



THE UNIVERSITY OF BRITISH COLUMBIA
Materials & Manufacturing Research Institute

Annual Report 2020-2021

**Collaborative Expertise for
Innovative Solutions**





SUMMARY AND HIGHLIGHTS

- **New collaborative research initiatives:** NSERC CREATE in Immersive Technologies; UBC GCRC-funded Research Cluster for Microplastics
- **Members:** 93 from academia and 65 from industry
- **Members success:** Over \$15M research funding; Over 450 articles; Over 200 HQP trainees
- **Events:** Biocomposite Research Seminar Series; 2nd Symposium on Image Guided Therapeutics: From Conception to Commercialization
- **Staffing:** One new full-time staff was recruited through the awarded grants

Materials and Manufacturing Research Institute (MMRI) is a multidisciplinary, interdepartmental research hub at the University of British Columbia (UBC) fostering collaboration between local, national and international R&D sectors.



Mission

To build on UBC's existing strengths in materials and manufacturing research and create new opportunities for multidisciplinary research in related emerging areas through shared knowledge and network-based funding.

Vision

MMRI will be a role model linking basic and applied science and contributing to knowledge advancement in multidisciplinary research areas of advanced materials and manufacturing, through close partnership between UBC faculty and other sectors of academia, industry and government organizations; and by world-class training of students and scientists, and dissemination of high-quality research.

OPERATIONS

Structure: MMRI currently has six research pillars that host researchers from a wide range of disciplines across both campuses of UBC and beyond. These pillars include:



Affiliated Research Clusters and initiatives: MMRI has supported the establishment of the following research clusters and initiatives at UBC:

- NSERC CREATE in Immersive Technologies (CITech)
- Cluster of Research Excellence in Biocomposites, funded through UBC Eminence Program
- Cluster of Research Excellence in Comfort-Enhancing Technologies, funded through UBC Eminence Program
- Multidisciplinary Undergraduate Research Projects in Health (MURPH), funded through UBC PURE Program
- AI-based Optimization of Manufacturing Processes with Limited Data, funded through NFRF-Exploration
- Biocomposites Research Network

Management team: Each MMRI research pillar has one dedicated Lead from the Point Grey campus and one Lead from the Okanagan campus who oversee and coordinate the pillar activities. A Chief Development Officer is also leading Cross-Disciplinary Initiative. The MMRI management team is listed below:

- Director: Dr. Abbas Milani (Engineering, UBCO)

- ATMM Leads:
 - Dr. Rajeev Jaiman (Mechanical Engineering, UBCV)
 - Dr. Mohammad Arjmand (Engineering, UBCO)
- BBMM:
 - Dr. David Liu (Biomedical Engineering, UBCV)
 - Dr. Adriana Manso (Dentistry, UBCV)
 - Dr. Sepideh Pakpour (Engineering, UBCO)
- BCMM:
 - Dr. Joe Dahmen (Architecture, UBCV)
 - Dr. Shahria Alam (Engineering, UBCO)
- ENMM:
 - Dr. Frank Ko (Materials Engineering, UBCV)
 - Dr. Jian Liu (Engineering, UBCO)
- PNMM:
 - Dr. Parisa Mehrkhodavandi (Chemistry, UBCV)
 - Dr. Robert Godin (Chemistry, UBCO)
- DSEMM:
 - Dr. Bhushan Gopaluni (Chemical and Biological Engineering, UBCV)
 - Dr. John Braun (Mathematics, UBCO)



Membership: MMRI continues to integrate new members from academia and industry into its research structure. The Institute currently boasts 89 academic and 58 industry members.

Space/facilities: Since January 2018, the institute has been officially located in EME 2131 on UBC Okanagan campus.

Staff and administration: MMRI currently has three full-time as listed below:

- Research Engineer:
 - Mahdi Takaffoli, PhD (full-time)
 - Bryn Crawford, PhD (full-time)
 - Chungyeon Cho, PhD (full-time)
- Administrative Assistant:
 - Jolene Campbell, BBA (full-time)

ACADEMIC MEASURES

The academic measures reported in this section is based on the information collected from members on their academic records from September 2020 until August 2021.

