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

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Abstract

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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 nanopapers 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. © 2020 Elsevier Ltd

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