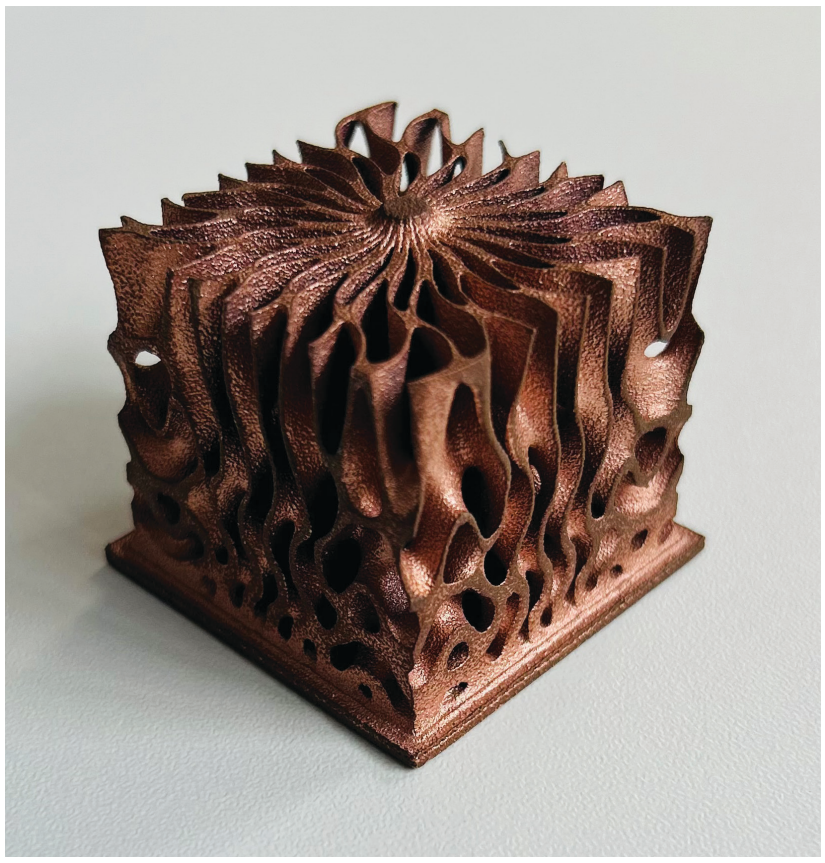
Innovate UK | Knowledge Transfer Partnerships

UNIVERSITY OF WOLVERHAMPTON

AceOn



The company

AceOn has over 30 years' experience in the design and manufacture of custom-built battery packs and is a leading supplier of industrial and consumer batteries to the worldwide market. AceOn is also a key player in the UK energy storage market with the ambition to grow its presence internationally.

Challenge

Battery usage is expected to grow exponentially. Suboptimal thermal management is a leading cause of battery degradation and can result in reduced capacity and thermal runaway. Battery packs generally feature a range of cooling methods, from passive heat sinks to advanced liquid and refrigerant options, dependent on the performance requirements and costs associated with a particular system and application.

The growing demand for higher energy density in battery packs calls for sophisticated cell layout and packaging strategies to ensure optimal thermal management. Despite their advantages, the adoption of custom thermal management systems and optimisation remains largely unexplored. Our research collaboration aims to fill this gap by introducing customisable thermal management architectures specifically designed for battery modules that can be additively manufactured.

Solutions

A Knowledge Transfer Partnership (KTP) programme was established between AceOn and the University of Wolverhampton to address the challenges of thermal management (TM) and battery module standardisation.

This collaboration leverages the advantages of metal additive manufacturing (3D printing) and generative design to create a customisable framework. The initiative aims to develop proof-of-concept demonstrators for customisable thermal management systems which are applicable to various battery products, including those used in electric vehicles, energy storage/ harnessing, and second-life battery applications.

