SELF-SENSING BEHAVIOUR OF TRIPLY PERIODIC MINIMAL SURFACE LATTICES ENABLED BY ADDITIVE MANUFACTUIRING

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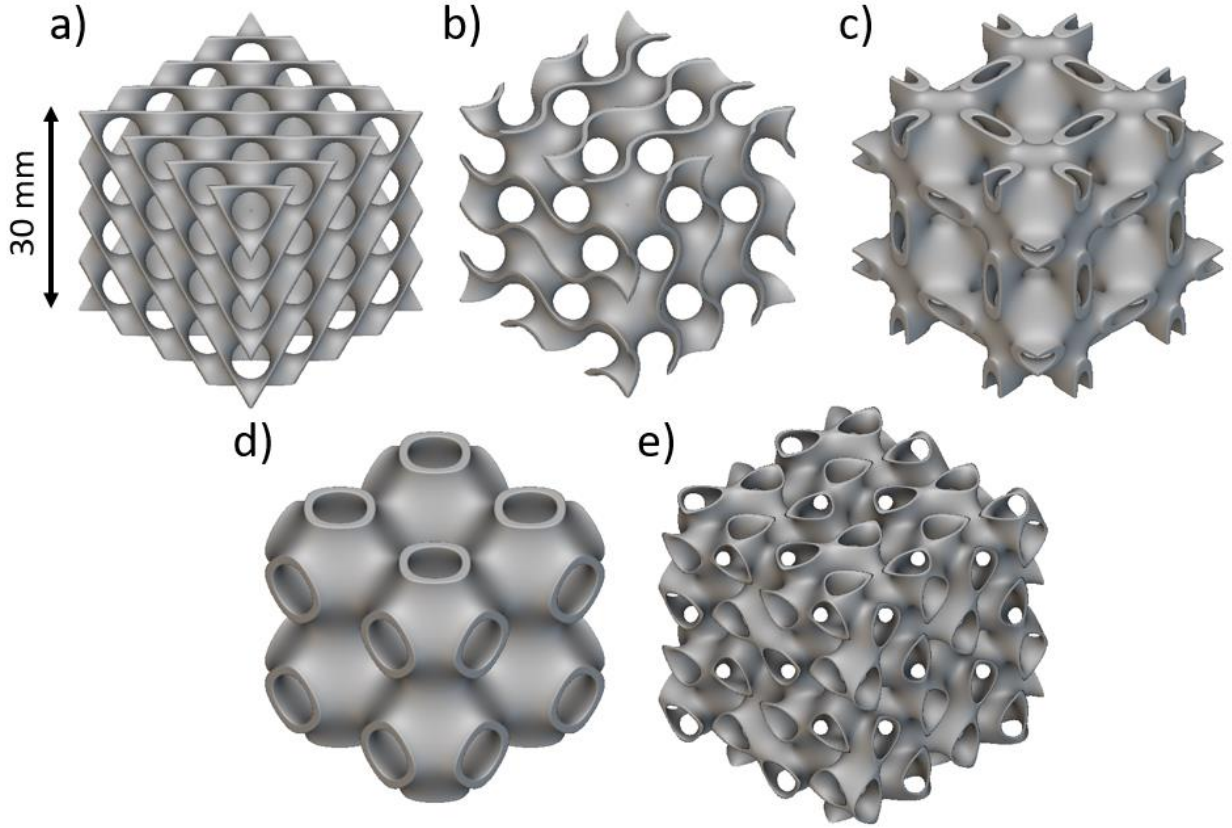
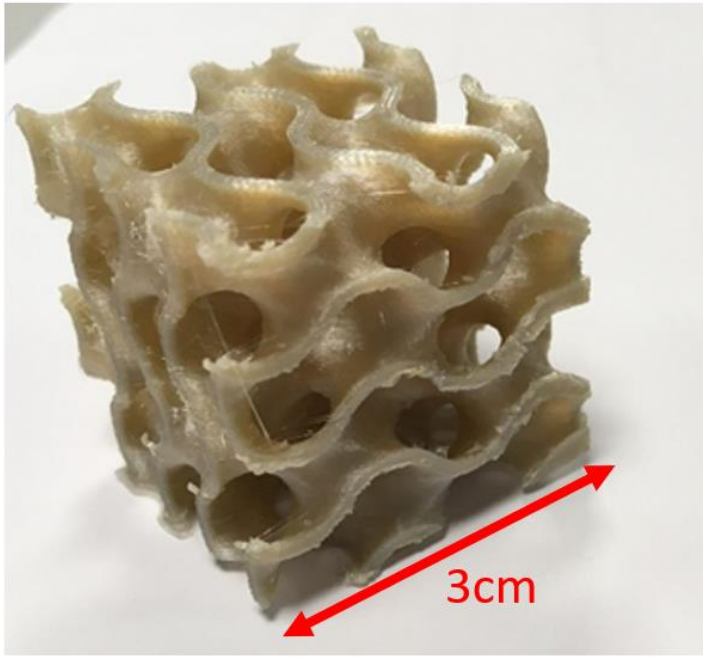
Triply periodic minimum surfaces?

