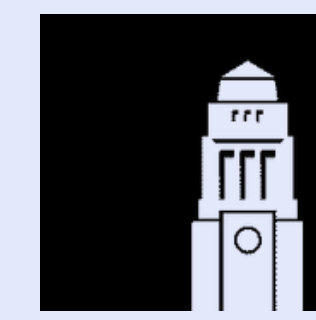


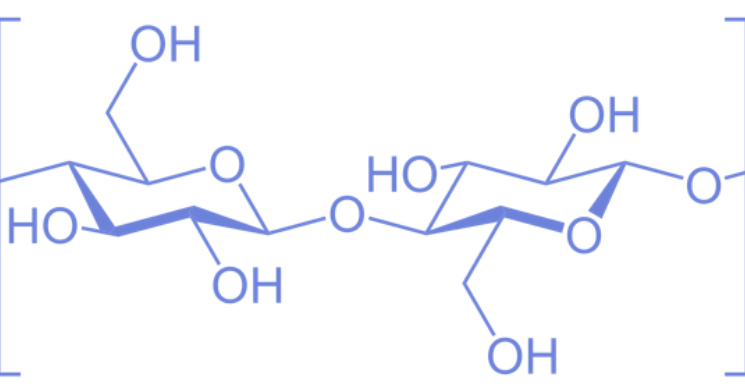
# REGENERATED FIBRES FROM ALL-CELLULOSE COMPOSITES: A CIRCULAR ECONOMY FOR TEXTILES

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**Aim:** To explore the potential of wet spinning regenerated cellulose fibres (RCFs) from cotton all-cellulose composites (ACCs) whilst utilising the IONCELL process, in order to recycle textiles into novel materials and fibres.

