Effect of intratow fibre hybridization on the fracture toughness of polymer composite materials

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Composite materials, in particular fibre-reinforced composites, play an important role in structural applications, namely in aeronautical industry, however, their use is partly hampered due to the low toughness they exhibit.

Fibre hybridization, which consists of combining multiple types of fibres in the same composite material, is a strategy that can lead to improved composite properties and performance, because it not only changes the material properties but also the damage propagation mechanisms leading to final failure [1,2]. Fibre hybridization can potentially be designed to trigger specific damage sequences that result in an increase of the material's intralaminar fracture toughness, thus avoiding the catastrophic failure characteristic of conventional composite materials.

In this work, the tow spreading technique is used to comingle two types of fibres to produce intratow hybrid unidirectional tapes. Several materials were manufactured with different hybrid volume fractions, including the two baseline non-hybrid composites. An extensive experimental test program was carried out to determine the effects of fibre hybridization, focusing on the properties in the fibre direction. The test program included fracture mechanics tests to derive the materials' R-curves and cohesive laws for both tension and compression. Based on the experimental results and modelling approaches previously developed, improved design parameters for hybrid composites are proposed.

References

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