

# Mechanical properties of electrospun polystyrene nanofibre veils reinforced with cellulose nanocrystals

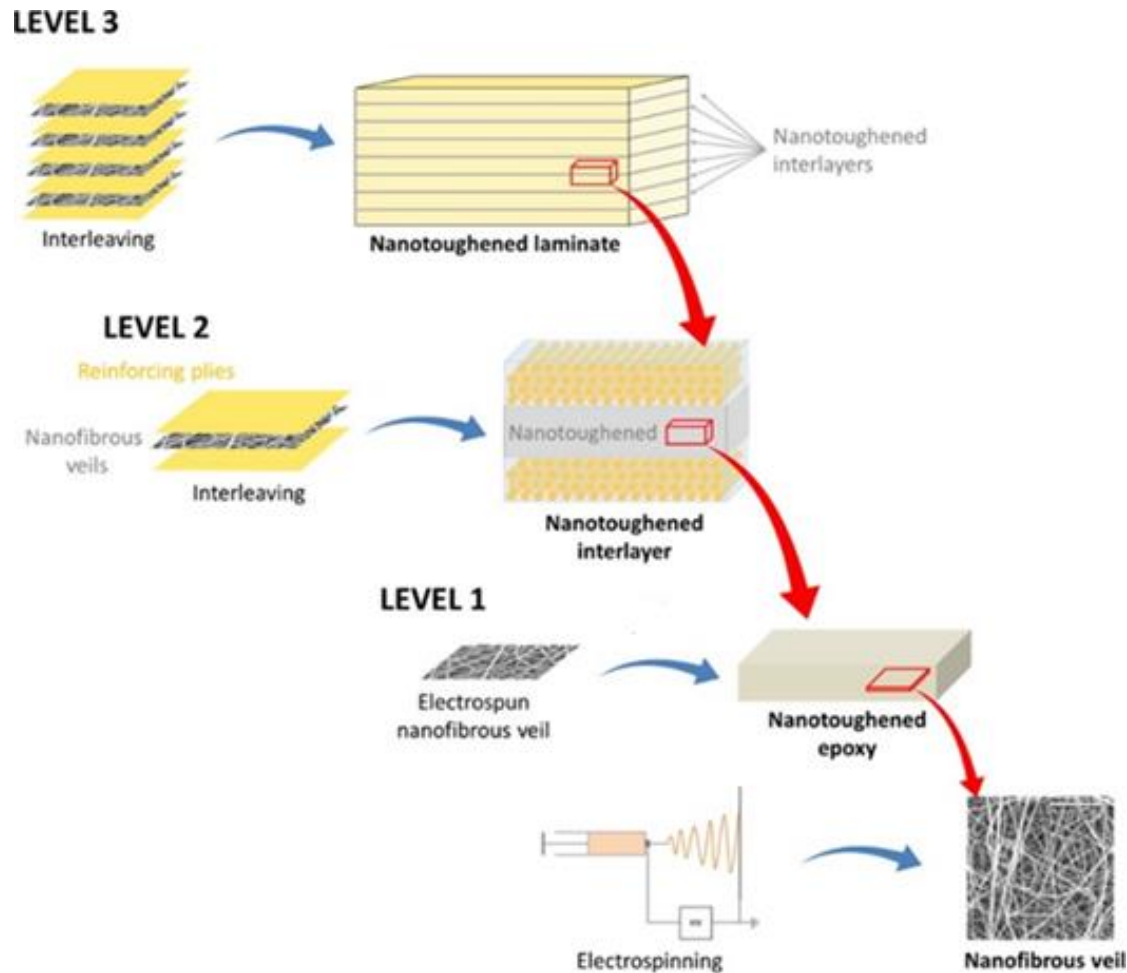
Konstantina Kanari

BCI Postgraduate Research and  
Training Showcase

13 April 2021

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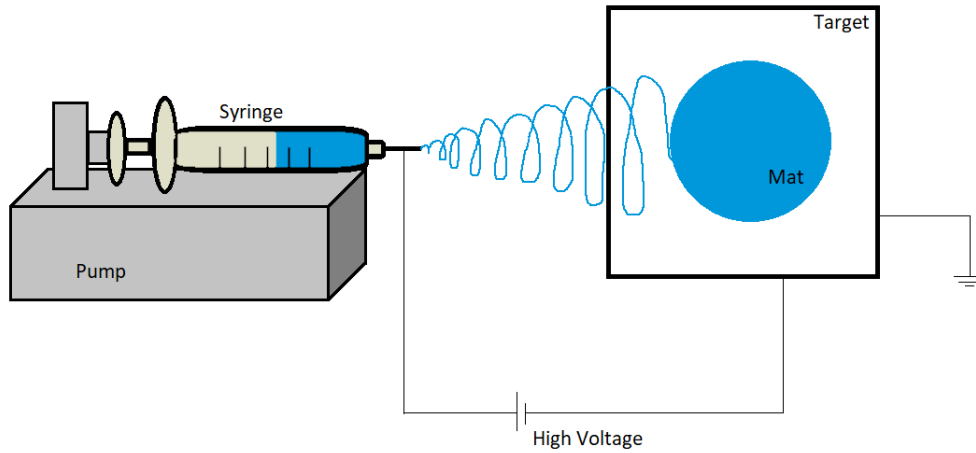
# Aims and Objectives



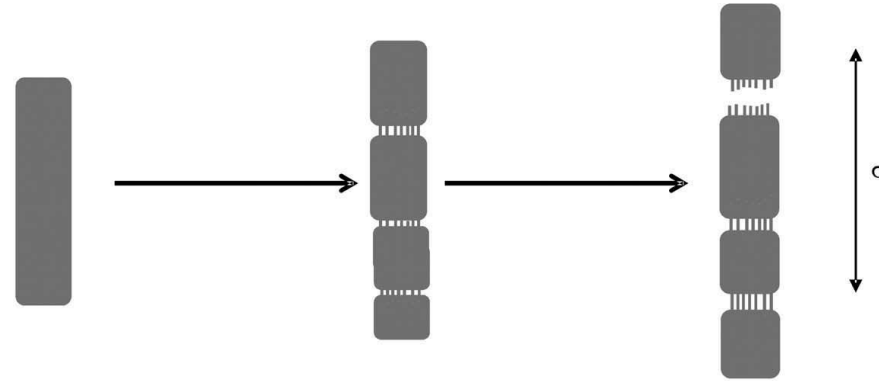
Different mechanisms for the enhancement of a laminate's fracture toughness (1)

- Main objective
  - Improve composite laminate
- Aim 1
  - Produce electrospun fibres
- Aim 2
  - Improve interlayer toughness

# Electrospinning



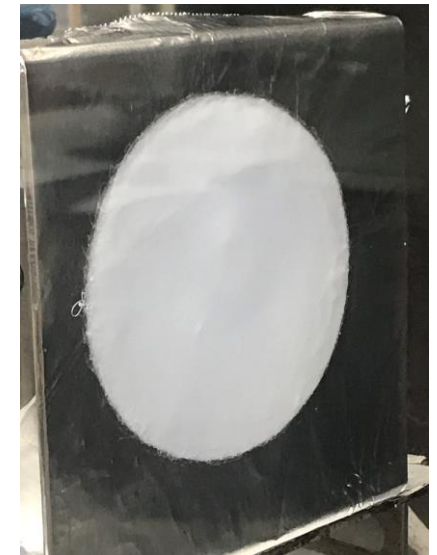
Schematic representation of electrospinning setup



Schematic representation of crazing development (2)