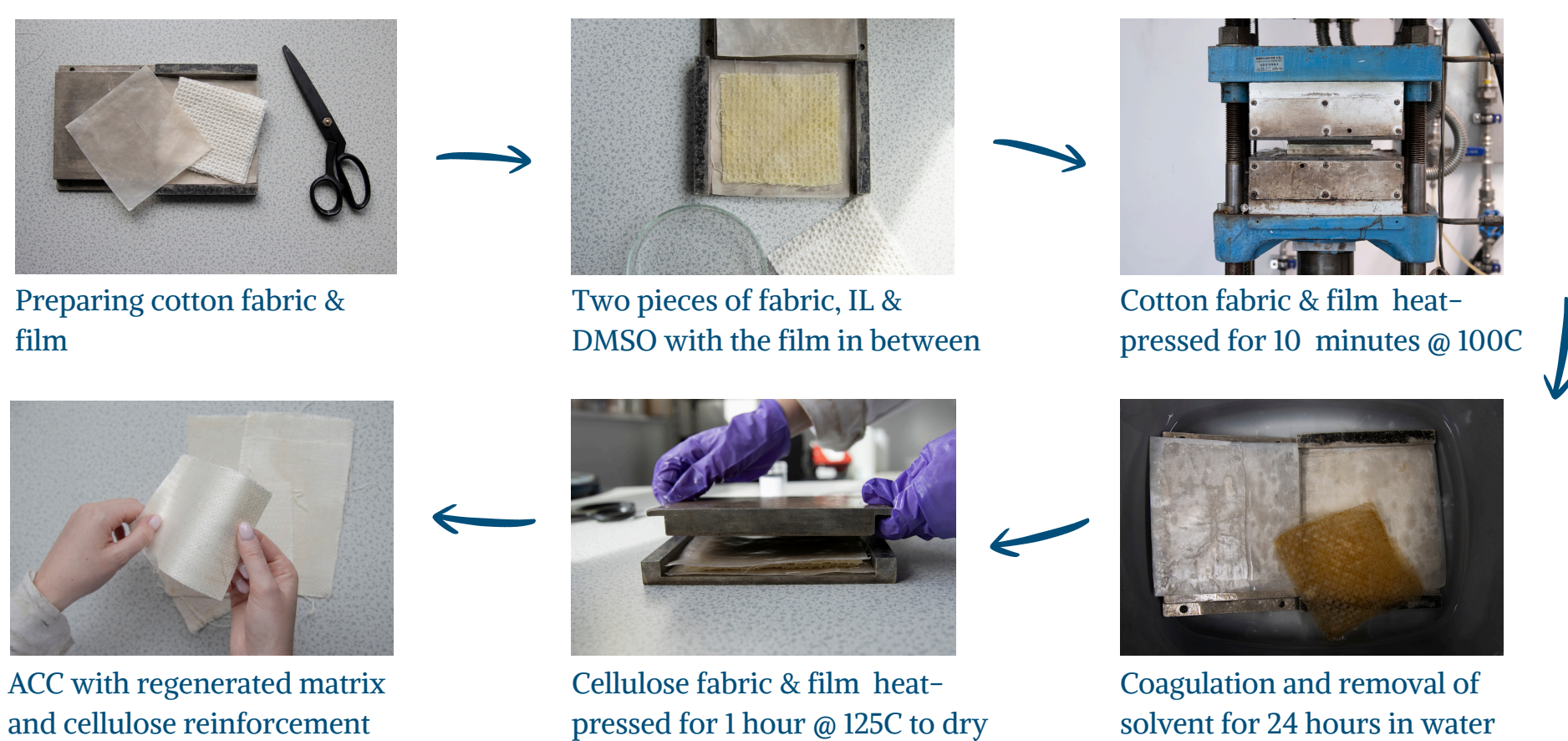
## CELLULOSE



Around 40% of all textiles produced contain cellulose, with cotton comprising the highest quantity of cellulose polymers – around 95%. These cellulosic fabrics have the capacity to be partially or completely dissolved, creating composite materials and regenerated fibres.

