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# Quick-fire Presentations

Meiran Abdo
Stefania Akromah
Umeir Khan
Athira Anil Kumar
Ian Lee
Cameron Woodgate
George Worden
Burak Ogun Yavuz

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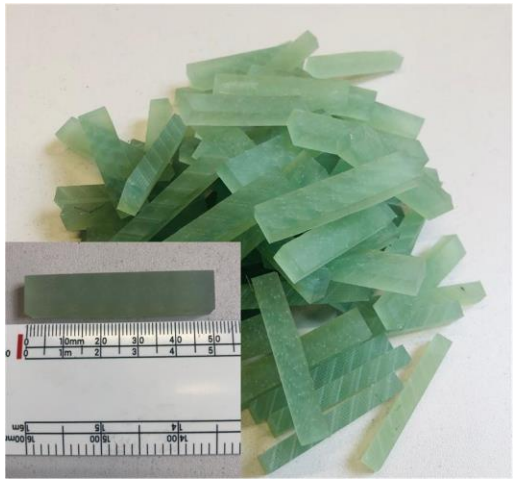
# Recycling of FRP Wind Blade Waste Material in Concrete


Meiran Abdo

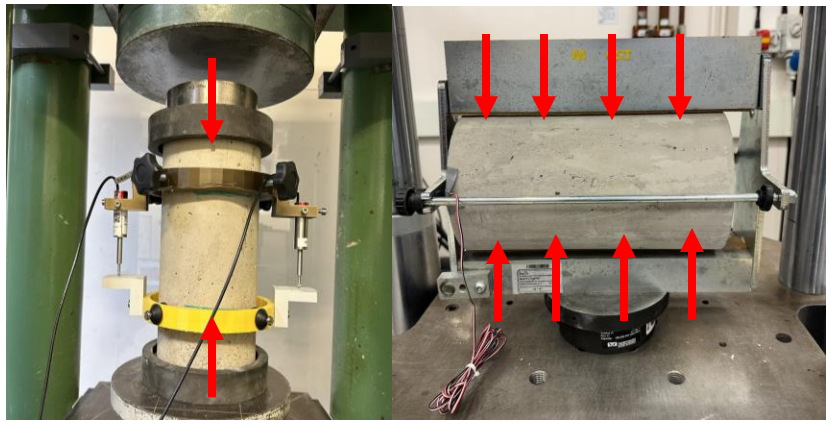
Supervisors: Eleni Toumpanaki, Andrea Diambra, Lawrence C. Bank, Gianni Comandini, Stephen Eichhorn