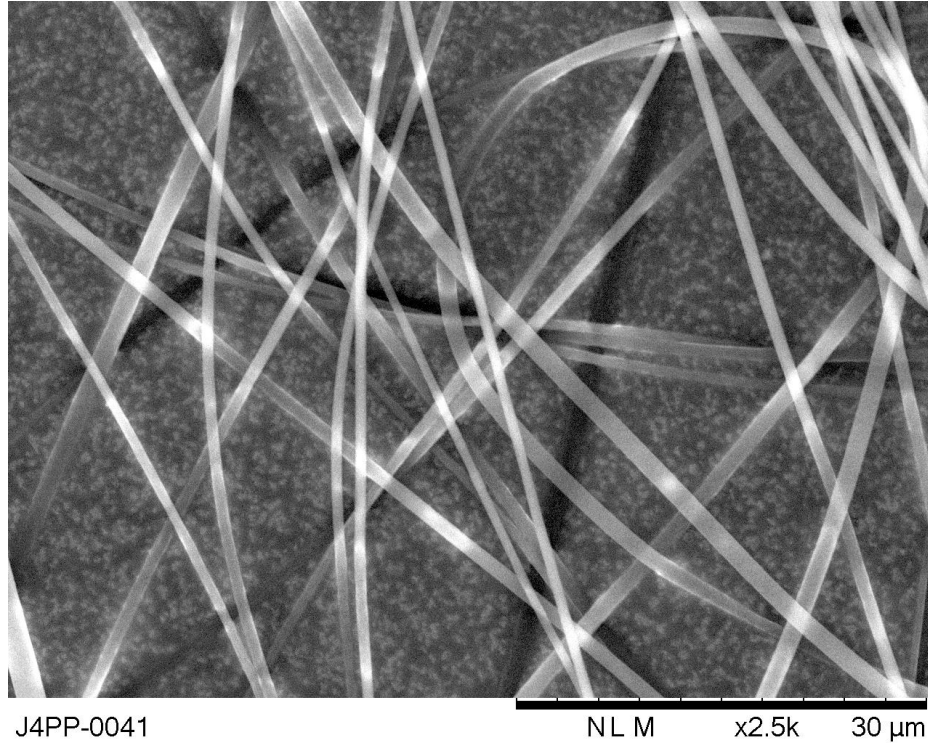


Polystyrene solutions with different concentrations of cellulose nanocrystals (CNC)

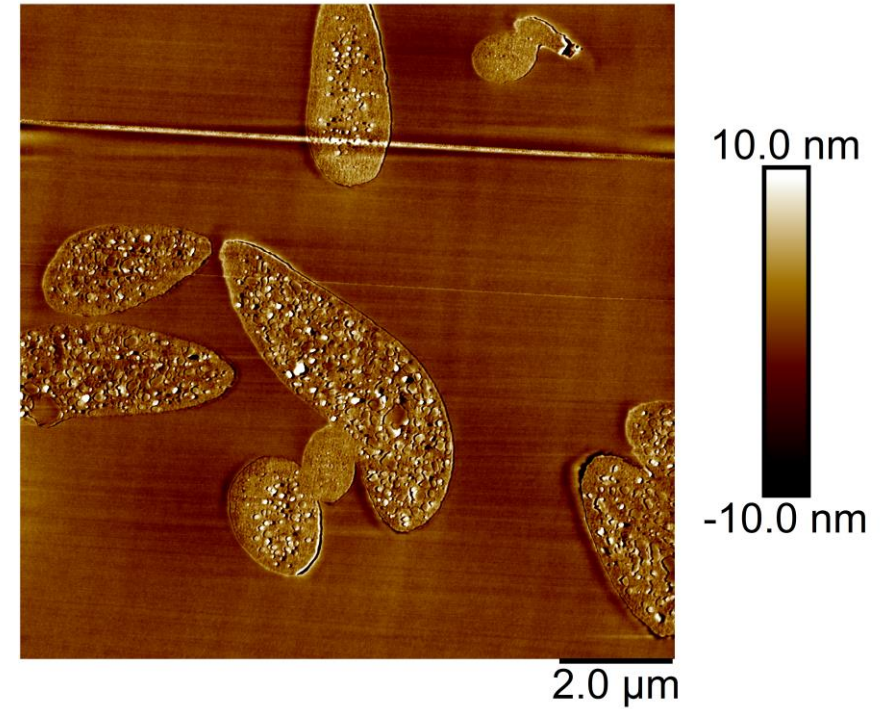


Electrospun fibrous mat (veil)

