

# **UW - TU Joint Workshop on Materials and Devices**

**Mar 4, 2026 7:00 PM - 8:30 PM (EST)**

**Mar 5, 2026 9:00 AM - 10:30 AM (JST)**

**Online**



**UNIVERSITY OF  
WATERLOO**



**WATERLOO INSTITUTE FOR  
nanotechnology**



**TOHOKU  
UNIVERSITY**

# UW - TU Joint Workshop on Materials and Devices

## University of Waterloo Waterloo Institute for Nanotechnology (WIN)

The Waterloo Institute for Nanotechnology (WIN) is Canada's largest nanotechnology institute, and an innovation powerhouse in the four key thematic research areas of smart and functional materials, connected devices, next generation energy systems and therapeutics and theranostics.

Housed in the custom-built Mike and Ophelia Lazaridis Quantum-Nano Centre (QNC), WIN scientists and engineers have access to state-of-art research infrastructure to support their endeavours. Aligning their research interests with the United Nations Sustainable Development Goals, WIN members are creating new materials and system to improve the economy, the environment, our health and welfare, and society as a whole.

## Tohoku University Semiconductor Technology Co-creation (STC2)

The Semiconductor Technology Co-creation (STC2) at Tohoku University is a collaborative initiative focused on advancing semiconductor technologies through interdisciplinary research and international partnerships. Tohoku University is one of Japan's leading research universities, renowned for its contributions to materials science, electronics, and advanced manufacturing.

With world-class facilities including the NanoTerasu synchrotron radiation facility and leading research institutes such as the Advanced Institute for Materials Research (AIMR), the Research Institute of Electrical Communication (RIEC), and the Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Tohoku University provides an exceptional environment for cutting-edge research in nanotechnology, quantum devices, and semiconductor technologies.

## Workshop Purpose

- Expand research engagement between WIN and Tohoku University (TU)
- Identify complementary expertise for future collaboration
- Explore new research themes in materials, devices, and semiconductors
- Build momentum toward the UW-TU Joint Seed Funding Framework



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# Agenda

Time	Event	Speaker
EST : 19:00 - 19:06 (6 min) JST : 09:00 - 09:06 (6 min)	Opening Remarks	Prof. Sushanta Mitra Prof. Kentaro Totsu
EST : 19:06 - 19:13 (7 min) JST : 09:06 - 09:13 (7 min)	Phase contrast nano-CT using sub-10 micron pixel direct conversion X-ray detectors	Prof. Karim Karim, <a href="#">University of Waterloo</a>
EST : 19:13 - 19:20 (7 min) JST : 09:13 - 09:20 (7 min)	A 3D printable all-solid-state Li-ion battery	Prof. Itaru Homma, <a href="#">Tohoku University</a>
EST : 19:20 - 19:27 (7 min) JST : 09:20 - 09:27 (7 min)	AI-driven sensor networks, quantum-inspired NEMS/THz devices, and multifunctional microsystems	Prof. Mustafa Yavuz, <a href="#">University of Waterloo</a>
EST : 19:27 - 19:34 (7 min) JST : 09:27 - 09:34 (7 min)	Cutting-Edge Synthesis of 1D and 2D Atomic Layer Materials	Prof. Toshiaki Kato <a href="#">Tohoku University</a>
EST : 19:34 - 19:41 (7 min) JST : 09:34 - 09:41 (7 min)	Biomaterials nanotopography for regenerative medicine applications	Prof. Evelyn Yim <a href="#">University of Waterloo</a>
EST : 19:41 - 19:48 (7 min) JST : 09:41 - 09:48 (7 min)	Semiconductor Quantum Technologies Using Artificial Nanostructures and Emerging Materials	Prof. Tomohiro Otsuka <a href="#">Tohoku University</a>
EST : 19:48 - 19:55 (7 min) JST : 09:48 - 09:55 (7 min)	Functional oxide materials as proton conductors and memristors	Prof. XiaoYu Wu <a href="#">University of Waterloo</a>
EST : 19:55 - 20:02 (7 min) JST : 09:55 - 10:02 (7 min)	Fabrication and Electrical Validation of Ultimately Scaled 2D Transistors Toward THz ICT, Supported by Operando X-ray Nanospectroscopy	Prof. Hirokazu Fukidome <a href="#">Tohoku University</a>
EST : 20:02 - 20:09 (7 min) JST : 10:02 - 10: 09 (7 min)	Recent advances in energy harvesting technologies	Prof. Armaghan Salehian <a href="#">University of Waterloo</a>
EST : 20:09 - 20:30 (21 min) JST : 10:09 - 10:30 (21 min)	Discussion, wrap-up, confirmation of next steps identifying specific research projects	All participants

