CUSTOMIZATION OF TEMPO-OXIDIZED NANOCELLULOSE PAPERS FOR IMPROVED MECHANICAL PROPERTIES

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Nanofibrillated cellulose (CNF) shows great potential for a variety of applications such as large-scale reinforcement in high-loading cellulose composites, substrates for printed electronics or in water treatment applications, as environmentally friendly and renewable alternative to conventional synthetic polymers [1]. In particular, papers prepared from CNF are a promising candidate as base material in the aforementioned applications. Thereby, the mechanical properties of these nanopapers are of essential significance for a successful implementation.

In this study, special attention was paid to nanofibrils that were produced via TEMPO-oxidation (T-CNF). In this process, the surface of cellulose fibres is modified with carboxylic groups, commonly not present in cellulose. This enables preparation of fibrils, having diameters down to 3-5 nm, with low energy consumption. T-CNF were utilized for the production of 2 different types of nanocellulose materials with improved mechanical properties.

The first approach was to prepare T-CNF/epoxy resin composites utilizing monomers with multiple epoxy groups to form a cross-linked cellulose network. This was anticipated to give enhanced tensile strength and stiffness. Another, relatively simple but still underexplored, approach was the creation of all-cellulose composite papers from blends of various grades of nanocelluloses by establishing hierarchical structures. Through combining T-CNF with e.g. bacterial cellulose nanofibrils, the mechanical properties of the resulting composite nanopapers outperformed the ones of the single constituents, showing synergistic effects.

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[1] D. Klemm, F. Kramer, S. Moritz, T. Lindström, M. Ankerfors, D. Gray, A. Dorris, Angewandte Chemie: International Edition, 2011, 50, 5438-5466.