

Institute of Lightweight Engineering and Polymer Technology

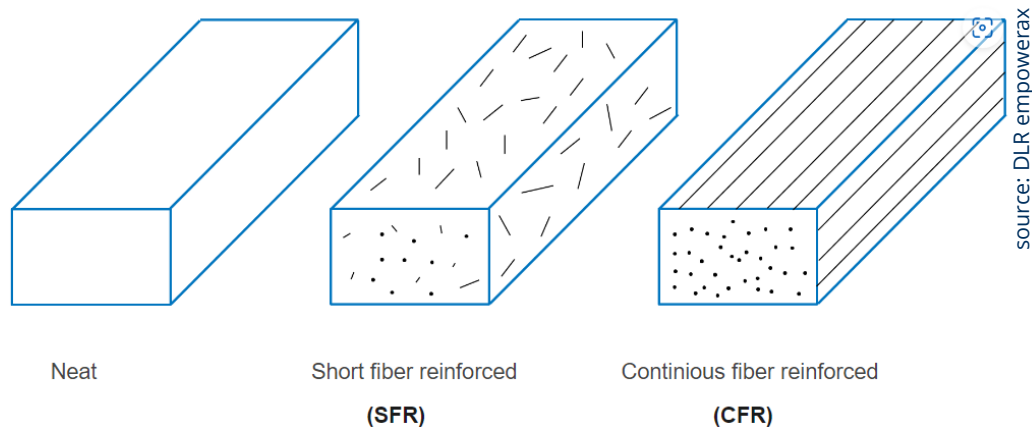
Curing composites with UV-light

3D-printing continuous fiber reinforced composites

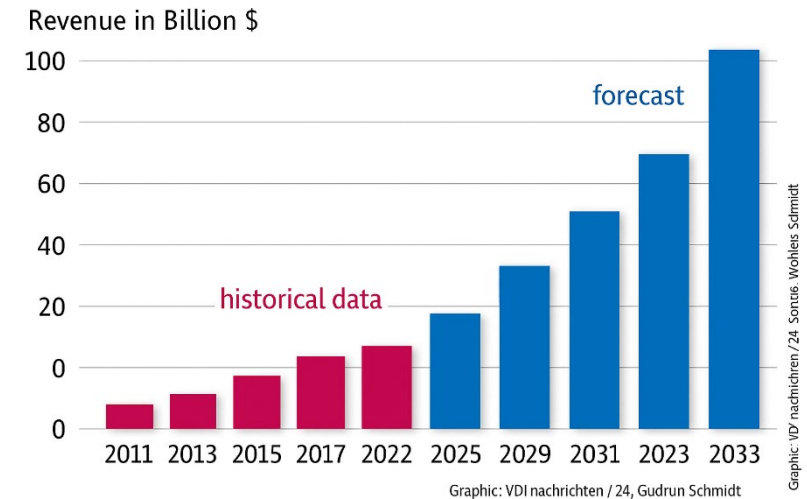
Eureka 2025 project proposal

FIBER REINFORCED COMPOSITE AND 3D-PRINTING MARKET

Fibers reinforce neat matrix materials in terms of stiffness and strength



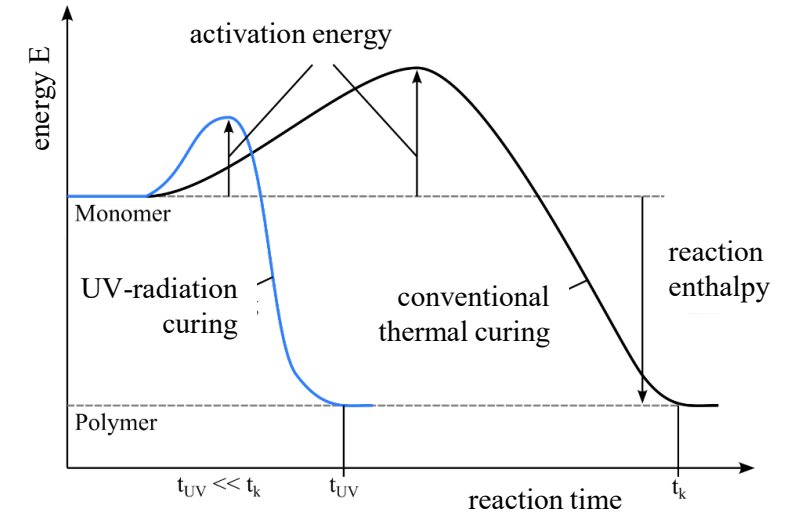
Potential of 3D printing for small batch and tool free production, but the majority of processes is without continuous reinforcement



