
DTU

# Hybrid composite materials for wind turbine blades

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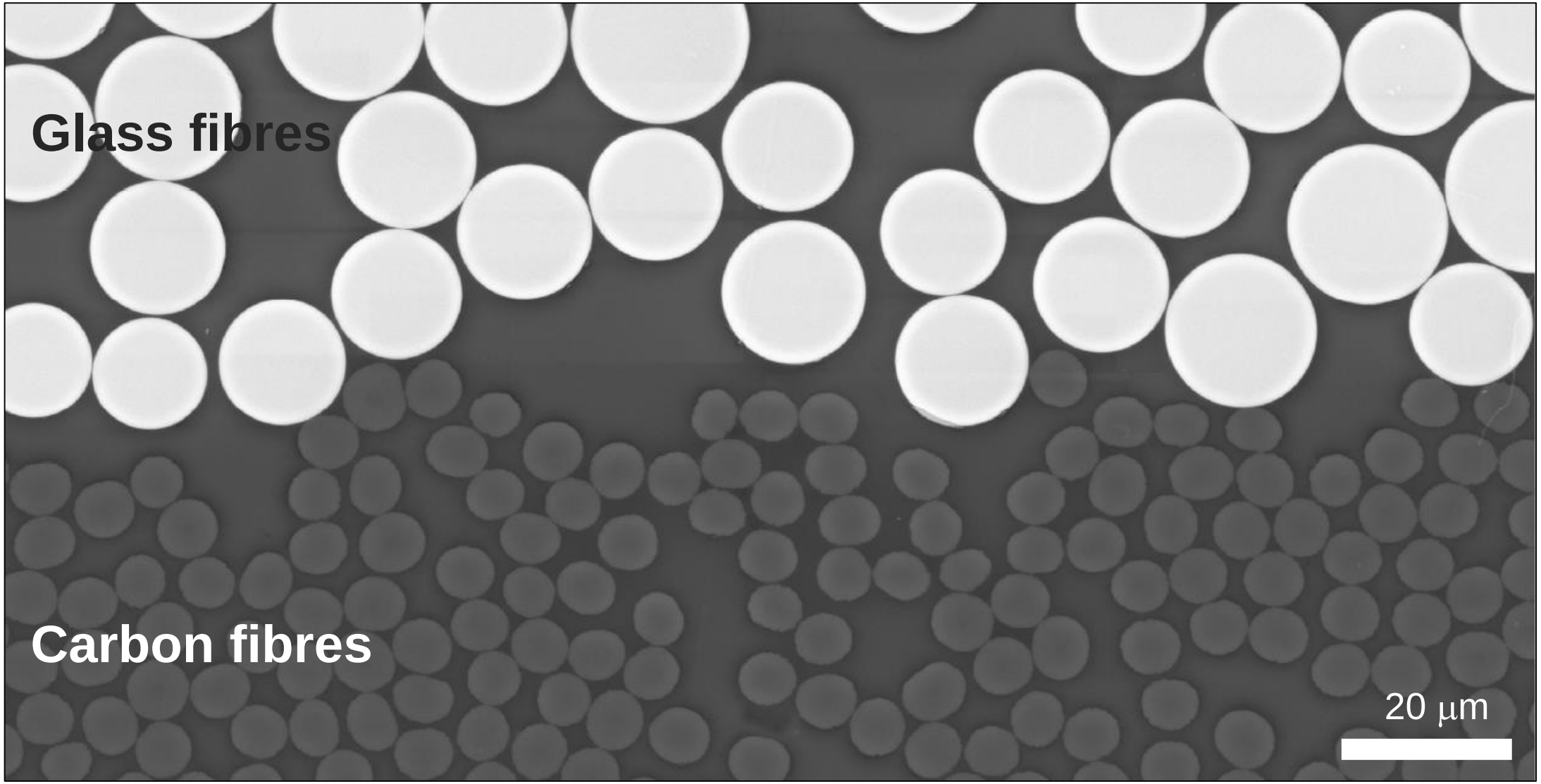
# Hybrid composites

More than one type of reinforcement fibres
in a common matrix


*More optimal design of composite properties*
*to meet specific performance profile*

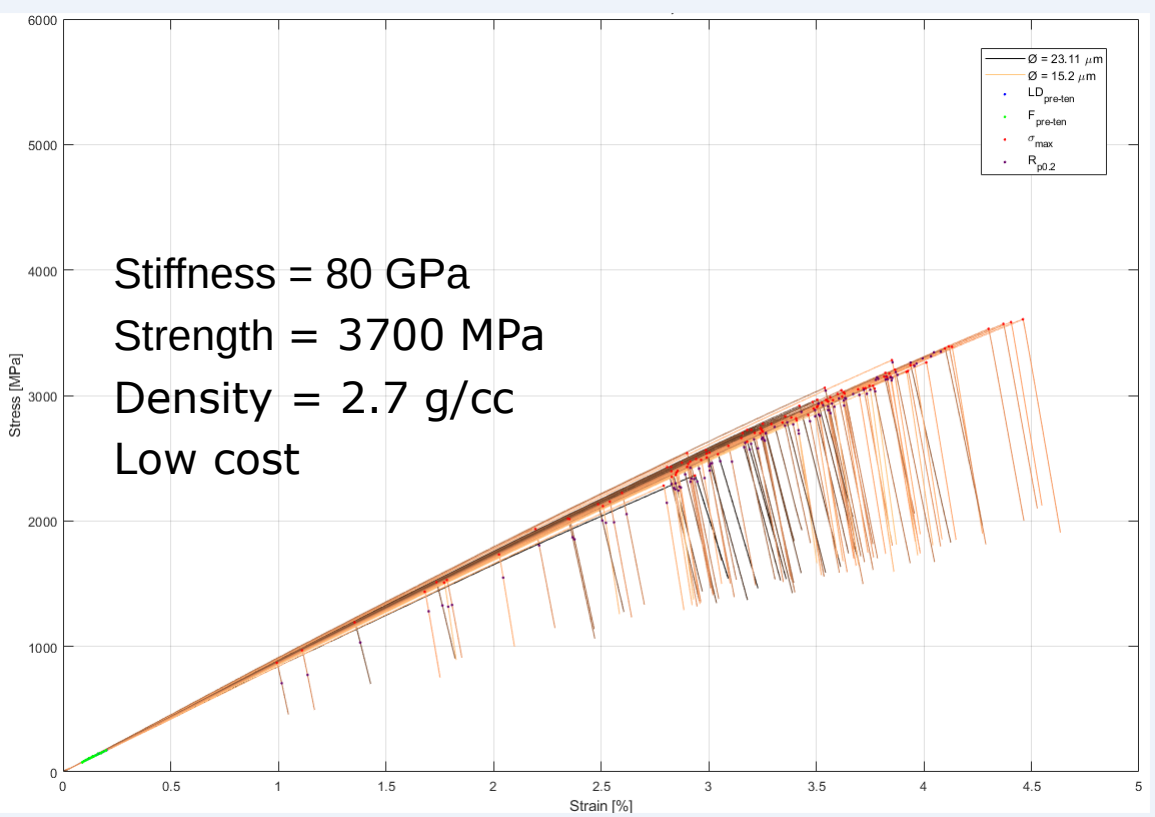
*Potential synergetic effect (so-called hybrid effect)*

