suprem

Unidirectional Thermoplastic Composites Materials

Designed for Automated Processing

Tailored to your Application

Swiss quality

Continuous Fibre Thermoplastic Materials for 3D Printing

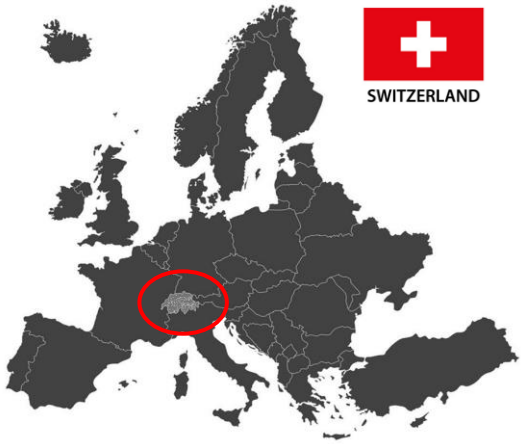
Rodolphe HENRI

Agile & part of a Group

35 years of experience in thermoplastic composite materials

Operations from **prototype** to **large volume** serial production

Supported by a Swiss **industrial** investor **group**



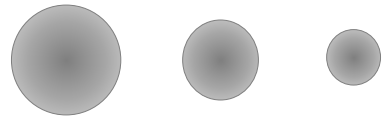
Qualified for Medical, Aerospace and Energy applications

Products portfolio

Suprem™ T
UD Tape (prepreg)

Suprem™ P
UD Profile (filament)

Suprem™ R
UD Rod

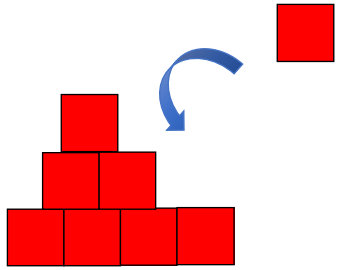


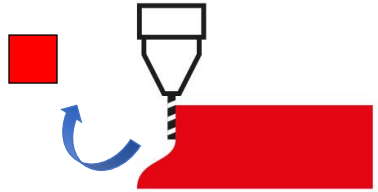
Designed for Automated Processing

Customized Products

Additive manufacturing (AM)

Adding / Laying materials vs. **Subtracting / Removing** materials





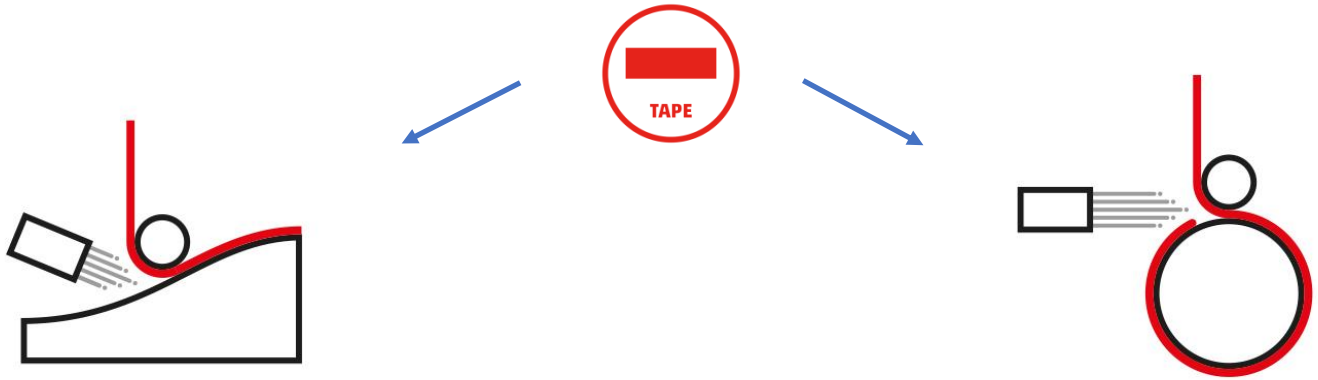
=> Fibre Reinforced Plastics ("**composites**") vs. Metals

Standard composites processes involve 2nd step for **curing / consolidation** applying temperature (**T**), pressure (**P**) and time (**t**)