## *Aim*



Martin .Ch, 2020*

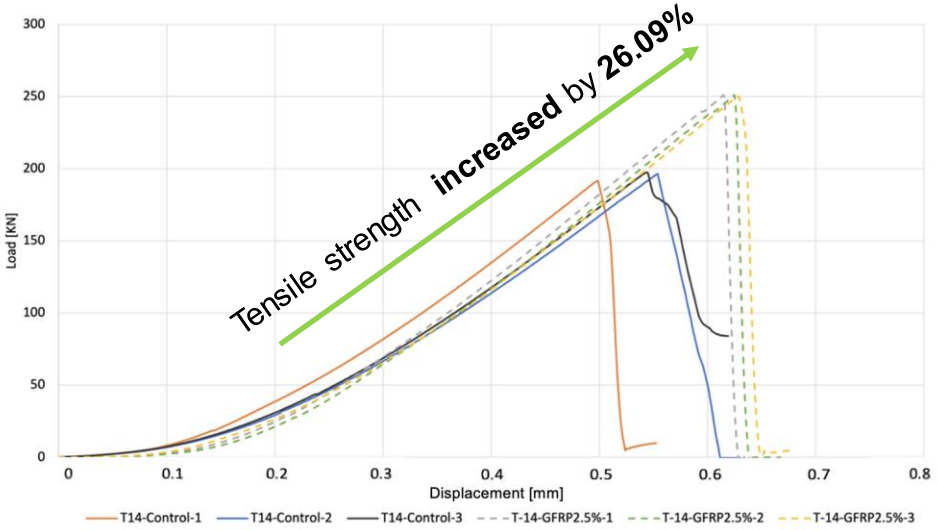
## *Progress and results*

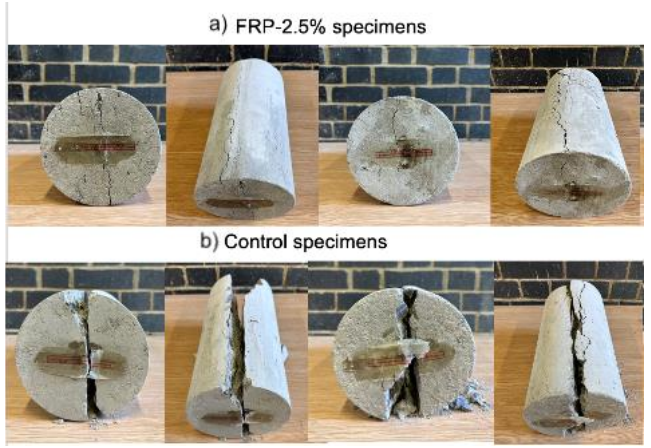


*Compressive test*



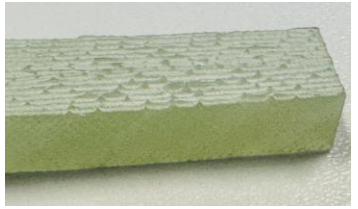
*Split tensile test*




*Split Tensile failure pattern*

*FRP needles Surface analysis*





*Martin .Ch, [2020], Wind Turbine Blades Can't Be Recycled, So They're Piling Up in Landfills, Bloomberg UK.

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# Mycelium Composites as Sustainable Alternative for Developing Countries

S. Akromah, N. Chandarana, S.J. Eichhorn

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UKRI Engineering and Physical Sciences Research Council

BCI Symposium

4th April, 2023

Cost- & energy-efficient

Eco-friendly agricultural waste management

Tuneable properties; versatile

Biocompatible, compostable, recyclable, low $CO_2$ emission

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# Defect Identification of in-Factory Photographs

**Umeir Khan**

Vincent K Maes, Robert Hughes, James Kratz.

Jon Wright, Turlough McMahon, Airbus.

BCI Doctoral Research Symposium

04/04/2023

bristol.ac.uk/composites

Supported by

AIRBUS

Acknowledgements:

Claudia Jimenez Martin

Pedro Galvez-Hernandez

# Overview

***Ramp-up in rate*** has driven move to dry-fibre processes

***Preforming complex shapes*** can lead to ***defects***

***Quantify defects at scale*** from factory photographs?

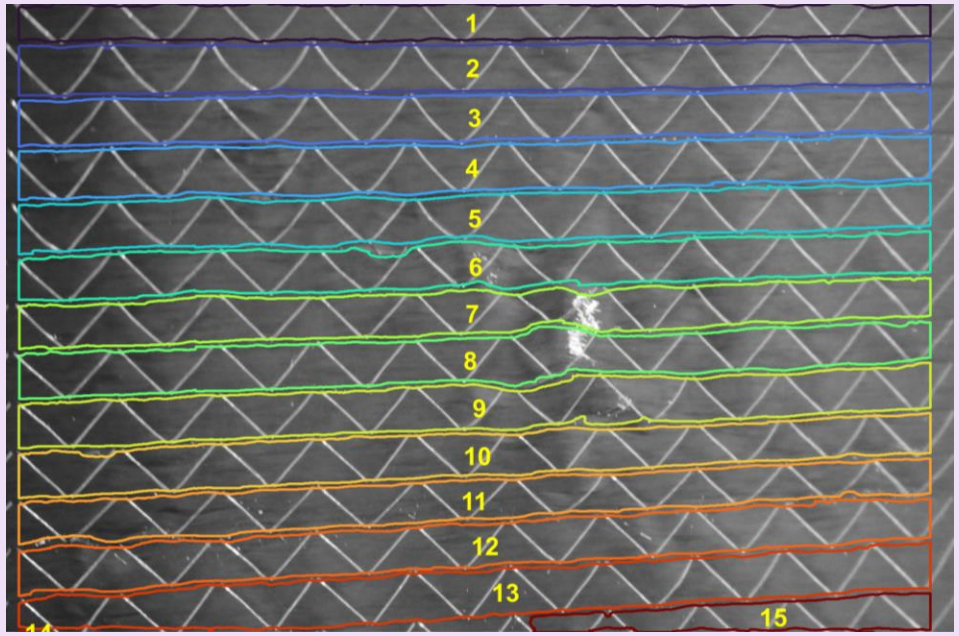


***Figure 1.*** *Photographic data capture of preform defects in bi-axial NCF. Deep Learning enables individual tow tracing – for characterising wrinkle parameters.*

