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 **Kato Daems**

The public defense will take place on **Wednesday 26th November 2025 at 4 pm** in the **Green Room** (U-Residence, VUB Main Campus)

To join the digital defense, please click here

ELECTROCHEMICAL-THERMAL MODELING AND SALT OPTIMIZATION OF SOLID-STATE ELECTROLYTES FOR NEXT-GENERATION BATTERIES

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Abstract of the PhD research

As the world confronts global warming, the shift to green energy, powering electric vehicles and storing renewable electricity, depends on the creation of better batteries. However, today's batteries face two major hurdles: they often contain a flammable liquid that can be a safety risk, and developing new, improved versions is a slow and expensive process of experimental trial-and-error. This PhD research addresses both problems by focusing on two goals: creating smarter design tools and safer materials.

To make battery development faster and more efficient, an accurate computer simulation of a lithium-ion battery was built. This virtual tests makes it possible to see inside a battery as it operates, test new designs without building them, and pinpoint exactly where dangerous hotspots might form. A key breakthrough of this work is the demonstration that the model can use data from small, lab-scale batteries to predict the performance of large, commercially sized batteries. This provides a powerful tool to speed up the innovation process, saving significant time and money.

To make batteries safer, the research focused on replacing the flammable liquid electrolyte with a solid, flexible material known as a solid polymer electrolyte. The research involved finding the "recipe" of a polymer and various lithium salts to allow energy to flow efficiently. The investigation led to a surprising discovery that challenges a long-held belief in the field: it's not just the physical structure of the material that matters most, but rather the quality of its chemical recipe. By understanding how to create a more stable connection between the battery's components and optimizing this chemical recipe, this work provides a clearer roadmap for designing the fundamentally safer, longer-lasting, and more powerful next-generation solid-state batteries.