

Curriculum Vitae

Jian Zhao, Ph.D.

Assistant Professor, Department of Mechanical Engineering, Mississippi State University

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Education

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|---------------|---|
| 9/2014-6/2019 | Ph.D. in Mechanical Engineering
University of Waterloo, Canada |
| 9/2010-1/2013 | M.A.Sc. in Power Machinery and Engineering
Tianjin University, China |
| 9/2006-7/2010 | B.A.Sc. in Thermal Energy and Power Engineering
Dalian University of Technology, China |

Work Experience

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| 1/2024-present | Assistant Professor at the Department of Mechanical Engineering, Mississippi State University |
| 9/2022-12/2023 | Postdoctoral Research Associate at the Center for Advanced Vehicular Systems, Mississippi State University, advisor: <i>Prof. Like Li</i> |
| 5/2019-8/2022 | Postdoctoral Fellow at University of Waterloo, advisor: <i>Prof. Xianguo Li</i> |
| 5/2021-8/2021 | Sessional Lecturer at University of Waterloo |
| 9/2014-4/2019 | Graduate Student Research and Teaching Assistant |
| 5/2017-8/2018 | Receptionist and Proctor in the <i>AccessAbility</i> Services Exam Centre |
| 3/2013-7/2014 | Engineer at Engine Department of China FAW R&D Center |

Academic Service

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|----------------|--|
| 4/2022-present | Board Member, International Association for Green Energy (IAGE) |
| 6/2019-present | Assistant Editor, International Journal of Green Energy (Taylor & Francis) |
| 7/2023-present | Guest Editor, Special Issue for Advance in Green Energy, Energy (Elsevier) |
| 7/2023-present | Guest Editor, Special Issue for Hybrid Renewable Energy Systems for Power, Heating, and Cooling, Frontiers in Thermal Engineering (Frontiers) |
| 7/2023-present | Guest Editor, Special Issue for IGEC2023, International Journal of Green Energy (Taylor & Francis). |
| 5/2022-11/2023 | Guest Editor, Special Issue for Emerging Green Energy Technologies, Energy (Elsevier). |
| 1/2023-4/2023 | Editor-in-Chief, second issue of "Green Energy Today" magazine. |
| 7/2022-7/2023 | Co-Chair of Technical Committee, International Organizing Committee, 15th International Green Energy Conference (IGEC-XV, Glasgow, UK, July 10-13, 2023) organized by the University of Glasgow, UK. |

- 12/2022-12/2022 Keynote Speaker and Session Chair, at ICEPAG (International Colloquium on Environmentally Preferred Advanced Generation) and 2022 World Fuel Cell Conference (WFCC2022, Irvine, CA, USA, December 12-15) held by the University of California, Irvine (UCI).
- 7/2021-7/2022 International Organizing Committee, Technical Committee, Session Chair and Conference Secretary, 14th International Green Energy Conference (IGEC-XIV, virtual, July 4-8, 2022) co-organized by the University of Waterloo and University of Glasgow.
- 5/2020-8/2021 Local Organizing Committee and Session Chair, 2021 World Fuel Cell Conference (WFCC2021, Waterloo, Canada, August 17-20) co-organized by the Fuel Cell Division, International Association for Hydrogen Energy (IAHE), the University of Waterloo, and the Canadian Hydrogen and Fuel Cell Association (CHFCA).
- 7/2020-7/2021 Guest Editor, Special Issue “Recent Progress in Multi-generation Systems” in International Journal of Green Energy (Taylor & Francis).
- 7/2020-7/2021 International Advisory Committee, Session Chair and Conference Secretary, 13th International Green Energy Conference (IGEC-XIII, Tianjin, China, July 15-18, 2021) co-organized by IAGE and Tianjin University.
- 12/2019-8/2020 Conference Secretary, 2020 World Fuel Cell Conference (WFCC 2020) (Toronto, Canada, cancelled due to Covid-19) organized by the IAHE Fuel Cell Division and the University of Toronto.
- 3/2019-8/2019 Conference Secretary and Session Chair, 2019 World Fuel Cell Conference (WFCC2019, Shanghai, China, August 25-29) co-organized by the IAHE Fuel Cell Division, Shanghai Jiaotong University, and Tsinghua University.
- 3/2019-5/2019 Scientific Committee, the 5th International Conference on Sustainable Thermal Energy Management (SusTEM2019) organized by the Thermal Energy Challenge Network funded by the Research Council UK.