# Glass fibre/carbon fibre hybrid composites



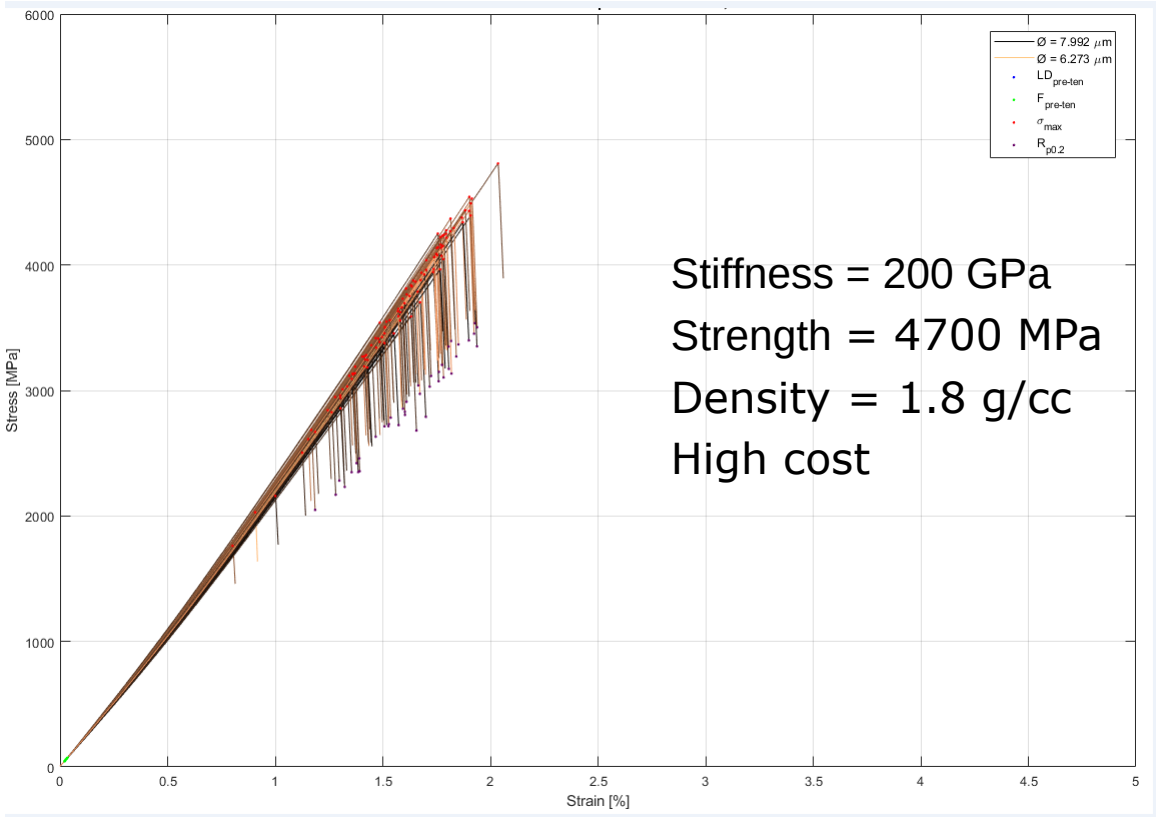
# Properties of glass and carbon fibres

## Glass fibres




Stiffness = 80 GPa
Strength = 3700 MPa
Density = 2.7 g/cc
Low cost

## Carbon fibres




Stiffness = 200 GPa
Strength = 4700 MPa
Density = 1.8 g/cc
High cost

# Previous projects at DTU Wind Energy working with hybrid composites

**Blade King, 2009 – 2013**

LM Wind Power, Comfil, Aalborg University, DTU Wind Energy

*To develop faster and more cost effective manufacturing of wind turbine blades*

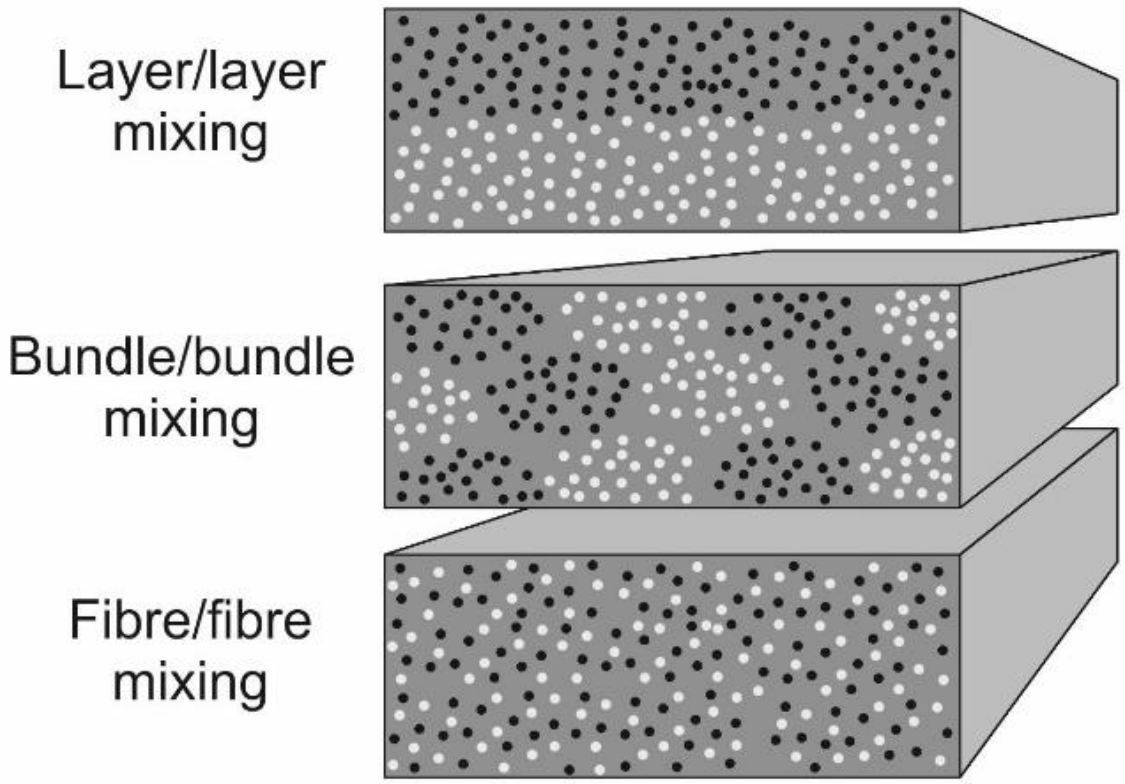
**OptiMaDeBlade, 2015 – 2018**

LM Wind Power, Fiberline, Aalborg University, DTU Wind Energy

*To optimise production of wind turbine blades to lower the cost for offshore wind energy*


In 2016, world's largest wind turbine blade,
88 meter, 34 tonnes
8 MW turbine
LM WIND POWER
Pilot Plant
Hybrid composites,
glass and carbon fibres