Enabling cameras as a ***low cost inspection solution***

***Inform decisions pre-cure***

Re-layup

Concession

Infusion

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# Higher-Order Multi-Scale Modelling of 3D-Woven Composites Using Machine Learning

Athira Anil Kumar, Aewis KW Hii, Stephen Hallett, Bassam El Said

BCI Symposium 2023

Supported by:

CERTEST

UKRI Engineering and Physical Sciences Research Council

Code Integration and Compatibility study

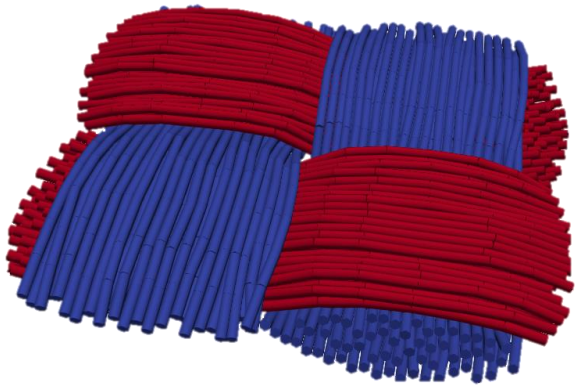
Implementation of second-order homogenisation framework using shell elements for 3D woven composites

Elastic models

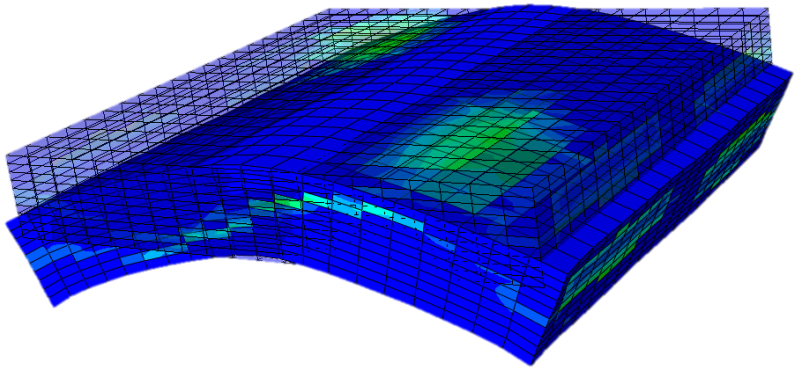
Damage models

Development of second-order homogenisation framework using solid elements for 3D woven composites

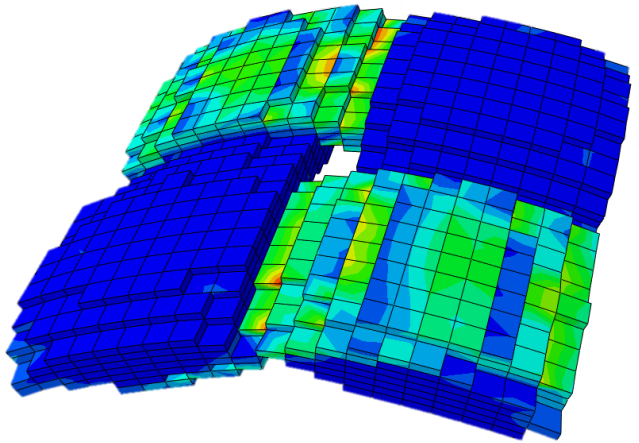
Implementation of Machine Learning techniques for optimisation




Weaving simulation and compaction



Plain weave composite meso-scale RVE undergoing bending



Voxelised yarn elements

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Next COMP
Next Generation Fibre-Reinforced Composites