Publications

Peer-Reviewed Journal Articles

- [1] **Zhao J**, Korba D, Mishra A, Klausner J, Randhir K, AuYeung N, Li L*. Particle-based High-temperature Thermochemical Energy Storage Reactors. *Progress in Energy and Combustion Science* 2024 (Accepted). doi:10.1016/j.pecs.2024.101143
- [2] Mishra A, Korba D, **Zhao J**, Li L*. Heat and mass transfer model for a counter-flow moving packed-bed oxidation reactor/heat exchanger. *Journal of Solar Energy Engineering: Including Wind Energy and Building Energy Conservation* (Under Review)
- [3] Huang Z, Zhou Z, **Zhao J**, Wu W-T, Wei L, Hu C, et al. Three-dimensional modeling for a 100 cm² PEMFC with different Pt loadings under cathode Pt catalyst degradation. *International Journal of Hydrogen Energy* 2024;53:1107–22. doi:10.1016/j.ijhydene.2023.12.118

- [4] Yang Y, Bai M, Zhou Z, Wu W, **Zhao J**, Wei L, et al. A 3D PtCo degradation model for long-term performance prediction of a scaled-up PEMFC under constant voltage operation. *Energy Conversion and Management* 2024;300:117918. doi:10.1016/j.enconman.2023.117918
- [5] **Zhao J**, Liu H, Li X*. Structure, Property, and Performance of Catalyst Layers in Proton Exchange Membrane Fuel Cells. *Electrochemical Energy Reviews* 2023;6(1),13. doi.org/10.1007/s41918-022-00175-1
- [6] **Zhao J**, Li X*, Shum C, McPhee J. Computational Fuel Cell Dynamics – Model Order Reduction vs. Computational Speed. *Energy* 2023;266:126488. doi.org/10.1016/j.energy.2022.126488
- [7] **Zhao J**, Li X*, Shum C, McPhee J. A Computationally Efficient and High-fidelity 1D Steady-state Model for PEM Fuel Cells. *Journal of Physics: Energy* 2023;5:015003. 10.1088/2515-7655/acafa3
- [8] Liu H, **Zhao J**, Li X*. Controlled Synthesis of Carbon-supported Pt-based Electrocatalysts for Proton Exchange Membrane Fuel Cells. *Electrochemical Energy Reviews* 2022;5:1-52. doi.org/10.1007/s41918-022-00173-3
- [9] Legala A, **Zhao J**, Li X*. Machine Learning Modeling for Proton Exchange Membrane Fuel Cell Performance. *Energy and AI* 2022;10:100183. doi.org/10.1016/j.egyai.2022.100183
- [10] Yin Y, Li Y, Qin Y*, Li M, Liu G, Zhang J, **Zhao J***. Ex-situ experimental study on dynamic behaviors and detachment characteristics of liquid water in a transparent channel of PEMFC. *Renewable Energy* 2022;187:1037-1049. doi:10.1016/J.RENENE.2022.02.031
- [11] **Zhao J**, Li X*, Shum C, McPhee J. A Review of Physics-based and Data-driven Models for Real-time Control of Polymer Electrolyte Membrane Fuel Cells. *Energy and AI* 2021; 6:100114. doi:10.1016/j.egyai.2021.100114
- [12] Pan M, Pan C, Li C, **Zhao J***. A review of membranes in proton exchange membrane fuel cells: Transport phenomena, performance and durability. *Renewable and Sustainable Energy Reviews* 2021;141:110771. doi:10.1016/j.rser.2021.110771
- [13] Alaefour I, Shahgaldi S, **Zhao J**, Li X. Synthesis and Ex-Situ characterizations of diamond-like carbon coatings for metallic bipolar plates in PEM fuel cells. *International Journal of Hydrogen Energy* 2021;46:11059–70. doi:10.1016/j.ijhydene.2020.09.259
- [14] Li Y, Zhou Z, **Zhao J**, et al. Three-Dimensional Thermal Simulations of 18650 Lithium-Ion Batteries Cooled by Different Schemes under High Rate Discharging and External Shorting Conditions. *Energies* 2021;14(21):6986.
- [15] Chang Y, **Zhao J**, Shahgaldi S, Qin Y, Yin Y, Li X. Modelling of mechanical microstructure changes in the catalyst layer of a polymer electrolyte membrane fuel cell. *International Journal of Hydrogen Energy* 2020;45:29904-16. doi:10.1016/j.ijhydene.2018.10.157
- [16] Wang J, Zhang L, Huang Y, **Zhao J***. Safety of Autonomous Vehicles. *Journal of Advanced Transportation* 2020. doi.org/10.1155/2020/8867757
- [17] Liu G, Qin Y, Wang J, Liu C, Yin Y, **Zhao J**, et al. Thermodynamic modeling and analysis of a novel PEMFC-ORC combined power system. *Energy Conversion and Management* 2020;217:112998. doi:10.1016/j.enconman.2020.112998