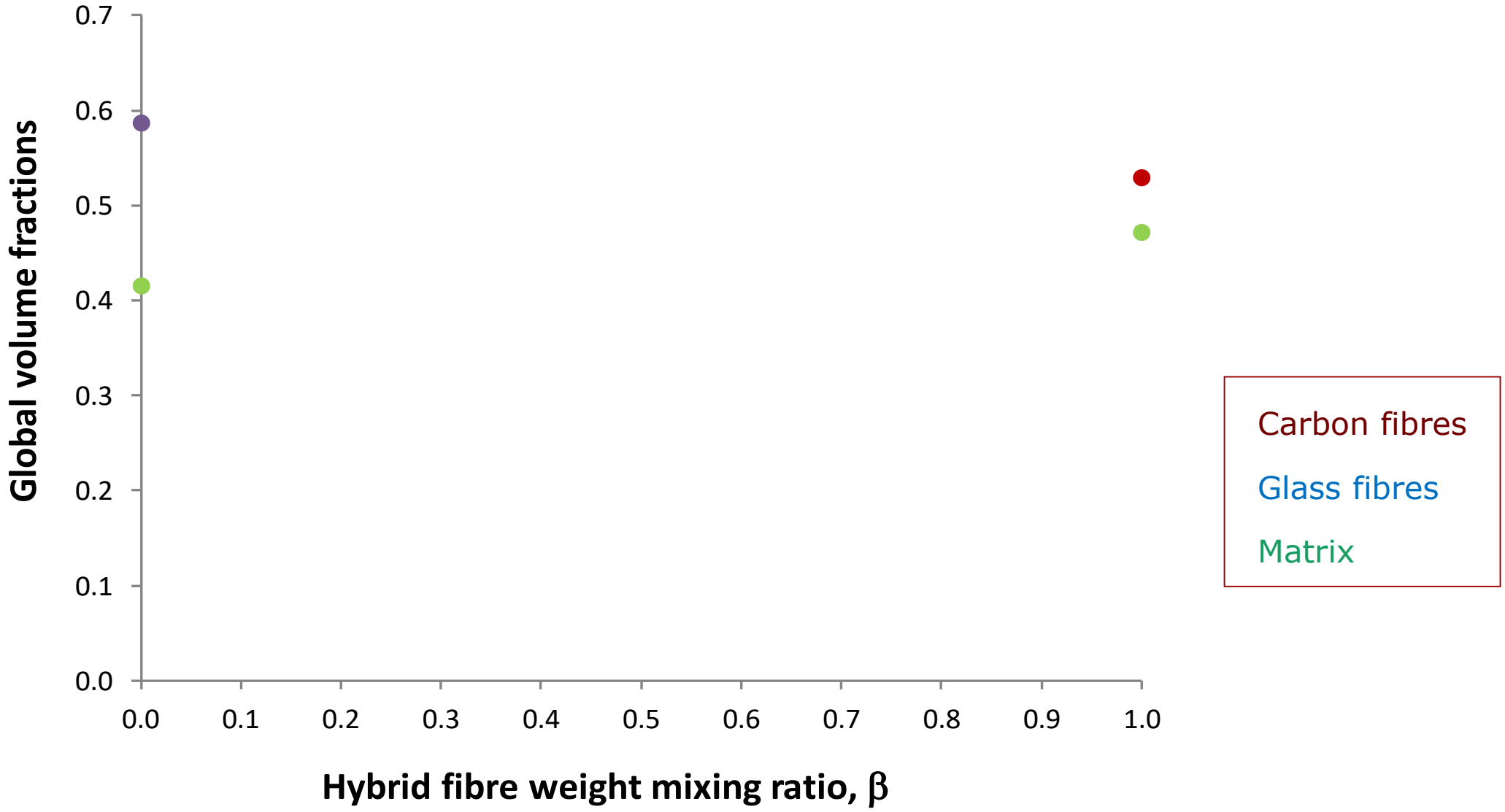
# Composition of hybrid composites



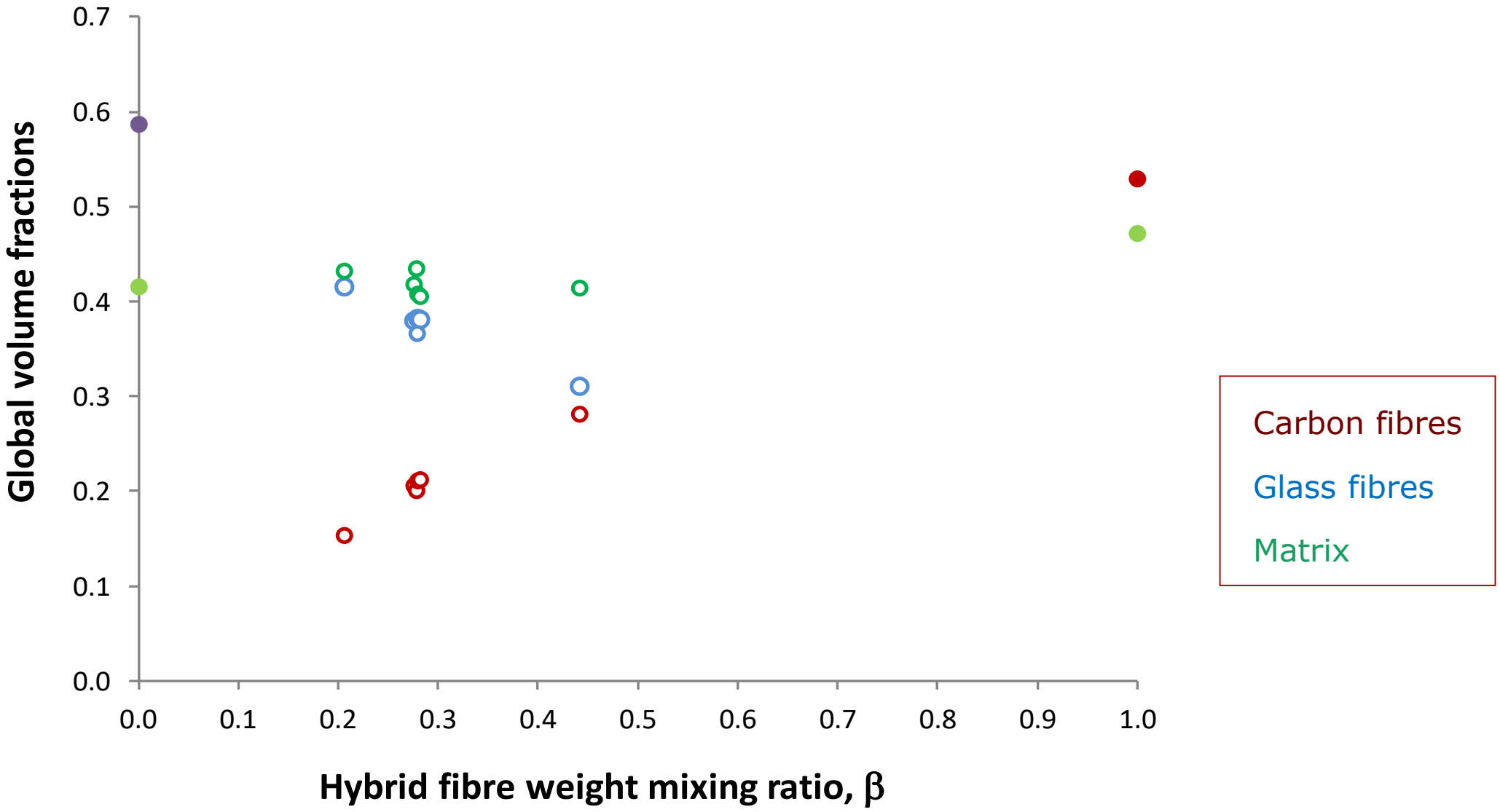

**Hybrid fibre mixing ratio, β**