HiPerDiF
High Performance Discontinuous Fibre

# Highly Aligned, Discontinuous Fibre Composites for Enhanced Compressive Performance

I.R. Lee, L.R. Pickard, I. Hamerton, G. Allegri

BCI Doctoral Research Symposium

04/04/2023

Ian.Lee@bristol.ac.uk

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# The Project

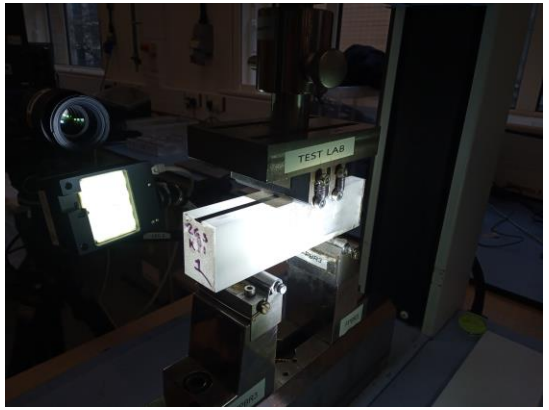
- NextCOMP - EPSRC funded investigation of next generation composite materials
- HiPerDiF - Patented fibre alignment technology developed at UoB
- Project Aims:

Highly-aligned, discontinuous fibre tapes in compression

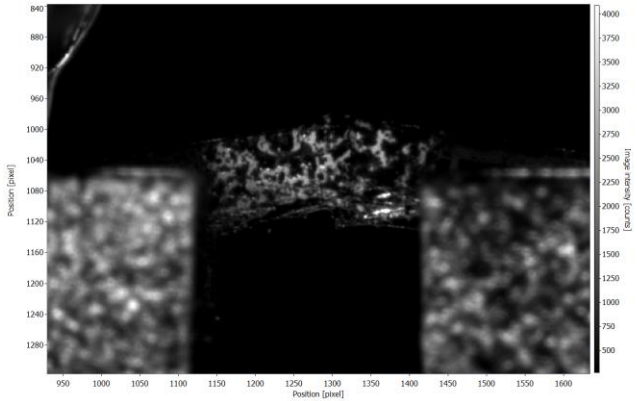
  - Experimental Characterisation
  - Modelling of Effective Properties
  - Bioinspired hierarchical architectures
  - Automated lay-up
  - Industrial specimen production


Material Processing

Sample Curing




Material Testing



Failure Analysis

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# Compressive Characterisation of Single Carbon Fibres and their Interface via *in situ* Raman Spectroscopy