- [18] Ozden A, Shahgaldi S, **Zhao J**, Li X, Hamdullahpur F. Degradations in porous components of a proton exchange membrane fuel cell under freeze-thaw cycles: Morphology and microstructure effects. *International Journal of Hydrogen Energy* **2020**;45:3618–31. doi:10.1016/j.ijhydene.2018.10.209
- [19] **Zhao J**, Shahgaldi S, Ozden A, Alaefour IE, Li X, Hamdullahpur F. Effect of catalyst deposition on electrode structure, mass transport and performance of polymer electrolyte membrane fuel cells. *Applied Energy* **2019**;255:113802. doi:10.1016/J.APENERGY.2019.113802
- [20] **Zhao J**, Li X. A review of polymer electrolyte membrane fuel cell durability for vehicular applications: Degradation modes and experimental techniques. *Energy Conversion and Management* **2019**;199:112022. doi:10.1016/J.ENCONMAN.2019.112022
- [21] **Zhao J**, Li X, Liu Z. The effect of ink dilution and evaporation on the microstructures of catalyst layers in polymer electrolyte membrane fuel cells. *International Journal of Energy Research* **2019**;43:6799–6811. doi:10.1002/er.4671
- [22] **Zhao J**, Shahgaldi S, Ozden A, Alaefour IE, Li X, Hamdullahpur F. Geometric pore surface area and fractal dimension of catalyzed electrodes in polymer electrolyte membrane fuel cells. *International Journal of Energy Research* **2019**;43:3011–3019. doi: 10.1002/er.4260
- [23] Chang Y, Liu J, Li R, **Zhao J**, Qin Y, Zhang J, et al. Effect of humidity and thermal cycling on the catalyst layer structural changes in polymer electrolyte membrane fuel cells. *Energy Conversion and Management* **2019**;189:24–32. doi:10.1016/J.ENCONMAN.2019.03.066
- [24] **Zhao J**, Li X. Oxygen transport in polymer electrolyte membrane fuel cells based on measured electrode pore structure and mass transport properties. *Energy Conversion and Management* **2019**;186:570–85. doi:10.1016/J.ENCONMAN.2019.02.042
- [25] Shahgaldi S, Alaefour I, **Zhao J**, Li X. Impact of ionomer in the catalyst layers on proton exchange membrane fuel cell performance under different reactant flows and pressures. *Fuel* **2018**;227:35–41. doi:10.1016/j.fuel.2018.04.076
- [26] **Zhao J**, Ozden A, Shahgaldi S, Alaefour IE, Li X, Hamdullahpur F. Effect of Pt loading and catalyst type on the pore structure of porous electrodes in polymer electrolyte membrane (PEM) fuel cells. *Energy* **2018**;150:69–76. doi:10.1016/j.energy.2018.02.134
- [27] **Zhao J**, Shahgaldi S, Li X, Liu Z (Simon). Experimental Observations of Microstructure Changes in the Catalyst Layers of Proton Exchange Membrane Fuel Cells under Wet-Dry Cycles. *Journal of The Electrochemical Society* **2018**;165:F3337–45. doi:10.1149/2.0391806jes
- [28] Ozden A, Shahgaldi S, **Zhao J**, Li X, Hamdullahpur F. Assessment of graphene as an alternative microporous layer material for proton exchange membrane fuel cells. *Fuel* **2018**;215:726–34. doi:10.1016/j.fuel.2017.11.109
- [29] Xu Q, Zhang W, **Zhao J**, Xing L, Ma Q, Xu L, et al. Effect of air supply on the performance of an active direct methanol fuel cell (DMFC) fed with neat methanol. *International Journal of Green Energy* **2018**;15:181–8. doi:10.1080/15435075.2018.1431547
- [30] **Zhao J**, Shahgaldi S, Alaefour I, Yang S, Li X. Pore structure and effective diffusion coefficient of catalyzed electrodes in polymer electrolyte membrane fuel cells. *International Journal of Hydrogen Energy* **2018**;43:3776–85. doi:10.1016/j.ijhydene.2018.01.019

