology, in a way that considers the environmental, social and economic implications of resource use, so as to avoid lock-in of technologies that do not benefit societies. Finally, we will present the tensions that exist with respect to the circular economy, resource use and management, and achieving the SDGs.

Biography/Research Interests

Dr. Goretty Dias is a professor in the SEED within the Faculty of Environment at the University of Waterloo, Canada. She holds a PhD in Atmospheric Science from the University of Guelph, and has 30 years of combined experience in greenhouse gas measurement and analysis, environmental modeling, and product life cycle modeling. Goretty's research bridges the natural and social sciences in order to provide holistic evidence-based solutions for sustainability issues occurring throughout the supply chain for various products and services. Using an interdisciplinary lens, she combines environmental sciences, industrial ecology, and sustainability science, to study food and agricultural systems and emerging technologies. Her current research includes sustainability assessment of: Controlled Environment Agriculture Technologies (e.g. aquaponics, hydroponics, vertical farms, etc.); bioproducts; alternative sources of protein; and dietary patterns.

This presentation was co-authored by Dr. Steven B. Young, an industrial ecologist in the School of Environment, Enterprise & Development in the Faculty of Environment. Following 15-years of consulting in the private sector, he now researches management approaches to build a circular economy to meet the needs of people today and for future generations. This includes making commodity materials like steel and concrete more sustainable resources -- and ensuring responsible access to materials like tungsten and tantalum that are critical for a low-carbon society. Since 1999 he has taught at Waterloo on environmental management, corporate responsibility and sustainable development.

Drs. Steve Young and Goretty Dias are founding members of the Waterloo Industrial Ecology Group, a diverse research group that uses an interdisciplinary approach to understanding complex sustainability issues related to food, resources, metals, and urban and international development.

Nanotechnology for a Sustainable Future

Jatin Nathwani

Executive Director, Waterloo Institute for Sustainable Energy
Waterloo Institute for Nanotechnology
Professor, Department of Management Sciences
University of Waterloo
Waterloo, Ontario, Canada

Abstract: Sustaining a Clean Energy Transition Beyond COVID

Professor Nathwani will focus on the unique challenges of a global energy transition to a clean energy future. The talk will highlight the need for accelerating critical investments in a circular economy enhanced through digitalization and technological innovations.

Biography/Research Interests

Professor Nathwani is the founding Executive Director, Waterloo Institute for Sustainable Energy (WISE) at the University of Waterloo. As the inaugural Ontario Research Chair in Public Policy for Sustainable Energy(2007-2020), he has led research initiatives on accelerating energy transitions for a zero-carbon economy through systems assessments of technology, financing strategies, risk management and public policy. Professor Nathwani, co-Directs with Prof Joachim Knebel (Karlsruhe Institute of Technology, Germany) the Global Change Initiative - Affordable Energy for Humanity (AE4H). The consortium comprises 150+ leading STEM and social science researchers, energy access thought leaders and practitioners from 50 institutions in 30 countries committed to eradicating energy poverty by 2030. The vision of WISE is to advance foster research and development for clean energy solutions that remain accessible and affordable for all. WISE brings together the expertise of all the faculties at UW to spur innovation, develop and deploy and spur innovation through multi-disciplinary research projects in collaboration with businesses, industry, governments, and civil society groups. Prior to his appointment at the University in 2007, Professor Nathwani worked in a leadership capacity in the Canadian energy sector for 30 years. He brings a unique combination of academic perspectives with extensive experience in the business sector that includes corporate planning and strategy, energy sector restructuring, integrated power system planning, environmental and regulatory policy developments, and research program management. Professor Nathwani serves on several Boards at the provincial and national levels and has appeared frequently in the media (print, TV, radio) and has over 100 publications related to transition road-maps, energy policy, environment and climate risk management, including seven books. He is a Registered Professional Engineer in the Province of Ontario, Canada.

Ken Uchida

Professor
Department of Materials Engineering
The University of Tokyo
Tokyo, Japan

Abstract: Nanoscale Thermal Management for Low-Energy Integrated Electronics in the Internet-of-Things era

Hydrogen is an important biomarker for the human digestive system. However, accurate detection of ppm-level hydrogen in breath is difficult due to the competing detection of high concentration water. We fabricated Pt thin films that respond to hydrogen in air at concentrations as low as 500 ppb [1]. In both dry and humid air, these films have almost identical response to hydrogen. Even at high relative humidity, the Pt thin films can detect ppm-level hydrogen. In addition, to demonstrate the feasibility of a fast, low-energy breath diagnosis method, multi-molecular detectable sensors utilizing Joule self-heating were developed [2]. The sensors consisted of suspended graphene films functionalized with Pd nanoparticles as sensing layers and utilized self-heating to achieve fast responses and humidity robustness with low energy consumption. Thanks to nanoscale point contacts between the graphene and Au electrodes, heat dissipation to the electrodes was greatly suppressed. By applying an appropriate voltage bias, the graphene temperature was increased with a low power consumption. Finally, we demonstrated voltage-controlled multi-molecular detection by self-heating. Fast, low-energy multi-molecule detection realized by self-heating paves the way for mobile, low-power, real-time molecular sensors for use in health diagnosis applications.

[1] T. Tanaka et al., Sensors and Actuators B., vol. 258, 913, 2018
[2] T. Yokoyama et al., ACS Appl. Nano Mater., vol. 1, 3886-3894, 2018.