Ex: Hand **lay-up** (HLY) + **post consolidation** (press, oven, autoclave)

AM with thermoplastics

Automated deposition + with / without consolidation



Tape Placement / Laying

Tape Winding

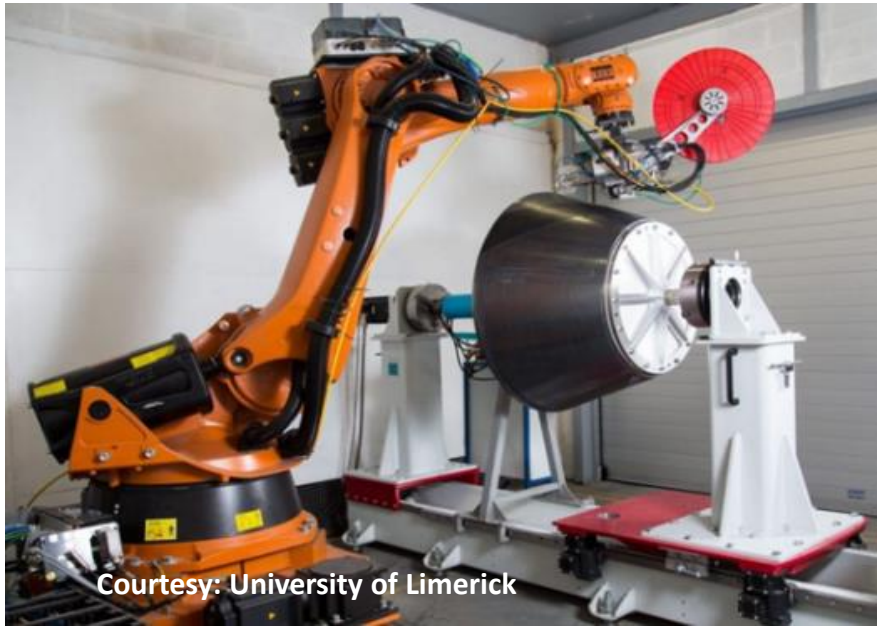
in-situ consolidation (additive) : *laying & consolidating in **1-step***

ATP for space structures (1/3)

ESA project

Payload adapter

Laser assisted ATP

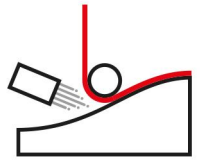


Development of heated tool

Process parameters for in-situ consolidation

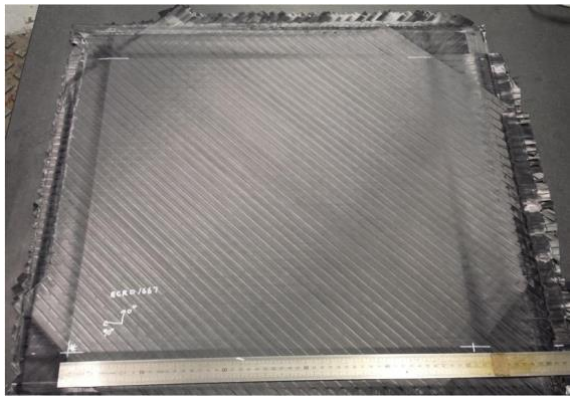
Laminate, sub-component and part test

ATP for space structures (2/3)

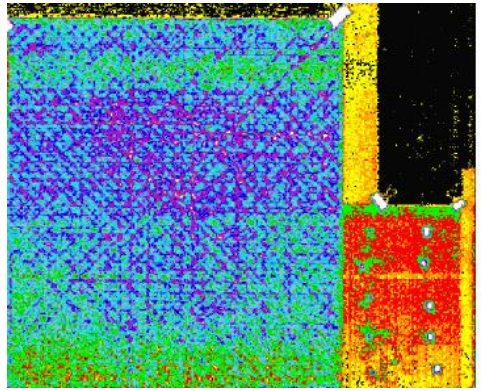


Carbon (IM) / PEEK Tape

Laminate (16 & 32 plies)



Non-destructive testing (C-scan)



