KU LEUVEN
RESEARCH & DEVELOPMENT

Hybrid self-reinforced composite material

Technology Offering

The present invention provides novel hybrid self-reinforced composites, combining a high stiffness/low failure strain fibre and an oriented thermoplastic polymeric ductile fibre (as reinforcement phases) in the same thermoplastic polymeric matrix phase. These hybrid self-reinforced composites possess a unique combination of impact/crash resistance and stiffness/strength. Such combination is typically very difficult to achieve in man-materials.

The present invention also relates to methods to produce said hybrid self- reinforced composites by the hot compaction technique.

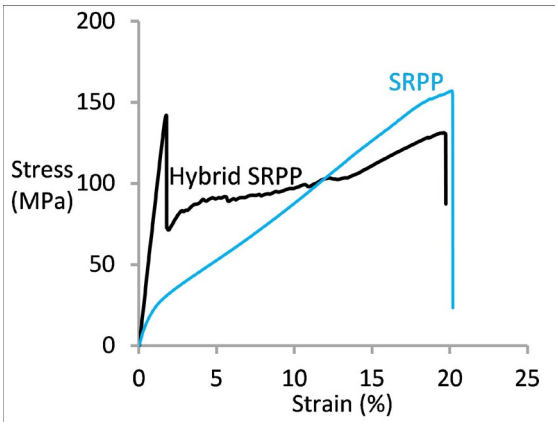
Keywords: hybrid self-reinforced composites, carbon, intralayer, intrayarn

Background & basic concept of the technology

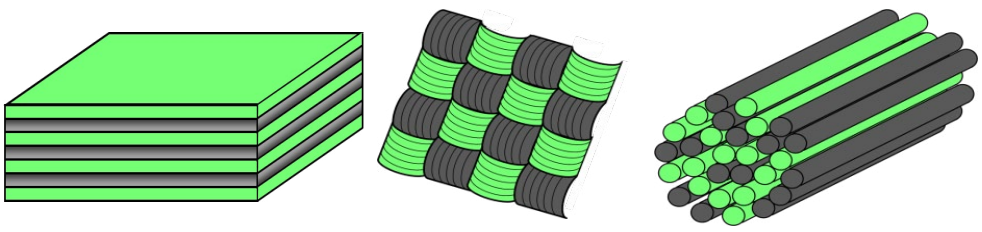
The use of carbon fibre-reinforced composites has been growing exponentially in the past few decades. They offer excellent mechanical properties in combination with a low density, making them an ideal solution for many lightweight applications. However, they often suffer from a lack of toughness.

In contrast with carbon fibre composites, self-reinforced (or all-polymer) composites have an excellent toughness, but a relatively low stiffness and strength. They consist of an oriented polymer fibre or tape in a matrix made from the same polymer. The present invention aims to break through the typical stiffness-toughness dilemma by hybridising carbon fibres with self-reinforced polypropylene (SRPP) to design a material that has some optimum combination of stiffness and toughness.

Hybridisation of SRPP with carbon fibres resulted in a novel class of hybrid composites with a unique combination of stiffness, strength, ultimate failure strain and impact resistance. The key to the invention is to develop suitable strategies to maintain the toughness of the SRPP at the point when the carbon fibres fail. A key parameter in achieving this, is the bonding between both components. For strong bonding, the energy released by carbon fibre failure can create damage in the SRPP fraction, causing a decrease in the ultimate failure strain and hence toughness. For weak bonding, the hybrid composite can immediately delaminate over its entire length. The key is therefore to find the optimal level of bonding, thereby controlling the damage development while providing good stiffness and strength.



A second key parameter is related to the distribution of the fibres in the hybrid composites. The carbon fibres should be distributed in the hybrid composites instead of grouped together in thick layers. Three strategies are proposed: thin layers (layer level), co-weaving (intralayer level) and co-mingling (fibre level).



The final parameter is the fibre volume fraction of the carbon fibres. At high fractions, the energy released by the carbon fibres can damage the SRPP. At an optimal fraction however, the ductility and impact resistance of SRPP can be maintained, while still achieving a substantial increase in stiffness and strength over a pure SRPP.

Advantages & strengths

The developed hybrid SRCs possess a unique combination of stiffness, strength and toughness.

Applications & market opportunities

Since hybrid SRCs can be thermoformed, their products can be manufactured in high volumes. This material therefore has a strong potential to be used in the automotive industry.

Intellectual property status

Patent protection has already been established in Europe and US.

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Collaboration

Collaboration sought: (e.g. License, R&D contract, Joint development, Venture funding, …)

We, the technology transfer department of KU Leuven and University of Leeds, are looking for interested industrial partners to collaborate with and/or to license-in the offered technologies. We are certainly willing to provide you with a more elaborate presentation of the technology.

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