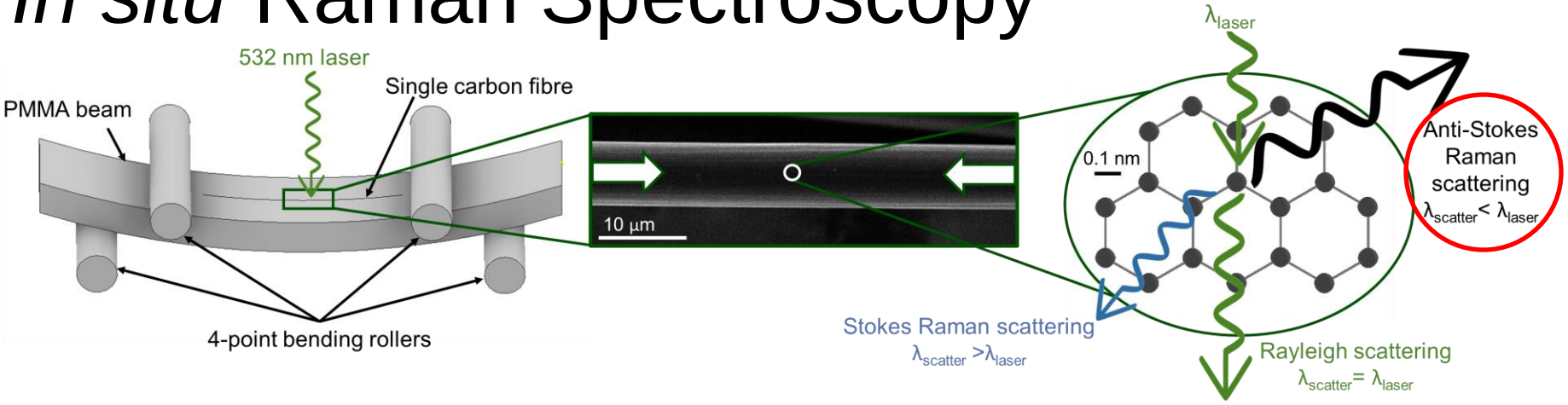

Next Generation
Fibre-Reinforced Composites

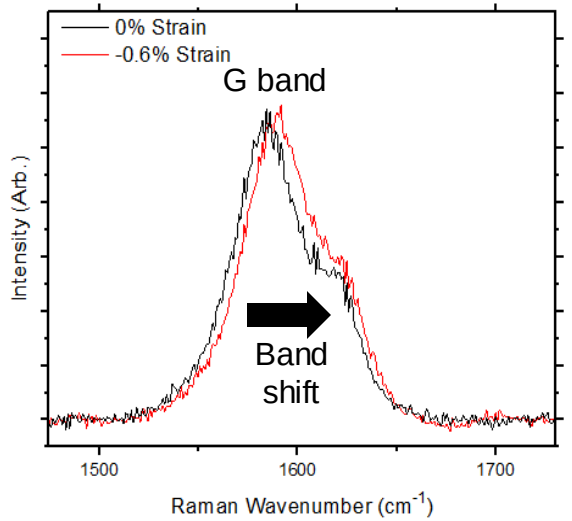
Cameron Woodgate, R.S. Trask, M.S.P. Shaffer, S.J. Eichhorn

BCI Doctoral Research Symposium

04/04/2023

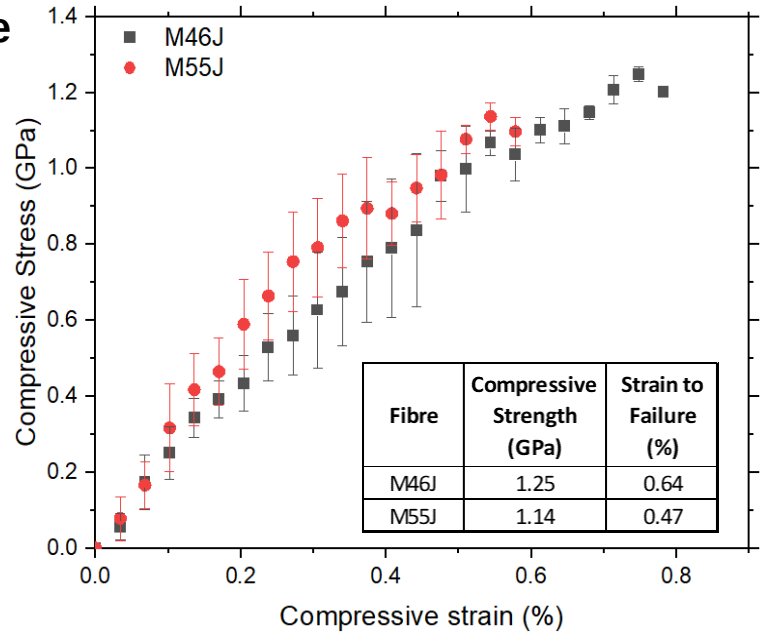
# *In situ* Raman Spectroscopy




## Single fibre compressive response

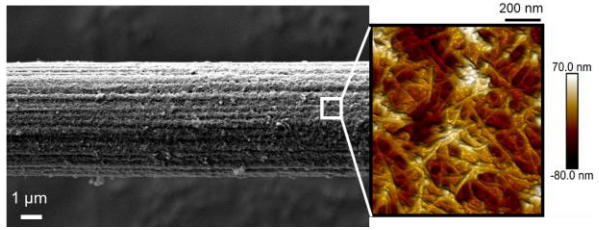
- Obtains single fibre compressive stress – strain curves.
- Simple sample preparation.
- Avoids fibre buckling.
- Compressive loading applied to fibre on face of beam.
- Study of carbon fibre structure changes in compression.
- Stress calibration for later testing.

