Nano cellulose with cation-exchange resin catalysed hydrolysis.

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Description

Cellulose is that the most abundant compound on earth and is present during a big variety of living species, like animals, plants and bacterial. This linear polymer is constituted of repeating β-D-glucopyranosyl units joined by glycosidic linkages. The molecules of cellulose are stabilized laterally by hydrogen bonds between hydroxyl groups and oxygen of adjacent molecules. However, they can be broken chemically under strong aqueous acid or high temperature. Manipulating cellulose molecules on the nanometer scale to create the nano cellulose of excellent properties has become a hotspot of cellulose science. As for Nan cellulose, it is currently believed that at least one of its dimensions is lower than 100nm. Moreover, nano cellulose exhibits the property of certain gels or fluids under normal conditions. Compared with microcrystalline cellulose, Nano cellulose presents very attractive properties such as low density, high chemical reactivity, high strength and modulus, and high transparency.

Therefore, Nan cellulose has a great potential for use as filler in nanocomposites and have attracted a great deal of interest recently. Nano cellulose has been reported to improve the mechanical properties by incorporating into a wide range of polymer matrices, including poly(3-hydroxybutyrate), hydroxypropyl cellulose, poly(L-lactide), waterborne polyurethane, poly(3,4-ethylenedioxythiophene), polyvinyl acetate, poly(o-ethoxyaniline). The composite applications could also be to be used as coatings and films, paints, foams, packaging. Moreover, the potential of Nan cellulose applications in the area of paper and paperboard manufacture is obvious.

Nano cellulose is expected to enhance the fiber-fiber bond strength and, hence, have a strong reinforcement effect on paper materials. Nano cellulose could also be useful as a barrier in grease-proof sort of papers and as a wet-end additive to reinforce retention, dry and wet strength in commodity sort of paper and board products. Nano cellulose also can be used as a low calorie replacement for today's carbohydrate additives used as thickeners, flavour carriers and suspension stabilizers in a wide variety of food products and is beneficial for producing fillings, crushes, chips, wafers, soups, gravies, puddings etc. On the other hand, the food applications were early recognized as a highly interesting application field for nanocellulose due to the rheological behaviour of the nanocellulose gel the preparation of nanocellulose derived from wood was introduced more than two decades ago.

Although wood is one among the most resources for the cellulose, competition from different sectors like the building products and furniture industries and therefore the pulp and paper industry, as well because the combustion of wood for energy, makes it challenging to provide all users with the quantities of wood needed at reasonable cost. Besides wood, nanocellulose also could be prepared from many agricultural residue and corps, such as cotton, hemp, sisal, bagasse, wheat straw. Therefore, nanocellulose are going to be key to the event of higher-value agricultural residue products and will find economic interest. In literature, there are many reports on nanocellulose prepared from diverse non-wood sources including wheat straw.

Sulfuric acid hydrolysis of cellulose may be a well-known process to get rid of amorphous regions, leaving the crystalline segments intact and resulting in the formation of high purity single crystals. Ion-exchange resins are used commercially as solid acid catalysts in many areas, like alkylation with olefins, alkyl halides, alkyl esters, isomerization, transalklation and nitration. Compared with liquid acid, the main advantages of cation-exchange resin include reduced equipment corrosion ease of product separation less potential contamination in waste streams and recycles of the catalyst.

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