- [31] **Zhao J**, Shahgaldi S, Alaefour I, Xu Q, Li X. Gas permeability of catalyzed electrodes in polymer electrolyte membrane fuel cells. *Applied Energy* **2018**;209:203–10. doi:10.1016/j.apenergy.2017.10.087
- [32] Shahgaldi S, **Zhao J**, Alaefour I, Li X. Investigation of catalytic vs reactant transport effect of catalyst layers on proton exchange membrane fuel cell performance. *Fuel* **2017**;208:321–8. doi:10.1016/j.fuel.2017.07.035
- [33] Shu G, Liu L, Tian H, Wei H, **Zhao J**. A two-stage ORC combined cycle used in cascade recovery of various grades waste heat of internal combustion engine. *Journal of Tianjin University (Science and Technology)* **2013**;46:857–61. doi:10.11784/tdxb20131001
- [34] Liu L, Shu G, Tian H, **Zhao J**, Yu G. Working Fluid Pair Selection of a Dual-Loop Organic Rankine Cycle (DORC). *Journal of Engineering Thermophysics* **2013**;34(9):1626-1629
- [35] Shu G, Liang Y, Wei H, Tian H, **Zhao J**, Liu L. A review of waste heat recovery on two-stroke IC engine aboard ships. *Renewable and Sustainable Energy Reviews* **2013**;19:385–401. doi:10.1016/j.rser.2012.11.034
- [36] Shu G, **Zhao J**, Tian H, Liang X, Wei H. Parametric and exergetic analysis of waste heat recovery system based on thermoelectric generator and organic Rankine cycle utilizing R123. *Energy* **2012**;45:806–16. doi:10.1016/j.energy.2012.07.010

Peer-reviewed Book Chapters

- [1] **Zhao J***, Li X, Shum C, McPhee J. "Control-oriented computational fluid dynamics models for polymer electrolyte membrane fuel cells." Fuel Cells for Transportation. Woodhead Publishing, 2023. 393-417
- [2] **Zhao J***, Li X. "Fuel cell durability under automotive driving cycles—fundamentals and experiments." Fuel Cells for Transportation. Woodhead Publishing, 2023. 419-462