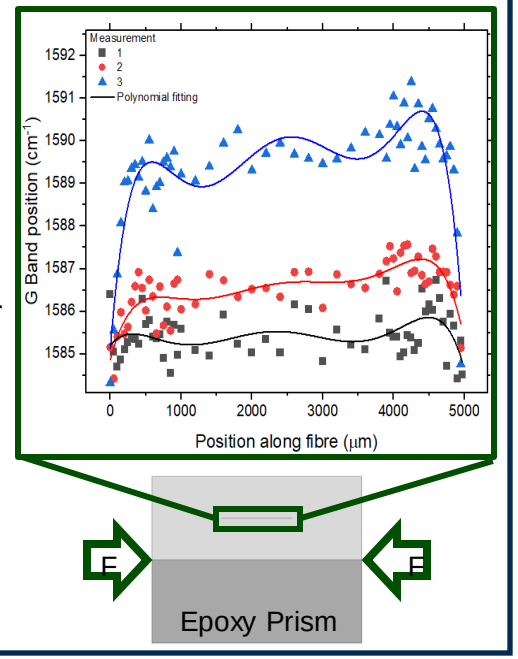



| Fibre | Compressive Strength (GPa) | Strain to Failure (%) |
|---|---|---|
| M46J | 1.25 | 0.64 |
| M55J | 1.14 | 0.47 |

## Interfacial analysis

- Point-to-point stress mapping along length of single fibre.
- Interface analysed under compressive loading.
- Changes to interface investigated.
- Interfacial shear strength, stress transfer length, debonding investigated.



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# Digital Engineering of Composite Materials for Space Applications

George Worden

Supervisors: Kate Robson Brown & Ian Hamerton

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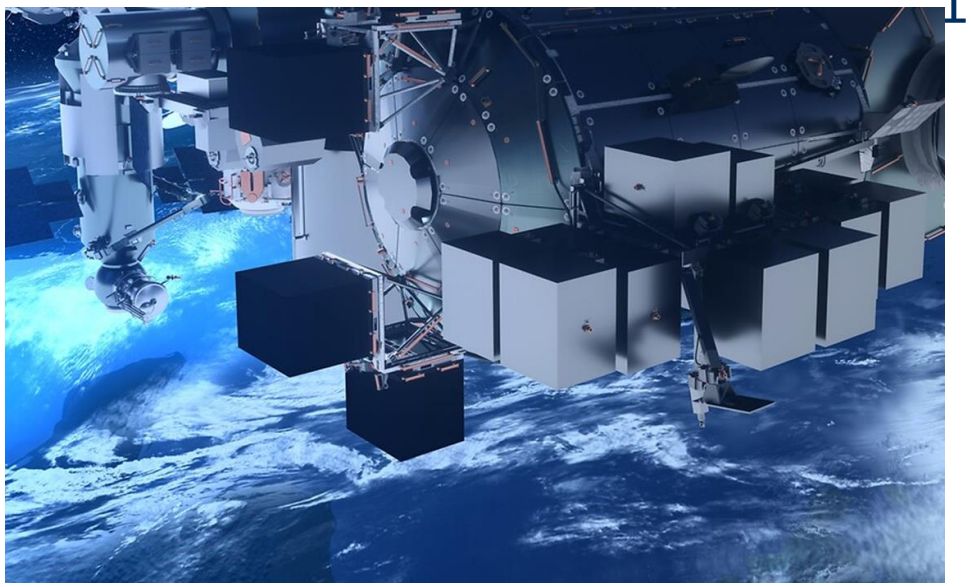
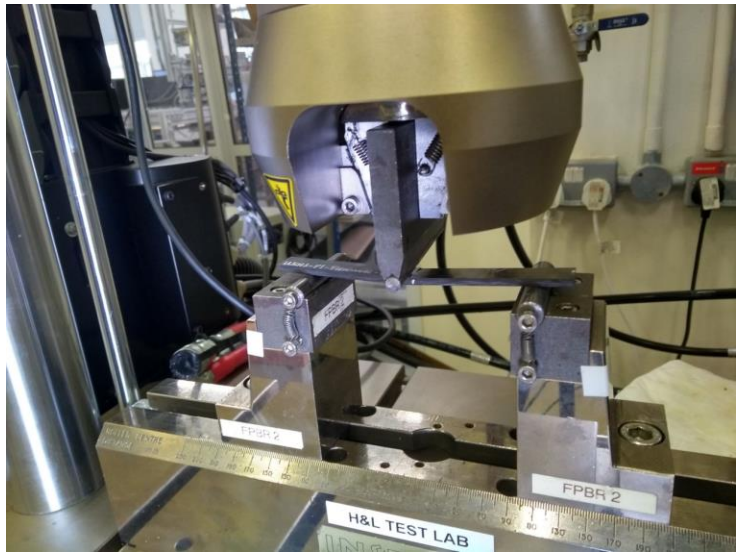
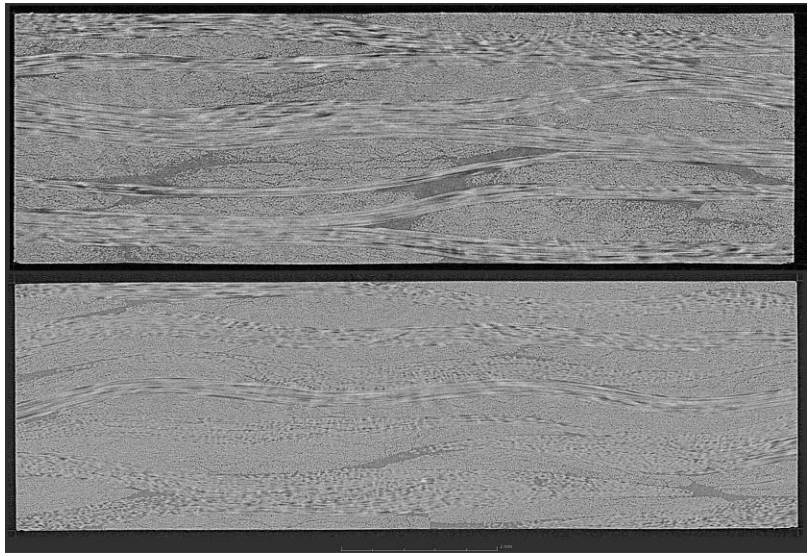
We thank UKSA/STFC for additional support in the form of ST/W000377/1 and ST/W004992/1