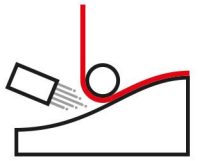
Mechanical tests (static, AITM)

Tensile modulus/strength (0°, QI) => equivalent to autoclave

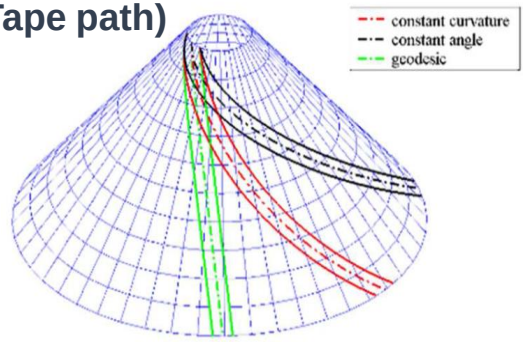
Compression strength (0°, QI) => 10-30% knock-down

In-Plane-Shear modulus/strength => 15% knock-down

ATP for space structures (3/3)

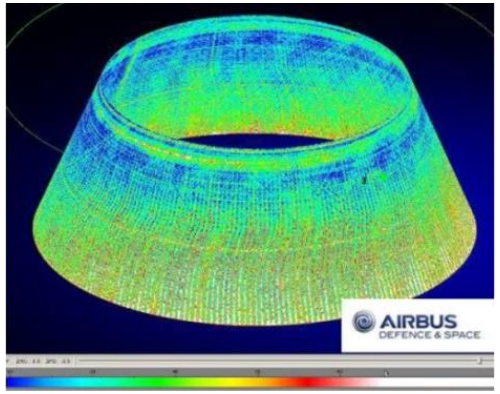


Simulation
(Tape path)

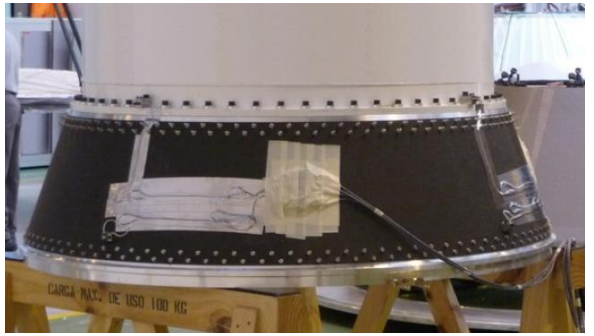


Demonstrator
(diameter = 1m)

Non-destructive testing
(C-scan)



Shock test
(Launch vibration)



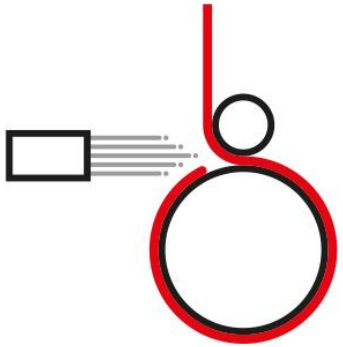
Vibration damping similar to thermoset structure

In-situ consolidation with sufficient part quality

TW for tubular parts

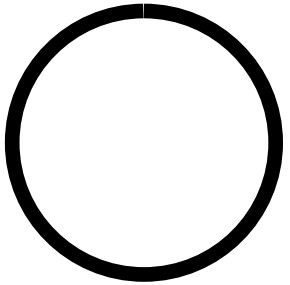
In-situ consolidation for chemical-mechanical resistant parts