$$\beta = \frac{m_{f\ carbon}}{m_{f\ carbon} + m_{f\ glass}}$$

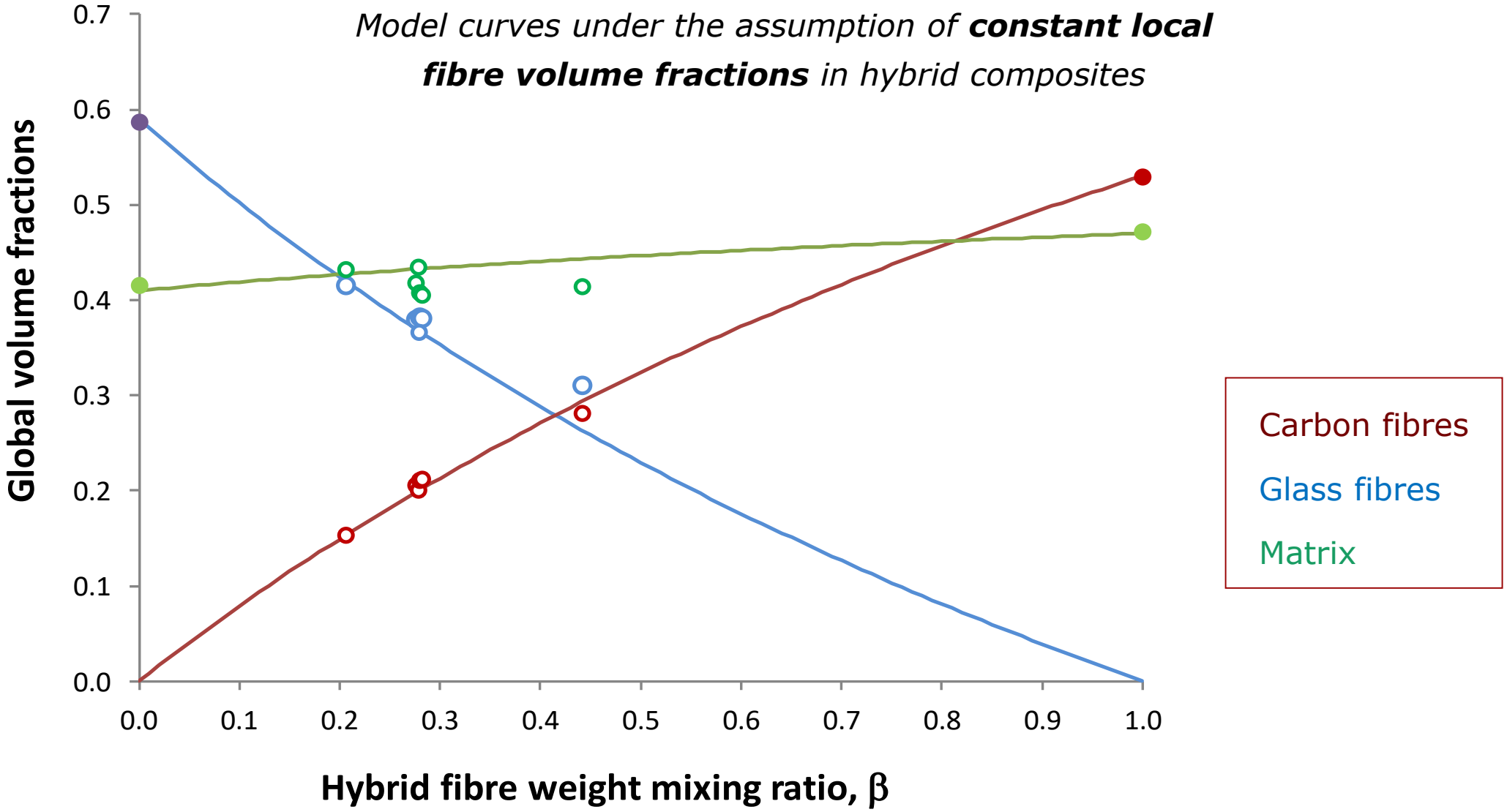
# Experimental data and model predictions