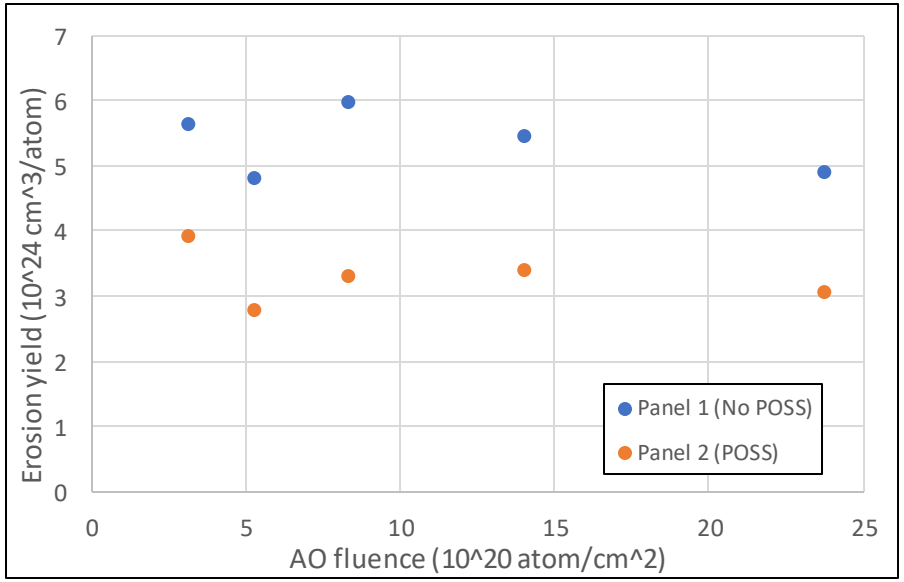
# Project outline

- The environment in low Earth orbit (LEO) is hostile to many materials and testing them in space is costly and time-consuming.
- The development of a computer model to predict degradation could assist in the design of future spacecraft by providing a more accurate estimate of material lifespan.
- A novel CFRP material is undergoing terrestrial mechanical, thermal and exposure testing in order to provide the data for this model.







