MME NEWSLETTER

The latest news and updates from The Department of Mechanical and Manufacturing Engineering

IN THIS ISSUE

A Message from the Department Chair

Welcome to the Mechanical and Manufacturing Engineering Department. We have started our mechanical engineering program with two streams in mechatronics and energy engineering. Over the years the department has grown in terms of the number of undergraduate students, graduate students, staff, and faculty members. In particular, the mechatronics stream has shown demands from undergraduate students and thus it was decided in 2016 to offer mechatronics as a standalone program.

The program continued to grow and it graduated its first cohort in the Winter of 2020. The program has also received its accreditation from the Canadian Engineering Accreditation Board (CEAB). To accommodate the growth in the number of faculty members, undergraduate students, graduate students, research activities, and to better serve our students, the Faculty has restructured our department.

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OntarioTech Engineering & Applied Science

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Dr. Atef Mohany, Department Chair, Mechanical and Manufacturing Engineering.

This has led to the creation of the Department of Automotive and Mechatronics Engineering and renaming our department as the Department of Mechanical and Manufacturing Engineering. We continue to offer strong steam in Energy Engineering within the Mechanical Engineering program.

Our department has 20 faculty members who are world renowned researchers in strategic areas for Ontario Tech including; Renewable Energy, Climatic Engineering, Advanced Manufacturing, Smart Materials, and the general area of Design and Applied Mechanics. Several of our colleagues have had industrial R&D experience before joining Ontario Tech and they continue leading state-of-the-art research projects in collaboration with industry. This provides our students with some exposure to real life engineering problems with unique experiential learning opportunities. It is my pleasure to lead this great team of experienced professors and researchers who are determined to serve our students and provide them with the best learning experience to prepare them for their future careers. I am excited to share with you this newsletter that covers some of our recent activities and success stories during the past year.

IMPORTANT DATES

September 4th - 5th, 2021
Fall semester orientation

September 6th, 2021
Labour Day, No Lectures

September 7th, 2021
Lectures begin, fall semester.

October 11th, 2021
Thanksgiving Day

October 12th - 17, 2021
Fall Reading Week

December 6th, 2021
Lectures End

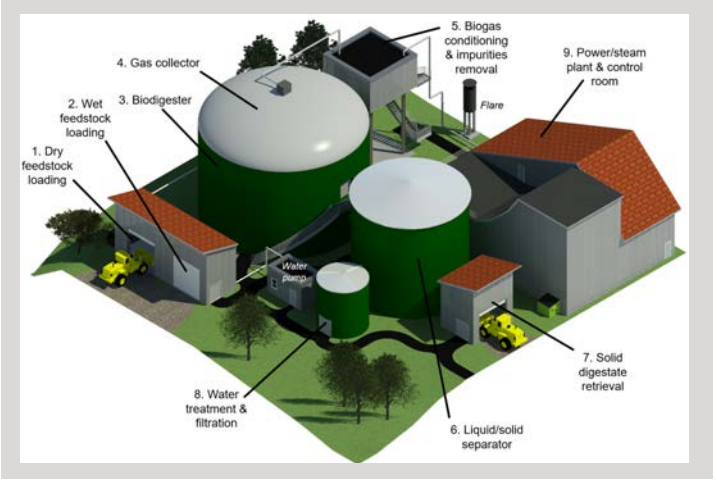
2021 Capstone Design

See all of the 2021 Capstone Design Projects by clicking here.

Project Highlights from Mechanical Engineering:

1. Design and Testing of an Automated and Integrated Biodigester for Biogas Production and Other Useful Outputs

Group Members:
Victor Cavuoti, Brett Hall, Robert Klana and Ryan Ratcliff.
Supervised by: Dr. Ibrahim Dincer.

