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A study of factors controlling the compressive behaviour of hybrid composites

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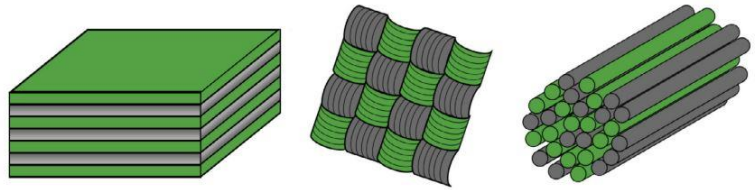
Introduction

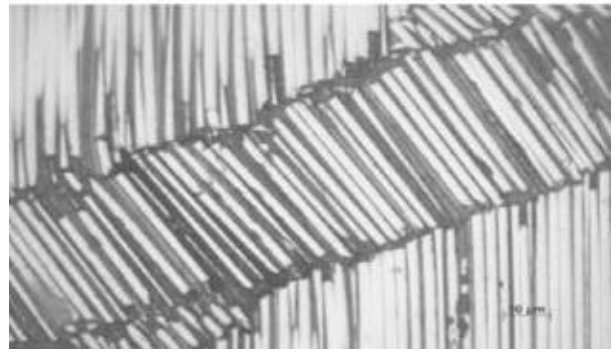
- Hybrid composites have been studied to improve the mechanical properties of the composites.
- The compressive failure mechanism of the hybrid composites is not well understood.



Swolfs et.al (2007)

Aim of the study

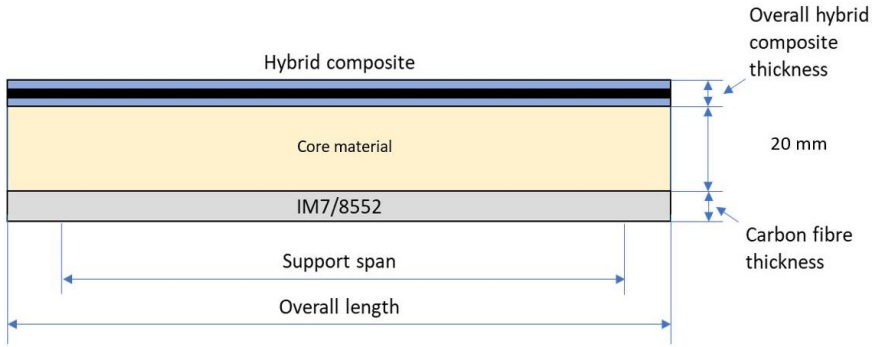
- To investigate the failure characteristics of the selected hybrid composites
- To investigate the possible factors controlling the failure characteristics of hybrid composites



Lee and Soutis (2007)

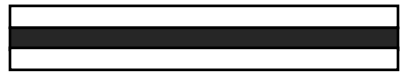
Specimens and Experiments

Sandwich beam



Hybrid systems

$SG_1/M55_1/SG_1$ Thickness: 0.34mm



SG (88 GPa)

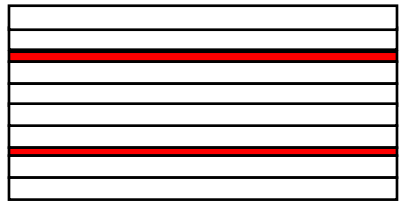
High modulus M55J (540GPa)

$SG_1/TC33_1/SG_1$ Thickness: 0.34mm

SG (88 GPa)

High strength TC33 (230 GPa)

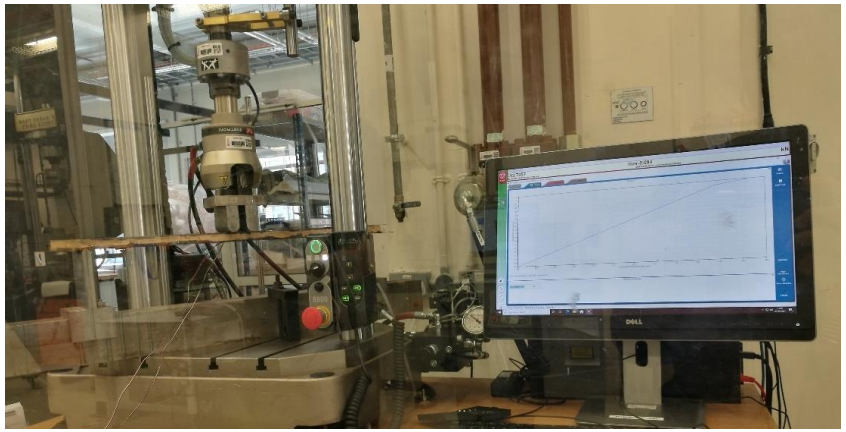
$[34\text{-}700_2/HR40_1/34\text{-}700_2]_2$ Thickness: 0.51mm