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# Forming of Aligned Discontinuous Fibre Thermoplastic (HiPerDiF) Prepreg for Sustainable Composite Manufacturing


Authors: Burak Ogun Yavuz, Jonathan Belnoue, Marco Longana, Ian Hamerton


BCI Doctoral Research Symposium

Date: 04/04/2023

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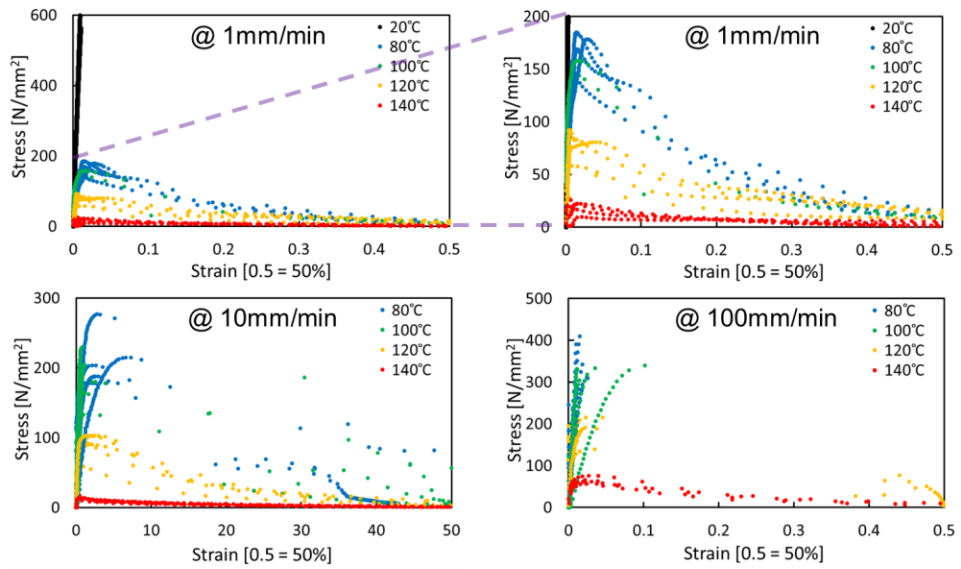
SIMprocs

HiPerDiF

# Tensile Characterisation of HiPerDiF PLA/Short Carbon Fibre Tape Under Processing Conditions with Micromechanical Model

## Tensile Characterisation under Processing Conditions

### Tensile behaviour temperature and speed dependency

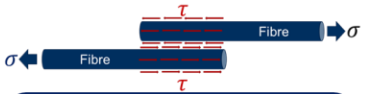



- Temperature ↑ => Load transfer ↓
- Speed ↑ => Load transfer ↑
- Depends on shear stress between fibres


$$\tau = \mu \frac{d\gamma}{dt}$$

## Micromechanical Model

- Shear rate dependent storage modulus ($G(\dot{\gamma})$) and corresponding viscosity ($\eta(\dot{\gamma})$) data taken from rheology experiment with high crystallinity
- Fibre length ($L$)=3mm, Diameter ($D$)=7µm, Fibre volume fraction ($f$)=0.35, Overlap length ($\delta$)=1.5mm, Fiber volume fraction parameter ($K$)=2.64




$$\sigma = 2\tau f \frac{\delta}{D}$$

Shear stress to Tensile stress

$$\tau + \frac{\eta}{G}\dot{\tau} = \eta\dot{\gamma}$$

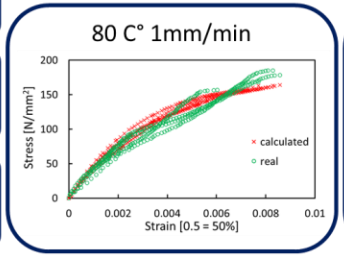
Maxwell viscoelastic model

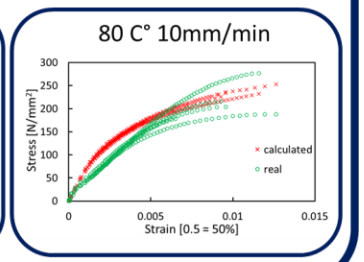
$$\dot{\gamma} = \frac{L-\delta}{D}[K-1]\dot{\varepsilon}$$

Shear strain to Tensile strain

$$\dot{\sigma} = \left(2G(\dot{\varepsilon})\left(\frac{L-\delta}{D}[K-1]f\frac{\delta}{D}\right)\dot{\varepsilon} - \left(\frac{G(\dot{\varepsilon})}{\eta(\dot{\varepsilon})}\right)\sigma\right)$$

Micromechanical model




Future work: Implementing material behaviour into forming simulations → Forming defect free parts experimentally

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Thank you for listening.

That concludes our presentations for today.

Please join us for lunch in the atrium and take some time to view the student poster displays and chat to the presenters in the main room.

Plus, don't forget to cast your vote in our poster competition!!

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