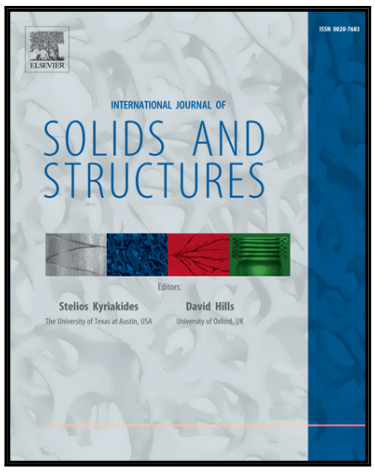

Effect of inter-fibre bonding on the fracture of fibrous networks with strong interactions

Stergios Goutianos, Rui Mao, Ton Peijs

PII: S0020-7683(17)30557-7
DOI: 10.1016/j.ijsolstr.2017.12.020
Reference: SAS 9838

To appear in: *International Journal of Solids and Structures*

Received date: 16 May 2017
Revised date: 1 July 2017
Accepted date: 28 November 2017

Please cite this article as: Stergios Goutianos, Rui Mao, Ton Peijs, Effect of inter-fibre bonding on the fracture of fibrous networks with strong interactions, *International Journal of Solids and Structures* (2017), doi: 10.1016/j.ijsolstr.2017.12.020

Effect of inter-fibre bonding on the fracture of fibrous networks with strong interactions

Stergios Goutianos[a], Rui Mao[b], Ton Peijs[b,*]

[a] *Department of Wind Energy, Section of Composites and Materials Mechanics, Technical University of Denmark, Risø Campus, DK-4000 Roskilde, Denmark*
[b] *School of Engineering and Materials Science, Queen Mary University of London, Mile End Road, London E1 4NS, United Kingdom*

Abstract

The mechanical response of cellulose nanopaper composites is investigated using a three-dimensional (3D) finite element fibrous network model with focus on the effect of inter-fibre bonds. It is found that the Young's modulus and strength, for fixed fibre properties, are mainly controlled by the density and strength of the inter-fibre bonds. An increase of the inter-fibre bond density and inter-fibre bond strength results in an increase of both the Young's modulus and strength of the fibrous network materials. The fracture energy of the inter-fibre bonds has a minor effect on the mechanical properties of the cellulose nanopapers. The inter-fibre bond properties and density have a minor effect on the strain to failure of the cellulose nanopaper. The effect of the fibre properties, through the ratio of fibre tensile strength to fibre Young's modulus, has also a significant impact on mechanical response of the network including the strain to failure.

Keywords: Nanocellulose; Nanopaper; Inter-fibre bonds

1. Introduction

Cellulose nanofibres are the main reinforcement in plants and can be extracted from plant cell walls through either enzymatic or chemical pretreatments followed by mechanical disintegration (Henriksson et al., 2007; Saito et al., 2007). Cellulose nanofibres are characterised by their high strength and

*Corresponding author
Email address: t.peijs@qmul.ac.uk (Ton Peijs)