High porosity cellulose nanopapers as reinforcement in multi-layer epoxy laminates

By: Mautner, A (Mautner, Andreas)[1,2]; Nawawi, WMFW (Nawawi, Wan M. F. W.)[1,2,3]; Lee, KY (Lee, Koon-Yang)[4]; Bismarck, A (Bismarck, Alexander)[1,2,5]

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Abstract

Utilizing high-performance cellulose nanopapers as 2D-reinforcement for polymers allows for realizing high-loading-fraction (80 vol.-%), high-performance (strength >150 MPa, modulus >10 GPa) laminated nanopaper reinforced epoxy composites. Such cellulose nanopapers are inherently dense, which renders them difficult to be impregnated with the epoxy-resin. High-porosity nanopapers facilitate better resin impregnation, truly utilizing the properties of single cellulose nanofibres instead of the nanofibre network. We report the use of high-porosity (74%) but low strength and modulus bacterial cellulose (BC) nanopapers, prepared from BC-in-ethanol dispersion, as reinforcement for epoxy-resin. High-porosity nanopapers allowed for full impregnation of the BC-nanopapers with epoxy-resin. The resulting BC-reinforced epoxy-laminates possessed high tensile modulus (9 GPa) and strength (100 MPa) at a BC loading of 30 vol.-%, resulting from very low void-fraction (3 vol.-%) of these papregs compared to conventional nanopaper-laminates (10+ vol.-%). Better resin impregnation of less dense nanocellulose networks allowed for maximum utilization of stiffness/strength of cellulose nanofibrils.

Keywords

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Author Information

Reprint Address:

University of Vienna Univ Vienna, Polymer & Composite Engn PaCE Grp, Inst Mat Chem & Res, Wahringerstr 42, A-1090 Vienna, Austria.

Corresponding Address: Mautner, A; Bismarck, A (corresponding author)

+ Univ Vienna, Polymer & Composite Engn PaCE Grp, Inst Mat Chem & Res, Wahringerstr 42, A-1090 Vienna, Austria.

Addresses:

+ [1] Univ Vienna, Polymer & Composite Engn PaCE Grp, Inst Mat Chem & Res, Wahringerstr 42, A-1090 Vienna, Austria
+ [2] Imperial Coll London, Dept Chem Engn, Polymer & Composite Engn PaCE Grp, South Kensington Campus, London SW7 2AZ, England
+ [3] Int Islamic Univ Malaysia, Dept Biotechnol Engn, POB 10, Kuala Lumpur 50278, Malaysia
+ [4] Imperial Coll London, Dept Aeronaut, South Kensington Campus, London SW7 2AZ, England
+ [5] Univ Johannesburg, Fac Engn & Built Environm, Dept Mech Engn, Johannesburg, South Africa

E-mail Addresses: andreas.mautner@univie.ac.at; alexander.bismarck@univie.ac.at

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