

(BOREAS) – Advanced thermal management technologies for Li-ion battery modules

Record number : OPR-825

Overview

RESEARCH DIRECTION

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RESEARCH CO-DIRECTION

Julien Sylvestre, Professeur - Department of Mechanical Engineering

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ADMINISTRATIVE UNIT(S)

Faculté de génie
Département de génie mécanique
Institut interdisciplinaire d'innovation technologique (3IT)

LEVEL(S)

2e cycle
3e cycle

LOCATION(S)

3IT - Institut interdisciplinaire d'innovation technologique

Project Description

The Interdisciplinary Institute for Technological Innovation (3IT) at the Université de Sherbrooke (Quebec, Canada) in collaboration with Bombardier Recreational Products (BRP), the Center of advanced technologies (CTA) and Plastiques Gagnon Inc (PGI) offers Msc and PhD positions as part of the BOREAS project. The positions are funded with a competitive salary.

BOREAS - Background: Electrification of transportation is a priority for governments to reduce GHG emissions in Canada, especially through our unique renewable electricity resources. On the other hand, the adoption of electric vehicles is limited by the use of batteries, which bring a high cost, an uncertainty of autonomy, risks of thermal runaway and a limited lifespan. All of these aspects are affected by the operating temperature of the batteries, so their effective thermal management is critical. This project aims to accelerate the use of advanced thermal management methods based on the phase change of a coolant, in order to mitigate these challenges to electrification. Two technologies will be developed and demonstrated, namely immersion cooling and heat pipe cooling. More specifically, the implementation challenges for the immersion approach will be assessed, including when boiling a dielectric fluid directly on the cells. Also, fabrication methods for pulsating polymeric heat pipes (PPHP) will be developed and demonstrated. Tests will be conducted in the laboratory, but also on recreational vehicles on the road. Models will also be set up to facilitate the implementation of these technologies in a wide range of battery modules for electric vehicles. This will pave the way for the deployment of advanced thermal management methods within electric vehicle manufacturers in Canada and elsewhere, thus supporting the electrification of transportation and a more sustainable society.

We are looking for outstanding and motivated candidates with a variety of skills. The candidate must hold a bachelor degree (for Msc) and a master degree (for PhD) in the field of Engineering (mechanical, chemical, materials) or Science (materials, chemistry, physics), or a related discipline. In addition to your curiosity for research, your fields of interest revolve around:

- Electric vehicles
- Integration of new battery thermal management technologies
- Analytical modeling and numerical simulation (CFD, FEM) of heat transfer and fluid mechanics phenomena
- Design, machining, molding and assembly of prototypes

- Design and installation of experimental setups

Please see below the list of the master's and doctoral projects:

PhD1: Experimental thermal study of Li-ion batteries for immersion cooling applications.

PhD 2: Advanced Thermal modeling of Li-ion battery for immersion cooling applications.

PhD3: Design and Analysis of Two-phase Thermosyphon for Electric Vehicle Thermal Management.

PhD4: Analytical modeling, numerical simulation and design of pulsating heat pipes used in Li-ion battery cooling.

PhD5: Fabrication and characterization of pulsating heat pipes used in Li-ion battery cooling.

Msc1, Msc2, Msc3 and Msc4: Technological implementation and challenges of immersion cooling including safety, reliability and weight/cost optimization.

Msc5: High barrier layer coatings for polymers used for manufacturing pulsating heat pipes.

Msc6: Enhanced thermal conductivity of nanocomposite polymers used for manufacturing pulsating heat pipes.

The Université de Sherbrooke (UdeS) is the Canadian leader in industrial partnerships. By following your graduate studies at UdeS, you will develop, on the one hand, your skills and acquire knowledge in a cutting-edge scientific field. On the other hand, by working closely with the teams of industrial partners, you will be able to acquire solid applied experience in areas such as R&D project management, intellectual property management and the commercialization of advanced technologies.

The project will be led by professors Julien Sylvestre and Luc Fréchette (UdeS).

For more information, or to submit your application, contact Omidreza.Ghaffari, PhD (omidreza.ghaffari@usherbrooke.ca) or Amrid Amnache, PhD (amrid.amnache@usherbrooke.ca).

| Discipline(s) by sector | Funding offered | Partner(s) |
|---|------------------------|--|
| Sciences naturelles et génie Génie mécanique | Yes | Bombardier Produits récréatifs (BRP), Plastiques Gagnon Inc (PGI) |

The last update was on 12 March 2024. The University reserves the right to modify its projects without notice.