# Tohoku University Presenters



## Itaru Honma

Professor

Director, Centre for Mineral Processing and Metallurgy,  
Institute of Multidisciplinary Research for Advanced  
Materials (IMRAM)

### A 3D printable all solid state Li-ion battery

3D printing technologies have been adapted to enable all solid-state lithium-ion battery (LIBs) fabrication, allowing flexible designs such as scalable 3D shapes. We studied quasi-solid state electrolytes composed of ionic liquids and silica nanoparticles, that show liquid-like mobility within solid state matrix. The electrolyte maintains its structural integrity and high Li-ion conductivity, enabling quasi-solid state (QSS) Li-ion batteries.

Keywords : All solid state Li- ion battery, Nanomaterials, 3D printing, Battery manufacturing



## Toshiaki Kato

Professor

Department of Electronic Engineering, Graduate School  
of Engineering/ Advanced Institute for Materials  
Research (AIMR)

### Cutting-Edge Synthesis of 1D and 2D Atomic Layer Materials

Atomic layer materials exhibit extraordinary electronic, optical, and quantum properties arising from their reduced dimensionality and tunable symmetry. We develop advanced synthesis strategies for both 1D and 2D atomic layer materials with atomic-scale structural precision. Using plasma-assisted chemical vapor deposition, we have achieved scalable integration growth of graphene nanoribbons with controlled width and alignment, establishing a platform for low-dimensional carbon electronics [1,2]. Building on this capability, we have discovered a new catalyst that enables selective growth of (6,5) carbon nanotubes, providing a pathway toward chirality-pure nanotube production [3]. We further extend our structural engineering approach to transition metal dichalcogenides (TMDs), achieving Janus engineering and curvature-induced structural transformation [4,5]. Beyond materials synthesis, we are advancing these materials into quantum devices, such as Josephson junctions and superconducting hybrid structures, to explore next-generation quantum functionalities. [1] Nature Nanotechnology, 7 (2012) 651-656. [2] Nature Communications, 7 (2016) 11797-1-10. [3] ACS Nano, 18 (2024) 23979-23990. [4] ACS Nano, 18 (2024) 2772-2781. [5] ACS Nano, 19 (2025) 34918-34927.

Keywords : Nanotechnology, Materials, microsystems

# Tohoku University Presenters



## Tomohiro Otsuka

Associate Professor

Advanced Institute for Materials Research (AIMR)/

Research Institute of Electrical Communication (RIEC)

### **Semiconductor Quantum Technologies Using Artificial Nanostructures and Emerging Materials**

Semiconductor qubits are considered one of the candidates for realizing large-scale quantum computing, and silicon-technology-based quantum chips have recently seen rapid progress. Further improvements in performance and functionality require not only the optimization of conventional device structures but also the incorporation of emerging materials that expand controllability and quantum properties. This presentation introduces qubit devices based on artificially engineered nanostructures and discusses material characteristics that strongly influence quantum behavior. It further outlines the potential for advancing quantum devices through the use of new materials and highlights research directions that may foster collaboration between materials science and quantum-device research communities.

Keywords : Nanotechnology, Materials, Semiconductors, optical and atomic physics



## Hirokazu Fukidome

Associate Professor

Research Institute of Electrical Communication (RIEC)

### **Fabrication and Electrical Validation of Ultimately Scaled 2D Transistors Toward THz ICT, Supported by Operando X-ray Nanospectroscopy**

Next-generation information and communication technologies (ICT) demand radical advances in device performance and energy efficiency, including power amplification in the THz regime. I study ultimately scaled transistors, with an emphasis on fabrication and electrical validation, aiming for high energy efficiency and order-of-magnitude gains in output power. By orthogonally integrating graphene and transition-metal dichalcogenides (TMDs), I achieve sub-nanometer effective gate lengths and channel thicknesses (<1 nm) without advanced lithography and demonstrate DC transistor operation. To support optimization and reliability, I use operando X-ray nanospectroscopy under electrical bias—an approach I developed—to map electronic and chemical states with elemental selectivity at synchrotron facilities such as NanoTerasu (situated in the campus of Tohoku University) and SPring-8. This workflow links fabrication, operation, and in-device diagnostics, providing quantitative feedback for nanoscience-guided design toward future THz ICT.