# As-spun fibres



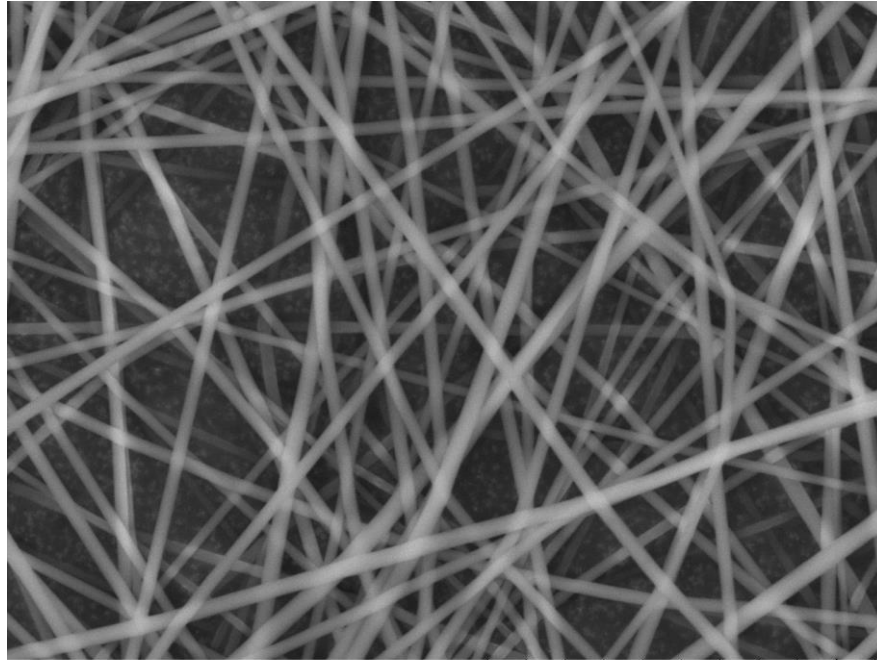
SEM image of electrospun polystyrene fibres,  
produced at 17.5 kV



AFM image of electrospun polystyrene fibres,  
produced at 17.5 kV

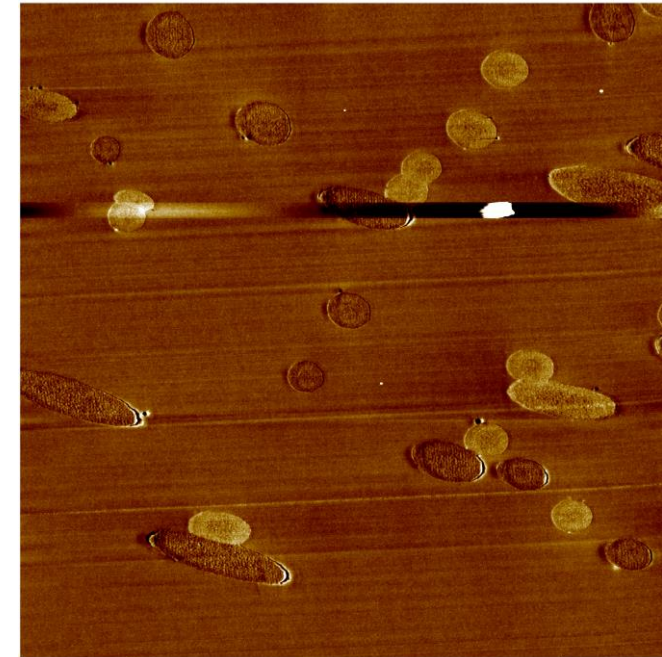


# Annealed fibres



screw0095 2020-10-09 NMM x2.5k 30  $\mu$ m

SEM image of electrospun polystyrene fibres,  
produced at 17.5 kV, after annealing