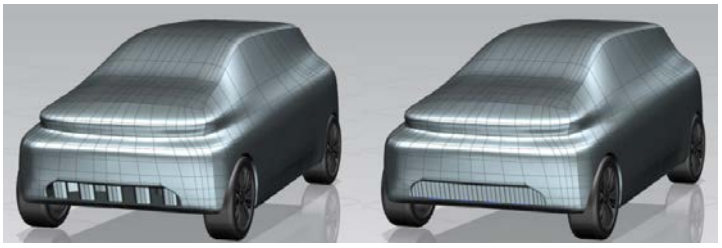


Scale rendering of complete biodigester system as designed for the Target Farm

This project focused on the conceptualization, design, analysis and virtual testing of a biodigester system capable of being integrated into a hypothetical "Target Farm" in Eastern Ontario. The virtual proof-of-concept produced a steady supply of clean-burning methane gas via anaerobic digestion of wet & dry agricultural feedstocks and could generate up to 320 kW of net electric power plus predictable quantities of hot water and pathogen-free fertilizer. Concurrent engineering & design techniques and a variety of modeling/simulation tools were used to develop the base biodigester system and to identify the tradeoffs imposed by varying its operating parameters. Extensions of the base system were further investigated in four case studies that respectively evaluated its potential for supplying heat to an outdoor Olympic-sized swimming pool, processing municipal solid waste, refining bioethanol and producing biochar for use as a soil amendment.

2. Active Grille System for Electric Vehicles

Group Members:
Rachel Illman, Rafi Fadle Aziz, Blair Huycke, Jaykumar Prajapati and Igor Rodrigues
Supervised by: Dr. Martin Agelin-Chaab.



Assembly of Proposed Grille Design on Project Arrow Concept Vehicle

For the Capstone Systems Design Project, a hybrid prototype of a Soft Robotic Active Aerodynamic Grille System for the APMA's Project Arrow concept vehicle has been developed. The grille system is designed to provide essential cooling to the electrical vehicle's internal components including the battery pack, motors, brakes and passenger air cabin. The prototype utilizes silicone, soft robotic grille panels that deform to a maximum of 45 degrees upon pneumatic actuation. The system is controlled via a micro-controller and opens and closes in response to environmental input. When the internal components' temperature is outside of the optimal predetermined range, the active aerodynamic grille panels will open to allow air to flow into the vehicle. Conversely, when cooling is not needed, or when the vehicle is travelling at high speeds, the active grille panels are shut, directing airflow around the vehicle and minimizing drag.

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Project Highlights from Manufacturing Engineering:

1. Multi-purpose Stands and Fixtures for Maintaining Armored Vehicles

Group Members:
Tommy Frost, Christopher Hrenczuk, Uni Lee, Rachel Lynds and Dharma Solaiman.
Supervised by: Dr. Sayyed Ali Hosseini.

This project consisted of the design and development of a stand to support the powertrain assembly of WWII-era tanks during maintenance and restoration activities. The work, sponsored by the Military Museum at Canadian Forces Base (CFB) Borden, supports efforts made by volunteers to restore and maintain historic armed vehicles in the museum's collection. Throughout the restoration process, it is often necessary for the powertrain assembly, including the transmission, of tanks to be removed from the hull. These assemblies weigh more than 2 tons and cannot be moved using legacy methods from the 1940s due to safety concerns. The focus of the work was to develop a safe way for the powertrain to be removed and supported for long periods of maintenance work. ACE's support was sought for the manufacturing and assembly of a working model." The tank and Stand Transmission are shown in the picture.

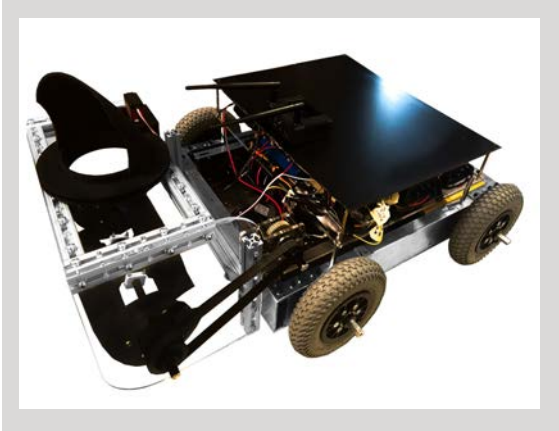
Tank

Stand Transmission

2. Internet of Things (IOT) - based Autonomous Snow Removal

Group Members:
Tristan Zonta, Kieran Wilson, Jonathan Selvanathan, Harvin Kaura and Jay Patel.
Supervised by: Dr. Ahmad Barari

For the Capstone Systems Design Project, a hybrid prototype of a Soft Robotic Active Aerodynamic Grille
The Internet of Things (IoT) enabled Snow Blower aims to solve the problem of users having to shovel their own driveway during the winter months, this is a large injury risk due to slips and falls. The snow blower uses the robot operating system (ROS) to integrate software and hardware components to work together. This allows the motor encoders, Arduino, and camera to work with existing navigation and mapping packages to autonomously navigate a driveway setting. It accomplishes this by generating a map of the area using its stereo camera. This occurs simultaneously while clearing any snow that is present and avoiding any obstacles in its way. The Snow blower also looks to enable IoT to decide the optimum time to clear the driveway. The program pulls weather data to help decide when to begin removing snow based on the precipitation volume. This helps conserve energy and eliminate user interaction.