Conference Papers and Abstracts

- [1] Mishra A, Abourazzouk O, **Zhao J**, Li L*. Discrete Modeling of Flow and Heat Transfer in High-Temperature Gravity-Driven Granular Flows for Thermal Energy Storage. ASME Energy Sustainability, 2024, p. ES2024-131719 (Under Review)
- [2] **Zhao J**, Liu H, Li X. Effect of Microstructure on the Transport Coefficients, Electrochemical Properties, Performance and Durability of Catalyst Layers in PEM Fuel Cells. *2021 Canadian Society for Mechanical Engineering International Congress*, Paper No.: 204
- [3] Liu H, **Zhao J**, Li X. Perspectives on mass production of carbon supported Pt-based electrocatalysts for proton exchange membrane fuel cells. *2021 Canadian Society for Mechanical Engineering International Congress*, Paper No.: 172
- [4] **Zhao J**, Li X. Modeling of Cathode Oxygen Transport in Polymer Electrolyte Membrane Fuel Cells Based on Measured Permeability and Effective Diffusivity (Abstract only). *Proc. of The Joint Canadian Society for Mechanical Engineering and CFD Society of Canada International Congress 2019*, Paper No.: 286
- [5] Park J, **Zhao J**, Li X. Through-plane permeability of a successively strained gas diffusion layer in polymer electrolyte membrane fuel cells. *Proc. of The Joint Canadian Society for Mechanical Engineering and CFD Society of Canada International Congress 2019*, Paper No.: 219.

- [6] **Zhao J**, Li X. Effect of Catalyst Layer Fabrication Methods on Electrode Structure and Mass Transport in Polymer Electrolyte Membrane Fuel Cells. *10th Int. Conf. on Applied Energy (ICAE2018)*, Paper No.: 433
- [7] Alaefour I, Shahgaldi S, **Zhao J**, Li X. Synthesis of Diamond-like Carbon by Plasma Enhanced Carbon Vapor Deposition (PECVD) on Different Substrates for Fuel Cell Application. *Proc. of The Canadian Society for Mechanical Engineering International Congress 2018*, Paper No.: 225
- [8] **Zhao J**, Shahgaldi S, Alaefour I, Ozden A, Li X, Hamdullahpur F. Pore Structure of Porous Electrodes in Polymer Electrolyte Membrane (PEM) Fuel Cells. *Proc. of the 12th Int. Green Energy Conf.*, Paper No.: IGEC2017-098
- [9] **Zhao J**, Li X. Influence of Solvent Evaporation on the Microstructure Formation of Catalyst Layer of Polymer Electrolyte Membrane Fuel Cells. *Proc. of the 11th Int. Green Energy Conf.*, Paper No.: IGEC-2016-1033
- [10] Shu G, **Zhao J**, Tian H, Wei H, Liang X, Yu G, Liu L. Theoretical Analysis of Engine Waste Heat Recovery by the Combined Thermo-Generator and Organic Rankine Cycle System. *SAE Technical Paper 2012-01-0636*
- [11] **Zhao J**, Shu G, Liang X, Zhao Z. Research on the Simulation of Cascade Utilization of Engines' Waste Heat Based on TEG and ORC. *Proc. of the 2nd Int. Conf. on Mechanic Automation and Control Engineering (ICMACE)*, IEEE, 2011; pp. 5199-5205
- [12] Zhu T, Wei H, **Zhao J**. Simulation of the Original Injection MAP Diagram of Electronic-Controlled Gasoline Engines Based on MATLAB/SIMULINK. *Proc. of the 2011 Int. Conf. on Electrical and Control Engineering (ICECE)*, IEEE, 2011; pp. 815-819
- [13] **Zhao J**, Tang B, Tang Y, Qi K, Ma E. Transient Performance Simulation of Single-cylinder Engines Based on Tribology Behaviors. *Applied Mechanics and Materials*, 2010; Vol. 34, pp. 946-950