# Experimental data and model predictions

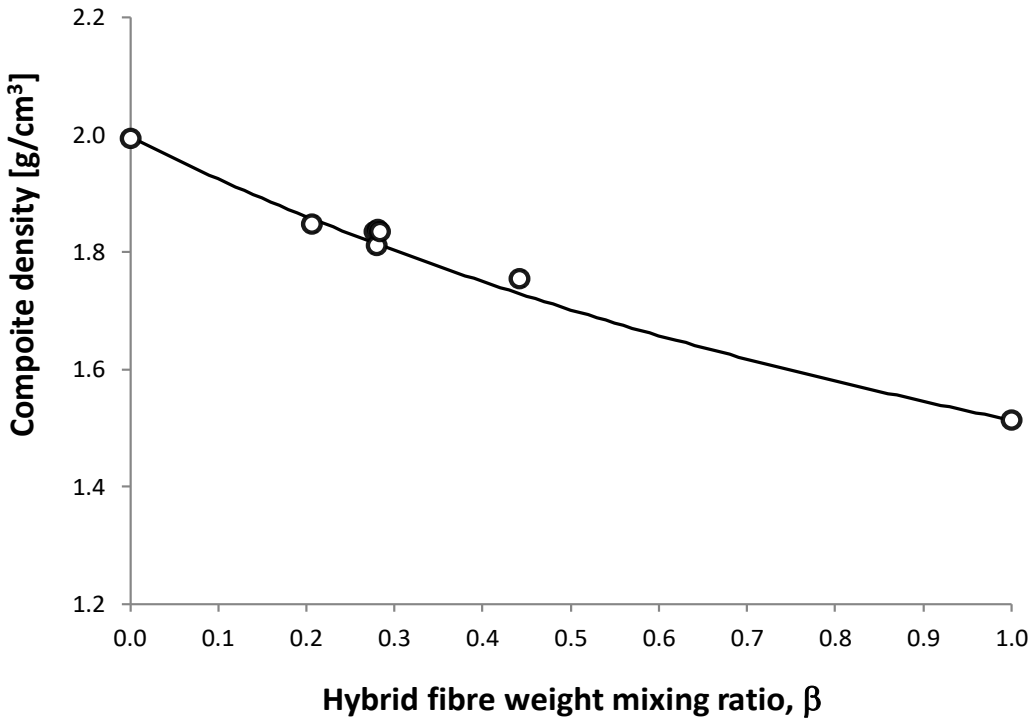


# Experimental data and model predictions

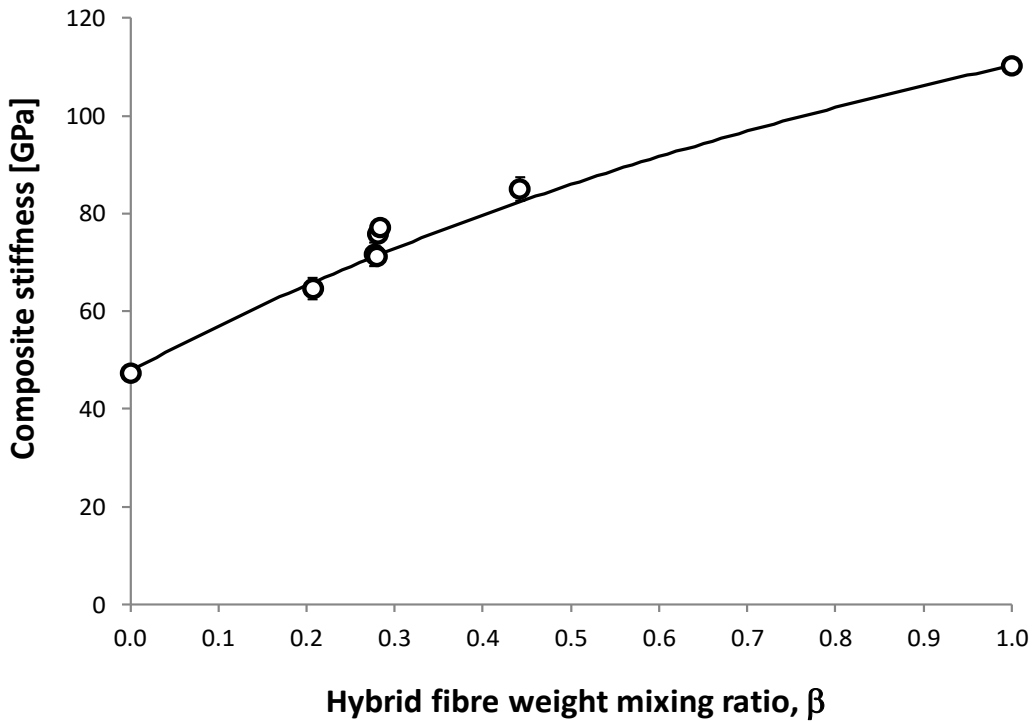


# Performance of hybrid composites

## Density

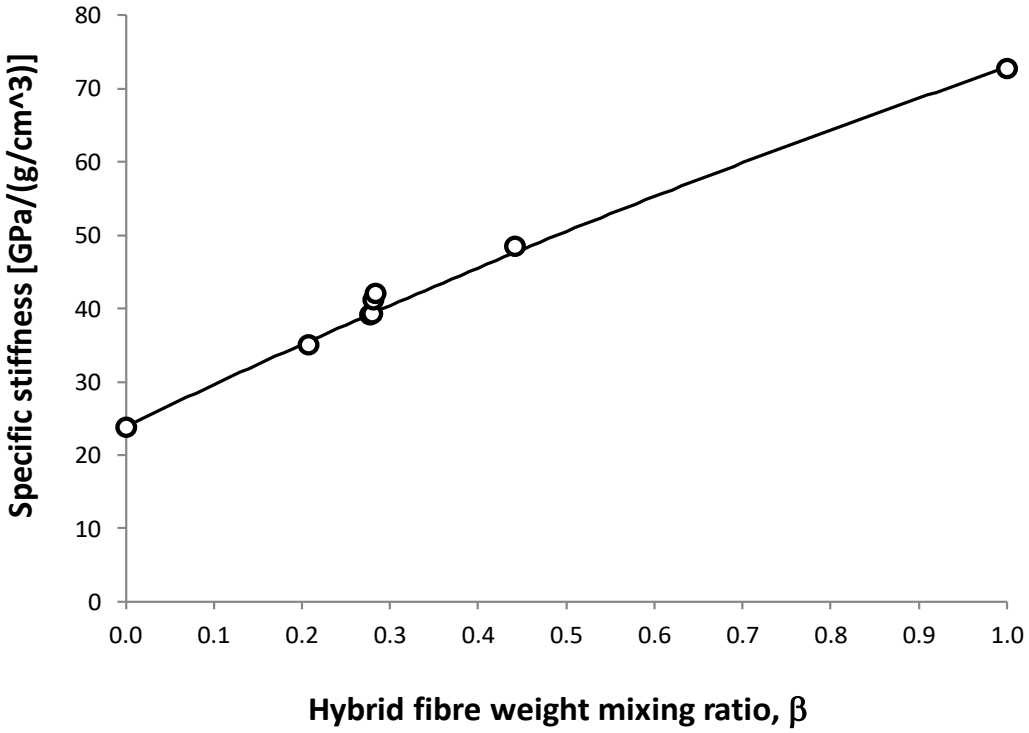



## Stiffness

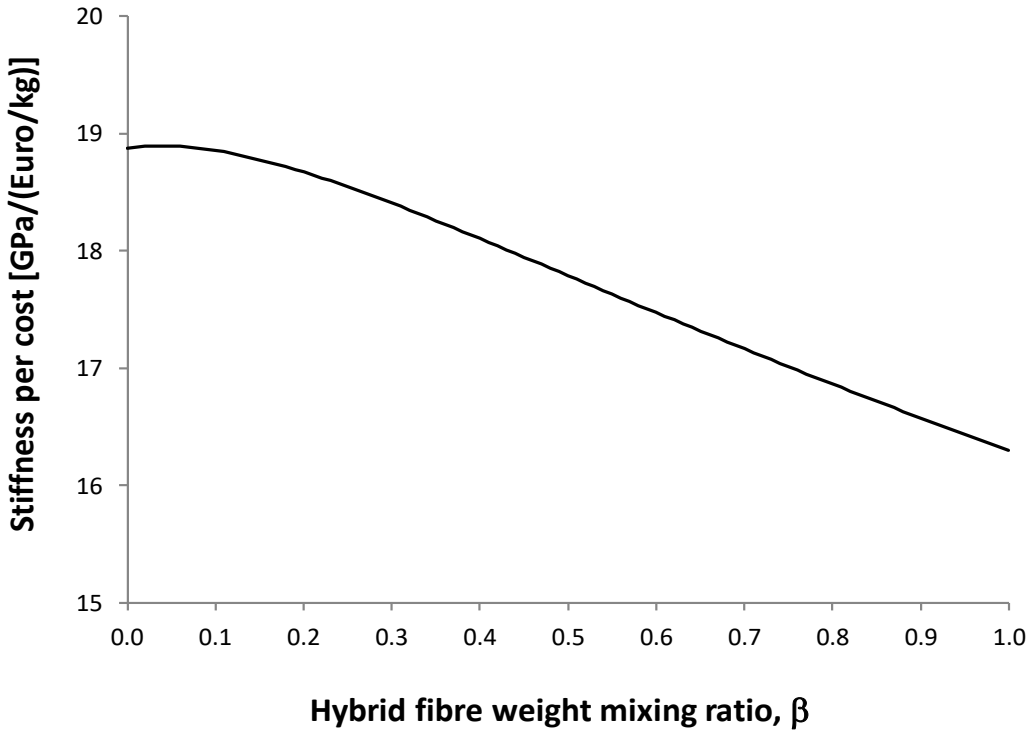


# Performance of hybrid composites

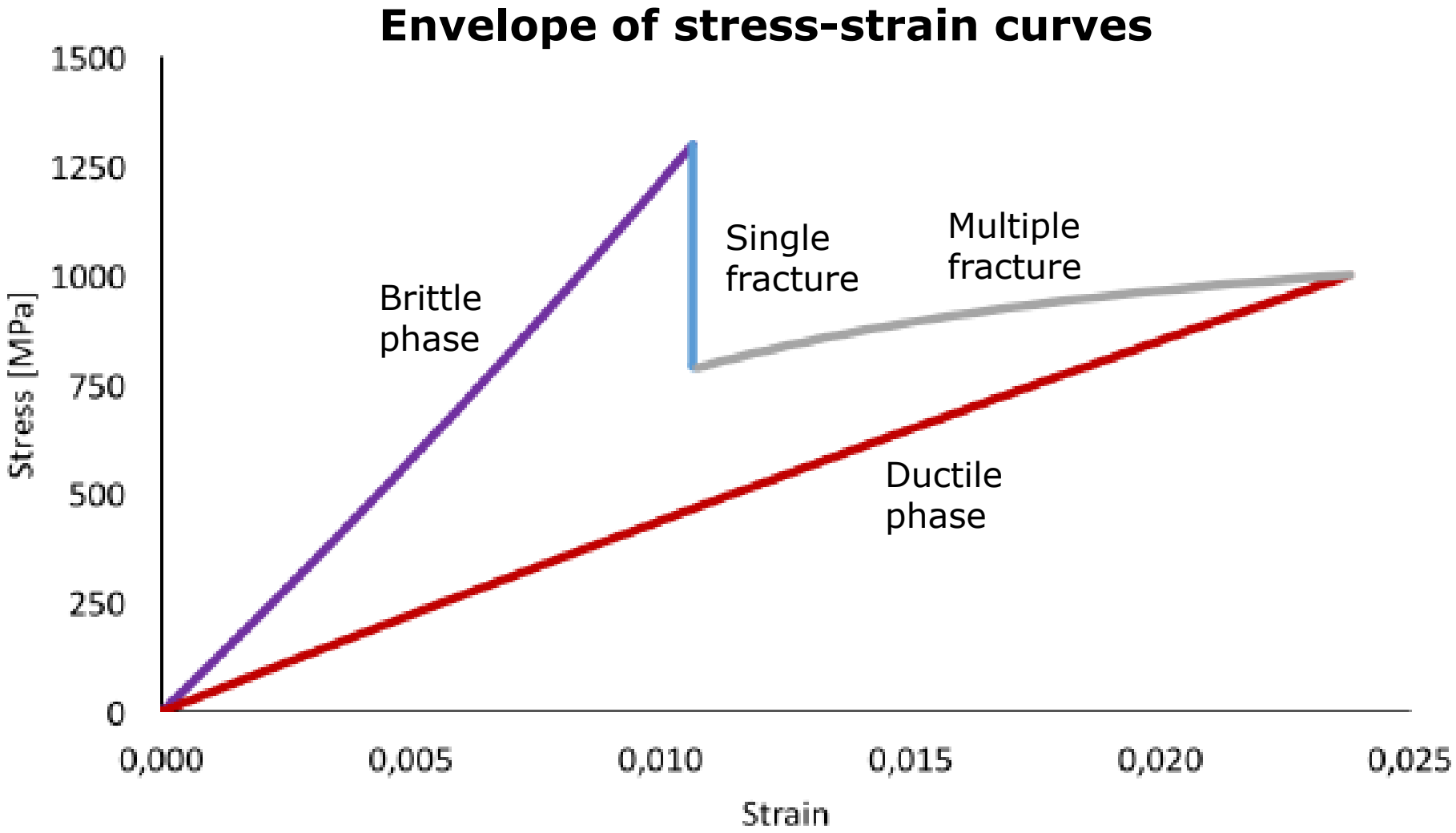
