

DcAFF

Discontinuous Aligned Fibre Filament for 3D Printing :Production, Printing and Performance

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DcAFF (Discontinuous Aligned Fibre Filament) is a novel composite material for 3D printing or, fused filament fabrication (FFF), where highly aligned discontinuous fibres, produced using the High Performance Discontinuous Fibre (HiPerDiF) technology, reinforce a thermoplastic matrix to provide high mechanical performance while retaining high formability.

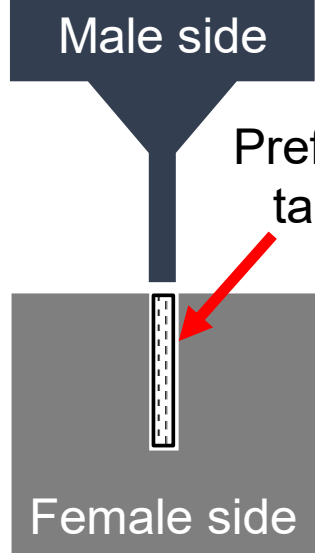
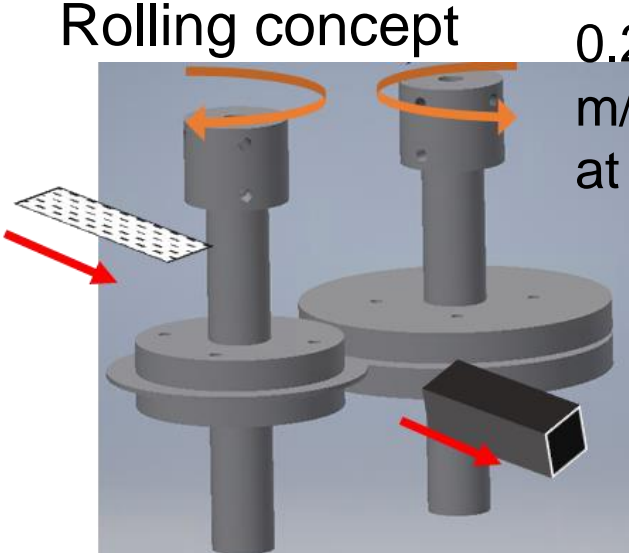
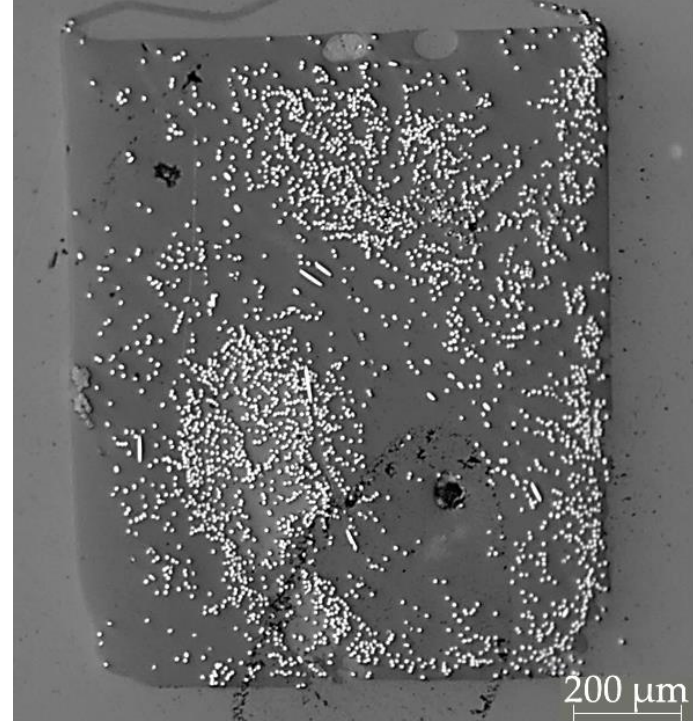
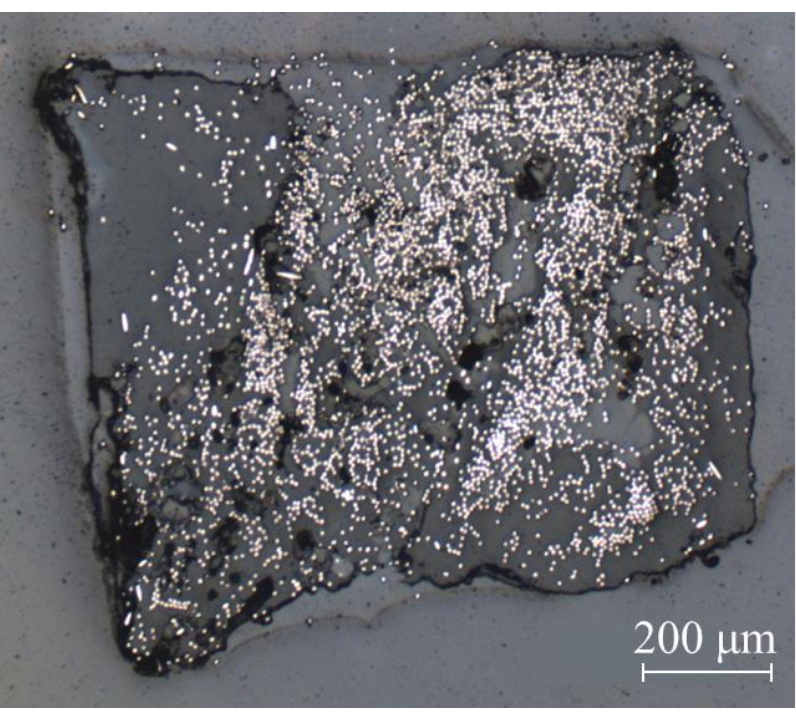
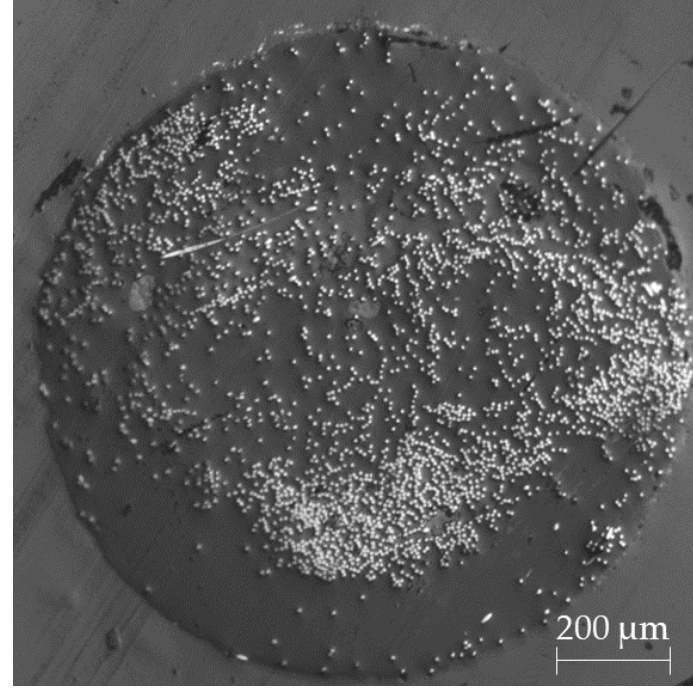
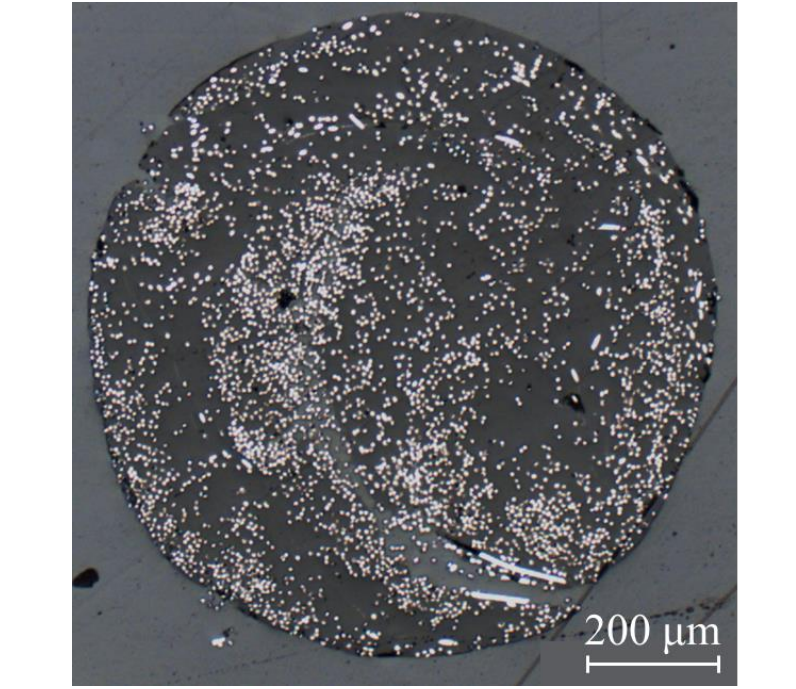


Production

The main challenge of filament production is to form the HiPerDiF thin composite tape into a circular cross-section filament while preserving fibre length and a high level of alignment.