- Mathematically generated topologies repeating themselves in 3 dimensions to form a lattice structure
- They form cellular materials known for their tuneable mechanical properties and high energy absorption



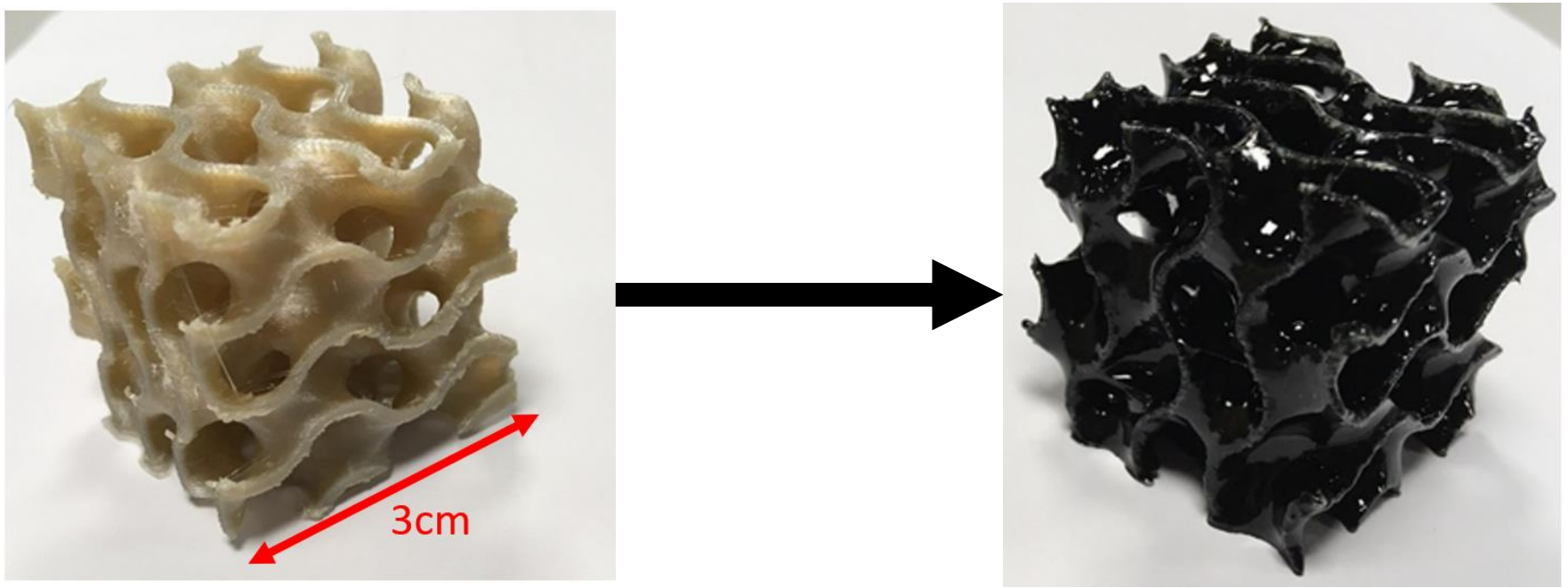
Polymeric structures

- These structures can only be obtained through additive manufacturing
- Poly-ether-imide selected as a high performance thermoplastic amorphous polymer with good thermal and chemical resistance.
- Suitable for use in components prone to damage (due to these resistances and energy absorption of the lattices).