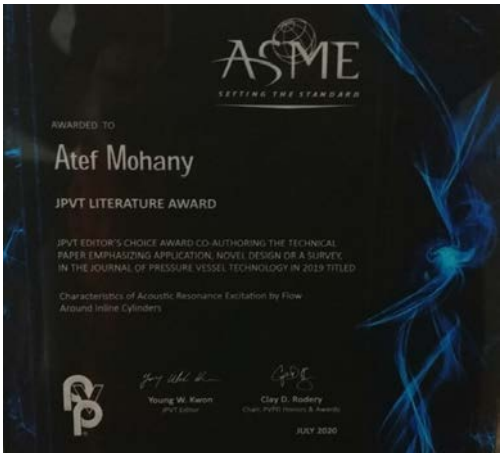
Snow Blower Prototype

2020 - 2021 Awards

The MME Department would like to Congratulate colleagues for their successful collaboration in research and receiving outstanding Awards.

PEO VOLUNTEER AWARD

Congratulations to **Dr. Remon Pop-Iliev** on receiving an Ontario Volunteer Service Award for a 15 years of his continued services with Professional Engineers Ontario - Academic Requirements Committee (ARC).



THE ASME JOURNAL OF PRESSURE VESSEL TECHNOLOGY (JPVT) LITERATURE AWARD

Congratulations to **Dr. Atef Mohany** on receiving the ASME Journal of Pressure Vessel Technology (JPVT) Literature Award for co-authoring a technical paper with significant emphasizes on application and novel design of pressure vessel components.

THE ASME REVIEWER OF THE YEAR AWARD

Congratulations to **Dr. Atef Mohany** on receiving the ASME reviewer of the year Award for outstanding contributions to the Journal of Pressure Vessel Technology.

Research Grants

Dr. Ibrahim Dincer

- Development of a new mobile and effective oxygen generator for Covid-19 coronavirus patients (Research grant of $50,000)
- Sectoral use of ammonia as a clean solution (Research grant of $90,000)
- Carbon neutrality through combined CO2 capture and novel H2 technology with production of non-conventional fuels for smart cities (Research grant of $175,900)
- Development and Assessment of Alternative Fuel Choices for Clean Transportation Sectors (Research grant of $94,500)

Dr. Rizvi Ghaus

- Design and Implementation of a Measurement System for Determining Bedsores-related Shear Stress at the Body-Bed Interface (Research grant of $104,436)
- Material Formulation and Sheet Extrusion of Thermoplastic-Graphite Composites for Compression Molding of PEMFC Bipolar Plates (Research grant of $110,000)

Dr. Marc Rosen

- Analysis and optimization of a novel thermal storage system for ground-source heat pumps (Research grant of $69,000)

Dr. Sayyed Ali Hosseini

- Finish machining of additive manufactured metals (Research grant of $147,500)

Dr. Martin Agelin-Chaab

- Implementation and evaluation of a surface estimation algorithm to modify the control of ADAS features (Research grant of $45,000)
- Development of techniques to improve the performance of autonomous vehicle sensors in adverse weather (Research grant of $140,000)

Dr. Atef Mohany

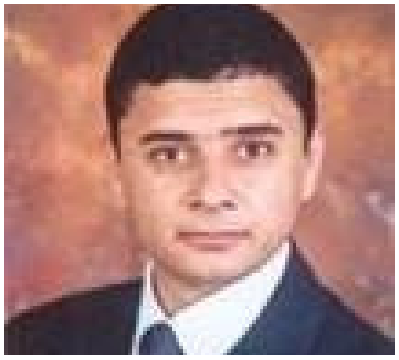
- Investigation of the Dynamic Characteristics of CANDU Fuel Bundle (Research grant of $295,150)
- Investigation and Implementation of Pulse-Electro Thermal De-Icing in Commercial Electric Vehicles (Research grant of $120,000)

Industry Advisory Committee

The Department of Mechanical and Manufacturing Engineering welcomes the following members to its industry advisory committee. The industry advisory committee consists of practicing professional engineers from different industries and it is an integral part of the department's continuous improvement process. The industry advisory board provides feedback on the learning outcomes of our programs and the market needs, which help improve the students' preparedness to the job market.