## ALL-CELLULOSE COMPOSITES

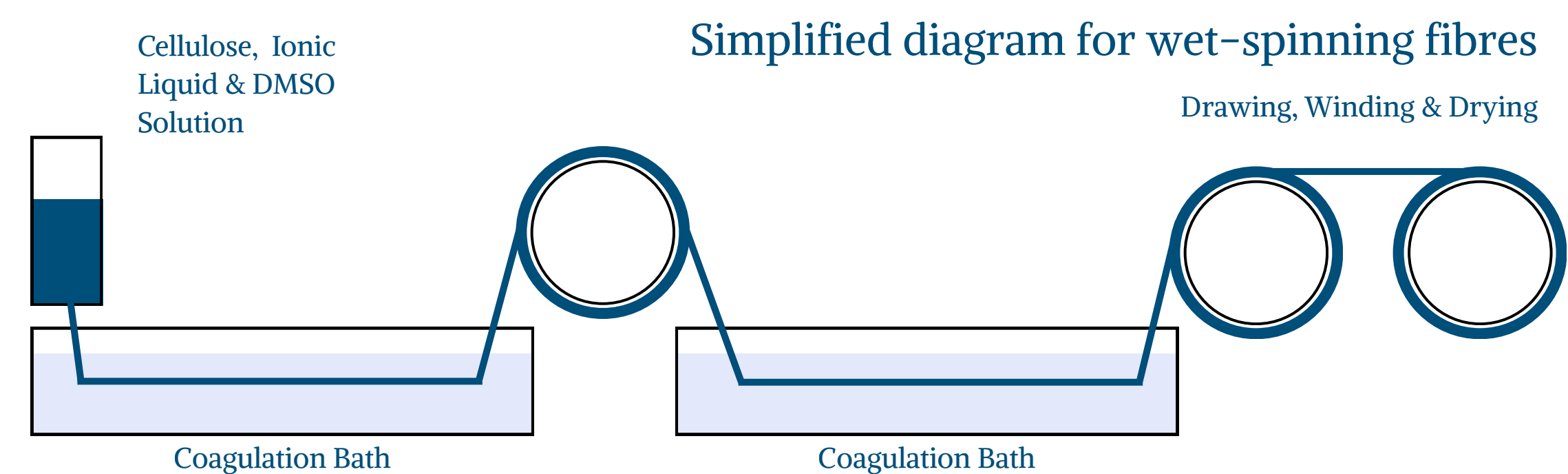
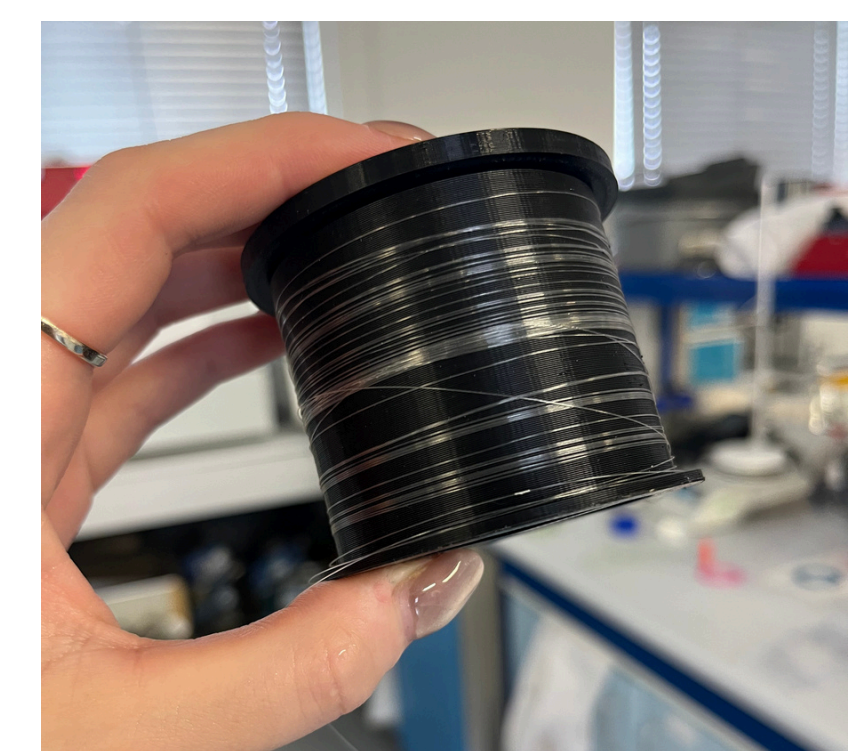
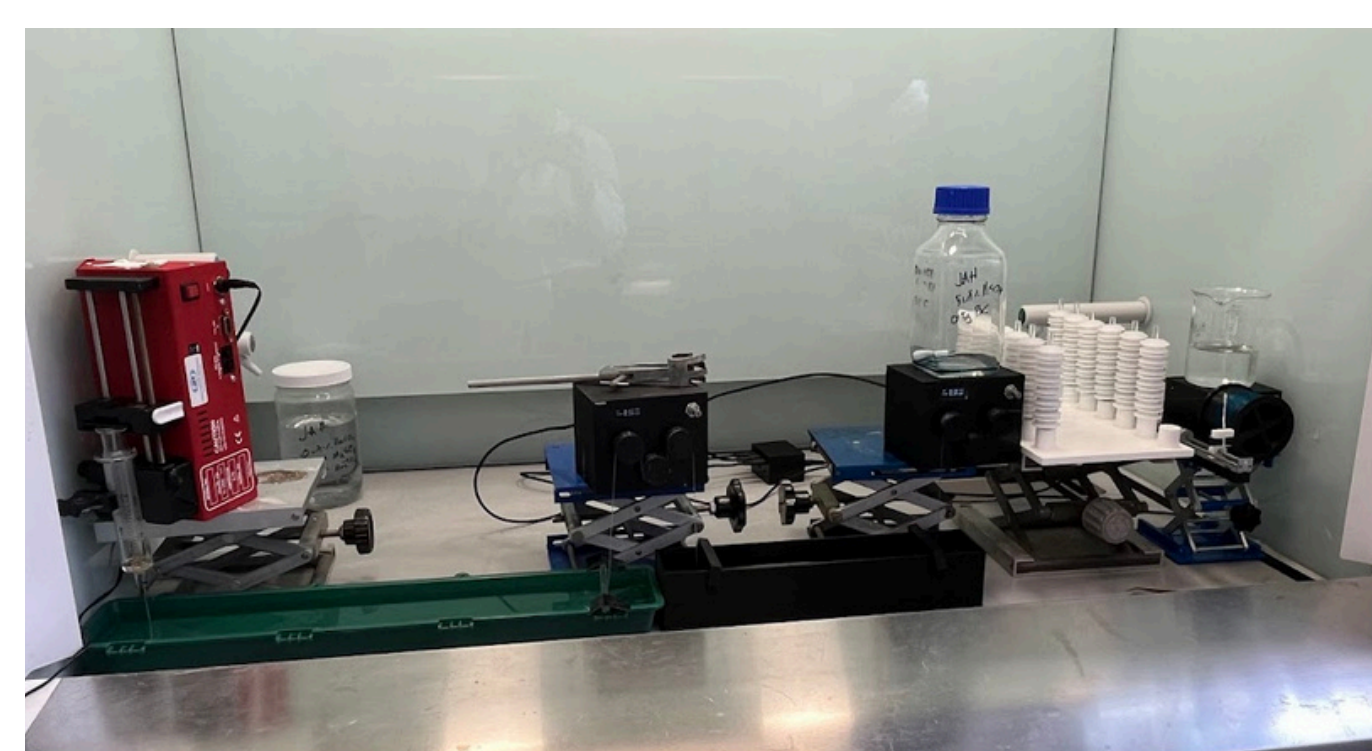
Cotton fabric, cellulosic film, the ionic liquid EMIMAC and cosolvent DMSO are used to manufacture all-cellulose composites. A plain weave mercerised cotton (sourced from Whaley's, UK) was used as the cellulosic matrix, together with a regenerated cellulose film (provided by Futamura) as the reinforcement.