There are two main steps in filament-forming:

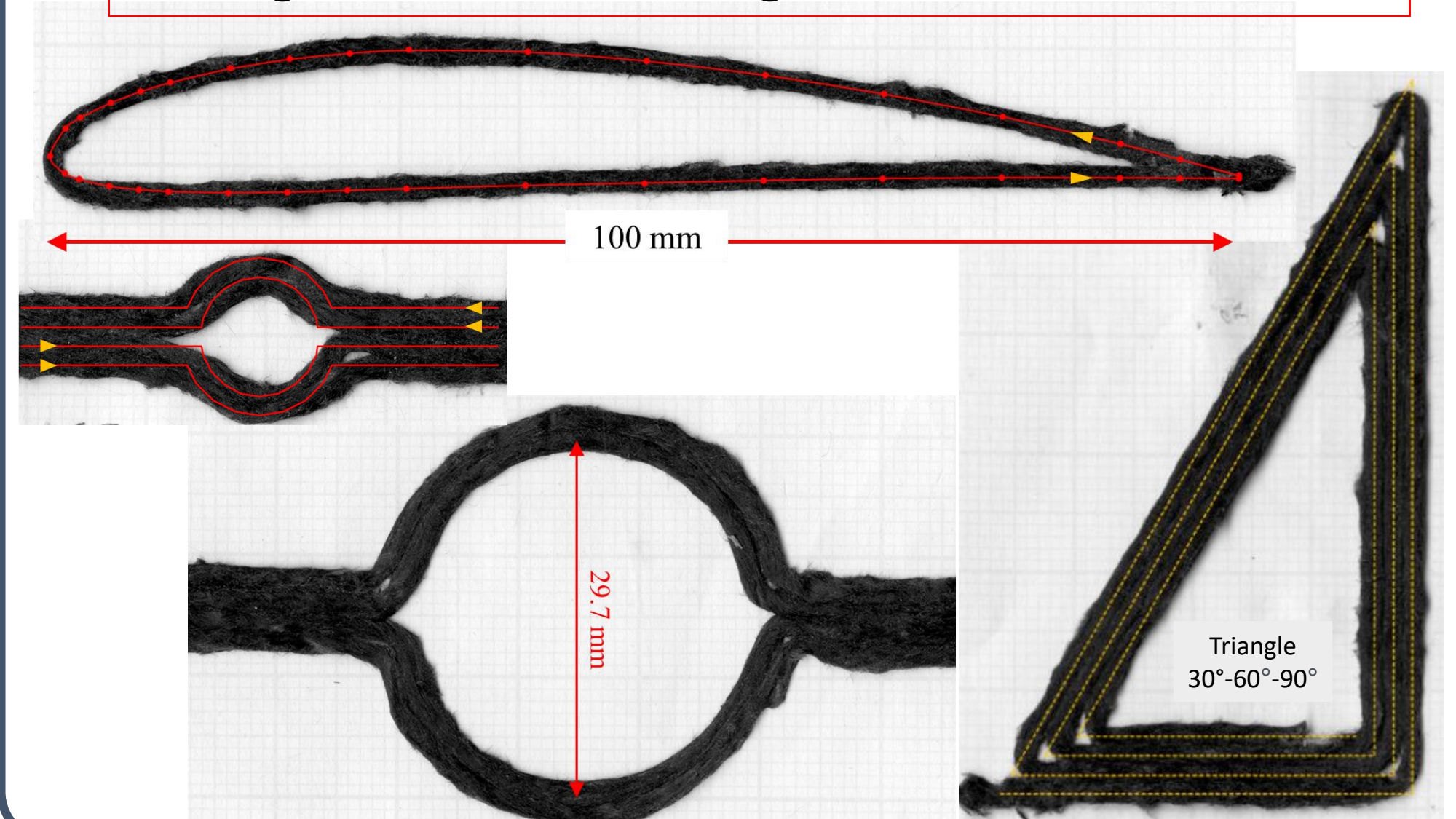
1. Bulking tape into a square-like cross-section;
2. Hot-pultrusion through several nozzles to form a circular cross-section filament

	Initial trial with manual moulding	Semi-automated method
Bulking Tool	 <p>Heated in an oven at 250°C for 1 hour before compress</p>	 <p>0.2-0.5 m/min at 130 °C</p>
After Initial Forming (Bulking)		
After Nozzle Pultrusion		
	Controllable bulked shape (low voids)	High production rate (~50 cm/min)
	Slow process (< a meter per hour)	Inconsistence pressure (small internal voids)



Printing

- ✓ Accurate deposition when printing of straight line, or low curvature geometry
- ✗ Poor accuracy when printing tight radius corners, or high curvature turning



Performance

Tensile properties of DcAFF (PLA-carbon fibre) compared to other composite 3D printing materials: PLA, PLA-short carbon fibre (PLA-S.CF), PLA-continuous carbon fibre (PLA-C.CF), and nylon-continuous carbon fibre (nylon-C.CF)

DcAFF is better than other PLA composites, particularly PLA-C.CF, but it is still lower than nylon-C.CF