Committee Members:

Dr. Ahmed Omar



Dr. Omar has twelve years of experience in the nuclear power industry, working at Ontario Power Generation (OPG) Nuclear Safety Analysis and Operations Training Departments. Dr. Omar taught, as sessional lecturer at Ontario Tech University, a course on Nuclear Safety Design and a course on Nuclear Power Plant Steam Systems. Dr. Omar received his PhD. degree in Mechanical Engineering from McMaster University and a Masters Certificate in Project Management (MCPM) from Durham College, Ontario. He is a Professional Engineer (P.Eng.) in the province of Ontario since 2010.

Ms. Karen Chan

Ms. Karen Chan, a member of the Professional Engineers of Ontario and a Fellow of Engineers Canada, is a Founding Member of Adaptovate Toronto and senior agile consultant and leader with experience in sales engineering, automotive design and manufacturing, digital media, technology, and financial services. She graduated from mechanical engineering and has also completed a BA (English) and MBA (Executive). Karen volunteers extensively in engineering and her roles include Past-President OSPE, PEO Lake Ontario Chapter Past Chair, SWE Global Ambassador, Women for STEM Advisory Council at Ontario Tech U, and Advisory Council Western Engineering

Dr. Ayman Saudy

Dr. Ayman Saudy is a senior technical expert at Kinectrics. He has more than 30 years of experience in structural analysis and engineering mechanics of nuclear systems. He Participated in OECD's international benchmarking project, IRIS, to assess response and behavior of concrete barriers to resist high-speed impact missiles at VTT facilities, Espoo, Finland. Moreover, he participated in international round robin pre-test analysis of ¼-scaled Pre-stressed Concrete Containment Vessel (PCCV) at Sandia National Laboratories in Albuquerque, New Mexico, USA. Dr. Saudy is a registered professional engineer in Ontario.

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Dr. Jovica R Riznic

Dr. Jovica R Riznic, a member of the Professional Engineers of Ontario and a Fellow of the American Society of Mechanical Engineers
, is a Technical Specialist at the Canadian Nuclear Safety Commission (CNSC), working on regulatory analysis and assessment of technical issues with operating nuclear power plants (NPP). He served CNSC on various positions. He is an adjunct faculty at Algonquin College in Ottawa in the School of Business and the Centre for Continuing and Online Learning teaching courses within the Project Management Certificate Program, and he was an adjunct professor at the University of Waterloo and McMaster University. He has completed his PhD Degree and M.Sc in Mechanical Engineering from Belgrade University.

Mr. Aqeel Zaidi

Dr. Aqeel Zaidi is a registered Professional Engineer in Ontario and a member of Ontario Society of Professional Engineers, Association of Energy Engineers, and Energy Solutions Center based in Washington, D.C. Aqeel is currently co-chair of the Industrial and Major Account Consortium (IMAC). Aqeel has 40 years of professional engineering experience in the energy industry, primarily dealing with energy efficient and low carbon energy transition technologies, demand side management (DSM), combined heat and power (CHP), natural gas heat pumps (GHP), boilers, steam systems, combustion, industrial process heating equipment, energy analysis of industrial facilities, solar energy and GHG emissions analysis including Ontario's electric grid marginal emissions.

Mr. Saad Dahdouh

Mr. Saad Dahdouh is a member of Professional Engineers of Ontario. His present role is to manage the research and development budget and overseas OPG participation in: Candu Orner's Group (COG), University network of Excellence in Nuclear Engineering (UNENE), Electrical Power Research Institute (EPRI), as well as the involvement with Canadian Standards CSA. He coordinates and help direct research projects to support the nuclear licence, including yearly reporting to the regulator (CNSC). He has recently added the role of Enterprise risk Engineering SPOC. He has completed M.S.Eng in Industrial and Operations Engineering and B.Eng in Mechanical Engineering with Distinction.

New Additions to MME

The MME Department would like to welcome three faculty members: Dr Dima Jawad, Dr. Horia Hangan and Dr. Ramona Fayazfar, along with one new staff member, Karishma Karim.

