Size limitations on achieving tough and healable fibre reinforced composites through the use of thermoplastic nanofibres

Amaël Cohades, Lode Daelemans, Charlie Ward, Timo Meireman, Wim Van Paepegem, Karen De Clerck, Véronique Michaud

PII: S1359-835X(18)30264-1
DOI: https://doi.org/10.1016/j.compositesa.2018.07.002
Reference: JCOMA 5097

To appear in: *Composites: Part A*

Received Date: 28 November 2017
Revised Date: 1 May 2018
Accepted Date: 3 July 2018

Please cite this article as: Cohades, A., Daelemans, L., Ward, C., Meireman, T., Van Paepegem, W., De Clerck, K., Michaud, V., Size limitations on achieving tough and healable fibre reinforced composites through the use of thermoplastic nanofibres, *Composites: Part A* (2018), doi: https://doi.org/10.1016/j.compositesa.2018.07.002

Size limitations on achieving tough and healable fibre reinforced composites through the use of thermoplastic nanofibres

Amaël Cohades[1], Lode Daelemans[2], Charlie Ward[1], Timo Meireman[2], Wim Van Paepegem[2], Karen De Clerck[2], Véronique Michaud[1*]

[1] *Laboratory for Processing of Advanced Composites (LPAC), Institute of Materials (IMX), Ecole Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland*

[2] *Department of Materials, Textiles and Chemical Engineering (MATCH), Ghent University, Technologiepark 907, B-9052 Zwijnaarde, Belgium*

* Corresponding author: Tel. +41 21 6934923, e-mail address: veronique.michaud@epfl.ch

Abstract. Phase-separated blends of epoxy and poly(ε-caprolactone) (PCL) provide crack repair in composites after a thermal treatment at 150°C, but decrease the material's fracture toughness. This article investigates the combination of healing with interlaminar fracture toughness improvement using electrospun PCL nanofibrous veils, interleaved between glass fibre reinforcement layers. Cure temperature close to PCL melting leads to both phase-separated domains and intact nanofibre regions. With the fast cure kinetics of the epoxy resin, phase-separated domains consist of small epoxy particles (1-5 μm diameter) surrounded by a PCL matrix. Interlaminar crack propagation in Mode I demonstrates up to 48% toughness increase when 30 g/m^2 of nanofibres are inserted between each layers. Thermal treatment however results in limited healing due to slow flow of PCL in the narrow channels. Further insight is provided regarding the channel width and polymer viscosity requirements to provide a microstructure efficient for both crack healing and interlaminar toughness improvement.

Keywords: A. Smart materials, A. Nano-structure, B. Fracture toughness, D. Vacuum infusion