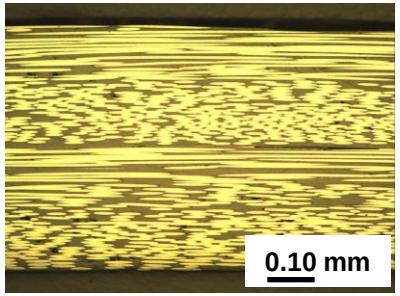
UD **Tape**

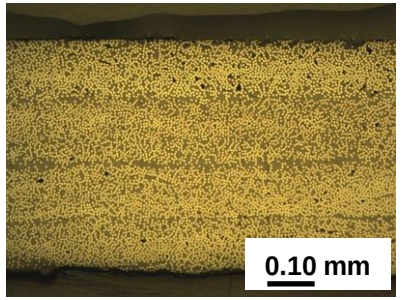


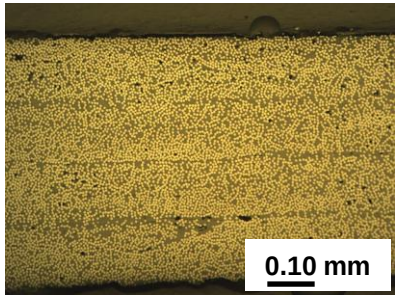
Tape Winding

«Pure» composite

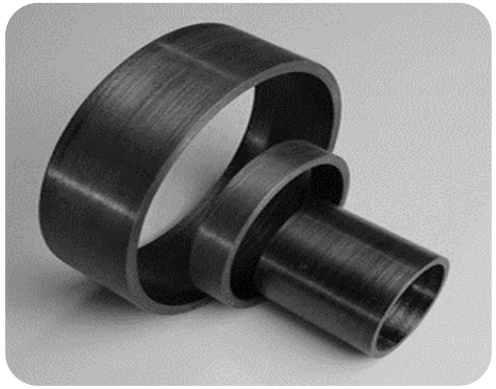




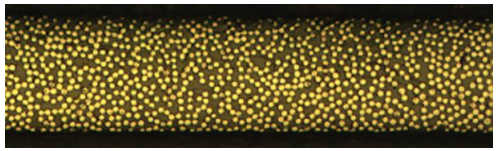




Ring



0.14 mm

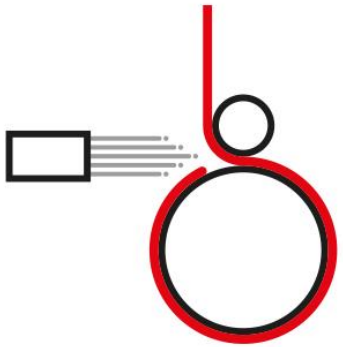


Carbon (SM) / PEEK Tape

TW for pressure vessels

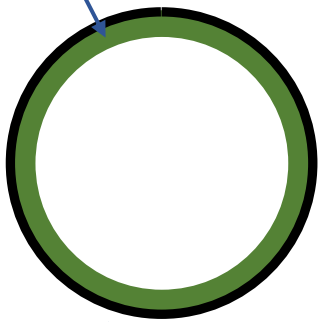
In-situ consolidation for high burst pressure parts