Feature Article in Magazines

- [1] **Zhao J**, Korba D, Li L. Introduction to Thermochemical Energy Storage. *Green Energy Today 2023*;2:7-8

Poster & Video Presentations

- [1] **Zhao J**. "Micro-porous Structure and Mass Transport Properties of the Catalyst Layers in Polymer Electrolyte Membrane Fuel Cells", in the *2018 MMEGA Symposium (University of Waterloo)*, Feb. 23, 2018. Waterloo, ON, Canada. (**Best Poster Presentation Award**)
- [2] **Zhao J**, Li X, Liu Z. "Micro-porous Structure and Mass Transport Properties of the Catalyst Layers (CLs) in Polymer Electrolyte Membrane (PEM) Fuel Cells", in the *CaRPE-FC Annual Technical Review Meeting*, Jun. 7-8, 2017. Vancouver, BC, Canada.
- [3] **Zhao J**, Sakars A, Liu Z, Li X. "Micro-porous Structure of the Catalyst Layers (CLs) of Polymer Electrolyte Membrane (PEM) Fuel Cells", in the *5th Annual CaRPE-FC Technical Review Meeting*, May 3-4, 2016. Vancouver, BC, Canada.
- [4] **Zhao J**, Li X, Liu Z, Pan Z. "Formation of Storm Eye and Mushroom Cloud Cascading in Nanoparticle-laden Evaporating Drops", in the Gallery of Fluid motion at the 72th Annual Meeting

of the APS Division of Fluid Dynamics. <https://doi.org/10.1103/APS.DFD.2019.GFM.V0081>

Patent

[1] Energy feedback heat pipe heat exchange device (Publication #: CN102536510 A).

Invited Talks and Presentations

- [1] **(Invited Keynote Speaker)** “Structural dependent Properties of Catalyst Layers for PEM Fuel Cells - A Comprehensive Review” at the 2022 International Colloquium on Environmentally Preferred Advanced Generation (ICEPAG) and the 2022 World Fuel Cell Conference (WFCC), Dec. 12-15, 2022, University of California, Irvine, USA.
- [2] “Numerical Investigation of Oxygen Transport in Polymer Electrolyte Membrane Fuel Cells”, at the 2019 World Fuel Cell Conference (WFCC), Aug. 25-29, 2019, Shanghai, China.
- [3] “Experimental measurement of Gas Permeability and Effective Diffusion Coefficient in Fuel Cell Electrodes”, at the 2019 World Fuel Cell Conference (WFCC), Aug. 25-29, 2019, Shanghai, China.
- [4] “Experimental Techniques for Polymer Electrolyte Membrane Fuel Cell Durability”, in the 2019 World Fuel Cell Conference (WFCC), Aug. 25-29, 2019, Shanghai, China.
- [5] “Modeling of Cathode Oxygen Transport in Polymer Electrolyte Membrane Fuel Cells Based on Measured Permeability and Effective Diffusivity”, in the Joint Canadian Society for Mechanical Engineering and CFD Society of Canada International Congress 2019, Jun. 2-5, 2019, London, ON, Canada.
- [6] **(Invited Speaker)** “Engineering Advanced MEAs”, (invited speaker) in announcement workshop of Canadian Urban Transit Research & Innovation Consortium (CUTRIC) project entitled *Development of Low-Cost, High Performing and Durable PEM Fuel Cells (Phase I)*, Mar. 1, 2019, Waterloo, ON, Canada.
- [7] “Polymer Electrolyte Membrane Fuel Cell”, (invited speaker) in the course of ME751 *Fuel Cell Technology* in University of Waterloo, Jul. 3, 2018, Waterloo, ON, Canada.
- [8] “Pore Structure of Porous Electrodes in Polymer Electrolyte Membrane (PEM) Fuel Cells”, in *12th Int. Green Energy Conf.*, Jul. 31-Aug. 3, 2017, Xi’an, Shaanxi, China.
- [9] “Microstructure and Macro-property of Porous Electrodes in Polymer Electrolyte Membrane (PEM) Fuel Cell”, in *CaRPE-FC workshop*, Mar. 16-17, 2017. Vancouver, BC, Canada.
- [10] “Influence of Solvent Evaporation on the Microstructure Formation of Catalyst Layer of PEMFCs”, in *CaRPE-FC workshop*, Feb. 17-18, 2016. Vancouver, BC, Canada.
- [11] “Theoretical Analysis of Engine Waste Heat Recovery by the Combined Thermo-Generator and Organic Rankine Cycle System”, in *SAE 2012 World Congress & Exhibition*, Apr. 24-26, 2012. Detroit, MI, USA.
- [12] “Research on the Simulation of Cascade Utilization of Engines' Waste Heat Based on TEG and ORC”, in *2011 Conference of the Chinese Engineering Thermophysics Society*, Nov. 5-7, 2011. Wuhan, Hubei, China.