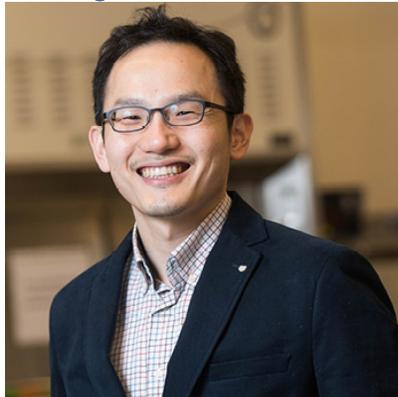
Grants: MMRI members has received over \$15M research funding from different funding sources. See Appendix I for the list of sample grants.

Publications: MMRI members published over 450 articles in peer-reviewed journals. See Appendix II for the list of sample publications.

Trainee supervision: MMRI members have been supervising more than 200 graduate students.

Members Success Stories

Dr. Jongho Lee



Selected to join the Journal of Membrane Science Early Career Editorial Board

Dr. Warren Poole



Elected to the Canadian Academy of Engineering (CAE), one of the highest professional honours an engineer in Canada can receive.

ACTIVITIES AND PROJECTS

Collaborative research programs

NSERC CREATE in Immersive Technologies (CITech): As the first CREATE grant awarded to UBC Okanagan, CITech is a highly multidisciplinary graduate training program at the University of British Columbia focusing on skills development and collaborative research to design immersive solutions for various real-world applications from manufacturing to healthcare, to community engagement and education. The core founding members of CITech are 11 faculty members from five academic units at UBCO: Engineering, Computer Science, Nursing, Creative and Critical Studies, and Medicine.



UBC Okanagan first to offer 'immersive technologies' graduate program

UBCO is developing a program using a \$1.65 million grant from the federal government that will offer master's and PhD degrees.



NSERC CREATE funding awarded to UBCO for the first time

Funding from the Government of Canada will help establish one of the world's first truly interdisciplinary immersive technologies graduate programs at UBC's Okanagan campus.



Multidisciplinary Undergraduate Research Projects in Health (MURPH): MURPH was run for the second time at the Okanagan campus, supporting 5 projects with the involvement of 11 undergraduate students, 10 faculty members, and 2 graduate students (MURPH Graduate Mentors).

MURPH 2020-2021 Highlights



**MURPH Launch Event
(Oct 15, 2020)**
Introduction to the program, management members, and funded project teams



**Workshop #1
(Nov 18, 2020)**
Teamwork & Collaboration



**Workshop #2
(Jan 20, 2021)**
Patient-Oriented Research & Design Thinking



**Workshop #3
(Mar 20, 2021)**
Research Dissemination



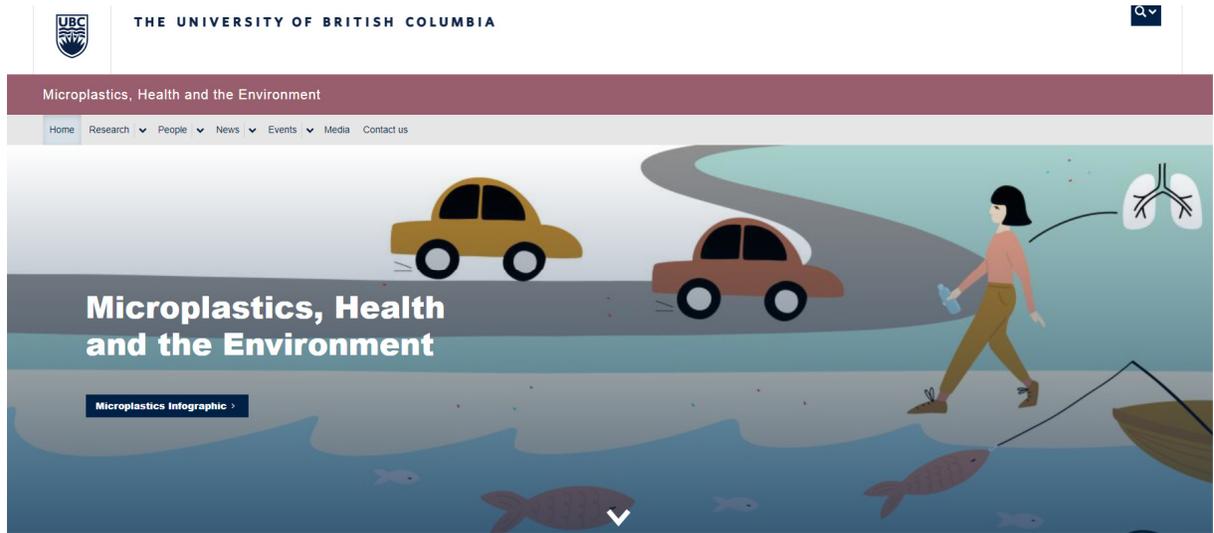
**UBC Okanagan Interdisciplinary Student Health Conference
(Mar 9, 2021)**