Dr. Dima Jawad

Dr. Dima Jawad has a Ph.D. in Civil Engineering and a Master's in City and Regional Studies from Rutgers University, New Jersey, USA. Dr. Jawad has extensive experience in academic teaching and research at international universities including the American University in Dubai and Notre Dame University in Lebanon. Her area of research covers recent trends and innovative tools in project management, economic evaluation and optimization under uncertainty, project risk management, transportation infrastructure systems management, and sustainability and resiliency of infrastructure. Her academic expertise is further complemented with years of experience in the management of post-war rehabilitation and reconstruction of cities where she has worked as a management consultant for the public sector as well as the World Bank projects in the Middle East.

Dr. Horia Hangan

Dr. Horia Hangan joined MME Department as a Full Professor in May 2021. Dr. Hangan is the university's fourth-ever Tier 1 Canada Research Chair. He comes to Ontario Tech from Western University in London, Ontario. Professor Hangan's research is in the simulation and impact of high intensity winds (downbursts and tornados), wind energy (sitting in complex terrain, wind turbine blade aerodynamics) and wind environmental impacts (atmospheric pollution-dispersion, particulate transport). He will collaborate extensively with Ontario Tech's ACE Climatic Wind Tunnel as well as the university's Environment Canada Meteorological Supersite at Windfields Farm.

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Dr Ramona (Haniyeh) Fayazfar

Dr Ramona (Haniyeh) Fayazfar is currently an assistant Professor in Mechanical and Manufacturing Engineering department in University of OntarioTech in Canada. Her main research concentrates on Additive Manufacturing (with a focus on development and optimization of AM-specific categories of materials as well as surface Engineering of additively manufactured parts), Nanostructured Composites/Hybrid Materials, Advanced Coatings with Smart Properties, Electrochemical Synthesis of Nanostructured materials, and Biosensors for Point-of-Care Diagnostics and Health Monitoring. The outcomes of her research so far have been published in high prestigious journals and conferences and covered by various media outlets. Dr Fayazfar got the Best Research Award from "Intern. Research Awards on New Science Inventions (Science Father)", 2021.

The MME Department would like to welcome one new staff member, Karishma Karim.

Karishma Karim

Karishma Karim as the Administrative Assistant. Karishma comes to us from the Department of Earth and Space and Engineering (ESSE) in Lassonde School of Engineering at York University. She has worked at York University for fourteen Years in different positions. One of the recent positions was the Graduate Program Assistant in the Department of Mathematics in Faculty of Science. She has joined MME Department on April 12, 2021. Karishma is looking forward to supporting and assisting faculty and students.

Research Spotlight

Dr Ramona (Haniyeh) Fayazfar

Assistant Professor, Mechanical Engineering

Prior to joining Ontario Tech, Dr Ramona (Haniyeh) Fayazfar was a postdoctoral fellow in Multi-Scale Additive Manufacturing research group (MSAM) in Mechanical and Mechatronics Engineering Department at University of Waterloo. Her main research as a PDF, concentrated on developing novel feedstock materials for AM tailored towards specific applications, and addressing current challenges of metal AM. For example, she successfully developed a conductive polymeric composite based on carbon fiber filler to be used as a wearable sensor for health monitoring applications (Figure B). A novel in-house developed material jetting (MJ) AM system was established to successfully 3D-print the novel composite materials. The significance of this contribution has been covered by a media outlet, "3D print.com". On the other hand, Dr Fayazfar developed efficient post-surface treatment methods to address one of the most demanding limitations of challenging 3D-printed metallic components in aerospace and automotive industries, the poor surface quality, within the desired range of specifications for the industry partners. She innovatively developed low cost and eco-friendly (electro)chemical-based methods to decrease uniformly the roughness of external and especially internal difficult-to-reach surfaces of AM metals (Figure 3). Also, in collaboration with Lockheed Martin, she successfully developed advanced surface coatings of copper on AM plastic antennas by a low-cost metallization approach (electroless plating) to obtain highly conductive, lightweight, design-flexible, and low-cost plastic antennas with copper coating as a replacement to heavy and costly metallic counterparts for mobile and aerospace applications (Figure 4). Moreover, her interdisciplinary knowledge and experience in surface engineering and AM led to 3D printing and gold

