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Ductile unidirectional continuous rayon fibre-reinforced hierarchical compositesSiti-Ros Shamsuddin^a, Koon-Yang Lee^b, Alexander Bismarck^{a,c,§}^a *Polymer and Composite Engineering (PaCE) Group, Department of Chemical Engineering, Imperial College London, London, SW7 2AZ, UK*^b *The Composite Centre, Department of Aeronautics, Imperial College London, London, SW7 2AZ, UK*^c *Polymer and Composite Engineering (PaCE) Group, Institute of Materials Chemistry and Research, Faculty of Chemistry, University of Vienna, Währinger Straße 42, 1090 Vienna, Austria*[§]Corresponding author: alexander.bismarck@univie.ac.at (A. Bismarck), Tel: +43 (1) 4277 71301, Fax: +43 (1) 4277 871302**Abstract**

Endless rayon fibres (Cordenka[®]) were used to reinforce polyhydroxybutyrate (PHB) nanocomposites containing 2.5 wt.% nanofibrillated cellulose (NFC) to create truly green hierarchical composites. Unidirectional (UD) composites with 50-55% fibre volume fraction were produced using a solvent-free continuous wet powder impregnation method. The composites exhibit ductile failure behaviour with a strain-to-failure of more than 10% albeit using a very brittle matrix. Improvements at a model composite level were translated into higher mechanical properties of UD hierarchical composites. The Young's moduli of rayon fibre-reinforced (NFC-reinforced) PHB composites were about 15 GPa. The tensile and flexural strength of hierarchical PHB composites increased by 15% and 33% as compared to the rayon fibre-reinforced neat PHB composites. This suggests that incorporation of NFC into the PHB matrix binds the rayon fibres, which does affect the load transfer between the constituents resulting in composites with better mechanical properties.

Keywords: A. Biocomposite; A. Cellulose; B. Adhesion; E: Prepreg processing

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