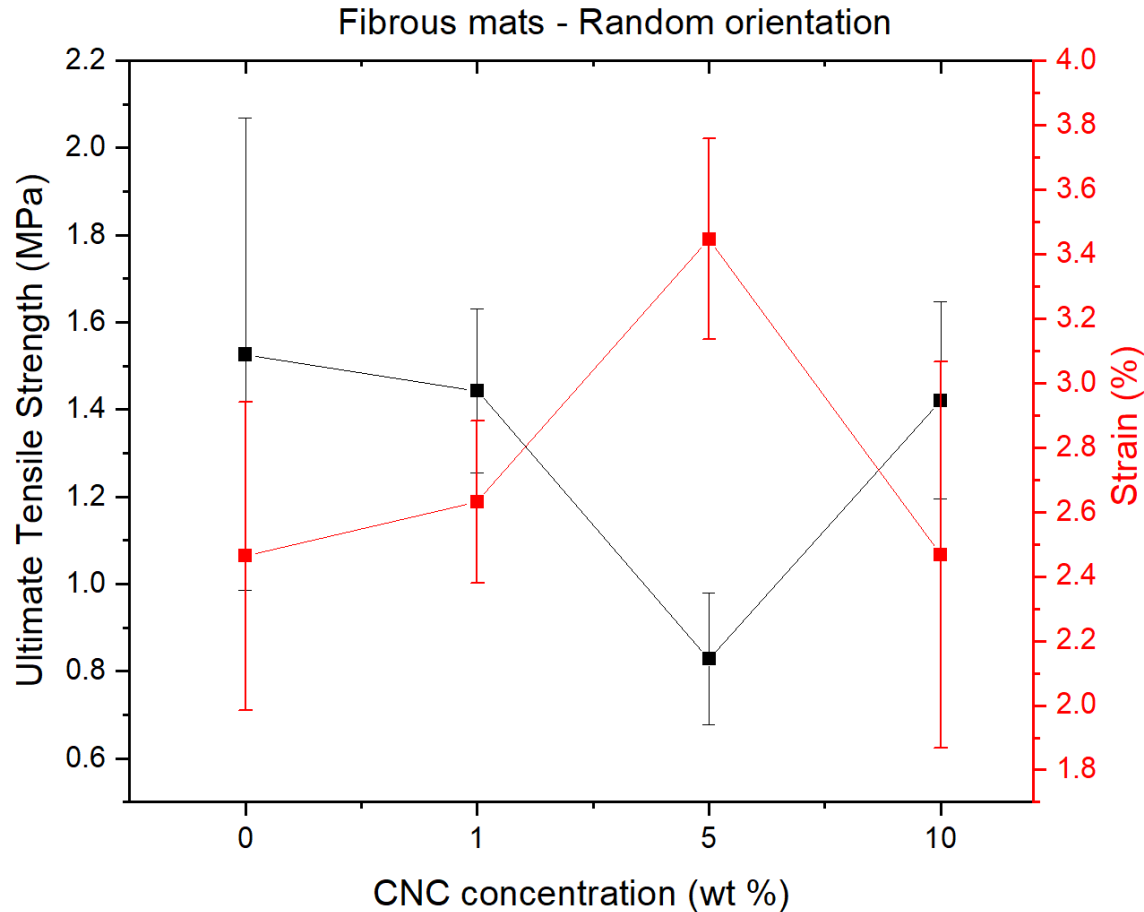


10.0 nm  
-10.0 nm

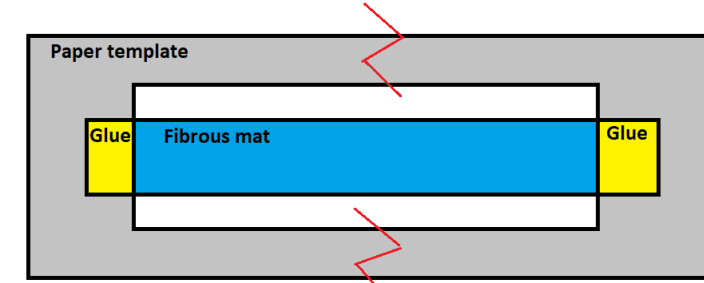
2.0  $\mu$ m

AFM image of electrospun polystyrene fibres,  
produced at 17.5 kV, after annealing