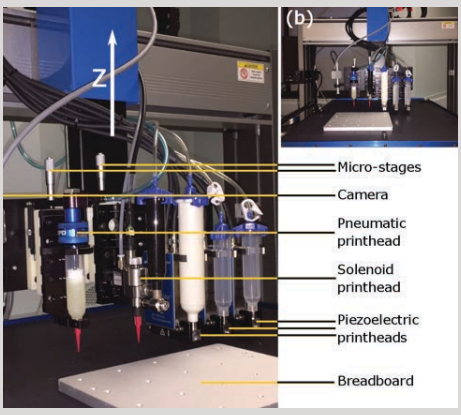

Fig A. In-house developed high-speed material jetting AM system

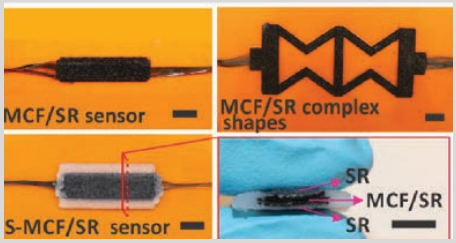

Fig B. 3D printed wearable sensor based on silicon polymer and carbon fiber filler

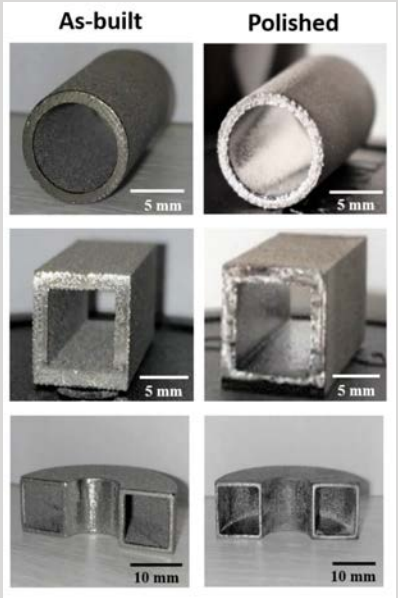

Fig C. Optical images of as-built (left column) and electropolished (right column) additively-manufactured Ti6Al4V samples

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electroplating of convocation medals for graduating students at U Waterloo, for the first time on campus, which has been credited in UWaterloo Alumni website and covered by UWaterloo Magazine (Figure 5). Prior to joining University of Waterloo, Dr Fayazfar received her Bachelor's, Master's, and PhD degrees in Materials Engineering from Sharif University of Technology (SUT) in Iran. She has been awarded the University commemorative plaque and medal from the President of SUT for being ranked first among all graduated PhD and Master's students. Development of advanced nanocomposite structures with outstanding multifunctional properties initially conceived during her PhD. She innovatively synthesized aligned carbon nanotubes (CNTs) by using a scalable chemical vapor deposition technique, and decorated them with different morphologies of gold nanostructures in a nanocomposite configuration, by using an eco-friendly and low-cost electrochemical approach (Figure 6). Her research produced the required knowledge for architectural control and uniform distribution of nanomaterials in a nanocomposite layout by just simple controlling of process parameters, which is critical toward future nanodevices and are ideal for industrial automotive, marine, aerospace, and energy applications. Dr Fayazfar's future vision in Ontario Tech is to be a world-leading laboratory of excellence in two areas: 1) developing new emerging and multifunctional nanocomposite materials and coatings with smart properties by using low cost methods to be used in automotive, aerospace, and medical industries, and 2) development of novel feedstock materials for low-cost additive manufacturing approaches and develop tangible technological and innovative solutions for surface modification of metal AM.

Fig 5. 3D printed and gold electroplated convocation medals.

Fig 4. 3D printed plastic antennas metallized with copper by an electroless plating technique.