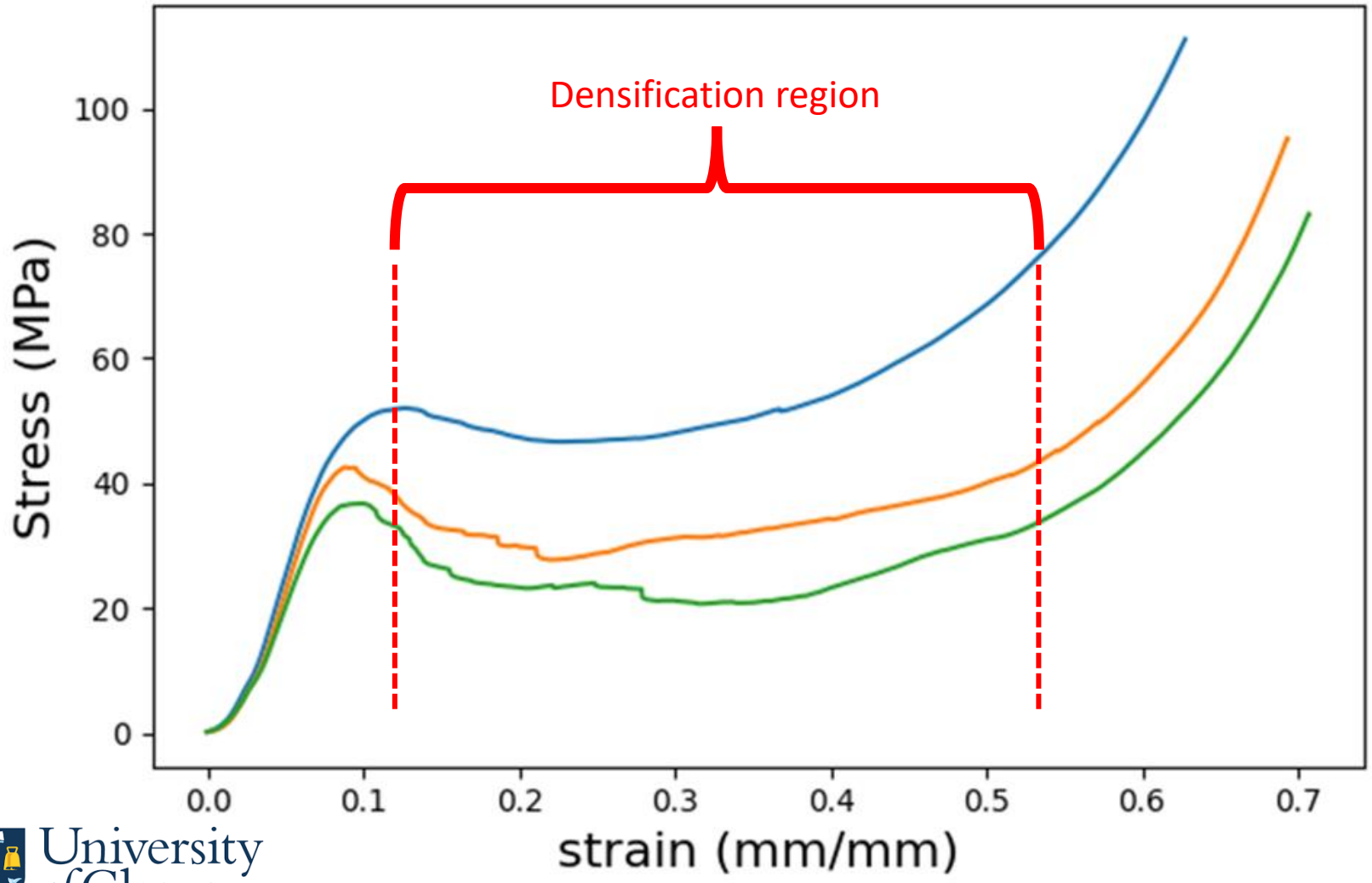
Multifunctionality?

- How can we make it suitable for damage prone components?
- Neat polymer lacks multifunctionality
- Solution for it to be applied in a strain and damage monitoring situation?
- Structures are coated with an epoxy and carbon nano-tube composite coating which provides electrical sensing properties.



