

Applications of nanocellulose

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an overview of the recent research on the fundamental and applied properties of nanoparticles extracted from cellulose, the most abundant polymer on the planet and an essential renewable resource. Given the rapid advancements in the field and the high level of interest within the scientific and industrial communities, pioneered the use of cellulose nanoparticles (cellulose nanocrystals or whiskers and cellulose microfibrils) in nanocomposite applications. In the life sciences and bio-based applications, biological, chemical and agricultural engineering, organic chemistry and materials science. Cellulose has great potential as a nanomaterial as it's abundant, renewable and biodegradable. It can be used in paper for its superior strength properties and can also be used as a wet-end additive to enhance retention in coating and packaging applications.

Nanocellulose can form transparent films with excellent barrier properties, allowing it to be competitive with petroleum-based plastics in food packaging. Due to its reinforcing properties, nanocellulose can also be used in bio-composites and other matrix materials. 6. 9 Concluding remarks Natural fibres, cellulose and other constituents of natural fibres are very promising materials for the future, having the capability to replace current synthetic materials. With the rapid developments in nanotechnology, nanocellulose brings many new insights to the materials world, such as its modulus value of 160 GPa, which is much greater than metallic materials. Considering the challenges mentioned earlier, it is rational to predict that immediate applications of nanocellulosic materials can be formulated from water-based polymer matrices, like polyvinyl alcohol, starch/polyvinyl alcohol blends and latexes, by which two major problems can be eliminated.

Here, the dispersion is done in the aqueous phase, so the additional step of drying can be omitted and the hydrophobic modification of the nanocellulose materials is not required. However, the main limitation is that this will give a product that can be used only under dry conditions like This paper provides an overview of recent progress made in the area of cellulose nanofibre-based nanocomposites. An introduction into the methods used to isolate cellulose nanofibres (nanowhiskers, nanofibrils) is given, with details of their structure.

Following this, the article is split into sections dealing with processing and characterisation of cellulose nanocomposites and new developments in the area, with particular emphasis on applications. The types of cellulose nanofibres covered are those extracted from plants by acid hydrolysis (nanowhiskers), mechanical treatment and those that occur naturally (tunicate nanowhiskers) or under culturing conditions (bacterial cellulose nanofibrils).

Research highlighted in the article are the use of cellulose nanowhiskers for shape memory nanocomposites, analysis of the interfacial properties of cellulose nanowhisker and nanofibril-based composites using Raman spectroscopy, switchable interfaces that mimic sea cucumbers, polymerisation from the surface of cellulose nanowhiskers by atom transfer radical polymerisation and ring opening polymerisation, and methods to analyse the dispersion of nanowhiskers.

The applications and new advances covered in this review are the use of cellulose nanofibres to reinforce adhesives, to make optically transparent paper for electronic displays, to create DNA-hybrid materials, to generate

hierarchical composites and for use in foams, aerogels and starch nanocomposites and the use of all-cellulose nanocomposites for enhanced coupling between matrix and fibre. A comprehensive coverage of the literature is given and some suggestions on where the field is likely to advance in the future are discussed.