THE IMPORTANCE OF DESIGN FOR DISASSEMBLY OF LITHIUM-ION BATTERIES

A comprehensive review of new pack and cell designs to simplify battery recycling

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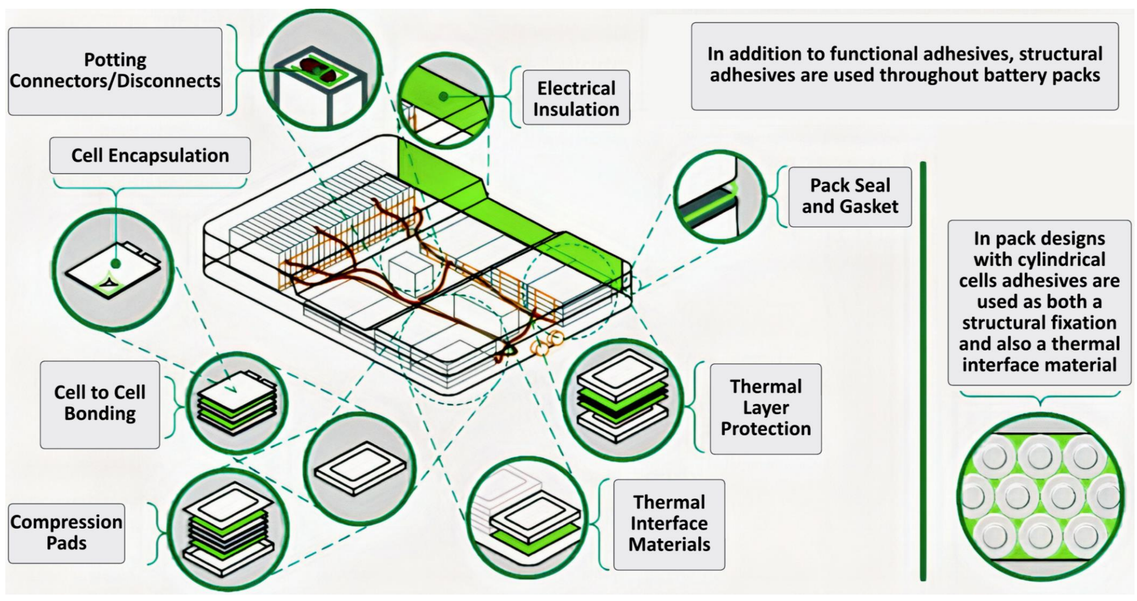
ABSTRACT

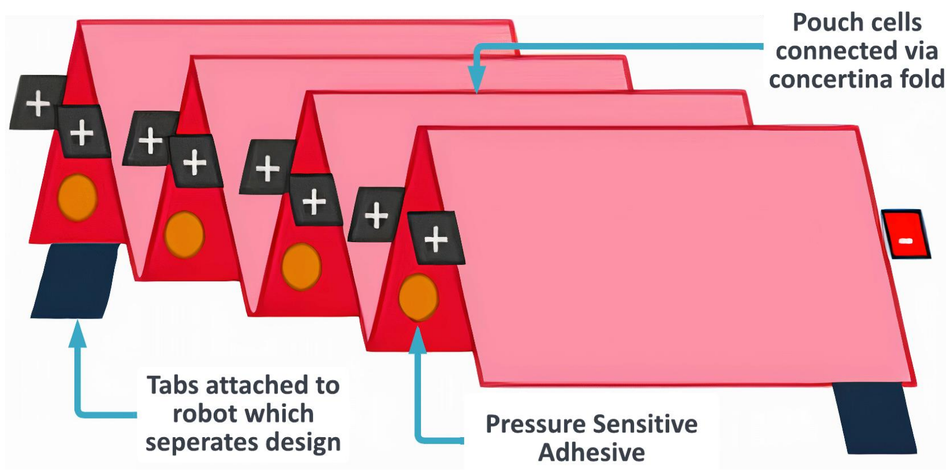
- **By 2030 the worldwide usage of lithium-ion batteries alone is predicted to hit 2 million metric tonnes per year [1]. One of the major issues limiting automatic disassembly, and hence faster recycling, is the structural adhesives used during assembly of the cells, modules and packs [2]. In this work, a concertina-fold design was developed for packing cells to decrease disassembly times, with Pressure Sensitive Adhesives (PSAs) used to hold them together. These designs were then disassembled automatically by cutting-edge robot technology**