MURPH launch event





Research Cluster for Microplastics, Health and the Environment: MMRI played a key role in building the team and putting together the proposal for establishing this research cluster through UBC GCRC program. This cluster bring together over 20 faculty members from both campuses of UBC to collaborate on microplastics research. MMRI staff will continue to provide support to the execution of cluster’s activities.



Research Pillars



Source, Type, and Pathway Characterization



Human and Ecological Health



Policy, management strategies, and knowledge mobilization

Circular Economy Seed Funding: Sponsored by NRC IRAP, this program provided financial support to 19 university-industry projects relevant to different aspects of circular economy. The university leads of the projects were UBC faculty members from both campuses and the industry partners were small and medium sized enterprises based in BC.

Events organization

Image Guided Therapeutics: From Conception to Commercialization (2nd Symposium)

Jun November 19, 2020 | Virtual Event

- 6 talks delivered by government and industry associates
- Over 90 attendees
- MMRI co-organized the event.



IMAGE GUIDED THERAPIES WEBINAR SERIES
November 19th | 9:30am – 1pm (PST)

 Brian Thornton Senior Expert, Stakeholder Engagement, Medical Devices Directorate, Health Canada	 Geraldyn Ochab Chief Executive Officer, Imagia		
 Cameron Piron President, Synaptive	 Laura Conquergood Vice President, Operations, Baylis Medical	 Goldy Singh VP, Product Management, Profound Medical Inc	 Scott Phillips President, Starfish Medical

BioComposites Research Network's Research Day (2nd event)

October 7, 2020 | Virtual event

- 5 presentations delivered by faculty members and industry associates from Canada and India
- A panel discussion on future of biocomposites

BioComposites Research Network's Seminar Event

April 29, 2021 | Virtual event

- 3 presentations delivered by faculty members from UBC and University of Alberta
- 3 presentations delivered by industry associates



GOALS FOR NEXT YEAR

- **Launch the NSERC CREATE in Immersive Technologies training program:** We will work toward developing and delivering CREATE courses in January 2021 and recruit the first cohort of students into the training program.
- **Continue supporting team-based proposals:** We will remain committed to support planning, team building and writing multidisciplinary proposals for different funding programs, such as NFRF, CREATE, NSERC Alliance, UBC GCRC and UBCO Eminence.
- **Focus on building capacity for research and industry support toward circular economy:** We aim to expand our current Circular Economy Seed Funding program to a national level so that SMEs and academic researchers across Canada can participate and receive funding.
- **Sustaining the MURPH program at UBCO:** As the funding support through UBC PURE will end in early 2021, we will look into different internal and external mechanisms to continue running this program at the Okanagan campus.



CONTACT INFORMATION

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APPENDIX I: ACADEMIC METRICS

Member Name	Faculty	Number of Publications	\$ Amt Grant Received	Number of Grad Students Supervised/Co-supervised
Shahria Alam	Applied Science	40	\$800,000	20
Mohammad Arjmand	Applied Science	98	\$2,500,000	22
Michael Deyholos	Applied Science	3	\$90,000	3
Cigdem Eskicioglu	Applied Science	29	\$4,365,000	8
Robert Godin	IKBFOS	4	\$126,251	3
York Hsiang	Medicine	12	\$30,000	3
Ardestani Jaafari	Management	7	\$528,000	4
Feng Jiang	Forestry	25	-	8
Xiaoliang Jin	Applied Science	8	-	11
Andrew Jirasek	IKBFOS	7	\$100,000	6
Hossein Kazemian	NALS-UNBC	20	\$750,000	5
Vicki Komisar	Applied Science	8	-	0
Jongho Lee	Applied Science	7	\$250,000	4
Jian Liu	Applied Science	26	\$652,637	11
Zheng Liu	Applied Science	22	\$700,000	15
Adriana Manso	Dentistry	12	\$371,148	6
P Mehrkhodavandi	Science	11	\$324,000	8
Abbas Milani	Applied Science	41	\$1,711,441	16
Hadi Mohammadi	Applied Science	12	\$180,000	10
Susan Murch	Science	9	\$194,325	4



