Custom formulation

Photocentric JM UKRI Innovate UK

3D printed solid-state batteries with controlled geometry

Developing custom-formulated materials to enable solid-state battery manufacture with bespoke configurations using Additive Manufacturing.

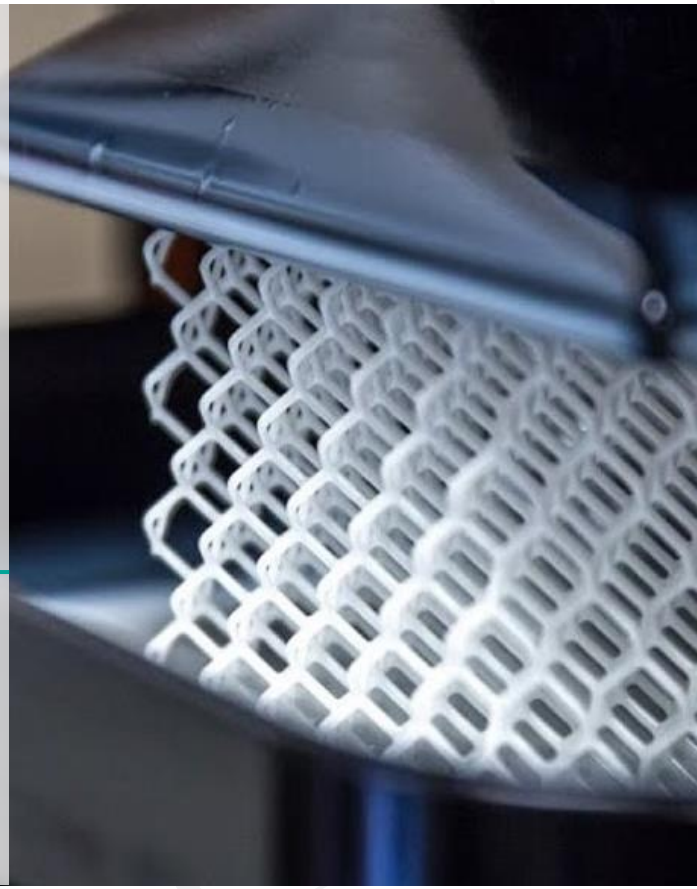
Collaborative R&D | 18 months | £120,399

OUTCOMES AND IMPACT

- Feasibility of 3D printing a solid-state battery of any shape which is less hazardous and more sustainable than conventional lithium-ion batteries
- Developed novel composite materials, including complete curing for resins highly-filled with light-blocking anodes
- Printed the cathode materials using a functional binder via a Fused Deposition Modelling process, removing the need for energy-intensive sintering processes

"With CPI's help, we now have a solid proof-of-concept that we've been able to move forward in the development process to higher TRL levels. CPI aided in delivering results and knowledge with a reduced capital investment, allowing us to to achieve our goal in a shorter time span."

Robert Young
Head of Chemistry and Batteries, Photocentric



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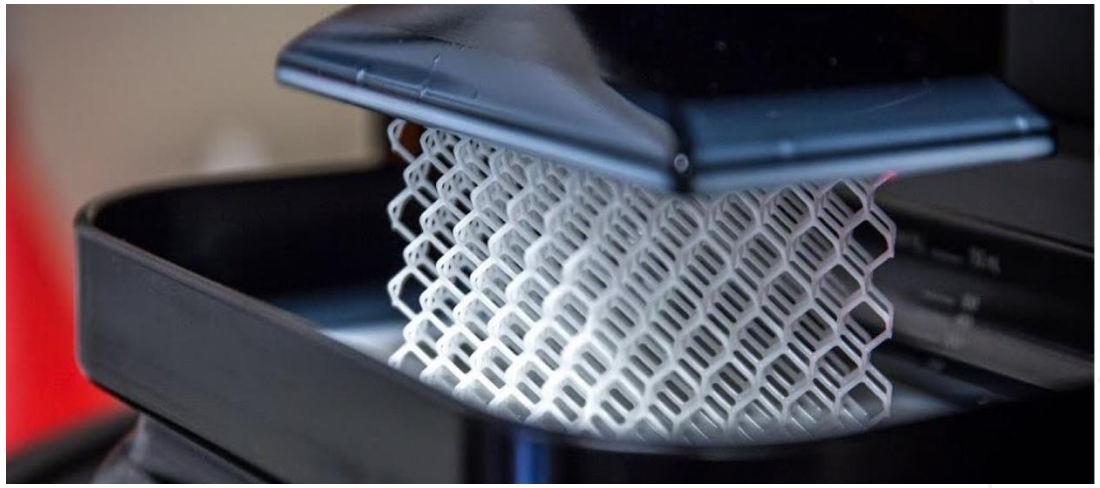
Innovating together with CPI

CASE STUDY

3D printed solid-state batteries with controlled geometry

Developing custom-formulated materials to enable solid-state battery manufacture with bespoke configurations using Additive Manufacturing.



Photocentric

JM

UKRI Innovate UK

Collaborative R&D project

18 months

£120,399

Outcomes and impact

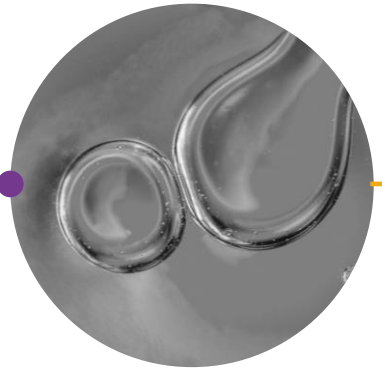
- *Feasibility of 3D printing a solid-state battery of any shape which is less hazardous and more sustainable than conventional lithium-ion batteries*
- *Developed novel composite materials, including complete curing for resins highly-filled with light-blocking anodes*
- *Removed the need for energy intensive sintering processes by using a polymer electrolyte binder*

3D printed solid-state batteries

Formulation of electrode and electrolyte resins for subsequent 3D printing

Raw material characterisation

Anode, cathode and electrolyte powder characterisation including XRD, iGC, DSC, SEM and dynamic vapour sorption



Functional resin formulation

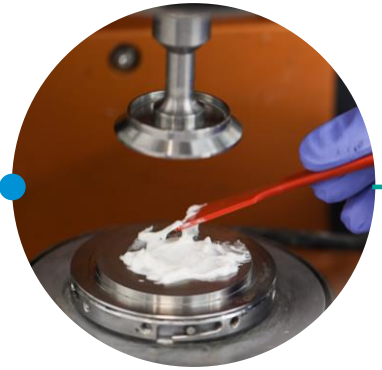
Developed and optimised polymer electrolyte binders and anode and cathode powders into a printable photopolymer or thermoplastic resin.

Applied high throughput automation capabilities to explore photopolymer formulations.

Formulation screening using Photo-DSC

Explored photo-DSC to understand curing of photopolymer formulations.

Results used to inform 3D-printing process, enabling identification of promising formulations.



Rheology of resin formulations

Used rheology to confirm compatible flow properties and sufficient stability for 3D printing, including melt rheology of thermoplastic polymers.

3D printed film characterisation

Efficient screening methods utilised to enable high throughput testing of 3D printed electrodes including electrical impedance spectroscopy (EIS) to measure ionic conductivity and four-point probe measurements to determine electrical conductivity.

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