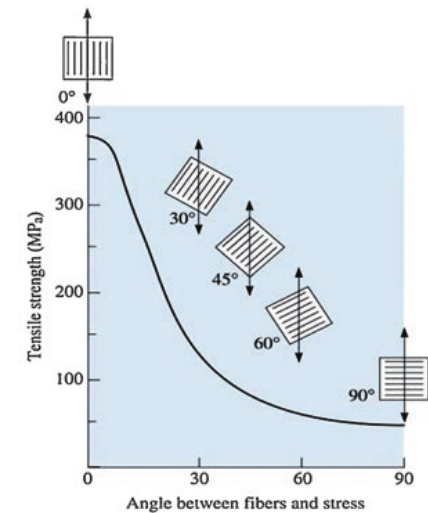
Market volume of 3D-printing industry (world wide)

DID YOU KNOW, THAT ...

- UV-radiation curing is 100x faster than thermal curing of composites (seconds vs hours)
- the energy required for UV-radiation curing with LED-technology is much lower than for thermal curing
- UV-radiation curing can be stopped and continued at any time
- UV-radiation curing is established in stereolithography for non-reinforced plastics
- 3D-printing allows production of individualized parts without specific tools
- Placing fiber reinforcement in load path direction utilizes the maximum potential of the reinforcement fibers



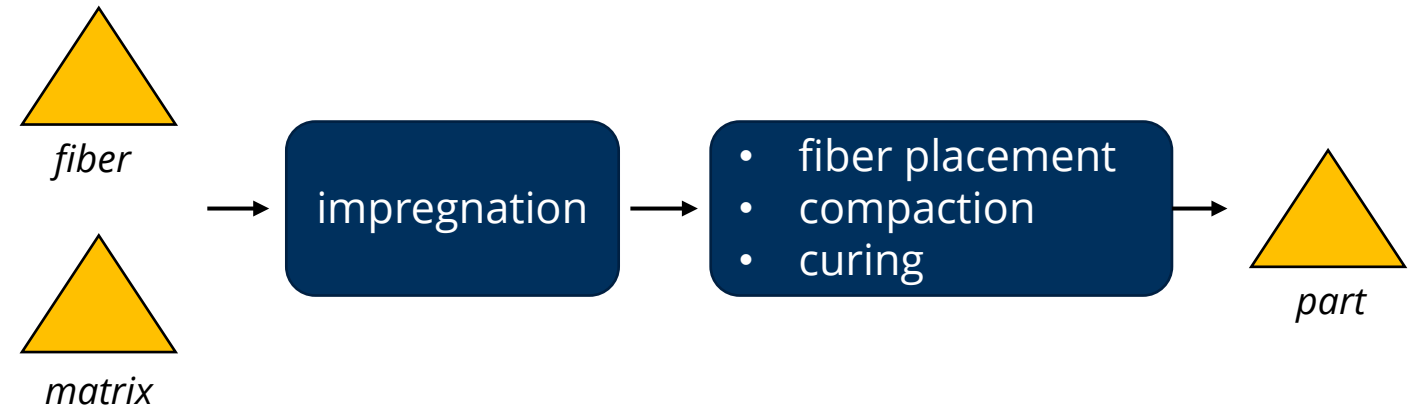
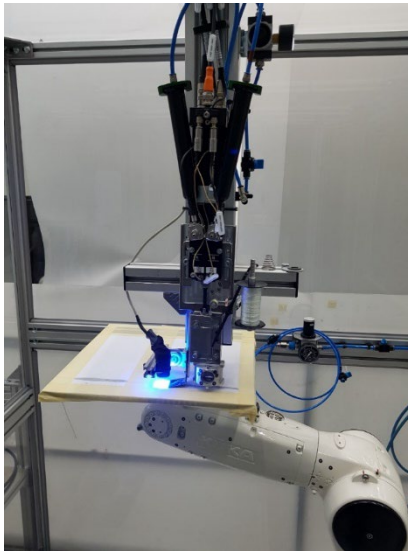
UV-radiation allows for instant curing



Material strength as a function of fiber orientation

A POSSIBLE NEW PRODUCTION METHOD COMBINING FIBER REINFORCEMENT AND 3D PRINTING

- Variable-axial fiber placement of reinforcement fiber
- In-line-impregnation for free choice of fiber and resin
- UV-radiation curing for fixing the fiber orientation and consolidation of the composite material
- **GOAL→ single-stage production process for industrial use with load-path-adapted fiber placement and efficient use of resources based on UV-curing resins**