THE PROBLEM



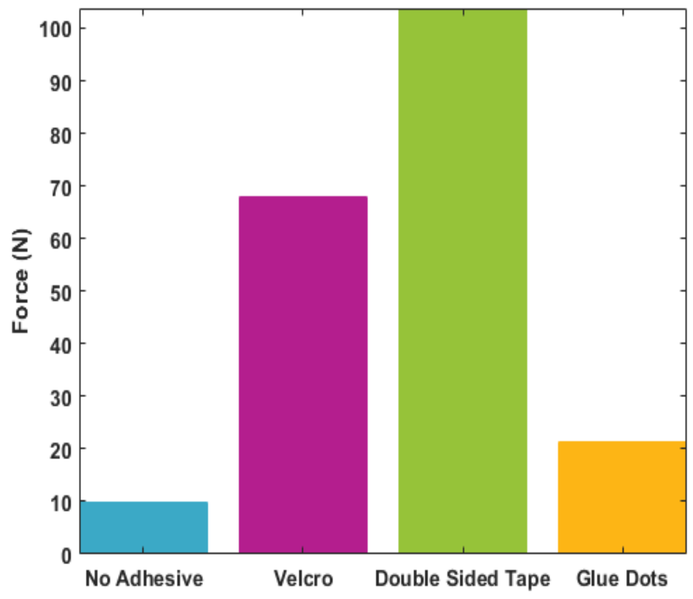
- **As seen in the figure above the extensive use of adhesives and complicated cell packing results in long module disassembly times and inefficient recovery of active materials. To decrease the time taken the packs should be able to be easily automatically disassembled whilst being structurally rigid**

OUR SOLUTION



- **The concertina style of packing cells significantly reduced disassembly time and the PSA's proved worthy of resisting shearing motion and held the design firmly together**

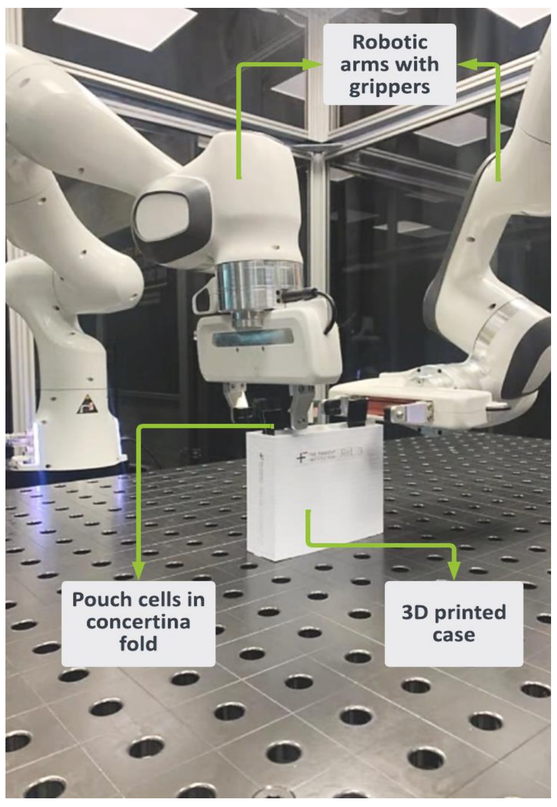
PRESSURE SENSITIVE ADHESIVES



PSAs are used everywhere in our daily life ranging from glue dots and blu tack, to Velcro and even double-sided tape. These were all integrated into our concertina design. Their load-bearing properties were investigated using a tensile testing machine. These results were promising for cell design.

ROBOTIC DISASSEMBLY

- **Two manually programmed robotic arms were used to extend the pouch cell design, pulling apart the pressure sensitive adhesives. This process was quick, taking only 15 seconds instead of 90 min with conventional adhesives!**



TECHNO-ECONOMIC ASSESSMENT

Application of Adhesive & Setting Time

In comparison to industrial epoxy, PSAs were easier to disassemble and hence required less energy and no chemical consumption

Disassembly, Expoxy must be dissolved first

Type	Time To Separate Module
Pressure Sensitive Adhesive	15 s
Industry Standard Epoxy	1 hr 30 min

REFERENCES

[1] Mitch Jacoby, C&EN Global Enterprise, 2019, 97, 29–32.

[2] K. R. Mulcahy, A. F. R. Kilpatrick, G. D. J. Harper, A. Walton and A. P. Abbott, Green Chemistry, 2022, 24, 36–61.

CONCLUSION & NEXT STEPS

- **Our concertina design combined with pressure sensitive adhesives could prove effective in simplifying the entire lithium-ion battery recycling process and benefit the industry hugely**

Battery Module → **Fully Automatic Disassembly** → **Discharged Cells** → **Active Material**

INTERN BIO

Zayd is currently a 3rd year aerospace student at Imperial College London who aspires to provide beneficial aid to the battery recycling industry in the future and learn more about the energy and battery sector. He hopes to "establish his own company working at the forefront of global technological developments for the renewable energy industry."

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