## Stiffness per weight




## Stiffness per cost

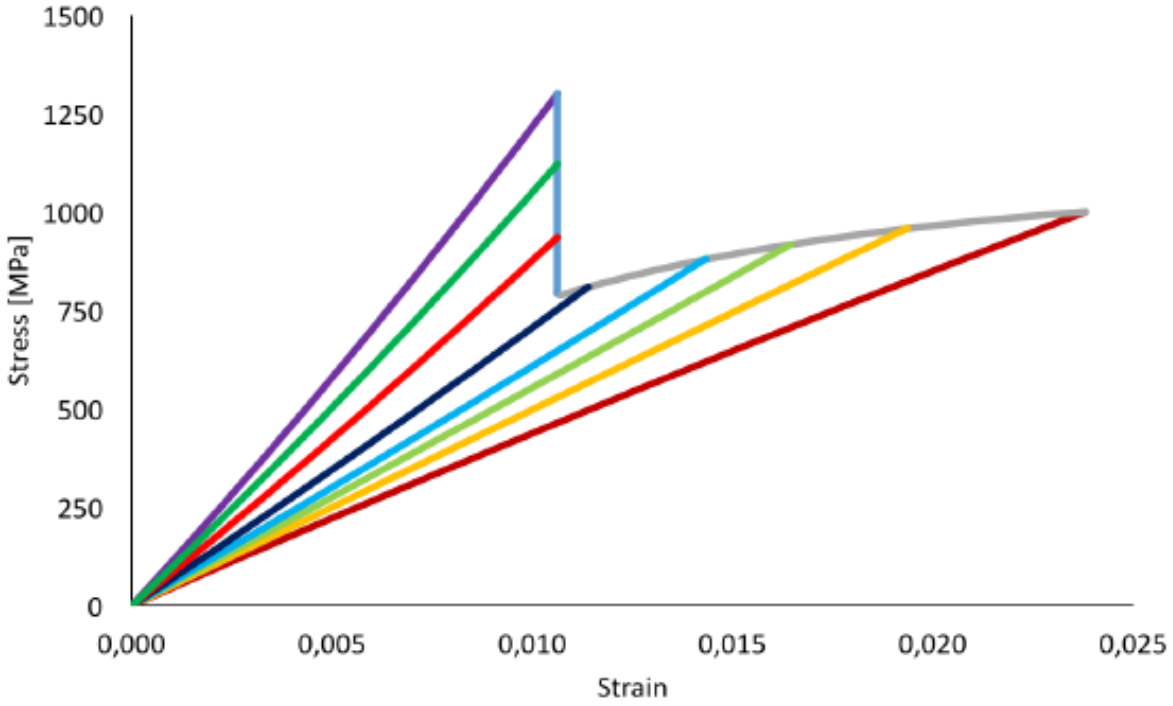


# Rule-of-mixtures model for composite strength

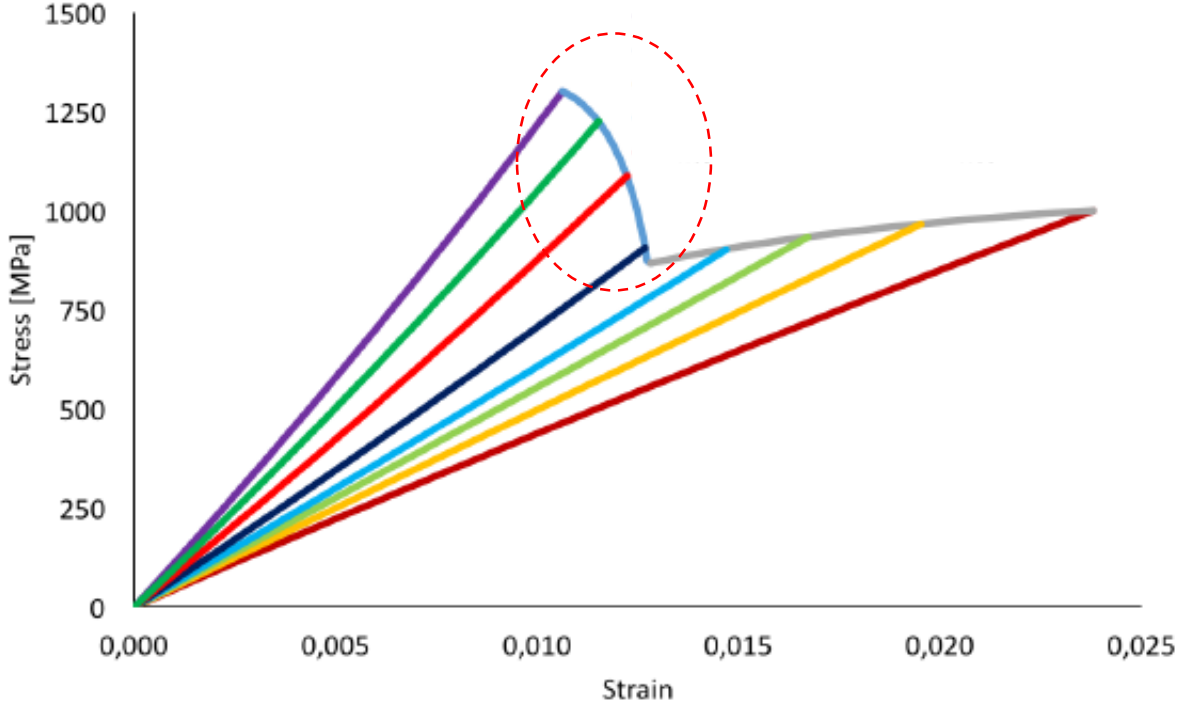


# Rule-of-mixtures model for composite strength

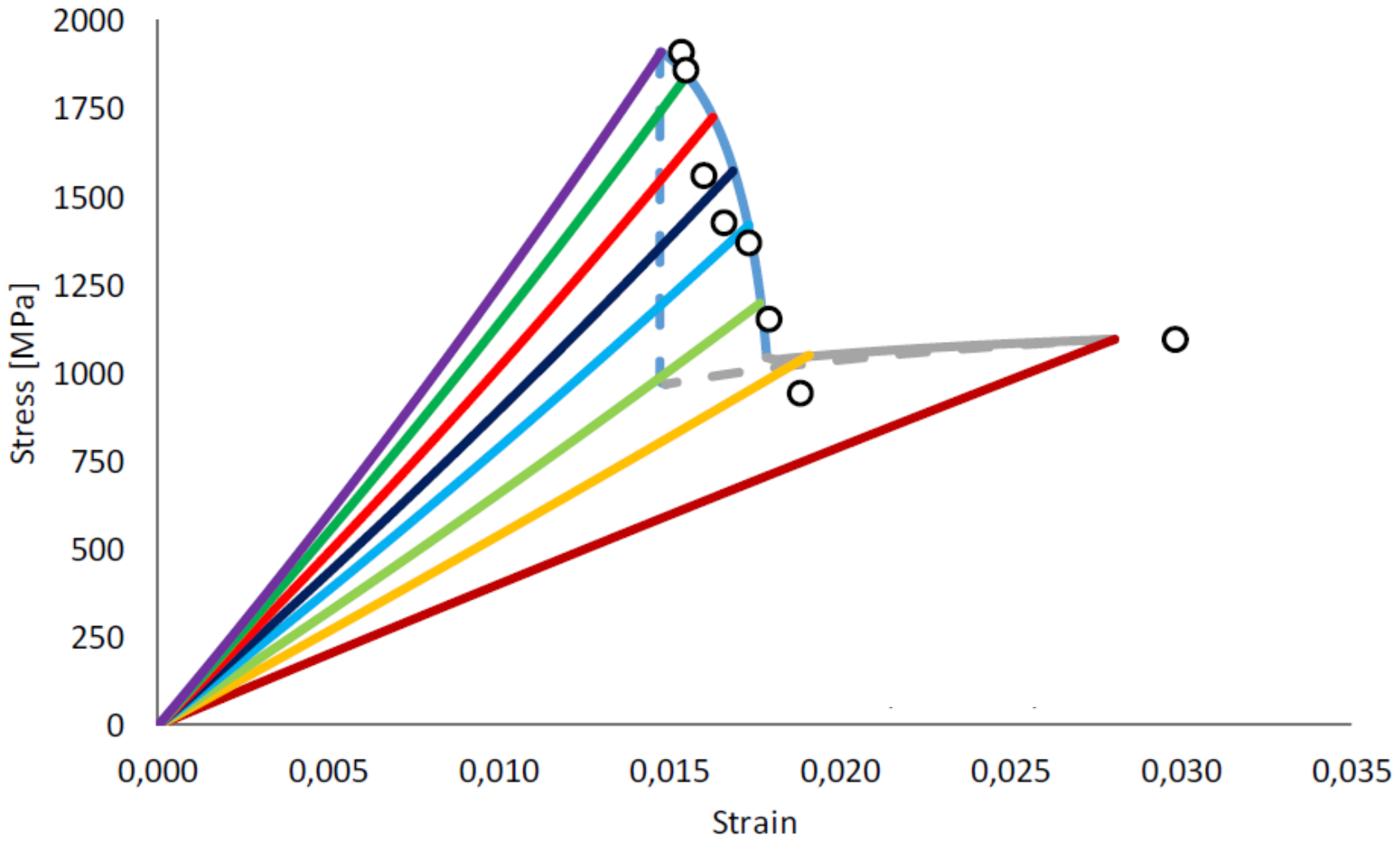
## No hybrid effect




## Hybrid effect



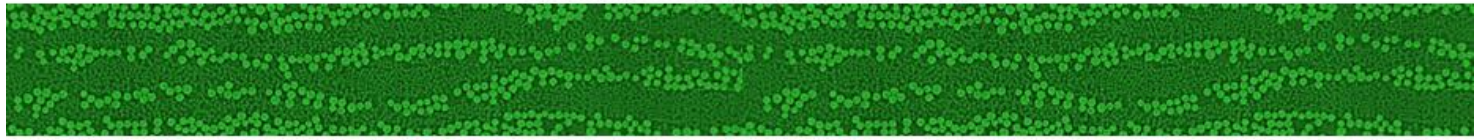
# Experimental data and model predictions



# New project on hybrid composites

HyFiSyn

*Hybrid Fibre-reinforced composites: achieving Synergetic effects through microstructural design and advanced simulation tools*



KU LEUVEN

ELG Carbon Fibre Ltd.
RECYCLED CARBON FIBRE

universität wien

DTU 4RealSim

ntpt

MŰEGYETEM 1782

Imperial College London

sirris
driving industry by technology

SLC lab

SIOEN INDUSTRIES

FIBERLINE COMPOSITES
CREATE MORE WITH LESS

University of Nottingham
UK | CHINA | MALAYSIA

BMW GROUP

EPFL
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

University of BRISTOL

www.hyfisyn.eu

Contact: Dr. Yentl Swolfs (coordinator)
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