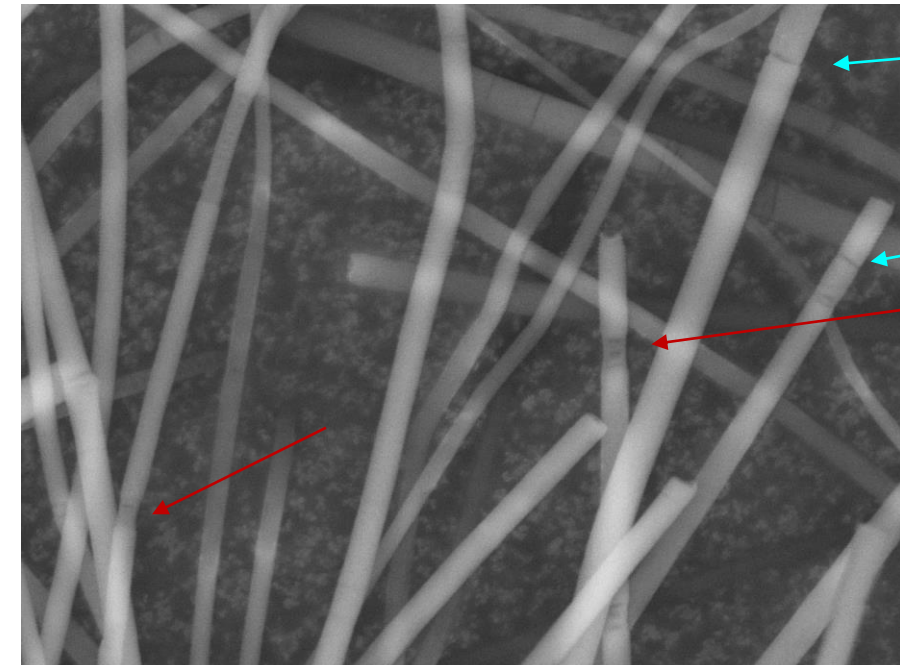
# Tensile testing



Ultimate Tensile Strength and **Strain at Break** results after tensile testing of fibrous mats with different CNC concentrations



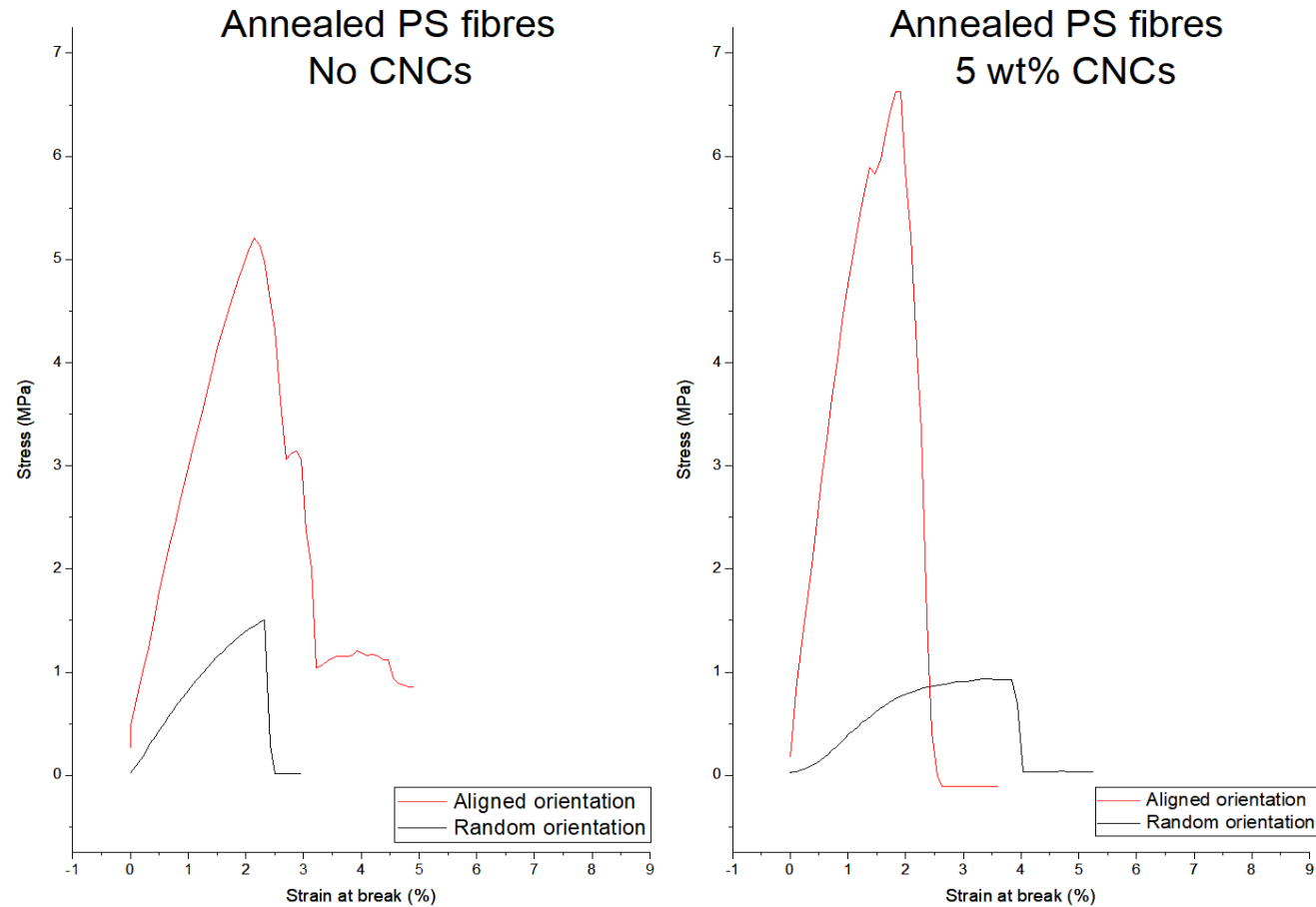
Schematic representation of glue-tab methodology for tensile testing



