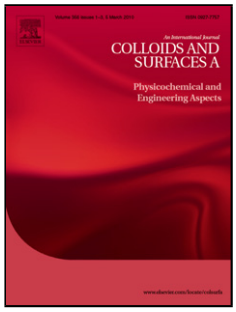

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Nanocellulose-Montmorillonite Composites of Low Water Vapour Permeability

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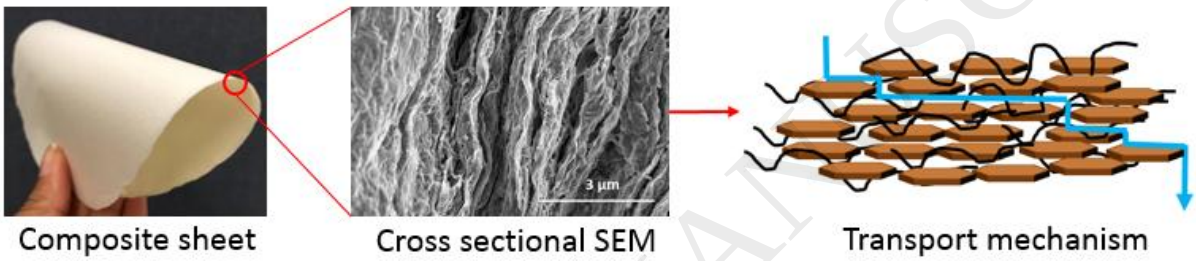
1 Graphical abstract



2 Abstract

A simple technique was developed to well disperse montmorillonite (MMT) into novel nanocellulose composites of varying MMT content (9.1-37.5 wt%). The objective was to develop nanocellulose-MMT composites of very low water vapour permeability (WVP) by increasing the composite tortuosity. The new composites are strong (strength-110 MPa), stiff (modulus-11 GPa) yet flexible. Scanning electron micrographs revealed MMT platelets to be uniformly distributed across and within the composite, creating a tortuous path restricting water molecules diffusion. WVP decreased by half, from 24.2 ± 2.7 g.µm/m^2.day.kPa without MMT to 13.3 ± 2.0 g.µm/m^2.day.kPa with only 16.7 wt% MMT. Further increasing the MMT content increased composite WVP, due to MMT aggregation. Two separate MMT dispersion methods were tested to break down MMT stacks and improve WVP by increasing MMT available surface area: (a) sonication, which worsened WVP, and (b) high pressure homogenization, which reduced WVP further to 6.33 ± 1.5 g.µm/m^2.day.kPa with 23.1 wt% MMT. This is the lowest WVP reported in literature for nanocellulose-MMT composites. This study developed a recyclable composite of very low WVP. These thin, inexpensive, strong and flexible nanocellulose-MMT composites present a new and attractive option as recyclable/compostable packaging materials for large volume packing applications where water vapour protection is critical.