VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Rekabra Youssef**

The public defense will take place on **Monday 11th December 2023 at 10:00am.**

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NOVEL AND ENVIRONMENTAL DESIGN OPTIMIZATION FOR BATTERY THERMAL MANAGEMENT SYSTEM IN ELECTRIC VEHICLE

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Abstract of the PhD research

Lithium-ion (Li-ion) batteries play an essential role in our daily lives and are considered the main power source in electric vehicles. The process of charging and discharging the battery continuously drives to a significant amount of heat generation which results in temperature differences, non-uniformity, and thermal runaway. An effective battery thermal management strategy (BTMS) is required to maintain battery temperature in the optimal range and thus ensure high performance, safety, and longevity of lithium-ion batteries. Many cooling mediums have been conducted into BTMS to transfer, absorb, or dissipate the heat generated from the batteries. Thermal conductivity, heat transfer coefficient, cooling performance, cost, poison, environment, system size, and equipment needed are critical factors in choosing the ideal heat transfer coolant for the BTMS.

In this PhD thesis, a novel and environmental material called jute is integrated with both cooling strategies, air-cooling, and passive cooling PCM assisted. Jute is a cheap, light , eco-friendly, widely available material well-known for its cooling properties, Jute fibers haven't been investigated and integrated before with battery thermal management strategies.
Temperature evolution, uniformity, and cooling performance were investigated. Afterwards, a comparison between the thermal behavior of the air-based BTMS and PCM-assisted cooling system was performed. The results indicated that adding jute to the BTMS increased the cooling improvement and especially decreased the temperature development. Furthermore, the temperature difference (ΔT) was enhanced by 60% when integrating jute with PCM, and temperature uniformity improved by 3% when integrating jute with air-based BTMS. This study compared the integration of jute with active cooling and passive cooling; thus, it sheds the light on the importance of jute as a novel, eco-friendly, lightweight, cheap, available, and nontoxic material added to two strategies of BTMS. The setup was physically made and experimentally studied for the purpose of BTMS optimization. The results of this research confirm that the proposed designs with jute fibers combination improved the cooling performance besides reduced the equipment and weight.