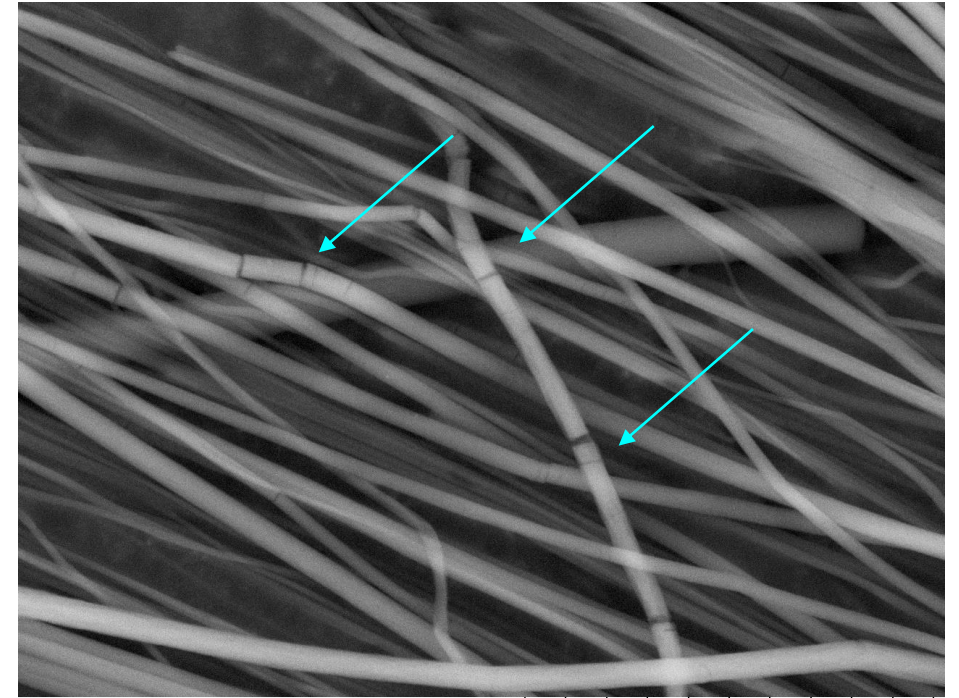
FFT6PLA-0119 NL M x5.0k 20  $\mu$ m

SEM image of electrospun polystyrene fibres after tensile testing. Red arrows show necking, while blue arrows show crazing

# Tensile testing



Representative tensile tests of annealed polystyrene fibres with **random** and **aligned** orientation, with different CNC concentrations



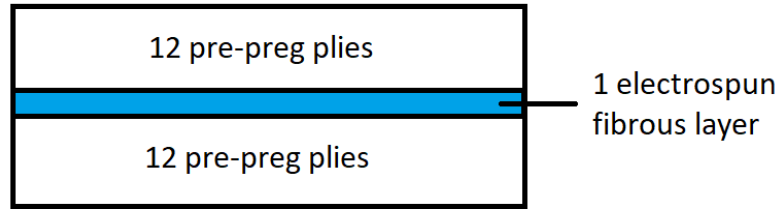
2021-03-08 NMM x2.5k 30 µm

SEM image of aligned electrospun polystyrene fibres after tensile testing. Blue arrows show areas with crazing