EXISTING LABORATORY SYSTEM FOR CONTINUOUS FIBER 3D PRINTING

1K/2K reactive resin



Continuous roving



UV-light



Mixing & Metering

Impregnation

Placement

Curing

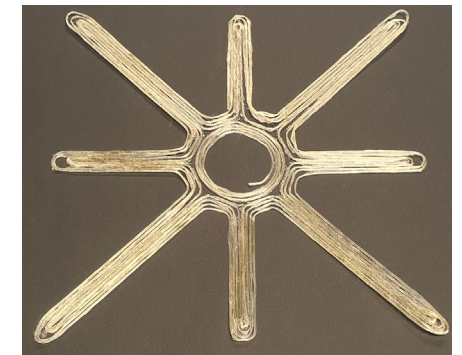
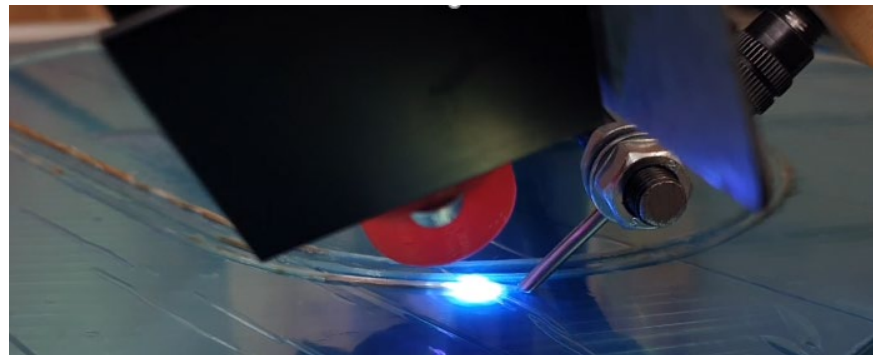
Fiber bobbin

Fiber placement head with metering machine and UV-lamp

Print bed



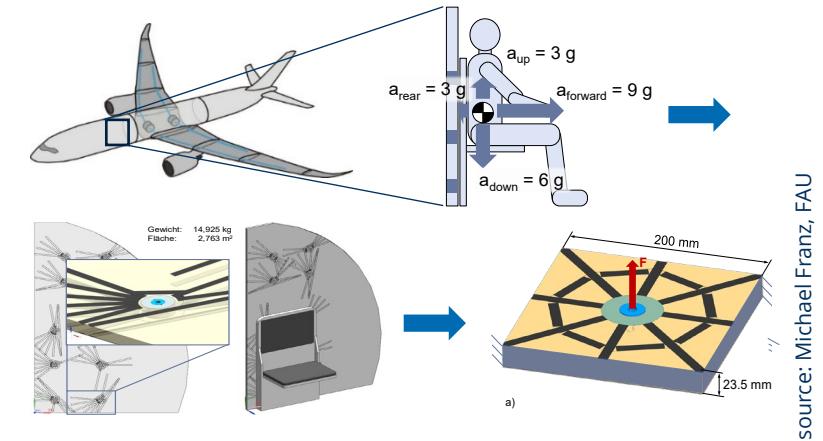
- Robot-guided print bed, fixed print head incl. exposure unit
 - Passive fiber pull-off from the bobbin through the impregnation tool
 - Deposition of the impregnated roving on the print bed
- Kuka KR6 robot, Viscotec DuoP 4/4 metering machine
- Control of resin impregnation and exposure intensity depending on the printing speed (10 mm/s)
- Path planning using Rhino/Grasshopper + Kuka PRC



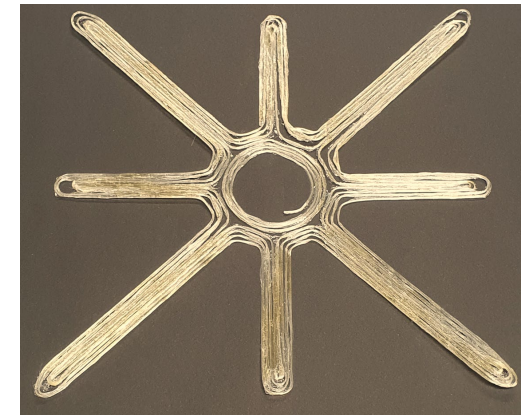
WHAT WE ARE LOOKING FOR

a partner for the application oriented development of this new process:

- open to any field of application, e.g.
 - 3D-printing of structures without tooling
 - „Functionalization“ → printing on existing structures, e.g. for custom feature or as reinforcement
- scaling up of process
- transfer to carbon fibers



potential application, e.g. load introduction



spider web like reinforcement ($\varnothing$ approx. 350 mm)

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