Processing of nanocellulose and its use in composite materials

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ABSTRACT

Cellulose nanocomposites have been very popular research subject during the last 15 years and many studies have been made on the development of these materials. Nanocelluloses can be prepared using mechanical and chemical methods. We are working with Masuko ultrafine grinding process and separation of industrial residues to nanosize cellulose and focussing on energy consumption and yield. The viscosity, optical microscopy images and mechanical properties are usually evaluated to follow the fibrillation process. X-ray diffraction (XRD) and Raman spectroscopy can be used to reveal that the materials are isolated without affecting their crystallinity. We have shown that a residue from carrot juice process is very easily bleached and consumes less energy during grinding process compared with common pulp. Moreover, dried nanofiber networks from carrot showed high mechanical properties, with an average modulus and strength of 12.9 GPa and 210 MPa respectively, thus indicating a homogeneous nanosize distribution. We believe that residues such as carrot have great potential for the industrial production of cellulose nanofibers because of the processing efficiency combined with low raw material cost. (Siqueira et al 2016, Berglund et al 2016)

Processing methods such as foaming, solvent casting, resin impregnation, fiber spinning and extrusion of cellulose nanocomposites are currently of great interest and will be discussed. Addition of nanocellulose into the polymer matrix do not only improve the mechanical properties of the composite but can add new functionalities for the polymer but one of the difficulties, when producing cellulose-based nanocomposites, is to disperse the nanocellulose in the polymer matrix without degradation the polymer or the nanocellulose. Pros and cons are as well as future application are shown. (Aitomäki et al 2016, Herrera et al 2016, Hooshmand et al 2015, Oksman et al 2016, Zhou et al 2016, Siqueira et al 2016)

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