Mechanical Results

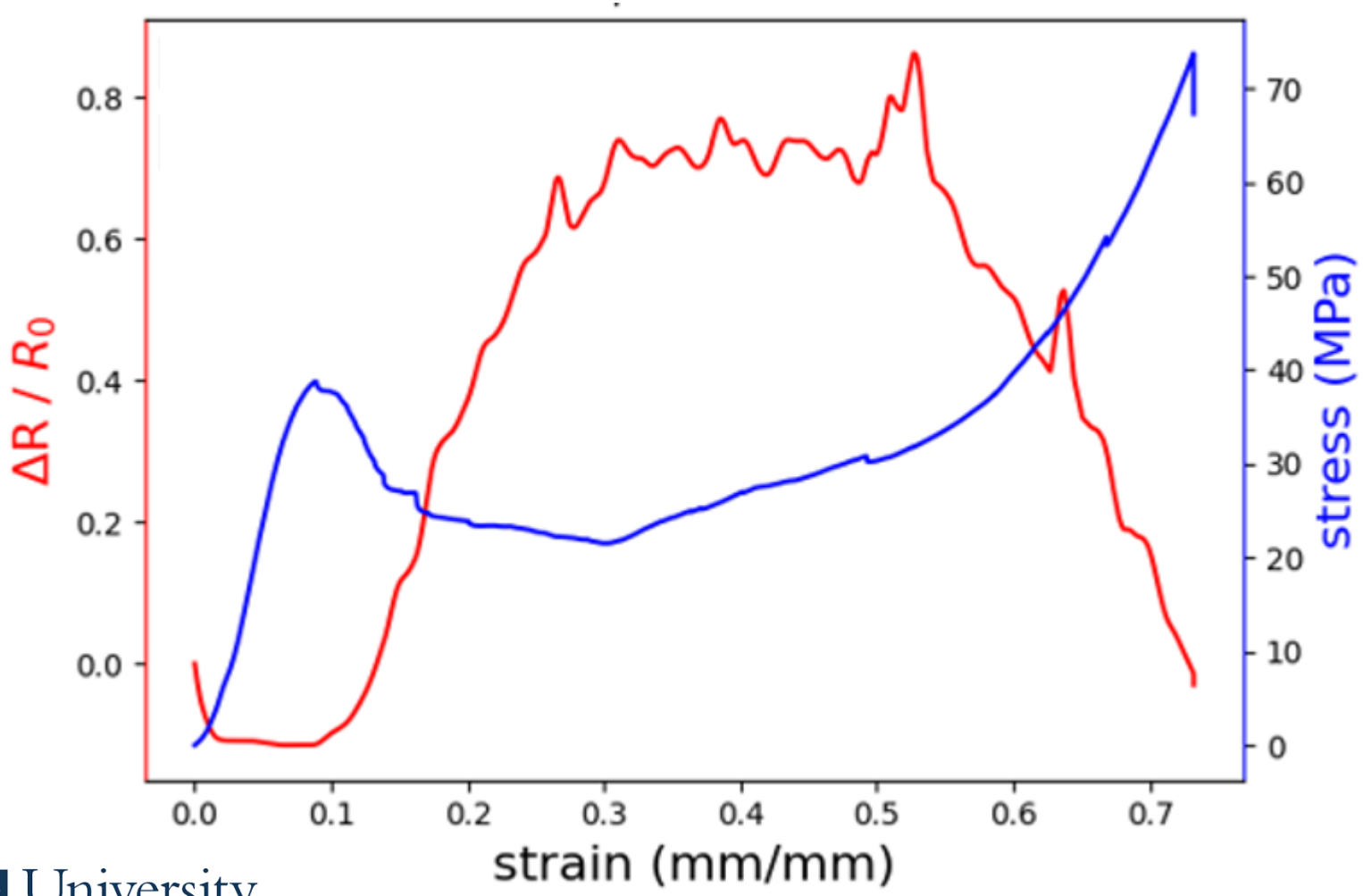
Stress – strain curve of TPMS structure under compression



- Achieved the successful reinforcement of mechanical properties by the coating and increase of up to ~10 fold energy absorption due to smooth densification region in failure mechanism in cellular material.

Multifunctionality

Stress – strain & Piezo-resistive curve of TPMS structure under compression



- Successful piezoresistive response to track strain and failure in the material
- Reversible in elastic region
- Limited to a continuous monitoring situation

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UKRI Engineering and Physical Sciences Research Council

Conclusions

- PEI TPMS lattice structures provide suitable failure mechanism for use in structural components prone to damage requiring high energy absorption.
- CNT epoxy coating fully adhered to the PEI lattices (no adhesive failure during testing)
- Piezo-resistive CNT coating provided the self-sensing behaviour for strain and damage (while limited to a continuous monitoring)

Ask questions at the poster session (poster num 082)

or

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