Biography/Research Interests

Ken Uchida is a professor in the School of Engineering, The University of Tokyo. He received his B. S., M. S. and Ph. D degrees from The University of Tokyo in 1993, 1995, and 2002, respectively. He has studied carrier and thermal transports in nano-scaled materials and developed advanced transistors and molecular sensors. He has studied carrier transport in nanoscale devices such as Single-Electron Devices, Schottky source/drain MOSFETs, Ultrathin-body SOI MOSFETs, Strained Silicon MOSFETs, Carbon Nanotube Transistors, (110) Si MOSFETs, self-heating effects on nanoscaled electronic devices. Recently, he is focusing on molecular sensors for health diagnosis.

Ryotaro Matsuda

Professor
Department of Materials Chemistry
Nagoya University
Nagoya, Japan

Abstract: Management of Gas and Heat by Nanoporous Metal Complexes

Nanoporous solids having a large nano-sized space in the structure can trap various molecules and ions. The devices based on nanoporous solids have been extensively studied for the applications in gas storage and separation, water purification, energy conversion, and so on. Research on nanoporous materials are essential in the academic field of nanotechnology and indispensable for our sustainable future. To create a new function or enhance the performance of the nanoporous devices, it is necessary to design the structures and properties of nanoporous materials at the molecular level. Recently, metal-organic frameworks (MOFs) or nanoporous metal complexes, composed of organic ligands and metal ions, have attracted attention. While MOFs are crystalline solid, some of them can dynamically and flexibly transform their structure in response to external physical and chemical stimuli.[1,2] Dynamic effects can arise either locally from flexible ligands and/or flexibility of the coordination geometry of the metal ions, or from the global cooperative movement of the framework on a periodic scale. The switchable structure enables highly selective capture of molecules and molecular adsorption and desorption with low energy consumption, which cannot be realized in the other conventional nanoporous solids. Further, MOFs have high freedom to incorporate various functionalities in the skeleton, such as photo-reactive modules.[3-5] In this presentation, we will focus on MOFs having flexible and/or stimuli-responsive frameworks and introduce some functions and mechanisms of selective gas trapping. Also, we will present prospects for heat control devices using MOFs.

References:
[1] Science, 2014, 343, 167-170.,
[2] J. Am. Chem. Soc. 2019, 141, 15742-15746.
[3] Nature Chem. 2010, 2, 633 - 637
[4] Nature Mater. 2010, 9, 661-666.
[5] Small, 2020 in press.

Biography/Research Interests

Ryotaro Matsuda received his doctoral degree in engineering from Kyoto University, Japan in 2005. In 2006 he started to work at Kyushu University as an Assistant Professor. In 2008, he was appointed group leader of ERATO Project promoted by Japan Science and Technology Agency (JST), and after that, in 2013, he became an Associate Professor at the Institute for Integrated Cell-Material Sciences, Kyoto University. Since November 2015, he is a Full-Professor at the graduate school of engineering, Nagoya University. In the meantime, he also worked as a PI researcher of PRESTO program promoted by JST from 2014 to 2018. He advanced research on molecular recognition in the nanospace of Porous Coordination Polymers (PCPs) or Metal-Organic Frameworks (MOFs), so as to develop new porous materials for molecular storage and separation. His research group is also interested in the creation of structurally transformable MOFs, so-called flexible MOFs that can change sorption behaviors in response to external physical or chemical stimuli. In addition, his expertise in the field of measurement technology as well as synthetic chemistry and developed various original in-situ measurement systems.

Ali Abbas

SOAR Fellow
Associate Professor
University of Sydney School Chemical and Biomolecular Engineering Health
University of Sydney Nanotechnolgoy Institute (Sydney Nano)
Sydney, Australia

Abstract: Opportunity and challenges of nanomaterials in the Circular Economy

Our consumption patterns are linear – 'take-make-dispose' – resulting in colossal waste and pollution problems facing human society. Implementation of circular economy concepts can offer a vast opportunity to address these problems. This talk presents a discussion on the role of innovations in nanomaterials science and engineering in the development of circular products across industry sectors. The challenges for nano-innovations in aligning with circular economy guiding principles will be reviewed to direct innovation towards sustainable and economic outcomes.

Biography/Research Interests

Ali Abbas is Associate Professor and SOAR Fellow at the University of Sydney in the School of Chemical and Biomolecular Engineering. He is the founder and director of the Laboratory for Multiscale Systems and is Director of the Waste Transformation Research Hub, a national centre aimed at addressing the waste industry's research and technological challenges. Dr Abbas received both his Bachelors and PhD in Chemical Engineering from the University of Sydney, Australia. He has held previous academic appointments at NTU (Singapore) and UNSW Asia (Singapore) and visiting professor positions at several institutions including Harvard. His engineering research and expertise is in Process Systems Engineering with application to clean energy, waste biotechnology and biomedical systems. In recent years, he has been working on circular economy transitions, identifying ways to translate the circular economy principles into practice. He conducts fundamental computational and applied research with emphasis on multi-scale systems resource optimisation and efficiency, and has published more than 100 papers in international scientific and engineering journals. Dr Abbas is the recipient of multiple awards including the Australia-Harvard Fellowship 2011 as well as the Academy of Technological Sciences and Engineering (ATSE) Fellowship 2012 (Australia-China Future Leader in Clean Coal Technologies). In 2008, Dr Abbas was awarded the PSE Model-based innovation prize (London, UK) recognising his work in model-based optimal process operations, and received the same award as runner-up in 2015. Recently he received the inaugural Sydney Research Accelerator (SOAR) fellowship for University's most talented researchers in recognition of research leadership. He provides consultations to industry and Government and is Founding Director of Scimita Ventures Pty Ltd – a deep tech consulting company pioneering product innovations across industry sectors. He is also developing several technologies including an AI technology for vertical farms.