Apurva Narayan	Computer Science	24	\$573,628	4
Dimitry Sediako	Applied Science	9	\$348,000	5
Rudolf Seethaler	Applied Science	7	\$150,000	7
Sumi Siddiqua	Applied Science	24	\$254,563	17
Babak Tosarkani	Applied Science	5	\$652,500	-
Total		470	\$15,651,493	200



APPENDIX II: SAMPLE GRANTS

Project Title	Funding Body	Amount	Member
Seismic performance assessment of different types of bridge configurations using advanced numerical tools	MITACS	\$495,000	Shahria Alam
Developing seismic design guidelines for pallet racks	NSERC	\$130,000	Shahria Alam
Genesis Control Post-Occupancy Evaluation (POE)-based Framework for Net-Zero Home Construction- Wilden Living Lab (Phase II)	MITACS	\$225,000	Shahria Alam
Green Construction Research & Training Center: A multi-disciplinary platform for resilient and sustainable communities	EMINENCE	\$300,000	Shahria Alam
Plastic Recycling Research Cluster	EMINENCE	\$180,000	Mohammad Arjmand
Synthesis of Graphene Nanomaterials and Development of Their Multifunctional Polymer Nanocomposites	NSERC	\$780,000	Mohammad Arjmand
Advanced 3D Printed Graphene/Polymer Nanocomposites for Electromagnetic Interference Shielding of Satellites	IDeaS	\$158,000	Mohammad Arjmand
Breeding Flax for Western Canada.	Agriculture Dev. Fund		Michael Deyholos
Mobile energy efficient tissue culture laboratory for northern agriculture development and crop improvements	MITACS		Michael Deyholos
Pectin-modifying enzymes in plant development and interactions with fungi	NSERC		Michael Deyholos
Advanced Resource Recovery from Wastewater	NSERC		Cigdem Eskicioglu



Towards development of a biodegradable polymer for use in single-use surgical gloves	MITACS		Cigdem Eskicioglu
Training in applied biotechnology for environmental sustainability (TABES)	NSERC		Cigdem Eskicioglu
Urgent Upgrade of Atomic Layer Deposition with Plasma Capability to Accelerate Energy Storage, Energy Conversion and Gas Sensing Research	NSERC	\$104,409	Robert Godin
Development of carbon dots for solar energy conversion & Software development for advanced optical microscopy	UBC	\$21,842	Robert Godin
A Randomized Double Blind Surgical-Placebo Controlled Clinical Study to Assess Blood-Borne Autologous Angiogenic Cell Precursor Therapy in Patients with Critical Limb Ischemia (ACP-CLI)	HEMOSTEMIX INC		York Hsiang
Post pandemic supply chain recovery	SSHRC	\$51,000	Ardestani Jaafari
Adjustable robust optimization and its applications	NSERC	\$12,500	Ardestani Jaafari
Food bank operations during the COVID-19 pandemic	SSHRC	\$25,000	Ardestani Jaafari
Enhancing thermal and mechanical performance of engineered wood product adhesives using novel fire retardant nanoclays	BC Forest Innovation Investment		Feng Jiang
Next generation biobased aerogels and hierarchically structured nanocomposites	NSERC		Feng Jiang
Developing Fire Retardant Thermal Insulating Bioproducts From Lignocellulosic Nanomaterials for Building and Construction	Ministry of Forests		Feng Jiang
Mobilizing Additive Manufacturing for Automotive, Aerospace and Clean Energy	Canada Foundation for Innovation	\$2,300,000	Xiaoliang Jin
MOF for environmental application	NSERC	\$170,280	Hossein Kazemian



