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Nanotechnologies — Characterization of individualized cellulose nanofibril samples

Nanotechnologies — Caractérisation d'échantillons de nanofibrilles individualisées de cellulose

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Foreword

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This document was prepared by Technical Committee ISO/TC 229, *Nanotechnologies*.

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Introduction

Cellulose nanomaterials derived from naturally occurring cellulosic fibres are renewable advanced materials with unprecedented properties. They are of wide variety in morphology, e.g. different shapes, branching and networking. Basic research related to cellulosic nanomaterials has been increasingly conducted worldwide. At the same time, manufacturing industries have already started to deliver cellulose nanomaterials to the market. Application industries are also becoming more and more interested in these new materials.

All native cellulosic fibres are composed of bundles in which the smallest fibril unit is an elementary fibril originating from a cellulose terminal enzyme complex. An elementary fibril is made of a certain number of cellulose molecules and contains crystalline regions predominantly. The size of an elementary fibril is specific to the native cellulose source. In wood pulp, the cross-sectional dimension of an elementary fibril is about 3 nm and its aspect ratio can reach more than 200. In native cellulose fibres, elementary fibrils do not exist as single fibrils but adhere to each other through hydrogen bonding and are densely packed to form a bundle of fibrils. Very recently, however, some novel methods to extract and separate these elementary fibrils, through chemical modification of the outer surface of the fibrils followed by mechanical treatment, were developed. The chemical modification methods include TEMPO-mediated oxidation and phosphorylation. Using the above treatments, each native elementary fibril can be converted to an individualized cellulose nanofibril (iCNF) with charges at its surface. An iCNF has the functional groups on the outer surface of the fibril, and iCNFs can be separated from each other, one by one, by the static repulsion due to the electrostatic charge of newly introduced functional groups. Refer to Annex B for more explanations on iCNFs.

Several manufacturing companies have already begun producing iCNFs. iCNFs are now delivered increasingly to the worldwide market for applications in the industrial fields of polymer composites, adhesives, additives, gels, etc. Some examples of iCNF-containing commercial products are diapers with deodorant performance and gel ink for ballpoint pens. In all applications, appropriate characterization of the iCNF samples is necessary so that desired products can be manufactured.

This document provides a sound basis for the commercialization as well as the research and development of iCNF materials.