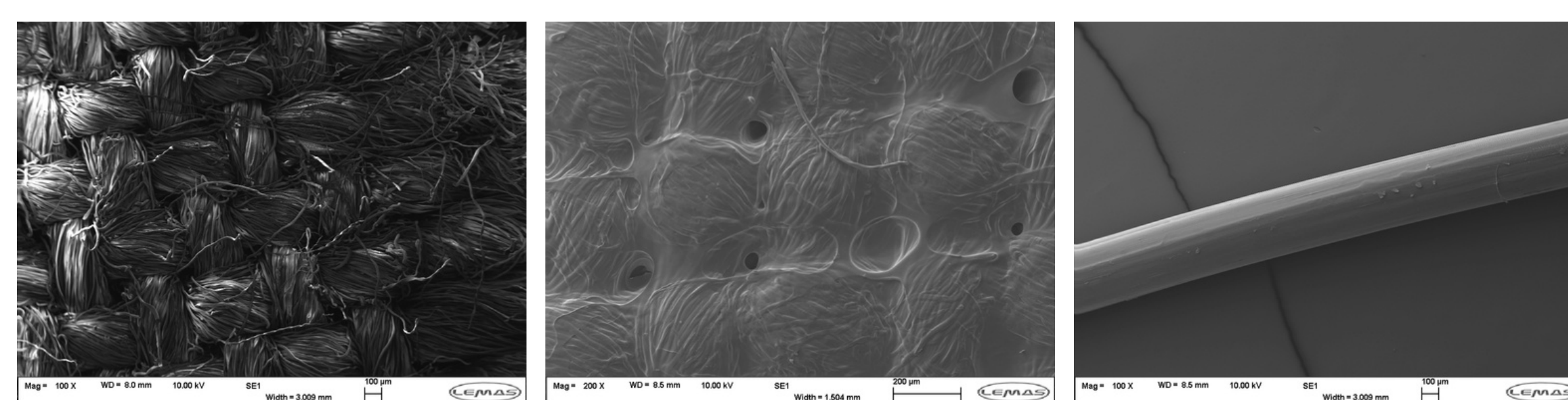
The cotton was soaked in the IL & DMSO and heat pressed to allow for partial cellulose dissolution. The material is then washed overnight in water, before drying for 1 hour, the resulting material is comprised solely of cellulose with the solvents being removed during coagulation.

## REGENERATED CELLULOSE FIBRES

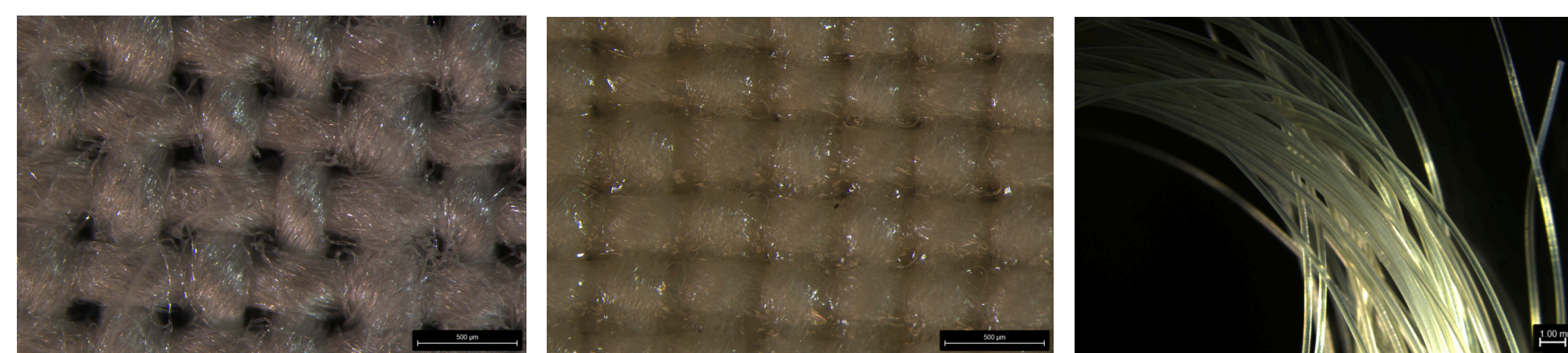
In order to generate new fibres, the ACCs are milled into a cellulose powder to facilitate dissolution, before mixing with the same ionic liquid EmimAC & DMSO. This method is similar to that of the viscose and lyocell fibre spinning technology, where ionic liquids are used as the solvent. The solution is then wet-spun using a lab-built spinning system, using two water baths to allow for solvent removal and the drafting of the fibres to stretch the filaments, before winding. Parameters including the pump speed, draw ratio, extrusion diameter can be used to alter the physical properties of the fibres.



