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BSI Standards Publication

Nanotechnologies — Standard terms and their definition for cellulose nanomaterial

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National foreword

This Published Document is the UK implementation of ISO/TS 20477:2023. It supersedes PD ISO/TS 20477:2017, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee NTI/1, Nanotechnologies.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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2023-05-11

Nanotechnologies — Vocabulary for cellulose nanomaterial

*Nanotechnologies — Vocabulaire pour les nanomatériaux à base
de cellulose*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO/TS 20477:2017), which has been technically revised.

The main changes are as follows:

- some existing definitions have been revised;
- new terms and definitions have been introduced;
- micrographic images of cellulose nanomaterials have been introduced to illustrate some of the defined terms.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Cellulose is a polymer produced in nature. In plants, animals, algae and bacteria, cellulose is extruded from terminal enzyme complexes (TC). TCs are made up of many identical subunits, each containing at least one catalytic site from which a single cellulose chain is synthesized. Cellulose chains from a single TC combine to form an elementary fibril. As TCs in plants, animals, algae and bacteria have different numbers and configurations of subunits, the elementary fibrils they produce have different geometries. [1] Whether cellulose nanomaterials are separated by industrial processes or produced directly by organisms, they all contain a common structural component, which is the elementary fibril. This common component, the elementary fibril, provides a way to describe cellulose nanomaterials from all manufacturing methods and cellulose sources.

Cellulose nanomaterials can be manufactured industrially by conversion of wood pulp through chemical, biological or mechanical processes. Bacterium-based cellulose nanomaterials are produced directly by bacteria and can be further acid-hydrolysed to smaller dimensions. Besides trees and bacteria, algae are another potential source of cellulose nanomaterials for industrial applications. Owing to their unique properties and renewable nature, cellulose nanomaterials have developed into platform materials that have application potential in a wide range of products including those that currently utilize petroleum-based ingredients.

At the current stage of development, several terms that describe cellulose nanomaterials coexist and have created confusion among users. The difficulty of measuring sizes in the low micrometre and nanometre scale has given rise to confusion in the classification of materials, particularly for the fibrillate materials. Rather than delaying standards development until knowledge accumulated with research advancement and market maturity, there is an opportunity to define a standard vocabulary for cellulose nanomaterials, and for clarity, describe micro-scale cellulose materials, as given in [Annex B](#). Although terms in the ISO/IEC 80004 series were not developed for specific types of nanomaterials such as cellulose nanomaterials, to be consistent with existing ISO/TC 229 hierarchy, this document utilizes terms from the ISO/IEC 80004 series. It is anticipated that as the market for cellulose nanomaterials matures, so too will the standard vocabulary. Beginning to define a standard vocabulary now will facilitate future communication, eliminate confusion, remove trade barriers, and provide policy makers and regulators with a set of consensus-based terms.

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Nanotechnologies — Standard terms and their definition for cellulose nanomaterial

1 Scope

This document defines terms and definitions for different types of cellulose nanomaterials including secondary components found in cellulose nanomaterials originating from their manufacturing processes. This document also provides information on cellulose micromaterials in [Annex B](#).

Where necessary, terms from the ISO/IEC 80004 series are included in this document. Terms in this document are applicable to all types of cellulose nanomaterials, regardless of production methods and their origin (plants, animals, algae or bacteria).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Core nanotechnology terms related to cellulose nanomaterials

3.1.1

nanoscale

length range approximately from 1 nm to 100 nm

Note 1 to entry: Properties that are not extrapolations from larger sizes are predominantly exhibited in this length range.

[SOURCE: ISO/TS 80004-1:2015, 2.1]

3.1.2

nanomaterial

material with any external dimension in the *nanoscale* ([3.1.1](#)) or having internal structure or surface structure in the nanoscale

Note 1 to entry: This generic term is inclusive of *nano-object* ([3.1.3](#)) and *nanostructured material* ([3.1.5](#)).

Note 2 to entry: See also definitions of engineered nanomaterial, manufactured nanomaterial and incidental nanomaterial in ISO/TS 80004-1:2015.

[SOURCE: ISO/TS 80004-1:2015, 2.4, modified — Note 2 to entry has been added.]

3.1.3

nano-object

discrete piece of material with one, two or three external dimensions in the *nanoscale* ([3.1.1](#))

Note 1 to entry: The second and third external dimensions are orthogonal to the first dimension and to each other.