UD Tape

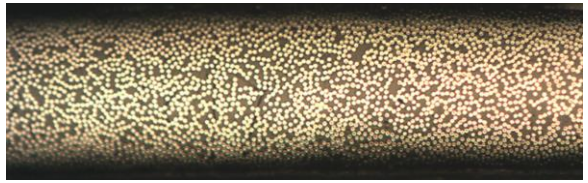


Tape Winding

TP Liner



Composite

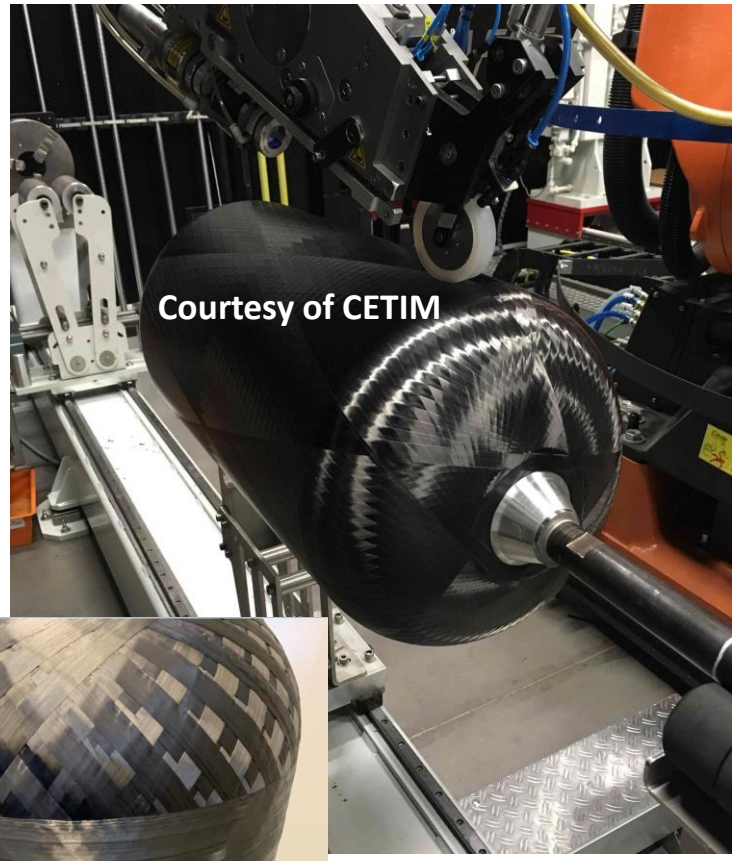


0.14 mm

Carbon (SM) / PA Tape

> 1’400 bars
(THOR project)

H_2 Tank

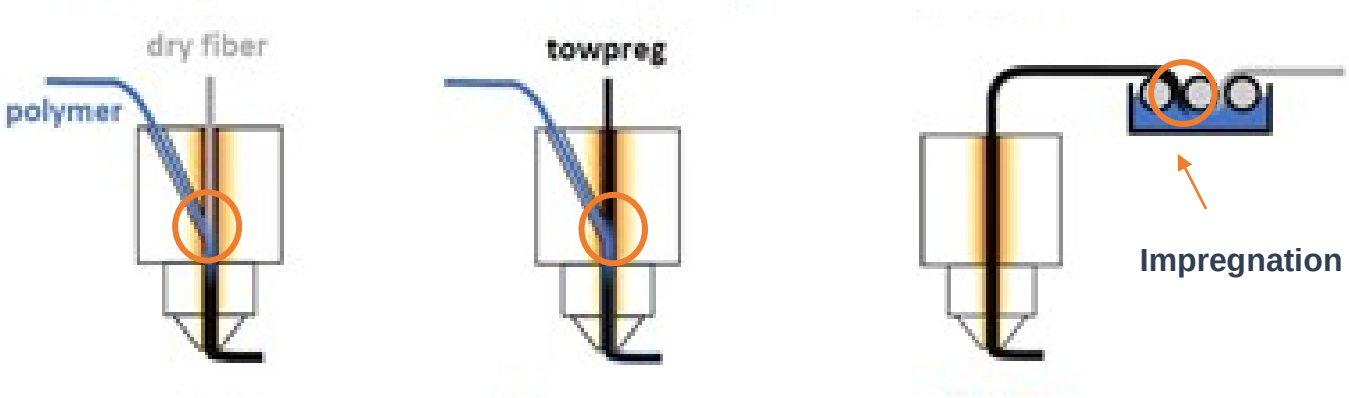


3D-printing with continuous fibre

Contact heating + low deposition pressure

Material extrusion (ISO/ASTM 52900)

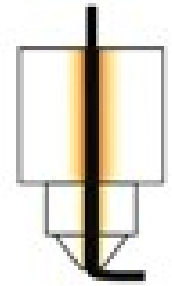
Fibre impregnation of fibre while printing



Alexander Matschinski, M. Sc. | Virtual Symposium on AFP and AM | Munich, Sept. 2020