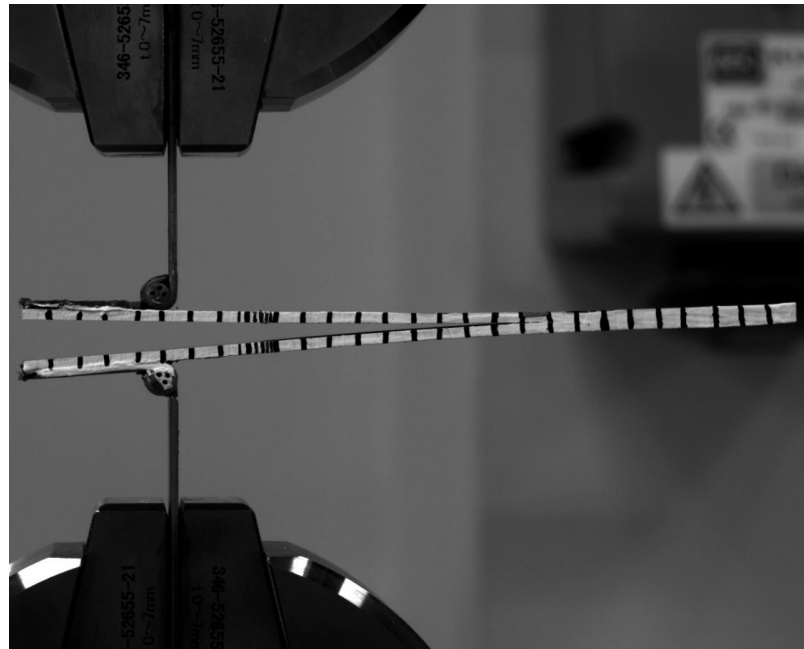
Increased alignment

- Increased UTS
- Decreased strain at break for 5 wt% CNC

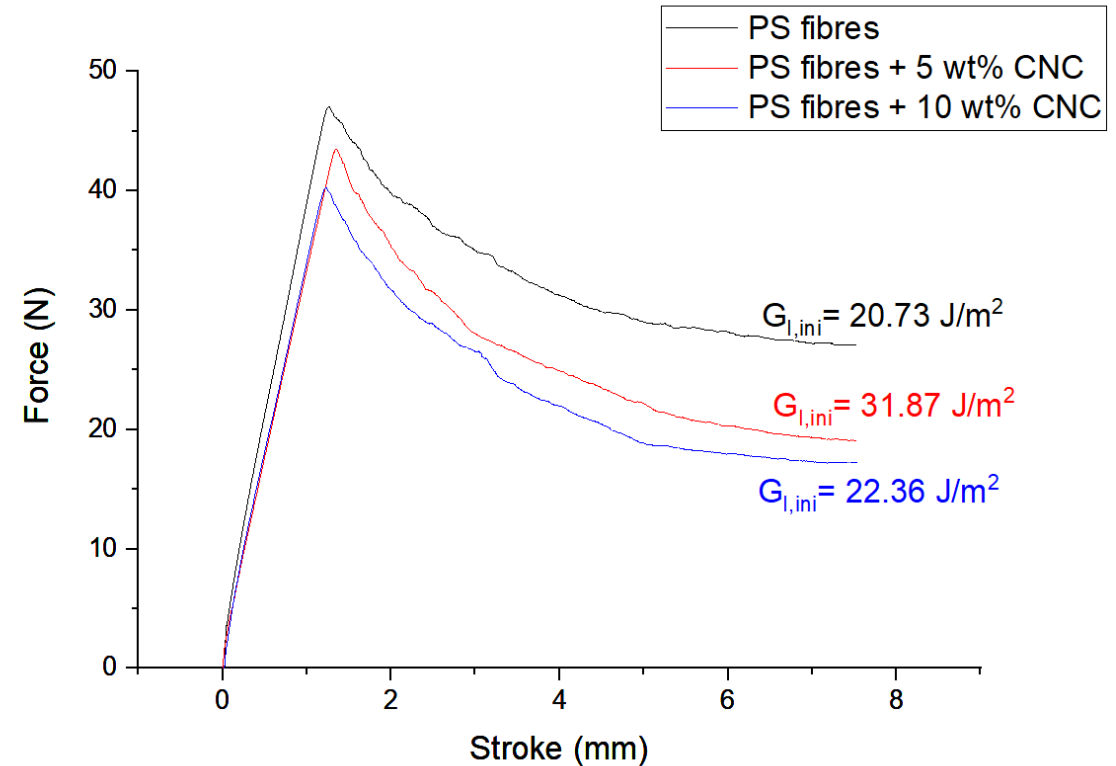
# Composite laminates (preliminary)



Representation of composite laminate with incorporated fibrous veils



DCB testing of composite laminate with incorporated fibrous veil



Preliminary results from DCB testing of composite laminates with incorporated fibrous veils; The initiation fracture toughness value for each specimen has been labelled.



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