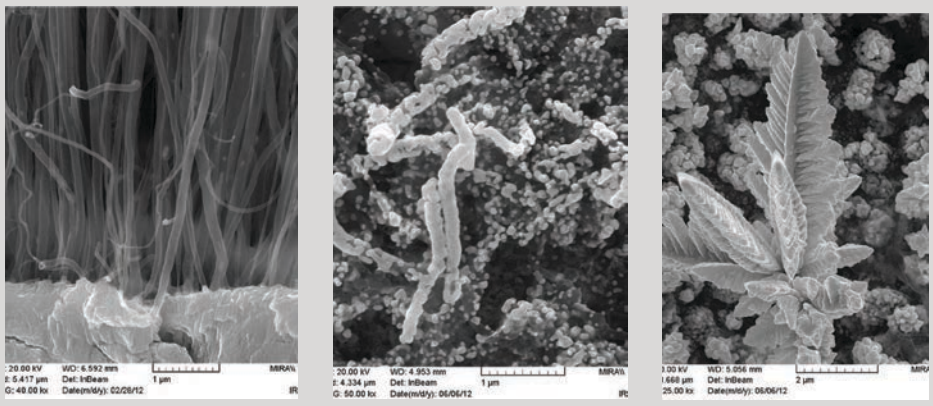
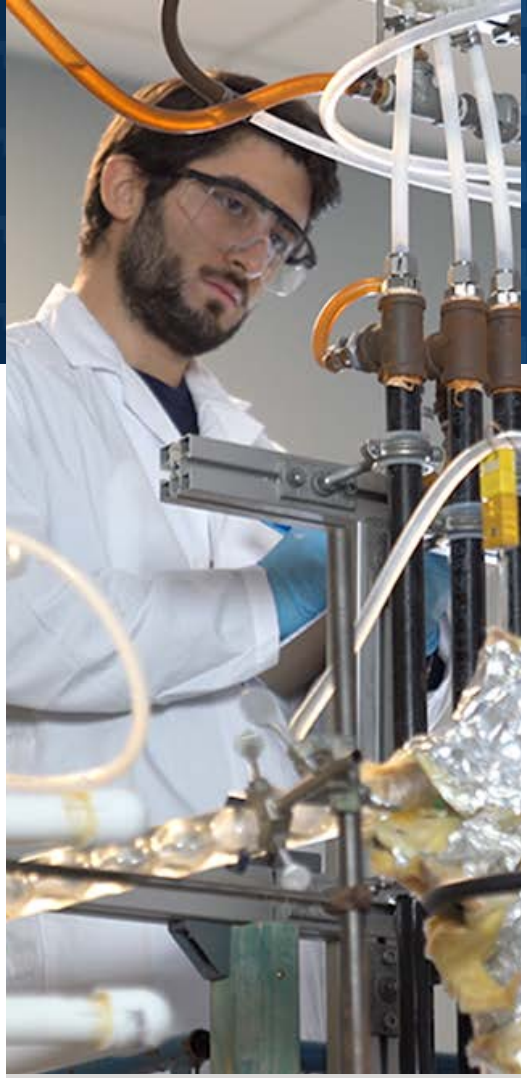


Fig 6. Aligned carbon nanotubes by chemical vapor deposition (CVD) and decorating gold nanoparticles and nanoflowers by electrochemical method.



Research Spotlight

Hydrogen Energy Technologies: Challenges and Opportunities

Ontario Tech recently established its Brilliant Energy Institute, which is positioned to be a change agent leading Canada's energy transition. This new research institute will harness the significant research and sectoral expertise at the university, in collaboration with other universities and industry partners, to mobilize Canada's transition to a sustainable energy future and change how Canadians utilize energy for daily life.

A key part of the university's energy research ecosystem is the Clean Energy Research Laboratory (CERL), which opened in 2010. As the leading research university in Canada on hydrogen energy, Ontario Tech researchers are developing cost-effective and carbon-free methods for hydrogen production, including:

The world's first lab-scale demonstration of a four-step copper-chlorine thermochemical cycle for water (H2O) splitting using heat from nuclear, solar or other heat sources such as waste/process heat from industrial plan emissions. The net reaction produces hydrogen and oxygen. mum of 530 degrees Celsius. The ingredients in the process are water, a copper-chlorine compound, and heat with temperatures ranging from 70 degrees Celsius to a maximum of 530 degrees Celsius.

- Synthesizing and utilization of ammonia (NH3) as an energy source for fuel cells in transportation, marine, aviation, farming, pharmaceuticals and other applications.
- Explore Canada's Hydrogen Strategy (Natural Resources Canada)

Ontario Tech has an impressive legacy of research leadership on hydrogen, including hosting a number of international conferences that assembled leading global hydrogen production experts in Oshawa. Most recently, the university hosted a one-day virtual workshop and panel discussion on January 14 on hydrogen challenges and opportunities. The event coordinated by Prof. Ibrahim Dincer.

"CERL is a vital centre of research, innovation and technology development where we are experimenting, modelling, simulating, prototyping, and scaling-up for eventual clean-energy commercialization with our industry partners," "To date, CERL has attracted more than $20 million in research funding and filed nearly 20 patents and invention disclosures."

- Dr. Jacobs, Professor and Vice President, Ontario Tech University