Keywords : Nanotechnology, Materials, Thin-film surfaces and interfaces

# University of Waterloo Presenters



## Karim Sallaudin Karim

Professor

Department of Electrical and Computer  
Engineering

### **Phase contrast nano-CT using sub-10 micron pixel direct conversion X-ray detectors**

This talk will describe the development of a phase contrast nano-CT with sub-micron spatial resolution that was directly enabled by a previously reported in-house developed direct conversion 8-um pixel X-ray detector. The nano-CT enables phase contrast imaging that enhances visualization of structures at the nano scale that are traditionally transparent to X-rays. The nano-CT opens up new applications for biomedical research, materials science, electronics, and non-destructive testing where the system excels in detailed 3D visualization of fine structures across multiple disciplines.



## Mustafa Yavuz

Director

Graduate Nanotechnology Program

Professor

Department of Electrical and Computer  
Engineering

The Nano and Micro Systems Lab (NMSL) at the University of Waterloo, led by Dr. Mustafa Yavuz, is advancing metal-insulator-metal (MIM) terahertz (THz) tunneling diode technology through the innovative use of defective functional materials. Building on Dr. Yavuz's extensive research in nanoscale manufacturing, PECOD and NEMS sensors, quantum and plasmonic devices, and high-frequency electronics, the group is redefining how intrinsic material defects can be engineered as performance-enhancing features rather than limitations. Recent NMSL work demonstrates that controlled defect states in ultrathin oxides and 2D materials can significantly improve tunneling efficiency, device nonlinearity, and THz response—capabilities that are increasingly critical for AI hardware acceleration, next-generation chemical/biological sensing platforms, and compact THz communication systems. These advances position MIM-THz tunneling diodes as foundational components for future intelligent, fast, and resilient microsystems. Through collaboration with colleagues at Tohoku University, the Waterloo team aims to unify materials innovation, atomic-scale device engineering, and system-level integration. Together, the research groups seek to push forward new architectures for AI-driven sensor networks, quantum-inspired NEMS/THz devices, and multifunctional microsystems that can operate reliably in extreme environments and high-frequency domains.

# University of Waterloo Presenters



## Evelyn Yim

Canada Research Chair in Nanomaterials for  
Regenerative Medicine (Tier 1)

Professor

Department of Chemical Engineering

### **Biomaterials nanotopography for regenerative medicine applications**

Biological cell niche comprises of biochemical and biophysical signals. An ideal scaffold for tissue engineering application should mimic the microenvironment and present the appropriate biochemical and biophysical cues such as topographies and rigidity to regulate cellular responses. Our research group is interested in studying the interfacial interactions of cells with the extracellular substrate and how to apply this knowledge to stem cell differentiation and tissue engineering applications. We are also interested to explore application of novel materials for tissue engineering applications. In this presentation, nanotopography-modulation on cell behaviors for applications in small diameter vascular grafts and corneal tissue engineering will be presented as examples of applying nanotopography in regenerative medicine applications.



## XiaoYu Wu

Associate Professor

Department of Mechanical and Mechatronics  
Engineering

### **Functional Oxide materials as proton conductors and memristors**

My research group fabricates functional oxide membranes and studies the transport mechanisms of charged species in perovskite oxide materials for applications such as fuel cells and memristors. Because the conductivities of these oxide materials can be controlled by the oxygen vacancy concentration inside the lattice, their conductance states can be continuously tunable and non-volatile. This enables the use of oxide materials in applications such as memristors towards in-memory or neuromorphic computing. Yet the sensitivity of perovskite materials to moisture, oxygen and thermal environmental may cause material- and device-degradation.

# University of Waterloo Presenters



## Armaghan Salehian

Associate Professor

Department of Mechanical and Mechatronics  
Engineering

### **Recent advances in energy harvesting technologies**

Professor Salehian, Associate Professor in the Department of Mechanical and Mechatronics Engineering at the University of Waterloo, will deliver a talk on energy harvesting technologies and piezoelectric devices. The presentation will also highlight how additive manufacturing techniques enable the development of novel designs for this purpose.