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PII: S1359-835X(17)30434-7
DOI: https://doi.org/10.1016/j.compositesa.2017.11.028
Reference: JCOMA 4849

To appear in: *Composites: Part A*

Received Date: 11 July 2017
Revised Date: 13 October 2017
Accepted Date: 30 November 2017

Please cite this article as: Finley, J., Yu, H., Longana, M.L., Pimenta, S., Shaffer, M.S.P., Potter, K.D., Exploring the pseudo-ductility of aligned hybrid discontinuous composites using controlled fibre-type arrangements, *Composites: Part A* (2017), doi: https://doi.org/10.1016/j.compositesa.2017.11.028

Exploring the pseudo-ductility of aligned hybrid discontinuous composites using controlled fibre-type arrangements

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Abstract

Pseudo-ductility presents a potential means for preventing catastrophic failure in composite materials; large deformations will prevent brittle fracture and provide warning before final failure. This work explores how the pseudo-ductility and strength of aligned hybrid discontinuous composites can be controlled by manipulating the arrangement of different fibre types. Aligned carbon/glass hybrid specimens with different fibre arrangements are manufactured and tested using a modification to the High Performance Discontinuous Fibre (HiPerDiF) method. Experimental results are complemented by an improved virtual testing framework, which accurately captures the fracture behaviour of a range of hybrid discontinuous composite microstructures. With a randomly *intermingled* fibre arrangement as a baseline, a 27% increase in strength and a 44% increase in pseudo-ductility can be achieved when low elongation fibres are completely *isolated* from one-another. Results demonstrate that the HiPerDiF method is the current state-of-the-art for maximising the degree of intermingling and hence the pseudo-ductility of hybrid composites.

Keywords: Pseudo-ductility, hybrid, microstructures, fracture,

1. Introduction

Composite materials are widely used in aerospace and automotive applications due to their high specific strength and specific stiffness [1]. However, composite materials often fail in a brittle manner, which may lead to catastrophic failure; consequently, composite structures are often over-designed and overweight. There is therefore a strong desire for

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