Research Experience

- 2023-2024 “Thermochemical Energy Storage Reactor Design and Demonstration to Accommodate Renewable Energy Intermittency”
- Funded by Tennessee Valley Authority (TVA)
- 2022-2023 “Solid State Solar Thermochemical Fuel (SoFuel) for long duration storage”
- Funded by U.S. DOE
- 2019-2022 “Data-Driven Fuel Cell Stack Modeling for Real-Time Control Applications”
- Funded by Toyota Motor North America R&D and Natural Sciences and Engineering Research Council of Canada (NSERC)
- 2019-2020 “Development of Low-Cost, High Performing and Durable PEM Fuel Cells”
- Co-funded by Canadian Urban Transit Research & Innovation Consortium (CUTRIC), Natural Sciences and Engineering Research Council of Canada (NSERC) and Ballard Power Systems Inc.
- 2015-2016 “Measurement of Pore Size Distribution and Porosity of Catalyst Layers in PEM Fuel Cells by the Method of Standard Porosimetry (MSP)”
- Funded by Automotive Fuel Cell Cooperation (AFCC) Corp.
- 2014-2018 “Catalysis Research for Polymer Electrolyte Fuel Cells (CaRPE-FC)”
- Funded by Natural Sciences and Engineering Research Council of Canada (NSERC) Strategic Network in Low-Pt Polymer Electrolyte Membrane Fuel Cell Research (Low-Pt PEMFC)
- 2014-2016 “The Initial Microstructure of the Catalyst Layers in PEM fuel cells”
- Funded by National Research Council (NRC) Canada
-

Teaching Experience

Sessional Lecturer, *University of Waterloo*

2021 Spring **Fuel Cell Technology** (ME751), *graduate elective course, 24 students*

Substitute Lecturer, *University of Waterloo*

2019 Winter **Heat Transfer 1** (ME353), *undergraduate required course, 83 students*

Graduate Student Teaching Assistant, *University of Waterloo*

2019 Winter **Heat Transfer 1** (ME353), *undergraduate required course, 83 students*

2018 Spring **Fuel Cell Technology** (ME751), *graduate elective course, 11 students*

2018 Winter **Combustion 1** (ME557), *undergraduate and graduate elective course, 30 students*

2018 Winter **Thermodynamics 2** (ME354), *undergraduate required course, 119 students*

2017 Fall **Heat Transfer 1** (ME353), *undergraduate required course, 112 students*

2017 Winter **HVAC Energy Efficiency** (CIVE497/ME599/ME760), *undergraduate and graduate elective course, 90 students*

2016 Fall **Energy Conversion** (ME459), *undergraduate and graduate elective course, 53 students*

2016 Spring **Fuel Cell Technology** (ME751), *graduate elective course, 16 students*