Accepted Manuscript

Thinner and better: (Ultra-)low grammage bacterial cellulose nanopaper-reinforced polylactide composite laminates

Martin Hervy, Frederic Bock, Koon-Yang Lee

PII: S0266-3538(18)30552-9

DOI: 10.1016/j.compscitech.2018.07.027

Reference: CSTE 7313

To appear in: *Composites Science and Technology*

Received Date: 6 March 2018

Revised Date: 22 June 2018

Accepted Date: 18 July 2018

Please cite this article as: Hervy M, Bock F, Lee K-Y, Thinner and better: (Ultra-)low grammage bacterial cellulose nanopaper-reinforced polylactide composite laminates, *Composites Science and Technology* (2018), doi: 10.1016/j.compscitech.2018.07.027.

Thinner and better: (Ultra-)Low grammage bacterial cellulose nanopaper-reinforced polylactide composite laminates

Martin Hervy[‡], Frederic Bock[†,‡] and Koon-Yang Lee[‡]*

[‡]*The Composites Centre*, Department of Aeronautics, Imperial College London, South Kensington Campus, SW7 2AZ, London, United Kingdom; [†]*Institute of Polymer and Composites*, Hamburg University of Technology, Denickestrasse 15, D-21073, Hamburg, Germany

*Corresponding author (KYL): koonyang.lee@imperial.ac.uk

Abstract

One of the rate-limiting steps in the large-scale production of cellulose nanopaper-reinforced polymer composites is the time consuming dewatering step to produce the reinforcing cellulose nanopapers. In this work, we present a method to reduce the dewatering time of bacterial cellulose (BC)-in-water suspension by reducing the grammage of BC nanopaper to be produced. The influence of BC nanopaper grammage on the tensile properties of BC nanopaper-reinforced polylactide (PLLA) composites is also investigated in this work. BC nanopaper with grammages of 5, 10, 25 and 50 g m^{-2} were produced and it was found that reducing the grammage of BC nanopaper from 50 g m^{-2} to 5 g m^{-2} led to a three-fold reduction in the dewatering time of BC-in-water suspension. The porosity of the BC nanopapers, however, increased with decreasing BC nanopaper grammage. While the tensile properties of BC nanopapers were found to decrease with decreasing BC nanopaper grammage, no significant difference in the reinforcing ability of BC nanopaper with different grammages for PLLA was observed. PLLA composite laminates reinforced with BC nanopaper at different grammages possessed a tensile modulus of 10.5-11.8 GPa and tensile strength of 95-111 MPa, respectively, at a $v_{f,\,fibres}$ = 39-53 vol.-%, independent of the grammage and tensile properties of the reinforcing BC nanopaper(s).

Keywords. (A) Laminate; (A) nano composites; (A) Polymer-matrix composites (PMCs); (B) mechanical properties; nanocellulose