Analytical method development award	WorkSafeBC	\$141,135	Hossein Kazemian
Chromium speciation project award	WorkSafeBC	\$144,123	Hossein Kazemian
Developing Artificial Trees for Extreme-Weather-Resilient Cities	New Frontier Research		Jongho Lee
A New Solution to the Instability Issue of Li Metal Anode and Solid-State Electrolyte Interface	NRC	\$50,000	Jian Liu
Nanoscale surface coating to enable stable and dendrite-free Zn anode for rechargeable aqueous Zn-ion batteries	NSERC	\$135,000	Jian Liu
COVID-19. Mobile Uninterruptible Power Supply (UPS) System for Ventilators	NSERC	\$50,000	Jian Liu
Phase I - MIST Fusion - Multimodal Input Surveillance & Tracking	IDeaS		Zheng Liu
SeaMIST - Maritime Surveillance & Tracking with Artificial Intelligence	IDeaS		Zheng Liu
Novel Multifunctional cur cumin-based adhesive varnish for caries control	Colgate	\$38,000	Adriana Manso
Novel multifunctional metal-doped antimicrobial resin-based dental materials	New Frontiers for Research Funds	\$277,000	Adriana Manso
Development of Lignin-based Polymers and Nanomaterials for High Performance Engineering Applications	MITACS	\$147,000	Parisa Mehrkhodavandi
Influence of Chemical Dyes on Polyethylene Terephthalate Polymerization	MITACS	\$30,000	Parisa Mehrkhodavandi
Light-Weight, Healable Vehicle Armour	DND	\$200,000	Abbas Milani
Develop a Sim-to-real Transfer Learning AI architecture for reliable predication and optimization of advanced manufacturing processes in the presence of limited data	New Frontiers in Research Fund	\$273,175	Abbas Milani
Modeling and Predicting The Thermophysiological Comfort of	MITACS		Abbas Milani



Clothing Using an Advanced Multi-Sector Sweating Torso		\$333,333	
Hand Tremor Attenuators	MITACS	\$90,000	Hadi Mohammadi
Mechanical Heart Valves	MITACS	\$90,000	Hadi Mohammadi
ARCTIC Change - Arctic Research and Conservation Team Investigating Climate Change Funding Body	NRC		Susan Murch
Acoustic Force Spectroscopy System	UBCO		Susan Murch
H2LAB: A laboratory for investigating hydrogen blending in natural gas from injection to combustion	NSERC		Dimitry Sediako
Development of Novel Aluminum Alloys and MMCs Strengthened with Rare Earth Elements, Nano Ceramic and Carbon Particles	MITACS		Dimitry Sediako
Development of Al Ce alloys and MMC for automotive engines	MITACS		Dimitry Sediako
Aluminum Casting and FSW Technologies for Next-Generation Automotive Powertrains	NSERC		Dimitry Sediako
Translating Shuttle Foil (TSF) Wind Energy System	IDeaS		Rudolf Seethaler
Formulation of environmentally sustainable growing media using industrial waste streams as nutritious amendments	MITACS		Sumi Siddiqua
Durability of rammed earth blocks	NSERC		Sumi Siddiqua
	NSERC	\$142,500	Babak Tosarkani
	EMINENCE	\$500,000	Babak Tosarkani
	UBC	\$10,000	Babak Tosarkani

APPENDIX III: LIST OF SAMPLE PUBLICATIONS

- 1) Aldabagh, S., & Alam, M. S. (2021). Low-cycle fatigue performance of high-strength steel reinforcing bars considering the effect of inelastic buckling. *Engineering Structures*, 235, 112114.
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- 12) H Liu, IA Basar, A Nzihou, C Eskicioglu, Hydrochar derived from municipal sludge through hydrothermal processing: A critical review on its formation, characterization, and valorization, *Water Research* 199, 117186.
- 13) V Kumar, R Nabaterega, S Khoei, C Eskicioglu, Insight into interactions between syntrophic bacteria and archaea in anaerobic digestion amended with conductive materials, *Renewable and Sustainable Energy Reviews* 144, 110965.
- 14) RS Khoei, A Stokes, B Kieft, P Kadota, SJ Hallam, C Eskicioglu, Biochar amendment rapidly shifts microbial community structure with enhanced thermophilic digestion activity, *Bioresource Technology* 341, 125864.

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