Standard modulus 34-700 (234 GPa)

High modulus HR40 (390 GPa)

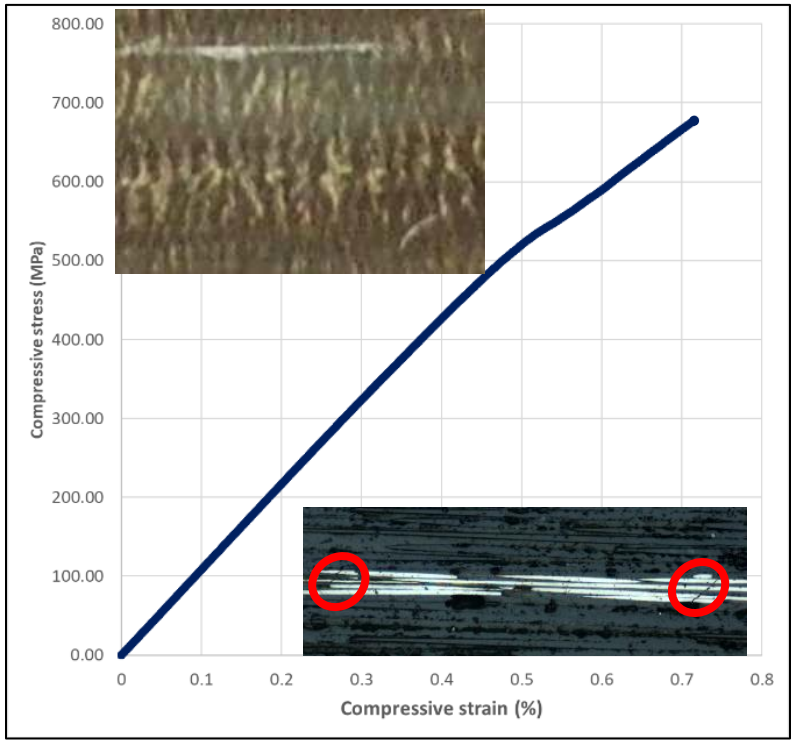
Experiment setup



- Perform static 4-point flexural test on 3 different hybrid configurations on sandwich beams to observe the compressive response of hybrid composites at the top skin
- Failure mechanisms were characterised through a microscope.