> AceOn has enjoyed considerable benefit from this KTP, which drove the competitiveness of our advanced battery packs to become industry-leading. This is supporting our business growth through novel thermal management and the development of talent.
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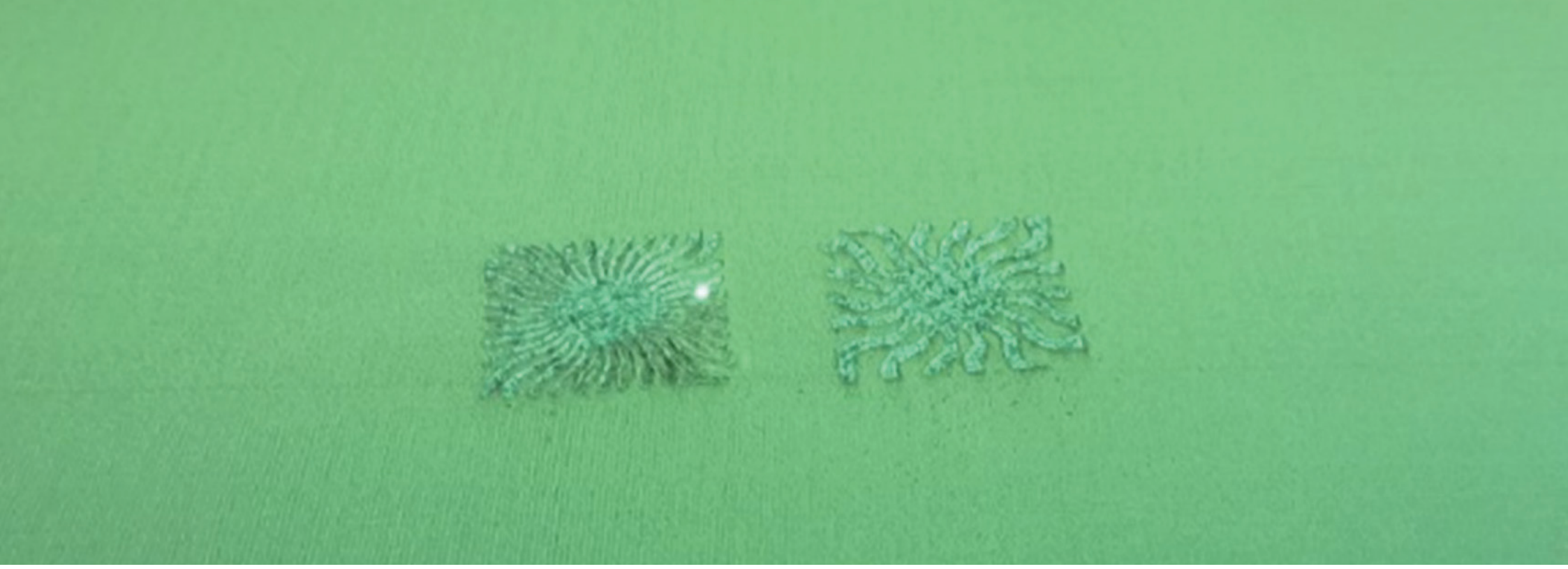
> Engagement with academia and in particular the University of Wolverhampton has ensured that we remain at the forefront of technology and build a sustainable future for our business.
>
> **Richard Partington**
> **Managing Director, AceOn**



> This post-doctorate KTP experience has been truly unparalleled for me, providing not just incredible career development but also invaluable hands-on learning opportunities. The support, resources, and connections from both the university and AceOn have helped to make this programme an essential stepping stone for my professional growth and made use of my training during my PhD. The KTP also offered me a diverse set of skills and additional advanced training. In short, the KTP has become an indispensable part of my career journey.
>
> **Dr Tharumal Wanniarachchi**

Results

Phase 1 of the project involved investigation and rigorous testing to ascertain battery thermal characteristics. The tests showed that the inverter that manages the power in these batteries was found to exceed safe temperature, which can damage the electronics and make it less efficient. For this reason, there is a need for improved inverter thermal management to ensure the devices' longevity and performance.

Informed by this research, Phase 2 involved exploring materials such as copper and aluminium alloys for their suitability for heat dissipation and additive manufacturing. This included Laser Powder Bed Fusion (L-PBF), an advanced additive manufacturing method.

The optimal material and process parameters for 3D printing were determined using the surrogate modelling technique informed by experimental data developed by the additive manufacturing group at the University of Wolverhampton. Through careful experimentation and analysis, the most effective combination of parameters was identified to ensure superior heat transfer properties.

A new battery thermal management architecture was chosen for its inherent ability to maximise surface area and therefore decrease temperature while maintaining structural integrity. This innovative approach allowed for the development and manufacturing of a novel triply periodic minimal surfaces (TPMS)-based structure specifically tailored for integration into Battery Module Thermal Management Systems (BMTM). This represents a significant advancement in the optimisation of battery thermal management, promising improved efficiency and reliability for AceOn's advanced battery packs.

> Participating in the KTP has been an amazing journey. It has been eye-opening to witness how the theoretical knowledge and research conducted at the university can directly influence the industry. Through this project, we have combined theory with cutting-edge experimental methods and additive manufacturing optimisation algorithms to enhance and revolutionise commercial battery packs for AceOn. We have shown first-hand how academic research can create tangible results in the real world. These experiences also provide valuable case studies for our future engineering students, enriching the research-driven curriculum.
>
> **Professor Arun Arjunan**

Knowledge Transfer Partnerships (KTPs) aim to help businesses improve their competitiveness and productivity through the better use of knowledge, technology and skills within the UK knowledge base. This KTP project was funded by UKRI through Innovate UK.

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