## MICROSCOPY - FABRIC / COMPOSITE / FIBRE



SEM Imagery - Taken at 100x magnification

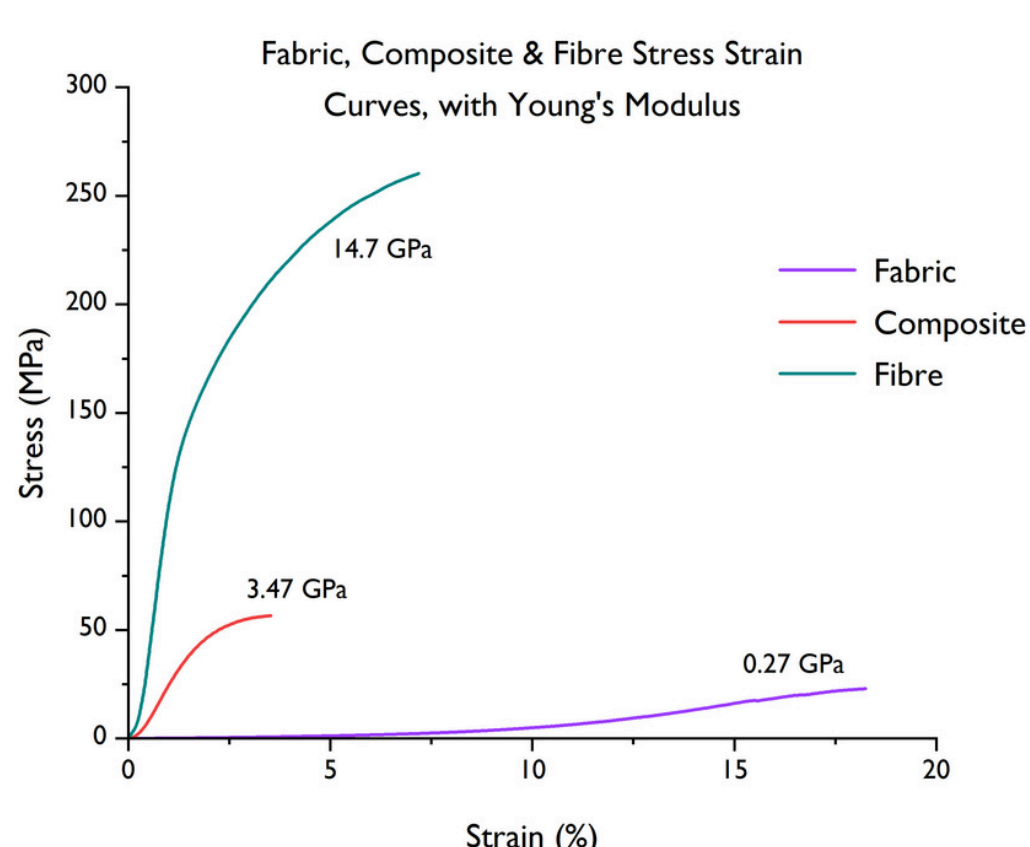


Optical Microscopy Imagery - Observing the structure and diameter using a Leica M205 C

## FABRIC / COMPOSITE / FIBRE

Undyed Cotton

Dyed Cotton



Measuring the mechanical properties of the original cotton fabric, composite and regenerated cellulose fibre. The fibre was made using 7.5wt% in 80:20 DMSO:IL, before mixing for 3 hours and stretching at a draw ratio of 1.6. The RCF shows a higher tensile strength and Young's Modulus.

## FURTHER RESEARCH

Exploring second-hand textiles such as denim, to create ACCs before recycling into RCFs. Mainly pre-consumer fabric has been utilised thus far, but ultimately, it is post-consumer materials, that would otherwise have been wasted, that are of interest to recycle using these methods.



## SOURCES

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