Result

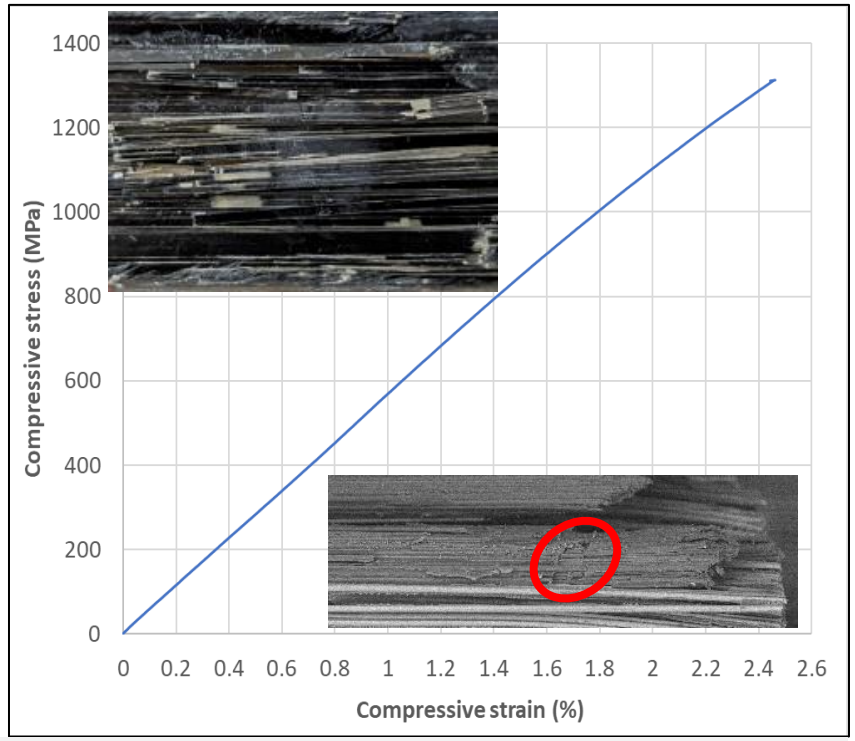
$SG_1/M55_1/SG_1$



Small carbon fibre fragments

Failure compressive strain of M55J is improved: **0.31** to **0.78%**

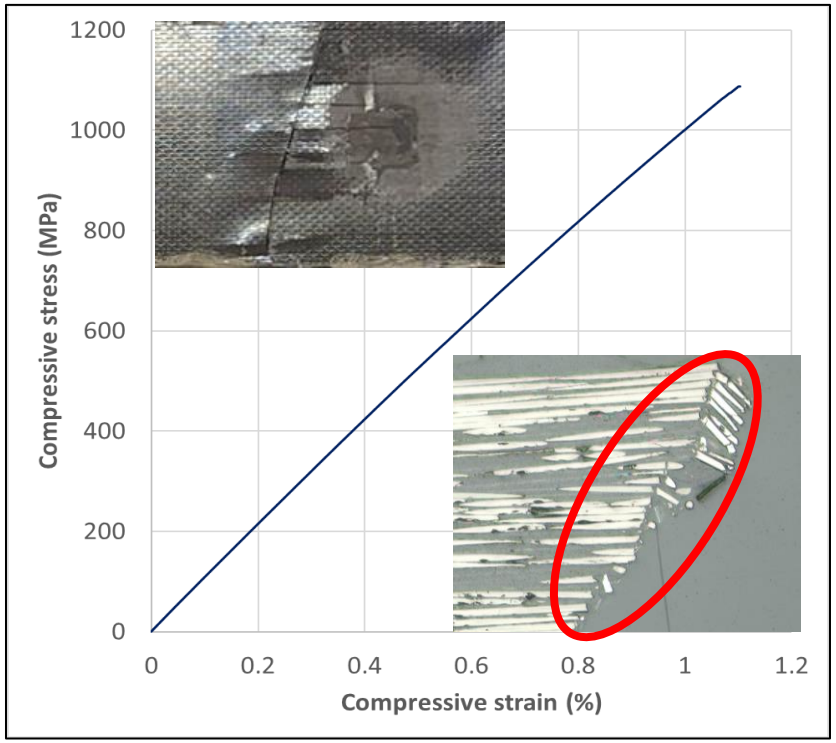
$SG_1/TC33_1/SG_1$



Dispersed fibre splitting and kink band failure

Failure compressive strain of TC33 is improved: **1.5** to **2.609%**

$[34\text{-}700_2/HR40_1/34\text{-}700_2]_2$



Single angled crack with kink band

Failure compressive strain of HR40 is improved: **0.584** to **1.134%**

Conclusion

- The compressive failure strain of lower-strain material was improved with the hybridisation concept.

- Each hybrid system in this study created different failure characteristics.
  - SG/M55: small fragmentations
  - SG/TC33: dispersed fibre splitting and kink bands
  - 34-700/HR40: single crack with kink band

- The failure characteristic would be driven by low-strain fibre.
  - Only M55 carbon fibre created multiple fractures along the carbon fibre region.

$SG_1/M55_1/SG_1$

$SG_1/TC33_1/SG_1$

$[34\text{-}700_2/HR40_1/34\text{-}700_2]_2$

Future works

- Study another hybrid system to observe the failure characteristics of the material under compressive loading (S-glass/HR40).
  - Is it small fragmentations or single crack failure?
  - Is there a significant change in stress-strain response?

- Compare to the previous hybrid systems to analyse possible factors controlling failure characteristics
  - To investigate the key factor creating multiple fragmentations if small fragmentation is observed on S-glass/HR40 hybrid composite.

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Thank you

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