- Complex
- Quality consistency

Printing with impregnated fibre

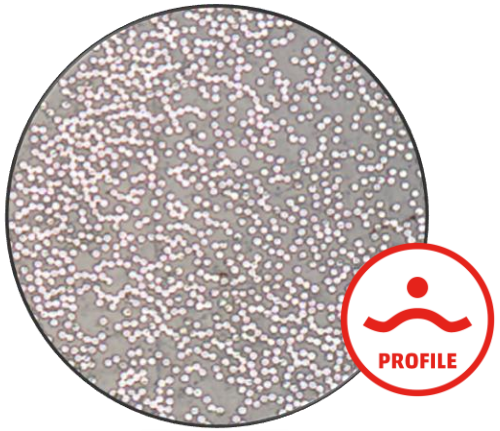


- Simple
- Focus on printing process

Tailored materials for 3D printing

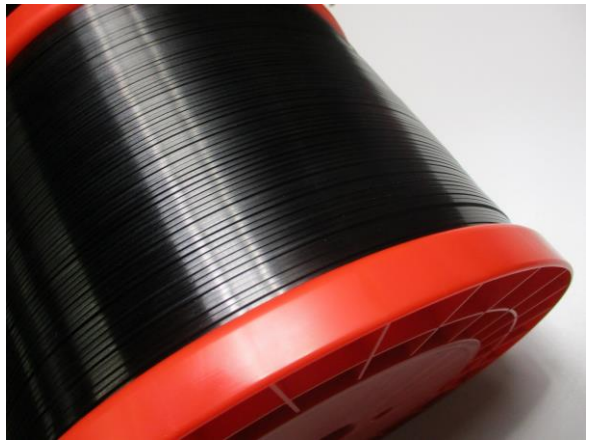
3D printing => **miniaturization**

filaprem



Low porosity (< 1%)

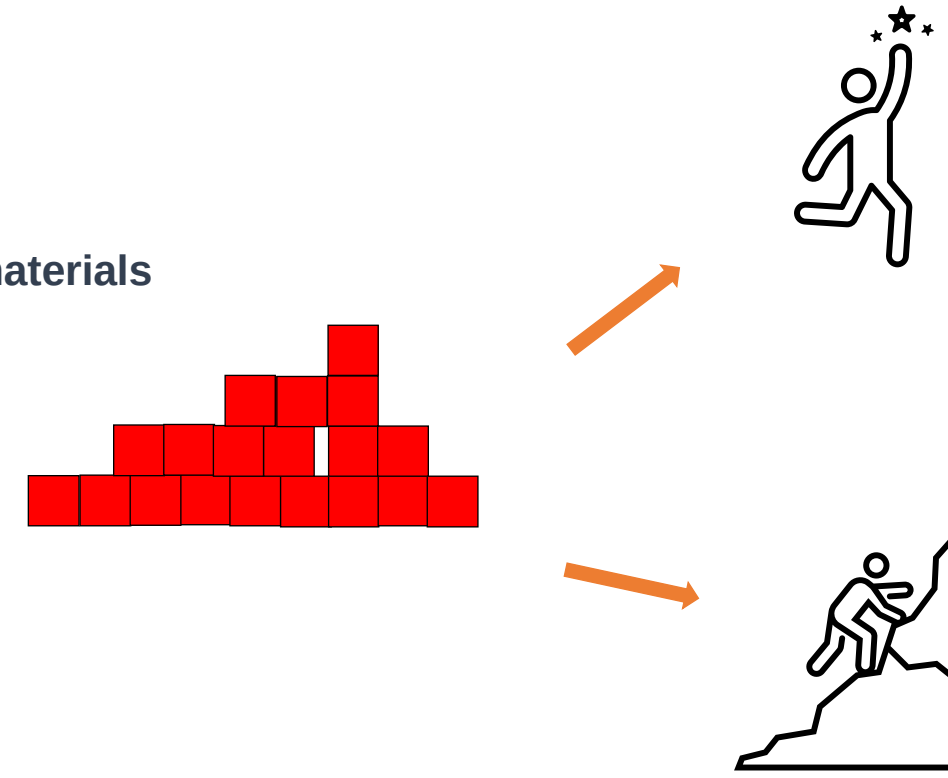
Homogeneous fibre-matrix distribution



3D in composites: challenges

Mature technology ?

- part quality
- reproductibility
- printing cost reduction
- available, affordable and consistent materials



Sustainable applications ?

- small & complex shape
- number of parts
- mechanical properties
- cost competitive

Take-Aways

- **A**dditive **M**anufacturing => **automation** + **in-situ consolidation**
  - Tape **Placement**
  - Tape **Winding**
- **3D** printing => **miniaturization**
  - **Part quality** highly dependent on **printing** technology
  - Need for **industrialization** and appropriate **applications**
- **Industrial** continuous fibre reinforced thermoplastic materials

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